118 -- 2017-03-09 11:48:58
Session 3A Paper 2
Vadym V. Paznukhov[1], David Altadill[2], Charles S. Carrano[1], Keith M. Groves[1], Dwight T. Decker[1]
(1) Institute for Scientific Research, Boston College, 140 Commonwealth Ave., Boston, MA, 02467, USA
(2) Observatori de l'Ebre (OE), CSIC - Universitat Ramon Llull, SPAIN

Ionospheric tilt measurements: climatology and applications for HF Geolocation

Ionospheric vertical incidence sounders are capable of measuring tilts, which are a measure of horizontal gradients in the ionosphere. Digisondes routinely make skymap measurements, which represent a set of angles of arrival for each reflection point of the ionosphere, from which tilts are derived by computing a representative "mean" point of the reflection of HF waves.

In a frame of IARPA HFGeo we took advantage of the tilt measurements for improving HF geolocation using ROAM data assimilative model (see paper by Carrano et al.,).
Here we illustrate the reliability of the digisonde tilt measurements by comparing the expected angles of arrival (AoA) measurements calculated using simple "mirror model" as well as 3D raytracing to the real AoA measurements on a corresponding HF link. The accuracy of the AoA prediction and sources of errors are discussed.

Digisonde at Ebro station in Spain routinely measures ionospheric plasma drift and tilts. Analysis of the tilt measurements made in 2012-2015 is presented. The emphasis is put on observing the wave-like processes, e.g., Travelling Ionospheric Disturbances (TIDs) using the tilt measurements. These irregularities are one of the major sources of errors in HF Geolocation. Spectral analysis with Lom-Scargle method is used to identify the presence and exact periods of TIDs. The tilts are represented in terms of Norts-South and East-West components with the instrumental biases removed. Daily trends in the tilts are subtracted with the running average window. Still, however, it is not possible to completely eliminate the effect of the sunrise, and during this period the spectral analysis is the least reliable.

Using several years of observations a climatological distribution of the TIDs is established. Most of the TIDs appear after the sunrise and have major periods of 30 min to 1.5 hours. These characteristics are typical for middle-scale TIDS (MSTIDS). Summertime appears to have the most frequent occurrence of the TIDs. Direction of propagation of the TIDs is estimated from the dominant azimuthal angle of the titlt variations associated with TIDs. Long-term patterns in the TID propagation direction are also analyzed and compared to the direction to the subsolar point. There are indications that TIDs tend to propagate in the sunward direction, which suggest a link to the neutral wind direction. This is also an indication that most of the TIDs observed originate in the troposphere.

Recommendation for the operational use of the tilt measurements for the HF geolocation are given.