



Combining remote sensing, soft data and parameter transfer to enhance flood predictions in the Swat and Lower Kabul Rivers of Pakistan

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The Swat and Lower Kabul Rivers in Pakistan (23567 km²) recently experienced devastating floods due to monsoonal deluges in 2010. Development of flood forecasting models is challenging as these river basins are sparsely gauged; runoff data is only available for a small part of the basin, as well as precipitation and temperature data which are available at a limited number of sites. In this study we present a calibration method for a hydrological model (the distributed wflow model) using soft data, remote sensing and transfer of parameter values from gauged to ungauged sites to improve understanding of hydrological behaviour of the area and thereby allow better prediction of floods for the Swat and Lower Kabul Rivers. Data sources include MODIS remotely sensed snow cover areas to better constrain the snowmelt and accumulation dynamics. Parameter values obtained at the gauged locations based on topographic and climatic similarities are transferred to the areas with no runoff data. The model is further constrained by incorporating local expert knowledge on land-use and the occurrence of flash-floods. The Budyko framework is used as a reference to constrain long term average runoff. The model was validated using data from news articles and Youtube videos from the 2010 flooding. Overall the use of parameter transfer, remotely sensed data and various sources of soft data improved the model's capability to predict floods in these poorly gauged rivers of Pakistan.