

## **GlobeSAR-2 Program and RADARSAT Applications Review**

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### **Abstract**

GlobeSAR-2 is a training, technology transfer, and applications development program, focussing on RADARSAT, being conducted in 11 countries in Latin America. The program is led by the Canada Centre for Remote Sensing (CCRS) with the South American portion of the program funded by the Canadian International Development Agency (CIDA). The International Development Research Centre (IDRC) is supporting the Central American portion. RADARSAT International Inc. (RSI), PCI, and Atlantis Scientific are private sector partners in GlobeSAR-2. The program goal is : 1) to enhance the resource management capabilities in the participating countries through demonstration and training of radar remote sensing, in particular RADARSAT, and 2) to demonstrate the value of RADARSAT applications for improved natural resource and environmental monitoring and planning, promote the integration of RADARSAT information into each country's ongoing programs and projects, and help to establish and enhance the radar remote sensing capacity in each of the participating countries, in particular the integration of RADARSAT with other data. This paper will briefly describe the GlobeSAR-2 program, highlight the training approach being implemented for the program, and provide an overview of the variety of applications in each participating country.

### **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 the private and/or public 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 has been 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-II are: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Honduras, Panama, Peru, Uruguay and Venezuela. Over the next two years, CCRS and our Canadian and International partners will be involved in over 80 projects in these 11 countries.

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.

The program will demonstrate the value of RADARSAT applications for improved natural resource and environmental monitoring and planning, promote the integration of RADARSAT information into each country's ongoing programs and projects, and help to establish and enhance the radar remote sensing capacity in each of the participating countries, in particular the integration of RADARSAT with other data. As expertise is developed during the project, the results will be disseminated to a wider user community. This facet of the project ensures that those who may not be directly involved will become aware of this new capability, and will have the opportunity to utilize RADARSAT derived information for their own program needs.

This paper describes the GlobeSAR-2 program and the approach being implemented for achieving its objectives. An overview of the partners involved in the program will also be

provided, as well as the applications being evaluated. Detailed presentations, either at this symposium or in future meetings and publications, should be referred to by the reader for additional information on specific project results.

### **GlobeSAR-2 Program Partners**

The project is being led by CCRS, the Canadian Government organization responsible for satellite data reception, processing, archiving, and applications development for all of Canada. The South American portion of the program is funded by CIDA while IDRC is supporting the Central American portion of the program. Participating private sector companies include:

- RADARSAT International Inc. (RSI) - a Canadian company which has the worldwide distribution rights for RADARSAT data;
- Atlantis Scientific - a Canadian radar image analysis software company; and
- PCI Ltd. - a Canadian image analysis software company.

In each country there are national coordinating agencies who interact with CCRS staff to plan and execute the program. These agencies are:

CONAE - Argentina - the national space organization.

ABTEMA - Bolivia - the national coordinating agency for the environment.

INPE - Brazil - the national space organization.

PUCC/U Chile- Chile - 2 universities in Chile with significant remote sensing experience.

IGAC - Colombia - the national mapping and remote sensing organization.

CONIDA - Peru - the national aerospace research organization.

CECAL - Uruguay - the faculty of computer sciences at the National University.

CPDI - Venezuela - Centre for Digital Image Processing.

IGN - Costa Rica - the national mapping and remote sensing organization.

AFE-COHDEFOR - Honduras - the national mapping and forestry agency

MPCRPE - Panama - the Ministry of planning and regional coordination.

In addition to the country coordinating institutions, there are over ninety other institutions in the eleven countries participating in the program. Table 1 provides the names and contact information for the CCRS and in-country national coordinators of the GlobeSAR-2 program.

### **GlobeSAR-2 Program Background**

The remote sensing capacity in the eight South American and three Central American countries participating in this project varies significantly, however, they share a common need to improve their access to and use of up-to-date spatial data for the management of their land and natural resources. All the countries involved rely on their natural resource base to develop and sustain their economies, as well as to meet the basic food requirements for their people. In order to manage these resources in a sustainable manner, and to contribute to a sound economic base for future growth and development, information is essential. At present, in most areas of Latin America the information that countries such as Canada take for granted is less available. For example, in most cases, there is no fundamental geoscience database which can be used for mineral and hydrocarbon

exploration. Elsewhere, there is often no means by which a national census of agricultural production can be made - even of lands which are under production.

A major concern of six of the countries involved in GlobeSAR-2 is the state of development of the Amazon Basin which lies within their territory. At present, none of these countries have a capability to monitor activities in the Amazon region on a regular basis. Part of the present CIDA-supported ProRadar project is addressing this issue, but can only do it on a one-time basis, without provision for on-going training in each of the countries (projects in Bolivia, Brazil, Colombia, Peru and Venezuela). GlobeSAR-2 will significantly contribute to the technology and training base of the participants, assisting them to improve their management of resources in the Amazon region on a long-term basis.

Countries in Latin America, like others around the world, are faced with the problem of obtaining timely information to enable them to carry out local and regional land development, monitoring and management activities. In large part, the problem is caused by nearly-continuous cloud cover, which renders much of the region virtually invisible to optical observations, either from satellite or aircraft. Such information is necessary to plan and manage the use of their land and natural resources, and it is essential for these countries to be able to provide a stable information base to support their economic development objectives and programs. In addition they must be able to plan effectively for their future development, they must be able to adequately assess existing conditions. They must also plan for the impact of potential disastrous events, and at the same time maintain a pace of economic development to adequately provide for their populations.

### **Project Development**

Over the past year, CCRS and RSI have been developing this project. In March and April, 1996, CCRS and RSI carried out a planning mission to all the countries in South America who had expressed an interest in participating. The planning mission announcement generated excitement everywhere, and many of the National Coordinators remarked that they had not expected such an enthusiastic response from local institutions and individuals.

The planning mission visited eight potential participating countries in South America, and was hosted by the National Coordinator in each country. Presentations, ranging from one to three days, focused on the application capabilities of RADARSAT, with special emphasis on those which were known to be of particular relevance to the individual countries. During the initial presentations, there was a free-flowing discussion of various aspects of radar in general, and RADARSAT in particular. Following initial presentations, and these discussions, individual participants were invited to present overviews of their interests and the projects that they were proposing to submit for inclusion in GlobeSAR-2. All those who presented overviews submitted formal project proposals to CCRS-RSI, and many more were forwarded by others who were unable to attend the meetings. In total, 116 proposals were submitted for evaluation and following an evaluation by CCRS and RSI, some 65 were recommended for inclusion in GlobeSAR 2 (see Project List - Tables 3-9).

## **Industrial and University Liaison**

As previously mentioned, several Canadian companies are directly involved in GlobeSAR-2. Atlantis Scientific, RSI, and PCI are contributing data and software at a reduced cost as well as in-kind services to South-American collaborating agencies. MIR télédétection and Noetix Research provide research and administrative assistants to support the GlobeSAR-2 projects as well.

The Canadian remote sensing industry and community will be kept informed of GlobeSAR-2 activities. A GlobeSAR-2 WEB site will list project descriptions and Canadian and South-American points of contacts. The regional seminars, planned for February 1998 and 1999, provide program participants from each country an opportunity to get together and discuss results. These meetings also present a good opportunity for Canadian companies to meet and discuss potential collaborations, services, or products, with Natural Resource managers and with end-user agencies from Latin America. GlobeSAR-2 also encourages collaboration between private sector companies in Canada and our Latin American participants in the program. This will include support for on-going projects as well as assistance in developing future initiatives.

The response from universities in the region prompted the program planning team to include the development and distribution of a complete radar education package as part of the program objectives. This will include specific radar education and analysis modules, based on the successful modules that have been developed by CCRS and Canadian Industry in the past, as well as example imagery from all the participating countries. These materials will give universities in the region the capability of educating their students in all aspects of radar and remote sensing, and keep them up-to-date on developments in the program as it proceeds. The universities will participate in the workshops in their country, and in some cases may have workshops delivered on-site. They will also have the opportunity to interact with other in-country project teams through field work and/or collaborative research, including graduate student support.

An additional component of the University program within South America fosters collaborative studies between South American and Canadian Universities to facilitate future interactions. The GlobeSAR-2 Program thus encourages exchanges between Canadian and South-American Universities. Funds will be available for collaborating Universities for short-term (3-4 months) personnel exchanges, graduate students and research and/or curriculum development work. Progress in the development of this aspect of the program will be reported elsewhere.

## **Workshops and Symposia**

During the GlobeSAR-2 program CCRS and the program partners will conduct a number of workshops in each country to help in developing the applications of RADARSAT and the capability to exploit the data. These workshops have already begun, with the project review, coordination, and RADARSAT data acquisition planning workshops which were

held in each country in early 1997. A seminar on RADARSAT Status and Applications Review was also included as part of these workshops.

A general introduction to radar and to RADARSAT in particular was either included in the initial workshops or has been scheduled for part of a later workshop. Radar image analysis software from PCI and Atlantis Scientific is being installed from May to September, 1977 and training on the basic operation of the software will be conducted shortly after delivery. Another series of workshops, scheduled between June and October, will provide detailed training on the geometric and radiometric correction techniques used for radar image processing. Methods for information extraction, with an emphasis on those unique to radar image exploitation, and a general applications review will also be included in this week-long workshop. Final workshops will be conducted during the last phase of the program, and will review the analyses methods, applications results, and recommendations for each project.

During the GlobeSAR-2 program there will be national meetings held in each country where the project leaders will present their results and conclusions. In the first year, this will include preliminary results, analyses reviews, and application feedback since all the RADARSAT data may not have been acquired or analysed. The program will also include an international symposium where the various participants from each country can meet and share results, experiences, and recommendations. In the final year of the program, the same combination of national and international symposia are planned to present the final results and recommendations from the various projects. Table 2 summarises the program milestones.

### **GlobeSAR-2 RADARSAT Applications Overview**

This program will address a wide range of government priorities in each of the participating countries, including agricultural applications and crop estimations, coastal zone monitoring, flood delineation and lateral extent prediction, landslide potential estimation, environmental assessment of hydroelectric developments, infrastructure planning, geology, geomorphology, deforestation monitoring, etc. These applications are of direct interest to each of the countries involved, in varying degrees depending on their national needs. Each will be able to benefit directly and immediately from this program, with minimal additional outside support required for future activities.

The purpose of this paper is not to present results from the various projects being conducted during GlobeSAR-2, which the project investigators expect to do, but rather to present the diversity of applications being investigated and to identify the principle investigator and institution leading each project. This information is summarised in Tables 3 to 12. Additional details on the projects, institutions and investigators involved can be obtained from the CCRS web site or from CCRS staff who coordinate the program. They are identified in Table 1.

One can see from Tables 3-12 that the studies cover a number of radar applications ranging from RADARSAT's "speciality" sea ice mapping, but in this case on the Antarctic shelf in

both Argentina and Chile, to tropical forest mapping and monitoring studies throughout Central and South America. DEM generation from stereo coverage and other mapping related studies are also being conducted in many of the countries. This is a particularly important application because of the widespread need for improved base map information in many of these countries and the constraints on conventional optical sensors caused by extensive and frequent cloud cover. Land cover mapping (including the coastal zone), flood monitoring and wetland mapping, soil erosion, hydrology, and agriculture applications are also prevalent. In Argentina, Brazil, Chile, and Peru there are ocean related studies which were not emphasised during the first GlobeSAR program. Finally, many geological studies are also included, especially since RADARSAT is ideally suited to this application in the often cloud covered regions of South and Central America, which still have significant mineral and petroleum exploration potential.

The national and international symposia mentioned in the preceding section will provide showcases of the results of these projects over the next two years. While some of the applications involve more technical risk than others, the GlobeSAR-2 team is confident that RADARSAT will prove to be a very useful source of data for the information requirements of our Latin American colleagues.

### **Summary**

This paper has presented the GlobeSAR 2 program description and background as well as an outline of the applications being investigated in the various projects. Through GlobeSAR-2 Latin America will further develop its capacity to use remote sensing technology, especially RADARSAT, for various mapping and monitoring applications. As well, the program will generate increased collaboration between the public, private, and university sectors within Latin America and between Canada and Latin America. From these perspectives we view the GlobeSAR 2 program as a vehicle for helping all participants achieve their goals.

### **Acknowledgements**

The authors would like to acknowledge all our colleagues, far too numerous to name, from CCRS and our program partners who have helped to contribute to the distillation of GlobeSAR 2. We would also like to acknowledge CIDA and IDRC for their support in defining and executing this program. Finally, we would like to thank all our colleagues from throughout Latin America for their input to developing this program. We look forward to working with you to make GlobeSAR-2 a success for all involved.

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Table 1. CCRS and National Coordinators for the GlobeSAR-2 Program in Latin America.

COUNTRY	CCRS COORDINATORS	NATIONAL COORDINATORS
GlobeSAR-2 Program	Fred Campbell CCRS 588 Booth Street Ottawa, K1A 0Y7 (613) 947-1227 (f) 947-1382 campbell@ccrs.nrcan.gc.ca	Not applicable
Argentina	Brian Brisco/Marc D'Iorio (613) 947-1262 (f) 947-1385 Brian.Brisco@noetix.on.ca	Ing. Ida Nollmann, Comision Nacional de Actividades Espaciales (CONAE), Dorrego 4010, 1425 Buenos Aires, Argentina, f: 011-54-1-774-5703, t: 774-9310, e-mail: nollmann@orbis.conae.gov.ar
Bolivia	Christine Hutton/Mike Manore (613) 947-3593 (f) 947-1385 chris.hutton@ccrs.nrcan.gc.ca	Dra. Sofia Moreau, Asociacion Boliviana de Teledeteccion para el Medio Ambiente (ABTEMA), Calle Reyes Ortiz #41 Piso 3, La Paz, Bolivia, t: 011-591-2-3-315-320; 355-824; 324-609, f: 011-591-2-315-220; 320-425 email: abtema@coord.rds.org.bo
Brazil	Robert Landry/Chuck Livingstone (613) 947-1241(f) 947-1383 robert.landry@ccrs.nrcan.gc.ca	Dr. Waldir Paradella, Instituto Nacional de Pesquisas Espaciais (INPE), Av. dos Astonautas, 1758-C.P. 515-12227-010-Sa Jose dos Campos, SP, Brazil, t: 011-55-123-256-438, f: 011-55-123-256-440 e-mail: paradella@ltid.inpe.br
Chile	Mike Manore/Christine Hutton (613) 947-1281 (f) 947-1385 mike.manore@ccrs.nrcan.gc.ca	Dr. Carlos Pattillo, Programa de Percepcion Remota & SIG, Universidad Catolica de Chile, Av. Vicuna Mackenna 4860, Casilla 306 - Santiago 22, Correo Interno 906 Chile, t: 011-56-2-686-4137; 4693, f: 011-56-2-553-2900 email: cpattillo@sas.puc.cl
Colombia	Cathryn Bjerkelund/Vern Singhroy (613) 947-1260 (f) 947-1385 cathryn.bjerkelund@ccrs.nrcan.gc.ca	Dra. Myriam Ardila Torres, Subdirectora de Cartografia, Instituto Geografico Augustin Codazzi (IGAC), Carrera 30 No. 48-51 Bogota, Colombia, t: 011-57-1-368-0957; 368-1215, f: 011-57-1-368-0991 email: nmyard_itecs5.telecom_co.net

Table 1 (cont'd) . CCRS and National Coordinators for the GlobeSAR-2 program.

<b>COUNTRY</b>	<b>CCRS COORDINATORS</b>	<b>NATIONAL COORDINATORS</b>
Peru	Vern Singhroy/Cathryn Bjerkelund (613) 947-1215 (f) 947-1385 vern.singhroy@ccrs.nrcan.gc.ca	Ing. Ricardo Coloma, Jefe Institucional CONIDA, Felipe Villaran 1069, Apartado 2985-Lima 100, Lima, Peru, f: 011-51-1-441-9081, t: 011-51-1-441-9081 or 440-8426
Uruguay	Marc D'Iorio/Brian Brisco (613) 947-1350 (f) 947-1385 marc.d'iorio@ccrs.nrcan.gc.ca	Sr. Gabriel Carballo, Centro de Calculo, Facultad de Ingenieria, Julio Herrera y Reissig 565, 11300 Montevideo, Uruguay, t: 011-598-2-71-4229; 71-4231, f: 011-598-2-71-0488, email: gabriel@fing.edu.uy
Venezuela	Chuck Livingstone/Robert Landry (613) 947-3593 (f) 947-1385 chuck.livingstone@ccrs.nrcan.gc.ca	Mr. Ramiro Salcedo, Centro de Procesamiento Digital de Imagenes (CPDI), Instituto de Ingenieria, Carretera de la Puerta - Baruta Urb. Monte Elena II, Entrada IDEA, Edo. Miranda, Apdo. Postal 40200 Caracas 1040-A, Venezuela, f: 011-58-2-943-1011, t: 011-58-2-943-2122 email: fii@conicit.ve
Costa Rica	Tim Perrott/Brian Brisco (613) 947-7953 (f) 947-1385 tim.perrott@ccrs.nrcan.gc.ca	Dr. Carlos L. Elizondo, Instituto Geographico Nacional, Apartado 2272, San Jose, 1000 Costa Rica, f: 011-506-257-7418, or 223-9384, both ext. 2620, t: 011-506-257-5246
Honduras	Tim Perrott/Brian Brisco (613) 947-7953 (f) 947-1385 tim.perrott@ccrs.nrcan.gc.ca	Ing. Angel Murillo, Corporacion Hondurena a de Desarrollo Forestal AFE-COHDEFOR, Apartado Postal 1378, Tegucigalpa, Honduras, f: 011-504-23-4346, t: 011-504-22-2614
Panama	Brian Brisco/Tim Perrott (613) 947-1262 (f) 947-1385 Brian.Brisco@noetix.on.ca	Ing. Juan de Dios Villa, Direccion General de Recursos Minerales, Ministerio de Comercio e Industrias, Apartado 8515, Panama 5, Panama, f: 011-50-7-236-1825, t: 011-50-7-236-3173

Table 2. GlobeSAR-2 Schedule of Program Milestones

<b>EVENT</b>	<b>DATE</b>
Kick-off/Data Planning Meetings	January to March, 1997
PCI / Earthview Software Training	May to September, 1997
GER/97 Conference, Ottawa	May 25-30, 1997
Level-II Radar Image Processing Workshops	June to October, 1997
Year -1 National Seminar	December 1997 to March 1998
Mid-Term GlobeSAR-2 Symposium	March 1998
Year-2 national Seminar	December 1998 to March 1999
Final GlobeSAR-2 Symposium	March 1999

Table 3. GlobeSAR-2 Bolivia Projects

<b>Project #</b>	<b>Principal Investigator</b>	<b>Affiliation</b>	<b>Application/ Theme</b>
BO-1	Sophie Moreau	ABTEMA/ALT/SENA MHI	soil moisture (comp with ERS-1) and vegetation discrimination
BO-3	Captain Miguel Gutierrez	IGM	-DEM generation with Stereo data
BO-5	Maria Rodriguez	INE	-Agr/Non- Agr -determination of pasture and crop discrimination
Borders	Jose Luis Lizeca	SERGEOMIN	- alteration zone mapping and mineral exploration

Table 4. GlobeSAR-2 Argentina Projects

<b>Project #</b>	<b>Principal Investigator</b>	<b>Affiliation</b>	<b>Application/ Theme</b>
AR-1	G. Marin	DNSG	Geological Survey
AR-5	P. Lombardo	Asuntos Agrarios	Soil Moisture/ Crop Monitoring
AR-6	A. Giraldez	CONAE	Image Geo- rectification
AR-10	Stella Maris Navone	Fac. Agron./INTA	Evaluation of Land Degradation
AR-11	M.C. Serafini	University Lujan	Land use/Land cover
AR-12	G. S. de Salmuni	UNSJ/CONAE	Monitoring Land use
AR-13	Pablo A. Mercuri	INTA	Crop Monitoring
AR-15	D. A. Gagliardini	CONAE	Ocean Dynamics
AR-18	Hector Salgado	Fac. Agron. (UBA)	Monitoring fields with hydric erosion...
AR-22	Gustavo Martinez	UNMDP	Geomorphology
AR-26	Celina Montenegro	CONAE	Forestry - Salta region
AR-27	Miguel Angel Giraut	DNRH	Flood Hazard Mapping
AR-28	Ruben Aguglino	DAIS	Flooding
AR-29	Carlos G. Cotlier	University de Rosario	Urban and Agricultural Analysis
AR-30	Haydee Karszenbaum	UBA	Mapping: Forestry and Vegetative areas
AR7/20	Manuel H. Picasso Hector Salgado	Meteorological Services UNLP	Antarctica - Mapping, Navigation, and Nautical Chart Updating
AR-U1	Mirta Raed	CRS	Geological Mapping
AR-U2	I. Schalamuk	CRS	Geomorphology

Table 5. GlobeSAR-2 Brazil and Venezuela Projects

<b>Project #</b>	<b>Principal Investigator</b>	<b>Affiliation</b>	<b>Application/ Theme</b>
BR-1	Joao dos Santos Vila da Silva	EMBRAPA	Flood area mapping (multidates) Vegetation mapping (veg. & deforest)
BR-2	Paulo Roberto Meneses	Brasilia University	Geological mapping Fractured crystalline rock mapping
BR-7	Mario Ivan Cardoso de Lima	IBGE/DIGEON/N.	Geology Lithologic and morphostructural mapping
BR-12	Alvaro P. Crósta	UNICAMP	Geology Lithologic and structural mapping
BR-15	Raimundo Almeida Filho	INPE/PETROBRAS	Geology
BR-20	Laerte Guimaraes Ferreira	Federal U. of Goiás	Land use, Agriculture
BR-21	Valério Barbosa da Silva	INCRA/CPRM	Planimetric natural or artificial features mapping (road, rivers, building...) Land use mapping
BR-22	José Carlos N. Epiphanyo	INPE/U. of Sao Paulo	Agriculture Crop detection
BR-25	Joao A. Lorenzetti	INPE	Oceanographic features detection (surface current & mesoscale feature)
BR-26	Carlos Alberto Eiras Garcia	URG	Oceanographic features detection (those originated by topo. changes)
VE-6	Ramiro Salcedo	CPDI	Agriculture

Table 6. GlobeSAR-2 Chile Projects

<b>Project #</b>	<b>Principal Investigator</b>	<b>Affiliation</b>	<b>Application/ Theme</b>
CH1	Roberto Castro	PUCC	Vegetation monitoring Forest change, cuts and burns
CH2	Carlos Pattillo	PUCC	Grassland biomass, Erosion
CH3	Martin Farias	PUCC	Snow extent, Hydrologic modeling
CH5	Mario Munoz/	INACH Hydrogr. Inst.	Sea ice navigation
CH8	Jose Luis Gomez	CIREN	Flood risk mapping Land use and hydrology
CH9	Martin Farias	PUCC	Ocean feature detection
CH10	Fernando Pino Roberto Richardson	University of Chile	Land use/ Land cover, Migratory settlements
CH11	Alfredo Lopez	INFOR	Forest classification

Table 7. GlobeSAR-2 Country Status - Colombia

<b>Project #</b>	<b>Principal Investigator</b>	<b>Affiliation</b>	<b>Application/ Theme</b>
C10 C11	Jaime E. Jaramillo	CRECE	relic forest + land-use mapping
C7/6/12	Elena Possada	IGAC	forest + topo + land-use mapping
C1	Fanery Valenia	IGAC	geomorphology mapping
C4	Domingo Mendivelso	IGAC	geological mapping
C8	Nathalie Beaulieu	CIAT	land-use + relic forest mapping

Table 8. GlobeSAR-2 Peru Projects

<b>Project #</b>	<b>Principal Investigator</b>	<b>Affiliation</b>	<b>Application/Theme</b>
P4	Victor B. Arroyo	UMolina	mangrove mapping
P8	Victor B. Arroyo	UMolina	deer habitat mapping
P6	Victor B. Arroyo	UMolina	deforestation mapping
P1	Ricardo Coloma	CONIDA	coastal zone/ contamination mapping
P2	Ricardo Coloma	CONIDA	glacier + hazards mapping
P12	Guillermo Hassenbank	Hydrographic and Navigation Directorate	sediment plume + shoreline mapping

Table 9. GlobeSAR-2 Uruguay projects.

<b>Project #</b>	<b>Principal Investigator</b>	<b>Affiliation</b>	<b>Application/Theme</b>
URU 1	Gabriel Carballo	ICA	Forest Growth Monitoring
URU 2	Carlos Perez Arrarte Gabriel Carballo Daniel Panario	CIEDUR Ce. Cal. UCE	Rice, Cattle and Wetlands. Monitoring the Sustainability
Uruguay University Project	Carlos Lopez	Ce. Cal. (Universidad de Republica)	Remote Sensing Education

Table 10. GlobeSAR-2 Central America Projects: Costa Rica

<b>Area</b>	<b>Applications</b>
Osa Peninsula	forestry (deforestation/type mapping/plantations); geology (marine terraces/coastal geomorphology); hydrology; land use
Tempisque	land use/land cover mapping; forestry (type mapping/ plantations
Tortuguero	forestry (deforestation/type mapping/plantations); land cover/land use mapping (inc. change detection); erosion; geology (siesmology/volcanism/natural risks)
Guatuso	forestry (deforestation/type mapping/plantations); geology (structural/seismology/volcanism/natural risks); wetlands
Central Valley	urbanization

Table 11. GlobeSAR-2 Central American Projects - Honduras

<b>Area</b>	<b>Applications</b>
Northwest	land use mapping
South	mangrove deforestation
North	deforestation/colonization
Central.	forest/non-forest boundary delineation

Table 12. GlobeSAR-2 Central American Projects - Panama

<b>Area</b>	<b>Applications</b>
Chiriqui	geology (volcanic); coastal geomorphology; mangroves; agriculture (banana plantations); forestry
Azuero	mangrove deforestation (w/ associated salinity problems); agriculture (sugar cane plantations); aquifer location
Coclé	geology (volcanic/faults/surficial materials); coastal erosion; forestry (coastal mangroves/deforestation)
Darien (2-sites)	cartographic updating; land cover mapping; geology; mangroves
Panama City	shoreline flooding