- Making a Difference –

Scientific Capacity Building & Enhancement for Sustainable Development in Developing Countries

Final Report

Project Reference Number: CBA2014-07NSY(B&ES)-Jia

INTERNATIONAL TRAINING ON REGIONAL ECOSYSTEM-CLIMATE INTERACTIONS

The following collaborators worked on this project:

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Project Reference Number: CBA2014-07NSY(B&ES)-Jia

"International training on regional ecosystem-climate interactions"

Final Report submitted to APN

OVERVIEW OF PROJECT WORK AND OUTCOMES

Minimum 2pages (maximum 4 pages)

Non-technical summary

< 200 words >

In last several decades, Asia region has experienced rapid changes in land use and land cover, and therefore, ecosystem structure and function, due to rapid economic development, increased population, industrialization and urbanization. Meeting those challenges requires better understanding of the physical science basis of interactive changes of regional climate and ecosystems, consideration of their impacts on all spheres of human activity, and development of policy strategies and actions. Training of young researchers and practitioners with advanced knowledge and skills will enable them to gain capacity for actively contributing to the process of adaptation and mitigation to climate change in their home countries and sub-regions.

The 12-day training program and science-policy dialogue aims to provide young researchers and practitioners from Asia countries with advanced knowledge and skills in interactive changes of ecosystems and climate. The training was delivered to 16 international young scholars from 14 Asia countries and 10 domestic participants from CAS institutes and several universities, with diverse background of science and policy dimensions. It addressed various scientific aspects of interactions between ever changing ecosystem and climate, and focused on coupled climate-ecosystem processes and policy options that are critical in the region.

Keywords

Capacity building, climate change, ecosystem, science-policy dialogue

Objectives

The main objectives of the project were:

1. To provide young researchers and practitioners from Asia-Pacific countries with advanced scientific principles and methods on interactive changes of ecosystem and climate;
2. To facilitate science-policy dialogue on critical regional issues;
3. To enhance the environmental capacity building for the regional sustainable development.

Amount received and number years supported

The Grant awarded to this project was:

US$ 45,000 for Year 1:

US$ 00,000 for Year 2:

Activity undertaken

Experts from China, Australia, and USA gave state-of-art lectures to address various issues related to interactive changes of ecosystems and climate. The training was organized in a very interactive way to encourage effective communications between trainers and trainees, and among trainees themselves. It presented an opportunity for the participants to learn about the range of strategies to

cope with increased climate extremes and declined ecosystem services, including the use of both traditional and technological advances, in the Asia countries and later on could apply them in climate change adaptation and ecosystem management in their home countries and sub-regions.

The training program includes the following components and activities during the two-week events and the follow-up after training:

1) Lectures: The training courses cover four major themes: regional climate change theory and data analysis, field and satellite observation technologies, land surface and climate modeling, and impacts and adaptation.

2) Model practice: Trainees also had opportunity to practice numerical simulation on IAP based supercomputer with ecosystem-climate interaction model (AVIM) and regional climate model (RegCM) in four practice sessions.

3) Site visit: totally 4 site visits were organised at field ecological and climate stations, research facilities, and the National Science & Technology Museum, respectively, where trainees were demonstrated with climate observation platforms and equipment, and low carbon showcase.

4) Presentation and science-policy dialogue: Participant presentation and science-policy dialogue were organized in the last two days of the training programe. Each participant gave a 15-min presentation, and followed by a very active discussion. Training experts and guest officers and experts from various agencies were invited to join the dialogue, and interacted with our participants during break-out group discussions.

5) Follow-up: Online forum and mailing list were established after the training, and participants and training experts used the platform to communicate on their progresses and to discuss on various ecosystem and climate change issues in the region.

Results

The training program addressed various scientific aspects of interactions between ever changing ecosystem and climate, and focused on coupled climate-ecosystem processes that are critical in the region. Key issues include impacts of climate trends and extremes on natural and managed ecosystems, and their links to food security, water balance, and biodiversity; human driven land use and land cover changes and their effects on ecosystem services and regional climate; science-policy interfaces that address ecosystem-society adaptation and mitigation of climate change. Some of the key regional issues are covered by the lectures: 1) Intensified monsoon climate change and extremes, and changing seasonality / phenology; 2) Heavy pressures on natural ecosystems from human disturbances and climate change, sensitive temperate ecosystems to warming; 3) Major landuse change and consequence, such as large scale urban expansion and exposure to extremes and disasters; 4) Increased human population, vulnerable food security, and declined water supply and quality, etc.

Advanced tools of climate-ecosystem modeling, remote sensing, and data analysis were provided in the program to demonstrate science solutions to address specific regional issues for sustainable development. The technical sessions covered multi-platform observation, trends and impacts analysis, and ecosystem and climate modeling. At the session of ecosystem-climate modeling, participants practiced AVIM and RegCM model simulation at regional and sub-regional scales. Meanwhile, they were also provided with PC based downscaling modules to practice the simulation at local scales. The curriculum comprises lectures, seminars, science-policy dialogue, along with site visits at CAS satellite facilities, Beijing Climate Research Station, and ICSU Integrated Research on Disaster Risks (IRDR) international program office.

The program is designed to encourage active discussions between participants and instructors to ensure the prime issues that some of the participants face can be fully addressed in the training. Therefore, dialogue and report writing are also integrated components of the training. In the session of science-policy dialogue, each participant gave a 15-min presentation, and followed by a very active discussion. They were also guided to write a report in his/her field and focus on science-policy interface. Meanwhile, open discussion and interactions between experts and trainees were encouraged throughout the training workshops, and further facilitated with web-based dialogue.

Relevance to the APN Goals, Science Agenda and to Policy Processes

This project is closely related to the APN's Third Strategic Plan (2010-2015), and provided valuable input to APN's science and institutional agendas. The training scheme is very relevant to most of APN science agendas, namely 1) Climate Change and Climate Variability, 2) Ecosystems, Biodiversity, and Land Use, 3) Changes in the Atmospheric, Terrestrial and Marine Domains, 4) Resources Utilisation and Pathways for Sustainable Development. It aims to enhance the capacity and skills of young scholars from Asia developing countries in understanding key regional issues related to climate change, extremes, response and effects of ecosystems to changing climate, adaptation and sustainable ecosystem management. It especially aims to strengthen the interface of policy- and decision-making processes and society in general for mainstreaming environmental concern.

The training also well fits the APN institutional agenda by encouraging member countries' representatives to play an active role in promoting the APN programmes at the national and regional levels, and by enhancing follow-up dialogues and communications among participants and their institutions.

This training is very relevant to APN goal of scientific capacity development and Biodiversity and Ecosystem Services programme. The training on regional ecosystem-climate interactions provided relevant researchers and practitioners from monsoon Asia countries with advanced knowledge and skills in this fast-moving field. It also contributes to enhancing the environmental capacity building of young scientists in the region for the regional sustainable development. It addresses various scientific aspects of regional ecosystem and climate changes, including multi-platform observation, trends and impacts analysis, and ecosystem-climate modeling.

Policy-relevant questions were addressed in the training through lectures, participants presentations, and especially science-policy dialogue. Main policy-relevant topics of the training are: climate extreme events and risk management, modified ecosystem services under climate change, climate effects of land cover and use change, terrestrial ecosystem carbon budget, satellite-based ecosystem assessment, and climate change adaptation strategies. The workshop also promotes linkages between various national, regional and international institutions participating in the workshop and such linkages are crucial for the successful implementation and communication of appropriate case services and products for various climatic risk management strategies to make regional ecosystem management in Asia more sustainable.

Self evaluation

The training project was very successful, and is expected to lead major enhancement of participants' knowledge and skills in analysing climate change and its impacts on ecosystems over their region and sub-regions, especially with the use of regional models, to get better understanding of critical climate related issues through dialogue, and to expand and sustain the network of young scholars in regional ecosystem and climate change.

Potential for further work

Participants were very excited about their new knowledge and skills on the critical regional ecosystem-climate issues and policy implications gained from this training. Participants decided to continue their dialogue via web-based platform facilitated by START TEA. We will continue to interact with our participants and follow-up on their progresses after the training. With great success of this training, we plan to organize more training programs in coming years. We will also keep in touch with all participants to follow-up their progresses.

Publications (please write the complete citation)

No

References

No

Acknowledgments

The authors acknowledge the financial support from APN as the main sponsor and contribution from CAS Institute of Atmospheric Physics as the host and co-sponsor of the training program. The authors also thank all training experts, namely Hsiao-ming Hsu, Shuli Niu, Howard Epstein, Gensuo Jia, Jason Evans, Xing Yuan, Li Dan, and Hanqin Tian for giving lecturers and sharing knowledge with our participants. Further acknowledgement is extended to all training participants and invited guests for their important inputs at the science-policy dialogue. Meanwhile, the great efforts from Anzhi Zhang and other organizers are critical for the success of the events.

TECHNICAL REPORT

Minimum 15-20 pages (excluding appendix)

Preface

Limit to 100 words

Impacts of climate change are especially visible in Asia on various sectors across different ecosystems. Training of young researcher and practitioners with advanced knowledge and skills will enable them to gain capacity for actively contributing to the process of climate change adaptation and ecosystem management in their respective countries and sub-regions. This training program provides young researchers and practitioners from Asia-Pacific countries with advanced knowledge and skills in this fast-moving field, and to enhance the environmental capacity building for the regional sustainable development.

Table of Contents

1.0 Introduction

Climate and ecosystem changes are highly heterogeneous over the globe, with strong regionality. Under combined pressure of climatic change and intense human use of natural resources, the natural environment in Asia has steadily degraded, hence ecosystem services are being affected. In last several decades, Asia region has experienced rapid changes in land use and land cover, and therefore, ecosystem structure and function, due to rapid economic development, increased population, industrialization and urbanization. Meeting those challenges requires better understanding of the physical science basis of interactive changes of regional climate and ecosystems, consideration of their impacts on all spheres of human activity, and development of policy strategies and actions.

Training of young researchers and practitioners with advanced knowledge and skills will enable them to gain capacity for actively contributing to the process of adaptation and mitigation to climate change in their home countries and sub-regions. It can enhance participants' knowledge and skills in analysing climate change and its impacts on ecosystems over their region and sub-regions, especially with the use of regional models, to get better understanding of critical climate related issues through dialogue, and to expand and sustain the network of young scholars in regional ecosystem and climate change.

The overall goal of the training is to help the young researchers better understanding of regional ecosystem-climate interactions through formal lectures, hands-on modelling practices, field exposures, and dialogues with senior scientists. Because of limited scientific capacity in the region, the training aims also to deal with the science challenges of regional climate change and better facilitate young scholars from the region with badly needed knowledge and skills of analysing the physical science basis of climate change, its impacts on all spheres of human activity. Furthermore, the training hopes that the young researchers will be able to provide science-based solutions in support for policy strategies and action. The participants are not only expected to learn science facts, but also to learn skills and how to perform research and outreach by themselves.

The 2014 APN-START International Training on Ecosystem-Climate Interactions was held from September 8-20, 2014 at Chinese Academy of Sciences (CAS) Institute of Atmospheric Physics (IAP) in Beijing. It aims to provide young researchers and practitioners from Asia countries with advanced knowledge and skills in this fast-moving field, and to enhance the environmental capacity building for regional sustainable development. The training was delivered to 16 international young scholars from 14 Asia countries, including Bangladesh, Cambodia, India, Indonesia, Iran, South Korea, Laos, Malaysia, Nepal, Pakistan, Philippines, Russia, Tajikistan, and Thailand, along with 10 domestic participants from CAS institutes and several universities. Participants are from universities, research institutions, and government agencies in Asia countries, with active participation across the regional scientific community and policy aspect.

Some relevant key issues were identified over the region:

- Intensified monsoon climate change and extremes
- Heavy pressures on natural ecosystems from human disturbances and climate change, sensitive temperate ecosystems to warming
- Major landuse change and consequences
- Large scale urban expansion and exposure to extremes and disasters
- Increased human population and vulnerable food security
- Declined water supply and quality
- Changing coast: land-ocean-atmosphere and human interface
- Sensitive cryosphere: snow and permafrost

2.0 Methodology

2.1. Design and plan for the training program

Major collaborators of the project worked together to develop training plan, and consulted with APN experts in the region. During the development of this proposal, some of the key issues are identified as: 1) Intensified monsoon climate change and extremes, and changing seasonality / phenology; 2) Heavy pressures on natural ecosystems from human disturbances and climate change, sensitive temperate ecosystems to warming; 3) Major landuse change and consequence, such as large scale

urban expansion and exposure to extremes and disasters; 4) Increased human population, vulnerable food security, and Declined water supply and quality, etc.

To make sure diverse key issues can be addressed in the training, we have consulted with APN sub-regional committees and regional experts to select priority issues during development of this proposal. We also sent out the draft program to broader experts to review and provide feedbacks prior to release of announcement. In addition, the program is designed to encourage active discussions between participants and instructors to ensure the prime issues that some of the participants face can be fully addressed in the training.

Figure 1 Training schemes include vegetation-climate interaction, extreme climate impacts, observation technologies, and regional climate change

We tried very hard to make the training program not too technical/academic to build practical capacity, and not too narrow in specific topics that are only relevant to small areas or communities. To achieve those goals, the training program is developed to focus on coupled climate-ecosystem processes that are critical in the region. Such as impacts of climate change trends and extremes on natural and managed ecosystems, and their links to food security, water balance, and biodiversity; human driven land use and land cover changes and their effects on ecosystem services and regional climate; science-policy interfaces that address ecosystem-society adaptation and mitigation of climate change.

2.2. Call for application and selection of participants

Call for application was released in early June 2015 at START TEA and APN websites, and sent to various institutes and networks over the region. We generated a draft training program, and made it ready before releasing the announcement. In general, this is a two-week short training and focuses on priority science-policy issues in ecosystem-climate interactions in our region. We distributed call for application through various networks of science and policy communities, and well balanced two components during the selection of candidates.

We assume that all selected participants have already gained basic knowledge and skills in ecosystem and climate sciences from regular academic institutions, and hope to provide them with more objective oriented knowledge, skills, and solutions to be applied in their home countries and the region.

Figure 2 Group photo of the participants for the international training on regional ecosystem-climate interactions

By the due date, we received 233 complete applications from 21 Asia countries, including those who are nominated by national academies, START regional centers, and APN nFPs. Based on the academic background and excellence, 18 participants were selected from 15 countries. 16 of them attended the training, while 2 cancelled due to personal reasons. Full list of international training participants is provided on Table 1.

Table 1 List of international training participants

Country	Name	Institution	Email
Bangladesh	Mohammad Arifur Rahman	Bangladesh Centre for Advanced Studies	arif_es36@yahoo.co.uk
Cambodia	Noeun Him	Cambodian Center for Study and Development in Agriculture(CEDAC)	cedacinfo@cedac.org.kh
China	Ma Wei	Institute of Atmospheric physics, Chinese Academy of Sciences	mawei@tea.ac.cn
China	Guo Yang	Beijing Normal University	18735716474@163.com
China	Li Zheng	Beijing Normal University	bnulizheng@163.com
China	Zhang Xiaoxuan	The Institute of Remote Sensing and Digital Earth, CAS	zhangxiaoxuanzxx@sina.cn
China	Hou Xiaoli	The Institute of Remote Sensing and Digital Earth, CAS	xiaolihou@163.com
India	Irfan Rashid	University of Kashmir	irfangis@gmail.com
India	Sangeeta Sarmah	Institute of Atmospheric physics, Chinese Academy of Sciences	ssarmah87@gmail.com
Iran	Shiva Ebrahimi	Institute of Tibetan plateau research, Chinese Academy of Sciences	shiva1389@yahoo.com
Indonesia	Alberth Christian Nahas	Indonesian Agency for Meteorology, Climatology and Geophysics	stagaw.kototabang@bmkg.go.id
Korea	Boknam Lee	Seoul National University	leeboknam@gmail.com
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Laos	Nokpaliya Inthavong	Ministry of Natural Resource and Environment	Nok.dreams@gmail.com
Malaysia	Lee Ping Shin	University of Malaya	leepingshin@gmail.com
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Pakistan	Sana Ilyas	The Urban Unit (Planning & Development Department)	Sanna.ellyas@gmail.com
Pakistan	Ghulam Hussain Dars	Ministry of Planning, Development and Reform, Government of Pakistan	darsghulam@gmail.com
Pakistan	Tahir Khan	NUIST Nanjing	Mtsana_pk@yahoo.com
Philippines	Rafaela Delfino	The OML Center (Oscar M. Lopez Center for Climate Change Adaptation and Disaster Risk Management Foundation, Inc.)	rdelfino@omlopezcenter.org rjpd12@gmail.com
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Tajikistan	Kodirov Anvar	Institute of water problems, hydropower and ecology, Academy of sciences of the Republic of Tajikistan	as.kodirov@gmail.com
Thailand	Tipaporn Homdee	Nakhonphanom University	tipaporn.homdee@gmail.com
Vietnam	Hong Tinh Pham	Land Resource Investigation and Assessment Center	phamhongtinh@gmail.com

2.3. Lectures

Experts from China, Australia, and USA gave state-of-art lectures to address various issues related to

interactive changes of ecosystems and climate. The lectures were delivered in 11 sessions. The training lectures cover four major themes: regional climate change theory and data analysis, field and satellite observation technologies, land surface and climate modeling, and impacts and adaptation. Topics of training lectures:

- Coupled Landuse-ecosystem-climate changes in Asia
- Ecosystem flux measurements and data application
- Satellite view of ecosystem and climate dynamics
- Asia monsoon climate dynamics
- Climate extremes and ecosystem consequences
- Linked open data for regional climate change and ecosystem study
- Understanding ecosystem-climate interactions with regional models
- Climate change adaptation
- Building capacity for future Earth

Table 2 Training Program

Date	Session	Contents	Instructor
2014-9-8 Monday			
	All day	Participants arrival and registration	
2014-9-9 Tuesday			
	7:30-9:30	Registration	
	9:30-10:00	Opening ceremony and introduction	
	10:00-10:15	Tea break and group photo	
	10:15-11:30	Orientation	JIA Gensuo
	11:30-13:30	Lunch break	
	13:30-16:30	Climate and Climate change: Global Numerical Simulations and their Comparisons with Observations and Reanalysis	Hsiao-ming Hsu
2014-9-10 Wednesday			
	8:30-11:30	Terrestrial ecosystem in response and feedback to climate change	NIU Shuli
	11:30-13:30	Lunch break	
	13:30-16:30	Earth observation of ecosystem-climate interactions	JIA Gensuo
2014-9-11 Thursday			
	9:00-12:00	Visit Beijing Museum	ZHANG Anzhi
	12:00-13:00	Lunch	

13:00-17:30	Visit CMA Climate Research Station	LIU Weidong
2014-9-12 Friday		
8:30-11:30	Ecosystem-climate interactions related to terrestrial carbon cycling	Howard Epstein
11:30-13:30	Lunch break	
13:30-16:30	Using regional climate modeling and remotely sensed observations to quantify the role of the dynamic ecosystem on the development of drought	Jason Evans
2014-9-15 Monday		
8:30-11:30	Vegetation as a physical entity on the landscape	Howard Epstein
11:30-13:30	Lunch break	
13:30-16:30	Dryland eco-hydrology and climate change	YUAN Xing
2014-9-16 Tuesday		
8:30-11:30	Coupling atmosphere-vegetation interaction module in Earth system models	DAN Li
11:30-13:30	Lunch break	
13:30-16:45	Modeling practice	Shaukat Ali
2014-9-17 Wednesday		
8:30-11:30	Understanding and quantifying land ecosystem dynamics at multiple scales from landscape to global in the context of global change	Hanqin Tian
11:30-13:30	Lunch break	
13:30-17:00	Visit CAS RADI Satellite Facilities	LIU Jie
2014-9-18 Thursday		
8:30-11:30	Participants presentation and science-policy dialogue (Detailed agenda will be available later)	
11:30-13:30	Lunch break	
13:30-17:00	Participants presentation and science-policy dialogue (continue)	
2014-9-19 Friday		
8:30-12:00	Participants presentation and science-policy dialogue (continue)	
12:00-13:00	Lunch break	
13:00-15:00	Science-policy dialogue (continue)	
15:00-16:00	Graduate ceremony	

2014-9-20 Saturday

All day Participants departure

Morning session: 8:30-11:30; Afternoon session: 13:30-16:30
Location of lectures: Room 319 of IAP Building

Active discussions between participants and instructors were important parts of the training to ensure the prime issues that some of the participants face can be fully addressed.

2.4. Modeling practices

Trainees also had opportunity to practice numerical simulation with ecosystem-climate interaction model (AVIM) and regional climate model (RegCM) in four practice sessions. State-of-art tools of climate-ecosystem modeling, remote sensing, and data analysis were provided in the program to demonstrate science solutions to address specific regional issues for sustainable development.

At the session of ecosystem-climate modeling, participants used IAP supercomputer terminals to practice RegCM and AVIM model simulation at regional and sub-regional scales. Computer terminals in the classroom were connected to CAS supercomputer with user-friendly model interface. Model practice guidelines were developed in plain language to ensure that trainees without modelling background can quickly gain the skill.

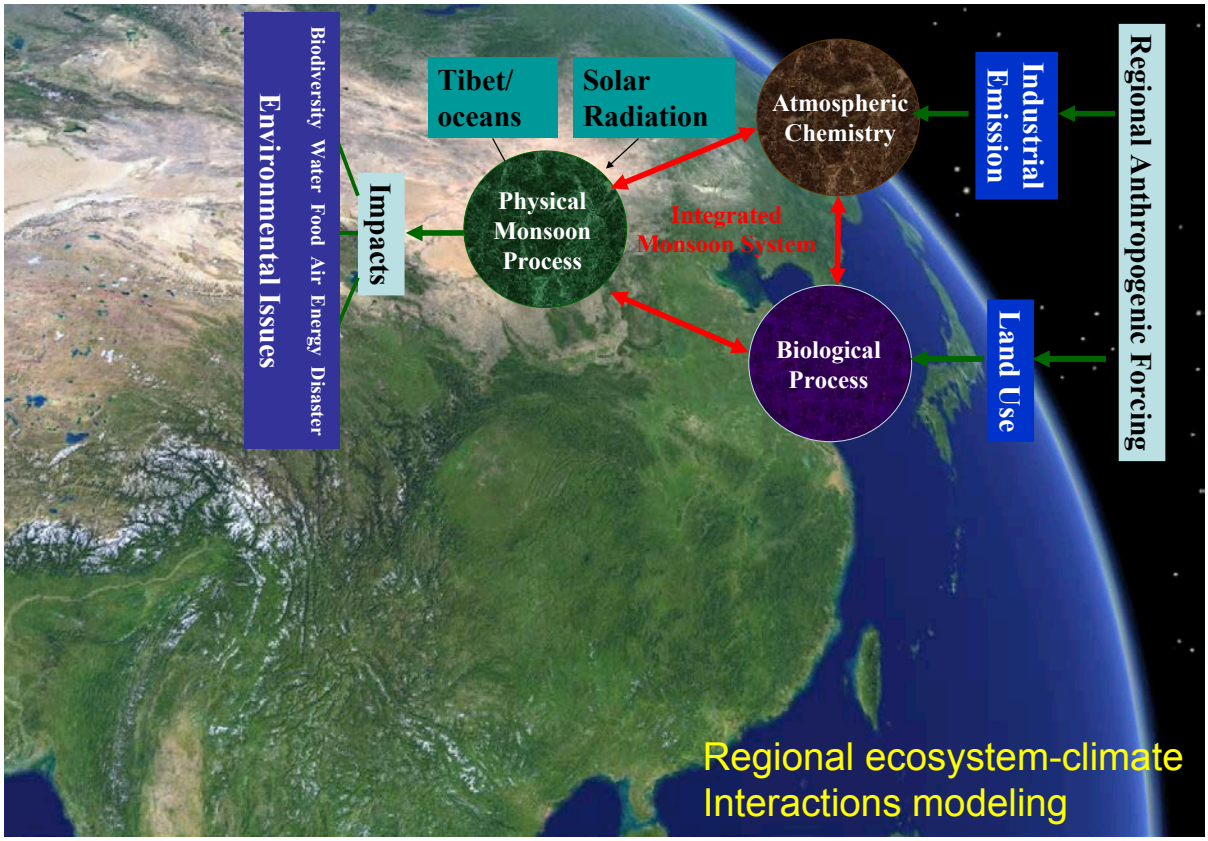

Figure 3 Key processes in regional models of ecosystem-climate interactions, as highlighted at the modelling session of the training program

START-TEA has developed and widely applied a regional ecosystem-climate interaction model (AVIM) and a regional integrated environment system model (RIEMS) in past 20 years, with support from

APN, START, and CAS, and therefore, has strong expertise in regional modelling. Participants were also provided with PC based modules to practice AVIM simulation at local scales.

2.5. Site visits

During the training, three site visits were organized, including visits at CAS satellite facilities, Beijing Climate Research Station, and ICSU Integrated Research on Disaster Risks (IRDR) international program office.

Figure 4 Sites visited during the training. Left: Beijing Daxing Climate Research Station; Right: CAS RADI Satellite Facilities

Beijing Daxing Climate Research Station

Daxing Station is CMA's ordinary weather and climate surface observatory, which was established in January of 1957.It experienced five relocations, and its current location is in the east of JunYi Road, HuangCun town.Daxing Station has a total area of 4060.46 square meters and build-up area of 478.26 square meters.In recent years, two sets of instrument system were equipped to the sites, namely manual-observation and auto-observation.The station was set up to detect a number of meteorological elements, such as surface air temperature, atmospheric pressure, air humidity, wind speed and direction, precipitation, cloud fraction. Daxing station also provides meteorological data from the balloons for Daxing meteorological bureau and Beijing meteorological bureau to improve the local and regional weather forecast skill.

Figure 5 Site visit to Beijing Climate Research Station

CAS RADI Satellite Facilities

CAS RADI satellite ground station is one of three ground stations of Chinese Satellite Remote Sensing Center. The Center is devoted to receiving, archiving and processing remote-sensing data from satellites both at home and abroad, and developing the technologies for upgrading the service and operation capacities of the ground systems. The RADI satellite ground station covers 80% of the Chinese territories, as well as part of Korea, Japan, Okinawa, Northeast Russia and Mongolia, receiving remote sensing data from more than ten satellites, such as Landsat, SPOT, Radarsat ERS, Envisat. It served as a member of international satellite ground station network, providing satellite image data and space remote sensing information service for China and other countries. The station is about 70 km from central Beijing.

China Science and Technology Museum

China Science and Technology Museum is the only state-level comprehensive science and technology museum in China. It is situated at No. 5 Beichen East Road of Chaoyang District. To its east is the residential district of the Asian Games Village. The water system of the Olympic Village is to its west. The main stadium of the 2008 Olympic Games lies to the south of it. North of it is the Forest Park. It covers an area of 48,000 square meters with the architectural scale reaching 102,000 square meters. It is a key part of the Olympic Park central area that embodies three conceptions, namely, "Green Olympics, Hi-tech Olympics and People's Olympics".

There are permanent exhibition centers of five themes, including Glory of China, Science Paradise, Exploration & Discovery, Sci- tech and life, Challenge and future; aimed at arousing your interest in science and inspiring scientific concept. Visitors can learn science from practice, interactive activities or personal experience, guiding them to explore and discover science. Moreover, it has domed theatre, huge screen theatre, motion theatre and 4D theatre; audiences can experience various

special visual stimulation and enjoy the beauty of human and nature.

2.6. Participant presentation and science-policy dialogue

Participant presentation and science-policy dialogue were organized in last two days. Each participant gave a 15-min presentation, and followed by a very active discussion. Science-policy dialogue is organized to bring science-oriented participants, policy-oriented participants, and invited experts and officers from several domestic and international institutions located in Beijing to share knowledge and ideas on issues related climate change adaptation and ecosystem management. Researchers and policy makers will be paired in several break-up groups on each identified key issue, and outcome of discussion will be presented to all participants.

We invited officers and experts from international organizations, government agencies, and training participants to get involved in the science-policy dialogue in last two days of the training. Science-policy dialogue is organized to bring science-oriented participants, policy- oriented participants, and invited experts and officers from several domestic and international institutions together to share knowledge and ideas on issues related climate change adaptation and ecosystem management. Researchers and policy makers were paired in several break-up groups on each identified key issue, and outcome of discussion were presented to all participants.

Trainee presentations and report writing is important and integrated component of the training. Each participant is required to give a 15-min presentation, and followed by a very active discussion. Each trainee is asked to write a report in his/her field and focus on science-policy interface.

The science-policy dialogue brought science-oriented participants, policy- oriented participants, and invited experts and officers together to share knowledge and ideas on issues related climate change adaptation and ecosystem management in the region and sub-regions. Researchers and policy makers were paired in break-up groups on each identified key issue in subregions of temperate east Asia (TEA), southeast Asia (SEA), south Asia (SA), and central and west Asia (CA-WA). Through the dialogue, participants recognized that many climate and environmental issues are closely inter-connected in the region. One of the regional issues highlighted in the dialogue was spatial connection among black carbon pollutant, alpine glacier retreat, and climate and hydrological impacts on agriculture. In south Asia, char collection and vegetation damage is related to domestic fuel use at large scale among some poor communities. Such large scale char burning could become major contributor to black carbon emission in the region that drives faster glacier melting in Asia mountain areas. The changes of hydrological regime and increased extreme events related to retreat of glacier in turn lead to major impacts on crop yield and livelihood in those poor communities in lowland areas. Many other similar linkages among ecosystem-climate issues across sub-regions were also identified. Considering such complex linkages among those key issues, participants recognized that sector based climate change adaptation policies will likely fail without understanding their linkages with other sectors, and that more coordinated or integrated adaptation strategies are badly needed across various sectors at sub-regional and regional scales.

3.0 Results & Discussion

The main components of the training program are formal lectures. The title and key messages of the lectures are summarized here.

Lecture 1: Climate and Climate change: Global Numerical Simulations and their Comparisons with Observations and Reanalyses

Expert: Hsiao-ming Hsu, Ph. D., National Center for Atmospheric Research/NCAR Earth System Laboratory/Climate and Global Dynamics Division (NCAR/NESL/CGD), USA. Email: hsu@ucar.edu

Summary: The concept of scales (time/space) is reviewed. The NCAR's Community Earth System Model (CESM) and its numerical experiments for IPCC/AR5 are introduced. The CESM includes numerical models of the atmosphere, land surface, ocean, sea ice and land ice. The plan was to focus initially on the physical aspects of the climate system, and still is. Additionally, biogeochemistry, coupling to the upper atmosphere, and coupling to the chemistry are currently being improved. Then the analyses for the monsoon rainfall are described as an example, and compared with available observations and reanalyses.

Lecture 2: Terrestrial Ecosystem in response and feedback to climate change

Expert: NIU Shuli, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China. Email: sniu@igsnrr.ac.cn

Summary: Global change has fundamentally changed ecosystem carbon cycling. It can increase or decrease carbon sequestration, with a consequent negative or positive feedback. Although it was proposed that climate-carbon feedback is positive and regulated by complex ecological processes, we have very limited understanding on the underlying mechanisms of climate - carbon cycle feedback. In this talk, we will first broadly introduce approaches that ecologists used to study terrestrial ecosystem in response and feedback to climate change, including gradient studies, global change manipulative experiments, data mining and synthesis, and modeling. Then we will more explicitly explain how to use manipulative experiments and data mining to study the interactions of ecosystems and climate change by a few examples of case studies. Specifically, we will present the following regulatory mechanisms:

a) Water regulation. Water availability plays dominant role in regulating ecosystem C fluxes and their responses to climatic warming in the semi-arid ecosystems.

b) Nitrogen regulation. The increase of nitrogen use efficiency via a shift in species composition toward C4 dominance is a key mechanism underlying the stimulated plant biomass growth under climate warming in tall grass prairie.

c) Species composition regulation. Plant functional types are important factors regulating ecosystem carbon cycle in response to climate change.

d) Ecosystem acclimation and adaption. Ecosystem has the potential of thermal optimization, which makes the ecosystem C fluxes acclimate and adapt to temperature changes.

These complex regulatory mechanisms underlying ecosystem feedback to climate warming are critical for better understanding ecosystem in response and feedback to climate change.

Lecture 3: Earth observation of ecosystem-climate interactions

Expert: JIA Gensuo, project PI

Summary: Better understanding regional climate change cross scales requires a system approach that should include the use of advanced technologies and data. One of the key space technologies available to international community is Earth observation tools and methods that allow scientists and policy makers to acquire timely information about fluctuation, trends, and impacts of climate change over space and time. The objective of this training session is to help participants to get better idea about the availability, application, and interpretation of geospatial products and information, so that they can be equipped with the need tools and methods for analysing changes in their own countries and fields. The lecture provides a balance between understanding and investigating regional climate change while presenting the potential that remote sensing data sets have for

observing regional climate and its driving forces. It includes three sections: 1) basic principles of remote sensing and capacity of current earth observation systems in investigating regional climate change; 2) Current earth observation platforms and sensors available for climate change research communities, including airborne and space borne systems; 3) Application of earth observation technologies in regional climate change study as demonstrated with various case studies over the region.

Lecture 4: Ecosystem-climate interactions related to terrestrial carbon cycling

Expert: Howard Epstein, Major collaborator of the project

Summary: Ecosystem-climate interactions related to terrestrial carbon cycling – in this section, we will focus on some of the basic issues involved in carbon cycling, including photosynthesis, primary productivity, soil carbon properties, and decomposition and soil respiration. We will discuss the climatic controls on carbon cycling processes in terrestrial ecosystems, and the tools and techniques that many current researchers are using to measure or estimate these carbon cycling processes – these include portable field instruments, flux towers, and remote sensing. There will be a case study on climate-vegetation interactions and carbon cycling in ecosystems of the Mid-Atlantic region of the U.S., including temperate forests and successional fields.

Lecture 5: Vegetation as a physical entity on the landscape

Expert: Howard Epstein, Major collaborator of the project

Summary: Vegetation as a physical entity on the landscape – in this section, we will focus on the abiotic effects that vegetation has on land-atmospheric interactions. This includes controls on i) evaporation (in addition to transpiration), ii) energy exchange (e.g. insulation) between the air and soils, and iii) erosion of soils through effects on roughness, shear stress, and resource trapping. We will have two case studies in this section, both related to shrub expansion – one in arctic tundra environments, and the other in a desert grassland-scrubland.

Lecture 6: Using regional climate modeling and remotely sensed observations to quantify the role of the dynamic ecosystem on the development of drought

Expert: **Jason Evans**, School of Biology, Ecology and Earth Sciences, Faculty of Science, University of New South Wales, Australia. Email: jason.evans@unsw.edu.au

Summary: Land surface (ecosystem) changes have an impact on the near surface atmosphere and local climate. These changes can magnify (or dampen) externally forced changes through a feedback mechanism between the land and the atmosphere. How these feedbacks influence the development of the extreme events, like droughts, can be examined through the use of regional climate models. Here I present an example of using WRF, in combination with remotely sensed observations of albedo and vegetation, to quantify the land-atmosphere feedback during the development of a severe drought in Australia. It can be seen that the albedo changes alone enhance the severity of the drought by 15-20% through a relatively fast acting physical mechanism. While the vegetation changes tend to dampen the development of the drought through a relatively slow acting mechanism, partially offsetting the affect of the albedo changes.

This lecture involves general issues of water cycle processes over land, and how we can change them, largely through changes in land use and changes in climate. It focuses at the regional (or watershed) scale and studies processes including river flow, evaporation/transpiration, water vapour transport

and precipitation. Topics include: (1) Climate system science;(2) Regional climate modelling; (3) Hydrology modelling; (4) Land surface - atmosphere hydrological interactions, particularly in terms of climate modelling; (5) Modelling the effects of climate, landscape and land use on hydrological response, including stream discharge; (6) Numerical model (and software) development of relevant tools.

Lecture 7: Dryland eco-hydrology and climate change

Expert: YUAN Xing, START TEA, Institute of Atmospheric physics, Chinese Academy of Sciences, China. Email: yuanxing@tea.ac.cn

Summary: This lecture presents the observation, understanding and modeling of fundamental processes and feedback mechanisms occurring among climate, soil and vegetation in dryland ecosystems, and the prediction and predictability of hydrologic extremes (e.g., drought) under a changing climate. The goal is to provide scientists and students with a synthesis of new research approaches and recent results in the field of ecohydrology and hydroclimatology. The focus on drylands is motivated by the strong coupling existing between ecological and hydrologic processes in arid and semiarid environments. These ecosystems are highly sensitive to fluctuations in climate and hydrologic conditions, and in turn play an important role in affecting regional water cycle.

Lecture 8: Coupling atmosphere-vegetation interaction module in Earth system models

Expert: DAN Li, START TEA, Institute of Atmospheric physics, Chinese Academy of Sciences, China. Email: danli@tea.ac.cn

Summary: The Atmosphere-Vegetation Interaction Model (AVIM) is one of earliest land surface models (LSM) to consider the ecophysiological processes. The model has two interactive components: the physical process module (PHY) and the biological module (BIO). The PHY module represents the typical SVAT-model, which simulates the energy, water transfer among the atmosphere-vegetation-soil. The BIO simulates the carbon exchange between vegetation, soil and atmosphere, and variation of morphology of the vegetation such as leaf area index. AVIM contains one layers of vegetation, ten layers of soil, one layer of snow. It has been coupled to the general circulation models of GOALS (Global Ocean-Atmosphere-Land system model) and FGOALS-s2 (Flexible Global Ocean-Atmosphere-Land system model), as well as the regional climate model RIEMS2 (Regional Integrated Environment Modeling System). The land surface model and climate models are developed by Institute of Atmospheric Physics, Chinese Academy of Sciences. The interface between AVIM and climate models is connected through the exchange of heat, momentum and water vapor between the atmosphere and the land. By incorporating the ecophysiological processes into climate models, the climate simulation has been improved, e.g. the overestimated summer temperature and precipitation being declined over East Asia. This is made through the interactive exchange of surface heat fluxes between land and atmosphere.

Lecture 9: Understanding and quantifying land ecosystem dynamics at multiple scales from landscape to global in the context of global change

Expert: Hanqin Tian, International Center for Climate and Global Change Research, Auburn University, USA. Email:tianhan@auburn.edu

Summary: Our understanding of land ecosystem dynamics is directly linked to the scale at which we make our ecological observations. To understand, predict, and assess the large-scale and long-term impacts of global changes on land ecosystem dynamics , we need such a new approach for extrapolating the growth of plants, animals, or ecosystems into the future when climate, CO_2, and other factors may be different, and extrapolating individual plant or site studies onto a regional or global scale. The lecture focuses on a broad scale and examined ecosystem processes and exchanges (energy, carbon, nitrogen and water) that occur at the interfaces of the atmosphere, biosphere and hydrosphere. His work in regional and global carbon cycle, greenhouse gas emission and climate change impacts is at the leading edge of the field.

4.0 Conclusions

In last several decades, Asia region has experienced rapid changes in land use and land cover, and therefore, ecosystem structure and function, due to rapid economic development, increased population, industrialization and urbanization. Meeting those challenges requires better understanding of the physical science basis of interactive changes of regional climate and ecosystems, consideration of their impacts on all spheres of human activity, and development of policy strategies and actions. Training of young researchers and practitioners with advanced knowledge and skills will enable them to gain capacity for actively contributing to the process of adaptation and mitigation to climate change in their home countries and sub-regions.

The 12-day training was concluded with great success. Through the training and dialogue, 16 APN-funded young trainees from Asia developing countries, especially those from the least-developed/low-income countries, got the opportunity to update their knowledge and skills regarding the principal issues involved in developing strategies for climate change adaptation and ecosystem management. This also enabled them to establish contacts that will assist considerably in their daily work on returning to their countries of origin. They will also continue to get benefit even after the training through follow-up online forum that bring trainers and trainees together via Internet.

The science-policy dialogue brought science-oriented participants, policy- oriented participants, and invited experts and officers together to share knowledge and ideas on issues related climate change adaptation and ecosystem management in the region and sub-regions. Researchers and policy makers were paired in break-up groups on each identified key issue in subregions of temperate east Asia (TEA), southeast Asia (SEA), south Asia (SA), and central and west Asia (CA-WA).

5.0 Future Directions

The training project was very successful, and is expected to lead major enhancement of participants' knowledge and skills in analysing climate change and its impacts on ecosystems over their region and sub-regions, especially with the use of regional models, to get better understanding of critical climate related issues through dialogue, and to expand and sustain the network of young scholars in regional ecosystem and climate change.

Participants were very excited about their new knowledge and skills on the critical regional ecosystem-climate issues and policy implications gained from this training. Participants decided to continue their dialogue via web-based platform facilitated by START TEA. We will continue to interact with our participants and follow-up on their progresses after the training. With great success of this training, we plan to organize more training programs in coming years.

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Appendix

Conferences/Symposia/Workshops

Agenda/Programme (including title, date and venue)

Participants list (comprising contact details of each participant, including organisation, address, phone number, fax number, and email address)

International Training on Ecosystem-Climate Interactions Participants Presentation | September 18-19, 2014

2014-09-18 Thursday

08:30-9:50 Ecosystem-Climate Interactions in TEA

ZHANG Anzhi China Monitoring drought using multi-sensor microwave remote sensing data

Boknam Lee Korea Water Resources and Climate Change Modeling in Korea

Ekaterina Pozdnyakova Russia Participation IGCE in international programs for example monitoring and assessment of coniferous forest damage on ICP IM Sites in Russia

ZHANG Xiaoxuan China Satellite based assessment of urban climate effects in eastern China

9:50 - 10:00 Tea break

10:00-11:00 Ecosystem-Climate Interactions in TEA (continue)

LI Zheng China Diverse spatiotemporal responses in vegetation growth to droughts in China

MIAO Chen China A Brief Introduction of Work in CMA Public Meteorological Service Center

Group discussion and science-policy dialogue for TEA

11:00 - 13:00 Lunch break

13:00-15:00 Ecosystem-Climate Interactions in SEA

Noeun Him Cambodia Promoting climate resilient agricultural techniques for improving livelihood's small scale farmers in Cambodia

Nokpaliya Inthavong Laos Ecosystem-Climate Situation in Laos

Lee Ping Shin Malaysia Reading mammal diversity from flies: the persistence period of amplifiable mammal mtDNA in blowfly guts and a new DNA mini-barcode target

Rafaela Jane P. Delfino Philippines Stakeholder Perspectives on Food Security and Ecosystems: Translating Climate and Disaster Information for Effective Decision-making in the Philippines

Tipaporn Homdee Thailand Future Scenarios of Climate Change and its Impacts on Water Resources: THAILAND

Group discussion and science-policy dialogue for SEA

15:00 - 15:10 Tea break

15:10-17:10 Ecosystem-Climate Interactions in SA

Mohammad Arifur Rahman Bangladesh Char formation process and livelihood characteristic of Alluvial river in Bangladesh

Irfan Rashid India INDICATORS OF CLIMATE CHANGE OVER NORTH WEST HIMALAYAS

Bijay Raj Bagale Nepal Status of Climate Change in Nepal and Adaptation Interventions Carried Out

Sana Ilyas Pakistan Climate Change and its Implications in Pakistan's Socio Economic Development

Khan Muhammad Tahir Pakistan Impact of anthropogenic aerosol on hurricane; a numerical case study

Group discussion and science-policy dialogue for SA

2014-09-19 Friday

8:30-9:50 Ecosystem-Climate Interactions in CA and WA

Kodirov Anvar Tajikistan Glaciers saving problems and monitoring of the hydrological regimes of river basins

Shiva Ebrahimi Iran Investigation of satellite precipitation data in different time scale over Tibetan plateau

Group discussion and science-policy dialogue for SA

13:00-16:30 Science-policy dialogue for Asia

Funding sources outside the APN

A list of agencies, institutions, organisations (governmental, inter-governmental and/or non-governmental), that provided any in-kind support and co-funding for the project and the amount(s) awarded. If possible, please provide an estimate amount.

Additional funding was provided by the host, Institute of Atmospheric Physics, Chinese Academy of Science.

Listed here are the details of the involvement and co-financing costs, including all aspects of in-kind contributions, of other organizations:

1) Training room and facilities: conference room will be provided by IAP and equipped with projector and multi-media facilities; computer lab will be provided by IAP and equipped with desktops; Field flux towers and satellite data facilities will be provided by IAP to support the training practice. In-kind: 16,000 USD.
2) Administrative support: IAP will provide administrative support in travel documents, financial management, Internet and library, and others. In-kind: 8,000 USD.
3) Personnel support: IAP will support 4-5 professors as training experts, along with team of local organizers. START will support 1-2 international experts for the training. In-kind: 4,000 USD.

List of Young Scientists

Include brief detail (full name, involvement in the project activity) and contact detail (name of institution/country and email address) of your scientists involved in the project. Also include short message from the young scientists about his/her involvement in the project and how it helps develop/build his capacity and the knowledge he gained.

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Glossary of Terms

Include list of acronyms and abbreviations

In the Appendix section, the report may also include:

Actual data or access to data used in the study

Abstracts, Power Point Slides of conference/symposia/workshop presentations

Conference/symposium/workshop reports

The final project report must follow the template outlined in this document. Use Calibri font size 12 for all the headings and font size 11 for the text.

The report is to be submitted **one month before the end the Contract Period** in the following formats:

1. By airmail to the address below:
   a. **Soft Copy – 2 CD-ROMS**, appropriately labeled and covered using the design and information on the cover page of the Report Template
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2. By e-mail and addressed to Dr. Stevenson (lastevenson@apn-gcr.org) and Ms. Dyota Condrorini (dcondrorini@apn-gcr.org).

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        - http://www.filefactory.com/
        - http://www.mediafire.com/
        - http://www.yousendit.com/
3. A separate **CD** containing other project outputs (i.e. publications, photos, etc)