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Study of medium-scale traveling ionospheric disturbances (MSTID) with sounding rockets and ground observations

YAMAMOTO, Mamoru[1*] ; KATO, Tomohiro[1] ; ISHISAKA, Keigo[2] ; YOKOYAMA, Tatsuhiro[3] ; IWAGAMI, Naomoto[3] ; TAKAHASHI, Takao[5] ; TANAKA, Makoto[5] ; ENDO, Ken[6] ; KUMAMOTO, Atsushi[6] ; WATANABE, Shigeto[7] ; YAMAMOTO, Masa-yuki[8] ; ABE, Takumi[9] ; SAITO, Susumu[10] ; TSUGAWA, Takuya[3] ; NISHIOKA, Michi[3] ; BERNHARDT, Paul[11] ; LARSEN, Miguel[12]

[1]RISH, Kyoto University, [2]Toyama Prefectural University, [3]NICT, [4]School of Science, University of Tokyo, [5]ICT Education Center, Tokai University, [6]School of Science, Tohoku University, [7]School of Science, Hokkaido University, [8]Kochi University of Technology, [9]JAXA/ISAS, [10]ENRI, [11]NRL, [12]Clemson University

Medium-scale traveling ionospheric disturbance (MSTID) is an interesting phenomenon in the F-region. The MSTID is frequent in summer nighttime over Japan, showing wave structures with wavelengths of 100-200 km, periodicity of about 1 hour, and propagation toward the southwest. The phenomena are observed by the total electron content (TEC) from GEONET, Japanese dense network of GPS receivers, and 630 nm airglow imagers as horizontal pattern. It was also measured as Spread-F events of ionograms or as field-aligned echoes of the MU radar. MSTID was, in the past, explained by Perkins instability (Perkins, 1973) while its low growth rate was a problem. Recently 3D simulation study by Yokoyama et al (2009) hypothesized a generation mechanism of the MSTID, which stands on electromagnetic E/F-region coupling of the ionosphere. The hypothesis is that the MSTID first grows with polarization electric fields from sporadic-E, then show spatial structures resembling to the Perkins instability. We recently conducted a observation campaign to check this hypothesis. We launched JASA ISAS sounding rockets S-310-42 and S-520-27 at 23:00 JST and 23:57JST on July 20, 2013 while an MSTID event was monitored in real-time by the GPS-TEC from GEONET. We found 1-5mV/m northeastward/eastward electric fields during the flight. Variation of electric fileds were associated with horizontal distribution of plasma density. Wind velocity was measured by the TME and Lithium releases from S-310-42 and S-520-27 rockets, respectively, showing southward wind near the sporadic-E layer heights. These results are consistent to the expected generation mechanism shown above. In the presentation we will discuss electric-field results and its relationship with plasma density variability together with preliminary results from the neutral-wind observations.

Keywords: MSTID, Sounding rocket, Electric field, GPS-TEC, Observation campaign