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Chorus and hiss scales in the inner magnetosphere: statistics from high-resolution filter bank (FBK) Van Allen Proves multi-point measurements

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The spatial scales of whistler-mode waves, determined by their generation process, propagation, and damping, are important for assessing the scaling and efficiency of wave-particle interactions affecting the dynamics of the radiation belts. We use multi-point wave measurements in 2013-2019 by two identically equipped Van Allen Probes spacecraft covering all MLTs at L=2-6 near the geomagnetic equator to investigate the spatial extent of active regions of chorus and hiss waves, their wave amplitude distribution in the source/generation region, and the scales of chorus wave packets, employing a time-domain correlation technique to the spacecraft approaches closer than 1000 km, which happened every 70 days in 2012-2018 and every 35 days in 2018-2019. The correlation of chorus wave power dynamics using two spacecraft measurements is found to remain significant up to inter-spacecraft separations of 400 km to 750 km transverse to the background magnetic field direction, consistent with previous estimates of the chorus wave packet extent, but indicating the likely presence of two different scales of about 400 km and 750 km. Our results further suggest that the chorus source region can be slightly asymmetrical, more elongated in either the azimuthal or radial direction, which could also explain the aforementioned two different scales. An analysis of average chorus and hiss wave amplitudes at separate locations similarly reveals different radial and azimuthal extents of the corresponding wave active regions, complementing previous results based on THEMIS spacecraft statistics mainly at larger L>6. Both the chorus source region scale and the chorus active region size appear smaller inside the outer radiation belt (at L< 6) than at higher L-shells.