

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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This publication addresses global emissions of methane from vegetation. Currently the global source strength of this newly discovered source process is highly uncertain and, therefore, efforts to narrow the range are of a high scientific priority. In this study, a significantly narrowed range of vegetation emissions is derived from global atmospheric constraints on the contemporary and historic budgets of methane and its ^{13}C isotope, the results of which are compared with bottom up extrapolation methods. This approach is quite a logical and obvious step that has to be done in order to verify the global source estimates. In this sense, this publication makes a valuable and necessary contribution. However, as will be explained further below, it remains unclear what the basic assumptions are which the preferred budgets are based on. While

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some assumptions are varied to account for uncertainty, other critical and uncertain assumptions are simply postulated. The underlying ‘decision tree’ is barely motivated or discussed but is nevertheless key to the overall outcome. In my opinion revision of the document is needed to further clarify the approach and repair some serious shortcomings listed below.

TABLE 1

According to Section 2 the budgets that are listed in this table add up to global totals that are required by certain observations. It is not mentioned, however, what numbers are used as observations, which source totals follow from these numbers, and which relationship is assumed to connect the two. Note 5 provides some information, which, however, doesn’t seem to be correct. According to Ferretti et al. 2005, the 13C level of medieval methane was roughly comparable to what it is today. Yet, it is assumed that the source was 2 per mil lighter. When I recalculated the overall isotopic signature per budget I found out that the upper and lower limit differ by approximately 2 per mil. This would account for the assumed range of atmospheric fractionation, but this means that the varying C3:C4 contribution has no additional effect. Also I noticed that the overall isotopic signature of ‘maximum estimate’ budgets does not always agree with the corresponding ‘best estimate’ budgets, without an explanation that this is the case and why. What is needed is a summary of the basic constraints and a emission totals and fractionations per proposed budget so that the reader can reproduce and verify the numbers.

2000AD EMISSION TOTALS

The emission scenarios are designed such that they allow for maximal vegetation emissions, yet the 2000AD emissions are rather low. 540 Tg/yr is within the uncertainty range, but recent estimates, summarized in the IPCC report, are about 50 Tg higher - which would allow for additional vegetation emissions. The current choice of emissions has to be motivated. This choice has also consequences for the 0-1000AD budget, be-

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cause both are linked by the observed CH₄ increase and the estimated change in OH. However, it remains unclear whether this relation has been taken into consideration, and if so, which relation has been assumed. More detailed information and explanation is needed.

PREINDUSTRIAL BIOMASS BURNING EMISSIONS

Among the postulated emissions is biomass burning. However, very little is known about the history of biomass burning, which doesn't justify a hard constraint on this process. Keppler et al. (2006) speculate that plant emissions provide an alternative for high medieval biomass burning. Here this option is not taken into consideration, nor discussed, while it would nevertheless allow for higher preindustrial plant emissions.

CLIMATIC VARIATION OF PLANT EMISSIONS

Page 4 mentions "However, there is no evidence for temperature dependency of plant emissions over ambient ranges (~10-30 °C)". Subsequently, this is used to rule out the option that vegetation emissions have varied with climatic conditions. However, the current status is that there is no evidence for temperature dependent plant emissions because it hasn't yet been measured. It is rather likely that there is a relation. Besides climatic effects, the progressive cultivation of land might have contributed. The fact that we have no clue how vegetation emissions might have varied cannot be used as an argument that the preindustrial variation in ¹³C-CH₄ is most likely due to biomass burning. Ignorance should increase rather than reduce uncertainty ranges.

ATMOSPHERIC FRACTIONATION

As rightly mentioned in the text the atmospheric fractionation is an important and uncertain variable influencing the isotopic budget and thereby the possible range of plant emissions. It is unclear how the assumed -7 and -5 per mil have been derived. What is meant by 'ref 7'? The atmospheric fractionation is composed of tropospheric and stratospheric oxidation by several reactants. Besides this the soil sink should be ac-

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counted for somehow. The treatment of none of these components is explicitly worked out in this document, nor how they might have changed over time. More information is needed.

Finally, I'd like to point to another paper on this subject which has come out recently: Houweling et al., 2006, Atmospheric constraints on global emissions of methane from plants, *Geophys. Res. Lett.*, 33, L15821, doi:10.1029/2006GL026162.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 6, 5867, 2006.

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