火星中間圏における異常昇温層の発見

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Unexpected warm layer in the summer nightside mesosphere of Mars and its behavior during the global dust storm by MAVEN/IUVS

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The Mars mesosphere and thermosphere (up to ~100 - 200 km) is well known as an intermediate atmospheric region strongly impacted by coupling with the underlying lower-middle atmosphere (via gravity waves, planetary waves and tides, and dust storms) and coupling with the overlying exosphere and ultimately the Sun (via solar EUV radiation and solar wind particles). Information on this part of the atmosphere is vital to prepare spacecraft missions performing aerobraking, aero-capture or EDL (entry, descent and landing). On the other hand, the Martian atmosphere at this intermediate region is still poorly known due to its highly variable nature and a lack of measurements. This paper presents a new set of stellar occultation measurements made using the Imaging Ultraviolet Spectrograph (IUVS) onboard Mars Atmosphere and Volatile EvolutionN (MAVEN). We report the detection of an extensive layer of warm air at 70 - 90 km altitudes on the night side in the summer hemisphere on Mars. Our result suggests the relatively permanent peaks of atmospheric temperature around 80 km exist over the northern summer night at Ls = 0 - 180 deg. Mars Climate Database does not reproduce a warm layer around 80 km altitude, gradually declining along the height. The predicted temperature by MCD underestimates the quantities of temperature by 10 to 90 K. The longitudinal distribution of atmospheric temperature suggests a mode wave-3 structure. Such distinct layer was also found in the dusty southern summer at Ls = 249 deg, that implies 20 km-higher peaks. The saturated water amount was estimated by the observed temperature profiles by IUVS self-consistently as the possible maximum. Warm air at this altitude range can attribute to preserve the water vapor more than hundreds ppmv in the mesospheric atmosphere and prevent the water vapor condensation falling in the lower atmosphere. Our observations show that as much as more than 100 times more water vapor than expected could be present at this altitude, that will impact the water loss to space. We believe that our result highlighted the dynamical mesospheric thermal structure and upsurge of aerosol plays some role not fully considered in the current model. Although the water vapor amount is not measured by IUVS, the interaction between water, aerosol, and background thermal structure could be addressed in near future by a new observation of TGO. The response of mesospheric thermal structure during the global dust storm 2018 is shown in the paper.