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Hybrid simulation of the Mars environment: comparisons with MEX in-situ data.

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Abstract

As part of the HELIOSARES project (PI F. Leblanc) granted by the French National Research Agency, a hybrid simulation model was developed to describe the Martian environment and to study the interaction between Mars and the solar wind. Using this model, we simulate the signal that would be measured by an instrument onboard a satellite passing through the simulated Mars environment. Taking into account solar conditions, IMF inclination, season, etc, at the time and along trajectories of the MEX probe, simulation results are compared to in-situ data and the variability of the bow shock or the magnetic pile-up boundary (MPB) / induced magnetospheric boundary (IMB) are observed.

1. Introduction

The hybrid simulation provides a description of the solar wind plasma, of the neutral coronae (O, H, CO_2) and of the planetary plasma. The planetary plasma is obtained from the computation of the ionization of the neutral coronae, the ionosphere chemistry and the effect of the crustal field. [1] [2] [3]

In this study, we focus on planetary and solar wind protons and want to compare moments, particularly densities of protons, with hybrid simulation results along trajectories of the spacecraft. Trajectories of MEX probe are studied. The Mars environment and solar wind conditions for these trajectories are determined. Simulation results are compared to in-situ data and the variability of the different boundaries of Mars' induced magnetosphere are investigated.

2. Methodology

The trajectory of MEX probe has been studied to determine several similar trajectories, regarding to night or day side, seasons or solar activity. To compare moments along these similar trajectories, simulation needs several inputs. To obtain optimal results, inputs have to be coherent with the environment of Mars and with the solar wind conditions during MEX trajectories. Several useful tools have been used, such as solar wind prediction models.

3. Results

Several test cases have been identified. These test cases are differentiated by solar conditions, interplanetary magnetic field (IMF) inclination, seasons, day or night side, crustal field, since it is known that the Mars environment is really dependent on these parameters. Comparisons between MEX calculated moments and simulation results are presented.

Acknowledgements

References

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