Comparison of the Martian thermospheric density and temperature from IUVS/MAVEN data and general circulation modeling

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The Mars Atmosphere and Volatile Evolution (MAVEN) Mission, which operates for slightly over one year to date, has been specifically designed for investigating the upper atmosphere. The Imaging Ultraviolet Spectrograph (IUVS) onboard MAVEN measures spectra of mid- and far UV atmospheric emission, which are used for retrieving vertical density profiles of CO2 and other species.
Newly released IUVS/MAVEN measurements of CO2 density in the Martian thermosphere have been used for comparison with the predictions of the Max Planck Institute Martian General Circulation Model (MPI-MGCM). In this study, we focus on the October 2014 campaign in which a total of 122 density profiles were obtained for the period between 18 and 22 October (Ls=216.68-218.94). IUVS nicely covers the thermosphere in the altitude range of 130-220 km. The MGCM demonstrated the sensitivity of simulated density and temperature profiles on (i) solar flux, (ii) atomic oxygen, and (iii) small-scale gravity waves (GWs). It is the only MGCM to date that includes a parameterization of effects of subgrid-scale GWs with broad spectra.
The simulations reproduced (within one standard deviation) the available zonal mean density and derived temperature above 130 km. The comparison shows a great role of gravity waves in the thermosphere, and in bringing the simulated density and temperature closer to observations.
The MGCM replicated the observed dominant zonal wavenumber-3 non-migrating tide, which was already reported by MAVEN measurements (Lo et al., 2015). The simulations also demonstrated that it represents a non-moving imprint of the topography in the thermosphere.
This comparison confirms that, with the current state of knowledge of the Martian thermospheric physics, MGCM can reproduce its state and variability. Further observations will help to constrain physical parameterizations and improve modeling capabilities.

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