Abstract of dissertation

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Rainfall-runoff models play an important role in flood-forecasting, planning and water resources managements. But users may face technical problems in implementing hydrological modeling simulation. Because the simulation is and always was a highly specialist application area, with a high degree of difficulty. Besides simulation beginners often spend a great amount of time to accumulate the knowledge as well as the experience to overcome the technical complexity of simulation, and even for the experienced user, developing, executing, and analyzing a simulation model can be a very time-consuming and error-prone process. An ideal way to handle such kind of situation is creating transparent and platform independent model with suitable parameter estimation methods which could be accessible through Internet. That solution will be a real breakthrough in modelling of hydrological models. So, this study presents the development of open-access user-friendly web-based XinAnJiang (XAJ) model with calibration supporting functions.

Another major difficulty associated with the use of XAJ model is their calibration since it involves 15 parameters and there is interaction among them. Then it becomes a challenging task and this study takes part in modifying the model structure and reducing parameters, which will not only become easy to handle calibration process but also provide accurate results.

In the XAJ model, runoff concentration to the outlet of a basin is represented by three linear reservoirs: surface flow, interflow and baseflow. In contrast, proposed model combines them into two linear systems: one for surface flow, and another one for subsurface flow including interflow and baseflow. The response functions of the two linear systems are derived by using MISO system, and then runoff at basin outlet is calculated using these response functions. Analysis results of the interaction of response function to different parameters point out that proposed model has an ability to adjust impact of parameters automatically and make the best response function for calculating runoff at basin outlet. To demonstrate the performance of this model, it is applied to six river basins of different aridity indices in United States and compared with other XAJ model (hereinafter referred to as mXAJ model) in which channel routing component of XAJ model is modified and used it in pure lumped way for the single basin simulation. The results reveal that proposed rainfall-runoff model has better and more stable performance with high daily Nash-Sutcliffe efficiencies (NSE) and can also represent the relationship between rainfall and runoff of relatively large basins well.

This study also investigates the data adjustment and runoff concentration parameters estimation methods for XAJ model. Based on the analysis results from actual practice at previously mentioned study basins, it is found that optimized parameter values using proposed estimation methods are applicable as calibration support functions for users who will do XAJ model calibration.