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Spectral Characteristics of Ionospheric Plasma Density and Tilt Variations from the Dynasonde Data

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Unique capabilities of the Dynasonde technique of ionospheric radio sounding allow measuring echo ranges and angles of arrival with high precision. The inversion algorithm NeXtYZ, which is a part of the Dynasonde data analysis package, uses this information to restore parameters of a three-dimensional plasma density distribution over the sounder location, including its vertical cross-section (vertical profile) and tilts of constant electron density surfaces as functions of the true altitude. With a month-long data series from a state-of-the-art Dynasonde installation at Wallops Island, VA, we demonstrate how results of this analysis can be used to study temporal spectral characteristics of the wave disturbances at a wide range of mesospheric and thermospheric altitudes. Spectra describing dominant activity at low frequencies are determined from observations over large time periods. Also, the time evolution of high-frequency (up to 4 mHz) components is studied using a short ($\sim$2 hours) sliding window spectral calculation technique. The procedure has a relatively high sensitivity level and an estimate of it is provided. Possible sources of variability at all frequencies are investigated. Some spectral features have clear sources, such as tidal effects. Both the diurnal peak and its higher harmonics are clearly visible in our results. Other parts of the spectra have less obvious sources that may include interactions of a wind with orography and a coupling with wave motions in the ocean and/or seismic activity in the crust. We discuss likely causes for features such as the increased activity in the East-West direction compared to activity in the North-South direction at the Wallops location.