

Interactive comment on “European anthropogenic AFOLU emissions and their uncertainties: a review and benchmark data” by Ana Maria Roxana Petrescu et al.

Anonymous Referee #2

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The authors present a comprehensive compilation of greenhouse gas (GHG) emissions from the agriculture, forestry and other land use (AFOLU) sector in Europe based on official country reports to UNFCCC and FAOSTAT, the global EDGAR inventory and several different types of bottom-up models. They provide an overview of the basic methodologies underlying the different emission estimates and present information on uncertainties where available. Unfortunately, uncertainty estimates are only available for UNFCCC and EDGAR. It would, however, be important to get estimates of the uncertainties for the other datasets and in particular for the models as well. The authors check for inconsistencies between the different approaches and also trace where the same underlying information is used, which might result in an overoptimistic interpre-

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tation of the consistency of emission estimates for some sectors.

Together with the review the authors also provide a compilation of the emission data themselves (in the form of excel sheets), not only those shown in the Figures but also some underlying data, like time series of emissions from different information sources. The excel sheets would be even more useful, if a better and more comprehensive documentation was included directly in the tables. This is highly recommended. In order to serve as benchmark for models and other inventories a better documentation of the emission data sets is indispensable. The excel files should also be restructured in a way that automated reading and processing is possible in programming languages like python or R.

Furthermore, a comprehensive list of all original data sources would be important. The authors should make sure that the underlying data are traceable by clear and direct reference to the original providers.

This compilation provides a good starting point for a detailed analysis of the European carbon budget but similar synthesis efforts are needed for the other components.

The main part of the paper is well written and well structured. The data source description in Appendix B, however, needs some careful editing, in particular the section describing UNFCCC, see specific comments below. The authors should also carefully check the paper for ambiguous use of the word 'source' and clearly distinguish between emission source and data/information source.

Specific comments:

Line 75: Please add a brief definition of 'Annex I countries'

Line 77: 'current year-2' - please explain in words what is meant

Line 79: add year and reference for Paris agreement

Line 80: What is CO_{2e}? Please define before using.

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Line 81: Please explain GWP100 and give reference for its definition.

Line 81: Please explain acronym LULUCF and how this relates to AFOLU.

Line 80 and 87: Is there a difference between '2018 NGHGI estimates' and 'NGHGI 2018 data'? If not, use consistent naming. Otherwise explain difference.

Figure 1: What is 'remaining land' and 'converted land' and how does this relate to AFOLU? What is HWP? Please explain in the legend or add clear references to these terms in the text.

Line 106: Please define FOLU. Is this exactly the same as LULUCF?

Line 112 and 120: Do these 'total EU28 GHG emissions' include the LULUCF sector?

Line 131: Will the comparison between bottom-up and top-down estimates of CH₄ and N₂O emissions be part of a following study? Better mention the top-down studies in the conclusions where you outline the next steps.

Line 152 and Table A2: In contrast to 'For all three GHGs, total emissions... in Table A2', there are no CO₂ emissions listed in that specific table.

Line 154: What are 'observational data streams' in this context? Is there anything measured or observed? Please clarify.

Lines 198-200: Consider moving the information on CO₂ emissions from agriculture to the introduction of Section 3 as it does not fit well in a section explicitly on CH₄ and N₂O emissions.

Figure 2 legend: 'The positive values represent a source.' Define somewhere in the main text that source and sink, positive and negative values respectively, are defined from an atmosphere point of view.

Line 325: The disagreement in % change of emissions between last reported year and 2005 between the different data source is of course also partly due to the different

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length of the time period and hence not necessarily surprising. Please comment.

Line 386: 'top-down and bottom-up SOURCES' sounds misleading, rather 'top-down and bottom-up estimates' or similar. Are these 'natural CH₄ emissions'? Probably not, please clarify.

Line 466: Please clarify this part of the sentence: 'carbon emissions from fire (some models and CO₂ emissions from harvested wood products)'

Line 499: Please add an explanation or reference why removing afforestation from FAOSTAT numbers would result in an even bigger sink?

Line 516: Please explain acronym FAO-FRA. What is the difference to FAOSTAT mentioned in the previous sentence?

Line 543-546: Not entirely clear how much of Finland and Sweden is covered by grassland: 'most of Finland and Sweden' or 'grassland covered less than 6 % of the land in Finland and Sweden'.

Line 557: Can the increase of emissions from grasslands in 2016 in UNFCCC be explained by changes in specific countries? This would be worth mentioning.

Line 625: Is 'Houghton's estimate' the same as the H&N results? If so, please use consistent names.

Figure 13: The underlying data for this figure seem to be missing. At least I could not find them in any excel file. Is there a reason why these data are not provided? If so please comment in the paper.

Figure 13: What is the meaning of 'Model (Cumulative from 1990)'?

Line 676: The link points to the JRC report of the workshop on 'Atmospheric monitoring and inverse modelling for verification of greenhouse gas inventories' (Bergamaschi et al., 2018) and not to an InGOS report. Please check and provide correct citation.

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Line 728: Why is freshwater CO2 emission considered to be a disturbance?

Figure 14 legend: The explanation of what is included in the DGVMs and how changes are derived needs some clarification, it is difficult to follow.

Line 811: It is true that global inversions are needed for a consistent constraint of the global carbon balance but for an estimate of the European carbon fluxes from inverse modelling, high-resolution regional inversion systems would be more appropriate, of course coupled with global inversions. The regional systems are supposed to better represent atmospheric transport and spatial heterogeneity of the fluxes. VERIFY will also make use of regional inversions.

Line 815: What is meant by 'total emission column'?

Line 815 ff: Also regional inversions have been used to estimate European CH4 and N2O emissions (Bergamaschi et al., 2015; Bergamaschi et al., 2018). Might be worth mentioning.

Appendix B UNFCCC: Please give a list, incl. references, of all UNFCCC guidelines in chronological order and refer to them in the appendix text and also in the main text of the manuscript to provide a clearer structure and better traceability of the statements. In the current state this section is rather unstructured and difficult to follow.

Line 884 ff: These are the rules to combine uncertainties using error propagation not to compute uncertainties in general. You do not mention the two different approaches to combine uncertainties, i.e. error propagation and Monte Carlo simulation. Is the Monte Carlo method not used or not relevant?

Line 894: Table B1 is interesting to know but which sectors are missing?

Lines 909-912: What is the difference to lines 867-871?

Lines 913ff: What is the difference between this paragraph and the information in the paragraphs starting line 851 and 865, respectively?

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Please restructure the whole section describing UNFCCC

Line 977: What type of correction factor is this? What is corrected and why? Please specify.

Technical corrections:

Line 61: DGVM - please explain acronyms when they first appear, in addition to the acronym list.

Line 87 and Figure 1: Use consistent naming CO2e or CO2-eq

Line 129: ... top-down GHG emission estimates.

Table 1: To enhance readability please structure the table in a way that the different gases are highlighted and that for all gases the same dataset is in the same column.

Table 2: To enhance readability please format the table in a way that there is one row per sector and combined rows where needed.

Figures 2, 5, 6, 10 legends: Use same name for a data source. Or are 'UNFCCC 2018 communications', 'UNFCCC NGHGI 2018', 'UNFCCC' different data sources?

Line 345: Reference to dataset was already given above in the same paragraph, remove here.

Line 345: Please clarify to what 'count for as much as ...' refers to. Consistency? Agriculture emissions from the countries listed?

Line 346: 'reported by UNFCCC' or 'reported to UNFCCC'?

Line 394: depends -> depend

Line 395: ...estimate to have...

Line 425: The acronym GHGI is missing in acronym list.

Line 450: separate -> separately

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Line 451: because, -> , because

Line 457: Please clarify the structure of the sentence.

Line 576: Something seems to be missing in 'that is, the sink that favorable environmental changes, in particular CO2 fertilization'

Figure 12: Shows also definition of anthropogenic land in DGVMs, please include in the legend.

Figure 12 legend: Add reference to specific version of GCP.

Line 666: remove 'takes'

Line 685: According to...

Line 730: 'the last GCP 2018'. Please remove 'last' as there is no other GCP2018 and it is no longer the last GCP.

Line 741: ' In order to limit temperature increase to 1.5°C and keep it below 2°C' does not sound logical, please rephrase.

Line 768: '*changes*' Is there any meaning in the starts?

Line 783: countries reports -> county reports

Line 788: Please specify what is flowing... e.g. information flow between...

Line 819: Please give proper reference of InGOS report - if that is what you refer to.

Line 899: 'level uncertainties'?

Line 983: Explain acronym CAP and add to acronym list.

References:

Bergamaschi et al.: Atmospheric monitoring and inverse modelling for verification of greenhouse gas inventories, EUR 29276 EN, Publications Office of the Eu-

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European Union, Luxembourg, 2018, ISBN 978-92-79-88938-7, doi:10.2760/759928, JRC111789

Bergamaschi,et al.: Top-down estimates of European CH₄ and N₂O emissions based on four different inverse models, Atmos. Chem. Phys., 15, 715–736, <https://doi.org/10.5194/acp-15-715-2015>, 2015.

Bergamaschi et al.: Inverse modelling of European CH₄ emissions during 2006–2012 using different inverse models and reassessed atmospheric observations, Atmos. Chem. Phys., 18, 901–920, <https://doi.org/10.5194/acp-18-901-2018>, 2018.

Interactive comment on Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2019-199>, 2019.

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