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Comment on acp-2021-1059

Zbigniew Klimont (Referee)

Referee comment on "Opinion: Coordinated development of emission inventories for climate forcers and air pollutants" by Steven J. Smith et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-1059-RC1>, 2022

The issue of harmonization of GHG and air pollutant inventories has been discussed and attempted at regional and global level since a while...with mixed the success. The recognized importance of SLCFs led to another attempt of harmonization with GHG inventory process; in fact IPCC tried that some 10-15 years ago but at the time the conclusion was that the uncertainties and data availability is not satisfactory; at the time the focus was on black carbon. The new attempt appears more promising and the effort is supported by a larger group of scientists. This paper provides a good account of key advantages and challenges associated with the development of the harmonized (or coordinated) inventories that could serve several purposes, even though the process is driven by (and the needs) of IPCC.

My impression is that the authors occasionally deter from the main purpose of the IPCC TF and discuss this development as a way to develop an all-purpose inventory, which in my view is neither feasible nor desirable. Such discussion appears in few places referring to the multipurpose of inventories and is included also in Conclusions (see from line 541). The key reasons and end uses for this specific work and process are clear and are not meant to replace some of the existing work and established systems like the European EEA/EMEP Guidebook and the EU or UNECE reporting system. These serve different purposes. I agree that learning, exchange of information, benefit from resources available within well established national and international systems shall be utilized.

The other more general comment is about lack of reference and discussion of the EEA/EMEP Emission Inventory Guidebook and the UNECE (Air Convention) supported process that led to it. Interestingly, here the air pollutant inventory system (developed in the 90's) was extended and an attempt of harmonization with the IPCC formats was made over time, simplifying some of the air pollutant reporting but at the cost of detaching the reporting categories from the sources of emissions, losing important detail for NMVOCs, and making further enhancements to improve inventories of particulate matter more difficult. Nevertheless, EEA/EMEP guidebook and methods continue to be developed, used by all UNECE countries and many other countries of the world, even if the

methods are often not very representative for developing countries. Several developers and users of EEA/EMEP guidebook and methodology are members of the IPCC TF. I believe the paper shall include brief discussion and reference to this, for example in section 2.3, but also in Figure 1, where one could mention the only internationally (not globally) accepted reporting system and methods (beyond scientific tools and attempts, like EDGAR or CEDS and some specific models).

I guess, the authors have spent some time discussing the order in the paper and decided for air pollutants, GHG, SLCF and I was surprised but the start of the discussion with the air pollution impacts on health as entry point to this paper - is this because of the attempt to make the link to SDGs and Paris Agreement? I was wondering myself what would be best. Considering the fact that this is the IPCC driven process that attempts to bring and update methods to include SLCFs along the GHGs, I would probably start with GHG section followed by the SLCF discussion that would link to air pollutant inventories and experience as this includes pretty much all SLCFs, apart from CH₄ and HFCs that are already included under GHG inventories. I was also wondering if the 'impact' sections in air pollutant and also GHG sections shall not be part of the introduction to the paper giving background to inventories in general.

Finally, I am not entirely sure what purpose Figure 2 serves - in the context of this paper. Maybe additional reason for this question is my personal belief that the concept of equivalent particulate matter emissions is not very useful and not only because of the spatial scales at which air pollution is truly relevant, rather than large scale (national or regional averages) but also because of changing atmosphere composition the assumed relationships on the roles of each species contributing to ambient PM are far from constant.

Few more specific comments:

line 24: one could say 'greenhouse gases and air pollutants' instead of 'gases and particulates'

line 26: for completeness, fugitive sources shall be mentioned too, not only incomplete combustion, since NMVOC, NH₃, and even fugitive PM play a role in formation of pollution

line 41: I'd say 'recent decades' rather than 'recent years'

line 55: I am not sure if 'verify' is the correct word here; maybe 'monitor progress in implementation' would be more representative

line 63: here and above few references would be useful. for example in line 63 a reference to EPA (when referring to the US) and the EEA/EMEP guidebook and LRTAP Convention (when referring to Europe) could be mentioned ; see also general comments above

line 66: 'this pattern'? what pattern? Are the authors referring to strong increase in pollution and then decline driven by introduction of controls? Agree, but the previous sentences mostly speak about role of inventories and various multilateral efforts...nothing like this happened in China and there is no harmonized and official emission inventory for China even now.

line 110-113: It has been the case in the past, but for several countries already now the role of non-combustion emissions (NH₃) has been increasing strongly and even in Europe key primary source of PM is biomass for heating rather than fossil fuels. And so I disagree with this statement as a universal truth.

line 120: How relevant is this statement in perspective of this paper? How does this relate to harmonization of emission inventory methods and challenges?

line 131: Suggest adding 'often' before 'major' as it is not always the case, especially if we consider that the text is referring to various temporal and spatial scales where locally (or even regionally - say heavy industry, or poorly controlled industrial and power coal boilers) carbonaceous aerosols might not be the major part of PM_{2.5}.

line 137-141: This is the section where I think reference to the internationally accepted and used (while not global) EEA/EMEP guidebook and LRTAP process shall be added.

line 146-147: Not only in these countries; Europe has undertaken action way before any systematic officially agreed and harmonized inventory systems were introduced. The observation of health and ecosystem damage and link with the air pollution was enough to trigger action. Of course progress and triggering more efficient and coordinated action required agreed methods to report emissions.

line 163: Maybe I misunderstood the statements here but I believe that in China or Vietnam (just to give two examples) the observed PM_{2.5} is also playing that role. But maybe I am missing something here. Further, this whole paragraph could benefit from references to some of the regulations, e.g, NEC Directive in Europe, and also for other regions there are good references to established regulatory and enforcement frameworks. For some of the less informed readers it might be useful information.

from line 173: as above, few more references would be useful, especially to the the Air

Convention, since Gothenburg Protocol is referred to in the text.

line 281: Here at the end it would be useful to add reference to Kigali Amendment to the Montreal Protocol since there are specific regional/country requirements given there.

line 283: This paragraph begins with a statement that I do not agree with. International reporting requirements within the EU and also within the UNECE LRTAP Convention have triggered and actually institutionalized regular update of methods and national emission reporting.

Line 294: As above, this last sentence in this paragraph is not correct. The air pollution inventories reported within the UNECE Convention are often updated also for historical years and it is regularly documented in annual submissions and informative reports submitted with it.

line 372: 'improve air quality could unmask' - in this particular statement it would appropriate to make it clear it refers to PM2.5 as for ozone reduction (as the authors discuss further in the paper) the picture is might be different.

line 454: I think a reference to the methods used and established in Europe and beyond could be referred to here as they are harmonized and broadly available and in fact applicable with some exceptions; the global GHG inventory and default emission factors proposed in the IPCC methods are also strongly limited for some GHGs and particular sectors and regions.

line 519: But is the large number of metrics the issue? I think the problem is rather the problem that one needs a value judgment with respect to why a particular metric is used as their choice will strongly affect the relevance of species, sources and therefore policy message.

line 535: reference to MOVES was made also earlier, one could also mention other tools like COPERT for Europe, also mobile sources method used widely in Europe and elsewhere. In fact also MOVES is used in some other countries.

line 541: I mentioned this before in the general section; I think this discussion diverts a little from the main purpose of the paper. These different needs will always remain and there is no need (and it is not feasible) to develop a 'one for all' inventory.

line 845: With changing SO₂ emissions role of NH₃ in formation of ammonium particulates will be (is) changing

line 863: In fact the paper that is quoted in this paper (Klimont et al 2017) does include mineral PM_{2.5} at a global level and even national estimates can be derived from the gridded global files. Additionally, maybe relevant, Philip et al (<https://doi.org/10.1088/1748-9326/aa65a4>) discusses also the role of fugitive and mineral dust.

line 875: Maybe adding a refer to Gomez et al (2022; <https://www.nature.com/articles/s41467-021-27624-7>) might be useful