



*Biennial Report*  
2010 - 2012



## **Mission**

*The mission of IAI is to develop the capacity of understanding the integrated impact of past, present and future global change on regional and continental environments in the Americas and to promote collaborative, well informed actions at all levels.*

## **Core values**

*IAI pursues the principles of scientific excellence, international cooperation and full and open exchange of scientific information relevant to global environmental change.*

## **Vision**

*The IAI was envisaged as an intergovernmental instrument by which scientists and decision makers of countries throughout the Americas might jointly address the critical issues associated with global change in the region.*

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# Inter-American Institute for Global Change Research

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## Biennial Report 2010 - 2012

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**Cover photo credits:** Form top to bottom: 1. CRN 2015 - pivot irrigation, 2. CRN 2017 – measuring mobile emissions, 3. CRN 2047 – Grapes, 4. CRN 2047 Sampling sites of Araucaria araucana in National Reserve Ralco (38° 46'S, Chile) behind, Llaima volcano 5. SGP-HD 008 - Dry forest after fire, MG, Brazil, 6. CRN 2076 - Ocean measurements, 7. SGP-HD 004 - Vineyards in the upper oasis of the Mendoza River (Argentina) with the Andes as backdrop, 8. CRN 2015 - Petals in Guatemala. **Inside photo credits:** pages 5 and 6, CRN 2031 // page 8, CRN 2017 // page 11, CRN 2047 // pages 12 and 13 CRN 2050 // page 14, CRN 2076 // pages 18-19, CRN 2021 //page 22, Andrés Moreno, FAUBA - www.agro.uba.ar and Jim Sietz, LSU University Relations // page 27, Guilherme Martins, CPTEC //page 34, Shadi Ardalan

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## Foreword

Twenty years have passed since 16 countries in the Americas established the IAI with a mandate to promote regional collaborative research on global change. Ever since its first programs, the IAI has funded multidisciplinary, international projects, that have helped consolidate collaborative networks throughout its now 19 member countries. The IAI has harnessed the creativity of the region's scientists using open calls for research proposals, while at the same time shaping the science portfolio towards the goals of improving the capacity of the continent to investigate, understand and adapt to the challenges of global change. The goal of knowledge creation towards informed decision making has meant that human dimensions, both of the causes of change and in the adaptation to change, have assumed a crucial role in IAI research. Initially, human dimensions research was promoted through separate calls for proposals that aimed to fill gaps, but in its latest round of Collaborative Research Networks, integration across the disciplines has become more established. Yet, the integration of disciplines from the outset of developing a research program remains as much a research as a capacity building mandate.

A large part of the IAI's capacity building aims at communication; at promoting an integration and synthesis of its science that permits the transfer of knowledge, and the development of systematic links between scientists and users of science and knowledge. The capacity building program involves scientists, practitioners and decision makers exploring the needs of different sectors of society in understanding the risks and opportunities of global change impacts and adaptation. Several capacity building workshops have been linked to the synthesis process, that aims at integrating science across projects and promotes dialogue at the science-policy interface from the global (UN Conventions) to the local (e.g. land users) level. Developing such science for the purpose of informed decision making at all levels has made the history of the IAI one of continuously evolving challenges and excitement.

Holm Tiessen  
*Director*

## The science

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The IAI has attracted leading scientists in global change research to become part of its regional research networks and training institutes. Many of the researchers have developed use-inspired science and are engaging in dialogue with such stakeholders as legislators, landuse planners, or public health departments on the impacts of and responses to global change. IAI-funded research has influenced planning and policy from forest protection in Costa Rica or Brazil to water management in the dry border areas of the US and Mexico or in the fertile valleys of Chile that depend on Andean runoff. In combining the experience from different parts of the continent, projects interacted and built upon each other so that the sum is greater than its parts.

Approximately one quarter of the La Plata Basin (LPB) has undergone land cover change in recent years. In an example of cross-program collaboration, several CRN2 (Collaborative Research Network) projects on land use, ecosystem function and regional climate have combined their expertise in an IDRC (Canadian International Development Research Center) financed project that examined different options for landscape management and provided an economic analysis as an important step towards informed decision making. This collaboration was the basis for a two-week international training event in Paraguay on landuse change, tools for decision making and user perceptions of the resulting science output. Such integration between science, applications and training are critical

to build the capacity of the region for research and informed decision making on global change.

Several climate and hydrology projects have made a strong case for regional climate science that can complement downscaling efforts with regional weather information and an understanding of important teleconnections between weather systems an the oceans. This points to a need for regional climate science and climate services that will be explored in the new round of Collaborative Research Networks starting in 2012. ☈

The integration of CRN2 with the human dimensions grants has provided for innovative interdisciplinarity that has added significant value to the knowledge generated. This portfolio of projects demonstrates the importance of regionally connected science that provides knowledge with the credibility, acceptability and actionability needed by the users. All of these projects have produced excellent science, as documented by the many publications, while also striving for outreach and policy relevance. An important achievement of the IAI networking has been the development of synergies, cross-cutting syntheses and value-added output that links disciplines and regions, and challenges scientists to conduct science that is open to integration, accessible, and ready to communicate its results beyond its peers.

Synthesis workshops on specific themes or cross-cutting issues, regular contacts with and between projects, and joint publications promoted by the IAI are important tools to translate the CRN's science into policy relevant information. The program-wide synthesis has also identified several key themes of importance on the continent. These include the effects of land cover change on regional societies, ecosystems and climate, the links between water security, climate variation and recharge, particularly in the high Cordilleras, and the role of understanding regional climate systems to provide predictions and climate services that address vulnerabilities to climate variability and change. ☈

## La Plata Basin: an integrated view

The effects of land use changes on carbon cycling/storage and regional hydrology were explored linking them to climate change mitigation and ecosystem function in the La Plata Basin<sup>2031</sup><sup>1</sup>. Soil carbon stocks decreased as a consequence of the conversion of grasslands to croplands in the last 25 years. Agricultural intensification can reverse this trend somewhat increasing soil C stock as a result of higher plant productivity.

Soil C losses are similar under deforestation (Atlantic forest, Chaco, Espinal) but woody biomass removal caused additional C loss. Under transitions from forest to crops, or pastures to tree plantations, increased reflection (albedo) cancels the warming effects of C emissions from deforestation. This becomes more relevant towards temperate and drier zones. Therefore, for

dry forests, deforestation avoidance (such as REDD) may have low or no cooling impact. Tree plantations particularly in humid grassland regions combine biomass C gains with soil C losses.

Under full C accounting, as a result of ecosystem C losses on newly cultivated lands, the production of maize for bioethanol and soybean for biodiesel may not have a net positive climate mitigation effect for over 50 years. Protecting native vegetation and the establishment of perennial pastures can sequester more C than the fossil C offset by grain biofuel. Using native dry forests that naturally burn frequently to harvest bioenergy for local power generation may be an option in parts of Argentina, Bolivia and Paraguay. CRN2031 explored patterns of fire occurrence in dry forest ecosystems and analyzed fire association with climate, land cover and land use. Fire size and duration varied among vegetation covers, with shrublands supporting bigger fires and

woodlands more persistent fires. Evaluation of fire risk and energy release from fires indicated that fire-prone dry forests can become a sustained energy source capable of locally replacing fossil fuels for electricity generation with little competition with food production and synergies with forest preservation. The extent of fire-prone ecosystems is expanding due to climate change (ecosystems that never burned before now burn frequently). The removal of available fuel to bioenergy plants will reduce wildfire risks, and fuel harvesting



After the flood

<sup>1</sup>These and further numbers refer to network project numbers. See Projects, page 49

could offset fossil fuel use and avoid the low albedo situations generated after fires leave a charred surface. Calculations based on remote sensing show that between 2003 and 2006, global fires released energy equivalent to ~39% of global electricity consumption. Energy yields from biomass harvesting in the Chaco and other dry forests compare favorably with biodiesel production from soybeans on deforested land.



Analysis<sup>2031</sup> of the last flooding cycle (1997-2003) in the Pampas showed that not only higher precipitation (+20% over long term average) but also the expansion of low water-consuming croplands have contributed to floods and resulting economic loss. The study provided guidance to maximize groundwater contributions to agricultural productivity (water tables 1.5-2.5 m deep) and minimize waterlogging risks (water table < 1.5 m deep) for croplands. Farmer groups not only receive the research results but participate in data collection. Human decisions influence floods and affect groundwater levels through strategies of risk aversion, for instance to sow or not with shallow water tables, availability or not of water consumption options with low financial risk. This calls for coordinated actions beyond farm limits, making the county and watershed levels crucial for land use planning and flood control.

Changes in land cover alter physical properties of the land-atmosphere interface (such as albedo, surface roughness, stomatal resistance and leaf area index) as well as near surface variables (the boundary layer, the atmosphere's convective instability, the low level moisture fluxes), and ultimately, their combined effects on rainfall. The mesoscale WRF/NOAA Weather Research and Forecasting model was used to investigate<sup>2094</sup> land surface-atmosphere feedbacks and their impacts on regional climate. Simulations showed that the regional climate of the La Plata basin is sensitive to extensive changes in land cover, causing regional changes in temperature extremes and precipitation large enough to affect crop productivity.

Land surface processes occur across a range of timescales from rapid energy and water exchange with the atmosphere to changes in soil moisture, vegetation structure (human-induced) and vegetation phenology on longer timescales. However, many numerical models for weather forecasting that consider the atmosphere and land surface as a coupled system, represent vegetation constant in time. In order to improve simulations of biosphere effects on the atmosphere, CRN 2094 used Ecosystem Functional Types (EFTs) to replace the conventional land cover categories. EFTs are groups of ecosystems that share functional characteristics in relation to climate. EFTs are defined yearly, and therefore can represent time-varying actual characteristics of vegetation, and can capture the effect of human-driven changes in land use and management. Experiments with soil moisture over the entire La Plata basin using NOAA Land Surface Model are

in progress. The team is also evaluating modeled precipitation against observed data.

Critical challenges are to link large-scale descriptions of land use changes from satellite imagery or top-down modelling techniques with analysis of decision-making, adaptation and learning, and social interactions. A tighter integration between natural and human processes, including enhanced social modelling, should explore such links in future. One need is a broader spectrum of talents and scientific expertise, as well as the early and meaningful involvement of relevant social actors.

The decision processes associated with land use changes were examined by a team in Uruguay using agent-based models, which helped better understand the co-evolution of social and ecological systems. This local focus facilitated the reconciliation of model

results with information obtained from land users.

There is little appreciation of rural regions of the La Plata basin as a cultural space that sustains different types of livelihoods. Social cohesion of rural areas may well depend on alternatives that would allow smallholders to buffer against unfavorable years. Crop insurance, longer repayment periods for agricultural loans to accommodate climate cycles, economic alternatives for rural employment are needed to increase resilience. In the words of one IAI Training Institute participant, an “agro-sociological zoning” (by analogy to agro-ecological zones) will be necessary. ☈

## Air pollution in big cities

More than 75% of Latin Americans now live in cities, which both influence and are affected by climate change. SAEMC<sup>2017</sup> mapped urban air pollution to support the development of response plans to curb emissions from the most important sources such as transport. Data for particulate

matter (PM10, PM2.5) and gaseous air contaminants are being made available for public chemical weather forecasts. These are now used routinely by the Chilean and the Peruvian Weather Services. Dust particles in the air of Mexico, Santiago and Bogotá exceed the standards of the World Health

Organization (WHO) by 90%, and the levels of nitrous oxide pollution in these three cities exceed WHO standards by 73%, 38% and 25%, respectively. ADAPTE, the associated human dimensions project created maps to show the geographical distribution of health data and social vulnerability factors

*Smog over Santiago, Chile*



in Bogota, Buenos Aires, Lima, Medellin, Santiago, and São Paulo and related them to hot and cold weather. This application of Geographic Information Systems (GIS) provides computer visualization, database management and spatial analysis for identifying vulnerable social sectors, planning, intervention and design of emission control measures.

Both statistical and variational methods were used to evaluate monitoring networks. Combining *in situ* and remote air quality observations, it is now possible to apply inverse modeling to improve emission

inventories and model performance, and to design better monitoring networks. The methodology will be extended to several additional cities as part of the overall CRN program outreach and stakeholder involvement goals. There is an urgent need for a permanent monitoring of South American emissions and air quality. This will be aided by cost effectiveness of an integrated monitoring network that not only monitors compliance to standards but can integrate ecological, health and climate impacts. The network is a step towards stronger coordination, the integrated use of modeling tools, multiple instruments and

observing platforms, instrument calibration and maintenance, and sharing of laboratory and analytical facilities. The CRN has shown this is feasible at moderate cost and has been successful in overcoming bureaucratic and cultural obstacles. Such international networking brings together expertise and mobilizes resources: the project has achieved in 4 years with just under 1 million dollars a quality and amount of directly usable science output that would have been difficult to achieve without network synergies. ☈

## Andean annual snowpack, streamflow and water availability

Glacier retreat in the tropical Andes is one very visible sign of climate change: the large Southern Patagonian Ice field decreased from 13,500 (1944) through 13,000 (1986) to 12,555 km<sup>2</sup> (2009), showing a doubling in annual loss rate between these two periods<sup>2047</sup>. But analysis of the hydrological change along the Cordillera involves much more: annual snowpack and time of melt, resulting streamflow seasonality, and a trend of declining streamflow in Chile over the past 100 years. Disentangling long term trends from cyclical changes is one of the major challenges in understanding the variability and controls of Andean snowpack and the resulting streamflow. Analyses revealed that major changes in hydrological regimes coincide with the Pacific Decadal Oscillation (PDO). In 1945 streamflow dropped by 31% as the PDO switched into cool mode, then nearly recovered (28%

increase) in 1977 as the PDO switched to its warm mode. The interactions of different climate oscillations such as PDO, ENSO and the Atlantic modes which affect rainfall over the Andes, make climate change predictions for the region a challenge that cannot be solved by downscaling Global Circulation Models. More reliable prediction of climate variation requires aggregation of regional data. This is particularly important for changes in seasonality: runoff in 30% of 37 examined Andean rivers is now peaking significantly earlier in the year.

Climate change is not the only cause for reductions in streamflow and water availability. Such reductions are exacerbated by the loss of native forests at rates of 4% yr<sup>-1</sup> for native forest (Maule region, 1989-2003). Each 10% decrease in native forest cover is estimated to reduce summer streamflow

by 14%. Regional observations aggregated into mapped drought severity indices for the southern Andes show critical zones of vulnerability, which points to the need for better inter-agency coordination, early warning systems and institutional emergency plans. In the Chilean Maipo river basin<sup>HD003</sup>, a predicted 40-50% probability of water scarcity under changed climate by far exceeds the current 6-20% drought rate. Such analyses are needed to improve planning and the adaptive capacity of agricultural producers and local administrations to climate change. In the Rio Turbio basin, fossil groundwater is now being exploited unsustainably, and groundwater levels have already been lowered by 1.5-2.0 meters. The research team showed the importance of some of the regional effects of human activities on the environment.

### **Learning from the past**

Changes in climate induce changes in the behavior and organization of societies. Analysis of tree-ring widths from *Polylepis tarapacana* which vary consistently with rainfall, revealed the occurrence of severe, long droughts in the 14th century. The CRN team analyzed radiocarbon dates of charcoal from domestic hearths and timbers from constructions in “vulnerable” and “fortified hilltop” (Pukara) villages in the Altiplano. The transition in settlement patterns from vulnerable villages on the valley floors to fortified hilltop Pukaras coincided with the long 14th century drought. This suggests that changes in social conditions, possibly triggered by competition for water resources, led to increased conflict, which required the relocation and fortification of villages for defence. ☈



*The valley of the Rio Grande de Jujuy, looking towards Tilcara, Northwest Argentina. View from a pukara (defensive settlement) established in the 1300s when agricultural villages in the valley floor were abandoned following severe drought that led to conflict over water (See IAI Science Snapshot II)*

## Tracking hurricanes

Is hurricane activity increasing? Are the regions affected changing? Public perceptions are swayed by extreme events in the news. Past and current hurricanes were examined in the context of continental weather systems, event predictability and regional vulnerability. Coastal lagoon sediments that receive sandy over-wash material when hurricanes hit, and other proxies were used<sup>2050</sup> to reconstruct hurricane incidence for the past 1,500 years. Atlantic hurricane activity peaked during medieval times (ca. AD 900-1100), calmed notably after AD 1500, to rise again after

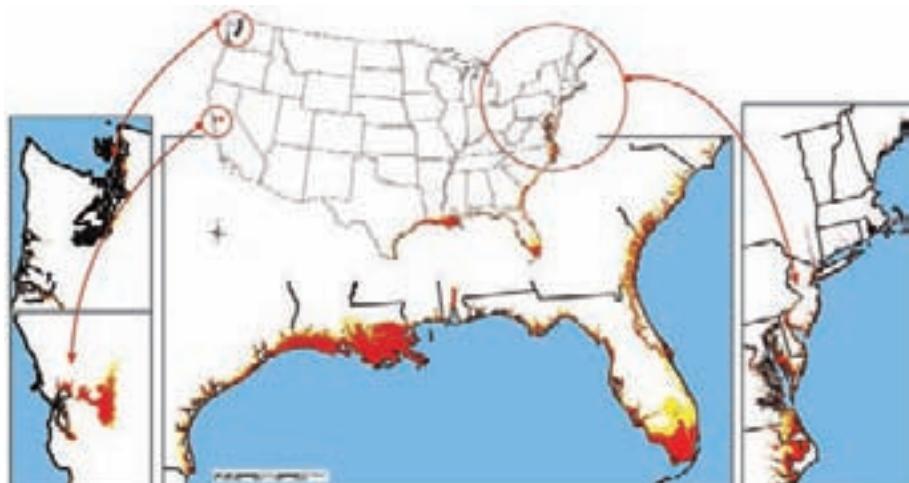
1850, especially after 1980. Peak hurricane activity during the medieval optimum, when Atlantic surface waters were warm, was comparable to present day activity. Further global (and Atlantic) warming may result in more active hurricane seasons in the future. Proxy records vary between different Caribbean locations, with high hurricane incidence in the southern Caribbean Basin (e.g., Nicaragua) during periods when activity in the Gulf of Mexico and the U.S. Atlantic coast is low and vice versa. CRN2050 has documented that Caribbean hurricane activity is influenced not only by ENSO,

but also by the strength of the vertical and horizontal wind shear produced by the Intra-Americas Low-Level Jet, and its effects on sea surface temperatures and moisture advection. Regions of locally enhanced sea surface height and ocean heat content were associated with anticyclonic ocean vortices and correlated with the development of major hurricanes. These results help forecasting the evolution of intensity, since ocean eddies have longer lifetimes than the cyclones, move more slowly, and can be monitored from satellite.



*During hurricane landfall, high waves driven by the storm surge over the sand barrier and wash sand into the coastal lake, forming what geologists call an overwash fan that appears as a sand layer (white bands in inset), distinct from the fine organic mud that accumulates under normal conditions. These layers can be seen in sediment cores and provide information about the number and strength of prehistoric storms (Liu, Kam-biu (2007) Uncovering prehistoric hurricane activity. American Scientist, Volume 95, pages 126-133.) (IAI (2010) Warmer future, stronger hurricanes? Caribbean hurricane history shows that medieval cyclone peaks rivaled current ones. Science Snapshots, 2.)*

Vulnerabilities to the risk of hurricanes are just as important as the exposure. Low-lying areas are vulnerable and will become more so with sea level rise. Detailed maps<sup>2050</sup> show 19 million people living in low-lying coastal zones vulnerable to sea level rise. In the hurricane prone regions of the Gulf and East Coast, vulnerabilities under sea level rise will be compounded by higher storm surges. Integrating regional science can thus improve hurricane forecasting on seasonal to inter-annual timescales.



The map shows for the first time how many people in the U.S. coastal states live in areas below 3 meters (red areas) or below 6 meters (yellow areas) above sea level. (Read more in IAI (2010): Heads above water. How many people live in vulnerable coastal areas of the U.S.A.? Science Snapshots 3)

The most active hurricane region on earth is the Eastern Pacific basin. The CRN2048 team modeled and followed hurricane tracks and showed weaknesses in both models and atmospheric data collection. These caused erroneous and late track predictions with resulting greater impacts on populations. As a result of the project, the Mexican meteorological service is now taking more upper atmosphere soundings to improve forecasting. The team has been able to clarify some basic rules of hurricane development: when all atmospheric variables are favorable, ocean heat content plays a minor role in hurricane intensification. When ocean heat content is locally high, hurricanes can experience rapid or explosive deepening. When hurricanes move over regions of low ocean heat content, they will become less intense, no matter how favorable atmospheric conditions are. When the atmosphere has low humidity from the surface to the mid troposphere, wind intensity is very likely to decrease and the cyclone may even disappear. Yet, when a series of simulations were compared to observed cyclones, none of them accurately reproduced cyclone intensification. Hurricanes also have positive impacts: high rainfall brought by hurricanes contributes to filling the aquifers in the dry US-Mexico border region<sup>HD005</sup>.

## Ocean productivity and the fate of CO<sub>2</sub>

Climate variations over the La Plata basin, affect not only landuse and terrestrial ecosystems but also the productivity and fisheries in the South Atlantic<sup>2076</sup>. River outflows wash continental constituents into the coastal ocean. The Rio de la Plata with its seasonal fluctuations exerts a remarkable influence on the biological, geological and physical characteristics of the continental shelf off eastern South America.

It is often assumed that the success of fisheries exclusively depends on management factors such as conservation or overfishing, but the interplay between river outflow and ocean currents was found to be decisive in the shrimp fisheries of the Patos Lagoon in Brazil. For the regional economy these environmental effects were compounded by policy constraints such as inflexible fishing seasons that would need to be changed to take into account the ecological controls on productivity.

Inter-annually, the Plata discharge is modulated by the El Niño/Southern Oscillation (ENSO), but its distribution critically depends on

the along-shore winds which counteract the strong northward plume penetrations predicted from theory during the positive ENSO phase. In the south, exchange processes between the deep ocean and the Patagonian Shelf determine primary biological activity. The Patagonian shelf hosts one of the most productive marine ecosystems on earth.

Two important aspects of ocean productivity were explored by the CRN2076 team. Nutrient upwelling into the light zone enhances algal and plankton growth, the base of the food chain that sustains fisheries. And carbon fixation by algae is an important removal mechanism for atmospheric CO<sub>2</sub>. Numerical and analytical models have shown that the interaction of the nutrient-rich Malvinas Current with the bottom slope induces permanent upwelling along the shelf break, a previously unknown mechanism. Similar frontal characteristics have since been identified between the South and Mid Atlantic Bights on the US east coast.

Despite the high productivity of the region, there are signs of overfishing which together with global change are affecting marine food webs. One prediction yet to be fully documented is the increase of jelly fish population as a consequence -and therefore an indicator- of the disruption of food webs. The project has tested novel acoustic techniques for the detection and quantitative estimates of jellyfish abundance which can re-examine past echo records to permit long-term analysis. This provides a unique practical application of the teams' research. ☀



## Outreach

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### Communicating science

Carbon sequestration by the ocean, climate feedbacks from land use and land cover change, threats to biodiversity, all are of importance to decision making. CRN research projects provided state-of-the-art scientific knowledge and potentially transformative science. The output of some CRNs has directly affected policies. Others have helped improve the relevance of

science for society, e.g. through improved weather forecast and information systems, or by providing input to the international research dialogues of UN Conventions and Assessments. By making scientific information available through its researchers, IAI-fostered research has attained direct and indirect policy impact. Capacity building activities also have

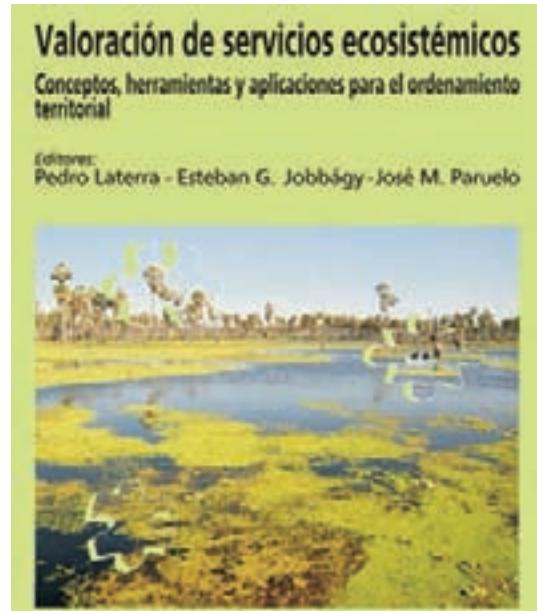
reached out through science-policy fora on the impacts of agricultural expansion on the environment (Asuncion, April 2011) and on climatic and environmental vulnerability in productive sectors of Uruguay (Montevideo, July 2011). Both events were well attended, which reflects the interest of the public in global change related issues. ☕

## Providing scientific knowledge for decision making

### The value of ecosystem services

CRN2031 results assisted the Argentinean Ministry of Agriculture in the development of a Federal Initiative on Land Use Regulation and Policy. The high level of integration of research results provides tangible concepts and measures of ecosystem services, which are documented in a publication with the Argentinean agricultural research service (INTA), sponsored by INTA and CRN 2031.

Results of IAI science have supported national science and data collection programs on global change adaptation and preparedness. CRN2014 results on the role of symbiotic soil fungi were used by the Government of Canada to select wheat genotypes with improved compatibility with mycorrhiza native to the Prairies and with reduced dependence on fertilizers. This helps improve food security and production levels in drylands vulnerable under climate change. ☈



## Deciding what forests to protect

Protecting “pristine” ecosystems is not a realistic goal in countries where most ecosystems have been used and modified for centuries. Secondary forests and mixed species-rich shrublands still provide multiple services such as carbon storage and forest products. Projects investigating biodiversity and forest margin dynamics (CRN2005, CRN2015) provided evidence in favor of preserving such secondary forests to the Parliament in Cordoba. The Parliament approved a new forest law that reserves protection for only some of the most “natural” forests. This decision is pointing to the importance of quantifying ecosystem services to facilitate a full evaluation of conservation needs.

One of the ecosystem services provided by forests is hydrological regulation (see page 10). The project on Andean hydrology<sup>CRN2047</sup> contributed to the Native Forest chapter for the Chilean National Commission for the Environment’s (CONAMA) report on the state of the environment. One project scientist is on the Native Forest Advisory Council which coordinates water, soil and wetlands protection and provides subsidies to land owners for forest preservation. In the Argentinean province of Mendoza with its billion dollar wine industry depending on Andean water supplies, project investigators act as advisors to the Climate Change Agency on resource management policies. CRN investigators have also led the initiative

to develop a new national inventory of glaciers in Argentina, a task recently awarded to the Instituto de Nivología, Glaciología y Ciencias Ambientales (IANIGLA). Furthermore, they have provided significant inputs to the development of the national Glacier Protection Law.

The project, which extended along the entire Cordillera of the Americas, also documented that in the Western Sierra Madre of Mexico, land-use changes, deforestation, and overgrazing increased runoff and decreased the base flow of streams that supply water for industrial and urban uses. ☈



## Tropical dry forest research

The Tropi-Dry<sup>2021</sup> project is an example of the multiple benefits of interdisciplinary and international research with flexible management and the goal of informing policy and decision making. At a macro-level, Tropi-Dry showed differential long-term responses of tropical dry forests to climate change across the Americas using satellite information. Forests near the equator changed little, while forests far from the equator showed either increases (South-Central Brazil) or decreases in productivity (NE-Brazil and Mexico) attributable to longer or shorter growing seasons respectively. These broad observations were linked to detailed ecological knowledge and vegetation composition using newly developed extensive libraries of spectral signatures that made it possible to discriminate different successional stages. As these spectral indices are related to plant functional traits, spectral data can now be used to infer ecosystem processes and management options.

Because of their continent-wide knowledge on dry forests, the Tropi-Dry team was asked by the Brazilian appeals court to provide expertise towards forest protection in the state of Minas Gerais. State laws introduced in Minas Gerais in 2008 and 2010 removed the protection from much of the state's forests, arguing that these forests should be considered part of the Caatinga biome, which is not protected by Federal law. Removing the protection risks loss of ecosystem services, habitat, biodiversity, soil fertility, erosion, and shifts in the regional climate regime. Loss of important environmental services in turn increases the vulnerability of rural populations and causes rural migrations. A recent survey by the Universidade Estadual de Montes Claros, Minas Gerais, a Tropi-Dry partner, revealed that about 11.6% of forest was lost between 1986



and 2006. The team could successfully demonstrate that the forests should be protected as Atlantic Rainforest by Federal law, and in January 2011, the State laws were revoked.

But conservation cannot be a goal in itself, particularly where human livelihoods are affected. Tropi-Dry analyzed social-environmental conflicts between traditional populations and conservation units (CUs) in Northern Minas Gerais showing their exposure to food insecurity. This information will be used to change the management of some CUs in the region. The ecosystems were illustrated in an audio slideshow released by the NSF to mark the Earth Week 2011 ([http://www.nsf.gov/news/newsmedia/dry\\_forest/](http://www.nsf.gov/news/newsmedia/dry_forest/))

Balancing human needs and aspirations with resource conservation requires sound information for landuse planning and monitoring. Tropi-Dry's remote-sensing products now form the basis of the official land cover maps of the Costa Rica National Forest Financing Fund (FONAFIFO in Spanish). FONAFIFO uses these maps for monitoring and evaluating the effectiveness of payment for environmental services programs. Tropi-Dry scientists contributed to continental policy development for arid and semi-arid regions by the Inter-American Development Bank. In Mexico, one of the network researchers has been interacting with Mexico's National Forest Commission (CONAFOR in Spanish) to integrate Tropi-Dry results into emerging programs for payments for Environmental Services. ☘

## Climate Services

Soybean has created great wealth in the countries of the LaPlata basin, accompanied by an expansion of arable agriculture over grasslands and forests. The preservation of natural resources will in part depend on improving the efficiency with which agriculture can produce on already cultivated lands. To reduce climate risks, SGP-HD014 implemented climate-based decision support systems for agricultural practice in close cooperation with cooperatives of soybean producers in Eastern Paraguay and southern Brazil. The web-based climate information

system is available for Paraguay (<http://py.agroclimate.org/>) and is being developed for Brazil. Several cooperatives have invested in weather stations to support this system.

The researchers of SGP-HD005 examined how effectively knowledge on climate and hydrology is communicated to communities in the U.S.-Mexico Border region. A new extension program by project associates has attracted major funding from NOAA and provides support to rural and urban water management and planning. The broad collaborations with multiple agencies in

this project have led the IAI to invite project partners to develop a center of excellence for water security together with the Catholic University of Santiago, Chile (see page 25).

Following recommendations by CRN2048, the Mexican Weather Service improved its upper air sounding program to provide better predictions of hurricanes and their tracks. This is resulting in improved early warning systems that reduce vulnerability of populations to extreme weather impacts. ☑

## **Pollution forecasts in Latin American cities**

Urban pollution is relevant to different government departments, environment, public health, and transport. Members of the research network on urban pollution (CRN2017/SAEMC) made great efforts to reach stakeholders in the weather services and in municipalities. In Bogotá, city authorities used detailed emission data provided by this project to update the city decontamination plan. Likewise, in Medellín, SAEMC provided crucial support to an urban decontamination plan now implemented. Project studies on urban traffic emissions contributed to revisions of Santiago's air quality attainment plan. In the greater Buenos Aires area, the collaboration of scientists with municipal authorities is being followed up by the Argentinean project team to evaluate the communication mechanisms between different relevant provincial departments and the scientists.

Through SAEMC efforts, daily online forecasts of air pollutants for Santiago, Medellín and Lima are now available as a public service. The network has facilitated the international collaboration on urban air pollutant emissions, their forecasting and climate modeling. This was in part facilitated through shared computing in a grid network that links up institutions in Brazil and Chile, developed as part of SAEMC's activities. The city of Lima has gained a functional chemical-weather forecast system thanks to the capacity building efforts of the project in collaboration with the Peruvian National Meteorology and Hydrology Service (SENAMHI), which allowed training for SENAMHI staff in São Paulo. New legislation, currently under approval, is expected to make SENAMHI the institution that issues alerts on air quality standards for the Peruvian Ministry of Environment. 

## Awards to IAI researchers

Esteban Jobbág, Principal Investigator (PI) in CRN 2031, has received the Argentinean 2009 Houssay Award in the category biology, agriculture and veterinary science. The prize was presented by the President of Argentina. Since 2000, Jobbág has been studying soils under changing vegetation cover to understand the interactions between vegetation and groundwater in terms of biomass productivity, salt dynamics, and water quality. His research and discussion with colleagues in Argentina, Uruguay and the US, made it possible to identify environmental costs of land cover change and evaluate the effectiveness of attempts to regulate atmospheric CO<sub>2</sub> with vegetation management. These findings were taken into consideration by environmentalist, producer and governmental sectors on both sides of the La Plata River.

Sandra Diaz, PI in CRN 2015, became a Foreign Associate of the National Academy of Sciences of the US (2009), a member of the Third World Academy of Sciences (TWAS) (2010) and a member of the National Academy of Sciences of Argentina (2011).



Hugo Berbery, PI in CRN 2094 was elected Fellow of the American Meteorological Society.

Nina Lam, Co-PI in CRN 2050, was named the 2010 Louisiana State University Distinguished Research Master in Arts, Humanities and Social Sciences, honoring faculty with a long-term record of distinguished research and scholarship. ☈

Researcher Nina Lam. Photo courtesy by Jim Sietz, LSU University Relations



Investigator Esteban Jobbág with Argentinean President Cristina Fernandez de Kirchner  
photo by Andrés Moreno, source: FAUBA - [www.agro.uba.ar](http://www.agro.uba.ar)

## Impacts of agricultural intensification on the environment

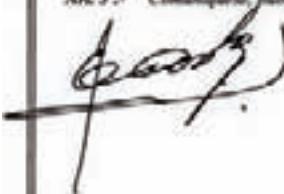
Paraguay and Uruguay were hosts to Science-Policy Fora on climate and environmental vulnerability in April and July 2011 respectively. Both fora were held back to back with an IAI training activity (see Table, page 28). Beyond their training mandate, these IAI capacity building activities strengthened the relationship between the IAI and the hosting countries. In Asuncion land, climate, hydrology, and social (economics and anthropology) scientists discussed the interactions and impacts of agricultural expansion in the La Plata Basin. IAI investigators served as lecturers at both forum and Training Institute (TI). The audience of about 370 participants, included representatives from Paraguay's government, universities, research centers, and participants of the TI. The president of Paraguay, Fernando Lugo, and the mayor of Asuncion, Arnaldo Samaniego, declared the IAI Training Institute to be of national and municipal interest given its intellectual merit in providing capacity building on important issues such as agriculture, food and water security.

The Science-Policy Forum on climate and environmental vulnerability in productive sectors of Uruguay was hosted by the Municipality of Montevideo. Over 100 participants from government agencies such as the Ministries of Agriculture, Environment, Health, Energy, universities, national and international research and development centers attended. The forum promoted a dialogue among scientists, policy-makers and civil society on global environmental change and its impacts. A scientific and a political panel discussed how public policies have incorporated scientific findings and explored the mechanisms for facilitating the flow of research into public policies.

### EL PRESIDENTE DE LA REPÚBLICA DEL PARAGUAY

#### DECRETA:

- Art. 1º.- *Declarar de Interés Nacional la "Capacitación sobre Cambio de Uso de la Tierra, Seguridad Hídrica y Alimentaria en la Región de la Cuenca del Río de la Plata" y la "Reunión Política del Instituto Interamericano de Investigación para el Cambio Global", que se llevarán a cabo del 6 al 15 de abril y del 14 al 17 de junio del año 2011, respectivamente, organizados por la Facultad de Ciencias Exactas y Naturales de la Universidad Nacional de Asunción (FaCEN-UNA), conjuntamente con el Instituto Interamericano de Investigación para el Cambio Global-IAI.*
- Art. 2º.- *El presente Decreto será refrendado por el Ministro de Agricultura y Ganadería.*
- Art. 3º.- *Comuníquese, publíquese e insértese en el Registro Oficial.*



The Science-Policy Fora provided a focus on the different perspectives and motivations between the scientific and policy sectors, and thereby facilitated the dialogue. These two communities are faced with similar challenges and are seeking options for responding to common environmental problems. Attributes that can define the usefulness of scientific information for policy-making are salience, relevance and credibility, among others. A common concern, particularly among junior researchers, was how far scientists should engage along the research-policy continuum. Complex societal and environmental problems do not always have an answer that can be identified through scientific research alone. Instead, the existence of multiple viewpoints and values throughout society implies that multiple solutions or possible answers to a complex question coexist. Two approaches were recommended by the participants: to ensure that relevant social actors are involved in the research process in such way that their needs, expectations and personal values are taken into account in both the research design and interpretation; and to design well-structured and transparent scientific processes that can provide information to support decision-making but leave choices to societal actors. The communication of uncertainties, "envelopes" of possible outcomes, and of alternatives needs to be improved to aid this decision process. ☈

## Integrating knowledge for water security

A continent-wide network of scientists of hydrology-related projects is beginning to synthesize knowledge on water security based on the results of several years of IAI funded research. Coordinated through the IAI directorate, such synthesis and integration now provide new insights into one of the most important and least predictable components of global change on the continent. A synthesis meeting on climate risk and water security in the Americas was held in March 2011 in Los Cabos, Mexico, under the auspices of the IAI and the University of Arizona (UA) with 40 researchers and water managers from Brazil, Chile, Argentina, Mexico, United States and Canada. One outcome of this meeting was the establishment of an IAI Center for Climate Risk and Water Security (AQUASEC, <http://aquasec.org/>), led by UA in close collaboration with Pontificia Universidad Católica de Chile. The center was endorsed by the 18th CoP of the IAI and represents the first of the IAI Centers of Excellence envisaged in the Agreement establishing the IAI. Objectives of the center are to promote water security through adaptation and innovation with adaptive management; to develop science-policy networks for global-change adaptation in intersectoral, transboundary, and cross-regional contexts; and to produce usable knowledge that addresses uncertainty in the face of evolving water security challenges. ☈



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## Investing in people

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*IAI Capacity Building is about knowledge integration at the science-application-policy interface. It goes beyond individual disciplines, traditional training methods and national borders. Interdisciplinary training programs build on the contribution from different scientific fields and the understanding of their interactions, in addition to the practical knowledge and experience from environmental practitioners, stakeholders and user groups. Activities build skills and design mechanisms for integration, collaboration and communication among sciences and with policy. Coupling IAI training activities with science programs provides additional scientific capacity building and further encourages collaborative networks.*

From January 2010 to February 2012 eight capacity building events, including Training Institutes (TIs), Science-Policy Fora, a Colloquium and a Workshop were organized by the IAI (see Table on page 28). Six hundred and fifty three professionals from 21 countries participated in these activities. The training events were funded with resources from NSF grants and through successful leveraging of funds by the IAI, which permitted a considerable expansion of the capacity building program. These capacity building activities explored regionally important themes of global environmental change (GEC), and developed programmatic and financial partnerships with institutions in IAI member countries and with other international organizations.

IAI capacity building provided knowledge on GEC and opportunities to practice research and communication tools such as modeling, geo-referencing techniques, climate prediction, risk assessment, and the formulation of policy briefs, case studies and environmental policies. As part of the IAI's mandate for promoting outreach, participants explored mechanisms to provide scientific information for productive sectors; develop and maintain interdisciplinary, institutional and multinational collaboration; and initiate future research networks.

Through presentations, discussion and practical exercises, the interdisciplinary TIs addressed the tasks of synthesizing information, weighting the contribution

from various disciplines, identifying best visual tools (maps, graphics) for supporting arguments and the information provided, and communicating scientific findings to society in simple but comprehensive language.

Training Institutes were effective in fostering an integrated approach to assess environmental problems and demonstrating the interconnections among climate, hydrology, land use, urbanization and socioeconomic development and public health. This highlighted the importance of interdisciplinary research in addressing complex global change issues and their social and economic impacts. Many participants had not worked with scientists from other disciplines and found this interaction stimulating and valuable, particularly when defining common goals in seeking responses to GEC problems.

To further encourage interdisciplinary collaboration, application of scientific information into practical work, and the development of collaborative networks, the IAI Training Institute Seed Grant program provided participants of the IAI TI on climate and health (Piriápolis,

Uruguay) with the opportunity to continue working together, combining and complementing expertise and knowledge in tackling environmental health concerns. The seed grant program, at the same time, provided training on proposal development and the management of international projects.



*Hands-on training on the use of seasonal climate predictions for applications in Latin America, in Buenos Aires. Photo courtesy by Guilherme Martins (CCST/INPE, Brazil)*

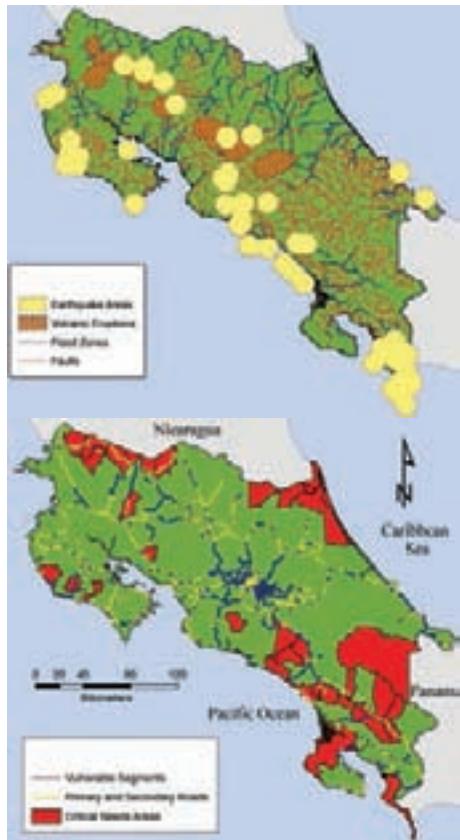
<b>Event</b>	<b>When &amp; where</b>	<b>Participants</b>	<b>Sponsors</b>
Colloquium on Knowledge innovation at the Science-Policy interface	12-23 April 2010 San Jose, Costa Rica	29 from 13 countries	 
TI on the use of seasonal climate predictions for applications in Latin America	2-13 August 2010 Buenos Aires, Argentina	36 from 13 countries	   
TI on Urban Responses to Climate Change: Politics, Strategies and Instruments for Latin America and the Caribbean	1-6 November 2010 Santiago, Chile	37 from 16 countries	   
Science-Policy Forum on Agricultural expansion is creating wealth for nations; is it also destroying the natural resource base for development	6 April 2011 Asuncion, Paraguay	370	   
TI on Land Use Change Analysis and Water and Food Security in the La Plata Basin Region	6-15 April 2011 Asuncion, Paraguay	35 from 11 countries	
Workshop on Climatic and Environmental Vulnerability in the Region of the La Plata basin: Case Studies of Agricultural Intensification using GIS and Crop Models	19-22 July 2011 Montevideo, Uruguay	24 from 7 countries	   
Science-Policy Forum on Climatic and Environmental Vulnerability in Productive Sectors of Uruguay	22 July 2011 Montevideo, Uruguay	100	
TI on Climate and Health	7-18 November 2011 Piriapolis, Uruguay	22 from 9 countries	   

Links to these events are under Capacity Building in the IAI website ([http://www.iai.int/index.php?option=com\\_content&view=article&id=29&Itemid=77](http://www.iai.int/index.php?option=com_content&view=article&id=29&Itemid=77))

## Designing policy briefs

**Disaster preparedness** Costa Rica is vulnerable to hurricanes, volcanic eruptions, landslides and floods. Some 20% of the total national population live in small and/or isolated rural communities in 15 districts with “very high” levels of critical needs. The lack of resources and the distances to urban centers make those communities particularly vulnerable to natural disasters. Impacts are made worse if access is interrupted. More than 2000 km of Costa Rica’s principal and secondary roads are threatened by volcanic eruptions, earthquakes and flooding. Thus, it is essential that communities develop the capacity to provide first disaster response by themselves until the National Emergency Committee and other rescue teams arrive. This was the major recommendation proposed by the 29 professionals, who attended the IAI-NCAR Colloquium in Costa Rica. Through a collaborative work that synthesized the available knowledge, combined various expertises, and used GIS tools the group prepared a policy brief and designed risk maps that illustrate the case for policy and decision makers in a simple and concise manner.

Participants of the IAI TI held in Asuncion were faced with the challenge of preparing policy briefs assessing environmental problems, synthesizing scientific information. This required exploring multiple disciplines in the assessment and in the design of potential actions. The dynamics of the TI process are visible in the topics chosen by the participants for the policy briefs, which dealt with both environmental problems and with the process itself by which such communications are developed: *Interdisciplinarity: an opportunity to understand environmental systems; Facing the complexity of landuse change impacts on food security; Changes in land cover and landuse; Water security in Latin America; Capibary, Paraguay: a multidisciplinary example; Changes in land use and water resources.* ☒



Hazards in Costa Rica (upper map) and road segments vulnerable to natural hazards (bottom)

### ***First opportunities for young scientists in IAI collaborative research***

Three projects resulting from the TI on climate and health (Piriápolis, Uruguay) were approved for funding under the seed grants. The projects established regional networks of cooperation on climate and health for the application of the knowledge

and tools provided by the course. Project results should contribute to the MERCOSUR Strategy to Protect Human Health under Climate Change, defined by the Ministers of Health of the Region in 2009. Despite being a modestly funded program, these

seed grants are catalytic in promoting new collaborations among professionals and institutions of the Americas, as well as providing ways to disseminate knowledge to guide future research and support policy.☒

### ***Research Internships***

A joint initiative of the IAI and Brazil's National Institute for Space Research (INPE) through its Center for Weather Forecast and Climate Studies (CPTEC), the Research Internship Program on Understanding Climate Change and Variability in the Americas provides an opportunity for masters, PhD students and young scientists to develop global change research and applications in socioeconomic sectors

and promote partnerships among Latin American researchers and institutions.

INPE/CPTEC facilitates training on climate models, climate data analysis and applications for interns to develop their research studies. IAI involves interns in its research and capacity building programs to strengthen their training program and provide additional scientific capacity

building. For instance, two participants of the TI on seasonal climate predictions (Buenos Aires) subsequently developed their research proposal conceived during the Training Institute in a 6 months internship at CPTEC. A total of 5 interns spent between 6 and 7 months each in the program in 2010-12.☒

## The challenges ahead...

Attempts to make interdisciplinarity into a “discipline” (that might be learnt in a degree program) often result in knowledge that is too shallow to be reliable or useful. Decision makers often require general insights and overviews, but when decisions are challenged, the underlying science must withstand rigorous scrutiny. This means that interdisciplinarity must be based on teamwork and networking, and the ability of scientists to collaborate and ask the right questions of their network members. Such networking requires a change of culture: institutional incentives and rewards for interdisciplinary work must be established.

Publication of interdisciplinary research may be more difficult than traditional disciplinary work, and citations indices don't necessarily show the value of such efforts.

Real world problems are not delimited by disciplinary boundaries. Therefore, user-inspired science needs interdisciplinarity. But in addition to the challenges that brings, communicating results to knowledge users requires yet another type of professional to act as “translators” or “bridge builders” who may be working in boundary organizations or be part of the science teams. Such intermediaries facilitate communication

among members of an interdisciplinary team, and between researchers and other social actors - always guided by the goal of providing reliable, credible, usable science.

These challenges require a significant re-thinking of institutional and scientific governance and funding mechanisms as well as the development of new training programs that teach not so much “interdisciplinarity” but the ability to listen to and communicate with other disciplines and end-users. ☒

## Global dialogue

*Since 2005, the IAI is an observer intergovernmental organization (IGO) at the United Nations Framework Convention on Climate Change (UNFCCC) and participates in meetings of the Subsidiary Body for Scientific and Technological Advice (SBSTA).*

### United Nations Framework Convention on Climate Change

In the research dialogue of SBSTA-32 in 2010 the IAI highlighted findings from three of its collaborative research networks to improve CO<sub>2</sub> accounting and the understanding of regional hydrological processes.

At SBSTA-33 held during COP-16 in Cancun, Mexico, the IAI participated in a side-event which allowed CRN 2050 investigator Kam-biu Liu to provide an assessment of vulnerabilities to cyclones. The side-event featured research by the IAI, the WCRP, the Global Carbon Project (GCP), and the IAI's sister organization Asia Pacific Network (APN) for nearly 200 participants including the UNFCCC Executive Secretary Christiana Figueres. In her concluding remarks,

Figueres said "The history of this Convention proves that the policy response is always trying to catch up with science and that science is always a step ahead of policy-makers so you need to show them the way. The period between IPCC reports is 5 years, what do we do in between, when we meet at every 6 month period? We need much faster more timely input from science".

In 2011, at a UNFCCC workshop on Research in conjunction with SBSTA-34, investigator Esteban Jobbág (CRN 2031) presented findings on interactions between land cover and climate. In the subsequent research dialogue, the IAI provided highlights from the Tropical Dry Forest network (CRN

2021) on communicating science to policy-makers and capacity-building to delegates, scientists and representatives from regional and international research organizations and the IPCC. In its recommendations, the SBSTA noted research discussions under the UNFCCC have enhanced consideration and understanding by Parties of the emerging scientific findings and related issues on communication and research-related

capacity-building, particularly in developing countries.

In a side-event at the UN Climate Change negotiations in Durban, South Africa (November 2011), IAI researchers Alberto Piola and Edmo Campos of CRN 2076 underscored the importance of understanding the links between biological carbon sequestration, chemical absorption, physical transport and possible re-release

of CO<sub>2</sub> to the atmosphere and what this implies for carbon management options. Other invited speakers were Dr. Chris Sabine, Director of NOAA's Pacific Marine Environmental Laboratory and Dr. Pedro Monteiro, head of the Oceans Systems and Climate of the Council for Scientific and Industrial Research (CSIR) in South Africa, who presented on behalf of the Earth System Science Partnership (ESSP). ☒

## Blue carbon

The IAI CRN 2076 team from Argentina, Brazil, Canada, Chile, the United States and Uruguay presented critical findings on how the physical processes over the Patagonian shelf control the ocean productivity and how the most productive shelf regions are responding to climate changes at the UN Climate Change Conference in Durban.

The ocean may be the ultimate long-term sink for as much as 90% of human-

released carbon dioxide. Understanding that sink may open ways to mitigate climate change, but very little is known about the subsequent fate of the sequestered carbon. The million square kilometer Patagonian shelf every year absorbs an amount of carbon equivalent to 100 thousand hectares of rainforest. The net ocean uptake of two billion metric tones of carbon per year is the difference between a much larger large ocean absorption of carbon nearly balanced

by a very large release of carbon. A change in the processes controlling that delicate balance could be a game changer when it comes to predicting future climate change and the scale of our emissions reduction targets.

The photosynthetic productivity of the oceans not only sequesters carbon, it also is the basis of the food chains that sustain the world's fisheries. The Patagonian

shelf break is one of the most important fisheries regions on earth, with a harvest of millions of tons of fish and squid per year. Overfishing not only reduces future catches but also disrupts the marine ecosystem's food web and can affect the capture of carbon.

The opportunity to present science at the UNFCCC was an important experience for the scientists, as it "brought together

high level representatives from most nations to propose a global agenda about nothing else than how to manage our future on Earth. Thus, this is one of those venues in which we, as scientists, are the odd characters. Unlike scientific meetings, where we vividly discuss our science till the late hours and we feel at home, at this Conference the details of our research are unimportant. The task is not easy, here we face two equally challenging issues:

identifying what facts and ideas we believe are most important for decision makers, and transmitting these to them in a way they may realize why these are important. The side event was well attended, and the questions asked by the "public" suggest we may have been successful in transmitting our science and its relevance. It will contribute to the delineating of better policies for sustainable development, and to making the best possible decisions," commented principal investigator Alberto Piola. "I am convinced that the message on the importance of the ocean currents in the advection of carbon from zones of uptake to areas of outgassing contributed to augment a little bit the concerns on the need to maintain widespread ocean monitoring systems", added Edmo Campos. A video on the research of this group of IAI investigators is available at <http://www.youtube.com/v/06mmKNuf0Sw>. 



## **Collaboration with the UN Economic Commission for Latin America and the Caribbean (ECLAC)**

A Memorandum of Understanding signed in June 2011 between the IAI and ECLAC, facilitates joint activities for technical collaboration, training and research aimed at improving capacities in environmental management, scientific knowledge on global environmental change issues and their socio-economic impacts on regional sustainable development in Latin American and Caribbean countries.

The first activity under the MoU is an editorial forum to prepare a book *Building a sustainable future. ;Why learning to live with climate change is important for urban areas in Latin America and the Caribbean? How can this be achieved?* The MoU grew from the training institute on Urban responses to climate change: policies, strategies and tools for Latin America and the Caribbean, in

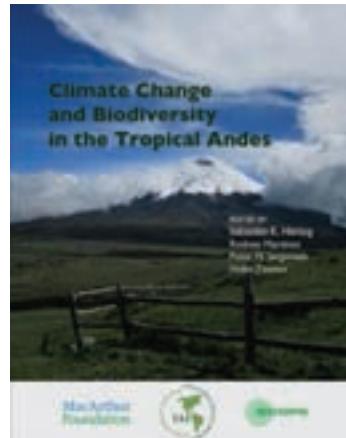
Santiago, Chile in November 2010 that was jointly organized by the IAI and ECLAC.

ECLAC, one of the five UN regional commissions, based in Santiago, was established to encourage economic collaboration and development in and amongst its member states. ☈

## Assessments and syntheses

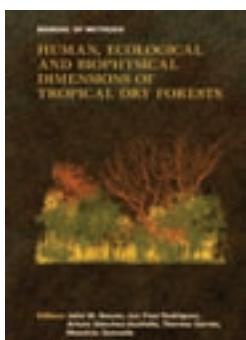
The process of generating knowledge does not end with the individual science projects of the IAI. Projects have generated a large number of scientific publications and theses. Bringing scientists together to develop syntheses and crosscutting themes goes beyond these publications and provides additional new insights that add value to the original research effort. IAI has repeatedly teamed up with SCOPE, the Scientific Committee on Problems of the Environment, to develop syntheses of its science.

The assessment of research and institutional needs to cope with the effects of climate change on Andean biodiversity concluded in 2010. The three-year project funded by the John D. and Catherine T. MacArthur Foundation and coordinated by the Directorate resulted in an e-book, a comprehensive state-of-the-art appraisal on biodiversity and climate change for the tropical Andes (a Spanish version will be printed). In addition, the project produced several policy strategy documents for biodiversity conservation under climate change. The successful assessment led the foundation to award a second grant to the IAI, to develop a standard methodology for estimating climate change risks for biodiversity at local scales (along two transects in Colombia-Ecuador and in Bolivia-Peru) that can be used to design adaptation measures tailored to particular conditions. Arising from the assessment project, our partner, CIIFEN is carrying out the project "Regional information system on climate change and biodiversity in the Andean countries" funded by the Inter-American Development Bank. This policy oriented project is aimed at facilitating access to scattered existing information on climate change and biodiversity to support public policies. IAI and CIIFEN will combine the activities of both projects for larger regional benefits and outcome.





IAI-funded research projects continue to provide information after their finalization. The CRN on comparative studies of global change effects on the vegetation of two tropical ecosystems (1999–2006) studied the effects of global change on high mountains and the savanna. Part of this research is now published in Spanish, in two volumes on 778 pages. Editors are professors Gilberto Morillo, Benito Briceño and Juan F. Silva from the Universidad de los Andes, Venezuela. The book describes the diversity of monocotyledon plant species in the Venezuelan paramos and their ecotones, gathering for the first time ever an enormous amount of scattered information and providing new botanical and ecological data.



Manual of Methods: Human, Ecological and Biophysical Dimensions of Tropical Dry Forests - developed by the IAI Tropi-Dry network (CRN 2021). Editors: Jafet M. Nassar, Jon Paul Rodríguez, Arturo Sánchez-Azofeifa, Theresa Garvin, Mauricio Quesada. This book was designed specifically for tropical dry forests with emphasis on the topics included in the IAI project, but it has wide application potential, as the global change questions addressed with these methods are similar to those in other terrestrial ecosystems. The book describes a wide range of methods: ecological, remote sensing and social science, with emphasis on the dynamics of the systems investigated, so that the analyses provide a picture of the processes of deterioration and/or recovery of heavily disturbed systems (in English).

## **Policy briefs**

### ***The here and now of climate change: adapting to changing seasonality***

People are used to divide each year into seasons, cyclical changes of weather, temperature, precipitation, wind and daylight. Seasons determine patterns of water availability, food production, health, the economy, social life and culture. In many regions seasons are changing. Flexible planning and management are needed to adapt to changes in climate and seasonality: planning that integrates climate, hydrology, landuse disease, flexible management that considers natural phenomena, legal and political issues across spatial and temporal scales, and develops responsive educational and communication strategies. The document is available at [http://www.iai.int/files/policy\\_brief/SeasonalityBrief.pdf](http://www.iai.int/files/policy_brief/SeasonalityBrief.pdf).

### ***Sustainability strategies and sustainability research in Latin America***

Sustainability in Latin America has often been seen as a problem of rainforests and diversity only, but we argue that several important areas have been overlooked. The role of non-rainforest ecosystems in biodiversity, the sustainability of land management in agricultural areas and its effects on carbon and water balances, the problems of big cities and urban sprawl, the vulnerability of coastal ecosystems and populations, the management of hydrological resources under climate change, and the depletion of ocean resources are of increasing importance to secure sustainability on the continent.

A new series of Science Snapshots explains the science behind key research illustrations, available in English and Spanish on the IAI website. Four issues of the Newsletter have been published and are available in print or as pdf on the IAI site. [↗](#)

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## People

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### IAI Directorate

The Directorate's primary responsibilities are to promote and represent the Institute within the region and the rest of the world, develop and implement the Institute's long-range plans and strategies, implement financial policies and monitor budgets. The evolution of IAI sponsored global change science and related activities, has resulted in the inclusion of multiple disciplines in all research projects. The Directorate plays a crucial role in guiding and promoting such interdisciplinarity, which includes the human dimensions: social and economic sciences, outreach to non-scientific audiences and dialogue with policy and decision makers. In addition, coordination and collaboration among projects is guided by the Directorate to enrich the science dialogue and permit cross-program synthesis of results.

The Directorate's capacity building activities aim at the integration of research and training in global change sciences and applications. Besides providing lectures and instruction, IAI researchers are also students at IAI training events. This double role is possible because of the unique space the IAI explores at the interface between different sciences and policy and decision making - where everyone has something to learn. The international character of those activities provides "take home" capacity building that enriches research groups and networks.

The Directorate's capacity building is not limited to human resources or to global change knowledge, but also aims at institutions. When signing the contracts and implementing international projects involving different institutions and management procedures, the IAI provides advice and cooperates with the administration of research institutions, so that they can meet international management and accounting standards. Hundreds of research institutions in the Americas have improved capacities and knowledge on international grant management, accountability and interactions with other institutions in the Americas.

In the past year, one of the central activities of the Directorate has been the synthesis of results of the Collaborative Research Network program (CRN) and its complement, the Small Grants Program for Human Dimensions (SGP-HD). Projects have received extensions to allow for a more comprehensive synthesis of the program and an analysis of the effects of science management on the development of interdisciplinarity. Three synthesis meetings were held, two of them in conjunction with IAI training institutes. One of these was also combined with a science-policy forum. The combination of events allowed taking advantage of expert knowledge and research findings to enrich training activities with new results and current analytical techniques. ☈



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*Director*



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*Assistant: Science Programs*



Antonio de Oliveira  
*Driver*



Paula Richter  
*Publications Editor*



Tania Regina Freire Sanchez  
*Executive Assistant*

Anita Soares  
*Accountant*

## Farewells

Ivan Donizetti de Oliveira Junior  
*Computer Programmer*  
worked with us until October 2010

Ana Claudia A. Paiva Rosa  
*Executive Assistant*  
left the IAI in December 2010

Christopher Martius  
*Assistant Director: Science Program*  
left in December 2011

## Conference of the Parties

The Conference of the Parties (CoP) is the principal policy-making organ of the Institute. It establishes, reviews and updates the policies and procedures of the IAI and evaluates its work and the accomplishment of its objectives.

### Argentina

**Carlos Eduardo Ereño**

### Agueda Menvielle

Ministerio de Ciencia, Tecnología e Innovación Productiva

### Bolivia

**Carlos Salinas Torrico (Point of Contact)**

Programa Nacional de Cambios Climáticos

### Brazil

**Maria Virginia Alves**

Instituto Nacional de Pesquisas Espaciais

### Canada

**Karen L. Dodds**

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Environment Canada

### Chile

**José Miguel Aguilera Radic**

Comisión Nacional de Investigación Científica y Tecnológica

### Colombia

**Ricardo José Lozano Picon**

Instituto de Hidrología, Meteorología y Estudios Ambientales

### Costa Rica

**Roberto Villalobos**

Instituto Meteorológico Nacional

### Cuba

**Enrique Moret Hernandez**

**Daysarih Tapanes Robau**

Ministerio de Ciencia, Tecnología y Medio Ambiente

### Dominican Republic

**Ernesto Reyna**

**Omar Ramírez**

Ministerio de Medio Ambiente y Recursos Naturales

### Ecuador

**Manuel Eduardo Baldeon**

**Marco Fornasini Salvador**

Secretaría Nacional de Educación Superior, Ciencia, Tecnología e Innovación

### Guatemala

**Luis Ricardo Alvarez Giron**

Secretaría Nacional de Ciencia y Tecnología

### Jamaica

**Leonie Barnaby**

Ministry of Land and Environment

### Mexico

**Adrián Fernandez Bremautz**

**Gerardo Arroyo O'Grady**

Instituto Nacional de Ecología

### Panama

**Leslie Enrique Marin Lascano**

Autoridad Nacional del Ambiente

### Paraguay

**Constantino Nicolás Guefes Kapsalis**

**Fernando José Mendez Gaona**

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Ministerio del Ambiente

**Ken Takahashi Guevara**

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**Elizabeth Silvestre Espinoza**

Servicio Nacional de Meteorología e Hidrología

## **Uruguay**

### **Jorge Rucks**

Ministerio de Vivienda, Ordenamiento  
Territorial y Medio Ambiente

## **USA**

### **Maria Uhle**

### **Paul E. Filmer**

### **Tim Killeen**

National Science Foundation

## **Venezuela**

### **Guillermo Barreto**

Ministerio del Poder Popular para Ciencia,  
Tecnología e Industrias Intermedias 

## **Executive Council**

The Executive Council (EC) is the executive organ of the Institute elected by the CoP for two year terms. Currently it is made up of Argentina, Brazil, Canada, Chile, Colombia, Cuba, Mexico, Paraguay and USA. The composition of the EC Bureau in 2011 is as follows, Paul E. Filmer, USA (Chair), Carlos E. Ereño, Argentina (First Vice-Chair) and Ricardo J. Lozano, Colombia (Second Vice-Chair).

## **2009-2011 meetings of the CoP and EC**

- 27th EC – 16th CoP - 28th EC, Bogotá, Colombia, 18-21 May 2009
- 29th EC - 17th CoP - 30th EC, Brasília, Brazil, 08-11 June 2010
- 31st EC - 18th CoP - 32nd EC, Asunción, Paraguay, 14-17 June 2011 



*Participants to the Executive Council Meeting, June 2010, Brasilia, Brazil*

## Scientific Advisory Committee

*As defined in the Agreement establishing the IAI, the Scientific Advisory Committee (SAC) is the main scientific advisory body of the Institute. It makes recommendations to the Conference of the Parties regarding the Scientific Agenda, long-range plans and annual program of the Institute.*

*The SAC is composed of ten members elected by the CoP. These members are scientists recognized internationally for their expertise in a variety of disciplines relevant to global change research.*

*Members are appointed for three year terms, with eligibility for a single additional term. Brief descriptions of SAC members bios can be found in the IAI Newsletters of 2009 -2011.*

### **Members of the Scientific Advisory Committee (SAC) (June 2011)**

#### **Frank Müller Karger (Chair)**

University of Massachusetts Dartmouth, USA

#### **Walter Baethgen**

International Research Institute  
for Climate and Society (IRI), USA

#### **Rodolfo Dirzo**

Stanford University , USA

#### **Jose Antonio Marengo Orsini**

Instituto Nacional de Pesquisas Espaciais, Brazil

#### **Harold Mooney**

Stanford University, USA

#### **Claudia Eleonor Natenzon**

Universidad de Buenos Aires, Argentina

#### **Silvio Cesar Pantoja Gutierrez**

Universidad de Concepcion, Chile

#### **Ramon Pichs Madruga**

Centro de Estudios de la Economía Mundial  
(CIEM)Cuba

#### **Juan Valdés**

University of Arizona, USA

#### **Carolina Susana Vera**

CIMA/Universidad de Buenos Aires, Argentina

### **Members who retired from the SAC**

#### **Telma Castro Romero**

UNAM, Mexico, 2005-2011

#### **Rana Fine**

University of Miami, USA, 2004-2010

#### **Luis Mata**

University of Bonn, Germany, 2005-2011

#### **Maria Carmen de Mello Lemos**

University of Michigan, USA, 2007-2010

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## The numbers

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### **13 Collaborative Research Networks (Second round - CRNII) - 2006-2012**

with 180 investigators in 97 institutions and 18 countries

9 of the 13 networks are led by institutions and investigators in Latin America

USD 10,424,000 have been provided by the US NSF for the 5-year program

USD 22,472,729 of complementary funding have been raised by the projects

1510 degree students are part of the projects, 704 received scholarships from the grant

1491 students participated in training events

the networks have produced 354 peer-reviewed journal articles and 73 books or book chapters

### **7 Small Grants for the Human Dimensions (SGP-HD) - 2007-2011**

with 43 investigators in 29 institutions and 10 countries

USD 1,390,000 were provided by the US NSF

USD 4,500,000 of complementary funding have been raised by the projects to date

91 degree students are part of the projects, 62 of whom received scholarships from the grant

444 students participated in training events

the projects have produced 28 peer-reviewed journal articles and 9 books or book chapters

### **9 Small Grants for Collaborative Research in the Americas (SGP-CRA) - 2012-2014**

funded with USD 2,757,000, involving 76 investigators in 53 institutions and 13 countries

## the numbers (cont.)

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The research project on **landuse change and hydrology in the La Plata Basin (2008 - 2011)**

with 29 investigators from 13 institutions in 3 countries funded with USD 440,000 provided by IDRC Canada

40 students have received scholarships and 69 participated in project training courses and workshops

The **Assessment of climate impacts on Andean biodiversity (2008 - 2010)**

funded with USD 450,000 by the John D. and Catherine T. MacArthur Foundation

held 12 consultation and assessment meetings with 400 participants from 183 institutions in 12 countries

The research project on **Climate change impacts on biodiversity in the tropical Andes: climate risks, vulnerability and decision making tools for the planning of conservation (2011 - 2013)**

funded with USD 500,000 by the John D. and Catherine T. MacArthur Foundation

with 12 principal investigators from 9 institutions in 5 countries

**6 capacity building** events of 10-14 days each were held with 166 participants from 19 countries

funded with approximately USD 287,000 by NSF and others. ☈

## Financial statements

### Science and training programs

Programs	Number of Projects	Total Amount US\$	Period
<b>Science Programs</b>			
Collaborative Research Networks II	13	10,424,000	2006 - 2012
Small Grant Program for Human Dimensions	7	1,390,000	2007 - 2011
<b>Training Funds</b>			
Training Institutes		300,000	2009 - 2011
IAI Administered Funds		978,000	2006 - 2012
<b>Grants Administered</b>			
MacArthur Foundation	2	950,000	2008 - 2013
SGP-CRA	9	2,757,000	2012 - 2014
IDRC	5	425,000	2008 - 2011
<b>Total</b>	<b>36</b>	<b>17,224,000</b>	

## Country Contributions to Core Budget - 2011 / 2012

<b>Member countries</b>	<b>Contribution Level (US\$) Approved for FY 11/12</b>	<b>Contributions (US\$) Due as of 01-Apr-12</b>
Argentina	63,000	<b>141,957</b>
Bolivia	5,000	<b>30,000</b>
Brazil	110,000	-
Canada	159,000	-
Chile	7,000	<b>5,000</b>
Colombia <sup>(1)</sup>	12,000	<b>(1,311)</b>
Costa Rica	5,000	<b>17,536</b>
Cuba	5,000	<b>40,067</b>
Dominican Republic	5,000	<b>75,000</b>
Ecuador	5,000	<b>5,000</b>
Guatemala	5,000	<b>75,000</b>
Jamaica	5,000	<b>40,000</b>
Mexico	77,000	<b>294,000</b>
Panama	5,000	-
Paraguay	5,000	<b>50,721</b>
Peru	5,000	<b>33,351</b>
Uruguay	5,000	<b>55,000</b>
USA <sup>(2)</sup>	762,000	<b>123,183</b>
Venezuela	41,000	<b>295,521</b>
<b>Totals</b>	<b>1,286,000</b>	<b>1,280,025</b>

<sup>1</sup> Colombia made a partial advance payment of the 2012-2013 contribution

<sup>2</sup> US funding for the current year has been made available, but is not shown as paid until funds are requested and received

## Projects

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CRN2005

From landscape to ecosystem:  
across-scales functioning in  
changing environments

PI: Guillermo Sarmiento  
(ended Dec. 2009)



CRN2015

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

PI: Sandra M. Díaz



CRN2014

Functional links between  
aboveground changes and  
belowground activity with land use  
in the Americas: soil biodiversity and  
food security (AMFOODS)

PI: Ricardo Luis Louro Berbara



CRN2017

South American emissions,  
megacities and climate (SAEMC)

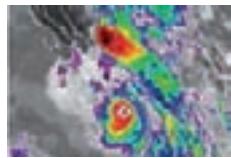
PI: Laura Gallardo



CRN2021

Human, ecological and biophysical dimensions of tropical dry forests (TROPI-DRY)

PI: Arturo Sánchez-Azofeifa



CRN2048

Tropical cyclones: current characteristics and potential changes under a warmer climate

PI: Graciela Binnimelis de Raga



CRN2031

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

PI: Esteban Jobbág



CRN2050

Paleo-tempestology of the Caribbean region: A multi-proxy, multi-site study of the spatial and temporal variability of Caribbean hurricane activity

PI: Kam-biu Liu



CRN2047

Documenting, understanding and projecting changes in the hydrological cycle in the American Cordillera

PI: Brian H. Luckman



CRN2060

Effective adaptation strategies and risk reduction towards economic and climatic shocks: lessons from the coffee crisis in Mesoamerica

PI: Edwin Castellanos  
(ended May 2010)



CRN2061

Caribbean coastal scenarios (CCs):  
an integrated analysis of Inland-  
Coastal linkages to guide  
sustainable use and protection of  
coastal ecosystems

PI: Assefa Melesse



SGP-HD 003

Climate change and irrigated  
agriculture towards a better  
understanding of driving forces  
and feedbacks between decision  
makers and biophysical environment  
and their impacts on hydrological  
cycle and land use

PI: Francisco J. Meza



CRN2076

An international consortium for the  
study of oceanic related global and  
climate changes in South America  
PI: Alberto Piola  
and Climate change, oceanographic  
variability and the artisanal fisheries  
in the South West Atlantic  
PI: Patrícia Raggi Abdallah



SGP-HD 004

Coming down the mountain:  
understanding the vulnerability of  
Andean communities to hydro-  
climatologic variability and global  
environmental change

PI: David Gauthier



CRN2094

The impact of land cover and  
land use changes (LCLUC) on the  
hydroclimate of the La Plata Basin  
PI: Ernesto Hugo Berbery



SGP-HD 005

Information flows and policy:  
use of climate diagnostics and  
cyclone prediction for adaptive  
water-resources management  
under climatic uncertainty in  
western North America

PI: Christopher Scott



SGP-HD 008

Conservation policy impacts in tropical dry forest: regional & spatially focused analyses given other social and natural drivers of land use

PI: Alexander Pfaff



SGP-HD 014

Decision support system (DSS) for risk reduction in agriculture phase II: soybean DSS for eastern Paraguay and Rio Grande do Sul

PI: Clyde Fraisse



SGP-HD 009

Designing a methodology to evaluate local knowledge on global change and its role in the construction of future land use scenarios by local actors

PI: Jean-François Tourrand  
(ended August 2009)



SGP-HD 013

Adaptation to the health impacts of air pollution and climate extremes in Latin American cities(ADAPTE)

PI: Rodney Martinez

# IAI Science Agenda

## I. Understanding Climate Change and Variability in the Americas

- to observe, document and predict climate change and variability in the Americas and its links to changes in natural systems and societal impacts
- to understand the role of the ocean-land-atmosphere interactions in climate, to determine the key processes that cause climatic variability, from seasonal to decadal time scales in order to improve weather and climate predictions

## II. Comparative Studies of Ecosystem, Biodiversity, Land Use and Cover, and Water Resources in the Americas

- comparative and integrated analyses of the effects of global environmental change on natural and anthropogenic systems and processes among tropical, temperate and cold latitude systems. increase knowledge of the drivers and dynamics of variability, and the impacts of such variability on food security, biodiversity and the provision of ecological goods and services. terrestrial, coastal and oceanic environments; and integration across the land/sea interface

## III. Understanding Global Change Modulations of the Composition of the Atmosphere, Oceans and Fresh Waters

- to observe, document and understand the effects on productivity and human welfare processes that modify the chemical composition of the atmosphere, inland waters and oceans using a multidisciplinary approach

## IV. Understanding the Human Dimensions and Policy Implications of Global Change, Climate Variability and Land Use

- to research the dynamic interaction of global change, climate variability, land use and human beings – their health, welfare and activities which depend on the productivity, diversity and functioning of ecosystems
- to address the complex interactions between natural and socio-economic systems through interdisciplinary approaches
- to inform public policies that increase sustainability of natural systems and human welfare

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