

Geosci. Model Dev. Discuss., referee comment RC5
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Reply on RC4

Baylor Fox-Kemper (Referee)

Referee comment on "The interpretation of temperature and salinity variables in numerical ocean model output, and the calculation of heat fluxes and heat content" by Trevor J. McDougall et al., Geosci. Model Dev. Discuss.,
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Prof. Tailleux is correct that my report is more positive than his, but I think he misinterprets my intention or rationale. I am in favor of this publication because it begins the calculation of the differences between these methods in an orderly way. It is of critical importance to have a handle on how big these differences are.

The point he makes about the GISS model is an excellent one, and I think it goes to show that there are *many other factors affecting the skill of climate models beyond the EOS*. It is common practice to evaluate "model biases" and "reduction in model bias" by changing one factor at a time (e.g., adding or retuning a parameterization). However, because such models have many counterbalancing errors, changing a single process is as likely to reveal other errors as to lead to overall improvement. It is only in attaching *independent evidence* to a particular change that we can hope to move forward, e.g., process models at higher resolution, observational constraints, etc.

However, our community has neither the financial nor human capital to simultaneously explore all processes represented in these models. Thus, quantitative sensitivity experiments are a crucial step in identifying where the errors needing the most attention are. I take this paper as falling into the sensitivity category and thus is valuable, as well as being a band-aid on the wound of the slow transition of the community from EOS-80 to TEOS-10 (and its decendents), and a pedagogical excercise in highlighting the differences between the two. Right now, it is clear that modeling centers have not decided to move forward rapidly on TEOS-10 implementation (otherwise, there would be no need for this stopgap or sensitivity excercise). In my mind there is little doubt that the formulation of EOS-80 is improved by the TEOS-10 approach, but what is not clear is the urgency and this paper contributes to establish that metric.