The role of anthropogenic aerosol in near-future sub-Saharan precipitation change

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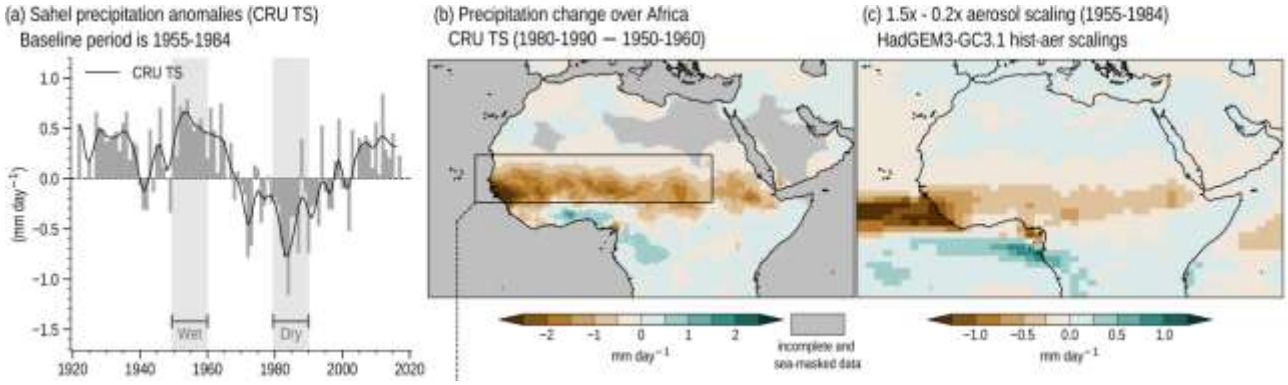
Sub-Saharan Africa is densely populated and highly sensitive to climate change. West Africa has experienced both prolonged periods of drought and increased flooding over the last 50 years, and there is substantial concern that intensifying climate risk will exacerbate existing vulnerabilities. Although historical Sahel drought has been attributed to aerosol increases, African precipitation responses to aerosol changes are relatively unexplored. There is almost no existing literature exploring the impact of aerosol changes on East African rains.



Observed drying over the Sahel in the 1980s is largely due to increases in anthropogenic aerosol emissions. Source: IPCC 6th Assessment Report

There are large uncertainties in projections of African precipitation due to differences between models. Differences in the simulation of the atmospheric response to forcing, and the response to aerosol forcing in particular, play an important role in this uncertainty. Aerosol emissions from remote regions have been implicated in driving historical changes in several African regions, while some of the largest uncertainties in future emissions are also found over Africa. Much of the current requirement for projection information for Africa focuses on near-term, 10–40-yr time scale, climate adaptation. Changes in short-lived pollutants like aerosols play a much stronger role than greenhouse gases in driving the spread of near-term projections. In this project, the role of aerosol in African climate projections, and the uncertainties in these projections, will be explored through three research questions:

- What is the response of sub-Saharan African climate to potential future anthropogenic aerosol changes?
- What are the relative roles of local and remote aerosol changes, and different aerosol species, in climate projections for Africa?
- What are the mechanisms for West African and East African precipitation responses to regional aerosol forcing? Do these mechanisms depend on model climatology, model process representation, or internal variability?

To address these questions, the student will have access to a new set of coupled model experiments, designed to explore the role of aerosol in near-term projections and be easily comparable to projections typically used in decision making. The student will perform idealised experiments to aid diagnosis of important mechanisms. There is the potential to expand these experiments to quantify the role of model biases, or the role of internal variability, in the response to aerosol changes.

This project is an opportunity for the student to become an expert in a scientific topic that will become increasingly relevant as climate change, and societal responses to increased climate risk, progress. The regions where precipitation changes are expected have a large population and are undergoing considerable development with a need for mitigation. The project will thus potentially inform the next assessment of the IPCC.

Training opportunities:
The project will involve the student in an international effort to quantify the role of regional aerosol changes in near-future change, providing experience of collaborative research whilst ensuring that the student leads and develops their own novel analysis. The CASE placement offers an opportunity for the student to work for at least 3 months at CICERO. There, they will experience a highly interdisciplinary, non-academic research environment, and interact with researchers at the forefront of broader aspects of the climate problem. The student will have the opportunity to explore extensions of their work beyond analysis of the physical climate and to provide input to ongoing projects in climate risk quantification and human health.

The student will be offered NCAS courses in atmospheric science, scientific computing, python, and the use of the UK Earth System Model, alongside the opportunity to attend the Climate Modelling Summer School. During the project the student will develop strong programming skills and the ability to manage large datasets.

SCENARIO and CICERO both provide opportunities to develop presentation skills, to network at conferences, and to disseminate results.

Student profile:
This project would suit a student with a background in physical or mathematical sciences, perhaps specialising in atmospheric physics or similar. The student must have strong analytical skills. During the project the student will be expected to develop the necessary computer programming and climate data analysis skills. Some previous programming experience would be beneficial.

Funding particulars:
This project has co-funding from the CICERO Center for International Climate Research (Norway) as a CASE studentship comprising an additional £1,000 per annum towards the research and training grant for the student and extra expenses for travel and subsistence associated with placements at CICERO.

https://research.reading.ac.uk/scenario/