Precipitation in SCMs: Precipitation is one of the most poorly parameterized physical processes in GCMs. One of the difficulties with modeling precipitation stems from the fact that in addition to large-scale circulation, precipitation is affected by a variety of complex processes that needs to be parameterized in large-scale models. The single-column model (SCM) is a useful and effective tool to study the parameterization schemes in GCMs. The SCM approach is also a key strategy of the US DOE's ARM and ASR programs. However, most of the SCM inter-comparison studies organized by ARM have been focused on special cases, or week-to-month-long periods. To make a statistically meaningful comparison and evaluation on modeled precipitation, three-year-long SCM simulations of seven GCMs participating in the FASTER project at the ARM SGP site have been carried out by DOE scientists at the Brookhaven National Laboratory. The results show that that although most SCMs can reproduce the observed precipitation reasonably well, there are significant differences in their details, including differences between daytime and nighttime, between warm and cold seasons, between frequency and mean precipitation intensity, and between convective and stratiform partition. Further analysis reveals distinct meteorological backgrounds for model precipitation underestimation and overestimation events. The different SCM performances and associations with large-scale forcing and thermodynamic factors shed useful insights on convection parameterizations and future development as well.

Reference: Song, H., W. Lin, Y. Lin, A. B. Wolf, R. Neggers, L. J. Donner, A. D. Del Genio, and Y. Liu (2013), Evaluation of precipitation simulated by seven SCMs against the ARM observation at the SGP site, *J. Climate*, doi:10.1175/JCLI-D-12-00263.1, in press.

Contact: Dorothy Koch, SC23.1, 301-903-0105.

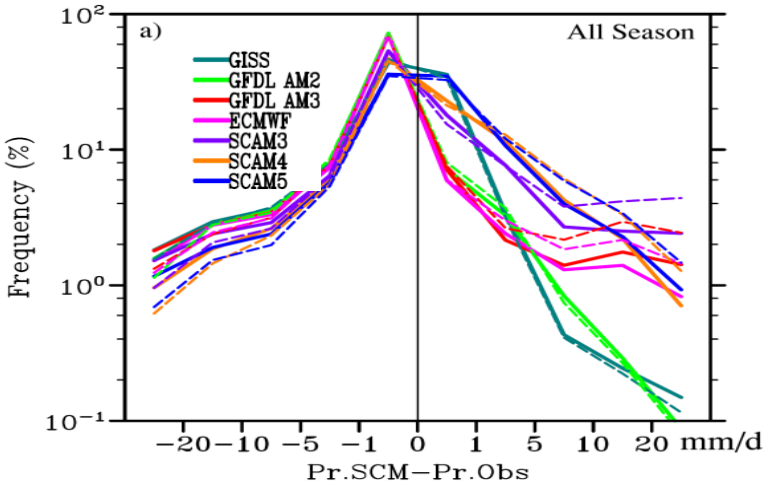
Long-Term Evaluation of Precipitation Simulated by Seven SCMs against ARM Observations at SGP Site

Motivation and Approach

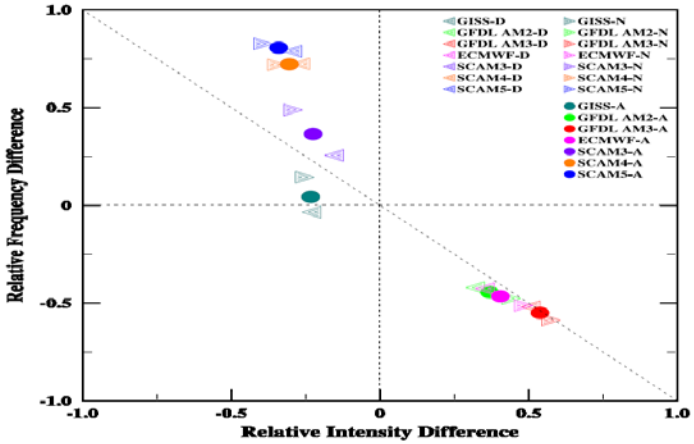
- Long-term measurements with good statistics are a key to evaluating precipitation-related parameterizations. This study, for the first time, uses 3 year (1999-2001) simulations of seven SCMs driven ARM-produced large scale forcings are evaluated against the precipitation measurements at SGP. The long-term data also allows us to investigate the large-scale backgrounds against which the model biases occur through the studies of extreme events.

Results

- Although SCMs can produce the observed precipitation reasonably well, they differ tremendously in details.
- Most SCMs have a precipitation peak in weak vertical motion regimes in day-time, different from the observation.
- Model underestimation events occur in strong ascending regimes with negative low-level horizontal heat and moisture advection.
- Model overestimation events occur in weak or moderate ascending regimes with positive low-level horizontal heat and moisture advection.
- Even for those where all the SCMs suffer from small precipitation bias, different models achieve the good simulations differently, i.e., presence of compensating errors between precipitation occurrence frequency and intensity.



Frequency distribution of model precipitation biases for all-time (solid) and day time (dash).



Relative difference in precipitation intensity vs that in precipitation frequency for the cases with small model bias (<5 mm/day). Diagonal line marks complete error compensation between intensity and frequency.

Song, H., W. Lin, Y. Lin, A. B. Wolf, R. Neggers, L. J. Donner, A. D. Del Genio, and Y. Liu (2013), Evaluation of precipitation simulated by seven SCMs against the ARM observation at the SGP site, *J. Climate*, doi:10.1175/JCLI-D-12-00263.1, in press.