

## ***Interactive comment on “The efficacy of aerosol-cloud-radiative perturbations from near-surface emissions in deep open-cell stratocumulus” by Anna Possner et al.***

**Anonymous Referee #2**

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General comments: Possner et al present an interesting modeling study in which the effect of ship emissions on cloud microphysical and macrophysical properties of deep open cells is examined. Based on field campaign measurements, and previous modeling study of Wang et al 2010, Possner et al. show that despite the lack of typical linear ship tracks, the cloud adjustments can be significantly larger than one would expect. The manuscript is well written and the analysis support the authors conclusions. I recommend the manuscript to be published after minor revisions.

Specific comments: 1. The authors cite that 70% of marine Sc form in deep boundary layers (p16119; citation needed, e.g., Muhlbauer et al., 2014). Do the 70% compose

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mainly open cells? How much of the 70% are closed cells? This needs to be mentioned in order to asses the global effect of ship emissions in deep open cells.

2. The domain mean increase in albedo is function of the domain size. For a smaller domain, the increase would be larger, and for larger domain size, smaller. Therefore, domain mean increase in albedo of 0.05 is somewhat arbitrary. If the authors can estimate the density of ship tracks in a given regions with frequently observed deep open cells, a more meaningful value of regional mean increase in albedo can be estimated.

3. The authors claim in the abstract that changes in cloud-radiative properties are masked by the natural variability. What is the meaning of natural variability in this context? The abstract further says that the above can be overcome by utilizing the spatio-temporal distribution of the aerosol perturbation. However, in Figure 3 the aerosol plume can be easily seen in Nd, which serves as a tracer to where one can expect cloud adjustment. This can be used in observational studies.

4. The authors should improve the description of the tables: Table 1: The caption says the simulated values are domain mean. These values are compared with RF06, which seems to be in-clouds values (for LWP at least). Clarification is needed. Table 2: The left column is unclear. What is the difference between ship, ship-seeded and ship-unseeded? (ship-unseeded is not mentioned anywhere else in the text). Under the CF column, how CF can be not 100% inside walls? given that walls are defined by ascending air? Is the wall CF is the fraction of walls out of the total CF/domain? If so it means that there is also a dynamical adjustment.

5. I recommend to elaborate more in the introduction on previous studies that attempted to quantify the regional effect of ship tracks (e.g., Schrier et al. 2006, 2007, Peters et al. 2011).

6. The simulation assumes an idealized case with no perpendicular winds. I assume that most ship tracks don't have head/tail winds, rather side winds. Would the wind direction relative to the emission source increase/decrease the regional area that is

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affected by the emissions? This should be discussed.

Technical corrections: Section 2.2: What was the duration of the simulations?

P816: Remove “and”.

P8115: Any statistical tests were done to determine the 30km band around the emission line? It is mentioned that inside this region  $\text{Na}_{\text{sub}}$  are elevated, but by how much? I also would expect the plume to expand and dilute as it gets more mature, and not being fixed.

P1217-10: This paragraph is not clear.

P12128: Observational studies showed ship tracks closing open cells (e.g., Goren and Rosenfeld 2012 where at least part of the open cells seems to be deep, based on the cells spatial scale; Christensen and Stephens 2012). While simulations do not show a reverse transition, observational evidence should be provided as well.

P16117: Consider changing “such tracks” to “linear shaped tracks”, and to add that they are rare in deep boundary layers in comparison to shallow boundary layers (reference is needed).

P16128-29: How do the fractional percentages calculated? From which table?

P16126 the → the.

P16127 annular → annual.

Figure 5: In the caption the boundary layer depth for each of the simulations should be provided (i.e., shallower in Wang et al 2011).

Figure 6: In order to cover also the night time in Figure 6d, consider replacing (or adding) cloud optical thickness with cloud albedo?

Supplementary: Caption 3: What is “ship\_open”?

Caption 6: remove “and” in line 3. Caption is not clear. X axis label is not consistent.

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