Project Details

ROSES ID: NNH10ZDA001N
Selection Year: 2011
Program Element: Focused Science Topic

Topic: Incorporating Plasma Waves in Models of the Radiation Belts and Ring Current

Project Title:
Modeling the global distribution of chorus, plasmaspheric hiss, and equatorial magnetosonic waves, and their effect on radiation belt dynamics

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Summary:
In the collision-less magnetosphere, the dynamic variability of energetic electrons in the radiation belts is largely controlled by interactions with plasma waves. Consequently accurate modeling of radiation belt variability, in response to change in the solar wind or geomagnetic activity, requires the development of global models for important magnetospheric waves. We therefore propose to develop improved models for the global distribution and spectral properties of three important waves (Chorus, Plasmaspheric Hiss, and Equatorial Magnetosonic Waves) using data from THEMIS, DE1 and RBSP once it becomes available. We will also attempt to identify the particle distributions responsible for the wave excitation. Chorus is an electromagnetic emission produced in the low-density region outside the plasmapause, which can cause both precipitation loss and local acceleration of energetic electrons. Detailed modeling of nightside chorus has already been obtained from CRRES data, but the satellite coverage was extremely restricted on the dayside, and many important properties of dayside chorus remain poorly established. The five THEMIS spacecraft have excellent spatial coverage for over 3 years over the entire chorus source region. Specifically this data will be used to develop an improved model for dayside chorus, and identify the mechanism for chorus excitation. We will also model the properties of Plasmaspheric Hiss, which provides the dominant loss process for energetic electrons during quiet periods in the extended storm recovery phase, and test the proposed origin of hiss from Chorus. Equatorial Magnetosonic Waves may contribute to local electron acceleration, but our current understanding of the wave properties is limited to a very restricted range of L-shells (Cluster) or wave frequencies (CRRES). The THEMIS data will allow us to develop a comprehensive global model for the power spectral intensity of this important emission and it's relationship to ion ring distributions. The improved wave models will be used to evaluate quasi-linear diffusion rates, which can be incorporated into dynamic models of the radiation belts. The proposed research addresses the NASA Strategic Goal 3.2 listed in the 2007-2016 Science Plan: Understand the Sun and its effects on Earth and the solar system. It also addresses several key scientific problems identified in the 2009-2030 Heliophysics Roadmap:

1) Understand the fundamental physical processes of the space environment from the Sun to Earth.

2) Understand the plasma processes that accelerate and transport particles.

3) Understand changes in the Earth's magnetosphere, ionosphere, and upper atmosphere to enable specification, prediction, and mitigation of their effects.

The proposed topics for study are directly relevant to the current NASA missions on the Time History of Events and Macroscopic Interactions during Substorms (THEMIS) and the Radiation Belt Storm Probes (RBSP) of the Living With a Star program.

Publication References:

no references