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United Nations/Austria/Switzerland/European Space Agency/International Centre for Integrated Mountain Development Workshop on Remote Sensing in the Service of Sustainable Development in Mountain Areas

(Kathmandu, 15-19 November 2004)

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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-sixth session, in 2003, the Committee on the Peaceful Uses of Outer Space endorsed the programme of workshops, training courses, symposiums and conferences planned for 2004.[2] Subsequently, the General Assembly endorsed the United Nations Programme on Space Applications for 2004 in its resolution 58/89 of 9 December 2003.

3. Pursuant to resolution 58/89 and in accordance with the recommendation of UNISPACE III, the United Nations/Austria/Switzerland/European Space Agency/International Centre for Integrated Mountain Development Workshop on Remote Sensing in the Service of Sustainable Development in Mountain Areas was held in Kathmandu from 15 to 19 November 2004. Organized by the Office for Outer Space Affairs of the Secretariat in cooperation with the European Space Agency (ESA) and the Governments of Austria and Switzerland, the five-day Workshop was hosted by the International Centre for Integrated Mountain Development (ICIMOD) and the Ministry of Population and Environment of Nepal. The Workshop was the first in a new series of activities dedicated to sustainable development in mountain areas.

4. Mountain areas are environmentally delicate, the source of freshwater for more than half of humanity, rich in biological and cultural diversity, places of spirituality for many societies and recreation sites for millions of people around the world. Yet mountain areas have unique problems that must be solved. Precious mountain ecosystems are being affected by climate change, exploitative mining, environmental degradation and conflict. As a consequence, mountain people are still among the world's poorest and most disadvantaged. Often isolated and marginalized, many mountain people have little influence over the decisions that affect their lives and environments.

5. The population of mountain regions is normally concentrated in valleys, their livelihoods dependent on agriculture or tourism. It is important for policy for the development of mountain areas to be environmentally, economically and socially sustainable. In reality, however, this is not often achieved: for example, landslides are caused by overused or eroded soils and the destruction of natural forest, while the natural topographical features mean that mountain areas are susceptible to floods and avalanches, all of which have disastrous effects in the overpopulated valley areas. Shortages of safe water sources are a problem in mountain areas as a result of natural disaster and human impact. Climate change in mountain areas can reduce the stability of rock or/and permafrost, thereby increasing the probability of landslides. Drought and forest fires are also experienced in those areas.

6. The following statistics on mountain regions illustrate the sensitive nature of the mountain environment and the scope of the problems and challenges faced in achieving sustainable development in such areas. Mountains cover about 25 per cent of the world's land surface. About 12 per cent of the world's population live in the mountains, but over 50 per cent of the world's population are directly or indirectly dependent on mountain resources. In 2000, the Food and Agriculture Organization of the United Nations estimated the total number of mountain people at 718 million. Of these, 625 live in developing countries and countries with economies in transition. Some 80 per cent of mountain people live below the poverty line. As many as 245 million rural mountain people in developing countries and countries with economies in transition may be at risk of, or are actually experiencing, hunger.

7. Environmentalists are now launching a campaign to include Nepal's Everest National Park on the World Heritage in Danger list. In a petition to the United Nations Educational, Scientific and Cultural Organization, it was stated that climate change had caused Himalayan glaciers to melt and lakes to swell and, as a result, had increased the risk of catastrophic flooding. Unless urgent action was taken, many Himalayan lakes could burst their banks, threatening the lives of thousands of people and destroying Everest's unique environment.

8. The 20 countries with the highest percentage of mountainous areas are (in decreasing order): Andorra, Liechtenstein, Bhutan, Lesotho, Tajikistan, Kyrgyzstan, Switzerland, the former Yugoslav Republic of Macedonia, Lebanon, Rwanda, Armenia, Nepal, Georgia, Bosnia and Herzegovina, Lao People's Democratic Republic, Swaziland, Turkey, Austria, Albania and Slovenia. Cartographic statistics show that 48 per cent of the world's total terrestrial surface lies above 500 metres (m); 27 per cent above 1,000 m; 11 per cent above 2,000 m; 5 per cent above 3,000 m; and 2 per cent above 4,000 m. All of the world's mountains that are above 7,000 m are in Asia and all 14 peaks above 8,000 m are situated in the Greater Himalayan range, extending along the southern rim of the Tibetan Plateau.

9. Up to 80 per cent of the planet's fresh surface water comes from mountains. Tourism is increasingly a major source of income in many mountain areas of the world, although often with significant environmental and social implications. Mountain tourism constitutes between 15 and 20 per cent of worldwide tourism ($70–90 billion per year) and plays a significant role in national economies.

10. Sustainable development requires the optimal management of natural resources and depends upon the availability of reliable and up-to-date information at the national, regional and international levels. Remotely sensed data can provide a view of the Earth for many studies that require spatial and temporal observations such as inventory, surveying and monitoring for agriculture, hydrology, geology, mineralogy and the environment. Remote sensing is generally integrated with other disciplines such as photogrammetry, cartography, geodetic reference systems, geographical information systems (GIS) and global navigation satellite systems (GNSS).

11. Although it has considerable potential, the remote sensing of mountain areas does have some technological constraints, which need to be defined and considered in the planning of any capacity-building activities. In addition, education and distribution of the data products play a pivotal role in the effective adoption of remote sensing applications for sustainable development.

12. Effective communications in mountain regions are essential to ensuring adequate sharing of the information that is essential for sustainable development, for communication during disaster management and for provision of health and education services to remote areas. Terrestrial communications in mountainous regions are often expensive, unreliable and difficult to access. Satellite communications can offer a cost-effective solution and have a crucial role to play in mountain areas, not only in the distribution of data for sustainable development, but also in disaster management, education and health care.

13. GNSS are indispensable in the application of remote sensing for sustainable development and in disaster management. For example, GNSS are useful for accurate field verification of remote sensing data and for ground-based collection of data for sustainable development.

14. The primary objective of the Workshop was to discuss the potential uses of remote sensing in facilitating sustainable development in mountain areas. In addition, the Workshop provided an ideal opportunity for participants to learn about and discuss the potential of satellite communications and GNSS for sustainable development in mountain areas. A further objective was to define follow-up activities that would test and demonstrate the appropriateness of space technology for sustainable development in mountain areas.

15. The present report was prepared for submission to the Committee on the Peaceful Uses of Outer Space at its forty-eighth session, in 2005.

B. Programme

16. The Minister for Population and Environment of Nepal inaugurated the Workshop and opening statements were made by representatives of ESA, the Governments of Austria and Switzerland, ICIMOD, the United Nations Development Programme (UNDP) and the Office for Outer Space Affairs.

17. Keynote presentations were given by representatives of the Office for Outer Space Affairs, ICIMOD, ESA and the Governments of Austria and Switzerland. A total of 25 presentations were made during the thematic sessions and a number of interactive presentations were delivered directly via satellite from Austria. A special event in the ESA Eduspace programme was organized for educators from universities in Nepal and was attended by 200 participants. In addition, sponsored participants made presentations on the status of the use of remote sensing for sustainable development in their respective countries.

18. The discussion sessions allowed deliberations on the structured discussion topics, with the aim of defining follow-up activities for the region. The participants were divided into working groups in the areas of sustainable development; environment and natural resources; disaster management; and education and capacity-building. A fifth working group, comprising representatives of the sponsoring and organizing institutions, was established in order to coordinate the various proposals. Each working group submitted project proposals for further consideration and selection for financing by interested sponsors.

C. Attendance

19. Around 150 scientists, educators, decision makers and engineers from the following 20 countries participated in the Workshop: Afghanistan, Armenia, Austria, Bangladesh, Bhutan, Cambodia, China, Denmark, India, Iran (Islamic Republic of), Kyrgyzstan, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Switzerland, Thailand and Viet Nam. A high proportion of the participants were female. In addition, representatives of the following international bodies participated in the Workshop: UNDP, the United Nations Institute for Training and Research, ICIMOD, ESA and the Office for Outer Space Affairs.

20. Funds allocated by the United Nations and the sponsors, ESA and Governments of Austria and Switzerland, were used to defray the cost of logistics, air travel, accommodation and daily subsistence allowance of 22 participants from the region.

II. Summary of presentations

21. The presentation sessions enabled participants to learn about the potential application of satellite remote sensing and other space-based technologies for sustainable development in mountain areas. The presentations will be made available on the ICIMOD website (http://www.icimod.org).

22. The keynote addresses established a framework for the discussions that were to follow and highlighted the potential of remote sensing and geographical information technologies in sustainable development in the region, as well as the existing constraints in applying space technology in mountain areas. The use of satellite communications in support of remote sensing applications was presented live from Graz, Austria, by satellite. The participants were shown examples of current initiatives for improving access to remote sensing, other space infrastructure and space data for sustainable development.

23. The first presentation session, “Space technology: Earth observation; from satellite to the product”, included five presentations, during which participants learned about the use of Envisat satellites for Earth observation. Envisat is currently the only environmental satellite covering the realm of the atmosphere, the land and the ocean surface simultaneously. Its 10 instruments cover optical, infrared and microwave bands, providing a nearly daily global coverage in high, medium and low spatial resolution for atmospheric trace gas concentration, chlorophyll production (land and ocean), surface height and many other geophysical measurements. Data access and analysis is assured through online catalogues and free software (http://earth.esa.int). For scientific purposes, Envisat data can be received at low cost or free. In future, ESA will ensure the continuation of Earth observation data by launching satellites for scientific purposes or natural disaster monitoring. A presentation was made on the United Nations Organization Satellite (UNOSAT) initiative, which was established to facilitate access to remote sensing data for geographical regions that currently have limited access to such data. UNOSAT provides information to local authorities and field personnel involved in such activities as emergency response, hazard preparedness, peacekeeping and socio-economic development. The role of the United Nations in activating the

Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters (International Charter "Space and Major Disasters") was also described. A further presentation covered the ESA Earth observation applications programme in the mountain environment. ESA initiatives to develop data application to monitor slope movement and snow and glaciers were presented. The application of interferometric synthetic aperture radar (SAR) techniques allows monitoring and improved mapping of slope movement, with some constraints due to satellite orbit. The assessment of snow coverage using optical sensors and of snow type using microwave provides valuable input to water run-off models. In the fifth presentation, participants received a conceptual overview of information retrieval from remote sensing data. The final presentation at the session gave a personal view of the social, economic and environmental problems in a developing country and the meaning of sustainable development in that context. It was emphasized that sustainable development solutions must take into consideration the social issues and difficult living conditions of the final beneficiaries.

24. The second presentation session, "Remote sensing in the Hindu Kush-Himalayan region: status and issues", gave an opportunity for participants to present research papers and reports on the status of space technology applications for sustainable development in their countries. A total of 22 presentations were made on topics of sustainable mountain development, environment and ecology, natural resource management, floods and cyclones, landslides, soil erosion, disaster management, land use and land cover, urban slum area identification, flood monitoring, food and agriculture, water resources and education. It was agreed that much research in those areas was being conducted in the region and in Europe using remote sensing and GIS. The recommendations made at the end of the session were that the availability of real-time data should be improved; that more training activities and workshops were required; and that regional and international cooperation should be encouraged.

25. The third presentation session was on geographical information and cartography in mountain areas. Firstly, participants learned about the Mountain Geographic Information System Portal (http://www.icimod-gis.net/), which had been developed to provide GIS resources that addressed sustainable development issues in the Hindu Kush-Himalayan region. The Portal included training and education resources, database and map resources and application resources. It uses a common platform to facilitate the sharing of information and knowledge about GIS technology and its application to mountain development. The second presentation was on the applicability of available geodata for high mountain environmental research. The importance of selecting the most suitable remote sensing data sets and sequences of time series for topographic mapping and monitoring was highlighted. It was concluded that the availability of free, downloadable GIS and remote sensing data would save both time and money and allow the use of remote sensing and GIS data in a wider range of sustainability research in the Hindu Kush-Himalayan region. The second part of the presentation covered the use of remote sensing data in high mountain research, using examples from the Himalayas, the Alps, the High Tatras and the Andes. The use of remote sensing data for purposes such as glacier monitoring, forestry applications, climatic suitability mapping and mapping and monitoring of surface mining areas was demonstrated. It was concluded that the correct choice of remotely sensed data was important in order to obtain significant results in the documentation and monitoring of human activities. The

third presentation demonstrated how remotely sensed data and GIS could be used for alpine cartography.

26. The fourth presentation session gave participants an opportunity to learn about and discuss issues relating to the use of space technology for managing the environment and natural resources in mountain areas. The first paper was on regional land cover mapping and vegetation cover assessment in the region. Standards for mapping, in particular the mapping of habitat degradation, were addressed. The presentation on environment and health showed how remote sensing was used to optimize the locations of environmental monitoring stations. The final presentation demonstrated the importance of glacier monitoring for climate change detection and water resources and hazard management in high mountains. Space-borne methods provided new possibilities for observing changes in glacier length, glacier area, glacier mass and glacier dynamics over large and remote areas. Related global activities were the World Glacier Monitoring Service (WGMS) and the Global Land Ice Measurements from Space (GLIMS) project.

27. The fifth presentation session gave participants an opportunity to learn about the use of space technology for disaster management in mountain areas. In the first presentation, satellite remote sensing methods for mapping, monitoring and modelling high mountain hazards and disasters were discussed. Those techniques were of particular importance for glacier and permafrost hazards, which usually occurred in very remote areas but were able to affect areas up to several thousands of kilometres downstream. The second presentation gave an overview of climate modelling and the implications of climate change in mountain areas. Remotely sensed data could potentially contribute to mountain climate modelling by providing a source of physical parameters and a means of validating simulation results. A third presentation was made on the topic of flood disaster mitigation in the Hindu Kush-Himalayan region. The flood mitigation and integrated water management system, which was based on a hydrological information system, used satellite remote sensing for data collection and satellite communication for data distribution. The system consisted of a forecasting methodology, a decision support tool, an early warning system and coordination mechanisms for flood management and response. Key issues in the implementation of the system were the transboundary nature of rivers, the lack of exchange of timely real-time data (especially across national boundaries), the diversity of technical, scientific and institutional capacity and the lack of regional mechanisms.

28. Case studies of the activations by the United Nations of the International Charter “Space and Major Disasters”, including the activation for landslides and flooding in Nepal in August 2003, were presented. The products that were provided in response to the activations were used to facilitate resource mobilization; for detailed disaster assessment; to raise public and private assistance; for humanitarian aid planning and coordination; and for future planning and vulnerability risk reduction. It was emphasized that such products should be distributed as widely as possible among humanitarian aid agencies and local communities and that removal of restrictions on data reutilization would assist vulnerability risk reduction efforts. A presentation was made on disaster early warning, prevention and management, during which participants learned how Earth observation data and GIS could be used for large-scale rescue operations. The following speaker discussed how topographical maps, aerial photographs, satellite images and digital elevation

modelling were used to generate a digital inventory of glaciers and glacial lakes. Future activities of the project included development of an early warning system to minimize the impacts of glacial lake outburst floods; enhancement of regional coordination and cooperation; and awareness-raising among policy makers and the general public. The final presentation at the session concerned the use of GIS and remotely sensed land use and water use information for water accounting in mountainous watershed areas, using a minimum amount of ground-based information.

29. Remote tele-lectures on a variety of disaster management topics specific to mountain areas were delivered from Graz, Austria, via satellite in order to demonstrate the potential use of mobile satellite communications for disaster management, health and education. The first tele-lecture was on the use of remote sensing for alpine monitoring for forest management. The second demonstrated a pulsed radar for snow and mud avalanche detection and research, used specifically for surveillance of dangerous avalanche slopes, early detection of natural avalanches, accurate verification of artificially triggered avalanches and measurement of avalanche dynamics. Applications of the system included road protection and monitoring of naturally released avalanches. The final tele-lecture covered landslides, hydrology of mountain areas and glacier monitoring.

30. The sixth presentation session included an overview of GIS for Education and an Eduspace pilot project for the Hindu Kush-Himalayan region. Within the ESA educational Earth observation website for secondary schools and lower university levels, a basic structure to host Hindu Kush-Himalayan remote sensing material had been developed. The project was seeking contributions of case studies to be produced by research and educational institutions of the region. The website included examples and data of various remote sensing satellites (www.eduspace.esa.int).

III. Observations and recommendations

A. Observations

31. In general, participants agreed that there could be no sustainable development without adequate information about the state of the Earth and its environment. In addition, participants agreed that joining the International Partnership for Sustainable Development in Mountain Regions, launched by the World Summit on Sustainable Development, would be a definite step towards implementing two different outcomes of the World Summit, focusing on: (a) sustainable development in mountain areas; and (b) space applications. The following paragraphs summarize the statements made during the Workshop about the status of sustainable development and the use of space technology in the Hindu Kush-Himalayan region and, in particular, in Nepal.

1. Hindu Kush-Himalayan region

32. The Hindu Kush-Himalayan region includes many remote areas, to which access is often very difficult and expensive. Given the topography and climatic variability of the region, people are food-sufficient for less than three months per

year. The region lacks infrastructure facilities, has low agricultural production, suffers from widespread and pervasive poverty and has poor social services from both governmental and non-governmental organizations. In addition, women are overburdened with household work. Cyclic droughts, floods and natural disasters still complicate development efforts in the region. The region is experiencing rapid change as a result of human impact on the mountain environment as it is becoming highly populated compared with other mountainous regions of the world. Because of its inaccessibility, data about the region, specifically in terms of information on land use and land cover, are limited. Land use change is occurring very rapidly and there is a need for an inventory of past and present knowledge about land use and land cover in the region. Remote sensing is the only effective means of obtaining data in inaccessible areas of the region.

2. Nepal

33. The overall goal of development efforts in Nepal is poverty reduction. Despite noticeable progress achieved over the past decade, there is still widespread poverty in the country, most noticeably in the rural and mountain areas where most of the population reside. Of the total population of 23.2 million, 38 per cent officially live below the poverty line. The geographical setting of the country is generally considered to be a constraint for infrastructure development. However, the country is rich in natural and cultural diversity. The mountain areas of Nepal constitute one of the most environmentally sensitive regions in the world. The poor communities depend on subsistence farming, forestry (both timber and non-timber forest products) and mountain tourism industries. However, the resource base is often overused and the erosion of soils and the destruction of natural forest cause landslides, while the natural topography is susceptible to floods, soil erosion and avalanche, all of which can have disastrous effects in both the mountain areas and the valleys.

3. Sustainable Community Development Programme

34. The Sustainable Community Development Programme in Nepal was designed in line with the principles of Agenda 21,[3] which was adopted by the United Nations Conference on Environment and Development in 1992. It focuses on participatory community development to improve socio-economic conditions that would result directly in environmental conservation. There was a need to demonstrate that communities, given the choice, the resources and self-confidence, could move away from subsistence farming and revitalize traditional conservation practices. The Programme promotes environmental sustainability by helping reverse the resource degradation that eventually undermines rural and mountain communities.

35. Like many grass-roots projects, the Programme starts with social mobilization by helping communities take control of their development and offering training to help them build their social, economic and environmental capital. It has promoted environmental management through an integrated and holistic approach, attempting to combine increased stakeholder participation, information-sharing and integration of economic, social and environmental priorities. The social mobilization process has been a foundation for building self-governing local institutions, mobilizing local capital and resources, improving skills to reduce poverty and enhancing

environmental quality. Over 1,300 community-based organizations have been established as a result of the Programme.

B. Recommendations

1. International Partnership for Sustainable Development in Mountain Regions

36. A major recommendation of the Workshop is that participating organizations should participate in the Mountain Partnership, which is a global alliance of individuals and organizations involved in mountain issues. The Partnership aims at initiating specific activities to improve mountain livelihoods and environments. ESA and the Office for Outer Space Affairs are interested in joining the Partnership.

37. The Mountain Partnership is a dynamic force for change. Launched during the International Year of the Mountains, 2002, at the World Summit for Sustainable Development, the Partnership is enhancing cooperation among members and pooling expertise, capacity and skills to promote specific action at all levels of society. Forty-two countries, 14 intergovernmental organizations and 50 major groups have joined the Partnership so far.

2. Forum

38. In order to continue to build upon the initiatives discussed at the Workshop, a forum, web page and electronic database will be developed. It was recommended that ICIMOD host the forum. The sponsors and organizers of the Workshop mobilize, to the extent possible, the necessary resources to implement the selected pilot projects.

3. Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters

39. It was proposed by participants that use of the International Charter “Space and Major Disasters” be extended. The Charter is an operational mechanism between space agencies to provide free space imagery to authorized users in the event of a disaster. The Office for Outer Space Affairs is a cooperating body, which means that the United Nations can request imagery for disaster management purposes. It was suggested that, in the event of a disaster in the region, the local UNDP representative should request that the Charter be activated, in which case, the space data would then be distributed free of charge to the United Nations, which could work with local representatives and local authorities to define and produce the end product in order to enable better management of the disaster, including mitigation, rehabilitation and reconstruction.

C. Proposals for follow-up activities

40. The objective of the discussion sessions was to identify potential follow-up activities to the Workshop with a view to promoting the use of space applications in the mountain region by implementing pilot projects with regional, national and local users within the framework of the Mountain Partnership. The timeline for potential projects is as follows:

Year	*Action*
2004	
November	Project concept
2005	
January-February	Draft project proposal
April-May	Reach partnership agreement
June-July	Planning and concept validation meeting
October	Launch meeting
November	Annual review
2006	
November	Annual review End of phase 1; decision on phase 2
2007	
November	Annual review

The ultimate aim is to establish an open-ended, sustainable, long-term partnership. The sponsors and organizers of the Workshop will help mobilize resources to the extent possible in order to implement the selected pilot projects.

41. Participants were informed that their proposed projects must meet the following criteria: integrate mountain user needs; be related to space applications; involve regional cooperation; incorporate transboundary issues; include education, training and capacity-building components; involve strategic partnerships to ensure sustainability; ensure compliance of technology with user capabilities; address cross-cutting issues; include knowledge exchange and transfer components; and build upon existing networks and initiatives.

42. To facilitate the discussions, four working groups were formed in the following areas: sustainable development; environment and natural resources; disaster management; and education, training and capacity-building. In addition, a working group was formed in order to coordinate the various proposals. The projects proposed by the working groups are described below.

1. Land use and land cover for sustainable mountain development

43. The working group indicated that, in the Hindu Kush-Himalayan region, there was a lack of information on land use and land cover, that there were only isolated and fragmented studies on land use and land cover dynamics and that the ecosystem was changing as a result of inappropriately managed exploitation of the natural resources in mountain regions. The goal of the proposed project was to contribute towards sustainable development of mountain regions through scientific land management, in order to develop a biophysical and socio-economic database related to land management; a methodology for land use and land cover dynamic assessment; and a scientific proposal for sustainable land management.

2. Food security assessment in the Hindu Kush-Himalayan region

44. With regard to this project proposal for food security assessment in the region, the working group stated that most of the region was poorly served by governmental and non-governmental organizations; most of the population was food-sufficient for only three months per year; and most of the region lacked adequate infrastructure and facilities. The goal of the project would be to support decision makers in solving the problem of food security through sustainable development of mountain areas in the Hindu Kush-Himalayan region by using remote sensing data. The objectives of the proposed project are to identify potential areas for crops, livestock, horticulture and forest resources; to identify existing and potential synergies; and to develop a suitable methodology for sustainable development in the region using remote sensing and GIS.

3. Land cover mapping and dynamics in mountain areas of Southern Asia

45. The working group recognized that in the region there was a lack of a regional database on land cover; regional and national coordination; identification of resources; specific training on adopted methodologies and institutional management. The goal would therefore be to produce periodic land cover maps, land cover change maps and a database for future planning and management, by developing a standardized regional database on land cover and establishing linkages among participating countries for data-sharing and institutional capacity-building relating to the project.

4. Glacier monitoring for water resource and climate change detection in Southern Asia

46. The working group acknowledged that, with regard to glacier monitoring, the following technical problems existed: unavailability of an automatic or semi-automatic glacier inventory; use of inappropriate remote sensing data; and high debris cover. In addition, coordination and cooperation among institutions, lack of standardized inventory methods, lack of quantitative knowledge about glacier change in the region and difficulty of access to the area created problems in the monitoring of glaciers. The goal was therefore to better understand the existing water resources and identify potential climate change in the region by standardizing automatic/semi-automatic inventories for the region; building capacity in institutions of the region; strengthening partnerships; and conducting repeated inventories for selected sites in the region.

5. Remote sensing applications for regional disaster information network

47. The group recognized that disaster mitigation was being hindered by a lack of hazard maps and information; there was a need to build cooperation and coordination in disaster mapping in the region; the region had many hazards, including glacial lake outburst floods, permafrost failure, floods, landslides and debris flow, soil erosion, drought, cyclones, forest fires and earthquakes. The goals would therefore be to develop an information network that could facilitate the rapid transfer of remote sensing data from international and regional space agencies to regional users for disaster mitigation and to develop a hazards map for the region. The specific objectives would be to develop a mechanism for sharing space

information in the region and to determine and adapt remote sensing methods for the mapping of hazards.

6. Remote sensing in education

48. The working group recognized that remote sensing curricula were utilized sporadically in various institutions of the region and that those curricula had usually been obtained from websites of institutions in developed countries. The curricula, therefore, might not meet the needs of each particular country in the region. The goal would therefore be to develop and provide a remote sensing curriculum for the sustainable management of the environment and natural resources in the Himalayan region. This would be achieved by developing a curriculum for remote sensing education from the school to the university level based on strengthening and transforming the existing curricula according to the needs of local, national and regional entities; propagating remote sensing education to interested individuals and groups from various sectors of society; developing a culture of electronic learning (e-learning) and distance learning through remote sensing in the region; and promoting understanding between various communities of the region.

7. European Space Agency/Eduspace “Himalayas from Space” module

49. The objectives of this project would be to develop and provide teaching and learning materials for students and teachers from schools and colleges on the use of remote sensing in the teaching of various subjects such as geography, biology and environmental sciences, using examples from the Himalayan region. A CD-ROM would be produced containing basic components of Eduspace and the proposed module, “Himalayas from Space”.

Notes

[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, Fifty-eighth Session, Supplement No. 20* (A/58/20), para. 75.

[3] *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 I, annex II.