LARGE STATIONARY GRAVITY WAVES: A GAME CHANGER FOR VENUS' SCIENCE. T. Navarro[1], G. Schubert and S. Lebonnois[2], [1]Dept of Earth, Planetary, and Space Sciences, UCLA, USA (tnavarro@epss.ucla.edu) , [2]Laboratoire de Météorologie Dynamique (LMD/IPSL), Sorbonne Universités, UPMC Univ Paris 06, CNRS/INSU France.

Introduction: Illustrated in figure 1, the recent discovery of a stationary planetary-scale structure in the atmosphere of Venus by the spacecraft Akatsuki [1] leaves many unanswered questions: What is the nature of this wave? What is its origin? What is its role in the superrotation of the atmosphere? Etc … In this work, we tackle these issues with the use of a Global Climate Model (GCM). It appears that the implications of this study are of substantial importance for science priorities and future measurements.

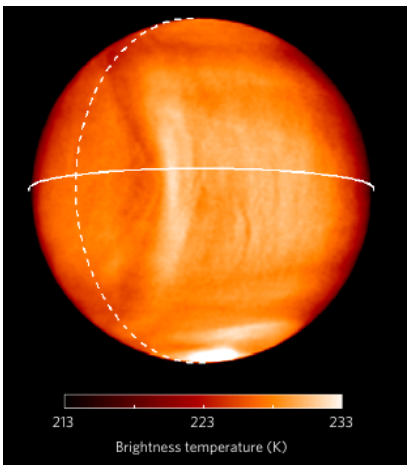

Figure 1: Brightness temperature of the Venus disk acquired by Akatsuki's Long Infrared camera on December 7th,2015. From [1].

Model: The model used in this study is the Institut Pierre-Simon Laplace (IPSL) Venus GCM [2]. It includes a dynamical core on a longitude-latitude grid and a full parameterization of the physics with, among other things, a predicted vertical stability profile, a complete radiative transfer and a latitude-dependent cloud layer. In order to address the origin of the gravity wave seen by Akatsuki, we implement a parameterization of the effects of subgrid topographic slopes on the flow, a classic implementation for Earth GCMs [3].

Results: As seen in Figure 2, the GCM is able to reproduce well the observations, above Aphrodite Terra (Figure 1), by turning on the slope parameterization. The results show a direct link of the topography on the whole Venusian atmosphere, with preferred locations above topographic heights, suggesting that the nature of this wave is a mountain wave.

Implications: Before the Akatsuki-era, such a big structure dominating the atmosphere was unthinkable. The ability to reproduce it with a model opens the possibility to better understand and study it. In the face of this discovery, there are several considerable, previously not recognized, implications for science on Venus that we will elaborate on at the meeting. We hope to see these issues tackled by the Venus Exploration Analysis Group in the future.

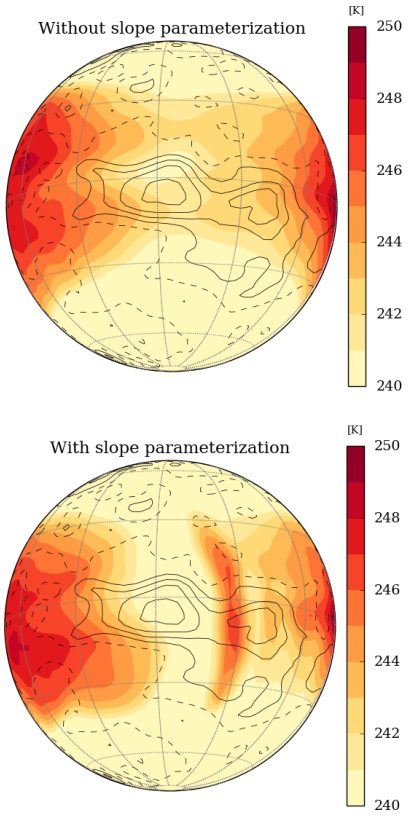

Figure 2: Temperature at 70 km simulated by the IPSL GCM, with and without slope parameterization of subgrid topography. Topography at the GCM grid scale is shown in black contours.

References:

[1] Fukuhara, T. et al. (2017) Nature Geoscience, 10(2), pp. 85-88 [2] Lebonnois, S. et al. (2010) JGR, 1159(6) [3] Lott F., and Miller M.J. (1997) QJRMS, 123, pp. 101-127