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Titan's plasma wake investigation from Langmuir Probe observations and global hybrid simulations

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Titan, one of the primary scientific goals of the Cassini-Huygens mission, possesses a dense atmosphere which interacts directly with the magnetospheric plasma of Saturn. We investigate the interaction of the corotating plasma with the upper part of the atmosphere of Titan by analyzing the observations of the Cassini Radio and Plasma Wave Science (RPWS) Langmuir Probe (LP) sensor and predictions obtained from a three-dimensional and multi-species hybrid model. We examine the T9 flyby of Titan on December 26th, 2005 which provides an ideal occasion to explore the structure of the Titan's plasma wake and to estimate the atmospheric loss rate. Moreover the configuration of this flyby allows for comparisons to the Voyager-1 data set. The Langmuir Probe sensor observed the cold plasma environment surrounding Titan, providing the electron density and temperature as well as other plasma parameters. The simulation takes into account a fully kinetic description for ions and a fluid description for electrons. The hybrid formalism describes fully and self-consistently the dynamics of the ions, including all kinetics effects. In this model, the exosphere of the satellite is described by three neutral species (methane, molecular nitrogen and hydrogen) where the profile densities are derived from the INMS observations. The neutral environment is partially ionized by solar photons, electron impacts, and charge exchanges between the incoming plasma and the neutral species. The production rates are computed self-consistently from the neutral densities and the ionization frequencies or the cross-sections.