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Comment on acp-2021-63

Anonymous Referee #1

Referee comment on "Contrasting characteristics of open- and closed-cellular stratocumulus cloud in the eastern North Atlantic" by Michael P. Jensen et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-63-RC1>, 2021

Summary of manuscript

The authors present observations and their basic statistical evaluation of meteorology, boundary layer properties, and cloud properties collected over the period 2013-2018 at the Atmospheric Radiation Measurement (ARM) Facility's Eastern North Atlantic (ENA) site on Graciosa Island. The data are divided into two categories based on the state of cloud mesoscale organization: closed-cell stratocumulus and open-cell stratocumulus. Properties of composites of the data (mean, variability, diurnal cycle, probability distribution functions) in each category are presented and discussed.

Summary of review

This manuscript gives an excellent, quantitative, systematic, and detailed view of the closed- and open-cell stratocumulus state and of their meteorological context at Graciosa Island. The text is written clearly, logically, and consisely, and the data and their analysis are presented in a way that will make them very useful for others. This work hence advances the science, even though no specific new scientific insights are presented.

There are a few items, listed below, in the text that require attention before publication. These items are significant in substance and should not be glossed over, but can be addressed with a focused yet limited effort. Hence a minor revision is recommended.

Specific comments

Line 42-42, and 316-317: "Despite these important impacts, the atmospheric processes responsible for the formation and maintenance of these organizational states remains poorly understood."

A host of literature exists on the processes that are involved in driving and maintaining closed- and open-cell stratocumulus cloud decks, and the processes that convert one into the other. Hence writing that "processes responsible for the formation and maintenance of these organizational states remains poorly understood" is incorrect. Here are a few references. Please add any other works based on a literature search and change the text to reflect the existing understanding of the subject.

Shao and Randall, 1996, Closed Mesoscale Cellular Convection Driven by Cloud-Top Radiative Cooling
Stevens et al., 2005, Pockets of open cells and drizzle in marine stratocumulus
Comstock et al., 2005, Mesoscale variability and drizzle in Southeast Pacific stratocumulus
Wood et al., 2008, Open cellular structure in marine stratocumulus sheets
Bretherton et al., 2010, Southeast Pacific stratocumulus clouds, precipitation and boundary layer structure sampled along 20° S during VOCALS-REx
Wood et al., 2011, An aircraft case study of the spatial transition from closed to open mesoscale cellular convection over the Southeast Pacific
Xue et al., 2008, Aerosol effects on clouds, precipitation, and the organization of shallow cumulus convection
Savic-Jovcic and Stevens, 2008, The structure and mesoscale organization of precipitating stratocumulus
Wang et al., 2009, Modeling mesoscale cellular structures and drizzle in marine stratocumulus. Part II: The microphysics and dynamics of the boundary region between open and closed cells
Feingold et al., 2010, Precipitation-generated oscillations in open cellular cloud fields
Kazil et al., 2014, On the interaction between marine boundary layer cellular cloudiness and surface heat fluxes
Yamaguchi et al., 2015, On the relationship between open cellular convective cloud patterns and the spatial distribution of precipitation
Feingold et al., 2015, On the reversibility of transitions between closed and open cellular convection

Line 54-56: " However, Wood et al. (2011) and Terai et al. (2013) found that drizzle rates are not significantly different between open and closed cells, concluding that drizzle, and its associated thermodynamic feedbacks, are not the only factor causing the transition between mesoscale organizations."

There is more to be written on this subject - see, e.g., Yamaguchi et al., 2015, "On the relationship between open cellular convective cloud patterns and the spatial distribution of precipitation", and Feingold et al., 2015, "On the reversibility of transitions between closed and open cellular convection".

Line 63-65: "Hence, most of the open-cellular stratocumulus that are observed over the

ENA are fundamentally different than those observed in the other parts of the subtropical oceans under quiescent large-scale forcing conditions"

Cold air outbreaks do conceptually differ from the air masses in the eastern subtropical oceans with stratocumulus cloud decks, but do the open cells really differ in these two situations, and how? In other words, it will not do to just state that "open-cellular stratocumulus that are observed over the ENA are fundamentally different than those observed in the other parts of the subtropical oceans under quiescent large-scale forcing conditions" without supporting evidence, literature references, and specifics. Please provide these or remove this passage if it cannot be supported.

Figure 8e: A logarithmic y-axis might perhaps help visualize the data better(?)