Consideration of the CubeSat for Observation of IHFAC at LEO

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A current pattern in the dayside ionosphere during solar quiet time is well known as the Sq current system. The Sq current is mostly generated by the diurnal tidal mode of the neutral wind, also has an obvious seasonal variation on its current pattern due to the seasonal variations of ionospheric electric conductivities. In general, the vortex current is stronger (weaker) in the summer (winter) hemisphere. This feature indicates that the potential of the Sq current shows the north/south asymmetry depending on the seasons. In order to eliminate the potential asymmetry between the both hemispheres, Inter-Hemispheric Field Aligned Currents (IHFACs) is considered to flow between the both hemispheres. The IHFAC was first theoretically expected by Maeda [1974] and Fukushima [1979, 1991], then several observations by the satellites [Yamashita and Iyemori, 2002, and Park et al., 2002, 2020], and global ground magnetic observation networks [Yamazaki et al., 2009, Owolabi et al., 2018]. On the other hand, such 3D currents system is also strongly affected by the electric field imposed on the polar ionosphere which is consequence of the magnetosphere-ionosphere couplings. Therefore, the accurate monitoring of the 3D Sq current system is quite important to understand the comprehensive multi-scale coupling in the space weather sciences.

In this study, we propose the CubeSat project which make in-situ observation of the Sq current system including IHFAC at the LEO in the altitude of ~400km. The feasibility of CubeSat with 2U-size structure is considered for the electric power budget, communication capability, and specification of the magnetometer. In particular, the several kinds of magnetometer are considered to onboard the CubeSat for in-situ magnetic field measurement with an accuracy of less than 1 nT. The result of the feasibility study shows that the observation of the Sq current by CubeSat is enough considerable with a short duration of the development and quite low-cost.

キーワード：CubeSat、Interhemispheric FAC、Sq電流
Keywords: CubeSat, Interhemispheric FAC, Sq

