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**Committee on the Peaceful
Uses of Outer Space****Report on the Twelfth United Nations International
Training Course on Remote Sensing Education for
Educators****(Stockholm and Kiruna, Sweden, 2 May-8 June 2002)**

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I. Introduction

A. Background and objective

1. The Twelfth United Nations International Training Course on Remote Sensing Education for Educators, held in Stockholm and Kiruna, Sweden, from 2 May to 8 June 2002, was organized by the United Nations Programme on Space Application of the Office for Outer Space Affairs of the United Nations Secretariat in cooperation with the Government of Sweden as part of the 2002 activities of the Office for Outer Space Affairs. As was the case for the 11 previous courses in the series, the course in 2002 was conducted specifically for the benefit of educators from developing countries with the objective of enabling them to introduce remote sensing courses in their respective academic institutions. It was co-sponsored by the Swedish International Development Cooperation Agency (Sida) on behalf of the Government of Sweden and was hosted by the Department of Physical Geography and Quaternary Geology of Stockholm University in Stockholm and by Metria Satellus AB (former SSC Satellitbild) in Kiruna.

2. The present report describes the organization of the training course, its technical contents, the results of the course evaluation and proposed follow-up action. It has been prepared for consideration by the Committee on the Peaceful Uses of Outer Space at its forty-sixth session and by its Scientific and Technical Subcommittee at its fortieth session, in 2003. Participants have reported on the knowledge acquired and on the work conducted during the course to the appropriate authorities of the Government, universities and research institutions in their respective countries.

B. Organization and programme

3. Application forms for and information brochures on the training course were sent out in November 2001 by the Office for Outer Space Affairs to the permanent missions to the United Nations of 51 developing countries. Copies were also sent to the local offices of the United Nations Development Programme in those countries for transmission to the relevant national authorities. The same materials were distributed simultaneously to relevant Swedish embassies and to previous course participants for circulation in their academic institutions. One hundred and seventeen completed applications from 42 developing countries were subsequently received and processed jointly by the Office for Outer Space Affairs and Stockholm University.

4. Twenty-eight candidates, including 12 women, were selected as participants from the following 22 countries: Brazil, Cambodia, Chile, Colombia, Costa Rica, Ecuador, Ethiopia, Guatemala, Haiti, Kenya, Malawi, Mongolia, Mozambique, Namibia, Nepal, Nigeria, Sri Lanka, Thailand, United Republic of Tanzania, Venezuela, Viet Nam and Zambia. Funds for the international travel of 13 participants were provided from the fellowship budget of the United Nations Programme on Space Applications. Support for the international travel of the remaining 15 participants, as well as the cost of room and board, course materials and inland transport for all 28 participants, was provided by the Government of

Sweden. The European Space Agency (ESA) funded the participation of one course instructor.

5. Course instructors and speakers came from several institutions, including the Office for Outer Space Affairs, ESA, Sida, Stockholm University, the Swedish Royal Institute of Technology, Uppsala University, the Swedish National Space Board, L & L Monitor AB and Metria Satellus AB.

II. Summary of the contents of the course

6. Except for minor modifications to reflect technological advances and feedback received during annual course evaluations, the core content and structure of the course have not changed significantly over the years. The course is modular in format and consists of a series of lectures and office and field exercises. A more detailed summary of the contents of the course can be found in the report on the fifth course in the series (A/AC.105/617).

7. The first technical module of the course lasted four days and dealt with the fundamental principles of remote sensing. The principal topics covered were electromagnetic radiation, the reflective properties of various types of materials on the surface of the Earth and elementary optics; electronic imaging; georeferencing of objects in the field, on maps and on satellite imagery; Earth resources and environmental satellites; and remote sensing for land use planning and environmental monitoring.

8. The next 10 days were subsequently devoted to image interpretation, digital image processing and analysis and geographic information systems (GIS). This part of the programme also included presentations on the introduction to visual interpretation and in-service training in developing countries and on applications of remote sensing.

9. To reinforce understanding of the principles of image interpretation, participants were divided into groups on a regional basis; each group studied a case where visual interpretation of satellite images played a key role.

10. Other aspects of this technical module covered digital analysis (theory); computer image enhancement (theory); GIS theory; and digital image processing techniques, including computer-aided analysis, GIS applications, CD-ROM data capture and global navigation satellite systems (GNSS).

11. The participants were then introduced, over a period of five days, to the principles of radar image formation and the use of such images in various development and research applications. There were also lectures on and practical training in GIS. In addition, the participants were introduced to the use of appropriate procedures for the field verification of interpretation of remotely sensed data using Landsat TM images of the Skinnskatteberg area in southern Sweden.

12. The next part of the course was held in Kiruna, at the facilities of Metria Satellus AB. Seven days were reserved for visual interpretation in project planning exercises and presentation of results, as well as for digital classification of satellite images and comparison of results of visual and digital interpretation. Wherever possible, exercises were carried out on images selected by the participants of areas

of their countries with which they were familiar. Lectures were also given on archiving, catalogue updating and standard production of images; selecting satellite products; value-added production, radiometric and geometric corrections, digital elevation model production; and future Earth resource satellites.

13. While in Kiruna, technical visits were arranged for the participants to a number of sites of interest, including the ESA/Salmijärvi and Esrange satellite receiving stations. Lectures were supplemented by a tour at the production facilities of Metria Satellus AB.

14. The final part of the course concerned the development of remote sensing curricula and was held over a period of three days in Stockholm at the Department of Physical Geography and Quaternary Geology. The participants worked in small groups set up on a regional basis and in the last day of this part of the course each group presented a sample remote sensing curriculum project, which, in addition to educational content, included such components as necessary teaching staff and equipment and required budget. The participants also received and took back home sets of teaching materials, which included books, teachers' notes, slides and images, as well as a compact disc (CD) with satellite data and GIS and image-processing software.

III. Course evaluation

15. On the last day of the course, during a half-day evaluation session, participants made a formal presentation of the course evaluation to representatives of the Office for Outer Space Affairs, Sida, the Department of Geography and Quaternary Geology of Stockholm University and several course lecturers. Discussions following the formal presentation by a representative of the participants allowed additional inputs to be made by all participants.

16. During the formal presentation and discussions, the participants emphasized that the training programme was well organized and that the course had achieved its major goal. They also made some suggestions, which they believed would improve the programme of the course in the future. The main suggestions and recommendations made were as follows: (a) more time should be allocated for work in the library and for practical exercises in the computer laboratory; (b) more time should be devoted in future to digital image processing and GIS subjects; (c) teaching notes and other course-related materials should be distributed among participants in advance, including the possibility of using the course's web site for downloading or uploading data and material.

17. In order to evaluate the general organization of the training programme, a questionnaire prepared by Sida was distributed among participants during the final part of the course. A summary of the opinions of the participants derived from 25 completed questionnaires is as follows: (a) 46 per cent thought the course was right in length; (b) 12 per cent found the schedule too heavy, while 46 per cent thought the daily schedule was right; (c) 42 per cent found that the theoretical training corresponded to their professional needs to a large or very large extent and 42 per cent said the same about the practical training; (d) 65 per cent found the overall level of the programme to be adequate from their personal professional point of view; (e) 58 per cent found that there were subjects not adequately covered in the

programme, with most of them indicating geo-referencing, microwave remote sensing, digital techniques and GIS as being such subjects; (f) 62 per cent found the methods of instruction to be good or very good; and (g) 54 per cent found the content of the programme relevant to their professional environment to a large or very large extent and 58 per cent thought that they would have an opportunity to apply the newly acquired knowledge and experience in their present employment to a large or very large extent.

18. The feedback received from the evaluation exercise will be taken into account in the development of the course programme for 2003, just as, for example, recommendations made by participants in 2001 had led to extension of time devoted to computer-based exercises in 2002, as well as to a larger amount of data and software on CD prepared by Stockholm University and given to the participants at the end of the course.

19. At the conclusion of the discussions, the participants expressed their appreciation to the Government of Sweden, Sida, Stockholm University and the United Nations for making possible their participation in the training programme.

IV. Follow-up action

20. A number of follow-up activities that could be undertaken in order to increase the success of the programme in the future and to enhance the local impact of the United Nations/Sweden training courses were proposed in the report of the survey on the local impact of the series of United Nations/Sweden international training courses on remote sensing education for educators (1990-2000) (ST/SPACE/9).

21. Pursuant to that report, the Office for Outer Space Affairs and ESA continued the practice of selecting qualified former participants of the course for participation in the United Nations/ESA long-term fellowship programme and in 2002 two former participants joined the six-month fellowship programme in remote sensing.

22. Stockholm University is also working to adjust the course programme to meet the increasing demand for more computer-based education, as well as on the preparation of CDs with data and software that could be used by former participants for teaching and research purposes.

23. The Office for Outer Space Affairs and Stockholm University also continued the practice of selecting well-qualified representatives of universities in developing countries on a repeat basis in order to build up a "critical mass" of knowledgeable educators in those institutions.