EPSC Abstracts
Vol. 6, EPSC-DPS2011-167, 2011
EPSC-DPS Joint Meeting 2011


# Consequences of auroral energy deposition on planetary thermospheres/ionospheres

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## Abstract

Extra-atmospheric electrons, ions, and neutrals originating from the space environment of planets and moons deposit their energy in the atmospheres through collisions with atmospheric species. The processes involved include ionization, dissociation, and excitation of the neutral species and energy transfer to the thermal, ambient electrons. Through direct excitation or indirectly after a chain of chemical reactions, the interaction of the auroral particles with the atmospheric species yields the spectacular auroral emissions observed throughout the Solar System. At planets possessing a strong intrinsic magnetosphere, that is, the Earth and the giant planets, auroral particle precipitation - combined with the presence of electric fields - is a major source of heating of the thermosphere through Joule heating. This friction process is induced by the closure of the field-aligned currents through the conducting, auroral ionosphere. Among the various heating sources induced in the presence of particle precipitation, it is the dominant one, significantly larger than heating through neutral chemistry and through collisions with heated ambient electrons and ions. After a short review of auroral processes in planetary atmospheres, we will assess the effects of Joule heating in the auroral region of Saturn and compare it with the cases of Earth and Jupiter. We will discuss the importance of this process in the context of the energy crisis at the giant planets and highlight how the analysis of auroral emissions can be used to provide constraints to help solve this outstanding problem.