R009-22
Zoom meeting D ：11/2 AM1 (9:00-10:30)
09:00-09:15

Retrieval of vertical structure in the Martian atmosphere during 2007 global dust storm by OMEGA/MEx limb observation

#Risei Kogure[1)], Arnaud Mahieux[2),4)], Hiromu Nakagawa[3)], Shohei Aoki[2),5)], Yasumasa Kasaba[1)], Nao Yoshida[3)]
[1)]Tohoku Univ.,[2)]BIRA-IASB,[3)]Geophysics, Tohoku Univ.,[4)]University of Texas at Austin, USA,[5)]LPAP , Belgium and FNRS, Belgium

Recent observations have revealed an unexpected high abundance of water vapor in the middle atmosphere, which may be able to drive the enhancement of the atomic hydrogen escape (Chaffin et al., 2017; Fedorova et al., 2018, 2020; Heavens et al., 2018; Vandaele et al., 2019; Aoki et al., 2019). However, it is unclear how to extract water vapor from the lower atmosphere and place it in the middle atmosphere, since the vertical propagation of water vapor is limited by 'the cold trap' at its condensation level. The cold trap confines water in the lower atmosphere by its freezing out. Effective water vapor transportation into the middle atmosphere has been proposed by an inflation of the lower atmosphere, due to the sunlight absorbed by the upsurge of dust associated with intensified meridional circulation can (Aoki et al., 2019; Neary et al., 2019). For the comprehensive picture of the water transport and the background atmospheric condition in the middle atmosphere, two-dimensional (vertical vs latitudinal) distribution of physical parameters is needed to clarify the transient phenomena, such as a rocket dust storm (Spiga et al., 2013).
In this study, we aim to present the 2D vertical structures of water vapor, dust opacity, and CO2 non-local thermal equilibrium (LTE) emission in the periods of 2007 global dust storm (Ls = 265-305) using the OMEGA limb observation onboard Mars Express. The indexes of water vapor and dust opacity are obtained from the wavelength ratio between 2.50 and 2.64 μm and the radiance at 2.77 μm, respectively. CO2 non-LTE emission is seen at 4.3 μm. From the slope of the observed spectrum between 0.5 and 3.0 μm, the effective radius of aerosol particles is estimated. As the reference, observations during the global dust storm in Orbit-4483 (Ls = 268) and Orbit-4621 (Ls = 292) is compared with that at clear-sky season in Orbit-291 (Ls = 17) and Orbit-647 (Ls = 64). The preliminary results are summarized as follows.
(1) The observed radiance at 2.77μm increase up to 50~55km altitude at Orbit-4483 during the global dust storm compared to clear-sky at Orbit-291. This could be caused by suspended dust.
(2) The slopes of observed spectra suggest a larger particle size at 40 km during the global dust storm at Orbit-4483 (~1.0 μm) than that in the clear-sky at Orbit-291 (~0.4 μm). This is comparable with previous studies.
(3) We confirmed that the CO2 non-LTE emission peaks at higher altitudes (100-120 km) during the global dust storm in Orbit-4483. This result basically suggests about 20 km increase of peak altitudes comparing with that in the clear-sky at Orbit-291. This can be explained by the heating by absorption of incoming sunlight via suspended dust particles.
(4) The water vapor exists up to 55 km altitudes at Orbit-4483 during the global dust storm. This is totally different from that at Orbit-647 at clear-sky season, which shows the confined water vapor up to ~30 km altitude. This water vapor transportation to high altitude may occurred due to the results of (1) ~ (3).