A New Approach to Locate Ionospheric Exit Points of Magnetospheric Whistler Mode Emissions

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The populations of energetic charged particles in near-Earth space environment are highly dynamic and a leading source of spacecraft damage and lifetime constraints. The complex and multifaceted interactions between particles, waves and solar driven phenomena in near-Earth space is described as space weather. Among the many space weather processes, whistler mode waves and their interaction with energetic electrons via cyclotron or Landau resonance are known to be a dominant player

Ground observations of these waves are important for discovery science, numerical model validation and space weather monitoring. However, work with ground observation involves the added complication of trans-ionospheric propagation of the magnetospheric emissions since the waves propagate along the geomagnetic field lines in the magnetosphere and need to pass through the ionosphere to reach the surface of the Earth. In most case, subsequent propagation between the ionospheric exit point and the receiver further modifies the wave properties.

Determining the exit point of the magnetospheric emissions is of a great importance in understanding the natural ionospheric and magnetospheric phenomena. Magnetospheric emissions observed on the ground have in the past provided a powerful means of remotely sensing magnetospheric plasma. A new approach to identifying the ionospheric exit points of the magnetospheric whistler mode emissions is presented. The method relies on the initial circular polarization of the magnetospheric emissions which is shown to convert to linear polarization after propagation in the Earth- ionosphere waveguide at a predictable rate. Finite difference time domain modeling of observed eccentricity provides a metric for determining distance from observer to ionospheric exit point. The method is shown to produce good agreement with observations.