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Dr. Graham Feingold,
Editor
Atmospheric Chemistry and Physics
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Dear Dr. Feingold:

We sincerely appreciate this new opportunity to revise and improve our manuscript on "On the relationship between mesoscale cellular convection and meteorological forcing: Comparing the Southern Ocean against the North Pacific".

In the revised manuscript, we have made comprehensive modifications to address the questions and suggestions put forth by both referee #1 and you.

We thank both referees for their insightful and useful comments. Below are our point-to-point responses to each of your comments and referee #1's comments.

Sincerely,
Francisco Lang

Editor

Some minor comments of my own:

1) The NE Atlantic has been the subject of quite a bit of recent MCAO work (ACTIVATE campaign) and while I don't suggest rigorous comparison, briefly addressing commonalities/differences based on published analyses would be a useful addition.

R: Thank you for your suggestion. We have included additional sentences in the discussion section of the revised manuscript, addressing recent studies conducted over the North Atlantic. Specifically, we have noted the similarities in the transition from closed MCC to open MCC clouds and the influence of MCAOs.

2) cloud radius --> cloud droplet (or drop) radius

R: Suggested revision made.

3) The paper would benefit from a careful read to weed out some typos and grammatical errors.

R: Thank you for your comment. We have meticulously revised the new manuscript to eliminate any typos and grammatical errors. We believe this new manuscript represents an improved version of the previous one.

4) Line 3: abstract: ideal --> idealized

R: Suggested revision made.

4) Line 19: required --> able

R: Suggested revision made.

5) Line 247: LTS --> LST

R: Suggested revision made.

6) Line 266 needs work

R: Thank you. We have rewritten the sentence to enhance clarity and improve understanding.

7) Line 333 needs work

R: Thank you. We have rewritten the sentence to enhance clarity and improve understanding.

8) Lines 360/361: repeats "In addition"

R: Thank you for noticing this. We have rewritten the paragraphs to eliminate any errors.

Referee #1:

The authors present an improved version of their paper but need to improve further to make a substantial enough contribution. Please find several major issues below that the author should address before publication.

Major concerns

The authors connect meteorological variables to open and closed cellular structures and there is little to no information about their expected connection provided so far. There are several aspects that come to mind that I am missing in the introduction:

(1) What are the expected mechanisms leading to open versus closed cellular organization? And is “closed” considered to be a stage prior to “open”?

R: Thank you for your suggestion. In the Introduction of the revised manuscript, we have explored the expected mechanisms leading to open versus closed MCC organization. Specifically, we discussed the influence of atmospheric and thermodynamic factors on MCC morphology. We have also noted that closed MCCs commonly transition into open MCCs, a phenomenon well-documented in studies such as Eastman et al. (2022) and Yamaguchi et al. (2017).

(2) Are these mechanisms expected to be identical in both subtropical and mid-latitude clouds? For example, Scott et al. (2020) lists subsidence as an important parameter in the subtropics – could that be relevant for the North Pacific and Southern Ocean?

R: Expanding upon the previous suggestion, in the Introduction of the revised manuscript, we have included a comprehensive comparison of open and closed MCC clouds in the midlatitudes, high latitudes, and subtropics. We have highlighted both the differences and similarities in the behavior of these cloud types. For instance, we discussed how the seasonal cycle of closed MCC clouds varies across latitudinal regions. In the midlatitudes, this cycle is influenced by surface forcing, while in the subtropics, it is more closely tied to lower tropospheric stability. The importance of regional environmental factors in shaping MCC cloud characteristics is emphasized by this distinction.

To better embed the results into the state-of-the-art research, the author should then reflect on these expectations in their discussion. For example, do the authors cover all parameters connected to the expectations or are there parameters missing (e.g., parameters indicative of cloud microphysics)? And importantly, are the correlations unambiguously pointing at certain mechanisms or are there several parameters with high correlation (i.e., regions where parameters are well-correlated with one another)?

R: Thank you for you comment. In the revised Introduction, we have explored previous studies that have identified the most important large-scale meteorological and thermodynamic factors that can significantly influence MCC cloud development. Open MCC clouds are particularly sensitive to the most important larger-scale surface forcing, while closed MCC clouds exhibit greater responsiveness to longwave cloud top cooling (McCoy et al., 2017; Wood, 2012). These added references contribute to a comprehensive analysis of the most important larger-scale meteorological parameters driving MCC clouds development. Furthermore, in the Discussion section of the revised manuscript, we have examined additional microphysical parameters that may impact the development of open and closed MCCs.

The authors decided to examine monthly statistics when calculating correlations between meteorological parameter and occurrence frequency, and it is unclear what motivated this decision. What are the expected timescales of parameters driving cloud organization (e.g., are monthly means expected to resolve these rather than hourly data)? Regarding Section 3.3, why look at the diurnal cycle to begin with?

R: The motivation for monthly statistics is because the correlation analysis involves the frequency of occurrence of both types of MCC clouds against the meteorological parameters outlined in the manuscript (EIS, M index, average SST, and near-surface wind speed). Calculating hourly frequency of occurrence is not feasible because hourly data represents Open and Closed MCC as integer numbers, lacking physical meaning, and serving solely to distinguish between cloud types. Furthermore, larger time scales, such as daily frequencies, do not provide a robust sample size for calculating frequencies and correlating them with the meteorological parameters. Thus, we believe that the most robust correlations are derived from monthly frequency of occurrence.

Regarding the diurnal cycle, in Lang et al. (2022), we investigated the diurnal cycle of open and closed MCCs. As stated in the introduction, our goal is to expand this climatology to the NP. We believe that illustrating the differences in the daily cycles between both regions lays the groundwork for future publications to explore these daily cycles in a more detailed and comprehensive manner, as mentioned in the last paragraph of the manuscript as a potential avenue for future research.

The authors sometimes equate correlation with causality (e.g., ll. 184-185, l. 316, and elsewhere). The authors should carefully examine their language throughout the paper.

R: Thank you for your comment. We have revised and rewritten accordingly the new manuscript to avoid any causality regarding the correlations.

The authors included some discussion elements into the results section (e.g., ll. 177-183, and elsewhere). To create a crisper results section that is largely free of speculation, I strongly urge the authors to move discussion material into Section 4.

R: We have exhaustively reviewed and revised the manuscript to ensure the removal of any elements from the results section that belong in the discussion. We believe that the revised manuscript now presents the results and discussion sections more clearly.

Minor concerns

l. 5 Replace “roughly” with “evenly” if that is meant here.

R: Suggested revision made.

l. 7 Include “presumed” before “meteorological forcings”.

R: Suggested revision made.

13 Please rephrase sentence (“cycle … cycle”).

R: Suggested revision made.

l. 27 McCoy et al. (2023) additionally excluded optical depth effects.

R: Suggested revision made.

ll. 70-72 This sentence seems better suited elsewhere.

R: Thank you for the suggestion. We have moved the sentence to Section 2.3, 'Large-scale meteorological indices.

ll. 142-143 Please rephrase “colder SST” with “greater SST”, for example.

R: Suggested revision made.

ll. 175-177 These sentences do not fit well here. Please check if ordered (and placed) correctly.

R: Thank you for bringing this to our attention. We have revised and reorganized the paragraphs to improve this section.

l. 136 Please also cite Eastman et al. (2022).

R: In Eastman et al. (2022), MCAOs are not explicitly defined. They did not utilize the *M* index, making this reference unsuitable for the context of the sentence.

Fig. 4 Please show data points of one selected grid box in a separate scatter plot (perhaps as supporting information) and also plot the interdependence of parameters (windspeed, SST, EIS and M).S

R: We have added scatter plots for selected grid points of every variable in the revised Supplementary Material (Figure S2).

Fig. 1, 3, 4, 5, 6, 7, 8: If “closed” is considered the stage prior to “open” (see major points), better order plots showing “closed” on the left and “open” on the right.

R: Suggested revision made.

Section 1: Perhaps better have one paragraph on identification methods (i.e., uniting ll. 28-33 and ll. 43-49) rather having information scattered throughout.

R: Thank you for your comment. We have slightly reorganized the introduction to consolidate all the information regarding identification methods, which is now presented in the second paragraph.

Spelling

l. 54 Replace “region” with “regions”.

R: Suggested revision made.

References:

Eastman, R., McCoy, I. L., & Wood, R.: Wind, rain, and the closed to open cell transition in subtropical marine stratocumulus. Journal of Geophysical Research: Atmospheres, 127, e2022JD036795. doi:10.1029/2022JD036795, 2022

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McCoy, I. L., Wood, R., and Fletcher, J. K.: Identifying Meteorological Controls on Open and Closed Mesoscale Cellular Convection Associated with Marine Cold Air Outbreaks, Journal of Geophysical Research: Atmospheres, 122, 11,678–11,702, doi:10.1002/2017JD027031, 2017.

Wood, R.: Stratocumulus clouds, Monthly Weather Review, 140, 2373–2423, https://doi.org/10.1175/MWR-D-11-00121.1, 2012

Yamaguchi, T., Feingold, G., & Kazil, J.: Stratocumulus to cumulus transition by drizzle: Stratocumulus to cumulus by drizzle. Journal of Advances in Modeling Earth Systems, 9(6), 2333–2349. https://doi.org/10.1002/2017MS001104, 2017