



#### CORDEX-East Asia: Lessons and Issues

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and

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- Introduction to the CORDEX-Asia activities
- Some results and lessons from the phase I
- Issues for the current phase

# Introduction

#### **CO**ordinated **R**egional **D**ownscaling **EXperiment** <u>http://www.cordex.org</u>

The CORDEX vision is to advance and coordinate the science and application of regional climate downscaling through global partnership



- To better understand relevant regional/ local phenomena, their variability and changes through downscaling
- To evaluate and improve regional climate downscaling models and techniques (RCM, ESD, VAR-AGCM, HiRes-AGCM)
- To produce large coordinated sets of regional downscaled projection worldwide
- To foster communication and knowledge exchange with users of regional climate information

## **CORDEX - History**

- Initial discussions across the downscaling community (mostly RCM) -Toulouse 2009
- Establishment by the WCRP of the Task Force on Regional Climate Downscaling TFRCD (2010)
- Design of Phase I framework and first CORDEX conference Trieste
  2011
- Establishment by the WCRP of the Science Advisory Team SAT (2012)
- The second PAN-CORDEX conference ICRC 2013 Brussels, 2013
- Establishment by WCRP of the Working Group on Regional Climate, WGRC - 2013
- SAT meetings 2014, 2015 to coordinate protocol for the next Phase
- The third PAN-CORDEX conference ICRC 2016 Stockholm, 2016

#### CORDEX - Management



SAT-1 meeting @ ICTP (Italy), 16-17 May, 2014



SAT-2 meeting @ SMHI (Sweden), 25-27 Feb., 2015

- International Project
   Office for CORDEX
   (IPOC) hosted by SMHI since January 2015.
- 12 SAT members (co-Chairs: F. Giorgi, W. Gutowski) for planning and revisit CORDEX activities
- ESGF-based CORDEX archiving coordinated by IS-ENES
- Regional points of contacts (POCs), 2-3 per region

#### CORDEX-East Asia





The 3rd International Workshop on CORDEX-East Asia 11-12 August 2014, National Institute of Meteorological Research, Jeju, Korea

- Initiated by KMA funding since 2010
- 5 RCM and 1 SDM from groups from Korea
- Series of Workshop on CORDEX-EA 2011, 2012, 2014, and 2015
- Strong feedback among Asia community (Pan-Asia Science and Training Workshops, AOGS meetings, ICRC, and etc.)
- Data archived at KMA (<u>http://cordex-ea.climate.go.kr</u>)
- CORDEX-Asia ESGF training workshops (Nanjing 2014, Jeju 2016)

## Results from the Phase I and Limitations

## A Regional Downscaling Project coordinated by KMA

#### Domains for climate projections at KMA



- 5 regional climate models for CORDEX-EA domain (50 km) and smaller sub-region (12.5 km).
- I statistical downscaling model for Korean peninsula up to I km's resolution.
- I group from Japan (U.Tokyo) has participated recently.

#### Downscaling Experiments



evaluation / historical / rcp 2.6, 4.5, 6.0, 8.5

## Highlights

- Performance-based ensemble average (PEA) method (Suh et. al., J. Climate, 2012)
- East Asian summer monsoon
- Impacts of aerosol forcing (Hong and Kang, submitted, 2015)
- Extreme for precipitation and temperature (Park, Min et al., Clim. Dyn., 2015)
- Tropical Cyclones (Jin, Cha et al., Clim. Dyn., 2015)
- Additional papers: APJAS special issue on "Regional Climate Downscaling over Asia-Pacific Region" - May 2016

#### East Asia Summer Monsoon



JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

#### East Asia Summer Monsoon (850 hPa Circulations)



#### Impacts of the SST bias correction



#### Impacts of the SST bias correction



#### Impacts of aerosol forcing



Aerosol number density









-2

-6

140E

130E

120E

110E

30N

- TAS and PR will increase both mean and extremes
  - ✓ Stronger warming in northern areas than southern, higher spatial variability in precipitation than in temperature
  - ✓ Good inter-RCM agreement
- Precipitation increases shows consistent with CC relation
  - ✓ PR increases for mean and extreme are 3% and 7%, respectively.

Mean and Extreme Projections using 5 RCMs' ensemble (Courtesy of Park et al., 2015, Clim. Dyn.)

3.5

2.5

1.5

0.5

30

25

20 15

10

-5

-10

-15

-20

#### **Tropical Cyclones**



#### **Tropical Cyclones**



Reasonable results for Typhoon genesis and track density but 50 km resolution shows limitation in capturing storm intensity

#### Limitations

- Most participating groups are from Korea. A few more from other countries but no feedback.
- Only one GCM forcing and with spectral nudging in most RCMs constraint the spread of model uncertainties. (cf. EURO-CORDEX: 12GCMs/8RCMs/ 3RCPs for 50 km, 7/8/3 for 12.5 km)
- No statistical downscaling for the CORDEX domain.
- Data archive and provision without quality control. Standard protocol for CORDEX archive (ESGF) is essential.

#### Issues for the Phase II

#### **CORDEX-EA Phase II**



Domain	Number of Grids	Resources		
50 km (0.44 deg)	220 x 183	I		
25 km (0.22 deg)	396 x 251	4.8		
12 km (0.11 deg)	792 x 501	38		

60°E

Preliminary results for precipitation bias against GPCP precipitation





90°E 120°E 150°E

#### Plans for the Phase II

- Flexible resolution for standard domains
  - 12.5, 25, 50 km (higher for some region and/or specific FPSs)
- CMIP6 (+ CMIP5) driving GCMs
- Flagship Pilot Studies and CORE framework
  - Proposals to be elicited from regional communities
  - Procedure/criteria for endorsement of FPS being designed
- Better integration with statistical downscaling
- ESGF framework for the data storage and provision
- More emphasis on the process-based assessment and model development

#### Common Issues for the Phase II

- GCM-RCM metrics and point of contacts for each group
- ESGF as a Data Support Framework
- Feasibility to contribute for FPS and/or CORE
- How to encourage ESD group to join CORDEX-EA

#### Dynamical Downscaling Groups (POCs)

#### 14 groups are joining the CORDEX-EA Phase II

- KMA/Korea: Dr. H.-S. Kang (<u>hyunsuk306.kang@gmail.com</u>)
- KNU/Korea: Prof. M.-S. Suh (sms416@kongju@ac.kr)
- PNU/Korea: Prof. J.-B. Ahn (jbahn@pnu.ac.kr)
- POSTECH/Korea: Prof. S.-K. Min (<u>skmin@postech.ac.kr</u>)
- UNIST/Korea: Prof. D.-H. Cha (<u>dhcha@unist.ac.kr</u>)
- NCC/China: Dr. X. Gao (gaoxuejie@mail.iap.ac.cn)
- NJU/China: Prof. S. Wang (<u>wsy@tea.ac.cn</u>)
- NJU/China: Prof. J. Tang (jptang@nju.edu.cn)
- NUIST/China: Prof. ZH JIANG (zhjiang@nuist.edu.cn)
- NIED/Japan: Dr. K. Dairaku (<u>dairaku@bossai.go.jp</u>)
- MRI/Japan: Dr. H. Kawase (<u>hkawase@mri-jma.go.jp</u>)
- AORI/Japan: Prof K. Yoshimura (kei@aori.u-tokyo.ac.jp)
- CUHK/HK China: Prof.T. C. Yung, Francis (<u>Francis.Tam@cuhk.edu.hk</u>)
- CSIRO/Australia: Dr. J. McGregor (<u>John.McGregor@csiro.au</u>)

#### **GCM-RCM** metrics

#### provided by EA countries

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

## East Asia summer monsoon by CMIP5 models (1st EOF mode of precipitation)



#### Pan-Asia ESGF Training Workshop - February 23-25, 2016, Jeju, Korea -

- Co-sponsored by NIMS/KMA, WCRP/CORDEX, and IS-ENES three trainers from European ESGF community and 30 trainees from CORDEX-Asia community.
- Lectures and hand-on exercises on ESGF installation, CMORlization, data publication, and quality control.
- The current web-based data centre will be replaced with ESGF data node at KMA.



#### An Important IPCC Meeting Summary

IPCC Workshop on Regional Climate Projection and their Use in Impacts and Risk Analysis Studies, 15-18 September 2015, INPE, Sao Jose dos Campos, Brazil

- Issue on Usefulness of downscaling information across WGs
- Requirements
  - Homogeneity across regions
  - Relevant for VIA applications and process-oriented analysis
- Recommendations
  - Task force or team with participants from CORDEX, VIACS, and Working Groups I and 2
  - Discuss the best experimental design for CORDEX to be used by impact assessment groups and process-oriented analysis
  - Atlas-like products

#### CORDEX - CORE

- I. Sources of boundary conditions for both RCMs and ESD
  - At least 3 GCMs up to 6 that have good quality, distinctive development history, and able to represent range of climate sensitivity
  - CMIP5 or CMIP6 (under discussion on advantages/disadvantages)
  - Not addressed within the existing standard CORDEX framework
- 2. Scenario
  - Historical (last half of 20C) and RCP 8.5 (21C), Era-interim driven simulation is mandatory
- 3. Downscaling methods and models
  - Both ESD and RCMs (no more than 4 that had extensive application in many regions; e.g., RegCM, WRF, HadRM, COSMO-CLM, etc)

#### CORDEX - CORE

- 4. Resolution and Domains
  - Should be finer (suggests 12.5 km)
  - Optimally all CORDEX domains. Minimally 10 domains (N., C., S. America, Europe, C., SE., E Asia, Australia, discussion on MENA and MED)
- 5. Archive
  - Quality control, provenance, meta data, documentation
  - Variables: CORDEX core set should be minimised
  - Common grids for ease of users
  - Format: NetCDF, but also GIS-compatible and text/tabular format
- 6. CMIP6 coordination
  - Possibility to coordinate with Highres-MIP, VIA Advisory Board and/or other CMIP6

## Thanks for your Attention !