MECHANICS

Methods to Enhance Capability in High-resolution information for AdaptatioN: Initial Case Studies

Context

Convective-scale (<4km) modelling over Africa has demonstrated its value in improving representation of atmospheric/land-surface features and processes and extreme events, whilst recent work on understanding regional climates over Africa and their variability have identified key climate drivers, the importance of resolution and gaps in our current knowledge.

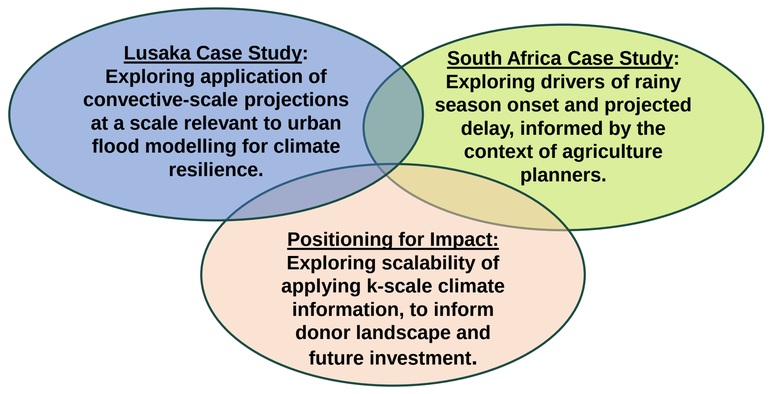
Analyses of observed and projected climate changes over sub-Saharan Africa have identified clear signals in impact/risk relevant climate indices/system states though with some important caveats. This includes where:

- Observed and projected changes are not consistent;
- There are inconsistent messages about projected changes between groups of models;
- Consistent messages about projected changes from lower resolution models are not supported by clear process understanding related to poorly resolved or incomplete knowledge on processes

Current Met Office k-scale simulations over Africa are driven by observations and several global models, significantly increasing the scope for their application to understand the processes and thus assess robustness of projected future changes.

Purpose

- Demonstrate the utility of high-resolution kilometre-scale (k-scale) climate modelling, through a case studies approach targeting specific decision contexts in South Africa and Lusaka (Zambia).
- Through co-exploring whether k-scale climate information can aid real-world evaluation of adaptation decisions and building capability in the application of k-scale information in each focus country.
- Make the case for further investment in core capabilities and to grow the community of scientists and users of such information to inform real-world decisions.



Lusaka, Zambia

Defining the problem

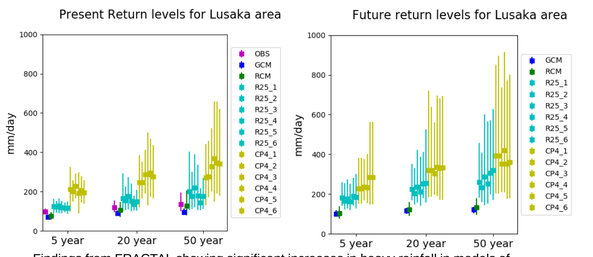
Flooding has extensive impacts in informal settlements

Climate projections indicate an increase in intensity and frequency of flood events

Relatively coarse resolution of data and no clear quantification of expected changes

Can convective scale modelling results be combined with community-based evidence to improve responses to flooding?

Perennial flooding and a lack of reliability in clean water supply in informal settlements impacts physical and mental health, property, people's ability to work, children's education.



Findings from FRACTAL showing significant increases in heavy rainfall in models of all resolutions from coarse (150km) to convective-scale (4km)

Aim: To explore the value of convective scale modeling in urban flooding adaptation and resilience.

South Africa

Defining the problem

Rainfall over much of southern Africa occurs in a single rainy season which commences at some point during austral spring (September to November).

Delayed onset in rainfall with co-occurring spring heat-waves has in recent years resulted in increased water demand and consequent water shortages, with heat-health impacts in informal settlements and economic impacts in urban areas

Delayed onset can result in delayed planting dates, consequent exposure of crops to unsuitable conditions, reduced total rainfall in the season, all impacting on agricultural yields.

Many models show a clear signal of onset being delayed in mid-century projections.

A range of processes are involved in determining the onset of the rainy season. Key amongst these is convection

What impact does convective-scale projections have on onset in a warming world?

Aim: To explore drivers of rainy season onset and projected delay, informed by the context of agriculture planners.

Achievements so far

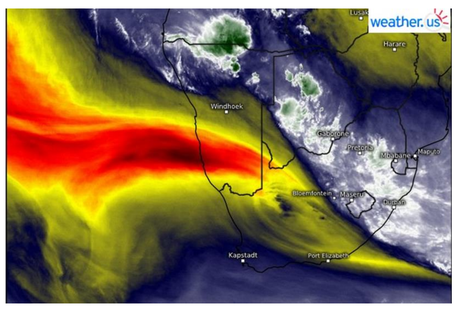
- Co-led by **Gilbert Siame** (University of Zambia) and **Chris Jack** (University of Cape Town).
- Official launch of MECHANICS in Lusaka in early Nov, which encompassed a two-day retreat to co-explore burning issues for building flood resilience in Kanyama and Kalikiliki
- Attended by ward councillors, community members, city council officials, disaster management, NGOs and academics
- Successful community mapping and engagement in Kalikiliki and Kanyama

Project launch workshop on urban climate adaptation

Her Worship Ms Chilando Chitangala, Mayor of Lusaka

Kanyama flooding

- Co-led by **Francois Engelbrecht** (University of the Witwatersrand) and **Johan Malherbe** (Agricultural Research Council).
- X-Project engagement with 'First Rains' (Neil Hart et al).
- In the process of agreeing metrics for analysing rainy season onset, including both statistical (rainfall accumulation/persistence) metrics as well as dynamical (atmospheric circulation/CAB) metrics.
- Data access has been successfully facilitated via JASMIN.



What are the next steps?

- Co-identify and map flood risks with community residents in informal settlements
- Collaboratively analyse complex drivers of floods within informal settlements (building on FRACTAL)
- Explore socio-spatial distribution of vulnerabilities across the community using maps
- Explore lived experiences of flood risk in informal settlements through qualitative methods that generate rich data
- Bring cutting-edge climate modelling together with evidence of lived experience in transdisciplinary learning labs to consider potential resilience pathways in Lusaka.
- Assess the value contribution of k-scale modelling in urban flood adaptation and resilience decision contexts

- Statistical analysis of onset in CP4A ensemble for present-day and future climates
- Dynamic analysis of onset in CP4A ensemble for present-day and future climates
- Crop modelling of onset impacts using CP4 data as forcing
- Stakeholder interactions towards the uptake of MECHANICS research in South Africa (Department of Agriculture: National Agrometeorological Committee, National Disaster Management Advisory Forum, Grain Crops Institute, South African National Seed Organization, Agriseker crop insurance, Landbank insurance)
- Submission of research paper on CP4ACMIP6 projected changes in rainfall onset over southern Africa (including model verification and underpinning analysis of dynamic circulation changes, and impact-analysis of changes)

Research for impact

- Focus on the **context-appropriate application** of science
- Use K-Scale information for different use cases and contexts identified with decision makers in the Global South, **building capacity of researchers and implementing partners**
- Case Studies **led by** K-Scale Application Team in **the Global South**
- Ensure **stakeholder engagement** throughout, with a focus on **transdisciplinary processes** where feasible.
- **Engaging with other CLARE projects** and other regional activities
- Include a **range of expertise** that spans the problem: decision makers and other decision-relevant perspectives (humanitarian responders, urban/agricultural experts, etc. depending on the decision), alongside researchers

- Demonstrate the added-value of k-scale information to each decision, evaluating the benefits and trade-offs of the adaptation options in each decision context **utilising MEL**
- Consider the transferability and scalability of the decision-making and application contexts. Any "translation science" undertaken ideally has wider applicability and can result in legacy knowledge transfer afterwards, **influencing opportunities**

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