Statistical Analysis of the Spatial Distribution of Low Frequency Magnetosonic Waves and Proton Ring-like Distribution

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We statistically investigate the spatial distribution of magnetosonic waves at f < 32 Hz and proton ring-like distribution observed by Van Allen Probes from September 2012 to December 2016. The spatial distribution of magnetosonic waves has an occurrence peak at L = 4 –6 and 13 –16 MLT and that of proton ring-like distribution has an occurrence peak at L = 4 –7 and 13 –17 MLT. The coincidence of the occurrence frequency peaks suggests that proton ring-like distribution is likely to be an energy source of magnetosonic waves. We reveals that the proton ring-like distribution with $V_r > 2V_A$ has potential to excite magnetosonic waves at f < 32 Hz, where V_r and V_A are ring velocity and Alfvén velocity, respectively. Case studies of convective growth rate analysis confirms the possibility of wave excitation by the proton ring-like distribution near the frequency of waves observed by satellites in these cases. Under the disturbed magnetospheric condition, the occurrence rate of magnetosonic waves increase up to 10 % and the ring energy increases up to ~20 keV. This is consistent with an idea that and the high ring energy satisfies the wave growth condition of $V_r > 2V_A$. The condition of wave excitation at low frequency is attributed of a weighting function included in the calculation of the convective growth rate. A statistical analysis of the wave frequency reveals that magnetosonic waves in plasma trough are observed around the multiples of local proton cyclotron frequency except the first harmonics and most of them are considered to be excited locally, while some of magnetosonic waves observed inside the plasmapause seems to propagate from the other region.

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