A quasi-global eddying simulation of OFES2 forced by JRA55-do

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Global eddying simulations at horizontal resolutions of about 10 km can shore up the observation data with coarse spatiotemporal scales, and their outputs have been commonly used to investigate various oceanic phenomena with wide spatiotemporal ranges since the early 2000s. We have conducted a quasi-global hindcast simulation at 0.1 degree horizontal resolution using a new version of OFES (OGCM for the Earth Simulator), which we call OFES2. OFES2 is forced by JRA55-do ver. 0.8 (Tsujino et al., 2018) from 1958 to 2016 and a tidal mixing scheme (St. Laurent et al. 2002) is implemented.

Some oceanic fields are improved in OFES2 compared to OFES (Masumoto et al., 2004) forced by NCEP reanalysis. The cold sea surface temperature (SST) bias in the subtropical Pacific and Atlantic Oceans (< 1°C) and warm SST bias in (patchy warmer than 1°C) in the Antarctic Ocean in OFES are much improved in OFES2 (mostly smaller than 0.5°C). Both the models moderately well represent the global map of sea surface height anomaly (SSHA) variability. The magnitude in OFES2 (OFES) is a bit smaller (larger) than the AVISO observation. The wind stress in the NCEP reanalysis is used in OFES and is estimated by using a bulk formula and relative velocity difference between 10 m wind and surface current in OFES2. The difference of SSHA variability magnitude is probably due to the difference between the wind stress estimation methods in OFES2 and OFES.

We conducted an additional sensitivity experiment without the tidal mixing scheme to examine impacts of the mixing on the model outputs. Although the scheme does not include the non-local effect, water mass properties in the Indonesian Seas are much improved by the scheme. In addition, we found that the Indonesian Throughflow (ITF) transport increases when the scheme is used. Tidal mixing decreases the density within and below the lower thermocline and rises the sea surface height (SSH). A large SSH increase occurs for the tropical Pacific, possibly because many islands exist in the tropical Pacific and tidal mixing is effective around their shallow and rough topographies. The SSH increase enhances the pressure difference between the western Pacific and the Indian Ocean and therefore the ITF transport increases.