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Investigating the thermal structure in Titan's atmosphere with a Net Exchange Rate formalism

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Abstract

Recent upgrades of the radiative transfer scheme in the Titan's 3-dimensional Global Climate Model developed at the Institut-Pierre-Simon-Laplace have led to improvements within the modeled circulation in the middle atmosphere compared to the previous works [4]. The simulated temperature profiles now feature a stratopause at an altitude consistent with the observations, and the stratospheric Hadley cell consequently tends to extend vertically. The minimum of zonal wind observed during Huygens descent [1] is also better reproduced in our simulations, as we observe a steep minimum in the vertical profile at all latitudes around 20-30 mbar. We discuss the possible origins of this feature in the model.

In this study the infrared opacities used in the *correlated-k* radiative transfer scheme in our GCM are also analyzed with a Net Exchange Rate Analysis formalism - on the basis of previous works on Venus atmosphere [2] - to analyze the energy exchanges in Titan's atmosphere and identify the dominant controls on the thermal profile. Hence it enables to investigate a possible radiative control of the zonal wind minimum - as it appears at a critical altitude where condensation of hydrocarbons and nitriles induce noticeable variations in gaseous and haze opacities [3] - as well as the sensitivity of the thermal profile control to the seasonal variations of trace compounds. The latter will be confronted to the results of [5] - *e.g.* strong cooling over the South winter pole correlated with global molecular enrichment - as a preliminary approach to the computation of radiative effect of these variations in the GCM radiative transfer scheme.

References

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