Thank you for your thoughtful reading of our work and for all of your suggestions and comments. Our responses are below in blue font.

In the manuscript egusphere-2024-868, titled “Improving the Estimate of Higher Order Moments from Lidar Observations near the Top of the Convective Boundary Layer”, the authors test a new approach of computing profiles of higher order moments and fluxes of atmospheric constituents. Higher order moment and flux profiles have been derived by a number of researchers from ground-based lidar observations and they are typically computed on a regular altitude grid in m above ground level. To reduce the sampling errors, higher-order moments and fluxes are normally averaged over a 1-hour time period. When the mixed layer height (zi) is changing rapidly (e.g., during the morning), a 1-hour window near the top of the mixed layer could encompass observations from both, the lower free troposphere and from within the boundary layer, leading to potential biases in the retrieved higher order moments and fluxes. To avoid this, the authors propose to compute the moments and fluxes on an altitude grid normalized by mixed layer height (z/zi), thereby guaranteeing that the data used for moment and flux calculations are completely from within or outside the mixed layer. The authors test the feasibility of this approach by running LES simulations over a 10 km x 10 km domain at the ARM SGP site. The domain-averaged higher order moment and flux profiles at each simulation time step are considered the truth and are compared to 1-hour time averaged moments and fluxes computed on a standard altitude grid and a normalized grid. The authors present convincing evidence that at 0.9 zi and above the moments and fluxes computed on the normalized grid consistently better match the domain averages than the moments and fluxes computed on the standard grid. The manuscript only contains results for a single day, but the authors state that they ran additional simulations, which produced similar results. The manuscript is logically well organized and in general written clearly and concisely. The conclusions presented in the manuscript are supported by the data. Tables and figures are all necessary, and the topic of the paper fits well within the scope of AMT. I recommend publication after minor revisions. Comments (suggested changes in bold):

Line 25: “Wulfmeyer et al (2016)” is repeated. Corrected

Line 47: "… restrict the analysis …" now, line 49: we have adjusted the phrasing to say "restricting the analysis to shorter time periods"

Figure1, caption: "… from the slab values (black), … of the single column (orange)." Corrected

Line 56: "… the overbar indicates a temporal …" Corrected

Line 64: Specify the time step of the LES simulation. It is mentioned in the caption of Fig. 1 ("… instantaneous 10-s values…"), but also spell it out here. Done

Line 65: "… time series at a single location …" Corrected

Line 72: Specify the degree of the smoothing polynomial of the Savitzky-Golay filter function. A filter window of 1 hour is mentioned here, but the Fig.1 caption states a 30-min temporal average. Please reconcile.

The Savitzky-Golay filter used the 3rd order degree, and it was 1-h. The caption to Figure 1 has been corrected.

Line 75: "… cross sections of variance, skewness, and kurtosis of water vapor …" Corrected

Lines 75-79: State here over which time window the higher order moments and fluxes are averaged. Fig. 2, 4, 6 captions mention "1-h period centered on each 30-min", so I assume the averaging window is 1 hour. Are the moment and flux data produced at the original 10-s resolution by averaging over 1 hour in a gliding fashion? The slab values are available at 10-s resolution. The q variance, skewness, and flux line plots in Figs. 8-10 are plo[ed at a resolution coarser than 10 s. What is the moment and flux time resolution? The slab values are output at 5-minute resolution, which has been corrected in the methods section (line 64). This is the resolution at which the slab is plotted. The single column output is at 10-s, and those data are used in the calculations. All the calculations are done using a running average over 1-hour. The resultant moment and flux temporal resolution is still 10s, and each of those calculations is done using the surrounding hour of temporal data.

Line 79: What is the z^ grid resolution? There are 300 equispaced levels between the surface and zi.

Line 90: "… of the variance, skewness, and kurtosis than using …" Corrected

Lines 90-91: Discuss briefly the error contribution of interpolating the time series data onto the z^ grid and interpolating the higher order moment and flux profiles back onto the z grid for comparison purposes. Since the z^ grid is so much finer in resolution than the z grid, the errors due to interpolation are extremely small. We checked this by simply interpolating the q values to the z^ grid and back and then calculating the RMSE of the result. We found that the RMSE was on the order of 10^-4 g/kg.

Line 92: 3. Results Corrected

Lines 93-94: … are the truth to which …" Corrected

Lines 96-98: "… but the normalized z^ grid has less of a gap just before 1500 CDT while the regular grid has a more significant gap there. This tells us that the normalized z^ grid captures the variance better than the regular grid." The differences between the regular and normalized grid q variances appear so small, that this statement is not justified based on the data shown in Fig. 2. Fig. 8 quantifies the slight improvement at 0.9 and 1.0 zi that is gained by using a normalized grid. Reserve the statement about which grid type better captures the true q variance until after Figs. 2, 3, 8, and Table 2, 3 have been discussed.

Thank you, this is a good point. This discussion has been moved to line 120.

Line 98: It seems Fig. 3a and 3b are exactly identical. Do they both show 2c – 2a? Yes, they were the same; we apologize for that mistake. This has been fixed.

Line 99: "… values except at 12:30 CDT …" Corrected

Lines 111-113: "… that both methods match with the slab values quite well in the early morning and in the late ahernoon, but not as much from 1000-1730 CDT, except for right along the top of the boundary layer., where it is very close to the slab values Corrected

Line 116: State more clearly that RMSE refers to the RMSE of the difference between the grid and slab values We have updated line 120 to say "The RMSE is calculated based on the difference between each grid method and the slab values."

Lines 121-122: "… at the flux (Figure 10), the normalized z^ grid method yields slightly smaller RMSE values at 90% of the boundary layer (Figure 10a) and at the top of the boundary layer (Figure 10b). Corrected

Lines 126-127: "In these tables, lower values are bolded by the standard error of the two or more are bolded to show the better value." The phrasing here was confusing. We have updated it to say "In this table, the grid method with the lower standard error for a given variable is bolded"

Line 128: "… or the values were better for an equal number of calculaions …" Unclear what the authors mean by that. We mean that, the regular grid was better for 2 cases (e.g., q variance and temperature flux), the normalized grid was better for 2 cases (e.g., q skewness and water vapor flux), and the rest were identical RMSE values. So, we can't say that, at 0.5 zi, one method was better than the other overall. Additionally, there is no clear advantage to using one method versus another for the calculations. (e.g., if the normalized was better for both skewness calculations). At 0.5zi, the two methods yield equivalent results.

Line 131: "… except w variance, where the methods yield the same RMSE. Corrected

Lines 131-132: Finally, at the top of the boundary layer (Table 3), the normalized z^grid method is be[er in all cases. except q variance, where the methods are the same. Fig. 8b shows that normalized RMSE is lower (0.391) than regular RMSE (0.403). It appears that the former value has not been entered correctly into Table 3. Thank you for catching that mistake. It has been corrected.

Lines 132-133: "At every height, the normalized z^ grid method was be[er for q skewness." This is also true for w skewness, w kurtosis, and both fluxes. While the values from the normalized grid are consistently lower, we wanted to only say that one value was "better" than another when it was lower than the other by the standard error of the two. For this reason, we did not bold each time one value was lower, and the w skewness was not identified as being better for all heights. However, you are absolutely right about the w kurtosis and the fluxes. This has been amended.

Line 135: 4. Discussion

Lines 147-148: "…we must remember that a single column will never be able to properly capture the spa0al variability because of sampling errors. It is clear, especially in the q variance and q flux time height cross seconds around 1230 CDT…" Corrected

Line 150: 5. Conclusions Corrected

Line 153: “… to the higher order moments and fluxes derived …” Corrected

Figures and Tables:

Group all three tables together after Fig. 10. Done

Q flux unit: (gkg^-1) (ms^-1) Corrected

T flux unit: (K) (ms^-1) Corrected

Bold z^ RMSE values for w variance and w skewness in Table 1. These values are not lower by the standard error of the two methods, so they are not bolded.

I gather that the line plots in Figs. 8-10 are extracted from the time-height cross sections that are all ona regular grid (see Figs 2, 4, 6). Do the line plots represent data at the regular grid height that is closest to 0.9/1.0 zi Yes

References: Lines 198-199: Lenschow et al. (2000) is cited incorrectly. Substitute with: “Lenschow, D. H., Wulfmeyer, V., and Senff, C.: Measuring second- through fourth-order moments in noisy data., J. Atmos. Oceanic Technol., 17, 1330–1347, h[ps://doi.org/10.1175/1520-0426(2000)017<1330:MSTFOM>2.0.CO;2., 2000. Corrected