A Climate of tidally locked terrestrial exoplanets

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Most of the studies for habitable planets focus on to determine the boundary of the habitable zone. From observation of exoplanet, planets with mass between the Earth and super-Earth around low-temperature star have been discussed. The rotation of such a planet is locked due to the tidal effect from the central star because they locate near the central star.

On most of the previous studies, they used one-dimensional climate models and estimated the habitable zone assuming water-rich planets, like the Earth. Recently, studies of habitable climate using a three-dimensional climate model have begun. They show that the habitable zone estimated by 3D GCM (three-dimensional general circulation model) is greatly different from that by the 1D climate model. The most important difference is the distribution of cloud in the planetary atmosphere. A terrestrial planet with liquid water on the surface around a low-temperature star has clouds in high altitude around the sub-stellar point, leading higher albedo. As a result, it can maintain a warmer climate if it is located out of the habitable zone estimated by a 1D climate model. However, when the rotation period of a planet is short enough, the pattern of the circulation changes to the super-rotation. In this case, no such clouds are formed around the sub-stellar point.

I investigate the pattern of the circulation and habitability for TRAPPIST-1 d and Proxima Centauri b. Additionally, I also investigate the effect of the distribution of water on the planetary surface on the formation of cloud.

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