Workshop report:

PYTHON FOR WEATHER AND CLIMATE DATA ANALYSIS

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INTRODUCTION

This report documents the workshop organised by Women in WACREN (WiW) on 'Python for weather and climate data analysis', held in Accra. The workshop is part of a series of initiatives aimed at strengthening women's skills in computer science, with a particular focus on the use of Python for the analysis of scientific data, especially those relating to meteorology and climate.

The event brought together participants from various academic and professional backgrounds, all committed to furthering their knowledge of programming and data analysis in the context of climate science. The workshop was designed to give these women the tools they need to analyse and interpret meteorological data, helping them make a significant contribution to research and initiatives to tackle climate challenges.

During the workshop, participants explored various data analysis techniques with Python, covering topics such as data manipulation with libraries such as Pandas, Matplotlib and Seaborn and climate trend analysis based on historical data. The workshop also served as a platform for exchanging ideas and experiences, strengthening the community of women scientists and computer scientists within the WACREN region.

This report summarises the activities carried out during the workshop, the skills acquired by the participants and the prospects for using Python to analyse weather and climate data.

I.   DAY 1: TUESDAY, 27 AUGUST

The first day of the workshop began with a welcome and registration of participants, followed by several speeches to welcome participants and highlight the importance of the event. Omo Oaiya, one of the moderators, introduced WACREN's objectives for the workshop, highlighting the importance of climate data analysis in the West African context.

Dr. Sena Kpeglo, Executive Secretary of the VCG, also took the floor to share a message of support, highlighting ongoing efforts to build capacity in West Africa. Dr. Eric Asuman, Acting Director General of GMeT, and Prof. Kabo-bah, representative of the Group on Earth Observation (GEO), also contributed by expressing their support for the program. Abigail Essel then presented the WiW program and its aspirations, highlighting the importance of including women in STEM fields.

The morning continued with a presentation on IoT technologies by Dr. Alowolodu, followed by a session on data collection techniques and best practices led by Dr. Naomi Kumi of Obafemi Awolowo University (OAU). Prof. Amos Kabo-bah of the University of Energy and Natural Resources (UENR) and Prof. Aderonke Okoya of the OAU then presented the regional activities of the WACREN-ICTP program, highlighting meteorological monitoring projects in Ghana and river pollution projects in Nigeria.

The afternoon was devoted to an introduction to climate data sources, as well as the analysis and visualisation of these data. Dr. Naomi Kumi detailed data sources such as reanalyses, satellite data and observations, before answering participants' questions in an interactive session.

The day ended with a session led by Doyin Afolabi from NITHUB on data analysis and visualization tools and techniques, covering time series, spatial maps, bar charts and pie charts.

II.   DAY 2: WEDNESDAY 28 AUGUST 2024

The second day focused on hands-on learning of Python and its libraries for climate data analysis. Mercy Mawunyo Apaw and Samuel Afful began with an introduction to the basics of Python and key libraries such as Numpy, Panda and Xarray, enabling participants to understand the types of weather data and their sources. This was followed by a presentation from NITHUB's Biodun Owadoye on the statistical analysis of weather data, covering concepts such as sums, averages, correlations and anomalies.

The afternoons were devoted to practical sessions where participants applied their newly acquired knowledge using Python to analyse climate data. Kingsley Ogbonna and Doyin Afolabi led these sessions, focusing on the pre-processing and formatting climate data using Numpy, Pandas and Xarray. The day concluded with group exercises, where participants worked on practical case studies, reinforcing their understanding and application of the concepts learned.

III.   DAY 3: THURSDAY, 29 AUGUST 2024

The third day saw advanced discussions on integrating IoT technologies with artificial intelligence and machine learning for climate data analysis, presented by Joshua Opoku Agyemang from the IoT Network Hub. This presentation paved the way for discussing open science and its importance in weather data analysis, moderated by Dr. Caleb Mensah of UENR.

Fatima-Bint Ibrahim from PyLadies then introduced Gitlab, an essential tool for creating, storing, managing and sharing code, reinforcing climate data analysis projects' collaborative and reproducible aspect. The afternoon was devoted to an interactive workshop where participants explored the construction and integration of advanced IoT solutions, followed by collaborative projects overseen by all the facilitators.

IV.   DAY 4: FRIDAY 30 AUGUST 2024

The final day of the workshop was dedicated to community involvement. Following registration, Abigail Essel opened the session with a welcome speech, followed by a special guest speaker. Theresa Sarpong from PyLadies and Luvina Sandra Atsu from Women In Tech then took the floor to discuss the impact of women in technology and strategies to increase this influence in climate data analysis.

GARNET presented a session on leveraging NRENs' capabilities to increase women's impact in climate data analysis. The discussion continued with strategies for sustaining IoT initiatives beyond the workshop, presented by Nutifafa Agbenor-Efunam and Joshua Opoku Agyemang. The day ended with a panel discussion on overcoming challenges and promoting gender

equality in STEM, followed by the closing ceremony hosted by Dr. Sena Kpeglo and Abigail Essel.

The workshop concluded with a gala dinner on the evening of Friday, 30 August 2024, providing participants with an opportunity to network and celebrate the knowledge and skills gained over four days of intense activity. The event not only enhanced participants' capabilities in climate data analysis but also fostered the emergence of an active and committed community for the future.

CONCLUSION

The Women in WACREN 2024 programme successfully achieved its objectives of training, collaboration and promoting gender equality in climate and weather science. Participants gained in-depth skills in Python programming, data analysis and IoT technologies, enabling them to contribute effectively to environmental monitoring initiatives in their respective regions.

The various sessions, from theoretical introductions to practical workshops and group discussions, encouraged interactive and dynamic learning. Exchanges with renowned experts and networking opportunities strengthened the women's scientific community within WACREN, creating lasting links and future collaborations.

In addition, discussions on the importance of open science and strategies for sustaining IoT initiatives after the workshop laid the foundations for ongoing and innovative projects. The closing of the programme underlined the collective commitment to the promotion of women in STEM. It highlighted the next steps to support and extend the initiatives launched during these days.

All in all, Women in WACREN 2024 not only enriched the knowledge and skills of the participants, but also strengthened the determination to pursue excellence and equality in the field of climate data analysis. This success paves the way for future editions and a continued expansion of efforts to integrate more women into environmental science and technology.

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Done at Ghana, 30 August 2024
Workshop rapporteur
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APPENDICES

Figure 1: flyer

Table 1: WiW 2024 Workshop_Programme

WOMEN IN WACREN 2024 - PROGRAMME			
Theme: Python for Weather and Climate Data Analysis			
Date : 27 - 30 August 2024			
Moderator: Effah Amponsah/Abigail Essel			
Day 1 : 27 August 2024			
8:00 - 9:00 am	**Arrival and Registration**	WACREN	**Time Allocation**
	Welcome Address		
	Welcome Addresses by WACREN	Omo Oaiya	5min
	Goodwill Message from VGG	Dr Sena Kpeglo (VCG, Executive Secretary)	2min
	Goodwill Message from GMeT	Dr. Eric Asuman (Ag. Director General)	2min
	Goodwill Message from Group on Earth Observation (GEO)	Prof Kabo-bah (Board Ghana Principal)	2min
	Introduction to the WiW Programme and its Aspirations	Abigail Essel	15min
9:00 - 10:30am	Introduction of Participant and Expectation	Everyone	30min

10:30 - 11:00	**Coffee Break & Group Photo**		
11:00 - 12:30	Overview of IoT Technologies: Concepts and Applications	Dr. Alowolodu	30min
	Data Collection Techniques and Best Practices	Dr. Naomi Kumi (OAU)	30min
	Regional Activities in the WACREN-ICTP Programme		
	- Weather monitoring in Ghana	Prof Amos Kabo-bah (UENR)	20min
	- River pollution monitoring in Nigeria	Prof Aderonke Okoya (OAU)	20min
12:30pm - 1:30pm	**Lunch**		
1:30 - 2:30pm	Introduction to sources of Climate Data (Reanalysis, satellite and Observation) and how to access these data sources	Dr. Naomi Kumi (UENR)	1hr
2;30 - 3:00pm	Q&A	Dr. Naomi Kumi (UENR)	30min
3:00 pm - 3:30 pm	**Coffee Break**		
3:30 - 4:30 pm	Introduction to Data Analysis and Visualization Tools and Techniques ((Timeseries, Bar charts, Spatial Maps, Pie Charts)	Doyin Afolabi (NITHUB)	1hr
4:30 - 5:00pm	Q&A	Doyin Afolabi (NITHUB)	30min
Closing		Abigail Esel	
	Day 2: 28th Aug 2024		
8:30 - 9:00 am	Registration	WACREN	30min
9:00 - 10:00 am	• Introduction to Python • Python libraries (Numpy, Panda, Xarray) for Climate Data Analysis	Mercy Mawunyo Apaw Samuel Afful	1hr
10:00 - 10:30 am	**Coffee Break**		
10:30am - 11:30pm	Understanding Weather Data: Types and Sources- raising several basic statistical analysis and visualisation directions (Summation, Means, Correlations, Anomalies)	Biodun Owadoye (NITHUB)	1hr
11:30 - 12:30pm	Practical Session: Application of Python for Climate Data Analysis	Kingsley Ogbonna and Doyin Afolabi (NITHUB)	1hr
12:30 - 1:30pm	**Lunch**		

	Practical Session: Application of Python for Climate Data Analysis(Contd)	Kingsley Ogbonna and Doyin Afolabi (NITHUB)	
1:30 - 3:00 pm	Climate Data Pre-processing and format using Numpy, Pandas and xarray	Kingsley Ogbonna and Doyin Afolabi (NITHUB)	1hr 30min
3:00 - 3:30pm	**Coffee Break**		
3:30 - 5:00 pm	Group Exercises: Case Studies and presentations	NITHUB	
Closing			1hr 30min
Day 3: 29th Aug 2024			
8:30 - 9:00 am	Registration	WACREN	
9:00 - 10:30 am	Advanced IoT Technologies: AI and Machine Learning Integration for climate data analysis	Joshua Opoku Agyemang (IoT Network Hub)	1hr
10:30 - 11:00 am	**Coffee Break**		
11:00 - 11:30am	Open Science and Its Importance in Weather Data Analysis	Dr Caleb Mensah (UENR)	30min
11:30 am - 12:30 pm	Introduction of Gitlab and how to use it to create, store, manage and share codes	Fatima-Bint Ibrahim (PyLadies)	1hr 30min
12:30 - 1:30 pm	**Lunch**		
1:30 - 3:00 pm	Interactive Workshop: Building and Integrating Advanced IoT Solutions	Joshua Opoku Agyemang (IoT Network Hub)	1hr 30min
3:00 - 3:30pm	**Coffee Break**		
3:30 - 5:00 pm	Group Activities: Collaborative Projects and Presentations	All Facilitators	1hr 30min
Day 4: 30th Aug 2024 - Community Engagement			
9:00 - 9:30 am	Registration	WACREN	
	Welcome	Abigail Essel	10min
	Keynote	Guest Speaker	30min
09:30 - 11:00 am	PyLadies	Theresa - Sarpong	20min
	Women In Tech	Luvina Sandra Atsu	20min
11:00 - 11:30 pm	**Coffee Break**		
11:30 - 12:15	Leveraging NREN Capabilities: Boosting Women's Impact in Climate Data Analysis"	GARNET	25min
	Q&A		20min
12:15 - 1:00 pm	Strategies for Sustaining IoT Initiatives Post-Workshop	Nutifafa Agbenor-Efunam Joshua Opoku Agyemang (IoT Network Hub)	25min
	Q&A		20min

1:00 - 2:00 pm	**Lunch**		
2:00 - 3:30 pm	Panel Discussion: Overcoming Challenges and Promoting Gender Equality in STEM	PyLadies - Fatima Women In Tech - Luvina Maud Ashong - VP Internet Society Ghana NITHUB Abby - Moderator	1hr30
3:30 - 4:00pm	**Coffee Break**		
4:00 - 4:30 pm	Closing Ceremony and Strategies for WiW Project Initiatives Post-Workshop	Dr Sena Kpeglo (VCG) Abigail Essel (WACREN) - Closing Remarks	30min
	Departure		

Figure 2: Speech at the opening ceremony

Figure 3: Group photo

Figure 4: Some of the workshop speakers

Figure 5: Some collaborations between participants from different countries

Figure 6: Some rewarded participants

Figure 7: Questions and answers

Figure 8: Coffee break and lunch

Figure 9: IOT practice

Figure 10: closing ceremony