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Perturbations to the neutral atmosphere caused by acoustic gravity waves at thermospheric altitudes as obtained from Dynasonde data

Catalin Negrea (1,2,3), Nikolay Zabotin (1,2), and Terry Bullett (4)

(1) Department of Electrical, Computer and Energy Engineering, University of Colorado at Boulder, USA (negreacatalin@gmail.com), (2) Cooperative Institute for Research in Environmental Sciences, University of Colorado at Boulder, USA, (3) NOAA/SWPC, Boulder, Colorado, USA, (4) NOAA/NGDC, Boulder, Colorado, USA

Gravity waves are known to have a major impact on the dynamics of the thermosphere-ionosphere. A number of recent studies addressed the issue of determining the characteristics of thermospheric gravity waves and associated Travelling Ionospheric Disturbances and also their impact on the background system. However, there are currently no methods that would allow for the continuous and uninterrupted study of both the spatial and temporal characteristics of gravity wave activity over a broad range of thermospheric altitudes. We present results obtained using Dynasonde measurements of electron density and ionospheric tilts. The data covers the bottom E- and F-Layers and implicitly contains information on induced perturbations in the horizontal plane at all accessible altitudes. The methodology that we developed is largely automated, allowing for the analysis of large amounts of data. A model of the thermosphere-ionosphere coupling is implemented to infer neutral atmosphere parameters from ionospheric measurements. This is done by accounting for ion-neutral interactions, changes to chemical composition due to wave propagation and the effect of the geomagnetic field. Background neutral temperature, neutral density and neutral composition are used from a numerical model. A sample dataset from October 24th at Wallops Island, Virginia is used to illustrate our approach. The frequency, wavevector components, group velocity, phase speed and amplitude of induced thermospheric and ionospheric perturbations are obtained. These include the TID amplitude as well as the underlying gravity wave amplitude in neutral density, temperature and zonal and meridional winds.