Evaluation of the performance of the United States Geological Survey (USGS) Stream Flow Model on the Shabelle River Basin in Somalia

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Abstract:

Somalia, located in the Hom of Africa, is a country constantly at risk of floods. Annual rainfall varies from less than 100 mm up to approximately 600 mm. There are two rainy seasons, which are controlled by the movement of the Inter-Tropical Convergence Zone (ITCZ) over the country. The Juba and the Shabelle, both of which originate in the eastern Ethiopian highlands, are the only perennial rivers. This study was carried out with the aim of testing the applicability of the United States Geological Survey Stream Flow Model (USGS-SFM) on the Shabelle Basin in Southern Somalia. The model was applied to the 90,000km2 Shabelle basin in Southern Somalia. Rainfall was converted to runoff, and routed down the basin using the local terrain slope to link cells along the line of the steepest descent to create a one-dimensional flow network. The simulated stream flow was then compared to the observed discharge to calibrate the model for the period of 1981 to 1986, while the validation period data ranged from 1986 to 1989. All the model parameters went through a parameter sensitivity analysis; this was specifically to determine the most sensitive model parameters. The results at the downstream gauging station of Afgoi represented the rainfallrunoff to an acceptable range both visually and statistically. A correlation coefficient of $r = 0.74$ was obtained between the observed and simulated flow during the calibration process and $r = 0.83$ during the validation process. The relationship between observed and simulated stream flow at the timing of the peak flows (gu and deyr rainy seasons) was good. The sensitivity analysis indicated that the Soil Water Holding Capacity (WHC), Soil Depth, Runoff Curve Number and Manning's Coefficient were the most sensitive parameters. The results showed that the model is applicable on the Shabelle Basin and therefore would be an important tool in early flood warning system of the catchment thus reducing the losses that are always experienced during flood events.