EPSC Abstracts
Vol. 14, EPSC2020-281, 2020
https://doi.org/10.5194/epsc2020-281
Europlanet Science Congress 2020

Characterising atmospheric gravity waves on the lower cloud of Venus - A systematic study

José Silva[1], Pedro Machado[1], Javier Peralta[2], and Francisco Brasil[1]
[1]Institute of Astrophysics and Space Sciences, Lisbon, Portugal (jsilva@oal.ul.pt)
[2]Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, Sagamihara, Kanagawa, Japan

- An atmospheric internal gravity wave is an oscillatory disturbance on an atmospheric layer in which the buoyancy of the displaced air parcels acts as the restoring force. As such, it can only exist in a continuously stably stratified atmosphere, that is, a fluid in which the static stability is positive and horizontal variations (within the atmospheric layer) in pressure are negligible when compared to the vertical variations (in altitude) [Gilli et al. 2020; Peralta et al. 2008].
- These waves represent an efficient transport mechanism of energy and momentum through the atmosphere which can dissipate at different altitudes, influencing the atmospheric circulation of several layers in the atmosphere. This dissipation or wave breaking can dump the transported momentum and energy to the mean flow, contributing to an acceleration, thus significantly altering the thermal and dynamical regime of the atmosphere [Alexander et al. 2010].
- We present here results on the detection and characterisation of mesoscale waves on the lower clouds of Venus using data from the Visible Infrared Thermal Imaging Spectrometer (VIRTIS-M) onboard the European Venus Express space mission and from the IR2 instrument onboard the Venus Climate Orbiter (Akatsuki) japanese space mission. We used image navigation and processing techniques based on contrast enhancement and geometrical projections to characterise morphological properties of the detected waves such as horizontal wavelength, packet length and width, orientation and relative optical thickness drop between crests and troughs, as further described in [Peralta et al. 2018]. Additionally, phase velocity and trajectory tracking of wave-packets was also performed. We combined these observations to derive other properties of the waves such as vertical wavelength of detected packets. Our observations include 13 months worth of data from August 2007 to October 2008, when the VIRTIS-IR channel became unable to provide data, and all the available data set of IR2 which comprises images from January to November of 2016. Each image was analysed "by eye" and characterisation was manually performed with tools from the same software described in [Peralta et al. 2018].
- We characterised almost 300 wave-packets across more than 5500 images over a broad region of Venus' globe and our results show a wide range of properties and are not only consistent with previous observations [Peralta et al. 2008] but also expand upon them, taking advantage of two instruments that target the same cloud layer of Venus across multiple time periods.

Acknowledgements

This research is supported by the University of Lisbon through the BD2017 program based on the regulation of investigation grants of the University of Lisbon, approved by law 89/2014, the Faculty of Sciences of the University of Lisbon and the Portuguese Foundation for Science and Technology FCT through the project P TUGA PTDC/FIS-AST/29942/2017. We also acknowledge the support of the European Space Agency and the associated funding bodies Centre National d'Etudes Spatiales (France) and Agenzia Spaziale Italiana (Italy) as well as the full team behind the VIRTIS instrument, Venus Express space mission and the PSA archives. Additionally, we acknowledge the support and work of the entire Akatsuki team. The first author also acknowledges the full support of Japan Aerosapce Exploration Agency (JAXA) for enabling a short internship in their facilities which greatly contributed to this work.

References

[1] M.J. Alexander et al. Recent developments in gravity-wave effects in climate models and the global distribution of gravity-wave momentum flux from observations and models. Royal Meteorological Society, 2010.

[2] G. Gilli et al., Impact of gravity waves on the middle atmosphere of mars: a non-orographic gravity wave parameterization based on global climate modeling and MCS observations. Journal of Geophysical Research - Planets, 2020.

[3] J. Peralta et al. Characterization of mesoscale gravity waves in the upper and lower clouds of venus from vex-virtis images. Journal of Geophysical Research, 113, 2008. doi: 10.1029/2008JE003185.

[4] J. Peralta et al. Analytical solution for waves in planets with atmospheric superrotation - I: acoustic and inertia-gravity waves. The Astrophysical journal, supplement series, 517 213:17, 2014. doi: 10.1088/0067-0049/213/1/17.

[5] J. Peralta et al. Nightime winds at the lower clouds of venus with akatsuki/ir2: Longitudinal, local time and decadal variations from comparison with previous measurements. Astrophysical Journal Supplement Series, 2018. URL: arXiv:1810.05418v2.