Increase of Indonesian Throughflow by internal tidal mixing in a high-resolution quasi-global ocean simulation

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The Indonesian Throughflow (ITF) is a major branch of the inter-basin exchange between the Pacific and the Indian Oceans. The ITF advects warm water from the Pacific Ocean to the Indian Ocean and plays a key role in climate variability. And, internal tidal mixing in the Indonesian Seas is considered to significantly alter water properties of the ITF, and previous studies succeeded to simulate well the water properties in the Indonesian Seas by using regional models including the tidal mixing effects.
We conducted a high-resolution quasi-global ocean simulation with a tidal mixing scheme developed by St. Laurent et al. (2002). The simulated distribution of vertical diffusivities shows large mixing penetrating upward over rough topography as seen in the observations. And the water properties in the Indonesian Seas are much improved by the scheme in the simulation. In this study, impacts of internal tidal mixing on volume transport of the ITF are examined by comparison of the simulations with and without the tidal mixing scheme.
The comparison shows that the ITF transport increased (about 0.9 Sv) by adding the scheme, which is due to the enhanced pressure gap between the Western Pacific Ocean and Indian Oceans. The sea surface height (SSH), corresponding to the pressure, raises more in the tropical Pacific Ocean than other basins. The upward penetration of large diffusivity into the thermocline is much observed over shallow rough topographies in the Tropical Pacific Ocean. The penetration changed the water properties, low density within and below the lower thermocline, and then the water property changes spread to all over the basin via Rossby wave, Kelvin wave, and advection. Correspondingly, the SSH is dynamically raised more in the Tropical Pacific, because there are much shallow rough topographies there. These results revealed that the ITF is increased by strong internal tidal mixing in the tropical Pacific Ocean.

Keywords: Indonesian Throughflow, Internal tidal mixing, Quasi-global high-resolution ocean simulation

