

## VALIDATION OF THE 4D IMAGING ALGORITHM IDA3D

Bust, G.S., Garner, T.W., Taylor, B.

Applied Research Laboratories, The University of Texas at Austin  
(ARL:UT), University of Texas at Austin

Abstract Submission Form

2006 National Radio Science Meeting

Abstract: bust18983

Date Received: September 18, 2005

Recently, several new methods have been developed to specify and/or predict ionospheric electron densities over large spatial and temporal regions. These methods have applicability both towards Space Weather modeling and forecasting, and towards helping in the understanding of what physical phenomena is responsible for the observed electron densities. Some of these algorithms are true data assimilation models that combine data directly with first principle models. Other algorithms, such as 4D ionospheric imaging algorithms, more directly use the data to specify or image the electron density. In order for these new imaging techniques to be useful they must be validated against independent data sets. This is particularly true when 4D imaging results are used to constrain first principle models and assist in determining what is the underlying physics. For such cases it is necessary that an accurate estimate of the error on the imaging be provided.

In this presentation we present the current status of our continuing validation of the 4D ionospheric imaging algorithm Ionospheric Data Assimilation Three Dimensional (IDA3D). In order to validate IDA3D we have selected analysis days that represent solar minimum and maximum conditions; summer, winter and equinox; and low and high geomagnetic activity levels. We compare the IDA3D results to climatology and to first principle ionospheric models. As independent data sets we use incoherent scatter radar (ISR) observations of electron densities, in-situ observations of electron density from the CHAMP satellite, and total electron content (TEC) observations from TOPEX. We analyze the accuracy of IDA3D both through direct comparisons with the independent data, and through a skill score calculation that measures the relative improvement IDA3D provides over climatology.

The skill score is defined as

$$S = 1.0 - \frac{\langle |\vec{D} - \vec{T}| \rangle}{\langle |\vec{M} - \vec{T}| \rangle}. \quad (1)$$

Where  $\vec{D}$  is the array of metric values output from IDA3D,  $\vec{T}$  is the independent measurements of the metric that serve as "truth", and  $\vec{M}$  is the array of climate predictions of the metric values. The skill is a function of time in the sense that every time IDA3D is improved a new skill score is generated. The values of the skill score range from 1.0 for when the data assimilative model is perfect (that is agrees with the measurements), to 0.0 when the data assimilative model is no better than the climate predictions, to negative infinity as the data assimilative model does much worse than climate.

We will present results of how well IDA3D estimates electron density and TEC in terms of an absolute measure of error and the relative skill score for the different days described above. This analysis of the accuracy of IDA3D is a first step towards fully quantifying the error on imaging algorithms.

1. (a)

Gary Bust

10000 Burnet

Austin, TX

78758 USA

gbust@arlut.utexas.edu

(b) 5128353623

(c) 5128353808

2. G - Ionospheric Radio and Propagation

3. (a) S-G4

4. C - Contributed Paper

5. No special instructions