Heat and Freshwater Budgets Estimated from Global Eddy-Permitting Reanalyses over 1989–2010

Maria Valdivieso
Environmental Systems Science Centre, University of Reading

Hao Zuo, Vladimir Stepanov and Keith Haines
Environmental Systems Science Centre, University of Reading

We present here new results from two global ocean reanalyses at eddy-permitting resolution (1/4o) carried out at Reading in the context of the EU GMES MyOcean project. These reanalyses were performed over the period 1989–2010 using the NEMO coupled ice-ocean model (Madec et al., 2008) in configuration ORCA025 (Barnier et al., 2006). The model is forced with the ECMWF ERA-Interim atmospheric reanalysis (Dee et al., 2011) with bulk fluxes calculated as Large and Yeager (2004). The first reanalysis assimilates only hydrographic profile data (Smith and Haines, 2009) obtained from the UK Met Office ENACT/ENSEMBLES (EN3_v2a) data set. The second reanalysis was carried out with the full Met Office operational FOAM assimilation system (Storkey et al., 2010), assimilating ocean profiles from EN3_v2a, now with XBT, MBT bias correction (Levitus et al., 2009), also in situ and satellite-based SSTs, altimeter SLA from AVISO and satellite-based sea ice concentrations from the EUMETSAT Ocean Sea Ice Satellite Application Facility (OSI-SAF).

Comparisons with independent datasets are used investigate the consistency of the ocean state. Then full-depth heat and freshwater budgets are diagnosed from the 5-day average reanalysis output on the model native grid. Terms of the budgets include local storage, air-sea interaction, horizontal advection and data assimilation increments. The contribution of assimilation is calculated explicitly from the data assimilation increments. The horizontal transports in particular are carefully evaluated against WOCE sections and inverse model calculations and against the RAPID array estimates in the subtropical Atlantic. In most cases mean transports are very consistent with independent estimates.

Where large scale heat and freshwater transports are realistic this implies that assimilation increments can be interpreted in terms of surface heat and freshwater flux corrections. On smaller scales heat assimilation increments can be seen to correct for local redistribution of heat content, eg. consistent with the lack of mesoscale Eddy transports. The global heat budgets agree well with observations indicating a warming of the upper oceans at a mean rate of ~0.5W/m2. The corrected SSTs induced by assimilation in combination with the bulk formulae flux calculations lead to a new global heat and freshwater balance being established.

Corresponding Authors:

Name: Maria Valdivieso and Keith Haines
Organization: Environmental Systems Science Centre
Address: University of Reading, Reading RG6 6AL
UK