

РЕЗЮМЕТА НА НАУЧНИТЕ ТРУДОВЕ ИЗПОЛЗВАНИ ПРИ ПРИДОБИВАНЕ НА АКАДЕМИЧНАТА ДЛЪЖНОСТ „ПРОФЕСОР“

на доц. д-р Венета Христова Гинева,

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B4_1.

Long-term variations in the correlation between NAO and solar activity: The importance of north–south solar activity asymmetry for atmospheric circulation

Katya Georgieva^{a,*}, Boian Kirov^a, Peter Tonev^a, Veneta Guineva^a, Dimitar Atanasov^b

^a Solar-Terrestrial Influences Laboratory at the Bulgarian Academy of Sciences, Bl.3 Acad. G.Bonchev Str., 1113 Sofia, Bulgaria

^b Faculty of Mathematics and Informatics, Sofia University, 5 James Bourchier Boulevard, 1164 Sofia, Bulgaria

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Abstract

General atmospheric circulation is the system of atmospheric motions over the Earth on the scale of the whole globe. Two main types of circulation have been identified: zonal – characterized by low amplitude waves in the troposphere moving quickly from west to east, and meridional with stationary high amplitude waves when the meridional transfer is intensified. The prevailing type of circulation is related to global climate. Based on many years of observations, certain “circulation epochs” have been defined when the same type of circulation prevails for years or decades. Here we study the relation between long-term changes in solar activity and prevailing type of atmospheric circulation, using NAO index reconstructed for the last four centuries as a proxy for large-scale atmospheric circulation. We find that when the southern solar hemisphere is more active, increasing solar activity in the secular solar cycle results in increasing zonality of the circulation, while when the northern solar hemisphere is more active, increasing solar activity increases meridional cir- culation. In an attempt to explain the observations, we compare the short-term reaction of NAO and NAM indices to different solar drivers: powerful solar flares, high speed solar wind streams, and magnetic clouds.

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Keywords: NAO; Atmospheric circulation; Solar activity; CME; Solar flare; High speed solar wind

B4_2.

O₂ Density and Temperature Profiles Retrieving from Direct Solar Lyman-Alpha Radiation Measurements¹

V. Guineva^a, G. Witt^b, J. Gumbel^c, M. Khaplanov^c, R. Werner^a, J. Hedin^c, S. Neichev^d,
B. Kirov^e, L. Bankov^a, P. Gramatikov^d, V. Tashev^a, M. Popov^a, K. Hauglund^f,
G. Hansen^f, J. Ilstad^f, and H. Wold^f

^a Solar-Terrestrial Influences Laboratory (STIL), Bulgarian Academy of Sciences (BAS), Stara Zagora Department, Stara Zagora, Bulgaria

^b Department of Earth Sciences, The Hebrew University (HUJI), Jerusalem, Israel

^c Atmospheric Physics Group at the Department of Meteorology (MISU), Stockholm University, Stockholm, Sweden

^d Space Research Institute, Bulgarian Academy of Sciences (BAS), Sofia, Bulgaria

^e Solar-Terrestrial Influences Laboratory (STIL), Bulgarian Academy of Sciences (BAS), Sofia, Bulgaria

^f Andøya Rocket Range, Andenes, Norway

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Abstract—The resonance transition $2P-2S$ of the atomic hydrogen (Lyman-alpha emission) is the strongest and most conspicuous feature in the solar EUV spectrum. The Lyman-alpha radiation transfer depends on the resonance scattering from the hydrogen atoms in the atmosphere and on the O_2 absorption. Since the Lyman-alpha extinction in the atmosphere is a measure for the column density of the oxygen molecules, the atmospheric O_2 density and temperature profiles can be calculated thereof. A detector of solar Lyman-alpha radiation was manufactured in the Stara Zagora Department of the Solar-Terrestrial Influences Laboratory (STIL). Its basic part is an ionization camera, filled in with NO. A 60 V power supply is applied to the chamber. The produced photoelectric current from the sensor is fed to a two-channel amplifier, providing analog signal. The characteristics of the Lyman-alpha detector were studied. It passed successfully all tests and the results showed that the so-designed instrument could be used in rocket experiments to measure the Lyman-alpha flux. From the measurements of the detector, the Lyman-alpha vertical profile can be obtained. Programs are created to compute the O_2 density, atmospheric power and temperature profiles based on Lyman-alpha data. The detector design appertained to ASLAF project (Attenuation of the Solar Lyman-Alpha Flux), a scientific cooperation between STIL—Bul.Acad.Sci., Stara Zagora Department and the Atmospheric Physics Group at the Department of Meteorology (MISU), Stockholm University, Sweden. The joint project was part of the rocket experiment HotPay I, in the ALOMAR eARI Project, EU's 6th Framework Programme, Andøya Rocket Range, Andenes, Norway. The project is partly financed by the Bulgarian Ministry of Science and Education.

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B4_3.

Peculiarities of the auroral emissions during substorms associated with high-speed solar wind streams

V. Guineva^(1,*), I. Despirak⁽²⁾, E. Trondsen⁽³⁾, R. Werner⁽¹⁾

1. Space and Solar-Terrestrial Research Institute, BAS, Stara Zagora, Bulgaria.

2. Polar Geophysical Institute, RAS, Apatity, Murmansk region, 184209, Russia.

3. University of Oslo, Department of Physics, Oslo, Norway.

(*)Email: v_guineva@yahoo.com

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ABSTRACT:

The behaviour of the auroral emissions 5577 Å and 6300 Å and the ratio I_{6300}/I_{5577} during substorms occurred at the time of recurrent streams (RS) has been examined. The development of the substorm bulge is followed up. The variations of the emissions depending on the different locations of the substorm bulge with respect to the point of observation have been studied. Estimations of the particle precipitation spectra at the polar edge of the auroral bulge and inside it have been obtained. For the study, data from the All-Sky Imagers at Andøya Rocket Range (ARR), Andenes, Norway (69.3°N, 16.03°E) and at the Auroral Observatory, Longyearbyen, Svalbard (78.20°N, 15.83°E) from the observational season 2005-2006 have been used. Data access has been provided under the Project "ALOMAR eARI" (RITA-CT-2003-506208), Andenes, Norway. This Project received research funding from the European Community's 6th Framework Program. Additional data concerning the solar wind parameters, IMF and the magnetic field are used from the WIND satellite and the IMAGE magnetometer network to determine the recurrent streams and the substorms during RS.

Keywords: Aurora Emissions, Substorms, Auroral Bulge, Solar Wind High-Speed Streams.

Development of substorm bulges during storms of different interplanetary origins

I.V. Despirak^{a,n}, A.A. Lubchich^a, V. Guineva^b

^a Polar Geophysical Institute, RAS, Apatity, Murmansk Region 184200, Russia

^b Solar-Terrestrial Influences Institute, BAS, Stara Zagora 6000, Bulgaria

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abstract

Different solar wind structures are observed: magnetic clouds (MC), recurrent streams (RS), and regions of their interaction with undisturbed solar wind (Sheath and CIR). Three of these structures, Sheath, CIR, MC, are the sources of geomagnetic storms. We have searched for distinctions in the development of substorm bulges occurring during geomagnetic storms connected with the MC, Sheath and CIR. Solar wind parameters were taken from the Wind spacecraft and the auroral bulge parameters were obtained from the Ultra Violet Imager onboard Polar spacecraft. We determined the dimensions of the auroral bulges, the poleward aurora propagation, and the onset latitude of auroral bulges. It is shown that auroral bulges “geometry” is different for the examined types of storms. In consequence, the ratio between longitudinal and latitudinal sizes is also different.

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Analysis of variations and trends of the NO₂ slant column abundance obtained by DOAS measurements at Stara Zagora and at NDACC European mid-latitude stations in comparison with subtropical stations

Rolf Werner^{a,n}, Dimitar Valev^a, Atanas Atanassov^a, Veneta Guineva^a, Andrey Kirillov^b

^a Space Research and Technology Institute, BAS, Stara Zagora Department, Stara Zagora 6000, PO Box 73, Bulgaria

^b Polar Geophysical Institute of the Kola Science Centre RAS, Apatity 184209, Russia

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abstract

Daily time series of the NO₂ slant column amounts obtained by the GASCOD-BG instrument at Stara Zagora and by instruments at European NDACC stations near 40°N and of two subtropical stations are analyzed. Monthly averages are determined after the rejection of the extreme values. The series are homogenized, based on linear regression between neighbor stations, by interpolation and by filling data gaps with seasonal means.

To determine the linear trend a multiple linear regression model is used, including different impact factors as the solar activity, the aerosol loading, the El Niño impact. The QBO effect on the NO₂ variation is also checked. With small exceptions the examined data show no significant trends. A significant solar activity impact on NO₂ was determined only for the station at Mauna Loa. An influence of the south oscillation index was established for the Izaña station. The significances of the impacts are tested, taking into account the auto-correlation of the NO₂ residuals.

The density variations of the stratospheric NO₂ can change the ozone concentration, which in turn influences the radiative balance in the stratosphere and troposphere. This makes the NO₂ trend analysis important for the global climate change study.

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Particle-Precipitation Fine Structure during the Development of Substorms at High Latitudes

I. V. Despirak^a, V. Kh. Gineva^b, and Zh. V. Dashkevich^a

^a*Polar Geophysical Institute, Apatity Division, Kola Scientific Center, Russian Academy of Sciences, ul. Fersmana 14, Apatity, Murmansk oblast, 184209 Russia*

^b*Institute of Space Research and Technologies, Bulgarian Academy of Sciences, Stara Zagora, Bulgaria e-mail: despirak@pgia.ru*

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Abstract—The energy of precipitating particles that cause auroras can be characterized by the ratio of different atom and molecule emissions in the upper atmospheric layers. It is known that the spectrum of precipitating electrons becomes harder when substorms develop. The ratio of the I_{6300} red line to the I_{5577} green line was used to determine the precipitating-electron spectrum hardness. The I_{6300}/I_{5577} parameter was used to roughly estimate the electron energy in auroral arcs observed in different zones of the auroral bulge at the bulge poleward edge and within this bulge. The variations in the emission red and green lines in auroral arcs during substorms that occurred in the winter season 2007–2008 and in January 2006 were analyzed based on the zenith photometer and all-sky camera data at the Barentsburg and Longyearbyen (LYR) high-latitude observatories. It has been indicated that the average value of the I_{6300}/I_{5577} emission ratio for arcs within the auroral bulge is larger than this value at the bulge poleward edge. This means that the highest-energy electron precipitation is observed in arcs at the poleward edge of the substorm auroral bulge.

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Analysis of global and hemispheric temperature records and prognosis

Rolf Werner^{a,†}, Dimitar Valev^a, Dimitar Danov^b, Veneta Guineva^a, Andrey Kirillov^c

^aSpace Research and Technology Institute, Bulgarian Academy of Sciences, Stara Zagora Department, P. O. Box 73, 6000 Stara Zagora, Bulgaria

^bSpace Research and Technology Institute, Bulgarian Academy of Sciences, Acad. Gerogy Bonchev Str. Bl. 1, 1113 Sofia, Bulgaria

^cPolar Geophysical Institute of the Kola Science Centre, Russian Academy of Sciences, Apatity 184209, Russia

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Abstract

Climate changes are connected to long term variations of global and hemispheric temperatures, which are important for the work out of socio-political strategy for the near future. In the paper the annual temperature time series are modeled by linear multiple regression to identify important climate forcings including external climate factors such as atmospheric CO₂ content, volcanic emissions, and the total solar irradiation as well as internal factors such as El Niño-Southern oscillation, Pacific decadal oscillation and Atlantic multidecadal oscillation. Adjusted temperatures were determined by removal of all significant influences except CO₂. The adjusted temperatures follow a linear dependence toward the logarithm of the CO₂ content, and the coefficient of determination is about 0.91. The evolution of the adjusted temperatures suggests that the warming due to CO₂ from the beginning of the studied here time interval in 1900 has never stopped and is going on up to now.

The global warming rate deduced from the adjusted temperatures since 1980 is about 0.14 ± 0.02 °C/decade. The warming rate reported in the IPCC assessment report 4 based on observed global surface temperature set is about 20% higher, due to the warming by the Atlantic multidecadal oscillation additional to the anthropogenic warming.

The predicted temperature evolution based on long time changes of CO₂ and the Atlantic multidecadal oscillation index shows that the Northern Hemispheric temperatures are modulated by the Atlantic multidecadal oscillation influence and will not change significantly to about 2040, after that they will increase speedily, just like during the last decades of the past century. The temperatures of the Southern Hemisphere will increase almost linearly and don't show significant periodic changes due to Atlantic multidecadal oscillation. The concrete warming rates of course are strongly depending on the future atmospheric CO₂ content.

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Study of structural break points in global and hemispheric temperature series by piecewise regression

Rolf Werner^{a,†}, Dimitar Valev^a, Dimitar Danov^b, Veneta Guineva^a

^aSpace Research and Technology Institute, Bulgarian Academy of Sciences, Stara Zagora Department, P.O. Box 73, 6000 Stara Zagora, Bulgaria

^bSpace Research and Technology Institute, Bulgarian Academy of Sciences, Acad. Gerogy Bonchev Str. Bl. 1, 1113 Sofia, Bulgaria

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Abstract

The study of climate trends taking into consideration possible structural changes is important for understanding climate development characterized by a stochastic trend or by a determined one.

In the paper global and hemisphere temperature anomalies are modeled by piecewise linear regression and break points in the temperature evolution are found. It was demonstrated that the used method allowed finding of breaks characterized by long time trends (low frequency processes) as well as abrupt changes (fast frequency processes). The obtained break points for slow temperature change are close to the ones found by other authors however additional conditions (as segment length, gradient and others) are not used here. The results for higher break point numbers are like the ones of step slope models. It was demonstrated that the successive phases of warming and cooling and most of the break points subdividing these periods in the Northern Hemisphere are introduced by the Atlantic multidecadal oscillation. Because the strong quasi periodicity of the Atlantic multidecadal oscillation the authors recommend the removal of its influence on the temperature from the temperature series before studies of trends or structural changes. The Northern Hemisphere temperature data after the removal of the Atlantic multidecadal oscillation influence show structures like the Southern Hemisphere temperatures. Model selection by the Schwarz–Bayesian Information Criterion developed by Liu, Wu and Zidek (LWZ criterion) shows that models with only one break point are to be preferred.

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Keywords: Climate change; Global warming; Temperature structural changes

The influence of metastable molecular nitrogen $N_2(A^3\Sigma_u^+)$ on the electronic kinetics of CO molecules

A.S. Kirillov^{a,†}, R. Werner^b, V. Guineva^b

^aPolar Geophysical Institute of Russian Academy of Sciences, Academytown, 26A, Apatity, Murmansk Region 184209, Russia

^bSpace Research and Technology Institute, Bulgarian Academy of Sciences, Stara Zagora Department, P.O. Box 73, 6000 Stara Zagora, Bulgaria

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abstract

The simulation of $N_2(A^3\Sigma_u^+)$ and $CO(a^3\Pi)$ vibrational populations at the altitudes of Titan's upper atmosphere and for conditions of a laboratory discharge in the N_2 -CO mixture is made. The influence of metastable molecular nitrogen $N_2(A^3\Sigma_u^+)$ on the electronic excitation of CO molecules in inelastic collisions is studied. It is shown that the increase in the density of the Titan's atmosphere and of the discharge mixture leads to more significant excitation of lowest vibrational levels of $CO(a^3\Pi)$ by intermolecular electron energy transfers from $N_2(A^3\Sigma_u^+)$ in comparison with direct excitation of the $a^3\Pi$ state by free electrons.

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Observations of substorm auroras by MAIN cameras system in Apatity during two winter seasons: 2014/2015 and 2015/2016

V. Guineva^{a,*}, I.V. Despirak^b, R. Werner^a

^a Space Research and Technology Institute, BAS, Stara Zagora Department, Stara Zagora, Bulgaria

^b Polar Geophysical Institute, Apatity, Murmansk Region, 184200, Russia

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ABSTRACT

Data of the MAIN cameras (Multiscale Aurora Imaging Network) obtained at Apatity (Kola Peninsula, Russia) during two winter seasons (2014/2015 and 2015/2016) have been used to study the substorms during different solar wind conditions. Solar wind parameters were taken from the 1-min sampled OMNI data base (http://cdaweb.gsfc.nasa.gov/cdaweb/istp_public/). Auroral disturbances were verified by the data of IMAGE magnetometers and by data of the all-sky camera at Apatity. All substorms were divided into different groups depending on the geomagnetic activity. First, the substorms were separated into two groups: substorms observed during storms and substorms under non-storm conditions. The substorms during storms were divided in sub-groups according to observations during different phases of the storm: initial, main and recovery phases, and the recovery phase was divided in near and late recovery phase. We considered also substorms during “structured recovery phase”, when the SYM/H index behavior was highly irregular. The substorms during non-storm conditions were classified as substorms under quiet conditions, when no structures in the solar wind were observed, and as substorms occurred when structures in the solar wind near the Earth were detected, but these structures did not provoke geomagnetic storms. It was shown that the latitude of the substorm onset was controlled by the value of the SYM/H index. Substorms at higher values of SYM/H index occurred to the North from the station zenith, and at smaller SYM/H values – to the South from it. The boundary between both types of substorms in terms of SYM/H index is in the range from ~ -30 to ~ -55 nT. It was found out also that the maximal relative intensity of auroras was greater for substorms with onset to the South from Apatity and smaller - for substorms with onset in zenith or to the North from Apatity.

Г7_1.

ПЛОТНОСТЬ O₂ И ПРОФИЛИ РАСПРЕДЕЛЕНИЯ ТЕМПЕРАТУР, ПОЛУЧАЕМЫЕ С ПОМОЩЬЮ НЕПОСРЕДСТВЕННЫХ ИЗМЕРЕНИЙ ЛАЙМАНОВСКОГО АЛЬФА-ИЗЛУЧЕНИЯ

¹В. Гуинева, ²Г. Витт, ³Дж. Гамбел, ³М. Хапланов, ¹Р. Вернер, ³Дж. Хедин, ⁴С. Нейчев, ⁵Б. Киров, ¹Л. Банков, ⁴П. Граматиков, ¹В. Ташев, ¹М. Попов, ⁶К. Хаугланд, ⁶Г. Хансен, ⁶Дж. Илстэд, ⁶Х. Волд

O₂ DENSITY AND TEMPERATURE PROFILES RETRIEVING FROM DIRECT SOLAR LYMAN- ALPHA RADIATION MEASUREMENTS

¹V. Guineva, ²G. Witt, ³J. Gumbel, ³M. Khaplanov, ¹R. Werner, ³J. Hedin, ⁴S. Neichev, ⁵B. Kirov, ¹L. Bankov, ⁴P. Gramatikov, ¹V. Tashev, ¹M. Popov, ⁶K. Hauglund, ⁶G. Hansen, ⁶J. Ilistad, ⁶H. Wold

Резонансный переход атомарного водорода (лаймановское альфа-излучение) $2P-2S$ является самой яркой особенностью солнечного спектра в далекой ультрафиолетовой области. Перенос лаймановского альфа-излучения зависит от резонанса, рассеивающегося из атомов водорода в атмосферу, и от поглощения (радиоволн) кислородом. Поскольку ослабление лаймановского альфа-излучения в атмосфере является показателем столбов плотности молекул кислорода, из этого можно рассчитать профили плотности и температуры O₂ в атмосфере.

Отделением Лаборатории солнечно-земных воздействий (ЛСЗВ) в Стара Загора был изготовлен детектор солнечного лаймановского альфа-излучения. Базовая деталь – камера ионизации, заполненная NO. К камере подсоединен источник питания в 60 В. Производимый фотоэлектрический ток из датчика подается в 2-канальный усилитель, обеспечивая аналоговый сигнал.

Нами были проведены исследования характеристик детектора лаймановского альфа-излучения. Он успешно прошел все испытания, и результаты показали, что такой инструмент мог бы использоваться в экспериментах с участием ракет для измерения потока лаймановского альфа-излучения.

Вертикальный профиль лаймановского альфа-излучения можно получить по данным измерений детектора. Созданы программы для вычисления плотности O₂, атмосферной мощности и профилей распределения температур, основанных на данных лаймановского альфа-излучения.

Совместная конструкция детектора осуществлялась в рамках проекта ОСПЛАИ (Ослабление Солнечного Потока Лаймановского Альфа-Излучения), проекта научного сотрудничества между STIL – Болгарской академии наук, Отделение в Стара Загора, и Группой физики атмосферы в Отделении метеорологии стокгольмского Университета (ОМСУ), Швеция. Совместный проект был частью ракетного эксперимента NotPay I, в проекте ALOMAR eARI, 6⁰⁰¹ Рамочной Программы ЕС, Андоия Рокет Рейндж, Анденес, Норвегия.

Проект частично финансируется Болгарским министерством науки и образования.

The resonance transition $^2P-^2S$ of the atomic hydrogen (Lyman-alpha emission) is the strongest and most conspicuous feature in the solar EUV spectrum. The Lyman-alpha radiation transfer depends on the resonance scattering from the hydrogen atoms in the atmosphere and on the O_2 absorption. Since the Lyman-alpha extinction in the atmosphere is a measure for the column density of the oxygen molecules, the atmospheric O_2 density and temperature profiles can be calculated thereof.

A detector of solar Lyman-alpha radiation was manufactured in the Stara Zagora Department of the Solar-Terrestrial Influences Laboratory (STIL). Its basic part is an ionization camera, filled in with NO. A 60 V power supply is applied to the chamber. The produced photoelectric current from the sensor is fed to a 2 channels amplifier, providing analog signal.

The characteristics of the Lyman-alpha detector were studied. It passed successfully all tests and the results showed that the so-designed instrument could be used in rocket experiments to measure the Lyman-alpha flux.

From the measurements of the detector, the Lyman-alpha vertical profile can be obtained. Programs are created to compute the O_2 density, atmospheric power and temperature profiles based on Lyman-alpha data.

The detector design appertained to ASLAF project (Attenuation of the Solar Lyman-Alpha Flux), a scientific cooperation between STIL – Bul.Acad.Sci., Stara Zagora Department and the Atmospheric Physics Group at the Department of Meteorology (MISU), Stockholm University, Sweden. The joint project was part of the rocket experiment HotPay I, in the ALOMAR eARI Project, EU's 6th Framework Programme, Andøya Rocket Range, Andenes, Norway.

The project is partly financed by the Bulgarian Ministry of Science and Education.

Г7_2.

ИЗУЧЕНИЕ ВЛИЯНИЯ СОЛНЕЧНОЙ АКТИВНОСТИ НА АВРОРАЛЬНУЮ ЭМИССИЮ И ВЫСЫПАНИЕ ЭЛЕКТРОНОВ

¹В. Гуинева, ²Е. Трондсен, ³С. Марпл, ⁴К.М. Холл, ⁵П. Кэннон, ⁴Т.Л. Хансен

STUDY OF THE AURORAL EMISSIONS AND ELECTRON PRECIPITATION DEPENDING ON THE SOLAR ACTIVITY

¹V. Guineva, ²E. Trondsen, ³S. Marple, ⁴Ch.M. Hall, ⁵P. Cannon, ⁴T.L. Hansen

Для изучения взаимодействия Солнца–Земля при различных условиях использовались одновременные наблюдения за эмиссией OI 5577 Å и 6300 Å, высыпанием электронов, магнитным полем Земли и параметрами плазмы, а также данные показателей соответствующего солнечного ветра, межпланетного магнитного поля и геомагнитной активности. Изображения эмиссий 5577 Å и 6300 Å были получены на камере всего неба (All-Sky Imager), расположенном в ARR, Анденесе (69.3° N, 16.03° E). Благодаря использованию риометра изображений для изучения ионосферы (IRIS) в Килписъярви, Финляндия (69.05° N, 20.79° E), была получена информация о высыпании электронов с энергиями в диапазоне 10–100 кэВ, и высотами высыпания, центрированными примерно на 90 км. Компоненты магнитного поля измерялись магнитометром в Анденесе (69.3° N, 16.03° E). Основные параметры ионосферы были получены по данным дигизонда, расположенного в Тромсе (69.6° N, 19.2° E). Наблюдается хорошая корреляция между пространственными и временными эволюциями излучения в оптическом диапазоне, потоками высыпающихся электронов и магнитным полем Земли. Изучен отклик ионосферы на изменения солнечной и геомагнитной активности.

Исследование выполнено в рамках проекта, являющегося частью Проекта ALOMAR eARI, 6-ой Рамочной Программы ЕС, Анденес, Норвегия.

Simultaneous observations of the OI 5577 Å and 6300 Å emissions, the electron precipitation, the terrestrial magnetic field and the plasma parameters, and the corresponding solar wind, Interplanetary Magnetic Field and geomagnetic activity indices data have been used in order to study the Sun-Earth interactions under various conditions. Images of 5577 Å and 6300 Å emissions have been obtained from the All-Sky Imager (ASI), positioned at ARR, Andenes (69.3° N, 16.03° E). The Imaging Riometer for Ionospheric Studies (IRIS), at Kilpisjärvi, Finland (69.05° N, 20.79° E) gave information about the precipitating electrons with energies in the range 10–100 keV and deposition heights centered at about 90 km. The magnetic field components have been measured by the Andenes magnetometer (69.3° N, 16.03° E). The essential ionosphere parameters have been acquired from the measurements of the Digisonde, situated at Tromsø (69.6° N, 19.2° E). A good correlation between the spatial and temporal evolutions of the optical emissions, the precipitating electron fluxes and the terrestrial magnetic field has been observed. The response of the ionosphere to the solar and geomagnetic activity changes has been studied. The study is performed under a project, part from the ALOMAR eARI Project, EU's 6th Framework Programme, Andenes, Norway.

Г7_3.

FORECASTING SUNSPOT NUMBERS FOR SOLAR CYCLE 25 USING AUTOREGRESSIVE MODELS FOR BOTH HEMISPHERES OF THE SUN

Rolf Werner, Veneta Guineva

(Submitted by Corresponding Member P. Velinov on December 9, 2019)

Abstract

The SunSpot Numbers (SSNs), a proxy of the solar activity, were considered as a time series and their statistical characteristics were studied. The dynamic processes in both solar hemispheres are not strongly coupled. Hence, the progress of the solar cycles was described by autoregression (AR) models worked out for the first time separately for the Northern and the Southern hemispheres and by summation, the total SSNs were calculated. Semi-annual data were used. The model orders were determined by best approximation ex-ante prognosis using AR models of different order to the observed solar cycle

24. A similar procedure was applied to the new solar cycle 25. The SSN maximum in the Northern hemisphere should be achieved before the maximum in the Southern hemisphere. The solar activity in the southern hemisphere would be dominant. The maximum of the total SSNs of about 117 (with a confidence interval from 77 to 165) is predicted for 2023.

Key words: solar cycle 25, SunSpot Numbers (SSNs), forecast, autoregression (AR) models

Г8_1.

VARIATIONS OF SUBSTORMS CONNECTED WITH DIFFERENT SOLAR WIND CONDITIONS

Veneta Guineva¹, Irina Despirak², Boris Kozelov²

¹Space Research and Technology Institute – Bulgarian Academy of Sciences

²Polar Geophysical Institute, Apatity, Russia

e-mail: v_guineva@yahoo.com; despirak@pgia.ru; boris.kozelov@gmail.com

Abstract

All-sky cameras data at Kola Peninsula from 2012/2013 winter season have been used to study the variation of substorm development in different conditions of interplanetary medium. Solar wind and interplanetary magnetic field parameters were taken from CDAWeb (http://cdaweb.gsfc.nasa.gov/cdaweb/istp_public/). Using WIND satellite data for the examined periods, the different solar wind streams were revealed: recurrent streams from coronal magnetic holes (RS) and magnetic clouds (MC) connected with non-stationary processes at the Sun. It is known that these solar wind structures are the sources of geomagnetic storms. Furthermore, the storms originating from these sources differ in intensity, recovery phase duration, etc. We investigated substorm development during storms caused by different sources in the solar wind. Substorm onset time and further development were verified by ground-based data of IMAGE magnetometers network and by data of all-sky cameras at Apatity and Lovozero. The particularities in behaviour of substorms observed during storms connected with solar wind recurrent streams and with magnetic clouds are discussed.

Г8_2.

SUBSTORMS OVER APATITY DURING THE PERIOD OF ENHANCED GEOMAGNETIC ACTIVITY 7-17 MARCH 2012

Veneta Guineva¹, Irina Despirak², Boris Kozelov², Rolf Werner¹

¹Space Research and Technology Institute – Bulgarian Academy of Sciences

²Polar Geophysical Institute, Apatity, Russia e-mail: v_guineva@yahoo.com

Abstract

The period 7–17 March 2012 is one of the most geomagnetically active periods during the ascending phase of Solar Cycle 24. Therefore the solar and interplanetary phenomena during this period along with the consequent processes in the magnetosphere and ionosphere were object of study of the scientific society. The whole chain of events was discussed on several scientific conferences. The solar flares, coronal holes, coronal mass ejections, high speed solar wind streams and interplanetary shocks were identified and the resulting response of the magnetosphere and ionosphere was examined. Four strong geomagnetic storms occurred during this period. The substorms generated in this time are the final effect of all these events. Measurements of the Multiscale Aurora Imaging Network (MAIN) in Apatity (Russia) and data of IMAGE magnetometers network have been used to verify the substorms onset and subsequent development. The characteristics of these substorms were studied and they were compared to substorms originated during similar or different conditions.

SUBSTORMS MANIFESTATION AT HIGH AND MID-LATITUDES DURING TWO LARGE MAGNETIC STORMS

Veneta Guineva¹, Irina Despirak², Natalia Kleimenova³

¹Space Research and Technology Institute – Bulgarian Academy of Sciences

²Polar Geophysical Institute, Apatity, Murmansk region, Russia

³Schmidt Institute of the Earth Physics RAS, Moscow, Russia e-mail: v_guineva@yahoo.com

Keywords: Substorms, Geomagnetic storms, Auroral latitudes.

Abstract

The dynamics of magnetic substorms at high and middle latitudes during two severe geomagnetic storms: on 17 March 2015 and on 22–23 June 2015 has been analyzed. The storms were rather similar: both storms were a result of the solar wind Sheath impact and both storms were characterized by a strong intensity ($SYM/H_{min} < -200$ nT). We studied the magnetic substorms during these storms on the base of the INTERMAGNET and IMAGE networks data. The attendant solar wind and Interplanetary Magnetic Field (IMF) parameters were taken from the OMNI database. The spatial-temporal dynamics of three substorms was studied in detail: at 17:29 UT and at 22:55 UT during the first storm and at 18:33 UT during the second storm. The substorms on 17.03.2015 originated during the main storm phase, and the onset of the substorm on 22.06.2015 followed the storm sudden commencement (SSC) of the second storm. All three substorms were characterized by a sharp poleward expansion of the westward electrojet simultaneously with a slower motion to lower latitudes. They were observed also at middle and low latitudes as positive magnetic bays. The westward electrojet reached $\sim 71^\circ$ CGMLat during the first two substorms and surpassed 75° CGMLat during the third substorm. Therefore, the first two events were “classical” substorms, and the third one – an “expanded” substorm. We suggested that this behavior is related to the different solar wind conditions: the “classical” substorms developed under magnetic cloud (MC) conditions, and the “expanded” – under the Sheath region effect.

THE GLOBAL TEMPERATURE ANOMALIES RELATED TO THE SLOWDOWN OF ATMOSPHERIC CO₂ CONCENTRATION OBSERVED FROM 1939 UP TO 1950

Rolf Werner, Veneta Guineva

Space Research and Technology Institute – Bulgarian Academy of Sciences e-mail: rolwer52@yahoo.co.uk

Keywords: Global temperatures, Atmosphere, Temperature anomalies, CO₂.

Abstract

It is very well known that carbon dioxide (CO₂) accumulated in the atmosphere is the main climate driver. The first precise direct continuous measurements of the atmospheric CO₂ concentration were provided from Keeling since 1958 at Mauna Loa Observatory. The measurements are going on up to day. Law Dom ice core drilling was started in 1969 by the Australian ANARE program.

The slowdown of the World economic development during the World War I, the Great Depression and the World War II lead to a deceleration of the CO₂ emissions. The integration of the total CO₂ emissions using the impulse response function concept shows that the observed slowdown of the CO₂ emission is not sufficient to explain the CO₂ plateau and additional CO₂ sinks are necessary. Based on multiple regression models adjusted global temperatures were determined by removal of temperature influences other than related to CO₂. The adjusted temperatures follow close the CO₂ radiation term. The difference between the estimated adjusted temperature time evolution with and without the CO₂ slowdown and also the short time trends demonstrate very clear the close relation between the temperature change and the CO₂ radiative forcing. It is shown that the slowdown of the CO₂ emission in the period from 1939 to 1950 and the related CO₂ concentration in the atmosphere, caused at least partially by human activities, generate slower increase of the temperature anomalies. Consequently CO₂ is the leading variable of the relation surface temperature – CO₂.

Substorm observations in Apatity during 2012/13 winter season: a case study

Veneta Guineva¹, Irina Despirak², Boris Kozelov²

¹Space Research and Technology Institute, BAS, Stara Zagora, Bulgaria

²Polar Geophysical Institute, RAS, Apatity, Murmansk region, Russia

E mail (v_guineva@yahoo.com).

Accepted: 27 March 2015

Abstract All-sky camera data obtained at Apatity (Kola Peninsula) during 2012/2013 winter season and during December 2013 have been used to study the variation of substorm development during different conditions of the interplanetary medium. Solar wind and interplanetary magnetic field (IMF) parameters were taken from CDAWeb (http://cdaweb.gsfc.nasa.gov/cdaweb/istp_public/). Using WIND satellite data for the examined periods, the different solar wind streams were revealed: high speed streams from coronal magnetic holes (HSS) and magnetic clouds (MC) connected with non-stationary processes at the Sun. It is known that these solar wind structures are the sources of geomagnetic storms. Furthermore, the storms originating from these sources differ in intensity, recovery phase duration etc. We investigated substorm development during storms and during quiet conditions. Substorm onset time and further development were verified by ground-based data of IMAGE magnetometers network and Apatity all-sky camera. The particularities in the behaviour of substorms observed during storms and during quiet conditions are discussed.

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Key words: solar wind, substorms, auroras, westward electrojet

r8_6.

Substorms observations during two geomagnetically active periods in March 2012 and March 2015

Veneta Guineva¹, Irina Despirak², Boris Kozelov²

¹Space Research and Technology Institute, BAS, Stara Zagora, Bulgaria,

²Polar Geophysical Institute, Apatity, Murmansk region, Russia

e-mail: v_guineva@yahoo.com

Accepted. 1 March 2016

Abstract In this work two events of strong geomagnetic activity were examined: the period 7-17 March 2012, which is one of the most disturbed periods during the ascending phase of Solar Cycle 24, and the severe geomagnetic storm on 17-20 March 2015. During the first period four consecutive magnetic storms occurred on 7, 9, 12, and 15 March. These storms were caused by Sheath, MC and HSS, and the detailed scenarios for the storms were different. The second event is a storm of fourth level with $K_p = 8$, the strongest one during the last four years, the so-called "St. Patrick's Day 2015 Event". A geomagnetic storm of such intensity was observed in September 2011. Our analysis was based on the 10-s sampled IMAGE magnetometers data, the 1-min sampled OMNI solar wind and interplanetary magnetic field (IMF) data and observations of the Multiscale Aurora Imaging Network (MAIN) in Apatity. The particularities in the behaviours of substorms connected with different storms during these two interesting strongly disturbed periods are discussed.

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Key words: solar wind, storms, substorms, auroras

r8_7.

Ozone Determination by GUV 2511 Ultraviolet Irradiation Measurements at Stara Zagora

Rolf Werner¹, Boyan Petkov², Dimitar Valev¹, Atanas Atanassov¹, Veneta Guineva¹,
Andrey Kirillov³

¹Space Research and Technology Institute - BAS, Stara Zagora Department, Bulgaria

²Institute of Atmospheric Sciences and Climate (ISAC) - CNR, Bologna, Italy

³Polar Geophysical Institute (PGI) - RAS, Apatity, Russia

E mail (rolwer@yahoo.co.uk).

Accepted: 17 February 2017

Abstract A Ground-based Ultraviolet Radiometer (GUV) 2511 was installed at Stara Zagora, Bulgaria, in February 2015. The GUV 2511 instrument was designed to measure the downwelling global solar irradiances at UV wavelengths 305, 313, 320, 340, 380, 395 nm and the irradiance at the wavelength interval from 400 to 700 nm in the visible range. The instrument allows a realistic estimate of the total column ozone (TCO) in the atmosphere, the evaluation of the UV-index and the retrieval of the cloud optical thickness. This study presents the methodology of the TCO retrieval from measurements of the GUV instrument and some preliminary results of the retrieved TCO. In particular, the TCO has been assessed by comparing the ratio of irradiances registered at 313 and 340 nm, with the corresponding ratio computed through the Tropospheric Ultraviolet and Visible (TUV) radiation transfer model for different solar elevation angles and TCO. To avoid the effect of clouds, which are able to cause high-frequency variations in the measured solar irradiance and hence, impact the chosen ratio, the latter was approximated by a polynomial determined using trimmed regression before applying the comparison with the model. The results were compared with the TCO amounts provided by the Ozone monitoring instrument (OMI) on board the Aura satellite and the correlation coefficient between the OMI values and those retrieved by the GUV 2511 surface measurements, both referred to the Stara Zagora station, was found to be higher than 0.975.

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Keywords: Ozone, ground-based measurements, validation

r8_8.

Auroras observations of the MAIN in Apatity during 2014/15 winter season

Veneta Guineva¹, Irina Despirak², Boris Kozelov²

¹ Space Research and Technology Institute, BAS, Stara Zagora Department, Bulgaria

² Polar Geophysical Institute (PGI), Apatity, Murmansk region, Russia

E mail (v_guineva@yahoo.com).

Accepted: 16 March 2017

Abstract. In this work we review substorms, originated during the 2014/2015 winter 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 from CDAWeb (http://cdaweb.gsfc.nasa.gov/cdaweb/istp_public/). Auroral disturbances were verified by the 10-s sampled data of IMAGE magnetometers and by data of the all-sky camera at Apatity. Subject of the review 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.

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Key words: solar wind, substorms, auroras

r8_9.

Substorm observations by THEMIS D and ground-based observations by MAIN camera system in Apatity – a case study

Veneta Guineva¹, Irina Despirak², Rolf Werner¹

¹ Space Research and Technology Institute – BAS, Stara Zagora, Bulgaria

² Polar Geophysical Institute, Apatity, Murmansk region, Russia

E mail (v_guineva@yahoo.com).

Accepted: 14 May 2018

Abstract In this work we studied the development of a substorm during the geomagnetic storm on 23 December 2014 using data of THEMIS D (THD) satellite, ground based magnetic field measurements and auroras observations by the Multiscale Aurora Imaging Network (MAIN) in Apatity. Solar wind and interplanetary magnetic field parameters were taken from the OMNI data base. THD was located at ~ 7Re from 18:30 to 19:30 UT in the time interval 23-24 December 2014 and the projection of its orbit crossed Kola Peninsula in this time. A substorm was observed over Apatity from 19:19:50 UT on 24 December 2014. A comparative analysis between ground based and satellite data was carried out. High energy electrons (1-10 keV) injections and reduction of the less energetic electrons flux (~100 eV) were observed during the substorm. Particles density reduction was found at the time about the auroras intensifications. Plasma fast flows were identified during the consecutive auroras intensifications. The time delay between the beginning of the different parameters disturbances registered by THD and the ground based observed ones is about 1.0 ± 1.5 min.

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Keywords: solar wind, storms, substorms, auroras, THEMIS satellites measurements

PECULIARITIES OF AURORAL EMISSIONS DURING SUBSTORMS

Veneta Guineva¹, Irina Despirak², Rolf Werner¹, Espen Trøndsen³

¹ Space and Solar-Terrestrial Research Institute, BAS, Stara Zagora Department, Stara Zagora, Bulgaria

² Polar Geophysical Institute, Apatity, Russia

³ University of Oslo, Department of Physics, Oslo, Norway e-mail:
v_guineva@yahoo.com

Key words: aurora emissions, substorms, auroral bulge, solar wind high-speed streams.

Abstract: The auroral emissions 5577Å and 6300Å and their intensity ratio I_{6300}/I_{5577} during substorms have been examined. The development of the substorm bulge is studied by the behaviour of the emissions during the substorm movement towards North. Estimations about the nature of the particle precipitation spectra at the polar edge of the auroral bulge and inside it have been obtained. For the study, measurement data from the All-Sky Imagers at Andøya Rocket Range (ARR), Andenes, Norway (69.3°N, 16.03°E) and at the Auroral Observatory, Longyearbyen, Svalbard (78.20°N, 15.83°E) taken during the 2005-2006 observational season have been used.

Additional data including the solar wind parameters, IMF, the precipitating particles and the magnetic field are used from the WIND satellite and the IMAGE magnetometer network to determine the interplanetary conditions and the substorm development.

It is found out that the intensity emissions ratio is lower at the polar edge of the auroral bulge than inside it, which goes to show that the most energetic particle precipitation occurs at the polar edge of the substorm bulge.

F8_11.

TREND ANALYSIS OF THE STRATOSPHERIC NO₂ SLANT COLUMN ABUNDANCE AT STARA ZAGORA

Rolf Werner¹, Dimitar Valev¹, Atanas Atanasov¹, Veneta Guineva¹, Mariana Goranova², Andrej Kirilov³

¹ Space and Solar-Terrestrial Research Institute, Stara Zagora Department – Bulgarian Academy of Sciences

² Technical University Sofia, Faculty of Computer Systems and Control

³ Polar Geophysical Institute of the Kola Science Centre RAS, Apatity, 184209, Russia e-mail:rolwer52@yahoo.co.uk

Key words: climate change, trace gases, trend analysis

Abstract: Since August 1999, daily ground-based spectrometric measurements are carried out during sunrise and sunset at the Stara Zagora (42°N, 25°E) department of the SSTRI-BAS to determine the NO₂ slant column abundance by the help of the GASCOD-BG instrument. Increase or decrease of stratospheric NO₂ density can change ozone concentration, which acts on the radiative balance at the stratosphere and the troposphere. Therefore, the NO₂ trend analysis is very important for the global climate change study. The method described in detail in the paper consists of three stages. In the first one, the daily time series of the NO₂ slant column amounts are analysed and the extreme values, which can result from tropospheric pollutions or be connected with strong lightning processes, are removed. Next, the monthly averages are determined from the remaining daily values. In the second stage, a linear regression model is applied to describe the NO₂ time series components. In the third stage, the significances are tested, taking into account the auto-correlation of NO₂ data.

F8_12.

THE AURORAL 5577 Å AND 6300 Å EMISSIONS DURING SUBSTORMS

Veneta Guineva¹, Irina Despirak², Rolf Werner¹

¹ Space Research and Technology Institute – Bulgarian Academy of Sciences ² Polar Geophysical Institute, RAS, Apatity, Murmansk region, 184200, Russia e-mail:
v_guineva@yahoo.com

Keywords: Aurora emissions, substorms, auroral bulge, polar edge boundaries.

Abstract: The 5577 Å and 6300 Å emissions intensities have been studied during substorms development. The emissions intensities in front of the polar edge of the auroral bulge, in the polar edge and inside it have been compared and estimations about the nature of the particle precipitation spectra in these regions have been made.

Data from two All-Sky Imagers: at Andenes (69.3°N, 16.03°E) and at Longyearbyen, Svalbard (78.20°N, 15.83°E), Norway from 2005-2006 observations have been used. The interplanetary conditions have been determined by WIND satellite data. The substorm development has been followed up by the magnetic field components data from the IMAGE magnetometer network. Different methods to determine the boundaries of the polar edge of the substorm auroral bulge are examined. A simple threshold method is applied (in our case an increase of the 5577 Å emission intensity above its mean value by 1σ - least square deviation). The boundaries of the bulge polar edge were evaluated and analyzed by Chow test, as well. The obtained by both methods boundaries coincide very well.

Г8_13.

СТРУКТУРНИ ИЗМЕНЕНИЯ ВЪВ ВРЕМЕВИТЕ РЕДОВЕ НА ГЛОБАЛНИТЕ И ПОЛУСФЕРНИТЕ ТЕМПЕРАТУРИ

Ролф Вернер, Димитър Вълев, Димитър Данов, Венета Гинева

Институт за космически изследвания и технологии – Българска академия на науките
e-mail: rolwer52@yahoo.co.uk

Ключови думи: климатични промени, глобални температури, структурни изменения

Резюме: Времевите редове на глобалната температура показват нарастване и намаляване на температурата в продължение на десетилетия. Редовете са изследвани за наличието на структурни изменения, за да бъде намерен отговор на въпроса дали след 1998 г. температурата намалява значително. Използван е методът на линейната регресия с поставени допълнителни условия за дадени интервали и са определени точките на структурни промени. В зависимост от използвания времеви ред те са разположени около 1910 г., 1940 г. 1970г. Намерена е точка на бърза структурна промяна за 1996/1997г. за северната полусфера.

Г8_14.

FINE STRUCTURE OF THE PARTICLE PRECIPITATIONS DURING SUBSTORM DEVELOPMENT AT HIGH LATITUDES

Veneta Guineva¹, Irina Despirak², Rolf Werner¹

¹Space Research and Technology Institute – Bulgarian Academy of Sciences

²Polar Geophysical Institute (PGI), RAS, Apatity, Russia e-mail:
v_guineva@yahoo.com

Key words: Aurora emissions, substorms, auroral bulge

Abstract: The fine structure of the particle precipitations during substorms was studied by data of aurora observations at 2 high latitude stations – Barentsburg (Russia) and Longyearbyen (Norway). The intensities ratio $I_{6300\text{Å}}/I_{5577\text{Å}}$ which is considered as a characteristic of the hardness of the precipitated electrons spectrum was used to estimate roughly the electrons energy in the arcs observed in different parts of the substorm bulge – at its polar edge and inside it. Simultaneous data from the zenith photometer and TV camera in Barentsburg, data from the all-sky imager in Longyearbyen and IMAGE magnetometers chain data were used. The following spectral characteristics were examined: the green line intensity $I_{5577\text{Å}}$ in zenith, the red line intensity $I_{6300\text{Å}}$ in zenith and their ratio $I_{6300\text{Å}}/I_{5577\text{Å}}$. It was shown that the ratio $I_{6300\text{Å}}/I_{5577\text{Å}}$ for arcs inside the bulge is higher than the one for arcs at the polar edge of the bulge. This indicates that the most energetic electrons were observed at the polar edge of the auroral bulge.

METHOD OF DETERMINATION OF THE SOLAR RADIATION EXTINCTION BY THE OXYGEN MOLECULES IN THE ATMOSPHERE

Veneta Guineva, Rolf Werner

Space Research and Technology Institute – Bulgarian Academy of Sciences e-mail:
v_guineva@yahoo.com; rolwer52@yahoo.co.uk

Keywords: O₂ atmospheric system, absorption, single scattering

Abstract: A method to compute the solar radiation extinction by the molecular oxygen in the atmosphere is developed. Absorption and single scattering towards the observer are included in the extinction model. Plane parallel, 100 km high atmosphere divided into layers with equal thickness is assumed. A computation following the “line-by-line” method is envisaged – the calculations are implemented consecutively for each rotational line from A (0,0) and b (1,0) bands of the oxygen atmospheric system.

r8_16.

A METHOD TO COMPUTE THE ATMOSPHERIC O₂ EXTINCTION SPECTRUM – ANALYSIS AND ESTIMATE OF SOME INPUT PARAMETERS

Veneta Guineva¹, Rolf Werner¹, Andrey Kirillov²

¹Space Research and Technology Institute – Bulgarian Academy of Sciences

²Polar Geophysical Institute, Apatity, Russia e-mail:
v_guineva@yahoo.com

Keywords: O₂ atmospheric system, absorption, single scattering

Abstract: A method to compute the solar radiation extinction by the molecular oxygen in the atmosphere was developed. Absorption and single scattering towards the observer were included in the extinction model. Plane parallel atmosphere divided into layers with equal thickness was assumed. A computation following the “line-by-line” method was applied – the calculations were implemented consecutively for each rotational line from A (0,0) band of the oxygen atmospheric system. Study of some needed input parameters was carried out. The optimal number of included transitions and the optimal values of the atmospheric layers thickness and of the upper limit of the atmosphere were estimated. In the purpose of the study, the radiation extinction at different angles of observation and using different atmosphere model parameters was computed. 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 models and different observation angles. The corresponding temperatures and atmospheric heights were obtained.

r8_17.

THE DISTRIBUTION OF SOLAR PROTON ENERGY ON ELECTRONIC STATES OF MOLECULES IN THE MIXTURE OF N₂, O₂, CO, CO₂ GASES

Andrey Kirillov¹, Rolf Werner², Veneta Guineva²

¹Polar Geophysical Institute – Russian Academy of Sciences Apatity,
Murmansk region, Russia

²Space Research and Technology Institute – Bulgarian Academy of Sciences e-mail:
kirillov@pgia.ru

Abstract: Precipitations of intensive fluxes of high-energy solar protons in the atmospheres of terrestrial planets cause electronic excitation of main molecular components of the atmospheres. Electronically excited molecules play very important role in chemical balances of the atmospheres. Recent investigations of Seppala et al. [2008] and Lillis et al. [2012] consider the precipitations of solar energetic particles in the atmospheres of Earth and Mars,

consequently. The main aim of our studies is the development of a model of electronic and vibrational kinetics of molecular components in the atmospheres of terrestrial planets. The calculated quenching rate coefficients of electronically excited molecules are applied in the simulations of vibrational populations of N₂, CO, O₂ electronic states in the mixture of N₂, O₂, CO, CO₂ gases. We consider electronic kinetics of triplet states of N₂ and CO and the kinetics of Herzberg states of O₂. The calculations are made for the altitudes of middle atmospheres of Earth and Mars.

Г8_18.

СУББУРИ НАД АПАТИТИ ПО ВРЕМЕ НА СИЛНИ ГЕОМАГНИТНИ БУРИ ПРЕЗ СЛЪНЧЕВ ЦИКЪЛ 24

Венета Гинева¹, Ирина Деспирак², Борис Козелов², Ролф Вернер¹

¹Институт за космически изследвания и технологии – Българска академия на науките

²Полярен геофизически институт, ФАНО, Апатити, Русия е-мейл:
v_guineva@yahoo.com

Ключови думи: аврорални емисии, суббури, геомагнитни бури

Резюме: Разгледани са три периода с висока геомагнитна активност: 8-10 март 2012, 17-18 март 2013 и 17-21 март 2015 г., през които са регистрирани геомагнитни бури със SYM/H индекс по-малък от -100 nT. Изследвани са суббурите, възникнали през тези периоди. За тази цел са използвани данните от системата камери Multiscale Aurora Imaging Network (MAIN) в Апатити. За параметрите на слънчевия вятър и междупланетното магнитно поле е използвана базата данни OMNI. Определени са различните потоци в слънчевия вятър, свързани с възникването на геомагнитни бури. Началото на суббурите и последвалото им развитие е потвърдено по данните от all-sky камерата в Апатити и мрежата магнитометри IMAGE. Сравнени са суббурите по време на различните фази на геомагнитните бури.

Г8_19.

ОПРЕДЕЛЯНЕ НА СЪДЪРЖАНИЕ НА ОЗОНА ЧРЕЗ GUV 2511 В СТАРА ЗАГОРА

Ролф Вернер¹, Боян Петков², Димитър Вълев¹, Атанас Атанасов¹, Венета Гинева¹, Андрей Кирилов³

¹Институт за космически изследвания и технологии – Българска академия на науките

²Институт за атмосферните науки и климата, Съвет за Национални изследвания, Болоня, Италия

³Полярен геофизичен институт, Апатити, Русия е-mail:
rolwer52@yahoo.co.uk

Ключови думи: Озон, наземни измервания

Резюме: През февруари 2015 г. в Стара Загора беше инсталиран наземен ултравиолетов радиометър (GUV) 2511. Уредът GUV 2511 е предназначен за измерване на преминаващата през атмосферата слънчева радиация с дължина на вълната 305, 313, 320, 340, 380, 395 nm и на радиацията във видимата област 400-700 nm. Уредът позволява получаването на общото съдържание на озон (ОСО) в атмосферата, определянето на UV индекса и пресмятането на оптичната дебелина на облачната покривка. В работата са представени първите резултати от измерванията. Методологията да се извлече ОСО от измерванията се основава на изчисляването на отношението 314 nm/340 nm чрез тропосферния UV и VIS (TUV) модел за радиационния пренос. Получените за деня отношения 314 nm/340 nm са апроксимирани с полином, за да се намали влиянието на облачността при определянето на концентрацията на озон. Получените резултати са сравнени с ОСО, определено по измервания на Ozone Monitoring Instrument (OMI) на борда на спътник Aura. Корелацията между стойностите на ОСО, определени от OMI и GUV 2511 за местоположението на Стара Загора, е по-добра от 0.97.

STUDY OF THE SUBSTORMS OBSERVED OVER APATITY IN 2015/2016 SEASON

Veneta Guineva¹, Irina Despirak², Boris Kozelov², Rolf Werner¹

¹Space Research and Technology Institute – Bulgarian Academy of Sciences

²Polar Geophysical Institute, Apatity, Russia e-mail:

v_guineva@yahoo.com

Keywords: substorms, aurora emissions, geomagnetic storms

Abstract: In this work the substorms, registered during the 2015/2016 observational season over Apatity, are examined. Observations of the Multiscale Aurora Imaging Network (MAIN) in Apatity have been used. Solar wind and interplanetary magnetic field parameters were taken from the 1-min sampled OMNI data base. Substorm onset was specified and the further substorm development was followed by the 10-s sampled data of IMAGE magnetometers data set and by images and keograms of the all-sky and GC cameras in Apatity. Subject of the study were the characteristics of substorms originated during different geomagnetic conditions. The behaviour of the substorms developed during geomagnetic storms and in non-storm time was discussed.

Г8_21.

ВТОРИЧНА ЕЛЕКТРОЗАХРАНВАЩА СИСТЕМА ЗА КОСМИЧЕСКИ ПРИБОР „ASLAV“ - ДЕТЕКТОР НА СЛЪНЧЕВО ЛАЙМАНОВСКО АЛФА-ИЗЛЪЧВАНЕ

Павлин Граматиков, Венета Гинева

Институт за космически изследвания и технологии – Българска академия на науките

e-mail: pgramatikov@space.bas.bg ; v_guineva@yahoo.com

Ключови думи: Вторични източници за хранване, проектиране на ключови източници за хранване, вторични електрохранващи системи, ефективност на електрохранващите източници,

Резюме: За удовлетворяване на техническите изисквания на европейска ракета-носител към бордни вторични електрохранващи системи (ВЕС) на космически прибор са реализирани редица авторски решения. Приложено е ново решение в схемата за ограничаване на пусковия ток. Използвана е нова схемотехника при свързването на мощна високоволтова интегрална схема в нисковолтов режим, с цел висока надеждност. Изследвано е техническо решение за повишаване на КПД в режим на малки сигнали в схема Flyback.

Г8_22.

DETERMINATION OF THE UV-INDEX USING MEASUREMENTS PERFORMED BY THE GUV 2511 INSTRUMENT AT STARA ZAGORA

Rolf Werner¹, Dimitar Valev¹, Veneta Guineva¹, Andey Kirillov², Boyan Petkov³

¹Space Research and Technology Institute – Bulgarian Academy of Sciences, Bulgaria ²Polar Geophysical Institute, - Russian Academy of Sciences - Apatity, Russia ³Institute of Atmospheric Sciences and Climate - CNR - Bologna, Italy

e-mail: rolwer52@yahoo.co.uk

Keywords: solar irradiance, total ozone, cloud optical depth, UV-index

Abstract: The UV-index (UVI) is a measure of the power of the UV irradiances at an Earth surface location weighted by the erythema action spectrum. The UVI is influenced mainly by the cloudiness and by the stratospheric ozone content. For public forecasts of the UVI, the maximum daily values UVI are given for clear- sky (cloudless) conditions taking

into account only the variations produced by the ozone UV absorption.

Based on the Tropospheric Ultraviolet and Visible (TUV) Radiation Transfer Model, look up tables were calculated. The tables describe the dependences of the UVI from the zenith angle, the total ozone content and the optical depth of the atmosphere, where the physical parameters were calculated using GUV 2511 measurements. The erythema UVI shows a typical for 40° N maximum between 8.5 and 10 during the summer months. During the same time interval at some days UVI between 3 and 6 are observed due to strong clouds. It was found out that the determined clear-sky erythema UVI for Stara Zagora is in good agreement with the satellite based overpass UVI for Sofia published at the Temis web site (<http://www.temis.nl/uvradiation/UVindex.html>).

Г8_23.

FORECAST SCHEME OF THE LOCAL UV-INDEX OVER BULGARIA – FIRST TEST RESULTS

Rolf Werner¹, Boyan Petkov², Dimitar Valev¹, Veneta Guineva¹, Atanas Atanassov¹,
Dimitar Danov¹, Andey Kirillov³

¹Space Research and Technology Institute – Bulgarian Academy of Sciences, Bulgaria ²Institute of Atmospheric Sciences and Climate – Council of National Researches, Italy ³Polar Geophysical Institute – Russian Academy of Sciences - Apatity, Russia
e-mail: rwerner@space.bas.bg

Keywords: Solar irradiance, total ozone, UV-index

Abstract: The UV-index (UVI) is a measure of the erythemally effective solar radiation reaching the Earth surface. It was introduced to alert people about the need of sun protection and to help for elaborating recommendations about safety exposure to solar UV radiation. Therefore, the UVI has to be determined with adequate accuracy and its forecast appears to be an essential task. To minimize the risk of too high sunburn levels, the UVI previsions are usually made for clear sky conditions (cloud and aerosol free atmosphere). In such conditions, the solar UV irradiance over a given geographical location depends mainly on the total ozone column (TOC) and thus, the UVI forecast implicates the knowledge of the TOC. Schemes of one-day UVI forecast for Stara Zagora and Bulgaria are presented and discussed in the present report. A detailed analysis has been supported by results of the first tests performed from 19th Sep. to 19th Oct. 2019.

Г8_24.

СТАТИСТИЧЕСКИ АНАЛИЗ НА ВРЪЗКАТА МЕЖДУ ТЕМПЕРАТУРАТА И СУМАРНАТА СЛЪНЧЕВА ЕНЕРГИЯ В БАЗОВА ОБСЕРВАТОРИЯ ПРИ ИКИТ, СТАРА ЗАГОРА

Димитър Вълев, Веселин Ташев, Ролф Вернер, Венета Гинева

Секция „Атмосферни оптични изследвания“ при ИКИТ – БАН, Стара Загора e-mail:
valev@gbg.bg

Ключови думи: сумарна слънчева енергия, приземна температура на въздуха, корелация

Резюме: Изследвани са редовете за температурата и сумарната слънчева енергия по данни от Метеорологичната станция Vantage Pro2 Plus инсталирана в района на Базова обсерватория при ИКИТ, Стара Загора. Данните обхващат периода от инсталирането на станцията през юни 2011г. до септември 2019 г. Посредством линеен регресионен анализ е установена висока корелация с $r = 0.90$ между месечните температури и сумарната месечна слънчева енергия. По такъв начин бе показано статистически, че решаващият фактор за формиране на месечната температура на приземния въздух се явява сумарната месечна слънчева енергия, а всички останали фактори имат второстепенно значение. На следващия етап посредством кроскорелационен анализ е показано, че средните месечни температури изостават с 1 месец след сумарната слънчева енергия. Най-вероятната причина за изоставането се явява топлинната инертност на подложната повърхност и ниската атмосфера. Това създава възможност за подобряване точността на прогнозата за средната месечна температура.

STRUCTURAL CHANGES IN GLOBAL TEMPERATURES TIME SERIES

R. Werner¹, D. Valev¹, D. Danov², V. Guineva¹

Abstract. *The global temperatures are the mean temperatures over the whole globe - over the land and ocean. For the determination are build world wide nets by the World Meteorological Organization. We are used global temperature time series of the Goddard Institute of Space Studies, the Met office Hadley Center and Climatic Research Unit and of the National Climatic Data Centre. The time series show decreasing or increasing of temperature during a time span of decades. The series are studied for structural breaks, to found the answer of the question, if the increase of the global temperature after 1998 if any, is statistically significant. It is used the method of piecewise regression was applied and the structural break points were determined. Depending on the used time series structural break points were localized near 1910, 1940, 1970 and 2005. However the trend after the structural break point 2005 is not statistically significant.*

Key words: climate change, global temperatures, structural changes

ОПРЕДЕЛЯНЕ НА ГРАНИЦИТЕ НА ПОЛЯРНИЯ КРАЙ НА СУББУРЕВАТА АВРОРАЛНА ИЗПЪКНАЛОСТ

Венета Гинева, Ролф Вернер

Резюме. *Представени са някои резултати за поведението на авроралните емисии по време на суббури. Използвани са данни от измерванията на нощните кислородни емисии 5577 Å и 6000 Å от all-sky камерите в Анденес, (69.3°N, 16.03°E) и Лонгиербиен, Шпицберген (78.20°N, 15.83°E), Норвегия. Разгледани са различни методи за определяне на границите на полярния край на суббуревата аврорална изпъкналост. Приложен е прост метод с използване на праг (в случая нарастване на интензивността на емисията 5577 Å с 1σ -средно квадратично отклонение). Границите на полярния край на изпъкналостта са определени и анализирани чрез Chow тест. Получените по двата метода граници съвпадат много добре.*

Ключови думи: аврорални емисии; суббури; аврорална изпъкналост; граници на полярния край на авроралната изпъкналост.

МЕТОД ЗА ПРЕСМЯТАНЕ НА ЕКСТИНКЦИЯТА НА СЛЪНЧЕВАТА РАДИАЦИЯ ОТ МОЛЕКУЛНИЯ КИСЛОРОД В АТМОСФЕРАТА

Венета Гинева, Ролф Вернер

Резюме. *Разработен е метод за пресмятане на екстинкцията на слънчевата радиация от молекулния кислород в атмосферата при регистрация на слънчевия спектър под определен ъгъл спрямо хоризонта. В*

пресмятанята са включени абсорбция и еднократно разсейване в посока на наблюдателя от кислородните молекули. Разглежда се плоско паралелна атмосфера с височина 100 км, разделена на слоеве с дебелина 2 км. Прилага се пресмятане по метода „линия по линия“ – изчисленията се извършват последователно за всяка ротационна линия от ивиците A и b на атмосферната система на кислорода.

Ключови думи: абсорбция, еднократно разсейване, теоретично пресмятане, молекулен кислород.

Г8_28.

ANALYSIS OF GLOBAL AND HEMISPHERIC TEMPERATURE SERIES – STRUCTURAL CHANGES AND THE INFLUENCE OF THE ATLANTIC MULTIDECADAL OSCILLATION

Rolf Werner, Dimitar Valev, Dimitar Danov and Veneta Guineva

Abstract

In the paper global and hemisphere temperature anomalies are modeled by piecewise linear regression and break points locations are determined. It was demonstrated that the used method allows obtaining of structures characterized by long time trends (low frequency processes) as well as abrupt changes (fast frequency processes). The obtained structures of the temperature series for higher breakpoint numbers are like the structures determined by step slope models. It was demonstrated that an important part of the change point structures in the Northern Hemisphere was associated with variations of the Atlantic multidecadal oscillations.

Key words: climate change, global and hemispheric temperatures, structural changes, Atlantic multidecadal oscillation

Г8_29.

МОДЕЛИРАНЕ НА ЕКСТИНКЦИЯТА НА СЛЪНЧЕВАТА РАДИАЦИЯ ОТ КИСЛОРОДА В АТМОСФЕРАТА

Венета Гинева, Ролф Вернер

Резюме. Разработен е метод за пресмятане на екстинкцията на слънчевата радиация от молекулен кислород в атмосферата. В модела на екстинкцията са включени абсорбция и еднократно разсейване към наблюдателя при регистрация на слънчевия спектър под различни ъгли спрямо хоризонта. Атмосферата се приема за плоско паралелна, с височина 100 км. Разглеждат се успоредни слоеве с различна дебелина. Установено е, че за точно пресмятане на спектрите трябва да се разглеждат слоеве, не по-дебели от 1 км. Приложено е пресмятане по метода „линия по линия“ за ивиците A (0,0) и b (1,0) на

атмосферната система на кислорода. Пресметната е екстинкцията при различни ъгли на наблюдение и са анализирани получените спектри.

Ключови думи: абсорбция, еднократно разсейване, теоретично пресмятане, молекулен кислород.

Г8_30.

МЕТОД ЗА ОПРЕДЕЛЯНЕ НА СПЕКТЪРА НА ЕКСТИНКЦИЯ НА АТМОСФЕРНИЯ КИСЛОРОД И ПРИЛОЖЕНИЕТО МУ ЗА АНАЛИЗ НА СПЕКТРОМЕТРИЧНИ ИЗМЕРВАНИЯ

Венета Гинева, Ролф Вернер

A METHOD TO DETERMINE THE EXTINCTION SPECTRUM OF ATMOSPHERIC OXYGEN AND ITS APPLICATION TO ANALYSE SPECTROMETRIC MEASUREMENTS

Veneta Guineva, Rolf Werner

Abstract. A method to compute the extinction of the solar radiation by the molecular oxygen in the atmosphere was developed including absorption and single scattering towards the observer when the solar spectrum was registered under different angles towards horizon. Plane parallel atmosphere 60 km high was assumed. Parallel layers with 1 km thickness were considered. A computation following the "line-by-line" method was applied for A (0,0) band of the oxygen atmospheric system. The radiation extinction at different angles of observation was computed and the obtained spectra were analyzed. The computed theoretical spectra can be used to model the real measurements conditions. They are needed to process correctly the measurements.

Ground based measurements of O₂ extinction were processed by means of theoretical spectra, computed for the same conditions. The obtained registered and computed spectra coincide very well. By the use of theoretical estimates and spectrometric measurements the corresponding temperature of the atmosphere can be determined.

Key words: atmospheric oxygen extinction, absorption, single scattering, theoretical spectra, ground based measurements.

Г8_31.

STATISTICAL ANALYSIS OF NORTHERN HEMISPHERIC TEMPERATURE RECORDS OVER LAND AND OVER OCEAN

Rolf Werner, Dimitar Valev, Dimitar Danov, Veneta Guineva

The temperature records from leading climate research institutions were analysed by linear multiple regression for the determination of the influence on the surface temperature of important external climate factors as atmospheric CO₂ content and the total solar irradiation as well internal factors as volcanic emissions, El Nino oscillations, Pacific decadal oscillation (PDO) and Atlantic multidecadal oscillation (AMO). AMO is related to the heat transfer from the tropics to the Northern Atlantic by the thermohaline circulation. Adjusted temperatures were determined by removal of all significant influences except CO₂. The adjusted temperatures follow a linear dependence toward the logarithm of the CO₂ content. The results

obtained in the present paper outlined that the temperatures are higher over land, manifested in higher CO₂ term regression coefficients. The short wave radiation temperature impact over ocean is smaller than over land due to the high heat capacity of the ocean. In consequence the outgoing long wave radiation from the ocean is smaller than over the land. A strong AMO influence on the temperature is found in the Northern Hemisphere surprisingly of the same order over land and over ocean. The reasons can be more complex but an effective atmospheric exchange between ocean and land air masses plays probably an important role.

Keywords: climate change; multidecadal variability; climate impacts; long time trends; warming rates; forecast

Г8_32.

SUBSTORMS OVER APATITY DURING 7-17 MARCH 2012 BY GROUND BASED MEASUREMENTS

Veneta Guineva, Irina V. Despirak, Boris V. Kozelov,

Rolf Werner

Abstract. The period 7-17 March 2012 is one of the most geomagnetically active periods during the ascending phase of Solar Cycle 24. The whole chain of events was discussed on several scientific conferences. Four strong geomagnetic storms occurred during this period. The substorms generated in this time are the final effect of all ongoing events. Measurements of the **Multiscale Aurora Imaging Network (MAIN)** in Apatity and data of IMAGE magnetometers network have been used to verify the substorms onset and subsequent development. The particularities in the behaviours of these substorms connected with different phases of the geomagnetic storms are discussed.

Key words: aurora emissions, substorms, geomagnetic storms

Г8_33.

GUV 2511 INSTRUMENT INSTALLATION IN STARA ZAGORA AND FIRST RESULTS

R. Werner, B. Petkov, A. Atanassov, D. Valev, V. Guineva,

E. Roumenina, A. Kirillov

Abstract. 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 and the methodology to derive TCO is described. The obtained results were compared with TCO determined by satellite observations.

Keywords: ozone monitoring, retrieval methods

BEHAVIOR OF THE 5577Å AND 6300Å EMISSIONS DURING SUBSTORMS CONNECTED WITH RECURRENT SOLAR WIND STREAMS

V.H. Guineva¹, I.V. Despirak², R.Werner¹, E. Trondsen³

1. *Space and Solar-Terrestrial Research Institute, BAS, Stara Zagora, Bulgaria, e-mail: v_guineva@yahoo.com;*
2. *Polar Geophysical Institute, RAS, Apatity, Murmansk region, 184209, Russia;*
3. *University of Oslo, Department of Physics, Oslo, Norway;*

Abstract. The behaviour of the auroral emissions 5577Å and 6300Å and the ratio I_{6300}/I_{5577} during substorms occurred at the time of recurrent streams (RS) has been examined. The development of the substorm bulge is followed up. The variations of the emissions depending on the different locations of the substorm bulge with respect to the point of observation have been studied. Estimations of the particle precipitation spectra at the polar edge of the auroral bulge and inside it have been obtained. For the study, data from the All-Sky Imagers at Andøya Rocket Range (ARR), Andenes, Norway (69.3°N, 16.03°E) and at the Auroral Observatory, Longyearbyen, Svalbard (78.20°N, 15.83°E) from the observational season 2005-2006 have been used. Additional data concerning the solar wind parameters, IMF, the precipitating particles and the magnetic field are used from the WIND satellite and the IMAGE magnetometer network to determine the recurrent streams and the substorms during RS.

SUBSTORM OBSERVATIONS IN APATITY DURING DIFFERENT SOLAR WIND CONDITIONS

V. Guineva¹, I. Despirak², B. Kozelov²

¹*Space Research and Technology Institute – Bulgarian Academy of Sciences, Stara Zagora, Bulgaria, e-mail: v_guineva@yahoo.com*

²*Polar Geophysical Institute, Apatity, Russia*

Abstract. All-sky camera data obtained at Apatity (Kola Peninsula) during 2012/2013 winter season have been used to study the variation of substorm development in different conditions of interplanetary medium. Solar wind and interplanetary magnetic field parameters were taken from CDAWeb (http://cdaweb.gsfc.nasa.gov/cdaweb/istp_public/). Using WIND satellite data for the examined periods, the different solar wind streams were revealed: recurrent streams from coronal magnetic holes (RS) and magnetic clouds (MC) connected with non-stationary processes at the Sun. It is known that these solar wind structures are the sources of geomagnetic storms. Furthermore, the storms originating from these sources differ in intensity, recovery phase duration, etc. We investigated substorm development during storms and during quiet conditions. Substorm onset time and further development were verified by ground-based data of IMAGE magnetometers network and by data of all-sky cameras at Apatity. The particularities in behaviour of substorms observed during storms and during quiet conditions are discussed.

SUBSTORMS OBSERVATIONS DURING GEOMAGNETIC ACTIVE PERIOD AT THE BEGINNING OF MARCH 2012

V. Guineva¹, I.V. Despirak², B.V. Kozelov²

¹*Space Research and Technology Institute (SRTI), Stara Zagora Department, BAS, P.O. Box 73, 6000 Stara Zagora, Bulgaria, e-mail: v_guineva@yahoo.com*

Abstract. The period 7-17 March 2012 is one of the most geomagnetically active periods during the ascending phase of Solar Cycle 24. Magnetic storms occurred on 7, 9, 12, and 15 March, these are called the S1, S2, S3, and S4 events. These storms were caused by Sheath, MC and HSS, the detailed scenario for all four storms were different. Measurements of the **Multiscale Aurora Imaging Network (MAIN)** in Apatity and data of IMAGE magnetometers network have been used to verify the substorms onset and subsequent development. Substorms during the chain of 4 geomagnetic storms in the interval 7-17.03.2012 were studied and the characteristics of these substorms were compared to different interplanetary conditions. It was shown that substorms, originated during strong geomagnetic storms provoked by interplanetary shocks and magnetic clouds, near the Dst minimum, occurred to the South of Apatity, and substorm auroras expanded in North direction. For substorms during the late recovery phase, auroras were observed to the North of the Apatity station, and their motion from North to South was registered.

Г8_37.

SUBSTORM OBSERVATIONS OF THE MAIN IN APATITY DURING St. PATRICK'S DAY GEOMAGNETIC STORMS IN 2013 AND 2015

I.V. Despirak¹, B.V. Kozelov¹, V. Guineva²

¹*Polar Geophysical Institute, Apatity, Russia*

²*Space Research and Technology Institute (SRTI), Stara Zagora Department, BAS, P.O. Box 73, 6000 Stara Zagora, Bulgaria*

e-mails: despirak@gmail.com, boris.kozelov@gmail.com, v_guineva@yahoo.com

Abstract. This study presents an analysis of the ground-based observations of the auroral disturbances during two St. Patrick's Day geomagnetic storms on March 17, 2013 and 2015. The first event on 17 March 2015 is the so-called "St. Patrick's Day 2015 Event". This 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 (Max. D_{st} was -228 nT) were reported. This magnetic storm is the largest one observed in the current solar cycle. The second event is the period on 17-18 March 2013 when a strong geomagnetic storm (the D_{st} index \sim -140 nT) was developed. This storm was caused by magnetic cloud (15 UT, 17 March – 6 UT, 18 March 2013) in the solar wind. Object of our study were the substorms observed during these periods. Observations of the **Multiscale Aurora Imaging Network (MAIN)** in Apatity have been used. Solar wind and interplanetary magnetic field parameters were taken from OMNI data base. Substorm onset time and the subsequent development were verified by data of IMAGE magnetometers network and by data of the all-sky camera at Apatity. The particularities in the behaviours of substorms connected with different storms during these two interesting strongly disturbed periods are discussed.

Г8_38.

OBSERVATIONS OF SUBSTORMS IN APATITY BY MAIN CAMERAS SYSTEM DURING DIFFERENT SPACE WEATHER CONDITIONS

I.V. Despirak¹, V. Guineva², R. Werner²

¹*Polar Geophysical Institute, Apatity, Russia, e-mail: despirak@gmail.com*

²*Space Research and Technology Institute (SRTI), Stara Zagora Department, Bulgaria*

Abstract. We studied the auroras observations during different solar wind conditions by data of the MAIN cameras (Multiscale Aurora Imaging Network) obtained at Apatity (Kola Peninsula, Russia) for two winter seasons: 2014-2015 and 2015-2016. Solar wind and IMF parameters were taken from the OMNI data base. Observations of aurora were conducted in Apatity, magnetic field disturbances were verified by the data of IMAGE magnetometers. All substorms were divided into different groups depending on the space weather conditions. First, the substorms were separated into two groups: substorms observed during storms and substorms under non-storm conditions. The substorms during storms were divided in sub-groups according to observations during different storm phases: initial, main, near and late recovery phases. We considered also specific space weather conditions, when the SYM/H index behavior was highly irregular, we called these conditions "structured recovery phase" of the storm. The non-storm conditions were classified as quiet conditions, when no structures in the solar wind were observed, and as conditions when structures in the solar wind near the

Earth were detected, but these structures did not provoke geomagnetic storms. It was shown that the latitude of the substorm onset was controlled by the value of the SYM/H index. It was found out also that the maximal relative intensity of auroras was greater for substorms with onset to the South from Apatity and smaller - for substorms with onset in zenith or to the North from Apatity.

Г8_39.

DETERMINATION OF THE TOTAL OZONE COLUMN WITH CONSIDERATION OF THE CLOUD OPTICAL DEPTH

R. Werner¹, B. Petkov², D. Valev¹, A. Atanassov¹, V. Guineva¹, A.S. Kirillov³

¹ *Space Research and Technology Institute (SRTI) - BAS, Stara Zagora Department, Stara Zagora, Bulgaria*

² *Institute of Atmospheric Sciences and Climate (ISAC) - CNR, Bologna, Italy*

³ *Polar Geophysical Institute (PGI), Apatity, Russia*

Abstract. Since the installation of a GUV-2511 instrument in February 2015 automatic measurements of the solar irradiances at wavelengths 305, 313, 320, 340, 380, 395 nm in the UV spectral range and the irradiance at the wavelength interval from 400 to 700 nm in the visible range have been carried out. The GUV instrument receives the solar irradiance from the sky. Therefore a simple calculation based on the Beer-Lambert Law is not applicable. So-called Lookup tables are prepared - for a multitude of ozone values irradiance ratios depending on different parameters as zenith angle and cloud optical depth were calculated previously using the Tropospheric Ultraviolet and Visible (TUV) radiation transfer model. The total ozone column amount was retrieved by interpolation of the tables for real measured ratios of the irradiance at 313nm, a wavelength with significant ozone absorption, and a second irradiance at 340 nm, which is insensitive against ozone absorption. For the estimation of the optical depth the ratio of the observed and the estimated for cloudless conditions irradiances at 380 nm is determined depending on the zenith angle. In addition a lookup table was previously calculated to obtain the actual optical depth in dependence from the zenith angle and the irradiance ratios at 380 nm. Ozone column data from OMI-instrument satellite Aura on the Earth Observing System were used for comparisons and to find the exact wavelength centre position for the 313 nm filter to minimise the ozone retrieval error for our algorithms. All observations from February 2015 up to January 2018 were included in the data processing.

Г8_40.

INTERMOLECULAR ELECTRON ENERGY TRANSFER PROCESSES IN UPPER ATMOSPHERES OF TITAN, TRITON, PLUTO

A.S. Kirillov¹, R. Werner², V. Guineva²

¹ *Polar Geophysical Institute, Apatity, Murmansk region, Russia*

² *Space Research and Technology Institute of Bulgarian Academy of Sciences, Stara Zagora Department, Stara Zagora, Bulgaria*

Abstract. The simulation of $N_2(A^3\Sigma_u^+)$ and $CO(a^3\Pi)$ vibrational populations at the altitudes of upper atmospheres of Titan, Triton, Pluto is made. The simulation includes the consideration of the electronic excitation of N_2 and CO triplet states by photoelectrons and the quenching processes in spontaneous radiation and in inelastic molecular collisions. Upper atmospheres of the planets are considered as mixtures of molecular nitrogen N_2 , methane CH_4 , carbon monoxide CO . The influence of metastable molecular nitrogen $N_2(A^3\Sigma_u^+)$ on the electronic excitation of CO molecules in inelastic collisions is studied. The role of molecular inelastic collisions in intermolecular electron energy transfer processes is investigated. It is shown that the increase in the density of upper atmospheres of the planets leads to more significant excitation of lowest vibrational levels of $CO(a^3\Pi)$ by intermolecular electron energy transfers from $N_2(A^3\Sigma_u^+)$. In comparison with direct excitation of the $a^3\Pi$ state by photoelectrons.

THE STUDY OF THE ROLE OF INTERMOLECULAR PROCESSES IN THE KINETICS OF $N_2(A^3\Sigma_u^+)$ IN UPPER ATMOSPHERES OF PLANETS OF SOLAR SYSTEM

A.S. Kirillov¹, R. Werner², V. Guineva²

¹*Polar Geophysical Institute, Apatity, Murmansk region, Russia*

²*Space Research and Technology Institute of Bulgarian Academy of Sciences, Stara Zagora, Bulgaria*

Abstract. We study the electronic kinetics of metastable molecular nitrogen $N_2(A^3\Sigma_u^+)$ in upper atmospheres of N_2 -rich planets. The simulation of $N_2(A^3\Sigma_u^+)$ vibrational populations at the altitudes of upper atmospheres of the planets is made. The mixtures of N_2 - O_2 gases and N_2 - CH_4 - CO gases are considered for the atmospheres of Earth and Titan- Triton-Pluto, respectively. The role of molecular inelastic collisions in intermolecular electron energy transfer processes is investigated. The influence of metastable molecular nitrogen $N_2(A^3\Sigma_u^+)$ on the electronic excitation of O_2 and CO molecules in inelastic collisions is studied. It is shown that the increase in the density of upper atmospheres of the planets leads to more significant excitation of electronically excited O_2 and CO by intermolecular electron energy transfers from $N_2(A^3\Sigma_u^+)$.

Lyman-alpha Detector Designed for Rocket Measurements of the Direct Solar Radiation at 121.5 nm

V. Guineva¹, G. Witt², J. Gumbel³, M. Khaplanov³, R. Werner¹,
J. Hedin³, S. Neichev⁴, B. Kirov⁵, L. Bankov¹, P. Gramatikov⁴,

V. Tashev¹, M. Popov¹, K. Hauglund⁶, G. Hansen⁶, J. Iilstad⁶,
H. Wold⁶

¹Solar-Terrestrial Influences Laboratory, Bulgarian Academy of Sciences, Stara Zagora Department, P.O.Box 73, 6000 Stara Zagora, Bulgaria

²Department of Earth Sciences, The Hebrew University, Jerusalem, Israel

³ Atmospheric Physics Group at the Department of Meteorology, Stockholm University, S 10691 Stockholm, Sweden

⁴Space Research Institute, Bulgarian Academy of Sciences, 6 Moskovska Str., 1000 Sofia, Bulgaria

⁵Solar-Terrestrial Influences Laboratory, Bulgarian Academy of Sciences, Acad. Georgi Bonchev Str., Block 3, 1113 Sofia, Bulgaria

⁶Andøya Rocket Range AS, P.O.Box 54, N-8483 Andenes, Norway Received 5 May 2007

Abstract. Rocket measurements of the direct Lyman-alpha radiation penetrating in the atmosphere were planned during the HotPay I rocket experiment, June 2006, Project ASLAF (Attenuation of the Solar Lyman-Alpha Flux), Andøya Rocket Range (ARR), Norway. The basic goal of ASLAF project was the study of the processes in the summer mesosphere and thermosphere (up to 110 km), at high latitudes using the Lyman-alpha measurements. The resonance transition $^2P-^2S$ of the atomic hydrogen (Lyman-alpha emission) is the strongest and most conspicuous feature in the solar EUV spectrum. Due to the favorable circumstance, that the Lyman-alpha wavelength (121.5 nm) coincides with a minimum of the O_2 absorption spectrum, the direct Lyman-alpha radiation penetrates well in the mesosphere. The Lyman-alpha radiation is the basic agent of the NO molecules ionization, thus generating the ionospheric D-layer, and of the water vapour photolysis, being one of the main H_2O loss processes.

The Lyman-alpha radiation transfer depends on the resonance scattering from the hydrogen atoms in the atmosphere and on the O_2 absorption. Since the Lyman-alpha extinction in the atmosphere is a measure for

the column density of the oxygen molecules, the atmospheric temperature profile can be calculated thereof.

The detector of solar Lyman-alpha radiation was manufactured in the Stara Zagora Department of the Solar-Terrestrial Influences Laboratory (STIL). Its basic part is an ionization chamber, filled in with NO. A 60 V power supply is applied to the chamber. The produced photoelectric current from the sensor is fed to a 2-channels amplifier, providing an analog signal.

The characteristics of the Lyman-alpha detector were studied. It passed successfully all tests and the results showed that the instrument could be used in rocket experiments to measure the Lyman-alpha flux.

From the measurements of the detector, the Lyman-alpha vertical profile can be obtained. The forthcoming scientific data analysis will include radiative transfer simulations, O₂ density, atmospheric power and temperature profiles retrieval as well as comparison with other parameters, measured near the polar summer mesopause and study of the processes in this region.

The ASLAF project was a scientific cooperation between STIL-BAS, Stara Zagora Department, the Hebrew University, Jerusalem, Israel, and the Atmospheric Physics Group at the Department of Meteorology (MISU), Stockholm University, Sweden. The joint project was part of the rocket experiment HotPay I, in the ALOMAR eARI Project, EU's 6th Framework Programme, Andøya Rocket Range, Andenes, Norway.

The project is partly financed by the Bulgarian Ministry of Science and Education and an EOARD grant.

r8_43.

Substorms observations during two strongly disturbed periods - in March 2012 and March 2015

V. Guineva¹, I.V. Despirak², B.V. Kozelov²

¹Space Research and Technology Institute, BAS, Stara Zagora, Bulgaria

²Polar Geophysical Institute, Apatity, Russia

Abstract:

In this work two events of strong geomagnetic activity were examined: the period 7-17 March 2012, which is one of the most disturbed periods during the ascending phase of Solar Cycle 24, and the severe geomagnetic storm on 17-20 March 2015. During the first period four consecutive magnetic storms occurred on 7, 9, 12, and 15 March. These storms were caused by Sheath, MC and HSS, and the detailed scenarios for the storms were different. The second event is a storm of fourth level with Kp = 8, the strongest one during the last four years. A geomagnetic storm of such intensity was observed in September 2011. Since then, the level of Kp never exceeded the value 7. Object of our study were the substorms registered during these periods. Observations of the Multiscale Aurora Imaging Network (MAIN) in Apatity have been used. The substorm developments during different storms were compared. Solar wind and interplanetary magnetic field parameters were taken from OMNI data base. Substorm onset time and the subsequent development were verified by data of IMAGE magnetometers network and by data of the all-sky cameras at Apatity. The particularities in the behaviours of substorms connected with different storms during these two interesting strongly disturbed periods are discussed.

r8_44.

The Atlantic multidecadal oscillation influence on temperatures and on structural changes

R. Werner¹, D. Valev¹, D. Danov¹, V. Guineva¹ and A. Kirillov²

¹Space Research and Technology Institute (SRTI), BAS,

Stara Zagora Department, Stara Zagora, Bulgaria

Abstract

The cooling and the following warming periods in the Northern Hemisphere are very well captured by the statistic models taking in consideration the Atlantic multidecadal oscillation (AMO). It is found that the AMO temperature influence increases from South to North, which is related to the heat transfer from the tropics to the Northern Atlantic by the thermohaline circulation. It is demonstrated, that structural breaks of the Northern Hemisphere and global temperatures are connected with AMO. The AMO influence removed temperature series show only one significant break. The strong AMO influence on the Northern Hemisphere and global temperatures will reduce the temperature increase in the next decades but when the AMO index will begin rising again the warming rates will achieve values close to the obtained ones during the last decades or greater than them due to higher dioxide content.

Г8_45.

GUV 2511 instrument installation in Stara Zagora and first results

R. Werner¹, B. Petkov², A. Atanassov¹, D. Valev¹, V. Guineva¹, E. Roumenina¹,

A. Kirillov³

¹Space Research and Technology Institute (SRTI), BAS, Sofia, Bulgaria

²Institute of Atmospheric Sciences and Climate (ISAC), CNR, Bologna, Italy

³Polar Geophysical Institute (PGI), Apatity, Russia

Abstract

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 results of the measurements are presented and the methodology to derive TOC is described.

Г8_46.

Kinetics of electronically excited O₂ molecules in the mixture of CO₂, CO, N₂, O₂ gases

Kirillov A.S. (1), Werner R. (2), Guineva V. (2)

(1) Polar Geophysical Institute of Russian Academy of Sciences
Apatity, Murmansk region, Russia

(2) Space Research and Technology Institute of Bulgarian Academy of Sciences
Stara Zagora Department, Stara Zagora, Bulgaria

CO₂, CO, N₂, O₂ gases are the main components in the atmospheres of terrestrial planets. Electronically excited molecules play very important role in chemical kinetics of a mixture of atmospheric gases. We apply the Rosen-Zener approximation to calculate the removal rates of O₂^{*} in inelastic collisions with CO₂, CO, N₂, O₂ molecules. The calculated quenching rate coefficients of electronically excited O₂ molecules are used in the simulations of vibrational populations of O₂ electronic states in the mixture of these gases. It is suggested that three-body collisions are the production mechanism of initially excited O₂. Vibrational populations of singlet oxygen are calculated at mixture pressures of 10⁻¹-10⁰ Pa. Similar behaviour of the populations is seen in the cases of N₂-O₂ and CO-O₂ mixtures. The principal influence of carbon dioxide molecules is shown in the case of CO₂-O₂ mixture. The results can be applied in the study of electronic kinetics of O₂^{*} at the altitudes of nightglows in the atmospheres of terrestrial planets.

Г8_47.

Substorms over Apatity during 2014/2015 Observational Season

Guineva V.¹, Despirak I.², Kozelov B.²

¹ Space Research and Technology Institute (SRTI), Stara Zagora Department, BAS, Stara Zagora, Bulgaria;

² Polar Geophysical Institute, Apatity, Russia

E-mail: v_guineva@yahoo.com

ABSTRACT

In this work we reviewed 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 review 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.

Г8_48.

Basic Results from the Scanning Spectrophotometer “EMO-5” onboard “IC Bulgaria-1300”

Guineva V., Stoeva P.

Space Research and Technology Institute (SRTI), Stara Zagora Department, BAS, Bulgaria

E-mail: v_guineva@yahoo.com

ABSTRACT

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.

Г8_49.

Ozone Determination by GUV 2511 Ultraviolet Irradiation Measurements at Stara Zagora

Werner R.¹, Petkov B.², Valev D.¹, Atanassov A.¹, Guineva V.¹, Kirillov A.³

¹Space Research Institute – Bulgarian Academy of Sciences, Stara Zagora Department, Stara Zagora, Bulgaria

²Institute of Atmospheric Sciences and Climate (ISAC), CNR, Bologna, Italy

³Polar Geophysical Institute (PGI), Apatity, Russia

E-mail: rolwer52@yahoo.co.uk

ABSTRACT

A ground-based Ultraviolet Radiometer (GUV) 2511, designed to measure the downwelling global solar irradiances at 305, 313, 320, 340, 380, 395 nm wavelengths and in the visible range from 400 to 700 nm was installed at Stara Zagora, Bulgaria in February 2015. The instrument allows obtaining a realistic estimate of the total column ozone (TCO) in the atmosphere. This report presents the first measurement results concerning TCO that has been assessed by comparing the ratio of irradiances registered at 313 and 340 nm, with the corresponding ratio computed through the Tropospheric Ultraviolet and Visible (TUV) radiation transfer model for different solar elevations and TCO. The results were compared with the TCO amounts provided by the Ozone monitoring instrument (OMI) onboard the Aura satellite and the correlation coefficient between the OMI values and those retrieved by the GUV 2511 surface measurements, both referred to the Stara Zagora station was found to be higher than 0.975.

r8_50.

Features of mid-latitude substorms during large magnetic storms

Guineva V.H.¹, Despirak I.V.², Kleimenova N.G.³

¹Space Research and Technology Institute (SRTI) BAS, Stara Zagora Department, Stara Zagora, Bulgaria

²Polar Geophysical Institute RAS, Apatity, Russia

³Schmidt Institute of the Earth Physics RAS, Moscow, Russia

E-mail: v_guineva@yahoo.com

Abstract.

We considered some peculiar properties of mid-latitude substorms during different solar wind and geomagnetic conditions. The data of the INTERMAGNET and IMAGE magnetometer networks and OMNI data base have been combined. Large magnetic storms (SYM/H<-100 nT) during the 24th solar cycle have been analyzed. Two severe storms, on 17 March 2015 (SYM/H_{min}=-235 nT) and on 22 June 2015 (SYM/H_{min}=-208 nT) have been chosen. The substorms registered at middle and low latitudes in the main phases of the selected magnetic storms have been considered. We have also studied the solar wind and Interplanetary Magnetic Field (IMF) conditions which could be favorable for the occurrence of a possible relationship of the low-latitude substorms with the so called “expanded” substorms developing at high latitudes.

r8_51.

Scheme to forecast the local UV-index over Bulgaria

Werner R.¹, Petkov B.², Valev D.¹, Guineva V.¹, Atanassov A.¹, Kirillov A.³

¹Space Research and Technology Institute (SRTI), BAS, Stara Zagora Department, Stara Zagora, Bulgaria

²Institute of Atmospheric Sciences and Climate (ISAC), CNR, Bologna Branch, Bologna, Italy

³Polar Geophysical Institute (PGI), Kola Science Centre, Murmansk, Apatity Division, Apatity, Russia

E-mail: rwerner@space.bas.bg

Abstract

The UV-index is a measure of the erythemally effective solar radiation reaching the Earth surface. It was introduced to alert people about the need of sun protection. Therefore the UV-index has to be determined with adequate accuracy. To minimize the risk of too high levels of sunburn the UV-index is determined usually for clear sky conditions. To alert people in time the UV-index forecast is essential. Here the schemes of UV-index forecast for one day in advance are presented. Because the UV-index under clear sky conditions depends on the total ozone column over a given geographic location the UV-index forecast (cloud free and aerosol free) implicates the forecast of the total ozone column. The scheme of ozone forecast is based on satellite data. For the determination of the UV-index, model calculations using the radiation transfer model TUV of Madronich are implemented. The land snow cover is taken into account.

Г8_52.

SPACE PROJECT “BULGARIA-1300”. BASIC RESULTS FROM THE SCANNING SPECTROPHOTOMETER “ЕМО-5” ON BOARD

“INTERCOSMOS 22 (BULGARIA-1300)”

Veneta H. Guineva, Penka V. Stoeva

SPACE RESEARCH AND TECHNOLOGY INSTITUTE, BULGARIAN ACADEMY OF SCIENCES, STARA ZAGORA DEPARTMENT, 6000 STARA ZAGORA, PO BOX 73, BULGARIA, E-MAIL: V.GUINEVA@YAHOO.COM

КОСМИЧЕСКИ ПРОЕКТ „БЪЛГАРИЯ-1300”. ОСНОВНИ РЕЗУЛТАТИ ОТ СКАНИРАЦИЯ СПЕКТРОФОТОМЕТЪР „ЕМО-5” НА БОРДА НА „ИНТЕРКОСМОС 22 (БЪЛГАРИЯ-1300)”

Венета Х. Гинева, Пенка В. Стоева

ИНСТИТУТ ЗА КОСМИЧЕСКИ ИЗСЛЕДВАНИЯ И ТЕХНОЛОГИИ, БЪЛГАРСКА АКАДЕМИЯ НА НАУКИТЕ, ФИЛИАЛ СТАРА ЗАГОРА, 6000 СТАРА ЗАГОРА, ПК 73, БЪЛГАРИЯ, Е-МЕЙЛ: V.GUINEVA@YAHOO.COM

Abstract. 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 16300 emission in the equatorial F-region have been examined.

Key words: scanning spectrophotometer, aurora, polar cap, SAR-arcs, equatorial glow.

High Resolution Spectroscopic Measurements and Theoretical Study of the (1,0) Band from the O₂ Atmospheric System

Guineva V.¹, Werner R.¹, Vince I.²

¹ Solar-Terrestrial Influences Laboratory, Bulgarian Academy of Sciences, Stara Zagora Department, Bulgaria, v.guineva@yahoo.com, rolver52@yahoo.uk

²Astronomical Observatory, Belgrade, Serbia

Abstract. The rotational absorption lines from the P branch of the molecular oxygen atmospheric system (1,0) band have been used for the effective temperature evaluation. Ground based spectroscopic observations have been performed during June/July 2006 at the solar telescope of Belgrade Astronomical Observatory. 20 observational sets have been done during this period. Every set consists of the averaged over 5 measurements CCD images of the doublets of the lines with rotational quantum numbers J from 1 to 25. The signal to noise ratio has been discussed and finally estimated about 400. A synthetic spectrum of the (1,0) band has been created based on line-by-line calculations, which has allowed to compute the theoretical equivalent widths. Typical summer temperature profiles have been used. The case of strong absorption has been assumed. The theoretical and measured line profiles and their equivalent widths have been compared. The dependence of the equivalent widths on the rotational quantum number has been worked out. The possible contaminations in some cases are discussed. The theoretical estimates and the measurement results have been examined.

Data base of geoeffective solar wind structures, geomagnetic indices, and atmospheric dynamics parameters

Georgieva K.¹, Kirov B.¹, Obridko V.², Shelting B.², Atanasov D.³, Tonev P.¹, Guineva V.¹

¹ Solar-Terrestrial Influences Laboratory, Bulgarian Academy of sciences, Sofia, Bulgaria, kgeorg@bas.bg.

² IZMIRAN

³ Faculty of Mathematics, Sofia University

By the term “solar activity” all types of changes in the appearance or energy output from the Sun are denoted. These changes may have different characteristics, different distribution throughout the solar cycle, and different effects on the Earth. Therefore, when studying solar influences on the Earth, the terrestrial responses should be sorted according to the type of the driver. We are describing criteria to identify magnetic clouds and high speed solar wind streams, and are presenting a data base of solar drivers of terrestrial disturbances, geomagnetic indices, and atmospheric dynamics parameters.

The Auroral Emissions, the Absorption at 38.2 MHz and the Terrestrial Magnetic Field under Different Solar and Geomagnetic Activity

V. Guineva¹, E. Trondsen², S. Marple³, K. Dahle⁴, P. Stauning⁵

¹ Solar-Terrestrial Influences Laboratory, Bulgarian Academy of sciences, Stara Zagora Department, Stara Zagora, Bulgaria, v.guineva@yahoo.com

² University of Oslo, Department of Physics, Oslo, Norway

³ Lancaster University, Department of Communications Systems, Lancaster, UK

⁴ Andøya Rocket Range, Andenes, Norway

⁵ Danish Meteorological Institute, Copenhagen, Denmark

Abstract. The opportunity for simultaneous multi-instrument observations by different instruments, as well by sets of instruments of the same kind, nowadays is a precondition for an extensive research of the polar ionosphere phenomena. The OI 5577 Å and 6300 Å emissions during the 2005/2006 season have been studied by data from the All-Sky Imagers (ASI) at Andøya Rocket Range (ARR), Andenes, Norway (69.3°N, 16.03°E) and at the Auroral Observatory, Longyearbyen, Svalbard (78.20°N, 15.83°E). Simultaneously registered absorption at 38.2 MHz, presenting the activity in the energetic particle precipitation over a large area of the ionosphere, and terrestrial magnetic field components are looked at. Measurements of the ALOMAR Imaging Riometer for Ionospheric Studies (AIRIS) and the magnetometer at ARR, Andenes, Norway; the Imaging Riometer for Ionospheric Studies (IRIS) at Kilpisjärvi, Finland (69.05°N, 20.79°E); and the 64-beam Imaging Riometer and the magnetometer at the Auroral Observatory, Longyearbyen, Svalbard have been used. The fields of view of the instruments cover a large area of the auroral oval and the polar cap. The distribution and the behaviour of the optical emissions and the absorption features have been analysed. A good correlation between the spatial and temporal evolutions of the optical emissions, the precipitating electron fluxes and the terrestrial magnetic field has been observed. The response of the ionosphere to the solar and geomagnetic activity changes has been studied. Data access has been provided under the Project “ALOMAR eARI” (RITA-CT-2003-506208), Andenes, Norway. This Project received research funding from the European Community’s 6th Framework Program.

Г8_56.

Variations of aurora emissions during substorms at Spitsbergen archipelago

Despirak I.V.¹, Dashkevich Zh.V.¹, Guineva V.²

¹ Polar Geophysical Institute, Apatity, Russia, despirak@pgia.ru

² Solar-Terrestrial Influences Institute, Stara Zagora, Bulgaria, v_guineva@yahoo.com

Spitsbergen photometer data from the 2005/2006 and 2007/2008 winter seasons have been used to study the variation of the auroral 5577 Å and 6300 Å intensity ratio during substorms. The substorm onset time and the further development were verified by ground-based data of the IMAGE magnetometers network and by data of the all-sky camera at Spitsbergen. Using WIND satellite data for the examined periods, the solar wind streams were revealed: recurrent streams from coronal magnetic holes and magnetic clouds. We considered the behaviour of the intensities I6300 and I5577 of the auroral emissions for 2 substorms observed during one recurrent stream and one magnetic cloud. It was shown that the precipitation of most energetic electrons occurs at the polar edge of the auroral bulge, and inside the bulge precipitation of less energetic electrons is observed. It was also shown that in front of the substorm auroras, a region of enhanced red emission of about 100 km width appears which can be related with a downward current.

Г8_57.

Development of Substorm Bulges During Storms of Different Interplanetary Origins

Despirak I.V.¹, Lubchich A.A.¹, Guineva V.²

¹ Polar Geophysical Institute, Apatity, Russia, despirak@pgia.ru

² Solar-Terrestrial Influences Institute, Stara Zagora, Bulgaria, v_guineva@yahoo.com

Different structures in solar wind are observed depending on the type of solar activity: magnetic clouds (MC), recurrent streams (RS), and regions of their interaction with undisturbed solar wind (Sheath and CIR). Three of these structures, namely, Sheath, CIR, and MC, are the sources of geomagnetic storms. Furthermore, the storms originating from these three sources differ in intensity, recovery phase duration, etc. We have searched for distinctions in the development of substorm bulges occurring during geomagnetic storms connected with the MC, Sheath and CIR. Solar wind parameters were taken from the Wind spacecraft observations and the auroral bulge parameters were obtained by data from the Ultra Violet Imager onboard Polar. We determined the longitudinal and latitudinal dimensions of the auroral bulges, the poleward aurora propagation and the onset latitude of auroral bulge. It is shown that auroral bulges “geometry” is different for these types of storms. The largest sizes of auroral bulge are found for CIR- and Sheath-storms situations. The latitudinal size of the auroral bulge during MC-storms is smaller, but the longitudinal size is larger. As consequence, the ratio between longitudinal and latitudinal sizes for substorms during MC is also larger. We suggest this latter feature is explained by different configuration of the near-Earth magnetotail during CIR- and MC-storms.

Г8_58.

Variations of the auroral emissions and the absorption at 38.2 MHz during substorms associated with a high speed stream of the solar wind

Guinea V.¹, Werner R.¹, Trondsen E.², Honary F.³, Marple S.³

¹ *Solar-Terrestrial Influences Institute, Bulgarian Academy of sciences, Stara Zagora Department, Stara Zagora, Bulgaria, y.guineva@yahoo.com.*

² *University of Oslo, Department of Physics, Norway, espen.trondsen@fys.uio.no*

³ *Lancaster University, Department of Communications Systems, UK, f.honary@lancaster.ac.uk, s.marple@lancaster.ac.uk*

The opportunity for simultaneous multi-instrument observations by different instruments, as well by sets of instruments of the same kind, nowadays is a precondition for an extensive research of the ionosphere phenomena. For this study, simultaneous ground based observations' data of the OI 5577 Å and 6300 Å emissions, the absorption at 38.2 MHz and the magnetic field have been used from the following instruments: the All-Sky Imager (ASI) and the magnetometer, positioned at Andøya Rocket Range (ARR), Andenes (69.3°N, 16.03°E), and the Imaging Riometer for Ionospheric Studies (IRIS) at Kilpisjärvi, Finland (69.05°N, 20.79°E).

The behaviour of the auroral emissions, the ratio I_{6300}/I_{5577} and the absorption at 38.2 MHz during 3 substorms occurred during a high speed recurrent stream has been examined. Variations of the emissions and the absorption at 38.2 MHz, related to the different locations of substorm bulge have been studied. Estimations of the particle precipitation spectra in the polar edge of auroral bulge and inside auroral bulge have been obtained. The correlation between the 5577 Å and 6300 Å emissions and the absorption at 38.2 MHz has been examined.

Г8_59.

Theoretical Development of a Device based on a Photomultiplier Tube, for Satellite Measurements of the Solar Lyman - Alpha ($L\alpha$) Radiation.

Tashev V.¹, Guinea V.¹, Manev A.¹, Witt G.², Gumbel J.², Khaplanov M.²

¹ *Solar-Terrestrial Influences Institute (STIL), Bulgarian Academy of Sciences (BAS), Stara Zagora Department, Stara Zagora, Bulgaria, veselinlt@abv.com*

² *Atmospheric Physics Group at the Department of Meteorology (MISU), Stockholm University, S 10691 Stockholm, Sweden*

Abstract

A device developed for satellite measurements is proposed for investigation of Solar Lyman - Alpha ($L\alpha$) Radiation. The input detector is designed with enhanced characteristics for operation in the severe conditions of the space environment. Its basic part is a photomultiplier tube R6835, for astrophysics and ultraviolet radiation detection. It has spectral response from 115 to 200 nm, maximum response 140 nm, quantum efficiency at 121 nm 26%, gain $1 \cdot 10^5$, anode dark current 0.03 nA and operating temperature from -30 to + 50° C. When the light intensity becomes so low that the incident photons are separated as discrete output pulses obtained from the anode, this technique is known as the photon counting method. The number of output pulses is directly proportional to the amount of incident light. This pulse counting method has advantages in signal-to-noise ratio and stability over the analog mode in which an average of all the pulses is made. Since the detected pulses undergo binary processing because of the digital counting, the photon counting method is also referred to the digital mode. The detector is supplied by 12 V supply voltage whose source is a board battery. This supply voltage is galvanically disconnected from the instrument power supply by means of a transformer.

Г8_60.

ЕЛЕКТРОНЕН УСИЛВАТЕЛ ЗА ИЗМЕРВАНЕ НА ПРЯКАТА СЛЪНЧЕВА ЛАЙМАН – АЛФА (L_{α}) РАДИАЦИЯ ПРОНИКВАЩА В АТМОСФЕРАТА

Tashev V.¹, Guineva V.¹, Manev A.¹, Witt G.², Gumbel J.²,
Khaplanov M.², Kirov B.⁴, Palazov K.¹, Bankov L.¹, G
ramatikov P.³, Spasov St. ¹, Petkov P. ¹.

(1)Solar-Terrestrial Influences Laboratory (STIL), Bulgarian Academy of Sciences (BAS), Stara Zagora Department, P.O.Box 73, 6000 Stara Zagora, Bulgaria;

(2)Atmospheric Physics Group at the Department of Meteorology (MISU), Stockholm University, S 10691 Stockholm, Sweden;

(3)Space Research Institute, Bulgarian Academy of Sciences (BAS), 6 Moskovska Str., 1000 Sofia, Bulgaria;

(4)Solar-Terrestrial Influences Laboratory (STIL), Bulgarian Academy of Sciences (BAS), Acad. Georgi Bonchev Str., Block 3, 1113 Sofia, Bulgaria;

ABSTRACT

The principle method for investigation of the atmosphere and the low thermosphere is rocket sounding for measurement of the decreasing solar L_{α} radiation. The flux of the direct solar L_{α} radiation is registered by a Lyman-Alpha detector. The detector is manufactured with enhanced characteristics for operation in the severe conditions of the space environment. Its basic part is an ionization camera, filled in with NO. It also incorporates a window of LiF, which is the primary radiation sensor in the spectral range 105 ÷ 135 nm. When the voltage is applied between the electrodes, the produced current is of order of 10^{-8} A, due to the ionization of NO molecules by the Lyman-Alpha radiation. This electric current is fed to a two-range amplifier, characterized by high sensitivity and gain, good conversion accuracy,

and temperature stability. The first stage is a preamplifier and a current-voltage converter, implemented through a precise JFET operation amplifier AD8627 (Analogue Devices). The second section is a scaling and correcting amplifier for instrument calibration. The amplifier A6 control the chambers voltage during measurements. The detector is supplied by 28 V supply voltage whose source is a board battery. This supply voltage is galvanically connected with the instrument power supply by means of a transformer.

МЕТОДИ ЗА ИЗМЕРВАНЕ НА УЛТРАВИОЛЕТОВИ СВЕТИЛНИ ПОТОЦИ С МНОГО НИСЪК ИНТЕНЗИТЕТ

Веселин Ташев¹, Венета Гинева¹, Ангел Манев¹, Георг Уит², Боян Киров¹

¹ - *Институт за Космически и Слънчево-земни Изследвания (ИКСИ), Българска Академия на Науките, Филиал Стара Загора, ПК 73, 6000 Стара Загора, България;*

² - *Група по Атмосферна Физика при Филиала по Метеорология (MISU), Стокхолмски Университет, S 10691 Стокхолм, Швеция;*

ABSTRACT

The measurement of weak light flows, especially in the ultraviolet range is related to solving many problems. The most important of these is the development or finding a factory sensor to convert light into electrical signals. This sensor should not only be extremely sensitive, but at the same time, this sensitivity must be located in the ultraviolet range. The device is manufactured with enhanced characteristics for operation in the severe conditions of the space

environment. Its basic part is a photomultiplier tube R10825, as sensor for detection the ultraviolet radiation. When the light intensity becomes so low that the incident photons are separated as discrete output pulses obtained from the anode, this technique is known as the photon counting method. The number of output pulses is in direct proportion to the amount of incident light. The device is supplied by 28 V supply voltage whose source is a board battery.

Г8_62.

ЕЛЕКТРОНЕН ФОТОУМНОЖИТЕЛ ЗА ИЗМЕРВАНЕ НА ПРЯКАТА СЛЪНЧЕВА ЛАЙМАН – АЛФА (L_{α}) РАДИАЦИЯ ПРОНИКВАЩА В АТМОСФЕРАТА

Ташев В.*, Гинева В.*, Манев А.*, Уит Г., Гумбел Й.**, Капланов М.**, Киров Б.*, Банков Л.*, Спасов Ст.*, Петков П.***

* *Централна Лаборатория по Слънчево-Земни Въздействия (ЦЛСЗВ), Българска Академия на Науките, ул. "Акад. Г.Бончев", бл.3, 1113 София, България*

** *Група по Атмосферна Физика при Филиала по Метеорология (MISU), Стокхолмски Университет, S 10691 Стокхолм, Швеция;*

ELECTRON PHOTOMULTIPLIER FOR MEASURING THE DIRECT SOLAR LYMAN -ALPHA (L_{α}) RADIATION PENETRATING IN THE ATMOSPHERE

Tashev V.*, Guineva V.*, Manev A.*, Witt G., Gumbel J.**, Khaplanov M.**, Kirov B.*, Bankov L.*, Spasov St. *, Petkov P. ***

* *Solar-Terrestrial Influences Laboratory (STIL), Bulgarian Academy of Sciences (BAS), Acad. Georgi Bonchev Str., Block 3, 1113 Sofia, Bulgaria;*

* *Atmospheric Physics Group at the Department of Meteorology (MISU), Stockholm University, S 10691 Stockholm, Sweden;*

ABSTRACT

The principle method for investigation of the atmosphere and the low thermosphere is the rocket sounding. The decreasing solar L_{α} radiation gives an excellent opportunity to study the atmospheric processes. The flux of the direct solar L_{α} radiation is registered by a Lyman-Alpha detector. The detector is manufactured with enhanced characteristics for operation in the severe conditions of the space environment. When the light intensity becomes so low that the incident photons are separated as discrete output

pulses obtained from the anode, this technique is known as the photon counting method. This pulse counting technique is known as the photon counting method.

Key words : photomultiplier, Lyman-Alpha , atmosphere, thermosphere

Г8_63.

ЗАХРАНВАЩО УСТРОЙСТВО НА ДАТЧИК ЗА ИЗМЕРВАНЕ НА СЛЪНЧЕВАТА ЛАЙМАН – АЛФА (L_{α}) РАДИАЦИЯ

**Ташев В.¹, Гинева В.¹, Манев А.¹, Уит Г.², Гумбел Й.², Капланов М.², Киров Б.³,
Банков Л.¹, Спасов Ст.¹.**

- (1) *Институт по Слънчево-Земни Въздействия (ИСЗВ), Българска Академия на Науките, Филиал Стара Загора, ПК 73, 6000 Стара Загора, България;*
- (2) *Група по Атмосферна Физика при Филиала по Метеорология (MISU), Стокхолмски Университет, S 10691 Стокхолм, Швеция;*
- (3) *Институт по Слънчево-Земни Въздействия (ИСЗВ), Българска Академия на Науките, ул. "Акад. Г.Бончев", бл.3, 1113 София, България*

POWER SUPPLY IN A DETECTOR FOR MEASURING THE SOLAR LYMAN -ALPHA (L_{α}) RADIATION

Tashev V.¹, Guineva V.¹, Manev A.¹, Witt G.², Gumbel J.², Khaplanov M.², Kirov B.³, Bankov L.¹, Spasov St. ¹.

- (1) *Institute of Solar-Terrestrial Influences (STIL), Bulgarian Academy of Sciences (BAS), Stara Zagora Department, P.O.Box 73, 6000 Stara Zagora, Bulgaria;*
- (2) *Atmospheric Physics Group at the Department of Meteorology (MISU), Stockholm University, S 10691 Stockholm, Sweden;*
- (3) *Institute of Solar-Terrestrial Influences (STIL), Bulgarian Academy of Sciences (BAS), Acad. Georgi Bonchev Str., Block 3, 1113 Sofia, Bulgaria;*

ABSTRACT

The power supply unit of the electronic measuring devices operating in the upper part of the atmosphere or in space plays an important role for their reliability and performance. The power supply of the first detector, designed for rocket measurements of the direct Lyman-alpha

solar radiation was initially constructed in the common way with many discrete elements, thus causing many disadvantages. The detector is manufactured with enhanced characteristics for operation in the severe conditions of the space environment. In these conditions the power supply unit must correspond to the detector. This paper contains a proposal for the development of a basically different modular power supply unit for satellite Lyman-alpha measurements. The modules are: High voltage, DC / DC converter and Voltage regulators. All modules are produced by leading electronic companies and provide high reliability and performance. The individual modules are packages, suitable for assembly on the PC-board and the connection among them is ensured by standardized connectors. This compact unit is with low weight, minimum overall dimensions and high operation efficiency. The power supply unit generates both standard low supply voltage for the electronic equipment and high voltage with a value of 2000 V, for the Photomultiplier tubes.

The detector is supplied by 28 V supply voltage whose source is a board battery. This supply voltage is galvanically disconnected from the battery power supply by means of a DC/DC converter.

This power supply unit is easily converted to a universal power supply for electronic space devices, through replacement of the module. In this way the receiving power supply voltage and the current are at the request of the user.