

Assessing the greenhouse effect in Titan's atmosphere

Stage topic Description

Titan, the largest moon of Saturn, is the only satellite in the solar system with a significant atmosphere (1.5 bar). Titan's atmosphere is composed primarily of N₂, H₂, and CH₄ and like Earth, it has a greenhouse effect. Titan also has an anti-greenhouse effect due to an optically thick haze layer detected in its stratosphere preventing visible sunlight from reaching the moon's surface. A total greenhouse warming effect of 10 K was previously estimated using 1D radiative-convective models, raising the surface temperature to about 95 K.

The main goal of this stage is to evaluate the greenhouse and anti-greenhouse effects on Titan's atmosphere using the latest 3D global climate models (GCM). Another goal for this stage would be to model the effect of increasing the solar/heating flux reaching Titan as it happened during the formation of the natural satellite (i.e. accretional heating). The temperature effects of methane lakes subliming on Titan would need to be considered in addition to the possible effects of underground ammonia and liquid water.

Candidate's tasks

- Estimate the greenhouse and anti-greenhouse effects in Titan's atmosphere using the latest Titan GCM.
- Model the effect of increasing the solar flux reaching the Saturn moon by implementing simple modifications to the code.

The ideal candidate

- A student with a background in Meteorology, Atmospheric or Climate Science.
- Experience with Fortran and Linux is a plus.

References

- C.P. McKay, J.B. Pollack, and R. Courtin, "The Greenhouse and Antigreenhouse Effects on Titan", *Science* 253:1118-1121 (1991).
- S. Lebonnois, J. Burgalat, P. Rannou, B. Charnay, "Titan global climate model: A new 3D version of the IPSL Titan GCM", *Icarus* 218 707–722 (2012).