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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Stable isotopes provide revised global limits of aerobic methane emissions from plants" *by* D. F. Ferretti et al.

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1. TABLE 1 A critical typo in Note 5 (e) of the original manuscript was responsible for the difficulties S. Houweling had in trying to reproduce our methane budget. We have modified the text accordingly so that the Ferretti et al. (2005) findings are described as having a total source of 232 Tg yr^{-1} and ($\delta^{13}CH_4$) -47(NOT -49) between 0 to 1000 AD.

We have included the following text as an additional note to Table 1 (note e) in the manuscript to explain why some readers may have trouble reproducing identical results for the total methane budget using our results:

We have deduced the individual methane source components so that the overall isotopic signature of the 'Maximum Estimate' and 'Best Estimate' are identical. However our presented results have been rounded so recalculating the overall isotopic signature

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of the ‘Maximum Estimate’ and ‘Best Estimate’ should not be expected to give exact results.

We have also expanded our description of the methane budget components so that the reader can closely reproduce and verify our numbers by adding an extra table (Table 2). See point number 5 in response to F. Keppler comments.

2. 2000AD EMISSION TOTALS Our choice of 540 Tg/yr for the modern budget was not motivated to minimise plant sources, it simply was taken to lie in the approximate mid-range of published values, which range between 500 to almost 600 Tg/yr. We have, however, made a change to allow a higher total source, and thus additional vegetation emissions, so that our revised limits do not appear to be motivated. The most recent estimates of the total source give higher values (about 590 Tg/yr as suggested by Houweling) and are probably more certain than the earliest estimate of the total source (500 Tg/yr by Fung et al.,1991). Increasing the modern source to 590 Tg/yr causes our ’Maximum’ and ’Best’ estimates of plant emissions to increase and lie in the range 0-213 and 0-176 Tg/yr, respectively. These values have been adjusted throughout the manuscript text and Table 1.

In response to Houweling’s comment about the estimated change in OH between modern and pre-industrial times we insert the following text near the end of the second to last paragraph of the Results and discussion section (as already discussed in response to point number 5 from Keppler comments:

We also consider sink uncertainties in the global methane budget so that the total aggregate sink encompasses a large range of errors (Table 2b) and is not significantly affected by estimated changes in OH between modern and pre-industrial times (Houweling et al., 2000).

3. PRE-INDUSTRIAL BIOMASS BURNING EMISSIONS The Ferretti et al. (2005) biomass burning reconstruction, which was published in Science and based on the agreement between top down atmospheric measurements and bottom up source con-

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structions, is used as a constraint as described in point number 5 in response to F. Keppler comments. There are only a few references that describe stable pre-industrial biomass burning levels over the last 2000 years, and these early works simply postulated stable pre-industrial biomass burning levels because investigating multiple biomass burning reconstructions was beyond the scope of that work. However, there is a larger number of recent works describing both regional and global scale multi-proxy evidence for high levels of pre-industrial biomass burning between 0-1000 AD and decreasing after that (see references within Ferretti et al., 2005). To discount this body of evidence and postulate stable pre-industrial biomass burning levels in favor of variable pre-industrial plant emissions would not be an evidence based decision.

To address Houweling's comment that we do not consider or discuss the Keppler et al. (2006) speculation that plant emissions provide an alternative for high medieval biomass burning, we insert the following text into the second to last sentence of the last paragraph of the Results and discussion section:

The "Maximum estimate" of plant emissions is a scenario in which we minimize pre-industrial biomass burning levels and variations in a very conservative way by ignoring both pre-industrial anthropogenic and modern natural biomass burning emissions (see Table 1, note b). However our "Best Estimate" scenario, which is based on more complete and recent evidence of comparatively higher fossil and biomass burning emissions (see Table 1, notes c and d), is more likely to occur than the "Maximum Estimate" scenario.

Also, see point number 5 in response to F. Keppler comments and the following sentence which has been inserted into the conclusions:

Besides some small differences between the assumed atmospheric composition and sink-weighted fractionation factor, the main reason for our lower estimate of pre-industrial plant emissions (46 $\mathrm{Tg\,yr^{-1}}$) compared to the Houweling et al. (2006) estimate (85 $\mathrm{Tg\,yr^{-1}}$) is that the Houweling et al. (2006) estimate of biomass burning

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emissions at 1000 AD (15 Tg yr^{-1}) is significantly lower than ours (25 Tg yr^{-1}). However, the atmospheric constraint during 1000–1700 AD causes biomass burning in the Houweling et al. (2006) budget to decrease below the lower feasible limit of natural wildfires.

4. CLIMATIC VARIATION OF PLANT EMISSIONS See point number 4 in response to F. Keppler comments.

5. ATMOSPHERIC FRACTIONATION We have added clarity about how the assumed fractionation factors (-5 and -7) were derived by adding a new table (Table 2) that explicitly describes the contributions from each of the methane sinks. This information is from Lassey et al., (2005) and this has been appropriately referenced, while the typo 'ref 7' has been removed.

6. ADDITIONAL REFERENCE See point number 6 in response to F. Keppler comments. Also added another new reference 'Scaling methane emissions from vegetation' by Parsons et al., 2006.

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