Book of Abstracts

Eighth Workshop

"Solar Influences on the Magnetosphere, Ionosphere and Atmosphere",

Sunny Beach, Bulgaria, May 30 - June 3, 2016

Scientific Organizing Committee

Topics:

Sun and Solar Activity
Solar Wind-Magnetosphere-Ionosphere Interactions
Solar Effects in the Ionosphere
Solar Influences on the Lower Atmosphere and Climate
Solar Effects in the Biosphere
Instrumentation for Space Weather Monitoring
Data Proccessing and Modelling

Local Organizing Committee:

(Space Research and Technologies Institute, Sofia, Bulgaria):

CONTENTS

Solar Wind-Magnetosphere Interactions

Sun and Solar Activity

Solar Influences on the Lower Atmosphere and Climate

Data Proccessing and Modelling

Solar Effects in the Biosphere

Instrumentation for space weather monitoring

Solar Wind-Magnetosphere Interactions

Electrical Conductivity Tensor for Low and Mid-latitude Ionospheric Plasma

Osman Özcan [1], Ali Yeşil [2], Selçuk Sağir [1], Kadri Kurt [2]
[1] Muş Alparslan University, Department of Physics, Muş, Turkey
[2] Firat University, Department of Physics, Elazig, Turkey

In this study, the electrical conductivity (σ0,σ1,σ2 for steady-state case) for low and mid-latitude ionospheric plasma is investigated by taking the geometry of Earth s magnetic field as B=B0z, for both solstices of these two different latitudes ionospheric plasma. Examination is made for the altitudes (280, 300, 340, 390 and 410 km) where the observations are predominantly referenced to the equatorial anomaly. It shows that the conductivity values for the low latitudes are higher during daytime (12:00 LT) than at night (24:00 LT) both the days in June 21 and December 21. The electron density in the crest with conductivity values consists of the same latitudes (-100S, -150N) at 12:00 LT, while the conductivities show different behavior both for the days in June 21 and December 21 at 24:00 LT for the considered altitudes (280, 300, 340, 390 and 410 Km).

Observed Changes in Ionospheric foF2 Critical Frequency During the Earthquakes

Osman Özcan[1], Tuba Karaboga [1], Murut Canyilmaz [2]
[1]-Muş Alparslan University, Department of Physics, Muş, Turkey
[2]-Firat University, Department of Physics, Elazig, Turkey

In this study, the variations of the ionospheric F2 region critical frequency (foF2) have been investigated statistically before earthquakes during 1980-2008 periods in Japan area. Ionosonde data was taken from Kokubunji station (35.71oN, 139.49oE) which is in the earthquake preparation zone for all earthquakes. Standard Deviations and Inter-Quartile Range methods are applied to the foF2 data. It is observed that there are anomalous variations which were both positive and negative ways on the foF2 before earthquakes during the specified time periods. These variations can be regarded as ionospheric precursors and may be used for earthquake prediction.

Heliospheric Current Sheet as a Factor of Geomagnetic Activity Floor Variation

Asenovski S.
Space Research and Technology Institute, Bulgarian Academy of Sciences

Observable depressions of the Earth`s magnetic field, which are indicator for changes in the near-Earth space plasma parameters, are caused mainly by transient Interplanetary coronal mass ejections (ICME) and High speed solar wind streams (HSS). However, even in the absence of these two manifestations of the solar activity, when our planet `float` in the relatively `quiet` space, there are still geomagnetic disturbances. Most of the time during any 11-years solar cycle (SC), Kp is less than 5 which corresponds to non-geomagnetic storm conditions according NOAA Space Weather Scales. Considering the ICME and HSS free periods for the last four solar cycles, in this work it is shown that the role of heliospheric current sheet (HCS) in the geomagnetic activity `floor` is significant, especially during solar minima, when almost all the time the Earth is shielded by it.

The Variation Depending on Solar Parameters of Electrical Conductivity Tensor at Mid-latitude Ionosphere

Ramazan Atici [1], Selçuk Sağir [1], Ali Yeşil [2], Hafız Alisoy [3]
[1] Mus Alparslan University, departmen of physics
[2] Firat University, Department of physics
[3] Tekirdag University, Deparment of physics

In the present study, the variation with solar indexes of electrical or classical conductivity tensor (AC and DC) calculated for 340 km altitude at the mid-latitude ionosphere was investigated. The changes occurred on March equinox and for universal time (UT) 12:00 and 24:00 were separately considered. For UT 12:00, while the Sigma 2 AC conductivity was positive relationship during all month except for last quarter, Sigma 0 and Sigma 1 AC conductivities had an inverse relationship at the same time. However, DC conductivities were negative relationship with solar indexes. For UT 24:00, in the case of both conductivities (AC and DC) were not observed any relationship between variables.

The Investigation of Relationship Between Solar Parameters and Total Electron Contect Models at Mid-latitude

Ramazan Atici [1], Selçuk Sağir [1]
[1] Muş Alparslan University, TURKEY

In this study, it is examined the relationship with solar parameters (F10.7 index, proton density and proton speed) of the TEC values obtained from IONOLAB and IRI-2012 models during equinox months (March and September) of 2009 at mid-latitude region. It is observed that the IONOLAB-TEC values are higher than IRI-2012 TEC values on both equinox months. Also, IONOLAB-TEC values on September 2009 are greater than ones on March 2009. When compored to the tho models, we concluded that IONOLAB model is more sensitive than IRI-2012 model to the changes occurring in the sun at mid-latitute.

Effects of the Geomagnetic Storm and the Solar Eclipse Observed During March 2015.

J.Boska, P.Koucka Knizova, D.Kouba, Z.Mosna, K.Potužníková.
Institute of Atmospheric Physics, Boční II/1401, Prague 4 , 141031, Czech Republic

During March 2015 two significant events strongly disturbed the state of the ionosphere over Central Europe. Strong geomagnetic storm with Kp - 8 and DST - 223 started 17.3.2015. During the recovery phase of this storm the second significant event Solar eclipse 20.3.2015 strongly affected the state of the ionosphere above Europe.

Paper presents changes of the state of the ionosphere observed during geomagnetic storm 17.3.2015 and Solar eclipse 20.3.2015 as was observed at ionospheric observatory Pruhonice.

Digisonde DPS4 D, installed at the Pruhonice observatory, allow standard ionospheric vertical sounding measurements. Digisonde DPS4 D is also working as Doppler radar and allow ionospheric drift measurements. Ionospheric vertical sounding and drift velocity was measured with standard delay time 15 minutes during geomagnetic storm. Solar eclipse 20.3.2015 above Pruhonice started 08:36 UT and finished 10:45 UT with magnitude 0.743.

Ionospheric vertical sounding data and drift velocity measurements with delay time 3 minutes was measured during eclipse event. Tis time resolution allow observation short time changes of the inosphere during eclipse event.

Large Scale Zonal Flow Generation by ULF Modes in Shear Flow Driven Ionosphere

Chargazia k., Kharshiladze O.
I. Javakhishvili Tbilisi State University

In the work the features of generation of the large scale flows in the ionosphere on the background of inhomogeneous non-stationary winds is considered. From the equation of magnetized (modified by the geomagnetic field) Rossby type waves using multi-scale expansion the nonlinear equation of interaction of amplitudes of five different scale modes is obtained. These modes are: ultra low frequency (ULF) primary magnetized Rossby wave, its two satellites, long wavelength zonal mode and large scale background mode (inhomogeneous wind). The effects of nonlinearities (scalar, vector) in formation of the large scale zonal flows by magnetized Rossby waves with finite amplitudes in the dissipative ionosphere is studied. In this case modified parametric approach is used. On the basis of theoretical and numerical analysis of the corresponding system (generalized problem on the eigen values) the new features of energy pumping from comparably small scale ULF magnetized Rossby wave and the background flow into the large scale zonal flows and nonlinear self-organization of collective activity of above mentioned five modes in the ionosphere medium is revealed. Generation of the zonal flow is caused by the Reinolds stress of the magnetized Rossby wave with finite amplitude and effect of the background shear flow. It is shown, that amplitude of the background flow affects the increment of modulation instability and the zonal flow generation. The satellite observation data is also analyzed by means of linear and nonlinear methods.

Auroral, Geomagnetic, and Ionospheric Disturbances During St. Patrick`s Day Geomagnetic Storms in 2013 and 2015

Klimenko M.[1], [2], Klimenko V.[1], Despirak I.[3], Ratovsky K.[4], Zakharenkova I.[1], Korenkova N.[1], Kozelov B.[3]
[1] West Department of Pushkov IZMIRAN, RAS, Kaliningrad, Russia
[2] Immanuel Kant Baltic Federal University, Kaliningrad, Russia
[3] Polar Geophysical Institute, RAS, Apatity, Russia
[4] Institute of Solar-Terrestrial Physics, SB RAS, Irkutsk, Russia

This study presents an analysis of the satellite-borne and ground-based observations of the geomagnetic disturbances and ionospheric electron density distribution during two St. Patrick`s Day geomagnetic storms on March 17, 2013 and 2015. The first event on March 17, 2015 is the principal event covering the interval from 15 to 18 March 2015, in which solar eruptive phenomena (a long-enduring C9-class solar flare and associated CME(s) on 15 March) and a strong geomagnetic storm on 16-18 March (Dst was -228 nT) were reported. This magnetic storm was the largest one observed in the current solar cycle. The second event is the period on 17-18 March 2013 which was strong geomagnetic storm (the Dst index ~ -140 nT) developed. This storm was caused by magnetic cloud in the solar wind. Solar wind and interplanetary magnetic field parameters were taken from OMNI data base. The magnetograms of the IMAGE network and Observations of the Multiscale Aurora Imaging Network (MAIN) in Apatity were used as indicator of auroral activity. Both of these storms characterized by the same moment of storm sudden commencement (SSC), but 2015 geomagnetic storm had much greater magnetospheric input into thermosphere-ionosphere system. We paid the particular attention to the ionospheric disturbances during the main and recovery phase of geomagnetic storms. The Global Self-consistent Model of the Thermosphere, Ionosphere and Protonosphere (GSM TIP) allows us to reveal the main processes that influence on the behavior of the total electron content and the F2 layer peak electron density during these storm events.

Magnetic Substorms of Different Types During the 23 and 24 Solar Cycles

Despirak I.V.[1], Lubchich A.A.[1], Kleimenova N.G.[2]
[1] Polar Geophysical Institute RAS, Apatity, Russia
[2] Schmidt Institute of the Physics of the Earth RAS, Moscow, Russia

On the base of the IMAGE magnetometers data, and the OMNI solar wind and interplanetary magnetic field (IMF) data, we have analyzed the occurrence of the magnetic substorms during the 23-th and 24-th solar cycles. All considered substorms were divided into 3 types according to their location in relation to the auroral oval dynamics. The first type- the substorms which are observed only at the auroral latitudes (called `usual` substorms); the second type- the substorms which propagate from the auroral geomagnetic latitudes to the polar ones (called `expanded` substorms, according to an expanded oval dynamics); and the third type- the substorms which are observed only at the geomagnetic latitudes above ~70 degrees in the absence of simultaneous magnetic disturbances below 70 degrees (called `polar` substorms, according to a contracted oval dynamics). We have analyzed the space weather conditions before the onset of these three types of substorms. Namely, we have considered the influence of the different types of the solar wind streams, of the magnetic storm intensity (or the non-storm conditions), of the geomagnetic indexes values etc. The substorm seasonal variations have been studied as well. It was found that although `polar` and `expanded` substorms observed at almost identical high geomagnetic latitudes, they appear under different space weather conditions. We argue that the space weather conditions differ for different types of the considered substorms and could be a useful tool for the investigation of the various magnetospheric plasma processes (or their location) caused these substorms.

Phase Fluctuations of GPS Signals and Auroral Activity During 17 March 2015 Geomagnetic Storm

Shagimuratov I.I.[1], Chernouss S.A.[2], Filatov M.V.[2], Efishov I.I.[1], Despirak I.V.[2]
[1] West Department of IZMIRAN, Kaliningrad, Russia
[2] Polar Geophysical Institute RAS, Apatity, Russia

We analysed space weather conditions during 15-17 Mach 2015 storm. Dual-frequency GPS measurements for individual satellite passes served as raw data. The rate of TEC (ROT) fluctuation activity measured. The data of GPS stations spaced in latitudinal range 67-50 degrees of latitudes over longitude of 20 degrees were involved in this investigation. Observations of aurora were conducted in Lovozero, in Apatity and Sankt-Petersburg. The magnetograms of the IMAGE network and geomagnetic pulsations at the Lovozero and Sodankyla were used as indicator of auroral activity. It was found good similarities between temporary development of substorm activity and intensity of TEC fluctuations. The best correlation of GPS data and optical and magnetic disturbances was achieved during this storm. The intensity of TEC fluctuations during magnetic bay decreased from north to south. Some features of the strong geomagnetic storm coincided with the TEC fluctuations in time. Based on the daily GPS measurements from 130-150 selected stations, the images of spatial distribution of TEC fluctuations (index ROTI) in CGL and MLT coordinates were constructed. These images demonstrate the irregularities oval, which was comparing with the auroral oval model. During the storm the auroral and irregularities oval moved to equator. The analysis shown that the high latitude phase fluctuations of GPS signals is very sensitive to change of auroral activity and can use as indicator of space weather conditions. We thank the Institutes who maintain the IMAGE Magnetometer Array, Grant of RFBR 14-05-98820 r-sever-a and PRAN (program N 7).

Substorms over Apatity During 2014/2015 Observational Season

Guineva V.[1], Despirak I.V.[2], Kozelov B.V.[2]
[1] Space Research and Technology Institute (SRTI), Stara Zagora Department, BAS
[2] Polar Geophysical Institute (PGI), Apatity, Russia

In this work we studied substorms, originated during the 2014/2015 season. Observations of the Multiscale Aurora Imaging Network (MAIN) in Apatity have been used. Solar wind and interplanetary magnetic field parameters were estimated by the 1-min sampled OMNI data base. Substorm onset and further development were verified by the 10-s sampled data of IMAGE magnetometers and by data of the all-sky camera at Apatity. Subject of the study were the peculiarities in the development of substorms occurred during different geomagnetic conditions. The behavior of the substorms developed in non-storm time and during different phases of geomagnetic storms was discussed.

Basic Results from the Scanning Spectrophotometer "EMO-5" on Board "IC Bulgaria-1300"

Guineva V., Stoeva P.
Space Research and Technology Institute (SRTI), Stara Zagora Department, BAS

The basic results from EMO-5 on board Bulgaria-1300 are summarized. EMO-5 consists of two photometric systems: filter system (SF) measuring the intensities of 5577Å, 6300 Å, 4278 Å, 4861Å and 7320 Å emissions in the foot point every 16 s., and spatial scanning system (SS) registering the 6300 Å intensity. The auroral oval and polar cap boundaries and their locations under different geomagnetic conditions have been defined by optical and energetic particles data. The average ratios of the optical emissions in the auroral oval zones and in the polar cap at different conditions have been analyzed. The conditions of appearance of SAR arcs, their structure and their geographical distribution have been studied. The seasonal and daily variations of I6300 emission in the equatorial F-region have been examined.

Signature of a Possible Relationship Between the Maximum CME Speed Index and the Critical Frequencies of the F1 and F2 Ionospheric Layers: Data Analysis for a Midlatitude Ionospher

Kilcik A.[1], Ozguc A.[2], Yiğit E.[3], Yurchyshyn V.[4, 5], Donmez B.[1]
[1] Akdeniz University, Department of Space Sciences and Technologies, Turkey
[2] Kandilli Observatory, Bogazici University, Istanbul, Turkey
[3] George Mason University, Space Weather Laboratory, Fairfax, USA
[4] Big Bear Solar Observatory, Big Bear City, USA
[5] Korea Astronomy and Space Science Institute, Daejeon, Korea

We analyze temporal variations of two solar indices, the monthly mean Maximum CME Speed Index (MCMESI) and the International Sunspot Number (ISSN) as well as the monthly median ionospheric critical frequencies (foF1, and foF2) for the time period of 1996□2013, which covers the entire solar cycle 23 and the ascending branch of the cycle 24. We found that the maximum of foF1 and foF2 occurred respectively during the first and second maximum of the ISSN solar activity index in the solar cycle 23. We ompared these data sets by using the cross-correlation and hysteresis analysis and found that both foF1 and foF2 show higher correlation with ISSN than the MCMESI during the investigated time period, but when significance levels are considered correlation coefficients between the same indices become comparable. Cross-correlation analysis showed that the agreement between these data sets (solar

indices and ionospheric critical frequencies) is better pronounced during the ascending phases of solar cycles, while they display significant deviations during the descending phase. We conclude that there exists a signature of a possible relationship between MCMESI and foF1 and foF2, which means that MCMESI could be used as a possible indicator of solar and geomagnetic activity, even though other investigations are needed.

Pre-earthquake Variations of Some Geophysical Parameters in Solar and Magnetically Quiet Periods

N.A.Kilifarska[1], R.N.Nedialkov[2], Ts.Velichkova[1]
[1]National Institute of Geophysics, Geodesy and Geography, Bulgarian Acad. of Sci,
[2] Faculty of Geology and Geography, Sofia University

The variability of near surface temperatures (T) and geomagnetic field prior to 1039 earthquakes (EQ) - occurred in the area 8˚-30˚ E longitude and 35˚-53˚ N latitude, during the period 2004-2014 - have been studied. After the exclusion of solar/magnetospheric influence from the time series, we found a statistically significant (at 2σ level): (i.) decrease in the mean values of geomagnetic Y-component diurnal amplitude, and (ii.) increase of the mean surface air temperature during the week prior to EQ.

Moreover, analysis of the spatial distribution of pre-EQ anomalies in geomagnetic and temperature field reveals their systematic synchronous variations. Thus in regions with positive magnetic anomalies (like Balkans, Aegean Sea and Anatolia) we found a pronounced negative anomalies in near surface temperature, while in regions with reduced diurnal magnetic Y-amplitudes (i.e. negative anomalies) - such as Tyrrhenian Sea, Apennines and Dinarides - positive pre-EQ temperature anomalies are detected. This similarity reasonably suggest that pre-EQ changes of geomagnetic field - generated supposedly by the rocks re-magnetization or demagnetization, when accumulated stress and strains approach the structural failure at the vicinity of a future EQ - are somehow transposed to the corresponding changes of near surface T. A mechanism connecting geomagnetic field to the surface T variations, as well as statistical evidences supporting it, are also presented in this paper.

Temporal Behaviour of Daytime VLF Emissions Caused by the Solar Wind and IMF Disturbances: a Case Study

Manninen J.[1], Kleimenova N.G.[2], Turunen T.[1], Gromova L.I.[3]
[1] SGO, Sodankyla, Finland; [2] IFZ RAS, Moscow, Russia; [3] IZMIRAN, Moscow, Russia

The analysis of the temporal variations of the daytime 1-6 kHz VLF emissions was made during moderate magnetic storm (Dst~70 nT, Kp=6) on 8 December 2013. The VLF emissions were recorded in the frequency band of 0.2÷39 kHz during the dark winter at Kannuslehto (KAN, L~ 5.5) in Northern Finland. The analysis results were compared with simultaneous variations in the solar wind and Interplanetary Magnetic Field (IMF). It was found that the intense VLF hiss emissions started after the solar wind dynamic pressure jump (from 7 to 12 nPa) under the positive IMF Bz. The VLF emissions occurred in two different frequency bands. The lower frequency (below ~2 kHz) band represents the strong long lasting right-handed polarized hiss, and the upper frequency band (above ~2 kHz) - the left-handed polarized hiss bursts with duration of about 1 hour. The plasmasphere was strongly compressed, and at that time KAN was mapped outside of the plasmapause. We suppose that VLF hiss emissions have been exited in the magnetosphere by the cyclotron instability of the radiation belt electrons. The lower frequency hiss was generated outside of the plasmapause and arrived to KAN along the meridional direction. The high-frequency band was generated inside of the plasmasphere arriving to KAN almost along the longitude. The opposite VLF emission dynamics, namely, the wave suppression, was revealed in association with sudden drop of the solar wind dynamic pressure.

High-latitude Geomagnetic Effects of Strong Positive IMF Bz: Case Study

Gromova L.I.[1], Kleimenova N.G.[2], [3], Levitin A.E.[1], Dremukhina L.A.[1], Antonova E.E.[3], [4], Gromov S.V.[1]
[1] IZMIRAN, Moscow; [2] IFZ RAN, Moscow; [3] IKI, Moscow, [4] SINP MSU, Moscow

Solar wind-magnetosphere interaction manifests in a magnetic storms occurrence. Solar wind energy storages in the magnetosphere under negative IMF Bz and disappears under positive IMF Bz.

We present unusual negative magnetic bay-like disturbances occurred in the dayside sector of the Earth at the polar geomagnetic latitudes under positive IMF Bz during main phase of the storm on Nov 24, 2001 and recovery phase of the storm of May 30, 2003. We supposed that development of these dayside polar substorms could be a response of the magnetosphere to high positive values of the IMF Bz occurrence. The dayside polar magnetic substorms were observed in the polar region where the specific system (NBZ) of field-aligned currents, caused by the positive IMF Bz, may be enhanced. Our vector construction of geomagnetic data (Scandinavian magnetometer chain IMAGE) showed the clockwise vortex in the first event. In the second event, we detected two opposing vortices, which could be a proxy of an intensification of upward and downward field-aligned currents. Our IZMIRAN model estimations as well as the simultaneous DMSP and CHAMP satellites data support this assumption. According to OVATION model, the IMAGE polar stations where these dayside polar magnetic substorms developing, were located in the dayside auroral oval, i.e. inside the closed magnetosphere.

Study of Electromagnetic Parameters of Space Weather in the ionosphere. Projects: Chibis-M, Obstanovka (1 stage), Vernov.

Klimov S.[1], Kirov B.[2], Ferencz Cs.[3], Korepanov V.[4]
[1] Space Research Institute of the RAS
[2] Space Research and Technology Institute of the BAS
[3] Eötvös University, Budapest
[4] Lviv Centre of Institute of Space Research

The investigation and monitoring of the electromagnetic environment (ionospheric parameters, VLF natural signal intensity, Schumann resonance intensity) of the Earth and the Earth-like planets is of great importance, because it opens the door for the comparative study of these planets, their evolution and actual state. Large amount of archived satellite data gathered during earlier missions are successfully integrated in various models of the upper atmosphere and ionosphere. New data mining techniques form the base of the idea of the Ionosphere Waves Service (IWS) developed in the frame of the FP7 POPDAT project (http://popdat.cbk.waw.pl) and opened for public access to assist the ionosphere and Space Weather (SW) research. The following questions should be answered: How can the data of earlier ionospheric missions be reprocessed with current algorithms to gain more profitable results? How could the scientific community be provided with a new insight on wave processes that take place in the ionosphere?

Here we demonstrate how we can include in the IWS configuration new data from the projects Chibis-M (2012-2014), Obstanovka 1 stage (2013-2014), Vernov (2014). This will provide an opportunity to investigate how short-period and 11-year variations of ionospheric electromagnetic parameters of space weather, ensure high spectral - temporal resolution, and significantly widen the range of research of electromagnetic parameters of space weather.

Ionospheric Vertical Drift Response at a Mid-latitude Station

Kouba, D., Koucka-Knizova, P.
Institute of Atmospheric Physics Czech Academy of Sciences, Prague, Czech Republic

Vertical plasma drift data measured at a mid-latitude ionospheric station Pruhonice (50,0N, 14,6E) were collected and analysed for the year 2006, a year of low solar and geomagnetic activity. Hence these data provide insight into the drift behaviour during quiet conditions. The following typical diurnal trend is evident: a significant decay to negative values at dawn; generally less pronounced negative peak at dusk hours. During daytime the vertical velocity rises from small negative values in the morning through zero around noon to small positive values in the afternoon. Nigh-time values display large variability without a regular pattern. All the characteristics of the drift behaviour are analysed with respect to seasons.

Variability of Ionospheric Parameters During Last Two Solar Cycles

Petra Koucka-Knizova [1], Zbysek Mosna [1], Katya Georgieva [2], Boian Kirov [2]
[1] Institute of Atmospheric Physics ASCR, Prague
[2] Space research and Technology Institute - BAS

Ionosphere is highly variable system that reflects both the influence of the solar and geomagnetic activity from above and neutral atmosphere from below. The response of the ionosphere varies during the solar cycle and from one cycle to the subsequent. We look at the statistical properties of the ionospheric data with respect to the phases of the solar cycle. By mean of the Wavelet Transform (CWT, XWT, WTC) we analyse coherency with solar and neutral atmosphere parameters. Study involves ionospheric data from several European stations (critical frequencies, plasma drifts), stratospheric data, geomagnetic data together with solar indices. The main goal of the study is to analyse in detail ionospheric response to the solar forcing during last exceptional low solar minimum.

March 15-17, 2015 Event and Turbulence of Middle-latitude Ionosphere

Lytvynenko O., Derevyagin V., Panishko S., Lytvynenko I.
Institute of Radio Astronomy of NASU

On March 15th, 2015 at 02:13 UTC occurred long strong solar flare (C9), which caused a CME which included Earth directed component. Its speed exceeded 500 km / s. On March 17th at 04:35 shock wave reached the Earth, interplanetary magnetic field had northern component and significant geomagnetic disturbance was not expected. Later northern component was changed to the south component. As a result, there was a largest geomagnetic storm and radiation belt storm in the solar cycle 24. In this report, we consider how this event affected the ionospheric turbulence. The extent of turbulence can be characterized by the intensity of the scintillation of radio emission compact cosmic radio sources, which is recorded on the Earth`s surface. In the spring of 2015 the radio telescope URAN-4, located near Odessa (Ukraine), carried out such measurements in the HF radio band. Sequence of the ionospheric scintillation data, including the period of March 15-17, 2015 Event was received. It is possible to study the ionosphere response. This made it possible to investigate the ionosphere response. The result of the reaction of the ionosphere, we compared the reaction to other ICME, which occurred on the decline of the solar cycle 24 and not caused such strong geomagnetic disturbances.

IONOLAB and Digisonde Derived Ionospheric Characteristics During Geomagnetically Disturbed Periods

Mosna Z.[1], Koucka Knizova P.[1], Kouba, D.[1], Rejfek L.[1], Arikan F.[2], Toker C.[2], Sezen U.[2], Koroglu O.[2], Gok G.[3], Arikan O.[3], Gulyaeva T.[4]
[1] IAP, CAS; [2] Hacettepe University, Ankara, Turkey;
[3] Bilkent University, Turkey; [4] IZMIRAN, Troitsk, Russia

Continuous monitoring and investigation of the ionosphere is important part of Space Weather research as the ionosphere affects heavily the communication, remote sensing, and navigation systems. Among the most important factors that force the ionosphere are solar and geomagnetic activity. The ionosphere can be described by means of electron densityprofile and derived parameters (total electron content, critical frequencies, height of layers). Ground measurement of the ionosphere is provided routinely by the network of ionosondes/Digisondes. The GPS based techniques and empirical models (namely IRI-Plas) were used by the IONOLAB group to recover electron density profiles using the computerized Ionospheric Tomography (CIT). The data were obtained from databases www.izmiran.ru/ionosphere/weather/, IONOLAB web page www.ionolab.org, GIM ftp://cddis.gsfc.nasa.gov/gps/products/ionex/, DIDB and spidr.ngdc.noaa.gov/spidr/. We compare the ionospheric characteristics from periods of enhanced geomagnetic activity at the sites of European midlatitude Digisonde measurement, and GPS based technique using the IONOLAB-TEC model. These results are compared with the results from quiet preference periods of low geomagnetic activity. The work was supported by a Joint project T?BITAK 114E092 and AS CR 14/001, and Grant GA15-24688S.

About Quasi-periodic Changes in Solar and Geomagnetic Indexes and Their Influence on the Drag Dynamics of Earth Artificial Satellites

Ryabov M.I.[1]., Sukharev A.L.[1], Komendant V.H.[2], Koshkin N.I.[3]
[1]Odessa observatory Uran-4 Institute of Radio Astronomy NASU
[2] Astronomy Department of Odessa I.I.Mechnikov National University
[3] Astronomical observatory of Odessa I.I.Mechnikov National University

The time-frequency analysis of the orbital parameter characterizing the drag of satellites on circular and elliptical orbits with different perigees and orbital inclinations in the atmosphere of the Earth was being conducted in 23-24 cycles of solar activity. Among the factors influencing braking dynamics of satellites were taken: W - Wolf numbers; Sp - the total area of sunspot groups of the northern and southern hemispheres of the Sun, F10.7 - the solar radio flux at 10,7 cm; E - electron flux with energies more than 0,6 MeV MeV; planetary, high latitude and middle latitude geomagnetic index Ap. In the atmospheric drag dynamics of satellites, the following periods were detected: 6-year, 2.1-year, annual, semi-annual, 27-days, 13- and 11-days. Similar periods are identified in indexes of solar and geomagnetic activity. Dependence of the periods of satellites drag on extremes of solar activities and space weather conditions was conducted.

The Characterization of the Thermal Conductivity in the Equatorial Anomaly Region

Selçuk Sağir [1], Kadri Kurt [2], Ali Yeşil [2],
[1] Muş Alparslan University, Department of Physics, Muş, Turkey
[2] Firat University, Department of Physics, Elazig, Turkey

In this study, the relationship between the classical thermal conductivity (λ0, λ1, λ2 for steady-state case) and the equatorial anomaly is investigated by taking (the geometry of Earth s magnetic field as $B=B_{0z}$ for both solstices of these two different latitudes ionospheric plasma. A relationship is examined for altitudes (280, 300, 340, 390 and 410 km) where the observations are predominantly referenced to the equatorial anomaly. It is seen that calculated value at 12.00 LT is greater than 24.00 LT for both solstice seasons. The most convenient behavior to the seasonal anomaly is observed for the thermal conductivity coefficient only for 24:00 LT at λ 1. For the other thermal conductivity coefficients and both hours apart from this wavelength, we do not observe such convenient behaviors to the seasonal anomaly.

Character of Appearance of the Main Periods of Geomagnetic Field Variations in the 24th Cycle of Solar Activity According to Digital Recording in Kiev and Odessa.

Sukharev A.[1], Ryabov M.[1], Orlyuk M.[2], Romenets A.[2], Sobitnyak L.[1]
[1] Observatory `URAN-4`, Institute of Radio Astronomy NAS of Ukraine
[2] Institute of Geophysics NAS of Ukraine

Based on data analysis of digital recording variations of the geomagnetic field induction vector, obtained by magnetic observatories near cities Kiev and Odessa, defined basic periods of their changes in the 24th cycle of solar activity. According to data of `Kiev` station we identified periods: 24, 12, 8, 6 hours. According to data of `Odessa` stations the periods are: 24, 12, 8, 6, 5, 4 hours. Temporal characteristics of these periods and their different appearance with presence of magnetic anomalies (Odessa), and in its absence (Kiev) were investigated. The response to impact of changes in space weather was determined by the change in the spectrum of periods and amplitude characteristics. The review of the phase and amplitude characteristics in dynamics evolution of magnetic storms in the two regions was performed. A comparison between periods of the geomagnetic field and the solar cycle indices was made.

The Behavior of the Classical Diffusion Tensor for Mid-latitude Ionospheric Plasma

Ali Yeşil [1], Selçuk Sağir [2], Kadri Kurt [1]
[1] Firat University, Department of Physics, Elazig, Turkey
[2] Muş Alparslan University, Department of Physics, Muş, Turkey

In this study, the relationship between the classical diffusion tensor (D0,D1,D2 for steady-state case) and the equatorial anomaly is investigated by taking the geometry of Earth s magnetic field as B=B0z for both solstices of these two different latitudes ionospheric plasma. Examination is made for the altitudes (280,300,340,390 and 410 km) where the observations are predominantly referenced to the equatorial anomaly. It is seen that calculated value at 12.00 LT is greater than 24.00 LT in both solstice seasons. This means that no anomaly is observed in the classical conductivity coefficient for the electron density at night. It is seen that all values are higher at 12:00 LT than the values at 24:00 LT for both solstices. This means that the classical conductivity relates with the night anomaly which is observed with the electron density.

Seasonal (winter) anomaly in the equatorial region (-100S, -150N) corresponds to 390 and 410 Km for D0, 280, 300 and 340 Km for D1 and similar condition to the seasonal anomaly for all altitudes for D2 (the measured values at 1221 are higher than the measured values at 621) at 12:00 LT. D0 and D2 values show seasonal anomaly for all altitudes while D1 does not show any values for any altitudes at 24:00 LT.

The Investigation of the Mid-latitude Electron Denstiy Trough by Using foF2 Data Taken from IRI and Ionosondes for Jeomagnetic Quiet Conditions

Ali Yeşil [1], Erdinc Timucin [2], İbrahim Unal [3]
[1] University of Fırat, Faculty Science, Department of Physics, Elazığ, Turkey
[2] Department of Physics, Faculty of Arts and Science, University of İnönü, Malatya, Turkey
[3] Faculty of Education, Department of Science Teaching, U. of İnönü, Malatya, Turkey

The mid-latitude electron density trough is the ionospheric projection of the magnetospheric plasmapause and is the main gross feature of the ionosphere between 40 and 60 invariant magnetic latitude (Λ). The trough marks the region where the electron density decreases abruptly and unpredictably. The unpredictable variability and the electron density depletion in the trough region greatly limit the efficiency of the operations of communication, radar and navigation systems which employ HF radio waves and reduce the maximum usable frequency that can be reflected by the ionosphere along the great circle. Therefore, it is essential to understand the role of the trough in ionospheric variability. The variation according to invariant magnetic latitude of the ionospheric critical frequency (foF2) data that are taken from ionosondes are situated at between 40o and 70o Λ of north hemisphere and IRI during June and December Solstice of 1972 for geomagnetic quiet (Kp<=2+) conditions have been investigated. The results have been compared with electron density data obtained by Ariel-3 satellite at ~ 550 km. Thus, it will be made a better description and prediction of the mid-latitude trough features in the ionospheric F2 peak heights by using results that obtained from variation according to invariant magnetic latitude of electron density for different altitudes.

Sun and Solar Activity

A Statistical Analysis of Solar Surface Indices through the Solar Activity Cycles 21-23

Goker U.D.[1], *Singh J.*[2], *Nutku F.*[3], *Priyal M.*[2]
[1] Physics Department, Bogazici University, Istanbul, Turkey;
[2] Indian Institute of Astrophysics, Koramangala, Bengaluru, India;
[3] Department of Physics, Faculty of Science, Istanbul University, Turkey

Variations of total solar irradiance (TSI), magnetic field, Ca II K-flux, faculae and plage areas due to the number and the type of sunspots/sunspot groups (SGs) are well established by using ground based data from various centers such as Solar Irradiance Platform, Stanford Data (SFO), Kodaikanal data (KKL) and National Geographical Data Center (NGDC) Homepage, respectively. We applied time series analysis for extracting the data over the descending phases of solar activity cycles (SACs) 21, 22 and 23, and the ascending phases 22 and 23 of SACs, and analyzed the selected data using the Python programming language. Our detailed analysis results suggest that there is a stronger correlation between solar surface indices and the changes in the relative portion of the small and large SGs. This somewhat unexpected finding suggest that plage regions decreased in a lower values in spite of the higher number of large SGs in SAC 23 while Ca II K-flux did not decrease by large amount or it was comparable with SAC 22 for some years and relates with C type and DEF type SGs. Thus, increase of facular areas which are influenced by large SGs caused a small percentage decrease in TSI while decrement of plage areas triggered a higher decrease in the flux of magnetic field. Our results thus reveal the potential of such detailed comparison of SG analysis with solar surface indices for understanding and predicting future trends in the SAC.

The Investigations of the Interplanetary Scintillations at Decameter Wavelengths: the Present State and Perspectives.

Kalinichenko N.N. [1], *Konovalenko A.A.* [1], *Brazhenko A.I.* [2], *Ivantishin O.L.* [3], *Lytvynenko O.A.* [1], *Olyak M.R.* [1], *Bubnov I.N.* [1], *Yerin S.N.* [1]
[1] Institute of Radio astronomy of NAS of Ukraine, Kharkiv, Ukraine
[2] Poltava Gravimetrical Observatory of the IGP of the NASU, Poltava, Ukraine
[3] Karpenko Physico-Mechanical Institute of the NASU, Lviv, Ukraine

The IPS observations at decameter wavelengths have a large potential. They allow the parameters and dynamic of the solar wind to be determined as at the small and large solar elongations (up to 180 degrees). Since 80s such observations have been carried out with the URAN radio telescope system (including the largest in the world decameter radio telescope UTR-2, the frequency range 8- 32 MHz), Ukraine. The report describes the present state of the IPS investigations at decameter wavelengths, equipment and methods using for observations and data processing. We discuss some interesting results devoted to long term monitoring of the solar wind parameters beyond Earth`s orbit, founding large scale disturbances associated with active processes at the Sun etc. Also we describe perspectives of IPS observations at decameter wavelengths for Heliosphere studies.

Solar and Geomagnetic Activity Relation for the Last Two Solar Cycles

Kilcik A[1], Yiğit E.[2], Yurchyshyn V.[3,4], Ozguc A.[5], Rozelot JP.[6]
[1] Akdeniz University Faculty of Science, Antalya, Turkey
[2] George Mason University, Space Weather Laboratory, Fairfax VA, USA
[3] Big Bear Solar Observatory, Big Bear City, CA, USA
[4] Korea Astronomy and Space Science Institute, Daejeon, South Korea
[5] Kandilli Observatory, Bogazici University, Istanbul, Turkey
[6] Nice University (OCA), Bvd. de l'Observatoire, France

The long-term relationship between solar (sunspot counts in different Zurich sunspot groups, International Sunspot Number (ISSN)), solar wind, and X-Ray solar flare index and geomagnetic indices (Ap and Dst) is investigated. Data sets used in this study cover a time period from 1996 to 2015. Our main findings are as follows: 1) The best correlation between the sunspot counts and the Ap and Dst indices are obtained for the large group time series, while the other categories exhibited lower (final and medium) or no correlation at all (small. 2) The magnitude of all solar and geomagnetic indices (except the solar wind speed) has significantly decreased during the current solar cycle as compared to the same phase of the previous cycle.

About the Regionality of Climate Variations and Their Explanation

N.A.Killifarska
National Institute of Geophysics, Geodesy and Geography, Sofia, Bulgaria

For more than 15 years the raise of the surface temperature is terminated. This fact raises the doubts about the decisive role of increased greenhouse gases concentrations in recent climate warming. On the other hand, the systematically enhanced water vapour density in the upper troposphere – predicted by the climate models – contradicts to the real measurements. Consequently, the other assumption that higher atmospheric humidity (resulting from the increased surface temperature) reinforces the initial warming from the increased carbon dioxide density is also quite suspicious.

We have shown that the amount of water vapour in the upper troposphere is actually determined by the lower stratospheric ozone density, controlling itself the tropopause temperature and static stability of air masses in the upper troposphere. The amount of ozone, in turn, is strongly influenced by the energetic particles precipitating in the Earth atmosphere. Being modulated by the heterogeneous geomagnetic field, particles effect on the ozone in both hemispheres is different, what reflects in the hemispherical and regional irregularities of ozone and water vapour spatial distribution. Due to the fact that upper tropospheric water vapour ensures more 90% of the greenhouse power of the water vapour content, the regional character of climate variations becomes easily understandable in the light of the concept for ozone-water vapour influence on climate variability.

Interferometer Observations of Solar Type III Bursts by the Radio Telescope UTR-2

Melnik V.[1], Shepelev V.[1], Brazhenko A.[2], Dorovskyy V.[1], Rucker H.[3], Poedts S.[4]
[1] Institute of Radio Astronomy, Kharkov, Ukraine
[2] Institute of Geophysics, Gravimetrical Observatory, Poltava, Ukraine
[3] Commission for Astronomy, Graz, Austria
[4] Catholic University of Leuven, Leuven, Belgium

Results of solar radio emission observations by the radio telescopes UTR-2 (Kharkiv, Ukraine) and URAN-2 (Poltava, Ukraine) on 29 May 2014 are discussed. Observations by the radio telescope UTR-2 were carried out in the interferometer regime using West-East arm of the UTR-2 with bases 225m, 450m and 675m at frequencies 20 MHz and 25 MHz. This day simple type III bursts and groups of type III bursts were observed against type IV burst. Analysis of visibility functions of radio emission sources at these frequencies was allowed to find spatial sizes of bursts sources, which changed from 9` to 36` at 25 MHz and from 12` to 44` at 20 MHz. Also sources distances at these frequencies were obtained. Radio emissions at frequencies 20 MHz and 25 MHz escaped at distances 2.9Rs and 2.6Rs, respectively. At these distances radio emissions at frequencies 10 MHz and 12.5 MHz are generated in the Newkirk corona so the observational radio emissions are the second harmonics. This fact is confirmed by the low polarizations of discussed type III bursts. Connections of frequency characteristics of type III bursts and their spatial properties obtained by interferometer method are discussed.

The On-line Catalog of Wind/EPACT Proton Events

Rositsa Miteva, Dimitar Danov
SRTI-BAS

We present the newly compiled proton event list using data by the Wind/EPACT instrument (as provided by the CDAWeb database). We visually scanned the proton data in the period 1996-2015 for enhancements in two energy channels ~25 and ~50 MeV. More than 300 events were identified and analyzed in each energy range: onset time, peak time and peak intensity are evaluated. In this report we describe the present status of the on-line catalog and discuss future additions.

The catalog is hosted by the Space Climate Group/Space Research and Technology Institute (Bulgarian Academy of Sciences) and will be regularly updated: http://www.stil.bas.bg/SEPcatalog/

MHD Simulations of Solar Flare and Comparison With X-ray Observations

Podgorny A.I.[1], Podgorny I.M.[2]
[1] Lebedev Physical Institute of the Russian Academy of Sciences;
[2] Institute of Astronomy of the Russian Academy of Sciences

It is impossible to define solar flares magnetic field dynamics in the solar corona using observations. For study solar flare mechanism the numerical MHD simulation is performed above the real active region. The aim of MHD simulation is to define the solar flare mechanism. No assumptions of flare mechanism are used for setting conditions of simulation. All conditions are taken from observations. The magnetic field distribution measured on the photosphere is used for setting boundary conditions. The electrodynamical model of solar flare is proposed basing on results of observations and numerical simulation. The model explains main observational flare manifestations. According to this model the primordial energy release takes place in the current sheet of the solar corona, where the source of soft X-ray emission appears.

The sources of hard X-ray emission appear in the places of intersection with the photosphere of magnetic lines entering from the current sheet. They appear due to interaction of electron beams with dense layers of the solar atmosphere. These beams appear in field-aligned currents, which are caused by the Hall electric field in the current sheet. The graphical system is developed that permits to find the position of the current sheet for the flare May 27, 2003 at 02:53 using calculated magnetic field. The current sheet position coincides with the observed position of the X-ray source. The strongly reduced time scale in the calculation led to the preliminary conclusion about beam origin of hard X-ray sources and its position on the photosphere.

Solar Cosmic Ray Generation by Solar Flares

Podgorny I.M.[1], *Podgorny A.I.*[2]
[1] Institute of Astronomy of the Russian Academy of Sciences;
[2] Lebedev Physical Institute of the Russian Academy of Sciences

Some solar flares are accompaniment by pulses of protons with the energy up to 20 GeV. The proton acceleration takes place during the magnetic reconnection at a solar flare. The duration of fast proton ejection from the Sun is ~10 min. It does not exceed time of a solar flare. But the duration of proton pulses arriving to the Earth orbit and measured with the GOES spacecraft is order of several days. This time is determined by solar wind flow and diffusion in the interplanetary space. Every proton flux is appeared after a big solar flare. The shape of the proton flux tail is not depended on the flare position, but the measured proton flux demonstrates two types of the front structure. The sharp front ~20 min appears at proton flux arriving from the flare appearing on the West side of the solar disk. The long front order of several hours is demonstrated the proton flux generated by eastern solar flares. The sharp front appears at particle traveling along magnetic line connecting the flare and the Earth. These particles arrive without Columbus scattering. They initiate the beam instability, and following particles are transported due to diffusion. The scattering initiate the change of the spectrum. The protons traveling across the magnetic lines arrive to the Earth orbit after the delay of 3 - 5 hours. It is much faster than the solar wind. One of possibility for such fast arriving is the turbulent diffusion.

About Hidden Properties of Solar Cycles and Need to Review Their Introductions.

Ryabov M.I [1]*., Sukharev A.L* [1]
[1] Odessa observatory URAN-4 Institute of Radio Astronomy NASU

Currently it is accepted that the introduction of solar cycles is on average monthly data and their smooth values for various indexes from the entire solar disk. This aggregate view creates an illusion of monotony of modify indexes on all phases of the solar cycle. Based on activity data of Northern (N) and Southern hemispheres (S) received by the method of wavelet analysis and Fourier filtering strip, the existence of `hidden` properties of solar cycles is shown, which were not previously accounted. We examined daily and monthly average indices of total area groups spots - SpN and SpS (1874-2016 years), Wolf numbers WN and WS (1940-2016 years), Flare index FN and FS (1966-2006 years). These indices are mutually complementary in introducing the power, the number of activity centres and flare processes. Among the detected differences in N and S cycles: time of the start and the end, properties of discreteness, the dynamics of the main periods, intervals of a coherent and joint time manifestation, time of maximum, spotless days interval, time of `crashing` and `synchronization`. It is shown that the degree of influence of N and S processes of solar activity on the Earth depends on its position on the orbit. There are periods of dominance of N or S activity and the time when they are acting simultaneously.The results obtained can be the basis for the prediction of the development of the solar cycles and the nature of the manifestations of the solar-terrestrial relationship.

Radio Emission of the Quiet Sun at Frequencies 20 MHz and 25 MHz According to Interferometer Observations by the Radio Telescope UTR-2

Shepeliev V.[1], Melnik V.[1], Brazhenko A.[2], Dorovskyy V.[1], Poedts S.[3], Rucker H.[4]
[1] Institute of Radio Astronomy, Kharkov, Ukraine
[2] Institute of Geophysics, Gravimetrical Observatory, Poltava, Ukraine
[3] Catholic University of Leuven, Leuven, Belgium
[4] Commission for Astronomy, Graz, Austria

Results of observations of the solar radio emission from 27 May to 2 June 2014 by the radio telescope UTR-2 (Kharkov, Ukraine) in the interferometric session at frequencies 20 and 25 MHz are presented. The interferometric measurements were accompanied with wide band observations in the range 8-33 MHz with the radio telescope URAN-2 (Poltava, Ukraine). The interferometers with baselines 225 m, 450 m, and 675 m were formed of sections of north-south and east-west antenna-arrays of the radio telescope UTR-2. There was just the day 29 May 2014, when strong sporadic radio emission consisting of type III, type II, and type IV bursts have been registered. On other days of the observational session there was no solar activity in the decameter range. Flux densities of such a quiet Sun were estimated to lie in the ranges 1050-1100 Jy and 1480-1570 Jy at 20 and 25 MHz, correspondingly. Angular sizes of the quiet Sun in the equatorial and the polar directions were 55` and 49` at 20 MHz and 50` and 42` at 25 MHz. Brightness temperatures of the radio emission turned out to be 5.1 10(5)K and 5.7 10(5)K at 20 and 25 MHz, respectively.

The Storm of Decameter Spikes During the Event of 14 June 2012

Shevchuk M.[12], Melnik V.[1], Poedts S.[2], Dorovskyy V.[1], Magdalenic J.[3], Konovalenko A.[1], Brazhenko A.[4], Briand C.[5], Frantsuzenko A.[4], Rucker H.O[6]
[1] Institute of Radio Astronomy, Kharkov, Ukraine
[2] Catholic University of Leuven, Leuven, Belgium
[4] Royal Observatory of Belgium, Brussels, Belgium
[5] Institute of Geophysics, Gravimetrical Observatory, Poltava, Ukraine
[3] Observatoire de Paris, Meudon, France
[6] Space Research Institute, Graz, Austria

The event observed on 14 June 2012 is discussed. Using spikes as a tool for diagnostics of coronal plasma parameters, we traced how the temperature and magnetic field changed during the day of observations.

Decameter Solar Drift-pair Bursts

Stanislavsky A.A., Konovalenko A.A., Koval A.A., Volvach Ya.S.
Institute of Radio Astronomy, 4 Chervonopraporna Str., Kharkiv 61002, Ukraine

In this consideration we give a new sight on the study of the solar bursts historically called drift pairs (DPs). Having a simple morphology on dynamic spectra of radio records (two narrow components separated in time, often the second component being the repetition of the first) and discovered at the dawn of radio astronomy, their features remain unexplained up to now. Generally, DPs are observed during the solar storms of type III bursts, but not every storm of type III bursts is associated with DPs. Detected by ground-based instruments at decameter and meter wavelengths, the DP bursts are limited in frequency bandwidth. They can drift from high frequencies to low ones and visa versa. Their frequency drift rate may be both lower and higher than typical rates of type III bursts at the same frequency range. The development of low-

frequency radio telescopes and data processing provide additional possibilities in the research. In this context the fresh observations of DPs, performed during the summer campaign of 2015, are just discussed. They were implemented by updated tools of the UTR-2 radio telescope at 9-33 MHz. This allows us to get a new information about such bursts in decameter wavelengths.

Characteristic of the Amount of Solar Energy Reaching the Earth`s Surface for Different Periods of Time in the Stara Zagora Region.

Tashev V.[1], Werner R.[1], Manev A.[1], Goranova M.[2]
[1]. Space Research and Technology Institute-BAS, Stara Zagora, Bulgaria.
[2]. Technical University of Sofia, Faculty of Computer Systems and Management.

The main source of solar energy falling on the Earth is the solar radiation. To measure the amount of solar energy use the data obtained from sensors solar radiation of the meteorological station Vantage Pro 2 Plus. The collected data from the sensors are integrated and recalculated in order to be obtained results for the solar energy that is absorbed for a certain period of time per unit Earth`s surface. The purpose of research is to trace how great is the repeatability during different periods. A high annual repetition provides a good opportunity to forecast energy yields in the coming years. The monitoring had been carried out for the region of Stara Zagora.

Properties of Long Drift-pair Bursts from Decameter Observations of 2015

Volvach Ya.S., Stanislavsky A.A., Konovalenko A.A., Koval A.A.
Institute of Radio Astronomy, 4 Chervonopraporna Str., Kharkiv, Ukraine

In this report we consider the drift-pair (DP) bursts forming the longest patterns on dynamic spectra obtained from the UTR-2 radio telescope observations at 9-33 MHz during 10-12 July of 2015. The experimental study was carried out with high time (50 ms) and frequency (4kHz) resolution. This set of DPs includes 7% of the total number of recorded DPs. Their patterns occupied about 8-15 MHz in the frequency band of this radio instrument. As a rule, the long DPs drifted from higher to lower frequencies (forward DPs) except for one reverse long DP, drifting from lower to higher frequencies. According to our observational data in July of 2015, the average frequency bandwidth was 3.6 MHz for forward DPs, whereas for reverse DPs it was 2.82 MHz. Our basic attention was focused on the frequency drift rates of the long bursts. Their propinquity with the S bursts is discussed.

Relationships in the System Disk – Corona

Yankova Kr.[1]
[1]. Space Research and Technology Institute (SRTI-BAS)

Modern astronomy is allowed to register quasars at the core of all known spiral galaxies, including our own: From some time there is a good trend to seek a unified model of AGN. Group of 140 (one hundred and forty) authors A. A. Abdo et al. 2009, started an observation program whose main conclusions are that no matter the host galaxy, a core is quasar and shows similar structure and the same mechanism of development. Differences in the observations are the result only of different levels of accretion, mass and direction monitoring.

In this paper will considering the structuring of the flow on the system disk - corona around the central black hole. We analyze the behaviour on the border between components. We discuss mechanism of development of the advective hypothesis in case of falling away some restrictions from the model.

Solar Influences on the Lower Atmosphere and Climate

Short-term Solar Activity Influence on Atmospheric Circulation

Asenovska Y, Georgieva K
Space Research and Technology Institute, Bulgarian Academy of Sciences

Most models for describing the solar activity influence on Earth`s atmosphere neglect the velocity, the density and the magnetic field of the solar wind. Our preliminary results based on the Northern Annular Mode (NAM) show that the solar torodial and poloidal magnetic fields affect the atmospheric circulation in a different manner. In this report the short-term (time scale of several days) influence of the solar activity on the weather in some regions on Earth is examined.

Role of Ionization Rates During Investigation of Atmospheric Response

Mironova I.A.
St.Petersburg State University, Institute of Physics, Earth Physics Department

This study deals with atmospheric species enhancements and subsequent ozone and temperature responses to the changes of the ionization rates induced by solar energetic particles. We focus on comparison between the observed and simulated results over the northern polar region, where Microwave Limb Sounder aboard (MLS) Aura satellite registered strong changed of chemical composition. For this study we performed long ten-member ensemble runs of the chemistry-climate model (CCM) SOCOL driven by the variable and constant daily ionization rates obtained by different scientific groups. The results of our study show that a new ionization rate model covering more wide energy range of precipitation particles is needed. In its turn observed odd hydrogen species can be good parameters to characterize the quality of the ionization rate data.

Investigation of the Temperature Dynamics in the Atmosphere of the Region of Stara Zagora

Tashev V.[1], Werner R.[1], Manev A.[1], Goranova M.[2], Shishkova A.[3]
[1] Space Research and Technology Institute- BAS, Stara Zagora, Bulgaria
[2] Technical University of Sofia, Faculty of Computer Systems and Management
[3] NIMH - Plovdiv Department, Bulgaria

The temperature of the atmosphere is determined by the difference of the amount of heat which heats the air and the amount of heat which cools the air. In this development is examined the thermal dynamics without taking into account the contributions of the individual factors. To trace the temperature variation using data obtained from sensors on weather station Vantage Pro 2 Plus. The data collected from the sensors are processed, averaged and ranked by hours, days, months and years. The results obtained are shaped in graphical and tabular form. The purpose of the study is to trace how big is a repetition in different periods. Monitoring is performed in the region of Stara Zagora.

Mesospheric Response to Global Lightning Activity Correlated by Solar Variability Model Estimations

Tonev P.
Institute for Space Research and Technologies, BAS

Large quasi-static electric fields of the order of magnitude of 1 V/m and more (occasionally exceeding 10 V/m) have been systematically observed at mesospheric altitudes in fair-weather regions. It has been experimentally established that these large electric fields, which may have important role in mesosphere, depend on diurnal time, and also correlate with solar activity. For their explanation different mechanisms have been proposed. We examine by means of modelling the contribution of the lightning activity in the global atmospheric electrical circuit in formation of these mesospheric electric fields accounting that a separate lightning discharge causes a significant transient variation of the ionospheric electric potential. The main is the contribution of the strongest positive cloud-to-ground lightning discharges over the globe. The effects of solar variability at different (few hours to decadal) time-scales on the parameters of the global electrical circuit, and thus, on the contribution of global lightning activity in the examined mesospheric electric fields are estimated, as well.

Data Proccessing and Modelling

Application of New Mathematical Methods of Data Processing to Study Solar-Wind-Magnetosphere Interactions: a Case Study

Zelinsky N.R. [1], *Kleimenova N.G.* [2], *Arkhipov R.Y.* [1]
[1] DAC Moscow Government, Russia; [2] IFZ RAS, Moscow, Russia

Some new methods of the discrete mathematical analysis (DMA) were applied to study the wave-like disturbances (anomalies) in the solar wind and Interplanetary Magnetic Field (IMF) occurring under strong solar wind dynamic pressure and its magnetosphere effects. The multi-station ground geomagnetic data collected from more than 30 stations, spaced from the polar to equatorial latitudes, have been used in the analysis. The original row magnetic digital data as well as the solar wind and IMF data were previously filtered by applying the sixth order Butterworth filter. To study the occurrence of wave bursts (the anomalies in term of DMA analysis) in the solar wind and IMF and at the ground stations, we use the DMA methods of a general dispersion of the covariance matrix eigenvalues and the calculation methods called length and energy, functionals. The combination of the new mathematical methods of econometrics cointegration and the Granger causality test were used to study a relationships between solar wind and Pc5-range geomagnetic pulsations. It was found that under high solar wind dynamic pressure, every wave bursts in the solar wind density were accompanied by simultaneous bursts of dayside Pc5 range geomagnetic pulsation in the global scale, i.e. from the polar to equatorial latitudes. However, the similar wave bursts in the IMF (Bz and By) did not show such effects. We support that the solar wind pressure fluctuations can penetrate deep into magnetosphere globally effecting to geomagnetic variations.

First Year of Ozone Determination from UV Radiation Measurements at Stara Zagora

Rolf Werner[1], *Boyan Petkov*[2], *Dimitar Valev*[1],
Atanas Atanassov[1], *Veneta Guineva*[1], *Andrey Kirillov*[3]
[1] Space Research and Technology Institute - BAS, Stara Zagora, Bulgaria
[2] Institute of Atmospheric Sciences and Climate (ISAC), CNR, Bologna, Italy
[3] Polar Geophysical Institute (PGI), Apatity, Russia

In February 2015 a Ground-based Ultraviolet Radiometer (GUV) 2511 was installed in Stara Zagora. The GUV 2511 instrument is designed for measurements of the downwelling global irradiances at 305, 313, 320, 340, 380, 395 nm and of the irradiance in the visible range of 400-700 nm. The instrument allows obtaining of the total column ozone (TCO) in the atmosphere, the determination of the UV-index and the retrieval of cloud optical thickness. In the paper the first measurements results are presented. The methodology to retrieve TCO from the measurements based on the 313/340 nm ratio simulations by radiation transfer Tropospheric Ultraviolet and Visible (TUV) model is described. The obtained ozone time series shows the well known seasonal variations typical for mid-latitudes with the abrupt ozone maximum in spring and a moderate decrease of TCO up to the minimum in the late fall. In the winter-spring season 2015/2016 a stronger ozone variability is obtained, resulting likely by the combination of polar vortex events and the strong El Niño. The obtained results were compared with TCO determined by Aura satellite observations using measurements by the Ozone monitoring instrument (OMI). The correlation between the OMI Aura TCO values and the TCO GUV 2511 values both for the Stara Zagora location is better than 0.97.

Solar Effects in the Biosphere

Are Geomagnetic Disturbances and Pulsations Really Hazardous?

Kleimenova N.G.
IFZ RAS, Moscow, Russia

Different types of geomagnetic disturbances including geomagnetic pulsations represent an important factor of the space weather which may seriously impact on the biosphere and human health. This problem is widely discussed more than 50 years surrounding by supporters and sceptics. The Interest to this problem grew after the discovery of the biogenic magnetite in different leaving systems and in the human body. However, there are a lot of conflicting opinions and myths. Some people believe magnetic storms as a main hazard for the human health. The morphology and the seasonal variations of magnetic storms accompanied by different geomagnetic pulsations are considered. It was shown that the magnetic storms are hazardous not always. The strongest negative effects of magnetic storms were observed in the winter season, while in summer such effect became very weak. It is found that one of plausible agents which could have a negative impact on the health is a specific type of geomagnetic pulsations (Pc1) with the periods of few seconds coinciding with the human heartbeat. The relationship between the occurrence of geomagnetic Pc1 pulsations and infarction has been found, but at different latitudes this effect seems to be different.

Instrumentation for space weather monitoring

Spacecraft Intercosmos Bulgaria-1300

Podgorny I.M.
Institute of Astronomy RAS

The Soviet-Bulgarian spacecraft IKB-1300 was launched in 1981, August 8 on a polar circular orbit (altitude 900 km). The idea to put forward the magnetospheric spacecraft belongs to K.B. Serafimov. All 12 scientific instruments were developed in Bulgaria with assistance of Soviet scientists and engineers. The spacecraft was built on the base of Meteor satellite under the guidance of outstanding Soviet aircraft designers A.G. Iosifyan and V.I. Adasko. Three-axis stabilization supplied unique possibility of measurements of three components of the electric and magnetic fields, and the plasma velocity. Three perpendicular rods 7.5 m were used for electric field measurement sensors. The fluxes of fast electrons, electron spectrum, and atmosphere luminosity in several spectral lines are also measured. The Earth magnetosphere was investigated in quiet time and during magnetic storms. The local electromagnetic structures in the magnetosphere demonstrate sources of accelerated electrons. It is shown that field-aligned currents are generated in the Earth current sheet during a substorm due to the Hall electric field. Fast electron accelerated in the field aligned currents produce aurora. The Hall effect manifests itself, if the electric currents transferred by electrons. However, such results were in contradiction with Earth current sheet theoretical consideration of particle motion in the drift approximation without dissipation. Current transfer by protons in a current sheet was not contested. Only in 2006 it was shown by Cluster measurements that such theoretical conclusions were wrong.

Protons capturing and strong surfatron acceleration by an electromagnetic wave in space plasma

Shkevov R.[1], *Erokhin N.S.*[2], *Zolnikova N.N.*[2], *Mikhailovskaya L.A.*[2]
[1] Space research and technology institute - Bulgarian academy of sciences
[2] Space research institute - Russian academy of sciences

Dynamic analysis of capture and subsequent protons strong surfatron acceleration by an electromagnetic wave propagating in space plasma across a weak magnetic field was carried out. The amplitude of the wave electric field was assumed to exceed a threshold value needed for the realization of surfatron acceleration mechanism. The results were obtained through the numerical solution of a nonlinear differential equation of second order for the wave phase on the accelerated proton trajectory. It is shown that component's dynamic depends on the initial proton and wave parameters like momentum, velocity, particle energy, the structure of the phase plane, capturing time by the wave and the value of the initial wave phase. The optimal conditions for maximum ultrarelativistic particles surfatron acceleration by the electromagnetic wave in space plasma were considered. On the time interval of numerical calculations an ultrarelativistic acceleration of particles with a relatively small spread of acquired energies was observed. Conclusions on the protons capturing and strong surfatron acceleration by an electromagnetic wave in space plasma were made.

Analysis of surfatron acceleration during interactions between low relativistic electrons and electromagnetic waves packet in space plasma

Shkevov R.[1], *Erokhin N.S.*[2], *Zolnikova N.N.*[2], *Mikhailovskaya L.A.*[2]
[1] Space research and technology institute - Bulgarian academy of sciences
[2] Space research institute - Russian academy of sciences

Strong surfatron acceleration of low relativistic electrons by electromagnetic waves packet in space plasma was studied. The analysis was done on the basis of numerical calculations of second order nonlinear, nonstationary equations for the wave packet phase on the carrying frequency. It is assumed that spatially localized waves packet with a smooth envelope propagates across the static magnetic field. The capture to surfing mode for weakly relativistic electrons occurs immediately for a wide enough range of favorite initial wave phase values on the particle trajectory. Temporal dynamics of momentum components and velocities of accelerated particles were considered. The phase plane trajectory structure on the captured charges was outlined. The profile of function determining the evolution of the particle energy growth is shown on the graphics. Conclusions about surfatron acceleration during interactions between low relativistic electrons and electromagnetic waves packet in space plasma was made.

Presenting authors

Asenovska Yana (1), Asenovski Simeon (1), Atici Ramazan (2), Boska Josef (1), Chargazia Khatuna (1), Despirak Irina (3), Goker Umitdeniz (1), Guineva Veneta (2), Kalinichenko Mykola (1), Kilcik Ali (2), Kilifarska Natalya (2), Kleimenova Natalia (4), Klimov Stanislav (1), Kouba Daniel (1), Kouckaknizova Petra (1), Lytvynenko Oleg (1), Melnyk Valentyn (1), Mironova Irina (1), Miteva Rositsa (1), Mosna Zbysek (1), Özcan Osman (2), Podgorny Alexander (1), Podgorny Igor (2), Ryabov Michael (2), Sagir Selcuk (1), Shepeliev Valerii (1), Shevchuk Mykola (1), Stanislavsky Aleksander (1), Sukharev Artem (1), Tashev Veselin (2), Tonev Peter (1), Volvach Yaroslav (1), Werner Rolf (1), Yankova Krasimira (1), Yeşil Ali (2)