R009-19
B 会場 ：11/7　AM1 （9:00-10:30）
10:15〜10:30

#吉田　奈央 [1), 青木　翔平 [2),Daerden　Frank[3),Erwin　Justin[3), 中川　広務 [4),Vandaele　Ann Carine[3),Thomas　Ian[3),Trompet　Loic[3), 村田　功 [5), 寺田　直樹 [6),Neary　Lori[3),Lopez-Valverde　Miguel Angel[7),Modak　Ashimananda[7),Geronimo　Villanueva[8),Giuliano　Liuzzi[8), 笠羽　康正 [9),Patel　Manish[10),Ristic　Bojan[3),Bellucci　Giancarlo[11),Lopez Moreno　Jose Juan[7)
([1 東北大・理・地物,([2 東大・新領域創成科学・複雑理工学,([3 ベルギー王立宇宙航空研究所,([4 東北大・理・地球物理,([5 東北大院・環境,([6 東北大・理・地物,([7 アンダルシア天体物理学研究所,([8NASA ゴダードスペースフライトセンター,([9 東北大・理,([10 オープン大学,([11Institute di Astrofisica e Planetologia Spaziali（IAPS/INAF)

CO distributions and climatology in the Martian mesosphere and lower thermosphere retrieved from TGO NOMAD solar occultation

#Nao Yoshida[1)], Shohei Aoki[2)], Frank Daerden[3)], Justin Erwin[3)], Hiromu Nakagawa[4)], Ann Carine Vandaele[3)], Ian Thomas[3)], Loic Trompet[3)], Isao Murata[5)], Naoki Terada[6)], Lori Neary[3)], Miguel Angel Lopez-Valverde[7)], Ashimananda Modak[7)], Villanueva Geronimo[8)], Liuzzi Giuliano[8)], Yasumasa Kasaba[9)], Manish Patel[10)], Bojan Ristic[3)], Giancarlo Bellucci[11)], Jose Juan Lopez Moreno[7)]
([1]Geophysics, Tohoku Univ.,([2]The University of Tokyo,([3]BIRA-IASB,([4]Dep. Geophysics, Grad. Sch. Sci., Tohoku Univ.,([5]Environmental Studies, Tohoku Univ.,([6]Dept. Geophys., Grad. Sch. Sci., Tohoku Univ.,([7]Instituto de Astrofisica de Andalucia（IAA/CSIC),([8]NASA Goddard Space Flight Center,([9]Tohoku Univ.,([10]School of Physical Sciences, The Open University,([11]Institute di Astrofisica e Planetologia Spaziali（IAPS/INAF)

Carbon monoxide (CO) is one of the tracers which can see the dynamics in the Martian atmosphere because the lifetime of CO is longer than the timescale of dynamics. CO is produced by the photodissociation of CO_2 and recycled to CO_2 by the catalytic cycle by odd hydrogen [e.g., McErloy & Donahue, 1972]. CO volume mixing ratio (VMR) is well mixed in the lower atmosphere, but it increases with altitude above ˜60 km. The further enhancement of CO VMR is simulated in the polar regions due to the meridional circulation from the thermosphere using the 3D GCM models [Daerden et al., 2019; Holmes et al., 2019]. The vertical distribution of CO VMR has been observed for the first time by the ExoMars Trace Gas Orbiter (TGO) mission [Olsen et al., 2021; Modak et al., submitted; Yoshida et al., 2022]. Olsen et al. (2021) focused on the distribution in MY34 L_s = 160 – 240, which includes the onset of the global dust storm event. Modak et al. (submitted) investigated the CO VMR in MY34. Yoshida et al. (2022) discussed the CO/CO_2 ratio with a subset of the data taken in MY35, and the altitude range was limited above 70 km due to the retrieval method. The retrieved CO VMR in Olsen et al. (2021) and Modak et al. (submitted) are qualitatively similar to the GCM model (Forget et al., 1999; Lefevre et al., 2004). However, they mentioned the quantitative disagreement with simulations. In this study, we report the CO distribution from MY34 L_s = 160 to MY35 L_s = 100 retrieved from the solar occultation (SO) channel of Nadir and Occultation for MArs Discovery (NOMAD) instrument aboard TGO [Vandaele et al., 2018]. We aim to show the CO climatology and the interannual variation and interpret its distribution using the GEM-Mars model [Daerden et al., 2019; 2022].

NOMAD is a spectrometer measuring between 0.2 and 4.3 μm aboard the ExoMars TGO [Vandaele et al., 2018]. Solar Occultation channel (SO) of NOMAD measures infrared between 2.3 and 4.3 μm (between 2320 and 4350 cm^{-1}) with a high spectral resolution, R ˜17000, thanks to the combination of an Acousto Optical Tunable Filter (AOTF) and an echelle grating [Neefs et al., 2015; Thomas et al., 2016; Vandaele et al., 2018]. The AOTF instantaneously selects diffraction orders (˜20 – 25 cm^{-1}), which enables us to measure 5 to 6 orders simultaneously during the same orbit. The spectral features of CO 2-0 bands (3970.72 – 4360.10 cm^{-1}) are recorded in order 186 – 192. The strongest line in the CO 2-0 bands, 4291.5 cm^{-1}, is included in order 190. The line intensities of the CO 2-0 bands in orders 186 and 192 are weaker by one order than that in order 190. Here, we analyze the transmittance spectrum observed in orders 190 and 186 because these are more frequently observed. The retrieval of CO is performed with the radiative transfer code, named ASIMUT [Vandaele et al., 2006], and the optimal estimation method (OEM) [Rodgers, 2006]. The atmospheric temperature and pressure profiles are inputted from the GEM-Mars simulation [Daerden et al., 2019; Neary & Daerden, 2018], whose model takes into account the effects of the dust storm events in MY34 [Neary et al., 2020]. The fitting is conducted for continuum and CO absorption features. The continuum is assumed to be the 4th polynomial function. The retrieval is calculated for each spectrum at each tangential altitude independently [e.g., Aoki et al., 2019].

The CO VMR is retrieved from the near-surface to 120 km altitude. We have validated the results in the altitude range between ˜50 and 110 km. The increase of CO VMR typically above 60 km is obtained as same as Olsen et al. (2021) and Modak et al. (2022). Our observation showed that the CO VMR is generally higher in the morning terminator than in the evening terminator. However, such a local time variation disappears in L_s = 120-126 and L_s = 277-283 in MY35, and L_s = 59-65 in MY36. The latitudinal-altitudinal distribution is symmetric near the equinox, but it is asymmetric near the solstice, which is the same result predicted by the GEM-Mars simulation presented in Daerden et al. (2019). A decrease in CO VMR in the upper atmosphere during the global dust storm event is measured, whose phenomena are observed by ACS as described in Olsen et al. (2021). We find that the interannual variation of CO distribution showed that the decrease in CO VMR during the global dust storm is restricted in the middle-latitude to the polar region. In the lower latitude, the CO VMR in MY34 is the same and/or large compared to that in MY35. At the presentation, we will show those variabilities in more detail and interpret the CO climatology using the GEM-Mars model [Daerden et al., 2019; 2022].