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Understanding the Response of the Ionosphere to Atmospheric Waves Generated by Tsunamis and Other Geophysical Disturbances

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We present results from the coupling of the ground-to-space atmospheric spectral gravity wave model of Drob et al., (2012) with the SAMI3/ESF first-principles ionosphere model of Huba et al., (2009). This coupled physics-based simulation capability provides a means to explore, understand, and characterize the various factors that determine the response of the ionosphere to atmospheric gravity waves generated by tsunamis and other geophysical seismo-acoustic phenomena. These factors include; 1) the wavelength, frequency content, and propagation direction of the ocean/ground motion; 2) the seasonal and geographic factors which determined the anisotropic atmospheric background wind filtering and thermospheric gravity-wave dissipation processes; 3) the seasonal, geographic, local-time, and solar flux conditions that determine the background electron density and ionosphere conductivity profiles; and 4) the relationship of the atmospheric perturbations with respect to the geomagnetic field. For example, by comparing the results of simulations with and without gravity wave-perturbations we explore the effect of zonal, meridional, and vertical gravity wave wind perturbations across a range of geomagnetic latitudes (and thus geomagnetic pitch angle) to the resulting plasma velocity perturbations along the corresponding geomagnetic fields lines, as well as to the subsequent perturbations of total electron content (TEC). For comparable atmospheric gravity wave amplitudes, we find TEC variations of $\sim$ +/- 0.1TECU (1 TECU = 10̂16 m̂2) which are consistent with observations made during the 11 March 2001 tsunami. This work sponsored by the Office of Naval Research.