

Interactive comment on “Assessing regional scale predictions of aerosols, marine stratocumulus, and their interactions during VOCALS-REx using WRF-Chem” by Q. Yang et al.

Anonymous Referee #2

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This manuscript presents regional scale modeling results from WRF-CHEM simulations that include prognostic aerosols and a representation of aerosol-cloud interactions in the South-East Pacific region. The region contains one of the Earth's largest and therefore climatically important marine stratocumulus decks. The role that continental and marine aerosols play in modulating the stratocumulus cloud in this region are however poorly understood. The authors utilize in-situ and remote sensing observations from the vast data-set collected during VOCALS-REx to evaluate the model performance. The paper is interesting and certainly addresses scientific questions that are relevant to the journal. I would therefore recommend publication in ACP once the authors have addressed the following comments.

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1. The main strength and novel scientific work described in this paper is that it is the first regional/global modeling study from VOCALS-REx that I am aware of in which the model includes a detailed representation of aerosols and their interactions with marine stratocumulus. It is therefore ideally placed to try and address some of the key VOCALS scientific hypotheses that relate to aerosol-cloud-drizzle interactions (Wood et al., 2011). The authors go some way in achieving this by showing that including aerosols leads to significant changes in the modeled marine stratocumulus e.g. cloud top effective radius, LWP, albedo, drizzle etc. However all of the results presented are averages over the VOCALS-REx time period and I feel that the authors could significantly improve the manuscript with a description of daily/synoptic scale variability. For example while the simulations capture a monthly mean gradient in aerosol, it strikes me that you could just use a climatology of aerosol or cloud droplet number concentration in a model and get the same result. In my mind WRF-CHEM is a model that should be looking to capture some of the interesting events seen in VOCALS-REx such as discrete aerosol plumes being advected away from the coast as was observed in satellite imagery and in-situ observations. After all, including prognostic aerosols in a regional/global model is computationally expensive and the benefit of doing so (instead of using a climatology) needs to be highlighted.

2. The non-aerosol simulations used a fixed cloud droplet number concentration of 250 cm⁻³ which doesn't seem to be the most suitable choice for marine aerosol conditions. Could the authors provide some justification for this choice? I imagine that if a more representative value of the off-shore conditions (~ 100 cm⁻³, fig 3) was used then the non-aerosol simulation would look very different.

3. The authors need to justify why no convection scheme was used. The model horizontal resolution (9 km) is certainly not high enough to explicitly resolve convection.

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