Geophysical Research Abstracts
Vol. 21, EGU2019-10970, 2019
EGU General Assembly 2019

On the predictability of flash floods and their impacts in Northern Malawi

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Flash floods frequently occur in Northern Malawi and have considerable impact on the local population, especially along the flat Lake Malawi shore where most communities are located. Predicting flash floods at the emergency response scale is critical to reducing these impacts. Unfortunately, forecasting such events is complex due to their small temporal and spatial scale, with that complexity exacerbated by the limited hydro-meteorological observational network typical to a developing country such as Malawi. Defining triggers for early action requires a good understanding of the hydro-meteorological conditions that lead to flash floods, as well as sufficiently granular historical impact and vulnerability data, which is not easy to obtain in a data poor context.

This study aims to improve the understanding of the occurrence of flash floods in Karonga, the main district in Northern Malawi, in order to pave the way for impact-based forecasting by humanitarian organisations. Our approach consists of six guided focus group discussions, two semi-structured interviews and several informal interviews, field observations and desk research of openly available data. We consolidate the primary and secondary data into a library of historical flood events in the administrative units within the district, and use GIS-based, satellite and large scale modelled data to analyse the factors that may increase the probability of occurrence of flash floods, such as geomorphologic, hydrologic and meteorological.

The triggering and temporal variation of flash floods depend on the rainfall intensity over the upstream catchment, while the spatial variation of flash flood and their impacts is attributed to the geomorphology, shaped by the Malawi rift (steep escarpments and a flat with a densely populated rift valley floor that forms the lake shoreline). We observe an increase of the impact (people affected, structural and livelihood damage) over the past 20 years. This increase may well be attributed to upstream deforestation and farming on river banks, leading to reduced conveyance capacity of the river courses as they cross the flat plain to the Lake. Our analysis of the spatial and temporal pattern of flash floods in Karonga reveal quite distinct behaviour in terms of scale and impacts of floods at the beginning and at the end of the wet season. We finally find that indigenous knowledge, especially on meteorological conditions (changes in clouds, wind direction, rainfall pattern and temperature), but also knowledge of the rivers (changes in water colour due to debris and sedimentation, speed and volume) and animal behaviour provide key links to the investigation of the larger scale meteorological factors that can lead to flash floods occurring.

We conclude that the susceptibility to flash floods can be characterized by the catchment geomorphology, and initial hydrological and meteorological conditions derived from larger scale global models. Future research will assess how a forecast for an extreme rainfall event can be combined with the susceptibility index, to provide early warning guidance on the potential impacts of flash floods to local communities and to inform early action by the humanitarian community.