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Specifying Plasma Density Profiles for Plasmasphere Refilling Using IMAGE RPI Observations

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Sounding measurements from the radio plasma imager (RPI) on the IMAGE satellite are used to derive electron density distributions along magnetic field lines in the nightside plasmasphere and plasma trough for three mid-latitude passes. These passes occurred during 1) a magnetic storm, 2) a prolonged quiet time, and 3) a sudden commencement of a storm, respectively. It is found that the density profiles of filled (in the inner plasmasphere) and depleted (in the plasma trough or outer plasmasphere) flux tubes have different field line dependence. A multi-variant least square fit with a simple analytical function is used to model the density profiles. The fitting parameters in the function define the field line dependence of a density profile, i.e., the steepness of the density profile at high latitudes and the flatness at low latitudes. In each pass the density profiles along the filled and depleted flux tubes can be well modeled with the selected functional form, with two different sets of fitting parameter values for filled and depleted flux tubes. For the three passes examined, the fitting parameter values are not sensitive to the geomagnetic activity for the inner plasmasphere density profiles but vary slightly for the plasma trough or outer plasmasphere density profiles from case to case. The equatorial densities extrapolated from the measured density profiles approximately have a power law relation with L values. The results suggest that the selected function has potential of being able to construct realistic global empirical plasmasphere/plasma trough models. Furthermore, it is now feasible to empirically determine the density profiles along the depleted flux tubes for plasmasphere refilling studies.