Causal relationships between interplanetary electric field and geomagnetic storms during this solar cycle

Tohru Sakurai[1]

[1] Dept. of Aero- and Astronautics, School of Engineering, Tokai University

Causes and effects of magnetic storms for Dst index greater than – 100 nT observed during this solar cycle from 1996 to 2004 are statistically studied using hourly values of omni-solar wind data offered by CDAWeb SPDF Goddard Space Flight Center, and Dst and AE indices offered by the WDC2 at Kyoto University. The study revealed that the most intense Dst value was -472 nT observed in the main phase of the super magnetic storm of November 20, 2003, and the corresponding peak interplanetary electric field was 31.3 mV/m, which was the most pronounced value observed during this solar cycle. The peak AE index during this November 20 storm was about 3000 nT, which was not the biggest one, 3500 nT observed during the main phase of the November 10, 2004 storm. The relationship between the interplanetary electric field (IEF) and Dst values shows a non-linear relationship expressed with Dst (nT) = - 0.1815(IEF)ˆ2 – 4.8565(IEF) -86.394. Another relationship between IEF and AE index is non-linear, too. The non-linearity is clearly seen above ∼18 mV/m of the peak IEF value. The relationship between Dst and AE indices has also a non-linear relationship. The AE index of 2500 nT seems to be a peak value, above which the non-linearity is pronounced. These non-linear relationships suggest that there may be some upper limits of the energy consumed in the disturbed terrestrial magnetosphere. Statistically significant values of the upper limits for the AE and Dst indices were about 2500 nT and – 300 nT, respectively. The geomagnetic activities above these values were very rare in this solar cycle.