Study of the characteristic of the growth of MSTID observed by GNSS

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Medium scale traveling ionospheric disturbance is one of phenomenon in ionosphere and has been long studied. Nighttime MSTID will be caused by Perkins instability, but linear growth time(e folding time) of Perkins instability is very slow as growth time from random thermal noise.

For this problem, we could solve by the geomagnetic connection between E-region and F-region, and inserting the sporadic E layer's polarized electric field as the energy source of growth. However, we have few examples of observational verification whether E-region is connected to F-region when a disturbance occurred. And Perkins instability's growth rate is independent from wavelength, but we observe more MSTID events which wavelength is 200km - 400km. Sporadic E layer has less than 100km periodic structure, which contradicts observation.

Therefore we think it is difficult to claim E-region and F-region connection as growth mechanism. To verify this idea, we studied the character of growth of nighttime MSTID.

Using this method, we statistically estimated growth rates of nighttime MSTID in japan in summer 2014 observed by GNSS. We applied three-dimensional spectral method for total electron content grid data ,and estimated propagation velocity. Using this velocity, we tracked movement of one wavefront of MSTID, and estimated the fastest growth time of each event by using wavenumber spectra when tracking. As a result, growth time is slower than 16 minutes. Propagation direction when growth time is fastest is southwestward(205 deg - 245 deg). Growth time is even faster when 240 degrees. This time is too slow as growth time of MSTID, and is within the range of one perkins instability expects.

We will show the detail about the relation between this growth time and both mechanisms, and also present the wavelength dependence of growth.

Keywords: Medium-Scale Traveling Ionospheric Disturbances, GNSS, Sporadic E layer, Perkins Instability

