Available online at www.sciencedirect.com

ScienceDirect

Advances in Space Research 52 (2013) 1959–1965

ADVANCES IN SPACE RESEARCH (a COSPAR publication)

www.elsevier.com/locate/asr

Effects of sector structure of the interplanetary magnetic field on the upper mesosphere–lower thermosphere dynamics

A.N. Fahrutdinova, S.V. Maksyutin, M.V. Elakhov *

Institute of Physics, Kazan (Volga Region) Federal University, 18 Kremlevskaya st., Kazan 420008, Russia

Received 16 December 2012; received in revised form 28 August 2013; accepted 29 August 2013
Available online 6 September 2013

Abstract

In this paper we study the influence of the interplanetary magnetic field (IMF) polarity changes caused by the Earth passing through the IMF sector boundary on the dynamic processes taking place in neutral atmosphere within the altitude interval of the upper mesosphere–lower thermosphere (83–101 km). The analysis has revealed the influence of the IMF sector structure on dynamics of the upper mesosphere–lower thermosphere. There has been a significant seasonal variation of the wind reaction to the IMF polarity changes observed. The influence of the IMF polarity changes on neutral atmosphere dynamics within the altitude range of 83–101 km is most pronounced in the zonal component of neural wind when the IMF polarity changes from negative to positive in all the seasons except for spring and when IMF polarity changes from positive to negative – in spring only.

Keywords: Neutral wind; Interplanetary magnetic field; IMF sector structure; Geomagnetic disturbance; Upper mesosphere–lower thermosphere; Seasonal wind variation

1. Introduction

During the past decades study of the influence of the Earth passing through IMF sector boundary on the magnetosphere, ionosphere and neutral atmosphere has been conducted by a number of scientists. Mansurov et al. (1969) and Svalgaard (1968) have found out that the IMF polarity changes in the circumpolar regions of the Earth (Vostok, geomagnetic latitude $F = 88°$ and Resolute Bay, $F = 84°$, Thule, $F = 87°$) were accompanied by simultaneous antiphase changes in the vertical component of the Earth's magnetic field. These antiphase variations were reaching 90–150γ in summer, according to Mansurov et al. (1969), which was much higher than the IMF itself. Mansurov has established Mansurov et al. (1969) an increase of Ap index values when the Earth was passing through the IMF sector boundary, with its maximum falling on the day following the boundary passing through day. Veselovsky et al. (2008) has made a linear approximation of Dst index values with Bz component of the IMF. Davis et al. (1997) has reported decrease in Dst index values (down to −60 nT) and increase in Kp index values (from 2 to 5.6) at the moments of the IMF polarity changes. Thus, if we take into account the effects of the IMF sector structure, this will permit us to more thoroughly study solar and geomagnetic effects produced on the atmosphere and ionosphere of the Earth.

A number of researchers have observed an effect produced by the sector structure of the interplanetary magnetic field on F2 ionospheric layer (Davis et al., 1997; Bremer et al., 1996; Tulunay, 1994, 1996). They explained the decrease in f_oF2 values namely by the IMF polarity changes.

A number of researchers have also studied an effect produced by the IMF sector structure on the thermodynamic regime of the neutral atmosphere (Ivanov and Harshiladse,

* Corresponding author. Tel.: +7 9172716223.
E-mail addresses: antonina.fahrutdinova@ksu.ru (A.N. Fahrutdinova), sergey.maksyutin@ksu.ru (S.V. Maksyutin), max.elakhov@gmail.com (M.V. Elakhov).

0273-1177/$36.00 © 2013 COSPAR. Published by Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.asr.2013.08.031