Latitudinal cloud structure in the Venusian northern hemisphere evaluated from VEX/VIRTIS with GCM

M. Kuroda[1], T. Kuroda[1], Y. Kasaba[1], P. Drossart[2], G. Piccioni[3], K. Ikeda[4], M. Takahashi[5]

[1]Tohoku Univ., [2]Observatoire de Paris, [3]INAF-IAPS, [4]JAMSTEC, [5]Univ. Tokyo

The averaged latitudinal distributions of several characteristics of Venusian northern cloud were evaluated from the Venus Express/VIRTIS nadir observations. The characteristics examined were cloud opacity, cloud-top temperature, cloud-top altitude, and carbon monoxide under the cloud.

There are three characteristics related to the polar region clouds: (1) The cloud optical thickness at 65–80° N is 1.5 times larger than that in the mid-latitudes. This feature suggests that the number of cloud particles is larger in polar regions, or the optical characteristics of cloud particles in polar regions are different. (2) The averaged cloud-top temperature decreases gradually from 0–40° N (232±2 K) to 70° N (223±5 K) and then increases to the north pole (233±6 K). In contrast, the averaged cloud-top altitude monotonically decreases from the equator (68.2±1.6 km) to the north pole (58.3±1.0 km). Both features suggest that the Venusian cold and hot polar structures are lower cloud-top regions. (3) The averaged CO mixing ratio under the cloud increases from the equator (16±3 ppm) to 70^{o} N (24±5 ppm) and then decreases until 80^{o} N (19±5 ppm). This profile correlates negatively with the cloud-top temperature. Since CO under the cloud is transported from the upper cloud layer, the negative correlation suggests that the cold collar represents a downwelling region.

In addition, using a Venus General Circulation Model, we traced cloud particle motions and investigated the effects of circulation on these characteristics. The numerical results showed that (1) the cloud-top altitude monotonically decreases from the equator (67.3 km) to the north pole (59.3 km), and (2) the cloud-top temperature is approximately constant from the equator to 40^{o} N (234 K), gradually decreases to 70^{o} N (228 K), and then increases toward the north pole (242 K). These structures originate from the downwelling of Hadley circulation around cloud-top regions at high latitudes. These results suggest that the Venusian polar structures, the cold collar and hot dipole, are created by a decrease of cloud-top altitude in high latitudes due to atmospheric circulations.