Session: C27 Poster: W106A

Dynamic downscaling of CFS winter seasonal simulations over the United States using the ETA/SSIB-3 model

Fernando De Sales[†]; Yongkang Xue
[†] University of California, Los Angeles, USA
Leading author: fsales@ucla.edu

The NCEP ETA/SSIB-3 regional circulation model (RCM) was 1-way nested in the NCEP Climate Forecast System (CFS) for a series of 22-year downscaling simulations of the winter season (December through April) over North America from 1982 through 2003. Each year' simulation has 10 ensemble members producing a total of 220 winter hindcasts. These simulations are part of the Multi-RCM Ensemble Downscaling (MRED) project, which aims to explore the utility and added value of dynamic downscaling in operational seasonal to interannual climate prediction. The Eta/SSIB-3 shows good downscaling ability for seasonal mean precipitation. The model reproduced well the winter precipitation pattern over the country, especially the high precipitation regions; over the East, the Northwest, and central California, with a large drier region in between. The RCM, however, did not simulate the precipitation maximum over the Southeast, which was well captured by the global model. The 22-year mean winter precipitation bias averaged over the whole country for the CFS is 1.52 mm day-1, while for the ETA/SSIB-3 model it is -0.1 mm day-1. Similar comparison yielded a 66.7% reduction in RMSE of precipitation with downscaling. The analysis of average precipitation time series indicates that overall the RCM improved the simulation by reducing excessive rainfall produced by the GCM, especially over the western states. RCM reduced the countrywide CFS' RMSE of the time series from 1.62 to 0.32 mm day-1. The error reduction was larger over the western states (nearly 83%) than over the eastern states (approximately 67%). However, the temporal correlation with observation shows little difference between GCM and RCM, indicating the dominant role of lateral boundary forcing from CFS in producing the temporal variability. Analysis of precipitation intensity spectrum revealed that downscaling not only improved the simulation of average precipitation but also of the distribution from weaker to stronger precipitation events. The simulation of seasonal snow water equivalent was also improved by the regional model. Comparison between models simulations and the Rutgers University observational data shows that the RCM produced better snow simulation especially over the Northwest and along the Sierra Nevada mountains. On average, the RCM reduced the RMSE of snow water equivalent simulation by approximately 8% over the U.S. The differences in simulated precipitation are partially caused by the difference in simulated surface energy budgets. The RCM significantly reduces the amount of latent heat flux from the surface to the lower troposphere, in particular in the coastal area. It also produces more sensible heat flux at surface than the global model, especially over the northwestern, eastern and southern parts of the U.S.