The 20th Century East Asian Summer Monsoon Simulated by Coupled Climate Models of IPCC AR4

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East Asian monsoon climate exhibits variability on many time scales. While the interannual variations of the monsoon are well documented, the East Asian monsoon also shows large interdecadal variations during the last 50 years or so, and this longer-term variability is poorly understood. Here we analyze the outputs of the 20th century climate simulations (20C3M) by 23 coupled climate models involved in IPCC AR4 to evaluate the performance of the latest generation of climate models in simulating the present climate over East Asia, and to address the question of whether the prescribed external forcing agents have played key roles in producing the interdecadal variability of the East Asian summer monsoon (EASM). The results show that only models employing a high resolution AGCM component have reasonable performances in producing the main monsoon circulations such as the East Asian westerly jet, the western Pacific subtropical high and the low level monsoon circulations. The decadal variations of the EASM in ten models have significant correlations with observations during 1880-1999. For the recent half century (1950-1999), the EASM indices of nine models are significantly correlated with the observations at time scales longer than 10 years. These nine models include the CCSM3, CGCM3.1(T47), GFDL-CM2.0, GFDL-CM2.1, GISS-AOM, GISS-ER, INM-CM3.0, IPSL-CM4, UKMO-HadGEM1. Starting from late 1970s, the EASM has experienced a strong weakening trend in observations, which resulted in less rainfall along the mid-lower Yellow River valley and excessive rainfall along the Yangtze River valley. This anomalous rainfall pattern is usually referred to as the "Southern Flooding and Northern Drought" (SFND). Our analyses show that only a small number of models, namely the GFDL-CM2.1, IPSL-CM4, and HadCM3, have successfully produced this weakening trend of the EASM. Furthermore, the weakening trend of the EASM in GFDL-CM2.1 is shown to be a forced-signal rather than model internal variability. Future work needs to separate the natural and anthropogenic forcing agents in climate model simulations and address the relative contributions of natural and anthropogenic forcings to the recent weakening of the EASM.