This work of Rosenberger et al. discusses a new approach to analyze higher-order moments of turbulent fluctuations in the convective boundary layer (CBL). Instead of normalizing the height range against the mean depth of the CBL in the analysis period (typically 30 minutes to 2 hours), the authors suggest a height grid normalized with a temporally smoothed depth of the CBL.

The authors base their analyses on large eddy simulation (LES) data of one day and discuss variance, skewness, and kurtosis of the turbulent fluctuations of water vapor mixing ratio as well as of vertical wind, and of the covariance of these two quantities, the latent heat flux (water vapor flux). Furthermore, they compare these simulated measurements of a vertical pointing lidar (one column measurements) with the data averaged over the whole domain of their model.

The manuscript is well written. I recommend accepting the manuscript after minor revision.

Specific comments:

Page 4, line 70ff: I think it would help if the authors added formulas to explain how they calculated the parameters for the three methods (more than just text). In addition, I suggest adding example plots of the three methods (or at least of the two lidar simulations) for a 1-hour example.

We have added more context about the derivation of the three methods of boundary layer depth calculations and for calculating the level of neutral buoyancy definition of boundary layer depth. Figure 1 shows an example of the three different methods. We have tried to make the connection thereof clearer by adding "All three of these were derived as the level of neutral buoyancy where the θ used for $\langle z_i(t)\rangle$ was from the slab-averaged LES output, for $z_{c,i}(t)$ it was the instantaneous θ from an individual column, and $\overline{z_{c,i}(t)}$ is the temporally averaged $z_{c,i}(t)$." to line 75.

Introduction: Please add references to the statements in the first paragraph. Done

Figure 1: Please use the same nomenclature for the different parameters like in the text (line 74). 'Blue' should be 'cyan', 'green' is 'black'. Mark local noon, sunrise, and sunset.

We apologize for the inconsistency. Thank you for your careful reading. The requested timings have been added to the figures in gray dashed lines.

All figures: Please add labels (a), (b), (c).

Done

Figure 2ff: Please define the white areas. I would prefer units at all color bars (instead of explaining the units of the color bars in the figure captions) and labels with the full parameter information (not just "Variance", "Flux" etc.).

This is an excellent suggestion for more clarity. We have added "In each of the following contour figures, data above 1.2 z_i has been masked so that we can focus on the top of the boundary layer and below." in line 96 to explain the white areas, and the colorbar labels have been updated.

Table 1, 2, 3: You refer to RSME values but do not show these. I suggest that you also show errthe RSME data in the tables.

Thank you for the comment. The values listed in the tables are the RMSE values, we have added "Table 1 A-C compares the RMSE values" in line 128 for clarification.

I think it would be better to use the same color scales for all plots of a figure, not different ones, so that it is easier to compare the results (Figs. 2, 6, 7). Same for the y scales in Figs. 8, 9, 10.

Thank you for your suggestion, however we feel that by using the same y scales across different moments, we will lose some of the information we wish to see in comparing the three different calculation methods. Since we are not comparing higher order moment results to one another (i.e., skewness to variance), we think that it is best to keep the scales consistent across the individual moment only (i.e., all the variance ranges are the same for the three different methods) rather than across the different ones.

I would also prefer time scales with ticks at 6, 12, 18 h etc.(not at 5, 10, 15, 20 h). In addition, small ticks at each hour would be helpful.

Thank you, this is much clearer and has been updated.

Instead of "error", I would prefer the term "uncertainty". We changed "sampling error" to "sampling uncertainty."

Instead of "q flux" (Fig. 6) or "WVMR flux" (Fig. 10), I would prefer "latent heat flux".

Thank you for the suggestion, we have also changed the potential temperature flux to sensible heat flux to keep it consistent.

All units should be in normal font (not italic).
Done