Internal tides and associated vertical mixing in the Indonesian Archipelago

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Tidal mixing in the Indonesian Archipelago contributes to regulation of the tropical atmospheric circulation and water-mass transformation in the Indonesian Throughflow. The present study quantifies the vertical diffusivity in the Indonesian Archipelago by driving a high-resolution three-dimensional numerical model and investigates the processes of internal tide generation, propagation, and dissipation. The numerical experiment shows that M_2 internal tides are effectively generated over prominent subsurface ridges. The conversion rate from M_2 barotropic to baroclinic energy over the whole analyzed model domain is estimated to be 85.5 GW. The generated internal tides dissipate 50 –100% of their energy in close proximity to the generation sites (“near-field”), and the remaining baroclinic energy propagates away causing relatively large energy dissipation far from the generation sites (“far-field”). The local dissipation efficiency q, therefore, has an extremely nonuniform spatial distribution, although it has been assumed to be constant in the existing tidal mixing parameterization for the Indonesian Archipelago. Compared with the model-predicted values, the existing parameterization yields the same order of vertical diffusivity averaged within the Indonesian Archipelago, but significantly overestimated (or underestimated) vertical diffusivity in the near-field (or the far-field). This discrepancy is attributable to the fact that the effects of internal wave propagation are completely omitted in the existing parameterization, suggesting the potential danger of using such parameterized vertical mixing in predicting the distribution of SST as well as water-mass transformation in the Indonesian Seas.

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