Identification of strong gradients and travelling ionospheric disturbances in the ionosphere using multiple instrumentation types during an ionospheric storm

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Extended Abstract

Ionospheric data assimilation methods are well established but there is still a significant barrier to achieving high spatial and temporal resolutions (tens of km and tens of seconds). This can limit the utility of data assimilation as a scientific tool for studying a disturbed ionosphere. A good solution to this is utilising multiple data sources; however this brings further challenges associated with biases in observations from individual instruments and multiple scale sizes in the observation set.

The MIDAS (multi-instrument-data-analysis-system) and IDA (ionospheric-data-assimilation) algorithms are two mathematically different approaches to assimilating multiple ionospheric data sources into a coherent picture of the 3D time dependent ionospheric electron density. Instrumentations included in this analysis/verifications are: ionospheric sounders, global navigational satellite systems, incoherent scatter radar and optical observations.

This paper brings together the two algorithms to explore the potential capability to reveal the 3D time dependent electron density field across the USA and Europe on a storm day (20 December 2015) and a quiet day (15 November 2015). The results reveal the 3D time dependent picture of the ionosphere on the quiet and the disturbed day, and provide a very detailed study into the accuracy of the results by comparing with a set of independent data. The results show the strong electron density gradients characteristic of a storm time ionosphere and also reveal the presence of travelling ionospheric disturbances. The implications for the resolution of ionospheric data assimilation algorithms and in particular the use of different observations to infer the presence of TIDs are discussed.