

Transition region of TEC enhancement phenomena during geomagnetically disturbed periods at mid-latitudes

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Large-scale TEC perturbations/enhancements observed during the day sectors of major storm periods, 12-13 February 2000, 23 September 1999, 29 October 2003, and 21 November 2003 were studied using high resolution GPS network over Japan. TEC enhancements described in the present study have large amplitudes (larger than 25×10^{16} electrons/m²) compared to the quiet time values and long periods (longer than 120 minutes). The sequential manner of development and the propagation of these perturbations show that they are initiated at the northern region and propagating towards southern region of Japan with velocities higher than 350m/s. On 12 February 2000, remarkably high values of TEC and background content are observed at southern region, compared to the north, because of the poleward expansion of the equatorial anomaly crest, which is characterized by strong latitudinal gradients near 35N (26N geomagnetically). When the TEC enhancements, initiating at the north, arrive and propagate through the region 39-34N (30-25N geomagnetically), they undergo transitions characterized by severe decrease in amplitude of TEC enhancements, which may be due to the restrictions offered by the high background TEC of expanded anomaly crest at the low latitude region. However, at the low latitude region, below 35N, increase in TEC is manifested as an enhanced ionization pattern (EIP). This could be due to the prompt penetration of the eastward electric field, which is evident from high values of southward interplanetary magnetic field and AE index. The TEC perturbations observed on the other storm days also exhibit the similar transitions, characterized by decreasing magnitude of perturbation component, at the region around 39-34N, due to the interaction with higher background content of expanded anomaly crest, indicate the repeatability of the above scenario. It is found that, the latitude and time at which either decrease in magnitude of perturbation component/ amplitude of TEC enhancement or the restrictions suffered by it are matching with the latitude and time of appearance of high background content due to the anomaly crest. In the present study, on 12 February 2000, the F-layer height increases at Wakkanai, and Kokubunji by exhibiting a typical dispersion feature of LSTID or passage of an equatorward surge, which is matching with the time of occurrence of the propagating TEC perturbation component. Similarly, on 29 October 2003, the increase in F-layer heights by more than 150 km at Wakkanai and 90 km at Kokubunji around 1800 JST, indicates the role of the equatorward neutral wind. On that day, TEC perturbation was observed at northern region, after 1830 JST, which propagates towards south, could be mainly caused by the equatorward neutral wind, leading to F-layer height increase.