

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 summarises the current main activities undertaken by APN to address some of the issues outlined in the recently published document **FCCC/SBSTA/2012/MISC.2** regards those topics for discussion at the dialogue meeting to take place during SBSTA36, taking into account developments in research activities outlined in document **FCCC/SBSTA/2007/4, Paragraph 47 (a-f)**.

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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 including DIVERSITAS, ESSP, IGBP, IHDP, START, WCRP and their related core and joint projects.

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

2. Ongoing APN Activities Relevant to the Convention:

2.1 APN Climate Synthesis Report and Work towards Springer Publication: Climate in Asia and the Pacific: Society, Security and Sustainability

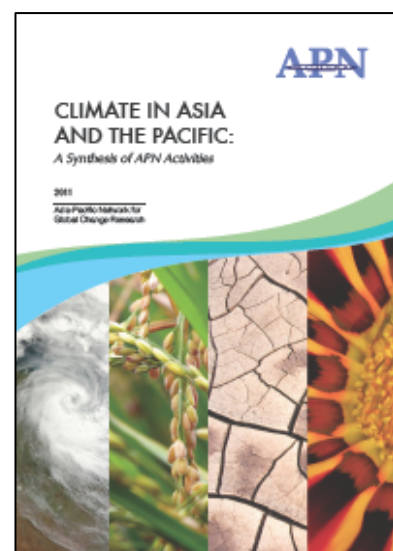
The APN Climate Synthesis activities began in November 2009 and involve key scientists from the Asia-Pacific region, all of whom have been involved in APN activities either through leading APN-funded projects and/or through being a member country or expert member in the APN.

2.1.1 Climate in Asia and the Pacific: A Synthesis of APN Activities

ISBN978-4-9902500-1-0

Citation: Manton MJ, Heath, L, Salinger, J and Stevenson, LA. 2011. Climate in Asia and the Pacific: A Synthesis of APN Activities, pp78. Asia-Pacific Network for Global Change Research.

Work for the present Synthesis – Climate in Asia and the Pacific: A Synthesis of APN Activities began in November 2009 with a scoping workshop followed by an authors' workshop in August 2010. The work entailed summarizing over fifty scientific research and capacity building projects funded by the APN that had a climate-related element – whether natural climate variability and/or climate change. The contributing authors of the present synthesis report are leaders in their field and many of them are authors for the next Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCCAR5). The present report will be a useful tool not only for the IPCC, but also for scientists, decision-makers and educators as it identifies both research gaps and future research activities for the Asia-Pacific region in the context of natural climate variability and climate change.



Copies will be available at the research dialogue on 19th May 2012 and can be downloaded from the APN website at:

<http://www.apn-gcr.org/uploads/reports/2011/Climate%20in%20Asia%20and%20the%20Pacific.pdf>

2.1.2 Book: To be published by Springer in its Advances in Global Change Research Series.

Following a workshop from 17-20 October 2011, in Kobe Japan, the book authors are now in the process of preparing Final Order Drafts for the Chapters outlined below. An outline of the book, which is scheduled for publication in Autumn 2012, looks at the current/emerging issues in the Asia-Pacific region, is as follows:

TITLE: Climate in Asia & the Pacific: Security, Society and Sustainability

i. Foreword

- Helen Clark of UNDP (to be confirmed)
- WCRP Executive Director (to be confirmed)

ii. Message from the Steering Committee Chair of APN

iii. List of Contributors

Chapter I: Introduction (Coordinating Lead Author: Michael Manton)

- Include purpose of the book, tools/methodologies used and opportunities for climate impact, adaptation and vulnerability assessments. There is a need to recognise the importance of Asian societies that extend from remote communities to mega-cities.

Chapter II: Climate Variability and Change (Coordinating Lead Authors: Jim Salinger & Madan Shrestha)

Section 1: Observed Climate, Variability and Trends

- o Highlight characters and drivers of climate, variability and trends across the Asia-Pacific, including extremes, glacial mass balance changes and large scales temperature , e.g. circulation and monsoon
- o Include pre-historical perspectives and variability across time-scales

Section 2: Modelling Projections and Regional Downscaling

- o Highlight regional climate modelling and downscaling for Asia-Pacific, including projections on future climate and potential applications of models outputs in projects initiated by WCRP [e.g. Coordinated Regional Climate Downscaling Experiment (CORDEX)], IITM, APCC, BoM, GCISC, IRI, etc.

Chapter III: Climate and Urbanisation (Coordinating Lead Author: Peter Marcotullio)

Section 1: Urbanisation as a driver of Climate Change

- o Highlight the needs of urban areas on food, water, and energy and hence recognise urban areas as source of greenhouse gases. Note the impact of urban design on water and energy efficiency.

Section 2: Mega-Cities (coastal and inland)

- o Highlight vulnerabilities of mega-cities to climate-related events such as sea-level rise and flooding. Note strategies for managing impacts, including urban planning.

Chapter IV: Climate and Security (Coordinating Lead Authors: Lance Heath & Elena Nikitina)

Section 1: Food Security: Agriculture and Fisheries

- o Highlight vulnerabilities and opportunities of agriculture and fisheries to climate variability and change and note strategies for managing and planning those vulnerabilities and opportunities.

Section 2: Water Security

- o Highlight vulnerabilities and opportunities of water security to climate variability and extreme events for Asia-Pacific including Himalayas, Tibetan Plateau and Pacific States. Note strategies to manage vulnerability including extreme events.
- o Include conflict resolution

Section 3: Disaster Management

- o Highlight strategies and opportunities for managing climate-related disasters

Section 4: Energy (distribution, efficiency, sources)

- Highlight vulnerabilities of energy supply to climate change and variability and extreme events. Note strategies to manage those vulnerabilities.

Chapter V: Climate and Society (Coordinating Lead Author: Kanayathu Koshy)

Section 1: Governance

- Describe capabilities and potential strategies for societies to manage climate risks at various levels of governance.

Section 2: Remote Communities

- a. Mountain Communities
- b. Small Islands
- Highlight vulnerabilities of remote communities to climate variability and change and discuss strategies to manage those vulnerabilities

Section 3: Human Health

- Highlight vulnerabilities of human health to climate variability and change including extremes and discuss potential strategies to manage those vulnerabilities

Chapter VI: Climate and Sustainability (Coordinating Lead Author: Rodel Lasco)

Section 1: Integrated Assessment and Energy Options

- Highlight development of integrated assessment methodologies to determine sustainable energy options for Asia-Pacific region.

Section 2: Ecosystem Management

- Highlight importance of natural ecosystems in sustainable development and discuss their roles in climate change adaptation and mitigation.

Chapter VII: Future Directions for Climate Research in the Asia-Pacific Region (All CLAs)

- Highlight overall conclusion and knowledge gaps across all chapters

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2.2 Selected Ongoing Research Activities related to:

2.2.1 Coastal and Marine Ecosystems

[Technical and scientific aspects of sources, sinks and reservoirs of all greenhouse gases for coastal and marine ecosystems (mangroves, tidal salt marshes, wetlands and seagrass meadows), with a view to identifying and quantifying the impact of human activities]

- **(Ongoing) Impact of Climate Change on Mangrove Ecosystems in South Asia (Salik).** A 3-year collaborative project in Pakistan, India, Sri Lanka and Bangladesh.

Mangrove forests are an important ecosystem for sustaining biodiversity and livelihoods of to its dependent communities. The total mangrove cover in South Asia is estimated to be about 10,000 km². A number of commercial and non-commercial activities (like cattle grazing, firewood, timber, agriculture, small industries, etc) are carried out by local communities. Climate change drivers that threaten mangrove ecosystems include changes in sea level, hydrology (tidal and fresh water flows within mangroves), high water events, storms, precipitation, temperature, atmospheric CO₂ concentration, ocean circulation patterns, etc. Therefore, a balance is required between resources and its utilization under climate change scenarios for sustainable development of both mangrove and their dependent communities.

There is a sizeable mangrove forest along South Asian coasts that is vulnerable to climate change. Little research has been performed in this region to provide a science-based of information to evaluate impacts and vulnerability of coastal regions to climate change. The extent and composition of regional mangroves are under major change. For example, few decades ago the Indus delta mangroves were regarded as the fifth largest mangrove forest of the world, with a cover of about 350,000 hectares, but now their cover has drastically reduced to about 78,000 hectares, a loss of approximately more than 75% of the origin extension. Similar trend are also found in other South Asian countries like India, Sri Lanka, Bangladesh. Alongi (2002) reported that in last 50 years, about one-third of the world's mangrove forests have been lost. Current projections on mangroves area loss suggest that mangroves in developing countries are likely to decline another 25% by 2025 (Ong and Khoon 2003). Research efforts are needed to understand the interaction of climate change and human impacts on the vulnerability of mangroves wetlands in South Asia.

The present project seeks to provide science-based information about the impact of climate change on mangrove ecosystem in South Asia. The impacts of sea level rise, decrease in fresh water flows in the region and other climatic parameters like temperature fluctuations, precipitation etc will be carried out for developing future scenarios of mangroves forests in South Asia. Moreover, the overall vulnerability of mangroves ecosystem will be evaluated by hydrological, climatic, institutional and socio-economic assessments using hydrodynamic modelling, regional climate models, GIS and RS techniques, landscape vegetation models and applying statistical methods

respectively.

This project intends to raise awareness among local and national level policy and decision makers about the potential impacts of climate change on mangroves ecosystem. This information will help to devise policies and interventions for mangroves sustainability, development and conservation by selection of appropriate site in the region to develop a conceptual institutional framework describing drivers, pressures, responses, trends and impacts on mangroves ecosystem. This will be achieved by involving distinguished researchers from participating countries i.e. Pakistan, India, Bangladesh, USA and Sri Lanka conducting research on these issues.

Specific Objectives:

1. To examine different climatic and hydrological factors under climate change scenarios and assess their linkage and interactions on mangrove ecosystems
2. To carry out vulnerability assessment for socio-economic variable, indicators and processes those are affecting mangroves ecosystem sustainability in South Asia.
3. To develop necessary framework of adaptation/recommendations with respect to for policy and institutional intervention for mangroves sustainability and development for decision-makers at local, national and regional level.

- **(Ongoing) Mangrove Ecosystems - Bioshields against Biodiversity Loss & Impacts of Local & Global Change along Indo-Pacific Coast (The Seagrass-Mangrove Bioshield Project, SMBP)** A 3-year collaborative project India, Indonesia and Philippines

In the Indo-Pacific, coastal management vis-à-vis environmental change mitigation and adaptation overly focuses on control of Malthusian over-fishing in coral reefs. It is well documented that among the coastal tropical ecosystems, coral reefs are the most popular, mangroves the most disturbed, and seagrass meadows, the least studied. Seven respected scientists and a number of collaborators from 6 countries (Australia, Japan, India, Indonesia, Philippines, Sri Lanka) are implementing the SMBP. Six sites from the four latter countries have been selected to demonstrate that a seagrass bed and mangrove forest – singly interlinked systems, serve as natural ‘bioshield’, sustaining system goods and services against local and global human and natural stressors. Adopting the Integrative Science for Society and the Environment (ISSE) framework, SMBP is phased in a way to first establish the scientific base (Phase 1: Science Establishment, 2years) and link this with academic programs and governance policies to ensure sustainability of the benefits gained (Phase 2: Capacity Building, 1 year).

Hence, we argue in favour of a growing consensus, which places seagrass-mangrove system conservation as priority, developing models of the ecosystems’ functions and health, which are the natural biological protector (‘bioshield’) in mitigating local and global changes along the region’s coasts. To be tested and promoted, these models will support decision-making and will be used to build capacity of stakeholder communities and governments so that they could utilize more efficiently ecosystem goods and services

while adapting to environmental changes.

SMBP will be implemented in 4 countries: India, Indonesia, Sri Lanka, and Philippines. In the last 3 countries, seagrass is virtually unknown and in all 4, the rate of its disappearance and degradation (together with mangroves), is one of the highest in the world, and so peoples' dependence upon them for survival.

In India, measurement of CH₄ and CO₂ nutrient fluxes and ecosystem goods and services in seagrass will be done in the Gulf of Mannar and in mangroves, in Pichavaram, both in Tamil Nadu. The area is impacted by discharges and disturbances from 47 villages. Fisheries have increasingly declined. In Indonesia, measurement of *Enhalus* seedling growth and survival, seagrass biomass and production, litter fall and ecosystem goods and services will be undertaken in Jakarta Bay, the specific area with a group of coral atoll islands, with a total area of about 12 km², two large lagoons and surrounded by well-developed fringing reefs with seagrass and mangroves. The inland area is considered as the primary source of waste and pollutants; In the Philippines, dugong feeding behaviour will be observed and population dynamics done in Davao Gulf (south), which has a continuum of corals, seagrass, and mangroves, relatively most pristine, with dugongs and turtles. The human threats are the fishing pressure for day-to-day survival of communities. Water quality, benthic biodiversity, photosynthetic efficiency and seagrass-mangrove ecosystem goods and services will be measured in Bolinao, northern Philippines and Davao Gulf. Bolinao has a small mangrove patch, continuous with a large area of seagrass, disturbed by sedimentation and nutrient pollution from nearby fish cages and fishpens. In Sri Lanka, nutrient cycling, salinity and mangrove plant biodiversity and density will be investigated in Puttalam Lagoon, a large 327 km² lagoon, which is fed by two rivers, discharging at 2.2-8.1 m³/s. The land is used for prawn fishing, salt production, and rice cultivation.

- **(Ongoing) Tracing Nitrogen and Carbon Biogeochemical Processes in the Inter-Tidal Mangrove Ecosystem (Sundarban) of India and Bangladesh: Implications of Global Environmental Change (Mathukumalli).** A 3-year collaborative project in India and Bangladesh

Approximately 50% of the world's human population currently lives within 100 km of a coastline. As population density and economic activity in the coastal zone are projected to increase, there is increasing interest in forecasting impacts of anthropogenic activities, land-use changes and climate on nutrient cycles and budgets. Human interventions in land use in coastal areas have increased nutrient and sediment loads, resulting in eutrophication and degradation of water quality. Owing to their high productivity and energetic exchange with terrestrial and marine ecosystems, mangroves play a crucial role in the biogeochemical cycling of carbon, nitrogen, and other nutrients. Exporting substantial amounts of terrestrial organic matter to the coastal oceans, mangroves play a key role in the regional carbon cycle. Furthermore, increasing land use change and aquaculture practices have increased nutrient discharges; have increased rates of eutrophication, changes in nutrient stoichiometry, and depletion of oxygen that has

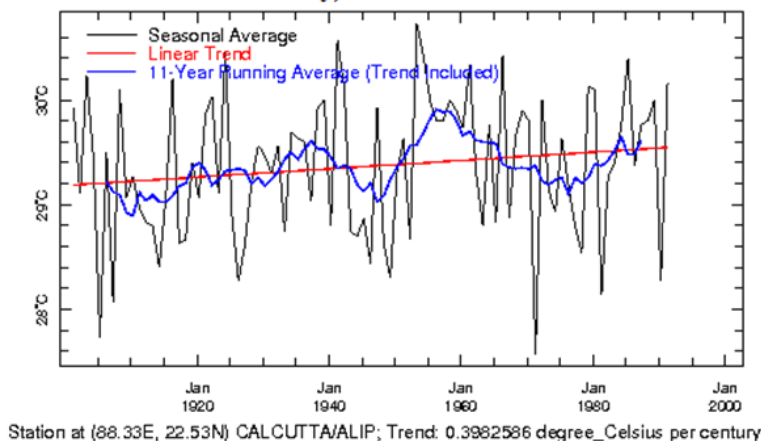
significant negative effects on the coastal biodiversity. Sundarban is the largest single block mangrove ecosystem (3861 miles²) in the World and 60% is distributed in Bangladesh and the rest 40% in India. Constantly Sundarban mangrove is degraded by rapid changes in land-use pattern/management, discharges of agriculture and aquaculture effluents and reduction in freshwater from the upstream due to the construction of dams have seriously affected the biodiversity and biogeochemical processes. Therefore, an integrated assessment is planned to evaluate the ecological and biogeochemical characteristics of mangrove to describe the biogeochemical processes in Sundarban in response to changing climate and land-use.

Specific Objectives:

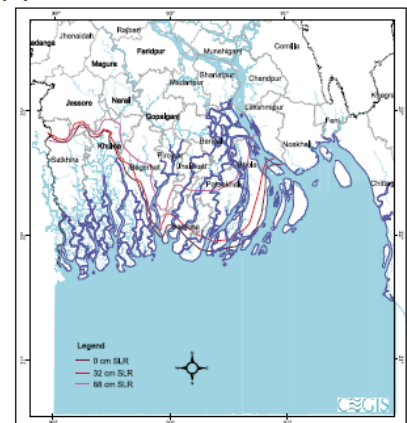
1. To elucidate the biogeochemical behaviour and cycling of various ecologically important nutrients (C, N, P, and S) and pollutants.
2. To track sources and impacts of environmental pollution, and 3) exploring historical changes and perturbations in the mangrove.

Climate and hydrology in the Sundarban area were collected from various sources to understand the response of ecosystem to changes in climate. It is very clear that the air temperatures were increased at the rate of 0.4 °C/century (Fig. 1a). Similarly, climate change induced sea-level rise caused increase in salinity along the coastal Bangladesh (Fig. 1b), that indeed impede the groundwater quality and also affects the nutrient biogeochemical processes in the Sundarban mangroves.

(a) Mar-May Seasonal Average Station Temperature Values, Decadal Variability, & Linear Trend



(b) Sea level rise in the Bangladesh Sunbarban



Publications to date:

Prasad, M.B.K., 2012. Nutrient stoichiometry and eutrophication in Indian mangroves. Environmental Earth Sciences, DOI: 10.1007/s12665-011-1508-8 (in press).

• **(Ongoing) Impacts of Global Warming on Coastal and Marine Ecosystems in Northwest Pacific (Jung). A 2-year collaborative activity in Russia, Republic of Korea, China and Japan**

The western North Pacific is highly productive, supporting the largest fisheries yields in the world and high consumption of fish products by residents of its bordering countries. Recently, however, the western North Pacific has experienced dramatic changes in coastal water quality, oceanographic conditions, and ecosystem structure, driven by global climatic changes and anthropogenic interventions, such as rapidly increasing human populations and industrial activity. Understanding climatic influences on marine ecosystems and fisheries in this region has been the focus of international and multidisciplinary studies since the North Pacific Marine Science Organization (PICES) was established in 1992. Increasing scientific evidence indicates that the responses of marine ecosystems to climatic change are not simple, but vary among regions and according to the scales of the processes. However, implications of these regional differences to vulnerability and possible policies for adapting fisheries industries to climate change have not yet been explicitly studied. Here we are conducting comparative studies across NOWPAP countries (China, Japan, Korea and Russia) to evaluate regional differences in the responses of marine ecosystems to the changes in the NOWPAP sea area (33-52°N; 121-143°E; Fig. 1) and their implications in developing adaptation policies for climate change by establishing a working group composed of natural and socioeconomic scientists.

Specific Objectives:

1. Develop preliminary IBMs that combine a 3-d ocean circulation model and a simple biological model for predicting transport and recruitment of early-life stage fishes.
2. Develop fisheries economic models that can evaluate and risks and vulnerabilities of fisheries sectors to the projected changes in marine ecosystems and fisheries resources in the NOWPAP area.
3. Contrast the different vulnerabilities of the NOWPAP regions to explore the implications in developing management plans for adapting fisheries sectors to climate change projected by IPCC AR4 (low, moderate, and high future emissions of greenhouse gases) or preferably AR5 models.
4. Investigate changes in production of fisheries due to climate changes and evaluate costing of policy changes

Publications

Kang, Y.S., Jung, S., Zuenko, Y., Choi, I., Dolgaova, N., In press. Regional differences in response of mesozooplankton to long-term oceanographic changes (regime shifts) in the northeastern Asian marginal seas. Progress in Oceanography.
<http://dx.doi.org/10.1016/j.pocean.2011.11.012>

2.2.2 Land use and Land Cover Change

[Technical and scientific aspects related to land-use and land-cover changes and other ecosystems with high-carbon reservoirs, in particular terrestrial ecosystems (e.g. tundra, peatlands and steppe), including in the context of consideration of practical mitigation options for achieving the 2°C temperature goal]

- **(Ongoing) Rapidly Changing Greenhouse Gas Budgets of South and Southeast Asia: A 3-year collaborative research activity.**

Rapid economic growth in many Asian countries has resulted in increased energy demand, which in turn is leading to increasing the global share of greenhouse gas emissions by the region. An understanding of the natural carbon exchange over the land and oceans due to tropical climate variability is also required for calculating interannual to interdecadal variations in atmospheric CO₂. The main aim of this 1st APN workshop was to assess resources available currently among the international research community working on various aspects of earth system sciences with a focus on South and Southeast Asia. The key issue discussed was the availability of data and models to work towards the establishment of the GHG budget for these two regions based on synthesis and reconciliation of top-down (atmospheric observations and inverse models) and bottom up estimates (ground based flux observations and terrestrial models). These included atmospheric measurements of GHGs, classifications of land cover and soil properties, coastal ocean biogeochemistry, forest and agriculture inventories, and remote sensing based estimates. The target GHGs are carbon dioxide (CO₂), methane (CH₄) and nitrous oxides (N₂O).

Principal Investigators: Josep Canadell and Prabir K. Patra

Introduction

Within the United Nations Framework Convention on Climate Change, 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.

Objectives

- (a) 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.

- (b) Observational data and numerical model results of various GHGs (CO₂, CH₄, N₂O etc.) will be analyzed and archived in a central data repository.
- (c) Access and analyze the results for the regions from 11 atmospheric CO₂ inversions, 6 global terrestrial biogeochemical model outputs, and one fire emissions product.
- (d) Discuss among the participating scientists during the proposed workshops, and share with all parties interested through peer-reviewed publications and the data repository.

Results to Date

Rapid economic growth in many Asian countries has resulted in increased energy demand, which in turn is leading to increasing the global share of greenhouse gas emissions by the region (Raupach et al., PNAS, 2007; Le Quere et al., NatGeosci, 2009). An understanding of the natural carbon exchange over the land and oceans due to tropical climate variability is also required for calculating interannual to interdecadal variations in atmospheric CO₂ (Patra et al., Tellus, 2005).

An international workshop was organized through financial supports from (1) the Asia Pacific Network (APN) funded project (ARCP2011-11NMY-Patra/Canadell), the Indian Space Research Organisation (ISRO) Geosphere-Biosphere Project (GBP) (ATCTM) at the Physical Research Laboratory (PRL), Ahmedabad. The main aim of this 1st APN workshop was to assess resources available currently among the international research community working on various aspects of earth system sciences with a focus on South and Southeast Asia. The key issue discussed was the availability of data and models to work towards the establishment of the GHG budget for these two regions based on synthesis and reconciliation of top-down (atmospheric observations and inverse models) and bottom up estimates (ground based flux observations and terrestrial models). These included atmospheric measurements of GHGs, classifications of land cover and soil properties, coastal ocean biogeochemistry, forest and agriculture inventories, and remote sensing based estimates. The target GHGs are carbon dioxide (CO₂), methane (CH₄) and nitrous oxides (N₂O).

The Project Co-Leader, Dr. Pep Canadell (GCP/CSIRO, Australia), highlighted the rapid emissions growth rates of countries in the region in 2010 superseding previous expectations and showing little effect of the Global Financial Crisis (e.g., China 9.9%, India 9.0%, South Korea 8.8%, Indonesia 7.6%). The growing global share of emissions from Asian countries is increasing the uncertainty of the global carbon budget, and more so for the targeted regional budgets; uncertainty reduction is one of the main goals of the APN effort.

Top-down observations and modeling: Michel Ramonet (IPSL/LSCE) highlighted the needs for high quality measurements, which are set at accuracy of 0.1 ppm, 2 ppb and 0.1 ppb for CO₂, CH₄ and N₂O, respectively for the upcoming Integrated Carbon Observation System (ICOS) project. Prabir Patra (RIGC/JAMSTEC) set a target for CO₂ flux estimation uncertainty for the South and Southeast Asia regions at 0.2 PgC/yr within the

time span of the APN project of 3 years, by utilizing in situ and remote sensing observations in atmospheric-CO₂ inverse modeling.

The observations of most important anthropogenic GHGs are being conducted at ground based sites through national and international collaborations and onboard of commercial/research aircrafts. Initial datasets have been analysed for understanding how regional sources and sinks (fluxes) interact with the atmospheric transport and chemistry using numerical models for simulating concentrations. One of the recent finding, based on atmospheric inverse modeling, is that the South Asia region has apparently acted as the net sink of CO₂ at a rate of 0.3 ± 0.3 PgC/year during 2007-2008 (P. K. Patra), but most parts of the Asian region behave as a significant source of CH₄ and N₂O (K. Ishijima; RIGC/JAMSTEC). These results, however, show high uncertainty and lack of confidence at the sub-regional level so falling short from showing the role of the various GHG species on the Earth's climate system and any possible implications for climate policy development. The workshop identified the need for molecular and isotopic data of GHGs as a key development (N. K. Indira, CCMACS; M. Naja, AIRES).

The workshop also highlighted the importance of regional applications of atmospheric inversion modeling using unique regional observations not yet part of the global datasets and measurements from commercial airliners in and out of the region (eg. CONTRAIL program from NIES/MRI/JAL by Y. Niwa, MRI; C.-H. Cho, NIMR; R. Lokupitiya, USJ; P. S. Swathi, CMMACS). The use of air pollutant species, such as carbon monoxide (CO), ozone (O₃), are shown to be effective for separating biomass burning and fossil fuel emissions, both dominant fluxes in the region (L. K. Sahu, PRL), and also useful for analyzing the detrimental effects of oxidants on crop yields (S. Lal, PRL). Ozone concentration over India increased at a linear rate of $\sim 1.4\%$ per year in the periods of 1950s and 1990s.

Bottom-up observations and modeling: A growing role of eddy-covariance flux towers is expected in the near future given the current deployment of a network in India under the ISRO-GBP and the institutions of the Ministry of Earth Sciences, Government of India. The well-established terrestrial ecosystem models, developed primarily for the temperate region, are tuned for light use-efficiency and soil moisture stress in order to adapt them for the regional conditions. Efforts are also underway for validating the modelled gross primary productivity and heterotrophic respiration under the National Carbon Project (NCP) (R. Nayak, NRSC). N. R. Patel (IIRS) suggested that agricultural net primary productivity (NPP) has increased in the past 50 years due both due to increased yield per hectare and overall extent of agricultural land. Explicit representation of crops in terrestrial modeling has been mostly ignored so far and will require the next generation of modeling development given the predominant role of agriculture in the region (E. Lokupitiya). Site level measurements of emission footprints are constructed for CH₄ and N₂O emissions from the rice and wheat cropping fields (D. Pandey, BHU) and also discussed their emission reduction potentials (I. Rusmana, IPB). Emerging new accounting techniques based on field observations, modeling and remote sensing are

providing new estimates of CH₄ emissions from Indian rice paddy fields (3.4 Tg/yr) and livestock (11.7 Tg/yr) (K. R. Manjunath, SAC). Emissions from wetlands are still highly unconstrained, particularly for Southeast Asia where extensive tropical peatlands exist. The satellite products of normalized difference vegetation index (NDVI), land cover change and land cover change, soil properties and soil carbon mapping, and agricultural practices are all identified as critical inputs for identifying the processes involved in the exchange of carbon and nitrogen in terrestrial ecosystems (T. Bhattacharya, ICAR).

The transport of terrestrial carbon to the estuaries (33 TgC/yr) and emissions from coastal oceans (6.4 TgC/yr) of India illustrates the importance of lateral transport and the coastal zones (V. V. S. S. Sarma, NIO) and the need for an Asia-wide effort (N. H. Oh, SNU; A. Koripitan, IPB). The concept of ocean acidification was also discussed in the context of rapidly changing scenario of CO₂, and oxidized sulfur (SO_x) and nitrogen (NO_x) species (M.M. Sarin, PRL).

The meeting cemented a set of initial steps towards a regional collaboration among the scientists with interdisciplinary research background who are interested in working on the budget and attribution of GHG budget to the major regions in Asia. The collaboration aims to facilitate the sharing of existing and new observations and numerical model simulations, and to contribute to the long term implementation of the goals of the Regional Carbon Cycle Assessment and Processes (RECCAP) of the Global Carbon Project.

An improved scientific knowledge is indispensable for developing informed national policy on GHGs emission mitigation strategies and their implementation, based on the sound understanding of the behaviour of natural ecosystems and intensity of the anthropogenic activity.

A concise version of this meeting report is submitted for publication in EOS (peer-reviewed):

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

2.3 New Opportunities for Developing Countries

2.3.1 New Opportunities Climate Change Adaptation for Developing Countries in the Asia-Pacific Region

Parties adopted the Cancun Adaptation Framework (CAF) as part of the Cancun Agreements at the 2010 COP 16/CMP 6 conferences in Cancun Mexico. In the Agreements, parties affirmed to enhance action on adaptation with the same level of priority as mitigation. At the 2011 COP17/CMP7 Conferences in Durban, South Africa, parties reaffirmed the above decision and decided on the modalities and procedures for the Adaptation Committee that supports enhanced action including engagement with, and draw on expertise of, relevant networks and centres. The objective of CAF (paras. 11-35 of UNFCCC Cancun report) is to enhance action on adaptation, including through international cooperation and coherent consideration of matters relating to adaptation under the Convention. Enhanced action on adaptation covers a wide range of fields such as:

- (i) Planning and implementing action identified in national and sub-national adaptation plans and strategies,
- (ii) Impact and vulnerability assessments,
- (iii) Strengthening institutional capacity,
- (iv) Enhancing climate related risk reduction strategies,
- (v) Research, development and diffusion of technologies, practices and processes,
- (vi) strengthening data, information, knowledge systems, education and public awareness; and
- (vii) Improving research and systematic observation.

It is particularly important to assist least developed countries to formulate and implement national adaptation plans including the above action points.

New activities

Based on the above decisions, the APN is expected to play a more important role in supporting action on adaptation in the Asia-Pacific region, particularly through regional cooperation in global change research, scientific and technical capacity building and interaction between scientists and policy-makers. More importantly, it is essential to enhance the support for member countries to achieve Goal 2 of APN, i.e., strengthening interactions among scientists and policy-makers. In this context of the CAF, it is critically important to strengthen the capacity of scientists and practitioners in our member developing countries so that they can be more effectively involved in decision-making processes on national adaptation planning, which requires regional and sub-regional cooperation. Therefore, we propose the following process to establish a new adaptation programme under the APN.

(1) Hyogo-Funded Activity: Scoping workshop to enhance the action of APN developing country members on adaptation in the Asia-Pacific region

APN, Hyogo Prefecture and the Institute of Global Change Adaptation Science (ICAS) of Ibaraki University will co-organize a scoping workshop to be held in Kobe, Japan. The workshop will be

conducted as a new HYOGO Activity and sponsored by Hyogo Prefecture. ICAS is renowned for research activities on climate change impact assessments and adaptation in the Asia-Pacific region.

The 3-day workshop will be held between August and September, 2012. The objective of the workshop will be to:

- (i) Compare recent experiences in the region to identify needs, gaps and lessons on planning and implementation of adaptation,
- (ii) Identify prioritized activities on adaptation under the CAF which should be supported by APN in regional or sub-regional scale, and
- (iii) Identify effective programmes and/or tools to support developing member countries in the region in the context of linking science and policy.
- (iv) Bring scientists, policy-makers and practitioners associated with adaptation together in one venue – both within and outside the APN member countries.

(2) Joint activity with UN-CECAR: Training course on adaptation planning and implementation in Asian-Pacific region

APN and University Network for Climate and Ecosystem Change Adaptation Research (UN-CECAR) will co-organize a training course on adaptation planning and implementation in developing countries in Asia-Pacific region. UN-CECAR is a joint initiative of more than 20 leading universities across Asia. It is committed to developing postgraduate educational and research programmes on climate and ecosystems change, adaptation and sustainability science. It has been actively conducting a series of training courses on adaptation for postgraduate students in Asian countries.

The joint training course will be held for three days back-to-back with a UN-CECAR training course in FY 2012, utilizing the above existing capacity development mechanism (venue will be decided later). It aims at raising capacity of scientist as well as practitioners that should be involved in policy making process on adaptation in respective countries.

The results of the joint activity will be reflected in the draft multi-year programme on adaptation that is described in (4) below, and that will be reported to the 18th IGM.

(3) Proposal Development Training Workshop

It is vital that countries in the Asia-Pacific region have the capacity to conduct high quality research that provides underpinning scientific support for policy-makers and policy-making processes. Under the CAPaBLE programme early-career scientists are provided with opportunities to develop their knowledge and capabilities in global change research. Since 2008, the APN has been conducting Proposal Development Training Workshops in various parts of the region. Most recently, these were held in Shanghai, New York, Kobe, Manila, Pune, China, VietNam, and Bhutan back to back with other important meetings.

Held back to back with (2) above, we are proposing that Asian adaptation students be engaged in a proposal development training workshop so that they might be able to actively engage in potential future calls for funding related to adaptation and (4) below.

(4) Formulation of draft multi-year programme on adaptation

Based on the results of the scoping workshop and the joint training course, we expect to draft a three to five year programme to support action on adaptation in member countries. This programme will be presented to the 18th IGM/SPG meeting in 2013 for approval. The draft programme will include research and capacity development activities on prioritized themes, as well as science-policy dialogues related to adaptation. If, once the draft programme is approved, it is expected that the programme will be reported and reviewed by the IGM/SPG meetings that will be held in subsequent years. We will introduce the above activities at events organized by UNFCCC and other relevant international fora.

2.3.2 New Opportunities: Low Carbon Initiatives for Developing Countries in the Asia-Pacific Region

Parties to the UNFCCC adopted the Cancun Agreements at the 2010 COP16/CMP conferences in Cancun Mexico. They agreed to work towards identifying a global goal for substantially reducing global emissions by 2050 (para. 5 of UNFCCC Cancun report). In order to achieve the global goal, both developed and developing countries agreed to enhance mitigation actions. In the case of developing country parties, parties agreed to take nationally mitigation actions in the context of sustainable development, supported and enabled by technology, financing and capacity-building (para. 48), and encouraged developing countries to develop low-carbon development strategies or plans in the context of sustainable development (para.65). At 2011 COP17/CMP7 conferences in Durban South, Africa, and parties recalled the above Cancun agreements and decided further on parties' mitigation actions.

APN has supported more than sixty research projects related to climate change and variability; a major theme in the APN's science agenda. APN has also supported workshops and training on GHG inventory compilation, sustainable technology transfer and measuring emissions from landscapes. The 15th IGM/SPG meeting, Busan, Republic of Korea (2010) hold the Low Carbon Green Growth and Development Session, which made participants share the concept on low carbon and green growth development.

Based on the results of UNFCCC conferences, it is critically important to strengthen the capacity of scientists and practitioners in developing countries so that they can be involved in decision-making processes on national strategies for low carbon and green growth. It is expected that the APN will play a significant role in enhancing scientific capacity of experts, strengthening science-policy linkages and strengthening synergies with other relevant organizations and networks that will ultimately assist in promoting low carbon technologies in developing countries in the region.

In this regard, the APN has recently established a new set of focused activities on **Low Carbon Initiatives (LCI)**. The LCI programme will be a three-year programme from April 2012 to March 2015, mainly comprised of: (i) regional-based research (ii) capacity development; and (iii) communication activities. It is estimated that proportion of fund for (i) regional research activities among the entire LCI programme will be approximately 60%. Category (iii) will include activities for communicating and collaborating with other low carbon networks in the Asia-Pacific region.

For (i) and (ii), an independent call for proposals will be launched over a 6 month-period from June to December 2012, with new research and capacity development activities expected to start in January 2013.