Geophysical Research Abstracts, Vol. 9, 05260, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-05260

Quantitative Separation of the Directly-driven and Unloading Components: View from the Ionospheric Electric Potential

W. Sun(1), X.-Y. Zhou(2) and A. Du(3)

(1)Geophysical Institute, University of Alaska Fairbanks, Fairbanks, Alaska, (2) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, (3) Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China

This paper presents a new application of the method of natural orthogonal components (NOC), which shed some insight on the storm and substorm study. In prior study NOC was applied to separate the ionospheric equivalent current to DP1 and DP2 currents on the basis of the ground-based magnetograms. Although DP1 and DP2 currents are very well consistent with the concepts of the substorm current wedge and the two-cell ionospheric convection pattern, it is argued that these conceptual DP1 and DP2 currents have been proved neither by observations nor by theories. As well known, observations have shown that the ionospheric electric filed turns to southward in auroral zone midnight sector at substorm expansion phase onsets. This southward electric field literally corresponds to a one-cell pattern in the contours of electric potential with the maximum potential change near midnight. Therefore, a separation of the one-cell electric potential from the total potential means a quantitative description of the ionospheric electric field of the substorm expansion phase onset and evolution. We call this application NOC-E ('E' presents electric potential).

This study is a NOC-E practice, i.e., to quantitatively separate the directly driven and unloading components in the ionospheric electric potential during storm-time and non-storm-time substorms. Three cases are examined. One is a series of substorm events during March 17-19, 1978. The ionospheric electric potential is calculated by using the KRM algorithm on the basis of six meridian chains magnetometer data during the IMS. The other two are storms during October 14, 2000 and October 21, 2001. The ionospheric electric potential is obtained from SuperDARN. The NOC-E results show that the first and second natural components dominate over the rest of the natural components. The first component is found to have a two-cell pattern, which is well known to be associated with global plasma convection in the magnetosphere. It is enhanced during the growth phase and expansion phase of substorms and decays during the recovery phase of substorms. This can be identified as the directly driven component. The second natural component reveals itself as an impulsive enhancement of the southward electric field around midnight during the expansion phase only. It can be identified as the unloading component related to the substorm current wedge. The role of the two components is discussed for different solar wind conditions and associated storms. This result would be helpful to quantitatively understand storm and substorm process.