

## The inner edge of the habitable zone considering the distribution of surface water

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Recently, the advancement of observation technologies has facilitated an increase in the number of extrasolar planets detected. Some of these planets are considered to be terrestrial planets. Liquid water is one of the most important materials affecting the climate and habitability of a terrestrial planet and thought to be necessary for the emergence and evolution of life on the surface of planets. The habitability of extrasolar planets has been actively discussed.

It is typical to assume that habitable planets, like the Earth, have liquid water on the planetary surface. The habitable zone has been defined as the region around the central star where liquid water is stable on the planetary surface. On most of the previous studies, they used one-dimensional climate model and estimated the habitable zone. Recently, estimates using three-dimensional climate models have begun. We focus on the distribution of surface water on the planetary surface and investigate the inner edge of the habitable zone using three-dimensional climate model (the general circulation model: GCM). As results, we recognized two climate regimes: the land planet regime, which has dry low latitude and wet high latitude regions, and the aqua planet regime, which is globally wet as previous studies have already shown. We showed that each regime is controlled by the width of the Hadley circulation. We found that the inner edge of the habitable zone varies continuously with the surface water distribution from 130% (an aqua planet) to 180% (the extreme case of a land planet) of the present insolation at Earth's orbit. Our results indicate that the inner edge of the habitable zone is not a single sharp boundary, but a border whose location varies depending on planetary surface condition. In this talk, we review the habitability of exoplanets and discuss the relationship between the distribution of surface water and habitable climates using our recent results.

Keywords: Habitable planets, exoplanets