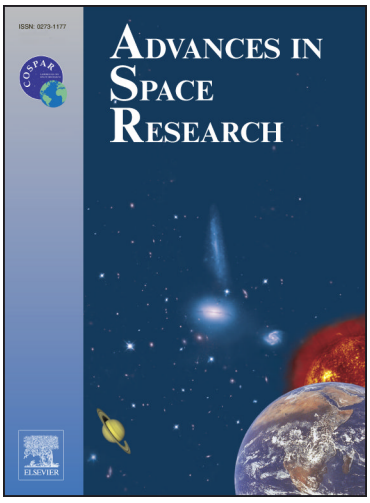

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Dynamics of ionospheric disturbances during the 17-19 March 2015 geomagnetic storm over East Asia

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Abstract

Based on vertical sounding data from nine ionosondes located at 19– 66° N, 100–130° E we investigated the latitude-temporal dynamics of ionospheric disturbances during the 17–19 March 2015 severe two-step geomagnetic storm, and compared it with temporal dynamics of total electron content (TEC) profiles along 120° E. The phenomena that accompanied the main and early recovery storm phases were in particular focused on in this study. The distinct storm-related ionospheric disturbances began 2.5, 4 and 5 h after onset of the storm main phase at subauroral, middle and low latitudes, respectively. To clarify the main mechanisms causing the disturbances at different latitudes we compared the changes in ionospheric parameters and TEC profiles with changes in the northern polar cap index and geomagnetic field in the vicinity of 120° E. The equatorward shift of the main ionospheric trough (MIT) and diffuse precipitations zone accompanied by an increase in precipitating particle flux was found to have a substantial influence on the subauroral ionosphere during the main and early recovery phases. The thermosphere Joule heating due to westward and polarized jets led to an increase in neutral wind velocity and generation of disturbed dynamo electric field. The strengthened wind was the main reason of the positive ionospheric disturbance observed at middle latitudes in the evening on 17 March. The further enhancement of magnetospheric convection caused the displacement of MIT and its associated negative ionospheric disturbance to middle latitudes. At low latitudes superposition of prompt penetration and disturbed dynamo electric fields play the decisive role in the ionosphere behavior till the end of the early recovery phase.

Keywords: magnetic storm, critical frequency, total electron content, storm-related ionospheric disturbances

1. Introduction

Magnetic storm is an extreme space weather phenomenon, and despite many years of research, the study of storm-related ionospheric disturbances preserves its importance. On the one hand, it is determined by a great variability of the ionospheric parameters during storms; on the other hand, by impact of ionospheric disturbances on ground-based and satellite radio, radar and navigation systems. Therefore, the ionospheric storm study is important for solving the following problems: forecasting of HF-communication conditions; providing of continuous operation of navigation and radar systems during extreme geomagnetic events.

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