Project Details

ROSES ID: NNH07ZDA001N
Selection Year: 2008
Program Element: Focused Science Topic

Topic: Toward combined models of acceleration, loss and transport of energetic electrons and protons in the magnetosphere

Project Title:
Integrated Assessment of Radiation Belt Drivers

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Summary:
We propose to assess the physical processes responsible for the formation and dynamics of the outer zone radiation belt with an array of physics-based models. In particular, the magnetospheric topology, plasma sheet, ring current, and the plasmasphere are primary factors influencing the radiation belts. The dynamics of the radiation belts are highly dependent on each of these drivers: the magnetospheric topology and dynamics for drift shell deformation and ULF wave intensity; the magnitude and morphology of the ring current through magnetic field perturbations and wave excitation; the plasma sheet as a source/seed population; and the location and evolution of the plasmasphere, particularly of the plasmapause and the different plasma wave regimes inside and outside of this boundary.

The Space Weather Modeling Framework (SWMF) will be employed to quantitatively and systematically assess each driver's influence on radiation belt dynamics. The SWMF includes modules for the global magnetosphere, ring current, plasmasphere, and radiation belts. Because the SMWF allows for easy exchange of subroutines for a given science module (once implemented within the framework), several models each will be used for the plasmasphere, the ring current, the global magnetosphere, and the radiation belts, resulting in model combinations of varying degrees of sophistication. A new physics model will be incorporated into the SWMF as part of this proposed effort (namely, the inner magnetospheric particle transport model developed by Dr. Ganushkina).

The research implementation will include both idealized input studies as well as specific storm event studies. Input parameters will cover a range of driver dynamics and radiation belt responses. Several more events, intervals, or cases will also be simulated in the second half of the project, as defined by the Focused Science Topic (FST) Team. All model results will be made available to the other funded researchers for use in their observational, theoretical, or numerical studies of the radiation belts.

The idealized input case studies will reveal how the radiation belts respond to various driver conditions, while the real event studies will allow for the assessment of how these individual drivers combine to form the observed radiation belt for a particular interval. For the real event studies, extensive data-model comparisons will be conducted of the radiation belt fluxes/phase space densities as well as the lower-energy plasma populations and near-Earth electric and magnetic fields. In particular, the balance between simultaneous sources and losses of the radiation belt will be examined, with special emphasis on the connection to the lower-energy plasma populations and global field configurations.

Publication References:

Summary: no summary

Reference: Glocer, A.; Toth, G.; Fok, M.; Gombosi, T.; Liemohn, M.; (2009), Integration of the radiation belt environment model into the space weather modeling framework, Journal of Atmospheric and Solar-Terrestrial Physics, Volume 71, Issue 16, p. 1653-1663, doi: 10.1016/j.jastp.2009.01.003