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Interactive comment on “Climatology of stratocumulus cloud morphologies: microphysical properties and radiative effects” by A. Muhlbauer et al.

Anonymous Referee #2

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This is an great overview of results from the A-Train satellites using a statistical technique to classify low-level clouds into several ‘types.’ The scope is quite broad, looking at the entire globe, picking out several important regions in the subtropics and midlatitudes, and including the seasonal cycle. This is a preliminary study, and one hopes that it is followed up with more detailed examinations of some of the intriguing results that are reported. The main weakness of the paper is that it only uses one year of data, but as the authors have explained, this is already a considerable effort. I think the paper should be published with just some minor revisions, which are described below mainly as some questions and suggestions.

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Minor Comments

1. In Section 2, a couple of points that would be stronger if quantified: (a) the fraction of scenes that lack cellular structure (maybe this isn't part of the algorithm, though), (b) the fraction of scenes that are homogeneous Sc that are grouped into closed MCC, (c) fraction of scenes obscured by higher clouds, and (d) fraction of scenes excluded because they are clear. Maybe these numbers are not available, but I think many readers would be appreciative if they could be included.
2. (very minor!) "Circumpolar Southern Oceans" is a curious choice of labels. Why not the more common "Southern Ocean"? Maybe to be more specific, it could be the "midlatitude Southern Ocean" (MSO)?
3. In a couple of places the "Arctic Ocean east of Greenland" is mentioned, but it isn't clear if that is the same as the "North Atlantic" box in Figure 1 or not. If so, I think that box is entirely within the Atlantic, and shouldn't be called the Arctic. If not, then I think it should be labeled or better explained.
4. On page 6989, the text says "... subtropical high-pressure systems and considerable upwelling of cold oceanic waters..." This is in regard to seasonality, so I wonder if there is a link between the seasonality of upwelling and clouds? If not, then consider removing that part of the sentence.
5. On page 6990 it says that LTS is derived from ECMWF analysis. Can any more detail be included? Is this from 5 years like in Figure 1, or just for the year of MODIS data that is used for the MCC types? Monthly or 6-hourly? On the native grid, or coarsened? Speaking of the time periods, that year of MODIS data should be stated explicitly in the text, but I only see that it is 2008 in the captions of Figure 5 and Table 3 and in the case study section.
6. On page 6990, it is mentioned that there's a lag between LTS and cloud cover, so there are other players at work controlling the cloud. Is this part of the analysis

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based on monthly averages, or instantaneous data? If instantaneous, it should be mentioned that the LTS-cloud correlation gets weak on short timescales (see Zhang et al. doi:10.1175/2009JCLI2891.1 for example).

7. On page 6991, there's a sentence: "Interestingly, there is also clear indication of closed MCC types over the equatorial cold tongue in the eastern equatorial Pacific especially during boreal winter (SON)." Why is it interesting?

8. Similarly, on page 6992: "Interestingly, the most prevalent MCC types in the NEA are disorganized and open MCC with little contributions from closed MCC, which in turn explains the overall low value in low cloudiness." I'd suggest rewriting to say why it is interesting, maybe something like, "The relatively small value of low cloudiness in the NEA may be explained by noting that the prevalent MCC types are disorganized and open, while closed MCC is much less common."

9. page 6996, I wondered whether the strongly skewed distributions of cloud fraction suggest something about time scales of cloud changes (i.e., autocorrelation in cloud fraction)?

10. page 6996, The text mentions using an appropriate Z-R relationship, but I wonder whether a Z-R relationship valid for subtropical stratocumulus would be valid for extratropical stratocumulus (where presumably there could be differences in vertical velocity and drop distributions)?

11. page 6998 & Conclusion #6, This study nicely shows the difference between the cloud types in drizzle and CTH, but this conclusion could be made easier to digest. Wouldn't it sound a lot catchier to simply say "Thicker clouds rain more." ?

12. The conclusions in general come across as a little wordy. The numbered list is great, but I'd suggest trying to make each item shorter, more like 2-3 lines.

Figures (all very minor, just suggestions) Figure 3: -I'd suggest adding "error bars" to the total cloud fraction to give a sense for the variability in each month and region.

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-Also, I suggest making the lines thicker and switching from dashes to all solid and colors for the drizzle (maybe light blue for light drizzle and dark blue for heavy drizzle).

Figure 4: - I'd suggest moving the LTS lines to Figure 3, making them a different color (maybe orange or red) and labeling the LTS value on the right-side axes.

Figure 5: Maybe put the season labels on the left side instead of on top of each map, and also put the MCC type on top of each column. Also delete the longitude labels. Also, consider using a color scheme that is not diverging (i.e., white in the middle).

Figure 7: I was surprised that the point at 21S, 81W is closed MCC. Is this an artifact of the figure being too small to see the fine details?

Figure 9: Label the panels with the type, even though it is obvious. Consider combining into one panel, with three box/whisker objects for each geographical region (maybe colored differently for open/closed/disorg).

Figures 9 & 11: Why are the whiskers 2-sigma instead of total range or 10/90 percentiles? Especially when considering skewed distributions, it seems like that would be more natural.

Typos & Editorial Suggestions

Section 2: -"each cloud scence constitutes" – 'scence' should say 'scene' -"volume is greater or equal 50%." should say "volume is greater or equal to 50%."

Section 3: -"braod strip around the global." – 'global' should be 'globe' -"heavy drizzle is tracking the" should be "heavy drizzle tracks the" -"LTS peaks out in" should be "LTS peaks in" -The last sentence, "Details of the MCC statistics for various regions at subtropics and midlatitudes are given in Table 3." seems a bit awkward. Maybe rephrase as, "Table 3 lists the frequency and cloud cover for each region and MCC type."

Section 4: -Suggest deleting "the near-coastal waters"

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Section 5.2 & conclusion #5: I suggest avoiding this use of parentheses, and simply writing out both relationships to increase ease of reading. See Eloquent Science by Schultz for a longer discussion of why not to use this convention.

Section 5.3: -"The little difference in cloud top" – suggest "The small difference ..."

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 6981, 2014.

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