Consequences of oblique chorus waves on the loss and acceleration of the outer radiation belt electrons

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Chorus waves are among the most important natural electromagnetic emissions in the magnetosphere as regards their potential effects on electron dynamics. They can efficiently accelerate or precipitate electrons trapped in the outer radiation belt, producing either fast increases of relativistic particle fluxes, or auroras at high latitudes. Accurately modeling their effects, however, requires detailed models of their wave power and obliquity distribution as a function of geomagnetic activity in a particularly wide spatial domain, rarely available based solely on the statistics obtained from only one satellite mission. Here, we seize the opportunity of synthesizing data from the Van Allen Probes and Cluster spacecraft to provide a new comprehensive chorus wave model in the outer radiation belt. The respective spatial coverages of these two missions are shown to be especially complementary and further allow a good cross-calibration in the overlap domain. The resulting synthetic statistical model of chorus wave amplitude, obliquity, and frequency is presented in the form of analytical functions of latitude and geomagnetic activity MLT, and *L*-shells outside the plasmasphere. Such a synthetic and reliable chorus model is crucially important for accurately modeling global acceleration and loss of electrons over the long run in the outer radiation belt, allowing a comprehensive description of electron flux variations over a very wide energy range.

The portion of wave power in very oblique waves decreases during highly disturbed periods, consistent with increased Landau damping by inward-penetrating suprathermal electrons. In summary, we have investigated in this paper how electron scattering and energization vary with geomagnetic activity. It has been shown that lower-band chorus wave obliquity observed by Cluster and Van Allen Probes abruptly decreases as *Dst* falls below –40 nT and that such an effect should concur with the concomitant sharp increase of wave intensity in producing a strongly enhanced energization of electrons during such active periods. Conversely, the moderate geomagnetic activity range (*Dst* from –40 to –10 nT) should be mainly characterized by stronger losses than during quiet times, due to the relatively high oblique wave power still present. In the loss-limited regime of electron energization pertaining to the outer radiation belt, the early-time effective energization level of electrons depends critically on losses provided by the oblique waves, in the opposite regime of negligible losses, while still increasing at lower plasma density. The variation of lower-band chorus wave obliquity with both latitude and geomagnetic activity turns out to be an important and hitherto rather neglected parameter which needs to be included in realistic Fokker-Planck calculations of trapped electron dynamics and energization.