Geophysical Research Abstracts
Vol. 16, EGU2014-6947-1, 2014
EGU General Assembly 2014

Three-dimensional measurements of traveling ionospheric disturbances with the Wallops Island Dynasonde

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Dynasonde is a method of precision ionospheric radio sounding which is based on detection of radio echoes (multiple radio reflections from irregular ionospheric plasma) in a broad frequency range (1-20 MHz) and on processing of a list of their parameters (range, angles of arrival, polarization, line-of-sight Doppler speed, amplitude). A component of Dynasonde data analysis software, the inversion procedure NeXtYZ attributes plasma density values, Doppler speed values and tilts to the altitudes in real space. The inversion procedure possesses of necessary accuracy and sensitivity for the tasks of visualizing and measuring wave activity in the upper atmosphere (between the base of the E layer and the maximum of F layer). Plotting of the plasma density variations, tilts and Doppler values in time vs real altitude axes reveals appearance and dynamics of the traveling ionospheric disturbances (TID) phase fronts. Further processing of NeXtYZ output yields comprehensive set of TID parameters (both vertical and horizontal): spectral composition, three wavevector components, phase speed, and direction of propagation. Comparable set of parameters may be obtained only from incoherent scatter radar with scanning capability. We use the Dynasonde technique to study the dynamics and the spectral composition of TIDs over the United States east coast location. We provide initial results on statistics of the direction of propagation of prevailing harmonics in TID spectra. We examine correlation between tropospheric winds and storms and generation of the TIDs. The emphasis in this presentation is done on methods that may be applied in time domain.