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Variability of the Martian thermospheric temperatures during the last 7 Martian Years

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The temperatures and densities in the Martian upper atmosphere have a significant influence over the different processes producing atmospheric escape. A good knowledge of the thermosphere and its variability is thus necessary in order to better understand and quantify the atmospheric loss to space and the evolution of the planet. Different global models have been used to study the seasonal and interannual variability of the Martian thermosphere, usually considering three solar scenarios (solar minimum, solar medium and solar maximum conditions) to take into account the solar cycle variability. However, the variability of the solar activity within the simulated period of time is not usually considered in these models. We have improved the description of the UV solar flux included on the General Circulation Model for Mars developed at the Laboratoire de Météorologie Dynamique (LMD-MGCM) in order to include its observed day-to-day variability. We have used the model to simulate the thermospheric variability during Martian Years 24 to 30, using realistic UV solar fluxes and dust opacities.

The model predicts and interannual variability of the temperatures in the upper thermosphere that ranges from about 50 K during the aphelion to up to 150 K during perihelion. The seasonal variability of temperatures due to the eccentricity of the Martian orbit is modified by the variability of the solar flux within a given Martian year. The solar rotation cycle produces temperature oscillations of up to 30 K. We have also studied the response of the modeled thermosphere to the global dust storms in Martian Year 25 and Martian Year 28. The atmospheric dynamics are significantly modified by the global dust storms, which induces significant changes in the thermospheric temperatures. The response of the model to the presence of both global dust storms is in good agreement with previous modeling results (Medvedev et al., Journal of Geophysical Research, 2013). As expected, the simulated ionosphere is also sensitive to the variability of the solar activity.

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