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Infragravity waves in the ocean as a source of acoustic-gravity waves in the atmosphere

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Infragravity waves (IGWs) are surface gravity waves in the ocean with periods longer than the longest periods ($\sim$30s) of wind-generated waves. IGWs propagate transoceanic distances with very little attenuation in deep water and, because of their long wavelengths (from $\sim$1 km to hundreds of km), provide a mechanism for coupling wave processes in the ocean, ice shelves, the atmosphere, and the solid Earth. Here, we build on recent advances in understanding spectral and spatial variability of background infragravity waves in deep ocean to evaluate the IGW manifestations in the atmosphere. Water compressibility has a minor effect on IGWs. On the contrary, much larger compressibility and vertical extent of the atmosphere makes it necessary to treat IGW extension into the atmosphere as acoustic-gravity waves. There exist two distinct regimes of IGW penetration into the atmosphere. At higher frequencies, one has surface waves in the atmosphere propagating horizontally along the ocean surface and prominent up to heights of the order of the wavelength. At lower frequencies, IGWs are leaky waves, which continuously radiate their energy into the upper atmosphere. The transition between the two regimes occurs at a frequency of the order of 3 mHz, with the exact value of the transition frequency being a function of the ocean depth, the direction of IGW propagation and the vertical profiles of temperature and wind velocity. The transition frequency decreases with increasing ocean depth. Using recently obtained semi-empirical model of power spectra the IGWs over varying bathymetry [Godin O. A., Zabotin N. A., Sheehan A. F., Yang Z., and Collins J. A. Power spectra of infragravity waves in a deep ocean, Geophys. Res. Lett., under review (2012)], we derive an estimate of the flux of the mechanical energy from the deep ocean into the atmosphere due to IGWs. Significance will be discussed of the IGW contributions into the field of acoustic-gravity waves in the atmosphere.