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Global hybrid simulations of the Titan plasma environment in the solar wind and in the kronian magnetosphere

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Titan, the biggest moon of Saturn, does not possess an intrinsic magnetic field; thus its exosphere and ionosphere interact directly with the corotating magnetospheric plasma of Saturn or with the solar wind plasma depending upon its orbital phase and upon the dynamic pressure of the solar wind. A three-dimensional and multi-species hybrid code taking into account the coupling between ionised and neutral species has been developed to simulate the ionised environment of Titan above the exobase. The hybrid approach combining a fluid description of electrons and a fully kinetic description of ions is mandatory due to the large Larmor radii of pickup ions with respect to the radius of the atmospheric obstacle. The model assumes a spherically symmetric neutral exosphere made of three molecular species: nitrogen, methane and hydrogen which are ionised by solar photons and electron impacts. Charge exchange reactions with the incoming external plasma are also taken into account by the model. The ionization processes are included self-consistently by taking into account ionization frequencies and charge exchange cross sections. The kronian plasma is assumed to be made of O+ and H+ and the planetary plama consists of N2+, CH4+ and H2+. The interaction of Titan with the kronian plasma is investigated for the submagnetosonic case, taking into account the different ram directions of the magnetospheric plasma and of the solar radiation representative of the situation encountered during flyby TA of Titan by spacecraft CASSINI on October 14th 2004. An investigation of a supermagnetosonic interaction of Titan with the solar wind plasma of the magnetosheath will also be presented.