

Simulation of the Asian summer monsoons of 1987 and 1988 with a regional model nested in a global GCM

Ji YM, Vernekar AD

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Abstract:

State-of-the-art general circulation models have deficiencies in simulating the observed amplitude and phase of the mean patterns of circulation and precipitation over the Asian monsoon region. They are also deficient in simulating the observed seasonal variations of circulation and precipitation averaged over the monsoon region. To improve these simulations, the National Centers for Environmental prediction regional Eta Model is nested in the Center for Ocean-Land-Atmosphere Studies (COLA) GCM. The Eta Model is a gridpoint model with a horizontal resolution of 80 km and 38 layers in the vertical. The Eta Model domain (30 degrees-140 degrees E, 30 degrees S-50 degrees N) covers the Asian monsoon region, which includes the Indian, Chinese, and Southeast Asian monsoons. The COLA GCM is a sigma coordinate spectral model with rhomboidal truncation at 40 waves and 18 vertical Levels.

The Eta Model is nested in the GCM such that its lateral boundary conditions and initial conditions are derived from the GCM simulations. The nested model is used to simulate the summer monsoons of 1987, an El Niño year, and 1988, a La Niña year, prescribing the seasonally varying sea surface temperature of the respective years. The model was integrated from mid-April to the end of September. Three separate runs were made for each year with atmospheric initial conditions for 14, 15, and 16 April, respectively.

The ensemble means of the three simulations for 1988 were calculated for the GCM and the Eta Model. Comparison of the results with observations shows that the amplitude and phase of the mean monsoon circulation and precipitation patterns, as well as the seasonal variations of areally averaged circulation parameters and precipitation, simulated by the Eta Model are closer to observations than the GCM simulations. The Eta Model simulation for 1987 showed deficient summer rainfall in northern and peninsular India and the Indonesian region, and enhanced rainfall in southeast China, Burma, and the sub-Himalayan region compared to the 1988 simulations. These results are in agreement with observations. The phase and amplitude of the variability in the 2 yr simulated by the Eta Model were closer to observations than the GCM simulations over both India and southeast China. Variability in the simulations due to changes in the initial conditions was smaller in the Eta Model than in the GCM.