

Referee comment on AMT-2023-15- second version

The revised manuscript now entitled “Long-term airborne measurements of pollutants over the UK, to support air quality model development and evaluation” by Angela Mynard et al., has been improved. The authors have addressed many of the concerns outlined in my original review but the structure and the content are partly still not satisfying.

Concerning the structure, the authors are reluctant to reduce the size of the introduction and the number of subsections. In particular in section 3, the titles of these subsections do not follow a clear logical central idea. Please replace the name of the section “Flight planning” by a more general one so that it can cover the content of the following subsections, in particular of the 3.8.

The authors emphasise in their answers that a deeper discussion of results is out of scope of this paper which has mainly a technical character. In any case, the introduction of short summary sections now and then with the same title “summary” (3.7, 4.2.4. and 4.3.3) does not help. This might be a suitable format for a scientific talk but it is confusing for a manuscript. In order to gain in concision and clarity I recommend the authors to include the discussion and summary of results in 4.2.4 and 4.3.3 in the section 5 at the end, which should be renamed as “Results and conclusions” or “Summary and conclusions”. The few sentences in the 3.7 section do not deserve a summary subsection and should be included in the introductory text just before 3.1.

There are still inconsistencies in the Appendices:

- Line 354 “(see case study in Appendix C)”. It actually seems to be Appendix B. The equations inside are by the way still numbered as C1, C2 etc
- Line 400 “This value is derived by weight-averaging the densities of PM_{2.5} aerosol components measured during a range of UK field experiments, as detailed in appendix C”. This seems to be correct as Appendix C.

Concerning the content of the revised manuscript, a critical issue is the new interpretation of some of the results made on the basis of the titration of O₃. Titration has a very clear meaning in chemistry and the revised text seems to imply that O₃ is titrated by NO₂, what is impossible as O₃ and NO₂ do not react. Be aware that the sum of O₃ and NO₂ is not NO and a potential reaction of O₃ and NO₂ does not lead to NO. Please clarify and/or correct. The basic principle of the O₃ formation and the relation with NO₂ is confusing and/or chemically wrong in:

- Line 633: “Assuming the simplest chemical setup, whereby chemistry in the vertical is controlled by O₃ titration (O₃ + NO₂ => NO)”.
- Figure caption of Figure 13: “odd oxygen (O₃ + NO₂ = NO)”
- Line 703: “As expected, given that NO₂ is photochemically split during the formation of O₃, observed O₃ aloft (not shown) is inverse to the NO₂ observations,” Here would be by the way very informative to see the O₃ concentrations this statement refers to.
- Line 754: “Comparison of odd oxygen implies that ozone titration is the dominant chemical process throughout the atmosphere and helps explicate the complex vertical structures of O₃ and NO₂ observed throughout the column.” In particular, revise thoughtfully the scientific part of this statement, which seems to be wrong and difficult to see on the data shown. What is the meaning of “complex vertical structures” and

how are they explained with a simple titration? How can you justify the statement that “ozone titration is the dominant chemical process throughout the atmosphere”?

Finally, the units of concentration and density are systematically wrong all over the text (e.g. such as $\mu\text{g m}^3$ or g cm^3 instead of $\mu\text{g m}^{-3}$ and g cm^{-3}). This can be a too recurrent typo or a conceptual mistake. Please revise carefully the text. Other typos will be probably corrected by the editorial office.

Minor comments:

- Line 584: “Here, the HIL AURN site, observed at $84 \mu\text{gm}^3$ (fig 11 left: grey 585 square and right: red triangle) is significantly higher than both other ground-sites in the region and the range of (...)” Do you mean : “Here, the $84 \mu\text{gm}^{-3} \text{NO}_2$ observed at HIL AURN site, (fig 11 left: grey 585 square and right: red triangle) is significantly higher than (...)”?
- Line 674 Please remove “ who, as discussed in sec.1, reported positive model ozone biases during a ground site AQUM comparison” It is redundant and makes the sentence unnecessarily long.
- Figure caption of Figure 13 is not complete and ends with: “is shown as a”. Please complete. What is the meaning of a 1-2-1 line?
- Line 738: “Conclusion and future plans” Please remove “future plans” from the title since they are not evident in the text.