

Climate of a tidally locked exo-terrestrial planet with NICAM

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For a tidally locked exo-terrestrial planet, the cloud stabilizing feedback has been considered to maintain surface water because of a difference in the distribution of insolation, causing permanent day-night sides. Clouds pose significant uncertainties in models for exoplanetary atmosphere. Traditionally, conventional GCMs with low resolution have used cumulus parameterization and large-scale condensation schemes to evaluate cloud-related processes. These treatments cannot explicitly resolve sub-scale physical phenomena, such as cloud formation processes.

Here, we introduce NICAM(Non-hydrostatic icosahedral atmosphere model), known as a global cloud-resolving model (GCRM). Our model can explicitly resolve cloud distribution and the vertical moisture transport of water vapor. We performed climate simulation with ~10 km horizontal mesh for the TRAPPIST1-e case. The assumed planet is an aqua planet configuration with 50 m of the mixed layer. The simulated period is 15 years to reach an equilibrium state. Our simulation is the highest resolution, long-term simulation with GCRM for exo-terrestrial planets to investigate characteristics of potential habitable climate. We will show the effect of clouds in the global climate of a tidally locked exo-terrestrial planet. Such a cloud-resolving model will open a new era of climate studies and our understanding of habitable planets.

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