Geophysical Research Abstracts
Vol. 19, EGU2017-10169, 2017
EGU General Assembly 2017

Modelling of Titan's middle atmosphere with the IPSL climate model

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Titan's 3-dimensional Global Climate Model developed at the Institute Pierre-Simon Laplace has already demonstrated its efficiency to reproduce and interpret many features of the Saturnian moon's climate (e.g. Lebonnois et al., 2012). However, it suffered from limits at the top of the model, with temperatures far warmer than the observations and no stratopause simulated. To interpret Cassini's overall observations of seasonal effects in the middle atmosphere (e.g. Vinatier et al., 2015), a satisfying modelling of the temperature profile in this region was first required.

Latest developments in the GCM now enable a correct modelling of the temperature profile in the middle atmosphere. In particular, a new, more flexible, radiative transfer scheme based on *correlated-k* method has been set up, using up-to-date spectroscopic data. Special emphasis is put on the too warm upper stratospheric temperatures in the former model that were due to the absence of the infrared ν_4 methane line (7.7 μm) in the radiative transfer. While it was usually neglected in the tropospheric radiative models, this line has a strong cooling effect in Titan's stratospheric conditions and cannot be neglected.

In this new version of the GCM, the microphysical model is temporarily switched off and we use a mean profile for haze opacity (Lavvas et al., 2010). The circulation in the middle atmosphere is significantly improved by this new radiative transfer. The new 3-D simulations also show an interesting feature in the modeled vertical profile of the zonal wind as the minimum in low stratosphere is now closer to the observations.

Works in progress such as the vertical extension and the computation of the radiative effect of the seasonal variations of trace components will also be presented.

- Lavvas P. et al., 2010. Titan's vertical aerosol structure at the Huygens landing site: Constraints on particle size, density, charge, and refractive index. Icarus 210, 832-842.
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- Vinatier S. et al., 2015. Seasonal variations in Titan's middle atmosphere during the northern spring derived from Cassini/CIRS observations. Icarus 250, 95-115.