Review of "On the interaction between marine boundary layer cellular cloudiness and surface heat fluxes" by J. Kazil et al. (acpd–13–188855–2013)

Idealized cloud-system-resolving simulations of open- and closed-cell regimes are performed using WRF in order to explore the relationship between surface fluxes and cloud properties. In particular, the work seeks to elucidate differences in surface flux behavior for the different regimes (open vs. closed cells). Through a series of sensitivity experiments, the authors show that enhancement of the surface sensible heat flux is conducive to maintenance of the open cell regime. The research is fundamentally sound and will be a solid contribution to the literature. I recommend publication after major revision.

General comments

1. There is no observational constraint whatsoever. It is a highly idealized modeling study, but given it appears to be loosely based on the DYCOMS–II period, the authors should be able to make some broad-brush comparisons with the observations.

2. The figures need substantial revisions. Many of my specific comments below address problems with the figures. Additionally, the sheer number of figures seems to distract from the main point of the paper. If there is any way for the authors to reduce the number of figures (currently 18), it would make for a much easier-to-read paper.

Specific comments

1. *Page 18856, lines 12–13. "The responsible mechanism is the entrainment of dry free tropospheric air into the boundary layer."* This is not clear. I believe the authors mean the greater magnitude of entrainment in the closed-cell state, but this is not clear from the abstract alone.

2. *Page 18856, line 13*. "The open-cell state drives oscillations…" should probably be "…is associated with oscillations…"

3. *Page 18856, lines 22–26, sea-salt flux in depleted aerosol conditions may help maintain the open-cell state.* This suggests that CCN concentration can become small enough, in the absence of surface CCN flux, to keep clouds from forming. Does this ever happen in nature?

4. *Page 18857, line 8.* Comma needed before "reflect."

5. *Page 18861, Lines 16–19*. So the aim is to represent open and closed cells over the northeast Pacific (NEP)? Although the case is highly idealized, this is an important distinction given the different character of MBL clouds over the NEP, SEP, and NEA.

This should be acknowledged. The "11 July 2001" initialization date suggests that this is a DYCOMS–II case. Would the authors please expand upon this and give a bit more in the way of observational context?

6. *Page 18863, lines 4 onward*. The authors might point out that neither of these simulations reaches steady state, despite the assertion in the introduction of the stationarity of closed cell circulations.

7. *Page 18865, lines 18–20, "…while the boundary layer air detrains into the free troposphere in the open-cell state."* The only interpretation that can be made from this figure is that of the relative measures of entrainment rate and subsidence on boundary-layer depth. For the open-cell case means that entrainment rate is quite a bit smaller than the subsidence.

8. *Page 18866, lines 12–19, latent heat release, leading the oscillations, followed by LWP, and the lag in rainfall*. Shouldn't the LWP oscillations follow the latent heat oscillations exactly? It is not obvious to me why the latent heat leads the LWP slightly. And how exactly is "latent heat release" calculated? Is it condensation rate minus evaporation rate over every model output interval? Upon initially reading this section I wanted to ask the authors to please quantify the lag more rigorously, but later in the manuscript they call out Table 3, which answers much of my criticism. It would be helpful to in this paragraph at least mention that later in the paper they will be more completely discussing the lag between the various quantities.

9. *Page 18867, lines 1–11*. I am really struggling to see how adding a (ug, vg) vector of (1 m/s, –1 m/s) will transform Fig. 8a into 8b. Look, for example, at the cell at x = 60 km, y = 20 km. Fig. 8a shows a relatively symmetric divergence signal. Adding the small (ug, vg) to this drastically changes the appearance of the vectors. I suspect something is amiss either with the calculation, or more likely, with the scaling of the vectors.

<u>Comments on Figures</u>
Fig. 2. This figure needs substantial revision. Having these four panels on one plot suggests the reader is supposed to be comparing them, so it's vital that the color table limits be identical in each. Or are they, except at large optical depths? In any case, it would be best to have a single color bar. In that case, you wouldn't need four color bars; one would suffice. The panels could be placed closer together and some of the redundant axis titles and/or labels omitted. Finally, why not put the S_open and S-closed, along with the time descriptors, at the top of each panel? That would be of great help to the reader.

Fig. 3. There's no compelling reason to have the right-side y-axis be identical to the left side. Omit the right side; color the left side in black.

Fig. 4. It would be greatly helpful to put S_open and S_closed symbols at appropriate places, and to label the top of the columns “Sensible heat flux” and “Latent heat flux.” Also, I think the axis titles could be more concisely placed; at present they’re too wordy and take up too much space.

Fig. 6. See comments above.

Fig. 7. See comments above.

Fig. 8. These panels have redundant bits (legends, y-axis titles/labels), and the flow features discussed in the text. I had to blow it up on my 27” monitor just to have a fighting chance at seeing the features in question.

Fig. 9. Many of the criticisms of Fig. 2 (above) apply to this figure. The panels need more concise titles. Also, what is the reason for the odd contour intervals?

Fig. 10. See comments on Fig. 9.

Fig. 11. See comments on Fig. 9.

Fig. 12. See previous comments about helpful panel titling and redundant panel components.

Fig. 13. (see also Fig. 3.) There’s no compelling reason to have the right-side y-axis be identical to the left side. Omit the right side; color the left side in black.

Fig. 14. See comments of Fig. 8.

Figs. 15–18. Many of the comments from previous figures apply to these as well.