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# The impact of time-dependent stellar activity on exoplanet atmospheres

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M-dwarfs are thought to be hostile environments for exoplanets. Stellar events are very common on such stars. These events might cause the atmospheres of exoplanets to change significantly over time. It is not only the major stellar flare events that contribute to this disequilibrium, but the smaller flares might also affect the atmospheres in an accumulating manner. In this study we aim to investigate the effects of time-dependent stellar activity on the atmospheres of known exoplanets (GJ 876c, GJ 581c, and GJ 832c). We simulate the chemistry of the atmospheres that go from H-dominated to N-dominated atmospheres using observed stellar spectra from the MUSCLES-collaboration. We make use of the chemical kinetics code VULCAN and implement a flaring routine that stochastically generates synthetic flares based on observed flare statistics. Using the radiative transfer code petitRADTrans we also simulate the evolution of emission and transmission spectra. We investigate the effect of recurring flares for a total of 11 days covering 515 flares. Results show a significant change in abundance for some relevant species such as H, OH, and CH4. We find a maximum change of ~6 ppm for CH4 in transmission spectra on GJ 876c. These changes in the spectra remain too small to observe. We also find that the change in abundance and spectra of the planets accumulate throughout time, causing permanent changes in the chemistry. We conclude this small but gradual change in chemistry arises due to the recurring flares.