UNOOSA United Nations Office for Outer Space Affairs

The Ministry of Communication and Information Technologies of the Republic of Azerbaijan

esa

United Nations / Azerbaijan / United States of America / European Space Agency
Workshop on the Applications of Global Navigation Satellite Systems
May 11- 15, 2009, Baku, Azerbaijan

GNSS

Regional cooperation in the field of space weather studies and applications in the southeastern and east central Europe and in the Caucasus region

Elchin Babayev [1], Katya Georgieva [2]

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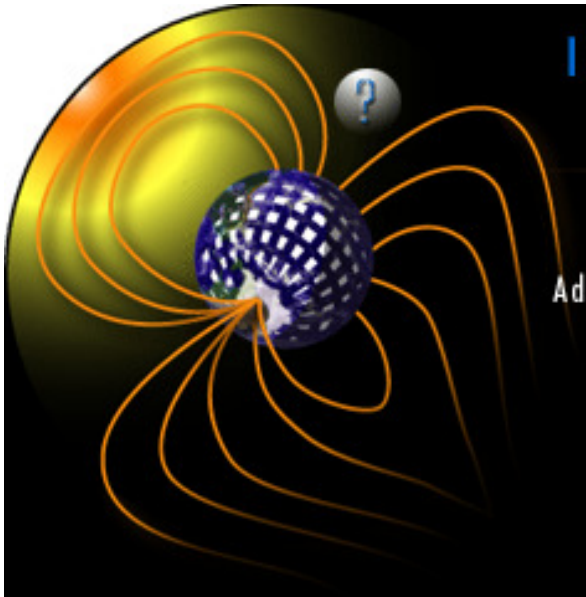
INTERNATIONAL HELIOPHYSICAL YEAR
IGY
1957
IHY
2007



INTERNATIONAL HELIOPHYSICAL YEAR

2·0·0·7 — 2·0·0·9

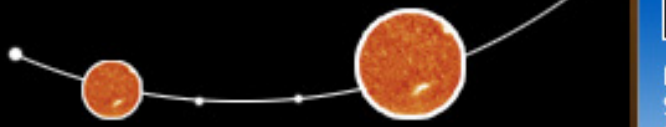
Advancing our Understanding of the Fundamental Heliophysical Processes that Govern the Sun, Earth and Heliosphere

Continuing the tradition of international research and advancing the legacy on the 50th anniversary of the International Geophysical Year

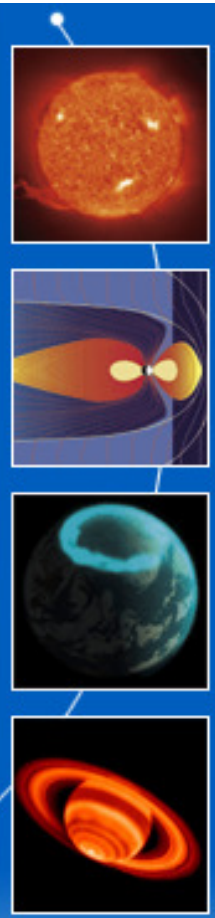
Demonstrating the Beauty, Relevance and Significance of Space and Earth Science to the World

International Geophysical Year

Continuing a Tradition of International Collaboration on the 50th Anniversary of IGY 1957



IGY Gold History Program



ENTER YOUR SCIENCE CIP ONLINE NOW

SCIENCE OBSERVATORY DEVELOPMENT OUTREACH HISTORY

International Heliophysical Year 2007

- One of six main goals of an international programme of scientific collaboration - **the International Heliophysical Year (IHY) – 2007** was the fostering international scientific cooperation in the study of heliophysical phenomena.

- Major planning activities have taken place for all aspects of the IHY programme:
  - *national, regional and international planning conferences and meetings have occurred;*
  - *teams have been formed for implementing IHY activities in all the regions of the globe on the basis for the four main programmatic thrusts of IHY (science, IHY/UNBSSI (the United Nations Basic Space Science) programme, outreach and history).*

- A **regional network** have been established in June 2005 to promote space weather studies in southeastern and east central Europe and in the Caucasus region.

- The main impetus behind establishing **the Balkan, Black Sea, and Caspian Sea Regional Network on Space Weather Studies** (hereinafter: Network) was to strengthen activities in the region in the field of space science - especially space weather-related studies – not only under the umbrella of the IHY, but also to promote in the future the collaboration between participating countries in basic space sciences.

8 June 2005, Sozopol, Bulgaria

PROTOCOL

OF THE REGIONAL IHY PLANNING MEETING FOR THE BALKAN AND BLACK SEA REGION

Regional IHY Planning Meeting for the Balkan and Black Sea Region (hereafter Meeting) was organized by the Solar Terrestrial Influences Laboratory at the Bulgarian Academy of Sciences (STIL-BAS) and was supported by the Bulgarian Academy of Sciences and European Office of Aerospace Research and Development (EOARD). The Meeting was held from 6 to 8 June 2005 at Sozopol, Bulgaria.

Representatives of 11 countries (Bulgaria, Armenia, Azerbaijan, Croatia, Georgia, Greece, Poland, Romania, Russia, Serbia and Montenegro, Ukraine) participated in the Meeting and scientists from Czech Republic, Slovakia and Turkey who were unable to attend the Meeting, expressed their wish to be included in the planned activities. There were reported about 50 papers: scientific papers, reviews, information about current researches in their countries.

The plans on the future activities and collaborations were discussed and relevant decisions were made on consensus basis which are summarized in the following as

MEMORANDUM OF UNDERSTANDING.

1. **Agreement on creation of the *Black Sea and Caspian Sea Regional Network on Space Weather Studies* (hereafter Regional Network) consisting of the following countries: Bulgaria, Armenia, Azerbaijan, Croatia, Czech Republic, Georgia, Greece, Poland, Romania, Russia, Serbia and Montenegro, Slovakia, Turkey, Ukraine. The Regional Network is open to other countries willing to participate in its activities.**
2. **The Regional Network will maintain a special web site.**
3. **The Regional Network will publish an International referred Scientific Journal "SUN and GEOSPHERE" with international editorial board. Proceedings the Meeting will be published in the first issue of this Journal.**
4. **To coordinate the activities on popularization of knowledge on Solar Terrestrial Physics, particularly, the Space Weather, by means of scientific-popular articles written by the members of the Regional Network in English with further translation into different languages for publishing in the web site of the Regional Network and in domestic periodicals.**
5. **To organize Annual Summer (or Winter) Schools on Solar Terrestrial Physics in different member countries. It is reasonable to use opportunities of the big scientific events to hold these Schools as satellite events.**
6. **To provide possibility of training of young scientists from member countries in different participating institutions.**
7. **To create both a scientific database as well as a database on each member country - their activities and participants.**
8. **To promote bilateral and multilateral joint projects and collaborations among member countries.**
9. **Concrete actions covering the items 1-8 were identified during the Meeting. They are listed in the Appendix.**

Member country representatives:

Armenia, A. Chilingarian

Azerbaijan, E. S. Babayev

Bulgaria, K. Georgieva

Croatia, D. Rosa

Georgia, M.Sh. Gigolashvili

Greece, A. Nindos

Poland, Z. Kobylinski

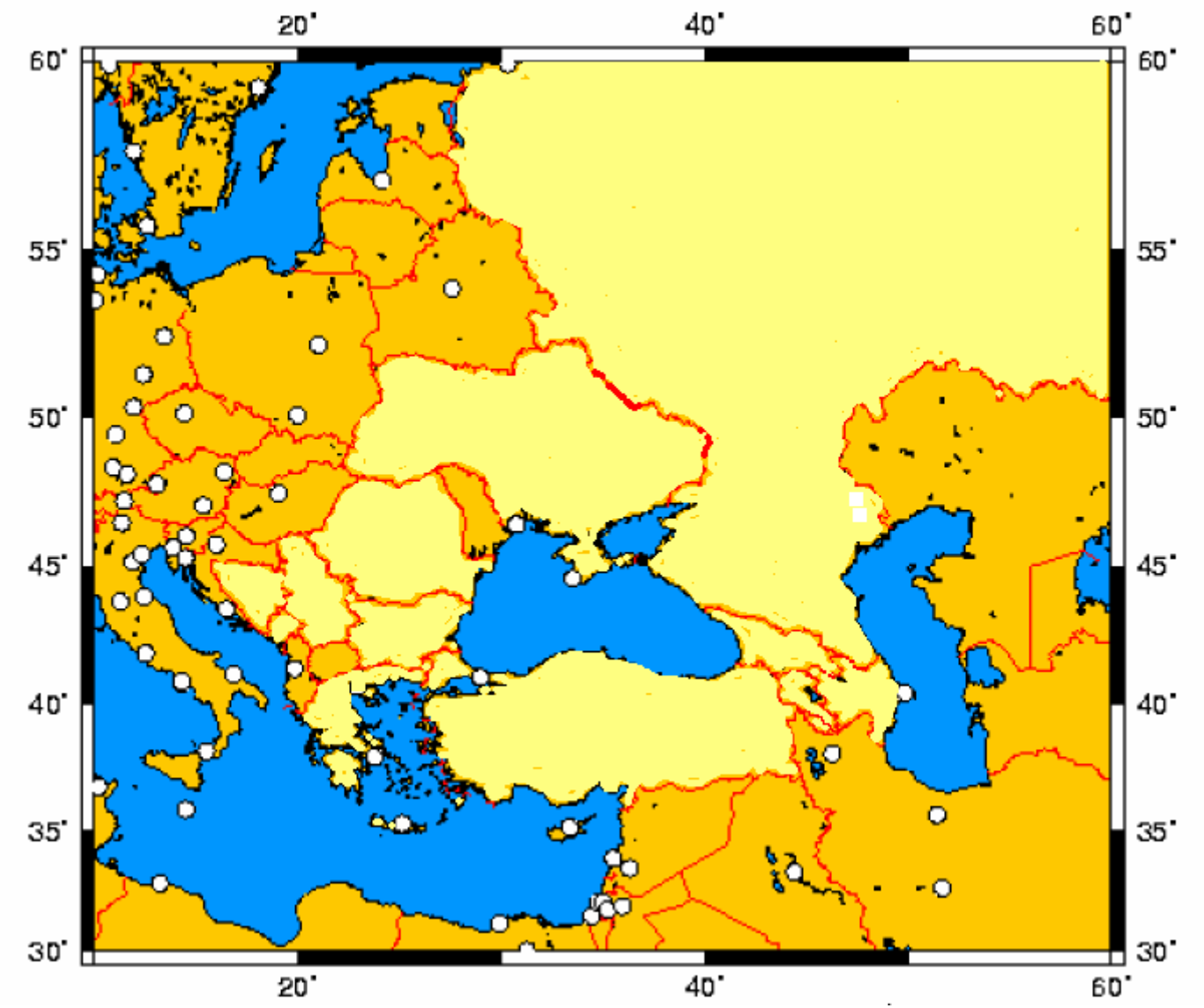
Romania, G.Maris

Russia, Y. Yermolaev

Serbia and Montenegro, I. Vince

Ukraine, O. Lytvynenko

- Network




UniCredit Group

- This talk summarizes the activities of the network and will present the research projects which have been proposed, completed and planned.

- Briefly focuses on some space weather applications, particularly, on navigation and communication systems, ionospheric VLF studies, so on.

- Resources and experience in the member countries

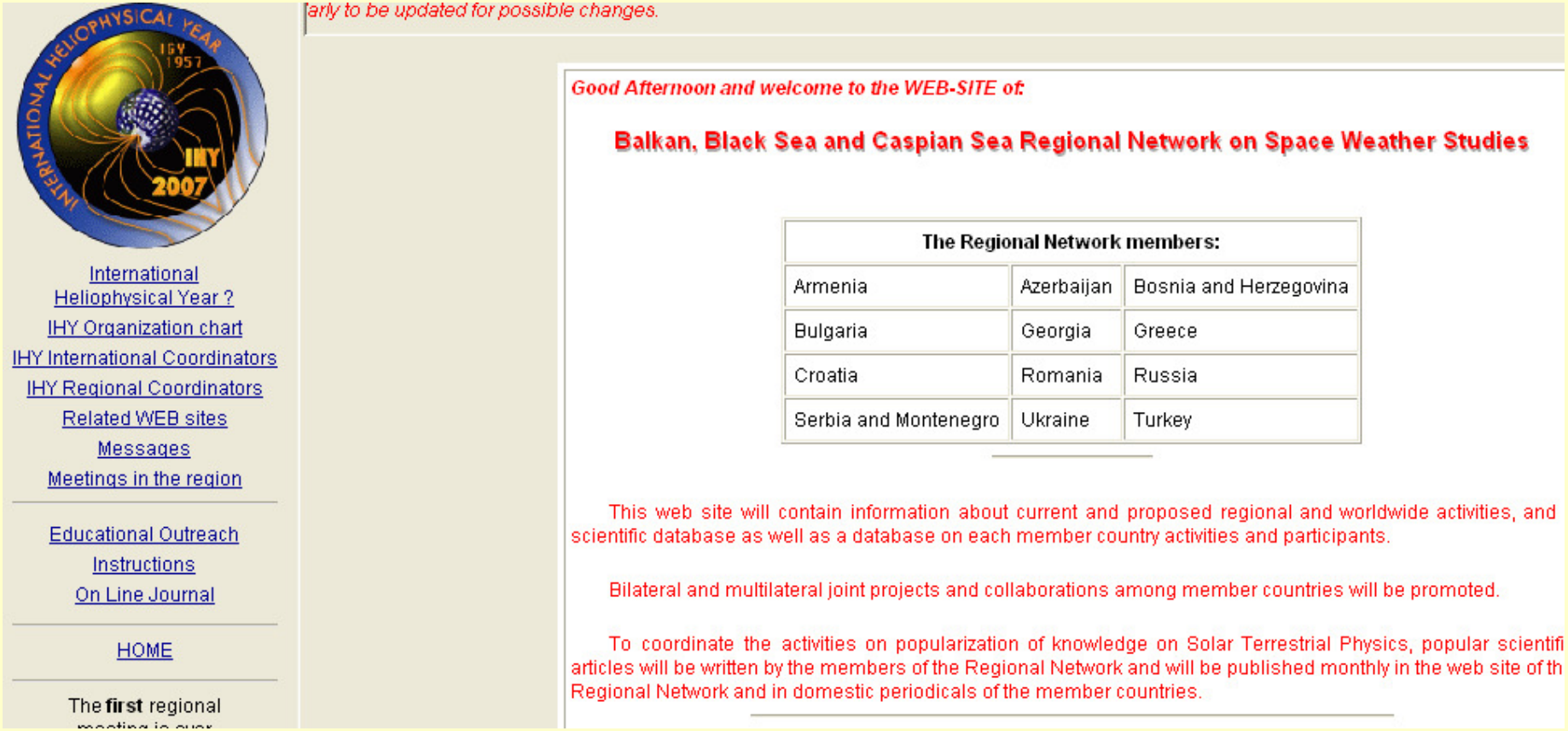
- Network activities
  - organizational
  - scientific
  - educational

8 June 2005, Sozopol, Bulgaria

APPENDIX to the PROTOCOL OF THE REGIONAL IHY PLANNING MEETING FOR THE BALKAN AND BLACK SEA REGION

- Proposal for establishing of a regional network
  A coordinating committee consisting of representatives of all countries and a regional coordinator on rotational basis.
- Proposed scientific topics
  - The physics of solar erruptive events and which ones are potentially hazardous;
  - Atmospheric changes caused by solar UV irradiation variability at different time-scales;
  - Comparative study of geomagnetic, ionospheric and seismic effects of Coronal Mass Ejections and High Speed Solar Wind;
  - Participation in the scientific program of the Russian Academy of Sciences.
- Proposed instrumental networks
  - New networks by installing in the participating countries of:
    - cosmic ray detectors - related to solar activity influences on space weather (Armenia will share experience in installing the detectors);
    - radio receivers for Doppler frequency spectrum monitoring - related to solar activity influences on seismic activity (Ukraine can provide the receivers).
  - New networks based on existing instruments:
    - - ionospheric
    - - magnetometric
    - - seismic
    - - meteorological
- Proposed observational campaigns:
  - expeditions for measuring geomagnetic parameters during the total solar eclipse
  - ground-based observations during the operation of OBSTANOVKA experiment aboard the International Space Station
- Necessary new instruments and upgrade of existing scientific instruments
  - H*a* telescope in Larissa, Greece
  - CIMEL photometer in Stara Zagora, Bulgaria
  - CCD camera in Abastumani, Georgia
  - radiotelescopes URAN-4 and UTR-2 for measuring sporadic solar emissions and ionospheric sounding in Ukraine
- Proposals for a web site of the Regional Network
  - Information on regional and global activities
  - Proceedings of this Meeting
  - Space Weather Alerts for the public
  - Form for submitting research and observational proposals
  - Database of scientific data publicly available
    - Greece provides solar telescope data
    - Romania provides data on active regions studied with helioseismis holography
    - Armenia provides access to data on changing fluxes of particles during solar events
    - Bulgaria provides data on NO2 and O3
    - Webmaster provides links to other databases
  - Database on member countries activities and participating scientists
  - Database of scientific publications by participating scientists on subjects related to IHY
  - Popular papers written by members of the Regional Network
- Public outreach and education

http://www.stil.bas.bg/IHY/



EOS, TRANSACTIONS AMERICAN GEOPHYSICAL UNION, VOL. 89, NO. 15,
doi:10.1029/2008EO150003, 2008

Promoting Space Weather Studies in Eastern Europe and Western Asia

Norma B. Crosby
Belgian Institute for Space Aeronomy, Brussels

Elchin S. Babayev
Shamakhy Astrophysical Observatory, Baku, Azerbaijan

Abstract

A regional network and an international refereed scientific journal have been established to promote space weather studies in southeastern and east central Europe and in the Caucasus region. The main impetus behind establishing the Balkan, Black Sea, and Caspian Sea Regional Network on Space Weather Studies is to strengthen activities in the region in the field of space science—especially space weather–related studies—under the umbrella of the International Heliophysical Year (IHY).

Published 8 April 2008.

NEWS

Promoting Space Weather Studies in Eastern Europe and Western Asia

PAGE 143

A regional network and an international refereed scientific journal have been established to promote space weather studies in southeastern and east central Europe and in the Caucasus region. The main impetus behind establishing the Balkan, Black Sea, and Caspian Sea Regional Network on Space Weather Studies is to strengthen activities in the region in the field of space science—especially space weather–related studies—under the umbrella of the International Heliophysical Year (IHY).

The network promotes bilateral and multilateral joint projects and collaborations among network countries; the training of young scientists from network countries at participating institutions; and the organizing of annual regional summer/winter schools and colloquia on solar-terrestrial physics and network meetings in different network countries. In addition, the network promotes activities to popularize the knowledge of solar-terrestrial physics through network network also promotes school competitions for proposals for joint/collaborative astrophysical observations. It also promotes "astronomy olympiads," a competition to test young people on their knowledge of astronomy that remains popular in former Soviet block countries.

An initiative begun by scientists from Azerbaijan and Bulgaria, the network was established during the IHY Balkan and Black Sea regional planning meeting in Sozopol, Bulgaria, on 6–8 June 2005, and it was supported by representatives of 11 countries (Armenia, Azerbaijan, Bulgaria, Croatia, Georgia, Greece, Poland, Romania, Russia, Serbia and Montenegro, and Ukraine) attending the meeting. Although scientists from the Czech Republic, Slovakia, and Turkey could not attend, they expressed their intent to be included in the planned activities. Bosnia and Herzegovina later joined the network, which is also open to participation by other countries. Representatives from France and the European Office of Aerospace Research and Development par-

30 March to 1 April 2006, followed the 29 March 2006 total solar eclipse and combined observational activities with a scientific meeting. Future annual meetings will be held during the 2–6 June 2008 United Nations Workshop on the International Heliophysical Year 2007 in Sozopol, and during a proposed spring 2009 International Astronomical Union symposium in Azerbaijan.

The *Sun and Geosphere* journal, also established during the 2005 meeting in Bulgaria, promotes space weather activities in eastern Europe and western Asia. The journal—published at least twice yearly on paper, CD-ROM, and online—is peer reviewed by international referees and has published papers by scientists from many countries. The editorial board consists of members from eastern European and western Asian countries as well as from other European and Asian countries and the United States, and each issue of the journal is managed by a guest editor. Coauthor Elchin S. Babayev, of the Shamakhy Astrophysical Observatory, Baku, Azerbaijan, is editor in chief.

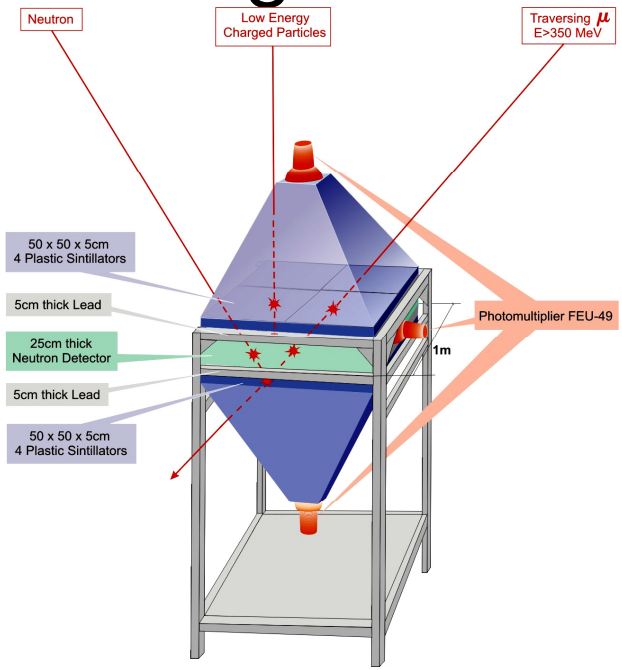
For more information about the network, visit the Web site http://www.stil.bas.bg/IHY. For information about the journal, visit the Web site http://www.shao.az/SG.

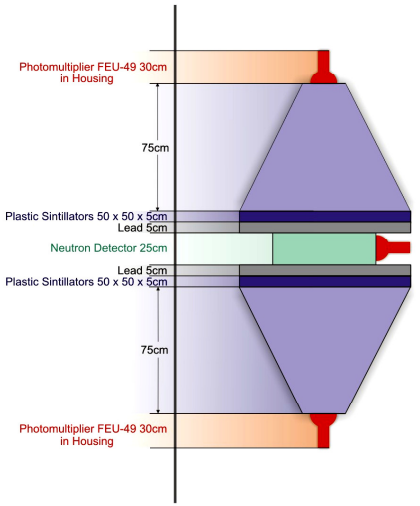
—NORMA B. CROSBY, Belgian Institute for Space

Balkan/Black Sea/Caspian Sea Regional Network SWS Activities

Caucasus countries
Bosnia and Herzegovina
Bulgaria
Croatia
Georgia
Greece
Romania
Russia
Serbia and Montenegro
Turkey
Ukraine

Modular Particle Monitor for Neutral and Charged Cosmic Ray fluxes





SPONSOR Provides:

8 scintillator slabs each of 50 x 50 x 5 cm;
2 photomultipliers;
Electronics board with counters, discriminators, optional temperature and pressure sensors and PC interface;
High voltage units for the photomultiplier;
DAQ, analysis and WEB software;
Access to DVIN data bases;
Training of students;
Documentation

RECIPIENT Provides:

Mechanical parts, including lead.
Purchase computer with GPS;
Uninterruptible electricity and Internet access;
Transportation of equipment from Yerevan;
Cover travel and stay expenses of sponsor experts (if necessary).

Middle-to-Low Latitude Particle Detector Network for Space Weather Research

Azerbaijan

- Shamakhy Astrophysical Observatory - Shamakhy
- Batabat Astrophysical Observatory - Nakhchivan
- Departments (Astrophysics, etc.) of the Baku State University, Azerbaijan Technical University

POTENTIAL PARTICIPANTS

- Research Institutes of the Azerbaijan National Academy of Sciences:
  - Institute of Physics
  - Institute of Radiation Researches
  - Institute of Cybernetics
  - Institute of Mathematics and Mechanics
  - Institute of Information Technologies
- National Aero-Space Agency

three main scientific trends in astronomical studies:

- physics of stars and nebulae
- solar physics
- solar-terrestrial relations
- investigation of the solar system bodies

"Working Group on Study of Solar-Terrestrial Relations" in the Azerbaijan National Academy of Sciences.

Space Weather effects and SW influences on the different technological and biological systems, including the human life and health:

- influence on technical, engineering and ecological systems (scintillation of microwave radio signals, oil production activity and functioning of oil-gas transportation pipelines, electric power grids, Caspian Sea level, climate, traffic, etc.);
- affects on human life and health (virus-epidemic diseases, human brain functional state, cardiovascular diseases, sudden cardiac deaths, etc.).
- Space weather education and outreach: special academic courses, mass-media, daily and weekly columns in newspapers, summer schools, young scientists conference

Bosnia and Herzegovina

- Solar physics group in the University of Banja Luka

Bulgaria

- Bulgarian Academy of Sciences
  - Institute of Astronomy
    - Rojen observatory
    - Belogradchik observatory
  - Solar-Terrestrial Influences Laboratory
    - Stara Zagora observatory
    - in situ measurements aboard the ISS during IHY
  - Institute of Space Research
  - Institute of Geophysics
    - Sofia ionospheric station
    - Panagyurishte magnetic observatory
- Sofia University – Center for Space Research
- Shumen University – Astronomical center
- 10 people's observatories with planetarium

Croatia

- Zagreb university
  Hvar observatory
- Visnjan observatory
- Planetarium at the Technical Museum

Georgia

National (Abastumani) Astrophysical Observatory

- Solar and Heliospheric Physics
- Center of Plasma Astrophysics

Institute of Geophysics

- Observatory of Cosmophysics
- Dushet Geophysical Observatory
- Department of Ozone and Aerosol Physics

Tbilisi State University

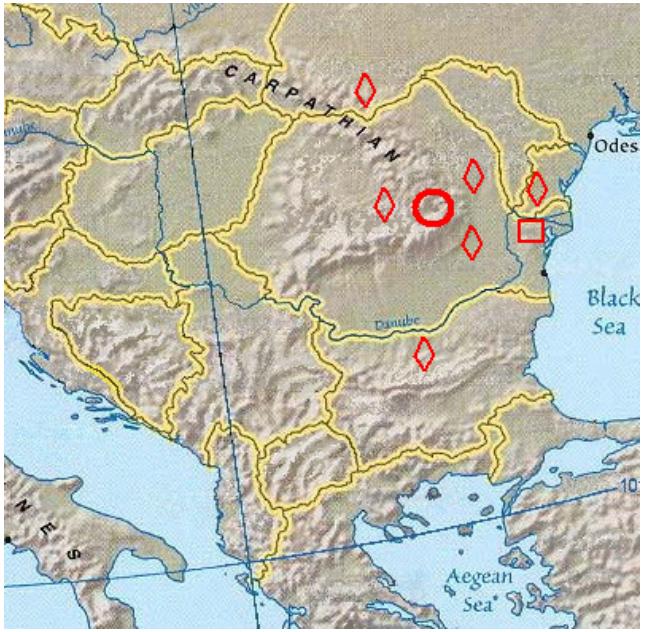
- Ionospheric Observatory
- Laboratory of Extraordinary Phenomena

Serbia and Montenegro

- Belgrade observatory
- Belgrade University, Faculty of Mathematics
- Institute of Physics
  - Ionospheric station
- Institute of geomagnetism
  - Magnetic observatory

Ukraine

- Crimean Astrophysical Observatory (optical and radio)
- Astronomical Observatory of the Odessa National University
- Space Radiophysics Department – Harkiv University
- Radioastronomical observatory - State University “Taras Shevchenko” (Kyiv)
- Academy of Sciences
  - Main astrophysical Observatory
  - Institute for Space Research (Kyiv, Lviv)
- State Institute of Ionosphere – Academy of Sciences and Ministry of Science and Education (ionospheric station)
- Institute of Radioastronomy (Odessa)
- Institute of Geophysics (Poltava) URAN system
- Institute of Physics and Mechanics (Lviv)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Black
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Danube
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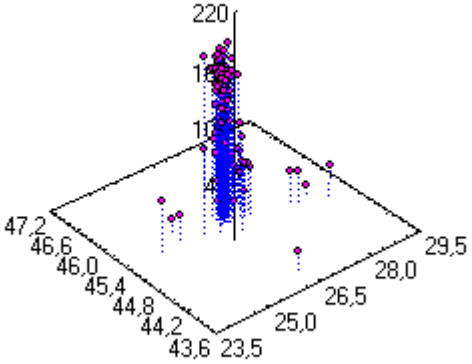
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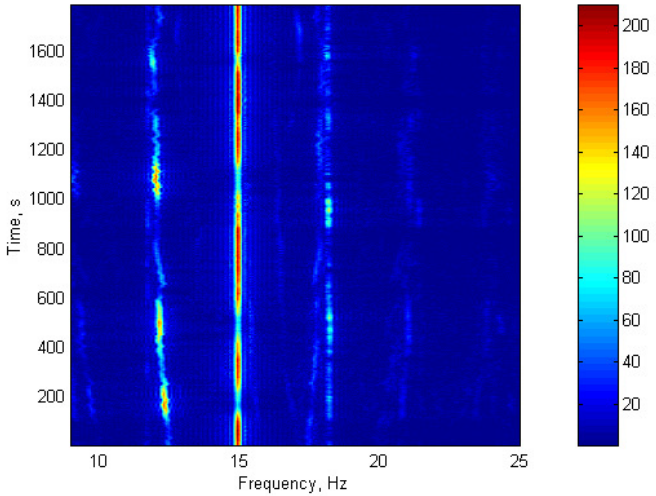
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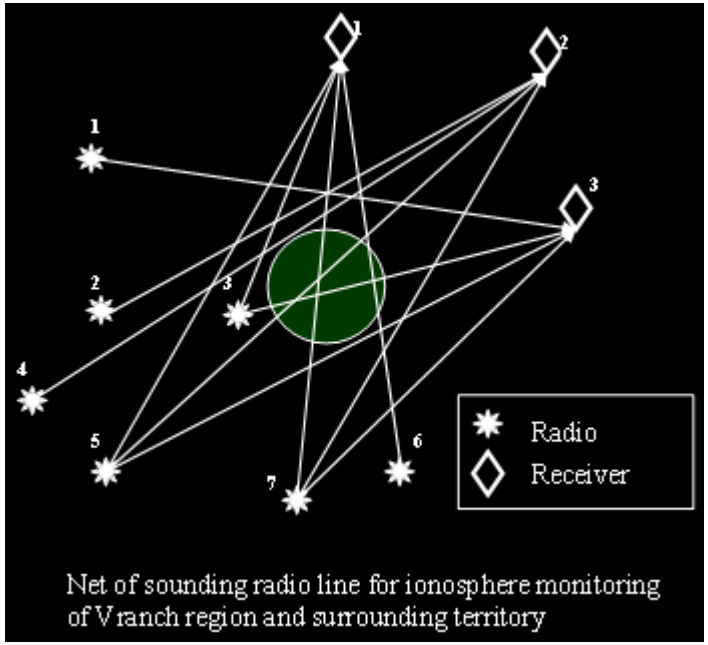
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Radio
Receiver
Net of sounding radio line for ionosphere monitoring
of Vranch region and surrounding territory

URAN – a system of radiointerferometers with extra long baseline in the decameter range including 5 radiotelescopes

Two proposals for IHY

- Use of the radioastronomical data for space weather forecast

development of a space weather forecast method based on using of the data radioastronomical observations of the Sun in wavelengths range from millimeter up to decameter.

- Ionosphere disturbance above Vranch region

- radiotelescope URAH-4, GPS permanent GPS stations (total electron contents) and Doppler spectrum measurement of radio station signals (Doppler radioreceivers network).

Elaboration of multi-channel portative Doppler radioreceivers

Network's activity

Scientific

Research proposals

- The physics of solar eruptive events and which ones are potentially hazardous;
- Atmospheric changes caused by solar UV irradiation variability at different time-scales;
- Comparative study of geomagnetic, ionospheric and seismic effects of Coronal Mass Ejections and High Speed Solar Wind;
- Participation in the scientific program of Russian AS
- Use of the radio-astronomical data for space weather forecast
- Ionospheric disturbances above Vranch epicenter

Network's activity

Scientific

- Deployment of instruments

  (cosmic ray monitors, Doppler radio-receivers…)

- Bilateral and multilateral collaborations

- Databases

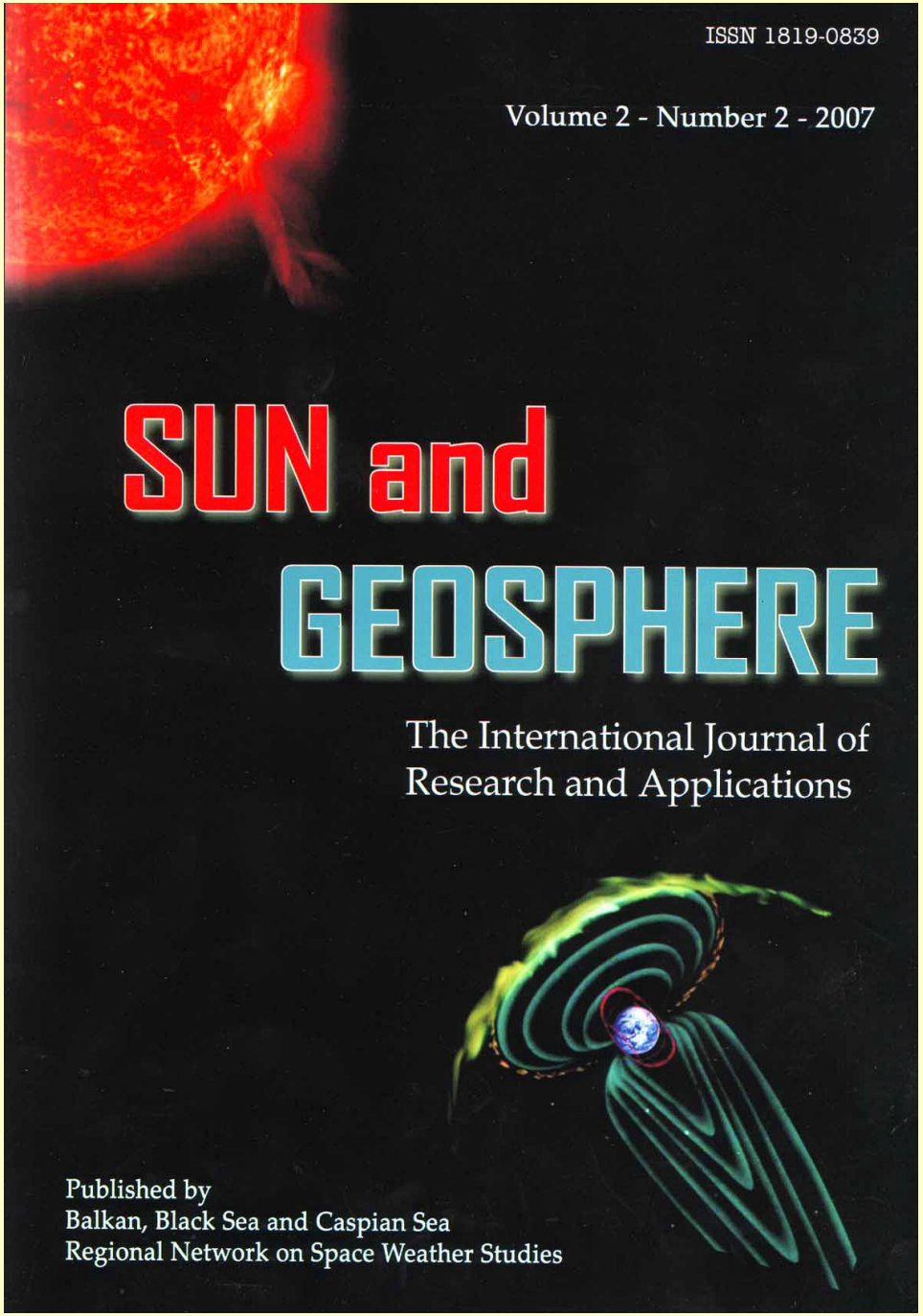
  (cosmic rays, high speed solar wind, solar flares, CME's)

Network's activity

Scientific - Annual regional Summer/Winter Schools on Solar-Terrestrial Physics

- August 2006 – Odessa, Ukraine – VI Gamow summer astronomical school
- II- IV Summer Astronomical School on Solar and Solar-Terrestrial Physics, Azerbaijan

  (review papers, contributed papers, proceedings published)



Scientific

An international refereed scientific journal “Sun and Geosphere” have been established in June 2005

- Peer-reviewed regular paper, thematic papers from conferences/ workshops of Network (after strong reviewing), so on

SUN and GEOSPHERE: The International Journal of Research and Applications

Is founded in 8 June 2005, peer-reviewed and published two times per year by the Balkan, Black Sea and Caspian Sea Regional Network on Space Weather Studies [http://www.stil.bas.bg/IHY/]

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ONLINE VERSIONS:

http://www.shao.az/SG/

http://www.stil.bas.bg/IHY/SUN_GEO.html

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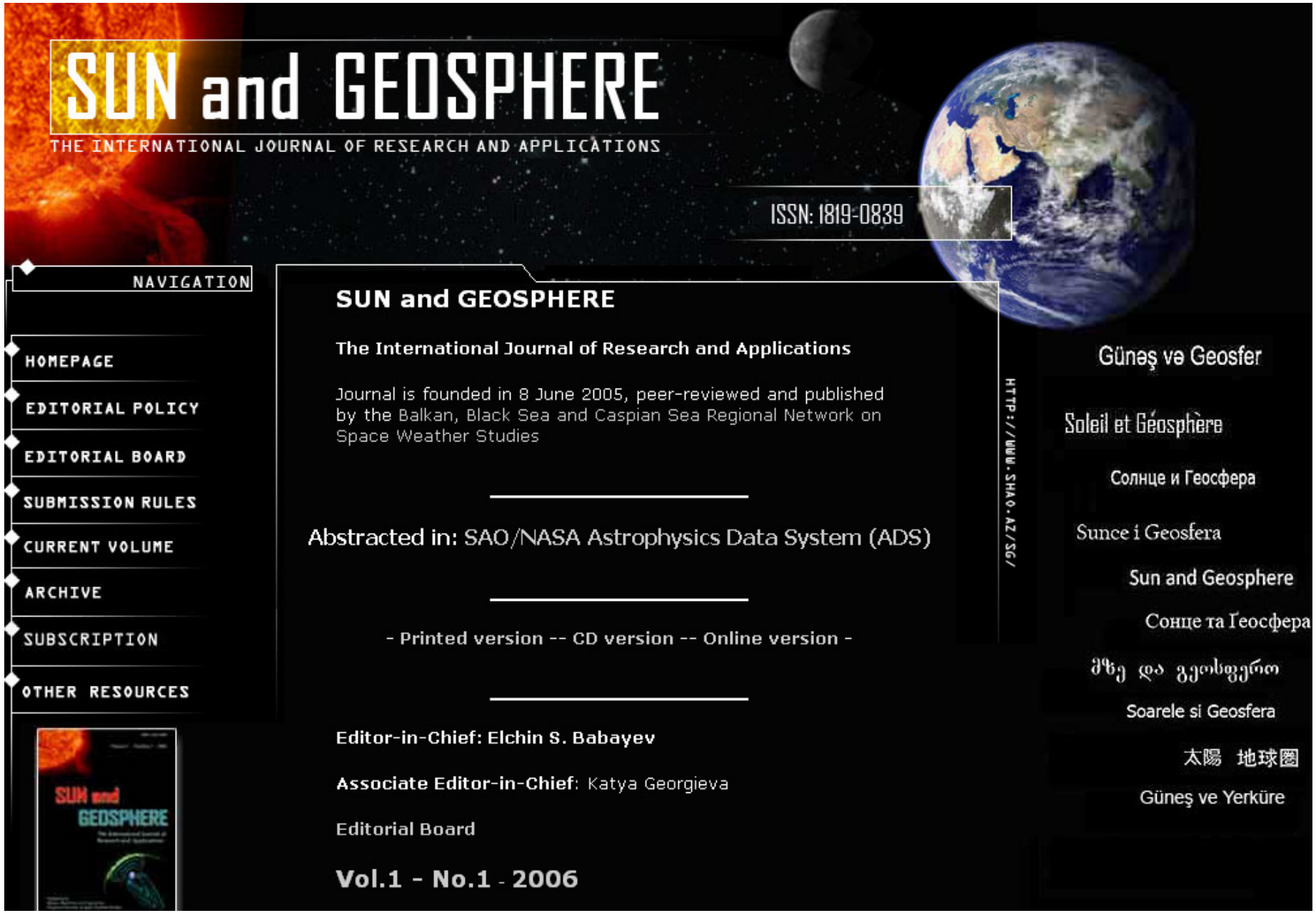
http://www.shao.az/SG/

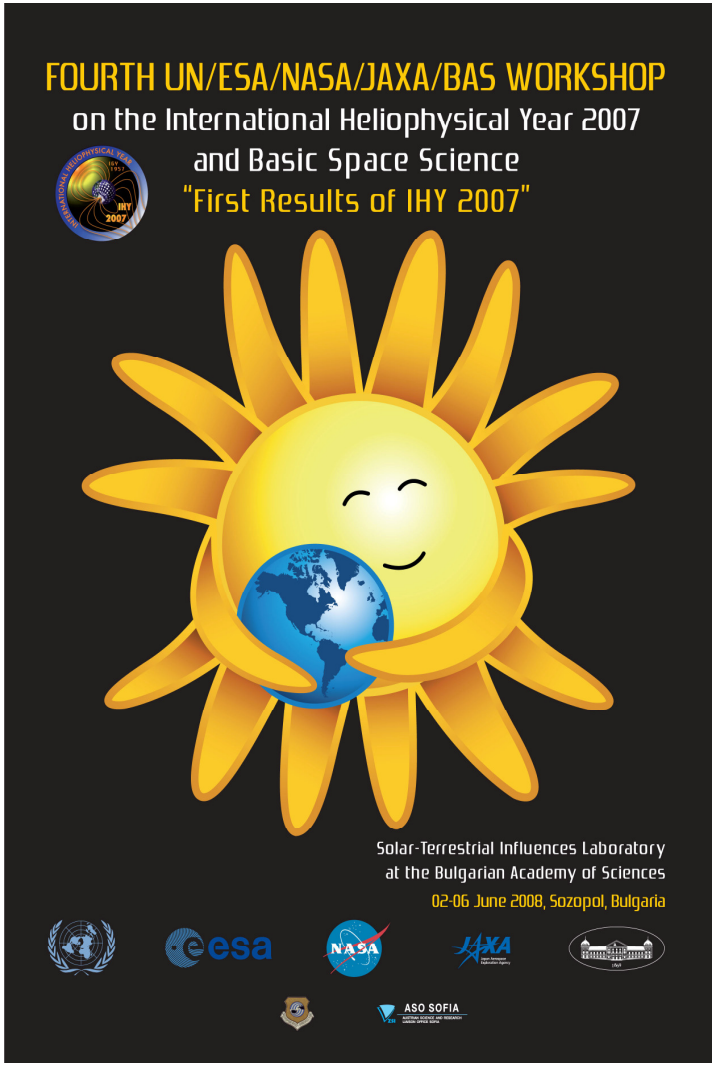


Network's activity

Scientific

Annual regional meetings/conferences

- First regional planning meting – June 2005, Sozopol, Bulgaria
- Second regional meeting - 30 March – 1 April 2006, Antalya, Turkey
- Third regional meeting – 5-11 November 2007, Zvenigorod, Russia
- Fourth regional meeting – 2-6 June 2008, Sozopol, Bulgaria
- Next meeting: Šibenik, Croatia (7-13 September 2009)



Annual Meeting of the Balkans, Black Sea and Caspian Sea Regional Network on Space Weather Studies
March 30 - April 1, 2006 / Manavgat - Antalya, TURKEY


Fourth UN/ESA/NASA/JAXA/BAS Workshop
on the International Heliophysical Year 2007 and Basic Space Science "First Results of IHY 2007"
hosted by the Solar-Terrestrial Influences Laboratory at the Bulgarian Academy of Sciences on behalf of the Government of Bulgaria
02-06 June 2008, Sozopol, Bulgaria
6 9:49PM

Network's activity

Educational

- Scientific-popular articles – www.stil.bas.bg/IHY

  *written by members of the network in English, translated into **local languages** and published in local periodicals and online on popular websites*

- school competitions for high school students
- formulating problems for astronomy olympiads
- school competition for experiments aboard the ISS
- School/university satellites, i.e., Tatyana - MSU

Black Sea and Caspian Sea Regional Network on Space Weather Studies

International Heliophysical Year

Educational Outreach

Following the decision of the Regional planning meeting: "*To coordinate the activities on popularization of knowledge on Solar Terrestrial Physics, particularly, the Space Weather, by means of scientific-popular articles written by the members of the Regional Network in English with further translation into different languages for publishing in the web site of the Regional Network and in domestic periodicals*", this page contains the papers written so far.

	Author	**TITLE**	Format	Lang
1.	*Marina GIGOLASHVILI*, Dr.Sc	**Sun's Magnetism**	HTML	Eng,
2.	*Dragan Rosa* and *Darije Maricic*	**Solar Rotation**	HTML	Eng,
3.	*Georgeta MARIS* Prof.	**Solar Eclipses**	PDF	Eng,
4.	*Georgeta MARIS* Prof.	**Total Solar Eclipse of 2006, March 29**	PDF	Eng,
7.	*Penka Stoeva*	**Sun and Spaceweather** poster	PDF	Bul,
6.	*Nadya Kiskinova*	**Astronomy for all**	HTML	Bul,
7.	*Nadya Kiskinova*	**Astronomy for all** part 1	PDF	Bul,

YURI'S NIGHT

WORLD SPACE PARTY APRIL 12

"Circling the Earth in the orbital spaceship I marvelled at the beauty of our planet. People of the world! Let us safeguard and enhance this beauty - not destroy it!"

- Yuri Gagarin

Network's activity

Educational

- Training of young scientists from member countries in different participating institutions
- Tutoring and co-tutoring of PhD students by members of the network

Collaboration within Network activities

- İNTAS - YSF Collaborative Call with Azerbaijan 2006
- INTAS Ref. Nr 06-1000015-6408
  - 2 years

"Solar and geomagnetic activities influence on the human health state, some biological and ecological systems in middle latitudes and its possible societal-economic impacts"

» **Shamakhy Astrophysical Observatory** named after N.Tusi, Department of the Sun and Solar-Terrestrial Relations, AZ NAS

» **Bogazici University Turkey**, Kandilli Observatory and Earthquake Research Institute, Astronomy Laboratory, Istanbul, Turkey

» Solar-Terrestrial Influences Laboratory, **Bulgarian Academy of Sciences, Bulgaria**

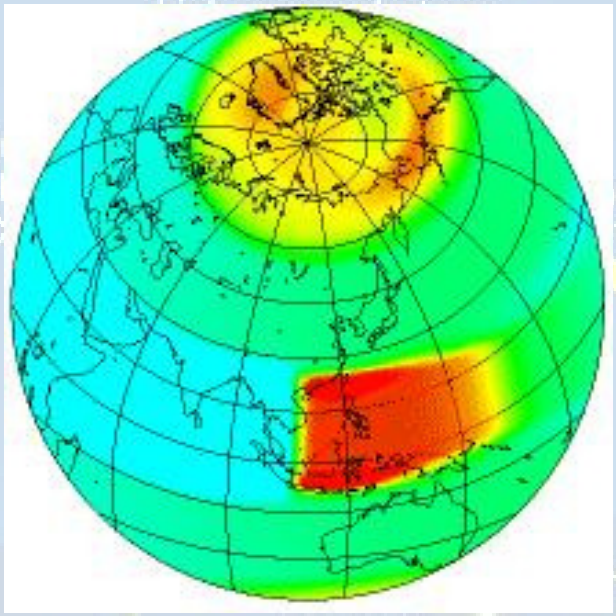
Problems

(and what help we could use)

- Educational materials

  (papers, movies, etc.)
- Travel grants
- New instruments and upgrade of existing instruments
- European and international programs

  (FP7, …)



Extremely

Computer and Memory
Upsets and Failures

Solar Cell
Damage

High energy
protons

Astronaut
Safety

Atmospheric Drag

Plasma
Bubble

Rainfall
Water Vapo

Radio Wave
Disturbance

Electricity Grid
Disruption

Earth Currents

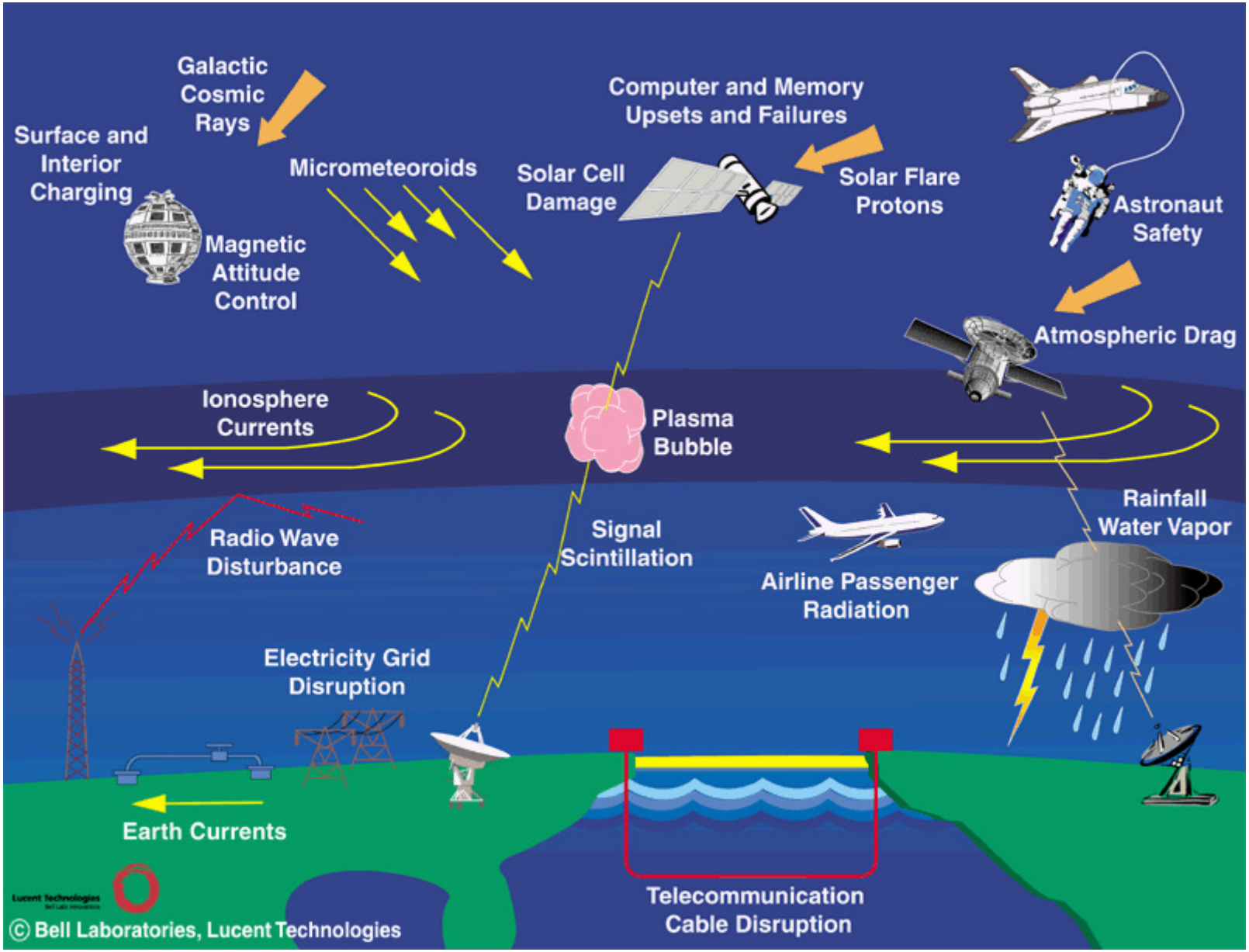
Telecommunication
Cable Disruption

SPACE WEATHER AND SCINTILLATION OF TRANS-IONOSPHERIC RADIO WAVES

SPACE WEATHER refers to:

"…conditions on the Sun and in the solar wind, magnetosphere, ionosphere and thermosphere that can influence the performance and reliability of space-borne and ground-based technological systems and can endanger human life or health…"

[*The National Space Weather Programme, The Strategic Plan, FCM-P-30-1995, Washington DC, August 1995*]


Galactic Cosmic Rays
Surface and Interior Charging
Micrometeoroids
Solar Cell Damage
Computer and Memory Upsets and Failures
Solar Flare Protons
Astronaut Safety
Magnetic Attitude Control
Atmospheric Drag
Ionosphere Currents
Plasma Bubble
Radio Wave Disturbance
Signal Scintillation
Airline Passenger Radiation
Rainfall Water Vapor
Electricity Grid Disruption
Earth Currents
Telecommunication Cable Disruption
Lucent Technologies
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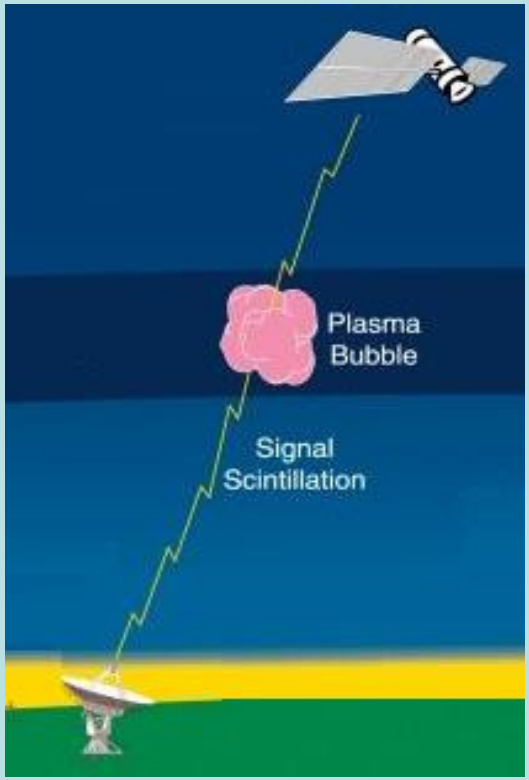
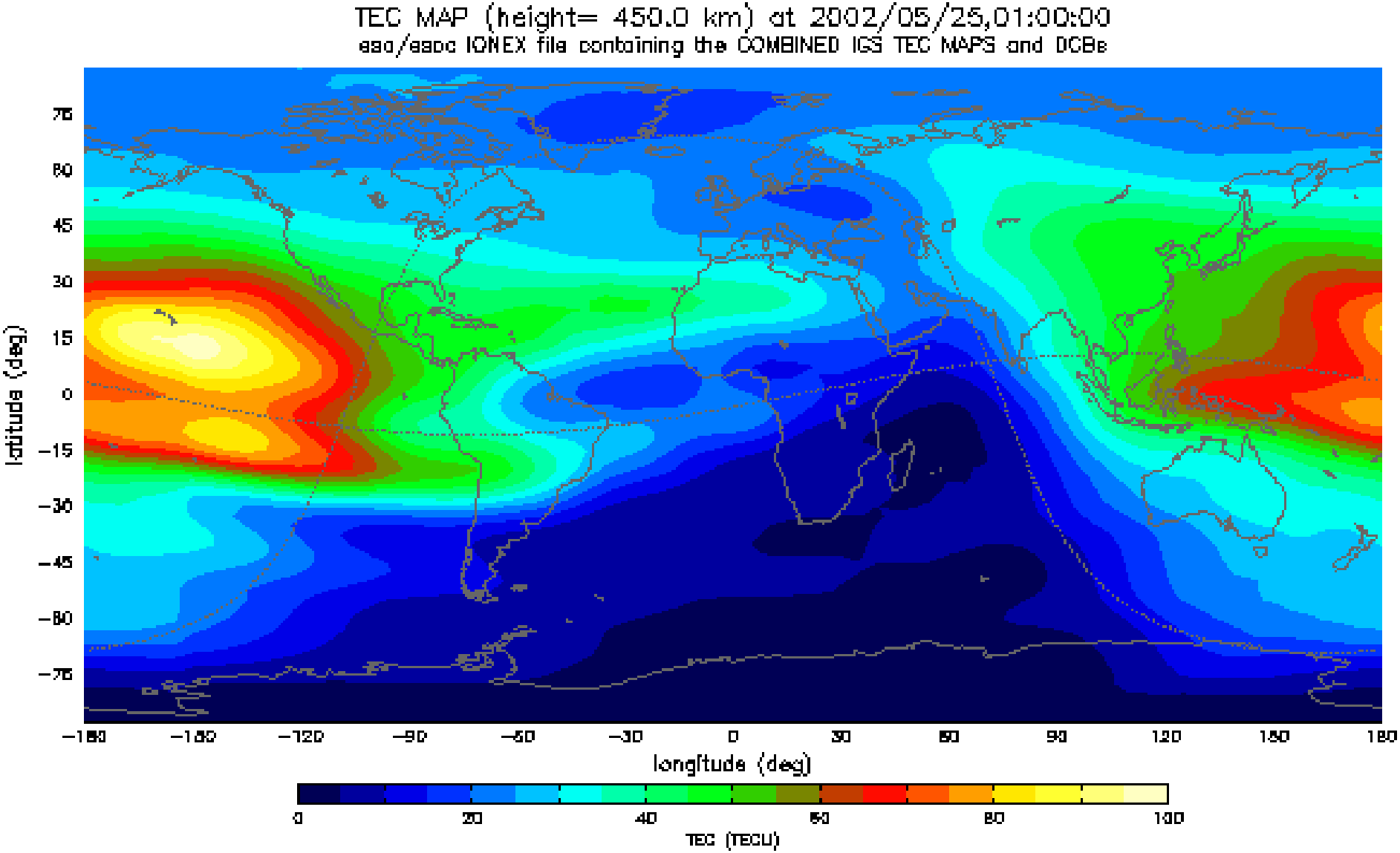

Plasma
Bubble
Signal
Scintillation


TEC MAP (height= 450.0 km) at 2002/05/25,01:00:00
esa/esoc IONEX file containing the COMBINED IGS TEC MAPS and DCBs
75
60
45
30
15
0
−15
−30
−45
−60
−75
latitude (deg)
−180
−150
−120
−90
−60
−30
0
30
60
90
120
150
180
longitude (deg)
0
20
40
60
80
100
TEC (TECU)

SOLAR AND GEOMAGNETIC ACTIVITY DEPENDENCE OF THE SCINTILLATION

- The probability of scintillation's occurrence increases with solar activity.

- The measurements made until now show that scintillation activity is directly proportional to solar activity, but is generally independent of the planetary geomagnetic index K_P.

- The severity (and its intensity) of the ionospheric scintillation varies with sunspot cycle along with other factors.

- Disturbance effects due to the ionospheric scintillation are most significant near solar maximum period, especially in the high- and low-latitude areas.

- In years of high solar flux, transionospheric propagation through polar and equatorial regions has experienced deep fading at frequencies ranging from 54 MHz to 4 GHz.

- The equatorial anomaly region (two belts of enhanced electron density at ~15^0 North and South of the magnetic equator) is the worst source of scintillation: during the sunspot maximum years, the fades exceeding peak-to-peak 27 *dB* at Global Positioning Systems' (GPS) L1-frequency (1.5 GHz) are often registered in this region (at Ascension Island) after sunset while only 5-6 *dB* fades occur within a few degrees of the magnetic equator.

- Statistics of polar scintillation at solar maximum period show much lower values of occurrence of strong fading than at the equatorial anomaly region.

- Although scintillation at middle latitudes is generally not as intense as at equatorial and high-latitudes, weak to moderate levels of scintillation occur.

- Some cases of severe scintillation have been recorded in mid-latitudes. During a magnetic storm on March 22, 1979, peak-to-peak scintillation of 18, 10, 15 and 3.5 *dB* were recorded at 136 MHz, and 1.7, 4, and 12 GHz, respectively, on different paths in and around Japan.

- Irregularity structures can cause scintillation simultaneously on several satellites during magnetically quiet nights. On magnetically disturbed nights (K_p >7) nearly all satellites can be affected at varying levels, most of the night.

- The near solar minimum observations showed that long periods of scintillation occur under both magnetically quiet and disturbed conditions.

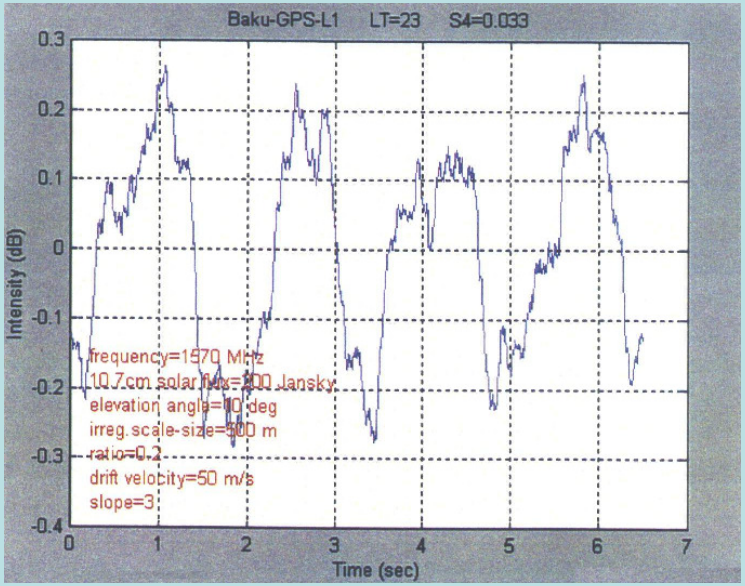
Morphological studies have showed that the high frequency (above 1 GHz) ionospheric scintillation characteristics and correlation can be characterized as follows:

(a) ***Sunspot number dependence***

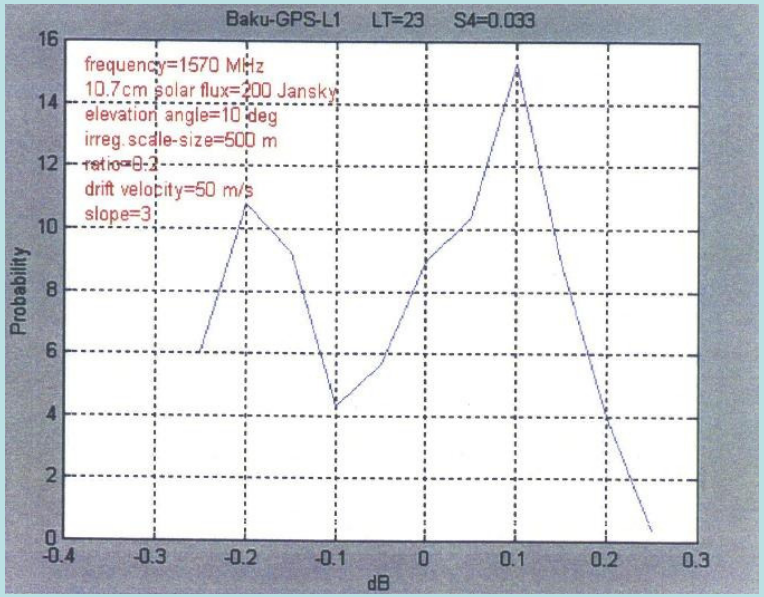
- No strong correlation between individual scintillation event occurrences and daily sunspot number;
- Strong correlation between the amplitude of the scintillation and the monthly sunspot number;
- Strong correlation between annual scintillation occurrence and the annual sunspot number.

(b) ***Temporal and geographical dependence*:**

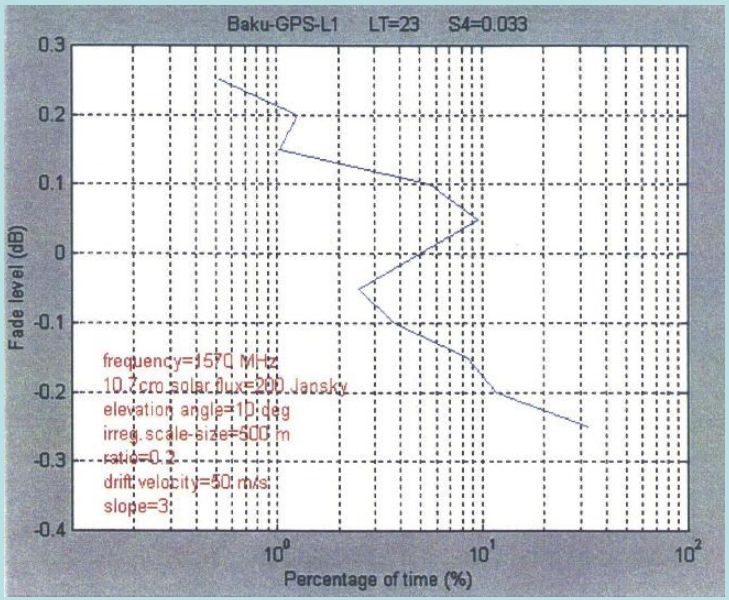
- Annual scintillation activity varies in an 11-year cycle in concert with solar sunspot cycle;
- Peak annual scintillation activity occurs at or just after the equinox periods. For equatorial GHz scintillation, peak activity around vernal equinox and high activity at the autumnal equinox have been observed;
- Peak daily scintillation activity occurs approximately one hour after sunset at the ionospheric height;
- GHz ionospheric scintillation of any significant amplitude only occur within approximately $\pm 30^0$ of the magnetic equator for the geostationary communication satellite links.



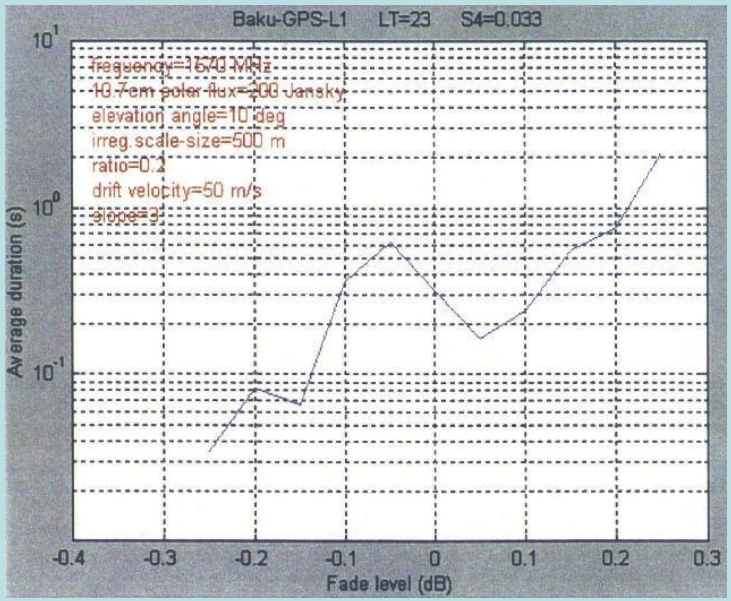
Signal intensity vs. time, Baku



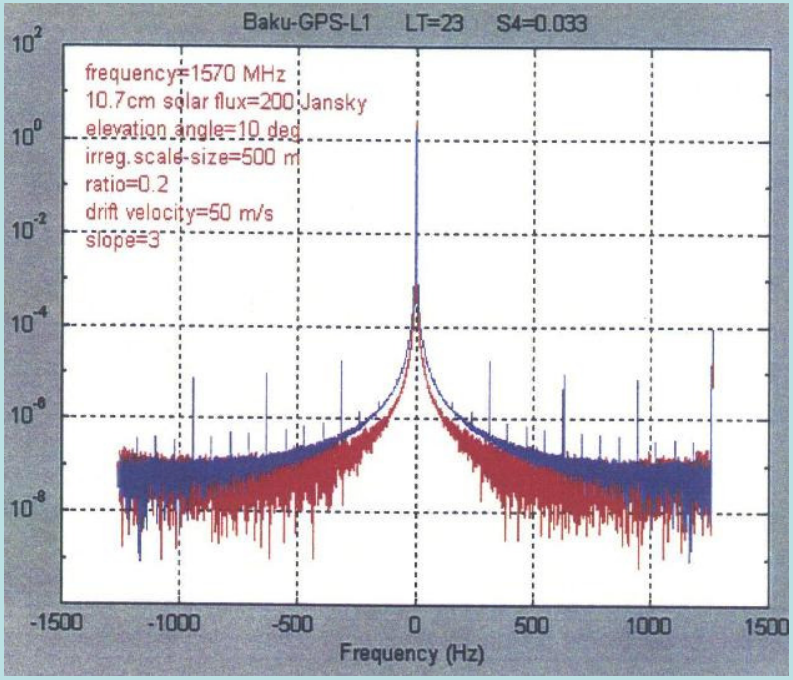
Probability of received signal intensity, Baku



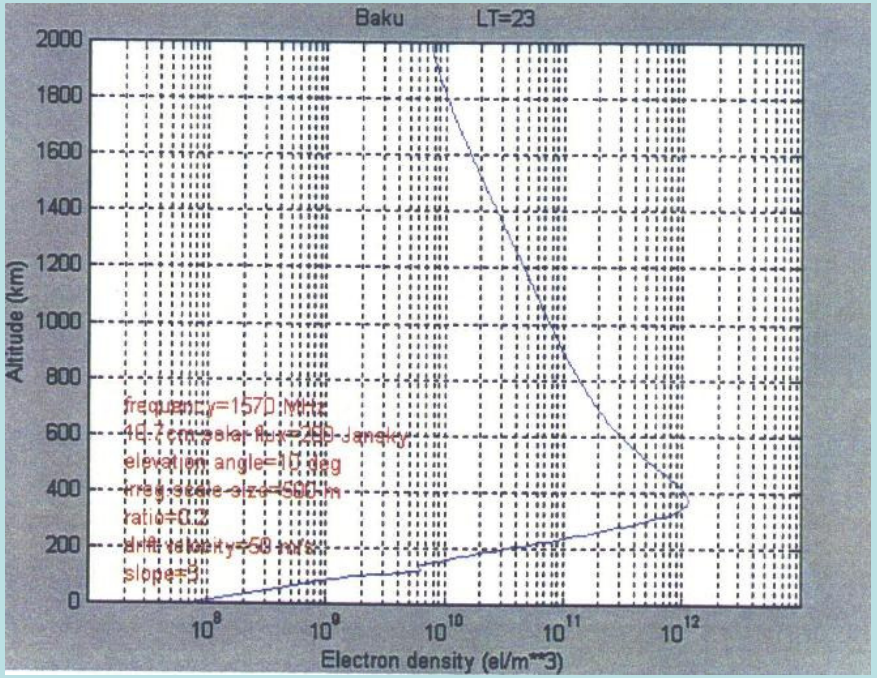
Channel availability, Baku



Average duration of fades, Baku



Intensity (blue) and phase (red) spectrum of received signal, Baku



Electron density as a function of height, Baku

Frequency = 1570 MHz
10.7 cm solar flux = 200 Jansky
Elevation angle = 10 deg
Irreg. Scale-size = 500 m
Ratio = 0.2
Drift velocity = 50 m/s
Slope = 3

Middle latitudes

Scintillation activity level	Generally very quiet to moderately active. The probability of occurrence of scintillations as well as their intensity is very low at middle latitudes.
Cause of scintillation	The daytime **random** scintillations occur because of the sporadic-*E*. The nighttime **random** scintillations are caused by the spread-*F*. **Quasi-periodic** scintillations originate from traveling ionospheric disturbances (*TIDs*) mainly in the *F* region on from sporadic-*E* disturbances
Frequency dependence	Usually scintillation index $S4 \propto f^{-n}$, where n=1.38 for nighttime, and n= 1.52 for daytime. The percentage of occurrence decreases with the frequency.
Diurnal Dependence	The occurrence peaks between 2000 LT and 2100 LT in summer. In other seasons they occur between 2400 LT and 0400 LT. According to the solar cycle, they are also observed rarely during daytime, between 0900 LT and 1500 LT. Maximum – nighttime; Sporadic – daytime.
Seasonal dependence	**Random** scintillations occur mainly in the summer and seldom during the other seasons. **Quasi-periodic** scintillations occur mainly in summer. Maximum: winter Minimum: equinox and early summer (May-July)
Solar activity dependence	The probability of scintillations occurrence and their intensity increases with the solar activity.
Magnetic activity dependence	Generally independent of *K*p

- IHY scientists from UNBSS member states now participate in the instrument operation, data collection, analysis, and publication of scientific results, working at the forefront of science research.

- It is proposed to continue the highly successful collaboration with the UNBSS program to continue the study of universal processes in the solar system that affect the interplanetary and terrestrial environments, and to continue to coordinate the deployment and operation of new and existing instrument arrays aimed at understanding the impacts of Space Weather on Earth and the near-Earth environment.

The AWESOME Monitor

Englis

A tmospheric
W eather
E lectromagnetic
S ystem for
O bservation
M odeling and
E ducation

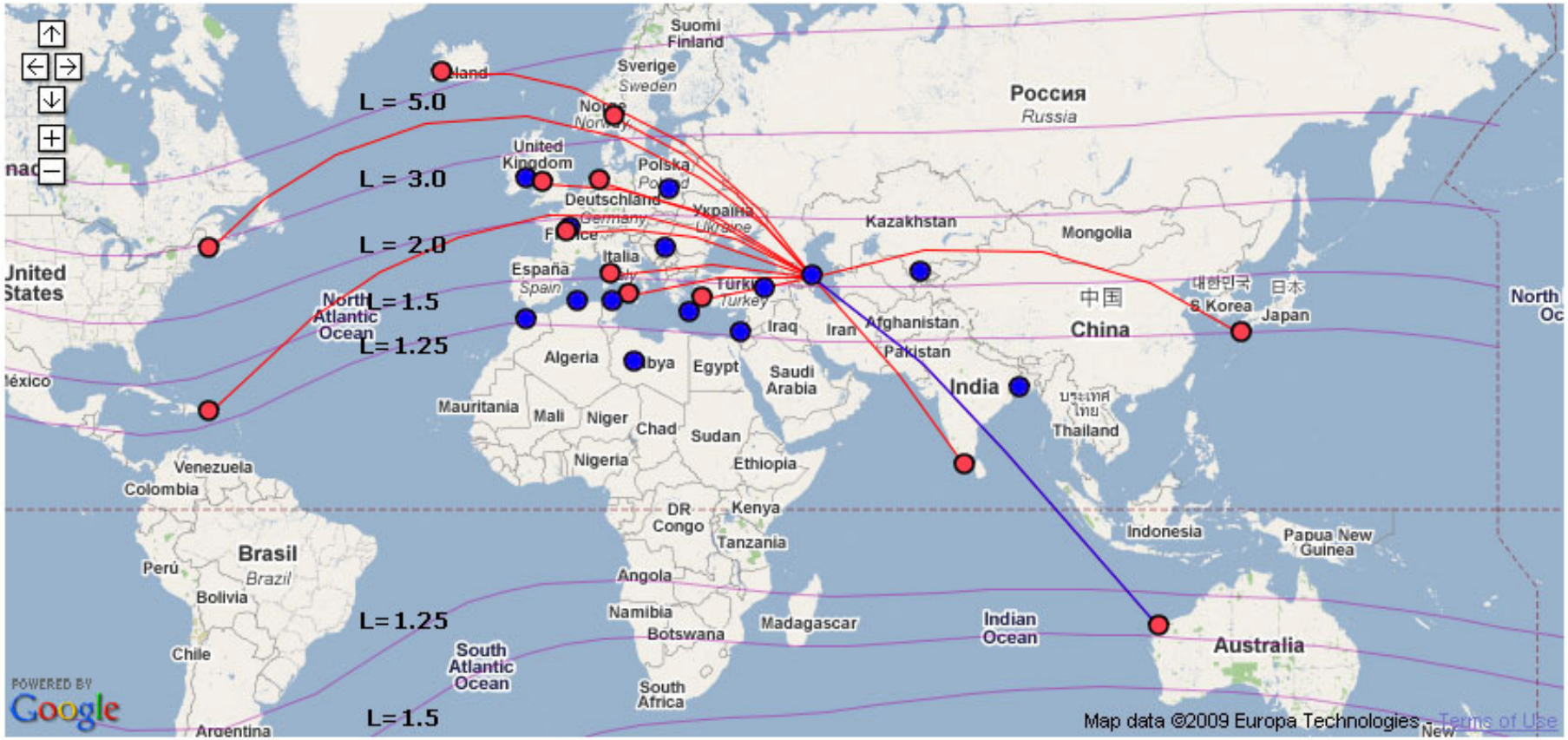
SID MONITORS
AWESOME MONITORS
SCIENCE
DATA
OBTAINING A MONITOR
DISTRIBUTION

Very Low Frequency (VLF) remote sensing studies of the lower ionosphere in middle latitude site of the Azerbaijan using AWESOME receiver

- Ground based observations of Extremely Low Frequency (ELF) / Very Low Frequency (VLF) (300 Hz 30 kHz) waves are considered as an important remote sensing tool for the investigation of the ionosphere and the magnetosphere. VLF waves find their origin in various natural and artificial phenomena; the natural sources include thunderstorms, lightning and associated phenomena. Sub-ionospheric VLF transmissions propagating inside the Earth-ionosphere wave-guide is also being widely used for investigating sudden ionospheric perturbations (SIDs) in lower part of the ionosphere.

- We monitor VLF signals continuously at Pirgulu location in Azerbaijani sector with the help of AWESOME (Atmospheric Weather Educational System for Observation and Modeling of Electromagnetics) VLF receiver from Stanford University. It was installed in Azerbaijan by Prof. U. Inan and his colleagues in the context of the IHY/UNBSS program for 2007 as part of the United Nations initiative to place scientific instruments in developing countries.

- VLF receiver enables handling of data that is used by researchers conducting ionospheric and space weather research. With the use of simple square air-core magnetic loop antennas of a couple of meters in size, the sensitivity of these instruments allows the measurement of magnetic fields in the frequency range of ~ 300 Hz to 50 kHz.
- AWESOME VLF receivers are capable of collecting both broadband (used for the study of natural signals) and narrowband (sub-ionospheric VLF signals corresponding to VLF transmitters) data.
- Sub-ionospheric VLF observations allow the measurement of the lower ionosphere, normally not accessible with other instruments.
- The obtained data will enable us to understand the generation and propagation mechanism of naturally occurring VLF waves in middle latitude region such as **radio atmospherics from lightning flashes, magnetospheric whistlers, VLF emissions, to conduct remote sensing of the lower ionosphere, lightning and thunderstorms, to investigate long-term trends of magnetospheric parameters such as electron density, total electron content in a flux tube and electric fields during quiet and active solar periods, to find correlation between VLF wave activity and geomagnetic activity**, and other phenomena.
- Narrowband sub-ionospheric VLF signals (remote sensing) and planned ground-based geomagnetic data in Azerbaijani middle latitude region will help us to study sudden ionospheric disturbances associated with transient phenomena like solar flares, geomagnetic storms, giant cosmic gamma-ray flares, lightning induced electron precipitation (LEP), effects of lightning discharge, sprites, elves, blue jets, gravity waves etc.
- Sub-ionospheric VLF signals are also helpful in the study of VLF waves as a **precursor to earthquakes**.
- AWESOME VLF receiver provides an open-ended potential for exploration and also can be used for **educational outreach**.


L = 5.0
L = 3.0
L = 2.0
L = 1.5
L = 1.25
L = 1.25
L = 1.5
Suomi
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Sweden
Россия
Russia
United
Kingdom
Polska
Deutschland
Kazakhstan
Mongolia
United
States
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Africa
South
Atlantic
Ocean
Indian
Ocean
Indonesia
Papua New
Guinea
Australia
Argentina
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VLF Data Viewer

Start Date: Jan 1 2009 Start Time: 00:00

End Date: Jan 1 2009 End Time: 23:00

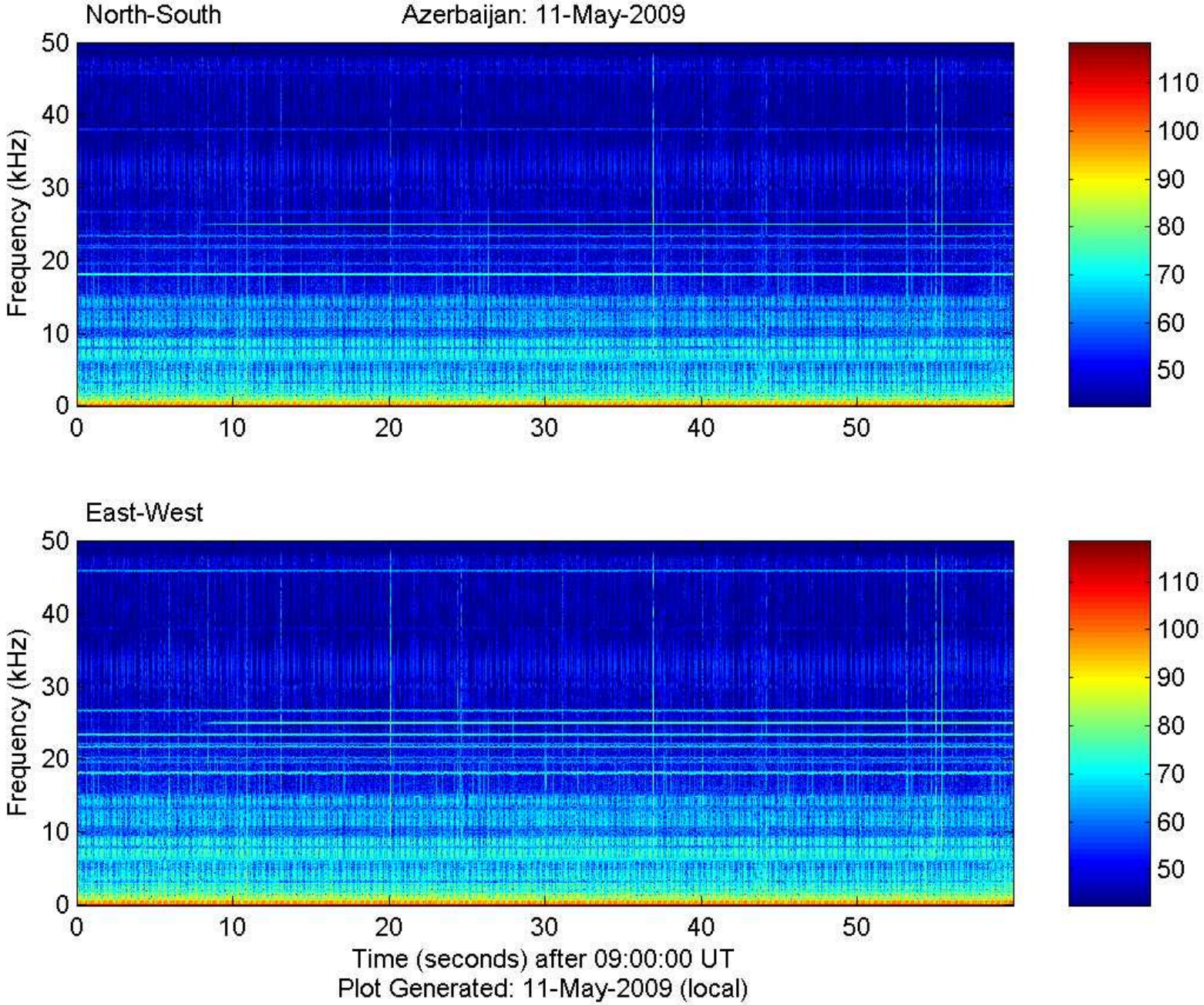
Samahky, Azerbaijan NWC/NS Amp Phase | Remove

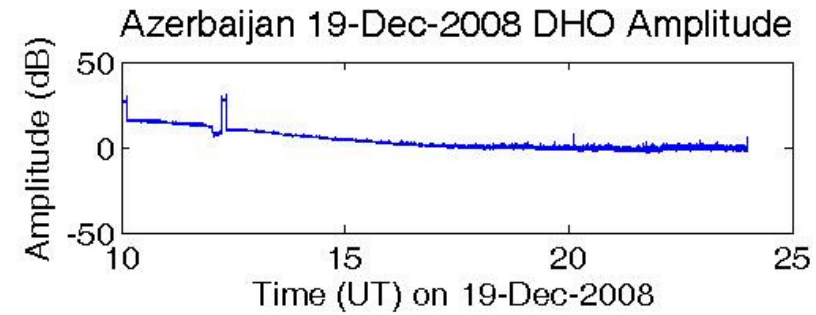
Add A Path

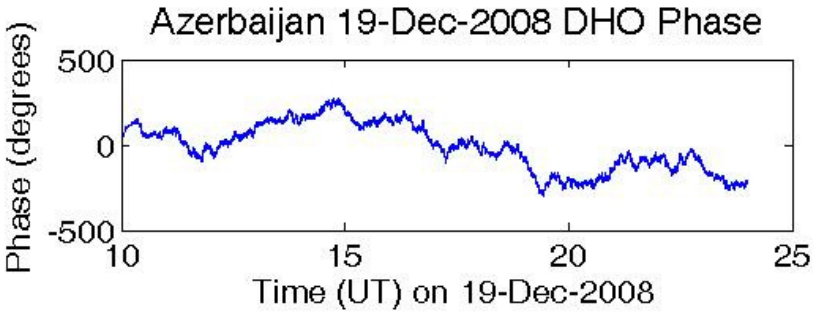
Plot Reset


U. M. S.
+ E. F. I. S.
VLF


SyncMaster 793DF
North-South
East-West
SAMSUNG
STANFORD UNIVERSITY
VLF LINE RECEIVER
N/S
E/W


North-South
Azerbaijan: 11-May-2009
Frequency (kHz)
0
10
20
30
40
50
110
100
90
80
70
60
50
East-West
Time (seconds) after 09:00:00 UT
Plot Generated: 11-May-2009 (local)

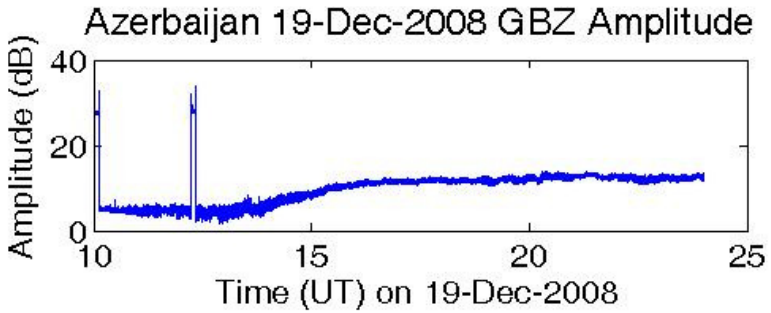


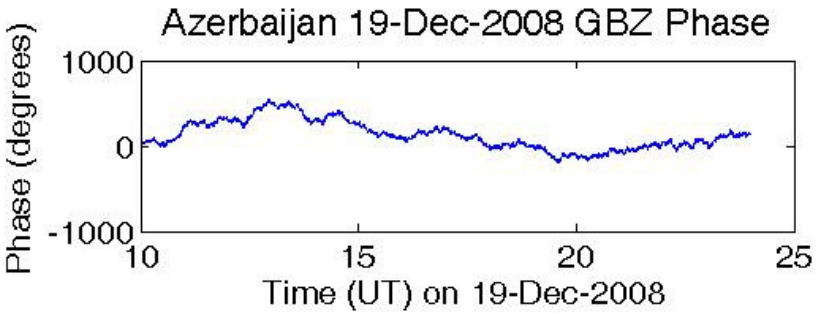


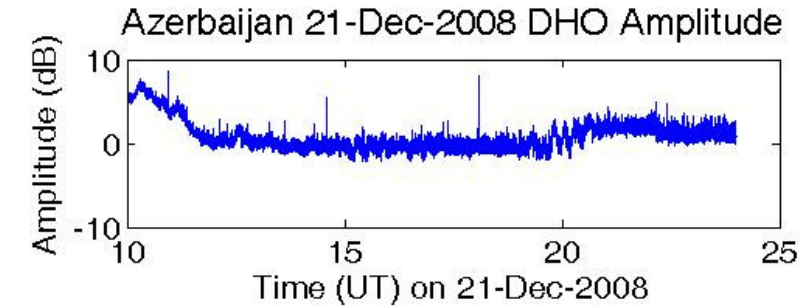
Earthquake M=2.4

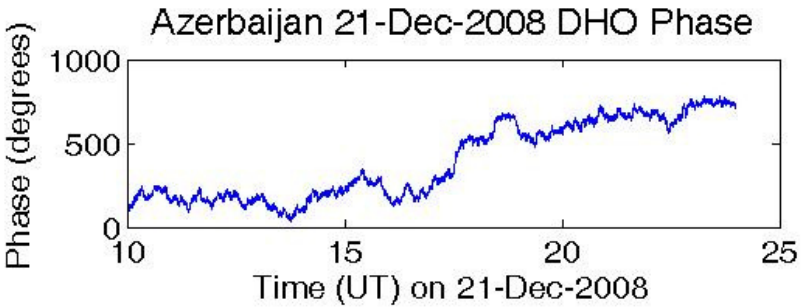
DHO –

Burlage, Germany

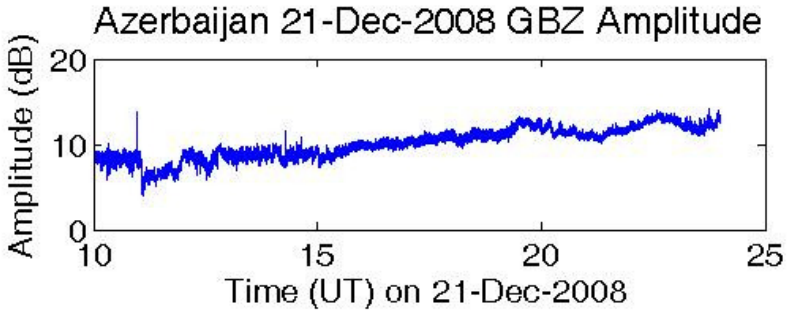






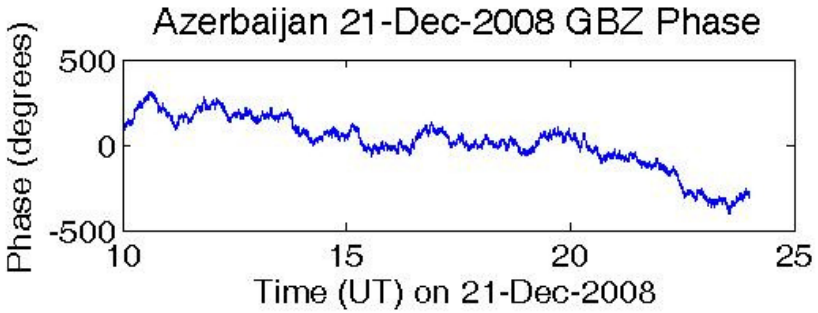


Earthquake M=4



GBZ –

Rugby, UK



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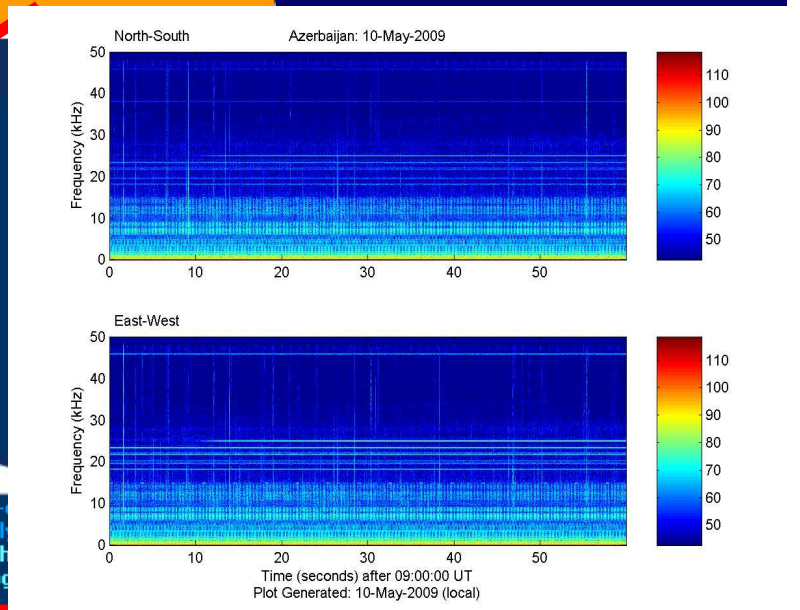
AZƏRBAYCAN ASTRONOMİYA JURNALI

SUN and GEOSPHERE

ShAO in 1966



International Space Weather Initiative (ISWI) 2010-2012

- The highly successful collaboration between the heliophysics science community and UNBSS program will be continued within IHY program's continuation: International Space Weather Initiative (ISWI) for years 2010-2012. ISWI was adopted as an UN supported program on 18 February 2009 during the session of the Science and Technical Subcommittee of the UN Committee of Peaceful Use of the Outer Space (COPUOS).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ON BASIC SPACE SCIENCE AND THE INTERNATIONAL HELIOPHYSICAL YEAR 2007
22~25 September 2009
HYATT REGENCY JEJU IN KOREA
Topics
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· Astronomy and Astrophysics
· Solar-terrestrial Interaction and Its Influence on Terrestrial Climate
· Planetary and Atmospheric Studies
· Origin of Life and Exo-biology
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on behalf of Korean Ministry of Education, Science and Technology (MEST)
IHY 2007


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GNSS