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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Proxies and uncertainties for $^{13}C/^{12}C$ ratios of atmospheric reactive gases emissions" *by* Sergey Gromov et al.

Anonymous Referee #2

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This paper presents a comprehensive synthesis of the carbon isotopic composition sources of CO and some hydrocarbons to the atmosphere. It is very useful work and provides a reference dataset (similar to emissions databases) for future model studies with isotope-enabled models. Most of my remarks are related to the presentation. One issue is uncommon usage of constructions or terms, which made the manuscript hard to read for me (see many detailed points below). At some places, I could not follow the argumentation based on the information presented in the figures (some of the figures may be incomplete?). A few general comments related to the handling of errors. The authors are encouraged to help the reader follow their argumentation at some places, where the link between results and scientific interpretation is not straightforward.

General points:

1) Since the authors make a strong and valid point on the value of errors, I was surprised that their individual budget estimates in section 3 do not come with errors

2) Figures: I wonder whether Figures 6a and 7a are shown correctly. There are hardly any emissions in Africa. This does not look OK. There are rather large biogenic emissions from Indonesia in Fig 6a but the isotopic composition is the one of the oceanic source. Can that be true? Also see comment below on the origin of the oceanic value of 13 permil.

3) Tables: there are at least two errors in the conversion from Tg(gas) to TgC, for C2H4 and C2H6 in Table 4. Please check the other values carefully. Table 5: Several points are not clear to me: a) how is the aggregate uncertainty factor derived specifically? b) What is the relation between columns 2,3,4 (individual surface sources) and column 6. c) Column 6 seems way too low as total surface emission for CO. d) Can you comment on the huge error bar for the isoprene emissions? Table 6: Is the uncertainty for CH3Cl isotopic composition really that low?

4) Part of the discussion (L630 ff) is very hard to follow and in my view does not reflect the results shown in the figures, see detailed points below. Another part is L672 ff (last paragraph of section 4.1). The conclusions that the authors are hard to related to the results shown in the figures.

5) The issue that inverse models report too optimistic posteriori errors for the combined source is quite a strong statement. I wonder whether this is not a misunderstanding by the authors. According to my knowledge inverse modeling involves rather solid error calculation, and especially in inverse modeling the constraint on the total source (from mole fraction observations) is much more tight than the sum of the individual components. I suggest that the authors contact with an inverse modeler to check this.

Scientific and presentation issues:

Title: This is in my view an uncommon usage of the term proxies. Does it need to be

in the title?

Line 27 “which factors determine a particular emission source isotope ratios“. The authors are encouraged to avoid such dense constructions with multiple nouns. For a reader, it is much easier to grasp constructions with “of”. In this case “which factors determine the isotope ratio of a particular emission source”. This could be simplified at many places throughout the paper: Here, there is also an “s” too much. Also, in the next sentence, please specify “the latter”

L47: see comment L27, too many nouns. . .

L58: “Tendencies” is a rather unspecific term. Why not concentrations?

L58/59: “by modifying its vertical diffusive flux boundary conditions at the lowest model layer” is very technical. Change to “by adding emissions to the . . .”

L86: For me “isotope separation” is a bit strange term in this context. Why not: Fluxes of individual isotopologues?

L 92: You could help the reader with an example calculation of Eq 1. E.g. for the case of CO with one 13C and one 18O atom. How do the ratios, deltas and fluxes behave?

L103-109: This is very hard to follow, please reformulate. Avoid “ex post facto”.

L142 ff: please rewrite sentence that includes Eq 5.

L150 ff: If the rare isotopologue fluxes are off by 1% and the abundant isotopologue flux is correct, the isotope ratios would be wrong by 10 permil. Please comment/clarify

L166: I cannot understand the remark on the uncertainties of guessed parameters. When you guess a parameter, you can often also guess an uncertainty.

L275: what about the sensitivity in other regions of the world (Africa, South America, Asia)?

L306: where does the ratio 250/280 come from?

L353: Cryptic sentence about the use of a different proxy for CO in GFED. Not clear to me

L382 and Fig 6: It is not clear for me how you come from the -20.5 for the marine carbon content in the text to the -13 in Fig 6 for oceanic CO.

L 480/1 and Fig 6. It is not visible in Fig 6 that NH terrestrial sources are smaller than oceanic ones in winter. Fig 6 implies that oceanic sources are zero?

L490: What causes the range in the isoprene emission?

L501: No emissions in Africa in Fig 7 (see above).

L541: why is photolysis of chloromethane included as isotope resolved processes

L570/1: Either number or plant type is wrong in the example.

L582: Where do the UF estimates come from?

L592: Where does the biofuel uncertainty come from? A table, or is this additional information?

L605: do not let the reader guess which of the studies are bottom-up.

Line 630 - 658: This part is not clear. I have a hard time following the arguments and finding back in the figures what the authors describe.

a) B00 does not really seem to have a much lower Ch4 derived CO source than B99 or SM89 (line 630)

b) the a posteriori sources . . . (line 633). The logic is wrong or at least not clear. I do not see that a posteriori sources are reduced in M97.

c) (l634) I do not see that B00 decreases CH4 derived CO less than M97. In the posteriori results the BB source also increases. The description is not clear at all, and it is also not clear what the bottom line should be.

d) L635: These two studies do NTO show the largest BB emissions, this is the case for SW89.

e) L645: please help the reader why and how the cold start issue could be addressed by 18O but not by 13C

f) L646: It is not immediately clear that the strengths of other sources can be constrained better with isotopes.

Technical issues:

L29-30: . . . how comprehensive should the model be

L46: It is not clear what "in the evaluation setup" means. Is this necessary?

L61: at THE respective

L67: specific emission category

L74: delete "THE"

L75: simplify: . . .. , which leads to more realistic. . ..

L79: the OBSERVED mixing

L87 regular → total

L114: not sure what these preparation tools are. Leave out?

L115: avoid double plurals (fluxes values –? flux values), also in several other places.

L124: leave out "superposed"

L125: clearly comprehensible → clear

L126: or various isotope mixtures → with different isotopic composition

L127: abundance → source strength

L129: Leave out "To give an example". This is not an example.

L136: avoid "impermeable"

L136/7: "because in contrast to ratios, it is much more difficult to relate" → because it is difficult to relate

L164: rewrite/explain "by fitting their (isotope mass-balanced) sum to the given integral."

L168 with → using

L176: add ISOTOPE ratio

L186/7. Leave out this sentence, it creates more confusion that clarification. (Why would it?)

L188 the → a

L202: "surface and adjacent layers" is unspecific. I think you mean the first and second model layer, correct?

L203: specify the remaining sectors

L206: and OTHER emitted

L262: significantLY HIGHER

L272: define "bio-petrol"

L315: use different word for "superincumbent" → higher?

L320 verb missing (is)

L329: second MODEL layer

L338: El Nino Southern Oscillation (ENSO) climate pattern

L341/2: The variation of the d13C of the emission flux is. . .

L401: replace “tolerating”

L436: replace “escorted”

L437: replace “rational”

L445/6: Rewrite: “may be used as a proxy for the average bulk leaf biomass, thus concluding the depletion of the emitted isoprene in relation to it.”

L459: framework DEVELOPED by

L461: a set of numerous parameters

L477: replace perceptibly by more quantitative term, or leave out

L478: . . . which results in

L495: Avoid double plural (trace gas emissions)

L501 & 503: the largest . . .. A comparable. Please modify.

L530: . . .sources associated with biogenic activity that emit isotopically light methane

L531: corresponding TO

L540: replace “isotopic carbon”

L562: In contrast, uncertainties of isotope signatures are reported . . .

L565/6; rewrite sentence

L583: avoid double plural

L620: One infers a similar. . .

L650: Replace/leave out “inquiries”

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