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Direct measurements of cold and hot plasma composition and EMIC waves in the outer magnetosphere: Implications for inner magnetosphere wave-particle interactions

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Although thorough characterization of magnetospheric ion composition is rare for EMIC wave studies, convective processes that occur more frequently in Earth's outer magnetosphere have allowed the Magnetospheric Multiscale (MMS) satellites to make direct measurements of the cold and hot plasma composition during EMIC wave activity. We will present an observation and linear wave modeling case study conducted on EMIC waves observed during a perturbed activity period in the outer dusk-side magnetosphere. During the two intervals investigated for the case study, the MMS satellites made direct measurements of cold plasmaspheric plasma in addition to multiple hot ion components at the same time as EMIC wave emissions were observed. Applying the in-situ plasma composition data to wave modeling, we find that wave growth rate is impacted by the complex interactions between the cold as well as the hot ion components and ambient plasma conditions. In addition, we observe that linear wave properties (unstable wave numbers and band structure) can significantly evolve with changes in cold and hot ion composition. Although the modeling showed the presence of dense cold ions can broaden the range of unstable wave numbers, consistent with previous work, the hot heavy ions that were more abundant nearer storm main phase could limit the growth of EMIC waves to smaller wave numbers. In the inner magnetosphere, where higher cold ion density is expected, the ring current heavy ions could also be more intense near storm-time, possibly resulting in conditions that limit the interactions of EMIC waves with trapped radiation belt electrons to multi-MeV energies. Additional investigation when direct measurements of cold and hot plasma composition are available could improve understanding of EMIC waves and their interactions with trapped energetic particles in the inner magnetosphere.