Geophysical Research Abstracts
Vol. 17, EGU2015-2947-1, 2015
EGU General Assembly 2015

Peak discharges in steep mountain catchments in relation to rainfall variability, vegetation cover and geomorphology of the Rift Valley Escarpment of Northern Ethiopia

Tesfaalem Gebreyohannes (1,2), Amaury Frankl (1), Mitiku Haile (3), Amanuel Abraha (3), Elise Monsieurs (4), and Jan Nyssen (1)

(1) Department of Geography, Ghent University, Gent, Belgium, (2) Department of Geography and Environmental Studies, Mekelle University, Mekelle, Ethiopia, (3) Department of Land Resources Management and Environmental Protection, Mekelle University, Mekelle, Ethiopia, (4) Royal Museum for Central Africa, Tervuren, Belgium

The hydrological characteristics of steep mountain streams are often considered to be mainly influenced by rainfall distribution and topography. In this study, with the objective of analyzing the runoff response of mountain catchments, a total of 340 peak stage discharges were recorded in three rainy seasons (2012-2014) in 11 sloping (27-65%) mountain catchments (0.4 - 25 km^2) of the marginal western Rift Valley escarpment of Northern Ethiopia. Daily rainfall data were collected using 7 rain gauges installed at different altitudes (1623 - 2851 m a.s.l) in and nearby the catchments, and used to calculate weighted average daily rain depths over the catchments. Event peak discharges were calculated from daily measurements by 11 crest stage gauges using the Manning's equation. Percentages of land use and cover classes were detected from high resolution (0.6 m) Google Earth imagery (February 1, 2014). Morphometric characteristics of the catchments were computed from ASTER digital elevation model and topographic maps. Correlation analysis between daily rainfall and peak discharge showed direct relationship (R^2 = 0.5-0.94, P<0.01) in all the catchments. The average specific peak discharge was negatively related to percentage of forest and grass cover (R^2 = 0.64, P<0.01), time of concentration (R^2 = 0.31, P<0.01), drainage texture (R^2 = 0.42, P<0.01), and catchment perimeter (R^2 = 0.36, P<0.01). The specific peak discharge was positively correlated with average slope gradient of the catchments (R^2 = 0.34, P<0.01) and with an index representing the spatial distribution of forest and grass cover (R^2 = 0.43, P<0.01). A stepwise multiple regression analyses showed that 84% (P<0.01) of the variability of the runoff response in the catchments can be predicted by the percentage of forest and grass cover and the relief ratio of the catchments. All in all, this study demonstrates that the magnitude of flash floods in mountain catchments is not only influenced by the morphometric characteristics of the catchments and by rainfall, but more importantly even by vegetation cover (forest and grasses).