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The Netherlands

## **The state of the earth: estimating physical parameters from noisy and incomplete earth observation data**

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### **Citation**

Arp, L. R. (2026, June 23). *The state of the earth: estimating physical parameters from noisy and incomplete earth observation data*. Retrieved from <https://hdl.handle.net/1887/4306907>

Version: Publisher's Version

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Stellingen  
Behorende bij het proefschrift  
The State of the Earth: Estimating Physical Parameters from Noisy and  
Incomplete Earth Observation Data

1. Spatial processes should not just be considered a function of distance, but rather as a system of repeating local processes whose distance-based approximation may sometimes be considered useful (Chapter 3).
2. Cloud removal performance evaluation should be performed primarily on (semi-)simulated data, as opposed to temporally proximal real-world data (Chapter 4).
3. The ill-posedness of parameter estimation and model inversion must be considered separately, rather than assuming that parameter estimation ill-posedness stems from model inversion ill-posedness (Chapter 5).
4. The solutions for all possible alternative realisations of noisy input data must be considered possible solutions for model inversion problems, which cannot usually be achieved by statistical uncertainty alone (Chapter 6).
5. Large, generalist models are currently not well suited to most Earth system parameter estimation tasks.
6. Without direct measurements of physical parameters, the supervision and evaluation of machine learning models for Earth system settings can be flawed or even misleading.
7. High solution sensitivity combined with input data noise presents as ill-posedness regardless of the estimation methods involved.
8. In the context of model inversion and its uncertainty, too much emphasis is often placed on whether we obtained a correct solution, and not enough on whether we asked the right question.
9. AI-informed environmental decision-making based solely on seemingly well-performing machine learning models, without special care for data quality, extrapolation reliability and causality, should be discouraged.
10. Effective interdisciplinary research is founded not on knowing everything about every involved discipline, but on learning enough about them to create unconventional novel approaches separate from any specialised paradigm.

Laurens Arp  
Leiden, 23 June 2026