EPSC Abstracts
Vol. 8, EPSC2013-605, 2013
European Planetary Science Congress 2013

Hybrid simulation of the influence of the Martian crustal field of the planet interaction with the Solar wind

S. L. G. Hess (1), R. Modolo(1) , F. Leblanc (1), J.-Y. Chaufray (1), G. Chanteur (2)
(1) LATMOS, UVSQ, IPSL-CNRS, France (sebastien.hess@latmos.ipsl.fr) (2) LPP, Ecole Polytechnique, CNRS, France

Abstract

In the frame of the HELIOSARES project (PI F.Leblanc) dedicated to the modeling of Mars environment (neutral and charged species) from the lower atmosphere to the solar wind, a modeling effort has been conducted to parallelize a multi-species hybrid simulation code. This code now provides a kinetic description of the ions with a rather improved spatial resolution (smaller than the ion inertial length).

This fully parallelized code describes both the dynamics and physical and chemical processes involved inthe interaction. Photoproduction, charge exchange and electron impact ionization are computed dynamically through the simulation domain. Moreover, the Martian crustal field is integrated in our model to study its influence on the interaction dynamic and the ionosphere escape rate. We hereby show the results of these simulations and discussed their impact on the understanding of the Martian environment.

1. Introduction

Due to the absence of strong intrinsic magnetic field, the Martian atmosphere/exosphere is directly

in contact with the Solar Wind (SW), exchanging part of its momentum and energy. This coupling

occurs via ionization processes and contributes to the erosion of the neutral environment of the planet. In this scope, and in the frame of the HELIOSARES project granted by the French National Research Agency, we have parallelized our previous hybrid model [1].

In the hybrid frame, only kinetic effects related to ions are taken into account. Ions are considered as macro-particles and electrons are treated as an inertia-less fluid ensuring the neutrality of the plasma and contribute to the total current and electronic pressure. The model solves the Maxwell equations to provide the temporal evolution of the electromagnetic field. The numerical code we developed simulates several physical and chemical processes. This capability is used to compute ionosphere profiles for each species from specified chemical processes.

2. Simulations

This study presents simulation results with a 80km spatial resolution from a 3-dimensional, parallel, multi-species (H, He, O+ , O2+ , CO2) hybrid model of the Martian interaction with the SW. Physical and chemical processes (photoproduction, electron impact ionization and charge exchange) modifying the concentration of these species are dynamically computed by the model.

Our code also permits us to model the effect of the crustal field on the interaction between Mars and the solar wind. As the Mars crustal field presents fine structures and varies a lot depending on the Sun sublongitude (SSL), we perform several runs with different SSLs. We show that the effect of the martian crustal field on th eatmospheric escape strongly depends on the SSL. The results are discussed and compared with previous studies.