

1 Project Title, Project Number, Principal Investigator, Key Words

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

CRN 2031

PI: Esteban Jobbágy

KEYWORDS: land use / land cover, Plata Basin, South America, ecohydrology, carbon cycling, social impacts and drivers.

WEBPAGE: <http://platabasin.unsl.edu.ar>

2 Project Funding

The CRN team has presented proposals related to the Plata Basin project goals to several funding agencies of national and international scope (Table 1). To the present our team has received ~900.000 USD from the following agencies: European Community, Agencia-SECyT (Argentina), INIA (Uruguay), INTA (Argentina), Global Environmental Facility, and local Universities. New projects have been approved and will receive funds in CRN-year 2 from National Science Foundation and National Geographic Society, providing to the CRN goals development additional ~280.000 USD. In addition, members of our team participate in several initiatives presented for additional funding to IAI (SGP-Human Dimension –Tourrand, Meza, Freise; Land-Climate feedbacks - Berbery) and through IAI to IDRC (Canada).

Table 1. Additional funding obtained by CRN 2031 CoPIs in year 1 (2006-2007)

<i>Funding received in year 1 of CRN 2031</i>							
Granting Institutions	Grant type	Grant code	Starting date	Ending date	CRN members involved	Role	Amount (USD)(*)
European Community Framework Programme (EU)	6th Framework Program - Integrated Project	SENSOR 003874	dic-06	jun-08	Coutinho	CoPI	382000
			dic-06	jun-08	Jobbagy	CoPI	57500
			dic-06	jun-08	Altesor	CoPI	46000
Secretaria de Cs & Tecnica - La Agencia (Arg)	FONCyT - PICT (2004)	PICT 200382	jul-06	jul-09	Jobbágy	PI	89000
Secretaria de Cs & Tecnica - La Agencia (Arg)	FONCyT - PICT (2005)	PICT 32399	mar-07	jun-10	Paruelo (with Jobbágy)	PI	89000
Instituto Nacional de Investigación Agropecuaria (Uy)	Fondo de Promoción de Tec Agrop	FPTA 175	oct-06	oct-09	Paruelo (with Altesor)	PI	137390

Secretaria de Cs & Tecnica - La Agencia (Arg)	FONCyT - PICT (2004)	PICT 32925	mar-07	jun-10	Noellemeyer	CoPI	8600
Universidad Nacional de La Pampa (Arg)	Proyectos CyT		abr-06	abr-07	Noellemeyer	PI	1200
North Carolina Space Grant Consortium (US)	New Investigations Program	2006-07 NC Space - Hoffmann	sep-06	sep-07	Hoffmann (with Di Bella)	PI	20000
Instituto Nacional de Tecnologia Agropecuaria (Arg)	Area Estrategica Recursos Naturales	AERN 4	jul-06	jul-07	Di Bella	PI	10000
Global Environmental Facility	Medium-sized GEF projects	GEF RioFormoso	jul-06	jul-07	Meirelles and Coutinho	CoPI	71800
<i>Approved for next CRN year</i>							
National Science Foundation (US)	Division of Environmental Biology	NSF 717191	sep-07	sep-10	Jackson (with Jobbagy)	PI	150000
National Science Foundation (US)	Coupled Natural and Human Systems	NSF -not available-	sep-07	sep-10	Podesta	PI	75000
National Geographic Society (US)	Research and Exploration Grants	8277-07	nov-07	oct-08	Jobbagy	PI	7000

3 Research Activities and Findings

This section is organized as follows: First we present a detailed list of the work performed in the frame of the research activities that were initially planned (3.1), finally we list all the collective events (meetings, workshops, etc) carried-on in the reported year (3.2). Readers are directed to <http://platabasin.unsl.edu.ar> for more details on the team members and the project scope and activities.

3.1. Detailed description of activities

GOAL A: Understand the drivers of land use changes in the Río de la Plata Basin
Activity 1 - Regional land use changes patterns:

We are progressing at two complementary scales: regional and continental. At the regional level we already generated land cover maps of 9 pilot areas distributed over the Rio de la Plata grasslands, from Rio Grande do Sul to the southern portion of Buenos Aires province (1980s to 2000s) (CoPI Paruelo + student Baldi). The analysis allowed us to define transition probabilities between three groups of land covers (grasslands, annual crops and implanted forests) and to study their environmental controls across phytogeographic and political boundaries. This approach is now being extended to other biomes, particularly dry forests of the Cerrado (CoPI Meirelles & Coutinho + several students).

At the continental scale progress has been made on the development of automatic classification algorithms for basin-wide implementation. This, together with the definition of a common nomenclature of land cover types will allow an integrated analysis of land use changes (CoPI Meirelles + Paruelo + student Caride). Current work on land cover maps

from phenological signatures is being linked to the the provision of ecosystem services associated to agricultural expansion in the province of Buenos Aires (CoPI Paruelo + student Caride), linking this activity to activity 13.

Activity 2 – Historical socioeconomic context of key land use changes:

This activity is being started in the Uruguayan territory in its first stage. The role of the globalization process and the transformations in the role of the national state are being explored as part of a series of integrated thesis in UDELAR (CoPI Piñeiro + student Carambula and others). Our plan is to use this first experience as a basis to compare Brazil-Argentina-Uruguay.

Activity 3 – Spatial and temporal controls of land use changes:

This activity is in preliminary stages under the direction of Paruelo.

GOAL B: Evaluate their impacts on ecosystems and societies

Activity 4 – Socioeconomic impacts

The first land use change focused for this activity is the expansion of afforestation in grasslands. A team of seven undergraduate and graduate students in UDELAR is documenting and understanding the consequences of this land use shift on the labor market, particularly on role of contractors, labor conditions, participation of women in the labor market, and technical change (CoPI Piñeiro + students). In another line of work the team is exploring the emergence of social movements linked to the expansion of afforestation. A third line explores the power relations among stakeholders in the development of the current forestry complex in Uruguay. These research activities are currently in the stage of finishing field data gathering and some in the early literature review stage.

Activity 5 – Carbon uptake

Current work is being conducted at the continental scale. We are centering on the dynamics of NDVI as a surrogate of fPAR, the main control of carbon gains (CoPI Epstein + Paruelo, student Alcaraz). We have finished the downloading of the whole MODIS NDVI 16-day 250x250 m time-series from 2000 to 2006 for the entire basin and the filtering of all dates using the Quality Flags provided with each image. In a preliminary step, different criteria of quality were applied to filter the whole basin to decide which one was the ideal one for the basin in order not to lose much information. The final criteria are no clouds, no water, no shadow, no snow, low quantity of aerosols and fair usefulness of the NDVI. The whole basin has been filtered under these criteria. Pixels with more than 20% of their dates unavailable (filtered) within one year were masked for that particular year. Also pixels with more than 2 years unavailable (masked) were masked for the whole period of 7 years. The final time series is now accessible for the team in ENVI format. This work has been connected with the longer term exploration of NDVI series from NOAA-AVHRR images, which is the basis for a collaborative project launched in the frame of activity 12 (CoPI Jobbágy + student Baldi).

Activity 6 – Carbon storage and turnover

Grassland afforestation has been the land use change first tackled in a collaborative effort. Paired grassland-tree plantation stands throughout the whole basin have been sampled for different type of analysis including carbon and nutrient pool shifts, isotopic signatures, microbial biodiversity (CoPIs Jobbágy, Jackson, Noellemeyer, Panario + students Piñeiro, Berthrong, others).

Review work analyzing soil C turnover in agricultural lands is being conducted. The review involves the use of the CENTURY model and stable isotopes data. This work has given theoretical insights on potential carbon sequestration in crop lands via root carbon allocation. Additionally, we have been analyzing the effects of biofuels production (mainly corn-ethanol) on soil carbon and making complete life cycle assessment of this crop (CoPI Jackson + Jobbagy, student Piñeiro).

Activity 7 – Biomass burning

We are exploring the process of biomass burning in the basin focusing on its patterns and drivers and on its consequences on post-fire ecosystem carbon-uptake (CoPIs Di Bella + Hoffmann + Coronel, several students). We linked fire occurrence and natural or human drivers such as land use, husbandry, crop sequences, agricultural practices, land property, education levels and socioeconomical status of farmers, among others, for Argentina and Paraguay. We are analyzing these relationships from regional and local scales, considering biomes, political divisions and fitogeographic regions.

We have been combining meteorological data, remote sensing, and a fire model to quantify the sensitivity of fire regimes to climate for Argentina. We used the WMO meteorological database to calculate daily values of the McArthur Forest Fire Danger Index (FFDI) for 67 locations across Argentina for 2003-2006. Counts of active fires from MODIS were obtained for this same period and were related to the FFDI using negative binomial regression. Although there is a great deal of spatial variation in the absolute numbers of fires, this approach has proved to be a very robust method of quantifying the sensitivity of fire regimes to climate. Forest ecosystems exhibited the greatest climate sensitivity, whereas agricultural landscapes exhibited the least.

We are exploring fire effects on plant regeneration upon different environments including woodlands, grasslands and shrublands from central-northern Argentina. Our approach is based on direct observations in a local experiment, and in the use of remote sensing tools to produce information from a regional point of view. We proposed accomplish three main objectives in the first part of our study. First, to measure differences on green recovery and regeneration times between different vegetation types through burned and control sites. Second, to evaluate possible interactions between fire severity and vegetation recovery, and third to model the dynamics of green recovery for different vegetation types immersed on diverse eco regional units. For the first two objectives, preliminary results indicate that woodlands ecosystems exposed to high fire severity levels are conditioned to a lower

photosynthetic development and a longer recuperation time, as Open Grasslands presented higher and faster regeneration levels.

The fires study in the Semi-arid Region of Argentina suggests that the climate, vegetation type and land use are the most important controls of the spatio-temporal fires distribution. In addition, the characteristics of the vegetation were analyzed as determinant factors to the occurrence and behavior of fires. From these results, it was observed that the quantity of biomass acted as an important factor on the fire occurrence while the fuel moisture content had bigger influence on size and duration of disturbances.

Activity 8 – Water balance changes from stands to watersheds

Current work is focused on groundwater – land use interaction in the flattest areas of the basin (Chaco-Espinal & Pampas) and on stream/river dynamics in rolling or hilly landscapes (Cerrado, Mata Atlantica, hilly grasslands in Cordoba and Uruguay).

One of the work lines has focused on grassland afforestation and its impacts on the water balance, particularly groundwater consumption and salinization, in flat landscapes (CoPI Jobbágy and student Nosetto). This line has yielded a general conceptual model that is able to predict the vulnerability to afforestation-induced salinization in plains (submitted for publication to GBC). In the same work line we have linked groundwater use to carbon uptake. This work is being complemented with watershed studies in rolling landscapes in Argentina and Uruguay in which stream flow and chemistry in paired small basins is being performed (CoPIs Jobbágy, Panario, Jackson and student Piñeiro).

Another line of work focuses on the effects of dry forest replacement by annual croplands. In the flat territory of Chaco and Espinal groundwater recharge and salt migration is being documented through deep soil and vadose zone sampling (dryland salinity syndrome reported in Australia) (CoPI Jobbágy and student Santoni). In rolling landscape of the Cerrado (Formoso river basin), the effects of land use change on water quantity and quality will be monitored. This activity is in its planning stage through a participatory process that involves the local community (CoPI Coutinho and Meirelles).

Finally, within a region that experiences agricultural intensification as its major land use shift (Pampa Interior, Argentina), we are developing a pilot study that attempts tackle the reciprocal links between land use, climate, and water table dynamics (main control of floods in the region)(CoPIs Jobbágy, Viglizzo, Podesta, student Aragon, Nosetto, Carreño). Currently we are quantifying the connection between precipitation and groundwater through time-series analysis of historic records of water table depth and precipitation. At this moment, we count with water table depth data from nearly 50 sites spread over an area of approximately 35,000 km² from early 80s to present. In addition, we are using Landsat images from the last decade to explore potential pond expansions or contractions in this region. These changes in the surface of free water are connected to groundwater dynamics, affect tank- evaporation, and ultimately influence regional water balance. Locally, we are relating groundwater accessibility by the vegetation and its functioning. To do this we work in an area that alternates high and low patches at landscape scale, and from where we

count with water level depth data measured by phreatimeters, evapotranspiration (estimated experimentally and by remote sensing).

Activity 9 – Land use changes and their impact on climate

This activity has been postponed in the project after our early discussion with IAI (Tiessen-Jobbagy-Paruelo in Montevideo, 2005). We have been collaborating with Hugo Berbery shaping a new proposal to be submitted through IAI for funding by IDRC (Canada). Our team has developed insights that will facilitate this work in the frame of activity 8 (CoPI Jobbagy + Viglizzo, students Aragon + Carreño)

GOAL C: Identify critical feedbacks and plausible future trends

Activity 10 – Interactive models:

Work is being conducted along two independent lines that are expected to converge in the following two years. We are progressing with A) a spatially explicit model aimed to describe and predict land use changes (CoPI Paruelo + student Vega) and B) with a physically based model that represents water dynamics and its reciprocal link with land use in flat landscapes (CoPIs Jobbágy+Viglizzo+Podesta, students Aragon, Nosetto, Carreño).

In the first work line, a spatially explicit simulation model of land use change (LUC) is being developed. The goals of this model are: a) to include spatially explicit environmental and socioeconomic variables; b) to identify which LUC processes are more sensitive to fluctuations of the above mentioned variables; c) to evaluate possible regional-scale consequences of changes in the main variables of LUC. At present there is a functional almost definitive version of this model. The main characteristics of the model are:

- Spatially explicit variation is simulated through a rectangular grid; temporal change from time (t) to (t+1) of cell c_{ij} depend on: i) its particular set of environmental conditions at time (t); ii) the conditions in its immediate neighborhood at time (t);
- Each cell c_{ij} has layers of environmental and socioeconomic variables and of response variables (land use covers);
- LUC in a cell c_{ij} is simulated through a markovian model, composed by a matrix A of transition probabilities between the land use covers, and a vector v with the proportions of each land use. Temporal change of these proportions from (t) to (t+1) are stated as $A \times v(t) = v(t+1)$;
- Transition probabilities of A can be modified by: i) the particular set of variables in cell c_{ij} ; ii) relatives abundances of each land cover in the neighborhood of the cell; iii) relatives abundances of each land cover in all the grid.

The second work line explores the multiple connections between climate, the hydrological system and land use in very flat and poorly drained plains (Pampa Interior). Ultimately, this approach attempts to represent the role of human decisions in land use/management as an agent that can potentially shape hydrology and perhaps climate. To achieve this goal we need to recognize the reciprocal connections between climate, groundwater levels, and land use and its consequences on evapotranspiration and agricultural production. In a first stage a biophysical model will be assembled and management/use rules will be fixed by the

researchers. In a next step, the behaviour of land use based on climatic and hydrological signals will be included allowing for an explicit representation of coupled dynamics. Currently we are in the stage of developing the basic relationships for the biophysical model while we simultaneously discuss the needs of the model in its fully coupled stage (CoPIs Jobbágy, Viglizzo, Podesta, students Aragon, Nosetto, Carreño, Bert).

Activity 11 – Plausible scenarios:

-- This activity has not been initiated

GOAL D: Support regional planning through dissemination of knowledge and tools

Activity 12: Open scientific forum:

We are in the process of developing a collaborative web site that will operate as a forum and virtual directory of expertise on ecosystem changes in the whole continent. Land Ecosystem Change Utility for South America (LECHUSA, <http://lechusa.unsl.edu.ar>) is in its first on-line stage receiving opinions of selected experts. Functional changes in land ecosystems are characterized with long term NDVI series. Foci of intense shifts (positive or negative) have been identified and experts on those regions are invited to collaborate with their expert knowledge (hypotheses, unpublished evidences, publications) on the nature, drivers, and possible consequences of the detected large scale changes in NDVI. After the first stage is finished we plan to make this initiative broader inviting researchers from other CRNs (Diaz, Sarmiento, Sanchez) to be an active part of the initiative. We already applied for additional funds to hire collaborative-web experts to improve the site for the second stage. In its third stage the site will be publicized to different types of users. One of the main advantages that we see for this site is the possibility of showing to the general public that 1) where big functional ecosystem changes take place, 2) that causes and impacts are under progressing debate among scientists, 3) that those scientist can be contacted directly through the site which will serve as a directory of SA expertise.

Activity 13: Land use planning to optimize ecosystem products & services

-- This activity has not been initiated

3.2. CRN 2031 Events

During the reported periods we held four CoPI meetings/workshops (3.2.1) that helped us initiate work on CoPI clusters. At mid 2008 we plan a large plenary session. In addition many of our CoPIs participated in workshops organized or co-organized by IAI.

3.2.1. CoPI meeting

3.2.1.1. Start-up meeting with CoPIs from Ar-Py-Uy.
Buenos Aires, Argentina - October 15 - 16, 2006

Goals of the meeting - Present/update CRN 2031 goals

- Expose interests, expectations, and capacities of all CoPIs
- Introduce new postdocs
- Start an agenda of specific collaborations and activities for the next 2 years
- Review administrative issues

With many of the CoPIs that were not in this meeting we had some initial discussion around these goals before (Meirelles, Coutinho, Podesta, Jackson, Hoffmann) and your opinions and ideas were brought to the discussion in BA.

Participants:

CoPIs: Alice Altesor - Genaro Coronel - Carlos Di Bella - Esteban Jobbágy - Juan Maceira - Elke Noellemeyer - Daniel Panario - Diego Piñeiro - José Paruelo
 Authorized Institutional Representative (AIR): Roberto Fernández
 Executing agency: Florencia Counyo - Federico del Pino - Dolores Arocena
 Postdocs/Students: Roxana Aragon - Germán Baldi - Matías Carambula - Carlos Céspedes - Victoria Marchesini - Gervasio Piñeiro - Ernesto Vega - Andres Wehrle

Activities

- 1 – Presentation of CRN goals and activities (Jobbágy)
- 2 – Start-up questionnaire (All) Guiding questions distributed beforehand A. What activities are you already carrying on that are related to our CRN(or what would be your contributions in a business as usual scenario) B. What expectations and motivations you have regarding our CRN(or what new things, different than A, would you do in the frame of our CRN) C. What capacities, infrastructure, relevant contacts, etc, can you bring to the table and share with the rest of the CRN people
- 3 – Challenges in the integration of Social and Biophysical dimensions (Diego Piñeiro)
- 4 – Group discussion: CRN group Mission, Actions, and Agenda (All)
- 5 – Ecosystem Products and Services as a scientific framework (Paruelo)
- 6 – Administrative issues (Jobbágy & Counyo)

Outcomes

1. MISSION: discussion The need for (a) quality science, (b) integration of disciplines and national territories and (c) “real world” relevance of our quests and actions, as well as (d) training of a new generation of scientists was discussed. Synergies and trade-offs among all these missions were discussed.

2. ACTIONS: discussion The following collaborative activities were proposed/discussed. I considered our previous discussions with those missing in the meeting. We expect to achieve some products and a more clear road map for each one of them for our plenary meeting in March 2007. Far from being a fixed list, this admits people additions and deletions as well as other collaborative activities. All these activities attempt to progress in points a-b-c-d of our mission beyond what we, as scientist, would do in a bussines as usual scenario. Off course, besides these collaborative activities, I expect a lot of “business as usual” products from all the CRN participants. Activity 2 of CRN: socioeconomic context of LUCs – focus on afforestation and soybean expansion in Uruguay & Argentina D Pineiro, Carambula, Maceira, Paruelo Patterns & Controls of fires in the basin (in addition to biophysical factors explore human drivers such as type of farmer/rancher -e.g. peasant

vs. large scale operations-, or proximity to urban centers, affecting fire frequency) DiBella, Coronel, Hoffmann.

Soil carbon storage and dynamics following key land uses change in the basin (conceptual framework and data synthesis) G Pineiro, Panario, Coutinho, Jobbagy, Jackson, Noellemeyer.

Land use change patterns and drivers in a spatilly explicit context (Work in pilot areas, use of Cellular automata and agent models) Vega, Paruelo, Meirelles, Podesta, Epstein.

Integration of Soil data bases in the Basins (identify gaps, possible sources, and lobby actions to make data more accessible and integrated across countries) Panario, DiBella, Coronel, Meirelles & Coutinho.

Development of web site for the convergence of expert knowledge on land use and ecosystem function shifts in South America based on long term NDVI trends Jobbagy, Baldi, Meirelles, DiBella, Guerschman.

Feedbacks among climate, groundwater and land use in the western Pampas (Besides the purely biophysical link between precip, water table depth and land use/evapotranspiration, we will explore how different farmer behaviors affect the system) Aragon, Jobbagy, Viglizzo, Fernandez, Jackson.

Application of an ecosystem product & services matrix together with a cost/benefit appropriation matrix across sectors of the society to explore trade-offs under different scenarios. Two pilot areas with dynamic land use changes (possibly Chaco – agr vs. cattle in dry forest- and Uruguay agr vs. afforest vs. cattle in grassland) will be targeted Paruelo, Maceira, Viglizzo, Altesor, Schlichtler, Pineiro / We are looking for a posdoc here... Bold means main responsible(s)

3. AGENDA: Our schedule of large plenary workshops includes only 3 large meetings during the five years of the project. Rather than having more of those we will target smaller task-oriented meetings.

3.2.1.2. Land use change patterns and drivers in Plata Basin: resources, techniques and a common work agenda.

Buenos Aires, Argentina - December 18,19 and 20, 2006

Goals

1. To define a common methodology for land use change description at the local and basin level
2. To identify pilot study areas for LANDSAT-scale analyses
3. To explore approaches and methodologies for the identification of drivers

Participants:

Aragón, Roxana (UBA)

Baeza, Santiago (UDELAR)

Baldi, Germán (UBA)

Bert, Federico (UBA-U of Miami)

Demonte Ferraz, Rodrigo (EMBRAPA)

Jobbagy, Esteban (UBA)

Jonathan, Milton (EMBRAPA)

Liras, Elsa (UBA)

Meirelles, Margareth (EMBRAPA)
Paruelo, José (UBA)
Piñeiro, Gervasio (UBA)
Podesta, Guillermo (U of MIAMI)
Ortiz Valencia, Ivan (EMBRAPA)
Vega, Ernesto (UBA)

3.2.1.3. Fire Dynamics in the Plata Basin Buenos Aires.
Buenos Aires, Argentina - December 14 -16, 2006

Goals:

Discussion and development of common methodologies
Focus on key scientific and technological challenges regarding fires

Participants:

Di Bella, Carlos (INTA)
Hoffmann, Willam (North Carolina State University)
Fischer, M.Angeles (INTA)
Mari, Nicolas (INTA)
Melchiori, Arturo E. (INTA)
Straschnoy, Julieta (INTA)
De Ruyver, R. (INTA)

Topics presented:

- Regional assessment of fire risk (FFDI) (Hoffmann)
- Vegetation conditions favoring fires (Fischer)
- Postfire regeneration across a climatic gradient in Plata Basin (Mari)
- Human factors influencing fire occurrence at a county scale (Straschnoy)
- Biotic and abiotic factors conditioning fires at the continental scale (Di Bella)

3.2.1.4. Reciprocal interactions among climate, hydrology and land use in the Inner Pampas: Scientific and technological challenges.

San Luis, Argentina - February 5, 2007

Cooperation meeting among members of the research groups in Grupo de Estudios Ambientales (Jobbágy, UNSL/CONICET) and Programa de Gestión Ambiental (Viglizzo, INTA)

Goals:

Presentation of aims, capacities and current work lines of both groups
Identification of common motivations
Definition of common activities and work plan for 2007-2008

Participants:

Ernesto Viglizzo (INTA-Santa Rosa, Inv. CONICET)
Federic Frank (INTA-Santa Rosa)
Lorena Carreño (INTA-Santa Rosa)

Estudiante Belga (U de Lovaina, Bélgica)
Esteban Jobbágy (GEA, Inv. CONICET)
Roxana Aragon (GEA/IFEVA, Postdoc IAI)
Marcelo Nosetto (GEA, Bec. CONICET)
Carla Rueda (GEA, Bec. CONICET)
Germán Baldi (GEA, Bec. SECyT)

3.2.2. IAI-related workshops

Training institute on climate, land use, and modeling

Organizer: IAI, CPTEQ

Cachoeira Paulista, Brazil - August 13-18 2006

Participants: Jobbágy, Hoffmann, Meirelles, Coutinho, Nosetto, Guerschman

Understanding ecosystem function and environmental constraints to guide the land management strategies of the future.

San José, Costa Rica - December 13 - 17, 2006

Organizer: IAI, SCOPE

Participants: Coutinho, Noellemeyer

Development of a new Plata Basin initiative merging LPB and IAI projects: Climate, land use, risk and rural development.

Buenos Aires, Argentina - March 27 - 30, 2007

Organizer: IAI, CLIVAR, IDRC

Participants: Coutinho, Meirelles, Jobbágy

4 Contributions of Co-PIs

In its first year our CRN team has initiated work within “clusters” of CoPIs dealing with the most challenging and cross-cutting aspects of our project as follows:

Land use change description and monitoring at the whole basin level and spatially explicit modeling

Paruelo + Meirelles + Altesor + Epstein

Steering postdoc: Ernesto Vega

Soil carbon across land use changes – Ecosystem carbon balance

Jobbágy + Jackson + Coutinho + Noellemeyer + Panario + Oosterheld

Steering postdoc: Gervasio Piñeiro

Climate-Hydrology-Land use interactions in plains

Jobbágy + Viglizzo + Podesta

Steering postdoc: Roxana Aragon

Human and natural controls on biomass burning and impacts on C-uptake

Di Bella + Hoffmann + Coronel

This cluster had meetings in BA and is exchanging information and students

Land use change and policy making in the Plata Basin

Paruelo + Jobbágy + Schlichter + Maceira + Piñeiro + Podesta

This cluster initiated meetings on afforestation policy with stakeholder in Uruguay and Argentina and plans to expand this work mode to the issue of agricultural expansion in year 2.

In addition, all CoPIs worked in more specific lines that are indicated in section (3.1)

5 Publications

During the reported period our team has published seven papers in international and national peer-reviewed journals and submitted six more. Several manuscripts are currently in preparation. Presentation in meetings involved 30 posters or talks by CoPIa and their students. Some of the forums included “Reunion Argentina de Ecología – 2006”, “American Geophysical Union, Joint Assembly 2007” (this is the first meeting held in Latin America by this association), and “Reunión Española de Teledetección” (first meeting of this European association held in Latin America).

5.1. Published

1. Jobbágy EG, RB Jackson. 2007. Groundwater and soil chemistry changes under phreatophytic tree plantations. *Journal of Geophysical Research – Biogeosciences* 112-10.1029/2006JG000246
2. Nosetto MD, EG Jobbágy, T Toth, CM Di Bella. 2007. The effects of tree establishment on water and salts dynamics in naturally salt-affected grasslands. *Oecologia* 10.1007/s00442-007-0694-2
3. Paruelo JM, JP Guerschman, G Piñeiro, EG Jobbágy, SR Verón, G Baldi, S Baeza. 2006. Cambios en el patrón espacial de uso de la tierra en Argentina y Uruguay: marcos conceptuales para su análisis. *Agrociencia* (Uruguay) 10:47-61
4. Jobbágy, EG, M Vasallo, K Farley, G Piñeiro, M Garbulsky, M Nosetto, R Jackson, JM Paruelo. 2006. Forestación en pastizales: Hacia una visión integral de sus oportunidades y costos ecológicos. *Agrociencia* (Uruguay) 10:109-134
5. Carámbula, M. Piñeiro, D. 2006. Forestación en Uruguay: cambios demográficos y empleo en tres localidades. *Agrociencias* (Uruguay) 10:63-75
6. Jobbágy EG, MD Nosetto, JM Paruelo, G Piñeiro. 2006. Las forestaciones rioplatenses y el agua. *Ciencia Hoy* 16:14-22.
7. Bert, F.B., G.P. Podestá, E.H. Satorre and C.D. Messina. 2007. Usability of climate information on decisions related to soybean production systems of the Argentinean Pampas. *Climate Research* 33: 123-134.

5.2. Submitted

Oyarzabal, M., J.M. Paruelo, F. del Pino, M. Oesterheld, y W.K. Lauenroth. Structural and

functional plant traits of C₃ and C₄ dominant grasses across a precipitation gradient. *Journal of Vegetation Science* (accepted 25/6/2007).

Aragon, R., M. Oesterheld. Linking vegetation heterogeneity and functional attributes of temperate grasslands through remote sensing. *Applied Vegetation Science* (in review).

Herlin, I.; Berroir, J-P; Bouzidi, S.; Jonathan, M.; Meirelles, M. S. P.; De la Torre, C. "Data fusion to support satellite monitoring of land degradation." *IEEE Transactions on Geoscience and Remote Sensing*, submitted 2007.

Baeza, S.; Lezama, F.; Piñeiro, G.; Altesor, A. and Paruelo, J.M. Spatial and Functional Heterogeneity of Uruguayan Grasslands. Enviado *Journal of Applied Vegetation Science*

Piñeiro, G., José Paruelo, Esteban Jobbágy, Robert Jackson, Martin Oesterheld. Grazing effects on belowground C and N stocks along a gradient of cattle exclosures in temperate and subtropical grasslands of South America. Submitted to *Ecology*. Manuscript # 07-0648

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6 Data

Web sites: Project site: <http://platabasin.unsl.edu.ar>
Collaborative site: <http://lechusa.unsl.edu.ar>

Databases and data sharing

Our team has developed a web site in which all users can download long-term satellite NDVI series (lechusa, see above). We are working on similar initiative for data access on phreatic groundwater levels in the Pampas in collaboration with a farmer association (AACREA).

7 Capacity Building

7.1. Students

During this first year our team recruited 17 students (4 undergraduates, 4 master, 5 Ph.D, 4 posdocs) who are supported by IAI funds. In addition we have recruited 28 students who are supported by other financial sources such as CONICET, INTA, EMBRAPA, and local Universities. See Appendix A at the end of this document for details.

A specific goal of our project was to develop scientific capacities in Uruguay and Paraguay. In the case of Uruguay we have two PhD students (Baeza & Lezama, directed by Altesor and Paruelo) working on their dissertation in UBA, and a PhD student doing his degree in Universidad de Cordoba (Carambula, codirected by Piñeiro). A posdoc from Uruguay, Gervasio Piñeiro, links groups in UDELAR, Duke and UBA and is expected to achieve the status of independent researcher within year 2 of the project. Regarding Paraguay, we have identified a PhD candidate (Andres Wehrle) who started his IAI fellowship in July 2007 to perform doctoral studies in Hydrology (codirected by Jobbagy).

CoPIs in the CRN work as directors or codirectors of many students working in institutions with strong local influence such as INTA and EMBRAPA. These students participate in CRN-related activities and transmit goals, ideas, and capacities to their home institutions.

7.2. Training activities

Besides the courses and practices associated with the formal programs in which students are enrolled, in the current year CRN 2031 students visited the labs of different CoPIs acting as a very effective link across groups:

Gervasio Piñeiro (with Jobbágy) visited Jackson and Panario.
Domingo Alcaraz (with Epstein) visited Paruelo, Jobbágy, Di Bella
Sean Berthrong (with Jackson) visited Jobbágy and Noellemeyer
Santiago Baeza and Felipe Lezama (with Altesor) visited Paruelo and Oesterheld
Dario Ceballos (with Schlichter) visited Jobbágy
Fernando Pío Barrios and Maria Hume (with Coronel) visited Di Bella
Ernesto Vega (with Paruelo) visited Altesor
Lorena Carreño (with Viglizzo) visited Jobbágy

In addition Domingo Alcaraz participated in the MODIS imagery workshop (Baltimore, United States - January, 2007). This activity was complemented with visits of Alcaraz to different remote sensing labs in UBA, UNSL (San Luis), UDELAR, and INTA for the diffusion of the new skills and updates that he acquired in the workshop.

7.3. Outreach

In the first year our team was involved in a series of debates with stakeholders regarding the impacts of two major land use changes: Afforestation in grasslands, and agricultural expansion and intensification.

7.3.1. Afforestation and its impacts

First encounter, Buenos Aires 12-September, 2006

Organizers: CRN 2031 and INTA (Jobbágy & Schlichter)

In this workshop, scientists from different disciplines and institutions revised the major impacts and opportunities of the conversion of grasslands to tree plantations. The audience involved policy makers (the highest forestry authorities of Argentina were present), conservationist/environmentalist NGOs, and major forestry companies CEOs. A fruitful debate yielded as an ongoing internet forum (Forestación Sostenible, <http://www.ambienteysdesarrollo.com.ar/forestacion/>) carried on by private forestry consultants. Secretaria de Agricultura de la Nación (Argentina) has issued a report on this activity (http://www.sagpya.mecon.gov.ar/new/0-0/forestacion/revistas/boletin0906/CF%2009_06.pdf).

A follow-up event was carried in 2007, with the following characteristics:

Second encounter, Buenos Aires 4-July, 2007

In this workshop the roles were reverted and major forestry companies presented their goals and actions with regard to the environmental and local societies. These presentations were discussed in an audience composed by policy makers, researchers, and NGOs representatives. The number of institutions enrolled in this continuous forum has increased including now AFoA (largest forestry association in Argentina).

In future events the group plans to invite forestry stakeholders from Uruguay based on our previous successful experience from IAI-SGP 004, which resulted in a very insightful forum developed in Montevideo and partially documented in a special issue of the Uruguayan journal “Agrociencia” – see publications.

Along the same line, CoPIs Altesor and Panario had participated in the development of an important document signed by UDELAR revising the role, impact, and future projection of afforestation in the Uruguayan territory. This document had a strong political impact in Uruguay and has been a cornerstone in the international debate on forestry and paper/pulp mills (http://www.fcien.edu.uy/archivo/informe_consejo_plantas_celulosa_28_06_06.pdf)

CoPI Noellemeyer had an active participation in the provincial consultative organism on soil conservation in La Pampa (Argentina) in the elaboration of the provincial soil conservation law and its reglamentation. She collaborated with the provincial Council of Agronomists and presented in that forum a conference on “Afforestation as an alternative for soil conservation: its benefits and drawbacks”.

7.3.2. Agricultural expansion

Secretaria de Ciencia y Técnica de la Nación y Asociación Argentina para el Progreso de la Ciencia (Argentina) Fundación Brasileira para o Progreso de la Ciencia (Brazil) organized a joint workshop in Buenos Aires in July 2006 to debate the issue of agricultural shifts in both countries. CoPIs Paruelo, Jobbágy, and Oesterheld participated with presentations on

Remote Sensing applications, Capacity building for rural development, and hydrological impacts of agricultural expansion on dry forests.

7.3.3. Climate, Hydrology and Agriculture

In the frame of the training program of farmer association AACREA (Asociación Argentina de Consorcios Regionales de Experimentación Agrícola), CRN 2031 participants gave two classes in a course oriented to field agronomists. Federico Bert presented on the values of climate information in soy and corn production (“El valor de la información climática en los cultivos de maíz y soja. Analizando el impacto de escenarios de mediano y largo plazo sobre la producción y su resultado económico”) and Esteban Jobbágy presented on groundwater-crop interactions. This is a traditional course of high impact across leading farmer nuclei across the Pampas and the Chaco/Espinal Plains.

On similar topics both Bert and Jobbágy presented in the event “Mundo Agro 2007” (www.mundoagro.com) to an audience of 1500 attendants, mainly farmers, and ag-tech and ag-business professionals.

7.3.4 Forage production monitoring systems

We are in the process of transferring a system for forage production monitoring to a consortia of farmers (AACREA). The last stages of this system have been developed within the CRN 2031 framework by CoPIs Oesterheld and Paruelo.

8 Regional Collaboration/Networking

In the current year our team become involved in the following networks/teams

SENSOR: This European Commission funded project, carried out by 33 Institutions from 15 European countries, aims at developing a Sustainability Impact Assessment Tool for policies related to land use changes. It relates to the IAI CRN project since it has components for the identification of land use change drivers, the elaboration of a spatial reference database, integrating thematic data from the La Plata basin, modeling future land use changes considering different scenarios for the state of the drivers, and the involvement of stakeholders, from land owners to policy makers to validate the system that will be developed, specially the impact indicators and their thresholds. The knowledge acquired in the Sensor project, involving UBA, UDELAR, and Embrapa, will be greatly useful for the development of the IAI CRN project. CoPIs Coutinho, Meirelles, Jobbágy, Altesor. (see www.sensor-ip.org).

ENVIAR: Ongoing effort bringing together researchers at Embrapa, UFRJ (Federal University of Rio de Janeiro), UERJ (State University of Rio de Janeiro) and INRIA (Institut National de Recherche en Informatique et en Automatique, France). It is focused on the development of advanced digital image processing technologies for the automatic monitoring of deforestation, land degradation and expansion of no-tillage agriculture through systematic classification of land use and land cover. CoPIs Meirelles & Coutinho

Redlatif (Red Latinoamericana de Incendios Forestales): The principal goals is to compile a list of Latin-American experts working on remote sensing and forest fires, to foster the participation of Latin-American scientist in global networks related to the fire programs, and to generate thematic networks for participation in fire-related projects within the Latin-American region. CoPI Di Bella coordinates this initiative.

ADMIT-Consortium: Consortium for “Climate change ADaptation and MITigation strategies and policies for land use activities in the Parana-Plata basin” (ADMIT), coordinated by Alterra – Green Research Centre (Wageningen UR, Netherlands) as an effort to produce a research proposal submitted to Europe’s Seventh Research Framework Programme (FP7). This network involves researchers from several countries in Europe and South America, thus providing an interesting opportunity to foster valuable partnerships for our CRN project, particularly in the field of land use change modeling. Approval of this proposal may also contribute with significant financial support for data assemblage necessary to our CRN project, as well as for important pilot area field works and research activities. CoPIs Meirelles and Coutinho

Involvement in other IAI projects: Our team has endorsed projects presented in the las SGP-human dimension call and will collaborate with three granted projects led by Tourrand, Freise and Meza. In addition we have become part of the LPB initiative led by Hugo Berbery from University of Maryland and had contributed to assemble a joint proposal on climate-land use links presented for funding to IAI. Finally, our team has collaborated in a new larger scope proposal on the Plata Basin presented by IAI to IDRC (Canada).

9 Media Coverage and Prizes

Afforestation and its impacts/opportunities

Le Monde (Paris, France)

http://www.lemonde.fr/web/imprimer_element/0,40-0@2-3244,50-894416,0.html

Diario Perfil (Buenos Aires, Argentina)

<http://www.conicet.gov.ar/diarios/2005/diciembre/055.php>

IndyMedia (Montevideo, Uruguay)

<http://uruguay.indymedia.org/news/2006/07/52556.php>

Semanario Brecha (Montevideo, Uruguay)

Las Plantas de celulosa: del maniqueísmo a la racionalidad. February 2007. (Jobbágy, Altesor, Paruelo), Una nueva oportunidad. April, 2007 (Altesor), Las cortinas de humo no dejan ver el bosque. April, 2007. (Altesor, Paruelo, Panario), El General tiene quien le escriba I. May, 2007 (Altesor, Paruelo, Panario), El General tiene quien le escriba II. June, 2007 (Altesor, Paruelo, Panario)

Climate, groundwater and crops in the Pampas

La Nación (Buenos Aires, Argentina)

http://www.lanacion.com.ar/edicionimpresa/suplementos/elcampo/Nota.asp?nota_id=917621

La Voz del Interior (Córdoba, Argentina)

http://gea.unsl.edu.ar/pdfs/art%20diarios%20de%20congreso%20mundo%20agro/LAVOZ_com_ar%20%20EI%20agua%20de%20napa,%20una%20mediadora%20entre%20los%20cultivos%20y%20el%20clima.htm

La Nueva Provincia (Bahía Blanca, Argentina)

<http://gea.unsl.edu.ar/pdfs/art%20diarios%20de%20congreso%20mundo%20agro/LNP%20Economía%20y%20negocios.htm>

Groundwater and irrigated vs. native vegetation conflicts in arid regions

National Geographic on-line (Washington, US)

<http://news.nationalgeographic.com/news/2007/06/070620-argentina-water.html>

10 Policy Relevance

At this stage the project has generated its major impact on policy through the involvement of CoPIs in the discussion of afforestation laws and their implementation. CoPIs Jobbágy, Altesor, Panario, Paruelo and Piñeiro had participated in several discussions, workshops, and published articles for the general public. Many of these participations had a strong impact on the current debate on afforestation among policy makers of Argentina and Uruguay, with some international influence through articles in Le Monde (France) and the participation of the PI Jobbágy as a contributing author in the last IPCC report (2007) from Work Group III (Mitigation) in Chapter 9: Forestry.

http://www.mnp.nl/ipcc/pages_media/FAR4docs/chapters/CH9_Forestry.pdf

11 Main Conclusions

In the first year the CRN 2031 team has consolidated five important work clusters that are already interconnected and will yield more integrative results in the following years. These clusters focus on the following aspects of land use change in the Plata Basin: a) description, monitoring and spatial modeling, b) carbon cycling shifts, c) interaction with hydrology and climate, d) interaction with fire dynamics, e) connection with policy and production through debates and tool development for the general public. Afforestation in grasslands, which was the land use trajectory in which most of the CRN 2031 members had more experience, was the area of fastest progress in this year, but we are now producing results on two additional trajectories: agricultural expansion over dry forests and agricultural intensification in the Pampas.

The project has hired 17 students with IAI funds and involved 28 more financed by other sources. These students are already bridging the labs of different CoPIs. We have published and submitted 12 publications and made 30 presentations in scientific meetings. Members of the team had been actively involved in workshops and debates with stakeholders such as ag-policy officials, farmer associations and environmental NGOs. Two active web sites had been generated in this year

12 Work Plan for Next Year with Associated Costs

We will continue our work in the clusters mentioned above, focused on the following aspects of land use change in the Plata Basin: a) description, monitoring and spatial modeling, b) carbon cycling shifts, c) interaction with hydrology and climate, d) interaction with fires, e) connection with policy through debates and tool development for the general public.

The work initiated within these clusters will be continued along the same lines described in the results section (3.1.). However, the following four aims will guide some improvements and challenges in the activities of year two:

1. “Humanize” clusters “a-c-d”

The team is interested in capturing the strong connection between societies and ecosystems in its research, yet, disciplinary and cultural barriers often favor a separation of biophysical and human aspects of the work in each cluster. We will include behavioral issues as well as policy and economy rules in the evaluation of land use change patterns (cluster a). Decision rules by farmers in relation to groundwater elevation will be included in the modeling of climate-hydrology-land use, this assessment will include an explicit analysis of the economic outcome of different groundwater scenarios in terms of gross margin, a variable that will likely have more direct effect on farmers decisions (cluster c). In the case of fire dynamics, human behaviour a more explicit representation will be sought. The project counts now with the support from three teams dedicated to human dimension aspects funded by SGP-HD grants. We will initiate collaboration with them

2. “Climatize” cluster “c”

Initially considered in our project, but eliminated after revisions with IAI before funding, the feedbacks of land cover on climate were an issue of great interest. We will include this issue in the exploration of groundwater-land use dynamics in the humid and semiarid plains of Plata Basin. We already established a collaboration with Hugo Berbery and will evaluate the potential impacts of agriculture in dry forests and flooding in the herbaceous pampas on climate through regional climate models and empirical observations based on the TRMM precipitation database developed by Goddard-NASA

3. Take cluster “e” a step beyond in terms of the involvement of policy makers and regional visibility

We had very positive results from our participation in the afforestation debate in the Uruguayan and Argentine forestry community. Our team had been responsible of putting water and soil conservation issues in the agenda of this debate. In years 2-3 of CRN 2031 we want to achieve a similar impact on the debate of agricultural expansion over native vegetation in the semiarid/subhumid belt of the basin.

Negotiations with Secretaría de Agricultura de la Nación in Argentina are already in their way for a possible workshop. On a different avenue, our team wants to create a very visible forum of scientific discussion on land use changes, their causes and impacts that meets two complementary goals: brings the dispersed community of land use change researchers of South America together into the scientific discussion and makes this discussion visible to the general public with an explicit map-type representation of land use changes. This work is currently in its experimental face with the LECHUSA (<http://lechusa.unsl.edu.ar>) site and our aim for year 2 is to achieve the fully functional stage of the web-site (domain could be transferred to IAI if that can make it more successful) publicizing it to the broadest possible audience (policy makers, farmers, companies, NGOs, general public)

4. Create stronger links across clusters

As defined in the project formulation stage, our team identifies grad and postdoc students as the key agents capable of connecting groups, and more important, able to integrate disciplines more effectively than their advisors. The long term goal of CRN 2031 is to incubate a group of well connected young students that will become independent researchers at the end of the project. In year two we will conduct a Training Institute to connect clusters and integrate students and CoPIs from other IAI teams. The event will take a week in a retired location in San Luis and will respond to the following lines:

Title: Coupling climate, society, and land use change: Scientific tools to manage risk and opportunity

Goals

- a) Advance land use change science through the explicit representation of coupled systems
- b) Facilitate networking of land use change research teams through their graduate and postdoctoral students
- c) Promote the exchange and development of scientific tools
- e) Identify outreach challenges and opportunities and shape strategies to cope with them

Target audience:

CRN2031 students and postdocs (20 students)

SGP Human dimension proposals (Meza, Tourrand) (4 students)

Other CRN's students (Luckman, Diaz) (4 students)

Other groups (Grau, LIEY-CONICET) (2 students)

Forecasted budget for year 2 is the following

	UBA-CONICET	INTA cautelar	EMBRAPA SOLOS	UDELAR Ciencias	UDELAR Sociales	SAGPyA & UB	UNIV MIAMI	INTA La Pampa	UNIV N. Asuncion	INTA Bariloche	NCSU	Duke	UVA	Univ La Pampa	capacity building in PY	TOTAL
Salaries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fellowships	31860	3180	19352	6120	6120	0	0	6120	0	0	0	0	0	16200	6120	95072
Travel	12075	7390	5854	2688	1937	1481	4109	569	569	569	1039	1039	1039	2761	0	43120
Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Expenses	10581	4069	6380	6730	1171	1171	0	587	1882	2027	0	0	0	3202	0	37800
Communication	1000	250	500	500	250	250	250	250	250	250	250	250	250	0	0	4500
Publication	222	56	111	111	56	56	56	56	56	56	56	56	56	400	0	1400
Administration	6740	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6740
Overhead	3793	907	1955	980	579	180	268	460	167	176	82	82	82	1370	372	11452
TOTAL	66272	15851	34152	17130	10112	3137	4683	8042	2924	3078	1427	1427	1427	23932	6492	200084

A few modifications from the budget presented in the original project were introduced:

1. Grad student fellowship for U of MIAMI is transferred to INTA-La Pampa
2. Postdoctoral fellowship shared by UBA and INTA Castelar is now divided into two grad student fellowships for each institution

Details on each budget category can be seen in the original project

Appendix A – List of students enrolled in IAI fellowships in year 1 of CRN 2031

	Name	Affiliation	Nationality	Grade	Area of expertise	Training activity	Student involvement in project	Scholarship duration & amount	Exchange programs
1	Aragón, Roxana	GEA-FAUBA	Argentine	Postdoctoral student	Pattern analysis, hydrological time series		The inter-connection of land use change and the underground hydrology system in plain grassland ecosystems	2 years, 700 USD/month	
2	Baeza, Santiago	Fac. Cs. UDELAR	Uruguayan	MSc student			analyzing the environmental and land use controls over ecosystem functioning over Uruguay	3 years, 300 USD/month	FAUBA
3	Ballesteros, Sivina	GEA-FUBA	Argentine	MSc student			Análisis regional de flujos de carbono en la cuenca del Plata y su vinculación con el uso de la tierra	3 years, 540 USD/month	INTA Clima y Agua
4	Carambula, Matías	Fac. Cs Sociales UDELAR	Uruguayan	PhD student				3 years, 510 USD/month	
5	Carreño, Lorena	INTA La Pampa	Argentine	PhD student				3 years, 510 USD/month	GEA
6	Joyce Costa Barbosa	EMBRAPA Solos	Brazilian	MSc student			Soil quality, biomass, and activity in restoration areas in the Atlantic Forest	2 months 450 USD/month	
7	de Oliveira Macedo, Michele	EMBRAPA Solos	Brazilian	Postdoctoral student			Soil carbon stocks, organic matter fractionation and greenhouse gas emissions under contrasting land uses in the Brazilian field sites in the La Plata river basin	1 year 1600 USD/month	
8	Lezama, Felipe	Fac. Cs. Univ. Rep. Uruguay	Uruguayan	PhD student	Grassland Ecology		Description of the structural and functional heterogeneity of the Rio de la Plata grasslands	3 years 300 USD/month	FAUBA

	Name	Affiliation	Nationality	Grade	Area of expertise	Training activity	Student involvement in project	Scholarship duration & amount	Exchange programs
9	Melchiori, Arturo	INTA- Instituto de Clima y Agua	Argentine	MSc student	Ecosystem modeling, data base analysis		study of lightning as a factor controlling fire occurrence at the national level.		
10	Piñeiro, Gervasio	GEA-FAUBA	Uruguayan	Postdoctoral student				2 years, 350 USD/month	Duke- UDELAR
11	Vega, Ernesto	FAUBA	Mexican	Postdoctoral student			Model patterns and drivers of land use change. Develop a spatially explicit simulation model of Land Use Change	2 years, 730 USD/month	
12	Morazzo, Germán	FAUNLPAM	Argentine	PhD student	Soil chemistry	Ph.D. in soil chemistry at San Luis University	Characterization of humic substances under forest species	4 years, 600 USD/month	
13	Martini, Juan Pablo	FAUNLPAM	Argentine	PhD student	Remote sensing and GIS	Ph. D. at ?	Development of a land capability map	4 years, 600 USD/month	
14	Cavigliaso, Marcelo	FAUNLPAM	Argentine	Undergraduate student	Agronomy	Undergraduate thesis at Universidad de Río Cuarto	Evolution and impact of biofuel crops on land use and socioeconomic conditions in central Argentina	2 years, 110 USD/month	
15	Diaz, Guillermo	FAUNLPAM	Argentine	Undergraduate student	Agronomy		Carbon dynamics under different land use	2 years, 100 USD/month	
16	Barraza, Matías	FAUNLPAM	Argentine	Undergraduate student	Agronomy		Carbon dynamics under different land use	2 year 100 USD/month	
17	Cetolini, Karina	FAUNLPAM	Argentine	Undergraduate student	Agronomy	Undergraduate thesis at UNLAP	Evolution of different stubble mixtures during fallow and subsequent crops	2 years, 100 USD/month	

Other students funded by non-IAI fellowships

GEA-Jobbagy

Germán Baldi - FONCyT

Carla Rueda - CONICET

Celina Santoni - CONICET

FAUBA-Paruelo

Costanza Caride - CONICET

Mayra Milcovic - FONCYT

INTA Inst Clima y Agua - Dibella

Fischer, María de los Angeles - INTA Inst Clima y Agua

Straschnoy, Julieta Verónica - INTA Inst Clima y Agua

Mari, Nicolas Alejandro - INTA Inst Clima y Agua

Univ. Asuncion - Genaro Coronel

Andres Wehrle – UNA Paraguay

Fernando Pio Barrios – UNA Paraguay

Maria Elena Hume (LIAPA-Inst Clima y Agua INTA, Dibella)

Udelar -Piñeiro

Antonio Graciano - UDELAR.

Emilio Fernández - UDELAR

Natalia Vibel - UDELAR

Victoria Menéndez - UDELAR

Jimena Vázquez - UDELAR

Ivana Cúrbelo – UDELAR

Eduardo Méndez - UDELAR

Lia Rubial - UDELAR

Epstein -Univ. Virginia

Domingo Alcaraz – CSIC- Spain

Oesterheld - IFEVA

Irisarri, Gonzalo - Fundación Estenssoro Doctoral Fellow

Durante, Martín - CONICET Doctoral Fellow

Schlichter - INTA

Darío Ceballos - INTA

Jackson, Robert - Duke

Berthrong, Sean - NSF

Podesta – Univ. of Miami-FAUBA

Federico Bert – NSF

Elke Noellemeyer - FAUNLPAM

Riestra, Diego - CONICET

Perez, Mauricio – ANPCYT

Bazan, Juan Cruz - FAUNLPAM