Cyprus Ionospheric Research group

http://cyirg.frederick.ac.cy/

Frederick University

Nicosia, 20 September 2022

Cyprus Ionospheric Research group (CyIRG) research scope

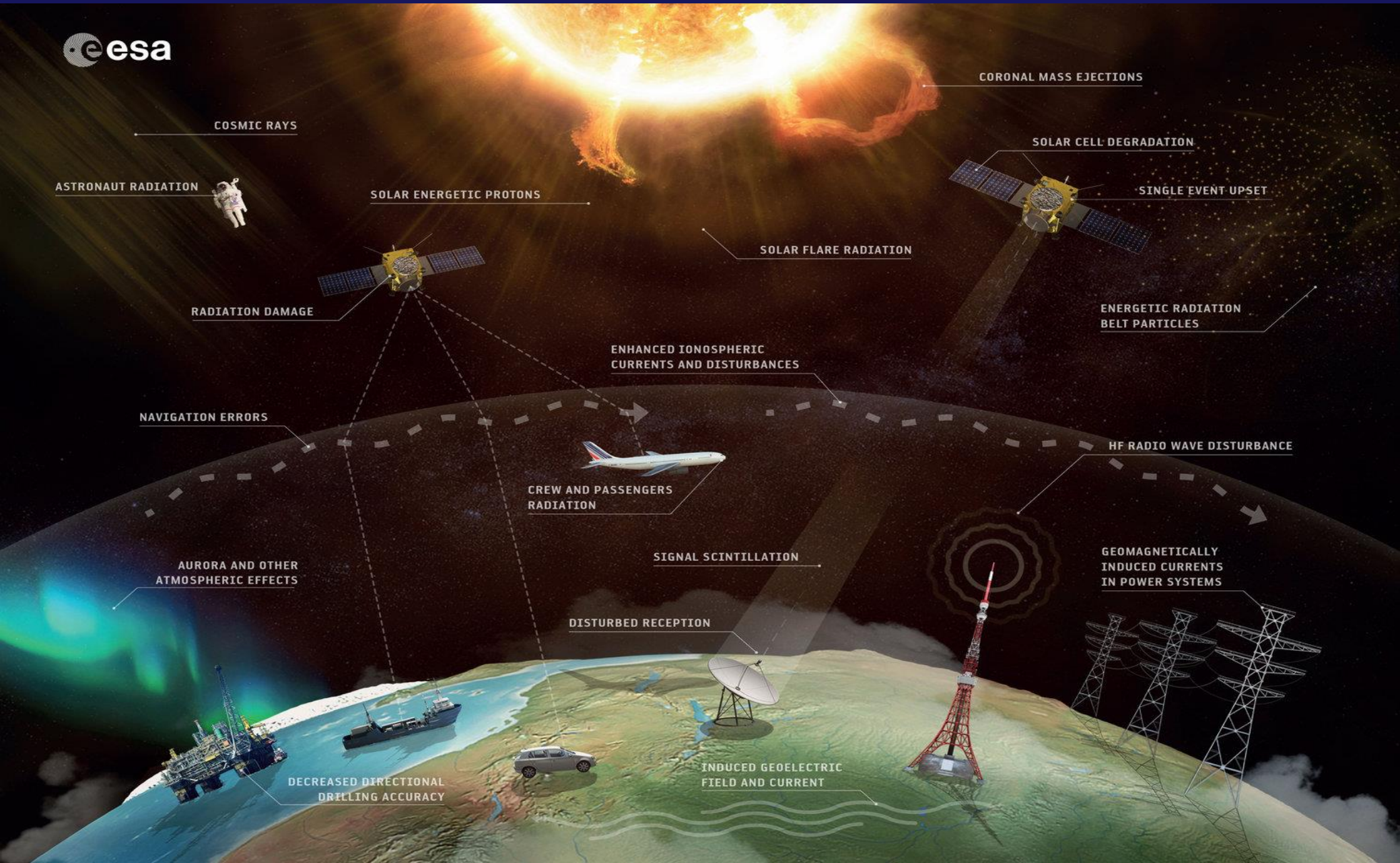
- The research activity of the Cyprus Ionospheric Research group lies in the context of the study and mitigation of ionospheric effects on radio systems.

- It is in the position to pursue this aim by means of its infrastructure that facilitates continuous remote sensing of the state of the ionosphere, within various parts of the electromagnetic spectrum.

- Detrimental ionospheric effects on radio systems usually have their origin on the disturbed state or natural variability of the Sun and therefore the group has a genuine research interest on Space Weather and its subsequent impact on the Upper Atmosphere.

http://cyirg.frederick.ac.cy/

Cyprus Ionospheric Research group (CyIRG) research scope



Permanent Cyprus Ionospheric Research Group researchers

Dr. Haris Haralambous
Cyprus Ionospheric Research Group Head
Call: *(+357) 22 394 394 ext. 46107*
Email: *eng.hh@frederick.ac.cy*

Dr. Christina Oikonomou
Permanent Cyprus Ionospheric Research Group researcher
Call: *(+357) 22 394 394 ext. 46110*
Email: *res.ec@frederick.ac.cy*

Dr. Theodoros Leontiou
Permanent Cyprus Ionospheric Research Group researcher
Call: *(+357) 22 394 394 ext. 46128*
Email: *t.leontiou@frederick.ac.cy*

Dr. Harris Papadopoulos
Permanent Cyprus Ionospheric Research Group researcher
Call: *(+357) 22 394 394 ext. 46123*
Email: *com.ph@frederick.ac.cy*

Dr. Andreas Konstantinidis
Permanent Cyprus Ionospheric Research Group researcher
Call: *(+357) 22 394 394 ext. 43158*
Email: *com.ca@frederick.ac.cy*

Dr. Eleni Tsolaki
Permanent Cyprus Ionospheric Research Group researcher
Call: *(+357) 22 394 394 ext. 49145*
Email: *eng.te@frederick.ac.cy*

Dr. Michael Makrominas
Permanent Cyprus Ionospheric Research Group researcher
Call: *(+357) 22 394 394 ext. 49139*
Email: *bus.mm@fit.ac.cy*

Dr. Marios Charalambides
Permanent Cyprus Ionospheric Research Group researcher
Call: *(+357) 22 394 394 ext. 46135*
Email: *bus.chm@frederick.ac.cy*

Cyprus Ionospheric Research Group Post-doctoral researchers

Dr. Arun Kumar Singh
Cyprus Ionospheric Research
Group Post-doctoral researcher

Dr. Christos Giannaros
Cyprus Ionospheric Research
Group Post-doctoral researcher

Dr. Antonios Constantinides
Cyprus Ionospheric Research
Group Post-doctoral researcher

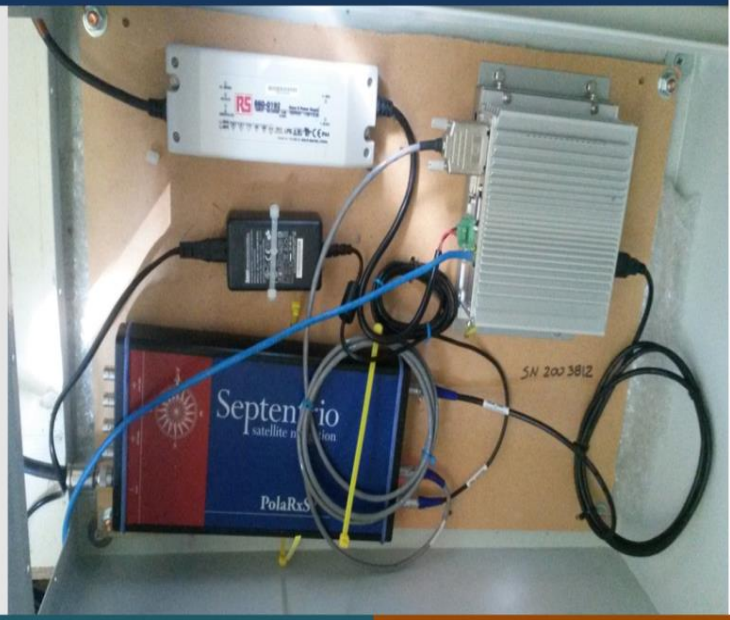
Dr. Krishnendu Paul
Cyprus Ionospheric Research
Group Post-doctoral researcher

Dr. Md Golam Mostafa
Cyprus Ionospheric Research
Group Post-doctoral researcher

Cyprus Ionospheric Research group (CyIRG) infrastructure

CYPRUS DIGITAL IONOSONDE - DIGISONDE DPS-4D

SCINTILLATION RECEIVER & ANTENNA



GNSS REFERENCE STATION & METEOROLOGICAL STATION – KLIR

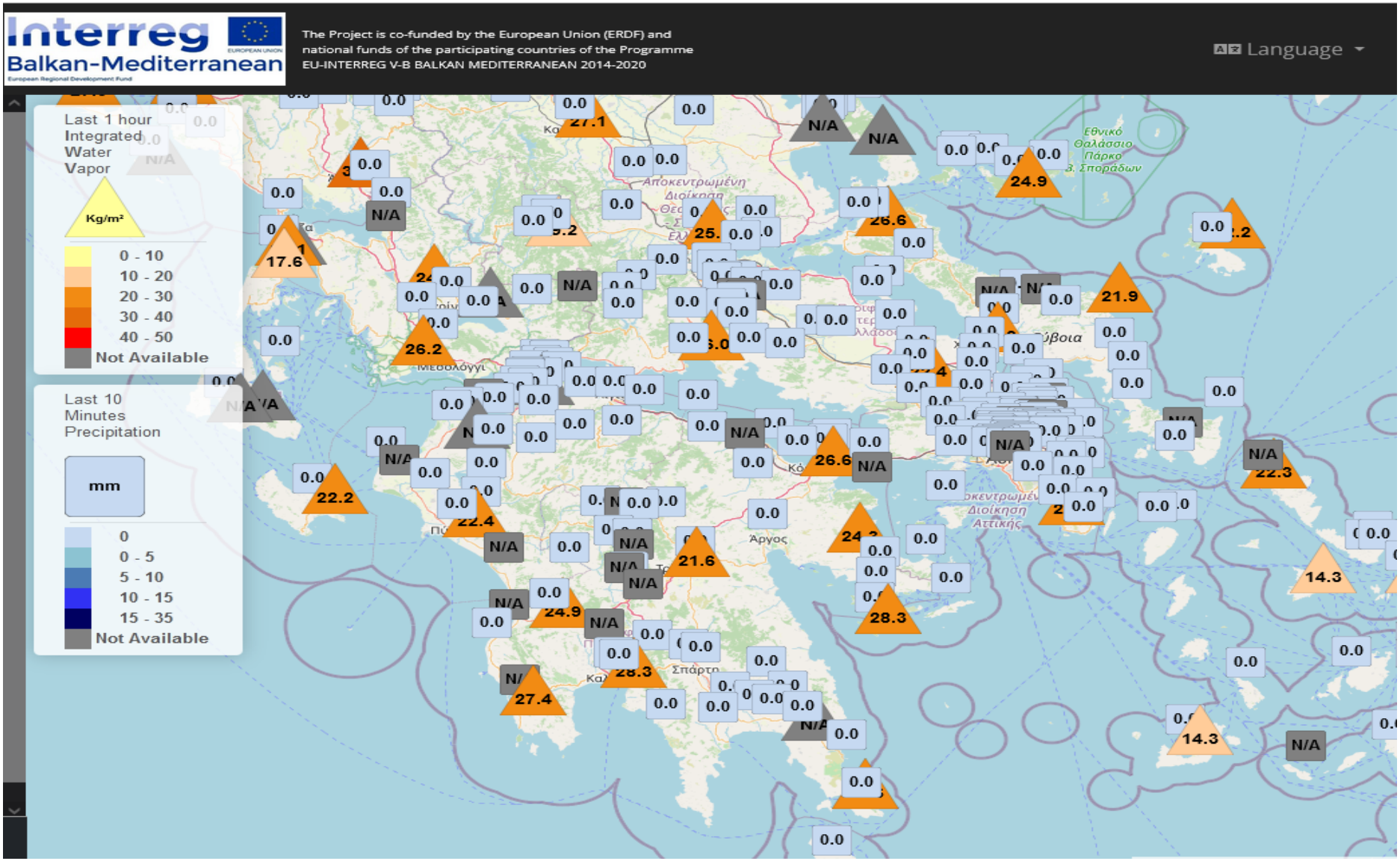
HF SPECTRAL MONITORING SYSTEM

VLF RECEIVER

BalkanMed real time severe weather service

- *15 new GNSS stations were installed in Bulgaria (12), Cyprus (1) and Greece (2)* (***red lines***)
- *25 new Meteorological stations were installed in Bulgaria (3), Cyprus (8) and Greece (14)* (***blue lines***)

BalkanMed real time severe weather service



PAST PROJECTS UNDER PECS

Enhancing Space Awareness in Cyprus through Space Weather Studies, (ESACSWS)

Contractor: Frederick University			**ESACSWS Budget:** 49.751 € **Co-funded Budget:** 0 €
Contract No.: 4000124780/18/NL/SC	**Proposal:** CY1_04	**Year of Contract: 2018**	**Proj. Mgr.:** Haris Haralambous **ESA TO/TEC:** S.P. Airey (IPL-IPS)/ A. Glover (OPS-SW)
TRL	**Initial:** n/a	**Achieved:** n/a	**Target TRL:** does not apply to this type of project

Background and justification:
The mission is an important step towards initiating significant interest for space related research in the immediate future and also towards boosting the visibility of high level space technology in Cyprus in an effort to increase the number of Cypriot qualified scientists and engineers in space science and technology in the long run.

Objective(s): The project aims to enhance awareness of the widest possible societal spectrum in Cyprus about space science, relevant technologies and their application through space weather studies.

Achievements and status:
The exhibition was completed in September 2019 and it was inaugurated on the 10th of September by eminent Greek Space Physics scientist Dr Stamatios Krimigis. Since then it has been visited by schools and other groups and individuals attracting around 550 visitors.

Benefits:
The knowledge and experience gained by young people will increase their motivation about space weather technology and application and therefore it can generate more interest for space related sciences in the long run in Cyprus. The database of space awareness and educational material that will be created could be exploited by teachers in the future. It could also be utilized by the Ministry of Education and Culture to enrich the national curriculum. Part of this material such as the 'PLANETERRELLA' presentations and the Greek version of the material might utilized by the European Space Education Resource Office (ESERO) project. The 'PLANETERRELLA' can be used in future exhibitions, festivals and outreach events.

Next steps:
The following phase will be the organisation of more space educational and awareness activities in the FU exhibition hall and the intensification of promotion and advertising of the exhibition to attract more interest and increase public and school visits in the next months.

Enhancing Space Awareness in Cyprus through Space Weather Studies

Exhibition main theme and logo

The Sun and Us" exhibition floor diagram

FREDERICK UNIVERSITY

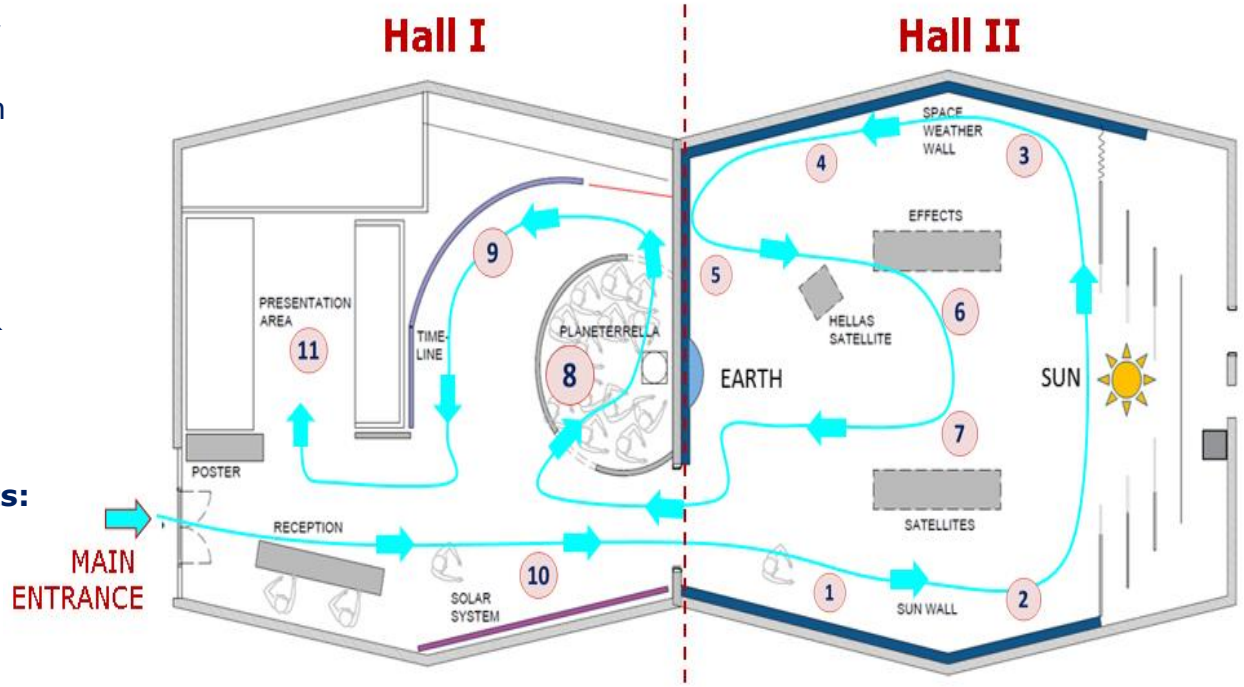
Hall I sections

8 'PLANETERRELLA' experiment
Aurora Simulation

9 TIMELINE
History of Space Weather

10 SOLAR SYSTEM & Space Weather

11 CINEMA area
Documentary **"Northern Lights: A Magical Experience"**, produced by the internationally recognized solar physicist, **Pr Pål Brekke**



Hall II sections

Sun Wall

1 **SUN**
Characteristics, Anatomy & Magnetism

2 **SUN**
Solar Explosions & Space Weather

Earth Wall

3 **EARTH**
Magnetosphere

4 **EARTH**
Ionosphere & Atmosphere

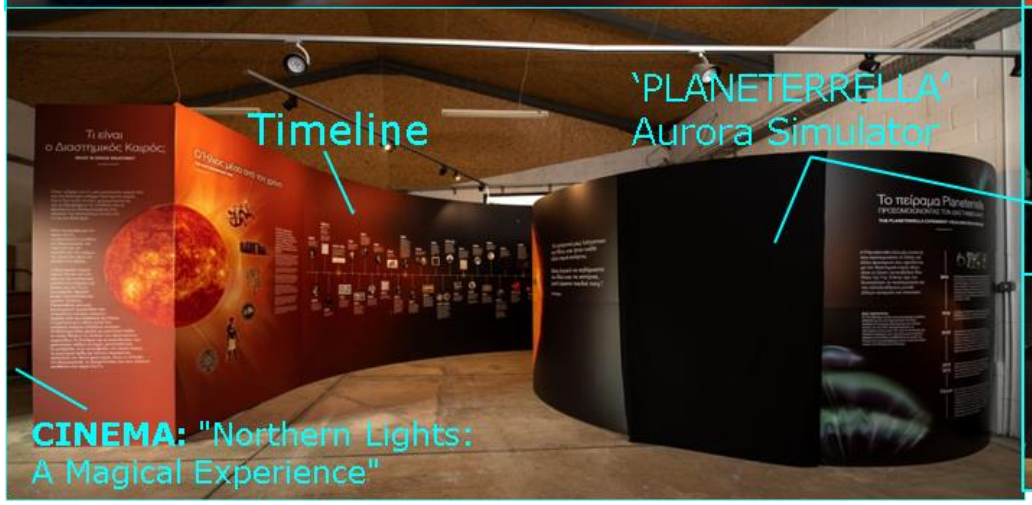
5 **EARTH**
Atmosphere

Touch Screens

6 **EFFECTS**
Of Space Weather

7 **HELIOPHYSICS 'FLEET'**
Spacecraft for observation of Sun & Space Weather

Exhibition Halls



“The Sun and Us” exhibition floor diagram

FREDERICK UNIVERSITY

HALL 2

“The Sun and Us” exhibition floor diagram

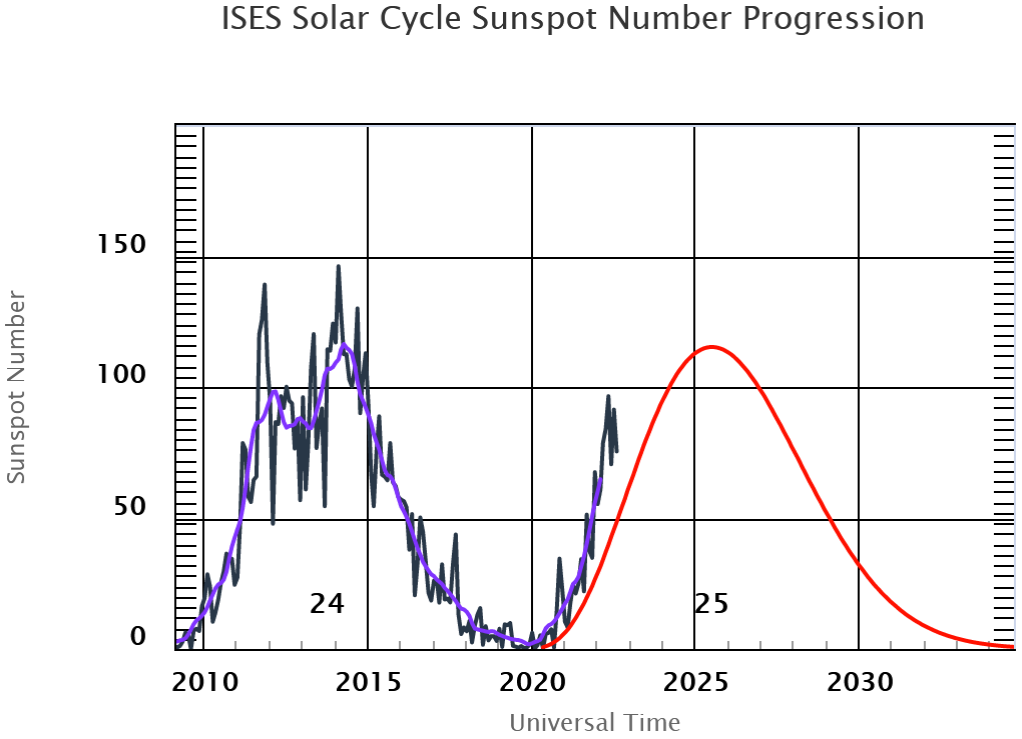
FREDERICK UNIVERSITY

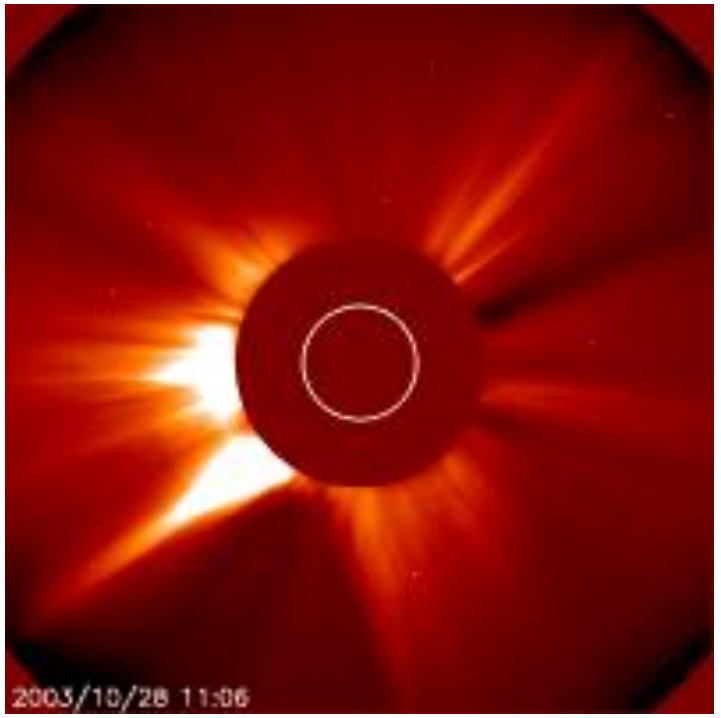
HALL 1

Frederick University Planeterrella

“The Sun and Us” next steps

- CyIRG under negotiation with Eugenides Foundation to host the “The Sun and Us” exhibition and the NOESIS Science Center and Museum of Technology in Thessaloniki with a potential to be visited by 15,000 and 5,000 students respectively.
- CyIRG under negotiation with a number of relevant Institutes in Europe to make a translated version of the “The Sun and Us” exhibition available to raise awareness on Space Weather during a period of rising solar activity.





Potential Enhancements in Ionospheric Monitoring under SSA, (PEIMSSA)

Contractor: Frederick University			**PEIMSSA Budget**	**49.092 k€**
			Co-funded Budge	**0 €**
Contract No.: 4000126946/19/NL/MH	**Proposal: FU/1-9288/2**	**Year of Contract: 2019**	**Proj. Mgr.:** Haris Haralambous **ESA TO/TEC:** S.P. Airey (IPL-IPS)/ A. Glover (OPS-SW)	
TRL	**Initial: n/a**	**Achieved: n/a**	**Target TRL:** does not apply to this type of project	

Background and justification: The PEIMSSA project aims to assess whether an introduction of the Cyprus ionosonde into the existing European Ionosonde Service (EIS) SSA service will improve the ionospheric representation over the eastern Mediterranean region. It also aims to indicate the expected degree to which accurate ionospheric radio occultation (RO) measurements will enable future RO missions to be exploited in ionospheric assimilation procedures over Europe.

Objective(s): The project aims to provide assessment of the possible benefit of introducing of the Cyprus ionosonde into the existing EIS SSA service and to evaluate the possibility of exploiting future RO missions to assimilate electron density profiles into 3d electron density representation over Europe in the future.

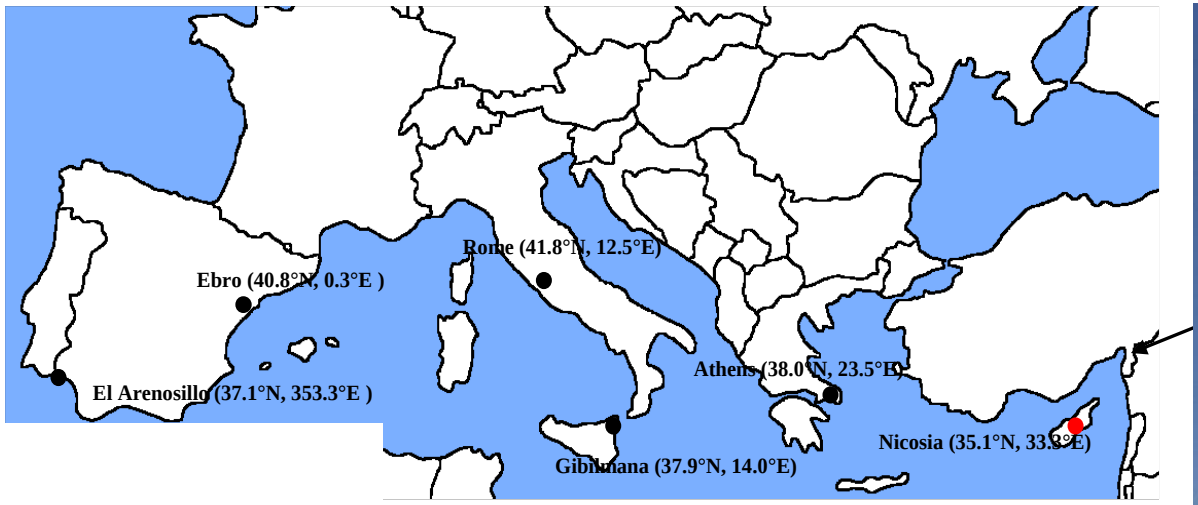
Achievements and status: The various stages of the proposal are pogressing as planned with minor delays. All the databases necessary for the analysis to be initiated have been completed and submitted to ESA. The analysis of these databases to meet the scientific objectives of the project is in progress. The analysis to quantify the discrepancy between manually scaled foF2 measurements and EIS maps is almost completed.

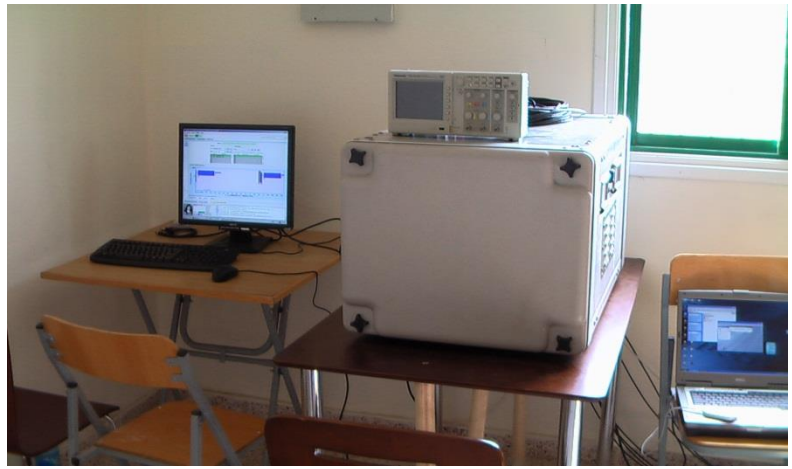
Benefits: The primary benefits of PEIMSSA as a preparatory activity will be a quantitative assessment of the benefit of extending EIS over the eastern Mediterranean is possible and will pave the way for extending EIS coverage over Cyprus. It will also contribute to better understanding whether it is possible to assimilate RO EDPs in 3D ionospheric modelling activities over Europe in the near future and specify the conditions under which this is feasible. This is very important in anticipation of exploiting a significant number of commercial RO missions in the coming years.

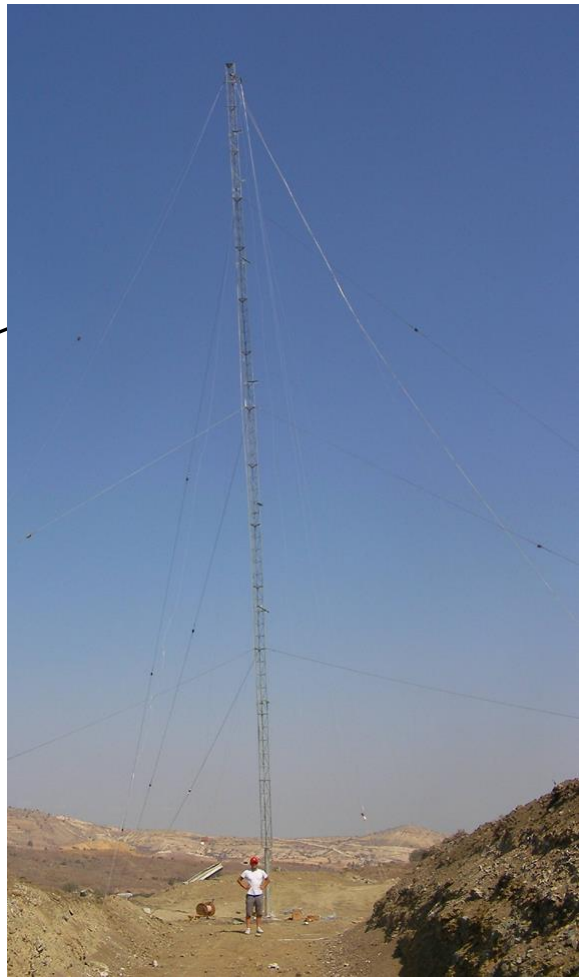
Next steps: The following phase will be to complete the radio occultation dataset related analysis and express the results into conclusive reports and recommendations to be exploited in the near future.

CYPRUS DIGITAL IONOSONDE

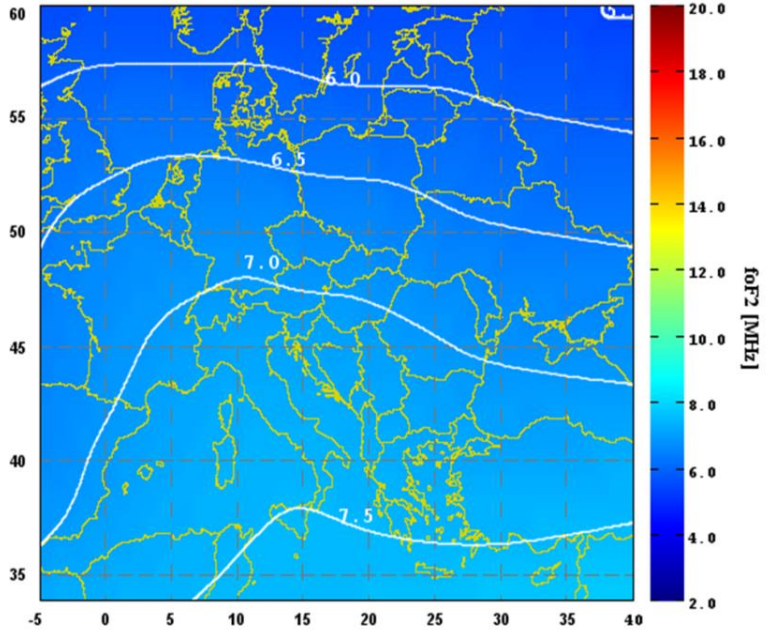
More than 15 ground-based ionosondes are currently available covering European ionosphere. The recently started Nicosia DPS-4D ionosonde station is expected to introduce new opportunities for real-time ground based ionospheric operations in the Mediterranean area.

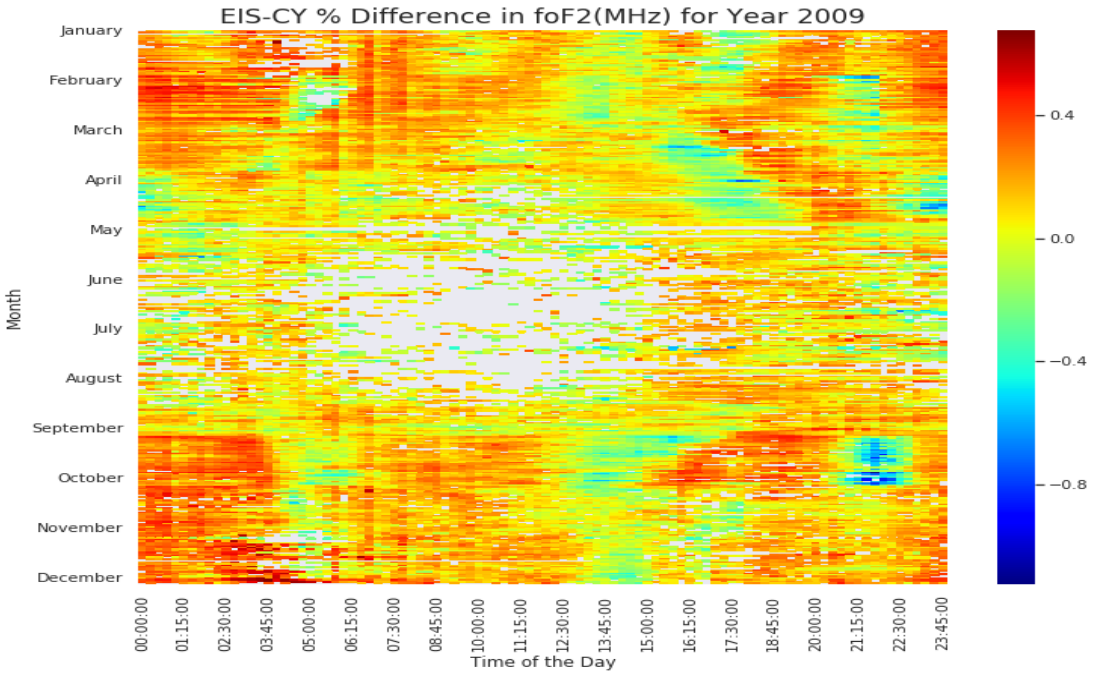


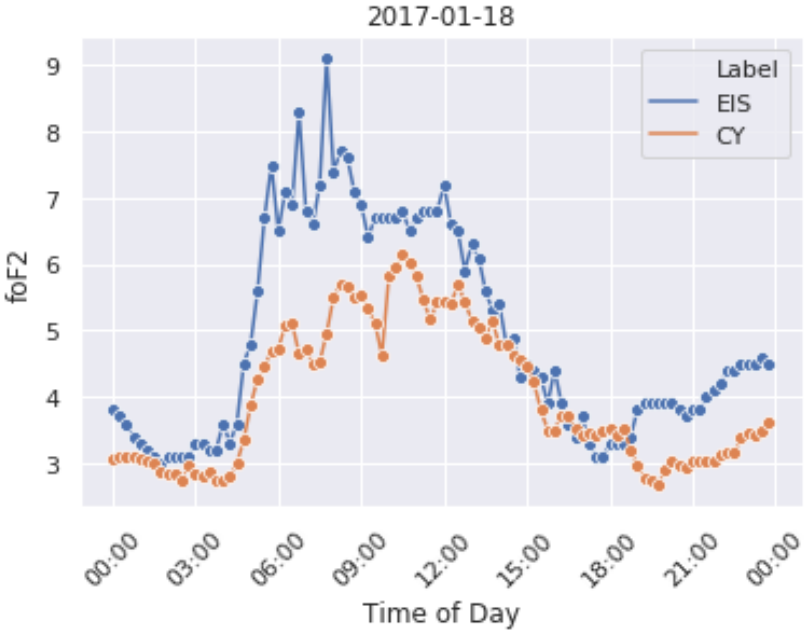




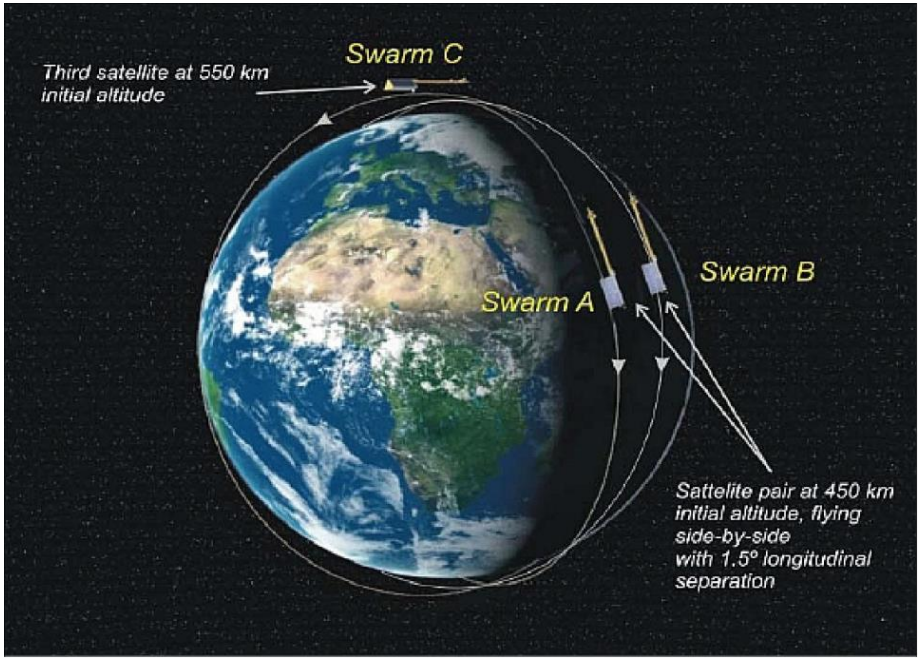
Potential Enhancements in Ionospheric Monitoring under SSA

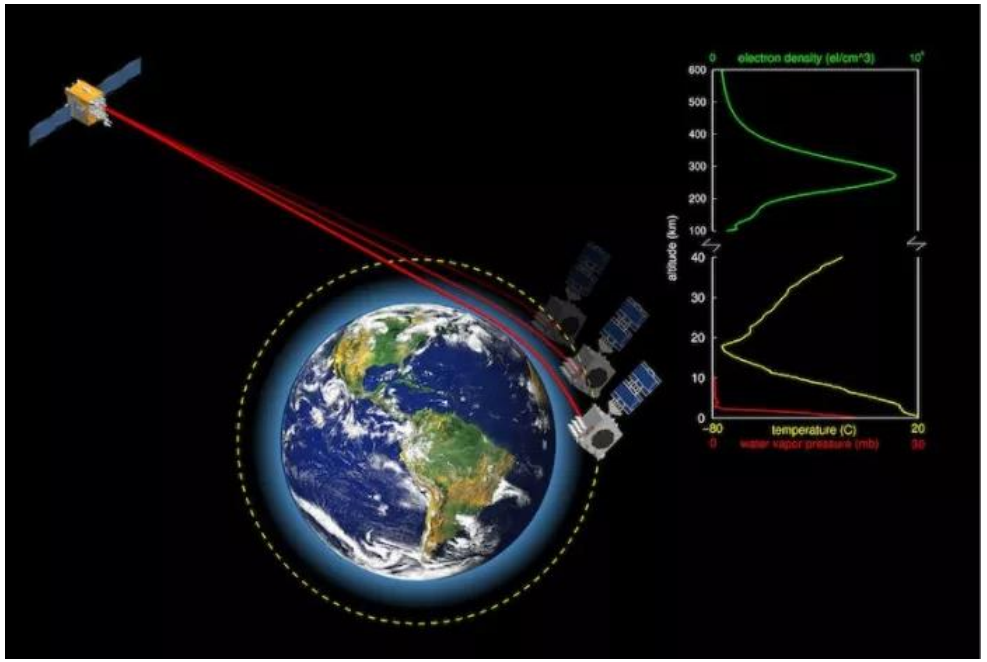


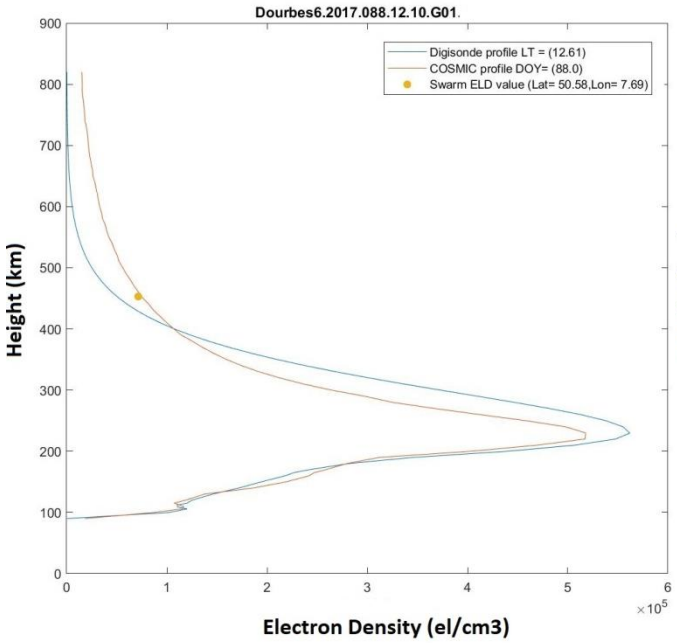


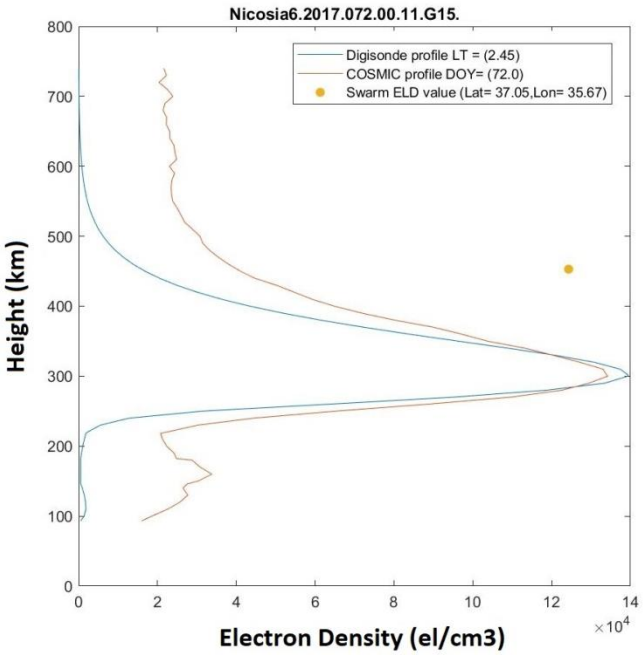


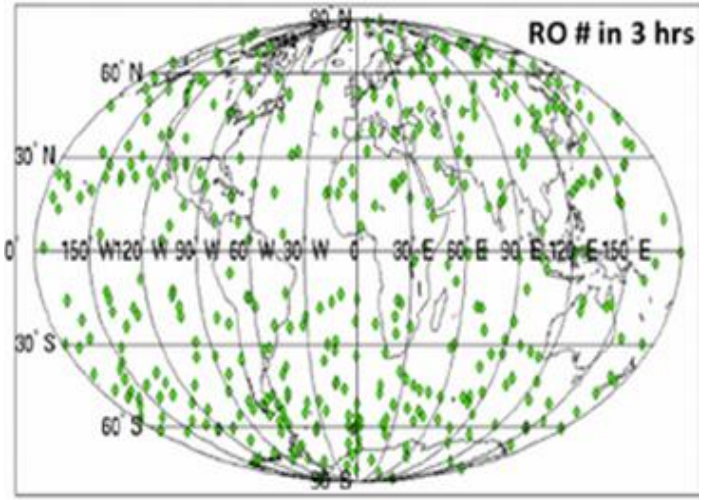
Potential Enhancements in Ionospheric Monitoring under SSA



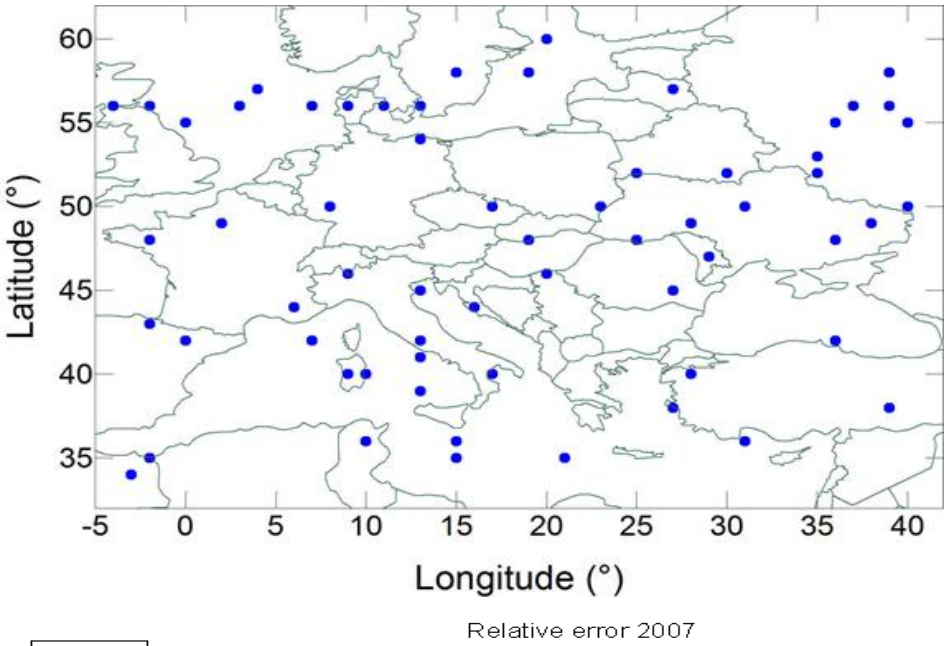




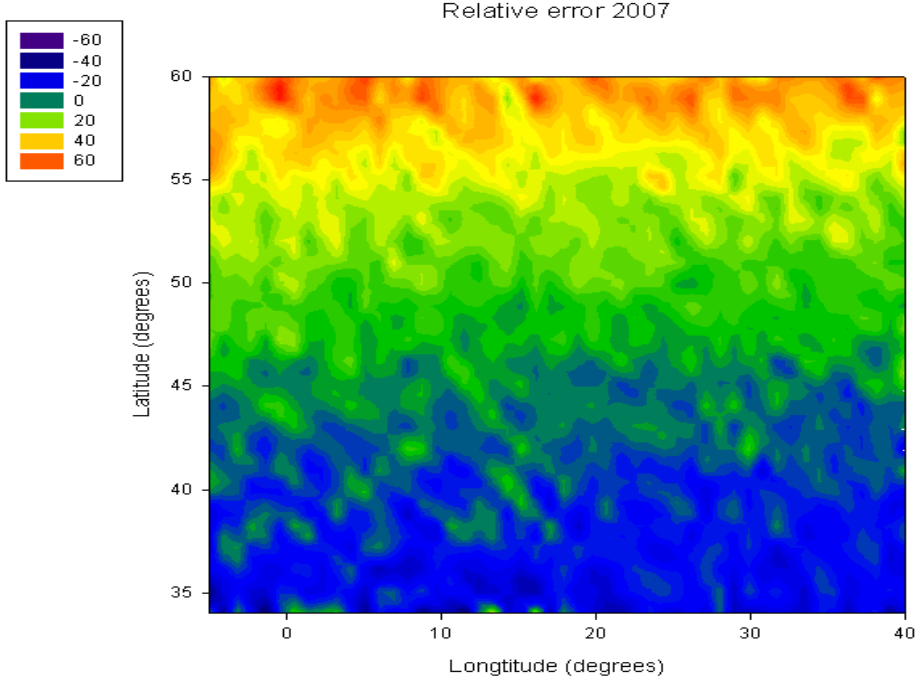


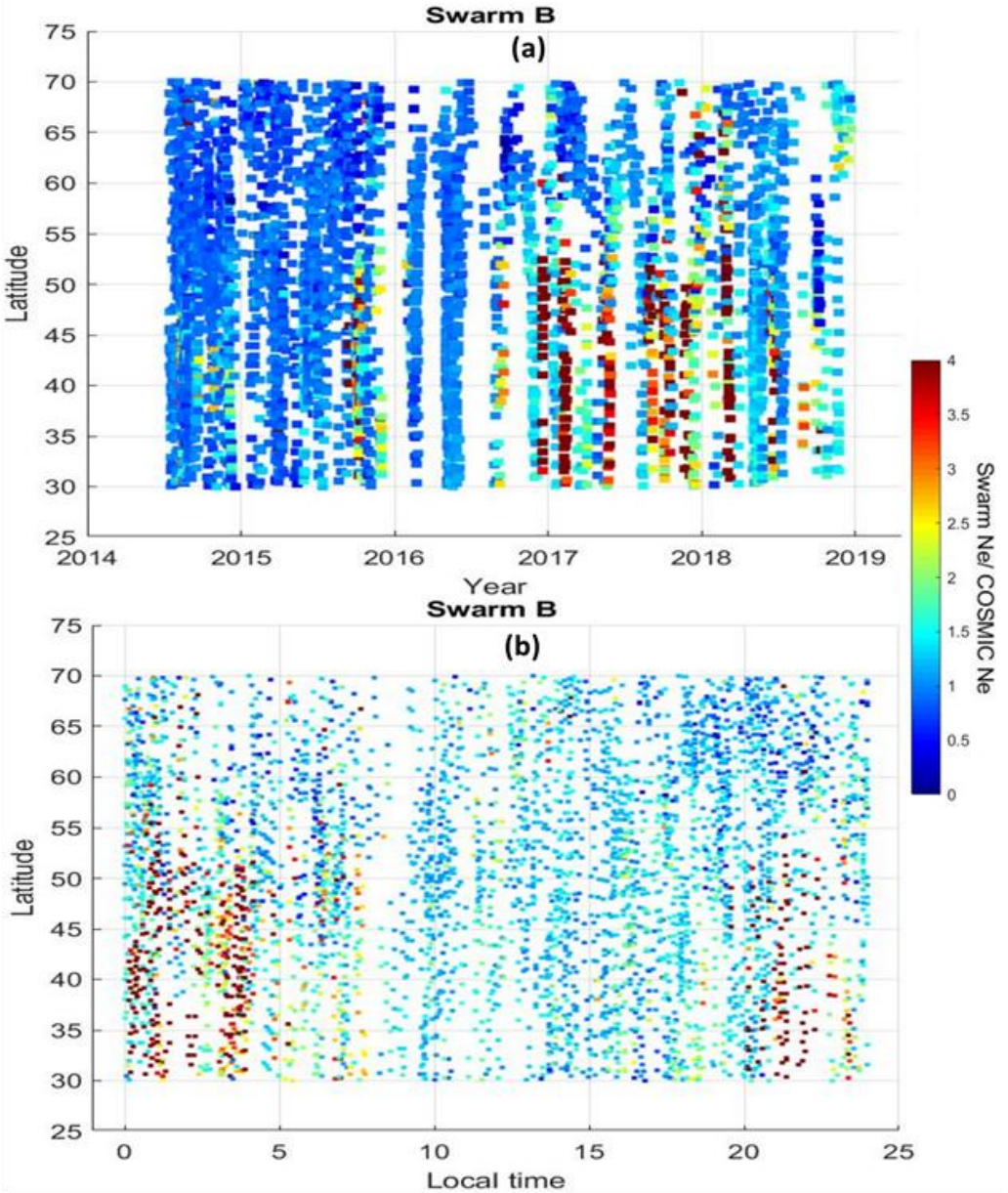


Potential Enhancements in Ionospheric Monitoring under SSA



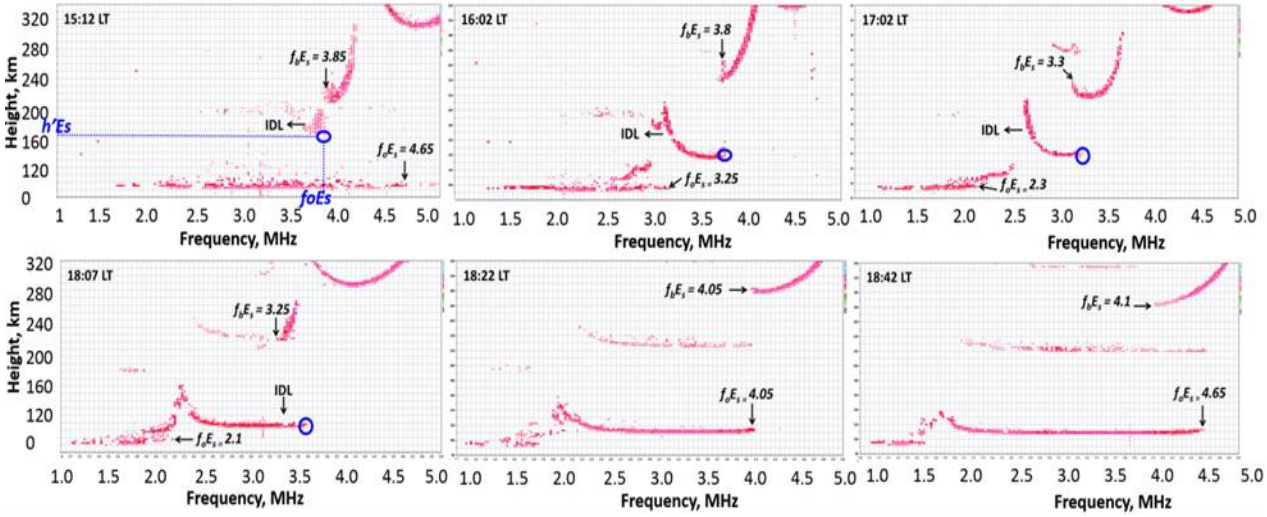
Relative error 2007

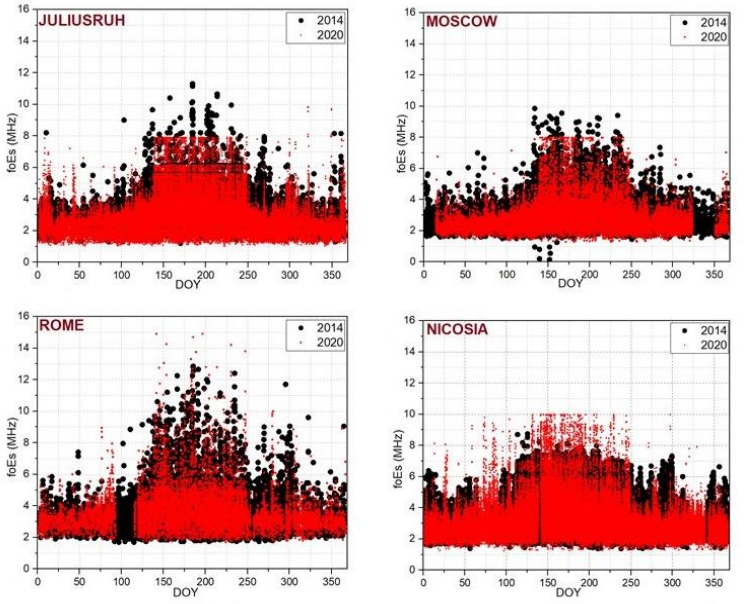


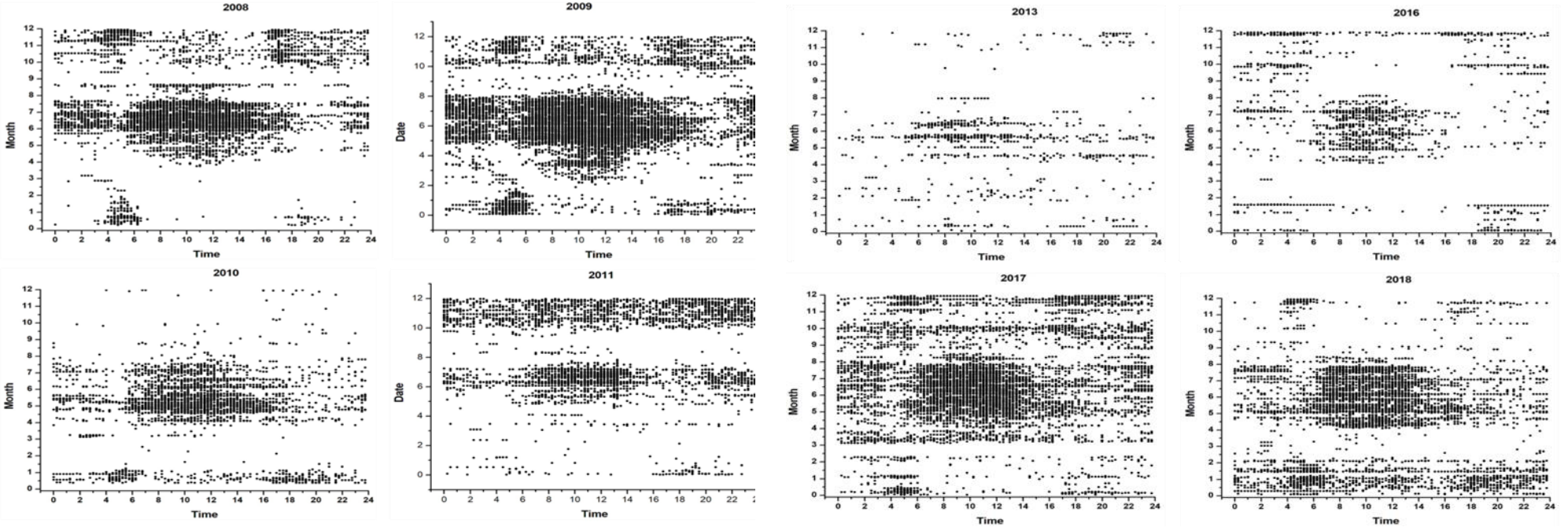


CURRENT PROJECTS UNDER PECS

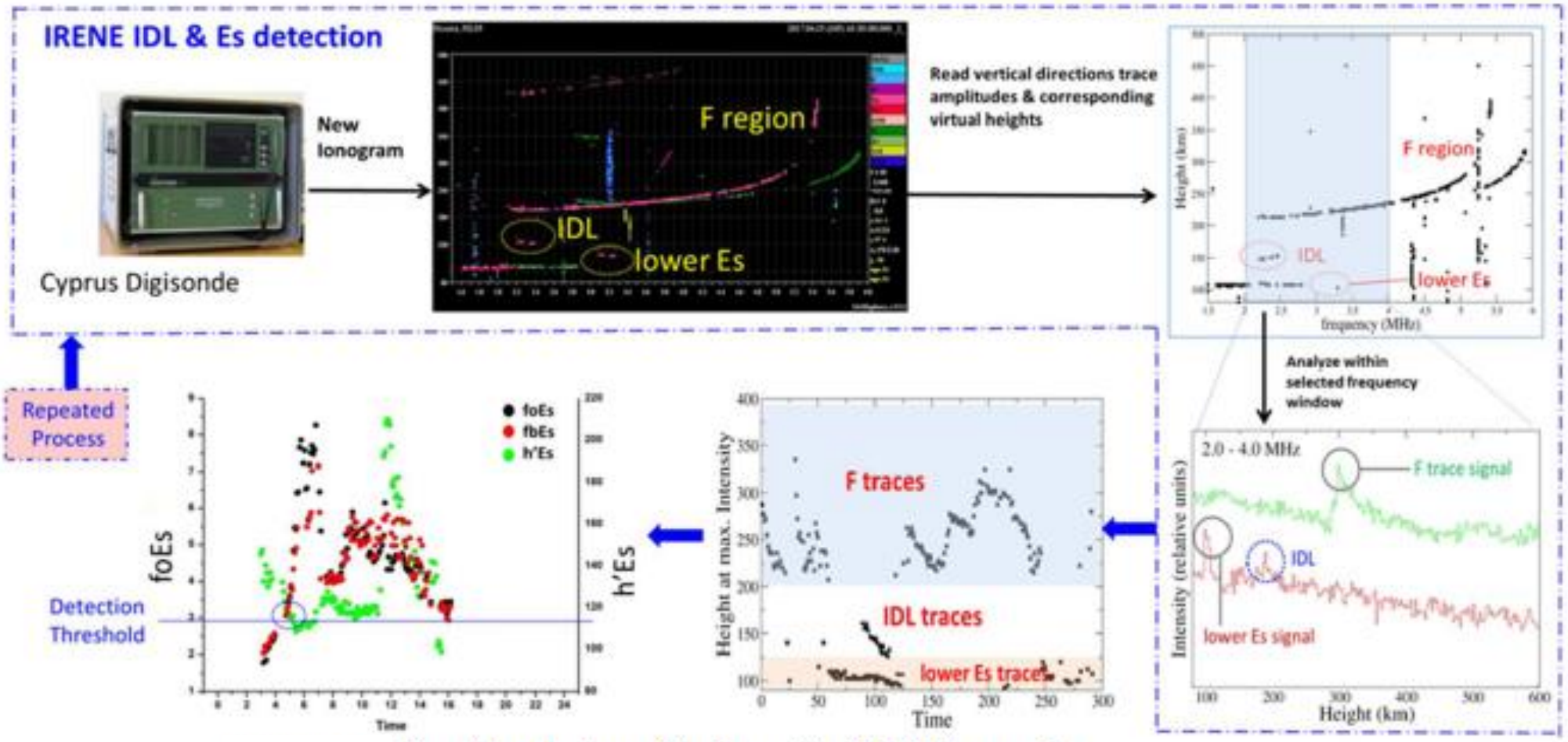
Ionospheric Representation Enhancement in Near-real timE (IRENE)





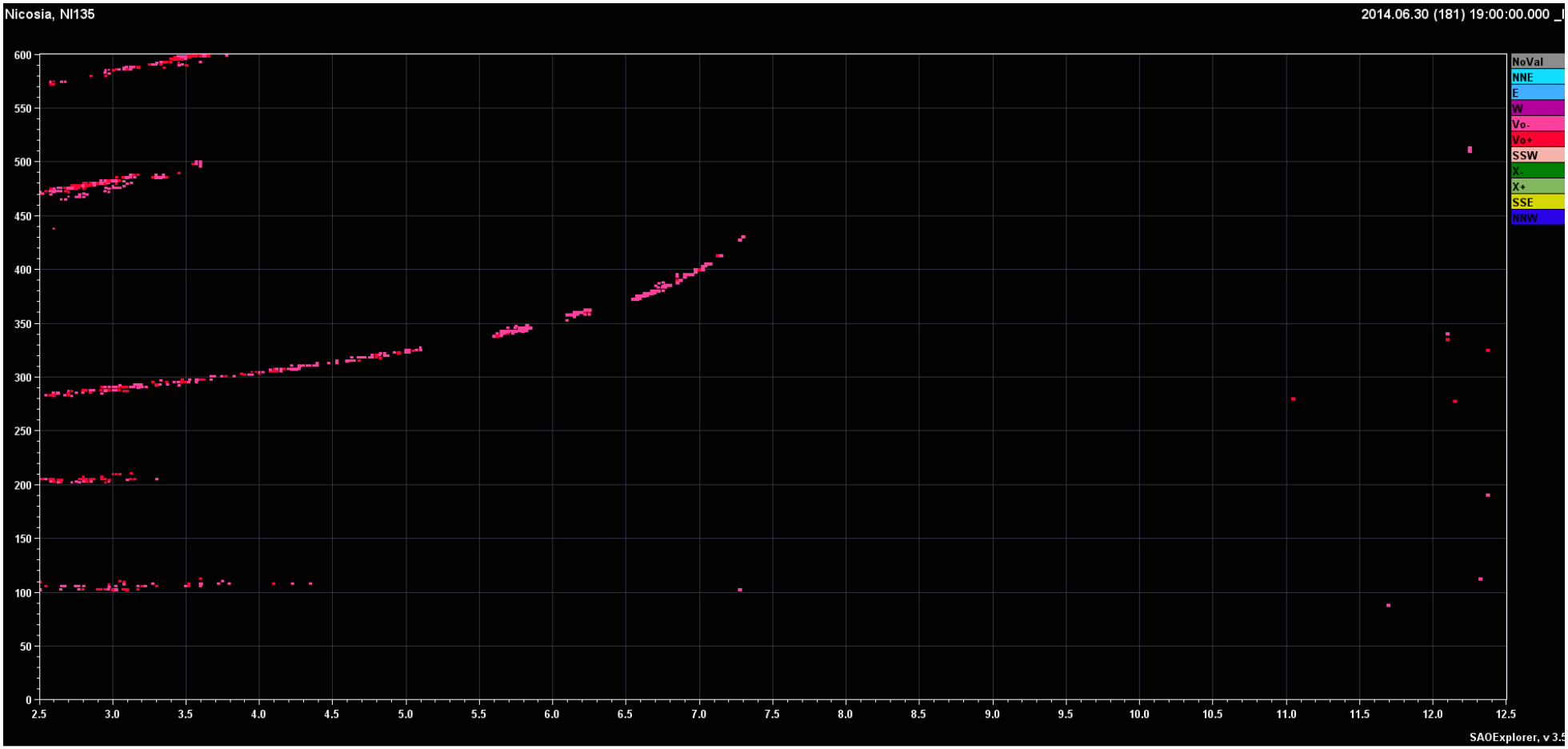


Ionospheric Representation Enhancement in Near-real timE (IRENE)

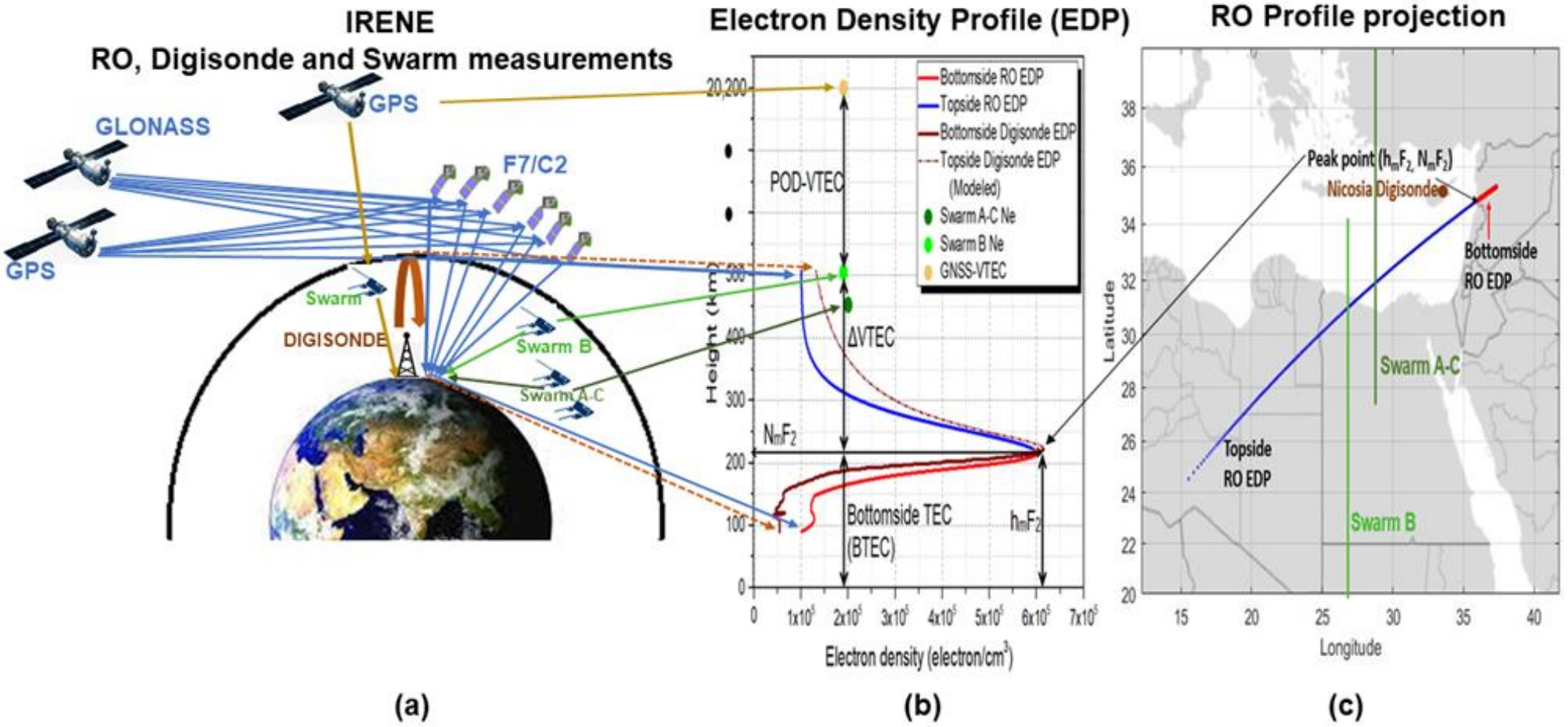


Baseline design of bottomside IRENE aspect.

EFFECT OF SPORADIC-E (Es) LAYER OVER CYPRUS



Ionospheric Representation Enhancement in Near-real timE (IRENE)



FUTURE PROJECTS UNDER PECS

Title: Cyprus Radar for Ionospheric Space Situational Awareness (CYRISSA)

Prime Contractor: Frederick University		**PECS Budget:**	**49.996 €**
		Co-funded Budget:	**0 €**
Contract No.: 4000132330/20/NL/SC / Proposal ID: CY3_08	**Year of Contract: 2020**	**Proj. Mgr.:** Haris Haralambous	
TRL	**Initial: n/a** / **Achieved: n/a** / **Target:** does not apply to this type of project	**Email PoC:** eng.hh@frederick.ac.cy	

Background and justification:
CyDARN will be the only mid-latitude SuperDARN operating in Europe it will offer a significant prospect for utilisation within ESA Space Situational Awareness (SSA) activities. The operation of CyDARN will fully exploit the strategic position of Cyprus at the south-eastern border of the European region as its Field Of View (FOV) will cover a significant part of central and northern Europe making its placement ideal to be exploited fully through synergies with other projects.

Objective(s):
The project aims to assess whether an introduction of CyDARN products into the existing SSA Ionospheric Weather Expert Service Centre (I-ESC) service will improve the ionospheric plasma convection representation and MSTID detection capabilities over European latitudes during quiet and disturbed geomagnetic conditions.

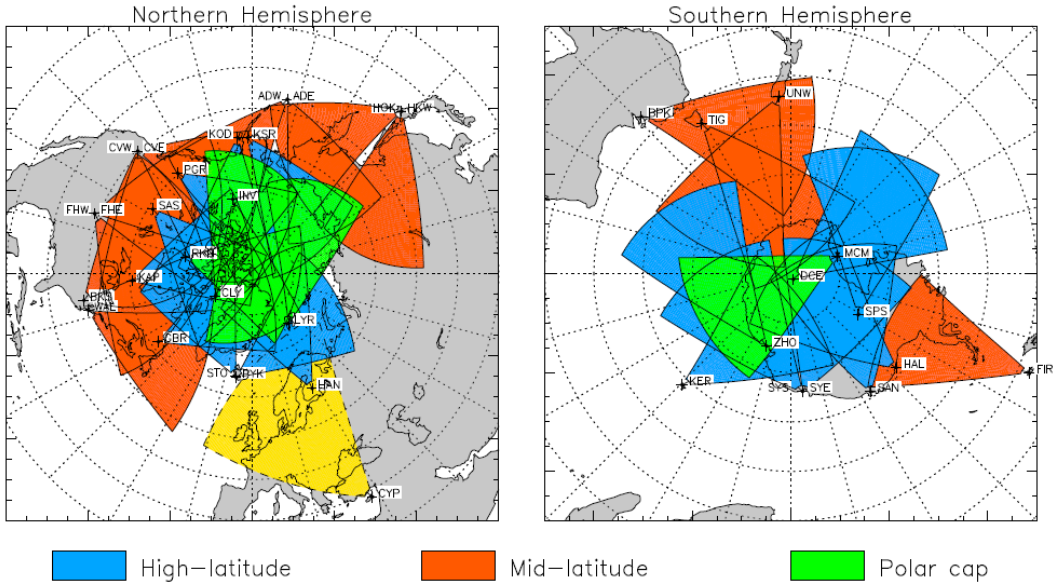
Achievements and status: Due to the pandemic, activities for the deployment of the radar will commence in 2023.

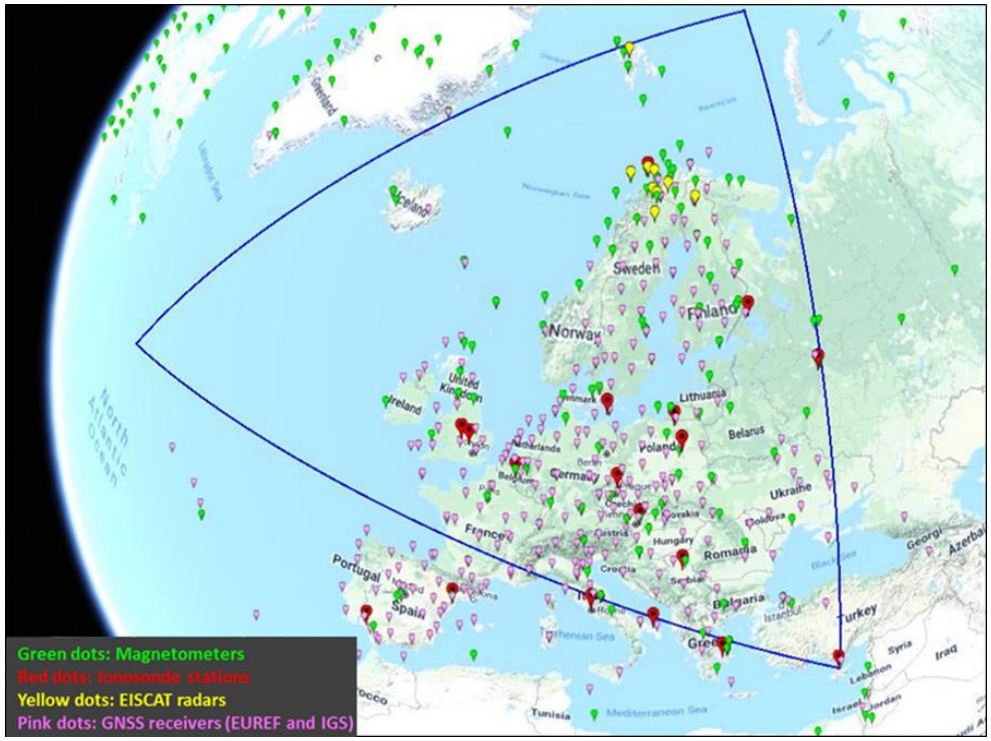
The installation and operation of the radar is under the responsibility of the Cyprus Space Exploration Organisation (CSEO) in cooperation with the Radio Space Plasma Physics Group of Leicester University and Lancaster University.

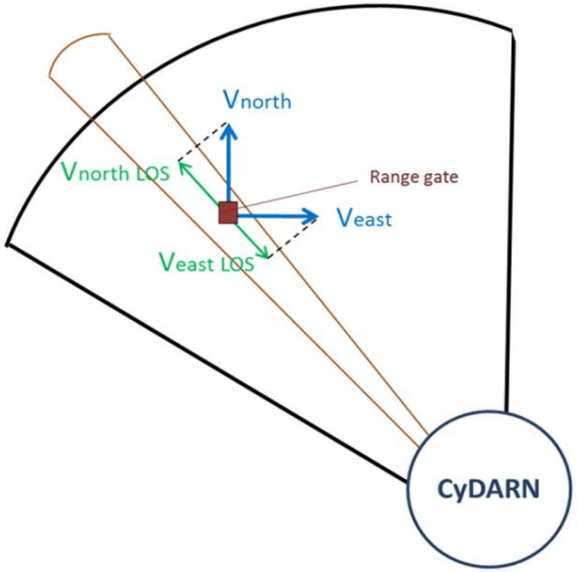
Benefits: Demonstrating that significant improvement in monitoring ionospheric convection over Europe is possible, through the introduction of CyDARN in the SSA Ionospheric Weather Monitoring framework, will pave the way for integrating this unique infrastructure in ESA SSA activities. If CyDARN is also proven to be able to adequately detect MSTID events over Europe this is also a benefit as it will satisfy a clear customer requirement (marked "essential") for the Space Weather segment of the Space Situational Programme (SSA) of the European Space Agency (ESA) (Space Situational Awareness - Space Weather Customer Requirements Document, SWE-CRD-TIO-1636).

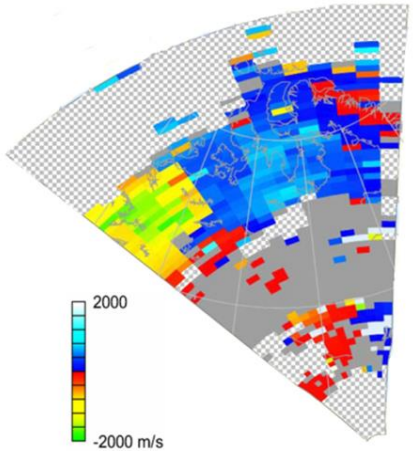
Next steps:
To validate CyDARN products once the facility is installed.

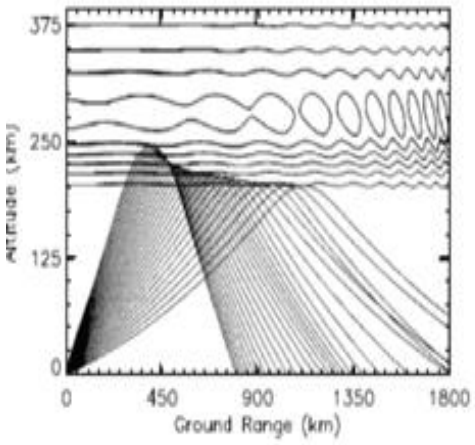
CYprus Radar for Ionospheric Space Situational Awareness
CYRISSA

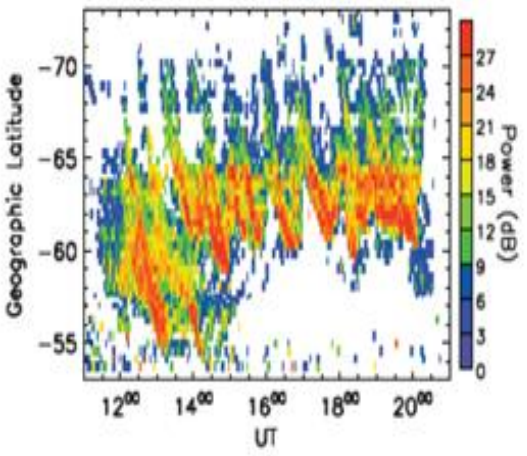




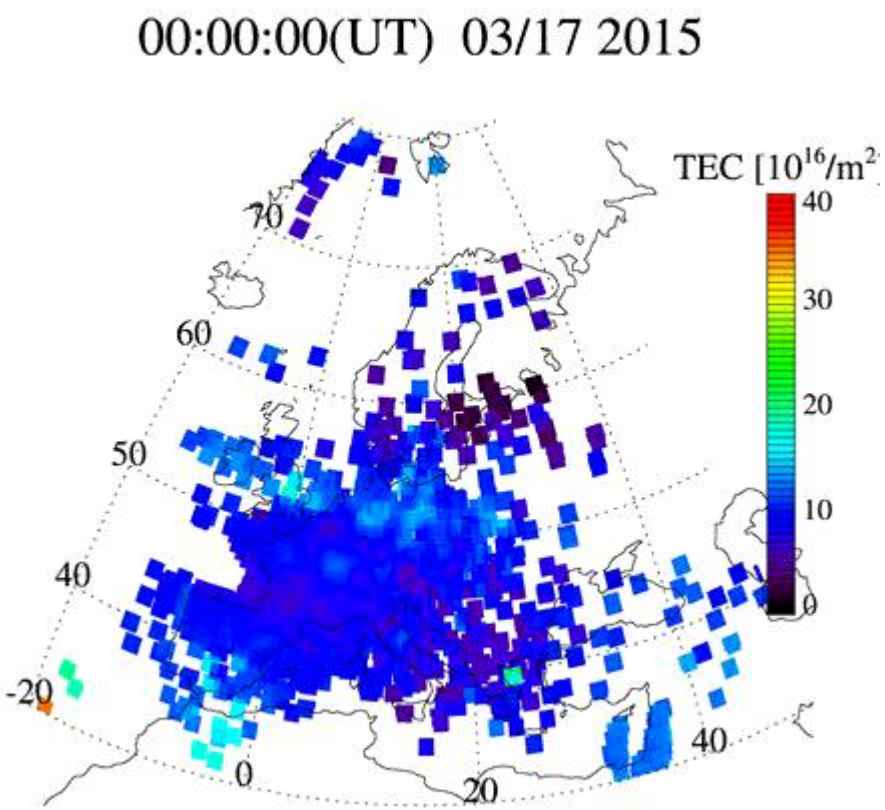


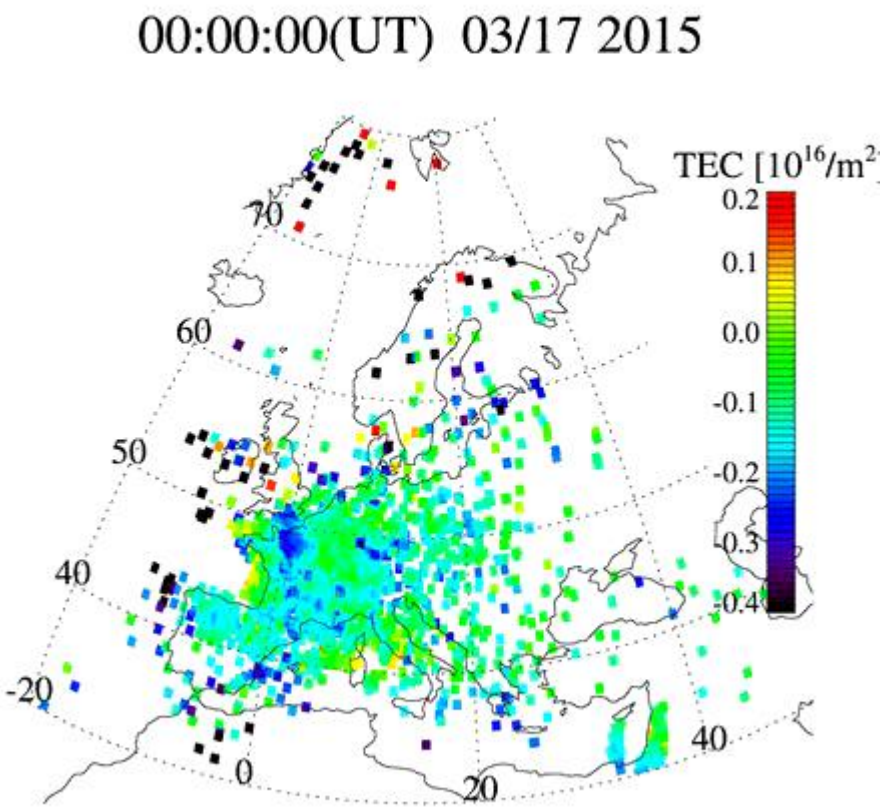






Radar for Ionospheric Space Situational Awareness significance





Strong equatorward plasma convection on 17 March 2015 (left plot) and Travelling Ionospheric Disturbances (right plot) as shown on Total Electron Content maps.

FREDERICK UNIVERSITY

Cyprus Ionospheric Research Group
Frederick Research Center

FREDERICK RESEARCH CENTER

THANK YOU!