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Variations in the distribution of the unknown UV absorber associated with planetary-scale waves at the Venus cloud top

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The fast-rotating atmosphere of Venus, known as super-rotation, reaches velocities up to ~100 m s^{-1} at the cloud-top altitude (~70 km). Planetary-scale waves, including the ~5-day Rossby wave and the ~4-day Kelvin wave with zonal wavenumber 1, are observed as periodic variations in winds and temperatures. Recent general circulation model (GCM) studies [Takagi et al., 2022; 2023] demonstrated that these waves undergo alternating phases of growth and decay, which are closely linked to quasi-periodic variations of the mean zonal winds. Because planetary waves play an essential role in transporting angular momentum and heat, understanding their dynamics is key to revealing the mechanisms that maintain super-rotation and the general circulation on Venus.

Observations by Venus Express and Akatsuki revealed quasi-periodic variations of more than 20 m s^{-1} in the super-rotation, along with multi-year to decadal changes of up to 40% in cloud albedo at 365 nm [Lee et al., 2019]. These albedo variations are estimated to modulate the solar heating rate in the upper atmosphere by a factor of ~2 (27 – 50 K day^{-1}). In addition, Akatsuki/UVI observations identified a prominent 5-day Rossby wave associated with equatorially symmetric, planetary-scale vortices [Imai et al., 2019], and showed that the growth and decay of these waves on a timescale of 2 – 3 months coincide with large (~10%) changes in the spatial contrast of the ultraviolet albedo.

In this study, we focus on the periods in 2017 and 2018, during which signatures of planetary waves were prominent in Akatsuki observations. We investigate how the distribution of the unidentified ultraviolet absorber at the cloud top evolved in association with the growth and decay of planetary waves. By comparing these temporal changes in detail, we aim to improve our understanding of the vertical structure of planetary waves and the three-dimensional distribution of the ultraviolet absorber in the Venus atmosphere.