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Statistical Properties of Whistler Wave Distributions in the Earth Inner Magnetosphere

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We present the statistical study of polarization and amplitude distribution properties of the ELF/VLF emissions based on analysis of CLUSTER STAFF-SA measurements performes in 2002–2009. Chorus type whistler waves in plasma have profound effects on acceleration and scattering of radiation belt particles. To model the radiation belts dynamics one should evaluate the diffusion coefficients due to wave particle interaction. They determine particle losses and acceleration. To obtain valuable estimate of the diffusion coefficients it is necessary to know statistical distributions of plasma wave parameters. Cluster dataset of wave fields measurements during 2002-2009 years has nearly uniform coverage in MLT and in L-shells thus it provides good statistics in the vicinity of the equatorial radiation belts region close to the source of chorus waves. The chorus type whistler wave packets formed in the vicinity of the magnetic equator are frequently observed aboard different spacecraft. We reconstruct the chorus emissions distribution function in the radiation belts and in the inner magnetosphere. To achieve this aim the data from the electric and magnetic field measurements captured by STAFF-SA onboard Cluster spacecraft is used to determine the major characteristics of the chorus signal around the equator region, namely, its averaged wave vector, wave vector distribution, Poynting flux and polarization. From the analysis performed we deduce the statistical 3D model of plasma wave polarization and amplitude parameters observed by CLUSTER satellites within radiation belt region. The most intensive chorus waves are observed in the MLT range from 23 to 13 MLT and on L-shells from 2 to 3 and from 4 to 6. The chorus waves are generated with small but nonzero angle between the wave vector and background magnetic field (from 3° to 20°). The angle increases with the magnetic latitude. The Probability Distribution Function (PDF) data base of the wave intensity and polarization provides unique opportunity to estimate the charged particles scattering diffusion coefficients in the radiation belts. We found that there exist three regions with different properties of the whistler type emissions: internal region L = 2–4 (up to plasmapause): here lightning generated whistler waves and whistlers generated in the inner magnetosphere in the form of chorus waves are observed and coexist;
L = 4–6.5: the region where the chorus type whistler waves dominate;
L > 6.5 – here whistler waves observed are presumably generated by different mechanism, their wave vectors even in the equator region have angles with magnetic field quite large with the maximum near 90°.