MID-LATITUDE COHERENCE BANDWIDTH ESTIMATIONS FROM TRANSIONOSPHERIC VHF SIGNALS

Roussel-Dupre, R. A. , Huang, Z.
Atmospheric, Environmental and Climatic Dynamics Group, Earth and Environmental Sciences Division, Los Alamos National Laboratory

Broadband radio signals with spectral content in the VHF can experience significant temporal and spatial distortion as a result of propagation through electron density perturbations in the ionosphere. While the most intense effects are observed in the equatorial and polar regions, an understanding of such effects at mid-latitude is crucial in view of our increased reliance on space-based communication and navigation systems which are vulnerable to mid-latitude ionospheric scintillations. The coherence frequency bandwidth is an important parameter that describes the characteristics of the signal distortion in time and represents the primary method for characterizing ionospheric structure by means of transient signals measured at a single satellite. This study examines the likely occurrence of ionospheric scintillations of the broadband VHF signals (30-100MHz) from the Los Alamos Portable Pulser (LAPP) received by the FORTE (Fast Onboard Recording of Transient Events) satellite during the period of 1997-2002. The scintillation characteristics, the mean time delay and its standard deviation of the transionospheric signals, are analyzed and the coherence frequency bandwidths are calculated using the thin phase-screen approximation in which the thick scattering layer is simplified by an equivalent thin phase-screen with infinitesimal thickness and the same overall phase variance. The variations of coherence bandwidth at Los Alamos with the changes in local time, season, solar activity, and geomagnetic conditions are described. The results are compared with the values estimated from a wideband scintillation model (WBMOD) and those from other mid-latitude coherence bandwidth studies. Selected case studies are conducted to demonstrate the 4th power relationship between the signal frequency and the coherence bandwidth. The uncertainties related to the FFT spectrogram based algorithm are discussed for a range of FFT windowing sizes and the appropriate values are validated through an independent wavelet-based algorithm. Preliminary case studies on the coherence bandwidth at equatorial regions are presented using FORTE lightning data to illustrate the reasonable differences in the coherence bandwidth between the mid-latitude and the equatorial region as indicated in previous literatures.

Abstract Submission Form

2004 National Radio Science Meeting

Abstract: huang22246

Date Received: September 24, 2004

1. (a)
Zhen Huang
Atmospheric, Environmental and
Earth and Environmental Science
Los Alamos National Laboratory
Los Alamos, NM
87545 USA
zhen_huang@lanl.gov

(b) 505-667-4579

(c) 505-665-3415

2. G - Ionospheric Radio and Propagation

3. (a)

4. C - Contributed Paper

5. No special instructions