R009-44
Zoom meeting D ：11/2 PM2 (15:45-18:15)
16:45〜17:00

Study of SO2 transport using Akatsuki UVI images and radiative transfer calculation

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The cloud layer which covers the entire Venus has a great influence on the Venus climate system. The clouds are composed of H_2SO_4 aerosols, and the mechanism of its formation involves sulfur cycle; SO_2, which is abundant in the lower part of the cloud layer, is transported to the cloud tops, where SO_2 is photochemically converted to H_2SO_4. H_2SO_4 forms cloud particles and is transported downward by sedimentation and the meridional circulation, and is thermally decomposed into SO_2 (Mills, Esposito and Yung, 2007). However, the mechanism of SO_2 transport is not understood well.

Akatsuki has been continuously observing Venus. One of its objective is to observe the spatial distribution of SO_2 in the Venus atmosphere (Nakamura et al., 2016). UVI onboard Akatsuki takes images at the wavelength of 283 nm, which is close to the center of the absorption band of SO_2 (Yamazaki et al., 2018). These images reflect the spatial distribution of SO_2, which should be strongly affected by atmospheric circulation. The horizontal wind velocity distribution has been obtained by tracking small-scale patterns in the UV images (Ikegawa and Horinouchi, 2016).

In our recent study, the mechanism of SO_2 transport was qualitatively examined by comparing the horizontal divergence calculated from the wind velocity distribution and the change in the UV reflectance along the movement of each air parcel. The horizontal divergence is used as an index of upward flow, and the reflectance and its temporal variation along the movement of the air parcel were used as indices of SO_2 abundance and its supply rate, respectively. As a result of comparison of these distributions, it is suggested that SO_2 is transported by convection which changes temporally and spatially. Furthermore, an analysis of the UV reflectance and the wind field averaged on the local solar time-latitude coordinate suggested a SO_2 supply process by thermal tides of wavenumber 2 (semi-diurnal tide). However, these analyses are only qualitative. In order to evaluate the roles of those SO_2 transport in cloud formation quantitatively, the mixing ratio of SO_2 at the cloud top and its variation need to be investigated.

In this study, we developed a radiative transport model for the estimation of the abundance of SO_2 at cloud tops. We used the Adding-Doubling method (van de Hulst, 1980), which can calculate the effect of multiple scattering, to calculate the radiative transport in UV region. We adopted the Lebedev quadrature (Lebedev, 1976), which is a kind of quadrature method of the spherical integration, to achieve a uniform resolution with respect to the solid angle. Under the geometrical conditions of observations by Akatsuki UVI, radiative transfer calculations were performed with various SO_2 mixing ratios. By comparing the observed reflectance and the radiative transfer calculations, we can estimate the SO_2 mixing ratio that agrees with the observed reflectance. In this presentation, we show the results of these calculations.