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REPORT OF THE UNITED NATIONS/EUROPEAN SPACE AGENCY/CHILE WORKSHOP ON SPACE TECHNOLOGY TO PREVENT AND MITIGATE THE EFFECTS OF DISASTERS

(Santiago, 1-5 July 1996)

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INTRODUCTION

A. Background and objectives

1. In its resolution 37/90 of 10 December 1982, the General Assembly endorsed the recommendations of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82). In that resolution, the Assembly decided that the United Nations Programme on Space Applications should, among other things, disseminate, through panel meetings and seminars, information on new and advanced technology and applications, with emphasis on their relevance and implications for developing countries.

2. The United Nations/European Space Agency (ESA)/Chile Workshop on Space Technology to Prevent and Mitigate the Effects of Disasters was one of the activities of the Programme for 1996, which was endorsed by the General Assembly in its resolution 50/27 of 6 December 1995. The Workshop was held at Santiago from 1 to 5 July 1996 in cooperation with the Government of Chile for participants from developing countries of the region covered by the Economic Commission for Latin America and the Caribbean (ECLAC).

3. The Workshop, which was one of the follow-up activities of the Pro Tempore Secretariat of the Second Space Conference of the Americas (Santiago, 26-30 April 1993) to the recommendations made by that Conference, was hosted on behalf of the Government by four entities: the Ministerio de Relaciones Exteriores; the Oficina Nacional de Emergencia of the Ministerio del Interior (ONEMI); the Comité de Asuntos Espaciales de Chile; and the Fuerza Aérea de Chile.

4. The objectives of the Workshop were as follows: (a) to expose the participants, particularly the managers of emergency response agencies, to ways and means by which space technology could be utilized to prevent or mitigate the effects of disasters; (b) to address the development of databases and their use with the Geographic Information System (GIS) to prevent disasters or to mitigate their effects when they occur; and (c) to recommend appropriate actions that could be undertaken through international cooperation to strengthen the emergency response capabilities of the region.

5. The present report, which covers the background, objectives and organization of the Workshop and the observations and recommendations made by the participants and which contains a summary of the presentations, has been prepared for the Committee on the Peaceful Uses of Outer Space and its Scientific and Technical Subcommittee. The participants have reported to the appropriate authorities in their own countries.

B. Organization and programme of the Workshop

6. Most participants in the Workshop were professionals with several years of management experience with national and regional emergency response agencies and services. Other participants had experience in remote sensing, satellite meteorology, satellite communications and broadcasting, electronic networking and the use of databases such as those integrated into GIS.

7. The Workshop was attended by 289 experts from 21 Member States and 11 international and regional organizations; 240 of them represented 17 countries of the ECLAC region: Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Guatemala, Mexico, Nicaragua, Peru, Trinidad and Tobago, Uruguay, Venezuela; Nuova Telespazio (Italy), NEC Corporation (Japan), Spain, United States of America, European Commission, ESA, Earth Observation Satellite Company, Caribbean Disaster Emergency Response Agency (CDERA), Caribbean Telecommunications Union, Inter-American Development Bank; and, from the United Nations system, the Department of Humanitarian Affairs, the Office for Outer Space Affairs, the secretariat of the International Decade for Natural Disaster Reduction, the United Nations Development Programme (UNDP) and the World Health Organization (WHO).

8. Funds allocated by the United Nations and ESA were used to defray the cost of air travel and provide an allowance for the incidental expenses of 27 participants and speakers from 17 countries and 2 regional organizations. The Government of Chile, through the entities mentioned in paragraph 3, provided room and board for these same participants as well as the conference room, other meeting facilities and local transportation for all participants.

9. Opening addresses were made by the Secretary of the Pro Tempore Secretariat of the Second Space Conference of the Americas, the Director of ONEMI, the representative of ESA, the representative of the Office for Outer Space Affairs and the Minister of National Planning of Chile.

10. The presentations at the Workshop covered remote sensing, satellite communications and broadcasting in combination with electronic networking, satellite meteorology, satellite positioning systems and how they could be used, separately or in combination, to prevent, warn, monitor and mitigate the effects of disasters such as flooding, drought, landslides, earthquakes, volcanic eruptions, fires, environmental degradation and regional and global phenomena such as El Niño. They also covered the wide range of activities being conducted by national, regional and international institutions to upgrade preparedness and capacity of response in the event of a disaster.

11. The programme for the Workshop was developed jointly by the United Nations, ESA and the Chilean organizations concerned. The Workshop was conducted in the form of plenary and working group meetings. The working group focused on the needs of emergency response services, the ability of space technology to satisfy those needs and the actions that would be necessary in the short- and medium-term to take advantage of that ability.

12. The Workshop made a number of recommendations and concluded with the signing of the Ibero-American Declaration of Joint Action for the Comprehensive Development of Civil Defence and Protection (annex) by representatives of the emergency services of 11 countries in Latin America and of Spain. At the Workshop, the participants discussed issues related to the use of space technologies to prevent and combat the effects of natural disasters and concluded the meetings with the observations and recommendations presented below.

I. OBSERVATIONS AND RECOMMENDATIONS OF THE WORKSHOP

A. Observations

13. The Workshop noted that the damage caused by natural phenomena to people and to productive infrastructures had steadily risen since the 1960s. There were strong indications that that trend would continue. Disasters had set back development agendas and could destabilize social and political structures. While industrialized countries suffered greater economic damage in absolute terms, developing countries were impacted more severely in relative terms. Also, the loss of human life due to natural disasters was greater, in absolute terms, in developing countries.

14. The participants indicated that disaster management was a development activity. While responsibility for disaster preparedness and management lay with both the public and private sectors, protecting the country in the event of disasters remained a duty of the State. However, that duty should not be borne only by ministries of health or defence, which were most effective in a response mode. To promote the reduction of disaster vulnerability, it was necessary to also involve educators, researchers, urban planners, financial policy makers, those involved in the preparation of industrial or housing blueprints and, in general, the institutions that shaped the future of a country.

15. The Workshop recognized that disaster emergency response agencies and services in the region made limited use of the potentials of space technology for the prevention and management of disasters and their effects. The potentials indicated below were among the most important.

16. Satellites could provide communications services independently of the local telecommunications infrastructure, making them ideally suited for disaster emergency and relief work. The development of mobile or transportable satellite terminals would allow rapid deployment of emergency communications systems in disaster-affected areas. Such terminals also offered an important means of rapid dissemination of information warning of impending or possible disasters.

17. Anticipated developments in global fixed and mobile satellite communications and broadcasting systems, using both geostationary and non-geostationary orbits, would greatly enhance the possibilities of support for disaster warning and relief mitigation efforts. The future availability of truly global personal communications and broadcasting services at affordable prices would enable emergency response services to routinely use voice communication, digital data transfer and paging in all phases of disaster management activities.

18. At the international level, organizations concerned with national emergency planning, such as civil defence units and police and fire brigades, were increasingly incorporating satellite communications into their disaster relief plans. Over 150 international disaster relief organizations were using International Mobile Satellite Organization (Inmarsat) terminals to enhance their work. In addition to its standard services, INTELSAT also offered the Intelnet service, which could be used for environmental monitoring networks and disaster relief.

19. The economies of many developing countries were small and relatively specialized, leaving them particularly vulnerable to natural hazards. At the same time, the capacity to prepare for and respond to natural and man-made hazards was minimal in many of those countries. The wide array of remote sensing information technologies could provide cost-effective means for collecting information about the Earth's surface and for assessing a variety of environmental impacts.

20. The Workshop noted that remote sensing satellites were used to observe, map and monitor features and phenomena on the Earth's surface in the optical, infrared and microwave regions of the electromagnetic spectrum. These satellites were differentiated from meteorological satellites by their higher spatial resolution (10-100 m) and their lower temporal resolution (typically, two weeks). However, if the sensors could take images of points located off the satellite nadir ground track, their temporal resolution could be much better (three days) than the actual revisit time of the satellite.

21. Meteorological satellites provided images of cloud location and motion from which information to generate extreme-weather warnings could be derived. The images were also used to study and monitor volcanoes, geology, icebergs, ice-fields, fire and flooding. Low-resolution instruments provided valuable data for indirectly estimating rainfall, drought and locust infestations. Meteorological satellites were also used to carry instruments for search-and-rescue purposes. The International Search and Rescue Satellite System (COSPAS/SARSAT) was able to receive distress signals and transmit location details of downed aircraft and ships that had capsized or gone adrift to the nearest of an international network of rescue centres. COSPAS/SARSAT had so far saved the lives of more than 4,600 persons.

22. Countries often faced similar disasters or even the same ones when the disasters were of a transnational nature. Thus, managers of disaster-related programmes needed to maintain a fluid, continuous and informal dialogue, both within and across the borders. The Internet made it possible for individuals and agencies to keep in touch following face-to-face meetings or formal communications.

23. The participants emphasized that the costs, in both human and financial terms, associated with losses caused by disasters were of a very large magnitude and that investments should be made, particularly at the national level, to prevent or minimize the effects of these events.

24. The participants concluded that the use of space technologies and other modern technologies could greatly enhance preparedness and capacity of response when disasters occurred. However, to benefit from those technologies, it would be necessary to enhance or develop programmes to educate and train professionals to use them in the emergency response services and agencies; to promote the sharing of international experience and information on the use of the technology; and to identify, upgrade and link disaster-related databases.

25. In discussing the recommendations presented below, the participants took note of the recommendations related to disaster management that had been made by the participants at the United Nations/European Space Agency Regional Conference on Space Technology for Sustainable Development and Communications, held at Puerto Vallarta in 1995 (A/AC.105/622).

B. Recommendations

26. The Workshop recommended that civil defence institutions of the region, in collaboration with outside entities, should develop mechanisms based on existing infrastructures that incorporate the use of satellite communications, remote sensing, global positioning and other space technologies for the prevention, early warning and mitigation of the effects of disasters. Any such mechanism should facilitate the exchange of information across sectors and disciplines and make it possible for individual civil defence institutions to receive technical advice on the specific equipment required and on the education and training needed to utilize it in their work.

27. There was a need for education and training programmes designed specifically for civil defence managers and staff. Programmes for managers should be able to review the potentials of space technologies and should include criteria to select appropriate technologies. Programmes for individuals at the working level should teach both fundamentals and practical aspects of selected technologies.

28. The Workshop recommended that short- and medium-term pilot projects to demonstrate the value of space technology in meeting the needs of managers of disaster agencies should be identified and implemented. These projects should first of all strengthen on-going initiatives such as those that were presented at the Workshop, including the inventory on risk assessment that is being conducted by countries from the Andean Group in collaboration with the Pan American Health Organization (PAHO); the establishment of a centre to utilize space technologies for disaster management being developed by ONEMI; the integrated coastal area management system for small island developing States of the Caribbean proposed by the Office for Outer Space Affairs in collaboration with ESA and Nuova Telespazio; and the coordination of an emergency plan for Central America.

29. It is particularly important for every country to prepare risk assessment maps for specific disasters. Where groups of countries are exposed to the same type of disaster(s), efforts should be made to build databases that can be accessed by all of them.

30. In respect of design and development of disaster warning systems, the Workshop recommended as follows:

(a) Space technology should be used for forecast and immediate warning systems in the event of flash floods due to heavy rain run-off from mountains;

(b) Early warning functions need to be linked to risk assessment and preparedness programmes within a coherent disaster management strategy;

(c) Continued research and development on the technical specifications of early warning systems should be carried out for explicit user-determined needs and applications;

(d) More attention should be paid to different international and national perspectives on what warning systems can do, technically, and what they need to do, practically.

31. A disaster-oriented home page should be created and its address on the World Wide Web should be extensively disseminated. Alternatively, information could be placed in established web sites (for example, ReliefWeb) and made available in CD-ROM versions.

32. National and local governments should rationalize a strategy for funding disaster management planning. Such a strategy must include a significant commitment on the part of these governments to support the costs of essential technological and human infrastructure building. Although expensive in the short term, such an investment will result in much larger savings in both financial and human terms in the long term. Donor governments and international funding agencies can then be approached for support in the form of technical assistance, education, training and, when necessary, financing.

33. The Third Space Conference of the Americas (4-8 November 1996, at Punta del Este, Uruguay) was expected to be a valuable means for pursuing the goals of this Workshop. Related recommendations made by the Conference on Space Technology for Sustainable Development and Communications, held at Puerto Vallarta and by this Workshop, as well as those made by the Third Space Conference of the Americas, should be reviewed together to develop a strategic and coordinated follow-up plan. This procedure would reduce the duplication of efforts and provide for continuity.

II. SUMMARY OF PRESENTATIONS

A. Disaster-related facts and situations

34. Over the last 25 years, the damage caused by natural phenomena to people and national productive infrastructures has steadily risen. Economic damage has more than tripled, from US$ 40 billion in the 1960s to US$ 140 billion in the 1980s. There are strong indications that this trend will continue. Natural disasters, like complex emergencies, absorb increasing amounts of global resources and set back development agendas. Before 1987, only one disaster had exceeded US$ 1 billion in insured losses. Since then, 13 more such disasters have occurred. Besides causing human and economic losses, disasters also can destabilize social and political structures.

35. While industrialized countries suffer greater economic damage in absolute terms, developing countries are impacted more severely in relative terms. The gross national product (GNP) lost as a result of natural disasters is estimated to be 20 times greater in developing countries than in industrialized countries. Also, deaths from natural disasters are more frequent in developing countries. Japan, for example, averages 63 deaths per year from natural disasters; Peru, with similar natural hazards and only one sixth the population of Japan, averages 2,900 deaths per year.

36. The factors that make countries vulnerable to disasters increase in dimension much faster than the ability of governments to control them. For many disaster-prone countries that have to contend with competing demands on scarce resources, vulnerability reduction programmes are considered an important, integral part of their development strategies. However, the options and resources available to them for this purpose are often very limited.

37. Disasters are often the trade-off for ignoring environmentally sustainable development practices. Yet, the connection between disasters and poor development practices is often not made. Only gradually are a growing number of emergency management professionals becoming aware that disasters are often unsolved development problems. Each year building codes are ignored and zoning laws overlooked as communities expand into areas prone to earthquakes, landslides, floods, tidal surges, droughts, volcanic eruptions and high winds. Poverty, lack of education and overpopulation, all obvious root causes, need to be addressed for a realistic approach to disaster reduction.

38. Traditionally, disasters are classified as either natural or man-made. As far as disaster relief is concerned, the classification into sudden onset disasters and complex emergencies is more appropriate, as it is less the cause of the disaster than the sequence of events that dictates the response to it. On the one hand, an outbreak of civil strife can be as sudden as a volcanic eruption, and so are most technological or industrial disasters. On the other, a drought is in most cases a slowly developing event and its consequences (e.g. the displacement of populations and civil unrest) can be highly complex.

39. Local response is, for reasons of time and location, the first element of relief in practically all cases. No national or international assistance can replace that of the local emergency services. National authorities have the primary overall responsibility for disaster prevention, preparedness and response as well as for mitigation. Whenever local resources are not sufficient, intervention on the national level is required. It is only where this second level does not have the necessary response capacity that international assistance is mobilized. While emergency communications at the local and national levels can pose enormous problems, the need for satellite communications is most evident at the third, or international, level.

40. New technologies, particularly in data gathering and communication, have advanced the predictability of potentially destructive natural phenomena. The technical ability to foresee and interpret hazards is no longer as limited as it once was. Modern communications technologies provide wider and quicker access to information. However, while this technical ability remains essential, it is not sufficient.

41. Early warning is not a disaster preparedness measure in itself. It takes a functioning disaster preparedness system to translate early warning signals into an understandable message for the end users. Although technological improvements have increased the capacity of early warning systems, they have also widened the gap between the alert message and the end users in developing, disaster-prone countries. The discrepancy lies in the often highly technical content of the warning itself and in the ability of communities in disaster-prone areas to, firstly, understand it and, secondly, act in a pre-established manner. This is particularly important in countries with different languages and local dialects.

42. Three abilities constitute the basis of early warning. The first, largely a technical ability, is the identification of a potential risk (i.e. the likelihood of occurrence of a hazardous phenomenon). The second is the accurate determination of the population to whom a warning needs to be directed. The third, which requires considerable social and cultural awareness, is the communication of information to specific recipients about the threat in sufficient time and with enough clarity so that they can act to avert negative consequences.

B. Satellite communications and broadcasting for disaster management

43. To the extent that public networks exist and survive the impact of disasters they are used in relief operations. However, because they are so highly centralized, if one vital element is damaged, communications with the outside world can be completely disrupted. Technology has enabled such widespread access to telecommunications that if a network fails, very many people are affected. Moreover, each communications failure is likely to have critical effects on vital establishments such as hospitals.

44. In addition to wire communications systems and terrestrial microwave systems, Japan utilizes a network known as the Local Authorities Satellite Communications network (LASCOM) for protection against disasters

and for emergency services during disasters. In non-emergency conditions, the network is used for administrative purposes. The usefulness of satellite communications was validated during the Kobe earthquake of January 1995, when terrestrial communications became vulnerable.

45. Another problem in the past was that the efforts of humanitarian organizations to deploy supporting telecommunications equipment such as radios and satellite communications have sometimes been hampered at national borders owing to lack of prior customs clearance. The Plenipotentiary Conference of the International Telecommunication Union (ITU), in its resolution 36 of October 1994, urged member States to take all practical steps for facilitating the rapid deployment and the effective use of telecommunications equipment for disaster mitigation and for disaster relief operations by reducing and, where possible, removing regulatory barriers.

46. Humanitarian organizations are major users of state-of-the-art mobile telecommunications technology. Five of the largest institutions, three of them based in Geneva, use more than 250 mobile satellite terminals and thousands of two-way radios and short-wave transmitters and receivers. National and international relief organizations and rescue teams worldwide, both governmental and non-governmental, make widespread use of various types of telecommunications equipment.

47. The Department of Humanitarian Affairs is responsible for facilitating the work of the operational partners in humanitarian assistance. This includes the coordination of available telecommunications resources in order to optimize their use and a consolidated effort to remove national regulatory barriers, which in many countries still prevent the full use of telecommunications equipment during international relief operations. As the five major organizations spend over US$ 6 million per year on communications fees for satellite terminals alone, the Department and its Working Group on Emergency Telecommunications are also working towards reduced tariffs for humanitarian operations.

C. Use of satellite-based telemedicine in disaster relief

48. Telemedicine has not been institutionalized as a routine practice and until recently applications in this field have typically been of short duration. Further, there has been only scarce validation of telemedical systems in the variety of settings and situations that would be required to satisfy a cautious and, sometimes, skeptical medical community. What has given the health applications of satellite technology the dramatic attention they receive today is certainly not newly discovered needs. Rather, it is the rapid improvement in telecommunications and information technology and the realization that low-cost, easy-to-access and easy-to-use systems are available.

49. Continuous development of telemedicine by the military has resulted in a tremendous improvement in the way medical support is provided to military personnel in the field. Although the benefits of this development have often been used to assist civilian casualties of natural disasters and complex emergencies, they deserve much wider application in primary and public health interventions.

50. During the recent outbreak of the Ebola virus in Zaire, a low Earth-orbiting satellite (HealthSat-2) operated by SateLife, a non-profit organization with headquarters at Boston, was used for a very basic yet important telemedicine application. A group of doctors near the town of Kikwit used a SateLife ground station for store-and-forward e-mail communications with colleagues outside the affected area. The doctors used another SateLife service, the Program for Monitoring Emerging Diseases (ProMED), to exchange information and request medical equipment.

D. Remote sensing capabilities from space

51. The ability of remote sensing satellites to map geological and geomorphological features is of immense help in identifying earthquake-prone areas. Even though the science of earthquake and volcano prediction

is in its infancy, the possibility of measuring small tectonic movements using laser ranging techniques or the differential Global Positioning System (GPS), combined with temperature measurements on the surface, is promising.

52. Earth observation satellites provide unique data to monitor Earth surface phenomena. The damage caused by recurrent floods can be mitigated by using remote sensing data on different types of terrain and surface water areas to classify different risk zones in flood-prone areas. As these data also provide information on wet areas, standing water, sand-covered areas, agricultural land that is completely damaged, marooned villages, canal systems and drainage patterns, they can help in taking appropriate measures to mitigate the sufferings of affected people and in making reliable estimates of damage. The ability of radar satellites to obtain data through cloud cover is particularly valuable for these purposes.

53. The first satellite of the European Remote Sensing Programme (ERS-1) was launched in 1991 and carries several microwave sensors on board. Its primary instrument is an active microwave instrument (AMI), which can provide both high-resolution images (in C-band) and wind speed (by analysing ocean wave spectra). While in the imaging mode, AMI covers a swath of 80-100 km, with a resolution on the order of 27 m in the range direction and 29 m in the azimuth direction. Operating in the wind mode, it covers a swath of 400-500 km over the ocean with resolution cells of 50 km and measures wind speed in the range 4-24 m/s with an accuracy of 0.5-2.0 m/s.

54. ERS-1 also carries a radar altimeter (RA) that operates at a wavelength of 2 cm. RA is used to measure average wave height and wind speed and to determine meso-scale ocean topography. Data from this altimeter have been used successfully to determine ice type and topography as well as water/ice boundaries.

55. A third instrument on board ERS-1 is an along-track scanning radiometer (ATSR) that operates in three bands in the thermal region of the electromagnetic spectrum (EM). These bands are centred around 3.7, 11 and 12 µm. The ATSR looks through the atmosphere at the surface of the ocean from two directions: directly downwards and at an incidence angle of 50°. The difference between the oblique and vertical measures provides information on atmospheric absorption, while the differences between measurements at the three wavelengths are used to determine atmospheric water vapour content.

56. The second satellite of the European Remote Sensing Programme (ERS-2) was launched on 21 April 1995 and is placed in the same orbit as ERS-1, following it by 31 minutes. As the satellites are being operated in tandem, ERS-2 can visit a site 24 hours after ERS-1. Such an arrangement allows interferometric analysis that produces digital elevation models of the terrain being imaged with a precision of centimetres. In addition to the instruments carried by its predecessor, ERS-2 also carries global ozone monitoring equipment (GOME). However, the ATSR instrument on board ERS-2 operates in the visible portion of the EM.

57. Although originally designed for ocean and ice applications, synthetic aperture radar (SAR) images obtained by ERS-1 and ERS-2 have been tested, with varying degrees of success, in agriculture, forestry, hydrology, cartography and geology applications and for monitoring natural hazards such as floods and mud flows. Near coastlines, SAR images have also found applications in aquaculture, mangrove forestry and coastal monitoring. As such, they have become valuable as data gathering satellites to support environmental monitoring and sustainable development programmes.

58. The ENVISAT-1 satellite is envisioned as an enhancement of the European Remote Sensing Programme. However, in addition to contributing to environmental studies, this satellite will be an important tool for marine biology and atmospheric chemistry studies. Its instruments will include advanced synthetic aperture radar (ASAR), a global ozone monitoring by occultation of stars (GOMOS) instrument, a medium resolution imaging spectrometer (MERIS), a Michelson interferometer for passive atmospheric sounding (MIPAS), a radar altimeter (RA-2) and an advanced ATSR.

59. The likelihood of a landslide occurring is assessed by identifying critical combinations of site conditions, such as soil characteristics, degree of slope, type of bedrock, vegetative cover and rainfall and snow-melt conditions, that correlate well with the past occurrence of landslides. Remote sensing satellites, because of their synoptic and stereoscopic viewing capabilities, together with aerial remote sensing, are very effective in determining these features.

60. Potential health disasters can also be identified using space technology. A pilot project that addressed a potential health disaster caused by malaria-carrying mosquitos was carried out as a cooperative effort between the Centro de Investigación del Paludismo, Mexico, and several teaching institutions in the United States of America, with support from the National Aeronautics and Space Administration (NASA) of the United States. The project, conducted in the state of Chiapas, illustrated the complementary nature of space-based communications, global positioning, remote sensing and GIS.

61. This project used remote sensing and GIS technologies to discriminate between villages at high and low risk for malaria transmission, as determined by landscape characteristics that were correlated to the probable future abundance of Anopheles albimanus mosquitoes.

62. Satellite data for an area in southern Chiapas were digitally processed to generate a map of landscape elements. GIS processes were used to correlate mapped landscape elements surrounding 40 villages where field data had been collected determining the abundance of Anopheles albimanus. The analysis indicated that rainfall and growth of vegetation could be correlated with mosquito production; that changes in these parameters could be monitored and quantified by remote sensors; and that changes in mosquito populations could, accordingly, be predicted. Using Landsat Thematic Mapper (TM) images from 1985 and 1987, the project team predicted, with an accuracy of 90 per cent, which rice fields would become heavy producers of malaria-carrying mosquitoes two months before peak mosquito production.

63. In the United States, TM multispectral data allowed monitoring forest fires in Yellowstone National Park, Wyoming (1988), and in Laguna Beach, California (1993). The 16-day repeat coverage of Landsat allowed resource managers to develop a chronology of events related to the fires, useful in planning future fire-suppression activities and in developing a better understanding of forest fire dynamics. TM data were also used to monitor reforestation efforts that included planting more than 18 million new trees after the volcanic eruption of Mount St. Helens, Washington (1980).

64. The Foreign Agricultural Service of the United States Department of Agriculture routinely uses data from Landsat, Indian remote sensing satellite (IRS), satellite pour l'observation de la Terre (SPOT) and other satellites to monitor crop conditions worldwide, focusing on drought areas. The Famine Early Warning System (FEWS), created in the early 1980s, uses Landsat data with advanced very high resolution radiometer (AVHRR) and other types of data to monitor famine conditions. Private farming concerns utilize a combination of remote-sensed data to watch for the beginning of crop infestation and take early remedial action.

65. Satellite remote sensing data have also been used in many countries to monitor man-made disasters such as nuclear power accidents, ground and water pollution, deforestation, biomass degradation, oil spills and water shortages. In all these cases, periodic satellite coverage allowed monitoring the progress of the subsequent mitigation or corrective actions.

E. Global monitoring and warning systems

66. The Society of Japanese Aerospace Companies has proposed that the Global Disaster Observation System (GDOS) could be established through international cooperation. It would use the capabilities of existing satellite systems, supplemented by those of new satellite systems for situations where the existing systems cannot meet the needs.

67. The main objective of GDOS would be to minimize damage in large-scale disasters. It would operate in tandem with conventional disaster prevention systems and would be able to do the following:

(a) Provide detailed, near-real-time information on disasters to enable effective deployment of rescue and fire fighting services to suppress or reduce potential secondary disasters to the minimum;

(b) Acquire oceanic and other data to improve the accuracy of predicting and warning of events such as tsunamis, typhoons and hurricanes;

68. The desirable features of the GDOS system would be the following:

(a) Ability to acquire a full view of the disaster-stricken area within 2.5 hours of the occurrence of the disaster;

(b) For wide area coverage, ability to observe the disaster-stricken area with a resolution of 5 m regardless of time of day and under any weather conditions;

(c) For narrow area coverage (i.e. within a ground observation radius of 40 kilometres), ability to observe the disaster-stricken area with a resolution of 2 m;

(d) Ability to observe the disaster stricken area at frequent intervals (i.e. every 2 hours) and for extended observation periods (i.e. two observation periods of 25 minutes for each time interval);

(e) Ability to promptly detect various types of disasters, such as forest fires and volcanic eruptions;

(f) Ability to detect vertical movements, variations and dislocations of ground areas to a resolution of a few centimetres;

(g) Ability to acquire information on ocean propagation of tsunamis (for example, water level, wavelength, geographical location, sea wave height and wind speed);

(h) Ability to obtain data on ocean water vapour, precipitation, sea surface temperature and wind speed for use in the prediction and tracking of typhoons.

F. Actions by the United Nations and other international organizations

69. The Global Conference on Sustainable Development of Small Island Developing States, held at Bridgetown, Barbados, in 1994, noted that small island developing States are prone to extremely damaging natural disasters, primarily in the form of severe weather, volcanic eruptions and earthquakes (A/CONF.167/9).

70. The Caribbean region is constantly exposed to hurricanes and earthquakes. In recent years, there has been massive damage to Caribbean countries through natural hazards. Impacts on the public infrastructure are severe, require large sums of money for critical reinvestment and severely impair the capacity of countries to cope with the crises in human and financial terms.

71. Most of the small island developing States, including the Caribbean islands, are in the tropical zone, where they are exposed to seasonal climatic conditions of a catastrophic nature such as cyclones, hurricanes, typhoons and tropical storms. Satellites can track these weather formations continuously, and early warning can be given on television, radio and other special networks to populations in the path of the menace. However, for sudden onset disasters, such as tsunamis, a short, simple message must be broadcast to a relatively large number of user terminals scattered throughout the area of impending disaster.

72. To address this problem, the Office for Outer Space Affairs proposed developing, in cooperation with interested specialized agencies of the United Nations, a project to implement a satellite-based disaster warning broadcasting system for remote, rural and outer communities of small island developing States. This system would provide warning capability for sudden onset disasters using non-voice, one-way communications technology and could be integrated into the Command, Control, Coordination and Information (C3I) proposal described below.

73. As a result of recommendations made at the United Nations/European Space Agency Regional Conference on Space Technology for Sustainable Development and Communications, an initiative that would result in the implementation of a satellite-based communications system for risk management in small island developing States of the Caribbean is being pursued by the United Nations Office for Outer Space Affairs and Nuova Telespazio of Italy.

74. The initiative involves adapting a satellite-based C3I system developed by Nuova Telespazio for risk management to meet the needs of Caribbean countries without duplicating existing infrastructures. In its custom-tailored version, the system would enable civil protection agencies to manage preparedness, prevention, early warning, relief intervention and mitigation as well as post-crisis analysis for major natural and technological risks. It could also contribute to an integrated coastal area management system to benefit small island developing States, as recommended by the United Nations Conference on Environment and Development (UNCED) in chapter 17 of Agenda 21[1] and more recently by the Global Conference in Barbados. An effective coastal management system should be able to provide access to innovative technologies such as remote sensing and geographic informations systems.

75. The command-and-control process for risk management is carried out through a computer and telematic infrastructure. The C3I system allows for three hierarchical levels: (a) command and control national centres, (b) regional centres and (c) field systems for detection and action. The data-gathering stations are the first level involved in acquiring and processing data. They interface directly with sensors deployed in the field.

76. C3I sensors, appropriately distributed throughout the area of responsibility, are linked through a telecommunications network to a command-and-control centre and to scientific centres, where the data are processed, stored and presented to the decision-making bodies in appropriate formats (e.g. as text, tables, maps or graphics). After decisions are taken, the system makes it possible to transmit the orders to operative forces in the field. Information from forces in the field and additional data from the sensors to the control centre make the new situation known, thus closing the command-and-control loop.

77. At present C3I is optimized for monitoring radioactive elements in the atmosphere, certain chemical components in the atmosphere, dynamics of seismic activity (earthquakes, volcanic eruptions), water level of rivers, lakes and basins and meteorological data. However, by choosing different field sensors, the risk factors taken into consideration can be adapted to various operating environments.

78. The Department of Humanitarian Affairs is the specialized office of the Secretariat responsible for disaster-related matters. One of its main functions is to mobilize, direct and coordinate external assistance provided by the United Nations system in response to disasters. The Department also promotes pre-disaster planning as well as the study, prediction, prevention and control of natural disasters.

79. The secretariat of the International Decade for Natural Disaster Reduction operates within the framework of the Department of Humanitarian Affairs. The Decade was proclaimed by the General Assembly in its resolution 42/169 of 11 December 1987, with a view to reducing, through concerted international actions, especially in developing countries, loss of life, property damage and social and economic disruption caused by natural disasters.

80. The activities in connection with the Decade were designed to achieve the above-mentioned objective by the following means:

(a) Improving the capacity of each country to mitigate the effects of natural disasters expeditiously and effectively, paying special attention to assisting developing countries in the assessment of potential damage caused by disasters and in the establishment of early-warning systems and disaster-resistant structures when and where needed;

(b) Devising appropriate guidelines and strategies for applying existing scientific and technical knowledge, taking into account the cultural and economic diversity among countries;

(c) Fostering scientific and engineering endeavours aimed at closing critical gaps in knowledge in order to reduce loss of life and property;

(d) Disseminating existing and new technical information related to measures for the assessment, prediction and mitigation of natural disasters;

(e) Developing measures for the assessment, prediction, prevention and mitigation of natural disasters through programmes of technical assistance, technology transfer, demonstration projects, and education and training, tailored to specific disasters and locations, and to evaluate the effectiveness of those programmes.

81. In defining specific targets to be achieved during the Decade, the Scientific and Technical Committee of the Decade called primarily for action at the national level, with supporting action at the regional and global levels. Thus, by the year 2000 all countries, some through regional arrangements, should have in place the following:

(a) A national assessment of risk, including an overall identification of natural hazards that pose a disaster threat; for each type of hazard threat, an evaluation of the geographic distribution of the threat and estimates of its recurrence frequency and of its impacts; and an estimate of the vulnerability of the most important concentrations of population and resources;

(b) National and local prevention and preparedness plans, including the adoption of land-use and construction practices that resist or avoid hazards; the adoption of emergency-response plans that identify responsible organizations, hazard scenarios and essential actions; awareness programmes to educate people on the nature of the threat, including a training component; and concrete measures to mitigate damage and increase resilience in case of a disaster.

82. The challenge and the opportunity for the United Nations and other organizations is to provide the leadership and the commitment to create an agreed basis for coordinating and collectively benefiting from improved and comprehensive systems to meet those targets. To meet this challenge, it will be necessary to draw upon the full range of organizational experience and resources in a methodical way. Policies and procedures are needed to match the requirements with the capabilities of governments, specialized institutions and intergovernmental and non-governmental organizations and to develop frameworks for preparedness, early warning and response systems.

83. CDERA coordinates disaster relief in the Caribbean region. For the purpose of improving disaster preparedness, it has made arrangements for regional cooperation for support to countries affected by disasters. Since April 1994, small island countries and areas of the Caribbean region have experienced several major natural disasters, including tropical storm Debby (Saint Lucia, September 1994); tropical storm Gordon (Haiti and Cuba, November 1994); and hurricanes Luis and Marilyn (Antigua and Barbuda, Dominica, Saint Kitts and Nevis and Netherlands Antilles, September 1995).

84. There are three major applications of space technology for disaster management in the Caribbean. Satellite imagery, along with other meteorological data, is used for weather forecasting. The images provide early warnings on tropical cyclone activity and other severe weather conditions. In the second application, weather forecasting offices have recently begun using satellite communications for two-way transmissions of meteorological data. This application is part of the Regional Meteorological Telecommunication Network (RMTN), a cooperative effort of the United States National Weather Service and the World Meteorological Organization (WMO). The National Oceanic and Atmospheric Administration of the United States provides the Satellite Telecommunications and Analysis for Region IV (STAR-4) computer terminals used by the meteorological offices for access to the network. The third major application is the use of GPS for volcano monitoring. The Montserrat Volcano Observatory is using GPS technology to monitor deformation in the Soufrière Hills volcano, which began erupting in July 1995. The measurements allow scientists to detect small changes in the dimensions of the volcano, providing clues about impending behaviour.

85. Many of the Caribbean small island developing States are undertaking disaster-reduction activities in a number of sectors. Priority attention is being given to tourism, health, education, infrastructure and agriculture. These activities are supported by the Caribbean Disaster Mitigation Project (CDMP), implemented by the Organization of American States, with funding by the United States Agency for International Development. Emphasis is on regional disaster-mitigation activities and exchange programmes.

86. Insurance against disasters is an important issue in the Caribbean region. Several initiatives are being taken to address the need for insurance to be made available. CDMP attempts to improve cooperation between national disaster-management agencies and insurance companies. A workshop on meteorological and hydrological data for the insurance industry was organized by WMO and ECLAC at Port-of-Spain in 1995; at the workshop, the Food and Agriculture Organization of the United Nations (FAO) provided advice on the basic considerations involved in insurance for weather-related agricultural losses.

87. The Disaster Preparedness Programme of the European Community Humanitarian Office (ECHO), begun in 1994, was consolidated in 1995 and has received increasing attention from international organizations and non-governmental organizations active in both emergency and development programmes. The budget reserved for disaster preparedness activities in 1995 amounted to ECU 4.2 million. In 1995, ECHO started 27 preparedness and prevention projects in Africa, Asia and Latin America and in the newly independent States and continued funding 6 projects that had been started in 1994.

88. The three key elements of the Disaster Preparedness Programme are the development of human resources, the strengthening of institutional capacities and the implementation of community-based, low-cost technology projects for preparedness and prevention. The projects that were selected met several of the following criteria:

(a) Implementation in countries ranked unfavourably in the Human Development Index;

(b) Focus on the needs of the most vulnerable groups;

(c) Complementary in nature to national development programmes and relief operations;

(d) Sustainability over the long term, and environmental soundness;

(e) Community participation/management, strengthening of local capacities;

(f) Emphasis on the involvement of women.

89. By the end of 1995, operational projects had been evaluated, with most showing very positive results despite modest financial support and (often) small areas of impact. Evaluators have praised the projects for their cost-efficiency, their rootedness in local resources and their potential for preventing or mitigating disaster.

90. European Commission activities in the field of disaster preparedness take full account of the recommendations of the Yokohama Plan of Action, agreed upon in the context of the International Decade for Natural Disaster Reduction.[2] The challenge for the future will be to consolidate and develop the experience gained in 1995. A challenge being addressed in 1996 and 1997 is to further develop specific elements of the Disaster Preparedness Programme, including the establishment of a preparedness technical advisory committee as an expert group to give advice on the Programme.

G. Electronic networking and information databases

91. While the Internet has been rapidly spreading in developed countries for several years, until recently it was much less familiar to the disaster community in Central America. Misconceptions about the complex technological aspects of transferring information persist, but these are being clarified as disaster managers begin to observe the practical uses and importance of the Internet. It is more and more recognized by disaster managers in Central America as a tool that allows them to communicate quickly and inexpensively among themselves and thus improve the management of mass casualties and other disaster-related events.

92. The objective of a joint PAHO/NASA project is to contribute to the establishment of a global health network in the health and disaster sectors in Central American countries. For this purpose, it has been necessary to convince national institutions in Central America, many of which were not familiar with the Internet, of the benefits of using this medium to improve coordination and share information in mass casualty events. Such activities would prepare the groundwork for the use of telemedicine and other techniques in disaster management.

93. At the beginning of the PAHO/NASA project, only Costa Rica had direct access to the Internet. Although the situation still varies from country to country, it has improved substantially. The contacts developed by PAHO in health-related fields as well as in the disaster community (through its Emergency Preparedness Programme) have helped to bring about a synergy between the health sector and the emergency response community at the national level and throughout Central America. The enthusiasm generated by health disaster professionals at the national level has resulted in the establishment of strong multidisciplinary working groups (telecommunications, computer experts, disaster management) in the various countries.

94. Central American countries have demonstrated their interest and support by assuming recurring costs such as those for telephone line installation and fees. In the face of the reluctance of donors or executing agencies to assume recurrent costs, PAHO shifted from providing telephone lines for individual accounts to establishing nodes on a cost-sharing basis.

95. In Costa Rica, the Office of the President has established a governmental network known as GobNet. The Office has provided funding for the project which has been distributed among managers of health disasters working at the Ministry of Health, the Institute of Social Security, the Regional Disaster Documentation Center, the Disaster Supply Management Project, the National Emergency Commission, the subregional office of the International Decade for Natural Disaster Reduction and the PAHO disaster focal point.

96. In Nicaragua, PAHO developed an Internet node that connects the entire health system and provides points of access for six national disaster managers. PAHO specialists in Nicaragua have also developed audiovisual and printed information materials and have made other contributions to the effort of training users. Training sessions on the use of Internet for disaster-related activities are ongoing in Guatemala,

Honduras and Panama. In other countries of the subregion, all health disaster coordinators in ministries of health have been, or will be, provided the necessary hardware to become integral members of the envisaged global health network.

Notes

[1]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.

[2]See "Report of the World Conference on Natural Disaster Reduction (Yokohama, 23-27 May 1994)" (A/CONF.172/9), chap. 1, annex II.