Initial results from an induction magnetometer observation at Middlemarch (L = 2.7) in New Zealand

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The plasmas in the inner magnetosphere have wide energy ranges from ~eV to ~MeV. Their interaction with plasma waves causes their acceleration and loss into the ionosphere. In order to establish that the loss of radiation belt particles due to EMIC waves occurs in the deep inner magnetosphere, we installed a new high-sensitivity all-sky camera and induction magnetometer at Middlemarch (L=2.7) in New Zealand where a fluxgate magnetometer has been operated.

So far, the following results have been obtained.
Ionospheric Alfvén Resonator (IAR) is found in a dynamic power spectrum of the geomagnetic field variations as spectral resonance structures in the frequency range of 0.1–10 Hz. We find IAR in the data from the induction magnetometer for three consecutive days of October 4–6, 2020. Lower harmonic modes are present throughout local nighttime, but higher harmonic modes with frequency of >~5 Hz suddenly disappear at the onset time of substorms. This may indicate that geomagnetic disturbances cause interference in the resonance condition of Alfvén waves in the ionospheric cavity between E and F2 layers, and the interference is effective only for the higher harmonic modes.

Unique Pc1 pulsations are found in a dynamic power spectrum of the geomagnetic field variations as a band-type structure in the frequency range of ~0.2–1 Hz before and after a small geomagnetic storm (minimum Dst = -40 nT). Before the geomagnetic storm, Pc1 events with different center frequencies were observed intermittently almost all day, regardless of local time. No pulsation was observed in frequency ranges of 0.2 to 30 Hz during the main phase and the early recovery phase after the occurrence of a sudden commencement of the geomagnetic storm, despite expecting to be observed at higher frequencies. During the recovery phase, four Pc1 events were observed at a periodic interval of about 3-4 hour following an IPDP (interval of pulsations of diminishing period) type Pc1 occurrence. It was found that these events were also observed at four stations in Canada and Iceland in the opposite hemisphere at the same time.

Keywords: ULF wave, ELF wave, Pc 1, ElectroMagnetic Ion Cyclotron (EMIC) wave, Ionospheric Alfvén Resonator (IAR)

