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# Wave activity below the clouds of Venus with the IPSL Venus GCM

Sebastien Lebonnois (1), Itziar Garate-Lopez (2), Arthur Le Saux (1), and Riwal Plougonven (1)

(1) Laboratoire de Meteorologie Dynamique/IPSL, Sorbonne Université, ENS, PSL Research University, Ecole Polytechnique, Université Paris Saclay, CNRS, Paris, France, (2) Dpto. Física Aplicada I, Universidad del País Vasco/Euskal Herriko Unibertsitatea (UPV/EHU), Bilbao, Spain

Observing the dynamical structure and activity below the cloud base ($\sim$45 km) of Venus's atmosphere is a very difficult challenge. However, a better understanding of this complex atmospheric system is very important, as the deep atmosphere of Venus plays a key role in the overall climate. Advanced Global Climate Models (GCMs) are valuable tools to investigate this question and help for specific future mission planning purposes. In this presentation, we will discuss the wave activity predicted in this region with the IPSL Venus GCM developed in Paris (Lebonnois et al., 2016; Garate-Lopez et al., 2018) and its consequences on the angular momentum budget and the global circulation.

To model the temperature profile in the deep atmosphere, it is crucial to investigate the radiative transfer and the opacity sources below the clouds. Lebonnois et al. (2015) studied how the solar energy absorbed below the cloud may be balanced with infrared energy heating the base of the cloud, convecting up to the middle cloud to escape finally to space mostly in the 20-30 micron region. The temperature profile in our GCM is computed using recent solar flux calculations (Haus et al., 2015) and up-to-date datasets for IR gaseous opacities and collision-induced absorptions. Yet, some tuning through assumptions on the haze below the cloud is necessary to fit the observed temperature profile between the cloud base and the surface.

In particular, the distribution of solar forcing below the cloud base has a strong impact on the wave activity developing in the deep atmosphere. Wave activity around the cloud base (40-60 km) was obtained in recent simulations, contributing to angular momentum convergence in the equatorial region (Garate-Lopez et al., 2018). In previous simulations (Lebonnois et al., 2016), large-scale gravity waves were transporting angular momentum equatorward and downward, improving the distribution of zonal wind below 40 km. As both wave activities were not obtained in the same simulations, we investigated the conditions for the development of each of these wave groups. Tuning of the solar heating rates in the deep atmosphere allowed us to improve simultaneously the temperature and the zonal wind profiles in this region, with the development of both types of waves. We will describe here these waves and discuss their origin and consequences on the angular momentum budget of Venus's deep atmosphere.

References

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