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Sun and Solar Activity.

OBSERVATION ON THE RADIO TELESCOPE URAN-4 OF RADIO SOURCES, CONNECTED WITH THE CORONAL MASS EJECTION ON THE SUN

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ABSTRACT

Radio telescope URAN-4 (RT) is the part of long base radio interferometer system (LBRS), which is located on the Ukraine territory from west to east. Operation frequency range of this instrument is 10-30 MHz. Radio telescope consist of antenna array with the phased system, direction diagram control system and receiving instrumentation with systems of precision time synchronization and information registration.

Antenna of the radio telescope is represents the electrically controlled phased array that consist of 128 tourniquet vibrators with the linear size of 232.5 on 22.5 m. It can select two polarized components of the signal. This instrument is used as a part of very long base radio interferometer system and also to carry out an independent research programs.

Direction diagram width of this antenna, measured on the half power level on the frequency 25 MHz has value 2.7 x 22 degrees. In the long base radio interferometer regime there is near 2 seconds resolution provided.

In 2012 and 2013 the observations of radio sources covering by the solar corona was made on the radio telescope URAN-4. In obtained data there was fixed the records of the strong radio sources, which hadflow levelcomparable with the 3c461 source. As a result of solar activity conditions information analysis from miscellaneous observatories we reach the conclusion that they are connected with the coronal mass ejections which was took place that time.

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SOLAR FLARE SUPEREVENTS: WHEN THEY OCCUR AND THE ENERGY LIMITS OF THEIR REALIZATION

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ABSTRACT

Statistics reliable series of Wolf numbers (timeline in 14 SC) to give a consistent picture of the solar cyclicity. This pattern provides for regular changes of sunspot forming regime in the transition from the epoch of the `higher` solar activity (SC 7-11 and 18-22) to the epoch of the `lower` solar activity (SC 12-16) and vice versa. Before each such epoch occurs a change of the magnetic field generation regime in the solar convective zone, which occurs during approximate one physical 22-year solar cycle. The reconstruction of the sunspot-forming regime, apparently, could be observed in the SC 10-11 and SC 22-23, when the reconstruction having been converted to the `lower` SA and in SC 17-18 was a similar restructuring to the era of the `higher` SA. On this statistics the most powerful solar flare superevents (1859, VIII-IX-SC 10; 1991, VI-SC 22; 2003, X-XI-SC 23) were observed precisely in these periods. They all were occurrence in the anomalously large solar sunspot groups with the areas of >3000 mvh. Since solar flare events are the consequence of interaction of new magnetic flux with the already existing magnetic field of active region, are examined the cases of the observations, which lead to the solar flare superevents. The attempt to estimate the greatest possible intensity and powerful of solar flare superevents is made.

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DEVELOPMENT OF THE CURRENT 24 SOLAR CYCLE AND THE REAL SCENARIO OF THE SOLAR CYCLICITY

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ABSTRACT

A reliable series of the relative Wolf numbers (165 years) it leads to the only scenario of solar cycles (SC) - to the alternation of epochs of `increased` (SC 18-22) and `lowered` (SC 12-16 and 24) solar activity (SA) with the periods of solar magnetic field reconstruction in solar zone of the sunspots formation (11, 12, 23) from one epoch to another. The regime of the produce of magnetic field significantly changes in these periods, providing to the subsequent 5 SC the stable conditions of SC. Space solar research made it possible to sufficiently fully investigate characteristics of the SC for the epoch of `increased` solar activity and period of the reconstruction (SC 22-23) to the epoch of `lowered` SA (24). In this scenario SC 24 is the first SC of the second epoch of `lowered` SA. In the current SC the sunspot-forming activity is lowered, the average areas of the sunspot groups correspond to values for epoch of `lowered` SA, average magnetic field in the umbra of sunspots was reduced approximately to 700 gauss. Flare activity substantially was lowered: it was occurrence of large solar flares-72, class X-28, from which only 2 solar flares of class X> 5. The first five years of the SC 24 evolution confirm this assumption and the possibility to give the qualitative forecast of his evolution and development of the subsequent four cycles of SA.

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Galactic cosmic ray intensity during 23rd and 24th solar activity cycles

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ABSTRACT

Solar activity, violent bursts and coronal mass ejections (CMEs) modulates rather stable flux of the Galactic cosmic ray flux entering solar system. During solar activity cycles the frequency of CMEs can significantly change and intensity of Galactic cosmic rays entering solar system and reaching the earth will change as well. Thus, during “standard” solar cycle, usually starting from low solar activity, the intensity of Galactic cosmic rays is maximal, decreasing as maximum of activity approaches and decaying with diminishing solar activity. However, not all solar activity cycles are the same and current 24-th solar activity cycle is drastically different from the previous 23-rd one. As a “proxy” of the Galactic cosmic ray intensity we will use secondary neutron flux measured by Nor Amberd Neutron Monitor (NANM) in years of 1997-2014 (from beginning of 23rd to the middle of 24th Solar Activity cycle). Due to high altitude location of NANM (18NM24 type) it is one of world more precise monitors. The unique “horizontal median” filtering algorithm provides continuous calibration of all 18 proportional counters of NANM and enables reliable 18-year monitoring of the cosmic ray intensity.

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Sunspot activity for last cycles

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ABSTRACT

Here we analyzed the behavior of different class sunspot groups by separating them in different categories for last cycles. In result of our analysis, we found that observed sunspot groups behave differently for different solar cycles, and each class sunspots have different relation with geomagnetic indices. Our main findings are as follows: 1) All groups behave similarly during the solar cycle 22, while the situation is quite different for other cycles (cycle 23 and 24). 2) Complex sunspot groups describe the geomagnetic activity better than simple groups. 3) The periodic behavior of different group sunspot counts show remarkable differences that it may explain the unusual behavior of solar cycle 23, and may be the behavior of current cycle.

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Solar Energetic Particle origin, acceleration and transport in the Heliosphere

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ABSTRACT

The physical processes that accelerate Solar Energetic Particle (SEP) events to high energies remain controversial. Those are considered to be accelerated either at the reconnection processes inside solar flares or by coronal shocks around coronal mass ejections (CMEs), the former being referred to as `impulsive` and the latter as `gradual` events. We will first address open fundamental scientific questions that give rise to challenges and debates within the scientific community such as: the flare vs CME component in large SEPs and the (in)-consistency of the propagation of particles (e vs p) within space. We will also review recent developments in SEP event research focusing on the well-defined SEP events that have been made publicly available through open repositories. We will present a comprehensive case study of the 13 July 2005 SEP event, both from the data driven methods and the modeling approach. As a follow up we present the systematic study of the timing and duration of the release processes of near relativistic electron (>50 keV) SEP events in the low corona, which will also demonstrate the usage of the recent SEP event catalogues in the scientific analysis. Finally, using the unprecedented multi-spacecraft data available by the twin STEREO NASA spacecraft and complementary data from L1 spacecraft, we discuss various source and transport scenarios currently under debate in the context of results of a statistical survey of SEP events exhibiting a large longitudinal spread in the Heliosphere, a feature which is intensely investigated by the scientific community.

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Comparison of the defined features at different locations on the track during total solar eclipse 2006

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ABSTRACT

The track of total solar eclipse March 29th, 2006 started in Brazil at local sunrise (8:36 UT) and ended in northen Mongolia at local sunset (11:48 UT). It was seen at Salloum (Lat. = 31^0 34' 3.23''N, Long = 25^0 7' 39.35''E) near the west border of Egypt, beginning at 10: 40 UT with a duration 03m 56.5s.

We select six locations from sunrise to sunset to compare the observed features on the track of the total solar eclipse 2006 with each other image. We find that the details of our processed image are more distinct and show more features than other secured images along the track of the examined eclipse.

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Global Complexes of Activity

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ABSTRACT

A new concept of Global Complexes of Activity's on the Sun is presented, which brings together objects associated with both global and local fields in a single framework. Activity complexes have traditionally been identified purely from observations of active regions. We show here that a global complex also includes coronal holes and active regions. Our analysis is based on a large dataset on magnetic fields on various scales, SOHO/MDI observations of active regions and magnetic fields, and UV observations of coronal holes. It is shown that the evolution of coronal holes and active regions are parts of a single process. The relationships between the fields of different scales during the generation of the cycle is discussed.

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Variability of solar cycles and solar dynanmo with fluctuations of the dynamo governing parameters

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ABSTRACT

Solar activity cycle demonstrate a substantial variability which includes such dramatic events as the famous Maunder minimum and other less spectacular epesodes. A possible scenario to explain this variability in the framework of solar dynamo is to include fluctuations of soilar dynamo governing parameters, in particular, the regeneration rate of poloidal magnetic field from the toroidal one. he fluctuations arize just because the number of convective cells in solar convective envelope is finite. The talks presents solar dynamo models obtauined in the framework of this scheme.

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Activity cycles as a result of the change of wave processes of Northern and Southern hemispheres of the Sun.

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ABSTRACT

The dynamics of the cycles of solar activity as a result of wave processes in the northern and southern hemispheres were reviewed. The data for the study is: 1. Monthly values of groups of sunspots in Northern (Sp-N) and Southern hemispheres (Sp-S) (1874-2013) 2. Daily Wolf numbers in the Northern (W-N) and Southern hemispheres (W-S) (1992-2003), 3. Daily values of flare index FI-N and FI-S (1976-2006). In order to get a detailed picture of the development of the `Northern` and `Southern` solar cycles methods of expanded application of wavelet analysis were developed. This allows identifying different wave processes which form the solar cycle and the time of their existence. Application of Fourier filtering shows that the length of the 11-year cycle in the northern hemisphere on the Sp index varies in the range of 10.2-11.5-year and southern hemisphere 9.7- 13.2 years. The existence of the 35-year-old «Northern» and 42-year-old `Southern` cycles was revealed. The formation of each cycle is defined as a result of the combined effect of long-period (2-5 years) and short-period (less than 2 years). Long-period processes in the transition from cycle to cycle show merger, separation, modulation and recurrent attenuation. Manifestation of abnormal activity in the increase phase, maximum and decrease phase of solar cycle is formed by simultaneous intensifying of the short-period processes. The spectra of these periods are markedly different in the northern and southern hemispheres.

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What can be interesting in the analysis of crowded solar bursts for the study of solar activity?

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ABSTRACT

The scope of our report is intended to be the solar sources of space weather and their monitoring by radio astronomy methods to improve the understanding and the predictions of the solar corona parameters. At decameter wavelengths the radio astronomy observations reveal a wide variety of solar bursts. They are associated with solar activity such as propagation of electron beams, shock waves, flare-related events, coronal mass ejections from the Sun. Their analysis gives useful information about parameter changes (electron concentration, macroscopic magnetic field strength and others) of solar corona during solar activity. By measurements of different types of solar bursts occurred about the same time one can provide a comparative analysis of their properties, complementing the missing pieces in the complex mosaic of solar events. In this purpose we discuss low-frequency radio observations of quasi-periodic bursts like a zebra pattern related to Bernstein modes. The measured frequency periodicity of the bursts at 18-32 MHz gives the magnetic field strength in upper corona, which we compare with the magnetic field strength obtained from the band-splitting of the type II burst associated with the zebra pattern at the same frequency range. This allows us to measure the coronal field strength by two independent ways. To match results in these cases, we assume that the source of the type II burst was a perpendicular shock wave. Possibly, lower coronal magnetic field strengths, following from the measurements, are specified by features of the protracted solar minimum in the solar activity.

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White light solar corona observed during the November 14, 2012 total solar eclipse

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ABSTRACT

Results from observations of the white-light corona during the November 14, 2012 total solar eclipse, half a year before the MiniMax24, are presented. Observations were conducted in the region of Mount Molloy, 150km from Palm Cove, Cairns, Queensland, Australia. WL images show the continuum K-corona that results from photospheric light scattering by electrons in the corona.

Observations of the solar corona were made with 300 mm objective and 2000 mm Macsutov-Cassegrain telescope. Photos were taken with different exposures in order to obtain high-resolution composite image of the white light corona, which allows us to reveal its small- and large-scale structures. The white light coronal images were compared with near-simultaneous SOHO EUV and SOHO LASCO visible-light coronagraphic images.

The Ludendorf flattening index (0.024) and phase of the solar cycle (+0.87) show that white light corona is solar maximum type the shape is spherical with many streamers located at all azimuths around the occulted disk.

Observations of the November 14, 2012 total solar eclipse give us the possibility to investigate solar corona structure during this unique minimal maximum of the solar activity cycle and compare it with previous eclipse observations during maximum.

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FORECASTING ANNUAL SOLAR ENERGY TO A PARTICULAR REGION USING DATA MEASUREMENTS WITH METEOROLOGICAL STATION Vantage Pro2 Plus.

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ABSTRACT

The amount of sunlight reaching Earth`s surface is monitored and accumulated by automatic weather station Vantage Pro2 Plus. Applying the data, sun energy characteristics of different months are monitored and related to the sun position during the seasons. The degree of repeat ability is presented for the corresponding days and months in different years. The annual repeat ability is estimate on the base of these measurements. The monthly and daily repeat ability has been compared with the annual one, as the latter turned out to be significantly better. The high annual repeat ability provides an opportunity for sunlight forecast for subsequent years.

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Theoretical modeling on the advective nature of magnetized accretion disk

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ABSTRACT

In this paper we are researching the structuring of the flow in the system disk-corona. We Will analyze the the interaction between stream and magnetic field. How does the new advective hypothesis and why this type of advection manifests itself only in the magnetic environment. Will discuss the importance of the factor dynamo for self-induction on advection in the disk.

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Solar Wind-Magnetosphere-Ionosphere Interactions

Shock ahead ICMEs analyzed from in situ data

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ABSTRACT

We analyzed solar wind disturbances recorded by WIND satellite which can be connected with corresponding ICMEs recorded in Solar Terrestrial Relations Observatory (STEREO) data, in the period from 2008 to 2013. Detailed analysis of the in situ data reveals complex and different internal structures of the disturbances, where signatures of the initially independent ICMEs could be recognized. Separating the disturbances in different types, we focus on the disturbances in which we can analyze shock ahead the ICMEs. Correlations of the magnetic field strength, solar-wind speed, proton density and thermal velocity are presented. Finally, we employ the ground-based cosmic ray observations and Dst index, to investigate the connection between CME manifestations with the Forbush decrease (FD) and its influence on the Earth's magnetic field. The results presented provide a better understanding of the ICME morphology and reveal effects that should be taken into account in forecasting of the arrival of such compound structures.

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Observations of substorms signatures during different solar wind streams

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ABSTRACT

In the literature there is enough evidence that in the course of substorm fast plasma flows in the magnetotail are observed and satellites in the near or middle tail can register a reversal of a tailward plasma flow to an earthward plasma flow. The observation of oppositely directed flows is interpreted as tailward movement of the reconnection site. In this work we will investigate the reconnection site location in the magnetotail during substorms observed under different solar wind structures - recurrent streams (RS), magnetic clouds (MC), and the region of compressed plasma in front of these streams (Sheaths and CIRs). We use data from Geotail spacecraft in the magnetotail and solar wind parameters from Wind spacecraft observations; the auroral bulge parameters were obtained by the Ultra Violet Imager onboard Polar. We considered data from the Geotail spacecraft in the magnetotail measured in the course of auroral bulge formation, during passage of solar wind magnetic clouds, recurrent streams and Sheaths and CIRs regions. 17 events are selected. It is shown that magnetic reconnection in the magnetotail takes place closer to Earth when substorm is observed during MC, and further in radial distance for substorms during solar wind recurrent streams.

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Aurora during week magnetic storms and model description of auroral precipitation

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ABSTRACT

Characteristics of auroral precipitation during week magnetic storms on December 11-12, 2004 and on January 11-12, 2005 were examined. These two storms were caused solar wind high-speed recurrent streams. Interactive Auroral Precipitating Model (APM) and meridian scanning photometer observations at Barentsburg and Lovozero were used to show the possibility of APM using for the description of the auroral luminosity features. Spectral characteristics of aurorae observed from MSP in the pre-noon and after-noon sectors on Dec. 12, 2004 on the recovery phase of the storm showed that discrete forms were caused by precipitation of relatively soft electrons. In the after-noon auroral arcs were observed near the poleward edge of the red auroral band which was narrower than in the pre-noon and observed at latitudes from 73^0 to 77^0 CGL. On Jan. 12, 2005 discrete structures with intensity up to 40 kR in 557.7 nm emission were registered inside the red band at latitudes from 74^0 to 77^0 CGL during the main phase of storm. These structures were caused by precipitation of hard electrons and their intensifications coincided with solar wind velocity increased and growth or drop of the solar wind dynamic pressure.

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Polar and high-latitude substorms and solar wind conditions

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ABSTRACT

All substorms observed at high latitudes can be divided into 2 types - `polar` (observed only at > 70 latitudes in the absence of substorms at <70 latitudes during the day) and `high-latitude` substorms (propagating from auroral (< 70) to polar (> 70) geomagnetic latitudes). The aim of this study was to compare solar wind conditions during these two types of substorms. For this purpose, we used the data of IMAGE magnetometers and OMNI solar wind data for 1995, 2000, 2006-2011 periods. There were selected 105 `polar` and 55 `high-latitude` substorms. It is shown that `polar` substorms observed during the late recovery phase of a geomagnetic storm, after passing of the high speed stream of the solar wind (when the velocity is reduced from high to low values). `High-latitude` substorms, on the contrary, are observed during passing of the recurrent high-speed stream of the solar wind, increased values of the southward B_Z component of the IMF and E_Y component of the electric field, increased temperature and pressure of the solar wind. Also, it is noted that variability of these solar wind parameters for the 'high-latitude' substorms is stronger than for 'polar' substorms.

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Observations of substorms during different storms

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ABSTRACT

All-sky cameras data at Kola Peninsula from 2012/2013 winter season have been used to study the variations of substorm development in different conditions of the interplanetary medium. Solar wind and interplanetary magnetic field parameters were taken from OMNI data base. Using solar wind data for the examined periods, the different solar wind streams were revealed: recurrent high-speed streams (RS) and magnetic clouds (MC). It is known that these solar wind structures are the sources of geomagnetic storms. In our study substorm development during different storms and during quiet geomagnetic conditions were compared. Substorm onset time and further development were verified by data of IMAGE magnetometers network and by data of all-sky cameras at Apatity and Lovozero. The particularities in the behaviours of substorms observed by storms connected with solar wind recurrent streams and by magnetic clouds are discussed.

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Coordinated investigations of the solar wind, solar radio emission and Earth`s ionosphere by the Ukrainian decameter radio-telescopes UTR-2 and URAN for space weather application

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ABSTRACT

This report is devoted to coordinated investigations of the solar wind, solar radio emission and Earth`s ionosphere which are carried in Ukraine with the decameter radio-telescopes UTR-2 and URAN for space weather applications. The plan of these experiments is the following. During summer months we carried out the monitoring of the sporadic solar radio emission. If II or IV type of solar radio bursts are registered the monitoring of the interplanetary plasma and Earth`s ionosphere by using observations of scintillations of cosmic radio sources are immediately started. So the experiments must answer the question `Can appearance of some type of solar radio burst be used for prediction the changes in space weather: appearance large scale solar wind or ionospheric disturbances? To have reliable data from IPS observations we inculcated a digital spectrum analyzer and created some techniques which allowed us to separate ionospheric and interplanetary scintillations (four criteria were proposed: cross-correlation, spatial, spectral, probabilistic) and to raise noise immunity. This allowed us to find ICME associated with Valentine`s day CME February 15 2011 and to teach its dynamic and parameters beyond Earth`s orbit. It was found that Valentine`s day CME continued slowing at distances more than 1 a.u. while their angular size remained a constant. This proved large perspectives of such experiments in future.

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Analysis of the Geomagnetic Activity during the SC 24 Maximum Phase

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ABSTRACT

Geomagnetic storms are known to be of great importance to life on Earth through their impact on telecommunications, electric power networks and much more. Our study analyses the geomagnetic activity during the SC 24 maximum phase (July 2011 - October 2013) that has already passed. We present the variation of the Ap, aa indices in comparison with the intensity of high speed streams. The registered geomagnetic storms are classified by the Dst index and their main phase structure. We also analyze in detail two months of solar and geomagnetic activity after the SC24 maximum, these being March 2012 and March 2013. An ICME (Interplanetary Coronal Mass Ejection) is recorded on March 9, listed in the Richardson and Cane catalogue, correlated with a Halo CME (Coronal Mass Ejection) from the 7th. An intense geomagnetic storm (minimum Dst = в€’ 131) was registered on March 9, 2012. Two ICMEs are also recorded on the 17th and 20th March 2013, the first one being correlated with a Halo CME from the 15th. March 17 is a day of intense geomagnetic storm (minimum Dst = в€’ 132). We focus on these events, such that the interaction between fast solar wind and interplanetary magnetic field from the Sun to the Earth can be thoroughly described.

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The Solar Wind - Earth Interaction

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ABSTRACT

The fact that there is a good correlation between changes in solar activity and changes in Earth's rate of rotation can hardly be understood in other ways than that the Earth's spin rate is sensitively affected by the interaction between the solar wind and the magnetosphere. The Solar Wind interaction with the magnetosphere and the terrestrial system may go via the transfer of pulse moment or via the effects on the electric circuit. The planetary beat seems to generate variations in the solar activity (PRP, Sp. Iss. 1, 2013) giving rise to changes in solar luminosity (irradiance) and Solar Wind. A central role in the Sun'Earth interaction seems to be played by the solar wind interaction with the magnetosphere, changing in the Earth's rate of rotation by that effecting the ocean and atmosphere circulation. The strength and shielding capacity of the Earth's magnetosphere is a coupled function of heliomagnetism (the Solar Wind) and geomagnetism (the Earth's own dynamo). Recorded changes in 14C may have an external Solar Wind origin, an internal geomagnetic origin or an effect from ocean/air ventilation. Similarly, the recorded variations in 10Be may have an external Solar Wind origin, an internal geomagnetic origin or an effect of local to regional precipitation. The centennial changes between grand solar maxima and minima imply that we will soon be in a new solar minimum and, in analogy with past events, probably also in Little Ice Age climatic conditions (e.g. PRP, 2, 205-206, 2013).

✓

A tentative reconstruction of the Dst index back to 1840, based on long time-span models of the core magnetic field

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ABSTRACT

It has long been known that the annual means from geomagnetic observatories contain an external contribution, which we show is mostly storm-time related. That external contribution leaks into main field models that are based on observatory data. We used low pass filters with a cutoff period of 11-year to evidence a residual signal with seemingly external sources present in two long time-span core field models, namely gufm1 (Jackson et al., 2000), 1590-1990, and COV-OBS (Gillet et al., 2013), 1840-2010. Based on the correlation between the horizontal component of the external dipole (Hext), provided by the COV-OBS model, and the Dst index we discuss the possibility of extending the latter back to the advent of geomagnetic observatory data (~1840). A simulation of the Dst index calculated from COV-OBS time series of the external signal for the four locations traditionally used for the Dst determination (Honolulu, San Juan, Hermanus and Kakioka) was used.

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Solar Effects in the Ionosphere

Modification of the ionosphere about terminator by treveling the powerfull tropical ciclone the big island

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ABSTRACT

Earlier, in the works of authors from satellite Intercosmos Bulgaria -1300 and Cosmos - 1809 was shown that a tropical cyclones (TC) are modified ionosphere. Observed local perturbations of the plasma density, the occurrence of electric fields and the development of ELF - VLF zone of turbulence, which explains the upward jet injection of neutral particles from TC. In this paper we analyzed the data of the satellite Cosmos -1809 when passing vehicle Harry (1989) trough the island of New Caledonia. It is analyzing the effects of evening and morning terminators on the structure of the ionosphere from TC. It is detected: 1 - the emergence latitude belt (up to 5000 km) structured perturbations in the night ionosphere; 2 - excitement in the illuminated ionosphere periodic oscillation of the electric field with a long ~ 400 km, passing beyond plasmapause. A model of the formation of the vehicle in the lower ionosphere vertical submerged jet is injected into the upper ionosphere on ballistic trajectories neutral particles of different varieties. Jet deflection when interacting with island and TC change ionization of neutrals near the terminator are confirmed in the proposed model.

✓

Ionosphere effect of a moon shadow movement across magnetosphere

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ABSTRACT

Experimental research of dynamic processes in an ionosphere, as a rule, runs into the problem of authentication of influence factors. Such factors are the variance of corpuscular and wave flux of solar radiation, magnetosphere, troposphere, and lithosphere transient process. A solar eclipse is an unique event, allowing directly to look after the role of solar factors.

In this work the analysis of the ionosphere remote sensing data which obtained in the Observatory URAN-4 during solar eclipse August 1, 2008 is carries out. Two types of sounding were used. Radioastronomy method of estimation of ionosphere irregularities intensity was used for observation of irregularities in the layer of F2. For investigation of E-layer disturbance ionospheric we used bistatic method of a radio sounding on frequency of 1÷2 MHz. Radio-receiving stations are placed near Odessa (Ukraine). Radio waves of broadcast stations are used for sounding. Distance between transmitters and receivers was 300-450 km.

It is not found out the changes of character of ionosphere F2- layer irregularities in the period of solar eclipse. A quasi wave disturbance of E-layer concerned with solar eclipse was revealed. Mean wave period is 23,6 min. The beginning of the disturbance corresponds to time, when the shadow cone has not yet reached the Earth. It allows as suspecting, that initial disturbance has arisen in a magnetosphere and then was transferred to an ionosphere.

✓

Equatorial Plasma Bubbles and Solar Flux 10.7 cm observations during the period 2002-2013 over low Latitude region

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ABSTRACT

The Total Electron Content (TEC) is computed from Global Positing System (GPS) from Bangalore (13.020N, 77.570E) IGS station for the period 2002 to 2013. We have found out the simultaneous occurrence of EPBs in both TEC and OI 630.0 nm emissions using both radio and optical techniques. In the present work we have also discussed the possible mechanism of day-to-day variability in the occurrence of EPBs. We present the mean diurnal, monthly, seasonal, and annual variation in the ionospheric TEC and % occurrence rate of Equatorial plasma bubble during the highest to highest solar activity phase for the periods of 2002÷2013. We found that the during quiet and disturbed period both average GPS-TEC and % occurrence rate of plasma bubbles are positively correlation with solar flux for the entire 12 year period.

✓

Red sprites as possible factor in the link between solar activity and conditions in strato/mesosphere

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ABSTRACT

Different mechanisms have been proposed to explain the role of solar activity in formation of Earth's climate. The relationships between these both can include a link between the solar activity and the chemical and thermal balance of the meso- and stratosphere. Here a possible way of realization of such link through processes in the global atmospheric electric circuit is discussed and studied. The processes considered are the electron avalanches and streamers in the lower ionosphere which are created above thunderstorms and result by positive cloud-to-ground lightning discharges. Actually, each red sprite is created by a set of positive streamers whose visible path is from 80-85 km down to about 45 km accompanied with further branching and formation of negative streamers moving upward. Recent studies show that streamers can influence the chemical and thermal balance at mesospheric and stratospheric altitudes. According to some authors, the streamers in a well developed sprite can lead to significant (up to tens of times) density modifications of some small constituents (NO_x, O_3, etc.) for time period of order of one hour in the region 40-80 km. Another authors show that the streamers of a sprite can lead to a temperature change in mesosphere. On the other hand, we analyze conditions of the formation of sprite streamers at altitudes 80-90 km and their possible sensitivity to solar activity. In this case, the influence of the solar activity would be transmitted from altitudes about 90 km to the mesosphere and stratosphere.

✓

Conditions for initiation and propagation of electric streamers in lower ionosphere above thunderstorms at night

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ABSTRACT

Generation of positive and negative streamers in the lower ionosphere occurs typically in red sprites, where streamers form large branching structures at altitudes between 85-90 and 40-45 km. It has been suggested recently that the sprites (essentially, the streamers in their body) can play a role in chemical and thermal balance in the strato- and mesosphere, and also can be possibly used as indicator for the lower ionospheric status. Although intensively studied experimentally and theoretically, there are still gaps in explanation of creation and development of streamers, and thus the onset of sprites. Here the conditions are studied for initiation and propagation of positive downward streamers generated after a positive cloud-to-ground lightning discharge at nighttime. These conditions are determined by three groups of factors: lightning discharge characterized by the time distribution of the lightning current moment; ambient electron and ion densities and conductivity; the formation of small-scale irregularities of electron density at altitudes ~80-90 km. The quasi-electrostatic field generated in lower ionosphere above a lightning discharge is studied by modeling: it is obtained as solution of continuity equation for the Maxwell current. A first-order estimation of the conditions for streamer initiation is made by a help of ionospheric irregularity. The possible role in initiation of streamers of the galactic cosmic rays and of their modulation by solar activity is discussed.

✓

PC index as a proxy of the solar wind energy that entered into the magnetosphere

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ABSTRACT

The PC index has been introduced [Troshichev et al.,1988] as a characteristic of the polar cap magnetic activity responding to variations of the interplanetary electric field EKL [Kan and Lee, 1979]. The time evolution of PC taken with time delay ~ 20 min highly correlates with variations of EKL reduced to magnetopause (mean correlation > 0.80 in 50% of events). On the other hand, the following experimental facts make it clear that the PC index is steadily related to such space weather indicators, as AL and Dst indices:

- ✓ the substorm onsets are preceded and accompanied in all cases by the PC index growth;
- ✓ the substorms and storms start only if the PC index reaches the threshold value ~ 1.5 mV/m;
- ✓ the substorm intensity and growth phase duration are determined by rate of PC increase
- ✓ substorms and storms decay as soon as the PC index firmly falls below 1 mV/m;
- ✓ the storm length is terminated by the duration of the period, for which PC > 1.5mV/m; the storm intensity is linearly related to the PC index averaged over the storm time interval;
- ✓ the substorms and storms under conditions of northward IMF are related to PC > 1.5 mV/m;
- ✓ the PC index adequately responds to impulses in the solar wind dynamic pressure.

Thus, the PC index can be regarded as an adequate proxy of the energy incoming into the magnetosphere.

✓

Solar Influences on the Lower Atmosphere and Climate.

Evolution of Global Temperature during Solar Cycles 20-23 in connection with Cosmic Rays and Dst index

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ABSTRACT

Global temperature variations in connection with evolution of Dst index and CR variations is analyzed for conditions in interplanetary space, which can have an influence on galactic cosmic ray (CR) and climate change. Dst index is commonly used as the solar wind-magnetosphere-ionosphere interaction characteristic. The important drivers in interplanetary medium which have effect on cosmic rays as CMEs (coronal mass ejections) and CIRs (corotating interaction regions) undergo very strong changes during their propagation to the Earth. Therefore, the geomagnetic indices have some inestimable advantage as continuous series other the irregular solar wind measurements. We have compared the yearly average variations of Dst index and the solar wind parameters with cosmic ray data from Moscow, Climax, and Haleakala neutron monitors during the solar cycles 20-23. The descending phases of these solar cycles (CSs) had the long-lasting solar wind high speed streams occurred frequently and were the primary contributors to the recurrent Dst variations. They also had effects on cosmic rays variations. We show that long-term Dst variations in these solar cycles were correlated with the cosmic ray count rate and can be used for study of CR variations. We demonstrate also that the annual means of global surface air temperature in 1965-2012 show the maxima during CRs and Dst index minima. It proves that CRs play essential role in climate change and main part of climate variations can be explained by the mechanism of action CRs modulated by the solar activity on the state of lower atmosphere and meteorological parameters.

✓

Solar signals in long time series of the Danube discharge data

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ABSTRACT

The analysis of a river flow can bring information on the climate evolution in its catchement basin, due to the integrating of precipitation and temperature effects over the basin in the discharge data. In this paper we analyze discharge data, available since 1840 from the Danube river, the second largest river in Europe, with the aim to infer solar signals – a result of the solar-terrestrial connection in the evolutioon of climate in the catchement area. Time series were analyzed, from four gauge stations along the Lower Danube segment. We first compare the discharge data recorded at the entrance on the Romanian territory (Orsova station) with precipitation data from the Upper and Middle Danube Basin, and discharge data at the end station (Ceatal) with precipitation in the Lower Danube Basin. Decadal variations with a period of ~11 years (amplitude of about 1500-2500 m^3/s) and variations with longer periods, of 22 and 30 years (amplitude of about 500 m^3/s), have been evidenced in discharge data. They are interpreted as solar signals at the Schwabe and, respectively, Hale cycles time scales.

✓

The inter-annual and long-term distributions of cloudless days and nights in Abastumani (41.75N; 42.82E): coupling with cosmic factors and climate change

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ABSTRACT

The inter-annual distributions of cloudless days (CD) and cloudless nights (CN) in Abastumani have been considered. The number of CD is greatest in August when mean daily temperature at the Earth's surface in this region is the highest. For geomagnetically disturbed conditions, when planetary geomagnetic index Ap>12, the greatest number of CD shifts to September, where there is the highest frequency of magnetically disturbed day-nights (as well as at spring equinox period). Such a coupling observed between the inter-annual distribution of CD and the occurence of geomagnetic disturbances indicates a possible link of cloud covering processes with cosmic factors. This also shows that in AAO the biggest number of CN occurs in September and it moves to August for geomagnetically quiet conditions (Ap<12). This assumption of influence of cosmic factors on cloud covering is supported by the fact that geomagnetically disturbed CN appear more frequently in June, while for quiet ones their number is minimal. Galactic cosmic rays (GCRs) flux variations are thought as a possible cosmic factor that could affect the cloud covering process, since it is considerably low in June for cloudless nights of the considered dataset. This decrease is even more at sudden storm commencement and is maximal for strong geomagnetic disturbances (Ap>50). We consider that different influence of cosmic factors on day- and night-time cloud covering processes is significant for climate change. This is also indicated by the observed summer negative trend in the number of geomagnetically disturbed CN and positive trend in magnetically disturbed CD.

✓

Effects of the solar variability on the North temperate climate

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ABSTRACT

In this study, possible climatic effects related to solar variability were investigated by means of long-term statistical correlations between surface air temperature and solar/geomagnetic indices. The data from NCEP/NCAR reanalysis database for the North temperate zone (Europe, North America and northern Asia) have been processed. Power spectral analysis of surface air temperature indicates the occurrence of periodicities between 2 and 7 years, associated to atmospheric phenomena, and periodicities around 11 and 22 years, normally associated to solar variability. By applying simple filtering procedures we can get the 11 and 22-year signals in our temperature data. Various features of these signals will be discussed on different spatial scales of the Northern hemisphere. The differences between observed and reanalysed data will be also discussed.

✓

A method of determination of the atmospheric O_2 extinction spectrum

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ABSTRACT

A method to compute the extinction of the solar radiation by the atmospheric molecular oxygen was developed. Absorption and single scattering towards the observer were included in the calculations. The atmosphere was considered as plane parallel and divided into layers with equal thickness. A computation following the `line-by-line` method was applied. The calculations were performed for A(0,0) band of the oxygen atmospheric system. The radiation extinction at different angles of observation and using different atmosphere model parameters was computed. The optimal number of included transitions and the optimal values of the atmospheric layers thickness and of the atmospheric height were estimated. The profiles of the separate rotational lines were obtained and the equivalent widths were calculated in the optimal way. The dependences assuming strong absorption were built for different atmospheric models and different observation angles. The corresponding temperatures and atmospheric heights were obtained. Ground based measurements of O2 extinction and theoretical spectra for the same conditions were compared.

✓

Total ozone and solar activity

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ABSTRACT

The response of the ozone in the atmosphere to the solar activity changes has been studied. Data of the total ozone content (TOC) from the satellite experiments TOMS-EP and SCIAMACHY over Bulgaria during the 23-rd solar cycle (1997-2008) and from OMI during the recent 24-th solar cycle are used.

The annual ozone course in 2003 (maximum of the 23-rd solar cycle) is presented and compared with those in 1997 and 2008 (minima of this cycle). TOC course in 2013 (maximum of the 24-th solar cycle) is compared with the course in 2008 (minimum of this cycle).

The solar activity is characterized by the sunspot daily numbers W, the solar radio flux at 10.7 cm (F10.7) and the MgII wing-to-core ratio solar index. The estimation of the influence of the solar activity on the TOC is made by an analysis of the ozone response to some separate cases of sharp changes in the course of W, F10.7 and Mg II in the examined period.

✓

The connection between the troposphere temperature and variations of solar and geomagnetic activities

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ABSTRACT

The multiple-factor correlation analysis of connection between the temperature of different troposphere layers and variations of solar (f 10.7cm) and geomagnetic (AA index) activities was carried out for period 1950-2007. NCEP/NCAR reanalysis data have been used for calculating the temperature. Influence of volcanic effects, El NiГ±o and Arctic ice area on characteristics of the connection under study was also considered.

The temperature response to effects of solar and geomagnetic activities has been found to have a well-pronounced spatial structure. Temperature of the most troposphere area correlates with solar and geomagnetic activities, however, there are observed significant anticorrelation in some regions.

It is shown the degree of connection between the troposphere temperature change and variations of solar and geomagnetic activities depend on the time scale. As the time averaging period increases from 1 to 7 years the correlation coefficient grows in most regions (up to 0.6-0.7), but if the increase continues, only weaker growth is observed. This time-scale dependence can be explained by the fact that the majority of variations in troposphere temperature on the time-scale of less than 7 years are affected by processes having no connection with solar or geomagnetic activity.

There is performed analysis of atmospheric circulation influence on the connection between the troposphere temperature change and variations of solar and geomagnetic activities. The temperature change in regions, which are frequently occupied by cyclones, is shown to have practically no connection with variations of solar and geomagnetic activity.

✓

The analysis of troposphere response to geomagnetic disturbance

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ABSTRACT

The analysis of response of various troposphere levels to strong geomagnetic disturbance was carried out on basis of the geomagnetic activity data (AA index) and data of the NCEP/NCAR reanalysis. It was shown that spatial gradients of the temperature and pressure at various troposphere levels increase at the time of the strong geomagnetic disturbance. The analysis of the global temperature change at the various troposphere levels show that it can or increase or alternatively decrease during the strong geomagnetic disturbances. The global temperature change is determined by the spatial distribution of the temperature and pressure before the geomagnetic disturbance.

✓

The effect of the space weather and solar cycle dynamics on magnetic field, upper atmosphere and the Black Sea level

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ABSTRACT

According to the observatories `Odessa` and `Kiev` total vector magnetic field variations data for the 2008-2010 period, the dynamics of space weather manifestations were considered. Wavelet analysis application made possible the determination of structure changing in circadian period. The features of displaying 12, 8 and 6 hour periods are shown. The nature of their correlation and modulation in a solar and geomagnetic activity changing is seen. Two stations changes differences that can result from the latitudinal dependence are examined. The existence of `Odessa` magnetic anomaly located on land and at sea is reviewed.

In the Earth-Sun relationship studies the important information is stored in the month values of the Black Sea level, which is a sensitive resonator of helio and geophysical global processes. The longest measurement series were carried out in Ochakov (since 1874), Odessa and Sevastopol (since 1875). Long-period variations, of the Black Sea level for Odessa and Sevastopol stations, are studied with the help of wavelet analysis. The well-known annual season variation is shown and the existence of successive 2, 3 and 4-5 year periods is represented. The correlation between the sea level and 11-year period of solar activity is clearly shown.

✓

Low Clouds and Cosmic Rays: possible reasons for correlation changes

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ABSTRACT

In this work we investigated the nature of correlations between cloud cover anomalies and galactic cosmic ray (GCR) variations detected on the decadal time scale, as well as possible reasons for the violation of these correlations in the early 2000s. It was shown that the link between cloud cover at mid-latitudes and GCR fluxes is not direct, but it is realized through GCR influence on the development of extratropical baric systems. As the character of this influence reveals a ~60-year periodicity related to the evolution of the stratospheric polar vortex, a possible reason for the violation of correlations between cloud cover anomalies and GCR intensity in the 2000s may be the sign reversal of GCR effects on baric system development due to the change of the vortex state. The results obtained provide evidence for an important part of the polar vortex in the mechanism of solar-atmospheric links.

✓

Influence of the solar activity on cave air temperature regimes

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ABSTRACT

We discuss cave air temperature response to solar and geomagnetic activity for a period of 46 years (1968 ÷ 2013) using everyday noon measurements for four show caves in Bulgaria - Ledenika, Saeva dupka, Snezhanka and Uhlovitsa cave.

Temperatures of the air in the zone of constant temperatures (ZCT) are compared with surface temperatures recorded at meteorological stations situated near about the caves in the towns of Vratsa, Lovech, Peshtera and Smolyan, respectively.

The Hansen cave, Middle cave and Timpanogos cave from the Timpanogos Cave National Monument, Utah, USA situated nearly at the same latitude have also been examined for comparison.

Our study shows that the correlation between cave air temperature time series and sunspot number is better than that between the cave air temperature and Apmax indices, and that surface temperature trends depend on the climatic zone, in which the cave is situated, and there is no apparent relation between temperatures inside and outside the caves.

We consider possible mechanism of solar cosmic rays influence on the air temperatures in caves. It is based on the variations in transparency of the atmosphere to visible and infrared radiation under the influence of ionizing cosmic radiation.

Studies of the cave air temperature regimes show that cave systems preserve a record of environmental changes, which is very important for investigations of the apparent effect of solar and geomagnetic activity variations on the Earthп's climate.

✓

Instrumentation for Space Weather Monitoring.

Different coil systems used for magnetometers calibration - a comparative analysis

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ABSTRACT

In this study we address some aspects of the theoretical model, configuration and requirements to practical realization of coil systems, utilized to create a homogeneous magnetic field used for magnetometers calibration. This analysis is applied to two different types of discrete magnetic coil systems with two (Helmholtz coils), three and four coils, with round and square shapes. It is also applied to solenoids with a different number of windings and a different diameter-to-the-length ratio. Monte Carlo methods have been used for varying mechanical parameters of the coil systems and analyzing uniformity of the magnetic field in a three-dimensional central zone with different sizes. It is shown that the achievement of the magnetic field with extremely high homogeneity (>10^5) depends not only on coil system configuration (number of coils, size and current ratio), but is especially sensitive to the mechanical precision of specific implementation design.

✓

Measurements of Electric Fields in the Wide Frequency Range for the RESONANCE Project

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ABSTRACT

The measurement of electric fields and waves on board of satellites is mainly done by a double probe method. The measurement is performed using the potential difference between couples of sensors immersed in plasma. To measure the field vector three components are needed. Similar measurements of DC, up to frequencies 20-30 kHz, are routine when investigating the flow processes in the plasma and are made on board of many satellites.

In order to solve the scientific tasks of the new project RESONANCE it is necessary to perform measurements in a wide frequency range of DC up to frequencies 1 MHz, both for magnetic and electric fields and waves.

In this work a development of electric sensors and device for detection and data processing of the signals is presented.

✓

Space Weather Studies in Azerbaijan Using AWESOME Receiver

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ABSTRACT

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 receiver provides an open-ended potential for exploration and also can be used for educational outreach.

✓

Data Processing and Modeling.

GALACTIC COSMIC RAY MODULATION: PREDICTIVE ABILITIES

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ABSTRACT

The galactic cosmic rays (GCR) are the most energetic particles from the Earth's space radiation environments. They have a very important contribution to the ionization of the lower part of the ionospheric D-region below 60-70 km, and also they are the main initiator of the nucleonic-electromagnetic interactions below 30 km in the atmosphere. GCR don't pass unimpeded through the interplanetary space, but interact with the solar wind and the interplanetary magnetic field, as a result of which we observe modulation of the galactic spectrum, which follows the 11-year solar cycle: with the increase of the solar activity the intensity of the galactic cosmic rays decreases, and vice versa: with the decrease of the solar activity - it increases. However, the solution of the task for adequate description of the relation between the modulation processes in the heliosphere and the profiles of the modulated GCR spectrum is a difficult task. That is why we propose a model, whose parameters are discussed as a function of the indices of the solar activity. Because the flux of GCR has a delay relatively to the values of the solar-heliospheric parameters, we can use them to predict the intensity of the galactic cosmic rays.

✓

Adoption of continuous wavelet analysis and recurrence plots to comparative studies of quality of Hel observatory geomagnetic records with Lovo, Belsk and Niemegk data (1966-2012)

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ABSTRACT

The hourly geomagnetic data from the Polish station Hel (geog. lat. 54.61 and long. 18.82) for the whole registration period 1966-2012 are compared with records of nearby stations: Lovo, Belsk and Niemegk, using the absolute values of the H and D components and the IHV indices derived from these components. We apply correlative analysis, wavelet technique and recurrence plots. Generally our analysis shows a good quality of the Hel registration that agrees with the results of the other nearby stations. There are small inconsistencies in the registration of the H component during the time periods: 1982-1986 in the range of oscillations with periods of 480–280 days and 160–50 days; 1987 – 1989 and 1999 – 2001 with periods of about 300–260 days, and similarly in D component during the time periods: June 1971 – March 1974 in the range of oscillations with period of about 512 days and with periods 128-32 days; July 1979 – 70-50 days, July 1986 – Nov 1987 – 150-16 days, Feb 1991 – Jan 1992 – 256–64 days, July 1994 – Sep 1998 – 1450-1020 days and 256-40 days. Data from these periods ought to be corrected before further elaboration by a repeated read-out of original data types or by means of a neuron network calculations. The method used here is sensitive for the inconsistency of measured equally sampling time series and could be employed in other similar experimental cases.

✓

Meeting of the BBC Regional Network.

The regional peculiarities of the long-term trends in the upper atmosphere-ionosphere parameters and its coupling with climate changes by nightglow observations in Abastumani

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ABSTRACT

The post-twilight positive and midnight negative trends in the annual and seasonal mean values of the oxygen red OI 630.0 nm line nightglow intensities observed in Abastumani Astrophysical Observatory (AAO-41.75N, 42.82S) are used to establish a tendency of global cooling in the upper atmosphere-ionosphere regions accompanied by the global warming in the lower atmosphere. The positive trends in the thermosphere meridional wind in this region of Caucasus are determined, using the observed negative trend values of the ionosphere F2 layer peak height hmF2 and its maximum electron density NmF2 at the Tbilisi ionosphere station (41.65 N,44.75 E). The regional peculiarity in the trends of the oxygen molecule ions density ( ) of the ionosphere F2 region and the long-term descending in the red line luminous layer are noted. The significance of geomagnetic activity inter-annual and long-term variations in the red line intensity, which also have regional peculiarities, is noted as well. The non-stationary Chapman type height profiles of the F2 layer electron and ions density (taking into account the presence of thermospheric meridional wind) are used in theoretical estimations.

✓

SPACE WEATHER INVESTIGATIONS AND ACTIVITIES IN GREECE

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ABSTRACT

We present investigations and activities on Space Weather (SW) carried out in Greece. Greece hosts several SW assets, such as ionospheric stations, neutron monitor recordings and radio emission measurements. The National Kapodistrian University of Athens (NKUA) maintains the ARTEMIS-IV radio spectrograph and the Athens neutron monitor infrastructures, disseminating the GLE warning alert to the scientific community. Eruption prediction activities carried out in the Academy of Athens will be highlighted. The activities of the Hellenic National Space Weather Research Network in which several Universities and Research Institutes participate will also be presented. The National Observatory of Athens (NOA) has been involved in two SW related EU FP7 projects. The forecasting of SEP radiation storms and geomagnetic storms based on scientific data analysis and extensive modeling has been recently incorporated into an automated operational European Space Weather Alert system by the COMESEP consortium. We will present the aforementioned novel forecasting system and its building blocks. `SEPServer` focuses on the implementation of a comprehensive and up to date Solar Energetic Particle (SEP) analysis service including scientific data-driven analysis both for 1 AU and for > 1 AU using data from various spacecraft in the Heliosphere. SW research at NOA from the SEP perspective will be highlighted, including the analysis of SEPs and the associated electromagnetic emissions, the effect of the large-scale structure of the IMF on the particle propagation as well as investigations on the SEP sources, and acceleration processes operating on SEPs in terms of solar flares, ICMEs and their associated shocks.

✓

SEE/VarSITI Kickoff Meeting.

Feature Finding for Solar Physics

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ABSTRACT

NASA`s Solar Dynamics Observatory (SDO) data repository dwarfs the archives of all previous solar physics missions put together. The traditional methods of analyzing data-analyzing the images by hand - would simply not work and NASA tasked my Feature Finding Team (FFT) with developing automated feature recognition modules for solar phenomena likely to be observed by SDO. Having the derived metadata now available on-line enables to conduct statistical studies involving large sets of events that would be impossible now with traditional means.

First we developed some existing and new task-specific solar feature finding modules to be `pipe-line` ready for the stream of SDO data. Secondly, we took it upon us to develop an entirely new `trainable` module that would be capable of identifying different types of solar phenomena starting from a limited number of user-provided examples.

Next I will focus on our most innovative 'trainable' module, developed mostly at MSU in collaboration with Prof. Angryk and his students at the Computer Science department there. TFirst, there is the strong similarity between solar and medical X-ray images with regard to their texture, which allowed us to apply some advances made in medical image recognition. Second, we found that there is a strong similarity between the way our trainable module works and the way our brain recognizes images. The brain can quickly recognize similar images from key characteristics, just as our code does. We conclude that our approach represents the beginning of a more human-like procedure for computer image recognition.

✓

Cosmic factors of evolution of biosphere and geosphere. (review of the Interdisciplinary colloquium, May 21-23)

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Institute of Terrestrial Magnetism, Ionosphere and Radio-Wave Propagation (IZMIRAN)

ABSTRACT

Main topics. Connection to the SCOSTEP international program VarSITI. The young Sun: paradoxes and hypotheses. A review of ideas of life origin: from ancient times to the present day. The early stages of life evolution: archaeon, early proterozoic. Evolution of biosphere. The role of climate-ecosystems interaction in climate response to exterior impact. Geomagnetic reversal, its properties, causes, possible impact on biosphere. Cosmic rays as a factor of biosphere evolution, An estimate of the extreme energy of flares from the theoretical point of view. Estimation of the maximal height of solar cycle. The Maunder Minimum, its main characteristics and hypotheses of its origin. Live organism adjustment to cosmic factors impact: problems and prospective research.

✓

Origin of Solar Extreme Activity

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ABSTRACT

The observed sunspot record shows that the Sun's activity cycle entered a quiescent phase known as the Maunder minimum during 1645-1715 AD – during which very few sunspots were observed on the solar surface. Long-term solar activity reconstructions stretching over 10,000 years based on cosmogenic isotopes also point to the existence of multiple quiescent phases similar to the Maunder minimum. These observations indicate the Sun has resided in these grand minima phases intermittently, at other times displaying regular to higher than average activity levels. The magnetohydrodynamic dynamo mechanism which is invoked to explain the origin of the solar cycle should be able to explain this behaviour; however, this remains a challenging task. In this review, I will give an overview of extreme solar activity observations, their implications for the space environment and planetary climates and discuss theoretical efforts to understand the origin of such extreme solar activity fluctuations. These are some of the major focus areas that the SCOSTEP VarSITI program, Solar Evolution and Extrema (SEE), will seek to address.

However, explaining self-consistent entry and exit to and from these grand minima phases has been a long-standing challenge. Here, we present ideas to resolve this problem, and based on explicit simulations demonstrate how solar activity can go into quiescent minima phases but still recover back to normal or higher levels of activity.

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Solar Wind Evolution over Long-time Scales

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ABSTRACT

The study of other stellar systems can help us understand better our own solar system. By investigating solar-type stars at different evolutionary stages, one is able to understand how the Sun and the solar wind have evolved and also constrain the conditions that surrounded the young Earth. In this talk, I will present an overview of what we have learnt about other stellar systems with the goal of understanding the evolution of our Sun in a stellar context.

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Analysis of the current UV-index determination at Stara Zagora

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ABSTRACT

Since June 2011 a meteorological station Davis Vantage Pro 2 operates regularly at Stara Zagora. The station measures not only weather parameters but also the total solar radiation and the total UV solar radiation. It calculates the current value of the UV-index (UVI) as well. The influence of the cloudiness and the ozone on the current UVI near the solar noon (at 12.15 UT) is studied. The cloudiness is the most important parameter reducing the UVI determined by the seasonal changes of the total solar radiation. To describe the cloudiness a parameter depending on the top of atmosphere total solar radiation and the measured at the surface total solar radiation was used. During the period under study (June 2011 - April 2014) the ozone column varies in the range from 230 DU up to 470 DU and causes a reduction of the UVI from approximately 1.5 up to 3 units.

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Climate changes at polar latitudes

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ABSTRACT

By application of regression models strong temperature modulations in the Arctic connected with the Atlantic multidecadal oscillations (AMO) are observed. The remaining temperature slope is approximately 1 deg. C from 1920 up to now corresponding to 0.11 deg. C per decade. Not AMO climate impact is found in the Antarctic. In the Antarctic a tropopause inversion layer (TIL) is observed only during the austral autumn. In the Arctic a tropopause inversion layer of different size is observed during the whole year. The arctic tropospere is strongly isolated from the stratosphere by TIL while in the Antarctic climate warming processes are restricted. Probaly the very low surface temperatures in the inner East Antarctic have an influence on the temperature profile and the water vapour and cloud feedbacks are different in the Arctic and the Antarctic.

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