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Analysis and numerical modeling of the global free infra-gravity wave climate for the SWOT mission

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All sea level variations of the order of 1 cm at scales under 30 km are of great interest for the future Surface Water Ocean Topography (SWOT) satellite mission. That satellite should provide high-resolution maps of the sea surface height for analysis of meso to sub-mesoscale currents, but that will require a filtering of all gravity wave motions in the data. Free infragravity waves (FIGWs) are generated and radiate offshore when swells and/or wind seas and their associated bound infragravity waves impact exposed coastlines. Free infragravity waves have dominant periods comprised between 1 and 10 minutes and horizontal wavelengths of up to tens of kilometers. Given the length scales of the infragravity waves wavelength and amplitude, the infragravity wave field will can a significant fraction the signal measured by the future SWOT mission. In this study, we analyze the data from recovered bottom pressure recorders of the Deep-ocean Assessment and Reporting of Tsunami (DART) program. This analysis includes data spanning several years between 2006 and 2010, from stations at different latitudes in the North and South Pacific, the North Atlantic, the Gulf of Mexico and the Caribbean Sea. We present and discuss the following conclusions: (1) The amplitude of free infragravity waves can reach several centimeters, higher than the precision sought for the SWOT mission. (2) The free infragravity signal is higher in the Eastern North Pacific than in the Western North Pacific, possibly due to smaller incident swell and seas impacting the nearby coastlines. (3) Free infragravity waves are higher in the North Pacific than in the North Atlantic, possibly owing to different average continental shelves configurations in the two basins. (4) There is a clear seasonal cycle at the high latitudes North Atlantic and Pacific stations that is much less pronounced or absent at the tropical stations, consistent with the generation mechanism of free infragravity waves. Our numerical model uses the energy balance equation, used for large scale models of swells and wind-waves, extended to periods of 100 s. The source of FIGWs energy is treated like coastal reflection (Ardhuin and Roland 2012). The amount of FIGW energy at the shoreline is crudely represented as a constant fraction of the incoming bound wave energy. The spatial and temporal variability of the modeled FIGW energy is similar to that in data from DART stations. Future work will include an estimation of seismic noise sources of hum, following the method of Ardhuin et al. (2011), in order to use the global seismic network for the validation of FIGW energy levels.