Responses to Referee #2, Timothy Dunkerton

The paper provides a detailed analysis of stratocumulus (Sc) in the SE Pacific, and the spatial variation of Sc in a quasi-Lagrangian framework, obtained from a criss-crossing flight track designed to keep step (approximately but not exactly) with the horizontally translating cloud deck, sampling orthogonal to the boundary between open and closed cells. Emphasis is therefore given to the spatial, not temporal, evolution of the cells. The two regions afford a sharp contrast between relatively homogeneous properties in the closed-cell region, and strong heterogeneity in the pocket of open cells. The boundary between the two regions also has some noteworthy properties.

We thank the reviewer for the constructive review.

Two general recommendations for this type of study can be given:

1. Consideration should be given to the intrinsic time evolution of the open- and closedcell regions. It is clear from animations of the imagery that temporal variation occurs in the translating frame, as might be expected of clouds in general. One particular question I have is whether a closed cell evolves temporally (and intrinsically, following horizontally the fluid) into an open one, at least in some cases. Could it be that some proportion of individual Sc cells, grouped spatially, undergo a lifecycle resulting in their opening up eventually, forming a new POC? And would such a lifecycle be consistent with the observed properties of the open cells?
This is an important question and one that is rather difficult to answer. Given the available satellite data and in-situ wind measurements, I was unable to rule out the hypothesis that, during the course of the measurements, the open-closed cell boundary (as defined by eye from the IR satellite images) simply was advecting with the mean MBL wind determined from the flight data. We have included a dashed line in Fig. 4 of the revised manuscript which appears to show a boundary advecting with the mean wind.

2. As suggested by the reviewer, spatial averaging must be done with care in the open-cell region. I recommend that statistics be conditioned on the data within the open-cell region, such that heavily precipitating regions are segregated from relatively clear regions. Enough data exist to do a conditional analysis with statistical confidence.

I assume that you are referring to Reviewer #1 here. Please see my responses above. We feel that we have done this conditional sampling, at least in part. For example, Figure 8 conditions by cloud only (lower panels) so that one can see the statistics of cloud and drizzle liquid water content for the cloud only regions. Again, Fig. 9 shows the volume radius and drizzle drop concentration conditions on regions where the drizzle drop concentration exceeds a given threshold. Finally, Fig. 11 shows pdfs of various properties conditioned on cloud being present. I wonder what more I should do in that regard.

Other comments:

3. In or near the Conclusion, provide a succinct summary of aerosol-cloud-precipitation interactions. They can be labeled according to your confidence (speculation is ok). The important thing is to put these inferences together in one place, as they are presently scattered about. The "a-c-p" (no pun intended) interaction is one of the underlying motivations for the study, though not the major theme of this paper.

This is a good point, and something that Reviewer #1 also pointed out. We now do this.

4. The visual impression of open vs closed cells suggests the naive idea that vertical motions in the closed deck consist of subsidence along creases between individual cells, whereas in the open-cell region it is the updrafts that are spatially concentrated with slow subsidence in the surrounding part of the cell. With respect to vertical motion, the two regions are a mirror image of one another. It would be interesting to hear the authors' view on this interpretation.

This is essentially a common conceptual view of how the open and closed cell vertical motions are organized. Here though, there is an issue of what the horizontal scale of the vertical motions is. Our instruments are not good at detecting the weak upward motions that may constitute the “mean” ascending motion (horizontal scale of 10+ km) in the closed cell centers, or the weak downward motions in the open cell centers. It is not clear whether in the open cell region there really is a weak downward motion in the cell centers, or if there is no motion at all. And we don’t know if the mean ascending motion in the center of the closed cells is really just an aggregate of lots of updrafts and downdrafts with strength order 1 m/s, or if there really is a mean mesoscale updraft. We know that the mirror image idea only goes so far because we don’t see 3 m/s downdrafts in the clear slots in between closed cells, yet we do see updrafts of this size in the centers of open cells (e.g. Fig. 21). Hopefully more analysis of the Doppler radar data from the WCR and from the C-band on the Ron Brown will shed some light.

5. On oscillations of w and N_a in POC outside the active Cu: hints of gravity waves on the strong vertical gradient of N_a (Figures 17, 18, 21). The authors are commended for making good use of ACP’s excellent color graphical capabilities.

We agree with the reviewer that gravity waves likely play a role at compensating the strong updrafts found in the open cell centers, a la Bretherton and Smolarkiewicz (1989). Modeling simulations being conducted by a graduate student of Chris Bretherton are finding that the inversion height in the open cell region is essentially “propped up” by the presence of the nearby closed cell region, presumably through a compensating circulation which one can envisage as a gravity wave response. The significance of these waves is unclear to me at present. I included a sentence discussing this possibility in the text associated with Fig. 18.