REFERENCE - ACP submission DOI: -10.5194/egusphere-2023-2901 – " How Rainfall Events Modify Trace Gas Concentrations in Central Amazonia" by Machado et al.

Dear Editor Dra. Graciela Raga,

Thank you for considering our manuscript "How Rainfall Events Modify Trace Gas Concentrations in Central Amazonia" for publication in ACP. Please find attached the revised manuscript. We are grateful to both reviewers for their constructive, detailed, insightful and helpful reviews, which helped us to improve our manuscript. Below, we provide a point-by-point response to the comments, concerns and suggestions made by both reviewers, and also outline the changes made in the revised manuscript. We hope that you will find our revisions satisfactory. The reviewers' comments are in black and our responses are in blue in regular font; changes to the manuscript text are in *blue italics and underlined*.

Referee #2 (Remarks to the Author):Review for manuscript entitled, " How Rainfall Events Modify Trace Gas Concentrations in Central Amazonia " by Machado et al

Manuscript format description:

Black text shows the original referee comment, blue text shows the authors response. Changes to the manuscript text are shown as *italicized and underlined*. We used bracketed comment numbers for referee comments (e.g., [R2.1]) and author's responses (e.g., [A2.1]).

General Comments:

[R2.1] The authors use a term, "fluctuation" of the trace gas concentrations, to show the rainfall impact without explaining how the fluctuation is defined. Is it the difference in the corresponding gas concentration at the time from the background concentration? If so, is the seasonal variation in the background concentration considered?

[A2.1] We used fluctuation incorrectly, the correct denomination is difference. The presented composite is computed as the difference between the average median value for all time steps, before and after the max rain rate, and composite value. We are now using difference in all text, including in the figures legend. We also added an explanation on how the composite was computed.

[R2.2] The authors provided the profiles in the daytime and nighttime for each gas during the rainfall event (Fig. 1). Can the authors also provide the background profiles without rainfall events?

[A2.2] We added supplementary figures showing rain and non-rain events for day, night, wet and dry season, for each gas mixing ratio profile. We also added in the supplement the diurnal cycle for rainy and non-rainy events.

[R2.3] I also believe that showing the actual ozone profiles during the rainfall events, in additional to their anomaly from the background, will help the authors to illustrate their points. Such profiles can be shown in the Supplement.

[A2.3] We added several new figures on the supplement showing the profiles for rain and non-rain events, we hope these new figures provide the information requested by the reviewer. We also added a new figure, with the composite of the absolute mixing ratio of the ozone, for different composite types.

[R2.4] The authors used a 4-hour window that centres at "maximum rain rate". It is not clear how rainfall is distributed during the 4 hours. No rain at all except at the time with the maximum rain rate time?

[A2.4] A discussion including new figures was added to the manuscript including information about rain duration, and intensity. Most of the rain events have a duration smaller than one hour.

[R2.5] As Figure 3 shows, the variation in rainfall is associated with changed in other meteorological elements (radiation, cloud cover, temperature, humidity, wind, boundary layer height, and GLM density). The authors discussed the impact of rainfall on the trace gas concentrations mainly based on the variations in other meteorological elements. The authors missed the discussion on direct rainfall impact on these gas concentrations through examining the solubility of these gases.

[A2.5] A discussion about solubility was included in the same paragraph mentioned by the reviewer. "*Rainfall is correlated with changes in other meteorological variables, as described above, but gas solubility is also directly affected by rain events. Rain can increase the rate of air-water gas exchange, Ho et al. (1997) empirically calculated the gas transfer velocity and rainfall rate for different rainfall rates and drop sizes, quantifying the enhancement of air-water gas exchange by rainfall. There is also the wet deposition effect, which may not be an efficient removal mechanism for hydrophobic gases as described by Mullaugh et al. (2015). The direct rainfall effect depends on the solubility of gases, and wet deposition is highly complex, especially for VOCs, due to the water solubility of this heterogeneous mixture covering several orders of magnitude (Niinemets and Reichstein, 2003)*."

[R2.6] Line 282-290, "The decrease of CO2 concentration within the canopy after the rainfall is directly linked to the simultaneous increase in humidity and cloud cover and decrease in temperature". The reduction in radiation is likely to be the main driver for the variation in CO2 concentration, this is not explicitly mentioned. "Another possible reason could be associated with an increase in mixing within the canopy, destroying the stable layer within the canopy by mixing free tropospheric air into the canopy." Can the authors provide supporting evidence for this? This also applies for other discussions in the paper, the audience would be benefited if some pieces of supporting evidence are provided. If no supporting evidence, the authors can use phrases like: "we suspect", "this study suggests", or some expressions like that.

[A2.6] The sentence was modified to "*The decrease in the CO2 mixing ratio within the canopy during the rain event is correlated with the simultaneous increase in humidity and decrease in temperature as a consequence of the reduction in radiation due to the increase in cloud cover Pedruzo-Bagazgoitia et al. (2023). As discussed above, these environmental conditions suppress both soil and tree CO2 exchange and surface flux and reduce photosynthesis. Another possible reason could be associated with increased mixing within the canopy, destroying the*

stable layer within the canopy by mixing free tropospheric air into the canopy Betts et al. (2002). These two effects may contribute to the reduction in CO2 mixing ratio after the rain event; however, the importance of each of these effects could not be quantified with the current data.".

Specific minor comments:

[R2.7] Line 245, 292, 327: Figure ??

[A2.7] All supplementary Figures was cited as ?? because the journal asked to split main text and supplementary in different text, and we didn't realize that problem. Sorry, now it was fixed.

[R2.8] Line 227, "Environmental", "E" should be in a lower case.

[A2.8] It was changed as recommended.

[R2.9] Line 259, "Carbon Monoxide", "C" and "M" should be in lower cases.

[A2.9] It was changed as recommended.

[R2.10] Line 349, Add "Fig." before "5".

[A2.10] It was changed as recommended.

[R2.11] Line 385, change "reported in (Pfannerstill et al. 2021)" to "reported in Pfannerstill et al.(2021)". Similarly, in Line 392 and other places.

[A2.11] It was changed as recommended

[R2.12] Line 348, can this reference be cited in this way? "Machado, L. and all: How the Amazonian Forest Produces New Particles, Submitted to Nature, XX, XX, 2023."

[A2.12] The reference was deleted as it is still in the review phase.

[R2.13] Fonts for some figures are too small to read.

[A2.13] The Figures fonts were changed.