VARIATIONS OF THE MID-LATITUDE IONOSPHERE DURING STRONG GEOMAGNETIC STORMS: OBSERVATIONAL RESULTS

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The ground-based ionosonde data obtained at Alma-Ata station [φ=43.25^{0}N, λ=76.92^{0}E, Φ = 33.47^{0}N, L=1.44) are analyzed to study ionospheric responses at fourteen intense (Kp≥8) geomagnetic storms with storm sudden commencement (*ssc*). The collected data show that ionospheric responses to intensive geomagnetic storms (Dst<-100nT) are very complex with a great degree of variability; however, negative ionospheric disturbances are a common feature of the responses. The time delay between storm *ssc* and beginning of the negative ionospheric disturbances shows a tendency to be noticeably larger in winter events than the summer events. Positive ionospheric effects are observed during storm recovery phases or when the Dst almost fully recovered. The occurrence of the unusual for Alma-Ata location night E, F1 layers and auroral type *r* (**r**etardation) sporadic Es layers is observed during developing or around main phases in Dst index. Employing the International Reference Ionosphere 2001 (IRI-2001), the nighttime E region electron density has been estimated for "quiet" conditions on the epochs of the storm time. Direct comparison of the "quiet" and "storm" ionospheric data shows a very significant storm induced increase of the electron density in the 110 to 200 km altitude range that reaches a factor of about 10 at the 110km altitude. Interaction of precipitating energetic neutralized ring current particles with the upper atmosphere during geomagnetic disturbances is assumed to be a possible explanation for the observed night events at this latitude sector.

Geomagnetic storms, International Reference Ionosphere (IRI), ionospheric disturbances

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