Properties and propagation effects on EMIC wave k vectors: Outer magnetospheric observations from MMS

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Electromagnetic ion cyclotron (EMIC) waves play important roles in particle heating and loss processes in the magnetosphere. The character of the EMIC wave-particle interaction is determined by the wave dispersion in the plasma, and can be diagnosed with the wave frequency and wave vector, **k**. Determining the evolution of EMIC waves with propagation and how those changes affect wave-particle interactions therefore requires accurate knowledge of **k** as the waves propagate. Because **k** is extremely difficult to measure, and so generally inferred indirectly, EMIC wave properties and their variation with latitude, radial distance, and local time, and so the corresponding effects on resonance conditions and particle scattering, are still poorly constrained. We present a technique using the curl of the wave magnetic field to determine **k** observationally, enabled by the unique configuration and instrumentation of the Magnetospheric MultiScale (MMS) spacecraft. We then utilize the wave curl analysis technique to determine **k** for individual EMIC wave packets during a several-hours-long interval of EMIC wave activity in the dayside outer magnetosphere on 2015 October 28 at large L shells (>10). During this time, MMS transits an off-equator EMIC wave source region, passing through regions of varying distance from the source along the field line. This allows us to probe the variation and evolution of **k**, which has direct consequences on subsequent wave-particle resonances. Additionally, these analysis techniques can be applied to simulations of EMIC wave propagation to further understand how mode conversion and reflection at high-latitudes may manifest in the observations. The application of the techniques illustrated in this event provide the basis for a comprehensive survey of EMIC wave events observed by MMS in the outer magnetosphere.