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3D multispecies hybrid simulations of Titan's highly variable plasma environment– Comparison with Cassini MAG data

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We present three-dimensional hybrid simulations of the interaction between Titan's ionosphere and the Saturnian magnetospheric plasma flow. Titan's orbit is located inside Saturn's magnetosphere most of the time, where the corotating plasma flow is superalfvenic, yet subsonic and submagnetosonic. Due to the characteristic length scales of the interaction region being comparable to the ion gyroradii in the vicinity of Titan, magnetohydrodynamic models can only offer a rough description of Titan's plasma environment. For this reason, Titan's plasma interaction has been studied by using a three-dimensional hybrid simulation code, treating the electrons as a massless, charge-neutralizing fluid, whereas a completely kinetic approach is used to cover ion dynamics. The simulations include up to two magnetospheric and three ionospheric ion species. The simulations show the formation of a strong magnetic draping pattern and an extended pick-up region, being highly asymmetric with respect to the direction of the convective electric field. Besides, the results indicate that Titan's ionospheric tail acts like a natural mass-spectrometer. Due to the dependence of the gyroradii on the ion mass, ions of different masses become spatially dispersed in the tail region. It is also illustrated that the pick-up process of the light ionospheric species is slowed down by the heavier ones. The simulation results are compared to magnetometer data from recent Cassini flybys.