Abstract

The purpose of this thesis is to modify an energy balance atmospheric model created by R. Pierrehumbert (Pierrehumbert 2011). His energy balance model gave an estimate of Gliese 581g's, a tidally locked exoplanet, atmosphere. Using an energy balance model, the surface and air temperatures can be found for a planet in equilibrium, when the amount incoming energy is equal to the amount of outgoing energy. Starting from Pierrehumbert's model, we have added for a greenhouse effect and an ice-albedo feedback. We have also modified the model to test a rotating planet (similar to Earth) in addition to a tidally locked planet. This model, by varying the planet's surface pressure, stellar flux, and the atmosphere's emissivity, can find which conditions leads to the planet having the temperatures needed to support liquid water. Surface pressure affects how efficient the planet is at redistributing heat leading to uniform temperatures across its surface. As the incoming stellar flux or the emissivity increase, the planet's surface temperatures rise due the increase in absorbed energy from the planet's surface. We have also found that the orbital distances that are able to support liquid water depend heavily on the pressure of the planet's atmosphere. In future work, this model will produce the planet's IR emission to determine if the planet is detectable using telescopes like the James Webb Space Telescope.