Earth Syst. Sci. Data Discuss.,
https://doi.org/10.5194/essd-2018-31-AC1, 2018

ESSDD

Interactive comment

Interactive comment on "Gridded Emissions of Air Pollutants for the period 1970–2012 within EDGAR v4.3.2" *by* Monica Crippa et al.

Monica Crippa et al.

monica.crippa@jrc.ec.europa.eu

Received and published: 7 August 2018

The authors are grateful for the comments of Reviewer 1, which helped to improve the manuscript. We report below the answers point by point to the Reviewer's comments.

An updated EDGAR dataset is presented that contains many important improvements and extensions. I recommend publication after minor revisions, based on suggestions in the annotated manuscript (attached). In addition, I suggest to give some indications on how to deal with seasonality and the speciation of non-methane hydrocarbons. Perhaps a recommendation about emission heights can be given in the form of a reference.

1) As suggested by the Referee, we included in the section 2.1 of the manuscript the following sentences about the treatment of NMVOC speciation in EDGAR v4.3.2:

Printer-friendly version

Discussion paper

“In our paper we focus on total NMVOC emissions, however, region- and sector-specific NMVOC speciation profiles have been developed and applied to the EDGAR database, with the same sector resolution as the total NMVOC, as shortly described below. The complete documentation on the speciation profiles and on the methodology used can be found in Huang et al. (ACP, 2017), while speciated NMVOC emissions for EDGARv4.3.2 are available at the following website: http://edgar.jrc.ec.europa.eu/overview.php?v=432_VOC_spec. Based on a comprehensive literature review, speciation profiles from regional measurements and databases are applied to split the EDGAR total NMVOC emissions into individual species, which are then lumped into 25 species groups as proposed within the Global Emissions InitiAtive (GEIA). NMVOC speciation profiles collected from the different databases and publications were the mapped to all EDGAR processes. A quality assessment by region, emission source and NMVOC species is performed focusing on Europe, North America and China. In addition the comparison between the EDGAR speciated database and the RETRO (Schultz et al., 2007) data is conducted, showing a general good agreement of the two datasets for Europe and USA, while for China higher contents of chlorinated hydrocarbon emissions from fuel extraction and industrial and power generation sectors are found from the EDGAR data set, consistently with speciation profiles of coal combustion sources collected from Chinese local studies (Cai et al., 2010; Liu et al., 2008; Wei et al., 2012).”

2) We have also included the following sentence about the seasonality of the emissions, rephrasing the manuscript as following: “For the spatial and temporal distribution of the sector-specific emission totals of a substance x for a country C in the year t (monthly) and space (on 0.1ïĆřx0.1ïĆř grids, defined with bottom-left corner for each cell) the same allocation algorithm and proxy datasets used for the GHG emission dataset of Janssens-Maenhout et al. (2017) are applied (refer to Sections 2.4 and 2.5 of Janssens-Maenhout et al. (2017)). The temporal variability of human emissions is an important factor to be modeled by a global emission inventory, therefore, the EDGAR database provides both annual and monthly emissions for

each sector. The EDGAR v4.3.2 monthly emissions available on the EDGAR website (http://edgar.jrc.ec.europa.eu/overview.php?v=432_AP&SECURE=123) are computed using the EDGAR temporal profiles described in Table S4a by Janssens-Maenhout et al. (2017). However, we point to a recent study that has been performed in order to improve the modeling of the seasonal pattern of air pollutant and GHG emissions in the EDGAR database. This approach, as documented by Huang et al. (2018), will be applied to the EDGAR forthcoming version of the EDGAR emission database (i.e. after v.4.3.2). We report Tables S4a and S4b of the aforementioned paper in Tables S6a and S6b of the supplementary material, as references for the geospatial proxy data and temporal profiles applied to the EDGAR v4.3.2 data."

3) We have included the following sentence about the emission heights as suggested by the Referee in Section 2.1:

The emission height as well as the injection velocity for emissions emitted at stacks are very important for plume dispersion modeling. However, this aspect is not addressed in this study as information on stack height and plume rise is in general not available for most regions. Anyway, we introduced the following recommendations in the manuscript: "The EDGAR database provides emissions disaggregated for different heights only for the aviation sector (both domestic and international). Aviation emissions are evaluated for three different heights corresponding to different flight phases: landing and take-off estimated at the height between 0 and 1 km altitude, climbing and descent estimated at the height between 1km and 9 km altitude, cruise flight estimated at the height between 9km and 13 km altitude. In addition, for supersonic flights emissions are estimated to happen at the height above 13 km altitude, although being a minor source of emissions. No military flights are taken into account. For the other sectors, the EDGAR database does not provide information about the emission heights, although it is a determining factor together with plume rise for emissions emitted at stacks for plume and global transport modeling. In this study we do not address this aspect, however, we can provide the following recommendations. For a global dataset of air pollution, precise stack heights cannot be provided due to the lack of information but a classification of each emission sector into ground level or at stack height emission can be assumed, as done in former publications using the EDGAR datasets (UNEP/WMO, 2011). Anthropogenic emissions which are classified as areal emissions (e.g. transportation, agriculture, residential) are mostly happening close to the ground and modelers can assume an emission height below 150 meters, while point source emissions are mostly from the stacks of power plants and industrial facilities in general occuring above 150 meters. However it should be noted that emission heights from smaller scale industries in developing countries may be at lower heights.“

We have also included the changes requested by the Referee in the manuscript as following:

1) “depending on the pollutants life time, reactivity” has been changed to “depending on the pollutants reactivity”

2) The following sentence has been removed accordingly with the reviewer's suggestion: “A new version of the EMEP/EEA guidebook (2016) has been recently released with significant updates for the emission factors (in particular for the agricultural sector); however, these updates are not included in the current release of EDGAR v4.3.2.”

3) have the residential wood burning emission updates by Van der Gon (2015) been included? The updates by Van der Gon (2015) are not included in EDGARv4.3.2 to keep the consistency of the activity data through all sectors (EDGARv4.3.2 it is based on the 2014 IEA activity data). The next version of the EDGAR data will include the latest estimates by IEA (2017) of residential wood burning emissions, which are based on the modeled wood availability for each country, similar to the approach of Van der Gon (2015).

4) “The emissions cover all human-induced activities” has been replaced with “The emissions cover all known activities”

5) While I realize that you only provide total NMVOC emissions, it would be helpful if you could make some recommendation about speciation into NMVOC compounds/categories. We have included a couple of sentences about NMVOC speciation as in point 1)

6) Comparing global totals, we find 1% deviation for PM10, 12% for PM2.5, 17% for OC and 43% for BC (mainly due to the likely underestimation of the EDGAR v4.3.2 emissions compared to the ECLIPSEV5a of coal combustion in residential activities in China and India). Is there a way to correct this? BC emissions are important for climate simulations, having a big impact on solar radiation absorption.

This is a critical point, since coal statistics for residential purposes are more uncertain than the coal used for power generation. The fuel used in several sectors is generally well known since based on the amount on fuel officially sold. However, amount of coal used for domestic heating and cooking purposes is very uncertain since it can be mined directly and does not have to undergo a distillation process (Bond et al. (2004)). It is important to mention, that in addition to coal, dirty fuels like residual fuel oil and wastes are used for domestic purposes in India and China. In addition, the combustion efficiency, different technologies and abatement measures applied to reduce pollutant emissions in the residential sector are very uncertain as well. Therefore, depending on the assumptions emission estimates for this sector are likely to differ among several emission inventories, but these discrepancies give an indication of the uncertainty of some sector- and fuel- specific pollutant emissions. As there is no obviously ‘correct’ estimate, we do not plan to correct or calibrate our emission estimates to match the emission values provided by the other inventories. As reported by Bond et al. (2004) and as discussed in the manuscript, aerosol emissions are very uncertain up to a factor of 2 for the organic components. Finally, China and India have much more super emitters (because of the fast development) which are not modeled by the EDGAR database. These considerations are duly discussed in the manuscript.

7) Please make clear if/that your aerosol emissions refer to primary particles only.

Otherwise there would be redundancy between your particle emissions and the ones formed from precursors. Or please explain. Do your OC emissions account for primary and secondary aerosols? Aerosol emissions refer only to primary particulates only. This has been clarified throughout the text.

8) "although we cannot fully understand it" has been replaced with "which we cannot fully explain".

References

Bond, T. C., Streets, D. G., Yarber, K. F., Nelson, S. M., Woo, J.-H., and Klimont, Z.: A technology-based global inventory of black and organic carbon emissions from combustion, Journal of Geophysical Research: Atmospheres, 109, D14203, 10.1029/2003jd003697, 2004.

Cai, C., Geng, F., Tie, X., Yu, Q., and An, J.: Characteristics and source apportionment of VOCs measured in Shanghai, China, Atmos. Environ., 44, 5005–5014, https://doi.org/10.1016/j.atmosenv.2010.07.059, 2010.

Huang, G., Schieberle, C., and Friedrich, R.: Mapping and integration of temporal profiles in the EDGAR system, JRC report, 2018.

Janssens-Maenhout, G., Crippa, M., Guizzardi, D., Muntean, M., Schaaf, E., Dentener, F., Bergamaschi, P., Pagliari, V., Olivier, J. G. J., Peters, J. A. H. W., van Aardenne, J. A., Monni, S., Doering, U., and Petrescu, A. M. R.: EDGAR v4.3.2 Global Atlas of the three major Greenhouse Gas Emissions for the period 1970–2012, Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2017-79, in review, 2017.

Liu, Y., Shao, M., Fu, L., Lu, S., Zeng, L., and Tang, D.: Source profiles of volatile organic compounds (VOCs) measured in China: Part I, Atmos. Environ., 42, 6247–6260, https://doi.org/10.1016/j.atmosenv.2008.01.070, 2008.

Schultz, M. G., Backman, L., Balkanski, Y., Bjoerndalsaeter, S., Brand, R., Burrows, J. P., Dalsoeren, S., de Vasconcelos, M., Grodtmann, B., and Hauglustaine, D. A.: REanalysis of the TROpospheric chemical composition over the past 40 years (RETRO) – A long-term global modeling study of tropospheric chemistry, available at: http://retro-archive.iek. fz-juelich.de/data/documents/reports (last access: January 2017), 2007.

UNEP/WMO: Integrated Assessment of Black Carbon and Tropospheric Ozone, ISO 14 001: 2004, UNON/Publishing Services Section, Nairobi, 2011.

Wei, W., Wang, S., Hao, J., and Cheng, S.: Trends of chemical speciation profiles of anthropogenic volatile organic compounds emissions in China, 2005–2020, Front. Environ. Sci. Eng., 8, 1–15, https://doi.org/10.1007/s11783-012-0461-4, 2012.

Interactive comment on Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2018-31, 2018.