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Utility of remotely-sensed precipitation products for hydrological simulations at basin scale

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In this study, we investigated the utility of remotely-sensed precipitation products (Climate Prediction Center’s MORPHing technique (CMORPH), Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks - Cloud Classification System (PERSIANN-CCS), and Next Generation Weather Radar (NEXRAD) stage III) for hydrological simulations at basin scale during non-winter seasons in the Little Washita (583 km2) watershed, Oklahoma, USA. The distributed hydrological model, GEOtop (Rigon et al. 2006) was used to simulate the streamflows. We simulated the streamflows for the years 2003 and 2007, for which we have complete measurements, including remotely-sensed precipitation, raingage, and streamflow data. The temporal resolution of all precipitation products that are used for forcing the GEOtop model is 1 hour. The spatial resolution of CMORPH is 8km, while the spatial resolutions of PERSIANN-CCS and NEXRAD are 4km. For the year 2003, the raingage data and the other atmospheric forcing data were collected from 44 meteorological stations, while for the year 2007, the raingage data and the other atmospheric forcing data were collected from 17 meteorological stations. The atmospheric forcing data are also given to the GEOtop model at an hourly time step.

GEOtop model simulations were carried out as follows. First, the GEOtop model was calibrated and validated for the energy fluxes (sensible heat, latent heat, ground heat, and net radiation), soil temperature and moisture profiles, and streamflows, using SGP97 and SGP99 datasets (Bushara et al. 2010, EGU). Using this calibrated model, simulated streamflows were obtained using CMORPH, PERSIANN-CCS, and NEXRAD precipitation data and compared to the measured streamflows and to the simulated streamflows obtained using raingage measurements. Simulated streamflows from a further CMORPH precipitation product, bias-adjusted by us based on the raingage measurements, were also tested.

Results show that overall the remotely-sensed precipitation products all produce comparable streamflows, and the streamflows they produce are very similar to the streamflows produced using the raingage data and to the measured streamflows. However, during one period (Mar-Jun, 2003) CMORPH overestimates streamflows compared to the streamflows produced by the other precipitation products and the measured streamflows. Thus it is concluded that all the above mentioned remotely-sensed precipitation products have value for streamflow simulations at the watershed scale.