Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., author comment AC1
https://doi.org/10.5194/acp-2021-180-AC1, 2021

Reply on RC2

Adam R. Vaughan et al.

Author comment on "Spatially and temporally resolved measurements of NO_x fluxes by airborne eddy covariance over Greater London" by Adam R. Vaughan et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-180-AC1, 2021

Authors' Response to Reviewer 1 (acp-2021-180)

The authors' would like to thank the reviewer for their supportive comments and for taking the time to review the manuscript. Outlined below is a breakdown of the reviewer comments (bold and italic) with corresponding author responses give below each. Line numbers correspond to the revised manuscript.

Specific Comments:

1. Introduction: it will be more valuable to summary more about the significance and the current progress of NOx flux measurement in complex terrain and then the advantage of airborne eddy-covariance approach should be emphasized.

The introduction section of the manuscript has been updated to have a short discussion as to the current status of NO_x flux measurements, their focus to date and the next steps, which this manuscript presents in linking complex NO_x emissions to heterogeneous urban topographies (lines 60-66).

2. Methods: the general description on the AQD instrumentation and the methodology of eddy covariance with environmental response functions (ERF) can be shortened as it is well established instruments and software packages. In contrast, more information on the use of AQD and the specific improvement on the ERF as well as the aircraft cruises (flight time, heights, speed, etc.) shall be added.

Section 2.2 has been updated to keep a core description of the AQD instrument and its principles only. Discussion regarding calibrations, dark count assessment, and the flow schematics (Fig. 2) has been moved to the supplementary, listed as section 1.1. Section 2.2 should now read more clearly and focus more on instrument uncertainties than NO_x analysers internal workings. Table 1 has been updated to include more information as to when each research flight occurred. Section 2.3 has also been shortened, with specific wavelet eddy-covariance discussion moved to the supplementary.

3. Methods: the specification of 9 Hz for the AQD instrument as the data frequency (time resolution) is not appropriate. The 9 Hz is the data acquisition rate but the input values of edd4R requires the time resolution. Sum up all the residence time of the air samples in the AQD shall be roughly the response time and the time resolution will be even longer than that.

The resonance time of the instrument's NO_2 converter is 0.11 s, and so this is taken as the appropriate sampling rate (9 Hz). This is now stated in the manuscript text.

4. Results: the authors may show and analyze their original observations of NO and NO2 before the results of EC deduced NOx flux. There are plenty of information from the directly observed values of both NO and NO2. For example, the NO2/NO ratio will give you some estimates of the observed air mass ages. To show the directly observed values are also a check of the data quality for the subsequent EC analysis. The flight legs may cross different terrains. The observed NO and NO2 may be different for traffic (surface) and industrial (point) emissions.

The manuscript's focus is on calculating NO_x emission rates and assessing the Spatio-temporal variability in relation to London's heterogeneous emission surface. Considering calculated fluxes are compared to the NAEI, which already contains multiple emission source information, we don't feel adding concentration data will benefit the emission assessment being described in this study.

5. Results: Are there nighttime flights or twilight flights? The stated minimum flight height is around 300-400 meter which is limited in the range of nocturnal residual layer and the NOx emissions may not be measured precisely. The needs additional explanations.

Due to significant air traffic control restrictions over London, no nighttime flying was possible. Therefore, the flying hours as shown in the updated Table 1, ranged from 08:00 to 16:00 UTC only.

6. Results: The solar azimuth angle seems to be a dominant factor for the NOx emission rates which means a strong diurnal pattern of the varied emissions sources. Some in-depth discussions on this feature may be added in the paper.

Section 3.1 has been updated to include an additional figure (now called Fig. 4), discussing the temporal variability of measurement NO_x flux in three distinct areas during the campaign (lines 270 – 286). The strong-temporal variability fits with the solar azimuth angle be a dominant factor in the measured NO_x fluxes.

7. Results: in previous publications by the same group, tower platform has also been used by the same group in GLR to deliver the NOx emission flux. Will there be a better idea to pin point the key environment factors of NOx emissions?

Measurements at the BT Tower in London did not occur during the flight period discussed, unfortunately. Future work within the group may want to look into coupling both types of

measurements and applying ERF analysis from the tower to extract key emission factors as suggested, but at this moment in time, this is out of scope for this study.

Technical Corrections:

1. On line 17, "the Greater London region" is mentioned here for the first time, the abbreviation "GLR" should follow.

This has been updated to use GLR abbreviation after line 17.

2. On line 35 the second page, extra spaces appear in brackets.

This has been corrected.

3. On line 80 Table 1, the first and last line of the table needs to be upper/underlined. Besides, all the other tables in the main text should be modified to an identical format.

All tables have now been updated to use this formatting.

4. On line 113, please add more detailed descriptions on how the 3.3 % correction was calculated.

This statement has now been clarified by discussing the effect of WPL corrections in Section 3.1. Figure S4a in the supplementary shows the effect of correcting from wet mole to dry mole NOx and the effect it has on the calculated flux, which is less than 1.5%.

5. On line 122, please unify the tense of the sentences of the experiments. This sentence uses the present tense, while the previous sentence uses the past tense.

This information now appears in section 1.1 of the supplementary and has been updated to use the correct tense.

6. On line 128, please provide specifications about the UV pen ray lamp.

Section 1.1 supplementary now contains information about the UV pen ray lamp with a central wavelength of 254 nm.

7. On line 235, shall be table 2.

This has been corrected to read table 2.