Joint COSPAR and WMO Capacity Building Workshop on COSPAR Capacity Building Workshop (CBW) "Impact of Space Weather on Earth", 15 August– 26 August 2016, Institute of Cosmophysical Research and Radio Wave Propagation Far Eastern Branch of Russian Academy of Sciences, Paratunka, Kamchatka, Russia

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The present COSPAR Capacity Building Workshop (CBW) aimed to expand picture of the status of space weather and to introduce the students to system-wide investigation of space weather (SW) phenomena, bringing together different types of ground based and space observations for coordinated analysis. As CBW combines lectures and training courses, it allows students to consolidate their knowledge in practice of new research methods and SW data processing. Key space-based observations and complementarities with the ground based measurements which formed the basis of the CBW students training and their project works.

Choice of CBW venue is determined by IKIR unique location on Kamchatka where volcanic activity and seismic processes are additional special factors of the influence on the space weather parameters. This event took place from 15 August to 26 August 2016. This time is more comfortable to visit Kamchatka due to weather conditions.

Each of the 12 guest lecturers presented their research area and the method of space weather study, so students were presented research data on the whole consecutive chain of Sun-magnetosphere-ionosphere-atmosphere – Earth.

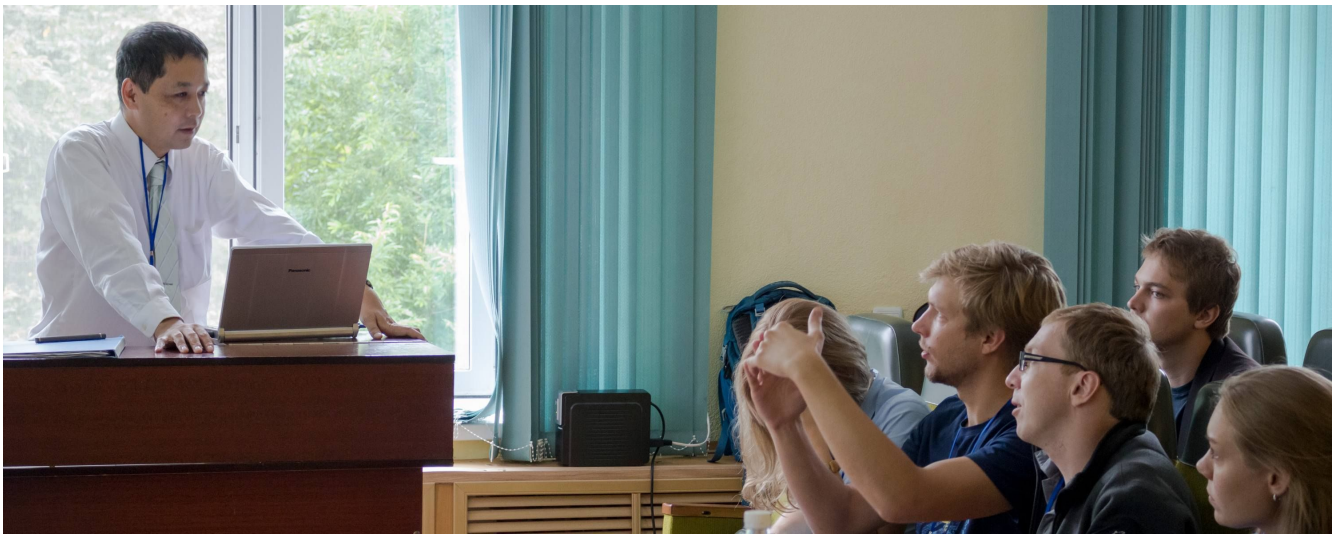
Program of CBW has been drawn up taking into account that the determining factor of space weather is the Sun, so the issues related to the Sun, were discussed at the beginning of the program. The primary sources of space weather are solar flares and CMEs, electromagnetic and corpuscular radiations of the Sun, coronal holes, solar wind, CIRs, shock waves, etc. Impacts of these agents of solar activity on near-Earth space and technical system are discussed. Magnetic storms, atmospheric and ionospheric effects, satellite's electronic failure, radiation hazards for astronauts, effects of geomagnetically induced currents (modern electric power grids, railway electronics, oil and gas trunk pipelines, etc.) are analyzed as manifestations of space weather.

Besides, Space Research of the Sun are considered. New space missions, such as the Interhelioprobe, Solar Orbiter, Solar Probe Plus, etc., will follow the currently operating ones (Hinode, SDO, STEREO, etc.) to

observe the Sun from short distances and from out-of-ecliptic positions, as well as to conduct in-situ measurements in the vicinity of the Sun and outside the ecliptic.

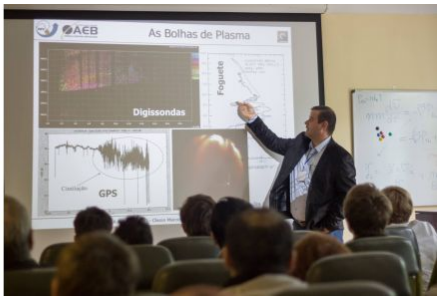
The special role of European Space Agency (ESA) is noted in space research and technology and their applications. ESA's scientific spacecraft such as SOHO and Cluster help further our understanding of the Sun and space weather phenomena. In addition, ESA's Space Situational Awareness Programme focusses on detection and forecasting of Space Weather events and their effects on European space assets and ground based infrastructure.

The most interesting issues of solar-terrestrial physics are considered: structure and dynamics of the Earth magnetosphere, influence of the solar activity on the magnetosphere, magnetosphere-ionosphere coupling, the origin of ionospheric disturbances, including nighttime medium-scale traveling ionospheric disturbances at middle latitudes, features of ionosphere at high geomagnetic latitudes such aspects as aurora, auroral substorms, polar cap and cusp phenomena; impact of global change on the upper atmosphere-ionosphere system; studies, an extension of the possibility to study global electric circuit including thunderstorms and lightning, such as the observation of Schumann Resonances (resonances of the Earth Ionosphere Cavity) above the F2 peak in the ionosphere electron density; the discovery of Transient Gamma Flashes from lightning, including the discovery that antimatter generate by lightning, and, the detailed study of global lightning generated whistler plasma waves in the ionosphere and magnetosphere; whistler wave propagation effects are studied by the new global lightning detection networks such as the WWLLN network. Also the issues of unusual non-universality of solar-terrestrial connections were considered.



Since these research works are based on ground-based and satellite observations, students of CBW are acquainted on training courses with access to Internet resources on factors of space weather; real-time monitoring of radiation conditions in the near Earth space and radiation safety of space satellites; long-term and short term forecasting of the radiation and geomagnetic conditions in the near-Earth space information technologies used for lightning and whistler analysis and monitoring; processing of geophysical data such as analysis methods of ionospheric and geomagnetic data in the mission of space weather and its realization in software; processing of Intermagnet data.

The CBW received a financial support for participation of students and lecturers, and logistical support through generous financial assistance from the Committee on Space Research (COSPAR), World Meteorological Organization (WMO), Institute of Cosmophysical Research and Radio Wave Propagation Far East Branch of Russian Academy of Sciences, Paratunka, Kamchatka; Federal Agency of Scientific Organizations, Moscow, Russia; Institute for Space-Earth Environmental Research, Nagoya University, Japan; Institute of Solar-Terrestrial Physics (ISTP) SB RAS, Irkutsk, Russia, Institute of Cosmophysical Research and Aeronomy SB RAS, Yakutsk, Russia; West Department of IZMIRAN, Kaliningrad, Russia, and Kamchatka State University by Vitus Bering, Petropavlovsk-Kamchatskiy, Russia.

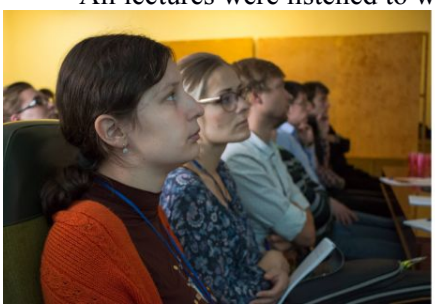
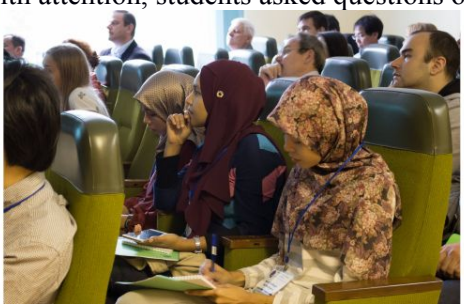
The CBW was directed by Prof. Boris Shevtsov from Institute of Cosmophysical Research and Radio Wave Propagation Far East Branch of Russian Academy of Sciences, Paratunka, Kamchatka, Russia; Organizing Committee consisted of (in alphabet order): Dr. Nina Cherneva (Scientific secretary, IKIR FEB RAS); Dr. Alexi Glover (Space Weather Service Development Coordinator, ESA/RHEA, Darmstadt, Germany), Dr Robert H. Holzworth (Director World Wide Lightning Location Network, University of Washington,USA), Prof. Vladimir Kalegaev (Leader of Centre of Space Monitoring, Scientific Institute of Nuclear Physics Moscow State University), Prof. Vladimir Kuznetsov Director, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation RAS, Russia), Prof. Jan Lastovicka (Department of Aeronomy, Institute of Atmospheric Physics CAS, Czech), Ass. Prof. Wojciech J. Miloch (Department of Physics, University of Oslo, Norway), Dr Clezio de Nardin (Head of the Embrace Space Weather Program / INPE, Brazil), Prof. Kazuo Shiokawa (Director, the Center for International Collaborative Research Institute for Space-Earth Environmental Research, Nagoya University, Japan), Dr. Akimasa Yoshikawa (International Center for Space Weather Science and Education, Kyushu University, Leader of MAGDAS network, Japan).

The tasks, carried out by Local Organizing Committee included organization of the CBW in Institute of Cosmophysical Research and Radio Wave Propagation FEB RAS, partial financial support of CBW, visa support of participants, accommodation for lecturers and students, transfer of participants from Petropavlovsk-Kamchatskiy airport to IKIR and back, organization of excursions, etc. During the CBW, LOC was supported by the IKIR volunteers. LOC was chaired by Boris Shevtsov**.**

18 lecturers from Brazil, Czech, Germany, Japan, Israel, Norway, USA and Russia during two weeks gave 42 lectures and training courses. Topics of the lectures included reviews of Space Weather Science and Applications at ESA (Alexi Glover), International Space Environment Service (Clezio De Nardin) and detailed reports about parameters of Space Weather according ground-based and satellite observations and its research methods.

Prof. Jan Lastovicka delivered special lecture «How to get published» by request COSPAR. Jan Lastovicka is the member of COSPAR publications Committee, so he gave some recommendations and rules. He devoted attention to correct preparing of scientific articles, its structure. The authors should be very attentive to the discussion part of an article to show advantages and specific features of results, and also be careful in correspondence with a editor and reviewer. He noted bad English in the articles, so he advised to use simple proposals, expressions and terms, used in present scientific area.

All lectures were listened to with attention, students asked questions on topics.


Special attention was paid to training courses on which most of time was devoted to processing of archive data of IKIR and World Centers of the collection of Space Weather information. Data of such international network as Intermagnet, MAGDAS, WWLLN (World Wide Lightning Location Network) were also the subject of the study. It should be noted, that IKIR's observation systems have been integrated into global networks for monitoring of Space Weather. Issues of simulation, forecasting, monitoring and analysis of geophysical

parameters, their realization in software, 3D simulation of atmospheric response to cosmic influences were considered in other part of training courses. Theme of one of the training was specific for geophysical processes in the lower atmosphere and ionosphere are interconnected to Kamchatka seismic processes in solid Earth. Earthquakes and tsunami influence on ionospheric disturbances. So training was devoted to Earth's crust deformation by InSAR technique. This powerful tool of satellite data helps to investigate Earth's crust deformations inducing ionosphere variations.

Lecturers advised students on all matters within the framework of group projects and talked about how to interpret the data for assessing space weather.

A team of lecturers consisted of (in alphabet order): Dr. Alexi Glover (Space Weather Service Development Coordinator, ESA, Darmstadt, Germany), Dr Robert H. Holzworth (Director World Wide Lightning Location Network, University of Washington,USA), Prof. Vladimir Kalegaev (Leader of Centre of Space Monitoring, Scientific Institute of Nuclear Physics Moscow State University), Dr. Sergey Khomutov (representative of Russian segment Intermagnet, IKIR FEB RAS, Russia), Ass. Prof. Alexey Krivolutskiy (Central Aerological Observatory, Moscow, Russia), Prof. Vladimir Kuznetsov Director, Institute of Terrestrial magnetism, Ionosphere and Radio Wave Propagation RAS, Russia), Prof. Jan Lastovicka (Department of Aeronomy, Institute of Atmospheric Physics CAS, Czech), Ass. Prof. Oksana Mandrikova (IKIR FEB RAS, Russia), Ass. Prof. Wojciech J. Miloch (Department of Physics, University of Oslo, Norway), Dr. Tsutomu Nagatsuma (National Institute of Information and Communications Technology, Japan), Dr Clezio de Nardin (Head of the Embrace Space Weather Program / INPE, Brazil), Dr. Prof. Lev Pustil'nik (GeoSciences Department of Tel Aviv University and Israel Space Agency, Izrael; Prof. Boris Shevtsov (Director IKIR FEB RAS, Russia), Prof. Kazuo Shiokawa (Director, the Center for International Collaborative Research Institute for Space-Earth Environmental Research, Nagoya University, Japan), Dr. Sergey Smirnov (IKIR FEB RAS, Russia), Dr. Gleb Vodinchar (IKIR FEB RAS, Russia), Dr. Akimasa Yoshikawa (International Center for Space Weather Science and Education, Kyushu University, Leader of MAGDAS network, Japan), Dr. Il'ya Zhivet'ev (IKIR FEB RAS, Russia).



Altogether 30 international and Russian young scientists and students attended this workshop. 8 foreign students came from China, India, Indonesia, Malaysia, Pakistan, and Japan. Participants were selected by the Organizing Committees mainly on the basis of their qualifications. To apply for the workshop, young scientists completed the Application for Participation Form with a CV and a list of publications; letters of recommendation from senior scientists familiar with the applicant; and a one-page research statement about how the attendance to this workshop would benefit their future research. Selection Committee tried to get participants from different countries, and different cities, universities and organizations in Russia.

Lectures and training courses were given in the conference hall of the Administration building of IKIR FEB RAS, located in Paratunka, Kamchatka. The conference hall was very comfortable for about 40 persons, the training rooms were in the same building.

The room was equipped for training in the Institute's library, which inspired the working mood. In this room, equipped with the TV, used as a great display for the PC, (the wall screen size was very good for presentations). Internet connection was carried out using high-speed Wi-Fi, enough to work with 40 laptops simultaneously. The compact arrangement of conference hall, training rooms, the dining room had created a comfortable environment for all participants.

The working environment has been created virtually for the first time, when it was announced that ths students would be divided into 5 international teams. Each team was assigned a period of 1 month for which they would analyse the available ground and space based space weather observations in order to interpret what

activity had taken place. At the end of the training course all teams were asked to prepare a presentation and defend the project. So students immediately started to work on these projects, taking advantage of every opportunity: during lunch breaks, immediately after a visit to the dining room.

The program of the CBW was very intense. Lectures started at 9-00 and ended at 18-30. LOC organized breakfasts, coffee-breaks, lunch and dinners in the dining room of IKIR. Even a halal food table was specially organized for participants from the Muslim countries. The first working day of CBW was ended by round table for lecturers to discuss training and project work and then a special dinner for all participants - lecturers and students. During the closing ceremony all participants received personal certificates of attendance. Besides 5 awards were presented for Best project, Best presentation, Best Teamworking, Most comprehensive study, Best use of IKIR data.

The farewell party was organized in the open air on the shore of scenic Lake with the participation of the Kamchatka ethnographic national ensemble «Koritev». Performance of the ensemble was met with enthusiasm.

During the workshop students took part in sport activities: table tennis, slacklining master class, volleyball, billiard. Lecturers also played..The intense work schedule was supplemented by cultural activities. A week-end between two working weeks of CBW was used for two bus excursions to Geothermal Springs «Dachnye», to Halatyrsky beach (Pacific Ocean coast), and to Petropavlovsk-Kamchatskiy. The excursion in Petropavlovsk-Kamchatskiy included a visit to the museum of the Institute of Volcanology and Seismology. All excursions were guided in English by a professional interpreter. All students and lecturers lived in the hotel, situated in the recreational area in the valley of the river Paratunka. After each working day they had the opportunity to relax in the thermal pools.

The CBW was very successful thanks to the efforts of all organizers, sponsors, lecturers and participants who already sent their feedback to LOC COSPAR CBW with comments. All of them were very thankful to the organizers for hospitality and friendly atmosphere on the workshop. Students noted that they heard useful concentrated volume information on space weather from the Sun to the Earth and have greatly expanded their representations in this area, have a more clear view about impact of Space Weather on Earth. It is a great experience thanks to very interesting lectures and trainings in the area of Space Weather research and its applications.

Prof. Jan Lastovicka has commented during his lecture at the CBW «Sun seems to enter a period of low solar activity. Therefore, if this is correct, we can expect such a deep solar activity minima and the related extraordinary response of the ionosphere to geomagnetic storms in a few next solar cycles – over most of scientific carrier of students of this COSPAR Capacity Building workshop».

The COSPAR CBW achieved its goals: to create conditions for dialogue of the participants, develop lecture material, and collaborate on projects. The results of the projects and the possibility of their publication were discussed with special interest. This international school was held in an atmosphere of goodwill and cooperation, which impressed by both the students and lecturers. One of the important results of the workshop can be noted as the continuity of generations.