Bringing climate forecasts down to earth

Climate change is causing shifts in historical weather patterns in the Horn of Africa, negatively affecting agriculture and pastoralism across the region. Researchers in the DOWN2EARTH project are developing new models and tools that will deliver information to governments, organizations, and people on the ground, helping them adapt to the impacts of climate change, as **Professor Michael Singer** explains.

The Horn of Africa is highly vulnerable to the effects of climate change, and even a slight tip in the balance towards making the region drier can lead to many complications for human society. Regular rainfall is essential to the production of agricultural crops, which is an important part of the economy in the Horn of Africa drylands (HAD), and people in the region have organised their economic activities around established patterns. "Rainfall patterns vary across the region, but in general there's a rainy season sometime between October and December, called the short rains. There's another season between March and May, called the long rains," outlines Professor Michael Singer from Cardiff University, Principal Investigator on DOWN2EARTH. Climate change, driven by global emissions from developed countries rather than by countries of the HAD, is disrupting these rainfall patterns and negatively affecting lives and livelihoods in the region. "The anomalous heating up of sea surface temperatures in distant oceans drives particular weather patterns, that yield extremely high or low rainfall in the HAD," explains Prof Singer. "These changes in climatic extremes and the increase in associated hazards can have significant impacts on people that rely on water sources, vegetation, and crops for their lives and livelihoods."

DOWN2EARTH project

This issue lies at the heart of Prof Singer's work as the Principal Investigator of the DOWN2EARTH project, an EU-funded initiative bringing together partners from across Europe and East Africa. The wider aim of the project is to help people and communities in the Horn of Africa adapt to the impacts of climate change in part by delivering information that is directly relevant to their circumstances, beyond the more general picture provided by climate forecasts. "Forecasts tell us about rainfall or temperature, but we rarely have direct information from those forecasts about whether there will be water in a well, or enough soil moisture to support crop growth," says Prof Singer.

The idea in the project is to take these climate forecasts and essentially bring them down to Earth (where the project gets its name), helping people in the region – including subsistence farmers and pastoralists raising livestock – to adapt to the impact of climate change. "We aim to use our novel impact-focused modelling, and a deeper understanding of what's happening at both the land surface and below it, to improve our understanding of the problems that people face," outlines Prof Singer. A lot of effort has been devoted to community-based work to understand peoples needs and the strategies they apply in their daily lives, providing a solid foundation for the project's wider agenda. "We can then look to develop better tools, strategies, and policies for adaptation across the region," explains Prof Singer.

A new, high-resolution hydrological model has been developed in the project, which is now being operated on a regional scale, spanning Ethiopia, Somalia, Kenya and surrounding areas. A lot of work has been devoted to developing the model so that it reflects the specific circumstances of dryland environments and provides detailed outputs that support decision making at different levels in society. Prof Singer says It's already installed, ready for operation at the IGAD

DOWN2EARTH team visiting pastoralist ranch in drylands Kenya. Photo Credit: Michael Singer

Pastoralist woman in northern Kenya carrying fuelwood. Photo Credit: Diana Njeru

Climate Prediction and Applications Centre (ICPAC) in Nairobi, an international body supported by the World Meteorological Organization to provide a range of climate services to multiple stakeholders in 11+ countries across East Africa. "ICPAC will embed the model within their seasonal forecasting workflow, so that it becomes part of the regular system that they use to provide impact-based warnings to different member countries in response to key rainfall seasons," he outlines. The insights generated by the model can also be sent to individuals and communities via other channels, making sure that it reaches the people likely to be affected by climate change. "We are creating application programming interfaces (APIs) that connect our modelling algorithms to different app services," explains Prof Singer. "That could be a Whatsapp group, chatbot, or a web-based geographical platform such as that which ICPAC is already using; there are lots of different possibilities. Our aim is to create a decision support system that is agnostic to the end delivery mechanism, which is where APIs come in. They allow end-users to request precisely what information they want."

The idea from DOWN2EARTH is to give people access to information that they didn't previously, which could then support more informed decision-making and help them adapt to climate hazards (e.g., floods and droughts) and climate change. For example, if people in an agricultural community learn that their local area is likely to be a lot drier than normal in the upcoming season, then they can make different decisions about when and what crops to plant. "People make those kinds of decisions on a regular basis, but without a clear expectation about conditions of soil moisture, for example. We're trying to provide more information to support these life and livelihood decisions," says Prof Singer. This could have a wider impact in the region, for example in helping overcome socio-cultural-religious divisions between communities and encourage collaboration. "If more communities have access to the same information, then they can start to interact with one another and share that information for the benefit of the region as a whole," continues Prof Singer. "We want to move away from a situation where people tend to hoard information, and get to a point where most people have access to similar information, but maybe in different forms specific to their local needs."

Livestock drinking water from a water hole on a pastoralist ranch in drylands Kenya. Photo Credit: Toby Pitts

Power of technology

There may be some people and communities in the region who prefer to rely on more traditional forecasters who use indigenous ways (e.g. reading goat intestines) to predict the upcoming seasonal rains. But many community members, especially in the younger generation, recognise the power and utility of technology, and are perhaps more likely to make use of the project's modelling outputs in addition to traditional methods. The modelling system created by DOWN2EARTH doesn't generate absolute predictions about what conditions to expect, but rather provides more nuanced outputs about the conditions in the upcoming season working in collaboration with regional seasonal forecasts. "We're not saying; 'your well will be dry.' Rather we're saying; 'locally, there's a higher probability that your well will be dry in the next few months compared to a historical baseline'," explains Prof Singer. The goal is to present this information in a way that's useful for people on the ground, and Prof Singer says progress is being made. "We're getting very close to that point of provision. We now have a full working version of our regional modelling system for the HAD, and we've set it up so that we can start exploring what the outputs mean for people," he outlines. "We can then decide how best to disseminate this critical information in a tailored way to a range of potential stakeholders. We are also researching how best to display the information so it is understandable for climate action to different audiences."

Project researchers are working to deliver sustained benefits via capacity building and new climate adaptation policy frameworks

Women fetching water from a hand-dug well along a river in drylands Kenya. Credit: Diana Njeru

to people in the region. This is particularly challenging in the case of Somalia, which still faces significant governmental and political instability, yet Prof Singer and the project team are working very closely with their colleagues in the country. "We're trying to build capacity there by investing in their infrastructure, for example in new automatic weather stations that have filled in gaps within the existing network. We are working closely with Somali government officials to take ownership of the station infrastructure and the data that's been collected, and to share that data more broadly amongst more users," he says. The project team is also working with radio stations and journalists in the region to provide training and mentoring and heighten awareness of climate change. "BBC Media Action developed a massive open online course (MOOC) to train journalists around the world in how to report on climate issues and climate change, and we have supported the provision of that course in Somali, so that new climate-focused reporting will reach millions more people," says Prof Singer.

The project team is also working with rural communities in Ethiopia, Somaliland, and Kenya to understand their information needs and access, and researchers are now trying to incorporate their perspectives and needs to all the DOWN2EARTH project work. ICPAC will have a major role to play in this respect, and a delegation from the organisation have travelled to the UK for training on how to use the new regional hydrological model and generate the sorts of outputs that are required for decision support. Subsequently, several members of the project team have travelled to Nairobi, Kenya to embed the model in ICPACs forecasting workflow. "We have now installed the model at ICPAC in late November, and train local people operating it on the technical aspects. Next year we'll hold a full-blown training session for ICPAC staff on both how to run the model, and also how to interpret its outputs for early warning purposes," outlines Prof Singer. "We plan to scale that up and do something similar in Ethiopia, while we will also invite other external stakeholders for training. It's an open-source modelling system so the idea is that it can be installed anywhere, in any institution with the capacity to run it and use it once trained." These innovations are expected to build new capacity in the HAD to adapt to climate in an increasingly uncertain world.

Climate change is **impacting weather patterns**, yielding **much higher or lower rainfall** in the Horn of Africa drylands, and **creating associated climatic hazards.** These changes can have significant effects on people who plan their lives and livelihoods around key rainy seasons.

DOWN2EARTH

Translation of climate information into multilevel decision support for social adaptation, policy development, and resilience to water scarcity in the Horn of Africa Drylands

Project Objectives

Our project activities are aimed at improving regional climate services delivery, promoting adaptation to climate change for HAD through new and enhanced decision-support tools, capacity building, citizen science, information dissemination to improve multi-level decision making, expansion of data networks, and climate change adaptation policy implementation.

Project Funding

DOWN2EARTH has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 869550.

Project Partners

The DOWN2EARTH project is led by a consortium of 14 institutional partners from 8 countries and is coordinated by Cardiff University.

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