

Study of the characteristics of growth of Nighttime-MSTID in mid-latitude observed by GNSS

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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 analyzed the statistical characteristics of nighttime MSTID in mid-latitude at 2014 observed by GNSS. We applied two-space and time spectral analysis to calculate MSTID's growth rates. We compared growth rate observed with linear growth rate of Perkins Instability for two method. We calculated latter using by ion temperature, neutral wind velocity, electric field and O mass density of GAIA model [Jin et al., 2008] and magnetic field of IGRF model. First, we compared maximum growth rate observed in one day with maximum growth rate of Perkins model in one day. Observed maximum growth rate was $0.13-8.7 * 10^{-4} s^{-1}$, which was similar to maximum linear growth rate of Perkins instability. Second, we compared observed growth rate with one of Perkins instability about seasonal dependence in 2014. Observed growth rate was $1.0-6.0 * 10^{-4} s^{-1}$ during 1800LT-0600LT in summer (May-Jun-Jul-Aug). In winter (Nov-Dec-Jan-Feb) growth rate was $1.0-6.0 * 10^{-4} s^{-1}$ during 1800LT-2400LT, after than growth rate was less than $1.0 * 10^{-4} s^{-1}$. Linear growth rate of Perkins instability was larger in summer. Observed growth rate in summer was not related to Es layer intensity [Ogawa et al., 2002] observed by Ionozonde at Kokubunji. Linear growth rate of Perkins Instability is decided to F-region neutral wind, so nighttime MSTID's growth in mid-latitude would be decided by Perkins Instability and F-region neutral wind, not E-F coupling.