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Comment

Interactive comment on “Impacts of aerosol particles on the microphysical and radiative properties of stratocumulus clouds over the Southeast Pacific ocean” by C. H. Twohy et al.

Anonymous Referee #3

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This paper brings together a number of aspects of the VOCALS study. While providing useful observations for an important area of the world, it also discusses and demonstrates many of the problems associated with the aerosol indirect effect. Further, it addresses the issue of the pollution sources contributing to the aerosol that influences the marine stratocumulus along 20oS. The use of the models (WRF-CHEM and the LES) to interpret processes in the observations is another nice part of this work. The paper is interesting and generally well written. Please consider the following comments.

1) In the abstract, you state that “Cloud droplets were more numerous and smaller near shore, and there was less drizzle.” In the paragraph bridging pages 19725 and 19726,

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you say drizzle was quite variable and weakly correlated with distance from shore, but in Table 1 you reject the null hypothesis; although in that case it is probably just as easily accepted. There is no mention of drizzle in the conclusions. The statement in the abstract suggests something stronger than “variable and weakly correlated”, and the absence of some mention of drizzle in the conclusions is inconsistent with the abstract. While I appreciate the difficulty with this, I recommend that you try to make the results of the drizzle observations and the related discussions a little clearer, even if it only to say in all major areas that the results of the drizzle indicate a very weak correlation with distance from the shore.

2)I assume that you examined >60 μm droplets in cloud to try to assess whether drizzle was initiated, regardless of whether it fell far from cloud base. Does the use of the 60 μm limit, which is based on the detection limit, risk increasing your variability due to uncertainty around that measurement? Did you or why not look at the concentrations of drops >100 μm or >200 μm , in addition to the 60 μm , which may increase the confidence in the measurements? Also, was drizzle observed below cloud in any of these cases?

3)Page 19718, line 1 – rather than “which initiate drizzle”, I suggest “some of which may initiate drizzle”?

4)Page 19720, line 15 – “the above hypothesis” rather than “this hypothesis”?

5)Page 19721, lines 1-17 - what does "pre-calibrated" mean, and does it only apply to the UHSAS and not the PCASP?

6)Page 19724, lines 23-25 - Mean droplet concentrations are more representative of impacts (and perhaps variability), but the mean includes the effects of more processes than looking at the maximum (or the droplet concentration at the max LWC). If you are trying to evaluate the effect of the below-cloud aerosol on the Nd, it is more appropriate to consider one of the above maxima.

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7)Page 19724, lines 25-27 – Concerning the intercept remark - it really is an open question as to whether a cloud would form in the complete absence of aerosol particles, and what the droplet concentrations would be in that situation. Would droplets form from homogeneous nucleation or ion-assisted nucleation?

8)Page 19725, lines 10-14 – Yes, but not necessarily in all such regions; e.g. Leaitch et al. (ACP, 2010) showed how organic components can contribute significantly to cloud albedo.

9)Page 19726, lines 21-24 - could sulphate in sea salt not also result from gas-phase sulphuric acid condensing on and reacting with sea salt particles?

10)Page 19727, lines 25-27 – Maybe worth drawing the potential connection between this and the absence of an association of the total particle number concentration with distance offshore.

11)Page 19733, lines 20-27 – I can't find any discussion of the CVI enhancement factor. It is mentioned in the caption of Figure 10 as a reason for the smoother nature of the in-cloud distributions. Since it is fundamental to many of your observations, the method of determination of the enhancement factor and how it is applied to these data need to be discussed.

12)Page 19735, lines 11-14 - Only one of your probability plots in Figure 11 is zero at 50%. In each of the other 3 cases, the values at 50% are higher than zero, indicating that your vertical velocities above zero must be reduced by the value at 50%. That will impact your estimations of supersaturations and related discussion.

13)Page 19741, line 28 and Table 1 – The MODIS spatial average of 1 degree is not far from your in-situ observations that are averaged over approx. 70 km. Also, there are more in-situ samples than MODIS samples. Why then is the MODIS dataset “statistically more robust”?

14)Figure 12 – units on vertical axes are missing.

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15)Figure 13 - are the aerosol concentration units correct? Should they be cm^{-3} instead of m^{-3} ?

16)Figure 14b – With the colour scheme used, it is hard to distinguish between the day and night points.

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