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Report on the United Nations/Austria/European Space Agency Symposium on Space Tools for Monitoring Air Pollution and Energy Use for Sustainable Development

(Graz, Austria, 12-15 September 2006)*

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* The present report required preparation by the individual speakers of abstracts of the presentations they had made during the Symposium. That process delayed the submission of the report.



I. Introduction

A. Background and objectives

1. At the World Summit on Sustainable Development, held in Johannesburg, South Africa, from 26 August to 4 September 2002,¹ Heads of State and Government reaffirmed their strong commitment to the full implementation of Agenda 21,² which had been adopted at the United Nations Conference on Environment and Development, held in Rio de Janeiro, Brazil, from 3 to 14 June 1992. They also committed themselves to achieving the internationally agreed development goals, including those contained in the United Nations Millennium Declaration (General Assembly resolution 55/2 of 8 September 2000). The Summit adopted the Johannesburg Declaration on Sustainable Development³ and the Plan of Implementation of the World Summit on Sustainable Development (Johannesburg Plan of Implementation).⁴

2. In its resolution 54/68 of 6 December 1999, the General Assembly endorsed the resolution entitled “The Space Millennium: Vienna Declaration on Space and Human Development”,⁵ which had been adopted by the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in Vienna from 19 to 30 July 1999. UNISPACE III had formulated the Vienna Declaration as a nucleus of a strategy to address future global challenges using space applications. In particular, the Vienna Declaration noted the benefits and applications of space technologies in addressing the challenges to sustainable development, as well as the effectiveness of space instruments for dealing with the challenges posed by the pollution of the environment and the depletion of natural resources.

3. The implementation of the recommendations contained in the Vienna Declaration supports the actions called for in the Johannesburg Plan of Implementation to strengthen the capacities of Member States, in particular of developing countries and countries with economies in transition, in order to assess the impacts of air pollution using space-based tools. Space technology provides tools for monitoring and managing energy supply and consumption by providing information on resource location and availability, as well as by providing energy-saving spin-off technologies.

4. In 2002, the Office for Outer Space Affairs of the Secretariat organized a symposium in Stellenbosch, South Africa, prior to the World Summit on Sustainable Development, to consider the steps that could be taken to carry out actions proposed

¹ *Report of the World Summit on Sustainable Development, Johannesburg, South Africa, 26 August-4 September 2002* (United Nations publication, Sales No. E.03.II.A.1 and corrigendum).

² *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992* (United Nations publication, Sales No. E.93.I.8 and corrigenda), vol. I: *Resolutions adopted by the Conference*, resolution 1, annex II.

³ *Report of the World Summit on Sustainable Development*, chap. I, resolution 1, annex.

⁴ *Report of the World Summit on Sustainable Development*, chap. I, resolution 2, annex.

⁵ *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.

for inclusion in the Johannesburg Plan of Implementation. That symposium recommended that pilot projects be launched to demonstrate the operational capabilities of space technologies to support sustainable development. In its follow-up to that recommendation, the Office for Outer Space Affairs, with the sponsorship of the Government of Austria and the European Space Agency (ESA), held a series of symposiums from 2003 to 2005 to examine how such projects could be initiated, in particular in water resource management. Details of the series of symposiums, including the programme and background materials, are available on the website of the Office (<http://www.unoosa.org/oosa/en/SAP/act2005/graz/index.html>).

5. Based on the positive experience of that series of symposiums, the Office for Outer Space Affairs, in cooperation with the Government of Austria and ESA, is organizing a second series of three consecutive symposiums to consider how space applications could contribute to other areas addressed at the World Summit on Sustainable Development, in particular air pollution monitoring and the use of energy resources. The present report is on the 2006 symposium, the first of the series, which addressed the benefits of using space technologies for monitoring air pollution and energy production and for sustainable development. The later symposiums may explore the possibility of developing and implementing pilot projects and address issues related to policy development in order to make operational use of space applications for monitoring air pollution and energy use.

6. Pursuant to General Assembly resolution 60/99 of 8 December 2005, the United Nations/Austria/European Space Agency Symposium on Space Tools for Monitoring Air Pollution and Energy Use for Sustainable Development was co-organized by the Office for Outer Space Affairs, the Federal Ministries for European and International Affairs and for Transport, Innovation and Technology of Austria, the Province of Styria and the city of Graz and co-sponsored by ESA. The Symposium was held at the Austrian Academy of Sciences, Institute for Space Research, Graz, Austria, from 12 to 15 September 2006.

7. The overall goal of the current series of three symposiums, spanning 2006 to 2008, is to promote the use of the demonstrated capabilities of space technology to support some of the actions called for in the Johannesburg Plan of Implementation. The objectives of the 2006 symposium were:

(a) To inform participants about the uses of the demonstrated capabilities of space technology to support the actions called for in the Johannesburg Plan of Implementation related to monitoring air pollution and energy use;

(b) To examine what low-cost space-related technologies and informational resources were available for addressing air pollution and energy use;

(c) To examine what type and level of training would be required, and for which target groups, in using space technologies for addressing air pollution and energy use;

(d) To examine the strategy for including space technology-based tools and information in the decision-making process in monitoring air pollution and energy use;

(e) To identify a functional partnership that could be established in order to promote the use of space technologies for monitoring air pollution and energy use;

(f) To enhance the participation of women in decision-making related to monitoring air pollution and energy use.

8. The present report was prepared for submission to the Committee on the Peaceful Uses of Outer Space at its fiftieth session, in 2007.

B. Programme

9. The opening ceremony of the symposium included introductory and welcoming statements by representatives of the Austrian Academy of Sciences, the Federal Ministry for European and International Affairs, the Federal Ministry for Transport, Innovation and Technology, the Province of Styria, the city of Graz and the Office for Outer Space Affairs. Representatives of the National Aeronautics and Space Administration (NASA) and the European Commission made keynote presentations.

10. The symposium consisted of five presentation sessions, entitled variously “Air pollution and energy use: a challenge for sustainable development”, “Space applications for exploration and production of energy”, “Addressing the impact of energy use on air pollution using space applications”, “Remote sensing for monitoring sources of air pollution in urban and rural areas” and “Affordable space technologies and information resources for addressing air pollution and energy use”. The discussion panel, of which the theme was “Enhancing the participation of women in decision-making related to monitoring air pollution and energy use”, focused on the question of enhancing the leadership role of women in the decision-making process. A total of 20 presentations were delivered by invited speakers from both developing and industrialized countries and comprehensive discussion sessions were held at the conclusion of each presentation session.

C. Attendance

11. Funds allocated by the United Nations and the co-sponsors were used to defray the costs of air travel and daily subsistence allowance and accommodation of 29 participants from developing countries and countries with economies in transition.

12. A total of 60 participants attended the symposium, from Algeria, Austria, Cambodia, Georgia, Guatemala, Hungary, India, Indonesia, Iran (Islamic Republic of), Kazakhstan, Kenya, Madagascar, Maldives, Mongolia, Morocco, Nigeria, Pakistan, Romania, Rwanda, Senegal, Thailand, the Philippines, the United States of America, Viet Nam, Zimbabwe and from the United Nations Interim Administration Mission in Kosovo. The International Institute for Applied Systems Analysis, the Office for Outer Space Affairs and the secretariat of the United Nations Framework Convention on Climate Change were also represented.

II. Summary of presentations

13. The presentations highlighted the increasing demand for energy and therefore for production, as well as the increased focus on the environmental impact of energy

sources currently in use, in particular solar, biomass, hydropower and geothermal renewable energy sources. There were also presentations on space-based technologies that were being used to monitor air pollution and to improve the generation, transmission and use of energy for sustainable development.

14. Details of the programme of the Symposium, the background materials and the presentations made are available on the website of the Office for Outer Space Affairs (<http://www.unoosa.org/oosa/en/SAP/act2006/graz/index.html>).

15. At the opening session, the keynote addresses were given by NASA and the European Commission. These were entitled respectively "Space applications to monitor the impact of energy generation and use on air pollution" and "European contribution to the Global Earth Observation System of Systems in the context of the Framework Programme of Community Research". The presentations focused on needs that could be met using space technologies, in particular those that could be met only by observation from space or for which observation from space would have substantial advantages over other data-collecting techniques. Examples of current initiatives aiming at improving access to space infrastructure and data for monitoring air pollution and energy use were presented.

16. The first session focused on linkages between energy use for sustainable development, air pollution and climate change. It looked at what could be done to address these issues and make better use of energy by reducing the environmental impact of its use. The first paper dealt with the link between energy use and air pollution. It was noted that growing energy consumption by industry, transport and the domestic sector had presented a challenge for air quality management. Of particular concern were the levels of sulphur dioxide and nitrogen dioxide emissions in most Asian cities, where rapid industrial development and growing energy demands had increased air pollution. The second paper discussed the impact of air pollution from indoor sources and stressed that reliance on traditional fuels particularly affected women and children, who were most frequently at home. The third paper stressed that there was a need for continued monitoring of energy use and its impact on air pollution, as well as access to information, interdisciplinary knowledge for applied research and institutional capacity-building. The final presentation gave an overview of climate change, describing the relationship between climate change and the concentration of greenhouse gas emissions in the atmosphere. The Kyoto Protocol to the United Nations Framework Convention on Climate Change⁶ was presented as a framework for action to address climate change at the national and international levels.

17. The second session dealt with space applications for the exploration and production of energy. The importance of space-based technologies in the identification of new and renewable sources of energy, as well as in measuring the level of air pollution and monitoring, was highlighted. It was noted that space applications such as remote sensing could support the modelling of regionalized, highly distributed energy generation potential, as well as improve simulation of electric grid loads based on population and industry distribution. Participants also learned how spin-offs of space technology could be used to improve the generation, transmission and use of energy. The participants were shown examples of decision-support tools, such as the clean energy project analysis software (RETScreen) and

⁶ FCCC/CP/1997/7/Add.1, decision 1/CP.3, annex.

the Hybrid Optimization Model for Electric Renewables (HOMER). The RETScreen software could be used worldwide to evaluate energy production and savings, life-cycle costs, emission reductions and risk for various types of energy-efficient and renewable energy technologies. The systematization and sensitivity analysis algorithms of HOMER could be used to simplify the task of evaluating design options for both off-grid and grid-connected power systems for remote, stand-alone, and distributed generation applications.

18. The third session addressed the study of the impact of energy use on air pollution using space applications. Participants learned how space technologies could contribute to combating air pollution and observing the atmosphere. Participants were given an overview of the implementation of the Geosphere Biosphere Programme initiative at the Indian Space Research Organization, which aims at characterizing the spatio-temporal properties of aerosols, using satellites for measuring and tools for analysing and modelling. In addition, participants from Cambodia and Pakistan provided information on their experiences in the use of space applications for monitoring and studying air pollution. It was noted that space applications are the only source of data for remote and rural areas where ground-based measurements are not available or possible.

19. The fourth session was devoted to remote sensing for monitoring sources of air pollution in urban and rural areas. The first two presentations focused on the energy sources (hydro, thermal, coal, biomass, oil and gas) that are used to meet energy demand for both domestic and industrial sectors. Both presentations pointed out that a wide range of gaseous and particulate compounds have adverse impacts and could be considered air pollutants, including nitrogen oxides, sulphur dioxide, carbon dioxide and metals. It was also noted that, with energy becoming a major global concern, energy policies had become a central component of national planning. A further presentation focused on coal and lignite as two of the main air-pollution-related energy sources. Participants were shown trends of atmosphere-polluting emissions. It was emphasized that industrial emissions contribute significantly to ambient levels of particulates, sulphur dioxide and nitrogen oxides, especially when factories are located in urban areas. The final presentation of the session was on air-pollution-forecast numerical models, during which participants learned how three-dimensional atmospheric diffusion and transport models could be used to visualize air pollution trajectories at different scales using geographic information systems.

20. The topic of the fifth session was space technologies and information resources for addressing air pollution and energy use. The first presentation was on remote sensing-based methods (direct and indirect) for the inventory of wood biomass, with a particular focus on medium- and low-resolution imagery. Examples of ongoing projects were presented, with a particular focus on the enhancement of the accuracy of medium- and low-resolution satellite imagery for better biomass estimation. Participants were also given an overview of existing space-based telecommunications tools for monitoring air pollution and energy use. They also learned how the broadband connection could help to speed up the retrieval of free data available through the Internet. In addition, participants from Guatemala and India provided information on their experiences in the dissemination of air pollution- and energy-related space-based information to policy and decision makers. These presentations provided further examples of the use of satellite

measurements and the methodology that is used for estimating greenhouse gas emissions from various industrial processes. The Office for Outer Space Affairs contributed a presentation on the educational opportunities in space applications offered by the regional centres for space science and technology education, affiliated to the United Nations, for Africa, Asia and the Pacific, and Latin America and the Caribbean. Participants also learned that these centres offered in-depth training in space-based meteorology, communications, remote sensing and geographic information systems, as well as in space sciences.

III. Conclusions and recommendations

21. Each of the presentation sessions was followed by discussion sessions focusing on practical measures and options to speed up efforts to meet the Johannesburg Plan of Implementation in relation to monitoring air pollution and energy production and use. The results of the deliberations of the Symposium were summarized and presented at the closing session, when a final discussion was held and the conclusions and recommendations were adopted.

22. During the first discussion session on the uses of the demonstrated capabilities of space technology to support the actions called for in the Johannesburg Plan of Implementation related to monitoring air pollution and energy production and use, participants highlighted that significant research had facilitated a better understanding of air pollution and the atmosphere. However, in many countries the policy framework for air pollution needed to be strengthened. Emission reduction technologies and cleaner fuels were not widely available. In order to strengthen the use of space technology, participants emphasized several issues:

(a) The need to build sustainable national and regional infrastructure for space applications through research and development programmes and mechanisms for the transfer of technology to ensure that new and advanced technologies are developed and widely demonstrated;

(b) The need to help managers and decision makers to better understand the potential of space-based technologies;

(c) The need to develop effective solutions and policies for data sharing on transboundary air pollution, and enhancing and expanding current monitoring arrangements. In some countries there was also a need to enact “clean air acts” and to acquire equipment for land and water environments.

23. During the second discussion session on low-cost space-based technologies and information available for addressing air pollution and energy use, participants noted that low-cost data were available from various satellite sensors, such as Surface Meteorology and Solar Energy (SSE) of NASA for energy management and the Moderate Resolution Imaging Spectroradiometer (MODIS) that could be used to determine air quality. Participants also noted that a number of free support tools had been developed by the scientific community and were readily available on the Internet. Participants agreed that low-cost space-based technology should be made available not only to scientists and technicians, but also to end-users in order to ensure the sustainability of their programmes and that, for that purpose, dedicated workshops and training courses should be organized.

24. During the third discussion session on the strategy for including space tools and data in the decision-making process in monitoring air pollution and energy use, participants recognized that there was a need for the space technology community to understand the particular needs of the user community. There was also a need for continuing education and training in space science and technology and for the development and consolidation of national and regional expertise.

25. During the fourth discussion session on the functional partnership that could be established in order to promote the use of space technologies for monitoring air pollution and energy use and production, participants agreed that international organizations should assist in strengthening the capacity of developing countries to utilize satellite-based data and products to enable them to benefit from space technology. At the same time, capacity-building should be seen as a process initiated by ongoing or new energy-related projects and projects on air quality and air pollutants.

26. During the fifth discussion session on the type and level of training required in using space technologies for addressing air pollution and energy use and production, the importance of “training the trainers” was repeatedly mentioned as vital for a variety of user levels. Participants agreed that it would be beneficial to organize training courses to prepare project proposals and that the Office for Outer Space Affairs and other relevant organizations should consider organizing such courses.

27. Participants put forward the following recommendations on integrating space tools in the development and implementation policies for monitoring air pollution and energy use, in particular in developing countries:

(a) There should be exchanges of experience and greater cooperation among countries;

(b) There should be mechanisms to bridge the gap between the space technology community and decision makers, with a particular focus on middle managers;

(c) Access to available data and decision-support tools should be promoted to assist policymakers and decision makers in monitoring and managing atmospheric pollution, in particular in developing countries.

28. Participants also recommended that the Office for Outer Space Affairs use proposals made at the Symposium as input to the “Communities of Practice” currently being established by the international Group on Earth Observations in order to identify the needs for access to satellite and ground data, and share expertise by applying Earth observation products to decision-making.

29. The discussion panel on enhancing the participation of women in decision-making for monitoring air pollution and energy use provided an opportunity to address energy-related problems and solutions by showing how the degree of equity in women’s access to resources, such as information, training and work, affects the use and management of energy sources. It was noted that a number of national and international efforts were aimed at increasing the use of clean and safe cooking and heating practices, in particular in rural areas, and that other programmes were aimed at encouraging the use of liquefied petroleum gas and butane as substitutes for wood and other fossil fuels in an effort to protect the environment and improve indoor air quality. Participants also noted that the methods used for disseminating information

on air pollution and energy use should be appropriate and include indigenous methods. Finally, they noted that various Governments had made a number of commitments to encourage women to participate in energy-related projects and to provide the necessary financial resources for the practical implementation of such commitments.
