RESPONSE LETTER

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Rio Claro, September 01st, 2023.

Dear. Dr. Thijs Heus,

Detailed point-by-point responses to all referee comments and specify all changes in the revised manuscript are presented below. These referee comments were essential to improve the original manuscript and have contributed for the radical modifications made in the manuscript revised version.

Specific response to reviewer 1

Major comments

Comment: Why aren't these intra-events variations analyzed? Why is high-frequency sampling useful for this goal? What not just sampling the precipitation twice a day, once at sunrise and once at sunset?

Response: According to your suggestion, we modified the explanation of the sampling, see lines 90-98 (in subsection 2.2) and included an intra-event (subsection 3.2) and inter-event comparison (subsection 3.3). In addition, we didn't imagine building a work based on day-night differences, we wanted to analyze differences in rainfall types using high-frequency sampling, so these results surprised us as well. We did not sample one event during the day and another during the night on the same day, it was performed in different days (see in detail in Table 1). In this new version, we have used only one convective event collected during the day and one convective event collected at night to present the day-night differences in isotopic composition of rainfall (subsection 3.4).

Comment: Fig 4 and Table 1 aim at identifying relationships for a given season and for a given period of the day across samples that reflect intra-event and/or inter-event variability. However, most of the discussion focuses on the day-night contrast. So, it's not clear how Fig 4 and Table 1 feeds the discussion on the day-night contrast.

Response: This figure and table were removed, and the discussion was reformulated as presented in the previous response.

Comment: Make different sections in the paper, one devoted to the day-night contrast, and one devoted to the interevent variability and/or intra-event variability? Alternatively, the paper could be focused on the day-night contrast only.

Response: Thanks for your suggestion. It was accepted. In the new version we focus on two parts: a) local aspects, for characterizing the seasonal distributions, monthly isotopes, outgoing longwave radiation, and latent heat flux were presented in subsection 3.1; an intra-event analysis based on the temporal evolution of isotopic composition and meteorological data (at the surface, the vertical profile of radar and GOES-16), see subsection 3.2. b) regional aspects, using an inter-event comparison with moisture transport and origin by the Hysplit model and reanalysis data, see subsection 3.3.

Minor comments

Comment: "low-level convergence (stratiform clouds)": no, stratiform are rather associated with low-level divergence, since there is a mesoscale ascent above the freezing level and mesoscale descent below [Houze, 1989, Houze, 2004]

Response: The sentence was corrected, and references included. See line 42.

Comment: also high-frequency within squall lines, e.g. [Taupin et al., 1997, Risi et al., 2010, Tremoy et al., 2014].

Response: These references were included. See line 67.

Comment: clarify errors using the same format as l 107. what is the error on *d*-excess?

Response: The sentence was added, see lines 114-115.

Comment: "used calculations" -> "used for calculations"

Response: The sentence was corrected. See lines 157 and 164.

Comment: "data, for" -> "data were used for"

Response: The sentence was corrected. See line 159.

Comment: confusing: why aren't there any rainfall samples collected at night during spring? Because of Covid restrictions or because convective events occurred predominantly during the day? What percentage of events are we missing due to covid restrictions?

Response: There aren't rainfall samples collected at night during spring because of the Covid-19 restrictions. As the sampling was performed manually, it was impossible to sample all rainfall events, which difficult the computed a percentage. In addition, the person responsible for the sampling was waiting for the rain considering the university restrictions due to the pandemic. The covid-19 has restricted access to the university, especially at night. The sentence was rewritten, and the explanation of the sampling was detailed in lines: 90-98.

Comment: 188-189: unclear logical link: why are there equal amounts of rainfall during the day and nights? Previous studies suggest that this diel distribution mainly depends on the convective organization, types of convective systems and their propagation, e.g. [Tai et al., 2021, Sato et al., 2009].

Response: We computed the rainfall amount for day and night only during the monitoring period (2019-2021) to characterize the role of convection and its influence on rainfall. The diurnal cycle in Amazon (Tai et al., 2021) is quite different than the observed in our study area (e. g. higher temperature) because is modulated by different meteorological systems (cold fronts have few influences in Amazon, for instance). The role of the cold front in the study area could contribute to an equal amount of rainfall during day and night, despite the cold front also influencing to organization of the convection across south-eastern portion of Brazil. A major temporal evaluation of convection processes is necessary to compare these other studies, which is not the objective of this article.

Comment: Risi et al 2019 and Hu et al 2022 are not appropriate here. The coincidence between LCL and cloud base has been known for many decades.

Response: This paragraph and the references used were removed.

Comment: the logical link between cloud depth and time of interaction of raindrops with the ambient air is not clear. Only the link with the cloud-base altitude makes sense.

Response: The processes below-cloud were entirely rewritten. See subsection 3.4.

Comment: remove "(not include vapor isotope data)". Because a lot can be said about convective processes with precipitation data, e.g. [Risi et al., 2010**]**

Response: It was removed.

Comment: clarify where the wind comes from: e.g. Northwesterly "Moist air masses of Atlantic origin are transported westward over the Amazon Forest, undergoing intensive recycling and rainout.

Response: This sentence was entirely modified. Description about Amazon transport are presented in lines 307-313.

Comment: cite papers documenting the isotopic signature of evapo-transpired moisture, e.g. [Salati et al., 1979, Gat and Matsui, 1991, Risi et al., 2013, Shi et al., 2022].

Response: The references were added.

Comment: Clarify and/or simplify. If both night-time events and all events come from the Amazon, nothing is different.

Response: Corrected. It was clarified in lines 256-258.

Comment: this is not specific to day/night. I recommend to tighten the discussion to demonstrate one or a few key messages. e.g. what explains the day-night contrasts. Anything that is not specific to day or night shouldn't be discussed here.

Response: The structure of the article was modified. The day-night contrast was discussed in only one subsection 3.4, using two convective rainfalls as case studies.

Comment: "Therefore": the logical link is not clear. The 2 sentences seem to contradict each other.

Response: These sentences were removed.

Comment: this appears to contradict the rest of the paper and the summary schematic in Fig 5. Basically, there are 2 kinds of processes that can explain the day-night contrast: (1) local processes, (2) regional processes. How do you quantify the relative importance of these 2 kinds of processes? A clear picture should emerge on which kind of process is most important, and it should be cosistent between different parts of the text and the summary schematic.

Response: The day-night schematic in Fig 5 was removed. However, we present new results and discussion about day-night differences in subsection 3.4. For this purpose, we have evaluated two summer events as case studies, for day and night situations. It was computed the influences of below-cloud evaporation processes (major contribution during day-event), consequently, regional processes had a major contribution during the night event. The

mechanism to control isotopic composition in regional processes as detailed in subsection 3.3. This evaluation was not computed for all summer convective events because the other events were different in relation to the duration and meteorological data (Table 1). In addition, differences in day-night during autumn and spring were not observed during the monitoring period (see subsection 3.1) due to the lower convective activity in relation to the summer.

Comment: "partial evaporation and isotope exchange of raindrops" -> "partial evaporation of raindrops and rain-vapor interactions"
Response: The sentence was removed.

Comment: clarify this rationale. Previous studies on the diurnal cycle of convection in this region could also be cited to support or refute the rationale.
Response: Previous studies were cited.

Comment: Fig 1: for which seasons are the back-trajectories plotted? In the text, different origins depending on seasons are discussed, but this does not appear on this Fig.
Response: A new figure of back-trajectories was plotted subdivided into seasons. See Fig. 5.

Comment: how are the different types of systems defined? It would be useful to add a subsection on this classification in the Methods section.
Response: This information was included in the Methods, see lines 135-140.

Comment: why are droplets smaller during the day? This represents stronger rain evaporation, but is it consistent with observations of rain size distribution?
Response: In the previous version, data on drop size was not available. Such as for the new version, in this way, which difficult to compute the difference between day and night events. Alternatively, the evaporation processes in raindrops were assessed using the widely conceptual framework for isotope effects, see subsection 3.4.

Comment: Sub-section 2.4 on "convective rainfall classification": where is this classification used in the paper? If not used, remove
Response: It was modified in subsection 2.6, where was described how the convective rainfall was characterized using micro rain radar and GOES-16 imagery.

Response to reviewer 2

Major comments

Comment: To verify a hypothesis (post-condensation effect and precipitation history), it must be tested quantitatively, not qualitatively.

Response: The revised version included the quantitative information to verify the hypothesis of the article. For the post-condensation effect (see subsection 3.4) a semi-quantitative assessment of the impact below-cloud evaporation was carried out using isotope and meteorological values, the main results of this subsection are synthesized in Table 2.

Hysplit ensemble analysis (Fig. 5), ERA-5 eastward vapor flux (Fig. 6) and evapotranspiration values were used to explain the precipitation history between seasons (summer, autumn and spring), see subsection 3.3. For vapor flux and evapotranspiration were included the quantitative values to differentiate the moisture transport. This meteorological dataset was combined with isotopic composition (median values in Table 1) and it was carried out an inter-event analysis.

Comment: [...] explanation about sampling intervals and how many precipitation events are used to calculate the daily and nightly averages.

Response: This comment has contributed for improving the new version of the manuscript. In the previous version, we decided to group the rain events together to form a more robust dataset. However, for the new version, we modified entire the results and discussion and presented an intra-event analysis to better explore the high-frequency samples. Table 1 and Fig. 4 illustrate the number events and this temporal evolution, respectively. Now, for the day-night contrast (described in subsection 3.4), it was compared one-day (24/02/2021, n = 16) and one-night (2020/02/10, n = 18) summer events with a similar number of samples, respectively.

Minor comments

Comment: I can't find a description of how many precipitation events are used to calculate the daily and nightly averages.

Response: This description was included in the new version in section methods and Table 1, see lines 90-98. A total of 8 convective events have been collected, 4 in summer (2 in the day and 2 nights), 2 in autumn (1 day and 1 night), and 2 in spring (only day). One summer-event during the day and one summer-event at night were used to characterize diurnal differences in subsection 3.4.

Comment: I can't understand how many trajectories are used to identify the moisture origin for each precipitation event. What time did you launch the trajectory analysis? How many trajectories do you compute? A single trajectory analysis does not provide reliable moisture source for each precipitation event. And it is necessary to consider the replenished moisture from the surface during the transport to discuss the moisture sources.

Response: According to your suggestion, the Hysplit model was modified in relation to the previous version of the manuscript. In the new version, 27 trajectories were used to identify the moisture origin for each rainfall event, see lines 143-153 and Fig. 5. The time was the local start time of each rainfall event.

Comment: Introduction of a conceptual model is not a "Results". Results just show your observed results. Your speculation and conceptual model should be noted in Discussion section. The manuscript should be reorganization before resubmission.

Response: The conceptual model was removed. We present new results and discussion about the local processes in subsection 3.4. In this subsection, a semi-quantitative assessment of the impact of below-cloud effects was carried out based on the generally accepted conceptual framework for isotope effects, which resulted in lower speculation about evaporation processes than the previous version.

Comment: The same reference was cited with different names. For example, Aemisegger et al. 2015a and Aemisegger et al. 2015b refer to the same paper. Similar mistakes is found for Kurita et al. 2013a and Kurita et al. 2013b. Check the reference carefully.

Response: The references were revised.