

EGUSPHERE-2025-5285 – Author comments to RC

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Legend: Referee comments in *blue and italic*, author comments in **black**, changes in the manuscript text in **green**

We thank the reviewers for their careful reading of the manuscript and their constructive feedback throughout the review process. The comments have contributed to a clearer and more rigorous presentation of the results. We are grateful for the collaborative and thorough nature of the review.

Report #1

The authors have carefully addressed my concerns, and I do not have more comments to add.

Report #2

The authors have addressed the previous comments accordingly, and the revisions have improved the clarity and robustness of the manuscript. The article provides a useful contribution to the discussion of the applicability of the RGF for VOC attribution. I recommend it for publication, with a minor editorial adjustment. As a suggestion, the newly added Section 2.5 (site descriptions) could be moved to the beginning of the Methods section to improve the overall flow and readability.

The section “Measurement Sites” has been moved to the second position in the Methods section, directly following the MAX-DOAS instrumentation description (Section 2.1). Placing it at the very beginning of the Methods section would leave the site categorisation without the necessary methodological context, as the classification of sites relies on concepts introduced in the MAX-DOAS section. The chosen position therefore balances the reviewer's suggestion with the need for a coherent reading order.

Additionally, a cross-reference to the backward trajectory methodology has been added to the site description. The updated text now reads (Line 208): “Annual and seasonal horizontal footprints derived from backward simulations (details in Sect. 2.4) show, as expected, the highest sensitivity in the vicinity of each instrument (Fig. 3).”

Report #3

For the response to Minor comments 7, how do you compare "ATTO + Orléans" with "Athens + Incheon"? What I mean is, should the monthly average data be summed up in groups or simply added together? If it were simply added together, the ATTO seasonal cycle in the Southern Hemisphere would not be consistent with that in the Northern Hemisphere. Please

consider adding some clarification in the text to address this point. After that, the manuscript can be ready for publication.

The data are not combined mathematically; rather, the monthly means from both stations within each group are treated as a single set of observations for the purpose of statistical comparison. To clarify this, the relevant paragraph has been revised. The updated text now reads (Lines 308—318):

“To compare biogenic and anthropogenic environments, represented by ATTO & Orléans and Athens & Incheon, the data are aggregated to monthly means **per station** (e.g., two years of data yield 24 values) **before grouping. The differing seasonal cycles between the Northern and Southern Hemisphere sites inflate intra-group variability, biasing the test conservatively towards non-significance; the reported p-value therefore represents an upper bound.**

Differences between groups are tested using Welch's t-test (Welch, 1947; Delacre et al., 2017} applied to the log-transformed data, which accounts for unequal variances and sample sizes. The same aggregation strategy is used for station-to-station comparisons. In this case, a Welch analysis of variance (ANOVA) (Welch, 1951; Delacre et al., 2019) is applied first to the log-transformed data to assess overall differences among stations. It is followed by a Games—Howell post hoc test (Games and Howell, 1976), which evaluates pairwise differences while accounting for unequal variances and sample sizes.”

Other changes made to the manuscript during the review process:

- Changed from full space to half space before unit declaration
- Moved the supplement figures to a supplement file
 - Refined the reference to those figures by clearly pointing to the supplement
 - Lines 345, 416
- References that are cited only in the supplement have been removed from the main manuscript.