Coincident Compression Generated EMIC Chorus and Hiss waves

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Electron radiation belt dynamics are controlled by the competition of multiple acceleration and loss mechanisms. Electromagnetic ion cyclotron (EMIC), chorus, and hiss waves have all been implicated as potential loss mechanisms of radiation belt electrons along with Chorus waves proposed as a mechanism for accelerating the lower energy source population to MeV energies. Understanding the relative importance of these waves as well as where and under what conditions they are generated is vital to predicting radiation belt dynamics.

Although the size of the solar wind compression on 9 January 2014 event discussed here was modest, it has given us an opportunity to observe clearly how a magnetospheric compression can lead to the generation of EMIC, chorus, and hiss waves. The ICME generated shock encountered the Earth’s magnetosphere on 9 January 2014 at ~20:11 UT, and the Van Allen Probes observe the coincident excitation of EMIC and Chorus waves outside the plasmasphere, and hiss waves inside the plasmasphere. As the shock encountered the magnetosphere, an electric field impulse was observed to generate an increase in temperature anisotropy for both ions and electrons. This increased temperature anisotropy led to increased wave growth on both the ion and electron cyclotron branches. The simultaneous generation of multiple types of waves may lead to significant impacts on the acceleration and loss of radiation belt electrons, especially during geomagnetic compressions observed during substorms, and the storm sudden commencement and main phases of geomagnetic storms, as well as during quiet time sudden impulse events. For example, the excitation of both EMIC and chorus waves at the same place, and at the same time, may complicate studies seeking a causal connection between specific individual plasma wave bursts and observations of particle precipitation into the atmosphere. During this relatively small event BARREL had three payloads in conjunction with the Van Allen Probes, two of the payloads inferred electron precipitation within the energy range typically associated with chorus wave pitch angle scattering. One can hypothesis that with larger and/or longer lasting ICME-shocks, or with a larger initial population of radiation belt electrons, more electron precipitation, and a larger range of energies, may be observe.

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