

## **ARGOS/EUVIP Data Development and Utilization**

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### **LONG-TERM GOALS**

Our long term goal is to understand the density structure of the Earth's plasmasphere and the physical processes that contribute to the formation of the plasmopause. Of particular interest is the coupling between the plasmasphere and the ionosphere, the use of global helium images to obtain the density structure, and the physical constraints that restrict any theoretical model.

### **OBJECTIVES**

We wish to refine our current model of the plasmasphere, the Multi-Species Kinetic Model of the Plasmasphere (MSKPM), using numerical models for both the topside ionosphere and the large-scale convection electric field. We also wish to validate MSKPM using the data from the Extreme Ultraviolet Imaging Photometer (EUVIP) instrument on the Advanced Research and Global Observation Satellite (ARGOS), as well as from the Extreme Ultraviolet (EUV) instrument on the Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) satellite. Both EUVIP and EUV will measure the 30.4 nm sunlight scattered by helium ions in the topside ionosphere and the plasmasphere. Inversion of this data (Meier *et al.*, 1998) is necessary to recover the density structure and any parameters that govern the density structure.

### **APPROACH**

We will incorporate into MSKPM realistic boundary conditions by using the exobase model that has been developed by Melendez *et al.* (1999) as well as the global MHD model that was partially developed at the Naval Research Laboratory (NRL) by J. Fedder. In addition, we will obtain the EUVIP instrument data from E. Korpela, the EUVIP project scientist at UC Berkeley, and process the data for scientific analysis. G. Ganguli and S. Slinker at NRL, and D. Melendez at NOAA (formerly of NRL) will collaborate on the theoretical issues. Students at both Howard University and Embry-Riddle

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University will be responsible for processing the EUVIP data, comparing it to the model MSKPM, and improving the model.

## **WORK COMPLETED**

The predictions of MSKPM have been compared with the full 11 years of geosynchronous density data obtained by the Los Alamos satellites. This work was presented at the AGU Spring Meeting in June 2001, and a manuscript is currently in preparation.

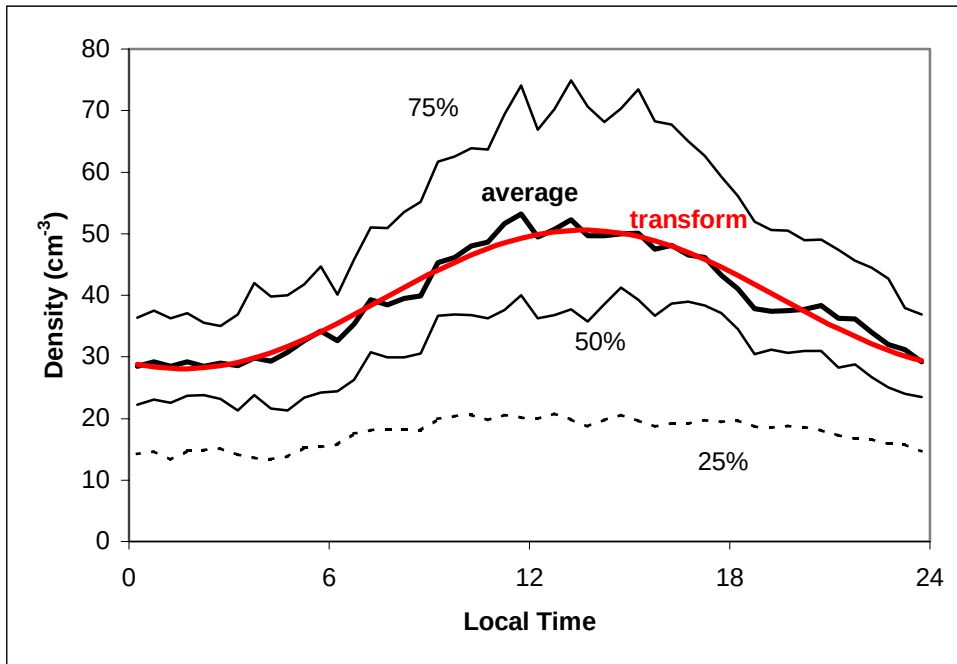
Realistic lower boundary conditions have been added to MSKPM – this work was presented at the AGU Fall Meeting in December 1999 and is currently in publication (Reynolds *et al.*, 2001). In addition, we have collaborated with D. Melendez to understand in detail the structure of the topside ionosphere and how it acts as a source for the plasmasphere. This work was presented at the AGU Spring Meeting in June 1999 and a manuscript is currently in preparation.

A general electric field module for MSKPM has been developed that incorporates the output of the Fedder-Lyon MHD code. Preliminary results of this work were presented at the AGU Spring Meeting in June 2000.

We have obtained some of the data processing algorithms from Eric Korpela, and have applied them to preliminary EUVIP data. This data is currently being analyzed in a regular fashion.

## **RESULTS**

We have shown that a local-time dependent exobase can be quite important in determining the density structure of the plasmasphere. An altitude and density variation on the order of 100% can be strong enough to swamp the effects of diurnal convection. Details are shown in Reynolds *et al.* (2001). Comparing the theoretical prediction with measurements obtained at geosynchronous orbit show a similar local-time dependence in the plasma density. This can be seen in Figure 1, where the statistical plasma density at geosynchronous orbit depicts a similar density structure to the ionosphere, which means that, as expected, the ionosphere is coupled to the geosynchronous plasmasphere. A comparison with the figures in Reynolds *et al.* (2001) shows this correspondence.



**Figure 1.** Plasma density at geosynchronous orbit as measured by the Los Alamos satellites during quiet geomagnetic conditions. The black traces are percentile and average measurements (excluding densities below  $10 \text{ cm}^{-3}$ ), while the red trace is the best fit Fourier series to the average.

## IMPACT/APPLICATIONS

An accurate model of the density, composition, and temperature structure of the plasmasphere is necessary to interpret the results of NASA's IMAGE satellite, which was launched in early 2000, and which will also measure the helium density, but from a global perspective. In addition, this kind of first-principles model will greatly enhance the understanding of space weather as it applies to the plasmasphere.

## TRANSITIONS

This model will ultimately be parameterized into an operational model that space weather forecasters will be able to use to predict the impact on Earth of conditions in space.

## RELATED PROJECTS

An investigation into the statistical nature of the magnetic activity index  $K_p$ , which is used as an indicator of quiet geomagnetic conditions, is underway. In addition, a study of the structure of the large-scale convection electric field is also underway. This electric field governs the particle dynamics of such populations as the ring current and the radiation belts as well as the plasmaspheric population.

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