Cloud top structure revealed by Akatsuki IR2 dayside images

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The 2-micron camera (IR2) onboard Japanese Venus orbiter, Akatsuki had regularly observed Venus with four narrow-band filters (1.735, 2.02, 2.26, and 2.32 micron) from the late of March, 2016 until the electronic device was unable to control IR2 on December 9, 2016. For approximately nine months, we accumulated more than 3,000 dayside and nightside images of Venus. The main purposes of analyzing IR2 data are (i) to study the dynamics in the upper, middle, and lower atmosphere with the cloud-tracked winds, (ii) to derive the cloud top altitude with the 2.02 micron channel which is located in a CO_2 absorption band, (iii) to deduce CO distribution, which is thought to be a good tracer of the atmospheric circulation below the massive clouds, by utilizing the 2.26 and 2.32 micron channels, and (iv) to investigate aerosol properties of the lower clouds with the 1.735 and 2.26 micron channels.

For purposes (ii)-(iv), we have developed a line-by-line based radiative transfer model for generating synthetic radiance at the IR2 channels. For both solar and thermal radiation cases, adding doubling method (Hovenier et al., 2004; Liu and Weng, 2006) is selected for solving multiple scattering by clouds and molecules. We considered a total of eight molecules (H_2O, CO_2, CO, SO_2, HF, HCl, OCS, and N_2) and line parameters of the first three molecules are taken from HITEMP10 and those of the others are from HITRAN12. For all considered molecules, their line shapes are modelled as Voigt function with cutoff of 125 cm^{-1}. For CO_2, additional modification is done based on Tonkov et al. (1996). A cloud model consisting of four modal cloud particles with a mixture of 75% H_2SO_4 and 25% H_2O is taken from Haus et al. (2015). This model was tested from near-infrared to mid-infrared ranges for the spectral analyses of Venus Express and Venera 15 data, which is useful for interpreting the very limited spectral information such as Akatsuki data.

In this presentation, we will show the detail of the radiative transfer modeling for analyzing the IR2 data and spatiotemporal variations of the cloud top altitude revealed by the IR2 dayside images.

Keywords: Venus, atmosphere, Akatsuki, cloud structure, radiative transfer

