Reviewer 1:

The authors thank the reviewers for their comments. We hope to have addressed all their concerns.

This paper was a pleasure to read. The results are not particularly profound or unexpected, but are a very nice presentation of how to think about particle trajectories and histories. The writing is clear and straightforward and the graphics are generally well chosen to get the points across. Most of my thoughts while reading were about how nice it would have been to extend the work farther rather than about whether I trusted the reasoning. I don't actually have a lot of substantive comments.

I was a bit confused by figure 6. The legend describes panels b through d as "the time-height evolution of the column count normalized deposited particle concentration" whereas the text described those plots as "the probability of a deposited particle's maximum altitude reached, given a particular lifetime". I don't understand the first phrasing at all, but the second makes some sense to me.

Response: We agree with the confusing description of Figure 6. We have modified the figure caption to "the probability of a particle's maximum altitude achieved given a particular lifetime".

I was surprised not to see explicit mention of an apparent pattern that the slightly unstable plots would look a lot like the unstable ones if the x-axis were T_{eddy}. Yes, Figure 8 shows that some details would differ, but the overall impression is that characterizing mixing in the MBL simply with T_{eddy} would be useful.

Response: We have added a few explicit references to the fact that certain features occur at similar values of T_{eddy}, including in the discussion of Figures 6 and 8.

I'm trying to think of whom this information would be really valuable. After all, a sudden release of low-altitude 10 μm particles is not a common occurrence! I wind up thinking about time scales of mixing: how long after a front passage or scavenging event (a rain storm) do I have to wait before I can assume that aerosol in the mixed layer is well-mixed? How often is a particle likely to have encountered clouds in stratocumulus or trade wind cumulus regimes? What do I need to know to make those estimations? These questions would be relevant to sampling expeditions or modeling.

Response: This is an excellent point, and one of our primary motivations. We chose a pulse release to not simply replicate a sudden event: rather, it helps us address precisely the questions you pose regarding the mixing time. We could certainly apply a continuous release at the lower surface (and indeed we have in other simulations), but mathematically our results would be unchanged since we are looking at statistical properties of individual particles over their lifetime. That is, if we applied a continuous release but shifted the particle properties to be relative to when they were released, we could regenerate every figure in this manuscript. Thus one interpretation of our "pulse" is that it is doing this time shift automatically. As the authors point out, in the real world we'd like to know how long the particles have taken to get where they are, *relative to their own start time*, and this allows us to do precisely that.

We have added a brief explanation in this regard in the manuscript where the particle injection is described:

"We emphasize that while the particles in the simulations are released as a single pulse, this is not meant to literally represent such an event, which is a rather unrealistic situation. Rather, this technique allows us to automatically reference the individual particle trajectories and lifetimes to a common reference point; i.e., the statistics presented below could be exactly generated with a continuous release of particles at the surface, where Lagrangian statistics are computed relative to an individual particle's generation. So while in the real MABL newly generated aerosol particles would be continuously injected into a populated background, this technique allows us to speak directly to the individual fate of a single new particle and distinguish its lifetime and position relative to other nearby particles. This has strong implications for Eulerian-based sampling strategies and interpretations of particle observations, including assumptions made about their exposure time and distance from their source."

Line 163--4: "The particle sizes are set to 10μm in aerodynamic diameter to represent coarse mode particles, which is much smaller than the smallest turbulence scales of the flow" Well, yes, but any realistic particle size is smaller than the turbulence scale. I expect you're referring to stopping distance for the particle being much smaller than turbulence scales or terminal velocity much less than typical vertical winds.

Response: Yes, though some large droplets (spray, rain, etc.) could easily exceed the smallest turbulence scales and have appreciable inertial effects. We are trying to differentiate from these cases. We have added a parenthetical comment "unlike large droplets including rain and spray" to this line.

Equations 2 and 3: Inconsistent use of boldface to indicate vector quantities

Response: Thank you for noting the inconsistent use of boldface, we have modified the text accordingly.

Line 210: Is Q_* supposed to be Q_0?

Response: Yes, the correct expression is Q0 instead of Q*, we have modified the text accordingly.

Line 283: "There is a slight crossover in wind speeds at the top of the mixed layer, with neutral having a lower wind speed at 9.2 m/s, and unstable at 10.7 m/s" That crossover is at something like 30 meters, hardly the top of the mixed layer. Seems to be more at the transition between a surface layer and the bottom of the central mixed layer.

Response: Yes, this was a typo and was meant to refer to the "top of the surface layer".

The lower x-axis in Figure 2b is paradoxical. A log scale can't go to zero. Is it linear between -10^{-4} and $+10^{-4}$? That would explain the kinks in the blue and orange lines and the smooth passage through 0. Makes it hard to imagine dividing the blue lines by 10. Not sure I know of a better way to present the data though.

Response: The reviewer is correct: we are using a signed-log-scale outwards of 10^-4, and between we are using a linear scale. We are trying to simultaneously highlight the features of the profile (which require a log scale to see), but also the inherently signed nature of the TKE production terms. We realize now that we had never specified this, and indeed having "0" on the x-axis is confusing. We have provided an explanation in the caption.

Figure 3: It is gorgeous, but since the w' color scale is biased, it looks like there are net downdrafts since a 0.4 m/s downdraft looks just as saturated as a 0.8 m/s updraft. Does it not work with a symmetric color scale, leaving the strongest downdrafts unsaturated?

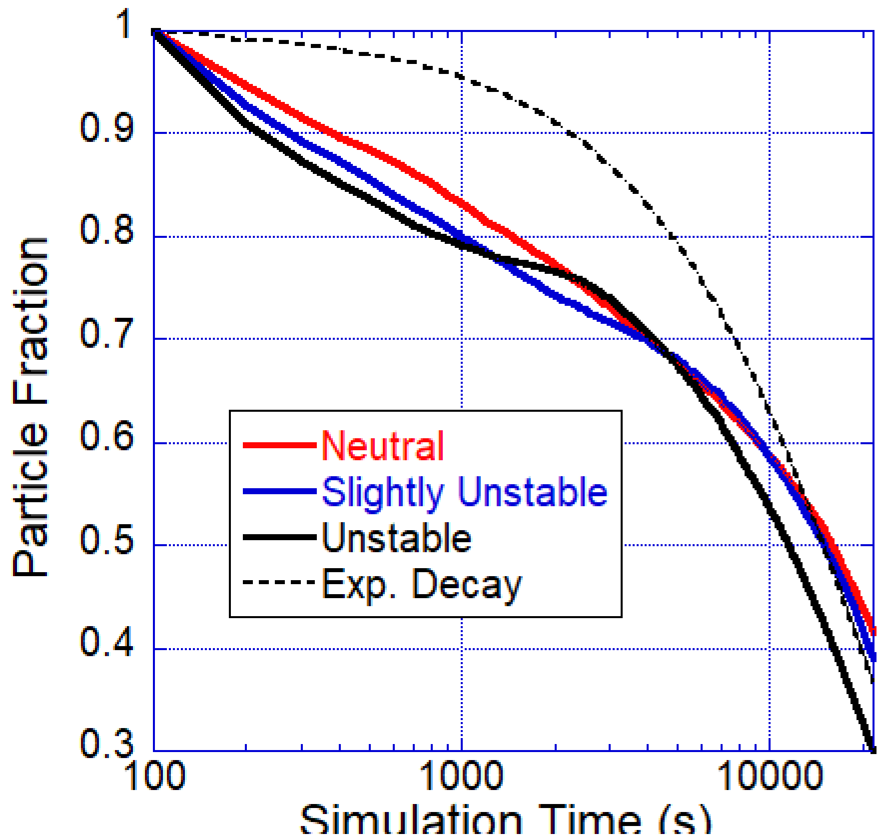
Response: The purpose of the scale being set to an asymmetrical color scale but with white at zero is to emphasize the state of less frequent, but stronger values of positive w' (updrafts), in contrast to the more frequent, but smaller values of negative w' (downdrafts). We have added an additional note on the Figure description. These features are difficult to see when the color scale is symmetric. We have provided this explanation in the caption.

Figure 6a: It appears that the most probable lifetime is much shorter than the 1000 s you mention. If the data are saved every 5 s, you could have shown even shorter periods at the beginning of the run. Does that not work?

Response: Unfortunately, the information to make Figure 6a is not included in the particle statistics that are written every 5s. To generate Figure 6a, we had to run an additional set of simulations past 10^5 seconds (in order to get the full lifetimes). However this required us to decrease the frequency of statistical output due to computational storage requirements.

I'd be interested to see something like 6a, but with fraction of original particles remaining. It wouldn't have the nice dips in the unstable cases that you point out, but a flattening of the curve, so it wouldn't be as striking a plot, but would be easier to understand.

Response: The attached figure illustrates the fraction of original particles remaining for the first 6 hours of the run (approximately one e-fold loss)



Indeed, it has the features which the reviewer predicted. However, since our primary purpose of Figure 6a was the emergence of the bimodal lifetime distribution, we have chosen to keep the original version since this is not as clear on the above figure. However, we have added the above figure to emphasize the reviewer's point.

Line 593: "spatially" is missing the y

Response: Thank you, we have corrected the text.

Line 627: "Even for neutral conditions, it can take over 90 minutes" implies that unstable conditions take longer! Perhaps just ditch the "Even"

Response: Thank you, we have removed the word “Even”.