The authors would like to thank Reviewer 1 for their comments on this paper. These comments have been reproduced here in black font color, and author responses are included in red.

Title: Observations of the thermodynamic and kinematic state of the atmospheric boundary layer over the San Luis Valley, CO using remotely piloted aircraft systems during the LAPSE-RATE field campaign

Summary: The manuscript describes sampling strategies and data collection using remotely piloted aircraft (RPA). Additionally,there are sections on platform inter-comparability, data quality,and processing. Lastly, techniques are described to evaluate the thermodynamic and kinematic state of the atmospheric boundary layer (ABL) over complex terrain with focus on applications for convective initiation, drainage flows, and ABL transitions.

Recommendation: The authors present the results from an interesting and unique field campaign. I recommend publication with minor revisions.

Key points

I suggest reorganizing the manuscript a bit for clarity. Section 4 “Data Processing”, comes at the end of the paper but it would strengthen the conclusions in Section 3 “Examples of Flight Data” if Section 4 was moved earlier into Section 2.1 “Description of the CopterSonde”. Along this line of thinking I suggest moving Table 4 out of the summary section and showing it earlier in the paper. In the summary it is suggested to include larger implications to the data collection and analysis such as if the datasets collected throughout the six days led to improved forecasts for the San Luis Valley or did the campaign provide an avenue for increased use of RPAs in WMO, NOAA, or NCAR field campaigns? Line 19 of the introduction mentions, “unique opportunity to undertake an intensive comparison of the sensing capabilities of the aerial systems being utilized as a part of the campaign.” But the summary does not reiterate the reason this opportunity was unique or its lasting implications.

We agree with the reorganization of the paper. Table 4 is now moved up to section 2 and is now Table 2. The Data Processing section will now come before the case study examples. We have added some text and references to highlight how this data is being used to the summary to solidify the projected impact of this data set. The last paragraph of the introduction has also been reworked to reflect all of the changes to the architecture of the paper.

As for the comment regarding line 19, we have added some text and references to the first introductory paragraph in lines 20-24. We hope this will more easily point readers to information regarding the overall LAPSE-RATE campaign (de Boer et al BAMS 2020) as well as highlight a case study examining the utility of using RPAS data from LAPSE-RATE for forecasting applications (Glasheen et al JAIS 2020, Pinto et al ESSD 2020) and the ESSD paper highlighting the work forecasters did as a part of this effort.

It is nice to see the larger detail in figures 3 and 4 but it would help the reader in the discussion of comparisons if the figures were side by side or closer together.
Figures 3 and 4 were combined into one figure and the caption was changed to reflect the subfigures.

Section 3.2 would be strengthened with more discussion on accuracy and precision of the dataset rather than just listing references so moving Section 4 earlier can address this. Additionally, adding in comparison data on figures from the radiosonde flights, CLAMPS AERI and Doppler LIDAR observations would be beneficial.
Section 4 (data processing) was moved to now precede the data examples as Section 3. Since the AERI and LIDAR data are described in a separate paper, the appropriate citation was added and we chose not to overlay those data here for clarity.

The following suggested changes are to help with clarity;

Line 35-36: Type of sensors (WMO approved)? Moving table 4 up would be helpful here.
The data processing section now comes sooner after this, and references to tables 1 and 4 (now Table 2) were added to direct the reader to the appropriate information. An additional citation was added to Segales et al. (2020) which outlines this aircraft and the sensors used.

Line 44-45: "Section 6 will provide concluding remarks about the dataset as well as future outlooks regarding the future applications of the dataset." The summary section does not seem to currently include "outlooks regarding the future applications of the dataset."
Two sentences have been added starting at line 237 to highlight what studies this data set has already been utilized as a part of as well as upcoming papers that will be harnessing this data. We have also restructured this last paragraph of the introduction to point readers to efforts by other LAPSE-RATE teams as well as the overview and intercomparison efforts.

Figure 1 and Line 56: An immediate question for the reader is how the props influence the atmospheric sensors when viewing figure 1 then on line 56 it is mentioned the props were changed. Including a sentence or two on how prop wash has been considered would be helpful to the reader.

We added a comment that changing these propellers should not affect thermodynamic observations (lines 86-88) and also added a citation to Greene et al. (2019), which studied these effects on the same model of CopterSonde.

Line 64-69: Resolution of sensor measurements differ among variables. Moving lines 186 –190 here would be helpful to the reader.
We added the following to lines 79-80: "As will be discussed later, data from the different sensors were interpolated or downsampled so that all observations have a common time vector."

Line 123 –124: Why different ascent and decent rates? Are rates optimized for sensor accuracy accounting for airflow? Was 10s loiter data kept? Did you use separate surface platform measurements to combine the last 10m of descent? Moving lines 199 –208 here would be helpful.
We have added the following at lines 135-139: "As will be discussed in Section 3, only the ascent portion of these vertical profiles are considered for analysis. We therefore chose to fly slower on the ascent to maximize the vertical resolution when accounting for thermodynamic sensor response times. Moreover, by descending more rapidly we are able to achieve a higher maximum profile altitude than we would otherwise with the same battery configuration on the CopterSonde."

Figure 3: The significant digits on the temperature contours seem to imply a measurement precision that is contradicted in table 4.
This was an artifact of creating the figures in Python. The number of significant figures have been reduced to reflect the accuracy of the measurements.

Line 136 –137: It is mentioned that flight frequency changed between 15min and 30 min for MOFF site but figures 3 and 4 both show changing flight frequency depending on time of day. It would be helpful to describe why flight frequency changed at particular times. For example, there is an hour between flights on Figure 3 (1500 –1600) and there is an increase in flight frequency on Figure 4 from 1830 –1944.
The sentence was reworded to reflect when the flight frequency at MOFF changed and why. A sentence was added at ~line 195 was added to explain why the flight frequency increased after 1830 UTC at both sites.

Line 141: "Figure 3 also shows the post convection cool down around 1800 UTC." This cool down is difficult to discern in the figure given the changing temperature contour separations and not knowing measurement precision (unless table 4 is moved earlier). It could help the reader to give actual temperature values or ranges to strengthen this observation.

Two sentences were added (lines 200-204) were added to clarify the observed temperature difference. It will also help that the two figures are now next to each other.

Line 154 –155: "While a small bias between the two aircraft exists in temperature. . ." At the surface and at 600m this looks to be almost 2 degrees which may not be small given the claim of a post convection cool down in figure 3. For all the graphs, does showing error bars make the graphs too difficult to read? Having the error bars could support the claim that the biases are small and winds show reasonable agreement.
This is an interesting observation and we agree that additional context is warranted. The following was added in lines 231-241: In our experience with the CopterSonde, the discrepancies in the temperatures between the two identical platforms can be attributed to three main sources: 1) sunlight on an inadequately shielded sensor (discussed in Greene et al. 2019) at the correct relative angles of aircraft heading and sun zenith/azimuth; 2) natural variability in the atmosphere -- the 2 aircraft were 10-20 m apart, so this is not entirely unreasonable for a convective boundary layer; and/or 3) systemic bias related to calibration of the CopterSonde thermodynamic sensor package as a whole. While a combination of these three is the most likely explanation, we believe the spatial/temporal heterogeneity of the atmosphere during these observations should not be overlooked. For example, 3-second sonic anemometer temperatures from the Bailey et al. 2020 ESSD paper for this campaign reveal that during the 10-minute timeframe during these concurrent CopterSonde profiles (albeit at a different site but featuring similar land cover properties), 2-meter temperatures fluctuated by up to 4°C. Doppler lidar observed vertical velocities collocated with the CopterSondes (Bell et al. 2020a,b) also indicate ~3 m/s updrafts at the same time as the profile in this figure. Turbulent transport of temperature therefore likely contributed to large spatial and temporal heterogeneity that can be detectable at the 10 - 20 m separation scales in this particular comparison flight.

While further investigation into the relative contributions of these differences is beyond the scope of this paper, the context outlined above has been added for clarity. Here we also choose not to include error bounds, as the +/-0.5 °C accuracy from Table 4 (now Table 2) does not explicitly incorporate the effects of the spatial heterogeneity impacting the comparison of these two profiles that future studies may be interested in examining.

Line 157: While it is helpful to have references on the accuracy and precision of the dataset, it is recommended the authors address this issue in at least a paragraph to support the claims of the inter-comparison flights similar to the explanations given in section 4 Data Processing.
The "Data Processing" section has been moved forward to now be Section 3, so the following details have been added at the end of this section (lines 180-187): "In an effort to quantify the CopterSonde thermodynamic and kinematic observational biases relative

to a ubiquitous standard, Bell et al (2020a) compared vertical profile CopterSonde flights from LAPSE-RATE and in Oklahoma to collocated Vaisala RS92-SGP radiosondes. While unable to explicitly account for factors such as horizontal heterogeneity, the sample ranges in temperature, dewpoint temperature, and horizontal winds were large enough to determine baseline accuracies in each (Table 2). Namely, CopterSonde temperatures were within 0.5 °C of the radiosondes in the aggregate, which is largely due in part to the considerations taken for temperature sensor placement on-board the CopterSonde (Greene et al, 2018, 2019). Additionally, a broad intercomparison effort during the LAPSE-RATE campaign (Barbieri et al, 2019) resulted in similar statistics when comparing the CopterSonde observations to a common mobile meteorological reference."

Line 165: Please give the time for local sunrise.
Edited as suggested.

Line 230: "intercompariblity"is misspelled. Intercomparability
Edited as suggested.