The Van Allen radiation belts present a great challenge to modellers because of the dynamic variability they exhibit. In particular, the outer radiation belt can be entirely depleted over the course of an hour in the main phase of geomagnetic storms, only to be rebuilt over the course of the next few days. Moreover, the final post-storm flux levels can be higher, similar, or lower than the initial pre-storm flux levels and not easily predicted by any of the solar wind parameters. A typical assumption in global modelling codes is that wave-particle interactions are all linear and incoherent, leading to overall diffusive behaviour. However, these assumptions are not always true, especially in light of recent observations of large-amplitude, coherent whistler-mode waves. In this talk, we will review the characteristic non-linear behaviour of energetic electrons scattered by large-amplitude coherent whistlers, we will show statistics of large-amplitude waves from the THEMIS satellite, and show our recent efforts to cast the effects of this nonlinear behaviour as advection coefficients in diffusion-based global modelling codes.