



Multipoint observations of discrete whistler-mode waves in plasmaspheric plumes

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The fleet of four Cluster spacecraft has provided us with multi-point measurements of VLF and ELF waves in the magnetosphere and in the solar wind for almost 24 years. Complementary measurements of the Wide band data (WBD) and Spatio-temporal analysis of field fluctuations (STAFF-SA) instruments are used in this study to investigate whistler mode emissions in plasmaspheric plumes.

These natural emissions of whistler-mode electromagnetic waves, especially chorus and hiss can influence the dynamics of the Van Allen radiation belts through quasi-linear or nonlinear wave particle interactions. Therefore, these waves play a role in complex processes of coupling between different electron populations in this region but also in losses of energetic particles by their precipitation into the atmosphere.

The high-density regions of plasmaspheric plumes can serve as a natural waveguide for the whistler mode waves which can thus propagate from outer regions into the plasmasphere. We have selected a case in which the Cluster spacefleet observed both whistler mode hiss and discrete nonlinear wave packets of chorus in plasmaspheric plumes. The integrated amplitudes reached up to 200 pT, with median values of 2-40 pT. Our measurements show that these mostly quasi-parallel propagating whistler-mode waves are often generated at low latitudes. Discrete emissions were found in more than one-half of the observed plume intervals. Their amplitudes are significantly higher than amplitudes of hiss.

Detailed analysis of the structures of discrete emissions shows that their intensities and wave vector angles exhibit large-scale spatial variations which are scanned by the orbital motion of the Cluster spacecraft while the onset of discrete emissions is observed by different spacecraft at the same time.