Geophysical Research Abstracts
Vol. 18, EGU2016-16390-1, 2016
EGU General Assembly 2016

The role of sea ice in slowly rotating aquaplanet simulations

Josiane Salameh (1), Max Popp (2), and Jochem Marotzke (3)

(1) Max Planck Institute for Meteorology, International Max Planck Research School on Earth System Modelling, Hamburg, Germany, (2) Princeton University, Princeton, United States, (3) Max Planck Institute for Meteorology, Hamburg, Germany

A large fraction of recently discovered exoplanets are found in close orbit from their star. Their rotation period is expected to be slow due to important tidal forces. Therefore, in order to assess the habitability of slowly rotating planets, it is imperative to understand how slow rotation periods affect the climate. Under different Earth-like configurations, previous studies focused on the special case of synchronous rotation where the orbital and planetary rotation periods are identical. In addition, simulations with non-synchronous rotations did not account for sea ice. Therefore, we turn on the thermodynamics sea-ice model in the state-of-the-art atmospheric general circulation model ECHAM6 coupled to a mixed-layer ocean and investigate the aquaplanet's climate across rotation periods between one and 365 Earth days. Simulations with the sea-ice model turned on show a global-mean surface temperature up to 25 K lower than simulations with the sea-ice model turned off, particularly for rotation periods between 64 and 300 days. For both type of experiments, the climate cools with increasing rotation period. However, when sea ice is included, the significant drop in the global-mean surface temperature is due to sea-ice reaching low latitudes. Then, beyond a 200 days rotation period, sea ice grows over the equatorial region during the nighttime and persists well into the daytime. This causes a high contribution of the sea-ice albedo to the planetary albedo. Our study illustrates, thus, that sea-ice plays a crucial role in shaping the climate on slowly rotating planets.