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Comment on gmd-2021-130

Anonymous Referee #2

Referee comment on "Harmonized Emissions Component (HEMCO) 3.0 as a versatile emissions component for atmospheric models: application in the GEOS-Chem, NASA GEOS, WRF-GC, CESM2, NOAA GEFS-Aerosol, and NOAA UFS models" by Haipeng Lin et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-130-RC2>, 2021

This manuscript describes the HEMCOv3 system, a flexible tool for processing and adapting emission inventories for air quality modelling purposes. The strength of HEMCO is in its ability to combine multiple inventories in a very flexible and transparent way, as well as in the fact that it can be used on-line with multiple atmospheric chemistry transport models. The paper is well structured and a good contribution to GMD. Nevertheless, it is sometimes lacking details. Therefore, the paper should be revised according to the following comments before being published.

The new version of HEMCO is capable of calculating emissions at any model resolution including multiscale and unstructured grids. This is highlighted by the authors as an improved capability of the system compared to its previous version. However, no description is provided in terms of: 1) how HEMCO creates multiscale and unstructured grids, 2) how the regridding of emissions is performed for these cases (i.e., how the mass conservation is ensured) and 3) how the definition of these types of grids needs to be provided by the user. Besides these points, authors should also clarify if the new version of HEMCO can perform a remapping to working grids using projections different than regular lat-lon (e.g., lambert conformal conic, polar stereographic) as these types of projections are widely used in the modelling community.

A general description of the "HEMCO extensions" should be provided (i.e., a brief description of how the built-in algorithms estimate emissions from vegetation, dust, lightning and ocean, including parameters and estimation methodologies used. Specific references to these extensions should be also included if available.

I think it would be useful for the reader to know which are the emission inventories that are currently considered in the database library of HEMCOv3. A summary table or link to a

page where this information is specified would work. Is there any pre-processing associated to the original emission inventories so that they can be ingested by HEMCO (e.g., renaming of pollutant names to have them homogenized across all inventories)?

The vertical preprocessing of emissions is not required anymore in HEMCOv3, as it performs an on-line vertical regridding of the original emissions. It is however not clear to me how the user can assign sector-dependent vertical profiles to input emission inventories. This is relevant for those sectors in which emissions are originally reported in a single layer (e.g., emissions from energy sector in CEDS). Perhaps an example could be added in Figure 2.

HEMCOv3 can operate on a higher resolution than the model working grid for masking and scaling purposes. This feature allows achieving greater accuracy at country borders between different inventory domains. Authors illustrate this function with an example in which two emission inventories are masked at resolutions of 4x5 deg and 2x2.5 deg, the later allowing a better resolution for the US-Mexico border. This is clear to me but, should not be better to directly perform the masking and scaling operations on the original grids of the emission inventories before performing the regridding? Nowadays most of the available global and regional emission inventories are provided at very fine resolutions (i.e., 0.1x0.1 deg), which would allow having a good definition of country borders. Some inventories (e.g., EMEP) even provide the information of the emitting country per grid cell. In that case, using a country mask would not be the best solution. Is the information of emitting country used in HEMCO when given?

P10 L268: There is a limit to the resolution of the HEMCO grid. Could you specify this limit?

Figure 3: "Using the 4 x finer" – Should not be 2x finer?