ASIA-PACIFIC NETWORK FOR GLOBAL CHANGE RESEARCH

ARCP Final Report

Project Reference Number: ARCP2015-02CMY-Ailikun

Project Title: Coordinated Regional Climate Downscaling Experiment (CORDEX) in Monsoon Asia

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Project Overview

Project Duration	**:**	July 2017 – August 2018
Funding Awarded	**:**	USD125,000 for 3 Years
Key organisations involved	**:**	1. Institute of Atmospheric Physics, Chinese Academy of Sciences, China, 2. Monash University, Australia 3. Indian Institute for Tropical Meteorology 4. International Centre for Integrated Mountain Development (ICIMOD) 5. National Institute of Meteorology Research, Korean Meteorological Agency, Korea 6. Nanjing University, China 7. World Climate Research Programme(WCRP)

Project Summary

The main objective of this project is to set up a more enhanced, open, efficient, and shared collaborative platform for climate downscaling groups in Asia. By organizing a series of workshops in last 4 years, we have re-grouped and re-designed the three sub-domains for CORDEX Asia into South Asia, East Asia, and Southeast Asia. We have shared and exchanged the data, experiences, and technics on climate downscaling with all the CORDEX groups in Asia. We have supported setting up the ESGF nodes (RCM data sharing) in Asia by collaboration with WCRP-ESGF core group. We have established the CORDEX Asian Empirical-Statistical Downscaling (ESD) group to support the application of climate downscaling products to end-users. We have organized the science-policy dialogues focusing on climate adaptation during the workshops. We have trained more than 130 young scientists from developing countries under the support of this project.

Keywords:
Regional model, Asia, downscaling, climate change, adaptation

Project outputs and outcomes

Project outputs:

Under the support of this APN project, we have organized following workshops in 3 years:

1) "The 2nd WCRP CORDEX South Asia Science and Training Workshop", 27-30 August 2013 in Kathmandu, Nepal.

2) “The 1st WCRP/CORDEX Science and Training workshop in Southeast Asia”, 17-20 November 2014 in BMKG Training Center, Citeko Bogor, Indonesia.
3) “The 4th WCRP/CORDEX Science and Training workshop in East Asia”, 23-26 November 2015 in UCAS International Conference Centre, Beijing, China.
4) Supported CORDEX EA workshop, 11-12 August 2014 in Jeju, Korea
5) Supported ESGF Training workshop for CORDEX Asia on 4-5 December 2014 in WMO Regional Training centre in Nanjing (RTC), Nanjing University of Information Science and Technology, China.
6) Supported “The Empirical-Statistical Downscaling (ESD) Asian Workshop” on 23 November 2016 in Hanoi University of Science, Hanoi, Vietnam.

Project outcomes:

1) Re-designed the domain and implementation plan for Phase II CORDEX East Asia Experiment
2) Supported the designing and implementation plan for New CORDEX Southeast experiment
3) Supported the establishment of ESGF nodes in CORDEX Asian region in India, Korea, and Thailand
4) Built up CORDEX Asia Empirical-Statistical Downscaling (ESD) group
5) Established the data sharing mechanism for CORDEX Asia groups

Key facts/figures

Through this project, we have trained 40 young scientists on climate modelling and downscaling in “The 2nd WCRP CORDEX South Asia Science and Training Workshop”, 27-30 August 2013 in Kathmandu, Nepal; 40 young scientists in “The 1st WCRP/CORDEX Science and Training workshop in Southeast Asia”, 17-20 November 2014 in BMKG Training Center, Citeko Bogor, Indonesia; 30 young scientists in “The 4th WCRP/CORDEX Science and Training workshop in East Asia”, 23-26 November 2015 in UCAS International Conference Centre, Beijing, China. We have trained 20 young scientists in establishing ESGF node in Asia in “The ESGF Training workshop for CORDEX Asia” on 4-5 Dec. 2014 in WMO Regional Training centre in Nanjing (RTC), Nanjing University of Information Science and Technology, China. In total, about 130 young scientists have joined the training supported by this project.

Potential for further work

1. To support and push the CORDEX South Asia group moving to Phase II, with current 50 KM to 25KM resolution.
2. To promote the 12KM resolution products for some key regions such as megacities, high mountains, and intensive low land agriculture area.
3. To support the CORDEX ESD group to have ESD model-comparisons in specific areas.
4. To develop 1-2 pilot projects for the implication of RCM modelling products to end-users in Asia.

Acknowledgments

We sincerely thank all the collaborators of this project, Prof. M. Manton, Prof. R. Krishnan, Dr. M. Shrestha, Dr. Hyun-Suk Kang, Dr. Shuyu WANG and Dr. M. Rixen for their great support.

We would like to give sincere thanks to Prof. F. Tangang from Malaysia National University for his active contribution to this project by establishing the CORDEX Southeast working group.

We would like to acknowledge the great support on establishing the CORDEX Asian ESD group led by Dr. Koji Dairaku from National Institute of Environment Sciences (NIES), Japan.

We would like to express sincere thanks to following organizations for their financial and facilitation support to the workshops and trainings organized by this project:

1) MAIRS: Monsoon Asia Integrated Regional Study
2) ICIMOD: International Centre for Integrated Mountain Development
3) BMKG: Indonesian Agency for Meteorology, Climatology, and Geophysics
4) WCRP: World Climate Research Programme
5) RIMES: Regional Integrated Multi-hazard Early Warning System
6) International Centre for Climate and Environment Sciences (ICCES), Institute of Atmospheric Physics, Chinese Academy of Sciences)
7) WMO Regional Training centre in Nanjing (RTC), Nanjing University of Information Science and Technology, China
8) Hanoi University of Science, Vietnam
9) KMA: Korea Metrological Agency

1. Introduction

The World Climate Research Programme (WCRP) has established a major project called Coordinated Regional Climate Downscaling Experiment (CORDEX), aimed at promoting regional climate science and applications based on the utilization of the output of global climate models. Downscaling techniques, including both dynamical and statistical approaches, are used to extend the value of global climate models by providing high-resolution climate information that can be utilized by the vulnerability, impact, and adaptation (VIA) community for the assessment of the impacts of climate change and variability on human systems and natural ecosystems.

Recognising the regional nature of downscaling and VIA applications, the CORDEX program has identified a number of distinct regions across the globe, in which focused downscaling and associated applications can be carried out. Across monsoon Asia, there are CORDEX regions for South Asia, East Asia, and South East Asia. Coordinated activities are being carried out in each region to achieve the aims of CORDEX.

While the development of activities in each sub-region of monsoon Asia is appropriate and effective, it is clear that there are commonalities across the region in features of climate, ecology, and human activity that suggest that, while the modelling and specific downscaling are best carried out for each sub-region, the analysis and application of downscaling can be conducted collaboratively across the region. The proposed project, therefore, aims to build on those commonalities and to bring together the downscaling and VIA communities of monsoon Asia.

2. Methodology

Through this project, we organized three main workshops held in 2013, 2014 and 2015 for CORDEX South Asia, Southeast Asia, and East Asia groups by fixing their different requests. The workshops fostered synergies and coherence between the various climate downscaling and vulnerability, impact and adaptation (VIA) communities in the Asia Pacific region through direct engagement. The workshops will be scientific in nature and will cover state-of-the-art climate downscaling research, training and capacity building. A bottom-up approach was applied with participants involved in the formulation of key science and VIA questions to be considered. Most participants for each workshop came from the local sub-regions, key representatives of the communities in the other two sub-regions will also participate. Participants were involved in the formulation of key science and VIA questions to be considered at the workshops.

3. Results & Discussion

3.1. Organized "The 2nd WCRP CORDEX South Asia Science and Training Workshop", 27-30 August 2013 in Kathmandu, Nepal.

This workshop was hosted by the International Centre for Integrated Mountain Development (ICIMOD) in collaboration with the World Climate Research Programme (WCRP), the Indian Institute of Tropical Meteorology (IITM), the Chinese Academy of Sciences (CAS), and Monsoon Asia Integrated Regional Study (MAIRS). The title of the workshop is called "The 2nd WCRP CORDEX South Asia Science and Training Workshop", and it was held on 27-30 August 2013 in Kathmandu, Nepal. About 70 experts from 16 countries participated.

The first two days of the workshop focused on the evaluation of monsoon climate simulation in Hindu Kush-Himalayan and Tibetan Plateau region from multiple climate models and assessment of downscaling techniques and their products to understand uncertainties accompanying the regional climate projections. On the third day, a dedicated session on end users applications (hydrology, agriculture, water resources, land cover and ecosystem, human health etc.) was held. The user's needs from the climate modelling communities were expressed and the needs to bridge the gaps between end users' needs and climate modelling communities. Discussions were held on downscaled products, with the definition of data types, formats and resolutions, for vulnerability, impacts and adaptation analysis. Hands on training on various user modules (hydrology, agriculture, the economic impact of climate change on agricultural production, land use change etc) were introduced and training conducted.

3.1.1 Key issues for climate downscaling experiment in South Asia

1) Climate modelling
    - Accuracy and availability of observed data is very important for verification and for bias correction
    - On regional scales climate simulations from different climate models can vary significantly, for example, Indian monsoon rainfall simulation
    - Comparison of RegCMs or WRF used by different groups
    - Quantify and reduce uncertainties in regional climate projections
    - Set up CORDEX Southeast Asia working group

2) Impact modelling
    - Application of CORDEX data for impact assessment of climate change through various modelling approaches (hydrology, agriculture, health, ecosystems, water resources, etc)
    - Generate knowledge for different impact models for different sectors – Status and gaps
    - Quantify uncertainties in impact models and improvement in existing impact models by incorporating reliable observations
    - Adaptation measures to climate change must be integrated holistically with other related issues and not treated as a problem by itself.
    - Suggestion to have inter-comparison of hydrological models for the HKH region with consistent data and inputs

3) End user interface with climate scientists
    - User chain – various levels of end users - suggestion to invite the various users including the extension workers who can demonstrate real impact
    - Application scientists are the ones to bridge the climate scientists and the end users.
    - Need reliable and convincing and clear signal and impact assessment – need fast and attractive information – idea about knowledge management system to communicate to the end users
    - Limitations and applicability of observations and model data must be clearly understood by users. Need to convert the scientific information that can be understood by the end users.

4) Data and products
   - Coordinate data distribution, archival and hosting of data at CCCR-IITM through CCCR web-portal (cccr.tropmet.res.in) in standard format using Integrated Rule-Oriented Data System (iRODS)
   - Data supporting frame in CORDEX Asia (download, documentation, evaluation, parameter recommendation for different users) depending on the current data centres in 3 regions. Link websites of coordinating agencies eg., IITM, ICIMOD, MAIRS, GDSC-Korea, etc.

5) Capacity building and training
   - Reliable technical supports for data access and downscaling is important for the user community.
   - Need for capacity building in understanding the uncertainties and applying climate scenarios.
   - Downscaling supporting frame in CORDEX ASIA (key scientists and core institutes) including dynamical and statistical downscaling is suggested
   - Appointing key organizations as centres of excellence for CORDEX Asia training

3.1.2 Key messages from "The 2nd WCRP CORDEX South Asia Science and Training Workshop"

A) Establishing the data supporting frame in CORDEX Asia (download, documentation, evaluation, parameter recommendation for different users) depending on the current data centres in sub-regions
   - South Asia: http://cccr.tropmet.res.in/cordex/files/downloads.jsp
   - East Asia: http://cordex-ea.climate.go.kr/
   - RMIP: http://rmip.nju.edu.cn/

B) Build a long term and sustained plan for developing core group of application scientists for the Asia region to interact with climate modelling groups and develop climate application tools
   - Interactions among CORDEX South, East and Southeast domains
   - Encourage young researchers (PhD and Post-doc fellowship)
   - Encourage interactions among Climate Modeling, Applications and User groups

C) Develop CORDEX Asia Training supporting mechanism by appointing core institutes and organizations

D) Set up “CORDEX Asia end-users’ forum” by recognizing key institutes and organizations in assessment research of hydrology, agriculture, ecosystem, land cover/use change and human health et al.

3.2. Organized “The 1st WCRP/CORDEX Science and Training workshop in Southeast Asia”, 17-20 November 2014 in BMKG Training Center, Citeko Bogor, Indonesia.

In CORDEX Phase I, the CORDEX South Asia and East Asia groups are preparing 50-km products for each area, and Southeast Asia region was covered by CORDEX East Asia. Through the efforts of and requests from local scientists, CORDEX Southeast Asia was established in 2013, coordinated by Prof. Fredolin Tangang from The National University of Malaysia. By the support of APN ARCP2014-05CMY-Ailikun, the 1st WCRP CORDEX science and training workshop in Southeast Asia was held during 17-20 November 2014 in BMKG Training Center, Citeko Bogor, Indonesia. About 70 scientists from 3 Asian sub-regionals attended the workshop.

The science workshop focused on 4 topics:

- ✓ Evaluation of climate simulations in Southeast Asia region from multiple climate models;
- ✓ Assessment of downscaling techniques and their products in Southeast Asia;

- ✓ Meeting the requests of end-users on downscaled products, with definition of data types, formats and resolutions, for vulnerability, impacts and adaptation analysis;
- ✓ Training on RCMs modelling, data analysis and applications for young scientists from Southeast Asia.

There are 15 institutions from 10 countries participated CORDEX SEA experiment. In 2015, CORDEX Southeast Group will focus on 25KM resolution output by 14 models for SEA domain.

Domain of CORDEX SEA

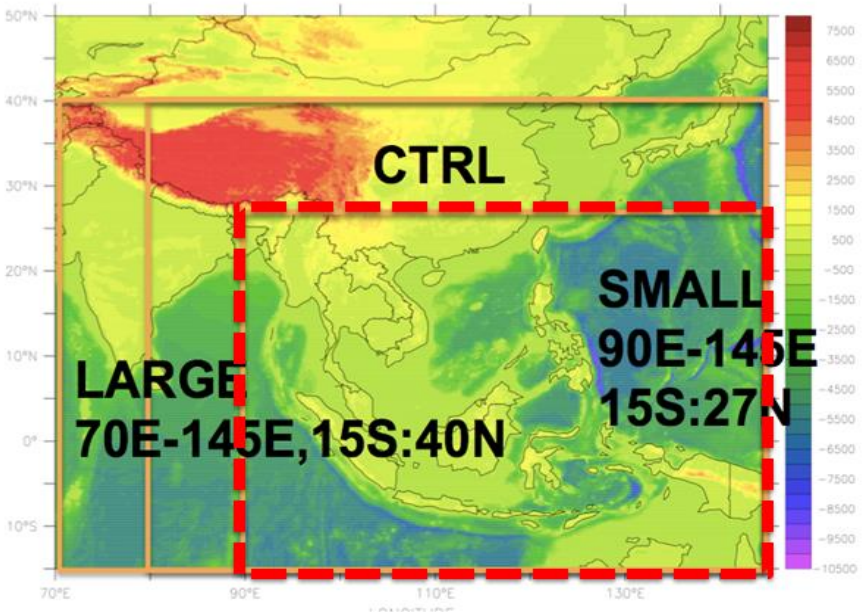

Figure 1: CORDEX Southeast Asia Domain (15S-27N, 90-145E)

CORDEX SEA participating models

Country	GCM	Institution & Country developed the GCM	RCP	RCM
Vietnam	CNRM-CM5	Centre national de Recherches Meteorologiques, France	RCP8.5, 4.5	RegCM4
Philippines	HadGEM2	Hadley Centre, UK	RCP8.5, 4.5	RegCM4
Thailand	MPI-ESM-MR	Max Planck Institute for Meteorology, Germany	RCP8.5, 4.5	RegCM4
Thailand	EC-Earth	EC-Earth consortium	RCP8.5, 4.5	RegCM4
Indonesia	ACCESS1.3	CSIRO, Australia	RCP8.5, 4.5	RegCM4
Malaysia	CanESM2	Canadian Centre for Climate Modeling and Analysis, Canada	RCP8.5, 4.5	RegCM4
Malaysia	IPSL-CM5A-LR	Institute Pierre-Simon Laplace, France	RCP8.5, 4.5	RegCM4
Malaysia	GFDL-ESM2M	GFDL, USA	RCP8.5, 4.5	RegCM4
Australia	CNRM-CM5	Centre national de Recherches Meteorologiques, France	RCP8.5	CCAM
Australia	CCSM4	NCAR, USA	RCP8.5	CCAM
Australia	ACCESS1.3	CSIRO, Australia	Australia	CCAM
Hong Kong SAR	CCSM or CESM	NCAR, USA	Hong Kong SAR	WRF
United Kingdom	HadGEM2-ES	Hadley Centre, UKMO	United Kingdom	PRECIS
South Korea	HadGEM2-AO	Hadley Centre, UKMO	South Korea	WRF

Figure 2: List of CORDEX SEA participating models

3.3. Organized "The 4th WCRP/CORDEX Science and Training workshop in East Asia", 23-26 November 2015 in UCAS International Conference Centre, Beijing, China.

The Coordinated Regional Downscaling Experiment (CORDEX) is a WCRP (World Climate Research Programme) initiative to provide global coordination of regional climate downscaling for improved regional climate change adaptation and impact assessment. In CORDEX Phase I, the CORDEX South Asia and East Asia groups are preparing 50-km products for each area. By the support of APN Project: ARCP2015-02CMY-Ailikun, "The 4th WCRP/CORDEX Science and Training workshop in East Asia" was successfully held on 23-26 November 2015 in UCAS International Conference Centre, Beijing, China. About 50 participants from East Asia, Southeast Asia and South Asia with 2 days of science meeting and 2 days for young scientists training.

3.3.1 Key scientific topics for this workshop

i. Continue discussion on Phase II experiment of CORDEX East Asia following the 3rd CORDEX EA workshop in Jeju 2014
ii. Evaluation of climate simulations in East Asia region from multiple climate models (East Asia monsoon, ENSO, seasonal and intra-seasonal variability, Typhoon and tropical cyclone, extreme events etc.).
iii. Assessment of downscaling techniques and their products in East Asia to understand uncertainties accompanying the regional climate projections and to determine the utility of climate model results.
iv. Meeting the requests of end-users (hydrology, agriculture, water resources, land cover and ecosystem etc.) on downscaled products, with definition of data types, formats and resolutions, for vulnerability, impacts and adaptation analysis.
v. Building up CORDEX ESGF nodes in Asia
vi. Training on RCMs modeling, data analysis and applications for young scientists from East and Southeast Asia.

3.3.2 Implementation plan for Phase II simulation of CORDEX East Asia

1) Driving GCMs (total 6):

ERA-int, HadGEM2-AO, MIROC5, EC-EARTH, MPI-ESM-LR, IPSL-CMSR-MR

2) Participating RCMs:

- ✓ HGM3-RA: KMA
- ✓ RegCM4:KNU, NJU, IAP/NCC

- ✓ WRF: PNU, NJU, CUHK
- ✓ SNUMM5: UNIST
- ✓ COSMO-CLM: POSTECH, NJU
- ✓ LMDZ4: NUIST
- ✓ RAMS: NIED
- ✓ NHRCM: MRI

GCM / RCM	ERA-int	HadGEM2 -AO	MIROC5	EC-EARTH	MPI-ESM-LR	IPSL-CMSR-MR	TBD
HGM3-RA	KMA	KMA					KMA
RegCM4	KNU, NJU, IAP/NCC	KNU	IAP/NCC	IAP/NCC	IAP/NCC		
WRF	PNU, NJU	PNU					CUHK?
SNUMM5	UNIST	UNIST					
COSMO-CLM	POSTECH, NJU	POSTECH		NJU		NJU(?)	
LMDZ4	NUIST				NUIST	NUIST	
RAMS	NIED						NIED
NHRCM	MRI		MRI				
CCAM							

Figure 3: List of CORDEX EA participating models

Points of Contact for each team:

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- ✓ AORI/Japan: Prof K. Yoshimura (kei@aori.u-tokyo.ac.jp)
- ✓ CUHK/HK China: Prof. T. C. Yung, Francis (Francis.Tam@cuhk.edu.hk)
- ✓ CSIRO/Australia: Dr. J. McGregor (John.McGregor@csiro.au)

Simulation Period:

- ✓ GCM driven simulation: 1979-2010
- ✓ Historical: 1950-2005
- ✓ Projection: 2006-2100 for RCP4.5/8.5

List of Variable to Archive

- ✓ CORDEX Archive design at http://cordex.dmi.dk/joomla/images/CORDEX/cordex_archive_specification.pdf, variable list appears in Appendix B of the above document – About 66 variables in total
- ✓ Core: Monthly and seasonal mean
- ✓ Tier 1: daily,
- ✓ Tier 2: higher frequency data
- ✓ Fast-track variables:
- ✓ Daily mean Precip., Temp (mean, max, min), SLP, Surface winds, SH/LH, 850 hPa winds, 850hPa moisture, 500 hPa GPH, 200 hPa winds
- ✓ Standard NetCDF data format is recommended

Observation Data for Evaluation

- ✓ Gridded-Precipitation: CMAP, GPCP, APHRODITE (5km for Asia, 1 km for Japan), CRU, TRMM,GPM, CM05.1
- ✓ Gridded-Temperature: CRU, APHRODITE, CN05.1 from NCC/CMA
- ✓ Sharing the station measurements (precip., mean/min/max Temperature) from each countries: China, Japan, Korea, Mongolia, India, Thailand, Vietnam, Myanmar, etc
- ✓ Needs to compare characteristics of each gridded data

CORDEX Asia Statistical Downscaling Group

Establishing CORDEX Asia statistical downscaling group in near future

Leader: Koji Dairaku from NIES, Japan

3.4. Supporting the design of Phase II simulation for CORDEX East Asia group, by organizing CORDEX EA workshop, 11-12 August 2014 in Jeju, Korea

After Phase I experiment of WCRP/CORDEX, higher resolution RCMs was promoted during CORDEX conference in Brussels in Nov 2013. To prepare and coordinate the next activity of East Asia group, the 3rd International Workshop on CORDEX-East Asia was held on 11-12 August 2014 in Jeju, Korea, hosted by National Institute for Meteorological Research (NIMR).

The major objectives of the workshop were to make general consensus on the plans for next phase CORDEX-East Asia experiments and stimulate more groups to join with CORDEX-EA and its nearby regions such as South Asia, Southeast Asia, and Australasia. Most importantly, during the workshop, domain size with 25 km resolution aimed to be confirmed. In this context, the workshop consists of three sessions featured by a combination of a short presentation given by chair persons and open discussion with the audience on a range of following themes.

Parameters for RCM using other system coordinates (in non-rotated coordinates):

- TLC (51.59; 50.50), CNB (116.70; 61.90), TRC (181.50; 50.31)
- CWB (67.11; 25.72), CPD (116.57; 34.40), CEB (165.94; 25.56)
- BLC (76.91; -0.10), CSB (116.51; 6.90), BRC (156.08; -0.24)

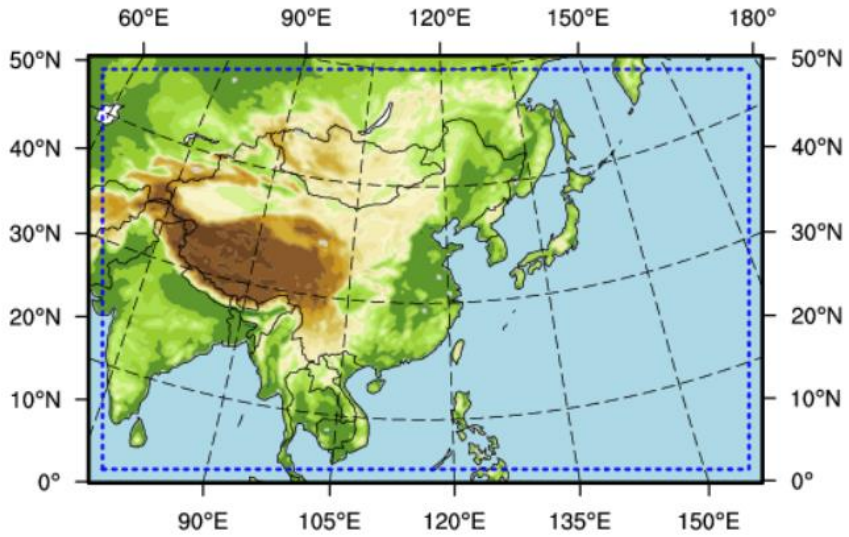

Figure 4: New CORDEX East Asia Domain (0-50N, 70-155E)

3.4.1 Modeling Issues

Dr. S.-Y. Hong gave a presentation on several issues in regional climate downscaling based on his recent review paper (Asia-Pacific J. Atmos. Sci., 50(1), 83-104). It covers model development, grey zone issue, domain and resolution issues, regional ocean processes, the role of Tibetan Plateau, large-scale forcing issue, and others. He emphasized that development and/or improvement of regional climate models should be in line with the strategy for the short-range numerical weather prediction by avoiding tuning for specific physics component in a particular model.

Recommendations for further study were 1) to use of non-hydrostatic model, 2) to improve the model physics and verify short-range forecasts against observations, 3) not to expect the regional model to produce better large-scale features but avoid their error growth within the domain, 4) to develop more mathematically rigorous lateral boundary conditions, 5) to develop atmosphere-ocean coupled model, and 6) to develop skill evaluation metrics.

A few suggestions were given for Flagship of Pilot Study (FPS) in phase II, which is: 1) sensitivity study with a given regional climate model on the large-scale forcing driven by multi-reanalysis data; 2) very high-resolution simulation up to less than 5 km's resolution for the common interests (e.g., tropical cyclone and heavy rainfall that could lead to disasters); and 3) sensitivity study to investigate attribution of anthropogenic forcing (e.g., aerosol impact in East Asia Urban areas). Participants

agreed to discuss further for FPS until its proposal is developed by the worldwide CORDEX community.

3.4.2 Analysis issues

In order to find better GCM forcing to drive the regional climate model for CORDEX-EA domain, skill score in Taylor diagram can be useful in terms of statistical performance. Nevertheless, several questions to be answered are still remained, which are: 1) what variables we should analyze? (e.g., precipitation, atmospheric circulation, SST); 2) what GCM variables are available?; and 3) which GCMs we are going to use (e.g., CMIP5 CGM?, high-resolution AGCM? or CMIP6 GCM?). Dr. Kawase introduced cluster method to make SST forcing to drive a high-resolution AGCM and experimental configuration to investigate the added value of high-resolution simulation for tropical cyclone and Asian summer/winter monsoon systems. Dr. McGregor also proposed a method for ranking the GCM performance in terms of goodness of present climate simulations, SST, and spread of climate change signals by combining several methods from individual studies.
By analyzing extremes of precipitation and temperature simulated by CORDEX-EA experiments, Dr. S.-K. Min found clear added value in precipitation extremes and close relationship between mean and extreme for model errors and future projections. In summary of his study, surface air temperature has better skill in mean than in extreme because of higher spatial correlation whereas precipitation shows better skill in extreme than in mean due to better spatial variability. Multi-model ensemble helps to capture the reliable behaviour of interannual variability of tropical cyclone's activities; however, there are significant discrepancies between individual models due to different physical processes. Experiences from high-resolution AGCM implied horizontal resolution is critical to capture the realistic behaviour of tropical cyclones.

3.5. Promoting the sharing of GCM forcing data in 3 CORDEX Asian groups

In the above CORDEX Asia workshops supported by APN, we decided to share available CMIP5 GCM forcings archived by each group. We figured out that 17 GCMs (6 are re-confirmed in November 2015) are available to drive regional climate models (see Appendix 1). Regarding the very-core variable list to be shared for fast analysis, we agreed that each group is supposed to select most preferable variables based on the CORDEX archive design 2, and then circulate to confirm. The available GCM datasets will be shared in all 3 CORDEX Asia groups.

	Model	Resolution	Scenarios	Period	Available Institute	Data Size (TB)	Contact Person
1	CanESM2	Spectral T42L35 (~ 2.8°, 128× 64)	Historical, RCP4.5, 8.5	1950~2005~2100	NCC/CMA, from ICTP	1.6	Xuejie Gao gaoxuejie@mail.iap.ac.cn
2	CSIRO-Mk3.6.0	Spectral T63L18 (~1.875°, 192× 96)	As Above	1950~2005~2100	As Above	1.9	As Above
3	EC-EARTH	1.125° longitudinal spacing, Gaussian grid T159L62 (320× 160)	As Above	1969~2005~2100	As Above	5.0	As Above
4	GFDL-ESM2M	2.5° lon × 2.0° lat M45L24 (144 × 90)	As Above	1951~2005~2100	As Above	1.8	As Above
5	HadGEM2-ES	1.875° lon × 1.25° lat N96L38 (192 × 145)	As Above	1950~2005~2099	As Above	5.1	As Above
6	IPSL-CM5A-LR	96× 95 equivalent to 1.9° lat × 3.75° lon L39	As Above	1940~2005~2105	As Above	2.2	As Above
7	MPI-ESM-MR	T63L47 (~1.875°, 192× 96)	As Above	1970~2005~2099	As Above	5.5	As Above
8	FGOALS-g2	2.8125° × 2.8125° (128× 60)	As Above	1950~2005~2099	NCC/CMA	1.2	As Above
9	BCC-CSM1.1	T42L26 (~2.8°, 128× 64)	As Above	1950~2005~2099	NCC/CMA	1.2	As Above
10	IPSL-CM5A-MR	Global (2.5°×1.2676°)	Hist, RCP4.5, 8.5	1951 ~ 2005 ~ 2100	France, IPSL	2.2	Zhihong Jiang: zhjiang@nuist.edu.cn,
11	MPI-ESM-LR	T63L47 (~1.875, 192×96)	As Above	1979~2005 2019~2050 (will be extended to 2100)	UNIST, from ????	1.2	Dong-Hyun Cha dhcha@unist.ac.kr
12	HadGEM2-AO	1.875° lon ×1.25° lat N96L38 (192 ×145)	Historical, RCP2.6, 4.5, 6.0, 8.5	1970~2005~2100	NIMR/KMA	14.9	Hyun-Suk Kang hyunskang@korea.kr
13	MRI-CGCM3*1	TL159 L48 (～1.12°, 160x320)	Hist, RCP4.5 (2.6, 6.0, 8.5) *1	1980-2000 2080-2100	MRI	1	Hiroaki Kawase (MRI) hkawase@mri-jma.go.jp
14	MIROC5*2	TL85 L40 (～1.4° 128×256)	Hist, RCP4.5 (2.6, 6.0, 8.5) *2	1980-2000 2040-2060, 2080-2100	MRI	0.15	As above
15	NCAR CCSM4*3	(～1.0° 192×288)	Hist, RCP4.5	1980-2000 2080-2100	MRI	0.5	Asuka Suzuki-Parker (University of Tsukuba) suzuki.asuka.fp@u.tsukuba.ac.jp
16	MRI-AGC3.2*4	TL959 L60 (～20km 1920×960)	Hist, RCP2.6, 4.5, 6.0, 8.5	1979-2003 2075-2099	MRI	36	Hiroaki Kawase (MRI) hkawase@mri-jma.go.jp
17	MRI-AGCM3.2*5	TL319 L60 (～60km 640×320)	Hist, RCP2.6, 4.5, 6.0, 8.5	1979-2003 2075-2099	MRI	6	As above

Figure 5: Details of 17 GCMs sharing in CORDEX Asia (yellow is high-resolution GCM)

3.6. Developing the mechanism for data managing/sharing for CORDEX Asia

- The available GCM datasets will be shared not only in CORDEX East Asia group but also South Asia and Southeast Asia.
- There was a strong consensus that ESGF nodes are efficient ways to share CORDEX outputs for not only the regional climate scientists but also the IAV sectors.
- To share the burden of ESGF nodes and fix the big gaps of internet speed among different Asian countries, we will try to ask all the CORDEX related ESGF nodes in Asia to host the CORDEX-Asia datasets in all three regions: South Asia, East Asia, and Southeast Asia.
- All the CORDEX related ESGF nodes will share the information on IT support, data formats and users' platform.

3.7. Organized ESGF Training workshop for CORDEX Asia on 4-5 Dec. 2014 in WMO Regional Training centre in Nanjing (RTC), Nanjing University of Information Science and Technology, China.

The Earth System Grid Federation (ESGF) is an international collaboration with a current focus on serving the World Climate Research Programme's (WCRP) Coupled Model Intercomparison Project (CMIP) and supporting climate and environmental science in general. WCRP is planning to publish CORDEX (Coordinated Regional Climate Downscaling Experiment) outputs to ESGF network. ESGF is an open consortium of institutions, laboratories and centres around the world that are dedicated to supporting research of climate change, and its environmental and societal impact. ESGF will become WCRP main mechanism for exchanging data (including observations, climate simulations and reanalysis data) in the next decade.

In Asia, IITM was already endorsed as one of ESGF indicator nodes for South Asia, KMA is applying for a new node in East Asia, Malaysia National University and Ramkhamhaeng University are willing to establish new nodes in Southeast Asia. To support setting up WCRP/ESGF node in each region of CORDEX Asia, a small group training workshop was held for CORDEX Asian groups on 4-5 Dec. 2014 in WMO Regional Training centre in Nanjing (RTC), Nanjing University of Information Science and Technology, China. About 20 participants from France, Sweden, China, Korea, India, Malaysia and Thailand participated in the workshop. Two experts from Europe, Dr. Michael Kolax from SHMI and Dr. Nicolas Carenton-Madiec from IPSL gave 2-day lectures and hands-on exercises to more than 20 trainees.
The training focused on following items:

- Introduction to Earth System Grid Federation

- Setting up ESGF Node
- Quality Control for CORDEX
- Data Publishing on ESGF Node

3.8. Established the "Empirical-Statistical Downscaling (ESD) group in CORDEX Asia" by organizing the ESD Asian workshop on 23 November 2016 at Hanoi University of Science, Vietnam

During "The 4th CORDEX Science and Training workshop in East Asia" from 23-26 November 2015 in Beijing, the issue of establishing Empirical-Statistical Downscaling (ESD) group in CORDEX Asia was discussed. Dr. Koji Dairaku from Japan was recommended to lead the CORDEX Asia ESD group. Following CORDEX Beijing workshop, the further arrangement of Asian ESD group is discussed in an informal meeting during the 2nd ESGF training workshop in Jeju 23-25 February 2016, it was decided to have the 1st CORDEX Asia ESD group meeting in Hanoi on 23rd Nov 2016 in conjunction with the CORDEX SEA workshop from 24-25 Nov. 2016.

This main purpose of this meeting is to formally set up the CORDEX Asia ESD working group, to discuss the objectives, tasks, coordination frame and future activities of CORDEX Asia ESD group.

1. Objectives of CORDEX Asia ESD

The objectives of CORDEX Asia ESD group are to:

- To provide high-resolution products of current climate and future scenarios to climate, agriculture, water resource/cycle, LULCC, water/land management, disaster reduction and others stakeholders which include policy makers, NGOs and communities.

- To coordinate the joint regional ESD activity by recognizing common interest on specific topics in selected case study areas.
- To provide technical support to sub-regions ESD activities
- To provide ESD training to end-users from various communities.
- To develop pilot projects and promotion of ESD activity in the Asia regions.

2. Possible Activities and Outcomes

- Coordinated information, knowledge, technical support and exchange.
- Coordinated production of regional downscaling in Asia
- Coordinated case studies in small domain with sufficient observation
- Coordinated improvement/production/verification of observational data
- Coordinated evaluation and improve methods
- Co-design of common framework and set up (e.g 1.5℃/2℃ scenarios)
- Coordinated interaction with “next” users (IAV)

3. Current Members of CORDEX ESD group

The meeting concludes that there is a need to establish the CORDEX ESD group for better coordination of ESD activities over the Asia region. An initial group will be set up, with 10-15 ESD scientists from South Asia, East Asia and Southeast Asia. After the establishment of this technical group, we will explore and extend the communication to invite more end-users to join in.

- Group leader: Koji Dairaku (NIES, dairaku@bosai.go.jp), Ailikun(co-chairs, ITPCAS, aili@itpcas.ac.cn)
- Japan: M. Nishimori(NIAES, mnishi@affrc.go.jp), N. Endo (NIAES, endon855@affrc.go.jp), A. Yatagai (yatagai@hirosaki-u.ac.jp)
- China: Lianhua ZHU(NIUST, ahualian@nuist.edu.cn), Lijun FAN(ITP/CAS, fanlj@tea.ac.cn), Xieyao MA (NUIST, xyma@nuist.edu.cn)
- Malaysia: Liew Juneng (Malaysia National University, juneng@ukm.my)
- Thailand: Jerasorn Santisirisomboon (RU, jerasorn@ru.ac.th)
- India: Ashwini Kulkarni, ashwini@tropmet.res.in
- Korea: Hyun-Han Kwon, hkwon@jbnu.ac.kr
- Indonesia: Muhammad Ridho Syahputra, Ardhasena Sopaheluwakan
- Vietnam: Quang Dinh, quangnd2006@gmail.com
- Philippines: Francia B. Avila, avila.fb@gmail.com

4. Summary of Discussions:

- **Priorities for Asian ESD:** Agriculture and hydrology are suggested to be the targeted and prioritized sectors, urban management and planning could be an alternative for future study
- **SD model inter-comparison:** To facilitate comparison, software and tools, as well as ESD technology, are suggested to be shared across the members.
- **Ground observations:** Latest and updated APHRODITE data as well as local station data were proposed.
- **ESD future products:** Agriculture and hydrology oriented variables (e.g precipitation, minimum temperature, maximum temperature, mean temperature, solar radiation etc). There is also a request for sub-daily information to accommodate specific scale needs. Agriculture assessment needs more variables than hydrology, for the regions without multi-elementary observation, it is better to focus on hydrology study in the current stage.
- **Coordination Frame:** The common protocol and framework of ESD activities in Asia are to be discussed further by the group members. Domain, sub-regions for case study will be determined later and it is suggested to be based on the availability of observational data. Also, there is a need to better coordinate between the CORDEX ESD Group and the CORDEX dynamical downscaling groups in the regions.
- **Issues:** Some issues are identified to be crucial – added values, scales dependence, implication on climate change signal interpretation etc.
- **Training:** Annual training workshops and seminars were suggested during the discussion session. The training will include various KIV users.
- **Funding:** CORDEX Flagship Pilot Studies (FPS); GEWEX Regional Hydroclimate Project(RHP); APN; future earth, etc.

3.9. Promoting Knowledge transfer and interaction with end-users

The climate modelling groups are requested to transfer information to end users, such as governance body, policy makers, NGO, private sectors to enhance the contribution from the science community. The gaps between climate models and end-users and pathways are discussed in this workshop.

Gaps:

- Understanding and transferring the knowledge of uncertainties
- Not understanding each other's needs
- Science is always curiosity driven, not solution-oriented

- Need bridging scientists to interpret between science and end-users

Pathways:

- Long-term communication with end-users on uncertainties
- Make sure to engage to government and decision making from beginning, and keep engaging
- Identify end-users according to your research objectives
- Involving young scientists to be the bridging scientists
- Dissemination of research outputs

4. Conclusions

Under the support of APN and collaborating with various organizations, such as Monsoon Asia Integrated Regional Study (MAIRS), ICIMOD (International Centre for Integrated Mountain Development), BMKG (Indonesian Agency for Meteorology, Climatology and Geophysics), CCSR/IITM (Centre for Climate Change Research/ Indian Institute of Tropical Meteorology), NIMR/KMA(National Institute of Meteorological Research, Korea Meteorological Administration), Malaysia National University, WCRP, we have accomplished:

1) Organized 3 Science and training workshops for CORDEX South Asia (2013 in Nepal), CORDEX Southeast Asia (2014 in Indonesia) and CORDEX East Asia (2015 in China);
2) Organized 1 CORDEX East Asia workshop in 2014 in Korea;
3) Organized 1 ESGF training workshop in 2015 in China;
4) Trained 130 young Scientists from Asia developing countries;
5) Re-grouped and re-designed the 3 sub-domains for CORDEX Asia into South Asia, East Asia and Southeast Asia;
6) Sharing and exchanging the GCM, RCM and observation datasets within CORDEX Asia groups;
7) Supported setting up the ESGF nodes (RCM data sharing) in Asia by collaboration with WCRP-ESGF core group;
8) Established the CORDEX Asian Empirical-Statistical Downscaling (ESD) group to support the application of climate downscaling products to end-users;
9) Organized the science-policy dialogues focusing on climate adaptation during the workshops.

5. Future Directions

1. To support and push the CORDEX South Asia group moving to Phase II, with current 50 KM to 25KM resolution.
2. To promote the 12KM resolution products for some key regions such as megacities, high mountains and intensive low land agriculture area.
3. To support the CORDEX ESD group to have ESD model-comparisons in specific areas.
4. To develop 1-2 pilot projects for implication of RCM modelling products to end-users in Asia.

6. Appendices

Conferences/Symposia/Workshops

1) Agenda of "The 2nd WCRP CORDEX South Asia Science and Training Workshop", 27-30 August, 2013 in Kathmandu, Nepal.

The 2nd WCRP CORDEX Science and Technology Workshop in South Asia
(in partnership with MAIRS, APN, ICIMOD, CCCR-IITM, IAP)
27-30 August 2013, ICIMOD, Kathmandu, Nepal

AGENDA

Day 1: Tuesday, 27 August 2013

09:30–10:45 **Opening session** (Chair: Arun Shrestha, Rapporteur: Ailikun)
09:30–09:45 Welcome addresses: Dr. Arun Bhakta Shrestha (ICIMOD)
Gokarna Mani Duwadee (APN NFP in Nepal)
M. Manton (MAIRS SSC chair, PI of APN project)

09:45 –10:00 Michel Rixen : Intro of CORDEX/WCRP (via Skype)
10:00 –10:15 Ailikun : Intro of MAIRS activities
10:15–10:30 Mandira Shrestha : Intro of ICIMOD
10:30–10:45 R. Krishnan : Intro of CCCR-IITM

10:45–11:30 Group photo and coffee/tea break

11:30-13:00 Scientific session 1: Overview of CORDEX South Asia
(Chair: Manton, Rapporteur: Krishnan)

11:30–12:00 R.Krishnan : CORDEX South Asia: A framework for addressing regional monsoon issues in a changing climate
12:00–12:30 J. Sanjay : Report of 1st CORDEX South Asia training workshop (On behalf of Michel Rixen)
12:30–13:00 Arun Shrestha : Regional climate and its variability over the Hindu-Kush Himalayas: Users Perspective

13:00–14:00 Lunch Break

14:00–15:30 Scientific session 2: Hindu-Kush Himalayas and Tibetan Plateau: Regional climate and model performance
(Chair: Krishnan, Rapporteur: Manton)

14:00–14:30 Rishi Sharma : **"Climate Portal"** developed by DHM

15:30–15:00 Xuejie GAO : Uncertainties in Monsoon Precipitation Projections over China and the Tibetan Plateau: Results from Two High-Resolution RCM Simulations

15:00–15:30 Ziqian WANG : Time-lagged Impact of Spring Sensible Heat Source over the Tibetan Plateau on the Summer Rainfall Anomaly in East China

15:30–16:00 Coffee/Tea Break

16:00–16:30 Pinhong HUI : Regional Climate Modeling in the Source Region of Yellow River with complex topography using the RegCM3: Model validation (session 2 contd)

16:30–17:30 Interaction with participants: (Co-ordinators: Mandira Shrestha and Ailikun)

Day 2: Wednesday, 28 August 2013

09:00–13:00 Scientific session3: Climate Projections in Hindu-Kush Himalayan and Tibetan Plateau

(Chair: Fredolin, Rapporteur: Sanjay)

09:00–09:30 Wenjie DONG : Regional and Sub-regional Asian Climate Simulation and Projection based on CMIP5.

09:30–10:00 Rajiv Chaturvedi : CMIP5 based climate change projections for South Asia: its application in IVA studies, an example of Karakoram-Himalaya region

10:00–10:30 Jai-Ho Oh : Projection of the global Climate change with the high-resolution AGCM based on the RCP Scenarios

10:30–11:00 Shuyu WANG : Multi-model climate scenarios in South Asia and Tibetan Plateau

11:00–11:30 Coffee/Tea Break

11:30 –13:00 Scientific session 3 continue

11:30–12:00 John McGregor : CORDEX South Asia simulations from the CCAM model

12:00–12:30 J. Sanjay : Role of soil moisture coupling on the surface temperature variability over the Indian subcontinent

12:30–13:00 Milind Mujumdar : Analysis and modelling of the 2010 heavy precipitation events over Pakistan

13:00–14:00 Lunch Break

14:00–15:30 Scientific session 4: Assessment of regional climate and model downscaling techniques and products
(Chair: Manton, Rapporteur: Ailikun)

14:00–14:30	Jinwon Kim :	Evaluation of precipitation over the Indian subcontinent
14:30–15:00	Paul Ramirez :	Demonstration of RCMES for the CORDEX South Asia domain
15:00–15:30	Yinpeng Li :	Climate downscaling and assessment studies

15:30–16:00 Coffee/Tea Break

16:00 – 17:00 (Scientific session 4 contd)

16:00–16:30	Fredolin Tangang :	Regional climate downscaling over the western part of the Maritime Continent
16:30–17:00	Jayashree Revadekar:	Analysis of observed temperature and precipitation extremes over South Asia

18:30–20:30 Reception

Day 3: Thursday, 29 August 2013

09:00 – 13:00 Scientific session5: Dialogue with end-users
Please note that Day 3 morning is plenary session with 80 people
(Chair: John McGregor, Rapporteur: Fredolin)

09:00–09:30	Mandira Shrestha :	Hydrological Applications
09:30–10:00	Chet Raj Upreti :	Climate Change and Agriculture
10:00–10:30	P.C Tiwari :	Integrated Land and Water Management for Ecosystem Restoration and Climate Change Adaptation

10:30–11:00 discussion and dialogue with end-users (joint discussion)
(discussion topics to be announced later)

11:00–11:30 Coffee/Tea Break

11:30–13:00 Session 6: Data and services
(Chair: Kim, Rapporteur: Paul)

11:30–12:00	Shuyu WANG :	RMIP data
12:00–12:30	Milind Mujumdar :	CORDEX South Asia data system

12:30–13:00 Yinpeng LI : Introduction of SimCLIM system

13:00–14:00 Lunch Break

15:30–16:00 Coffee/Tea Break

14:00–15:30 Session 7: Introduction to hands on training

14:00–14:30 --- J. Sanjay, IITM, Pune - CDO applications for CORDEX South Asia data analysis

14:30–15:00 --- Jayashree Revadekar, IITM, Pune - Observed climate data for South Asian region

15:00–15:30 --- Vimal Mishra, IIT Gandhinagar - Climate change, Hydrology and Water Resources

15:30 –16:00 Coffee/Tea Break

16:00–17:30 Introduction to hands on training (Session 7 continued)

16:00–16:30 --- Devraju, IISc, Bangalore – Climate change and terrestrial carbon cycle

16:30–17:00 --- Senthilnathan, TNAU, Coimbatore – Climate change, Agriculture & Economics

17:00–17:30 ---

Day 4: Friday, 30 August 2013

09:00–13:00 Session 8: Hands on training

Venue – Training Room	**Venue: Conference Room**
09:00 – 11:00 Hands on training Module 1 (Trainers: J. Sanjay, Jayashree Revadekar, Milind Mujumdar and Vimal Mishra)	**09:00 – 11:00 Hands on training Module 2** (Trainers: Rajiv Chaturvedi, Devaraju, Senthilnathan, Sandip Ingle)
11:00–11:30 Coffee/Tea Break	**11:00–11:30 Coffee/Tea Break**
11:30–13:00 Hands on training Module 2 (Trainers: Rajiv Chaturvedi, Devaraju, Senthilnathan, Sandip Ingle)	**11:30–13:00 Hands on training Module 1** (Trainers: J. Sanjay, Jayashree Revadekar, Milind Mujumdar and Vimal Mishra)

13:00–14:00 Lunch Break

14:00-15:30 Session 9: Feedback, discussion and summary

(Chair: Arun, Rapporteur: John McGregor)

- Feedback by user groups

- Joint discussion on coordination of CORDEX Asia: south Asia, east Asia and southeast Asia
- Summarize outcomes of the training workshop

2) Agenda of "The 1st WCRP/CORDEX Science and Training workshop in Southeast Asia", 17-20 November 2014 in BMKG Training Center, Citeko Bogor, Indonesia.

The 1st WCRP CORDEX Science and Technology Workshop in Southeast Asia
(in partnership with MAIRS, APN, BMKG, NUM, IAP)
17-20 Nov. 2014, BMKG Training Centre, Citeko Bogor, Indonesia

AGENDA

Day 1: Monday, 17 November 2014 (Training workshop)

08:00-08:45	**Registration**
08:45-09:00	**Opening Speech : Dr. Andi Eka Sakya** Director General of BMKG
09:00-09:15	**Opening Address:** Dr. Edvin Aldrian from BMKG Dr. Fredolin Tangang from SEACLID/CORDEX SEA Dr. Ailikun from MAIRS
09:15-09:45	**Group Photo and Coffee/Tea Break**
09:45-11:00	Training Theme 1: Introduction to dynamical regional climate downscaling and CORDEX Lecture by: Liew Juneng
11:00-12:30	Training Theme 1: Introduction to regional climate model evaluation and analysis Lecture by: Faye Cruz
12:30–13:30	**Lunch Break**
13:30-14:30	Training Theme 2: Cumulative distribution function-based downscaling method (CDFDM), a simple tool for learning a bias-correction type statistical downscale method. Lecture by: Motoki Nishimori
14:30-15:00	**Coffee/Tea Break**
15:00-17:00	Hand-on exercise on Theme 2 by: Motoki Nishimori
17:30-18:30	**Dinner**

19:00-21:00 Hand-on exercise of Theme 1: Application of CDO and visualization of model output using initial results from the CORDEX-SEA project by Thanh Ngo-Duc

Day 2: Tuesday, 18 November 2014 (Training workshop)

09:00-10:30 Training Theme 3: Using CORDEX model outputs for informing water sector
Lecture by: Dewi Kirono

10:30-11:00 Coffee/Tea Break

11:00-12:30 Training Theme 3: Using CORDEX model outputs on hydrology and water resources models
Lecture by: Dewi Kirono

12:30–13:30 Lunch Break

13:30-17:30 Training Theme 4: Using CORDEX model outputs on Agriculture & Ecosystems (lecture)

13:30-14:15 Attachai Jintrawet: Assessing impacts of climate change scenarios on rice, cassava, maize and sugarcane production systems in Thailand using DSSAT v4.6 package and MWCropDSS shell

14:15-15:00 Rizaldi Boer: Utilization of climate information for managing climate risk in crop production

15:00-15:30 Coffee/Tea Break

15:30-17:30 Hand-on exercise of Theme 4: DSSAT v4.6 package and MWCropDSS shell by Attachai Jintrawet

17:45-18:45 Dinner

19:00-21:00 Hand-on exercise of Theme 3 by Dewi Kirono and Shaukat Ali

Day 3: Wednesday, 19th November 2014 (Science workshop)

08:30-09:00	**Registration**
09:00–10:20	**Opening session**
	(Chair: Budi Suhardi, Rapporteur: Ailikun)
09:00–09:20	**Welcome addresses:**
	Dr. Fredolin Tangang from SEACLID/CORDEX SEA
	Dr. Ailikun from MAIRS
09:20–09:40	Michel Rixen: Intro of CORDEX/WCRP (via Skype)
09:40-10:00	Ailikun: Intro of MAIRS
10:00–10:30	**Group Photo and Coffee/Tea Break**
10:30-12:00	**Scientific session 1: Overview of CORDEX Asia**
	(Chair: Manabu Yamanaka, Rapporteur: Ailikun)
10:30-11:00	Fredolin Tangang: CORDEX Southeast Asia
11:00–11:30	Hyun-Suk KANG: CORDEX East Asia
11:30–12:00	Sanjay Jayanarayanan: CORDEX South Asia
12:00–13:00	**Lunch Break**
13:00–14:30	**Scientific session 2: Climate and its variability in Southeast Asia**
	(Chair: Hyun-Suk Kang, Rapporteur: Faye Cruz)
13:00-13:30	Manabu Yamanaka: Physical Climatology of Indonesian Maritime Continent: An Overview of Observational Studies
13:30-14:00	Fredolin Tangang: Intra-seasonal to interannual climate variability in the Southeast Asia region: Understanding and gaps.
14:00-14:30	Jaiho OH: From global scenarios on climate change to regional extremes: A global downscaling perspective
14:30-15:00	**Coffee/Tea Break**
15:00-15:40	**Science session 3: Climate change in Southeast Asia**
	(Chair: Fredolin Tangang, Rapporteur: Faye Cruz)
15:00-15:20	Ahmad Jamaluddin: MJO Modulation of Rainfall Diurnal Cycle over Peninsular Malaysia during Boreal Summer
15:20-15:40	Sandeep Sahany: Dynamical Downscaling of the CMIP5 Models Over the Western Maritime Continent: Historical Simulations
15:40-16:00	Seree Supratid: Uncertainty of precipitation from CMIP3 and CMIP5 climate models downscaling for Bangkok
15:40–17:00	**Interaction with participants: how to interact with users of climate models**
	(Chair: Tangang, Rapporteur: Sanjay)
	Commentators: Ailikun, Jack, Dewi, Attachai
18:30-20:30	**Reception**

Day 4: Thursday, 20 November 2014

09:00–12:00	**Scientific session 4: Dynamical Regional Climate Downscaling**
	(Chair: Edvin, Rapporteur: Juneng)
09:00-09:20	Dodo: Intro of BMKG
09:20–09:50	Jason Evans: NARCliM: Providing regional climate projections for Southeast Australia
09:50–10:20	Jack Katzfey: High resolution climate projections for Indochina
10:20–10:50	Xuejie Gao: Improvements of RegCM4 simulation over Southeast Asia: tests of Sea Surface Fluxes scheme
10:50–11:00	**Coffee/Tea Break**
	Scientific session 4 continue
	(Chair: Jason Evans, Rapporteur: Juneng)
11:00–11:20	Shuyu WANG: Multi-RCM in regional climate change: experience and expectation
11:20-11:40	Faye Cruz: Evaluation of the sensitivity of temperature on physical parameterization schemes of RegCM4 over CORDEX-SEA region
11:40-12:00	M. Nishimori: MMLR-SD for multi-surface climate elements over Japan by using the general circulation field from reanalysis datasets, GCMs and RCMs.
12:00–13:00	**Lunch Break**
13:00-14:20	**Scientific session 5: Statistical Downscaling**
	(Chair: Hyun-Suk Kang, Rapporteur: Sanjay)
13:00-13:30	Edvin Aldrian: Climate Change & Intra-seasonal to inter-annual climate variability in Southeast Asia region
13:30–14:00	Liew Ju Neng: Downscaling Projection of Peninsular Malaysia Daily Precipitation Using Bias Correction Techniques
14:00-14:20	Pushp Raj Tiwari：Southeast Asia in the midst of uncertainties: Can potential future plights could be alleviated with currently available forecasting skill?
14:20–16:00	**Scientific session 6: Application of Regional Climate Downscaling Products in Hydrology & Water Resources**
	(Chair: Dodo, Rapporteur: Shuyu WANG)
14:20–14:40	Dewi Kirono：From Climate Change Impacts to Adaptation: an Assessment of Water Security in Makassar City, Indonesia
14:40–15:00	Heru Santoso: Managing risk of drought from climate extreme and change in small islands: the importance of climate and sea level rise projections in the artificial groundwater recharge design
15:00–15:20	**Coffee/Tea Break**
	Scientific session 6 continue
15:20–15:40	Nguyen-Khoi Dao: Hydrological responses to future climate and land-use changes in the Srepok watershed, Vietnam
15:40-16:00	Thanh Ngo-Duc: Performance evaluation of RegCM4 in simulating Extreme Rainfall and Temperature Events over the CORDEX-SEA regions
16:00-	**Scientific session 7: Application of Regional Climate Downscaling Products in Agriculture & Ecosystem**

(Chair: Jack Katzfey, Rapporteur: Heru Santoso)

16:00–16:20 Attachai: Impacts of climate change scenarios on rice, cassava, maize and sugarcane production systems in Thailand: TRF's experiences

16:20–16:40 Ramasamy Jagannathan: Downscaling CMIP5 projections for Peninsular India and impact studies through crop yield simulation models

16:40-17:00 Nguyen Cuc: Functions and services of mangrove ecosystem in Vietnam in the context of climate change

17:00-17:20 Rafaela Jane Delfino: Climate Knowledge Portal for the Philippines: bringing climate information for effective CCA and DRM

17:20-18:00 Discussion, conclusions and closing
(Chair: Fredolin, Rapporteur: Ailikun)

18:30-19:30 Dinner

3) Agenda of "The 4th WCRP/CORDEX Science and Training workshop in East Asia", 23-26 November 2015 in UCAS International Conference Centre, Beijing, China.

The 4th WCRP CORDEX Science and Training Workshop in East Asia

23-26 Nov. 2015
University of Chinese Academy of Sciences, Beijing, China

AGENDA

08:15-08:45	**Registration**
08:45-09:00	**Opening Speech :**
09:00-10:30	Training Theme 1: Analysis of global climate model simulations and NCL Lecture by: Ying XU (CMA)
10:30-11:00	**Coffee/tea break and group photo**
11:00-12:30	Training Theme 2: Application of regional climate models and regional climate change projections Lecture by: Xuejie GAO (IAP/CAS)
12:30–13:30	**Lunch Break**
13:30-18:00	Training Theme 3: Modeling Water-Food-Energy Nexus with the GEPIC Model Lecture by: Junguo LIU (Beijing Forestry University)
15:30-16:00	**Coffee/Tea Break**
16:00-18:00	Hand-on exercise on Theme 3 by: Junguo LIU
18:30-19:30	**Dinner**

Day 2: Tuesday, 24 November 2015 (Training workshop)

09:00-11:00	Training Theme 4: Application of regional climate model output into hydrological simulation, Lecture by: Xieyao MA (JAMSTEC)
11:00-11:30	**Coffee/Tea Break**
11:30-12:30	Training Theme 4: Application of regional climate model output into hydrological simulation, Hand on exercise on Theme 4: Xieyao MA (JAMSTEC)
12:30–13:30	**Lunch Break**
13:30-15:30	Training Theme 5: Downscaling using variable-resolution global models (in particular CCAM) Lecture by: John McGregor (CSRIO)
15:30-16:00	**Coffee/Tea Break**
16:00-18:00	Training Theme 6: Circulaton-Index-Based Statistical Downscaling Model (CISDM), a tool for learning how to downscale daily precipitation Lecture by Lijun FAN (IAP/CAS)
18:30-20:30	**Dinner**

Day 3: Wednesday, 25th November 2015 (Science workshop)

08:30-09:00	**Registration**
09:00–10:30	**Opening session**
	(Chair: Manton, Rapporteur: Ailikun)
09:00–09:10	**Welcome addresses:**
	Dr. Michael Manton (MAIRS SSC)
	Dr. Ailikun, APN project leader
09:10-10:40	**Scientific session 1: Overview of CORDEX Asia**
09:10–09:40	Hyun-Suk KANG (NIMR/KMA): CORDEX-East Asia: Lessons from Phase 1 and Issues for Phase 2
09:40-10:10	Fredolin Tangang (National University of Malaysia): The Southeast Asia Regional Climate Downscaling (SEACLID)/CORDEX Southeast Asia Project: An update of the latest progress
10:10-10:30	Ailikun (IAP/CAS): report of APN CORDEX Asia project
10:30–11:00	**Group Photo and Coffee/Tea Break**
11:00-12:30	**Scientific session 2: climate variability and climate modeling in East Asia**
	(Chair: Hyun-Suk Kang, Rapporteur: H. Kawase)
11:00-11:20	Izuru Takayabu (MRI/Japan): Database for Probabilistic Description of Future Climate Change (d4PDF)
11:20–11:40	Shuyu WANG (Nanjing University/China): Multi-model simulation of Asian monsoon climate: experiences and lessons learnt from RMIP
11:40–12:00	Koji Dairaku (NIED/Japan): Development of probabilistic regional climate scenario in East Asia
12:00-12:20	Dong-Hyun Cha (Ulsan National Institute of Science and Techonology/Korea): Added values in regional climate simulations over the Korean Peninsula and East Asia
12:30–13:30	**Lunch Break**
13:30–15:10	**Scientific session 2: Climate variability and climate modeling in East Asia**
	(Chair: Fredolin Tangang, Rapporteur: Koji Dairaku)
13:30-13:50	John McGregor (CSRIO): Recent climate downscaling activities using CCAM
13:50-14:10	Hiroaki Kawase (MRI/Japan): Future projection of extreme snowfall in Japan
14:10-14:30	Seung-Ki Min (POSTECH/Korea): Multi-RCM Future Projections of Summer Climate Extremes over East Asia
14:30-14:50	Lijun FAN (IAP/CAS): Comparison between two statistical downscaling methods for summer daily rainfall in Chongqing, China
14:50-15:10	Xiaodan GUAN (Lanzhou University/China): The role of dynamically induced variability in the temperature variability over the Northern Hemisphere
15:10-15:30	**Coffee/Tea Break**
15:30-18:00	**Science session 3: Application of climate modeling products (Invited talks)**
	(Chair: Ailikun, Rapporteur: John McGregor)
15:30-16:00	Jianguo HUANG (South China Botanical Garden/CAS): Effects of future climate change on radial growth of four dominant tree species in the

	Canada boreal forest
16:00-16:30	Yongyong ZHANG (IGSNRR/CAS): Simulation and classification of the impacts of projected climate change on flow regimes in the arid Hexi Corridor of Northwest China
16:30-17:00	Hongming HE (The institute of soil and water conservation/CAS): Hydrological processes and Systems in a changing environment: sustainability of ecosystem restoration in the Loess Plateau, China
17:00-17:30	Junguo LIU (Beijing Forestry University/China): Water resources assessment and management in the Context of Global Change
17:30-18:00	Hui JU (Chinese Academy of Agriculture Sciences): Predicting agriculture production capacity with climate modelling

18:30-20:30 **Reception**

Day 4: Thursday, 26th November 2015

08:30–10:10	**Scientific session 4: regional activity** (Chair: M. Manton, Rapporteur: F. Tangang)
08:30-08:50	Zhaohui LIN (IAP/CAS): Regional climate modeling and its implication in ICCES/CAS
08:50-09:10	G. Srinivasan (Regional Integrated Multi-hazard Early warning System /RIMES): Introduction of RIMES via Skype
09:10–09:30	Muhammad Afzaal (Pakistan Meteorological Department): Regional climate modeling in Pakistan
09:30–09:50	H.M.R.C. Herath (Department of Meteorology of Sri Lanka): Sri Lanka climate modeling activity
09:50–10:10	Hla Tun (Department of Meteorology and Hydrology/ Myanmar): Introduction of climate and modeling research in Myanmar

10:10–10:30 **Coffee/Tea Break**

10:30-12:00 **Discussion: Next step of CORDEX East Asia and CORDEX Asia** (Chair: Hyun-Suk Kang, Rapporteur: Ailikun)

12:30–13:30 **Lunch Break**
14:00-18:00 **Free Time**

4) Agenda of CORDEX EA workshop, 11-12 August 2014 in Jeju, Korea

The 3rd International Workshop on the CORDEX-East Asia

National Institute of Meteorological Research, Seogwipo, Jeju, Korea

August 11-12, 2014

co-sponsored by
Monsoon Asia Integrated Regional Study (MAIRS)

August 11 (Monday)

09:30 ~ 09:50	Welcoming (with coffee)
09:50 ~ 10:00	Opening and welcoming speech (Jae-Cheol Nam, Director-general of NIMR)

Session 1: Summary and Updates on Recent Activities (Chair: Hyun-Suk Kang)

10:00 ~ 10:20	Summary of recent meetings (Ailikun)
10:20 ~ 10:40	RMIP project (Shuyu Wang)
10:40 ~ 11:00	SOUSEI program (Hiroaki Kawase)
11:00 ~ 11:20	CODEX-East Asia and SAT meeting (Hyun-Suk Kang)
11:20 ~ 11:40	SEACLID: CORDEX-Southeast Asia (Fredolin Tangang)
11:40 ~ 12:00	CORDEX-South Asia (Milind Mujumdar)
12:00 ~ 12:20	Australasia CORDEX (John McGregor)
12:20 ~ 12:35	Efforts of UN Science Advisory Board for sustainable development (Dong-Pil Min)
12:35 ~ 14:00	Lunch

Session 2: Scientific Issues for CORDEX-EA Phase II

14:00 ~ 15:30	**Domain and resolution issues** (Chairs: Xuejie Gao, Shuyu Wang, Hyun-Suk Kang)

- Mandatory domain with 25 km resolution (should be fixed in the workshop)
- Alternative domains or sub-domains
  - for specific phenomena to capture such as tropical cyclones, storm track, snow feedback over Tibetan Plateau, or
  - with higher-resolution up to ~10 km with and/or without multi-nesting approach

15:30 ~ 16:00 Coffee Break

16:00 ~ 18:00 **Modelling issues**
(Chairs: Song-You Hong, Shuyu Wang, Koji Dairaku)

- Model development/improvement
- Process and/or sensitivity studies (e.g., driving force, physics parameterisation, horizontal/vertical resolutions, domain sizes, and etc.)
- Tropical cyclones and regional ocean processes
- Tibetan Plateau and regional hydrological cycles
- Urban effects and PBL processes

18:30 ~ Dinner (Hotel Bareve)

August 12 (Tuesday)

Session 2: Scientific Issues for CORDEX-EA Phase II (Continued)

09:00 ~ 11:00 **Analysis issues**
(Chairs: Hiroaki Kawase, Myung-Seok Suh, Seung-Ki Min)

- GCM analysis to choose LBC forcing
- Added-value of high-resolution simulations (including how to define added-value), such as
  - Climate extremes (e.g., precipitation, temperature)
  - Extreme phenomena (e.g., tropical cyclones, strong/weak monsoon, heat wave/cold surge, etc.)
  - Ensemble methods and uncertainty assessment

11:00 ~ 11:30 Coffee Break

Session 3: Practical Issues for CORDEX-EA Phase II

11:30 ~ 12:30 **Arrangement for the Simulations**
(Chairs: Hyun-Suk Kang, Koji Dairaku, John McGregor)

- Mandatory experiments (evaluation, historical, and projection) and others if necessary
- Experimental configurations (period, driving force, RCP/GCM/RCM metrics)
- Timeline (NB: needs to meet CMIP6 timeline)
- List up very-core variables (at most 10) for fast analysis

12:30 ~ 14:00 Lunch

14:00 ~ 15:00 **Data Center**
(Chairs: Shuyu Wang, Hyun-Suk Kang, Hiroaki Kawase)

- ESGF node for data publication and service
- Roles of current web portal (cordex-ea.climate.go.kr)
- Other possibility or candidates for data center

15:00 ~ 16:00 **Task Sharing** (Chair: TBD)

- Identify participating groups to be joined
- Observational datasets and gathering station measurements by each group
- Who will provide reanalysis and GCM forcing and how?
- Leading group for each given scientific issue

16:00 ~ 16:30 Coffee Break

16:30 ~ 17:30 **Preparation of CORDEX-SEA meeting in November**
(Chairs: Fredolin Tangang, Milind Mujumdar, Ailikun)

17:30 ~ 19:00 **AOB and Meeting Summary**

5) Agenda of ESGF Training workshop for CORDEX Asia in 4-5 Dec. 2014 in WMO Regional Training centre in Nanjing (RTC), Nanjing University of Information Science and Technology, China.

Agenda of ESGF training workshop for CORDEX Asia
4-5 Dec 2014, WMO regional training center in Nanjing,
Nanjing University of Information Science and Technology

Day 1, Thursday, 4 Dec 2014

09:00-09:30 Opening ceremony: (Chair: Prof. Suchun WANG)
Local host: Prof. Shengjie NIU, vice-president of NUIST
MAIRS: Ailikun
WCRP/ESGF: Michael Kolax, Nicolas Carenton
Group Photo

09:30-12:00
Session 1: Introduction to Earth System Grid Federation (ESGF), (by Nicolas Carenton)

- ✓ International community and sponsors
- ✓ ESGF goals and challenges
- ✓ Federation architecture
- ✓ Software stack

10:30-10:50 Coffee break

10:50-12:00 **Session 1 continue (by Nicolas Carenton)**

- ✓ Federation example – ESGF nodes in France
- ✓ Release management processes and tools
- ✓ Distribution Mirrors

12:00-13:30 Lunch

13:30-17:00
Session 2: Setting up ESGF Node (by Nicolas Carenton)

- ✓ Hardware / Pre-requisites software / packages requirement
- ✓ Installation of ESGF and Configuration of Node

15:30-15:50 Coffee break

15:50-17:30 Session 2 continue
Hand-on exercises on setting up an ESGF test federation

18:30-20:00 Dinner

Day 2, Friday, 5 Dec 2014

09:00-12:00

Session 3: Quality Control for CORDEX (by Michael Kolax)

- ✓ Quality Control - The QC-4.0 by DKRZ
- ✓ Operational Quality Control for CORDEX at SMHI

10:30-10:50 coffee break

10:50-12:00 **Session 3 continue (by Michael Kolax)**

- ✓ Practical Examples

12:00-13:30 Lunch

13:30-15:30
Session 4: Data Publishing on ESGF Node (by Nicolas Carenton)

- ✓ Directory Structure and drstool
- ✓ Publication

15:30-15:50 Coffee break

15:50-17:30
Session 4: User experience (by Nicolas Carenton)

- ✓ Federated search
- ✓ wget and gridftp download
- ✓ OpenDAP Access
- ✓ LAS Access

18:30-20:00 dinner

6) Agenda of "The Empirical-Statistical Downscaling (ESD) Asian Workshop" in 23th Nov. 2016 in Hanoi University of Science, Hanoi, Vietnam.

The 4th Workshop of the Southeast Asia Regional Climate Downscaling (SEACLID)/ CORDEX Southeast Asia Project & **Discussion on the Formation of Empirical-Statistical Downscaling (ESD) Group in CORDEX Asia**

Hanoi, Vietnam

23-25 November 2016

Workshop venue: Le Van Thiem lecture hall, VNU University of Science, 19 Le Thanh Tong str., Hoan Kiem, Hanoi

WORKSHOP PROGRAM

November 23 (Wednesday)	Formation of Empirical-Statistical Downscaling (ESD) Group in CORDEX Asia
13.00 – 13.30	Registration
	Presentation Session (13.30 – 15.30) Chair: Prof. Dr. Ailikun
13:30-13:45	Dr. Koji Dairaku (CORDEX Asia ESD Leader): Opening and Brief Introduction of CORDEX Asia ESD
14:00-14:15	Dr. Nishimori (Japan): Bias Correction, Weather Generator and Empirical Statistical Downscale for Impact Studies on Agriculture - Previous and Ongoing Activities of NIAES-
14:15-14:30	Dr. Lianhua ZHU (China): Downscaling daily precipitation over the Yangtze-Huaihe River Basin in China using multiple statistical Methods
14:30-14:45	Dr. Liew Juneng (Malaysia): Downscaling and Bias Correction of Precipitation and Surface Air Temperature over the Southeast Asia Regions
14:45-15:00	Dr. Jerasorn Santisirisomboon (Thailand): Statistical Downscaling Activities of RU-CORE
15:00-15:15	Dr. Akiyo Yatagai (Japan): APHRODITE-2: Asian Precipitation -- Highly Resolved Observational Data Integration Towards Evaluation of Extreme Events
15:15-15:35	Coffee break
16.00 – 17.30	**Discussion Session** Chair: Dr Koji Dairaku Rapporteur: Juneng, Ailikun

	Topics: 1. The main objectives of ESD group 2. What kinds of ESD datasets, methodologies or software can be shared in Asian group? 3. What kinds of products can be provided by ESD group? 4. Task allowance of ESD Asian team and coordination mechanism 5. Plan of Joint activity and funding opportunities

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

1) Participants list of "The 2nd WCRP CORDEX South Asia Science and Training Workshop", 27-30 August, 2013 in Kathmandu, Nepal.

The 2nd WCRP CORDEX Science and Training Workshop in South Asia

27-30 August 2013

ICIMOD, Kathmandu, Nepal

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