GPS PLASMSPHERIC IMAGING OF THE ELECTRON DENSITY

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Abstract: This paper outlines a mathematical approach to imaging the electron density distribution in the lower plasmasphere using GPS measurements from low Earth orbit (LEO) satellites. The problem of ionospheric imaging using ground-based GPS measurements has been studied for a number of years. Such methods have proved extremely useful in providing details of the larger scale morphology of the global ionosphere. The work presented extends these methods so as to be able to image the plasmasphere up to altitudes of the GPS satellites at 20000km. The problem of limited observations due to the small number of LEO's in operation is overcome by constraining the plasmaspheric electron density to be constant along magnetic field lines. It is shown that a coordinate transform from a spherical coordinate system to one defined in terms of Euler potentials is sufficient to provide unambiguous solutions. Preliminary results using data from the COSMIC satellite constellation are presented showing the response of the plasmasphere to changes in the interplanetary medium.

The results (example Figure 1) clearly show the response of the plasmasphere to changes in the IMF magnetic field are consistent with reported observations from other authors using independent observation techniques.



Figure 1. Example image of the electron density distribution in the plasmasphere.