Geophysical Research Abstracts
Vol. 12, EGU2010-7731, 2010
EGU General Assembly 2010

From a hybrid model to a fully kinetic model: On the modeling of planetary plasma environments by a fully kinetic electromagnetic global model HYB-em

Valter Pohjola (1,2) and Esa Kallio (1)

(1) Finnish Meteorological Institute, Helsinki, Finland, (2) Department of Mathematics, University of Helsinki, Finland

We have developed a fully kinetic electromagnetic model to study instabilities and waves in planetary plasma environments. In the particle-in-a-cell (PIC) model both ions and electrons are modeled as particles. An important feature of the developed global kinetic model, called HYB-em, compared to other electromagnetic codes is that it is built up on an earlier quasi-neutral hybrid simulation platform called HYB and that it can be used in conjunction with earlier hybrid models. The HYB models have been used during the past ten years to study globally the flowing plasma interaction with various Solar System objects: Mercury, Venus, the Moon, Mars, Saturnian moon Titan and asteroids. The new model enables us to (1) study the stability of various planetary plasma regions in three dimensional space, (2) analyze the propagation of waves in a plasma environment derived from the other global HYB models. All particle processes in a multi-ion plasma which are implemented on the HYB platform (e.g. ion-neutral-collisions, chemical processes, particle loss and production processes) are also automatically included in HYB-em model.

In this presentation we study the developed approach by analyzing the propagation of high frequency electromagnetic waves in non-magnetized plasma in two cases: We study (1) expansion of a spherical wave generated from a point source and (2) propagation of a plane wave in plasma. We demonstrate that the HYB-em model is capable of describing these space plasma situations successfully. The analysis suggests the potential of the developed model to study both high density-high magnetic field plasma environments, such as Mercury, and low density-low magnetic field plasma environments, such as Venus and Mars.