Geophysical Research Abstracts, Vol. 7, 06119, 2005
SRef-ID: 1607-7962/gra/EGU05-A-06119

Influence of the solar EUV flux on the Martian plasma environment

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The interaction of the solar wind with the Martian atmosphere and ionosphere is investigated by using three-dimensional, global and multi-species hybrid simulations. In the present work we focus on the influence of the solar EUV flux on the Martian plasma environment by comparing simulations done for conditions representative of the extrema of the solar cycle. The dynamics of four ionic species (H+, He++, O+,O2+), originating either from the solar wind or from the planetary plasma, is treated fully kinetically in the simulation model in order to characterize the distribution of each component of the plasma, both at solar maximum and at solar minimum. The solar EUV flux controls the ionization frequencies of the exospheric species, atomic hydrogen and oxygen, as well as the density, the temperature, and thus the extension of the exosphere. Ionization by photons and by electron impacts, and the main charge exchange reactions are self-consistently included in the simulation model. Simulation results are in reasonable agreement with the observations made by Phobos-2 and Mars Global Surveyor (MGS) spacecraft: 1) the interaction creates a cavity, void of solar wind ions (H+, He++), which depends weakly upon the phase of the solar cycle, 2) the motional electric field of the solar wind flow creates strong asymmetries in the Martian environment, 3) the spatial distribution of the different components of the planetary plasma depends strongly upon the phase of the solar cycle. The fluxes of the escaping planetary ions are computed from the simulated data and results for solar maximum are compared with estimates based on the measurements made by experiments ASPERA and TAUS onboard Phobos-2.