

Review ESSD-2020-68

Editor requests a review, presumably because of non-availability previous reviewers. I accepted. I regret my choice. Difficult challenging paper, ruined my weekend.

Along with others, I felt pleased to see EDGAR 4.3.2 (Janssens-Maenhout et al. 2019, <https://doi.org/10.5194/essd-11-959-2019>) emerge into peer-reviewed open access. Prospective users certainly benefit; one hopes authors feel likewise. The current manuscript presumably responds to strong recommendation in Janssens-Maenhout et al. 2019: “EDGAR v4.3.2 grid-map uncertainties are currently the subject of scrutiny and are being further investigated under European (Horizon 2020) research projects CO2 Human Emissions (CHE, <https://www.che-project.eu/>) ...” (Section 2.4).

My review benefits from substantial thoughtful efforts of two prior reviewers. If I may crudely simplify assessments from initial reviews, they essentially said “potentially a useful product but badly written”. Authors have returned a revised manuscript. Extending over-simplification, I conclude: not clear its utility and still badly written.

I identify two major scientific weaknesses.

First, this product focuses on uncertainties derived from “anthropogenic CO2 emission inventories ... processed into gridded maps” (line 15 and many other places). But, we know from other assessments, and from authors’ own words, that other errors, particularly in proxy-based population distributions “will likely outweigh the combined uncertainty of activity data and emission factors” (Janssens-Maenhout et al. 2019). Therefore, current product does not in fact represent a systematic effort to understand emissions uncertainties in EDGAR or any other emissions compilation - e.g. starting from Andrew 2020, <https://doi.org/10.5194/essd-12-1437-2020> as these authors do primarily in Table 7 - but rather an attempt to reprocess EDGAR product for assimilation into ECMWF’s IFS. Fair enough. One presumes EU H2020 funding portended exactly that outcome. But that outcome is not a systematic uncertainty analysis but rather a data assimilation effort. Authors should inform readers from the start. As these authors conclude after comparison of their work to other products, this product “shows lowest values mainly due to the aggregation technique”. They have applied skill and effort to improve aggregation for purposes of model assimilation, in this case for a single very-specific (and very skillful) model. An accurate title might read: ‘Development of emission uncertainty co-variances and maps to enhance utility of EDGAR 4.3.2 for direct assimilation by ECMWF’s Integrated Forecasting System’. I harp on this point because I think previous reviews also raised this issue: what exactly do these authors want to present? A data assimilation effort or a systematic uncertainty assessment? The former might fit better as a JRC or ECMWF technical report while the latter would build nicely on Janssens-Maenhout et al. 2019, compliment EDGAR 4.3.2, and - if presented as a broadly-useful product - prove interesting to ESSD readers. As presented, reader does not know what authors intend.

Second, authors seem to assume stationarity of error terms. They use as starting source data some ill-defined combination of EDGAR 2012 and EDGAR-FT 2015 (they never define or explain FastTrack, reader needs to return to JRC technical literature to learn that terminology) to produce static maps. Authors, ECMWF modelers, and readers need to assume that 2012/2015 values / error maps, however determined, apply to prior and subsequent years? The IFS, assimilating e.g. daily upper air data, will apply one standard fixed error co-variance to all CO2 observations / reports over all years? Even given large delays and even-larger structural deficiencies of UNFCCC reports, error terms from 2012 or 2015 will not pertain for 2020? Authors mention necessary corrections to coal emission data from China. In USA and perhaps Europe, sector based emissions from transport will probably (have probably?) passed energy as largest CO2 emission sources. Again, fair enough that this work derives from a single

funded project with a targeted outcome, but authors should at least admit this further limitation of their work and inform readers what authors or readers will need to do to extend this work both in impact and in utility for future use. In particular, their dismissal of wildfire sources (e.g. what they call 'short-cycle' carbon emissions and other LULUC changes based on UNFCCC definitions) will - this reviewer suggests - prove very short-sighted. Again, if they only intend to improve EDGAR for ECMWF assimilation, good enough. If they intend a broad review of emissions uncertainties, they have missed / dismissed too many factors.

Authors moved some text, composed new paragraphs, revised some tables, and corrected typographic errors but the manuscript remains very difficult to read. It continues to include redundancies, omissions, non-sequiturs (in one paragraph we read about global carbon budgets while in the next we jump to super power plants located in single grid cells); too much material distributed with a general lack of focus, very disorderly. JRC staff must include experienced technical writers; please use them. Or hire someone outside. Otherwise authors only re-arrange their own text; like most of us they evidently remain too close to project and work to recognize overall lack of focus.

Authors declare, in abstract, intent to adhere to consistent units: "uncertainties in % and kg·m⁻²·s⁻¹ for each *ECMWF* group" (my emphasis, see point above about specificity to ECMWF assimilation system). Unfortunately, in handling large variety of external data as part of their discussion, they promptly violate those assertions. One finds GtC, GtCO₂, MtCO₂, Pg, ppm, etc. At one point (lines 67 to 69) reader encounters GtCO₂ and ppm in a single sentence, with also percent expressed in two (!) significant figures. Authors should follow example of Janssens-Maenhout et al. 2019 (or Andrew 2020 or global carbon budget or most other ESSD papers): set and scrupulously adhere to consistent units and uncertainty terms. Ideally they would apply identical units and terms in text as they do in data products but one understands in this case why they might need different units. Two different units, not twenty.

One wishes that these authors had / took time to browse through rapidly-emerging emission literature. Even if - as I barely manage - they peruse only recent ESSD literature, they will find updates to India emissions, assessment (with uncertainties) of population data products, comparison of non-gridded emission source data (e.g. Andrew 2020 already mentioned), global energy imbalance (of direct relevance to emissions calculations), etc. In this product as written one gets the sense - not surprising for any of us - that in their focus to complete CHE task they missed developments occurring parallel to but outside of that project. In these very difficult days of managing health of one's self and family, one understands necessary attention to task at hand, but this reviewer senses that manuscript lacks a slightly broader outlook that would extend beyond JRC-ECMWF axis and serve to re-assure readers of quality and utility of work?

Finally, a word about IPCC. Adopting once again my crude simplification, these authors have most often answered reviewer comments with the phrase 'IPCC made us do it'. Please understand IPCC as our on-going process, subject to constant revision and improvement. If past IPCC standards begin to 'control' or 'direct' our science (as we see in impact of IPCC cutoff dates on manuscript submissions), we have put cart before horse. IPCC should exist to adopt and share progressive evolving state-of-the-art guidelines and standards. JRC, with strengths and prominence, should represent one of our community's most influential advocates for IPCC improvements. To read, instead, that these authors justify their terms, approaches, definitions (ignoring for the moment how they 'happily' distort and re-sort IPCC sectors to better fit ECMWF assimilations) based on IPCC 2006 or even IPCC 2019, disappoints this reviewer in part because one hates to see this group 'tailor' their science to meet old IPCC standards but also in part because JRC should set a good community example by challenging and contending IPCC definitions when those definitions seem orthogonal to or obsolete for science needs.