Legal and institutional aspects of Latin-American space cooperation AQUARELSat: The Water Monitoring Constellation

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PROEFSCHRIFT

ter verkrijging van
de graad van Doctor aan de Universiteit Leiden,
op gezag van Rector Magnificus prof. mr. P.F. van der Heijden,
volgens besluit van het College voor Promoties
te verdedigen op donderdag 7 oktober 2010
Klokke 17.30 uur

door

Cynthia Jiménez Monroy

geboren te Mexico City, Mexico, in 1975

Promotiecommissie:

Promotor:	prof. dr. P.M.J. Mendes de Leon
Overige leden:	prof. dr. P.P.C. Haanappel (emeritus)
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Lay-out: Anne-Marie Krens – Tekstbeeld – Oegstgeest

Druk: Wöhrmann Print Service – Zutphen

ISBN 978-90-8570-595-6

This manuscript is dedicated to

my parents, Miguel Jiménez Granados and Caty Monroy Caballero,

my little sister Kathia Lorena and my brother Miguel,

my grandparents,

my family, and

Seppo Heikkilä.

For you, who are the perfect components in my equation of happiness.

Acknowledgments

The thesis was written in fulfillment of the requirements of the Doctoral degree at the International Institute of Air & Space Law, Faculty of Law, Leiden University, The Netherlands.

I would like to express my gratitude to drs. T.L. Masson-Zwaan and Prof. Pablo Mendes de Leon for their guidance. My sincere thanks also go to Dr. Isabella Diederiks-Verschoor, who was always happy to help and encourage me to finish my doctoral thesis.

I am grateful to Paula van der Wulp for supporting me with the university procedures and for sharing interesting aspects of the Dutch culture. A special recognition needs to be given to librarian Carla Matallana for her friendship and interest in providing me with new sources to continue my research in the Law Library of Leiden University.

My appreciation to my dear friends who made the lonely journey of writing my thesis easier: Meta van Heusden and Edoardo Ramos for introducing me to the Dutch-Mexican culture in Leiden; Carien and Frans Röselaers-Pluimers for their kind support during my research in The Hague; Francis and Yvette Albiach my angels in Bordeaux, and; Jose and Christianne Nieto my angels in Strasbourg. I would like also to thank two multidisciplinary and international groups that keep my social life interesting: the Dinner Club of Leiden University and the LEO discussion group.

I owe my gratitude to Dr. Sylvia Ospina, expert in space law in Miami, for reviewing the style of the thesis, and providing me with useful feedback and research tips. Thank you for your friendship and all your kind support to finish the thesis. In addition, I am indebted to L. van der Wulp for translating the summary into Dutch.

I am thankful to Enrique Salazar and Seppo Heikkilä for designing the cover of my thesis with the representation of the satellite mission of AQUARELSat. Unfortunately, the final design of the cover could not include the illustrations.

Finally, I would like to express my heartfelt gratitude to my family for their support and love through the distance. Special thanks to Seppo Heikkilä, *muchas gracias* my space partner for always having a smile and a hug for me during the long journey of writing my doctoral thesis.

Cynthia Jiménez Monroy
Leiden, 2010

Preface

My interest in remote sensing applications for water management started in 2006 with an UNCOPUOS agenda item titled 'Space and Water'. That same year the 16th United Nations/International Astronautical Federation workshop held in Valencia, Spain, addressed the use of space technologies for water management. My participation in this workshop was an opportunity to learn about technical aspects of water management at the national, regional and international levels. At that time it was difficult for me to identify the legal aspects involved in the topic of space and water.

When I started my Ph.D. research I decided to work on the legal aspects of regional space cooperation for human development, but I also had in mind to research the legal aspects of space and water, considering that access to safe water is a basic component of human development. Thus, I decided to combine both topics in my research, which became a proposal of the legal and technical aspects of Latin-American space cooperation, in particular a proposal of space-water cooperation.

Since I began my research in 2006, new developments on the human right to water and space missions to study the Earth's water systems have taken place, the most recent being the UN General Assembly resolution of 28 July 2010. This resolution (A/RES/64/292) recognizes access to clean water as human right. It was adopted by recorded vote of 122 in favour, none against, and 41 abstentions. Latin-American countries which voted in favour are: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela. Indeed, the draft resolution on the human rights to water and sanitation was introduced by Bolivia.

The support of Latin-American countries to the right to water as a human right reaffirms my interpretation that the region is interested in implementing practical measures to achieve the right to water and water security. My research proposes the use of satellite technologies and applications to improve water management in the Latin-American region, in order to achieve the right to water for all.

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List of Principal Abbreviations and Acronyms

BSA	Brazilian Space Agency (Agência Espacial Brasileira)
AWCI	Asian Water Cycle Initiative
BLMIT	Beijing Landview Mapping Information Technology Ltd
BNSC	British National Space Centre
CAN	Andean Community Nations (Comunidad Andina de Naciones)
CATHALAC	Water Center for the Humid Tropics of Latin America and the Carribbean (Centro del Agua del Trópico Húmedo para América Latina)
CEA	Space Conference of the Americas (Conferencia Espacial de las Américas)
CEOS	Committee on Earth Observation Satellites
CERN	European Centre for Nuclear Research
CITEL	Inter-American Telecommunication Commission
CNTS	Centre National des Techniques Spatiales
COHRE	Centre on Housing Rights and Evictions
CONAE	National Commission on space Activities (Comisión Nacional de Actividades Espaciales)
COPERS	Commission Préparatoire Européenne de Recherches Spatiales
COPUOS	Committee on the Peaceful Uses of Outer Space
COSPAR	Committee on Space Research
CP Covenant	UN International Covenant on Civil and Political Rights
CRECTEALC	Regional Centre for Space Science and Technology Education in Latin America and the Caribbean
CSA	Canadian Space Agency
Declaration on Friendly Relations	Declaration on Principles of International Law concerning Friendly Relations and Cooperation among States in accordance with the Charter of the United Nations
Declaration on Space Benefits	Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, taking into Particular Account the Needs of Developing Countries
DEM	Digital Elevation Models
DLR	German Aerospace Centre (Deutschen Zentrums für Luft- und Raumfahrt)
DMC	Disaster Monitoring Constellation
DMCii	DMC International Imaging
DTM	Digital Terrain Models
EAC	European Astronaut Centre

EC	European Council
ECEL	European Council on Environmental Law
ECLAC	Economic Commission for Latin America and the Caribbean
ECOSOC	Economic and Social Council
EESS	Earth Exploration Satellite Services
ELDO	European Launcher Development Organization
ELDO Convention	Convention for the Establishment of a European Organization for the Development and Construction of Space Vehicle Launchers
EOS	Earth Observation Summit
ESA	European Space Agency
ESA Convention	Convention for the Establishment of the European Space Agency
ESAC	European Space Astronomy Centre
ESAWG	European Space Agency Working Group
ESC	European Space Conference
ESC Covenant	UN International Covenant on Economic, Social and Cultural Rights
ESCAP	Economic and Social Commission for Asia and the Pacific
ESDAC	European Space Data Center
ESDP	European Security and Defense Policy
ESLAB	European Space Laboratory
ESOC	European Space Operations Centre
ESRIN	ESA's Centre for Earth Observation
ESRO	European Space Research Organization
ESRO Convention	Convention for the Establishment of a European Space Research Organization
ESTEC	European Space Technology Centre
ESTRACK	European network for satellite tracking and telemetry stations
ETM+	Enhanced Thematic Mapper Plus
EU	European Union
FAO	Food and Agriculture Organization
FSS	Fixed-Satellite Service
G-77	Group of 77
GDP	Gross Domestic Product
GEERS	Groupe d'etudes européen pour la collaboration dans le domaine des recherches spatiales
General Comment 15	ECOSOC's General Comment No.15: The right to water (arts. 11 and 12 of the International Covenant on Economic, Social and Cultural Rights)
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information System
GMES	Global Monitoring for Environment and Security
GOCE	Gravity Field and Steady-States Ocean Circulation Explorer
GRACE	Gravity Recovery and Climate Experiment

GSO	Geostationary Satellite Orbit
IAA	International Academic of Astronautics
IAC	International Astronautical Congress
IACHR	Inter-American Commission of Human Rights
IACSR	Inter- American Committee for Space Research
IADB	Inter- American Development Bank
IAF	International Astronautical Federation
IASC	Inter-American Space Commission
IAWRN	Inter-American Water Resources Network
ICG	Committee on Global Navigation Satellite Systems
ICJ	International Court of Justice
ILA	International Law Association
INAOE	National Institute of Optical and Electronic Astrophysics (Instituto Nacional de Astrofísica, Óptica y Electrónica)
INDAE	Instituto Nacional de Derecho Aeronáutico y Espacial. National Institute of Air and Space Law
INPE	National Institute for Space Research (Instituto Nacional de Pesquisas Espaciais)
Disasters Charter	Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters
ISI	International Space Information Service
ISU	International Space University
ITAR	International Traffic in Arms Regulation
ITU	International Telecommunication Union
IWRM	Integrated Water Resources Management
KHTT	Know-How Transfer Training
LASA	Latin American Space Agency
LEO	Low-Earth Obit
MDGs	Millennium Development Goals
MEO	Medium- Earth Orbit
MERCOSUR	Southern Common Market (Mercado Común del Sur)
MODIS	Moderate Resolution Imagine Spectroradiometer
NASA	National Aeronautics and Space Administration
NASRDA	National Space Research and Development Agency
NOAA	National Atmospheric Administration
OAS	Organization of American States
OCDE	Organization for Economic Co-operation and Development
OEI	Organization of Ibero-American States for the Education, Science and Culture (Organización de Estados Iberoamericanos para la Educación, la Ciencia y la Cultura)
OSA	Optical Sensor Assembly
PAHO	Pan-American Health Organization
PASO	Pan American Space Organization
PECS	Plan for European Cooperating States
PSA	Programme on Space Applications
RS Principles	Principles Relating to Remote Sensing of the Earth from Outer Space

SAR	Synthetic Aperture Radar
SASA	South American Space Agency
SBDA	Brazilian Association of Air and Space Law
SELPER	Latin-American Society in Remote Sensing and Spatial Information Systems (Sociedad de Especialistas Latinoamericanos en Percepción Remota)
SICA/CCAD	Central American Commission for the Environment and Development (Sistema de Integración Centroamericano)
SMAD III	Space Mission Analysis and Design
Space Millennium Declaration	Space Millennium: Vienna Declaration on Space and Human Development
SSTL	Surrey Satellite Technology Ltd.
UDHR	Universal Declaration on Human Rights
UN Charter	Charter of the United Nations
UNASUR	Union of South American Nations (Unión de Naciones Suramericanas)
UNDP	UN Development Programme
UNECE	UN Economic Commission for Europe
UNEP	UN Environment Programme
UNESCO	UN Educational, Scientific and Cultural Organization
UNICEF	UN Children's Fund
UNISPACE 82	Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space
UNISPACE III	Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space
UNOOSA	United Nations Office for Outer Space Affairs
UN-SPIDER	UN Platform for Space-based information for Disaster Management and Emergency Response
USA	The United States of America
USGS	U.S. Geological Survey
USSR	The Union of Soviet Socialist Republics
WHO	World Health Organization
WSSD	World Summit on Sustainable Development
WWDR2	Second United Nations World Water Development Report

1 Introduction

> 'We international lawyers must be disciples of innovation and invention although we remain slaves to tradition'. Lecture delivered by Philip C. Jessup on 22 July 1970 at the Academy of International Law, Peace Palace, The Hague.

Since the 1960s Latin-American experts have supported the idea of regional space cooperation. Nevertheless, the way to implement this idea in legal terms has not been found yet. The lack of legal clarity in space cooperation has limited its implementation in the region; thus, this research addresses the legal options available to Latin American countries[1] for implementing regional space cooperation, evolving from a non-institutional model to consolidated institutional models of space cooperation.

At the beginning of this research the focus was limited to finding a general institutional model for space cooperation in Latin America. The logic was that once this appropriate institutional cooperation model would be selected, then it could be translated into a concrete proposal to implement space cooperation in the Latin-American region.

Nevertheless, the progress of the research brought new elements to be considered. I realized that the Latin-American current conditions are not appropriate for starting directly with institutional space cooperation; *i.e.* with the creation of a regional space institution. At present, in addition to the lack of regional infrastructure and space capabilities, there are geopolitical and economic constraints to reach institutional cooperation on a sustainable basis. Therefore, perhaps a beautiful convention for a space organization could be elaborated, but it is unlikely that this option would be an effective way to start regional space cooperation.

In this context, the logical order of the initial hypothesis changed because I realized that the definition of a multilateral space project is the pre-requisite for any further decision about a legal model to implement space cooperation,

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1 For definitional purposes, Latin-American countries consist of Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, Bolivarian Republic of Venezuela. The classification is based on their common past, because the listed countries were colonies of Spain and Portugal before their independence.

and not the opposite. The re-structuring of the hypothesis included another change; Latin American space cooperation needs more than one general legal model. The region requires different legal models of space cooperation according to the development of its space capabilities in a long-term strategy that I have defined in a three-phase plan. After this re-structuring the next step was to draft a proposal for the first multilateral space project in Latin America, and then proposes its legal implementation.

In need of a concrete space project to limit the broad theoretical framework and generate the legal aspects to a particular scenario, I started to identify the areas of national and regional development, in which most Latin-American countries could benefit from the use of space applications.

In my opinion, Latin America needs to implement practical measures to realize the right to water[2] and achieve water security.[3] The realization of the right to water should be a priority in the region due to the positive impact of access to water in different areas of human development.[4] In this regard, the progressive realization of the right to water requires good water governance[5] to lead the efforts. Water governance is guided by the paradigm of water management in its complete modality of integrated water resources management (IWRM).[6]

2 Right to water is the right that entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses. Economic and Social Council, General Comment No. 15: The right to water (arts. 11 and 12 of the International Covenant on Economic, Social and cultural Rights). UN Doc. E/C.12/2002/11 (2002).

3 Water security exists when all people have physical and economic access to sufficient and safe water for a healthy life. This definition of water security is based on the same elements that define food security in the Introduction, para. 15 of the Food and Agriculture Organization, Voluntary Guidelines to support the progressive realization of the right to adequate food in the context of national food security, 127th session 5 (2004).

4 Human development includes three essential capabilities for people (1) to lead long and healthy lives; (2) to be knowledgeable, and; (3) to have a decent standard of living. Human development puts people at the centre of all development process. Unite Nations Development Programme, Glossary of terms, at http://hdr.undp.org (last visited 20 March 2010).

5 Water governance determines the appropriate role for the government in service delivery and ensures that water and sanitation services meet the needs of the people. Water governance involves the decisions about how best to use, develop and manage water resources. Unite Nations Development Programme, Water Governance for Poverty Reduction: Key issues and the UNDP response to the Millennium Development Goals 10 (2004).

6 *See* the definition in the Ministerial Declaration of The Hague on Water Security in the 21st Century paragraph 5 (The Netherlands, 2000). IWRM, '[…] includes the planning and management of water resources, both conventional and non-conventional, and land. This takes account of social, economic and environmental factors and integrates surface water, groundwater and the ecosystems through which they flow'.

One way to improve water management is through the use of Earth observation or remote sensing satellites,[7] which provide satellite imagery and data for water management.

The improvement of water management is a tool to realize the right to water, providing options to solve the lack of access to safe water. In addition, an improved water management scenario could prevent water conflicts at national and regional levels. These are the main reasons why this study suggests that the first Latin-American space project focuses on monitoring water quality and quantity, and related themes (*e.g.* tele-epidemiology,[8] food security, etc). Based on these reasons, I propose the development and operation of a small satellite constellation for monitoring water resources, named 'AQUARELSat: The Water Monitoring Constellation'.[9] The primary objective of the AQUARELSat Constellation is to obtain continuous data on the quality and quantity of water.

Considering that satellite imagery and data can combine applications and services, the sustainability of AQUARELSat Constellation is based on a larger user base. AQUARELSat Constellation has been designed according to primary and secondary objectives. The primary objective is to provide satellite information for water management to achieve water security, and the secondary objectives are to monitor other natural resources and natural disasters.

1.1 HYPOTHESIS

Overall, the research explores three main hypotheses:

1 Regional cooperation is the way to encourage space activities in the Latin-American region to solve common problems. The question becomes on how to implement Latin American space cooperation; the answer is a three-phase plan for the legal implementation of space cooperation in Latin America, which is explained in Chapter 6.

2 The definition of a multilateral space project is the pre-requisite and the necessary platform to start Latin-American space cooperation. After defining the multilateral space project the appropriate legal model to implement multilateral space cooperation could be decided. The discussion should

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7 Earth observation satellites are utilized for gathering information to support management of natural resources, land cover, national security related to natural disasters, and food and water security.

8 'Tele-epidemiology' or 'landscape epidemiology' is part of the second generation of space applications, where 'extrinsic factors that drive the biological behaviour of a population of vector/ hosts are the same that influence components of the landscape that can be sent by satellite imagery'. C. Scavuzzo and M. Fea, *International Workshop on Space Technologies Applied to Human Health for the Benefit of Latin American and Caribbean Countries*, Edición Especial Revista Sociedad Latinoamericana de Percepción Remota y Sistemas de Información Espacial 5 (2005).

9 The name of AQUARELSat comes from a metaphor of the French word *aquarelle* by which, with satellite data, a water resources *aquarelle* would be painted.

be focused on defining the first multilateral space project and its agreement rather than on discussing the creation of a Latin-American space institution.

3 Space-water cooperation is important for the Latin-American region. The pairing of space and water addresses two areas in need of improvement due to the lack of space capabilities and the access to safe water to achieve water security. Water security depends on timely and continuous input of information that remote sensing satellites can provide to decision makers, in order to make appropriate decisions.

1.2 Methodological framework of the research

The combination of legal and technical aspects of this research provides the basis for a multidisciplinary analysis, utilizing three different methodologies: analytical, descriptive and comparative. However, the overall research is based on a legal critical analysis.

Chapter 2 includes the historical review of international space cooperation in the UN framework. Furthermore, this section identifies Latin-American projects and achievements in space cooperation, as well as international and regional institutions working in the field of remote sensing. The analysis identifies that most Latin-American countries support the establishment of a regional space institution. This chapter utilizes analytical and descriptive methods.

Chapter 3 explores the current institutional and non-institutional space cooperation models, using a comparative method. This section aims to demonstrate that the pre-requisites for an institutional model, such as the European Space Agency (ESA), are missing in Latin America. Thus, a non-institutional model is suggested to initiate multilateral space cooperation. Considering that a non-institutional model requires a specific space project to generate the legal aspects of its implementation, Chapter 4 drafts the mission design of AQUARELSat Constellation.

Thus, Chapter 4 provides the description of AQUARELSat, a satellite constellation for improving water management, in order to achieve the right to water and water security in Latin America. This chapter is complemented by the Glossary of AQUARELSat (Appendix C), in which the technical aspects related to AQUARELSat are defined. It is recommended to review the Glossary of AQUARELSat to introduce the readers to the technical concepts in Chapter 4.

Chapter 5 presents the legal justification of AQUARELSAt's primary objective in water management. The key justification for the development of AQUARELSat lies in the advantages that remote sensing applications can bring in improving water management as a practical measure to implement the right to water. However, before to deal with the right to water as a human right, a deductive approach in this chapter addresses the legal background of international

cooperation and remote sensing. This chapter uses analytical and descriptive methods.

Chapter 6 contains the proposal for the legal implementation of Latin-American space cooperation in a three-phase plan. The first phase aims to achieve a multilateral agreement to develop and operate AQUARELSat. The second phase considers the creation of the Latin-American Space Agency (LASA). The third phase seeks coordinating Inter-American space cooperation through the Organization of American States (OAS).

The concluding remarks and recommendations in Chapter 7 answer the issue of how to implement space cooperation in Latin America from a practical perspective. In addition, this chapter emphasizes the importance of the Space Conference of the Americas (CEA, *Conferencia Espacial de las Américas*) to implement practical measures in Latin-American space cooperation and coordination of regional resources. The research outcome identifies the relation between space applications and the practical measures that national authorities can adopt to realize space cooperation and human rights (safe water, adequate living standards, health, well-being).

1.3 Objectives of the research

The research has eleven objectives aimed to implement space cooperation in the Latin-American region. It is also mostly focused on the improvement of technological and legal capabilities:

1 the identification of an appropriate legal framework for regional space cooperation (*e.g.* non-institutional and institutional);
2 the promotion of regional space activities for the effective and efficient use of space resources (for the definition of space resources see infra Appendix C);
3 the broadening of the involvement of Latin-American countries in space activities for improving areas of national and regional development;[10]
4 the promotion of regional experience in space projects through the development and operation of a constellation of small satellites;
5 the increased utilization of satellite applications to improve the management of water and other natural resources, and the management of natural disasters;
6 the progressively realization of the right to water;

10 Related to national development, it has been noted that the decision making process is able to formulate long-term and multi-sectorial policies with satellite information, due to the access to the full cycle picture. UN Office for Outer Space Affairs. Seminars of the UN Programme on Space Applications: Selected papers on space science education, remote sensing, and small satellites, UN Doc. A/AC.105/650, at 19 (1997).

7 the reinforcement of the right to health, especially through prevention activities and control of waterborne diseases to be assisted by tele-epidemiology applications with satellite data;
8 the encouragement of space science and technology in the region;
9 the creation and development of a space industry in the region;
10 the promotion and development of national space law;
11 the opportunity for the Latin-American region to be an active actor, who is not only receiving, but also providing satellite data to the scientific network. An actor who will be monitoring, assessing and helping to solve national, regional and global problems, such as the lack of water and food security, pollution of inland waters and transboundary rivers, etc.

1.4 Determination of the topic

Why was Latin-American space cooperation selected as the principal theme of this research? For many years the proposal for Latin-American space cooperation has been discussed. However, it has not been clear in what way one should proceed with the legal and institutional aspects of such regional cooperation, or what specific space project could be carried out. The statements that support regional space cooperation have been formulated in general terms but not in legal terms.

Therefore, this research proposes an answer to the question on how to implement Latin-American space cooperation in legal terms. The proposal to implement Latin-American space cooperation includes legal, institutional and technical aspects. The technical aspects involve the mission design of AQUARELSat Constellation.

This research seeks to contribute to the work of the Space Conference of the Americas (CEA, *Conferencia Espacial de las Americas*), providing a new perspective and options for the legal implementation of space cooperation in Latin America.

Why should AQUARELSat focus on remote sensing applications to realize the right to water? Needless to say that access to water is important since without water there is no life. The access to safe water has a positively impact on different areas of human development, such as health, well-being, adequate living standards, healthy environment, etc. In this regard, Latin America is facing problems to realize the right to water for all citizens. Besides, the measures to control and stop pollution of surface water and groundwater have been deficient. These problems can find in satellite data and imagery a tool for their solution. For example, decision makers could count on more information about quantity and quality of water to improve water management.

The secondary objectives of AQUARELSat are directed to providing satellite imagery about natural resources to monitor and update inventories of natural resources which is valuable information to control their sustainable use. In

addition, the objective related to monitoring natural disasters is also crucial in Latin America due to the hurricane and flood seasons.

The lack of space capabilities and access to safe water are national and regional problems for most of the Latin-American countries. The suggestion is to solve these problems through multilateral space-water cooperation. The initial involvement of four Latin-American countries in a multilateral space-water project such as AQUARELSat Constellation could evolve later to an institutional level. Institutional cooperation will be consolidated with the establishment of a regional space institution and the participation of more Latin-American countries. Actually, this research foresees the possibility of having Inter American space cooperation in a three-phase plan.

2 Description of the problem

> 'In theory, there is no difference between theory and practice. But, in practice, there is.' Jan L. A van de Snepscheut, Yogi Berra.

This section analyses the historic and current situation of international and Latin-American space cooperation; secondly, it identifies the organizations and scientific institutions that work in the space field at the international and regional levels. Whereas the final part concludes with the explanation of the areas in which Latin America could benefit from space cooperation.

2.1 INTERNATIONAL COOPERATION

Usually, the introduction to international cooperation in space activities is based on the successful launching of Sputnik 1 in 1957. Nevertheless, in my opinion there are two events occurring before Sputnik 1 that are worth mentioning.

The first event was the establishment of the International Astronautical Federation (IAF), an organization that has been in existence since 1950. Its annual sessions are attended by experts, professionals and students, who have the opportunity to exchange information on practical applications of space science and technology. It was in this forum where the discussions on how to put a spacecraft into orbit and the legal aspects of space activities started.[1]

The second event that promoted space cooperation was the International Geophysical Year (IGY). The IGY was organized by the International Council of Scientific Unions (ICSU)[2] from July 1957 to December 1958.[3]

During the IGY the possibility of launching an artificial satellite was studied. In fact, a few months after the IGY started, on 4 October 1957, the successful

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1 N. Mateesco-Matte, Aerospace Law: From Science Exploration to Commercial Utilization 13 (1977).

2 The ICSU was established in 1931 under the principle of the universality of science. In 1998 it was renamed the International Council for Science, but it maintained the existing abbreviation ICSU.

3 The year 1957 was selected for the IGY, because scientists found that the Sun was about to be more active during that year. A. C. Clarke, Voices from the Sky 60 (1966).

launching of Sputnik 1 surprised the world. For the first time the feasibility to reach orbits around the Earth was demonstrated.

By this time a number of concerns and questions arose to determine the legal implications of space activities. The use of outer space required an international legal and technical framework so as to prevent confrontation between the two space powers of that time, the United States of America (USA) and the then Union of Soviet Socialist Republics (USSR).

Thanks to the leading role of the United Nations, space activities were conducted towards international cooperation in accordance with international law to guarantee peace and security.

Following the aim of peace and security, the UN emphasised the peaceful purposes of using outer space[4] and international cooperation for civilian applications of space technology.

The first step towards international cooperation in outer space under the UN framework is contained in the UN General Assembly resolution 1348 (XIII)[5] 'Question of the peaceful use of outer space'. This resolution recognized the importance of international cooperation in the use of outer space for peaceful purposes and considered the advantage brought by the establishment within the UN of an appropriate international body for cooperation in the study of outer space.

Further, paragraph 1 of resolution 1348 (XIII) mentioned the establishment of an '*ad hoc* Committee on the Peaceful Uses of Outer Space' composed of 18 members.[6] The *ad hoc* Committee was requested to inform to the General Assembly at its fourteenth session on the following themes:

- activities and resources of the UN related to the use of outer space;
- international cooperation activities that could be undertaken under the UN auspices;
- future organizational arrangements for international cooperation;
- the nature of legal problems which may arise from the use of outer space.

A year later, the UN General Assembly at its fourteenth session adopted resolution 1472 (XIV).[7] This resolution established the permanent Committee on the Peaceful Uses of Outer Space (COPUOS) with 24 State Members.[8] In

4 The use of outer space for peaceful purposes was stressed, among other reasons, to avoid its militarization. When Sputnik 1 was launched, the USA and the USSR were trying to reach an agreement to control intercontinental ballistic missiles and other issues related to disarmament, such as the prohibition of nuclear and thermonuclear weapons, and the establishment of an international control and inspection system. Both space powers concurred on the importance of the 'peaceful' use of outer space. *See* S. Gorove, Studies in Space Law: its challenges and prospects 25-33 (1977).

5 UN Doc. GA/RES/1348 (XIII).

6 Three Latin-American countries participated in the *ad hoc* Committee of 18 representatives: Argentina, Brazil and Mexico.

7 UN Doc. GA/RES/1472 (XIV A).

8 Argentina, Brazil and Mexico were among the 24 members of COPUOS.

addition, this resolution requested from COPUOS 'To review, as appropriate, the area of international co-operation, and to study practical and feasible means for giving effect to programmes in the peaceful uses of outer space […]'.[9]

Resolution 1472 (XIV) was titled 'International co-operation in the peaceful uses of outer space'. At present, the same title still introduces the section on space activities in the UN General Assembly resolutions in accordance with the objective of COPUOS. COPUOS' objectives encompass to encourage and follow up on international space cooperation for the benefit of all countries. Furthermore, this intergovernmental body facilitates the exchange of information on space science and technology, national space legislation, and space programs; and promotes the development of space law.

2.1.1 UN Committee on the Peaceful Uses of Outer Space (COPUOS)

COPUOS started with 24 members in 1958, and now there are 69 Member States.[10] The growth in the number of COPUOS Member States is perhaps the reflection of the increasing awareness regarding the importance of space activities at a national level. In addition to the Member States, COPUOS meetings are also attended by different intergovernmental and non-governmental organizations with the status of observers, among which for instance are: the IAF, the International Institute of Space Law (IISL), the UN Educational, Scientific and Cultural Organization (UNESCO), the European Space Agency (ESA), the Committee on Space Research (COSPAR), the Committee on Earth Observation Satellites (CEOS), and others.

COPUOS works under the principle of consensus.[11] The increased number of Member States might compromise the possibility of reaching consensus among all States. Nevertheless, such an increase is also advantageous to strengthen COPUOS resolutions and decisions. For instance, when 69 countries accept by consensus a resolution with legal implications, we have the acknowledgement of *opinio iuris* by a considerable number of members of the international community, which represents a solid base for developing international custom as one of the sources of international law.

COPUOS has two subcommittees: the Scientific and Technical Subcommittee and, the Legal Subcommittee. They each deal in detail with the technical and legal aspects of space activities. Although they meet at different times and their fields of expertise are different, sometimes both subcommittees jointly

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9 *Supra* note 7.

10 UN Doc. GA/RES/62/217. With this resolution Bolivia and Switzerland were included as new members of COPUOS.

11 There was just one exception to this general rule and it was with the adoption of the Principles Governing the Use by States of Artificial Earth Satellites for International direct Television Broadcasting, adopted on 10 December 1982. UN Doc GA/RES/37/92.

deal with complicated topics, such as the first time that the space lawyers were working on the legal aspects of remote sensing or the use of nuclear power sources.

The Scientific and Technical Subcommittee promotes international cooperation in science and technology, and it is a forum to share information about different projects, studies, and results from space research and applications.

The agenda items of the Scientific and Technical Subcommittee include the implementation of the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), applications of remote sensing for developing countries and monitoring of the Earth's environment, space debris, Space-based Information for Disaster Management and Emergency Response (UN-SPIDER), Near-Earth objects (NEOs), technical aspects of the geostationary orbit and other matters.

On the other hand, the Legal Subcommittee has been the forum where space lawyers and policy makers meet to discuss and negotiate the international legal framework of space activities. It has the big responsibility to continue developing space law in accordance with the advancement of space technology, *e.g.* legal aspects of space exploration and suborbital flights, inter alia.

The Legal Subcommittee has provided the international community with five UN treaties on outer space:

- Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space (Outer Space Treaty);[12]
- Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (Rescue Agreement);[13]
- Convention on International Liability for Damage Caused by Space Objects (Liability Convention);[14]
- Convention on Registration of Objects Launched into Outer Space (Registration Convention);[15]
- Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement).[16]

12 UN Doc. GA/RES/2222(XXI) (1966).
13 UN Doc GA/RES/2345 (XXII) (1967).
14 UN Doc. GA/RES/2777(XXVI) (1971).
15 UN Doc. GA/RES/3235 (XXIX)) (1974).
16 UN Doc. GA/RES/34/68) (1979).

Table 1 – The status of ratification of the UN treaties on outer space, as at 15 February 2010[17]

Treaties on Outer Space	*UN Member States* *Number of ratifications*
Outer Space Treaty	100
Rescue Agreement	92
Liability Convention	90
Registration Convention	54
Moon Agreement	13

In addition to these five treaties, there are five General Assembly resolutions that adopted legal principles applicable to outer space concerning particular matters of space activities:

- Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space;[18]
- Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting;[19]
- Principles Relating to Remote Sensing of the Earth from Outer Space (RS Principles);[20]
- Principles Relevant to the Use of Nuclear Power Sources in Outer Space;[21]
- Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries (Declaration on Space Benefits);[22]

The Legal Subcommittee includes in its agenda's items the following topics: the definition and delimitation of outer space; the character and utilization of the geostationary orbit; capacity building in space law; nuclear power sources; status and application of the UN treaties on outer space, and exchange of information on national legislation.

COPUOS and its two subcommittees meet annually and submit the reports of the meetings to the UN General Assembly, which contain the recommendations adopted by the Members of COPUOS.

17 UN Office for Outer Space Affairs, Searchable online Treaty Status, http://www.unoosa.org/oosatdb/showTreatySignatures.do (Last visited 15 February 2010).
18 UN Doc. GA/RES/1962 (XVIII)) (1963).
19 UN Doc. GA/RES/37/92 (1982).
20 UN Doc. GA/RES/41/65 (1986).
21 UN Doc. GA/RES/47/68 (1992).
22 UN Doc. GA/RES/51/122 (1996).

2.1.2 UN Office for Outer Space Affairs (UNOOSA)

The work of COPUOS is supported by the UN Office for Outer Space Affairs (UNOOSA) which functions as COPUOS's Secretariat, helping also both sub-committees and the related working groups. UNOOSA is located at the UN Office in Vienna, Austria. Furthermore, UNOOSA carries out other functions, such as the following:

1 maintenance of the UN Register of Objects Launched into Outer Space;
2 assistance to developing countries in the use of space technology;
3 dissemination of space science and technology to Member States with the elaboration and distribution of studies, publications and reports addressing different topics of space science and technology and international space law;
4 enhancement of capacity building in space-related topics through workshops and events organized by the UN Programme on Space Applications (PSA) (Developing countries participate in the PSA activities through fellowship programmes);
5 provision of technical assistance to the regional centres for space science and technology education;[23]
6 participation as cooperating body in the Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters (the Disasters Charter).[24] UNOOSA is the focal point to request satellite imagery during or after a natural disaster, by maintaining a 24 hour hotline for this purpose;
7 participation in the organization, convening and work of inter-agency meetings on outer space activities;
8 management of the UN-SPIDER;
9 provision of secretariat services to the Working Group of the Whole of the Special Political and Decolonization Committee (Fourth Committee) of the UN General Assembly;
10 provision of secretariat services to the International Committee on Global Navigation Satellite Systems (ICG);
11 information on space activities and relevant documents online. As part of the International Space Information Service, UNOOSA set up a Website in 1996, on which can be found the relevant documents of COPUOS, the reports elaborated by UNOOSA, the link to consult the UN Register of Objects Launched into Outer Space and the searchable index to review the status

23 The Regional Centre for Space Science and Technology Education for Latin America and the Caribbean (CRECTEALC) was established in 1997 and has been operational since 2003.
24 Charter on Cooperation to Achieve the Coordinated Use Of Space Facilities in the Event of Natural or Technological Disasters Rev.3 (25/4/2000)2 (2000).

> of UN treaties on outer space. This Website is continuously updated by UNOOSA.[25]

Therefore, as can be seen, there are effective mechanisms within the UN framework for promoting and assisting space cooperation. The next step in the flow of this analysis is to define 'space cooperation' making clear its scope and implications.

2.1.3 Definition of space cooperation

There are references to the definition of 'international cooperation in the use o and exploration of outer space' in the UN treaties on outer space and the doctrine. However, it is difficult to find a clear conceptualization of 'space cooperation'. The first answer to this question could be that it is a problem of terminology. This reason is correct but incomplete.

In my opinion the term of space cooperation is a more modern and comprehensive concept that incorporates broader themes and modes of cooperation in space activities. Hence it is not only a question of terminology, but also of content. The evolution of the term space cooperation was imperceptible, but for the purpose of this research it is important to lay down a well defined concept of space cooperation. My proposal for the definition of space cooperation is presented after the examination of the concept of international cooperation in the use and exploration of outer space.

The Russian experts provide a good first approach to the definition of space cooperation by the description of most of its elements. In their own words they said:

> '[I]nternational cooperation in the exploration and use of outer space may be described as joint scientific, technical, economic, political and legal activities of states to ensure the use of achievements of space science and technology for peaceful purposes and for the benefit of all countries and peoples'.[26]

This definition encompasses three main fields where international cooperation in the exploration and use of outer space can be implemented:

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25 UNOOSA http://www.unoosa.org/ (Last visited 7 December 2009).

26 K. E. Vereshchetin, E. Vasilevskaya & E. Kameneckaja, Outer Space Politics and Law 87 (1987).

1 Scientific and technical activities

International cooperation in space activities began with cooperation in space scientific projects.[27] As mentioned before, the IGY was a good opportunity to encourage international cooperation in the study of space matters, from space physics to the launching of artificial satellites. Since the beginning of the space era international cooperation in space science has been successfully applied.

Nowadays, the scientific networks are the ones who provide the best examples of coordination and collaboration in space projects. A good example in scientific cooperation is the Committee on Space Research (COSPAR) established by the ICSU in 1958, which has the objective of promoting international scientific research in space. Other examples of multilateral space cooperation for science and research on particular space topics are mentioned by Ferrazani,[28] *e.g.* the Committee on Earth Observation Satellites (CEOS) created in 1984; the Inter-Agency Space Debris Coordination Committee (IADC) founded in 1993; the International Global Observing Strategy (IGOS) since 1998, and; the Disasters Charter since 2000. In this context, Ferrazani draws our attention to the alternation of no formal mechanism of international cooperation to initiate the coordination for sharing satellite information among intergovernmental or space agencies, without implications of funding or technology transfer.

Concerning technological cooperation in space activities, the main issue to solve in this field is how to improve space technology transfer, thereby providing a more flexible scheme for developing countries to participate in space activities. This has been a lock that is difficult to open in space activities. Therefore, the best approach could be the investment in capacity building applied to domestic space technology. In order to promote this approach it would be an advantage to assign contracts to international satellite companies that include training of experts.

2 Economic activities

Space missions are expensive and risky projects. For that reason, international cooperation is a feasible alternative for pooling economic resources and sharing costs and risks to increase the participation of developing countries in space activities. Nevertheless, the combination of budgets and transfer of funds is a sensitive matter that follows particular guidelines in accordance with the space policy adopted by each of the space agencies involved in a cooperation

27 But see J. Johnson- Freese, Changing Patterns of International Cooperation in Space 9 (1990). This author concluded that in the period from 1950s to 1960s, there was a deep competition between the USA and the USSR. 'Therefore, as the antithesis of competition, cooperation was impossible'. However, he recognized the importance of some agreements reached by that time, such as the arms control agreements.

28 M. Ferrazani, *Alternative Approaches to International Cooperation*, 110 ESA Bulletin 77-78 (2002).

project. For instance the USA's National Aeronautics and Space Administration (NASA) Policy Directive adopted on December 2008 indicates the principles that apply for reimbursable, non-reimbursable, and funded agreements.[29]

3 Political and legal

Legal and political cooperation is needed in the development of international space law.

In this respect, Prof. Kopal draws attention to the fact that it was during the 'Cold War' that international space law experienced its major development, between 1963 and 1979. In Kopal's own words '[i]n this pioneering period, the international space law instruments were negotiated effectively and they were agreed upon in a relatively short time.'[30] The five UN treaties on outer space were adopted within this period. There was a 'Cold War' but also a political will to cooperate and define the legal scope of space activities.

On the other hand, we can observe the slowdown of international space law making from the 1980s onwards. Since then, the Member States of COPUOS worked on set of principles rather than on treaties on particular subjects, and the negotiation of these principles took many years to reach consensus despite the fact that they were principles and not treaties.

In the last few years, the Member States of COPUOS have been working on studies, guidelines, resolutions and non-binding documents dealing with specific problems such as space debris, nuclear power sources in space, assistance for management of natural disasters and the concept of launching State.

There have been proposals to open for review some of the treaties and principles, such as the Moon Agreement or the RS Principles, but these proposals have not been supported by the majority of the Member States of COPUOS.

Prof. Kopal wrote more than ten years ago on his diagnosis of the slowdown in the development of international space law. He found the following factors:

> '[O]ne of the important factors working against further development of international space law has been the weakening of the political will on the part of the international community, and of its readiness to be bound by further and more specific legal obligations'.[31]

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29 NASA Policy Directive NPD 1050.11 . Effective Date: December 23, 2008, Expiration Date: 23 December 2013. NAII 1050-1A NASA Advisory Implementing Instruction, Space Act Agreements Guide.

30 V. Kopal, *International Law of Outer Space: A Useful Tool of International Cooperation in Space Activities*, at N. Jasentuliyana and K. Karnik (Eds) Space Futures and Human Security 215 (1997).

31 *Id.* Kopal at 216.

At present, the factors pointed out by Prof. Kopal have not been overcome. The development of space law is encouraged by the advancement of space technology and its applications, but also depends on international relations. This, however, is a very sensitive area, in which delegates are very careful in their words when supporting or condemning acts of other countries in outer space, or expressing their positions. We have observed this situation in the Legal Subcommittee. However, in the Technical & Scientific Subcommittee the situation is different, the scientific delegates have the opportunity to express their opinions more openly, even though they are supervised by the representatives of their Foreign Ministries.

There are proposals to change the adopted international space regulations, or to develop the principles into binding documents or to elaborate new regulations for new space activities such as suborbital flights. Nevertheless, the main argument against changes to the *status quo* is that everything has been working well in the past and does so now, thus there is no need to change. Behind this argument the main obstacle to overcome seems to be still the 'weakening of the political will' to move international space law forward, a problem which has been identified before by Prof. Kopal.[32]

The dominant trend supported by the private space sector, is to advocate for less regulation and more freedom, with the presumption that 'everything that is not prohibited is permitted', although Prof. Manfred Lachs stated that this principle is not valid in space activities. The freedom of action is limited by the rights of others. The activities performed by a State can not affect the rights of other States in particular when we refer to outer space.[33]

Apart from the three above-mentioned fields of space cooperation in accordance with the definition provided by the Russian experts, in my opinion there has to be added a fourth field that encompasses education and training. These two activities are fundamental for developing indigenous capability in space applications. Perhaps education and training were not mentioned in the definition of international cooperation, because rather than cooperation these activities were considered as a sort of assistance.[34] At present, a good example of reciprocal space cooperation in education is the agreement between Brazil and Argentina for cooperation in space law.[35]

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32 *Id.*

33 *See* Vereshchetin *supra* at 26.

34 V. Leister explains that in the use of space technology for economic development, the policy draws a distinction between space 'participation' and space 'benefits', because benefits can be supplied as a foreign aid, but participation means mutual actions by partners. In this case space benefits are understood as assistance and participation implies cooperation. V. Leister, *International Cooperation in Outer Space: Extending the European Model*, in the Proceedings of the Twenty-Fourth Colloquium on the Law of Outer Space September 208 (1981).

35 *See* Declaración de Buenos Aires sobre Cooperación en Derecho Espacial (2004). European Centre for Space Law (ECSL), Space Law virtual network with Latin American countries http://www.esa.int/SPECIALS/Space_Law_virtual_network_Latin_America (last visited

Finally, I close this first portrayal of approaches towards international cooperation with a suggestion for defining space cooperation.

Space cooperation is a mechanism for the efficient use and exploration of outer space. It includes institutional and non-institutional cooperation in science and technology; economics and innovation; legal issues and politics; education and training. These areas of cooperation are in the sphere of the peaceful use and exploration of outer space.

Space cooperation activities are performed under equitable and reciprocal conditions, mutually accepted by the countries involved. A particular feature of space cooperation is the global commitment to improve quality of life for all people.

Taking into account this last characteristic in space cooperation, the participant countries in space cooperation should consider not only the advantages of such cooperation in national terms, but also the contributions that could derive from such a cooperation for the benefit of other countries at the regional and international levels; considering the local and global interaction around the world and the common goal of sustainable development.

2.2 REGIONAL COOPERATION IN SPACE ACTIVITIES: THE LATIN-AMERICAN EXPERIENCE

Latin-American regional cooperation in space activities has in its favour the following circumstances:[36]

- Physical proximity, *e.g.* the Andean Community of Nations (CAN, *Comunidad Andina de Naciones*): Bolivia, Colombia, Ecuador and Peru. The member countries are in the Andes Mountains in South America;
- Spanish and Portuguese common cultural legacy, *e.g.* The Organization of Ibero-American States for the Education, Science and Culture (OEI, *Organización de Estados Iberoamericanos para la Educación, la Ciencia y la Cultura*) participant countries are Portuguese and Spanish speaking nations of America and Europe.
- Common national interests, *e.g.* the Union of South American Nations (UNASUR, *Unión de Naciones Suramericanas*) which comprise Southern Common Market (MERCOSUR, *Mercado Común del Sur*) and the CAN. UNASUR was modelled after the European Union.

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10 November 2009). This declaration was an initiative of Prof. Maureen Williams from Argentina and Prof. José Monserrat Filho from Brazil.

36 C. Sepúlveda, Derecho Internacional Público 2: Terminología Usual en las Relaciones Internacionales 53 (1992). Sepúlveda defined the phenomenon of 'regionalism' on base of these elements.

Despite having elements of regionalism, regionalism cannot be achieved at once. There are five different processes involved in regionalism and regional cooperation:[37] (1) regionalization; (2) regional conscience; (3) cooperation among States; (4) integration conducted by the States, and: (5) regional consolidation. In Latin America can be observed institutional economic integration of sub-regions and attempts at political coordination. Nevertheless, at present the scenario is complex considering geopolitics and ideological aspects.

Latin-American space cooperation has in favour elements of regionalism, but the limited advance in its own process of regionalism has delayed multilateral agreements in this field. For fifty years the region has been trying to find its way to implement space cooperation. In this regard, two earlier institutions tried to achieve permanent status to conduct space cooperation in the region:

1 the Inter- American Committee for Space Research (IACSR);
2 the Latin-American School on Space Science and Technology.

Ad 1 – The Inter-American Committee for Space Research (IACSR)

Dr. Cocca explains that IACSR was created after the First Inter-American Meeting on Space Research in Buenos Aires, Argentina, held on 28 November 1960.[38] Countries that were participants to this meeting signed a declaration to promote and increase space research in the Latin-American region and for that purpose a provisional committee was established called the IACSR. Signatory countries to this declaration were Argentina, Brazil, Chile, Peru and the USA. The Committee's first president was Teófilo M. Tabanera, a renowned Argentinean engineer.[39]

The activities of IACSR included to 'assist in the creation of international bodies to encourage and coordinate space related activities'[40] in the Latin American countries, and; to organize symposia and other meetings. IACSR is part of the Latin-American history in regional space cooperation. Unfortunately, it was a provisional Committee that could not reach a permanent status, even though by the time that IACSR was operating, it had the status of UN observer in COPUOS.

The last activities of IACSR were described by Prof. Mateesco-Matte.[41] In August 1964, Buenos Aires was the venue for the Inter-American Symposium on Space Research, where the experts analysed the methods of research in

37 *See* A. Hurrell, *Comparación entre Europa y América: ¿qué clase de problemas?, ¿qué clase de teorías?* (Comparison between Europe and America: what kind of problems?, what kind of theories?) in Regionalismo y Poder en América: los Límites del Neorrealismo 195 (1996).
38 A. Cocca, *Space Law-Latin America's Contribution*, 7 Space Policy 155 (1991).
39 *See generally* O. Fernández-Brital & M. Sánchez Peña, *Teófilo Tabanera (1909-1981) the Divulger*, 50 Acta Astronáutica (2002) at 257-259 (informing about the outstanding career of Teófilo M. Tabanera).
40 N. Mateesco-Matte, Aerospace Law, 135 (1969).
41 *Id.*

the upper atmosphere and related problems of limited financial support to perform these studies.

In October 1966, IACSR organized a meeting in Mexico City. At this meeting the Congress on Engineering Teaching was arranged by the Pan-American Union of Engineers.

Regarding the situation of Latin-American cooperation in space activities by the end of the 1960s, Prof. Mateesco-Matte referred to two main problems: 'it is to be noted that Inter-American regional activities in space exploration are of limited nature, because of lack of financial resources and technical know-how.'[42]

The question that the Latin-American countries should ask themselves is whether the same problems identified almost 50 years ago are still limiting regional cooperation in space activities and what alternatives might there be to overcome these limitations.

Concerning technical know-how, there have been single steps made by countries like Argentina and Brazil, which have advanced in this field due to the development and operation of national satellites. Nevertheless, a regional step forward in the advancement of technical know-how is missing.

The problems related to limited financial resources can find solutions in the current regional resources, such as the expert groups working within the OAS or the Inter-American Development Bank (IADB). We will assess the alternative of OAS involvement in space cooperation in Chapter 6.

Ad 2 – The Latin American School on Space Science and Technology

The Argentine National Commission for Space Research (CNIE) in collaboration with the IACSR organized a Latin American School on Space Research. The first course was scheduled between 15 January and 3 February 1968. The CNIE sponsored the international travel and subsistence costs of the students who participated from American countries. The Argentinean representative sent a letter to COPUOS dated 11 September 1967[43] to inform COPUOS about the programme and professors appointed for the course. The Latin-American School is not functioning anymore. However, since 1997, thanks to the UN, the Latin-American and Caribbean countries have the Regional Centre for Space Science and Technology Education for Latin America and the Caribbean (CRECTEALC). CRECTEALC is affiliated to the UN under the PSA in charge of

42 *See* Mateesco-Matte, *supra note* 40 at 136.

43 UNGA, Space Education and Training: Letter dated 11 September 1967 from the Permanent Representative of Argentina addressed to the Chairman of the COPUOS, A/AC.105/42, 12 December 1967. *See also* UN Department of Political and Security Council Affairs, *Space activities and resources,* A/AC.105/193, at 217 (1977).

UNOOSA.[44] Furthermore, the UNESCO also supports space education in the region through the UNESCO's Space and Education Programme.[45]

At present, several Latin-American scientific organizations and institutions are working in the space field and a regional forum on space cooperation. Among them are the following:

1 the Latin-American Society in Remote Sensing and Spatial Information Systems (SELPER, *Sociedad de Especialistas Latinoamericanos en Percepción Remota*);
2 the Water Center for the Humid Tropics of Latin America and the Carribbean (CATHALAC, *Centro del Agua del Trópico Húmedo para América Latina*);
3 the Central American Commission for the Environment and Development (SICA/CCAD, *Sistema de Integración Centroamericano*);
4 the Space Conference of the Americas (CEA, *Conferencia Espacial de las Américas*).

Ad 1 – The Latin-American Society in Remote Sensing and Spatial Information Systems (SELPER)

In 1980 SELPER was set up with the objective of developing regional cooperation programmes in remote sensing. According to Araya 'it is hoped that science and technology will help to obtain a more solid integration among our countries and this is the main reason for the existence of SELPER.'[46]

One of SELPER objectives related to regional cooperation in remote sensing is 'to obtain the cooperation of national and international institutions to develop remote sensing activities in benefit of Iberoamerica.'[47]

A crucial area of SELPER is space education, which is under the direction of the Education Committee,[48] in charge of encouraging activities related to

44 CRECTEALC has two campus: (1) the Centre in São José dos Campos Brazil, and (2) the National Institute for Space Research (INPE) Campus Mexico. CRECTEALC provides courses in meteorology, communications, space science, remote sensing, GIS, and atmospheric sciences.

45 UNESCO's space education programme works in cooperation with Space Agencies, the International Astronautical Federation (IAF) and a number of renowned academic institutions. It is worth mentioning that since the 1970s UNESCO has participated actively in remote sensing through the organization of training and capacity building activities for environmental applications in developing countries. In accordance with this, the programmes for using remote sensing embraced more fields in 1980, such as geology, mineral resource assessment and natural hazards. Letter from W. Erdelen, Assitant Director-General for Natural Sciences, UNESCO, to J. Achache, CEOS Chairman (25 September 2002). (available at http://ceos.esa.int/plenary16/papers/doc7_membership.pdf).

46 M. Araya, *The Role of the Society of Latin American Specialists on Remote Sensing (SELPER) in the Analysis and Actions Related to the Main Advances and Needs of Spatial Remote Sensing for Latin America*, 4 Advances in Space Research 44 (1984).

47 *Id.*

48 Sociedad Latinoamericana de Percepción Remota y Sistemas de Información Espacial, *Comité de Educación*, http://www.inpe.br/unidades/cep/atividadescep/comite_docencia/HTML/espanhol.html (last visited 10 April 2008).

education and research in remote sensing and Geographic Information Systems (GIS). Furthermore, the objectives of the Education Committee include the exchange of information and knowledge among SELPER affiliates through international and regional symposia and workshops.

SELPER has an important role in science and technology for remote sensing applications in the Latin-American region; consequently, SELPER participation should be considered in any future endeavours to adopt and implement a regional space project for remote sensing applications.

Ad 2 – The Water Center for the Humid Tropics of Latin America and the Caribbean (CATHALAC)

CATHALAC was established in 1992 with the objective of promoting sustainable development and integrated watershed management through applied research and development, education and technology transfer. It is an international organization at the service of the humid tropics of Latin-America and the Caribbean. Its projects and programmes are open to all countries of the humid tropics in Latin America and the Caribbean. In addition countries outside the region can participate, as well as intergovernmental, private and philanthropic organizations.

CATHALAC has a specialized area in natural resources management, where integrates watershed management, water resources management, GIS and landscape analysis are studied.

In the field of education, CATHALAC is providing regional graduate degrees related to remote sensing such as the Master in Earth Observation and GIS, and; the Master in Watershed Management.

CATHALAC is a participant organization in the Group of Earth Observation (GEO); implementer of the Regional Visualization and Monitoring System (SERVIR, *Sistema Regional de Visualización y Monitoreo para Mesoamérica*);[49] regional project manager for the Disasters Charter; manager for the National Oceanic and Atmospheric Administration (NOAA) GEONETCast satellite receiver; manager for the NASA MODIS satellite receiver.[50]

Ad 3 – Central American Commission for the Environment and Development (SICA/CCAD)

In 1991, the Central American Integration System (SICA) was established to provide an institutional framework for regional integration in Central America.

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49 SERVIR is a platform for collaboration that integrates Earth observation information for timely decision-making. The operational facility of SERVIR in Latin-America was established in 2005 with the collaboration of NASA, USAID, CATHALAC, the Central American Commission for the Environment and Development (CCAD), and other partners. SERVIR provides access to geospatial data that has helped to natural disaster management and environmental threats in the region. SERVIR, Overview of the SERVIR Program at http://www.servir.net (last visited 5 July 2009).

50 CATHALAC, Brochure Science, Education, and Policy for People, www.cathalac.org

SICA comprises the following countries: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama. The Dominican Republic participates as an Associated State. Regional observers include Mexico, Chile and Brazil, and; the Republic of China (Taiwan), Spain and Germany have the status of extra-regional observer countries.

The SICA has a Commission for Environment and Development (CCAD). The founding States of CCAD are Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua. CCAD's functions include distribution of information; determination of priority action areas and promotion of a participatory environmental management.[51]

SICA/CCAD participates in GEO. In this context, expert Ohlemacher considers that

> 'Central American governments have developed significant capacity for use of Earth observations through interactive 3D visualization of data from NASA research satellites for use in support management and policy decisions'.[52]

Ad 4 – The Space Conference of the Americas (CEA)
This forum is attended by experts from the Latin-American region, UNOOSA, UNESCO and observers such as space agencies, non-governmental organizations, academics and representatives from the private sector. The CEA's discussions are focused on regional and international space cooperation with the aim to contribute to the advancement of regional development.

- The first CEA held in San Jose, Costa Rica (12-16 March 1990), entitled 'Prospects of Cooperation for Development.'

- The second CEA was held in Santiago, Chile (26-29 January, 1993), entitled 'Cooperation, Development and Regional Integration.' During this Conference the Declaration of Santiago was adopted,[53] which states in paragraph 4 the need for national programmes and projects that converge progressively towards the integration of space activities in the Americas.

- The third CEA was held in Punta del Este, Uruguay (4-8 November 1996), with the title 'Technology, Education and Environment'. Here the Declaration of Punta del Este and an Action Plan were adopted. Two points in this declaration are related to regional cooperation:

51 SICA, Institution of SICA: CCAD, http://www.sica.int (last visited 6 July 2009).
52 R. Ohlemacher, The Earth Observation Summit: Heralding a New Era for International Cooperation, 19 Space Policy 281 (2003).
53 European Centre for Space Law (ECSL), Conferencia Espacial de las Américas II CEA, 26-30 Abril de 1993, Declaración de Santiago, http://www.esa.int/SPECIAL/space_law_virtual_network_Latin_America (last visited 10 April 2008).

'[…] (3) Affirms that in order to create and enhance space capabilities in the countries of the region, the parties shall see long-term continuity, coordination and stability together with the development of technology in national space activities. Furthermore, the parties agree to undertake appropriate cooperation and interaction so as to make future projects possible, […]
(6) Firmly believes that cooperative projects in space matters should seek to develop and foster applications of space technology in the region, in the widest and most effective way.'[54]

The quotes from the Declaration of Punta del Este cited above were formulated in general terms. One of the problems to implementing these general statements into specific reality concerns the unclear approach: What are the future projects? To what applications of space technology and cooperation projects is the text related?

- The fourth CEA was held in Cartagena de Indias, Colombia (14-17 May, 2002) under the title 'The Application of Space Science and Technology in the Americas and their Benefits for Civil Society.' This conference adopted the Declaration of Cartagena de Indias and a Plan of Action.
  During this conference mechanisms were discussed concerning cooperation and coordination within the region with respect to space science and technology for space applications on disaster management, tele-education, tele-medicine, public health, environmental protection and space law.[55]
  The Declaration of Cartagena refers to regional cooperation in paragraph 17:
  '17. Agree that it is important to establish mechanisms for effective cooperation and coordination in the region (…); and welcome the report presented by the delegation of Chile on the creation of a mechanism for regional coordination on space matters'.[56]
  In order to follow up paragraph 17 of the Declaration of Cartagena a paragraph 6 was included in the Plan of Action stating that the Pro Tempore Secretary shall take the following actions pursuant paragraph 17 of the Declaration:
  '(a) Analysis of common requirements, based on a survey to be sent to all the countries in the region, so as to identify priorities, areas of interest, available human resources, existing research centres, projects in progress, focal points […] (d) Creation of working group composed of representatives of the countries of the region, designated by their respective Governments, to help determining areas of regional coordination […].'[57]

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54 E. Gaggero, *Space policy-making in the Americas*, 13 Space Policy, May 1997, at 172.
55 Press Release. UNCOPUOS Concludes Forty-Fifth Session in Vienna, UN Doc OS/1779 (Jun. 17, 2002).
56 UNGA, Report of the COPUOS. Fifty-seventh session, UN Doc. Supplement No. 20 A/57/29, at 34-36 (2002).
57 *Id.*

It is worth mentioning that the drafting of paragraph 17 came from the Chilean proposal presented under the title 'The Creation of a Regional Organism on Space for Latin America and the Caribbean during the Fourth CEA'.[58]

- The fifth CEA was held in Quito, Ecuador (24-28 July 2006) with the title 'Regional Space Collaboration for Security and Development.' The result of this Conference was the Declaration of San Francisco de Quito entitled 'Regional Space Agreement for Human Security and Development'.
  Within the Declaration of San Francisco de Quito, Latin-American and Caribbean countries 'were invited to set up national space entities to lay the foundation for a regional entity for cooperation […].'[59]
  Paragraph 9 in the same declaration stated the following:
  '9. Highlight the advantage and need to establish effective cooperation and coordination mechanisms for the region with the purpose of promoting the development of space activities in the countries of the Americas, as well as for the application and peaceful uses of space technology.'
  Finally, theUN publication, Highlights in Space in 2006 informed that during the fifth CEA:
  'plans were developed to make better use of the existing satellite capacity in Latin America, particularly of remote sensing/ Earth observation spacecraft, to monitor the environment, with the view of preventing natural disasters […]'.[60]

- The sixth CEA was planned to be held in 2009 in Guatemala. During the session of COPUOS in 2008 recommendations for the preparation of the sixth CEA were introduced.[61] These recommendations were adopted at the meeting held in Quito, Ecuador on 13-14 December 2007. The meeting was attended by representatives of the Governments of Colombia, Ecuador and Guatemala, the International Group of Experts of the CEAs, and experts from UNOOSA. By the end of August 2008 a second meeting was held in Ecuador.
  Nevertheless, the Ecuadorean Pro Tempore Secretariat of the CEA V informed in June 2009 during COPUOS meeting, that was 'holding consulta-

58 *Cf.* Agencia Chilena del Espacio, Informe Ejecutivo de Actividades Julio 2001- Enero 2003 at 88-92 (2003), available at http://www.INFOJEC%20JUL2001%ENE2003%20Version%2013 mar03[1].pdf. (transcribing in Annex H the presentation made by the Chilean Space Agency titled 'The Creation of a Regional Organism on Space for Latin America and the Caribbean').

59 COPUOS, Report of the Scientific and Technical Subcommittee of its forty-fourth session, held in Vienna from 12 to 23 February 2007, para. 50, UN Doc. A/AC.105/890 (March 6, 2007). *See also* the Declaration of San Francisco de Quito para. 21 (Ecuador, July 28, 2006) (holding the advisability of establishing national space agencies to encourage the creation of a regional space organization).

60 UNOOSA, Highlights in Space 2006, at 87 (2007).

61 COPUOS, Draft Report of the Fifty-first Session, Vienna 11-20 June 2008, UN Doc. A/AC.105/L.271E , para. 26 (2008).

tions to decide on the venue for the CEA VI, to take place in 2010'.[62] Finally the CEA VI will be held in Pachuca, Mexico on 15-19 November 2010.

Table 2 – Summary of the CEAS

Year	*Date and venue*	*Theme*	*Documents*
First CEA 1990	12-16 March 1990 San José, Costa Rica	Prospects of cooperation for development	n/a
Second CEA 1993	26-29 January 1993 Santiago de Chile, Chile	Cooperation, development and regional integration	Declaration of Santiago
Third CEA 1996	4-8 November 1996 Punta del Este, Uruguay	Technology, education and environment	Declaration of Punta del Este and Plan of Action
Fourth CEA 2002	14-17 May 2002 Cartagena de Indias, Colombia	The application of space science and technology in the Americas and their benefits for civil society	Declaration of Cartagena de Indias and Plan of Action
Fifth CEA 2006	24-28 July 2006 Quito, Ecuador	Regional Space Agreement for Human Security and Development	Declaration of San Francisco de Quito and Plan of Action
Sixth CEA 2010	15-19 November 2010 Pachuca, Mexico	Space and Development: Space Applications at the Service of Humanity and for the Development of the Americas	(TBD) Declaration of Pachuca and the VI CEA Plan of Action

2.2.1 Four regional proposals to implement space cooperation

There have been four regional proposals to encourage space activities in Latin America:

1 the South American Space Agency (SASA);
2 the Latin American Space Agency (LASA);
3 the Pan-American Space Organization (PASO);
4 the satellite project Simon Bolívar.

Ad 1 – The South-American Space Agency (SASA)
During the Second UN Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82)[63] Chile submitted a proposal to create the SASA. Chile's Position Paper in UNISPACE 82 mentioned the following:

> '(a) At the international level, Chile proposes an institutional structure which would allow South America to make extensive and effective use of space for peaceful purposes […].

62 UN COPUOS, Information note by the Pro Tempore Secretariat of the Fifth Space Conference of the Americas, Doc. A/AC.105/2009/ CRP.14 (2009).
63 *See* UN Doc. A/CONF 101/10 (1982). COPUOS, Report of the UNISPACE- 82, Vienna Aug. 9-21, 1982.

> (b) […], it is essential in Chile's view, to begin studies aimed at establishing a South American space agency, with equal participation by all States, to organize co-operation among the countries of the continent […]'.[64]

To give a better idea of this project, I refer to the draft of the Agreement for the creation of the SASA, which was translated by Dr. González. This document comprises 18 articles, however I refer just to the articles that set SASA's nature, objectives and membership, considering their importance in describing this project:

> 'Article 1
> An international intergovernmental body known as the South American Space Agency shall be established. […]
> Article 2
> The South American Space Agency shall channel the cooperation among countries in the area towards a mutual elaboration, executions and financing of projects for the utilization of space technology entailing economic and social development of the peoples.
> Article 4
> […] The only requirement for joining this body is that of being a South American country'.[65]

In the words of Dr. Cocca, the South American Space Organization 'was to be an intergovernmental organization with legal status, formed by South-American countries'.[66]

The idea to create a SASA came from the preparatory Seminar on the Applicability of Space Sciences held in Quito, Ecuador on April 19-23, 1982.

At this point, it is important mentioning that it is confusing to read about this proposal in the sense that it is sometimes considered a single proposal yet with two different names: 'South-American Space Agency' and 'Latin-American Space Agency'. For example, in the Journal of Space Law volume 10 there are two contributions by Dr. González, one is the translation of the SASA Agreement quoted above, and the second is concerning the comments on the national monograph of Chile presented at UNISPACE 82, a document that supported the creation of the LASA with statements such as the following:

> 'Since Latin American countries, isolated from each other could not reach the 'critical mass' required for an effective lift-off toward said self reliance, the way

64 International Space Programmes and Policies: Proceedings of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE), Vienna, Austria, August 1982, 195 (1984).

65 R. González, *South American Space Agency Proposal*, 10 Journal of Space Law 258 (1982).

66 *See* Cocca *supra* note 38, at 155.

> out is to add up the available human and material resources in a joint venture: A LATIN AMERICAN SPACE AGENCY'.[67]

In this regard, Cocca provides some clues how the idea evolved from SASA to LASA.[68] He explains that at the beginning it was called SASA, but at the headquarters of the UN Economic Commission for Latin America and the Caribbean (ECLAC), after the 1983 Seminar on Outer Space in Santiago, Chile, the attendees agreed to change the name to LASA in accordance with an Argentinean proposal.

After UNISPACE 82 a seminar was convened in Brazil to review the results of UNISPACE 82. The participants to the seminar agreed on 'the importance of regional cooperation, but did not support the idea of the creation of another international organization'.[69]

In June 1986, Colombia with the collaboration of the ECLAC hosted a meeting to promote regional cooperation in space research, and satellite telecommunications and meteorology. From this meeting came practical recommendations to enhance cooperation in these fields: (1) each country should identify their national resources in space activities; (2) countries should seek to establish national institutions for space activities to facilitate the co-operation network; (3) the participation of the ECLAC should be considered, and the possible participation of international financial institutions; (4) further study on coordination mechanisms to facilitate regional cooperation.[70]

Ad 2 – Latin American Space Agency (LASA)

The idea to establish a LASA in similar terms as the European Space Agency (ESA) has been proposed by governmental and academic representatives in Latin-America for many years. That is the trend in Latin-American space cooperation: to follow the ESA model. Since the beginning of the 1980s this idea has been part of public statements; for instance, Dr. Leister mentioned in her doctoral thesis:

> 'Following the pattern of the European Space Agency the Brazilian Commission for Space Activities believes that there is a tendency to integrate in the same bloc countries close geographically or sharing ideological views'.[71]

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67 R. González, *Seminar on the Applicability of Science of Space Science, April 19-23, 1982, Quito, Ecuador*, 10 Journal of Space Law 218 (1982)

68 A. Cocca, *El Papel de America Latina en el Derecho del Espacio Ultraterrestre*, in the Proceedings of the Latin American Conference International Air Transport and Activities in Outer Space Mexico, 14-18 August, 1988, at 372 (1989).

69 V. Leister, *Prospects for a Latin American Space Agency* in the Proceedings of the Thirty-First Colloquium on the Law of Outer Space 127 (1988).

70 *Id.*

71 V. Leister, *Space Technology: From National Development to International Cooperation*, Doctoral thesis McGill University 269 (1982).

It is interesting to observe in this quotation that at some point Brazil was enthusiastic about the idea of establishing a LASA, which is a different situation than what prevails today.

Early in 2002, Franklin R. Chang-Díaz, a NASA astronaut born in Costa Rica, and instrumental in convening the first CEA[72] explained in an interview that the idea to have a LASA has been discussed for a long time.[73] Chang-Díaz is acknowledged as one of the original organizers of LASA and he provided interesting information about the development of the LASA proposal and his experience in dealing with this idea in practice.

Chang-Díaz explains that in 1990 at the first CEA in Costa Rica, the idea to create a LASA was considered on a more formal basis. The creation of LASA started to be discussed within a small group of Latin-American scientists, but the first CEA allowed the involvement of the official delegations in this proposal, which 'was not endorsed by all of the countries, but the idea remains […]'. The case of Brazil is peculiar in the region, as 'the Brazilians have been quite reticent to be a part of it [LASA] because they felt they wanted to go it alone.'[74]

The general idea was directed towards the creation of a Pan-American Space Agency to include the USA and Canada. In addition ESA was identified as a model for a space agency to be implemented through Latin-American space cooperation.

Finally, Chang- Díaz outlined the importance of more action and less talk. His position is reflected in his strategy:

> 'One of the things we need to do is more projects that are multilateral in nature and take advantage of this infrastructure […], which is scattered throughout the continent, and bring it together in a project that will bring results'.[75]

I agree with Chang-Díaz that we need more action. Perhaps the conferences and meetings are a good start for regional cooperation; however, if general statements can not be translated into concrete space missions, regional cooperation in Latin America will remain in the status of good intentions.

The idea of creating a LASA was considered again during the fourth CEA; as mentioned before it was during this conference that Chile proposed the

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72 NASA, Information Summaries Astronaut Fact Book 33 (2005). (Chang-Díaz was selected by NASA in 1980, executed seven flights, and currently has a management position in NASA).

73 21st Century Science & Technology, Interview [by Marsha Freeman] with Astronaut Franklin Chang Díaz Reaping the Benefits of Latin American Space Cooperation, (21 February 2002) http://www.21stcenturysciencetech.com/articles/winter01/Chang_Diaz.html (last visited 9 April 2010).

74 *Id.*

75 *Id.*

establishment of LASA.[76] Nonetheless, on that occasion the idea was more detailed and the proposal included concrete actions towards the creation of LASA:[77]

- creation of an expert commission with the objective to set a regional space policy and to organize the technical coordination through specific regulations;
- analysis of common needs among the countries in order to identify priorities and the current resources;
- participation and support of UNOOSA;
- study the possibility for setting up an international funding system for the organization;
- creation of national space agencies in each country in order to allow for better global coordination.

At present, in my opinion Argentina is taking the lead in the proposal to create the LASA. In fact, Argentina has included this proposal in its own national space policy. The Argentine National Space Plan (ANSP) embraces a number of Courses of Action; one of them is related to strategic associations with other national and international entities in order to reach particular objectives. According to this document, these activities can be useful as a tool of foreign policy and for the creation of a regional space entity.[78]

An interesting aspect to be noted from this proposal in the ANSP, elaborated by the Argentinean National Commission on Space Activities (CONAE, *Comisión Nacional de Actividades Espaciales*) is that the suggested regional space entity be created within the framework of MERCOSUR, an organization in which not all the Latin-American countries are participating. Thus, this proposal could be more similar to the establishment of SASA instead of LASA. Nevertheless, the general view is that CONAE supports the establishment of a LASA.

Following the support for a regional space agency, the Executive Director of the CONAE, Dr. Conrado Varotto, has expressed on different occasions the idea to create a regional space agency. For instance, during the Earth Observation Summit held in July, 2003, Dr. Varotto delivered a speech in which he referred to regional cooperation in space activities and the benefit to support the creation of a regional space agency in Latin America.[79]

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76 COPUOS, Implementation of the Recommendations of the UNISPACE-82: International Cooperation in the Peaceful Uses of Outer Space: Activities of Member States, UN Doc. A/AC.105/679, at 9 (1997).

77 *See* Agencia Chilena del Espacio *supra* note 58 (This was the Chilean proposal in the Fourth CEA).

78 CONAE, Plan Espacial Nacional : Argentina en el Espacio 2004-2005, at 4, 41, 50 &51.

79 International Earth Observation Summit, *CONAE's capacities for contributing to an International Earth Observation System. Argentinean statement* by Dr. Conrado Franco Varotto available at: http://www.earthobservationsummit.gov (last visited 2 April 2008).

Ad 3 – Pan American Space Organization (PASO) project
Cocca considers that 'this is a longer-term project than the South American Space Organization.'[80] However, he anticipated that scientists and researchers would be not interested in participating in PASO because of a lack of recognition of intellectual property rights. At the end, PASO was just one project of regional cooperation in space activities.

Ad 4 – The satellite project Simon Bolívar
This was a project by the five members of the Andean Pact: Colombia, Ecuador, Bolivia, Peru and Venezuela. These countries established the Andean Telecommunication Enterprises Association (ASETA) to provide a regional satellite system of telecommunications. The initial project was named 'Project Condor' and subsequently it was renamed 'Simon Bolivar' satellite. The proposal wanted to reach an 'Andean Telecommunication Satellite System' for national and intra-regional traffic.[81]

The satellites of Project Condor were to be located at the following orbital positions: 74° and two more at 77.5° and 89°.[82]

At present, a different project is under development but with similar objectives to Project Condor. The Andean Community of Nations (CAN) has signed an agreement with Dutch New Skies Satellites B.V., to put a satellite in 2010 at the 67° west orbital position. The satellite will provide services for social connectivity programmes to the CAN countries.[83] But Bolivia in the meantime has also signed an agreement with China, to launch a national satellite DFH-4 third generation in 2013.[84]

80 *See* Cocca, *supra* note 38 at 156.

81 S. Ospina, *Regional Satellite Systems: Are they 'the solution'?* 22 Acta Astronautica, at 289-298 (1990). (The article analyses regional satellite systems (RSS), and in particular the feasibility of the Condor / Simon Bolivar project). *See also* Ospina, S., LL.M., *Project CONDOR: an analysis of the feasibility of a regional satellite system for the Andean Pact countries*. (Unpublished LL.M. thesis; IASL, McGill University, 1988).

82 F. Beltran, *Andean Pact Countries Plan Joint Satellite*, Bogota EL TIEMPO 13 September 1984 in Worldwide Report: Telecommunications Policy, Research and Development by the National Technical Information Service (JPRS-TTP-84-030) 9 October, at 18 (1984).

83 Comunidad Andina Secretaría General, CAN makes Andean satellite a reality, available at: http://www.comunidadandina.org/ingles/press/press/np5-2-10a.htm (last visited 15 February 2010).

84 BBC Mundo, El primer satélite boliviano, más cerca del espacio http://www.bbc.co.uk/mundo/ciencia_tecnologia/2010/04/100401_2304_satelite_bolivia_lav.shtml (last visited 2 April 2010).

2.3 How to implement multilateral space cooperation in Latin America?

Latin-American countries have agreed on the importance of regional space cooperation for the benefit of their population. However, as mentioned before there is no consensus about the necessary elements to implement space cooperation. For instance no specific objectives that such cooperation would seek to reach have been identified; consequently there is no definition of a regional space project or programme nor of the space applications which could be involved.

In my opinion the first problem to solve towards the implementation of Latin-American space cooperation is that it has not found the legal bridge to translate the words into actions. The problem is how to implement space cooperation in the region? Nevertheless, the discussion has focused the problem on the institutionalization of space cooperation towards a LASA rather than the definition of the first Latin-American space project. This approach has led to years being spent without a concrete case of multilateral space cooperation.

Therefore, one of the hypotheses in this research focuses on the possibility of implementing space cooperation in Latin America, based on the definition of the first space project AQUARELSat, and the adoption of a flexible legal and financial scheme of space cooperation under a multilateral agreement. Nevertheless, this is just the first phase of a three-phase plan that is explained in detail in Chapter 4. The first phase proposes to overcome the lack of financial and technical resources mentioned above (see 2.2 Regional cooperation in space activities: the Latin-American experience). Besides, it is a proposal to implement in legal and practical terms space cooperation in Latin America.

Regional space cooperation without a concrete space project in which scientists and engineers participate in designing and developing a space mission, is a proposal in the political sphere that can garner beautiful statements, but difficult to implement in the short and long-term. General statements do not contribute positively to scenario where distrust prevails, where Latin America faces internal divisions of sub-regions, such as Central- America, South America and the Andean Countries. The first approach to multilateral space cooperation in Latin America has to be based on scientific and research cooperation, not just on political declarations.

2.3.1 Bilateral cooperation: the Basic Agreement in Cooperation in Peaceful Applications of Space Science and Technology between the Government of the Federative Republic of Brazil and the Government of the Argentine Republic

Although in Latin America a multilateral agreement in space activities has not been reached yet, there is a successful case of bilateral space cooperation

through the agreement between the Argentina and Brazil.[85] In accordance with this Agreement the Brazilian Space Agency (BSA) and the CONAE develop joint programmes and projects on peaceful uses of outer space. The areas of cooperation in the Agreement include space science and technology, the assessment and monitoring of natural resources with the use of remote sensing satellites, and launch services, among others.

In November 1998, CONAE and BSA signed a protocol with the objective to set up cooperation programmes. These cooperation programmes included project SABIA or SAC-E[86] which is related to the design, construction and operation of a satellite for monitoring the environment, water resources and agricultural production over the area of MERCOSUR.[87]

The SABIA satellite is planned to be launched on 1st January, 2012 and the end of its life is calculated to be on 1st January, 2017. It will provide information for food production, environmental monitoring; inner coastal and water quality. SABIA will have a repeat cycle of 9 days, descending. Altitude, period and inclination have not been decided yet.[88] As we can see this agreement includes aspects of space science and applications and specific projects to work on, which are necessary elements towards space cooperation in practical terms.

2.4 PRACTICAL VALUE OF IMPLEMENTING REGIONAL SPACE COOPERATION

At present, remote sensing data are available worldwide on internet (*see* Appendix A). Users can buy or obtain images free of charge from satellites: MODIS, NOAA/AVHRR, CBERS/WFI, ORBVIEW with resolutions of 260 metres to 21 kilometres. High spatial resolution images are available from IKONOS, EROS, ORBVIEW, IRS and RECOURCESAT. For research and application projects other satellite images can be obtained free of cost on internet from CBERS and MODIS.[89] In the hydrology field, images can be downloaded free of cost or at low cost from Landsat TM-ETM with 30 meters resolution.[90] In this scenario it seems easy to obtain satellite imagery.

85 *See* the Basic Agreement on Cooperation in Peaceful Applications of Space Science and Technology between the Government of the Federative Republic of Brazil and the Government of the Argentine Republic signed in Buenos Aires, Argentine on 9 April 1996.

86 *See* the specific objectives and description of the project SAC-E (SABIA) on the Web page of CONAE http://www.conae.gov.ar/satelites/sac-e.html (last visited 3 April 2008).

87 The Southern Common Market (MERCOSUR) was set up in March 1991 by Brazil, Argentina, Uruguay and Paraguay, who are full members. The Bolivarian Republic of Venezuela is pending of ratification to obtain the status of full member. Bolivia, Chile, Colombia, Ecuador and Peru participate as associate members and Mexico has status of observer.

88 CEOS, Climate Change Special Edition 2008: The Earth Observation Handbook 175 (2008).

89 UNOOSA. *Proceedings UN/ Brazil workshop on Space Law. Disseminating and developing international and national space: the Latin American and Caribbean perspective* 246-250 (2005).

90 A.M.J. Meijerink, Remote Sensing Applications to Groundwater 16 (2007).

Consequently, what would be the rationale for implementing space cooperation? Why should Latin-American countries not choose to limit their research and satellite applications to the products that already exist in the satellite data market? Is it worthwhile to invest in a space project when satellite data can be purchased or obtained for free easily on internet?

My first approach to answer these questions relies on three advantages that come from the development of space activities:

1 A tailored made solution for national and regional problems

Starting from the premise that final users in Latin America would define the characteristics of the space mission, the satellite constellation would be designed to provide tailored solutions to complete the data needs for monitoring natural resources and natural disasters. The satellites' payload would be designed according to the specific satellite applications to be performed. It is important to mention that normally national and local studies require high spatial resolution data for low repetition rate, and global studies need fairly high resolution.

On the other hand, when a country pays for or receives free satellite imagery from other countries or companies, it has to adapt to what is available; it is not always in accordance with the needs of the end-users.

The previous arguments do not justify that every country should have their own satellites in order to meet the requirements of each end-user. That case would not be a rational use of space resources. The efficient and rational use of space resources in the context of needs of end-users, finds in regional cooperation an option to use satellite data for monitoring natural resources and natural disasters to improve aspects of national and regional development.

In this context, regional cooperation follows the useful path of space technology. Satellite images covering large areas allow neighbouring countries to seize the opportunity to use the same space project for their national development activities. At national and regional level satellite data can support water and food security by helping improve the sustainable management of drinking water and soil for present and future generations. Moreover, satellite data can also be used for natural resources monitoring.

Latin-American countries, such as Bolivia, Guatemala, Mexico, Peru and Venezuela among others, have similar problems with water management. This is an opportunity to share and also have tailor-made solutions. Space projects are expensive to be funded by only one country. However, regional cooperation is feasible and recommended for small countries or countries with small budgets for science and technology, and to find allies in developing space projects.

2 Promotion of space science, research and innovation

From the scientific and technological point of view space activities promote science, research and innovation within and among the countries. The spin-offs

from space technologies are experienced everyday. This could be a measure against technological dependence, and to encourage new generations to get involved in space activities.

3 Economic growth at the national and regional level
The third aspect is related to economics because space activities are the source of jobs and economic growth, encouraging employment of expert staff and creation of space industries. Besides, the national space sector returns on investment are high in comparison with the initial investment. Thus, it is a hollow argument to say that developing countries should be fighting poverty problems instead of investing in space activities. Poverty relief is the creation of employment. This is one advantage of being an actor in space activities. However, the revenues do not come quickly: space activities are part of a long-term plan that requires from the decision makers vision and clear objectives to adopt a sustainable space programme.

2.4.1 Drawbacks to space cooperation

The main purpose of this research is to find the practical, legal and institutional means for implementing regional space cooperation, opening the door to a long-term plan in which Latin America could become a space power in future. Other reason to promote regional space cooperation is to overcome the following problems:

1 Limited opportunities to access space resources
Despite the international instruments which warrant the free use of outer space or the equitable access to space resources, reality has demonstrated that the main constraint for countries to develop national space projects is the high cost of space activities. Most countries prefer to buy a license to use satellite data from foreign providers. I consider that the amounts which are paid to foreign providers of remote sensing data could be used to develop a regional space project. For this purpose, interested countries in the region could assume individually the cost and risk of a small satellite in a Latin-American satellite constellation, meeting the particular needs of end users in the region.

2 Growth of the 'space divide'
I adopted this term to express in the space field the growing gap in the space field among countries regarding their involvement in space activities. I classify the countries in two categories:

- Countries that are participating directly in space activities and are making efficient use of information provided by satellites. For example Argentina and Brazil;

- countries that are not performing national space activities directly, but whose governments and universities are using satellite information. For instance Colombia, Ecuador, Honduras, Guatemala, Uruguay.

The inequality in access to information technology is called the 'digital divide' in the information society after the network revolution. I consider that the 'space divide' is the inequality in access to satellite information and space applications.

In the case of the 'digital divide', Silveti has pointed out that part of the difficulties in utilizing telecommunications and digital technology strategically come from the lack of comprehension about what the information technology can do.[91] I consider that this situation is also applicable to the 'space divide', where space technology has not been fully understood by decision makers and civil society; there is still little knowledge about what space technologies can do for improving national development and have direct impact on the quality of life of the population.

3 Small budgets are allocated for science, technology, innovation, research and development in the region

In Latin America, governments are the main investors in science and technology research, while industry and business have a low level of involvement. Research and development expenditures represent a very small part of the Gross Domestic Product (GDP), and are not increasing. In fact, the trend in the region is that funds reserved for research and development have declined as fractions of GDP, except for Brazil and Chile.[92]

Most of Latin-American countries are not aware of the importance of developing science, technology and innovation in their countries; decision makers are focused on solutions in short term and there is no vision to the future. However, science and technology are basic concepts that governments must consider to foresee the future of their countries. Science and technology are not a luxury prerogative of developed countries, but a need of all countries to have a better present and future. Latin America has an outstanding example in this regard; Brazil has invested more than any other Latin-American country in science and technology; besides, this decision has benefited the budget allocated to the National Institute for Space Research (INPE, *Instituto Nacional de Pesquisas Espaciais*). Brazil is growing in economic terms with a sustainable ground in science and technology. The better control of its natural resources and the discovery of oil fields in the sea is not a coincidence, but the result

91 See E. Silveti, *Brecha digital en América Latina ¿problema u oportunidad?*, 109 *AHCIET Revista de Telecomunicaciones* 77-80 (Enero / Marzo 2007).

92 IADB, *Education, Science and Technology in Latin America and the Caribbean: a statistical compendium of indicators* 33 (2006).

of a long-term plan to invest in science and technology. Brazil broke a paradigm in the region.

The problem is explained in a study by the IADB in the following words: 'the region lags substantially behind more technologically advanced countries on key measures of science and technology capacity and innovation, and the gap is growing'.[93]

Essential background to any space programme is the previous implementation of national policies directed to strengthen science, technology and innovation activities, ensuring the allocation of budget resources for this purpose. It is necessary to pave the way towards the consolidation of strong scientific and technological capacities in each country and the whole region. Otherwise, the development of space activities is unachievable under sustainable basis.

The lack of financial resources has been a constraint for encouraging science, technology and innovation. This situation is reflected in the space field in the scarce investment in space projects. In most cases, there is, in fact, absence of financial support for space activities by the government. In this respect, it has been noted that the lack of interest in space technology to support indigenous capacity is the main cause for missing opportunities and gaining benefits from technology transfer.[94]

Notwithstanding the adverse circumstances within the governmental policies for science and technology, basic space sciences are supported by Latin-American universities at which outstanding researchers in astronomy, astrophysics and geophysics are working. In Latin America, researchers are the main promoters of educational outreach in space.[95] The challenge will be to switch from theoretical science to practical space technology that can generate spin-offs and innovation.

Decision makers' awareness about the benefits of space technologies is crucial to activate political will for the development of space activities, endorsing such decision with a fair budget to develop space projects and introduce satellite data as a strategy to improve national development.

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93 *Id*.

94 Transfer of technology is not achieved in one step; it is a gradual process. It has been noted that knowledge and research in space technology would allow developing countries understand what a given technology can do, but also why and how it works the way it does. 'Through such a process, the developing countries can contribute to its growth and development, as well as make an effective use of their research efforts in solving their own problems.' See United Nations, *Seminar of the UN Programme on Space Applications. Selected papers on Remote Sensing* 169 (1990).

95 For instance, see activities perform by the Institute of Astronomy of the National Autonomous University of Mexico (UNAM) http://www.astroscu.unam.mx/ , the Institute of Astronomy and Space Physics (IAFE) in Argentina http://it.iafe.uba.ar, and the Segio Arboleda University in Colombia where the CubeSat Libertad 1 was built.

4 Lack of awareness about the importance of space activities

Decision makers and the general public in Latin America do not support the idea to invest public funds in space projects because they consider that fighting poverty is their priority and space activities are not; besides, they are of the opinion that space activities are reserved for developed countries. In order to update decision makers' vision regarding space activities, it is absolutely necessary to inform them and the population about the relation between space applications and national development, if the intention is to find support for national space activities.

Concerning awareness of decision makers, I think the best way to involve decision makers is to open channels for the participation of all governmental ministries in the development of national space policies. Under this practice ministries can identify the specific space applications and satellite data that they could use for improving their activities within the framework of national development adopted by each country.

5 Narrow opportunities in space careers

There are limited job opportunities open to space-qualified professionals. Latin American experts in the space field working or studying abroad face difficulties when they return to their own countries and do not find opportunities for a space-related career.

6 Few options for participating in space projects

Support and promotion of activities related to capacity building in space and technology would be encouraged by the collaboration of experts and students in a regional space project. A regional space project such as AQUARELSat is an opportunity for acquiring practical skills and expertise in the development and operation of satellites.

For instance students in CRECTEAL could participate in the AQUARELSat mission, identifying the scientific objectives and the chore of applications from satellite data; dealing with storage and follow up of satellite information; working with GIS and Digital Elevation Models (DEM) to provide value-added services and solutions. Chapter 4 provides more details about what could be the involvement of CRECTEALC in the AQUARELSat project. CRECTEAL is an excellent platform for regional cooperation in processing space data.

7 Slow development in national space law and few experts in the region

Most of the lawyers in the region still consider that space activities are limited to space telecommunications and the International Telecommunication Union (ITU) Regulations. It is true that telecommunication satellite services are very important from the social and economic point of view. Even so, telecommunication is just one of the different space technology applications.

On the other hand, UN treaties and principles on outer space, and likewise, the activities of UNOOSA are almost unknown by lawyers in Latin America.

Despite the fact that some countries in the region ratified the UN treaties on outer space (see Appendix B), not all of them have implemented in their national legislation the international commitments accepted by their ratifications. For instance, the registry of space objects that the 'launching State' shall maintain.[96] Chile and Mexico have both launched satellites, but do not have a National Registry yet.

2.4.2 Academic research

There are exceptions to the general rule. Some Latin-American countries have academic institutions that teach and do research in space law:

- Argentina, the National Institute of Air and Space Law (INDAE, *Instituto Nacional de Derecho Aeronáutico y Espacial*), which was established by Decree n. 249/65 in 1965. However, its background goes as far back as 1947[97]
- Brazil, the Brazilian Association of Air and Space Law (SBDA), which was founded during the 1970s.[98]
- Uruguay, the *Centro de Investigación y Difusión Aeronáutico-Espacial* (CIDA-E), which was established more than 30 years ago.[99]

Argentina and Brazil are leading the region in national space law, through the elaboration of studies, researches, courses and dissemination activities concerning space law. Both countries converge in the fact that they perform space activities by themselves. For instance, they operate remote sensing satellites and deal already with satellite data issues. I highlight this situation because in my opinion, the development of national space law is related with the performance of national space activities. I do not mean that there is no space law at all in countries that do not perform space activities: *e.g.* there might be theoretical education. However, the development of space law is a topic that is to be performed in tandem with actual practice.

Regional cooperation in space law is also headed by Argentina and Brazil, who following the intention to implement a cooperation programme in space law, adopted the Declaration of Buenos Aires for Cooperation in Space Law

96 *See supra* note 15 (Requirement established in Article II (1) of the Convention on Registration of Objects Launched into Outer Space).

97 Fuerza Aérea Argentina, Instituto Nacional de Derecho Aeronáutico y Espacial http://www.fuerzaaerea.mil.ar/mision/indae.html (last visited 30 April 2010).

98 A.F. dos Santos & J.M. Filho, *Toward National Brazilian Center on Space Policy and Law Studies* in the Proceedings of the Fiftieth Colloquium on the Law of Outer Space: 24-28 September 2007, Hyderabad, India.

99 *Trigésimo Aniversario 1975-2005, Centro de Investigación Aeronáutico- Espacial (CIDA-E)*, 23 Space Policy 136 (2007).

by the end of 2004.[100] In this respect, during the COPUOS Legal Subcommittee session of 2007, Prof. José Monserrat Filho made a presentation in which he informed that: 'unfortunately, so far, the most favourable conditions and support for the implementation of the 2004 Buenos Aires Declaration on Space Law Co-operation have not been found'.[101]

More recently, in 2007 the Declaration of Montevideo on Space Law Co-operation was adopted by Argentinean, Brazilian and Uruguayan experts. The declaration includes a proposal to establish a Regional Centre for Space Law Studies.[102]

Other regional academic institutions related to space law are worthy of mention; however in my opinion they are more focused on air law than space law. They are the following:

- the Ibero American Institute of Air and Space Law (IAIASL I*nstituto Iberoamericano de Derecho Aeronáutico y del Espacio y de la Aviación Comercial*), which has agreements of collaboration with academic institutions in the following countries: Argentina, Venezuela, Panama, Uruguay, Honduras and Peru;
- the Latin-American Association of Aeronautical and Space Law (ALADA *Asociación Latino Americana de Derecho Aeronáutico y Espacial*)

At the international level, experts from Argentina and Brazil are participating in the International Law Association (ILA) Space Law Committee. Prof. Maureen Williams from Argentina is the Chair of this Committee and Prof. Monserrat Filho from Brazil is a member.

It seems to me that expertise in space law has been sparkling more in the south side of Latin America.

2.4.3 Status quo research and development in Latin America

There is no a homogenous scenario, research and cooperation regarding space activities in the Latin American region. Whilst Brazil has a licensing system

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100 *See generally* Declaración de Buenos Aires sobre Cooperación en Derecho Espacial (2004). European Centre for Space Law (ECSL), Space Law virtual network with Latin American countries http://www.esa.int/SPECIALS/Space_Law_virtual_network_Latin_America (last visited 10 November 2009). This declaration was an initiative of Prof. Maureen Williams from Argentina and Prof. José Monserrat Filho from Brazil.

101 J. Monserrat Filho, *The needs of teaching institutions in the Latin American and the Caribbean region; specific features and initiatives,* Presentation at the 46th session of the Legal Subcommittee during the Space Law Symposium on capacity building in space law, Vienna, Austria 2007 http://www.unoosa.org/oosa/COPUOS/Legal/2007/symposium (last visited 3 December 2007).

102 Declaración de Montevideo sobre Cooperación en Derecho Espacial, (Montevideo: 2007). The Declaration was signed by Dr. Sylvia Maureen Williams, Dr. Eduardo D. Gaggero, and Dr. Jose Monserrat Filho.

for space activities[103] and Argentina a national register of space objects,[104] other countries do not have any reference to space activities in their national legislation. Furthermore, the differences are not just in the legal field; there are also differences in their involvement in actual space activities.

For instance, Brazil and Argentina have experience in the design and operation of remote sensing satellites; Brazil has a national launch centre in Alcantara; Chile has the experience of the construction of FASAT 1, a scientific Earth resource microsatellite; Colombia built a CubeSat Libertad-1. Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Peru and Venezuela have national authorities dealing with space activities. By contrast, other countries in Central America, for instance El Salvador or Nicaragua, are not involved in space projects or national space law beyond satellite telecommunication services.[105] In these countries there are universities and governmental institutions that use satellite data, but they have not participated directly in the design and construction of satellite projects. It is difficult to identify any national institution that is coordinating space activities at the national level.

Therefore, as can be seen there are many differences within the Latin-American region; however, it is possible to reach regional cooperation in space activities though the coordination of efforts. For that purpose, it is necessary to find a suitable legal model of regional space cooperation. The implementation of space cooperation could be an opportunity to adopt a new strategy for improving national and regional development with the use of space technology. This new strategy could enable Latin-American countries to work together amongst themselves to find real alternatives to access and to use outer space resources for improving their national development, instead of asking for help from developed countries. As a consequence the performance of regional space activities could promote space collaboration with developed countries and international organizations for the benefit of both sides.

2.5 CONCLUSION

The regulation of space activities came to the scene with the particular feature of space cooperation. Space regulation provides certainty to the performance of space activities, but also constitutes a framework for the promotion of space cooperation.

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103 Brazil Space Agency, Administrative Edict No. 27, 20 June 2001. See M. Benkö, et.al. Space Law: Current Problems and Perspectives for Future Regulation 78 (2005) 78.

104 Argentina National Decree No. 125/95 set up a National Registry of Space Objects, according to the Plan Espacial Nacional Argentina en el Espacio 1997-2008.

105 Nevertheless, concerning remote sensing information and GIS a contact point in Central America is the intergovernmental organization CATHALAC http://www.cathalac.org (accessed 12 April 2008).

In the Americas the IACSR was established in 1960, this Committee being the first regional space organization even before the European initiatives of regional space cooperation. The IACSR was a good start but it could not achieve a permanent status, and in less than one decade it disappeared. I think the problem was not just the difficult access to know-how and financial resources, but also the lack of a defined space programme and political will. The justification of a space organization is difficult without a space programme to shape the common interests in space of the Latin-American countries.

Space cooperation has been successfully implemented under bilateral agreements in the region (Argentina-Brazil). However, Latin-American cooperation in space activities has not reached a multilateral agreement for developing a common space programme. The statements and declarations have been made in general terms: appropriate cooperation, future projects possible, cooperative projects, effective cooperation. Furthermore, another problem is that after the declarations and plans of action it is not clear who is the person or group responsible to follow up and implement these proposals.

It is true that there are financial and technical constraints for using and exploring outer space. The option to take up regional cooperation and pool efforts to enhance national and regional development through space applications needs a legal model to start being considered seriously.

This section identifies that most Latin-American countries favour the establishment of the LASA as a step toward regional space cooperation.
Finally, this chapter identifies that regional space cooperation could impact positively different areas of national and regional development, starting for promoting science and technology, and economic growth.

3 Models of space cooperation

> 'The only way of discovering the limits of the possible is to venture a little way past them into the impossible'. Arthur C. Clarke, Clarke's third Law.

Space cooperation models range from non-institutional to institutional; the selection of the suitable form to implement space cooperation laid on the consistent assessment of the conditions of the participant countries and the objectives of the space cooperation. This section analyzes two examples that are currently working well: the European Space Agency (ESA) as a model of institutional space cooperation, and; the Disaster Monitoring Constellation (DMC) a model of non-institutional cooperation.

3.1 Model I, institutional cooperation: the case of the European Space Agency (ESA)

ESA is the archetype example of the institutionalization of regional cooperation in space activities. In this regard it is important to mention that ESA was not a spontaneous creation, because behind ESA's consolidation there were almost fifteen years of practical learning and negotiation among the European countries involved in space activities. Even though there were, and are differences among the countries, space cooperation in Europe was coordinated around their common national and regional interests in space.

The initial idea of space cooperation by the European scientific community evolved gaining political will and creating a well defined space programme for its implementation. At present, the ESA case has important lessons to offer for future endeavours in regional cooperation. This section is a review of ESA's evolution with the aim to identify the three main lessons in the institutionalization of ESA.

3.1.1 Historical review

By the beginning of the 1960s the idea of space cooperation was promoted by two European scientists: Edoardo Amaldi from Italy and Pierre Auger from

France.[1] They envisaged that the alternative for Europe to become a space power was through the 'Europanisation' of space activities. With this measure national space programmes would be able to overcome financial and technical difficulties to support long-term space projects.

The practical approach to space cooperation in Europe started with the creation of two organizations which formed the scientific, technical, legal and financial basis for the creation of ESA. These organisations are the following:

1 the European Space Research Organisation (ESRO)
2 the European Launcher Development Organisation (ELDO)

Later, it was decided to form a catalyst forum for coordinating efforts from both organizations, and this is the so-called: European Space Conference (ESC).

3.1.1.1 The European Space Research Organization (ESRO)

The creation of ESRO found support with the European scientists, who had good communication amongst themselves. In particular the Committee on Space Research (COSPAR) played an important role promoting networking and exchange of scientific information at regional and international levels.

The idea of space cooperation started with a letter by Amaldi to his colleagues in Europe, in which he suggested the establishment of an organization for space research similar to the European Centre for Nuclear Research (CERN). The next step was made by Auger inviting space scientists to hold an informal meeting in 1960 in Paris. With this purpose Auger invited representatives of Italy, the Federal Republic of Germany, Belgium, Netherlands, Sweden, Switzerland and the United Kingdom. This group of scientists met again on different occasions to define the programme of the future organisation, the integration facilities, inventory of the launching means, and tracking stations.[2] In this scenario was formed the *Groupe d'etudes européen pour la collaboration dans le domaine des recherches spatiales* (GEERS),[3] and; the *Commission préparatoire européenne de recherches spatiales* (COPERS) which defined the scientific programme and administrative structure of the future ESRO in 1961.

These commissions decided on the location of headquarters, the establishment of the European Space Technology Centre (ESTEC); the European network

1 *See* R.M Bonnet & V. Manno, *International Cooperation in Space: The Example of the European Space Agency* 4 (1994). It is interesting to mention that Amaldi and Auger were also involved in the creation of the European Center for Nuclear Research (CERN). Thus, they had already experience in the field of European scientific cooperation.

2 *Id.*

3 The GEERS was formed by scientist from ten European Countries. GEERS established the COPERS, a commission at which government representatives would explore possibilities for regional space cooperation. ESA, 50 Anniversary of Space 50 Anniversary of Europe: Supplement to Annual Report 2007, at 5 (2008).

for Satellite Tracking and Telemetry Stations (ESTRACK); the European Space Data Center (ESDAC); the European Space Laboratory (ESLAB) close to ESTEC, and; a launching base (ESRANGE). Likewise, the ESRO authorities were discussed. Once that most of the important elements of ESRO were decided, the adoption of the legal document for its implementation took place.

On June 14, 1962, ten European countries signed in Paris, the Convention for the Establishment of a ESRO (ESRO Convention).[4] The signatory founding Members were: the Federal Republic of Germany, Belgium, Denmark, Spain, France, Italy, Netherlands, United Kingdom, Sweden, and Switzerland. Austria and Norway participated on particular bases. The ESRO Convention was signed in 1962, and entered into force in 1964.

One of the main purposes of ESRO was the development of satellites. And in this context, the achievements of ESRO included the development of seven satellites and the launching of 150 sounding rockets.[5] Nevertheless, it is my opinion that the most crucial milestone made by ESRO was the creation of technical and operational centres and stations to make feasible the creation of ESA some years later.

The Convention for the Establishment of a European Space Research Organization

· *Purpose and objectives*

The purpose of ESRO was to promote collaboration among European States in space research and technology for peaceful purposes.

The particular objectives are mentioned in Article V. ESRO shall pursue a programme of scientific research and related technological activities focus on three areas:

1 Space technology: design and construction of satellites and sounding rocket payloads, and; the procurement of launching vehicles.
2 Satellite data: reception, collection, reduction and analysis of data, and; dissemination of information among ESRO Members.
3 Cooperation within ESRO members: enhancement of communication between scientists and engineers, and cooperation among research institutes.

· *Infrastructure*

The provisions for the establishment and operation of the ESRO common facilities are indicated in Article VI. The following facilities were to be established to meet the ESRO objectives in accordance with its programme:

1 ESTEC, to promote and develop technological research and studies. And near to ESTEC a research laboratory to support research programmes

4 Convention for the Establishment of a European Space Research Organization, COPERS/AWG/18rev.6 (1962).
5 H. Kaltenecker, *The New European Space Agency*, 5 *Journal of Space Law* 37 (1977).

2 Sounding rocket launching facilities
3 Data Centre and Tracking, Telemetry and Telecommand stations to fulfil obligations of data reception, collection, reduction, analysis and distribution.

· *Regular organs*

ESRO selected a centralised coordination through two main authorities the ESRO Council and the Director General assisted by a staff[6] (Article IX).

1 ESRO Council (Article X)

The Council of ESRO was composed of not more than two delegates per Member State, however the rule was one vote per Member State. The Council used to meet at least twice per year. Its functions coincided with the legislative powers, because the main decisions over ESRO needed to be approved by the Council. For instance the approval of ESRO programmes and annual work plans; the determination of financial resources and arrangements; the review of expenditure and the approval of the audited annual accounts; the decision about accession of new Member States, and; cooperation with organizations, governments and institutions of non-Member States.

2 Director General (Article XI)

The Director General was the executive officer and the legal representative of ESRO. The functions of the Director General were assisted by the scientific, technical, administrative and office staff.

· *Other remarks*

The financial system of ESRO was based on the net national income to determine the contribution of each Member State. The Council used to approve a scale every three years based on the net national income (Article XII).[7]

The settlement of disputes regarding the lack of interpretation or application of the ESRO Convention, were to be first submitted to the ESRO Council. However, if the issue could not be settled by the Council, the Member States were allowed to submit their case to the International Court of Justice (ICJ) or select another mode of settlement by agreement (Article VI).

3.1.1.2 The European Launcher Development Organization (ELDO)

ELDO was created by governments interested in taking advantage of the experience gained in the development of missiles for launcher activities. The

6 Dr. Leister explains that 'ESRO organizational structure was based on the European Nuclear Research Center (CERN)'. CERN and ESRO had the same organizational formula: (1) Council: policy maker, determination of contributions, and; 2) Director General in charge of implementing the decisions of the Council. V. Leister, *Space Technology: From National Development to International Cooperation*, Doctoral thesis McGill University 88-89 (1982).

7 *See also* the Financial Protocol annexed to the ESRO Convention.

relation of missile technology with military applications was a sensitive subject for the scientific community, and this was a reason for ESRO scientists to avoid getting involved in launching activities with suspicious dual applications, even though the activities of ELDO were understood as being of a peaceful nature.[8] Consequently, the negotiations for the establishment of ESRO and ELDO proceeded independently.

On 30 January 1961, the fundamentals of ELDO were adopted at the *Maison de l'Europe* in Strasbourg. ELDO's objective was to develop a 'launcher capable of placing about one ton into circular orbit at five hundred kilometres'.[9] This future launcher was called 'Europa'.

On 29 March 1962, the Convention for the Establishment of a European Organization for the Development and Construction of Space Vehicle Launchers (ELDO Convention) was signed by seven countries: Belgium, France, the Federal Republic of Germany, Italy, Netherlands, United Kingdom, and Australia. Switzerland and Denmark obtained the status of observers later. The ELDO Convention entered into force in 1964, like the ESRO Convention.

As was mentioned above 'Europa' was the main project of ELDO, which developed into three different versions:

- *First project: Europa A, later named Europa 1*

It was a launcher composed of three stages that did not work. By 1962 ELDO was dealing with financial and schedule problems. During the ESC in 1966 it was decided to work on a new version of Europa.

- *Second project: Europa 2*

In 1971 Europa-2 was tested in Kourou, French Guiana, unfortunately it failed. Facing this situation ELDO Members reviewed the management procedures and identified responsibilities within ELDO and industry.

- *Third project: Europa 3*

Europe-3 was under study since 1968, but it was cancelled. However, from this project became the basis for Ariane in later years.[10]

In 1974 ELDO abandoned its launcher development work,[11] coinciding with the transfer of personnel to ESRO for the creation of ESA. However, one year

8 Article 2 (3) of ELDO Convention notes that the ELDO only deals with the peaceful applications of launchers and equipment.

9 Bonnet, *supra* note 1, at 12.

10 The European satellite launcher was renamed Ariane. ESA was responsible for Ariane's development and CNES was entrusted with the tasks of technical direction and financial management. Arianespace has been responsible for Ariane launchers since 1980. ESA, ESA Achievements: more than thirty years of pioneering space activity 87 (2005). Also *see infra* Resolution 6 of the ESA Convention.

11 *See* Kaltenecker, *supra* note 5, at 36.

later when ESA was established, the main tasks of ESA included the development of the Ariane launcher.

Bonnet & Manno[12] have identified two mistakes of ELDO: (1) dependency directly on the auspices of its Members, and;[13](2) absence of central management capability.[14]

The Convention for the Establishment of a European Organization for the Development and Construction of Space Vehicle Launchers

· *Purposes and objectives*

The main purpose of ELDO was the 'development and construction of space vehicle launchers and their equipment suitable for practical applications and for supply to eventual users' (Article 2 (1)). The peaceful applications of the launchers and equipment of ELDO was expressly mentioned in Article 2 (2).

· *Infrastructure*

The headquarters for administrative functions were established in Paris (Article 1 (2)). The ELDO Convention decided to have national facilities under national control and no ELDO facilities, but there was the option to establish additional ELDO facilities (Articles 5 (2) (4)).[15]

The facilities that were available for ELDO activities were Blue Streak facilities in Britain (Spadeadam) and Australia in Woomera, the programme's launching site (Art 16 (2)). Furthermore, the French facilities composed of general rocketry centres, test establishments and industrial plants.[16]

· *Regular organs*

The coordination was via the Secretariat under Council's direction. The Secretariat functions included:

12 *See* Bonnet, *supra* note 1 at 14.

13 *See* Bonnet, at 13. The budget of ELDO added the contributions of each participating country in support of their respective tasks. The problem was that the Members were free to contract but all Members paid for that. That practice did not have clear limits and financial difficulties arose.

14 The Europa launcher had three stages which were developed by different countries (United Kingdom, France, and the Federal Republic of Germany). The absence of a central authority and the subsequent lack of coordination among the three stages generated poor results. At present, in the field of launching activities ESA has a central authority responsible for financial and technical aspects, the *Centre National d'Etudes Spatiales* (CNES) in France.

15 *See* K. Madders, A new force at a new frontier: Europe's development in the space field in the light of its main actors, policies, law and activities from its beginnings up to the present 46 (1997).

16 *Id.*

> '1) to follow ('supervise') the execution of programmes generally; 2) to develop and exercise control over the execution of detailed plans and cost, estimates, through a Technical Director; and 3) to make status reports to Council'.[17]

Despite these provisions, it is important to emphasize that in fact ELDO worked without central authority, expecting a lot from the partners' ability to achieve tasks such as the following: (1) to establish a compatible management; (2) to maintain liaison with other Member States' facilities, and; (3) to coincide with other partners' on the schedule, requirements and constraints.

The lack of central authority allowed the right of each Member State to place contracts for its work (Article 6(1)), and ELDO would assume the expenses incurred. Within this scenario it was no surprise that ELDO had many financial problems, due to the weak costs control of its programme.

On the other hand, there was an ELDO Council composed of participating Member States; this organ was in charge of decisions regarding the programme, budget and distribution of work. By unanimous vote the Council could transform the initial programme if the two year review showed the need for changes (Article 14(3)).

3.1.1.3 The European Space Conferences (ESC)

The ESCs were ministerial meetings that functioned as a catalyst element for the coordination and subsequent unification of ESRO and ELDO until a single space body.[18] The ESCs were convened nine times between 1966 and 1977.[19] During these meetings it was discussed how Europe could become a space power, identifying the necessary measures.

From this forum came the suggestion to establish ESA and to redefine the space policy and programmes.[20]

While the ESCs convened nine times, only a few of these meetings will be referred to, based on the importance of the decisions that were adopted:

- *ESC 1968*

The ESC Working Group on Institutions (The Bannier Group) proposed the concept of having a European Space Research and Development Organisa-

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17 *See* Madders, at 52.

18 Nevertheless, there were other activities within the ESC, for instance it established a Working Group to discuss the issues included in the COPUOS Agenda. See R. Gibson, *Law and Security in Outer Space: International Regional Role: Focus on the European Space Agency*, 15 Journal of Space Law 17 (1983).

19 *See* Bonnet, *supra* note 1, at 10.

20 von Preuschen draws our attention to the fact that the priority in the discussions was the future of the European space programmes and not the uniform structure for space cooperation. R. F. von Preuschen,, *The European Space Agency*, 27 International and Comparative Law Quarterly 46 (1978).

tion.[21] The ministers agreed to merge ELDO and ESRO into ESA with a single space programme. In this meeting were discussed the concepts of optional programmes to facilitate the merging of ESRO and ELDO. In addition, the importance of the basic programme which would be mandatory for all Members was reaffirmed.[22]

· *ESC 1971*

The ESC agreed on the elements of the ESA space programme in the document referred as the 'first package deal'; this document contained the principles of ESA that were useful in drafting the ESA Convention.[23]

· *ESC 1972*

The ESC worked on a detailed plan. It was decided to unify ESRO and ELDO; and in order to implement this decision a 'European Space Agency Working Group' (ESAWG) was established.[24] The discussions in the ESC and the results from the ESAWG defined the basis for the draft Convention for the Establishment of ESA.

In addition, Bourély mentions that in the same year, the ESC agreed on two satellite application programmes: the Spacelab and the Ariane launcher programme. In his view, these programmes were one of the two pillars for a true European space programme.[25]

· *ESC 1975*

The ESC discussed the role of the national space facilities of ESA Member States[26] and the draft of the Convention for the Establishment of the ESA (ESA Convention) was approved. The next step was the signature and ratification of the ESA Convention. For this purpose, the Government of France organised the Conference of Plenipotentiaries for the establishment of ESA in Paris on 30 May 1975; the ESA Convention entered into force on 30 October 1980. The conference was attended by twelve Governments, and three international organizations as observers: the Council of Europe, ESRO and ELDO.[27]

The ESA Convention was signed by eleven countries: Belgium, Denmark, the Federal Republic of Germany, France, Ireland, Italy, Netherlands, Spain,

21 *Id.*
22 Bonnet, *supra* note 1, at 10-11.
23 *Id.* at 11.
24 Final Act of the Conference of Plenipotentiaries for the Establishment of a European Space Agency (Ref.CSE/CS(73) 20, rev.7).
25 The second element was the further signature of the ESA Convention in 1975. M. Bourély, *Space Law and the European Space Agency*, in N. Jasentuliyana (Ed.) Space Law: Development and Scope 88 (1992).
26 von Preuschen, *supra* note 20, at 47.
27 Para. 4 of the Final Act of the Conference of Plenipotentiaries for the Establishment of a ESA.

Sweden, Switzerland and the United Kingdom. Later, Austria and Norway became Associate Member States of ESA. Since 1978 Canada has been participating in ESA, first as an associate State and then as a cooperating State.[28]

At present, ESA has 18 Member States. Furthermore, there are other countries participating in ESA under the framework of the Plan for European Cooperating States (PECS), for instance Hungary, Romania and Poland.[29]

Final Act of the Conference of Plenipotentiaries for the Establishment of a European Space Agency

The Final Act was based on the resolution adopted at the ESC on April 15, 1975 and signed on May 30, 1975, embracing the ESA Convention and ten attached Resolutions. Below are the resolutions that provide interesting elements regarding coordination, space programmes and policy.

· *Resolution No.1. The 'de facto' functioning of ESA*
Member States were aware of the time required for the ratification of international instruments. Therefore, this resolution enabled Members to start activities towards the establishment of the ESA Council, before the ratification of the Final Act.

· *Resolution No. 4. Optional programmes of the ESA*
The introduction of optional programmes in ESA activities was the new flexible approach selected for ESA activities. This resolution recommended that ESA should undertake enough optional programmes to guarantee its viability.

· *Resolution No. 5. Application Programmes*
Europe assumed its role in the space applications market. This approach emphasized applications and the need to organize consultations with users towards a successful space application policy.

· *Resolution No. 6. Launchers and other space transport systems*
ESA undertook the Ariane and Spacelab programmes. In this context, ESA Members agreed to give preference to ESRO and ESA products.

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28 R. Gibson, Law *and Security in Outer Space: International Regional Role: Focus on the European Space Agency* 11 Journal of Space Law 15 (1983*). See generally* the Agreement Between Canada and the European Space Agency Concerning Cooperation, December 9, 1978; January 1984; May 1989; January 2000.

29 European Space Agency, New Member States at http://www.esa.int/SPECIALS/About_ESA/SEMP936LARE_0.html (last visited 10 March 2010).

3.1.1.4 The Convention for the Establishment of a European Space Agency (ESA Convention)

The Preamble of the ESA Convention[30] justified regional space cooperation through a single European space organization as a measure to face the magnitude of the human, technical and financial resources required for space activities which are beyond the means of any single European country. One of the goals of ESA was to encourage efficiency in the use of outer space and to define a European space programme for peaceful purposes.

1 Purposes and objectives

Europe established a single space organisation to strengthen European cooperation for peaceful purposes in space research and technology, and their applications for scientific purposes and operational space application systems (Article II).

In the context of Article II, expert von Presuschen[31] explains the main areas related to the purposes in detail:

1 European space policy
2 Space research and development of technology

Ad 1 – European space policy

The basic principles of the European space policy are laid down in the ESA Convention and the Final Act. The guidelines for future development of the European space policy were the following:

- The coordination and integration of national space programmes into the European space programme. 'The Convention provides a mechanism for the mandatory Europeanization of Member States' national space programmes';[32]
- The elaboration of a long-term European space policy for ESA activities. This decision has financial consequences in the approval of contributions;
- The utilisation of European and national space facilities and services for the development of ESA space projects. ESA facilities for constructing, deploying and operating satellites enable ESA's independence in the fields of science, technology, applications and industry, gaining experience in space know-how;
- The competitiveness of the European space industry. It was envisaged at that time to establish multinational European consortia. A key element in ESA's industry policy was the fair industrial return;

30 Convention for the Establishment of a European Space Agency, Ref. CS(73)19, rev.7, (1975).
31 von Preuschen, *supra* note 20, at 49-55.
32 *Id.* at 49.

- The access to available technology and products to ESA members, and the obligation to use European technology and products, for instance the launcher policy (Article VIII (1));
- The consultations with the users of space technology to formulate the space applications policy.

Ad 2 – Space research and development of technology
ESA followed the path of ESRO bringing into its priorities space science, research and development of technology. However, the ESA Convention was formulated with a flexible approach as evidenced by Article I. In accordance with Article I, ESA Member States have the obligation of participating in the mandatory activities and of contributing to fixed common costs of ESA. The mandatory activities are in space science. Nevertheless, ESA Members have the option of deciding freely whether to participate in optional and operational activities. This flexible approach was stipulated in Article V of the ESA Convention. This measure was taken to avoid future conflicts that end up splitting the countries into different groups.

The summary explanation of the three classifications of activities by the ESA Convention is the following:

- *Mandatory activities*

The mandatory activities are those activities where all ESA Member States have to participate and these activities include: education, documentation, studies of future projects and technological research work, dissemination of information and execution of the scientific programme.

- *Optional activities*

The optional activities refer to the activities over which countries can decide their participation or formally declare disinterest in participating. The list of optional activities includes: the design, development, launching and control of satellite and other space systems; the design, development and operation of launch facilities; and space transport systems.

- *Operational activities*

The operational activities are in the area of space applications subject to the conditions made by the ESA Council with the majority of all Member States. These activities include the placing at the disposal of operating agencies the ESA's own facilities; the launching and control of satellites. Operational activities are not part of the ESA programmes' budget, as a result the costs of these activities correspond to the user concerned.

2 ESA Facilities

ESA's headquarters are located in Paris, France. In addition, ESA counts on various specialist centres, such as the following:[33]

- The European Space Operations Centre (ESOC) in Darmstadt, Germany. ESOC is in charge of tracking and controlling ESA satellites. In addition, ESOC functions' cover commands for spacecraft manoeuvring, carry out routine systems monitoring and transmit payload operational instructions. The ESA's Directorate of Operations and Infrastructure is located there.
- ESA's Centre for Earth Observation (ESRIN) is in Frascati, Italy. This centre is in charge of managing the ground segment for ESA and third-party Earth observation satellites. It deals with the coordination of over 20 ground stations and ground-segment facilities in Europe and cooperation with 20 foreign ground-segments operators worldwide.
- The European Space Research and Technology Centre (ESTEC) at Noordwijk, The Netherlands is the ESA establishment for the technical preparation and management of ESA space projects. ESTEC is the home of ESA's Directorates of Technical Quality Management and Human Spaceflight, and of the Research and Scientific Support Department.
- The European Astronaut Centre (EAC) at Cologne, Germany. EAC deals with astronaut selection, training, medical support and surveillance, support of astronauts and their families.
- The European Space Astronomy Centre (ESAC) for space science at Villanueva de la Cañada, Spain. In ESAC are located the science operation centres for ESA astronomy and planetary missions.
- Europe's Spaceport is located in Kourou, French Guiana, an overseas department of France. ESA owns the infrastructure built for the Ariane launchers.

Finally, ESA has liaison offices in countries that are considered of strategic importance in space cooperation: Washington DC and Moscow. Furthermore, a liaison office was established in Brussels for dealing with the issues related to ESA and the European Commission.

3 Regular organs

ESA is composed of legislative and executive organs (Article X). The legislative function is in charge of the ESA Council, and the executive function is held by the Director General.

33 ESA, space for Europe, Establishments and facilities, available at: http://www.esa.int/SPECIALS/About_ESA/SEMY8TEVL2F_0.html (last visited 12 February 2010).

Article XI indicates the composition, procedures and functions of the ESA Council, which is the international decision-making legislative body,[34] composed of national representatives of ESA Members. One vote is held by each ESA Member; however there are some exceptions to this general rule.[35]

The tasks of ESA Council include: definition of ESA's policy; determination of contributions by Member States; approval of the annual work plan and budgets; establishment of subordinated bodies for instance the Science Programme Committee; etc. Besides, Kaltenecker[36] draws attention to a new element in the ESA Council regarding the attributions to meet at delegate and ministerial level. Before the ministerial meetings were held by the former ESC.

On the other hand, the Director General holds legal representation of ESA and is in charge of implementing decisions, activities and programmes which have been approved by the ESA Council. The functions of the Director General are assisted by scientific, technical, administrative and office staff, and both are subjected to responsibility of international character in order to guarantee their independence from national interests (Article XII). Furthermore, the Council and Director General can create advisory bodies to assist them with their tasks. The Council also can establish Subordinate Committees with decision-making power, with prior approval by a two-thirds majority of all Member States of ESA.

4 Other remarks

Article XIII stipulated the rules for financial contributions. The ESA Convention followed the ESRO financial system based on the national income. The ESA mandatory activities are funded by the contributions of ESA Members and the amount of such contributions is determined on the basis of the national income of each ESA Member. However, the contributions for optional programmes are determined freely by ESA Members which are participating in such programmes.

Regarding internationalization of ESA cooperation, Article XIV established that ESA Council by unanimous vote of all Member States takes decisions regarding cooperation with other international organizations and with Governments and institutions of non-Member States under the form of participation; or associate membership.

The settlement of disputes firstly is submitted to the ESA Council (Article XVII), however if no agreement is reached, then Member States shall resort to arbitration procedures for settlement.

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34 *See* von Preuschen, *supra* note 20, at 57.

35 In the optional programmes the vote is limited to the Member States participating in such programmes. In addition, when a Member States fails the payment of financial obligations with ESA it may loose the right to vote in the Council and subordinated bodies.

36 *See* Kaltenecker, *supra* note 5, at 38.

There are five annexes to the ESA convention: Annex I. Privileges and Immunities; Annex II. Financial Provisions; Annex III. Optional Programmes; Annex IV. Internationalization of national Programmes, and; Annex V. Industrial Policy, in which can be found the answer to the following question: what is the contribution of ESA to its Member States?

The particular approach of ESA's industrial policy considers the efficient use of financial and technical resources in combination with the distribution of opportunities for all ESA Member States. Article II in Annex V, indicates that ESA shall prefer industry and organisations of the ESA Members in placing contracts. In the case of optional programmes there is a preference clause indicating that particular preference shall be given to industry and organizations in the participating States to the optional programme.

In summary there are two crucial aspects in the ESA industrial policy: 1. the geographic distribution of ESA contracts[37] and, 2. the sharing of economic and technological resources in equitable form with the so called 'just return'.[38] Concerning these two aspects, Article IV explains the general rules for the geographic distribution of ESA contracts. For instance, it clarifies means to assess and determine the return coefficient, making reference to the weighing factors in the calculation of return coefficients, and establishes 0.8 as the lower limit for the cumulative return coefficient for the subsequent period.[39]

To conclude this section, the guidelines of the European space cooperation in the ESA Convention, which were identified by expert Kalkectner, are mentioned below:[40]

- The flexibility in the elaboration of new programmes
- Efficiency in the execution of programmes
- Respect for the different interest of Member States
- Acceptance of industrial return
- Equilibrium between legislative and executive functions
- Appropriate long-term planning

37 Dr. Leister explains the practical advantage of this measure: 'In this way governments can view money invested in the agency as indirect subsidies that help their industries develop space technologies'. V. Leister, Space Technology: From National Development to International Cooperation, Doctoral thesis Mc Gill University 92 (1982).

38 'Just return is measured through an industrial return coefficient that is calculated as the ratio of all contracts placed by ESA in the space industry of a given Member State to the budget that ESA spends on projects a whole'. E. Sadeh, *International Space Cooperation*, in E. Sadeh (Ed.) Space Politics and Policy: An evolutionary Perspective 303 (2002).

39 In 1997 the minimum return coefficient was updated for mandatory programmes to 0.9. ESA Members and Canada shall be guaranteed a minimum return coefficient of 0.9 at the end of each formal review taking place every three years. Chapter IV in the ESA Council Resolution (C-M/CXXIX/Res.1) on the European Space Agency's Industrial Policy.

40 *See* Kaltechner, *supra* note 5, at 43.

3.1.2 From the European Space Agency (ESA)'s Policy to the European Space Policy

Since 1975 ESA has been the only independent organization dealing with the space sector in Europe. ESA's purposes include the elaboration of the long-term European space policy,[41] by recommending objectives and concerting national policies. In this context, ESA has defined and implemented space policy decisions regarding particular issues; for instance, the ESA's information and Data Policy, the European Earth-Observation Policy, and ESA's intellectual property policy, etc. Interestingly, these policies were adopted with the title of ESA's policies and not European policies.

Nevertheless, since 2000 the European Council (EC) of the European Union (EU) has been working with ESA towards more collaboration and the further integration between the two institutions. Peter[42] mentions that the increasing involvement of the EC of the EU in space issues came from its Presidency, which recognized the importance of space policy in regard to industrial and innovation policy.

Professor Hobe explains that the catalyser of the institutional reform process was the report named 'Towards a Space Agency for the European Union'[43] better known as the report of the Three Wise Men.

In this report was suggested to set policies with stronger commitments and move the institutions closer. The first paragraph of this report states the necessary new perspective for the European space policy:

> 'A Europe without a clear space policy and a clear commitment to space as an integral part of its other policies will be a Europe that limits its own possibilities of success'.[44]

In addition, the report emphasised the contributions of space activities in different areas of development. Considering the importance of space activities, the report suggested that the European space policy should pursue the Euro-

41 Article II (a) ESA Convention.

42 N. Peter, *European Space Activities*, in K-U Schrogl & et.al (Eds.) The Global Context in Yearbook on Space Policy 2006/2007: New Impetus for Europe 28 (2008).

43 C. Bildt, J. Peyrelevade & L.Späth, *Towards a Space Agency for the European Union: Report to the ESA Director General*, in S. Hobe, B. Schmidt-Tedd & K-U Schrogl, Project 2001 Plus: Legal Aspects of the future Institutional Relationship between the European Union and the European Space Agency: Proceedings of the Workshop 5/6 December 2002 in Brussels Doc.1c (2003) . This report was requested by the ESA former Director General Antonio Rodotá in order to have an independent advice on the evolution of ESA. The recommendations were presented at ESA Headquarters in Paris on 9 November 2000. *See also*, ESA News, Benefits for Europe, Report of the 'Wise Men' disclosed in Paris Today: Towards a Space Agency for the European Union at www.esa.int (last visited 6 June 2009).

44 *Id.*

pean space infrastructure for strategic or commercial applications and the maintenance of the European access to space, encouraging launch capabilities.

On the other hand, the EU deals with the protection of European citizens and issues related to security.[45] Thus the new strategy for space policy introduced these issues, defining the role of space applications in the evolution towards the European Security and Defence Policy (ESDP). In this respect, the report of the Three Wise Men mentioned that space technology can help the EU to carry out the Petersberg tasks[46] of peace in the form of conflict prevention and crisis management, embracing civil and environmental emergencies.

This was a controversial issue for ESA, because the ESA Convention establishes in Article II that the purpose of ESA shall be to provide and promote cooperation among European States with exclusively peaceful purposes. ESA has rejected the interpretation of 'peaceful' as 'non-aggressive' for itself.[47] However, Prof. Hobes draws attention to the fact that 'with the participation in GALILEO[48] and Global Monitoring for Environment and Security (GMES)[49] ESA is already entering the areas of military activity and cannot reject any EU policy efforts'. In his opinion ESA will adopt the interpretation of 'peaceful' as 'non-aggressive' at some point.

Other interesting topics discussed in this report were the European independence in accessing space, the leading role in science, space applications for peace and development in Europe, and for solving global concerns. Besides, it considered space business and the importance of the permanent dialogue between the space sector and the entrepreneurial sector.

The recommendations of this report include:

1 implementation of the proposal made by ESA and the EC document on Galileo and GMES;
2 maintaining the open nature of ESA programmes;

45 In accordance with the Common Foreign and Security Policy (CFSP) and, the European Security and Defense Policy (ESDP).

46 In 1992 the Petersberg Declaration established these tasks. The Petersberg tasks are part of the ESDP and they were included in Article 17 of the Treaty of the European Union. The tasks are the following: humanitarian and rescue; peace-keeping, and; combat forces in crisis management, including peacemaking. European Commission, Europe Glossary, Petersberg tasks at: http://europa.eu/scadplus/glossary/petersberg_tasks_en.html (last visited 15 November 2009).

47 *See* S. Hobe, *ESA and the EU: A Coherent Approach in Space* in *supra* note 43, at 15.

48 GALILEO is the Europe's global radionavigation satellite system which is developed jointly by ESA and the European Union. GALILEO will provide highly accurate timing and positioning services. Commission of the European Communities, *Communication from the Commission to the Council and the European Parliament: European Space Policy presented by the Commission on 26 April 2007 (COM(2007) 212 final of April 26, 2007) Annex 2* in K-H Böckstiegel, M. Benkö & S. Hobe (Eds.) Space Law Basic Legal Documents, 3 Vol. doc C.I.3.2 (2007)

49 GMES, Global Monitoring for Environment and Security is a common initiative by the European Union and ESA. GMES combines space and in-situ observing systems for supporting European goals towards sustainable development and global governance.

3 closer institutional integration of ESA and the European Union to impact the overall evolution of European policies. In this regard, for the institutional convergence of ESA and the European Union it was suggested the following:
   - the EC should define the European Space Policy and the guidelines for its implementation;
   - ESA should be the space agency of Europe. However, it is to preserve its openness to countries which are not Members of the European Union;
   - the European Commission should define the regulatory framework of space activities;
   - the European Parliament should discuss and review the European Space Policy.

In the same year 2000, the ESA Council adopted a Resolution on a European Strategy for Space.[50] This document identified the main aspects that would be developed jointly by ESA/EU to define the direction of space activities.

Part I, titled the Political Dimension of Space explained the importance of reflecting the political ambitions of Member States in space policy and recognizes that the implementation of space policy requires a sustained political commitment from the Members. The political dimension includes the commitment to stimulate private investment within public/private partnership in the development and utilization of space systems.

Part II addressed the theme of Common Strategic Goals, which include enhancing the scientific knowledge and the benefits for society and markets; keeping the competitive position of European launchers for accessing to space; encouraging the participation in international cooperation projects to understand better the Universe and Earth; stimulating private investment through public/private partnerships.

Part III identifies the specific Course of Action:

- having a cooperative structure for ESA and the EC to formulate joint proposals for the development of the European strategy;
- provide the European Union with technical expertise from ESA to implement and develop joint programmes;
- the joint initiatives are: GMES for environmental management, regional planning, task monitoring, safety and civil security, and; GALILEO a satellite navigation system for Europe.[51]

50 ESA Council Resolution on a European Strategy for Space Adopted on November 16, 2000 (C-M/CXLVIII/Res.1) in *supra* note 48.

51 Galileo and GMES initiatives are concrete steps towards the closer relationship between ESA and the European Union.

Table 3 – Summary of ESA Council Resolution on a European Strategy for Space

Part I- Political Dimension of Space	*Part II. Common strategic Goals*	*Part III. Course of action*
- Political ambitions of the Member states - Implementation requires sustained political commitment - Stimulate private investment with public/private partnership - Link between space systems and knowledge-based society	- Consider the developments in European society's use of satellite systems - Importance of research and development science and technology operational infrastructure - Accessing to space and the competitive position of European launchers - European contribution to international cooperation	- Cooperative structure of ESA with the European Commission for making joint proposals - Joint initiatives: GMES and GALILEO - Contribution of the satellite communication to the information society

Further joint meetings and initiatives contributed in defining the priorities of the European space policy and the necessary changes to reach a closer relation and coordination between the EU and ESA. In 2003 the Framework Agreement between the European Community and ESA was signed,[52] while in June 2005 the Space Council established the guidelines and nature of the European space policy, as well as some elements of the future programmes. During 2006 and 2007 ESA and the EC were analyzing the European space policy. Three main outcome documents set forth the outcome of this analysis:

· *Agenda 2011, the ESA long-term plan 2007-2016 that will implement Agenda 2011*[53]

Agenda 2011 was elaborated by the ESA Director General and the Directors. This document dealt with the evolution of ESA activities linked to the development of ESA space policy and programmes. In addition, this document addressed the evolution of ESA according to the new scenario: (1) the amendment of the ESA Convention for improving ESA effectiveness and its relation with the European Union; (2) it was expected to increase the number of ESA Members or cooperative States, and; (3) ESA should become an Agency of the European Union by 2014.[54]

· *The European Council Resolution on the European Space Policy*[55]

On May 25, 2007 the EC adopted this resolution, in which the main features of the European space policy are mentioned.

52 Council Decision on the signing of the Framework Agreement between the European Community and the European Space Agency, 12858/03 RECH 1527 (2003).

53 *See* ESA, *Agenda 2011: A document by the Director General and Directors*, 128 ESA Bulletin 9 (2006).

54 *See* Peter, *supra* note 42, at 25.

55 European Union Council Resolution on the European Space Policy adopted on May 25, 2007, 10037/07 in *supra* note 48, at C.I.3.1.

Section I recognizes that space sector contributes to the independence, security and prosperity of Europe and the world. Furthermore, space activities contribute towards the Lisbon strategy for growth and employment by providing technologies and services for the emerging European knowledge society.

Section II describes the further steps, defining programmes and their implementation. For instance the GMES and GALILEO initiatives, and the use of space-related integrated applications.

· *Commission of the European Communities. Communication from the Commission to the Council and the European Parliament: European Space Policy*[56]

The strategic mission of the European space policy emphasizes the importance of space assets in different fields: science, defence, economy, high technology innovation, commercial markets and in particular is relevant in the daily life of citizens. To ensure that the space sector counts on strategic investment the following steps were mentioned: the establishment of a European Space Programme, the growth of synergy between defence and civil space programmes, and the development of a joint international relations strategy in space.

As to governance the institutional framework emphasized that, due to the EU dimension of space, the efficient cooperation between EU and ESA would be necessary. For this purpose, the Framework Agreement between the EC-ESA was considered to be a solid base for future coordination.

In this respect, the amendments introduced by the signature and ratification of the Treaty of Lisbon[57] included the recommendations and considerations of the documents mentioned above.

Title XIX in the Consolidated Version of the Treaty on the Functioning of the European Union reflected the new approach:[58]

Article 189 (1) stipulates that in order to promote scientific and technological progress and industrial competitiveness the EU 'shall draw up a European space policy. To this end, it may promote joint initiatives, support research and technological development and coordinate the efforts […]'. It indicates also that ESA space policy will be developed into a European space policy. Furthermore, it is interesting to observe the integral approach to space, which is linked to science, technology and industry.

Article 189 (2) establishes that the European Parliament and the EC, 'shall establish the necessary measures, which may take the form of a European space programme, excluding any harmonisation of the laws and regulations of the Member States'. Article 189 (3) required the EU to establish appropriate relations with ESA.

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56 Commission of the European Communities. *See supra* note 48.

57 Treaty of Lisbon (2008 O.J. C 115/1).

58 Consolidated Version of the Treaty on the Functioning of the European Union (2010 O.J. C83/47).

3.1.3 Three lessons from the consolidation of European cooperation in space

1 Coordination and continuity in the European space activities

ESA did not start from zero, because ESA took advantages of ESRO and ELDO resources:

- ESRO European space facilities and ELDO national facilities contributed to the feasibility of performing the initial ESA programmes;
- ESRO and ELDO paved the way to establishing space industry in European countries;
- ESRO and ELDO staff gained hands-on experience in space projects;
- ESRO demonstrated how important it was to have a central authority to coordinate Member States, and ESA's internal structure implemented this approach;
- ESA coordinated the continuity of the ESRO and ELDO space programmes with the necessary updates.

These elements provided ESA with a solid background to undertake space activities with a practical approach beyond political declarations.

2 Flexible approach to the European space programme taking into consideration the differences among the ESA Member States

The agreement on the different interests of ESA Members was a difficult task to achieve, for instance there were members of ESRO not interested in participating in the launching activities performed by ELDO. However, in order to include an alternative to overcome the lack of agreement in some projects a flexible scheme was introduced, in which were included mandatory, optional and operational activities. The two last activities were under the premise that ESA Member States could participate freely in these activities. This decision with the passage of time has been a measure to maintain dynamism and diversity in the ESA space projects without failing to support basic space science.

Another aspect concerning the differences of ESA Member States is reflected in the heterogeneous composition of ESA Member States when ESA was established. For that reason, the ESA Convention considered from the economic point of view how the contributions were to be defined. In this scenario, the option for European countries to participate independently of the size of their economy was possible through the decision of determining the contribution of ESA Members States on the basis of the national income of each one.

3 Respect for the interests of ESA Member States

Different cultures, languages and national space programmes converged around a common interest in becoming a European space power. This ambitious aim of ESA was possible due to particular tools that respect the interests of all ESA Member States. For instance the introduction of the geographic

distribution of ESA contracts among ESA Member States, decisions related to the industrial policy on the basis of 'just return' or the geographic return rule.

3.1.4 Toward the Latin-American Space Agency (LASA)

I do not think that ESA could be the right first approach to start space cooperation in Latin America. Nevertheless, in the hypothesis that the ESA example could be considered as a benchmark for starting Latin-American space cooperation, what do the Latin-American countries need in order to establish a LASA?

In November 2010, the next CEA VI should adopt an Action Plan that describes concrete actions to be performed by a Working Group of experts from space agencies, academia and research institutes. The Working Group would be in charge of the following duties:

- elaboration of a database with national space facilities, academic and research institutes, space industry, and the regional organizations involved in space science, technology and applications;[59]
- define the strategies of coordination among the regional resources identified in the database;
- definition of the first LASA space programme. In this context the LASA space programme also should be calculated in terms of budget; this implies drafting the rules for the contribution schemes, and defining the funding sources for the space programme and the daily operations of LASA;
- definition of a long term LASA space policy: an important policy issue in space cooperation is what would be the rules to disseminate satellite data among the LASA members and non-LASA members?;
- negotiation about the location of the LASA headquarters and the Latin-American space facilities;
- Legal drafting of the LASA Convention, in which would be decided the permanent organs, LASA programme priorities, budget allocation, etc.;
- Design strategies to boost space industry and capacity building in the region, which is a difficult situation without national experience in space programmes;
- Rules to select and hire LASA staff;
- Propose a roadmap to encourage science and technology in the region;

In this scenario for the creation of LASA, a final remark is that Brazil and Argentina in particular would need to contribute part of their space experience

59 During the workshop on Latin-American space policy, J.A. González, CRECTEALC Academic Coordinator, informed that CRECTEALC Mexico is working on the elaboration of a regional database. *CRECTEALC/SWF/SRE Workshop Space Policy in Latin America and the Caribbean: Looking to the Future*, Mexico City, 3-5 November 2009.

and space assets for the common benefit of the region.[60] As mentioned before, currently Argentina has been the promoter of the South-American Space Agency (SASA) or LASA, coinciding this objective of regional space cooperation with its national and regional space policy. (see supra 2.2.1 Four regional proposals to implement space cooperation). The question is how Brazil would react to the possible creation of the LASA?. It seems that there is a lack of interest on this proposal, Brazil has already a successful framework of international space cooperation.[61]

Why Brazil could be interested in sharing its space assets with Latin-American countries? In my opinion, a high level of regionalism and regional cooperation would be necessary, which is not the situation in Latin-America to expect Brazil to share its space assets. Nevertheless, in practical terms it is difficult to imagine a LASA without Brazil. Therefore, one solution is that a greater number of Latin-American countries could work on their national space capabilities to achieve a more homogenized version of the regional scenario for future collaboration in terms of a partnership. In this way, Brazil will obtain benefits and the other Latin-American countries too.

Finally, I consider that starting with the institutionalization of regional cooperation could be a wrong approach. The definition of a space programme, establishment of regional space facilities and demonstration of benefits from space applications are needed before the institutionalization. The above proposal would be an institutional initiative for a short time in the political sphere, but would not be sustainable on a practical long-term basis.

Furthermore, I would like to point out that in the vent that the institutionalization would come before the creation of regional space capabilities, there will not be options to assign the LASA contracts to Member States of LASA which pay contributions, because of the lack of space industry in the region. Therefore, most of the contributions would go to pay contracts with space industries in other regions and countries. The 'just return' of ESA cannot be applied in the current circumstances, since the LASA proposal would be difficult to succeed as a first project due to financial considerations. Thus, LASA

60 When ESRO and ELDO were established France and England were leading Europe in space research and science along with Germany and Italy. However, these European space powers shared their knowledge and experience in the space field for achieving a European common project in space cooperation.

61 For instance the Brazilian Space Agency (BSA) has agreements with the National Space Agency of Ukraine for the Alcântara Launch Center, and; the Russian Federal Space Agency to develop a new family of launch vehicles. The National Institute for Space Research (INPE) has an agreement with the Chinese Space Agency for the China-Brazil Earth Resources Satellite Programme (CBERS). In October 6, 2009 Brazil signed a cooperation agreement with Belgium to collaborate in Earth observation and satellite technologies. *See* Space News, *Satellite Cooperation Pact Signed by Brazil, Belgium*, 12 October, 2009. In other words, Brazil does not need to share its space experience and assets for regional space cooperation, because Brazil has been participating directly in international space cooperation programmes for more than twenty years.

will be an expensive investment without 'just return', *i.e.*, contributions would go to pay international space contracts rather than being re-invested into the space capabilities and industries of the region.

3.2 Model II, non-institutional space cooperation: the case of the Disaster Monitoring Constellation (DMC)

Institutional cooperation is not the only option to pave the way for successful instances of cooperation in space. There are some examples of innovative space cooperation, in which the participant countries are not geographically next to each other. In this context, we can observe that space cooperation has brought together international alliances through common interests in particular space applications despite the participant countries not sharing the same language or cultural values, political affinity or territorial proximity (see regionalism 2.2 Regional cooperation in space activities: the Latin-American experience).

One of these examples is the Disaster Monitoring Constellation (DMC) in which Algeria, Nigeria, China, Turkey, England and Spain are participating. These countries have a common interest in providing global monitoring of natural disasters, satellite information that is useful to deal with floods, earthquakes, hurricanes, tsunamis and fires. Although the common interest is focused on natural disasters, the partners of the DMC also use the satellite information to cover their national needs for information to improve development in their countries.

3.2.1 Historical review

The DMC started as an initiative presented by Surrey Satellite Technology Ltd. (SSTL) in 1996. The suggestion was to develop an affordable constellation of small satellites for Earth observation with a medium resolution instead of a complex and expensive space mission. The funding was planned to find diverse sources, 'a novel concept was adapted based on individual ownership of a single spacecraft and ground station pair.'[62] DMC Members maintain the ownership of the DMC satellites, but they agree to share satellite data and the infrastructure that might be required for operating the satellites.

62 A. da Silva, L. Boland & *et al.*, *First Result from the Disaster Monitoring Constellation (DMC)*, 56 Acta Astronautica 262 (2005).

SSTL is the private partner in the DMC,[63] which with the support of the British National Space Centre (BNSC) and in collaboration with the other countries has designed and built the satellites forming the DMC:[64]

Table 4 – Disaster Monitoring Constellation satellites

Country	*Organizations representing member nations*	*Satellite*
Algeria	Centre National des Techniques Spatiales (CNTS)	AlSAT-1 (2002)
China	Beijing Landview Mapping Information Technology Ltd (BLMIT)	Beijing-1 (2005)
Nigeria	National Space Research and Development Agency (NASRDA)	NigeriaSat-1 (2003)[65]
Turkey	TÜBITAK BILTEN	BilSat-1 (2006-mission completed)
United Kingdom	Surrey Satellite Technology Ltd (SSTL)	UK-DMC (2003)[66]
Spain	Deimos Space S.L.	Deimos-1

Satellites from Algeria, Turkey and Nigeria were built under the Know-How Transfer Training (KHTT) program at Surrey.[67] In the case of TUBITAL-BILTEN its collaboration with SSTL was not only related to the development of the microsatellite BilSat-1 and its capability to produce its own satellites; but also included assistance in establishing space facilities in Turkey, such as the assembly and integration room, research and development laboratories, and ground control station.[68]

The DMC International Imaging (DMCii), a subsidiary of SSTL, is in charge of distribution of data and supply of satellite imagery products and services to international costumers. Likewise, DMCii activities include the following:

63 The DMC is an interesting case, due to the public-private partnership (PPP) involved in its operation.

64 University of Surrey, DMCii Pioneers New Framework for Satellite Imaging Quality Control, at:http://www2.surrey.ac.uk/mediacentre/press/2008/1497_satellite_imaging_quality_control.htm (last visited 20 July 2009). The second generation of DMC satellites includes the following satellites: NigeriaSat-2, UK-DMC2 and Deimos-1 (Spain) by Deimos Space S.L.

65 NigeriaSat-1 provides Earth observation information with applications in national environmental problems such as the Niger delta mangrove swamps, gully erosion, deforestation, desertification and food security. See more about Nigeria's space programme in T. Brisibe, *Law and Regulation of Space Activities Related to Outer space in Nigeria*, 55 German Journal of Air and Space Law ZLW 562 (2006).

66 UK-DMC provides imaging of disaster areas through the ESA's project RESPOND. DMCii, DMC Constellation at: http://www.dmcii.com/about_us_constellation.htm (last visited 7 September 2009).

67 Group on Earth Observations, GEO Portal, Disaster Monitoring Consortium http://www.geoportal.org

68 A. Bradford, L.M. Gomes & et. al., *BILSAT-1: A Low-Cost, Agile, Earth Observation Microsatellite for Turkey*, 53 Acta Astronautica 761 (2003).

- management of data quality across the constellation;
- coordination of the commercial activity of the DMC such as the provision of satellite imagery for different applications: precision agriculture, natural resource management and planning;
- working in partnership with the BNSC and the DMC Consortium Members to provide services and imagery to the Disasters Charter;[69]
- provide satellite data for daily imaging of disaster area to aid agencies through Reuters AlertNet in the beginning;[70]
- DMCii also provides satellite imagery to monitor deforestation in the sub-Saharan Africa for environmental management, due to a ESA contract of 3.9 million Euros within the framework of GMES.[71]

Some of the general but important aspects of the DMC are mentioned below.[72]

- *Purpose and objectives*

DMC 'was designed as a proof of concept constellation, capable of multi-spectral imaging of any part of the world every day'.[73] DMC's main objective is to support with satellite information activities related to the management of natural disasters. Nevertheless 'its main function is to provide independent daily imaging capability to the partner nations'.[74]

- *Facilities*

The DMC operates with national facilities instead of common facilities. In contrast to the common facilities of ESA, such as ESTEC, ESOC, ESRIN, etc.; the DMC facilities are owned and operated by the individual partners. Nevertheless, it is possible to sign agreements for shared use.

- *Regular organs*

The DMC is not an international organization and it has no regular organs in a strict sense. It is a consortium that meets approximately every six months. The decisions regarding policy have to be made by consensus among the DMC Members. The DMCii often adopts the role of an executive Secretariat.

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69 The BNSC and the DMCii on behalf of the DMC consortium members are the representatives of the DMC constellation within the Disaster Charter. Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters Rev.3 (25/2000)2 (2000).

70 DMC ii, DMC Constellation: http://www.dmcii.com/about_us_constellation.htm (last visited 28 November 2009).

71 *DMCii Nabs Contract for Satellite Imagery of Africa*, Space News, 24 August 2009, at 8.

72 The information included in the infrastructure, regular organs and interesting remarks of the DMC were provided by Dave Hodgson, Managing Director DMCii. Electronic communication by email Friday, 20 November 2009

73 DMC International Imaging, DMC Constellation: http://www.dmcii.com/about_us_constellation.htm (last visited 28 November 2009).

74 *Id.*

· *Interesting aspects*

The DMCii is the central authority for the management of the DMC constellation; it guarantees the coordination of national and international interests in space among the DMC partners.

This model of cooperation adopted by the DMC has particular features in the field of data policy. At a national level, the partners own all rights to license imagery from their own satellite and are the point of contact within the national territory for imagery requests. On the other hand, at the international level the point of contact is the DMCii, which is in charge of coordinating international data provision for commercial and non-commercial purposes.

3.2.2 Three lessons from the DMC

1 This model overcame the paradigm of opposites in space cooperation through a partnership among them, in this converge model:
   · developed, developing and emerging countries;
   · public and private sector;
   · South-South and North-South cooperation;
   · national and international interests in space;
   · commercial and public interests in space applications and services.
2 The DMC is an affordable option to participate in a global Earth observation constellation. It is a fast way to become an actor in space activities. In addition, this form of cooperation provides a solid base for future national space projects. In this respect, it is important to mention that the know-how transfer scheme and the possibility to receive assistance in the establishment of space facilities by SSTL are crucial elements to developing indigenous resources.
3 The DMC has a practical national, regional and international impact in improving the provision of satellite data to deal with natural disaster management and natural resources management.

3.2.3 Toward the first Latin-American satellite constellation

The DMC cooperation model seems to be suitable for countries seeking capacity-building to gain hands-on and practical experience in satellite mission technology. A satellite project similar to the DMC could be an option to develop low-cost satellite technology allowing Latin-American countries to individually afford the cost of one of the satellites in the constellation with different sensors. A constellation of small satellites has two advantages: (1) hands-on experience with a small and simple project that can be developed in relatively short time;

and (2) 'constellations increase operational utility and reduce operational risk'.[75]

It is the opinion of this author that the DMC cooperation model could be used to overcome economic and technical concerns that have limited the direct participation of most of Latin-American countries in space activities. The DMC model could be a quick starting point for a first Latin-American space programme. Regional space cooperation could be implemented based on a concrete proposal such as AQUARELSat: The Water Monitoring Constellation. Furthermore, this space project would be a source to consolidate future endeavours towards institutionalizing space cooperation in the region.

The way forward to implement this idea is that four Latin-American countries participate in a satellite constellation project such as AQUARELSat. For this purpose, participant countries should identify the needs of satellite information considering the end-users at the national and regional levels. Subsequently, the scope and objective of the satellite mission should be defined to start work on the satellite design and construction, and on the legal implementation of AQUARELSat as the first concrete project of space cooperation in Latin America.

This modest project under a reliable legal model would boost different areas in the chain of regional Earth observation activities: satellite distribution, value-added products, space industry, research and innovation in space technology, national regulation on remote sensing and other areas of space activities, experience in space projects.

In addition, a Latin-American Satellite Constellation could be a tool to homogenize space capabilities in the region. The operation of a satellite constellation by some countries in Latin America could bring fairer conditions for the future implementation of a more ambitious project, such as the institutionalization of Latin-American space cooperation with the LASA.

3.2.3.1 AQUARELSat: The Water Monitoring Constellation

Considering that one of the rationales of using space applications is to solve national, regional and global problems, the question is on which of the different problems should the first Latin-American Satellite constellation focus?

My proposal to answer this question is to focus the first satellite mission on providing satellite data to deal with the problems of water and food security which are deeply interrelated. In addressing this problem, satellite data should seek to improve water management as a necessary tool to improve and achieve water and food security. The benefits to the end-users justify the selection of water management, because this is a practical measure to implement the right to water and improve the quality of life of the population.

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75 SSTL, *Earth Observation Products and Services* IQ 1336 09/09 (2009).

In this context, the Latin-American region is still facing a shortage of safe water supply. Safe water is a vital element for quality of life, for maintaining health and preventing water-borne diseases.

In this case, regional water and food security would be identified as the target of the first Latin-American space mission; the next step is the space mission design. My proposal is to set up the AQUARELSat the Water Monitoring Constellation. The space programme of AQUARELSat aims to construct and operate a Latin-American small remote sensing satellite constellation for monitoring water and other natural resources.

The AQUARELSat constellation will be composed of four small remote sensing satellites. Each of the four satellites collects different types of data as a result of its specific payloads and objectives. The four satellites are based on existing payload instruments which have been incorporated in satellites that are still working in orbit. The challenge in the construction of these satellites will not be the invention of new payloads but the miniaturization of the payload instruments for use in small satellites.

3.3 CONCLUSION

Since Europe started regional space cooperation, an institutional model was selected for the establishment of ESRO and ELDO. The decision regarding institutional cooperation was suitable to the international environment of the Cold War when space activities were dominated by two countries. At that time, access to space technology, know-how, launching facilities and satellite data were under more strict military controls, and high level of funding were required. National prestige and other political motivations were some of the main reasons to seek the leadership in space activities. In that context, institutional regional space cooperation was a practical solution for Europe in seeking a role in the international space arena that was once reserved for the USA and the URRS.

However, the international pressure that promoted regional space cooperation no longer exists. Regional and international cooperation are both valid and effective options in space cooperation under institutional and non-institutional frameworks. The current argument behind effective and efficient regional and international space cooperation is to count on space applications for improving the quality of life of the population. Based on this premise, Latin-American space cooperation should begin with the definition of a specific space project to be developed and operated for the benefit of the population.

Another aspect to consider in the analysis of the European space cooperation is that at the beginning of the 1960s France and Germany along with the United Kingdom and Italy led space activities in Europe. In order to implement institutional space cooperation these countries shared part of their advantages and knowledge with other European countries to create ESRO and ELDO. In

the Latin-American case, the implementation of institutional space cooperation could call for particular efforts from Brazil and Argentine to share part of their experience and space assets under the framework of a future LASA. In realistic terms this situation will be difficult to achieve.

Regarding space policy, in Europe the creation of a common space policy started with the ESA space policy and lately has become the European space policy, when ESA enhanced its communication and coordination with the European Council and other European bodies. Having in mind the ESA case, it seems ambitious to start working on the definition of a Latin-American space policy, because the discussion should be start with the clear definition of objectives of the first Latin-American satellite mission, later the LASA space policy and the last step is the regional space policy.

For the reasons mentioned before, in my opinion ESA is a good example of institutional regional space cooperation, but it is not the right legal model for a first attempt to implement space cooperation in Latin-America. The conditions and key pieces to implement cooperation on terms similar to ESA are missing in Latin-America: *e.g.* there is no common or national facilities, no space programme, no funding scheme, no space sector or political will based on a common interest to become a Latin-American space power. When the ESA Convention gathered all these pieces it solved the puzzle to European space cooperation.

Before discussing the establishment of the LASA, Latin America needs to start working on the creation of a space programme, facilities, industries and a funding scheme in a flexible and non-institutional framework of legal space cooperation. Otherwise, a beautiful convention on space cooperation could be drafter, with the risk of having an organization without sustainable and realistic objectives and resources.

Therefore, the first approach to the implementation of Latin-American space cooperation should be flexible and non-institutional, to overcome regional tensions and save time and resources in complex structures, such as a new regional institution. The ideal scenario should be to invest all efforts in a fast track approach towards the action and hands-on in the development of a space mission: a first Latin-American satellite constellation under the framework of the DMC model to boost space capabilities and experience in more countries of the region. The first Latin-American satellite constellation that is proposed in this research is AQUARELSat and the legal model lies in the elaboration of an international agreement among four Latin-American countries.

4 AQUARELSat: the Water Monitoring Constellation

> 'There seems no way that we can plan any longer, for plans become outdated as fast as they are implemented. By the time we recognize a problem, action must be taken at once; and by the time we take action, however quickly, it is too late; the problem has changed its nature and gotten away from us'. Isaac Asimov. Gold: The Final Science Fiction Collection.

Based on the AQUARELSat Constellation, the proposal is to achieve multilateral cooperation through the development of a specific satellite project that could help solve regional problems, such as the lack of satellite imagery and data for water management.

Satellite data from AQUARELSat Constellation could contribute to monitoring water resources and other natural resources, as well as natural disasters.

Furthermore, AQUARELSat could be the key element for Latin-American countries to implement their first multilateral satellite project. This concrete case would provide experience in the development and operation of a space mission. Furthermore, AQUARELSat Constellation is a practical way to start efficient space cooperation, paving the way for an institutional model of regional space cooperation in the future.

This section describes AQUARELSat space project as the first step in implementing space cooperation in Latin America. The technical concepts included in this chapter are defined in Appendix C: Glossary of AQUARELSat the Latin-American Water Monitoring Constellation.

4.1 AQUARELSAT: THE WATER MONITORING CONSTELLATION

The first Latin-American small satellite constellation is called 'AQUARELSat', as a metaphor of the results from the information provided by AQUARELSat Constellation, which would allow to have a complete *aquarelle* or water colour of the water resources in Latin-America, an *aquarelle* made of satellite imagery.

The AQUARELSat proposal does not aim at presenting an accurate engineering mission design, but an approach to the development of a small satellite constellation for monitoring water resources.

AQUARELSat is a constellation[1] composed of four small remote sensing satellites for monitoring water resources. Each of the four satellites collects different data of natural resources as a result of its specific payloads and objectives.

The four small satellites in the AQUARELSat Constellation are:

1 *Azul*, designed to provide information about surface water and moisture. It will be equipped with an ETM+ (Enhanced Thematic Mapper Plus) for applications related to measuring surface radiance, horizontal distribution of surface water temperature, land cover state and change, study of spatial variability, calculation of water consumption by rural and urban areas, and localization of water stress areas;

2 *Celeste*, equipped with an Optical Sensor Assembly (OSA), while its applications include Digital Terrain Models (DTM) data imaging to identify particular features of the Earth's surface.[2] This information assists in locating and monitoring groundwater resources, elaborating Digital Elevation Models (DEM), and mapping natural resources in rural and urban areas;

3 *Turquesa*, follows the model of the TERRA satellite. One of the instruments of TERRA is the Moderate-Resolution Imaging Spectroradiometer (MODIS). This instrument provides information about soil moisture for water surface estimation, groundwater recharge and soil chemistry, and data on biological and physical processes on the surface of the Earth;

4 *Cian*, whose satellite payload includes Synthetic Aperture Radar (SAR) (see infra 4.2.2.2 Remote sensing for studying groundwater). This instrument is sensitive to water for location of wetlands and for measuring changes in water heights. Besides, SAR can obtain information of water in desert areas. Other operational applications[3] of SAR include hydrologic mapping (*e.g.* of aquatic vegetation), wetland mapping, geological features for DEMs production, land use change, groundwater exploration and soil moisture qualitative identification.

The four satellites depend on existing payload instruments which have been incorporated in satellites that were successfully launched and are still working in orbit. A positive point is that the payloads already exist; but to develop them in small or miniature scale to be incorporated in small satellites will be a challenge.

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1 'Constellation' is planned for non-geostationary satellites to ensure continuous coverage of any region. At non-geostationary orbit satellites have limited coverage, hence a number of satellites are needed to have permanent coverage. 'The constellation design process consist in optimizing the number and the relative placement of the satellites that best satisfies space and time coverage requirements at the lowest cost'. International Telecommunication Union, Handbook on Satellite Communications 360 (2002).

2 H. J. Kramer, *Observation of the Earth and its Environment* 287 (2002).

3 V. Singhory, *RADARSAT Business and Applications*, lecture at the MSS/MSM Academic Year 2005/2006 Program, International Space University, Strasbourg, 9 January 2006.

The technology that could be used by AQUARELSat satellites is related to existing satellites as follows:

1 *Azul*, Landsat 7 ETM+ satellite, operated by the US Geological Survey and NASA;
2 *Celeste*, IKONOS satellite, operated by GeoEye;
3 *Turquesa*, TERRA satellite, operated by NASA;
4 *Cian*, RADARSAT 2 satellite; operated by a private company and the Canadian Space Agency (CSA).

Table 5 – General information on the AQUARELSat Constellation[4]

Mission	*Status*	*Applications*	*Instrument*	*Orbit details*
Azul Landsat 7 USGS/NASA	Currently being flown Launch: 15 Apr 99 End of life: 31 Dec 12	Earth resources, land surface, monitoring, agriculture and forestry, disaster monitoring and assessment.	ETM+ Landsat Comms	Type: Sun-synchronous Altitude: 705 km Period: 98.9 mins Inclination: 98.2° Repeat cycle: 16 days Descending URL: http://landsat7.usgs.gov/
Celeste Ikonos	Currently being flown Launch: 24 Sep 99 End of life: > 8.3 years	Urban and rural mapping of natural resources, land management	ITT camera on multiple targets OSA (Optical Sensor Assembly)	Type: Sun-synchronous Altitude: 681 km Period: 98 mins Inclination: 98.1° Repeat cycle 14 days (max) URL: www.geoeye.com
Turquesa TERRA Formerly EOS AM-1 NASA	Currently being flown Launch: 18 Dec 99 End of life: 01 Oct 09	Water and energy cycles, carbon and water, atmospheric dynamics and chemistry, vulcanology	MODIS	Type: sun-synchronous Altitude: 705 km Period: 99 mins Inclination: 98.2° Repeat cycle: 16 days URL: http://terra.nasa.gov/
Cian Radarsat 2 CSA	Currently being flown Launch: 14 Dec 07 End of life: 17 Apr 15	Environmental monitoring, physical oceanography, land surface	SAR (Radarsat-2)	Type: sun-synchronous Altitude: 798 km Period: 100.7 mins Inclination: 98.6° Repeat cycle: 24 days Ascending URL: www.space.gc.ca

4 Information regarding Landsat 7, TERRA and Radarsat-2 *See* Committee on Earth Observation Satellites (CEOS), Climate Change Special Edition 2008: The Earth Observation Handbook 97 (2008). Regarding Ikonos, the information was found on the GeoEye Web page, Imagery Sources, Ikonos http://www.geoeye.com (last visited 28 August 2008).

4.1.1 Mission statement

AQUARELSat Constellation. Because the sustainable use of freshwater and other natural resources of limited nature are fundamental to development, water and food security, the Latin-American countries need to improve the acquisition of accurate, continuous, constantly updated and timely data on their water resources towards their efficient and sustainable use. Likewise, this information could assist activities related to the prevention and relief of natural disasters.

In addition, and in accordance with the UN Millennium Declaration[5] the objectives that countries agreed on, including all Latin American countries, are the following:

1 to increase the percentage of their population with access to safe drinking water and sanitation services, and to work on the prevention of waterborne diseases [para. 19];
2 to develop water management strategies at regional, national and local levels [para. 23];
3 to integrate sustainable development into policies and programmes [para. 22];
4 to increase and improve nutrition in their countries and reduce the proportion of people who suffer from hunger [para. 19];
5 to adopt a new ethic of conservation and reduce biodiversity loss (e.g. proportion of land area covered by forest, proportion of water resources used, proportion of terrestrial and marine areas protected) [p. 23];
6 to intensify cooperation to reduce the number and effects of natural and man-made disasters. [para. 23].

In order to reach these objectives, satellite information is a crucial tool in improving water management and the use and protection of natural resources. In this context, it is necessary to use satellite technology to monitor, measure and model surface and groundwater sources and supplies; to collect and organize hydrological information in a long-term project; to introduce precision farming and environmental mapping; to monitor deforestation; to monitor natural disasters and man-made disasters.

4.1.2 Mission objectives

The primary objectives of AQUARELSat are:

- to detect, identify, and monitor inland surface water and groundwater supplies;
- to update national hydrography databases and work on a regional hydrography database;

5 UN Doc. A/RES/55/2 (2000).

- to develop national and regional digital elevation databases with the use of DEMs;
- to locate and map fractures and faults for groundwater evaluation and exploration;
- to map soil moisture, water consumption, water pollution and water stress.

The secondary objectives of AQUARELSat are:

- to monitor and update information regarding national natural resources;
- to monitor and prevent natural disasters;
- to demonstrate to the public that positive actions are underway: (1) to increase the percentage of the population with access to safe water; (2) to encourage water management through satellite data; (3) to implement sustainable development; (4) to work on water and food security;
- to demonstrate to the public that preventive action is adopted to control waterborne diseases through continued satellite monitoring for tele-epidemiology applications;
- to locate, explore and protect groundwater supplies;
- to demonstrate to the public that the national water authorities, Environmental, Health and Agricultural Ministries are well informed by satellite data regarding changes in water quality and quantity; soil conditions; forest cover; areas prone to natural disasters;
- to work towards water and food security in the region;
- to achieve an integrated assessment of water resources availability and use in Latin America;
- to provide necessary information to set up a multidisciplinary network in the region that works on water management with satellite data and ground based data;
- to achieve sustainable development in the region through informed decisions based on satellite data interpretation for water management;
- to contribute to improving the quality of life in the Latin-American population;
- to demonstrate to the region that it is feasible to develop joint space projects dealing with regional problems, such as water scarcity;
- to monitor transborder contamination of rivers;
- to demonstrate to the international community that positive actions are being taken to incorporate the Latin-American region in the space arena, as an emergent region in space activities;
- to participate actively in the international efforts of the Committee on Earth Observation Satellites (CEOS) towards a global coverage by Earth observation satellites;
- to monitor water sources and natural resources for other countries, being able to provide them with environmental mapping.

4.1.3 Mission requirements

Based on the Space Mission Analysis and Design (SMAD III)[6] table of requirements, I have identified the mission requirements of AQUARELSat as follows:

Table 6 – AQUARELSat mission requirements

Requirement	*AQUARELSat Contstellation*
Performance	*Azul*, surface information. ETM. LEO. Sun-synchronous. Model satellite Landsat 7 ETM. *Celeste*, groundwater information. OSA. LEO. Sun-synchronous. Model satellite IKONOS. *Turquesa*, soil moisture, hydrogeology information. MODIS. LEO. Sun-synchronous. Model satellite Terra. *Cian*, surface features, groundwater, soil moisture. SAR antenna. LEO. Sun-synchronous. Model satellite RADARSAT-2.
Coverage	The constellation is comprised of four small satellites. They will be located in the same sun-synchronous LEO orbit. All of them have a different swath width. They will be working in pairs, providing different information of the same sensed area at the same time. Azul with Turquesa Celeste with Cian
Responsiveness	Send registered mission data within 30 minutes to up to 20 users
Secondary mission	Environment: monitoring natural resources and contamination of water supplies. Agriculture: soil moisture. Health: tele-epidemiology. Civilian protection: natural disaster management with emphasis on floods and droughts.
OPERATIONAL	
Duration	Mission operational over seven years
Availability	Level of redundancy 95 %, two days maximum outage
Data distribution	Up to 15 national points of contact, 30 water monitoring offices. One Data Center with two ground stations for processing and interpreting satellite data (value-added services).
CONSTRAINTS	
Cost	Research and development, construction, launch and insurance costs
Schedule	Operating capability within four years. Three years for the construction of the satellites and a year for launching. Three years before launch identification and contracting for the launch facility.
Regulation/ Political issues	Space policy and laws in the region are far from an ideal scenario. Firstly, the legal framework for national coordination of space activities is needed in most of Latin-American countries and secondly, Latin-American countries have to agree on the legal aspects for regional cooperation in space activities.
Interfaces	Communications. Relay and interoperable through four principal ground stations.

6 W. Larson & J. Wertz (Eds.), Space Mission, Analysis and Design (SMAD III), 3rd Ed., 854 (2003).

4.1.4 Data flow

This section analyses the AQUARELSat data flow for effective and efficient delivery of satellite information: how do satellite data go from AQUARELSat Constellation to the national end-users.

The first aspect to consider is that the four small satellites have different sensors for detecting water: Azul, ETM; Celeste, OSA; Turquesa, MODIS; and Cian, SAR. The raw data obtained by these satellites is digitized and filtered. For these tasks we need to know where on the ground the sensor took the images, information coming from attitude and orbit parameters of each small satellite. Attitude and orbit will be determined on board. Once we know where the sensor was looking, the imaging information is transferred to a map of hydrologic regions to incorporate the results.

The ground stations for telemetry and control are continuously monitoring the correct performance in orbit by the AQUARELSat satellites. For this purpose, each of the four AQUARELSat Members would fund a ground station for telemetry and command of the satellite, receiving the satellite imagery and data directly from their respective satellite. In addition, the options for international cooperation should be explored to find support in monitoring AQUARELSat satellites in the rest of the world; for instance ESA in Germany could provide assistance concerning these functions. Other ground stations that the AQUARELSat constellation could consider are located in Sweden, Norway and India.

For processing and distribution of data at the national level, each AQUARELSat member should be able to count on national facilities and experts to receive and distribute satellite imagery and data among their governmental ministries. AQUARELSat members would be responsible at the national level for efficient distribution of information to their end-users, within their Ministries or official agencies, such as water authorities, and Environmental, Health and Agricultural Ministries. End-users also include national universities and research institutes.

AQUARELSat's central authority would coordinate the functions of the regional Data Centre, which will be in charge of processing of AQUARELSat data on the ground for regional and international users. In addition, at this Data Centre different groups of scientists from AQUARELSat members could be working or receiving training in the development of complex regional studies related to water management, soil moisture, agriculture, environment, tele-epidemiology and natural disasters.

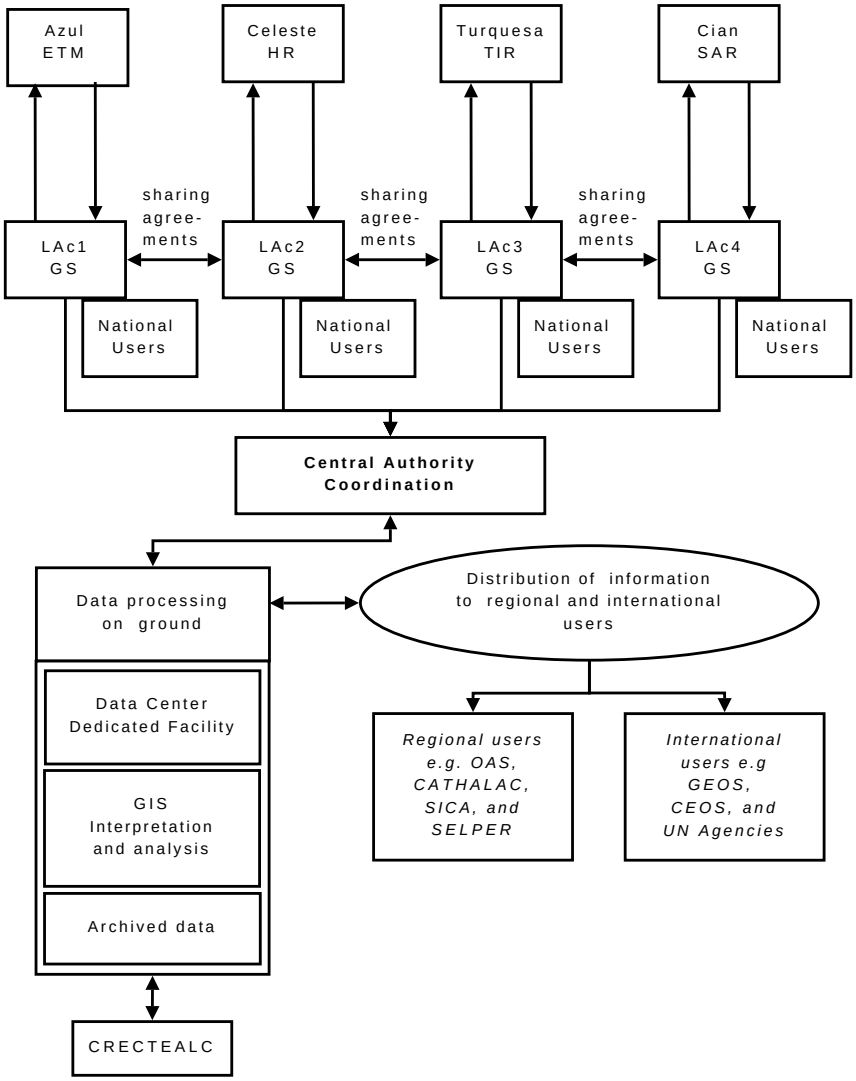
The principal activities of the Data Centre can be divided into two:

1 Geographic Information System (GIS), interpretation and analysis

The image analysis and interpretation is an important phase of the mission, because in this phase the concrete advantages of having satellite data are demonstrated. It is necessary to integrate a team of scientists, who can interpret

and find concrete applications of satellite data in the sustainable use of natural resources and in natural disasters management. The value of satellite data derives from their interpretation and subsequent applications for solving problems. For this purpose, GIS will be a useful tool. Finally, it is important to mention that value-added services and products provided by the Data Centre will be key elements for the future commercialization of satellite imagery of the AQUARELSat Constellation to international users.

Figure 1 – AQUARELSat mission operation from data-oriented perspective



LAc= Latin-American country. GS= Ground station, Tracking, Telemetry, Telecommand and Monitoring

2 Archived data
Satellite data will be classified and collected for record keeping and provide the necessary background to interpret future data. Moreover, this collection will include reports from water authorities, statistics and water management information in Latin American countries.

CRECTEALC will receive satellite information for training new students, although the students could also collaborate in specific projects with the Data Centre. Master students from CRECTEALC would have opportunity to apply their theoretical knowledge for data processing.

AQUARELSat's central authority would be established with the mandate of coordinating the activities of AQUARELSat Constellation and representing it in international fora.

Finally, international users can request information, value added services or products from the AQUARELSat Constellation through the AQUARELSat central authority in charge of handling information requests from the international community.

4.1.5 Mission utility evaluation

The evaluation of the mission's expected utility depends on the analysis of potential performance and costs; this information is crucial for decisions makers to support the space project. In order to assess mission utility we need to quantify how well the requirements and broad objectives are met as a function of cost and key system-design alternatives. This assessment requires participation from developers of the space mission, scientists and the end-users of the satellite system.

For instance, decision makers could justify the allocation of monies for the AQUARELSat Constellation based on the importance of the data supplied by the small satellites in performing the following activities: identifying percentages of contamination in water supplies detected within four hours; updating a synoptic view detected within twelve hours; reporting changes in land surface detected within eight hours; developing national hydrography databases and national elevation databases with input of satellite information detected within two hours, for a period of six months to complete both projects, then following up on changes in databases; and working on digital models to asses implementation of projects for sustainable use of natural resources.

4.1.6 Constraints

The initial mission design has to meet particular constraints related to cost, schedule and technology. A good strategy to face this situation is to invite end-users and developers to participate together in the decisions to trade off

between operational requirements and constraints, in order to find the best alternatives to achieve the space mission objectives. In this context, for instance the following issues could be considered:

4.1.6.1 Technology transfer

The USA is the space-faring power closest to Latin-America. Its space industry has a large number of companies working in the aerospace field and provides components and services related to high technology for developing space projects. Besides, the USA has national launch facilities, in other words, independent access to outer space.[7] The problem is the time and expertise required to deal with Export Laws and Regulations like the International Traffic in Arms Regulation (ITAR) to which the aerospace sector in the USA is subject.

Satellites are classified as 'dual use' technology. Remote sensing applications have undeniable important civilian, but also military applications. For that reason, space technology has been subject to export controls.

The ITAR has a detailed list of articles and services which are subject to prior approval by the Department of State. The United States Munitions List refers to space issues as follows:

> 'Category IV-Launch vehicles…
> […]
> Category XV-Spacecraft Systems and Associated Equipment Spacecraft, including communication satellites, remote sensing satellites, scientific satellites, research satellites, navigation satellites, experimental and multi-mission satellites.
> Ground control for telemetry, tracking and control of spacecraft or satellites […]'.[8]

In the case that AQUARELSat members would decide to contract with USA companies, it would be necessary to include ITAR regulations in the schedule and costs of the small satellites. Three of the four model satellites for AQUARELSat Constellation were built in USA and they are operated by USA actors: Landsat 7 operated by NASA and the U.S. Geological Survey; Terra operated by NASA; and Ikonos operated by GeoEye, Inc.

Nevertheless, there are other options in the space industry, for instance the United Kingdom, South Korea, Canada, Europe, China, Russia, Japan and India. Of course this will mean a trade-off in the mission requirements, but the important point here is to find other options that meet the mission statement and objectives of AQUARELSat. Furthermore, through international agreements with other countries AQUARELSat members can seek space cooperation

7 However, the ESA's launch facility in Kourou, French Guiana, is also located in the American continent representing a good and reliable option for contracting the launch.

8 Electronic Code of Federal Regulations. Subchapter M, International Traffic in Arms Regulations. Part 121. § 121.1. General. The United States Munitions List. http://www.gpoaccess.gov (last visited 25 July 2008).

for designing, building and operating such a satellite constellation. At the end, the decision has to be thoroughly analysed by the teams of engineers, scientists and lawyers familiar with space activities to find the best options in terms of costs, schedule and reliability.

4.1.6.2 *Availability and protection of frequencies for Earth exploration satellite services (EESS)*

At present, there are various satellite services as defined by the International Telecommunication Union (ITU). All of them are allocated specific frequency bands. Thus, there being a limited amount of frequency bands and many satellite operators, it has become necessary to allocate the same frequency band to be shared by more than one service. For instance, the 18.6-18.8 GHz band is shared by EESS and fixed-satellite service (FSS).

In Region 2,[9] EESS (passive) is subject to sharing the 18.6-18.8 GHz band on a primary basis with FSS space to Earth services. Therefore, in order to avoid harmful interference between EESS and FSS, Article S5 of the Radio Regulations requires Administrations 'to limit the power of fixed services transmitters and the power flux density (pfd) produced by FSS stations as far as possible in order to reduce the risk of interference to passive sensors'.[10]

The 18.6-18.8 GHz band is very important to the EESS, due to its characteristics designed to obtain environmental information of land and ocean surfaces. Regarding the sharing of this band, efforts have been made for the protection of EESS through a suitable pfd limit.

Harmful interference can come from man-made radio emissions, in this case at the beginning the noise can be confused with signals from natural emissions. The problem for remote sensing applications is that interference adds errors to the measured frequencies and wrong data is delivered, which affects the validity of information.[11]

On the other hand, active EESS (space-to-Earth) and FSS (Earth-to-Space) services share the 8025-8400 MHz band in Region 2 on an equal-primary basis.

Regarding the importance of frequency bands for remote sensing applications, there are two recent achievements towards their protection:

1 During the World Radio Communication Conference 2007 (WRC-07), a resolution was adopted on the use of radiocommunications for Earth observation applications, 'to maintain the existing bandwidth allocated

9 The ITU has divided the world in three geographic regions for the allocation of frequencies to services pursuant to Article S5 of the ITU-RR. The three regions are: Region 1 (R1) Africa, Arab nations, Europe, Russian Federation (including the part in Asia); Region 2 (R2) the Americas and; Region 3 (R3) Asia and Oceania.

10 *See* ITU, *supra* note 1, at 858.

11 V. Meens, *Space Science Issues*, 8 ITU NEWS Special Edition 32 (2007).

to Earth observations, thus preventing unintentional interference from other users of radio frequencies'.[12]

2 The Memorandum of Understanding to strengthen cooperation on remote sensing, signed by the Group on Earth Observations and the ITU.

This collaboration is a commitment to help in the protection of 'dedicated radio frequencies used by remote sensing and Earth-based monitors for gathering high-quality data on the environment'.[13] Another important area that will benefit from this Memorandum is capacity building in developing countries for the effective use of remote sensing data in decision-making, which is very important topic in consolidating awareness of decision makers on the applications of satellite data.

I consider that AQUARELSat Constellation as a regional project has the advantage of getting Latin-American countries involved in the same space project within Region 2. Hence, it will be easier to reach an agreement to use and protect the frequency bands allocated to EESS (active and passive), which are needed for AQUARELSat in accordance with its mission design. Besides, as a group, Latin-American countries can deal with international coordination of orbits and frequency bands in a more optimal way than individually, because the procedures to use orbits will be more efficient in time and costs.

4.1.6.3 The lack of national space policy and regulation

The lack of space policy and regulation in most Latin-American countries could result in lengthening the process for achieving a regional agreement on the operation of the AQUARELSat Constellation. Experience has shown that in bureaucratic systems without applicable regulations, any procedure can take more time than is expected, and this situation would be reflected in the schedule and costs of AQUARELSat.

For instance, the absence of a national entity in charge of coordinating the distribution of satellite information could result in decision-makers setting up barriers to use space applications effectively at national and regional levels. In contrast, a well defined national space policy and regulations can promote the efficient use of space applications for national and regional development, providing satellite information in a continuous and timely manner.

The review of national space policy and regulation is an important issue in the discussions to negotiate the rights and obligations of AQUARELSat members.

12 *Global Forum adopts initiatives to strengthen response in emergencies*, 1 ITU NEWS 15 (2008).
13 *Id.*

4.2 RATIONALE TO SELECT WATER MANAGEMENT

This section aims to describe in general terms the advantages of monitoring water and other natural resources, and the utility of satellite data in monitoring natural disasters.

AQUARELSat Constellation is to be developed as a sustainable satellite mission with a large user base; *i.e.*, AQUARELSat is designed to meet the requirements for supplying useful satellite data for water management to reach water and food security. In addition, AQUARELSat Constellation will be able to provide useful data for different applications related to monitoring other natural resources and natural disasters. For instance, soil moisture data can be utilized for studies of food security; or measurements of height in surface water for prevention and management of natural disasters.

One of the problems in the region is the lack of access to safe water for the whole population.[14] With the exception of Panama, there is no country in Latin America where one is able to drink safe tap water. Notwithstanding the progress in terms of coverage/percentage of access to safe water, there are people in Latin America without basic services. The current solution for access to drinking water is to buy bottled water, which is sold by private companies, since the government is not able to provide safe water. A considerable amount of fresh drinking water is located in Latin American territories. However, the region cannot offer the safe water to the entire population. Governments in Latin America need to find alternatives to improving the quality and quantity of safe water available.

The case study for suitable remote sensing applications centers on the problem of deficient satellite information for water management in Latin America to address the access to safe water and waterborne diseases in the context of human development. Three more issues are linked with water: (1) the production of food; (2) the protection of the environment, and; (3) the management of natural disasters. In order to solve these problems, regional cooperation and remote sensing applications could provide the necessary information for improving the sustainable management of water and other natural resources, and also the measures to mitigate natural disasters.

Satellite information is essential for decision makers. Nevertheless, in the case of water, the necessary information is not getting to water managers, 'critical data are not available and existing data are not effectively com-

14 According to the meeting of Ministers of Health of the Americas in 2007, the situation analysis and health trends in the Americas states that regarding water and sanitation coverage, 91% of the population in Latin America and the Caribbean have access to water in the household, and sanitation coverage is 77%. Deficits are more evident in rural areas. Pan-American Health Organization (PAHO), *Health Agenda for the Americas 2008-2017. Presented by the Ministers of Health of the Americas in Panama City, June 2007* http://www.paho.org/English/DD/PIN/Health_Agenda.pdf (accessed 23 November 2007).

municated to decision-makers'.[15] This is a common problem in Latin America, where governmental agencies and institutes do not have adequate data on water quality and quantity in surface and groundwater levels. Inadequate data supply affects the design and implementation of national programmes for water management. Moreover, simulation of hydrological models for water management[16] is also affected by deficient information because they are particularly based on very reliable data that have to be updated continuously.

Hubert George, an expert from the Food and Agriculture Organization (FAO), noted that some decision makers and national agencies are more aware about the benefits of remote sensing data and space applications. In George's own words the problem is that '[…] despite growing awareness, however, developing countries still lag considerably behind more technologically advanced nations in the local adoption and application of these technologies'.[17]

4.2.1 Regional overview

There are different scenarios for the situation concerning safe water in Latin America. The biggest underground source of freshwater is located in and shared by Argentina, Brazil, Paraguay and Uruguay, and is known as the Guarani Aquifer. Based on the existence of extensive water resources, it could be inferred that access to freshwater should not be a problem in Latin America.

Nevertheless, the availability of water in Latin America is variable. The region has three important water zones: the Gulf of Mexico; the south Brazilian Atlantic, and; the Paraná-Uruguay-La Plata Basins. However, many areas in South America, such as the Andes, the Brazilian northeast and the Caribbean have recurrent or chronic water shortages.[18]

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15 National Research Council, Sustainable Management of Groundwater in Mexico: Proceedings of a Workshop. Series: Strengthening Science-Based Decision Making in Developing Countries (2007). During this workshop participants were asked to identify the circumstances which represented the most significant barriers to effective groundwater management and the lack of information was pointed out among these barriers. *See also* the UNESCO water portal, which includes projects in Latin America selected for the initiative 'Help Basins'. Latin American countries such as Mexico, Peru, Panama, Brazil and Uruguay are listed in this initiative and the activities to improve water management includes work on hydrological data bases, georeferenced information systems and update inventories. http://portal.unesco.org/science/en/ (accessed 5 November 2007).

16 P. Bauer *et. al.*, Modeling concepts and Remote Sensing Methods for Sustainable Water Management of the Okavango Delta, Botswana, in *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences XXXIV, Part 6/W6* (2004).

17 H. George, *Developing countries and remote sensing: how intergovernmental factors impede progress*, 16 Space Policy 267 (2000).

18 UNEP, GEO Latin America and the Caribbean, Environment Outlook 2003 (2003).

Latin America also has arid and semi-arid areas,[19] totalling an equivalent of 5 million square kilometres, which is around 25% of the land mass. These areas are located in the north of Mexico, the north of Chile, the south of Peru, the Argentinean Patagonia and some areas in Brazil. Arid and semi-arid regions are frequently relying on groundwater supply. For that reason sustainable management and protection of groundwater play a crucial role in access to safe water in those regions.

Concerning groundwater, projects for water management are limited due to deficient information regarding groundwater in Latin America and the Caribbean. The availability levels and the amounts extracted annually need to be studied thoroughly.[20]

In addition to the lack of information regarding groundwater and surface water, there are three other problems for water management:[21]

1 old infrastructure with deficient maintenance and inefficient irrigation, the main cause of the waste of important quantities of water, and;
2 pollution of water resources;
3 the growing population in Latin America is an important concern in the availability of drinking water. Whilst the number of population is increasing, the quantity of water supply is decreasing.

In Latin America we can observe that water security for present and future generations is an area that requires the improvement of specific tasks. In this respect, satellite data can help in governmental and private activities towards water security. In particular satellite data is the required input for an efficient water management towards the sustainable management of water resources.

4.2.1.1 A regional problem to reach water management: deficient information

Governmental offices and decision makers face incomplete data for elaborating hydrological and geo-referenced maps and simulation models, and these data can be provided by satellites.

Efficient interpretation, analysis and use of satellite information require experts in national institutes and governmental offices, in order to take real advantage of satellite information.

In particular water management faces the problem of deficient information for elaborating reliable prediction models for long-term planning, where a set of complete information is required. For instance models used for prediction

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19 R. Meganck & E. Bello, *El papel de la OEA en el Manejo de Agua en las Americas*, 2 Agua Latinoamérica (Mayo/ Junio 2002) at: http://www.agualatinoamerica.com/NewsView.cfm?pkArticleID=40 (last visited 28 November 2007).

20 ECLAC, The Water Resources of Latin America and the Caribbean and their Utilization: A report on progress in the application of the Plan of Mar 15 (1984).

21 *See* Meganck *Id.*

of the aquifer life or over-exploitation need information such as the following:[22]

1 geological, hydrological, physical and chemical properties of the aquifers;
2 down rates of the aquifer and identification of critical water levels;
3 vulnerability to contamination;
4 appropriate rates of ground water withdrawal;
5 rates and impacts of growth on water resources;
6 location of active production wells and abandon wells;
7 human settlements and industries in the area.

Furthermore, some of the information necessary for long-term research programme for determining the hydrologic, physical, chemical and biological characteristic of aquifers include:[23]

1 changes in water quality and depth;
2 the degree of connectivity between various zones within aquifers and in the recharge zones. Mapping for this purpose can be performed by remote sensing satellites;
3 the extent and location of faults or other factors for optimizing well placement;
4 physical, chemical and biological characteristics of aquifers;
5 development of GIS's;
6 policies on water resource planning and the collection of data should anticipate the rates and impacts of population growth on water resources

During the workshop on ground water in Mexico City in 2007, the following barriers to effective water management were identified:[24]

1 the necessary information is not getting to water managers and existing data are not communicated to decision makers;
2 the need for data information on quantity and quality of water in real time and over long-term periods;
3 local managers cannot have a proactive and long-term approach without information on the rates of aquifer recharge and extraction;
4 the need for information on estimated of levels of contaminants;
5 the need to develop science-based strategies for managing and protecting water resources;

22 National Research Council. *Mexico City's Water Supply: Improving the Outlook for Sustainability* 79 (1995).

23 This was a specific recommendation of the group of Mexico City's Water Supply, the proposal is for the management of the Mexico City aquifer but it can be applied for regional purposes. *Id.* at 80.

24 *See* National Research Council, Sustainable Management of Ground Water in Mexico, *supra note* 15. During this workshop barriers in the analysis of groundwater management were identified. However, I consider these barriers are applicable to water resources in general. Lack of information is the most serious problem.

6 creation of a systematic, long-term data collection effort shall be a priority;
7 development of science-based water management plans for the region;
8 some countries already have data, but face a severe shortage of useful information or chronic under-use of this information in high-level decision-making;[25]
9 weak national information systems, which is a limitation to the better use of remote sensing data and information.

4.2.2 Remote sensing applications for monitoring water

This research is focused on remote sensing applications for monitoring water resources. It is my view that remote sensing has a crucial role to fulfil towards sustainable development, as well as in water and food security in the Latin-American region. Since remote sensing data constitute a technical element of this research, this section explains what remote sensing is and how remote sensing data are used for monitoring water and other natural resources.

The RS Principles define remote sensing in Principle I (a):

> '(a) The term 'remote sensing' means the sensing of the Earth's surface from space by making use of the properties of electromagnetic waves emitted, reflected or diffracted by the sensed objects, for the purpose of improving natural resources management, land use and the protection of the environment'[26]

One of the purposes of remote sensing is improving natural resources management and the protection of the environment; for example Earth observation data can locate easily natural resources, such as fresh water.[27]

For water management, hydrologists require remote sensing data when they work on the prediction of drainage of water and floods, run-off to rivers, the observation of erosion, or the role of water in vegetation,[28] or the measure of soil moisture to assess the freshwater budget of land.

Hydrologists obtain these data from remote sensing satellites, which have different techniques for collecting hydrologic information.[29] The techniques

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25 UNOOSA, Seminars of the United Nations Programme on Space Applications: Selected papers on space science education, remote sensing and small satellites, UN Doc. A/AC.105/650, at 28 (1997).
26 UN Doc. GA/RES/ 41/65.
27 Committee on Earth Observation Satellites (CEOS): Towards an Integrated Global Observing Strategy, CEOS Yearbook 2 (1997).
28 *Id*. at 48.
29 Hydrologic information is related to the scientific study of hydrology, the science of water. Hydrology may be divided in two branches: 1. surface hydrology focused on the science of water on the ground surface; and 2. subsurface hydrology also called geohydrology or hydrogeology. This is the science of water in pores and fractures of rocks beneath the ground surface. Furthermore, it studies the flow characteristics of underground water or

are related to the characteristics of the satellite sensors, which determine the water information and measurements coming from satellite images. For instance, remote sensing satellites can be designed to provide hydrologic information concentrating on surface or groundwater information in a long-term projection. The function of integrated water resources management (IWRM) is to integrate surface and groundwater information to design strategies and programmes for the sustainable use of water resources.

In this regard, the advantage to using space technology for IWRM is that remote sensing satellites provide synoptic, high-resolution measurements which are complemented by ground measurement networks and systems, and the integration of all these data result in objective inputs for taking decisions in water management.

Nevertheless, it is important to make clear that the production of remote sensing data by satellites is just the first step in a larger chain; the next step is to count on experts to convert satellite information into useful components for scientific applications, solve particular cases, and design national programmes for improving the sustainable use of natural resources.

4.2.2.1 Remote sensing for studying surface water

According to the Water Science Glossary of Terms compiled by the US Geological Survey (USGS), surface water is 'water that is on the Earth's surface, such as in a stream, river, lake, or reservoir'.[30]

Surface water is considered vital in the cycle for balancing global models of weather and climate. These models are affected by floodplains and wetlands due to their characteristics as areas of storage and evaporation providing diffusive flow hydraulics, which hampers measurement using in situ methods. It is in situations like this that remote sensing assists researchers.

Two remote sensing techniques can assist researchers for studying surface water flow and storage:[31]

1 *Radar images*

· Altimetry radar – the altimeter emits a radar wave that reflects on the surface returning to the satellite measuring surface height and surface roughness. This instrument provides information that can have applications in calculating the water level with decimetre scale measurements of water surface heights in lakes and rivers. The altimetry satellites that are currently

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the geological settings of underground water. *See* C.G. Morris (Ed.), The Academic Press Dictionary of Science and Technology 1062 (1992).

30 USGS, *Water Science Glossary of Terms*, http://ga.water.usgs.gov/edu/dictionary.html#G (last visited 01 March 2008).

31 D. Alsdorf & J. Famiglietti, *Global hydrology, remote sensing and geodesy* (Abstract 7895) EGS-AGU-EUG Joint Assembly in Nice, France, 6-11 April 2003.

in service in accordance with the ESA are the following Jason-1 and Jason-2; Envisat; ERS-2; and GFO.[32]

- Interferometric Synthetic Aperture Radar (INSAR). INSAR, in the words of expert Richards 'is a technique for using pairs of high resolution SAR images to generate high quality terrain elevation maps, called Digital Elevation Maps (DEMs)'.[33]

Meijerink indicates that INSAR takes phase differences between corresponding pixels in the SAR images with different positions but covering the same area.[34]

This technique is used to measure centimetre-scale changes in water heights across large areas with flooded vegetation. This information is useful to predict floodplain storage changes.

Satellites that use INSAR to generate DEMs are: ERS1&2, ENVISAT, and RADARSAT.

2 Gravity field images

The magnetic field measurements from satellites supply data about the geodynamic activity of Earth and some of this information can be used for hydrological applications. The gravity field measurements come from a variety of sensors and supporting systems (one or multiple accelerometers, navigation satellites, satellite to satellite tracking).

Regarding surface water, these measurements have applications such as the estimation of the mass and volume redistribution of freshwater for understanding the hydrological cycle.[35]

For instance, a current mission providing information regarding the gravitational field is the joint mission of NASA and the German Aerospace Centre (DLR). The mission is called the Gravity Recovery and Climate Experiment (GRACE-A/-B). It concerns twin satellites supplying detailed measurements of Earth's gravitational field to understand the gravity and Earth's natural systems. For example, GRACE provides useful information about the advent of monthly gravity anomaly maps, and assists hydrologists in measuring temporal variations in the Earth's total water on a global basis.

Since March 2009 ESA's mission Gravity Field and Steady-States Ocean Circulation Explorer (GOCE) is providing new insights into geodesy and applications to the water cycle, surveying and mapping.

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32 European Space Agency, Radar Altimetry Tutorial, http://earth.esa.int/brat/html/missions/current_en.html (last visited 12 November 2008).

33 M.A. Richards, A Beginners Guide to Interferometric SAR Concepts and Signal Processing 22 IEEE Aerospace and Electronics Systems Magazine 5 (2007).

34 A.M.J Meijerink, D., Bannert & O. Batelaan *et. al.*, Remote Sensing Applications to Groundwater 79 (2007).

35 CEOS, Earth Observation Handbook 2002: the World Summit on Sustainable Development 58 (2002).

4.2.2.2 Remote sensing for studying groundwater

The USGS Water Science Glossary of Terms defines groundwater: '(1)water that flows or seeps downward and saturates soil or rock, supplying springs and wells. […] (2) Water stored underground in rock crevices and in the pores of geologic materials that make up the Earth's crust'.[36]
The Berlin Rules on Water Resources Article 3 (11) defines groundwater as follows: 'means water beneath the surface of the ground located in a saturated zone and in direct contact with the ground or soil'.[37]

The study of ground water includes the study of secondary surface phenomena,[38] such as mapping of vegetation, geomorphological mapping, detection of natural risks like volcanoes and landslides, exploration of geothermal anomalies and the very important aspect of soil moisture.

Remote sensing technologies for groundwater research can provide three different sorts of images:

1 digital remote sensing images;
2 radar images;
3 thermal images.

Ad 1 – Digital remote sensing images
Multi-spectral images are particularly useful for studies of groundwater and soil moisture contents, which is a surface parameter in agriculture and hydrology. Imaging multi-spectral radiometers operate in a number of channels at microwave wavelengths,[39] is a convenient technique for any weather circumstance, due to the cloud penetration, an important characteristic being used in Latin America, because of the hurricane season every year.

These images assist researchers by informing them about vegetation indices, estimating net drafts of aquifers used for irrigation, estimates of pollution loadings, and vegetation-groundwater interactions.

Ad 2 – Radar images
According to Meijerink, satellites with active radar provide satellite images useful for groundwater studies with the interpretation of structures and geomorphology.[40] Radar images are a good means to obtaining information over the desert. Furthermore, radar images assist researchers with altimetry and interferometry information for the elaboration of DEMs and the identification of deformation in surface aquifers.

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36 *See* USGS *supra* note 30.
37 International Law Association Committee on Water Resources Law, Berlin Conference: Fourth Report 3 (2004).
38 ESA Land Applications Working Group, Remote Sensing for Advanced Land Applications, 43 (1987).
39 *See* CEOS (1997), *supra* note 27, at 24.
40 *See* Meijerink, *supra* note 34, at 18.

An active radar technique called SAR is most widely used. It works with a radar antenna that moves across the image scene transmitting a series of pulses which are processed together so as to obtain a long aperture with very high angular resolution along the direction of flight.[41]

The information on landscape topography comes primarily from multi-band optical imagers and SAR instruments. For instance, the stereo optical instruments and SARs capability of SPOT supply stereo images that are used to create DEMs.[42] In addition, SAR can detect particular geological features to locate underground water.

In addition, passive radar in satellites is used to measure soil moisture.

Ad 3 – Thermal images

Temperature differences in water are parameters that can be used to calculate the concentrated groundwater discharge in coastal waters, lakes and rivers, as well as the spatial patterns of evapo-transpiration.

IR Thermal detection provides information on increases in heat capacity and thermal conductivity,[43] which have consequences for soil moisture content. Soil moisture content is deduced from surface-moisture data from remote sensing together with proper modelling in the use of auxiliary data.

4.2.2.3 Hydrological modelling

Modelling is a tool to simulate possible impacts before making management decisions in the hydrological field, such as evaluation of water supply options and impact of sustainability.[44] The model simulates anthropogenic changes (water abstraction, damming, dredging). Fundamental information for this model is provided by topographic characteristics and variability and statistical properties.

Information is incorporated systematically for controlling parameters and their interactions within the framework of the hydrological model. Some models can be composed for two layers, first an upper layer for the surface flow in channels, rivers and swamps, and a second layer for the groundwater flow in the underlying aquifer. The topographic surface is the interface between these two layers.

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41 NASA, Soil Moisture: Report of a Workshop held in Tiburon, California, 25-27 January 1994, at 41 (1995).

42 *See* CEOS (1997), *supra* note 27, at 48.

43 *See* ESA Land Applications Working Group, *supra* note 38, at 81.

44 *See* Bauer, *supra* note 16, at 136-143.

4.3 INTERNATIONAL OVERVIEW

Safe water has been an important topic at many international meetings (see Appendix D). The results of these meetings materialize most of the time as declaration documents; however, so far there has not been a binding document addressing concrete obligations of States regarding safe water.[45]

There is not an international agreement on the right to water. However, there is consensus about the importance of safe water and its inherent role in reaching well-being, development and the right to health. Within the ethical sphere, safe water is related to human dignity, sustainable development, environmental justice, as well as inter-generational and collective responsibility.[46]

The commitment of the international community to safe water is stated in the UN Millennium Declaration, where Member States resolved 'to halve, by the year 2015, the proportion of people who are unable to reach or to afford safe drinking water'.[47]

In order to promote the effectiveness of the UN Millennium Declaration a road map was elaborated, comprising eight global goals and eighteen targets related to the eradication of poverty and hunger; the reduction of diseases, literacy and child mortality; and the implementation of sustainable development. This roadmap is called the Millennium Development Goals (MDGs). Goal number 7 is entitled 'ensure environmental sustainability', specified, among other things, in target 7c as: 'halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation'.[48]

The UN has already identified the trends for improving access to safe water which include the following aspects:[49]

1 sustainable development;
2 long-term projects considering economic rationality;
3 international cooperation;

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45 J. Scanlon and N. Nemes, Water as a human right? 33 (2004). (The authors consider that it would be useful to acknowledge the formal status of the access to drinking water as a human right, in order to 'increase the pressure to translate such a right into concrete national and international legal obligations and responsibilities').

46 L. Selborne, The Ethics of Freshwater Use: A survey, (1997). (UNESCO through its Commission on Ethics of Scientific Knowledge and Technology (COMEST) analysed the importance of drinking water in the Sub-Commission on the Ethics of Fresh Water. During the analysis of 'water, health and sanitation' the values and concepts that are involved with drinking water were identified.)

47 UN Doc. GA/RES/55/2 (2000). Section 19, para.1.

48 Millennium Development Goal Indicators: The Official United Nations site for the MDG Indicators http://mdgs.un.org/unsd/mdg/Host.aspx?Content=Indicators/OfficialList.htm (last visited 30 June 2009).

49 UN World Water Assessment Programme (WWAP), The 2nd UN World Water Development Report (WWDR2): 'Water, a shared responsibility' 11 (2006). The report outlines a set of conclusions and recommendations to guide future actions for sustainable use and management of freshwater.

4 prevention of diseases;
5 IWRM policies.

These five aspects for improving access to safe water are supported by remote sensing information.

In order to have an idea of the big picture of the problem, let us consider the statistics below:

- The Earth's total water reserves are approximately 1.39 billion cubic kilometres, 96.5% of which is in the global oceans. About 1.7% is in polar ice caps and glaciers, 1.7% is in groundwater, lakes, rivers, streams and soil. Finally, just 0.007% is available to people via rivers.[50] Water security is one of the greatest challenges for the 21st century.
- In 2006 the 2nd UN World Water Development Report (WWDR2) concluded that 'sanitation coverage in developing countries (49%) is only half of developed world (98%)'.[51] This situation is a source of health problems related to waterborne diseases.
- Concerning water-related diseases, the WWDR2 also found that it has been shown that '1.7 million deaths could also be avoided each year by providing access to safe drinking water, sanitation and hygiene'.[52]
- According to the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) over 1.1 billion people do not use safe water from improved sources, and a total of 2.6 billion people lack basic sanitation.
- In addition, the migration from rural to urban areas has been identified as one of the major challenges for governments because this situation requires extension of basic drinking water and sanitation services to peri-urban and slum areas to reach the poorest people.[53]
- Future world population is expected to increase 65% (3.7 billion) by 2050. Hence, additional food will be required to feed future generations and that will further put enormous pressure on freshwater resources. Global water assessments conclude that around 70% of the future world population will be dealing with water shortages and 16% will have insufficient water to grow their basic food requirements by 2050.[54]
- The statistics become even more interesting when we translate into money the required actions to improve access to safe water and sanitation services; how much will it cost to reach the target for safe water and sanitation? WHO experts performed an interesting study about cost estimates in this field. The study states that annual required spending for safe water (50.2%

50 *See* CEOS, Climate Change Special Edition 2008: The Earth Observation Handbook 48 (2008).
51 *See* WWPA, WWDR2, *supra* note 49, at 20.
52 *Id.* at 19.
53 WHO/UNICEF Joint Monitoring Programme, Meeting the Millennium Development Goals Drinking Water and Sanitation Target: the urban and rural challenge of the decade (2006) available at http://www.who.int/water_sanitation_health/monitoring/jmpfinal.pdf
54 *See* CEOS (2002) *supra* note 35, at 25.

> of target 7c) is higher than for sanitation (49.8% of that target). New coverage for rural areas requires a spending of 64% and maintaining the existing coverage in urban areas correspondingly requires 73%.[55]

It is necessary to spend annually around US$ 70 billion (EUR 48.2 billion) on safe water and sanitation. The cost for increasing coverage of hitherto unserved population is US$ 18 billion (EUR 12.4 billion) and the cost for maintaining existing coverage is US$ 52 billion (EUR 35.8 billion). It is curious to realize that the cost of maintaining existing coverage is more than double the amount required for increasing coverage.

A recent effort to highlight the importance of drinking water took place in Valencia, Spain, during the 20th edition of the King James I Prizes, where the jury comprised of 18 Nobel laureates endorsed a declaration supporting that 'drinking water' should be considered as a part of the common heritage of mankind.[56] In addition to this declaration, Mexican Nobel laureate Dr. Mario Molina called for the adoption of an international pact to involve all the continents in the commitment to safeguard drinking water.[57]

4.3.1 The Committee on Earth Observation Satellites and the study of water management (CEOS)

The Committee on Earth Observation Satellites (CEOS) was created in 1984, based on a recommendation by a Panel of Experts on Remote Sensing from Space during the Economic Summit of Industrialized Nations. The recommendations called for working towards the coordination of international civil space-borne Earth observation missions.[58]

International coordination of space related Earth observation activities is the main goal of CEOS, in accordance with the recommendations. In addition, CEOS has two other goals: cooperation for optimizing the benefits of space-borne Earth observation; and broader exchange of policy and technical information to encourage complementary and compatibility among Earth observation systems.[59]

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55 G. Hutton & J. Bartram, *Global costs of attaining the Millennium Development Goal for water supply and sanitation* 86 Bulletin of the World Health Organization 13-19 (2008).

56 EL PAIS.com, *18 Premios Nobel piden que el agua sea Patrimonio de la Humanidad* (2 June 2008) http://www.elpais.com (last visited 2 June 2008).

57 Milenio, *El agua dulce debería ser patrimonio de la humanidad: Mario Molina* (2 June 2008) http://www2.milenio.com/node/26587 (last visited 2 June 2008).

58 *See* CEOS (1997), *supra* note 27, at 5.

59 *See* G. Withee, D. B. Smith & M. B. Hales, *Progress in multilateral Earth Observation Cooperation: CEOS, IGOS and the ad hoc Group on Earth Observations*, 20 Space Policy 38 (February 2004).

CEOS' work is focused on global observation to understand the Earth System processes and to assess the impact of human activities on Earth. In this context, CEOS is the principal forum of Earth observation satellite programmes.

CEOS membership includes both CEOS members and CEOS associates. CEOS members are governmental organizations of national and international nature performing activities in civil space-borne Earth observations. In 2008, the number of members was 29.[60]Only two Latin-American countries are CEOS' members: Argentina's National Commission on Space Activities (CONAE)[61] and Brazil's National Institute for Space Research (INPE)). In fact in 2010, INPE is CEOS Chair. Furthermore, INPE is CEOS' Chair. Furthermore, INPE is co-chair in the CEOS Working Group on Education, Training and Capacity Building. The first CEOS remote sensing workshop in 2010 was scheduled to take place in March in Brazil on the topic of Geotechnologies for Natural Disasters.[62]

There are 20 CEOS associates: these include satellite coordination groups and scientific governmental bodies of an international nature which develop activities in support of CEOS's objectives. Within this category we can find the Economic and Social Commission for Asia and the Pacific (ESCAP). In a future scenario of Latin-American regional space cooperation, the ECLAC can find reason for participating in CEOS.

The involvement of CEOS in water management is clarified by developments at the World Summit on Sustainable Development (WSSD), held in Johannesburg, South Africa, from 26 August to 4 September 2002, which was an important event for the direction of CEOS activities. At this Summit, Earth observation satellites and related treaties, were acknowledged to be an important factor for reaching sustainable development.[63] Sustainable development for the use of natural resources is the trend that countries are trying to implement. In this connection, the importance of the long-term continuity of remote sensing systems for studying natural resources towards sustainable development strategies was outlined.

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60 *See* CEOS (2008) *supra* note 50, at 21. For instance, ESA, NASA, Canadian Space Agency (CSA), Indian Space Research Organization (ISRO).

61 Argentina's CONAE was 2006 CEOS Chair.

62 *See* CEOS, CEOS Newsletter 34, at 7-8 (February 2010).

63 *See* R.W. Flint, *The Sustainable Development of Water Resources* 127, Universities Council on Water Resources Water Resources Update 46(2004). Flint provides a definition of sustainable development of water resources: '[…] a multi-dimensional way of thinking about the connection or interdependencies among natural, social, and economic systems in the use of water'. From the environmental standpoint the natural capital includes surface / groundwater quantity and quality and land use conversion, which requires information that can be supplied by Earth observation satellites. The social capital embraces topics such as drinking water supply, quality of life, the regulatory framework and resource policies. The economic capital deals with resource ownership, true-cost pricing, and waste of water.

Two years later, in 2004 the CEOS WSSD follow-up programme was adopted.[64] In particular module 2 addressed the study of water resource management. This module was following the activities of ESA's TIGER project that was implementing recommendations of the WSSD for sustainable water resource management in Africa with the help of Earth observation information.

In November 2007 the CEOS plenary was held in Hawaii. The CEOS progress review 2007 & 2008 included the issue '8.2 Space Segment Targets for Water' in the agenda. The report by Chu Ishida from Japan noted that 'prospects for implementing water quantity and quality monitoring systems are not certain, though potential has been identified'.[65] The plan for 2008 includes support for possible new missions addressing water quantity and water quality.

At the regional level, Asia is a good example of regional cooperation to address water issues through Earth observation information. Asia is working on the implementation plan to achieve data integration and capacity building in its region within the Asian Water Cycle Initiative (AWCI).

4.3.2 The Group on Earth Observations (GEO) and its activities related to freshwater resources

The Group on Earth Observations (GEO) is an intergovernmental group created 'to promote comprehensive, coordinated, and sustained Earth observations'.[66] GEO was established in 2005 during the Third Earth Observation Summit (EOS) held in Brussels.

The principal project of GEO's consists in the Global Earth Observation System of Systems (GEOSS) a 10-Year Implementation Plan for the period 2005-2015. GEOSS is an important initiative for promoting international cooperation in Earth observation systems; sharing observations and products; interconnecting present and future Earth observation systems; supporting common standards and reducing costs. A particular feature of GEOSS is the taking into account the users' needs and the generation of integrated data sets.[67] GEOSS' role is

64 *Id.*, at 39.

65 Presentation during the Plenary in November 2007, Hawaii. Presentation titled 'First Annual Report on CEOS implementation of the GEOSS space segment in the Plenary.'

66 Prior to the Third EOS other summits contributed to the establishment of GEO: the World Summit on Sustainable Development in Johannesburg in 2002; the Group of Eight Summit in June 2003; the First EOS was held in Washington, DC on July 2003, and; Second EOS took place in Tokyo in 2004. E. Christian explains that GEO began in July 2003 as an ad hoc group at the First EOS in Washington. However, GEO was formally established during the Third EOS, where a resolution was adopted for its creation supported by 60 Governments and 40 international organizations. *See* E. Christian, *Planning for the Global Earth Observation System of Systems (GEOSS)* 21 Space Policy 105 (2005). *See generally* R. Ohlemacher, The Earth Observation Summit: Heralding a New Era for International Cooperation, 19 Space Policy 281 (2003).

67 *See* GEO, *The GEOSS*, Information Sheet 1, 1 April 2009.

to be a distribution 'system of systems', taking into account interoperability as an architectural principle to facilitate the integration of Earth observation systems.

The GEOSS Implementation Plan identifies nine 'Societal Benefit Areas' linked to different, but mutually interdependent groups of users and uses. Within these areas are included water, health, agriculture and disasters:

1 Improving water resource management through a better understanding of the water cycle. Water experts are defining the data and systems needed for improved water-cycle forecasting. The collaboration is conducted through GEO's 'Integration of In-Situ and Satellite Data for Water Cycle Monitoring' project. This project has in view to reach complete global measurements with standardized metadata. Besides, there are other initiatives related to information on precipitation, soil moisture, and groundwater.[68]
2 Understanding environmental factors that impact human health and well-being. In the health field key environmental information includes water pollutants, land-use change; food security and nutrition; and weather-related stresses and disease vectors.
3 Development of an Agricultural Monitoring System of Systems to integrate in-situ and space data from multiple fields to assist farmers and policy-makers for improving food production.
4 The use of Earth observation satellites to reduce the loss of life and property due to natural disasters, providing forecast, data on land, maps of infrastructure, seismographic data.

As of June 2009 GEO Members include 79 governments (plus the European Commission) and 56 Participating organizations, which are international, intergovernmental and regional organizations with a mandate in Earth observation.

GEO Members from the Latin-American region are Argentina, Brazil, Chile, Costa Rica, Honduras, Mexico, Panama, Paraguay and Peru. Bolivia has the status of Observer.

GEO Participating organizations from Latin-America are the Center for the Humid Tropics of Latin-American and the Caribbean (CATHALAC), and; the Central American Commission for the Environment and Development (SICA/CCAD).

68 GEO, *How GEOSS supports decision making in nine Societal Benefit Areas (SBAs)*, Information Sheet 2, 1 April 2009.

4.4 CONCLUSION

This Chapter explains the mission design of AQUARELSat and presents an overview of the practical justification for its primary objective, which is focused on water management. The general technical aspects of remote sensing applications in water management are explained in the practical justification.

AQUARELSat could provide Latin America with an opportunity to have an operational remote sensing system for water management. The areas in which AQUARELSat would have a positive impact are water and food security; environmental protection; sustainable development; natural disaster management; space technology; availability of updated satellite information and geo-referenced maps of the region; satellite data processing and distribution; space industry; space science and research; space law and policy, and; awareness of the importance of space activities among the people in Latin America.[69]

The advantages of developing AQUARELSat include, inter alia, the promotion of capacity building in different fields of expertise in space; the encouragement of the creation of a space sector and the establishment of national space facilities in the region. Furthermore, with AQUARELSat the region could gain experience in data distribution on a small-scale, and at the same time the regulatory and institutional issues will develop at national and regional level.

Due to the objectives of AQUARELSat, which are focused on monitoring water and other natural resources, as well as monitoring natural disasters; Latin America would have the opportunity to participate in GEOSS as a region, supporting global research of Earth processes. AQUARELSat is the starting point of the proposal that is developed in Chapter 6.

69 Awareness of importance of space activities was defined by Gaggero as follows: 'it means accepting that we live in the space age, in which science and technology have provoked a series of changes, developing countries are included, and they need to assume their role'. E. Gaggero, *Developing Countries and Space – From awareness to participation* 108 Space Policy 5 (1989).

5 Legal framework

> 'No nation is sufficient unto itself; there are plenty of examples to show that isolation means, eventually, stagnation'. Arthur Clarke, Voices from the Sky.

The main objective of this thesis is the legal implementation of Latin-American space cooperation. The analysis of the legal framework is fundamental to designing a suitable legal cooperation model.

Chapter 4 presented the space mission named AQUARELSat, as a concrete proposal for the construction and operation of the first Latin-American satellite constellation for water and food security. Chapter 5 presents the legal justification for AQUARELSat's primary objectives in water management. A deductive approach in this chapter addresses the legal background of international cooperation and remote sensing activities, and then deals with the right to water as a human right.

The legal implementation of regional space cooperation requires the study of the legal and institutional aspects of international cooperation. The most important legal reference for international cooperation is the Charter of the United Nations (UN Charter) that considers cooperation as a tool for maintaining world peace and security, and; improving the development of countries.

Since the beginning of the space era, the promotion of international cooperation has been fundamental to space activities carried out within the UN framework. The promotion of international cooperation in space activities has had positive results, from the difficult Cold War period[1] to the present projects on international space exploration or GEOSS.

Among these space activities, remote sensing applications have various possibilities for improving sustainable development and the well-being of the people. Remote sensing activities find their legal underpinning in the Principles Relating to Remote Sensing of the Earth from Outer Space (RS Principles),

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1 For instance some earlier examples of international cooperation related to remote sensing can be found in 1963 when the UN General Assembly noted that the USSR and the USA reached an agreement seeking cooperation in meteorology and magnetic field mapping. That same year the UN General Assembly endorsed the efforts towards the establishment of a World Weather Watch (WWW) under the auspices of the World Meteorological Organization (WMO). The new WWW planned to use satellite and conventional data. See UN Doc GA/RES/1963 (XVIII).

which include the guidelines for international cooperation in remote sensing activities. This chapter reviews the legal implications of the RS Principles and the development of the final document after lengthy discussions held in the two subcommittees of COPUOS. In this respect, Latin-American delegates actively participated in the elaboration of the RS Principles. However, at the national level remote sensing applications were not seriously considered in Latin America, with only a few exceptions such as Brazil and Argentina, countries which a few years later started to operate their national remote sensing satellites.

The last part of this chapter 5 focuses on the legal aspects of the right to water as a human right. This theme is introduced in this Chapter 5 due to the particular area that the AQUARELSat Constellation is focused on: water management. However, it must be remembered, as explained in Chapter 4 that AQUARELSat applications are not limited to water management. AQUARELSat is a sustainable space mission, which has also secondary objectives such as monitoring other natural resources and natural disasters. This analysis on legal aspects of adopting the right to water as a human right is an opportunity to link rights and duties of citizens, public authorities and private entities to remote sensing applications. Specifically, this part of the study answers the question of how the right of access to safe water could be fulfilled, protected and implemented with the help of space technologies.

5.1 INTERNATIONAL COOPERATION IN INTERNATIONAL LAW

After the Second World War the main role of the new international legal order was to prevent future wars. The UN Charter identified international peace and security as its main purposes. In this context, international cooperation was chosen as a means for maintaining and promoting peace and security,[2] because cooperation helps to improve economic and social conditions, and obviate armed conflicts.

The role of international cooperation for development attracted much attention within the UN during the 1960s and 1970s, when the number of new independent nations grew.[3] The former colonies were facing profound economic and social problems, such as poverty, lack of infrastructure for basic services and limited access to science and technology. Thus, in order to improve this situation, international cooperation for development was identi-

2 *See* UN Charter Preamble & art 1. The UN Charter was signed on 26 June 1945, and entered into force on 24 October 1945.

3 Former colonies of the United Kingdom, France and Portugal obtained their independence during this period. For example, among the African countries which obtained their independence in the 1960s-1970s are Algeria, Angola, Burkina Faso, Kenya, Madagascar, Malawi, Niger and Nigeria.

fied as a driving instrument to solve the problems of developing countries, which were calling for more efficient action from the UN system.

International cooperation for development assists Member States in the solution of their economic and social problems which in my opinion are summarized in two words: poverty and inequality. What is more, among the poverty characteristics there is frequently a lack of access to safe water[4] jeopardizing the right of people to reach well-being and indeed life itself.[5] At a national level, water conflicts threaten peace. This situation occurs also at regional and international levels: when there is lack of access to safe water from shared groundwater supplies, peace and security are at risk of ending in armed water conflicts.

International cooperation in economic, social, cultural, health, technological and other fields is coordinated within the UN system through the functions of the UN General Assembly, the Economic and Social Council (ECOSOC) and the specialized agencies.[6] In the case of international cooperation in the use and exploration of outer space COPUOS, a specialized committee is in charge of promoting international cooperation in space activities.[7]

In practice, problems can not always be avoided in the international arena. However, international cooperation supports development to prevent conflicts, and encourages peaceful settlement of disputes in order to maintain international peace and security.

5.1.1 Charter of the United Nations (UN Charter)

The UN Charter is one of the basic legal sources of international law. This document embraces the obligations of Member States, as well as the principles and rules for international relations, in order to maintain international peace and security, and promote well-being in all countries.

The analysis of the UN Charter in this subsection aims to identify the role of international cooperation within international relations and its influence on the development of international law.

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4 *See* C.A. Sullican & *et. al.*, *The Water Poverty Index: Development and application at the community scale*, 27 Natural Resources Forum 190 (2003). This document referred to the relation between the access to safe drinking water and the eradication of extreme poverty and hunger, water being the basis of all life: 'nobody can be lifted out of extreme poverty without adequate access to water'.

5 *See* The Universal Declaration on Human Rights 25 (1), and; the UN International Covenant on Civil and Political Rights art. 6 (1).

6 UN Charter art. 62 (1).

7 *See* UN Doc. GA/RES/1472 (XIV A).

1 The Preamble

The Preamble is a short introduction with guidelines for interpreting the UN Charter. It can be divided into three parts according to its three subtitles. The first part refers to the purposes of the UN, the second part identifies the means to reach the purposes, and the third part determines the institutional character of the UN Charter.

The first part listed four main purposes behind the adoption of the UN Charter and consequently the creation of the UN organization. There are two aims related to international cooperation: (1) to establish conditions under which respect for treaty obligations and other sources of international law can be maintained, and; (2) to promote social progress and better standards of life.

Concerning the UN aims, the first aim that was above is related to the intention of setting conditions that support the respect of international obligations. From the legal and political standpoint, conditions for the respect of international obligations involve international cooperation because it is through international cooperation and friendly relations that international law is supported, endorsed, respected and implemented.

The second aim of the UN as mentioned above invokes the promotion of social progress and better standards of living, areas in which the UN specialized agencies and developed countries can assist the developing countries in the improvement of quality of life of their population. For instance, the UN can coordinate technical or financial cooperation to increase the population's access to safe water and sanitation in developing countries.

The second part of the Preamble refers to the means for reaching the above mentioned aims: 'AND FOR THESE ENDS […] to employ international machinery for the promotion of the economic and social advancement of all peoples'.

Promotion of international cooperation falls under the responsibility of the UN General Assembly with the assistance of the ECOSOC,[8] the latter being the UN body in charge of coordinating the UN's efforts towards economic and social cooperation among Member States.

The third part of the Preamble affirms the institutional character of the adoption of the UN Charter as an international agreement.[9] The last paragraph states that 'Governments' agree with the UN Charter and the creation of the UN organization. This last paragraph acknowledges the institutional nature of the UN Charter.

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8 The creation of a UN body named the Economic and Social Council (ECOSOC) came from the Dumbarton Oaks proposals during the discussions on the structure of the organization. *See* UN Department of Public Information, Guide to the Charter of the United Nations 6 (1955).

9 *See generally*, R.St.J. Macdonald, *The United Nations Charter: Constitution or Contract?*, in R.St.J. Macdonald & D.M. Johnston (Eds.), The Structure and Process of International Law 889-911 (1983). There is much debate to clarify whether the international agreement named the UN Charter is a world constitution or a contract.

2 International cooperation and friendly relations within the purposes of the UN Charter: Article 1 (2) (3)

Article 1 (2) (3), establishes within the purposes of the UN: 'friendly relations' and 'international cooperation':[10]

> 'The Purposes of the United Nations are:
> […]
> 2. To develop friendly relations among nations based on respect for the principle of equal rights and self-determination of peoples, and to take other appropriate measures to strengthen universal peace;
> 3. To achieve international co-operation in solving international problems of an economic, social, cultural or humanitarian character […]'.

Regarding the relationship between friendly relations and international co-operation, the Czech expert Dr. Bystrickỳ concluded that friendly relations are not possible without co-operation because 'without co-operation, it is impossible to create either political, or material or cultural prerequisites for friendship'.[11] On the other hand, co-operation is certainly possible without friendly relations. For instance during the Cold War, even amidst the tension between the USSR and the USA, these countries participated in bilateral agreements of cooperation in different space projects, and their relationship at the time can hardly be described by the word 'friendly'.

3 International cooperation as a principle of the UN Charter: Article 2 (2)

Article 2 (2) embraces the UN Charter principles

> 'The Organization and its Members, in pursuit of the Purposes stated in Article 1, shall act in accordance with the following Principles.
> …
> 2. All Members, in order to ensure to all of them the rights and benefits resulting from membership, shall fulfill in good faith the obligations assumed by them in accordance with the present Charter.'

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10 Regarding the meaning of international cooperation in the Charter, Babović explained the importance to refer to the concept 'peaceful cooperation', which is the joint action or operation of two or more states in the interest of peace. In other words, he refers to 'peaceful cooperation' considering that cooperation in times of war also is feasible. B. Babović, *The Duty of States to Cooperate with One Another in Accordance with the Charter*, in M. Šahović (Ed.), The Principles of International Law Concerning Friendly Relations and Cooperation 288 (1972).

11 R. Bystrickỳ, *On the Principles of Obligatory Co-operation of States*, in the Legal Principles Governing Friendly Relations and Co-operation among States in the Spirit of the United Nations Charter: lectures delivered during the seminar organized by the World Federation of United Nations Associations, Smolenice Castle, Czechoslovakia, April 20-24, 1965, at 99 (1966).

Good faith in fulfilling international obligations is a necessary element in the development of friendly relations, and in the promotion and implementation of international cooperation.

4 Political cooperation by the UN General Assembly: Article 11(1)

International cooperation in the political field is addressed in Article 11 (1):

> 'Article 11
> The General Assembly may consider the general principles of co-operation in the maintenance of international peace and security, including the principles governing disarmament and the regulation of armaments, and may make recommendations with regard to such principles to the Members or to the Security Council or to both'.

In this text we can observe the acknowledgement of co-operation in the political field for maintaining peace.

Regarding disarmament, there are two UN bodies dealing with this issue:[12]

· *The Disarmament Commission*

This Commission was set up in 1978 in order to have in the UN a universal deliberative body on disarmament. The Commission meets annually in New York for three weeks, and its functions include formulating recommendations on disarmament.

· *The Conference on Disarmament*

In 1969 a negotiating body on disarmament was established under the name of Conference of the Committee on Disarmament. In 1984 it was renamed Conference on Disarmament.[13] It is a hybrid autonomous body, but close to the UN. For instance, the conference costs are included in the UN budget and the UN staff helps with the work related to the Conference. Further, the Conference submits reports to the UN and when new agreements or treaties are negotiated, they are forwarded to the UN General Assembly for adoption.

The Conference on Disarmament has sixty five members and it is the forum where negotiation of multilateral arms control and disarmament are discussed. The Conference meets annually at the *Palais des Nations* in Geneva to deal with the prevention of an arms race in outer space. Latin American countries that

12 K. Krause, *Overcoming the Stalemate: Disarmament Commission and the Conference on Disarmament*, in T.G. Weiss & S. Daws (Eds), The Oxford Handbook on The United Nations, 290-292 (2007).

13 *But c.f.* The Website of the UN Office at Geneva, which mentions that the Conference on Disarmament was 'established in 1979 as the single multilateral disarmament negotiating forum of the international community, following the first Special Session on Disarmament (SSOD I) of the UN General Assembly held in 1978'. UN Office at Geneva, http://www.unog.ch (last visited Feb. 6, 2009).

are members of the Conference are: Argentina, Brazil, Chile, Colombia, Cuba, Ecuador, Mexico, Peru and Venezuela.

5 General Assembly recommendations for promoting for promoting international cooperation: Article 13 (1.a & 1.b)

The functions of the General Assembly including making recommendations for promoting international cooperation are found in Article 13 (1.a) and (1.b). These are set forth as follows:

> '1. The General Assembly shall initiate and make recommendations for the purpose of:
> a. promoting international co-operation in the political field and encouraging the progressive development of international law and its codification;
> b. promoting international co-operation in the economic, social, cultural, educational, and health fields […]'.

Article 13 (1.a) encourages the progressive development of international law recognizing the dynamic nature of law. Some new topics addressed by international law following the adoption of the UN Charter include the exploration and utilization of outer space and the deep sea; sustainable development; scientific research in the Arctic; the prohibition of chemical weapons and the peaceful uses of nuclear sources.

The UN General Assembly is assisted in the progressive development of international law and its codification by special committees. 'The method of establishing special committees for the preparation of important legal texts and instruments has been resorted to by the Sixth Committee with increasing regularity'.[14] Article 13 (1.a) has justified the creation of special committees that have worked on different legal texts such as the special committee that was in charge of the 1970 Declaration on Principles of International Law Concerning Friendly Relations and Co-operation among States in accordance with the Charter of the United Nations (Declaration on Friendly Relations).

Another example of a special committee is COPUOS (see supra 2.1.1 UN Committee on the Peaceful Uses of Outer Space), the Legal Subcommittee of which has been working on legal aspects of space activities since the beginning of the space era. The Legal Subcommittee of COPUOS has created a body of space law and it continues to follow the progressive development of international space law within the UN. COPUOS reports are submitted to the Special Political and Decolonization Committee (Fourth Committee) as an agenda item called 'International cooperation in the peaceful uses of outer space', within the issues related to maintaining international peace and security.

14 C.A. Fleischhauer, *Article 13*, in B. Simma (Ed.), The Charter of the United Nations a Commentary, 34, 2nd ed., at 308 (2002).

The tasks of the UN General Assembly in encouraging progressive development of international law do not include legislative or regulatory powers.[15]

> 'The role of the UN General Assembly is limited to deliberation, drawing up of texts, adopting and recommending them for signature, ratification and accession. But it is the Member States, each acting on its own, that make decisions, according to their own political will and constitutional provisions'.[16]

Article 13 (1.b). As to the recommendations of the UN General Assembly concerning the promotion of international cooperation in different areas such as in the economic, social, cultural, educational, and health fields, among others, these recommendations are usually supported by studies undertaken by ECOSOC (Article 62 (1) of the UN Charter) and its subsidiary bodies, other UN specialized agencies and Member States.

Space cooperation is not mentioned in this article; however, it can be deduced that the founders of the UN did not intend to provide an exhaustive list of fields of cooperation; they just enumerated some of the fields. This interpretation is based on the acknowledgement of progressive development of international law by the UN Charter.

6 Economic and social cooperation: Article 55

Article 55 is part of Chapter IX, 'International Economic and Social Cooperation'. This article states that conditions of stability and well-being allow for peaceful and friendly relations, and for that reason the UN shall promote: 'a. higher standards of living,[17] full employment, and conditions of economic and social progress and development; b. solutions to international economic, social, health and related problems […]'. This article reaffirms the aim of international cooperation in the UN activities related to the Preamble, and Articles 1, 2 and 13 of the UN Charter.

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15 J. Fomerand & D. Dijkzeul, *Coordinating Economic and Social Affaire,* in Weiss & Daws *supra* note 12, at 564. In March 1945, the Latin-American countries and the USA met to discuss international cooperation after the war. The Latin-American countries emphasized that the development policies needed regulatory mechanisms at the national and international level to fulfill the socio-economic gaps. A crucial proposal of Latin-American countries was that the UN General Assembly be entitled to control the International Monetary Fund (IMF) and the World Bank. However, the USA did not agree to include legislative or regulatory powers in the UN. At present, this situation limits ECOSOC's functions in the field of development.

16 Fleischhauer, *supra* note 14, at 300.

17 'Higher standards of living' are related to quality of life. This relationship is important to keep in mind in the analysis of the legal aspects involved in the right to water as a human right, and its linkage to the UN Charter provisions. The lack of access to safe water deteriorates the quality of life and other rights, such as health.

Zemanek draws attention to the fact that socio-economic rights were formulated less imperatively.[18] The problem related to this sort of formulation is the broad diversity in its possible interpretations. This situation affects the strength of international cooperation in the socio-economic field.

Bystrickỳ considers that international law's main function became the prevention of disputes, and this preventive function is carried out through international cooperation.[19]

7 Other remarks: Articles 56, 57 and 58

Article 56 calls on all Members to commit themselves to taking joint or separate action in cooperation with the UN to promote development and the solution of international problems, in accordance with Article 55.

Two other Articles are related to the theme of cooperation. The first, Article 57, mentions specialized agencies in the economic, social, cultural, education, health and related fields. At present, cooperation for development is the most important goal of the UN, and this embraces the different fields that are mentioned in Articles 55 and 57. The second article, Article 58, establishes that the UN is in charge of coordinating policies and activities undertaken by its specialized agencies. As to coordination, Article 63 (2) is more specific in indicating that ECOSOC's functions include the coordination of activities which are carried out by specialized agencies. For coordination purposes ECOSOC can resort to consultations with and make recommendations to such agencies, or recommendations to the UN General Assembly and to the Members of the UN.

In the light of specialized agencies it can be observed that science and technology developments have led to the creation of new agencies in fields such as aviation, atomic energy, environment, etc. Nevertheless, there is no UN specialized agency for space activities.[20] There has not been consensus on the need to create a new specialized agency on the peaceful uses of outer space, the argument against the creation of such specialized agency being that COPUOS and UNOOSA's coordination of international cooperation in the peaceful uses of outer space have been working well.

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18 K. Zemanek, *15. The Basic Principles of UN Charter Law*, in R.St.J. Macdonald & D.M. Johnston (Eds.), Towards World Constitutionalism 404 (2005).

19 *See* R. Bystrickỳ, *supra* note 11, at 113.

20 *See* S. Gorove, *Studies in Space Law: its challenges and prospects* 32 (1977). The Soviet proposal UN Doc. A/3818 and Corr.1(1958) called for the establishment of a UN Agency for International Cooperation in the Study of Cosmic Space, but the proposal of the twenty-power-draft for the establishment of an *ad-hoc* committee was chosen. *See also* K. E. Vereshchetin, E. Vasilevskaya & E. Kameneckaja, Outer Space Politics and Law 99 (1987). The Soviet proposal dated 15 March 1958 suggested setting up a special body for international cooperation in space. The proposal for its integration as a subsidiary body of the UN General Assembly and the main areas of its activity were indicated by resolutions UN Doc. GA/RES/1472 (XIV) (1959), and UN Doc. GA/RES/1721 (XVI) (1961).

5.1.2 Declaration on Principles of International Law Concerning Friendly Relations and Co-operation among States in accordance with the Charter of the United Nations (Declaration on Friendly Relations)

The UN Charter set forth the purposes and principles of the UN in Articles 1 and 2. However, Member States had different interpretations of the general formulation of these articles in the UN Charter. Therefore, the UN General Assembly decided to study the UN Charter principles for the further elaboration of a declaration according to the task stated in Article 13 (1.a), to encourage the progressive development of international law and its codification. It was planned that the interpretation of the principles by the representatives of all regions could be given in an official document in the form of a declaration that Member States would have to observe in their international conduct.

The Declaration on Friendly Relations came into being in 1970 This declaration contributed to the progressive development of international law, providing an official interpretation of the principles identified in the UN Charter. In addition, there were other considerations leading to its formulation such as the following:

- Socio-economic and political changes, as well as scientific development by the beginning of the 1960s that brought about changes in the international scenario.
- The interests of new Member States of the UN, which were not included in the drafting of the San Francisco Declaration of 1945, had to be considered. The new Member States wanted to participate in the interpretation of the UN Charter and to contribute in the development of international law.
- An important practical objective was to secure more effective application of the principles.
- The twenty-fifth anniversary of the UN in 1970 coincided with the adoption of the Declaration on Friendly Relations by the UN General Assembly. This declaration was considered a landmark in international law and a proper way to celebrate the anniversary of the UN.

5.1.2.1 Historical review of the Declaration on Friendly Relations

On 12 December 1960, the Resolution entitled 'Future work in the field of the codification and progressive development of international law'[21] called for the reconsideration of the work programme of the Sixth Commission, taking into account the development in international law and its importance for promoting friendly relations and cooperation.

21 UN Doc RES/GA/1505 (XV) (1960).

One year later Resolution 1685, also entitled 'Future work in the field of codification and progressive development of international law' was adopted.[22] At paragraph 4 the UN General Assembly decided to include in the provisional agenda of the seventeenth session an item on 'Consideration of principles of international law concerning friendly relations and co-operation among States in accordance with the Charter of the United Nations'.[23]

In 1962, Resolution 1815 (XVII)[24] listed seven principles of the UN Charter: (a) refrain from the threat or use of force against any State; (b) peaceful settlement of disputes; (c) the duty of non-intervention in domestic jurisdictional issues; (d) the duty to co-operate with others; (e) equal rights and self-determination of peoples; (f) sovereign equality of States; (g) States shall fulfil in good faith the obligations assumed.

However, the study of only four principles was decided during the eighteenth session: (a) States shall refrain from threat or use of force; (b) States shall settle disputes by peaceful means; (c)the duty of non-intervention in issues of the domestic jurisdiction; (d) sovereign equality of States.

Resolution 1966, established the creation of a 'Special Committee on principles of international law concerning friendly relations and co-operation among States' (Special Committee).[25] The Special Committee was composed of Member States from all geographic regions. The Latin-American countries that were included in the Special Committee were Argentina, Guatemala, Mexico and Venezuela. In 1965, Resolution 2103 resolved that Chile would become member of the Special Committee. At the beginning, the Special Committee was composed of twenty-seven Members, but eventually the number grew to thirty-one. The Special Committee agreed to work by consensus.[26]

The objective of the Special Committee was the study and drafting of a report on the four principles previously mentioned. Later, the objective of the Special Committee became not just to draft the report, but to negotiate a multilateral document. Its work on the draft declaration was expected to provide legal certainty to the interpretation of the general principles of international law.

In the final part of Resolution 1966 the UN Secretary General was requested to co-operate with the Special Committee in providing services and facilities for its meetings.

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22 UN Doc RES/GA/1685 (XVI) (1961).

23 From the seventeenth to the twenty-fifth session of the General Assembly this item was included in the Agenda with the same title.

24 UN Doc. RES/GA/1815 (XVII) (1962).

25 UN Doc. GA/RES/1966 (XVIII) (1963).

26 *See* R. Rosenstock, *The Declaration of Principles of International Law Concerning Friendly Relations: A Survey*, 65. Am. J. Int'l L. 714 (1971).Rosenstock explains that purpose of this decision was to set forth a declaration to which all States could adhere, consequently the declaration could reach the status of authoritative statement of principles of the UN Charter.

Resolution 2181 requested the Special Committee to work on a draft declaration on the seven principles set forth in Resolution 1815 'which will constitute a landmark in the progressive development and codification of those principles'.

The Declaration on Friendly Relations was finally adopted in Resolution 2625[27] during the twenty-fifth anniversary session of the UN. The work performed by the Special Committee included six sessions between 1964 and 1970; on the final day of the 1970 session the Declaration on Friendly Relations was eventually concluded.[28] This Declaration is recognized as the legal framework of the basic principles of international law.

The Annex to Resolution 2625 contains the Declaration on Friendly Relations that includes seven principles of international law in accordance with the UN Charter.

Regarding outer space, the Preamble of the Declaration on Friendly Relations states:

> 'Recalling the established principle that outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means […]'.

The adoption of the non-sovereignty principle in outer space has avoided conflicts of sovereignty over the Moon and other celestial bodies. The reason for this paragraph in the Preamble is to reaffirm the importance of international cooperation in outer space and the applicability of the principles of international law in space law; this is noteworthy when taking into account the fact that space cooperation was not considered when the UN Charter was adopted.

In addition, the Preamble listed the seven principles that are later described with detail in paragraph 1 of the Declaration on Friendly Relations. With regard to this, expert Rosenstock mentions that the recital of each of the principles was a compromise between Latin-American Members to emphasise non-intervention and the views of most of the other members about the interrelation of the principles.[29] The preamble included also statements on sovereignty and self-determination, which were of concern in the decade of the 1960s.

In paragraph 1 the Declaration on Friendly Relations solemnly proclaims the following seven principles:

1 'States shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any States'. This principle exhorts States to comply in good faith with their

27 UN Doc. GA/RES/2625 (1970).
28 See Rosenstock, at 714.
29 *Id*. 717.

international obligations to respect international law and maintain international peace and security.

2 States shall settle their international disputes by peaceful means. This is the basic principle of political co-operation. The formulation of this principle mentions the means for peaceful settlement of international disputes: 'negotiation, inquiry, mediation, conciliation, arbitration, judicial settlement, resort to regional agencies or arrangements or other peaceful means of their choice'.

3 The duty of States not to intervene in matters within the domestic jurisdiction of any State, in accordance with the Charter. Armed intervention and other forms of interference in the political, economic and cultural elements of another State are a violation of international law.

This principle goes into detail when enumerating the activities that States shall refrain from to avoid intervention in other State's national issues: 'no State shall organize, assist, foment, finance, incite or tolerate subversive, terrorist or armed activities directed towards the violent overthrow of the regime of another State'.

4 The duty of States to co-operate with one another in accordance with the Charter. The duty of co-operation with other States should avoid discriminations due to different political, economic and social systems. International cooperation in the different fields maintains international peace and security, as well as, promotes international economic stability and the general welfare of States.

To this end:

- States shall co-operate with other States in maintaining international peace and security;
- States shall co-operate in the promotion of universal respect for human rights and fundamental freedoms;
- States shall conduct international relations in accordance with the principles of sovereign equality and non-intervention;
- States members have the duty to co-operate with the UN in accordance with the UN Charter.

The last paragraph of this principle mentions the different areas of cooperation: economic, social, cultural, science and technology for promoting economic growth and international cultural and educational progress. The last sentence emphasizes the promotion of economic growth in the world, with particular reference to the developing countries.

Concerning the principle of the duty to co-operate, Rosenstock draws our attention to the difficulties in formulating this principle when the Eastern European delegations supported the inclusion of 'some mandatory language on non-discrimination',[30] also raising other problems related to the relationship among States with different trade preferences. In order

30 *Id.*, at 730.

to be accepted by all the delegations, this principle was written in rather general language.

5 Equal rights and self-determination of peoples. States have the duty to promote the principle of equal rights and self-determination of peoples with the objective of promoting friendly relations and co-operation among States.

6 Sovereign equality of States. States have equal rights and duties under international law regardless of their differences.

7 States shall fulfil in good faith the obligations assumed by them in accordance with the Charter. The duty of States to fulfil in good faith their international obligations under international law is an important principle for the maintenance of peace and respect for the rights of others.

The last paragraph of this principle establishes a particular rule for the application of this principle: 'Where obligations arising under international agreements are in conflict with the obligations of Members of the United Nations under the Charter of the United Nations, the obligations under the Charter shall prevail'.

The General Part of the Declaration on Friendly Relations declares in para. 2 that the principles are interrelated. Therefore, the interpretation and application of any of these principles should consider the interrelations with the other principles included in this Declaration.

Furthermore, para. 3 of the Declaration on Friendly Relations stipulates that the principles of the UN Charter which were included in this Declaration constitute fundamental principles of international law. Therefore, States should be guided by these principles in their conduct and relations.

5.1.2.2 The duty of States to cooperate with one another in accordance with the Charter

Principle 4 in the Declaration on Friendly Relations refers to international cooperation as the duty of States to cooperate for maintaining international peace and security, and promote cooperation for the solution of economic and social problems.[31]

In order to understand the integration of Principle 4, I have selected three topics that were discussed within the Special Commission during the elaboration of the Declaration on Friendly Relations. These three topics allowed the

31 *See generally* Zemanek, supra note 18, at 426-429. In relation with the alleviation of economic and social problems, Zemanek identified another principle related to socio-economic development which is the principle of solidarity in socio-economic matters for reaching general welfare. This principle reflects in international law the moral value of common good, in other words the States' responsibility to the general global welfare. This principle represents, in my opinion, a mature stage of international cooperation.

review of different standpoints and the trade-off in the final document. The three topics are the following:

1 the legal nature of the principle of cooperation;
2 the international or universal application of the principles;
3 the fields of international cooperation.

Ad 1 – The legal nature of the principle of cooperation

The Declaration on Friendly Relations defines the principle of international cooperation in the following words: '(d) The duty of States to co-operate with one another in accordance with the Charter'.

Babović explains that the term 'duty' implies an objectively imposed obligation, and the reference of the Charter assists to clarify the meaning and model of application of international cooperation.[32]

The discussion on the term 'duty' was focused on the legal nature of international cooperation, whether the UN Charter refers to a moral or legal duty.

Non-Aligned countries supported the standpoint that international cooperation was a legal duty and not a moral obligation. In their opinion international co-operation was a legal obligation endorsed by the UN Charter and other resolutions where its meaning became to be legal obligation.

On the other hand, Western countries supported the opinion that international cooperation was a moral duty, because it had been adopted as a declaration in a general statement about the competences of the UN in the Charter. Consequently, international cooperation was in their opinion a moral duty in international behaviour.[33]

The principal arguments can be summarized is the following table:

Table 7 – Principal arguments to consider international cooperation a legal or moral obligation

Legal obligation	*Moral obligation*
Rule of general behaviour for all States	Moral duty in terms of international behaviour
International cooperation developed into a principle of customary law	The purpose of the Charter in Article 1 was not representing *per se* legal rules

Ad 2 – The international or universal application of the principles

Another controversial issue was to determine the universal or international character of the principle of international cooperation: to whom does this principle apply to the entire international community or only to UN Members?

During the discussion, the then Czechoslovakia and the Non-Aligned countries supported the universal value of the principle of international co-

32 *Id.* 279.
33 *Id.* 283.

operation as a universal duty.[34] Furthermore, it was pointed out that Article 55 of the UN Charter does not make a restriction in the application of the Charter to UN Members.

The Western countries considered that the duty to cooperate should be restricted in its application to member states of the UN. In addition, they explained that this restriction was not an obstacle for cooperation between UN Member States and non-UN States. In this connection, they referred to cases where members of specialized agencies were not members of the UN.[35]

The UN Charter in Article 2 (6) establishes that: 'the Organization shall ensure that states which are not Members of the United Nations act in accordance with these Principles so far as may be necessary for the maintenance of international peace and security'.

Article 2 (6) recognizes that states outside of the UN are not bound by the UN Charter despite their having to conduct themselves in accordance with international law. However, this same article mentions that in order to maintain international peace the UN shall encourage non-UN members to conduct themselves in accordance with the principles of the UN Charter, because international peace is fragile and requires the participation of all countries.[36]

The final text of the Declaration on Friendly Relations adopted the following wording for the principle of international cooperation in para. 1 (4.d): 'State Members of the United Nations have the duty to take joint and separate action in co-operation with the United Nations in accordance with the relevant provisions of the Charter'.

One interpretation of this para. 1 (4.d) is that action towards cooperation is an accepted duty of the UN Member States. However, there is room for a flexible approach in the last part, which refers to relevant provisions of the UN Charter with which international cooperation and law should be in accordance. This is an open door to turn to Article 55, where there is no restriction concerning non-UN Members. Thus, the direction of the last sentence of this paragraph is towards the universal application of the Declaration on Friendly Relations.

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34 *Id.* 292.

35 *Id.*

36 During the 1960s, when the discussion took place, this was a relevant issue but at present it is not, or at least far less so. In 1970, when the Declaration on Friendly Relations was adopted, the UN Member States numbered 127. As of 2009, the UN has 192 member states. The Holy See has UN permanent observer Status, and there are about ten States lacking general international recognition.

The principal arguments for the two viewpoints were the following:

Table 8 – Principal arguments to support the universal or international application of the Declaration on Friendly Relations

Universal	*International*
The principle of international cooperation applies to all States	The principle of international cooperation applies only to UN Members
Universal value and duty of all countries	It is a duty for UN Members
The purpose of the UN is to establish a general order embracing the international community as a whole	The duty of cooperation in accordance with the Charter is an obligation for the UN Member States

Ad 3 The fields of international cooperation

The last paragraph in the section regarding the duty of States to cooperate with one another in accordance with the UN Charter stipulates the following:

> 'States should co-operate in the economic, social and cultural fields as well as in the field of science and technology and for the promotion of international cultural and educational progress. States should co-operate in the promotion of economic growth throughout the world, especially that of the developing countries'.

This formulation indicates the different areas of cooperation and emphasizes the role of cooperation in the promotion of economic growth in developing countries.[37]

There are two crucial areas of cooperation in space activities, namely science and technology. During the debates in the Special Committee at its Sixth Committee, the importance of a global approach to make the benefits of science and technology available to all countries was mentioned.[38] Indeed, during the debates of the Special Committee, international cooperation in space activities was invoked as a successful example.

5.1.2.3 Legal implications of the Declaration on Friendly Relations

The analysis of the legal implications of the Declaration on Friendly Relations requires not just to study the Declaration as a whole, but also to identify individually the legal value of the principles *per se*.

The seven principles have to be studied individually to determine their degree of imperativeness which is found in the words selected in their draft-

37 The Declaration on Friendly Relations introduced the term of 'developing countries', whilst the UN Charter did not mention this term because the historical, economic and social situations were different and this concept was not current at the time.

38 V.S. Mani, Basic Principles of Modern International Law: A study of the United Nations Debates on the Principles of International Law Concerning Friendly Relations and Cooperation among States 193 (1993).

ing.[39] In this respect, Zemanek pointed out that the various degrees of imperativeness of the principles could provoke a hypothetical conflict among them, and there is no rule dealing with the interrelation of the principles, but this could be solved 'by establishing an authoritative hierarchy among the principles'.[40]

Zemanek[41] classifies the principles into three basic groups, taking into account their formulation:

1 Legal rule: A legal rule prescribes the required conduct; for instance, non-intervention and settlement of disputes by peaceful means;
2 Maxim: The principles included in the UN Charter that are 'self evident' due to the length of time they have been part of international law. Examples of maxims are: justice, good faith and sovereign equality. And I would include international cooperation in the maxims due to the long time that it has been part of international law under the UN Charter.
3 Endorsement of UN programmes: There are principles that endorse programmes of UN bodies or specialized agencies. The principle of international co-operation is one of the principles underpinning the UN programmes for the general welfare of States, which is a source of solidarity in socio-economic matters.

The practical approach to identify the legal value of the principles can be found in the opinion of the International Court of Justice (ICJ).

There has not been any case regarding the breach of the duty to cooperate with other States. Nevertheless, there is a case in which the Declaration on Friendly Relations was invoked by the ICJ. In the Case Concerning the Military and Paramilitary Activities in and Against Nicaragua,[42] the Merits established that the majority of the judges considered that the USA breached the following obligations under customary law:

1 not to intervene in the affairs of another State;
2 not use force against another State;
3 not to violate the sovereignty of another State.

These three principles are part of the Declaration on Friendly Relations.

In the Merits, section X, paragraphs 187 to 201 the Declaration on Friendly Relations is recognized as an *opinio juris*:

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39 *See generally* Zemanek, supra note 18, at 405. Zemanek explains the differences between principles and legal rules, and the differences among principles, to understand their normative value and legal implications.

40 *Id.* 407.

41 *Id.* 401-403.

42 Military and Paramilitary Activities in and Against Nicaragua (Nicaragua v. United States of America), 1986, I.C.J., Merits 165 (June 27).

> 'It considers that this *opinio juris* may be deduced from *inter alia*, the attitude of the Parties and of States towards certain General Assembly resolutions, and particularly resolutions 2625 (XXV) entitled 'Declaration on Principles of International Law concerning Friendly […]' Consent to such resolutions is one of the forms of expression of an *opinio juris* with regard to the principle of non-use of force, regarded as a principle of customary international law, independently of the provisions, especially those of an institutional kind, to which it is subject on the treaty law plane of the Charter'.

Thus in accordance with this quotation, the Declaration on Friendly Relations has been acknowledged by the ICJ as an expression of *opinion juris*, an element of customary international law, which is the source of international law according to article 38 of the Statute of the ICJ.

The issue of the legal value of UN resolutions is very complex, because in the UN Charter, the UN General Assembly is not given legislative attributions. Therefore, the UN resolutions were not included in the sources of law listed by Article 38 of the Statute of the ICJ. UN resolutions are generally considered political declarations or soft law. The alternative in the case of the Declaration on Friendly Relations is to add to the *opinio juris* the practice of the States, and by joining these two elements the Declaration is considered international customary law. The opinion that prevails among the experts is that the Declaration on Friendly Relations is international customary law.[43]

Finally, one weakness of the Declaration on Friendly Relations lies in its general formulation, allowing for broad interpretations by States. However, we have to consider the difficulties to reach consensus in the adoption of this Declaration during a period when the world was deeply divided by ideologies.

Despite the general wording, Rosenstock notes that:

> '[…] the generality of the language in the Declaration does not deprive this instrument of its significance as the most important single statement representing what the members of the United Nation agree to be the law of the Charter on these seven principles'.[44]

In brief, we should keep in mind that the UN Charter and the Declaration on Friendly Relations are the main legal sources of the principle of international cooperation. Both documents use a general formulation with a flexible approach.

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43 With respect to this Mani explains that 'the Court has held that the critical element in international law making is the evidence of the opinio juris' and the ICJ has decided, on the basis of intrinsic and extrinsic evidences, that the Declaration on Friendly Relations has passed this test and its formulations include principles of customary law and their operative rules. V.S. Mani, *The Friendly Relations Declaration and the International court of Justice, in A. Anghie and G. Sturgess (Eds.),* Legal Visions of the 21st Century: Essays in Honor of Judge Christopher Weeramantry 341 (1998).

44 Rosenstock, supra note 26, at 714.

This subsection was included in order to identify the legal aspects of international space cooperation. In this regard, the current legal framework for international cooperation could facilitate and promote the beginning of regional space cooperation among the Latin-American countries. International space cooperation could add to regional security and stability in the economic and social fields under a mechanism of South-South space cooperation.

5.1.3 International Cooperation and the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty)

The Outer Space Treaty[45] provides the legal framework and the legal basis for space activities, establishing the principles and concepts that have guided the progressive development of international space law. Treaties and declarations on outer space that followed the Outer Space Treaty have developed and clarified many of the principles included in the Outer Space Treaty. In this context, international cooperation is an essential principle in the regulation of space activities, a principle which has been developed in more detail in the Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries (Declaration on Space Benefits)[46] (see 5.1.4.3, infra). While the Outer Space Treaty is binding on the States that have ratified it, the Declaration on International Cooperation is a declaration of intent, with no legally binding force.

The principle of international cooperation is addressed in the following articles of the Outer Space Treaty:

Article I para. 1, indicates that the use of outer space shall be carried out for the benefit and in the interest of all countries, irrespective of their degree of development. (The Declaration on Space Benefits is based on this Article 1, para. I). In addition, Article 1, para. 3, deals with freedom of scientific investigation in outer space to promote international cooperation and understanding.

Article III indicates that States Parties to the Treaty shall carry out space activities, in accordance with international law, including the UN Charter, in the interest of promoting international cooperation.

Article V regulates the assistance to astronauts, which implies international cooperation to protect the life and health of astronauts.

Article IX reaffirms that activities in outer space shall be guided by the principle of cooperation, and addresses the importance of international cooperation in the protection of the outer space environment to avoid harmful contamination. Although this article is related to planetary protection and space

45 UN Doc. GA/RES/2222 (XXI), annex, entered into force 10 October 1967.
46 UN Doc. GA/RES/51/122.

exploration, it could also be related to avoiding harmful interference in satellite communications.

Article X, indicates that in order to promote international cooperation in the exploration and use of outer space, States shall consider the requests by other State Parties to observe the flight of space objects launched. The conditions for such observations are decided by agreement between the States concerned.

Article XI also aims to promote international cooperation, by States sharing information concerning their national space activities with the UN, the general public and the scientific community. The Secretary General of the UN is in charge of disseminating such information. This article is elaborated upon in the Convention on Registration of Objects Launched into Outer Space.[47] In this regard, international cooperation is important in keeping the information updated in the UNOOSA's Register of Space Objects. Information concerning the status of space objects launched to outer space helps deal with space debris and safe access to outer space, efficient use of space resources (*e.g.* radio frequencies and orbits),[48] and international responsibility and liability regarding the practice of on-orbit transfer ownership of satellites.[49]

In brief, the promotion of international cooperation in outer space activities is a crucial principle and concept of space law. The development of the technical and legal aspects of outer space has been made possible through international cooperation. In addition, international cooperation has helped maintain peace in outer space. Various articles of the Outer Space Treaty form the basis for international cooperation in space activities.

5.1.3.1 Latin-American position regarding the obligation to cooperate in space activities

The Latin-American experts in space law consider that international cooperation has an obligatory nature in space activities. This position was established during the Seminar on Teaching of International Law concerning Outer Space and Space Communications, held in Buenos Aires in 1972, where the participants agreed that since adoption of the Outer Space Treaty, international

47 UN Doc. Res. 3235 (XXIX), annex, entered into force 15 September 1976. The participation of States to maintain the information updated in the UN Register of space activities is also an important tool to deal with problems of international responsibility and liability of the 'launching State(s)'. *See* 1972 Convention on International Liability for Damage Caused by Space Objects UN Doc. GA/RES/3235 (XXIX), annex, entered into force on 1 September 1972.

48 *See* C. Jiménez Monroy, *The Case of Space Robotic Applications in the Evolution of International Space Law* (IAC-09.E8.6.9) Colloquium on the Law of Outer Space, International Astronautical Congress, Daejeon, South Korea (2009).

49 *See* A/RES/59/115. Resolution on the application of the concept of the 'launching State'. Para. 3 of this resolution addresses the practice of on-orbit transfer, recommending that States share this information on a voluntary basis.

cooperation is a legal obligation and a condition for the lawfulness of space activities.[50]

According to the Argentinean expert Dr. Ferrer, international cooperation in space activities is obligatory,[51] a real legal obligation that is considered a 'jus cogens' rule.[52]

Likewise, Dr. Cocca reaffirms that, in his opinion, international cooperation is mandatory under the provisions of the Outer Space Treaty and the other UN treaties on outer space. He states that '[…] a position that is shared by most Latin American countries -international cooperation amounts to a legal obligation which conditions the lawfulness of all space activities'.[53]

Dr. Gaggero from Uruguay and Dr. Williams from Argentina also support this thesis on the legal obligation of international space cooperation. Dr. Williams draws attention to the fact that this Argentinean thesis is accepted by an important number of the experts around the world.[54]

In this respect, Dr. Leister comments on that there are practical limits to the legal obligation of international cooperation:

> 'Even if international cooperation may be seen as a legal obligation, the political reality shows that one cannot separate legal issues from political, military, economic and technical factors. These factors converge in the national interests and it is difficult to imagine that space cooperation could be enforced without considering the national interests of the countries involved'.[55]

The observation of Dr. Leister is correct: international cooperation cannot be enforced, because the decision to participate in international cooperation is based on national interests, to which sovereignty issues are related. To date no case in the ICJ has invoked the breach of the obligation of international cooperation. International cooperation is more a moral duty than a legal duty in the practice, friendly relations and negotiation being the most effective tools to reach international space cooperation under the UN legal framework.

International space cooperation is result of bilateral or multilateral treaties, conventions or agreements on a mutually accepted basis. The consideration

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50 *See* S.C. Negro, Cooperación Espacial comunitaria: Regulación Jurídica Exploración y Explotación del Espacio 39 (1997).

51 *Id*., at 38.

52 *See* E.D. Gaggero, International Cooperation in Space: An Uruguayan Point of View at in Proceedings of the Twenty-Sixth Colloquium on the Law of Outer Space, October 10-15 1983, Budapest, Hungary.

53 A. Cocca, *El espacio ultraterrestre labor de las Naciones Unidas en la codificación del espacio*, in M.T. Infante & J. Irigoin (Eds.), Problemas Contemporáneos de la Actividad Aeronáutica y Espacial 146 (1977).

54 *See* Negro, *supra* note 50, at 40.

55 V. Leister, *Regional Space Agencies: A Mechanism to Maintain Outer Space for Peaceful Uses* in Proceedings of the Twenty-Eighth Colloquium on the Law of Outer Space, October 7-12 1985, Stockholm, Sweden 81(1985).

of international space cooperation as a legal duty is not useful without the particular measures for promoting and enhancing space cooperation. In other words, it is more important to work on the development and implementation of particular space projects, than to discuss if international space cooperation is a legal obligation.

5.1.4 From benefits of space to space benefits

The advancement of space technologies impacts not only the society and international relations, but also the development of international cooperation in space, bringing a broader scope and set of applications, new actors and modes to this sector. At the same time that the number of space technology applications has grown, developing countries have realized that space activities are not only for seeking national prestige, but tools to improve national development.

The UN Conferences on the Exploration and Peaceful Uses of Outer Space (UNISPACE) in 1968, 1982 and 1999 helped to spread the benefits of using data from Earth observation satellites for agriculture, water, land use, etc.; the benefits from telecommunication satellites for educational purposes, global communications and universal service coverage; and the benefits from meteorological satellites for natural disaster management, among others.

Developing countries realized what space technologies could do. Then the question was how interested countries could have access to space applications to improve their national development. Particularly, developing countries were interested in seeking mechanisms to share in more fair terms the benefits of space activities.

The perspective on the benefits of space applications was extended from national to global issues. In 1988, COPUOS started working on the issue of international cooperation and the benefits of space. By the end of 1996 the UN General Assembly was adopting the Declaration on Space Benefits submitted by COPUOS the same year. This Declaration helped to limit the ideological debate, ratified the commitment of Member States to promote and participate in space cooperation, and paved the way to encourage the vision of Earth-oriented space applications for development, as reflected in the Space Millennium Declaration.

5.1.4.1 The Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space: UNISPACE 82

UNISPACE 82 was held 9-21 August 1982 in Vienna, Austria. This Conference adopted a broad agenda to discuss social, economic and organizational aspects and not only science and technology issues. Regarding space cooperation, the discussion focused on the programmes of international cooperation and the

role of the UN. In this context, the organizational elements were discussed to find a way to share in more equitable terms the benefits of space.

The preparatory work of the conference included regional and international meetings and the drafting of background papers, national papers, and exhibitions.[56]In Latin America a regional seminar on the applicability of space science was held from 19 to 23 April, 1982 in Quito, Ecuador. During this seminar the Latin American delegates approved by consensus the establishment of a LASA. For this purpose it was decided that the ECLAC would undertake various feasibility studies on the establishment of the LASA.[57]

The recommendations of UNISPACE 82 included the promotion of space cooperation amongst developing countries, the introduction of space applications for the environment, agriculture, disaster management, and; the need of capacity building to create an independent technological base in developing countries.[58] Regional cooperation amongst developing countries counted on successful cases by the time UNISPACE 82 was held, such as regional cooperation in Africa and Asia, and the proposal for a Latin American Remote Sensing Council and LASA.[59]

UNISPACE 82 suggested regional and international cooperation for remote sensing satellite systems and the operation of regional data research centres, in order to have access to space technology in affordable terms and avoid duplication of national efforts.[60]

Regional cooperation in Latin America was addressed by the Chilean Delegation to UNISPACE 82, who 'obtained the inclusion of a new paragraph (para. 353) in the final Report of the Conference. Recommending the creation of a regional cooperation mechanism and requesting the UN to promote this initiative'.[61]

The outcome of UNISPACE 82 in the field of international cooperation included the establishment of the centres for space and technology education, as well as, the decision to strengthen the Programme on Space Applications (PSA) in charge of UNOOSA.

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56 *See* N. Jasentuliyana, *The Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82)*, 10 Journal of Space Law 189 (1982).

57 R. González, *Seminar on the Applicability of Space Science, April 19-23, 1982, Quito Ecuador*, in *Id.*, at 219.

58 *See* Y. Pal, *UNISPACE 82 and Beyond*, in *Id.*, at 184 (1982).

59 *Id.*

60 *See* Jasentuliyana, *supra* note 56, at 192.

61 *See* González, *supra* note 57.

5.1.4.2 Space benefits: a new item in the agenda of the Legal Subcommittee of COPUOS

After the adoption of the RS Principles,[62] developing countries presented in 1988 a new agenda item in the Legal Subcommittee of COPUOS

> 'Consideration of the Legal Aspects Related to the Application of the Principle that the Exploration and Utilization of Outer Space should be Carried Out for the Benefit in the Interest of all States Taking into Particular Account the Need of Developing Countries'[63]

The short name of this new item was 'the space benefits'. The first discussion on the agenda item on space benefits addressed issues of 'distributive justice of benefits from space applications and redistribution'.[64]

When the new agenda item on space benefits was introduced its mandate was not clear. Developing countries could not clarify what they were expecting from this new agenda item. Hence, in order to find a position regarding the new agenda item the developing countries were assisted by UNOOSA.

The strategy for clarifying the agenda item on space benefits made use of questionnaires, which were sent to COPUOS Members States from 1988 to 1991. The objective was to obtain more information in order to draft a position on the subject of space benefits. The questionnaires informed about national frameworks for space activities, and the assessment of existing treaties in space activities.[65] In 1992 the results of these questionnaires were presented by the Dr. Raimundo González,[66] who was the chairman of the Working Group on agenda item 5. However one year before, in 1991 the first working paper with the position of the developing countries[67] regarding the agenda item space benefits had already been submitted to the Legal Subcommittee of COPUOS.

This first working paper was named 'Principles Regarding International Cooperation in the Exploration and Utilization of Outer Space for Peaceful Purposes'.[68] Dr. Benkö explains that this document included a set of principles formulated with strong ideological language demanding a new international

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62 The RS Principles were adopted in 1986. UN Doc. GA/RES/41/65 (1986).

63 M. Benkö & K-U Schrogl, *The 1996 UN-Declaration on 'Space Benefits' Ending the North-South Debate on Space Cooperation* in Proceedings of the Thirty-Ninth Colloquium on the Law of Outer Space October 7-11, 1996, Beijing, China, 183 (1996).

64 *See* M. Benkö & K-U. Schrogl, *'Space Benefits'-towards a useful framework for international cooperation*, 11 (1) Space Policy 5 (1995).

65 *See*, Benkö *supra* note 63.

66 Dr. R. González is Chile's representative to COPUOS and promoter of the Latin-American Space Agency.

67 Nine countries endorsed this first working paper: Argentina, Brazil, Chile, Mexico, Nigeria, Pakistan, the Philippines, Uruguay and Venezuela.

68 UN Doc. A/AC.105/C.2/L.182 (1991).

economic order and suggesting a regime of forced cooperation with automatic transfer of financial and technological resources from North to South.[69]

Logically, this working paper did not help the debate because developed countries were not interested in discussing 'space benefits' in those terms. When developing countries noticed that the agenda item on space benefits was stuck, their next move was to re-write the working paper.

In 1993 a group of ten developing countries submitted a redrafted working paper.[70] On this occasion Brazil guided the drafting of the document, since it is a developing country with space capabilities, and so it became an ideal interlocutor for developing countries and space-faring nations. The redrafted working paper was named 'Principles Regarding International Cooperation in the Exploration and Utilization of Outer Space for Peaceful Purposes'.[71] Dr. Benkö draws our attention in the positive impact of this document, in which the sovereignty of States in deciding the modalities of cooperation was recognized.[72]

In 1994 the difficulties to reach an agreement were focused on two controversial subjects, one was the preferential treatment for developing countries, and the second was the sovereign right to decide the modes of cooperation.

In 1995 Germany and France submitted a working paper 'Declaration on international cooperation in the exploration and use of outer space for the benefit and in the interest of all States, taking into particular account the needs of developing countries'.[73] Their proposal consisted of three parts: 1. General elements of international cooperation, 2. Modes of cooperation, and 3. Areas of cooperation. Dr. Benkö has identified the key element of this proposal, as the acknowledgement that States are free to decide on all aspects of their cooperation to allocate resources efficiently.[74] However the main 'difference between this paper and the other working paper of a group of developing countries lies in the fact, that all cooperating partners are regarded as equal, thus negating preferential rights as well as discriminatory treatment'.[75]

Another working paper was presented by the group of developing countries, which was the second revision of the working paper called 'Principles regarding international cooperation in the exploration and utilization of outer space for peaceful purposes'.[76] However, there were no substantial changes.[77]

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69 *See* M. Benkö supra note 64, at 6. *See also* Benkö, *supra* note 63, at 184.

70 Argentina, Brazil, Chile, Colombia, Mexico, Nigeria, Pakistan, the Philipines, Uruguay and Venezuela.

71 UN Doc, A/AC.105/C.2/L.182/Rev.1 (1993).

72 *See* Benkö, *supra* note 64, at 5.

73 A/AC.105/C.2/L.197 (1995)

74 *See* M. Benkö & K-U Schrogl, *A New Approach for the Debate on 'Space Benefits' in the UNCOPUOS*, in Proceedings of the Thirty-Eight Colloquium on the Law of Outer Space, October 2-6, 1995 Oslo, Norway, 294 (1995).

75 *Id.*, at 295.

76 A/AC.105/C.2/L.182/Rev.1.

77 A/AC.105/C.2/L.182/Rev.2.

This document was submitted by the delegations of Brazil, Chile, Colombia, Egypt, Iraq, Mexico, Nigeria, Pakistan, Philippines, Uruguay and Venezuela.[78]

In 1996 both proposals, the one from developing countries and the French-German proposal, were merged to be discussed.[79] The discussion ranged from the intention to draft principles to the use of terms that did not contribute to clarifying the text. The negotiation of the document ended with the adoption of the Declaration on Space Benefits by UNCOPUOS, and months later, by the UN General Assembly during its session in December 1996.

The Declaration on Space Benefits contributes to the legal framework of space activities by providing an authoritative interpretation of Article 1 of the Outer Space Treaty, regarding the principle that the use of outer space shall be carried out for the benefit and in the interest of all countries. This measure would avoid future controversies on space cooperation, conflicts of distribution, or ideological debates regarding a new order for outer space.[80]

5.1.4.3 Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, taking into Particular Account the Needs of Developing Countries (Declaration on Space Benefits)

The Declaration on Space Benefits[81] is based on the UN Charter; the Outer Space Treaty; relevant resolutions regarding space activities, and; recommendations of UNISPACE-82.

The introduction to this Declaration mentions that there is a growing scope of space cooperation, and recognizes the need for strengthening international cooperation. Furthermore, it emphasizes the desire to facilitate the application of the principle that the use and exploration of outer space shall be carried out for the benefit of all countries and shall be the province of all mankind.

The Declaration on Space Benefits is comprised of eight paragraphs.

Para. 1 of the Declaration on Space Benefits refers to Article 1, para. 1 of the Outer Space Treaty; in which the exploration and use of outer space shall be carried out for the benefit and in the interest of all countries, irrespective of their degree of development.

Para. 2, indicates the freedom of States to determine the terms with which they decide to participate in international cooperation. Likewise, this paragraph indicates the conditions of space cooperation; they should be on 'equitable and mutually acceptable' terms. Furthermore, the contractual terms in 'international cooperative ventures should be fair and reasonable', and in accordance to the legitimate rights of the parties, for example, intellectual property rights.

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78 It is interesting to note that on this occasion the proposal was submitted not only by Latin-American countries, but also by countries in Africa and Asia.

79 *See* Benko, supra note 63, at 184.

80 *See generally*, *Id.*, at 185.

81 UN Doc. GA/RES/51/122 (1996).

Para. 3, indicates that States with space capabilities should promote and foster international cooperation on 'equitable and, mutually acceptable' terms. Special attention should be made in this regard to the benefit of developing countries and countries with incipient space programmes.

Para. 4, identifies the following modes of international cooperation: governmental and non-governmental; commercial and non-commercial; global, multilateral, regional or bilateral, and; cooperation among all countries. In this paragraph it is interesting to note that the modes of cooperation include regional cooperation.

Para. 5, lists the goals of space cooperation: promoting the development of science and applications; fostering space capabilities; facilitating the exchange of expertise and technology among States on mutually acceptable basis.

Para. 6, introduces the aspect of individual responsibility to use space for their development goals. This paragraph addresses the issues of international law, including national and international agencies and organizations, research institutions, developed and developing countries.

Para. 7, calls for strengthening the role of COPUOS as a forum to exchange information on space activities in the field of international cooperation.

Para. 8, makes reference to the PSA, in order to advise that all Member States should contribute to this programme according to their space capabilities.

The Declaration on Space Benefits maintains the stereotype of opposite actors in space activities: developed countries with relevant space capabilities versus developing countries with particular needs. The Declaration did not include the new paradigm of space actors: developing countries with space capabilities, for example, Brazil and India, which by that time were outstanding examples in this category.

Considering that the Declaration on Space Benefits started as a new agenda item at the initiative of the Latin-American countries in COPUOS, this Declaration should have been a mechanism to encourage the implementation of regional space cooperation. However, we can observe that declarations are hollow words without the will of countries to move forward in the area of regional space cooperation.

One positive aspect of the Declaration on space Benefits is that it provides clear rules on how space cooperation should be conducted in order to facilitate the access to the use of outer space by more countries. Nevertheless, countries decide whether to take advantage of space cooperation or not, of participating in space cooperation projects.

It is submitted that the Declaration should have made more emphasis on the cooperation among developing countries within regional cooperation. However, Dr. Benkö has explained to me an interesting reason for mentioning regional cooperation in general terms. Dr. Benkö pointed out that all regions are different, with different needs, interests and problems. There was no point

in formulating in detail the issue of regional cooperation in the Declaration on Space Benefits, because the terms of regional cooperation has to be decided by the participating countries.

5.1.4.4 The Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space: UNISPACE III

UNISPACE III took place from 19 to 30 July, 1999, in Vienna, Austria. The theme of the Conference 'Space benefits for humanity in the twenty-first Century' coincided with the last Declaration on Space Benefits adopted by COPUOS in 1997. Dr. Benkö correctly anticipated the impact that the Declaration on Space Benefits could have in UNISPACE III: the adoption of this declaration focusing on international cooperation were a significant part of the discussions. The Declaration on Space Benefits was reaffirmed as a guiding document to promote bilateral, regional and international cooperation in the field of outer space, and the basis for further improvement in space technology exchange.

The outcome of UNISPACE III is summarized in the document called the Space Millennium: Vienna Declaration on Space and Human Development[82] (Space Millennium Declaration). The Space Millennium Declaration is the reference document for conducting the activities of UNOOSA and Members States of COPUOS. This document highlighted the importance of space cooperation and capacity building, and the need of funding mechanisms to reach those goals.

The Latin-American recommendations, based on the regional preparatory conferences for UNISPACE III, included concrete actions towards regional space cooperation, such as the identification of national focal points to exchange information and to encourage regional and interregional coordination in education.[83]

The summary of the general exchange of views in the Report of UNISPACE III mentions the importance of developing space projects in concrete terms: in para. 456, 'the view was expressed that cooperative activities should not be limited to capacity-building in space technology applications alone, but should be extended to programmatic development of satellite missions and application programmes'.[84]

The general view was that regional cooperation should be strengthened and for that purpose regional organizations and intergovernmental bodies of the UN could help in the promotion of regional space activities. There was

82 The Space Millennium: Vienna Declaration on Space and Human Development A/CONF. 184/6.

83 *See Id.* Annex Recommendations of regional preparatory conferences for the Third United Nations Conferences on the Exploration and Peaceful Uses of Outer Space, para. 28 (e).

84 A/CONF.184/6, para. 456

an agreement to conduct regional space programmes in science, disaster management, environmental monitoring, education and training. Finally, the discussion on regional cooperation mentioned the potential for South-South cooperation within the PSA to develop cooperative satellite projects.[85]

5.2 REMOTE SENSING REGULATION

The legal principles that govern remote sensing activities are based on international law, the UN Charter,[86] the Outer Space Treaty and other UN treaties in outer space. In particular, the following concepts were developed in connection with remote sensing: international cooperation,[87] the use of remote sensing applications for the benefit of all countries, associating remote sensing applications with issues of global interest, *e.g.* protection of the environment, natural disasters, etc.[88] Likewise, the obligation to inform the UN Secretary General about national remote sensing activities.[89]

From the technological and legal point of view, remote sensing was a new topic on which the two subcommittees of COPUOS worked to elaborate the first international legal document. The drafting of the RS Principles took more than 15 years of discussions and trade-offs among the Member States of COPUOS, until consensus was reached on the final document in 1986. The result was the adoption of the RS Principles adopted on 3 December 1986.[90]

5.2.1 Historical review of the debate on the legal aspects of remote sensing

Remote sensing started to call for attention with the UN General Assembly resolution 2600 (XXIV) adopted on 16 December 1969. This resolution expressed the desire that Earth resources survey satellite programmes would be available to produce information for all countries. In addition, the UN General Assembly invited Member States to share their experience and information on remote sensing, and; to continue the studies on international cooperation in remote sensing to benefit all countries.

In 1970, the first proposal by Argentina sought an international agreement on remote sensing activities.[91] The Argentinean proposal was entitled 'Draft International Agreement on Activities Carried Out Through Remote Sensing Satellite Surveys of Earth Resources'. The themes included in this draft were

85 *Id.* para 457.
86 Outer Space Treaty, Article III.
87 Outer Space Treaty: Articles I, III, IX, X, XI and XII.
88 Outer Space Treaty, Article I.
89 Outer Space Treaty, Article XI.
90 UN Doc. GA/RES/41/65 (1986).
91 UN Doc. A/AC.105/C.2/L.73 (1970).

those related to international cooperation and the benefits for all mankind. Besides, this document suggested a major role of the UN in remote sensing, in order to have a 'data storage and dissemination centre'.

In May 1974, the French delegation presented a proposal[92] in the Legal Subcommittee called 'Draft Principles Governing the Activities of States in the Field of Remote Sensing of Earth Resources by Means of Space Technology'.[93]

In May 1974, France and the USSR presented a new proposal. The joint proposal kept the same title as the first French proposal submitted days earlier, 'Draft Principles Governing the Activities of States in the Remote Sensing of Earth Resources by Means of Space Technology'.[94]

The Franco-Soviet draft agreed with the right to sense within the freedom of use of outer space. However, at the same time that the Franco-Soviet draft referred to freedom, it also reaffirmed the sovereignty of States over their natural resources and the inalienable right to dispose of information concerning those resources.

Regarding access to satellite data, this draft proposed that all states should be entitled on 'equal and mutually acceptable terms' to obtain remote sensing data of their territory. Nevertheless, the Franco-Soviet draft did not agree with unlimited free dissemination of data. In its view, the dissemination of satellite data should follow certain conditions, for instance the express consent by sensed states before satellite data related to their territory could be disseminated to third parties.[95]

In the same year, on 15 October 1974, Argentina and Brazil supported by Chile, Mexico and Venezuela presented the draft called 'the Treaty on Remote Sensing of Natural Resources by means of Space Technology'.[96] This proposal emphasized the rights of sovereignty over natural resources of sensed states, meaning that the sensed states have the right to dispose of their natural resources and of information regarding those resources.

Furthermore, this document supported the idea of prior consent from sensed states at the beginning of the collection of data. And in line with this thought, Article VI of the Latin-American proposal mentioned how to protect the right to prior consent, which in technical terms is very difficult. This Article VI suggested that countries could take measures authorized by international law to protect their territory and maritime areas from remote sensing activities.

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92 UN Doc. A/AC.105/L.69 (1974).

93 E. Pépin, *French Proposals with Respect to Remote Sensing of Earth Resources by Satellite*, in N. Mateesco Matte & H. DeSaussure (Eds.), Legal Implications of Remote Sensing from Outer Space 85 (1976).

94 UN Doc. A/AC.105/C.2/L.99 (1974).

95 *See* also G.P. Zhukov, *Problems of the Legal Regulation of Using Information Concerning Remote Sensing of the Earth from space*, in *supra* note 93. *See* Pépin, *supra* note 93.

96 UN Doc. A/C.1/1047 (1974).

As to access to information, the Latin-American draft considered that sensed states should have the right to control access to the information over their natural resources and also the dissemination of such data.[97]

In addition, the Latin-American proposal drew attention to the importance of the participation of sensed states in remote sensing activities, which could require technical assistance from sensing states and agreements for technological transfer.

Professor Cocca summarized the position of Latin-American Members of COPUOS to this proposal. In Cocca's own words:

> 'It is the view of Latin American countries that, sovereignty and international cooperation plus and appropriate participation, shall allow a remote sensing activity for the benefit of all and to the detriment of nobody'.[98]

In 1975, the USA submitted a proposal in the form of a working paper entitled 'The Development of Additional Guidelines for Remote Sensing of the Natural Environment of the Earth from Outer Space'.[99]This document did not agree with restrictions to the right to sense, and it supported the practice of open dissemination of data. The justification against restricting remote sensing activities was that these activities were working well in practice without restrictions such as the prior consent of sensed states or of data dissemination. Besides, it was mentioned that those restrictions could generate problems for regional and international cooperation.

In 1982, the Group of 77 (G-77)[100] submitted a position paper, supporting sovereign rights of sensed states.[101] Basically, the G-77 suggested that sensed states should have 'timely and unhindered access on a priority basis at nominal cost, to all data and information over their territories'. And the dissemination of such data to a third party should require the prior consent of the sensed country.

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97 S. Gorove, *Legal and Economic Implications of Remote Sensing From Outer Space- Focus on Latin America*, in *supra* note 93, at 83.The Franco-Soviet draft and the Latin American draft had common elements such as the support to the right to prohibit the dissemination to third parties of data regarding the natural resources of sensed states.

98 A.A. Cocca, *Remote Sensing of Natural Resources by Means of Space Technology: a Latin American Point of View*, *supra* note 93, at 68.

99 UN Doc. A/AC.105/C.2/L.103 (1975).

100 The Group of 77 at the United Nations was created in 1964 with the Joint Declaration of the Seventy-Seven Countries. During the 1970s, the members of COPUOS from Latin America that were members of the G-77 included Argentina, Brazil, Chile and Mexico. Venezuela joined to COPUOS in 1973 and Colombia in 1977. At present, the G-77 has 130 members. Latin-American Member States are: Argentina, Brazil, Bolivia, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua, Paraguay, Panama, Peru, Uruguay, Venezuela (Bolivarian Republic of). Group of 77 at the United Nations, Sep. 17, 2008, http://www.g77.org/ . (Last visited Feb. 12, 2009).

101 UN Doc. A/CONF.1011/L3 (1982).

A new French proposal was submitted in 1984, which included issues supported by developed and developing countries. The text was analyzed and the result from the discussions and informal consultations was reflected in the proposal submitted to the Legal Subcommittee in 1985 by Austria.[102]

In 1985, the Austrian delegation drafted a proposal called 'the compromise text of '85', which included the viewpoints of both sensing and sensed states. The delegations in COPUOS reviewed the document, but it was not accepted that year, because Vietnam, Mexico and a few other countries asked for more time to study the text.[103]

At the meeting of COPUOS in 1986, 'the compromise text of '85' was discussed and there were no objections by the State Members. Therefore by 1986 consensus had been reached on the RS Principles.[104] Subsequently, during the next UN General Assembly on 3 December 1986, the RS Principles were adopted in resolution 41/65.

5.2.1.1 *Themes on remote sensing activities discussed during the drafting of the RS Principles*

For more than 15 years countries were involved in the debate on remote sensing activities at COPUOS. Various issues were controversial in the debate. However, for the purpose of this research three main questions will be analyzed:

1 international cooperation in remote sensing activities;
2 prior consent to sense and to distribute data to third parties;
3 access to data.

Ad 1 – International cooperation in remote sensing activities
International cooperation has been the main driver in the regulation of space activities. Space law encourages international cooperation as is reflected in the UN treaties and principles on outer space. Indeed, COPUOS's main function is to promote international cooperation in space activities, as evidenced by COPUOS's mandate.

Remote sensing is based on international cooperation. The debate was not focused on international cooperation as such but on how to implement international cooperation in remote sensing activities.

International cooperation to facilitate technical assistance and capacity building for using satellite data to developing countries is a good example of cooperation in remote sensing activities. By the time the RS Principles were

102 *See* J. Gabrynowicz (Ed.) The United Nations Principles Relating to Remote Sensing of the Earth from space: A Legislative History – Interviews of Members of the United Sates Delegation 142 (2002).
103 *See Id.* at 157.
104 *See Id.* at 158.

in discussion, the international cooperation programme of Landsat was cited as an example in which developing countries were already participating under mutually acceptable terms, but sensed states expected broader cooperation in the access to satellite data.

At present, there are more cases of international cooperation in remote sensing under multilateral initiatives such as the Committee on Earth Observation Satellites (CEOS), the Integrated Global Observing Strategy (IGOS) or the Global Earth Observation System of Systems (GEOSS). The Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters (Disasters Charter) is another case of international cooperation in remote sensing, in which satellite data is provided to mitigate the effects of natural disaster.

In addition, the PSA of UNOOSA has made available to developing countries different courses on remote sensing applications with the support of developed countries.

Ad 2 – Prior consent to sense and distribute data to third parties

As noted earlier in the debate on the legal aspects of remote sensing,[105] in the 1970s there was an intergovernmental organization called the G-77 made up of developing countries from Latin-America, Asia and Africa. During the discussions on the RS Principles, sensed states that were also developing countries negotiated as a group under the coordination of the G-77.

Developing countries were concerned about dissemination of remote sensing data of their natural resources. In their opinion this information could be a threat to their sovereign rights, which for developing countries included information on their natural resources.[106] For instance, a foreign company would have satellite information that located an oil deposit in a developing country, and this company bought the land in which the oil deposit was located at a very cheap price. In this case the developing country would be at a considerable disadvantage due to the lack of information about resources in its own territory. On the other hand, third parties would be at an advantage because they could have access to satellite data for locating valuable natural resources in developing countries.

Thus, in order to protect sensed states, the proposal of the G-77 was to require prior consent from the sensed state to being sensed, and prior consent to the distribution of satellite data of sensed states to third parties.

The main arguments against prior consent centered on two aspects:

1 From the technical point of view, it would be very difficult or impossible to limit borders of countries when remote sensing satellites were obtaining data. Besides, this practice was considered a barrier to dealing with global problems;

105 *See* Group of the 77, *supra* note 100.

106 *See* Gabrynowicz, *supra* note 102, at 60.

2 From the legal point of view, the Outer Space Treaty states that outer space shall be free for exploration and use for peaceful purposes. Therefore a main principle in space activities is the freedom to use outer space, and this general principle could not be limited. Besides, it was mentioned in the debate that prior consent was not in accordance with the protection to the freedom of information and the freedom to disseminate information. These issues were defended in COPUOS by the delegate of the United Kingdom Mr. Greenwood,[107] and the Dutch delegate Mr. Riphagen.[108]

The final text of the RS Principles did not include prior consent to sense and to disseminate information of sensed states to third parties. Nonetheless, Principle IV reaffirms the full and permanent sovereignty of all states over their natural resources. Besides, this principle indicates that remote sensing shall not be conducted in detriment to the rights or interests of sensed states, because remote sensing activities shall be performed for the benefit and the interest of all countries, according to Article I in the Outer Space Treaty.

Ad 3 – Access to data

Regarding access to data, Hosenball identified the main questions that were addressed in the COPUOS discussions on this subject: how do you obtain the data, what kind of data is obtained, and when is it obtained?[109] The answers to these questions are included in the RS Principles. However, before reaching consensus on the draft of the RS Principles, there were different approaches to accessing satellite data; these are described below.

The G-77 wanted to maintain control of satellite information over their territories. The report of UNISPACE-82 included the position of the G-77 expressed at this conference. From the analysis of the report, Prof. Diederiks-Verschoor identifies the G-77's standpoint: 'They request to have timely and non-discriminatory access to the primary data concerning their territories'.[110]

Therefore, the first position on behalf of the G-77 was that sensed states should have total access to primary data concerning their territories, and also called for restrictions to the dissemination of data over their territories. In this respect, Hodgkins mentions that 'there was some debate about the price as a means of denying access to data'.[111] Sensed states were concerned about their ability to pay for satellite information.

One solution to guarantee access to satellite information on a non-discriminatory basis had been suggested since the beginning of the remote sensing debate in the Argentinean draft of 1970: the creation of a UN database. In fact,

107 UN Doc. A/AC.105/C.2/SR.288 (1978).
108 UN Doc A/AC.105/C.2/SR.290 (1978).
109 *See* Gabrynowicz, *supra* note 102, at 70.
110 I.H.Ph. Diederiks-Verschoor & V. Kopal, An Introduction to Space Law 77, 3rd ed. (2008).
111 Gabrynowicz, *supra* note 102, at 120.

the Scientific and Technical Subcommittee proposed to study the feasibility of establishing a Global Centre for data dissemination.[112]

On the other hand, sensing states supported freedom to sense and to disseminate satellite information. To justify their position, as noted earlier, the USA had the Landsat programme, in which countries were participating through bilateral agreements, having access to satellite data.

According to the document 'Foreign Investigators in the NASA Landsat Programme 1972-1975' the following Latin-American countries were participating: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guatemala, Mexico and Peru.[113]

The third approach was the position of the USSR and France. In the Franco-Soviet draft they considered that sensing states should not be entitled to make public information concerning natural resources of sensed states, without the clearly expressed consent of the sensed state. Thus, the Franco-Soviet draft did agree with the right to sense, but did not agree with the dissemination of data to third parties without the consent of the sensed states.

The proposal to give the UN a main role in remote sensing activities through a UN Centre in charge of satellite data distribution and indeed remote sensing operations was not accepted.[114]

However, despite the fact that the UN is not in charge of remote sensing operations or data distribution, Principle VIII indicates that the 'United Nations system shall promote international cooperation with technical assistance and coordination in remote sensing activities'. Consequently, this has been the main function of UNOOSA in remote sensing activities; promoting capacity building in remote sensing through the Regional Centers of Space Education Furthermore, the SPA organizes every year different workshops on remote sensing issues. Furthermore, the UN programme for disaster management: the UN Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER). In addition, there are other UN Agencies which contribute to remote sensing activities, for instance the FAO, UNESCO, and the UN Environmental Programme (UNEP).

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112 *See* Diederiks-Verschoor, *supra* note 110, at 75.

113 *See* E. Galloway, *Remote Sensing from Outer Space: Legal Implications of Worldwide Utilization and Dissemination of Data*, in *supra* note 93, at 103-104.

114 Within the period of discussions while the RS Principles were being drafted UNISPACE 82 was held. The final report of UNISPACE 82 included two recommendations related to operations and satellite data, respectively. In the field of operations, the recommendation was to carry out '[f]easibility studies on the need and viability of operational international satellite systems for meteorology, remote sensing and navigation'. The recommendation concerning satellite data was the '[s]etting up of an international space information service'. The final report of UNISPACE 82 was adopted by unanimous agreement of all the participants. Therefore the expectations for implementing these recommendations were high. Nevertheless, these recommendations were not included in the RS Principles. *See* Pal, *supra* note 58, at 182-183.

The conclusion on the issue of access to data is contained in Principle VIII and Principle XII states:

> 'As soon as primary data and the processed data concerning the territory under its jurisdiction are produced, the sensed State shall have access to them on a non-discriminatory basis and on reasonable terms'.

Thus, all countries have access to remote sensing data on a non-discriminatory basis, but only to primary and processed data concerning their territory. Analysed information is not included; this requires that the country, which is obtaining the primary or processed data, count on experts to interpret the data to make remote sensing data useful. Moreover, the above Principle states that all countries have access to satellite data, but the access will be effective through a previous payment of the data in terms of reasonable cost, which is a broad statement. At the end, Principle XII was supported by public and private interests in remote sensing activities, making data accessible and allowing partial cost recovery to maintain the operation of the satellite system.

5.2.2 Principles Relating to Remote Sensing of the Earth from Outer Space (RS Principles)

The RS Principles were the first international guidelines of conduct regarding remote sensing activities, and the first international legal acknowledgement of remote sensing activities.

The RS Principles helped to clarify remote sensing purposes, applications and the conditions for accessing the data provided by this space technology. Another important contribution of the RS Principles is that they indicate the rights and obligations of 'sensing states' and 'sensed states'[115] in the field of international cooperation in remote sensing activities.

One of the most difficult issues in reaching international agreement was related to the access to satellite data. Remote sensing applications opened new legal issues, such as how to deal with data collection, processing and delivery. The main outcome of remote sensing missions is satellite data; the country

115 In the 1970s, when the RS Principles started to be discussed, remote sensing activities were led by the USA and the USSR. Remote sensing activities distinguished two main groups of countries: 1. Sensing states, countries with the capability to operate remote sensing satellites and interpret processed satellite data, and; 2. Sensed states, countries without space technology capabilities to carry out operational remote sensing, the territories of which are, however sensed by remote sensing satellites of other sensing states. When this issue was discussed the difference was clear and opinions in the debate reflected these two types of connectedness with remote sensing. Today, the original sensing states are now also sensed states, since different remote sensing satellites are operated by developing countries.

that owns and controls satellite data is the one that has implicit power of information. This situation was the main concern of sensed states.

The purposes of the RS Principles emphasize the benefits to society and national development, paving the way to trust in this technology by sensed states. Principle I includes the following purposes of remote sensing activities: improving natural resources management; land use; protection of the environment.

In this context, natural resources management and land use are invaluable advantages for national development. And the protection of the environment is important at national and international levels, because this activity is crucial to realize sustainable development.

There is a fourth purpose of remote sensing activities that was included in Principle XI, to 'promote the protection of mankind from natural disasters'. At present, natural disasters are one of the main remote sensing applications, due to the importance of obtaining timely satellite data for disaster management.

Principles II and IV reaffirm the content in the Outer Space Treaty, stating that remote sensing activities shall be performed for the benefit and in the interest of all countries.

Furthermore, Principle IV refers to the freedom of exploration and use of outer space on the basis of equality. The equality among the countries is part of the argument that supports the access to primary and processed data by all countries, on a 'non-discriminatory basis and on reasonable cost terms', in accordance with Principle XII.

Following the mandate of COPUOS to promote international cooperation in space activities, the RS Principles elaborated on this theme. We can find different references to international cooperation in remote sensing activities, which is based on 'equitable and mutually acceptable terms' in accordance with Principle V and through agreements or arrangements which are mentioned in Principle VI. There is also the alternative to enter into consultations, as stated in Principle XIII. Principle VII establishes that states performing 'remote sensing activities shall make available technical assistance to other interested States on mutually agreed terms'.

The final version of the RS Principles considered the standpoint of sensing and sensed states, an achievement of multilateral negotiation. However, since the document adopted was called 'principles' instead of 'treaty', we can notice that some countries did not agree to the creation of a binding document in this domain. After the adoption of this document the question was how to determine the legal implications of the RS Principles.

In this respect, there are two different opinions:

1 The RS Principles should be considered as voluntary guidelines to be followed on a good faith basis.
2 The RS Principles should be considered as a binding document with the status of international customary law. The argument supporting this

opinion is that even though the UN resolutions are not binding documents, the practice of the countries has created one of the elements of international custom. Furthermore, the RS Principles were adopted by consensus among the then 53 Member States of COPUOS, which could be interpreted as the *opinio juris* of those countries.

In the case of the USA they have made public their interpretation of the legal implications of the RS Principles. During the General Assembly of 1986 the USA's Representative to the Special Political Committee explained its position over the implications of the RS Principles: '[…] these Principles can be only recommendatory in character; they cannot, in and of themselves, possess legal force'.[116]

In recent years, the need to improve the effectiveness of the RS Principles has been an issue supported by the delegation of Brazil at COPUOS. Brazil has encouraged the study of remote sensing activities, and with the support of other countries, introduced an agenda item in the Legal Subcommittee to review the RS Principles and even explore the possibility of converting them into a treaty.

5.2.3 Other recommendations, studies and discussions on remote sensing activities

This section presents other contributions on remote sensing. The review includes the following reports:

1 UNISPACE III;
2 the proposal submitted to the Legal Subcommittee in 2004 regarding the review of the RS Principles;
3 the International Law Association (ILA)'s Space Law Committee.

5.2.3.1 UNISPACE III

The conclusion from the Workshop on Space Law identified challenges for the RS Principles' adaptability to globalization, privatization, national security and monitoring services of arms control.[117]

UNISPACE III's report, the Space Millennium Declaration[118] included strategies to address global challenges in the future. In this declaration remote

116 United States Mission to the United Nations, Statement by William J. Lowell, United States Representative to the Special Political Committee, in Explanation of Vote under Item 72, Principles Relating to Remote Sensing of the Earth from Space, USUN 173-(36), (1986), in *supra* note 102.
117 See Diedreriks-Verschoor, *supra* note 110, at 81.
118 *See* the Space Millennium Declaration, *supra* note 82.

sensing was seen as a valuable tool in the management of resources and natural disasters. Furthermore, the enhancement of coordination of remote sensing systems and the development of the Integrated Global Observing Strategy were suggested.

5.2.3.2 Proposals submitted to the Legal Subcommittee

Section X in the report of COPUOS 2004 was titled 'Proposals to the Committee on the Peaceful Uses of Outer Space to be considered for discussion at subsequently sessions of the Legal Subcommittee'.[119] In this section X, para. 122 (d) was included the discussion on the development of an international convention on remote sensing, proposed by Argentina, Brazil, Chile, Colombia, Cuba, Ecuador, Greece, Mexico and Peru.

In 2007, the General Assembly endorsed the recommendation formulated by COPUOS, in which the Scientific and Technical Subcommittee should consider the item 'Matters relating to remote sensing of the Earth by satellite, including applications for developing countries and monitoring of the Earth's environment'.[120]

5.2.3.3 Reports by the International Law Association (ILA)'s Space Law Committee

· *ILA 2004 Report*

The 2004 report[121] addressed the 'legal aspects of the privatization and commercialization of space activities'. In particular the conference discussed different issues related to remote sensing and national space legislation.

Three principal conclusions linked to remote sensing from the 2004 report are mentioned below.[122]

First, the meeting addressed the legal value of the RS Principles. In this respect, the experts concurred that the Principles are declarative of customary international law. However, there was no consensus on the adoption of a binding instrument on remote sensing.

Second, the experts noted that the deficiencies of the RS Principles are being solved in practice, for instance when countries clarify or improve ambiguous terms of the RS Principles in the elaboration of national legislation; or in bilateral and regional agreements on remote sensing.

119 UN Doc. A/AC.105/826 (2004).
120 UN Doc. A/Res/61/111 (2007).
121 Williams M., Report of the ILA Space Law Committee, Part I, 71st ILA Conference, Berlin (2004).
122 Williams M., Second Report of the ILA's Space Law Committee, Part I, 72nd ILA Conference, Toronto 18-19 (2006).

Third, international cooperation was reaffirmed as an important element in remote sensing activities, having the potential for closing the gap between countries.

· *ILA 2006 Report*

In 2006, on the 20th anniversary of the RS Principles, the ILA assessed the status and situation of the RS Principles. For that purpose a questionnaire was drafted in 2005. The results from this questionnaire were presented at the 73rd ILA conference in 2008.

ILA's 2006 report refers to the Toronto discussion on remote sensing, in the section, 'Legal Aspects of the Privatization and Commercialization of Space Activities Remote Sensing and National Space Legislation'. Three crucial themes were discussed during this session:

1 the new scenario of remote sensing activities and applications;
2 the legal value of the Principles of RS, and;
3 the alternative concrete proposals to improve the RS Principles.

Ad 1 - New scenario of remote sensing activities and applications

The first approach to the new scenario is identified clearly by Gabrynowicz, who pointed out the developments in remote sensing activities: first, some developing countries are also sensing states, and; second, there are hybrid entities 'as a result of merging both governmental and private characteristics, civil and military functions, national interest and global functions'.[123]

Having developing countries as sensing states breaks the paradigm of categorical differentiation between states which are sensed states/developing countries and sensing states/developed countries. This differentiation came from the position that Member States held in COPUOS during the discussion on the RS Principles, as noted earlier.

Concerning hybrid entities, the ILA 2006 report, mentions that this situation could impact on dispute settlement procedures, because public-private partnership allows dispute settlement by international arbitration, which is a faster procedure.

Ad 2 – Legal value of the RS Principles

Experts have tried to determine whether the Principles have declarative or legal value as a source of law within the figure of international custom. Regarding the legal value, the ILA Report 2006 sums up its position as follows: 'The prevailing *opinio*, possibly the soundest, is that the principles do reflect, in great measure, international custom. A general practice no doubt exists and psychological element coincidental or otherwise -shows as well'.[124]

123 *id*. 6.
124 *id.* 11.

Consistent with general practice and the new scenario of remote sensing activities, developing countries which are now sensing states, also contribute to the establishment of state practice as evidence, for instance the right to access data stated in Principle XII of the RS Principles, according to expert Gabrynowicz.[125] During this session in Toronto, most of the experts considered it necessary to improve on this Principle XII.

Ad 3 – Alternative concrete proposals to improve the RS Principles
The 2006 Report indicates that experts proposed the following alternatives:
- bilateral, regional and multilateral agreements as practical means to interpret gaps and ambiguities within the RS Principles, as was pointed out earlier in the ILA Report 2004;
- discussion of the text, without further implications;
- elaboration of 'ILA Interpretation Guidelines';
- adoption of a special UNGA resolution or a separate protocol with the interpretation guidelines.

Regarding the alternatives, the Committee chair informs that: '[…] to sum up the common denominator would be an agreement to discuss the Principles, or simply to talk about them, without further implications for the moment except for the possibility of drafting some ILA guidelines'.[126]

- *ILA 2008 Report*

The working session in Rio de Janeiro addressed again controversial issues of remote sensing; three main ideas were discussed:
1 the right of access and the democratization of access to information;
2 the Legal Subcommittee of COPUOS and the possibility of drafting interpretation guidelines;
3 use of satellite data in international and national litigation.

Ad 1 – The right of access and the democratization of access to information
This report indicates that 'in Latin America, presently, there is a move towards what is called the 'democratization of access to information' particularly in Brazil and Argentina'.[127]

For instance the Argentinean satellite SAC-C was intended to distribute satellite data at no cost to Ecuador. In Brazil the INPE promotes an open access

125 *Id.* 7.
126 *Id.* 11.
127 Williams M., Third Report of the ILA Space Law Committee, Part I, 73rd ILA Conference, Rio de Janeiro 4 (2008).

RS data policy worldwide[128] through the delivery of CBERS data freely to African countries in a partnership with Italy, South Africa and Spain.[129] Furthermore, CBERS images are free to the Latin-American countries within the reach of INPE'S receiving antenna located in Cuiabá.[130]

In a broader perspective, I consider that today's good example of the democratization of access to global satellite imagery is through the use of virtual globes (Google Earth, NASA's World Wind, ESRI's ArcGISExplorer) which can be accessed by millions of people around the world.[131]

Ad 2 – The Legal Subcommittee of COPUOS and the possibility of drafting interpretation guidelines

With the objective of providing more legal certainty to the RS Principles, work on a draft document of interpretation guidelines was a concrete proposal. This idea was not well accepted in the Legal Subcommittee of COPUOS, the argument against this proposal was that remote sensing principles have been working well and there have been no serious claims in the field.[132]

Ad 3 – Use of satellite data in international and national litigation

Since 2006, the ILA's Space Law Committee has discussed the legal aspects involved in the use of satellite imagery in courts in case of international conflict, the analysis on this theme being a particular contribution of ILA to the development of space law.

5.2.3.4 Evaluation of the discussions on the RS Principles

The discussions that have been reviewed above are summarized in three principal ideas below:

1 *Replacement of categorical differences for new paradigms*

128 In 2004 Brazil adopted a policy of sharing satellite data freely worldwide to support sustainable development, protect the environment and improve people's welfare. ITU News, *Brazil's President Luiz Inácio Lula da Silva visits ITU* (July-August 2009) at: http://www.itu.int/net/itunews/issues/2009/06/13.aspx (Last visited 10 February 2010).

129 H Santos & G. Câmara, Current status and Recent Developments in Brazilian Remote Sensing Law, 34 (1) Journal of Space Law 15 (2008).

130 CBERS Press Room, *CBERS-2B completes a full year in orbit* (19/09/2008), at: http://www.cbers.inpe.br/en_noticias/index.php?cod=not101 (Last visited 3 February 2010).

131 See C.D. Elvidge, *How Virtual Globes are Revolutionizing Earth Observation Data Access and Integration*, The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Vol. XXXVII, Part B6a., Beijing 2008, (2008). Available at www.isprs.org/proceedings/XXXVII/congress/6a_pdf/4_WG.../01.pdf. The use of virtual globes allows to download the basic software for free and have open access to global earth observation imagery.

132 *See* Williams, ILA Report 2008, *supra* note 127.

When the RS Principles were elaborated there were two groups involved in the negotiations: the 'sensing states' and the 'sensed states'. At present, emerging space nations have broken the categorical classification of sensed and sensing states. Many emerging space nations are developing countries with space capabilities in the operation of remote sensing satellites, for instance Malaysia with RazakSAT; Nigeria with NigeriaSat-1 and 2; Argentina with SAC-C, etc. In this scenario the observation of Prof. Gabrynowicz is relevant, developing countries which are also sensing states are participating in establishing State practice on remote sensing activities.

The identification of 'hybrid entities' by Prof. Gabrynowicz brought our attention on the development of remote sensing activities. At the beginning remote sensing activities were carried out only by the government, but currently private companies are involved in the provision of remote sensing services. Indeed, the government and private sector are partners in remote sensing missions. Thus, at present there are cases of private-public partnerships in remote sensing activities, which impact areas such as the settlement of disputes because the private partner has the option to resort to international arbitration.

2 The role of regional agreements in the improvement of the RS Principles

Bilateral, multilateral and regional agreements on remote sensing activities could resolve the ambiguities that arise out of the RS Principles. This is a more feasible option than introducing changes in the RS principles through the Legal Subcommittee of COPUOS.

The Latin-American countries participate as a regional group in the submission of documents to the COPUOS. Thus, they could translate the team spirit into the implementation of a remote sensing mission and draft an agreement, which would include their definition of the ambiguous terms of remote sensing that need clarification.

3 Legal value of the RS Principles

Most of the experts on the ILA Space Law Committee agreed to consider the RS Principles as international custom, which is a source of international space law in accordance with Article 38 (1.b) of the Statute of the ICJ. In my opinion this is a correct interpretation. The RS Principles were adopted as a soft law document. Nevertheless, the RS Principles have evolved and become international custom, thanks to the *opinion iuris* and the practice of the States.

5.3 THE RIGHT TO WATER

Access to safe water is essential for human life, socio-economic development and poverty reduction. Furthermore, access to water is a prerequisite to achiev-

ing rights to personal dignity, health, housing and food,[133] all rights within the sphere of human rights.

One of the UN's purposes is to promote and encourage respect for human rights;[134] therefore at the international level the UN guides the development of human rights legislation. In this context, the UN has led the discussion on the right to water at the international level through Economic and Social Council (ECOSOC).[135]

The emblematic document with the position of the UN regarding the right to water is the General Comment No. 15 drafted by ECOSOC. General Comment No. 15 formulates the definition of right to water as follows: 'the human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses'.[136]

General Comment No. 15 was adopted in 2002; however, the study on international water law had started more than 50 years before by the ILA.[137] The legal implications of water began to be studied in the context of international management of water[138] (international water courses and equitable utilization) and environmental law. Only recently has water law been linked to the rights of persons.[139] In my opinion, this connection began with greater attention to environmental law, in which it was pointed out how a healthy environment is needed to achieve high standards of physical and mental health.[140] The problem was not only to protect the environment, but also to protect human life and health from diseases and epidemics. Every year the lack of safe water results in epidemics, diseases and death.

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133 *See* also Article 8 of the Declaration on the Right to Development. UNGA Doc. A/RES/41/128 (1986).

134 Art. 1, para. 3, UN Charter.

135 See the UN Charter, Article 55 (a)(b) regarding the UN functions in international economic and social co-operation, and Article 60 which stipulates that the responsibility of these functions is under the General Assembly assisted by ECOSOC.

136 Para. 2 in the General Comment No. 15. UN Doc. ECOSOC E/C.12/2002/11 (2003).

137 In 1954 the ILA's Committee on The Uses of the Waters of International Rivers was established. This Committee presented in 1966 the Helsinki rules on the Uses of the Waters of International Rivers. S. Bogdanović, International Law of Water Resources: Contribution of the International Law Association xv(1954-2000).

138 The ILA's Committee on Water Resources has defined 'management of water' in the ILA's Berlin Rules (2004). Art. 3 (14) management of water 'includes the development, use, protection, allocation, regulation and control of waters'.

139 As mentioned before, General Comment No.15 was adopted in 2002, and two years later the ILA's Berlin Rules included the right to water in Chapter IV, the Rights of Persons.

140 *See* para. 4, General Comment No. 14, which indicates what the right to health embraces: 'food, nutrition, housing, access to safe potable water and adequate sanitation safe and healthy working conditions, and a healthy environment'. The Right to the Highest Attainable Standard of Health (General Comment No. 14). ECOSOC E/C.12/2000/4 (2000).

The development of environmental and human rights law[141] drew experts' attention to the importance of the right to water to achieve human development.[142] UN has expressed its position regarding the right to water in General Comment No. 15. Nevertheless, currently there is not an international agreement to recognize the right to water.

At present, there are many expectations in the formal acknowledgement of the right to water as a human right at the international level.[143] However, when the right to water is recognized in an international agreement, the States will be challenged individually to demonstrate their capacity to fulfill human rights effectively, taking concrete actions at the national level and report to ECOSOC (international supervision).

Nevertheless, States can start working now to realize the right to water at the national level, while the international community is seeking an agreement on this issue. In my opinion, attention should focus on national measures to begin implementing the right to water. Ultimately, the right to water will be reflected in practical advantages for the citizen only if national authorities take practical measures to make it a reality.

The adoption of the right to water at the national level implies that states are obliged to provide their citizens access to water. States' obligations include to respect, protect and fulfill the right to water. Nevertheless, in practice, it is not easy to implement the right to water. It is important to note that the right to water belongs to the category of positive rights 'to be respected gradually and realized in a distant future',[144] a situation that makes its enforcement very vague.

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141 The rights-based approach for development considers that human rights are universal, interdependent, indivisible and interrelated. Under this approach the right to water is an essential element to the right to development as are other human rights such as health, housing, education, etc.

142 Human development is a holistic concept, which puts people at the centre of the development process, a process that seeks to enlarge people's choices by expanding human capabilities and functions. The basic capabilities for human development are to be knowledgeable and to have a decent standard of living. UNDP, Glossary of terms http://hdr.undp.org/en/humandev/glossary/#h (last visited 18 March 2010).

143 In the World Water Forums in Kyoto 2003, Mexico 2005 and Turkey 2009 the proposal to recognize the right to water as a human right was not accepted. During the last World Water Forum in March 2009 the Istanbul Ministerial Statement included a 'soft' message on this regard. Para. 15: 'We recognize that access to safe drinking water and sanitation is a basic human need'. Ministry of Foreign Affairs of Turkey, Istanbul Ministerial Statement (22 March 2009).

144 I. E. Koch, *Good Governance and the Implementation of Economic, Social and Cultural Rights* in H-O Sano & G. Alfredsson (Eds.), Human Rights and Good Governance: Building Bridges 76,77 (2002). Koch explains the weakness of positive obligations in the economic, social and cultural rights. Positive rights are elaborated as goals or pragmatic instructions to the states. 'The link between the facts and the legal consequences are replaced by a relation between an end and the means supposed to lead to the end'.

AQUARELSat Constellation aims to assist the States in their obligation to respect, protect and fulfill the right to water. This section on the right to water has two main objectives:

1 to provide a compilation of international, regional and national documents (legal as well as non-binding) that address the right to water as a human right;
2 to explain how space technologies, such as AQUARELSat, could help states to realize progressively the right to water, for the benefit of the quality of life of their population. AQUARELSat is a practical measure to strengthen the right to water. This justifies why the first Latin-American space mission should focus on water monitoring for water management.

5.3.1 Arguments in favour of recognising the right to water

Why should countries recognize the right to water as a human right?. Malcolm Langford provides the following reasons:[145]

- lack of water and sanitation killed many children every year;
- the recognition of water as a human right could solve conflicts with due respect to the position of marginalized groups, 'water has to be recognized as an independent human right and made part of the balancing act'.

Jacques Chirac summarizes the reason in these words:

> 'Access to safe water must be consecrated as a universal human right. Every man, woman and child must have an enduring right to drink and to bathe without risking their lives. In 2008, the most fundamental of human dignities is still denied, hushed, unspoken'.[146]

Emilie Filmer-Wilson's opinion is that:

> 'a right to water might not solve the problems arising from growing competing demands and potential conflicts, but would provide a framework for finding solutions. This held true for issues like non-discrimination, equality, participation and accountability'.[147]

Scott Leckie Executive Director of the Centre on Housing Rights and Evictions (COHRE) mentions that:

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145 K. Engbruch, *Workshop Report-Day One: The Right to Water on International and National Law* 137, in E. Riedel &P. Rothen (Eds.), The Human Right to Water 137 (2006).

146 President Jacques Chirac's Speech on November 13th, 2008 during the International Encounters Water for Peace, Peace for Water, available at: http://www.fondationchirac.eu.

147 *See* Engbruch, *supra* note 145, at 131.

> 'the official recognition in law of the right to water, and the corresponding governmental obligation to respect and ensure it, provide a solid basis upon which grassroots groups, communities, non-governmental organizations, lawyers and others can more forcefully and effectively demand accessible and sufficient water for all'.[148]

It is submitted that acknowledgement of the right to water at the international level in a legally binding document will provide a certain legal framework to take practical measures towards the access to water and water security. Otherwise, the right to water will continue to depend on general political declarations without binding commitments, a scenario that could not handle a possible water crisis.

5.3.2 Developing the right to water under the framework of the UN

At the international level, the binding legal instruments that support the right to water include:

1 the UN Charter;[149]
2 the UN International Covenant on Civil and Political Rights (CP Covenant);[150]
3 the UN International Covenant on Economic, Social and Cultural Rights (ESC Covenant);[151]

On the other hand, non-binding international instruments the following can be mentioned:

4 the Universal Declaration on Human Rights (UDHR);[152]
5 General Comment No.15: The right to water (arts. 11 and 12 of the International Covenant on Economic, Social and Cultural Rights) (General Comment 15);[153]

148 COHRE, Source No.8: Legal Resources for the Right to Water: International and National Standards 4 (2004).
149 U.N. Charter (1945).
150 UN Doc. GA/RES/2200A (XXI) (1966).
151 *Id.*
152 UN Doc. GA/RES/217(III) (1948). The legal value of the UNDHR is a controversial issue. The UNDHR was adopted in a UN resolution conceived as a document with moral and diplomatic influence. 'The Universal Declaration retains its international moral value even after the adoption of the Conventions [CP Covenant and ESC Covenant]'. F. Ermacora, Human Rights and Domestic Jurisdiction (Article 2, § 7, of the Charter), Recueil des cours, Volume 124 (1968-II) 395. At present, the UNDHR is considered part of international customary law by some experts, but there is not a unified position on this regard.
153 ECOSOC, General Comment No. 15: The right to water (arts. 11 and 12 of the International covenant on Economic, Social and Cultural Rights), UN Doc. E/C.12/2002/11 (2002).

6 ILA's Berlin Rules on Water Resources (2004);[154]
7 Report on the Realization of the Right to Drinking Water and Sanitation by the Special Rapporteur, El Hadji Guissé (Special Report 2005);[155]
8 Annual Report of the United Nations High Commissioner for Human Rights (UNHCR Annual Report 2007);[156]
9 Report of the Human Rights Council on its Seventh Session, 3 March-1 April 2008.[157]

The relation of these documents with the right to water and sanitation is explained below:

Ad 1 – The UN Charter
The UN Charter, at Article 1(3) states that one of the purposes of the UN Charter is to promote and encourage respect for human rights. Thus, the legal fundament of the UN work on human rights relies on this article of the UN Charter.

Article 55(a) stipulates that the UN shall promote 'higher standards of living, […], and conditions of economic and social progress and development'. Access to water is a pre-requisite for appropriate living standards, well-being, social progress and development. These areas cannot be promoted unless access to water is guaranteed. The intrinsic relation between the right to water and development is a good reason for the UN to be interested in the implementation of the right to water.

Article 55(c) indicates that the UN shall promote universal respect and observance of human rights without discrimination. The element of non-discrimination in access to water is an important issue to protect and to assist vulnerable and disadvantaged groups in obtaining access to safe water.

Article 56 emphasizes the role of international cooperation in achieving the purposes referred to in Article 55. International cooperation could be carried out through an international fund to help vulnerable groups to have access to water under strict international supervision to make sure that the funds are used to benefit these groups.[158]

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154 Fourth Report of the ILA's Committee on Water Resources Law, 71st ILA Conference, Berlin (2004).
155 ECOSOC, *Report on the Realization of the Right to Drinking Water and Sanitation*, UN Doc E/CN.4/Sub.2/2005/25 (Jul.11, 2005).
156 Human Rights Council, *Report of the UN High Commissioner for Human Right on the Scope and content of the Relevant Human Rights Obligations Related to Equitable Access to Safe Drinking Water and Sanitation under International Human Rights Instruments*, UN Doc. GA/A/HRC/6/3 (Aug. 16, 2007).
157 *See* A. Artucio, Report of the Human Rights Council on its Seventh Session, UN DOC A/HRC/7/78 at 63-65 (2008).
158 Regarding an international fund, for example Jacques Chirac has suggested considering a tax for development. In 2005, he suggested the tax on plane tickets to finance the fight against the major pandemics.

Ad 2 – The UN International Covenant on Civil and Political Rights (CP Covenant)
Article 6(1) mentions that: '[e]very human being has the inherent right to life'. The formulation of this article is directed against the arbitrary deprivation of life. There is discussion on the scope of this article, in order to determine whether guarantees against death from lack of water, food or medical attention are included in its possible interpretations.[159]

Ad 3 – The UN International Covenant on Economic, Social and Cultural Rights (ESC Covenant)
Article 11(1) establishes that '[t]he States Parties to the present Covenant recognize the right of everyone to an adequate standard of living […], including adequate food, clothing and housing […]'. This paragraph includes also the states' obligation to ensure the realization of this right and to achieve this end international cooperation needs to be considered.

Concerning this article it is important to note that we have again a formulation with the word 'including' which means that the list is not exhaustive.[160]

Article 12(1) refers to the right to health in these words: '[t]he States Parties to the present Covenant recognize the right of everyone to the enjoyment of the highest attainable standard of physical and mental health'. One of the steps that States Parties to the Covenant shall take is the improvement of all aspects of environmental hygiene (Article 12(2.b)). A healthy environment promotes the availability of safe water.

Ad 4 – The Universal Declaration on Human Rights (UDHR)
The UDHR includes provisions concerning basic rights that are considered customary international law or authoritative interpretations of the UN Charter's provisions on human rights. In the case of welfare rights that include an adequate standard of living 'it is uncertain whether it can be considered to be protected by a norm of customary international law'.[161]

The following articles in the UDHR are related to the right to water:

Article 1 refers to human dignity without discrimination. This statement was included in the introduction to General Comment No. 15, which states that '[t]he human right to water is indispensable for leading a life in human dignity'. Furthermore, the second sentence of Article 1 states that human beings 'should act towards one another in a spirit of brotherhood'. In this respect Bielefeldt has mentioned that the 'spirit of brotherhood' or solidarity is related

159 S. McCaffrey, *The Human Right to Water*, in E. Brown Weiss, L. Boisson de Chazournes & N. Bernasconi (Eds.), International Economic Law Series 97 (2005).
160 *See Id*. *See* also General Comment 15, paragraph 3 (mentioning that '[t]he use of the word 'including' indicates that this catalogue of rights was not intended to be exhaustive').
161 McCaffrey, at 96.

to the right to water because international solidarity is needed to secure the right to water.[162]

Article 2 states that everyone is entitled to the rights of this Declaration without discrimination. This is particularly important for the protection of vulnerable groups.

Article 25(1) stipulates that '[e]veryone has the right to a standard of living adequate for the health and well-being […] including food, clothing, housing and medical care […]'.

As McCaffrey points out, the word 'including' in the formulation of Article 25 allows for the interpretation that the list of items is not exhaustive.[163] Thus, it is not relevant that water was not included, since it is obvious that water is essential to life, health, well-being, and food security.

Ad 5 – The General Comment 15: the right to water

The General Comment 15 sets forth the obligations of States in relation to a human right to water.[164] This document presents the position of ECOSOC, which is a UN human rights body.

General Comment 15 is comprised of six parts: introduction, normative content of the right to water, States parties' obligations, violations, implementation at the national level, and obligations of actors other than States.

The paragraphs that are relevant in this research are the following: Introduction, para. 1, which establishes that water is a public good.[165] This is expressed in these words: '[w]ater is a limited natural resource and a public good fundamental for life and health'.

The recognition of water as a 'public good' fundamental for life and health as phrased here allows for different interpretations. Some authors consider that with this formulation the affordability to water is emphasized, whether public or private entities are in charge of it. The relevant detail is that the user should be able to afford the cost.[166]

Boesen & Lauridsen draw attention to water services as public goods and thus, part of the human rights; for instance, a water supply that ensures the

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162 H. Bielefeldt, *Access to Water, Justice and Human Rights in The Human Right to Water*, in *supra* note 145, at 51.

163 *See* McCaffrey, *supra* note 159.

164 *See* COHRE, *supra* note 148, at 14, 80. General Comments are elaborated by UN Committees, which draft authoritative interpretations of specific rights.

165 *See* J. Boesen & P.E. Lauridsen, *Fresh Water as a Human Right and Global Public Good*, in E.A. Andersen & B. Lindsnaes (Eds.), Towards New Global Strategies: Public Goods and Human Rights 475-478 (2007). The definition of public good is the following: a public good is a service or product that you cannot exclude others from using. According to the classification of public goods, 'water' is an 'impure' public good because there is limited access to its use as a 'scarce' good that exists in limited quantities. It is interesting to mention that 'not all global public goods are human rights, but all human rights are public goods'.

166 S. McCaffrey, at 106.

quantity and quality of accessible water.[167] These authors consider that sometimes water management is the public good rather than water itself, when the distribution of the water is the main issue.

Para. 2 defines the right to water as follows:

> 'The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses. An adequate amount of safe water is necessary to prevent death from dehydration, to reduce the risk of water-related disease and to provide for consumption, cooking, personal and domestic hygienic requirements'.[168]

In general terms para. 12 refers to quality and quantity of water for everyone. Furthermore, it indicates that the following factors apply in all circumstances:

- Availability. The water supply must be sufficient and continuous for personal and domestic uses. The quantity of water available for each person should correspond to WHO guidelines.
- Quality. The water must be safe: free from micro-organisms, chemical substances and radiological hazards that are threats to health.
- Accessibility. Water and water facilities have to be accessible to everyone without discrimination. Accessibility includes four dimensions: physical, economic, non-discrimination, and information.

Para. 20, regarding specific legal obligations, the right to water as a human right requires three types of obligations: obligations to respect, protect and fulfil the right to water.

Para. 34, refers to international assistance and aid. This topic is related to the discussion on the international obligation of developed countries to assist other countries with obtaining the right to water.[169]

Para. 37, identifies nine core obligations in relation to the right to water. However, for the purposes of this study I refer to obligations that could be carried out with space applications. The obligations considered are the obligation to protect and the obligation to fulfil the right to water according to para. 20.

- To ensure access to the minimum essential amount of water […]; [obligation to fulfil]

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167 J. Boesen & P.E. Lauridsen, at 400-401.

168 S. McCaffrey, *supra* note 159, at 107.

169 For example, Smets informs that regarding the right to water in developing countries, France had legalized decentralized aid for improving water supply and sanitation in developing countries (Oudin-Snatini law, up to 1% of water bill to be used abroad). *See* H. Smets, *Rights and Duties Associated with the Right to Water*, in A. Fischer-Lescano et. al. (Eds.), Freiden in Freiheit: Peace in Liberty: Paix en Liberté: Festschrift für Michael Bothe zum 70 Geburstag 718 (2008).

- To ensure physical access to water facilities or services that provide sufficient, safe and regular water […] [obligation to fulfil and protect]
- To ensure equitable distribution of all available water facilities and services; [obligation to fulfil]
- To adopt and implement a national water strategy and plan of action addressing the whole population; the strategy and plan of action should be devised, and periodically reviewed […] [obligation to fulfil]
- To monitor the extent of the realization, or the non-realization, of the right to water; [obligation to fulfil and protect]
- To take measures to prevent, treat and control disease linked to water, in particular ensuring access to adequate sanitation. [obligation to protect]

Para. 43, cites concise examples of violations to the right to water:

- violations of the obligation to respect the right to water follow from state interference with the right to water: discriminatory or unaffordable price of water, pollution and diminution of water resources, problems that affect human health;
- violations of the obligation to protect the right to water follow from the failure of a state to take all necessary measures to safeguard persons within their jurisdiction from infringements of the right to water by third parties: failure to prevent water pollution and to control water services providers;
- violations of the obligation to fulfil the right to water follow from the failure of states to take all necessary steps to ensure the realization of the right to water: failure to implement a water policy and monitor the realization of the right to water.

Para. 47, of the General Comment 15 states that governments have the obligation to adopt a national strategy or plan of action to realize the right to water. In other words, para. 47, requires that concrete measures be taken at the national level to implement the right to water. In this regard, improving water management could be achieved through the elaboration and implementation of a national strategy using space technologies.

Para. 49 refers to the importance of good governance for effective implementation of human rights such as the right to water. Thus, a national water strategy and plan of action should be based on the principles of accountability, transparency and independence of the judiciary.

Paragraph 53 and 54 refer to the monitoring process of implementation of the right to water through the identification of water indicators and benchmarks at the national level.

Paragraph 55 mentions that individuals and groups who have been denied their right to water should have access to effective judicial or other remedies at national and international levels. This paragraph takes into account the importance of national enforcement mechanisms to implement and protect the right to water.

Regarding the legal value of General Comment 15, Eibe Riedel considers that it is not a binding document,[170] but emphasizes that they are statements of ECOSOC's practice. General Comment 15 clarifies ECOSOC's position regarding particular questions on the implementation of certain rights and guidance to countries to change their practices.

For example at a national level, Carolina Fairstein explains that in Argentina, judges and courts have referred to General Comment 15 in their decisions.[171] Furthermore, she notes that in Argentina the right to water has been related to the right to health and the right to information.

Ad 6 – ILA's Berlin Rules on Water Resources (2004)

The Berlin rules are a comprehensive collection of customary international law on water management. Furthermore, the Berlin Rules took into account the development of international environmental law, international human rights law and humanitarian law.

In Chapter IV, 'Rights of Persons' defines the 'right of access to water', and makes a list of states' obligations to progressively realize this right.

Article 17, provides a definition of the 'right of access to water'. The formulation of this article is similar to the definition of the right to water in General Comment No.15. Article 17(1) states: 'Every individual has a right of access to sufficient, safe, acceptable, physically accessible, and affordable water to meet that individual's vital needs'.

The same Article 17 (3) sets forth specific states' obligations, which can be divided in the three categories: respect, protect and fulfil.

The obligations to respect are set forth in para. (3.a), refraining from interfering with the enjoyment of the rights; and para. (3.c), taking measures to facilitate access to water, such as defining and enforcing legal rights of access to water.

The obligation to protect is found para. (3.b), preventing third parties from interfering with the enjoyment of the right of access to water.

The obligation to fulfil is in para (3.d) providing water or the means for obtaining water when the individuals are in need of help for reasons beyond their control.

Article 17 (4) refers to the states' obligation to monitor periodically the implementation of the right of access to water. As mentioned above, the right to water is within the category of positive rights to be respected gradually and realised in the future, in other words with limited judicial control.[172]

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170 *See* Engbruch, *supra* note 145, at 131.

171 *Id.*, at 136. Carolina Fairstein is Legal Officer, Economic, Social and Cultural Rights Programme at the Center on Social and Legal studies (CELS), Buenos Aires, Argentina.

172 *See* Koch, *supra* note 144.

Ad 7 – Report on the Realization of the Right to Drinking Water and Sanitation by the Special Rapporteur (Special Report 2005)

Expert El Hadji Guissé drafted guidelines with the objective to help governments, policymakers, international agencies and members of civil society to implement the right to water and sanitation.

In the introduction or preamble, it is mentioned that '[c]onsidering that water resources constitute a common heritage and must be used in an equitable manner and managed in cooperation with the users in a spirit of solidarity'. It is interesting to note that this formulation went beyond declaring water a 'common good' when stating that water resources constitute a 'common heritage'. The term 'common heritage' has been included in other legal fields, such as space law, wherein the Moon and its natural resources are considered 'the common heritage of mankind' in the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies-. However, this was a new approach in laws relating to water.

Of particularly interest is section 4, 'Availability and equitable distribution of water':

> '4.1 States should ensure that everyone has a sufficient amount of safe water, including by adopting and implementing integrated water resources management programmes and water efficiency plans […]
> 4.4 The right to water should be exercised in a manner that is sustainable for present and future generations'.

Section 4 recognizes water management as a means to ensure the right to water. Water programmes based on water management are sustainable and more effective, due to the advantage of obtaining the 'big picture' from satellite data, and including interrelated issues such as vegetation, geology, urban planning and development. Therefore, improving water management through accurate and continuously updated information obtained from remote sensing satellites is a practical measure to fulfil and protect the right to water.

Section 5 'Improving the access to drinking water supply' indicates in para. 5.1 that 'States should progressively ensure that everyone has access to water and sanitation services and that these services are equitably distributed'. In this regard geo-referenced maps and GIS applications are very useful for controlling, monitoring and planning the distribution of public services such as water and sanitation.

Section 6 refers to affordability; para. 6.1 states that States should ensure appropriate water and sanitation pricing policies. Para. 6.2 establishes that for vulnerable groups, such as: low-income household and poor areas, states should subsidize water and sanitation services. Para. 6.4 mentions that '[n]o one should be deprived of the minimum essential amount of water to basic sanitation facilities'. The protection of vulnerable groups is part of human rights, and this document sets forth a specific alternative to help poor areas with subsidies concerning water and sanitation services.

Regarding water quality, Section 7 says that water-quality standards should follow WHO guidelines and consider the particular need of vulnerable groups. Para. 7.4, mentions that 'States should prevent and reduce contamination of watersheds and aquatic ecosystems […]'. In this connection, information obtained from satellites to control contamination and monitor quality of water is very useful.

The draft guidelines in Section 9 includes remedies and monitoring. This is an essential part of enforcing the right to water. This section refers to the need of having administrative or judicial procedures for making complaints about failures by public or private organizations to respect the right to water. Regarding monitoring, the States should monitor the implementation of obligations to the right to water and sanitation and for this task satellite data could be useful.

The last section of this document, Section 10, is about the international obligation and duty of solidarity. Once again the particular role of developed countries is pointed out in the realization of the right to water and sanitation through technical and financial assistance. For this purpose, developed countries should allocate a portion of their official development assistance to achieve the goals in the UN Millennium Declaration and the Johannesburg Plan of Implementation adopted during the World Summit on Sustainable Development (WSSD).

Ad 8 – Annual Report of the UN High Commissioner for Human Rights (UNHCHR Annual Report 2007)

In the conclusions and recommendations of this document, the UN High Commissioner for Human Rights, Louise Arbour, expressed that:

> 'it is now time to consider access to safe drinking water and sanitation as a human right, defined as the right to equal and non-discriminatory access to a sufficient amount of safe drinking water for personal and domestic uses […] to sustain life and health. States […] should take steps to ensure that this sufficient amount is of good quality, affordable for all and can be collected within a reasonable distance from a person's home'.[173]

Ad 9 – Report of the Human Rights Council on its Seventh Session, 3 March-1 April 2008

Resolution 7/22 on human rights and access to safe drinking water and sanitation called for the clarification of human rights obligations in the right to water. For this purpose, the Human Rights Council decided to appoint, for a period of three years, an independent expert on human rights obligations

173 UN Doc. GA/A/HRC/6/3, *supra* note 156, at para. 66.

related to access to safe drinking water and sanitation.[174] The tasks of the independent expert are, among others, to work on the further clarification of the human rights obligations, and the compilation of the best practices related to access to drinking water and sanitation.

In this regard, the international expert should also clarify what constitutes sufficient water per person per day.[175] An international consensus on this regard will provide a clear reference to national governments to establish fair water regulation to protect vulnerable groups when a free water policy is established. Should a limit be set to governmental assistance in providing free water to vulnerable groups? How to protect the right to water and the right to receive a payment for supplying water? The clear formulation of the authority's obligations will contribute to providing certainty to citizens and to the authorities in deciding controversial cases.

5.3.3 Regional and national efforts towards the protection of the right to water as a human right

Regional and national measures to implement the right to water in practical terms should be the basis for the international recognition of the right to water as a human right. Perhaps the difficulty to achieve a general consensus to adopt an international agreement on the right to water derives from the wrong strategy, going from international to national recognition. I consider that the strategy towards the recognition to the right to water should go from national to regional level; subsequently, the regions should push for the adoption of an international agreement on the right to water.

Regarding regional efforts to realize the right to water, this section analyses the situation in Latin America and Europe to identify the particular measures that they have adopted towards the recognition, implementation and protection of the right to water.

The choice to focus on these two regions is based on the following criteria:

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174 The Human Rights Council appointed Ms. Catarina de Albuquerque as the independent expert in charge of the further clarification in the content of the human right obligations related to access to drinking water and sanitation.

175 *See* for example the case Lindiwe Mazibuko and Others v. the City of Johannesburg and Others, CCT 38/09-ZACC28 (ZA Const. Ct. 2009). In this case, the national courts gave different interpretations on the quantified content of sufficient basic water. The South Gouteng High Court established 50 litres of free basic water daily. Later, the Supreme Court of Appeal held that 42 litres of water per day would be sufficient. However the Constitutional Court of South Africa concluded that according to the national regulation a basic water supply constitutes 25 litres per person daily which was the same quantified content of 25 litres in the City's Free Basic Water Policy. This case shows on a national scale the different interpretation of the quantified content that constitutes sufficient water, important information to evaluate whether the authority is fulfilling its obligations to the right to water.

First, the Latin-American region is the object of this study and the application of space technologies for monitoring water is the primary objective of AQUARELSat Constellation. The legal instruments that support the right to water in Latin America could provide arguments to justify that the first Latin-American space project aims at water-space regional cooperation, to improve water management with the use of remote sensing satellites. The final goal is to reach water security at a national and at a regional level.

Secondly, the European region is included as an example of effectiveness in the practice. Europe has been supporting at national, regional and international levels the discussions on the right to water. At the regional level Europe has taken measures for the realization of the right to water. For example the European Directives and standards have clarified general aspects of international treaties, recommendations, declarations and obligations.

5.3.3.1 The Latin-American approach to the right of water

There is no regional agreement addressing the right to water. However, the following regional documents refer indirectly to the right to water:

1 the American Declaration of the Rights and Duties of Man (American Declaration);[176]
2 the American Convention on Human Rights: 'Pact of San Jose Costa Rica' (Pact of San Jose Costa Rica);[177]
3 the Additional Protocol to the American Convention on Human Rights in the Area of Economic, Social and Cultural rights: 'Protocol of San Salvador' (Protocol of San Salvador);[178]
4 reports of the Inter-American Commission of Human Rights (IACHR) and decisions of the Inter-American Court of Human Rights ;
5 national cases related to the protection of the right to water.

Ad 1 – The American Declaration of the Rights and Duties of Man (American Declaration)

The American Declaration has a status comparable to the UNDHR, both were originally adopted as non-binding instruments. However, the General Assembly of the Organization of American States (OAS) has recognized that 'the

176 Organization of American States (OAS), The American Declaration of the Rights and Duties of Man (1948).
177 OAS, The American Convention on Human Rights of 22 November 1969 [in force: 18 July 1978] A-17955 UNTS 1144.
178 OAS, Additional Protocol to the American Convention on Human Rights in the Area of Economic, Social and Cultural Rights (1988).

American Declaration is a source of international obligations for the member states of the OAS'.[179]

The American Declaration is comprised of 38 articles on the rights and duties of OAS member states. The contribution of the American Declaration to the OAS Charter was that the American Declaration specified the human rights mentioned in the OAS Charter; for instance Article IX recognized the right to health and well-being.[180]

Article XI states the right to health and public services. It is a right that entitles every person to the preservation of his or her health through sanitary and social measures.

Ad 2 – The American Convention on Human Rights 'Pact of San Jose Costa Rica' (Pact of San Jose Costa Rica)

This is the main binding document on human rights for the Inter-American System.

Article 26 refers to progressive development and the necessity for state parties to adopt measures for the full realization of the rights implicit in the economic, social, educational and cultural fields set forth in the Charter of the OAS, as amended by the Protocol of Buenos Aires.

Ad 3 – The Additional Protocol to the American Convention on Human Rights in the Area of Economic, Social and Cultural Rights: 'Protocol of San Salvador' (Protocol of San Salvador)

Article 11 mentions the right to live in a healthy environment with access to basic public services, which includes access to safe water. Regarding the provision of public services, this is a states' obligation. States are responsible for ensuring that the population has access to the water network and this it works properly.

Ad 4 – Reports of the Inter-American Commission of Human Rights (IACHR) and decisions of the Inter-American Court of Human Rights

The IACHR was established in 1959, while the Inter-American Court of Human Rights was created 10 years later. These Inter-American bodies promote and protect human rights, and supervise the obligations of State Members in this field.

The IACHR is in charge of processing and solving individual cases of human rights violations by member States of the OAS, after domestic remedies have been exhausted. When the processing of a case is completed, the IACHR's

179 *See* Inter-American Court of Human Rights, *Interpretation of the American Declaration of the Rights and Duties of Man Within the Framework of Article 64 of the American Convention on Human Rights.* Advisory Opinion OC-10/89 of July 14, 1989. Ser. A No. 10 (1989), para. 42.

180 M. Castillo Daudi, *B) El Derecho Humano al Agua en el Derecho Internacional: Aspectos Generales*, in A. Embid Irujo (Dir), El Derecho del Agua 66 (2006).

prepares a report which generally provides recommendations to the State concerned. If the state does not comply with the recommendations, the case could be submitted to the Inter-American Court of Human Rights.[181]

Castillo Daudi points out that the IACHR has indicated the connection between health, food and the access to safe water in adequate living conditions to the exercise of other human rights, such as the right to education and cultural identity.[182]

McCaffrey mentions that the 1997 report on Ecuador could be considered as the recognition of the link between potable water and human well-being.[183] States members of the OAS have the duty to protect the physical integrity of individuals in accordance with the American Convention. And the IACHR identified the risk to human health and life by the contamination of water supplies in the 'Oriente' region in Ecuador. The right to water was not recognized in this case, but the Inter-American Court of Human Rights declared that the failure to meet basic water needs contributed to the violation of other rights.

Another case submitted to the IACHR regarding the right to health from which is inferred the right to water, is the case of the Sawhoyamaxa Indigenous Community v. Paraguay.[184]

The Sawhoyamaxa community alleged that Paraguay had not ensured the ancestral property rights of its community and members. Consequently, the Sawhoyamaxa community was in a state of nutritional and health vulnerability, which threatened their survival and integrity.

The separate opinion by Judge Ventura-Robles includes at point 12, a quotation from the report drafted by expert Dr. Pablo Balmaceda for the IACHR. This reference summarizes the situation in the Community, stating:

> '[the] the [C]ommunity has no source of drinking water. The most reliable source of water may be the rainwater they gather, but it is always very scarce because of inadequate storage facilities. The main source of water consists of the small earth dams […]. These small earth dams are exposed to contact with animals and their water is used both for human consumption and for personal hygiene [...] water has not been supplied for several months […] All the [C]ommunity has been living in severely strained circumstances for many years […] without even one latrine […] without drinking water, there is not even enough water to meet the minimum basic needs […]*The Sawhoyamaxa [C]ommunity lives in extreme poverty*'.[185]

181 *See generally, Id*. 75-77. Castillo Daudi elaborates a summary of the procedure that follows the IACHR.

182 *Id.* at 66.

183 *See* McCaffrey, *supra* note 159, at 99.

184 Sawhoyamaxa Indigenous Community v. Paraguay, Inter-American Court on Human Rights, Judgement (Mar. 29, 2006).

185 *Id.* Separate Opinion of Judge Ventura-Robles para. 12, at 3.

Para. 14 in the separate opinion of Judge Ventura concludes that the IACHR found that the State violated the obligation to respect the rights as alluded to in Article 1(1) and the right to life set forth in Article 4(1) of the American Convention, since Paraguay has not adopted the necessary positive measures within its powers to prevent or avoid putting at risk the right to life of the members of the Sawhoyamaxa community.

The main failures of Ecuador and Paraguay in these two cases were: 1. the failure to fulfil and ensure access to water and sanitation services, jeopardizing the right to health, and; 2. the failure to protect vulnerable and marginalized groups.

Ad 5 – National cases related to the protection of the right to water

Ecuador and Uruguay are the Latin-American countries that have included in their constitutions the right to water as a human right.[186] Bolivia's Constitution recognizes the fundamental right to water and alimentation in Art. 16. Most of the other Latin-American countries could infer right to water from the rights to health and an appropriate environment (healthy environment), for example Argentina, Brazil, Chile, Peru, Venezuela and Mexico.

The reference to national cases is limited to Argentina and Paraguay. The cases address the access to safe water, and in the case of Conet, the right to water. These cases are also related to the protection of health and vulnerable groups, *i.e.* marginalized groups and indigenous communities.

Argentina has two precedents regarding the protection to the right to water: (1) the case of Conet, and (2) Paynemil Mapuche Community. Expert Carolina Fairstein provides the description of these two Argentinean cases:[187]

· *The case of Conet*

Next to Buenos Aires a marginalized area called Conet did not have access to the minimum amount of safe water. The population was suffering from diseases caused by contaminated water.

During the economic crisis, Aguas Argentinas S.A. limited its expansion plans and Conet inhabitants were affected. The construction of a network for this area was delayed. Thus, Conet inhabitants demanded temporary provision of water in tanks and the construction of the network.

An important issue was whether the demand should have relied on the right to water or should have invoked the right to health and safe environment to justify the immediate stake of Conet inhabitants.

The Argentinean Supreme Court had indicated in a previous decision that in the application and interpretation of international human right treaties, the

186 Ecuador introduced the human right to water in its Constitution, Art. 12, and; Uruguay recognized not only the human right to water, but also the right to sanitation in its Constitution, Art. 47.

187 C. Fairstein, *Legal Strategies and Right to Water in Argentina*, in *supra* note 145, at 107-108.

courts should follow the authoritative interpretation of the monitoring bodies of each treaty. Thus General Comment 15 was invoked as a legal basis for the demand, which includes assertions as to the right to water and health.

The importance of Conet case lies in the recognition of the legal value of General Comment 15 in the legal arguments by a national court.

· *The case of Paynemil Mapuche Community*

This case refers to the Paynemil Mapuche Community in Neuquén, Argentina, an indigenous community, that was affected by the pollution produced by transnational oil companies.[188] The water was contaminated with lead and mercury.

In October 1995, members of the community discovered the pollution in the water. Hence, they complained to six different authorities about the heavy-metal pollution in the drinking water.

In November 1996, the local authorities ordered health studies and the results demonstrated that many children had high levels of heavy and highly toxic metals in their bodies.

In March 1997, the Neuquén's Official Defender of Minors filed an 'amparo action'[189] on behalf of the children and youth of Mapuche communities Paynemil to protect their right to health, which was being jeopardized by their exposure to contaminated water. This situation implied that the Province was neglecting to fulfil its obligations to protect the health of the population. The Court accepted the Public Defender's arguments.

A decision dated 11 April 1997 ordered the Provincial Executive Power to do the following:

- first, to provide 250 litres of drinking water per inhabitant per day;
- second, to ensure the provision of water to the affected people;
- third, to take measures and determine the damages;
- fourth, to provide necessary treatment;
- fifth, to take the necessary measures for the prevention of environmental contamination.

The Argentine State failed to comply with the measures to supply water, thus the case was submitted to the IACHR in March 1998. The case was accepted

188 Menores Comunidad Paynemil s/acción de amparo, Expte. 311-CA-1997. Sala II. Cámara de Apelaciones en lo civil Neuquen, 19, Mayo 1997. Minors of Paynemil amparo action. *See generally* International Network for Economic, Social & Cultural Rights (ESCR) Menores Comunidad Paynemil s/acción de amparo: http://www.escr-net.org/caselaw/caselaw_show.htm?doc_id=405963 (last visited 20 February 2009). *See also* Comisión Inter-Americana de Derechos Humanos, *La Causa N° 12.010 Comunidades Mapuche Paynemil y Kaxipayiñ-Neuquen, Argentina* available at: http://www.cedha.org.ar/docs/doc221-spa.doc. *See also* COHRE, supra note 148, at 110.

189 An 'amparo' action is a protective action, to seek the court's protection. It is a remedy for the protection of constitutional rights.

for consideration under the title 'Mapuche Paynemil and Kaxipayiñ Communities, Case N° 12.010'.[190] The solution came when the Argentine State accepted a conciliatory agreement to construct a water treatment plant and other sanitary measures.

In brief, Latin America still has a long way to go before achieving a regional agreement on the right to water as a human right, despite some advances at the national level. The regional authority that should guide the draft of a regional agreement on the right to water is the Inter-American Commission of Human Rights (IACHR) with the assistance of the Pan-American Health Organization.

5.3.3.2 The European position to the right to water

Smets has listed the European countries that recognize the right to water: Belgium, France, Finland, Germany, Italy, Norway, Portugal, Spain, Sweden, Switzerland, Ukraine, United Kingdom.[191]

In the European region there are instruments supporting the right to water, detailed standards and guidelines for their implementation. The European Union recognizes the right to water, in its position at the Water World Forum 2006.[192]

A selection of legally binding documents related to the right to water includes:

1 UN Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (the Aarhus Convention). 25 June 1998;[193]
2 Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes. 17 June 1999;[194]

190 International Network for Economic, Social & Cultural Rights, Mapuche Paynemil and Kaxipayiñ Communities, Case N° 12.010. Available at: http://www.escr-net.org/caselaw/caselaw_show.htm?doc_id=405939&searchstring=mapuche. See also, COHRE, *supra* note 148.

191 *See* Smets, *supra* note 169, at 718.

192 *See* European Parliament, Resolution on the Fourth World Water Forum in Mexico City (16-22 March 2006, Doc. P6_TA (2006)0087 (2006).

193 Convention on Access to Information, Public Participation in Decision Making and Access to Justice Environmental Matters of 25 June 1998 [in force: 30 October] 2161 UNTS 447. *See* also, UNECE, *The Aarhus Convention: An Implementation Guide* (2000). The Aarhus convention has been signed by thirty-nine countries and the European Community, and it has 44 parties. The Aarhus Convention is open to accession by non-Europeans. Kofi A. Annan, former Secretary-General of the UN said that: '[a]lthough regional in scope, the significance of the Aarhus Convention is global'.

194 Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes of 17 June 1999 [in force: 4 August 2005] N. 33207, ECOSOC doc. MP.WAT/AC.1/1999/1 to 24 March 1999.

3 Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy (Water Framework Directive). 23 October 2000;[195]

The following legally non-binding documents are included:

4 Resolution on the Right to Water, European Council on Environmental Law (ECEL). 7 August 2000;[196]
5 Recommendation 14 of the Committee of Ministers to member States on the European Charter on Water Resources, Council of Europe. 17 October 2001;[197]
6 Resolution on the Recognition of the Right to Drinking Water in the Member States of the European Union, European Council on Environmental Law. 17 January 2004;[198]
7 European Parliament Resolution on the Fourth World Water Forum in Mexico City. 15 March 2006;[199]

The individual analysis of the documents will present their contributions to the right to water in Europe.

Ad 1 - UNECE Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (the Aarhus Convention)

The Aarhus Convention was adopted at the Fourth Ministerial Conference 'Environment for Europe' in Aarhus, Denmark. This document links the protection of environmental rights with human rights, addressing the access to information, public participation in decision-making, consultation and access to justice through legal resources for a healthy environment. The convention also makes reference to government accountability, transparency, and responsiveness.[200]

Article 1 indicates that the objective of this convention is to contribute to the protection of the right to live in an environment adequate for health and well-being. States shall guarantee the rights to information, public participation, and access to justice in environmental matters.

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195 OJ L 327 (2000).
196 ECOSOC: Commission on Human Rights, The Resolution on the Right to Water E/CN.4/Sub.2/2000/NGO/19 (Aug. 7 2000). The Resolution on the Right to Water is an Annex to the written statement submitted by the International Council of Environmental Law, a non-governmental organization with special consultative status.
197 Council of Europe, Recommendation (2001) 14 of the Committee of Ministers to Member States on the European Charter on Water Resources (2001).
198 European Council on Environmental Law, Resolution on the Recognition of the Right to Drinking Water in the Member States of the European Union (adopted on 17th January 2004).
199 European Parliament, Resolution on the Fourth World Water Forum in Mexico City (16-22 March 2006, Doc. P6_TA (2006)0087 (2006).
200 UNECE, The Aarhus Convention: an implementation guide (ECE/CEP/72) 13 (2000).

Ad 2 – Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Protocol on Water and Health)

This Protocol is based on the UNECE Water Convention. In my opinion, this is the most complete and clear instrument concerning the right to water. Therefore, other regions should consider the Protocol on Water and Health to recognize, implement and ensure the right to water and sanitation in their region.

The Protocol on Water and Health has 26 articles. Article 1 stipulates that the objective of this document is to promote an appropriate level and protection of human health and well-being within a framework of sustainable development. To achieve this objective the strategy includes improving water management, and preventing and controlling water-related diseases.

Article 2 provides the definitions of the principal terms utilized in the protocol. In this article 'drinking water' is defined: 'means water which is used, or intended to be available for use, by humans for drinking, cooking, food preparation, personal hygiene or similar purposes'.

Article 4 establishes that Parties shall take measures to prevent, control and reduce water-related diseases within a framework of 'integrated water-management systems'.

In addition the Parties shall take measures for ensuring:

- adequate supplies of drinking water for everyone;
- effective protection of water resources used as sources of drinking water, and their related ecosystems;
- sufficient safeguards for human health against water-relate disease arising from various listed sources;
- effective systems for monitoring and responding situation likely to result in outbreaks or incidents of water-related disease.

Article 5 mentions the principles guiding the right to water:

- the precautionary principle meaning the action to prevent, control and reduce water-related disease;
- the polluter-pays principle, in which the polluter shall bear the costs of pollution prevention, control and reduction;
- sovereign right of States on their resources;
- water resources management shall consider needs of present and future generations
- preventive action rather than remedial action, in order to avoid outbreaks and incidents of water-related disease and protect water resources for the provision of drinking water;
- water has social, economic and environmental values and in its management should be considered the sustainable combination of those values;
- efficient use of water should be promoted through economic instruments and awareness-building;

- access to information and public participation in decision-making;
- water resources should be managed in an integrated manner.

Article 6 sets national and local targets and target dates for achieving the objective of this Protocol. The parties shall pursue the aims of: (1) access to drinking water for everyone, and; (2) provision of sanitation for everyone.

For these purposes the State parties shall provide information related to the quality of drinking water and the quality and occurrence of discharges, waste-water collection systems, the performance of water supply and waste-water treatment, applications of recognized good practice to the management of water supply and sanitation, and the reduction of outbreaks and incidence of water-related diseases.

Ad 3 – Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy (Water Framework Directive)

This Directive aims to maintain, improve and protect the aquatic environment. The protection of the aquatic environment is a practical measure to have or progressively realize a healthy environment.

The link between a healthy environment and human health is stipulated in para. 24 of the Preamble: '(24) good water quality will contribute to securing the drinking water supply for the population'.

To achieve the objective of good water the State Members should define and implement necessary measures to prevent and reduce pollution and promote sustainable water management.

This Directive has an integral approach to protect the aquatic environment, in which includes surface water and groundwater, as well as the quantity and quality of water (para. 34 of the Preamble).

In para. 53 of the Preamble, the Directive calls for the full implementation and enforcement of environmental law to ensure the protection of waters. Besides, it indicates that Member States' legislation should consider penalties (effective, proportionate and dissuasive) to ensure the implementation of this Directive.

Ad 4 – Resolution on the Right to Water, European Council on Environmental Law

This Resolution proposes that Governments and international organizations recognize the right of every person to water in accordance with the following principles:

- each person has the right to water in sufficient quantity and quality for his life and health;
- public authorities must adopt measures for improving the access to water for all and control operators in water services management;
- the cost of the service must be apportioned to allow every person to enjoy the right to water;

- individuals and economic actors must respect the right to water.

This Resolution recommends that public authorities ensure the affordability of water. Furthermore it recommends that development aid should be used for the supply of drinking water in developing countries.

Ad 5 – Recommendation 14 of the Committee of Ministers to Member States on the European Charter on Water Resources
Recommendation 14 adopted the European Charter on Water Resources that replaces the European Water Charter adopted in Strasbourg on 6 May 1968. It recommends Member States to assimilate the Charter and implement the principles in their national policies.

Para. 1 indicates that 'fresh water resources must be used in keeping with the objectives of sustainable development, with due regard for the needs of present and future generations'.

Para. 5 establishes that everyone has the right to 'sufficient quantity of water' for his or her needs. In addition, it indicates that social measures should be taken to prevent cutting off the supply of water to destitute persons.

Para. 6 states that public and private partners should introduce integrated water management, which means planning sustainable development in water management.

Para. 7 mentions that '[i]ntegrated management must be based on an inventory of water resources and aim to ensure their protection, conservation and, if necessary, rehabilitation'. An inventory of water resources must include an assessment of their quantity and quality, considering present and future uses.

Para. 8 indicates that '[w]ater policy and law must be based on the principles of prevention, precaution and correction at source as well as the 'polluter-pays' principle'.

Para. 10 mentions that water resources must be regularly monitored and their general state periodically assessed.

Paras.13, 14 and 15 consider the importance of regional cooperation in water management.

Para. 18 refers to legal procedures available through administrative or judicial appeal against decisions in connection with the management or utilization of water resources.

Ad 6 – Resolution on the Recognition of the Right to Drinking Water in the Member States of the European Union, European Council on Environmental Law
This resolution recommends that each State of the European Union take appropriate measures to ensure the effective implementation of the right to water:

- it recognizes the access to drinking water and sanitation as a fundamental right of the individual;

- individuals have the right to be provided with sufficient drinking water for their fundamental needs and entitles to benefit from the provision of sanitation services;
- the cost of water supply and sanitation services shall be calculated transparently and seek to recover the net costs of providing water services. Social measures shall be implemented for people in reduced financial circumstances;
- public authorities shall take measures to guarantee the quality of drinking water and to ensure that water supply and sanitation networks are enlarged in accordance with land use, planning, and urban development requirements.

Ad 7 – European Parliament Resolution on the Fourth World Water Forum in Mexico City

Para. 1 'declares that water is a shared resource of mankind and that, as such, access to water constitutes a fundamental human right'.

Para. 2 called for the Commission to represent the European Union at the Fourth World Water Forum

> 'With the mandate to seek the recognition in the final ministerial declaration that access to drinking water is a fundamental human right; calls, in this context, for the European Union and its Member States to propose, under the auspices of the United Nations, the drafting of an international treaty on water and the management of water resources which recognizes the right to access to drinking water'.[201]

Paragraph 11 promotes an integral approach that emphasizes the link of drinking water and sanitation with a cross-cutting development strategy that includes health, education, infrastructure, capacity-building, good governance and sustainable development.

Paragraph 12 refers to the importance of early prevention of regional water conflicts, especially where there are countries sharing a common basin, and calls to improve regional water policy coordination and to set up regional water management bodies.

5.3.4 The rights and duties related to the right to water

Smets has identified the rights and duties of citizens and public authorities to achieve the right to water.[202] The list below refers only to a selection of principal duties and rights, which, in my opinion, can be realized with the

201 *See supra* note 199, at para. 2.

202 To check all the listed right and duties *see* Smets, *supra* note 169 at 714-716.

use of space technology. Thus, I have linked these rights and duties to satellite applications below.

1 *Rights of citizens*

- the right to connect to existing networks (to fulfil this right public authorities can use satellite data from remote sensing and navigation satellites in the drafting of geo-referenced maps to maintain and extend the water networks);
- the right to use public standpipes and appropriate sanitary facilities (remote sensing and navigation satellites can find the best locations for installing standpipes and sanitary facilities such as public latrines taking into account distances, existing networks, population density and wastewater disposal management);
- the right to draw water from rivers, wells, standpipes, etc, for essential domestic uses (remote sensing satellites and navigation satellites can help authorities to locate and monitor water supplies; the right to access information about water supplies by citizens can also be improved with satellite information);
- the right for men and women to access to information, consultation and participation in decision making water services (remote sensing, navigation and telecommunication satellites can help with this right. The first two satellites can provide updated information and telecommunication satellites can contribute to the fast transmission of information to public websites, throughout the country and region including distant and remote communities);
- the right to initiate legal proceedings to protect the right to water (the output of remote sensing and navigation satellites can be combined to produce useful information in legal proceedings for the probationary phase. The problem is to determine the legal value of such information. For example, authorities can monitor the polluters by using satellite imagery at the national level. At the regional and international levels, satellite imagery can help ensure a country's compliance with the agreements to protect water supplies).
- the right to water supply in case of emergencies (earthquakes, pollution, etc.) remote sensing, navigation and telecommunication satellites have useful applications in the management of emergencies. For instance, navigation satellites can locate the closest water supplies and the possible routes to reach them; while remote sensing satellites can provide information about quality and quantity of water).

2 *Duties of citizens*

Authorities can use satellites to monitor at the national level the compliance of their citizens.

The different applications of remote sensing for water management include for example, control and monitor of wastewater to prevent pollution of water resources. Remote sensing and navigation satellites can help to locate polluted water supplies and the polluters, these being an effective means to implement national prevention and control of contamination of water supplies.

One of the duties of citizens is to avoid wasting water. This duty applies to citizens and authorities who should also commit themselves to avoiding water wastage, to maintaining in good condition the infrastructure that delivers water to citizens.

3 Rights of public authorities

Public authorities have:

- the right to protect drinking water sources from activities capable of impairing them (remote sensing satellites can help authorities to monitor and protect water resources from pollution and other activities that damage water quality and quantity such as deforestation, new human settlements, etc. Furthermore, space technologies can assist authorities in monitoring wastewater management from beach hotels, oil platforms, industries, hospitals, etc.);
- the right to select adequate technical standards taking into account agreed international standards and appropriate technologies (remote sensing and navigation satellites in combination with ground data provide information to monitor the quality conditions of water to compare them with international standards of safe water);
- the right to forbid distribution of unsafe water (remote sensing satellite applications can identify unsafe water. When unsafe water is identified, the authority needs to inform and take the necessary measures to forbid distribution of unsafe water. Furthermore, the authorities should implement a rehabilitation plan to recover the water sources that do not meet quality standards, and; consider the means for providing safe water to the population affected);
- the right to prosecute offences and violations related to water services and contracts (remote sensing satellites can help authorities to monitor activities related to water services and contracts *e.g.* coverage, infrastructure, etc., and in the case of violation, legal remedies).

4 Duties of public authorities

Public authorities have the duty:

- to adopt strategies and plans of action for water services, to ensure sustainability of costs of water supply and sanitation (remote sensing satellite applications help to design strategies and plans for water services; for instance, remote sensing data help to identify routes of coverage, basic characteristics of urban planning, geographical constraints, water network,

environmental impact etc., such information is crucial for decision makers to adopt a good strategy);

- to create and operate water supply and sanitation networks wherever necessary, to ensure proper maintenance and renovation of facilities (remote sensing satellites can assist authorities in the extension and maintenance of the water network with geo-referenced maps);
- to ensure protection of water collection points and water quality, to protect the environment against pollution by wastewater and collective treatment plants (remote sensing applications for the elaboration of geo-referenced maps to monitor water quantity and quality);
- to assess the quality of water services, to ensure compliance with contracts by private operators, and that water utilities meet their mission of public service (remote sensing satellites can monitor the compliance of private operators regarding provision of water service);
- to identify people without adequate access to water supply and sanitation in urban and rural areas (remote sensing satellites helps providing geo-referenced maps).

5.3.5 Justification of the primary objective of AQUARELSat

The primary objective of AQUARELSat is the monitoring of water resources to improve water management. The use of space technologies to improve water management is a concrete measure to implement the right to water as a human right and promote human development in Latin America.

Access to water is a regional problem in the Latin-American region, which is, perhaps the most unequal region in the world. Many people in the region have private swimming pools and spas, but many other people do not have access to safe water for their daily needs. The poverty in slums and remote areas can be as shocking as in Africa.

Thus, considering that countries cannot rely only on international aid, and they need to be independently, search for solutions to reduce poverty and realize the right to water, AQUARELSat proposes to develop national and regional capabilities in Latin America. Beyond the good intentions and political declarations Latin-American countries can improve the quality of life and reduce poverty through the use of space technologies. Satellite data can improve water management, which is a basic tool in making good decisions regarding water governance, and to achieve the right to water and water security.

Water-space cooperation aims to improve two areas in Latin America: water management, and space science and technology. Greater regional cooperation regarding water is feasible due to geographic reasons (shared transboundary aquifer resources).

5.4 CONCLUSION

The UN Charter establishes the legal platform of the principle of international cooperation to promote friendly relations among countries. This principle was formulated as a maxim in general terms in the UN Charter. However, it is difficult to imagine a legal rule for international cooperation to fulfil the duty of cooperation without considering national interests. The right of states to decide on international cooperation is a sensitive issue related to the right of sovereignty. Thus, the enforcement of international cooperation as a legal duty is complex in practical terms.

The principle of international cooperation was interpreted in the Declaration on Friendly Relations (along with another six principles). During the adoption of this Declaration, part of the debate tried to determine whether international cooperation was a legal or moral obligation. This same discussion went on in the space field. The position of Latin-American experts such as Dr. Cocca, Dr. Ferrer, and Dr. Gaggero, was that space cooperation is a legal obligation in accordance with the UN treaties and principles on outer space.

International cooperation is an essential legal principle in the Outer Space Treaty, a principle in the regulation of space activities which has been developed in different areas, for example remote sensing activities.
Regarding international cooperation in remote sensing activities, this principle was adopted in the 1986 RS Principles. Sensed and sensing states agreed to their rights and duties, and to the conditions for cooperation in remote sensing, finally reaching an agreement 15 years after discussions first began.

At present, the sensed and sensing states which represented different points of view and interests during the drafting of the RS Principles, are no longer opponents in opposite camps. The situation changed, because in practice we have now sensing states, who are also sensed sates and conversely. Besides, new forms of international cooperation have overcome much of the differences in remote sensing activities.

There have been proposals to modified the RS Principles or adopt a binding document. The ILA's Space Law Committee has identified that the further development of remote sensing should be addressed by multilateral and regional agreements in remote sensing. In this regard, the option to introduce changes in remote sensing within COPUOS seems impossible mission, thus countries should consider the alternative of being more active in remote sensing and participate in remote sensing agreements to fulfil the gaps of the RS Principles with their practice.

The last theme of this chapter is the right to water. The discussion on the right to water presented the legal background to the recognition of the right to water as a human right. Likewise, this section sought to emphasize the link between the right to water and the applications of remote sensing satellites. This link is based on legal arguments, justifying why the primary objective of AQUARELSat is on water management, in order to achieve the right to water

and water security. AQUARELSat is focused on bringing concrete benefits to people. With AQUARELSat national authorities could have an opportunity to take practical measures for the realization of the right to water.

The theoretical framework of the right to water as a human right has developed in the last few years. However, there is no political will to reach an international agreement to recognize the right to water as a human right. In this scenario, States have the option to start implementing measures to improve water management and work on the goal of obtaining the right to water and water security. A practical measure to realize the right to water is the use of satellite data to assist authorities in respecting, protecting and fulfilling the right to water.

The next Chapter 6 addresses the legal aspects in the implementation of the first Latin-American space mission AQUARELSat, by means of a multilateral agreement for its operation. Nevertheless, Chapter 6 foresees a broader scope of regional space cooperation beyond AQUARELSat. Thus, a long-term plan is presented with three legal models of space cooperation, in which one of the models is the AQUARELSat agreement. The development of space capabilities in the region will be the condition for proceeding from non-institutional to institutional legal models of space cooperation.

6 Proposal: a Three-Phase Plan

> 'Anyone who has never made a mistake has never tried anything new'.
> Albert Einstein

The three-phase plan is a detailed roadmap of the evolution and legal consolidation of Latin-American space cooperation. The first phase consists of learning by doing and the establishment of national space capabilities in more Latin-American countries. The concrete proposal in the first phase is to operate the AQUARELSat Constellation and implement space-water cooperation under a multilateral agreement.

The second phase is based on established national space capabilities and the political motivation to become a Latin-American space power, as reflected in the drafting of a Latin-American Space Agency (LASA) Convention.

The third phase is a proposal to achieve Inter-American space cooperation within the Organization of American States (OAS) through the coordination of LASA, the National Aeronautics and Space Administration (NASA), the Canadian Space Agency (CSA) and other national space agencies in Latin-America, such as the National Commission on Space Activities (CONAE), and the Brazilian Space Agency (BSA).The coordination of space capabilities is for 'integral development' in the continent based on space applications.

Table 9 – Summary of the three-phase plan for Latin-American space cooperation

AQUARELSAT	*LASA*	*IASC*
Multilateral space cooperation	Regional space cooperation	Inter-American space cooperation
AQUARELSat's objectives	LASA space policy	Inter-American space policy
Non-institutional	Institutional	Institutional coordination
Learning by doing	Political motivation	Political motivation
National facilities	Regional facilities	Coordination of regional and national facilities
Sovereignty	Regional community	Coordination of community and sovereign interests
4 Latin-American countries	All Latin-American countries	OAS Member States (LASA, Latin-American space agencies, NASA and CSA)

AQUARELSAT	*LASA*	*IASC*
Inter-governmental space cooperation	Regional space cooperation	Inter-American space cooperation
Water management Natural resources Natural disasters	Science & research Technology & innovation Different space applications	Space applications for integral development within Inter-American projects

6.1 First phase: multilateral space cooperation, AQUARELSat

In the first phase to implement multilateral space cooperation, the proposal is to develop and operate a small satellite constellation for water management and for monitoring other natural resources and natural disasters: AQUARELSat Constellation (see supra Chapter 4).The primary objective, water management, is selected as a priority in the region as a means to achieve national and regional water and food security. In addition, water security has a positive impact in all areas of national and regional development.

AQUARELSat is the starting point to develop the first legal model of space cooperation through a specific multilateral agreement among four Latin-American countries (see infra Appendix E).

Space cooperation in this first phase is not seeking to create a Latin-American space institution, but to initiate the development and operation of a constellation of small satellites to monitor water management, other natural resources and natural disasters.

The AQUARELSat Constellation will be funded by each of the AQUARELSat Members –they will each fund one of the four small satellites, as well as the ground station for logistics and operation of their respective satellite. This configuration allows for each AQUARELSat member to have direct reception of satellite imagery from their respective satellite to be distributed by them to their national end users and to the other countries participating in the AQUARELSat Constellation.

AQUARELSat Members should establish in the multilateral agreement the AQUARELSat central authority to coordinate and represent AQUARELSat Constellation at the regional and international level. The AQUARELSat central authority will be in charge of coordinating the operation of the four satellites and of distributing satellite data to non-members of AQUARELSat.

6.2 Second phase: institutionalization of regional space cooperation

The second phase would consist of extending space cooperation to more Latin-American countries. After the deployment of the first Latin-American satellite constellation it would be more feasible to count on the cooperation of more countries with national space capabilities and experience in the region. The scenario would be more homogeneous regarding the Latin-American countries

with experience in space projects, and data processing and distribution, thanks to the development and operation of the AQUARELSat Constellation. National space capabilities would facilitate the institutionalization of space cooperation in a permanent regional institution called LASA.

The establishment of LASA will require the drafting of a convention with annexes or protocols on specific matters concerning the structure, functions, and operations of LASA. Among the issues that the convention has to indicate are the following: the LASA space programme, the location of headquarters and regional space facilities, financial provisions, industrial policy, access to satellite data and space technology, issues of intellectual property and copyrights, the executive and legislative organs with their functions and procedures to adopt decisions. The Council of LASA will be in charge of defining the LASA space policy in general and in particular terms (*e.g.* industrial policy, remote sensing policy, data policy).

Therefore, the second phase consists of implementing an institutional model of space cooperation for the establishment of LASA. In this second-phase political will and motivation are needed, for the region to become a space power.

In this research, I have not included a draft of the Convention for the Establishment of the LASA (LASA Convention), because the key elements for its drafting would have to be decided by the countries participating in the in the drafting. Another reason for not including it is that national space capabilities need to be developed to determine how to deal with regional space facilities.

In general terms, the LASA Convention would be adopted to meet common objectives, where there will be trade-offs of rights and obligations to clarify the advantages of participating in such Convention. However, at present it is difficult to identify how far the Latin-American countries are prepared to move towards common space activities.

6.3 THIRD PHASE: INTER-AMERICAN SPACE COOPERATION

The third phase suggests the establishment of the IASC, an inter-governmental space advisory body within the Organization of American States (OAS). The IASC will be in charge of coordinating and promoting the exchange of information among LASA, NASA, CSA, CONAE, BSA and other national space agencies in Latin America to extend the benefits of satellite imagery to the Inter-American region. The IASC objective will include enhancing the use of space applications for the integral development of the Americas.

To achieve the third phase, no treaty would be required: the IASC could be created through an OAS General Assembly resolution.

The IASC will comprise experts from the space authorities of the IASC Member States. In addition, it is recommended that the IASC collaborate with

the Inter-American Communications Commission (CITEL) and the Department of Sustainable Development within the OAS. For instance, the IASC with the CITEL could work on guidelines to protect frequency assignments for remote sensing services and avoid harmful interference.

In this third-phase the challenge would be to achieve an effective coordination between LASA, NASA, CSA, and other Latin-American space agencies for the efficient use of space applications in development projects of the Americas.

6.3.1 The Organization of American States (OAS)

The OAS was established at the IX International Conference of American States in Bogotá, Colombia in 1948. The OAS is a regional intergovernmental organization with 35 members.[1] OAS includes North-America, Central-America, South-America and the Caribbean countries.

Within the framework of the UN, OAS is recognized as an international organization representing the Inter-American system; at regional level it is the authority that handles disputes and conflicts in the American continent, before UN intervention.

The Charter of the OAS[2] (OAS Charter) indicates its purposes in Article 1, in which the 'collaboration' is included:

> 'Article 1. The American States establish by this Charter the international organization that they have developed to achieve an order of peace and justice, to promote their solidarity, to strengthen their collaboration […]'.[3]

Article 2 (f) refers to the purposes of OAS, particularly para. f, refers to cooperation: 'f) To promote by cooperative action, their economic, social, and cultural development'.

Article 30 sets out that Member States should seek their 'integral development', which is understood as follows: 'Integral development encompasses the economic, social, educational, cultural, scientific, and technological

1 M. Diez de Velasco, *Las Organizaciones Internacionales* 739, 15ta ed. (2008). (With this regard, it is important to indicate that 35 Members States have ratified the OAS Charter. However, the participation of Cuba and Honduras are under circumstances. In 1962 Cuba was excluded to participate in the OAS, but in June 2009 OAS adopted a new resolution that ceased the exclusion of Cuba, and; Honduras has been suspended from active participation in the OAS since 28 June 2009. *See* OAS http://www.oas.org (last visited 20 July 2009).

2 Charter of the Organization of American States (A-41) (1948), entry into force 12/13/51, UNTS 119 (I-1609).

3 *See* OAS, The Charter of the OAS, Part One, Chapter I. http://www.oas.org/juridico/English/charter.html (last visited Feb. 2, 2008).

fields through which the goals that each country sets for accomplishing it should be achieved'.[4]

In order to achieve integral development countries of the Americas have the option of developing common projects through Inter-American cooperation. Space activities would encourage and enhance integral development at national and regional level; thus space activities can claim regional collaboration with due respect of national development programmes.

The OAS organ responsible for enhancing integral development is the Inter-American Council for Integral Development (CIDI). It promotes cooperation among the American States to reach integral development and eliminate extreme poverty.

At present, OAS is not involved in space projects or activities. However, it has been working on sustainable development through the Department of Sustainable Development (DSD), in which are included projects on water management. Furthermore, within OAS framework there are two other authorities related to space applications and services: CITEL, the Commission composed of experts on telecommunications and radio frequency spectrum issues, including space services, and; the Pan-American Health Organization (PAHO) which is the Inter-American System's specialized organization for health issues, and has been working on tele-epidemiology, tele-health and tele-medicine. OAS could be the proper channel to coordinate the use of satellite data to promote integral development in the Americas.

6.3.1.1 The Department of Sustainable Development (DSD)

The DSD is the institution that supports OAS Member States to design and implement policies and projects to reach sustainable development. The DSD is involved in remote sensing activities from the practical point of view, due to the diverse range of space applications that are needed to encourage sustainable development in Latin America. For example, space application for the protection of the environment to control contamination in natural areas, for the localization of groundwater, plans for irrigation canals for agriculture, etc.

The strategic areas leading DSD work are water management; renewable energy; natural hazards; climate change adaptation and land use planning; sound chemicals management and environmental health; biodiversity and payment for ecosystem services, environmental law, policy and trade.[5]

DSD depends on the Executive Secretary for Integral Development (SEDI) within the OAS.[6] The DSD is in charge of designing and implementing regional

4 *Id.* Article 30, Chapter VII in the Charter of the OAS.

5 OAS, *Department of Sustainable Development (DSD)* at http://www.oas.org/dsd/MissionObject.htm (last visited 5 January 2008).

6 *See* Charter of the OAS, art. 117.

cooperation towards sustainable development and reducing the hazards of natural disasters. Two specific objectives of DSD refer to regional cooperation: the first is related to the formulation and execution of technical cooperation projects; and the second to the promotion of cooperation among bilateral and international agencies and non-governmental organizations.

A future regional space programme could be classified as a technical cooperation project within the DSD's field of expertise, if the project were related to satellite applications for sustainable development.

One of the challenges that the DSD is facing to meet its mission is the need of satellite imagery:

> 'Improved data for decision-making. Among the key challenges facing the Hemisphere is the need to increase statistical information and analysis on environmental conditions and sustainability indicators at the country-specific and regional levels'.[7]

Water management and the sustainable management of other natural resources are specific areas that will benefit from improved data for decision-making. In my opinion this challenge can be met by Earth observation applications through a regional satellite project that supplies this information, such as AQUARELSat Constellation.

In the field of water management, the DSD supports Member States in improving management, conservation and sustainable use of water. For these purposes the DSD carries out the promotion of water governance, capacity building in institutions, and the exchange of information by the Inter-American Water Resources Network (IAWRN), which provides information from and for the experts in the region. The IAWRN has been a useful tool for promoting education, exchanging communication and cooperation, as well as strengthening water resources partnerships.

The projects on water resource management conducted by the DSD are performed in partnership with the United Nations Environment Programme (UNEP), the World Bank and the Global Environment Facility.

In this respect, there are different projects and initiatives, for instance the

Project for the Environmental Protection and Sustainable Development of the Guarani Aquifer System,[8] which is the most important source of freshwater in South America. Its regional importance has motivated governments of Argentina, Brazil, Paraguay and Uruguay to agree on the establishing a common framework for managing and preserving this aquifer with the assistance of the DSD.

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7 OAS, *DSD Mission* at www.oas.org/dsd/MissionObject.htm (last visited 24 July 2009).

8 OAS, *DSD, Integrated Water Resources Management* http://www.oas.org/dsd/waterresources.htm (last visited 5 January 2008).

6.3.1.2 The Inter-American Telecommunication Commission (CITEL, Comisión Interamericana de Telecomunicaciones)

The CITEL deals with the radiofrequency use for terrestrial and space services. CITEL is focused on the development of telecommunication services including satellite telecommunications.

In 2006 my first proposal to implement space cooperation in Latin-America was based on the creation of an ad-hoc working group in the CITEL's Permanent Consultative Committee II: Radiocommunication including Broadcasting (PCC II).[9] The PCC II was selected to host this working group because radiocommunication services include EESS.[10] This proposal suggested that this *ad hoc* group could be in charge of developing the space programme in Latin-America consisting of a constellation of small satellites.

Among the advantages of establishing an *ad hoc* group in the PCC II were experts in the region will be dealing with the protection and coordination of the necessary space frequencies for the remote sensing satellites that are used by the regional constellation. In addition, this group would allow for the development of a regional position to protect present and future frequencies allocated for the EESS.

Nevertheless, there are two main constraints to CITEL's being in charge of the Latin-American space programme. First, although the radiocommunication services include the EESS, CITEL's mandate is focused on telecommunication issues. Second, an *ad hoc* group in the PCC II cannot undertake the huge task of coordinating space cooperation to design, construct, deploy and operate a small satellite constellation. This task is beyond its faculties and functions.

6.3.1.3 Health and safe water. The role of the Pan-American Health Organization (PAHO)

In the health field, the Americas region works together with the Pan-American Health Organization (PAHO), which is the World Health Organization (WHO)'s regional office for the Americas. The WHO is part of the UN system.

The Americas is the most unequal region qua income distribution,[11] and poverty has been the main enemy of health for many years. PAHO describes this situation in one phrase: 'health is the human face of development'. National development is impossible without improving health. Countries in the Americas need to work at national and regional levels to improve health

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9 16th UN/ International Astronautical Federation (IAF) Workshop on the Use of Space Technology for Water Resources Management. Valencia, Spain, from 29- 30 September 2006. Presentation by C. Jimenez Monroy 'Multipurpose Microsatellite Constellation for the Latin American Region: an Option to Improve Water Management Activities'.

10 ITU Radio Regulations, Article1 (1.51).

11 Pan-American Health Organization (PAHO), *Millennium Development Goals* http://www.paho.org/english/mdg/cpo_bienvenida.asp (last visited 15 December 2007).

conditions of the population, reducing poverty and encouraging education, as part of different commitments related to human dignity and rights.

Access to safe water is reflected directly in health with obvious consequences for national development and the budgets of the countries. It is well known that populations vulnerable to waterborne diseases are affected by poverty and most of them are located in poor rural areas and urban slums. Furthermore, vulnerable populations are those people who do not have access to safe water or have a deficient service delivery, due to the lack of infrastructure to provide these services.

Safe water issues and related activities are organized under the guidelines of the Millennium Development Goals (MDGs).[12] The WHO has identified the health issues within the MDGs. Concerning access to drinking water, Goal 7 seeks to ensure environmental sustainability and establishes as a health target, as mentioned above, to '[h]alve, by 2015, the proportion of people without sustainable access to safe drinking-water and sanitation'. In order to evaluate advances, uniform measurements functioning as indicators have been adopted. Health target 10 is linked to MDG health indicator n. 30: 'Percent of population with sustainable access to an improved water source, urban and rural'.[13]

According to PAHO the regional situation in target 10 is that despite the fact that the region has abundant water resources, there is still inadequate service coverage and delivery: '[a]lmost 80 million people in the region still lack access to safe water, and more than 100 million do not have access to sanitation services'.[14]

In the field of sanitation, the situation in the region has many variations from one country to another. The countries that have been identified as having to work the hardest to meet the target for sanitation are: Nicaragua; Haiti; Saint Lucia; Bolivia, and; Guatemala.[15]

Regarding the control of waterborne diseases, the problem is that they are important cause sof deaths in the region. An example of the relationship between coverage of water and sanitation services and levels of health and human development is presented by the PAHO, which notes that the 'regional child mortality rate due to diarrhoeal diseases was 3.7% and as high as 7.8%

12 UN Doc. GA/RES/55/2 (2000).The MDGs are established in the United Nations Millennium Declaration adopted in this UN resolution. Section III titled 'development and poverty eradication', includes in paragraph 19 that it was resolved 'to halve, by the year 2015 […] the proportion of people who are unable to reach or to afford safe drinking water'.

13 WHO, *MDGs-The health indicators: scope, definitions and measurement methods* 5 (2003). (The indicators are part of the strategy as defined by the WHO. The 'Strategy for long-term development of core health indicators' is reported periodically in the elaboration of the world health reports.

14 PAHO, *MDGs: Regional situation analysis*. http://www.paho.org/english/mdg/cpo_meta7.asp (last visited Mar. 12, 2008).

15 *Id.*

in the Andean sub-region in 2000-2005'.[16] Ministries of Health spend many resources fighting waterborne diseases. However, the trend in health policy adopted by WHO and consequently by PAHO, is the policy of 'prevention'. The Latin-American countries need to implement local and regional strategies against waterborne diseases. For that purpose, countries need to extend the coverage of safe water and sanitation, as well as monitor polluted water and protect surface and ground water supply sites from contamination.

6.3.2 Coordination of satellite data within the OAS

There are different entities within the OAS that could improve their functions with the broader use of satellite data. For instance, PAHO's projects on tele-epidemiology and DSD's projects on environmental protection could find a useful tool in satellite data. Thus, an Inter-American mechanism, such as the IASC, to coordinate the exchange of information and best practices to support integral development projects of the Americas is a proper channel to strength space cooperation in the Inter-American region and support OAS' functions regarding development.

In particular, the projects that could derive from the collaboration between CITEL and the proposed IASC are interesting, because experts in the space field would participate in both committees. For example, CITEL could advise the IASC Members how to deal with the regional protection of radiofrequency spectrum for passive Earth observation operations.

6.4 CONCLUSION

Chapter 6 has presented the main aspects of the proposal for the legal implementation of Latin-American space cooperation, which is a three-phase plan. The three-phase plan takes into account the evolution of national and Latin-American space capabilities.

The first phase starts with space-water cooperation to develop, deploy and operate the AQUARELSat Constellation under a non-institutional model that requires a multilateral agreement concerning the operation of AQUARELSat Constellation.

The second phase is the proposal of having a regional space institution called LASA to extend the objectives of space cooperation and to extend space cooperation from multilateral to regional in scope. The second phase would combine practical aspects of space applications with the political will of the

16 See Pan- American Health Organization, *An Overview of Regional Health from the book Health in the Americas 2007*. Volume I-Regional http://www.paho.org/English/DD/PUB/csp27-stp622-e.pdf (accessed 3 December 2007).

region to become a space power. This second phase would be implemented through a LASA Convention that needs to be elaborated by the participant countries.

The third phase seeks to coordinate space agencies and authorities within the OAS to facilitate the use of satellite data for integral development projects in the Americas. The IASC would be an inter-governmental space advisory body within the OAS, which would be created by an OAS General Assembly resolution.

7 Conclusions and recommendations

> '…space law is not something that is just out there in outer space orbiting around; it is something that is on the earth. It involves people with problems on the earth; it involves funding and institutions, rules and regulations'. Eilene M. Galloway, UNISPACE 82.

The AQUARELSat Constellation is a concrete, specific proposal to achieve space-water multilateral cooperation. The AQUARELSat Constellation is an option for the legal implementation of multilateral space cooperation in Latin-America.

AQUARELSat is the first phase of a three-phase plan (see supra Tabla 9) for the legal consolidation of regional space cooperation in Latin-America. The first phase evolves from a non-institutional model towards a consolidated institutional model of space cooperation. In this three-phase plan, the progressive evolution of the legal models of space cooperation is linked to the development of the space capabilities in the Latin-American region.

The first phase consists of the development, deployment and operation of the first Latin-American small satellite constellation named AQUARELSat: the Water Monitoring Constellation (see infra Appendix E).

The AQUARELSat Constellation consists of a group of four small satellites, each one funded by one of the AQUARELSat members. The members would also establish and fund the four ground station for logistics and operation of their respective satellite.

The primary objective of AQUARELSat is to monitor water resources. The secondary objectives of AQUARELSat are related to monitoring of other natural resources and natural disasters. The combination of applications and services to carry out the primary and secondary objectives of AQUARELSat is planned, in order to gain a larger user base for a sustainable space mission.

Why small satellites? The short answer is that the small satellites are faster, cheaper and better due to the distributed mission complexity. It is faster because it provides a direct way to have hands-on experience in space. It is cheaper because with small satellites a country can obtain space expertise from satellite companies at affordable cost. It is better because small satellites are recommended for dedicated space missions to cover special niches of insufficient information. The small satellites encourage innovation in technologies and materials due to the miniaturization and reliability requirements of the components and instruments.

A small satellite alone would face limited coverage and information-gathering capabilities, but a coordinated group of small satellites could overcome those limitations by providing continuous coverage and complete information from different payload instruments.

The proposal to implement the AQUARELSat provides a flexible scheme under a multilateral agreement among the four participating Latin-American countries. This multilateral agreement establishes the legal basis for the coordination of the four small satellites in the AQUARELSat Constellation, emphasizing that the coordination of activities and the legal representation are facilitated through a central authority.

Why use a non-institutional legal model for the first phase? A non-institutional model is appropriate for the first phase because the priority in this phase is to achieve effective and efficient use of outer space through space cooperation. The legal implementation of the AQUARELSat Constellation under a non-institutional model is a practical way to start learning by doing. The legal implementation of space cooperation in this first phase has the clear objective to use remote sensing for achieving water and food security. In other words, the first phase focuses on space cooperation, through the development and operation of the AQUARELSat Constellation. This is done in order to have a positive impact on national and regional development using space applications.

Therefore, the institutionalization of space cooperation in this first phase is not a priority. This is because there is a practical goal in the configuration of the AQUARELSat Constellation, rather than a political goal to become a Latin-American space power and have a regional space institution.

The main trend in Latin America is towards institutionalization of regional space cooperation through creation of a Latin-American Space Agency (LASA) or South-American Space Agency (SASA). These two proposals are based on the archetype of ESA.

ESA is an outstanding success case of regional space cooperation, but institutional cooperation in the nature of ESA is not a convenient first step in implementing Latin-American space cooperation.

ESA was born as a sum of different elements, on which Europe started to work in the beginning of the 1960s with the establishment of ESRO and ELDO. Therefore, while the ministerial meetings of the ESC were discussing the development of the European space cooperation with the unification of ESRO and ELDO into ESA, State Members of ESRO and ELDO were already working on their space programmes on a multilateral basis. This situation brought particular advantages to the establishment of ESA.

The elements that ESA gathered before its consolidation as a European space institution were the following: 1) a space programme; 2) European space facilities; 3) a European space industry, and; 4) a common interest for establishing a European space power.

In contrast, these elements are not found in the Latin-American scenario. The Latin-American region needs to start working on the development of these

elements, for example through the development and operation of a constellation such as AQUARELSat. With the development of AQUARELSat, the Latin-American countries would obtain experience running a space programme at a national and multilateral level. In addition, AQUARELSat is a good option to promote the establishment of national space facilities and industries.

Regarding national support of space activities, the practical approach of AQUARELSat could enable the decision-makers and citizens to become more aware of the benefits of space activities, such as remote sensing. The development of the AQUARELSat Constellation could be the seed that rouses the interest in, and the need for a regional space institution.

An additional benefit from the operation of the AQUARELSat Constellation is that the regional space arena would be able to introduce new Latin-American countries to space capabilities. This is a step toward more uniform space capabilities in the region before the possible establishment of LASA. A more homogeneous scenario in space capabilities would allow sharing the weight of the new space institution with a larger number of Latin-American countries. The dynamism and synergy from working as a group would be more beneficial to all.

In addition, the establishment and operation of ESA has been successful because its integration followed two main principles: continuity and coordination. Otherwise, the ESA Convention would not have had the impact that it had on European space cooperation.

From the legal point of view, the ESA Convention respects and considers the interests of all ESA Members States. For example the Convention takes into account: (1) a flexible approach of the ESA space programme with mandatory and optional activities; (2) a flexible approach to the financial system for contributions based on the Gross Domestic Product (GDP) income, and; (3) an industrial policy to enable efficient use of financial and technical resources to justify distribute opportunities among ESA Members. These measures promoted and encouraged the European space industry.

On the other hand, in Latin America the situation is totally different. At present, (1) there is no general idea, draft or proposal for a Latin-American space programme; (2) there is no outline of a legal framework that would consider the different interests of the Latin-American States,[1] and; (3) there is only a limited space industry in the region. The problem of having a limited space industry would make it difficult to distribute the opportunities among the LASA Member States for placing LASA contracts among them.

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1 This point deserves explanation. There have been drafts of SASA and LASA conventions, which in fact followed the ESA Convention. However, there is no study has been undertaken of the principal characteristics and needs of Latin-American States to promote and enhance space activities. It is necessary to identify the Latin-American needs and resources to elaborate a suitable legal framework with due respect to the differences among Latin American States, providing fair conditions for all participant States.

Therefore, how could a LASA be established in the present circumstances when the Latin-American region is missing most of the elements that enabled the establishment of ESA? An elaborate theoretical answer could be presented in this regard, but from a practical perspective, a regional space institution would not contribute to the legal implementation of space cooperation. In this context, why are Latin-American countries discussing space institutionalization instead of defining the first multilateral space project and its legal implementation? As mentioned before, I think that in the first phase to begin efficient Latin-American space cooperation the creation of a regional space institution is not necessary.

Considering the current situation in the Latin-American region, my proposal is to develop and operate the AQUARELSat Constellation as the first project for multilateral space-water cooperation. The AQUARELSat Constellation can have a legal implementation through a non-institutional legal model such as the Disaster Monitoring Constellation (DMC) but in regional terms.

The following reasons support the idea that a model similar to the DMC is the correct way to proceed in the legal implementation of the Latin-American space cooperation:

1 the DMC legal model of cooperation is an efficient form of combining modest efforts to reach national, regional and international objectives such as to monitor water resources;
2 the DMC model overcomes the financial limitations because the funding of the small satellites comes from diverse national sources;
3 the lack of know-how in space technology is overcome through training provided by the satellite companies that manufacture and develop the satellites.

Therefore, the problems of lack of funding and technical know-how could be overcome under a similar scheme to the DMC cooperation model. At the same time, the DMC model could solve other limitations of regional cooperation such as the definition of a regional space project. A well-defined space project is an approach to gain political will from decision-makers who will trust a concrete space project more than the intention of establishing efficient space cooperation in Latin America.

Regarding satellite data sharing, the AQUARELSat could follow the same scheme as the DMC, in which the owner of the satellite receives, gathers and processes the satellite information and distributes such information at the national level. Hence, the responsibility to distribute satellite imagery and data at the national level lies with each of the AQUARELSat Members. The AQUARELSat Members have to develop their national strategies to reach their end users. For this purpose it is necessary to coordinate the ministries and government units. This situation is a stimulus for the AQUARELSat Members to develop indigenous capabilities, such as national facilities and experts.

A model similar to the DMC would bring the individual responsibility of each country to take advantage of the satellite data at national level to the attention of the AQUARELSat Members. The advantages are related to the efficient distribution of satellite data to reach decision-makers in time by adopting national coordination strategies for satellite data distribution.

The national aspect of the small satellites is that AQUARELSat Members maintain the ownership of the satellites. Nevertheless, the Constellation provides a friendly framework of partnership for data-sharing agreements among the AQUARELSat Members. Regional and international users' needs would be coordinated through a central authority, which would also be in charge of the coordination of the AQUARELSat small satellites. The central authority as a coordinating authority could serve as a platform for processing and combining satellite data for regional and international projects.

The satellite company that would participate in the public-private partnership (PPP) in the AQUARELSat as part of the central authority, should be selected based on reliability, experience, price, transfer of know-how and support in the establishment of national space facilities.

The second phase of the three-phase plan consists of the institutionalization of space cooperation in Latin-America through the establishment of the LASA. The legal implementation of the second phase would be done through an institutional model to establish the LASA under a LASA Convention. The development of this phase to reach regional space cooperation can be done with the assistance of the Space Conference of the Americas (*CEA, Conferencia Espacial de las Américas*).

It should be noted that, in this second phase, a LASA Convention, without a regional infrastructure and space capabilities, would be a document of limited value, far from any legal consolidation of Latin-American space cooperation. For that reason, the institutionalization of Latin-American space cooperation comes in the second phase, after the preparatory first phase of regional space cooperation with the multilateral space project of the AQUARELSat.

After the implementation of AQUARELSat, this second phase relies on more countries in the region with hands-on experience in national and multilateral space activities. LASA is a more ambitious project, but if there is consensus among the Latin-American sub-regions about becoming a Latin-American space power, LASA could be established under this political motivation. It is expected that in the second phase Latin America would have a platform of national space capabilities in the region, due to the AQUARELSat Constellation. Actually, the coordination of national space capabilities could be the starting point for developing the main features of the LASA.

In this second phase, the establishment of LASA would require the drafting of the LASA space policy as the first regional space policy, in order to indicate the guidelines for the LASA Convention, LASA space programmes and other regulations related to LASA activities and specific policies, such as remote sensing and data policy.

The ideal forum to start working on the LASA is the CEA. The CEA could start drafting an updated list of regional space resources and identifying the priority areas and problems of the region. As we know, the CEA is the most important forum for Latin America to discuss the proposals and means to introduce space cooperation in the region. The Plans of Action already adopted during the CEAs have identified the activities that are necessary for effective space cooperation, *e.g.* the integration of a working group to determine areas of regional coordination; and the identification of areas of common interest, availability of human resources and status of research.

The problem has been to carry out these activities adopted in the CEAs' Plans of Action. In this context, it is necessary to strengthen the functions of the CEA Pro Tempore Secretary with more active participation of the Latin-American countries. For instance, every country should designate a national point of contact responsible for submission of information and assist the Pro Tempore Secretary with its duties. In addition, the Pro Tempore Secretary could be supported by working groups with a clear mandate and a virtual forum in an online Internet tele-working platform,[2] along with the commitment to present a report or study within agreed deadlines.

The preparatory work of the CEAs and the follow-up of the activities in the Plans of Action by the Pro Tempore Secretary need to be a continuous effort before, during and after the meetings of the CEAs. In addition, the Pro Tempore Secretary's performance should be evaluated by the representatives of the Latin-American countries. This evaluation should include the progress made by the Pro Tempore Secretary towards regional space cooperation. The Latin-American scientific network, as well as regional and international observers should also participate in this evaluation. The evaluation will provide a roadmap in the development of regional space cooperation and the big picture for planning follow-on activities for the implementation of the Action Plans of the CEAs. Through this constructive evaluation, the performance of the Pro tempore Secretary can be improved.

An interesting aspect of the CEAs is that their declarations have recognized the importance and need of effective cooperation and coordination mechanisms. This is a self-awareness exercise of the region, if the adjective 'effective' cooperation implies action. In my opinion, the CEAs' declarations reflect the intention to move forward.

The third phase in the three-phase plan goes beyond the Latin America region, aiming to implement Inter-American space cooperation. The LASA

2 Regarding websites, it would be recommendable to set up an integrated and official CEA Website that combines the links elaborated by the different Pro Tempore Secretaries. I realized the lack of coordination among the information of the CEAs on the Internet, when I searched for background and documentation regarding them. In my opinion it is important that the CEAs take more advantages from information technologies to strength the functions of the Pro Tempore Secretaries and disseminate the activities of the CEAs and its documentation on an official website.

would not disappear in this third phase; on the contrary, LASA would be a main player in this project of Inter-American space cooperation. The Inter-American cooperation would be done through the IASC. The IASC would be in charge of coordinating within the OAS the work of LASA, NASA, CSA, and other national space agencies in Latin America. The objective of this IASC would be to boost regional development assisted by space applications and facilitate the flow of information for regional and national programmes. This last phase seeks to achieve continental space cooperation in the future.

Fifty years of discussions about space cooperation in Latin-America could be commemorated in 2010, during the Sixth CEA in Mexico, with the adoption of a multilateral satellite project. Such a multilateral space project could be, for example, the AQUARELSat Constellation to monitor the water resources and natural disasters. The Latin-American countries should be discussing the details of their first multilateral space project rather than the establishment of LASA.

It is time to implement space cooperation through a well-defined and useful space project for the region, rather than to continue discussing the institutionalization of the Latin-American space cooperation with the creation of LASA or SASA.

This new decade can be a turning point in which Latin America adopts a new attitude toward space activities through its active participation in the operation of the AQUARELSat Constellation. AQUARELSat could collaborate with other operational satellite missions in solving national, regional and international problems and in the improvement of the quality of life on Earth.

After explaining the AQUARELSat and the route for the legal implementation of Latin-American space cooperation through a three-phase plan, I have three final remarks related to:

1 space cooperation;
2 remote sensing, and;
3 water management and the right to water as a human right.

Ad 1 - Space cooperation

The definition of space cooperation proposed in this research is the following: Space cooperation is a mechanism for the efficient use and exploration of outer space. Its modes include institutional and non-institutional cooperation in science and technology; economics and innovation; legal and politics; education and training. These areas of cooperation are in the sphere of the peaceful use and exploration of outer space.

Space cooperation activities are performed under equitable and reciprocal conditions, mutually accepted by the countries involved. A particular feature of space cooperation is the global commitment to improve quality of life for all people.

Taking into account this last characteristic in space cooperation, the participant countries in space cooperation should consider not only the advantages of such cooperation in national terms, but also the contributions that could

derive from such a cooperation for the benefit of other countries at the regional and international levels; considering the local and global interaction around the world and the common goal of sustainable development.

In addition, international cooperation is the individual responsibility of the States to promote and participate in international cooperation ventures. International cooperation could be a legal obligation, but if States do not participate in the projects of space cooperation it becomes a hopeless victory of printed words without tangible benefits. Tangible benefits are what States expect from space applications and regulations.

Regarding the legal framework of international cooperation in space activities, the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty) addresses international cooperation in space activities in various articles. The Outer Space Treaty provides the legal basis for space activities, establishing the principles and concepts that have guided the progressive development of international space law. In this context, international cooperation is an essential legal principle in the regulation of space activities, a principle which has been developed in more detail in the Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries (Declaration on Space Benefits).

Ad 2 – Remote sensing

It is interesting to note that the regulation on remote sensing was an initiative from Argentina, whilst the Latin-American delegates in COPUOS were very active in the elaboration of the RS Principles. Nevertheless, no real concrete action was taken towards operating RS satellites in a multilateral space cooperation project. Most of the Latin-American delegates complained about the practices of the Remote Sensing states, but they preferred to continue accessing to satellite data through foreigner satellites of the Remote Sensing states, with some exceptions.

There is no multilateral space cooperation to develop and operate remote sensing satellites in the Latin-American region. However, there is a bilateral reciprocal agreement between Argentina and Brazil to cooperate in remote sensing missions.

Ad 3 – Water management and the right to water as a human right

The third remark is related to space-water cooperation, in particular water management and the right to water as a human right.

The primary objective of AQUARELSat is to provide satellite data and imagery for improving water management, in order to fulfil the right to water and water security in Latin America. The human right to water entitles everyone to sufficient and safe water for personal and domestic uses.

The theoretical framework for the right to water as a human right has been developed in the last years. However, there is no political will to reach an international agreement by which to recognize the right to water as a human right. In this scenario, States have the option to start implementing measures to improve water management, while they work on the goal of reaching an international agreement on the right to water as a human right. In this context, the development and operation of the AQUARELSat Constellation is a practical measure to implement the right to water.

The Latin-American countries have a commitment to work on achieving the Millennium Development Goals. AQUARELSat is an opportunity to join the efforts and have a regional space project on water management to meet the Millennium Development Goals. The AQUARELSat members would start working on their national space capabilities and water security, but at the same time they could contribute with satellite imagery and data to the regional water security.

This research included the legal aspects involved in the right to water as a human right, regarding the regulatory means for citizens to have access to safe water. The intention was to identify the duties and obligations of citizens and authorities. It was noted that the concrete duties and obligations of the authorities have been addressed by the ECOSOC's General Comment 15, the ILA's Berlin Rules on Water Resources, and the Aarhus Convention. For instance, the authorities' obligations include to respect, protect and fulfil the access to safe water.

The importance to identifying rights and duties of the authorities and citizens in the context of access to safe water was done with the objective to determine the use of space applications for water management. The identification of the authorities' duties could be a roadmap for improving the definition of the objectives in AQUARELSat. In this way the legal implementation of space-water cooperation could be done in specific and useful terms.

In this context, remote sensing applications can enhance water management activities by providing reliable tools to support the duties of the authorities to protect water supplies and the environment from contamination and protect the right to life, health and adequate environment. Furthermore, remote sensing applications can support the authorities to fulfil the obligation of providing access to safe water by improving and extending water networks. Remote satellite imagery can help to monitor and identify polluters and with geo-referenced maps and GIS, the decision makers can find sustainable options to extend the water networks. At the regional level, remote sensing applications can have an important role in monitoring the transboundary water basins.

Finally, this proposal of space-water cooperation presents a particular approach to address the relationship between space law and human rights, as part of a new strategy to improve human development and to justify the legal implementation of space cooperation in the Latin-American region.

Summary

Space law is a field of law in that it considers technical aspects of space activities in order to assess problems and provide legal solutions to them. Following this approach, the present research includes legal and technical aspects of Latin-American space cooperation. Some of the technical aspects include remote sensing applications for water management; the mission design of a satellite constellation; the use of space resources; and characteristics of small satellites. On the other hand, legal aspects include the analysis of international cooperation, legal implications of remote sensing; the right to water as a human right, and the legal implementation of regional space cooperation.

Latin-American space cooperation is a years-old proposal in need of a suitable legal model for its implementation. Thus, this research proposes to fill this need by drafting a legal model for regional space cooperation in Latin America.

Based on the research, the following recommendations are made:

- The region needs to address space cooperation in clear, unambiguous, legal terms. One of the problems of achieving Latin-American space cooperation lies in the lack of clear terms for its legal implementation.
- The definition of a multilateral space project is the pre-requisite for any further decisions regarding a legal model by which to implement space cooperation.
- At present, the conditions in Latin-American are not appropriate for beginning directly with institutional space cooperation, i.e. with the creation of a regional space institution such as the Latin-American Space Agency (LASA), as has been proposed for many years.
- Space cooperation in Latin America requires different legal models, which need to be in accordance with the development of space capabilities in the region.
- An option available to Latin-American countries in implementing regional space cooperation is to follow a long-term strategy consisting of a three-phase plan.
- The access to safe water for all populations should be a priority in the region in order to fulfill the human right to water. The right to water is fundamental to promoting human development and to reducing poverty.
- The first Latin-American satellite constellation should make use of remote sensing applications for improving water management, an effective measure to implementing the right to water in the region.

- The Space Conference of the Americas (CEA, Conferencia Espacial de las Américas) is the appropriate forum to draft an agreement on the legal framework necessary for the implementation of a specific regional space project.

The thesis consists of seven chapters, in which Latin-American space cooperation and a first Latin-American satellite project are presented and discussed. Overall, the research is based on critical legal analysis.

Chapter 1 provides the general introduction to and description of Latin-American space cooperation. It also sets forth three main hypotheses and methodology of the research.

Chapter 2 presents a historical analysis of international and regional space cooperation. This chapter discusses Latin-American projects and achievements in space cooperation, as well as international and regional institutions working in the field of remote sensing. The analysis leads to the conclusion that most Latin-American countries favour the establishment of the LASA as a step toward regional space cooperation.

Chapter 3 explores current institutional and non-institutional space cooperation models, in order to identify elements they may have in common, using a comparative method. This section aims to demonstrate that the pre-requisites for an institutional model, such as the European Space agency (ESA), are missing in Latin America. Thus, a non-institutional model is suggested as a starting point for multilateral space cooperation in Latin America.

Aware of the fact that a non-institutional model requires a specific space project on which to base a legal framework for its implementation, Chapter 4 drafts the mission design of 'AQUARELSat: the Water Monitoring Constellation'.

AQUARELSat aims to achieve multilateral space cooperation. This satellite constellation is composed of four small satellites, and would involve at least four countries. The primary objective of AQUARELSat is to provide satellite data and imagery for improving water management, in order to fulfill the right to water and water security in Latin America. This chapter is complemented with the technical glossary of AQUARELSat (Appendix C).

Chapter 5 presents the legal justification for AQUARELSat's primary objectives in water management. A deductive approach in this chapter addresses the legal background of international cooperation and remote sensing activities, and then deals with the right to water as a human right.

Thus, the Charter of the United Nations, and the Declaration on Principles of International Law concerning Friendly Relations and Co-operation among States in accordance with the Charter of the United Nations, are analyzed in relation to international cooperation. Further, the analysis of international cooperation in space activities is based on the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space; the Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account

the Needs of Developing Countries, and; the Principles Relating to Remote Sensing of the Earth from Outer Space, which are analyzed in detail.

Since remote sensing activities are based on international cooperation, these Principles are essential in deciding how to implement international cooperation in remote sensing activities at the regional level. In addition, they provide the guidelines to solve other questions; for example, how to deal with access to satellite data and the distribution of data to third parties. The analysis of the legal framework of remote sensing activities provides the background to remote sensing applications for improving water management.

The key justification for the development of AQUARELSat lies in the advantages that remote sensing applications can bring to improving water management. A practical measure to implementing the right to water is the use of satellite data to assist national authorities in respecting, protecting and fulfilling the right to water. The human right to water entitles everyone to sufficient and safe water for personal and domestic uses.

It should be stressed that the theoretical framework for the right to water as a human right has been developed in the last years. However, there is no political will to reach an international agreement by which to recognize the right to water as a human right. In this scenario, States have the option to start implementing measures to improve water management, while they work on the goal of reaching an international agreement on the right to water as a human right. In this context, the development and operation of the AQUARELSat Constellation is a practical measure to implement the right to water.

Chapter 6 suggests the roadmap to initiate the legal implementation of Latin-America space cooperation, based on a long-term strategy which includes a three-phase plan.

The first phase aims to achieve a multilateral agreement to develop and operate the AQUARELSat satellite Constellation. The second phase studies the creation of the LASA. The third phase seeks to bring about the coordination of Inter-American space cooperation through the Organization of American States (OAS).

Chapter 7 presents the conclusions and recommendations for the implementation of Latin-American space cooperation in legal terms, emphasizing the importance of the CEAs. The 2010 CEA VI is an ideal opportunity for the region to take practical measures toward defining the legal terms of Latin-American space cooperation and the coordination of regional resources to overcome technical and funding constraints. CEA VI could transform the CEA declarations, resolutions and plans of action into an agreement(s) to implement a regional satellite project, and the specific legal rights and obligations of participating countries.

In addition, this chapter proposes specific measures that can be taken toward the legal implementation of space cooperation in Latin America, based on the particular strategy of the three-phase plan.

The first phase does not seek to establish a regional space institution. Rather, it seeks to build and encourage national space capabilities and at the same time, initiate regional coordination on a small-scale for the operation of AQUARELSat. This project is focused on bringing concrete benefits to people. The conditions for the operation of AQUARELSat are set forth in the draft agreement on the operation of AQUARELSat (Appendix E).

The second phase depends on the development of national space capabilities guided by the political will to become a Latin-American space power. This second phase implies the drafting of a regional space policy, the establishment of regional space facilities and the creation of LASA, which would be created by treaty.

The third phase foresees the future coordination and cooperation of LASA with other space agencies within the Inter-American System (e.g. the National Aeronautics and Space Administration (NASA), the Canadian Space Agency (CSA), Brazilian Space Agency (BSA), National Space Activities Commission (CONAE, Comisión Nacional de Actividades Espaciales) and other national space agencies in the region). The coordination of the space agencies would be achieved through an Inter-American Space Committee (IASC) that could be established by resolution of the OAS General Assembly.

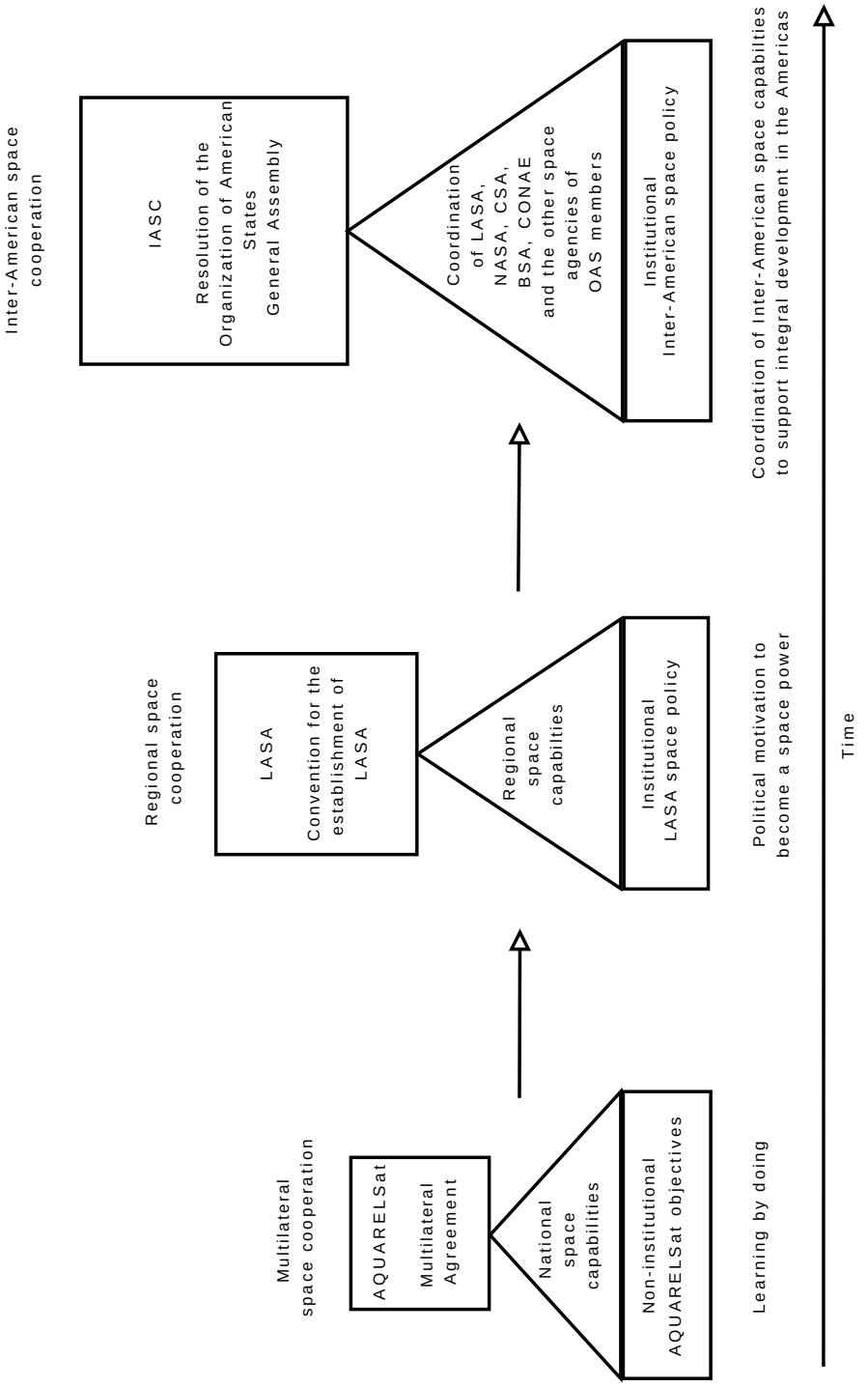
In brief, regional space cooperation is an essential tool in overcoming financial and technical constraints that impinge on space activities. Regional cooperation promotes the use of outer space by developing countries in order to solve some of their problems. In regard to international space law, the practice of the States as well as regional space cooperation contribute to the development of space law, through agreements that address the gaps between the regulation of space activities and the advancement of space technology.

An important aspect of this research is its emphasis on the importance of implementing national and regional measures to transform the principle of space cooperation and its relation to human rights (adequate standard of living, health, well-being) into real, practical advantages for improving the quality of human life, by improving access to water.

This research presents a particular approach to address the relationship between space law and human rights, as part of a new strategy to improve human development and to justify the legal implementation of space cooperation in the Latin-American region.

Finally, this approach, which includes human rights in the study of space law, confirms that space law involves people, institutions and regulations on Earth, as Dr. Eilene M. Galloway stated during the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82).

Figure 1 – Proposed structure of the three-phase plan for Latin-American space cooperation



Samenvatting

JURIDISCHE EN INSTITUTIONELE ASPECTEN VAN LATIJNS-AMERIKAANSE SAMENWERKING IN DE RUIMTEVAART. AQUARELSAT: EEN SATELLIETSYSTEEM VOOR WATERBEHEER.

Ruimterecht is een rechtsgebied dat de technische aspecten van activiteiten in de ruimte beschouwt om problemen op te sporen en voor juridische oplossingen te zorgen. Met deze manier van benadering omvat dit onderzoek de juridische en technische aspecten van de Latijns-Amerikaanse samenwerking in de ruimtevaart. Enkele van de technische aspecten zijn de praktische toepassingen van aardobservatie vanuit de ruimte ten behoeve van waterbeheer: de ontwerpopdracht voor een satellietsysteem; het gebruik van bronnen in de ruimte; en de karakteristieken van kleine satellieten. Aan de andere kant omvatten juridische aspecten de analyse van internationale samenwerking, juridische knelpunten van aardobservatie vanuit de ruimte; het recht op water als mensenrecht en de juridische aspecten van regionale samenwerking in de ruimte.

Latijns-Amerikaanse samenwerking in de ruimte heeft al jaren behoefte aan een geschikt juridisch model om dat te kunnen uitvoeren. Derhalve stelt dit onderzoek een juridisch model voor regionale samenwerking in de ruimtevaart voor.

Voortkomend uit het onderzoek worden de volgende aanbevelingen gedaan:

- De regio moet zich uitspreken voor samenwerking in de ruimtevaart in duidelijke, ondubbelzinnige, juridische termen. Een van de problemen om te komen tot Latijns-Amerikaanse samenwerking in de ruimtevaart ligt juist in het gemis aan duidelijke voorwaarden voor de juridische uitvoering ervan.
- Het opstellen van een multilateraal ruimteproject is de eerste vereiste voor ieder verder besluit betreffende een juridisch model, waarmee samenwerking in de ruimtevaart wordt ingevoerd.
- Op dit moment zijn de omstandigheden in Latijns-Amerika niet geschikt om direct te beginnen met institutionele samenwerking in de ruimtevaart, d.w.z. met de stichting van een regionaal ruimte-instituut, zoals het Latijns Amerikaans ruimte agentschap (LASA), dat al vele jaren geleden werd voorgesteld.

- Samenwerking in de ruimtevaart in Latijns-Amerika vereist verschillende juridische modellen, die in de regio moeten overeenstemmen met de ontwikkeling van de mogelijkheden in de ruimtevaart.
- Een nuttige keuze voor Latijns-Amerikaanse landen die regionale samenwerking in de ruimtevaart willen invoeren, is het volgen van een lange termijn strategie die bestaat uit een drie-fasen plan.
- De beschikbaarheid van veilig water voor de gehele bevolking in de regio moet een prioriteit zijn, teneinde het recht op water te verwezenlijken. Het recht op water is van fundamenteel belang om de ontwikkeling van de mens te bevorderen en armoede te bestrijden.
- Het eerste Latijns-Amerikaanse satellietsysteem zou gebruik moeten maken van aardobservatie vanuit de ruimte ter verbetering van het waterbeheer, als effectieve methode voor het verwezenlijken van het recht op water in de regio.
- De Space Conference of the Americas (CEA, Conferencia Espacial de las Americas) is het geschikte forum om een akkoord op te stellen voor het juridische kader dat nodig is voor de invoering van een specifiek regionaal ruimteproject.

Het proefschrift bestaat uit zeven hoofdstukken, waarin Latijns-Amerikaanse samenwerking in de ruimtevaart en een eerste Latijns-Amerikaans satelliet project worden gepresenteerd en besproken. Het onderzoek is globaal gebaseerd op een kritische, juridische analyse.

Hoofdstuk 1 bevat de algemene inleiding en een omschrijving van Latijns-Amerikaanse samenwerking in de ruimtevaart. Het vermeldt ook de drie voornaamste stellingen en de methodologie van het onderzoek.

Hoofdstuk 2 bevat een historische analyse van internationale en regionale samenwerking in de ruimtevaart. Dit hoofdstuk bespreekt zowel Latijns-Amerikaanse projecten en prestaties bij de samenwerking in de ruimtevaart, als de internationale en nationale instituten die werkzaam zijn op het gebied van aardobservatie vanuit de ruimte. De analyse leidt tot de conclusie dat de meeste Latijns-Amerikaanse landen de vestiging van LASA steunen als een stap naar regionale samenwerking in de ruimtevaart.

Hoofdstuk 3 onderzoekt huidige institutionele en non-institutionele modellen betreffende samenwerking in de ruimtevaart met het doel gemeenschappelijke elementen te vinden, en gebruikt daarbij een vergelijkende methode. Dit onderdeel heeft als doel aan te tonen dat de eerste vereiste voor een institutioneel model, zoals het Europees Ruimte Agentschap (ESA), ontbreekt in Latijns Amerika. Derhalve wordt een non-institutioneel model voorgesteld als uitgangspunt voor multilaterale samenwerking in de ruimtevaart in Latijns Amerika.

Aangezien de invoering van een non-institutioneel model een specifiek ruimte project vereist, gebaseerd op een juridisch kader, schetst Hoofdstuk 4 de ontwerpdracht voor AQUARELSat: een satellietsysteem voor waterbeheer.

AQUARELSat heeft als doel te komen tot een multilaterale samenwerking in de ruimtevaart. Dit satellietsysteem bestaat uit 4 kleine satellieten en er dienen tenminste vier landen bij betrokken te zijn. Het eerste doel van AQUARELSat is te zorgen voor satellietgegevens en -beelden ter verbetering van watermanagement, teneinde het recht op water en waterzekerheid in Latijns Amerika te realiseren. Dit hoofdstuk is aangevuld met een technisch verklarende woordenlijst van AQUARELSat (appendix C).

Hoofdstuk 5 presenteert de juridische rechtvaardiging van de primaire doelen van AQUARELSat op het gebied van watermanagement. Door middel van een deductieve benadering houdt dit hoofdstuk zich bezig met de juridische achtergrond van internationale samenwerking en activiteiten met betrekking tot aardobservatie vanuit de ruimte, en behandelt tevens het recht op water als mensenrecht.

Aldus worden het Handvest van de Verenigde Naties en de 'Verklaring over Uitgangspunten van Internationaal Recht met betrekking tot Vriendschappelijke Relaties en Samenwerking tussen Staten in overeenstemming met het Handvest van de Verenigde Naties' geanalyseerd met betrekking tot internationale samenwerking. Verder is de analyse van internationale samenwerking bij activiteiten in de ruimtevaart gebaseerd op het 'Verdrag inzake de Beginselen waaraan de activiteiten van Staten zijn onderworpen bij het onderzoek en gebruik van de kosmische ruimte met inbegrip van de maan en andere hemellichamen' uit 1967; de 'Verklaring betreffende internationale samenwerking bij het onderzoek en gebruik van de ruimte ten voordele en in het belang van alle landen, daarbij in het bijzonder rekening houdend met de behoeften van ontwikkelingslanden' uit 1996 en de 'Beginselen met betrekking tot aardobservatie vanuit de ruimte' uit 1986, die in detail worden geanalyseerd.

Aangezien activiteiten betreffende aardobservatie vanuit de ruimte zijn gebaseerd op internationale samenwerking zijn deze beginselen essentieel bij de besluitvorming hoe internationale samenwerking moet worden ingepast in aardobservatie vanuit de ruimte op regionaal niveau. Bovendien vormen zij richtlijnen voor het oplossen van andere vraagstukken; e.g. hoe om te gaan met het vrijgeven van satelliet gegevens en de distributie van die gegevens aan derde partijen. De analyse van het juridisch kader van activiteiten betreffende aardobservatie vanuit de ruimte geeft richting aan de toepassingen van aardobservatie vanuit de ruimte voor het verbeteren van watermanagement.

De centrale rechtvaardiging voor de ontwikkeling van AQUARELSat ligt in de voordelen die het toepassen van aardobservatie vanuit de ruimte kunnen opleveren om waterbeheer te verbeteren. Een praktische maatregel om het recht op water in te voeren, is het gebruik van satellietgegevens om nationale autoriteiten te helpen bij het respecteren, beschermen en realiseren van het recht op water. Het recht op water zorgt dat er voor iedereen voldoende en veilig water is voor persoonlijk en huishoudelijk gebruik.

Het moet benadrukt worden dat het theoretisch kader voor het recht op water als mensenrecht een ontwikkeling is van de laatste jaren. Er is echter

geen politieke wil om tot een internationaal akkoord te komen om het recht op water te erkennen als mensenrecht. Met dit scenario hebben Staten de optie om te beginnen met maatregelen te nemen om waterbeheer te verbeteren, terwijl zij toewerken naar een internationaal akkoord betreffende het recht op water als mensenrecht. In deze context is de ontwikkeling en exploitatie van het AQUARELSat systeem een praktische maatregel om het recht op water te realiseren.

Hoofdstuk 6 stelt de werkwijze voor om de juridische invoering van Latijns-Amerikaanse samenwerking in de ruimtevaart op te zetten met behulp van een lange termijn strategie die een drie-fasen plan omvat.

De eerste fase heeft tot doel een multilateraal akkoord te bereiken om het AQUARELSat systeem te ontwikkelen en te exploiteren. De tweede fase bestudeert de oprichting van LASA. De derde fase zoekt een middel om de coördinatie van Inter-Amerikaanse samenwerking in de ruimtevaart tot stand te brengen via de Organisatie van Amerikaanse Staten (OAS).

Hoofdstuk 7 geeft in juridische bewoordingen de conclusies en aanbevelingen weer voor de invoering van Latijns-Amerikaanse samenwerking in de ruimtevaart, met de nadruk op het belang van de CEA's. De CEA VI in 2010 is een ideale gelegenheid voor de regio om praktische maatregelen te nemen de juridische voorwaarden van Latijns-Amerikaanse samenwerking in de ruimtevaart en de coördinatie van regionale bronnen vast te stellen om technische en financiële beperkingen te overwinnen. CEA VI zou de CEA verklaringen, resoluties en plannen van aanpak kunnen veranderen in een akkoord om een regionaal satelliet project op te zetten inclusief de specifieke rechten en verplichtingen van deelnemende landen.

Daarbij stelt dit hoofdstuk speciale maatregelen voor, die genomen kunnen worden bij juridische invoering van samenwerking in de ruimtevaart in Latijns-Amerika, gebaseerd op de speciale strategie van het 3 fasen plan.

De eerste fase gaat niet zozeer om het opzetten van een regionaal ruimtevaart instituut. Deze fase streeft er eerder naar om nationale mogelijkheden voor de ruimtevaart op te bouwen en te bemoedigen en tegelijkertijd op kleine schaal te beginnen met de exploitatie van AQUARELSat via een regionale coördinatie. Dit project is toegespitst op het behalen van concrete voordelen voor de bevolking. De voorwaarden voor de exploitatie van AQUARELSat worden verder behandeld in het ontwerp akkoord betreffende de exploitatie van AQUARELSat (appendix E).

De tweede fase is afhankelijk van de ontwikkeling van nationale mogelijkheden in de ruimtevaart, en wordt gestuurd door de politieke wil een Latijns-Amerikaanse ruimtevaart macht te worden. Deze tweede fase omvat het formuleren van een regionale ruimtevaartpolitiek, het scheppen van regionale faciliteiten voor de ruimtevaart en de oprichting van LASA door middel van een verdrag.

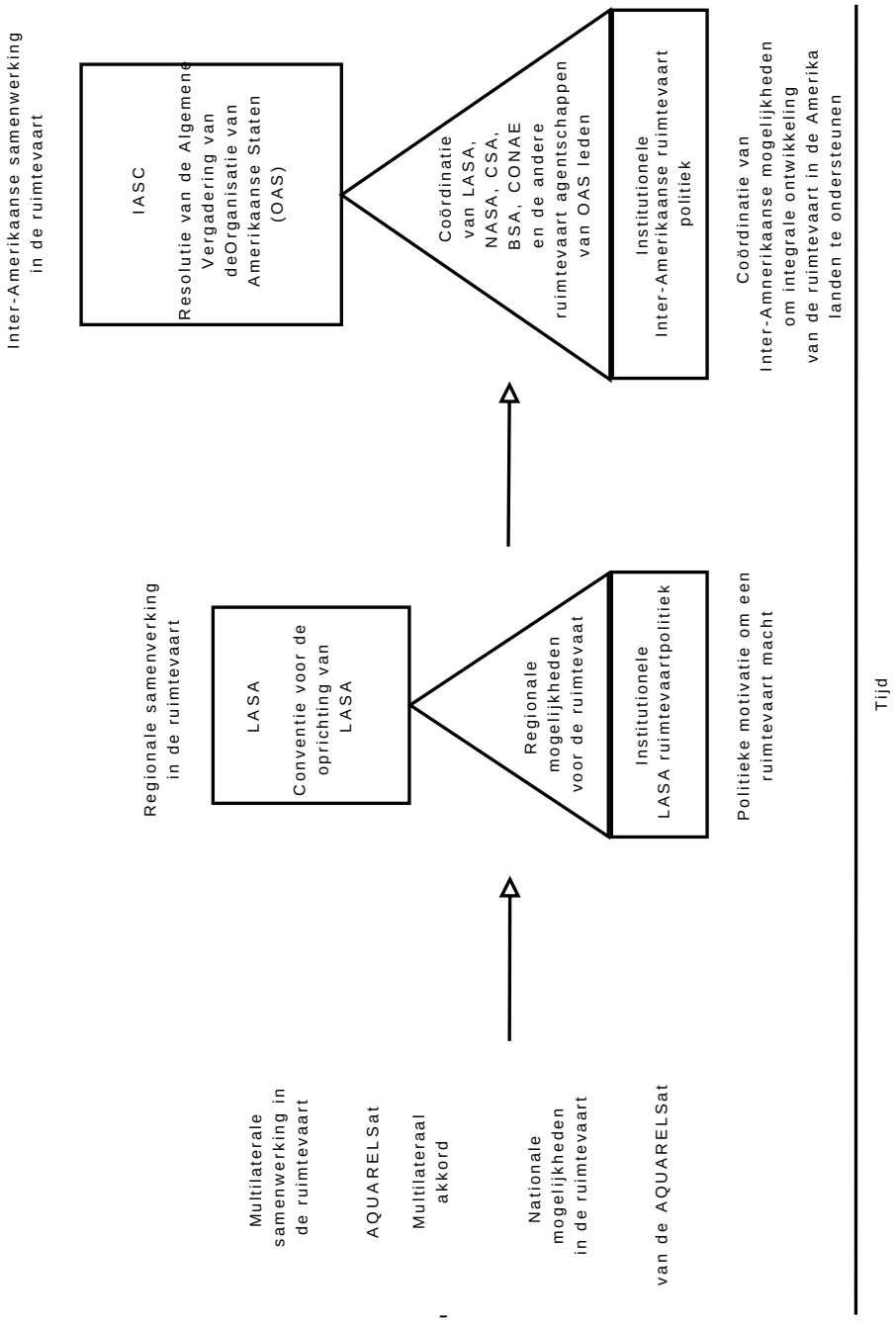
De derde fase kijkt vooruit naar de toekomstige coördinatie en samenwerking van LASA met andere ruimtevaart agentschappen binnen het Inter-Ameri-

kaans systeem (e.g. NASA, CSA, BSA, CONAE) en met andere nationale ruimtevaart agentschappen in de regio. De coördinatie van de ruimtevaart agentschappen zou bereikt kunnen worden via een Inter-Amerikaanse ruimtevaart commissie (IASC), die kan worden ingesteld door mideel van een resolutie in de Algemene Vergadering van de OAS.

Kortom, regionale samenwerking in de ruimtevaart is een essentieel middel om financiële en technische beperkingen te overwinnen die nadelig zijn voor ruimtevaartactiviteiten. Regionale samenwerking bevordert het gebruik van de ruimte door ontwikkelingslanden en helpt enkele van hun problemen op te lossen. Met betrekking tot het internationale ruimterecht dragen zowel de praktijk van staten als regionale samenwerking in de ruimtevaart bij tot de ontwikkeling van het ruimterecht, door middel van overeenkomsten die de hiaten tussen de regulering van ruimtevaartactiviteiten en de vooruitgang van ruimtevaarttechnologie aanpakken.

Een interessant aspect van dit onderzoek is de nadruk die gelegd wordt op het belang van het invoeren van nationale en regionale maatregelen om het beginsel van samenwerking in de ruimtevaart en de relatie daarvan met mensenrechten (gepaste levensstandaard, gezondheid, welzijn) om te zetten in wezenlijke, praktische voordelen ter verbetering van de kwaliteit van menselijk leven door het verbeteren van de toegang tot water.

Figuur 1 – Voorgestelde structuur van het 3 fasen plan voor Latijns-Amerikaanse samenwerking in de ruimtevaart



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Appendix A

Satellite information

Low spatial resolution

Satellite name	*Space agencies or remote sensing satellite companies*	*Satellite image characteristics*
MODIS Terra (EOS AM) AQUA (EOS PM)	National Aeronautics and Space Administration (NASA) http://modis.gsfc.nasa.gov	MODIS (Moderate Resolution Imaging Spectroradiometer). 36 spectral bands or groups of wavelengths. Spatial resolution from 250 to 1000 m
NOAA-AVHRR	National Oceanic and Atmospheric Administration (NOAA) http:// www.noaasis.noaa.gov/	AVHRR (Advanced Very High Resolution Radiometer). 6 detector to collect bands of radiation wavelengths (AVHRR/3).Ground resolution approximately 1.1 Km at the satellite nadir from the orbit. Information about cloud cover and the surface temperature of the Earth, clouds or body of water, geophysical parameters, agricultural assessment.
CBERS-2 (China-Brazil Earth Resources Satellite)	National Institute for Space Research (INPE) the Brazilian Space Agency, the Chinese Academy for Space Technology and other organizations. http://www.cbers.inpe.br	High Resolution CCD Camera. IRMSS Infrared Multispectral Scanner (IRMSS). WFI Camera-Wide Field Imager. Spatial resolution from 20 meters to 260 meters. Images for deforestation and fire control in the Amazon Region, water resources monitoring, urban growth, soil occupation, education and several other applications
OrbView 2 Commercial Satellite Imagery SeaStar	OrbImage/ GeoEye GeoEye was formed when OrbImage merged with Space Imaging in 2006 www.geoeye.com	SeaWiFS (Sea-viewing Wide Field-of-view-sensor). Spatial resolution around 1 km. Specific designed to monitor ocean characteristics and favourable conditions for fishing.

Medium and high spatial resolution

IRS-P6 (RECOURCES AT-1) (Indian Remote Sensing Satellite (IRS))	Indian Space Research Institute (ISRO) www.isro.org	High resolution Linear Imaging Self Scanner (LISS-4) operating in three spectral bands in the visible and Near Infrared Region (VNIR). Spatial resolution of 5.8 m both in panchromatic and multispectral modes. New generation scanner AWIFS Information for mapping, agriculture, forestry, and natural disasters
EROS (Earth Resources Observation Satellite)	ImageSat International International Company providing high resolution satellite imagery collected by EROS http:// www.imagesatintl.com	EROS A and EROS B have optical payload supplied by El-Op Camera with focal plane of CCD (Charge Coupled Device) detectors EROS B Larger camera CCD type, with standard panchromatic resolution of 0.70 meters
IKONOS and OrbView 3	GeoEye (OrbImage) http://www.geoeye.com	Digital satellite imagery with spatial resolution of 1m in panchromatic mode and 4 m in multispectral mode High mobility Information for land planning, oil and gas exploration, DEM, ecological monitoring and national security
SAC-C (First Argentinean Earth Observation Satellite)	National Commission on Space Activities (CONAE, *Comisión Nacional de Actividades Espaciales*) www.conae.gov.ar	Large coverage, multispectral and panchromatic capabilities, medium resolution and short revisit time Multispectral Medium Resolution Scanner (MMRS) with application to study the desertification processes, to identify and predict agriculture production, and to monitor flooded and fluvial areas

Appendix B

Latin America and the status of international agreements relating to activities in outer space as at 1 January 2010[1]

Country	*1967 OST*	*1968 ARRA*	*1972 LIAB*	*1975 REG*	*1979 MOON*
Argentina	R	R	R	R	
Bolivia (Plurinational State of)	S	S			
Brazil	R	R	R	R	
Chile	R	R	R	R	R
Colombia	S	S	S		
Costa Rica		S	S		
Cuba	R	R	R	R	
Dominican Rep.	R	S	R		
Ecuador	R	R	R		
El Salvador	R	R	S		
Guatemala			S		S
Honduras	S		S		
Mexico	R	R	R	R	R
Nicaragua	S	S	S	S	
Panama	S		R		
Paraguay					
Peru	R	R	R	R	R
Uruguay	R	R	R	R	R
Venezuela (Bolivarian Republic of)	R	S	R		

1967 OST Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies

1968 ARRA Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space

1972 LIAB Convention on International Liability for Damage Caused by Space Objects

1975 REG Convention on Registration of Objects Launched into Outer Space

1979 MOON Agreement Governing the Activities of States on the Moon and Other Celestial Bodies

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1 UNOOSA, UN treaties and principles on outer space and related General Assembly resolutions: Addendum status of international agreements relating to activities in outer space as at 1 January 2010 (ST/SPACE/11/Rev.2/Add.3) (2010).

Appendix C

Glossary of AQUARELSat: the Latin-American Water Monitoring Constellation

This section aims to facilitate the understanding of concepts that are used in the mission design of AQUARELSat Constellation. The technical concepts that are related to Chapter 4 are the following:

1 space activities
2 space resources;
3 international authorities dealing with the use of space resources;
4 sun-synchronous orbit;
5 small satellites

Ad 1 – Space activities
Space activities can be divided into two different scenarios:

· *Earth-oriented*

Basic space science: astronomy, astrophysics, gravitational studies, space weather, cosmology, space physics, NEOs.

Satellite technology applications: remote sensing of the Earth or other planets, space telecommunications, meteorology, navigation systems.

Incorporation of satellite data to different fields towards a national sustainable development: agriculture, hydrology, geology, cartography, forest management, teleepidemiology, contamination monitoring, natural disasters management, fishing, natural resources management.

· *Space exploration*

Construction of launchers, space manned missions, construction and maintenance of the lunar base, research in in-situ resources utilisation on the Moon, nanotechnology, space rovers, exobiology, microgravity research, astrobiology, space medicine.

Ad 2 – Space resources
The definition of space resources,[2] a concept frequently referred in this study is basically composed of two elements that are crucial for Earth exploration satellite services (EESS):

2 For the identification of space resources I refer to two international legally binding documents: (1)The International Telecommunication Union Constitution (Geneva, 1992), and; (2) The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies (Outer Space Treaty). UN Doc. GA/RES/2222 (XXI).

· *Orbital segment around the Earth*

Satellite orbits are classified according to the altitude:[3]

1 Geostationary Satellite Orbit (GSO). Precise altitude 35 786.1 km, but is generally referred at the altitude of 36 000 km
2 Medium -Earth Orbit (MEO). Altitude between 7000 and 12000 km
3 Low-Earth Orbit (LEO). Altitude between 400 and 1500 km

LEO is the orbit located within an altitude range of 500 to 1500 km.[4] AQUARELSat constellation could be located at 600 or 700 km within the LEO range.

EESS is usually used by spacecraft in non-GSO orbits to provide remote sensing services. Non-GSO satellites need international coordination, in certain services and frequency bands.[5] The International Telecommunication Union (ITU)'s Radio Regulations (RR)[6] contain the agreed rules for the use and coordination of orbit/ spectrum for GSO and non-GSO satellite systems.

· *Radio-frequency spectrum*

Different segments of the radio frequency spectrum are allocated to specific satellite services by the ITU. Satellites use radio-frequency spectrum for uplink and downlink communications, and for providing specific space services (telecommunications, Earth observation, science, meteorology). A satellite in any orbital position without radio-frequency spectrum according to the ITU's Radio Regulations is useless.

The main problem in regard to EESS is related to the protection from prejudicial interference to its frequencies when these are allocated as a secondary service. Harmful interference can distort the information gathered by the satellite.

Ad 3 – International authorities dealing with the use of space resources

There are two international authorities dealing with the utilization of space resources:

· *UN Office for Outer Space Affairs (UNOOSA)*

UNOOSA acts as the Committee on the Peaceful Uses of Outer Space (COPUOS)' Secretariat in the promotion of international cooperation for the peaceful uses of outer space.

The UN legal framework on outer space set forth the principle of freedom in the use and exploration of outer space. Article I of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer Space Treaty), stipulates freedom in the access to outer space, 'on a basis of equality and in accordance with international law'.[7]

Therefore, the Outer Space Treaty includes the principle of freedom in the use of outer space, but also set forth the requirement to inform the international community about national space activities.

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3 International Telecommunication Union. *Handbook on Satellite Communications*, 10 (2002).
4 *Id.* 359.
5 *Id.* 35
6 The International Telecommunication Union Radio Regulations (2004).
7 *See* Article 1 of the Outer Space Treaty.

> 'Article XI
> …, State Parties to the Treaty conducting activities in outer space, including the Moon and other celestial bodies, agree to inform the Secretary –General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of the nature, conduct, locations and results of such activities'.

Following this Article XI of the Outer Space Treaty, the Convention on Registration of Objects Launched into Outer Space establishes in Article II (1):[8]

> '1. When a space object is launched into Earth orbit or beyond, the launching State shall register the space object by means of an entry in an appropriate registry which it shall maintain. Each launching State shall inform the Secretary-General of the United Nations of the establishment of such registry'.

Therefore, the principle of freedom in the use of outer space has a parallel obligation to provide information about national space activities in the use and exploration of outer space. The provision of information support the sustainable management of space resources keeping in mind that they are limited resources. Furthermore, this information helps to deal with problems of international responsibility and liability for damage caused by space objects in accordance with the Convention on International Liability for Damage Caused by Space Objects.[9]

· *The International Telecommunication Union (ITU)*

The ITU has particular tasks in the effective, rational and cost-effective utilization of orbit and spectrum resources with emphasis on the equitable access to the geostationary-satellite orbit.[10]

The regulatory regime of ITU is composed of: the Constitution /Convention and the ITU Radio Regulations.

ITU is in charge of frequency spectrum allocations and international recognition of rights over space resources through the recording of frequency assignments and orbital positions in the Master International Frequency Register (MIFR). Therefore, there are two registers of space objects. MIFR recognizes the rights over the radio-frequency spectrum and orbital location, therefore the ITU's MIFR is particularly important to initiate and protect satellite operations.

Regarding remote sensing activities, Principle III of the Principles Relating Remote Sensing of the Earth from Outer Space (RS Principles),[11] recognizes the important role of the ITU in remote sensing activities establishing that remote sensing activities shall be conducted in accordance with the relevant instruments of the ITU, which is responsible for the allocation and protection of the radio-frequency spectrum for EESS. The ITU allocates frequencies to different services on a global basis. It allots, frequencies to the different regions, and the national administrations assign frequencies to different

8 UN Doc. GA/RES/3235 (XXIX), annex.
9 UN Doc. GA/RES/2777 (XXVI), annex.
10 *See* Article 44 in the Constitution of the International Telecommunication Union (1992).
11 UN Doc. GA/RES/41/65.

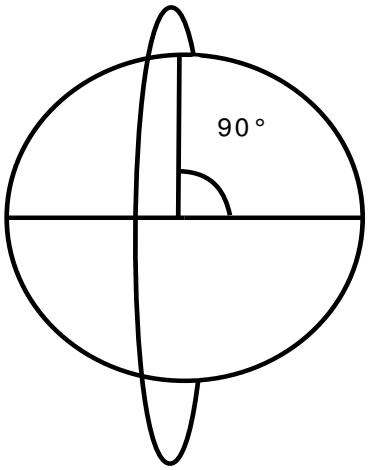
services. So one needs the cooperation of national administrations to avoid harmful interference.

Ad 4 – Sun-synchronous orbit
Sun-synchronous orbit[12] is where:

> 'The processing rate of the ascending node can be either positive (i <90°), negative (i >90°), frozen (i = 90°) or adjusted in inclination in order to exactly compensate for the orbital motion of the Earth around the Sun for the so-called sun-synchronous orbits'.[13]

In other words, a sun-synchronous orbit is a polar orbit used by Earth observation satellites with a north-south direction and an altitude of between 600 and 800 km. This location allows satellites to pass over the entire surface of the Earth on a repeating basis at the same local time for solar illumination consistency,[14] in such a way that the area surveyed is always viewed under the same angle of sunlight to prevent problems of interpretation with changing shadows.[15]

Figure 2 – Sun-synchronous orbit view



Ad 5 – Small satellites
There is no general definition for small satellites. Nevertheless, there are some parameters already agreed to among experts, for instance during UNISPACE III an upper limit of about 1000 kg was considered. Thus, if the satellite weight is higher than 1000 kg it would be considered as a large satellite.

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12 M. Williamson, Dictionary of Space Technology, 152 (1990).
13 *See* ITU, *Id., supra* note 2, at 353.
14 International Space University, Keys to Space: An interdisciplinary approach to space studies 15-5 (2003).
15 Munich Reinsurance Company, Space Flight and Insurance 42, 2nd Ed. (1993).

It is useful to provide a summary of proposals for the classification of satellites, in order to review the mass range differences and the different types of small satellites.

· *The Commission IV Study Group of the International Academy* of Astronautics (IAA) has proposed the following nomenclature for subsets of small satellites:[16]

Class	*Mass (kg)*
Mini satellites	< 1,000
Micro satellites	<100
Nano satellites	< 10
Pico satellites	< 1

· *The European Space Agency:*[17]

Class	*Mass (kg)*
Small satellites	350-700
Mini satellites	80-350
Micro satellites	50-80

· *University of Surrey in Great Britain:*[18]

Class	*Mass (kg)*
Small satellites	500-1000
Mini satellites	100-500

· *At the International Space University (ISU) in a lecture by Professor John Farrow:*[19]

Class	*Typical Mass (kg)*	*Cost Range ($ M)*
Large	> 1000	> 150
Small	500-1000	50-150
Minisat	100-500	10-50
Microsat*	10-100	3-5
Nanosat*	1-10	0.3-1
Picosat *	< 1	< 0.3

(* They can take different meanings)

For the purpose of this study, small satellite is a spacecraft with a mass of < 1000 kg. The small satellite family includes: Mini satellites, Micro satellites, Nano satellites and Pico satellites. The AQUARELSat Constellation will be composed of four satellites within the range of 500-1000 kg.

16 *See* International Academy of Astronautics (IAA), International Study on Cost-Effective Earth Observation Missions 3 (2005).

17 *Id*. 19.

18 *Id.*

19 J. Farrow, *Small satellites and low cost approaches,* lecture at the MSS/ MSM Academic Year 2005/2006, International Space University, Strasbourg, 10 October 2005.

The development of small satellites has many years. In 1988, the International Academy of Astronautics organized its first session on inexpensive scientific satellites at the 39th International Astronautical Congress (IAC) in Bangalore.

Later, in 1999 the subject of small satellites again gained international attention at the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III). During UNISPACE III a workshop on small satellites at the service of developing countries was held, and its conclusions and proposals[20] were included in the Report of UNISPACE III. There are two particular recommendations relevant for this study:

> '316. Another priority area is the development of small- and mini-satellite technology, which has the potential to offer to many countries great possibilities for affordable access to space through the rapid development of fully integrated national space programmes.
> […]
> 327. In preparing a space plan, each State may consider small satellites one of the most valuable tools to initiate and develop indigenous space capability. As small-satellite offer an ideal possibility for training, States are encouraged to include training programmes based on small satellites in their space plans and in plans for international cooperative programmes'.[21]

The above quotes highlight the following issues: first, it was acknowledged that small satellites are an affordable alternative to access to the use of outer space. Secondly, experts encouraged developing countries to take advantage of small satellites to 'initiate and develop indigenous space capability'. Some countries have taken the risk of investing in small satellite projects, for instance Brazil, Argentina, Chile, Malaysia, Turkey, Algeria, Nigeria among others; indeed, the number of new emerging space nations is increasing every year.

Finally, it is important to mention that small satellites are not only beneficial for developing countries. Since the mid 1990s, NASA has developed different missions with small satellites. Capability has been main the driver to invest in small satellites. However, the reasons to choose a small satellite can vary from testing of instruments, training and education, or filling the gaps of information in specific areas.

The rationale of small satellites: faster, cheaper, better

The rationale for small satellite is three-fold: they are Faster, Cheaper and Better (FCB) 'sometimes'. The philosophy of FCB is generally applied in the design, construction and operation of small satellites. Small satellites seeks to work with a simple organization, reduced documentation, freedom of innovation, reasonable risk,[22] and focusing on engineering solutions and effective working.

Below are explained the elements in the small satellite rationale:

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20 *See* Annex III, XXVI Conclusions and Proposals of the workshop on small satellites at the service of developing countries in the Report of UNISPACE III. United Nations document (A/CONF.184/6) 149 (1999).

21 Report of UNISPACE III, Vienna 19-30 July (A.CONF.184/6) para. 316, 327 (18 October 1999).

22 Farrow, *supra* note 18.

· *Faster*

From approval to launch, small satellites can take less than 3 years[23] to put in operation. However, time reduction depends on the characteristics of the small satellite because not the same time is required for developing a pico satellite that a mini satellite. The fact that small satellites are faster to put in operation, allows scientists to have different and more frequent new space missions.

· *Cheaper*

A small satellite is identified as an opportunity to do more with less, as the cost is around < 250 M$.[24] The importance of the reduction in costs is that new users (small national programmes or students) find in the construction, deployment and operation of small satellites, a gateway to access, use and explore outer space.

Overall, small satellite missions have lower costs in the different phases such as construction, launch, insurance and operation.

1 The construction requires simpler small systems and components, no complex design
2 Launch costs are quantified by kilogram, small and light components reduce the weight and thus the launch costs. Likewise, small satellite can find cheaper options for their launch
3 Insurance cost is reduced as the sum insured is lower.
4 The reduction in operation costs is because the simplification of operating timelines, development of small ground stations, improvements in onboard processor capability.[25]

For many years, expensive launch and insurance costs have limited the development of space projects. At present, the situation is more favourable for small satellites, the next 2 points explains in more detail why it is cheaper to launch and insure small satellites.

Reduction of launch cost

The average cost per kilogram to launch into LEO[26] is from $20,000 per kg, or $10,000 per pound of payload.[27]

Launch cost usually constitutes half the cost of the satellite system on orbit.[28] In the case of small satellites, the advantage is that size and mass reduction results in less weight to pay in the total launch cost. For some years, launch costs were a barrier difficult to overcome for small satellites, because the launch costs were much higher than the cost of the satellite construction. However, at present small satellites have more options into the launch market to find a cheaper launch to deploy satellites on orbit.

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23 *Id.*
24 *Id.*
25 *Id.*
26 *See* ITU, *supra* note 2.
27 D. Weeks, S. Walker & R. Sackheim, *Small satellites and the DARPA/Air Force FALCON program*, 57 Acta Astronautica 469-477 (2005).
28 W. Larson & J. Wertz (Eds.), Space Mission, Analysis and Design (SMAD III), 3rd Ed., 854 (2003).

The launching options for small satellites are as follows:

1 Piggyback launch

In an expendable vehicle, the small satellite is launched as secondary satellite. Utilizing a heavy launcher a constellation of small satellites alone or simultaneously with a main satellite can reach the orbit.[29] For instance Ariane 5 heavy launch by ESA. Ariane 5 can deliver 18-ton payloads to LEO, or 5.9-6.8-ton payloads to a geostationary transfer orbit, or 10,000 kg to Sun-synchronous orbit with orbit parameters of 98.6° inclination and 800 km altitude.[30]

This option has a problem for the small satellite, which as a secondary payload, needs to adapt their schedule to the schedule of the partner or the primary payload.

2 On a single dedicated expendable launch for small payloads into low altitude orbits

At present, Soyuz vehicles have two important advantages over the other launchers:[31] priced lower than the others, and it has the best reliability record in the World.

Soyuz vehicles are launched from two places:[32]

Baikonur Cosmodrome in Kazakhstan, leased by Russia. It is located at 45.6° N, 63.4° E.

Plesetsk Cosmodrome in Russia locates at 62.9° N, 40.8° E.

For both places the available launch azimuths are limited by land impact zones.

Despite the lower price and reliability of Soyuz that cannot be the main driver of choosing the launcher. For instance, from Latin America to the test and launch facilities in Russia, the satellite shipment and insurance will be expensive.

In my opinion, the best option for launching the small satellites of AQUARELSat constellation would be Arianespace through the new VEGA launcher that will be available from Ariane Spaceport in 2010. Ariane Spaceport is located in South America at Kourou, French Guiana 5.2° N, 52.8° W. This is an advantage to lower transportation costs, and its proximity to the equator is another advantage.

Besides two more aspects in favor of Vega launcher: first, the reliability of Soyuz is recovered in the Vega launcher, which is a joint project developed by Russian and European experts; secondly, Vega is filling a gap in the launch market, because it is particularly designed 'to provide highly efficient access to low-Earth and Sun-synchronous orbits for small and medium-sized payloads'.[33] LEO and Sun-synchronous orbit are two technical parameters of AQUARELSat Constellation, which coincide with the target of VEGA.

Acceptable risk and insurance options

Before the satellite launch, space projects have to obtain an insurance contract to protect the operator from satellite failures, but also to protect the Launching State from acci-

29 Committee on Space Research (COSPAR), Microsatellite as research tools 33 (1999).

30 S. Umansky, Launch vehicles launch sites 193 (2003).

31 H. Hertzfeld, *et al*., *The relevance of economic data in the decision-making process for orbital launch vehicle programs, a U.S. perspective*, 61Acta Astronautica 1083 (2007).

32 S. Isakowitz, J. Hopkins & J. P. Hopkins Jr., International Reference Guide to Space Launch Systems, 3rd Ed., 524-525 (1999).

33 Arianespace service & solutions, launch services http://www.arianespace.com/launch-services/launch-services-overview.asp (last visited Nov. 15, 2008)

dents that become causal of international responsibility[34] and liability[35] for its national space activities.

There is always a risk in space projects, nevertheless, small satellites bring reasonable risks in the different project domains: software, engineering, verification and schedule. The advantages of small satellites are in part the simplification of operating timelines, reduction of complexity and simpler organization.

Small satellites such as nano satellites and pico satellites do not have insurance as a general rule, since most of the developers are students and their main goal is hands-on – training for developing practical skills in space projects. However, in the case of more complex and expensive payloads it is worth to insure them for the main risks, for instance the launch and the correct performance in orbit. Other lower risks can be managed by risk transfer or self insurance.

The options for insurance include: pre-launch policy, launch policy, In-orbit policy, liability policy and political[36]risks. In my opinion, AQUARELSat's four small satellites need to obtain insurance for launch, liability and in-orbit operation to protect the imaging capacity such as capture, store and download.

Finally the rates to insure small satellites are lower, likewise the sum insured. In the case of AQUARELSat, the convenience to contract additional insurance will depend on negotiations among the Latin American countries involve in AQUARELSat Constellation. Those who are financing the project will decide after the analysis of documentation, the risk management plan and the recommendations provided by the project manager and the team for risk management the insurance characteristics.

· *Better*

The development of new space technology is enhanced by the construction and operation of small satellites, due to the necessary innovation to achieve the reduction of size and weight. Small satellites require small sensors available through micro-technologies and light materials. Processors on board have been miniaturizing for small satellites, 'computers are another instance where miniaturizing has provided highly capable, affordable machines.'[37]

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34 *See* Article VI of the Outer Space Treaty which indicates that 'State Parties to the Treaty shall bear international responsibility for national activities in outer space'. Then, in case of accident the particulars are not international responsible, but the State. The State who is in charge of authorization and supervision of national space activities from its territory or facility or by its nationals will be international responsible.

35 *See* Article VII of the Outer Space Treaty, which stipulates that 'Each State Party to the Treaty that launches or procures the launching of an object into outer space, […] and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural and juridical persons'. *See* also the Convention on International Liability for Damage Caused by Space Objects (resolution 2777 (XXVI, annex) adopted on 29 November 1971, opened for signature on 29 March 1972, entered into force on 1 September 1972.

36 This classification was explained by Guillaume de Dinechin, Executive Vice President of International Space Brokers, in the lecture titled *An introduction to space insurance* lecture at the MSS/ MSM Academic Year 2005/2006, International Space University, Strasbourg, October 2005.

37 See SMAD, *supra* note 27, at 858.

Considering the limit of space and weight in small satellites, the design is dedicated to develop and build driven missions.[38]

Regarding reliability, it may be a concern that less redundancy – due to the limit of weight and size – could result in less reliability. Expert Rick Fleeter explains that: '[…]reliability gained in a larger system via redundancy is achieved in the smaller system through the reduction in the number of parts … Here too, a smaller, simpler system has a significant reliability advantage'.[39]

38 IIA, supra note 15, at 1.
39 SMAD III, at 860.

Appendix D

International events, declarations, recommendations, resolutions and studies related to the right to safe water

1948	*The Universal Declaration of Human Rights*. Everyone is entitled to the rights of this Declaration without discrimination according with Article 2. Article 25 (1) sets: Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary services Comment: There is no health and well-being without safe water. This could be considered an indirect reference to the importance of safe water
1965	*International Convention on the Elimination of All Forms of Racial Discrimination*. Condemn racial discrimination. Article 5 (e)(iii)(iv) stipulates that State Parties undertake to guarantee equal enjoyment of rights such as the right to housing, public health and social services
1966	*The International Covenant on Economic, Social and Cultural Rights (ICESCR).* Article 11, para.1, refers to the right to an adequate standard of living 'including' food, housing, and clothing. The article does not mention the right to safe water but is inferred from the necessary elements to have an adequate living standard. The word 'including' reflect that this article was not exhaustive, it only mentions some elements of the right to an adequate standard of living no all elements. Article 12 recognizes the right to the highest standard of physical and mental health
1966	*The International Covenant on Civil and Political Rights (ICCPR).* Access to safe water is essential for the right to life. Article 1(2) states that people may not be deprived of its own means of subsistence
1969	*The American Convention on Human Rights 'Pact of San Jose Costa Rica'*. Article 26
1972	*Stockholm Declaration, UN Conference on the Human Environment*. Principle 1 reaffirms the right to adequate conditions of life. Principle 2 refers that natural resources such as water, which are samples of natural ecosystems that must be safeguard for the benefit of present and future generations through proper management
1977	*United Water Nations Conference at Mar del Plata*. This Conference initiated global activities in water. The 'Mar Del Plata Declaration' indicates that regardless the level of economic development, all people have the right to access to safe water in quantities and of a quality equal to their basic needs
1979	*The Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW).* Article 14 (2.h) States Parties shall take measures to eliminate discrimination against women in rural areas, in order to ensure to such women the right to enjoy adequate living conditions, such as sanitation and water supply
Decade (1981-1990)	*UN Doc. GA/RES 35/1980.* The United Nations declared the period of 1981-1990 'The International Drinking Water Supply and Sanitation Decade'. This measure brought valuable extension of basic services to poor communities Goal: by the end of 1990 all people should have access to an adequate water supply
1989	*The Convention on the Rights of the Child (CRC).* Article 24 recognises the right to an adequate standard of health and healthcare facilities. State parties shall implement necessary measures to avoid disease and malnutrition, such as provide safe water

1990	*The African Charter on the Rights and Welfare of the Child*. Regarding health and health services, Article 14 (2.c) indicates that States Parties to the present Charter shall undertake to pursue the full implementation of this right and in particular shall take measures 'ensure the provision of adequate nutrition and safe drinking water'
1990	*Global Consultation on Safe Water and Sanitation for the 1990's, New Delhi*. 'The Dublin Statement' emphasized the importance of safe water and proper means of waste disposal, which must be at the centre of integrated water resources management (IWRM)
1992	*The International Conference on Water and the Environment in Dublin* established four Principles: (1) Fresh water is a finite and vulnerable resource essential to sustain life; (2) Water development and management should be based on a participatory approach; (3) Woman play a central part, and; (4) Water has an economic value in all its competing uses and should be recognized as an economic good
1992	*The United Nations Conference on Environment and Development (UNCED Earth Summit)* in Rio de Janeiro, Brazil. The Rio Declaration on Environment and Development Agenda 21: Chapter 18 Programme areas for action in freshwater deciding the following: (18.47) Safe water-supplies and environmental sanitation are vital for improving health and alleviating poverty; (18.38) refers to three objectives related to water quality. At this Conference, water was recognized as an essential element of sustainable development. Furthermore, it was mentioned that protection of the quality and supply of freshwater resources need to apply an integrated approach to the development, management and use of water resources
1994	*Programme of Action of the International Conference on Population and Development*. Cairo, Egypt. Principle 2 states that the right to adequate standard of living includes water and sanitation, and; it emphasizes the importance of human beings at the centre of concerns for sustainable development
1995	*World Summit for Social Development in Copenhagen*. The 'Copenhagen Declaration on Social Development' suggested that efforts and policies should focus on providing basic needs to all people, including the provision of safe water and sanitation
1996	*Habitat Agenda, UN Habitat II Conference*, in Istanbul, Turkey. Paragraph 129 called for an integrated approach to have sustainable human settlements that enhance the quality of life and reduce negative impact on the environment Paragraph 136 (b) recommends that Governments should improve health and well being, adopting measures to prevent and control air, water and soil pollution
1997	*First World Water Forum in Marrakech*. The 'Marrakech Declaration' called: 'to recognize the basic human needs to have access to clean water and sanitation', and 'to establish a mechanism for management of shared waters'
1997	*UN Convention on the Law of the Non-Navigational Uses of International Watercourses*. The convention includes rules on water resources. The rules for shared water resources indicate that they shall be utilized in an equitable and reasonable manner, considering the interests of the watercourse States concerned. In case of conflict between uses of watercourses it has priority has to be given to the vital human needs. The convention is not yet in forceThere are two signatures from Latin-American countries: Paraguay and Venezuela (Bolivarian Republic of)
2000	*UN Millennium Summit of 2000*. The 'UN Millennium Declaration' establishes the Millennium Development Goals (MDG) for 2015. Regarding safe water, the Goal 19 is 'to halve, by 2015, the proportion of people living in extreme poverty and to halve the proportion of people who suffer from hunger and are unable to reach or to afford safe drinking water' (Goal 19)
2000	*Second World Water Forum in the Hague*. The 'Ministerial Declaration of the Hague on Water Security in the 21st Century' establishes a long-term political commitment to solving global water issues in collaboration and partnership to work towards a secure and sustainable water future

2001	*International Conference of Freshwater in Bonn*. The Ministerial Declaration stated that (1) combating poverty is the main challenge of achieving sustainable development, and (2) water plays a vital role in human health
2002	*World Summit on Sustainable Development. Rio +10*, in Johannesburg, South Africa. The 'Johannesburg Plan of Implementation' includes the Millennium Goal for drinking water: Section II. Poverty eradication, 8 to halve, by the year 2015, the proportion of people who are unable to reach or afford safe water
2002	*Plan of Implementation of the 2002 World Summit on Sustainable Development* denotes that cost-recovery of water should not become a limitation for poor people to access to drinking water. Furthermore, this document provides a list of commitments for financial and technical support to the programmes to expand access to water and sanitation in developing countries
2002	UN *Economic and Social Council (ECOSOC)s General Comment No. 15: The right to water (arts. 11 and 12 of the International Covenant on Economic, Social and Cultural Rights.* Para.2 indicated that the right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses. This document identifies the obligations that includes the right to water
2003	*International Year of Freshwater* was a measure to increase awareness on freshwater importance. Furthermore, the declaration on the International Year of Freshwater was an opportunity to accelerate the implementation of the principles on IWRM
2003	*The 1st United Nations World Water Development Report: Water for People, Water for Life*. This is the first report on the world's freshwater resources. This report was elaborated with the collaboration of 23 United Nations Agencies
2003	*Third World Water Forum in Kyoto*. The Ministerial Declaration in paragraph 16 refers to the Millennium Development Goal (MDG) related to access to water, in order to halve the proportion of people without access to drinking water by 2015. This declaration called to develop strategies for water supply. The General Policy approved 'water' as a driving force for sustainable development
2004	*International Law Association (ILA)s Berlin Rules on Water Resources.* Article 17, defines the right of access to water and Art. 17 (3) set forth specific states' obligations
Decade (2005-2015)	*International Decade for Action 'Water for Life'*. It called for attention on water related issues at all levels and on the implementation of water-related programmes in order to reach water-related goals (Agenda 21, Millennium Development Goals (MDG) and Johannesburg Plan)
2006	*The 4th World Water Forum in Mexico*. The Ministerial Declaration reaffirms in para 2, the commitment to achieve the internationally agreed goals on integrated water management (IWRM) and, access to safe water
2006	*The 2nd United Nations World Water Development Report*. This report outlines conclusions and recommendations to guide future action and encourages sustainable use, productivity and management of scarce fresh water
2006	*The World Water Day 22 March 2006* was guided by the UNESCO under the theme 'Water and Culture'
2007	*The World Water Day 22 March 2007* with the theme 'Coping with Water Scarcity'
2008	*The World Water Day 22 March 2008* This declaration underscores sanitation issues, and this year was declared the International Year of Sanitation by the UN General Assembly. At this time the report of the World Wide Fund for Nature (WWF) about the World's Top Rivers at Risk informed that major rivers are under threat from dams, pollution, over extraction of water and climate change.

2009	*The First Ministerial Forum on Water of the Group of 77*, in Muscat, Sultan of Oman, 23-25 February 2009. The Muscat Declaration on Water recognizes the importance of water to human existence. An interesting aspect of this Declaration is the emphasis in the theme of exchange of scientific and technological know-how among developing countries in water management. Para.11 'stress the importance to create a comprehensive water data and information centre among developing countries'
2009	*The 5th World Water Forum in Turkey*. The Ministerial Declaration recognized water as a basic need in Principle 15. However, the right to water was not recognized as a human right
2010	UN *Doc. A/64/L.63/REV.1. General Assembly resolution recognizing access to clean water, sanitation as human right*, by recorded vote of 122 in favour, none against, 41 abstentions. Latin-American countries which voted in favour are: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela. The draft resolution on the human rights to water and sanitation was introduced by Bolivia. The resolution calls on States and international organizations to provide financial resources, build capacity and transfer technology, particularly to developing countries, to provide safe water and sanitation for all.

Appendix E

Draft agreement concerning the operation of AQUARELSat

Agreement among the Government of the LA1,[1] the Government of the LA2, the Government of LA3 and the Government of LA4 Concerning the Operation on AQUARELSat: The Water Monitoring Constellation

The Government of the LA1, the Government of the LA2, the Government of the LA3 and the Government of the LA4, hereinafter 'the Parties';

RECOGNIZING the sovereign right of the four States to manage their national space activities, in particular in relation to remote sensing activities;

TAKING into account that the Parties have expressed their interest in establishing their national Earth observation systems, which are anticipated to become operational in the year 2014;

RECALLING that in November 2010 the Delegation of LA1, LA2, LA3 and LA4 decided to develop and operate a small satellite constellation named AQUARELSat the Water Monitoring Constellation. The Parties agreed on the general terms of their participation for the development and operation of the AQUARELSat Constellation as it was established in a Memorandum of Understanding dated November 2010, during the Sixth Space Conference of the Americas;

RECALLING that the Space Conferences of the Americas have been a fruitful forum for regional space cooperation, in which AQUARELSat multilateral space project was generated;

RECOGNIZING that the four small satellites in AQUARELSat Constellation are each one funded by one of the Parties;

CONFIRMING the desire of the Parties to join efforts and coordinate the operation of the four satellites to work under a constellation scheme, with which are expected more space benefits from the combination of satellite imagery and data from different payload instruments;

CONVINCED the Parties that the coordinated operation of AQUARELSat Constellation will further expand space cooperation to and in the Latin-American region;

RECOGNIZING that it is desirable to establish among the Parties a legal framework for the design, development, operation, coordination and utilization of the AQUARELSat Constellation;

Have agreed as follows:

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1 'LA' refers to a Latin-American country.

Article I
Definitions

For the purposes of this Agreement, the terms and definitions of the Principles Relating to Remote Sensing of the Earth from Outer Space shall apply. The following definitions shall also apply:

1 AQUARELSat the Water Monitoring Constellation (hereinafter AQUARELSat Constellation) shall refer to a constellation of four small Earth observation satellites, in sun-synchronous orbit. The AQUARELSat constellation is composed of:

1.1 *Azul*, to provide information for measuring surface radiance, horizontal distribution of surface water temperature, land cover state and change, localization of water stress areas. LA1 is in charge of the development and operation of satellite *Azul*.

1.2 *Celeste*, to provide information for locating and monitoring groundwater resources and mapping other natural resources in rural and urban areas. LA2 is in charge of the development and operation of satellite *Celeste*.

1.3 *Turquesa*, to provide information about soil moisture for water surfaces estimation, groundwater recharge and soil chemistry. LA3 is in charge of the development and operation of satellite *Turquesa*.

1.4 *Cian*, to provide information for hydrologic mapping, land use change and groundwater exploration. LA4 is in charge of the development and operation of satellite *Cian*.

2 Remote sensing small satellite of AQUARELSat Constellation shall refer to the space station providing remote sensing services, which is licensed by a Party, as appropriate, and whose technical characteristics are coordinated within the AQUARELSat constellation.

3 National ground station shall refer to the subsystems that are used for carrying out operations from the ground for the logistical support of the satellites.

4 The AQUARELSat central authority shall refer to the central authority in charge of coordinating AQUARELSat operations and representation at the regional and international level.

5 Primary objectives of the AQUARELSat shall refer to the monitoring of water resources, a practical measure to improve water management, in order to achieve the human right to water and achieve water and food security.

5.1 The human right to water entitles everyone to sufficient, safe physically accessible and affordable water for personal and domestic uses.

5.2 Water security exists when all people have physical and economic access to sufficient and safe water for a healthy life.

5.3 Food security exists when all people have physical and economic access to sufficient and safe food to meet their dietary needs for a healthy life.

6 Secondary objectives of the AQUARELSat shall refer to the monitoring of other natural resources and natural disasters.

ARTICLE II
Purposes

The purposes of this Agreement are:

1 To establish a multilateral space cooperation framework among the Parties, on the basis of genuine partnership, for the development, operation and utilization of the AQUARELSat Constellation for civilian purposes, in accordance with international law.
2 To establish a coordinated arrangement among the Parties for the satisfactory operation of the AQUARELSat Constellation, in furtherance of reciprocity and efficient use of satellite imagery and data obtained by or from the AQUARELSat system.
3 To cooperate in the coordination of the four satellites which are each funded by one of the Parties within the scheme of AQUARELSat Constellation and under the direction of the AQUARELSat Central Authority.

ARTICLE III
Cooperating Agencies

The Parties agree that the LA1 Space Agency (hereinafter SALA1) representing the Government LA1; the LA2 Space Agency (hereinafter SALA2), representing the Government of LA2; the LA3 Space Agency (hereinafter SALA3) representing the Government LA3; the LA4 Space Agency (hereinafter SALA4) representing the Government of LA4, shall be Cooperating Agencies responsible for implementing cooperation in the operation of the AQUARELSat Constellation.

ARTICLE IV
International Rights and Obligations

The AQUARELSat Constellation shall be developed, operated, and utilized in accordance with international law, including the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies; the Convention on International Liability for Damage Caused by Space Objects; Convention on Registration of Objects Launched into Outer Space; the Declaration of Legal Principle Governing the Activities of States in the Exploration and Use of Outer Space; Principles Relating to Remote Sensing of the Earth from Outer Space, and; the Declaration on International cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries.

ARTICLE V
Registration; Jurisdiction and Control

1 Pursuant to Article VIII of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, each Party shall retain jurisdiction and control over an object launched unto outer space.

2 In accordance with Article II (1) of the Convention on Registration of Objects Launched into Outer Space, each Party shall register its national space objects as the launching State.

ARTICLE VI
Ownership of Satellites and Ground Stations

1 Each of the Parties through their respective cooperating agencies shall maintain the ownership, control and operation of the satellite it funded as part of the AQUARELSat Constellation.
2 Each of the Parties shall own and operate a ground station for logistics and operation of its respective satellite.

ARTICLE VII
Funding

Each Party shall bear the costs of fulfilling its respective responsibilities under this agreement, including sharing on an equitable basis the system's common operational costs as agreed upon by the AQUARELSat Central Authority within approved estimated operational costs.

ARTICLE VIII
Conditions of Coordination of AQUARELSat

1 The conditions of coordination are subject to the Protocol of Satellite Coordination of AQUARELSat: The Water Monitoring Constellation. The implementation of this Protocol is under the direction of the AQUARELSat Central Authority.
2 The Parties shall assess the effectiveness of this Protocol during future multilateral meetings led by the AQUARELSat Central Authority, as appropriate.

ARTICLE IX
Resolution of Disputes

In the event of a dispute concerning the interpretation or application of this Agreement, the Parties shall cooperate to find a mutually acceptable solution such as conciliation, mediation, or arbitration.

ARTICLE X
Entry into Force

This Agreement shall enter into force on the date in which the Parties have notified each other, through the exchange of diplomatic notes, of compliance with the requirement of their respective national legislation for entry into force of the Agreement. The Agreement shall remain in force until it is replaced by a new agreement or is terminated.

ARTICLE XI
Termination

This Agreement may be terminated by mutual agreement of the Parties or by one of the Parties transmitting a written notice of termination to the other Parties through diplomatic channels. In the case of the latter, the Agreement will terminate six months after the receipt of this notice.

IN WITNESS WHEREOF, the respective representatives have signed the present Agreement.

Done in quadruplicate, at _____, this ____ day of ____, _____, in the English and Spanish languages, both texts being equally authentic.

For the Government of the LA1:For the Government of LA2:

For the Government of the LA3:For the Government of LA4:

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Curriculum vitae

Cynthia Jiménez Monroy was born in Mexico City, Mexico in 1975. She graduated from the Universidad del Valle de México high school in Mexico City in 1992. From 1993 to 1998 she studied law (LL.B) at the Faculty of Law of the Universidad Nacional Autónoma de México (UNAM), the National Autonomous University of Mexico. In 1999, she did an internship at the Consulate General of Mexico in Atlanta, Georgia, the United States. In 2000, when she returned to Mexico she joined the International Affairs Bureau of the Federal Commission of Telecommunications to work with international satellite regulations. At the same time she completed her masters of laws with honors at the UNAM and obtained her LL.M. degree in 2005.

In 2005 she attended a one-year master's programme at the International Space University in Strasbourg, France, and received a Master of Science (M.Sc.) in Space management. In 2006, upon the acceptance to the Doctoral programme at Leiden University (eLaw@Leiden), she started working on her doctoral thesis, and also did an internship at the United Nations Office for Outer Space Affairs (OOSA) in Vienna, Austria. Her three years in residence in Leiden (2006/2009) were funded by the National Council on Science and Technology (CONACYT) of Mexico. The rest of her doctoral research was self-funded.

Ms. Jimenez is member of the International Institute of Space Law and the Association of Attenders and Alumni of The Hague Academy of International Law.

In de boekenreeks van de Graduate School of Legal Studies van de Faculteit der Rechtsgeleerdheid, Universiteit Leiden, zijn in 2009 en 2010 verschenen:

MI-156 N.M. Dane, *Overheidsaansprakelijkheid voor schade bij legitiem strafvorderlijk handelen*, (diss. Leiden), Tilburg: Celsus juridische uitgeverij 2009, ISBN 978 90 8863 034 7

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