Preliminary flood inundation estimates using CREST hydrological model: Case study of Mangla subwatershed of Indus River System Simulation using GIS and RS Technologies

Muhammad Umar Khan Khattak[1]; Yang Hong[2,3] and Sadiq I. Khan[2,3]
[1]*Institute of GIS, NUST, Islamabad*
[2]*School of Civil Engineering and Environmental Sciences, University of Oklahoma, Norman, OK 73019, USA*
[3]*Hydrometeorology & Remote Sensing (HYDROS) laboratory, National Weather Center, Advanced Radar Research Center, Suite 4638, University of Oklahoma, Norman, OK 73072, USA*
ukhattak@igis.nust.edu.pk

Abstract

Flood of 2010 in the Indus Basin has devastated the already weak agrarian economy and caused enormous damage to life and property in arid to semi-arid Pakistan. There is a dire need for research in the water sector and in flood early warning system. In the absence of a widespread on-ground coordinated precipitation and water discharge monitoring system, water resource management and risk management systems, typically multidisciplinary tasks, geographic information sciences (GIS) and satellite remote sensing (RS) technologies can play a key role in providing innovative information to decision makers through research. GIS and RS technologies offer state of the art innovative insight not only into urgently needed sustainable water resource management and into near-real time flood disaster risk assessment, forecasting, management, and damage reduction strategies.

This paper attempts to use NASA's Tropical Rain Measuring Mission (TRMM) daily rain estimates, and global evapotranpiration estimates as major forcing in calibrating CREST hydrologic model with the in-situ daily river discharge data from Mangla subwatershed. The Nash-Sutcliffe Coefficient of Efficiency (NSCE) of 0.49 was achieved with a correlation coefficient of 0.70 and a bias of 1.17%. Improvement in the prediction of available water resource as a result of monsoonal precipitation and water discharge from the Mangla and other major subwatersheds of the Indus River System is on-going. The results indicate that the CREST model behaves well with the TRMM rain estimates in simulating surface runoff in general, but ignores the snow melt contribution to the discharge. Improvement in the NSCE through tweaking various empirically adjusted parameters will help in the prediction of flood hazards, riverine as well as flash flood hazards – possibly in the form of establishment of a pre-disaster information system and a coordination strategy to cope up with expensive natural disasters, and a shift in preparedness strategy from post-disaster rescue and relief to pre-disaster early warning and early action.