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The dynamics of the plasmasphere

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The plasmasphere is the extension of the ionosphere at higher altitudes. A three dimensional physical dynamic model of the plasmasphere has been developed at BISA. The velocity distribution functions of the particles in the plasmasphere are obtained from the kinetic approach. The position of the plasmapause, the outward limit of the plasmasphere, is determined by the interchange instability mechanism and depends on the level of geomagnetic activity. The dynamics of the plasmasphere is mainly determined by the convection electric field combined with the corotation electric field. Different empirical electric field models have been used and their results are compared. The highly dynamic region of the plasmasphere is disturbed during geomagnetic storms and substorms, with formation of a sharp plasmapause closer to the Earth and of a plume in the afternoon MLT sector. The deformation of the plasmasphere during quiet and disturbed geomagnetic periods is illustrated and compared with observations from IMAGE and CLUSTER satellites. The plasmasphere model is also coupled with the IRI ionospheric model to determine the composition, the number density and the temperature in the plasmasphere.
Comparisons of ionospheric trough observations with results of plasmasphere models have shown that there is generally a correspondence between plasmapause and the ionospheric trough. Moreover, the plasmaspheric region has direct influence on other regions of the magnetosphere. For instance, radiation belt energetic particle populations are very sensitive to the core plasmasphere distribution and specifically to the position of the plasmapause. The relationship between the position of the plasmapause and the inner edge position of the outer radiation belt is studied on basis of CLUSTER observations.