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Effects of dust storms on the Martian ionosphere

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Abstract

Dust storms on Mars, particularly the planet-encircling ones, are one of the most dynamic phenomena that substantially alter the temperatures and circulation patterns of the Martian lower atmosphere [1]. Observational and modeling studies have shown that the Martian ionosphere also responds to the lower atmospheric dust storms [2]. The effects of the lower atmospheric dust storms on the altitude of the Martian ionosphere in magnetic and non-magnetic field regions is studied using measurements by a topside radar sounder aboard the Mars Express spacecraft. For this purpose, we selected two periods of intense dust activity during the southern hemispheric summers of Martian years 28 and 29. The results consistently indicate that the altitude of the Martian ionosphere is higher during the dust storm period than before the onset of the dust storm. In non-magnetic field regions, the altitude ascent with the progression of the dust storm is gradual and smooth. In strong magnetic field regions, however, the gradual altitude ascent is superimposed by several irregular altitude variations. As a result, the altitude ascent rates are smaller in strong magnetic field regions than that in non-magnetic field regions. The altitude ascent rates are ~1.31 km/L_s (L_s is the solar longitude) and 1.95 km/L_s in non-magnetic field region and are 1.07km/L_s and 1.79 km/L_s in strong magnetic field region for MY 28 and 29, respectively. Expansion of the atmosphere during the dust storms along with the solar wind electron precipitation from above and field-aligned transport from below, both along near-radial magnetic fields are considered as plausible mechanisms for explaining the observed results.

References

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