Comparison of horizontal distributions of temperature and UV absorbers at the Venus cloud-tops

*Shinichiro Kawase[1], Makoto Taguchi[1], Tetsuya Fukuhara[1], Yeon Joo Lee[2], Atsushi Yamazaki[3,4]

1. Rikkyo University, 2. Max Planck Institute for Solar System Research, 3. Institute of Space and Astronautical Science, 4. Japan Aerospace Exploration Agency

Venus is the nearest neighbor planet, which has a size similar to that of the earth. However, unlike the earth, Venus is covered with thick - clouds floating at 45-70 km altitudes (Nakamura et al. 2011). It is considered that the clouds are photochemically generated by oxidation of and . In the visible region, light reflected by the clouds are poorly absorbed and few structures are noticeable. On the other hand, in the ultraviolet (UV) region, inhomogeneity of albedo has been identified to be inhomogeneous distribution of UV absorbers above the layer of UV scattering. It has been identified that in the Venusian atmosphere absorbs light in the wavelength region between 200 nm and 320 nm, but chemical species responsible for the absorption in the wavelength region longer than 320 nm is still unidentified. and are candidates (Perez et al. 2018). The UV absorbers play an important role in the atmospheric dynamics, controlling vertical thermal stability by heating at the top of convection layer. The dynamics may feedback the distribution of the UV absorbers by transport of them from the lower atmosphere. Details of the chemical and dynamical coupling are still unknown.

We analyzed images obtained by the Longwave Infrared Camera (LIR) and Ultraviolet Imager (UVI) onboard the Venus orbiter Akatsuki. LIR takes images of thermal radiation in the wavelength range of 8-12 μm emitted from the cloud-tops (Fukuhara et al., 2011). Temperature distributions are derived from the images. Disturbances seen in the temperature distributions are thought to be caused by atmospheric waves and tides, changes in the cloud-top altitude and adiabatic heating and cooling due to convection, direct heating by the UV absorbers, and so on. UVI takes images of the solar radiation reflected by the clouds with narrow bandpass filters centered at the 283 and 365 nm wavelengths, which correspond to the absorption bands of and unknown absorbers (Yamazaki et al., 2018).

Observations at 365 nm often find clouds with a little radiation in the middle latitudes. Such clouds with low radiation (bright) are covering on the clouds with high radiation (dark). The bright clouds are hard to receive the supply of UV absorbers from the lower layer (Titov et al., 2008). We found such bright distributions in the middle latitudes of images taken by LIR and UVI. Examples (on January 26, 2017) are shown in figures. The fact that we can see the similar distributions at different wavelengths means that two cameras observe clouds almost the same altitude. Therefore, we are studying of the dynamics of cloud top distributions at middle latitudes to use data taken by LIR and UVI.

We converted the UV radiation obtained into the absorption rate. Furthermore, we compared by combining the absorption rate and the temperature. The combined image is displayed more reddish when the temperature is higher and it is displayed more blueish when UV absorption rate is higher. Example are shown in figures. The figure is displayed blackish in the equatorial region and whitish in the polar region. In the middle latitudes where we pay attention, the temperature is high and the amount of absorption is small, so it is displayed reddish. In this presentation, we will introduce some examples like this, and will present relationships between temperature and , temperature and unknown absorbers.

As a next step, we will further study the relationship between temperature and UV absorbers for each

latitude and local time, and will clarify what atmospheric dynamics is occurring at the cloud top.

Keywords: Venus, Akatsuki, unknown UV absorber