ON THE TESTING OF THE ELECTRON DENSITY ASSIMILATIVE MODEL (EDAM)

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Abstract:

Comprehensive, global and timely specifications of the earth’s atmosphere (particularly refractivity profiles of the troposphere and ionosphere) are required to ensure the effective operation, planning and management of many radio frequency systems. There are currently a number of groups worldwide who are actively working on systems to provide 3D images of the ionosphere. Data for ionospheric imaging may be provided by a range of measurement techniques. Of particular note is data from the International GPS Service (IGS) GPS receiver network. Some IGS stations provide data in hourly files with low latency (~90 minutes), which can be used to calculate near real-time slant total electron content (TEC). Radio Occultation (RO) methods are also being increasingly investigated. RO measurements are made by monitoring transmissions from GPS satellites using receivers on Low Earth Orbiting (LEO) satellites and provide the potential of measuring refractivity profiles in regions where ground based sensors cannot easily be located, such as deep sea waters. This paper will describe the Electron Density Assimilative Model (EDAM), developed at QinetiQ in the UK. EDAM has been developed as a compromise solution to the ionospheric imaging problem that, in terms of complexity, lies somewhere between the full physical model data assimilation systems and the more data driven tomographic solutions. As such, it uses a median model for its background model, but does allow the analysis and background error covariance matrix to evolve in time. EDAM is routinely run using input data from the IGS network of GPS stations and from the USAF vertical ionosonde network. It is also capable of ingesting other integrated TEC data such as from radio occultation instruments as well as in-situ measurements of electron density.This paper will describe the testing of the EDAM electron density grids against independent validation data. The validation data includes critical frequencies from vertical ionosondes, in-situ measurements from CHAMP and TEC data from JASON-1. Furthermore a chirp sounder has also been operated on a path between the UK and Rome during the test period and has been used to measure the channel’s maximum usable frequency. A ray tracing programme has then been used in conjunction with the 3D ionospheric images to simulate oblique ionograms, which have then been compared with the measured truth data.As different ionospheric imaging techniques are developed, it will become increasingly important to undertake studies to compare performance between different models as well as to assess performance against independent ionospheric data. Therefore, it is also hoped to present results from comparative testing conducted under the auspices of the URSI working group G4 (Ionospheric research to support radio systems) if such data is available.