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Development of a Coupled Atmospheric and Hydrological Modelling System and Applications to the Huaihe Basin, China

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By integration of a hydrological model and the WRF (Weather Research and Forecast) model, we have established a fully coupled atmospheric and hydrological modelling system (AHMS). The integration of the atmospheric and hydrological model components is achieved via the Noah land surface scheme (NoahMP-LSM). Two modifications are made to the NoahMP-LSM: (1) the infiltration scheme is modified to account for topographic influences; and (2) the Darcy-flux boundary condition is applied to allow for interactions between the unsaturated and saturated zones. The AHMS enables the simulation of the hydrological processes in the atmosphere, land surface and subsurface as well as the feedbacks between them. AHMS can be used for investigation of long-term hydrological response to climate change on catchment scales as well as short-term forecast of hydrological events such as flood.

In this paper, we first present the results of a 25-year (1979-2003) offline model simulation of the hydrological response of the Huaihe Basin (2.7×10^5 km^2), China, to climate change. To examine its performance for modelling of catchment-scale hydrological events, the AHMS is applied to the Huaihe Basin with a spatial resolution of 20 km for the period of July to November, 1991. During this period, the basin experienced a flood in July and a drought in September/October. The model is applied both in one-way and two-way coupled mode. The capacity of the AHMS for short-term hydrological forecast will be analysis on hand of the various simulations.