# Modeling Radiation Belts and Ionospheric Outflows With the Space Weather Modeling Framework (SWMF)

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**Abstract**

The space environment is a complex system defined by regions of differing scales, characteristic energies, and physical processes. Moreover, each region is highly dependent on what is happening in the other regions. We utilize several models running together under the Space Weather Modeling Framework (SWMF) to study this highly interconnected system. Our endeavors are centered around two topics: First, we examine the impact of the global system on the radiation belts by integrating the Fok Radiation Belt Environment model (RBE) into the SWMF. RBE is coupled to the global magnetosphere component (represented by BATSRUS) of the SWMF. The radiation belt model solves the convection-diffusion equation of the plasma in the range of 10keV to a few MeV. In the SWMF the BATSRUS model provides the time dependent magnetic field by efficiently tracing the closed magnetic field lines and passing the geometrical and field strength information to RBE at a regular cadence. Our second focus is on ionospheric outflow. We have developed the the Polar Wind Outflow Model (PWOM), and coupled it to various components of the SWMF. The PWOM solves the field-aligned gyro-tropic transport equations for $H^+$ , $He^+$ , $O^+$ along several field-lines in the altitude range of 250 km to a few Earth Radii. The resulting outflows are put into the global magnetosphere where they can impact the composition and dynamics. For both topics, we discuss the coupling algorithms and show results from simulating periods of steady IMF conditions and active time periods.

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