Project Details

ROSES ID: NNH08ZDA001N
Selection Year: 2009
Program Element: Independent Investigation

Topic: Measure the properties of the solar dynamo that affect solar irradiance and active region generation.

Project Title:
Determining the loss of outer radiation belt electrons: a high priority of LWS/RBSP

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Summary:
Energetic electrons in the magnetosphere have been observed to exhibit

high variation in flux during geomagnetic storms. The electron flux

enhancements are known to be due to acceleration processes within the

Earth's magnetosphere, while the largest loss due to precipitation into

the atmosphere also occurs during magnetic storms. Thus the acceleration

mechanisms that replenish radiation belt electrons during storms

must be even more effective than they appear since they act in the

face of this enhanced loss. Without a quantitative knowledge of the loss,

a quantitative knowledge of the acceleration mechanisms cannot be obtained.

A high priority of the NASA/LWS/Radiation Belt Storm Probe program is to

differentiate among competing processes affecting the precipitation and

loss of radiation belt electrons.

We propose to investigate and quantify the loss rate of radiation

belt electrons due to precipitation. We will accomplish this by analyzing

SAMPEX data over a solar cycle. SAMPEX circles the Earth 15 times each day

in a high inclination orbit and has been providing the measurements of

radiation belt electrons at different since its launch in 1992. Because

of its low altitude and large geometric factors and the fast time

resolution of its detectors, SAMPEX data are ideally suited for determining

losses of electrons to the atmosphere. A simple Loss Index Method to

calculate the loss rate will be applied to a variety of storm events and over

different phases of solar cycle to quantify the electron loss rate as a

function of radial distance, magnetic local time, electron energy and relevant geomagnetic indices. We will also adopt the Drift-Diffusion Model that includes the effects of azimuthal drifts and pitch angle diffusion. The detailed Drift-Diffusion Model method will be used to validate the loss rate results from the Loss Index Method. And we will also apply the Drift-Diffusion Model method to obtain complete information about the pitch angle diffusion rate as functions of energy and pitch angle during indvidual storms.

The proposed research has the direct impact to the LWS goals and is closely related to LWS/RBSP mission. RBSP measurements will be taken near the equatorial plane and because of the limited angular resolutions, the pitch angle distribution near and inside the loss cone is difficult to be resolved. SAMPEX still has the best data to address the precipitation loss. Our proposed study will help the mission to ensure full science closure by having a better understanding of the precipitation loss.

Publication References:

Summary: no summary

Reference: Tu, Weichao; Selesnick, Richard; Li, Xinlin; Looper, Mark; (2010), Quantification of the precipitation loss of radiation belt electrons observed by SAMPEX, Journal of Geophysical Research, Volume 115, Issue A7, CiteID A07210, doi: 10.1029/2009JA014949

Summary: no summary

Reference: Zhao, H.; Li, X.; (2013), Inward shift of outer radiation belt electrons as a function of Dst index and the influence of the solar wind on electron injections into the slot region, Journal of Geophysical Research: Space Physics, Volume 118, Issue 2, pp. 756-764, doi: 10.1029/2012JA018179