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Atmospheric Chemistry and Physics Discussions

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 #2

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This study reports on aircraft measurements during the VOCALS campaign over the southeastern Pacific Ocean. The title indicates that the manuscript will deal mainly with the influence of particles on the microphysical and radiative properties of clouds. The actual presented analysis does this to some extent, using measurements from a UHSAS and electron microscopy. Measurements collected downstream a CVI are also discussed. One main finding seems to be that there is a gradient in sub-cloud particle concentration and cloud drop concentration from near shore (higher) to off-shore (lower). The dominant particle type near shore is suggested to be neutralized sulfates with the source being from central Chile. Clouds were thinner near the shore, which partly explained their smaller drop sizes near the shore (i.e. emphasizing importance

of meteorology, which is already well known). Their CVI data also is used to suggest that larger drops contain larger seed particles. The paper addresses a topic that is of interest to ACP. This paper follows a series of other VOCALS papers that discuss similar topics, including aerosol composition and cloud properties. The paper is written fairly well and the figures are clear. The measurements and interpretation are of good quality. But I have major concerns with the manuscript. The first is that it lacks a central theme and is not woven together well to reflect the topic the title suggests the paper will be about. The paper lacks unity: some discussion is about the detailed microscopy data, and then it extends way far out to the thinning of clouds near the coast, and then tries to get into using a model to link smelter emissions to particle concentration, and then it goes into intercomparisons between a model and the CVI data. Each of these various topics should be treated separately probably and they are not unified well in this reviewer's opinion. As a result, the manuscript seemed like a collection of disjointed results. Just as an example, it seems that the WRF model is used to look at the impact of smelter emissions on particle concentrations. . .but what does this have to do with clouds, which is what the title and the introduction of the manuscript indicate that paper is about? Of course particles are linked to clouds, but this connection was not very strong in the section about the modeling. The second issue is that some of the results are fairly obvious (example: more pollution near the shore, which means more sub-cloud number concentration and cloud drop number; this is actually stated in different words in the last paragraph of the introduction that cites earlier work) and I cannot find much differentiation from previous VOCALS manuscripts with the exception of the microscopy data which appears to this reviewer to be the new contribution. The authors did not make it clear why this manuscript is unique in the large set of VOCALS papers that are already published. The third issue is that many details are glossed over in the manuscript with regard to the measurements. Overall, after reading the paper I do not believe there is a sufficient amount of scientific contribution that is woven together sufficiently well to warrant publication. The authors should seriously consider what the central point of their work is, why is their work novel and what is the new contribution,

and they should make it absolutely clear how it is different from the rest of the VOCALS papers. Of lesser importance, but still worthy of consideration is that it seems that a great chunk of the referenced work originates from the authors themselves; I highly encourage the authors to branch out and consider references to other work.

Minor Comments: Section 3.1: How is the discussion of this section different from previous VOCALS papers, especially the first paragraph? It seems to repeat what other papers already have shown. Also, 3rd and 4th paragraphs seem like expected results without much in the way of new findings. And the last paragraph of Section 3.1 seems to be heavily based on references to other work. The transition from Section 3.1 and 3.2 can be strengthened greatly. Similarly, the transition from 3.2 and 3.3 is absent. Sea salt is written two ways and should be kept consistent: seasalt and sea-salt Section 3.2.1 is weak on details. For example, what are the sample sizes? Why are only two case flights chosen for Figure 4? This section is too short and does not get into enough detail. This is consistent with other sections that seem to only briefly discuss specific topics without much in-depth analysis. Line 15-18 on page 19725: probably fits better in Methods Section Section 3.2.2: the shift from the VOCALS region to Arizona is quite puzzling, abrupt, and seems out of place. It is not tied in too well right now with the paper and no rationale is provided for why only that site is used for the sake of comparison. Section 3.2.2: What does this section have to do with clouds? This section belongs in a paper more focused on aerosol microphysical properties than a study that claims to be about aerosol-cloud interactions. How do the authors define when the aircraft was in a cloud? This is important to know since the quantification of drop concentration depends on this definition. Title: Ocean should be capitalized Line 25 on pg 19727: period is missing Figure 5 caption: what is the source of the sulfur emissions? Section 3.3.2: What does it mean to say that “Most of the non-drizzling cloud distributions show greater. . .”? Is it possible to be quantitative? Also, this section is not tied in well with the rest of the paper. Line 13 on pg 1938: “complet” is misspelled Section 3.4: This may be the most disjointed of all the sections as it gets far away from the detailed aerosol discussion in the previous sections and gets more in depth into

cloud properties and albedo. As noted above in many areas, the paper does not have a central focus and sections are not tied together well.

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