

Reviewer 1 (<https://doi.org/10.5194/essd-2023-514-RC1>)

General comments

In this study the development of an updated GHG emissions database, EDGARv8.0, is outlined and supplemented with regional case studies. Updated emissions inventories, point source data, shipping emissions, and proxy methodologies are explored. This effort is aimed to improve the accuracy and consistency of the spatiotemporal distribution of emissions at national and subnational scales. The goal is to better inform climate mitigation and adaptation policy and assist climate modelers in understanding the impact of emissions on the earth and atmosphere.

This paper is rightfully within the scope of ESSD and should be published after minor revisions.

The Authors acknowledge the comments made by Reviewer 1 which helped improving the quality of the manuscript. Hereafter, we provide point by point replies in red to each comment.

Specific comments

Line 69: It is not very clear what is meant by built-up surface information from GHSL. It would be helpful to explain this or refer to some source.

The definition of by built-up surface information and non-residential areas follows the INSPIRE directive: *“A Building is an enclosed construction above and/or underground, used or intended for the shelter of humans, animals or things or for the production of economic goods. A building refers to any structure permanently constructed or erected on its site.”*

This definition of built-up necessarily applied to remote sensing derived products excludes underground structures, while it includes temporary settlements as associated to slums, rapid migratory patterns, or displaced people because of natural disasters or crises. The residential use of built-up areas is defined as dominantly for housing of people, including mixed-use buildings (i.e. having offices or shops occupying part of the floor space). Therefore, “non-residential” indicates industrial or commercial facilities, warehouses, infrastructural nodes etc., which are commonly considered not suitable for residential use.

This concept is now clarified in the text as following:

ii) development of a gap-filling method for non-population based sources using built-up surface information¹

¹This information is compliant with the definition of ‘building’ as per the ‘Infrastructure for Spatial Information in Europe’, INSPIRE directive, <https://inspire.ec.europa.eu/id/document/tg/bu>) for non-residential areas (i.e. industrial or commercial facilities, warehouses, etc.) from the Global Human Settlements Layer (GHSL)

Line 141: How does EDGAR harmonize subnational and national data? Is there some scaling of the subnational data to match the national totals.

A downscaling procedure of national emission totals is applied to obtain gridded (at 0.1x0.1 degree resolution) and sub-national data in EDGAR. Therefore, the sum of sub-national data matches the national values. This concept is clarified as following:

‘The challenge of using different and not coherent databases is overtaken by the EDGAR database, being able to consistently work both at the national and regional level, thus offering the user the possibility to work across different geographical scales. This is achieved through the downscaling of national emissions to sub-national data making use of high-spatial resolution proxies, as discussed in this paper.’

Line 148: What is meant by legal site?

‘Legal site’ has been changed to ‘legal address’. The legal address is the place where a company/industry/plant is registered legally but it does not necessarily coincide with the physical location of the company/industry/plant.

Line 253: Can also explain in this section that venting is the release of flare gas (e.g., natural gas) without burning, which is distinct from flaring. Is venting included as an emission source in EDGAR (for CH₄)?

The text has been changed as following:

‘These spatial data were also used as best approximation to spatially distribute emissions from venting, which is the controlled release of natural gas without being burned, although the two activities may not overlap.’

EDGAR includes CH₄ emissions from venting.

Line 327: Is the impact of using these new gap-filling proxies implemented in other databases or validated through other studies?

The use of the non-residential built-up surface information developed by the Global Human Settlements Layer (GHSL) represents a key novelty in the field of global emission inventories. However, similar methodologies are already applied in regional inventories, such as in Europe (Kuenen et al., 2021) where for the area source emissions, the CORINE land-use dataset was used to spatially allocate emissions to areas with industrial activity, thus supporting the validity of this assumption. Therefore, the following statement has been added to the text:

‘This methodological assumption is a key novelty of this work due to its application at the global level. However, it is in line with methodologies already applied in regional inventories, such as in Europe (Kuenen et al., 2022) where the CORINE land-use dataset is used to spatially allocate emissions to areas with industrial activity, thus supporting the validity of this assumption.’

Has consideration been given to incorporating emissions at height data as a potential feature? In our recent paper we find that SO₂ injection height is a source of inter-model variability, so

having a standardized set of data would be useful for climate models.
<https://acp.copernicus.org/articles/23/14779/2023/>

Emission height is not addressed in this work which is focussing on the spatial characterisation of the emissions. However, we recognise the relevance of this information for atmospheric modelling purposes. Therefore, we added the following sentences in Section 3:

‘Atmospheric modellers require information not only the spatial distribution of the emissions but also on the, temporal and vertical distribution of the emissions, as described in Ahsan et al. (2023), Bieser et al. (2011) and De Meij et. al. (2006). For example, De Meij et al. (2006) found that an important role is played by the vertical distribution of SO₂ and NO_x emissions in understanding the differences between emission inventories on calculated gas and aerosol concentrations. For example, accordingly with the EMEP model, industrial point sources and power plants emissions are injected up to the third level (top up to 184 m), while shipping emissions happen in the first level (top up to 20 m).’

The conclusion section can be improved with some more discussion on potential future works that address the limitations identified in the paper.

Few sentences on the strength and weaknesses of this work have been included.

Technical corrections

Line 35: Perhaps say “Knowing where emissions are released...”

Change implemented.

Line 113: Can remove “...also represented by...”

Change implemented.

Line 123: Rephrase this to be more coherent, for example "...but also for other countries such as the United States, China, and India, by providing emissions at the state or province level."

Change implemented.

Line 136: The word “cell” here is redundant.

Change implemented.

Line 147: 1970-Present

Change implemented.

Line 161: Can delete “...including the latest available information...”

Change implemented.

Line 271: “2012 to 2022”

Change implemented.

Figure 10: Is this showing CO2 equivalent?

GHG emissions in Figure 10 are expressed in CO₂eq. This information has been added to the figure caption.

Line 521: Can use the word species instead of substance.

Change implemented.

Line 543: "...what is available..."

Change implemented.

References

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