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Comparing CAM5 and Superparameterized CAM5 Simulations of Summer Precipitation Characteristics over Continental East Asia: Mean State, Frequency–Intensity Relationship, Diurnal Cycle, and Influencing Factors

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Numerical experiments are conducted to investigate the differences between summer precipitation over continental East Asia simulated by the Community Atmosphere Model, version 5 (CAM5), and superparameterized CAM5 (SPCAM5, a multiscale modeling framework). The results show that SPCAM5 effectively alleviates several original biases. Overestimates of precipitation on the eastern periphery of the Tibetan Plateau are reduced from CAM5 to SPCAM5 as a result of decreases in both the average hourly precipitation frequency and mean hourly intensity. Underestimates along the coastal regions in southern China are improved following a corresponding increase in mean hourly intensity and a decrease in average hourly precipitation frequency. The frequency–intesnsity relationship is also more realistic in SPCAM5. For western China, overestimated frequency values (in CAM5) of both weak-to-moderate (0–20 mm day^{-1}) and heavy (20–50 mm day^{-1}) intensity ranges are reduced in SPCAM5. For southern China, overestimates of frequency values (in CAM5) in the weak-to-moderate range are also reduced, whereas underestimates in the intense ranges are enhanced. In terms of diurnal variability, SPCAM5 generally exhibits a delay in the afternoon peak time and greater diurnal amplitude. The possible physical reasons for the variations in the precipitation between the models are further investigated. It is found that the change in deep convection intensity is a primary factor governing the shift in the precipitation simulations. SPCAM5 better simulates an intermediate transition stage from shallow to deep convection, which helps the deep convection to grow more fully to a greater magnitude, thus delaying the peak time and increasing the precipitation maxima.