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THE RELATIVE UTILITIES OF DATA ASSIMILATED BY GLOBAL ASSIMILATIVE IONOSPHERIC MODELS

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Summary: This paper presents an approach for assessing the relative utilities of various data types used by global assimilative ionospheric models.

1 INTRODUCTION

Current global ionospheric models can assimilate data of multiple types from multiple sources to provide a real-time, 3-D, specification of electron density. However, all data types are not equally useful. To obtain estimates of the relative utilities of the different types, we use an equation similar to the Drake equation which attempts to estimate the number of advanced technological communicable civilizations in the galaxy at any one time.

2 DISCUSSION

This paper discusses an approach to assessing the relative utilities of the data types that are assimilated by global models of the ionosphere such as the Utah State University GAIM-GM model, which is used operationally by the Air Force Weather Agency. The general objective of this class of models could be stated as “to specify accurate vertical electron density profiles (EDPs) that can provide temporal and spatial representation of ionospheric features with scale sizes approximately equal to the size of the grid cells and dynamics up to half the data sampling rate.”

We used this definition: An assimilation data type will have maximum utility if it provides a reliable observation and estimate of its uncertainty, with no latency, of a quantity that is relevant to providing the electron density in each model grid cell at each model epoch, for the current version of the model.

To provide an approximate ranking of data types, we have developed an equation wherein values for several attributes are assigned to each data type. The attributes include data quality, correlation length, relevance (to the Objective EDPs), and latency. Clearly, the resultant ranking depends critically on the procedures used for obtaining the values assigned to these attributes.

Approaching the data utility issue from the global perspective, we have defined an initial set of values for the attributes based on data sources available today. In this initial ranking, we found that the data type with the greatest utility, i.e., the one that contributes most to the objective, was ground-based observations of slant TEC (STEC) made using GPS satellites. We found in situ observations made on board scientific satellites to be at the opposite end of the spectrum of utility. Factors that drive down the utility of such observations include (a) the observations have limited spatial and temporal coverage, (b) the observations provide just one point on a 1500 km profile, and (c) the observations may arrive at the modeling site with data latencies of ~90 minutes. However, one mitigating attribute is that *in situ* observations made over ocean areas have an intrinsic merit because they are one of the few data types available there.

We will discuss in detail our equation, the chosen attributes, and our initial process for assigning values to the attributes. We will also indicate how results may vary for alternate processes and data application perspectives.

CONCLUSIONS

The Grouse equation, modeled on the Drake equation used for SETI, was used to rank the relative utilities of the data types that are assimilated by global assimilative models of the ionosphere. We found the data types with the highest utility to be ground-based GPS slant TEC, and satellite-based GPS Radio Occultation. Estimates were made for the values of seven attributes assigned to each of ten data types. Many of these estimates are somewhat subjective, and other scientists are encouraged to critique the Grouse equation as presented here.