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Statistical analysis of ion composition and effects on EMIC waves in the outer magnetosphere

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Ionospheric-originating cold ions are difficult to measure throughout Earth's magnetosphere due to spacecraft charging limiting our ability to measure this low energy population, thus complicating investigations into how these cold ions participate in the growth of electromagnetic ion cyclotron (EMIC) waves. While these cold ion populations pose measurement challenges for most missions, recent event studies have shown that, at times, the Magnetospheric Multiscale (MMS) mission is capable of directly measuring both the low-energy cold populations as well as the hot ion composition, enabling improved understanding of EMIC wave generation, propagation, and wave polarization properties [1, 2, 3, 4]. These studies demonstrated the utility of considering the full ion composition for improving our understanding of different aspects of EMIC waves in the outer magnetosphere. We applied our experience analyzing the combined ion composition and EMIC wave data from event studies and conducted a statistical analysis of MMS datasets during the Prime Mission dayside intervals, with plans to expand the analysis to later mission phases and other magnetospheric regions. Out of approximately 6000 dayside wave intervals identified, around 25% of the intervals also contained simultaneous measurements of the cold ion composition needed to conduct more accurate modeling of linear wave growth in the outer magnetosphere, where the free energy source of EMIC waves may also be modulated by solar wind pressure pulses. This paper will discuss observations and progress on the statistical analysis and possible implications for studies on inner magnetospheric EMIC waves.

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