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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of natural and anthropogenic aerosols on stratocumulus and precipitation in the Southeast Pacific: a regional modelling study using WRF-Chem" *by* Q. Yang et al.

Anonymous Referee #3

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The authors have conducted a suite of month-long WRF–Chem simulations taking place during the VOCALS–Rex field campaign. The methodology is sound, the paper is well written, and the figures are nicely constructed. The results are not validated by observations, but the work has value as a sensitivity study looking at the interactive behavior of aerosol–cloud interactions in a mesoscale modeling framework. The paper notes rather subtle differences in cloud MBL macrophysical properties (zb, D_cld, LWP), with large differences only accompanying huge aerosol perturbations. Stronger effects are noted in radiatively-important quantities (re, COD). The most dramatic effect

on the radiation budget for the realistic cases (i.e., non-ScaledEmis cases) appears to be confined to effects on the SW radiation budget in region P. The 5x emission experiment (ScaledEmis) unsurprisingly exhibits drastic differences.

Comments:

Abstract. Lines 17–21 of the abstract were terribly unclear on my first reading. After having read the paper, I understand it now. However, I would suggest rewording it to make it more understandable to a reader looking at it for the first time.

Page 14625, lines 25–9. Lines 6–9 correctly describe some effects of giant sea salt, but the previous part of the paragraph applies only to large sea salt aerosol. Sea salt particles in the submicron size range, however, act quite similarly to sulfate aerosols, so it is not completely proper to say "The effect of anthropogenic aerosols is counteracted by that of large sea-salt particles." See Kogan et al. (JAS, 2012) for how different size ranges of sea-salt particles influence MBL clouds.

Also, "The effect of anthropogenic aerosols is counteracted by that of large sea-salt particles" is not completely consistent with framing the problem in the context of anthropogenic AIEs. The sea-salt component represents part of the background base state, which is perturbed by anthropogenic aerosols.

Page 14629, line 6. The purpose of the phrase "full online interactions" is to describe the fully interactive nature of the processes represented in WRF–Chem, but the "full online" part sounds bit strange to my ear.

Page 14635, line 4. The authors should note at this point (as they do later in the manuscript) that this quantity is a "susceptibility" in principle similar to precipitation susceptibility the discuss later in the manuscript.

Page 14637, lines 18–30. Two mechanisms may explain the increase of entrainment with increasing droplet concentrations.: 1. The potential buoyancy argument of Stevens et al. (1998), which focuses on drizzle-induced asymmetry in the boundary-layer circu-

lation; and 2. The cloud droplet sedimentation formulated by Bretherton et al. (2007). I would argue that mechanism #2 is more subtle than #1 (i.e., it took many years of people running LES to identify mechanism #2), but in any case it is not exactly clear which mechanism is operating here. The authors should address both or provide evidence that the cloud sedimentation mechanism is the only one operating.

Page 14643, line 10. Does the "wet scavenging" in WRF–Chem represent the effects of coalescence processing (i.e., droplet coalescence and evaporation or fallout ultimately reducing the CCN field), or does it represent something else? Ideally, this quantity should be proportional to R*N_d (see Wood, JGR, 2006).

Page 14662, Fig. 1. Please exponentiate the color table label: "1.E-2" looks bad.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 14623, 2012.