3rd URSI AT-AP-RASC, Gran Canaria, 29 May – 3 June 2022

Occurrences of regional strong Es irregularities and corresponding scintillations characterized using a high-temporal resolution GNSS network

Wenjie Sun(1), Guozhu Li* (1), Yuyan Yang(1), Libo Liu(1), and Baiqi Ning(1)
(1) Beijing National Observatory of Space Environment, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China.

The ionospheric sporadic E (Es) layer and associated irregularities were traditionally investigated and characterized based on observations from ground-based radars, e.g., ionosondes and very high frequency radars, which usually suffer from a small spatial distribution. Ever since strong Es were revealed to be detectable by ionospheric total electron content (TEC) measurements from ground-based Global Navigation Satellite Systems (GNSS) receivers, the morphology of large-scale strong Es structures has been studied over different regions [1]. However, the occurrences of strong Es irregularity structures, with scale sizes down to a few kilometers along the same latitude/longitude are not clear. Whereas GNSS observations in a dense network provide a valuable dataset for Es investigation, the most commonly-used measurements such as the L-band amplitude scintillation index and the well-defined rate of TEC index (ROTI) are for F-region irregularities. No index specialized in identifying strong Es irregularities has been proposed.

In this regard, strong Es irregularities over China are investigated based on high-temporal-resolution TEC derived from two crossed chains of Beidou geostationary satellite (BD-GEO) TEC receivers along 110 °E and 23 °N, respectively. The High Resolution Rate Of TEC index (HR-ROTI) calculated at an interval of 30 s, is proposed to characterize small-scale strong Es irregularity structures [2]. Based on the HR-ROTI measurements and the typical drift velocity of Es 60 m/s, the scale sizes of strong Es irregularity structures were revealed to be mainly ~7 km. The structures were mostly quasi-periodically separated with distances of 7-16 km. Through a further statistical analysis of strong Es irregularity structures along the two chains, it was found that the Es irregularity structures predominantly occur during local summer at middle and low latitudes, with the occurrence rate peaking at ~30 °N. On average ~2-5 small-scale strong Es irregularity structures may be embedded in one larger-scale structure. Unlike the equatorial and low-latitude F-region irregularities which cause scintillations under most conditions, the strong Es irregularity characterized by HR-ROTI caused scintillation with relatively low occurrence rates 37% and 12% at middle and low latitude respectively.

1. Sun, W., Zhao, X., Hu, L., Yang, S., Xie, H., Chang, S., et al, "Morphological characteristics of thousand-kilometer-scale Es structures over China," *Journal of Geophysical Research: Space Physics*, **126**, 2021, e2020JA028712, doi:10.1029/2020JA028712.

2. Sun, W., Hu, L., Yang, Y., Zhao, X., Yang, S., Xie, H., et al., "Occurrences of regional strong Es irregularities and corresponding scintillations characterized using a high-temporal resolution GNSS network," *Journal of Geophysical Research: Space Physics*, **126**, 2021, e2021JA029460, doi:10.1029/2021JA029460.