2nd URSI AT-RASC, Gran Canaria, 28 May – 1 June 2018

Estimating energetic electron densities in the Radiation Belt using statistical chorus wave amplitudes

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The energetic electrons (a few keV - a few 100 keV) in the outer belt are accelerated to relativistic energy by various physical processes (radial diffusion, wave-particle interaction). These high energy particles sooner or later will be scattered or precipitated, but while they are trapped in the radiation belts, they are the major source of danger for space assets. Whistler-mode chorus waves are generated by nonlinear wave-particle interaction outside of the plasmapause. at the magnetic equator. Theoretical and model studies [Omura and Nunn, 2011] on generation of whistler-mode choruses revealed that the density of energetic electron can be derived from the wave amplitude of generated choruses. On the other hand, the wave amplitude is proportional to the frequency sweep rate of individual chorus elements. To derive the density of the energetic electrons, one can use in-situ chorus wave measurements – that may be available and usually is accompanied by particle measurements. Therefore it is not very useful. However, choruses detected on the ground can also be used for this purpose, though the propagation of chorus waves needs to be accurately modeled and inverted to obtain the correct sweep rate.

A recent empirical chorus model based on Cluster and Van Allen Probes wave measurements [Agapitov et al, 2017] provides analytical functions of latitude and Kp in three different magnetic local time sectors and for two ranges of L shells outside the plasmasphere for chorus wave amplitude, obliquity and frequency. Assuming that the estimated wave amplitude at a frequency is close the optimal wave amplitude, it can be used to calculate the energetic electron densities for various conditions at the equator, based on the guideline described above.

In this talk we present the combined model and some results that is compared with in-situ particle measurements.

References

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