

Response to Reviewers

Title: Measurement report: Long-term measurements of ozone concentrations in semi-natural African ecosystems

Author(s): Donnou et al.

MS No.: acp-2024-284

The authors would like to thank the editor and reviewers for the valuable time spent on the manuscript to further improve its quality. Their comments were constructive and helpful.

In general, we have modified the title, abstract and conclusion of the manuscript. Corrections have been made in the introduction by rewording some sentences. The axis ranges of some figures in sections 3.1 and 3.2 have been reduced. A recent reference has been added to the manuscript in the discussion of annual ozone trends. The analysis of these trends has been reformulated and summarized in Table 6.

Below, we provide a point-by-point response explaining how we have responded to each of the referees' comments. Our responses to the comments are in blue. We are confident that this stage of revision has further improved the manuscript. We look forward to the referees' feedback on the revised article, and to the editor's decision. With our best regards, and our deepest gratitude to the referees and editor.

On behalf of all the co-authors

Sincerely yours

Venance Donnou and Corinne Galy-Lacaux

REFEREES' REPORTS:

REFEREE 1

Recommendations: I recommend this be highlighted in a revised title: Long-term measurements of surface ozone and trends in semi-natural ecosystems in sub-Saharan African ecosystems." The latter change is recommended because the paper does not include north African data from nations along the Mediterranean.

Author's response: This comment is now included in the revised manuscript.

Author's changes in manuscript: Modified Title of Manuscript

Line 138 – Better form to say low surface ozone... "recorded at many sites..."

Author's response: This comment is now included in the revised manuscript.

Author's changes in manuscript: Modified Line 142

Line 142 – Do you mean “ Lee et al. (2021) used models and measurements to estimate that 24% of boundary-layer ozone over Africa is estimated from biomass burning?” And what does that mean “over Africa” – the entire continent? Which regions? Important to clarify whether papers like Lee et al are using models or actual data

Author's response: In the works of Lee et al. (2021), the authors used aircraft-based measurements of O₃ and a range of its precursors in African wildfire outflow during 12 research flights spanning March 2017 to February 2020. The flights ranged from within a few kilometres of the fires over Senegalese and Ugandan savannah to several hundred kilometres away over the North Atlantic Ocean near Cape Verde. This part has been further clarified in the revised manuscript by integrating the study sites and data used.

Author's changes in manuscript: Modified Line 145 to 148

Lines 154-158. An awkward sentence – the meaning is not clear. Do you mean “Changing isoprene emissions, the temperature sensitivity of NO_x and O₃ chemistry (Brown et al., 2022) as well as meteorological changes have all been implicated in the seasonality and spatial patterns of ozone trends in the tropics (Stauffer et al., 2024)” ?

Author's response: This paragraph has been rephrased in the revised version of the manuscript. We say that Brown et al, (2022) and Stauffer et al, (2024) recommended studies on isoprene emissions changes, on the temperature sensitivity of NO_x and O₃ chemistry, as well as on meteorological changes involved in the seasonality and spatial patterns of ozone trends in the tropics.

Author's changes in manuscript: Modified Line 161 to 163

Line 219 - use a monthly...

Author's response: This comment is now included in the revised manuscript.

Author's changes in manuscript: Modified Line 221

Line 412 – In the dry savanna (insert ‘the’)

Author's response: This comment is now included in the revised manuscript.

Author's changes in manuscript: Modified Line 402

Line 609 – should read “during which” not during “what”

Author's response: [This comment is now included in the revised manuscript.](#)

Author's changes in manuscript: [Modified Line 606](#)

Line 612 – can delete “was evaluated and”

Author's response: [This comment is now included in the revised manuscript.](#)

Author's changes in manuscript: [Modified Line 609](#)

Line 640 – “densify” not a good word. Start sentence with Additional efforts must therefore be made through programs to enhance the density of monitoring networks...

Author's response: [This comment is now included in the revised manuscript.](#)

Author's changes in manuscript: [Modified Line 636 to 637](#)

Lines 835 to 840 – These sentences are confusing. In general you are using different criteria on uncertainties- (Mann-Kendall) and p-values. That is fine. Figures 14 and 15 provide excellent summaries of the results! In both cases it is seen that only 3-4 sites have annual trends with low confidence (p value >0.2). Figure 14 is very convincing that losses occur at a number of ecosystem types. Recommend that you revise text with less reference to uncertainty – the reader can see that in the Figures and also in a Table – recommend in the next paragraph that you add a Table. The discussion in Section 3.1 would be easier to follow if you make a Table with the 4 columns: station name // trend in ppbv/decade // p value // addl comment on confidence level/ comment on related VOC or other trend. Line 837 – no need to say “there is very little chance ... will occur.”

Author's response: [This comment is now included in the revised manuscript.](#)

Author's changes in manuscript: [Modified Line 657 to 692](#)

Line 856 – Start a new paragraph with “The absence...”

Author's response: [This comment is now included in the revised manuscript.](#)

Author's changes in manuscript: [Modified Line 694](#)

Lines 858-869. The Wang et al. (2022) is mostly a modeling study with satellite results; that is not a good comparison point for your observational study. Recommend you delete it in this part of the paper. Comparisons made with Gaudel et al (2020) are somewhat relevant and your points about the airport stations being more polluted and close to sources are excellent interpretations. Note, however, at Nairobi (Thompson et al., 2021) the ozonesonde changes are almost negligible, so even in urban areas trends can be modest.

Author's response: [The reference of Wang et al. \(2022\) has been deleted in the manuscript the revised manuscript.](#)

Author's changes in manuscript: [Modified Line 698](#)

You should add a new TOAR II paper in press: Gaudel et al. (2024). It will be published very soon and is a successor to the Gaudel et al. (2020). The new paper uses a lot of IAGOS aircraft data to derive trends ~1995-2019. However, the Supplemental Material in the paper (look at egosphere-2023-3095) reveals a large “jump” or discontinuity over IAGOS stations not only in Africa but over South America between 1994-1997. That jump is generally NOT seen in African or South American ozonesonde records (Witte et al., 2017; 2018) although there are only 3 central and South American stations with 20 year trends. Trends after 2000 (a paper in preparation by Van Malderen et al. (for TOAR II on TOAR II /HEGIFTOM ground based data: 2000-2022 – tropospheric ozone from spectrometers as well as sonde and aircraft profiles), also show quite modest trends. In summary, one can assume that Gaudel et al. (2020; 2024) report overestimates of African trends. Gaudel et al. (2024) also contains NEW OMI/MLS satellite data (newer than Hou et al.) that cover 2005-2019/2020. The new data have relatively small trends over Africa, an excellent reference for your paper.

Author's response: [The reference of Gaudel et al. \(2024\) has been cited in the revised manuscript.](#)

Author's changes in manuscript: [Modified Line 698 to 702, 708 and 732 to 739](#)

Line 894 - Start the sentence with “The tests reveal...”

Author's response: [It is now in the revised manuscript](#)

Author's changes in manuscript: [Modified Line 732](#)

Lines 924 – Remember to use months not “spring” or “summer” for Irene because the seasons are opposite months in the southern hemisphere.

Author's response: [It is now included in the revised manuscript](#)

Author's changes in manuscript: [Modified Line 750](#)

Line 961 – “In the semi-arid”

Author's response: [It is now included in the revised manuscript](#)

Author's changes in manuscript: [Modified Line 785](#)

Suggested Text Changes in the Conclusion

Author's response: [Suggestions for changes in the conclusion are included in the revised manuscript.](#)

Author's changes in manuscript: [Modified Line 801 to 818](#)

Suggested Text Changes in the Abstract

Author's response: [Suggestions for changes in the abstract are included in the revised manuscript.](#)

Author's changes in manuscript: [Modified Line 25 to 58](#)

REFEREE 2

Technical Corrections:

It should be NO (subscript x) and not NO_x, please correct throughout the manuscript.

Author's response: [This comment is now included in the revised manuscript.](#)

Author's changes in manuscript: [Modified Line 67 to 1 194](#)

Line 101, page 3:

ENSO is first used in line 101, page 3 but defined in line 119, page 3.

Author's response: [This comment is now included in the revised manuscript.](#)

Author's changes in manuscript: [Modified Line 111](#)

Line 125, page 3:

I would keep the phrase 'Further work has been carried out in different locations in Africa to characterise O3 levels.' without including the citation to avoid repetitions since the citations are mentioned just below.

Author's response: [It is now in the revised manuscript](#)

Author's changes in manuscript: [Modified Line 134 to 138](#)

Line 266, page 8:

NOX has been introduced in line 58 and VOCs in line 59.

Author's response: [It is now in the revised manuscript](#)

Author's changes in manuscript: [Modified Line 282](#)

Line 321, page 10:

ITCZ abbreviation has been already introduced in line 138.

Please check where the abbreviations are introduced throughout the manuscript.

Author's response: [It is now included in the revised manuscript](#)

Author's changes in manuscript: [Modified Line 337](#)

Figure 2, page 10:

Would it be possible to keep the same axis ranges for all the sites (e.g. 0-600 for left axis and 0-7 for the right axis)? I believe that having the same ranges would help to compare between the sites. I would suggest having as few different ranges as possible. Same for Figure 5, page 14 and Figure 11, page 20.

Author's response: [The reviewer's comments are pertinent and have been taken into account for the most part. Indeed, to prevent certain parameters represented on the graphs from being overwritten and illegible to the reader, we have not been able to set all the graphs to the same range. However, we tried as far as possible to having as few different ranges.](#)

Author's changes in manuscript: [Modified Line 350 to 365 \(Figure 2\), Line 423 to 433 \(Figure 5\), Line 488 to 499 \(Figure 8\) and Line 553 to 564 \(Figure 11\).](#)