United Nations A/AC.105/903

General Assembly

Distr.: General
15 January 2008

Original: English

Committee on the Peaceful
Uses of Outer Space

Report of the United Nations/Russian Federation/European Space Agency Workshop on the Use of Microsatellite Technologies for Monitoring the Environment and Its Impact on Human Health (Tarusa, Russian Federation, 3-7 September 2007)

Contents

V.08-50215 (E) 050208 060208

I. Introduction

A. Background and objectives

1. In its resolution entitled “The Space Millennium: Vienna Declaration on Space and Human Development”,[1] the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) recommended that activities of the United Nations Programme on Space Applications promote collaborative participation among Member States at both the regional and international levels by emphasizing the development of knowledge and skills in developing countries and countries with economies in transition.

2. At its forty-ninth session, in 2006, the Committee on the Peaceful Uses of Outer Space endorsed the programme of workshops, training courses, symposiums and conferences planned for 2007.[2] Subsequently, the General Assembly endorsed the United Nations Programme on Space Applications for 2007 in its resolution 61/111 of 14 December 2006.

3. Pursuant to resolution 61/111 and in accordance with recommendations of UNISPACE III, the United Nations/Russian Federation/European Space Agency Workshop on the Use of Microsatellite Technologies for Monitoring the Environment and Its Impact on Human Health, organized in cooperation with the Space Research Institute of the Russian Academy of Sciences and hosted by the Special Design Bureau for Space Device Engineering of the Institute, was held in Tarusa, Russian Federation, from 3 to 7 September 2007.

B. Programme

4. Opening statements were made by representatives of the Space Research Institute and the Office for Outer Space Affairs.

5. The keynote address was given by a representative of the Space Research Institute. A total of 27 presentations were made during the thematic sessions. Two round-table discussion sessions, as well as observation and recommendation sessions, were organized. Two technical visits were also organized. All the sponsored participants made presentations on the status of the use of space science and technology, as well as on microsatellite projects for space education, in their respective countries.

6. At the discussion sessions, the structured topics were discussed with the aim of defining follow-up activities for the region in order to encourage space education and the utilization of small satellites for space missions and satellite applications on Earth, such as remote sensing and telecommunications for e-health. The participants worked in plenary sessions. Observations and recommendations were made by the participants at the final discussion session.

---

[1] *Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 19-30 July 1999* (United Nations publication, Sales No. E.00.I.3), chap. I, resolution 1.

[2] *Official Records of the General Assembly, Sixty-first Session, Supplement No. 20* (A/61/20), para. 87.

C. Attendance

7. Forty-five people from the following countries and the Office for Outer Space Affairs attended the Workshop: Argentina, Bulgaria, Colombia, Hungary, India, Malaysia, Mexico, Poland, Russian Federation, the former Yugoslav Republic of Macedonia and Uzbekistan.

8. Funds allocated by the United Nations, the Government of the Russian Federation, the European Space Agency (ESA) and the Office for Outer Space Affairs were used to defray the cost of logistics, air travel, accommodation and daily subsistence allowance for 14 participants.

9. The hosting institution, the Special Design Bureau for Space Device Engineering of the Space Research Institute, is located in the city of Tarusa, in the Kaluga region. The Design Bureau is an autonomous branch of the Space Research Institute, comprised of design departments, experimental workshops and corresponding testing facilities.

10. The Russian Federal Space Agency and the Russian Federation supported the Workshop as part of a plan adopted for 2006-2007, in order to commemorate the 100th anniversary of the birth of S. P. Korolev, the 150th anniversary of the birth of K. E. Tsiolkovsky and the fiftieth anniversary of the launching of the first satellite.

II. Summary of presentations

11. Opening statements were made by representatives of the Space Research Institute, the Space Bureau of the Russian Academy of Sciences, the Special Design Bureau for Space Device Engineering of the Space Research Institute and the Office for Outer Space Affairs.

12. The keynote address was given by a representative of the Space Research Institute, who introduced the participants to the main subjects that would be addressed during the workshop: (a) space science addressing the areas of space physics, geophysics, aerospace biomedicine and biology; and (b) space technology, in particular the development and production of microsatellites, including microsatellites for space education.

A. Space weather

13. Space weather is the concept of changing environmental conditions in outer space. It is distinct from the concept of weather within a planetary atmosphere and generally deals with the interactions of ambient radiation and matter within interplanetary, and occasionally interstellar, space. Space weather describes the conditions in space that affect Earth and its technological systems. The Earth's space weather is a consequence of the behaviour of the sun, the nature of the Earth's magnetic field and our location in the solar system.

14. Within our own solar system, space weather is greatly influenced by the speed and density of the solar wind and the interplanetary magnetic field carried by the solar wind plasma. A variety of physical phenomena are associated with space weather, including geomagnetic storms and substorms, energization of the Van Allen

radiation belts, ionospheric disturbances and scintillation, aurora and geomagnetically induced currents at the Earth's surface. Coronal mass ejections and their associated shock waves are also important drivers of space weather as they can compress the magnetosphere and trigger geomagnetic storms. Solar energetic particles, accelerated by coronal mass ejections or solar flares, are also an important driver of space weather as they can damage electronics on-board spacecraft and threaten the life of astronauts.

15. Information on space weather is of paramount importance for humanity. One practical aspect is the study of the magnetosphere focusing on radiation belts, in particular particles that could be dangerous for human beings. The magnetosphere is a unique shield, which protects humans from penetration by high-energy radiation particles of space origin. The ionosphere, like the atmosphere and its ozone layer, protects humans from disastrous (at large doses) ultraviolet and X-radiation. Knowledge of these processes, which can change the state of the magnetosphere and ionosphere, is crucial for human life and health. Many are determined by 11- and 22-year solar cycles, which means that correspondingly long observations are required.

16. Disturbances are elements of space weather that arrived in the surrounding outer space from the surface of the Earth. Disturbances have a natural or technogenic origin. The term "natural origin" includes natural phenomena such as earthquakes, volcanic eruptions and typhoons; industrial electromagnetic radiation and gases and technogenic catastrophes are examples of technogenic disturbances.

17. Ejections of industrial gases from the Earth reach the heights of the upper atmosphere and even ionosphere, changing their natural chemical composition and consequently the electrodynamic parameters of plasma. Global monitoring of disturbances in the ionosphere was started with the aim of mitigating catastrophic changes.

18. The ESA space weather programme has demonstrated the effects of perturbations in the geomagnetic field on humans, in particular on individuals with heart problems. Through holter monitoring of patients with ischaemic heart disease, increases in cardiac rhythm and arterial pressure have been shown.

19. In addition to disturbances of natural and technogenic origin, there is another important field of study in space sciences related to the monitoring of greenhouse gases such as carbon dioxide on the surface and in the atmosphere and ionosphere of the Earth. The circulation of carbon dioxide in the atmosphere, the ocean and the biosphere is to a great extent regulated by natural factors. Over the last 100 years, the concentration of carbon dioxide in the atmosphere has increased by 30 per cent. The possible climatic consequences of this process are under intensive study by the leading scientific centres. The last 40 years of observations carried out by the ground-based network show that only about half of the anthropogenic carbon dioxide remains in the atmosphere, while the other half is absorbed by the oceans and continental ecosystems.

20. At present, there is insufficient coverage of carbon dioxide drains. To verify numerical models and forecasts and to evaluate the balance of carbon dioxide, precise local measurements of the carbon dioxide concentration in the atmosphere need to be obtained. There are no operational satellites to solve this problem from a global and regional perspective.

21. High-sensitivity equipment could be used to monitor the minor constituents of and harmful impurities in the atmosphere by solar radioscopy in order to obtain data about scattered pollution.

22. Measurements of reflected and scattered solar radiation in the ultraviolet and near-infrared spectra make possible the use of remote sensing for basic greenhouse gases such as carbon dioxide, methane and numerous other atmospheric admixtures.

23. Satellite-based measurements have made it possible to conduct global monitoring of the distribution of greenhouse gases in the atmosphere of the Earth and plasma-wave effects in the atmosphere and ionosphere of the Earth, which influence the environment and humankind.

24. Spectroscopic observations in the near-infrared range are the most promising for conducting precise measurements of the complete content of carbon dioxide in the atmosphere, subject to two conditions: (a) high spectral resolution, which can distinguish the separate unsaturated spectral lines in the weak strips of carbon dioxide and (b) good knowledge of the optical path, which passes through the entire thickness of the atmosphere. The small overall size and mass of the instrument play an important role.

25. The development of a compact spectrometer with high resolution for the Venus Express project made it possible to propose for the Chibis microsatellite the "Oracul" spectrometer with a resolving power of $\lambda/\Delta\lambda \approx 20,000$ at the 1.58 micron wavelength, the development of which has just been completed.

26. New physical mechanisms of electrical discharges in the atmosphere are a crucial issue. Knowledge of lightning discharges has increased due to a number of physical phenomena in the atmosphere having been discovered in recent years.

27. Data from observations carried out by the Compton Gamma Ray Observatory and the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) satellites have revealed exceptionally powerful pulses of gamma emission, which irradiated from the Earth. These phenomena are currently being investigated in detail. It has been experimentally proven that these pulses are generated during the 2-3 milliseconds before the basic lightning discharge. Since the Compton and RHESSI satellites were not designed for thunderstorm studies, the measurements carried out on them do not reflect the complex nature of the phenomena and do not possess a sufficient time resolution of the phenomena.

28. The data also revealed the generation of the short (~1 s) single radio burst, which leads to the emission of radio-frequency pulses of super high power. Pulses are generated in thunderstorm clouds at high altitude (13-20 kilometres (km)). Such pulses create radio emissions in the very wide frequency band, observed at distances of several thousand kilometres. Ground observations have also revealed gamma ray bursts, associated with electric field jumps.

29. The main reasons for studying the physical mechanisms of electrical discharges in the atmosphere are (a) super-power gamma bursts at an altitude of 10-20 km are important for safety reasons to civil and military aviation; (b) the large surfaces of the Earth exposed to intensive gamma emissions have an influence on ecology and the safety of people; and (c) super-power single radio-frequency pulses have powerful emission in practice in the entire operating range of the radio-frequency spectrum (up to 3 gigahertz and above). They can serve as a

convenient natural radiation source to establish global monitoring of radio communications.

B. Microsatellites

30. In the last decade, the entire space industry has been affected by budget reductions. This situation has encouraged the use of microsatellites for scientific missions as an option to develop space activities without big budgets.

31. On 20 March 2002, after separation from the cargo ship Progress M1-7, a scientific and educational microsatellite called the Kolibri-2000 (developed by the Space Research Institute of the Russian Academy of Sciences, which has been developing microsatellites throughout the last seven years) was delivered into orbit close to the orbit of the International Space Station. The spacecraft, with a total mass of 20.5 kilograms (kg), was equipped with unique scientific instruments to study lightning discharges, as well as with data collection and housekeeping systems.

32. The scientific programme of Kolibri-2000 addressed, inter alia, the monitoring of technogenic activity in the ionosphere and the study of ionospheric disturbances caused by the development of magnetic storms in the terrestrial magnetosphere.

33. A new microsatellite called Chibis, with a total mass of 40 kg, is now being developed. The first phase of the project was completed in 2006. The Space Research Institute of the Russian Academy of Sciences has facilities for the complete cycle of ground-testing of microsatellites.

34. The following new space instruments were also developed as the Chibis payload: (a) super-lightweight induction magnetometers, (b) a lightweight electric probe for measuring the tension of electric fields and (c) a wave probe.

C. Programmes and projects on space science and technology

35. In Argentina, the National Commission on Space Activities is in charge of carrying out the national space programme, which develops the following three satellite series, depending on what type of main instruments they carry on board: (a) the Scientific Applications Satellite (SAC) series, with instruments for the optical and passive microwave spectra; (b) the Observation and Communications Satellite (SAOCOM) series with active instruments for the microwave spectrum; and (c) the SARE series for both technology validation and Earth sciences objectives.

36. SAC-C was the first Argentine Earth-observation satellite; it was launched on 21 November 2000 and operated for over six years.

37. The Aquarius/SAC-D satellite carried out a science mission, conducting local measurements over Argentina and contributing to global investigations of the atmosphere, the oceans and the effects of technogenic activities and natural phenomena on the environment in accordance with the strategic plan of the Argentine national space programme. Aquarius/SAC-D was developed within the framework of international partnership with the Italian Space Agency, the Centre

national d’études spatiales (France), the Instituto Nacional de Pesquisas Espaciais (Brazil) and the Canadian Space Agency.

38. The Italian-Argentine Satellite System for the Management of Emergencies (SIASGE) is a satellite system dedicated to preventing, mitigating and managing natural disasters, focusing on floods, landslides, fires, seismic events, volcanic eruptions and epidemiology. The system requires combined observations of the same scene in the X- and L-bands, which would be effective for floods, soil, ice-monitoring, hydrology and geology.

39. The Research Institute for Particle and Nuclear Physics of the Hungarian Academy of Sciences has been a permanent participant in international space science missions for the last three decades. Some of the most memorable missions in which it participated are the Vega small launch vehicle, the Phobos Martian probe mission, Spectrum-X-Gamma, Mars-96, Cassini-Huygens, the Rosetta mission and the BepiColombo Mercury orbiter mission.

40. This research group has accumulated a lot of experience, appreciated by the international science community, in the field of designing, manufacturing and testing on-board electronic subsystems for spacecraft, on-board computers, data acquisition systems and ground support equipment.

41. The Hungarian research group has been working on the Electrical Ground Support Equipment (EGSE) as a tool to develop and verify the reliability of on-board instruments. The EGSE control function is to simulate telecommands; it also has a visualization function to display telemetry packets.

42. EGSE architectures have drastically changed over the years. In the early projects, signal-level simulators used personal computer (PC) resources (memory) and put data into a PC bus. The next generation had two separate units: controlled signal-level simulators with an embedded processor and the PC was the user interface; the communication protocol was implemented in compliance with an RS-232 standard. The current approach for developing EGSE is similar to previous architecture, but the embedded processor is a PC-compatible Intel processor card and the communication is implemented on the Ethernet standard, which has no distance limitation between the dedicated unit and the PC.

43. The National Atmospheric Research Laboratory (NARL) of India has been studying the application of Global Positioning System (GPS) radio occultation data for climate change studies.

44. The non-linear characteristics of the climate require long-term observations of temperature profile and water vapour concentrations in the atmosphere for understanding both its natural variability and its response to anthropogenically driven changes. For studies of long-term climate trends (for example, temperatures, water vapour, tropopause height or geopotential height at specific pressure levels) sufficient accuracy, resolution, spatial and temporal coverage of the parameter is required, since only small variations are expected over the lifetime of an instrument.

45. The above-mentioned requirements for the studies are partly addressed by the GPS radio occultation technique, which requires no external calibration but relies on stable oscillators and is therefore most useful for climate research and weather prediction. The data set received by the GPS radio occultation technique has been

successfully used for weather forecasting. Many studies have shown that forecasting can be improved by incorporating global data from GPS radio occultation.

46. The proof-of-concept GPS/Meteorology radio occultation experiment (United States of America) was followed by several missions such as Ørsted (Denmark) and SAC-C (Argentina). The Challenging MiniSatellite Payload (CHAMP) project (Germany) was a successful mission that collected a wealth of information by providing parameters profiles with good accuracy and on a long-term basis. Recently, Formosa Satellite 3 of the Constellation Observing System for Meteorology, Ionosphere and Climate (COSMIC) was launched. The constellation consists of six satellites with dual-frequency GPS receivers on board.

47. The application of GPS radio occultation for weather forecasting provides data that are effectively used for climate change studies by continuous monitoring of tropopause height, which is an indicator for climate change and/or water vapour from all these missions. Monitoring and predicting the onset of the Indian summer monsoon is another application with high impact on the socio-economic conditions of the entire country.

48. NARL has proposed studies with the Indian Space Research Organization on forthcoming missions such as the Radio Occultation Sounder for Atmosphere (ROSA), in collaboration with Italy, and Megha-Tropiques, in collaboration with France.

49. The Institute for Geobiology, Archaeology, Ground Water and Ecology of Macedonia presented the "Stojan cosmic net" (the cosmic S-net), which was described as a new discovery and a technical solution using nanotechnology for fast, undisturbed and safe communications at low cost. The good conductibility of the cosmic S-net can be used for directing or using atmospheric electric discharges.

50. The effect of radiation on the living world has been investigated in detail by the Institute. As a consequence of the damage to the ozone layer, there are so-called ozone holes above large areas of the Earth. Ultraviolet radiation can easily penetrate through them. If people are exposed to this ultraviolet radiation, there is a high risk of getting sunburn and skin cancer. Besides ozone holes, there are other sources of electromagnetic irradiation, known as radiation from space nets.

51. The space sources for radiation (knots) that are able to get through the ozone layer represent active knots and are dangerous to the living world. Only three types of cosmic net harmful to the living world have been detected to date. Scientific studies have shown that people and livestock exposed to these active knots develop malignant diseases: people within nine years and livestock within three months of exposure.

52. The National Space Agency of Malaysia (ANGKASA) has been conducting various activities related to the design and construction of microsatellites, small satellites and research and educational satellites. In September 2000, TiungSAT-1, a 50 kg microsatellite, was placed in a low-Earth circular orbit with a mission lifetime of three years. Its payload included charge-coupled device (CCD) cameras, the Cosmic-Ray Energy Deposition Experiment and the Digital Signal Processing Experiment.

53. Within the framework of the small satellite programme, the RazakSAT project is being developed: it is a small satellite, weighing 200 kg, hexagonal in shape, with

a sun-tracking system with three-axis stabilization based on four reaction wheels. Its payload includes a medium-sized aperture camera with a resolution of 2.5-5 m, transmitting data at a rate of 30 megabits per second.

54. The Malaysian experience includes research satellites such as CubeSats (10-centimetre cubes with a mass of less than 1 kg and a typical lifetime of six months). Such satellites have the advantage of being smaller, cheaper, faster and better. Furthermore, CubeSats are able to perform as a test bed for new systems and core space technologies to be applied to space programmes. InnoSAT is another Malaysian space project, supported by the participation of Malaysian universities.

55. In the educational field, ANGKASA has a project for an educational satellite, called CanSat, which weighs between 350 and 1,050 grams. CanSat has all the basic functions of a satellite, such as those of power and communications, and fits into a 350-millilitre drink can. A typical CanSat launch is implemented on a balloon and the satellite has its own recovery system. A new initiative for national space educational programmes helps ANGKASA to organize a competition for undergraduate students to experience the CanSat development process.

56. The Space Research Centre of the Polish Academy of Sciences presented various Polish instruments that have been used in space missions for (a) solar X-ray diagnostic experiments; (b) plasma physics experiments; (c) physical and geodesic studies of planets; and (d) astrophysics experiments.

57. The technological baselines to develop each instrument follow ESA standards to ensure the high reliability of experiments and the standards are imposed at each level of the project, starting from the design philosophy, the architecture of the instrument, numerical simulations, the selection of components and materials, through the manufacturing process, instrument verification and finally, the involvement of the Polish Academy of Sciences. The very restrictive ESA rules are used throughout the entire process.

58. The second technological baseline is simplified technology. The reliability aspects are not taken into account at the component level. The proper levels of reliability of whole units, adequate for low-cost and relatively short missions, are achieved by intensive tests done on the instruments prior to the launch. This simplified technological approach has been able to provide extremely interesting data and has been utilized in orbit for periods significantly exceeding the initial guidelines of the mission.

59. The Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation of the Russian Academy of Sciences has been studying the use of nanosatellites for monitoring ionospheric and magnetospheric currents. Nanosatellites and picosatellites have the following advantages: (a) projects have small budgets; (b) microtechnologies; (c) projects could be implemented by a group of students in a single academic year.

60. The Northern Lights educational nanosatellite is a proposal from the Space Communications and Informatics Youth Center of Troitsk in the Russian Federation. The objectives of the educational programme are (a) to build an electrical prototype of the Northern Lights nanosatellite; (b) to test a telemetry channel in the amateur radio band using the RK3DXB station in Troitsk as the control centre; (c) to write a reference book in Russian about picosatellites; (d) to collect and test a software

package to operate picosatellites; (e) to test sensor prototypes that might be used in flight models of nanosatellites; (f) to present the results in conferences devoted to microsatellites; and (g) to find support and funding to carry out work with a flight model of a nanosatellite after 2008.

61. This educational project will continue in 2008. After its completion, a proposal for a system of monitoring of the ionosphere-magnetosphere currents will be submitted to the relevant entities.

62. Space weather issues and the use of nanosatellites to provide space magnetometer data for space weather services are widely discussed within Russian academic institutes (such as the Space Research Institute and the Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation).

63. A technological nanosatellite called TNS-0, developed by the Russian Institute of Space Device Engineering, was designed for short-term flight testing of a new nanosatellite platform, a new flight control technique using the Globalstar satellite communications system, new on-board miniaturized devices and a serviceability monitoring method using the International Satellite System for Search and Rescue (COSPAS-SARSAT).

64. The Institute has also developed the technological nanosatellite TNS-1, which is equipped with remote sensing instruments for various applications, such as natural resources exploration, ecological and agricultural monitoring, meteorology and education.

65. Future systems to be built on the TNS nanosatellite platform are a remote sensing system called Lokon and a low-Earth orbit satellite communications system called Koskon for the gathering of information on the monitoring of global emergencies and its transfer to central and local rescue centres.

66. The Suffa programme of the International Radio Astronomy Observatory (IRAOS) was established under an agreement between the Russian Federation and Uzbekistan. The agreement provides a legal basis for the deployment of a 70 m radio telescope on the Suffa plateau in Uzbekistan, at an altitude of 2,500 metres, which will be part of IRAOS. The IRAOS structure will consist of (a) a radio telescope operating in the 0.9÷60 millimetre wavelength band; (b) two removable sub-reflectors; (c) a satellite communication station; and (d) a data receiving and processing system and other necessary supporting infrastructure. The radio telescope is due to start experimental operations by 2010 and to start observations in 2011.

67. Under the agreement, other States, international organizations or national scientific institutions may participate in the project, under three possible formats: (a) cooperation in completion of the development of the Suffa project; (b) participation in providing equipment; or (c) scientific cooperation through co-sponsoring future operations of the radio observatory and scientific data-sharing.

68. New pilot projects in radio astroclimate, the correlation between solar activity and radio transparency, magnetosphere-ionosphere disturbance, plasma waves, turbulence and radio conditions could be implemented. The long-term observations will constitute a database for modelling of the atmosphere and ionosphere to forecast the “radio-weather”.

D. Applications of space technology for telemedicine

69. The Telemedicine Center of the University of Colombia supports the use of satellite technology for telehealth mobility in Colombia. It works on the implementation of e-health, telehealth and telemedicine solutions with the application of information and communications technologies (ICTs) to health issues. The project is one option for solving national problems such as the restricted access to rural and remote areas, the vulnerable situation in some communities and the needs of urban areas. Telecommunications solutions for telemedicine have been found in satellite communications using, inter alia, very small aperture terminals.

70. The International Society for Telemedicine and eHealth has a mission statement to facilitate the international dissemination of knowledge and experience in telemedicine and e-health and to provide access to recognized experts in the field worldwide. The Society is the international representative body of national and other associations, institutions, corporations and individuals. It works in partnership with the World Health Organization, the International Telecommunication Union, the Office for Outer Space Affairs, the World Academy of Biomedical Technologies and the United Nations Educational, Scientific and Cultural Organization and liaises with other international associations.

71. Med-e-Tel is an international educational and networking forum for e-health, telemedicine and health-related ICT. It brings manufacturers and suppliers of specific equipment, as well as service providers, together with buyers, health-care professionals, executives of international organizations and associations, institutional decision makers and policymakers from all over the world. It provides them with hands-on experience and knowledge about currently available products, technologies and applications. It is a forum where state-of-the-art products, services, ideas and projects are presented and discussed. It is a meeting place for developing existing relationships and establishing new cooperation and partnerships among individuals, scientific groups and institutions and small, medium-sized and large enterprises.

72. Med-e-Tel reflected on the role of e-health in the context of early warning and space applications, emphasizing that health systems need to act to prevent and manage the impacts of disasters on populations. At the same time, health services face serious problems such as rising costs, the ageing society, globalization and migration.

73. Med-e-Tel considers that the role of an e-health organization in disaster management is varied, such as setting up e-health centres and/or mobile medical clinics, connecting hospital specialists and disaster victims, bringing specialists into the disaster field via ICT, training volunteers, providing teleconsultations and addressing the care of disaster victims.

74. The Space Research Institute of the Russian Academy of Sciences gave a presentation on the use of microsatellite technology in the medical prophylaxis of cardiovascular and nervous diseases. The problem comes from the weak electromagnetic fields (EMF) in the near-Earth environment, so-called biotropic factors of helio-geomagnetic activity. The general targets of weak natural EMF in biological systems are (a) the cardiovascular system (of 10 diseases and traumas registered in Moscow ambulance calls for the three-year period 1979-1981, only

people suffering from myocardial infarctions and brain strokes were affected by irreversible action of helio-geomagnetic activity); (b) the blood system (this refers to blood coagulation, increases in viscosity, deceleration of blood flow in the capillary system and erythrocyte aggregation, which were observed during geomagnetic storms); and (c) the nervous system.

75. The preliminary conclusions of a study on the magnetic sensitivity of healthy people and patients with arterial hypertension showed that, for patients with arterial hypertension, a maximal correlation with geomagnetic activity can be observed approximately one to two days after the main phase of a geomagnetic storm. Blood pressure is also correlated with temperature and atmospheric pressure.

76. Research also shows the existence of negative effects of space weather on patients with cardiovascular and nervous system diseases. In order to prevent the development of arrhythmias, heart fibrillation, sudden death from myocardial infarction, brain strokes, epilepsy crises and suicide attempts, medical prophylaxis is needed. Consequently, space weather forecasting is of paramount importance to address the above issue. The most effective measure of prophylaxis for sick people is the short-term prediction of magnetic storms.

77. Microsatellites can be effectively used for space weather forecasting by permanently monitoring the solar wind and interplanetary magnetic field. Such a microsatellite has to be placed in a libration point between the Sun and the Earth. With a small payload, including an on-board processor, such a microsatellite could forecast and send an alarm one to two hours before geomagnetic disturbances developed in the Earth's magnetosphere.

78. If a satellite could forecast and provide a warning about a forthcoming geomagnetic storm, it would be possible to implement a project on the basis of the "traffic light principle" as a preventive measure. Then, in every location where such information is required and for every person who might require it (at air traffic control centres, in intensive care units of cardiological clinics, in psychiatric clinics, among industrial infrastructure that could be damaged by power surges, and, in particular, for individuals who had already had a myocardial infarction or brain stroke or who suffered from, for example, vegetative nervous system crises) a portable device with a warning red light could be activated as a preventive action following the satellite warning.

III. Observations and recommendations

A. Observations

79. Participants of the meeting observed that:

(a) Satellite information-sharing would assist in avoiding duplication of instruments or satellite missions. In order to improve the effective use of satellite information, the importance of improving capacity-building in the use of satellite data for taking full advantage of this information was emphasized;

(b) The participants considered a potential follow-up of activities related to the use of microsatellite space technology. The Space Research Institute of the

Bulgarian Academy of Sciences expressed an interest in hosting the next meeting of the group.

B. Recommendations

80. Participants of the meeting recommended that:

(a) Communication channels among microsatellite experts around the world should be opened by the publication of a newsletter every quarter. The option could be considered of having a link to the Office for Outer Space Affairs website containing the contact information of experts in this field for further discussions and action;

(b) A data-sharing pilot project should be implemented as an effective tool to share and exchange information. The first step would be the identification of the project, with a broad explanation of the specific application focus in the near future. The second step would be to advertise, through the above-mentioned newsletter, the project description in order to find a centre, institution or experts who could support the project or provide satellite images for a particular project;

(c) The use of microsatellites in developing countries should be encouraged as a first step to their gaining experience in space technology and space activities. The technology would not be a problem, but ensuring the existence of the know-how to use it would be a challenge. Microsatellite technology is a good example of how space applications could be integrated.