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Statistical Analysis of the Electronic Density Distribution in the Plasmasphere using WHISPER/CLUSTER data

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The plasmasphere is the innermost region of the magnetosphere. It consists of a dense (10^2 - 10^4 cm^{-3}) and cold (1 < eV) plasma of ionospheric source, corotating with Earth and trapped by closed quasi-dipolar geomagnetic field lines. The plasmasphere can be seen as the high altitude extension of the low-middle-latitude ionosphere. Its outer edge, called the plasmapause, is characterized by a sharp density gradient due to the interplay between the Earth's rotation and the magnetospheric convection. The plasmasphere is an active region and plays an important role in the dynamics of the magnetosphere. It can experience a rapid restructuring in response to geomagnetic activity increase; in quiet steady conditions, the plasmasphere can refill over few days.
Characterizing material distributions in the plasmasphere and at the plasmapause location is of primary importance to study the coupling with others regions of the magnetosphere. For instance, plasmapause is known to be the site of wave-particle interaction processes capable of affecting radiation belts and ring current particle populations.
In this context, the ESA CLUSTER mission offers an excellent opportunity to study the inner magnetosphere dynamics over a complete solar cycle, due to more than 6000 plasmasphere crossings near perigee. A systematic analysis of WHISPER plasmaspheric observations is conducted to describe statistically the spatial distribution of the electronic density, both globally and at smaller scale (within magnetic flux tubes). One of the objectives is to estimate the latitudinal dependence of the electronic density along field lines in order to characterize its variation with respect to geomagnetic locations and dynamic activities. Another objective is to better understand the erosion phenomena at the plasmapause and to study the evolution of the density distributions within specific structures, such as plumes.
We present the method used to elaborate an empirical database of electronic density based on WHISPER observations, which consists in coupling data to a magnetic model of the magnetosphere (IGRF-11 + Tsyganenko 2004). From two years of measurements, we propose a statistical classification of the dynamical state of the magnetosphere (using geomagnetic indices and interplanetary parameters) in order to discuss the evolution of the spatial distribution of the electronic density within the plasmasphere and at the plasmapause.