



Traveling Ionospheric Disturbances and Ionospheric Gradients: Implications for Radio Astronomy

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1. Extended Abstract

This talk will review ionospheric phenomena that affect measurements from the new low frequency radio astronomy arrays. For example, differential errors in phase can be introduced by large gradients in the total electron content (TEC), such as those associated with the storm enhanced density (SED) feature. To a lesser extent, differential errors are also introduced by traveling ionospheric disturbances (TIDs). Finally, small- scale electron density irregularities can cause scintillation and/or loss of ability to track radio signals. Each of these ionospheric phenomena will be illustrated using new data products available in the MIT Haystack Madrigal database. The Madrigal database is a central repository for data created by the upper atmosphere community. This database currently includes binned vertical two-dimensional Global Navigation Satellite Systems (GNSS) TEC data as a continuously updated data product. This TEC data can be downloaded every 5-minutes as a bin of 1-degree latitude by 1 degree longitude. Corresponding global TEC plots are also available every 20 minutes. Data in the Madrigal database is freely available, and the GNSS data product extends back to 2000. In 2017, a new GNSS TEC data product will be made available. Currently, on a daily basis, Madrigal downloads Global Navigation Satellite Systems (GNSS) data from ~6000 receivers worldwide and processes more than 100 million line-of-sight TEC measurements daily. This new data product will provide the individual line-of-sight TEC values at a 30-second cadence for each receiver in the network. This higher resolution data is invaluable for ionospheric modelers and for the processing of differential TEC maps that enable the visualization of TIDs. We will provide multiple examples from the Madrigal TEC database of large-scale gradients in the TEC due to SED; large-scale and medium-scale traveling ionospheric disturbances; and scintillation. We will also provide information on how to access the Madrigal database.