

The statistical study of the growth rates of Medium-Scale Traveling Ionospheric Disturbances observed with GPS-TEC

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We think two mechanism, E-F coupling and Perkins Instability, will relate to growth for nighttime-MSTID in mid-latitude [Tsunoda and Cosgrove., 2001 ; Perkins., 1973]. Linear growth rate of perturbation intensity of Pedersen conductivity expected from E-F coupling is around 15 minutes [Yokoyama et al., 2009], which is far shorter than one expected from Perkins Instability [Fukao and Kelley, 1991 ; Miller et al., 1997 ; Shiokawa et al., 2003]. However, Es layer' s spatial and temporal scale is less than 100km and 15min [Maeda et al., 2013 ; S.Saito et al., 2007]. They are different from MSTID' s ones, which are 200-400 km and around 2hours [Otsuka et al., 2011]. To decide which instability is responsible for growth of nighttime MSTID, the growth rate of MSTID was observationally determined with ground-based GPS network data.

We statistically investigated the growth rate of nighttime-MSTID in Japan in 2014 observed with GPS-TEC. The growth rate of nighttime -MSTID observed was $1.0 - 6.0 \times 10^{-4} \text{ s}^{-1}$ during 1800LT-2400LT in summer. Linear growth rate of Perkins instability in summer was $1.0 - 6.0 \times 10^{-4} \text{ s}^{-1}$ during 1800LT - 2400LT, so they were less than one of the E-F coupling instability. Also, Seasonal distribution of observed growth rate before midnight was similar to that of linear growth rate. $U \times B$ derived by GAIA model was high in spring - summer and seasonal distribution of $U \times B$ was similar to that of linear growth rate. Therefore, the growth of MSTID when propagating is not determined by E-F coupling instability but Perkins instability and neutral wind.

Keywords: MSTID, GPS-TEC, Ionosphere