

Relationship between solar sources and geomagnetic disturbances for the super magnetic storms occurred in October-November, 2003

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During the period from October to November, 2003 the sun became very active. The plural numbers of active region appeared on the solar surface. The most prominent one was the number 486, which yielded extremely large flares X17/4B at 0951 UT on October 28, and X10/2B at 2037 UT on October 29, successively. These big flares hurled massive coronal mass ejections (CMEs) toward the earth. In this paper the solar-terrestrial relationship is discussed. Two fast moving clouds of gas from the sun swept past the earth and sparked extreme geomagnetic storms, which commenced at 0611 UT on October 29, and at 1637 UT on October 30, respectively, and produced the big ground magnetic field depressions with approximately -350 nT and -400 nT of the Dst. While, on November 20 another large magnetic storm occurred with the biggest ground magnetic field depression of Dst with a value of approximately -470 nT, which was ever observed during this solar cycle.

During the second half period of 2003 the geomagnetic activity was characterized with a bi-modal sector-like structure, which corresponds to a bi-modal solar surface magnetic field variation. This bi-modal magnetic field variation was very stable and continued from September to December, 2003. During a period of away polarity of interplanetary magnetic field (IMF), B_y , high speed solar wind and southward magnetic field variations were dominant, while the other period was characterized with a toward polarity of IMF, B_y , and the low speed solar wind and the northward magnetic field of IMF, B_z . The November 20 storm occurred in a period corresponding to the sector change from the away to toward polarity, while the October 29 storm occurred during the period of the toward polarity, in which the extremely large flares occurred successively on October 28 and 29. This was due to the sudden appearance of the active region of the number 486.

The geomagnetic response of these two super magnetic storms was different. The severity was superior in the October 29-31 storm to the November storm in spite of the largest growth of Dst on the November 20. The large amplitude Pc 5 oscillations were observed in the latter phase of the storm on October 31, which appeared with a short period, approximately 250 s. While, a similar Pc 5 pulsations occurred in the November 20 storm on November 21. However, the amplitude was a little smaller than that of the October 31 Pc 5, and the period was longer. These observed facts suggest that the magnetospheric condition was different even in the last phase of the magnetic storm.