磁気嵐時におけるグローバル地磁気変動

新堀淳樹[1], 西村幸敏[2], 辻裕司[2], 菊池崇[2], 長妻努[3], 亘慎一[3]
[1] *京大生存圏研究所*
[2] *名大太陽地球環境研究所*
[3] *情報通信機構*

Global geomagnetic field variations during a geomagnetic storm

Atsuki Shinbori[1], Yukitoshi Nishimura[2], Yuji Tsuji[2], Takashi Kikuchi[2], Tsutomu Nagatsuma[3], Shinichi Watari[3]
[1]*Solar-Terrestrial Environment Laboratory (STEL), Naogya University*
[3] *National Institute of Information and Communications Technology (NICT)*

It has been well-known that two-cell ionospheric convection in the polar ionosphere driven by a dawn-to-dusk electric field which carries the region-1 (R-1) field-aligned currents (FACs) are significantly intensified and expand to middle-low latitudes during the main phase of geomagnetic storms. The two-cell ionospheric currents produce negative and positive disturbances of the H-component of geomagnetic field in the morning and afternoon sectors, respectively. The dawn-to-dusk polar electric field penetrates to the magnetic equator, and drives the eastward equatorial electrojet current (eEJ) due to the Cowling effect in the daytime sector. During the recovery phase which is caused by the weakness of southward interplanetary magnetic field (IMF) or northward turning of the IMF, the two-cell ionospheric currents in the polar ionosphere are abruptly reduced and the equatorward boundary of auroral electrojet currents (AEJ) move to high latitude. In this case, the magnetic field at the magnetic equator show a significant enhancement of negative variations of the H-component in the daytime sector produced by the westward equatorial electrojet current (wEJ) driven by the dusk-to-dawn electric field originating from the R-2 FACs. However, due to the lack of geomagnetic field data in the middle-low latitudes, detail relationship between the magnetic field variations of high-middle latitudes and at the equator during geomagnetic storms has not been clarified yet. In this paper, we investigated time and spatial evolution of global geomagnetic field variations from high-latitude to the magnetic equator during the geomagnetic storm occurred on May 23-24, 2002, using geomagnetic field data with time resolution of 1 minute obtained from the CARISMA, GIMA, IMAGE, MACCS, and NSWM networks, and provided from WDC geomagnetism in Kyoto. In the present analysis, we first subtracted geomagnetic field variations during a magnetically quite day (May, 31, 2002) from the disturbed field during the geomagnetic field for each station. As a next step, we excluded the magnetic effects produced by magnetospheric currents (for example, ring current) by subtracting the low-latitude (10-20 degrees, GMLAT) geomagnetic field variation of the northward component. As a result, the equivalent current system showed that two-cell ionospheric currents are significantly enhanced in the daytime sector together with a strong enhancement of the eEJ at the daytime equator during the main phase of the geomagnetic storm. The centers of these vortices were located at 70 degrees and 65 degrees in the morning and afternoon sector, respectively. The two-cell ionospheric currents expanded to the low-latitude region of less than 30 degrees (GMLAT). In the nighttime sector of middle-low latitudes, the arrows of the equivalent current were directed in the northward direction. This signature indicates that the nighttime magnetic field signatures are produced by the magnetic effect of the R-1 FACs. On the other hand, during the recovery phase associated with strong northward turning of the IMF, the equivalent current system showed that the two new vortices different from two-cell ionospheric currents driven by the R-1 FACs system appear in the polar cap and middle latitude. The former led to the enhanced NBz current driven by the lobe reconnection due to the strong northward IMF, while the latter was generated by the enhanced R-2 FACs produced by the strongly asymmetric ring current flowing westward in the inner magnetosphere. In this case, the equatorial magnetic field variation showed a strongly negative signature produced by the wEJ current due to the dusk-to-dawn electric field. Therefore, it seems that the enhanced NBz current system plays an important role in the intensification of the dusk-to-dawn electric field from the middle-latitudes to the magnetic equator.