**Ocean Science
Discussions**

Interactive comment on "Evaluating two numerical advection schemes in HYCOM for eddy-resolving modelling of the Agulhas Current" *by* B. C. Backeberg et al.

Anonymous Referee #2

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"Evaluating two numerical advection schemes in HYCOM for eddy-resolving modelling of the Agulhas Current " describes the benefit of using a 4th order advection scheme instead of the 2nd order scheme in representing the Agulhas Current and associated mesoscale variability. As noted by the authors, the improvement of 4th order advection schemes compared to 2nd order schemes has been shown previously. However, the paper is a very detailed model validation study and as such I believe that it can become an interesting publication of Ocean Science after revision.

Page 431: The vertical coordinate system of HYCOM is documented elsewhere. Since the analysis of the authors does not rely on the particular coordinate system, this para-

graph should be removed.

Page 437: "In these experiments with HYCOM, the QUICK scheme was only applied to momentum advection following the arguments by Sanderson (1998)". This reads as if Sanderson showed that higher order advection scheme for tracers are useless. This statement should be nuanced and better placed in the context.

Page 440, line 19: What is the average vertical of the HYCOM model at this depth and which coordinate system it used? If the model uses isopycnals at this location, shouldn't it be able to represent the extent of the current by adjusting the layer thickness?

Page 441: The manuscript would benefit if the authors would try to explain why the transport is increased using the 4th advection scheme. Certainly less numerical diffusion on momentum plays a role. But are also the temperature and salinity gradients enhanced by using a 4th order advection scheme for momentum?

Page 441, line 27: Why does the transport become negative in O2? What is the spatial structure of the current at this time? Is it due to a uniform decrease of the velocity at this location or is the current displaced from its mean track, possibly by an eddy?

Page 446 and figure 6: It is difficult to see from figure 6 which model gives the best overall results. Please provide a quantitative measure which model results are closer to the standard deviation of the observations.

Page 450: Using the skewness to determine the preference of cyclonic and anticyclonic eddies is an interesting approach. How large has the sample to be to distinguish between positive and negative skewness (for a given significance level)? How large is the zone where the skewness is not significantly different from zero around the mean current? This is related to the question how accurately the central position of the current can be determined by using skewness.

Page 454, lines 5-10: Consider to reword this paragraph to make it more readable.

Section 4.3: I believe that most readers of Ocean Science will be familiar with the concept of covariance but not necessarily with variogram. Since there is straightforward relationship between both, please include this in your manuscript. A brief discussion why you prefer to interpret a variogram instead of the covariance would also be useful.

Section 4.3.1: How are land points treated in the Fast Fourier Transform and the fact that the model grid is curvilinear?

Page 458, conclusions: "Moreover, this is achieved at a fraction of the computational cost of increasing the grid resolution. " This is to be expected but not shown in the manuscript. The authors compare the realism of an O2 momentum advection scheme versus an O4 scheme. However a comparison of the necessary resolution to achieve with an O2 scheme similar results than with O4 scheme was not shown in this paper. This statement should therefore not appear in the conclusions (but may appear in the introduction by citing the relevant research).

Quality of figures needs to be improved. In particular the font-size too small.