COLUMBIA CLIMATE SCHOOL
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CGIAR
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CCAFS

WORKSHOP REPORT

Regional Training for East and Southern Africa

Amanda Grossi | Tufa Dinku | Rija Faniriantsoa | Andrew Robertson | Bohar Singh

WORKSHOP REPORT NO. 002

CGIAR
AICCRA
Accelerating the Impact of CGIAR Climate Research for Africa

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Titles in this series aim to disseminate interim climate change, agriculture and food security research and practices and stimulate feedback from the scientific community.

About CCAFS
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Photos: Amanda Grossi, International Research Institute for Climate and Society (IRI)

Abstract

From November 1-6, 2021, the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) and the International Research Institute for Climate and Society (IRI) of Columbia University brought together representatives from 11 meteorological services across primarily East and Southern Africa and the IGAD Climate Prediction and Applications Centre (ICPAC) to conduct three parallel capacity building workshops in the context of Accelerating the Impact of CGIAR Climate Research for Africa project (AICCRA) project. The three workshops, which were hosted in Kampala, Uganda, were on the topics of 1) the Climate Data Tool (CDT) and Automatic Weather Station Data Tool (ADT); 2) the IRI Data Library and Maprooms; and 3) Seasonal Forecasting Approaches. Altogether, the workshops aimed to advance the availability, access, and use of high-quality climate information to anticipate, manage, and respond to climate-related disasters and longer-term climate change in the East and Southern Africa region.

Keywords

East Africa; SADC countries; agriculture; climate change; climate variability; food security; capacity development; climate-smart agriculture; climatology; monitoring systems; forecasting; Goal 2 Zero Hunger

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Especially to the administrative and management teams of CCAFS, who navigated significant logistical challenges to successfully organize an 11-country training in the midst of the global COVID-19 pandemic in order to meet the region's exigent capacity building needs for climate services, a debt of gratitude is owed.

The contributions from experts and administrators across these institutions towards the implementation of this training were invaluable, and the hospitality of the Government of Uganda and Uganda National Meteorological Authority (UNMA) in hosting this important regional training in such unprecedented times is deeply appreciated and recognized.

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Acronyms

AWS	Automatic Weather Station
ADT	Automatic Weather Station Data Tool
AICCRA	Accelerating the Impact of CGIAR Climate Research for Africa
CDT	Climate Data Tool
CGIAR	Consultative Group for International Agricultural Research
ENACTS	Enhancing National Climate Services
ICPAC	Climate Prediction and Applications Centre
IGAD	Intergovernmental Authority on Development
M&E	Monitoring and Evaluation
NMS	National Meteorological Services
STEM	Science, technology, engineering, and mathematics
UNMA	Uganda National Meteorological Authority

East and Southern Africa Regional Training Builds Foundational Capacity to Anticipate, Manage, and Respond to Climate Risk

In areas like East and Southern Africa, which are the most affected by increasingly erratic precipitation and temperature patterns but possess the least adaptive capacity to manage the associated risks, solutions to adapt to and mitigate the negative effects of climate change and variability are in dire need. Beyond the generation of high-quality climate data, appropriate tools, approaches, and platforms to improve the access and use of that information for decision-making are key for improving the resilience of the region. In November 2021, a first-of-its kind regional training brought together eleven national meteorological services from across the region and beyond to build foundational capacity to anticipate, manage, and respond to climate-related disasters and longer-term climate change.

Introduction

Climate information has an enormous role to play in improving resilience and decision-making in the face of increasingly erratic precipitation and temperature patterns. From shorter-term decisions such as planning for, managing, and responding to climate hazards such as droughts or floods associated with climate variability to longer-term decisions to inform strategic or policy planning around climate risk management and climate change, climate information is the bedrock of climate-smart decision-making for governments, organizations, communities, and individuals (Cooper et al., 2008).

In Africa, however, the use of climate information for research and applications has been scanty. National Meteorological and Hydrological Services (NHMS), which are mandated with collecting and providing weather, water, and climate information, struggle to do so as a result of long-term under-investment, a narrow commercial base, inadequate resource models, and civil unrest, amongst other reasons (Dinku, 2018). East and Southern Africa is no exception, and here and in most other African nations dependent upon

CDT workshop participants listen intently and take notes as the ENACTS data merging process is explained.

Doreen Anande, a meteorologist from Tanzania, networks with fellow meteorologists from East Africa as she conducts Python exercises.

rain-fed agriculture for their livelihoods and economic well-being, this patchy climate data is extremely problematic, as data is a critical input for decisions and programs designed to build resilience of those highly affected by climate variability and change but with poor adaptive capacity.

The Enhancing National Climate Services (ENACTS) initiative of the International Research Institute for Climate and Society (IRI) is one effort that has addressed climate data gaps by introducing a methodology to blend rainfall and temperature observations collected by national weather services with freely available global products derived from satellite data. Beyond this, however, it has been intentional in ensuring this data is transformed and tailored into actionable and decision-relevant information for a wide variety of users, in making this information freely accessible, and in promoting the broad dissemination, appropriate communication, and capacity building that underpin its ultimate effectiveness (Nsengiyumva, 2021).

Two applications that have been revolutionary in enabling the generation of high-quality climate data that underpins high-quality climate information and service are the Climate Data Tool (CDT) and the Automatic Weather Station Data Tool (ADT). And one of the platforms that has facilitated the transformation and tailoring of that information into actionable and decision-relevant visualizations is the Data Library and its component "Maprooms." These applications and visualizations, which were the topic of two of the three trainings conducted in Novmber 2021, are briefly summarized below, alongside the NextGen forecasting approach which builds on these advances to allow objective forecasting at both the seasonal and subseasonal level and comprised the topic of the third training.

The Climate Data Tool (CDT)

The Climate Data Tool (CDT) is an open-source, R-based software package with an easy-to-use a graphical user interface (GUI), which can be run under multiple operating systems, including Windows and Linux. The only system requirement is the installation of the latest version of R.

After five years of evolution and thanks to the iterative feedback from national meteorological services (NMS) around Africa, CDT has become a powerful, dynamic, intuitive, and user-friendly tool. The main functionalities of CDT include:

- Organization of station and proxy data;
- Assessment of data availability;
- Assessment and correction of data quality;
- Combination of station observation with proxies
- Extraction of data from gridded products, including satellite, reanalysis and combined data products, at any point, for a selected box, and for any administrative boundary; and
- Analysis and visualization of station and gridded datasets.

Though it has a graphical user interface (GUI), CDT can also be run at script level for advanced users who need more flexibility.

The CDT has so far been installed in 24 countries and two Regional Climate Centers (RCCs), including the IGAD Climate Prediction and Applications Centre (ICPAC) in East Africa which partook in the regional training.

The Automatic Weather Station Data Tool (ADT)

In contrast to CDT, the Automatic Weather Station Data Tool (ADT) is a *web*-based tool initially developed by the IRI in the context of Rwanda. The ADT helps to address challenges in accessing and processing Automatic Weather Station (AWS) data collected by different systems and networks such as Vaisala, Edkon, and KOICA, which are on different servers and in different formats, by enabling data quality control, processing, and visualization.

The Data Library and Maprooms

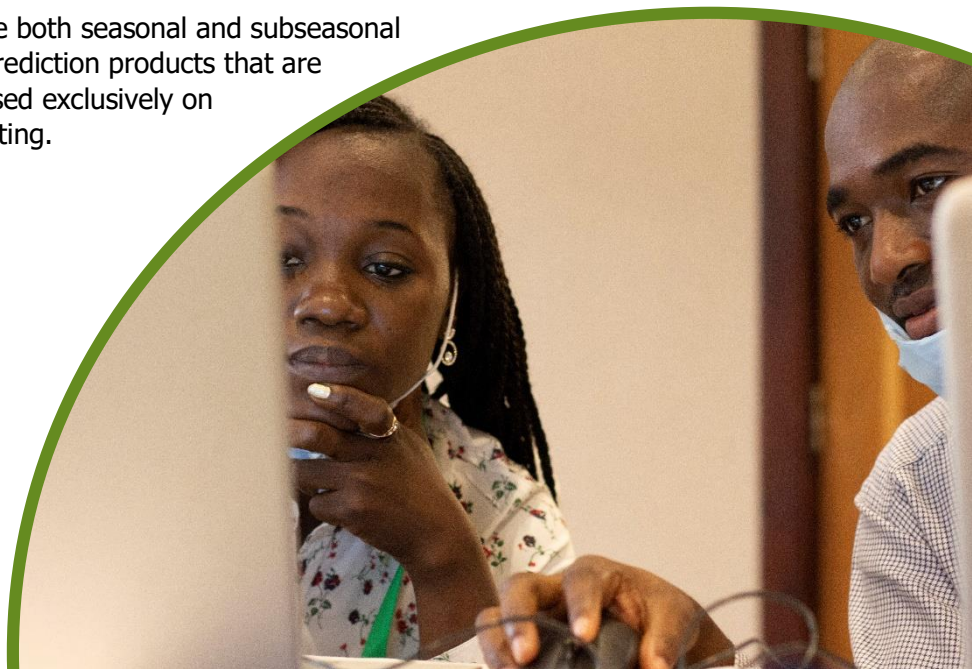
A major part of facilitating the access and wider use of climate information in decision-making by governments, as well as in the public and private sectors, has been the co-creation of climate information products tailored to the requirements of different "users," whether they be at the local, national, or international level. A key platform for supporting this has been the IRI's Climate Data Library, which is a powerful and freely accessible online platform that allows users to view, analyze, download, and share hundreds of terabytes of multidisciplinary climate-related data through a standard web browser (Blumenthal et al., 2014). ICT solutions like this and especially co-created map visualizations (Amarnath et al., 2018) such as the IRI's interactive "maproom" visuals and graphs of climate data can play a large role in making climate information more usable by translating past, present, or future conditions into expected impacts and management advisories for different decision-makers (Christel et al., 2018; Daron et all, 2015).

The NextGen Forecasting Approach

NextGen is an approach to produce climate forecasts at timescales of weeks to months. It is based on more than 25 years of research at Columbia University's International Research Institute for Climate and Society, and is being implemented in different countries across the world.

The NextGen approach helps forecasters assess past model performance, which can inform how best to correct and combine different global climate models. It also helps forecasters select the best climate models for any region of interest through a process-based evaluation, and it automates the generation and verification of tailored predictions at multiple timescales at the regional, national or sub-national level. To produce these forecasts, an easy-to-use Python interface to the Climate Predictability Tool (CPT) called PyCPT is used. Under continuous development, this set of libraries enables the user to run CPT via Python scripts and Jupyter Notebooks, helping automate and mass-produce CPT tasks that will normally take significantly more time in the Windows version.

While the NextGen approach can generate both seasonal and subseasonal forecasts to provide weather-to-climate prediction products that are more seamless, the November 2021 focused exclusively on building capacity around seasonal forecasting.



Participants from Mali help each other to run PyCPT for the first time. The regional training provided an opportunity for spillover benefits and training beyond the AICCRA-targeted countries.

Meteorological services from 11 countries across East, Southern, & West Africa gathered in Kampala to advance climates services for improved resilience.

Objectives

Each of the three trainings carried out had distinct learning objectives and target competencies, which are outlined below:

<u>Training 1:</u> Climate Data Tool (CDT) and Automatic Weather Station Data Tool (ADT) Workshop

Length: 5 days (November 1-5)

The aim of this training of trainers (ToT) workshop was to provide *advanced* training on the Climate Data Tool (CDT) to national meteorological service staff in the East and Southern Africa region so that they could pass along expertise and cultivate skills related to the workshop's objectives within their respective meteorological services. The workshop also provided an opportunity to demonstrate a web-based application called Automatic Weather Station Data Tool (ADT).

Specific objectives included:

- Reviewing the different functionalities of the CDT tool
- Using CDT for data preparation, quality control, combining datasets, validation, analysis, and visualization
- Understanding the use and purpose of ADT

<u>Training 2</u>: IRI Data Library and Maprooms Workshop

Length: 5 days (November 1-5)

The aim of this workshop was to provide training on the navigation, understanding and use of Enhancing National Climate Services (ENACTS) maprooms for national meteorological service staff. In particular, the training demonstrated the use and potential applications of existing maproom products, including how best to communicate maproom information with a range of users.

Specific objectives included:

1. Explaining some of the statistics, maps, and graphs used in the maprooms
2. Navigating through the different components of the ENACTS maprooms
3. Understanding the specific use of some of the maproom products
4. Explaining maproom navigation and use to non-technical users

The workshop also provided an opportunity to learn about some new and upcoming features of the IRI Data Library software, namely maprooms developed in Python (instead of Ingrid), which will increase the ease with which national meteorological service staff can troubleshoot and update their own maprooms, and tools for systems administrators that facilitate installation and maintenance of the software.

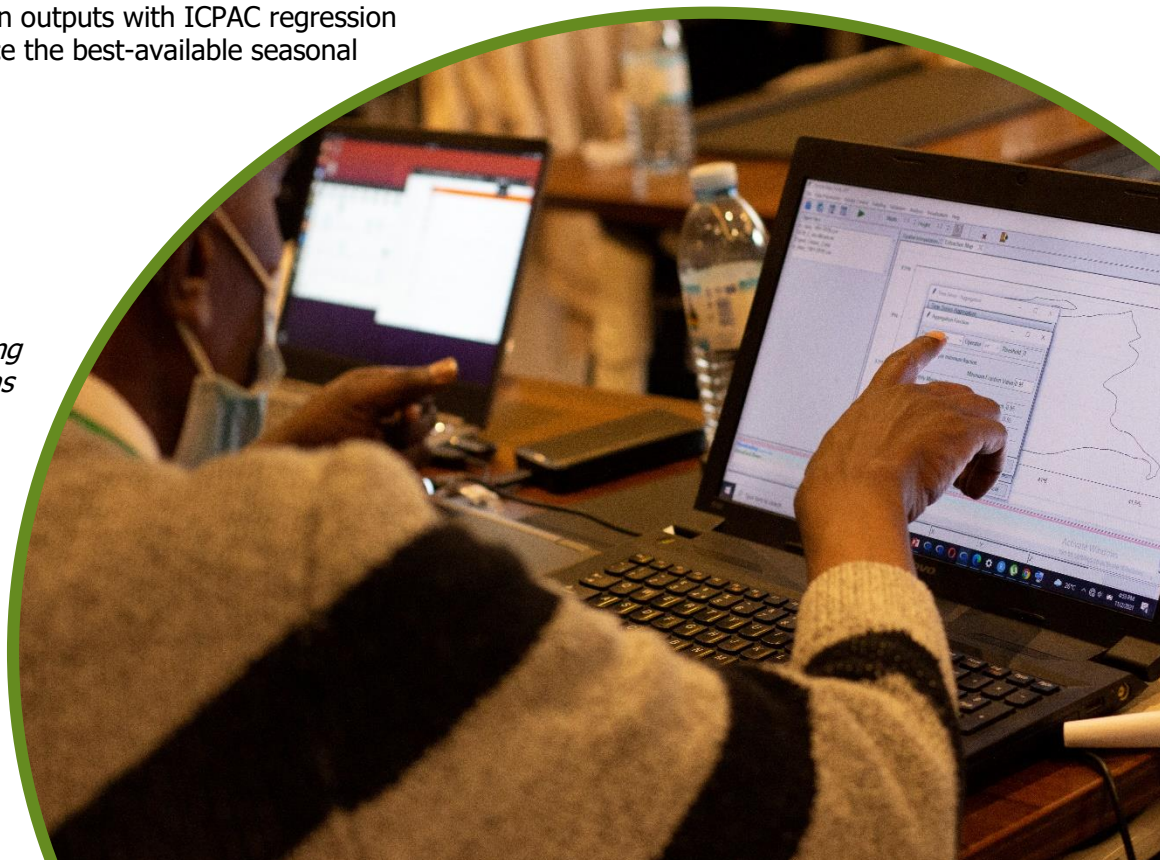
<u>Training 3:</u> Seasonal Forecasting Approaches: NextGen and ICPAC Regression Approach Workshop

Length: 6 days (November 1-6)

The aim of this workshop was to provide both theoretical background and practical skills towards generating high-skill seasonal climate forecasts, using both the "NextGen" approach combined with a regression approach developed through the IGAD Climate Prediction and Application Centre (ICPAC).

Specific objectives included:

1. Reinforcing knowledge of seasonal predictability for East and Southern Africa
2. Reinforcing knowledge around seasonal forecast methods including relevant statistical methods
3. Outlining the inputs to the NextGen forecasting system
4. Running PyCPT and explaining how to configure it to make the best forecasts in participants' home country, including forecast verification
5. Combining NextGen outputs with ICPAC regression methods to produce the best-available seasonal forecasts



Participants from Ethiopia practice running advanced CDT functions during group work.

Approaches and Methods

Participants

A total of 44 participants representing 11 national meteorological services and one regional Clilmate Center (ICPAC) participated in the workshop.

While the regional training initially was to target just the AICCRA countries (Ethiopia, Kenya, and Zambia), the topics and skills to be covered in the training were in high-demand by other countries in the East and Southern Africa region, and critical capacity building to strengthen meteorological services was long-overdue due to the COVID-19 pandemic. To maximize the impact of the training, therefore, and ensure its benefits spilled over into neighboring countries not formally included as AICCRA target countries, the organizing team synergized its efforts with related projects and invited participants from the meteorological ccountries of the following countries:

List of Particiipating Countries and Invitees		
No.	Country	Number invited
1	Kenya *AICCRA country	6
2	Ethiopia *AICCRA country	5
3	Zambia *AICCRA country	6
4	Uganda	3
5	Tanzania	3
6	Sudan	3
7	South Sudan	3
8	Malawi	3
9	Zimbabwe	3
10	Mozambique	3
11	Mali	2
12	ICPAC (East Africa)	6

Moreover, due to the well-documented under-representation of women in science, technology, engineering and math (STEM) and in an effort to promote women's inclusion and leadership within climate services and AICCRA activities, each country was requested to have at least one-third of its participants (i.e. 1 out of 3 participants for most countries, or 2 out of 6 in the case of Zambia and Kenya) be women.

A full-list of participants who attended the workshop can be found in Appendix A.

It should be noted that participants from Mali, while not actually part of the East and Southern Africa region, were also invited and able to attend due to synergies with a related project.

Trainers and Format

The trainers included four staff from the IRI, three of whom were physically present in Kampala and one of whom joined remotely to conduct his respective sessions related to Training 3 (Seasonal Forecasting Approaches). Additionally, six staff members from ICPAC who had been previously trained by the IRI were present to assist with facilitation due to the hands-on nature of the trainings and desire for personalized attention for each learner. All trainers, facilitators, and organizers are also outlined in Appendix A.

Resources and Materials

In terms of materials, a Resource Drive (Google Drive) that contained the relevant manuals, PowerPoints, research, Zoom recordings, software files, and other related materials for each of the trainings was created, such that particiapnts could easily refer to them, both during the trainings and even after the trainings concluded.

For Training 3 (Seasonal Forecasting Approaches), an additional IRI Wiki page was set up as a repository containing all of the resources just mentioned, as well as links to the PyCPT software, tutorials, datasets, model outputs, and relevant publications.

Monitoring and Evaluation Approach

To monitor and evaluate the training, the team integrated opportunities for both written and oral feedback from participants. For formal written feedback, a self-assessment and feedback forms were developed jointly with the IRI and the Alliance of Bioversity International and CIAT. There was a 1) pre-training assessment and 2) post-training for each of the 3 trainings.

In addition to these feedback mechanisms, exercises were integrated throughout the trainings, as well as group project work and presentations, as supplemental checks on learning outcomes.

Schedule of Training

A full, detailed schedule of the each of the 3 trainings can be found in Appendix B. However, in terms of general time allocation for each training, the following was adhered to:

Training 1 (Climate Data Tool and Automatic Weather Station Data Tool): 5 days

Training 2 (IRI Data Library and Maprooms): 5 days

Training 3 (Seasonal Forecasting Approaches): 6 days

The regional training provided opportunities to share experiences and knowledge amongst countries in East and Southern Africa for the implementation of CDT, maprooms, and seasonal forecasting.

Key Results and Findings

The team was able to measure and gather feedback on the value of the three parallel trainings both through monitoring and evaluation (M&E) surveys, as well as oral feedback with each group and individual interviews with some of the participants. Below is a summary of both qualitative and quantitative evidence regarding learning outcomes and perceived value of the trainings.

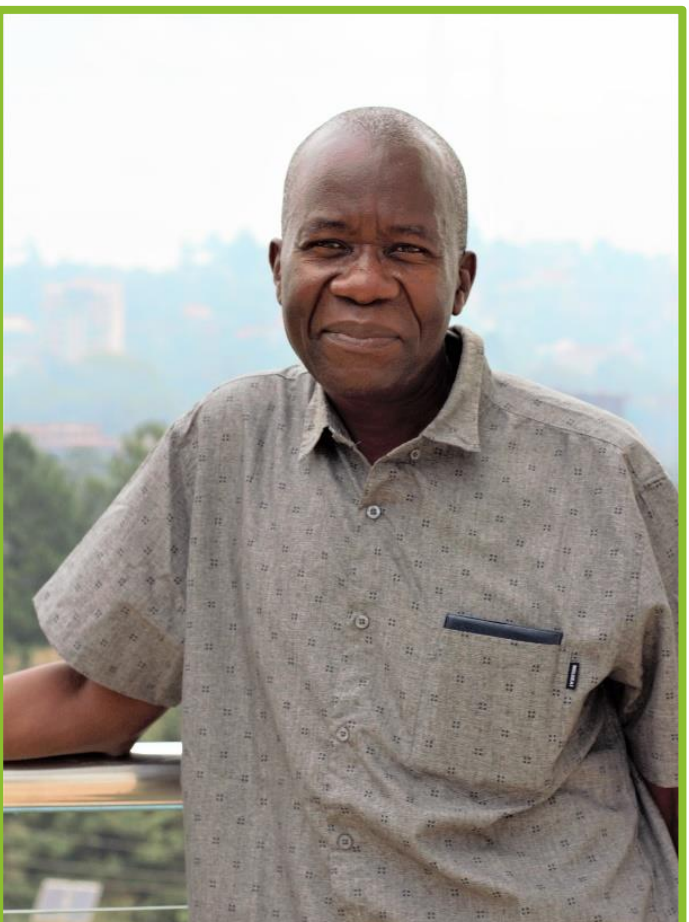
Training 1: Climate Data Tool and Automatic Weather Station Data Tool

Participant Feedback

On average, the participants rated both the content (4.6) and facilitation (4.7), as between "good" and "excellent."

Most participants indicated that the most valuable part of this training was the instruction on how to merge station and satellite data (the ENACTS approach). Other valuable components cited included improved ability to interpolate, prepare, and validate data using CDT, as well as awareness of the ADT functionalities and possibilities, even if it is not yet available for use by most participating national meteorological services yet. However, they would have liked to have more time to explore individual applications of CDT and have hands-on practice with data from their own countries. In other words, participants found value in the breadth of topics covered but felt additional training was needed to give appropriate depth on the many uses and applications of CDT.

Participants also indicated that they saw a lot of value in doing the training together as a region rather than separately in their respective countries. Most felt that doing the combined regional training important for networking, sharing experiences on how others handle similar or new challenges in climate science, and building synergies and would like to see more of them. For focused trainings to meet the specific needs of individual countries, individual trainings are still desired. In other words, almost all participants wanted to see more regional trainings of this nature as a complement, but not a replacement, for individual trainings on the topic of CDT in their countries.



"DOING THIS TRAINING AS A REGION WAS VERY VALUABLE. WE NOW UNDERSTAND THAT SOME COUNTRIES ARE AHEAD IN THE USE OF CDT, WHILE OTHERS ARE STILL STUCK. WHEN YOU BRING US ALL TOGETHER, WE CAN SHARE EXPERIENCES AND SEE WHAT OTHER COUNTRIES ARE DOING."

-Ismael Lutta, Climate Data Management Assistant, ICPAC

Participants of the Training 1 (Climate Data Tool and Automatic Weather Station Data Tool Workshop) pause for a group photo.

Training 2: IRI Data Library and Maprooms Workshop

Participant Feedback

For the IRI Data Library and Maprooms Workshop, participants appreciated the instruction to improve their foundational knowledge on climate basics, as well as exposure to different maproom products from different countries and their specific applications. Seeing what kinds of products are available in other countries that are different from their own, such as with Ethiopia's extensive suite of maprooms, was also motivating and useful for participants to articulate and anticipate their own maproom wants and needs. Lastly, the advice and training received on how to explain maproom products and outputs to non-technical users (i.e. those who are not necessarily working with a national meteorological service) was also cited as one of the most valuable parts of the training.

Participants of the Training 2 (IRI Data Library and Maprooms) gather for a group photo after wrapping up their training.

Training 3: Seasonal Forecasting Approaches: NextGen and ICPAC Regression Approach Workshop

In terms of learning outcomes, a major accomplishment of this training was that each participant was able to produce the seasonal forecacst using PyCPT for his/her country.

Participant Feedback

For the Seasonal Forecasting Workshop, participants appreciated the hands-on nature of the training and that they were able to generate the seasonal forecast for their respective countries using PyCPT. They found discussion of the influence of the El Niño-Southern Oscillation (ENSO), output map interpolation, and practice choosing the best models over their country and/or different parts of their country valuable.

Many participants, as a next step, requested the organization of additional advanced trainings on the PyCPT dictionary for the seasonal forecast, as well as on producing sub-seasonal forecasts (the time period of about a week to a month ahead). In the post-training survey, all participants who responded indicated that they plan to implement the new skills and knowledge gained during the training by sharing the methods, resources, and tools with their colleagues on the forecasting teams, which was the goal of the ToT. Several also highlighted that the skills were not only just useful, but immediately useful and that they are planning to now use the PyCPT approach to produce their forecasts.

Participants of Training 3 (Seasonal Forecasting Approaches) pause for a photo after wrapping up an afternoon producing the seasonal forecasts for their countries with PyCPT.

Gender

The inclusion of women in capacity building efforts is an essential catalyst to ensure that the perspective of women is integrated in the development of climate services in Africa and in strengthening the position of women as scientists, meteorologicsts, and leaders in decision-making for climate adaptation. Despite this, women are under-repesented in science, technology, engineering, and mathematics (STEM) generally, and the field of meteorology is no exception.

The AICCRA regional training for East and Southern Africa therefore made intentional efforts to include female meteorologists and data managers across all three component trainings. As such, a total of 13 of the 44 total participants (30%) were female. In the Seasonal Forecasting Approaches Workkshop (Training 3), 7 out of the total 17 participants (41%) were female.

"For this training, we had many women. It really builds our confidence. We can do it. Even for the difficult things like programming languages, we are here. I am out here doing it! Women can be powerful and very strong! It is not only men."

-Doreen Anande, Meteorologist, Tanzania Meteorological Agency`

"I was really happy when I saw the training invitation letter requiring women. In Kenya and even the whole of Africa, the people who are most affected by climate change are women. It's good to be able to be given a platform to express what goes on with women and to understand it, so we can give better advice to the communities."

-Rose Lekalesoi, Meteorologist, Kenya Meteorological Department

The training provided a forum for female forecasters across East and Southern Africa to network and share experiences and forecasting methods from their respective countries and regions.

Conclusions and Recommendations

The AICCRA Regional Training for East and Southern Africa met the need of AICCRA target counties (Kenya, Ethiopia, Zambia) and surrounding countries in the region and beyond for critical capacity building on tools, approaches, and methods for climate risk management. In particular, trainings on the Climate Data Tool and Automatic Weather Station Data Tool, the IRI Data Library and Maprooms, and Seasonal Forecasting Approaches provided venue for meteorologists and data managers from 11 countries and a regional meterolgical service center (ICPAC) to strengthen their knowledge and skills related to improving the quality of climate information, the visualization of that information for decision-makers, and the production of high-skill seasonal forecasts.

While the trainings were effective in improving knowledge and skills in these areas and especially in sharing knowledge, experiences, and ideas amongst the participanting countries for how their respective climate services can be improved, additional training is still required, especially in the domain of advanced CDT functions and in extending the use of the PyCPT forecasting approach for the sub-seasonal time scale that is most relevant for decision-makers like farmers.

Moreover, although the training in this instance was done on a regional level to accommodate practicalities relating to restricted travel following from the COVID-19 pandemic, the oral and written responses to such a format were overwhelmingly positive. Reasons cited included improved networking and cross-national collaboration, knowledge and experience sharing amongst countries, opportunities for inspiration and motivation (Many participants were impressed and motivated by Ethiopia's expansive suite of Maproom products, for example), and improved accountability and monitoring of progress towards implementing these tools (especially at a regional level). However, participants were clear that such regional trainings should act as a complement and not a replacement for focused country-specific trainings on these topics.

Going forward, therefore, the AICCRA program might prioritize periodic implementation of such trainings at a regional level for the reasons participants cited, as well as to maximize spillover benefits to countries not formally involved with the project but with similar and exigent needs related to the same kinds of capacity building for improved climate services.

Appendices

APPENDIX A : Participants, Trainers, and Organizers

List of Participants: Training 1 (CDT and ADT)				
No.	Name	Gender	Country	Email
1	Zachiarias Maru	M	Ethiopia	zekariasmaru@gmail.com
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9	Dolly Elviegi Faustino	F	South Sudan	elviegijoe@gmail.com
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11	Joyce Banda	F	Mali	bbandajoy@gmail.com
12	Marta Mbeve	F	Mozambique	mbevemarta@gmail.com
13	Okoth Kabaka *also assisted in training	M	East Africa (ICPAC)	Okoth.Kabaka@igad.int
14	Ismael Lutta *also assisted in training	M	East Africa (ICPAC)	Ismael.Lutta@igad.int

List of Participants: Training 2 (IRI Data Library and Maprooms)				
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4	Lillian Mzyece	F	Zambia	mamzyece@gmail.com
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10	Tolani Kanyenda	M	Malawi	tolanikanyenda@gmail.com
11	Jose Sequeira	M	Mozambique	jasequeira.JS@gmail.com
12	Leta Bekele	M	Ethiopia	letaabreham@gmail.com
13	Herbert Misiani *also assisted in training	M	East Africa (ICPAC)	Herbert.Misiani@igad.int

List of Participants: Training 3 (Seasonal Forecasting Approaches)				
No.	Name	Gender	Country	Email
1	Bekele Abeshu	M	Ethiopia	bekeleabeshu@gmail.com
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List of Trainers and Organizers							
No.	Name	Training	Gender	Organization/ Project	Location (base)	Position	Email
1	Tufa Dinku	2 (Maprooms)	M	IRI	New York	Senior Research Scientist/ENACTS Lead	tufa@iri.columbia.edu
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3	Andrew Robertson	3 (Seasonal Forecasting)	M	IRI	New York	Senior Research Scientist/Climate Group Lead	Awr@iri.columbia.edu
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APPENDIX B: Schedule of Training

Opening Session: Monday November 1, 2021:

Time	Content	Facilitator
08:30-09:30	• Arrival and registration • Introductions	Organizers (Amanda Grossi, Addah Magawa, Anne Miki)
09:30-10:00	Opening remarks • UNMA (Guest of Honour) • IRI • ICPAC • CCAFS	Mr. Festus Luboyera/ representative Tufa Dinku George Kakaka Teferi Demissie
10:00-10:30	Introduction to the training	Tufa Dinku
10:30-11:00	Coffee break and pictures	Organizers

For all days:

Morning Coffee Breaks: 10:30-11:00

Lunch Break: 13:00-14:00

Afternoon Coffee Break: 15:30-16:00

Agenda for Training 1

Climate Data Tool (CDT) and Short Demo of Automatic Weather Station Data Tool (ADT) Workshop
November 1-5, 2021

Day	Content	Facilitator
November 1 (Monday)	**Review** • Overview CDT main menu • Data Preparation and processing • Climate Data Quality Control	Rija Faniriantsoa
November 2 (Tuesday)	**Review** • Interpolation for climate data • Reanalysis downscaling • Merging station observation with satellite rainfall estimates and reanalysis data • Validation of gridded data (satellite rainfall estimates, reanalysis)	Rija Faniriantsoa
November 3 (Wednesday)	• Overview: CDT data analysis and visualization • Daily rainfall analysis	Rija Faniriantsoa
November 4 (Thursday)	• Rainy season analysis • Climate Extremes Indices • Drought indices	Rija Faniriantsoa
November 5 (Friday)	• Spatial Data Analysis • Demonstration on AWS Data Tool • Connection with CDT	Rija Faniriantsoa

Agenda for Training 2

IRI Data Library and Maprooms
November 1-5, 2021

Day	Content	Facilitator
November 1 (Monday)	• Overview of training • Climate Basics	Tufa Dinku
November 2 (Tuesday)	• Overview of ENACTS maproom • Climate Analysis Maprooms • Climate Monitoring Maproom	Tufa Dinku
November 3 (Wednesday)	• Climate Forecast Maprooms • Climate and Agriculture	Tufa Dinku
November 4 (Thursday)	• Climate and Health • Climate and Water • Overview: The new version of ENACTS maproom	Tufa Dinku Aaron Kaplan (afternoon)
November 5 (Friday)	Project work and presentations	Tufa Dinku

Agenda for Training 3

Seasonal Forecasting Approaches: NextGen and ICPAC Regression Approach Workshop
November 1-6, 2021

Day	Content	Facilitator
November 1 (Monday)	Introductions Workshop Outline NextGen Intro (AR) Seasonal predictability of E African Climate & ICPAC PyCPT System (ICPAC) Python and Jupyter Notebooks (BS) Installation of PyCPT (ICPAC) Running PyCPT demo (BS)	Andrew Robertson (morning) Bohar Singh (afternoon)
November 2 (Tuesday)	CPT Forecasting methodology concepts + demo II (AR) Hands-on: Training and validating a CPT model (1 GCM) MOS techniques: CCA and PCR (BS) Hands On continued	Andrew Robertson (morning) Bohar Singh (afternoon)
November 3 (Wednesday)	Global Ensemble Prediction Systems: NMME (AWR) Making a Forecast: Probabilistic forecast products, Flexible representation of forecast (AWR) Hands On with NMME - multi model ensemble Regression model validation and Forecast verification (BS) Hands On continued	Andrew Robertson (morning) Bohar Singh (afternoon)
November 4 (Thursday)	Global Ensemble Prediction Systems: The European models (AWR) Hands On: C3S	Andrew Robertson (morning) Bohar Singh (afternoon)
November 5 (Friday)	Country presentations of results Wrap-up session	Andrew Robertson (morning) Bohar Singh (afternoon)
November 6 (Saturday)	ICPAC Regression Seasonal Forecasting approach	ICPAC

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