


# Projects that involve Brazil

2011

# Functional links of aboveground changes and belowground activity with land use (CRN2014)

Land use and cover change (LUCC) affects the ecological functions which soil microorganisms provide, and that, in turn, affects how they relate to plants. Microorganisms living in symbiosis with plants play an important role in sustaining agriculture and food security. This projects looks at how soil microorganisms react to changes in climate and LUCC in different temperate and tropical ecosystems in the Americas.

## Goals

- Test the hypothesis that the soil carbon sink and ecosystem resilience can be increased by managing a key group of soil microorganisms - arbuscular mycorrhizal fungi (AMF)
- Document how plant community structure and productivity are linked to AMF diversity and activity

## First results

- One might expect that the biodiversity of below-ground fungi reacts only slowly to environmental change. However, DNA analysis of dominant AMF taxa has shown shifts in species abundance even between different seasons of the year.
- This change in diversity affects their function. Both the diversity and the symbiotic ability of AMF declined so much in warm and dry seasons that the symbiotic relationship between AMF and their host plant may have been lost.
- Thus, climate change may have significant below-ground effects, which may reduce the performance of the associated plants.
- In the páramos region, project researchers from Bolivia and Ecuador have been successful in using this knowledge to produce bio-fertilizers that increase growth of potatoes. Experiments with other crops are continuing.

## Principal investigator and lead agency

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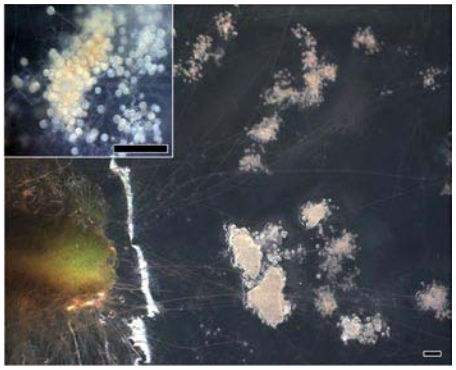
## Links to other IAI projects

CRN2014 and the **TROPIDRY** project (see CRN2021) have been collaborating in several joint sites and ecosystems, integrating above and belowground data.

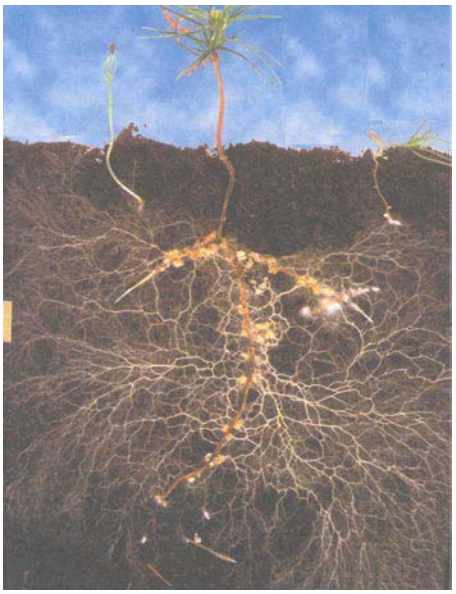
**Project web site:** http://www.ufrrj.br/amfoods

**List of publications:** http://iaibr1.iai.int/bs?publications/CRN2014.pdf



*Mycorrhizae and bryophytes: an ancient plant-soil fungi association*

Paramos *(high altitude vegetation) in the Ecuadorian Andes*



*Mycorrhizae (white) explore soils and aid plant nutrition (Photo by D. Read)*

# INTER-AMERICAN INSTITUTE FOR GLOBAL CHANGE RESEARCH

## Designing a methodology to evaluate local knowledge on global change and its role in the construction of future land use scenarios by local actors (SGP-HD009)

How do American rural producers perceive and assimilate climate changes and incorporate this knowledge into their future scenarios? Which policies, both at the local and the regional level, will lead to improved environmental governance? This research group tests and validates local knowledge on global change and land-use scenarios in order to document people's perceptions of global environmental change and how such knowledge affects future land uses and decision making.

### Goals

- Elaborate, test and validate a methodology to evaluate local knowledge on global change and how this may be used for the construction of future land use scenarios
- Contribute to increasing scientific understanding of local knowledge and expectations on land use using interdisciplinary approach of environmental and social sciences
- Transfer scientific global change related knowledge to communities and reinforce individual/ community awareness
- Develop an interdisciplinary network on social & environmental aspects of global change based on participative methods in order to generate new scientific knowledge and foster capacity building including new tools for decision making

### Results

- The project's main objective is the development of a methodology to evaluate local knowledge, the Local Knowledge Scenarios (LKS) method that combines field work with the application of Agent-Based Models for the participative construction of land use scenarios. Workshops and field work were held in all five project areas (Pampa in Uruguay; Amazonian Rainforest in Brazil; North Atlantic Coast in Newfoundland and Canada; Andean Mountain in Peru; North American Prairie in Canada) to elaborate, test and validate the method.
- The LKS method is being applied in the study sites and has generated first results. The complex policy challenge of global change is often difficult to address with local policies. In the Amazon, an increased awareness of the local population to hydrological changes and soil degradation due to deforestation is noted, but the application of environmental laws especially those related to deforestation, remains difficult, as they are not accepted by the local population. In the Change Islands, Canada, the goal to maintain a decent standard of living for the fishing community while diversifying into other sources of income such as tourism, cannot be reached without a national public policy that allows adaptation to specific situations.

*Scheme of study area in Amazonia, Brazil*


*Amazonia, Brazil, May 2008*


*Huaraz, Peru*


*Change Islands, Canada*

### Principal investigator and lead agency

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### Links to other IAI projects

This project contributes with the Collaborative Research Network projects on **Land use change in the Rio de La Plata basin: linking biophysical and human factors to understand trends, assess impacts and support viable strategies for the future** (**CRN2031**) and **Caribbean coastal scenarios** (CRN2061).

**List of publications:** http://iaibr1.iai.int/bs?publications/SGPHD009.pdf

SMART
Strategic Monitoring of South-American Regional Transformations

*Updated May 2010*

# From landscape to ecosystem: across-scales functioning in changing environments (CRN2005)

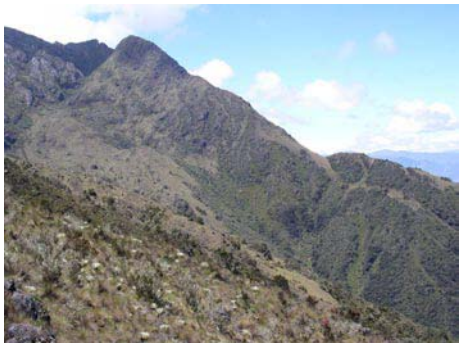
How are ecosystem boundaries defined? How do they relate to water availability and climate; how do they shift under global change? Can we predict ecosystem displacements? This study compares the transition zones (ecotones) between forest and non-forest sites under different climate and land use pressures in one Canadian and four South American sites.

## Goals

- Analyze interactions between vegetation and environment in time and space
- Identify current ecotones, and map past changes
- Examine the processes of species colonization at ecosystem boundaries
- Predict future advances of ecosystems over others under climate change
- Indicate risks to ecosystem services when ecosystems are displaced

## First results

- Ecotones are explained by functional traits of plants that determine the plant's vulnerability to climate change and human intervention. In the Andes, the boundary between ***páramo*** and forest is defined by the effect of temperature and its extremes on trees and on seedling success. Trees, once established, modify the environment to their own advantage, stabilizing the boundary. In contrast, human disturbance favors ***páramo*** species, moving the ecotone downward even against climate trends. In Southern Brazil, sediment cores show that forest-grassland boundaries have moved back and forth under variable climate over centuries.
- The extensive (80%) deforestation of the Gran Chaco dry forest is due largely to land use, responding to remote markets -e.g., soybean- and facilitated by increasing rainfall.
- In Canada and Brazil, increased atmospheric $CO_2$ has increased tree productivity, but that effect is counter-balanced by decreasing water availability, now leading to declining tree growth. This challenges the assumption that increasing $CO_2$ levels invariably boost plant growth.
- The project has shown explicable interactions between anthropogenic and natural factors that define ecotones – this can now be explored for conservation and adaptation decisions.



*On the high slopes of the Venezuelan Andes, a winding treeline seems to be advancing upwards over the paramo vegetation due to the twentieth century climate warming.*

*Recurrent fires are crucial drivers controlling the distribution of montane forest and grasslands in the Sierras de Córdoba, Argentina. LEAF aims to understand the specific mechanisms involved in the maintenance of forest-grassland mosaics.*

*In the high and moist tablelands of Rio Grande do Sul, Brazil, mosaics of Araucaria forests, shrublands, natural grasslands and croplands seem to be under the control of climate, land forms, fire and grazing, overlying an extended history of climate fluctuations and ecosystem displacements.*

## Principal investigator and lead agency

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**List of publications:** http://iaibr1.iai.int/bs?publications/CRN2005.pdf

# DIVERSUS: Functional biodiversity effects on ecosystem processes, ecosystem services and sustainability in the Americas: an interdisciplinary approach (CRN2015)

The provision of ecosystem services is vulnerable to land cover change (LCC). Changing land-use patterns and practices affect the properties and biodiversity of ecosystems. This has implications for the delivery of ecosystem services. Ecological studies of land use change and its impacts on biodiversity and ecosystem properties must be integrated with an understanding of the multiple contributions of ecosystems to human well-being. This is a major challenge for science. The DiverSus Collaborative Research Network concentrates on this challenge by developing and testing a new interdisciplinary framework to analyze and compare field studies of land use change from the tropics to the tundra. Comparisons, focus on (1) functional biodiversity as a bridge between land-use patterns and ecosystem properties; and (2) ecosystem services as the key conceptual link between ecosystem properties and the livelihoods of social actors who benefit from them.

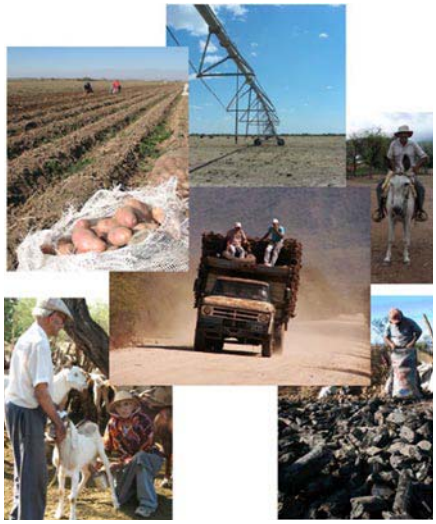
## Goals

- Construct a network of scientists to address links between LCC, changes in functional biodiversity, ecosystem responses and those ecosystem services that people use towards their livelihoods
- Develop the first comparison of the effects of land-use change on functional biodiversity and establish how this can modify ecosystem properties
- Examine links between functional biodiversity, ecosystem properties and ecosystem services as perceived by different stakeholder groups
- Develop a conceptual framework and a set of empirical tools and recommendations, available to a wide community of scientists, managers, and society to be used in land-use decisions that take into account ecosystem services and potentially conflicting interests of different stakeholders

## First results

- Measure functional biodiversity (by assessing species composition and measuring the functional trait values of dominant species)
- Characterize ecosystem properties including C sequestration and nutrient cycling under contrasting land-uses in case studies in Alaska, Costa Rica, Brazil, Bolivia and Argentina
- Develop statistical tools to analyze the effects of functional diversity on ecosystem properties
- Identify ecosystem services through social surveys and describe stakeholder livelihoods (in Argentina) and the economics of ecosystem services (in Costa Rica)
- Develop and apply an integrative framework to link land-use change to stakeholder livelihoods in all case studies

*Land-use change can dramatically change biodiversity, with strong impacts on ecosystem properties and the various services they provide to society (photo Zayra Ramos)*



*People's livelihoods depend on the continued provision of ecosystem services. Science cannot ignore the resulting conflicts between decision on use and conservation of ecosystems if it is to be relevant (photos: Daniel Cáceres, Georgina Conti, Fabien Quétier & Esteban Tapella)*


## Principal investigator and lead agency

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**Project web site:** www.ecosystem-services.org/diversus

**List of publications:** http://iaibr1.iai.int/bs?publications/CRN2015.pdf

# SAEMC: South American emissions, megacities and climate (CRN2017)

Deteriorating air quality in South American mega-cities is receiving increasing attention from local decision makers, scientists and the public. SAEMC provides regional scale past, present and future climate change scenarios, with emphasis on the evolution of air quality in South American megacities, and on the implementation of coordinated regional chemical weather forecast tools.

## Goals

- Establish the basis for operational chemical weather forecasting for South American megacities
- Provide accurate regional emission and climate change scenarios for South America, with emphasis on the impacts of and on megacities
- Strengthen and expand an active research and capacity building network on Earth System Modeling in the Americas

## First results

- An on-line emission data base has been compiled for Bogotá, Buenos Aires, Lima, Medellín, Santiago, and São Paulo that will be used to develop automated emission scenarios; so far available for Medellín (http://modemed.upb.edu.co/).
- Factors affecting local emissions have been compiled which helps environmental authorities manage air pollution. Urbanization maps for the main Brazilian cities have been constructed from satellite images. Inventories for traffic emissions and aerosols including black carbon particles are being developed for Buenos Aires, São Paulo, and Bogotá.
- The Chilean Weather Office is now providing chemical weather forecasting for Santiago based on SAEMC work.(http://www.meteochile.cl/modeloPOLYPHEMUSozono.html)
- A fully linked climate modeling system is now operational for South America, providing a sound basis for the comparison of emissions.
- A grid-based computational system is being tested.

## Principal investigator and lead agency

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## Links to other IAI projects

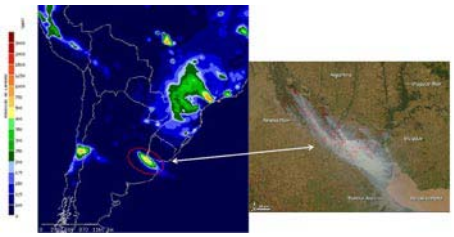
Research in this project is complemented by the *Human Dimensions* component **2017-HD ADAPTE**

**Project site:** http://saemc.cmm.uchile.cl/

**List of publications:** http://saemc.cmm.uchile.cl//index.php?option=com_docman&Itemid=46 or http://iaibr1.iai.int/bs?publications/CRN2017.pdf

*The large urban centers in South and Central America keep growing posing serious environmental and health problems*

*Traffic emissions are substantial contributors to the burden of pollutants in all megacities. SAEMC has developed and compiled consistent emission inventories that provide the basis for air quality assessments and chemical weather forecasting at various scales*



*C-CATT-BRAMS running in operational mode is able to capture meso-scale events of transport. In this case, a smoke plume advected over Buenos Aires in the fall of 2008 is captured by the model. (photo on the right: http://earthobservatory.nasa.gov/NaturalHazards/Archive/Apr2008/Argentina_AMO_2008107_lrg.jpg)*

# TROPI-DRY
## Human, Ecological and Biophysical Dimensions of Tropical Dry Forests (CRN2021)

Tropical dry forests (TDFs), with their high agricultural and touristic potential and ideal conditions for human settlement are extremely vulnerable. This research network is developing a comprehensive knowledge basis of the human and biophysical dimensions for TDFs in the Americas.

### Goals
- Understand ecology and diversity of TDFs and the climatic and socio-economic drivers of their development and degradation
- Document long-term trends in extent, biomass and integrity of secondary and primary TDFs
- Develop innovative links between government agencies, scientists, and communities to promote sustainable management of TDFs

### First results
- The first-ever map of TDFs in the Americas shows their extent and conservation/deforestation trends. In Costa Rica this mapping serves as a legal basis for conservation monitoring.
- Dry forests are highly fragmented by touristic and agricultural development, and conservation policies need to reflect this better. TROPI-DRY proposes the creation of TDF conservation networks and payments to local communities for the environmental services they provide.
- Phenology monitoring shows that close to the equator, the dry season is now shorter and dry forests have become more productive. Farther north and south, dry seasons last longer and dry forest growth has slowed. Productivity of dry forests is increasing in Brazil and decreasing in Bolivia.
- Data are being compiled how rural communities use natural resources in dry forests in Brazil.
- These results are creating a solid basis for the sustainable management of dry forests across the American continent.

*Installation of phenology monitoring station, Minas Gerais, Brazil*


*Serra do Cipo National Park, Minas Gerais, Brazil*


*Mata Seca State Park, Minas Gerais, Brazil*

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### Associate organizations
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### Links to other IAI projects
TROPI-DRY collaborates with the *Collaborative Research Network* on **soil microbe-plant interactions** (CRN2014) and with the *Small Grants Project for the Human Dimension* on **conservation policy impacts in tropical dry forests in the context of other social and natural drivers of land use** (SGP-HD008).

**Project web site:** http://tropi-dry.eas.ualberta.ca

**List of publications:** http://tropi-dry.eas.ualberta.ca/2_datapub.html or http://iaibr1.iai.int/bs?publications/CRN2021.pdf

# INTER-AMERICAN INSTITUTE FOR GLOBAL CHANGE RESEARCH

## Land use change in the Rio de la Plata Basin: linking biophysical and human factors to predict trends, assess impacts, and support viable land use strategies for the future (CRN2031)

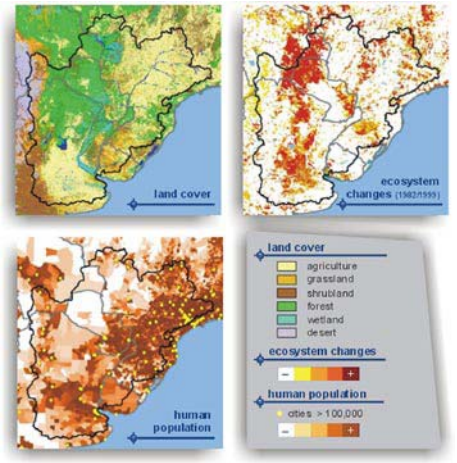
Food and biofuel production drive large-scale ecosystem conversion; in the La Plata basin alone it has resulted in the conversion of some 30 million hectares over the past 25 years. Yet, ecosystems provide fresh water, store carbon, and regulate the climate. What are the trade-offs and synergies between agriculture and ecosystem services? How can we optimize both?

### Goals

Characterize patterns and drivers and assess the consequences of land use change, explore feedbacks and trade-offs. Develop tools for rational land use planning.

### First results

- Expansion of crops in the La Plata basin over the last 25 years has reduced soil carbon (C) by about 30%, at loss rates of 28 million metric tons (MMT) of C per year. Intensively grazed pastures are also losing C, at rates near 1.7 MMT per year.
- Some of this conversion is now driven by a desire to substitute fossil fuels by "carbon-neutral" biofuels. However, letting the natural vegetation recover on former agricultural land is better for the carbon balance than growing biofuel crops. Carbon released from soil under corn grown for ethanol completely compensates for carbon gains from bio-alcohol for 50 years. Also, carbon was higher in soils under recovered grassland than the possible C credits from corn ethanol on the same land for 40 years, with equal or greater economic value.
- Strong human interventions in landscapes affect regional hydrology. Tree plantations in humid areas of the La Plata basin have lower albedo (reflectance to sunlight) than grasslands. Pine stands decreased (region's) albedo by 30% compared to grasslands. Afforested grasslands also decreased water yield by 50%, and caused soils to acidify. This was most marked under Eucalypt stands.
- Map of land cover changes showing regions of C sequestration and losses on the continent (http://lechusa.unsl.edu.ar/).
- This project provides insight for governments, industry and NGOs to develop sustainable strategies for land use and eventual substitution of fossil fuels.




*Plata Basin territory - Whole-basin studies use existing databases and remote sensing tools*

*Soybean plot in the dry forest area of San Luis. Researchers are installing a groundwater observation well*

*Interviewing local stakeholders in a town with challenging water supply issues*

### Principal investigator and lead agency

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### Links to other IAI projects

Collaboration with the *Small Grants Projects for the Human Dimension* **Climate change and irrigated agriculture** (SGP-HD003) and **Designing a methodology to evaluate local knowledge on global change and its role in the construction of future land use scenarios by local actors** (SGP-HD009), and with the *Collaborative Research Network* (CRN2094) **The impact of Land Cover and Land Use Changes on the Hydroclimate of the La Plata Basin.**

**Project web page:** http://platabasin.unsl.edu.ar

**List of publications:** http://iaibr1.iai.int/bs?publications/CRN2031.pdf

Updated 2/2010

# Documenting, understanding and projecting changes in the hydrological cycle in the American cordillera (CRN2047)

Fresh water is becoming increasingly scarce in a warming and more crowded world. Better data are needed for effective management of threatened water supplies from many of the Americas' mountain regions. This project examines hydrological cycles in several basins in Bolivia, Chile and Argentina as well as in the Western Cordillera of North America.

## Goals

- Provide and validate climate and runoff data for the past 300 years and identify causes of variability
- Document and model the shrinking of glaciers and how this modifies downstream water flow
- Assess how changing water supply impacts on economies and livelihoods; identify what this might mean for future water management, for policies and institutions

## First results

- Long-term variation seen in a 700-year record of tree-ring widths allowed reconstruction of the rainfall variability in the high Andes. One major drought period, in the 14th century, had critical social impacts: open pre-Inca villages in lowlands were abandoned in favor of fortified sites, with evidence of local warfare starting during the driest years in the tree-ring record (1314-1315); two major droughts followed in the same century.
- There is a slight trend of declining regional streamflow in Chile during the past one hundred years, and there were two major climate regime changes: in 1945 average annual rainfall dropped by 31%, to recover only in 1977 (by 28%). These sudden variations coincide with well-known shifts in the atmospheric circulation over the North Pacific (the Pacific Decadal Oscillation). Expected future oscillations, superimposed on the trend towards less rainfall, may have major impacts on water availability.
- In some critical zones, adaptation to climate change will be more pressing and more challenging than in others. A drought severity index for the southern Andes (35.5°-39.5°S), for example, indicates higher drought risk in 1920-2002 than in the reconstructed 1346-1919 record. If continued, this trend would certainly threaten agriculture and hydroelectric power production.

## Principal investigator and lead agency

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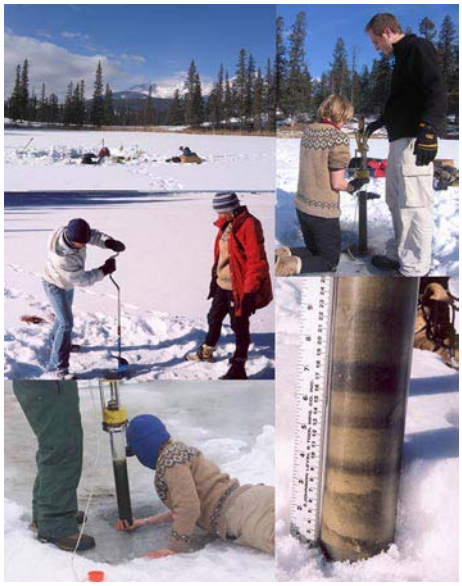
## Links to other IAI projects

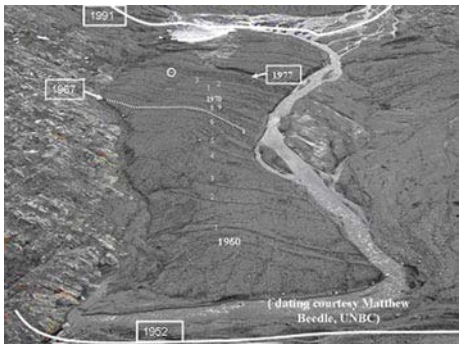
This project collaborates with the *Small Grant Projects for the Human Dimensions* **Climate change and irrigated agriculture** (SGP-HD003) and **Coming down the mountain: understanding the vulnerability of Andean communities to hydroclimatologic variability and global environmental change** (SGP-HD-04).

**Project web page:** http://www.climaycomunidades.org/

**List of publications:** http://www.climaycomunidades.org/nweb_portal/site/index.php or http://iaibr1.iai.int/bs?publications/CRN2047.pdf



*Coring Lake Sediments Jasper, Canada, February 2007*

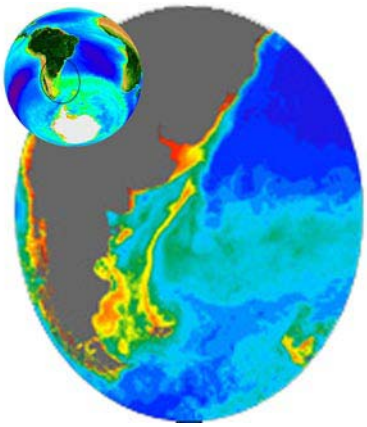



*Annual Moraines at Castle Mountain Glacier, Cariboo Mountains, British Columbia, Canada*

*Preparing to sample 1500 year old logs exposed (beneath fallen tree) in Rio Frías, Argentina*

# SACC: An international consortium for the study of ocean related global and climate changes in South America (CRN2076)

Oceans play a huge role in the global climate system; they sequester greenhouse gases, move heat from the equator to polar regions and control the global hydrology. Oceans, especially their continental margins, have soaked up half of the man-made $CO_2$ emissions since the mid 1800s. Oceanic phytoplankton produces half of the Earth's chlorophyll, and half of this is found on continental shelves which occupy only 9% of the ocean area. Researchers in this project are studying exchange processes between the deep ocean and the Patagonian shelf, and how these vary in time. Direct observation, historical data and modifications to earth system models all contribute to understanding ocean circulations and ocean biota.



*Satellite derived sea surface chlorophyll distribution in the Southwest South Atlantic in January (values range from 0 mg / m³ (blue) to 20 mg / m³ (red))*

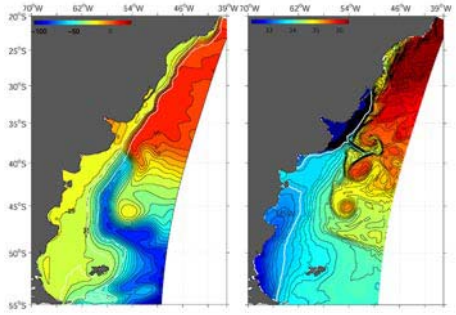
## Goals

- Identify the physics, and the currents and tides that control physical and biogeochemical exchanges (species, nutrients, $CO_2$, sediments) between the deep ocean and the continental shelf, and their variability
- Determine the influence of currents and inflows on the production and biodiversity of the marine environment
- Improve understanding of the dynamic processes controlling upwelling and cross-shelf exchanges for the development of better global carbon models

*Deployment of a Conductivity-Temperature-Depth profiler in the western South Atlantic*

## First results

- The Patagonia shelf, which covers 4% of the global continental margins, absorbs about 17 Tg C $yr^{-1}$ (million metric tons of carbon per year).
- The important fishery on the shelf break, with about two million tons of fish and squid landed every year (3% of global production) shows signs of overfishing, indicated by growing jellyfish populations. This is important to monitor and manage since overfishing could affect plankton and alter the capture $CO_2$ through photosynthesis.
- The project contributes to developing state-of-the-art ocean models that more realistically represent the circulation and upwelling mechanisms which sustain the productivity of the shelf break.
- Freshwater input from the Rio de la Plata and Patos Lagoon is important for ecosystem production and diversity in the Southwest Atlantic.
- CRN2076 and various Argentinean institutions maintain BioMare, an integrated fishery and oceanographic information system to support fishery policies. BioMare developers expect to expand the system beyond Argentina.



*Sea surface height anomaly (left) and sea surface salinity (right) from a regional high-resolution ocean model*

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## Links to other IAI projects

Research in this project is complemented by the *Human Dimensions* component **2076-HD on artisinal fisheries in the Patos Lagoon**

**Project web page:** http://www.sacc.org.uy/

**Publications:** Atlas of the Patagonian Sea, Species and Spaces: http://www.iai.int/files/communications/publications/scientific/Atlas_del_mar_Patagonico.pdf

**List of publications:** http://www.sacc.org.uy/iai_papers.php
http://iaibr1.iai.int/bs?publications/CRN2076.pdf

*Updated 3/2010*

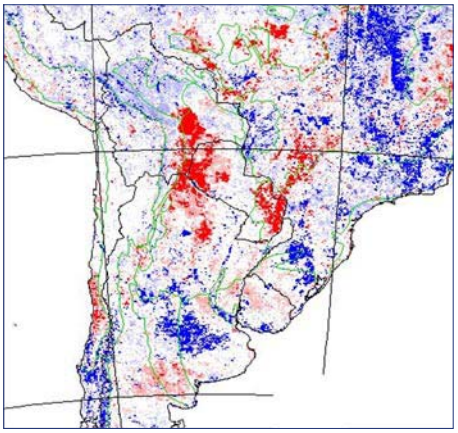
# INTER-AMERICAN INSTITUTE FOR GLOBAL CHANGE RESEARCH

## The impact of land cover and land use changes on the hydro-climate of the La Plata Basin (CRN2094)

The La Plata basin is key for the economic and social development of Argentina, Bolivia, Brazil, Paraguay and Uruguay. During the last decades, land use and cover have changed significantly as a result of ever expanding agriculture and forestry. Since the end of 2008, this project investigates the impacts of such changes on the regional hydroclimate of the La Plata Basin and their interaction with climate change.

### Goals

- Develop 25-year datasets that integrate all in-situ and remotely sensed observations on land use and cover, and develop regional models to assess in which way and how much land use changes affect the hydroclimate of the La Plata basin
- Investigate the role of land use and cover changes in the intensity and length of floods and droughts
- Investigate potential changes in the hydrological characteristics of the Basin (soil moisture, infiltration, and runoff)



*Changes in the normalized difference vegetation index (NDVI) from 1980 to 2000*

### First results

- The project is using 1980-2005 datasets to assess the impact of land use and cover changes on the hydro-climate of the La Plata Basin, and the physical mechanisms by which these impacts take effect.
- These datasets are being used for a regional land surface re-analysis in a Weather Research and Forecast (WRF) modeling system run on continental scale with a nested grid over the La Plata Basin.
- WRF simulations are being prepared for different land cover scenarios, from no agriculture to intensive arable agriculture.
- The project defined a new approach to investigate changes in land cover, the Ecosystem Functional Types (EFTs) and investigated their year-to-year evolution. EFTs replace the current time-fixed land cover types and will be tested in regional models.

*Forest to agriculture (NDVI decreases)*

*Grassland to tree plantation (NDVI increases)*

*The figures are courtesy of Jose Paruelo and Esteban Jobbágy.*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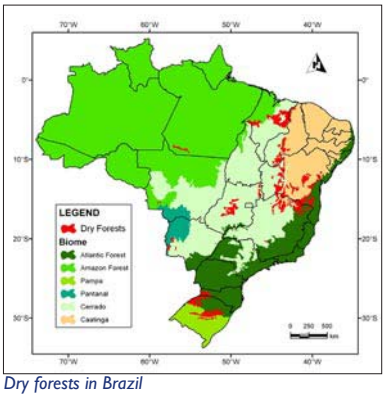
**Project web page:** http://www.atmos.umd.edu/~berbery

**List of publications:** http://iaibr1.iai.int/bs?publications/CRN2094.pdf


*Updated 3/2010*

# Conservation policy impacts in tropical dry forest: regional & spatially focused analysis given other social and natural drivers of land use (SGP-HD008)

Effective conservation of tropical dry forest requires innovative approaches that are well rooted in scientific excellence. This project is evaluating the impacts of payments and of establishment of reserves in tropical dry forest areas in Costa Rica and Brazil. Payments for ecosystem services and the establishment of forest reserves are important conservation tools. The project addresses the following questions: what factors affect deforestation in tropical dry forests, and does the driving dynamic differ from the dominant forces for other forest types? How effective are the conservation policies, such as payments for ecological services (in Costa Rica, PSAs, Pagos por Servicios Ambientales) and the establishment of forest reserves (parks), in reducing deforestation in tropical dry forest locations?



*Dry forests in Brazil*

## Goals

- Compare the impacts of protected areas and payments for environmental services on tropical dry forest with those on other forest areas in Costa Rica and Brazil. Costa Rica is a global leader in eco-payments and parks.

## Results

- When assessing impacts of policies, studies have to control for non-policy factors.
- Assimilating the impacts of non-policy drivers of land use and especially, deforestation, helps us to understand whether non-policy factors are confounding the analysis of eco-payment policies that pay land users for protection services they provide to society. In fact, impacts of biophysical (e.g.; slopes, soil quality, rainfall) and socioeconomic drivers (e.g.; distance to markets and roads) could be confirmed, so that it may not have been eco-payments but other factors that prevented clearing. Thus, the design of eco-payment policies matters a lot for their success.
- Conservation areas: protected areas have prevented significant amounts of clearing in Costa Rica, which is a pioneer country in the establishment of parks. Yet, conventional approaches to evaluating conservation impact, which did not control for observable covariates correlated with both protection and deforestation, substantially overestimated avoided deforestation (by over 65%, based on our estimates). More careful analysis shows that parks have prevented much less clearing than is commonly believed, as they were often established in places (distant and inaccessible, or on slopes) which were less under threat than other forest land. Thus, conservation policy designs, as well as the location of the protected areas, are both critical factors to prevent deforestation. If protected areas are targeted on locations where clearing is most likely, the impact can be raised.
- A study found that protected areas within 85 km of Costa Rica's capitol city, San Jose, prevented over 4% of their forest area from being cleared during 1986-1997. Those further away prevented under 1%. Protection within 7.5 km of national roads blocked the clearing of about 5% of the forest, and protection on land with slopes under 7.12 degrees avoided 14% deforestation, while essentially no protection (i.e., not statistically different from zero) resulted from the protected areas far from national roads or those that were located on high slopes.

## Principal investigator and lead agency

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## Links to ther IAI projects

This project integrates with and extends the Collaborative Network project **CRN2021 on Human, Ecological and Biophysical Dimensions of Tropical Dry Forests**

**List of publications:** http://iaibr1.iai.int/bs?publications/SGPHD008.pdf

*Updated May 2010*

# Decision support system (DSS) for risk reduction in agriculture phase II: soybean DSS for Eastern Paraguay and Rio Grande do Sul (SGP-HD014)

Climate variability, particularly lack or excess of rainfall, is a major agricultural production risk. The El Niño Southern Oscillation (ENSO) is the strongest known driver of interannual climate variability. ENSO phases are characterized by sea surface temperature anomalies in the eastern equatorial Pacific Ocean. When sea surface temperature is higher than normal the phenomenon is referred to as El Niño, whereas La Niña has lower than normal temperatures. El Niño causes excess precipitation in subtropical southeastern south America, La Niña reduces precipitation in southern brazil and eastern Paraguay and central Argentina.

## Goals

- Reduce production risks associated with climate variability

## Results

- Producers in Paraguay and Brazil were introduced to the use of seasonal climate forecasts.
- A crop growth model was used to evaluate adaptive management options (e.g.; planting different soybean varieties, varying the planting dates) under different ENSO scenarios. Strategies for communicating risks were developed, including a web-based climate information system. Soybean producers in Brazil and Paraguay were very interested in understanding climate variability effects on their crop yields, and volunteered to co-develop a decision support system available on the Internet.
- Research in eastern Paraguay and southern Brazil demonstrated that the challenge of providing farmers with trustable, useful, science-based information, which they in turn can use to make informed decisions, can be best met by developing and implementing climate-based decision support systems in close cooperation with local cooperatives. The project uses a probabilistic approach, rather than looking for a clear-cut, "yes-or-no" responses to climate forecasts. The project received strong support from growers; three cooperatives have committed funds for the purchase of weather stations to provide weather information to their growers.
- Decision support tools for yield and climate risks were adapted for Paraguay (http://py.agroclimate.org/) and will soon be available for Rio Grande do Sul in Brazil (http://.br.agroclimate.org/).

*Soybean planted using no-till management practices in Rio Grande do Sul, Brazil*

*Grain crops production field in Rio Grande do Sul, Brazil*

*Julian Baez talking to the members of the Camara Paraguaya de Exportadores de Cereales y Oleaginosas (CAPECO), Paraguay*

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## Links to other IAI projects

Contribution to the Collaborative Research Network project on **land use change in the Rio de La Plata Basin: linking biophysical and human factors to understand trends, assess impacts and support viable strategies for the future** (see **CRN2031**).

*Updated May 2010*