

Interactive comment on “Uncertainty analysis of a European high-resolution emission inventory of CO₂ and CO to support inverse modelling and network design” by Ingrid Super et al.

Anonymous Referee #1

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Review of "Uncertainty analysis of a European high-resolution emission inventory of CO₂ and CO to support inverse modelling and network design" by Super et al.

This manuscript describes an effort to construct an anthropogenic CO₂ and CO inventory for a portion of Europe with carefully constructed uncertainties. The authors also show some basic analysis of their results, comparing uncertainties in different sectors and between countries, and the effect of some uncertainties on concentrations on CO₂ or CO in the atmosphere. It is well-written, relevant, and extremely thorough, and should be published in ACP. The only major comment I have is about the data availability statement. The data availability requirement for publication has not been met:

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data is only available by request to authors, which is not acceptable to this journal, I believe. Even if it is, I think the data (i.e. the inventory and uncertainties) should be made available publicly and without restriction, especially as I think this product would be of interest to many researchers.

Otherwise, my comments are fairly minor, and detailed below.

Introduction:

Please define TNO the first time to define the acronym for international readers.

L33 - How are the national numbers determined for reporting? These are also inventories, presumably of the scaled-up variety? perhaps the authors can make this section more specific to inventories that are spatially gridded and temporally downscaled, perhaps those commonly used for atmospheric studies?

L51: I am left wondering what a Tier 3 consists of in this regard, which the US EPA follows I believe.

L72: What is H2020?

L72: Should be made public, not on request - Journal editors can decide on this but that is my understanding of current publishing policy.

L70-76: These sentences are not actually very clear as to what the work is and confuse the reader. Are the 10 inventories part of this work, or only the new high-resolution inventory for the zoom region? No doubt this will be made clear later in the paper but should be outlined here.

L81: Should read: ... (12-16h LT) emissions, which could be the only emissions optimized in a study with a small domain, such as a city, using only afternoon observations? [if a study is regional or the city is large, then using mid-afternoon observations will still allow optimization of early morning emissions for example, depending on wind speed and location of emissions relative to the measurement point, for example]. But

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I absolutely agree that looking at the temporal variability and whether that is correct can be crucial in an urban study as well as a regional one (as illustrated by Hu et al. Science Advances 2019 for continental work). It may be an issue even if the inversion is sensitive to all hours.

L108. Comma should be a period.

L108: if it's not described later, an additional sentence on the temporal disaggregation would be nice (does it account for weekday/weekend effects for example?).

L109: What is GNFR vs. NFR?

L138: is the point source data also temporally explicit? I am specifically thinking of energy generation (e.g. gas or coal-fired power plants, whose hour-to-hour emissions can vary drastically with no predictable cycle, at least in the U.S.).

Fig. 2: I understand from the text that correlations between sub-sectors are accounted for, but as this (and the next) figure shows aggregated sectors and no off-diagonal terms (i.e. no correlations in the uncertainties between sectors), why show these in this manner? Is the color axis in units of emissions, or do they range from 0-1 because they are covariances? (I would think the former, or they would all be 1 on the diagonal?). Or am I missing something here. Please clarify.

L218: should read "it is important to ensure"...

L234 define MC as Monte Carlo earlier

Fig 7 & 8: Captions should indicate left and right panels, for example "Contribution of source sectors to the total uncertainty in CO₂ (left) and CO (right) emissions, summing to 100 %."

Same for Fig 9, it is easy enough to just say (left) and (right) in the caption here.

To clarify for fig 10 & 11, these spreads in concentration are from the experiments using different random emissions maps, i.e. the model was run 500 times, correct?

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Fig 11 - I find this to be a very interesting analysis. It points to whether we expect an inversion to identify the true location of these 20 plants among all these scenarios. I.e. can some of the maps be shown to be false by the observed CO₂? The large spread indicates maybe so, but then again, once all the other sources and their uncertainty are included, it would likely be pretty hard!

Section 3.3: inversion usually does not only include time from 12-16, just because those are the observation times. You may be optimizing emissions from earlier in the day, depending on the domain size and wind speeds. This should just be noted.

Fig 12 and text related: this standard time profile (black) seems to have a monthly mean that is then also distributed hourly through the day? Is it hourly, or 3-hourly? weekday/weekend (for businesses vs. residences, assuming those are contributing to stationary combustion for on-site heating, e.g. burning of gas)? These details could be mentioned in the caption, I realize they are not necessary for describing the uncertainty method, but they are useful to know for users of the inventory emissions.

Fig 14, the text on the map, especially "Tirol" and "Hotspot", is hard to see here - perhaps larger, or placed in a different section with an arrow to the appropriate box?

L475: Does this statement refer to their methods for calculating emissions or uncertainties?

Data Availability: See note at top, this data should be publicly available on a public-facing data portal.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2019-696>, 2019.

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