Venusian Thermosphere variability by IPSL Venus GCM

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For fifteen years, a Global Climate Model (GCM) has been developed for the Venus atmosphere at "Institut Pierre-Simon Laplace" (IPSL), in collaboration between LMD and LATMOS, from the surface up to 150 km altitude (Lebonnois et al., 2010; 2016). Recently, the vertical grid was extended from 10^{-5} Pa to 10^{-8} Pa (~180-250 km) and allows us to simulate the Venusian upper thermosphere. At the same time, improvements were made on the parameterization of non-LTE CO_2 near infrared heating rates, on the parameterization of non-orographic gravity waves and a tuning was performed on atomic oxygen production to improve the thermospheric densities and their effects (heating and cooling; Martinez et al., 2022; submitted).

This work focuses on validating the modeled thermospheric structure by comparison using data from the Pioneer Venus, Magellan and Venus Express missions which cover similar and complementary (equator and pole) regions at different periods of solar activity, typically above 130 km in altitude. In particular, we will discuss the importance of atomic oxygen in regulating the thermospheric temperature, the effect of the solar cycle on the upper thermosphere and the effect of non-orographic gravity waves on the diurnal temperature profile.

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