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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Quantifying the effect of aerosol on vertical velocity and effective terminal velocity in warm convective clouds" *by* Guy Dagan et al.

Anonymous Referee #1

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Overview

This study investigated the aerosol effects on warm convective clouds via the interplay of updraft (w) and effective terminal velocity (eta) using both single cloud model and large eddy simulation (LES). The topic is very interesting and the authors provided detailed analysis on how aerosols affect the evolution of thermodynamic instability of cloud field using both characteristic vertical velocities.

General comments

1. The simulated clouds from both cloud model and LES were growing at very humid environment, e.g., "the relative humidity in the cloudy layer was 90%" (L134). The au-

thors found monotonically increased vertical velocity with enhanced aerosol loading, i.e., aerosol invigoration effect on warm convective clouds. As we know from previous studies, however, the aerosol indirect effect varied with different atmospheric conditions. For instance, if the atmosphere is not so humid or the relative humidity is lower than the current study, will the aerosol suppress effect be expected? If so, how will aerosol effects on both characteristic vertical velocities as well as thermodynamic properties change with varied relative humidity?

Specific comments:

1. Fig. 4 show nicely the similar trend of COG velocity (VCOG) and the "authors-defined-Angle" (A). The authors argued that the VCOG can be an indicator of thermodynamic instability and also of the aerosol effects on warm clouds. But for A, what can we learn from the evolution of it? Or does it have different function with VCOG? The amplitude of A seems depend on the relative amplitude of both velocities between the first and the last third part of simulation period, in other words, the order of peak time of both characteristic velocities for different aerosol scenarios. If w and (eta) peak earlier (at the first third stage in a clean run, for example) during the cloud lifetime, A might be around $\sim$100 degree; whereas if they peak later (say at the last third part and may appear in polluted run), A might be around $\sim$360 degree. I hope the authors give more information about how we can use the parameter A in the study of aerosol-cloud interactions.

2. The authors split the simulation period into 3 parts for the analysis of LES runs in Fig. 3a. Does the three parts stand for different stages of cloud evolution?

And in Fig. 3b, "only clouds in the growing stage" were considered for the first and the last third part of simulation period. I am confused here. What should we expect for growing clouds at different part of simulation period?

3. Fig. 1c and 1d show that VCOG became negative after 65 min for clean run (blue curve), but COG height continues to increase until the end of the simulation. What is

the reason for that, since negative VCOG seems denote the downward movement of center of gravity of cloud?

4.L275: “and therefore delaying the increase in (eta) values early in the cloud’s lifetime”, I think (eta) should be |eta|. The value of (eta) is originally negative. I suggest the authors check the descriptions of |eta| and (eta) in the manuscript carefully.

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