The Angular Distribution of Whistler-Mode Chorus and the Importance of Plumes in the Chorus-Hiss Mechanism

David P. Hartley¹, Lunjin Chen², Craig Kletzing¹, Richard Horne³, and Ondrej Santolik⁴,⁵

¹University of Iowa, Iowa City, Iowa, USA
²University of Texas at Dallas, Richardson, Texas, USA
³British Antarctic Survey, Cambridge, UK
⁴Institute of Atmospheric Physics, Prague, Czech Republic
⁵Charles University, Prague, Czech Republic

Correlations between chorus waves and plasmaspheric hiss have been directly observed, leading to the proposition that the two wave modes are causally linked. Ray tracing simulations have confirmed that chorus waves can propagate into the plasmasphere and be a source of plasmaspheric hiss, but only for a specific set of initial conditions, particularly relating to the orientation of the wave vector at the chorus source. In this study, both survey and burst mode observations from the Van Allen Probes EMFISIS Waves instrument are coupled with ray tracing simulations to determine the fraction of chorus wave power that exists with the conditions required to enter the plasmasphere. In general, it is found that only a small fraction (< 2%) of chorus wave power exists with the required wave vector orientation. An exception is found when the chorus source is located close to a plasmaspheric plume. Here, azimuthal density gradients modify the wave propagation to permit a large fraction, up to 94%, of chorus wave power to access the plasmasphere. Therefore plasmaspheric plumes are identified as an important access region if a significant fraction of chorus wave power is to enter the plasmasphere and be a source of plasmaspheric hiss. To provide context, we note that plumes are most commonly observed on the dusk side whereas chorus wave power typically peak on the dawn side. The post-noon sector, where these two statistical distributions overlap, appears to be key for observing correlations between chorus and hiss. As such, particular attention is devoted to this region.