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The Influence of Atmospheric Dust on the Atmosphere and Ionosphere of Mars as seen by the Radio Science Experiment MaRs on Mars Express

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Abstract

The low atmospheric pressure as well as its pronounced topographical diversity lead to a highly dynamical atmosphere on Mars. Atmospheric dust, lifted from the surface, transported to other regions where sedimentation occurs has a strong influence on the dynamical processes on Mars. Atmospheric dust absorbs solar radiation and emits in the infrared, influencing the local weather as well as the global climate via diabatic heating and cooling. Dust is therefore strongly correlated with atmospheric waves [1], clouds, and the transport of aerosols and atmospheric species [2,3]. Its importance is comparable to the water cycle on Earth [3,4].

The atmospheric heating by dust can have strong effects even far away from the surface in the thermosphere of Mars. Higher temperatures can lead to an extension of the atmosphere which also influences the ionosphere, shifting the ionospheric layers to higher altitudes [5].

1. The Radio Science Experiment MaRS on Mars Express

The Mars Express Radio Science experiment MaRS retrieves vertical profiles of the refractive index from the lower atmosphere (a few hundred metres above the surface) to the topside of the ionosphere. These measurements are used to derive temperature, pressure and neutral number density profiles in the lower atmosphere (from a few hundred metres above the surface up to ~ 40-50 km) and electron density profiles in the ionosphere of Mars. The atmospheric and ionospheric profiles have a high vertical resolution of only a few hundred metres. They contain valuable information about small scale vertical structures as the planetary boundary layer [6], or small-scale gravity waves [7]. Radio waves are not sensitive to dust. They can propagate through dust loaded atmospheres which are inaccessible for other instruments.

2. The Influence of Atmospheric Dust

These colocated atmospheric and ionospheric measurements will be used in combination with the information about dust from other instruments, e.g. [2], to study the influence of atmospheric dust over an extended vertical range up to ionospheric altitudes. Possible correlations between atmospheric heating, enhanced wave activity, and the atmospheric dust content will be investigated.

References

[1] Hinson, D.P., Wang, H., and Smith, M.D. (2012), A multi-year survey of dynamics near the surface in the northern hemisphere of Mars: short-period baroclinic waves and dust storms, *Icarus, 219*, 307 - 320.

[2] Montabone, L., et al., (2015), Eight-year climatology of dust optical depth on Mars, *Icarus, 251*, 65 - 95.

[3] Medvedev, A.S., Kuroda, T., and Hartogh, P. (2011), Influence of dust on the dynamics of the martian atmosphere above the first scale height, *Aeolian Res., 3*, 145 - 156.

[4] Heavens, N.G., McCleese, D.J., Richardson, M.I., Kass, D.M., Kleinböhl, A., and Schofield, J.T. (2011), Structure

and dynamics of the Martian lower and middle atmosphere as observed by the Mars Climate Sounder: 2. Implications of the thermal structure and aerosol distributions for the mean meridional circulation, *J. Geophys. Res., 116*, E01010.

[5] Wang, J.-S., and Nielsen, E. (2003), Cyclones, tides, and the origin of a cross-equatorial dust storm on Mars, *Plan. Space Sci., 51*, 329 - 338.

[6] Hinson, D.P., Pätzold, M., Tellmann, S., Häusler, B., and Tyler, G.L. (2008), The depth of the convective boundary layer on Mars, *Icarus, 198*, 57 - 66.

[7] Tellmann, S., Pätzold, M., Häusler, B., Hinson, D.P., and Tyler, G.L., (2013), The structure of Mars lower atmosphere from Mars Express Radio Science (MaRS) occultation measurements, J. Geophys. Res., 118, 306 - 320.