論文の内容の要旨

Study of the Venus' upper haze

(金星上部もや層の研究)

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Venus is completely shrouded by a thick cloud deck floating at 45 – 70 km. The major material of the cloud deck is thought to be H_2SO_4 – H_2O droplets. The upper haze on Venus lies above the cloud layer surrounding the planet, ranging from the top of the cloud (～70 km) up to as high as 90 km. The upper haze particles with an effective radius of ～0.25 μm was suggested from Pioneer Venus Orbiter (PV) measurements. The particles were most likely composed of sulfuric acid in terms of refractive index ～1.45. The haze vertical optical thickness in the polar region at 365 nm was found to be 0.8 above the main cloud of 1 μm particles by PV measurements. By comparison, the optical thickness of the haze above the main cloud at low latitudes was found to be 0.06 [Kawabata et al., 1980]. Knibbe et al. (1998) and Braak et al. (2002) observed a gradual decrease of the haze particle column density during the PV mission. Braak et al. (2002) reported a correlation between the decrease of SO_2

abundance [Esposito et al., 1988; Na et al., 1990] and that of the polar haze optical thickness. However, it is unclear how haze are produced and composition of haze.

The upper layer detected (above the clouds) is characterized by a SO_2 mixing ratio increase with altitude from 85 to 105 km [Belyaev et al., 2012]. It shows a new source of SO_2 at high altitude. One possible source of SO_2 in the upper haze layer could be photo-dissociation of H_2SO_4 vapor resulting from evaporation of acid aerosol droplets. However, recent upper limit of H_2SO_4 from sub-mm ground-based observation makes this theory less likely [Sandor et al., 2012]. The cause of the phenomena given above is still controversial.

The Solar Occultation at InfraRed (SOIR) on board Venus Express (ESA) is designed to measure the atmospheric transmission at high altitudes (70 – 220 km) in the IR (2.2 – 4.3 μm) with high resolution by solar occultation. The SOIR data obtained in 2006-2009 are analyzed to examine the upper haze at altitude above 90 km. Vertical and latitudinal distribution of haze extinction, optical thickness and mixing ratio are calculated in using SOIR data statistically. Extinctions and optical thickness at low latitude are two times thicker than those of high latitude. One of the notable results is that mixing ratios increase at altitude above 90 km at both high and low latitudes. It is speculated that sources of haze are transported upward from under altitude 90 km and haze is produced at high altitude. From comparison with the vertical distributions of SO and SO_2 mixing ratios reported by Belyaev et al. (2012), it is speculated the correlation between sulfide and haze.