Atmos. Chem. Phys. Discuss., 11, C11772–C11775, 2011
www.atmos-chem-phys-discuss.net/11/C11772/2011/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Limited-area modelling of stratocumulus over South-Eastern Pacific" *by* M. Andrejczuk et al.

Anonymous Referee #2

Received and published: 11 November 2011

Review of ms. "Limited-area modelling of the stratocumulus over the SE Pacific" by Andrejczuk et al.

This paper describe the ability of WRF to simulate the lower-troposphere over the South-Eastern Pacific, with emphasis in the cloud topped MBL that develops below a strong, well defined temperature inversion. The paper takes advantage of the observations gathered in VOCALS-REx, although only data from one flight was used. Not surprisingly (see comments below), the authors found that the model greatly underestimate the MBL depth, affecting the amount and structure of the clouds embedded on it. Nevertheless, the authors use the model outputs to diagnose the occurrence of localizes cloud clearing in an otherwise cloudy environment, reaching some conclusions on the potential role of drizzle-induced subsidence and entrainment in depleting

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the cloud liquid water.

Overall, I found the present work only marginally increases our understanding of the SE Pacific regional climate, and the manuscript could be accepted for publication in ACP only after major changes (including extra simulations are done). My major points are the following:

1. The finding that WRF underestimate the MBL depth (by a factor of 2) over the SE Pacific is not new at all, but little referenced in this manuscript. At the end of this review I provided a list of works –many of the in ACP VOCALS special issue- noting this problem, not only in WRF but in many other regional models. The authors spend significant text and 6 figures showing this problem (probably figs. 3 and 6 will make the job). . .reducing the length of this section (4.1) is needed. On the other hand, the authors doesn't comment that the model bias tend to reduce offshore.

2. The authors then try different model configurations (changes in vertical levels, grid spacing and many different physical parameterizations) without getting any significant improvement. Next, the authors present a conjecture: a problem with the initialization based on GFS. I agree that GFS represents the MBL rather poorly and this is a good point but I'd like to see something more concrete. Is here where I strongly suggest further modeling work: use a longer simulation, with an initialization several days before of your target time so the WRF can depart from the GFS initial condition. Alternative, the authors could modify the initial conditions so as to better represent the lower troposphere. . .I understand that this could be difficult but definitely worth trying.

3. Section 4.2 is devoted to the simulated formation of mesoscale cloud-free regions. I was a bit reluctant to read this part after all the negative issues on the model performance noted by the same authors (section 4.1 and first paragraph of 4.2). In any case, the model does produce cloud-free regions and the authors present some interesting diagnostic of this. The main problem in this section is the quality of the figures. The authors can do a lot improving them to guide the reader in their reasoning. For

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instance, given the key role of the vertical velocity, they could shade the periods with upward/downward motion in Fig. 11. In line 13 of page 25531 they said “the disappearance seems to result from strong (up to 4 cm s-1, not shown) subsidence in the model column”. . .what do you mean with not shown. . .isnt’t that presented in Fig. 11? Likewise, the aspect ratio of Fig. 9 and the colored vectors in Fig. 12 make them difficult to interpret.

In sum, reducing the length of section 4.1, adding more references on the biases found in regional models, adding a sensitivity experiment with variable initialization time, and improving the figures in section 4.2, could move this manuscript to the standard expected for ACP papers.

(Incomplete) List of papers addressing the performance of mesoscale models over the SE Pacific.

The PreVOCA experiment: modeling the lower troposphere in the Southeast Pacific, Atmos. Chem. Phys. Discuss., 9, 23909-23953, 2009

Marine boundary layer over the subtropical southeast Pacific during VOCALS-REx – Part 1: Mean structure and diurnal cycle, Atmos. Chem. Phys. Discuss., 9, 26029-26062, 2009

Precipitation and cloud cellular structures in marine stratocumulus over the southeast pacific: model simulations, Atmos. Chem. Phys. Discuss., 10, 8341-8378, 2010

Evaluation of stratocumulus cloud prediction in the Met Office forecast model during VOCALS-REx, Atmos. Chem. Phys. Discuss., 10, 16797-16835, 2010

A regional real-time forecast of marine boundary layers during VOCALS-Rex, Atmos. Chem. Phys. Discuss., 10, 18467-18505, 2010

Assessing regional scale predictions of aerosols, marine stratocumulus, and their interactions during VOCALS-REx using WRF-Chem, Atmos. Chem. Phys. Discuss., 11, 22663-22718, 2011

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The diurnal cycle of circulation and cloudiness over the subtropical southeast Pacific: A modeling study. J. of Climate, 17, 1699-1710

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 25517, 2011.

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