Open source tools and skills for climate information flows

Story of change: Key findings & emerging impacts

Summary

- Identifying barriers to sharing and making use of climate information is an important aspect of REACH programme research in Ethiopia's Awash Basin.
- REACH partners have worked together to build tools and skills to facilitate management, curation, validation, visualization and comparison of climate data from weather and streamflow gauging stations in the region.
- This long term capacity building interaction has involved weekly collaborative coding sessions with forecasters (EMI), practitioners (MOWE) and graduate students (WLRC).
- Outputs from these sessions include code to produce clear and readable local forecasts and support water allocation planning in the Awash Basin.

Introduction

Part of the REACH programme's climate resilience research is exploring how people use climate information in decision-making processes. Whilst many projects seek to improve the information itself, REACH work also focuses on understanding why climate information isn't used even when it is technically available. In Ethiopia's Awash Basin, we have been examining the knowledge networks that facilitate climate information flows and identifying bottlenecks in the sharing and use of climate information.

Ethiopia

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Improving water security for the poor
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A major component of this research has involved extended interviews with creators, transformers, and users of climate information in organisations such as the Ethiopian Meteorological Institution (EMI), the Ministry of Water and Energy (MOWE) and the Ethiopian Public Health Institute (EPHI). One stakeholder made a specific request for help to use a forecasting tool called PyCPT (iri-pycpt.github.io/) and for general training in using the open source coding language, Python (www.python.org/). This story of change features a long-term capacity building interaction that developed as a result.

Climate information networks in Ethiopia

Much of the climate information used for seasonal forecasting in Ethiopia comes from a relatively dense network of weather and streamflow gauging stations. These are managed by different institutions including the EMI and MoWE. EMI is a member of the IGAD Climate Prediction and Applications Centre which is focused on delivering seasonal forecasts in Eastern Africa. EMI shares seasonal forecasts at climate outlook forums with other authorities such as the Ethiopian Public Health Institute (EPHI), who use this information in their decision-making and policy development processes.

Building Python skills for meteorology

In response to the research interviewee's request, REACH offered an in-person workshop on "Python skills for meteorology" for stakeholders at EMI, MoWE, and the Ethiopian Public Health Institute (EPHI). We also set aside two days of training for graduate students at the Water, Land and Resource Centre at Addis Ababa University.

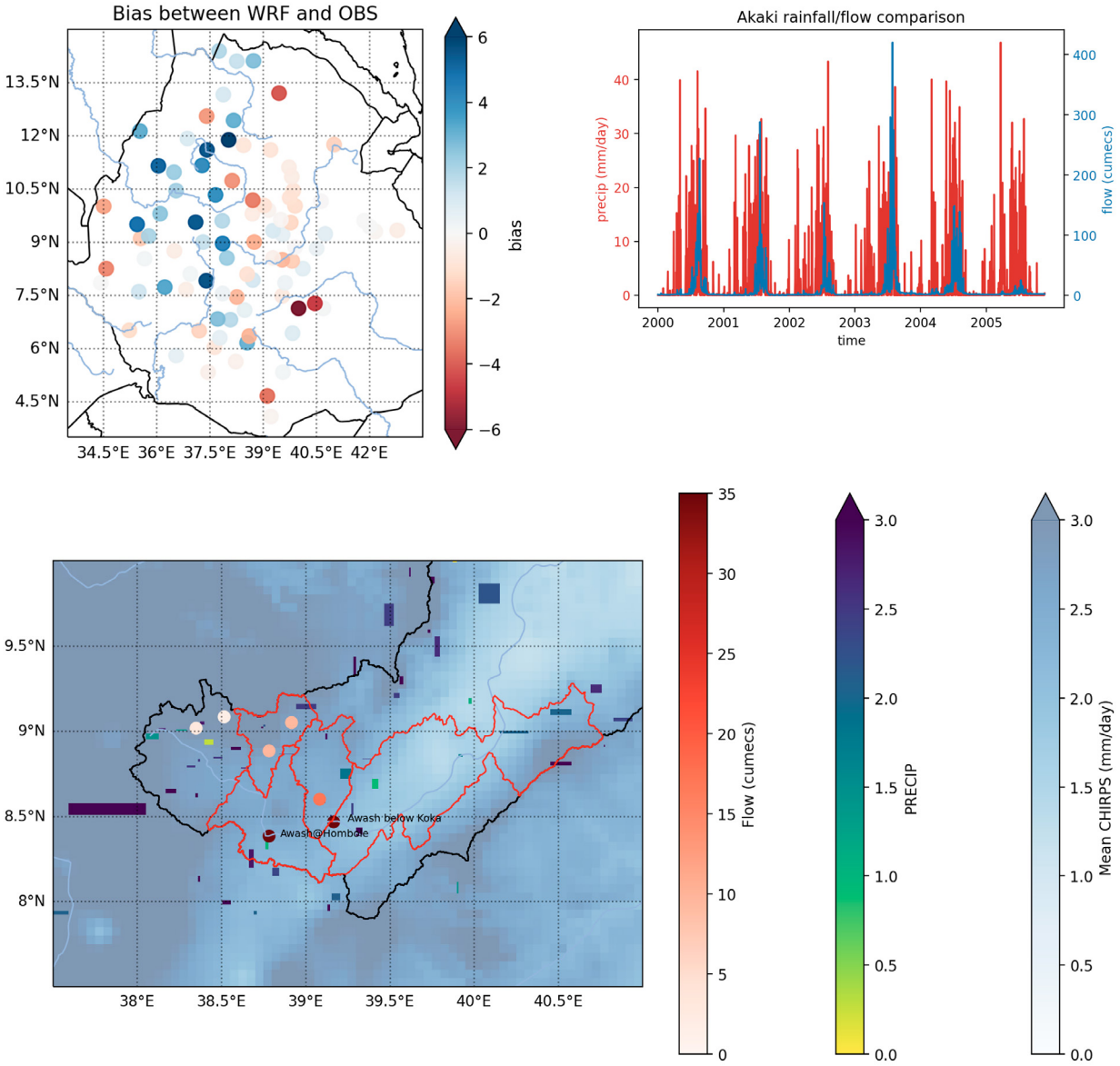
A few key lessons we learned from these sessions:

- One-off trainings are more often a burden on time-pressured practitioners than they are useful.
- Even when tools create useful outputs, these might be impossible for practitioners to use due to technical or skills capacity gaps.
- Stakeholders are researchers too, and don't always want to be 'implementers' while international partners are doing research on local topics.

At our workshop we realised that the technical barriers that participants faced were greater than anticipated. Very old laptops, and old or compromised operating systems, were among the most common issues. As we weren't providing a polished 'black box' tool, everyone had to get to grips with the instructions and hands-on process of installing Python on their computer. While this involves a steep learning curve for many participants, it also means that there is a solid baseline for tools to be collaboratively developed and adapted over time. During the workshop we worked through a number of barriers as a team. We then went through some simple coding examples using the CHIRPS gridded rainfall dataset and a package built for climate data called Xarray.

As we learned that one-off trainings are relatively ineffective, we decided to sustain the engagement with the workshop group through weekly Zoom calls. In each online call, we focused on a new or existing piece of code, and the agenda would include time to demonstrate how it worked and for a Q&A. This is an ongoing learning experience, and takes an ongoing time commitment for everyone involved. Because of this we had to take a total hiatus for two months as we couldn't guarantee the time to prepare the sessions for some time. We were worried that this would have damaged the trust within the group. However, when we were able to start the group calls again participants were again enthusiastic, and we have continued developing new tools. The online component of this activity is not linear. We frequently repeat sessions and review older code for people who want to catch up, and we have also started to have troubleshooting sessions where people can come and ask about any challenges or errors they are having with their computers and their code.

Figure 1: Some examples of plots created by code in our repository. Top-left is a bias calculation between mean Weather Research & Forecasting (WRF) model rainfall forecasts and gauged station based rainfall at station locations. Top-right is a time series comparison of gauged station based flow measurement and the catchment accumulation of rainfall over the same period. Bottom is an example of how code combines multiple types of input data including streamflow measurements, station based rainfall, gauged rainfall, and catchment shape files.



Participants have been providing feedback and making requests for upcoming sessions, and the online sessions will continue, mixed with occasional in-person trainings, until we fully hand over the code repository at the end of the project. Another aspect of the online sessions is bringing in new users.

We are very enthusiastic to welcome new participants who have heard about this initiative from their colleagues, and will do additional online sessions to support new users to get set up to use these tools.

This training is embedded in existing workflows and designed around locally measured climate information that is available to Ethiopian researchers and practitioners (Figure 1).

For this reason, a lot of the code developed through this interaction has evolved specifically to support data access and management.

For instance, we have developed sets of code to deal with EMI station data spreadsheets to efficiently bring together a lot of station data and work around errors in file types, as most of this data is compiled by individuals rather than by an automated system. Similarly, we have developed code to deal with MOWE streamflow spreadsheets. Other tools are focused on mapping and the calculations and comparisons you can do when data is formatted on a grid. These tools facilitate the evaluation of forecasts and comparison of a host of datasets.

Adaptive climate information tools on Github

The major output of this activity is a publicly accessible and modifiable repository of code that is hosted on GitHub. The Adaptive-climate-information-tools repository has instructions to set up Python on any operating system and sample files to run code examples in the repository. Currently the repository includes code that can be used to read in both EMI and MOWE gauging station data and deal with data discrepancies so that climate information from many locations can be compiled and used alongside gridded satellite, reanalysis, and other modelled data. Anyone interested in using the code can download the repository, specific data files, or pieces of code to run and modify on their own machines. Users can also push their own code to the repository or make changes to the available code.

Key findings

- There is a lot of desire to build local technical skill.
- Local researchers spend a great deal of time dealing with technical and information sharing practices that significantly hamper their ability to lead research.
- Local data sets can be very challenging for local researchers to use due to access barriers, but also because of irregularities and formats that haven't been designed with the users in mind.
- Local validation of models and datasets is key to building and maintaining trust between information sharers and users. Barriers to information access or the tools to do this validation slow the evolution of locally available climate information.

Capacity building

Capacity building is at the heart of this initiative. We targeted skills training for forecasters at EMI, practitioners at MOWE, and researchers and graduate students at WLRC who are the next generation of local research leaders and practitioners. Graduate students have really taken to the training as it can help them do their research much more efficiently.

Important aspects of capacity building for improved climate information flows emerged from discussions between forecasters and stakeholders at our in-person workshop:

- A key capacity in this context is the ability to specify and request the information you need
- Building relationships of trust is key to successful training and useful capacity strengthening.
- Sustainable capacity strengthening is slow, can be repetitive, and takes a lot of time.

As we have continued to engage through the online meetings, we have received more requests to develop tools from MOWE and EMI.

Policy and practice impact

- Code was written for use in a weather forecasting pilot project for the MOWE. This pilot project was to share five-day forecasts from the EMI using the WRF model to big farms along the River Awash using Telegram. Our code transformed tabular forecasts into a clear and readable Telegram message.

- Our code supported water allocation planning in the Awash Basin (but could be applied in any basin as it is based on sub-basins) by bringing together station gauged streamflow measurements with gridded rainfall accumulation within catchments.
- One participant, who is a graduate student, has made a series of instructional videos and blog posts so these tools are accessible for more students and researchers in Ethiopia.
- Participants are keen to invite data curators at MOWE and EMI to our next in-person workshop so we can highlight the importance of standardising data formats to support the use of nationally produced datasets.

Output

Adaptive-climate-information-tools repository

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Story of change themes

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