

Interactive comment on “Rapid changes in ice core gas records – Part 2: Understanding the rapid rise in atmospheric CO₂ at the onset of the Bølling/Allerød” by P. Köhler et al.

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Reviewer: Mark Siddall

This is a very interesting paper that should be published in *Climates of the Past*. The result is very important on many levels. For one it takes us a step beyond a sort of ‘steady state’, essentially additive way of working on the carbon budget and towards a more dynamic way of working with the ice core data. The paper therefore offers not just new insights, but an improved overall approach.

I have general comments and then some specific comments.

C601

GENERAL COMMENTS:

1. The authors mention direct effects of continental shelf flooding but there are other effects relating to the extent of the tidally mixed zone on carbon burial on the submerged shelf:

Rippeth, T. P., J. D. Scourse, K. Uehara, and S. McKeown (2008) The impact of sea-level rise over the last deglacial transition on the strength of the continental shelf CO₂ pump. *Geophys. Res. Lett.*, 35, L24604, doi:10.1029/2008GL035880

note that this paper itself documents a first-order effect of tides on shelf carbon sequestration. There are also second-order effects of tidal energy dissipation on the shelf to keep in mind:

Green, J.A.M., Green, C.L., Bigg, G.R., Rippeth, T.P., Scourse, J.D. and Uehara, K. 2009. Tidal mixing and the strength of the Meridional Overturning Circulation from the Last Glacial Maximum. *Geophysical Research Letters* 36, L15603

2. It is not clear to me that the model should be in an AMOC off state during the whole experiment. It seems to me to be important to consider a hypothetical transition from the off to the on state as one experiment.

3. The authors note differences between MIS 3 and the termination in terms of the phasing of the CO₂ response and also in terms of the rate of sea level change. We found some similar differences in a recent study which may be worth referring to (at the complete discretion of the authors). Although our results are tentative, it seems to me that the links to the conclusions of the paper in review are intriguing:

Siddall M., Kaplan M.R., Schaefer J.M., Putnam A., Kelly M.A., Goehring B., 2010: Changing influence of Antarctic and Greenland temperature records on sea level over the last glacial cycle, *Quaternary Science Reviews*, 29(3-4), 2010, 410-423

4. Although the text is mostly good I did spot a good number of typos and other language errors. I have tried to identify these where I can but I do not guarantee that I

C602

have managed to spot them all. It may be worth getting a native speaker to have a proof read.

SPECIFIC COMMENTS:

5. P1475, L8-10: Clarification is needed. Perhaps expanding this phrase is what is needed. It is very dense in its current form.
6. P1475, L22: 'needs' (add 's')
7. P1475, L26: unclear which Köhler 2010 paper is being referred to.
8. P1476, L15: remove '...is different, and...'
9. P1482, L27-30: this is a little ambiguous. It may be better to indicate when they were first 'exposed' and then when they were 're-flooded' or 're-submerged'
10. P1483, L5: is Smith and Sandwell 1997 the most accurate, up to date bathymetry you can use? This is not likely to affect your result but this is an old reference by now.
11. P1483, L10: you should add glacio-isostasy here to this list to be complete. This will cover isostatic effects from the period previous to the MWP as well as the dynamic effects on relative sea level during it.
12. P1484, L15: a subtle point perhaps but '...is still discussed... ' seems to imply that we ought to have an answer by now and in fact we seem a long way from resolution to this issue. I think '...is debated... ' more closely states where we are at
13. P1485, L4: how about '...no study considers how...'
14. P1485, L7: replace '...we like to... ' with '...we attempt to...'
15. Fig.1, top left: the Siddall data is best shown as a line for the period which it is continuous but there is a discontinuity in this data during MIS 2 because the Red Sea salinity rises above 49 PSU, causing an aplanctonic zone in the cores (e.g. Siddall et al 2004). It is misleading to show the data joined up over this period – MIS 2 data is

C603

best shown as discrete points

16. Fig.1, top right: you should mention in the caption that there is only very limited age control on the Red Sea record in this period from five radiocarbon dates with no reservoir correction. Note that reservoir correction in the Red Sea is problematic because of large changes in the reservoir age of the basin coupled to changes in sea level.

Mark Siddall 11/08/2010

Interactive comment on Clim. Past Discuss., 6, 1473, 2010.

C604