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**SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE**

**Twenty-fifth session**

**Nairobi, 6–14 November 2006**

**Item 6 of the provisional agenda**

**Research and systematic observation**

## **Summary reports drawing on the special side event on research needs relating to the Convention held during the twenty-fourth session of the Subsidiary Body for Scientific and Technological Advice**

### **Submissions from regional and international climate change research programmes**

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA), at its twenty-fourth session, expressed its appreciation to the regional and international climate change research programmes for the information provided during the special side event\* on research needs relating to the Convention held during its twenty-fourth session. It invited these programmes to provide, together or separately, to the SBSTA, before its twenty-fifth session, a short summary report or reports drawing on the special side event, including identification of any gaps in their research programmes with respect to the research needs of the Convention, as viewed by Parties, for example in document FCCC/SBSTA/2006/INF.2, and considering options for addressing these needs (FCCC/SBSTA/2006/5, paragraph 41).
2. The secretariat has received two such summary reports in response to the above-mentioned invitation. In accordance with the procedure for miscellaneous documents, these submissions are reproduced\*\* in the language in which they were received and without formal editing.

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\* The list of regional and international climate change research programmes that participated in the special side event can be found on the UNFCCC website at:  
<[http://unfccc.int/methods\\_and\\_science/research\\_and\\_systematic\\_observation/items/3738.php](http://unfccc.int/methods_and_science/research_and_systematic_observation/items/3738.php)>.

\*\* These submissions have been electronically imported in order to make them available on electronic systems, including the World Wide Web. The secretariat has made every effort to ensure the correct reproduction of the texts as submitted.

CONTENTS

	<i>Page</i>
1. WORLD CLIMATE RESEARCH PROGRAMME ON BEHALF OF THE EARTH SYSTEM SCIENCE PARTNERSHIP* (Submission received 10 October 2006).....	3
2. INTER-AMERICAN INSTITUTE FOR GLOBAL CHANGE RESEARCH (Submission received 24 October 2006).....	8

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\* According to the letter from the World Climate Research Programme accompanying the submission, the summary submitted comprises input from all four of the Earth System Science Partnership member programmes.

PAPER NO. 1: WORLD CLIMATE RESEARCH PROGRAMME  
ON BEHALF OF THE EARTH SYSTEM SCIENCE PARTNERSHIP

**ESSP Input to SBSTA25 on Research Gaps and Needs for the UNFCCC  
(29 September 2006)**

**I. Background**

The letter to all parties from Halldor Thorgeirsson, Deputy Executive Secretary of UNFCCC's SBSTA dated 8 June, refers to the draft conclusions from SBSTA24 on its agenda item 5 (see FCCC/SBSTA/2006/L.7) dated 23 May 2006 which state *inter alia*:

Following the Special Side Event hosted by SBSTA in Bonn on 19 May "the SBSTA invited these programmes to provide, together or separately, to the SBSTA, before its twenty-fifth session (November 2006), a short summary report or reports drawing on the above-mentioned special side event, including identification of any gaps in their research programmes with respect to the research needs of the Convention, as viewed by Parties, for example in document FCCC/SBSTA/2006/INF.2, and considering options for addressing these needs."

The organisations that made presentations on 19 May were: WCRP, IHDP, IGBP, START, IAI and the ESSP Joint Project on Global Carbon, and some regional and national contributors. These presentations are available on the UNFCCC web site.

In this document, the Earth System Science Partnership (ESSP) has tried to gather together all their views i.e. to reply to SBSTA "together" rather than "separately". Of course this does not preclude any organisation from making separate input to SBSTA prior to SBSTA25 in November 2006.

**II. Gaps in Research Programmes With Respect to the Need of the Convention as Viewed by the Parties**

i) FCCC/SBSTA/2006/INF.2 gathers research needs into a summary (pages 13-15) as follows:

Parties to the UNFCCC noted that, although progress has been made since 2002, work needs to continue on improving:

- (a) Quantifying of the anthropogenic component of observed changes in climate and estimates of natural influences and natural variability;
- (b) Understanding the mechanisms and factors, both anthropogenic and natural, leading to changes in radiative forcing, and reducing uncertainties;
- (c) Climate related systematic observation and, in particular, a global climate observing system for climate related research.

The United States also observed that the representation of developing countries in international climate change research would be enhanced by improving observation systems, by the efforts of more developing countries to share their climate data and through encouragement and incorporation of such research into their sustainable development planning.

Parties have also noted several specific subjects where more work is needed to meet the needs of the Convention. These subjects include:

- (a) Improvement of methods to quantify uncertainties of climate projections and scenarios, including long-term ensemble simulations using complex models;
- (b) Improvements in the integrated hierarchy of global and regional climate models with a focus on the simulation of climate variability, regional climate changes and extreme events;

- (c) More effective links between models of the physical climate and the biogeochemical system, and incorporating the consideration of the human dimension into climate change research.

In order to coordinate activities in climate change monitoring, advanced climate modelling, and impact and adaptation studies, Japan indicated the necessity of the establishment of a database system where data obtained from observations, climate change projection models, and impact and adaptation studies are integrated so that information from different research areas can be made accessible and more applicable to mitigation policies. International and regional research programmes attempted to identify remaining gaps in research and observations and specify directions in the research to address these gaps.

ii) **FCCC/SBSTA/2006/MISC.3** contains summary statements of research needs from some nations as proposed prior to the SBSTA24. These include (from the EU):

- Strengthening of the dialogue between scientists and the policy community to better use scientific results in the development of policies on both mitigation and adaptation; and
- Initiating an international programme or framework that would:
  - a) assess global and regional impacts and risks associated with various greenhouse gas stabilization levels and emission pathways, taking into account adaptation. This should also include better estimates of thresholds and probabilities for abrupt, or irreversible, events and assessment of the risk of the possible amplification (or amelioration) of anthropogenic climate change; and
  - b) assess the economic, environmental and social costs and benefits associated with different stabilization levels and emission pathways and the technological and adaptation scenarios associated with each, including improved understanding of factors affecting resistance to change and learning processes.

The EU also noted that the G8 science academies and those of China, India and Brazil in a statement issued in July 2005 had recommended that governments should be urged to ‘*launch an international study to explore scientifically informed targets for atmospheric greenhouse gas concentrations, and their associated emissions scenarios, that will enable nations to avoid impacts deemed unacceptable*’ (e.g. Royal Society <http://www.royalsoc.ac.uk/>). In this regard the EU encourages the Earth System Science Partnership ([http://www.essp.org/about\\_essp.html](http://www.essp.org/about_essp.html)) to take appropriate steps towards such integrated global research essential to tackling climate change.

### **III. ESSP Views of Gaps in Research Programmes With Respect to the Needs of the Convention**

The Earth System Science Partnership (ESSP) responds to the SBSTA request to identify research needs for the UNFCCC in the framework established by the SBSTA: issues of anthropogenic climate change and of improved sharing and understanding followed by more specific proposals.

#### **i) Climate Change**

The ESSP considers the following research tasks as particularly important:

- Improving climate observations, especially the consolidation of the efforts of the various global observation entities (e.g. GEO, IGOS, CEOS, GCOS, GTOS, GOOS...), and a better link to international research programmes.
- Improving the understanding of radiative forcing and coupling including that of GHG concentration changes (presumably via radiative forcing and other associated processes, e.g. CO<sub>2</sub> feedbacks on oceans and the terrestrial biosphere) because this forcing is the basis of greenhouse warming.
- Improving the understanding of feedbacks between climate and major biogeochemical cycles, especially carbon (e.g. vulnerabilities of presently stable carbon pools to release under climate

change). Likewise, greater understanding is needed about feedbacks between climate and the hydrological cycle. To accomplish this, it is important to embed better descriptions of the major elemental cycles (e.g. C, N, S) and the hydrological cycle, together with their interactions, into climate models.

- Improving the treatment in climate models of the dynamics of aerosols and clouds, and their consequences for the Earth's radiation balance and hydrological cycle. Related to this is the use of palaeo-data to test climate models.
- Improving the descriptions of human activities in climate models so that they begin to represent true "earth system models". For this, the natural and social science communities must begin to work together more intensively. It is particularly important to understand and model trends in human energy use, urbanisation and land use, and their interactions with climate and biogeochemical cycles. ESSP is working actively on these trans-disciplinary questions through its joint projects, including the Global Carbon Project.

### **ii) Improved Understanding and Capacity Building**

ESSP Programmes and Projects mandate that ESSP has a geographical distribution of members on its governing boards. This is one means of enabling developing countries to be engaged in its activities. One of the central activities of the ESSP – “START” – is a major effort to build capacity for understanding and acting on climate change and its impacts.

Specifically, the ESSP offers detailed proposals in response to FCCC/SBSTA/2006/INF.2, p. 4-9 grouped by the three IPCC Working Groups.

### **iii) Modelling Vulnerability**

The climate system is so complex and the scientific and computational requirements for providing societally-beneficial regional climate forecasts are so enormous that the nations of the world should create an international research and computational facility dedicated to the ‘grand challenge’ of climate prediction.

Climate feedbacks involve highly complex non-linear interactions in both space and time and, therefore, climate models must be run at sufficiently high space and time resolutions to be able to understand and resolve, for example, the climate processes involving deep convective cloud systems. Climate research and climate prediction during the past 30 years has been done by models with space resolution of about 100-300 km, which were adequate to resolve cyclones. We now must advance from cyclone resolving models to cloud system resolving models with resolutions of about 2-5 km. This will require petaflop computers and a critical mass of hundreds of scientists working together to build the next generation of climate prediction models.

The scientific expertise to revolutionise climate prediction of the physical-biogeochemical Earth system and its interactions with the global socio-economic systems resides in no one nation or scientific discipline. An international joint effort is required to make very necessary advances in the 21<sup>st</sup> century. Immediate beneficiaries of such a multi-national joint effort focussed on the ‘grand challenge’ of climate prediction will include Parties to the UNFCCC and others to ‘environmental’ UN Conventions wishing to develop vulnerability assessments and adaptation policies.

### **iv) Impacts, Vulnerability and Adaptation**

ESSP believes that delivery of climate information on regional scales underpins all efforts in this category. ESSP is pleased to be able to point to its efforts in this area, especially highlighting the ESSP

Integrated Regional Study approach, and particularly the impressive success of the Global Environmental Change And Food Security (GECAFS) regional case study approach.

Assessment of impacts, vulnerabilities and adaptation to climate change is so complex that it is difficult to prioritize research needs. However, the ESSP identifies issues of great importance as being:

- Multi-scale analysis of climate change impacts and mitigation responses including economic costing of climate change. Assessment of climate impacts at different greenhouse gas stabilisation levels.
- Assessment of impacts from abrupt and/or irreversible climate changes.
- Study and analysis of adaptation strategies and their links to sustainable development i.e. “climate proofing”.
- Assessment of the second-order impacts of adaptation strategies.

#### **v) Mitigation**

There is now no reasonable doubt that human-caused climate change is occurring. While ESSP believes that some degree of climate change is unavoidable, it also believes that all efforts should be made to lessen the intensity and speed of climate change and its impacts through concerted mitigation and adaptation measures.

To be attractive to policy makers, it is essential to identify mitigation costs, effectiveness of strategies and barriers to accepting them. ESSP believes that holistic analyses of energy and land use options, including demand management and enhancing innovation in GHG abatement technologies, are essential now. We note that ESSP already has significant research efforts in the areas of bio-sequestration potential through Land Use, Land Use Change and Forestry (LULUCF) – especially through accounting and reporting.

It is also of great importance to identify different future “portfolios” of renewable energy that would maximize their benefits to climate mitigation and other sectors and minimize their undesired impacts.

While the ESSP takes no position on geo-engineering as a mitigation approach, we believe that the feasibility and consequences of various proposals should be scientifically studied.

#### **IV. Making ESSP Research More Relevant to the UNFCCC**

The ESSP mandate calls for ESSP research to be relevant to important policy issues of society. With this in mind, the ESSP will initiate a discussion within our community about making our work more immediately relevant to the UNFCCC. This includes:

- Considering playing a role in the development of scientific scenarios related to the UNFCCC (emission scenarios, climate scenarios, integrated scenarios);
- Sending ESSP representatives to SBSTA meetings;
- Establishing a reporting system so that ESSP results are directly reported to the SBSTA;
- Beginning an ongoing “dialogue” with SBSTA, which opens the possibility that ESSP re-orient its research to give special priority to key policy-relevant questions defined by the SBSTA.

Already an initial comparison of research needs of the SBSTA and ESSP shows that research interests are converging. Topics of common interest include:

- ✓ Ensuring the quality of the climate observing system, in particular improving monitoring of extreme events;
- ✓ Improving the exploitation of the available hierarchy of global and regional climate models to focus more strongly on predicting climate variability, regional climate changes and extreme events;

- ✓ Improving the quantification of uncertainties in climate projections and scenarios, including using ensembles of long-term simulations and using multiple models;
- ✓ Increasing the links between models of the physical climate, the biogeochemical system and the world hydrological cycle, and incorporating the consideration of the human dimension into climate change research;
- ✓ Linking social as well as natural sciences, and the interaction between the two, in responding to the research needs arising from the assessment reports of the IPCC (section C, paragraph 31, point b) - something ESSP is designed and mandated to do.

Finally, ESSP wishes to stress the need for a forum for an **ongoing and lasting** dialogue with the UNFCCC/SBSTA community. ESSP and its partners hope that SBSTA considers our May 2006 meeting as only the first in a set of regular meetings between ESSP and the UNFCCC SBSTA (a recognised "stakeholder" for all the ESSP Programmes and Joint Projects). We would like to use these meetings to establish common priorities and to allow the ESSP and our Programmes to be able to respond to the needs of the UNFCCC through the SBSTA.

Prepared and approved by the ESSP Task Team on UN Conventions

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PAPER NO. 2: INTER-AMERICAN INSTITUTE FOR GLOBAL CHANGE RESEARCH

**Summary note by the Inter-American Institute for Global Change Research (IAI) on  
“Research needs and priorities relating to the Convention”**

At its twenty-fourth session, the SBSTA invited climate change research programs to provide a short summary report identifying any gaps in their research programs with respect to research needs of the Convention, as viewed by Parties, for example in document FCCC/SBSTA/2006/INF.2 and considering options for addressing these needs.

The SBSTA noted the continued need to improve communication of scientific information on climate change to policy-makers and the general public. The SBSTA also noted the need for enhancing two-way communication and cooperation between the Parties and regional and international research programs to meet the research needs of the Convention.

Pursuant to that request and further to the participation of the Inter-American Institute for Global Change Research (IAI) at the UNFCCC special side-event, held during SBSTA-24, this document introduces IAI's new cooperative 5-year science program, the Second Round of Collaborative Research Network (CRN II). The CRN II program started in June 2006 and includes 12 international research consortia, involving at least 40 institutions across 18 countries in the Americas. It is designed to create networks of scientists throughout the region who will work collaboratively on global change problems of importance to the Americas. CRN II projects are expected to contribute to the development and strengthening of the regional capacity to deal with global environmental change issues and their socio-economic impacts. Using an integrative multidisciplinary approach, the program seeks to provide the best possible scientific basis for documenting, understanding and projecting changes in the Earth's system and to facilitate full use of scientific information in policy and decision making.

As an intergovernmental organization with 19 member countries in the Americas, the IAI's main objectives are to: augment the scientific capacity of the region; encourage research beyond the scope of national programs on scientific issues important to the region as a whole; provide informed action at all levels; and to provide information to policy makers in a useful and timely manner.

The IAI has a dynamic and evolving Science Agenda to ensure the incorporation of changing regional priorities and the needs of IAI member countries regarding global change research. With all past calls for proposals and subsequent project sponsorship, the IAI has implemented this agenda. This has resulted in a large number of successful projects on climate change and variability and other themes of the IAI Science Agenda including ecosystems, biodiversity, land use/cover and water resources; the composition of atmosphere, oceans and fresh waters and the human dimensions of global change.

In a survey circulated by the IAI among its member countries in late 2004, the following topics, among others, were identified as global change research priorities: climate change variability, vulnerability and adaptation to climate change; bridging mechanisms between science and policy; vulnerability of coastal zones; participation and equity in environmental-related decision making; mitigation of GHG emissions and impacts on global change (energy, forest); global carbon cycle; glaciers, water resources and land-use, land-cover change. Some of these topics are being addressed by CRN II projects (see table below).

Research needs still to be addressed include climate change and variability (human and political dimensions); integrated assessments of climate variability, its impacts, and scenarios of climate risks applied to health, agriculture, fisheries, water, tourism and energy; climate change effects on glaciers and water resources; use of general circulation models on a regional scale; vulnerability of coastal zones to climate change.

In most scientific investigations gaps exist between research, assessments and policy. It is essential that the different parts of science investigations be interconnected and linked to technical and societal decision processes, as in the CRN II and SGP-HD programs. The IAI is developing a regional program dealing with land use, agriculture and renewable energy sources (biofuels). The topic of biofuels links to most topics of the IAI science agenda and is highly relevant in the regional and global context, namely in technological aspects of energy conversion and carbon off-sets, ecosystem function and biodiversity, agriculture, rural development, and regional risk evaluations that link agricultural development to climate change and variability.

The IAI is making significant efforts in engaging member nations in the science programs and in the translation of scientific information into policy relevant information. A workshop was held jointly with the Scientific Committee of the Environment (SCOPE) on "Linking the Sciences of Environmental Change to Society and Policy - lessons from 10 years of research networks in the Americas". This workshop focused on the importance of links to society and policy in the research networks under the first round of CRN projects exploring the following themes: science policy, generating and steering science for policy relevance; making science credible, practical and operationally valuable to policy and society; stakeholders: identification and integration into the science process (and enhancing the north-south dialogue) and articulating science for different sectors of society. Links were numerous, invariably guided by excellent research and science, and often had considerable policy impact. The analysis of the underlying process of linking global change science to society has yielded significant insights will be published in 2007 as part of the SCOPE series of science synthesis books.

Since its inception, the IAI has actively promoted, supported and facilitated global change research in the Americas through the planning and support of workshops, education and training and direct support of research. The IAI has contributed to several hundreds of workshops and conferences in the Americas and beyond, which have provided effective *fora* for the development of coordinated research strategies which have greatly enhanced scientific networking in the region. The IAI science programs have always been designed to complement each other, providing for longer-term core activities and also for flexible short-term initiatives to address specific science issues and capacity building. The sequence of programs allowed the systematic creation of multinational and multidisciplinary research networks based on rigorous scientific planning and a competitive selection process. When the funded portfolio leaves gaps, either in the science or the development of regional opportunities, additional small grants have been successful to complement existing projects and bring under-represented regions or nations into the program.

To complement this research network program, the IAI will launch in late 2006 a Small Grants Program on Human Dimensions (SGP-HD) that will not only integrate a broad range of human science as an integral part of the new generation of projects under CRN II but will also build on the developing network synergies to further enhance the networking between the individual projects and provide the human dimensions research teams with a rich field of study and interdisciplinary interaction. The thematic priority will be on selected topics under the topic "human dimensions and policy implications" (IAI Science Agenda item 4) that is of strategic importance in complementing the existing CRN II global change portfolio, and for which synergies are expected with approved CRN II projects: urban centers & urbanization; current and future vulnerability and adaptability of socio-ecological systems to global environmental change; rural transformation and sustainability; capacity of institutions to respond to global environmental change related uncertainties and human health.

The table below lists CRN II project titles, their principal investigators (PIs) and countries involved and the subsequent paragraphs will briefly introduce those 12 projects.

CRN II Project Title	Principal Investigator (PI)/Institution	Countries ( <i>PI country in bold</i> )
<b>From Landscape to Ecosystem: Across-scales Functioning in Changing Environments (LEAF in Change)</b>	<b>Sarmiento, Guillermo</b> Universidad de Los Andes, Venezuela	<b>Venezuela</b> , Argentina, Brazil, Canada, (Germany)
<b>Functional links between aboveground changes and belowground activity with land use in the Americas: Soil biodiversity and food security</b>	<b>Berbara, Ricardo Luis Louro</b> Universidade Federal Rural do Rio de Janeiro, Brazil	<b>Brazil</b> , Bolivia, Canada, Chile, Cuba, Ecuador, Mexico, USA
<b>Functional Biodiversity Effects on Changing Ecosystem Processes and Services and Sustainability: Interdisciplinary Approach</b>	<b>Diaz, Sandra Myrna</b> Universidad Nacional de Córdoba (CONICET), Argentina	<b>Argentina</b> , Bolivia, Costa Rica, USA
<b>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</b>	<b>Jobbagy, Esteban</b> Universidad de Buenos Aires, Argentina	<b>Argentina</b> , Brazil, Paraguay, Uruguay, USA
<b>Documenting, understanding and projecting changes in the hydrological cycle in the American Cordillera</b>	<b>Luckman, Brian</b> University of Western Ontario, Canada	<b>Canada</b> , Argentina, Bolivia, Brazil, Chile, Mexico, USA
<b>Tropical cyclones: current characteristics and potential changes under a warmer climate</b>	<b>De Raga, Graciela Binimelis</b> Universidad Nacional Autónoma de México, Mexico	<b>Mexico</b> , Costa Rica, Cuba, USA
<b>Paleotempestology of the Caribbean Region: A Multi-proxy, Multi-site Study of the Spatial and Temporal Variability of Caribbean Hurricane Activity</b>	<b>Liu, Kam-Biu</b> Louisiana State University, U.S.A.	<b>USA</b> , Canada, Costa Rica, Mexico
<b>An International Consortium for the Study of Oceanic Related Global and Climate Changes in South America (SACC)</b>	<b>Piola, Alberto</b> Servicio de Hidrografia Naval/ Universidad de Buenos Aires, Argentina	<b>Argentina</b> , Brazil, Chile, Uruguay, USA
<b>Effective Adaptation Strategies and Risk Reduction towards Economic and Climatic Shocks: Lessons from the Coffee Crisis in Mesoamerica</b>	<b>Castellanos, Edwin J.</b> Universidad del Valle de Guatemala, Guatemala	<b>Guatemala</b> , Costa Rica, Mexico, USA
<b>Understanding the human, biophysical and political dimensions of tropical primary and secondary dry forests in the Americas</b>	<b>Sanchez Azofeifa, Gerardo Arturo</b> University of Alberta, Canada	<b>Canada</b> , Brazil, Costa Rica, Cuba, Mexico, USA, Venezuela
<b>South American Emissions, Megacities, and Climate (SAEMC)</b>	<b>Klenner, Laura Gallardo</b> Universidad de Chile, Chile	<b>Chile</b> , Argentina, Brazil, Colombia, Peru, USA
<b>Caribbean Coastal Scenarios</b>	<b>McClain, Michael</b> Florida International University, U.S.A.	<b>USA</b> , Cuba, Dominican Republic, Jamaica, (Puerto Rico)

### **From Landscape to Ecosystem: Across-scales Functioning in Changing Environments**

*Guillermo Sarmiento, Facultad de Ciencias, Universidad de Los Andes, Venezuela*

This network assembles a sizable group of researchers and advanced students from five institutions in four countries: Argentina, Brazil, Canada and Venezuela. The project will study environmental and economical consequences resulting from global climate change and the role of climate change on the functioning and dynamics of certain North and South American ecosystems. The research will focus on selected pairs of neighbor ecosystems showing sharp differences in structure, upper montane and sub-arctic forests on the one side, open formations such as tundras, paramos and grasslands. Their responses to environmental changes, mainly in temperature, radiation and rainfall, will be fairly divergent. Furthermore, the physiognomic contrast between these ecosystems permits the straightforward detection, either on the field or on remote sense imagery, of past and ongoing shifts in their boundaries.

These studies, besides suggesting the expected functional shifts arising from climate changes, will allow the group to determine the probability of displacements in their respective geographical areas. They will also look into how predictable climate changes modify the functioning and dynamics of ecosystems and the many services ecosystems afford. Furthermore, they will look into shifts in ecosystem boundaries, following the different scenarios of change in each of the five study areas and how it will affect the use of land, water and other natural resources.

Another objective of the group is to establish how the distribution and characteristics of these ecosystems have varied along different time scales, from the last hundreds of thousand of years to the last decades, identifying patterns in past changes and relating them to external determinants, thus allowing the prediction of forthcoming trajectories. The network will strengthen the scientific relations between researchers, institutions and countries significantly contributing to the formation of highly qualified people to continue confronting these crucial environmental and social issues.

### **Functional Links Between Aboveground Changes and Belowground Activity with Land Use in the Americas: Soil Biodiversity and Food Security (AMFOODS)**

*Ricardo Berbara, Universidade Federal Rural do Rio de Janeiro, Brazil*

This multinational multidisciplinary research network seeks to determine how soil microflora's belowground activity will counteract global climate changes and land use cover changes (LUCC). The project will test, at an ecosystem level, the hypothesis that soil carbon sink and ecosystem resilience can be increased by key soil microorganisms associated with plants. Most findings linking below-ground soil activity to mitigation of global change negative effects are of limited relevance since they come from indoor experiments. The project will conduct its large scale research in a wide range of field conditions in 8 countries in the Americas.

The group will address gaps in knowledge on the mechanisms involved in soil functioning and stability. LUCC processes may be particularly drastic in Latin American countries because of the increases in deforestation rates with the introduction of crop and pasture systems. In North America, land used for agriculture is declining relative to land under forestry. The opposite is happening in South America, where crops are replacing tropical forest areas. This difference in land occupation patterns between North and South America is an important element of analysis to determine impacts not only on gas emissions, but also on several soil functions mediated by soil organisms, which could lead us to determine reliable carbon budgets. Existing knowledge indicates that the influence of mycorrhizal fungi on carbon dynamics under global change remains largely unknown, but most certainly plays a significant role in soil carbon sequestration.

Proposed research locations span over a wide range of latitudinal and altitudinal gradients that should reveal a broad assortment of soil microflora's responses as well as general responses, which are linked to the fundamental mechanisms of soil functions.

### **Biodiversity, ecosystem services and stakeholders: conflict compromise and the challenges ahead**

*Sandra Diaz, Instituto Multidisciplinario de Biología Vegetal, Universidad Nacional de Córdoba (CONICET), Argentina*

This network will implement a new interdisciplinary framework to analyze and compare field studies of land use change in the Americas from the tropics to the tundra. They will build a conceptual link between major land use change trajectories, functional biodiversity (FB), ecosystem processes and services, and vulnerability-sustainability of the production systems that are based on them. They propose to: construct a network of scientists addressing links between land use as a driver of global change, FB shifts, and ecosystem processes and services in the Americas; develop the first comparison of the effects of land use on FB and to establish how this in turn has the potential to modify ecosystem processes in systems under different degrees of climatic control; establish links between FB, ecosystem functioning and major ecosystem services perceived by different local and non-local stakeholders; develop a conceptual framework and a set of empirical tools and recommendations, available to a wide community of scientists, para-scientist and land-managers, to be used as the basis for management decisions aimed to assess and optimize the ecosystem-service value of the land considering the interests of different stakeholders.

They seek to address the question of how global initiatives to protect biodiversity and sustain the provision of ecosystem services face a multifaceted challenge as different ecosystem processes cannot always be simultaneously optimized.

In order to address these issues, they are constructing an interdisciplinary conceptual framework where the quantification of plant functional biodiversity and ecosystem processes under different land use regimes will be done using the specific techniques of plant ecology whilst the perception and manipulation of those ecological variables by stakeholders with different, often conflicting, interests will be documented using social science methods.

### **Land Use Change in the Rio de La Plata Basin: Linking Biophysical Human Factors to Understand Trends, Assess Impacts, and Support Viable Strategies for the Future**

*Esteban Jobbágy, Facultad de Agronomía, Universidad de Buenos Aires, Argentina*

This research network will explore questions focusing on land use changes, their drivers and impacts within the Plata Basin. This team of 18 researchers from 13 institutions, 5 nations, and a broad disciplinary background recognizes that land use changes in the Plata Basin pose urgent environmental challenges and unique opportunities to advance global change science at the same time. Among the vast array of existing land use changes they will identify those of greatest relevance such as the expansion of crops on dry forest lands and the establishment of tree plantations on grasslands, and possibly others.

This project will look at questions that pose urgent challenges and unique opportunities to global change scientists, particularly in a region like the Rio de la Plata Basin, where the largest and most productive agricultural systems of the continent are experiencing their fastest expansion in history. The goals in this project are to: understand the drivers of land use changes in the Río de la Plata Basin; evaluate their impacts on ecosystems and societies; identify critical feedbacks and plausible future trends, and support regional land use planning through an active dissemination of scientific knowledge and tools. Furthermore, they will explore the dominant land use changes of the last three decades across the basin, namely, the expansion of agriculture over forests and tree plantations over grasslands, and the intensification of agricultural systems, and grazing on natural vegetation.

Working at multiple scales, the project will bridge the gap between a growing, but disperse body of local studies, and the novel perspectives and tools of global change science. They will develop a regional forum for global change science extension that will actively reach policy makers, stakeholders, and the

public in general. Training new scientist and integrating them into an international research network will be a priority.

### **Documenting, understanding and projecting changes in the hydrological cycle in the America Cordillera**

*Brian H. Luckman, University of Western Ontario, Canada*

The principal objective of this CRN is to assess the ongoing effects of climate change on water resources in selected mountain regions of the Americas by documenting and understanding the variability of precipitation and streamflow; their linkages to atmospheric and sea surface temperature controls in adjacent oceans; their variation in time and space; and how they may vary in the future in response to global environmental changes. The project will also examine the potential impact of these changes on socioeconomic activity.

This CRN network focuses on four critical regions: the southern Andes, the Bolivian Altiplano, northern Mexico and the North American Cordillera. Study sites range from rain-fed river basins in Mexico and Chile where land use changes have significantly impacted runoff patterns, to small basins fed by rapidly diminishing glaciers that supply water to the city of La Paz in Bolivia. It will examine and develop contemporary and proxy climate and runoff data to establish links with the dominant causes of climate and streamflow variability over the last ca 300 years (e.g. ENSO, PDO, NAO); assess whether the instrumental records are representative of long term climate and streamflow variability; document and model the mass loss from glaciers and their contributions to streamflow in selected areas. The project will also assess the impact of these hydrological changes on economic and social activities and their implications for future water management scenarios, policies and institutional frameworks. This research will increase our current knowledge of the dynamics of the water cycle in these regions and also provide information on the causes, magnitude and frequency of significant regional droughts.

Fresh water will be an increasingly scarce resource in the warmer, more crowded world resulting from ongoing Global Changes. In many areas of the Americas, mountain regions provide water that sustains adjacent arid lowland communities. Future changes in the amount, seasonality and quality of that water will be critical determinants of human activities in these areas. Increasing demand coupled with changes in supply will create severe problems in water availability that will require effective management and mitigation strategies.

### **Hurricanes in a changing climate: A look at the Eastern Pacific region**

*Graciela de Raga, Centro de Ciencias de la Atmósfera, Universidad Nacional Autónoma de México, Mexico*

This project will study aspects of formation and intensification of storms in the Eastern Pacific, a region that has not been given the same degree of attention as other regions, even though more cyclones per unit area form there than in any other region in the world. Hurricane Juliette in 2001 reached Category 4 and even though it weakened before landfall on the Baja Peninsula, it caused widespread destruction of bridges and roads. Cyclones that develop in this region may result in intense precipitation over land when they interact with the steep topography that lies very close to the coast, potentially leading to landslides and loss of life and large economic damage, as when Pauline (1997) resulted in over 200 deaths in Oaxaca and Guerrero. Their study will address the question of whether the large scale environmental conditions associated with the intensification of tropical cyclones in this region will be more frequent in a future warmer climate, as predicted by the models currently involved in the Fourth Assessment of the IPCC. Furthermore, the study will investigate potential changes in the timing of landfall, which in the past have predominantly occurred late in the season.

Intense tropical cyclones can cause devastation when they impact on land, as evidenced last year when Katrina and Rita affected the United States and when Wilma hit the Caribbean coast of Mexico. Wilma

as a Category 5 hurricane, had the lowest ever recorded pressure in the Atlantic basin. Recent studies have indicated an increase in the frequency of the most intense cyclones (4 and 5), but not an increase in the total number of cyclones. The question of whether the increased frequency of these intense storms is due to climate warming or natural variability is currently being discussed within the scientific community, but also in the media and by policymakers.

**Paleotempestology of the Caribbean Region: A Multi-proxy, Multi-site Study of the Spatial and Temporal Variability of Caribbean Hurricane Activity**

*Kam-biu Liu, Louisiana State University, U.S.A.*

This project deals with the hurricane hazard in the Caribbean region. Hurricane climate is an important scientific subject in global change research, and it is also a topic of enormous societal relevance, especially to stakeholders in this hurricane-prone region. This project aims to study the spatial and temporal variability of Caribbean hurricane activity across multiple timescales from the interannual to the millennial by employing the principles and methods of paleotempestology, a young but burgeoning scientific field that studies past tropical cyclone activity by means of geological and archival techniques. Paleotempestology can provide a long-term perspective that is vital for understanding the climate mechanisms affecting hurricane activity and for predicting the future.

The 13 scientists involved in this CRN, from ten institutions in four countries (U.S.A., Mexico, Costa Rica, Canada), will advance the research frontiers in paleotempestology by employing for the first time a multi-proxy approach in paleohurricane reconstruction. Their research methodology will involve not only relatively well established techniques such as high-resolution stratigraphic studies of coastal sediments from backbarrier lakes, swamps, and atoll lagoons, but also new and promising proxies and archives such as oxygen isotope ( $\delta^{18}\text{O}$ )-based records from coral skeletons, speleothems, and tree rings. The team will apply this multi-proxy approach to a large number of sites across the entire Caribbean region. They will use these proxy records to reconstruct the basin-wide patterns of Caribbean hurricane activity at various timescales, which will be statistically analyzed in relation to other large-scale climatic phenomena such as ENSO and NAO.

The capstone objective of this project is to integrate findings from paleotempestology with data and concepts from the social sciences. Using a geographic information systems (GIS) approach, this project will develop an interactive model that links hurricane risks to potential loss of life, economic damage, and post-hurricane environmental and health hazards in the Caribbean region. The results, to be made available to decision makers and the public, will be useful for an accurate assessment of hurricane risks and for reducing the vulnerability of this region.

**South Atlantic biological productivity: physical mechanisms at work and their potential response to global change**

*Alberto Piola, Servicio de Hidrografía Naval and Universidad de Buenos Aires, Argentina*

The main aim of this IAI research network is to advance the understanding of the physical mechanisms that influence biological processes in productive regions of the western South Atlantic. They seek to understand how ecosystems respond to variations in the environment and if such variability is linked to global change. Combining new physical and biological observations at sea with mathematical models and satellite data, they will look for evidence on the mechanisms that drive productivity and cause its time variability. This knowledge is important to better understand the role of the ocean on climate, how the ocean biota responds to environmental changes and for designing management strategies of ocean resources.

Optical measurements from satellites reveal that ocean phytoplankton productivity varies drastically from year to year. In the western South Atlantic, for instance, productivity has risen about 60% since the mid 1980's. Such interannual fluctuations are likely to impact on the ecosystem and climate, but the causes

of the observed changes are unknown. Measurements taken at sea reveal that regions of enhanced productivity are linked to strong absorption of CO<sub>2</sub> from the atmosphere and may therefore modulate climate variations.

The group has just completed a three week oceanographic cruise to the southern Patagonia continental shelf and slope where they occupied 56 hydrographic stations across the shelf. Most of the cruise was financed by the so-called GEF Patagonia. In each station, they collected a variety of biological, chemical and physical data, from the water column and underlying sediments. The survey provided a unique opportunity to obtain a first time ever high-resolution section of the eastern mouth of the Straits of Magellan, which were carried out specifically as part of and financed by their IAI project. The new data will allow them to determine the winter thermohaline properties and planctonic composition of the inflow from the southeast South Pacific into the Patagonian shelf through the Straits. This data is relevant because the inflow is thought to play a central role in shaping basic characteristics of the productive southern Patagonia shelf.

### **Effective strategies of adaptation and risks reduction in face of the Economic and Climatic Impacts**

*Edwin Castellanos, Centro de Estudios Ambientales, Universidad del Valle de Guatemala, Guatemala*

This research network will study how to reduce risks and increase the adaptation capacity of the most vulnerable farmer groups in view of the constant stress resulting from climate and global market unpredictability. The research strategy is multidisciplinary, with the participation of researchers from a broad range of disciplines such as anthropology, sociology, ecology and environmental economy.

A comparative case-study involving coffee producers in Mexico, Guatemala, Honduras and Costa Rica will analyze the strategies developed at local, national and regional levels to face the stresses and impacts on farmers' livelihoods from three sources: climate events, price fluctuation and pest incidence. The study also seeks to establish the role of grassroots organizations as well as governmental and non-governmental bodies in the process of adaptation to global changes. The analysis of satellite images showing the changes in land use resulting from different management and institutional strategies will supplement field findings.

Systematized information and recommendations based on the lessons learned from the case studies may strengthen grassroots institutions and organizations that support coffee producers. In addition, these results will be important to developing national policies aimed at strengthening the capacity of rural homes and regions to adapt to the multiple changes environmental global change.

### **Human and Biophysical Dimensions of Tropical Dry Forests in the Americas**

*Arturo Sanchez-Azofeifa, University of Alberta, Canada*

The *Tropi-Dry* research network was created to improve scientific knowledge on the natural and social dynamics of secondary and primary dry forests in the Americas. The project aims to improve the capacity of societies to manage these regions through comprehensive and comparative analyses of land use and related policies. The joint work with decision makers in participating countries aims at establishing an exchange that will result in the protection of the ecosystems under study. Studies will be conducted across a latitudinal range all the way from Mexico to Brazil. *Tropi-Dry* is made up of researchers from Brazil, Canada, Costa Rica, Cuba, Mexico, USA and Venezuela.

Tropical dry forests in the Americas are one of the least studied ecosystems both from the perspective of their floristic and structural composition and the socio-economic drivers that contribute to their development and degradation. To a certain degree, these forests take second place in terms of conservation compared with tropical rain forests. Tropical dry forests are located in areas of high agricultural potential, have excellent conditions for human settlement, and great value for the tourism

industry. Tropical dry forests have been considered to be the cradle of human development in the Americas, which has contributed to making them one of the most degraded ecosystems on the continent.

### **Emissions, Megacities and Climate in South America (SAEMC)**

*Laura Gallardo Klenner, Universidad de Chile, Chile*

The goals of this IAI CRN team of researchers and students from Argentina, Brazil, Chile, Colombia and the USA are to: provide accurate regional emissions and climate change scenarios for South America, with emphasis on the impacts of and on megacities; establish the basis for operational chemical weather forecast for South American megacities; strengthen and expand an active research and capacity building network in the Americas functional to Earth System Modeling.

They will look at what and how much emissions of atmospheric pollutants are coming from South American megacities and plan to collect and analyze available data and generate new information by combining monitoring campaigns and numerical models to generate past, present and future emission scenarios for the region. Today, meteorological services in the world forecast precipitation, temperature and “chemical weather”. One of such centers is CPTEC (Centro de Previsão de Tempo e Estudos Climáticos, Brazil). Through a pilot activity with DMC (Dirección Meteorológica de Chile) making use of the computer infrastructure in the region, daily predictions of air quality in the Chilean cities will be prepared.

Seventy five percent of the South American population is concentrated in megacities causing serious environmental problems such as air pollution. It is less well known that megacities are a global change agent and that climate changes affect air quality. The group aims to develop regional scientific capacity to increase our understanding of megacities and provide tools for improved air quality management.

### **Caribbean Coastal Scenarios**

*Michael McClain, Florida International University, United States*

The Caribbean Coastal Scenarios Program addresses the question: “What is the future of water in the Greater Antilles, and how can the island nations of the region meet their growing water demands without causing irreparable damage to fragile coastal resources?” This network is designed to facilitate a national and regional dialogue on these issues and seek a common vision of the way ahead. The dialogue will be based on credible scientific research to develop plausible scenarios of future water availability and demand over the next 80 years.

The island nations of the Caribbean are among the countries most vulnerable to global environmental change. While their populations are projected to increase significantly over the next 100 years, the fresh water and coastal resources on which they depend are projected to decline. Future infrastructure development, such as dams and diversions that modify rivers and alter the timing, quantity and quality of flows to coastlines would mean impacts to coastal flows.

Caribbean Coastal Scenarios partners academic institutions with governmental and nongovernmental organizations will investigate the likely water-related scenarios that the countries will face and seek consensus on the characteristics of a preferred development pathway that meets water needs without causing unacceptable degradation to resources and ecosystems. Scenarios will be based on computer models that integrate the best available scientific data on water flows in the countries, international projections of climate change, and the human management factors (such as diversions for irrigation and domestic water supply) that influence flows. The outputs of computer models will be discussed and revised in stakeholder workshops to arrive at the most plausible scenarios possible, and results of the program will be presented and debated in national and international forums. Meeting the countries’ water demands of the 21<sup>st</sup> Century will require new national policies to adapt to global environmental change and stronger institutions capable of adapting management programs to new realities.

The IAI welcomes SBSTA-24 recommendation on “Research and Systematic Observation” and supports its initiative to explore how SBSTA might facilitate a more effective dialogue between Parties and the regional and international climate research programs, in the context of decision 9/CP.11 and looks forward to further discussion at twenty-sixth session of the SBSTA.

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For more information on IAI programs, please visit the IAI website at: [www.iai.int](http://www.iai.int) or contact:

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