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Potential Biosignatures in Super-Earth Atmospheres: Photochemical Responses

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Abstract

Spectral characterisation of Super-Earth atmospheres for planets orbiting in the Habitable Zone of M-dwarf stars is a key focus in exoplanet science. A central challenge is to understand and predict the expected spectral signals of atmospheric biomarkers (species associated with life). Our work applies a global-mean radiative-convective-photochemical column model assuming a planet with an Earth-like biomass and planetary development. We investigate planets with gravities of 1g and 3g and a surface pressure of one bar around central stars with spectral classes from M0 to M7. The spectral signals of the calculated planetary scenarios have been presented by Rauer et al. (2011). Ozone is a potential biomarker for complex life. An important result of our analysis is a shift in the ozone photochemistry from mainly Chapman production (which dominates in Earth's stratosphere) to smog-dominated ozone production for planets in the Habitable Zone of cooler (M5-M7)-class dwarf stars. This result is associated with a lower energy flux in the UVB wavelength range from the central star, hence slower planetary atmospheric photolysis of molecular oxygen, which slows the Chapman ozone production.