



Ministry of Higher Education, Scientific Research and Innovation

**4th EDITION OF THE ISWI-MAGHREB-WEST AFRICA (IMAO 2019)
SCHOOL OF SPACE WEATHER
Thiès / SENEGAL [15 to 25 October 2019]**

Organized by
The UFR - SET / University of Thiès
LapTPAD Laboratory
In collaboration with: **CRASTE-LF** and **Le GIRER**

With the support of
International Space Weather Initiative (ISWI)

Under the High Patronage of the Minister of Higher Education, Scientific Research and
Innovation

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- International organizations (ICTP, CRASTE-LF);
- Documentation and Information Center of Thiès CDI-NTW.

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Summary

The IMAO 2019 Space Weather School aims to strengthen the capacities of young scientists, Master and PhD students from Maghreb and West Africa in all the scientific disciplines concerned with "**Space Weather**".

The Space Weather is a new branch of astronomy that is concerned with understanding and predicting the electromagnetic and solar particle impacts on the Earth's environment. It aims to predict the arrival and the magnitude of solar events, solar winds, magnetospheric and ionospheric disturbances, geomagnetic disturbances and associated ground currents and their impacts on technological infrastructures.

The courses will focus on the Physics of the Sun, of the Magnetosphere and the Ionosphere, the Atmosphere / Ionosphere / Magnetosphere and Geomagnetism couplings, and also on Climate Modeling, on Ocean Dynamics and Tele connections, on the GNSS, (Global Navigation Satellite System).

1- CONTEXT AND JUSTIFICATION

1.1 Background

The enthusiasm generated by the COP21 and COP22 summits in the international community shows the importance of the environmental issues and climate change that were debated there. These summits have all drawn the attention of policymakers around the world to the urgency of collective awareness of the growing threats to our global ecosystem. The fragility of our modern technological infrastructures in both space and terrestrial environments, in front of the electromagnetic impacts of solar activity has made it necessary to develop a new discipline known as "Space Weather".

Space Weather is a very recent discipline, still in development. It studies the impact of solar activity on our terrestrial environment. The interaction of electromagnetic radiation and solar particles with the geomagnetic field and the Earth's atmosphere has important implications for our technological world and our space environment. Indeed, the Sun constantly blows large masses of particles (electrons and protons) of high energy that carry part of the solar magnetic

field. This mass called "solar wind" causes in the terrestrial environment important electromagnetic disturbances (magnetic storms) which may seriously damage our economic infrastructures (satellites, telecommunication networks and transport of energy, pipelines, etc.), and the normal course of certain activities such as air and space navigation. The events of Quebec in January 1989 and Sweden in October 2003 are eloquent examples. In order to better understand and prevent such events, a consortium bringing together the United Nations through its UNOOSA agency (United Nations Office for Outer Space Affairs, <http://www.oosa.unvienna.org>), US NASA space agencies, European ESA and Japanese JAXA, initiated in 2007 the scientific program called "International Year of the Heliosphere" IHY ([http:// ihy2007](http://ihy2007)). As part of this program, several instruments were deployed throughout the Globe. Notably in Africa, magnetometers, GPS receivers, particle detectors, etc. were installed in order to collect data on ionospheric, magnetospheric and heliospheric phenomena from 2007 to 2009. To continue the IHY 2007 program, the International Space Weather Initiative ISWI (www.iswi-secretariat.org) has been launched in order to promote the study and development of Space Weather. Still under the umbrella of the United Nations, a new program called UNISPACE +50, from 2018 to 2030, was launched during the UN / USA / ISWI workshop in July 2017. UNISPACE +50 will continue the research activities initiated by IHY 2007, and make the acquired knowledge evolve towards their operationalization.

1.2 Justifications

Due to the fragility of our modern terrestrial and space infrastructures facing the disruptive effects of solar disturbances and the obvious scientific interest of Space Weather, the African countries, in particular Senegal, are involved in these international scientific programs. Thus, it was highly appropriated that Senegal organizes the fourth edition of the ISWI-Maghreb-West Africa School (IMAO) on Space Weather in 2019, given the important role it has always played in education and in scientific research in Africa. The UFR-SET is the best choice to host the school, according to its mission of training and research in disciplines related to science and technology: Mathematics, Physics, Computer Science, Physical Sciences, Life Sciences of the Earth, Environment.

The ISWI-Maghreb-West Africa School on Space Weather is a high-level scientific meeting that is held every two years. The first edition was held from May 6 to 16, 2013 at the University of

Science and Technology Houari Boumediene (USTHB) of Algiers (Algeria), the second at CRASTE-LF Rabat (Morocco) from February 16 to 21, 2015, the third at the University Felix Houphouet Boigny of Abidjan from October 16 to 28, 2017. At the end of the third edition, Senegal was chosen by the organizers and by all participants, because of its strong scientific potential to host the fourth edition in 2019.

2. OBJECTIVES

The organization of the school IMAO 2019 in Senegal on Space Weather aims at several objectives whose principal ones are:

2.1 General objective

Strengthen the capacity of young researchers, including Master 2 students and PhD students from the Maghreb and West Africa, in all the scientific disciplines concerned with "Space Weather"

2.2 Specific objectives

- 1- Develop skills in using already existing data sets and the necessary tools for Space Weather studies;
- 2- Assimilation of recently collected data and existing databases;
- 3- Use space weather results, by combining ground and satellite data, for research and sustainable development;
- 4- Train world-class researchers in Space Meteorology in the Maghreb-West Africa region;
- 5- Promote scientific collaboration between researchers from the Maghreb-West Africa region;
- 6- Stimulate vocations in Space Physics through public conferences in schools (secondary and primary schools).
- 7- Help dissemination of the results of research in Space Weather;

3. EXPECTED RESULTS

At the end of the 4th edition of the IMAO 2019 school:

- 1- Management techniques of the multiple databases available for environmental studies are acquired.

2- Local expertise in using tools for data processing is developed.

3- The training of scientists and researchers from West Africa and the Maghreb in using the results of studies combining environmental sciences, space weather and sustainable development is carried out.

4- Researchers from the Maghreb and West Africa have acquired high level scientific knowledge for space weather forecasting.

4. METHODOLOGY

4.1 Participants

The courses offered during the school are intended for Master 2 and PhD students and junior researchers in Space Physics. For this fourth edition, we expect 40 auditors (students) including 20 foreigners and 20 nationals. The courses will be taught in French by 18 high-level scientists, including 15 foreigners from Africa and Europe and 3 nationals.

4.2 Dates and Location

The school will take place from 15 to 25 October 2019 in the premises of the University of Thiès.

4.3 Program

To achieve the objectives of MAOI 2019, courses will include:

1) A scientific part for understanding measurements, results that can be extracted from the data and examples of applications in Space Weather;

2) Lab works with computers, and internet connections for the direct use of databases such as OMNIWEB, SPIDR, INTERMAGNET, Kyoto World Data Center, and existing models such as IRI, IGRF, TIE-GCM, etc ...;

IMAO 2019 will make it possible to understand processes of solar physics and their actions on the near Earth environment: magnetosphere, ionosphere and atmosphere;

The following points will be detailed:

- Recent discoveries on the sun;
- Impact of the Sun on the ionized terrestrial environment;
- Influence of the sun on the Earth's atmosphere;
- Use of instruments and useful measurements such as GNSS data (GPS, GLONASS, GALILEO, etc ...) for navigation, space weather, climate or magnetic field measurements for the study of GICs .

The disciplines taught are focused on the physics of environment and phenomena involved in Sun-Earth relations, namely:

- 1- The Sun;
- 2- The interplanetary space;
- 3- The terrestrial magnetosphere;
- 4- The terrestrial ionosphere;
- 5- Geomagnetism;
- 6- Impact of solar disturbances on technological infrastructures;
- 7- Use of GNSS data (Global Navigation Satellite System), for the study and the forecast in Meteorology of the space.
- 8- EGNOS;

ANNEX

1. COMMITTEE OF HONOR

Professor Mary Teuw NIANE, Minister of Higher Education, Scientific Research and Innovation, Senegal.

Professor Ramatoulaye Diagne Mbengue, Rector of the University of Thiès, Senegal.

Professor Gregory SISSOKO, Director of GIRER, Senegal.

Professor Mamadou SARR, Former Director of SET UFR, Senegal.

Professor Bamba DIAW, Director of the Polytechnic School of Thiès, Senegal.

Professor ANAS Emran, Director of CRASTE-LF, Morocco

Mrs Aicha BAMMOUN, ISESCO, Morocco

2. SCIENTIFIC COMMITTEE

President: Pr Thierno Amadou GAYE (Senegal)

Vice-President: Professor Christine Amory Mazaudier (France), Pr. Zaourar Naima (Algeria)

Members: Pr. Vafi Doumbia (Ivory Coast), Prof. Obrou Olivier Kouadio (Ivory Coast), Dr ZAKA (Ivory Coast), Prof. Arsène Kobéa Toka (Côte d'Ivoire), Pr Cheikh SARR (Senegal), Pr Ibrahima LY (Senegal), Pr Salif GAYE (Senegal), Pr Senghane MBODJ (Senegal), Pr Mapathé NDIAYE (Senegal), Pr Hawa LY DIALLO (Senegal), Pr Saïdou SALL (Senegal), Dr Eric MACHU (Senegal), France), Mr Oumar KONTE (Senegal).

3. INTERNATIONAL ORGANIZING COMMITTEE

President: Pr. KOBEA Arsène (Ivory Coast),

Vice-President: Professor Christine Amory-Mazaudier (France), Pr. Zaourar Naima (Algeria),

Members: Pr. PITOUT Frédéric (France), Pr. Vafi DOUMBIA (Ivory Coast), Pr. ADOHI BIBI Jean-Pierre (Ivory Coast), Pr. OBROU Olivier (Ivory Coast), Pr. KOBEA Arsène (Ivory Coast), Dr. Idrissa GAYE (Senegal).

4. LOCAL ORGANIZING COMMITTEE (Senegal)

President: Dr. Idrissa GAYE

Vice-president: Pr. Ousmane SALL

Other members: Pr Mouhamadou THIAM, Dr Moussa Déthié SARR, Dr Issa SAKHO, Dr Mouhamadou Lamine DIAGNE, Dr Seydou NDAO, Dr Doudou GAYE, Dr Ibrahima DHIEDHIOU, Dr Talla GUEYE, Pr Mouhamadoune SECK, Pr Mamadou WADE, Mr Papa DIOP, Mrs ADO, Mrs DEME, Dr Ousmane SOW, Dr Demba Bocar BA.

5. PROFESSORAL TEAM

LOCAL PROFESSORS		
1	Grégoire SISSOKO gsissoko@yahoo.com	University Cheikh Anta Diop of Dakar, Laboratory of Semiconductors and Solar Energy. Dakar-Senegal
2	Cheikh SARR csarr@univ-thies.sn	University of Thies, UFR-SET, Thies-Senegal
3	Thierno Amadou GAYE atgaye@gmail.com	University Cheikh Anta DIOP of Dakar, Laboratory of Physics of the atmosphere. Dakar-Senegal.

FOREIGN PROFESSORS		
1	AMORY-MAZAUDIER Christine Christine.amory@lpp.polytechnique.fr	Universities of the Sorbonne, Laboratory of Plasma Physics (LPP) UPMC Polytechnic, 4 place Jussieu 75005, Paris, France
2	ANAD Fatma f_anad@yahoo.fr	Research Center in Astronomy, Astrophysics and Geophysics. CRAAG. Observatory road. BP 63, Bouzareah, Alger Algeria
3	EMRAN Anas emran@israbat.ac.ma	Scientific Institute, Mohammed V-Agdal University, Coordinator CRASTE-LF affiliated to the UN, 1 Avenue Ibn Sina, Agdal, Rabat, Morocco
4	FLEURY Roland rolland.fleury@telecom-bretagne.eu	Lab-STICC, UMR 6285 Mines-Telecom, Telecom Bretagne, France
5	BERTHOMMIER Matthieu Matthieu.berthomier@lpp.polytechnique.fr	Sorbonne Universities Laboratory of Plasma Physics (LPP) UPMC Polytechnic, 4 place Jussieu 75005, Paris, France
6	KLEIN Karl-Ludwig Ludwig.klein@obspm.fr	LESIA Observatory of Paris 5 Place J. Jansen 92195 Meudon, France
7	LILENSTEN Jean jean.lilensten@obs.ujf-grenoble.fr	Institute of Planetology and Astrophysics of Grenoble (IPAG) UMR 5274 CNRS / UGA, Office: 124 street of the swimming pool, Building D of physics, 38400 Saint Martin of Hères, France
8	OUATTARA Frederic fojals@yahoo.fr	Laboratory of Research in Energy and Meteorology of Space (LAREME), University of Koudougou / Burkina Faso
9	PITOUT Frédéric frederic.pitout@irap.omp.eu	Institute of Research in Astrophysics and Planetology (IRAP) 9 avenue Colonel Roche, BP44346 Toulouse cedex 4, France
10	VILTARD Nicolas nicolas.viltard@lamos.ipsl.fr	Laboratory Atmospheres, Environments, Spatial Observations LATMOS. .ipsl.fr, University of Versailles St-Quentin, CNRS / INSU,
11	SAHRAOUI Fouad Fouad.sahraoui@lpp.polytechnique.fr	Universities of the Sorbonne, Laboratory of Plasma Physics (LPP) UPMC Polytechnic, 4 place Jussieu 75005, Paris, France
12	YAHIAI Yasmina yasminayahiat@yahoo.fr	Laboratory of Geophysics, FSTGAT / USTHB, BP 32 El Alia, Bab- Ezzouar 16111 Algeria
13	DOUMBIA Vafi dombia.vafi@univ-fhb.edu.ci	Félix Houphouët-Boigny University, UFR-SSMT, Laboratory of Atmospheric Physics, 22 BP 582 Abidjan 22, Ivory Coast
14	KOBEA Toka Arsène kobeatoka@yahoo.fr	Félix Houphouët-Boigny University, UFR-SSMT, Laboratory of Atmospheric Physics, 22 BP 582 Abidjan 22, Ivory Coast
15	ZAOURAR Naima naimaboulasba@gmail.com	Laboratory of Geophysics, FSTGAT / USTHB, BP 32 El Alia Bab- Ezzouar 16111 Algeria
16	Aziza BOUHNIR bounhir@fstg-marrakech.ac.ma bounhiraz@yahoo.fr	FSTG UCAM University, Applied Physics Department Av Abdelkrim Khattabi, BP 549, 46001 Marrakech, Morocco

6. ESTIMATED BUDGET

6.1 Estimated budget for local funding

Printed	75	Ballpoint pen	200	15 000
	75	Flat folders	1 000	75 000
	10	Paper ream	3 500	35 000
Restoration	1950	Coffe Break (75 x 13 x 2)	2 000	3 900 000
	975	Lunch {Entrance / resistance / mineral water / dessert} (75 x13d)	7 000	6 825 000
	975	Dinner {Entrance / resistance / mineral water / dessert} (75 x13d)	7 000	6 825 000
	3900	Indoor water (75 x 13 x 4)	400	1 560 000
Transport and logistics	1	Logistics + Fuel + Transport Vehicle	750 000	750 000
Accomodation	130	Hébergement pour Professeurs (10 chambres de 1 lit pour 13 nuits)	35 000	4 550 000
	260	Accommodation for Teachers (10 rooms of 1 bed for 13 nights)	20 000	5 200 000
Excursion	1	Excursion (sightseeing: Pink Lake, Saly Portudal) + Lunch (1st Week end)	2 000 000	2 000 000
		Total		31 735 000 FCFA
				47 722 €

6.2 Estimated budget for participants Tickets :

tickets Professors	Paris/France – Senegal/Diass (AIBD) A/R (5) Grenoble - Senegal/Diass (AIBD) A/R (1) Toulouse - Senegal/Diass (AIBD) A/R (1) Brest- Sénégal/Diass (AIBD) A/R (1)	~ 419 € x5 = 2095 € 666 € + train 150 € = 816 € 614 € 614 € - train 150 € = 816 €	4289 €
	Algiers/Algeria- Senegal/Diass (AIBD) A/R (3)	352 € x3 = 1056 €	1056 €
	Ouagadougou/ Burkina Faso – Senegal/Diass (AIBD) A/R (1)	557 €	557 €
	Casablanca/Morocco- Senegal/Diass (AIBD) A/R (3)	579 € x 3 = 1737 € + train/Maroc (30€)	1767 €
	Abidjan/Côte d’Ivoire - Senegal/Diass (AIBD) A/R (2)	~ 387 € x 2	774
Total Professors			8443 €
Tickets Students	Algiers/Algérie - Senegal/Diass (AIBD)/AR (2)	352 € x 2 = 704 €	1100€
	Ouagadougou/Burkina Faso - Sénégal/Diass (AIBD) A/R (2)	557 € x 2 = 1114 €	800€
	Casablanca/Morocco - Sénégal/Diass (AIBD) A/R (2)	579€ x 2 = 1158 € + train (30€) = 1370€	1188 €
	Yaoundé/Cameroon - Senegal/Diass (AIBD) A/R (2)	~788 € x 2 = 1576 €	1200€
	Abidjan/Côte d’Ivoire - Sénégal/Diass (AIBD) A/R (2)	~ 387 € x 2 = 774 €	~ 774 €
	Kigali/Rwanda – Senegal/Diass (AIBD) A/R(2)	~519 € x 2 = 1038 €	~450 €
	Kinshasa/DRC - Senegal/Diass (AIBD) A/R (2)	~770 € x 2 = 1540 €	1800 €
	Brazzaville/RC - Senegal/Diass (AIBD) A/R (2)	~698 € x 2 = 1396 €	~890 €
	Cotonou/Bénin- Senegal/Diass (AIBD) A/R (2)	~572 € x 2	~1144 €
	Tunis/Tunisie - Senegal/Diass (AIBD) A/R (2)	603 € x 2	1206 €
Total Students			10552 €
General Total			18 995 €

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