SUMMER SPACE WEATHER SCHOOL
Physics and use of tools

17-28 October 2022

Houphouët Boigny University, Abidjan, Côte d'Ivoire

2022

- ✓ Centenary of the discovery of the Equatorial Electrojet
- ✓ Thirty years of the International Year of the Equatorial Electrojet

Organized by

The Ivorian Society of Physics (SIPhys), the Laboratory of Matter and Solar Energy Sciences (LASMES), UFR-SSMT, Félix Houphouet Boigny University

With the support of

International Space Weather Initiative (ISWI)

ICG (International Commission of GNSS)

Under

the High Patronage of Mr. Minister of Higher Education and Scientific Research

Professor Adama DIAWARA

Summary

I. THE COMMITTEES –

Honorary Committee

To be determined
Prof Adama DIAWARA (Minister of Higher Education and Scientific Research, MESRS) President,
Prof BALLO Zié (President of Félix Houphouët-Boigny University), Vice-president –

Steering committee

Vafi DOUMBIA (Director General of Higher Education), President
OBROU Kouadio Olivier (Vice-dean of UFR SSMT in charge of Research), Vice-president
Dr KAKOU Modeste (Secretary General of the Ivorian Society of Physics, SIPHYS), Vice-President

Members of the Organizing Committee

Dr ZAKA Komenan Zacharie (Félix Houphouët-Boigny University / Ivory Coast)
Dr MENE Niangoran Médard (Péléoforo Gon Coulibaly University / Ivory Coast)
Dr COULIBALY Soro (Félix Houphouët-Boigny University / Ivory Coast)
Dr GRODJI Ostwald (Félix Houphouët-Boigny University / Ivory Coast)
Dr KOUADIO Kouakou (Permanent Secretary of SIPHYS)
Dr BAMBA Adama (Deputy Permanent Secretary of SIPHYS)
Dr N'GBESSO Yao Josée (Félix Houphouët-Boigny University / Ivory Coast)

Scientific committee

KOBEA Toka Arsène (Director of Cabinet of MESRS, Dir.of Laboratory), President
AMORY-MAZAUDIER Christine (LPP / Polytec./UPMC /France), Vice-President
ZOUEU Jérémie (1st Vice-president of the Ivorian Society of Physics, SIPHYS), Vice-President
KRE N'Guessan (2nd Vice-President of the Ivorian Society of Physics, SIPHYS),
ADOHI Jean-Pierre (Félix Houphouët-Boigny University / Ivory Coast)
OUATTARA Frédéric (Norbert Zerbo University / Burkina Faso),
ZAOURAR Naima (Hari Boumediene University / Algeria),

Faculty team

AMAECHI Paul (Chrisland University, Nigeria)
DOUMBIA Vafid (Director General of Higher Education, Côte d'Ivoire)
EMRAN Anas (Mohammed V University / Morocco)
FLEURY Rolland (IMT Atlantique, Brest / France)
GHALILA Hassen (Faculty of Sciences of Tunis / Tunisia)
KAFANDO Pétronille (University of Ouagadougou / Burkina Faso)
LECONTEL Olivier (LPP/ France)
LE HUY Minh (Institute of Geophysics of Hanoi / Vietnam)
LILENSTEN Jean (IPAG / France)
OBROU Kouadio Olivier (Vice-dean of UFR SSMT in charge of Research)
PITOUT Frédéric (IRAP / France)
SOULA Serge (Paul Sabatier University / France)
YAHIAT Yasmina (Hari Boumediene University / Algeria)
ZERBO Jean Louis (University of Bobo Dioulasso / Burkina Faso)
To complete

II. INTRODUCTION

As part of the international ISWI (International Space Weather Initiative) project, in collaboration with GIRGEA, the 5th MAOI school (ISWI Maghreb Africa West) will be organized at Houphoüet Boigny University in Abidjan, in October 2022.

The main objective of this school is to improve the level of expertise of students in the sub-region to enable them to participate and contribute to international projects. The two key points are:

1) competence to use already existing datasets and tools relating to studies of the terrestrial environment; there are a lot of environmental and geophysical data. The use of existing data is estimated to be less than 10%. These data, using new technologies, knowledge of physical phenomena, various models, are the source of original scientific work.
2) The development and use, by scientists from the Maghreb and West Africa, of the results of studies combining environmental sciences and sustainable development by combining ground data with satellite data - for example: geophysical studies, telecommunications, positioning etc ...

To achieve these objectives the courses will include:

1) A scientific part for understanding the measurements, information that can be extracted from the data and examples of applications in different fields.
2) A computer part on the algorithms used, their performance, and their installation.
3) Practical computer work for the use of algorithms and ground and satellite databases.
4) The use of models like TIEGCM, CTPIM, IRI, NeQuick, IGRF.
5) Information presentations on new technologies used in this field such as Grid, Web services, databases

To achieve these goals, we offer a school to discover and use:

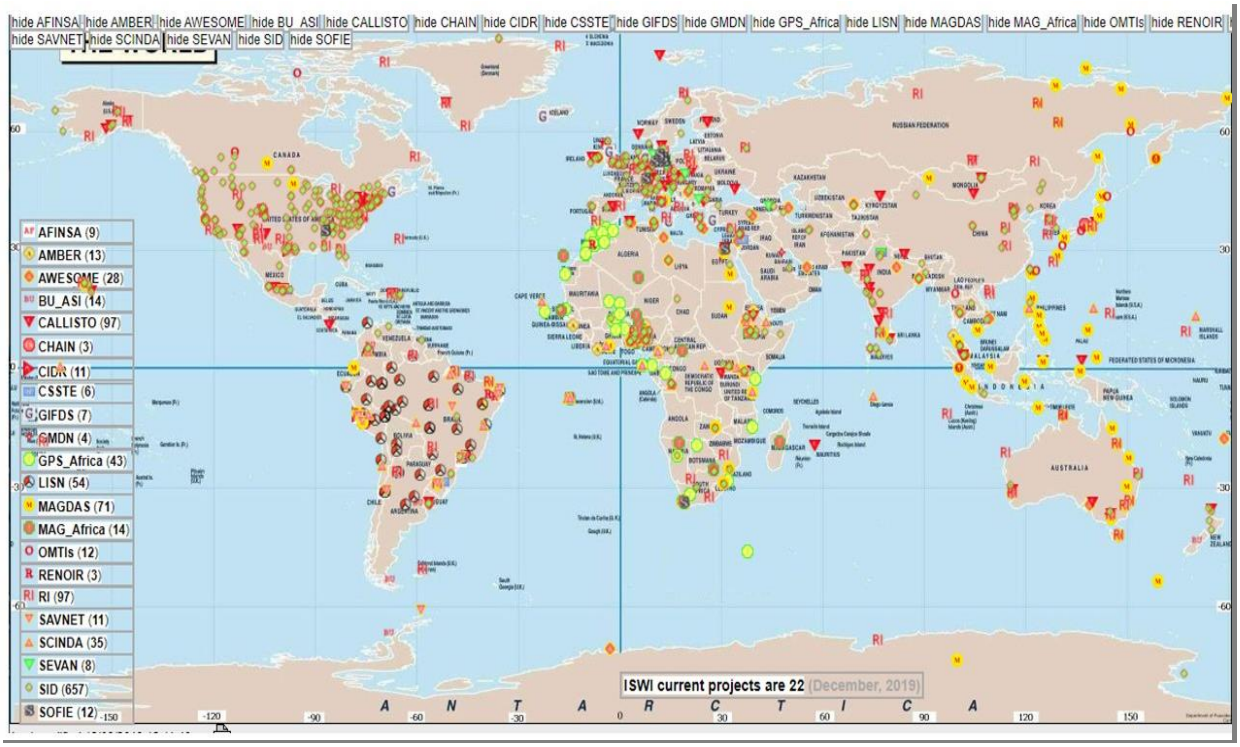
1) All the possibilities of measurements of the ground network of GNSS stations, radar and other instruments located in Africa and in the world, as well as the measurements available via the internet:
    a. Studies of the ionosphere and the impact of the Sun on the earth's ionized environment (International Year of the Heliosphere and ISWI project);
    b. Exploit other instruments for development.
2) Geographic information systems that allow the management and visualization of spatial data in all areas.
3) 3) The development of local databases and the use of existing databases via the internet and an introduction to new technologies.

The purpose of this school is to develop data analysis in Africa and thus make many existing projects profitable (IHY: *International Heliophysical Year*, ISWI: *International Space Weather Initiative*, etc.).
It will also offer an opportunity to researchers and scientists from the Maghreb and West Africa who wish to learn or acquire the skills to use the already existing datasets and the tools relating to Space Meteorology studies, to participate and contribute to international projects.
The IMAO schools also bring together young researchers from different countries to forge lasting and fruitful collaborative relationships.

III. MOTIVATIONS

1. Instrument networks in Africa and around the world

After the project "International Heliophysical Year 2007-2009, the International Space Weather Initiative ISWI program (2010-2012) continued the development of instrument networks on the African continent and in the world and in particular networks of GNSS stations, magnetometers , radars, etc…. (See figure below from the site http://www.iswi-secretariat.org.)



GIRGEA (International Group for Research in Geophysics Europe Africa www.girgea.org) present in Africa for more than 30 years has developed research teams in different countries in Africa (Côte d'Ivoire, Burkina Faso, Algeria, Egypt, Morocco , DRC…) and in Asia (Vietnam, Nepal, Pakistan).

In tropical and equatorial zones, it is necessary to know the contributions of the ionosphere (*ionized layer surrounding the earth and located between 90 and 1000 km*) and the atmosphere to the GNSS signal for many and various applications, because the crossing of these two media disturbs the received signals.
This school will focus on GPS applications to study the impact of the sun on the ionized layers of the atmosphere.

The adoption of information and communication technologies (ICTs) and access to the Internet are booming in Africa, but due to their rapid growth all over the world, the digital divide between Africa and the rest of the world persists. It is also important to inform and train scientists and students on databases (creation and use of existing ones), monitoring of the Internet network in order to verify its evolution, and access to computers and the grid calculation to enable them to exploit their data, run their simulations, and collaborate with teams from all over the world.

2. Training: SPACE WEATHER SCHOOL

GIRGEA has already organized schools in Côte d'Ivoire (1995, 2017), Republic of Congo (2009), Egypt (2010), DRC (2011), Algeria (2013), Morocco (2010, 2014, 2015), Senegal (2019). All the reports of the preceding schools are on the website www.girgea.org.

The schools aim to:
1) to introduce students to Sun-Earth relations and Space Meteorology with specialists from different disciplines (physics of the Sun, solar wind, magnetosphere, ionosphere, troposphere and internal and external magnetic field),
2) to analyze the existing data in these different disciplines using digital tools, computing grid, data server, internet, intensive computing resources,
3) to develop student scientific mini-projects on a given event,
4) to learn the management of a project, the progress of theses and scientific publications, participate in national or international calls for tenders,
5) to promote exchange and cooperation between students of different nationalities,
6) to publish in refereed journals despite the cost which is sometimes difficult to find.

3. . The Project

The school caters to 40 participants from universities in West Africa and the Maghreb. Successful participants must already have basic computer skills and databases.
This school aims to allow participants to:
• Master the handling of GPS and the collection of information in the field;
• Master the use of GPS data according to their area of expertise and possible applications;
• Initiation to cartography and mastery of basic and advanced GIS functionalities with various standard software;
• Promote synergy between GIS and GPS.

At the end of this training, participants should be able to:

<u>For Space Weather</u>
• Thoroughly analyze solar activity and its consequences on the earth's environment and related systems.

<u>For GNSS</u>
• Know how to use a GPS (different functions of the instrument, installation);
• Quantify the various errors in positioning accuracy and analyze correction systems of the local differential GNSS type or by geostationary satellite;
• Know how to use measurements on the ground or on board satellites / probes for morphological studies of the atmosphere, ionosphere and geodesy;
• Analyze the various existing satellite navigation systems and their evolutions;
• Know the different fields of application.

<u>For GIS</u>
• Establish a geographic database (opening and creation of layers, scanning, digitization, structuring and organization of geographic data, modification or deletion of graphic objects,

change of coordinates and manipulation of projection systems, geo-referencing, integration of points GPS in an existing basemap);
• Carry out thematic and spatial analyzes (cartographic restitution);
• Know the equivalences between software (principles and terminology).

For GPS and GIS
• Know how to take charge of: recording, identification, storage, search for coordinates of points in the field, report of points, etc…;
• Know the interesting databases in the various fields covered;
• Know how to collect field data from a GPS and transfer them to a GIS;

For new technologies
• Know the calculation resources available and the underlying techniques;
• Know how to create databases and the portals to access them;
• Have technical support for network monitoring;
• Participate and collaborate in the global effort of new technologies.

Practical applications should be based on varied thematic data and relate to areas of national interest.
An analysis of the targeted needs of participants and their level will be made as soon as registration opens.
We recommend that registered students bring their laptop. The content of the various courses is generally provided at the end of each session. Participants will be master's students, theses and academic staff or other organizations requiring an upgrade in their training.

IV. CLASSES

2 weeks of 40 hours spread over 8 days => ~ 80 hours

A detailed schedule will be given in November 2022

V. ESTIMATED BUDGET

Regarding the financing of schools, GIRGEA is a network which does not have a permanent infrastructure and which only manages training schools within the framework of large projects with the help of different laboratories and international structures.

The institutions of the teachers participating in the training contribute by covering the mobility of teachers. GIRGEA's internal regulations suggest that the country which organizes the school takes charge of catering and accommodation for teachers and students. In accordance with the spirit of helping and sharing knowledge, which drives GIRGEA, teachers do not have a per diem. Half of the students attending the school are from the host country, and the other half of the students come from countries in the Maghreb and West Africa.

Student tickets are supported by different organizations (AUF, French embassies, PNST, CNRS, SCOSTEP, ICTP, ICG, EGNOS, Nagoya University etc.).

Local budget supported by Côte d'Ivoire

Chapter	**amount**	**Description**	P.U.	**cost**
Prints	75	Ballpoint pen	fr. 200	fr. 15 000
	75	Shirt fla^p	fr. 1 000	fr. 75 000
	10	ream	fr. 5 000	fr. 50 000
Restoration	1200	Coffee Break	fr. 1 500	fr. 1 800 000
	700	Lunch{Starter/Resistance/mineral water/Dessert/water in the Dining room)	fr. 7 000	fr. 4 900 000
Transport and logistics	1	Mini Bus type vehicle	fr. 500 000	fr. 500 000
	10	Conference room	fr. 50 000	fr. 500 000
Accomodation	280	Accomodation (20 rooms with 2 beds for 14 nights)	fr. 30 000	fr. 8 400 000
	280	Accomodation (20 bed rooms for 14 nights)	fr. 50 000	fr. 14 000 000
Honoray	20	Professors (Dinner)	fr. 140 000	fr. 2 800 000
	40	Listeners (Dinner)	fr. 98 000	fr. 3 920 000
				fr. 36 960 000
Funded				**Eu. 56 345**

Plane Ticket for some teachers paid by their institutions[$]

[$]: when the institution can support

Country	Unit Cost	Total Cost
Algeria[$]	300€	2 x 300€ = 600€
Burkina Faso[$]	450€	2 x 450 = 900€
France[$]	750€	7x 750 = 5250€
Morocco	1200€	1200€
Nigeria	670€	670€
Tunisia[$]	500€	500€
Vietnam	1700€	1700€
Total Funded Not funded		10820€ 7250€ 3570€

Student plane ticket

Conutry	Unit Cost	Cost for 2 students
Algérie	300 €	600€
Bénin	200€	400€
Burkina Faso	450 €	900€
Cameroun	600€	1200€
Guinée Conakry	400€	800€
Maroc	1200€	2400€
République Congo	788€	1576€
Rép. Démocratique Congo	700€	1400€
Sénégal	800€	1600€
Tunisie	500€	1000€
Rwanda	600€	1200€
Total not funded		13 076€