Simulating US Summer Rainfall in NU-WRF: Sensitivity to cumulus parameterizations

Background:

The discrepancy and spread across simulations with different cumulus parameterizations are recognized as major factors contributing to uncertainty in regional seasonal/climate simulations. It is important to evaluate sensitivities due to the selection of specific parameterizations via comparisons with observed characteristics at various time and spatial scales.

Significance:

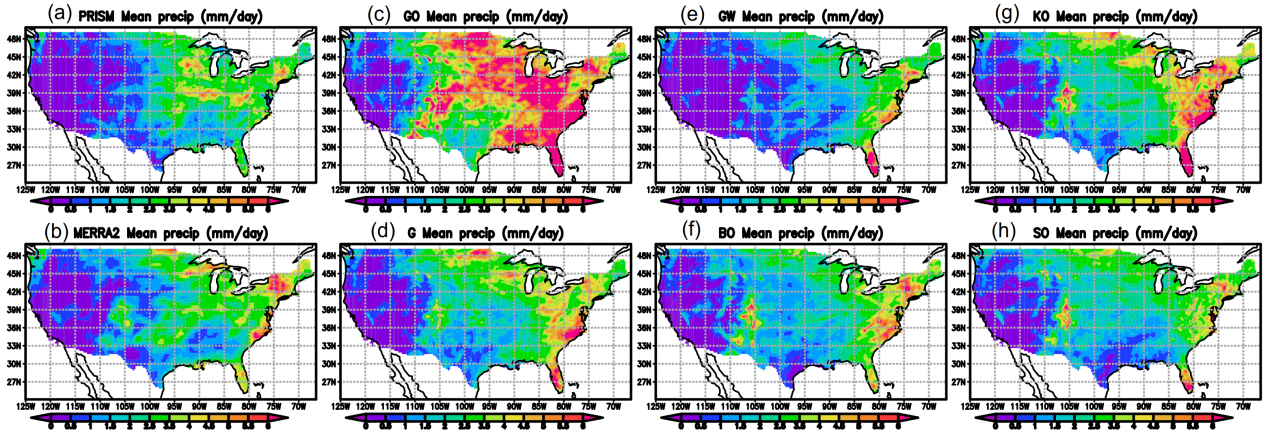
Optimally-weighted ensembles were analyzed to investigate what types of error are reduced by a mixture of multiple simulations with different cumulus parameterization schemes.

Analysis:

Daily rainfall fields for June, July, and August of 2000 simulated at 24-km resolution over the continental US using NU-WRF with four cumulus parameterization schemes and two options for shallow cumulus components in a specific scheme were analyzed.

Findings:

Adopting a single simulation result was preferable to generating a better result for the seasonally averaged daily rainfall simulation, whereas an ensemble of multiple simulation results was more effective in reducing errors in the case of also considering day-to-day temporal variation.



Horizontal distribution of daily rainfall rates (mm day-1) averaged for June, July, and August 2000: (a) PRISM observational data, (b) MERRA2 reanalysis data, and NU-WRF simulations with the (c) Grell-3D scheme with the native shallow cumulus components (GO), (d) Grell-3D scheme without native shallow cumulus components (G), (e) Grell-3D scheme with the University of Washington shallow cumulus parameterization scheme (GW), (f) Betts-Miller-Janjic scheme (BO), (g) new Kain-Fritsch scheme (KO), and (h) new simplified Arakawa-Schubert scheme (SO).

Iguchi, T., W.-K. Tao, D. Wu, C. Peters-Lidard, J. A. Santanello, E Kemp, Y. Tian, J. Case, W. Wang, R. Ferraro, D. Waliser, J. Kim, H. Lee, B. Guan, B. Tian, and P. Loikith. 2017: Sensitivity of CONUS summer rainfall to the selection of cumulus parameterization scheme in NU-WRF seasonal simulations. *J. Hydrometeor.* 18, 1689–1706, doi: 10.1175/JHM-D-16-0120.1.