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The importance of wave-particle interactions for radiation belts dynamics

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The relativistic electron flux in the outer electron radiation belt is highly variable and can change by 4 even 5 orders of magnitude. Modelling studies show that if the electron flux measured near L = 5 is used as an outer boundary then radial diffusion can reproduce a large amount of the variability at lower L shells. However, this does not explain how the electrons near L = 5 are accelerated in the first place. Conversely, rapid electron loss known as flux drop-outs events have been associated with outward radial diffusion. However it is very difficult to see how outward diffusion can remove electrons near L = 3.5 when the phase space density gradient is in the wrong direction. Here we discuss some of these events and the important role that wave-particle interactions play in both acceleration and loss. We present a modelling study that shows how chorus waves can accelerate electrons to MeV energies near geostationary orbit and form the outer radiation belt. We show that the resulting flux is most sensitive to the distribution of chorus wave power and the ratio of the electron plasma to cyclotron frequencies and relatively insensitive to the presence of a pre-existing electron radiation belt.