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Ocean Science Discussions

Interactive comment on "Towards measuring the meridional overturning circulation from space" *by* D. Cromwell et al.

D. Cromwell et al.

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RESPONSE TO REVIEWER 3

Re: General comments

We welcome the reviewer's recommendation to publish our paper once complementary information has been provided. We do so below and in the revised paper. The reviewer asks a number of questions about the model. The model was initialized from previous runs of the model (one 20 year simulation: see Stammer et al, 1995 and the initial 0.5° simulation of Semtner and Chervin, 1992, with a spin-up of 33 years.) This is sufficient for the circulation in the model, including bottom circulation, to reach equilibrium. As explained in the paper, most OGCMs conserve volume rather than mass so that, typically, there is a model drift in the SSH. It does not seem particularly helpful to provide

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a plot in the paper to illustrate this when this topic has been adequately covered in the literature. The same applies to drift in bottom pressure and other questions raised by the reviewer regarding properties of the model. We have now added the relevant references to the revised version of the paper. (see Stammer et al. 1996; Tokmakian, 1996; Tokmakian and Challenor, 1999).

The reviewer also asks about the model EOFs and how representative they might be of the real ocean. An EOF decomposition has been examined in the model and with results shown in a conference paper. (Tokmakian, R., McClean, J.L., Semtner, A.J., and Braccio, P., "A High Resolution Global Ocean Model With Variable Forcing of Wind, Heat, and Freshwater: I) Initial Evaluation", Conference of the World Ocean Circulation Experiment and Climate, Halifax, Canada, 19-24 May 1998). On the global scale, the EOFs compare well with the SSH fields derived from TOPEX/POSEIDON altimeter data.

Re: Specific comments

(1)-(3): These have been made in the revised paper. Re: (3) - we feel that this is addressed in (4)-(6) below and in the text of the revised paper.

(4)-(6): The physical relevance of taking predictors north and south of 26N is that this is close to the line of zero wind stress curl and therefore approximately marks the separation of the subtropical and subpolar gyres. This latitude corresponds closely to the location where the meridional oceanic heat flux is a maximum: a significant factor in deciding where the RAPID monitoring array was located. As we have tried to emphasise, our paper is a feasibility study rather than a prediction exercise. The intention in the future is to test this method by applying it, not to model output as we have done here, but to real observations from the RAPID array. There is a good physical basis for choosing pointwise detrending rather than global detrending. As stated earlier, OCGMs conserve volume, not mass. Some locations will gain/loss mass more than at other locations. We therefore are more likely to get better results by

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detrending pointwise (locally), rather than globally.

(7): Further examination of the random errors showed that the random errors on BPA did not affect the results, rather it was the error in the SSH that matters. The error on altimeter measurements is well studied and known to be about 2 cm. We therefore did not think it was worth producing a figure as requested. We could do so if the referee or editor would still like one. We would like to thank the referee for making us re-examine this issue.

Re: Technical corrections

(1)-(3): These have been made in the revised paper.

(4): We do not understand the reviewer's objection to our definition of the THC which is both standard and consistent with that given in, e.g. Rahmstorf, S. (2006). Thermohaline Ocean Circulation. Encyclopedia of Quaternary Sciences. S. A. Elias. Amsterdam, Elsevier: 10pp.

(5): In Equation (1), z0 as the upper limit of the integration is indeed the sea surface elevation as stated. The integration is performed from the bottom depth at that geographic location given in the ETOPO5 dataset. The notation used in Equation (1) is standard oceanographic usage.

(6): We chose the POCM model because it is a reliable, well-tested model that has frequently appeared in the literature (see earlier comments). Note that the POCM values of the MOC are consistent with the observations of Marsh et al. (2005): Figure 2a.

(7): The monthly values are shown by the open black circles, and the smoothed MOC is the black line. We have corrected the wording on page 1630 accordingly.

(8): The 's' simply stands for 'smoothed' - we have stated this now in the text.

(9): We have improved the figure as suggested.

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Final Remark

We have incorporated the above comments and complementary information in the revised paper. We would like to thank the reviewer for his/her careful comments and helpful suggestions.

Interactive comment on Ocean Sci. Discuss., 3, 1623, 2006.