

Interactive comment on “Ultrafine sea spray aerosol over the south eastern Pacific: open-ocean contributions to marine boundary layer CCN” by R. Blot et al.

Anonymous Referee #2

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General Comments:

This is an interesting study that predicts the contribution of sea-salt aerosol particles to potential CCN in a clean marine region. It concludes that not only source functions, but also sinks (in particular, precipitation), are required to explain the observational data. The paper has a nice progression from background information, to various pieces of evidence, to the final result. I recommend it be published after some minor revisions/corrections as described below.

The introductory material states that the contribution of sea-salt particles to the marine ultrafine number is still debated, and the authors' method does not directly measure

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sea-salt via composition, but instead as refractory particles. This made me a little uncomfortable with the initial designation of the term SSA (sea-salt aerosol) for data acquired in this way. However, strong evidence is presented that these particles are predominately sea-salt (at least for the VOCALS regions)—i.e. the AMS, which includes smaller particles, measured very low organic signature, the refractory signal is correlated with windspeed, etc. A summary or reiteration of this evidence would be beneficial when the SSA designation is directly applied to the thermal measurements (pp 3283-3284).

Throughout the paper, single or narrow-range supersaturation values are used for calculations based on the location of the Hoppel minimum (for example, middle of p. 3300, elsewhere). In fact stratocumulus clouds include air parcels with a continuum of different updraft and supersaturation histories (e.g., Snider et al., JGR, 2003, Twohy et al, ACP, 2013). Particles smaller than the Hoppel minimum can be activated in strong updrafts; they just have not been through enough condensation/evaporation cycles to grow through the gap. These issues should at least be acknowledged.

It should be noted that sea-salt particles are important not only for number of CCN/cloud microphysics, but also for reactions with sulfur species and aqueous-phase chemistry (O'Dowd et al., GRL, 1999, Hegg et al., JGR, 1992)

The paper is filled with typos, which are distracting and suggest a lack of attention to detail. The ones I caught are given below.

Minor Comments/Typos:

Abstract: suggest changing “ambient CCN” in last sentence to “potential CCN”, as that seems to be more correct.

p 3281 line 7: Do you mean dimethyl sulfide? Paragraph starting line 8: A useful reference here would also be: Heintzenberg J, Covert D C and Van Dingenen R 2000: Size distribution and chemical composition of marine aerosols: a compilation and review

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Tellus B 52, 1104–22.

p. 3282 line 1: second “their” should be “there”. line 8: insert “previously” before “activated”. Line 24: something is wrong with this sentence “do you mean “issued” instead of “issue”? Line 26: “with a very little contribution of the sea-salts mass” also is grammatically awkward.

p. 3283: Another grammar problem: “are well correlated with surface wind speeds which is considered as the major parameter” Line 25 “what about advection?”

p. 3284: “cover” should be “covered”.

p. 3285 line 7: “mission” should be “missions”. “coast” is missing. line 15: “grow” should be “grows”. The comparison with the GNI is interesting and valuable.

p. 3286 line 13: “particle” should be “particles”. Line 22: “organic” should be “organics”.

p. 3287: “describe” should be “described”. line 3-4: Doesn’t the DMA actually measure mobility size? line 14: insert “of” before “the OPC”. Refer should be “referred” etc

p. 3288, line 3: “particles” should be “particle” line 11: “exited” should be “excited”. line 16: “and” should be “who” or some other phrase.

p 3289 line 9: acquired is misspelled.

p 3290 line 4: insert “to” after “refer”. insert comma after ddry. line 17: “value” should be “values”. “in the meanwhile keeping a reasonable amount of data” is very awkward.

p 3299, line 2: Careful with wording. If I understand correctly, these are not activated particles but simply a predicted number of SS aerosol particles in a certain size range, based on the assumptions.

p. 3292, line 4-5: criteria should be criterion.

p. 3292, line 7: “affected” should be “affect”. line 9: Do you mean organic concentrations? If so, insert “organic” before “concentrations”. Might want to reiterate here that

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the AMS measures particles < 50 nm, so isn’t missing much.

p. 3293 line 4: Delete “volatile” “ammonium sulfate is not volatile under atmospheric conditions, which is what is discussed here. Same on p. 3300 line 9. line 5: Specify what diameters you’re using for “associated with”. End of page: Just because there is a Hoppel minimum there doesn’t mean smaller particles aren’t sometimes activated at higher supersaturations “see earlier discussion. Some comparison with measured updraft velocities would be interesting.

p 3294 line 11: Insert “see also” before Murphy et al., 1998 since the reference does not seem to be the direct source of your prior statement, just additional support for it. line 16: delete “aerosol” (redundant with next line). line 17: change “aerosols” to “aerosol particles”.

p. 3299-3300 discussion of precipitation: It’s not clear if you mean the precipitation sink is through nucleation and coalescence scavenging of particles, or impaction scavenging of aerosol by falling drizzle/raindrops. Also, I can think of other reasons why the SSA number concentration would be reduced offshore. For example, the higher supersaturations in offshore clouds (due to lower CCN concentrations and generally stronger updrafts) would activate smaller SSA, subjecting them to all the in-cloud loss mechanisms discussed above. Also, the larger drops offshore will enhance coalescence and reduce particle number even if drizzle drops evaporate below cloud, rather than precipitating. Perhaps these complexities should be mentioned.

p. 3300, line 6: “imply” should be “implies”. Here and in Fig. 12 the Hoppel minimum for clean air is specified as ~0.05-0.08 but an earlier example (p. 3292) uses 0.075-0.11, which seems much higher “a more representative example should be used to avoid confusion. line 23-24: Suggest changing “depth and width” to “height and width” if that is what you mean. The differences could also be a result of higher supersaturations due to fewer CCN (less competition for vapor) and stronger updrafts farther offshore.

p. 3301 line 10: “averaged” should be “average”. Line 17: Insert “clean” before MBL

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CCN.

Fig 4 caption: "Total number of data" data points specify sample rate.

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