Evaluation of remote-sensing-based rainfall products through predictive capability in hydrological runoff modelling

The emergence of regional and global satellite-based rainfall products with high spatial and temporal resolution has opened up new large-scale hydrological applications in data-sparse or ungauged catchments. Particularly, distributed hydrological models can benefit from the good spatial coverage and distributed nature of satellite-based rainfall estimates (SRFE). In this study, five SRFEs with temporal resolution of 24 h and spatial resolution between 8 and 27 km have been evaluated through their predictive capability in a distributed hydrological model of the Senegal River basin in West Africa. The main advantage of this evaluation methodology is the integration of the rainfall model input in time and space when evaluated at the sub-catchment scale. An initial data analysis revealed significant biases in the SRFE products and large variations in rainfall amounts between SRFEs, although the spatial patterns were similar. The results showed that the Climate Prediction Center/Famine Early Warning System (CPC-FEWS) and cold cloud duration (CCD) products, which are partly based on rain gauge data and produced specifically for the African continent, performed better in the modelling context than the global SRFEs, Climate Prediction Center MORPHing technique (CMORPH), Tropical Rainfall Measuring Mission (TRMM) and Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (PERSIANN). The best performing SRFE, CPC-FEWS, produced good results with values of R(NS)(2) between 0.84 and 0.87 after bias correction and model recalibration. This was comparable to model simulations based on traditional rain gauge data. The study highlights the need for input specific calibration of hydrological models, since major differences were observed in model performances even when all SRFEs were scaled to the same mean rainfall amounts. This is mainly attributed to differences in temporal dynamics between products. Copyright (c) 2009 John Wiley & Sons, Ltd.