# Numerical experiments on climate of the Earth-like extrasolar planets using one-dimensional energy balance model

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Recently, extrasolar planets with a mass similar to the Earth were discovered by observations. It is an important question that what kind of climate could have such an Earth-like extrasolar planet. In this study, we performed a series of numerical experiments using one-dimensional Energy Balance Model (EBM), and investigated dependence of climate of the planet on parameters such as orbital radius, obliquity angle, and rotation rate of the planets.

Assuming that the efficiency of north-south heat transport of the planet is inversely proportional to the square of its rotation rate, the steady climate state of the planet at the obliquity angle of 23.5 degrees was calculated by changing two parameters of the heat transport efficiency (that is, the rotational rate) and the orbital radius.

In the range where the heat transport efficiency is large, the orbital radius leading to the global freezing decreases with a decrease in the heat transport efficiency. On the other hand, in the range where the heat transport efficiency is small, the orbital radius leading to the global freezing increases conversely with a decrease in the heat transport efficiency. In the range where the heat transport efficiency is large, heat is efficiently transported from the equator to the pole, so the temperature difference between the equator and the pole becomes small. In this case, since the temperature in the polar region rises, it is possible to maintain the ice-free climate condition even with a smaller stellar radiation. Therefore, in this range, the orbital radius leading to global freezing decreases as the heat transport efficiency decreases. On the other hand, since heat is difficult to be transported from the equator to the pole in a range where the heat transport efficiency is small, the temperature does not rise except for the low latitude and freezes. The amount of heat accumulated in low latitude increases as the heat transport efficiency decreases. That is, the lower the heat transport efficiency, the higher the temperature at the equator. Therefore, in the range where the heat transport efficiency is small, the orbital radius leading to the global freezing increases with a decrease in the heat transport efficiency.

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