4th URSI AT-RASC, Gran Canaria, 19-24 May 2024

Multi mission EMIC dataset properties: comparisons between machine-learning and automatic detections

Benjamin Grison*[(1)], Vavrinec Kavan [(1)], and Ondrej Santolik[(1,2)]
(1) Department of Space Physics, Institute of Atmospheric Physics, Czech Academy of Sciences, Prague, Czechia, e-mail: grison@ufa.cas.cz; kavan@ufa.cas.cz; os@ufa.cas.cz
(2) Faculty of Mathematics and Physics, Charles University, Prague, Czechia

Density gradients, as observed at the plasmapause, and temperature anisotropies, as observed in the ring current, have been known for a long time to enhance growth of ElectroMagnetic Ion Cyclotron (EMIC) waves. When the linear amplification saturates, non linear processes lead to formation of wave packets with increasing frequency. EMIC triggered emissions with the largest frequency dispersion are found in the vicinity of the plasmapause and plasmaspheric plumes. In addition to their typical shapes, EMIC rising tones have been shown to be more coherent than the surrounding EMIC waves.

This study gathers observations of EMIC waves observed by the Cluster spacecraft, the THEMIS spacecraft and the Van Allen Probes whose datasets supplement each other. Cluster orbit is polar and its apogee is at almost 20 Earth Radii (perigee above 4 Earth radii). Van Allen Probes and THEMIS orbits are designed to probe the inner magnetosphere equatorial region (from about 2 to 6 Re for Van Allen Probes and beyond the magnetopause for THEMIS).
Statistical properties of EMIC emissions need to be studied on large datasets that can be built by visual selections, automatic detection or machine-learning selections. The EMIC wave distribution can be then analyzed in term of location (Magnetic local time, L-shell, magnetic latitude, distance to the magnetopause), frequency (absolute in Hz or normalized to the local proton gyrofrequency), and polarizations (including also wave normal angle, planarity and coherence). For the analysis of the wave properties analysis we rely on the Singular Value Decomposition method [1].

In the first part of this study we compare the datasets obtained for each mission based on an empirical detection procedure (adapted from [2]) and based on machine-learning procedure. This helps to identify potential bias of each selection.
In the second part of the study we analyze the distribution of EMIC triggered emissions among the EMIC wave dataset. Comparisons are made between the subset of triggered emissions resulting from an automatic procedure (based on the coherence and the frequency dispersion of the waves) and on a machine-learning selection.

1. Santolík, O., M. Parrot, and F. Lefeuvre (2003a), Singular value decomposition methods for wave propagation analysis, *Radio Sci.*, 38(1), 1010, doi:10.1029/2000RS002523.

2. Bortnik, J., Cutler, J. W., Dunson, C., & Bleier, T. E. (2007). An automatic wave detection algorithm applied to Pc1 pulsations. *Journal of Geophysical Research*, 112, A04204. https://doi.org/10.1029/2006JA011900