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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Some issues in uncertainty quantification and parameter tuning: a case study of convective parameterization scheme in the WRF regional climate model" *by* B. Yang et al.

Anonymous Referee #1

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This study examines the sensitivity of model simulation of precipitation to five tuning parameters in the KF convective parameterization in an effort to quantify the uncertainty of the model to convective parameterization. The authors use the WRF model simulation of precipitation during a convectively active period in the US Southern Great Plans. The parameters they chose to examine are CAPE relaxation timescale, updraft mass flux entrainment rate, downdraft intensity, downdraft starting height and maximum TKE in subcloud layer. A statistical analysis method was used to quantify the model performance in terms of average bias and pattern correlation coefficient and to identify an optimal parameter set for the model. The authors found that the model simulated precipitation is sensitive to CAPE relaxation timescale, entrainment rate and downdraft intensity, but less so to maximum TKE and downdraft starting level. They further investigate the issue of transferability of the identified parameter set to higher model resolution and other precipitation regimes, and found that with the optimal parameter set, both simulations at higher resolution in the SGP region and in the North American Monsoon region are improved relative to the model default setup.

This is a very useful paper for uncertainty quantification of a widely used regional atmospheric model. It demonstrates that with proper choices of model parameters, the performance of the model can be significantly improved, and such improvement is transferable to other model resolutions and climate regimes. The manuscript is well written and is publishable with minor revision.

Specific comments:

1. Sec. 3.3. The authors suggest that optimization in precipitation simulation also improves the simulation of other model fields such as 2-m mean temperature and 10-m wind speed. From Fig. 11, it is difficult to gauge how significant these improvements are in terms of physical quantities. Additional information, e.g. geographic maps similar to Fig. 5 (or observations, plus difference from observations) for temperature and wind speed would be helpful. Also, a concise comparison, such as a Taylor diagram, comparing model simulations (using both default and optimized parameter sets) with observations would be more indicative of the improvement of model performance.

2. The results presented are for two-month averages. Diurnal cycle of precipitation is very difficult to simulate in this region. How well is it simulated in the WRF model, and is it improved using the optimal set of the parameters identified? In particular, increased entrainment in updrafts can act to delay the initiation of deep convection, thereby preventing convection from occurring too early in the model. Is this seen in the WRF simulation?

3. p. 31783, lines 17-18. How is kernel density estimation performed? A brief description would be helpful to readers.

4. p. 31785, last para: discussions on Fig. 8. An important effect of increased downdraft is enhanced cooling and drying of the boundary layer, where cold and dry air from downdrafts is dumped. I suggest the authors to include 2-m temperature and PBL moisture in Fig. 8 and include some discussions of this effect. The sensible heat flux variation is probably partly due to this enhanced cooling of PBL air: colder 2-m temperature leads to more sensible heat flux from the surface. Also, the authors interpret the increase of lower troposphere (800-900 hPa) air humidity with increasing downdrafts as a result of increased rain evaporation (supposedly within downdrafts). I suspect the reduced adiabatic drying in the convection environment is probably more important. As downdraft mass flux increases, the net upward mass flux inside convection (up minus down) is reduced, therefore requiring less compensating subsidence in the convection environment. This subsequently leads to less subsidence-induced adiabatic drying. The authors could easily check on this by comparing the relative importance of the moisture source and sink terms.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 31769, 2011.

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Interactive Comment