

**Small scale gravity waves observed from Radio Occultation experiments of Venus .** T. Maria Antonita, R. K. Chaudhary<sup>2</sup> and T. Imamura<sup>3</sup>

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**Introduction:** Gravity waves are ubiquitous in any planetary atmospheres. Planetary exploration over decades provided clue to the presence of gravity waves in the inner planets like Venus[1],[2],[3] as well as Outer Giant planets like Jupiter [4] apart from the Earth's atmosphere [5]. The sources of the gravity waves in the terrestrial atmosphere are proven to be orography, jet streams and convection[5]. These waves are mainly generated in the tropospheric regions of Earth's atmosphere and propagate to the upper atmosphere thus carrying energy and momentum from source to sink regions. By depositing of energy and momentum fluxes they play paramount role in influencing the dynamics and chemistry of Earth's mesospheric lower thermospheric regions.

Gravity waves are believed to play a major role in the dynamics of our twin sister, Venus. Though the super rotation of the Venusian atmosphere are believed to be caused by the Tidal oscillations, the contribution from gravity waves to this phenomena still remains a puzzle. Radio occultation experiments of the various missions to Venus provide unique opportunity to study the gravity waves in the Venus atmosphere globally. The present study aims to delineate the characteristics features of gravity waves such as its vertical wavelength, energy and momentum fluxes in the Venusian middle atmosphere using the radio occultation data from Venus missions like Akatsuki and Venus express. The results will be discussed in detail.

**Data used :** Radio Occultation data from Akatsuki Radio Science experiment using UDSC and IDSN for the years 2016-2018 are used in the present study. The RO over the equatorial region are taken from Akatsuki mission. RO data used from Akatsuki are X- band (~8.4 GHz) in open loop mode[6]. More 50 occultation events from Akatsuki has been chosen to study the gravity wave characteristics. In addition to Akatsuki RO data, VEX Radio Science Experiment (VeRa) data are also used in the present study. VEX uses two coherently generated S-Band (2.3 GHz) and X-band (8.4 GHz) in the closed loop mode [7]. Combination of these two mission provides a opportunity to elucidate the variations in the gravity waves characteristics in both temporal and spatial domains.

**Advantage :** This work provides background to the Radio Occultation experiments proposed in the ISRO Venus mission. The RO proposal with International collaborators will definitely compliment the Radio Science Experiment of the ISRO'S Venus mission and bring out new perspective to the mysteries pertaining to the Venusian atmospheric dynamics and unique science results along with other suite of experiments.

**References:** [1] Hinson, D.P., Jenkins, J.M., (1995). *Icarus* 114, 310–327. [2] Tellmann, S., Häusler, B., Hinson, D. P., Tyler, G. L., Andert, T. P., Bird, M. K., et al. (2012).. *Icarus*, 221(2), 471–480. [3] Imamura, T., Miyamoto, M., et al. (2018). *JGR Planets*, 123, 2151–2161 [4] Flasar, F.M., Gierasch, P.J., (1986). *J. Atmos. Sci.* 43 (22), 2683–2707. [5] Fritts, D.C., Alexander, M.J., (2003).. *Rev. Geophys.* 41 (1), 1003.[6]. Imamura, T., Toda, T., Tomiki, A., Hirahara, D., Hayashiyama, T., & Mochizuki, N. (2011). *Earth, Planets and Space*, 6, 493–501. [7] Häusler, B., Pätzold, M., et al. (2006).. *Planetary and Space Science*, 54(13-14), 1315–1335.