磁気嵐急始初期インパルスの数秒以内同時性と地面電離層導波管 TM0 モード伝播による理解

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Simultaneity within a few seconds of the preliminary impulse of SC and its explanation with the Earth-ionosphere waveguide model

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The preliminary reverse impulse (PRI) of the geomagnetic sudden commencement (SC) appears simultaneously at the dayside geomagnetic equator and afternoon high latitude within the temporal resolution of 10 sec as found by Araki (1977). These latitude and local time features were explained by means of the DP2-type ionospheric currents driven by the dusk-to-dawn electric field impressed from the magnetosphere. Araki et al. (1985) further found that a positive impulse preceding the SC (PPI) appeared at the nightside geomagnetic equator when the PRI was observed on the dayside, implying that the dusk-to-dawn PRI electric field drove eastward currents at the nightside equator. In this paper, we examined the simultaneity of the PRI and PPI at high latitude and equator with the GPS controlled high time resolution data, to confirm more accurately the instantaneous transmission of the polar electric field/currents to the equator. We found simultaneity within a few seconds of the onsets of the PRI and PPI at the equator and of the PRI at afternoon high latitude. This finding leads to a scenario that positive/negative electric potentials were transmitted to the equator instantaneously along the dusk/dawn terminator, and drove ionospheric currents along the equator both on the day and nightside. Considering that the fast mode waves in the ionosphere would need several 10s of second to propagate to the equator, we conclude that the PRI electric field was transmitted by the TM0 mode waves propagating at the speed of light in the Earth-ionosphere waveguide (Kikuchi et al., 1978; Kikuchi and Araki, 1979).