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Interactive comment on "Core and margin in warm convective clouds. Part I: core types and evolution during a cloud's lifetime" *by* Reuven H. Heiblum et al.

Anonymous Referee #2

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Review of: "Core and margin in warm convective clouds: Part I: core types and evolution during a clouds's lifetime"

Authors: Reuven Heiblum, Lital Pinto, Orit Altaratz, Guy Dagan, Ilan Koren

General comment:

The work herein seeks to examine and compare three methods of defining convective cores through analysis of buoyancy (B), relative humidity (RH), and vertical velocity (W). The authors do a thorough job of comparing and contrasting the evolution of the various core definitions and highlight the overlap or lack thereof among the 3 defining core characteristics. They have performed their analysis via multiple methods including

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a theoretical model, single column type model, and a couple of models at the LES scale with bin microphysics and without saturation adjustment assumptions which can be limiting. The results appear quite robust among all methods of representing convective clouds and their cores and among various thermodynamic environments represented by different initial soundings. The manuscript is well-written, clear and concise, but a few questions and concerns, given below, should be addressed.

1.The motivation of the paper seems to lack its proper placement with respect to previous published work regarding convective cores and entrainment. While the focus of this work is specific to examining the relative differences between core definitions and their evolution over time, the work should be more appropriately placed in context and should emphasize what is novel in this work.

2. Some aspects of this work regarding entrainment, dilution, and their impacts on buoyancy are not new. However, the framework of comparing cores, core subsets, and their evolution in multiple model frameworks is perhaps more unique. It may help to better frame the paper in such a light.

Specific comments:

Line 40: Here you mention that negatively buoyant cloud may exist due to W>0 and S>1. You might specifically mention the other components of the W equation that keep W>0 and S>1 and their relative contributions during stages of B>0 and B<0. Perhaps this could also be addressed in the main text in greater detail. Once B<0, the other components of the W equation will begin to weaken since the “fuel” is missing. What tends to weaken faster, and what implications does this have for the W core?

Lines 177: The potential initial temperature perturbation of 1C is rather large for this type of shallow convection setup. Could such a large perturbation shock the initial field and generate a sizeable convective pulse and gravity waves that impacts the rather small domain size?

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Line 182: The cloud pixel threshold here of 0.01g/kg seems rather small. What could be deemed a visible cloud would likely be closer to 0.1g/kg. Including values closer to 0.01g/kg would likely include very diffuse clouds at cloud edges that are generated in models. Choosing a different threshold could seemingly have a great impact on the definition of the cloud volume. Have you examined the impact of this threshold choice? I am aware that many papers have used the 0.01 g/kg threshold; but the choice here seems more critical given the examination of cloud volume and such.

Line 184-186: Here you state that buoyancy is determined relative to the mean thermodynamic conditions for non-cloud pixels. How is buoyancy computed and applied in the dynamic core of the model? Are these the same or different, and what are the implications if these are different?

Line 257: Here you state that the cloud top downdraft promotes adiabatic heating that leads to the decay phase positive buoyancy. Is this definitive or supposition here? Is this seen in other clouds? Is this adiabatic heating greater than any local evaporative cooling?

Line 268-270: Are the changes in cloud volume fraction susceptible to the choice of cloud mass concentration used to define a cloud grid cell (0.01 g/kg)? How would choosing a different threshold impact your analysis?

Line 722: How valid is this non-changing temperature assumption to your analysis? This seems like a rather unrealistic and constricting assumption. The local dT could be large which could greatly impact dB and mixing.

Technical corrections:

Line 267: “expect” should be “except”. Line 371: “overweighs” should be “outweighs”. Line 591: “cloud’s” should be “clouds”. Line 619: “from precipitation” should be “by precipitation”. Line 634: This should read: “In cases where the. . ..”

Figures: My main comment about the figures is that most of the them need to be larger,

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especially the fonts, so that they are easily readable. The time series plots need to be much large in order to see overlap where it exists.

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