Effect of precipitate water vapor on high-contrast imaging in the thermal infrared

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Abstract

The mid-infrared (IR) regime provides the optimal contrast for detecting rocky exoplanets. Currently, 8-10 m class ground-based telescopes are capable to image giant planets in the habitable zone of nearby stars. One such major demonstration of high-contrast imaging (HCI) capability in the mid-IR was the NEAR (New Earths in the Alpha Cen Region) experiment. NEAR demonstrated a detection sensitivity of a few Jupiter mass planets within a few hours of observing time in nearby systems.
One of the biggest limitations to HCI in the mid-IR is the thermal sky background, which is directly correlated with the amount of precipitate water vapor (PWV) in the atmosphere. The effect becomes more important the bigger the telescope is, and it is one of the main risks for the ELT-METIS HCI performance at ten micron. In this work, we show that PWV is the principal contributor to thermal sky background and science PSF quality. In the presence of high PWV, the contrast in the background limited regime is significantly degraded.

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