

Short presentation of an expertise profile for the 5th call Space in FP7

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Bulgaria



COSMOS Matchmaking Event
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Draft Call Topics that we are interested in*

Space-based applications at the service of European Society (GMES)

➤ *Pre-operational validation of GMES services and products*

- Preparing take-up of GMES Sentinel data

We will take part in the preparation activities to the future Sentinel data (especially Sentinel-4 and Sentinel-5 precursor and Sentinel-5), namely tests implementation for data processing and validation. We will specialise on the use and analysis of Sentinel data and their integration and comparison with other data (i.e. our and other ground based measurements). Students will be included in these activities.

➤ *Support to the coordinated provision of observation data*

- Research and development for In-situ component

We will contribute to the monitoring activities by including environmental dataset for ground based measurements of greenhouse gases, aerosols and cloudness.

- Climate Change – GMES service coordination

We will perform homogenisation of greenhouse gases monitored time series by comparison data of other stations, estimation of greenhouse gases trends important for climate models.

Strengthening the foundations of Space science and technology (SSF)

➤ *Research to support space science and exploration*

- Exploitation of space science and exploration data

We would like to take part in projects, connected to atmospheric emissions.

Cross-cutting activities

➤ *SME specific research*

- Bringing terrestrial SME research into the space domain

Development of miniature compact ground based spectrometer for greenhouse gases monitoring as technology model for space use.

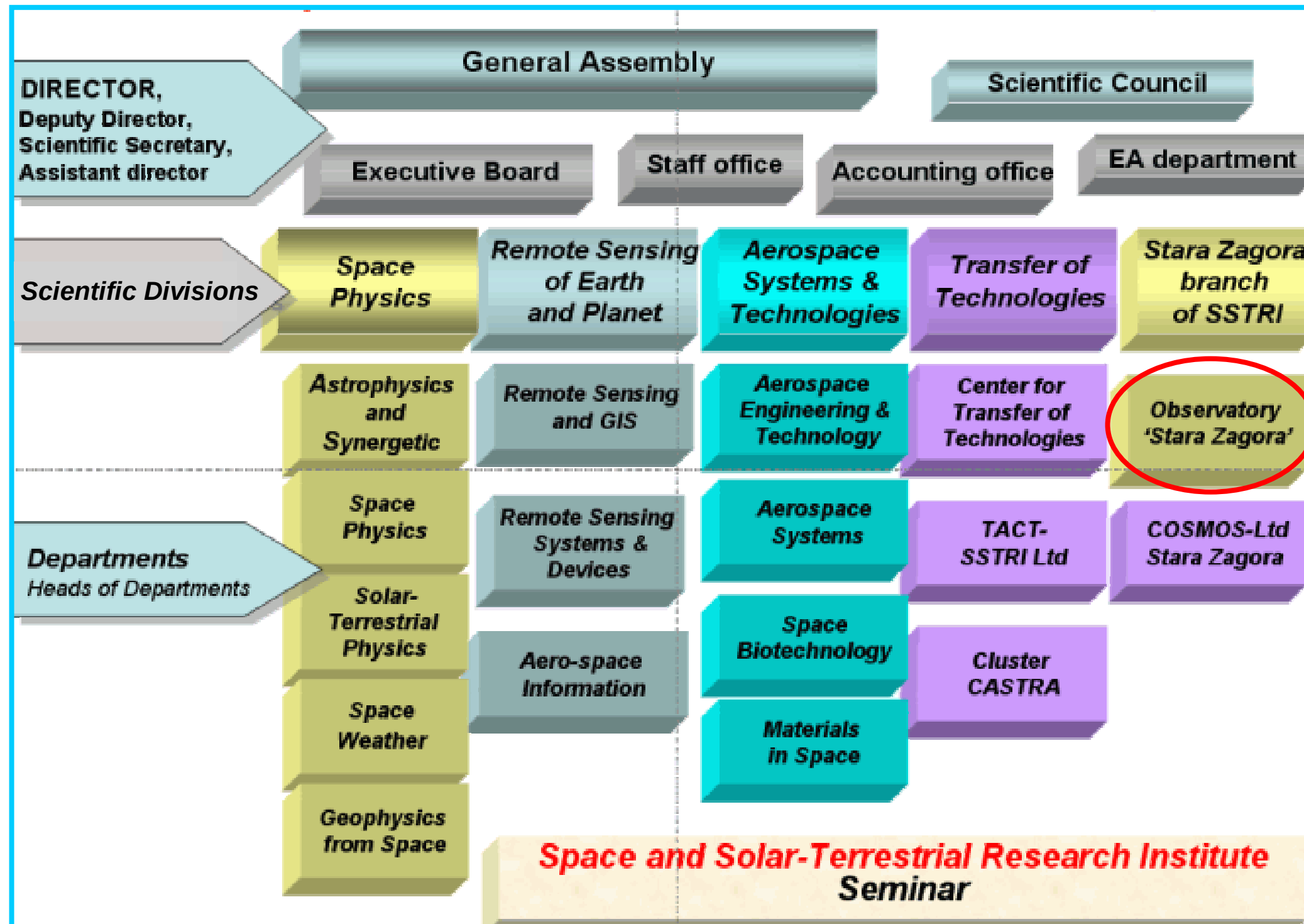
➤ *Studies and events in support of European Space Policy*

- Studies and events in support of European Space Policy
- Research agenda definitions and research activity road-maps

*Please chose the topics from the list, erase the others and adapt the letter size adequately.

Presentation of the Space and Solar-Terrestrial Research Institute (SSTRI), Bulgarian Academy of Sciences

➤ Structure of the organisation



➤ Short history of the organisation and / or working group

The Space and Solar-Terrestrial Research Institute (SSTRI), located in Sofia, the capital of the country, is the highest quality national academic institution in the field of space research and technologies hiring qualified and motivated staff with a long-year experience in space solar-terrestrial physics, Earth observations, space biology and medicine, and in the field of aerospace technologies. It was created by the fusion of two former academic institutes in 2010: Space and Solar-Terrestrial Influences Institute (STIL) and Space Research Institute (SRI).

The Observatory in Stara Zagora town (population of about 160000) is a regional division of SSTRI (pointed out by a red oval in the structure picture in the previous slide), situated at 220 km from the capital. The Observatory is a promising research entity with well defined gravity centre in remote sensing of the atmosphere. The activities of its highly experienced team include design of unique devices for environmental remote sensing and in-situ studies, development of methodologies for Earth atmosphere investigation and application.

Team members are highly experienced in spectrometric measurements, data processing, atmosphere processes modeling, and analysis and interpretation of spectrometric and time series data. Our current research is oriented mainly to chemical and dynamical processes in the troposphere and stratosphere, optical investigations of regional scale atmospheric motion, solar activity and its impact on the atmosphere, and on issues regarding air mass dynamics.

Another research area is terrestrial remote sensing, mainly by in-situ (laboratory, field and airborne) measurements.

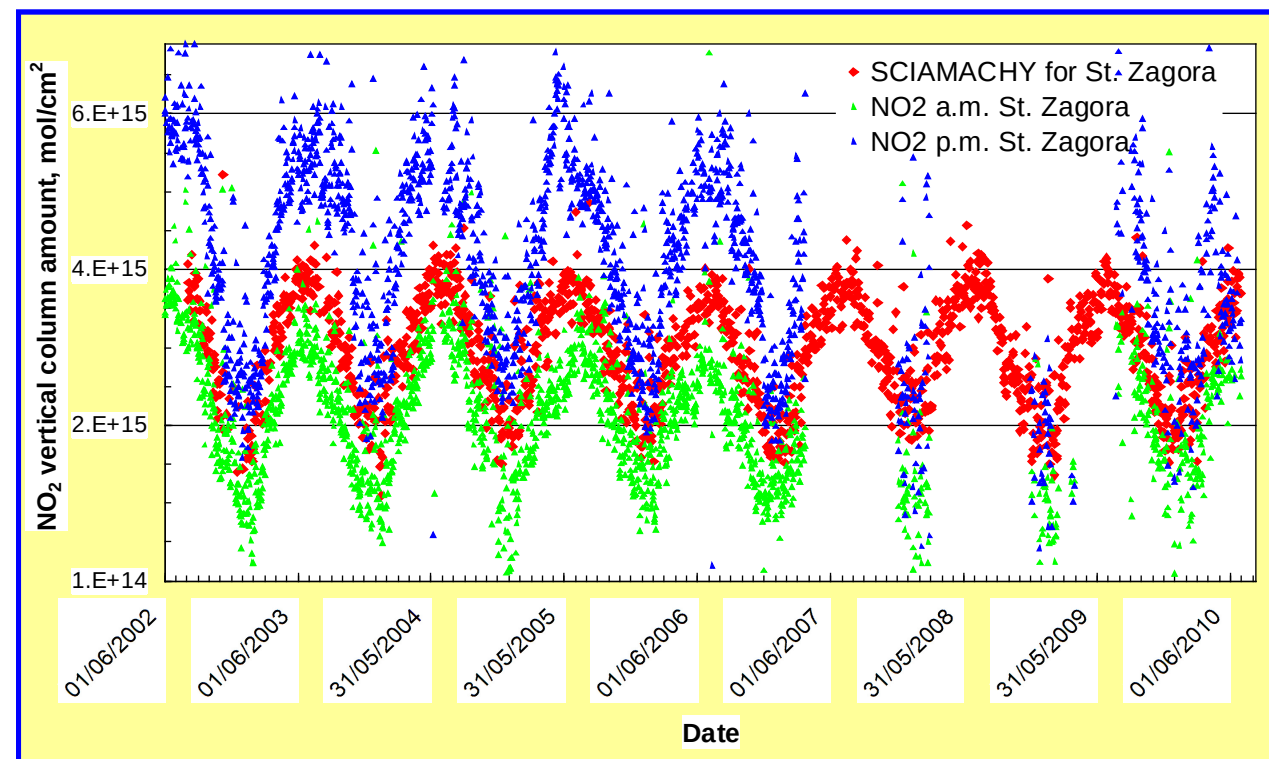
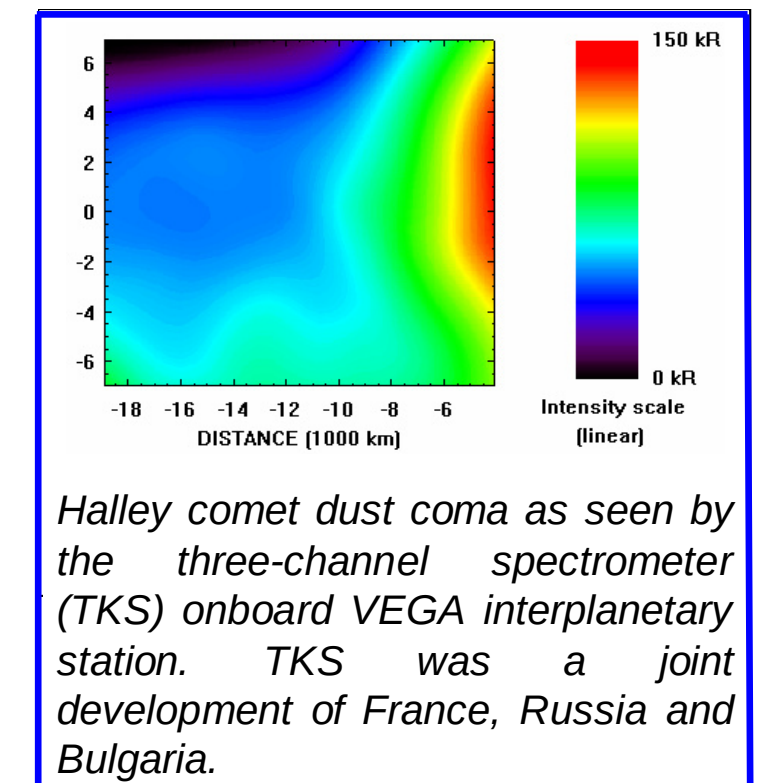
Atmospheric Optical Investigations Department consists of 8 scientists, including 3 senior research scientists.

The research fields include: optical investigations of the upper and middle atmosphere, balance and dynamics of minor atmospheric components, spectral and spatial distribution and temporal variations of optical emissions, radiation transfer in the visible and near infrared band, etc.

The staff was formed of highly motivated scientists with large expertise in space research, who participated in numerous space experiments on INTERCOSMOS series of rockets and satellites, Bulgaria–1300 space research project, interplanetary probes as Vega (Venus-Halley), and in the scientific programs of the first and second Bulgarian cosmonauts.

Since 1990 the team was involved in a number of space experiments, as APEX, ACTIVNY, INTERBALL.

Recent studies concern the content of minor constituents, solar activity and its impact on the atmosphere. The team conducts monitoring of trace gases, specifically of NO_2 and O_3 , by GASCOD-BG spectrometric device. ***The Observatory is the only station on the Balkans, where NO_2 measurements are provided.***

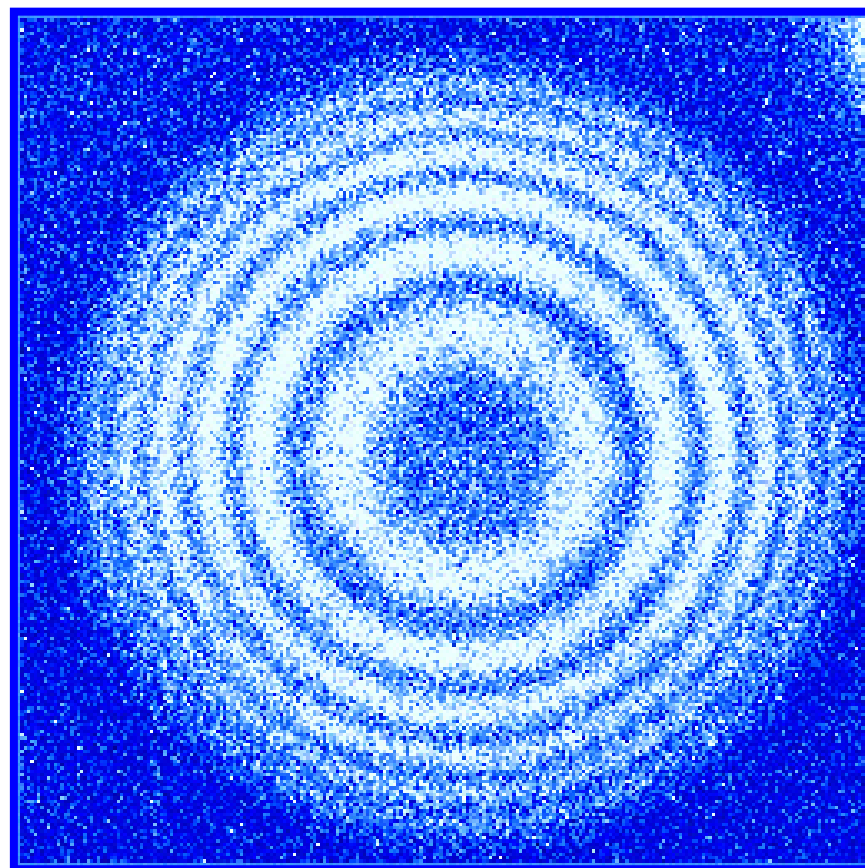


Comparison of the Sciamachy (red rhombs) and the Stara Zagora Observatory (blue and green triangles) NO_2 time series measurements. .

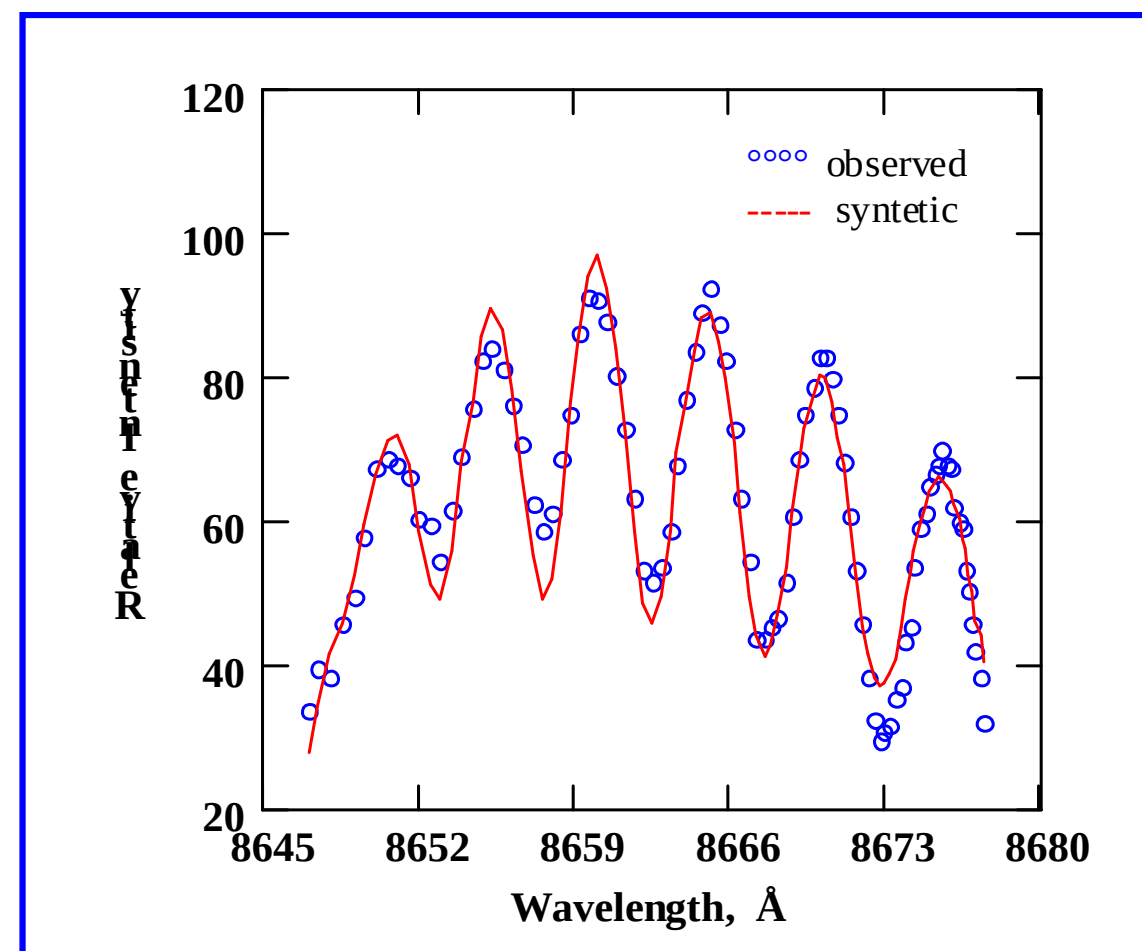
The data series has been included in the international QUILT-project. The Observatory has participated with the acquired NO_2 data in the validation procedure of the spectrometer SCIAMACHY performance onboard the ESA-ENVISAT Satellite. Stara Zagora Town is included in the station list of stratospheric NO_2 columns.

http://www.iup.uni-bremen.de/doas/scia_no2_data_acve.htm.

Investigations of the dynamics of the mesosphere/thermosphere/ionosphere system with separation into tides, gravity and planetary waves are carried out. We perform ground-based optical measurements by means of the SATI-3SZ (Spectral Airglow Temperature Imager) instrument. The SATI instrument, has been developed in cooperation of our team with researchers from Canada - Prof. Shepherd, Dr. Sargoychev, CRESS, York University, Toronto and produced in Stara Zagora. As a result of this cooperation, 7 other SATI instruments were produced, operating in Canada, Kazakhstan, China, and at research sites on the poles. We participate in a network of similar measurements under an INTAS project with partners: Dr. M.-J. Lopes-Gonzales, IAA-CSIC, Granada, Spain; Dr. D. Pancheva, University of Bath, UK; ISAC-CNR, Bologna Italy; Prof. G. Shepherd, CRESS, York University, Toronto, Canada; Prof. I. Suleymenov, II-MES, Almaty, Kazakhstan; Dr. G. Didebulidze, AAO-GAS, Tbilisi, Georgia; P. Muhtarov, GI - BAS, Sofia, Bulgaria (The cooperation with Canada, Kazakhstan and Georgia is supported by the existing joint **NATO** and **INTAS** Projects).

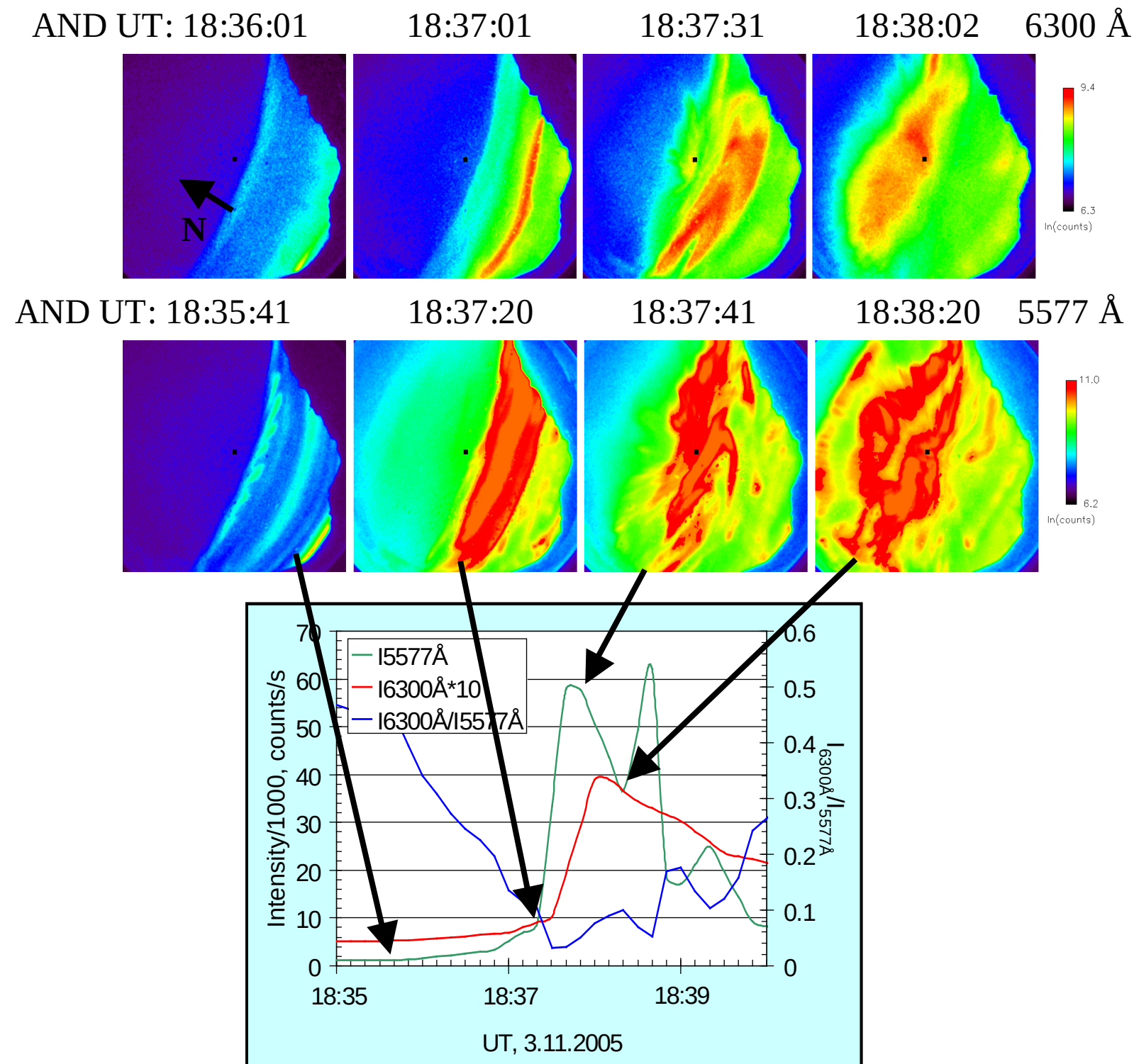


Interferometric image
obtained by SATI



Interferogram and
synthetic spectrum of
molecular oxygen
used to determine the
mesopause
temperature

The behaviour of the auroral emissions during different geomagnetic conditions by all-sky imager and spectrometer data from high latitude stations has been studied. Special attention was paid to the cases of generation and development of substorms. The emissions characteristics at the polar edge of the auroral bulge and inside it have been compared and estimations about the nature of the particle precipitation spectra in these regions have been made.



The polar edge of the auroral bulge crossing the station zenith registered by the all-sky imager at Andenes station (6300 Å and 5577 Å emissions) during a substorm generated on 3 November 2005. In the bottom picture the course of the auroral emissions and their ratio in zenith is shown.

Important recent publications

- Werner R., K.Stebel, H.G.Hansen, U.-P.Hoppe, M.Gausa, R.Kivi, P.von der Gathen, Y.Orsolini, N.Kilifarska. **Study of the seasonal ozone variations at European high latitudes**, *Adv. Space Res.*, v.47, iss.4, pp.740-747, 2011
- Guinea V., I. Despirak, E. Trondsen, R. Werner. **Peculiarities of the auroral emissions during substorms associated with high-speed solar wind streams**, 37th Annual Meeting on Atmospheric Studies by Optical Methods (37AM), 23-27 August 2010, Valladolid, Spain; submitted to *OPA (Optica Pura y Aplicada)*, ISSN: 0030-3917
- Despirak I.V., A.A. Lubchich, V. Guinea, **Development of substorm bulges during storms of different interplanetary origins**, *JASTP*, ISSN: 1364-6826, in press, Corrected Proof August 2010, doi: 10.1016/j.jastp.2010.08.003, 2010
- Gogosheva Ts.N., V.N.Grigorieva, Ts.T.Evgenieva, B.D.Mendeve, N.I.Kolev, D.G.Krastev, B.H.Petkov. **Recent ozone investigations over Bulgaria by remote sensing: Ground-based and satellite data**, *Adv. Space Res.*, v.43, iss.2, pp.201-205, 2009
- Werner R., D. Valev, A. Atanasov, Kostadinov, I., B.Petkov, G. Giovanelli, K. Stebel, A. Petritoli, E.Palazzi. **Ozone minihole observation over the Balkan Peninsula in March 2005**, *Adv. Space Res.*, v.43, iss.2, pp.195-200, 2009
- Guinea V., G.Witt, J.Gumbel, M.Khaplanov, R.Werner, J.Hedin, S.Neichev, B.Kirov, L.Bankov, P.Gramatikov, V.Tashev, M.Popov, K.Hauglund, G.Hansen, J.Ilstad, H.Wold. **O₂ density and temperature profiles retrieving from direct solar Lyman-alpha radiation measurements**, *Geomagnetism and Aeronomy*, v.49, iss.8, pp.1292-1295, 2009
- Werner R., **The latitudinal ozone variability study using wavelet analysis**. *JASTP*, v. 70, Issue 2-4, p. 261-267, 2008
- Stoeva P., A.Stoev, N.Kiskinova, N.Stoyanov. **Localized climatic responses during the 29 March 2006 eclipse at Manavgat, Turkey**, *Solar-Terrestrial Physics*, v.2, iss.12, pp.313-315, 2008
- Mikhalev A.V., P.Stoeva, I.V.Medvedeva, B.Benev, A.V.Medvedev. **Behavior of the atomic oxygen 557.7 nm atmospheric emission in the solar cycle 23**, *Adv. Space Res.*, v.41, iss.4, pp.655-659, 2008
- Stoeva P., A.Stoev, S.Kuzin, Y.Shopov, N.Kiskinova, N.Stoyanov, A.Pertsov. **Investigation of the white light coronal structure during the total solar eclipse on March 29, 2006**, *JASTP*, v.70, iss.2-4, pp.414-419, 2008
- Werner R., K. Stebel, G. H. Hansen, M. Gausa, U.-P. Hoppe, U. Blum, K. H. Fricke. **Application of the wavelet transform to determine gravity wave characteristics observed by lidar measurements**, *JASTP*, v. 69, Issue 17-18, p. 2249-2256, 2007
- Georgieva K., B.Kirov, P.T.Tonev, V.Guinea, D.Atanasov. **Long-term variations in the correlation between NAO and solar activity: The importance of north south solar activity asymmetry for atmospheric circulation**, *Adv. Space Res.*, v.40, iss.7, pp.1152-1166, 2007
- Guinea V., R. Werner. **NH₂ and NH intensity spatial distribution in the Halley comet coma**, *Adv. Space Res.*, v.40/2, pp.155-159, 2007, DOI 10.1016/j.asr.2007.04.024; abstract <http://www.cosis.net/abstracts/COSPAR2006/01353/COSPAR2006-A-01353.pdf>
- Gogosheva Ts.N., V.Grigorieva, B.Mendeve, D.G.Krastev, B.Petkov. **Solar Dynamics Influence on the Atmospheric Ozone**, *Comptes Rendus de l'Académie Bulgare des Sciences*, v.60, iss.8, pp.833-838, 2007
- Werner R., I. Kostadinov, D. Valev, A. Hempelmann, At. Atanassov, G. Giovanelli, A. Petritoli, D. Bortoli, F. Ravegnani, T. Markova. **NO₂ Column Amount and Total Ozone in Stara Zagora (42°N, 25°E) and their Response to the Solar Rotational Activity Variation**, *Adv. Space Res.*, v. 37, pp. 1614-1620, 2006
- Guinea V., R. Werner, P. Stoeva, I. Kostadinov. **Spatial distribution of the neutral carbeneous compounds glow in the sunward Halley comet coma**, *Adv. Space Res.*, v.38, pp.1952-1957, 2006

➤ Experience with the EU Framework Programme

Team members have taken part in the following EU FP5 and FP6 projects:

- ☐ **Study of the ozone response to the winter-spring time atmospheric dynamics at high latitudes**, Project from FP5 project of ALOMAR, Norway: ARI HPRI-CT-1999-00002, 2002-2003
- ☐ **Study of the polar vortex development and the ozone response during the autumn-winter transition in 2004**, project from FP5 project of ALOMAR: ARI HPRI-CT-1999-00002, 2003-2004
- ☐ **Study of the ozone response to stratospheric-tropospheric exchange events, and of inner gravity waves by observations of ozone, temperature, and wind fields at high latitudes**, project from FP6 project of ALOMAR: eARI RITA-CT-2003-506208, 2004-2005
- ☐ **Study of the Generation, Spatial and Temporal Development of Auroral Structures and the Related Phenomena**, №: 22_VeGi from FP6 project of ALOMAR, Norway: eARI RITA-CT-2003-506208, 2005-2006
- ☐ **Attenuation of the Direct Solar Lyman-Alpha Flux**, №: HP11_VeGi (HotPay-Projekt) from FP6 project of ALOMAR eARI RITA-CT-2003-506208, 2005-2006
- ☐ **Study of the short-term ozone and nitrogen dioxide variability at high latitudes**, project from FP6 project of ALOMAR eARI RITA-CT-2003-506208, 2005-2007
- ☐ **Study of the Auroral Emissions and the Related Processes at Quiet Sun and Geomagnetic Conditions**, №: 40_VeGi from FP6 ALOMAR project: eARI RITA-CT-2003-506208, 2007

Our Department has scientific cooperations with the following foreign partners:

- ISAC, CNR, Bologna, Italy;
- CRESS, York University, Toronto, Canada;
- Polar Geophysical Institute (PGI), Apatity, Russia;
- Belgrade Astronomical Observatory (BAO), Serbia

We had carried out joint research with Norwegian, Sweden, German scientific teams, as well.

At national level we have scientific cooperation with Trakia University, Stara Zagora.

Competencies

- List of competencies on the basis of the recent work programme
Space
 - Design, development and manufacturing of unique devices for environmental remote sensing and in-situ studies;
 - Implementation of spectrometric measurements;
 - Data processing, data fusion, data validation;
 - Atmosphere processes modeling, development of methodologies for Earth atmosphere investigation and application;
 - Expertise in analysis and interpretation of space and ground based spectrometric and time series data;
 - Study of chemical and dynamical processes in the troposphere and stratosphere, optical investigations of regional scale atmospheric motion, solar activity and its impact on the atmosphere, and on issues regarding air mass dynamics.

➤ Reference projects

1. “Creation of a system of methods and high-speed means for photometric quantities measurements”, Project on Theme 13 of Fund “Technical progress”, 1984-1985
2. ”Halley comet emissions in the visible region – processing and analysis of the data, obtained from the Interplanetary Station Vega-2”, financed by the National Science Fund “Scientific investigations” of the Ministry of Education and Science, Project №Ф-233/92, 1992-1995
3. “Study of the solar activity impact on the middle atmosphere composition”, financed by the National Science Fund “Scientific investigations” of the Ministry of Education and Science, Project №H3 626/1996, 1996-1999
4. “Investigation of the processes in the mesopause region by rocket measurements of the direct Lyman-alpha radiation penetrating in the atmosphere”, financed by the National Science Fund “Scientific investigations” of the Ministry of Education and Science, Project №H31515/05, 2005-2008
5. „Center for European dimensions of Bulgarian Space research and technologies” financed by the National Science Fund “Scientific investigations” of the Ministry of Education and Science, – №15/05, 2005-2008
6. EOARD Grant FA8655-06-1-3048: „Influence of different solar drivers on the winds in the middle atmosphere and on geomagnetic disturbances”, 2006 – 2007

Intended Role in a Consortium

- Coordinator / partner

We expect to be a project partner.

- Work package leader (**which work package?**)

We could be a work package leader (for example in the field of minor gases monitoring, spectrometric study of upper atmosphere processes) or a work package participant, as well

- End user / market access

Contact and further information (if any)

➤ Address data of the person to contact:

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➤ Relevant links / references

<http://www.stil.bas.bg/> → Projects&Data

→ GASCOD

→ UVSIPS

→ QUILT

<http://www.stil.bas.bg/> → About us → Thematic groups

→ Chemical and Dynamical Processes in the Troposphere and Stratosphere

→ Power Point Presentation (right bottom corner)

→ Optical Investigations of Regional Scale Atmospheric Motions

<http://www.stil.bas.bg/> → About us

→ 10.A.4....ozone and...

→ 10.B.5. Spectral Airglow.