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Processes of Neutral Winds in the Jovian Thermosphere

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Abstract

High-resolution infrared and far ultraviolet spectroscopy of the Jovian aurora indicates the presence of high-speed (>2 km/s) winds in Jupiter's 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 interpret observations of neutral winds and their underlying processes on a global scale. Such general circulation models have been used to explain the global dynamical structure self-consistently with the thermal structure and compositions (ion and neutral) in the Jovian thermosphere. The coupling between ions in the Jovian auroral ovals and the corotating neutral atmosphere has been 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 develop mainly by auroral-region pressure gradients and temperatures up to 3000 K (depending on the magnitude of Joule heating). These outflows, characterized by wind speeds up to 1.3 km/s, is determined by various competing processes such as large pressure gradients, coriolis force, ion-drag process, and hydrodynamic advection. We will describe how these processes can be used to reasonably explain strong Jupiter winds generated in the auroral ovals. The models demonstrate that a significant amount of auroral energy is transported to equatorial latitudes by the Jovian wind system.