Response to Reviewer #1 comments:

This paper gives results from the recent ORACLES campaign off the western coast of Africa during the biomass burning season. Specifically, the authors report observations of CCN, aerosol size distribution, and vertical updraft velocity collected during research flights within the marine boundary layer. This work convincingly demonstrates that cloud droplet variability can be limited by updraft velocity of aerosol concentration. Classifying conditions into such regimes could be useful to global models attempting to represent aerosol indirect effects in this important region. This paper was very well written and concise. I believe it should be published mostly as is; however, I ask the reviewers to address a few questions and consider amending the manuscript to include the answers to these questions for clarity.

We want to thank the reviewer for the enthusiastic response and thoughtful comments that improve the manuscript. Below, we include the response to comments and questions raised.

Reviewer comment: “In Figure 1, can you add the mean AOD over the time period?”

Answer: *This is an excellent suggestion, and is now included in the revised manuscript.*

Reviewer comment: “I do not understand why, if you measured the updraft velocities, you need to assume a Gaussian distribution of updraft velocities? (e.g. line 178) What happens if you use your observed updraft velocities rather than the Gaussian assumption? Or, are your observations consistent with a Gaussian assumption?”

Answer: *The probabilistic approach used here for computing cloud droplet number has been shown to successfully predict cloud-scale values in field studies (e.g.,Conant et al., 2004;Peng et al., 2005;Meskhidze et al., 2005;Fountoukis et al., 2007; Morales et al., 2014). Stratocumulus clouds, such as those sampled in this study, are well characterized by a Gaussian distribution of vertical velocities with a mean close to zero. For such clouds, calling the activation parameterization with updraft w* provides the average droplet number (e.g., Fountoukis et al., 2007; Morales and Nenes, 2010). The droplet closure carried out in this study also supports this approach. These points will be further clarified in the revised manuscript.*

Reviewer comment: “Why do you assume these kappa values (line 185)? Are there sensitivities associated with these assumptions?”

Answer: *These characteristic hygroscopicity values are assigned based on a large body of literature to date on the topic (e.g., Gunthe, et al., 2009; Dusek, et al., 2010; King, et al., 2010). The main uncertainty in κ arises from the organic fraction, as the hygroscopicity of sulfate is well known (Petters and Kreidenweis, 2007). Therefore, the maximum variability in κ occurs if the aerosol is composed of pure organic species – so that the maximum uncertainty in* κ, $\Delta\kappa \sim 0.1$ *units. This, combined with the sensitivity of droplet number to κ (Figure 4c) can be used to address the importance of uncertainties in κ:* $\partial N_d/\partial\kappa \sim 55\ \mathrm{cm^{-3}}$ *for clean conditions,* $75\ \mathrm{cm^{-3}}$ *for intermediate conditions, and* $\sim 40\ \mathrm{cm^{-3}}$ *for polluted conditions. Assuming therefore that the uncertainty in droplet number from variations in κ can be approximated by* $\Delta N_d \sim (\partial N_d/\partial\kappa)\ \Delta\kappa$, *we have* $\Delta N_d = 5.5$ cm^{-3} *for clean*, 7.5 cm^{-3} *for intermediate and* 4 cm^{-3} *for polluted conditions. These levels of* ΔN_d *amount to less than 5.5% of the corresponding* N_d (*Figure 3b), therefore hygroscopicity uncertainties introduce insignificant uncertainty in droplet number.*

Reviewer comment: "You hint in the conclusion that there may be some relationships between BC absorption and updraft velocities, but downplay these effects somewhat. What additional information would you need to better establish this relationship and/or its significance? Why do you downplay the effects?"

Answer: *Our intent was not to downplay such possibilities (which can clearly be important!) but rather not overstate their potential importance – as measurements and analysis to support the statements were lacking.*

Reviewer comment: "You hint in line 363 that models may overestimate wet deposition if they assume activation when it isn't really occurring. It could be very useful to elaborate on if most models probably make this overestimate and how that could impact the extent of the BB plume."

Answer: *An overestimation of wet deposition would mean that the extent of the BB influence in the MBL would be larger than is currently being considered, as the BB aerosol in the MBL would have a longer lifetime before being lost to the process. We cannot here make a general statement for models – other than to point out that if too much aerosol is activated in them, that the effects of BB aerosol is underestimated and vice-versa.*

Reviewer comment: "Further, it would be useful to suggest ways models could incorporate your results to better represent aerosol-cloud interactions in this important region.".

Answer: *The data and results can be used in numerous ways. The most straightforward is to use the microphysical (aerosol concentration, droplet number) and dynamical (vertical velocity distribution) properties for model evaluation. However, such evaluations provide relatively limited insight on whether models get the "right answer for the right reason". The sensitivities of droplet number to aerosol and vertical velocity provides more insight, as they determine whether cloud droplet formation is in the velocity- or aerosol- limited. Finally, the attribution of droplet variability to aerosol and cloud dynamical variations quantitatively expresses how much of the aerosol indirect effect is magnified (or dampened) by covariations in dynamics.*

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