Review ACP-2018-331

A new global anthropogenic SO_2 emission inventory for the last decade: A mosaic of satellite-derived and bottom-up emissions

By Liu et al.

This paper presents a much appreciated (much needed?) upgrade of global estimates of emissions of sulfur dioxide (SO2) using a combination of bottom-up information (HTAP) and satellite measurements (OMI).

Each source of information has its pros and cons, but not necessarily the same, so it is worthwhile to try to integrate them into a combined bottom-up/top-down SO2 emission inventory (HTAP-OMI).

The paper convincingly shows that, using the emission inventories in model simulations and comparing model results with independent observations of atmospheric SO2, that the combined OMI-HTAP emission database provides better results.

The study reveals many discrepancies related to slight mis-allocation of sources, as well as well-known issues with regard to representativeness of measurements, satellite data quality, and documented emission sources like underreported regions.

Overall, the approach is a step forward towards the integration of bottom-up information with top-down information. The method also provides a direction for increased and integrated use of upcoming new satellite missions to better estimate worldwide sources of emissions.

Overall, the paper is well written and well structured, and publishable after consideration of the remarks and suggestions below.

[1] general remark

I know the use of "higher/lower" is commonplace science publications when referring to other things than heights, but Personally, I prefer to use "larger/smaller" rather "higher/lower" when discussing anything unrelated to heights, in particular in atmospheric science, in order to avoid confusion.

I leave it up to the authors to decide, but if agreed, please check the entire paper and modify accordingly.

[2] typos and suggestions for minor grammar changes. Please note the remark regarding P9, L17-L19. Also note some suggestions are provided for improving a few figures.

P1, L31. Change to "We focus for the validation …"
P1, L32. Change to "… and for which a relatively large number of …"
P1, L33. Change to "… improves the agreement between the model and observations."
P1, L34-35. Suggest to move "Additionally, our … detected by satellites" to earlier in the abstract in L28, after "… with such missing sources.". Then, suggest to change "Additionally" to "In addition".
P1, L39/P2, L1-2. Suggest to move last line of abstract to after the previous suggestion (P1, L34-35).
P1, L37. Remove "For example,"

P2, L13. "earlier" could be made more specific (SO2 emission regulations in the US and EU are introduced in the 1980s)
P2, L21. I think it should be "removal", not "removals"
P2, L21. Suggest to change to "The spatial distribution of emissions is even more uncertain"
P2, L21-22. Change to "… are in most cases allocated by spatial proxies rather than …"
P2, L23-L24. Move "developing" to the beginning of the sentence: "In addition, developing …"
P2, L26. Replace "indicate" with "identify"

P3, L5. "Gaussian distributions" or "Gaussian dispersion"
P3, L11-L12. I think what is meant here is "that combines information about large SO2 sources from …"

P4, L3-5. Please provide a brief justification or explanation (or reference) for the source strength dependence on parameter L.
P4, L7. Unclear where "In this way …" refers to.

P5, L1. "monitoring systems" (plural)
P5, L20. Latest: later, more recent?
P5, L24. Replace "it is located" with for example "emissions are located" or something similar
P5, L30. Explain what is meant here with "profile". In atmospheric sciences, a "profile" generally refers to a vertical distribution of a parameter.
P5, L33. "OMI-HTAP inventory"

P6, L4-L5. Delete “On the contrary,”
P6, L24. Change “less” to “smaller”
P6, L33. Maybe replace “reported” with “documented” to avoid double use of “report” in the sentence?

P7, L1. “Long standing experience”, would still be nice to add some references.

P9, L14. “identifies” maybe change to “shows” or “reveals”?
P9, L17-19. I think it would be nice to mention here (or in the conclusions) that OMI-HTAP changes 2008-2008 are more consistent with EPA estimates than HTAP. Important finding.

P11, L3. Change “knowledge of” to “information about”

P12, L1. “my” should be “may”
P12, L6. Replace “less” with “fewer”
P12, L14. “averaged” to “average”
P12, L31. Maybe use “The OMI-HTAP emission database developed …”?

P13, L1. “leading”, maybe “widely used”?
P13, L5. “since decades” to “for many decades”?
P13, L12. “The exact location of …”

[3] figures

Figure 2, upper panel. Most land areas are color coded in dark blue/purple. Does this include the 0.0 value, or does this mean that emissions indeed are larger than zero. If not zero, this also begs the question how SO2 emission over most land areas are larger than zero. If indeed zero, it is worth considering color coding land areas with zero SO2 emissions in grey or white. Please clarify in caption and/or modify the figure.

Figure 2, lower panel. Is not necessary insightfull because of the small pixels. Is it possible to use symbols like a filled circle that for example indicate the size of the difference? I don’t know if that would work, but I think it is worth trying to see if that helps for the usefulness of the panel. Also, it might be worth to color code non-zero differences between +/- 5 Gg/yr/grid with greys (see discussion about the upper panel). As the panel now stands, there is no separation between zero emission locations and locations with small differences.

Figure 3, upper panel. Add whites for (near) zero concentrations, as now everything is mostly blue, not very appealing. And similar to previous discussion, maybe separate small concentrations from zero concentrations.