

Interactive comment on “CAM5-TEMPO: global and European emission temporal profile maps for atmospheric chemistry modelling” by Marc Guevara et al.

Anonymous Referee #1

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M. Guevara and co-authors present a manuscript that discusses the development of a new CAM5-TEMPO dataset, which provides temporal profiles for seven atmospheric pollutants and two greenhouse gases for use in 3D atmospheric chemical transport models. Depending on the sector and compound, the dataset provides compound-specific profiles with monthly, weekly, daily, and hourly temporal resolution and reports profiles as a function of emission sector. Two final data products are publicly available, which provide gridded data at 0.1x0.1 degree spatial resolution at the global scale and 0.1x0.05 degrees for European countries, and are consistent with sectoral definitions of emission inventories developed under the CAM5 program.

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This manuscript describes much-needed updates to emission temporal profiles and does a fairly thorough job of documenting the development process. The majority of the manuscript is devoted to the methods section, while the results and discussion section provides select comparisons with available profiles for select sectors, cities, and time periods. The manuscript describes a large amount of excellent work and is generally well-written. However, my first main comment is that the authors should spend additional time in the introduction clarifying exactly how these profiles are an improvement upon past profiles. It is clear that the development of this dataset is well thought-out and has taken a monumental effort, the authors just need to further distinguish the novel aspect of their profiles.

To aid in this clarification, the authors could include a summary table in the introduction or in the supplement that explicitly states which sectors, species, and temporal profiles were developed in this work. While this information is described in the text, a summary table in the main text or supplement would be helpful for modelers seeking to incorporate these updated profiles in their work. While Tables 1 and 2 do provide most of this information, it would be helpful to extend these tables to also include explicit information about the profiles available for each compound in each sector and their spatial resolution. As the CAM5-TEMPO data are provided on a grid, readers may initially think that each of the profiles vary with the same spatial resolution, however, many sectoral profiles are only available at the country level.

My second main comment is that this manuscript would be improved if the authors provided additional discussions (where relevant) about the applicability of their assumptions in regions with limited data, such as Asia, Africa, and South America, which may have different profiles than European countries. This manuscript does a great job of discussing and presenting the regional European data used to derive the CAM5-REG-TEMPO dataset (plus the European countries in the global dataset) but is limited in its discussion of other regions. Similarly, Section 3.1 only provides an evaluation of the CAM5-TEMPO profiles by comparing the data to independent observations in Europe.

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If sufficient data does not exist to provide a robust comparison for other regions, this needs to be clearly stated.

Along these lines, the Editorial on ESSD goals, practices, and recommendations by D. Carlson and T. Oda state that authors must describe and document the uncertainties in their datasets. While uncertainties are very difficult to quantify for datasets such as CAMS-TEMPO, the authors should include an additional section where they explicitly discuss the sources of uncertainties in their temporal profiles and how these uncertainties may impact their dataset. Some of this information is already provided in a discussion of limitations on lines 820 – 833, which should be moved to a separate section.

Other relatively minor comments are below and are meant to help improve the clarity of the manuscript. Most comments are requesting additional discussion about the assumptions made in the derivation of profiles for select sectors. For the road sector, the authors generally do the most thorough job of explaining the applicability and impact of their assumptions to regions outside of Europe.

Specific Comments: Introduction – The authors provide a thorough description of widely used global and regional temporal profiles that are currently available. The paragraph starting on line 71 then goes on to discuss some of the limitations in current profiles, including that the same profiles are applied across multiple countries and sectors. The remainder of the introduction indicates that the CAMS-TEMPO dataset is an improvement upon these past datasets as it is derived with more updated input datasets and includes unique profiles across countries, sectors, pollutants, and year, depending on the given profile. However, this is where a summary table would be helpful to highlight exactly which profiles (e.g., which resolution, sectors, and species) are improved over past work and what the basis of the improvements are (e.g., meteorologically -dependent, finer spatial resolution, etc). Since some of the CAMS-TEMPO profiles are taken from the TNO dataset and some are derived by applying the data from the most spatially similar country, it is unclear in the introduction exactly what the

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improvements are for each sector and compound compared to previous profiles, particularly since the EDGAR and GAINS profiles are relatively-recently released. This could be clarified with a table in the introduction that compares the years, temporal resolution, and spatial resolution of previous datasets compared to this one.

In addition, it would be helpful to add a few sentences at the end of the introduction about the structure of the manuscript. State that the first few sections describe the development of the sector-specific profiles and that the remaining sections compare the profiles to currently available datasets.

Section 2 – Methodology General comments - Since the availability of monthly, weekly, daily, and hourly profiles, as well as the degree of spatial information is different for each sector and compound, it would be helpful if the authors clarified early on in each section why only certain profiles were derived and why certain sector and compound profiles are spatially invariant (similar to line 324). For example, are the limited profiles due to a data limitation issue (as for the industry sector) or due to the characteristics of the emission source?

It would also be helpful to briefly describe the data used to develop the TNO profiles so that the readers have a sense for how contemporary the TNO profiles are.

Could the authors also comment on the applicability of fuel-weighted profiles that are spatially aggregated to the national-level? For instance, the use of coal in power plants in the US is not evenly distributed geographically across the country. What impact does the spatial variation of fuel use have on the derived temporal profiles (for the energy sector specifically)?

Line 120 – If aviation is discussed in the methods, it should be included in the lists of sectors in the abstract and introduction.

Line 161 – The IEA data is available for a large range of both OECD and non-OECD countries. Could the authors comment on their decision to use TNO profiles for some

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countries that have available IEA data?

Line 188 – It is unclear why the fuel-specific monthly factors for countries with IEA data could not be derived. IEA data is provided for each of the fuel types described above from the ENTSO-E dataset.

Line 192 – Provide a reference link to the EPA's recommendations.

Line 199-201– It is not clear what 'methodology' this line is precisely referring to. Are the authors referring to Eq. (1)? (Same comment for line 208)

Line 258 – 267 – While the authors provide sufficient evidence for the choice of $f = 0.2$ for European countries, they also note that there are large differences in the relative use of biofuel for home heating vs. cooking in developing regions. The authors note that an investigation of the choice of different values of f and T_d will be presented in future work. As global emissions from the residential sectors are largest throughout Asian countries, such as India and China (Hoesly et al., (GMD) 2014), the authors should provide examples of monthly and daily profiles under a range of f and T_d values and discuss how the current assumptions based on European statistics may impact the derived profiles in other regions that produce a large share of the global total residential emissions.

Line 301 – typo – assign

Line 302 – did the authors mean to include CH₄ in the list with NO_x and SO_x?

Line 340 – 347 – This paragraph discusses some of the assumptions of low inter-annual variability and relatively constant monthly profiles across different industrial sub-sectors. These assumptions are supported by evidence in European countries in Figures S3 and S4, however, there is no discussion on the applicability of these assumption to other large emission regions such as the U.S. and China. Select monthly profiles from non-European countries should be discussed here as well.

Section 2.5 – General comments In Table 2, it appears that unique profiles are reported

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for different vehicle fuel types in the CAMS-TEMPO regional dataset. However, there does not seem to be a discussion in this section on differences in profiles from different fuel types. Can the authors clarify whether the CAMS-REG-TEMPO profiles are the same for the GNFR_F1, GNFR_2, GNFR_F3, and GNFR_F4 sectors?

Paragraph on line 382 – Could the authors clarify whether a vehicle type-weighting was applied to derive the temporal profiles for regions with vehicle-type emissions? How were the temporal profiles derived in these cases?

Line 451 – typo, missing period

Figure 4 – The authors should include the flat weekly profile for evaporative NMVOCs to highlight that the profile is flat. As is, it looks as if weekly data for those emissions is unavailable.

Lines 519 – 525 – This text is a repeat of the text from line 409 – 415 and could be replaced by a reference to the previous section. It should also be noted whether the profiles for China were derived from the Guangzhou study and the rationale behind applying factors from Germany to other countries throughout Asia and Africa.

Line 625 – remove one of the instances of 'hourly' in this sentence.

Line 773 – The tables in the appendix should be referenced throughout the main text as they are helpful for the reader.

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