A statistical study of EMIC rising and falling tone emissions observed by THEMIS.

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Electromagnetic ion cyclotron (EMIC) waves with rising or falling frequency variations have been studied intensively because of their effects on energetic particles in the Earth's magnetosphere. We develop an automated classification method of EMIC events based on the characteristics of frequency variations. We report some basic statistical properties of frequency variations in EMIC waves observed by three Time History of Events and Macroscale Interactions during Substorms (THEMIS) probes from January 2012 to December 2014. We clarify whether rising-tones or falling tones are observed in each 20-minute time segment. In the present analysis, we find that the occurrence rate of EMIC rising- or falling tone events is more than 30 % of the total EMIC wave events. The dayside magnetosphere is a preferential region for the EMIC frequency variations. The occurrence rate of rising tone events is slightly greater than that of falling tone events. We examine the relation between the frequency characteristics and the magnetospheric conditions. The solar wind pressure strongly controls the occurrence rates of frequency variations. We also calculate ranges of frequency variations. Large amplitude EMIC waves tend to have wider frequency variations and the range of frequency variation is largest around the pre-noon region. In addition, the fine-structures in wave amplitudes called "sub-packet structures" are found in 70 % of EMIC rising- or falling- tone events in the dayside region. Sub-packet structures appear mainly in large amplitude EMIC rising or falling tones. These features are consistent with nonlinear wave growth theory.

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