UNITED NATIONS

A

General Assembly

Distr.
GENERAL

A/AC.105/623
1 February 1996

ORIGINAL: ENGLISH

COMMITTEE ON THE PEACEFUL
USES OF OUTER SPACE

REPORT ON THE UNITED NATIONS/EUROPEAN SPACE AGENCY TRAINING COURSE FOR ASIA AND THE PACIFIC COUNTRIES ON APPLICATIONS OF THE EUROPEAN REMOTE SENSING SATELLITE DATA TO NATURAL RESOURCES, RENEWABLE SOURCES OF ENERGY AND THE ENVIRONMENT

(13-24 November 1995, Frascati, Italy)

CONTENTS

V.96-80542T

INTRODUCTION

A. Background and objectives

1. At its thirty-seventh session, the General Assembly adopted resolution 37/90 of 10 December 1982, in which it endorsed the recommendation of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82) that the United Nations Programme on Space Applications should, *inter alia*, stimulate the growth of indigenous nuclei and an autonomous technological base in space technology in developing countries, and promote greater cooperation in space science and technology between developed and developing countries as well as among developing countries.

2. The Committee on the Peaceful Uses of Outer Space (COPUOS), at its thirty-seventh session in June 1994, endorsed the activities of the Programme on Space Applications for 1995 as proposed by the Expert on Space Applications (A/AC.105/555) and as recommended by its Scientific and Technical Subcommittee at its thirty-first session. Subsequently, the General Assembly, in its resolution 49/34 of 9 December 1994, endorsed the activities of the Programme on Space Applications for 1995.

3. In response to Assembly resolution 49/34, and in accordance with the UNISPACE 82 recommendations, the Programme on Space Applications included, as part of its activities for 1995, the organization of a Training Course for Asia and the Pacific Countries on Applications of the European Remote Sensing Satellite (ERS) Data to Natural Resources, Renewable Sources of Energy and the Environment. It was the third in a series of similar training courses that were organized for the benefit of African French-speaking countries (1993) and Latin American and Caribbean countries (1994).

4. The United Nations/European Space Agency Training Course for Asia and the Pacific Countries on Applications of the European Remote Sensing Satellite Data to Natural Resources, Renewable Sources of Energy and the Environment was organized jointly by the Programme on Space Applications, the Office for Outer Space Affairs and the Department for Development Support and Management Services (DDSMS) of the Secretariat, in cooperation with the European Space Agency (ESA).

5. The objectives of the Course were as follows: (a) to provide participants from the region of Asia and the Pacific with a theoretical basis and practical experience in various aspects of microwave remote sensing, focusing on the applications of that technology to natural resources, sources of renewable energy and, in particular, its use in conducting inventories and monitoring the environment; and (b) to familiarize the participants with the operational services of ERS-1 and -2 satellites (for example, data coverage, data sources and products processing levels) and with the bibliography and archives of ERS materials and data available at the European Space Research Institute (ESRIN) facility at Frascati, Italy.

B. Organization and programme of the Course

6. The Course was held at the ESA/ESRIN facility from 13 to 24 November 1995. It was attended by 14 participants from the following countries: Bangladesh, Bhutan, Cambodia, China, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Pakistan, Philippines, Singapore, Sri Lanka, Thailand and Viet Nam. Financial support to defray the cost of international air travel and living expenses of the participants was provided by the Office for Outer Space Affairs and the United Nations Trust Fund for New and Renewable Sources of Energy. The programme for the Course (see annex) was developed jointly by ESA and the United Nations (Office for Outer Space Affairs). The lecturers came from France, Spain and ESA.

7. The Course provided participants with the physical theory on which remote sensing, both active and passive, is based. The Course presented an overall view of remote sensing in various intervals of the electromagnetic spectrum, including the visible, infrared and microwave regions, and highlighted the multidisciplinary nature of the use of the data. Since the ERS-1 and -2 payloads are composed mostly of active radar instrumentation, the Course

emphasized active microwave remote sensing. The Course included the theory and concepts of synthetic aperture radar (SAR) image formation, as well as an introduction to digital image processing of radar data in oceanographic, geologic, hydrological, topographic and cartographic applications. The Course also provided the participants with examples of the applications of the data received from the various instruments on board ERS-1 and -2 satellites, as well as with hands-on experience in digital processing of microwave image products. The complementary information that can be obtained from optical and radar data was stressed as a powerful asset for remote sensing. Presentations made by the lecturers included case-studies of programmes or projects conducted in Asia and the Pacific.

8. The United Nations and ESA took advantage of the presence of participants representing institutions in 14 countries in the region of Asia and the Pacific to further develop the concept of a programme proposal that could provide satellite data for institutions in developing countries. That concept had originated during the first course, for African French-speaking countries, held at Frascati in 1993, and had further evolved during the second course, for Latin American and Caribbean countries, in 1994. The concept discussed by the participants and co-sponsors of the Course is summarized in section I below.

9. The present report, which covers the background, objectives and organization of the Course, has been prepared for COPUOS and its Scientific and Technical Subcommittee. The participants in the Course have reported on the knowledge acquired and on the work conducted during the Course to the appropriate government authorities, universities and research institutions in their own countries.

I. POSSIBILITIES FOR THE ACQUISITION OF SATELLITE DATA

10. Together with satellite systems of other national agencies, the remote sensing satellites of ESA contribute to observing the Earth and its environment in a systematic, global and accurate manner. Through modern technology they provide measurements of physical parameters of the ocean-land-atmosphere system with continuity, compatibility and full coverage, night and day. Where supported by operational ground acquisition stations, they ensure long-term observations and yield time-series of consistent and calibrated remote sensing data that may be used to build up a history of parameters describing a physical phenomenon such as climate. From such a history, characteristics, trends and anomalies of the phenomenon could be identified.

11. Given the capability of microwave radiation to penetrate clouds, ERS provides all-weather images of the Earth surface and allows the monitoring of surface features even in areas, such as over equatorial and polar regions, where optical instrumentation fails because of frequent or permanent cloud coverage. In addition, radar images provide information on surface geometry and humidity that significantly complements surface albedo and temperature data provided by optical satellites, making remote sensing observations a very powerful and versatile tool for applications to environmental disciplines. The nature of such satellite data is in effect multidisciplinary, since they can be used simultaneously for many applications and different operational requirements. Directly or through ESA services, national institutions may gather and archive the data, and, if required, further process them to serve their users in fields as diverse as geology, oceanography, hydrology, meteorology, glaciology, forestry, agriculture, topography, cartography, land use and environmental matters ranging from urban settlement to pollution monitoring.

12. During the courses held at Frascati in 1993 and 1994, the participants had indicated that two obstacles to the utilization of image products such as those covered in the courses were the lack of access to them and the need for further education on the principles of their use, together with hands-on training to develop experience in the mechanics of analysis. The representatives of the Secretariat and ESA had indicated that they would explore ways and means of providing at least a limited amount of data and further training for the ongoing activities of the participants.

13. After the first course held in 1993, representatives of the Office for Outer Space Affairs, DDSMS and ESA discussed the issue and drew the following conclusions:

(a) For the courses to achieve their objectives fully, it was essential that participants returning home should have access to satellite data and to the necessary image-processing software in order to strengthen their newly acquired skills;

(b) Institutions with ongoing projects would be the most likely to need and utilize the data;

(c) The co-sponsors could develop a programme proposal for building capacities and strengthening institutions, through which a limited amount of data, necessary software and further training could be provided to some institutions in developing countries.

14. The development of the programme would include the following three phases: (a) needs assessment to determine the degree of interest of institutions in the regions participating in the programme and the quantities and types of data needed; (b) identification of ongoing projects that are using or could use satellite data in the regions of Africa, Asia and the Pacific, and Latin America and the Caribbean; and (c) selection of projects on the basis of those remote sensing applications that were in greatest demand in the regions concerned. Subsequently, the programme would be presented by the co-sponsors, with the endorsement of the institutions and their Governments, to potential funding sources. The data provided by the programme would not be limited to ERS-1 and -2 data, but, on the basis of project requirements, could originate from other satellites (for example, the Land Remote Sensing Satellite (LANDSAT) and the Satellite Système Probatoire d'Observation de la Terre (SPOT)) or from a combination of satellites in order to take advantage of the complementary nature of data obtained by satellites.

15. During implementation of the above-mentioned programme, the data needs of several ongoing projects were to be submitted to the United Nations (Office for Outer Space Affairs and DDSMS) and ESA by participants in the first two training courses held at Frascati in 1993 and 1994. The first series of submissions came from Latin America, and were integrated thematically into modules that the co-sponsors were to present to potential financial contributors. A similar process was also under way for Africa, using input received from participants in other training courses jointly organized by the United Nations and ESA in the region.

16. The above-mentioned programme was presented to the participants in the Course held in 1995, with an invitation to participate in the project and to contribute to the first two phases of the programme. The participants expressed great interest in the offer. A number of discussions took place to consider the issues related to phases (a) and (b) described in paragraph 14 above. The United Nations and ESA provided additional information and assisted the participants in the discussions.

17. During discussion of possible follow-up projects at the conclusion of the Course, the participants emphasized that ERS data could provide vital input for applications to the monitoring of natural resources, renewable sources of energy and the environment. They identified a number of projects that could benefit from ERS data, some of them ongoing projects involving the institutions or agencies of the participants. Discussing issues related to availability, accessibility and practical applications of ERS data, the participants noted, among other things, that present and potential users of the data should be more exposed to and trained in the basic sciences underlying microwave remote sensing technology, so that they could more fully benefit from the use of both the technology and the relevant data. The limited availability of data and the lack of appropriate hardware and software needed for ERS data processing were the other obstacles to routine utilization of radar images. It was also noted that combining ERS radar data with optical data would speed up the adoption of microwave technology, by supplementing existing operational methods of optical remote sensing. That would assist in overcoming the cloud-cover problem in the region, and the complementary data would be especially useful in such applications as map updating, temporal monitoring and hazard assessment.

18. The United Nations and ESA informed the participants that the co-sponsors would conduct, on the basis of submissions received from the institutions and agencies of the participants, a survey to assess the needs of the region as a preparatory phase in the process of developing the programme proposal referred to above. The co-sponsors would keep the participants and their institutions informed of the progress that was made. The participants were also

informed that the Office for Outer Space Affairs and ESA were jointly organizing a workshop on microwave remote sensing applications to be held at Manila in April 1996 for the benefit of developing countries in the region of Asia and the Pacific. The planned workshop would provide an opportunity to continue the process of needs assessment and selection of ongoing projects for further consideration.

II. SUMMARY OF PRESENTATIONS

19. The training programme offered in the Course was similar to that of courses organized for the African French-speaking countries in 1993 and for the Latin American and Caribbean countries in 1994. A detailed overview of topics presented at the Course is contained in the report on the United Nations/European Space Agency Training Course for Latin American and Caribbean Countries on the Monitoring of Natural Resources, Renewable Sources of Energy and the Environment using Data from the European Remote Sensing Satellite (ERS-1) (A/AC.105/594).

III. RECOMMENDATIONS AND CONCLUDING REMARKS

20. During discussion at the conclusion of the Course, the participants made a number of recommendations, which may be summarized as follows:

(a) Pilot projects on the application of microwave remote sensing data in the region of Asia and the Pacific should be initiated at the earliest opportunity and with financial assistance coming from various donor agencies such as the United Nations Development Programme, the World Bank, the Asian Development Bank and ESA;

(b) At least two training courses on applications of ERS data should be organized by the United Nations and ESA for countries in the region of Asia and the Pacific. The duration of the training programmes should be at least six weeks, and emphasis should be placed on practical exercises;

(c) Upon request by States of the region, the United Nations and ESA, in cooperation with other donor agencies, should provide technical and financial assistance in establishing ERS data-processing facilities;

(d) The number of participants in the long-term fellowship and on-job training programmes offered by the United Nations and ESA in the area of ERS data applications should be increased.

21. The participants in the course expressed their commitment to following up the work discussed in relation to the programme proposal to be prepared by the United Nations and ESA. In that connection, they would inform the authorities of their institutions, and submit to the co-sponsors a brief overview of the objectives and current status of their ongoing projects. The overview would include specific details concerning the type and quantity of the satellite data required.

22. The participants expressed their appreciation for the technical quality of the training programme delivered to them, for the fellowships received from the co-sponsors, which had made their participation in the Course possible, as well as for the cooperation and support provided by the administrative and technical personnel of ESRIN.

Annex

PROGRAMME OF THE COURSE

Date/Time	*Subject*	*Speaker*
13 November 1995		
	Opening and introduction to remote sensing	
0930-0955	Opening ceremony and welcoming statements	F. Roscian (ESA) S. Chernikov (Office for Outer Space Affairs)
0955-1010	Introduction to ESA and ESRIN	E. Löffler
1010-1045	Introduction of participants and support personnel	M. Fea
1115-1315	Principles of remote sensing	M. Fea
1415-1530	Visible, infrared and microwave remote sensing	M. Fea
1600-1715	Practical exercises. Optical and microwave image analysis	Co-sponsors
14 November 1995		
	Microwave remote sensing and Earth observations (EO)	
0900-1045	Passive and active microwave instruments. Radar theory and concepts	M. Fea
1115-1315	Synthetic aperture radar (SAR), a modern remote sensing tool	M. Fea
1415-1715	Practical exercises. Complementarity of space EO data	Co-sponsors
15 November 1995		
	The European Remote Sensing Satellite Programme	
0900-1045	Polar and geostationary satellites	M. Fea
1115-1315	The ERS Programme	J. Fenard
1415-1530	Processing of ERS data	A. Argentieri
1600-1715	Visit to the ESRIN multimission facility	W. Lengert

Date/Time	*Subject*	*Speaker*
16 November 1995		
	Calibration and validation of satellite data products	
0900-1045	CAL/VAL and *in situ* campaigns	J. Sanchez
1115-1315	Image quality, filtering and colour coding	J. Lichtenegger
1415-1545	Interferometry	J. Lichtenegger
1615-1640	Demonstration of ERS "USERVICES"	A. Argentieri
1645-1715	Introduction to PC-based image processing system	J. Lichtenegger
17 November 1995		
	Applications to hydrology, sea ice and glaciology	
0900-1045	Hydrology and flood monitoring	S. Rémondiére
1115-1315	Sea ice and glaciology	J. Lichtenegger
1415-1715	Practical exercises. Contributions from participants	Co-sponsors
18 November 1995		
	Field trip and visit to the Fucino station	Co-sponsors
20 November 1995		
	Applications to agriculture and forestry (soil moisture, crop monitoring, vegetation index etc.)	
0900-1315	SAR applications	A. Beaudoin
1415-1530	SAR applications (continued)	A. Beaudoin
1600-1630	Scatterometer information	A. Beaudoin
1630-1715	Practical exercises	Co-sponsors
21 November 1995		
	Applications to coastal areas and cartography	
0900-1015	Cartography and urban settlements	S. Rémondiére
1015-1315	Coastal areas and oil spill monitoring	G. Campbell
1415-1715	Practical exercises. Contributions from participants	Co-sponsors

Date/Time	*Subject*	*Speaker*
22 November 1995		
	Applications to oceanography and meteorology	
0900-1045	Radar altimeter data for oceanography	G. Campbell
1115-1315	Wind scatterometry	P. Lecomte
1415-1530	SAR image and wave spectrum information: wind and wave models	J. Fenard
1600-1715	Practical exercises	Co-sponsors
23 November 1995		
	Applications to geology and mineral prospecting	
0900-1315	Theory and applications	J. Chorowicz
1415-1645	Practical exercises	J. Chorowicz
24 November 1995		
	Data policy, group work	
0900-1045	ERS data distribution policy	M. Fea
1115-1315	Discussion on possible follow-up projects within the framework of the United Nations and ESA	Co-sponsors
1415-1600	**Course evaluation and closing ceremony**	United Nations, ESA