Atmos. Chem. Phys. Discuss., 10, C7767–C7769, 2010
www.atmos-chem-phys-discuss.net/10/C7767/2010/

Atmospheric Chemistry and Physics Discussions

ACPD

10, C7767–C7769, 2010

Interactive Comment

Interactive comment on "Simulation of low clouds in the Southeast Pacific by the NCEP GFS: sensitivity to vertical mixing" *by* R. Sun et al.

Y. Wang (Referee)

yuqing@hawaii.edu

Received and published: 21 September 2010

Recommendation: Accept after a minor revision.

General evaluation: The authors have described the implementation and performance of two modifications intended to alleviate the systematic bias in simulating stratocumulus clouds over the subtropical southeastern Pacific. The two modifications are (1) the elimination of background vertical diffusion above the inversion and (2) the incorporation of a stability parameter based on the cloud-top entrainment instability (CTEI) criterion. The latter limits the strength of shallow convective mixing across the inversion. Their results show that the individual modifications make relatively very marginal

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

improvement in the simulation of stratocumulus clouds. However, the combination of the two modifications substantially improves the skill of the model in simulating the stratocumulus cloud deck over the Southeast Pacific. They argued that the nonlinearity arises as the effects of both modifications reinforce each other to trap moisture below the inversion. In addition, the cloud-top radiative cooling is suggested to play a role in enhancing turbulent mixing in the planetary boundary layer and help maintain the stratocumulus cloud cover. The paper is well-organized and well-written. The paper however can be further improved if some points below are taken into account.

Specific Comments:

1. The authors compared the one-month simulation with the climatological monthly mean satellite observations. Since satellite data are currently available from MODIS for cloud fraction and liquid water path, I am curious why the authors have not used the observations during the same time period in their comparison, for example, those in Figs. 2, 4, and 17. The vertical cross section of cloud properties may also be found somewhere. The authors can refer to Wyant et al. (2010) for more relevant datasets for comparison. 2. The stratocumulus deck core over the Southeast Pacific is around 10-15oS. Could the authors show some vertical-longitude cross-sections at 10oS, as shown in some previous studied, such as in McCaa and Bretherton (2004) and Wang et al. (2004a and b, 2005)? At this latitude, the cloud deck is generally more stable and persistent than that at 20oS, where synoptic disturbances force much larger variability of stratocumulus clouds. 3. When the authors discussed the mechanism for the cloud-top radiative cooling, they attributed the enhanced cloud fraction to a positive feedback, which is a local process. In Wang et al. (2005), they elaborated a positive feedback between the stratocumulus clouds and cloud-top radiative cooling through large-scale circulation feedback. Could the authors mention that possibility or examine the processes in their model results? 4. The authors also mentioned the possible effect of cumulus parameterization (RAS) in their model simulation. For example, in the second paragraph on page 18480, they wrote “RAS helps to produce clouds through

ACPD

10, C7767–C7769, 2010

Interactive Comment

the detrainment of cloud water at the cloud top". I am not quite sure how active of deep convection in the studied region. Have the authors looked at the details in this regard? This needs to be examined if this is the case.

References McCaa, J. R., and C. S. Bretherton, 2004: A new parameterization for shallow cumulus convection and its application to marine subtropical cloud-topped boundary layer. Part II: Regional simulation of marine boundary layer clouds. Mon. Wea. Rev., 132, 883–896. Wang, Y., S.-P. Xie, H. Xu, and B. Wang, 2004a: Regional model simulations of boundary layer clouds over the southeast Pacific off South America. Part I: Control experiment. Mon.Wea. Rev., 132, 275–296. Wang, Y. H. Xu, and S.-P. Xie, 2004b: Regional model simulations of boundary layer clouds over the southeast Pacific off South America. Part II: Sensitivity experiments. Mon. Wea. Rev., 132, 2650–2668. Wang, Y., S.-P. Xie, B. Wang, and H. Xu, 2005: Large-scale atmospheric forcing by Southeast Pacific boundary-layer clouds: A regional model study. J. Climate, 18, 934-951.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 18467, 2010.