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Exploiting Digisonde observations for nowcasting and forecasting ionospheric weather

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Digisonde sounders have been proven to be powerful instruments for remote sensing the bottomside ionosphere [1, 2]. In a synchronized operation, a regional network of Digisonde stations can efficiently nowcast and forecast ionospheric large scale negative and positive storm effects, detect medium scale and large scale Travelling Ionospheric Disturbances (TIDs), while the forecasting of TIDs has been recently attempted with high degree of success [3,4].

Another major advantage of the Digisonde sounders is the real-time inversion of the virtual height echo traces to obtain the bottomside ionospheric electron density profile [5]. Complementing this directly extracted information with models for the topside scale height, the full electron density profile can be obtained in real-time [6].

Research projects recently funded by the European Commission and by the European Space Agency (TechTIDE/EC, T-FORS/EC, SWESNET/ESA), have shown that advanced data processing techniques such as spectral analysis, data assimilation, machine learning for time series forecasting, but also some more traditional approaches such as data detrending and linear regression modeling, can result to the derivation of reliable products for ionospheric weather prediction purposes. Comparative studies with relevant products resulted from the exploitation of data from other types of instruments such as GNSS receivers and Continuous Doppler Sounding Systems, reveal the real potential and the capabilities of the Digisonde-based data-products, depending on the required accuracy, the spatial coverage, and the specific type of ionospheric phenomenon under investigation.

This talk summarizes the results from recent research projects based on the exploitation of Digisonde observations for the following developments:

- detection of TIDs triggered by geomagnetic storms, earthquakes, and volcano eruptions
- nowcasting and forecasting large scale TIDs

Finally, the talk presents some recent advances in improving electron density reconstruction models based on data from the global network of Digisonde stations.

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