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Calibration of HEC-Ras hydrodynamic model using gauged discharge data and flood inundation maps

Rui Tong and Jürgen Komma

Institute of Hydraulic Engineering and Water Resources Management, Vienna University of Technology, Austria (tong@hydro.tuwien.ac.at)

The estimation of flood is essential for disaster alleviation. Hydrodynamic models are implemented to predict the occurrence and variance of flood in different scales. In practice, the calibration of hydrodynamic models aims to search the best possible parameters for the representation the natural flow resistance. Recent years have seen the calibration of hydrodynamic models being more actual and faster following the advance of earth observation products and computer based optimization techniques.
In this study, the Hydrologic Engineering River Analysis System (HEC-Ras) model was set up with high-resolution digital elevation model from Laser scanner for the river Inn in Tyrol, Austria. 10 largest flood events from 19 hourly discharge gauges and flood inundation maps were selected to calibrate the HEC-Ras model. Manning roughness values and lateral inflow factors as parameters were automatically optimized with the Shuffled complex with Principal component analysis (SP-UCI) algorithm developed from the Shuffled Complex Evolution (SCE-UA). Different objective functions (Nash–Sutcliffe model efficiency coefficient, the timing of peak, peak value and Root-mean-square deviation) were used in single or multiple way. It was found that the lateral inflow factor was the most sensitive parameter. SP-UCI algorithm could avoid the local optimal and achieve efficient and effective parameters in the calibration of HEC-Ras model using flood extension images. As results showed, calibration by means of gauged discharge data and flood inundation maps, together with objective function of Nash–Sutcliffe model efficiency coefficient, was very robust to obtain more reliable flood simulation, and also to catch up with the peak value and the timing of peak.