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Geoscientific Model Development Discussions

Interactive comment on "^{14}C-age tracers in global ocean circulation models" *by* W. Koeve et al.

Anonymous Referee #1

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This submission uses three ocean models (two based on transport matrices of MITgcm and one UVic) to simulate a number of decomposed tracers of DIC-14 to investigate the distributions of preformed properties and ages (time elapsed since losing contact with the atmosphere) in the ocean interior. I do not ordinarily recommend an outright rejection of a submission, but I would make that recommendation here on two counts.

First, I do not believe this paper is appropriate for GMD. Even though there is a veneer of model assessment, this paper is not fundamentally about model assessment (or about development/evaluation of a new model or experiment protocol that GMD cares about). The only part that comes remotely close to assessment is the conclusion that the bulk 14C age may not be a good metric to assess the interior ventilation in ocean models. The paper describes a number of decomposed tracers of DIC-14 (section 2.2), but the more useful ones such as ideal age have been around for a long time. Most other tracers are not informative, and some can be diagnosed (e.g., DIC-

14_decay=bulk DIC-14 – preformed DIC-14) without the need for explicit simulation.

The second reason for recommending rejection, and this would be the overriding reason, is that I did not find anything new scientifically. There is too much textbook stuff that are discussed as if they are novel: about the longer timescale of isotopic equilibration vis-à-vis timescale of chemical equilibration, the relative importance of residence time versus equilibration timescale in determining the preformed 14C, age bias due to the nonlinearity of aging coupled with mixing (classic example is CFC age), the outsized importance of the small area of deep/bottom water ventilation sites that determine the preformed properties of interior waters, the importance of gas exchange kinetics over solubility in slow-equilibrating tracers like 14C. . .on and on. Most of the submission's figures and text are devoted to making these trite textbook points.

I was actually looking forward to reading this work, but I did not learn anything new from this submission and was disappointed. In fact, there are statements that are either incorrect or quite careless. For example, on page 7035 line 13: "14C is naturally produced in the upper atmosphere to reach rather constant atmospheric levels and enters the ocean via gas exchange." There is nothing about the nature of 14C production that leads to steady state budget of 14C in the atmosphere; rather it is the balance between the production by cosmic bombardment and loss by decay and exchange with the oceans and terrestrial biosphere. Or, on page 7036 line 18: "14C-ages in the interior ocean are not real," which is a very careless statement, because the geochemically measured 14C activity that gives the conventional age is definitely "real." It is contains useful information about the reservoir age (or preformed DIC-14 as the authors would like to say) and time elapsed since losing contact with the atmosphere. Then there is their final, punch line in the abstract: "if model evaluation would be based on bulk 14C-age it could easily impair the evaluation and tuning of a models circulation on global and regional scales. Based on the results of this study, we propose that considering preformed 14C-age is critical for a correct assessment of circulation in ocean models." The authors fail to understand or acknowledge that the

reason why bulk 14C is traditionally used in model-data comparison is because that is what is both directly measured and simulated. Preformed 14C age or activity may be diagnosed in water column data or reconstructed from archived surface samples for past times, but significant uncertainties are introduced when trying to compare them to model-simulated reservoir ages. So their main model assessment proposal seems completely unrealistic to me.

Interactive comment on Geosci. Model Dev. Discuss., 7, 7033, 2014.