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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.

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

Summary:

This study represents an excellently compiled, important and insightful addition to the ACP VOCALS Special Issue. This paper offers new insight into observed microphysical and radiative properties of marine Sc in the VOCALS region through an analysis of the measured atmospheric aerosol composition, general airmass analysis and modelling (LES, FLEXPART and WRF-CHEM are employed).

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Firstly, the paper presents aerosol and cloud microphysical data collected by the NSF-C130 aircraft during the VOCALS campaign, building on and adding to the results and interpretations presented by others in the VOCALS special issue. In this analysis, whilst only the data from one of the aircraft is discussed in detail, valuable new analysis is introduced, particularly from electron microscopy of filter samples on the C130 aircraft. This analysis is especially useful in understanding the detailed chemical composition of the MBL (and FT) aerosol in the region, especially the relative abundance (and hence importance) of sea-salt aerosol as CCN and the longitudinal gradients in continental aerosol sources and aerosol transformation (e.g. internal mixtures of sulphate), particularly those from smelter and mining activities in the area.

Secondly, the study provides an excellent and interesting analysis of the CCN properties of the measured aerosol size distributions in the VOCALS region. And finally, the study aims to place the findings in the context of predicted (important) cloud-radiative impacts with comparison to typical satellite remote sensing observations and offers new explanations to one of the key VOCALS hypotheses – that near shore cloud effective radii (and cloud albedo) is likely a function of both continental aerosol sources AND large-scale forcings, rather than either mechanism on its own. The importance of this statement cannot be over-stated as it is pivotal to the hotly debated utility of geo-engineering through cloud-seeding in this area of the world, in that dynamics should not be neglected in favour of “simple” cloud-aerosol interactions or vice versa. Whilst the vast majority of the community do understand this complexity, it is important to reiterate it and this study illustrates it very well. However, given the gravitas of this finding, it is absent from the abstract – can you add a sentence? In summary, this paper is highly relevant to ACP and the VOCALS Special Issue and offers important new science, presented in a highly competent fashion and I would suggest publication after consideration of just a few minor comments below.

General comments:

1/ Sources of error/uncertainty in aerosol and cloud droplet measurements: P. 19725,

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para 3 (line15): It would be good to summarize the bounds of confidence on the various measurements in some way, e.g. what the typical RMS of counting statistics would be over the length of a typical leg (over which measurements have been averaged in this analysis). Or you could cite other work which has summarised the results of inter-comparisons of the droplet probes on different aircraft (e.g. Kleinmann et al or Allen et al.) or more throughly, King et al (submitted to this special issue last month and now in ACPD). Small differences in CDP mode were noted on trailing intercomparisons between the C130 and BAe-146, which may carry some significance/uncertainty for the subsequent radiative and CCN analysis but simply noting what the potential measurement uncertainty may be would be sufficient I think as it is an open question as to which platform/instrument's data are closer to a true ambient spectrum. I very much doubt the small potential systematic error would manifest as a significant impact on any of the fundamental conclusions of this study.

2/ P.19729, line 5: Smelters: It may be worth a note here that the Ilo smelter was also switched off completely for a portion of the VOCALS experiment due to an industrial dispute. This further backs up the claim that the northern smelters would have less influence on the region. Grant Allen, Scott Spak or Rob Wood can comment further on this.

3/ Long-range transport (P.19730 and P.19731). The FLEXPART and WRF-CHEM analysis provides an excellent analysis of local sources, their transport and impacts. However, as noted in the earlier discussion of the paper surrounding remote region aerosol number concentrations, there are sometimes discrete high concentrations, which are thought to be associated with long-range transport of material from Australasia by Allen et al., 2011, as shown by back trajectory analysis in that paper. Obviously, WRF-CHEM and FLEXPART cannot be employed to look at this long-range long-timescale transport but it may be worth noting that not all aerosol sources (especially, and relatively, in the remote region) are local to the study region. Long-range aerosol seen in the first half of the VOCALS flight campaign, looked to have a relatively

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strong organic loading and CO, indicating combustion sources.

Minor (technical) corrections:

Abstract, line 3: Replace comma after “plants” with “and”.

P.S. It is refreshing not to have a long list of typos. Thank you.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 19715, 2012.

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