# INTER-AMERICAN INSTITUTE FOR GLOBAL CHANGE RESEARCH

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**IAI Directorate Report**

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**IAI Directorate Report to the Conference of the Parties, 2010**
**for the period of July 2009 - May 2010**

## 1. Directorate operations

### 1.1 Science and network integration

This year has seen unique achievements linked to the science program, its synthesis and a series of science digests and policy briefs that have been prepared in collaboration with the networks' scientists. Over the first three years of the Collaborative Research Networks and the associated human dimensions projects, cooperation between projects and with the Directorate has developed to such a degree, that the IAI has been able to produce science digests and timely responses to global change issues as they arose in the media and in international negotiations. The training program, too, has been integrated into aiding the synthesis and communication of global change science, providing hands-on training on such skills as science communication, and GIS applications in training institutes attended not only by scientists and students but also by the production sector, government representatives and other practitioners. This development is unique in that it has transformed the IAI from an agency that administers project selections and funding into one that actively participates in the dialogue between different sectors, steers science and makes science output available to end-users. This process now needs to be integrated with the realities of the member countries. Details of the science program are presented below. The whole science program represents an investment of approximately US$ 3 million annually (largely by the US-NSF, with smaller contributions from the Mac Arthur foundation and the Canadian IDRC).

### 1.2 Core Funding

This has also been a year of serious challenges for the IAI due to several important member countries not paying contributions which has aggravated the core funding situation to such a degree that salary payments had to be halted temporarily in Sept 2009, all travel had be suspended and therefore no Scientific Advisory meetings have been funded by the core budget, unliquidated obligations are no longer covered and several services (see below) are on hold. At the height of the cash-flow crisis (mid-August), the IAI had not received contribution payments from any of its member countries. This compounded by several outstanding contributions from the previous fiscal year, which included a delay in the US contribution of almost 7 months, and amounted to nearly 2 contributions; Canada was pending for 1.5 contributions, and Mexico 2 full contributions. Argentina had made a partial payment at the beginning of the calendar year and Brazil had also made a partial payment. The total of contributions not received at that point was US$ 2.7 million dollars, approximately half of which was recent un-budgeted non-payments which made the management of the Directorate nearly impossible.

At the time of this report, we have received payments for a total of US$ 945 k, and the total amount remaining due is now US$ 1.75 million; 46% corresponds to the US, 13.6% Venezuela, and 8% Mexico. The other larger amounts correspond to countries that have

never made significant contributions to the IAI, although all member countries have received significant science support.

In the context of country contributions, the role of the Conference of the Parties has also been put in question: in the agreement establishing the IAI, member country contributions are defined as "voluntary". Based on this, the Conference of the Parties receives and examines a 3 year budget and every year approves the budget and country contributions for the following fiscal year. This approval establishes a commitment to the annual budget, both in terms of approved expenses and work plan, and in terms of contributions. In the past two years this budget commitment has been undermined: While member countries approved the budget and contributions, including increments to compensate for the US $ decline relative to the Brazilian real, payments were either not made or made only partially. Arguments brought forward by one government representation indicated that there could "not be any arrears" in dues since contributions were entirely voluntary. This questions the validity of the annual commitments by the Conference of the Parties. Only one country (Argentina) indicated at the Conference of the Parties that it may not be able to pay the increment and accordingly did pay (in a timely fashion) at the previous rate. The US approval process of the 2008/09 contribution was delayed beyond the fiscal year, and the 2010 funding was not permitted to be applied to the funding gap. The US has now made available funds of $270k for 2009, but the shortfall in core funds still amounts to $400k. While an acute world-wide financial crisis is in part to blame, Venezuela and Costa Rica are regularly only making partial payments of some 40% and 20% respectively.

On the positive side, member countries such as Bolivia, Colombia and Paraguay are engaging more actively in the IAI, both with core budget contributions and science engagement, and Chile, which had paid much of its contribution in advance is now also beginning to reengage in the science dialogue.

**1.3 Data & Information System and Information Technology**

The IAI's Data & Information System (DIS) is an Internet-based tool for data collection and dissemination with 3 components: a data harvest process, a metadata editor, and a search and retrieval tool. The system is active since 1999 and has been improved steadily since then. Currently it is based on the Mercury system, developed by the Oak Ridge National Laboratory (ORNL), and each day there is a process running from Oak Ridge that updates the database. Approximately 600 records are documenting different information produced by the IAI science projects, especially from CRN-II.

The IAI has a service contract with the Oak Ridge National Laboratory to keep the system updated regularly, fix problems, and extend functionality to the international user group including features requested by the IAI. The yearly subscription for this service was US$ 20k, but has been re-negotiated at US$ 10k for 2010-2011. This should have been paid by February this year, but could not be paid due to budget restrictions. ORNL accepted a delay to July by which time the IAI must define if the contract with ORNL should continue or not. A direct consequence of cancellation would be that the service will stop and efforts made to build the DIS until now will be lost.

There are alternatives to the DIS: we could preserve the records and develop an in-house solution, but under that option we will lose the considerable ORNL expertise on this kind of system. A further option might be to close the DIS and instead of having a system to record metadata to document project information, we could consider having only a website describing data and publications. The IAI recently migrated the publication records provided by its projects to an open internet site sponsored by Springer: "http://www.citeulike.org/user/IAI#". However, this site does not work with metadata, but only provides links to real files. Metadata describe the attributes of the original data generated in the science projects and therefore facilitate re-use of data. The importance of re-analysis in global change studies, for instance linking climate data with hydrology or landuse data, suggests that the DIS should be strengthened, not abandoned. But this needs a renewed financial commitment seconded by a greater involvement by member countries in the IAI's information management.

All servers at the IAI are working now on open-source software (Linux) in order to minimize costs. One of the 3 servers needs to be replaced in the near future. Equipment for staff will soon need to be updated, as several computers are now running for more than 6 years.
We have an updated website (http://www.iai.int) using a modular CMS (content management system), which greatly facilitates timely updates. The site is now constantly updated to provide the latest information from science projects and generate a window to the IAI science. As a second source of information, we are using the Twiki website (http://twiki.iai.int) to share documents for meetings, training and other events. The database (http://iaidb.iai.int) maintains information about people and institutions linked with the IAI and compiles information about scientific projects and events. This system is maintained manually since the diverse types and sources of information do not allow the dynamic control. Anti-spam/anti-virus solutions are being maintained on the servers, so each email arriving or leaving is checked against viruses and spam. A recent malicious hack has been repaired and security further tightened.

**1.4 Staff changes**
Following the resignation of the Assistant Director for science programs in May of 2009, Christopher Martius joined the IAI in October. During the intervening months, program reporting and science administration fell entirely on the Director. Since his arrival the new Assistant Director has developed a number of initiatives that greatly increase science communications by the IAI and accompany the synthesis (see below). Ana-Claudia Rosa has joined the IAI from a previous position at the Brazilian aircraft manufacturer, and has taken responsibility for communications with member countries. Tânia Sanchez, who had worked for the IAI on a volunteer basis now continues in a part time position dealing with member country- and especially host country relations. Luciana Londe, who has a Ph.D. in remote sensing, is working in capacity building. The staff provided by the Brazilian government has found itself again in a series of emergency contracts, but Brazil is now making efforts to find a more permanent solution to this perennial problem.

**1.5 Host country relations**

The directorate has prepared suggestions for an amendment to the host country agreement, which should bring the IAI in line with newer legislation and provisions for international institutions in Brazil. In contrast to UN and other institutions, the IAI's agreement does not provide for tax and contributions exemptions on payroll, so that the annual fiscal burden to the IAI currently exceeds the Brazilian country contribution. A permanent solution to the staffing problems and amendment of the agreement will remain on the agenda for the coming year.

## 2. Science

This section highlights achievements in four scientific programs, covering the period June 2009-May 2010: (1) Second Collaborative Research Network (CRNII), (2) Small Grants Program for the Human Dimensions (SGP-HD), (3) Land use change and hydrology in the La Plata Basin, and (4) Assessment of research and institutional needs to cope with the effects of Climate Change on Andean Biodiversity. This science report also includes an update on research-related communications and outreach outputs.

### 2.1 Collaborative Research Networks (CRN II)

The UNFCCC CoP in Copenhagen has made it clear that regional approaches are increasingly important in providing adequate, targeted climate mitigation and adaptation. In this context, CRN II continues to produce high-quality science that contributes to better regional understanding of global change in the Americas. The directorate is producing brief summaries, highlights and policy briefs in collaboration with the investigators. Several of these have been distributed and are available on the IAI web site.

Total funding leveraged during the first 3 years of the CRN II program is approximately US$8 million. By August 2009, the program had produced 273 peer-reviewed journal articles, four books and 67 book chapters.

CRNII also continues to play a substantial role in building scientific capacity. In total, 288 students have been receiving scholarships (of between 1 month and 4 years duration) from CRNII projects. In year 3 alone, the number of students that participated in trainings and workshops was 375.

The projects will be completing their fourth year in June 2010 and year-4 reports will be received in mid-July. Four CRNII projects conclude their work this year: CRN2005 on ecosystem boundaries, CRN2017 on urban emissions and weather modelling, CRN2048 on tropical cyclones, and CRN2060 on adaptation strategies by Mesoamerican coffee producers. Some significant results of individual projects are listed below:

*From landscape to ecosystem: Across-scales functioning in changing environments (CRN2005)*

- Ecosystem boundaries are in part explained by functional traits of plants that determine the plant's vulnerability to climate 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.

- Extensive (80%) deforestation of the Gran Chaco dry forest is due largely to land use change responding to remote markets for soybean, and is facilitated by increasing rainfall.
- In Canada and Brazil, increased atmospheric CO2 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 CO2 levels invariably boost plant growth.
- The project has shown interactions between anthropogenic and natural factors that define ecosystem boundaries – this can now be explored for conservation and adaptation decisions.

*Functional links between aboveground changes and belowground activity with land use in the Americas (CRN2014)*

- DNA analysis of soils for different taxa of arbuscular mycorrhizal fungi has shown shifts in species abundance between different seasons of the year indicating substantial susceptibility to climate.
- This change in fungal diversity affects function. Both the diversity and the symbiotic ability of mycorrhiza declined so much in warm and dry seasons that the symbiotic relationship with 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 which increase growth of potatoes. Experiments with other crops are continuing.

*Functional biodiversity effects on changing ecosystem processes and services and sustainability (CRN2105)*

Objectives are to

- 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

*South American emissions, megacities, and climate (CRN2017)*

- 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 to help 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 project work (http://www.meteochile.cl/modeloPOLYPHEMUSozono.html).
- A fully linked climate modelling system is now operational for South America, providing a sound basis for the comparison of emissions.
- A grid-based computational system is being tested.

*Understanding the human, biophysical and political dimensions of tropical primary and secondary dry forests in the Americas (CRN2021)*

- The first-ever map of tropical dry forests 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 tourism 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.

*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)*

- 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 may well be more effective for carbon offsets than growing biofuel crops. Carbon released from soil under corn grown for ethanol completely negates carbon gains from bio-alcohol for some 50 years. Carbon content was also higher in soils under recovered grassland than the possible C credits from corn ethanol on the same land for 40 years, with pastures providing 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 and therefore absorb more solar energy which increases evapotranspiration. Pine stands decreased 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.
- Maps of land cover changes identify 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.

*Changes in the hydrological cycle in the American Cordillera (CRN2047)*
- 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, coincided with critical social change: 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 has been a slight trend of declining regional stream flow 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.

*Tropical cyclones: current characteristics and potential changes under a warmer climate (CRN2048)*
- Results provide evidence of the role played by atmospheric circulations as important determinants of storm tracks and rainfall. Cyclone intensity depends on mass and energy budgets in the atmosphere and how they interact with the ocean. Circulation speed increases a cyclone's (destructive) energy; surface friction decreases it.
- The study of three tropical cyclones that made landfall over north-western Mexico showed that "external" factors such as the inflow of warm dry air from the western United States need to be understood for better track prediction in the Eastern Pacific.
- The project has started to build a data base of historical records using newspaper articles and government reports, and that has allowed identifying and documenting past cyclones that made landfall over the Mexican Pacific States.
- Over 100 students were trained in three courses on the theory and practice of identification and evolution of tropical cyclones.
- Results have improved the team's knowledge of cyclone evolution, but have also shown that hurricane science needs to be further developed: regional climate studies and data collection need to be expanded to accurately assess regional risks.

*Paleo hurricane activity of the Caribbean Region (CRN2050)*

- A new coral-based proxy record of Atlantic sea surface temperatures for the period AD 1552-1991, the longest-ever established, shows that higher hurricane activity before 1550 and after 1750 coincides with warmer sea surfaces. When the Atlantic surface was cooler, there were fewer storms in the Caribbean.
- Caribbean hurricane activity varies following climate patterns such as the Atlantic Multidecadal Oscillation (AMO) and El Niño-Southern Oscillation (ENSO). Proxy data and modelling reveal peaks in Atlantic hurricane activity during medieval times (AD 900-1100) and again since 1980, explained by the prevalence of warmer sea surface temperatures and La Niña-like conditions.
- Air mass circulations in the Intra-Americas Sea are dominated by the Low-Level Jet. A re-analysis of the Jet shows that it critically affects sea surface temperatures and moisture advection – important factors for hurricane strength and storm damage.
- Geographical and demographic (2006) data shows approximately 19 million people living within vulnerable areas less than 1 km from the coast line in the conterminous U.S. and 12 million people live within three-meter elevation along the coast.

*Effective adaptation strategies and risk reduction towards economic and climatic shocks: lessons from the coffee crisis in Mesoamerica (CRN2060)*

- Even minor climate changes may move coffee crops out of the optimum ecological and economic range, particularly in areas where conditions are already marginal (e.g. overly dry or wet soils). Yet, farmers perceive market fluctuations as a bigger threat than climate variability. Many farmers in the research areas continue to plant risky coffee crops because the alternatives are even more perilous.
- To reduce the impacts of negative climate events, farmers use several strategies: some grow alternative crops, others diversify the sources of income, and a quarter of them (figures from Honduras) migrate, often with complicated social and legal consequences.
- Factors helping farmers adapt to global change are (1) better access to information about fluctuations in market and climate; (2) better access to insurance and credit; and (3) increased capacity to organize and maintain local groups (e.g.; cooperatives).
- Cutting coffee shade trees to prepare the land for other crops may lead to increased risks of erosion, soil degradation and loss of biodiversity. Deforestation also affects the carbon balance, since it reduces the number of carbon sinks.
- Where secondary forests dominate the landscape, conservation goals should incorporate sustainable transitions between forests and farming.
- It is easier for policy to respond to medium-term drivers such as emergence of new pests or new market opportunities which allow for institutional arrangements to be developed. Very slow processes such as declining soil fertility or climate change are difficult to perceive and often left out of the policy agenda despite their substantial long-lasting impacts.
- Project case studies suggest that policies need to fit local contexts and perceptions, and no single policy prescription is likely to meet the range of experiences and conditions in the region.

*Caribbean coastal scenarios (CRN2061)*

- Land-cover and soils in 84 watersheds that drain to coastal waters were mapped in the islands of Dominican Republic, Jamaica and Puerto Rico. Weather and hydrology were modelled. Calibration and validation of the model was completed in selected watersheds.
- Many rivers have been altered by construction of dams, channelling and sewage discharge, which has resulted in decreased water quality, and in increased algal biomass, nutrient export and sedimentation.
- In Puerto Rico, where about 80% of people live in urban areas, about 50% of the wastewater is treated. Nitrate and phosphate from sewage effluents contaminate the rivers.
- In the Dominican Republic, deforestation, overgrazing and slash-and-burn agriculture in the upper part of the Haina River watershed results in high peak runoff which causes flooding, destruction of infrastructure, properties and, occasionally, loss of life.

*An International consortium for the study of oceanic related global and climate changes in South America (CRN2076)*

- 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 CO2 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.

*The impact of land use and cover changes on the hydroclimate in the La Plata Basin (CRN2094)*

- 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) modelling 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.

## 2.2 Small Grants Program for the Human Dimensions (SGP-HD)

The human dimensions program expanded the interdisciplinarity, outreach and intellectual boundaries of the CRNs in eleven countries. The program has so far produced 35 peer reviewed publications and five book chapters; more is in print. Total additional funding leveraged under SGP-HD was approximately US$ 4,620,000, of which 4 million were received by SGP-HD 005 from NOAA for an expansion of the work on integrating climate science for decision support, mitigating risk and promoting resilience in the southwest. The SGP-HD Program had a strong training component in which 448 students participated in project short-training courses and workshops; 26 students received degree scholarships, (24 from IAI funds and 2 from external funding). The SGP-HD program concluded in February 2010 and some significant results are listed below

*Climate change and irrigated agriculture towards a better understanding of driving forces and feedbacks between decision makers and biophysical environments and their impacts on hydrological cycle and land use (SGP-HD003)*

- Rio Segundo basin, formerly the "peanut centre of Argentina", has seen a reduction in peanut, livestock and hay crops while soy bean area increased by a factor of almost 18, while also doubling the total agricultural area in little more than a decade.
- In Rio Segundo, precipitation and minimum temperatures steadily increased during the last decades of the 20th century. Global market opportunities and increased rainfall contribute to the agricultural expansion.
- The main perceived climate risks to agricultural production in Rio Segundo, besides shortages of irrigation water, are early and late frosts in April or November, and damaging hailstorms.
- What more rains may mean for agriculture is shown by higher precipitation during El Niño years which raised grain yields in summer crops, while lower rainfall in La Niña years reduced yields. The opposite trend was found for wheat with yields higher under La Niña, lower under El Niño. Winter (May-August) precipitation is correlated to El Niño.
- Supplementary irrigation improves grain yields and helps stabilizing production. The greatest impact was observed in wheat, with yields that more than doubling under irrigation.
- Irrigation systems are a strategy to improve the economic position of farmers. They are not an adaptation to climate change which in the region is accompanied by increasing rainfall.
- The vulnerability of permanent water rights under two climate change scenarios was analyzed for the Maipo river basin. The probabilities are that these water rights may fail the increased demand under global warming in up to 40-50% of the cases, compared to the current 6-20% failure rate. If water rights are to provide the same yields under future climate change, their adaptation will be imperative.

*Coming down the mountain: understanding the vulnerability of Andean communities to hydroclimatologic variability and global environmental change (SGP-HD004)*

- The current adaptive capacity of agricultural producers and of local and regional governments in the three studied basins (Mendoza, Argentina; Choquecota, Bolivia;

Elqui, Chile) is too limited to efficiently counter the emerging challenges of climate change and extreme climatic events

- Those limitations are reflected in weak coordination among public institutions, poor data on water availability, and lack of integrated water resource management.
- A higher level of development and stronger institutions in Argentina and Chile provide some protection from risks for large production-oriented commercial farmers, but do not necessarily translate into stronger adaptive capacity for the poor, most vulnerable populations. In the Choquecota basin (Bolivia), under traditional agriculture catering mainly to household consumption and local markets, and a weaker presence of the state, most of the population is highly vulnerable to climate change. Adaptive capacity mainly hinges on access to local resources and traditional knowledge.
- Limited water availability is an important risk for agricultural producers in all three basins. Nevertheless, climate vulnerabilities are greater for those already suffering from economic and social stressors.
- None of the communities have access to early warning systems, nor do they have the institutional support required to anticipate or respond to emergencies arising from sudden climatic events. This significantly reduces their capacity to deal with hazardous events.
- Policies aimed at reducing resource concentration and at improved planning and risk prevention can reduce vulnerabilities of rural communities to climate and water stresses. Climate change may also provide opportunities, as the warmer climate allows introducing new crops that demand fewer cold nights and days. Earlier crops may allow producers to obtain higher prices, while frost-sensitive crops will benefit from the reduction in frosts events.

*Information flows and policy: use of climate diagnostics and cyclone prediction for adaptive water-resources management under climatic uncertainty in Western North America (SGP-HD005)*

- Major climate-related risks to populations and economies in Western North America are (1) exposure of communities to weather extremes from cyclones to drought, (2) dependence of growing populations on limited water supplies in this dry region, and (3) climate and water-related agricultural production risks. Case studies in 2008 showed that hurricane information often does not reach the target population in a timely and effective manner, leading to a greater need for post-event remedial support.
- In addition to historical climate and water data, investigators gathered information about water managing institutions and the use and flow of climate information. Urban water management efficiency in much of Mexico could be improved by 20-30 percent with improved services and strengthened institutions.
- On both sides of the U.S.-Mexican border, groundwater is being depleted as farmers seek to adapt to climate change and variability. Rural water managers in both Sonora and Arizona rarely use climate and weather forecasts to decide on their choice of crops. Those decisions are mostly based on market prices and land suitability. Irrigation is an adaptive strategy to precipitation variability but may prove maladaptive over time as groundwater resources are already over-committed now.
- Weather and climate information potentially can improve irrigation decision making, but even readily available information is not used by farmers for better preparedness.

- Institutions involved in the project regularly produce the "U.S.-Mexico Border Climate Summary" (http://www.climas.arizona.edu/), an innovative policy information product to improve the flow of climate diagnostics for drought- and monsoon-affected areas straddling the U.S.-Mexico border.

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

- When assessing impacts of policies, studies have to control for non-policy factors. Understanding the impacts of non-policy drivers of land use change and deforestation, reveals whether non-policy factors are confounding the analysis of eco-payment policies that pay land users for protection services they provide to society. Effects of biophysical (e.g. slope, soil quality, rainfall) and socioeconomic conditions (e.g. distance to markets and roads) may determine outcomes, so that it may not have been eco-payments that prevented clearing. This needs to be considered in the design of eco-payment policies to make them successful.
- Protected areas have prevented significant amounts of clearing in Costa Rica, which is a pioneer country in the establishment of parks. However, conventional approaches to evaluating conservation impact, which did not control for observable covariates correlated with protection and deforestation, overestimated the avoided deforestation by more than 65%. 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. Conservation policy designs and location of protected areas are both critical factors to invest the prevention of deforestation effectively.
- When correcting for all factors, protected areas within 85 km of Costa Rica's capital city, San José, prevented over 4% of their forest area from being cleared during 1986-1997. Those areas 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 degrees avoided 14% deforestation, while essentially no protection resulted from the protected areas far from national roads or those on steep slopes.

*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)*

- This 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.

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

- This project introduced producers in Paraguay and Brazil to the use of seasonal climate forecasts as a strategy to reduce production risks associated with climate variability. A crop growth model was used to evaluate adaptive management options such as planting different soybean varieties, or varying 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 reliable, useful, science-based information, which they 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.

Based on the good performance of the SGP-HD projects, the IAI Directorate applied for a supplementary grant of US$ 400,000 to extend the Program until June 2011. Continued SGP-HD research work would benefit a program-wide synthesis cross-disciplinary synthesis. If granted this extension, the termination date would coincide with the end of the CRNII program. This extension would better synchronicity with CRNII and facilitate a joint synthesis of both programs. At the time of preparation of this report, the IAI has not received notification on the extension.

## 2.3 Landuse change, biofuels and rural development in the La Plata Basin

The La Plata Basin (LPB) plays an important regional and global role in food and biofuel production. The IAI's research network was built on components of the CRN and new participants and spans the 5 LPB countries, integrates multi-national research and provides capacity building. In recent years, the LPB has seen natural vegetation and pastures converted to arable agriculture at unprecedented rate and scale. The long-term environmental and economic consequences, opportunities and challenges are being examined in the light of the resilience of current production systems and their effects on regional hydrology.

This two-year project, supported by the International Development Research Centre (IDRC) of Canada has built an interdisciplinary, multi-national research network that studies natural and economic processes in the whole basin, synthesizes information to

guide decision processes, and builds in-country capacity to address the complex interactions between crop production, land use change, hydrology, rural livelihoods and development.

A workshop of project investigators (in April 2010) initiated the synthesis of the project. The different groups of researchers in the project are now harmonizing and making public data from remote sensing throughout the La Plata basin (LPB). Furthermore, they are beginning to coordinate two different approaches to agent-based models that will provide insight into decision-making among agricultural producers. This combined approach will be tested in flood-prone areas of the plains of the Western Pampas, to develop land management alternatives. The teams now are also developing "user manuals" for download at the IAI website, which will provide introductions on how to analyze land use patterns using remote sensing tools and integrate this with agent-based models of decision-making processes. An economic cost-benefit analysis of alternative policies and land use strategies will be developed to provide insight into alternative land management options - important information for producers and policy makers.

**2.4 Assessment of climate effects on Andean biodiversity**

The *"Assessment of research and institutional needs to cope with the effects of Climate Change on Andean Biodiversity"* funded by the MacArthur Foundation has completed 7 national meetings and 4 regional workshops in Bolivia, Colombia, Ecuador and Peru. These workshops mobilized approximately 350 professionals from the scientific, policy and conservation communities working on climate change and biodiversity in the Andes. The project documents the current status of scientific knowledge, identified research priorities, knowledge gaps, and institutional priorities for conservation management and climate change adaptation in the region. It produced: 1) an IAI-SCOPE book entitled *"Climate change effects on the biodiversity of the Tropical Andes: an assessment of the status of scientific knowledge"*; 2) Strategy Documents addressing institutional needs for biodiversity conservation and climate change; and 3) a Scientific and Institutional synthesis outlining the current research and institutional needs to cope with the effects of climate change on Andean biodiversity. The project has been extended until August 2010 to make the project outputs available in English and Spanish for wider distribution, and to present results of the assessment project to the scientific and policy communities in the Andes. Considering the current dynamic institutional and political processes in most Andean countries, disseminating outcomes of the project could generate a positive impact on public policies with a new and integrated approach of climate change and biodiversity. Therefore, the IAI will hold national meetings in Bolivia, Colombia, Ecuador and Peru and visits to key institutions in each country, such as the Ministries of the Environment and the Science and Technology Councils in August of 2010.

Using the results of the assessment, the IAI submitted a Letter of Intent entitled *"Impacts of climate change on biodiversity in the Tropical Andes: climate-related vulnerability assessments and improved decision making processes for conservation and land use planning in two Andean biodiversity hotspots"* in April 2010. The IAI requested US$ 500,000 for the project to be conducted in Bolivia, Colombia, Ecuador and Peru over 3 years (2011-2013). In this project, the IAI will coordinate a group of climate and biodiversity scientists and institutions including the Institute of Hydrology, Meteorology,

and Environmental Studies (IDEAM-Colombia), the School of Engineering in Antioquia (EIA-Colombia), the International Research Centre on El Niño (CIIFEN-Ecuador), the National Institute of Meteorology and Hydrology of Ecuador (INAMHI-Ecuador), the Servicio Nacional de Meteorología e Hidrología de Perú (SENAMHI-Peru), the Servicio Nacional de Meteorología e Hidrología de Bolivia (SENAMHI-Bolivia), the International Research Institute for Climate and Society (IRI-USA), WWF Peru, Asociación Armonía - BirdLife International in Bolivia, and the Missouri Botanical Garden (MBG-USA).

**2.5 IAI science synthesis**

A joint meeting of Principal Investigators (PIs) from the CRNII, SGP-HD and IDRC projects (for IDRC see below) was held in Montevideo, Uruguay, 24-26 June 2009, to start the synthesis of the IAI's current grant programs. This initiative is part of the IAI's mandate to promote informed action, improve public awareness and provide scientific information to governments. The meeting identified the most important cross-cutting themes that will provide the policy-relevant output. The project PIs provided brief presentations on their projects, identifying components and results that will contribute to such a synthesis.

A first synthesis between CRNs I and II has been published early 2009 in an e-book in cooperation with the Scientific Committee on Problems of the Environment (SCOPE) and the Inter-American Institute for Cooperation on Agriculture (IICA). This is available on the IAI website:
http://www.iai.int/files/communications/publications/institutional/Applying_Ecological_Knowledge_to_Landuse_Decisions.pdf .

Further synthesis workshops will develop ways to provide integrated information to the scientific community as well as to a broader audience, with an emphasis on policy-relevant results that are based on solid scientific evidence. The synthesis will also contribute to capacity building, interdisciplinary understanding and policy advice. Several smaller PI workgroups convene in 2010. Two synthesis meetings are scheduled to be held in Buenos Aires, Argentina in August 2010: a workgroup on Climate Modelling and Hydrology will meet back to back with the training institute on the "Use of Seasonal Climate Predictions for Applications in Latin America" and a workgroup on Ecosystem & Biodiversity will also meet. Other meetings are being held on urban (May, Buenos Aires) and oceanographic (August, Foz de Iguaçu) studies.

**3. Communication and outreach**

In 2009, the Directorate presented a brief and the Director gave a presentation to the Subsidiary Body for Scientific and Technological Advice (SBSTA) of the climate convention, UNFCCC, on the opportunities and challenges associated with increasing agricultural biofuel production, highlighting carbon balances and potential soil degradation. In an effort to facilitate research-related communication between IAI member country representatives and delegates to the SBSTA, and as a means to allow better in-country consultations and communication related to the IAI's participation at SBSTA, the IAI invited country representatives to nominate one focal point person each

by 1 May 2010. One nomination was received from IDEAM, Colombia. The IAI will be inviting them to engage in future UNFCCC-related IAI events.

Participation at the UNFCCC - SBSTA meeting was cancelled in 2010 as a result of the lack of travel funds. As in the past year, a written submission was made to the SBSTA, which highlighted research findings from three projects to demonstrate the importance of regional analysis for carbon accounting in the Southern Cone.

Many other collaboration and outreach activities were similarly cancelled as the core budget provided no travel funds during 2009/10. Most significantly the Directorate had to decline invitations to the agriculture meeting of the Summit of the Americas process 2009, and delegated participation at the UNFCCC to its sister organization APN in the hope to show some "presence" as an observer organization. Participation at IGFA, the international group of funding agencies, was possible since the Director combined this with personal travel. The IAI did participate in the IUCN La Plata meeting, since travel was paid by IUCN. New initiatives were planned with Conservation International on the occasion of the Director's visit to NSF. As a result, CI and IAI will be making a joint proposal to the MacArthur foundation on biodiversity and climate change.

The CRN II and SGP-HD project one-page 'Fact sheets' on the IAI website have been updated to provide essential information on each project including the most important results from each project to date.

After a longer gap in due to budget and personnel constraints, the only number of the IAI Newsletter for 2009 was published on the web site in December. The printed version was shipped in 2010. Given the cost of mailing and current budget constraints the directorate has re-designed the newsletter into an e-mail based publication and will in future only print one summary copy per year.

Based on the extraordinary productivity of the science programs, a new line of science briefs, 'Science Snapshots' has been launched in April 2010. Science Snapshots are two-page graphic-oriented information sheets based on a figure/graph/photograph that captures the essence of a research highlight of one of the IAI programs. The image serves as a visual entry point to the science, and the science behind is explained in accessible language. Practical conclusions provide a "take-home message" and advice. These briefs are available in English and Spanish, on the web and in printed format.

Communiqués are brief reports offering updates on important scientific findings and contributions to public debate. One communiqué was published to provide insight into glacial melt in the Americas when an error in the IPCC report exaggerated observed trends and resulted in unwarranted scepticism about the accuracy of all glacier monitoring. These communiqués are circulated via listserv in English and Spanish and posted on the IAI website.
Following last year's polemical debates on the IPCC and UNFCCC processes, the directorate has taken the opportunity to develop a training program on responsible and ethical conduct of science. A proposal to the US-NSF Pan-American Advanced Studies

Institutes has been prepared. The course will address questions of applied ethics and responsible scientific behavior for global change science conducted by young scientists in the IAI CRN II and the SGP-HD programs with participation by non-IAI research groups across the continent.

The Directorate has set up a list of publications from all science projects on the public web site http://www.citeulike.org/user/IAI#. This site will be regularly updated with all published peer-reviewed articles, book chapters, and books produced by the IAI projects.

A new bilingual flyer and poster for the IAI are available in English and Spanish.

The IAI Scientific Advisory Committee (SAC) and the principal investigator meetings were hosted by the UNESCO office in Montevideo and a UNESCO representative participated in discussions at the PI meeting, which resulted in renewed interest in collaboration on regional hydrology.

## 4. Capacity Building

A third joint ***IAI-NCAR colloquium*** was held at the University for International Cooperation from April 13-22, 2010, in San Jose, Costa Rica. Forty-nine participants from 11 countries discussed risk and vulnerability to global environmental change, learnt how to use graphic and geographic representations of data, and explored tools for knowledge dissemination and decision making. Participants learned strategies and tools for practical communication of scientific data to non-scientific audiences using GIS and other communication tools, through lectures, presentations, hands-on-training, and development of practical risk-assessment projects. More than 120 applications were submitted to the IAI-NCAR colloquium, indicating the importance of the topic chosen.

***A Science-Policy Forum on Ecosystem Services and Climate Change Adaptation in the Andes*** (July 2-3, 2009, Quito, Ecuador) was organized by IAI in collaboration with CIIFEN, the Catholic University of Ecuador, PUCE; the International Union for the Conservation of Nature, IUCN-SUR; Ecuador's Ministry of the Environment, science funding agencies, SENACYT and Planning Department, SENPLADES. The forum was held with the *IAI-MacArthur Foundation Regional Workshop for Institutional and Government Consultation* (June 29-July 1, 2009). Forty-five professionals from 8 countries, government agencies, universities, non-government organization, civil society, and international cooperation agencies participated. The forum was unique as it brought together, for the first time, climate and biodiversity experts and decision makers to discuss the interactions and potential impacts of climate change on the biodiversity of the tropical Andes. Up to now, most initiatives in the region have addressed climate and biodiversity independently. The forum produced five strategy documents addressing biodiversity conservation in the face of climate change for the scientific and policy communities. These documents will be distributed to the governments of Bolivia, Colombia, Ecuador and Peru in a series of meetings the IAI is organizing in the 4 countries, next August. In addition, these recommendations will also be delivered to conservation organizations and foundations, such as MacArthur. We hope these

documents will be useful in guiding future research and conservation programs in the region.

**Training Institutes**

Two Training Institutes are being prepared for the second semester of 2010:

***The Training Institute on the use of seasonal climate predictions for applications in Latin America*** (August 2–13, 2010, Buenos Aires, Argentina) will be hosted by the University of Buenos Aires in collaboration with the International Research Institute for Climate and Society (IRI). The Training Institute is funded by the University Corporation for Atmospheric Research (UCAR) and the US National Science Foundation (NSF), and co-sponsored by the World Climate Research Program (WCRP). The objective is to increase regional capacity for seasonal prediction tailored to user needs in different sectors such as agriculture, health, water resources, disaster risk reduction) of Latin America using lectures, discussions and practical exercises. The IAI has received over 210 applications for this activity from all 19 IAI member countries, demonstrating high level of interest in IAI training activities by scientists and professionals throughout the Americas.

***The Training Institute on Cities' Responses to Climate Change*** (November 29-December 3, 2010, Santiago, Chile) will be hosted by the Economic Commission for Latin America and the Caribbean (CEPAL). The objectives of the Training Institute are to 1) expand the knowledge and understanding of how and why cities respond or fail to respond to climate change with mitigation and/or adaptation measures; 2) develop a forum for dialogue to link urban studies, sustainability and climate change science with practical knowledge on urban growth in Latin America; 3) facilitate the communication between researchers and decision makers and practitioners to enhance the use of research results in policies shaping the construction and functioning of urban areas; 4) to develop a network of researchers and practitioners in urban areas.

In the ***IAI-INPE/CPTEC Research Internship Program*** a fourth young scientist, Katiusca Briones Estébanez (Centro Internacional para la Investigación del Fenómeno El Niño, CIIFEN), of Ecuador, developed her research program on "Determinación de esquemas multiparamétricos y aplicación de técnicas MOS para el mejoramiento del pronóstico climático a corto y mediano plazo en los Andes Tropicales utilizando Downscaling Dinámico" under the tutorship of Dr. Chou Sin Chan (INPE/CPTEC). An immediate result of her training was her admission at the Federal University of Rio de Janeiro to pursue a Master's degree. Moreover, after returning to Ecuador, Katiusca provided training to several scientists of CIIFEN on the installation and running of the "Eta Model" and interpretation of the results. In addition, CPTEC will provide information to assist CIIFEN in developing downscaling seasonal climate predictions for the Andean region.

Blanca Patricia Vazquez Agüero (Universidad Nacional de Asunción -UNA), a young scientist from Paraguay, will start her program in the second semester of 2010. Under the guidance of Dr. José Marengo (INPE/CSST), she will work on climate models and scenarios for Paraguay and their application in the water resources and health sectors.

## 5. Country contacts

In an effort to develop better collaboration and stronger links with member countries visits were arranged between the Assistant Director for Capacity Building and representatives from several countries on the occasion of training institutes:
**Ecuador**: In July 2009, Marcella met with Carlos Díaz, advisor to Pedro Montalvo (National Secretary for Science & Technology and official country representative to the IAI), Tannya Lozada, Undersecretary for Biodiversity of the Ministry of the Environment, Carolina Zambrano, Undersecretary for Climate Change of the Ministry of the Environment, and with Dania Quirola, advisor to Rene Ramirez (National Secretary for Planning & Development). Several Ecuadorian scientists involved in the IAI-MacArthur project have assisted in the communication with Ecuador's government. In August, Marcella will meet again with several authorities of the government to continue strengthening the IAI relationship with Ecuador.
**Costa Rica**: In April 2010, Marcella met with Dr. Eugenia Flores, Minister of Science and Technology, and with Linyi Baidal Sequeria, Deputy-Director for Foreign Policy of the Ministry of Foreign Affairs. The objective of the meetings was to inform government authorities of Costa Rica about the IAI and its activities. In May, 2010 there is a change of government in Costa Rica and the IAI will follow up on the contacts developed and pursue communication with key authorities of the new government.
**Paraguay**: Marcella has been in touch with Fernando Gaona, alternate representative of Paraguay to the IAI. Marcella has provided him with information on the IAI research and training programs. Paraguay is working towards paying its country dues and good communication and dialogue have been established between the IAI and this member country. In addition, the IAI is also discussing the possibility of organizing a training event in Paraguay associated with the IAI La Plata Basin project in 2011.
**Non-member countries**: On the occasion of the IAI-NCAR colloquium, IAI established contacts with the head of the meteorological services of St. Vincent and the Grenadines in the Caribbean, who participated in the colloquium. Information about the IAI was sent out to this contact to disseminate the work of the IAI and foster country membership.

The Director gave presentations on IAI science and explored opportunities for collaboration during a visit to **Washington** in November 2009. Talks were held at NSF, at Departments of State, Commerce and Energy, and at Conservation International.