United Nations A/AC.105/968

General Assembly

Distr.: General
18 December 2009

Original: English

Committee on the Peaceful Uses of Outer Space
Fifty-third session
Vienna, 9-18 June 2010

Report on the United Nations/Peru/Switzerland/European Space Agency Workshop on Integrated Space Technology Applications for Sustainable Development in the Mountain Regions of Andean Countries

(Lima, 14-18 September 2009)

I. Introduction

A. Background and objectives

1. The General Assembly, in its resolution 63/90, endorsed the schedule of activities of the United Nations Programme on Space Applications for 2009. Subsequently, at its fifty-second session, in 2009, the Committee on the Peaceful Uses of Outer Space endorsed the schedule of workshops, training courses, symposiums and conferences of the Programme for the remaining part of 2009.[1]

2. Pursuant to General Assembly resolution 63/90, the United Nations/Peru/Switzerland/European Space Agency Workshop on Integrated Space Technology Applications for Sustainable Development in the Mountain Regions of Andean Countries was held in Lima, from 14 to 18 September 2009. The National Aerospace Research and Development Commission of Peru hosted the Workshop on behalf of the Government of Peru. The Workshop was co-sponsored by the Government of Switzerland and the European Space Agency (ESA) and was the fourth in a series of activities on sustainable development in mountain areas (see A/AC.105/913, A/AC.105/870 and A/AC.105/845).

[1] *Official Records of the General Assembly, Sixty-fourth Session, Supplement No. 20* (A/64/20), para. 81.

3. In its resolution 62/196, entitled "Sustainable mountain development", the General Assembly encouraged Governments, the scientific community, mountain communities and intergovernmental organizations to collaborate to study, inter alia, the effects of global climate change on mountain environments.

4. In that connection, the primary objective of the Workshop was to discuss how remote sensing and other space-related technologies could facilitate sustainable development in mountain areas with the aim of developing priorities for building capacity in remote sensing for the benefit of mountainous regions. 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.

5. To use the available human and financial resources more cost-effectively, three additional events were organized at the same venue in parallel with the Workshop, namely: a United Nations Educational, Scientific and Cultural Organization/European Space Agency workshop on remote sensing and natural and cultural heritage sites; a workshop on the European Earth Observation Website for Secondary Schools (Eduspace) and a training course on the use of radar images.

6. The United Nations Educational, Scientific and Cultural Organization/European Space Agency workshop was attended by 100 participants responsible for heritage sites in Peru. The participants included Peruvian authorities from the archaeological sites of Machu Picchu, Cuzco, Chan Chan and Pachacamac.

7. The United Nations Educational, Scientific and Cultural Organization (UNESCO), in partnership with space agencies, research institutions and companies, is assisting with the use of space technologies for natural and cultural heritage sites in mountain areas in particular. Satellite images were combined with in situ data and processed to produce a readily comprehensible final product that was provided to the local heritage authorities.

8. The present report contains information on the background to and the objectives of the Workshop and provides a summary of some of the presentations and observations made by the participants.

B. Programme

9. Three of the five days of the Workshop were devoted to presentations on activities carried out by the participating institutions, and two days were devoted to the discussion of follow-up actions and projects.

10. The programme of the Workshop included 10 sessions. Presentations were given on the following topics: (a) the Andean region: genesis and space technology — from Mendoza to Lima; (b) national presentations; (c) climate change and mountain hazards; (d) hydrology; (e) natural resources; (f) agriculture; (g) protected areas and nature conservation; and (h) the ESA educational project Eduspace.

11. During the first three days of the Workshop, speakers invited from both developing and developed countries delivered a total of 48 presentations, which focused on national, regional and international projects and initiatives on the use of space technology for improved management of natural resources and the

environment and on the contribution of space technology to sustainable development programmes in the mountain areas of Andean countries.

12. On the fourth day, three working groups were formed to analyse the following topics, which were of interest to Andean countries: hydrology, agriculture and mining resources. The working groups also met to outline project proposals and to discuss issues such as inter-institutional communication, sources of financing, regional and international cooperative mechanisms, and resources for implementing projects.

C. Attendance

13. A total of 200 scientists, educators, decision makers and engineers from the following countries participated in the Workshop and parallel events: Argentina, Austria, Bolivia (Plurinational State of), Chile, Colombia, Ecuador, Italy, Mexico, Norway, Peru, Switzerland and Venezuela (Bolivarian Republic of). Representatives of the following organizations also participated in the Workshop: United Nations Environment Programme (UNEP), UNESCO, ESA, European Academy of Bolzano, the Consortium for the Sustainable Development of the Andean Ecoregion, the Mountain Forum and the Office for Outer Space Affairs of the Secretariat. Funds provided by the United Nations, the Government of Peru, the Government of Switzerland and ESA were used to defray the costs of air travel, daily subsistence allowance and accommodation for 26 participants.

II. Summary of presentations

14. The present section contains a summary of the main issues addressed by some of the invited speakers during the thematic sessions.

15. The Chairman of the Committee on the Peaceful Uses of Outer Space, Ciro Arévalo Yepes, highlighted the role of the Committee in promoting the peaceful uses of outer space and in organizing the space conferences of the Americas. He also stressed the need for continued cooperation among Latin American countries and applauded the expressed will of the Andean States to continue working at the regional level. Finally, he highlighted the importance of workshops and similar events, which provided a forum for communication and for developing networks of Latin American scientists.

16. The representative of ESA said that education, training, institutional and human capacity-building, technology development and transfer, expert consultation and investment were required to implement and invest in sustainable mountain development.

17. A detailed understanding of how Earth's surface was continuously shaped was essential for the appraisal of natural hazard processes and related changes. Data about the occurrence of past geomorphic events and related disasters were scarce, however, and predictions about how the expected climate change might affect the recurrence and volume of Earth-surface processes had to be based on limited data sets.

18. Dendrogeomorphology (i.e. the analysis of the growth rings of trees damaged by geomorphic processes) had on occasions proved to be a reliable tool for the acquisition of data on the frequency or the timing of past natural hazard processes in mountain environments. Based on the mapping of trees at the study site, dendrogeomorphology could be used to determine the reach and lateral spread of events. Movement rates could be reconstructed or the magnitude of incidences assessed.

19. In combination with meteorological, hydrological and/or seismological data, the results of tree ring studies could be consulted to identify the triggers of preceding events. Dendrogeomorphology, therefore, represented one of the most precise techniques to do the following: (a) to assess past process activity over several centuries; (b) to produce valuable databases on disasters in regions with no records; (c) to determine process activity on a very precise scale; and (d) to help with the field verification and assessment of the accuracy of remotely sensed or model-based data.

20. Landslides were a natural hazard of special relevance to mountainous areas, as they often had severe human and economic consequences. In the alpine zones in particular, i.e. in zones above the tree line, global warming caused a decline in the permafrost (rock glacier) and valley glaciers that in a number of situations resulted in greater slope instability, such as landslides.

21. Therefore, an in-depth survey of unstable slopes in those regions was required and would come to be of even greater importance in the future. The analysis of a set of interferometric synthetic aperture radar (SAR) images could help to determine whether or not many areas had been affected by mass wasting related to a decline in permafrost. Glaciers and most active geomorphic landforms in fact emit typical SAR signals. A typology has been established, as a useful tool for interpreting SAR data in an alpine environment.

22. UNEP, through its office in Vienna, was the global Environmental Reference Centre of the Mountain Partnership Secretariat and worked actively to factor environmental sustainability into the partnership's strategic planning and activities. The role of the Centre was to assist the Mountain Partnership in gaining access to the expertise of UNEP in the six thematic priority areas of its medium-term strategy, one of which was climate change.

23. The effects of climate change were not limited to mountain regions. Mountains' ecosystem services (such as climate regulation or water purification) extended beyond geographical boundaries, so that changes in those services had direct consequences for the densely populated areas in the lowlands. Currently, only a limited amount of data from high mountain stations was available. Mountain regions provided unique opportunities for detecting and analysing global change processes and phenomena.

24. Owing to their location, high mountain stations provided an opportunity for the effective study of atmospheric background conditions and global change processes through continuous monitoring. Maintaining high mountain stations was costly, however, and the value of such stations was often not evident to the funding bodies. Therefore, the global network of high mountain stations was limited and often could not provide data in a continuous way or over long periods. The network of high altitude stations needed to be expanded, at least in the main mountain

regions of the world in order to acquire a substantial, comparable and long-term data set.

25. In order to implement an integrated approach addressing all aspects of the effects of climate change in mountain regions, a consultative process was required to ensure harmonized regional strategies for adaptation to those effects.

26. The University of La Serena in Chile and the National University of San Juan in Argentina were involved in a project on satellite information for sustainable development in the mountain areas of Andean countries that was being developed by the National Commission on Space Activities of Argentina (CONAE). The project would involve monitoring the Andean areas to provide more reliable information about the climate situation and available water resources for use in planning and policy development. The universities could contribute new methodologies for advanced digital image processing, training of personnel, provision of images etc.

27. The offices in Argentina and Chile responsible for providing water for human consumption, agriculture, industry and hydroelectric energy were both using satellite data to predict river levels.

28. A recent study to estimate the vulnerability of Chilean forests and how the forests might overcome the stresses and consequences of the projected climate scenario for 2070-2100 had found that all the species studied would be affected, and that the productive forest would probably shift mainly southwards.

29. Various Chilean institutions and entities, such as the Centro de Información de Recursos Naturales (CIREN), the Forestry Institute, the Catholic University of Temuco, the University of La Serena, the University of Chile and the Agriculture and Livestock Service of the Ministry of Agriculture, were developing the following projects using satellite data to address important issues for mountainous areas: (a) Estimation of the vulnerability of the forests of Chile; (b) Characterization of high Andean plains and wetlands for sustainable management of water resources (part one: Antofagasta Region); (c) Understanding water systems and typical zonal Andean vegetation using satellite remote sensing techniques; (d) Applications of remote sensing for the assessment of native forest and its sustainable integrated management; and (e) Sustainable production systems for mountain ecosystems: implementation of the Andean Santiago Plan.

30. The Fundación Instituto de Ingenieria para Investigación y Desarrollo Tecnológico (FIIDT) of the Ministry of Science and Technology of Venezuela contributed to economic and social development through research, development and technology transfer in the areas of industry, public management, environment, security and defence, alternative energy and food security, based on environmental sustainability criteria and using tools such as satellite-based remote sensing data.

31. In recent years, in cooperation with the Center for Digital Image Processing (CPDI), FIIDT had developed projects aimed at land management and environmental monitoring in the Andean region of Venezuela. The most important projects were: (a) Geographical information system for risk zoning and endogenous development in the Lake Maracaibo Basin; (b) Comparative study of changes in the forest cover of Venezuela and the relation of that change to climate change;

(c) Information system for crop estimation and monitoring; and (d) Mineral studies using hyperspectral images.

32. In addition, FIIDT and CPDI were responsible for procuring and distributing images from the instruments of the satellite pour l'observation de la Terre (SPOT 4 and 5) satellites to Government institutions and universities, as well as contributing to capacity-building and training in geomatics.

33. The world's highest summits were in the Andes and the Hindu Kush-Karakorum-Himalayas mountain ranges. Their altitude and inaccessibility, added to the ancestral traditions of the inhabitants of those regions had made of them a contemporary myth. The Himalandes initiative, started a decade previously by a group of researchers from the Andes and the Himalayas, promoted research efforts taking advantage of the similarities and potential for exchange and cooperation between the regions on specific topics. The regions showed many similarities, and also substantive differences in terms of their physical, biological and sociocultural aspects.

34. In the past, the enormous distance between the two regions had hampered efforts to work on the similarities and attempts to promote the exchange of information and cooperation on projects on issues of interest for both regions, including agrobiodiversity, livestock, sustainable mountain tourism, high-altitude medicine, landslides and risk management, renewable energy sources and information exchange initiatives.

35. The advance of electronic communication had facilitated interaction between the two remote mountain regions. There was great potential for beneficial information exchange and cooperation in the above areas. Those mountain ranges could be a plentiful source of knowledge and technological advances that could benefit the world and particularly the mountain inhabitants.

36. According to research on agriculture and climate change in the Andes by the International Center for Tropical Agriculture, the predicted trend was towards higher rainfall in the northern Andes and reduced rainfall in the southern Andes. Also, a vulnerability assessment of 28 crops in Colombia pointed to challenges for decision makers at all levels.

37. The objectives of the ESA Eduspace project were the following: (a) to inspire teachers to incorporate satellite-based Earth observation into their curricula; (b) to provide ready-made projects; (c) to provide tools and Earth observation data for educational purposes; and (d) to enable schools to take part in collaborative work on Earth observation as part of a network. Eduspace was an online multilingual e-learning platform for Earth observation methods and applications (available at www.esa.int/eduspace). The data were available free of charge to registered schools, classes and universities.

38. Eduspace addressed subjects covered by curricula worldwide, including modules on global change (climate change, deforestation) and disaster monitoring (earthquakes, floods etc.). It provided a wealth of material for practical education organized around case studies developed on selected subjects in specific regions, containing background information and step-by-step instructions, image catalogues, a large collection of satellite data covering sites of interest such as cities, landscapes etc. Its geographical coverage ranged from Europe and Africa to the Himalayas.

39. Participants in the workshop had decided to develop a new module “Andes from Space” within the framework of the Eduspace project with ESA and CONAE playing a leading role. Twelve presentations were made on the new module by Argentina, Colombia and Peru.

40. During the preceding two years, more than 300 students, 30 teachers and 10 schools had had the opportunity to use remote sensing data and image processing at the European Academy of Bolzano with the help of the ESA learning observation works tool in the framework of the European Academy junior programme and the Remote Sensing School Lab, achieving very good results.

41. The solid and liquid particulate matter emitted by man-made and natural sources could endanger health. Satellite data could be used to retrieve information about such matter in the atmosphere and establish the relationship between highly polluted environments and health problems. A new method for measuring particulate matter concentration using satellite data applied to two testing regions in the Swiss and South Tyrol Alps had proved accurate in comparison with in situ measurements.

42. In the past, the lack of a standardized methodology for producing land maps in Colombia had not allowed monitoring of the land surface at the national level. Colombian institutions had consequently decided to produce a map of the Magdalena-Cauca river basins. In environmental and socio-economic terms, that was one of the most important river basins because it crossed the country from south to north and was one of the main sources of water in the Andean Colombian region. Land Remote Sensing Satellite images collected between 2000 and 2002 had been used to produce that map.

43. The experience gained had been applied to the rest of the country and, finally, a land map of Colombia had been created on a scale of 1:100,000. That initiative could set an example for other countries, given the success of the joint efforts made by Colombian Government institutions.

44. The Andean Páramo project coordinated by the Consortium for the Sustainable Development of the Andean Ecoregion was aimed at the preservation of biodiversity in the High Plateau in the northern and central Andes. One of the main objectives was to protect, conserve and recover the hydrological service provided by the Andean catchments.

45. It was concluded that the high Andean ecosystem hydrology was more relevant than glacial hydrology for the tropical Andes and that the impact of many land use changes was irreversible.

46. Praised as a biodiversity hotspot, the tropical Andes was also identified as one of the most severely threatened natural areas in the tropics. During the preceding century, the concentration of the human population in the inter-Andean valleys and on the inner slopes of the Andean ridge had transformed an important part of the natural vegetation cover causing the loss of its biological richness, especially in the northern Andes.

47. Finally, the high base flow in rivers descending from the Andean highlands was crucial for local water supply. In the Andes, large cities such as Quito (more than 85 per cent) and Bogotá (more than 95 per cent), relied almost exclusively on groundwater coming from the High Andean ecosystems for their water supply.

48. In 2005, the States members of the Andean Community had agreed on a mandatory decision for the Andean Committee of Environmental Authorities to design an Andean Environmental Agenda for the period 2006-2010. That agenda addressed three main themes: biodiversity, climate change and water resources.

49. An Andean ecosystem map had been produced to provide technical information for the implementation of the Andean Environmental Agenda and to support the implementation of the Regional Biodiversity Strategy for the Tropical Andean Countries by documenting the distribution and conservation status of the tropical Andean ecosystems.

50. Solar ultraviolet radiation at the Earth's surface was extremely variable and the most important parameter under cloudless conditions was solar elevation, which determined diurnal, seasonal and geographical variations. Further, important parameters in the atmosphere were the total ozone amount and the aerosol loading. Decreasing ozone would lead to a roughly proportional increase in the erythemally weighted ultraviolet radiation, and aerosols could attenuate ultraviolet radiation by about 5-35 per cent, depending on the amount and type of aerosol. Ultraviolet radiation increased with altitude by about 15 per cent per 1,000 m, also strongly depending on the local aerosol concentration. Ultraviolet radiation also increased by about 25 per cent on a horizontal detector where the land was covered with snow. Finally, clouds generally attenuated ultraviolet radiation, but by about 40 per cent less than they attenuated total solar radiation.

51. Human skin was acutely affected by ultraviolet radiation through erythema (sunburn) and chronically through several types of skin cancer. However, ultraviolet-B radiation was also responsible for the formation of vitamin D in the skin, a very important beneficial effect. The dose required for sufficient vitamin D synthesis was half of that which would produce erythema, but in winter even that low amount of ultraviolet-B radiation could not be attained at medium and high latitudes.

52. For the information of the public about the regional distribution of current levels of ultraviolet radiation, it was necessary to combine information from satellites (ozone and cloudiness) with ground-based measurements (for absolute scaling). For example, using information about the distribution of cloudiness from geostationary meteorological satellites, it was possible to generate regional maps of the level of ultraviolet radiation every 15 minutes for Austria, where a dense network of ground-based measurement stations was in operation. Those regional maps were available to the public via the Internet in near-real time.

III. Conclusions

A. General conclusions

53. On the basis of discussions held and presentations given, three working groups were established at the Workshop to generate ideas for sub-projects in the following areas: hydrology, agriculture and mining resources. The participants agreed:

(a) To prepare a proposal on the use of remote sensing for the sustainable development of the Andean region. Many components of such a proposal could come from the Workshop. It was suggested that the proposal be entitled "Natural resources environmental management and sociocultural sustainability in the Andes". CONAE would be in charge of collecting and distributing information for the proposal;

(b) To request ESA and CONAE to assist in providing satellite images for use in regional projects (the importance of availability of Advanced Spaceborne Thermal Emission and Reflection Radiometer satellite data and the need for improved access to the information were emphasized);

(c) To establish a website, a participants' network and an e-forum for all countries involved in the proposal;

(d) To share the outcome of space data applications available to ESA and CONAE with organizations such as the Mountain Forum and upload such information to the websites of other entities for geographical information technologies applications to enrich the content of those websites;

(e) To promote an active discussion of problems faced in the Andean region in international forums and use the Mountain Forum as a link to other regional entities (including the Inter-American Development Bank, the Organization of American States, the Andean Initiative, the Mountain Partnership, the Andean Páramo Project and the Adelboden Group on Sustainable Agriculture and Rural Development in the Mountain Regions) and initiatives such as the Sustainable Agriculture and Rural Development in Mountains Project;

(f) That mechanisms of the Organization of American States should be used to present proposals and projects;

(g) That the Andean countries should promote cooperation agreements and coordination between official institutions from the mining, hydrology and soil sectors;

(h) That the historic value of the Andean region and its culture should be maintained;

(i) That a common geographical reference system and set of methodologies should be adopted.

B. Outcome of the working group on hydrology

1. General objective

54. The general objective of the hydrology sub-project was to utilize space technology to reduce uncertainties in climatic and hydrologic scenarios so these could be used in planning and developing policies and in decision-making processes on the necessary steps.

2. Specific objectives

55. The specific objectives of the hydrology sub-project were:

(a) To establish an inventory of glaciers and conduct studies of relevant water basins in the Andean region in order to estimate the availability and size of water resources and the risk posed to communities in the region;

(b) To contribute to territorial planning activities aimed at optimizing the sustainable use of the resources;

(c) To improve conservation mechanisms in certain basin headwaters;

(d) To study protected high mountain areas, including basin headwaters;

(e) To contribute to biophysical vulnerability studies in Andean water basins.

C. Outcome of the working group on agriculture

56. The working group on agriculture addressed a wide range of activities, including farming, stockbreeding, pastureland and forestation.

1. General objective

57. The general objective of the agriculture sub-project was to guarantee data collection for the benefit of those active in agriculture.

2. Future actions

58. In the future, the agriculture sub-project should aim:

(a) To analyse alternatives to Landsat images and the development of appropriate training activities;

(b) To study the effects of climate change in terms of changes to farming practices;

(c) To study climate change and its impact on the surface of the soil;

(d) To research limitations on intensive farming activities (precision agriculture).

D. Outcome of the working group on mining resources

1. General objectives

59. The general objectives of the mining resources sub-project were:

(a) To determine the baseline potential of the mining resources in the Andean subregion using space data;

(b) To design a way for those resources to be used sustainably, in harmony with the environment.

2. Specific objectives

60. The specific objectives of the mining resources sub-project were:

(a) To create an inventory of all industries and strategic mining resources in the Andes, using optical and radar data;

(b) To determine the impact of mining activities using satellite data.

3. Future actions

61. In the future, the mining resources sub-project should aim:

(a) To initiate a geosemantics project as a tool for producing and exchanging information;

(b) To define a methodology and standards for processing space information so as to identify mining resources and outline an environmental baseline;

(c) To elaborate a mining resource management model.