

This paper examines the impact of aerosols on the evolution of marine clouds and their cellular patterns by using the WRF model in a Lagrangian framework. Overall, the results from several cases are interesting, and the experimental approach helps understand the impact of aerosol on cloud evolutions. The results from several case study experiments in WRF show that increased aerosol concentration suppressed drizzle and increased cloud water content. These changes can lead to larger radiative cooling rates at cloud top because droplet size is smaller and concentration is larger in polluted clouds. Thus, the authors mentioned that the vertical and horizontal wind speeds near the base of the lower tropospheric inversion increase, making marine cloud cells larger and the gap between shallow clouds smaller. However, the connection between the main results is not clear, and the explanation is insufficient to support them. I think the authors already showed many figures in the main text and supplement to support the results. However, some work is needed to minimize confusion about this finding and its implications. The results will merit publication in ACP if the authors are able to address my concerns. I hope my comments below will clarify a few points about the results.

Main comments:

My primary concern is about the capability of the WRF model to represent the entrainment and mixing near cloud top-driven radiative and evaporative cooling due to its vertical resolution. In the manuscript, the authors conclude that increased aerosol concentration leads to larger radiative cooling rates and stronger wind shear near cloud top. These changes are closely related to the enhancement of entrainment and mixing of dry air above cloud top. As shown in Table 2, most cases show that free troposphere entraining relative humidities are low, which means the evaporation of cloud droplets is more efficient if entrainment-mixing is enhanced due to larger radiative cooling and stronger wind shear. Therefore, enhanced free-tropospheric and cloudy air mixing can decrease cloud water content and broaden the gap between the clouds. However, this would be inconsistent with the main results in this manuscript. I am quite concerned about whether this model can represent the effect of cloud top mixing driven by radiative and evaporative cooling because the vertical resolution of this model is too coarse, about 50 to 100 m near the cloud top. Do the results here imply that the effects of cloud top mixing were appropriately represented? I think more information is needed regarding the cloud-top mixing effects for the results. For example, for each aerosol case, you can show the vertical profiles of some variables related to entrainment-mixing (e.g., the entrainment rate and evaporative cooling rate). I strongly recommend that the authors revise the abstract and conclusions to reduce the emphasis and confidence level about the statements related to the model's inability for cloud-top processes. I believe it would minimize the confusion, as mentioned above.

Minor/grammatical comments:

-Figure 6: It seems that cloud water content is derived from the aircraft measurement dataset (FCDP+2DS+HVPS), correct? If so, it needs to be explained how to derive it in detail.

-Figure 7: The droplet number concentration from the measurements is close to N2 case, and the liquid water path is slightly larger than N3 and N4 cases. However, the effective radius is similar to N2. I am not sure if it is correct. It needs to explain how to calculate an effective radius in detail. The brief information about “ceres” should be included in the caption.

-Figure 9: I could not find a similar figure on 07/18/2017 in the supplement. It should be included in the main text or supplement. Fig. 9(d) shows a slight difference in horizontal wind speed between pristine, unpolluted, control, and polluted. Can such a slight difference redistribute the clouds (expansion of cloud cells)?

Line 35: change “proposed by (Rosenfeld et al., 2006)” to “proposed by Rosenfeld et al. (2006)”

Line 300-306: The same figure for 07/18/17 should be included in the main text or supplement as mentioned above. Why does the rainfall suppression make the updrafts weaker in the lower PBL?

Line 464: If the sedimentation and entrainment rates are underestimated, the authors should show them for each case. I think it is not difficult to show them from the simulations.