Response to Reviews

May 23, 2017

Referee #2:

The dataset presented here is an important contribution for the paleoclimate commu- nity and deserves fast publication. It brings together multiple CO_2, CH_4 and N_2O measurements, and combines them in an intelligent way to produce a continuous history of these greenhouse gas concentrations, and the associated radiative forcing for the past 156ka. This is an essential contribution to the PMIP exercise. The method used (spline fitting) is appropriate, and explained very well. The uncertainties are also detailed clearly.

Two things are however missing from this dataset:

1. Although the uncertainty in the data are well constrained, they are not propagated to the spline fit, and I believe it would be really useful to provide an envelope of the spline fit, either in the form of a 1 sigma uncertainty, or in the form of an ensemble of solutions, that could then, be used by the modeling community to produce ensembles of response to the forcing.
   Our reply: Our revision will contain an uncertainty analysis, including Monte Carlo statistics, and variations of the cutoff periods. We will also propagate the error to the calculated radiative forcings and include the calculated uncertainties in the data set that will be uploaded to the scientific data base PANGAEA. New figures and a more extensive discussion of this topic is contained in the response to the comments of reviewer #1.
2. It would be useful in the paper to discuss the perspective to improve greenhouse gas reconstructions in the future: new samples, better replication, better understanding of the core to core offsets, continuous flow, inversion of the firn smoothing, NH reconstructions...
   Our reply: The task suggested here would in our understanding be a complete new review paper on greenhouse gas reconstructions, in which shortcomings of past measurements and potential improvements of future measurements are analysed and discussed. We believe this is beyond the scope of this data-based paper.

Specific comments:

- The core to core offset is an issue. I agree with the authors that this paper is not the place to solve this problem, but it would be useful to quickly state the possible mechanisms. For CO_2, in-situ production is likely the main cause, and we know that its not a lab or analytical offset, but its real, in the ice. In situ production can only increase ice core CO_2, and this is why we prefer the lower estimate, rather than take the mean between WDC and EDC. Someone that does not know about ice cores may be surprised by this decision, so I suggest you explain it more clearly.
  Our reply: An in-depth discussion of the CO_2 core-to-core offsets is contained in the SI to Bereiter et al. (2012). We will revise the text accordingly, refer to this SI material and add a few details in our paper.
- For N_2O, Im not familiar with the possible mechanisms, but since the offset correction is different, I think it should be detailed a bit more: list possible mechanisms, and explain strategy to bring different cores together (page 12, line 10-15).
  Our reply: There is no offset correction in N_2O. The only offset correction we performed are (1) for WDC CO_2 (calculated in detail in this study and already contained in the initial version of the paper) and (2) for WDC CH_4, since the discrete CH_4 data have

an unexplained interlab difference between Penn State University and Oregon State University. This CH_4 offset was stated to be 9.9 ppb (SI to Rhodes et al., 2015), and was not yet included in the initial version of the paper. It has been brought to our attention by a comment of reviewer #1.

- 10, line 28, add "A" to "A hundred year later"
  Our reply: Will be corrected.

I believe these comments can be addressed quickly, and I am looking forwards to the final publication.