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Venus' atmospheric waves indicated by ground-based dayside infrared spectroscopic observation

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In the Venus' atmosphere, waves of various scales transport angular momentum and play an important role in the atmosphere. For example, the mechanism of the super rotation may be explained by the equatorial Kelvin wave [Yamamoto & Tanaka, 1997] or by the thermal tides [Takagi & Matsuda, 2007].

Most of studies have focused on the ultraviolet region to observe atmospheric waves at 70 km [Del Genio et al., 1982, 1990]. Several studies have focused on the infrared region and analyzed thermal emission from the nightside to observe atmospheric waves at 50 km [Belton et al., 1991]. In contrast, we observed the dayside to derive the clouds structure at 60 - 65 km by quantifying CO_2 absorption. We performed infrared spectroscopic measurements at the NASA Infrared Telescope Facility (IRTF) with CSHELL spectrometer in May and November 2007, June 2009 and August 2010.

We derive the clouds structure from CO_2 absorption equivalent width above the clouds. We can compare data of different terms because equivalent width is unaffected by observation conditions. From the clouds structure, we estimated that the atmosphere rotates at 60 km with a period of 5 days in May 2007 and 5.5 days in August 2010. These periods are different from a period of 4 days at 70 km. It is found that the representative height in August 2010 was 2 km lower than that in May 2007. The changes suggest that the Venus' clouds descend gradually year by year. We derive the clouds structure by rigid body rotations like the past studies. We also derive that by differential rotation, made with wind speeds taken from Venus Express data.

Keywords: Venus, Planetary atmosphere, atmospheric waves, super rotation