General Response to Referee #2

Original referee comments are in blue.
Our responses are in black with regular font format. Text from the updated manuscript:

Appears in italics with 1⁄2 inch indentation with the removed parts exhibited with a ~~strikethrough~~ and red color while new text added is shown in green.

Summary of RC2 comments:
The paper is well-structured, and its results are effectively contextualized by comparing them with existing literature. Although certain analyses appear similar to prior studies, the utilization of different data and methodologies enhances the significance of this manuscript, particularly given the challenges of generalizing in-situ atmospheric observations. Notably, the exploration of moisture convergence analysis with this dataset appears to be novel.

We are grateful for the encouraging comments and would like to acknowledge the thoughtful revision, which helped improve our manuscript.

However, concerns persist regarding the potential impact of measurement uncertainties on the outcomes, as well as the statistical significance of the findings. (1) One of my main concerns regarding the methodology employed in this study, is the impact of the errors in the retrieval of the water budget terms, on the calculation of the divergence term.

This is addressed in responses 1-3 from the RC1. Here we are pasting the same answer.

In order to provide uncertainty estimates with respect to the water budget, we followed the reviewers' suggestions and considered different sources of precipitation in our updated analysis. In addition to the surface AOSMET precipitation [1], we are now also using the tipping bucket [2] and laser disdrometer (LD) [3]. Figure 9 in the current manuscript will be replaced by the figure below, which displays the updated results.

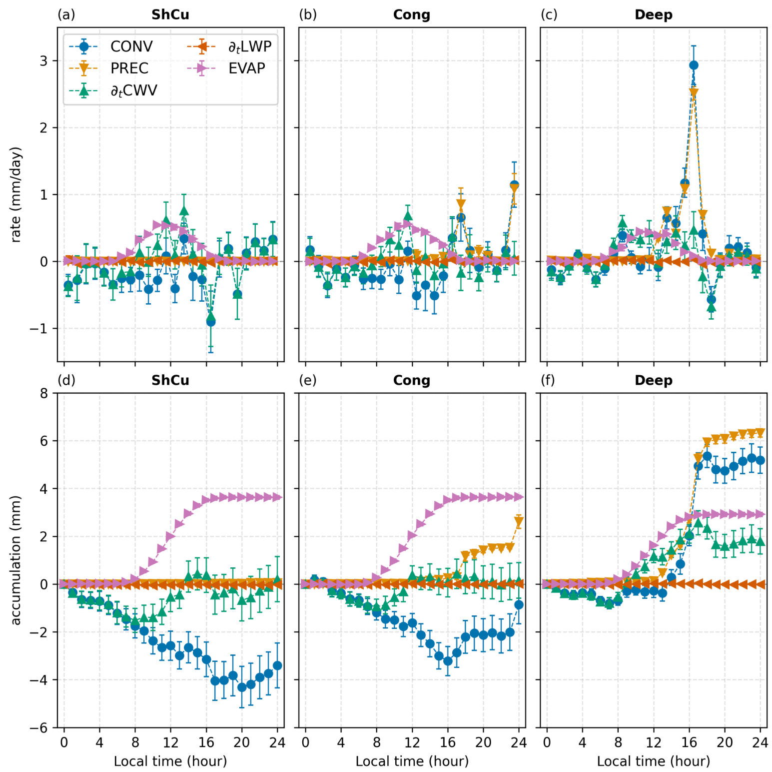

Figure 9. Surface water balance for (a,d) ShCu regime, (b,e) Cong regime, and (c,f) Deep regime. The upper panels represent the rates of change (mm/day) for water vapor convergence (CONV), evaporation (EVAP), precipitation (PREC), and the time derivatives of column water vapor ($\partial_t CWV$, where $\partial_t = \partial/\partial_t$) and liquid water path ($\partial_t LWP$). The lower panels display the accumulated water amounts for each term in the water budget along the day (mm). Note that CWV and LWP changes rely on microwave radiometer observations, evaporation on eddy correlation flux measurements, and precipitation ~~on aerosol observing system surface data~~ is estimated utilizing different sources, namely, the aerosol observing system surface data, tipping bucket, and laser disdrometer. The water vapor convergence term is estimated as a residual in the water budget equation (Section 2.2).

For the rate amounts, the time derivative of CWV or LWP corresponds to the microwave radiometer (MWR) data source. Evaporation rate is calculated from the Eddy Correlation (ECOR) Flux Measurement. Precipitation is the mean composite from the AOSMET, tipping bucket, and laser disdrometer sources. The precipitation uncertainty is estimated from the standard deviation of the different sources. Mean convergence is estimated from the water balance closure, i.e., equation (2) at line 137 from the manuscript. The standard deviation of mean convergence is estimated from the standard deviation of the mean $\partial_t CWV$, $\partial_t LWP$, EVAP, and PREC, i.e.,

$$\sigma_m = \sqrt{\sigma_m(\partial_t CWV)^2 + \sigma_m(\partial_t LWP)^2 + \sigma_m(EVAP)^2 + \sigma_m(PREC)^2} \ .$$

Mean accumulation amounts and their standard deviations are obtained analogously. Note that the convergence uncertainty is mainly attributed to the uncertainty of CWV. More importantly, the main message of our analysis remains unchanged despite the uncertainties included, i,e., shallow days are dominated by divergence while deep days by convergence. Finally, to provide additional information to the readers, we will also include the precipitation and convergence term associated with each data source in the Supplementary Materials, as indicated by the Figure below:

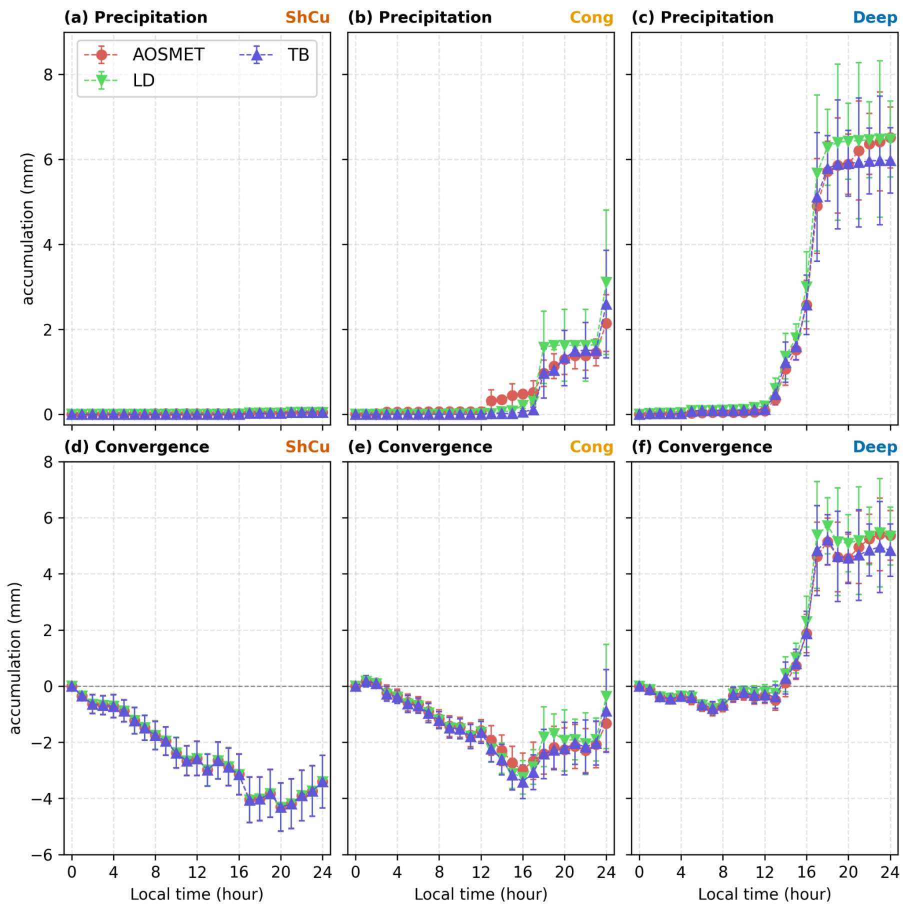

Figure A1. Accumulated surface precipitation (mm) for the aerosol observing system surface data, tipping bucket, and laser disdrometer are shown in the upper panels (a-c). The corresponding convergence (mm) term for each instrument is displayed in the lower panels (d-f). The ShCu, Cong, and Deep regime results are shown in the first, second and third columns, respectively.

With this improved analysis, we believe that all the uncertainties related to the water budget are resolved consistently, given the available observational data. Likewise, the results are statistically significant.

To include the updated version of the surface water balance, the current manuscript must be modified as follows:

Line 115:

Instead of using the S-band radar precipitation, the water balance analysis ~~uses the AOSMET surface precipitation~~ utilizes a combination of rain-gauge source measurements to provide a more robust estimation of the mean surface precipitation and its uncertainties. Specifically, we use the surface AOSMET precipitation [1], tipping bucket [2], and a laser disdrometer (LD) [3].

Line 141-143:

Specifically, CWV and LWP are based on the MWR. ECOR latent heat flux data is utilized for estimating the evaporation term. Precipitation is ~~taken from the AOSMET surface measurements~~ obtained utilizing different sources, namely, aerosol observing system data, tipping bucket, and laser disdrometer (Section 2.1).

Line 248-250:

The water balance results are shown in Fig. 9, with the top panels showing the hourly average rate values (mm/day) and the bottom panels showing the corresponding accumulated values (mm). The separate precipitation and convergence associated with each rain gauge used to estimate the mean surface precipitation and its uncertainty in the water budget results are provided in fig. A1. First, we notice that the variation in LWP appears negligible, and it does not contribute significantly to the water budget.

Line 254-255:

At day's end, the ShCu regime is estimated to lose 3.4 mm of water vapor due to divergence, while the Cong regime loses ~~1.3~~ 0.9 mm. In contrast, the Deep regime gains ~~5.4~~ 5.2 mm of water vapor due to convergence.

Figure 9, page 14:

Figure 9 is replaced by the updated one, shown above. To consider the new sources of surface precipitation, the caption is updated as follows:

Note that CWV and LWP changes rely on microwave radiometer observations, evaporation on eddy correlation flux measurements, and precipitation ~~on aerosol observing system surface data.~~ is estimated utilizing different sources, namely, the aerosol observing system surface data, tipping bucket, and laser disdrometer.

(2) The need to define a control volume in the water budget.

Our surface water balance analysis is based on the integral form of the total water continuity equation. While a control volume is only properly defined in models or theory, we can still define a scale where our analysis can be applied, as follows:

We only employed local surface measurements in the water budget with the intention of conducting a local surface water budget analysis. The term local is loosely used to indicate that the water budget is suitable for a local analysis, which could be imagined as a scale of ~ 1-10 km or single cloud size scale. However, the scales depend on each instrument. Surface fluxes depend primarily on the surface properties, and should not vary much at different points over the same vegetation type, but there is only one ECOR observational site for surface measurements. The infrared thermometer in the MWR has a field of view of less than 3 degrees, hence the column water vapor measurement represents the value over the site. Gauge-measured precipitation is a point measurement and can vary a lot over short distances in individual rain events. However, since an hourly average is applied to these data and our composites average over many events, these point measurements can characterize the scale of the event, i.e., of the clouds that are advected over the vertical experimental site.

To include this discussion in the manuscript, the following modifications were made:

Line 118-119:

~~The water budget derivation, including the water vapor convergence term, is provided in the next section.~~

Hourly averages are applied for the data utilized in the water budget analysis, and its mathematical derivation is provided in the next section.

Line 143-144:

The water vapor convergence term is estimated using the mean composites for ∂CWV/∂t, ∂LWP/∂t, EVAP, and PREC.

Note that we only employed local surface measurements. Surface fluxes depend primarily on the surface properties, which are uniform around the experimental site, at least up to 10 km away. Surface rain gauges and the microwave radiometer perform point measurements. However, since we are applying hourly averages for the water budget datasets and the composites average over many days, the mean precipitation, CWV, and LWP relate to regions associated with the domain average of a cloud size scale. Therefore, our water balance is consistent for a temporal-spatial scale of ~1 hr and ~10 km.

(3) Discuss the impact of the hydrostatic approximation in the calculation of CWV and LWP in the water budget.

We have assumed the hydrostatic balance only to perform the mixing ratio integration for the radiosonde measurements (Figure 7). Although equation (1) indicates integration at pressure levels, the column water path and liquid water path were taken from the microwave radiometer (https://www.arm.gov/capabilities/instruments/mwr) for the water budget analysis. As reported on the ARM MWR website, integrated water vapor and liquid water paths are derived from **radiance measurements** with a statistical retrieval algorithm that uses monthly derived and location-dependent linear regression coefficients. The MWR calibration does not involve the hydrostatic approximation.

Nevertheless, the MWR does not provide optimal measurements during precipitation events. This issue has a particular impact on the Deep regime composite, which also tends to deviate further from hydrostatic balance. Overall, the hydrostatic balance approximation would not affect the entire column mixing ratio (but near convective clouds) and the hourly averages in the water budget may also help minimize the impacts of any errors associated with unbalanced conditions. Moreover, the primary sources of error in the CWP and LWP within the water budget are due to the accuracy of the MWR and its limitations in operating under precipitation conditions, although data were removed during rainy periods, as we explained:

Lines 116-118: Here, CWV and liquid water path (LWP) are taken from the microwave radiometer (MWR). Similarly to Schiro et al. (2016), we exclude data in cases where the brightness temperature surpasses 100 K, and when water accumulates on the MWR lens surface during rainy periods.

Note that the primary source of uncertainty in the water budget is attributed to the CWV uncertainty across all convective regimes. Therefore, the error accounted for in the water budget serves to estimate the deviation from hydrostatic balance.

(4) Discuss the influence of the small sample sizes for regime analysis.

Our study encompasses 60 deep days, 27 congestus days, and 16 shallow days during the wet season, which is a sample size similar to other studies in the literature that also used GoAmazon data (Ghate & Kollias 2016, Zhuang et al. 2017, and Tian et al. 2021) and a much larger sample than studies that preceded the GoAmazon experiment (Machado 2002, Betts 2002, Silva Dias 2008, Khairoutdinov and Randall 2006, etc…).

Nonetheless, we agree with the reviewer that given the variability of clouds, convection, and precipitation, the larger the sample the better. Nevertheless, we can still make relevant scientific inferences from this data as long as we consider all uncertainties. In that regard, following the recommendations of both reviewers, the updated manuscript now includes estimates of the error in the water budget analysis (answers 1-3 for RC1 and answer 1 for RC2), and error bars have been added to all the remaining figures.

Having said that, we note that having a larger dataset for clouds and convection requires a huge scientific effort to make these measurements over tropical forests. This is now being pursued by Brazilian scientists at the ATTO tower. Before long, our scientific community will have access to a more extensive and comprehensive dataset for studying clouds and convection than what the GoAmazon campaign has provided.

(5) To Include an instrumentation table in the methodology section with the name and short description of each data source.

Ok. We have included the following paragraph at the end of the data section:

Line 126:
Finally, a table summarizing the data is also provided in the supplementary material (table A1).

We also noted that the microwave radiometer citation was missing. The text was updated as follows:

Line 116:
Here, CWV and liquid water path (LWP) are taken from the microwave radiometer (MWR, ARM, 2014d)

The table included in the manuscript is shown below:

Table A1. Data

Name	Description
Cloud mask (Giangrande et al., 2017)	Combines multiple sources of cloud data to provide a high-resolution temporal (30 sec) vertical profile of cloud type, including shallow, congestus, and deep. Cloud frequency profile is also calculated as the cloud counting fraction over 12 minutes.
S-band radar (Schumacher and Funk, 2018a, b)	Volume data of reflectivity and derived precipitation rate at 2 km. Rain cover is calculated as the fraction of reflectivity $>$ 20 dBZ over a 100x100 km^2 analysis domain. These data have a temporal resolution of 12 minutes, a horizontal resolution of 2 km, and a vertical resolution of 500 m.
Surface precipitation	We employ three source of surface precipitation data, namely, aerosol observing system surface data, tipping bucket, and laser disdrometer. They have only a temporal dimension, for which we use an average over 12 minutes or 1 hour.
Atmospheric State	Radiosonde data has a latency of 6 hours (launches at 02, 08, 14, and 20 LST). We utilized sounding profiles covering at least 8 km of the atmosphere. A derived planetary boundary layer height is also used. Additional variables, such as CWV, MLCAPE, and MLCIN are calculated.
Surface fluxes	Hourly average data from the ARM best-estimate dataset based on observations from the Eddy Correlation Flux Measurement. Surface evaporation is calculated and employed in the water budget analysis.
Water content	Hourly average data of CWV and LWP taken from the microwave radiometer are employed in the water budget analysis.
Large-scale wind field	Based on the variational analysis. It corresponds to a 3-hour average and a domain average of $\sim$100 km.

(6) The arbitrariness of the 2% threshold for 'rain coverage,'

This particular threshold is based on [4], as we indicated in the methods section. The regime classification method is inherently somewhat arbitrary. All the definitions (i-v, lines 157-167) are consistent, but not unique. We conducted numerous tests to develop our methods, including different cloud boundaries, minimum time frequency for observed clouds, among others. It is not feasible to show all the tests. However, we noticed that the mean composite of each analyzed variable always showed similar behavior. Therefore, small changes in the regime methods will cause small changes in the results, but qualitatively the interpretation of each result is unchanged due to these arbitrary possibilities. Given that, our final decision to choose the method definitions was based on closely following previous studies and prioritizing simplicity.

For instance:

- Cloud boundaries are based on Giangrande et al. (2017).
- Rain cover definition is based on Zhuang et al. (2017), which manually tested several parameters. Their results indicated that shallow rain cover never exceeds

2%, a criterion we adopted in our definition of minimum rain cover for identifying congestus or deep clouds.

- Early morning perturbation is based on Tian et al. (2021). However, they requested a precipitation rate of less than 0.015 mm/hr between 08:00 and 09:30 LST, whereas we adapted the procedure by requiring no observation of congestus or deep clouds between 06:00 and 10:00 LST.
- Local convection definition are based on the spatial scale of mesoscale convective systems, which typically cover approximately ~100 km [5]

Since every convective classification procedure is based on previous studies, this further justifies all the chosen parameters.

(7) The definition of 'bulk wind shear' is somewhat arbitrary.

We used the standard definition of bulk shear, as seen, for instance in reference [6], i.e.,

$$\text{wind-shear}(z) = \sqrt{[u(z) - u(0)]^2 + [v(z) - v(0)]^2}$$

The reviewer suggested that calculating the bulk shear from the level of maximum wind to the surface would complement our analysis with additional information, such as the height of the given maximum. We conduct the corresponding analysis by taking the maximum wind speed below 4 km (≈600 hPa), a suitable condition to evaluate only the low-level jet. The results are shown in the figure below.

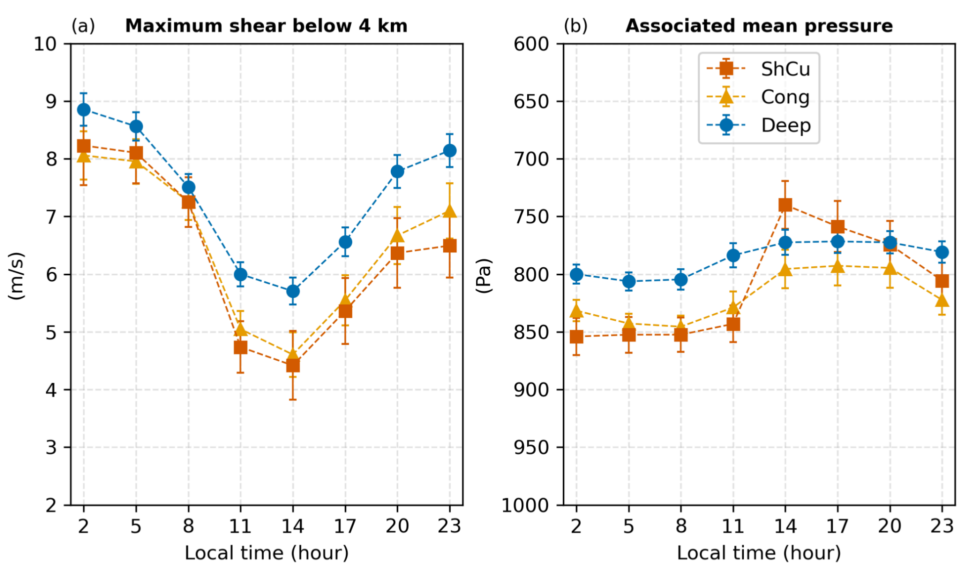

Figure A2. (a) Vertical bulk wind shear from the level of maximum wind speed below 4 km and (b) the associated pressure level.

Comparing the above results to our standard analysis (Figure 13, pag 17), it indicates that the main message still remains, where deep days exhibit the strongest wind shear only in lower levels. For the associated height levels for maximum wind speed, the same analysis that we conducted using figure 10 (wind speed profile, pag 15) also holds (lines 267-269).

Lines: 267-269
"During the morning, the ShCu regime reveals a lower and slightly stronger jet. However, the PBL grows during the day to a height of 1-2 km (see Fig. 8), reaching higher altitudes for ShCu days. As a result, the lower jet in the ShCu regime is more significantly affected by the PBL growth."

However, the following manuscript sentence must be improved:

Lines 269-270:
~~Thus, at both 11 LST or 14 LST, the Deep regime presents a more vigorous and slightly higher low-level jet.~~
Thus, at 14 LST, the ShCu regime reveals a less prominent low-level wind peak but at a slightly higher altitude compared to Deep days.

Therefore, both properties of height related to maximum wind speed and wind shear can be similarly obtained in figure 10 and figure 13, respectively. However, we included fig. A2 to further support our analysis. Thus, the text of the manuscript has been updated as follows:
Lines 290-293:
To evaluate the vertical wind shear, we used the bulk wind shear, which is defined as the magnitude of the vector difference of the wind at two levels. Figure 13 shows the vertical bulk wind shear for the layers 0-2 km, 0-4 km, and 0-6 km. Additionally, the bulk shear from the level of maximum wind speed below 4 km and the associated pressure level is provided in fig. A2. The 0-2 km layer exhibits a greater dependence on the diurnal cycle, with the Deep days followed by Cong days showing the most substantial wind shear at any time. Moreover, the Deep regime shows the largest difference between the maximum wind speed below 4 km and surface wind. ~~This result suggests~~ These results suggest that low-level vertical wind shear is related to convection development.

Figure A2 above is also included in the supplemental materials.

(8) Additionally, there also have been a few technical corrections reported regarding the text, aimed at enhancing sentence structures.

- line 14: Missing comma after ‘even moisture’
  Answer: done

- Line 46: Define ‘mid-levels’, for clarity
  Answer: We usually apply this term in a loose way. Here, the text is updated by “a moister layer from the surface to mid-levels (~ 5 km)”

- line 72: Typing error: ‘a city border the Rio Negro’
  Answer: I didn't understand. Rio Negro is the portuguese name of “Negro River.” I replaced ~~a city border~~ with a city that borders if that you mean by typing error.

- line 77-78: Suggested: ‘... a cloud mask based on time-height profiles of the cloud location’
  Answer: done

- Line 83: What do you mean by ‘cloud frequency profile’? Relatedly, in Fig 5’s caption, what is the percentage cloud frequency relative to?
  Answer: The cloud-mask gives one cloud type at every 100 m in the vertical and every 30 seconds, which are the space and time resolutions of the cloud mask data product developed by Z. Feng and S. Giangrande (Giangrande et al., 2017). The cloud types that we are considering are: shallow, congestus, and deep. The deep cloud frequency, for example, is the number of deep clouds found in a 12 min interval divided by 24 (the maximum possible) at each height. .

  To make this more clear, the text in the figure caption is updated as follows: “Cloud frequency (cloud counting fraction in %, colormap) as a function of height calculated over a 12 minutes window based on the cloud mask and surface precipitation rate (mm/hr, red line) locally measured by the aerosol observing system at the T3 site.”

- line 107: ‘water vapor mixing ratio’
  Answer: done

- Line 112: Do you mean ‘the 100-hPa depth layer immediately above the surface’?
  Answer: Yes. We checked, and the methods explains it on Line 112:
  Line 112: A mixed-layer parcel **from the surface to 100 hPa** is used as the initial state for the parcel’s ascent Stull (2016).

- Line 126: Need to define the control volume over which the conservation equation is being applied.
  Answer: This is addressed in the answer (2).

- Line 129: Please rephrase for clarity: 'E and P correspond to the water mass fluxes associated with **surface evaporation** and precipitation'
  Answer: Text modified as suggested.

- line 131: 'with the divergence of water vapor'
  Answer: done

- Line 132: I believe this statement is incorrect. Since the variable here is total water mass mixing ratio, it is not affected by phase transitions associated with cloud formation in the control volume.
  Answer: Thanks for catching that misleading statement. Looking at fig. 9, we clearly see that convergence and precipitation dominate the water budget during the cloud deepening period (panel c, 16-17 LST). Therefore, this phrase was removed:

  Line 131-133: The second integral is the water mass flux divergence, which is mostly associated with water vapor. ~~As convective clouds develop or dissipate, the time rate of change of total column water—the first integral—greatly contributes to the water mass balance.~~

- Line 134: I believe there is a mistake here. The terms in Equation 1 have units of mass flux, such as $kg/m^2/s$. Dividing by the density of liquid water would give units of m/s, which does not seem to be the intention. Moreover, to express the equation in terms of liquid and vapor water paths, it is not necessary to divide by anything, since the integral of the total water mixing ratio divided by the gravity acceleration with respect to pressure already represents the total water path in a hydrostatic atmosphere. This total water path can then be separated into vapor, liquid, and ice terms, as you mention below.

  Answer: This comment was just explaining about the change of units. We have to divide by the density of liquid water to get mm-of-rain (height of the equivalent layer of water on the surface) instead of kg/m2 (which could be from ice, liquid, or vapor).

  To make this more clear, we modified the text as follows:

For the sake of this analysis, we ~~divide equation (1) by the density of liquid water pl (103 kg m−3) and ignore~~ neglect the time variation of the ice term and express all terms in units of mm hr^{-1}.

- Line 134: ‘ignore’ should be ‘neglect’
  Answer: done

- Line 134: Are you neglecting the time variation of the ice mass or the presence of ice itself in the analysis? Does the observed LWP you use include all condensate or does it discriminate between ice and liquid water?
  Answer: Based on the MWR paper (https://ieeexplore.ieee.org/document/4373386), they use ground-based two-channel microwave radiometers to provide observations of downwelling emitted radiance from which precipitable water vapor (PWV) and liquid water path (LWP) are retrieved. Thus, our measurements of LWP do not include ice. The comment above is correct, i.e., the ice water path is neglected.

  The IWP is only retrieved by the upgraded version of the MWR. The MWR-Profiler (e.g., MP-3000 from Radiometrics) has more channels, has a wider field of view (30deg instead of 3o), and can retrieve the vertical profiles of temperature and humidity, as well as LWP and IWP. However, there are many greater uncertainties in these retrievals and those from the standard MWR.
- line 138: If you follow the suggestion I mentioned earlier and avoid dividing by any additional factors, the terms in the equation can be represented as EVAP = E and PREC = P. I recommend maintaining one naming convention for consistency and clarity
  Answer: We are using EVAP and PREC as rates (mm/hr).

- Line 141: The data in Fig 9 seems to have a higher frequency, intervals seem to be of 12 min.
  Answer: The water budget analysis is based on hourly averages. This is discussed in answer (2). Hence, the scatter plot shows 1-hr intervals.

- Line 152: Do these times define what you call ‘diurnal cycle’ throughout the paper? If so, please clearly define the term ‘diurnal cycle’ when it is first used in the text, to ensure that readers understand the time period being discussed.
  Answer: The diurnal cycle is first defined for the first time in his line. It refers to the period 10-20 LST. It is also mentioned in lines 157-159.

- Line 153: By ‘rain coverage’ are you referring to large hydrometeors, independent of the phase. Please clarify.

  Answer: The rain coverage is calculated as the fraction of reflectivity pixels > 20 dBZ over the analysis domain (100x100 km^2 , centered at T3). This is a common threshold, e.g., utilized in [4].

  Based on reference [4]: “The 20 dBZ and 40 dBZ rain fractions, defined as fractional coverage of **Z ≥ 20 dBZ representing the area of convective systems** and Z ≥ 40 dBZ representing the area of intense precipitation or a convective core in the 100 km grid box, are calculated for each level.”

- Line 157-164: By ‘precipitation’, do you mean ‘rain coverage’? If so, please correct the text here for consistency.

  Answer: Exactly, thanks for pointing that out. We have modified the text:

  In criteria (i-iii), ~~Precipitation~~ is replaced with Rain cover.

- Line 165-166: Above, you list the conditions for each type of convection regime, while here you list conditions that apply to all regimes, right? If so, I suggest clarifying this.

  Answer: Line 165: iv) Early morning perturbation: For the 06-10 LST period, we require that no congestus and deep clouds be observed.
  The criteria iv motivation is given in lines 169-171: “The exclusion of any relevant early morning disturbance (06-10 LST) associated with important pre-convective activity guarantees that nighttime MCSs do not cause significant preconditioning.”
  The criteria v is only about local convection, i.e., a filter to remove MCSs in our convective regime classification.

- line 173: I suggest ‘the propagating-convection category occurs more frequently during the wet season’, for clarity.
  Answer: done

- line 195: I suggest rewording ‘because’ to: ‘associated with’.
  Answer: done
  “~~because~~ associated with both the boundary layer height and the lifting condensation levels ~~are~~ being lower in the Deep regime.”

- line 200: Suggested rewording: ‘coincides’ to ‘is consistent with’
  Answer: done

- Line 207: Please add the figure numbers.
  Answer: done

- Fig 6c,d: Is the difference between the profiles for different regimes larger than the standard deviation of the measurements? The length of the bars is not evident in panels a and b, so at least commenting on that would be helpful.

  Answer: The current figure version did not include standard deviations on panels c-d. However, this issue was addressed in the answer to (4) from RC1, as pasted below:

We updated Fig. 6 to limit the y-axis from the surface to 5 km and also included the estimated standard deviation for the difference in potential temperature and mixing ratio ($\sqrt{\sigma_m(Deep)^2 + \sigma_m(ShCu\ or\ Cong)^2}$), as shown in figure below.

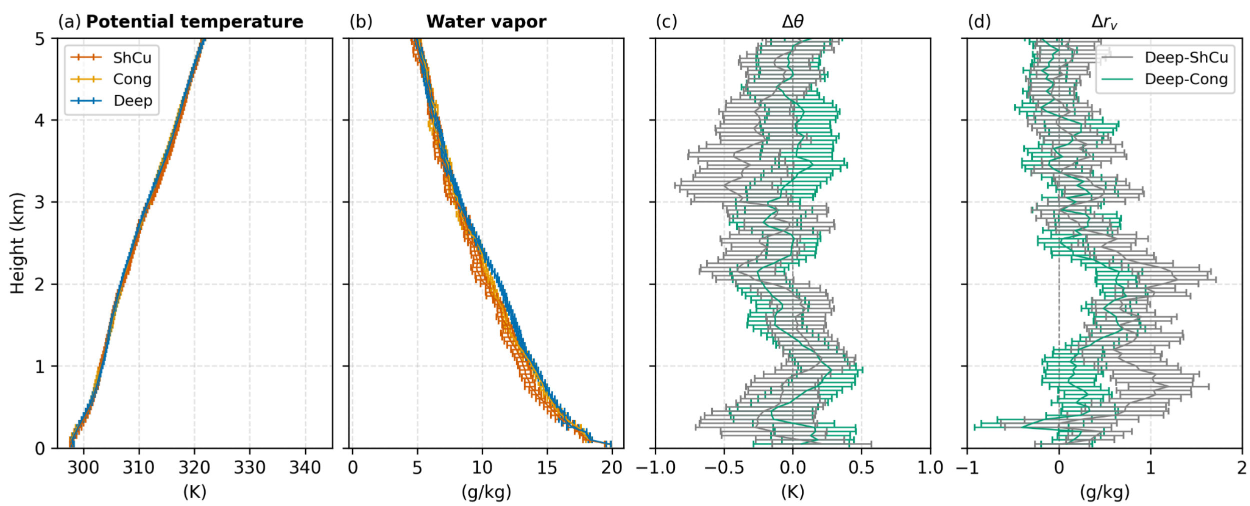

Figure 6. Atmospheric conditions. (a) Potential temperature (K) and (b) water vapor mixing ratio (g/kg) at 08 LST radiosonde observations. The corresponding convective regime differences (Deep-ShCu and Deep-Cong) for potential temperature (Δθ, c) and mixing ratio (Δr_v, d) are also included.

Despite the uncertainties in the difference of mixing ratio between Deep and ShCu composites, values are greater than 0 from the surface up to 3 km. Hence, our main message remains the same: Deep days are relatively moister than shallow days only in the lower levels. The differences between congestus and deep days are less pronounced, albeit the deep composite tends to be slightly moister than the congestus profile.

- line 214: I suggest providing a quantitative measure instead of ‘is quite similar’. Maybe something like: ’the difference between the moisture profiles for different regimes is less than 1/x of the maximum difference at lower levels’.
  Answer: Based on the updated figure (containing errors), discussing the values above 3 km is not advisable due to statistical errors. The text was updated as follows:

  Previous version:
  ~~Above 3 km, the moisture profile for all regimes is quite similar.~~

  Updated version:
  Above 3 km, the differences in moisture profile for all regimes have little statistical significance.

- line 217: Suddenly starting to talk about the tropical oceans reads a bit strange. If the goal is to mention contrasting results, I suggest rephrasing it to smooth the transition, for example: ’Moreover, these results contrast with studies over tropical oceans, where free-tropospheric humidity has been shown to play a more significant role...’.
  Answer: Thanks for the observation. We modified the text as suggested.

- Line 223: Where it says ‘...at 2 LST’, it should be noted that since the classification was done for times between 10-20 LST, measurements at other times of the day might include different types of cloud than those in the regime in question.

  Answer: Based on the RC1 technical comment, we modified the text above as follows:

  Lines 222-224: ~~Interestingly, CWV for Cong and Deep regimes is similar before the diurnal cycle starts, at 2 LST, but is already larger for the Deep by 8 LST. The difference is maximum at 14 LST when it reaches 2.1 mm.~~ The differences in CWV among Cong and Deep regimes show little statistical significance from nighttime to early morning, while their difference is maximum at 14 LST when it reaches 2.1 mm.

Since we mention that the difference in CWV between Cong and Deep regimes before the diurnal cycle has little statistical significance, it no longer seems appropriate to include observations about the methods during nighttime.

- Line 231: Where is says 'despite slightly larger latent heat', add a reference to the section of the manuscript where this is shown.

Answer: Thanks for the suggestion. The text is updated as follows:

"despite slightly larger ~~latent heat~~ surface evaporation (section 4.3)"

- Line 233: 'water vapor convergence', ditto

Answer: The text is updated as follows:

"water vapor convergence (section 4.3)"

- line 242: Please maintain the naming convention (MLCAPE for CAPE).
Answer: done. However, sometimes we use CAPE to refer to other studies. In this case, the CAPE notation was maintained.

- Line 249: It appears that you are calculating 'accumulated values' by numerically integrating the mm/day values over time intervals of approximately 12 minutes. However, it's unclear how the resulting values are still being expressed in mm. Given that the time step (dt) is 1/120 days, it seems that the resulting unit should be mm multiplied by the time step, which would be mm/120.

Answer: The top panel shows the variables as a function of time, in units of mm/day. The bottom panel shows the same variable but integrated in time since mid-night (local time), hence the time units cancel. The 120 factor is already included in the computation, when we convert minutes to days, as the integration is a sum of terms multiplied by dt:

$$accum\,precipitation = \int_{0h}^{24h} precip(t)dt$$

Precip is mm/day, accumulated precip is mm, and dt = 0.00833 days == 0.2 hours == 12 min.

- line 249: Instead of 'variation in LWC', I suggest using '∂tLWC', for clarify
Answer: done

- line 250: ‘dominated’ seems to imply that CONV is the largest term among those in the budget analysis, so I would suggest rewording, for example, ‘shows mostly water divergence’.
  Answer: done. Note that this sentence is also modified due to the next comment.

- Line 251: The ‘divergence’ term responds to changes in the total water, not just water vapor. I understand that the convergence is expected to occur in the form of water vapor, since horizontal transport of condensate is less likely, but this should be somehow clarified, at least in a footnote.

  Answer: Yes. To emphasize that divergence responds to changes in total water, we modified the text as follows:

  Previous text:
  Lines 250-251: ~~While the daytime of ShCu and Cong days is dominated by water vapor divergence, the Deep regime exhibits a neutral condition from night to early afternoon.~~ However, the water budget closure requires convergence in the period from 14 to 18 LST.

  Updated text:
  The daytime of ShCu and Cong days shows mostly water vapor divergence. This is primarily due to more significant negative changes in CWV and lower precipitation rates, whereas changes in condensate exert a minor influence on the water budget. On the other hand, the Deep regime exhibits relatively neutral conditions from night to early afternoon. However, the water budget closure requires convergence in the period from 14 to 18 LST.

- line 251: Suggest: ‘relatively neutral’
  Answer: done (see text above)

- Line 256: I suggest framing the discussion slightly different: instead of saying that high evaporation balancing the divergence leads to low precipitation, it is seems more intuitive to think it as high evaporation and low precipitation requiring strong divergence for closure.

  Answer: Thanks for the suggestion. The text is updated as follows:

  Previous version:

~~Evaporation approximately balances the water vapor divergence during the ShCu days, leading to minimal precipitation. On the other hand, the divergence of Cong days is relatively weaker, resulting in a higher contribution of precipitation, especially in the afternoon.~~

Updated version:
For ShCu days, relatively high surface evaporation and the absence of precipitation require a strong divergence for water balance closure. The Cong regime shows a significant divergence but is relatively weaker compared to the ShCu regime, as their surface evaporation is relatively similar, and congestus precipitation exhibits modest values.

- Line 257: Ditto

  Answer: Addressed above.

- line 258: Is CWP a typo? Do you mean CWV? As commented before, it is clearer to say ∂tCW V than 'the variation in CWV'.
  Answer: done
- Line 259: What do you mean by 'accumulation of water vapor'? Are you referring to Fig. 9d? If so, please clarify. Similarly, clarify the panels you are referring to in the rest of the text.

  Answer: Accumulation always refers to the lower panels (given in mm). Figure 9 caption indicates this: "The lower panels display the accumulated water amounts for each term in the water budget along the day (mm)." Nevertheless, we updated the text as follows:

  Lines 258-259: For ShCu days, the variation in CW~~P~~V tends to be small and negative from nighttime to early morning. Then, it increases and balances around noon. By the end of the day, the accumulation of water vapor (fig. 9d) in the column is negligible.

- Line 269: Please expand briefly on how the LLJ is affected by the PBL growth. Do you mean that the PBL growth slows down the LLJ? Please clarify that this is one possible explanation, since other factors may be involved in regulating the intensity of the LLJ.
-

  Answer: The factors contributing to peaks in low-level wind speed can vary significantly depending on the specific geographical context. However, several primary dynamic mechanisms associated with low-level jets include inertial oscillation driven by diurnal changes in eddy viscosity, as well as terrain effects such as the formation of slope and valley winds or induced wind deflection. Nevertheless, there is currently a lack of literature addressing the occurrence of a large-scale low-level jet within the Amazon. Given this, our intention is not to fully explain the mechanism associated with the low-level jet, but rather to provide a simple rationale justifying the observed differences among the different regime categories and the PBL, which is another result described in the manuscript. In light of this, we have included an additional sentence to address the reviewer's suggestion.

Lines 267-269: During the morning, the ShCu regime reveals a lower and slightly stronger jet. However, the PBL grows during the day to a height of 1-2 km (see Fig. 8), reaching higher altitudes for ShCu days, and the mixing of free-tropospheric and PBL momentum potentially reduces the wind speed. As a result, the lower jet in the ShCu regime is more significantly affected by the PBL growth.

- Line 271: Better refer to the layer between ~ 600 and ~ 350 hPa or so, since at 300 hPa the wind tends to be intense in the deep case.

  Answer: The text was updated as suggested:

  "For the mid- and upper-levels, between ~~600-300~~ 600-350 hPa layer, the ShCu regime shows an additional upper-level jet, while the Cong and Deep regimes exhibit weaker and comparable wind speeds."

- line 275: Suggested: 'The most notable difference'
  Answer: done

- Fig 9, caption: Instead of referring to the number of the subsection, I suggest referring to the number of the equation.
  Answer: done

- Line 295-297: Although the 6-km level is taken as a reference here, the corresponding 'bump' in the wind profile starts at 4km and reaches 8km height (as you mentioned in the discussion of Fig. 10). Moreover, it would be incorrect to say that only because it happens at levels higher than the top of the cloud, the wind pattern does not matter for the convection development. For example, the wind profile impacts the gravity wave pattern induced by convection itself, and these waves may then feedback on the dynamics of the convective clouds [e.g. CHK86].

Answer: Considering the reviewer's comment, the following text in lines 295-297 is removed:
~~However, this layer has an extension at least twice that of the cloud top of the shallow cumulus (< 3 km), suggesting that mid-level wind shear might play a minor role in the STD transition.~~

- line 308: 2.5 J/g = 2500 J/Kg, not 250 J/kg. But there is no need to mention both values anyway
  Answer: OK. We did not make any modifications. In Fig. 14d, we converted the unit for visibility because the x-axis is compact, making smaller numbers more suitable for use.

- Line 321: Based on this results, you can only state that CAPE is not a good indicator for precipitation. This analysis doesn't involve convection strength, but precipitation only.

  Answer: Agreed. The manuscript text is updated as follows:

  "These results suggest that CAPE is not a good indicator of ~~convection~~ precipitation in the Amazon, which is consistent with the findings of Itterly et al. (2016); Schiro et al. (2018)."

- Fig 14, caption: 'average' should be 'averaged'. Also, what do the vertical bars mean?
  Answer: OK, words changed as suggested.
  Vertical bars correspond to the standard deviation of the mean variable.

- Line 328: 'Results showed that isolated deep convection is associated with more extensive and longer-lived clouds throughout the diurnal cycle.' Do you mean compared to shallower clouds? I suggest omitting this statement, as such feature can be considered 'common knowledge'.

  Answer: done

- Line 339: Please clarify what you mean by 'noted significant differences between morning atmospheric conditions and convective intensity'.

Answer:

The phrase was too long and difficult to understand. What we wanted to say here is that Itterly et al (2016) observed significant correlations between the morning conditions of different variables and the convective intensity (it is stated in their abstract).

We change the phrase as follows:

Our results show that deep days are associated with moister conditions in the early morning, but only in the lower troposphere, particularly below 3 km. This contrasts with the results from Itterly et al. (2016). ~~Based on satellite-based observations, radiosonde data, and surface turbulent heat flux measurements distributed across the Amazon Basin before the GoAmazon2014/5 experiment took place, Itterly et al. (2016)~~ They also noted significant differences between morning atmospheric conditions and convective intensity, but indicated that ~~. However,~~ humidity in the upper ~~and lower~~ troposphere also exhibits ~~the strongest~~ a strong relationship with convective intensity.

- line 366: It should be 'captured', instead of 'capture'.
  Answer: done

- Line 380-382: Did they suggest that wind shear would both favor and hinder convection? Please clarify.

  Answer: The authors relate wind shear intensity with convection intensity. Deep days show the strongest wind shear at both layers 0-3 or 0-6 km only in the dry season, thereby favoring convection. However, the authors observed that Deep days do not show the strongest wind shear in the 0-6 layer during the wet or transition season, thereby suggesting that vertical wind shear could have no impact or might hinder convection in those seasons. There is no explanation in their paper relative to this specific interpretation. Please, check their paper [4] for more information. It is the last sentence before Conclusions and Discussion:

  > *"Thus, while larger vertical wind shear may appear to link to the shallow-to-deep convection transition during the dry season, it may have no influence or suppress the shallow-to-deep convection transition during the wet and transition seasons."*

Line 406: 'this value', which one?

Answer: Vertical velocity. The text is updated as follows:
“Nevertheless, it should be noted that ~~this variable~~ vertical velocity is challenging to assess through observations.”

We hope these answers provided clarifications and answers for the comments raised in this revision. Below you can find the papers mentioned explicitly in our response.

References:

[1] Atmospheric Radiation Measurement (ARM) user facility. 2013. Meteorological Measurements associated with the Aerosol Observing System (AOSMET). 2013-12-12 to 2015-12-01, ARM Mobile Facility (MAO) Manacapuru, Amazonas, Brazil; MAOS (S1). Compiled by J. Kyrouac, S. Springston and M. Tuftedal. ARM Data Center. http://doi.org/10.5439/1984920.

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[4] Zhuang, Y., R. Fu, J. A. Marengo, and H. Wang (2017), Seasonal variation of shallow-to-deep convection transition and its link to the environmental conditions over the Central Amazon, J. Geophys. Res. Atmos., 122, 2649–2666, doi:10.1002/2016JD025993.

[5] Houze, R. A.Jr. (2004), Mesoscale convective systems, Rev. Geophys., 42, RG4003, doi:10.1029/2004RG000150.

[6] Stull, R., 2017: "Practical Meteorology: An Algebra-based Survey of Atmospheric Science" -version 1.02b. Univ. of British Columbia. 940 pages. isbn 978-0-88865-283-6 .