

Report on: Space Weather and Upper  
Atmospheric data analysis training workshop for  
East African Community, held during, 25th -  
29th September 2023

Hosted by: Muni University

Sponsored by: The Scientific Committee on Solar-Terrestrial  
Physics

Under the program: Predictability of the variable solar terrestrial  
Coupling

Report submitted by

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# Chapter 1

## Introduction

### 1.1 Preamble

The titled workshop was held during 25 – 29th September 2023 at Muni University, Arua, Uganda. Whereas the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP) under the program, Predictability of the Solar-Terrestrial Coupling (PRESTO) provided USD 5000 to fund the workshop, Muni University as the host provided conference hall and internet access. The financial report is in separate report. The Organizing Committee was constituted as follows;

1. Dr. Patrick Mungufeni (Chairperson), Muni University, Uganda
2. Dr. George Omondi (member), Maseno University, Kenya
3. Dr. Geoffrey Andima (member), Busitema University, Uganda
4. Dr. Sharan Aol (member), Mbarara University of Science and Technology, Uganda
5. Dr. Valence Habyarimana (member), Mbarara University of Science and Technology, Uganda
6. Ms. Daphine Ayebare (member), Mountains of the Moon University, Uganda

The organizing committee held several meetings before the start of the workshop. The prominent issues discussed in the meetings included;

- Deciding the date for issuing a call for the participants to apply and selection of participants
- Discussing the utilization of the available funds
- Selection of topics to be discussed during the workshop and the lecturers of the topics

## 1.2 Participants of the Workshop

Based on the consensus during the preparation meetings, the participants shown in Table 1.1 were selected. Overall, there were 26 participants in the workshop. The responsibility (12 lecturers and 14 participants), gender (7 females and 19 males), and countries (Rwanda 02, Kenya 03, Uganda 18, Italy, Argentina 02, Sweden 01) associated with the participants are also shown in the table. From Table 1.1, it can be deduced that there were 19 and 7 participants in-person and online, respectively. The group photo of the in-person participants is shown in Figure 1.1.

Table 1.1: List of Participants

S.no	Name	Responsibility	Mode of attendance	Gender	Country
1	Patrick Mungufeni (p.mungufeni@muni.ac.ug)	Lecturer	In-person	Male	Uganda
2	George Omondi (omondigeok@yahoo.com)	Lecturer	In-person	Male	Kenya
3	Geoffrey Andima (geoffrey.andima@gmail.com)	Lecturer	In-person	Male	Uganda
4	Sharon Aol (sharonaol@ymail.com)	Lecturer	Online	Female	Uganda
5	Edward Jurua (ejurua@gmail.com)	Lecturer	In-person	Male	Uganda
6	Valence Habyarimana (valencehabyarimana@gmail.com)	Lecturer	In-person	Male	Uganda
7	Daphine Ayebare (ayebaredaphine@gmail.com)	Participant	In-person	Female	Uganda
8	Phillip Opio (popiophillo@gmail.com)	Participant	In-person	Male	Uganda
9	Moses Ojara	Lecturer	online	Male	Uganda
10	Doreen Agaba (doreen.agaba@sti.go.ug)	Lecturer	In-person	Female	Uganda
11	Brian Waibi (brian.waibi@sti.go.ug)	Participant	In-person	Male	Uganda
12	Jonah Chepkurui (chepkuruijonah@gmail.com)	Participant	In-person	Male	Uganda

13	Hellen Babirekere (babirekere192@gmail.com)	Participant	In-person	Female	Uganda
14	Habert Mbarushimana (herbertmbarushimana@gmail.com)	Participant	In-person	Male	Uganda
15	Delphine Nishimwe (nishdelphine9@gmail.com)	Participant	In-person	Female	Rwanda
16	Boniface Lokuny (bonifacelokuny2023@gmail.com)	Participant	In-person	Male	Uganda
17	Hannington A. Milimu (hanningtonamilimu@gmail.com)	Participant	In-person	Male	Kenya
18	Theogene Ndacyayisenga (ndacyatheogene@gmail.com)	Participant	In-person	Male	Rwanda
19	Nahum N. Maundu (nahumndunge001@gmail.com)	Participant	In-person	Female	Kenya
20	Faustine Abiriga (abifaus@gmail.com)	Lecturer	In-person	Male	Uganda
21	Tumuhairwe Bruce (tumuhairwebruce70@gmail.com)	Participant	In-person	male	Ugandan
22	John Bosco Habarulema (jhabarulema@sansa.org.za)	Lecturer	Online	Male	South Africa
23	Yenca Migoya-Orue (yenca@ictp.it)	Lecturer	Online	Female	Italy
24	Stephan Buchert (scb@irfu.se)	Lecturer	Online	Male	Sweden
25	Jorge Namour (jnamour@herrera.unt.edu.ar)	Lecturer	Online	Male	Argentina
26	Ticiano Torres-Peralta (ttorres@herrera.unt.edu.ar)	Lecturer	Online	Male	Argentina



Figure 1.1: Group Photo of in-person participants during the workshop

## Chapter 2

# Technical Presentations

The topics that were presented during the workshop and the responsible lecturers are shown in Table 2.1. The table shows the workshop program.

The presentation materials during the workshop can be obtained from the link: <http://dir.muni.ac.ug/handle/20.500.12260/576>

It is important to note that on the fourth day (28th September 2023), the technical presentations ended at 1 pm. After lunch, the participants were taken to tour Arua city. Specifically, the participants were taken to see the Cathedral building of the Roman Catholic Church at Ediofe, premises of FM radio station Pacis at Ediofe, cathedral building of the Anglican Church located at Mvara, and finally, the participants were taken to Ombaci to see the tallest mast installed in the 70's to aid radio communications. Figure 3 shows some participants at the Radio Pacis premises.



Figure 2.1: Photo of participants Ms. Helen, Ms. Nahum, and Ms. Delphine taken at Radio Pacis

Table 2.1: Workshop program

Local Time (East African Time) = UTC + 3 hours	Activity	Responsible person
Monday, 25th September 2023		
08:00 – 09:00	Arrival and Registration	-Secretariate (Ms Margret Taibo)
09:00 – 09:30	Welcome and opening remarks	-Organizing Chairperson, Dr. Patrick Mungufeni -Dean Faculty of Science, Assoc. Prof. Morgan Andama -VC Muni University, Assoc. Prof. Simon Anguma Katrini
09:30 – 10:15	Key note talk: Space Weather and its Impacts on Technological Systems	Dr. John Bosco Habarulema, South African National Space Agency, South Africa
10:15 – 10:45	Health Break	
10:45 – 11:20	Utilization of satellite technology in the development agenda of Uganda	Dr. Doreen Agaba Aeronautics and Space Science Bureau, Ministry of Science, Technology and Innovations
11:20 – 11:50	Infrastructure for meteorological services in Uganda	Dr. Moses Ojara Uganda National Meteorological Authority, Uganda
11:50 – 12:20	Techniques for observing solar phenomena	Dr. Sharon Aol (online), Mbarara University of Science and Technology, Uganda
12:20 – 13:10	Occurrence of Geomagnetic Storms	Dr. Sharon Aol
13:10 – 14:00	Lunch	
14:00 – 14:15	The status of Space Science and Astrophysics Education in Uganda	Assoc. Prof. Edward Jurua Mbarara University of Science and Technology
14:15 – 15:00	The Earth's ionosphere	Dr. Andima Geoffrey, Busitema University, Uganda
15:00 – 16:00	Basics of Python programming	Jorge Namour and Ticiano Torres-Peralta
16:00 – 16:30	Coffee break	
16:30 – 17:30	Ionospheric observations with Ionosondes	Mr. Phillip Opio, Mountains of the Moon University, Fortportal, Uganda



Tuesday, 26th September 2023		
09:00 – 09:30	GNSS for Ionospheric studies	Dr. Andima Geoffrey, Busitema University, Uganda
09:30 – 10:30	Basics of Matlab programming	Dr. Andima Geoffrey
10:30 – 11:10	Health break	
11:00 – 12:00	Basics of Fortran programming	Ms. Yenca Migoya-Orue (online), International Center for Theoretical Physics
12:00 – 13:00	Extraction of ionospheric parameters from NeQuick and IRI models	Ms. Yenca Migoya-Orue (online)
13:00 – 14:00	Lunch	
14:00 – 16:00	The study of Equatorial Electrojets	Dr. Valence Habyarimana, Mbarara University of Science and Technology
16:00 – 16:30	Coffee break	
16:30 – 17:30	Solar wind, IMF data analysis and interpretation	Dr. George Omondi Maseno University, Kenya
Wednesday, 27 September 2023		
09:00 – 10:30	Groups do assignments	
10:30 – 11:00	Health break	
11:00 – 12:00	Groups present results	
12:00 – 13:00	Kp, Dst, Ap, SymH, and AE data analysis and interpretation	Dr. Abiriga Faustine, Gulu University, Gulu, Uganda
13:00 – 14:00	Lunch	
14:00 – 15:00	GNSS RINEX observation and	Dr. Geoffrey Andima navigation data analysis
15:00 – 16:00	Radio occultation data analysis and interpretation	Dr. Patrick Mungufeni, Muni University, Uganda
16:00 – 16:30	Coffee break	
16:30 – 17:30	Groups do assignments	
Thursday, 28th September 2023		
09:00 – 10:30	Extraction of EEJ from Magnetometer data	Dr. Valence Habyarimana
10:30 – 11:00	Health Break	
11:00 – 12:00	Swarm Satellite mission and the data sets for Space weather and ionospheric studies	Dr. Stephan Buchert (online), Swedish Institute of Space Physics
12:00 – 13:00	Extraction of Equatorial Electrojet data from Swarm satellites	Ms. Daphine Ayebare Mountains of the Moon University
13:00 – 14:00	Lunch	
14:00 – 17:00	Tour of Arua City	Dr. Patrick Mungufeni Dr. Andima Geoffrey
19:30 – 21:00	Workshop dinner	

Friday, 29th September 2023		
09:00 – 10:30	Analysis of Global Ionosphere Maps from CODE	Dr. Patrick Mungufeni
10:30 – 11:00	Health break	
11:00 – 12:00	Space Weather research in East Africa	Dr. Faustine Abiriga, Dr. Valence Habyarimana, and Dr. Geoffrey Andima
12:00 – 13:00	Closing remarks, Lunch and Departure	Dr. Patrick Mungufeni Assoc. Prof. Simon Anguma Katrini.

## Chapter 3

# Opening Remarks

### 3.1 Organizing committee Chairperson, Dr. Patrick Mungufeni

After stating protocol appropriately, the chairperson communicated as follows: I am excited today to witness the opening of the Space weather and upper atmospheric data analysis training workshop for East African Community. In February this year, I received a positive response from the scientific committee on solar terrestrial physics, regarding my application, seeking for financial support to organize this workshop. Actually, the successful grant application was written jointly with, (i) Dr. George Omondi from Maseno University in Kenya, (ii) Dr. Geoffrey Andima, (iii) Dr. Sharon Aol. (iv) Dr. Valence Habyarimana, and Ms Daphine Ayebare. Our main motivation to organize this training is to build a vibrant research community in the field of space science in the East African Community. Unfortunately we did not get applications from other countries within the east African Community (Democratic republic of Congo, South Sudan, and Burundi). We are aware that several countries in the East African community have established space agency, others are planning to establish one. Moreover schools and Universities in the East African community are now incorporating space science and upper atmospheric studies in their curricula. This kind of training that is starting today can build the capacity of workers in the space agencies and Universities. For example, I benefited from such trainings organized in other countries and I am now working as a senior lecturer in Muni University. There are other examples in the audience here.

To achieve the objectives of the workshop, we invited presentations from South African National Space Agency (the keynote speaker, Dr. Hohn Bosco Habarulema), Aeronautics and space science bureau of Uganda (Dr Doreen Agaba and Engineer Brain Waibi), Uganda Meteorological Authority (Dr. Moses Ojara), Swedish Institute of Space science (Dr. Stephen Buchert). It is exciting for me to report here that we shall also have presentations given by data scientists from the international Center for theoretical Physics (Ms. Yenca Migoya-

Urue) and Argentina (Professors Jorge and Torres). Finally, I would like to thank the management of Muni University for supporting me to host the space weather and upper atmospheric data analysis training workshop here in Muni University. I hope the in-person participants will enjoy the University environment.

### **3.2 Dean of Faculty of Science, Assoc. Prof. Morgan Andama**

After observing protocol appropriately, the Dean communicated as follows;

Good morning distinguished ladies and gentlemen, I am honored to welcome all of you to this workshop and to Muni University today as the Dean of Faculty of Science, where the host Department of Physics falls. First and foremost, I would like to recognize the esteemed space scientists throughout East Africa and beyond who have dedicated their time to participate in this workshop and share their knowledge and expertise. The importance of space science in our lives cannot be overestimated as we continue grappling with several weather related challenges including climate change with disastrous impacts to humanity since space weather is driven by the sun. Through a more accurate weather prediction technologies, space science research would reduce the impact of climate change immensely. I was reliably informed that the speakers in this workshop are the leading scientists in the area and will provide the most up-to-date and relevant information in space science including the strides Uganda as a country has taken in Space Science. I am optimistic that you will benefit significantly from their presentations. For the student participants or even other participants, this workshop should not just be about learning from the experts but also about networking and building connections and partnerships which is important for the advancement of your career. The partnerships will also be beneficial to the relatively younger institutions like Muni University as they develop and roll out academic programmes in Space Science. Apart from the intellectual stimulation, I also urge the workshop participants during your free times to tour Muni University campus, discover WestNile with its ethnic diversity and culture, hospitable people, delicious foods and gifted nature. Last but not least, I would also like to commend Dr. Patrick Mungufeni and his team for their dedication and time spent in organizing this workshop. In conclusion, I greatly thank the funders for choosing Muni University to host this workshop and I hope that you will make the most out of it.

### **3.3 Vice Chancellor, Assoc. Prof. Simon Anguma Katrini**

After observing protocol appropriately, the Vice Chancellor communicated as follows.



Figure 3.1: Photo of participants and the CV Muni University, Assoc. Prof. Simon Anguma Katrini during the opening ceremony. Seated next to the VC is the Dean of Faculty of Science

On behalf of Muni University management and on my own behalf, I warmly welcome all the participants of the space weather and upper atmosphere data analysis training workshop to Muni University. This is a relatively new University. Actually the University was established in May 2013 as the 6th public University in Uganda under the statutory instrument number 31 of 2013. The first students were enrolled on 1st November 2014. Physics department has followed the department of nursing in organizing international workshop here in Muni University. This effort of Physics department led by Dr. Patrick Mungufeni, head of Physics department is commendable. I learned that this workshop has attracted in-person participants from the east African community countries. This kind of cooperation should be made stronger to achieve better results. Without scientists coming together and forming associations, it is difficult to get support from governments to pursue their research agenda. Therefore, I encourage the workshop to make a resolution to form a working group. Finally, I declare the workshop open. The picture in Figure 2 shows the Vice Chancellor making remarks in the opening ceremony.

## Chapter 4

# Workshop Evaluation

On the last day of the workshop, the participants evaluated the workshop based on good aspects, areas of improvement and way forward.

### 4.1 Good Aspects of the Workshop

The participants identified the following as the good aspects of the workshop;

- Feeding was good.
- Presentations cut across the different levels of participants and thus everyone was accommodated.
- The presenters/facilitators were friendly and lively.
- Appreciation for transport refund and accommodation.
- Participants appreciated the organizers and the depth of coverage of the talks.
- The environment was conducive.
- It was the first time to see international friends from Rwanda and Kenya, hence multi-country.
- Participants appreciated the organisation of the slides and the summaries given.
- Appreciated the tour to the different parts of Arua city.
- The university accommodated the workshop in the council hall as a way of giving respect to the participants.
- The selection of the participants was done well and encouraged one another to keep in touch.

- Appreciated the dinner that was given to them on the fourth day of the workshop.

## 4.2 Areas that require Improvement

The participants identified the following as the areas that require improvement;

1. Time given to the programming languages was inadequate.
2. Time was sufficient in the scope of discussion.
3. Since the epitome of academia is publications, there would be a tutorial on how to publish.
4. People from industries who are applying space physics should have also been invited.
5. Prerequisite packages should be circulated earlier to the participants.
6. Participants should have been allowed to present their research progress.

## 4.3 The Way forward

- To grow together through a body where we can voice out interests, though this is a process that requires profiling of the members.
- Steering committee to be formed to coordinate all the efforts and forward the views of the participants aimed at getting linked to other professional bodies.
- To continuously have such a workshop annually.

STEERING COMMITTEE: Chairperson: Dr. Patrick Mungufeni Representatives:

1. Muni University: Dr. Bosco Oryema
2. Gulu University: Dr. Faustine Abiriga
3. Busitema University: Dr. Geoffrey Andima
4. Mbarara University: Dr. Valence Habyarimana
5. Mountains of the moon: Mr. Opio Phillip
6. Maseno University: Dr. George Omondi
7. Pwani University: Ms. Nahum Ndunge Maundu
8. University of Rwanda CST: Mr. Theogene Ndacyayisenga

Members agreed that a Whatsapp group and an emailing list should be created for easy communication.