

Consideration of geomagnetically induced currents — a case of geomagnetic sudden commencement(SC)

ARAKI, Tohru^{1*} ; SHINBORI, Atsuki²

¹Polar Research Institute of China, ²RISH, Kyoto University

Siscoe et al.(1968) assumed a relationship between the SC amplitude, dH , and solar wind dynamic pressure, P_d , as $dH = fgk d(P_d)^{0.5}$ and experimentally determined the proportional constant, k . Here f is a constant associated with the solar wind-magnetosphere interaction and g shows effects of currents induced in the Earth. This constant g has been traditionally taken as 1.5 without detailed check of its meaning for a long time. Here we make a physical consideration on it based upon the present SC model.

The disturbance field of SC, D_{sc} , is expressed as $D_{sc} = DL + DP_{pi} + DP_{mi}$.

Here, DL is caused by the magnetopause current (MC) enhanced during sudden compression of the magnetosphere and dominant in low latitudes on the ground. DP is produced by field-aligned currents (FAC) and FAC- produced ionospheric currents (IC) and larger in the higher latitude region.

The DP shows a two pulse structure where the first pulse is called pi (preliminary impulse) and the following pulse is denoted as mi (main impulse). Thus we have to assume 3 current sources in the consideration of induction effects of SC.

The magnetopause current, MC induces currents both in the ionosphere and Earth. As the induced ionospheric current reduces the amplitude of SC on the ground while the earth currents enhance it, induction current effects will be small for the DL field. Ionospheric currents causing the DP field induces currents only in the Earth which enhances the DP field on the ground.

The LT variation of SC amplitude shows the maximum in the D-component and minimum in the H-component around 8h LT in low and middle latitudes. On the other hand, calculation of a global distribution of ionospheric currents produced by a pair of FACs shows that the current direction is in north-south near 8h LT. This means that the H-component amplitude of SC observed near 8h LT consists of only the DL field which is less affected by induction effects..

Keywords: sudden commencement, induced current, ionospheric current,, magnetopause current, DL/DP-field