

Abstract: Coupling XXT Hydrological Model with GRAPES for Flood Prediction Based on TIGGE Data

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Abstract: As an important operational numerical weather prediction system in CMA (China Meteorological Administration), GRAPES is short of functions for Global/Regional Assimilation and Prediction Systems, and further development of the system is still undergoing. Up to now, however, the operational GRAPES in CMA is not yet able to predict runoff and hence flood event. XXT, a recently developed hydrological model based on the soil moisture storage capacity distribution curve (SMSCC), the highlight of the Xinanjiang model, integrated with the simple concept and structure of TOPMODEL, has been integrated into NOAH LSM of GRAPES. In XXT model, the water-table is incorporated into SMSCC and it connects the surface runoff with base flow through a parameterization scheme modified from SIMGM proposed by Niu et al. (2005), which favors the model not only able to describe dynamically varying saturated contributing areas, but also capable of physically depicting underground water level of watershed.

This study aimed to fully couple the XXT hydrological scheme with the land surface model presented by NOAH LSM integrated in GRAPES for improving the representation of the hydrological process of GRAPES for flood event predictions. Three global ensemble weather prediction systems, namely babj (CMA), ecmf (ECMWF) and kwbc (NCEP), through the ``THORPEX Interactive Grand Global Ensemble`` (TIGGE) archive were used in this study to drive the coupled GRAPES/XXT model, for a case study of a flood event in July 2007 in the Linyi watershed located on the upstream of the Yishusi Catchment, Shandong province, China. Results suggested that the coupled GRAPES/XXT evidently improves the performance of the NOAH LSM in GRAPES in simulation of both latent heat flux and sensible heat flux; but rainfall forecasts with GRAPES/XXT by driving data of TIGGE from the three forecast centres all underestimated high rainfalls, among which the forecast by TIGGE data from NCEP forecast centre was closest to observations, followed by ECMWF and the CMA performed the worst.

Moreover, the Grand-Ensemble was found not performed better than each single Ensemble Prediction Systems (EPS) for rainfall forecasts. In contrast to rainfall forecasts, runoff forecasts performed much better with the TIGGE driving data from all three forecast centre, especially for the data from NCEP, which suggested that flood warning by GRAPES/XXT using TIGGE as driving data is feasible and provides a new approach to raise preparedness of hydrological disaster and thus to reduce the socio-economic impact of floods.

Keywords: TIGGE; GRAPES; XXT; Flood warning; Rainfall; Runoff

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