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Spatial spreading of magnetospherically reflected chorus wave packets

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Chorus type whistler waves are known to be generated in the vicinity of the magnetic equator, in the low-density plasmathrough region. These wave packets propagate towards the magnetic poles, deviating from the magnetic field lines, before being eventually reflected at higher latitudes due to the effects of the low hybrid resonance (LHR). These magnetospherically reflected (MR) whistlers then propagate back to the equator, making several bounces between the poles. Our study is devoted to the problem of geometrical spreading of these whistler waves during their poleward propagation and their return to the equator. Experimental studies, using a combination of modeling and CLUSTER and THEMIS observations, have shown the simultaneous experimental observations of the source and reflected whistler waves. It has been stated that the relative intensity of the reflected signal was generally between 0.005 and 0.05 of the source signal. We model such signals by means of ray tracing technique using a WHAMP-based numerical model, which calculates hot plasma dispersion function along the signal trajectory. A large number of such rays propagated from the equator throughout the inner magnetosphere and back to the equator, which allows one to numerically reproduce the topology of the energy distribution in every latitude plane. Our calculations show that the spatial spreading is strongly dependent upon the position of the starting point with respect to the plasmapause. However, the effect of the divergence of trajectories is present for practically all initial positions resulting in the relative intensity of reflected signals in the equatorial plane to be 20-40 times smaller, which is in excellent agreement with CLUSTER and THEMIS observations mentioned above.