



Investigation on the role of E-F region coupling processes on the generation of nighttime MSTIDs: Case studies over northern Germany

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Northwest to southeast phase fronts with southwestward moving features are commonly observed in the nighttime midlatitude ionosphere during the solstice months at low solar activity. These features are identified as nighttime MSTIDs (medium scale traveling ionospheric disturbances). Initially, they were considered to be a manifestation of neutral atmospheric gravity waves. Later on, investigations showed that the nighttime MSTIDs are electrified in nature and mostly confined to the mid and low latitude ionosphere. Although the overall characteristics of the nighttime MSTIDs are mostly well understood, the causative mechanisms are not well known. Perkins instability mechanism was believed to be the cause of nighttime MSTIDs, however, the growth rate of the instability is too small to explain the perturbations observed. Recently, model simulations and observational studies suggest that coupling between sporadic-E layers and other type of E-region instabilities, and the F region may be relevant to explain the generation of the MSTIDs.

In the present study simultaneous observation from OI 630 nm all-sky airglow imager, GPS-TEC, ionosonde and Meteor radars, are used to investigate the role of E and F region coupling on the generation of MSTIDs. Nighttime MSTIDs observed on three nights (14 March 2020, 23 March 2020 and 28 May 2020) in the OI 630 nm airglow images over Kuehlungsborn (54°07'N; 11°46'E, 53.79N mag latitude), Germany, are presented. Simultaneous detrended GPS-TEC measurements also shows presence of MSTIDs on these nights. In addition, simultaneous ionosonde observations over Juliusruh (54°37.7'N 13°22.5'E) show spread-F in the ionograms as well as sporadic-E layer occurrence. Furthermore, we also investigate the MLT region wind variations during these nights. The role of Es-layers and the interplay between the winds and Es-layers role on the generation of the MSTIDs will be discussed in detail in this presentation.