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Interactive comment on "Swept under the carpet: the effect of organic matter burial in global biogeochemical ocean models" *by* I. Kriest and A. Oschlies

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General comments The manuscript "Swept under the carpet: the effect of organic matter burial in global biogeochemical models" by Kriest and Oschlies describes the sensitivity of global biogeochemical models to circulation (MIT2.8 versus ECCO), remineralization length scale without burial, remineralization length scale with burial, and three burial algorithms. The authors find much more sensitivity in oxygen than in phosphate, and most importantly, that they are able to 'sweep under the carpet' much of the sensitivity to remineralization length scale choice by incorporating phosphate supply by rivers set to balance loss through burial. They incorporate an expansive suite

of vertical flux estimates in addition to the more common ocean tracer distributions to support their case. While I would have liked to see the authors consider regional variations in remineralization length scale through the ballasting/mineral protection, I find the manuscript a novel, thorough and expansive exploration of model construction sensitivities and an extremely useful contribution to the global ocean model development community. I have only minor suggested changes that I would like the authors to address before publication.

Specific comments Title: 'Swept under the carpet' is certainly catchy, but currently ambiguous in meaning. When I first read the title and introduction, I thought that the authors meant that burial was too important to be ignored – the typical usage of 'swept under the carpet'. As I got to the results and discussion, I began to think that the authors instead intended that they were able to eliminate the ongoing community problem of sensitivity to remineralization length scale by adding burial, which, as detritus, alludes to something that one might sweep. Unfortunately, this possible meaning is clouded by the confusion related to the term 'swept under the carpet' implying a short-sighted and short term solution. This possible interpretation is bolstered by the ad hoc nature of balancing phosphate burial prognosed in the model by adding the flux through rivers... so, this leads me to the following alternatives: 1) In ignoring burial, past work has 'swept this issue under the carpet' when they should not have because it turns out to have some very positive features for the ability of the models to represent tracers and fluxes. 2) In incorporating burial, the authors are able to 'sweep under the carpet' the problem that there is a great uncertainty in remineralization length scales, but they realize that the uncertainty remains a problem. 3) By ignoring weathering, the authors have 'swept under the carpet' the mechanistic representation of the rock cycle that would balance their prognosed burial flux. As I believe the authors are capable of making all these points, perhaps changing the title to: 'Swept under the carpet: organic matter burial decreases global ocean biogeochemical model sensitivity to remineralization length scale' to make it more specific? I'm not sure which direction the authors would like to stress.

10860,2 – not sure what the authors are getting at with 'eventually', perhaps simply omit. 10860,18 – 'and may be influenced by the data distribution and methodology' is ambiguous. I think the authors intend 'but definitive interpretation is confounded' instead of 'and may be influenced'. 10861, 11-16 – yet another possibility is the recently discovered role of habitat compression and chemolithautotrophy in driving enhanced remineralization above and below the hypoxic region such as in: Karen F. Wishner, Dawn M. Outram, Brad A. Seibel, Kendra L. Daly, Rebecca L. Williams, 2013: Zooplankton in the eastern tropical north Pacific: Boundary effects of oxygen minimum zone expansion. Deep Sea Research Part I: Oceanographic Research Papers, 79, 122-140, doi:10.1016/j.dsr.2013.05.012.

Rodriguez-Mora, M J., M I Scranton, Mary I., G. T. Taylor, and A. Chistoserdov, 2013: Bacterial community composition in a large marine anoxic basin: a Cariaco Basin time-series survey. Microbiology Ecology,- 84, 1574-6941, doi:10.1111/1574-6941.12094. 10862,13 and 15, omit 'aim to' 10862,20 – How long are the models run out? I know the TMM allows a time step of order days, but do you run out for 5000 years, 10,000 or until some equilibrium cutoff is reached? Adding 'run out to achieve a steady state equilibrium of X' would be fine. 10862,25 replace 'sinks at a sinking speed' with 'sinks at a speed' 10863,18 – omit extra 'the' 10865,14 and 15 – the two 'may's seem extraneous. 10866,15 – Fast rock cycle... accelerated by a factor of, what, 109... worth mentioning. 10866,26 – omit 'rather fine' 10868,1-4 – Not sure this should be a factor given the obs have strong zonal aliasing from transects spaced many degrees apart. 10868,10 – 'both' should be 'the two' 10868,13 – 'among' should be 'between' 10868,16 – 'homogenous' should be 'dispersive' or 'broad'... actual homogenization would lead to the generation of a more peaked histogram. 10869 –I found the distinction between 'fast' and 'slow' to trip me up a lot as I had trouble keeping straight whether 'fast' meant 'fast sinking' as intended or 'fast remineralizing' as opposite the intent. This was compounded by the reference to the exponents for which the larger values are associated with 'slow'. I would have preferred the authors to use 'shallow' versus 'deep' as their terminology, but adding more references that fast=deep and

slow=shallow like discussed in 10871,15 and add 'sinking' after 'fast' and 'slow' would help. 10869,18 – 'Obviously, we can expect' should be 'We show the' 10868,23-24 and 10870,1-2 – 'no figure' should be 'not shown' and it would be nice to have the numbers which would correspond to these in order for the reader to compare with those in the table. 10871,15 – it would be helpful to refer back to the terminology of 'slow sinking' and fast sinking' 10871,21 – Either omit 'refer to the title of our paper and' or replace it with a more explicit discussion relating to the answers to my above questions about the meaning of 'swept under the carpet'. 10873,17-19 – A very successful effort in addressing coarse model biases in the Arabian Sea can be found in: Resplandy, L., M. Lévy, G. Madec, S. Pous, O. Aumont and D. Kumar (2011), Contribution of mesoscale processes to nutrient budgets in the Arabian Sea, J. Geophys. Res., Vol. 116, No. C11, C11007 10874,6 – extraneous comma 10876,9 – It would be helpful for the reader for the authors to point out that this distinction is entirely consistent with the very different residence times of these two tracers, as PO4 has a residence time of 20-100 Kyears (Paytan, A. and K. McLaughlin, 2007: The Oceanic Phosphorus Cycle. Chem. Rev., 107, 563-576, doi: 10.1021/cr0503613.) whereas the o2 residence time is essentially the weighted average ideal age of the ocean, something like 1 Kyear... is this calculated in TMM? 10876,20-21 – this note is, I think, intended as a reference to the possible role of teleportation of PO4 from the pacific to the Atlantic... is that what was intended? The authors should be able to quantify this inter-basin exchange from the model, and compare it with the amount of excess remineralization generating the oxygen low bias between the runs. That would seem an easy addition if it works out. 10876,22 – It makes more sense to me to move this paragraph into the next section. 10877,25 – I would have phrased this to add after 'cores' 'meaning that these flux estimates assume steady state over multiple thousands of year. Perhaps counter-intuitively, simulated and observed burial estimates compare quite well, strengthening the case for both the validity of the steady state assumption over these time-scales and fidelity in the models.' 10877,29 – Replace 'somehow' with 'logistically' or 'for practical considerations'... Unless I'm mistaken, the reason is that it's easier to get cores

from close to shore. 10878,2 – also sediment erosion is a concern. 10878,20-22 – Bringing up future work here seems irrelevant. 10878,27 – Resolution should improve not just regional and nested models, but global models as well, correct? What resolution is required? 10879,1 – Suggest replacing “When neglecting shelf areas’ with ‘Considering only areas deeper than 2000 m’ 10879,6 – What do the authors mean by ‘sediment-water exchange’ -is it just ‘sediment burial and remineralization’, or actual water exchange across the sediment boundary... seems odd, but I’m not sure why the authors would otherwise deviate from the previous terminology. 10881,3 – The question the reader has at this point is that given the BUR and DUNNE algorithms give pretty much similar answers, why show them? Is the DUNNE better regionally but globally averages out? There are two reasons I can see for keeping both – one is to demonstrate that the simpler BUR algorithm does just as well as the more variable DUNNE algorithm for 1 non-mesoscale-resolving models, and two that one would expect the DUNNE algorithm to perform better in high flux coastal and shelf environments that are not represented in the current modeling approach. 10881,22-24 – How much nutrient is sequestered in this reservoir? Does it have to be large enough to impact the global PO4 inventory, or just local values? 10882,26 – So, are the authors using ‘swept under the rug as a ‘short-sighted, short term solution us usually intended, or do they think this is an unequivocal advance? Isn’t it the remineralization length scale problem that is being ‘swept under the rug’ in the more classical sense? As I described at the beginning, the intention is currently ambiguous. 10883,2 – suggest changing ‘can only partly be’ to ‘can be partly’ 10883,3,4 – suggest adding ‘but’ before ‘because’ and ‘due to limited robustness’ at the end. 10883,10 – suggest adding ‘finer scale’ or ‘higher resolution’ before regional Figure 1 – in both the legend and caption, is the solid red line equivalent to BUR and the dashed red line WBUR? If so please change legend and caption to add this reference. Figure 2 – I am confused by the B and E ‘mismatch’ plots... how does one get a observational mismatch of 0.6 mmol m-3? Typically if this were a bias map, the observations would define 0... Is this actually a reference depth/volume average value rather than a mismatch? If so, what depth or volume?

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