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Host in ISEE: Professor Yuichi Otsuka

Investigation of Seeding of postmidnight irregularities in the South Asian sector

Aim & purpose of the visit

Our work mainly focuses on investigating the seeding of postmidnight irregularities near the magnetic equator using the 47 MHz Equatorial Atmosphere Radar (EAR) in West Sumatra, Indonesia (0.20ºS, 100.32ºE; dip latitude 10.36ºN). Simultaneous Total electron content (TEC) perturbations associated with these irregularities were observed by satellites from north of the GPS receivers. We found that the wavy TEC perturbations were associated with the occurrence of Field Aligned Irregularities (FAIs) observed on 11 August 2019. Furthermore, using detrended total electron content (DTEC) two-dimensional (2D) maps, we observed the propagation of these wavy structures in the meridional (northeastward) direction, which is an unusual scenario, as FAIs and medium-scale traveling ionospheric disturbances (MSTIDs) typically propagate southwestward. The electrodynamics of these wavy structures require further investigation.

Dataset used for the study

The EAR radar, which is sensitive to 3-meter-scale irregularities, was used to investigate the postmidnight irregularities during the summer months of the low solar activity year 2019. Additionally, TEC data were obtained from the GPS receiver network in Sumatra, Indonesia, known as Sumatran GPS Array (SuGAr). TEC perturbations are derived by subtracting a 1-hour running average from the slant TEC. We used five SuGAr receivers located north of the EAR site, operated by Nagoya University. DTEC maps were employed to study the spatiotemporal evolution of TEC perturbations, using data from approximately 115 receivers.

Results

The TEC wavy perturbations associated with the FAIs observed near the magnetic equator

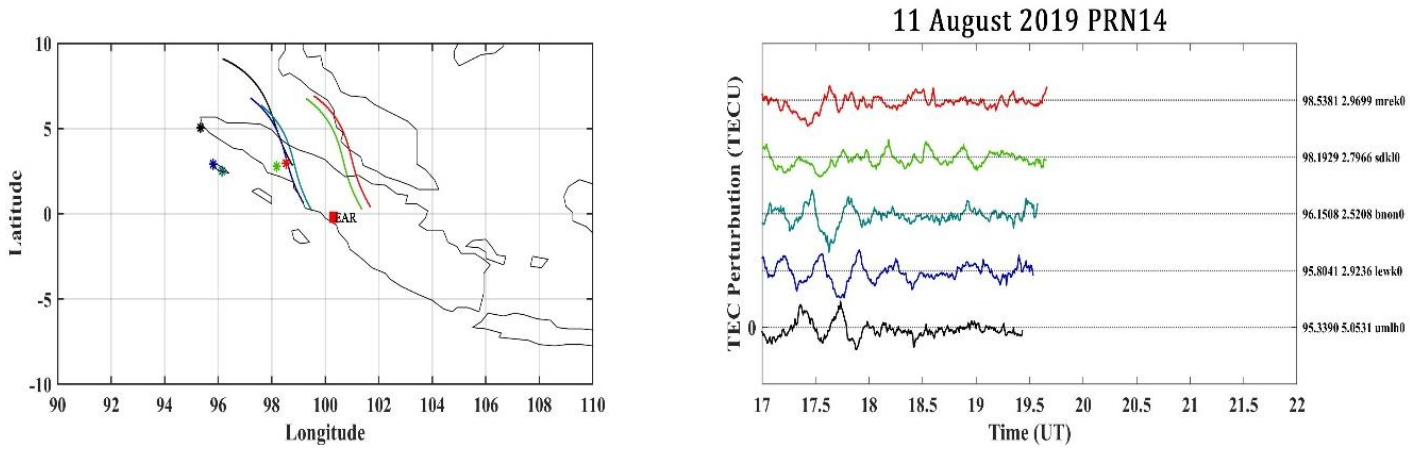

Figure 1: (a) shows the satellite passes observed from the northern receivers located near the EAR site. (b) shows the wavy TEC perturbations observed by all five receivers during 17:00 – 18:00 UT (00:00 – 01:00 LT) on 11 August 2019.

The TEC perturbations shown in Figure 1b are associated with FAIs structures generated near the magnetic equator during 18:30 – 23:00 UT (1:30-5:00 LT), as confirmed by the EAR radar observations.

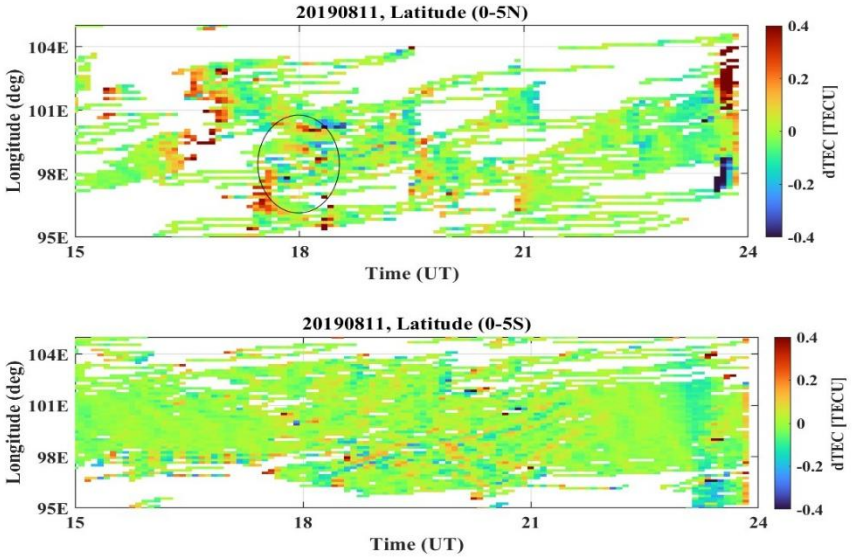

Figure 2: (a) TEC perturbations at a fixed northern latitude as a function of longitude and time. The eclipse shows the northeastward wavy propagation (b) TEC perturbation at a fixed southern latitude.

Furthermore, DTEC maps for the same day were generated to examine the horizontal structures of the TEC perturbations. In order to see the propagation characteristics, TEC perturbations at a fixed latitude were analyzed. The waves were found to propagate northeastward during 17:00 -18:00 UT (00:00 – 01:00 LT).

Acknowledgement

I have worked for three months under the guidance of Dr. Yuichi Otsuka, which provided me with a valuable opportunity to collaborate on research problems and exchange scientific ideas. I also had the chance to visit the MU Observatory in Shigaraki, a beautiful land of ceramics, with Professor Otsuka. During my stay, I explored several beautiful places in Japan, including Nara, Kyoto, Nagoya Castle, Nagoya Port, and Shirakawago Village. I became fascinated by Japanese cuisine – it is truly authentic and delicious. I am deeply grateful for the great support I received from my colleagues - Dr. Geetashree, Dr. Sridevi, Dr. Adhithya, and Mr. Adhi Guna at ISEE during my stay. I sincerely thank Dr. Kazuo Shiokawa, Director of ISEE, for providing me this wonderful opportunity to participate in the program. I would also like to thank Ms. Sayaka Fujiwara for her administrative assistance. Last but not least , my entire journey was made even more memorable by my friend Ms Amrutha from IIG. I truly enjoyed my stay in Japan - the people, the places, and the food. I hope to visit again soon!