

Coordinated observations of post-midnight irregularities and thermospheric neutral wind and temperature

*Tam Dao¹, Yuichi Otsuka¹, Kazuo Shiokawa¹, Michi Nishioka², Mamoru Yamamoto³, Suhaila M. Buhari⁴

1.Institute for Space-Earth Environmental Research, Graduate school of Science, Nagoya University, Nagoya, Japan., 2.National Institute of Information and Communication Technology, Tokyo, Japan, 3.Research Institute for Sustainable Humanosphere, Kyoto University, Uji, Japan., 4.Universiti Teknologi Malaysia, Malaysia

Field-aligned irregularities (FAIs) have been observed since last few decades by using UHF/VHF/HF radars. At equatorial F-region, FAIs are generated within plasma bubbles. The plasma bubbles are well-known to be initiated at evening terminator and occur frequently in equinoxes, especially during high solar activity conditions. On the other hand, recent observations show that the FAIs frequently occur at post-midnight around June solstice in low solar activity conditions. From the comparison of ionosonde data, it is found that uplift of the F layer could play an important role in generating the post-midnight plasma bubbles. However, mechanisms of uplift of the F layer has not been revealed yet.

In this study, we investigate an event of the post-midnight FAIs observed with the EAR (Equatorial Atmospheric Radar) at Kototabang in Indonesia. Two-dimensional map of rate of total electron content change index (ROTI) obtained from GPS receivers in Southeast Asia, thermospheric neutral winds and temperature observed at Kototabang by Fabri-Perot interferometer, and altitude of the bottomside of the F layer observed with ionosondes at Kototabang, Chumphon, and Chiang Mai, are compared. On the night of July 9, 2010, the post-midnight FAIs appeared within the field of view of the EAR. By estimating the vertical rise velocity of this FAI structure, we found that the FAIs could be accompanied by plasma bubble initiated at magnetic equator around 22:00 LT.

Two-dimensional ROTI map also showed an enhancement near magnetic equator around this time, then extended to the higher low latitudes and reached Kototabang at midnight. Thermospheric neutral wind was southward (magnetically poleward) from 19:30 to 23:00 LT, and northward (magnetically equatorward) enhancement was observed from 22:30 LT. The altitude of the bottomside of F-layer increased at 15:30-16:00 LT. This altitude increase of the F layer could be caused by the enhancement of the equatorward thermospheric wind. Thermospheric neutral temperature was higher at north than at south from 22:30 to 01:00 LT on the subsequent day, indicating that Midnight Temperature Maximum (MTM) existed at the north of Kototabang. We discuss a role of MTM in the generation of post-midnight FAIs at low latitude region.

Keywords: Post-midnight F layer field-aligned irregularities (FAIs) , Plasma bubbles, Equatorial Ionospheric region