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Evaluation of the Water Vapor Transport over the Yellow River Basin in CMIP5 Models

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Temperature, precipitation and water vapor transport in China, particularly in the Yellow River Basin simulated by the 16 models participating in phase 5 of the Coupled Model Inter-comparison Project (CMIP5) were evaluated for the period 1979-2005. Results suggest that most CMIP5 models are able to capture the climatological distribution patterns and inter-annual variations of surface air temperature, but with cold bias. Most models reproduce the spatial distribution pattern of warming trends identical with observations. Models tend to overestimate precipitation with relative biases ranging from 4.59 % to 61.46 %. Compared with observations, most models simulate more precipitation over the east of Tibetan Plateau and less in southeastern coastal regions. The spatial distribution of precipitation trends displayed in the observations cannot be well simulated by most models. The underestimation of temperature and the overestimation of precipitation simulated by some models over the east of Tibetan Plateau may be related to the anomalously strong western Pacific subtropical high and sufficient water vapor transport from Indian Ocean and western Pacific Ocean. In terms of the Yellow River Basin, modeled water vapor mainly flows in from eastern boundary and out from the western boundary. Water vapor also flows in through the southern boundary, but with smaller intensity. Owing to the overestimation of water vapor convergence, some models tend to exaggerate the climatological precipitation. Additionally, we found that the summer water vapor budget and precipitation keep pace with each other, which is well reflected by the FIO-ESM model. Models can also reproduce this relation in the lower reaches, with the total water vapor budget correlated strongly with water vapor transport from eastern, western and southern boundaries, indicating that water vapor budget and even the precipitation are strongly influenced by the water vapor transport from Indian Ocean and western Pacific Ocean. This situation is almost similar to the middle reaches, though the total water vapor budget is only related to water vapor transport from eastern and western boundaries, which mainly come from Indian Ocean. Nonetheless, in the upper reaches of the Yellow River Basin most models substantially underestimate the great contribution of water vapor transport from eastern and western boundaries, but overestimate the one from southern boundary, indicating that most models strongly overestimate the water vapor transport from the western Pacific Ocean which needs further improvement.