Geophysical Research Abstracts
Vol. 21, EGU2019-10011, 2019
EGU General Assembly 2019

On the effect of the seed population in Earth's Electron Radiation Belts

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Observations of the electron radiation belts have shown links between increases in the low energy seed population and enhancements in the >1 MeV flux. Low energy electrons are supplied to the radiation belt region during active times, before being accelerated to higher energies via a range of mechanisms. Using the British Antarctic Survey Radiation Belt Model (BAS-RBM), how variations in the seed population impact the 1 MeV flux level were explored. We find that, for a period from the 21 April to 9 May 2013, the increase in the low energy electron flux was vital to recreate the observed 1 MeV flux enhancement on the 1 May, but was less important for the 1 MeV enhancement on the 27 April 2013. To better understand the relationships between the different energy populations, a series of idealised experiments with the 2-D BAS-RBM were performed which highlight a careful balance between losses and acceleration from chorus waves. By elevating the phase space density gradient, seed population enhancements alter this balance by increasing the rate of energy diffusion, allowing acceleration to surpass loss. Additionally, we demonstrate that even with the same chorus diffusion coefficients and the same low energy boundary condition, ∼500 keV – 1 MeV electrons were increased when starting with a hard spectrum but decreased for a soft initial spectrum. This suggests that initial energy gradients in the phase space density were important to determine whether >500 keV electrons were enhanced due to chorus wave acceleration. Readdressing the Van Allen Probes A observations, we show that phase space density gradients were likely why the seed population was an important component for the second 1 MeV enhancement in the 21 April to 1 May 2013 period, but not the first.