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Biogeosciences Discussions

Interactive comment on "A model-based assessment of the TrOCA approach for estimating oceanic anthropogenic carbon" *by* A. Yool et al.

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[In the following text, all referee comments are given *in italics*, while our replies appear in normal font]

The title of this manuscript is misleading. This manuscript presents a comparison of results from three different models, not an objective assessment of the TrOCA approach.

While our manuscript briefly includes a comparison between TrOCA, ΔC^* and a simulation of the OCCAM model, the focus of the manuscript lies with applying the

TrOCA methodology to a synthetic dataset generated by the model in an attempt to objectively evaluate this method's performance in deconvoluting anthropogenic CO2.

There are many inaccuracies in this manuscript. For example, the text indicates that the TrOCA method was tuned using the WOCE I01 cruise data. This is not true (see Touratier et al., 2007).

In preparing our manuscript we misread Touratier et al. (2007) and erroneously assumed that the parameterisation of TrOCA that it describes was generated by an optimisation based on data local to WOCE I01. We have amended this error in our description of the TrOCA methodology, and have corrected this misapprehension throughout the manuscript.

The text further indicates that "negative concentrations are common with TrOCA" however Figure 7 shows that only the ΔC^* results of globally averaged vertical profiles present negatives values. Large negative concentrations are much more common with ΔC^* than with TrOCA.

Both the ΔC^* and TrOCA methods estimate negative anthropogenic CO2 in certain regions of the world ocean. As the referee correctly notes, our manuscript gives the misleading impression that only the TrOCA method has this property. We have amended the manuscript to more accurately report this feature of the techniques.

The authors rightly indicate that the OCCAM model presents (like all 3-D models) some deficiencies in the hydrography but then, they use these model results as "reference"! There are many hypotheses in this OCCAM model (hydrography, redfield ratios, monthly restored surface freshwater, salinity, air-sea fluxes, etc.) that influence

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the model results. These results from a deficient model should NOT be taken as "reference".

Since the true distribution of anthropogenic CO2 cannot be ascertained, it is not possible to validate methodologies such as TrOCA using observational data. Our paper attempts to circumvent this limitation by examining the TrOCA methodology using a synthetic dataset derived from a coupled physics-biogeochemistry model. While our model, like all models, contains deficiencies, we believe that its representation of the real ocean is sufficiently accurate to permit us to examine the principles that underlie the TrOCA methodology. In this regard, our work follows similar work on the ΔC^* methodology (Matsumoto & Gruber, 2005).

The Taylor diagrams presented in this manuscript are meaningless. A Taylor diagram can be used only with measured data as reference.

Taylor diagrams are a tool for generating a simple, summary representation of otherwise complex or multidimensional data. While they are frequently used for model-data inter-comparison, they can be used to compare any two datasets in terms of their correlation and relative variability. Here we use them to simplify the comparison of three-dimensional fields of simulated anthropogenic CO2 with those estimated by applying our optimised TrOCA variants. Should our variants successfully recover anthropogenic CO2 they should share their variability with the synthetic data and correlate strongly with it, making a Taylor diagram an appropriate way of presenting variant skill.

I could go on: : :. The only conclusion that can be drawn from this study is that results from the OCCAM 3-D model are different from the TrOCA and from the ΔC^*

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models. This is not surprising (since the various hypotheses of these three models are different)! There is nothing new here.

We respectfully disagree with the referee. Since anthropogenic CO2 is only available to us as estimates through methods such as TrOCA and ΔC^*, independent observation-based evaluation is not possible. As such, our manuscript instead aims to examine the TrOCA method by asking it to reconstruct a synthetic dataset derived from a plausible simulation of the modern ocean and the anthropogenic CO2 perturbation. Though such a dataset is derived from an incomplete model, it permits an evaluation that is simply not otherwise possible.

Interactive comment on Biogeosciences Discuss., 6, 7231, 2009.