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Prediction of the plasmasphere dynamics

Irina Zhelavskaya (1,2), Yuri Shprits (1,2,3), and Maria Spasojevic (4)

(1) GFZ Potsdam, Section 2.8: Magnetospheric Physics, Potsdam, Germany (irina.zhelavskaya@gmail.com), (2) Institute of Physics and Astronomy, University of Potsdam, Potsdam, Germany, (3) Department of Earth, Planetary, and Space Sciences, University of California, Los Angeles, California, USA, (4) Hansen Experimental Physics Laboratory, Stanford University, CA, USA

We present a new empirical model for reconstructing the global dynamics of the cold plasma density distribution based only on solar wind data and geomagnetic indices. Utilizing the density database obtained using the NURD (Neural-network-based Upper hybrid Resonance Determination) algorithm for the period of October 1, 2012 - July 1, 2016, in conjunction with solar wind data and geomagnetic indices, we develop a neural network model that is capable of globally reconstructing the dynamics of the cold plasma density distribution for $2 \leq L \leq 6$ and all local times. We validate and test the model by measuring its performance on independent datasets withheld from the training set and by comparing the model predicted global evolution with global images of He+ distribution in the Earth's plasmasphere from the IMAGE Extreme UltraViolet (EUV) instrument. We identify the parameters that best quantify the plasmasphere dynamics by training and comparing multiple neural networks with different combinations of input parameters (geomagnetic indices, solar wind data, and different durations of their time history). We demonstrate results of both local and global plasma density reconstruction. This study illustrates how global dynamics can be reconstructed from local in-situ observations by using machine learning techniques.