Review of MS by Madkaiker et al

High-resolution numerical modelling of seasonal volume, freshwater, and heat transport along the Indian coast

The MS uses advanced research techniques to study transport processes along the Indian coast. The main numerical model is MITgcm model that uses high for oceanic conditions spatial resolution of 1/20° (about 3 nautical miles, ca 5 km). The model is forced with climatological initial and boundary conditions. The model was run for five-year hindcast period (2012-2016) with daily output fields. To reduce the spin-up time and computational expenditure, the model is initialized with a warm start. For this, climatological zonal and meridional currents are prescribed from the Simple Ocean Data Assimilation (SODA) 3.12.2 dataset. The model results were compared with another model, the HYCOM model which was routinely run by Indian national authority with 1/16° resolution. The developed model was validated with a number of observational products: remotely sensed GHRSST and SMOS for sea surface temperature and salinity, gridded reanalysis CORA v5.2, and GlobCurrent zonal and meridional surface currents.

The research has been conducted according to contemporary standards. The model has high resolution for the ocean basins, the results of such a setup are verified. With such a start, the analysis methods are not up-to-date and are mainly adopted from ocean-scale oceanography. The results on volume, freshwater and heat transports are of interest, but it is not clear how much they go beyond the existing knowledge presented in the introduction and other publications. The introduction states: "The broad goal of this study was to set up the MITgcm model over our domain and estimate surface and subsurface volume, freshwater and heat transports in the basin." The model was successfully set up, but this goal and the results seem too narrow for a good scientific publication. Therefore, a revision of the MS is proposed.

A. Transports due to mesoscale eddies

The model is eddy-resolving. Therefore, it is useful to get knowledge of eddy-driven fluxes, e.g. by separating the freshwater and heat transports into the mean and eddy-driven parts. There are many such studies published, for example Ding et al. (2021). The updated study could also look at freshwater plume and fronts in the northern Bay of Bengal. At the same time, comparison with routine HYCOM model should be significantly condensed, both in the figures and in the text.

Ding, R., Xuan, J., Zhang, T., Zhou, L., Zhou, F., Meng, Q. and Kang, I.S., 2021. Eddy-induced heat transport in the south China Sea. Journal of Physical Oceanography, 51(7), pp.2329-2349.

B. Reference for freshwater transport

Large rivers transport freshwater to the sea as shown in Fig. 1. Impact of river discharge is evident in Fig. 3. In the Bay of Bengal salinities below 31 g kg^{-1} extend to the large sea area from the major rivers in the north, like Brahmaputra and Ganga.

The MS does not provide information where the salinity reference value 34.83 psu comes from and what are the justifications behind. The cited study by Stammer et al. (2003) does not define fixed reference salinity. From the references in the latter paper, Wijffels et al. (1992) present overall frame for flux calculation through the defined cross-sections. They also separate the transports due to the mean velocity and salinity values over the sections, and the component due to their variations within the section (see also comment A). Some key to the salinity reference value can be found in Rainville et al. (2022) who indicate that in an earlier study that 34.83 g kg^{-1} has been found as a mean salinity of the (open) Indian Ocean. The present MS gives 34.83 psu that is not correct adoption from the mentioned paper, since 34.83 g kg^{-1} = 34.67 psu.

The issue of reference salinity should be reconsidered.

C. Angles of the coast

There is strong misunderstanding in lines 167-168 and 173-174 that establish different equations (1)-(2) and (3)-(4) for calculation of alongshore and cross-shore current components at different coasts. In mathematics, angle definitions and equations for projections of the vectors are uniform, but the angle values are different. Strict mathematical approach should be used for defining the vector components.

One approach could be following. In any point of the "coastal" curve surrounding the land anticlockwise, we can draw the tangent vector to the curve at that point. The normal vector is then at right angles to the curve, so it is also at right angles (perpendicular) to the tangent. If extended trigonometry is needed, then it could be moved to an appendix.

D. Structure of the MS

The goals in the Introduction should be improved and clearly spelled out. There should be more oceanography than new setup and validation of the model. Discussion could be moved into the separate chapter, presently it is not easy to read. Summary (perhaps Conclusions) could be cleared from general statements, like "Ultimately, this work contributes significantly to our understanding of oceanic dynamics, paving the way for more nuanced research into the productivity and ecological aspects of this region."

There are also some technical comments.

1) Line 72: Abbreviation NC-HYC appears without explanation. For sequential reading it does not help that it is explained later in Line 124.

2) Line 78: Axis of Fig. 1 are not defined. Also, for Figs. 2 to 11.

3) Lines 171-172: References to Amol et al. (2014) and Mukherjee et al. (2014), are they needed?

4) Line 176: Definition of Sverdrup has an error.

5) Line 203: Fig. 2 presents seasonal SST climatology from different data sets. How well is the climatology determined, is averaging done over the same periods and data density.

6) Line 258: Fig. 4 introduces INCOIS-HYCOM. What is this?

7) Line 264: Naming problem in "in both the **model** and **INC-HYC** it flows further poleward". The same problem in lines 298, 330, 371, 403, 409, 423, 465, 466, 469.