3 May 2013

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UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

Subsidiary Body for Scientific and Technological Advice
Thirty-eighth session
Bonn, 3–14 June 2013

Item 7 of the provisional agenda
Research and systematic observation

Update on developments in research activities relevant to the needs of the Convention; and information on technical and scientific aspects of emissions and removals of all greenhouse gases from terrestrial ecosystems

Submissions from regional and international research programmes and organizations

Addendum

1. In addition to the two submissions contained in document FCCC/SBSTA/2013/MISC.5, seven further submissions have been received.

2. 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.

Contents

Paper no. 1: Asia–Pacific Network for Global Change Research

Acknowledgment: The APN welcomes and appreciates the continuing opportunity to inform, and engage in a dialogue with SBSTA on issues of global change research, capacity development and science-policy interfacing mechanisms within the Asia-Pacific region that is relevant to the convention. The present brief[1] summarizes the current main activities undertaken by APN to address some of the issues outlined in the recently published document FCCC/SBSTA/2012/L.25 related to Doha (COP18) and SBSTA37 regards those topics for discussion at the dialogue meeting to take place during SBSTA38, taking into account developments in research activities outlined in document **FCCC/SBSTA/2007/4, Paragraph 47 (a–f)**.

Contents

[1] Stevenson, L. A., Takemoto, A., Matthews, W. A. (2013). APN submission brief to the United Nations Framework Convention on Climate Change (UNFCCC) SBSTA 38 Research Dialogue. Asia-Pacific Network for Global Change Research (APN), Kobe, Japan.

1. What is the APN:

Established in 1996, the Asia-Pacific Network for Global Change Research (APN) is a network of twenty-two member governments in Asia and the Pacific whose vision is to enable countries in the region to successfully address global change (GC) challenges through science-based response strategies and measures, effective science and policy linkages, and scientific capacity development.

As APN is an Inter-governmental network, a high priority goal is to produce sound scientific results that can be made available as a supportive tool for policy-making processes. Accordingly, the APN conducts regular synthesis and assessment activities of the projects its supports in order to identify important outcomes, research gaps and/or emerging issues that could be used to support policy development.

APN is financially sponsored by the Governments of Japan (Ministry of Environment [MOEJ]; Hyogo Prefectural Government), New Zealand (Ministry for the Environment), Republic of Korea (Ministry of Environment [MEV]) and the United States (National Science Foundation [NSF]; United States Global Change Research Program [USGCRP]).

The APN goals are achieved through a number of activities selected from the APN's two main programmes, which involve **two annual open Calls for Proposals in which scientists based in APN member or approved countries can submit proposals for funding support**. The two main programmes are the *Annual Regional Call for Research Proposals (ARCP)* and the *Scientific Capacity Development Programme (CAPaBLE)*. Particularly encouraged to submit APN proposals are developing-country researchers working in collaboration with the APN's international Global Change partners and their related core and joint projects. APN is closely following and engaging in the development of its GC partners into the Future Earth alliance.

Research and capacity building activities under the ARCP, CAPaBLE and other related initiatives of the APN focus on four scientific themes identified in the APN's Science Agenda. These are (i) **Climate Change and Climate Variability**; (ii) **Ecosystems, Biodiversity and Land Use;** (iii) **Changes in Atmospheric and Terrestrial Domains;** and (iv) **Resources Utilisation and Pathways for Sustainable Development.** Under these scientific themes, the APN supports activities that are interdisciplinary in nature and cut across natural, social, economic and political sciences.

Examples of the kinds of activities APN undertakes are:

- Promoting and strengthening GC research, including identifying gaps via syntheses and assessment work
- Identifying and developing existing methodologies and developing new methodologies and tools for effective transfer of scientific knowledge
- Strengthening the interface of policy- and decision-making processes and society in general for mainstreaming environmental concern
- Encouraging initiatives from developing countries for place-based, integrative research
- Aligning with programmes of the GC community

At its recent annual meeting, 18th IGM/SPG Meeting, April 2013, the following topics were considered by its member governments to be of interest:

- B&ES including resiliency and main issues highlighted under the new APN B&ES Framework;

- Climate Impacts on health, agriculture, livestock;
- Water security (inland and ocean): in the face of extreme events; including management, quantity, quality, etc.; and
- Energy/energy efficiency, carbon capture, case studies at community-based levels, biofuels, etc.

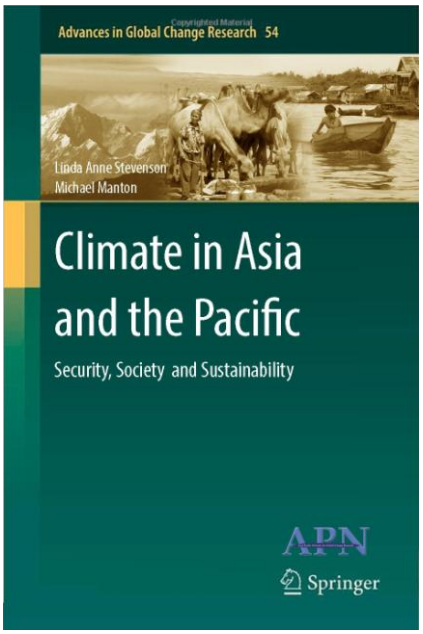
2. Ongoing and Completed APN Activities Relevant to the Convention

2.1 Climate in Asia and the Pacific: Security, Society and Sustainability

Following a mandate from its governing body, the Intergovernmental Meeting (IGM), the Asia-Pacific Network for Global Change Research (APN) produced a synthesis report of all of the activities it had conducted under one of its four broad themes of global environmental change - climate change and climate variability. The Synthesis Report – *Climate in Asia and the Pacific: A Synthesis of APN Activities* summarised more than 55 regional research and capacity building projects that the APN had conducted under this theme since 1998.

Positive feedback following wide distribution of the synthesis report prompted the need, and decision, to complement the report with a book explaining the current status of climate change and climate variability in the Asia-Pacific region; future directions in the area and overarching issues. It was agreed among the authors that the foci of the book be security (food, water and energy); society (urban and remote communities; human health and governance) and sustainability (low carbon development and ecosystem services).

The first chapter of the book addresses a number of key questions that relate to our current understanding of the interactions between climate, natural ecosystems and human communities across Asia and the Pacific. The analysis presented in subsequent chapters addresses these questions and provides recommendations for a number of future directions in research needed to better understand and manage the risks associated with climate change and variability in the region. The final chapter summarises the findings presented in the book and provides an overall picture of future needs for climate research in Asia and the Pacific. Finally, we suggest a number of overarching issues that should be taken into account in future considerations of climate interactions across the region.



Expected to complement the IPCC AR5 report and as a prelude to the release of the report, the book will be published under the Springer series *Advances in Global Change Research* in summer or autumn 2013.

2.2 Selected Research Activity related to Terrestrial Ecosystems: *Rapidly Changing Greenhouse Gas Budgets of South and Southeast Asia: A 3-year collaborative research activity.*

Within the UNFCCC, countries are continuing to negotiate emission reduction targets and exploring mitigation strategies best suited to their biophysical characteristics. One of the largest impediments to advance in this front is

the lack of high quality estimates of GHG fluxes in and out of natural and managed ecosystems. In this project, we have undertaken one of the most ambitious synthesis efforts to date using global and regional datasets and model outputs to constrain the regional GHG budgets of South and Southeast Asia, where the source/sink balance of GHGs has large uncertainty. For reduction of these uncertainties, analyses of land-use and land-use change, riverine carbon export, soil carbon distributions and other bottom-up estimations are being conducted. For top-down estimations (source/sink inversion from atmospheric data and models), efforts are being made to use the existing atmospheric data from various sources, as well as expansion of the present surface-monitoring network in the South Asia region.

The project objectives are:

- Reconciliation of top-down estimates using atmospheric GHG inversion models and bottom-up estimates using terrestrial biogeochemical models, remote sensing data, and flux and inventory datasets.
- Observational data and numerical model results of various GHGs (CO_2, CH_4, N_2O etc.) will be analyzed and archived in a central data repository.
- Access and analyze the results for the regions from 11 atmospheric CO_2 inversions, 6 global terrestrial biogeochemical model outputs, and one fire emissions product.
- Discuss among the participating scientists during the proposed workshops, and share with all parties interested through peer-reviewed publications and the data repository.

Based on work to date, the top-down and bottom-up estimations of carbon fluxes showed good agreements within their respective uncertainties, because we are able to account for the major flow of carbon in to and out of the South Asia regions. However, there are clearly some missing flux components those require immediate attention. The fluxes estimated and not estimated in this work are schematically depicted in Figure 1. Most notably the soil carbon pool and fluxes have not been incorporated in this analysis. The soil organic carbon (SOC) sequestration potential of the South Asia region is estimated to be in the range of 25 to 50 TgC yr yr-1 by restoring degraded soil and changing cropland management practices.

A key priority for the group is now to complete the second GHG budget for the region, the one for Southeast Asia. We expect to have it finalized within the next few months so that the group has also enough time to focus on some of the biggest uncertainties of the two budgets and addressed them within the duration of the project.

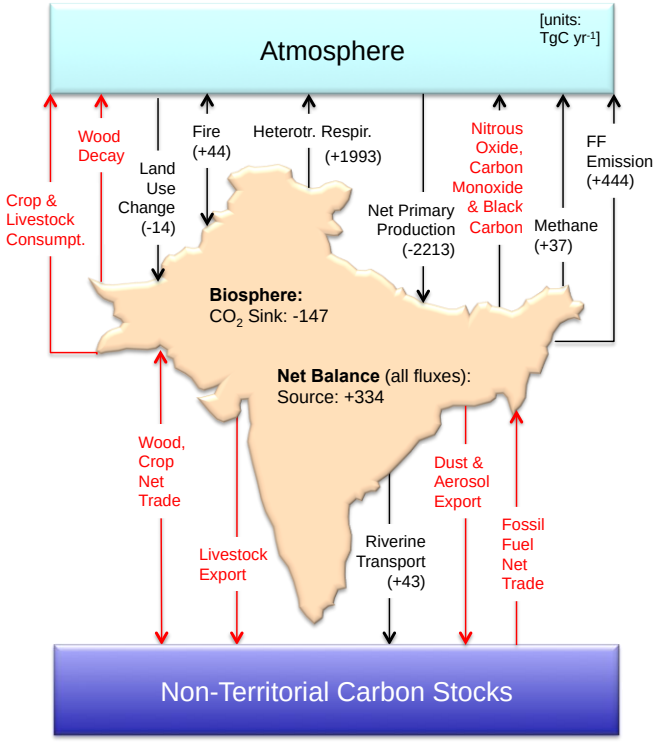


Figure 1: Schematic diagram of major fluxes of CO_2, CH_4, N_2O and related species in South Asia region. The flux components written in black ink are discussed in this work, and those marked in red ink requires attention for further strengthening our knowledge of regional GHGs budget. Direction of net carbon flow has not been determined well for some of the fluxes, which are represented by lines with arrowheads on both sides.

References:

Asia-Pacific Network for Global Change Research (APN). (2013). *Greenhouse Gas Budgets of South and Southeast Asia*. Retrieved from http://www.apn-gcr.org/resources/items/show/1592

Patra, P. K., Canadell, J. G., & Lal, S. (2012). The rapidly changing greenhouse gases (GHG) budget of Asia, EOS, Transactions, American Geophysical Union. Vol. 93, 2012, Doi: 2011ES003689

Patra, P. K., Ito, A., & Yan, X. (2012). Climate change and agriculture in Asia: A case study for methane 7 emission due to rice cultivation. Stadium press (India) Pvt. Ltd., October 2012.

Patra, P. K., Canadell, J. G., Houghton, R. A., Piao, S. L., Oh, N.-H., Ciais, P., Manjunath, K. R. … & Lasco, R. (2013). The carbon budget of South Asia. *Biogeosciences.* 10. 513-527.

Other research activities under this topic that may be of interest to the parties:

[1] Asia-Pacific Network for Global Change Research (APN). (2005). *Vulnerabilities of the carbon-climate system: Carbon pools in Wetlands/Peatlands as positive feedbacks to global warming*. Retrieved from http://www.apn-gcr.org/resources/items/show/1517

[2] Asia-Pacific Network for Global Change Research (APN). (2007). *Assessing the Mitigation and Adaptation Options for Tropical Peatlands to Reduce GHG Emissions and Increase Resilience to Climate Change*. Retrieved from http://www.apn-gcr.org/resources/items/show/1535

2.3 New projects under APN's Low Carbon Initiatives Framework for Developing Countries in the Asia-Pacific Region

APN launched a new Focused Call for Proposals under its Low Carbon Initiatives Framework. From this call, APN announced the following new activities under the programme that began work in April 2013:

Capacity Building

i. Capacity Building for Implementing a 'Measurable, Verifiable and Reportable (MRV)' Model in a Mid-Sized Thai Municipality
ii. Strengthening Community Voices in REDD+ Policy

Regional Research

i. Identification of policy and institutional gaps, drivers and strategies to scale-up low carbon and energy efficient technology application in the construction and infrastructure sectors in South Asia
ii. Understanding and Quantifying the Water-Energy-Carbon Nexus for Low Carbon Development in Asian Cities
iii. Assessment of Carbon Sequestration through Vermitechnology in Organic Farming
iv. Integrated sustainability assessment of bio energy potentials in Asia: An application of a hybrid approach on trade-offs and pathway
v. Low Carbon Urban Infrastructure Investment: Cases of China, Indonesia, and Japan

3. New Opportunities for Developing Countries in the Asia-Pacific Region

3.1 New Opportunities under APN's Climate Adaptation Framework for Developing Countries in the Asia-Pacific Region (see also Appendix 1)

Climate Change and Variability is 1 of APN's 4 research themes and, recently, we launched our **Climate Adaptation Framework** and our book on **Climate in Asia and the Pacific: Security, Society & Sustainability** (Springer: in press). APN aims to share research, capacity development & partnership opportunities with the international climate community and has, since August 2012, developed the following:

Scoping Workshop in 2012: Based on needs, gaps & lessons for climate adaptation in the Asia-Pacific region APN's research & capacity development activities focus on the following themes:

- *Developing high-resolution observational, model & downscaled datasets;*
- *Sharing of needs-oriented data;*
- *Calibrating/validating RCMs; & uncertainty analysis/assessment;*
- *Developing/utilizing impact, vulnerability, risk & economic assessments;*
- *Improving communication skills of scientists & practitioners with all stakeholders for encouraging decision makers to formulate/implement adaptation plans based on the latest scientific knowledge;*
- *Utilizing available information including climate data in adaptation practices.*

18th IGM, April 2013: Particularly relevant to the recent COP18 Conference in Doha to address loss & damage, and other climate impact-related issues are: Enhancing understanding of slow onset events, approaches to address them, etc; impacts on the most vulnerable (slow onset & extreme weather events); risk reduction, risk sharing & risk transfer tools; identifying/developing approaches to address slow onset events & extreme weather events, including through risk reduction, risk sharing & risk transfer tools; integrating impacts into climate-resilient processes; climate change impacts on mitigation & human displacement, etc.

Activities envisaged, in support of above:

- *Strengthening & supporting the collection & management of relevant data*
- *Enhancing coordination, synergies & linkages among various organizations, institutions & frameworks, to enable the development*
- *Strengthening & promoting regional collaboration, centres & networks*
- *Enhanced capacity-building at the national & regional levels*

A focussed call for proposals will be launched in summer 2013 for activities that address the above.

*3.2 New Opportunities: Biodiversity and Ecosystem Services Framework (**see also Appendix 2**)*

A series of meetings and workshops since February 2011 has identified important existing gaps for the Asia-Pacific region requiring attention through comprehensive scientific research, capacity development and science-policy mechanisms.

With input from key experts from ASEAN ACB, DIVERSITAS, GEOBON, ICSU, MSU, UNU, among others; the gap analysis report outlines important thematic areas and key activities for the region, and underscores the need for APN to effectively align its scientific theme of Biodiversity, Ecosystems and Land-Use with the international arena. In this context, APN invites member countries, stakeholders, the donor and international research communities, etc., to propose collaborative activities that will provide opportunities, particularly in developing countries, to engage in activities under its B&ES Framework.

Encompassing a range of comprehensive, regional-based and collaborative scientific research, capacity development, and science-policy mechanisms, "thematic gaps" will include, broadly speaking:

Four main research themes:

i. *Identification of drivers and pressures for biodiversity change that influence ecosystem services (land-use change; climate change, etc.)*
ii. *Assessment of the impacts of biodiversity loss and vulnerability to the shrinking of ecosystem services*
iii. *Prediction of changes in biodiversity and ecosystem services through model-based scenarios*
iv. *Adaptation, response and mitigation of the depletion of biodiversity and ecosystem Services*

Some of the key activities related to the above four themes are outlined in the Opportunity paper (see **Appendix 2**). Other activities that may be considered in line with the key activities are A) awareness-raising, B) capacity development, and C) science-policy mechanisms as elaborated below.

4. Framework that is forward looking

Ensuring that the framework is dynamic in nature, the following actions will be undertaken in the APN's present third strategic phase (**APN, 2011b**) from April 2013 (mid-term) until March 2015 (end):

- Identifying from the present paper selected topics for the annual calls for proposals (ARCP and CAPaBLE programmes) for 2013 and 2014.
- Developing an "opportunities brochure" inviting collaboration with organizations, stakeholders and other interested parties from the member countries and international community.
- Seeking investment from the donor community.
- Synthesizing results of activities under the APN's "Ecosystems, Biodiversity and Land-Use" Focused Activities programme (**EBLU, 2011**), and other relevant activities.
- Addressing and incorporating gaps identified for ecosystems services in the APN book on Climate in Asia and the Pacific: Security, Society & Sustainability (**Stevenson & Manton, 2013**).
- Undertaking an 18-month review (from September 2014) with the aim of integrating key activities under the B&ES framework into the 4th Strategic Plan of the APN (from April 2015).

APN Framework on Climate Change Adaptation

1. As a result of the discussions at the *APN-ICAS Scoping Workshop to Enhance the Climate Adaptation Actions of APN Developing Countries*, it is suggested that the APN establishes a multi-year strategic framework focusing on climate adaptation from FY2013 (April 2013), pending resource availability.

2. The framework aims to enhance science-based adaptation activities of APN developing countries and comprises the following components:
   i. regional research programme that has a capacity building element
   ii. capacity building programme (including projects at national and sub-national scales)
   iii. activities jointly conducted with other organizations and networks

3. Themes of activities under the framework include a range of climate adaptation areas prioritized in the decisions at Conference of the Parties of Unite Nations Framework Convention on Climate Change including COP16 related to *"Enhanced action on adaptation"* (1/CP.16, para.14.(a)-(i), FCCC/CP/2010/Add.1) and COP18 related to *"Approaches to address loss and damage associated with climate change impacts in developing countries that are particularly vulnerable to the adverse effects of climate change to enhance adaptive capacity"* (3/CP.18, para.7(a)-(f), FCCC/CP/2012/Add.1).

4. Based on needs, gaps and lessons for climate adaptation in the Asia-Pacific region (as described in the Appendix), regional research and capacity building projects should contribute to improving applicability by users, focusing on the following themes:
   i. Development of high-resolution observational, model and downscaled datasetsthat can contribute to filling data gaps
   ii. Sharing of needs-oriented data
   iii. Calibration and validation of regional climate models; and analysis of projections and assessment of uncertainties
   iv. Development and utilization of impact, vulnerability, risk and economic assessments
   v. Improvement of communication skills of scientists and practitioners with stakeholders including local government, community, private sector and civil society, for encouraging policy-makers to formulate and implement adaptation plans based on the latest scientific knowledge
   vi. Utilization of available information including climate data in applications for adaptation

5. It is recommended that the APN enhance its partnerships with local, national, regional and international organizations and networks under the new program, which include (but are not limited to) the following:
   i. ADB
      a. Collaboration on a regional climate scenarios consortium and library in the areas of coordination of data collection, rescue, mining and calibration
      b. Collaboration on needs assessment of users at national and local levels
   ii. APAN
      a. Multi-year collaboration on capacity development for scientists and practitioners on climate adaptation including themes onadaptation plans and "train the trainers" activities
      b. Organization of a follow-up meeting for recommendations to strengthen partnerships at the 2013 Adaptation Forum
   iii. ICAS

a. Involvement of Japanese scientists for adaptation activities implemented by APN and its partners
b. Organization of follow-up events with APN

iv. Ministry of Interior, Thailand

a. Cooperation with the APN national Focal Point for Thailand on the development of community-based adaptation activities that involves local governments and communities in Thailand

SBSTA38: Submission from APN (Appendix 1)
APN Climate Adaptation Framework

v. UNU (UN-CECAR)

a. Training activities for scientists and practitioners on climate adaptation including modeling, downscaling, resilience, etc

vi. WCRP

a. Collaboration with CORDEX-Asia on capacity development in climate downscaling

vii. International Center for Climate Change and Development ICCCAD:

a. Collaboration on activities on loss and damage associate with climate change impacts including Asia Pacific Forum on Loss and Damage

viii. Asia-Pacific Center for Security Studies (APCSS)

a. Collaboration on activities related to science and security associated with climate change impacts

ix. Climate Change Institute of Australia National University (CCI-ANU)

a. Collaboration on scientific activities on climate adaptation

6. It is recommended that APN further develops its climate adaptation programme and expand its partnerships with organizations and networks through relevant platforms. This should be considered in accordance with the APN work programme and budget, and the APN Strategic Plan and Framework Document.

Appendix to text
Needs, gaps and lessons for climate adaptation in the Asia-Pacific region

- **Data, Modeling, Downscaling**
  - Objective of downscaling
    - ✧ Huge spectrum, variety of purposes
    - ✧ Dynamic or statistically downscaling can be selected depending on the purposes
  - Data observation, collection and mining
    - ✧ In particular, the lack of capacity to collect and mine data
    - ✧ Development of common data formats
  - Calibration of RCMs
    - ✧ How to combine downscaled data with local data
  - Development of high resolution downscaling that is suitable to users' needs (sector-specific)
  - Time scale
    - ✧ Ranging from seasonal to decadal predictions, medium term(about 5 years) to long-term predictions; and long-term climate projections
  - Data distribution/interface with users
    - ✧ Capacity development to be a good user (individual and institution)

- **Impact and vulnerability assessment**
  - Development of assessment models

- ✧ Different types of assessment models (impact assessment, risk assessment, and vulnerability assessment)
- ✧ Cost analysis
- ✧ Current/ future impacts

– Compound impacts (integrated assessment of climate and non-climate impacts)
– Capacity building for both modelers and users

Adaptation planning and implementation

– Scientific capacity of practitioners/decision-makers to formulate national adaptation plans
– Development of a screening tool on climate risk assessment for infrastructure
– Development of approach to encourage policy makers to adopt scientific knowledge
  - ✧ Present response which is favored by practitioners
  - ✧ Consideration of policy priorities other than climate policies such as development policy
  - ✧ Consideration of economic aspects
– Role of public and private sector
– Range of capacity building
  - ✧ Individual, institution, governance
– Consideration of uncertainty
– Consideration of politics, governance, and culture
– Enhancement of communication skills for both scientists and policy makers
  - ✧ Scientists' capacity to communicate with society (i.e., mass-media)
  - ✧ Risk perception
  - ✧ People's acceptance

APN Biodiversity and Ecosystem Services Framework (SBSTA38/APN Appendix 2)

OPPORTUNITY PAPER

The present paper invites member countries, stakeholders, the donor community, and the international research communities and networks to propose and engage in collaborative activities with the APN that embarks on underpinning regional-based research; capacity development via training and technology transfer; strengthening, establishing and/or interacting with science-policy mechanisms in key thematic areas under its framework for biodiversity and ecosystem services for the Asia-Pacific region, especially in developing countries.

1. Introduction

Home to more than half the world's population and a region that is spectacularly rich in biodiversity, Asia and the Pacific is rapidly developing economically.

Policy- and decision-making in the region to realise sustainable, green growth practices need to be underpinned by sound scientific knowledge, and mechanisms that effectively link biodiversity and ecosystem services (B&ES) to sustainable development and green growth is lacking.

With this rationale the APN has undertaken a series of activities over two years culminating in the present *Opportunity Paper* for the APN B&ES framework (*Appendices 1 and 2*).

In the lead up to establishing the present document, questions of "What do we know about ecosystem services?" and "How do we want to manage them?" were raised.

While it was generally agreed that the B&ES framework must include green growth and sustainable development, the question to "What extent is economics involved?" was stressed, particularly in the context of policy- and decision-making in the region.

2. Underpinning the science of B&ES for policy

Effective ways of collaborative science that ensure policy- and management- decisions are informed by the best available information, and good understanding of uncertainties associated with science, are needed.

An example of such an established, effective process is the Intergovernmental Panel for Climate Change (IPCC), particularly via its synthesis reports, for example, the IPCC Fourth Assessment Report (**IPCC, 2007**).

An IPCC fifth assessment is underway and a report for policy makers is expected in 2014.

A similar mechanism was established recently for B&ES called the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES; see *www.ipbes.net*), as agreed by Governments in the Busan Outcome (**IPBES, 2010**). The first plenary of IPBES established preliminary rules and procedures for its work (**IPBES, 2013**).

An IPCC for biodiversity, IPBES recognises the global importance of freshwater, marine and terrestrial ecosystems, and the services they provide.

In June 2012, the landmark United Nations Rio+20 sustainability conference presented the outcome "The Future We Want" (**UNSKDP, 2012a**).

Under its B&ES framework, the APN supports activities that are in line with Rio+20 outputs, in particular those highlighted in Parts: (II)61; (IV)E97-99, 102, 111, 122; (V)A 160,163-165, 205, 174, 177, 193, 197, 198, 201, 202, 204, 205, 212; (VI)B275, 276; and (VI)C 280 (**UNSKDP, 2012b**; see *Appendix 3*).

These areas are not intended to be exclusive but rather complement the goals of the APN B&ES Framework as well as underscore the importance of marine, coastal, freshwater, forest, and wetland and dryland ecosystems for livelihoods and human well-being.

3. Opportunities under the B&ES framework

A series of meetings and workshops since February 2011 has identified important existing gaps for the Asia-Pacific region requiring attention through comprehensive scientific research, capacity development and science-policy mechanisms (**APN, 2011a**).

With input from key experts from ASEAN ACB, DIVERSITAS, GEOBON, ICSU, MSU, UNU, among others; the gap analysis report (*Appendix 2*) outlines important thematic areas and key activities for the region, and underscores the need for APN to effectively align its scientific theme of Biodiversity, Ecosystems and Land-Use with the international arena, importantly the work of UNCBD, Millennium Ecosystems Assessment

(**MEA, 2005**), such as the impact of degrading ecosystems on the ability to achieve the Millennium Development Goals (see http://www.un.org/millenniumgoals/); UNFCCC through decisions on REDD+ mechanisms, ecosystems-based approaches to climate adaptation, among others (**UNFCCC, 2012**); UNCSD Rio+20 (**2012a,b**); and IPBES, especially in this "United Nations Decade on Biodiversity 2011-2020" (**UNCBD, 2011**).

APN invites member countries, stakeholders, the donor and international research communities, etc., to propose collaborative activities that will provide opportunities, particularly in developing countries, to engage in activities under its B&ES Framework.

Encompassing a range of comprehensive, regional-based and collaborative scientific research, capacity development, and science-policy mechanisms, "thematic gaps" will include, broadly speaking:

Four main research themes:

i. *Identification of drivers and pressures for biodiversity change that influence ecosystem services (land-use change; climate change, etc.)*
ii. *Assessment of the impacts of biodiversity loss and vulnerability to the shrinking of ecosystem services*
iii. *Prediction of changes in biodiversity and ecosystem services through model-based scenarios*
iv. *Adaptation, response and mitigation of the depletion of biodiversity and ecosystem Services*

Some of the key activities related to the above four themes are outlined in *Table 1* (page 3).

Other activities that may be considered in line with the key activities in *Table 1* in are A) awareness-raising, B) capacity development, and C) science-policy mechanisms as elaborated below.

A. Awareness raising and activities that link and/or develop networks: Research on the effectiveness of conservation education/awareness raising and capacity building on diversity in nature at all levels of biological organisation; Traditional knowledge and culture in nature conservation and management; Joint curriculum development or instructional material development; Updating stakeholders on more recent developments in research on the fundamental importance of diversity in nature and ecosystems; Improving standards of professional environmental practice; Making more visible the connections between losses in diversity at all levels of biological organisation and human well-being.

B. Training: Developing capacity for scenario-development tools, training on predictive modelling and systems analysis at various scales; Training to evaluate diversity and ecosystem services for incorporating into decision-making systems and models.

C. Science-policy mechanisms: Developing appropriate tools and processes to facilitate policy and decision-making based on complex scientific understanding; Research to better understand the needs of policy-makers and the private sector on biodiversity

and ecosystem services; Research to better understand how to facilitate engagement and support of the private sector in education on biological diversity and nature conservation; Promoting research that is holistic, integrated and interdisciplinary in approach; Enhancing awareness of different types of uncertainties for model-based forecasts.

4. Framework that is forward looking

Ensuring that the framework is dynamic in nature, the following actions will be undertaken in the APN's present third strategic phase (**APN, 2011b**) from April 2013 (mid-term) until March 2015 (end):

- Identifying from the present paper selected topics for the annual calls for proposals (ARCP and CAPaBLE programmes) for 2013 and 2014.
- Developing an "opportunities brochure" inviting collaboration with organizations, stakeholders and other interested parties from the member countries and international community.
- Seeking investment from the donor community.
- Synthesizing results of activities under the APN's "Ecosystems, Biodiversity and Land-Use" Focused Activities programme (**EBLU, 2011**), and other relevant activities.
- Addressing and incorporating gaps identified for ecosystems services in the APN book on Climate in Asia and the Pacific: Security, Society & Sustainability (**Stevenson & Manton, 2013**).
- Undertaking an 18-month review (from September 2014) with the aim of integrating key activities

under the B&ES framework into the 4th Strategic Plan of the APN (from April 2015).

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United Nations Sustainable Development Knowledge Platform (UNSDKP). (2012b). Extracts from A/RES/66/288 - The Future We Want (2012). Outcome of the United Nations Conference on Sustainable Development, Rio de Janeiro from 20 to 22 June 2012. Retrieved from http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/66/288&Lang=E

Table 1. Key activities for thematic areas under the APN Biodiversity and Ecosystems Framework

Thematic Area	Key Activities for the Asia-Pacific Region
1	– Supporting the articulation of biodiversity and ecosystem indices – Understanding the dynamics of land and land-use change on biodiversity resources and ecosystem services including the influence of climate change
2	– Enhancing knowledge and understanding on the role of biodiversity in nature as a way of conferring ecosystem resilience and reducing vulnerabilities in the face of global environmental change – Research that will identify and document ecological tipping points; Research that will illustrate the linkages between socio-cultural knowledge and livelihoods to different levels of biodiversity – Case studies that will support the work of international programmes on evaluation of changes in biodiversity and ecosystem services AP-BON
3	– Build spatially-explicit models for areas of interest within the Asia-Pacific region that enable the potential for future change in biodiversity and ecosystem services to be assessed as a function of plausible scenarios of change in land use, climate and invasive species – Extending these models to incorporate the potential consequences of spatially-explicit configurations of management responses in terms of multiple values of diversity in nature and ecosystem services – Establishing links between models and associated models of human-natural systems and between these models and global-scale scenario modeling of biodiversity and ecosystem services
4	– Elucidating parsimony and conflict between carbon management and biodiversity conservation as key mitigation strategies – Integrating the human dimensions into action for biodiversity conservation and carbon management – Restoring biodiversity in disturbed or managed ecosystems – Synthesizing best practices for adaptation and mitigation for biodiversity and ecosystem services

Paper no. 2: DIVERSITAS

DIVERSITAS: An international programme on biodiversity science

Introduction

DIVERSITAS, under the auspices of ICSU and UNESCO, delivers policy relevant scientific knowledge on biodiversity, to promote the conservation and sustainable use of biodiversity. The study of the interactions between climate change and biodiversity represents a high priority throughout the DIVERSITAS projects ranging from studying 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.

DIVERSITAS along with a wide range of other partners has embarked on several initiatives to improve the observations, experiments and models in order to detect, understand and model climate change impacts on biodiversity as well as the feedbacks of biodiversity change on climate and global biogeochemical cycles.

Science highlights

Essential Biodiversity Variables for Global Earth Observation

GEO BON, the global observing system for biodiversity, represents the implementation of the biodiversity component of GEOSS, the Global Earth Observing System of Systems. One of the goals of GEO BON is to detect footprints of climate change impacts on biodiversity and ecosystem services, including carbon storage.

Following the example of the example of the Essential Climate Variables (ECVs), GEO BON (co-led by DIVERSITAS) has been developing Essential Biodiversity Variables (EBVs). The EBVs are intended to strengthen and standardise observation systems, and can be directly linked to ECVs. Examples of essential variables are the allelic diversity of selected wild and domestic species, the population abundances for groups of species representative of some taxa (e.g. birds) and the three-dimensional structure of habitats. These variables could be modeled globally, combining satellite remote sensing observations with local observations obtained by citizen scientists, and local, national and regional monitoring organizations. Essential biodiversity variables are crucial for the robust calculation of indicators assessing progress towards the Convention on Biological Diversity's 2020 Aichi targets. They can also provide the foundation for developing scenarios of the future of biodiversity under different policy and management options.

Pereira HM et al. 2012. Essential Biodiversity Variables. Science 339:277-278

http://www.earthobservations.org/geobon.shtml

Modelling the interactions between biodiversity and climate change

DIVERSITAS, in collaboration with a variety of partners, is facilitating the development of improved regional and global vegetation models. The global trait database "TRY", after six years of existence, contains 3 million trait records for 750 traits of 1 million individual plants, representing 69,000 plant species. About halve of the data are geo-referenced, providing a global coverage of more than 8000 measurement sites. It has become a centralized source of information to develop earth system models and test ecological and evolutionary hypotheses that involve the use of plant functional traits. In collaboration with the "Biome Boundary Shift" (BBS initiative), this work has led to substantial improvements of the representation of biodiversity in regional and global models.

http://www.try-db.org/TryWeb/Home.php

Assessing future changes in biodiversity and ecosystem services

DIVERSITAS, in collaboration with Université Paris-Sud XI, Universade de Lisboa, the PBL-Netherlands Environmental Assessment Agency, the Fisheries Centre of the University of British Columbia and UNEP-WCMC have been selected by the CBD to prepare the scenario assessment for the upcoming Global Biodiversity Outlook (GBO-4). The work will build on the scenario analyses presented for GBO-3, and will be aimed at informing policy decisions, in particular in regard to progress towards meeting the 2020 Aichi targets. For the GBO-4, a broad approach to scenario assessment will be taken, complementing "storyline" approaches to socio-economic scenarios (e.g., IPCC SRES scenarios, MA scenarios) with other types scenarios and extrapolations of current trends, examining shorter time frames, addressing specific policy targets (CBD "Aichi 2020 Targets", "2050 Vision"), and making links between indicators used in scenarios with those used for status and trends.

Pereira, Leadley et al 2010. Scenarios for Global Biodiversity in the 21st Century. Science 330:1496-1501

Biodiversity "tipping-points"

The GBO3 Biodiversity Scenarios synthesis highlights a wide range of biodiversity "tipping-points" that may occur in the 21st century. Many of these are partially or entirely driven by climate change or rising CO_2 concentrations and involve strong feedbacks between biodiversity and climate at large regional scales. Current work places emphasis on phenomena that may serve as indicators for (imminent) tipping points, options and requirements for monitoring indicators of tipping points, implication of tipping dynamics for management and restoration, and the potential relevant of tipping points for the programme of work of IPBES. The need for a data base of *indicators* for tipping points, applicable to wide range of systems, has been identified.

Leadley et al. 2010. Biodiversity Scenarios: Projections of 21st century change in biodiversity and associated ecosystem services. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series no. 50, 132 pages.

Evolution, in response to climate change, can be very rapid

Climate change renders populations poorly suited for their local environments, which can cause population declines, extirpation, and even extinction. These negative impacts can be staved off if (1) individuals move to more suitable environments, (2) individuals plastically shift their traits to better suit the new conditions, or (3) populations show adaptive genetic evolution. Examples are now known of all of these effects. With regard to the last, adaptive genetic evolution, clear examples have emerged of genetically-based evolutionary change in local populations facing changing environments – changes that appear adaptive and might arrest and reverse population declines, so-called "evolutionary rescue." Many other instances are known where the traits of populations are changing adaptively but the genetic versus plastic contributions have yet to be elucidated.
http://www.biogenesis-diversitas.org/

IPBES: a new assessment mechanism of great relevance to UNFCCC

IPBES, the Intergovernmental Platform for Biodiversity and Ecosystem Services,

SBSTA 33 delegates should be aware of efforts to establish an "IPCC-like mechanism for biodiversity and ecosystem services", was agreed by governments in April 2012**.** The first plenary of IPBES took place in

Bonn in 2013. IPBES will select the first set of themes for its reports at its second plenary in December 2013. IPBES will be of great relevance to the work of UNFCCC and its SBSTA.

http://www.ipbes.net/

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Paper no. 3: European Union's Seventh Framework Programme for Research and Technological Development

INFORMATION NOTE

Update on recent research activities of the EU 7th Framework Programme for Research and Technological Development in the field of Climate Change

This information note has the scope of complementing the extensive information provided to the Secretariat of the UNFCCC by the EU's 7th Framework Program for Research and Technological Development (FP7), for the purpose of the thirty-sixth session of the Subsidiary Body for Scientific and Technological Advice, Bonn, 14–25 May 2012 (document *FCCC/SBSTA/2012/MISC.3*). In particular, the current document provides information on three recently started projects in the area of adaptation and a brief summary from recent research highlights and conclusions from the FP7 project CARBOEXTREME *(The terrestrial carbon cycle under climate variability and extremes: a pan-European synthesis)*. This complementary information is provided in relation to the upcoming session of the Research Dialogue that will take place during the 38th session of SBSTA (3-14 June 2013, Bonn, Germany).

Adaptation to climate change:

Research into the manifold dimensions of impacts, vulnerability and adaptation to climate change continue to receive significant support by the FP7. Three new projects have now been funded in the area of adaptation:

The **ToPDAd**[1] project (*Tool-supported policy-development for regional adaptation*) focuses on the development of state-of-the-art socio-economic methods and tools to support the integrated assessment of climate change impacts and adaptation decision-making. Emphasis is placed on the energy, transport, tourism sectors, but also on the health, environment and the socioeconomic domains. The toolset to be developed by the project will support the estimation of the multiplier effect of initial damage throughout an economy and the rate of recovery of that economy following a climate event or long term changes. Analyses will address the meso and macro-economic levels, but also the economic impacts of planned and autonomous adaptation responses.

The **BASE**[2] project (*Bottom-up Climate Adaptation Strategies towards a Sustainable Europe*) focuses on reconciling the bottom-up nature of adaptation with top-down strategic policy making through novel combinations of models and qualitative analyses. Through the analysis of over 20 cases, the project will aim at improving adaptation knowledge availability, integration and utilisation, at the promotion and strengthening of stakeholder participation in adaptation decisions and policies, and at supporting coherent, multi-level and multi-sector adaptation policy development. The project has a strong economic assessment component which includes: (a) the employment of top-down approaches to assess the economic benefits and costs of adaptation to society as a whole; and (b) the economic valuation of the costs of climate change impacts and of potential adaptation measures in selected case studies

The **RAMSES** project (*Reconciling Adaptation, Mitigation and Sustainable Development for Cities*) focuses on EU and international cities with the aim to develop an analytical framework for the implementation of adaptation measures and strategies, within the context of wider sustainability goals/programmes. The project will also provide an evidence-based frame for adaptation decision-making. Research will focus on

[1] www.topdad.eu
[2] http://base-adaptation.eu

climate change impacts and on the full economic costs and benefits associated with adaptation; the developed framework will be converted into a user-friendly guide for stakeholders, responding to their need for prioritising adaptation and mitigation decisions.

Impacts of climate variability and extremes on carbon stocks of terrestrial ecosystems

Recent results of the project **CARBOEXTREME**[3] indicate that the impacts of climate extremes on the carbon balance of terrestrial ecosystems have the potential to accelerate climate change. Annual global losses of carbon stocks and fluxes associated with extreme weather conditions are at least as high as the current land carbon sink. Globally, extremes in the water cycle, in particularly droughts, have the strongest effects on the terrestrial carbon cycle, for instance exceeding that of temperature extremes. The most profound impacts are expected in forests, where fire induced by drought and heat waves can rapidly lead to large carbon losses and where tree mortality may cause a long-term legacy of committed carbon emissions. When considering future carbon management strategies, more attention must be given to the role of climate variability and extremes, in particular as related to the water cycle.

[3] http://www.carbo-extreme.eu

International Geosphere-Biosphere Programme

Introduction

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 processes 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 organising workshops and synthesis activities that bring together scientists from a wide range of disciplines. The eight core projects of IGBP address processes on land, in the atmosphere and oceans, and at the interfaces between these. The projects include two integrative crosscutting projects that address future and past global changes. Many IGBP activities have considerable collaboration with other partner programmes.

Research highlights

Black carbon and climate

January this year saw the publication of a comprehensive report on the role of black carbon (or soot) on climate. The report backs recent research proposing that black carbon is the second largest human contributor to global warming. It says the direct influence of black carbon on warming the climate could be about twice the previous estimates, including that in the IPCC's 4th assessment report. Accounting for all of the ways it can affect climate, black carbon is believed to have a warming effect of about 1.1 Watts per square metre (W/m^2). This is approximately two-thirds of the effect of carbon dioxide – the largest human contributor to global warming. Black carbon affects climate in complex ways: all effects must be evaluated together to determine the impact of policies aimed at cutting emissions of this substance. Based on such an evaluation, the report suggests that black carbon emission reductions targeting diesel engines followed by some types of small household stoves that burn wood and coal would have an immediate cooling impact. Because black carbon is an air pollutant that causes respiratory problems, cutting its emissions would have positive consequences for human health.

Bond T *et al*. (2013) *Journal of Geophysical Research (Atmospheres)* doi:10.1002/jgrd.50171. http://onlinelibrary.wiley.com/doi/10.1002/jgrd.50171/abstract

2012 carbon budget

The Global Carbon Project's (GCP) annual carbon budget reported that carbon-dioxide emissions rose 3% in 2011. The study shows that global carbon-dioxide emissions in 2011 were 54% above 1990 levels. Most of the growth in emissions was from the so-called emerging economies. Chinese emissions grew 10% in 2011, or over 800 million tonnes of carbon dioxide, which is as much as Germany emits in one year. China is emitting almost as much per capita as the European Union, about 36% higher than the global average per capita emissions. Not all emissions from developing countries are from goods produced for domestic consumption. To account for this, the budget calculated the emissions embodied in traded products. This analysis shows that the net emission transfer via international trade between the developing and developed countries has increased from 0.03 PgC in 1990 to 0.38 PgC in 2010, with an average annual growth rate of

10%. The increase in net emission transfers of 0.35 PgC from 1990 to 2008 compares with the emission reduction of 0.2 PgC in developed countries.

Peters G *et al.* (2013) *Nature Climate Change* 3: 4-6.
Le Quere C *et al.* (2012) *Earth System Science Data Discussions*, doi: 10.5194/essdd-5-1107-2012

http://www.globalcarbonproject.org/carbonbudget/

Increases in the global land and ocean carbon sinks

About half of the total CO_2 emissions is currently taken up by the land and oceans, but models predict a decline in future carbon uptake by these reservoirs. This may in turn result in a further increase in atmospheric CO_2 concentrations. However, there is little agreement about whether the rates of carbon uptake by the land and ocean have declined, remained constant or increased in recent decades. Ballantyne *et al*. (2012) used a variety of global data, including their uncertainties, to calculate changes in global CO_2 sources and sinks during the past 50 years. Their analysis showed that net global carbon uptake has increased significantly from 2.4 +/- 0.8 billion tonnes per year in 1960 to 5.0 +/- 0.9 billion tonnes per year in 2010. This amounts to an increase of about 0.05 billion tonnes of carbon per year per decade. Since 1959, approximately 350 billion tonnes of carbon have been emitted by humans to the atmosphere, of which about 55 per cent has moved into the land and oceans. Despite evidence for considerable regional variations in the uptake of carbon, Ballantyne et al show that the uptake has increased at the global scale. Why and where the increasing global carbon uptake has taken place is not clear but needs to be determined to better constrain the modern global carbon budget and predicting future carbon-climate interactions.

Ballantyne A P et al. (2012) *Nature* 488: 70-72, doi:10.1038/nature11299.

Carbon dioxide emissions from Indian monsoonal estuaries

Some estuaries are known to be a strong source for atmospheric CO_2. However, little information is available from Indian estuaries. In order to quantify CO_2 emissions from the Indian estuaries, Sarma et al. (2012) collected samples from 27 estuaries along the Indian coast during the high discharge (wet) period. The emissions of CO_2 to the atmosphere from Indian estuaries were 4–5 times higher during the wet period as compared with the dry-period data available in the literature. The source of CO_2 emissions was attributed to the microbial decomposition of particulate organic carbon (POC) originating in the watershed, based on the positive relationship of both mean pCO_2 and POC with the rate of river discharge. The annual CO_2 flux from Indian estuaries was estimated to be 1.92 TgC, which is small compared to the anthropogenic carbon emissions from the Indian subcontinent of 508 TgC/y for 2009. The CO_2 emissions from Indian estuaries are more than an order of magnitude less than that from European estuaries (30-60 TgC/yr). The low total CO_2 emissions from the Indian estuaries are attributed, in part, to rapid flushing rates. The authors suggest that Indian estuaries may contribute a much lower percentage to the anthropogenic CO_2 emissions than hitherto hypothesized.

Sarma VVSS et al. (2012) *Geophysical Research Letters* 39: L03602, doi:10.1029/2011GL050709.

Nutrient glut

The effects (both direct and indirect) of nitrogen on climate will be explored by the IPCC in its fifth assessment report. This includes not only the increased emissions of the greenhouse gas N_2O (associated primarily with fertiliser use) but also the effect of increased nitrogen deposition on carbon sequestration and aerosol formation.

A new report highlights how humans have massively altered the natural flows of nitrogen, phosphorus and other nutrients. These alterations have boosted food production and benefited energy production. But they

have also led to water and air pollution that is damaging human health, causing toxic algal blooms, killing fish, threatening sensitive ecosystems and contributing to climate change. The report on nutrients presents an assessment by nearly 50 experts from 14 countries that a 20% improvement in nutrient-use efficiency by 2020 would reduce the annual use of nitrogen fertiliser by 20 million tonnes. The researchers' analysis shows how such increased efficiency could provide a net saving worth around 170 (46 to 400) billion US dollars per year. This figure includes implementation costs and financial benefits from reduced nitrogen use and improvements to the environment and human health. The report stops short of recommending global legislation to control nutrient use, but recognises that this a global problem, especially given the global trade in agricultural products. It calls for an intergovernmental framework to address these issues, and proposes a road map of how such an agreement would look.

Sutton M A *et al*. (2013). Our nutrient world. ISBN: 978-1-906698-40-9, 120pp. www.initrogen.org

Estimating the loss of tropical land carbon in response to climate change

Climate models suggest that two competing processes will affect the storage of carbon on land in the future. The increased atmospheric carbon-dioxide concentrations are expected to enhance photosynthesis and hence carbon storage. In contrast, the warmer climate will increase soil and plant respiration rates, leading to decreases in storage. How these processes balance out is not entirely clear and current models vary widely in terms of their projections of the change in storage of tropical carbon on land by the year 2100. Peter Cox of the University of Exeter and colleagues used a statistical relationship between a suite of climate-model outputs to estimate the sensitivity of tropical land-carbon loss to climate change. In a study published in *Nature*, they estimate that tropical land will release 53 ± 17 gigatonnes of carbon per kelvin. This value is much lower than the projections of some models (over 150 gigatonnes of carbon per kelvin) and implies that there is relatively low risk of Amazon forest dieback due to carbon-dioxide-induced global warming.

Cox P M *et al.* (2013) *Nature* 341–344, doi:10.1038/nature11882

A region-by-region temperature history of the past two millennia

Global temperatures have increased over the last decades. Instrumental temperature measurements leave no room for qualified doubt about this observation, but reach back no more than a century and half. This length of time is insufficient to assess, for example, how Earth's climate varied in pre-industrial times. Yet, long-term records are essential if we are to understand climate variability and to isolate the effects of natural and human drivers. With this in mind, a global network of scientists have reconstructed and analyzed the climate of the last two millennia at a regional scale. A first set of temperature reconstructions, based on more than 500 sites worldwide, reveals substantial variability through time but also between regions. The data show no globally synchronous warm or cold intervals that would define a worldwide Medieval Climate Anomaly or Little Ice Age. On the other hand, robust features include a cooling over the last one to two thousand years across almost all continents, reversed by the distinct warming that began in some regions at the end of the 19th century. An analysis of the average temperatures over 30-year periods indicates that the interval from 1971 to 2000 was probably warmer than any other 30-year period in the last 1400 years. Going back further, some regions experienced warmer 30-year intervals. In Europe, a period during the Roman Empire between 21 and 80 AD was likely warmer than the period 1971-2000.

Ahmed M *et al*. (in press) *Nature Geoscience*

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Paper no. 5: International Human Dimensions Programme on Global Environmental Change

International Human Dimensions Programme on Global Environmental Change (IHDP)

Introduction

By means of its multi-disciplinary teams of scientists and its integrated, long-term research on cutting-edge themes, IHDP is at the forefront of mobilizing and integrating social science research to the largely natural sciences-dominated GEC debate. Thereby, it effectively addresses the drivers of, impacts on and potential responses to Global Changes, including Climate Change. The recent activities and achievements of IHDP and its projects are outlined hereafter.

Science Highlights

Earth system governance, policy interaction

The earth system governance research has produced findings on a wide range of topics, ranging from the role of side-events in climate change negotiations to the political influence of the IPCC, the governance implications of the concept of planetary boundaries, and the governance of REDD+. ESG also contributed to its main goal of exploring political solutions and novel, more effective governance systems to cope with global environmental change through the accomplishment of various activities, publications and science-policy interaction. Successful events, such as the open-science conference in Colorado and the Policy Assessment in support of the Rio+20 conference, significantly enhanced ESG's global network of partner institutions and researchers. One of the project's highlights was recent accomplishment of a policy assessment with key policy recommendations regarding the institutional framework for sustainable development as well as a recent publication in Science arguing for fundamental reforms of global environmental governance and drawing from the assessment.

Biermann, Frank, Kenneth Abbott, Steinar Andresen, Karin Bäckstrand, Steven Bernstein, Michele M. Betsill, Harriet Bulkeley, Benjamin Cashore, Jennifer Clapp, Carl Folke, Aarti Gupta, Joyeeta Gupta, Peter M. Haas, Andrew Jordan, Norichika Kanie, Tatiana Kluvánková-Oravská, Louis Lebel, Diana Liverman, James Meadowcroft, Ronald B. Mitchell, Peter Newell, Sebastian Oberthür, Lennart Olsson, Philipp Pattberg, Roberto Sánchez-Rodríguez, Heike Schroeder, Arild Underdal, Susana Camargo Vieira, Coleen Vogel, Oran R. Young. 2011. Transforming Governance and Institutions for a Planet under Pressure. Revitalizing the Institutional Framework for Global Sustainability: Key Insights from Social Science Research. Planet under Pressure Policy Brief, 3.

Modern lessons in sustainability from the ancient Maya

IHOPE encourages the testing of human/environment system models against the integrated history to explore options for the future of humanity. In a particular research activity iHope draws conclusions regarding the capacity to cope with climate change and other challenges in modern tropical cities, by investigating the experiences of past societies, such as the Maya of Central America. Modern cities in developing countries, particularly in tropical regions, are experiencing unprecedented population growth and encountering strain on water, food and energy resources. With climate change and increasing energy costs, these cities are poised to either fail to adapt to changing conditions, or will continue to maintain themselves drawing on resilient social-ecological support systems. iHOPE gains insight into the fate of modern tropical cities by examining resilience of past societies such as the Maya.

S. Van der Leeuw, S., R. Costanza, S. Aulenbach, S. Brewer, M. Burek, S. Cornell, C. L. Crumley, J. A. Dearing, C. Downy, L. J. Graumlich, S. Heckbert, M. Hegmon, K. Hibbard, S. T. Jackson, I. Kubiszewski, P. Sinclair, S. Sörlin, and W. Steffen. 2011 Toward an integrated history to guide the future. Ecology and Society 16(4):2.

Urbanization, climate change adaptation

UGEC continued its focus on climate change adaptation in urban areas and developed essential research findings in this context during the past year. Besides the organization of a training workshop on 'Urban Responses to Climate Change in Asia', held in Taiwan, UGEC also conducted studies in this field and generated essential findings. One major research result shows that disaster risk reduction and climate change adaptation converge and interplay in the context of urban areas. The awareness of these connections started to change how researchers and practitioners conceive and approach the analysis and management of urban climate risk and associated impacts and response activities.

Rosenzweig, C., Solecki, W.D., Hammer, S., Mehrotra, S. (Eds.) (2011). Climate change and cities: First assessment report of the Urban Climate Change Research Network. New York, NY: Cambridge University Press.

Climate change risks and risk governance

Working on the topics of Extreme Risks and Vulnerability & Adaptation the IRG-Project combines a multi-institutional, interdisciplinary team of natural scientists, social scientists, engineers, policy makers as well educators around the world who develop and apply theoretic, mathematic and computational tools for the decision making processes in the case of large-scale disasters around the globe. For this purpose the project developed eleven new initiatives in 2011, including a workshop for science policy interaction on 'Climate Change Risks, Low-carbon Society and Green Development' that was conducted in Nanjing, China.

Global Land Project

GLP started preparing its synthesis phase and continued its cooperation with IHDP's core project UGEC. Following the jointly organized International Conferences of GLP and UGEC, which focused on the linkage between urbanization, land and landscapes, and climate change, both projects worked together in a joint workshop in 2011, discussing and developing a vision for a new conceptual framework of urban-land teleconnections that would enable a novel approach to local-to-global-scale land use change processes. Among many other results, a major outcome of the 2010 GLP conference was published in the journal Science in November 2011 discussing the topic of ecosystem services.

Kinzig, A.P., Perrings, C., Chapin III, F.S., Polasky, S., Smith, V.K., Tilman, D. and Turner II, B.L., 2011. Paying for Ecosystem Services – Promise and Peril. Science, Vol.334, no.6056, pp.603-604. DOI: 10.1126/science.1210297

Inclusive Wealth Report

Unless the yardsticks which society uses to evaluate progress are changed, the continued downward spiral of the planet's natural systems will continue. Traditional indicators such as GDP and HDI have basic limitations as measures of social progress. Neither GDP/capita nor HDI reflect the state of the natural environment and both focus on the short term, with no indication of whether current well-being can be sustained. In this context, a prominent indicator for addressing the weaknesses in contemporary measures is 'Wealth' that relies on the stocks of different assets: Natural, Manufactured, and Human Capital. The Inclusive Wealth Report (IWR) features Inclusive Wealth as a comprehensive measure to track societal well-being.

The IWR is a United Nations University International Human Dimensions Programme on Global Environmental Change (UNU-IHDP) initiative with support from the United Nations Environment Programme (UNEP), in collaboration with the UN-Water Decade Programme on Capacity Development (UNW-DPC) and the Natural Capital Project, Stanford University. The project aims at developing the first

report on the wealth and changes in the wealth of nations, with a particular focus on Natural Capital. In the long-term, the project aims at producing a series of IWR's on a biennial basis. The first Inclusive Wealth Report will focus on a selection of 20 countries worldwide, with a special emphasis on developing countries, covering the 1990-2008 time period. It will be launched at the Rio+20 conference in 2012.

Assessment of human drivers of and responses to global environmental change

The Social Sciences and Humanities Assessment of Global Change is an international process that will provide policymakers and the public with "state of the art" scientific information on the behavioral and cultural drivers of global environmental change, as well as likely and preferred behavioral and cultural responses. It seeks to outline best practices for the social, cultural economic and political transition to sustainability by improving the information available for decisions and by informing and inspiring relevant stakeholders to press for necessary change. The Assessment will be guided by key questions identified through a participatory process with policymakers within governments and international conventions, and users within the academic and business communities and civil society.

The Assessment will be undertaken at multiple levels, including a global Social Science Assessment Panel, and regional coordination nodes bringing together regional scientists to conduct assessments using scientific literature from that region. And, while the Assessment will directly respond to the demand and information needs of governments and conventions, it will also place major emphasis on communication to business and civil society in recognition that these actors are as influential as governments in causing change. The Assessment will be undertaken by a global network of some 500+ social scientists and humanities scholars in collaboration with interdisciplinary environmental change researchers. IHDP will administratively support it.

Climate Change Research, Including Marine Research, on Technical and Scientific Aspects of Greenhouse Gas Emissions and Removals from Coastal and Marine Ecosystems

IHDP's core project LOICZ is working to support sustainability and adaptation to global change in the coastal zone. LOICZ supports adaptation to global change by linking natural and social sciences with knowledge of coastal communities at global, regional and local scales. The project's research in 2011 led to the identification of key coastal syndromes and appropriate responses. Of research interest were geographic hotspots of coastal vulnerability encompass the Arctic, small islands, river mouth systems, deltas and estuaries and urbanized coasts. A first status report of rapidly changing Arctic coasts has been published and the DPSIR framework was applied to coastal megacities.

Major findings of LOICZ coastal zone research included the worldwide decline of seagrass habitat and biodiversity. It also showed that changing material transfers along the continent-ocean interface in Brazilian rivers can be attributed to land use changes and global climate change. A further research activity of the project is the IGBP synthesis on Coastal Megacities. The analysis comprises impacts of megacities on coastal ecosystem goods and services, and welfare. It explores global change pressures, geo risks and opportunities for sustainable development.

Newton, A., Carruthers, T.J.B. & Icely, J. (2011): The coastal syndromes and hotspots on the coast. Estuarine Coastal and Shelf Science 96(1): 39-47. DOI information: http://dx.doi.org/10.1016/j.ecss.2011.07.012.

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Paper no. 6: Programme of Research on Climate Change Vulnerability, Impacts and Adaptation

PROVIA suggested research priorities for the research/donor communities on vulnerability, impacts and adaptation to climate change

Submission from PROVIA

PROVIA has participated in UNFCCC's SBSTA workshops by helping to identify gaps in vulnerability, impacts and adaptation (VIA) research and prioritizing that are critical from both the scientific and policy perspectives. The findings were communicated to UNFCCC and other international bodies to enable effective adaptation.

At the workshop on 11-12 April 2013 in London, PROVIA shared the suggested research priorities on vulnerability, impacts and adaptation to climate change with the research community, and discussed to take the findings to the next step – implementation of these topics into research projects with action plans. The list of VIA research topics incorporates comments from both scientific experts and policy community. The report also presents emerging issues, the issues that have long been recognized as important for which research is still required. The workshop brought a lost of interest, and suggested organizing similar workshops in other parts of the world to ensure dissemination of the VIA research gaps. After incorporating all the valuable information and suggestions from the workshop, the latest result would support decision-making, especially providing information to support decision making for policymaker and specific topics for sectoral and regional analysis.

PROVIA would like communicate the latest report on the identified research priorities in vulnerability, impacts and adaptation through UNFCCC and would like to generate discussion on the following topics including next step taking it forward.

- Unpacking the list of research topics, geographically, also considering cross-cutting issues with research action plans to take forward.
- Mapping existing research activities in vulnerability, impacts and adaptation and cross-checking with the list of research priorities developed by PROVIA.
- Research priorities vs stakeholder priorities – further consultation to list out research topics that interest to stakeholders and follow up actions.
- Understanding what works and what doesn't for policy from the list of research priorities.
- Explore how PROVIA should track and capture the emerging issues on VIA research in five year time.

Paper no. 7: World Climate Research Programme

World Climate Research Programme: Scientific Foundation for Decision Making

Introduction

The World Climate Research Programme (WCRP) supports a number of high priority scientific research activities with the aim of facilitating analysis and prediction of Earth's climate system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society.
A major emerging theme from the successful WCRP Open Science Conference (OSC) (24-28 October 2011, Denver, Colorado, USA, http://conference2011.wcrp-climate.org) was the need for actionable science to support decision-makers who are confronted with the challenges and opportunities posed by changes in the environment, in energy consumption and in economic development associated with the impending rapid growth in world population. To ensure adequacy of such information and its timely access and use, WCRP has engaged in an active dialogue with these stakeholders and decision-makers in the design, development and dissemination phases of its research activities.
WCRP leadership has identified six scientific grand challenges for integrating the research activities coordinated by its four Core Projects thus providing a focus for the development of targeted research efforts with the likelihood of significant progress over five to seven years. The WCRP scientific grand challenges are:

- Provision of skilful future climate information on regional scales (e.g. decadal predictability);
- Regional sea-level variability and change;
- Cryosphere response to climate change (including ice sheets, water resources, polar predictability, permafrost and carbon);
- Improved understanding of the interactions of clouds and radiation (including the role of aerosols and precipitation and contributions to climate sensitivity);
- Past and future changes in water availability (with connections to water security and water-resources management);
- The science underpinning the prediction and attribution of extreme events.

WCRP has also focused its efforts on capacity development to ensure that future generations of affiliate researchers and their networks are equipped with the required expertise and capabilities to address these grand challenges. The WCRP strategy and approach to international research coordination in the future will also be responsive to the needs of its primary sponsors and their major initiatives such as the Global Framework for Climate Services (WMO), Future Earth (ICSU) and the Integrated Framework for Sustained Ocean Observations (IOC).

a) On-Going WCRP Research Activities relevant to UNFCCC

Improving Climate Projections

Through its Climate Model Intercomparison Project-5 (CMIP5) WCRP is providing the framework for advancing climate change modelling research, improving climate projections and creating the basis for assessing climate variability and change in support of the next IPCC Assessment (AR5). More than 24 modelling groups from around the world are currently running the CMIP5 experiments that represent the most ambitious multi-model inter-comparison and analysis project ever attempted. The scope of CMIP5 is much broader than that of the previous intercomparison project (CMIP3) and includes four new representative

concentration pathways (RCPs) to support developing mitigation scenarios in addition to the long-term concentration-driven Atmosphere-Ocean Global Circulation Model (AOGCM) experiments and emission-driven Earth System Model (ESM) experiments - some of those with partial coupling to explore sensitivity of the carbon-cycle feedback. Many experiments in CMIP5 explore the impact of various natural and human-induced changes on climate. The paleoclimatic experiments assess the ability of models to reproduce past climate conditions to better inform the credibility of the models' future climate projections; and some experiments investigate the role of atmospheric aerosols and chemistry-climate interactions with higher resolution AOGCMs (about 50 km resolution) and even higher resolution (about 25 km) atmosphere-only models. CMIP5 also provides many more capabilities and new types of climate-change information, such as account of impact of the stratospheric ozone change on climate change, decadal climate predictions, and cloud-radiation feedback, to name but a few.

Decadal Climate Predictability and Predictions

Near-term climate predictions (also known as decadal climate predictions) were included in CMIP5 in an attempt to satisfy a growing demand for climate information for several years to a few decades ahead. Skilful interannual-to-decadal climate predictions have been achieved by using changes in boundary conditions such as atmospheric composition and solar irradiance. The type of information that can be obtained from the decadal experiments have been explored within the framework of the ENSEMBLES project, funded by the European Union, by using two types of climate forecasts: a multi-model (mostly with full initialization) and a perturbed-parameter ensemble with explicit initialization. Both approaches have forecast skill over large regions – especially over the tropical oceans and North Atlantic – but also over large continental areas. Most of the prediction skill on temperature is due to external forcing, while the improvements in prediction skill due to initialization appear mostly over the North Atlantic and the subtropical Pacific. Atlantic multi-decadal variability, associated with the Atlantic Meridional Overturning Circulation (AMOC), presents multi-year predictability, which improves in both the multi-model averages and the ensemble averages from single models.

Sub-seasonal, Seasonal and Interannual Climate Forecasts

From the end-user perspective, the sub seasonal time scale (2 weeks to 2 months) is a very important one, because it lies between the well-established and routine use of weather forecasts in diverse areas on the one hand, and the developing use of seasonal forecasts on the other. Many management decisions, such as in agriculture, fall into the intervening time period. The Pakistan floods (2010), concurrent with the Russian heat wave, were two extreme events with very high societal impact and for which reliable and skillful sub seasonal forecasts for this period could have been of considerable value. Despite the potential value, forecasting for this time range has so far received much less attention than medium-range and seasonal prediction primarily because making forecasts on this time range is a greater challenge since the lead time is sufficiently long that much of the memory of the atmospheric initial conditions is lost and it is too short a time range for the variability of the ocean to have a strong influence. However, recent research has indicated important potential sources of predictability for this time range such as from the Madden Julian Oscillation, stratospheric initial conditions, land/ice/snow initial conditions, and sea surface temperatures. Recent improvements in computing resources and model development may also make it possible to develop a better representation of these sources of sub seasonal predictability. Hence WCRP with its sister programme on World Weather Research has launched a project that aims to improve forecast skill and understanding on the sub seasonal to seasonal timescale, and promote its uptake by operational centres and exploitation by the applications community. Specific attention will be paid to the risk of extreme weather, including tropical cyclones, droughts, floods, heat waves and the waxing and waning of monsoon precipitation.

A WCRP community-wide assessment on the state of the science for seasonal climate prediction led to a consensus on some best practices for producing, using and assessing seasonal forecasts with the aim of improving seasonal prediction, as well as determining the extent to which seasonal prediction is possible. This

assessment pointed to the need for a suite of performance metrics and a common language to be applied systematically for assessing prediction skill. It was agreed that the skill must be evaluated both in terms of forecast quality and forecast value, where quality refers to the technical measurement of forecast performance and value relates to the practical benefits achieved through decisions made according to forecast information, usually in conjunction with other information. Progress in seasonal climate prediction depends on improvements in the building blocks of seasonal prediction systems: the models, observations and data-assimilation systems, as well as improved forecast verification and a more effective transfer of information to forecast users, increasing forecast value. WCRP is coordinating a multi-model, multi-institutional set of hindcast experiments – the Climate system Historical Forecast Project (CHFP) – for this purpose. CHFP aims to explore the untapped sources of predictability on seasonal-to-interannual timescales arising from interactions and memory associated with all the elements of the climate system (atmosphere-ocean-land-ice). These experiments provide a baseline assessment of current seasonal prediction capabilities using the best available models of the climate system and data for initialization, as well as of IPCC-class climate models in seasonal prediction mode. They provide a framework for assessing current and planned observing systems and a test bed for integrating process studies and field campaigns into model improvements with the ultimate goal of enhancing operational forecast skill.
The WCRP Working Group on Seasonal to Interannual Prediction (WGSIP) provides an effective interface between the operational community engaged in long-range predictions (weeks to months) and the research community engaged in exploring new sources of prediction skill, improvements in long-range prediction methodologies, and other scientific questions of relevance. Improvements in seasonal prediction skill that are derived from the implementation of best practices are expected to be quasi-immediate. Improvements in the building blocks of seasonal prediction systems will continue in the next years and longer and ongoing research into new sources of predictability in the climate system are expected to lead to operational improvements on the longer term.

Regional Climate Information

The provision of climate information on regional to local scales is an important requirement to support decision-making in response to potential climate change. Such information is needed to assess the impacts of climate variability and change on human and natural systems, enabling the development of suitable adaptation and risk-management strategies at the regional to local level. Despite recent advances in the horizontal resolution of most global climate models, there are still limitations in their ability to represent important local forcing features, such as complex topography, land-surface heterogeneity, coastlines and regional water bodies, all of which can modulate the large-scale climate on regional to local scales. Coarse spatial resolution of current models also precludes an accurate description of extreme weather events, which are of fundamental importance in assessing the socio-economic impacts of climate variability and change. In order to coordinate international regional climate modelling, WCRP developed a framework for the Coordinated Regional Climate Downscaling Experiment (CORDEX, http://wcrp-cordex.ipsl.jussieu.fr/). The framework is facilitating the evaluation and, where possible, the improvement of regional climate downscaling techniques for use in many regions worldwide, and to support the vulnerability, impact and adaptation analyses and assessments. Many CORDEX regions are already self-organizing and are developing matrices of regional climate change projections. In some regions, one example being Africa, access to reliable regional climate-change information is particularly limited. It is in these regions that the greatest benefits from the collaboration developed through CORDEX are anticipated. The international community therefore has targeted Africa for intensive collaboration and the effort is already producing a significant amount of information on African climate, both to support the IPCC Fifth Assessment Report (IPCC AR5) and to provide useful climate information to decision-makers involved in African climate risk management and adaptation planning.

Attribution and Prediction of Extreme Events

Unusual or extreme weather and climate-related events are of great public concern and interest, yet there are often conflicting messages from scientists about whether such events can be linked to climate change. This was one of the themes discussed at the WCRP OSC, where the development of a carefully conducted analysis of observed weather- and climate-related events could serve as a powerful tool for identifying the factors contributing to the occurrence of such events. New scientific results have shown examples of where there has been an increased risk of extreme weather attributable to human influence on climate. For example, new research has reconciled the results of previous studies by providing scientific explanations concerning the extent to which the 2010 Russian Federation heat wave could be attributed to human-induced climate change. In fact, the same event can be both mostly internally generated in terms of magnitude but also externally driven – through human influence on climate – in terms of probability of occurrence.

An ad hoc group completed an overview report "Drought predictability and prediction in a changing climate: assessing current predictive knowledge and capabilities, user requirements and research priorities" (http://www.clivar.org/organization/extremes/resources/dig). The report examines current prediction capabilities and user needs for drought-related information with the aim of identifying actionable research areas that would benefit from international coordination. Three major action items resulted from the WCRP workshops on this topic: (a) to develop a drought catalogue; (b) to carry out coordinated analyses of high impact droughts; and (c) to develop a drought early warning system. The workshop participants established three subgroups to implement these recommendations. These efforts, together with a worldwide survey of user drought information needs and capabilities are now part of the planning for an experimental global drought information system. This initiative is moving forward by building upon extensive worldwide investments in drought monitoring, drought-risk management, drought research and climate-prediction capabilities.

b) Emerging issues in climate change research

Regional Sea-Level Variability and Change

Analysis, assessment and prediction of sea-level variability and change, especially at the regional level, is a key area of focus for WCRP. A dedicated WCRP Workshop hosted by UNESCO-IOC in Paris in 2010 reviewed the state-of-the-knowledge in sea-level observations, research and modelling in great detail. The outcomes of the Workshop helped to formulate sea-level projections of the IPCC Fifth Assessment Report that will be published in 2013. A monograph entitled "Understanding sea-level rise and variability" (edited by J. Church et al.), resulting from a previous WCRP-sponsored workshop, was published in 2009. Major progress is being made in improving the observing networks and developing models capable of capturing essential processes that contribute to changes in the cryosphere, such as ice-sheet, sea-ice and glacier dynamics and changes in snow cover and extent. For example, significant efforts are being devoted to measuring and modelling all contributing factors to sea-level variability and change using a variety of techniques and technologies. For the first time, there is a remarkable convergence among independent estimates of the actual rate and magnitude of sea-level change, based on observational records since the 1970s. Another recent observation-based finding is enhanced net mass loss from the major ice sheets: if it continues at recent rates, the contribution of ice sheets to 21st century sea-level rise will be more than from any other contributing factor (e.g. glaciers). To manage the potential risks of sea-level changes and develop adaptive measures, it is imperative to know not only the global mean sea-level value but also its regional and temporal variations. WCRP is supporting research on understanding the underlying physical and dynamical processes that contribute to the patterns and magnitude of sea-level variability and change on regional scales. These studies have revealed some patterns of such variability, showing clearly that, while sea level is rising on the global average, it may be rising more in some regions of the world and falling in others, owing to the specifics of ocean dynamics and other geophysical processes. Regional sea-level rise increases the risk of coastal flooding, which also depends on local tides, storm-surges, precipitation, and local hydrological conditions. The outcomes of the WCRP sea-level studies will serve as valuable input to future assessments

and will, in turn, help to shape future WCRP-coordinated sea-level research.

Atmospheric Chemistry and Climate Connections

With focus on stratospheric ozone, the impact of climate change on atmospheric chemistry and, conversely, the impact of changes in atmospheric chemistry and composition on climate have been highlighted in the recent WMO/United Nations Environment Programme (UNEP) report Scientific Assessment of Ozone Depletion: 2010. Major contributions to this assessment derive from SPARC's activity in chemistry-climate model validation (http://www.sparc-climate.org/activities/ccm-validation/) efforts. According to the IPCC (2007), methane, ozone and halocarbons are the greenhouse gases that directly follow carbon dioxide in terms of strongest increase in radiative forcing owing to anthropogenic activities since the industrial revolution. Changes in tropospheric composition alter stratospheric composition via changes in the input to the stratosphere and, conversely, changes in the stratosphere affect the troposphere via changes in the input of ozone from the stratosphere and also changes in ultraviolet radiation.

Aerosols are also climate-forcing agents. Effects of anthropogenic aerosols on the climate may offset part of the increased radiative forcing of greenhouse gases due to their cooling effect. Aerosols can perturb atmospheric radiation through a direct effect of scattering and absorption of radiation. The effects of aerosols depend critically on their chemical composition and mixing state. Aerosols can also have an indirect effect via interaction with clouds (water, ice and cirrus clouds) by acting as cloud condensation nuclei (CCN). Further, clouds can modify aerosols, their optical properties, their size distributions and their ability to act as CCN. The indirect effect, which is a strong function of chemical and physical properties of aerosols, can perturb clouds and the hydrological cycle, two pivotal components of the climate system and its sensitivity to such changes. Stratospheric aerosols greatly alter the chemistry at the regional level region and lead to such changes as the Antarctic ozone hole, with major consequences for global climate.

Several important meetings on stratospheric processes have led to assessment of lifetimes of ozone-depleting substances, guidance to space agencies on the needs for stratospheric and chemical observations from space and on issues related to data processing, an international initiative of research of sulfur in the atmosphere, and an update on stratospheric temperature trends. Two state-of-the-art assessments of available global cloud and radiative flux data sets (WCRP Report No. 23/2012, Nov 2012 and WCRP Report No. 19/2012, Dec 2012, http://www.wcrp-climate.org/index.php/resources-room/wcrp-reports) advance our understanding of what is happening to the Earth's climate and assist climate modellers in improving their ability to predict and project future climate conditions.

New Results from CORDEX and Regional Projects

The CORDEX community has grown to include 13 major geographic domains encompassing the entire globe, and is producing regional climate projections for most of these domains (visit: http://wcrp-cordex.ipsl.jussieu.fr). To facilitate the analysis and visualization of these large-scale data sets, the Jet Propulsion Laboratory, California Institute of Technology (JPL), and their Joint Institute for Regional Earth System Science and Engineering (JIFRESSE) with the University of California, Los Angeles (UCLA), have developed the Regional Climate Model Evaluation System (RCMES). At present, RCMES is being utilized for evaluating model results from CORDEX-Africa and CORDEX-North America (aka NARCCAP, used for US NCA), and the capacity development activities of CORDEX-South Asia, CORDEX-East Asia, CORDEX-Arctic, and CORDEX-Latin America and Caribbean regions. This is but only one of several regional evaluation activities that WCRP is promoting to assess the quality of climate information being developed for example for Africa, S. Asia, Central America, Arctic and Australia. In parallel, the WCRP in partnership with other sister programmes and organizations such as Asia Pacific Network (APN) and Inter-American Institute (IAI) is establishing a series of regional networks of experts to carry out such evaluations and ultimately assist with interpretation of the scientifically based climate assessments for decision-makers and practitioners in economic sectors of interest to their region.

Recognizing the pressing need to narrow the large gap that currently exists between decision-makers and climate science researchers, WCRP is organizing a series of regional projects, conferences, capacity development and training activities focussing on the role of science in climate services and risk management. The first one, 15-18 October 2013, in Arusha, Tanzania, will be on the State of the African Climate System, followed by a similar forum in Latin America in February 2014 in Montevideo, Uruguay. The overall goal of the African conference is the production of an actionable climate research agenda that will result in outputs to inform adaptation decisions in Africa by mid- to end of the 21st century. The conference is organized jointly with the African Climate Policy Center (ACPC) and will engage both well-established and early career scientists across the continent. Likewise, a joint WCRP-IPCC-EU International Conference on Regional Climate will be held 4-7 Nov 2013 in Brussels, Belgium. This event aims to showcase the main outcomes of IPCC AR5 WGI report, key scientific results of the first phase of CORDEX, and to identify the future research priorities in regional climate science. In 2014 there will be the WCRP conference on Climate and Society for Latin America and the Caribbean to identify gaps and ways to overcome limitations in the chain of knowledge going from basic to applied climate science and to inform policy and decisions for the region. It is expected that the conference will contribute to further development of the emerging regional climate services.

Data Analyses and Global Observations

Unprecedented volumes of data containing climate historical simulations, climate predictions and projections, and observational datasets and their-reanalyses are being made available openly to scientists and other users through the Earth System Grid Federation (ESGF) archive. These data include the results from the Coupled Model Intercomparison Project, Phase 5, the Climate system Historical Forecast Project (CHFP) focused primarily on seasonal climate forecasts, the Coordinated Regional Climate Downscaling Experiment (CORDEX), the four major international re-analysis products from USA, Japan and Europe, and observation-based data sets prepared by the U.S. National Aeronautics and Space Administration (NASA) for inter-comparison with some of the CMIP5 model results. The ESGF is a highly distributed system with nodes in all major continents around the world to ensure ease of access to these large scale data sets on one hand, and consistency of protocols, formats, projection maps, documentation, etc. on the other hand to enable more effective analysis and intercomparison among them, as warranted. WCRP is promoting a pilot effort to improve the connection between data experts and scientists involved in climate model development and evaluation. The Obs4MIPs (http://obs4mips.llnl.gov:8080/wiki) initiative will greatly improve intercomparisons of models and observational datasets. The overarching goal is to enable the two expert communities to develop and document some datasets based on space-based observations from the past several decades, consistent with the format and standards of the CMIP5 model output to be made available on the Earth System Grid Federation (ESGF) for use by all researchers around the world.

The Obs4MIPs datasets match in time and space the model simulations developed as a part of the CMIP5 experiments. This technical alignment of observational products with climate model output will greatly facilitate model-data comparisons. Guidelines have also been developed for Obs4MIPs product documentation that is of particular relevance for model evaluation. Products available via Obs4MIPs are:

- Directly comparable to a model output field defined as part of CMIP5;
- Open to contributions from all data producers that meet Obs4MIPs requirements;
- Well documented, with traceability to track product version changes; and
- Served through ESGF for ease of access by all interested researchers.

In partnership with the Global Climate Observing System (GCOS), WCRP continues to advocate for the development of Essential Climate Variables (ECVs), including those for the ocean, and related information

to build long-term global datasets, recognizing that such datasets are a basis for diagnostic studies and particularly for study of long-term trends, detection and attribution of causes of climate variability and change, and the development and evaluation of climate models. In 2014, WCRP, in partnership with the Committee on Earth Observation Satellites (CEOS) and the Coordinating Group of Meteorological Satellites (CGMS), is co-convening in Darmstadt, Germany, a conference to discuss the current and future state of space-based climate observations in order to evaluate recent achievements, ascertain critical challenges ahead, and to identify gaps in the space-based climate observing system and the risk to the continuity of climate observational records. The international space agencies intend to use the outcome of this conference in developing their plans and priorities for the development of these observing systems.

Regional Capacity Development

WCRP is promoting active engagement of early career scientists in all its activities, with particular emphasis on scientists from least-developed and developing countries, so as to build up the diverse future workforce needed to meet the increasingly complex scientific challenges of climate research. Through strategic partnerships with WCRP sponsors (WMO, ICSU, and IOC) and sister organizations such as the START (Global Change System for Analysis, Research and Training), APN (Asia-Pacific Network for Global Change Research), and IAI (Inter-American Institute for Global Change Research), WCRP is currently undertaking a wide range of education, training and capacity development activities. For example, 71 students and early career scientists participated in WCRP meetings in 2012 including 25 early career scientists who participated in 13 regional WCRP workshops held in all the WMO regions, such as the:

- CORDEX regional training workshop in Asia, Pune, India, 17-20 October;
- Summer School on Climate and Ecosystem Interaction, Ankara, Turkey, 23-28 July; and
- Energy, Water and Climate Change young scholars forum, Nicosia, Cyprus 10-12 December.

CORDEX, in partnership with a large number of regional organizations including START, APN, IAI, development banks and non-governmental organizations, is developing regional research capacity for, among others, Africa, Asia and Latin America and Caribbean. CORDEX presents an unprecedented opportunity to advance knowledge of regional climate responses to global climate change and for these insights to benefit on-going climate-adaptation and risk-assessment research, policy planning and development investments in these regions. For example, a consortium of organizations, consisting of WCRP, the University of Cape Town's Climate Systems Analysis Group, START, the International Centre for Theoretical Physics, the Swedish Meteorological and Hydrological Institute-Rossby Center, and the Climate and Development Knowledge Network, initiated an analysis and training programme to provide an initial assessment of CORDEX results for Africa that is regionally focused and prioritized to the continent's information needs. The training programme focuses on skill development in working with climate model results, analysis of CORDEX datasets and compilation and writing-up of the results for broad dissemination to users. Participants in the training programme are grouped into teams according to the sub regions they represent and their respective areas of expertise. This approach, initially focused on Africa, is now being replicated for South Asia, Latin America and Caribbean, and other geographic regions worldwide.

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