

Interactive comment on “Bipolar carbon and hydrogen isotope constraints of the Holocene methane budget” by Jonas Beck et al.

Anonymous Referee #1

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Review of Beck, Biogeosciences, 2018

This paper will be a valuable addition to the literature on the isotopic composition of methane in the past and the Holocene methane cycle. The use of data sets from both hemispheres is very important, as the heuristic modeling in Figure 2 shows. This point could in fact be emphasized a bit more. I do not have any major concerns about the manuscript but do have several smaller issues to bring up that might help improve the clarity of the presentation.

Introduction in general: The introduction is slightly long, and while there is nothing wrong with it some of the sentences and paragraphs could be shortened.

Page 2, line 5: “Low pass” filter may be misinterpreted by those not familiar with ice

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cores, I suggest being more specific about what you mean here.

Line 17: Sowers 2010 is probably not the first reference for the bowl shape. Chappellaz et al., 1997?

Line 36: normally elements are not capitalized (deuterium rather than Deuterium).

Line 40: Leaves instead of leave.

Line 42: In instead of on.

Page 3, line 10-14: The sink discussion is a bit cursory particularly since there are papers in the literature about changing sink terms influencing the Holocene budget. For example, Kaplan et al., 2006, GBC. I suggest expanding this section to provide a more detailed defense of keeping the sink strength constant.

Page 4, line 30-31: It is not clear to me what “local average density” means in this sentence. Apparently the local average density is constant but the data are unequally distributed and this sounds contradictory.

Page 5, lines 14-18: It is not clear here if step 2 in the synchronization actually does anything. Is it necessary to have this as a separate component? It reads sort of awkwardly.

Section 2.4 Heading and elsewhere. The term deconvolution is used here, and I think in general this is probably fine, though some would associate it with signal processing, whereas I believe the technique used here would also be called inversion, a term also used in the paper.

Page 7, line 11. A minor point perhaps but is the ppb – burden conversion here consistent with the latest concentration scales?

Equation 3: Although one could calculate r_x , out of interest to the reader could you give the value for ITCZ at 5 N to make it clear how much difference it makes?

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Page 7, line 5: Is little r defined anywhere near equation 1?

Page 7, line 23: Should these sink terms be constant if the boxes are not the same size?

Page 9, line 6: Indicate if time is left to right or right to left in Figure 2.

Line 23: There may be a better word than “compensate” here, the emissions are required to have a certain time history by the assumptions made.

Line 42-43: This seems repetitive.

Page 11, paragraph 2: The data are interpreted in terms of 2 sigma uncertainty but 1 sigma is plotted. This gets confusing because from the figures there are interesting deviations in the results but the text tells us they are not to be interpreted that way.

Line 16-20: The last two sentences of this paragraph could be reworded. It is first stated that there is a remarkably strong constraint and then stated that the uncertainty does not allow robust conclusions. These two statements seem inconsistent. I think I know what is meant here but it could be made clearer to the reader.

Section 3.1: I may be missing something here. I understand that SF6 in the modern atmosphere can help determine mixing time. I presume that this calculation must by definition choose a value for the mean ITCZ position. One can, I guess, calculate different sets of mixing times for different assumed ITCZ positions given the SF6 data. Is this what was done for the sensitivity studies? If I have this correct, is this a full exploration of the possibility of changes in atmospheric mixing? Why not just vary the mixing term independently? Is there an assumption here that it only changes because of changes in ITCZ position? What about atmospheric dynamics, could that change?

Figure 3: It is clear enough that red and blue in the right hand panels are for N and S, though this is not actually labeled explicitly in the legend.

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