

Training Workshop on Numerical Weather Prediction to Improve Forecasting and Analysis of Meteorological and Earth Observations Datasets in Southern Africa Region

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Workshop Report



AICCRA
Accelerating Impacts of CGIAR
Climate Research for Africa



Training Workshop on Numerical Weather Prediction to Improve Forecasting and Analysis of Meteorological and Earth Observations Datasets in Southern Africa Region

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November 2022

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About AICCRA reports

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 AICCRA

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About the authors

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Background

It is a well-established fact that anthropogenic climate change is amplifying the natural climate variability and extreme events (IPCC-AR6, 2018)¹. The IPCC-AR6 report confirms that climate change affected and will continue to affect African economy and society negatively although it contributes less than 4 percent of global emissions. It also indicated that Africa is warming faster than the global average where certain parts of Africa could warm up by 2.6–4.8°C by 2050. The same report highlighted that hydro-meteorological hazards due to climate change and variability (e.g., droughts, floods, windstorms, tropical cyclones, landslides and wildfire) will increase in the continent, with evidence of greater damage to the economy, ecosystem and society. The coastal systems and low-lying areas of Africa are particularly sensitive to changes in sea level, ocean temperature and ocean acidification. Consequently, extreme weather is listed as the second most severe risk on a global scale over the next 10 years in the Global Risk Report 2022 of the World Economic Forum². The improved early warning systems using various models including the Numerical Weather Prediction (NWP) can, therefore, assist with mitigating the severity of disasters associated with climate extreme events by improving both the accuracy and the lead-time of weather forecasts.

Running NWP, however, requires massive computer power, intensive trainings on customization/development, data assimilation, GIS-based data visualization, and others. Specifically, the NWP model uses High Performance Computing (HPC) systems to produce quality forecasts with high resolution in a timely manner. The HPC is an ultramodern technology that helps to provide sufficient computational resources and improve the accuracy of short-term weather forecast systems models. Sadly, many African countries are lacking the HPC systems and unable to mitigate weather and climate related natural disasters. In response, the United Nations has tasked the World Meteorological Organisation (WMO) with spearheading action to ensure everyone on earth can access early warning systems in an effort of increasing climate adaptability and resilience. African countries also encouraged to forge partnership with national, regional and continental programmes to make the HPC systems available on the continent. In this regard, the Southern African Development Community (SADC) region is striving to improve its HPC, NWP, and geographic information system (GIS) infrastructure and expertise.

A project was, therefore, initiated through the Climate Research for Development (CR4D)³ initiative to improve NWP skills in six SADC countries namely Botswana, Mozambique, South Africa, Namibia, Tanzania and Zambia. This project allowed HPC specialists and weather scientists in these countries to collaborate on the implementation and running of an NWP model called the Weather Research and Forecasting (WRF) model on HPC systems hosted in all six countries. Through the project, the scientists compared the performance of NWP models used in SADC when simulating high impact weather; studied sensitivity of simulations to cloud microphysics; planetary boundary layer schemes; cumulus schemes; as well as to resolution and multi-nesting. While the project focused on NWP modelling, it recognized the gravity of challenges across the whole value chain of multi-hazard early warning systems in the SADC region. The observation network remains sparse, which means more investments are needed for the deployment of

¹ <https://www.ipcc.ch/assessment-report/ar6/>

² https://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2022.pdf

³ CR4D is an African-led initiative aims at strengthening the links between climate science research and information needs to support development planning in Africa. It is supported by the partnership between African Climate Policy Center (ACPC) of United Nations Economic Commission for Africa (UNECA), African Ministerial Conference on Meteorology (AMCOMET), World Meteorological Organization (WMO), and Global Framework for Climate Services (GFCS) where CCAFS – now AICCRA – is the member of the CR4D's Institutional Collaboration Platform.

more ground sensors. Moreover, targeted training is lacking on how to run NWP model and use combined satellite information with in situ observations. These challenges call, among others, for capacity building training that develop expert's skills on the usage of HPC systems, available open source software such as WRF and running NWP models.

A physical training workshop was, therefore, organized by the International Livestock Research Institute (ILRI) – Accelerating Impacts of CGIAR Climate Research for Africa in Eastern and Southern Africa (AICCRA-ESA) in collaboration with the South African National Integrated Cyber-Infrastructure Systems (NICIS)'s Centre for High Performance Computing (CHPC), the National Research Foundation (NRF)–South African Environmental Observation Network (NRF-SAEON), the South African Weather Service (SAWS), the African Climate Policy Centre (ACPC) of the United Nations Economic Commission for Africa (UNECA), WMO – Regional Office for Africa, and the African Open Science Platform (AOSP) to train experts on NWP using WRF, Geographic Information System (GIS) and Python software.

Scope of Workshop

Trainers at the workshop focused on HPC concepts and NWP with a focus on weather research and forecasting (WRF) models, QGIS and the grid analysis and display systems (GrADS) geared to improve forecasting and the analysis of meteorological and earth observations datasets in the SADC region. Specifically, the training workshop focused on:

- **HPC for weather and climate modelling** – to introduce the concepts of HPC and their relevance to weather and climate modelling. This included a hands-on training of basic scripts to introduce the concepts.
- **NWP with a focus on Weather Research and Forecasting model (WRF)** – to introduce the concepts of NWP and WRF modelling on the Centre for High Performance Computing (CHPC) cluster and demonstrations on the use of Grid Analysis and Display System (GrADS).
- **Geographic Information System (GIS)** – to introduce the basics of displaying satellite products and NetCDF format datasets in QGIS.
- **Python** – to introduce the participants to analysing weather data with python, and the use of Jupyter Notebook.

Target Participants

This workshop brought together about forty experts from the National Meteorological and Hydrological Services (NMHSs), Higher Learning Institutions – hosts of HPC systems in most countries, and other custodians of environmental datasets from a number of countries within the SADC region. The invited delegates are from Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe. Representatives from Ethiopia, Kenya, the ACPC and the African Centre of Meteorological Application for Development (ACMAD) (based in Niger) and others also attended the training. The training was held at the NRF from 21 to 25 November 2022 in Pretoria, South Africa.

Welcoming Remark



Mr. Bishen Singh, the Group Executive: Finance and Business Systems and Chief Financial Officer of the NRF, told the delegates in the workshop's opening address that they were gathering at an opportune time. "This workshop occurs at a very critical point in time when the world has suddenly stepped up and taken note of the impact of climate change. You found a flurry of world leaders gathering to fast-track efforts in decarbonisation, renewables, and policy imperatives to move to lower carbon economies and sustainability efforts," Singh said. "This workshop, in essence, is well aligned to contribute to these initiatives as well as to the mandate of the NRF, as defined in our Act 23 of 1998 as amended, which includes the support, promotion and advancement of research and human capacity development to facilitate the creation of knowledge, innovation and development in all fields of science and technology."

Dr Jonas Mphepya, Weather and Climate Services Executive at South African Weather Service, said the importance of HPC and its optimal use for accurate weather forecasts cannot be understated. "The computing capabilities of HPCs drive weather predictions. The HPC is the engine. It is like a car, you cannot get further without that engine. "This training also is timely in a sense that in September there was a SADC Ministerial meeting where the SADC ministers responsible for the weather service met in Mozambique under the auspices of the AU. What they were there for was a call that came from the secretary general of the UN that in the next five years all countries must have access to an early warning system."



Dr Mary-Jane Bopape, Managing Director at NRF-SAEON, pointed out that the region was prone to severe weather events. "We have got a lot of floods, damage to property, loss of life and injuries that happen because of these events. This is for people who might still need to be convinced that we need early warning systems." Dr Bopape stressed that the region needs to get the utmost from its HPC facilities to make up for investments that are lower than those of Europe. This necessitated initiatives such as the training workshop. She said, "The European Centre for Medium-Range Weather Forecasts (ECMWF), for example, made an announcement around 2020 that it will be investing around €800 million in their HPC system, while the UK announced that it will be spending about £1.2 billion on its HPC system in the next few years. Those are not the type of investments that we can make on the continent. But

there are some contributions that we can make in modelling in general."



Dr Yosef Amha reiterated that climate variability and change in Africa have major implications for food and water security, threaten human health, and put fragile infrastructure under further strain. The NWP models are, therefore, important tools in the process of generating weather forecasts to benefit the communities. NWP models often use HPC systems and produce forecasts with high resolution in a timely manner. He added that AICCRA is collaborating with the African Climate Policy Centre (ACPC) and promotes the research outputs of the Climate Research for Development in Africa (CR4D) initiative including NWP models in use in Southern Africa". This project tested different model configurations and modified the boundary layer and cloud microphysics schemes in collaboration with six countries, namely, Botswana, Namibia, Mozambique, Tanzania, Zambia and South Africa.

He also said that "this capacity building workshop is one of the activities taken by AICCRA and its partners to improve forecasting and the analysis of meteorological and earth observations datasets in SADC region".

Opening Remark



Dr Happy Sithole, Centre Manager at the Council for Scientific and Industrial Research's National Integrated Cyberinfrastructure Initiative (NICIS), told the delegates that the southern Africa's recent and ongoing developments around HPC facilities indicated the region has entered a new era on weather and climate forecasting. "NICIS is home to the Centre for High Performance Computing (CHPC), which is widely credited for increased research in weather and climate modelling in South Africa," Dr Sithole said. "Its construction, which kicked off in 2007, was the beginning of the end of so called "suitcase science". He described this concept as the reliance on overseas countries for research to improve weather forecasting and other HPC reliant sciences. "Prior to

the building of the CHPC, we were doing what we call "suitcase science", because for you to have access to scientific resources, you had to pack your suitcase and either go to Europe or the US or Asia. You all know that those countries, with their resources, have their mandate. It means that the priorities of those countries are directed to the mandates of their countries," said Dr Sithole. "In that, it was obvious that whatever that we planned to do, as African countries, was always going to remain behind. Hence, we put this to our government that we would like to have these facilities in the continent." Thanks to the SADC Cyber Infrastructure Framework, HPC centres are being rolled out across the region, Dr Sithole added. "One of the key sellers in the SADC Cyber Infrastructure Framework is that we will have to harmonise how we deal with climate issues in the region. The challenges that we see on climate broadly require collaboration," he said. The HPC infrastructure projects were now completed in many SADC countries, Dr Sithole added. "We are left with only five countries. Already this year we are working with Eswatini where we deploying a system. We have done the groundwork and established the data centre. We are confident that before the end of this year, Eswatini will be having their own HPC systems. By the end of this year, we expect that we will be left with three countries."

Overview Presentation

Dr. Frank Rutabingwa – a senior expert from the ACPC and Dr. Yosef Amha – a researcher at AICCRA presented about the overview of CR4D and AICCRA respectively. Moreover, Dr. Mary-Jane Bopape, a managing director of the South African Environmental Observation Network (SAEON), National Research Foundation (NRF), also presented about the overview of the training.

Training Programme

High Performance Computing (HPC) – CHPC

For this training course, student accounts were created on the CHPC LENGAU cluster for each participant. The participants learnt simple Linux commands and the procedure to log onto Lengau cluster. Further demonstrations included loading modules and the writing of a simple bash shell script using the text editors VIM and NEDIT (a text editor graphical user interface (GUI)). Moreover, they practiced how to write a simple PBS jobscript that are included in the PBS parameters, environment software modules, and MPI commands; submitting and monitoring jobs; and a discussion on scaling job sizes on LENGAU. Since the CHPC cluster uses PBSPro as its job scheduler, with the exception of interactive jobs, all jobs are submitted to a batch queuing system and execute when the requested resources become available. All batch jobs are queued according to priority. The CHPC also uses the “Fairshare” facility of PBSPro to modify priority based on activity to ensure the resources of the CHPC cluster are shared fairly amongst all users. Participants were also exposed to the following topics during the hands-on exercise:

- a) A list of commands typically used in the weather and climate modelling activities on LENGAU.
- b) Commands needed to create a file called `chpc_staff.txt`
- c) Commands needed to create a second file called `numbers.txt`
- d) Commands that will sort the names in `chpc_staff.txt` in alphabetical order, remove all duplicates and write the result file called `sorted_chpc_staff.txt`
- e) Commands that will count the number of lines present in `sorted_chpc_staff.txt`, which was created in question c
- f) Commands that will print the top 3 lines of `sorted_chpc_staff.txt`
- g) Commands that will print the bottom 4 lines of `sorted_chpc_staff.txt`
- h) Commands that will sort the numbers in the file `numbers.txt` in numerical order and write these to a file called `sorted_numbers.txt`
- i) Commands that will print the top two numbers in `sorted_numbers.txt`
- j) Commands that will print the bottom two numbers in `sorted_numbers.txt`
- k) Commands that will print the middle two numbers in `sorted_numbers.txt`? (*Hint: You should get the numbers e and g as the result*)
- l) Commands that will remove all files that end with `.txt`

Weather and Research Forecasting Model (WRF) – SAWS

This part of the course utilized compute resources from the LENGAU HPC system. The participants were comprehensively taken through the finer details of configuring and installing WRF on HPC architectures with specific reference to the South African HPC system, followed by detailed discussions on the;

- WRF Pre-Processing System (WPS) i.e., setting up a WRF run by configuring the model domain and forcing data.
- WRF Solver (WRF) i.e., setting up the WRF name list including solver options and finally submitting and monitoring the simulation.
- A discussion on WRF in operational use and Data Assimilation
- Running WRF

For the WRF practical session the participants interacted with the WRF source code, download input forcing files, set up the runtime WRF libraries and environment i.e. the “setWRF” script developed by Charles Crosby and finally load the WRF module to set up a simulation on the LENGAU cluster. The homework given to the participant here was to go home and together with ICT professionals work on installing WRF in their respective institutions as the general procedure had been outlined in the workshop. Participants uploaded and trained on WRF model using the links below:

- WRF Homepage>: <http://www2.mmm.ucar.edu/wrf/users/>
- WRF Registration page>: <http://mailman.ucar.edu/mailman/listinfo/wrf-news>
- WRF Model: <http://www2.mmm.ucar.edu/wrf/users/downloads.html>
- WRF ARWpost: http://www2.mmm.ucar.edu/wrf/users/download/get_source.html
- WRF online tutorial>: http://www2.mmm.ucar.edu/wrf/OnLineTutorial/compilation_tutorial.php
- WRF High-resolution geographical datasets webpage>:
http://www2.mmm.ucar.edu/wrf/users/download/get_sources_wps_geog.html

QGIS (Quantum Geographic Information System) and PYTHON

This session involved distinguishing GIS data types and use of the QGIS User Interface, and map layers. In addition to this, day 3 and 4 of the workshop involved using QGIS for geospatial data analysis and Google Colaboratory to run a Jupyter Notebook (.ipynb file extension) for Python coding. The presentation slides and exercises are attached to this report as an appendix.

- Introduction
- Raster vs Vector files
- Demo
- Hands-on session: Import NetCDF
- Questions & Bonus Task
- Plugins e.g. Google Earth Engine
-

The introduction to python code (syntax and data types) can be found at the link below https://drive.google.com/drive/folders/1ZYn9Smn123VBfkeVdeSvYZPFxP2Dav9y?usp=share_link. This tutorial below demonstrates how the weighted mean of seasonal temperatures are calculated. NetCDF Visualisation - Colaboratory (google.com)

Participants were also trained on Grid Analysis and Display System (GrADS). GrADS is an interactive desktop tool that is used for easy access, manipulation, and visualization of earth science data. GrADS has two data models for handling gridded and station data. Thus, the GrADS session covered;

- Reading gridded data files,
- Understanding GrADS descriptor files,
- Dimension environment,
- GrADS visualization

The GrADS tasks were as follows;

- 1) Login to the cluster using your student account ssh -X: username@lengau.chpc.ac.za
 - Login to the visualization node: ssh -X chpclic1
 - Load the GrADS module: module avail 2>&1 | grep -i “grads”
 - module load chpc/earth/grads-2.1.a3
- 2) Check if the module is loaded
 - module list
- 3) Change directory to your “lustre” dir
 - cd lustre

- 4) Decompress the tarred file
 - tar -zxvf GrADS.tar.gz
 - Open GrADS
 - Open NetCDF file (use "sdfopen" command)
 - Know the content of the file
 - Display a variable

Closing Remark

On behalf of AICCRA, Dr Yosef Amha urged the delegates to impart the knowledge garnered at the workshop to colleagues and students at their institutions. "As you know, training has not ended here. Try to address more people when you go back home to share all that you acquired here from your colleagues."

Dr Mary-Jane urged the scientists to demonstrate to their governments and funders that the climate research field needs more investments. "As you go home and start to write research proposals to get more resources to do your work, mention this and make it very clear to the funders or to the governments that we need more investment." She wished a safe travel to all participants.

Agenda for the NWP and GIS Training

21-25 November 2022 in Pretoria, South Africa

I. Topics to be covered	
High Performance Computing (HPC) - CHPC <ul style="list-style-type: none"> • Linux for High Performance Computing • Simple PBS jobscript • Running the jobscript • Scaling on LENGAU 	Python - SAEON <ul style="list-style-type: none"> • Libraries and Syntax • Python and NetCDF files Examples
Weather and Research Forecasting Model (WRF) - SAWS <ul style="list-style-type: none"> • WRF Libraries and Configuration • WRF Pre-Processing System (WPS) • WRF Solver (WRF) • Some thoughts on WRF in operational use and Data Assimilation 	QGIS - SAEON <ul style="list-style-type: none"> • Introduction • Rastor vs Vector files • Demo, Hands-on session: Import NetCDF • Questions & Bonus Task • Plugins e.g. Google Earth Engine
II. Team members for the training	
<ul style="list-style-type: none"> • Robert Maisha: South African Weather Services (SAWS) • Gift Rambuwani: South African Weather Services (SAWS) • Patience Mulovhedzi: South African Weather Services (SAWS) • Claire Davis Reddy: South African Earth Observation Network (SAEON) • Galaletsang Keebine: South African Earth Observation Network (SAEON) • Keneilwe Hlahane: South African Earth Observation Network (SAEON) • Caroline Mfopa: South African Earth Observation Network (SAEON) • Mthetho Sovara: Centre for High Performance Computing (CHPC) 	

III. Schedule

Time	Activities	Responsibility
DAY 1 – 21 Nov. 2022 (First Session before coffee/tea break)		
Session 1 – Opening		
09:00 – 09:30	Registration	Organizers
09:30 – 10:00	Welcoming Remark	Mr. Bishen Singh, the Group Executive: Finance and Business Systems and Chief Financial Officer of the NRF

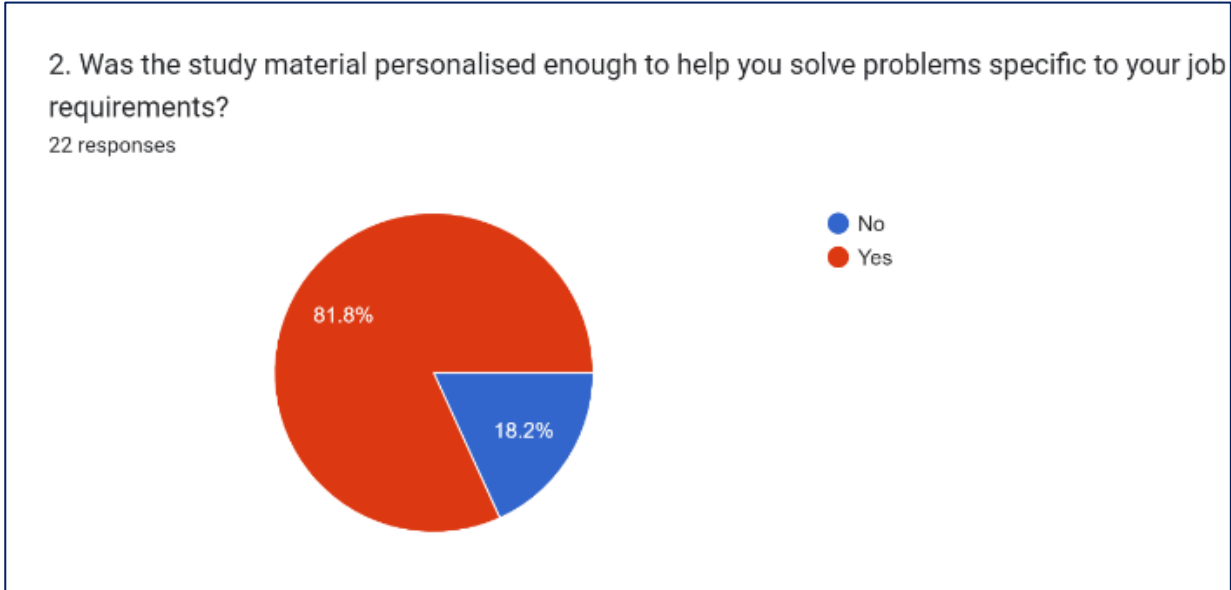
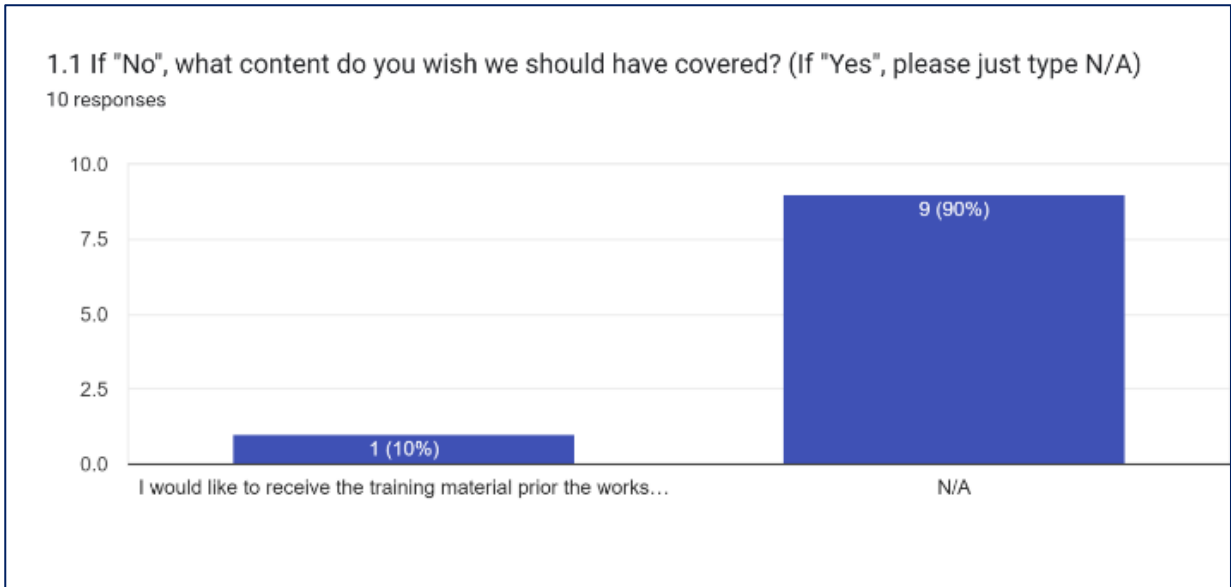
		Dr Mary-Jane Bopape - Managing Director, SAEON - NRF			
		Dr Yonas Mphepya			
		Dr. Yosef Amha, Researcher, AICCRA			
10:00 – 10:10	Opening remark	Dr Happy Sithole - Centre Manager, NICIS			
10:10 – 10:40	Introduction of participants	Participants			
Session 2 – Setting the Scene					
10:40 – 10:50	Overview of CR4D	Dr Frank Rutabingwa, CR4D-ACPC			
10:50 – 11:00	Overview of AICCRA	Dr Yosef Amha, Researcher, AICCRA			
11:00 – 11:15	Overview of the training	Dr Mary-Jane Bopape - Managing Director, SAEON - NRF			
	SESSION 1	SESSION 2	SESSION 3	SESSION 4	SESSION 5
	DATE	Monday	Tuesday	Wednesday	Thursday
		11/21/22	11/22/22	11/23/22	11/24/22
	TIME				
09:00 - 09:30	Welcome and Registration	Welcome and Registration	Welcome and Registration	Welcome and Registration	Welcome and Registration
09:30 - 11:00	Opening and setting the scene	WRF Configuration	QGIS & Python	QGIS & Python	GrADS Visualization
11:00 - 11:15	Break	Break	Break	Break	Break
11:15 - 13:00	Linux Basics	WRF (WPS)	QGIS & Python	QGIS & Python	Feedback Session
13:00 - 14:00	Lunch	Lunch	Lunch	Lunch	Lunch
14:00 - 16:30	HPC Basics	WRF (WRF)	QGIS & Python	GrADS Visualization	Closing event
16:30 - 17:00	Session 1 Round-up	Session 2 Round-up	Session 3 Round-up	Session 4 Round-up	Session 5 Round-up

List of Participants

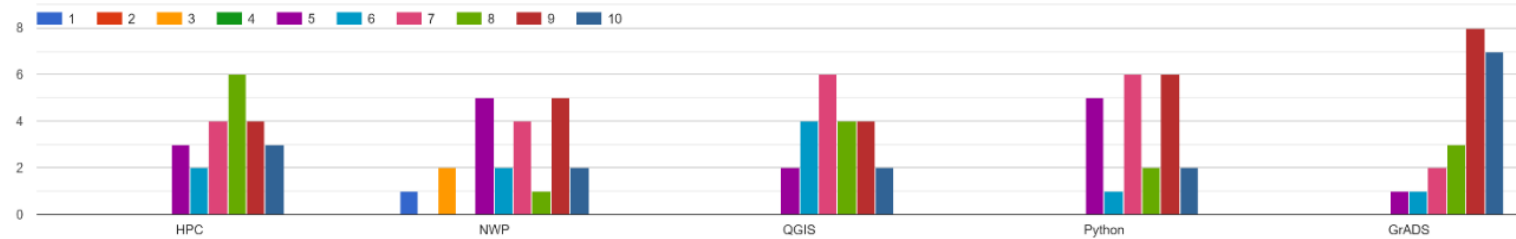
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Feedback results collected after completing the training workshop



3. On a scale of 1 to 10, how satisfied were you with each of the topics covered in the training? (1 = not satisfied; 5 = average; 10 = completely satisfied)



4. What do you suggest we improve in the future for each of the topics?

HPC – 18 responses

- Training that take more than 1 week
- In country exercises for particular NHMSs
- Establish the internet connection
- Installation of the libraries and modules because it tends to be hectic.
- Training Manual
- More on the scheduling and batch jobs
- More training on this issue, because this is new science for me
- Time was short though materials available would also ask to learn on administration of HPC
- To show how the structure of the HPC, the different servers: login nodes ? computing nodes ? storage nodes, and why users have to login on a server to do what ?
- May be a manual on the basic commands can be sent to the participants before hand so that they can get ready before coming to the training.
- It is better to have more time, tutorials and practice even remotely
- We need more time to really capture almost the all thing.
- I think everything was good, but in my point of view it would be good to bring things in detail like for example about scaling in HPC.
- A virtual workshop to prepare participants for the physical training and also will give the needed extra time to practice
- Well defined manual. Shared well in advance.
- Detailed step by step process and given a little more time. In other countries the service is not running and this is the opportunity to learn and go back home with enough background to kick start HPC
- Training manuals
- Provide notes

NWP – WRF – 19 responses

- Training that take more than 1 week
- On-line training, a week or 2 prior to physical meetings
- More time to practice the simulations in the platform
- Data assimilation
- Training Manual with appropriate exercises works
- Model configuration and runs
- More training on this because this is time to time introducing new things
- Time was short though materials are available

- The explanation was to fast
- (i) Clearer guideline for the participants;
- (ii) It would have been more helpful if the participants were able to run a very simple example during the hands-on session
- It is better to have tutorials at the same time while practicing
- Preparation needed more time to ensure that everything is working properly. We didnt see the end product.
- I think time is short to cover everything, so we didn't have time to explore, but the essentials remain and we can continue.
- For the facilitator to be more patient with participants and be open to the idea that not all participants in the room are fast followers/ learners.
- A virtual workshop to prepare participants for the physical training and also will give the needed extra time to practice
- Well defined manual. Shared well in advance. All examples should be tried and tested before. The facilitator was touching there and there. Explaining one flow and when asked to explain the flow he would go on explaining a different approach. So the flow was not consistent.
- Could be given more time and step by step guide provided so as to help freshman in NWP
- Training manuals
- Provide notes

QGIS – 19 responses

- Explore more the data visualization
- More time to explore the different plug-in such as GIS4WRF
- Explore more the capacity of another tools like SAGA and GRASS
- how to acquire shape files from the internet
- Training Manual
- More of Q4WRF
- I was not familiar with this by now I will investigate more on this ton know the functionality and more training will be good
- Required more time to comprehend.
- Add more examples,
- A guideline on what to install/ needed before the start of the training would have been helpful as some participants need admin rights to install software's.
- It is better to have tutorials as the same time while practicing
- The introduction part was well covered but using the plugins remained hanging. Facilitators needed to prepare in advance before presenting to the participants.
- It was very interesting but we didn't go until the end due to the short time.
- The facilitators should provide workbooks before hand so that we are able to follow along
- A virtual workshop to prepare participants for the physical training and also will give the needed extra time to practice
- Software to be used should be thoroughly checked and tested before the training. But in general, it was well done and it was fun to get outputs.
- There is need to do hands-on step by step that allows trainees to grasp concepts and be able to solve minor bugs on their own
- Training manuals
- Provide detailed notes for practice

Python – 18 responses

- Explore more the data visualization

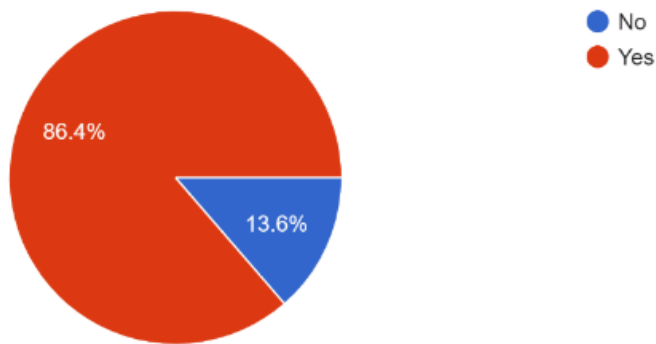
- Continued on-line support and training to enable practice, even having more exercises being shared via email or other platforms
- Nothing
- Making operational scripts
- Training Manual
- Modules
- more training
- PYTHON was fair, will continue with the material availed
- The hands-on was very good!
- It is better to have tutorials as the same time while practicing
- The presenter was too fast at some sessions
- This was well covered
- This topic was good, but many things were explained too quickly.
- A virtual workshop to prepare participants for the physical training and also will give the needed extra time to practice
- This was just basics. Well done
- There was need for more time and everything done step by step.
- Training manuals
- Provide detailed notes for practice

GrADS – 16 responses

- N/A
- Creation of a GrADS WhatsApp community to assist knowledge sharing
- Nothing
- automating the scripts
- Color bar scripts (contour color control)
- Managed to follow
- Pre-installation on the CHPC to improve before the practical session.
- No comment
- Resources provided are very useful
- So far so good GrADS is well covered
- Essential things have been covered in detail.
- A virtual workshop to prepare participants for the physical training and also will give the needed extra time to practice
- Well done.
- Great presentation and hands-on work. Everything was clear, however there is need to build on the work using similar method so as to increase trainee confidence in using Grads
- It was good
- N/A

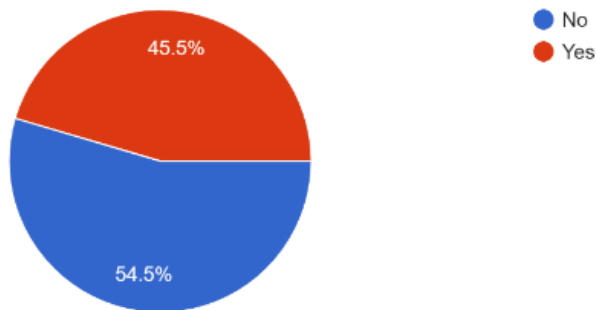
5. Were you able to get all of your questions answered during the training?

22 responses



6. Do you feel you were given enough time and resources to complete the training?

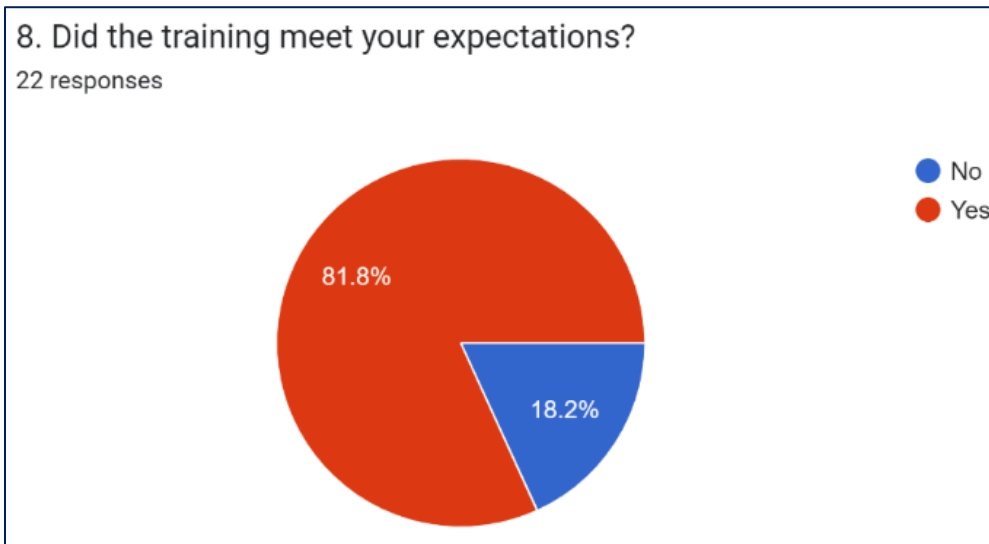
22 responses



7. What did you like the most about the training? (22 responses)

- HPC
- Interactive approach and multiple tutors as well as assistants that helped solve challenges encountered
- Thank you for the training as it is exactly what I wanted to do for a long time. I wanted to build my knowledge with these knowledge as a climate modeller
- Grads
- WRF and WPS configuration
- It was interactive.
- QGIS and GrADS
- The hands on sessions and direction to further resources
- all, but HPC, NWP and QGIS
- The Training was interactive and pointed where to find materials for further guidance
- "It was interactive, I appreciated the time dedicated to practical, learning by doing!"
- The logistic part was excellent. The timing also. But I regret about the electrical blackout which happen on Wednesday 24 November 2022 around 4 p.m to 5 p.m "
- Networking
- It motivates me to make more research on the tools and practice more.
- The hands in practical sessions

- GIS and Python
- I liked the way we learned GrADS and I also appreciated the QGIS and Python topics.
- The interactiveness of the sessions and how all the experts in the room were willing to assist participants during sessions.
- The interactive environment was encouraging open dialogue with instructors and other experts
- GrADS, QGIS, HPC
- The training covered very important aspects that are required to continuously improve forecasts and more so at micro-scale
- Time planning
- Coordination of the event



8.1 If "No", what are the shortcomings which you experienced during the training? (If "Yes", please type N/A) (22 responses)

- 14 responses were "N/A"
- Use Python
- More time was required with each
- Though time was short to comprehend everything
- I didn't know anything about Python and QGIS before the training, now I can use these tools to help me analysis and display Weather/Climate data.
- Timing was too short to cover all the topics. We're rushing from one topic to another.
- Some of the things we were doing them together with the facilitators as a result we did not see the final product. some things were not working
- I was mostly interested in understanding and improving my knowledge and confidence on WRF and Climate modelling. I don't think I have gained something in this context. This the part that should be improved in future. The rest (GrADS, Python and QGIS) are easy for me to learn on my own.
- The time was very short and everything hurriedly done and therefore leaving trainees having less appreciation of what they would have achieved.

9. Do you have any suggestions that can help us improve the training program? (20 responses)

- Training that take more than 1 week
- This training needs to be continued with other sessions to enhance the knowledge gained
- I wish we could have google drive for all materials and suggested materials to continue learning and have a follow up workshop maybe in 3 months to come.
- More time to practice WRF
- Have an online session before coming here physically.

- Training material provided before we start with the workshop as well all the presentations that were given during the workshop
- Add a few more days.
- Increase the time, 1 week is not enough
- Generally, it was GOOD, given the number of days
- Creation of web page for the training?
- Focusing on one or two topics would have been better.
- To allow participant accessing the HPC remotely for practice
- Climate Modelling training need more time so allocate more days and improve on the Perdiem
- Outside of the time that is short, I don't have many suggestions. Plus, it's complicated to have a training workshop that takes a long time, and my last suggestion is to keep the exchange of experience remotely so that we can move forward.
- Fewer tea breaks during the sessions as they at times interrupt productivity.
- Maybe regular check-ins via email to keep experts up-to-date and relevant after the training
- I think the right approach to do this is not to make assumptions of previously accumulated knowledge. Just share the information that is well explained and easy to follow like the ones for GrADS. It is not good to give the learners the impression that the concepts are difficult. I don't need to be reminded how Maths is difficult, or whether I did not like Maths at high school or not. I need an instructor who makes the difficult content easy to be digested. One of the facilitators was so short tempered (i.e., WRF). That's not how it supposed to be done. I hope this will be rectified in future for the benefit of all.
- The best would be to introduce one concept at enough time to assimilate the concept through enough time for practical's
- Preparation of training manuals that are well tested before the training
The provision of notes a week or two before session to get trainees ready.



AICCRA

Accelerating Impacts of CGIAR
Climate Research for Africa



About AICCRA

Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) is a project that helps deliver a climate-smart African future driven by science and innovation in agriculture.

It is led by the Alliance of Bioversity International and CIAT and supported by a grant from the International Development Association (IDA) of the World Bank.

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