Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC2
https://doi.org/10.5194/acp-2021-681-RC2, 2021

Comment on acp-2021-681

Anonymous Referee #1

Referee comment on "A climatology of open and closed mesoscale cellular convection over the Southern Ocean derived from Himawari-8 observations" by Francisco Lang et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-681-RC2, 2021

Review – **A climatology of open and closed mesoscale cellular convection over the Southern Ocean derived from Himawari-8 observations,** by Francisco Lang et al., (ACP, 2021)

This paper describes aspects of the climatology (spatial patterns, seasonality and diurnal cycles) of open and closed mesoscale cellular convection (MCC) over the Australasian swath of the Southern Ocean extending from 60E-160W. MCC is classified by applying machine learning to labeled open and closed cellular patches of thermal infrared satellite data from the Himawari satellite. The results document interesting differences in the seasonal cycle of open and closed MCC, with a much stronger seasonal variability in open MCC, peaking in late winter/early spring, and little seasonal cycle in closed MCC. Open MCC displays very little diurnal cycle, whereas closed MCC shows a diurnal cycle typical of that for marine stratocumulus. There is interesting latitudinal structure that appears to relate to the location of the polar SST front. Little MCC is found to the south of this front. MCC frequency is also related to the location of cold fronts, open cells typically occurring closer to the cold front, and closed cells more in the warm sector. The results are very interesting and will be of interest to others in the field. The paper is well written, the methods sound, and I recommend publication in ACP. I have a few technical questions and comments that the authors may wish to consider.

Potential major issue needing address: The only major potential issue I see is the use of the thermal IR channel only in diagnosing MCC types. I believe that this is fine for diagnosing open MCC, where there is clear contrast across the scene due to breaks in the clouds. For closed cells, there is very weak thermal IR contrast, and so my question is how well one can separate closed MCC from stratus that does not display MCC. The ML approach of Yuan et al. (2020) finds clear contrasts in the locations of stratus vs stratocumulus, and both prevail in midlatitudes. I think the authors need to at least comment on their choice of not including a stratus-type class in their approach. The authors' method seems to agree with previous results (Rampal and Davies 2020), which infrequent MCC poleward of 60S, but these results use visible imagery that has much more discriminating power to separate closed MCC from stratus. I don't know how stratus are removed from the authors' dataset given the use of thermal IR only. Some

explanation is required.

Specific comments

- Line 33: Rozendaal et al. (1995) is for me a classic paper on low cloud diurnal cycles and is well worth citing.
- Line 77. Provide references that the "largest model bias has been linked to this sector"
- Line 99: Advanced rather than advance.
- Section 2.2.1: Some additional information is needed regarding how high clouds and multilevel clouds are screened out using the data. In addition, some basic statistics on the frequency of open and closed cells, high clouds, stratus clouds, multilevel cases, etc would be very helpful.
- Section 2.2.2: Provide some examples of *visible* imagery for the open and closed MCC.
- Fig 3. Why not show visible imagery rather than thermal IR? I can't tell if the overcast clouds are closed MCC or just stratus.
- Line 195. A number of degrees is missing in my pdf.
- Line 198. What exactly constitutes a "system"? Is this an 80x80 km patch? Are these systems really independent if you measure them every 15 minutes?
- The lack of diurnal cycle in open MCC frequency is very interesting and novel. However, what would be even more interesting is whether the diurnal cycle of cloud cover (rather than frequency) in open MCC exhibits a diurnal cycle. Do the authors have cloud mask data that can be used to determine this?

References

Rozendaal, M. A., Leovy, C. B., & Klein, S. A. (1995). An Observational Study of Diurnal Variations of Marine Stratiform Cloud. Journal of Climate, 8(7), 1795–1809. https://doi.org/10.1175/1520-0442(1995)008<1795:AOSODV>2.0.CO;2