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**Geoscientific
Model Development
Discussions**

# *Interactive comment on* "A pre-processor of trace gases and aerosols emission fields for regional and global atmospheric chemistry models" *by* S. R. Freitas et al.

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Anonymous Referee #1

We thank the reviewer for his/her insightful and helpful comments. The paper is now much improved by his/her comments and corrections. The reviewer's comments are in italic style and blue color.

Q)The authors introduce the tool PREP-CHEM-SRC, which pre-processes data of various emission inventories to make them directly applicable for some atmospheric chemistry models. PREP-CHEM-SRC seems to be helpful for applicants of the models mentioned in the article, but some major questions arise about the universality of the



system: The authors list the models for which PREP-CHEM-SRC is currently used. It is not quite clear, how much work it would be to use it in other models as well: – What is to be changed for a model using a different grid, e.g., the limited area model of the consortium for small-scale modeling (the COSMO model) which works with a rotated Gaussian grid. – What needs to be implemented into an other model for the usage of the system?

We did cover the most common grid projections used in limited area and global models (Vide definition of the grid_type parameter in Appendix A). Indeed, the implementation of other grid projections will require some extra coding. However, our group is open to helping potential users of our code who are interested in different grid projections, once the details of the new projections are provided. Its use with other modeling systems simply requires a routine to convert the emission fields to the new model grid format.

Q)A statement about the data format of the output of the pre-processor is missing. In the "software" subsection it is mentioned that the package requires HDF and NetCDF libraries, so I suppose PREP-CHEM-SRC can produce HDF and NetCDF output. Furthermore it is not clear how many files (and fields) the preprocessor produces in the end. One per species and inventory or one per inventory or only one at all independent of the numbers of emissions chosen?

Output using NetCDF or HDF formats is not yet available. A new version of the code with this option will be released soon. Normally, all emission fields are stored in only one output file, with the exception of WRF, which uses 2 emission output files, one for biomass burning and another one for anthropogenic + biogenic emissions, following a special request from the WRF team.

Q)Apart from the general questions about the usefulness of the tools for users of other than the mentioned models, there is one major concern about this paper: The authors urgently need to improve their article in term of grammar and linguistic style. Sometimes the linguistic flaws are even clouding the meaning of the text (see questions

below). Thus I only support final publication after a thorough linguistic revision, copy editing might be a good idea.

A grammar and linguistic style revision was done by a native English speaker/writer.

Q)In the following more specific questions or remarks are listed: abstract: You state that PREP-CHEM-SRC was written to prepare emissions for chemical transport models. The term “transport model” is –after what I understood from your publication– to restrictive. Transport models are driven by externally calculated dynamics. But most of the listed models calculate their own dynamics.

The 1st sentence of the abstract reads now: “The preprocessor PREP-CHEM-SRC presented in this paper is a comprehensive tool aimed at preparing emission fields of trace gases and aerosols for use in atmospheric chemistry transport models, either on- or off- line.”

Q) p856, l. 19: I can imagine more details about the implementation of the emissions into the models. What do I need to use emissions produced with PREPCHEM- SRC? Most probably a “read-in” facility is required: is this available in a generalised form or is it implemented for each emission individually?

This tool has not been designed to implement emissions into the models but to allow the preparation of gridded emissions with flexible spatial resolution and grid projections. The typical output of this preprocessor is one binary or text file for each grid domain (more than one in case of nested grids) containing all the emission files, currently with up to 4 emission fields (urban, biomass burning, biogenic and volcanic processes) per chemical specie. As we wrote in the answer to the first question: The use of this tool with other modeling systems simply requires a routine to convert the emission fields to the new model grid format.

Q) Section 2.2.2: It does not become clear, how the MEGAN emissions are treated. You write that they depend on “land cover, weather, and chemical composition”. As



these parameters are changing with time, the emissions depend on time too. So how can it be calculated beforehand?

The dependence on land cover, weather variables and chemical composition is included in the MEGAN model to provide the daily net flux of the chemical species. Our system only provides this flux applied to the time period and spatial domain required by the user. We changed the text to clarify.

Q) p. 860, l.8/9: “The hypotheses assumed for the burnt area needed for Eq. (1) are detailed in Longo et al. 2007.”: Please give more details about this in the paper.

The following sentence has been included in the text: “The burnt area of detected fires in the GOES WF_ABBA product is estimated from the instantaneous fire size for each non-saturated and non-cloudy fire pixel, from which it is possible to retrieve sub-pixel fire characteristics. For detected fires in GOES WF_ABBA that have no information about the instantaneous fire size, a mean instantaneous fire size of 0.14 km2 (calculated from the GOES ABBA database of the previous years) is used. For fires detected by the MODIS and AVHRR systems, a mean value of 0.22 km2 of burnt area is used (Longo et al. 2010).”

Q)“See AM2001 for a complete list of species available within the PREP-CHEMSRC system.”; Please give the list in the paper (maybe in form of a table).

Done. See Table 2 in the manuscript.

Q) p. 861, l. 5-7; I am not convinced w.r.t. the good consistency of the emissions. GFEDv2 shows much less emissions in Bolivia and Acre and in the middle of the Amazonas region there are simply no emissions. With respect to Paraguay GFEDv2 provides larger emissions at the north-eastern border, whereas 3BEM provides high emissions at the eastern border of the southern part of Paraguay. This is not a “good consistency” in my eyes.

This sentence reads now: “These two biomass burning emission inventories show

general agreement, with most of the emissions being located in the area around latitude 10ïĆřS between longitude 67ïĆřW and 50ïĆřW, on the border between the Amazon forest and the main area of intense land use and land cover change for cropland and pasture. Nevertheless, there are strong disagreements in some places (especially in western SA). The choice of database really depends on the application. For example, 3BEM is more suitable for chemical weather studies, since its spatial resolution can be as fine as the pixel size of the satellite sensor used for the fire detection and it has a temporal resolution of one day or less, and also due to the fact that emissions are placed only in regions where fires were in fact observed (Longo et al., 2010). "

Q) Sect. 2.4.: Leave out the "umbrella cloud characterization" in the title of the section, as only 1-2 sentences refer to the umbrella cloud. By the way, it is "volcanic emissions" and not "volcanoes emissions".

Done.

Q) Sect. 2.4.1: It is not quite clear in this section, what is provided to the model. It could be, that the emissions are calculated by the pre-processor, or that the ESPs are provided to the chemistry models. The user first has to read Section 3.2 to know what you are talking about. This might simply be a linguistic problem. I recomment to rephrase this section.

We rephrased this section.

Q) p. 862, l. 8/9: "Each file contains the number of events for each day over the entire world." What do you mean, if each file contains each day you do not need more than one file, do you?

We rephrased this section. It now reads: "There is one file for each year which contains the number of events for each day of that year over the entire world."

Q) p. 862, l. 13/14 ( and p. 861, l.24/25): What do you mean by "collocates each volcano emission within the nearest grid box". As the grid covers the entire model



domain, I would expect the volcano to lay in one grid box. What do you mean by nearest grid box? By the way "collocate" means something like "arrange", "compose", most probably you mean something like "place" or "locate", dont you?

We rephrased this section. It now reads: "PREP-CHEM-SRC places each volcanic emission within the grid box which surrounds the volcano's geographical location."

Q) last part of Sect. 2.4.2.: The processing of the total emissions in one column is not clear: Is there one emission height for all volcanoes in one column? Does this lead to the emissions in one column being placed in one grid box only, which is located at the effective column height of the emissions? Or is it possible to distribute the emissions over a number of levels depending on the heights of the different volcanoes located in the respective column?

Currently, for a set of volcanoes residing within only one grid box, an effective column height will be given by the mean of each column height weighted by the SO2 mass emission rate of each volcano. This could be easily changed if the user wants a different approach.

Q) Section 3.1.: What about stacks? Following your description, they are part of the cold/low bouyancy emissions. But often stacks emit hot and wet fumes which are bouyant. How do you handle these?

Currently, we don't include stack emissions since we don't have this information available. We assume that this emission is already included in the EDGAR and RETRO inventories, but we treat it as a surface emission. A future release will have a special functionality (similar to the volcanic emission approach) in order to allow the user to specify the stack height in the emission file. With this information, it would be easy to determine in which vertical layer of the transport model the emission should be released in the atmosphere.

Q) Section 3.1.: Please give a unit for E.

Done (the unit is kg[$\eta$] /(kg[air] dy)).

Q) p. 864, l. 7: It is “emission rate”, not emission. Is the unit of the emission rate per dry air or per humid air?

It’s dry air, as stated in the text below Eq. 2.

Q) Eq. 6: Be precise: The emission depends on the time and rho depends on the level.

Thanks, Eq. 6 was reformulated.

Q) Fig. 2: improve the quality of the picture: it is out of focus, and it looks like a slide hastily copied into the paper. Reduce the size of the axis labels “r(t)” and “time”.

Done.

Q) Fig. 3: A sketch might be clearer than a photo.

Thanks for the suggestion.

Q) p. 865, l. 9-14: The sentence is much to long and not correctly completed, as the relation of “them” is grammatically wrong.

The sentence now reads: “In the methodology proposed by Freitas et al. (2006, 2007, 2010), a 1D plume rise model is embedded in each column of 3D low resolution atmospheric chemistry transport models (the hosts) to interactively provide the smoke injection height, the actual region where trace gases and aerosols, emitted during the flaming phase of vegetation fires, are released in the atmosphere.”

Q) p. 865, l. 16: What is lambda?

It is the fraction (between 0 and 1) of the total mass which is released to the atmosphere during the smoldering phase. This information has now been included in the text.

Q) Eq. 7: k > 1 is missing.

Here we use the expression h- Delta (zh)/2 < z(k) < h+Delta(zh)/2 instead of k>1.



Q) last paragrah of Sect. 3.2: Please give a reason for the diurnal cycle in biomass burning.

The following paragraph has been included in the text: "The burning diurnal cycle typically shows a peak between approximately 13:00 and 18:30 local time, with the fire activity peaking earlier for heavily forested regions. The diurnal fire cycle is dictated primarily by the diurnal cycle of human activity; however, for high fractional tree cover the diurnal meteorological conditions limit ignition to a relatively brief period of the day."

Q) Sect. 4.1 last paragraph: Does the emission generation depend on the chosen chemical mechanism? In other words do I have to use one of the named mechanisms or do you simple mean, that all species treated by these mechanisms are included in PREP-CHEM-SRC?

Yes, the system is prepared to be used with the chemical mechanisms indicated in the text. This is necessary because of the different species aggregations used by each chemical mechanism.

Q) Table 2 is very longish. As no information at all is provided about the individual entries of the namelist/table, I suggest to move the table into an electronic supplement, because it has no added value for the article itself.

Table 2 is now in Appendix A.

Q) Figure 5: The comparison would be easier if the smaller grid section would be displayed on both panels. As it is, details in the right panel are hard to spot.

We want also to show the system capability to produce emission fields on nested grids.

Q) p. 867, l. 18: “In this resolution is more discernible the emission rates within the SPMA”: I do not understand this sentence. Please, rephrase it.

Done.

Q) p. 868, l. 8: What is grid resolution G5?

The resolution is approximately 250 km. This information is in the text.

Q)In the end I give a list of some of the language flaws (please be aware that this is –by far– not a complete list): First, some more general remarks: use one spelling only: decide whether to write “pre-processor” or “preprocessor”.

Done. We are using now only ‘preprocessor’.

Q) The programming language is spelled Fortran 90 (not FORTRAN 90)

Done.

Q) 0.5 x 0.5_: Both directions are in degree, thus write 0.5_ x 0.5_. The same holds for other resolutions.

Done.

Q) The abbreviations AM2001, A2010 and M2009 are introduced and used only 2(3) times afterwards. It would be better to fully cite the articles throughout the text.

Done.

Q)Second, some specific reformulation suggestions: the title: “trace gas and aerosol emission fields”. “Trace gases and aerosols” need not to be plural, as they only describe the fields, which are in plural.

Done, thanks.

Q) p856, l. 7 (and p. 868, l. 25): plumerise model ! plume rise model; I only heard of “plume models” until I read this article.

We are now using only ‘plume rise model’. This term is indeed very common and denotes methods to determine the final rise of buoyant plumes.

Q) p856, l. 19: “The way .. is detailed” ??? Maybe “The inclusion of these emissions is described in detail”?



Done, thanks.

Q) p856, l. 14/15: “have became” ! “became” or “have become” or here simply “are”.

Done, thanks

Q) p.856, l. 17: “upper levels mass fluxes” ! “upper level mass fluxes”

Done.

Q) p.857, l. 3/4: “The emissions pre-processor is also under implementation ...”: Apart from the fact that emissions should be singular, do you really mean that it is currently being implemented or is it already implemented: “The emission preprocessor is also implemented into the global circulation model of the Brazilian Center ... “

Done, thanks

Q) p. 857, l. 14: what are “selected choices”?

The sentence was rephrased. It now reads: “This section is devoted to describe all types of emissions currently available within the PREP-CHEM-SRC system. Depending on the modeling system, the user may select all kinds of emissions (anthropogenic, biogenic, biomass burning, etc) or select only part of the entire available set.”

Q) p. 861, l. 16/17: “Volcanoes eruption” ! “Volcanic eruption”

Done.

Q) p. 868, l. 9/10: “On the left side, mostly of emission is associated to densely industrial and urbanized areas.” ! “Most emissions displayed in the left panel of Fig. 8 are associated to dense industrial and urban areas.”

Done, thanks.

Q) p. 868, l. 10: The first part of the sentence does not make sence to me.

The sentence was rephrased. It reads now: “On the right, urban emissions over Europe

and biomass burning emissions associated with deforestation activities in northwestern Africa are presented."

Q) p. 868, ll. 17/18: "Emissions fields are interpolated onto the model grid, with several options of map projections available and flexible spatial resolution." ¡'To interpolate the emission fields to the model grids, the user can choose between several map projections and determine the spatial resolution in a flexible way.

Done, thanks.

Q) "The main interests of this new pre-processor". I do not believe, that your pre-processor has interests itself. What about "The main accomplishments of this new pre-processor are ..." ?

Done, thanks.

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Interactive comment on Geosci. Model Dev. Discuss., 3, 855, 2010.