

Radiative Transfer Analysis of Gigantic Discontinuity in Venus Cloud Layer and Its Lifecycle

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Observations of Venus' night-side disc in the transparency windows of the CO₂ atmosphere (spectacular at 1.74 and 2.3 μm near-infrared wavelengths) allow us to study various morphology and dynamics in the middle to lower cloud layers of Venus. For such studies, Akatsuki, Japan's Venus Orbiter was equipped with the IR2 2- μm camera (Satoh, et al., 2017). A sharp and large discontinuity of cloud opacities was imaged in the night-side of Venus by IR2 (Peralta et al., 2020). This feature was best observed by IR2 in 4 occasions, 9 August, 18 August, 27 August, and 5 September in 2016. Since the faint night-side emission features receive contamination from intense light from the day crescent, we have developed image restoration techniques which successfully recovered the "true" contrast between this enormous cloud cover (ECC) and the adjacent background cloud (BC) regions. From such restored images, the radiance from pixels in BC and ECC from each image were extracted. By conducting a series of radiative transfer computations, we compare the observed brightness changes (from BC to ECC) in two filters of IR2 (1.735 and 2.26 μm). It is found that an increase of Mode 3 particles near the cloud base (~48 km altitude) can reproduce the decreasing radiance from BC to ECC for 9 August and 27 August data. On the other hand, the 18 August data require both the increase of Mode 3 particles AND decrease of smaller particles at the same time to explain the observation. Finally, the 5 September data do not need the increase of Mode 3 particles but slight increase of smaller particles explains the data. Although these are not a unique explanation of how the cloud structure changes from BC to ECC region, this seems to be a favorable characterization of its lifecycle. Implications to the possible mechanism will also be discussed.

Keywords: Venus clouds, opacity discontinuity, infrared observations, atmospheric waves