Geophysical Research Abstracts
Vol. 16, EGU2014-2305, 2014
EGU General Assembly 2014

Infragravity waves in a compressible ocean with a compliant seafloor

Oleg Godin (1,2)

(1) CIRES, University of Colorado, (2) NOAA/ESRL, PSD, Boulder, United States (oleg.godin@noaa.gov, (1) 303-497-5862)

Infragravity waves are surface gravity waves in the ocean with periods longer than the longest period (∼30s) of wind-generated waves. Away from shores, infragravity waves propagate transoceanic distances with very little attenuation and, because of their long wavelengths, provide a mechanism for coupling wave processes in the ocean, ice shelves, the atmosphere, and the solid Earth. In addition to transient events such as tsunamis, there exists a background infragravity wave field away from shore, which provides the signal to probe the shear rigidity deep into the ocean bottom via seafloor compliance measurements. Propagation of infragravity waves is usually studied by modeling the ocean as an incompressible water layer between a free surface and a rigid seafloor. Recent deep-water observations of tsunamis with satellite altimeters, seafloor pressure sensors, and GPS buoys have revealed that tsunami travel times are ∼1% longer than predicted by available numerical models. These observations have renewed the interest in investigations of the effects of water compressibility, density stratification, seafloor compliance, Earth's rotation, and ocean currents on the dispersion equation of the infragravity waves. Here we show that all these effects can be quantified in a rigorous, and yet rather straightforward, manner by applying to infragravity waves a recently developed perturbation theory for normal modes of acoustic-gravity waves. The perturbation theory takes advantage of the fact that the standard, incompressible model provides a good first approximation to the infragravity waves in the real ocean. Explicit, intuitive, and rather general expressions are obtained for the deviation of the infragravity wave dispersion equation from the standard model in an ocean of constant depth. In a number of particular cases, results of other authors are recovered. Theoretically predicted travel-time corrections are of the same order of magnitude as the observed discrepancies. Relative significance of the corrections due to the water density stratification, water compressibility, the Earth's rotation, and interactions with the seafloor and the atmosphere depends on infragravity wave frequency and the ocean depth. Additional travel time corrections, which can result from bathymetry variations and are not captured by ray tracing, are indicated.