

Interactive comment on “Environmental sensitivities of shallow-cumulus dilution. Part I: Selected thermodynamic conditions” by Sonja Drueke et al.

Anonymous Referee #1

Received and published: 3 June 2020

This paper discusses the sensitivity of dilution of shallow convection as a function of large scale state. While the paper is not unique, it does yield another piece in the puzzle of figuring out how to parameterize entrainment. The paper is generally well written, but sometimes also a little descriptive, with the theoretical interpretation mainly hypothesized.

To enhance the paper, I have the following suggestions. I realize that not all of them may be feasible within the scope of this paper.

1) The main finding to me is the dependence on 'continentality'. This is of course in reality more a dependence on the surface fluxes, and in itself it is no surprise that mar-

C1

itime clouds are different from continental once. So I would enjoy seeing this explored a bit further, for instance by looking into whether this is more an effect of the total buoyancy flux, or of the evaporative fraction/Bowen ratio. IN other words: Is this about the latent heat or the sensible heat?

2) The finding that the cloud base mass flux can explain the difference between the two regimes agrees with Dawe and Austin, and conflicts with Romps' Nature vs Nurture concept. Some discussion of that would help here

3) Detrainment is at least as important for cloud evolution as entrainment is. Is there a reason to barely include detrainment in this paper?

4) The cloud depth discussion is a bit too far simplified, as most clouds in a shallow Cu distribution would not come close to the cloud layer top, and therefore would not "feel" the extended depth of the layer. So what happens if you only sample clouds that actually did make it to the cloud layer top? Is there also some response in other variables here? Think of cloud (core) fraction, fluxes, etc.

5) Similarly, the subcloud layer alteration is a serious disturbance to the flow, and it seems like we are merely looking at the transient here. I am not sure I am learning a lot from that, so I recommend either removing the section, or clarifying its value.

6) For the change in cloud layer humidity, the argument is that changes are based on the relative difference between environment and cloud, and by extension between environment and sub-cloud. If it is the relative difference, does that mean that it is only the gradient that matters? So if one would shift the entire profile, no response would be visible?

Interactive comment on *Atmos. Chem. Phys. Discuss.*, <https://doi.org/10.5194/acp-2020-336>, 2020.

C2