

## ***Interactive comment on “<sup>14</sup>C-age tracers in global ocean circulation models” by W. Koeve et al.***

### **A. Schmittner (Referee)**

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Review Koeve et al.

Scientific Significance: Excellent Scientific Quality: Excellent Scientific Reproducibility:  
Good Presentation Quality: Excellent

This paper examines the relation between radiocarbon (D14C) and age in a new, interesting, and useful way by introducing the concept of preformed <sup>14</sup>C-age. Scientists have long known that the <sup>14</sup>C age and the real age of a subsurface water mass are not the same due to finite air-sea gas exchange. But I haven't seen such a clear presentation of the issue before.

The paper is useful for climate modelers and paleoceanographers working with radiocarbon. I recommend publication as is, or, if a revision is undertaken, with consideration

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of my minor comments listed below.

Page 7035: Observationalists could object to caling models “the method of choice”.

Line 18: I think capital  $\Delta^{14}\text{C}$  is usually refered to after correction for  $\delta^{13}\text{C}$ .

Page 7040: Definitions of  $^{14}\text{C}\text{-age}^{\text{pre}}$  and  $^{14}\text{C}\text{-age}^{\text{decay}}$ : Line 18: I don't understand why  $\text{DIC}^{\text{pre}}$  is in the denominator. Using the decay function  $C(t)=C(t=0)\cdot\exp(-t/\tau)$ , where  $\tau$  is 8033 years and solving for  $t=-\tau\cdot\ln(C/C(t=0))$  it seems to me that  $C(t=0)$  should be in the denominator, which, in this case should be  $^{14}\text{C}\text{-DIC}^{\text{pre}}$  at the surface. Do I miss something?

Line 23: Those ratios must have completely different orders of magnitude.  $^{14}\text{C}\text{-DIC}^{\text{pre}}/\text{DIC}^{\text{pre}} \sim R_{\text{std}} \sim 10^{-12}$ , while  $(\text{DIC} + ^{14}\text{C}\text{-DIC}^{\text{decay}})/\text{DIC} \sim 1$ . Am I missing something ?

Page 7042: line 24: “background mixing coefficients” are these in addition to a tidal mixing component? Please specify. If so, I suggest to refer to  $k_{\text{bg}}$  rather than  $k_{\text{v}}$ .

Page 7045: line 18 “two water masses of different age”: Which values were used in Fig. 5? 0 and 2000 years?

Page 4047: lines 15-17: “for  $\text{CO}_2$  the equilibration time is governed by the product of the time scale of gas exchange (order of one month) and the ratio  $\text{CO}_2\text{-3}/\text{COaq2}$  (10–15 in the surface ocean)” Why?

Page 7048 line 12: I don't see negative ages in Fig. 1b

Page 7049 lines 23-25: I suggest to add “except at the surface.”

Page 7053 lines 10-15: I suggest to discuss Schmittner (2003, EPSL 6702 1-10) who examines sea ice effects on bottom water radiocarbon.

The above review was not influenced by reading reviewer #1 and #2's comments. With regard to reviewer #1's comments I don't agree with him/her that there is nothing new

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here. To my knowledge the concept of preformed c14-age has not been proposed nor used before. This is therefore, in my opinion, a new contribution, even if much of the text sounds like “trite textbook points”. I also think that the paper is appropriate for GMD since it proposes a new way to analyze model output.

Andreas Schmittner

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

**GMDD**

7, C2382–C2384, 2014

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