Geophysical Research Abstracts
Vol. 17, EGU2015-5944, 2015
EGU General Assembly 2015

Magnetospheric ULF Waves with an Increasing Amplitude as a Superposition of Two Wave Modes

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Ultra-low frequency (ULF) waves play an important role in transferring energy by buffeting the magnetosphere with solar wind pressure impulses. The amplitudes of magnetospheric ULF waves, which are induced by solar wind dynamic pressure enhancements or shocks, are thought to damp in half or one wave cycle. We report on in situ observations of the solar wind dynamic pressure impulses-induced magnetospheric ULF waves with increasing amplitudes. We have found six ULF wave events, which were induced by solar wind dynamic pressure enhancements, with slow but clear wave amplitude increase. During three or four wave cycles, the amplitudes of ion velocities and electric field of these waves increased continuously by $1.3 \sim 4.4$ times. Two significant events were selected to further study the characteristics of these ULF waves. We have found that the wave amplitude growth is mainly contributed by the toroidal mode wave. We suggest that the wave amplitude increase in the radial electric field is caused by the superposition of two wave modes, a standing wave excited by the solar wind dynamic impulse and a propagating compressional wave. When superposed, the two wave modes fit observations as does a calculation that superposes electric fields from two wave sources.