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An assessment of equatorial variability and surface currents in FOAM-NEMO against observations, including the TAO Array

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The Met Office run daily analyses and 5 day forecasts using several operational configurations of the Forecast Ocean Assimilation Model (FOAM) system, using the NEMO ocean and LIM2 sea ice models. These configurations include the ¼ degree global (ORCA025); the 1/12th degree regional North Atlantic; the 1/12th degree regional Indian Ocean; and the 1/12th degree regional Mediterranean domains. Hindcast analyses of all these operational configurations have been run for the period 2007 to 2008, both with and without data assimilation.

Mean model drifts were estimated from the difference between the 2008 annual means for the assimilative and free runs. Qualitative assessment of simulated equatorial sea surface height between the AVISO observations and the assimilative global model indicated good agreement. In the free running global model there was a drift in sea surface height associated with a global freshwater imbalance. However, when this drift was removed the simulated sea surface height agreed reasonably well both with the observations and with the assimilative model. Qualitative assessment of simulated equatorial SST against the OSTIA observational analysis also indicated good agreement. Assessment of the simulated Pacific equatorial zonal flows with data assimilation against observations also indicated reasonably qualitative agreement.

Surface currents were assessed quantitatively against observations at ∼45 TAO Array moorings for the Global and Indian Ocean models through visual inspection, correlation, several cost functions, RMS, mean errors, Taylor diagrams etc. Visual inspection suggested that zonal (u) currents are less challenging to model accurately than the meridional flows (v) due to their lower variability and consistent direction. They also confirmed that there is considerable variability in model skill between individual locations, over the two year period.

The overall global equatorial quantitative assessment suggest that the assimilative global model had good skill (r=0.77) for zonal currents but poor skill (r=0.46) for meridional currents. By comparison, the non-assimilative global model had average skill (r=0.67) for zonal flows but poor skill (r=0.36) for meridional flows. In both runs, a band of negative mean bias of the order of 20cm/s is evident along the equator in all ocean.

For both global model runs, skills (defined in terms of r) appeared to be highest in the Indian Ocean (assimilative model u and v, r values of 0.77 and 0.63, respectively), medium in the Pacific Ocean (assimilative model u and v, r values of 0.78 and 0.43, respectively) and lowest in the Atlantic Ocean (assimilative model u and v, r values of 0.58 and 0.33, respectively).

In the Indian Ocean region, for the global assimilative ocean model correlations for u and v, respectively were good (r=0.77) and average (r=0.63) whilst for the non-assimilative model they were also good (r=0.73) and average (r=0.66). The regional 1/12th degree Indian Ocean model had similar skill to the global ¼ degree ocean model at simulating equatorial currents, i.e. no additional skill was evident for the higher resolution model.