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Characteristics of the Venus Boundary Layer, as modeled by the IPSL Venus GCM

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Abstract

The deepest region of Venus' atmosphere is still fairly unknown. The temperature structure was probed in-situ by the Pioneer Venus descent probes down to 12 km above the surface, and only the VeGa-2 probe measured the temperature accurately down to the surface [1]. The Planetary Boundary Layer (PBL) interacting with the surface plays a key role in the exchanges of energy and angular momentum between the atmosphere and the surface. To characterize this layer, we use the latest numerical simulations obtained with the IPSL Venus GCM to study the convective activity near the surface: diurnal cycle, vertical extent, dependence on latitude and topography. This behavior is analysed through energy balance and stability discussion.

Between around 20-km altitude and around 7-km altitude, the atmosphere appears to be stable, according to the temperature profiles of the VeGa-2 and Pioneer Venus probes. This feature is reproduced in the modeled temperature structure. Below this altitude, the simulations show that the deep atmosphere tends to be mixed by the mean meridional circulation. The PBL, with convective activity, is limited to daytime hours and extends from the surface to 1 to 2 km altitude, except above low-latitude high topography features, where convection can reach up to 8 km around noon (Figure 1).

The interpretation of the VeGa-2 temperature profile below 7-km altitude suggests that the atmosphere may not be uniformly mixed in that region. This hypothesis is also discussed and its consequences on the PBL behavior analysed.

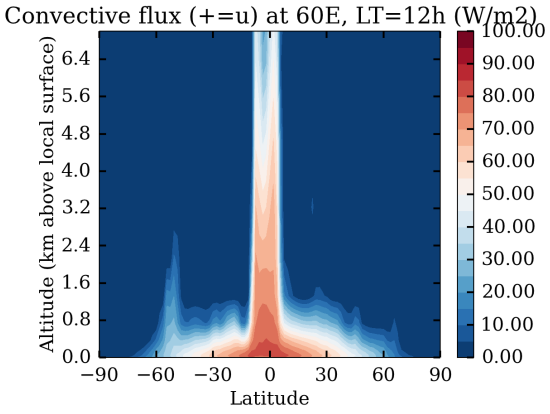

Figure 1: Convective flux modeled at noon at 60°E (positive flux is upward). The western edge of Aphrodite Terra is located around the equator.

References

[1] Zasova, L. V., Ignatiev, N. I., Khatuntsev, I. A. and Linkin, V.: Structure of the Venus atmosphere, Planet. & Space Sci., Vol. 55, pp. 1712–1728, 2007.