A New Global Core Plasma Model of the Plasmasphere

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Abstract

The Global Core Plasma Model (GCPM) is the first empirical model for thermal inner magnetospheric plasma designed to integrate previous models and observations into a continuous in value and gradient representation of typical total densities. New information about the plasmasphere in particular made possible retirement of several independent models. The Dynamics Explorer 1 Retarding Ion Mass Spectrometer (RIMS) has provided densities in temperatures in the plasmasphere for 5 ion species. These and other works enable a new more detailed empirical model of thermal plasma that will be presented. Specifically shown here are the inner plasmasphere RIMS measurements, scaled to densities and temperatures for H+, He++, O+, and O++ and then also associated with their solar input climate. Also shown are new subtle dependences on the f10.7 Parameter (Richards et al. 1994).

Ion Density Dependence On Radial Distance

Ion densities in the inner plasmasphere are included for all radial distances out to r=5RE. In what follows only the inner plasmasphere is considered where the line between inner and outer depends on the ion density behavior. The distinction is made because of the close variation in behavior and so it can be used to partition behavior at a time. The inner plasmasphere may in fact be expected to behave differently set it is less directly impacted by magnetic activity. Other potential dependences of plasmaspheric densities and temperatures will continue to be explored. Meanwhile expansion of GCPM can be provided for broader.

Inner Plasmasphere Ion Dependence On Radial Distance

Ion densities in the inner plasmasphere and all available temperatures are plotted against radial distance. The scattered values are fit with a linear function; the fit parameters are shown below. Error is obtained from the difference between data and trend normalized by the data. Quite a lot of scatter remains. The expected behavior is attributed to a dependence on radial distance.

Ion Dependence On F10.7 P-Parameter (f10.7+f10.7 81day-ave)/2

The strongest dependant of solar density on temperature in neutral spheres is the F10.7 Parameter. The quantity tested is H, He, He++, O+ and O++ and scaling values for each. Results are determined by the slopes of linear fits to preceding values over customized time periods. For H the preceding 1-day and 5-day periods are considered. For He, the preceding 9 hours and 1-day and 5-day periods. The previously found solar activity dependences are found for He and He++.

Summary of Model Composition

While there remains considerable scatter, trends in density and temperature can be quantified using the linear fits. Using only the radial distance fits, the plots below provide a summary of the expected behavior. The trend in He++ density may also be significant. No dependence in the other two ions or any of the temperatures is considered significant at this time.

The inner plasmasphere density profile is given by:

\[ n = 10^{(-0.79L+5.3)} \]

The He+/H+ density ratio is given by:

\[ n_{He+/H+} = 10^{(-1.541-0.176*r+8.557e^{-3}*P-1.458e^{-5}*P^2)} \]

That is the intended application of these results.

GCPM 2000

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and the He+/H+ density profile is given by:

\[ n_{He+/H+} = 10^{((-1.541-0.176*r))} \]

where the current treatment limits the density ratio to a function of radial distance in the form:

\[ n_{He+/H+} = 10^{((-1.541-0.176*r))} \]

Cars the standard deviation used, for these two factors at 0.0141 and 0.0052.

Model Plasmasphere: Inner Dependence