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Committee on the Peaceful Uses of Outer Space

Report on the United Nations/International Astronautical Federation Workshop on Integrated Space Technologies and Space-based Information for Analysis and Prediction of Climate Change

(Daejeon, Republic of Korea, 9-11 October 2009)

Contents

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I. Introduction

A. Background and objectives

1. The Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) recommended in its resolution entitled "The Space Millennium: Vienna Declaration on Space and Human Development"[1] that activities of the United Nations Programme on Space Applications should promote collaborative participation among Member States at the regional and international levels, emphasizing the development of knowledge and skills in developing countries.[2]

2. At its fifty-first session, in 2008, the Committee on the Peaceful Uses of Outer Space endorsed the programme of workshops, training courses, symposiums and conferences of the Programme on Space Applications for 2009. Subsequently, the General Assembly, in its resolution 63/90, endorsed the activities to be carried out under the auspices of the United Nations Programme on Space Applications in 2009.

3. Pursuant to General Assembly resolution 63/90 and in accordance with the recommendations of UNISPACE III, the United Nations/International Astronautical Federation (IAF) Workshop on Integrated Space Technologies and Space-based Information for Analysis and Prediction of Climate Change was held in Daejeon, Republic of Korea, from 9 to 11 October 2009, in conjunction with and as an associated event of the 60th International Astronautical Congress (IAC), also held in Daejeon, Republic of Korea, from 12 September to 16 October 2009.

4. The Workshop was organized by the Office for Outer Space Affairs of the Secretariat, as part of the activities of the United Nations Programme on Space Applications in 2009, and IAF. It was co-sponsored by the European Space Agency (ESA) and hosted, on behalf of the Government of the Republic of Korea, by the Korea Aerospace Research Institute (KARI).

5. The Workshop was the nineteenth one organized jointly by the Office for Outer Space Affairs and IAF. It built upon the recommendations and experience gained from the previous 18 workshops, held between 1991 and 2008.

6. The Workshop discussed a wide range of space-related technologies, services and information resources available for analysis and prediction of climate change. International, regional and national programmes and projects, such as the ESA Climate Change Initiative, Global Earth Observation System of Systems activities to ensure availability of relevant information to support decision-making and case studies on activities in developing countries, were presented at the Workshop as well.

7. The primary objectives of this event included: (a) increasing awareness among decision makers and representatives of the research and academic community about the use of integrated space technology applications for sustainable development

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[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] Ibid., chap. II, para. 409 (d) (i).

programmes supporting prediction, monitoring and early warning of climate change-induced disasters and environmental hazards in developing countries; (b) examining low-cost space-related technologies and information resources available for addressing social and economic issues caused by climate change and global warming; (c) strengthening capacity-building in the area of space technology applications for climate change monitoring and hazards management; and (d) strengthening international and regional cooperation.

8. The Workshop and its round-table discussion also provided an opportunity for direct dialogue between space technology experts, policy- and decision-makers and representatives of the academic community and private industry from both developing and industrialized countries. All participants were encouraged to share their experiences and to examine opportunities for better cooperation.

9. The present report describes the background, objectives and programme of the Workshop. It has been prepared for submission to the Committee on the Peaceful Uses of Outer Space at its fifty-third session and to its Scientific and Technical Subcommittee at its forty-seventh session, both in 2010.

B. Programme

10. The programme of the Workshop was developed jointly by the Office for Outer Space Affairs and the programme committee of the Workshop, which included representatives of a number of national space agencies, international organizations and academic institutions. A substantial contribution was made by the honorary committee of the Workshop, which consisted of prominent representatives of the Committee on the Peaceful Uses of Outer Space, IAF and the United Nations Secretariat. The input received from both the honorary committee and the programme committee, as well as direct participation of members of those committees, ensured that the aims of the Workshop were achieved.

11. The programme of the Workshop focused on integrated space technology applications for monitoring, analysis and prediction of climate change impact on sustainable development, with the aim of enabling and supporting participants to develop and implement projects in this area, and to provide reliable data and information for policy- and decision-making, as well as on ways of enhancing the capacity of developing countries in this area through the development of human and technical resources at various levels, enhancing regional and international cooperation, increasing public awareness and developing appropriate infrastructures.

12. The Workshop included three technical sessions. The first session considered capacity-building programmes and plans in the area of space technology applications to climate change studies, as well as international and regional initiatives and cooperation. The second session considered applications of space-based information and space technologies for observing and monitoring climate change, and the third focused on space technologies and information resources for monitoring, prediction and early warning of climate change-induced disasters and environmental hazards, with presentations and discussions on practical experiences, results and challenges by various countries and regions.

13. A total of 26 oral technical presentations were delivered during the two days of the technical sessions, and 9 papers were submitted for a poster session. All presentations and papers focused on national, regional and international projects and initiatives in the area of application of space-related technologies for climate change analysis and prediction and on the contributions of these technologies to sustainable development programmes in developing countries.

14. Opening statements were delivered by the Deputy Minister for Science and Technology Policy, Ministry of Education, Science and Technology, of the Republic of Korea; the Chairman of the Committee on the Peaceful Uses of Outer Space; and representatives of IAF, ESA and the Office for Outer Space Affairs. At the opening meeting, keynote addresses were delivered by Joo-jin Lee, President of KARI, and Jean-Louis Fellous, Executive Director of the Committee on Space Research (COSPAR). Closing remarks were made by representatives of IAF, the Office for Outer Space Affairs, ESA and the local organizing committee.

15. Each of the technical sessions was followed by open discussions, which focused on specific topics of interest and provided additional opportunities for participants to voice their opinions. The discussions were continued in-depth and summarized by two working groups established by the participants in order to develop a set of questions to be presented to panellists at the round-table discussion that took place after the working group meetings.

16. A detailed programme of the Workshop and its proceedings, together with the list of participants, is available on the website of the Office for Outer Space Affairs (http://www.unoosa.org).

C. Attendance and financial support

17. The United Nations, on behalf of the sponsors, invited developing countries to nominate candidates to participate in the Workshop. Participants were required to have a university degree or well-established professional working experience in a field related to the overall theme of the Workshop. In addition, participants were selected on the basis of their work experience in programmes, projects or enterprises that were already using space technology applications or that could potentially benefit from using space technology. The participation of specialists at the decision-making level from both national and international entities was particularly encouraged.

18. Funds allocated by the United Nations, IAF, ESA and the local organizing committee for the organization of the Workshop were used to provide financial support for 23 participants from developing countries. Full financial support was provided for 22 of those participants, including international round-trip air travel, hotel accommodation, living allowance for the duration of the Workshop and IAC registration fees for the Congress. One participant received partial funding (hotel accommodation, living allowance and Congress registration).

19. The local organizing committee provided conference facilities, secretarial and technical support and local transportation, as well as transportation to and from the airport for funded participants, and organized a number of social events for all Workshop participants.

20. The Workshop was attended by approximately 80 participants from the following 40 countries: Australia, Azerbaijan, Bangladesh, Botswana, Brazil, Cambodia, Cameroon, Canada, China, Colombia, France, Germany, Ghana, Guatemala, Guinea-Bissau, India, Iran (Islamic Republic of), Iraq, Japan, Kazakhstan, Lao People's Democratic Republic, Mexico, Mongolia, Morocco, Nepal, Nigeria, Peru, Philippines, Republic of Korea, Russian Federation, Seychelles, Singapore, Saudi Arabia, South Africa, Thailand, United Kingdom of Great Britain and Northern Ireland, United Republic of Tanzania, United States of America, Uruguay and Viet Nam. The following international organizations and other entities were also represented at the Workshop: IAF, International Academy of Astronautics (IAA), Group on Earth Observations Secretariat (GEOS), COSPAR, Space Generation Advisory Council and Office for Outer Space Affairs.

II. Overview of technical sessions and round-table discussion

21. The first technical session considered international initiatives and programmes related to the use of space technology and information for climate change studies, as well as issues related to capacity-building in space science and technology in developing countries. Papers presented at this session emphasized the necessity of regional and international cooperation in addressing a global problem such as climate change. Participants in the Workshop were updated on the latest development of the ESA Climate Change Initiative, which had the objective of fully realizing the potential of both long-term global Earth observation data collected by ESA in the past and of current and planned missions in significant and timely contribution to the essential climate variables databases required by the United Nations Framework Convention on Climate Change. In this regard, the Agency will implement all steps necessary for the systematic generation and regular updating of 21 essential climate variables, thus ensuring that full value is derived from ongoing and planned missions for climate purposes, and in coordination with international efforts.

22. The participants were also introduced to the activities of the Group on Earth Observations (GEO), which is an intergovernmental body with 80 member States and 56 participating organizations, established to lead a worldwide effort to build a Global Earth Observation System of Systems over the next 10 years. This globally distributed system, which includes satellite observation systems and global, regional and local in situ networks, will deliver the benefits of Earth observations to both data and information providers and consumers worldwide. In the area of climate change, GEO currently coordinates the international Integrated Water Cycle Management project and carries out the global forest carbon-tracking study. The GEO workplan for 2009-2011 in the area of climate change includes the development of the global carbon observation and analysis system, the development of environmental and climate information for decision-making, risk management and adaptation, and the reprocessing and reanalysis of key climate data from satellite systems for assessing variability and change.

23. Presentations at the session reviewed the impact of global climate change on developing countries in general, and on African countries in particular, and emphasized the need for capacity-building in space technology in order to ensure the full-scale participation of developing countries in programmes and projects

addressing climate change. Participants also recognized the importance of increasing secondary school students' awareness of how space technologies were used for the analysis and prediction of climate change. Contributions of the Office for Outer Space Affairs and IAF to capacity-building in space science and technology in developing countries were featured at the session as well, with particular emphasis on the series of United Nations/IAF workshops.

24. The second technical session considered issues related to applications of space-related technologies and information resources for climate change observations and monitoring. The presentations at the session demonstrated the huge potential of Earth observation data for climate change studies. The participants were shown examples of the application of microwave remote sensing data for global water cycle research, of integrated methods for monitoring terrestrial carbon from space and of combined analysis of satellite remote sensing data and simulation data for understanding the role of aerosol and clouds in the climate formation process. It was recognized that the Earth-observing satellites provided a unique opportunity to monitor the terrestrial environment on the global scale, and the interpretation of remote sensing data using advanced methods became a reliable technique for tracking temporal changes in the biosphere.

25. In this context, the presentations at the session also showed how space technology could contribute to national climate change programmes, including examples of Canadian space-based climate change activities, of detecting changes in Aral Sea borders in Kazakhstan and of water monitoring in Korea. The session also featured papers on the status of the use of spatial data for climate studies in Guatemala, on the establishment and use of an imagery database for developing a climate change model for the Mekong delta in Viet Nam and on applying remote sensing data for assessing climate change impact in Bangladesh. A brief overview of opportunities for receiving free GeoEye imagery was presented at the session as well.

26. The third technical session focused on space-related technologies and information resources available for addressing social and economic issues caused by climate change and climate change-induced disasters and environmental hazards. The papers at that session reviewed the consequences of global warming for our planet and presented capabilities of space-based instruments for global carbon observation from space using the example of the Greenhouse Gases Observing Satellite. Participants were shown how thermal infrared imagery received from remote satellites were used for surface temperature monitoring and how a new generation of environmental monitoring satellites could address challenges of climate change-induced natural disasters.

27. A number of papers at the session discussed ongoing or planned small satellite climate monitoring missions and the contribution of small satellite projects to sustainable development programmes. Case studies and reports on national projects in Africa, Asia and South America, as well as on data needs in the context of climate change studies, were also presented at the session.

28. The session concluded with a round-table discussion, in which top-level representatives of space agencies and other relevant national, regional and international institutions and organizations from both spacefaring and non-spacefaring countries participated, in order to establish a direct dialogue with

the Workshop participants on how space technologies and policies can contribute to reducing the impact of climate change.

29. The round-table discussion was moderated by Takao Doi, head of the United Nations Programme on Space Applications, and involved the following panellists: Se-jin Kwon (Professor, Division of Aerospace Engineering, Korea Advanced Institute of Space and Technology, Republic of Korea), Luiz Augusto Toledo Machado (Senior Researcher, Centre for Weather Forecast and Climate Studies, National Institute for Space Research, Brazil), David J. W. Kendall (Director, Space Science, Canadian Space Agency, Canada), Zinendeme Minia (Deputy Director-General, National Meteorological Agency, Ghana), Xuan Lam Nguyen (Director, National Remote Sensing Center, Viet Nam), and Einar-Arne Herland (Head, Science Strategy, European Space Research Institute/ESA).

30. Prior to the round table, two working groups were established to summarize critical issues and focal themes identified in the presentations delivered at the technical sessions of the Workshop and to bring them to the attention of the panellists. The first working group focused on issues related to capacity-building and international cooperation, and the second discussed practical aspects of space technologies and information applications for vulnerability assessment and for mitigation of and adaptation to climate change.

31. In the limited time available for discussion, the round-table panellists discussed the following issues brought to their attention by both the moderator and audience:

- Climate change data generation and distribution
- Capacity-building in access to and use of climate change data
- Awareness development among policy- and decision-makers
- International and regional cooperation

III. Findings and conclusions of the Workshop

32. The major findings of the Workshop's working groups and panellists of the round table may be summarized as follows:

(a) Climate change is a global problem but with local effects;

(b) Comprehensive satellite data on climate change are currently being generated. However, scientists have noted that data coverage, resolution and accuracy are not sufficient to address all climate change issues;

(c) Data should be more readily available in a standard format and at a low price so that maximum benefits can be derived from them in all parts of the world;

(d) The integration of satellite data into climate change information systems needs to be strengthened;

(e) Enhanced international coordination is required for better integration of climate change information into the policy- and decision-making process.

(f) Regional centres and groups need to be a source of public information to inform non-specialists at the policy- and decision-making levels in government and industry.

33. The Workshop reached the following conclusions:

(a) Satellite-derived climate data standards and systems that are globally available free or at a low price should be developed and adopted. Constellations of microsatellites could have good potential here;

(b) Regional groups or centres with globally shared access to satellite data for developing and sharing regional and global climate change information could be identified and established. Such centres should also contribute to international capacity-building efforts;

(c) Commercial, university, government and local community partnerships for such centres should be considered;

(d) Climate change information derived from satellites must be presented in a language that should be understood at the policy- and decision-making levels of government and industry;

(e) "One-stop" international access to climate change information is needed in order to respond to the needs defined at the regional level. This should provide standard-format data and support decision-making processes in the regions.

34. The above conclusions and concerns of the Workshop's round table were presented by Ciro Arévalo, Chairman of the Committee on the Peaceful Uses of Outer Space, to the IAC plenary event devoted to climate change and served as an input to the discussion.

IV. On-site evaluation of the Workshop

35. In order to receive feedback from participants and assess the Workshop, on the last day of the event the organizers conducted a survey of the participants. A total of 29 completed questionnaires were returned to the organizers, including 19 (68 per cent) from participants who received financial support from the sponsors and 9 (32 per cent) from self-funded participants. Some of the results of the survey are presented below.

36. All respondents felt that the theme of the Workshop was relevant to their current work and that the programme of the Workshop met their professional needs and expectations. All respondents would also recommend participation in the future United Nations/IAF workshops to their colleagues.

37. Fifty-two per cent of respondents believed that the overall level and quality of presentations at the Workshop was very good, and 48 per cent evaluated it as good. Sixty-eight per cent of respondents evaluated the overall organization of the Workshop as very good, and 32 per cent as good.

38. Participants indicated that participation in the Workshop helped them to:

(a) Gain and enhance knowledge of space technology and applications (22 replies);

(b) Confirm ideas and concepts in space technology and applications (18 replies);

(c) Generate new application project ideas (19 replies);

(d) Develop potential cooperation with other groups (25 replies);

(e) Develop possible partnerships (23 replies).

39. In answering the question on the actions or projects they would initiate as a follow-up to the Workshop, respondents indicated that they would:

(a) Contact experts and/or network (26 replies);

(b) Define new projects (15 replies);

(c) Undertake additional education or training (17 replies);

(d) Procure equipment or technologies (5 replies);

(e) Seek funding support for projects (12 replies).

40. Assessing the Workshop's round-table discussion, 63 per cent of respondents considered it very interesting, and 37 per cent interesting. Ninety-two per cent of respondents believed that issues of particular interest to them and their agencies were addressed by the round-table panellists. Seventy-five per cent also felt that they had a chance to bring their questions to the attention of the panellists.

41. Thirty-six per cent of respondents considered the level of interaction between panellists and the audience very interactive, 52 per cent interactive and 12 per cent not so interactive.

42. The survey also showed that no funded respondents would have been able to attend the Workshop and IAC without the financial support provided by the organizers.

V. Follow-up actions

43. At the meeting of the IAF Committee on Liaison with International Organizations and Developing Nations, held during the IAC and attended by representatives of the Office for Outer Space Affairs, it was decided that the twentieth United Nations/IAF Workshop should be held in Prague from 24 to 26 September 2010, as an associated event of and in conjunction with the 61st IAC which would take place from 27 September to 1 October 2010, also in Prague.

44. The theme of the twentieth United Nations/IAF Workshop should be finalized by the Office for Outer Space Affairs in cooperation with the local organizing committee and the IAF secretariat. Discussions on the objectives and programme of the next workshop would be continued at a planning meeting, to be held during the forty-seventh session of the Scientific and Technical Subcommittee, in 2010.

45. It was also reconfirmed at the meeting of the Committee on Liaison with International Organizations and Developing Nations that further round-table discussions between participants and heads or senior managers of space agencies and relevant institutions or organizations should be held during future United Nations/IAF workshops.