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Kinetic models for space weather: from the solar wind to the inner magnetosphere

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Kinetic models for the solar wind and different regions of the inner magnetosphere have been developed at IASB-BIRA. The velocity distribution functions (VDF) of the particles are determined by solving the evolution equation. The moments are obtained by integration of the velocity distribution function on the velocity space.
An exospheric model of the solar wind assuming a kappa VDF for the electrons has been developed in three dimensions for predictions at 1 AU. Photospheric magnetograms serve as observationally driven input and semi-empirical coronal models are used for the estimation of the plasma characteristics at the lower heliospheric distances to obtain the best comparison with available observations at the Earth's orbit.
A 3D dynamic model of the plasmasphere has also been developed on similar kinetic assumptions and provides the position of the plasmapause, the number density and the temperature of the electrons and protons in the ionosphere as well as inside and outside the plasmasphere. During geomagnetic storms driven by solar wind parameters, the plasmasphere is eroded and structures like plasmaspheric plumes and shoulders can appear. The radiation belts as observed with the Energetic Particle Telescope on board the PROBA-V satellite are also very dynamic during geomagnetic storms and show some links with the plasmapause positions just after the storms. The year 2015 was very active and was especially instructive for studies of the dynamic properties in the inner magnetosphere during geomagnetic storms.