Statistical analyses of low energy ion heating by electromagnetic ion cyclotron waves via wave-particle interaction analyses: Arase observations

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Electromagnetic ion cyclotron (EMIC) waves are generated through the cyclotron wave-particle interaction, affecting the plasma environment in the magnetosphere. Heating of ions by EMIC waves in the inner magnetosphere has been investigated using spacecraft observations by comparing the pitch angle distribution of the ions and the wave emissions. We can directly detect the energy transfer between the plasma waves and the ions via the wave-particle interaction analysis (WPIA) method which calculates the inner product between the wave electric fields and the ion velocities. We adapt the WPIA method to the Arase spacecraft data and investigate the spatial distribution of the positive region in the inner magnetosphere. From March 21st 2017 to September 27th 2019, we select 60 EMIC wave events with associated proton flux enhancement between 10 eV to 100 eV which are a suitable dataset for the WPIA method observed by PWE/EFD, MGF, and LEP-i onboard the Arase satellite. The peak of the proton heating occurrence appears in the dayside and post noon regions. Typical EMIC waves inside the plasma plume contribute to the peak in the afternoon sector in both geomagnetically quiet and active times. On the other hand, in the dayside region, the proton heating takes place predominantly during quiet times. It suggests that the protons in the region are energized by the EMIC waves generated through compression of the ambient magnetic field. We also discuss the species dependence of the ion heating.

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