

***Interactive comment on* “Spatial distribution of gaseous pollutants (NO₂, SO₂, NH₃, HNO₃ and O₃) in Abidjan, Cote d’Ivoire” by Julien Bahino et al.**

Anonymous Referee #2

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Overview

It is really welcome to see a paper with new chemically detailed air quality pollutant data from Abidjan, Cote d’Ivoire. As the authors outline there is currently very little information in this region and hence the paper represents a step change in knowledge. The protocols for the passive samplers are well applied with excellent quality assurance protocols.

However in order to be sufficient to publish in ACPD, there needs to be a clearer detailing of all the data and a stronger interpretative section in the paper.

There also needs to be a detailed review of the language and word use throughout as some of the choices of words do not fit and many sentences need to be sense checked.

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Technical and scientific comments:

1. Introduction Line 32 onwards There is a a lot of discussion of the specific project through which the research was done which is not particularly relevant for the paper. Could this be revised to be shorter and more specific to the intensive long term sites – what is being measured at them and at what resolution – if the supersite in Abidjan has been operational for the year it would be useful to know more detail about that and how the intensive reported fits in.

Beyond a primary survey of background air quality pollutant concentrations, what are the starting hypotheses and how does this study address them?

2. Experimental design P3 Line 9 onwards The economic description of Abidjan should really be in the introduction as it does not relate to the experiment. This paragraph could be shortened and refer to Figure 1 perhaps combining with section 2.1

P3 line 36: Is the Tecsalt report publically available or could it be put in the supporting material? If not then rather than refer to it, the details of the report suggested network design should be in the details of this paper, and perhaps can be critiqued. . .did the network design meet the aims of the project?

Can you extrapolate from this number of sites to the whole region for all pollutants (my feeling is that for ozone it may be fine, but for ammonia it may not be the best approach). Referencing the global literature on kriging and air quality impact assessment would be good. A variogram fit would be useful to understand how well the kriging worked for the different pollutants. What is the topography of the area?

P4 line 4: What method was used to assign the land use type for each station?

P4 line 39: It would be useful to discuss potential interferences/artefacts: e.g. HNO_3 will have interferences from other reactive oxidised N species, and NH_3 potentially amines – depending on the coating type. Could the authors add a little detail on this, even though they are in the reference Adon (2010) I think it is worth re-iterating them in this

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paper, perhaps in a table.

Section 2.2.2 I am impressed by the protocols used for the passive samplers. The blanks are slightly higher than I would expect for ammonia field blanks but data capture was good.

The purpose of the kriging needs to be put in context a bit more clearly: Is the purpose to derive background maps onto which high resolution data (e.g. from Supersite) can be superimposed?

Despite the high correlations, the use of emission dominated sites (e.g. the traffic sites) is likely to skew the background map high. Ideally all sites should be away from a specific strong source – however this may be what has actually done – Table 1 needs to explain the land use categories. It is noted that the advantage of measurement based concentration maps is that they avoid emission factor errors, but the drawbacks also need to be referenced.

P6: Section 3.1 It is disappointing that having had several exposure periods the authors went directly to using the average and also comparing the average of the period (2 months) to an annual average. Given that many of the pollutants have seasonal cycles as well as shorter term cycles some discussion about the appropriateness of extrapolating to an annual average is necessary.

Also it would be useful to see the data for each site for each measurement period. Perhaps a whisker plot with the average max and min or just a time series for each site and chemical?

NO₂ section P7 Line 12: Comparison of short term data against the annual average is not useful. Is it expected that the NO₂ is highest in the dry season or are emissions approximately constant over the year? If extrapolating to an annual average, the assumptions made should be made clear.

P7 line 24 The part about black carbon in this section does not appear to fit with the

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discussion around NO₂. It either needs to be removed or a discussion of black carbon correlation with NO₂ from the Keita pers comm reference. If it is a pers comm, perhaps the data could be added to this paper?

Ammonia P8 line 21 Human waste (and its management) is not really mentioned as a source of ammonia though it is likely to be a significant source.

P8 line 34 The measurements <5 m from sources are correctly not used in the krigin, however for background mapping as ammonia has such a short atmospheric lifetime I would suggest that >50 m from sources is appropriate. Could the authors clarify how close the other measurement points were from NH₃ sources. Again the full dataset should be presented in supplementary material so that readers can understanding the details rather than just the range being presented.

P9 line 9 at the end of the ammonia section the first part is repeated. Some tightening of the text would improve the manuscript here

Nitric acid P9 line 20: the statement that “HNO₃ appears to be emitted from several sources” cannot be backed up by the measurements. HNO₃ as the authors stated is frequently a secondary pollutant, rather than a primary emission. Also there are several other gas phase oxidised nitrogen chemicals which could also contribute to a passive HNO₃ sampling so some discussion of potential other contributions and reference to a review or overview of the issue.

P9 line 22: I think there are papers in the literature which have made direct observations of HNO₃ and therefore it would be useful to discuss the results in terms of the literature (although there is some discussion later)

Section 3.2 The discussion of the different source attributions would be improved by a more detailed description of each of the sites – perhaps a focused attribution for NO₂ using smaller maps or photos. This section is useful but slightly hard to follow with just the maps and average concentrations.

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Significant amounts of the text are fairly similar to the preceding sections on the measurements.

Section 3.3 The overview of the urban studies across the African continent is very useful. However it would be useful for the authors to adjust the discussion from listing the measurements and the range of values, but also to consider the impacts and purpose of the measurements. The snapshot campaign provides a picture, and it seems that Abidjan sits in a similar range to many other cities. A short atmospheric chemistry section discussing the mix of the pollutants and hence if one was to establish a continuous assessment to monitor changes (improvements or deterioration) air quality.

How can the dataset be used to disentangle sources – and here I think doing a more detailed land- use assessment for each position - all sources in vicinity of the sampling point as well as the dominant one. The overview seems to be that NO₂ and NH₃ are clearly the pollutants which are elevated. A transect approach across source areas may give a better view of variation which will lie on top of the kriged background maps.

I would be interested to understand the authors hypothesis for the future changes in air quality, and also how the current dataset may be exploited further (e.g. application of local/regional model to understand the pollutant source strengths required to reproduce the observations).

Conclusions section:

This section should be significantly shortened and should just give a concise overview of the main outcomes of the study. The implications of the study need to be drawn out.

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