Earth Syst. Sci. Data Discuss., referee comment RC1
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Comment on essd-2021-228

Anonymous Referee #1

Referee comment on "A comprehensive and synthetic dataset for global, regional, and national greenhouse gas emissions by sector 1970–2018 with an extension to 2019" by Jan C. Minx et al., Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2021-228-RC1, 2021

Interactive comment on "A comprehensive dataset for global, regional and national greenhouse gas emissions by sector 1970-2019" by Minx et al.

As described in the title, the authors made a comprehensive overview and summary of the various global estimates of GHGs by country and sectors over the last five decades. This synthesis is based mainly on estimates from the EDGAR v6.0 (and v5.0) data, GAINS model, and three bookkeeping models for the CO2 LULUCF. It focuses only on the anthropogenic emissions of CO2 (FF and LULUCF), CH4, N2O and some fluorinated gases. Some top-down HFCs estimates from WMO are compared to bottom-up estimates. For global GHG emissions the authors compared their values to the UNFCCC (2021) estimates (mainly for Annex-I countries). A general comment on this: Is the data you define as CRFs the one officially submitted by countries to UNFCCC? I don't see it referenced, but instead I see PRIMAP, perhaps authors could explain better. If you used both add please a reference to UNFCCC (2021), with link to the data.

Of high interest is the calculation of uncertainties pertaining to different gases and sectors, as well as global GWPs in CO_2eq. The authors used the 90% confidence interval. I would be interested to know, if authors compare with UNFCCC, why they did not use the 95% confidence interval as done in reporting?

Also linked to this topic, you use only the methodology of Solazzo et al., 2021 or the exact values for EDGAR uncertainties as calculated by Solazzo et al 2021? As far as I know Solazzo et al. (2021) calculated uncertainties for EDGAR only for 2015 using the 95 % confidence of a log-normal distribution; it is not clear if in this study you used those numbers for EDGAR uncertainties because a) you state that you use the 90% method b) you study 1970-2019.

Overall the paper is well written and has a clear structure and the authors did a good job in identifying and explaining the discrepancies between datasets. The authors provide also some explanations regarding the rates of change between different periods and confirm sustained emissions growth but they recommend more studies on drivers, and I totally agree with them. An interesting conclusion is that are no global sectors that show sustained reductions in GHG emissions. I think this is normal given the large differences in terms of industrialization and development between countries. This should be investigated more locally (region, continent) where local policies could affect the emission levels e.g. highlighted in the last two European EU27+UK syntheses by Petrescu et al 2021a,b.

I recommend it for publication, subject to some minor changes and suggestions, as highlighted below.

Specific comments:

L28-29: perhaps state that you use both bottom-up and top-down estimates (at least for HFCs)

L39: add "Global" GHG emissions

L40: add CO2 after Gt

L49: could you add a value in brackets with how much emissions slowed down between 2010-2019 compared to 2000-2009?

L51: higher rates like how much between 2018 and 2019?

L55: you state that "there is (worldwide?) a growing number of countries today on a sustained

emission reduction trajectory" do you exemplify this somewhere in a table or have reference for it? Would be interesting to see how much of these countries are non-Annex I

L84: I agree that non-Annex I countries lack well developed statistical infrastructure but they do submit biannual reports, see Z Deng et al 2021 where they use global BURs UNFCCC global data.

https://essd.copernicus.org/preprints/essd-2021-235/

L88: EDGAR add versions

Table 1: Time period for EDGAR v6.0: check the year "1970-2015 for other GHG" I think is 2018 see also your statement on L122

Table 1 and all the text: is Global Carbon Budget GCB or Global Carbon Project GCP, be consistent

Table 1: for GAINS you could add some recent refs as well (Höglund-Isaksson (2012), Höglund-Isaksson (2017), Höglund-Isaksson et al. (2020), Gomez-Sanabria et al. (2018), Winiwarter et al. (2018) and some contact info for the last column

Table 1: FAOSTAT inventory has been updated to 2019 this year, you have 1990-2017 why?

Table 1: GFED emissions should be reference everywhere in the text as van der Werf et al., 2017 because Giglio is only providing the burned area (AD), but van der Werf is providing emissions.

and please add in the last column the link: https://www.geo.vu.nl/~gwerf/GFED/GFED4/

L101: add Table for sectors disaggregation

L129: I would replace "as is common" with 'as commonly used in IPCC reports"

L130: IPCC here refers to AR5 but now there is AR6 available, could you perhaps update to it?

L220: Petrescu et al references are not updated, should be 2020, 2021a and 2021b

L233: same here, should be Petrescu et al 2021a,b

L235: regarding Solazzo et al. (2021) see my question in the general comments paragraph

L245: you refer here for CH4 right? Please add CH4

L252, 297, 324, 533, 610, 924: I am wondering why you reference everywhere in the text Blanco G. et al instead of Blanco et al?

L259-L266: this paragraph has a different line spacing

L286: can you give few examples for some countries?

Figure 1 the resolution is a bit low, not so clear to read the text and see the lines

L340: Caption Figure 1: Is Tubiello 2013 last reference for latest FAOSTAT N2O inventory? Was updated recently

Table 4: H&N *Sub-grid scale*: the no with down arrow means that is not represented in the model and therefore it decreases emissions? Why *Pasture conversion* has 'no, yes' next to arrows?

"*Distinction rangeland vs Pasture*": how are these two different? Can you reference the definitions you used for rangeland and pasture?

L424, 503: replace Giglio with van der Werf et al 2017

L425 and all text: check the 2 from CO_2 to be subscript

L426: to your statement "inventories of anthropogenic emissions are not completely independent" you could cite Petrescu et al 2020 AFOLU paper Figure 4

L445 and in all text: the unit Mt per year should be Mt yr^{-1}

Table 5: next to Saunois et al 2020 uncertainty for TD estimates I think Bergamaschi et al 2018 has an uncertainty estimate as well

https://op.europa.eu/en/publication-detail/-/publication/4aff4499-8322-11e8-ac6a-01aa75ed71a1/language-en

Table 5: please state how EDGAR uncertainties were calculated (see d and e notes, are from two sources)

L476: v4.3.2

L490: I would say: "The emissions from the agriculture sector have four components ..."

L491: how are ocean waters anthropogenic sources? You refer here to the national ocean/sea waters belonging to the countries beyond coasts or ?

L501: the better reference for N2O from GAINS is "Winiwarter, W., Höglund-Isaksson, L., Klimont, Z., Schöpp, W., and Amann, M.: Technical opportunities to reduce global anthropogenic emissions of nitrous oxide, Environ. Res. Lett., 13, 014011, https://doi.org/10.1088/1748-9326/aa9ec9, 2018."

L502: FAOSTAT-N2O

L530: would be nice to see values in brackets for this comparisons between sector uncertainties

Figure 3 and in all text: consistency between using v5.0 v6.0 and v5 and v6 for EDGAR releases

Figure 3 caption: add top-down (WMO)

Figure 3 caption and all text: sometimes you use words for sigma sometimes symbol, constancy

L576: which EDGAR v4? 4.3.2? please add reference

L581: “EDGAR had previously” which study? Reference please

L588: I would add after (Figure 3), we note that in the left panel

L592: after 90% I would add (right panel)

L597 and all text: equivalents sometimes is in words, sometimes eq, consistency

L608: “we are taking”

L617: sometimes GWP-100 sometimes GWP 100

L623, 647, 946 and all text: please use or methane or CH4

L623: add reference for the GWP values of 86t CO2eq

L633, 634 and all text: sometimes you write Second, Fifth Assessment Report or only AR2 or AR4 or AR5, consistency. Also, are you thinking during the review process to update to AR6?

Figure 4 caption: 90 % confidence interval (or 5%-95% percentile range)

L706: “greenhouse gas” please check all text and write GHG or in words

L718: AR5

Table 7: CO2 FFI column Growth 1.0%: I understand this is the growth between 2010 and 2019 (so in 2019 we see 1% growth compared to 2010?) or is the average growth (2010-2019) with respect to other average growth from a previous period??

L724, 742, 837, 892, 945, 957, 964: GHGs, GHG etc.

L737: H&N (FAOSTAT)?

L798: CMIP6 appears here for the first time in the text, can you please add a link or reference?

L857: please add UNFCCC (2021) and reference.

L863: "inventories *in 2021* was on..."

Caption Figure 8 is bold

L921: well characterized? Or better say correlated?

L946: comprehensive *global* assessments

L947: N2O

L962: CFCs and HCFCs: are there any studies where these two missing gases from your study are given a % contribution to global warming?

L969: can you give some hypothetic reasons for this high uncertain increase? References? Values for uncertainty?

L978: You mention here Tier 2 and 3 UNFCCC CRF data, if you are using the numbers from the CRFs (emissions) they should be almost all calculated according Tier-1 definitions EM=EFxAD with IPCC default EFs, higher Tiers are used only by few countries as well as for reporting uncertainties (see NIRs and their Annexes) where few countries report Tier 2 (Monte Carlo)

I think here you could present a table (in SM) where you specify which countries use which Tiers

L981: update Petrescu et al references

L982: non-Annex 1 should be I, and regarding the "lack of recent official GHG emissions inventories" please check the BURs

L988: complex Tier 3 estimation models are inversions as well (as well as a recommendation of IPCC 2019)

Figure 9 caption: add most recent (2021)

For the updates: even more updated global UNFCCC data

https://essd.copernicus.org/preprints/essd-2021-228/#discussion

Figure 9: figure could be redone with legend fitting inside and perhaps a different projection

Supplementary figures:

Figure SM1: interesting to see the differences between EDGAR versions, but one won't get the feeling on how EDGAR compares to other global estimates, perhaps add UNFCCC to the figures?

Figure SM3 should state the version of UNFCCC data (2021?) and the link to it.

For all tables some columns should be enlarged to read better the text