

Evaluating the Asian Summer Monsoon System in the Super-Parameterized CCSM

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Abstract

Climate simulations using a multi-scale modeling framework (MMF), in which traditionally parameterized effects of cumulus convection are explicitly simulated with multiple realizations of a cloud resolving model, may offer new insights into the role of convection on large-scale climate variability. Analysis of MMF simulations of the Community Climate System Model (CCSM, v3.0) indicates that the "super-parameterized" CCSM, or SpCCSM, dramatically improves variability of precipitation across a broad range of temporal scales (from intra-seasonal to intra-annual) at a variety of locations compared to the traditional CCSM.

In this study, we focus on the improvements in the simulation of the Asian monsoon system in the SpCCSM compared to the traditional CCSM. In addition to a more realistic regional precipitation climatology and annual cycle, super-parameterization improves monsoonal rainfall intermittency, eastward and northward propagation characteristics, spatial scale (i.e., the meridional structure of the disturbance), and produces more realistic interactions between SST and precipitation anomalies.

Improvements in the SP-CCSM SST-precipitation relationship compared to CCSM and uncoupled SP-CCSM (SP-CAM) suggest that the details of convective representation and its interaction with the sea surface may be responsible for the improved simulation. We explore this interaction via the mean annual cycle and intraseasonal composites of precipitation and the surface energy budget. The goal of this analysis is to identify physical processes that lead to improvements in monsoon simulation, and to evaluate if these same processes are of similar importance in nature.