変動IMFのもとでの夜側フローバーストとシータオーロラの時間発展

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Evolution of nightside flow bursts and theta aurora under changing IMF conditions

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We investigate a case study of sunward flow bursts on the nightside polar cap boundary observed by geomagnetically conjugate HF radars. The flow burst excitation consists of two factors: (1) (internal condition) At the time of the flow burst, the magnetosphere still held a memory of the stable and northward IMF (interplanetary magnetic field) period that had persisted up until one hour before the flow burst. During the northward IMF period, a theta aurora associated with a sunward flow channel was formed in the polar cap. After that the IMF turned southward and the transpolar arc decayed antisunward. However, by the time of the flow burst (i.e., one hour after the IMF southward tuning), the sun-aligned arc had not yet completely vanished, and in the poleward expanded portion of the northern plasma sheet, there was still a remnant of the sunward flow channel susceptive to an external forcing. (2) (external condition) One hour after the southward turning of the IMF, a sharp IMF transition from southward to northward BZ impinged on the dayside magnetopause. On arriving at the dayside cusp ionosphere, the BZ transition signal pervaded the entire polar cap ionosphere instantaneously (<1 min) and reached the nightside plasma sheet. There, the remnant of the sunward flow channel was then reactivated by the BZ transition, and a sunward flow burst was observed first in the northern ionosphere then in the southern ionosphere with a 7-min time delay. Thus the sunward flow burst represents a rapid global response of the ionosphere starting 2 33 min after the IMF change at the subsolar magnetopause.

In the talk, we discuss the nature of the global magnetosphere-ionosphere response to the IMF BZ transition and its timescales. This is a topic of recent controversy. Some results reported in the literature suggest that the ionospheric convection change starts first in the midday sector and then propagates eastwards and westwards. In contrast, some authors argue that the global ionospheric response is much faster and the electric field of the IMF is communicated to the entire polar cap ionosphere in less than 1 min. The ionospheric response observed in this event was very fast and consistent with the latter picture. This fast response, however, did not mean the onset of the magnetotail reconfiguration, because the nightside polar cap boundary continued to move equatorward (i.e., a signature for southward BZ) even during the sunward flow burst period. These suggest there are at least two different timescales in the magnetosphere-ionosphere response, and in this event we were seeing two different responses at the same time.