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## Reply on RC2

Jeroen Kuenen et al.

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Author comment on "CAM5-REG-v4: a state-of-the-art high-resolution European emission inventory for air quality modelling" by Jeroen Kuenen et al., Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2021-242-AC2>, 2021

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The authors first want to thank the reviewer for the positive feedback and constructive comments. Below we provide a point-by-point answer for each of the minor comments ( R = reviewer comments, A = answer from the authors).

R: General: in some earlier documents, CAM5 regional air pollutant emissions were referred to CAM5-REG-AP, as opposed to CAM5-REG-GHG for green house gases. Is it because CH<sub>4</sub> is included here that the new reference is CAM5-REG, and is there still a CAM5-REG-GHG where CO<sub>2</sub> (and other?) emissions would be reported?

A: What is named CAM5-REG in this paper is essentially CAM5-REG-AP. CH<sub>4</sub> is (and has been) a part of the AP inventory given its impact on ozone formation. Indeed CO<sub>2</sub> is reported as part of CAM5-REG-GHG. We added some explanation in the introduction to explain this.

R: Abstract P1 L15: EU countries are reporting simultaneously to LRTAP and European Commission for the NEC Directive, the second should also be mentioned here.

A: Updated accordingly.

R: Introduction P2L44: Add that this is mainly for the "\*European\* air pollution community"

A: Updated accordingly.

R: Introduction: It seems that UNFCCC is not just introduced as an analogy but also because it is the reference for CH<sub>4</sub> emissions. In that case it would be worth discussing here information about the gridding of emission data reported to UNFCCC.

A: We added 2 sentences to the end of the paragraph that for reporting of emissions under UNFCCC spatially distributed emissions are not considered, and hence no country reported grids are available for CH<sub>4</sub>.

R: Section 2 P3L89: in the LRTAP process, CEIP also gap-fills nationally reported emissions to produce what they deliver on their website as "emissions as used in models". Are those used in the methodology? If not a few words are needed on the difference in gap filling methodologies compared to the approach developed here.

A: Good point. The CEIP process is separate from this work, however it does use the spatial distribution component from the CAMS inventory in part of it. We added some text on this to the introduction (where reported gridded data are discussed) including an additional reference to the CEIP gapfilling and gridding report.

R: Section 2.2 P8L206: Unlike soil NO<sub>x</sub>, NMVOV from animal husbandry and manure application is not included in models biogenic emissions modules. Why GAINS has not been used for gap filling instead of just excluding those emissions?

A: Also GAINS unfortunately does not contain animal husbandry and manure application as sources of NMVOC (at least not the scenario used for this work). We updated the manuscript mentioning this. However we consider this a priority to improve for future versions.

R: Section 2.3.1: P10L262 why is CO<sub>2</sub> mentioned here?

A: We added a line in the manuscript explaining that CO<sub>2</sub> is added to complete the point source database, and in particular CO<sub>2</sub> is used for the gapfilling process since it is reported more completely and consistently than other substances.

R: Section 2.3.1 and 2.3.2: It appears (P11L285) that E-PRTR is not only used as proxy, but also withdrawn from the sectoral GNFR emission. This information is important and somewhat "hidden" in this section on spatial proxy. Please consider including it elsewhere. A word of explanation on the matching between E-PRTR subsectors and GNFR would also be helpful.

A: We added a few lines in Section 2.3 where the generic description of the spatial distribution is discussed to make this more visible.

R: Section 2.3.4: and 2.3.7 P14L416: more details on the proxies for residential emissions would be appreciated. The exact relationship applied to population density and wood proximity should be used as residential emissions are not directly proportional to population density. But it should also be commented whether this only applies to wood combustion. More generally, fuel use for residential emissions are also very different between dense urban centres and suburban areas.

A: The details are already given in the SI (Table S5) which give for residential emissions per subsector and per fuel the proxy used. The definition of total, urban and rural population is already provided in Sect. 2.3.4. We added a line in the discussion that the use of population density for residential is a simplification and that, when zooming in, different cities may behave differently. For wood consumption, we added some text to Sect. 2.3.7 describing in detail how the distribution map has been derived.

R: Section 2.3.6: as for residential emission, the exact relationship between traffic and emissions should be provided as the reference to "proxies" remains somewhat vague. Is only traffic density (and not speed) taken into account?

A: We assume the reviewer is referring here to road transport emissions instead of residential emissions. Only the total vehicle kilometers per vehicle category and road type are considered as pointed out in Sect. 2.3.6. Speed, traffic jams or any other parameters are not considered, as this would basically require a traffic model to generate distribution maps which would be large additional effort. We made the additional split between urban, rural and highway in the emission dataset before gridding to take into account the fact that per vkm emissions are typically different in urban and rural areas, and on highways. This way, we take into account a country specific differentiation between the road classes, however when zooming into individual cities or urban areas the

approach may be too simplistic. However, since the goal of this inventory is to support European scale air quality modelling work, we feel the approach is justified.

Some lines were added in the text reflecting the above, and also in the first paragraph of the discussion we added some more text on the limitations of the spatial distribution approach.

R: Section 2.7: more references are needed regarding the source of information for NMVOC and PM splits.

A: We have expanded the text in Sect. 2.7 and added multiple references for both the PM and VOC speciation.

R: Section 3.1: P18L525: red dots at large point source locations are not visible in my printout.

A: The resolution of the figures is sufficient to see the red dots in the maps (especially in population where the area sources are less important), but when the 2 maps are displayed next to each other they may be too small. We increased the size of the maps in the submitted document by placing one below the other.

R: Section 3.1: P19L537 could it be that the trend in residential emissions is also affected by inconsistent reporting of condensable in time? This would challenge drawing conclusions on the European coordination of actions to mitigate emissions.

A: Such a time series inconsistency within the time series of one reporting year would create a large jump in the time series which we would have picked up with our data checks. Also in country reporting time series consistency is a very important aspect where focus on, so we don't expect this to occur.

R: Section 3.2.1 P21L575: suggest replacing "this" by "CAM5-REG-v4.2"

A: Updated accordingly.