NOWCASTING AND DELIVERY SYSTEM FOR IONOSPHERIC ELECTRON DENSITIES AND SCINTILLATION GROWTH RATES

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This paper describes an operational system sponsored by the US Air Force for generating and distributing near real-time three-dimensional ionospheric electron densities and corresponding GPS propagation delays. The system adapts technologies developed and routinely used for operational weather forecasting in order to nowcast and forecast ionospheric conditions. It consists of two parts: a first-principles numerical model of the ionosphere and a data assimilation component.

The core ionospheric model solves plasma dynamics and composition equations governing evolution of density, velocity and temperature for 7 ion species on a fixed global three-dimensional grid. It uses a realistic model of the Earths magnetic field and solar indices obtained in real time from the NOAA Space Environment Center. While the core model is capable of delivering realistic results, its accuracy can be significantly improved by employing a special set of numerical techniques known as data assimilation. These techniques originated in and are currently used for numerical weather forecasting. The core ionospheric model is continuously fed real-time observational data from a network of reference GPS ground stations. This improves both the nowcast and the forecast.

We believe that given advances in computing power and increases in the number of real-time ionospheric measurements, forecasting ionospheric conditions with systems similar to the one described here will become routine in the very near future. This article aims to give a high-level overview of system principles, design, and operations as well as present current data delivery mechanisms based on SOAP/XML web services. Additionally, we describe extensions of the model to scintillation growth rates forecasting and the impact of intense solar activities. Web-based access to the system is provided to early users for validation and exploration purposes at http://www.fusionnumerics.com/ionosphere

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