



Simulation of proton precipitations in the upper atmosphere of Mars

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Proton and more generally ion precipitation has an impact in the energy balance of planetary upper atmospheres. The accurate computation of the ionization and excitation is difficult, a difficulty stemming from charge-exchange reactions and neutralisations altering the nature of the initial beam between ion and an energetic neutral atom. Both ion and ENA are capable of ionizing and exciting the ambient neutral species, while the secondary electron created by the first ionization is capable of ionizing the neutral medium in return. In addition, for protons of higher energy (as in Solar Energetic Particle (SEP) events), relativistic effects must be taken into account.

In this work, the transport of H^+/H in the upper atmosphere of Mars is presented in the form of a coupled system of equations that can be solved analytically. Ionization due to proton precipitation in both crustal magnetic fields and during SEP events are investigated by the Aeroplanet/Planetocosmics and NAIRAS/HZETRN models.