Waves over the summer southern pole of Mars observed by MGS TES

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MGS TES data have contributed a lot of martian atmospheric sciences and simulations. With TES mapping phase data accumulated, annual and interannual atmospheric variances of global scale have been discussed (e.g. Smith, 2004; Banfield et al., 2003). They have described planetary scale features like a stationary and planetary wave with application of the feature of the regular local time with the sun-synchronous orbit. However, they have less discussed about the polar region because it has quite different local time and low signal to noise ratio in the winter season less than 150K (Christensen et al., 2001). Although it is difficult to discuss about winter polar region using TES data, we expect it is available to discuss in the case of summer season, when it is more than 150K. Further more, we have noted the feature of the sun-synchronous orbit having more abundant data for zonal direction in polar region compared to equator region (for example, zonal intervals in MGS polar orbits have about 1,800km in equator region, and it decreases 600km, 300km and 100km with increasing latitudes 60, 70 and 80 degree respectively). On the other hand, as MGS TES observes frequently along meridian orbit paths, we can take spatially 100km high resolution in the polar region above 70 latitude. In this study, we have attempted to investigate daily atmospheric variances in summer southern pole with several hundred kilometers resolutions.

We have investigated the characteristics of temperature anomalies of wavenumber 1 encircling the summertime southern pole of Mars using the datasets of MGS TES retrieved temperature during MY25-26 funded by the NASA Planetary Data System. Our investigation indicates that the disturbance is localized near the pole, and it has a westward phase tilt with height and extends to the temperature anomaly near the surface which has the maximum around 180E longitude. This is the typical feature throughout Ls 245-290 degree in both MY 25 and 26, and it seems to be peculiar to the southern polar region. The phase tilt is indicative of planetary waves: actually, previous studies have revealed structures of planetary waves with westward phase tilt that propagate along the westerly jet in winter and equinoxes (e.g. Banfield et al., 2003). However, they suggest the prevalence of weak easterly wind near the summer pole and the wind may not allow the existence of planetary waves. Then, two questions arise: what generates these disturbances near the surface, and why do they propagate upward with westward phase tilt? Possible answers to the first question are the dynamical effect of topographical feature and the thermal effect of the asymmetric poleward regression of polar cap edge in summer (Kieffer et al., 2000; James et al., 2001). The second question can be answered by considering the possible occurrence of weak westerly wind near the summer pole, which might be driven by the thermal contrast across the polar cap edge (Siili et al., 1997), and the upward propagation of planetary waves.

References

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