

***Interactive comment on “Transports and budgets  
in a 1/4° global ocean reanalysis 1989–2010” by  
K. Haines et al.***

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In response to the main point in reviewer 1, we completely agree with them that a key challenge of using data assimilation in this way, particularly in relation to surface fluxes, is to be able to say something based on regional increments. This relies heavily on having confidence in the ocean transports and this is the reason we have used this paper to show the heat and freshwater budgets together with ocean transports together. Other approaches to using data assimilation to assess surface fluxes under the “long-window 4DVar” heading similarly critically rely on the quality of the ocean transports, and this is often overlooked when presenting results because these ocean transports can be very poor in low resolution ocean models.

In the context of this paper using a high resolution ocean model we believe we have  
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shown that the transports across a number of ocean sections are actually very consistent with independent assessments based on observational hydrographic sections. This would then justify the use of connecting average assimilation increments with air-sea fluxes in the regions between these sections, although we have not made that step to quantify the regional implications yet.

The referee notes figures 3 and 7 showing meridional transports of heat and freshwater, however these figures are mainly used to demonstrate consistency between the meridional transports and the surface flux and assimilation increments. By doing so they show that the assimilation increments fit perfectly well into this standard methodology comparing actual transports with surface flux forced water transformations. The agreement demonstrated in these figures does not prove that the model transports are correct, only that they are consistent with the fluxes and increments being applied.

Comparisons with independent transport estimates are made in Figure 3 which do indeed show discrepancies in the Atlantic sector and these are now the subject of further investigation.

We do however make the generic argument in the paper that a high resolution ocean model which has a good ocean density distribution, as constrained by data assimilation, and forced with the best winds we may have (atmospheric reanalysis) should stand the best chance of reproducing the real transports. More work is needed but if we can achieve this, then the connection between regional assimilation increments and surface fluxes will become more robust leading to a new quantitative assimilation-based methodology for evaluating air-sea fluxes and for quantifying model biases.

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