Processes of Auroral Thermal Structure at Jupiter: An Analysis of multispectral temperature observations with the JTGCM

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Recent studies of high-latitude ionosphere-magnetosphere coupling at Jupiter have indicated that the collisions between ions, magnetically connected to sub-rotating regions of the magnetosphere, and neutral species produces a rotational slippage of the neutral atmosphere. Such coupling is introduced via an ion-neutral coupling parameter, K, which is defined as a measure of reductions in the Pedersen conductivity as the corotation breaks down in the Jovian magnetosphere. *In-situ* measurements of the neutral atmospheric structure by the Galileo probe near the Jovian equator derived an exospheric temperature of ~ 900 K. While no *in-situ* measurement is available for the neutral atmosphere of Jupiter's auroral region, infrared and ultraviolet spectrographic imaging results indicate auroral temperatures > 1600 K. Furthermore, high-resolution infrared and far ultraviolet spectroscopy of the aurora suggests the presence of high-speed (> 2 km/s) winds in the Jovian thermosphere. While existing 1-D models are useful for understanding global averages of the Jovian thermosphere, 3-D models can provide significant insight into the regional importance of various processes.

We use our fully coupled 3-D Jupiter Thermosphere General Circulation Model (JTGCM) from 20 μbar (capturing hydrocarbon cooling) to 10^{-4} nbar to address above issues on a global scale. Such general circulation models allow the global dynamical structure (neutral wind and ion drift velocities) to be simulated self-consistently with the thermal structure and compositions (ion and neutral). The coupling between ions in the Jovian auroral ovals and the corotating neutral atmosphere can also be simulated. The heat sources that drive the thermospheric flow are due to solar EUV radiation and high-latitude auroral processes such as particle precipitation and Joule heating. Simulations of Jupiter's global thermospheric dynamics indicate significant ion transport by high-speed winds. Strong neutral outflows also develop with velocities >1 km/s (driven mainly by auroral-region pressure gradients) and temperatures up to 2500 K (depending on the magnitude of Joule heating). The models demonstrate that a significant amount of auroral energy is transported to equatorial latitudes, which can be used to explain the Galileo temperature profile. Auroral temperatures inferred from remote sensing experiments can also be explained. The values of K are obtained for standard model inputs to understand the characteristics of the ion-neutral coupling at Jupiter.