

The authors are grateful to both reviewers for the constructive comments that helped to improve the quality of the manuscript. Please see below our answers (in red) to the Reviewers' comments.

## Review 2 (Hugo Denier van der Gon)

The paper describes the construction of an emission database using where possible national or regional inventories and using a global dataset (EDGARv6) for gap filling and achieving completeness. A major difference with previous efforts (e.g. HTAPv2) is that a complete timeseries is provided and that much more recent years are covered. The dataset meets all the requirement of (global) AQ modellers and at the same time is highly policy relevant because generally speaking the regional inventories are closest to nationally-accepted emission levels. Moreover the authors made a great effort to accommodate potential users for example with sector-cross walk tables, tools to extract certain domains and a consisting mapping of VOC species. The paper is a valuable contribution to the scientific community and deserves to be published after a number of, mostly minor, corrections are made and a few issues are discussed in a bit more detail.

I only select major revision because I really like to EDGARv6 also in the figures S1-S4. (see the comments below)

The EDGARv6 emissions are now included in Figures S1-S5.

### Main concerns

Title: The title does not make clear that regional and global emission datasets are merged nor that it is a timeseries . I suggest changing the title. A suggestion could be (but not necessarily the best)

*“The HTAP\_v3 emission mosaic: merging regional and global emission time series (2000-2018) to support air quality modelling and policies”*

We revised the title including some suggestions of the Reviewer as following:

*“The HTAP\_v3 emission mosaic: merging regional and global monthly emissions (2000-2018) to support air quality modelling and policies”*

A more complete discussion on the use of REAS vs MEIC for China should be provided. In the Supp material (page 13) it is stated that *“CEDS is calibrated to MEIC, as is HTAP\_v3 (indirectly via REAS)”*. So are the MEIC emissions the same as REAS? In the paper this is not clear, as it says REAS is scaled to MEIC for the years after 2015. Scaling is more about trends, calibration is more about absolute levels. Since China is globally such a major contributor it would be good to be more explicit about why MEIC is not used directly (there can be very valid reasons) and what is meant with indirect calibration and what the scaling does.

Regarding the reasons for not directly including the MEIC inventory, we refer the reviewer to our responses to anonymous referee #1 on the same question (as reported here below). Regarding the scaling of REAS emissions after 2015, we can confirm that the scaling was done

with the trends from MEIC, and not the absolute emissions. The sentence of the Supplement mentioned by the Reviewer has been revised accordingly.

*As correctly pointed out by the Reviewer, the HTAP\_v3 mosaic aims to represent historic and current emission levels distributed over the globe, integrating to the extent possible officially reported emission maps and state-of-the-art inventories. When the third phase of the HTAP\_v3 emission mosaic was launched (Spring 2020) a consultation involving all emission inventory developers and the broader scientific community was conducted with the aim of identifying data providers for each region and defining technical details (e.g., sector disaggregation, time frame, data formats, etc.) as well as the willingness to commit to extensive cooperation with the mosaic development team in order to ensure that each regional inventory was appropriately integrated into the mosaic. The opening of the HTAP\_v3 mosaic data collection task was also announced at the TF-HTAP meeting in April 2020, and every year since a follow-up presentation at the Spring TF-HTAP meeting has been performed in order to communicate to a larger community the ongoing work, to ask for feedback, and to expand participation by the broader community.*

*The HTAP\_v3 mosaic does not represent only a collection of publicly available data, but also the community effort made by researchers and experts in the field of emissions working together to enhance our understanding of global air pollutant emission sources. In all cases, extensive cooperation between the mosaic development team and each regional team was required to ensure compatibility, identify sectoral gaps, and avoid double-counting of emissions.*

*After assessing the interest shown by different inventory compilers, the corresponding data availability, and the time schedule foreseen for this project (publication of the HTAP\_v3 mosaic by early 2022), the current data providers of HTAP\_v3 (CAM5-REG, REAS, USA EPA, ECCO, CAPSS-KU, JAPAN (PM2.5EI and J-STREAM), EDGAR) were selected. Furthermore, looking at the hemispheric transport of air pollution a major role is played by regions situated in the Northern Hemisphere which also reinforced our decision to start working with people already available for collaboration and then gap-filling missing information with the EDGAR database.*

*While the design and development of the HTAP\_v3 mosaic required focussed time and effort over a short time period, looking now at newly available datasets such as the GEAA-AEIv3.0M for Argentina by Puliafito et al. (2021), the INEMA for Chile by Alamos et al., (2022), and the DACCIWA for Africa by Keita et al., (2021) we believe that including some of these inventories in an updated version of HTAP\_v3 would be relevant. However, the modelling community needs the HTAP\_v3 data now and their modelling experiments cannot be delayed.*

*More specifically, the inventory for Argentina documented by Puliafito et al. (2021) seems to fulfil all of the requirements of HTAP\_v3 (e.g. temporal, spatial, and sectoral coverage), and the authors believe it would represent an important improvement to characterize South American emissions, although covering only Argentina.*

*The inventory for Chile (Alamos et al., 2022), on the other hand, covers only the 2015-2017 period, while the purpose of HTAP\_v3 was to support time series analysis of air pollutant emissions and the corresponding air quality modelling. So, the work by Alamos et al. (2022), although possibly representing the best available knowledge of recent emission levels in Chile, does not satisfy the selection criteria defined for the development of HTAP\_v3.*

Concerning the work by Huneus et al. (2020), it provides an overview of available global inventories (including EDGAR) and local/city scale datasets. This work aims at evaluating differences among inventories and approaches, but it does not provide a reference official inventory to be used over the South American domain. For this reason, only the Puliafito et al. (2021) work covering Argentina may be considered in future updates of HTAP\_v3. Another possibility would be to rely on the ongoing work under the ‘Latin America and Caribbean GEIA Working Group’ (<http://www.geiacenter.org/analysis/working-groups/latin-america-and-caribbean-wg>) and integrate state-of-the-art inventories for South American countries as soon as they become available. This process will require time and coordination with local experts, therefore being an ongoing work it cannot be integrated in the current HTAP\_v3 mosaic.

The DACCIWA inventory for Africa (Keita et al., 2021) was not yet published at the time when we gathered the contributions from the different data providers. Feeding the HTAP\_v3 mosaic with the DACCIWA data would require the support of the DACCIWA developers since higher sector resolution data should be shared, consistent with HTAP\_v3 features. Furthermore, the DACCIWA data require authorization for download.

To summarize, we agree with the suggestion of the Reviewer regarding the possibility to include inventories covering the South American and African domains in future updates of HTAP\_v3 in collaboration with the corresponding inventory developers.

In the conclusions we added the following paragraph to possibly include in future updates of HTAP\_v3 additional regional inventories following the scientific literature development:

‘Thanks to the continuous improvement of local and regional emission inventories, recent literature shows emerging new datasets reporting regional information over areas of the world not covered by local inventories in the current HTAP\_v3 mosaic (e.g. Argentina (Puliafito et al. 2021), Africa (Keita et al., 2021) or the MEIC inventory ([http://meicmodel.org.cn/?page\\_id=1772&lang=en](http://meicmodel.org.cn/?page_id=1772&lang=en))). Future updates of this work may also integrate reliable and up to data information over South America or Africa as time and resources permit.’

Similarly to the arguments reported above in the selection of the inventories contributing to HTAP\_v3, in the case of MEIC the authors were not able to obtain detailed data (e.g., sector disaggregation, temporal coverage, and high spatial resolution maps) and all of the support from the MEIC experts needed to appropriately integrate the MEIC data for China into the HTAP\_v3 mosaic. MEIC publicly available data ([http://meicmodel.org.cn/?page\\_id=1772&lang=en](http://meicmodel.org.cn/?page_id=1772&lang=en)) unfortunately do not follow the requirements of the HTAP\_v3 mosaic, so enhancing cooperation with the MEIC developers is of the utmost importance in future when representing Chinese emissions. We hope to be able to include Chinese emissions from MEIC in a future HTAP mosaic inventory through the necessary cooperation with the MEIC experts.

In line with the comments of the Reviewer regarding specific local inventories which could have been incorporated in HTAP\_v3, the following paragraph has been included in section 2.1 to clarify the choice of the selected local/regional inventories and possible future updates of HTAP\_v3:

*'Recent literature studies (Puliafito et al., 2021; Huneus et al., 2020; Alamos et al., 2022; Keita et al., 2021; MEIC for China ([http://meicmodel.org.cn/?page\\_id=1772&lang=en](http://meicmodel.org.cn/?page_id=1772&lang=en))) document additional regional/local inventories which may contribute to future updates of HTAP\_v3, in particular extending the mosaic compilation to regions in the Southern Hemisphere. Considering relative hemispheric emission levels as well as the atmospheric dynamics happening in the Northern Hemisphere and regulating the transboundary transport of air pollution, the current HTAP\_v3 mosaic should still satisfy the needs of the atmospheric modelling community, although improvements using latest available inventories for Africa and South America may also be considered for future updates.'*

P10 141 – the emphasis on energy (+98%) is misleading. The total emission for this sector is not even visible in fig3a. So, here it is necessary to discuss % change in combination with absolute importance.

We removed the mention to energy since it was misleading.

Fig 3a: BC and OC will be part of PM<sub>2.5</sub>. However, they make up less than 50% of PM<sub>2.5</sub> – some discussion on what the other 50+ % is made of? (sulfates, mineral)?

We appreciate the Reviewer's comment and we add the following explanation to the manuscript in order to clarify the difference between PM<sub>2.5</sub> and the sum of BC and OC:

*'Figure 3a shows more than 50% difference at the global level between PM<sub>2.5</sub> emissions and the sum of its carbonaceous components (BC and OC), which however varies depending on the region and sector. The largest difference between PM<sub>2.5</sub> and the sum of BC and OC is generally found for the energy and industrial sectors, where due to the high temperatures BC and OC are largely burned. Within this sector, the non carbonaceous fraction of PM<sub>2.5</sub> represents around 75% in Europe, 78% in the USA and up to more than 95% over Asian countries (e.g. China and India). This PM fraction is represented by other minerals, ash (mostly when burning coal) and sulphate. Road transport is also a sector showing large differences between PM<sub>2.5</sub> and the sum of BC and OC, with around 40% difference for Europe, around 90% difference for USA and lower values for India and China (around 15%). This component may be associated with other minerals. For the residential sector, this difference is generally lower and around 25% (for Europe and Asian countries), while around 37% in the USA and is possibly associated with other minerals and ash due to coal combustion. Shipping is also a sector where a large component of PM<sub>2.5</sub> (around 70%) is not associated with carbonaceous fractions but to sulphate. In particular, regions within the Sulphur Emission Control Area (SECA) show lower contributions from sulphates (e.g. Europe and USA) with an overall contribution of 5-10%. Another source of uncertainty which may contribute to enhancing the difference between PM<sub>2.5</sub> and the sum of BC and OC is associated on how different inventories consider condensable particulate matter.'*

Also on Fig 3 panel b- are there no CO emissions from int shipping? – seems strange giving the BC, NO<sub>x</sub> contributions. Or is it just not visible?

The absolute amount of CO emissions from int. shipping is just much lower compared to the other sources (0.9 Mt in 2018), so the corresponding line is not visible in the figure.

In the supp. Material page 12 in the section S2 – Comparison of HTAP\_v3 emission mosaic vs. regional and global inventories it says

*we compare HTAP\_v3 against CEDS\_v2021\_04\_21 (O'rourke, 2021), EDGARv5.0 ([https://edgar.jrc.ec.europa.eu/dataset\\_ap50](https://edgar.jrc.ec.europa.eu/dataset_ap50), (Oreggioni et al., 2022)), EDGARv6.1 (which is used in HTAP\_v3 as gapfilling inventory, [https://edgar.jrc.ec.europa.eu/dataset\\_ap61](https://edgar.jrc.ec.europa.eu/dataset_ap61)), etc.....*

However, in the figures S1-S4 (and legend) EDGARv6 is not present. Only v5 is represented (in green). This should be amended because now the question remains open what the difference is between v6 and the regional inventories used. Are the discrepancies the same as EDGARv5 or? Next to showing this in these valuable figures S1 -S4; the discrepancy (if present) with EDGARv6 and the regional inventories should be discussed because v6 is also used for gap filling and/or replacing any region w/o a consistent regional emission timeseries.

**Figures S1-S5 now include EDGARv6 as correctly pointed out by the Reviewer.**

The figures S1-S4 also raise a few additional questions.

EDGARv5 seems to show a very strange trend for the region “islands” (e.g. CO emissions around 2012). I assume the HTAPv3 here is in line with EDGARv6? Obviously the total emission level for this region is very small but the pattern is so strange that a brief comment would be helpful

**As shown in the updated Figures S1-S5, the strange pattern observed for the region ‘islands’ is not anymore present in EDGARv6.1. Furthermore, the difference in the comparison of SO2 and NOx emissions for the region ‘Islands’ is associated to the emissions of Maldives which are provided by the REAS inventory while the emissions of all the other countries are provided by EDGAR. A note is also included in the supplementary material as explanation.**

### **Minor corrections**

Throughout the paper (starting p2 l 34) HTAPv3 is called a tool. In my opinion it is an emission database, not a tool. I would favor correcting that throughout the MS. (e.g. a model is a tool, but an emission data base is a product in itself). Later it is said that it also contains tools for the extraction of certain domains. Yes, those are tools to be used on the emission database. (Not tools to be used on the tool.)

**We have changed the word ‘tool’ to ‘database’ throughout the manuscript.**

P2 l 42-43 This is duplication of what was said before

**Sentence removed.**

P2 l 50 allow

**Change implemented.**

P3 l4 remove wide

**Removed ‘wide’.**

P3 18 baseline or start year?

Changed baseline to start year.

P5 1 38 – constant appears 2x

Removed the duplication of ‘constant’.

P5 139 submitted – what is status now?

This paper is now published:

Foley, K. M., Pouliot, G. A., Eyth, A., Aldridge, M. F., Allen, C., Appel, K. W., Bash, J. O., Beardsley, M., Beidler, J., Choi, D., Farkas, C., Gilliam, R. C., Godfrey, J., Henderson, B. H., Hogrefe, C., Koplitz, S. N., Mason, R., Mathur, R., Misenis, C., Possiel, N., Pye, H. O. T., Reynolds, L., Roark, M., Roberts, S., Schwede, D. B., Seltzer, K. M., Sonntag, D., Talgo, K., Toro, C., Vukovich, J., Xing, J., and Adams, E.: 2002–2017 anthropogenic emissions data for air quality modeling over the United States, *Data Brief*, 47, 109022, 33 pp., <https://doi.org/10.1016/j.dib.2023.109022>, 2023

P6 15 2002 onwards

Change implemented.

P6 120 years 200 and 2001

Change implemented.

P10 15 replace can than consider with discuss

Change implemented.

P10 150 should be (-24.3%) not (24.3%)

Correction implemented.

P11 13 remove “it” from it is

Correction implemented.

P12 1 7-16 the more detailed CAMS-TEMPO dataset by Guevara et al (2021) is made specifically to match, and support the use of, the CAMS-REG inventory. So after 113 “Further analysis has shown that for the European domain 14 regional rather than country-specific monthly profiles are applied.” It would be better to say: Therefore, for Europe new state-of-the-art profiles have been made available under the CAMS programme by Guevara et al. (2021).

Change implemented as suggested.

P13 137 derives from the = is made by

Change implemented as suggested.

P14 11 remove certain

Removed 'certain'.

P14 12 pollutants = pollutant emissions. Moreover it would better to break 11-4 into 2 sentences.

Pollutants has been changed to pollutant emissions and the sentences have been rephrased.

Caption fig 3 delete 2018 as first word and add behind HTAP\_v3 "for the year 2018"

Change implemented.

Table 1; 2<sup>nd</sup> row US EPA (and ECCC) is country inventory not inventories

Change implemented.