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Titan's climate modeled with the IPSL Titan 3D-GCM

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Abstract

A new climate model for Titan's atmosphere has been developed at the IPSL. This model uses the current version of the LMDZ General Circulation Model (GCM) dynamical core with the physics part derived from the 2D Titan's IPSL-GCM. First simulations made at the LMD (Laboratoire de Météorologie Dynamique) used a version of the model with coupled haze microphysics only. We update the model with the implementation of the clouds microphysics scheme inherited from the previous 2D version. The model is now fully coupled with clouds processes and is a full 3D extension of the Titan IPSL-GCM. We have performed several simulations with different surface conditions for the methane reservoir, and it appears clearly that it impacts the cloud layer.

1. First results

The simulations were initiated from the 2D-GCM results. We run the model for 15 Titan years. The first objective was to set a correct surface temperature by tuning the amount of haze. Once the temperature appears correct, we started simulations with different conditions for the methane at the surface that are consistent with HASI measurements of 5% of methane at the Huygens landing site. We set a case with a global layer of methane at the surface and a saturation ratio set to 50% (with a bulk flux law) in the first atmosphere layer, a second case with methane only in the two polar regions (beyond 60° latitude), and finally a case with a saturation ratio set to 80% beyond 80° latitude.

Despite that the steady state is not completely reached yet, the clouds activity seemed to show some improvement comparing to the 2D simulations were the clouds asymmetry was not very well reproduced. We also obtain significant differences depending on the case, that may help to give contraints on the source of methane at the surface. the The new model present also some differences in term of precipitation which are less important than in the 2D version. In this presentation, we will compare the two models and present the most significant improvements of the 3D version concerning the clouds processes.

2. Perspectives

The first simulations including clouds microphysics are encouraring. It already show some improvements in term of clouds coverage despite the fact that the mi- crophysics scheme is still in 2-dimensions. The model is already prepared to produce full 3-dimensionnal simulations (including all the microphysics calcula- tions in 3D), but we need to improve the time exe- cutions of the model. Two major update are being prepared. The first one concerns the parallelization of the model. The second deals with the use of moments to represents tracers in the model. These two updates should significantly improve the time execution and al- low the model to run with its full capacities. Then the model results should be compared to the observations in order to improve the model and give interpretations of the observations.

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