International Speace Weather Initiative (ISWI)

Update of ISWI activities in Benin

Dr (MC) ADECHINAN A. Joseph

Teacher-researcher at the Faculty of Science and Technology/Benin

Janvier 2023

The activities of the ISWI network are not yet perceptible in our contry.

To do this, it was organized on Thursday, May 12, 2022, a first meeting to show the importance of space sciences in the development.

This approach aims to encourage young students to this science which is not well known in our country.

This initiative has been limited by several factors. The most important of them are: the covid-19 pandemic ; the lack of funding because our academic institutions and sponsors have not responded favorably.

In perspective for 2023, we want to resume the initiative of 2023 by associating Christine Amory for an online conference.

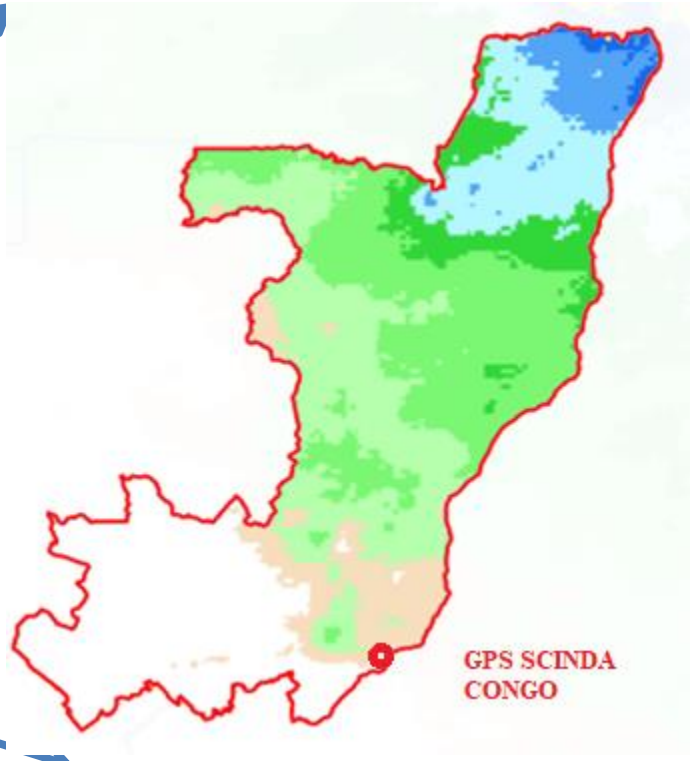
Thank you for your attention

Activities of ISWI –Congo National Coordination

Dr Jean Bienvenu DINGA,
National Coordinator ISWI, Republic of Congo
Ministère de l'Enseignement Supérieur, de la Recherche Scientifique et de l'Innovation Technologique

Localisation of the GPS Station (SCINDA)

Congo Republic



Activités ISWI CONGO

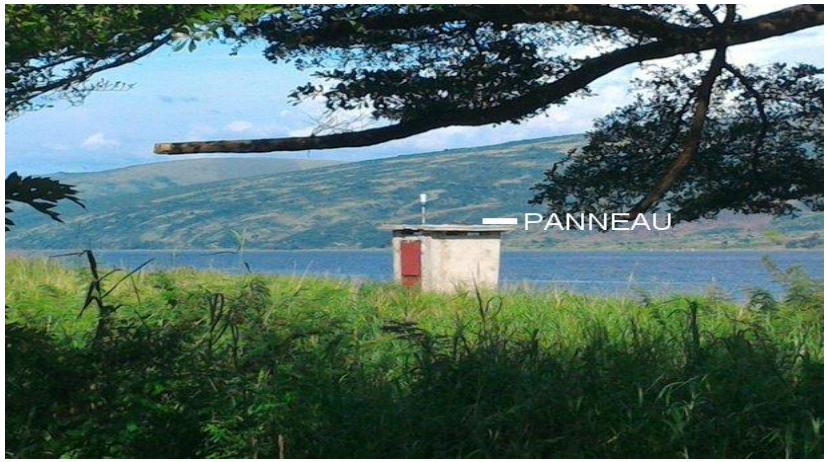
Coordonateur National : Jean Bienvenu DINGA

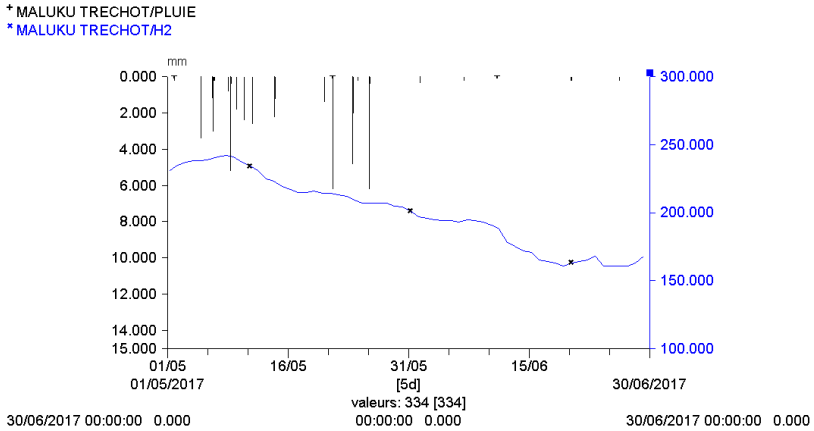
Date / Période	Activités	Référence
2019-2022	Prise en charge pour l'initiation à la recherche (en météorologie de l'espace) des étudiants de parcours_ type : Physique (Licence 3)	Rapports de projets Tutotés
2022	Participation à l'école IMAOC, en Côte d'Ivoir à Abidjan	
2022	Mémoire de master en Télédétection et Géomatique de **MOKOMBA Madzo Makouezi Christ** Thème: Etude dynamique de la pollution côtière due aux hydrocarbures par images hyperspectrales Dans le secteur de Madingo-Kayes (Département du Kouilou)	Soutenu
2019-2020	Mémoire de master de Physique de l'atmosphère à l'Université Marien NGOUABI) de **Jocelyn BOUNGOU POATY** Thème: ***Contribution des paramètres du vent solaire sur la variation de l'activité ionosphérique en zone équatoriale africaine***"	Soutenu
2019-2020	Méémoire de master de Physique de l'atmosphère à l'Université Marien NGOUABI de **Aaron BWASSA MALOANGA** Thème: ***Impact de l'activité géomagnétique sur l'ionosphère en Afrique équatoriale***	Soutenu
2016-2017	Mémoire de master de Physique de l'atmosphère à l'Université Marien NGOUABI de **Roselin NSONGA** Thème : ***Etude de la variabilité du TEC au dessus de la région intertropicale africaine en fonction des paramètres solaires et de l'activité géomagnétique***	Soutenu
2012-2013	Mémoire de master de Physique de l'atmosphère à l'Université Marien NGOUABI de **Pea OBA AKOLHADZO** **Thème:** ***Modélisation du Contenu Electronique Total (TEC) local et Impact induit par l'indice d'activité magnétique (Dst) en zone équatoriale.*** (	Soutenu
2009	IHY French, **GPS, GIS and Introduction to Space Weather/ 7 days**	Rapports de projets Tutotés

Hydrology Altimetric

- Using of altimitric data of satellite SENTINEL 3

For applications on hydrology, one station was bulding on C





Water level data and precipitation data at Maluku Station

Dr Bienvenu DINGA, Enseignant-Chercheur à l'Université Marien Ngouabi a participé à la Conférence technique 2022 sur les instruments et les méthodes d'observation météorologique et environnementale (TECO) (Paris, France, 10-13 octobre 2022).

Dr Jean Bienvenu DINGA est membre du African Working group on Space of African Union Commission (AWGS-AU), he participate to the elaboration of the strategic documents of african space. Ces documents de base ont été élaborés en vue de la création de l'Agence Spatial pour l'Afrique (AfSA).

the Heads of State and Government adopted the African Space Policy and Strategy during the 26- Ordinary Session of January 2016 Assembly. Through this decision the commission is mobilising member states and others key stakeholders to work together to establish a strategic african outer-space program.

E-JUST

الجامعة المصرية اليابانية للعلوم والتكنولوجيا
EGYPT-JAPAN UNIVERSITY OF SCIENCE AND TECHNOLOGY
エジプト日本科学技術大学

Space Weather Activities in Egypt

Ayman Mahrous
Professor of Space Weather, Head of Space Environment Program,
Egypt-Japan University of Science and Technology (E-JUST)
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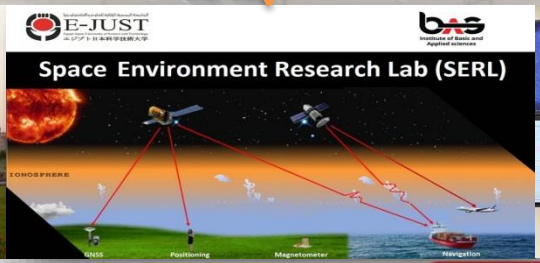
Space Environment Research Lab (SERL)



Space Weather Monitoring

Fluxgate Magnetometer and Telluric System

Date: October 12, 2021

Specifications:

Geomagnetic field Components: X, Y, Z

Resolution: Sub-nanotesla range

Accuracy: < 1 nT.

Sampling frequency: > 1 Hz

Data Logger: 24 Bit resolution

***Telluric field recorder**: 16 Bit Min. resolution 5 micro volt*

Telluric sampling freq.: 1 Hz

Maximum Field: 1.25 Volts

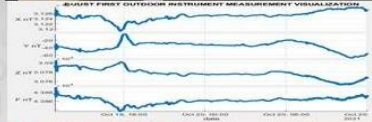
Non polarizable electrodes: 4X Cu-CuSo4

Solar System:

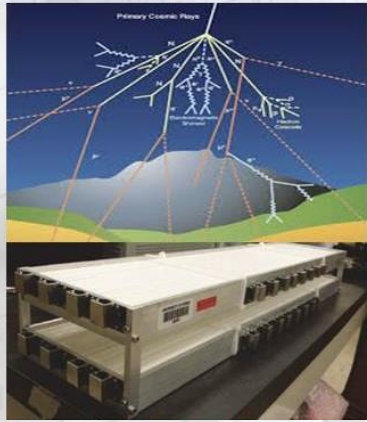
Power Source: 200 Watt solar panel

Solar Charger: 10 Amper with voltage regulator

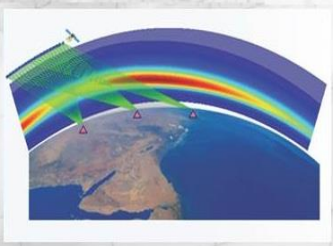
Batteries: 2 X 100 AH Varta or equivalent



Cosmic Ray Monitoring



GNSS TEC/Scintillation Monitoring Unit



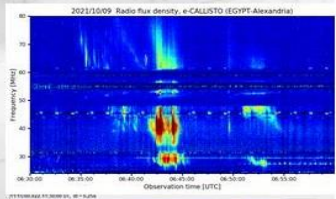
Specifications:

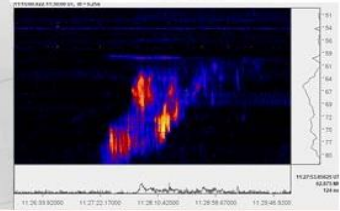
Very low noise GNSS carrier phase measurements with <1 mm precision in a 1 Hz bandwidth, GNSS chipset provide 672 channels

SATELLITE TRACKING - *GPS: L1C, L1 C/A, L2E (L2P), L2C, L5 -GLONASS: L1 C/A2 and unencrypted P code, L2 C/A L3 CDMA - Galileo: E1, E5A, E5B and E5AltBOC, E6 - BeiDou: B1, B2, B3, B1C, B2A - QZSS: L1 C/A, L1C, L1S, L2C, L5, LEX/L63 - IRNSS: L5, S-Band - SBAS: L1 C/A (EGNOS/MSAS GAGAN/SDCM), L1 C/A and L5 (WAAS) - L-Band: Trimble RTX™*

Maximum Data Logging Rate 100 Hz

CALLISTO Solar Radio Spectrometer





Date: August 15, 2021

Specifications:

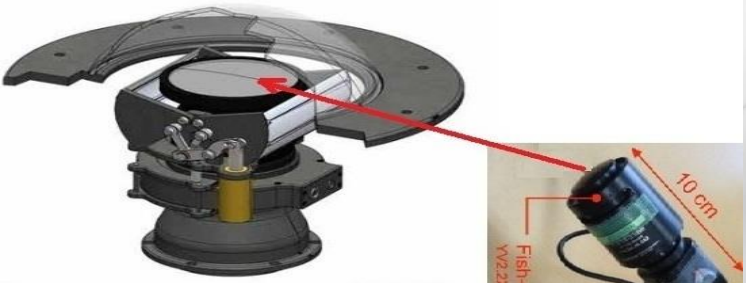
Frequency Agile Radio Spectrometers, heterodyne up-converter 10-90 MHz (5-108 MHz), shifting to 135-215 MHz (130-233 MHz) native frequency range, LWA-SYS Includes 1 each LWA-FEE, LWA-ANT, LWA-STK, LWAPC-Q LWA

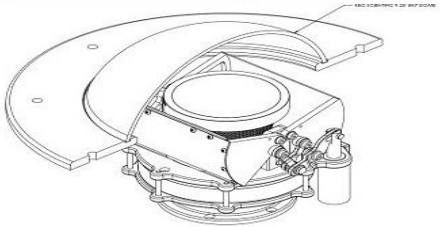
New Equipment: Plasma Bubbles Monitoring

Joint Project with (ISEE), Nagoya University, Nagoya, Japan

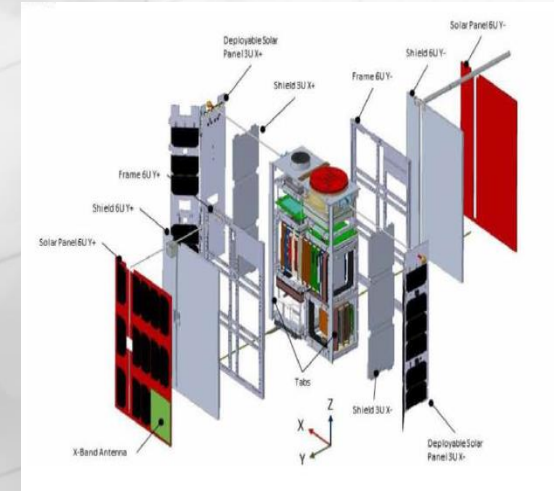
Three Cameras with glass filters:
630 nm, 557.7 nm,650 nm OH airglow

all-sky images of plasma bubbles every 4 sec





Project with the Egyptian Space Agency (EGSA)



Space Environment experiment (SPNS) is a space mission that aims at measuring and characterizing space plasma at the ionosphere.

Capacity Building: African Scholars

E-JUST

Eight African Scholars

1	Rehab Abdulmajed Abdo		Egypt
2	Felix Nakotey Minta		Ghana
3	Stephen Owino Omondi		Kenya
4	Wellen Rukundo		Uganda
5	Moheb Yacoub Saad		Egypt
6	Manar Gamal		Egypt
7	Stephen Tete		Ghana
8	Sebwato Nasurudiin		Uganda
9	Mahmoud Abdelhameed		Egypt
10	Lynne Nkatha Githio		Kenya
11	Kwabena Kyeremateng		Ghana
12	Pappoe Justice Allotey		Ghana
13	Asmaa Abdallah Ibrahim		Egypt

Activités ISWI Côte D'Ivoire

Dr Franck GRODJI

Université FELIX HOUPHOUËT BOIGNY,
Laboratoire de physique, Abidjan, Côte d'Ivoire

INTRODUCTION

- Ivory Coast's contribution to t*he International Space Weather Initiative* (ISWI) activities is supported by the External Geophysics team from the *Laboratoire des Sciences de Structure de la Matière, de l'Environnement et de l'Energie Solaire (LASMES).*

- *UFR Sciences des Structures de la Matière et de Technologie* (SSMT) of the Université Félix Houphouët Boigny (UFHB).

- We have a team of 4 Professors, 5 young researchers and 4 PhD students.

- The contribution of Ivory Coast to *the International Space Weather Initiative* (ISWI) activities can be summarized as follows:

1. School organization

2. Participation to the ISWI events in the world

3. Already defended and ongoing thesis during the last 10 years

SCHOOLS AND WORKSHOPS ORGANISED

- ❑ 3rd SPACE WEATHER School ISWI-MAGHREB-AFRIQUE DE L'OUEST (IMAO 2017), Abidjan/Côte d'Ivoire [16 - 28 OCTOBER 2017]

- ➢ School organised by the atmosphere physic Laboratory, UFR-SSMT, Université Félix Houphouët Boigny with the International SpaceWeather Initiative (ISWI) contribution.

- This School brought together participants from 11 different countries: Algeria, Burkina Faso, Cameroon, Ivoiry Coast, France, Guinea Conakry, Morocco, RC, RDC, Senegal and Tunisia

- **Participants**

There were 33 auditors (students) of which 15 internationals and 18 nationals. Courses were given by 15 scientists, including 12 Internationals (Africa and Europe) and 3 nationals scientists.

- ❑ 5rd SPACE WEATHER School ISWI-MAGHREB-AFRIQUE DE L'OUEST (IMAO5 2017), Abidjan/Côte d'Ivoire [17 - 28 OCTOBER 2022]

- ➢ School organised by the atmosphere physic Laboratory, UFR-SSMT, Université Félix Houphouët Boigny with the International SpaceWeather Initiative (ISWI) contribution.

- This School brought together participants from 14 different countries: Algeria, Burkina Faso, Cameroon, Ivoiry Coast, France, Guinea Conakry, Morocco, RC, RDC, Senegal, Palestine, Vietnam and Rwanda.

- This School was opened by the ivorian Minister of Higher Education and Scientific Research, Pr Adama DIAWARA. It brought together participants from 14 different countries: Algeria, Burkina Faso, Cameroon, Ivoiry Coast, Rwanda, RDC , RC, Senegal, Tunisia , France, Guinea Conakry, Morocco, Vietnam. This school was also, an opportunity to celebreated the thirty Years of IYEE (International Year of Equatorial Electrojet.

- Contribution of the International Space Weather Initiative (ISWI) in the IMAO workshops in Côte d'Ivoire has permitted the various doctoral students To strengthen the capacity of young researchers from Ivory Coast, in all scientific disciplines on Space Weather, Thus all thesis are defender in progress during the 10 last years.

❑THESIS DEFENDED

- GRODJI FRANCK OSWALD

THEME: *Study of the Equatorial Electrojet from the electrodynamic parameters of the equatorial ionosphere*

Defended in June 2018

- COULIBALI SORO IBRHIM

THEME: *Study of the perturbations of the equatorial ionosphere's F-layer at night during magnetic storms*

Defended in 2019

- JOSEE

THEME: *validation of NeQUICK 2 model in West Africa region from GNSS data*

Defended in January 2021

- TUO ZIE

THEME: *variations of the peak positions in the longitudinal profile of noon-time equatorial electrojet.*

Defended in June 2022

- AZIZ DIABY

THEME: *Estimating the daytime vertical E X B drift velocities in the F-region of the equatorial ionosphere using IEEY and AMBER magnetic data in West Africa.*

Defended in 2022

- NGUESSAN KOUASSI

THEME: *Geomagnetically-induced effects related to disturbed geomagnetic field variations at low latitude*

Defended in 2022

THANK YOU

Updates on Space Weather Activities in Kenya

Paul Baki

Department of Astronomy and Space Science , Technical University of Kenya

P.O Box 52428-00200, Nairobi, Kenya

Email: paulbaki@gmail.com

Overview

- Space Weather science has been growing in Kenya since 2007 and in the year 2022, significant developments continue to take place especially in infrastructure and also capacity building.
- Four universities are currently actively involved in space weather research, especially at postgraduate level. These are: Technical University of Kenya, Maseno University, Masinde Muliro University of Science and Technology and Pwani University.

Infrastructure development

- Kenya Space Agency has deployed some magnetometers across Kenya. Data from these facilities are currently being calibrated and will soon be accessible to the public.
- Deployment of more GPS receivers is also on going.

Capacity Building

- Many of the Kenya researchers participated in international meetings both physically and online e.g the Space weather meeting organized by the Abdus Salaam ICTP meetings
- 2 students graduate with Masters degrees in Physics, research work being undertaken in space weather domain.
- One Doctoral student undertook research visit at the National Space Research and Development Agency , Nigeria. The student is nearing completion of his studies.
- Collaborations across the globe and co-supervision of our students is enriching their research capacity.
- Research work published in per reviewed journals.

Research Focus

- Geomagnetism
- Ionospheric Scintillations
- Travelling Ionospheric Disturbances
- Geo-effectiveness and Impact of Solar Events GNSS Positioning and communication

Conclusion

- Challenges of scarce postgraduate scholarships in Kenyan Universities is limiting enrolment in space weather research as most students often have to sponsor themselves.
- We look forward to scholarship opportunities forb Masters and PhD students as well as postdoctoral positions globally.
- Any offer?

- Thank you!

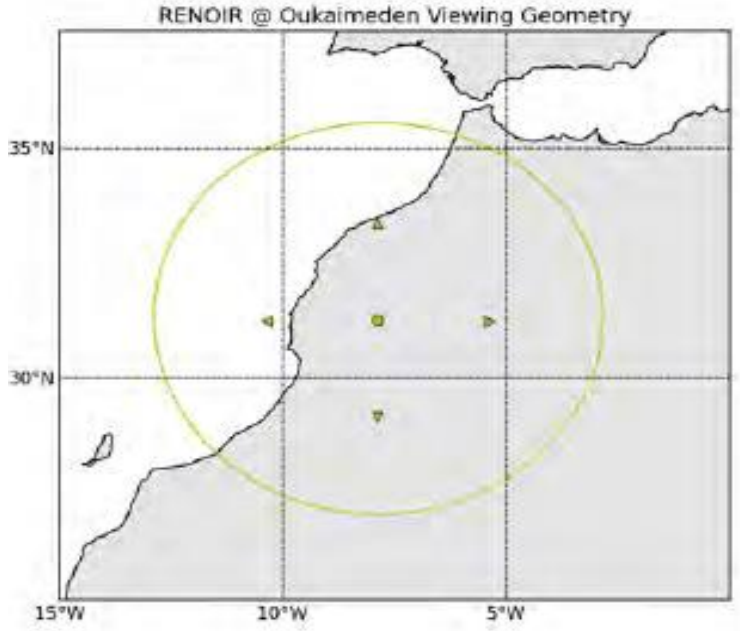
Space Weather in Morocco

Pr, AZIZA BOUNHIR

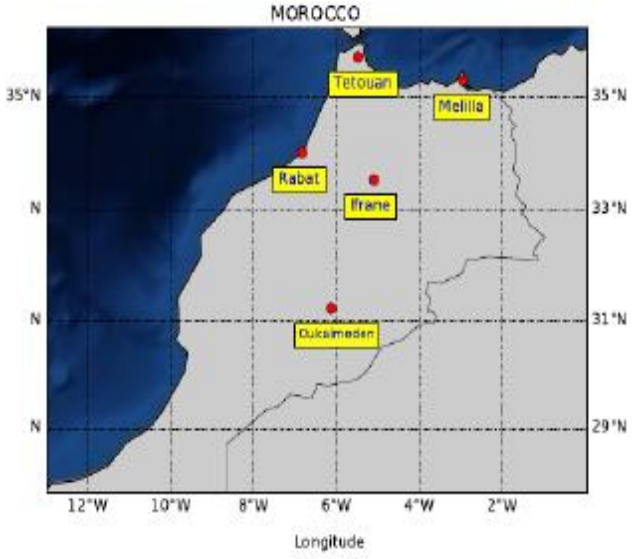
Faculty of Sciences at Rabat, University Mohammed V & Oukaimeden Observatory

- In 2010, ISWI delegation in Morocco
- In November 2013, RENOIR "Remote Equatorial Nighttime Observatory of Ionospheric Region" at Oukaimeden Observatory.
- In May 2014, International School on Space Weather at UCA University.

Fabry-Perot interferometer and Camera

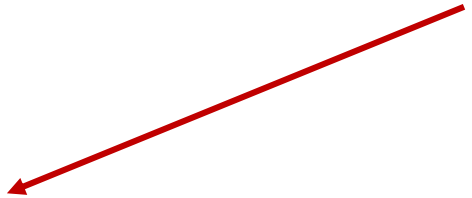


GPS stations



Scientific acheivements

- Measurement of **winds**, **temperature** and **ionospheric irregularities** at 250 km of altitude.
- Measurements of **TEC** from GPS stations.
- Make use of **satellite data: SWARM**.
- **Comparison to empirical and physics based models :** WM14, NRLMSIS-00, TIE-GCM and GITM



- Climatology of thermospheric winds and temperature and TEC data.
- Annual, seasonnal and solar cycle dependence.
- Effect of geomagnetic storms on thermospheric winds and temperature.
- Tidal and gravity wave signatures.
- Climatologies of EPBs over Africa.
- Geomagnetic storm study through multi-aparture data; a case study.

- Study of thermospheric response to geomagnetic storms in general (all FPI data over the area).
- Comparision of data with models.
- Effect of thermospheric winds on EIA (SWARM measurements)
- Longitudinal variation of EIA over the globe.

2 (3) professors
3 Ph.D thesis defended.
3 Ph.D students
Toubkal project success.

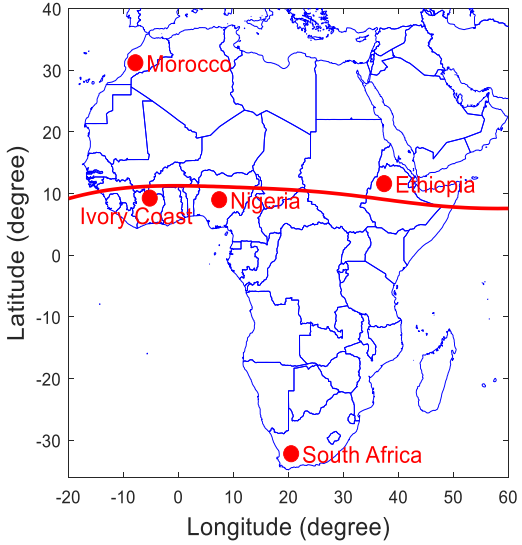
20 pubications

Scientific acheivements

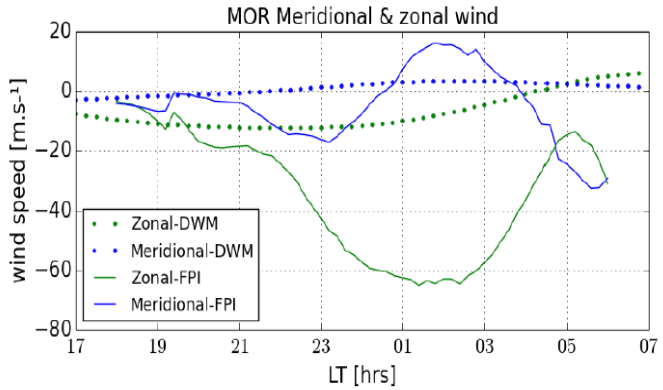
RENOIR Network

http://airglow.ece.illinois.edu/

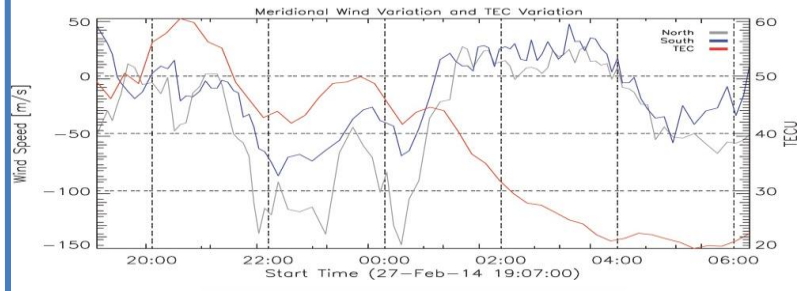
Thermospheric winds over Africa

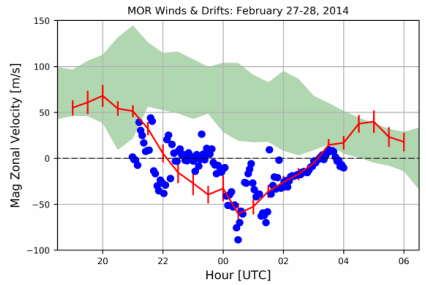


Storm time winds in general

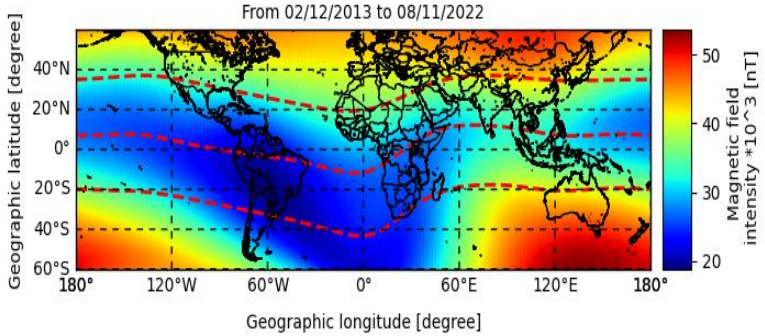


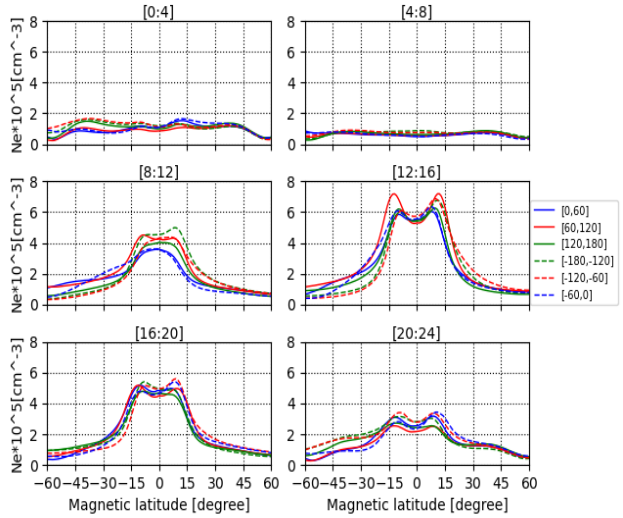
27-28 February stom





Longitidinal variation of ionosphere electron density





ISWI RELATED ACTIVITIES IN NIGERIA

BABATUNDE RABIU

UNITED NATIONS AFRICAN REGIONAL CENTRE FOR SPACE SCIENCE AND TECHNOLOGY EDUCATION - ENGLISH, (UN-ARCSSTE-E),

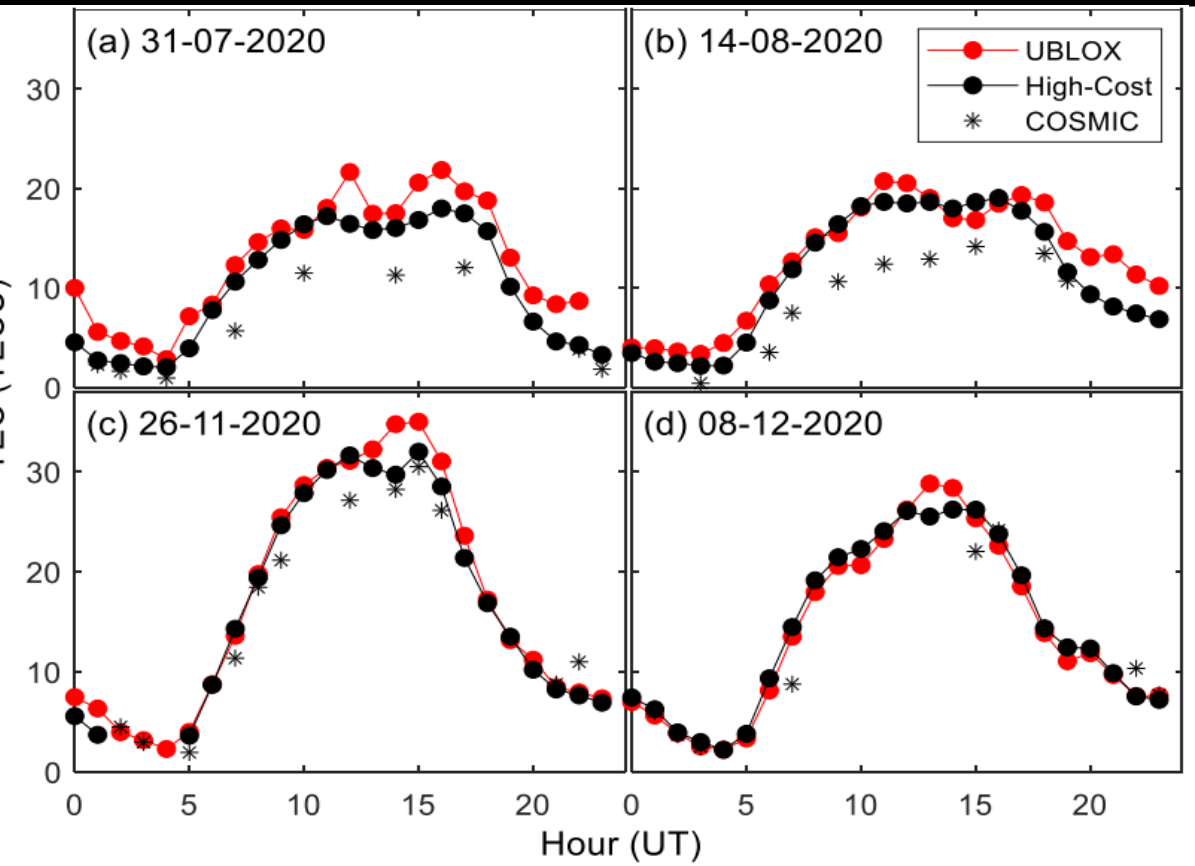
OBAFEMI AWOLOWO UNIVERSITY CAMPUS, ILE IFE, NIGERIA

EMAIL: TUNDERABIU2@GMAIL.COM; *TUNDERABIU@ARCSSTEE.ORG.NG*

SPACE WEATHER MONITORING FACILITIES IN NIGERIA

- 14 GPS stations for Space Weather monitoring
- I all-sky Optical Imager,
- I scintillation monitor,
- 1 Fabry Perot Interferometer,
- I SOFIE
- HF radio project
- I digisonde

Setting up of low cost GNSS Rx



Low-cost U- BLOX ZED-F9P

- ✓ Very good agreement between the measurements (R^2 >> 0.8) and similar dynamics.
- ✓ Slight discrepancies in U-Blox TEC due to antenna limitation.
- ✓ On average, COSMIC TEC were the lowest because of the height of integrati

3 units

Okoh et al 2021

International Colloquium on Equatorial and Low-Latitude Ionosphere

- 87 participants from across the globe
- 21 instructors

- Centre for Atmospheric Research, National Space Research and Development Agency, Anyigba, Nigeria,
- Institute of Space-Earth Environmental Research ISEE, Nagoya University, Japan,
- African Geophysical Society AGS, and
- Network of Space-Earth Environmentalists NSEE

18 - 23 SEP 2022
INSTITUTE OF SPACE SCIENCE AND ENGINEERING, AUST, ABUJA, NIGERIA .

ICELLI 2022

International Colloquium on Equatorial and Low-Latitude Ionosphere

21 LECTURERS FROM 9 COUNTRIES

Nigeria, Japan

France, Italy,

USA, Austria,

Uganda, India,

Norway

- 87 trainees
- drawn from over 11 countries
- Nigeria, Ghana, Ivory Coast, Pakistan, Italy, Brazil, Egypt, Rwanda, Kenya, USA

2015 – 2022
6 EVENTS
430 PARTICIPANTS IN ALL

BENEFITS

- Effective knowledge transfer
- Graduate training
- A number of PhD have been produced
- Productivity
- Enhanced research capability
- Joint cooperation/collaboration
- International model

FUTURE

- Physical event henceforth
- Resume International student participation (travel grant)
- Set up some national schools outside Nigeria
- Seek equipment grants

Space weather in Senegal

ISWI Steering Committee Annual Meeting , 10 February ,2023

Iba Der Thiam University of Thiès

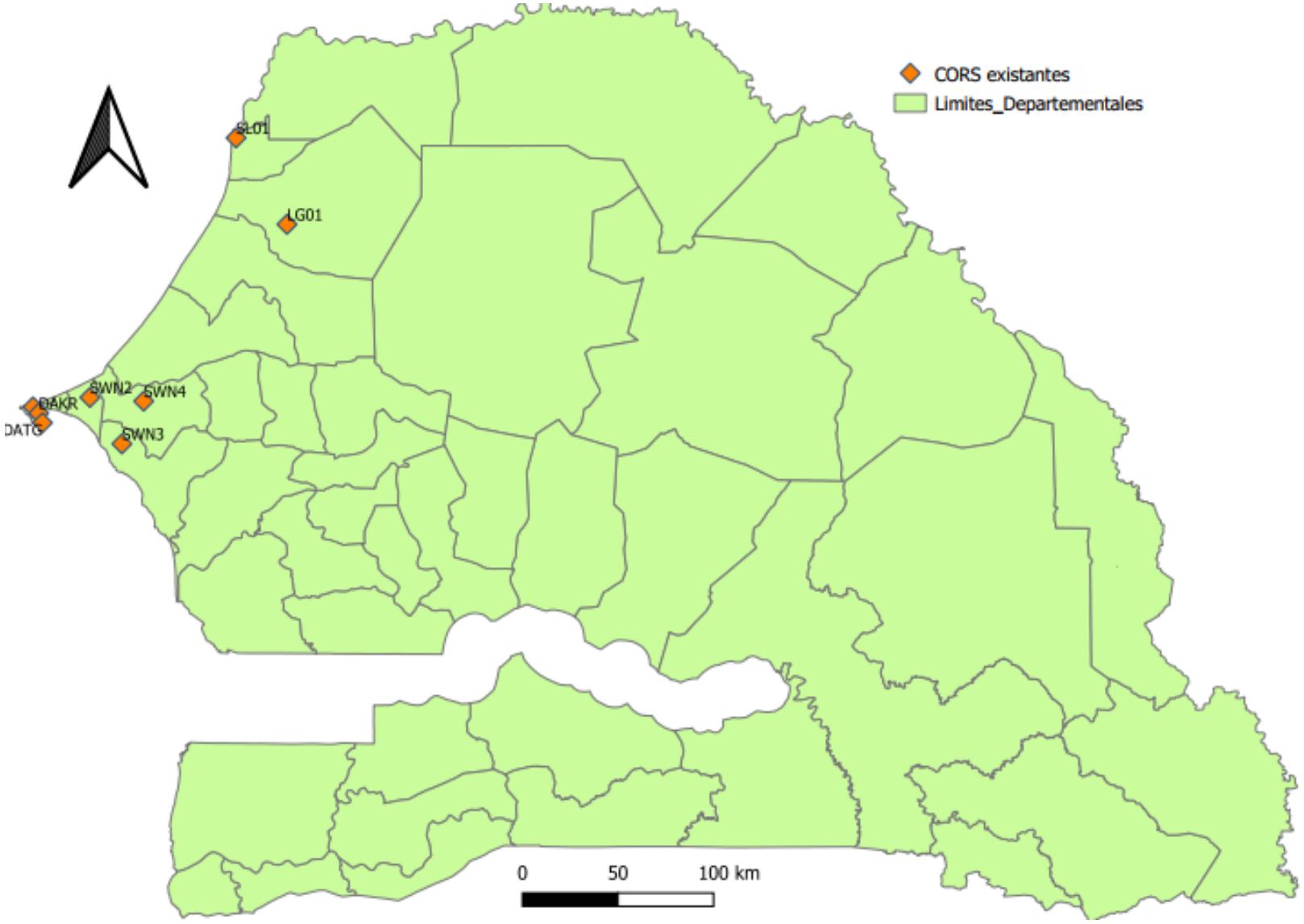
Dr Idrissa GAYE

idrissa.gaye@univ-this.sn

Status of CORS installed in Senegal

Contry: SENEGAL/ Région	Ownership and/or management body	ID	E	N	Start date	Comments
Dakar	ANAT/DTGC	DAKR	237333	1628915	2011	CORS integrated in the IGS network, provides only raw data
Dakar	ANAT/DTGC and SOMEL	DATG	239337	1623907	2017	public, provides only raw data
Dakar	S/C Africa	SCA1				private and operates in RTK via GSM
Dakar	SWAN	SWAN1	234385	1632208	2020	private and operates inNRTK
Dakar	SWAN	SWAN2	264171	1637160	2020	private and operates in NRTK
Thies	SWAN	SWAN3	280909	1612859	2020	private and operates in NRTK
Thies	SWAN	SWAN4	292323	1635203	2020	private and operates in NRTK
Louga	Cadastre	LG01	367346	1727821	2019	private and operates in RTK via radio
Saint Louis	Cadastre	SL01	340682	1773088	2019	private and operates in RTK via radio

Distribution of existing CORS



CORS network extension

- A research impulse fund exists at the Iba Der Thiam University of Thiès. And a project to set up and test a precise differential positioning device based on low-cost GNSS receivers is being funded to participate in the CORS network extension,

Status of GNSS training and Research progress

- **GNSS Training and Capacity building**

  ✓GNSS in Topography and Telecoms

  ✓GNSS positioning strategies and corrections

  ✓ SBAS (EGNOS)

Status of GNSS training and Research progress

- **Research progress**

Number of students who have defended a Master grade or PhD

Eight students have defended a Master grade

Two students are in the process of a PhD and

One student who will present his PhD grade in the next days

Important space weather projects in Senegal

Project to launch a nanosatellite in 2023

SBAS development for aviation and non-aviation users in Africa (SatNav Africa JPO)

Mains thematic of research

Ionosphere and Troposphere studies with GNSS signals

PPP using in redefinition Datum in Africa

Low cost receiver using in reference frame and others application

Others GNSS Project at Iba Der Thiam University of Thies

- Research capacity building Project between GIRGEA and University Iba Der Thiam of Thies. The objective is to develop trainings Master and Phd in Space Weather and GNSS. Create a GNSS research laboratory,
- Create startups in applications using Positioning and Navigation technology.
- Collaboration with SatNav Africa JPO contributing to ISWI activities

Partnership:

- Partnership agreement with the **SatNav Africa JPO**
- JPO is a Pan-African entity based in Dakar its premises made available by ASECNA within the contractual framework with the European Commission and the Director of the JPO manages in full autonomy the technical execution of the Program for the benefit of the entire Africa continent. The JPO has a staff of nine recruited experts from across Africa
- The specific objective of the Program is the acceleration, adoption and development in Africa of satellite-based augmentation systems (SBAS) based on EGNOS (European Geostationary Navigation Overlay Service) technology. It is funded by the European Commission and ASECNA which provides office infrastructure and provides financial administration in Senegal.

Merci

Some activities in South Africa in 2023.

1. In the framework of real-time operational Space Weather Centre, efforts to deploy instruments across the African continent continue. So far, GNSS receivers and or scintillation receivers have been deployed in Zambia, Botswana, Kenya, Uganda, and Nigeria. In 2023, there are plans to expand the network to include deployments in Gabon, Zimbabwe among others. The data is transmitted to SANSA in real-time to allow near real-time ionospheric monitoring.
2. Development of products and services as per ICAO's requirements continue in 2023. These include real-time data products as well as models for nowcasting and forecasting purposes.
3. The SuperDARN workshop/conference 2023 will be hosted and run by South Africa (SANSA) during the period of 29 May to 02 June 2023.
4. South Africa will co-host the International Space Weather Camp 2023 (ISWC 2023) with USA during the period 24 June – 23 July 2023. Students will attend lectures and participate in project activities in South Africa from 24 June – 8 July 2023; thereafter they will travel to USA for the second part of the camp. The ISWC is an annual collaborative effort between South Africa, Germany and USA which brings together students from the three countries to learn about Space Weather and Space Physics.

Space science in Sudan

MAGDI ELFADIL YOUSIF SULIMAN, assistant professor,
Sudan University of Science and Technology

February 2023

Former data instruments

- Back around 90'th one analouge ionosonde was installed in Sudan, the map showing these instruments, including the one in Sudan was found in:
- http://www.wdc.stp.rl.ac.uk
- But no data, no more information.

Current data instruments

- Currently, the only one and unique data instrument in Sudan is the magnetometer belongs to Kyushu University, Japan.
- It was installed since 2008 in the southern campus of Sudan University of Science and Technology.
- It is no longer providing data, because it is under a maintenance plan, and should be moved to a better new place of less or no noise.

Capacity building activities

- The institute of space research and aerospace (ISRA) is accustomed to organize activities during celebrations of the international space week every year, including 2022;
- These activities include public lectures, outreach, and presentations.

Looking forward

- However, we in Sudan we need to do a lot so as to improve our current status in terms of data instruments, and capacity building activities.
- We are looking forward for more collaborations, and ready to facilitate hosting any space science instrument.

ISWI in TUNISIA

https://iswi-tunisia.github.io/

Dr. Hassen Ghalila

LSAMA laboratory, faculty of sciences of Tunis, University of Tunis El Manar.

Dr. Ahmed Ammar

Astronomical Society of Tunisia

Optical Society of Tunisia

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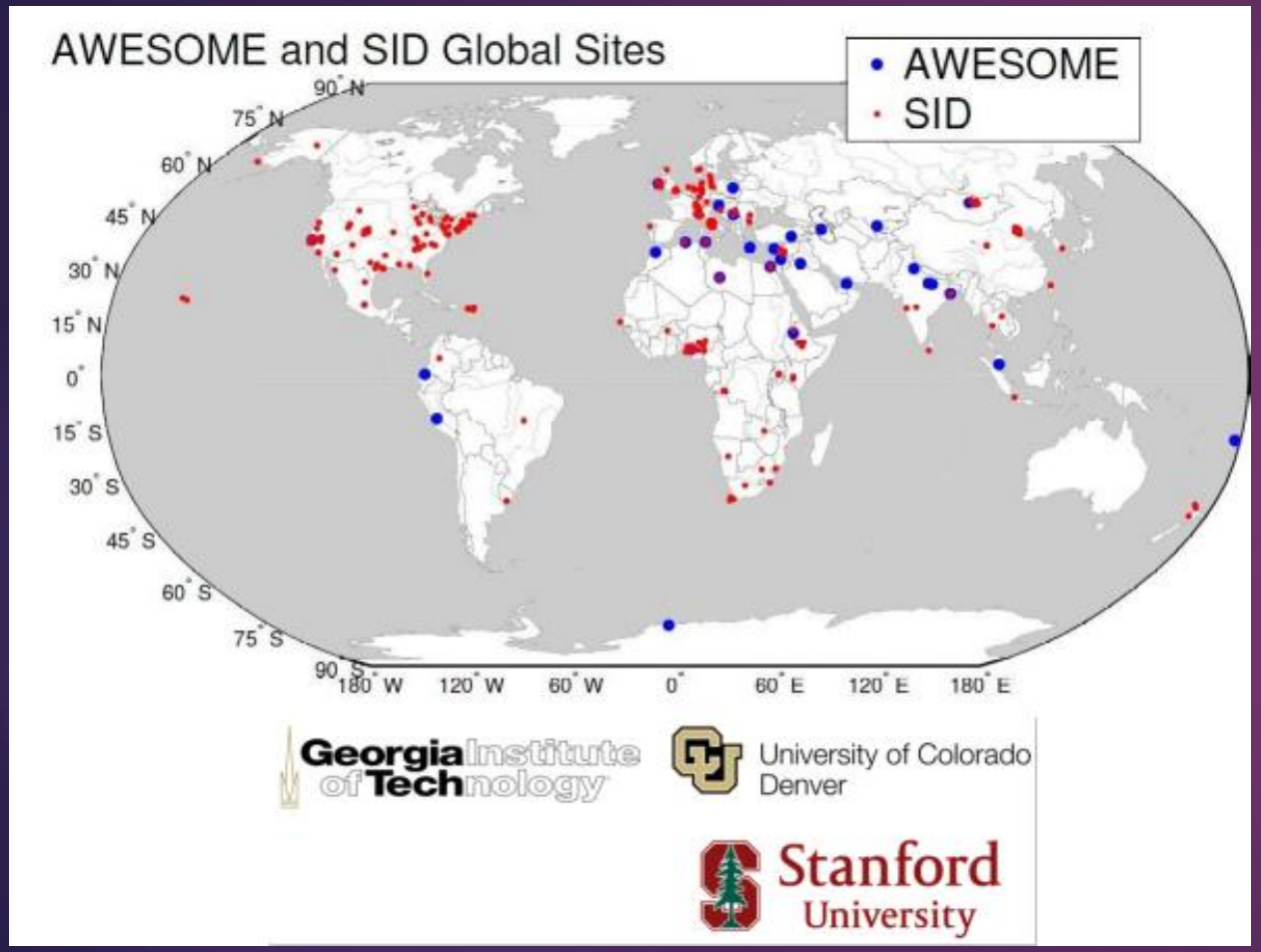

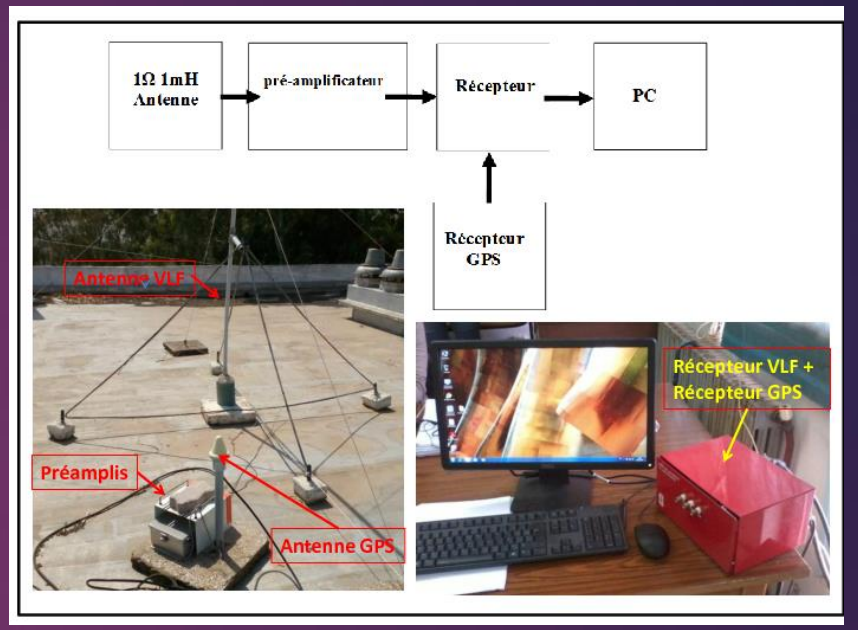

AWESOME instrument

Acknowledgment :
Dr. Morris Cohen
Georgia Institute of Technology

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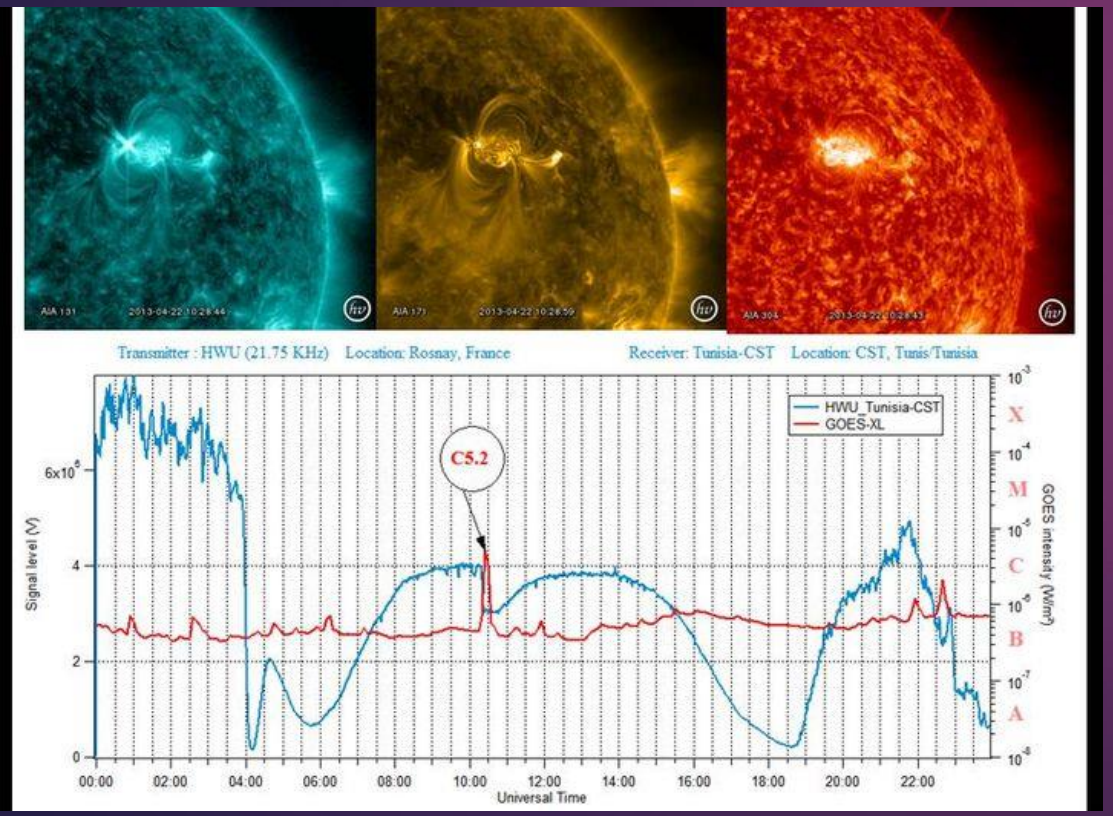
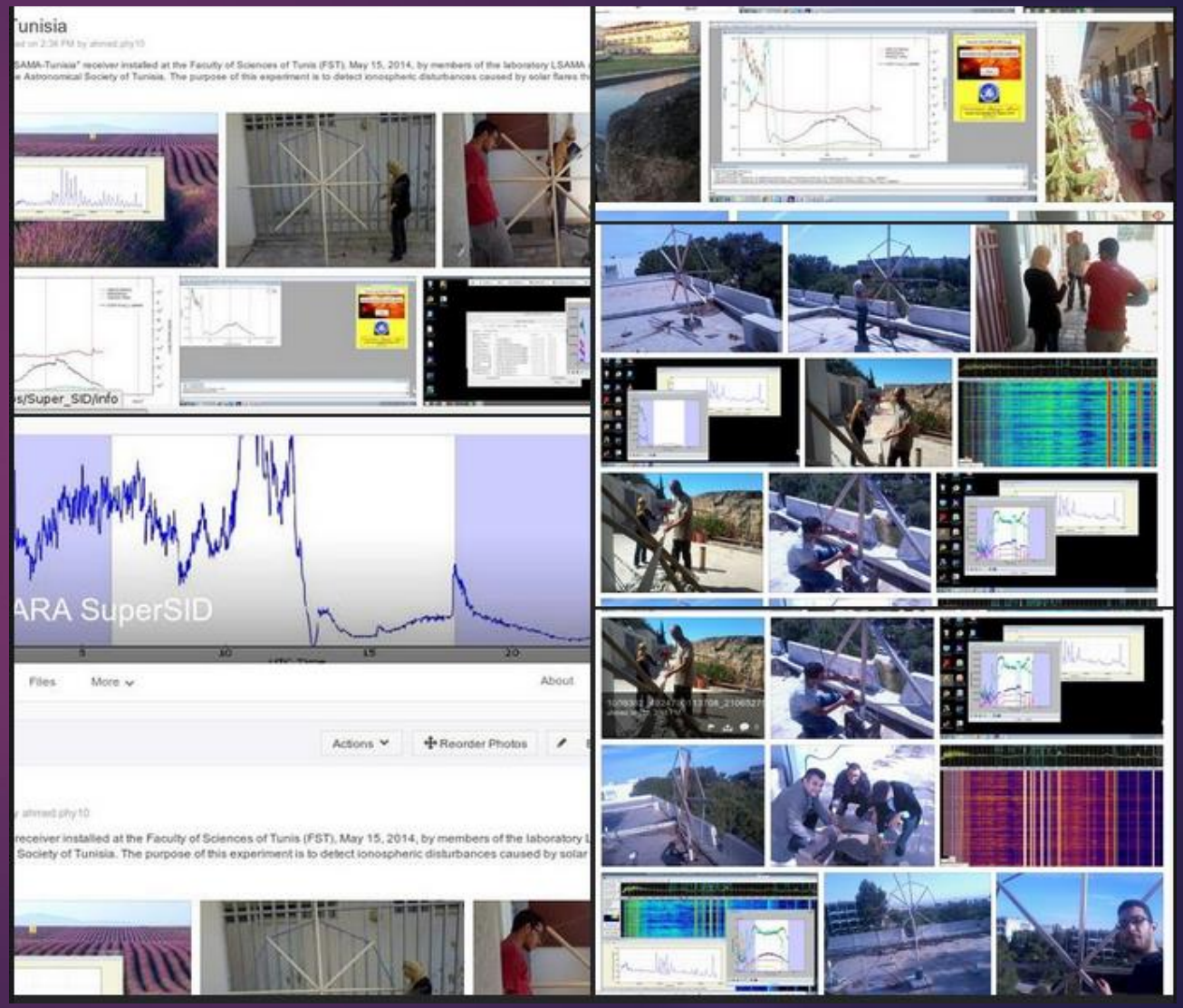
SuperSID instruments

Acknowledgment :
Deborah Scherrer
Stanford University





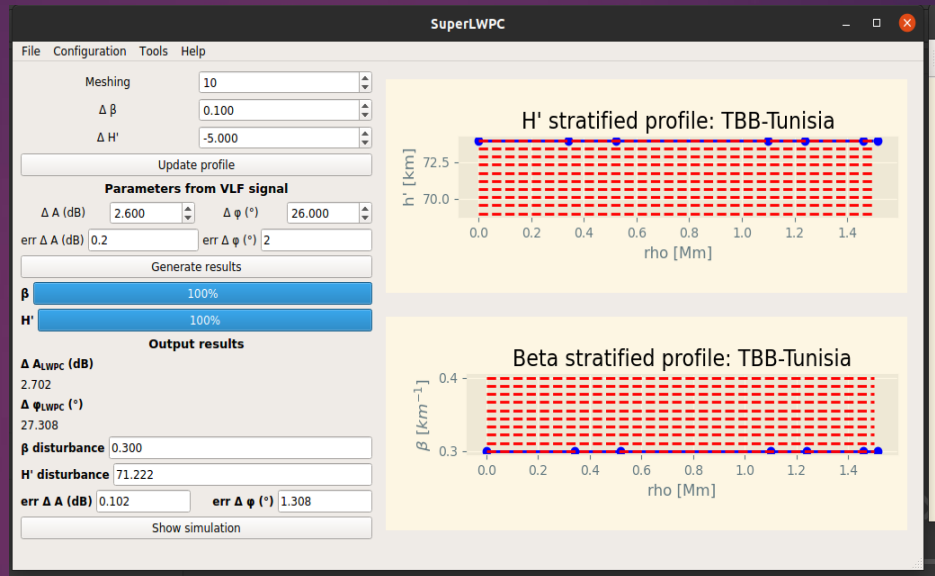
ISWI in TUNISIA

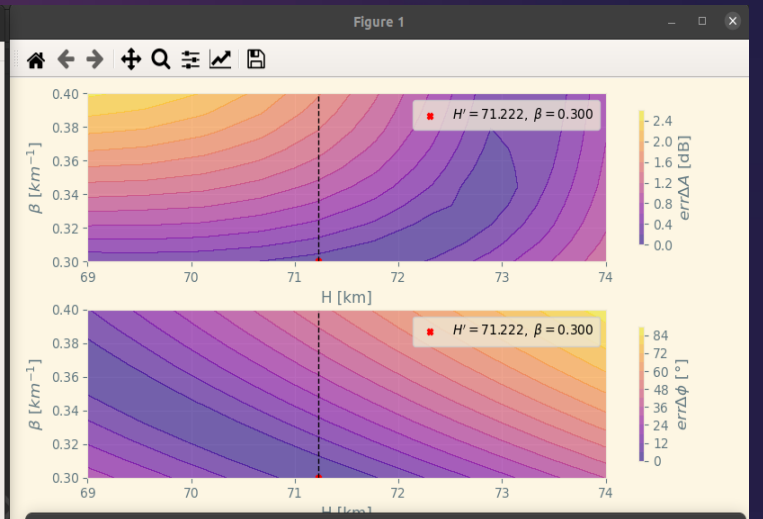
https://iswi-tunisia.github.io/

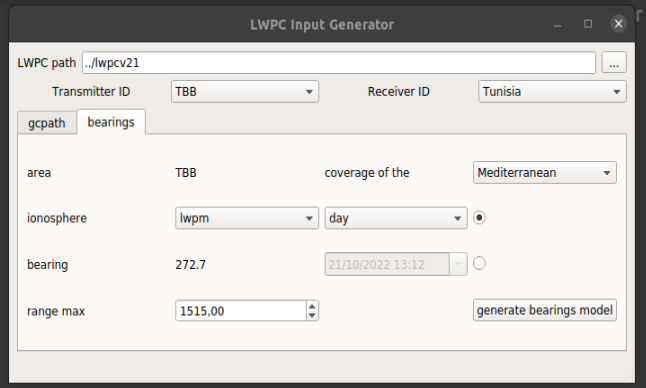
Open Source software : SuperLWPC

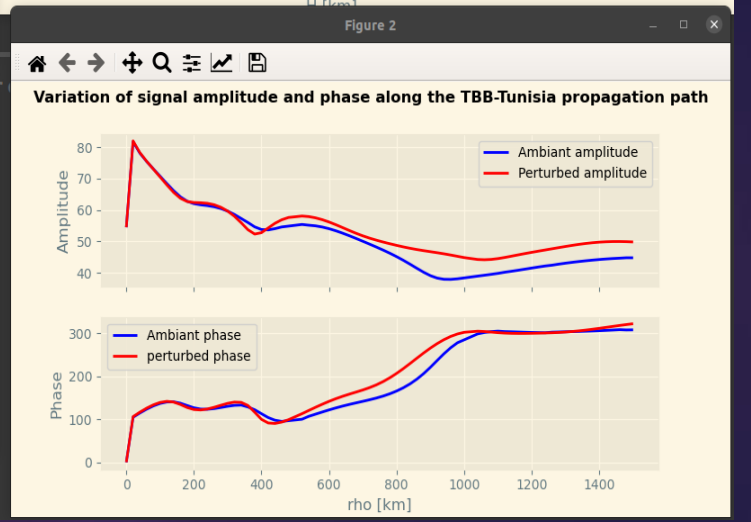
https://github.com/lwpc-gui/SuperLWPC

The determination of the coefficients *H'* and β is done interactively during which we seek to minimize the deviation between the measured ELF/VLF/LF signal perturbations and the introduced model. This procedure is very time-consuming and tedious to perform because the LWPC code as is requires running multiple executables with each adjustment made and at the end of each iteration. For this reason, we decided to develop a SuperLWPC interfaced application that allows to run a set of tests in an interactive and autonomous way. This application was developed using the Python programming language.









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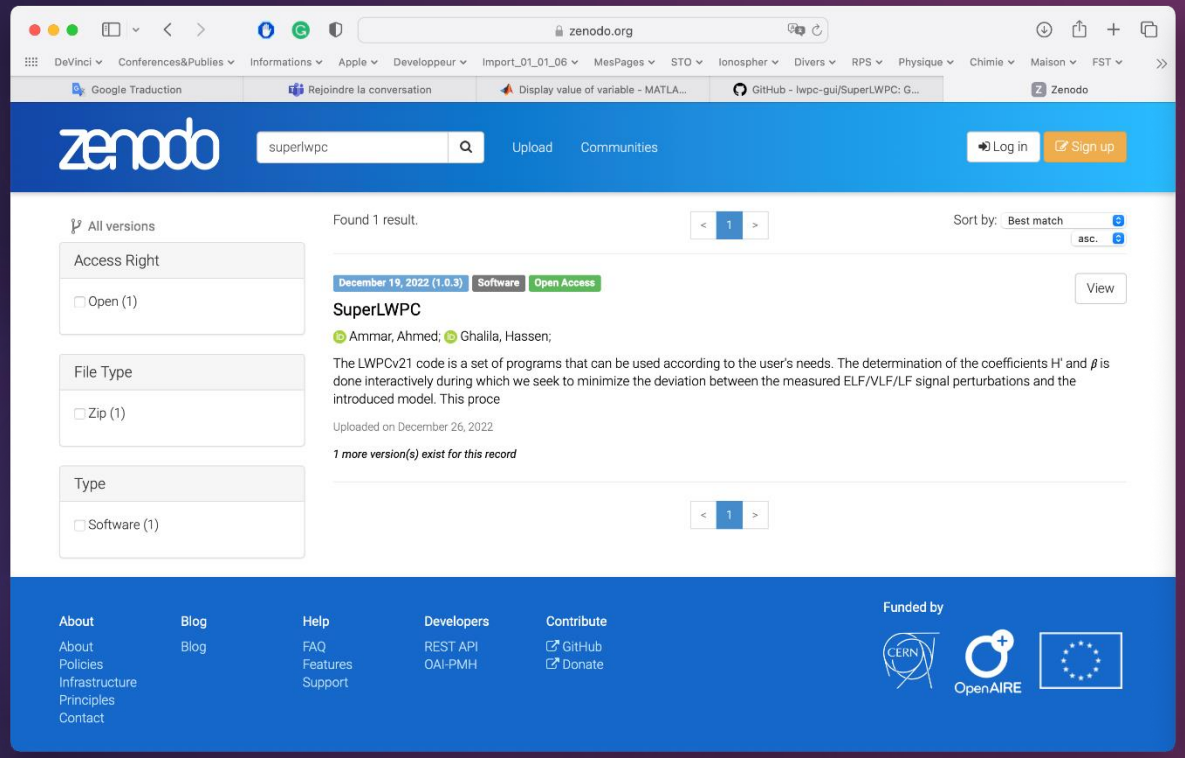

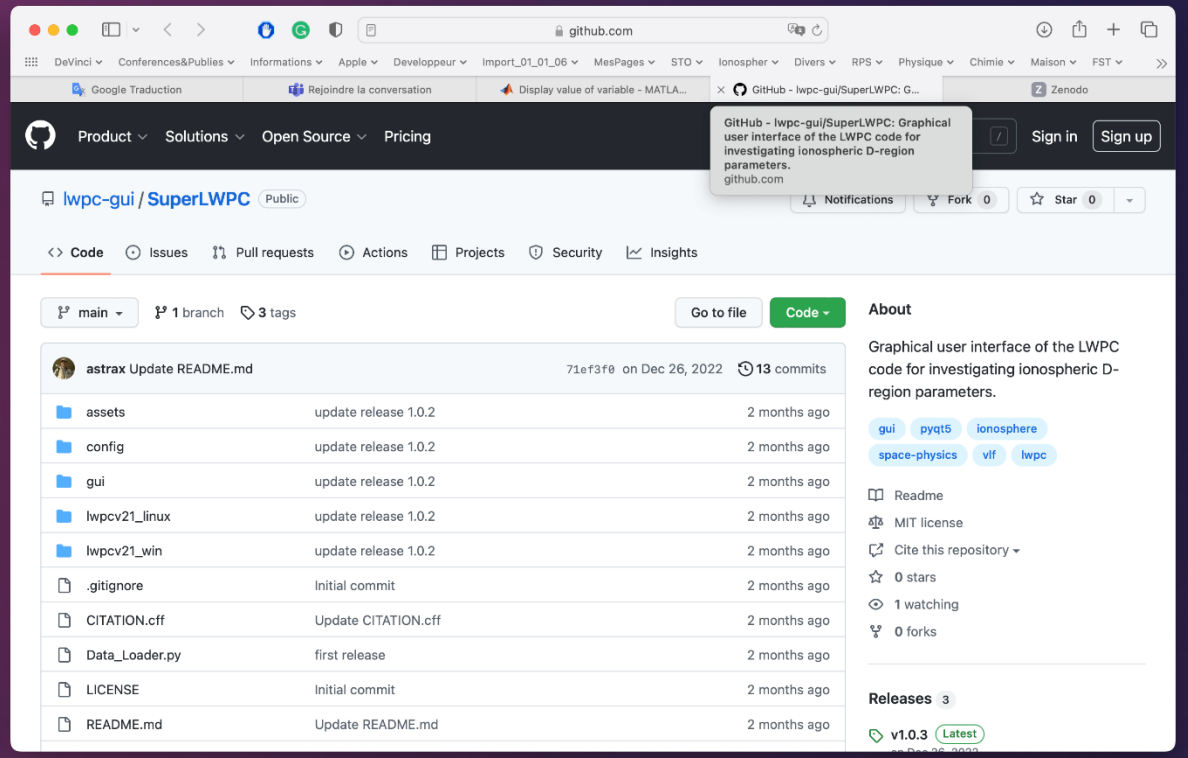

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New deployment, soon for solar eclipse events