INTERNATIONAL TRAINING COURSE ON REMOTE SENSING-BRAZIL:
FIVE YEARS TRAINING SPECIALISTS IN REMOTE SENSING
APPLIED TO NATURAL RESOURCES

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Apresentado no 24th Internacional Symposium on Remote Sensing of Environment, Rio de Janeiro, Brazil
27–31 May 1991

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Setembro de 1991
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ABSTRACT

The objective of the International Course on Remote Sensing is to qualify specialists from developing countries in remote sensing research and techniques for survey and monitoring of natural resources. Since 1985 INPE has held four international courses in this area in collaboration with the UN Outer Space Affairs Division (OSAD), the United Nations University (UNU), the European Space Agency (ESA) and the Coordination for the Improvement of Higher Education Personnel (CAPES)/Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq). For the last five years INPE has been training 38 specialists in remote sensing from Latin American and African Countries. These papers provide general information about the course and make an evaluation about it for the last 5 years.

1 - INTRODUCTION AND OBJECTIVES

In August 1982, the Conference of the United Nations about the Peaceful Exploration and Uses of Outer Space (UNISPACE 82) held in Vienna, Austria, called attention to the fact that there was a lack of capable and experienced technicians in remote sensing applied to natural resources development. To solve the situation UNISPACE 82 suggested that training courses in Remote Sensing be organized for developing countries in order to develop programmes and projects to preserve the natural resources.

After the conference the Outer Space Affairs Division - OSAD requested the National Institute for Space Research - INPE to hold a course in Remote Sensing (long-term fellowship programme) applied to natural resources, designed to benefit developing countries, especially in Latin America and Africa.

The National Institute for Space Research (Instituto Nacional de Pesquisas Espaciais - INPE) is an institution which has been working on remote sensing for more than 22 years under the Secretariat of Science and Technology of the Brazilian Government.

One of INPE’s main activities concerns the transfer of technology in the areas of its competence to prospective users in Brazil and abroad by organizing training workshops, master degree programs and specialized courses such as the International Course on Remote Sensing (ICRS).

The objectives of the International Training Course on Remote Sensing are:

- to qualify specialists from developing countries in remote sensing research and techniques for survey and monitoring of natural resources;
- to promote the use of remote sensing techniques for surveying, planning and management of natural resources in developing countries;
- to enable the course participants to familiarize themselves with remote sensing techniques applicable to their respective fields of specialization and work situation at home;
- to organize and collect information from remote sensing data to be used for planning and decision making; and
- to demonstrate the increasing contribution of remote sensing techniques for analyzing environmental impacts and indicate measures or further areas of investigations required to avoid the side effects of the impacts.

Since 1985, INPE has held Four International Courses in this area in collaboration with the UN Outer Space Affairs Division (OSAD), the United Nations University (UNU), the European Space Agency (ESA) and the Coordination for the Improvement of Higher Education Personel (CAPES)/Conselho NAcional de Desenvolvimento Cientifico e Tecnológico (CNPq).

In the last five years INPE has trained 30 specialists in Remote Sensing from Latin American (Mexico, Ecuador, Peru, Argentina, Uruguay, Paraguay, Chile and Dominican Republic) and African (Kenya, Nigeria, Ethiopia, Burkina Faso and Algeria) countries.

This year the Fifth International Course on Remote Sensing will be held at INPE. It is designed only for African students from English speaking countries and eight candidates from Kenya, Ethiyopia, Ghana and Nigeria have been approved to attend the Course.
2 - COURSE STRUCTURE

The course duration is 8 months, from March to November.

It is divided into two parts:

a) First part-theoretical training (March to May)

Lectures are given in the following areas:

- Physical Principles of Remote Sensing
- Spectral Behavior of Natural Targets
- Sensor Systems and Satellites
- Radar Systems
- Visual Analysis of Remote Sensing Data
- Digital Image Processing
- Scientific Research Methodology
- The ERS-1 program.

Study visits to various Brazilian institutions involved in remote sensing are organized. In the last five years the students have been visited the following institution:

- Aerosul, Agritec, Esteio and Engefoto; Curitiba, Paraná.

This technical visit was organized and sponsored by Associação Nacional de Empresas de Aerolevantamento - ANEA.

- Aerofoto Cruzerio do Sul, Rio de Janeiro, RJ.
- Prospec S.A., Prospeções e Aerolevantamentos, Petrópolis, RJ.

These institutions carry out projects in photogrammetry, cartography and Remote Sensing.

- Fundação de Ciência, Tecnologia e Aplicações Espaciais - FUNCATE; S.J. Campos, SP.

- Imagem Sensoriamento Remoto; São José dos Campos. This institution develops projects in remote sensing area applied to natural resources.

- Fundação Vale Paraibana de Ensino, Remote Sensing Laboratory; São José dos Campos, SP. This laboratory is in the university Fundação Valeparaibana de Ensino and is carrying out remote sensing researchs and projects applied to natural resources.

b) Second part-Practical Training (June to November)

Each student is required to develop a project in the application of remote sensing techniques in one of the following areas:

- agriculture
- cartography
- digital image processing
During the practical training each student is supervised by an advisor, and fieldworks are carried out. The purpose of the fieldworks is to apply to a real situation the concepts, methods, techniques and procedure learned in the theoretical training.

3 - STAFF

INPE has a multidisciplinary team of specialists (Dr. Msc and Bsc) with experience in training personnel in remote sensing and natural resources.

The course is composed by:

- one coordinator
- one secretary
- library support
- administrative support
- social assistance support:
  - 10 doctors
  - 9 masters
  - 2 bachelors

The courses are organized and directed by a board of studies with the full support of the technical staff of the Institute.

4 - ADMISSION REQUIREMENTS

To be considered for admission to the International Course on Remote Sensing the candidates must hold a Bsc degree or equivalent from a recognized university in the following natural sciences: geology, architecture, agronomy; geography, biology, ecology, forest engineering, cartographic engineering, agriculture engineering, computer science, etc.

Candidate should be native of developing countries from Latin America or Africa and be nominated by their institutions. They should be able to make professional use of the experience gained in the training course.

Since the First International course on Remote Sensing, which was held from August 1985 to August 1986, INPE has trained 30 specialists from developing countries.

The specialists are from 13 different countries as following:
a) From Latin America:

- Argentina - 7 students
- Peru - 8 students
- Mexico - 2 students
- Chile - 1 student
- Dominican Republic - 1 student
- Paraguay - 1 student
- Uruguay - 1 student
- Ecuador - 1 student

**Total - 22 students**

b) From Africa

- Ethiopia - 3 students
- Nigeria - 2 students
- Kenya - 1 student
- Burkina Faso - 1 student
- Argelia - 1 student

**Total - 8 students**

Among these 30 specialists trained by INPE only 3 are not working with remote sensing, one is getting his master degree at INPE and 26 specialists have returned to their countries and are involved with remote sensing activities.

Among the 8 peruvian specialists that attended the course, 5 were employees of the Oficina Nacional de Evaluacion de Recursos Naturales - ONERN. Today only 4 specialists are still working in this institution and are involved with remote sensing.

Two Argentinian students are researchers of the Comision Nacional de Investigacion Espaciales - CNIE.

The Ecuadorian student is a researcher of Centro de Levantamientos Integrados de Recursos Naturales por Sensores Remotos - CLIRSEN.

These three institutions are the most important ones involved with in Remote Sensing in their own countries, and they are well known and respected in Latin America.

Among the 8 africans students one is a researcher from Regional Centre for Training in Aerial Surveys - RECTAS (Nigeria) and one is a researcher from Centre Regional de Teledetccion (Burkina Faso).

These institutions have been carrying out remote sensing researches in the African Continent for the last 10 years.

This year INPE has selected 8 african students for the Fifth International Course on Remote Sensing. These students are from the following countries:
- Kenya - 4 students
- Nigeria - 2 students
- Ethiopia - 1 student
- Ghana - 1 student

Two Kenyan students are from the Ministry of Planning and National Development, Department of Resources Surveys and Remote Sensing, which has been working with remote sensing for the last 15 years.

One Kenyan student is from the University of Nairobi, Department of Geography, which held a Remote Sensing Course to undergraduate students. And the fourth kenyan student is from the Kennyatta University, Department of Geography.

Both universities intend to increase their remote sensing activities, but they have a lack of experienced professors in this area. So, the international course is a very good opportunity to solve this problem.

The Ghanian student is from University of Ghana, Department of Geography and Resource Development. This department has just installed equipment for a Remote Sensing Unit which has been given to them by the United Nations Development Programme (UNDP) and the Danish Government (DANIDA). But as the Kenyan Universities this University has a lack of experienced researchers, therefore the ghanian student is attending the course.

During the student selection process, which is conducted by the National Institute for Space Research academic staff and by the United Nations University, two very important points are taken into consideration:

- the students "curriculum vitae"
- candidates should be able to make professional use of the experience gained in the training course when they return to their countries.

Among the 30 students trained by the International Course, 7 are geologists, 6 are geographers, 6 are agronomists, 4 are forest engineers, 2 are photogrammetrists, 1 is a survey engineer, 1 is a cartographic engineer, 1 is a biologist, 1 is a zootecnist and 1 is a geophysicist.

5 - COURSE FINANCIAL SUPPORT

The First International Course on Remote Sensing, which was held from August 1985 to August 1986, was totally sponsored by the National Institute for Space Research (fees, training cost and fellowships). This course was designed for Latin American students.

There was a lot of difficulty to held this course, specially related to the students fellowships. The cost of the International Course is very expensive and INPE had to make an enormous effort to carry it out until the end.
Fortunately for the second course, which was held from August 1987 to April 1988, it was possible to share the course costs with the Coordination for the Improvement of Higher Education Personnel - CAPES, which sponsored the fellowships, and with the European Space Agency (ESA) which sponsored the fieldworks and technical visits.

This course was supported by Latin American Society of Remote Sensing Specialist - SELPER and by Science and Applied Space Technology Foundation - FUNCATE.

The Second International Course was designed for African Students.

Which the success of the first and second courses it was possible to find one more sponsor partner.

In January 1989, Dr. Abraham Besrat from United Nations University - UNU, and Dr. Hamilton Savi from CAPES visited INPE campus. It was discussed the possibility of UNU helping INPE to organize the course and also to share the cost with INPE under the terms of the General Agreement of Co-operation between CAPES/CNPq/UNU.

Since the third course, which was held from April to November 1989 and was designed to Latin American students, the costs of the course have been shared by:
- INPE (fees and training cost)
- ESA (fieldworks and technical visits)
- UNU (health, accident and travel insurance; economy class round trip air ticket; excess baggage at the completion of the training)
- CAPES/CNPq (fellowships)

This third course was also supported by Latin American Society of Remote Sensing Specialists - SELPER.

In November 1989 the students attended the Fourth Latin American Remote Sensing Symposium, in Bariloche, Argentina, and the United Nations University sponsored the students air ticket and per-diem expenses.

The fourth course was and now the fifth is being supported by SELPER. The fourth course was designed for Latin American students and the fifth is designed for African students.

6 - COURSE ANNOUNCEMENT

Since this specialization program started five years ago, the International Course has become well known and respected in Latin America and now also in Africa.
Every year INPE receives a lot of letters, from different countries in these two continents, asking about the programme and how to attend it.

Some countries in Latin America specially Peru and Argentina are preparing a basic core in Remote Sensing through this specialization program.

The United Nations Outer Space Affairs Division helps INPE to announce the course. Every year a guide book about "Fellowship and Training Opportunities Offered Within the Framework of the United Nations Space Applications Programme" is published with updated information about long-term fellowships and training courses in space research.

This guide book is sent to all institutions that work on space research and UNDP offices.

The OSAD helps INPE to contact directly the institution which works with remote sensing to announce the course and to give them detailed information about it.

For the first course the announcement was made by Dr. Adigum Ade Abiodun head of OSAD who had a trip around Latin America scheduled and taking advantage of this opportunity announced the course.

The announcement of the second course was made by the OSAD. In December 1986 an Symposium was held in Nairobi, Kenya, East Africa, INPE's Remote Sensing director and the head of technical Orientation Co-ordination attended the Symposium and announced the course to the participants through poster session.

For the third course, besides the OSAD assistance, INPE contacted the 15 SELPER's National Coordinator in Latin America to help us to announce the course. There are SELPER National Coordinators in the following countries: Argentina, Chile, Colombia, Ecuador, Mexico, Peru, Costa Rica, Uruguay, Venezuela, Bolivia, El Salvador, Guatemala, Panama, Paraguay and Dominican Republic. The SELPER's coordinator has contacted government institutions, research institutes and universities that work on remote sensing. With this SELPER coordinators network the course announcement became easier and faster, because most of them have been closely related with INPE in the last 15 years.

This same scheme was utilized during the Fourth International Course.

Last year when INPE, OSAD and UNU decided to offer the International Course to African students, it was necessary to organize a specific announcement scheme to Africa.

There is not an African Remote Sensing Society that could help INPE to announce the course in the English speaking African countries.
First of all, it was necessary to contact the former African students and request their help. Second OSAD gave INPE the addresses of African institutions that work on remote sensing.

The United Nations University sponsored me a trip to three African Countries - Nigeria, Kenya and Zambia - in the end of November 1990. I visited 9 African institutions and with former African students assistance it was possible to identify some course candidates. I also visited the UNDP offices and Brazilian Embassies in these three countries and requested their help to announce the course.

Besides this, with the assistance of the Brazilian Ministry of External Relations, it was also possible to contact the following countries: Ethiopia, Ghana, Sierra Leone, Zimbabwe, Uganda, Swaziland and Burkina Faso.

The United Nations University and the Outer Space Affairs Division have made a broad course divulgation in Africa with the assistance of the UNDP office.

INPE intends to hold this course in the next years: even years for Latin America students and odd years for African students.

As soon as African students get their specialization degree in Remote Sensing, INPE intends to build a former students network in order to assist us to announce the course in each English speaking African country. INPE does not have problems to announce the course in Latin America, because everybody knows INPE and Brazil but in Africa, INPE or even Brazil are not very well known and the former students support is vital.

One positive point in the course announcement in Africa was my personal visit to African institutions. It was an excellent opportunity to divulge the course and INPE in Africa and maybe a starting point to increase the relationship between INPE and Africa institutions that work on Remote Sensing.

7 - CONCLUSION

The International course on Remote Sensing - ICRS is a very new specialization program - only five course were developed, but fortunately with the efforts of all institutions responsible for the course it was possible to make it respected and well known in developing countries.

The objectives proposed for the course have been fulfilled and almost all the students that got their specialization degree in INPE are working on remote sensing.

Fortunately up to now it was possible to maintain a close linkage with the former students, and INPE intends to create an ICRS - students network around Latin America and Africa.
Through this network, it will be possible to announce the new courses, to develop joint projects, to announce job opportunities, symposiums, workshops etc, and probably in a new future to hold an ICRS - student meeting to discuss the course objective and to exchange remote sensing experiences between students and the countries.

There were two opportunities where the former students met each other. The first one was in the Fourth Latin American Remote Sensing Symposium, in Bariloche, Argentina, when the students from the First Course met the students from the Third Course. All these students (14 students) attended the Symposium and presented papers about Remote Sensing applied to natural resources.

The papers presented by the students from the Third Course were about the projects developed by them during the course.

The second opportunity happened during my trip to Africa when I met two African former students and had a follow up meeting with them about the course.

The international course success is noted through the high level students that have applied for the course in the last years. Besides the brand new graduate students, INPE receives applications forms from students with master degree in natural resources.