

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2021-446

Anonymous Referee #2

Referee comment on "Global evidence of aerosol-induced invigoration in marine cumulus clouds" by Alyson Douglas and Tristan L'Ecuyer, Atmos. Chem. Phys. Discuss.,
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This study investigates aerosol invigoration effect for marine clouds. Relative to previous studies concerning the invigoration, the uniqueness of this study lies in 1) the region of study is much larger than most (not all); 2) the focus is on shallow clouds in terms of rain rate, turbulence and deepening (most previous ones on the last). The data employed go beyond the normal parameters of cloud geometry (height in particular) and microphysics, as it relies heavily on the very special parameters of latent heat release and updraft derived from CloudSat in combination with cloud resolving modeling. Evidences are presented of increasing precipitation and cloud top entrainment under polluted conditions than clean conditions under certain meteorological regimes, whereas suppression was also found under other conditions. While the findings are consistent with previous ones, the uniqueness of the datasets used and some aspects of the approach are original that would warrant the publication of study if the following issues can be addressed.

Major comments:

- Given the key roles of the non-conventional products of latent heat and updraft, it is key to demonstrate that the uncertainties of these products won't outweigh the signals of the aerosol invigoration. Referring to the paper introducing these products (WALRUS) (Nelson et al., 2016), their uncertainties seem so large whose impact on the findings of this study may be overwhelming.
- In all the figures, only the mean curves are drawn without any measures of variations. I'd suggest to present some scatter plots showing the real distributions of the data points, and add standard deviations for all the rest, together with significance tests to see if the differences among the curves are significant at certain level of confidence. The colors of the different curves are too close to differentiate.

Minor comments

- Now that turbulence is estimated from updraft speed, it is somewhat misleading to state evidences are found for both updraft and turbulence. Of course, such inference itself is debatable that induce more uncertainties.
- The inference of latent heat was based on the RAMS modeling data which are highly limited to a handful of cases at very few locations. How much error may be incurred for this global application study ?
- All the findings are shown with respect to size of rain system which does have some merit to this study in disclosing the dependence of the invigoration on cloud size. It would also be valuable and revealing if some findings are given w.r.t. aerosol loadings as in many previous studies.