Hydrological research for AMMA-2050

Ponnambalam Rameshwaran, Vicky Bell, Helen Davies, Helen Houghton-Carr, Alison Kay, James Miller and Nathan Rickards
Centre for Ecology and Hydrology (CEH), Wallingford, UK.
Maimouna Bologo-Traore, Abdoulaye Diarra, Coulibaly Gnenakantanhan, Fowe Tazen and Karim Traore
2iE, Ouagadougou, Burkina Faso.
Contact: ponr@ceh.ac.uk

1. How will climate change affect flooding across West Africa?

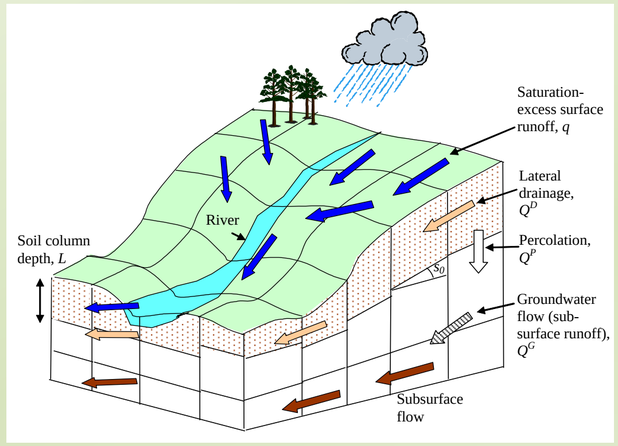
Aims:

We will carry out simulations of flood risk under a range of climate scenarios using present-day and future climate data from CORDEX and CMIP5 models as input to a gridded hydrological model – the Hydrological Modelling Framework (**HMF**).

Hydrological Modelling:

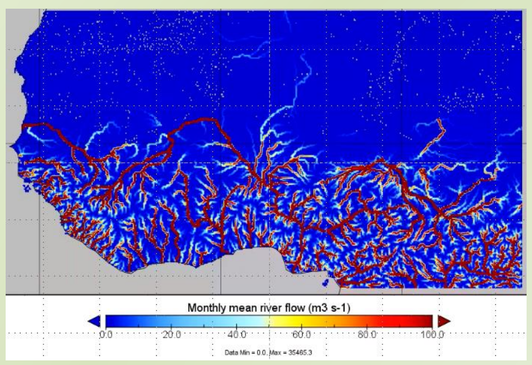
The **HMF** model is a grid-based, spatially distributed hydrological model similar to the **G2G** (Bell *et al.* 2009). It uses:

- Surface and sub-surface runoff-production.
- Kinematic-Wave routing of flows along river channels.



Output:

Changes in daily/monthly peak river flows and soil-moisture at a 10km resolution over West Africa between now and the future.



Typical model output: Monthly mean flow over West Africa.

Impact:

The model will quantify changes in the frequency, severity, timing and scale of extreme events across West Africa. This will highlight vulnerable areas and provide valuable information for planners of development and infrastructure.

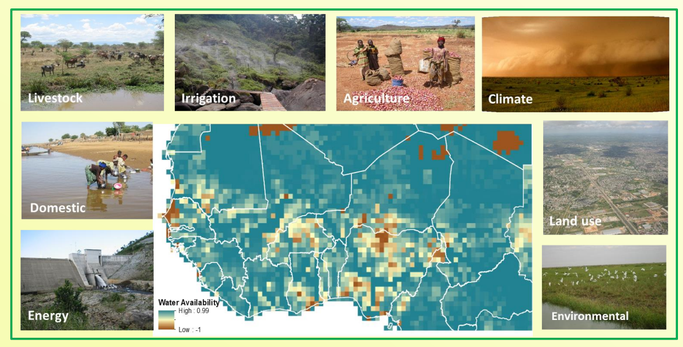
2. How will climate and socio-economic changes affect water resources across West Africa?

Aims:

The potential impact of future climate and social changes on the various economic sectors, communities and environment of West Africa is unclear. Consistent assessments of these impacts will help identify options for adaptation and sustainability at the national and regional scales.

Water Resource Modelling:

The **GWAVA** water resources model (Meigh *et al.*, 1999) provides quantitative information about plausible future states of a region's freshwater resources.



The GWAVA model: sectors modelled and initial water resources map for West Africa.

Output:

The effect of projected changes in climate and anthropogenic activity on water resources across West Africa, including the influence of abstractions, reservoir management and agricultural practices.

Impact:

Our findings will be presented in a clear way to water planners, managers and policymakers to convey the potential scale of water deficits or surpluses, and identify areas of concern.

Hydro-crop coupling of **GWAVA** with crop models (**GLAM** and **SARRA**) will help inform farmers of future crop yields and sustainable irrigation practices.

- **In recent decades, West Africa has experienced some of the most extreme rainfall variability anywhere in the world.**
- **At present there is no consensus on how changes in greenhouse gases, land cover and aerosols will impact rainfall and flow regimes in the region.**
- **AMMA-2050 will investigate how the West African monsoon will change in future decades, and investigate the causes of High Impact Weather (HIW) and how they might change in the future.**
- **We will use this information to increase the understanding of FUTURE changes in:**

1. Floods
2. Water resources
3. Urban flooding

3. How will climate change affect urban flooding in Ouagadougou ?

Aims:

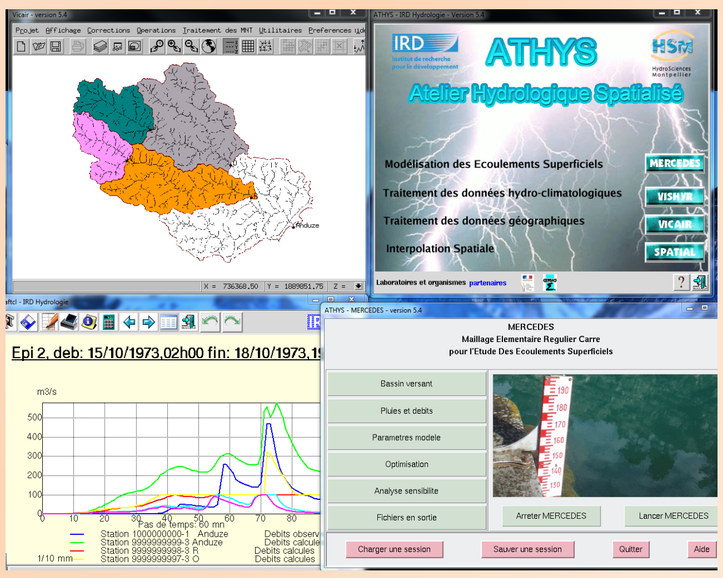
We will combine hydrological monitoring and modelling with socio-economic surveys to better understand the potential impacts of urbanisation and climate change on the city of Ouagadougou, Burkina Faso.

Hydrological Monitoring:

Data from a range of weather and level monitoring stations are being used to develop a better understanding of the rainfall-runoff response of African cities and the impacts of urban water management on flooding.

Urban Hydrological Modelling:

The combined effects of urbanisation and climate change are being analysed using the distributed hydrological model **ATHYS** (Bouvier and Delclaux 1996) that has been employed in Ouagadougou and represents urban drainage and dams.



Socio-Economic Surveys:

Surveys conducted with residents who live in Ouagadougou have revealed where flooding takes place and the impacts on local areas. Lack of sanitation and poor planning are key drivers of vulnerability.

House to House surveying in Ouagadougou.

Impact:

We will provide a range of tools for to inform decision making for sustainable urban development and flood management for future scenarios.

References:
Bell *et al*. (2009) Use of soil data in a grid based hydrological model to estimate spatial variation in changing flood risk across the UK. *J. Hydrol.*, 335-350.
Meigh *et al*. (1999) A Grid-Based Approach to Water Scarcity Estimates for Eastern and Southern Africa, *Water Resources Management*, 85-115.
Bouvier and DelClaux (1996) ATHYS: a hydrological environment for spatial modelling and coupling with GIS, *HydroGIS 96*, 19-28.

Acknowledgement:
AMMA-2050 is funded under the Future Climate for Africa Programme which is supported by funding from the NERC and DFID.

http://www.amma2050.org/