A Hydrological and Geomorphometric Approach to Understanding the Generation of Wadi Flash Floods

Mohammed Abdel-Fattah, Mohamed Saber, Sameh A Kantoush, Mohamed F Khalil, Tetsuya Sumi, Ahmed M Sefelnasr

Abstract:

The generation and processes of wadi flash floods are very complex and are not well understood. In this paper, we investigate the relationship between variations in geomorphometric and rainfall characteristics and the responses of wadi flash floods. An integrated approach was developed based on geomorphometric analysis and hydrological modeling. The Wadi Qena, which is located in the Eastern Desert of Egypt, was selected to validate the developed approach and was divided into 14 sub-basins with areas ranging from 315 to 1488 km². The distributed Hydrological River Basin Environment Assessment Model (Hydro-BEAM) was used to obtain a good representation of the spatial variability of the rainfall and geomorphology in the basin. Thirty-eight geomorphometric parameters representing the topographic, scale, shape and drainage characteristics of the basins were considered and extracted using geographic information system (GIS) techniques. A series of flash flood events from 1994, 2010, 2013, and 2014, in addition to synthetic virtual storms with different durations and intensities, were selected for the application of this study. The results exhibit strong correlations between scale and topographic parameters and the hydrological indices of the wadi flash floods, while the shape and drainage network metrics have smaller impacts. The total rainfall amount and duration significantly impact the relationship between the hydrologic response of the wadi and its geomorphometry. For most of the parameters, we found that the impact of the wadi geomorphometry on the hydrologic response increases with increasing rainfall intensity.

Keywords:

wadi; arid catchment; flash flood; hydrologic response; quantitative geomorphology; hydrological modeling

Published In:

Water, 9, 553-580