

## ***Interactive comment on “What was the source of the atmospheric CO<sub>2</sub> increase during the Holocene?” by Victor Brovkin et al.***

**Peter Köhler**

peter.koehler@awi.de

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This paper (Brovkin *et al.*, 2019) uses atmospheric greenhouse gases (GHG: CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, plotted in Figure 1b,c of the discussion paper) from spline routines based on various data sets. Since such a GHG data compilation exercise including the calculation of a spline has also been performed in a recent study (Köhler *et al.*, 2017), I asked the corresponding author to get access to their applied GHG time series to evaluate if and how they might differ from the final splines of this other study. I plot them here against these earlier results in the following figures 1–3. Spline routines applied here and there have been the same (developed by Fortunat Joos, University of Bern), but the underlying data and the chosen prescribed cutoff period  $P_c$  for the spline routines have been in detail slightly different leading to similar, but not identical

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splines.

For CO<sub>2</sub> (Fig. 1) both splines are nearly identical.

The CH<sub>4</sub> (Fig. 2) record in Köhler *et al.* (2017) is based on the WAIS Divide Ice Core (WDC) for large parts of the Holocene, that resolves multi-centennial variabilities, a small-scale feature that is ignored in the spline used in Brovkin *et al.* (2019). This comparison also highlights, that the CH<sub>4</sub> data used in Brovkin *et al.* (2019) are not global mean values, but southern hemispheric values. Due to an existing interhemispheric gradient, northern hemispheric CH<sub>4</sub> (e.g. from Greenland ice cores) and therefore also global mean CH<sub>4</sub> values are slightly larger than the CH<sub>4</sub> values of the chosen southern hemispheric spline.

In N<sub>2</sub>O (Fig. 3) the millennial-scale variability is slightly shifted in time between both splines, suggesting that the used age models of the underlying data might have been different.

The spline used in Brovkin *et al.* (2019) fall nearly always into the uncertainty bands ( $\pm 2\sigma$ ) of the splines described in Köhler *et al.* (2017).

For details of the spline method and further citations of the underlying data the reader is referred to Köhler *et al.* (2017). Layout of figures and captions have been adapted from the previous paper.

I believe these underlying details of the method and data might be of interest to the readers of Brovkin *et al.* (2019)

### **References**

Brovkin, V., S. Lorenz, T. Raddatz, T. Ilyina, I. Stemmler, M. Toohey, and M. Claussen (2019), What was the source of the atmospheric CO<sub>2</sub> increase during the Holocene?, *Biogeosciences Discussions*, 2019, 1–25, doi:10.5194/bg-2019-64.

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### Figure Captions

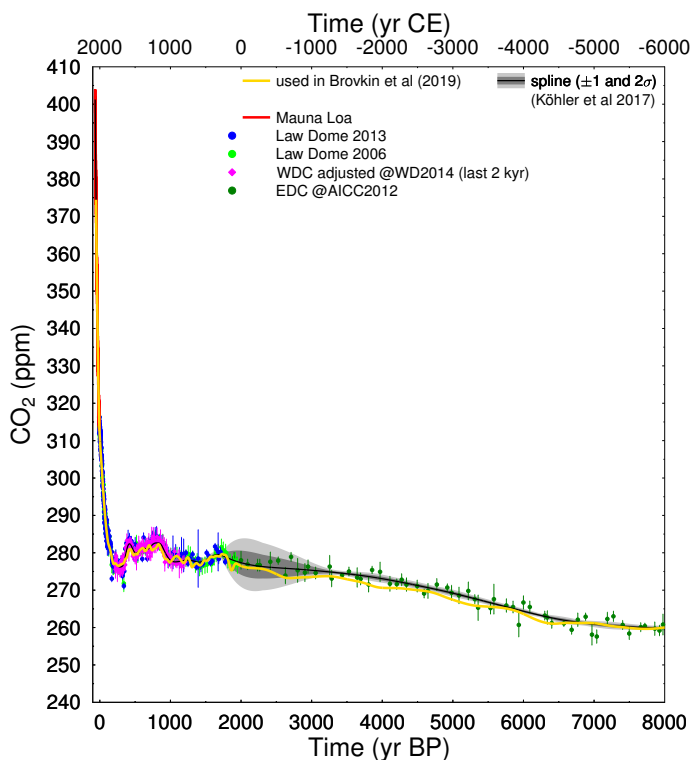
**Figure 1:** Atmospheric CO<sub>2</sub> spline and underlying data (2016 CE – 8,000 BP). Black spline as published in Köhler *et al.* (2017) against time series (gold) used in Brovkin *et al.* (2019). Error bars around the ice core data points are  $\pm 2\sigma$ . WDC data have been adjusted to reduce offsets, see Köhler *et al.* (2017) for details.

**Figure 2:** Atmospheric CH<sub>4</sub> spline and underlying data (2016 CE – 8,000 BP). Black spline as published in Köhler *et al.* (2017) against time series (gold) used in Brovkin *et al.* (2019). Details on plotted data are explained in Köhler *et al.* (2017). The maximum ice core data uncertainty ( $\pm 2\sigma$ ) is sketched in the lower left corner. Latitudinal origin of data is indicated by NH and SH, implying northern and southern hemisphere, respectively.

**Figure 3:** Atmospheric N<sub>2</sub>O spline and underlying data (2016 CE – 8,000 BP). Black spline as published in Köhler *et al.* (2017) against time series (gold) used in Brovkin *et al.* (2019). Details on plotted data are explained in Köhler *et al.* (2017). The maximum ice core data uncertainty ( $\pm 2\sigma$ ) is sketched in the upper right corner. Filled symbols: data taken for spline; open symbols: data not taken for spline.

Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2019-64>, 2019.

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**Fig. 1.** Figure caption is contained at the end of text.

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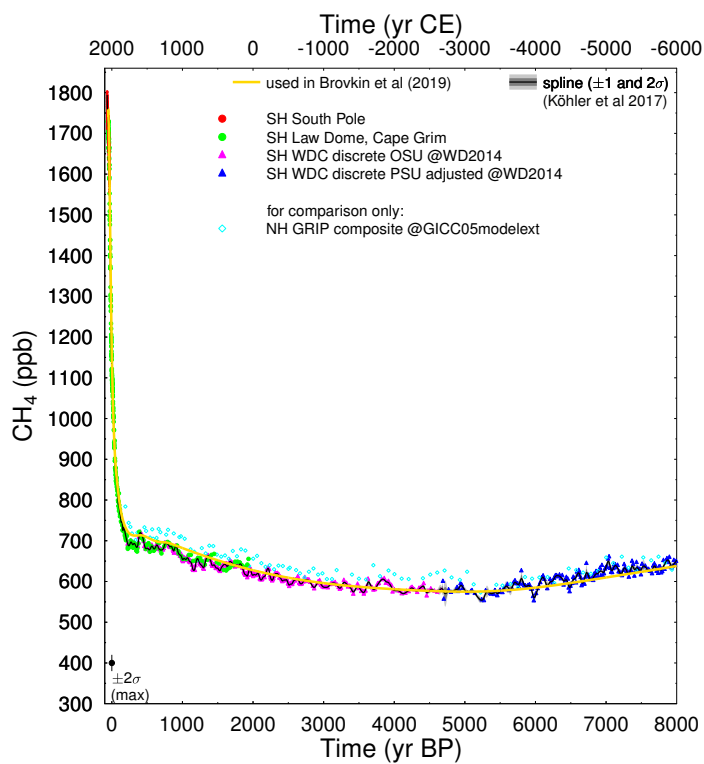


Fig. 2. Figure caption is contained at the end of text.

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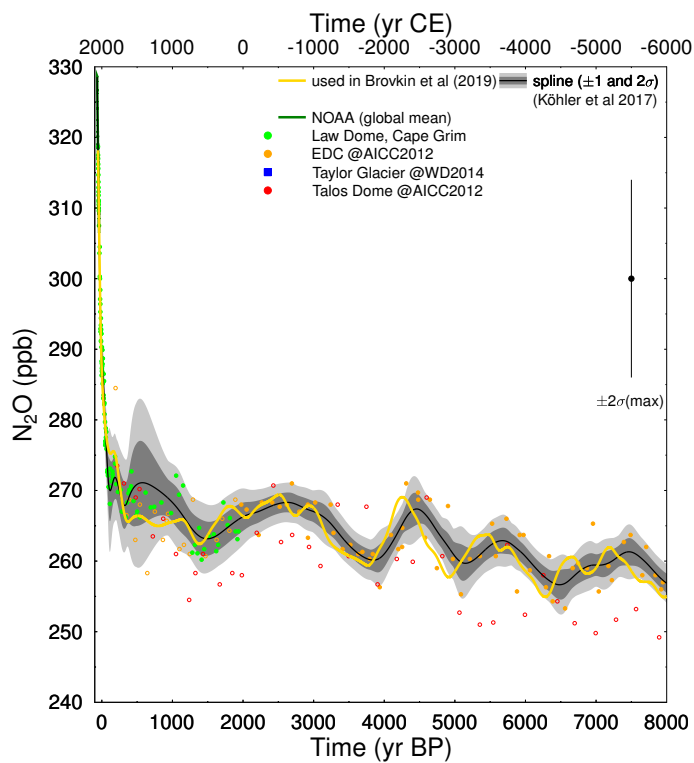


Fig. 3. Figure caption is contained at the end of text.

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