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Es layer and dynamics of neutral atmosphere during the periods of geomagnetic disturbances

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Abstract

Analysis of geomagnetic activity influence on parameters of E sporadic layer for ionosphere sounding station Moscow (56°N, 37°E) and on dynamics of neutral wind in the upper mesosphere–lower thermosphere for meteor radiolocation station Kazan (56°N, 49°E) was conducted. Discovered regularities of E sporadic layer response on geomagnetic disturbances are explained by the direct change of neutral atmosphere dynamics during the geomagnetic disturbances. © 2001 Elsevier Science Ltd. All rights reserved.

Keywords: Geomagnetic disturbances; Sporadic E layer; Upper mesosphere–lower thermosphere

1. Introduction

The influence of geomagnetic disturbances on sporadic E layer was investigated by some scientists (Whitehead, 1970; Chavdarov et al., 1975; Majeed, 1982; Baggaley, 1984; Whitehead, 1989), where they reported about both the revealing of positive and negative correlation of Es with the geomagnetic activity and the absence of correlation. They also reported about the dependence of Es layer response to the geomagnetic disturbances on latitude, season, time of the day and the type of Es layer. Thus, the question of the influence of geomagnetic disturbances on the Es layer has not been solved completely and so it is necessary the following investigation for a longer time interval with consideration of seasonal and diurnal variation. Since the behavior of Es layer is in many aspects defined by the dynamics of neutral wind (Akchurin et al., 1995; Fahrutdinova et al., 1997), it is necessary to consider the influence of geomagnetic disturbances on the intensity Es layer in combination with the influence of geomagnetic disturbances on the dynamics of lower thermosphere.

The present paper deals with solving the problem of detection of the effects of geomagnetic disturbances in the behavior of sporadic E layer and also in the prevailing and mesoscale turbulent motions within the upper mesosphere–lower thermosphere (80–110 km).

2. Data analysis technique

To perform the analysis, the data of Kp indexes of geomagnetic activity and Wolf numbers W characterizing the level of solar activity for the period 1958–1990 were used. We also used the hourly data of the prevailing wind in the neutral atmosphere measured by means of radiolocation station with phase altimeter in Kazan (56°N, 49°E) for the height interval 80–110 km during 1986–1990 (Sidorov and Fahrutdinova, 1991) the hourly data for critical frequency of Es layer — foEs, and monthly median values of hourly data of critical frequency of E layer — foEm for the period 1958–1990 obtained at the Moscow station (56°N, 37°E). Since the distance between the ionosonde at Moscow and the radar in Kazan is about 700 km, measurements produced in the west sector of radar visibility were chosen from the available wind data. In this case, the distance between areas of measurements of E sporadic layer parameters and wind parameters did not exceed about 300 km. This value

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