EGU21-1864
https://doi.org/10.5194/egusphere-egu21-1864
EGU General Assembly 2021

The evolution of complex Es observed by multi instruments over low-latitude China

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Early and recent observations suggested that E-region field aligned irregularities (FAIs) related closely to the sporadic E (Es) layer of the ionosphere. The Sanya (18.3 ºN, 109.6 ºE) very high frequency (VHF) radar can operate at ionospheric irregularities mode for the detection of 3-m scale FAIs. The development of a portable digital ionosonde (PDI) which is collocated with the Sanya VHF radar can operate with temporal periods down to 1 minute, facilitating the capability of capturing the fast evolution of Es structures. But the low spatial resolution of the two kinds of instruments makes it difficult to depict the horizontal morphology of the Es structures and E-region FAIs. Since the capability of ground-based GNSS in strong Es detection was presented, it serves as a perfect supplement for the investigation of E region of the ionosphere. So comprehensive observation with multi kinds of instruments makes it possible to reveal the relationship and mechanisms of Es and E-region FAIs.

A complex daytime sporadic E (Es) case with extremely high critical frequency (foEs) was observed over the low latitude of China on 19 May 2018. Simultaneous observational results from two very high frequency (VHF) radars, two ionosondes, and multiple Global Navigation Satellite System total electron content and scintillation receivers are analyzed to investigate the evolution of the complex Es occurrence, which consisted of a relatively weak ambient Es layer (foEs < 8 MHz) and band-like strong Es structures (foEs > 17 MHz) drifting from higher latitude. The strong Es structures elongated more than 500 km in the northwest-southeast direction, drifted southwestward at a speed of ~65 m/s. VHF radar backscatter echoes were generated when the strong Es structures passed the radar field of view, with different echo patterns due to different radar and antenna configurations. No VHF radar backscatter echo was associated with the ambient Es layer.