Temperature change during the global dust storm period obtained by ground observation of the Martian mesosphere by infrared heterodyne spectroscopy

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In the Martian atmosphere, it is revealed by Mars Express observation that the dust rises to the mesosphere (70-80 [km] in altitude) when dust storm occurs and water vaporis simultaneously transported to the same altitude [Maltagliati et al.,2013 , Heavens et al., 2018]. It leads to Hydrogen atom dissipation due to photodissociation of water vapor at high altitude. It is a new discovery that the phenomenon in the mesosphere can affect the evolution of the Martian environment, and the detailed understanding of the mesosphere is necessary. Therefore, we observed the non-LTE CO_2 emission of 10 μm band by ground observation using Tohoku University heterodyne spectrometer "MILAHI" with wavelength resolution of 10^7(velocity resolution 10 [m/s])to clarify the global mean temperature change during the dust storm period of the Martian mesosphere.
Observations were carried out at the summit of Haleakala, Hawaii from June 2018 (solar longitude Ls = 196, Southern Hemisphere Spring) in the global dust storm to November (Ls = 291 Southern Hemisphere Summer). The spatial resolution is 4 arcsec. (Mars: 19.1 arcsec in June, 10.7 arcsec in November). It is the first time continuous observation by infrared heterodyne spectrometer during the dust storm period at the altitude of 70-80 [km].
The temperature was derived for both kinetic temperature by Doppler width of emission and rotation temperature by line intensity [Sonnabend et al., 2008], and the obtained results were compared.
Kinetic temperature was 150 [K] (68% confidence interval -1sigma122/+1sigma 189 [K]) in June (Ls = 196) and 125 [K] (-1sigma 185/+1sigma 201 [K]) in Sptember(Ls=240), it turned out that the temperature decreased from the global dust storm period to the end.
Compared with the results of the general circulation model [Kuroda et al., 2005,2013,2015] in which dust is not transported at the same altitude, it indicated that 126-129 [K] (Ls = 196) and 132-135 [K] (Ls = 240) which was the opposite tendency to our result. It is thought that the temperature rises at Ls = 240, which is close to the perihelion (Ls = 270), because CO_2 radiation and absorption depend on sunlight. However, the observed higher temperature in Ls = 196 was considered to be caused by the heating by the uplifted dust.
For the rotational temperature, the decrease of line strength of about 1/2 was also detected from the dust storm period to the end. The tendency was similar to the kinetic temperature, and it is clear that absorption around emission was obstructed by dense dust in Ls = 196.
We will compare our results with the stellar occultation observation by MAVEN to validate our result. We will also discuss future prospects such as comparison with observation results at different altitudes in the presentation.

Keywords: Mars, Mesosphere, Temperature, Infrared heterodyne spectrometer

