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Predicting HF TID Signatures with GPS

Abstract:
Despite the availability of satellite systems and mobile phone technology, the use of high frequency (HF) radio signals for communications and over-the-horizon (OTH) surveillance persists and continues to increase in many parts of the world. The ionosphere serves as the reflecting layer that enables the long-distance capabilities of these HF technologies. Although the mid-latitude ionosphere is generally stable, a variety of phenomena generate small scale variations in the electron density causing dramatic changes in HF radio wave paths.

In this effort we use simple GPS sensors to characterize small-scale ionospheric disturbances to predict HF propagation effects. Our approach is based on the recently demonstrated capability of GPS sensors to detect medium-to-large scale ripples or waves known as traveling ionospheric disturbances (TIDs). TIDs represent one of the most challenging sources of HF propagation errors and are unfortunately equally challenging to model and predict. Combining GPS and oblique HF link observations allows us to unambiguously quantify the correlation between GPS TID signatures and HF propagation perturbations.

Given that GPS measurements are the most widely available real-time space environment data in the world, the potential pay-off for HF prediction applications is enormous. Preliminary comparisons between GPS TID characterization and single-hop HF propagation perturbations will be presented.

The results show that GPS provides sufficient sensitivity to detect perturbations that affect HF propagation, but quantitative correlations are relatively noisy and probably depend on the details of the observing geometry and the TID characteristics.