

R009-32

A 会場 : 11/25 PM1 (13:45-15:45)

14:30~14:45:00

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Aerosol transport by traveling waves in the Martian atmosphere studied with MRO/MCS data

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Traveling waves in the Martian atmospheres are considered to play a significant role in determining the climate at mid-to-high latitudes, as is the case with Earth. Previous observations from landers have revealed that these waves become particularly prominent from early autumn to late winter in the northern hemisphere (Barnes, 1981). Their behavior near the surface and in the middle atmosphere had been revealed by analyzing the measurements taken by infrared sounders on several spacecraft. Waves with a zonal wavenumber of 1 exhibited amplitudes of up to 20 K and were extended vertically through the atmosphere, whereas waves with higher zonal wavenumbers showed smaller amplitudes (Banfield et al., 2004). Gong et al. (2023a, 2023b) further characterized traveling waves in both the troposphere and mesosphere, identifying a vertically separated double-peak structure in temperature amplitude for waves with zonal wavenumber of 1. These peaks were observed in the upper troposphere and the mesosphere.

Dust storm is one of the notable features of the Martian meteorology. Their interaction with traveling waves has been explored using spacecraft measurements. Wang et al. (2005) revealed that the occurrence of dust storms is linked to the development of traveling waves, based on imagery from the Mars Orbiter Camera onboard the Mars Global Surveyor.

However, their impact on the transport of dust and water ice clouds has not been studied quantitatively. Examining how traveling waves influence the transport of aerosols provides valuable perspectives into the climatology of Mars. This study aims to quantitatively assess the relationship between traveling waves and the transport of atmospheric substances, such as dust and water ice clouds.

In this study, we utilize the data taken by the Mars Climate Sounder (MCS) onboard the Mars Reconnaissance Orbiter (MRO) in MY30 and MY31. MCS is an infrared radiometer which provides vertical profiles of temperature, dust opacity, and water ice opacity. Its vertical resolution is ~5 km, which provides a better vertical information than other infrared sounders of Mars. Observations revealed eastward-propagating waves during the northern autumn and winter, which were identified as Rossby waves. A pronounced zonal wavenumber-1 mode was detected in the regions where the zonal-mean temperature exhibits a steep meridional temperature gradient, consistent with a baroclinic origin. Our analysis further revealed distinct phase relationships among fluctuations in temperature, dust opacity, and water ice opacity within the region and season characterized by a strong zonal wavenumber-1 mode. Specifically, we identified a positive correlation between temperature and dust opacity, and a negative correlation between temperature and water ice opacity. The amplitudes of the temperature, dust, and water ice variations, when normalized by their respective meridional gradients, yield comparable horizontal displacement scales. This consistency suggests that these variations are driven by the meridional advection associated with traveling waves. These findings suggest that traveling waves play a crucial role in the transport of dust and water ice clouds in the Martian atmosphere.