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Effects of basin scale on the hydrological predictability potential of satellite based rainfall products

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The increasing availability of global satellite-based rainfall products represents an important step towards the goal of hydrological Prediction in Ungauged Basin (PUB). Combined with a parsimonious, spatially distributed hydrological model and land surface remote sensing data, it can potentially predict extreme flood events for any region in the world. However, to achieve this goal a better understanding of its predictive potentials for different scales and under different hydrological conditions is required. In this study we investigate the effects of data resolution and uncertainty in the prediction of peak flow by comparing hydrological simulations forced by different rainfall products. The case study is the Cedar River basin during the Iowa 2008 extreme flood event. Radar derived rainfall fields are used as benchmark and treated as error-free. These 1 km resolution/15 minute fields are aggregated to generate rainfall maps with lower spatial and temporal resolution (Including the expected resolution of Satellite products). The link-based hydrologic model CUENCAS was used, allowing the investigation of these effects across a large range of spatial scales. Our results indicate that the effect of rainfall resolution on peak flow prediction is scale dependent. Also, there is a range of scales for which satellite-borne rainfall estimation, at the resolution currently available, can be applied for hydrological prediction. The effects of spatial and temporal resolution degradation are different depending on the basin scale. A coarse temporal resolution (daily, for example) strongly weakens predictions for small basins but may provide accurate results for larger ones (∼20,000 km2). On the other hand, a coarse spatial resolution does not strongly affect small basins, but does, however, produce biased results for larger scales. This confirms the importance of precisely estimating total precipitation volume for flood prediction on large basins. Different satellite-based rainfall products were also used as input to the hydrological model, and compared to the radar products aggregated to the same spatial and temporal scale. The results demonstrate that the presence of errors other than those related to the data resolution produce larger biases on the estimation of peak flows across scales. This study demonstrates a methodology to evaluate remote sensing rainfall products and their actual potential for use in hydrology and the limits of predictability associated to the nature of the temporal and spatial scale.