

Review of “African Anthropogenic Emissions Inventory for gases and particles from 1990 to 2015” by S. Keita et al. submitted to ESSD in 2020

General Description:

The authors develop and describe a long-term anthropogenic emission inventory for Africa spanning 1990-2015. They also compare it to other regional inventories as well global inventories commonly used in models and estimate errors in the inventory using Monte Carlo simulations. The data are also available for public use in an accessible data repository. This is an important development for a continent that is experiencing rapid growth and severe degradation in air quality and that is often poorly represented in global inventories. Prior to publication in ESSD, the authors need to make their description of the methods clearer and also compare their emissions estimates to published regional inventories developed by other research groups. There are also many typos, grammatical errors, unfamiliar acronyms, and unclear statements in the manuscript. These are detailed below.

General Comments:

The authors only compare to regional inventories that developed by the same group. What about others developed for the continent and target African countries? These include, but are likely not limited to, Marais and Wiedinmyer (2016) for multiple inefficient and diffuse combustion sources across Africa, Bockarie et al. (2020) for charcoal production and use in Africa, Pretorius et al. (2015) for power stations in South Africa.

At the end of reading the paper, it isn't apparent whether this is a better inventory (more representative of conditions in Africa) than those the authors compare to.

There are many typos and formatting issues throughout the manuscript. These include, but may not be limited to:

- Unnecessary commas on line 33 “2050,.” and in many in-text citations in the format “Author et al., (YYYY)”
- Define acronyms on first use. For example, POLCA (line 35) and DACCIWA (line 38). Not all readers will know what these are.
- VIIRS is misspelled (line 185)
- Mathematical symbols used in the equations are inconsistent. The equations use “.”, “*”, and “x” for multiplication. Use “x” throughout for accuracy and consistency.
- Throughout, “x” in NO_x should be subscripted. This is also the case for “2” in NO₂ and “2.5” in PM_{2.5}.
- Throughout, change NMVOC to plural, NMVOCs, as presumably there is more than one represented in the inventory.

Often “growth rate” is used, but then a percentage increase value spanning 1990-2015 is given. If it’s a growth rate, it would be in units of “% per year or decade”. In many instances in the manuscript (e.g., lines 212 and 230) it would be more appropriate to refer to these as “growth” or “increase”.

Are Eqs (4)-(6) necessary? It seems that the information in the equations could be more clearly expressed in words rather than using obscure and unfamiliar acronyms that make it hard to follow along.

Many unfamiliar acronyms are used. In many instances these could just be written in full (e.g., TW for two-wheel). This will also make it easier for the reader to follow along.

Figures in the supplementary include acronyms with no explanatory text (proj, ccc, ref). Define these in the caption so that the reader doesn’t need to search for these in the manuscript.

Specific Comments:

Abstract, line 24: give the finding from the comparison.

Line 51: Name some of these important missing sources.

Line 54: Change “the entire of Africa” to “Africa” or “the whole continent”.

Line 57: The longest period compared to what? There are global inventories that span longer time periods (McDuffie et al., 2020).

Line 68 (Equation (1)): What values do you use for the combustion efficiency (CE)?

Lines 76-78: Provide DOIs or URLs for the UNSTAT and IEA data sources.

lines 80: What does “gathered together” mean? Does this mean that the data for these are reported by the IEA as a single summed value? How much do these 26 countries contribute to the total?

Line 82: What does this point to in the supplementary document? There doesn’t appear to be any consumption data in the supplementary material.

Line 94 and Table 1: What is “domestic navigation”?

Lines 95-108: Either change the acronym to two-wheel vehicles (TWV) or include “vehicles” after TW where relevant, otherwise sentences are incomplete. For example, “Fuel

consumption for TW is also calculated ...” reads as “Fuel consumption for two-wheel is also calculated ...”. There are other entries in this paragraph that are also incomplete.

Line 97: What does “Nigeria’s first African crude oil exporter” refer to?

Lines 110-113: What does “norms” mean? Consider rewording so that it is clear what this refers to.

Line 116: Swaziland is now eSwatini.

Lines 125-126: Would the highest value always be appropriate? The highest value for NO_x assumes the highest combustion efficiency, whereas the highest values for OC, NMVOCs and CO assume the lowest combustion efficiency.

Line 129: What is the “slightly higher” value? Quote the number.

Line 152: Why these countries? Because of their development status?

Line 166: Important improvement relative to what?

Lines 171-172: Why use only 2010 population distribution? Won’t this misrepresent population distribution, in particular in urban areas where urbanization rates are high?

Line 173: What data does EDGAR use to map traffic in Africa?

Line 174: The “Africa infrastructure (2009)” reference doesn’t appear to be in the reference list.

Lines 176-177: How about also considering improved mapping of charcoal production in rural areas, as in Bockarie et al. (2020)?

Line 186: Briefly tell the reader why gas flare volume values are missing for 2011.

Line 188: “df” already has a common usage (derivative). Consider using the standard notation (Greek symbol rho) for density.

Line 192: “in this paper” refers to which paper? Doumbia? If so, rather say “in Doumbia et al. (2019)”.

Line 198, Figures 1 and 2: These look like a time series, not trends. There are no trend lines or values in these figures.

Line 203: Higher rate than what?

Line 211: “globally in Africa” is confusing. Which is it? Global or in Africa?

Line 227: What does “(4 over 7)” and “(1 over 5)” mean? Should “over” be “of”?

Lines 233-234: What are the numbers in brackets? Population or emission growth rates? Are the units correct? Should these be “% a⁻¹”?

Lines 240-241: Has the relative contribution of the different sectors changed over time?

Line 255: What’s the justification for looking at these countries specifically?

Line 259: Is there a quantitative way to express the predominance of these two-wheel vehicles?

Line 265: Is it industry or coal-fired power plants in South Africa that make the largest contribution? How does your estimate compare to emissions from Pretorius et al. (2015)?

Line 275: The Lioussé et al. (2015) inventory projected dramatic increases in emissions in Africa. How do the % per year increase values in that inventory compare to your inventory?

Line 278: Is SO₂ “slightly lower”? The difference is ~1.5 Tg. What accounts for this difference?

lines 280-281: The reasons for the difference are quite generic (could be said for any emission inventory comparison). Can you be more specific about the source and sizes of the differences in activity factors and emission factors?

Lines 285-286: Are these global emission inventories independent of each other for Africa?

Line 291: What accounts for these differences in BC and NO_x (and likely other compounds too)?

Lines 299-302: Where do the other global inventories get their EFs from and by how much do these differ from the EFs used to develop your inventory?

Line 305: Higher by how much?

Line 320: Using the REF and CCC* acronyms immediately without first defining them assumes the reader knows what these are.

Section 3.4: Are subsections (3.4.1-3.4.2) is this section necessary? Each subsection is only a paragraph long.

Line 358: Would emissions always be overestimated? Is this because combustion efficiency varies with development stage? Wouldn't this lead to an overestimate for some emitted compounds and underestimate for others?

Figure 3: “-1” in “cell-1” should be superscripted.

Figure 6: Consider including a line starting from 2005 for the projected emissions from the Liousse et al. inventory.

Figure 7: What is the second “**D**” in “EDGARD**D**4.3”

Table 1: Is this table necessary, when the only difference is the daily consumption? This could be more succinctly stated in the text.

Table 2: Should “CH” be “charcoal use”, rather than just “charcoal”?

Table 3: Fix “Gg. year-1”.

References:

Bockarie et al., 2020, doi:10.1021/acs.est.0c03754.

Marais and Wiedinmyer, 2016, doi:10.1021/acs.est.6b02602.

McDuffie et al., 2020, doi:10.5194/essd-12-3413-2020.

Pretorius et al., 2015, http://www.scielo.org.za/scielo.php?script=sci_abstract&pid=S1021-447X2015000300004

Wiedinmyer et al., 2014, doi:10.1021/es502250z