Geophysical Research Abstracts
Vol. 17, EGU2015-2242-2, 2015
EGU General Assembly 2015

In-Situ Estimates of tidal mixing in the Indonesian archipelago from multidisciplinary data

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The Indonesian Mixing program (INDOMIX) was designed to quantify the very strong mixing that transforms Pacific waters into homohaline Indonesian Waters in the Indonesian archipelago. The turbulent dissipation rates and associated mixing were estimated and analyzed using a multidisciplinary approach that combines physical and geochemical observations: 1) direct measurements of the dissipation using a microstructure profiler, 2) use of density-based fine-scale methods, and 3) study of the vertical distribution of natural radionuclides (radium isotopes and actinium-227). Data were collected at five contrasting stations within the Indonesian archipelago.
Strong instabilities, inversions of the density profiles and a very strong water mass transformation were observed. A wide range of values is obtained for dissipation within [10-10, 10-4] W.kg-1 with spots of higher dissipation in the ocean interior correlated with a strong internal tide signal. Both Fine-scale and micro-scale methods allow us to identify very strong dissipation energy levels above the straits, ranging within [10-7, 10-4] W.kg-1, in contrast to lower values at stations far from generation sites. However, the dissipation in the interior water column for the station located in the center of Halmahera [10-9, 10-8] W.kg-1 is stronger than for the Banda station [10-11, 10-10] W.kg-1, which is further away from generation sites. The three approaches agree relatively well and provide Kz values ranging between 5 10-4 and 5 10-1 m2.s-1, except in the Banda Sea where values are similar to the ones found in the open ocean (10-6 m2.s-1). Kz values mainly increase toward the bottom, where stratification decreases. Surface mixing, at the base of the mixed layer is found to be still very strong with values within [10-4, 10-3 m2.s-1]. These results confirm the results of modelling studies, in which hypothesis of intensified subsurface mixing were made, a mixing that strongly modifies the whole tropical mean state and variability. We conclude, therefore, that climate models need to take into account this intensified ocean mixing to properly represent the mean state of the atmosphere and its climate variability.