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Atmospheric Chemistry and Physics Discussions

Interactive comment on "On clocks and clouds" *by* M. K. Witte et al.

Anonymous Referee #2

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General Comments

This manuscript explores a timely topic: That of assigning a non-dimensional time coordinate to the stages in the life cycle of a cumlus cloud. It is important for understanding and parameterizing many cloud processes to place them in their correct life cycle contexts. To be able to do this from measurements made a single moment in a cloud's life cycle would be especially valuable for aircraft measurements, but it also has potential applications in analyses of cloud-resolving and LES model results.

The authors explored several potential "clocks" and made a good case for choosing the volume-averaged total water mixing ratio as the best of those examined. The authors do not overstate their case, and discuss the difficulties of assigning times to multi-pulse clouds.

Specific Comments

1. The title could be more informative of the content.
2. It would help to include a sequence of cross sections of liquid water, total water, buoyancy, and vertical velocity for one cloud to show its structure and evolution.
3. 66:12 Which models? explain.
4. 66:18 What fraction of all the cells were cloudy?
5. 66:19 How were contiguous cells defined? (e.g., adjoining faces only?)
6. 66: 26 Define "virtual potential temperature" as used in your analysis.
7. 66: 26-28 Presumably "turbulent kinetic energy" refers to sub-grid scale TKE. If so, it will depend on the grid size, even when computing cloud averages. Make this clear to the reader.
8. 67:4-5 Positive buoyancy does NOT imply rising motion, nor does negative buoyancy imply subsiding motion. Instead, buoyancy contributes to the vertical acceleration.
9. 71:24 Is the "cloud top" instantaneous? or maximum over cloud lifetime?
10. 72:5 Does "mid-cloud" refer to mid-cloud at that instant? or relative to the maximum cloud top over the cloud lifetime?
11. 72:19 Define a_i
12. 73:21 Explain what "recorded data points" refer to.
13. 74:9-12 Why not add a category that encompasses the multiple pulse cases? (This would require two variables, presumably.)

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14. 75: 2-3 Change "Precipitation reduces the potential for evapora- tive cooling" to "Precipitation reduces the potential for evaporative cooling due to cloud droplet evaporation"

15. 75: 25 This statment needs to be revised: "there is disagreement in the treatment of entrainment and detrainment mixing among different cloud-resolving models (de Rooy et al., 2013)" because (1) the intended meaning of "treatment" is not clear: It could be "analysis" or "representation" and (2) the models considered by de Rooy et al. are not cloud-resolving models, but large-eddy simulation (LES) models. LES models should resolve the large entraining eddies and therefore be more realistic than cloud resolving models that entrain primarily via SGS fluxes.

Technical Corrections

1. 64.1 change "lifetime" to "lifetimes"
2. 64:23 change "temporal" to "temporal and spatial"
3. 66: 15,16, 25 change "cell" to "grid volume"
4. 68: 3-15 Use past tense.
5. 68:26 Omit "from condensation" because it is redundant.
6. 72: 27 a_1 and a_3 should not be used for two different quantities.
7. 76: 25 change "one" to "single"

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 23461, 2013.