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Implementation of a Coupled Atmospheric-Hydrological Modeling System for Real-Time Flood Forecasts Over the Huaihe River Basin, China

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Severe floods caused by heavy precipitation have posed a serious problem for all seven major river basins in China in the past and continue to do so. The Huaihe River Basin (270, 000 km2) is located between the Yellow and Yangtze Rivers, and has been suffering from flood disaster for centuries because of its geographical location and unique topographical feature. An accurate and timely flood warning system can help to minimize flood damages. We have developed and implemented a coupled atmospheric-hydrological modeling system over the Huaihe River Basin for predicting severe precipitation and real time flood forecast. The system consists of a high-resolution regional atmospheric model MC2 (Canadian Mesoscale Compressible Community) that is one-way coupled to two hydrological models (Chinese Xinanjiang hydrological model and Canadian Land Surface Scheme) for runoff generation; the Clark unit hydrograph and the Muskingum-Cunge channel routing method are used for flow routing to obtain hydrographs at selected basin control points. The system has been implemented over the basin and tested using hydro-meteorological data from 1998 and 2003 flooding seasons. A good result was obtained in the hydrological simulations as revealed by the Nash-Sutcliffe coefficients for both flooding seasons of 1998 and 2003. The system was then run in a real time flood forecast mode for the 2005 flooding season (May 1 to October 31). We updated both precipitation and flood forecasts at 8:00 GMT every 24 hrs. We first used the latest rain-gauge precipitation to correct errors of MC2 precipitation in the past 24 hrs; we then used rain-gauge precipitation and MC2 forecast to drive the hydrological model with a lead time up to 96 hrs. The forecasts were sent to the Chinese authority through Internet for consideration in the process of decision making should emergency situations emerge. We successfully forecasted the July 4 to 15 severe flood event with flood lead time up to 72 hrs. The forecast flood peak value and timing errors were less than 14% and 5 hrs. The encouraging result obtained in this study demonstrates the potential of using mesoscale model precipitation for real time flood forecast, which provides a longer flood lead time compared to many traditional methods.