Geophysical Research Abstracts
Vol. 13, EGU2011-4410, 2011
EGU General Assembly 2011

An Experiment on the Non-Breaking Surface-Wave-Induced Vertical Mixing

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Mixing induced by non-breaking surface waves was investigated in a wave tank by measuring the thermal de-stratification rate of water column. One experiment without waves and four experiments with waves of amplitude ranging from 1.0 to 1.5 cm and wavelength from 30 to 75 cm were conducted. Water temperature variations at distances from 4 down to 12 cm were measured. In the layer from 4 to 7 cm, the originally dense isothermal lines disperse soon after the waves are generated, while the vertical gradient from 9 to 12 cm is maintained for a relatively long time. The time span during which the water temperature becomes well-mixed changes from about 20 hours without the waves to tens of minutes with the waves, and it decreases with increasing wave amplitude and wavelength. One-dimensional diffusion model with wave-induced mixing parameterization shows consistent results with the measurement. The study demonstrates that the mixing induced by non-breaking waves may add an important contribution to the vertical mixing process in the upper ocean and suggests a way to parameterize wave-induced mixing in numerical ocean models.