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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Tropical Continental Downdraft Characteristics: Mesoscale Systems versus Unorganized Convection" *by* Kathleen A. Schiro and J. David Neelin

Anonymous Referee #2

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Review of

"Tropical Continental Downdraft Characteristics: Mesoscale Systems versus Unorganized Convection"

by Schiro and Neelin

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This paper uses the observations of the GOAmazon campaign to characterize the downdrafts and contrast the characteristics of the Mesoscale Systems downdrafts

versus the unorganized convection downdrafts. Time evolutions of thermodynamical characteristics around the moment of minimum equivalent potential temperature are shown and compare well with the literature. Then, composite of vertical velocity and reflectivity profiles are realised for both isolated cells and MCS. I am surprised by the un-smoothness of the figures (the same for the vertical profile in Fig 4) even though averaged over more than 10 cases. The highest probability of downdrafts in the levels below 3km is in agreement with the literature. The last section analyses the relationship between the drop in equivalent potential temperature and the precipitation. It could be improved by adding a discussion on how this relationship could be used as a constraint for parameterization. This paper is relatively well written even though some work on figures is still needed. However, I found that it does not present very original results. I suggest to better discussed or put into context the results. I have a few comments below that the authors should consider in revising their manuscript.

Comments:

Abstract: -l 18 : change 'have a probability' to 'have a probability of occurrence' -The abstract is too long. Please reduce it. I propose to suppress the sentence from l 20 to l 23. -You should also reformulate the end of the abstract after l28 which is unclear.

Introduction: This section could refer more to previous studies that use observations to document cold pools. Here are a few examples of reference missing: Charba, 1974; Engerer et al, 2008; Feng et al 2015; Redl et al 2015. Some are quoted in the rest of the text but this section should provide an overview of what we know about downdrafts from observations.

Data & Methods: -L 115: 'that create a subsequent drop in θ " at the surface of less than -5 o C': (also line 140 and line 167) How is the drop quantified ? Over which time interval? Please be more specific. From Fig 2, it seems that the drop is more than -5°C. And This is also indicated in l148 to 150: 'Values of theta_e are 353.6K on average before passage of the cell. An hour after the passage, the theta_e value drops by an average of 8.9° to an average value of 344.7K' -Also please mention here than no latent heat flux measurements are available at the passage of the convective systems and the following hour. -Please indicate how the recovery time is computed. Surface thermodynamics: - l 174-175: please indicate also the average value of CWV for the isolated cells. For the MCS, please compare the figure showing the evolution of the CWV with Figure 3 of Taylor et al, 2017 The surface flux panels are not commented in the text so either removed them from Fig 2 and 3 or comment them.

Downdraft origin and the effects of mixing: - the 1.3km and 2km for the origin of the downdraft with the assumption of no-mixing is only derived for one given case? Or is obtained from the composite of all the radiosondes for a given category? Could you please comment on the range of values obtained for all the cases and change Figure 4 by one figure showing the mean profile +/- the standard deviation.

Vertical velocity and downdraft probability: - This section is a bit short on conclusion ('These results suggest that in most downdrafts, a substantial fraction of the air reaching the surface originates in the lowest 3km'). According to Figure 7, above 3km there is still a probability of ~0.4 to get a downdraft. Also, Fig 5, 6 and 7 do not show much details in the lower levels you may want to zoom this figure in the lower 7 or 10 km. - please comment on the dispersion on reflectivity and vertical velocity obtained for the different individual cases. Relating cold pool thermodynamics to precipitation - l 328 change 'in Fig 5' to 'in Fig 4' - How do you interpret the fact that you have some points with very large negative anomaly (<15°) in equivalent potential temperature and no precipitation? - Please indicate that the Dtheta_e is always the same one, i.e. determined from in-situ observations. - l357-359: minimum or maximum of Dtheta_e: please make it clearer. :'The MAXIMUM of Dtheta_e within a 3-h window of a given precipitation rate is averaged to minimize the effects of local precipitation maxima occurring slightly before or after the MINIMUM in Dtheta_e'. -Please detail more how those diagnostics could be used as a constraint for parameterization.

Conclusions: - Temperature drop of 3.9°C or 4.4° and Equivalent potential tempera-

ture from of 8° or 8.9° (line 154 or line 381) for isolated cells: please be consistent. Also check the values for the MCS cases: they are in consistent in the text and the conclusion - 'with the moisture recovering faster than temperature': do you have an assumption to explain such feature. - L 411: 'For area-averaged precipitation on scales typical of GCM grids, precipitation magnitude is lower for strong, negative Dtheta_e, consistent with the points with large D_theta_e occurring at localized downdraft locations within a larger system with smaller area-average precipitation': I don't get the argument: why the Dtheta_e will not also be smaller in this case?

Figures: - Figure 1: Please provide in the caption the name of the field that is drawn and its unity - Figure 2: It will help the lecture of this graph if there were some horizontal lines for the values as shown in the upper panel of Figure 5. Otherwise, it is very difficult to get a quantitative information from these subplots. In the caption, you mention overbars, in fact there are only drawn for the precipitation; for the other parameters, a shading is indicated around the mean: please modify accordingly the caption. - Figure 3: to help in the comparison please add the mean values of Figure 2 on Figure 3 with a dashed line. - Figure 4: I guess those profiles are from one radiosonde profile only and a given case for each case (otherwise I do not expect such small scale vertical variations of the equivalent potential temperature for an average over more than 10 radiosonde profiles). Please replace by a figure showing the mean and +/- the standard deviation shown by a shading. - Figures 5 and 6 : I am impressed by the relatively un-smooth aspect of those figures for an average over 11 and 17 cases respectively. For the vertical velocity please use a red-blue colour bar in order for the reader to more rapidly identify the ascending versus descending areas. -Figure 8: what is the unit of the right panel. Please keep the same colour legend for all subplots. - Figure 9 & 10 : please add both sites on the same sub-plots and reduce the number of subplots from 3 to 6.

References: Charba, J., 1974: Application of gravity current model to analysis of squall-line gust front. Mon. Weather Rev., 102, 140–156 Redl, R., A. H. Fink, and P. Knippertz, 2015: An Objective Detection Method for Convective Cold Pool Events and Its Application to Northern Africa. Mon. Weather Rev., 143, 5055–5072 Taylor C.M., D Belusic, F Guichard, D J Parker, T Vischel, O Bock, P P Harris, S Janicot, C Klein, G Panthou, 2017Âă: Frequency of extreme Sahelian storms tripled since 1982 in satellite observations. Nature, 544, 475-478

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