A NEW ASSIMILATIVE MODEL FOR INTERMEDIATE SCALE IONOSPHERIC STRUCTURE

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An assimilative model for ionospheric particle density structure must include deterministic and stochastic components:

$$N(\mathbf{r},t) = \overline{N}(\mathbf{r},t)\left(1+\delta N(\mathbf{r},t)/N_0\right)$$

The component $\overline{N}(\mathbf{r},t)$ can be generated or assimilated with a physics based model. For radio diagnostics this is the TEC component. The spatial large-scale range is hundreds of kilometers to many kilometers with long lifetimes. The stochastic component $\delta N(\mathbf{r},t)/N_0$ is a fractional modulation that cannot be predicted in detail. The intermediate scale range from tens of kilometers to hundreds of meters is persistent to the extent that it can be considered frozen over typical measurement intervals. Small-scale structure below a few hundred meters is associated with enhanced plasma-waves that require more detailed characterization. In this paper only intermediate scale structure will be considered.

Developed intermediate scale structure is characterized by the intensity of spatial Fourier components, typical with inverse power-law dependencies. Such a spectral characterization is an integral part of the statistical theory of scintillation, which relates signal correlation measures to the spectral characteristics. However, standard methods of generating structure realizations do not constrain the fluctuations to conform to known physical field-aligned characteristics of plasma density structure, which is non-negative with an asymmetric size distribution. An ideal physical model must constrain the structure while preserving the known spectral characteristics.

We will demonstrate a configuration-space model derived from random distributions of field-aligned *striations*. Striations are defined by a cross-field size parameter, σ_k, an on-axis fractional strength, F_k, and a data-space intercept defining the location of the striation. For a random distribution of striations there is an analytic relation between σ_k and F_k that map to an inverse power law in the spectral domain. The model is fully three-dimensional. However, the stochastic structure comes only from cross field variations. Such relations are well known is physical processes that involve non-linear generation of structure distributions. A classic example is the particle distribution in an avalanche.

For assimilative modeling, configuration space models provide a highly efficient means of populating a data space. The parameter constraints that lead to inverse power-law spectra can be measured as size and fractional strength distributions. Such measures are routinely used to classify non-linear structure distributions in other fields of physics. A study of the propagation sensitivity to conventional structure realizations and configuration space realizations is in progress. Results will be reported at the meeting.