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SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE
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Item 6 of the provisional agenda
Research and systematic observation

Developments in research activities relevant to the needs of the Convention

Submissions from regional and international climate change research programmes and organizations

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA), at its twenty-sixth session, invited relevant regional and international climate change research programmes and organizations to regularly inform the SBSTA of developments in research activities relevant to the needs of the Convention (FCCC/SBSTA/2007/4, para. 47).

2. At its twenty-eighth session, the SBSTA invited the research programmes and organizations to continue to provide information pertaining to the activities outlined in document FCCC/SBSTA/2007/4, paragraph 47 (a–f) at the thirtieth and subsequent sessions of the SBSTA (FCCC/SBSTA/2008/6, para. 103).

3. The secretariat has received eight submissions from relevant research programmes and organizations. In accordance with the procedure for miscellaneous documents, these submissions are attached and reproduced[*] in the language in which they were received and without formal editing.

[*] 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.

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PAPER NO. 1: ASIA-PACIFIC NETWORK FOR GLOBAL CHANGE RESEARCH

SBSTA30 Informal Dialogue: Submission from the Asia-Pacific Network for Global Change Research (APN)

APN's[1] growing strength lies in its uniqueness to facilitate underpinning scientific research and capacity building that is systematically targeted for the needs of the Asia-Pacific region as identified by its government-appointed national Focal Points and scientists who, together, develop the science, policy and institutional agendas of the APN. With this, the APN welcomes the continuing opportunity to inform SBSTA of research, capacity development and science-policy interfacing within the Asia-Pacific region relevant to the convention.

Most APN member countries continue to identify climate vulnerability, impacts, and adaptation and/or mitigation assessments as their priority concerns[2]. GHG emissions, inventories, and the capacity to conduct activities in these areas are also considered important, particularly in the least developed nations. Climate change projections, uncertainties and modelling, particularly downscaling GCMs, are important as is access to/and the sharing of data across national borders for climate research. Besides defining research priorities to target important issues, the various conventions and assessment reports play a significant role in raising general awareness, resulting in enhanced appreciation of related issues and concerns.

Taking on board the challenges presented in climate impacts, vulnerabilities and adaptation, this is major interrelated issue for the UNFCCC and post-Kyoto agreements where skills in scenario development and impact quantification for climate sensitive systems will be needed. Particularly challenging for APN countries is the development of systematic efforts to implement adaptation strategies in various sectors likely to be affected by climate change. Currently, many APN member countries are developing adaptation strategies (and in some cases implementing them) in many sectors and all countries see the adoption of adaptation strategies as important to counter impacts and reduce vulnerabilities.

Citing an example from Indonesia[3] in adaptation strategies for future climate risks, fostering a co-evolution of interdisciplinary science is a major challenging strategy that is currently underway. In this regard, there is a need to enhance cross-sectoral governmental communication and coordination, improve education and increase public awareness. In this regard, the APN's capacity development programme, *CAPaBLE*[4]*,* is successful in that it can contribute to the process of developing effective climate information systems which meet client needs and are provided to the appropriate users in a timely fashion, allowing them to use this information to assist their decision making.

While the integration of various elements such as climate risk assessments, sectoral adaptation plans and international cooperation is seen as a systematic, coherent and sound basis for developing appropriate adaptation strategies, it is very clear that many APN developing countries lack the human and institutional capacity to plan and adopt such adaptation strategies. There are many limiting factors and developing countries, in particular, have yet to conduct much-needed vulnerability and impact assessments in many areas/sectors in order to plan appropriate adaptation strategies and mainstream these into national policy and plans. The most vulnerable sectors are agriculture, fisheries, water (floods and drought), forests, health and social welfare, transportation, coastal zones, mangroves and maritime resources.

Recognizing this, the APN is providing funds, in addition to its two annual calls for proposals, for focussed activities on scientific capacity building for impact and vulnerability assessments (Annex-1). This special call, together with

[1] The APN is a network of 21 member governments fostering regionally relevant global change research. www.apn-gcr.org
[2] APN 14th IGM Country Report Synthesis, March 2009
[3] Liana Bratasida, APN national Focal Point for Indonesia, APN-IAI side event, SBSTA28, 2008
[4] Published in April 2009, CAPaBLE "In Review" highlights the success of the programme and synthesises the outputs and key messages from a recent evaluation.

many related projects being conducted under the APN addresses issues identified in the Nairobi Work Programme. Another most recent example on adaptation planning for local government units is summarized in Annex-2.

In addressing the research needs of the region, research stemming from (and feeding into) the IPCC process is being conducted in many areas, and particularly in climate modelling. One example is the 3-year APN project (cited in IPCC AR4) undertaken in three sub-regions of Asia on Integrated Assessment Models. This project has developed a new framework for policy modelling and analysis to align sustainable development and climate change and this has input to national climate change action plans (Annex-3).

On science and policy communications, obstacles still exist in obtaining a common understanding between policy and scientific communities (in terms of language, acronyms, probability (risk), priorities, research versus political timeframes) and this remains a challenge in the Asia-Pacific region.

Annex-1

SPECIAL CALL FOR PROPOSALS FOR A FOCUSSED ACTIVITY

Scientific Capacity Building for
Climate Impact and Vulnerability Assessments (SCBCIA)

(1) SPECIAL CALL FOR PROPOSALS FOR A FOCUSSED ACTIVITY: Considering the urgent needs of developing countries that are particularly vulnerable to the adverse effects of climate change, the APN is inviting "Expressions of Interest" under the CAPaBLE programme for funding **from September 2009**.

A limited amount of financial support[5] is available for focussed activities that are undertaken at local, national or regional levels in Scientific Capacity Building for Climate Impact and Vulnerability Assessments.

(2) BACKGROUND: The IPCC AR4 notes that, in terms of the distribution of impacts and vulnerabilities to climate change, there are sharp differences across regions, and those in the weakest economic position are often the most vulnerable to climate change and the risks it presents. In this respect, the Asia-Pacific region is particularly vulnerable.

Key vulnerabilities to climate change may be associated with many climate-sensitive systems, including food and water resources, coastal systems, ecosystems, biogeochemical cycles, and modes of oceanic and atmospheric circulation.

The IPCC and the UNFCCC recognise that science can support informed decisions. However, under this premise, many countries lack the scientific capacity to be able to conduct crucial impact and vulnerability assessments in order to make informed decisions on how best to reduce the risks associated with climate change.

(3) ELIGIBILITY CRITERIA

1. The proposed activity must focus on scientific capacity building of developing nation(s) to conduct climate impact and vulnerability assessments
2. The proposed activity must have high potential to provide positive outcomes for developing countries that could also be used by the international community.
3. The proponent's institution must be based in a developing member or approved country of the APN (see the list of frequently asked questions provided separately).
4. The proponent and/or collaborators must possess the skills necessary to impart scientific capacity building in the focus area of climate impact and vulnerability assessments
5. The proponent must inform his/her APN country nFP and SPG member (where one exists), in advance, of the intention to submit a proposal. Contact details of APN members are available at http://www.apn-gcr.org/en/aboutapn/whoswho.html
6. The proposed activity must outline policy-relevant questions to be addressed and answered, organisational arrangements of the proposed activity and a publication and dissemination plan. In this respect, strong links with government units and/or agencies are expected.
7. The Expression of Interest must follow the template (provided separately) and be submitted to the APN Secretariat (lstevenson@apn-gcr.org) by **Friday 5th June 2009**.

(4) PROPOSALS SUBMISSION AND REVIEW PROCESS

- Stage 1 - Submission and review of Expression of Intent (compulsory)
- Stage 2 – Submission and review of Proposal (by invitation)
- Final Decision-Making

[5] Approximately US$200,000 is available for projects under this focussed activity. Average grants are expected to be approximately US$30,000 for one-year duration.

Annex-2

Local Government and Public Universities as Partners in Climate Change Adaptation Planning[6]

The Philippines is one of the countries most vulnerable to the adverse impacts of climate change. Government policies have to focus on adaptation initiatives to reduce vulnerability and minimise the impacts of climate change-associated events.

Local government units (LGUs) are at the forefront of disaster management including responding to the impacts of climate change. However, many LGUs are not aware of the climate change phenomenon and do not have the capacity to assist the affected communities in preparing climate change adaptation measures. Local public universities have resources (e.g. scientists, students and facilities) that can be capacitated as LGUs' partners to further enhance local climate change adaptation capacity. Their institutional linkages should be strengthened so that local scientists can input directly to the LGUs' policy-making processes.

This project is creating awareness and developing the capacity of LGUs, communities and regional universities to effectively respond to climate change for sustainable development. The goal is to enhance LGU-scientists partnership for science-policy interfacing and ensuring sustainability of adaptation plan implementation.

The project's capability building efforts are geared towards two major activities, vulnerability assessment and Indicative Climate Change Adaptation Plan (ICCAP) preparation. The idea is to form a team of scientists and LGU planners who will reinforce each other's expertise in coming up with programs that will enhance the people's adaptive capacity. The scientists will take the lead in the vulnerability assessment while the local planners will spearhead the ICCAP preparation based on the vulnerability assessment findings. The partners are expected to imbibe the principle that evidence-based planning is a key to effective climate change preparedness and adaptive capacity enhancement.

The project was undertaken in the five municipalities that were chosen not only because of their vulnerability but also their strategic geographic location and varying levels of disaster preparedness. It is also expected that these municipalities can serve as pilot cases that will demonstrate the feasibility of LGU-university alliance and capability enhancement.

As a levelling-off exercise, a climate change awareness-raising seminar was conducted for the project partners. Resource persons from the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA), University of the Philippines Los Baños' Interdisciplinary Program on Climate Change (UPLB-IdPCC) and the Presidential Task Force on Climate Change (PTFCC) discussed various aspects of climate change. The respective LGUs and local universities forged Memoranda of Agreement to institutionalise their partnership and commitment towards adaptive capacity enhancement.

Under the leadership of the scientist partners, vulnerability assessments of the respective study sites were conducted. Data was collected through public consultations and validated from the historical records obtained from PAGASA and the LGUs. Results of the vulnerability assessment, which were presented in a Vulnerability Assessment Workshop, showed that the study sites are at risk to climate change-induced events such as tropical cyclones, heat waves and sea level rise. These vulnerability assessment results were used by local planners in the formulation of the ICCAP and were presented in a workshop in March 2009.

The project partners expressed their appreciation for the avenue of collaboration that the project has opened for them. With the interpersonal and formal relationships that have been forged, they are hopeful that this partnership can be sustained beyond the project period. They, however, recognised that because the project was

[6] **Enhancing the Climate Change Adaptation Capacity of Local Government Units and Scientists in the Philippines**
(Project Reference #:CBA2008-09NSY Project Leader: Dr. Linda M. Peñalba)

able to cover only a few barangays within their municipality and reached only a few sectors therein, much is yet to be done to be able to formulate and implement a comprehensive climate change adaptation plan.

Annex-3

Integrated Assessment Model for Developing Countries and Analysis of Mitigation Options and Sustainable Development Opportunities

Key Components:

- Generating national GHG mitigation scenarios recognising explicit developing country dynamics
- Collaborating regionally to initiate national modelling exercises and develop national databases
- Generating knowledge to inform climate policy and develop GHG mitigation policies

Key Outcomes:

- *CAPaBLE CGE-IAM* model for analysing climate change policies in developing countries
- Model code and software, national scenarios framework and inventory of knowledge resources.
- Comprehensive web-based interactive tool with soft research infrastructure for stakeholder-scientist interaction
- Lasting networks including the newly established regional *Asian Energy and Environment Modelling Forum* (AEEMF)
- Extensive publications including key citations in IPCC AR4
- Dissemination at many policy fora including UNFCCC COP/MOP; UNCSD; ECO-Asia

Key Impacts:

- Close interface with policy-makers for receiving inputs to prepare national scenarios and to communicate results
- Scenarios and quantitative results used as benchmarks by stakeholders
- Contributed to prominent global research projects and initiatives including UNEP's *GEO4*; *IPCC AR4*; IEA's World Energy Outlook (WEO); IPCC's new scenarios initiative; UNEP RISO Development and Climate project
- Partner scientists contributing to the development of scenarios for the 5th IPCC Assessment Report

PAPER NO. 2: DIVERSITAS

Monitoring, understanding and predicting interactions between biodiversity and climate change: high-priority objectives for DIVERSITAS

DIVERSITAS, under the auspices of ICSU and UNESCO, aims to deliver socially relevant scientific knowledge on biodiversity, to provide the scientific basis for the conservation and sustainable use of biodiversity. Support for the study of the interactions between climate change and biodiversity has become a high priority throughout the DIVERSITAS projects ranging from research on rapid evolution of species in the face of climate change to improving the representation of biodiversity in earth system models that are used to project future climate.

Observations, experiments and models are being improved to better detect, understand and model climate change impacts on biodiversity. For example, DIVERSITAS is playing a key role in driving an international initiative to create a new global biodiversity monitoring network (GEO-BON). One of the goals of this monitoring network will be to detect footprints of climate change impacts on biodiversity and ecosystem services and to spot early warning signs of rapid and potentially irreversible changes in biodiversity and ecosystem services. The Global Mountain Biodiversity Assessment (GMBA), a cross-cutting network of DIVERSITAS, has already developed a number of products that illustrate the power of global monitoring initiatives by providing strong evidence of climate change impacts on biodiversity and ecosystem services of these vital and sensitive zones of the terrestrial biosphere. DIVERSITAS is also leading efforts to encourage the development of new, more robust models of climate change impacts on biodiversity and to provide syntheses of these model-based biodiversity scenarios for decision makers. As part of these efforts, DIVERSITAS is currently leading a broad synthesis of projections of biodiversity change for the 21st century for the Convention on Biological Diversity (CBD) to be published in the forthcoming Global Biodiversity Outlook 3 (GBO 3).

DIVERSITAS has stepped up its efforts to understand how changes in biodiversity will feed back on climate change. Recent efforts are focusing on more realistic scenarios of biodiversity change, including those predicted to occur due to climate change, and the impacts of these changes in biodiversity on ecosystem functions and services at multiple spatial and temporal scales. DIVERSITAS, IGBP and several other partners are also stimulating the development of improved models of regional and global vegetation and ecosystem response to climate change. One of the key aims of this work is to enhance the representation of plant diversity at the functional group level in these models using a newly developed global database of plant traits. Several demonstration projects are underway using these models to assess the importance of plant diversity in mediating climate change (e.g., by mediating ecosystem C storage, hydrological cycles, albedo, etc).

Two clear messages emerging from recent research are that:
1) Climate change will likely lead to large-scale and often negative impacts on biodiversity and ecosystem services in the 21st century, but our ability to detect and project these changes is currently insufficient; and that
2) Climate change cannot be projected with confidence without substantial improvements in our ability to project future shifts in the distribution and abundance of plants, animals and micro-organisms.
DIVERSITAS in collaboration with its ESSP partners is focusing a substantial part of its energy in coordination, networking and integration activities to assist the scientific community in making progress on both of these fronts and to help provide the scientific expertise required for international decision making bodies such as the UNFCCC and the CBD.

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PAPER NO. 3: EARTH SYSTEM SCIENCE PARTNERSHIP

Earth System Science Partnership (ESSP)

Community building for new insights in climate science and global environmental change research

Introduction

The ESSP is a science partnership of the four international global environmental change research programmes – an international programme of biodiversity science (DIVERSITAS), International Geosphere-Biosphere Programme (IGBP), International Human Dimensions Programme on Global Environmental Change (IHDP), and the World Climate Research Programme (WCRP) - for the integrated study of the Earth system, the ways that it is changing, and the implications for global and regional sustainability.

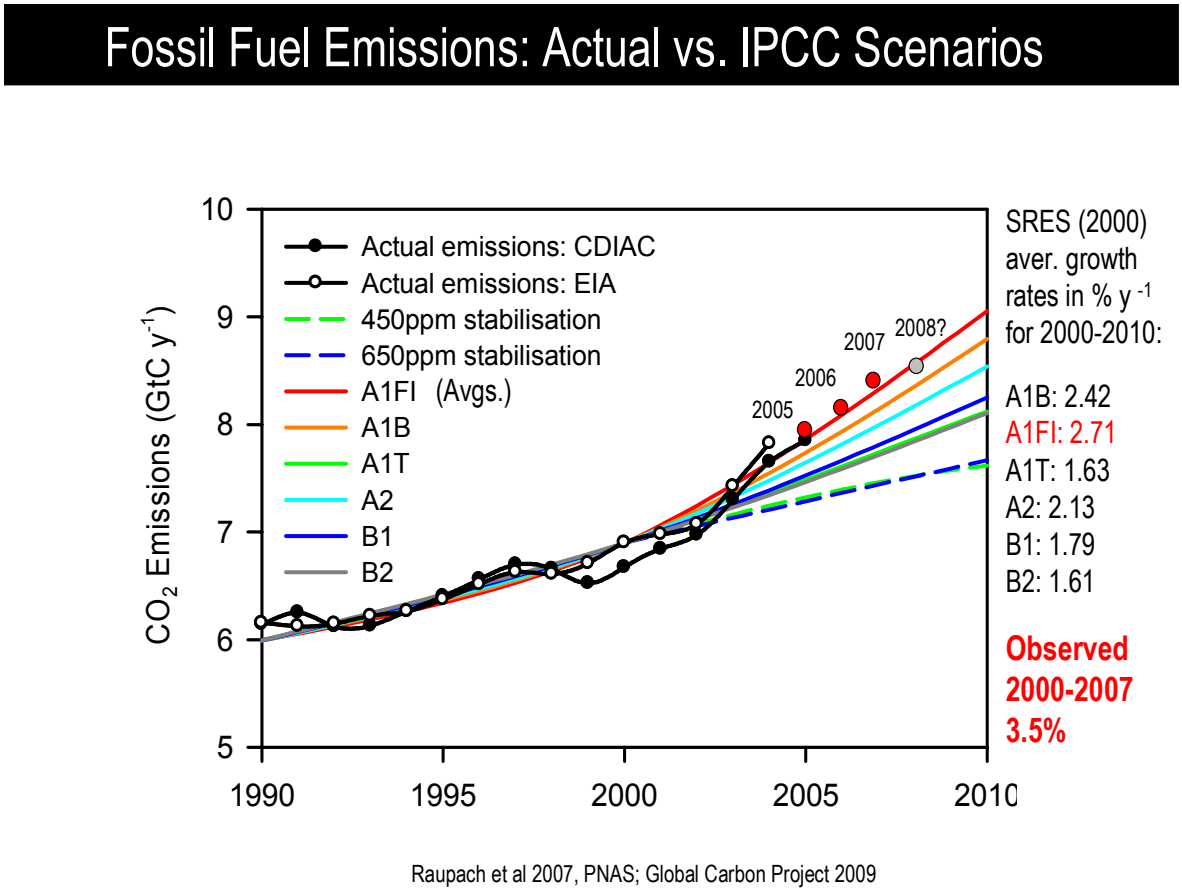
New Science

ESSP activities aim to develop a global environmental change (GEC)-oriented research agenda of direct relevance for societies. The ESSP joint projects aim to address the challenges caused by GEC with innovative integrative approaches, to elucidate interactions between natural and social systems and to understand the implications of human-driven changes for the functioning of the Earth system. The current suite of Joint Projects focus on carbon dynamics, food systems, water and health.

Carbon

The scientific goal of the Global Carbon Project (GCP) is to develop a complete representation of the global carbon cycle, including both its biophysical and human dimensions together with the interactions and feedbacks between them. Two major scientific findings resulted from the new analyses of recent trends in the global carbon cycle:

- For the first time, the GCP showed that the efficiency of the natural sinks to remove carbon dioxide is declining.
- The current fossil fuel emission trajectory is tracking if not surpassing the most carbon intense IPCC scenarios, and this is due, in part, to the fact that after decades of improvements, the carbon intensity of the global economy, the carbon emitted per unit of Gross Domestic Product (GDP), stalled during the period 2003-2005.



Raupach et al 2007, PNAS; Global Carbon Project 2009

In 2008, the GCP posted the most recent figures for the global carbon budget. This became immediately a key to understanding the balance of carbon added to the atmosphere, which constitutes a major underpinning of human induced climate change. Experience with the carbon budgets has shown that integrative and synthetic science products, which are released and updated regularly and which have a direct connection with the policy process, can generate a lot of visibility, excitement and comprehension. More information on these timely carbon cycle analyses are provided on: www.globalcarbonproject.org/carbontrends/index.htm. A particular effort was made this year to produce new carbon analyses focusing on Africa given the limited amount of reliable scientific information available for the continent (see also www.biogeosciences-discuss.net/special_issue37.html).

The Global Carbon Project is also taking the lead in an ESSP-wide bioenergy activity that will take an Earth system view of bioenergy, its opportunities and constraints in contributing to stabilizing atmospheric CO2.

Food

The Global Environmental Change and Food Systems (GECAFS) project addresses the two-way interactions between GEC and food security. Research aims to determine strategies to cope with the impacts of global environmental change on food systems (i.e. the food chain activities from producing to consuming food, and the outcomes of these activities for food security) and to assess the environmental and socioeconomic consequences of adaptive responses aimed at improving food security. GECAFS conducts conceptual research on food systems and their vulnerability to GEC, and bridges the science-policy-development interfaces with case studies in southern Africa, the Indo-Gangetic Plains and the

Caribbean. GECAFS outputs continue to be drawn upon for major reports by organisations such as UN-FAO, the European Science Foundation and national government departments.

In 2008, GECAFS (on behalf of ESSP) and the Centers of the Consultative Group on International Agricultural Research (CGIAR) successfully developed a major research project: the CGIAR Challenge Program on "Climate Change, Agriculture and Food Security (CCFAS)". This will be a major collaborative endeavour between the international agricultural research community and their partners, and the ESSP. It is aimed at overcoming the additional threats posed by a changing climate to achieving food security, enhancing livelihoods and improving environmental management in the developing world.

Water

The central research question of the Global Water System Project (GWSP) is "How are humans changing the global water cycle, the associated biogeochemical cycles, and the biological components of the global water system and what are the social feedbacks arising from these changes?" In order to address this question, the GWSP launched three Global Initiatives:

- Global scale initiative to rank the threats to the global water system;
- Global catchment initiative to bring the global perspective to river basin research and management; and
- The global water needs for humans and nature initiative

The initiatives are targeted towards the production of scientifically cutting-edge and highly policy-relevant results.

GWSP results have already been successfully represented in assessments such as the IPCC Fourth Assessment Report and Technical Paper on Water and will be made available to UNFCCC, as well as the 'Brazilian National Plan and Strategy for Climate Change' (a GWSP Endorsed Project). Other chief beneficiaries include the UN World Water Assessment Programme, FAO, disaster relief agencies, the Millennium Development Project, the international development banks, re-insurance companies (SwissRe, MunichRe) and the private sector.

Health

As this ESSP Joint Project on GEC and Human Health is only at the implementation stage it is too early to report scientific results, its impacts and the responsiveness of the Project at setting research agendas. However, the added value of this Project is clear in that it seeks to identify and quantify current health impacts of GEC and to forecast the future health impacts. These scenarios of future health impacts will form a new, dynamic and integrative node in the developing domain of Earth system science. They will help focus on policy options that ensure a healthier and more sustainable future. This Joint Project is being developed in collaboration with the World Health Organization (WHO).

Regional Activities

Monsoon Asia

The ESSP is developing a small set of Integrated Regional Studies (IRS), designed to contribute sound scientific understanding in direct support of sustainable development at the sub-global (regional and local) level. These studies will also improve overall knowledge of regional-global linkages in the context of Earth System dynamics. The first such study is in Monsoon Asia (MAIRS). Over the next three-years, MAIRS will develop observation and research in interactions between land cover change and climate, between aerosol emission and climate, regional climate and earth system modelling, and projection of

future trends in regional climate. Major tasks for MAIRS will include developing and coordinating a series of projects at the national and international level in the monsoon Asian region, focusing on water resources, air quality, regional climate, land cover and ecosystem service changes.

Africa

The African Network for Earth System Science (AfricanNESS) science plan and implementation strategy "A Strategy for Global Environmental Change Research in Africa" focuses on four top-level issues: food and nutritional security; water resources; health; and ecosystem integrity. This science plan was launched at the IGBP Congress in May 2008, was developed over a period of three years through the collective efforts of many African scientists, as well as colleagues and programmes (including ESSP) from outside the African continent. The Science Plan can be downloaded from: http://www.igbp.net/documents/AfricanNess-2008.pdf.

Capacity Building

The ESSP is also developing and implementing a scaled-up capacity-building agenda - to be delivered through START - which will enhance individual and institutional capacity. See START's abstract for more details about its contribution to advancing climate science, enhancing developing country expertise and its contributions to and interactions with the IPCC and the UNFCCC.

Communications

Knowledge Products

The ESSP will provide a mechanism to help promote and deliver knowledge products. As the experience with the carbon budgets released by the Global Carbon Project has shown, integrative and synthetic science products that are released and updated regularly, and have a direct connection with the policy process can generate a lot of visibility and excitement. Several other examples of such knowledge products within the different core and joint projects of the GEC research programmes already exist, including the GWSP digital water atlas (http://atlas.gwsp.org/). Others such as sustainability safeguards for bioenergy (that could emerge out of the bioenergy activity) will be developed.

Forum

The ESSP will co-convene Earth System Science Forum with strategic partners – the first one being the Tällberg Forum, 25 - 26 June 2009 with the Stockholm Resilience Centre and the Stockholm Environment Institute on "Making the Planetary Boundaries Relevant for Policy and Practice". This kind of forum will serve as a vehicle for a high-level dialogue with stakeholders, including opinion leaders from civil society, business and government. The Forum can also help highlight and communicate key insights from science, raise awareness and build support for interventions to support all the partner GEC research programmes, and identify key issues and areas relevant for the earth system science agendas of ESSP and its partners.

Journal

The ESSP will launch a high quality, interdisciplinary, peer-reviewed journal entitled 'Current Opinion in Environmental Sustainability' (published by Elsevier) in October 2009. This journal will provide a valuable outlet for the science of the programmmes and projects. It will appeal to a wide audience, through policy briefs, short assessments or issue summaries. It will also be open access to developing country scientists.

IPCC

As presented at previous SBSTA meetings, the ESSP and its partner GEC research programmes greatly contribute to the IPCC assessment reports. They have also convened, with the IPCC, various workshops to take stock of AR4 and plan future research. In January 2009, hosted by the Dutch Global Change Committee, the ESSP convened (in collaboration with IPCC) a workshop on "Future Climate Change Response Research: Learning from IPCC's Fourth Assessment Report". The workshop articulated some major research questions on the basis of IPCC reports, recent societal trends and latest scientific insights in order to guide future research strategies of ESSP and the research programmes. Key outcomes included the emergence of stronger collaboration between ESSP, UNEP and the impact, adaptation and vulnerability assessment communities.

Copenhagen Climate Congress

ESSP and its partner GEC research programmes (DIVERSITAS, IGBP, IHDP and WCRP) helped to organise the International Association of Research Universities (IARU) Climate Congress in Copenhagen (10 -12 March 2009) and will review the synthesis report of congress. The focus of this congress, in which 1500 experts participated, was to provide a picture of the "big issues" that the scientific community feels are necessary for policy makers to be aware of in order to make informed decisions concerning balancing adaptation and mitigation in societal responses to climate change. The main findings of the congress will be presented in plenary at UNFCCC-SBSTA 30 and will feed directly into the UN Conference on Climate Change (COP 15) hosted by the Danish government in December 2009.

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PAPER NO. 4: GLOBAL CHANGE SYSTEM FOR ANALYSIS, RESEARCH AND TRAINING

START's contribution to research activities relevant to the needs of the Convention

START's many research and capacity building activities in Asia and Africa directly contribute to meeting the goals of the Nairobi Work Programme's 9 work areas, as well as to the priorities delineated in SBSTA 26 as described below.

Research capacity-building activities, particularly in developing countries: START supports a wide range of activities to build capacity in research applications for adaptation. These include:

- The African Climate Change Fellowship Program (ACCFP) provides Doctoral, Post-Doctoral, Policy, and Teaching fellowships to African professionals, researchers and graduate students to enhance their capabilities to advance and apply knowledge for climate change adaptation. The Fellowships are conducted at host Institutions within Africa and are aimed at enhancing understanding of climate risks, vulnerabilities and adaptation strategies, assessing current practices for designing and implementing adaptation projects and promoting the integration of adaptation with planning, policy and decision-making.
- Building African Capacity for Conserving Biodiversity in a Changing Climate: This MacArthur Foundation funded capacity building program assists conservation professionals from the Albertine Rift countries of Burundi, Democratic Republic of Congo, Rwanda, Tanzania and Uganda to understand emerging risks to biodiversity conservation from climate change, and to develop adaptive management strategies. The program offers graduate level curriculum on climate change risks and provides case study exercises, field visits and field-based, guided externships that help participants design and implement place-based research. START plans to expand the programme through developing distance-learning modules.
- A recent assessment for Building Long Term Capacity for Managing and Adapting to Climate Change in Africa and Asia targeted current education and training capacities for improving research and understanding of vulnerability, adaptation and resilience to climate risks and relevant capacity building priorities in 15 least developed countries in Africa and South and Southeast Asia.

Relevant communication issues: START is committed to improving the communication of research findings on climate change in order to simulate effective adaptation planning, through activities such as:

- Integrating Climate Change Mitigation and Adaptation into Development Planning engages scientists and policy makers in West Africa, East Africa and South Asia through a series of national science-policy dialogues based on the findings of the IPCC Fourth Assessment Report and other regional sources of knowledge. A major outcome of this effort will be enhanced capability in target countries and regions to engage in IPCC and SBSTA/UNFCCC activities and dialogues.
- Program on Asian Mega-Cities at Risk: Developing Adaptive Capacity for Climate Change workshop brought together regional scientists, urban planners and officials and representatives from disaster management and development agencies to review projections for climate-related risks to several of Asia's coastal megacities, and to consider ways to better integrate science information, planning, development, disaster management, and communication between urban planners/officials and the scientific community in order to enhance urban resilience and adaptive capacities. A series of visioning exercises aimed at specific cities are planned for 2009 onwards that will train professionals to engage with city administration, private and public sector communities in mainstreaming climate change considerations in to their development trajectories.

- Climate change for Development Planners: START is providing technical support to the World Bank Institute in developing e-learning modules intended to raise awareness and improve communication around climate change issues relevant to World Bank staff and to development professionals within the Bank's client countries.
- The Advancing Capacity to support Climate Change Adaptation project recently developed and tested different methods and tools for communicating climate risk information to at-risk populations and decision-makers. These include training workshops targeted at community representatives, professionals, and national agency representatives, participatory monitoring and evaluation, focus group discussions and participatory workshops, dramas presented to at-risk communities, folk music, radio bulletins, videos, posters and leaflets. These actions have helped to enable and support effective adaptation planning to reduce vulnerability to climate change and promote sustainable development across Asia and Africa.
- Web-based knowledge platforms: START is partnering with the Stockholm Environment Institute and others on weADAPT, the web-based platform developed to enhance the knowledge base for adaptation. START is also exploring the creation of Africa DIVA (Dynamic assessment of Impacts, Vulnerability and Adaptation) in collaboration with research organizations from Africa, the US, and the UK, and is intended to provide a comprehensive portal on the state of the art and knowledge on climate change and Africa.

Research priorities and gaps in the implementation of these priorities: START's recent support in this area includes:

- Research to improve regional modeling and scenario generation of the monsoon climate in Asia , especially the most vulnerable regions identified in the IPCC 4AR (major deltas, semi-arid regions) where considerations of land cover use/change, aerosols and biogeochemistry of carbon and nitrogen cycles are of particular importance.
- A Global Environmental Change grants programme in Africa that allows regional scientists to pursue research themes related to climate change risks that inform adaptation planning .
- Advanced Study Institutes that provide support for research on such topics as 'Global environmental change and the vulnerability of water resources in the context of Millennium Development Goals in Africa' and 'Monsoon prediction and predictability in support of the Monsoon Asia Integrated Regional Study'.

Regional climate change research networks: The vast majority of START's activities are multi-institutional and regional in nature and thus directly contribute to building regional climate change research networks comprising researchers, educators and policy-makers, and their respective institutions.. Examples of START activities that actively foster such collaborative networks include the AIACC, ACCCA, ACCFP, and biodiversity conservation under a changing climate projects.

The activities described in this briefing are a result of a collaborative effort between START and its many partners, which include UNEP, UNITAR, IPCC, WMO, the World Bank, the Stockholm Environment Institute, the East-West Center, and numerous universities and research institutes in Africa and Asia as well as in the Europe and the United States. The global change SysTem for Analysis Research and Training (START) is a member of the Earth Science System Partnership and is sponsored by the WCRP, IGBP, and IHDP.

PAPER NO. 5: INTER-AMERICAN INSTITUTE FOR GLOBAL CHANGE RESEARCH

Submission from the Inter-American Institute for Global Change Research (IAI)

The Inter-American Institute for Global Change Research (IAI) provided in document FCCC/SBSTA/2008/MISC.8, an update on current research, and introduced its network initiative "Land-use change, biofuels and rural development in the La Plata Basin".

In this two-year initiative, funded by the Canadian International Development Research Centre (IDRC), IAI is successfully coordinating research teams in Argentina, Brazil, Bolivia, Paraguay and Uruguay to provide research and policy advice in the La Plata region. The La Plata Basin, the fifth largest basin in the world, presents a large diversity of challenges that range from unknown social and economic impacts of climate variability and changes in land-use patterns to management of hydropower, and the expanding use of land for food and biofuel production. The project integrates information on climate change, land-use change, ecosystem services and social and economic dynamics and characterizes the perspectives of bio-energy markets at local and regional scales. It aims to provide input towards the design of future research and monitoring of regional environmental impacts of climate and land use change.

At its twenty-eighth meeting, the SBSTA "stressed the need to enhance research and related institutional capacity, in particular in developing countries through individual, bilateral and multilateral action as and/or through the research programmes and organizations". The La Plata Basin project directly responds to activities under the Nairobi Work Programme (NWP) by providing cooperation among Parties, relevant organizations and stakeholders and by encouraging South-South cooperation to facilitate knowledge exchange on lessons learnt from local experiences.

The goal of the IAI is to augment the scientific capacity of the region and to provide information in a useful and timely manner to policy makers. For more effective regional guidance, the IAI wishes to involve its member countries more closely in IAI-UNFCCC interactions and invites member countries to support activities combining ecosystem and atmospheric carbon cycle research to guide decision making.

A brief summary of some critical issues in agricultural biofuel production (annexed) may serve to initiate discussion on the trade-offs between the use of renewable carbon for fuel and for sustaining the associated land base. The aim of biofuel production is to substitute fossil carbon with biologically fixed carbon. As new technologies permit increasingly exhaustive use of crops and residues for bioenergy production, knowledge on sustainable land management and soil carbon needs to be integrated with concerns on global carbon balances and renewable fuels, if food and fuel production is to be sustainable.

Among typical energy crops, sugar cane and oil crops produce principally carbon, while maize and soy beans have been selected and bred for high protein content. Using protein crops for fuel carbon, needs careful consideration of their nitrogen and therefore fertilizer requirements, that can offset any fossil carbon gains. As cellulosic technologies evolve, renewable energy production will be able to use crop residues that are currently left in the field to replenish soil organic matter, which is needed to maintain soil quality. Reducing soil organic matter causes problems with infiltration, erosion and nutrient availability. Balancing carbon needs for soils with those for human energy consumption therefore is a task that needs to be introduced into planning now as the bioenergy sector grows, particularly for many tropical regions whose soils have a lower ability to stabilize carbon and depend more on conservative management of residues.

Annex – Biofuels, Soil Carbon Balance and Sustainability

Substituting fossil fuels

Climate change has drawn attention to carbon used for energy. If fossil carbon is burned for energy, it is added to the atmospheric carbon dioxide and aggravates global warming and has other detrimental effects such as ocean acidification. If carbon from plants is burned instead, that recycles carbon recently fixed from the atmosphere, and thus can provide a "carbonneutral" energy source for mitigation of greenhouse effects.

A number of options exist for land-based biofuel plant production. Wood burning is a principal energy source for many households in developing countries, and is also for industrial processes such as iron ore smelting using charcoal. For mobile (automotive etc.) use, liquid fuels are needed, either ethanol to substitute for gasoline, or unmodified or esterified plant oils to substitute for diesel.

Biofuel sources

Sugar cane is the main source of ethanol. Cane sugar is extracted from the vegetative parts of the plant, fermented and distilled into fuel grade alcohol. Part of the cane residues are usually burned to generate heat for the distillation. Increasingly starch, principally from maize grain, is also being used to make fuel alcohol. Starch is not directly fermentable, so must be converted to sugars first by industrial enzymatic processes. A small number of distilleries have now begun to use the more complex conversion of cellulose to fermentable sugars, but the technology has not yet been developed into a viable large-scale industrial process. Substitutes for fossil diesel are derived from oil plants such as rape seed, soy bean or oil palm, either by direct admixture to the diesel or upon transesterification of the oils.

In all cases, the aim of biofuel production is to substitute fossil carbon with biologically fixed carbon. This makes sugar cane and to a lesser degree oil palm and rape seed relatively straight-forward energy crops because carbon (sugar or oil) is their main product. Maize and soy beans have been selected and bred for nutrition and protein content. Using these crops for the carbon content of their seeds, needs careful consideration of their nitrogen and therefore fertilizer requirements. Seeds normally contain 2-3 times the amount of nitrogen and phosphorus per unit of carbon than vegetative plant tissues. Using vegetative tissue as a carbon source therefore simplifies biofuel production. If seeds are used fuel production should be coupled to the utilization of the proteins remaining after fermentation for instance for feed. Several grasses, but also fast growing trees are being considered as cellulose sources for the future. Crop residues are vegetative plant parts that come "for free" after seeds have been harvested for other purposes. As cellulosic technologies evolve, the hope for non-fossil, renewable energy production is therefore to be able to use plant materials and crop residues that are currently not used.

Fuel carbon vs. soil carbon

Farmers know that organic matter is needed to maintain soil quality. Soil scientists have quantified typical carbon losses associated with arable agriculture, as well as the carbon gains that occur when land is reverted to forest or grassland. Carbon levels in soils are determined by the balance of inputs from plants and their residues and outputs by decomposition. Reducing inputs will reduce carbon levels unless decomposition is slowed at the same time. In agriculture introducing zero till or other conservation practices will slow decomposition and aid carbon build-up in soil. Reduced soil organic matter causes problems with infiltration, erosion and nutrient availability, and a very low level of soil organic carbon will cause soil to become unproductive. Carbon therefore needs to be returned to the soil from crop

production. Balancing carbon needs of soils and human energy consumption therefore is a task that needs to be introduced into planning now as the bioenergy sector grows.

In a recent review of a large number of land use conversions between conservation reserve lands and agriculture (Piñeiro et al. 2009), soil organic carbon accumulation on reserve land was on average near 0.5 Mg C ha-1 yr-1 over some 15 years, after which accumulation slowed significantly to reach its final steady level after some 80 years. The total carbon sequestered in an average soil under conservation reserve therefore amounts to over 10 Mg ha-1. Carbon losses upon converting natural vegetation to agriculture are faster but of similar magnitude. These changes in carbon storage compare with approximately 1.5 Mg in ethanol-carbon obtainable from an average US maize crop of 9 Mg ha-1. Piñeiro et al. (2009) analyzed the whole lifecycle of ethanol production and arrived at net avoided fossil carbon emission of 1.2 Mg of carbon dioxide equivalents, i.e. a carbon saving of near 0.4 Mg ha-1 yr-1. Carbon for carbon, during the first 15 years of biofuel production on former native or conservation reserve land, there is therefore no reduction in net carbon emission. The world average maize yield at only 2.5 Mg ha-1 yr-1 is much lower than the US average, so calculations for other regions would have to consider much lower efficiencies, but also lower fossil fuel inputs in the maize production. Taking into account the economics of maize production and carbon credits for the US, Piñeiro et al. (2009) conclude that soil C sequestration by setting aside former agricultural land was greater than the C credits generated by planting corn for ethanol on the same land for 40 years.

Piñeiro et al (2009) also indicate that producing cellulosic ethanol from grasslands provides higher rates of net carbon dioxide savings because it does not cause tillage-induced soil C losses. In addition using grasses may increase C storage in soils if grasslands are replanted on current agricultural lands (Ogle et al. 2003, Tilman et al. 2006). Even permanent plant cover, though, relies on the carbon recycling from above ground biomass litter to maintain soil carbon levels. How much could be harvested for biofuel production without reducing soil C remains to be determined, although experience from grazed pasture provides pointers for appropriate management. The development of cellulosic technologies will permit using crop residues, but removal of crop residue from the field must be balanced against impacting the environment (soil erosion), maintaining soil organic matter levels, and preserving or enhancing productivity (Willem et al. 2004). Maize stover can provide a renewable carbon source. Because of its relatively large biomass, maize produces 1.7 times more C than other common grains, but suitable sustainable removal rates will vary depending on yield, soil type, and cultural practices (Willem et al. 2004).

The concerns about maintaining soil organic matter and soil quality under regimes of increasing carbon diversion to fuel uses are greater for many tropical soils than for the cases above because these soils have a lower ability to stabilize soil carbon and depend more on conservative management of residues.

Summary - biofuels to replace fossil carbon emissions

- Biofuels will play a mayor role in carbon mitigation.
- The soil's need for carbon adequate carbon content and inputs will have to be considered when more and more carbon is removed from the land for energy production.
- Ideally, energy crops should produce carbon with few associated nutrients to reduce fertilizer needs and subsequent contaminants problems.
- If high nutrient plant (parts) such as seeds are used for biofuel production the coupled production of feed is a vital component of the production process. This may actually diversify rural economies. Accounting of the environmental benefits will not be easy, since renewable carbon and other products result.

- Much of the needed information for guiding decisions on fossil fuel substitution by agriculture and forestry is available. It must be synthesized in a format and forum suitable for strategic planning.

Literature

G. Piñeiro, E. G. Jobbágy, J. Baker, B. C. Murray, R. B. Jackson Ecological Applications, 19(2), 2009, pp. 277–282

Tilman, D., J. Hill, and C. Lehman. 2006. Carbon-negative biofuels from low-input highdiversity grassland biomass. Science 314:1598–1600

Ogle, S. M., F. J. Breidt, M. D. Eve, and K. Paustian. 2003. Uncertainty in estimating land use and management impacts on soil organic carbon storage for US agricultural lands between 1982 and 1997. Global Change Biology 9:1521–1542

Wilhelm W. W. , J. M. F. Johnson, J. L. Hatfield, W. B. Voorhees, and D. R. Linden. 2004. Crop and Soil Productivity Response to Corn Residue Removal: A Literature Review. Agronomy Journal 96: 1-17.

PAPER NO. 6: INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME

International Geosphere-Biosphere Programme
ABSTRACT for SBSTA Meeting June 2009
Prepared by Sybil P. Seitzinger, Executive Director IGBP

The International Geosphere-Biosphere Programme (IGBP') is a research programme that studies the phenomenon of Global Change (www.IGBP.net). IGBP research addresses the interactive physical, chemical and biological processes that define Earth System dynamics, changes that are occurring in these dynamics, and the role of human activities in these changes. IGBP contributes to new knowledge on climate change, as well as many other global environmental change issues, by coordinating research activities through the IGBP Core Projects and by organizing workshops and synthesis activities that bring together scientists from a wide range of disciplines. The nine Core Projects of IGBP address processes on land, in the atmosphere, and oceans, and the interfaces between these, and include two integrative cross-cutting projects that address future and past global change. Many IGBP activities have considerable collaboration with partner programs, including the World Climate Research Program (WCRP), the International Human Dimensions Program (IHDP), DIVERSITAS, and our partnership of the Earth System Science Program (ESSP).

International Engagement and Capacity Building
IGBP is truly an international network that has strong engagement of scientists from the developed and developing world at all levels (e.g., IGBP Scientific Committee, Officers, Core Project Scientific Steering Committees, research network, and National Committees in over 70 countries).

In May 2008, IGBP held its 4th Congress in Cape Town, South Africa, under the theme "Sustainable Livelihoods in a Changing Earth System". South Africa was an excellent venue to help strengthen IGBP's research and networking on issues crucial for developing countries all around the world. The Congress focused on many issues of direct relevance to civil society and the policy community, and helped IGBP identify ways to better contribute towards developing sustainable pathways for mitigation, innovation and adaptation.

Emerging Scientific Findings
A few of the recent results from IGBP activities that are relevant to increased emissions of greenhouse gases and climate change are highlighted below.

Ocean Acidification: The oceans are acidifying fast, at a rate and to a level not experienced by marine organisms for at least 20 million years. The cause of this acidification is related to dissolution in seawater of CO_2 that has been emitted to the atmosphere from human activities. Since industrialization began in the 18th century, surface-ocean acidity has increased by 30%. This ongoing ocean acidification is decreasing the ability of many marine organisms to build their shells and skeletal structure, with strong negative implications for the future of coral reefs, for example. New evidence of the effects on reproduction, behaviour, and general physiological functions of some marine organisms, such as oysters, sea urchins, and squid, is also accumulating. These results and others were presented at the 2008 Symposium on the Ocean in a High-$C0_2$ World (co-sponsored by IGBP, SCOR, IAEA and lOC). A conference declaration (The Monaco Declaration) urging climate change negotiators to take ocean acidification seriously was one of a number of products from this symposium (www.igbp.net/documents/MonacoDeclaration2009.pdf).

An intense effort will be needed to prevent severe damages from ocean acidification. For example, to stay below an atmospheric $C0_2$ level of 55O ppm, the current increase in total CO_2 emissions of 3% per

year must be reversed by 2020 (Anderson and Bows 2008). Even steeper reductions will be needed to keep most polar waters from becoming corrosive to the shells of key marine species and to maintain favourable conditions for coral growth. If negotiations at COP-1S in Copenhagen in December 2009 fall short of these objectives, still higher atmospheric $C0_2$ levels will be inevitable.

Ongoing research relevant to ocean acidification is conducted by scientists associated with many of the IGBP Core Projects. For example, a surface ocean CO_2 Atlas (mapped data from 1968-2007) is being developed by SOLAS (Surface Ocean-Lower Atmosphere Study). The impact of ocean acidification on marine ecosystems and biogeochemical cycles will be a key issue addressed by the next IMBER (Integrated Marine Biogeochemistry and Ecosystem Research) *imbizo* meeting in 2010. Ocean acidification over time was the topic of a recent IGBP fast-track initiative and involved participation from SOLAS, IMBER, LOICZ (Land-Ocean Interactions in the Coastal Zone), GLOBEC (Global Ocean Ecosystem Dynamics), and PAGES (Past Global Changes), as well as partners SCOR and IMAGES. The magnitude of past events of ocean acidification and how marine organisms and ecosystems responded are continuing to be addressed through palaeo records by work in PAGES.

High latitudes - Atmospheric Pollution and Climate: The high latitude regions are critical regions for climate change impacts. Several short-lived pollutants may be contributing to the accelerated rates of warming observed in the Arctic relative to the global annually averaged temperature increase. For example, new analyses emphasize that multiple forcings due to black carbon, methane, and tropospheric ozone lead to a positive surface temperature response indicating the need to reduce emissions of these species within and outside the Arctic (Quinn et al. 2008) (IGAC)

Carbon and Nitrogen Cycle-Climate Feedbacks: The importance of including both carbon and nitrogen cycle-climate feedbacks in predicting climate change are becoming increasingly apparent. Recent model inter-comparison studies have been important in quantifying these feedbacks, as well as quantifying the long-term consequences of carbon reduction commitments.

A new approach to scenario development using reference concentration pathways (RCPs) has been adopted for AR5, and these are being extended from including only $C0_2$, to now including a more complete suite of GHGs. (IGBP AIMES and WCRP)

A better understanding of the Earth's past environment can be used to make better predictions for the future. (IGBP PAGES)

Past Ice-free Nordic Seas: A recent reconstruction of sea-surface temperature at the last Glacial Maximum (21,000 years ago) has revealed the occurrence of ice-free Nordic Seas during summer, as well as many other new insights (MARGO Project Members, 2009).

Sea level: Relative sea level reconstructions and modeling of the last Interglacial Period (ca. 126,000 years) suggest that we are moving into a climate regime where the Greenland and West Antarctic ice sheets will become increasingly unstable. Palaeo sea-level data and modeling suggest that sea level rise related to current warming may be rapid at first and slow with time. Using palaeodata and direct observations, loose limits have been developed on how rapidly sea level rise might occur over the next century. For example, we may expect sea level rise over the next century to fall between the lower limit of 20th century sea level rise (0.12 m per century) and the sea level rise at the conclusion of TI (1 m per century). Extreme lower bounds (i.e., outside the range of possibility) can be derived by pre-industrial sea level rise during the Holocene (0.04-0.07 m per century), while extreme upper bounds of 2 m per century have been estimated by extrapolating the fastest observed ice stream responses to all of the

Greenland and West Antarctica ice streams. (Siddall et aI., in press, J. of Quaternary Science; Siddall et aI., in press, Eos; PAGES news special section on sea level change, in prep.).

There are many economic implications of sea level rise. A cost-benefit analysis of sea level rise for several areas, including the cost of defense and loss of high value land is being developed (LOICZ).

Climate Change and Water Resources in less Developed Countries: The Northern Hemisphere has been the primary focus of studies on the last 2000 years of climate. Information on climate for the Southern Hemisphere has been largely missing. However, new information for South America on temperature, precipitation and glaciation is demonstrating that glaciers are retreating at an unprecedented rate. (PAGES) Glaciers provide important water resources for people and ecosystems downstream. Increased rates of melting of glaciers can lead to downstream flooding in the short term, and as glaciers disappear a large decrease in available water over the longer-term.

Research Planning Activities
Key uncertainties and research needs identified by the IPCC or raised by Parties are important areas of investigation by IGBP. The recent and ongoing research being addressed by IGBP Core Projects that are outlined above are only a few examples of such IPCC relevant work. IGBP also has recently initiated a major synthesis and integration activity. This activity will be ongoing over the next 3-5 years with a series of scientific publications and communication products for policy makers being continually developed. Many of the topics being addressed are in response to key issues raised by IPCC and the Parties.

IGBP along with the other GEC programmes (WCRP, IHDP, DIVERSITAS) and ESSP, as well as other partners, have organized and been involved in a number of recent workshops in collaboration with past and current co-chairs of IPCC WGs I, II, and III with the goal of continuing to identify key uncertainties and research needs and to develop ways that we can collectively address these.

'IGBP is an interdisciplinary body of the International Council for Science (ICSU)

Anderson, K. and and A. Bows. 2008. Reframing the climate change challenge in light of post-2000 emission trends. Phil. Trans. R. Soc. A. doi:10.1098/rsta.2008.0138

Quinn, P.K., T.S. Bates, E. Baum, N. Doubleday, A.M. Fiore, M. Flanner, A. Fridlind, T.J. Garrett, D. Koch, S. Menon, D. Shindell, A. Stohl, and S.G. Warren. 2008. Short-lived pollutants in the Arctic: Their climate impact and possible mitigation strategies. Atmos. Chem. Phys. 8: 1723-1735.

PAPER NO. 7: INTERNATIONAL HUMAN DIMENSIONS PROGRAMME ON GLOBAL ENVIRONMENTAL CHANGE

"Meeting the climate change challenges – the contribution of Human Dimensions research"

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The International Human Dimensions Programme on Global Environmental Change (IHDP) is an international, interdisciplinary science programme, dedicated to provide international leadership in framing, developing, and integrating social science research on global change and to promote the application of the key findings of this research to help address environmental challenges.

Human actions lie at the heart of global environmental changes. Present changes in the Earth's climate system are due, in large part, to a buildup of greenhouse gases in the atmosphere resulting from human activities. These and other similar activities are triggering changes that threaten social welfare, raising questions about the resilience of the current world system. The impacts of climate change will depend upon human responses ranging from the actions of individuals to the creation of multilateral environmental agreements and the reactions of the wider global civil society. Avoiding dangerous anthropogenic interference in the Earth's climate system, for example, will require far-reaching changes in the production and consumption of energy and both mitigation and adaptation measures depend on the ability and willingness of societies to respond effectively to these major challenges.

Efforts to understand and to respond effectively will require major inputs from the social sciences. Policy makers at all levels need better knowledge of the demographic, economic, institutional, and technological roots of behavior leading to increases in emissions of greenhouse gases or the adoption or rejection of ambitious climate policies. Hence, IHDP aims to present a clearer picture of the determinants of human responses – both individual and collective – to global developments like climate change.

Meeting these needs in science for society will require a substantial increase in the contributions of the social sciences. For instance, research on vulnerability, adaptation and resilience, effective governance arrangements and tools, including risk management, or patterns of (large-scale) behavioral changes and other social transition processes such as transforming fossil fuel based energy systems are key areas of IHDP's research. It is no longer sufficient to engage in research on the biophysical elements of complex and dynamic systems on the assumption that human actions are largely exogenous to the workings of these systems or constitute only occasional perturbations that can be set aside safely for purposes of analysis.

The IHDP input is crucial for the development of a science of coupled systems or, as many now call them, socio-ecological systems in which the impacts of human actions are fully integrated into analyses of global environmental changes which is done, for example, within the context of the Earth System Science Partnership (ESSP).

PAPER NO. 8: WORLD CLIMATE RESEARCH PROGRAMME

"Climate Information for Decision Makers: Contributions from World Climate Research Programme"

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WCRP aims to improve the scientific knowledge delivered to policy and decision makers in support of climate change adaptation, mitigation and risk management. A primary focus of WCRP is improving climate modeling and prediction and working with partners to ensure resulting information are as skillful as possible and useful to the end-user. WCRP also supports capacity-building activities to help train climate scientists in the development and application of modeling and downscaling techniques as well as engaging with end-users to improve their ability to interpret the available information and to understand the possibilities and limitations of climate change projections.

Key to improving the climate information in support of mitigation approaches, adaptation strategies and risk management is enhancing and refining global climate models, as they form the basis of all regional and local simulations. Improving the models requires accurate and sustained observations, regional and process understanding research, a good understanding of models skill and uncertainties, and significant improvements in computing power and information management systems. All these efforts must be lead by scientific and technical experts who are also knowledgeable about the potential impacts of global climate variability and change on economic sectors of interest to their country and region.

To determine which mitigation strategies to pursue, decision makers need to know the effect of any potential actions as well as inaction. It is also important to be able to verify emission reductions as they occur. Adaptation planning for a changing climate requires predictions on a local or regional level, and on seasonal, annual, decadal, and centennial time scales. Downscaling techniques and regional models specifically need to be enhanced to allow this kind of resolution. It is also important to work closely with user groups, especially at regional level, to determine the types of information needed as well as build capacity to compile and interpret that data and information. Similarly, disaster risk reduction requires regional modeling and probabilistic estimates of prediction skill to plan for potential natural disasters.

Key steps to address these needs include: to sustain and standardize observation of current climate; to reduce and quantify uncertainty within and across models to aid in decision making; to develop models that have higher resolution at multiple time scales from sub-seasons to decades and centuries; to identify and institutionalize ways for climate information to be included in risk and disaster assessment and subsequently incorporated in e.g. National/Regional Action Plans; to continue to widely disseminate data and assessments to all user groups, in a timely and user-friendly format; and to increase the capacity for national and regional actors to access and interpret climate information and projections.

WCRP mission embodies these actions and its coordination and integration activities are organized to accomplish them in most effective ways by active engagement of best scientific and technical minds from around the world in close collaboration with users of climate information.

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