



ULSAN NATIONAL INSTITUTE OF
SCIENCE AND TECHNOLOGY

CORDEX East Asia Domain Activities

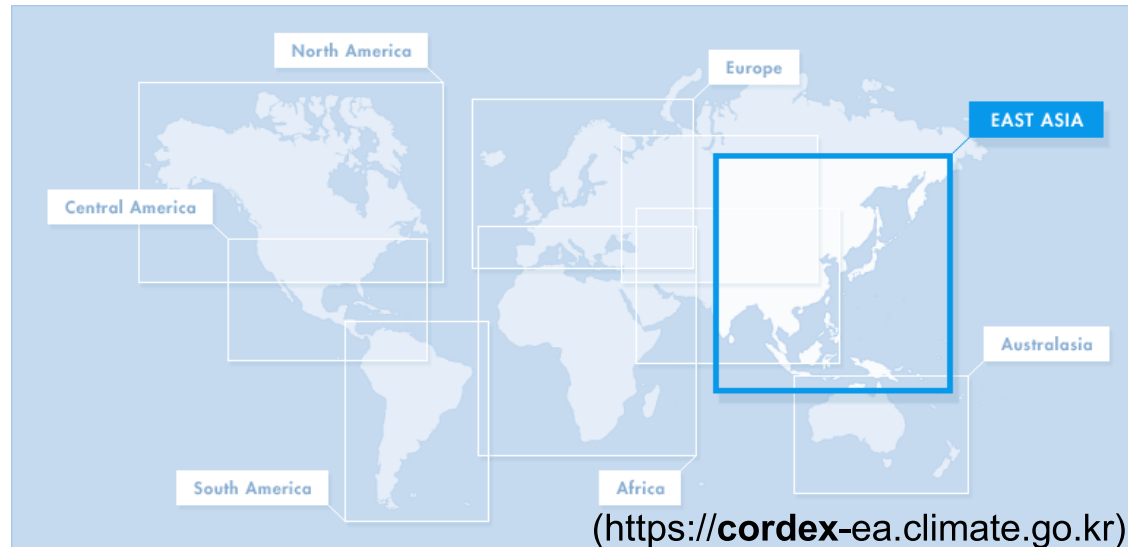
Dong-Hyun Cha

**Department of Civil, Urban, Earth and Environmental Engineering,
Ulsan National Institute of Science and Technology**

- 1. Introduction**
- 2. CORDEX EA**
- 3. Activities in East Asian Countries**
- 4. Summary**

CORDEX East Asia

CORDEX



- The World Climate Research Programme (WCRP) established in 2009 the Task Force for Regional Climate Downscaling (TFRCD), which created the CORDEX initiative to generate regional climate change projections for all terrestrial regions of the global within the timeline of the Fifth Assessment Report (AR5) and beyond.
- The major aims of the CORDEX initiative are to provide a coordinated model evaluation framework, a climate projection framework, and an interface to the applicants of the climate simulations in climate change impact, adaptation, and mitigation studies.
- **CORDEX-East Asia is the East-Asian branch of the CORDEX initiative and will produce ensemble climate simulations based on multiple dynamical and statistical downscaling models forced by multiple global climate models.**

International Collaboration in Regional Climate Modeling

The 3rd RMIP Workshop (2003, Shanghai)



The 4th RMIP Workshop (2004, Seoul)



International Collaboration in Regional Climate Modeling

CORDEX-EA Workshops

+ CORDEX-MAIRS (2024)



Jeju meeting (2012)



Beijing meeting with MAIRS (2015)



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

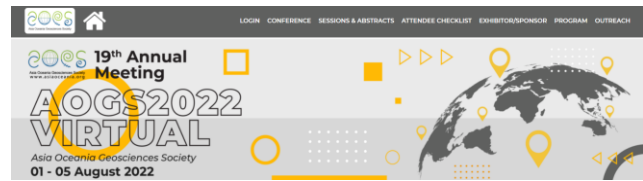
Jeju meeting (2014)



Jeju meeting (2019)

CORDEX Session in AOGS

Consecutive Sessions in AOGS Annual Meeting Regional Climate Downscaling and CORDEX: Challenges and Prospects



Title: Regional Climate Downscaling and CORDEX: Challenges and Prospects

The impacts of a changing climate and the adaptation strategies required to deal with them will occur on more regional and national scales. This is where regional climate downscaling has an important role to play by providing projections with much greater detail and more accurate representation of localized extreme events. A recent WCRP major project, Coordinated Regional Downscaling Experiment (CORDEX) provides a common framework that consists of 14 continental-scale domains, in which four initiatives belongs to: CORDEX-South Asia, East Asia, Southeast Asia, and AustralAsia. This region needs to be considered with caution and in- depth, both in geographical and climatological perspectives, because it covers very intrinsic and complex climatological phenomena. Despite the successful achievements made by CORDEX-Asia communities, we still need many issues to be addressed such as coupling ocean-atmosphere, climate-vegetation, climate-aerosols, and other climate processes. In addition, statistical/empirical regional climate downscaling approaches have received increasing attention by stakeholders in the regions. Hence, this session invites scientists within and outside the CORDEX initiatives to share their scientific findings on various issues related to dynamical and statistical/empirical regional climate downscaling methods.

- This session covers the following themes:
- 1) Evaluation of regional downscaling techniques (dynamical and statistical methods)
 - 2) Regional climate projection and understanding of climate sensitivity
 - 3) Comparison between CORDEX phases 1 and 2, and CMIP5 and CMIP6
 - 4) Added-values in regional climate downscaling by comparison with high-quality observation datasets
 - 5) Development of regional earth system model
 - 6) Process-based studies on sensitivity to the large-scale forcing, regional forcing, domain size, resolution, physics, etc.
 - 7) Impact studies of regional anthropogenic forcings such as land-use change, aerosol, and urbanization.
 - 8) Other issues relevant to regional climate downscaling including application to application sectors.

Co-conveners: Dong-Hyun Cha, Shuyu Wang, Koji Dairaku, Fredolin Tangang, and Jason Evans
Tentative Invited Speaker: Dong-Kyou Lee

Activities in East Asian Countries

CORDEX-EA Activities in South Korea

CORDEX projects in South Korea

2010-2011: CORDEX Phase I

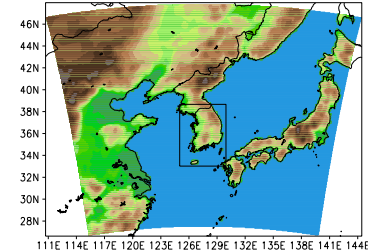
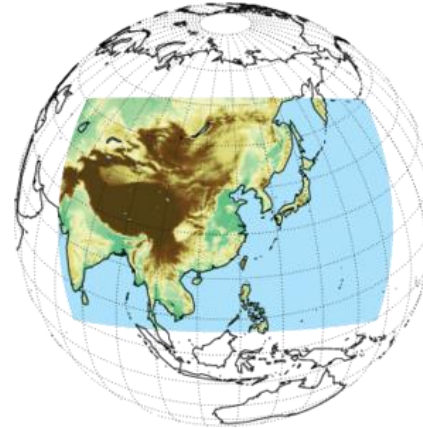
2012-2014: 12.5km Korea (KOR-11)

2015-2017: CORDEX Phase II (AR5)

2018-2020: CORDEX Phase II & FPS (AR5)

2020-2022: CORDEX Phase II & FPS (AR6)

2024-2026: CORDEX for Continuation of AR6 and Preparation for AR7



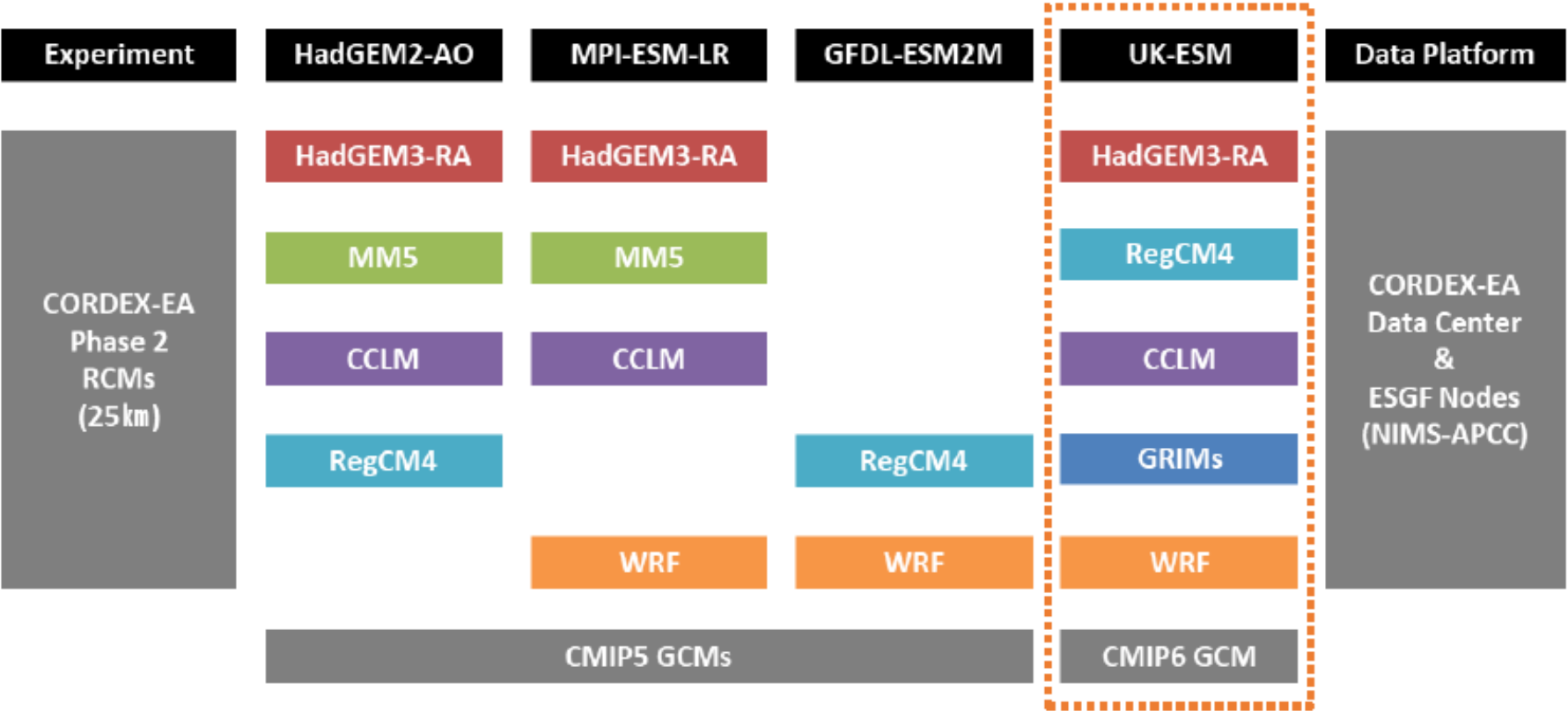
CORDEX EA
CORE
Experiments
(CMIP
downscaling)

CORDEX
FPS
Experiments
(CPM &
LULC)

Development
of RESM

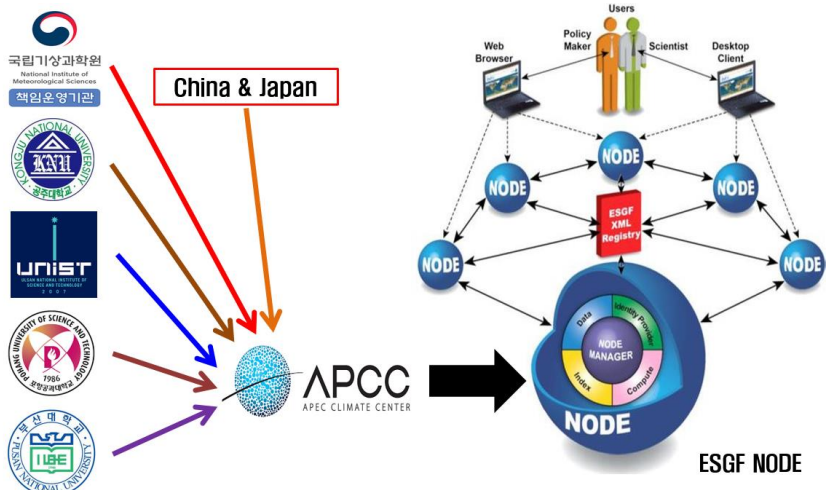
CORDEX-EA Experiments in Korea (CORE)

Dynamical Downscaling with multi-GCMs & multi-RCMs chains



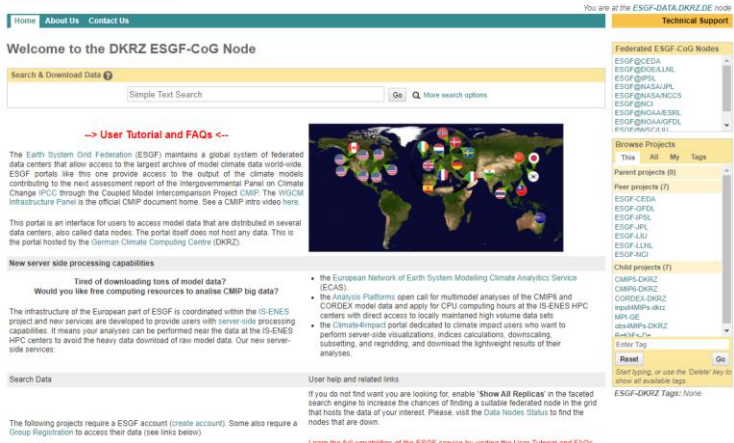
Sharing CORDEX-EA CORE Data

Earth System Grid Federation (ESGF) Node



<http://cordex-ea.climate.go.kr/cordex/dataDownload.do>

ESGF Node at DKRZ



ESGF Node at DKRZ

Welcome to the DKRZ ESGF-CoG Node

Search & Download Data

Simple Text Search [] [Go] More search options

--> User Tutorial and FAQs <-

The Earth System Grid Federation (ESGF) maintains a global system of federated data centers that allow access to the largest archive of model climate data world-wide. ESGF portals like this one provide access to the output of the climate models contributing to the next assessment report of the Intergovernmental Panel on Climate Change (IPCC) through the Coupled Model Intercomparison Project (CMIP). The IPCC Infrastructure Panel is the official CMIP document home. See a CMIP intro video here.

This portal is an interface for users to access model data that are distributed in several data centers, also called data nodes. The portal itself does not host any data. This is the portal hosted by the German Climate Computing Centre (DKRZ).

New server side processing capabilities

Tired of downloading tons of model data?
Would you like free computing resources to analyse CMIP big data?

- the European Network of Earth System Modeling Climate Analytics Service (ECAS),
- the Analysis Platforms open call for multimodel analyses of the CMIP5 and CORDEX model data and apply for CPU computing hours at the IS-ENES HPC centers with direct access to locally maintained high volume data sets
- the ClimateImpacts portal dedicated to climate impact users who want to perform sensor-side visualizations, indices calculations, downscaling, subsetting, and regridding, and download the lightweight results of their analyses.

User help and related links

If you do not find what you are looking for, enable "Show All Replicas" in the faceted search engine to increase the chances of finding a suitable federated node in the grid that hosts the data of your interest. Please, visit the Data Nodes Status to find the nodes that are down.

The following projects require a ESGF account (create account). Some also require a Group Registration to access their data (see link below).

Learn the full capabilities of the ESGF service by visiting the User Tutorial and FAQs.

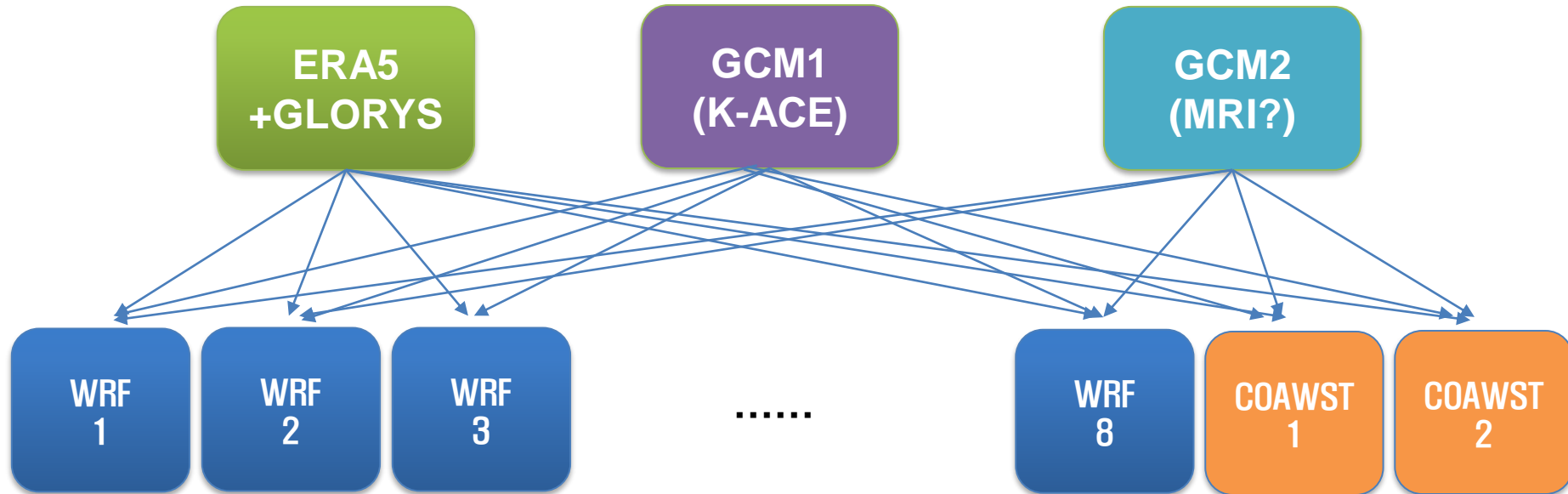
CMIP5	2621								
Domain	downscaling method	total	sem	mon	day	6hr	3hr	1hr	fx
EAS-44	CCLM5-0-2	1794	546	546	676				26
2541	HIRHAM5	576	172	172	224				8
	HadRM3P	171	37	40	50	28	13		3
Domain	downscaling method	total	sem	mon	day	6hr	3hr	1hr	fx
EAS-44j*	HadRM3P	80	37	40					3
80									

CMIP6	3343								
Domain	downscaling method	total	sem	mon	day	6hr	3hr	1hr	fx
EAS-22	CCLM5-0-9	6		6					
3343	CCLM5-0-9	43		42			1		
	RA	111		39	43		28	1	
	REMO2015	1100	270	280	280	80	150	10	30
	Regcm4-0	22		8	8		6		
	Regcm4-4	1951		630	630	466	207		18
	SNURCM	25		11	8		6		
	WRF370	85		26	32	12	14	1	

*EAS-44i: data produced by the Met Office Hadley Centre regional climate model HadRM3P and interpolated to a common latitude-longitude grid

CORDEX-EA Experiments in South Korea

High-Resolution (12 km) CORDEX CORE for CMIP7 downscaling



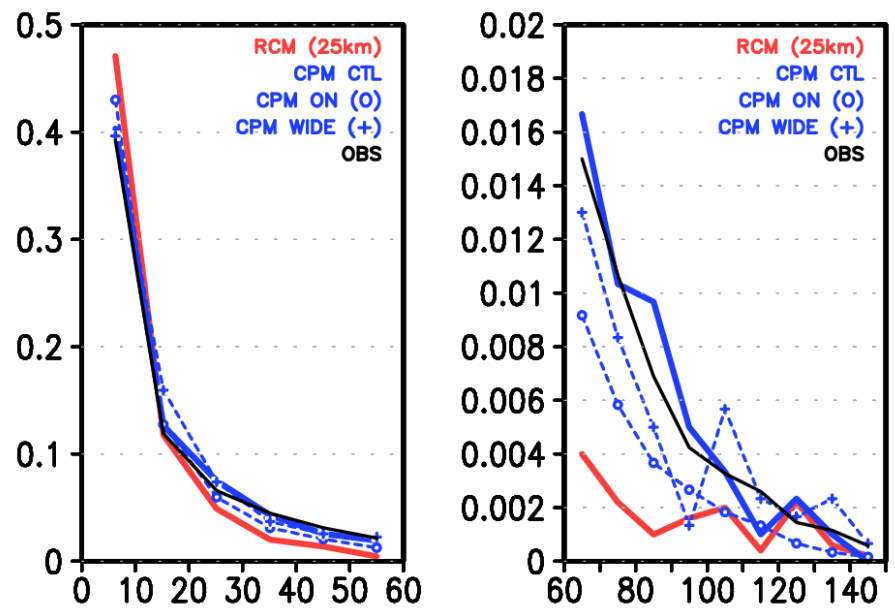
WRF: Multi-physics ensemble based on CPS, MPS, and PBL schemes (2x2x2)

COAWST (WRF+ROMS): 2 ensemble members based on physics schemes

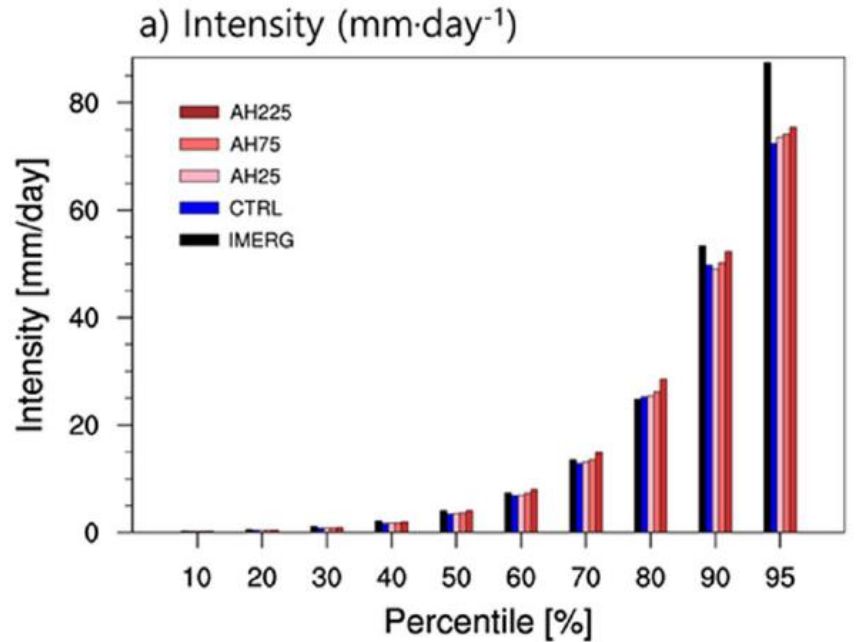
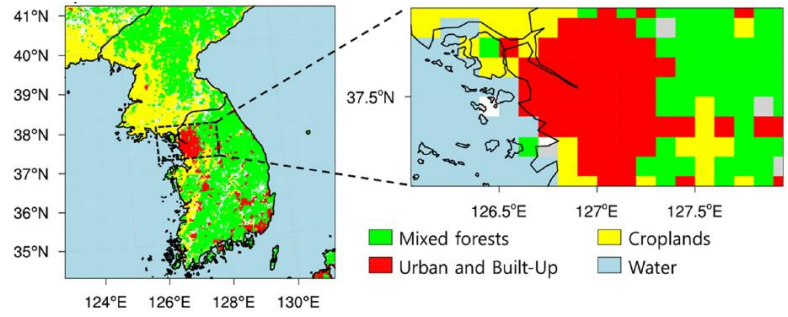
CORDEX-EA Experiments in Korea (FPS)

Flagship Pilot Studies(FPS)

Convection Permitting Model



Urbanization Effect on Extreme Rainfall

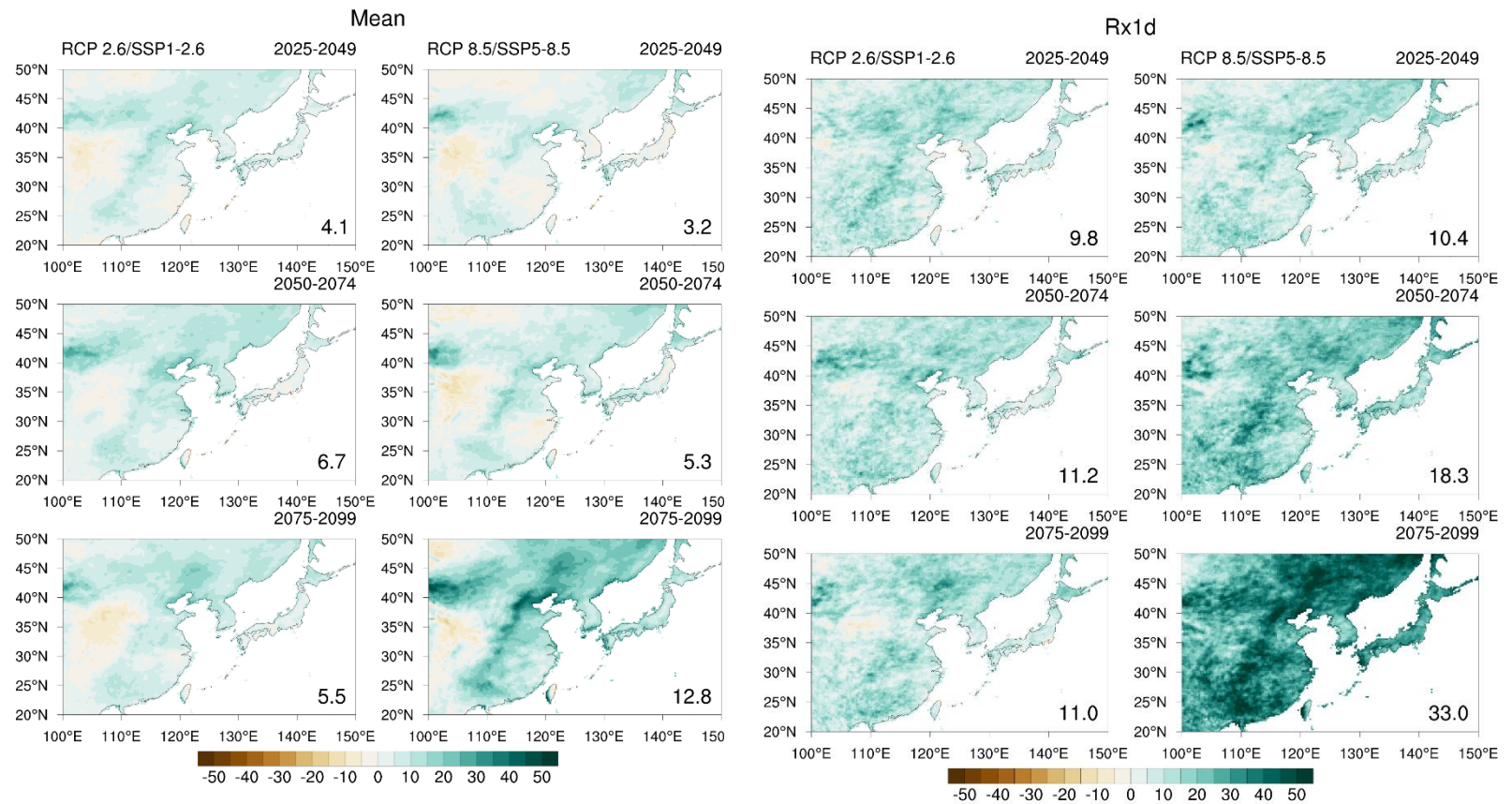


CORDEX-EA Experiments in Korea

CORE Results: Future Change in Precipitation

Future change – mean and Rx1D

(Jusbasic et al., 2024)

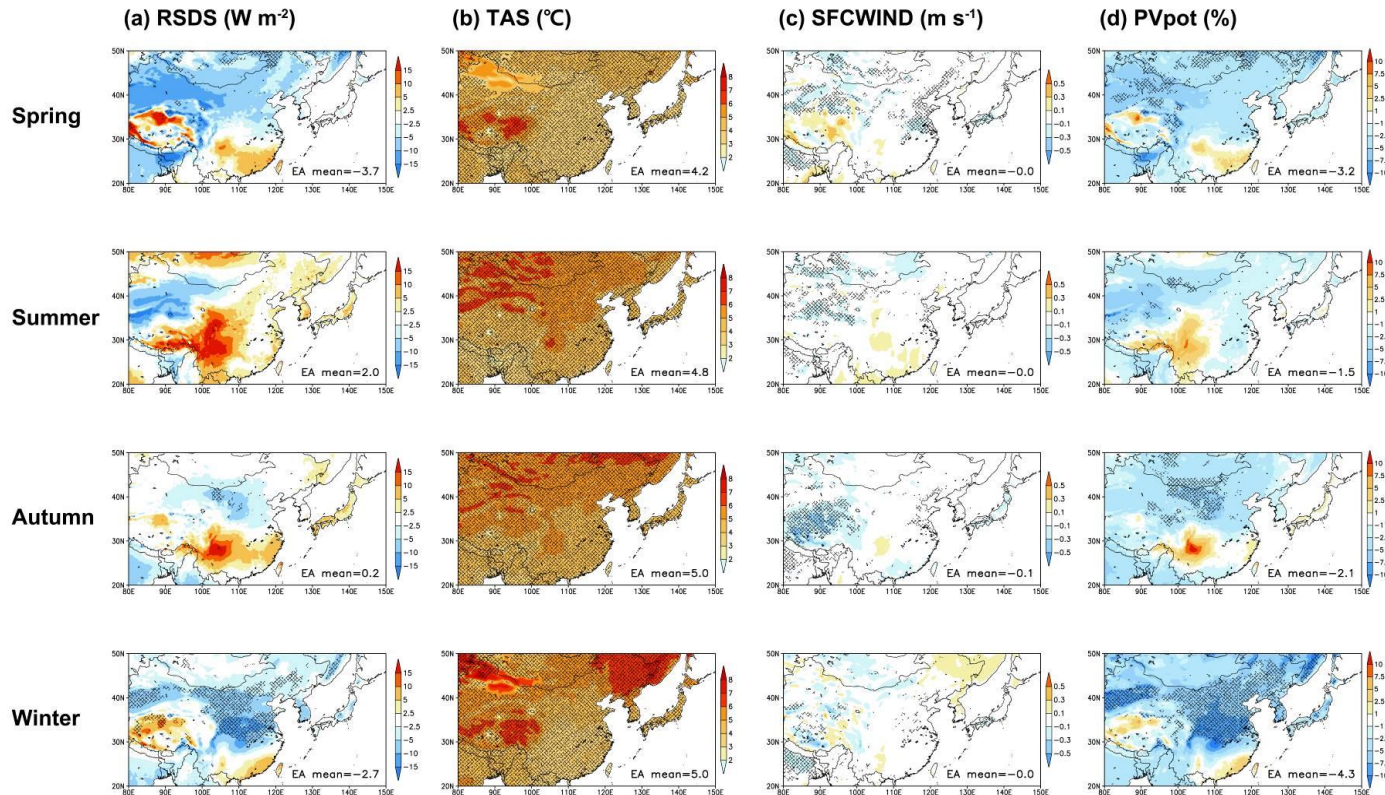


- Small, stable increase for low-emission scenarios
- Somewhat larger, constant increases in high emission scenarios, with some areas experiencing a decrease in mean precipitation
- Larger increase in Rx1d than mean, especially in high emission scenario at the end of the century

CORDEX-EA Experiments in Korea

CORE Results: Future Change in Renewable Energy

*Future changes (2070~2099 – 1979~2018)



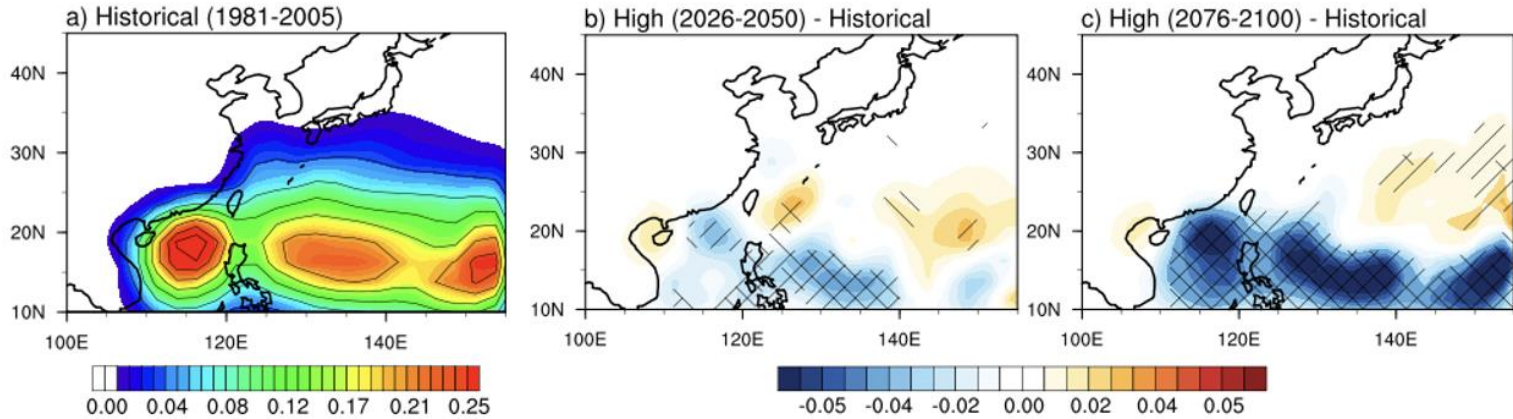
(Park et al., 2024)

- ❖ The future RSDS averaged over East Asia is predicted to change from $-3.7 W m^{-2}$ (spring) to $2.0 W m^{-2}$ (summer) compared to the present.
 - Southern China is projected to have an overall increase in the future RSDS.
- ❖ The future TAS predictions indicate increasing patterns everywhere with a good inter-RCM agreement* in most grids across all seasons. (*the same sign for four or more of the six RCM simulations)
- ❖ The future SFCWIND does not display any significant changes throughout East Asia.
- ❖ In all seasons, the spatial patterns of future PVpot change over East Asia are similar to those of future RSDS change.

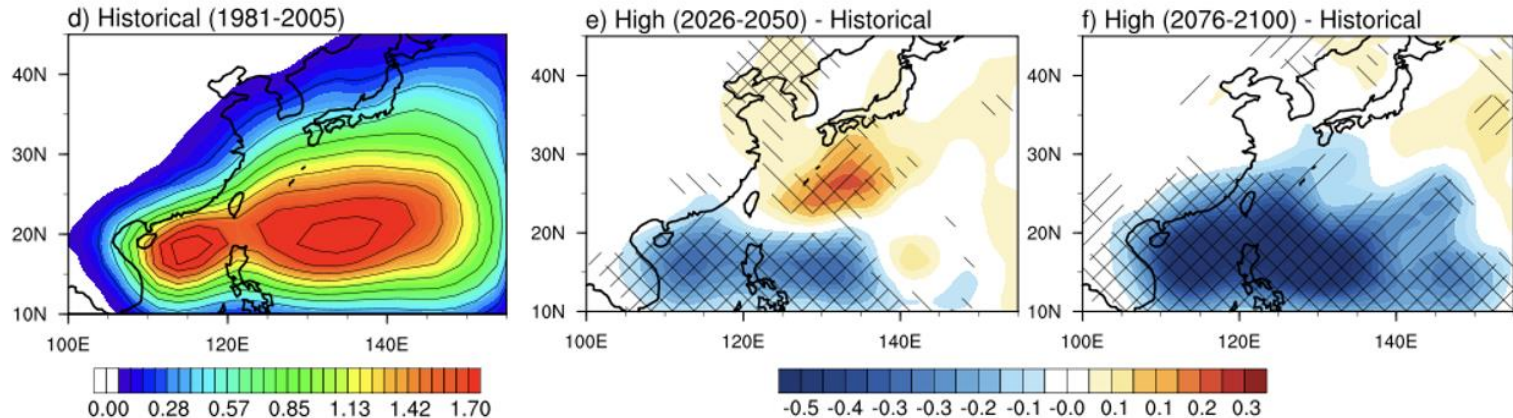
CORDEX-EA Experiments in Korea

- Future Changes in Typhoon Genesis & Track density

Genesis



Track



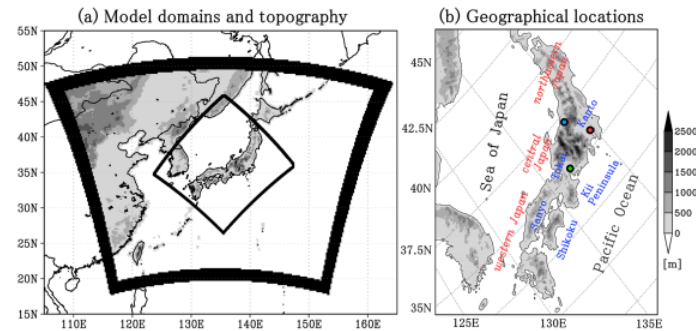
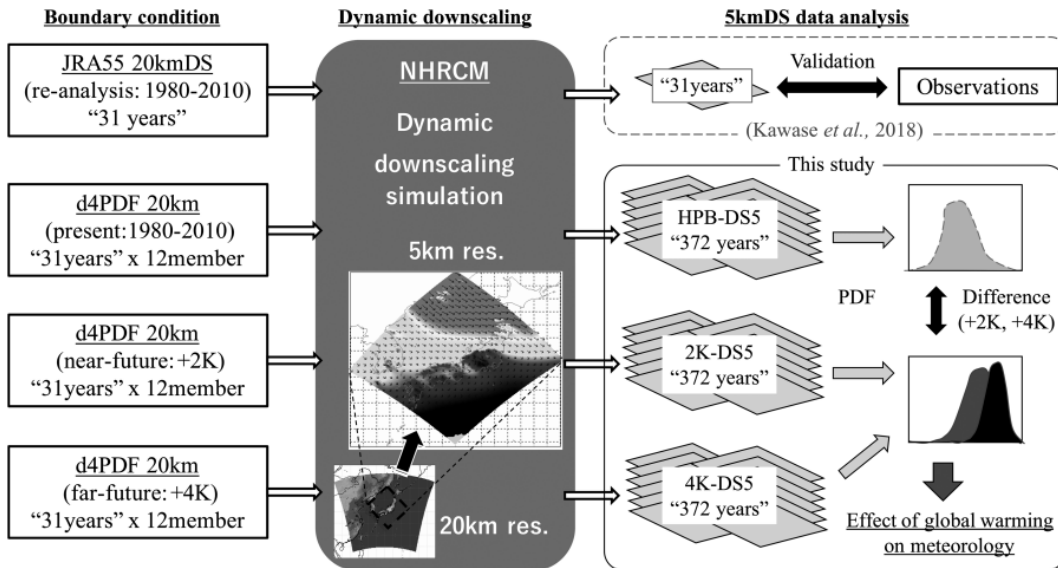
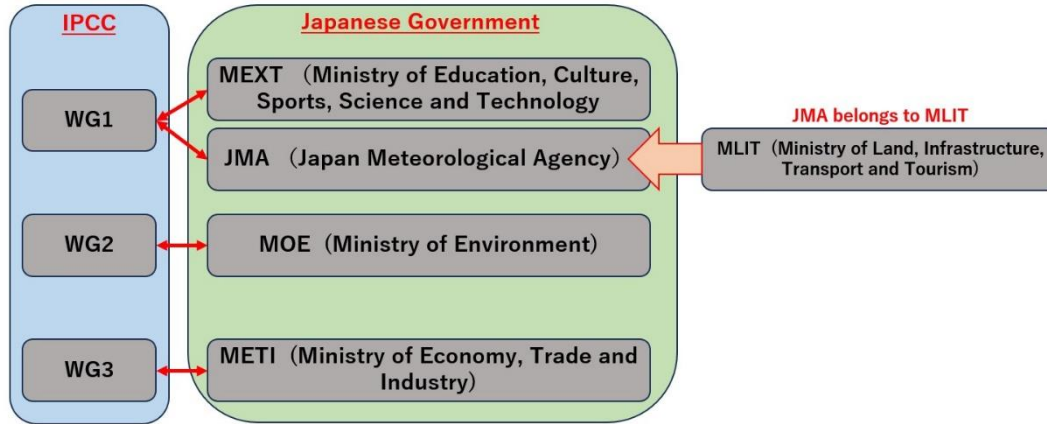
- Significantly decreasing TC activities in subtropics
- Slightly increasing TC activities in mid-latitudes

/ Significance at the **90 %** confidence level based on the student's t-test.
 \ The regions where more than **75 %** of RCMs agree on the sign of the difference.

Activities in Japan

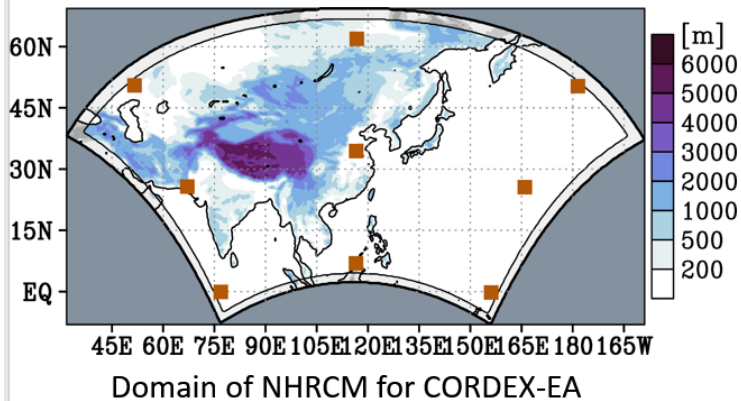
Climate Change Researches in Japan

Ministry in Charge



(Kawase et al., 2018)

Setup of MRI's RCM for CORDEX-EA



Model	
Model	NHRCM (Sasaki et al., 2008)
Grid spacing	25km
Cumulus	Kain-Fritsch scheme
Cloud microphysics	A bulk model prognosing mixing ratios (Q_c , Q_r , Q_{ci} , Q_s & Q_g) and number concentrations (N_{ci} , N_s , & N_g)
PBL scheme	Mellor-Yamada-Nakanishi-Niino Level-3
Radiation	A scheme implemented in JMA's global NWP model in 2004
Land surface	Improved MRI/JMA-SiB
Land use	GLCC (Fixed data)
Aerosol	Consider seasonal variation in radiation process
Spectral nudging	wave length: longer than 800 nm height: higher than 3000 m

Driving data

Driving data	ERA5 (ERA5.1 for 2000-2006)	UKESM	UKESM	UKESM	UKESM
GHG (Scenario)	Historical -> SSP3-7.0	Historical	SSP1-2.6	SSP2-4.5	SSP5-5.8
Status	Done	Ongoing	Ongoing	Ongoing	Ongoing

Downscaling for CMIP5 with 25 km RCMs

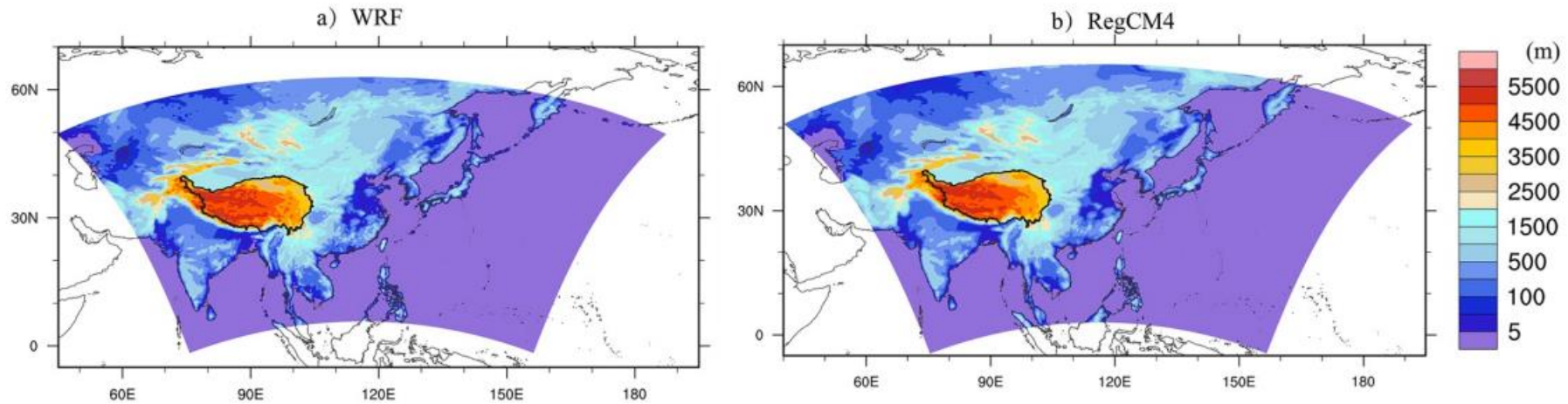


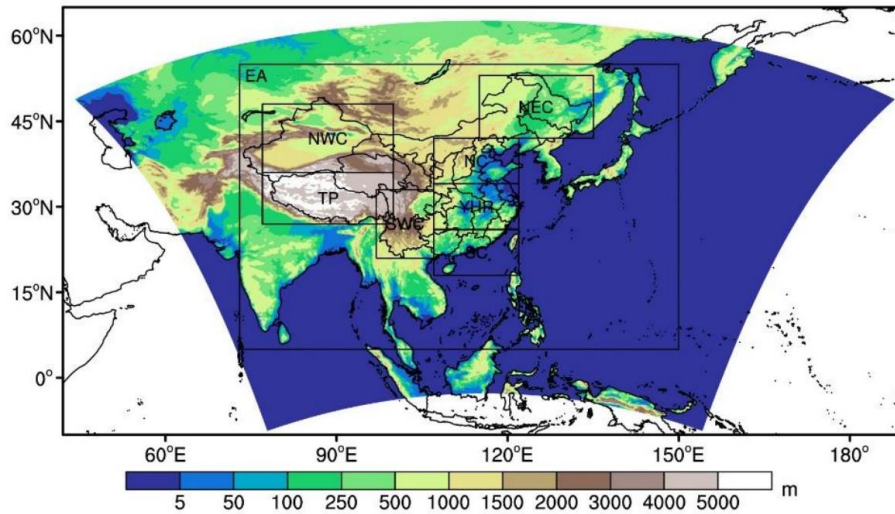
Table 2
Information About the Regional Climate Models Used in This Study

Experiment name	Name used	Driving GCM	Convective scheme	Microphysics scheme	Land surface scheme	Planetary boundary layer scheme	Long/short wave scheme
CNRM-CM5_WRF	CNRM_W	CNRM	KF	WSM-5	NOAH	YSU	CAM3
EC-EARTH_WRF	EC-EARTH_W	EC-EARTH	KF	WSM-5	NOAH	YSU	CAM3
GFDL-ESM2M_WRF	GFDL_W	GFDL	KF	WSM-5	NOAH	YSU	CAM3
MPI-ESM_WRF	MPI_W	MPI	KF	WSM-5	NOAH	YSU	CAM3
CNRM-CM5_RegCM4	CNRM_R	CNRM	Emanuel	SUBEX	CLM	Holtslag	CCM3
EC-EARTH_RegCM4	EC-EARTH_R	EC-EARTH	Emanuel	SUBEX	CLM	Holtslag	CCM3
GFDL-ESM2M_RegCM4	GFDL_R	GFDL	Emanuel	SUBEX	CLM	Holtslag	CCM3
MPI-ESM_RegCM4	MPI_R	MPI	Emanuel	SUBEX	CLM	Holtslag	CCM3

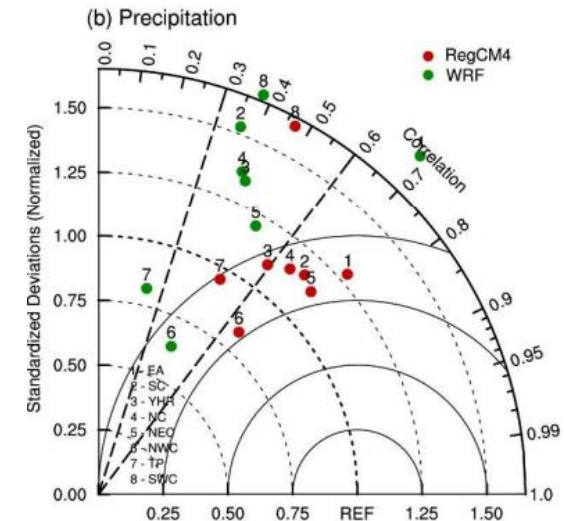
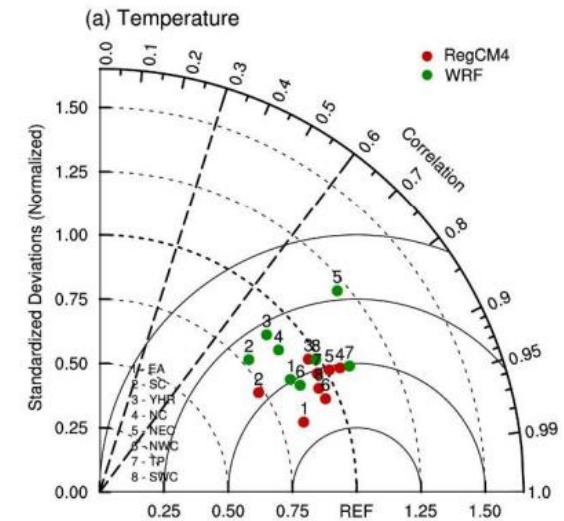
(Tang et al., 2021)

Activities in China

Downscaling for CMIP6 with 12.5 km RCMs



	RegCM4	WRF
Dynamic framework	Hydrostatic	Nonhydrostatic
Horizontal resolution	12.5 km (565 × 783)	12.5 km (580 × 780)
Vertical levels	σ -30	σ -32
Simulation period	1979.1.1-2019.12.31	
Initial and boundary conditions	ERA5	
Convection scheme	Tiedtke (Tiedtke, 1989)	Modified Tiedtke (Tiedtke, 1989)
Microphysics scheme	SUBEX (Pal et al., 2000)	Thompson (Thompson et al., 2008)
PBL scheme	Holtlag (Holtlag et al., 1990)	MYNN2.5 (Nakanishi and Niino, 2006)
Radiation	RRTM (Mlawer et al., 1997)	RRTMG (Iacono et al., 2008)
Land Surface Model	CLM (Oleson et al., 2013)	Noah (Chen and Dudhia, 2001)



(Yang et al., 2025)

- In East Asia, CORDEX EA projects have been conducted since 2009 to support climate change research. The CORE dynamical downscaling experiments, along with the Flagship Pilot Studies, have been carried out in support of AR5 and AR6. In the CORE experiments, future changes in high-impact weather and climate events such as tropical cyclones, heavy rainfall, and heat waves have been projected.
- We are currently preparing for the dynamical downscaling of CMIP7 GCM outputs using multiple RCMs (e.g., WRF, RegCM, and NHRCM).

- AOGS 2026 CORDEX Sessions
 - Fukuoka on August 4, 2026
 - Session AS102
 - Regional Climate Downscaling and CORDEX: Challenges and Prospects

- International Workshop for CORDEX EA domain
 - Seoul or Jeju island in late 2026
 - To establish the framework for AR7

Thank You!