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Anomalous Forbush effects associated both with remote western and eastern sources

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Abstract. Solar wind disturbances near Earth, as a rule, dominate the magnitude, shape and other properties of Forbush effects. At specific cases though, an inconsistency in the relation between the characteristics of the interplanetary disturbance and Forbush effect is observed, when a large decrease of cosmic ray intensity may correspond to a small disturbance of the near Earth solar wind. Most often such cases occur when the source of disturbance is a large release of solar substation in the eastern part of the solar disk. The study of the Forbuch effect on 16-17 July 2005 has shown that an anomaly in the relation of the interplanetary magnetic field intensity and the Forbush effect magnitude may not be caused by eastern but by far western sources. We analyzed the events from the database of IZMIRAN, which contains several thousands interplanetary disturbances and Forbush effects in order to search for anomalous Forbush decreases associated with both remote western and eastern sources. Analysis of such events testifies that cosmic ray variations are able to provide information on sufficiently remote heliospheric phenomena and thus, play a significant role to the understanding of space environment.

1. Introduction

Forbush effect (FE) is often said to be a storm in cosmic rays (CRs) (Belov et al., 2001). The actual definition of FEs is based on its origin and can be stated as: Forbush effect (FE) is a result of the influence of coronal mass ejections (CMEs) and/or high speed streams of the solar wind from coronal holes on the background CRs. Thus, interplanetary disturbances creating FEs are both of sporadic and recurrent nature (Belov, 2009). Since all sufficiently large FEs (e.g. >5%) are connected with CMEs, by studying the variations of large FEs we can extract useful information about CMEs, especially during time periods with no or minimum CME observations.

2. Anomalous Forbush Effects

Among all FEs we distinguished a subclass of events characterized by relatively unsettled interplanetary and geomagnetic conditions (IMF <15 nT, Kp <6), gradual decrease of the CR intensity on the main phase of FE and slow recovery

phase. It turned out that all these events were caused by far eastern or western solar sources and have very characteristic features in the behavior of CR variations. In normal FEs central sources are dominant, whereas anomalous FEs are mainly caused by extreme eastern or western sources. All anomalous FEs turned out to be of <3% magnitude and occurred in relatively weak disturbed interplanetary and geomagnetic conditions with gradual fall of CR intensity in the main phase of Forbush-effect (Eroshenko et al., 2009).

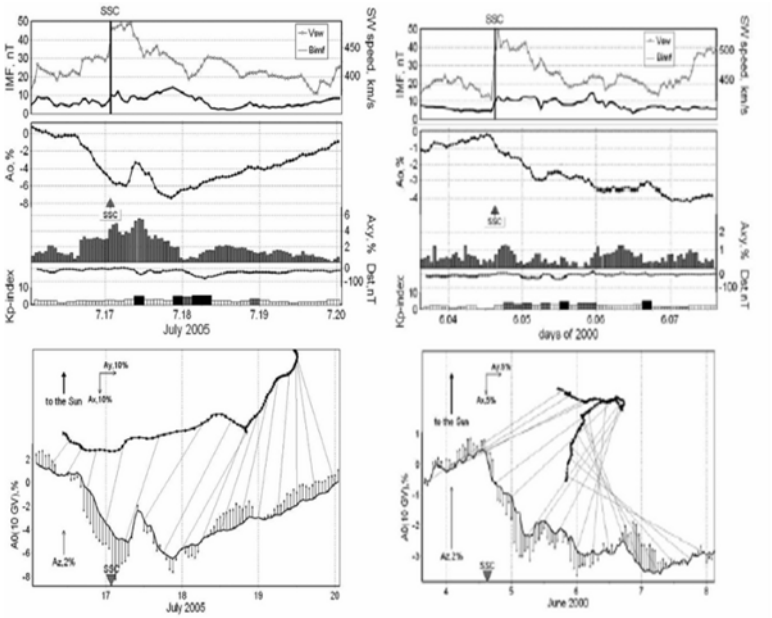

Figure 1. Examples of the FEs in July 2005 (left panel) and June 2000 (right panel) caused respectively by western and eastern solar sources

3. Discussion

It was possible to separate small but very definite groups of large FEs which were not followed by strong interplanetary disturbances near Earth, nor by high geomagnetic activity but seemed to be associated with great solar wind disturbances, the main part of which missed the Earth (Fig. 1). In the cases of far sources CR observations provide better information about the real power and size of a disturbance than near-Earth solar wind measurements.

References

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