

# LOBESAR-2 UNIVERSITY PROGRAM AND CURRICULUM DEVELOPMENT PACKAGE\*

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## ABSTRACT

GlobeSAR-2 is a RADARSAT training, technology transfer, and applications development program being conducted in 11 countries in Latin America by the Canada Centre for Remote Sensing (CCRS) with Canadian International Development Agency (CIDA) and International Development and Research Centre (IDRC) support. Private sector partners include Radarsat International (RSI), PCI, and Atlantis Scientific. The program goals are: 1) to provide the basic background and understanding of how to use SAR imagery in general, and RADARSAT products in particular; 2) to provide the necessary data and analyses tools to support applications development and demonstration; and 3) conduct collaborative detailed studies on a wide range of applications.

One of the major elements of GlobeSAR-2 is the university program and curriculum development package. The GlobeSAR-2 university program is a graduate student support and faculty/staff exchange program meant to foster the use of RADARSAT data in joint research projects between South American and Canadian universities. The curriculum development package is a digital collection on CD-ROM of training materials, application modules and image examples, image processing exercises, and other such material designed to aid universities professors or staff in developing a radar remote sensing curriculum at their particular institute.

This paper briefly describes the GlobeSAR-2 program and includes a detailed description of the university program being conducted within GlobeSAR-2 as well as the contents of the university package.

## INTRODUCTION AND BACKGROUND

With the successful continuing development of information extraction capabilities and the routine availability of satellite-based synthetic aperture radar (SAR) data, the problem of continuous cloud cover has been effectively overcome for a variety of applications. Canada's RADARSAT also has a "movable" radar beam, capable of covering areas far removed from the satellite track, thus eliminating the requirement to wait lengthy periods for coverage of critical areas due to the satellite repeat cycle, particularly during times of national emergency (Raney et al., 1991). RADARSAT also has on-board recording equipment which enables it to acquire and store data over any part of the world and "download" it to a receiving station, in Canada or elsewhere, and then deliver it to private and/or public

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sector clients. These capabilities make RADARSAT very attractive as a source of data for resource applications in many regions, including Latin America.

The original three-year GlobeSAR Program started in 1993, when the Canada Centre for Remote Sensing (CCRS) embarked on a worldwide program of airborne radar experiments and applications development activities (Campbell et al., 1995; Petzinger, 1995; Brown et al., 1995). Countries involved in the initial program included China, Jordan, Kenya, Malaysia, Morocco, Tanzania, Thailand, Tunisia, Uganda and Vietnam. The project was very successful, involving several hundred research scientists and application specialists who have participated in the many workshops held in each of the countries. A review of the applications studied during the GlobeSAR program can be found in Brown et al., 1996. Thanks to additional funding support from Canadian International Development Agency (CIDA) and International Development Research Centre (IDRC), Indonesia and Israel were also able to join the project.

GlobeSAR-2 builds on the success of similar programs that were carried out in the past in South America. In 1992, in cooperation with the European Space Agency's South America Radar Experiment (SAREX), a CCRS SAR-equipped aircraft collected data over Brazil, Costa Rica, Guyana, Colombia, and Venezuela. With CIDA support, the SAREX program continued in Brazil under the name ProRadar, which is now winding down. ProRadar built a far wider user group than originally envisaged and Brazil requested an extended radar training and technology transfer program. Following the success of SAREX, ProRadar, and GlobeSAR, there were many requests for a similar program from virtually all countries in Latin America, which has resulted in GlobeSAR-2. Countries participating in GlobeSAR-2 are: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Honduras, Panama, Peru, Uruguay and Venezuela. CCRS and our Canadian and International partners will be involved in over 80 projects in these 11 countries during the GlobeSAR-2 Program.

The goal of the program is to enhance national capacities for natural resource monitoring, management, and planning in the region. This will be done by training the in-country participants to analyze, interpret and use data from RADARSAT, and to apply this knowledge to on-going management and planning activities. The program has three primary purposes: 1) to build the capacity for radar remote sensing in the participating countries; 2) to demonstrate applications of RADARSAT for use in the priority areas of natural resource management, as identified by each country; and 3) to support the establishment of linkages between Canadian public and private institutions and their counterparts in Latin America. A detailed description of the GlobeSAR-2 Program and RADARSAT Applications review can be found in Brisco et al., 1997.

Part of the GlobeSAR-2 Program is a university program which is designed to help foster the involvement of university students, faculty, and staff in the research projects being conducted in the various countries. This includes the provision of curriculum development material to help in teaching radar remote sensing as well as funding to help support the involvement in existing or new research programs using RADARSAT data. The following sections describe the university programs being conducted as part of the GlobeSAR-2 Program and the contents of the university curriculum development package.

## GLOBESAR-2 UNIVERSITY PROGRAM

There are three elements to the GlobeSAR-2 university program. The first element is a university

package which is to be produced and distributed to all universities involved in the program as well as to other universities and institutions which want to increase their capabilities of working with RADARSAT or other SAR data. This package will be available during the latter part of 1999 through CCRS. The second element of the program is the provision of funds to help support university students and in some case faculty or staff to work with GlobeSAR-2 projects which have been allocated RADARSAT data. The third element of the program is an exchange program to promote north-south linkages between universities in Canada and South America. Each of these are described in more detail in the following sections.

## GLOBESAR-2 UNIVERSITY PACKAGE DESCRIPTION

The university package is being created to help universities in South America, and where appropriate in Canada, develop a radar remote sensing curriculum at the university graduate and under-graduate levels. The package is not meant to be a complete, ready to deliver curriculum, but will provide enough material that with minimum effort, several courses on radar remote sensing could be delivered.

This package includes the training materials developed during the GlobeSAR-2 Program, RADARSAT imagery with brief interpretations, image analysis exercises, a curriculum outline for teaching SAR technology, and other materials to aid in developing a curriculum for delivering radar remote sensing courses (table 1). This material will be available in French, Spanish and Portuguese, as well as English, and all participating universities will be provided with this package.

Table 1. University Package Content

SECTION	DESCRIPTION
Level 1	Introduction to Radar Course (text, drawings and images)
Level 2	Radar Image Processing and Information Extraction Course (text, drawings and images)
Detailed Curriculum Outlines	<ul style="list-style-type: none"> <li>- Radar Physics and Engineering</li> <li>- Radar Image Processing and Information Extraction</li> </ul>
Application Modules	<ul style="list-style-type: none"> <li>- Agriculture</li> <li>- Land Cover</li> <li>- Hydrology</li> <li>- Forestry</li> <li>- Coastal</li> <li>- Geology</li> <li>- Sea Ice</li> <li>- Oceans</li> <li>- Mapping</li> </ul>
Image Examples	WWW GlobeSAR-2 images and CCRS database
Glossary	Collection of radar remote sensing terms with their meanings
Bibliography	Radar references for the different application areas

Examples of the materials provided in the university package are given in Figures 1,2 and 3. Figure 1 shows basic radar imaging geometry, which is part of the Introduction to Radar Course. Figure 2 illustrates the use of stereo RADARSAT for DEM production, which is an example of the material provided in the Radar Image Processing and Information Extraction course material. Figure 3 provides an

example of the use of RADARSAT for flood monitoring which is typical of the material in the applications modules.

### PARTICIPATION IN GLOBESAR-2 PROJECTS

The provision of funds to help support university students, faculty, or staff to work with GlobeSAR-2 projects which have been allocated RADARSAT data is the second element of the program. South American university students, faculty, and staff became involved with the GlobeSAR-2 projects which have been allocated RADARSAT data in two ways:

- 1) Work with those project investigators which have been received RADARSAT data and image analysis software. This part of the program includes funds to support field work in Latin America and validation by the university students/staff and funds to provide graduate student support to those working with the project team. Table 2 provides a list of graduate students involved in this support program.
- 2) Attend the workshops, seminars, and symposia when possible, to participate in the training activities and results presentations and join in the subsequent discussions.

Table 2. GlobeSAR-2 Participants

STUDENT	PI	Project Title	UNIVERSITY
Enrico Campos Pedroso	Alvaro P. Crosta	Comparison of Airborne Radar and RADARSAT Data for Gold Exploration in the Rio Itapicuru Greenstone Belt, BA, Brazil	Geosciences Institute, UNICAMP Campinas, Brasil
Michael Rojas, Franco Lombardo	Ramiro Salcedo		CENAMB-UCV, Venezuela
Maria Gabriela Parmuchi	Haydee Karzenbaum		Universidad de Buenos Aires

### NORTH-SOUTH UNIVERSITY LINKAGES

The third element of the program is an exchange program to promote north-south linkages between universities in Canada and South America. The intent of this program element is to support joint projects between South American and Canadian Universities and foster staff exchanges. Table 3 provides a list of current projects being executed as part of the university exchange program. This program is still active and thus additional projects maybe added to the kit. The results from these projects will thus be reported on in the future.

Table 3. GlobeSAR-2 University Exchange Projects

South America		Canada		Title
PI	University	PI	University	
S. Navone	Faculty of Agriculture, U. Buenos Aires	D. Barber	Centre for Earth Observation Science, U. Manitoba	Evaluation of Land Degradation in Semi arid Intermountain Valleys in Argentina with RADARSAT and GIS
H. Salgado	Faculty of Agronomy, U. Buenos Aires	M Bernier J-P. Fortin	U. Quebec, Ste. Foy	Soil Surface Moisture Mapping using SAR images and distributed Hydrologic Models

C. Cotlier	Universidad Nacional de Rosario	G. Brent Hall Joe Piwowar	Faculty of Environmental Studies, University of Waterloo	Integration of RADARSAT Imagery With a Geographic Information System (GIS) for the Identification, Analysis of Structural Change and Demographic composition of Pockets of Urban Poverty
Miriam Presutti	National University of La Plata	Steven E. Franklin	University of Calgary	Forest Inventory and Crop Monitoring in the South East of Buenos Aires Province, Argentina (GSAR # 5)
Gustavo A. Martinez	Universidad Nacional de Mar del Plata	Hugh J. Gwyn	University of Sherbrooke	Geomorphology and Land Use Using Remote Sensing Techniques in SE Buenos Aires Province, Argentina
Graciela Salinas de Salmuni	Universidad Nacional de San Juan	J.Budgen,PI/ P.Howarth, Co-PI	University of Waterloo	RADARSAT Crop Identification and Rural-Urban Change in the Tulum Valley, Argentina
Daniela Marchionni	Universidad de La Plata	Francois Cavayas	University of Montreal	Aplicaciones de un Par Esteresocopico de Imagenes SAR de RADARSAT Para El Estudio Geologico-Estructural Del Macizo Del Deseado, Provincia De Santa Cruz, Argentina.
José Luis Lizeca	SERGEOMIN	W. Moon	Dept. of Geological Sciences, U. Manitoba	Study Geomorfologico and Tectonic by Means of Images of the RADARSAT (Area of Sud Lipez)
Ramiro Luis Cartegena Chávez	Universidad Mayor de San Simon	P. Howarth, PI/ J.Budgen, CoPI	University of Waterloo	Agricultural Crop Identification and Monitoring in Bolivia Using RADARSAT Data
M. Barbosa	Federal University of Paraiba	D. Barber	Centre for Earth Observation Science, U. Manitoba	Integration of SAR and Optical Wavelength EO data for Drought Assessment in Northeastern Brazil
Alvaro P. Crosta	State University of Campinas	Benoit Rivard	University of Alberta	Geologic Mapping and Exploration in the Tapajos Gold Province Using RADARSAT/SAR Data
Roberto Richardson	Universidad de Santiago de Chile	Michael Fox	Carleton University	Comparative analysis of land resource issues in Chile and Canada with special reference to the use of RADARSAT digital image processing
C. Salvatierra	CIAF (IGAC)	Steven E. Franklin	University of Calgary	Use of RADARSAT Imagery to Estimate Agricultural Statistics in the Cauca Valley, Colombia
Elena Possada	CIAF (IGAC)	Steven E. Franklin	University of Calgary	Evaluation of Landuse and Landcover With Emphasis on Forestry Applications, Through RADARSAT Imagery Interpretation in the Savanna Area of Bogota, Region Andina of Colombia
Jose Alberto Cristancho	IGAC	Robert Desjardins	Univ. of Quebec in Montreal	Geologic Analysis and RADARSAT Images Interpretation in a Mountainous Area – Manizales Region, Colombia
Gabriel Carballo	National University of Uruguay	Paul Fieguth	University of Waterloo	SAR Interferometry

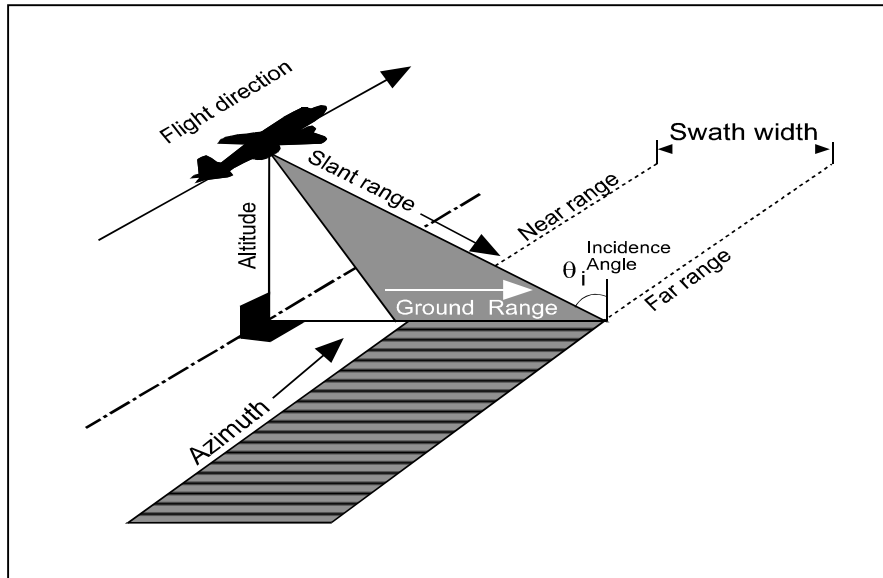


Figure 1. Basic Radar Imaging Geometry

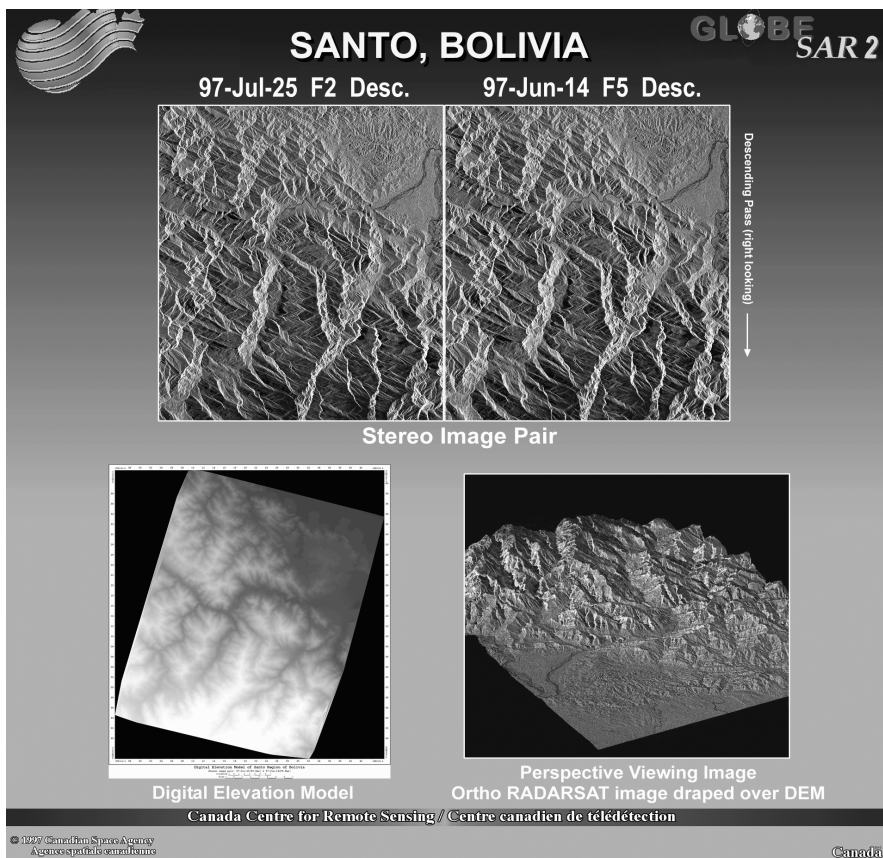


Figure 2. Example of use of stereo RADARSAT for DEM production.

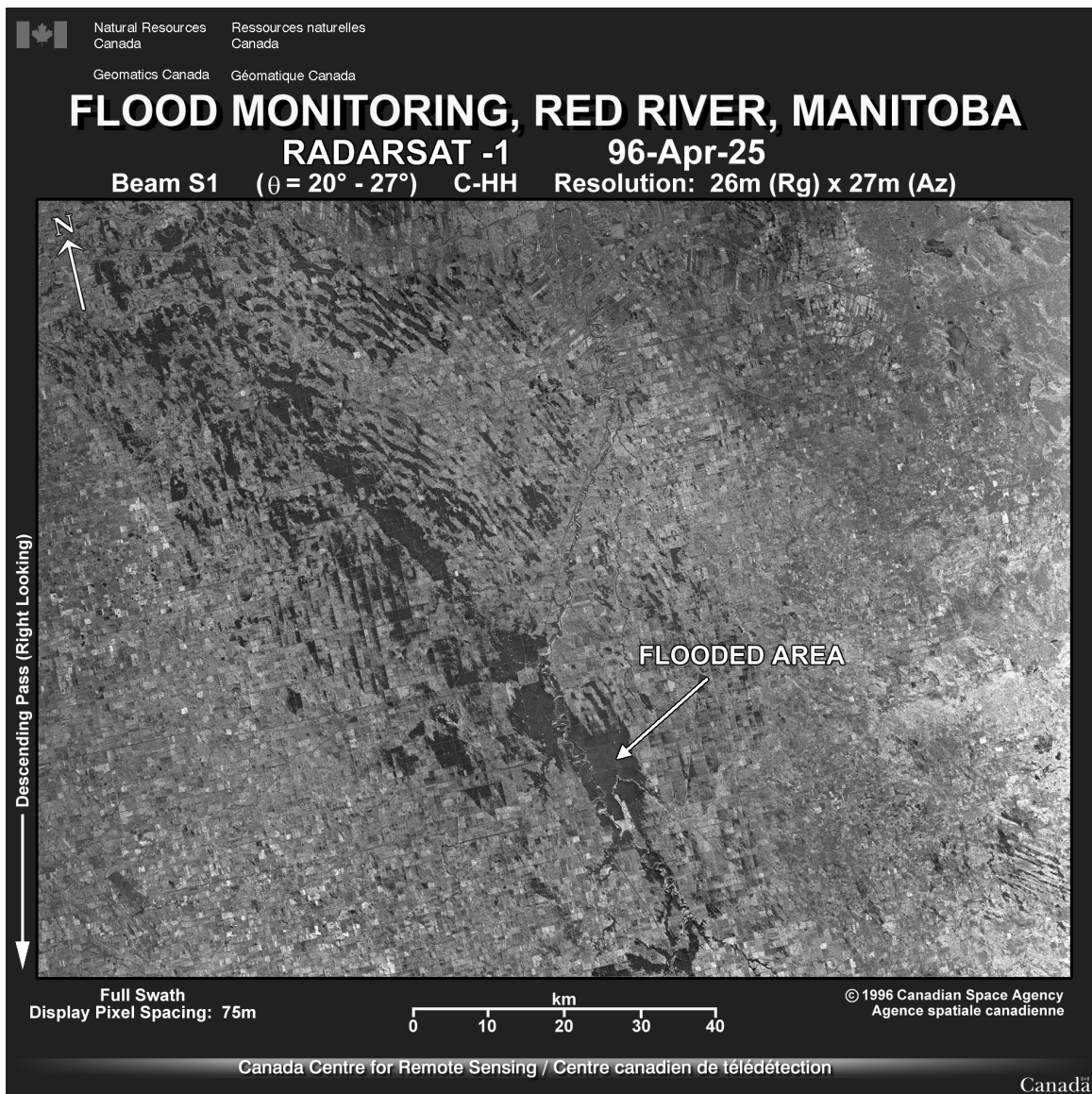


Figure 3. Flood Monitoring. Example from applications modules.

## SUMMARY

Through the university curriculum development package, the provision of funds for graduate students and the North-South university linkages, the GlobeSAR-2 Program prepares participants to use SAR data and strengthen their capability to use radar data for resource management applications. A complete description of this program is presented on the CCRS Web site (figure 4). It includes a description of the program and projects, a list of the partners in South and North America, examples of imagery and a bibliographic database.



Figure 4. GlobeSAR-2: Information on the Web.  
 (<http://www.ccrs.nrcan.gc.ca/ccrs/tekrd/internat/glbsar2/indexe.html>)

#### 4.0 REFERENCES

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