Integrating local and Indigenous knowledge with climate modeling in Uganda: an 'ethno-climatology' approach

Supervisors: Prof Lea Berrang Ford, Prof Andy Challinor, Prof James Ford, Dr Shuaib Lwasa

A collaborative project across the University of Leeds School of Earth and Environment, Leeds Institute for Health Sciences, School of Food Science and Nutrition, Priestley International Centre for Climate, Makerere University (Uganda), University of Cape Town, and the Ugandan Ministry of Health

Contact Lea Berrang Ford to discuss the project: l.berrangford@leeds.ac.uk

The challenge

Climate change is one of the biggest global health threats of the 21st century; a perspective supported by two Lancet Commissions,[1,2] the World Health Organization (WHO),[3] and the Canadian,[4] American,[5] and British[6] Medical Associations. Changes in climate have already been documented: high impact weather events have quadrupled since the 1960s,[7,8] the frequency and intensity of natural disasters have accelerated,[9,10] and the number of record-breaking extreme temperatures and droughts have increased.[11–13] These changes have direct and indirect health implications, including increased foodborne, waterborne, and vectorborne diseases;[14–18] exacerbated heat-related mortality;[19,20] and compromised food security.[14,21–24] The WHO estimated that 55 billion DALYs and 1.7 million deaths were attributed to climate change in the past decade, and this number is projected to increase to 2.5 million deaths[25] and cost USD$20-40 billion[26] between 2030-2040.

Despite a growing body of research on the impacts of climate change on health, there remains a substantial divide between the types of information climate research generates, and what nations and communities need to know in order to adapt. Currently, climate modeling is dominated by 'top-down' approaches; climatologists and natural scientists begin with climate models to project changes for a range of selected climatic variables, typically including average temperature, total rainfall, maximum and minimum winter temperature. Though such research provides critical information for projecting climate impacts, these approaches are unsuitable for informing the localized and near-term priorities of many communities. This studentship is part of a larger research programme targeted at addressing key gaps and grand challenges in the usability of climate research in informing policy and practice in remote communities: i) climate projections typically use generalized meteorological variables rather than the specific, self-identified conditions that matter to people's health locally; ii) projections are typically created for time-scales that are too long to meaningfully inform policy and practice (e.g. 50+ years); and iii) projections rarely integrate data on socio-economic gradients in health to predict how social determinants will exacerbate climate impacts on health or—critically— provide intervention opportunities to reduce climate risk to health.

This studentship is situated within these challenges, and aims to pioneer new approaches to 'bottom-up' climate modeling that is informed by local, community-based participation and climate services needs.

Project Summary

The *Indigenous Health Adaptation to Climate Change (IHACC)* project is a trans-disciplinary, international initiative working with remote Indigenous populations in the Peruvian Amazon, Canadian Arctic, and Uganda to examine the health effects of climate change. The interdisciplinary team includes climate modellers, epidemiologists, geographers, public health specialists, and nutritional experts. The team

collectively collaborates to mentor students in interdisciplinary approaches to tackling the grand challenges of climate change and health. We have regional teams in Canada, Peru, and Uganda, as well as substantial collaboration across regions to identify comparative insights. In Uganda, we are working with Indigenous Batwa (pygmy) communities in the southwest, as well as local Indigenous and health sector institutional partners. The IHACC research programme has been running for over 10 years. The research programme includes 3 pillars that pioneer methods and insights in climate-health community driven surveillance (Pillar 1), climate change agri-food futures (Pillar 2), and place-based pathways to adaptation (Pillar 3). This studentship is situated within Pillar 2 (climate and agri-food futures) and collaborates with our Ugandan field site and team (Figures 1 and 2).

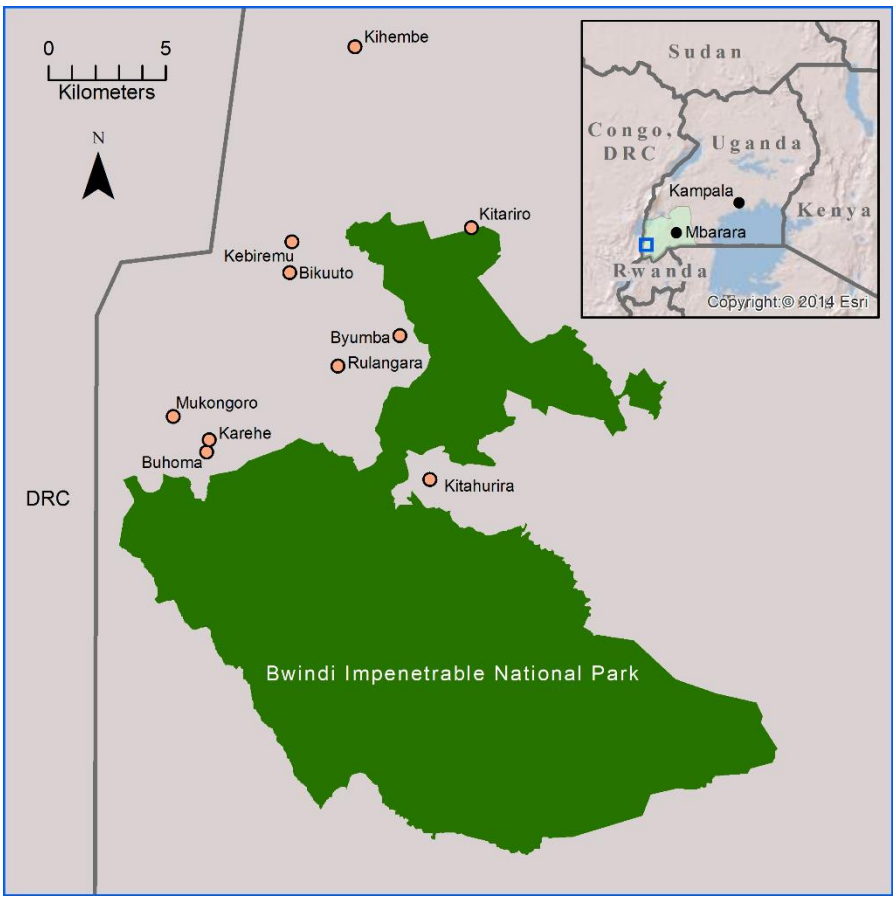

Figure 1: Study location in Uganda

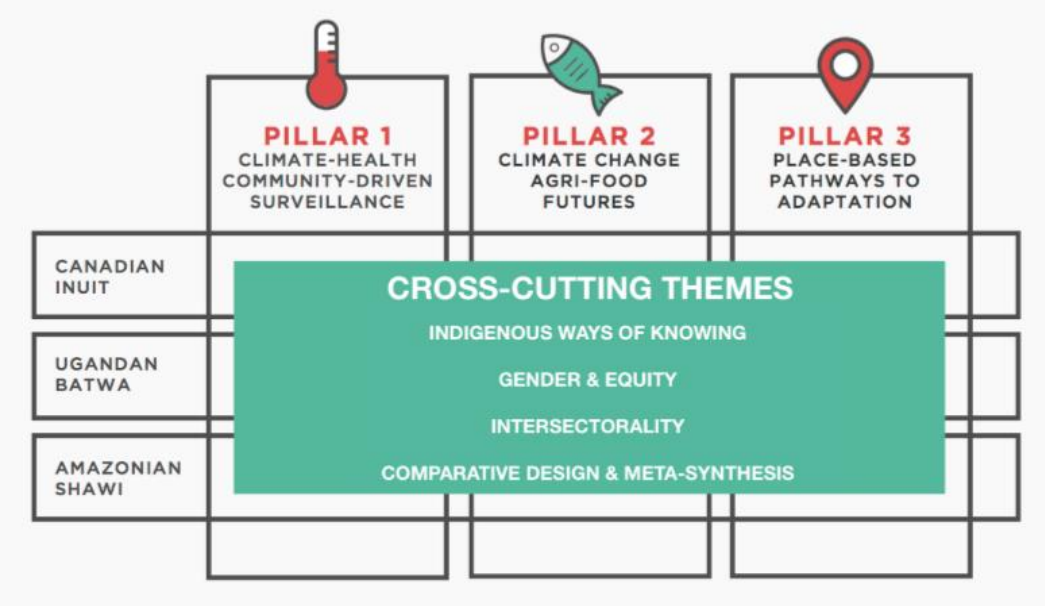

Figure 2: IHACC research programme structure

IHACC video: https://vimeo.com/54772398

Pillar 2 of the IHACC research programme aims to develop climate modeling approaches that reflect the local contexts of communities and their health priorities. A major barrier to robust and valid prediction of climate impacts on health, however, is a lack of expertise and capacity to integrate meteorological data and global climate projections with local knowledge of the non-climatic determinants of health that will mediate climate impacts. This represents a substantial research gap, with the need for novel approaches to pioneer improved risk frameworks and targeted use of models that are more relevant to the needs of adaptation planning (Figure 3). The IHACC team is looking for an interdisciplinary researcher with skills in climate and/or meteorological and impacts modeling to join the Pillar 2 IHACC team in Uganda.

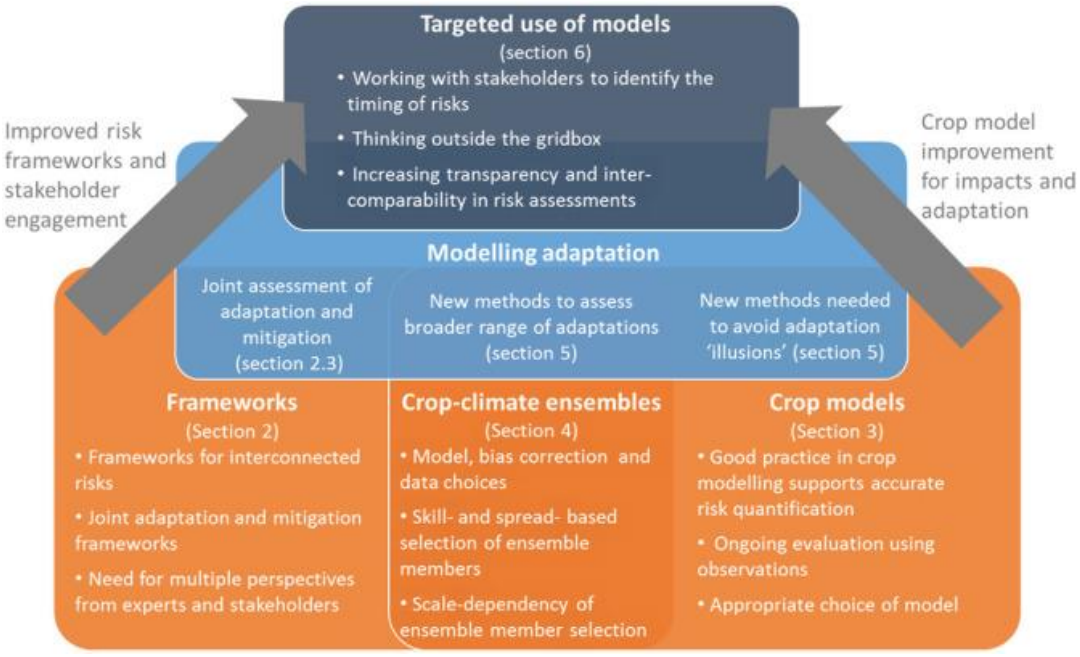

Figure 3: Summary of key issues facing crop modeling for risk assessment and climate change adaptation (from Challinor et al.)[27]

Objectives

The project will focus on developing and showcasing a tool for integrated assessment modeling of meteorological and climate data with Indigenous and local knowledge (ILK) to model the impacts of climate change on food systems in Uganda, where we have longstanding collaborations and extensive local support and capacity. You will work within a team of climate, health, and social scientists, and engage in transdisciplinary and impact-led research. Objectives include:

1) Characterise the meteorological conditions that affect key subsistence food crops among Batwa Indigenous communities in Kanungu District, Uganda;
2) Develop a climatic 'vocabulary' for the conditions relevant to food systems and security on the ground using local historic meteorological data;
3) Develop and model thresholds for these conditions for each crop, modeling across categories of non-climatic determinants of health (i.e. land quality, agricultural knowledge/capacity);
4) Develop a matrix/map of the relationship between meteorological conditions and health for a range of local socio-economic scenarios;
5) Project short to medium term trends in health impacts for a range of locally-relevant socio-climatic scenarios.

The project will involve some field work at our field site near Buhoma, Uganda, in collaboration with local partners, the University of Makerere, and 10 Batwa communities collaborating with IHACC.

The Batwa of Kanungu District, Uganda

The Batwa are an Indigenous pygmy population living in the forested regions bordering Uganda, Rwanda, and the DRC. Their traditional livelihoods were primarily as hunter-gatherers based in the forest. In Uganda, the Batwa were evicted from their lands in 1991 with the establishment of Bwindi National Impenetrable Forest as a conservation and tourism park. Since then, the Batwa have been adapting to a sedentary and pastoralist livelihood, but remain one of the most impoverished

populations in Uganda. The Batwa represent one of the three Indigenous communities partnering with climate scientists to document climate change at the local level over time, and to pioneer new, locally-relevant approaches to climate modeling for adaptation among the world's most vulnerable populations. Below are some photographs taken as part of IHACC's Adapt-to-Eat initiative, which documents IHACC research results through the voice of Batwa perspectives and imagery (www.adapttoeat.weebly.com).

Our partner communities and study site are located around the Bwindi Impenetrable National Forest Park, home of the silverback gorilla, an extensive gorilla tracking tourism industry, and mountainous rainforest. Credit: Matthew King

Agriculture is primarily subsistence-based, with key food crops including beans, maize, cassava, plantain, and sweet potatoes. Many of these crops are climate-sensitive, and Batwa report changing access, quality, and reliability of production and food security. Credit: Matthew King

Animal rearing is primarily used as a source of income security, and animal meat is eaten rarely, primarily at celebrations. The Batwa have a long tradition of honey production, with Indigenous traditional knowledge of how to smoke out wild hives. Credit: Matthew King

Traditional Indigenous knowledge, particularly among elders who grew up in the forest, remains a key part of Batwa culture and livelihoods. Credit: Matthew King


IHACC researchers have been working with Batwa communities and Ugandan research partners for over 10 years. Credit: Matthew King

Potential for high impact outcome

This research will pioneer interdisciplinary approaches to integrating local and global data to generate more robust and locally valid projections of climate impacts and adaptation opportunities. In particular the research will lead global expertise in combining data of the lived experiences of food and health on-the-ground with instrumental climate/meteorological data for integrative empirical assessment modeling. The results will have direct relevance for policy development locally as they will generate empirical evidence of entry points for intervention. Such approaches — what we call an 'ethno-climatology' approach for public health — are critically important in catalysing development of an evidence base to guide governments in developing health adaptation policy responses. This project is situated within calls for a new generation of interdisciplinary researchers with the skills to integrate across knowledge domains to tackle grand challenges in global health and environmental change.

Training

The School of Earth and Environment (SEE) was ranked 2nd in the UK for Research Power in "Earth and Environmental Sciences" in the 2014 UK REF Assessment. The student will work under the supervision of Profs Berrang-Ford, Challinor, and Ford at the Priestley International Centre for Climate at the University of Leeds, and Dr. Shuaib Lwasa at Makerere University in Uganda; all four project advisors hold leadership roles in national and global climate assessments, as well as IPCC Assessment Report(s) authorship. Their teams have a collective and longstanding track record of interdisciplinary research excellence and impact, including publications in *Nature, Nature Climate Change, PNAS, Climatic Change, Environmental Research Letters, Global Environmental Change, PLOS ONE, BMC Public Health, AJHTM,* and *Emerging Infectious Diseases,* and a strong record of mentoring students and trainees to publication. The successful candidate will interact with global research leaders within the Priestley Centre, as well as with researchers in Nutrition and the Nuffield Centre for International Health and Development, Makerere University in Uganda, and the University of Cape Town. The University of Leeds offers a tailored programme of dedicated training and development courses for postgraduate researchers (http://www.emeskillstraining.leeds.ac.uk/). This project will provide expertise and mentorship in: 1) interdisciplinary and integrated assessment modeling of climate impacts; 2) environmental change research using mixed methods; 3) interdisciplinary, international collaborative and impact-led research; 4) international partnerships; 5) community-based research.

Student Profile

This project is an excellent fit for a young researcher interested in mixed methods interdisciplinary climate change research. You will have a degree in atmospheric sciences, climate sciences, earth system sciences, physical geography, environmental sciences, or related/equivalent, and a strong interest in interdisciplinary research, including engagement with the social and health sciences. You will be interested in global health and environmental change, and willing to work closely with researchers from other disciplines and countries. You will be willing to conduct field work and travel in low-income settings, and be interested in the nexus of climate modeling with development challenges and local adaptation. You are not expected to have a background in all relevant disciplines. We are looking for a student with expertise in one or more of these fields who is excited to undertake a project that involves interdisciplinary training, with this particular studentship primarily grounded in climate impacts modeling.

Key publications

1. Ford, J., D. Clark, L. Berrang-Ford, L. Copland, J. Dawson, M. New, and S.L. Harper (In review) Connecting Indigenous knowledge and science in climate change research: Modeling access to ice, land, and water in Arctic communities. *Nature Climate Change*

2. Beveridge, L., S. Whitfield, A. Challinor (2018) Crop modelling: towards locally relevant and climate-informed adaptation. Climatic Change 147:475-489.
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