Resplandy et al. correction and response

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Guest commentary from **Ralph Keeling** (UCSD)

I, with the other co-authors of **Resplandy et al (2018)**, want to address two problems that came to our attention since publication of our paper in Nature last week. These problems do not invalidate the methodology or the new insights into ocean biogeochemistry on which it is based, but they do influence the mean rate of warming we infer, and more importantly, the uncertainties of that calculation.

We would like to thank Nicholas Lewis for first bringing an apparent anomaly in the trend calculation to our attention. We quickly realized that our calculations incorrectly treated systematic errors in the O_2 measurements as if they were random errors in the error propagation. This led to under-reporting of the overall uncertainty and also caused the ocean heat uptake to be shifted high through the application of a weighted least squares fit. In addition, we realized that the uncertainties in the assumption of a constant land O_2:C exchange ratio of 1.1 in the calculation of the "**atmospheric potential oxygen**" (APO) trend had not been propagated through to the final trend.

As the researcher in charge of the O_2 measurements, I accept responsibility for these oversights, because it was my role to ensure that details of the measurements were correctly understood and taken up by coauthors.

We have now reworked our calculations and have submitted a correction to the journal.

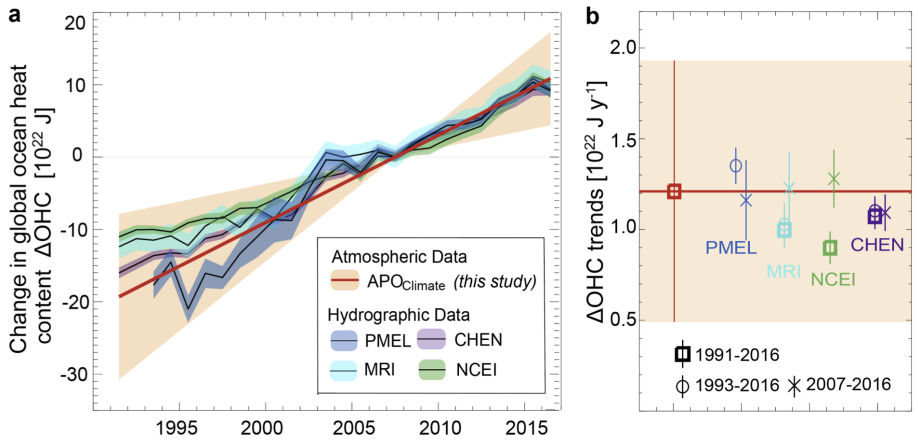
Details

In our definition ΔAPO, we used a default value of 1.1 for O_2:C oxidative ratio (OR) of land carbon. However, a lower ratio is probably more appropriate. Specifically, **Randerson et al. (2006)** argued for a ratio of around 1.05, based on the composition of stems and wood, given that woody biomass dominates longterm carbon sources and sinks on land. Other recent studies have suggested similar ratios e.g. **Clay and Worrall (2015)**. Our previous calculations did, in fact, allow for a range from 1.05 ± 0.05, consistent with above estimates and typical uncertainty ranges. However, we applied this range only for the $\Delta APO_{Climate}$ to-ΔOHC ratio but neglected the impact on the APO budget itself, which used a fixed ratio of 1.1. If the actual OR were lower than 1.1, the observed APO decrease (ΔAPO_{OBS}) would include a contribution from the global land carbon sink, because the ΔO2 term then imperfectly cancels the 1.1 ΔCO2 term.

In the updated calculations we now also allow apply the OR range (1.05 ± 0.05) to the APO calculation which by itself increases the $APO_{Climate}$ trend by 0.15 ± 0.15 per meg/yr relative to an estimate using 1.1.

Bottom Line

We recomputed the $\Delta APO_{Climate}$ trend and its uncertainty based on the distribution of the unweighted least square fits to each of the 10^6 ensemble realizations of $\Delta APO_{Climate}$ generated by combining all sources of uncertainty, with correlated errors now treated as systematic contributions to the trend. The resulting trend in $\Delta APO_{Climate}$ is 1.05 ± 0.62 per meg/yr (previously 1.16 ± 0.18 per meg/yr) which yields a ΔOHC trend of 1.21 ± 0.72 x 10^{22} J/yr (previously 1.33 ± 0.20 x 10^{22} J/yr), as summarized in the updated Figure 1:



The revised uncertainties preclude drawing any strong conclusions with respect to climate sensitivity or carbon budgets based on the APO method alone, but they still lend support for the implications of the recent upwards revisions in OHC relative to IPCC AR5 based on hydrographic and **Argo measurements**.

References

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2. J.T. RANDERSON, C.A. MASIELLO, C.J. STILL, T. RAHN, H. POORTER, and C.B. FIELD, "Is carbon within the global terrestrial biosphere becoming more oxidized? Implications for trends in atmospheric O2", *Global Change Biology*, vol. 12, pp. 260-271, 2006. **http://dx.doi.org/10.1111/j.1365-2486.2006.01099.x**
3. G.D. Clay, and F. Worrall, "Oxidative ratio (OR) of Southern African soils and vegetation: Updating the global OR estimate", *CATENA*, vol. 126, pp. 126-133, 2015. **http://dx.doi.org/10.1016/j.catena.2014.10.029**

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