

Interactive comment on “On the Indonesian throughflow in the OCCAM 1/4 degree ocean model” by U. W. Humphries and D. J. Webb

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This study, like many others using high resolution ocean models, has thrown up more problems than can be reasonably handled by the people involved. Some of them are technical, concerned with the inevitable approximations used in the model, but many are concerned with the basic physics affecting the region.

To summarise, problems that arose when writing the paper and which need further investigation:

1. The role of the shallow South China Sea in the throughflow. Is it primarily a question of wind driven flow on a shallow continental shelf or does it also involve sea level differences between the adjacent deep sea regions of the North Pacific and the Indian Ocean? It is also the westernmost path connecting the two oceans, so does the beta

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effect drive some of the throughflow through the region?

Are modern satellite measurements of wind stress, sea level and surface currents in the region, sufficiently accurate to help answer these questions?

2. Are the flows through the Makassar and Lombok Straits really affected by horizontal control points? Are the satellite and other measurements accurate enough to measure the sea level changes relative to the geoid? What in situ measurements need to be made? How does the Earth's rotation affect the control points? Can laboratory models give further insights?

3. Is a control point in the Lombok Strait the only reason for the larger transport through the Ombai Strait?

4. Is the bathymetry near the major sills and control points sufficiently accurate for models to reproduce the flow?

5. Why doesn't more of the flow from the South Pacific flow take the short route via the Halmahera Sea into the Indian Ocean?

6. What events and what source regions are responsible the different waves seen in the transport time series? What can adjoint models tell us? Are the differences between the northern and southern passages due to a filter? Alternative is it a resonance effect or is some other process involved?

7. How accurate is the models representation of the vertical distribution of transport? Are there significant flows in and out of the Pacific or is this another model error?

There are also the modelling problems which are mainly to do with representing processes occurring at the same scale as the model grid or at a sub-grid scale. As with the thermohaline circulation in the North Atlantic, this includes the representation of the flow near sills and the mixing that occurs in the resulting density currents. In the Indonesian Seas, there is also the question of how to accurately represent the strong highly non-linear internal tides of the region and the mixing they produce.

Model, satellite and in situ observational data that may help answer these questions is often freely available. However it is the skilled and properly funded manpower that is often missing.

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