3rd URSI AT-AP-RASC, Gran Canaria, 29 May – 3 June 2022

First Direct Observations of Propagation of Discrete Chorus Elements from the Equatorial Source to Higher Latitudes using the Van Allen Probes and Arase Satellites

Christopher Colpitts[1], Yoshizumi Miyoshi[2], Yoshiya Kasahara[3], Gian Luca Delzanno[4], John Wygant[1], Cynthia Cattell[1], Aaron Breneman[5], Craig Kletzing[6], Greg Cunningham[4], Mitsuru Hikishima Hikishima[7], Shoya Matsuda[7]

(1) University of Minnesota, USA
(2) Nagoya University, Japan
(3) Kanazawa University, Japan
(4) Los Alamos National Laboratory, USA
(5) NASA Goddard Space Flight Center, USA
(6) University of Iowa, USA
(7) ISAS/JAXA, Japan

Whistler mode chorus waves have recently been established as the most likely candidate for scattering relativistic electrons to produce the electron microbursts observed by low altitude satellites and balloons. These waves would have to propagate from the equatorial source region to significantly higher magnetic latitude in order to scatter electrons of these relativistic energies. This theoretically proposed propagation has never been directly observed. We present the first direct observations of the same discrete rising tone chorus elements propagating from a near equatorial (Van Allen Probes) to an off-equatorial (Arase) satellite. The chorus is observed first on the more equatorial satellite, and is found to be more oblique and significantly attenuated at the off-equatorial satellite. This is consistent with the prevailing theory of chorus propagation, and with the idea that chorus must propagate from the equatorial source region to higher latitudes. Ray tracing of chorus at the observed frequencies confirms that these elements could be generated parallel to the field at the equator, and propagate through the medium unducted to Van Allen Probes A and then to Arase with the observed time delay, and have the observed obliquity and intensity at each satellite. This result adds significantly to our understanding of chorus wave processes and scales, and highlights the importance of multipoint observations for confirming wave propagation and wave modes, demonstrating the need for multiple spacecraft at different locations in the Earth's magnetosphere.