Results and prospects of the project Norwegian-Ukrainian cooperation aimed to sustainable development of the education process in geospace researches.

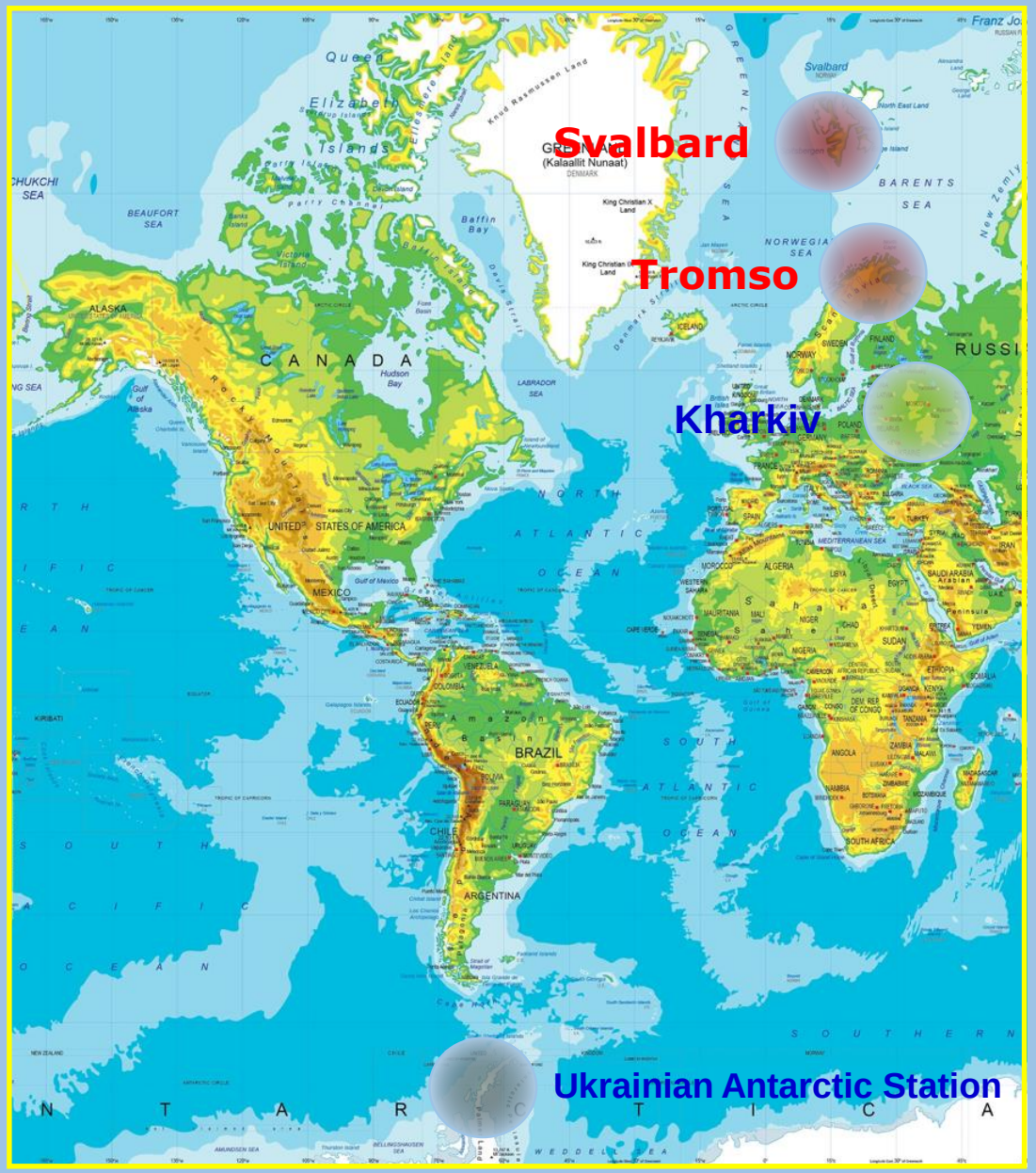
CPEA-2012/10021 (1 July 2012 - 31 December 2014)

Norwegian Centre for International Cooperation in Education
Norwegian Ministry of Foreign Affairs

INSTITUTIONS INVOLVED

- **UiT the Arctic University of Norway -** Project coordinator : Prof. Cesar La Hoz
- **Institute of ionosphere (Ukraine) -** Project coordinator : Prof . Valeriy Pulyayev
- **Institute of Radio Astronomy, Ukraine -** Project researcher: Dr . Alexander Koloskov

Historical background

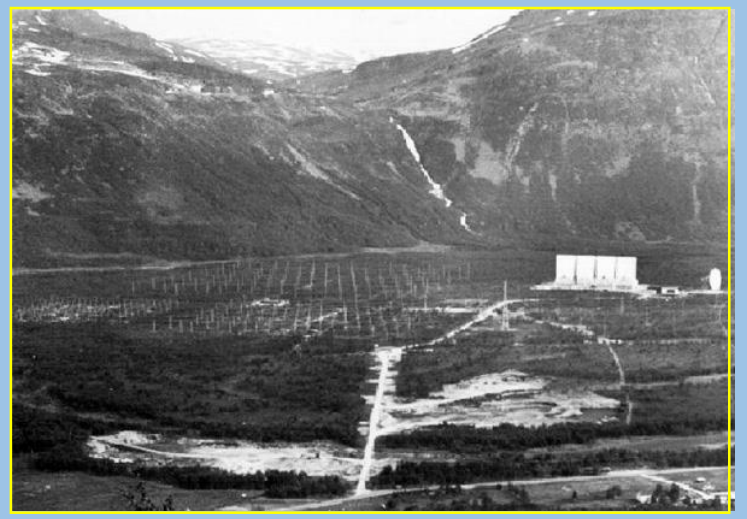


Research facilities located in Norway

VHF radar (224 MHz, Tromso)

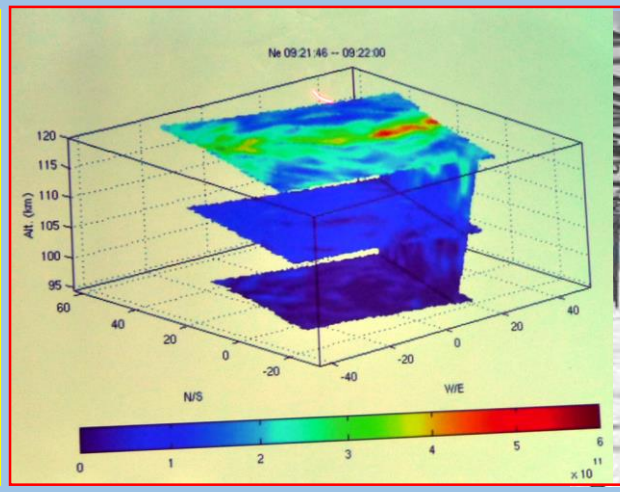
UHF radar (931 MHz , Tromso)

EISCAT heater (4-8 MHz, Tromso)



UHF radar (500 MHz, Svalbard)

EISCAT 3D (Project)



Ukrainian research facilities

Incoherent Scatter radar (158 MHz)

100 m dish antenna (biggest in Europe)

25 m fully steerable antenna

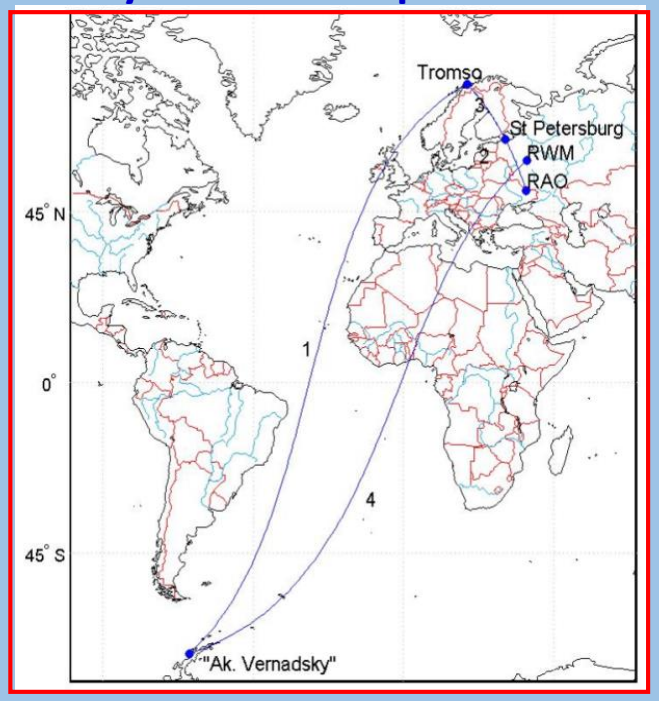
Ionosonde “BASIS”

UTR-2 radio telescope / Low Frequency observatory

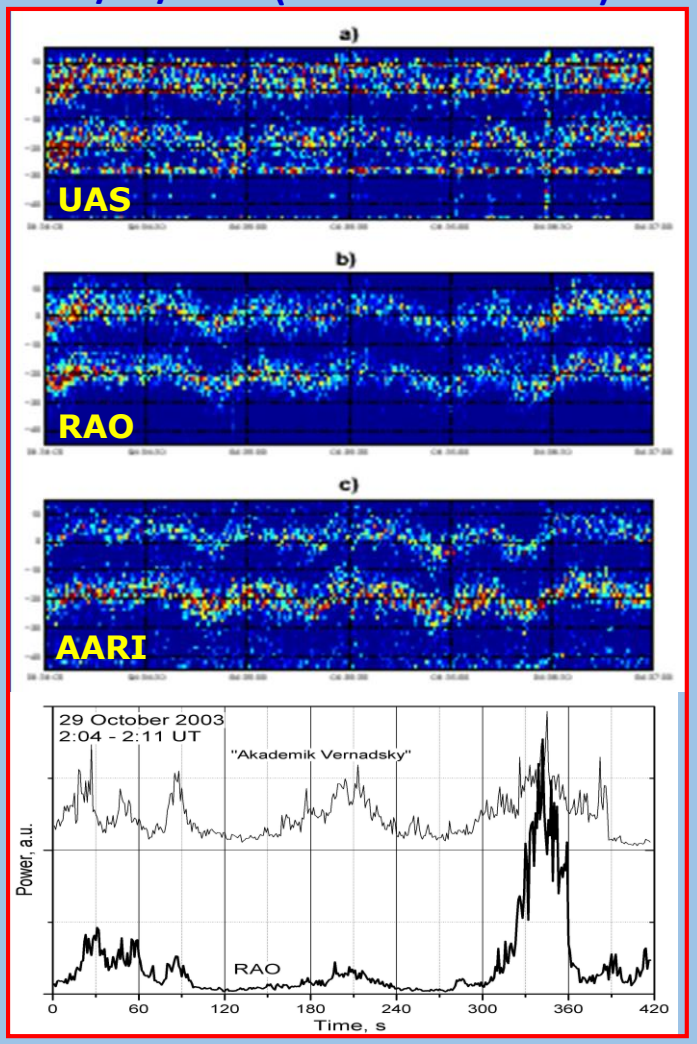
Ionosonde IPS-42, UAS (Antarctica)

Self-scattering experiment

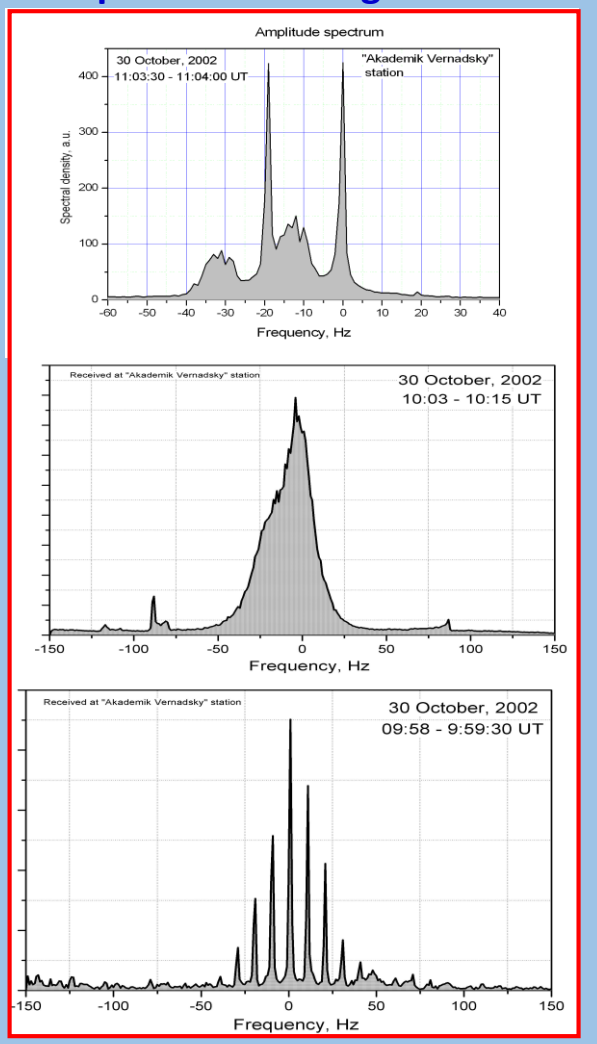
Layout of the experiment



29/10/2002 (04:34 to 04:37 UT)



Spectra of the signals



A.V. Zalizovski, S.B. Kascheev, Y.M. Yampolsky, V.G. Galushko, V. Beley, B. Isham, M.T. Rietveld, C. La Hoz, A. Brekke, N.F. Blagoveshchenskaya, and V.A. Kornienko. ***Self-scattering of a powerful HF radio wave on stimulated ionospheric turbulence*****.** - Radio Science, 2009, v. 44, RS3010, doi:10.1029/2008RS004111.

Since 2008 NASU allocates special funds for scientific cooperation with EISCAT - "SHPITSBERGEN" progect

НАЦІОНАЛЬНА АКАДЕМІЯ НАУК УКРАЇНИ
1. РАДІОАСТРОНОМІЧНИЙ ІНСТИТУТ
(РІ НАН)
61002, г. Харків - 2, вул. Червонопрапорна, 4
тел. (0572) 706-14-15
E-mail: rai@ri.kharkov.ua

ЗВІТ
ПРО НАУКОВО-ДОСЛІДНУ РОБОТУ

ДОСЛІДЖЕННЯ ШТУЧНИХ ТА ПРИРОДНИХ НЕОДНОРІДНОСТЕЙ ІОНОСФЕРНОЇ ПЛАЗМИ У ВИСОКИХ ТА СЕРЕДНІХ ШИРОТАХ СПІЛЬНО З ОРГАНІЗАЦІЄЮ EISCAT
(шифр – «Шпіцберген – 08»)
Заключний

Науковий керівник НДР,
зав. відділом,
чл.-кор. НАН України
д.ф.-м.н., проф. _____ Ю.М. Ямпольський
«_____» _____ 2009 р.

In 2009 Ukraine became a Full Affiliated Member of EISCAT

AGREEMENT
between
Institute of Radio Astronomy of the National Academy of Sciences of Ukraine
and the
EISCAT Scientific Association

General Provisions

1. According to a decree of the National Academy of Sciences of Ukraine, the Institute of Radio Astronomy, National Academy of Sciences of Ukraine (IRA NASU), has been designated as the Ukrainian Plenipotentiary in the EISCAT Scientific Association.

ДОГОВІР
між
Радіоастрономічним Інститутом Національної Академії Наук України
та
науковою асоціацією EISCAT

Загальні положення

1. Згідно із розпорядженням Національної академії наук України повноважним представником України у європейській науковій асоціації EISCAT є Радіоастрономічний інститут Національної академії наук України (далі РІ НАН).

The First EISCAT – Ukrainian School in geospace researches September 3-8, 2007 funded by National Academy of Sciences of Ukraine

Cooperation in the sphere of higher education

Norwegian Centre for International Cooperation in Education

Atmospheric-space weather system interaction in Arctic and mid-latitude regions (Seed money project)

CPEASMS 2011/10047 (27 June 2011 - 1 February 2012)

Institutions Involved: University of Tromsø (Norway); Institute of Radio Astronomy (Ukraine)

Activities

1. PhD students from Ukraine took part in the International Incoherent Scatter Radar workshop and the EISCAT radar school in Greenland. He made a presentation "Observing the polar ionosphere using incoherent scatter radar".

2. PhD students from Ukraine was granted by one month fellowship and had practical training in Norway. She: attended a course in cosmic plasma physics, took part in the educational measuring campaign with heater and IS radar, data processing and interpretation.

3. Member of academic staff of IRA took part and made presentations at the: 15-th EISCAT Workshop and 9-th EISCAT SOC Meeting at Qingdao (China).

4. Project coordinator from Ukraine visited Tromsø and Svalbard. He made preliminary work for installation of autonomous HF receivers, made presentation at the 10-th EISCAT SOC Meeting in Tromsø.

As a result of these efforts new Norway-Ukraine long-term cooperative project was developed and approved by SIU in March 2012.

Norwegian-Ukrainian cooperation aimed to sustainable development of the education process in geospace researches

CPEA-2012/10021 (1 July 2012 - 31 December 2014)

UiT the Arctic University of Norway – main partner institution in Norway
Institute of Ionosphere - main partner institutions in Ukraine
Institute of Radio Astronomy - network partner in Ukraine

MAIN GOAL: The project is focused on the development and dissemination of fundamental and applied knowledge of the properties of the near-earth space environment, as well as on the implementation of the modern scientific theories and diagnostic techniques to the educational process for training of highly qualified specialists in the areas of geospace research and development of space weather concept.

Activities to be supported:

- Implementation of the fellowship program for Ukrainian students at the Arctic University of Norway.
- Preparation and carrying out practical works for students with the incoherent scatter radars at the Ukrainian and Norwegian observatories. Arrangement of student measuring campaigns, and fieldwork for installation and managing of Internet-controlled diagnostic facilities developed in Ukraine.
- Organization of conferences and schools for students and young scientists by the project participants.
- Support for students and researchers to participate in international conferences and schools on the project-related subjects.
- Developments and publication of educational and training materials for students. Preparation of scientific publications by professors and researchers jointly with students.
- Mutual visits of the representatives of academic and administrative staff. Organizing of scientific lectures, workshops and seminars. Refresher training of the Ukrainian participants in the Arctic University of Norway, and ionospheric observatories.
- Preparing courses of lectures for students which are based on the experience obtained during visits to the partner organizations.

The fellowship program

An important part of the Project activities is the fellowship program for students performed at the Arctic University of Norway and EISCAT observatories in Ramfjordmoen and Svalbard. 14-th Ukrainian students have visited UiT the Arctic University of Tromso and University Center in Svalbard. The program includes:

1. Seminars of Ukrainian students in UiT (delivering presentations concerning their PhD projects).

2. Lectures and practical classes for students in UiT and EISCAT observatories (including educational runs of IS radars, data processing and interpretation).

3. Training in managing of the data of observations including Madrigal database. Working with literature in UiT library.

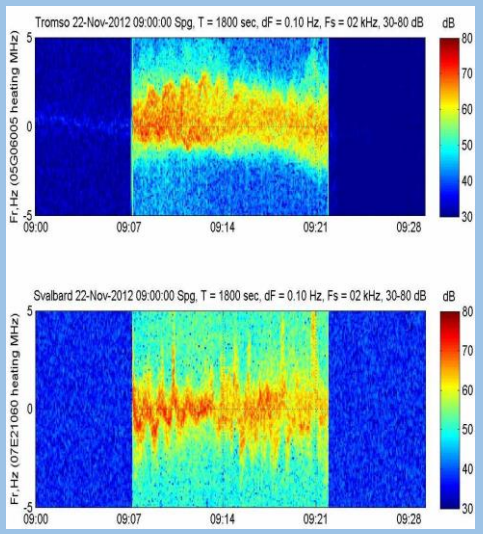
4. Measuring campaigns with IS radar and HF heater using the programs suggested by students.

Students measuring campaigns in Ukraine

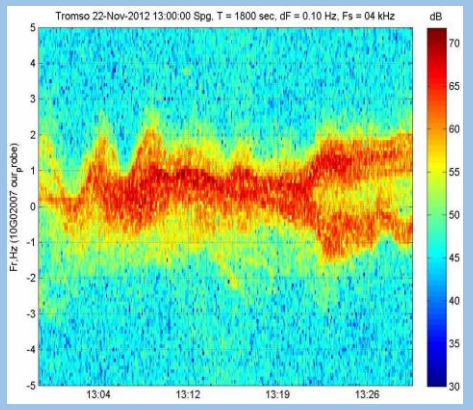
Ukrainan students took part in 3 measuring campaigns performed in Ramfjordmoen and Svalbard. One campaign will be organized next week. The total operation time is about 50 hours.

2012 probe HF transmitter of IRA was temporary installed in Tromso during heating campaign.

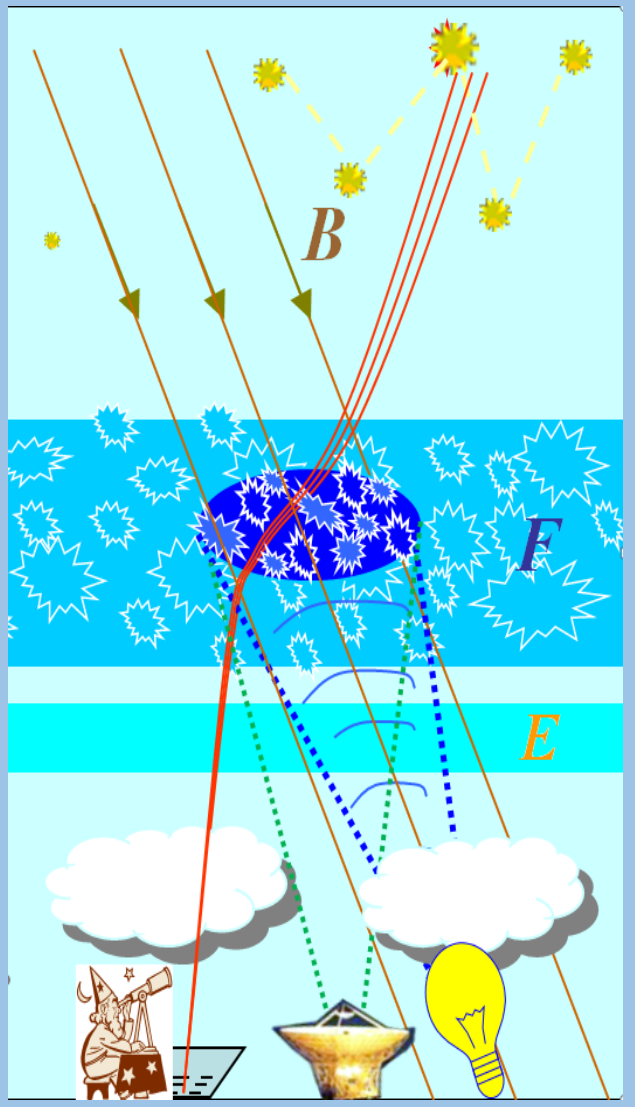
HF signals of EISCAT heater observed simultaneously in Tromso and Svalbard



Signal of probe HF transmitter



2013 Scintillations experiment proposed by Ukrainian PhD students



Students measuring campaigns in Ukraine

In Ukraine 11 measuring campaigns were performed at the Observatory of the Institute of Ionosphere. Observation time is about 300 hours.

2012 – 3 campaigns

1) August 28-30
2) September 24-28
3) December 18-21

2013 – 7 campaigns

1) June 18-19 (Summer solstice)
2) July 25-30 (Ariane-5 launch)
3) August 21-22 (SURA heater)
4) September 9-10 (Sura heter)
5) October 28-31 (EISCAT campaign)
6) November 13-14 (EISCAT, Spear)
7) December 18-19 (Winter solstice)

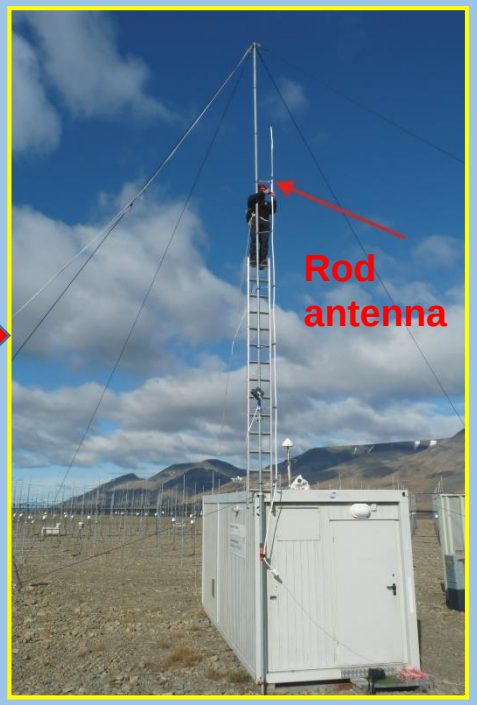
2014 – 1 campaign

1) September 21-28

Field work in Tromso and Svalvard

HF and ELF instruments in Tromso and Svalbard

Mounting of rod antenna for HF receiving facility



Installation of probes of the ELF magnetometer at Svalbard

Organization of International conferences and schools for students

1) "Electromagnetic Methods of Environmental Studies" EMES-2012 (Kharkiv)

109 representatives from Ukraine, Norway, Russia, USA, Israel and Kazakhstan including 17 participants of the Project took part at the conference.

2) "Remote Radio Sounding of the Ionosphere" IION-2013 (Alushta)

66 representatives from Ukraine, Russia and Norway took part in the school-conference. 28 students and postgraduate students represented 10 educational and research institutions. Most of them were participants of the Project.

3) "Remote Radio Sounding of the Ionosphere" IION-2014 (Tromso)

The Project gives opportunity for the students and young scientists to take part in the International scientific events

Radar School 2012, Sodankylä (2 participants)

EISCAT Symposium 2013, Lancaster (4 participants)

Planetary atmospheric electricity 2013, Bork (2 participants)

Vienna, Austria, 2014 (2 participants)

Beijing, China, 2014 (3 participants)

Liege, Belgioum, 2014 (2 participants)

In total project participants attended
17 scientific conferences and schools

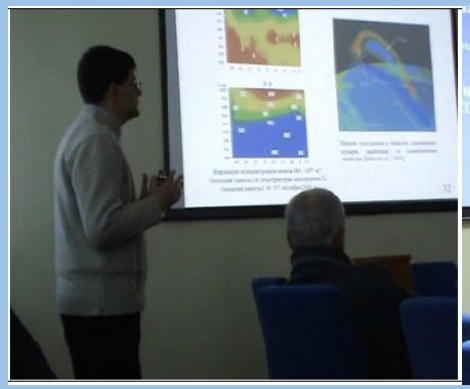
Publication of educational and training materials for students. Preparation of scientific publications.

Two textbooks for students in radio and geophysics were published:
1) V.O. Pulyayev, E.V. Rogozhkin, O.V. Bogomaz "Computational routines for the analysis of incoherent scattering data in the ionospheric plasma" (in Ukrainian),Kharkiv, 2014, 272 p.;
2) L.F. Chernogor, I.F. Domnin "Physics of the Geomagnetic Storms", - Kharkiv, 2014, 408 p. (in Russian)

The results of the scientific researches have been published in 19 scientific papers, 58 conference proceedings and abstracts.

Supervision by PhD students.

4 students have defended PhD theses:
- *Dmitro Belozorov (2012)*
- *Victor Burmaka (2013)*
- *Andrii Sopin (2013)*
- *Dmitro Kotov (2014)*



Mutual visits of researches, lecturers, representatives of administrative staff. Delivering of guest lectures. Organizing of refresher training of the project participants in Norway and Ukraine.

1) 16 mutual visits of representatives of academic and administrative staff of partner institutions occurred.

2) 22 guest lectures and seminars have been delivered in partner institutions.

3) 25 representatives of academic/technical/ research staff have been trained in Ukraine, Norway and at Svalbard.

Development and implementation of new curricula. 5 new courses have been implemented in National Technical University "KhPI"

A new permanent course: "Computerization of specialized environments"
("Комп'ютеризація спеціалізованих середовищ")
– lectures, laboratory work, practical classes (6.7 credits)
for bachelors majoring in "Computer engineering" (6.050102)
in the National Technical University "Kharkiv Polytechnic Institute".
Lecturer – Pulyayev Valeriy, professor, vice-director the Institute of Ionosphere

Course: "Radio engineering systems in radiophysic researches"
("Радіотехнічні системи у радіофізичних дослідженнях")
– lectures, laboratory work, practical classes (5 credits)
for masters majoring in "Radio Physics and Electronics" (7.070201)
in the National Technical University "Kharkiv Polytechnic Institute".
Lecturer – Pulyayev Valeriy, professor, vice-director the Institute of Ionosphere

Course: "Systems analysis and computer simulation"
("Системний аналіз та комп'ютерне моделювання")
– lectures, laboratory work, practical classes (5 credits)
for bachelors majoring in "Computer engineering" (6.050102)
in the National Technical University "Kharkiv Polytechnic Institute".
Lecturer – Panasenko Sergii, PhD, senior scientist the Institute of Ionosphere

Course: "Statistical radiophysics"
("Статистична радіофізика")
– lectures, laboratory work, practical classes (4 credits)
for bachelors majoring in "Radio Physics and Electronics" (7.070201)
in the National Technical University "Kharkiv Polytechnic Institute".
Lecturer – Kotov Dmytro, PhD student, researcher the Institute of Ionosphere

Course: "Radio receivers in radiophysics"
("Радіоприймальні пристрої в радіофізиці")
– lectures, laboratory work, practical classes (4 credits)
for masters majoring in "Radio Physics and Electronics" (7.070201)
in the National Technical University "Kharkiv Polytechnic Institute".
Lecturer – Bogomaz Oleksandr, PhD student, researcher the Institute of Ionosphere

Plans for the future

To improve the prospects of cooperation Long-term Collaboration Agreements between the Arctic University of Norway and Ukrainian institutions were signed.

The agreements give additional options for cooperation. One of them is possibility for Ukrainian students to continue education in Norway by the Norwegian Quota Scholarship Scheme. This year four students from the National Technical University "Kharkiv Polytechnic Institute" were awarded for two-year Space Physics Master program at the Arctic University of Norway started this August. Two new vacancies allocated for 2015.

We would like to use these opportunity by implementing a new initiative - joint supervision of students which will enhance academic cooperation between our institutions.

1) We plant that each student will have two supervisors – main from the UiT and additional one from Ukrainian partner institutions. We apply to SIU for additional funding to ongoing long-term project to implement this idea.

UiT NORGES ARKTISKE UNIVERSITET

UNIVERSITETET I TROMSØ

Scientific Advisers

Institute of Ionosphere

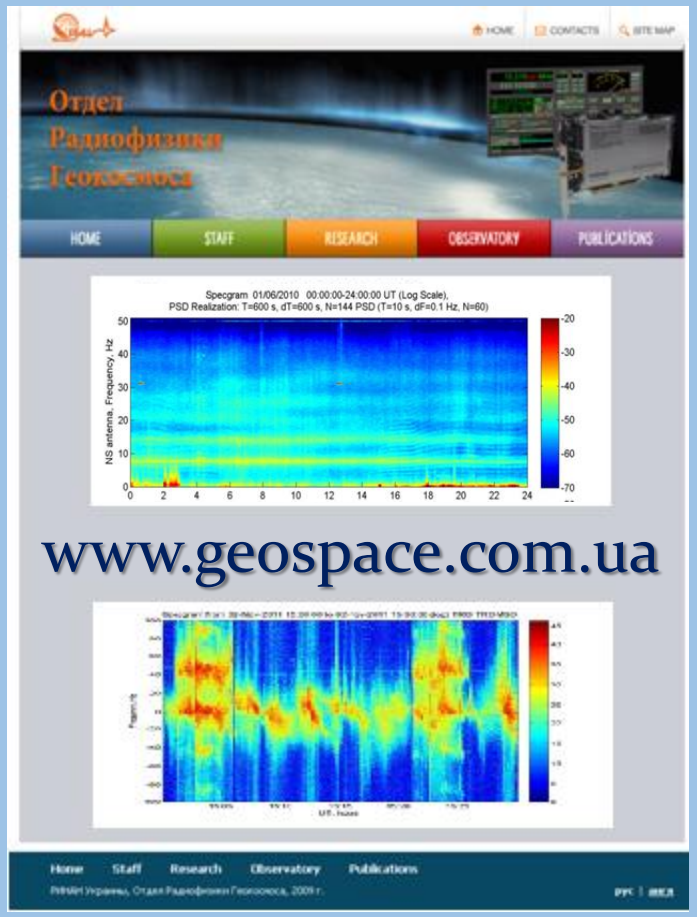
Institute of Radio Astronomy

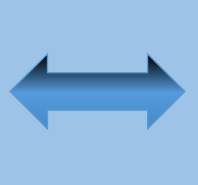
2) We propose to use spaced autonomous ELF and HF instruments developed by the Ukrainian project participants and installed during fieldworks performed within the long- term project for improving the educational process in the participating institutions.

Remote control and real-time Internet access to data

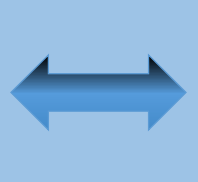
Internet

IRA Server, Ukraine

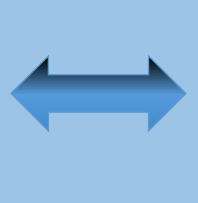




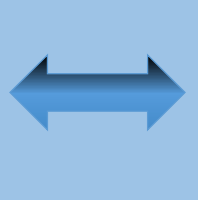
KHO, Svalbard (HF)



Tromso, Norway (HF)



LFO, Ukraine (HF, ELF)



SOUSY, Svalbard (ELF)

1) Project participants will develop compendia and prepare practical courses for students based on the data provided by the facilities. Students will be trained in controlling the facilities and processing the data of observations. In the future, we plan to develop web-based software for conducting practical classes "in virtual space" using internet access to control facilities and process observational data.

2) Direct communication of Ukrainian supervisors and students studying in Norwegian institution will be achieved during summer fieldwork which will be organized in Ukraine in June-July 2015.

The fieleldwork includes:

- Practical training at the Observatory of the Institute of Ionosphere including several runs of IS radar.
- Workshop and training courses at Low Frequency Observatory of IRA. LFO is equipped with HF and ELF facilities similar to instruments installed in Norway. Scientists of IRA will train the students how to operate the facilities and process data.

3) We also plan that the Ukrainian supervisors will visit Norway with short visits. One task of these visits is to prepare a workplace for managing facilities and processing HF/ELF data recorded by the instruments located in Norway. Visitors will also work together with Norwegian partners on preparation of new joint long-term project.

4) We suppose that one or two students measuring campaign(s) with EISCAT instruments will be organized next year.

Summary

- The ongoing long term cooperative project is very useful for improvement of cooperation between Norwegian and Ukrainian institutions. It initiate long-term students exchange at master (in the near future hopefully at PhD) level, and gives opportunity to implement new initiatives: joint supervision of students and involvement of new research instrument into educational process. We apply to SIU for a new short term project to support these ideas.

- We would like to apply for a new long-term project oriented toward coordinating the educational and research activities at the participating institutions with the aim of development of novel programs for master degree and PhD level students.


We hope that current Project will be a good background for successful and mutually beneficial cooperation
Thank you