Ground-based observations by Japanese observers

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We started to observe Venus in 1999 with the Okayama Astrophysical Observatory (OAO) / infrared imaging spectrometer (superOASIS) in Japan, and have obtained Venus spectra and images for 5 observing seasons until 2009. In this presentation, we introduce our measurements of minor consituente distributions [Iwagami et al., 2008; Iwagami et al. 2009; Iwagami et al., *in press*] and cloud-top thermal structures.

The abundance of HCl, CO and H_2O in the Venus atmosphere was measured by ground-based IR spectroscopy. The dayside measurements were performed in May and November 2007 with IRTF/CSHELL, a resolution of 40000, and the nightside measurements in Oct. 1999 with OAO/SuperOASIS, a resolution of 1000. The hemispheric distributions of the HCl mixing ratio measured above the Venus' clouds show no significant structure with a disc-averaged value of 0.74 +/- 0.06 ppm which is in the similar range as the previous report of 0.6 +/- 0.2 ppm. The representative height for the dayside measurements is estimated to be 60-66 km. Recent results by Venus Express/SPICAV/SOIR show much smaller values of 0.1-0.2 ppm at 64-94 km; however the direct comparison is difficult due to the different spatial conditions. The hemispheric distributions of the $^{35}Cl/^{37}Cl$ isotope ratio are also found to show no significant structure with a disc-averaged value of 3.1 +/- 0.4 which coincides with the terrestrial value of 3.1. The HCl mixing ratios below the clouds are also found to show no significant structure with a disc-averaged value of 0.40 +/- 0.05 ppm, which is similar to the previous reports of 0.4-0.5 ppm. The larger HCl mixing ratio above the clouds than below suggests the production of HCl in the cloud region or above. Also, a uniform hemispherical distribution of H_2O is found below the clouds with a disc-averaged mixing ratio of 25 +/- 5 ppm; this is in the same range as the previous measurements. Those uniform distributions of HCl and H2O support the fact that their chemical lifetimes are much longer than that of mixing as has been discussed so far. The abundance of CO in the Venus' dayside atmosphere above the clouds was measured by ground-based 2.3 μm spectroscopy for 4 days. The hemispherical distributions found show no significant latitudinal or longitudinal structure. The disc-averaged mixing ratio of 58 ± 17 ppm found at a representative height of 62–67 km is consistent with previous measurements. Such a flat distribution of CO abundance above the clouds seems to be controlled by an efficient horizontal eddy diffusion with a time scale of 30 days or shorter although the CO distribution below the clouds seems to be controlled by the meridional circulation. The pole-ward wind speed of the meridional circulation above the clouds is estimated to be 0.2 m s^{-1} or less based on the difference between the CO mixing ratios above and below the clouds.

Imaging and spectroscopic observations at mid-IR with the wavelengths ranging from 8 to 13 μm utilizing IRTF and the Subaru Telescope in 2005 and 2007. With these observations, we revealed temporal variations of the temperature structure around the cloud top of Venus. Observations with the Subaru telescope in 2005 discovered zonal or patchy thermal structures of the cloud top with a horizontal scale of several 100 km in low and mid latitudinal regions. This structures are resemble to the pattern seen in ultraviolet(UV) images which shows variations of UV reflectance due to unknown UV absorber in the cloud top (Rossow et al, 1980), and the patchy structures are likely to be produced by the convection.