南北両極域からの磁場ネットワーク観測による磁力線共鳴周波数・共鳴緯度幅の緯度依存性高空間分解能測定

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Field line resonance frequency and the resonance width as high-resolution continuous functions of latitudes in the auroral zones

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To investigate field-line resonances (FLRs) at high latitudes, coherence analysis of phase variations was performed using data observed at two sites (H57 and Skallen, newly installed by JARE-48) surrounding Syowa Station in Antarctica, and Tjornes in Iceland, which is the geomagnetically conjugate point of the Antarctic observation sites. Coherence analysis of the closely spaced Antarctic sites is unable to resolve FLRs due to the inclusion of multiple signals related to other types of pulsations (i.e. the ocean coast effect) over a broad frequency range. However, coherence analysis of individual Antarctic site and the Icelandic site clearly reveals FLRs with high coherence. Therefore, interhemispheric observations are more useful to distinguish the resonance structures than observations at adjacent sites on one-side hemisphere.

The amplitude-phase gradient method (APGM) [Pilipenko and Fedrov, 1994] is useful to find out the eigenfrequency and the resonance width as continuous functions of latitude. The APGM was applied to the data from the Antarctic sites for the frequency range, in which the FLR was clearly distinguished by the interhemispheric observation. We calculated the resonance frequency and the resonance width in the same fashion as in the work by Kawano et al. [2002]; as a result, it takes away the offsets associated with the other types of pulsations, and yields the eigenfrequency as continuous function of latitudes in the surrounding area of Syowa Station. Furthermore, the equatorial mass density along the field line between the conjugate points was estimated from the obtained FLR frequency by numerically solving the standing Alfven wave equation. Thus obtained mass density was similar in magnitude to those in-situ observed in the same area by past satellites [Chappell et al., 1971].

The results in the present work demonstrate that, if one wants to identify FLRs in the auroral zone with fine spatial resolution, it is effective to analyze low-frequency geomagnetic pulsation data simultaneously observed at closely spaced sites and their conjugate sites. This allows the magnetospheric equatorial mass density at the L of the auroral zones to be determined as functions of ground latitude and time.