

# Project Title: Floods in drylands: converting flood hazard into drought mitigation in East Africa

**Lead Institution/Department:** University of Bristol School of Geographical Sciences

**Primary Supervisor:** Professor Katerina Michaelides

**Co-Supervisor:** Dr Joseph Daron (Met Office), Dr Paolo Paron (FAO-SWALIM), Dr Guy Schumann (RSS-Hydro)

## Summary

Drylands are not typically associated with flooding, yet these regions are prone to both sudden flash floods and river floods which can have devastating impacts. This project focuses on the Horn of Africa drylands, a major hotspot of climate change. Recently, the region experienced unprecedented five consecutive failed rainy seasons (severe drought) which were both preceded and followed by, extreme rains that generated extensive floods. Both the drought and floods lead to loss of life and livelihoods. This “whiplash effect” thrashes communities between devastating hydroclimatic extremes and the compounding hazards pose immense challenges to climate adaptation for rural communities. There are numerous challenges with forecasting floods in drylands: 1) many of the rivers are ephemeral and prone to sudden flash flooding; 2) the location of flooding is highly dependent on the spatio-temporal patterns of rainstorms; 3) typical flood hazard models do not account for the dominant processes and timescales of flood generation in arid regions and the associated flood inundation impacts on floodplain communities. However, while floods pose a great hazard to communities, they also replenish groundwater and offer possibilities to alleviate water scarcity under climate change.

The PhD project aims to create a modelling framework for dryland flood forecasting in Somalia and to explore how floods can be used in water management to mitigate droughts.

## Methods

The project will develop a modelling framework for flood modelling and flood forecasting in dryland rivers across different ephemeralities (from ephemeral to perennial) that overcome the humid-bias of current flood modelling approaches. We will use a combination of modelling work that captures the hydro-climatic processes that lead to flooding in dryland rivers of Somalia: the conversion of storm precipitation into runoff and streamflow, the overbank flows that result in inundation over critical areas that pose risk to lives and livelihoods, and the potential for subsurface water storage in the alluvial aquifer. The modelling framework will be a unique combination of the dryland-specific water balance model, DRYP (Quichimbo et al. 2021; 2023), and the flood inundation model, LISFLOOD-FP, which would provide a system for evaluating the potential risks of flash floods and impacts to the water balance under historical climatic conditions, but it would also be applicable for forecasting seasonal rainfall and its potential impacts, as well as analysis of probabilities of future hazards/risks based on climate projections for the region. We will also consider coupling DRYP with models like HEC-RAS for creating and evaluating flood management approaches that could be used in drought mitigation.

## Background reading and references

1. Quichimbo, E.A., Singer, M.B., **Michaelides, K.**, Hobbey, D.E.J., Rosolem, R. and Cuthbert, M.O. (2021) DRYP 1.0: a parsimonious hydrological model of DRYland Partitioning of the water balance, *Geoscientific Model Development*, <https://doi.org/10.5194/gmd-14-6893-2021>
2. Quichimbo, E.A., Singer, M.B., **Michaelides, K.**, MacLeod, D.A., Asfaw, D.T., Rosolem, R. and Cuthbert, M.O. (2023) Assessing the sensitivity of modelled water partitioning to global precipitation datasets in a data-scarce dryland region. *Hydrological Processes*, <https://doi.org/10.1002/hyp.15047>
3. MacLeod, D.A., Quichimbo, E.A., **Michaelides, K.**, Asfaw, D.T., Rosolem, R., Cuthbert, M.O., Otenyo, E., Segele, Z., Rigby, J.M., Otieno, G., Hassaballah, K., Tadege, A., Singer, M.B. (2023) Translating seasonal climate forecasts into water balance forecasts for decision making. *PLOS Climate*, <https://doi.org/10.1371/journal.pclm.0000138>

**How to Apply:** The deadline for this position is 8th April 2024. The studentship will begin in September 2024. Please apply to the “PhD in Geographical Sciences (Physical Geography)” at <https://www.bristol.ac.uk/study/postgraduate/apply/>