

Response to Reviewer 1.

Our thanks to both reviewers for careful readings.

Major Comments.

(1) The reviewer notes that the ms. seemed to lack a specific hypothesis or question. The introduction has consequently been somewhat rewritten to make clearer that the paper is intended to clarify the problem of defining useful time scales from paleo-tracer transients and to at least implicitly, note that the central question is “how can one most readily interpret deep-sea core proxy data?” In particular, we now note more forcefully the distortion taking place in the temporal behavior as it would be recorded from the same surface transient, in different parts of the ocean—a serious complication in identifying common phenomena in time-dependent records.

(2) The use of a Dirichlet boundary condition for discussion of radiocarbon is questioned. We now re-emphasize the idealized nature of this study—in which the goal is understanding of time-scale orders of magnitude. Although a flux or Robin/Robbins condition seems more natural for ^{14}C , we have now added a sentence that notes that specifying the surface flux in a system in which e.g., the surface age distribution implies a strong injection from the ocean below, is not so easy. In a fluid with convecting regions, areas of Ekman suction and Ekman pumping, and a powerful seasonal cycle in many places, it is perhaps misleading to pretend that *any* single, simple, boundary condition with a fixed diffusion coefficient is likely to be applicable. A full discussion of the “correct” boundary condition on an ocean-only calculation would require a second, much longer paper. We do now note, however, that the best way to calculate oceanic radiocarbon (or other) concentrations is to consider the coupled ocean and atmosphere where the coupling would involve the full physics of the air-sea interface. Again, that is far beyond what is intended here.

All of the minor corrections have been made with the exception of a few where we thought the original wording was clearer. Thank you. We note only that “origination” does appear in the OED and usage is given starting from 1443 to the present day. But it’s not necessary and we changed it. In the 3rd minor comment, it is correct that $C_{OBS} = (C_0/2) \exp(-\lambda t_1)$ which would give an apparent age of $-\ln(1/2) + t_1 \neq \bar{\tau}$. The equation that was not dimensionally correct has been fixed.