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Effects of Clouds on Earth-like Planetary Thermal Emission Spectra at High Resolution

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Abstract

Clouds have an impact on the radiative transfer in planetary atmospheres by changing the planetary spectra (intensities and shapes) due to extinction events. Thereby, they influence the atmospheric and surface temperatures and can also generate false negative biomarker signatures.

1. Introduction

The effects of the presence of clouds in Earth-like planetary atmosphere are studied and compared using high and low resolution radiative transfer models. Accurate high resolution spectra are modeled using a combination of a line-by-line (lbl) molecular absorption code with a multiple scattering radiative transfer solver. Special emphasis is taken at regions of the infrared spectrum where bio-signatures may be present. Temperature profiles and low resolution spectra for Earth-like planets around different types of central stars are calculated using a radiative-convective climate model with a parametrized cloud description (see Kitzmann et al. 2010, AA, Vol 511, A66).

2. Results

The new lbl-multiple scattering code was tested successfully with respect to consistency to the low resolution radiative transfer code. The dependency of biomarker signatures on the presence of low-level water and high-level ice clouds have been analyzed, e.g. the thermal infrared band of ozone at 9.6 micrometer.

3. Summary and Conclusions

Our first results indicate the important impact of clouds on the detectability of biomarker molecules by dampening their spectral signatures. Furthermore, biosignatures may be lost in low resolution spectra leading to false negative classification, i.e. high resolution lbl modeling is mandatory for an assessment of detection feasibility. Hence systematic high resolution studies will be pursued covering other spectral ranges of interest (other biomolecules).

4. Acknowlegements

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References

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