West African Extreme Daily Precipitation in Observations and Stretched-Grid Simulations by CAM-EULAG

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Extreme precipitation and its possible alteration by climate change can have substantial societal impact. We evaluate the ability of our global, stretched-grid model CAM-EULAG (CEU) to simulate extreme precipitation and its physical causes. CEU combines the EULAG dynamics core with the physics package of the NCAR Community Atmospheric Model (CAM). CEU can use grid stretching to focus high resolution in selected regions. Here we analyze observed and simulated extreme daily precipitation and its underlying processes in observations and in a ten-year CEU stretched-grid simulation, where the stretching gives 0.5˚ x 0.5˚ resolution over West Africa. The simulation used observed sea-surface temperatures and ocean ice for the period 1996-2007. We discarded the first two years for model spin up, giving ten years for analysis.

We focus on a core monsoonal region in West Africa: (6-16N, 5W-5E). In both the onset (April-May-June; AMJ) and mature-monsoon (July-August-September; JAS) seasons, the model reproduces well the observed climatological annual and diurnal cycles of precipitation in this region, though with somewhat greater than observed time-average precipitation. Daily precipitation extremes at the 95% level and higher are stronger in the observations, but the spatial scale of extreme events in the model is comparable to the observed scale. The model also simulates fairly well the interannual and intra-seaonal variability of the extreme events. The diurnal cycle of precipitation on extreme-event days in the observations for both AMJ and JAS typically shows maximum precipitation in the early morning hours, in contrast to the late afternoon maximum in the overall ten-year climatology. The model has difficulty replicating this diurnal behavior, though comparison of wind, temperature and humidity fields on simulated extreme-event days with corresponding ERA-Interim reanalysis fields on observed extreme-event days indicates that the model is producing precipitation extremes with roughly the same physical behavior as the real world.