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Medium-Scale Travelling Ionospheric Disturbances Produced by Severe Tropospheric Disturbances in August 2023

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1 Extended Abstract

Severe tropospheric weather systems are known to be a potential source of atmospheric gravity waves which can propagate up to the height of the thermosphere. In the ionosphere these disturbances manifest themselves as travelling ionospheric disturbances of medium scale (MSTIDs), as opposed to the large scale disturbances typically associated with geomagnetic storms.

Here, we present a case study of MSTIDs observed during the passing of a tropospheric jet-front accompanied by severe convection over central Europe between 25 and 29 August 2023. Geomagnetic conditions were quiet during this period, allowing easier detection of MSTIDs which in the presence of larger, perturbations caused by geomagnetic storms can be difficult to identify.

The European region has a relatively dense network of ionospheric sensors. We use data from vertical incidence ionograms at various observatories, oblique sounding between ionosondes, Doppler sounding data, and vertical total electron content obtained from GNSS observations, as well as meteorological data. Ionosondes, Doppler soundings, and GNSS derived TEC all give information concerning different altitudes of the ionosphere. By combining and comparing these various independent data source we can form a detailed and comprehensive picture of the generation and propagation of MSTIDs produced by the tropospheric disturbances.

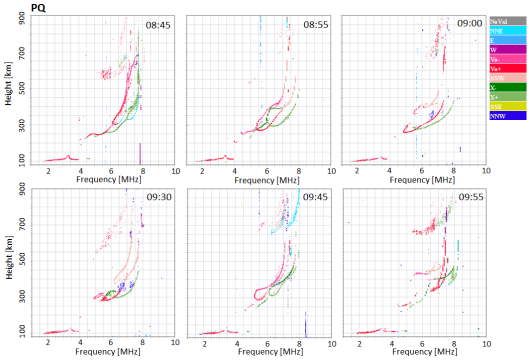

Figure 1. Ionograms from the ionosonde at Průhonice (PQ052), showing clear distortions caused by travelling ionospheric disturbances.

We were able to detect disturbances with periods from 15 to 70 minutes during several intervals in the studied period. Using the various data collections, we could gain some information about the speed and direction of propagation of the waves. We also discuss the limitations of this study, and indicate directions for future studies into the details of the generation and propagation mechanisms of tropogenic MSTIDs.