Non-hydrostatic simulations of tidally-induced mixing in the Halmahera Sea: A possible role in the transformation of the Indonesian Throughflow waters

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The Indonesian Throughflow (ITF) carries the relatively warm and saline Pacific waters into the Indian Ocean. These waters are significantly transformed while passing through the Indonesian Archipelago and eventually influence the large-scale ocean circulation such as Agulhas and Leeuwin Currents. Most OGCMs are, however, incapable of reproducing the transformation of the ITF waters, since tidal forcing is neglected in such models.
In the present study, we focus on the Halmahera Sea where the saline bias of the existing OGCMs is most significant. In order to clarify the physical mechanisms that control the water-mass transformation in the Halmahera Sea, we first drive a high-resolution (dx, dy ~ 180 m) non-hydrostatic three-dimensional numerical model incorporating realistic tidal forcing and bathymetric features. On the basis of the calculated results, we next evaluate each of the effects of tidally-enhanced vertical and horizontal mixing on the transformation of the ITF waters. It is shown that, although the water-mass transformation is dominated by the vertical mixing induced by breaking of internal tides, non-negligible contribution is found from the horizontal mixing enhanced by the sub-mesoscale eddies resulting from tidal flow interaction with complicated land configurations.

Keywords: Tidal mixing, Indonesian Throughflow, Water-mass transformation, Sub-mesoscale eddies

