AN INDIRECT HINT TO THE TORSION OF MAGNETIC FIELDS ABOVE ACTIVE REGIONS

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Abstract. A proxy information is suggested about the magnetic topology of the CME's with respect to the prevailing background IMF. The indirect information can be obtained from long-term patterns of specific tropospheric responses given to two basic (polar or equatorial) types of solar corpuscular impacts. The suggested topology might be resulted if the torsion of the original active region magnetic field was preserved in the CME.

Key words: CME, magnetic fields

1. Introduction

It is widely accepted that the coronal mass ejections (CMEs) cause the most geoeffective solar impacts and their effects are different from that of corotating stream - Heliospheric Current Sheet interaction region (Gonzalez et al., 1996; Legrand and Simon, 1993). Meanwhile, all authors admit that the available informations are fairly restricted about the magnetic topology of CMEs. We think that this might partly be explained by the huge sizes of these clouds, which makes almost impossible to map them by spacecrafts in specific *in situ* measurements and case studies. We suggest a proxy information instead.

1.1. Results from our earlier publications

Some fairly consistent patterns have been published in our previous papers about the responses given by the terrestrial lower atmosphere to the solar particle impacts (Baranyi and Ludmány, 1995, 1997). A remarkable feature of these patterns is that alternating input magnetic polarity conditions may cause alternating signs in the atmospheric responses.

Correlations between aa-index and surface temperature have been computed for several European stations on a 120-year time-span by distinguishing between those disturbances which come from the solar equatorial belt (active regions - shock or fluctuating geomagnetic activity) and those coming from the polar region (polar coronal holes - recurrent disturbances). The separation of types of disturbances was based on Legrand's classification of aa-index (1993). The two orientations of the solar main dipole field have also been separated by using the data of Makarov and Sivaraman (1986).

As was reported in our previous papers cited above, these studies revealed the following behaviour: the impacts coming from the equatorial active region belts release responses opposite to those coming from the polar coronal holes (recurrent disturbances) and, on the other hand, the senses of these responses alternate with the alternating solar main dipole magnetic field polarity.

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2. Magnetic topology of CMEs

In order to provide an explanation for these findings, we consider on one hand that the active region impacts are predominantly carried by CMEs and on the other hand the polarity conditions in the recurrent streams (coming from the polar coronal holes) represent those of the IMF. Thus we suggest the following scenario about the magnetic topology of the CMEs, which might account for the above findings:
(i) as an overall feature, the forefronts of the incoming CMEs apparently have magnetic field components predominantly opposite to those of the steady-state background IMF.
(ii) This kind of topology might be caused by the torsion of the original magnetic configuration bound to the active region. The twist of newly emerged magnetic flux results in a given helicity of the magnetic field above active regions.
(iii) This helicity, however, is accumulated in the atmosphere and it should somehow be removed in the course of the cycle in order to make possible the reversal of the global magnetic field in the next cycle. As there are no effective dissipation mechanisms to ensure this removal, therefore the body ejection of twisted magnetic fields appears to be the only efficient process to carry away flux and helicity (Low, 1996a, 1996b).

3. Discussion

The above consideration concerns only a theoretical expectation but, as was mentioned above, overall magnetic configurations of the CMEs could hardly be revealed in case studies because the satellite measurements are only fairly restricted samplings from an enormous structure and also these samplings may be contaminated with a noise of transients. However there are indications in the literature that the senses of the By and/or the Bz components can undergo a reversal at the moment of the encounter with a CME (Smith *et al.*, 1997) but this is not sufficient to make a conclusion about a general rule of the overall field distribution within CMEs. In our case, however, the whole magnetosphere-atmosphere system is the detector and the time scale is 120 year long instead of a single event, so the indicated rule may be revealed as a long term underlying trend.

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