APN
Asia-Pacific Network for Global Change Research

"UNU-CECAR/UNU-ISP/APN Training Programme on Climate Change Downscaling Approaches and Applications, 09-20 November 2012"
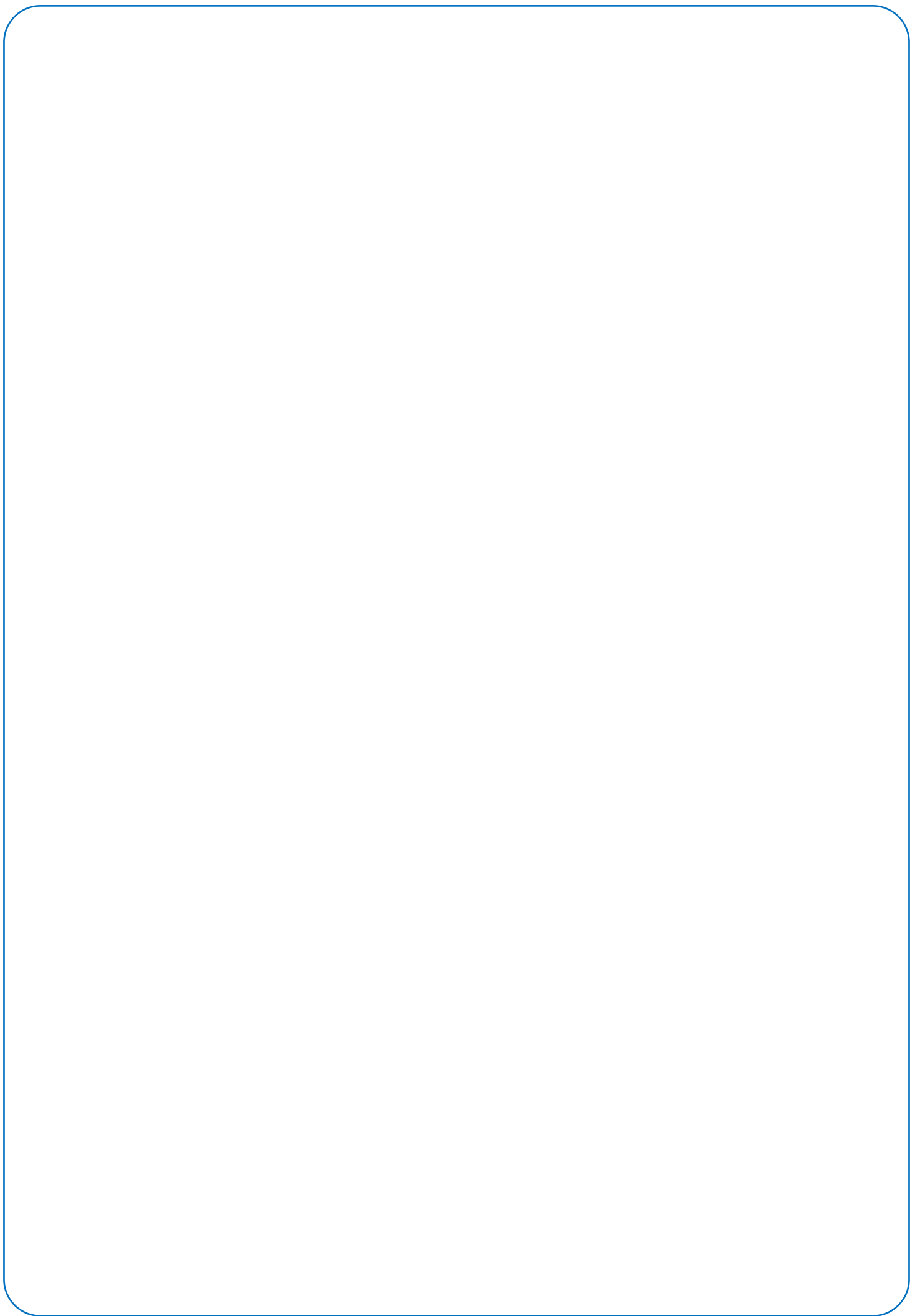
The following collaborators worked on this project:

Project Leader: Dr. Srikantha Herath, United Nations University Institute for Sustainability and Peace (UNU-ISP), Japan, Email: herth@unu.edu

Collaborator: Dr. Lal Samarakoon, Director, Geoinformatics Center, Asian Institute of Technology (AIT), Thailand Email: lalsmarakoon@gmail.com

Collaborator: Ministry of Environment, Government of Japan

Collaborator: Members of UN-CECAR

UNITED NATIONS UNIVERSITY
UNU-ISP
Institute for Sustainability and Peace

ASIAN INSTITUTE OF TECHNOLOGY
1959

Ministry of the Environment
Government of Japan

UN-CECAR
University Network for Climate and Ecosystems Change Adaptation Research

Training Course on Climate Change Downscaling Approaches and Applications (CCDAA)

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OVERVIEW OF PROJECT WORK AND OUTCOMES
Minimum 2pages (maximum 4 pages)

Non-technical summary

The University Network for Climate and Ecosystems Change Adaptation Research (UN-CECAR) is a network of universities and research institutes in the Asia-Pacific and Africa who develop research and educational programmes on climate change adaptation, ecosystems change adaptation, and sustainability science. The network aims to bring together the best resources and expertise in joint research for the design of appropriate policy and development strategies and development of postgraduate education courses and training across disciplinary lines. As sponsor and secretariat of UN-CECAR, United Nations University Institute for Sustainability and Peace (UNU-ISP) coordinates and supports the activities of the Network and acts as a repository for education programmes and research outcomes.

One of the main focus areas of UN-CECAR is to conduct capacity building and research on climate change and ecosystem change adaptation in different countries, and to help developing countries to assess impact of climate change in their region and to reduce their vulnerabilities. In order to ensure developing countries gain a comprehensive grasp in designing adaptation measures, significant efforts are needed to rapidly advance capacities and training of local researchers, professionals and practitioner, particularly in area of climate change downscaling. Effective training modules are critical in teaching participants the latest tools and methodologies necessary for them to know how to downscale climate projections and how to use the downscaled information.

Keywords

Climate Change, Downscaling applications and approaches; geographic information system

Objectives

The main objectives of the project were:

- To provide the content and knowledge of climate change, climate change projection and downscaling, the advantages and limitations of downscaling and impact assessment.
- to provide participants with an understanding of climate change and atmospheric science, downscaling techniques on statistical and dynamical approaches, risk assessment and Geographic Information System (GIS);
- to allow participants to choose participation in parallel sessions on Impacts on Floods and Impacts on Rice Production; and
- To provide hands on training.

Amount received and number years supported

The Grant awarded to this project was:

US$ 40,000 – First installment
US$ 10,000 – Final installment

Activity undertaken

Training Course on Climate Change Downscaling Approaches and Application (CCDAA) at the Asian Institute of Technology (AIT) in Bangkok, Thailand from 9 to 20 November 2012.

Results

Successful conclusion of the 10-day Training Course on Climate Change Downscaling Approaches and Applications (CCDAA) at the Asian Institute of Technology in Bangkok, Thailand from 9 to 20 November 2013.

The two training modules offered under training programme were:

Courses I: Two staggered sessions were conducted on Downscaling Methods: – 1st Session from 9 to 13 November; and 2nd session from 10 to 14 November 2012

Course II: Two Parallel Sessions were held for the following two modules:

- Impacts on Floods; and
- Impacts on Rice Production

There were 48 participants from 14 countries out of which 32 were women and 16 males. Out of the total number of students, 45 were from developing countries.

The lectures were delivered by 14 specialists in the field.

The students produced group reports based on the hands-on training and exercises provided during the training programme. The reports included summaries of the lectures, comparison of observed and WRF derived rainfall, maps of MRI data on temperature and precipitation of the participant's home country, maps on rainfall imported to GIS, flood inundation analysis and damage analysis and crop model application.

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

Self evaluation

Potential for further work

It is clear that there is a great demand to update knowledge on downscaling and using climate change projections. If sufficient financing could be mobilized, it is worthwhile to organize this programme in different countries in an annual basis.

The materials developed could be made available for the global community. In order to accomplish this, it would be useful to organize training workshops to train the trainers in the field including UN-CECAR faculty members. In return, they could conduct the programme at different institutes either locally or regionally.

Publications (please write the complete citation)

Attached the Handbook on the Training Course on Climate Change Downscaling Approaches and Applications

References

- Herath. S., Y. Wang and S. H. Teh (2012) "Proceedings of International Workshops for Developing a Training Programme on Climate Change Projections and Downscaling: Approaches and Applications", CECAR series No. 7, UNU-ISP.

- Herath. S. and S. H. Teh (2012) "Handbook and Proceedings of First Training on Climate Change Projections and Downscaling: Approaches and Applications", CECAR series No. 8, UNU-ISP.

- UNU-ISP (2012) Training Programme on Climate Change Projections and Downscaling: Handbook

Acknowledgments

Lecturers:

- Prof. Uma Charan Mohanty, Director, Centre for Atmospheric Sciences, Indian Institute of Technology Delhi (IIT-Delhi), India

- Dr. Dillip Kumar Swain, Assistant Professor, Agricultural and Food Engineering Department, Indian Institute of Technology Kharagpur (IIT-Kharagpur), India

- Dr. Srikantha Herath, Academic Director; Head of Global Change and Sustainability Section, UNU Institute for Sustainability and Peace (UNU-ISP, Japan;

- Prof. Toshio Koike, Professor, Department of Civil Engineering, The University of Tokyo (UoT), Japan

- Dr. Shoji Kusunoki, Head, First Research Laboratory (Climate Modeling), Climate Research Department, Meteorological Research Institute (MRI), Japan

- Mr. Shigeru Nakamura, Deputy Manager, Research & Development Center, Nippon Koei Co., Ltd. (NK), Tsukuba, Japan

- Dr. Priyantha Bandara Hunukumbura, Research & Development Center, Nippon Koei Co., Ltd. (NK), Tsukuba, Japan
- Dr. Akio Takemoto, Director, Secretariat of Asia-Pacific Network for Global Change Research (APN), Japan

- Dr. Lal Samarakoon, Director, Geoinformatics Center, Asian Institute of Technology (AIT), Thailand

- Mr. Kavinda Gunasekara, Senior Research Associate, Geoinformatics Center, Asian Institute of Technology (AIT), Thailand

- Prof. Robert Oglesby, Professor of Climate Modeling, Department of Earth and and Atmospheric Sciences, University of Nebraska-Lincoln (UNL), USA

- Dr. Sarah Opitz-Stapleton, Senior Associate Scientist, Institute for Social and Environmental Transition (ISET), USA

- Prof. Clinton Rowe, Professor of Meteorology-Climatology Program, Department of Earth and Atmospheric Sciences, University of Nebraska-Lincoln (UNL), USA

- Dr. Tran Thuc, Director General, Vietnam Institute of Meteorology, Hydrology and Environment (IMHEN), Vietnam

Supporting Staff:

- Ms. Mari Arimitsu, Project Assistant, UNU-ISP
- Ms. Sidat Atapattu, Researcher, UNU-ISP
- Mr. Lasse Christiansen, Computer and Web Manager, UNU-ISP
- Ms. Shoko Ikeda, Project Assistant, UNU-ISP
- Ms. Wilma James, Administrative Coordinator, Capacity Development,UNU-ISP
- Mr. Felino Lanuevo, Web Content Manager, UNU-ISP
- Mr. Hideyuki Konishi Mohri, Researcher, UNU-ISP
- Ms. Soo Huey Teh, Programme Associate, UNU-ISP
- Ms. Sudchai Naikaset, Administrative Officer, Geoinformatics Center, Asian Institute of Technology (AIT), Thailand
- Ms. Suwannee Manawakul, Assistant Administrative Office, Geoinformatics Center, Asian Institute of Technology (AIT), Thailand
- Mr. Ramesh de Silva, Systems Administrator, Geoinformatics Center, Asian Institute of Technology (AIT), Thailand
- Mr. Alagarasan Mahalingam, Intern, Geoinformatics Center, Asian Institute of Technology (AIT), Thailand
- Ms. Nopphawan Tamkuan, Intern, Geoinformatics Center, Asian Institute of Technology (AIT), Thailand
- Mr. Niresh Shamendra Nalliah, Intern, Geoinformatics Center, Asian Institute of Technology (AIT), Thailand
- Dr. Manzul Kumar Hazarika, Associate Director, Geoinformatics Center, Asian Institute of Technology (AIT), Thailand

TECHNICAL REPORT

Minimum 15-20 pages (excluding appendix)

Preface

The University Network for Climate and Ecosystems Change Adaptation Research (UN-CECAR) is a network of universities and research institutes in the Asia-Pacific and Africa who develop research and education programmes on climate change adaptation, ecosystems change adaptation, and sustainability science. The network aims to bring together the best resources and expertise in joint research for the design of appropriate policy and development strategies and development of postgraduate education courses and training across disciplinary lines. As sponsor and secretariat of UN-CECAR, United Nations University Institute for Sustainability and Peace (UNU-ISP) coordinates and supports the activities of the Network and acts as a repository for education programmes and research outcomes.

Table of Contents

1.0 Introduction

The University Network for Climate and Ecosystems Change Adaptation Research (UN-CECAR) is a network of universities and research institutes in the Asia-Pacific and Africa who develop research and education programmes on climate change adaptation, ecosystems change adaptation, and sustainability science. The network aims to bring together the best resources and expertise in joint research for the design of appropriate policy and development strategies and development of postgraduate education courses and training across disciplinary lines. As sponsor and secretariat of UN-CECAR, United Nations University Institute for Sustainability and Peace (UNU-ISP) coordinates and supports the activities of the Network and acts as a repository for education programmes and research outcomes.

One of the main focus areas of UN-CECAR is to conduct capacity building and research on climate change and ecosystem change adaptation in different countries, and to help developing countries to assess impact of climate change in their region and to reduce their vulnerabilities. In order to ensure developing countries gain a comprehensive grasp in designing adaptation measures, significant efforts are needed to rapidly advance capacities and training of local researchers, professionals and practitioner, particularly in area of climate change downscaling. Effective training modules are critical in teaching participants the latest tools and methodologies necessary for them to know how to downscale climate projections and how to use the downscaled information.

2.0 Methodology

Through a series of workshops, UN-CECAR academic programme developed a set of training modules on Climate Projection Downscaling Methods in 2011. This training programme was first conducted in November 2011 at UNU Headquarters and December 2011 at Institute of Meteorology, Hydrology and Environment Vietnam (IMHEN). The modules are intended to be flexible and dynamic, in recognition of the fact that the science, technology, modelling and methodologies are rapidly changing. Climate change is global in nature, but the impacts are localized and vary depending on the geography, topography, microclimate, ecosystems, etc., of each locality. As such the module syllabus and methodology need to be sufficiently generic to be easily taught in any context and location and allow educators and participants from various countries and disciplines to engage in and benefit from the training. A key element of the training is that it is linked and supported by the associate members of UN-CECAR, partner institutions and networks that have similar objectives and are engaged in climate change downscaling and adaptation research, and can contribute critical resources such as data-sharing, knowledge, practical technical expertise, etc., to the training programmes. Climate change projections provide an important basis for development of future climate change adaptation strategies. However, since projections of future climate is very much subjected to assumptions made in the models related to physical processes, parameterization, model complexity, societal and economic development trends, etc., there are tremendous uncertainties in the projected future climate. Another major challenge in climate change projection is the incompatibility of outputs from different General Circulation Models (GCMs). This range of possible climate scenarios as well as differences with historical observations and trends have led to public confusion about the validity of climate prediction and, more urgently, has led to the delay of appropriate action. As the coarse resolution of most GCMs are insufficient for detailed assessment of land surface processes and climate change impacts at local to regional scales, especially in regions with heterogeneous land cover and diverse topography, there is an urgent demand for high resolution future climate scenarios, which can be met by downscaling GCM simulations. As for downscaling techniques, they include dynamical and statistical downscaling. Each methodology has its advantages and limitations. How to deal with these uncertainty problems is an important task faced by global communities for adapting to climate change, especially developing countries due to their low adaptive capacities and lack of technology. Modules cover more than one downscaling model and include both physically based and statistically based downscaling models. The comparison of climate predictions with different downscaling models has implications for regional studies. This will help to minimize and assess uncertainties associated with individual model's biases or errors and develop local projections of appropriate climatic and hydrological variables.

The United Nations University Institute for Sustainability and Peace (UNU-ISP), Tokyo, conducted an intensive 10-day training programme on Climate Change Projections Downscaling Approaches and Applications in Water and Food Sectors from 9 November 2012 to 20 November 2012. The training programme was held for ten days, with four lecture sessions per day. Two morning lecture sessions were held at 9:30-11:00 and 11:30-13:00 and two afternoon lecture sessions held at 14:00-15:30 and 16:00-17:30. This programme was developed with the contributions from Indian Institute of Technology in Delhi and Kharagpur, Meteorological Research Institute of Japan, Nippon Koei Co., Ltd., of Japan, the University of Tokyo of Japan, Asian Institute of Technology of Thailand, the Institute for Social and Environmental Transition (ISET) of USA, University of Nebraska Lincoln in the USA on behalf of NCAR of USA, Institute of Meteorology, Hydrology and Environment of Viet Nam, and Asia Pacific Network for Global Change Research (APN). The Training Programme on Climate Change Downscaling Approaches and Applications in Water and Food Sectors was developed under the framework of the University Network for Climate and Ecosystems Change Adaptation Research (UN-CECAR). The training programme was developed with the support of the Ministry of Environment of Japan and The Institute for Global Environmental Strategies (IGES). The training

sessions were organized with the support of Asia Pacific Network for Global Change Research (APN).

The training programme consisted of two independent courses that can be taken either together or separately.

Course 1: Two training programmes, staggered by one day were organized for Course 1. The first group lectures were conducted from 9 to 13 and the second group received training from 10 to 14 November. Course 1 was on Downscaling Methods - focused on climate change, atmospheric science and downscaling techniques using statistical and dynamical approaches. Participants received training on downscaling weather forecasts to the local scale during this training programme.

Course 2: Parallel Sessions on Impacts on Floods and Impacts on Rice production were run in parallel from 16 to 20 November. Course 2 started with an overview of Course 1 done during the first half of the day for the participants who did not attend the Course 1. For those who attended Course 1, received training on Geographic Information System (GIS). After the GIS training session, participants were divided in to two parallel programmes on (A) Assessing flood impacts and (B) Estimating rice production utilizing future climate projections, according to their preferences made during the application process. The final day provided training on communicating results and report preparation.

The assessment of the training programme was based on class participation and final report for each course. For the assessment of the training programme, participants were required to produce a group report based on the exercises provided during the training programme. The report included summary of the lectures, comparison of observed and WRF derived rainfall, maps of MRI data on temperature and precipitation of the participant's home country, maps on rainfall imported to GIS, flood inundation analysis and damage analysis and crop model application.

TRAINING PROGRAMME OUTLINE

Course 1 – Modelling Methods

Day 1 morning session: Science of Climate Change and Downscaling: Uma Charan Mohanty

- General Idea of Atmospheric Science
- Introduction to Science of Climate Change, Climate Variability and Climate Change, Observed Climate Changes
- Concept and Evolution of Climate Models, Projection of Future Climate Change and Uncertainties
- Introduction to Downscaling Methods and its Advantages and Limitations
- IPCC Assessment Report 5

Day 1 afternoon session: Dynamical Downscaling: Robert Oglesby

- Description of Global and Regional Climate Models
- How to choose a Domain and set up a Present Day Control Run with WRF
- Developing Climate Change Simulations

Day 2 morning session: Dynamical Downscaling: Robert Oglesby

- Processing and Analyzing Model Output
- Using the Model Output for Impacts Assessment
- Construction of Regional Scenarios of Climate Change
- Quality of Climate Data used as Input in Models
- Hands on Exercises

Day 2 afternoon session: Dynamical Downscaling: Clinton Rowe

- Handling and Managing Regional Climate
- Model Output
- NCL (NCAR Command Language) and Graphics Sources of Climate Data
- NCO (netCDF Operators)
- Hands On Exercises

Day 3 morning session: Dynamical Downscaling: Shoji Kusunoki

- MRI 20-km Model Introduction
- Concept of Time Slice Experiment
- Assessing Model Output Data for Climate Change Projection

Day 3 afternoon session: Dynamical Downscaling: Shoji Kusunoki

- Communicating Results
- Hands On Exercises

Day 4 morning session: Statistical Downscaling: Toshio Koike

- Overview of what is out there
- Comparison and Selecting a Statistical Downscaling Method
- Introduction (Physics/Statistical)
- Methodologies (Predictand Fields)

Day 4 afternoon session: Statistical Downscaling: Toshio Koike and Tran Thuc

- Statistical Downscaling Hands on Exercise
- Communicating Results
- Hands on Exercises
- National Adaptation Case Study

Day 5 morning session: Risk Assessment: Srikantha Herath and Lal Samarakoon

- Risk Management Concepts in Climate Risk Management and Disaster Risk Management
- Methodologies in Long Term and Short Term Risk Assessment
- Hands on Exercises

Day 5 afternoon session: Discussion: Srikantha Herath, Robert Oglesby and Clinton Rowe

- Report Preparation
- Discussion

Course 2 - Parallel Sessions:

- Impacts on Floods; and

- Impacts on Rice Production

Day 6 morning session: Overview of Downscaling Methods: Akio Takemoto, Srikantha Herath, Robert Oglesby and Clinton Rowe

- Introduction and Framework of Asia-Pacific Network for Global Change Research
- Overview of Climate Projection and Downscaling from Course

Day 6 afternoon session: Geographic Information System: Lal Samarakoon and Shigeru Nakamura

- Basic and Use of GIS
- Integration of Various Data Sources
- Importing Current and Future Weather Data into GIS
- Demonstration and Hands on Exercises

Day 7 morning and afternoon sessions: Impacts on Floods: Srikantha Herath

- Rainfall and Runoff Events
- Spatial and Temporal Characteristics of Extreme Event
- Limitations and Constraints of GCM/RCM in Handling Extreme Events
- Derivation of Extreme Event Statistics from Corrected GCM Data
- Uses and Derivation of Rainfall Intensity-Duration-Frequency (RIDF) Curves

Day 7 morning and afternoon sessions: Impacts on Rice Production: Dillip Swain
- Introduction to Crop Models
- Terminologies in Crop Model
- Simulation Approach
- Concepts in developing Crop System Model
- Crop Simulation Models of DSSAT
- Biomass and Yield Simulation Processes in CERES-Rice

Day 8 morning and afternoon sessions: Impacts on Floods: Srikantha Herath and Shigeru Nakamura

- Introduction to Distributed Physically Based Hydrological Models and Inundation Modelling
- Setting up Targeted Basin using GIS Information
- Calibration and Validation of Inundation Models

Day 8 morning and afternoon sessions: Impacts on Rice Production: Dillip Swain

- Setting up a Crop Model (CERES-Rice of DSSAT)
- File System of the Model
- Input Data Requirements
- Calibration and Validation of the Model
- Uncertainty and Risk Analysis

Day 9 morning and afternoon sessions: Impacts on Floods: Shigeru Nakamura and Priyantha Hunukumbura

- Introduction to Damage Assessment Based on Loss Functions
- Assessing Potential Losses for a Given Future Scenario

Day 9 morning and afternoon sessions: Impacts on Rice Productions: Lal Samarakoon and Kavinda Gunasekera

- Hands on Exercise
- Model Calibration and Validation
- Future Yield Simulation and Results Interpretation

Day 10 morning session: Communicating Climate Information: Sarah Opitz-Stapleton and Robert Oglesby

- Appropriate Roles for and Communication of Climate Information in Various Adaptation and Resilience Planning Processes
- Report Preparation

Day 10 afternoon session: Panel Discussion by

- Kavinda Gunasekara (AIT)
- Srikantha Herath (UNU-ISP)
- Priyantha Hunukumbura (NK)
- Shigeru Nakamura (NK)
- Robert Oglesby (UNL)
- Sarah Opitz-Stapleton (ISET)
- Clinton Rowe (UNL)
- Lal Samarakoon (AIT)
- Dillip Swain (IIT)
- Akio Takamoto (APN)

3.0 Results & Discussion

The students produced group reports based on the exercises provided during the training programme. The reports included summary of the lectures, comparison of observed and WRF derived rainfall, maps of MRI data on temperature and precipitation of the participant's home country, maps on rainfall imported to GIS, flood inundation analysis and damage analysis and crop model application.

Course I

Due to the large group of students who participated in the programme, two one-day staggered training programmes were organized for Course 1. The first group of lectures were conducted from 9 to 13 November; and the second group started from 10 to 14 November.

Each class had 18 sessions of lectures – with a duration of 90-minutes for each lecture and four

lectures per day. Each class was again divided to 5 sections consisting of 2 groups per section. On the 5th day, sufficient time was allocated for the students to finalize their reports which were presented during the last session.

Course II

Course two had two parallel sessions: Group 1: Impacts on Floods; and Group 2: Impacts on Rice. In addition, two common sessions on GIS and Communicating Climate Information were held for all students.

Each group were divided to 4 sections and the group presentations were held at the last day of the courses.

4.0 Conclusions

Training Course on Climate Change Downscaling Approaches and Applications (CCDAA) was held at the Asian Institute of Technology (AIT) in Bangkok, Thailand from 9 to 20 November 2012. The course was opened for students from universities, governments and attended by 48 students.
The lectures were delivered by 17 experts from a number of major institutes from around the world involved in climate modelling and downscaling to discuss the module content, structure and outline. The National Center for Atmospheric Research, USA, the Japan Meteorological Research Institute, Japan, The University of Tokyo, Japan, the Indian Institute of Technology, the Asian Institute of Technology, Thailand, the University of Philippines, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Japan, the Institute for Global Environmental Strategies (IGES), Japan, the Institute for Social and Environmental Transitions, UK and the Institute of Meteorology, Hydrology and environment worked with UNU in developing the modules. The course was funded by the Asia-Pacific Network for Global Change Research (APN). The Ministry of Environment, Japan supported the project as a collaborative activity of the UNU-ISP.

Course 1: Downscaling Methods focused on climate change, atmospheric science and downscaling techniques using statistical and dynamical approaches. Participants received training on downscaling weather forecasts to the local scale during this training programme.


Due to large group of students who participated in the programme, two staggered training programmes were be organized for Course 1. The first group lectures were conducted from 9 to 13 November; and the second group started from 10 to 14 November.

Course 2: Parallel Sessions on Impacts on Floods and Impacts on Rice Production - participants received an overview of Course 1 and received training on Geographic Information System (GIS). The participants were allowed to choose from the two parallel programmes on (A) Assessing Flood Impacts: and (B) Estimating Rice Production - utilizing future climate projections. The final day provided training on communicating results and report preparation.

Course 2: Parallel Sessions were run on Impacts on Floods and Impacts on Rice production from 16 to 20 November.

Participants who successfully completed the courses were awarded a certificate of completion from

UNU-ISP.

List of Participants
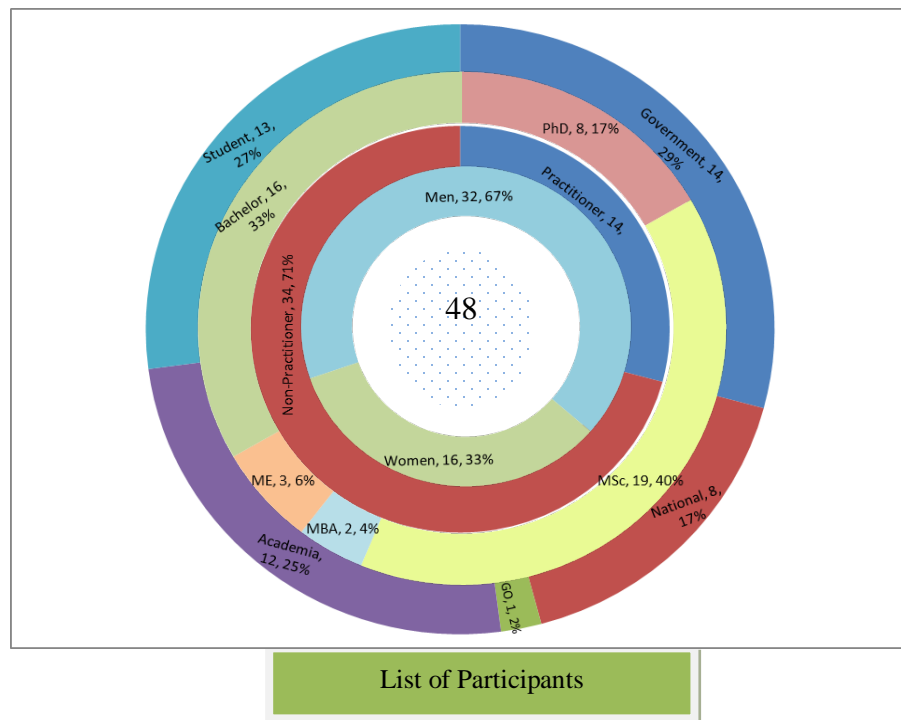
5.0 Future Directions

It is clear that there is a great demand for update knowledge on downscaling and using climate change projections. If sufficient financing can be found it is worthwhile to organize this program in different countries annually. In order to make these materials readily used by the global community, it would be useful to organize a workshop for the trainers in the field - UN-CECAR faculty members, so that they can conduct the program at different institutes either locally or regionally.

References
Follow a standard format when citing your references

- Herath. S., Y. Wang and S. H. Teh (2012) "Proceedings of International Workshops for Developing a Training Programme on Climate Change Projections and Downscaling: Approaches and Applications", CECAR series No. 7, UNU-ISP.
- Herath. S. and S. H. Teh (2012) "Handbook and Proceedings of First Training on Climate Change Projections and Downscaling: Approaches and Applications", CECAR series No. 8, UNU-ISP.
- UNU-ISP (2012) Training Programme on Climate Change Projections and Downscaling: Handbook

Appendix
Conferences/Symposia/Workshops

    i.   Course Brochure
    ii.   Course Schedule
    iii. List of Participants

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.*
N/A

List of Young Scientists

List of Lecturers – please refer to the attached Training Course Handbook - pages 15-22

Glossary of Terms
Include list of acronyms and abbreviations

AIT - Asian Institute of Technology, Thailand
CCDAA – Climate Change Downscaling Approaches and Applications
CERES - Crop Environment Resource Synthesis
DSSAT - Decision Support System for Agrotechnology Transfer
GCM – Global Climate Models
GIS - Geographic Information System
IGES - Institute for Global Environmental Strategies, Japan
IIT-Delhi - Indian Institute of Technology Delhi, India
IIT-Kharagpur - Indian Institute of Technology Kharagpur (), India
IMHEN - Vietnam Institute of Meteorology, Hydrology and Environment, Vietnam
ISET - Institute for Social and Environmental Transition, USA
JAMSTEC - Japan Agency for Marine-Earth Science and Technology, Japan
MRI - Meteorological Research Institute, Japan
NCAR - National Center for Atmospheric Research
NCL - NCAR Command Language
NCO - netCDF Operators
NK - Nippon Koei Co., Ltd., Tsukuba, Japan
RCM – Regional Climate Models
RIDF - Rainfall Intensity-Duration-Frequency
UN-CECAR – University Network for Climate and Ecosystems Change Adaptation Research
UNU-ISP – United Nations University Institute for Sustainability and Peace
UNL - University of Nebraska-Lincoln, USA
UoT - The University of Tokyo, Japan
WRF –Weather Research and Forecast

In the Appendix section, the report may also include:
Course Handbook
Attached reports Course I and Course II (Two reports: one each for Impacts on Floods; and Rice)

Report Prepared by
Srikantha Herath and Wilma James