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Interactive comment on "Tracking down global NH$_3$ point sources with wind-adjusted superresolution" *by* Lieven Clarisse et al.

Anonymous Referee #2

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This is a very-well written, and innovative study on how to use statistical techniques on long-time series to identify point sources of NH3 emissions across the globe. The paper is an extension of an earlier study published in Nature (Van Damme et al., 2018), and shows that adding information on winds derived from ECMWF's ERA re-analysis, allows to further increase the statistical power to discriminate point sources from the background signal.

The publication is build up in a logical well-chosen manner, examples (even if not pertaining per se to NH3) are well chosen. Somewhat surprising is that in this paper the authors do not estimate source strengths and uncertainties related to the point sources, for reasons not entirely clear to me. In contrast, the earlier Van Damme (2018) did provide such estimates (+uncertainties) so I do not see a strong reason why this paper

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[Discussion paper]

wouldn't- of course provided that everything works well.

In this context my main concerns are following:

- Mass conservation. Figure 3 nicely shows how oversampling and supersampling show enhanced plumes strength (as expressed by the maximum values). Given the short life-time of NH3 (likely short due to the abundant presence of sulfate aerosol), one can assume that the average column values in the 60x120 km domain are mostly (entirely?) determined by the local source. Can the authors demonstrate that the domain average (or integrated) NH3 columns are conservative across cases a) through e). Have such screening been performed for all identified large sources, and what was the result? With other words can we be sure that the algorithm does not artificially add mass, and be used to receive source strengths?

- This publication is an extension of the previous paper by Van Damme, which makes an important statement on the possible underestimation in inventories like EDGAR of nearly all agricultural and industrial point sources. As this paper is adding even more source, it would imply that the problem could be even aggravated. However, in none of these 2 papers an analysis is made of the potential impacts on regional and global emission budgets. I can easily imagine that the spatial allocation data used in inventories are not realistically representing a 0.1x0.1 degree resolution, but that 'point source' emissions are smeared out over larger areas. While the lack of spatial information in itself a serious problem, it may be less an issue for larger scale model analysis. It would be extremely helpful if the current paper could 1) provide quantitative information on derived emission strengths, similar to the previous paper 2) provide regional/global statistics of the aggregated amounts of annual point source emissions versus those in EDGAR and compared to all emissions, to get a better impression on how these new data would change our view on the global NH3 budget.

I recommend publication of this paper, after taken into account my concerns.

Minor comments:

P2 l. 14 what were these adverse effects?

P2 l. 15 It is also related to other pollutant becoming relatively less important.

P2 l. 24 Clarify what is meant with conservative residence time. Van Damme varied between 1, 12 and 48 hours. I presume you meant 48 hours- as this would imply the lowest emission rate? Not for this paper, but you could get a better handle on the lifetime issue by collaborating with one or more modellers and relate lifetime to column and emission rates.

P3 l. 16 'reduces spread and contribution of nearby source': I didn't get it. Explain better.

P 3 l. 30 What is meant with a constant underlying distribution? Of what? I didn't get it.

p. 5 l. 30 I haven't seen what is the case for NH3, only few iteration or many? And why?

p.6 l. 9 As described above the example seems to add 'mass' to with the oversampling/super sampling. The authors should show whether this is the case or not.

p. 6 l. 31 If understand it well this is discussing the McLInden approach (but not yours). 100 km2 is quite a large area to calculate background and signal of point sources.

p. 8 l. 25 what is meant with an NH3 map. Concentration/column or emission?

P 10 l. 3. Noisy map and fictitious sources. How do you know that? Are you still speaking about 10x10 km areas for which oversampling/supersampling would create a noisy map?

p. 10 l. 4 It sounds counterintuitive that only looking at downwind concentrations an improved point source map can be improved. What would this mean for the retrieved emission values? Some more theoretical foundation for this approach would be valuable.

p. 10 l. 23 'The new NH3 map'. It would help the reader if you could give a better name to this map, describing what it really is. Something like 'satellite derived source attribution map'- it should be made clear that this is a calculated map- not something that is directly observable by the satellite instrument.

p. 11 l. 3 improved performance in geo-allocation of the sources.

p. 11 l. 4 point source map? See earlier comment. Use unique name for this product. I think it is more than a point source map (in the sense that there is quantitative information on source strength).

p. 11 l. 14 0.01x0.01 degree corresponds roughly to 1-1 to 2-2 km? Maybe helpful to give the reader a feeling for this.

p. 11 l. 16 I am wondering if there is not something smarter possible, based on a pre-screening of all available IASI observations. If no elevated concentrations are found in any data point it is not likely to be a relevant points source. Possibly for discussion or future work. Or maybe I understood it wrong, and you are describing what you don't want to do?

p. 11 l 23 what is meant with a single point source map? A single year? A single source? Clarify.

p. 11 l.29/30 This is confusing as statements are made on disagreement with emission inventories.

P 13 l. 26. What would be the equivalent retrieved concentration (with some reasonable assumption on BL height).