Answer to Review of the paper entitled Global Thermocline Vertical Velocities: a Novel Observation Based Estimate

We thank the reviewer for the detailed revision of the manuscript and for the insightful comments.

We have included the suggested changes in Section 2.1, including the induction term in the Ekman divergence equations (new Eqs. 10 and 11; L120-L125). We have also clarified the computation of wg in the Perfect Model Test (L270-L271).

Regarding the reviewer's question of Section 3.5 (Improvement Relative to Ekman Pumping):

"How do you explain the poorer performance of wg compared to wEk in the NAD, ACC, and Agulhas Current? Why does the inclusion of the geostrophic component degrade the performance in these intense ocean currents? Would you have obtained better performance by taking β(vg + vEk) rather than βvg?"

Response:

In these regions, the ageostrophic component (wag) has a non-negligible contribution to the total vertical velocity (wtot). The combination of this contribution and the low correlation between wtot and wg suggests that wag is not correlated with the geostrophic component (wg). In fact, wtot, and therefore wag, shows a stronger correlation with Ekman pumping. Since wg is derived from the geostrophic meridional velocity (vg), this indicates that the variability of vg is not synchronised with that of wag. As a result, including the divergence of the geostrophic meridional flow degrade the representation of wtot variability, which further reduces the already weak correlation of the wek.

Including other terms of the vorticity equation and considering the total component of the meridional velocity could improve the representation of wtot variability.

We have included a sentence in L522-L524 to clarify this point.