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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evaluating WRF-Chem aerosol indirect effects in Southeast Pacific marine stratocumulus during VOCALS-REx" *by* P. E. Saide et al.

Anonymous Referee #2

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Summary: Authors used a regional model with comprehensive aerosol and cloud microphysics parameterizations to simulate aerosol-cloud interaction in marine stratocumulus clouds during VOCALS-REx. The focus is on the evaluation of simulated aerosol indirect effects using observations taken during the field campaign. They have found that the irreversible wet deposition parameterization in WRF-Chem is particularly questionable as it severely degraded the model performance in terms of the aerosol-cloud structure and marine boundary layer dynamics. I believe that evaluation and validation of the current regional models with state-of-the-art aerosol-cloud representation like what is done in this study is particularly needed to advance the understanding of the aerosol-cloud-climate interaction. This manuscript should be published. I have

following relatively minor comments.

Page 29729, line 21-23. " . . .. and Goddard short wave radiation were chosen to support aerosol direct, indirect and semi-direct climate interactions." It appears that the model configuration includes all these aerosol-cloud interactions (direct, indirect and semi-direct). Can you tell differences among these interactions? For example, when the aerosol loading increases in the NW simulation, the shortwave radiation should be changed too due to this increase. Do changes in the shortwave radiation (such as more absorption warming due to more aerosol particles outside of CCN-cloud interaction — semi direct?) play a role in the simulated cloud change? Are these changes in the same direction or different with the indirect effects? Note that your title is about "WRF-Chem aerosol indirect effects".

Page 29729, line 29. "No cumulus scheme was used, since tests showed that the addition of parameterized cumulus led to overestimated cloud liquid water path at this resolution. . .." Does this mean that no shallow cumulus parameterization was included? If answer is yes, could you provide observational evidence or physical argument that shallow cumulus clouds play insignificant roles during VOCALS-REx? Or the present shallow cumulus parameterization in WRF-Chem cannot realistically simulate shallow cumulus clouds during VOCALS-REx?

Page 29732, line 7-9. ". . ., we performed simulations where wet deposition was excluded. . . This represents a reasonable option since low rain rates were observed at the sea surface." Why do you say it is reasonable? Do you have any quantitative estimate on how the wet deposition rate correlates with the surface rain rate? Under what conditions can you reasonably assume that the wet deposition should be close zero?

Page 29740, line 1-6. "The higher accumulation mode aerosol load . . .. . This causes entrainment to increase and cloud heights to rise." Could you explain more clearly why the entrainment increases resulting from the MBL energy budget change due to

the change in the aerosol loading? This is an important part of aerosol-cloud indirect effects. Does direct or semi-direct effect play any roles in the MBL dynamics?

Page 29744, line 27-Page 29745, line 1. "... as a near-shore DMS emissions hot spot is found in this zone due to wind shear by the subtropical low-level jet..." I am not sure where this hot spot is located. Is it at 20ïĆř S nearshore? The low-level jet appeared to be generally located between 40ïĆř S and 25ïĆř S during VOCALS-REx, although the wind shear across the inversion was indeed usually intense due to northerly flow just above inversion nearshore.

Page 29748, line 21-22. "This study demonstrates the capabilities of the WRF-Chem model to simulate aerosol/cloud interaction." Note that the complete WRF-Chem configuration (the W run) poorly simulates stratocumulus clouds during VOCALS-REx. While the NW run compares significantly better with the observations, its configuration lacks the important process: aerosol wet deposition. This means that this version of WRF-Chem fails to realistically represent this important aerosol-cloud interaction process.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 29723, 2011.