Westward turning motions of nighttime medium-scale traveling ionospheric disturbances (MSTIDs) at the equatorward side of the dusk side auroral oval associated with auroral brightening

*Sneha Yadav[1,2], Kazuo Shiokawa[1], Shin-ichiro Oyama[1,3,4], Yuichi Otsuka[1]

1. ISEE, Nagoya University, Nagoya, Japan, 2. SPL, VSSC, India, 3. Ionosphere Research Unit, University of Oulu, Oulu, Finland, 4. NIPR, Tachikawa, Japan

The characteristics of high-latitude nighttime medium-scale traveling ionospheric disturbances (MSTIDs) have not been well investigated using all-sky imagers because of the hindrance caused by the bright aurora. The limited results on the propagation characteristics of MSTIDs over high-latitudes hindered the progress in our understanding on these dynamical structure. In a case study carried out by Shiokawa et al. (JGR, 2012), an event of oscillating MSTIDs was reported over Tromsø (69.6˚N, 19.2˚E; corrected geomagnetic latitude: 66.6˚N), which was observed to be associated with auroral brightening. However, after this case study, which comprised of only one event, no observations showing oscillating motion of MSTIDs have been reported till date. In this study, for the first time, the comprehensive investigation on the westward turning of the MSTIDs in the equatorward side of the dusk side auroral oval has been performed. The all-sky imaging data of 630.0 nm airglow emissions during 2010-2018 are used to study the motions of MSTIDs over Tromsø. The results indicate that the nighttime MSTIDs primarily exhibit eastward motion under quiet magnetic conditions but turned in the westward direction during the active geomagnetic conditions. The turning of MSTIDs in the westward direction were invariably associated with the auroral brightening observed at the poleward edge of the all-sky image and localized magnetic field perturbations observed by ground-based magnetometers at Tromsø. The interesting aspect of the observations is the fact that these westward moving MSTIDs again turned in the eastward direction when the geomagnetic disturbance ceases. The SuperDARN (Super Dual Auroral Radar Network) convection maps revealed that the location of Tromsø was inside/outside the convection cell region during the time of appearance of westward/eastward moving MSTIDs. The Doppler shift measurement of the 630-nm airglow by a Fabry-Perot interferometer at Tromsø showed that northeastward winds were predominant during the appearance of eastward moving MSTIDs. The cause of the observed MSTIDs remains in question as they might either be triggered by atmospheric gravity waves or by Perkins instability. These experimental evidences suggest that the MSTIDs tend to move eastward in accordance with the background F-region dynamo electric field, but show westward motion under the influence of electric field associated with auroral activities in the dusk side of two-cell convection pattern.

Keywords: MSTIDs, Auroral oval, Airglow

