EPSC Abstracts
Vol. 7 EPSC2012-696 2012
European Planetary Science Congress 2012


# Model for plasmaspheric mass loss during geomagnetic storm

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## Abstract

We estimate the total mass loss of plasmpasphere for 4 events using theory and previous empirical models. As the electrical potential of Volland-Stern, the electrical potential of SAPS effect, the plasmapuse position determined by the interchange instability mechanism and a model of electron density.

## 1. Introduction

The plasmasphere is a cold, dense torus of H+, He+, and O+ surrounding Earth and extending to distances of about 6 Earth radii ($R_E$) (Lemaire and Gringauz, 1998). During times of geomagnetic disturbance, sunward plasma convection plays a crucial role in plasmaspheric dynamics. Perhaps the most fundamental cause of inner magnetospheric convection is dayside magnetopause reconnection (DMR) (Dungey, 1961). A significant modification of DMR convection is a phenomenon that to be called the subauroral polarization stream (SAPS).

The plasma experiences gravitational and centrifugal forces. The latter arises due to corotation. The gravitational force decreases with altitude and there is a limit beyond which gravitational force is balanced by centrifugal force. The limit is called Zero Parallel Force Surface (ZPFS) (Pierrard and Stegen , 2008).

In order to estimate the mass loss, first be calculated the convection electric field (section 2), later be determinated the plasmapause position (section 3) and then use a model of density to get the mass loss (section 4). The section 5 is for the results and comparasions.

## 2. Convection Electric Field

The convection electric filed used in this model is the result of the Volland-Stern electric convection potential plus SAPS electric potential derived by Goldstein et al., 2005, on basis of a previous study of average characteristics of SAPS (Foster and Vo, 2002).

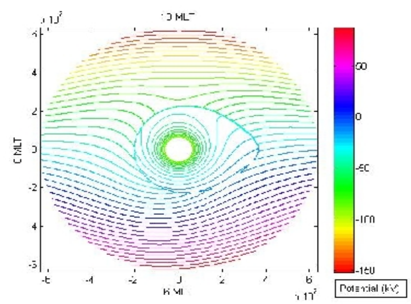

Figure 1. Equipotential map of electric field with SAPS for Kp = 7.

## 3. Plasmapase Position

To determinate the plasmapause position was considered that the plasmapause is the result of the interchange motion becoming unstable along the innermost geomagnetic field lines tangent to the ZPFS [Lemaire, 1989]. The plasmapause develops first in the equatorial region, and subsequently at lower altitudes along the magnetic field lines tangent to the ZPFS.

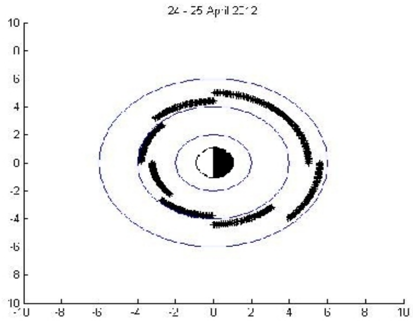


Figure 2. Plasmapause position for 24 -25 April 2012.

## 4. Mass Density

Once you have the plasmapause position, was used the power law form for electron density given by Denton et al., 2002. The equatorial electron density, $n_{e0}$, used is the empirical model of Carpenter and Anderson (1992).

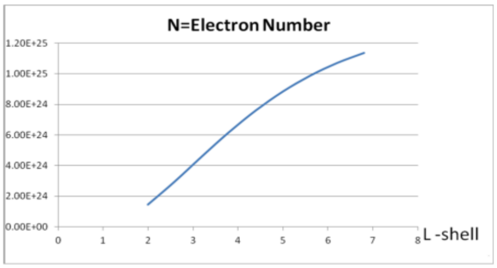


Figure 3. Total estimated electron number in the plasmpasphere.

Once it has the number of electrons can estimate the number of ions assuming the quasi-neutrality of plasma in the plasmasphere and the invariability of percentages of the ions present in the plasmasphere.

## 5. Total mass of material loss for 4 events

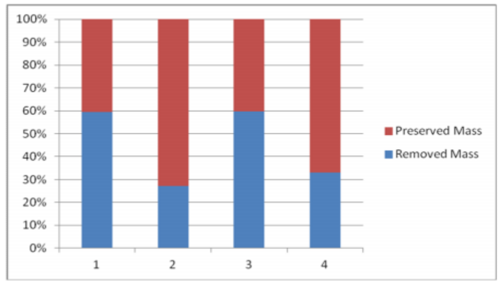


Figure 4. Total estimated mass removed versus the preserved mass for 4 events.

## 6. Summary and Conclusions

The study of the plasmasphere is an example several research techniques. Approaching theoretical, empirical models and measurements and in situ observations. All this leads to a more complete understanding of what is round us. In this case the Plasmasphere.

## Acknowledgements

I am greateful with H. Durand for guide me in this article, answer my questions large and small and so learn more about the plasmasphere. V. Pierrard tkanks a lot for their help and patience.

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