Titan's Plasma Environment From Global Hybrid Simulation: Improved Model

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Titan has a dense atmosphere, with an exobase well above its surface, which interacts with the magnetospheric plasma of Saturn. This interaction depends strongly upon the orbital phase of the satellite which determines the angle between the ram direction of the incident plasma and the direction of the Sun. A three-dimensional multi-species hybrid model is used to investigate this interaction. The hybrid formalism allows a fully kinetic description of the different species of ions: very low energy ions created through the ionisation of the neutral species of the upper atmosphere of Titan, thermal and energetic ions from the corotating magnetospheric plasma. With the original version of our model the ionospheric plasma was badly confined by the external plasma for physical parameters representative of the conditions seen by CASSINI. This improved version of our model includes the energetic component of the Kronian plasma which can contribute to about 50% of the external pressure. The exosphere of the satellite is described by three neutral species (methane, molecular nitrogen and hydrogen) for which density profiles are derived from CASSINI-INMS observations. The neutral environment is partially ionized by solar photons, electron impacts, and charge exchanges with the magnetospheric ions. The production rates are computed self-consistently from the neutral densities and the ionization frequencies or the cross-sections. A three dimensional picture of the plasma environment in the vicinity of Titan is presented for different flyby configurations encountered by the CASSINI spacecraft, corresponding to different orbitale phases. An estimation of the escaping flux of planetary pick-up ions is presented and compared to the observations by CASSINI.