CORDEX and its Progresses for East Asia

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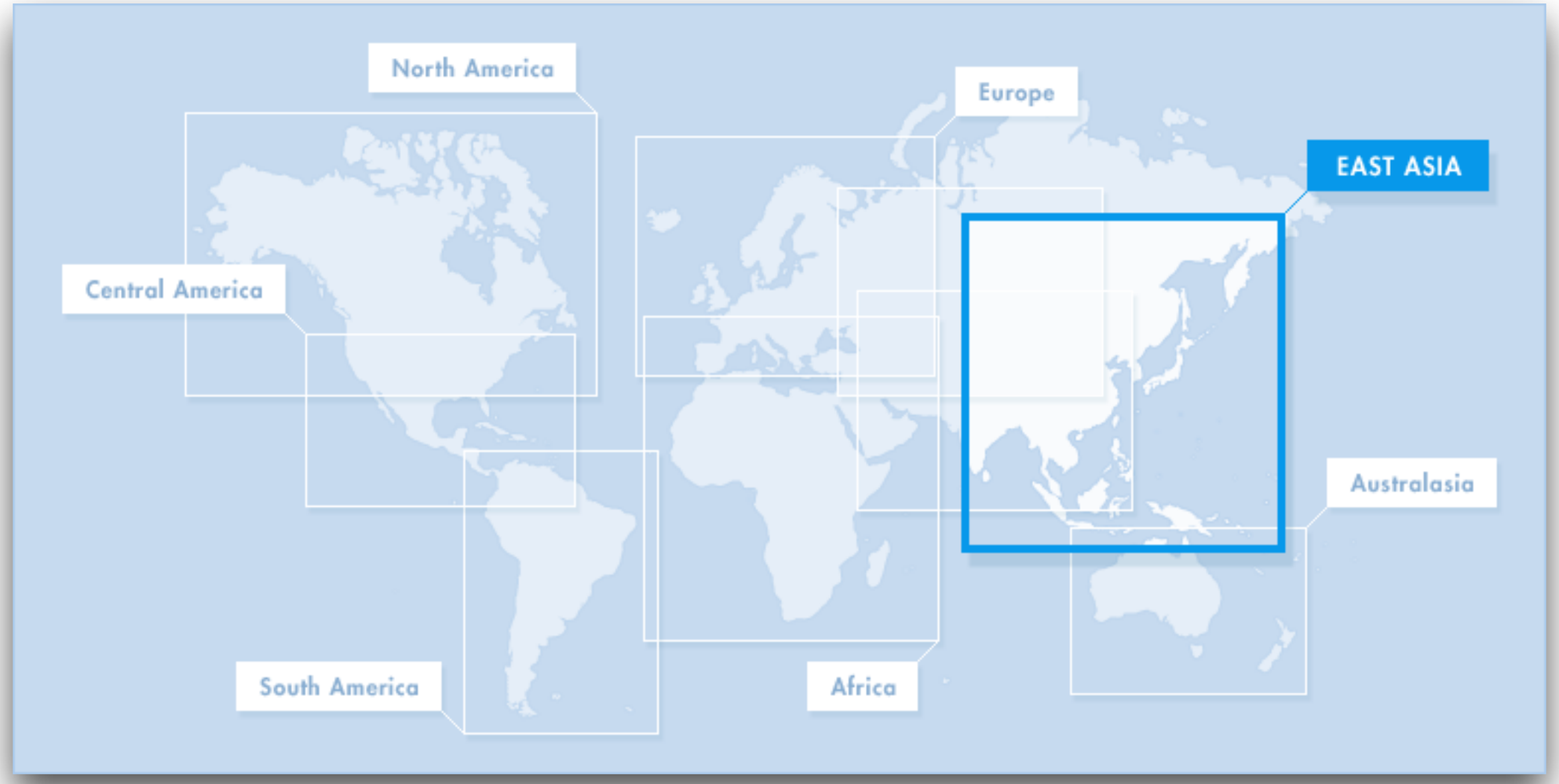
COordinated Regional Downscaling EXPeriment
CORDEX (http://wcrp-cordex.ipsl.jussieu.fr)

- CORDEX is a WCRP research project to provide global coordination of regional climate downscaling for improved regional climate change adaptation and impact assessment.

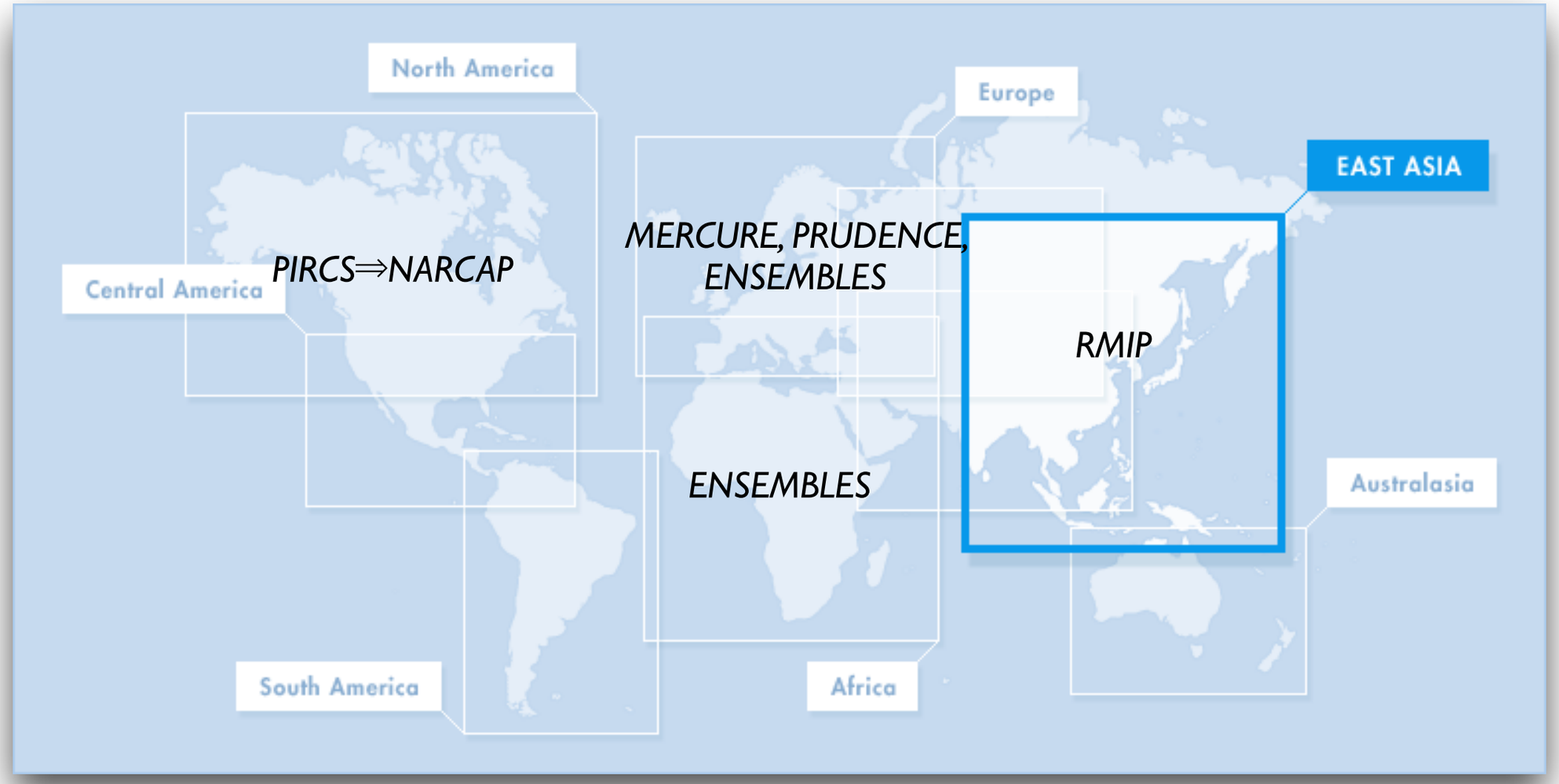
- Modelling framework designed to:
  - Evaluate and improve RCD models and techniques,
  - Provide a coordinated set of RCD-based projections/predictions for regions worldwide, and
  - Facilitate the communication with the IAV community and the involvement of the research community from developing countries.

CORDEX Domains



There are 14 domains at the moment with two additional domains for MENA (Middle East and North Africa) and SEA (South East Asia).

CORDEX Domains



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CORDEX Strategy

Model Evaluation Framework

Climate Projection Framework

Multiple regions (Initial focus on Africa)
50 km grid spacing

AMIP-like

CMIP-like

ERA-interim LBC
1989 ~ 2008

Regional Analysis
Regional Databanks

RCP 4.5, RCP8.5
1951 ~ 2100 or 1980 ~ 2050

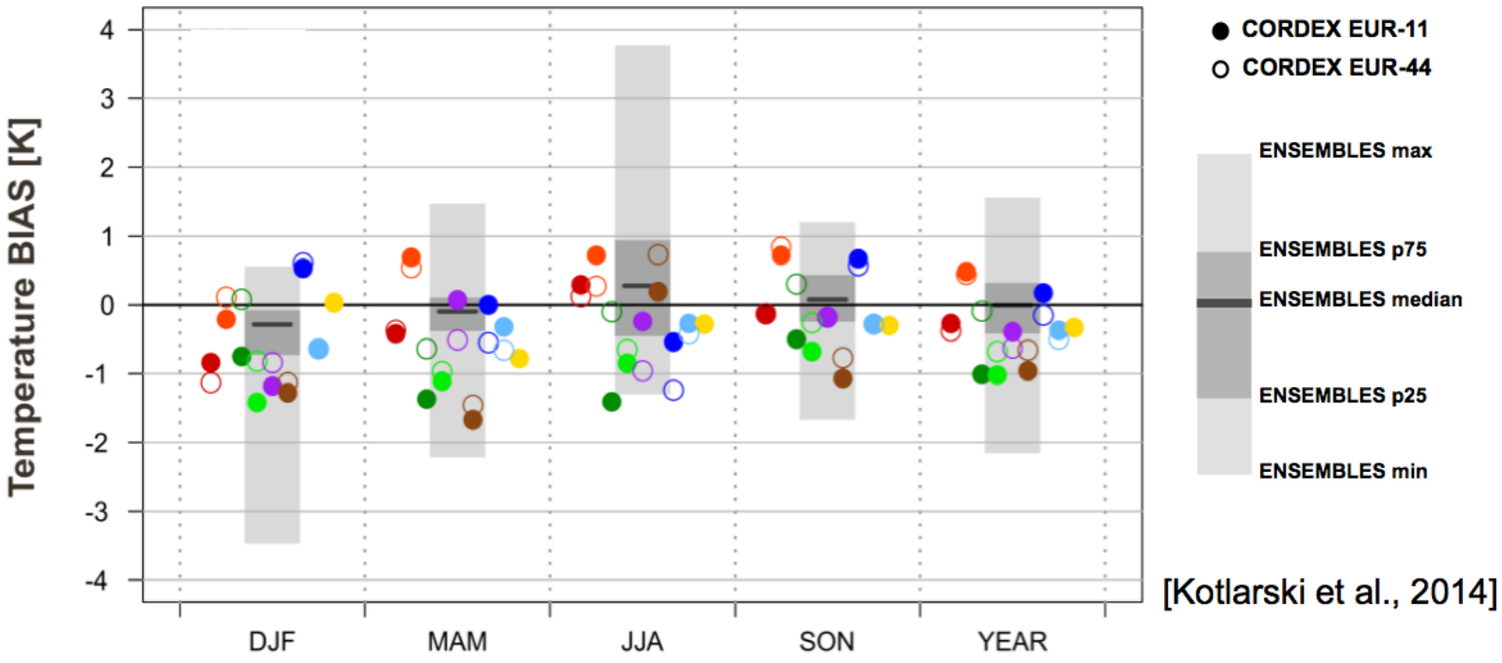
Decadal predictions
1980~2010, 1990~2000, 2005~2035

Multiple AOGCMs

EURO-CORDEX

- Courtesy of Kotlarski et al., 2013 -

"Standard" Evaluation [Kotlarski et al., 2014]



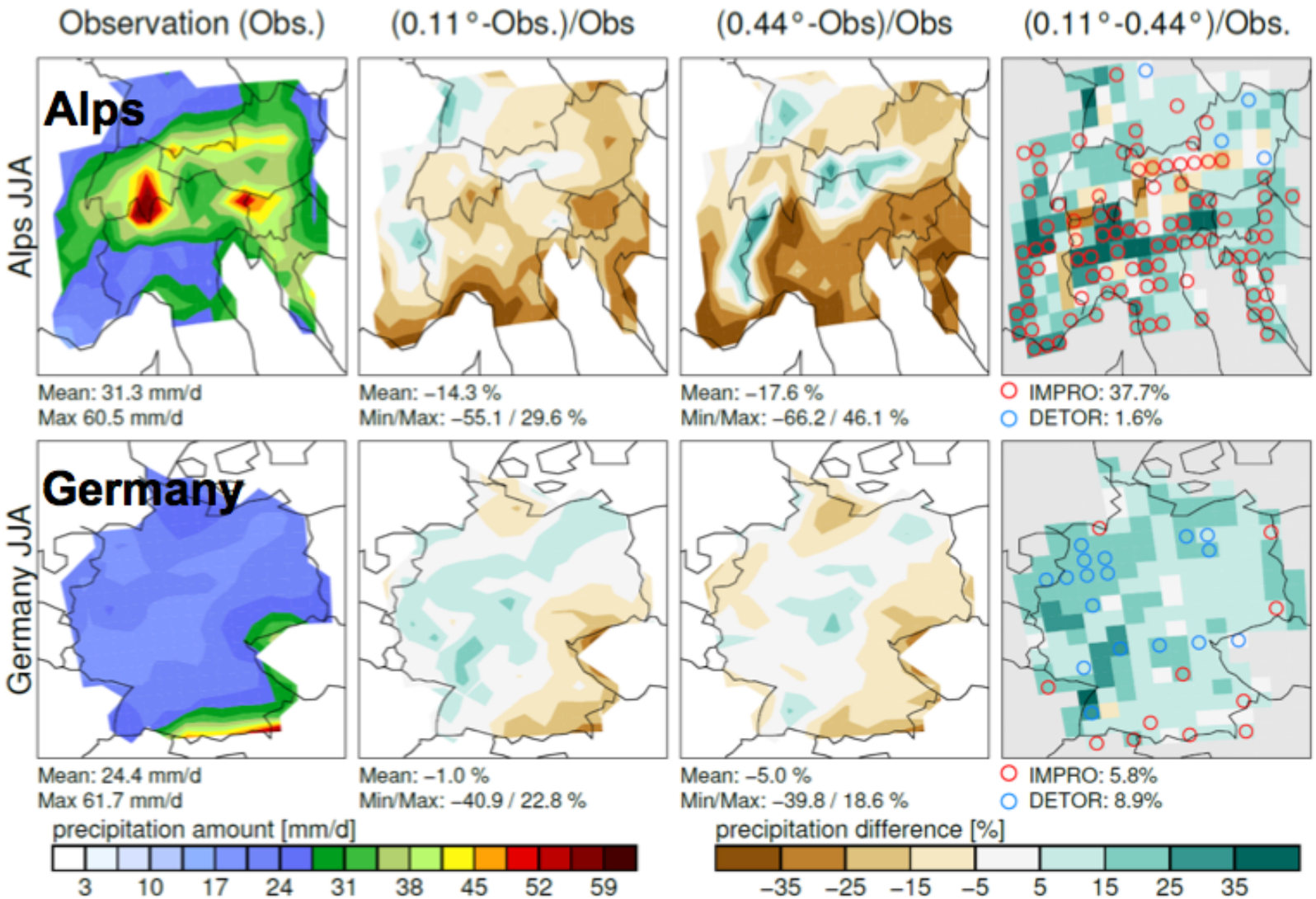
[Kotlarski et al., 2014]

- Basic features of European climate captured.
- Compared with ENSEMBLES: comparable, partly smaller error ranges
- No obvious benefits of increased resolution.

6 Different RCMs with 1 GCM: Shortcomings for selected metrics, seasons, and regions on identical forcing

EURO-CORDEX

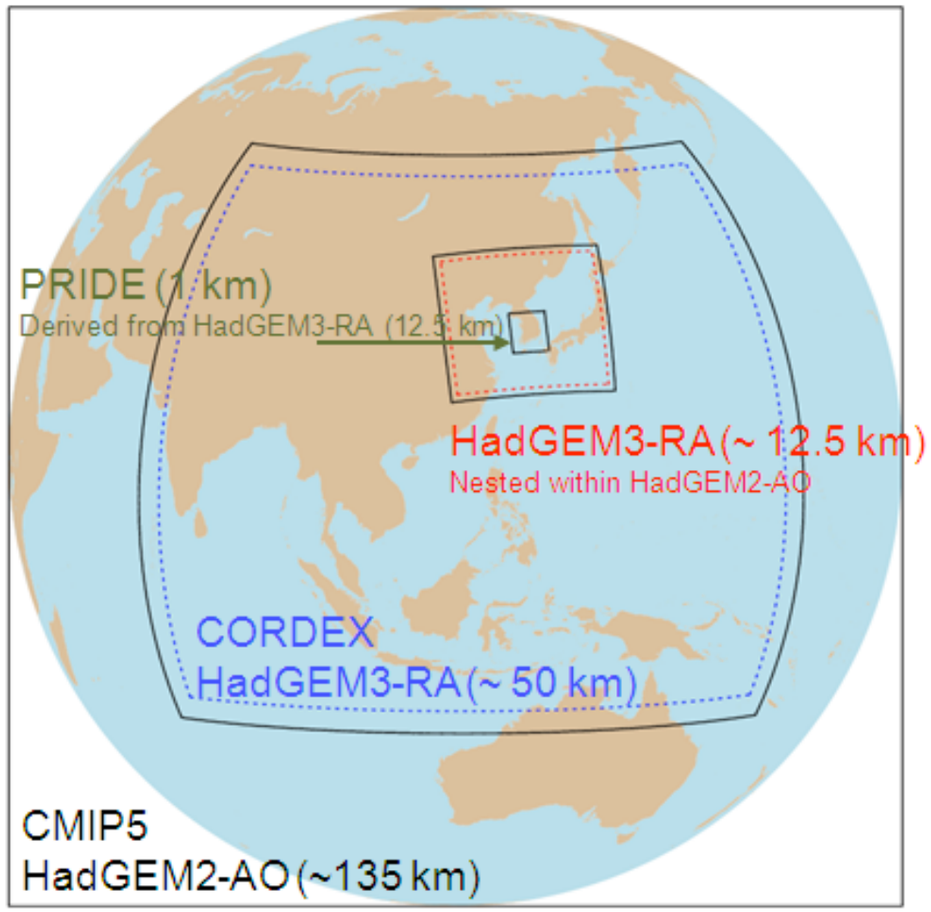
- Courtesy of Prein et al., 2013 -



- Clearly added value (red circles) in orographically influenced areas.
- Less added value in flat regions

A Regional Downscaling Project coordinated by KMA

Domains for climate projections at KMA



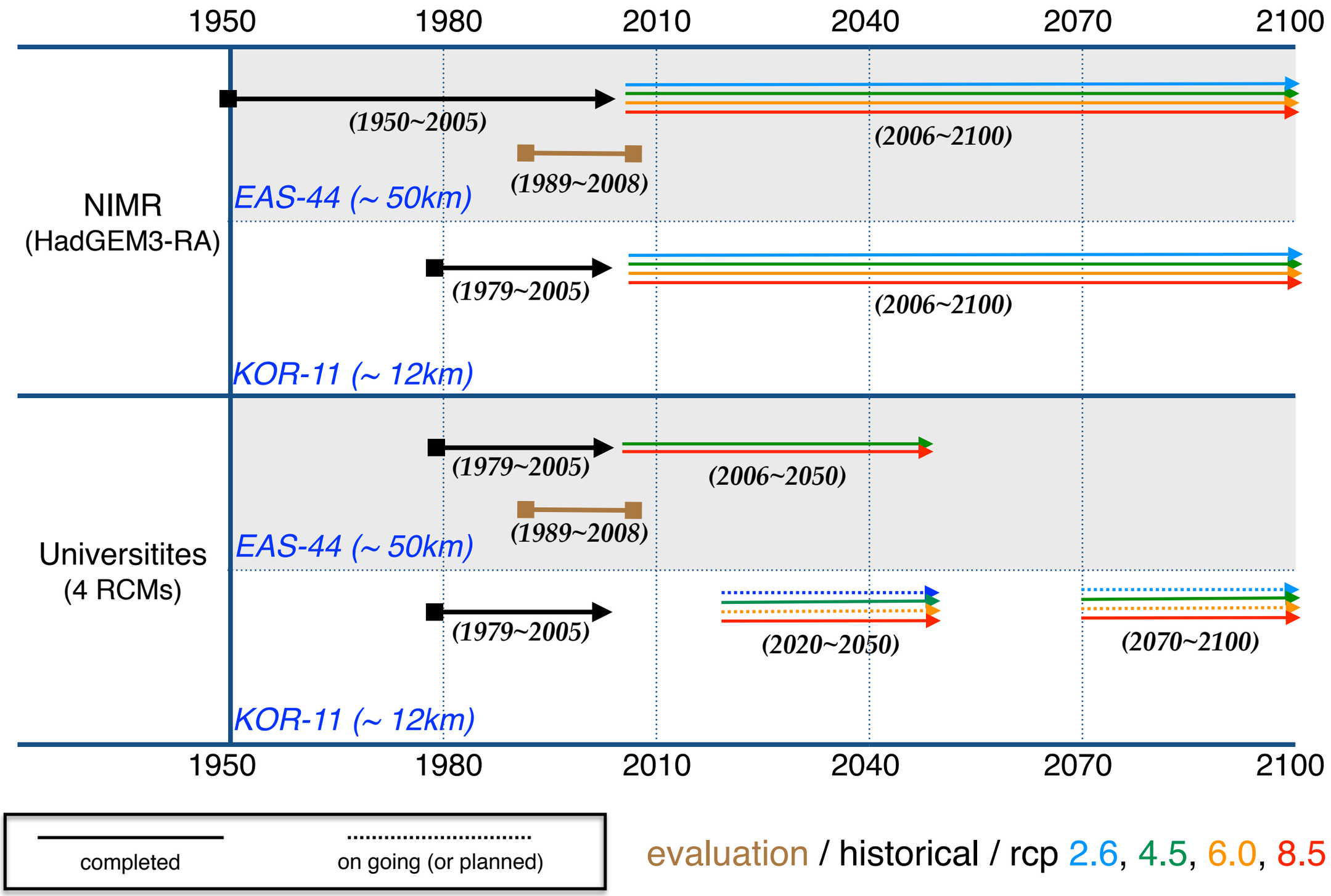
KMA/NIMR

CMIP5 experiment with HadGEM2-AO and provide GCM forcing
Regional downscaling for 2 domains with HadGEM3-RA
Maintaining CORDEX-EA databank

Dynamical Downscaling Group	Statistical Downscaling Group	(Extreme) Analysis Group	Application Group
• Multi-RCMs forced by HadGEM2-AO • Ensemble method • Uncertainty Assessment	• Method Development • High-resolution projection data up to 1 km • Focusing on national scenario	• Evaluation of CORDEX outputs for extreme events • Evaluation of Tropical Cyclones	• Essential factors for administrative districts in *agriculture*, *health*, and *disaster prevention* sectors.

- 5 regional climate models for CORDEX-EA domain (50 km) and smaller sub-region (12.5 km).
- 1 statistical downscaling model for Korean peninsula up to 1 km's resolution.
- 1 group from Japan (U.Tokyo) has participated recently.

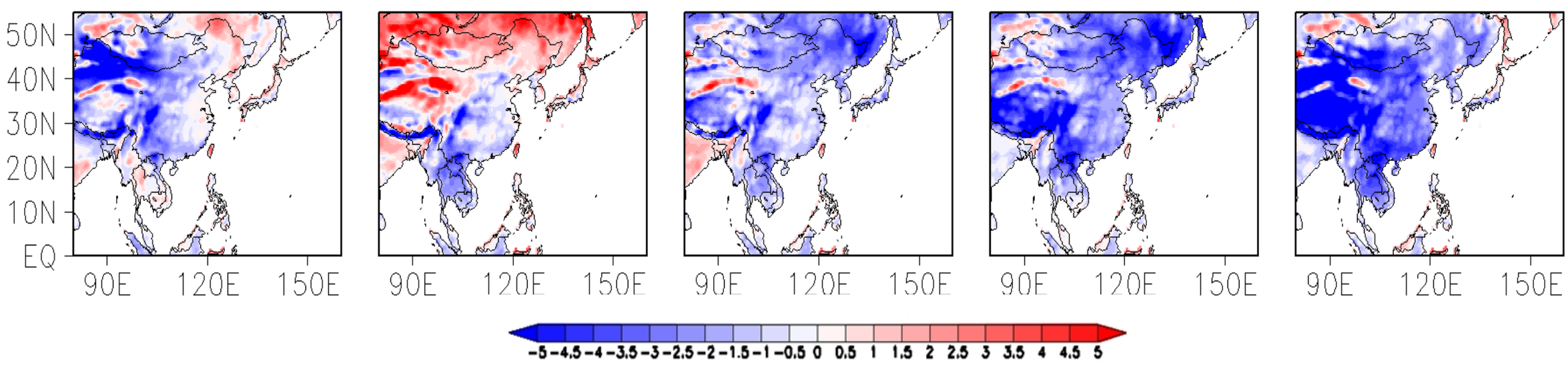
Downscaling Experiments



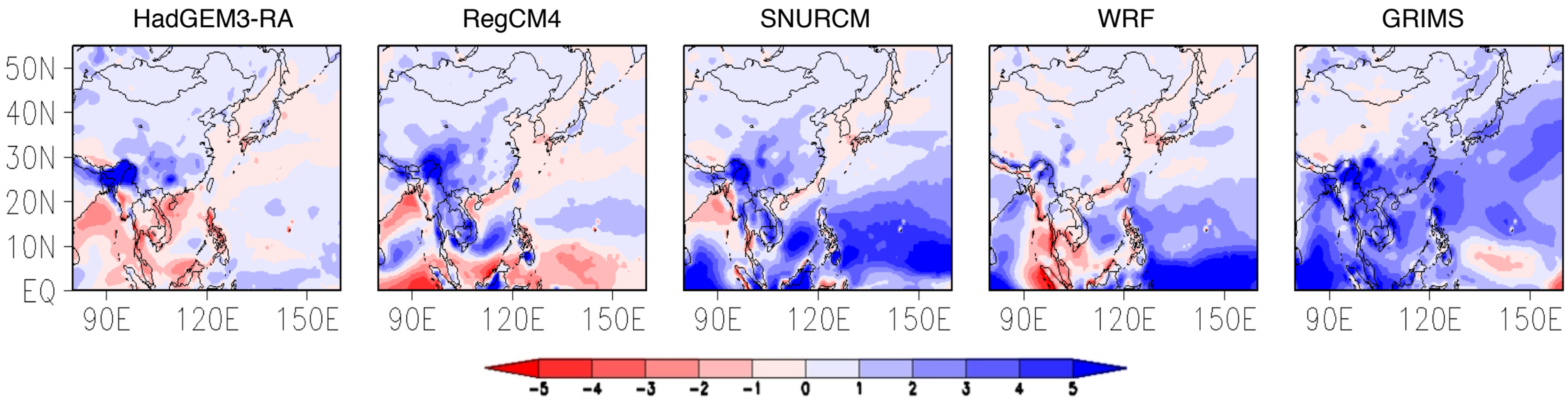
Annual Mean Bias (model - obs.)

20-year (1989-2008) mean

[Surface Air Temperature (°C)]

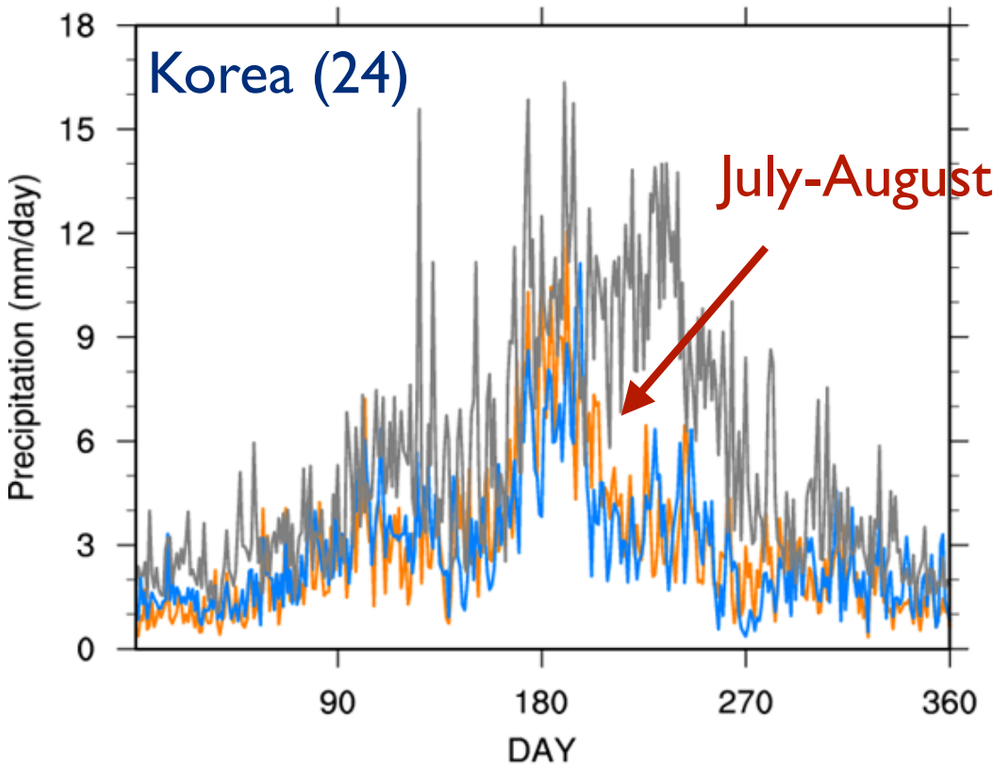


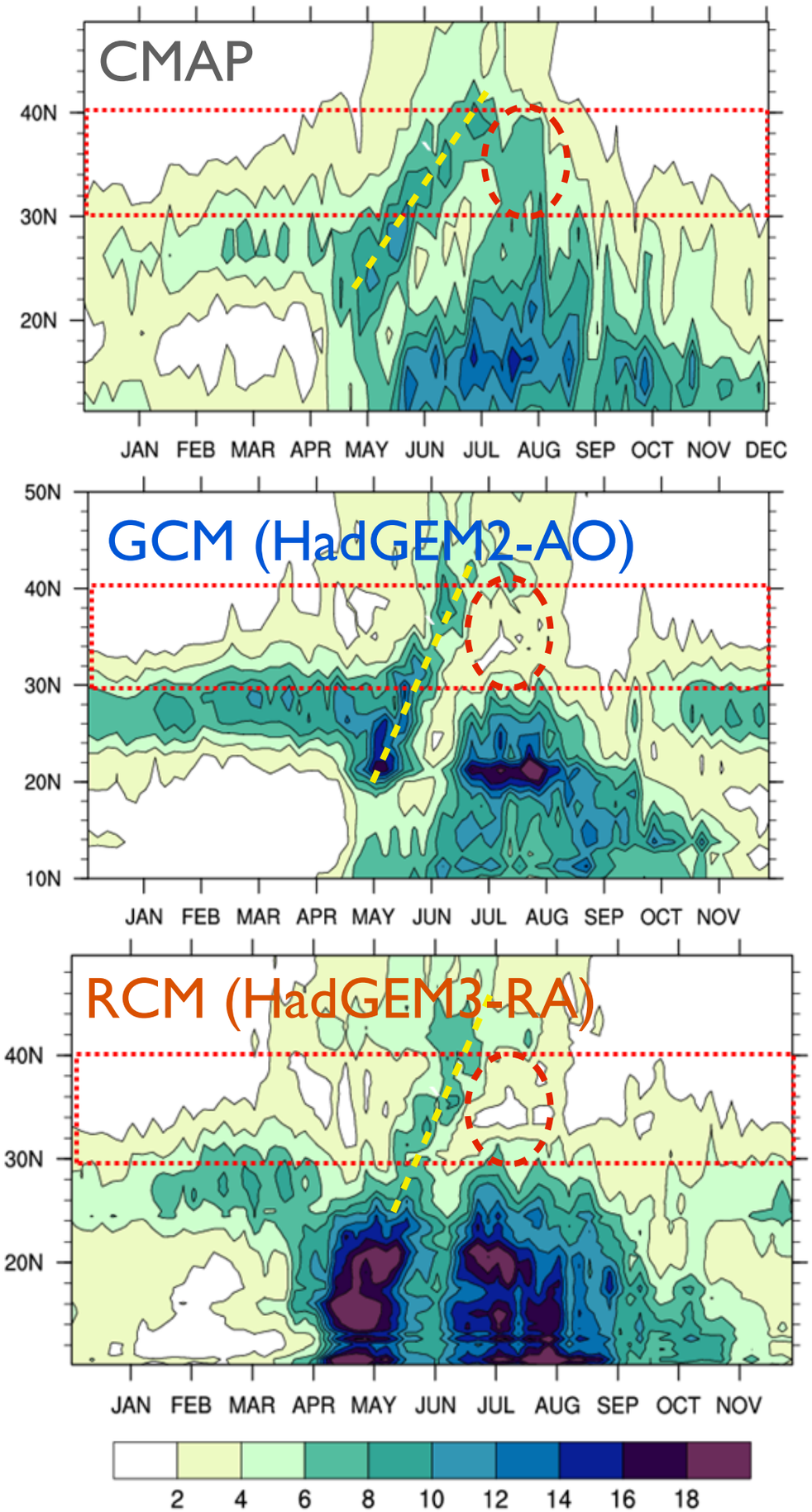
[Precipitation (mm/day)]



Monsoon Evolution (Korea)

Averaged over 120 -130 °E
(1979-2005)





CMAP

RCM (HadGEM3-RA)

RegCM4 (lon:120~130, lat:10~50)

RCM (RegCM4)

MM5 (lon:120~130, lat:10~50)

RCM (MM5)

WRF (lon:120~130, lat:10~50)

RCM (WRF)

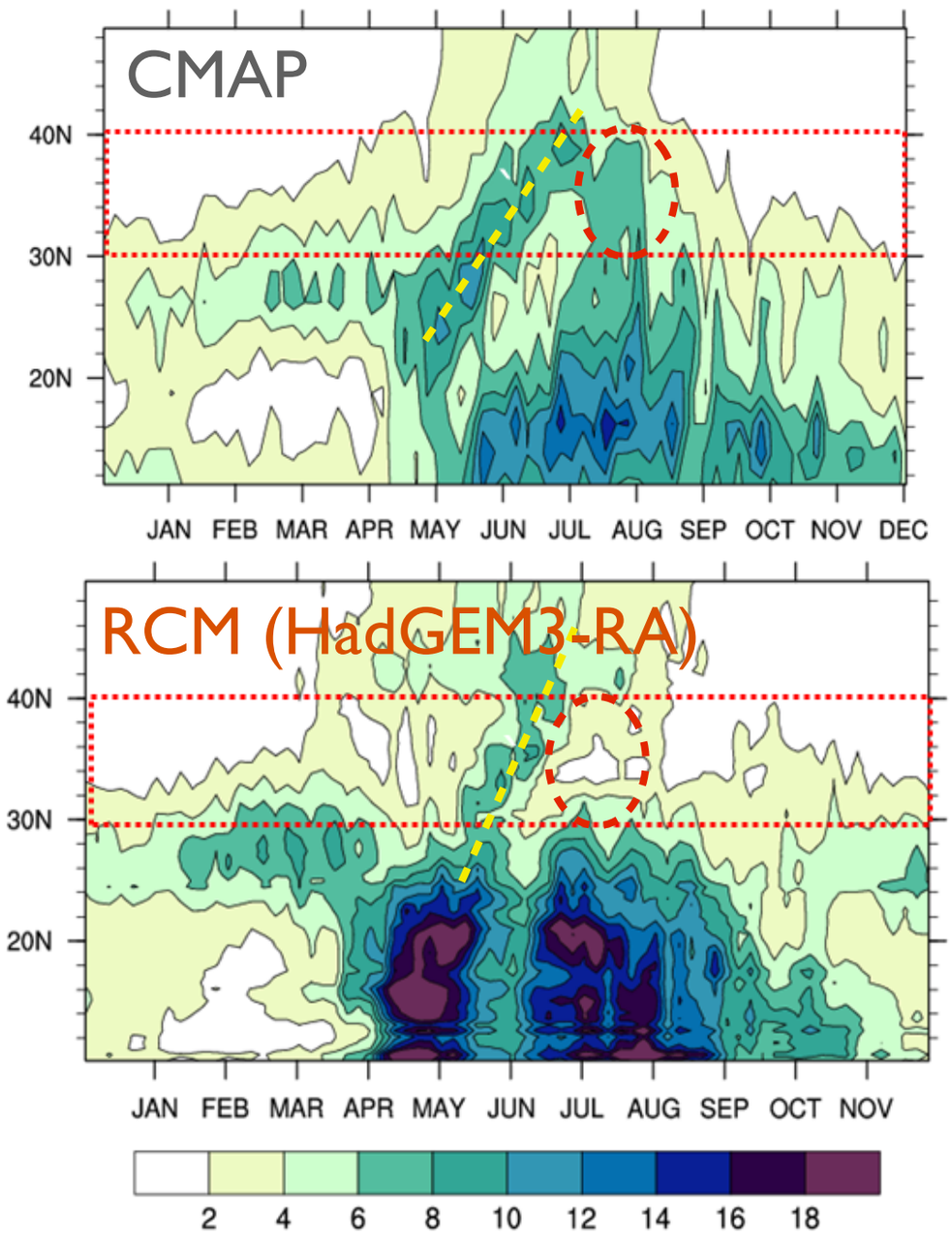
RSM (lon:120~130, lat:10~50)

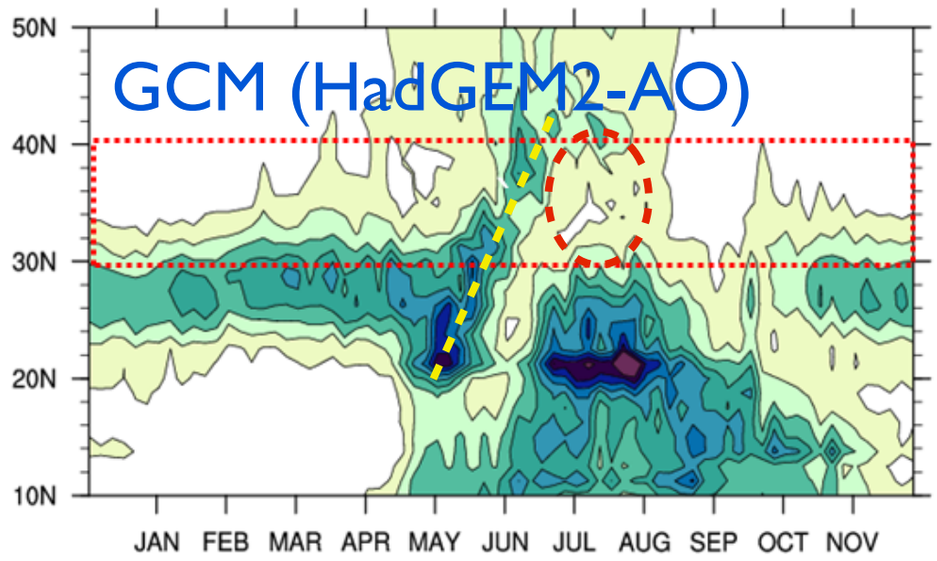
RCM (RSM)

40N
30N
20N

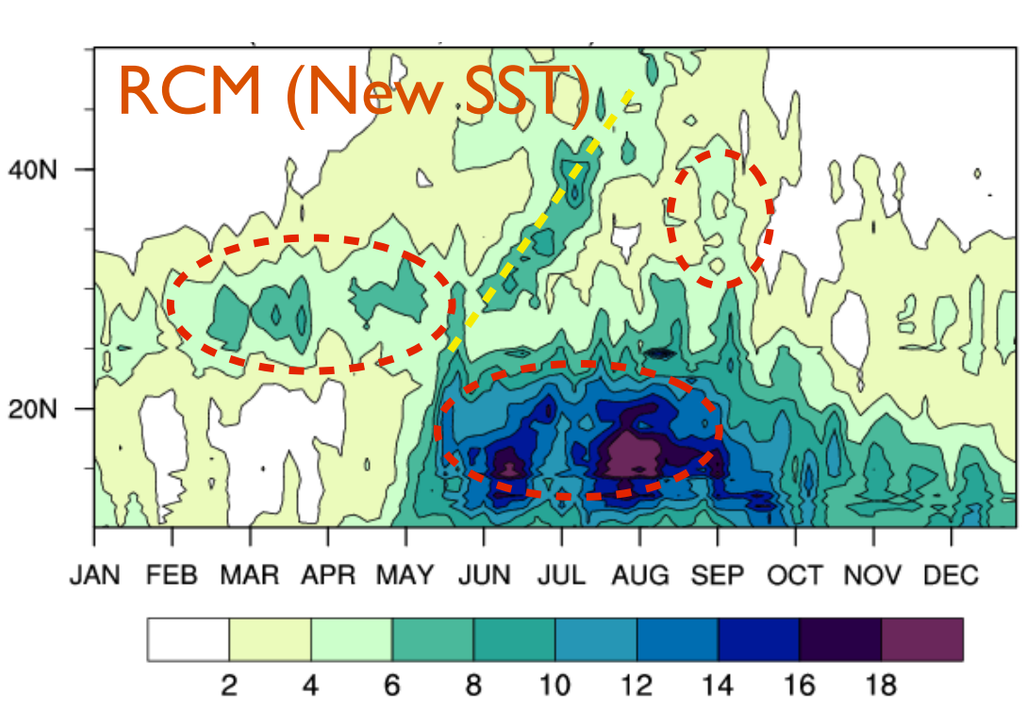
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

2 4 6 8 10 12 14 16 18


CMAP
40N
30N
20N
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


GCM (HadGEM2-AO)
50N
40N
30N
20N
10N
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV

RCM (HadGEM3-RA)
40N
30N
20N
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV
2 4 6 8 10 12 14 16 18

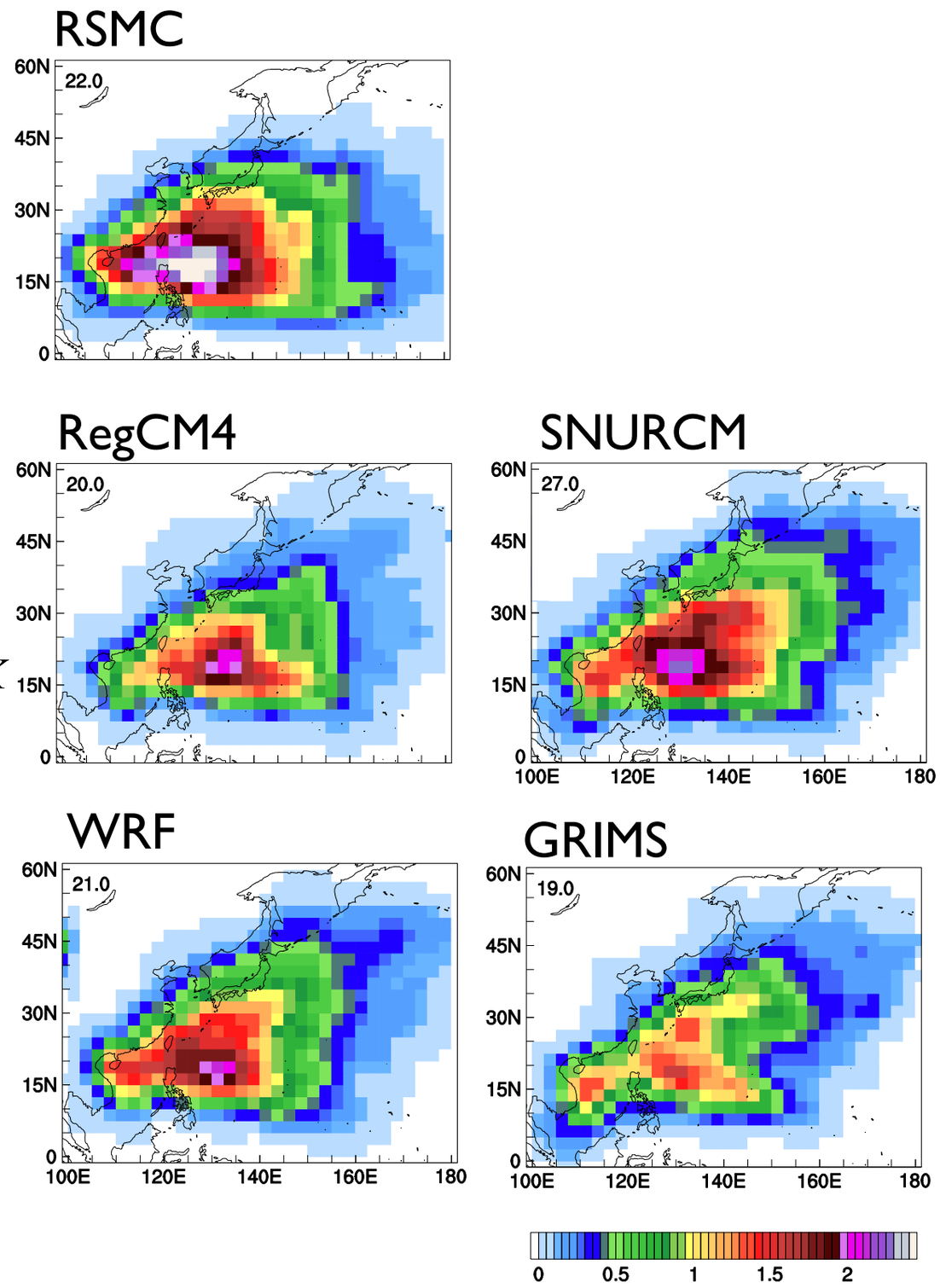

RCM (New SST)
40N
20N
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
2 4 6 8 10 12 14 16 18

Tropical Cyclone Track Density

Tracking Method

(Oouchi et at., 2006; Camargo et al., 2007)

1) Find the local minimum sea level pressure
2) Maximum RV at 850 hPa > 4.9 x 10^{-5} s^{-1}
3) Maximum wind speed at surface > 17 ms^{-1}
4) Warm core criterion: $\Delta T = \Delta T_{300} + \Delta T_{500} + \Delta T_{700} > 2.0K$
5) Maximum wind speed at 850 hPa > that at 300 hPa
6) Duration of all above condition > 2 days



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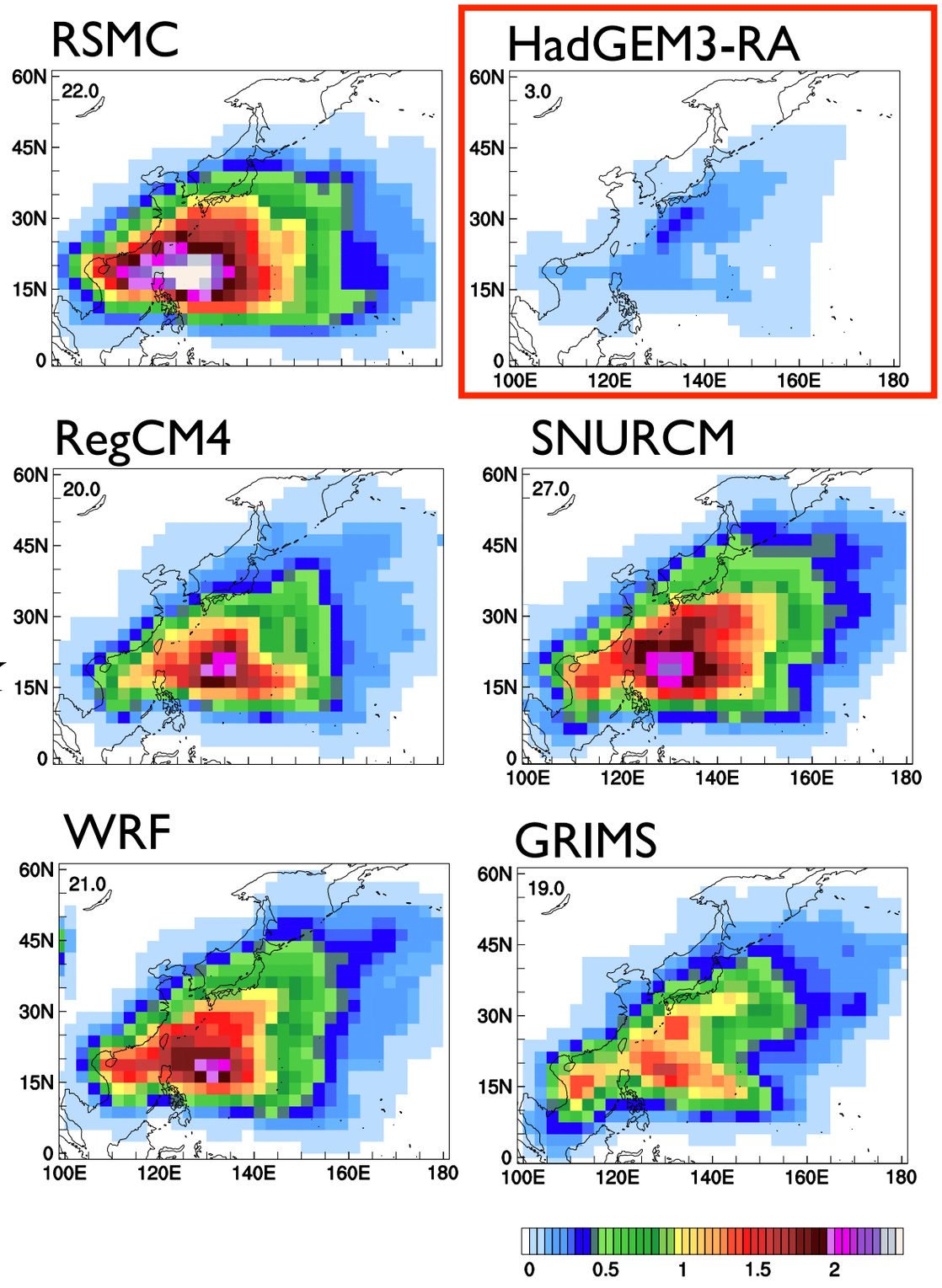
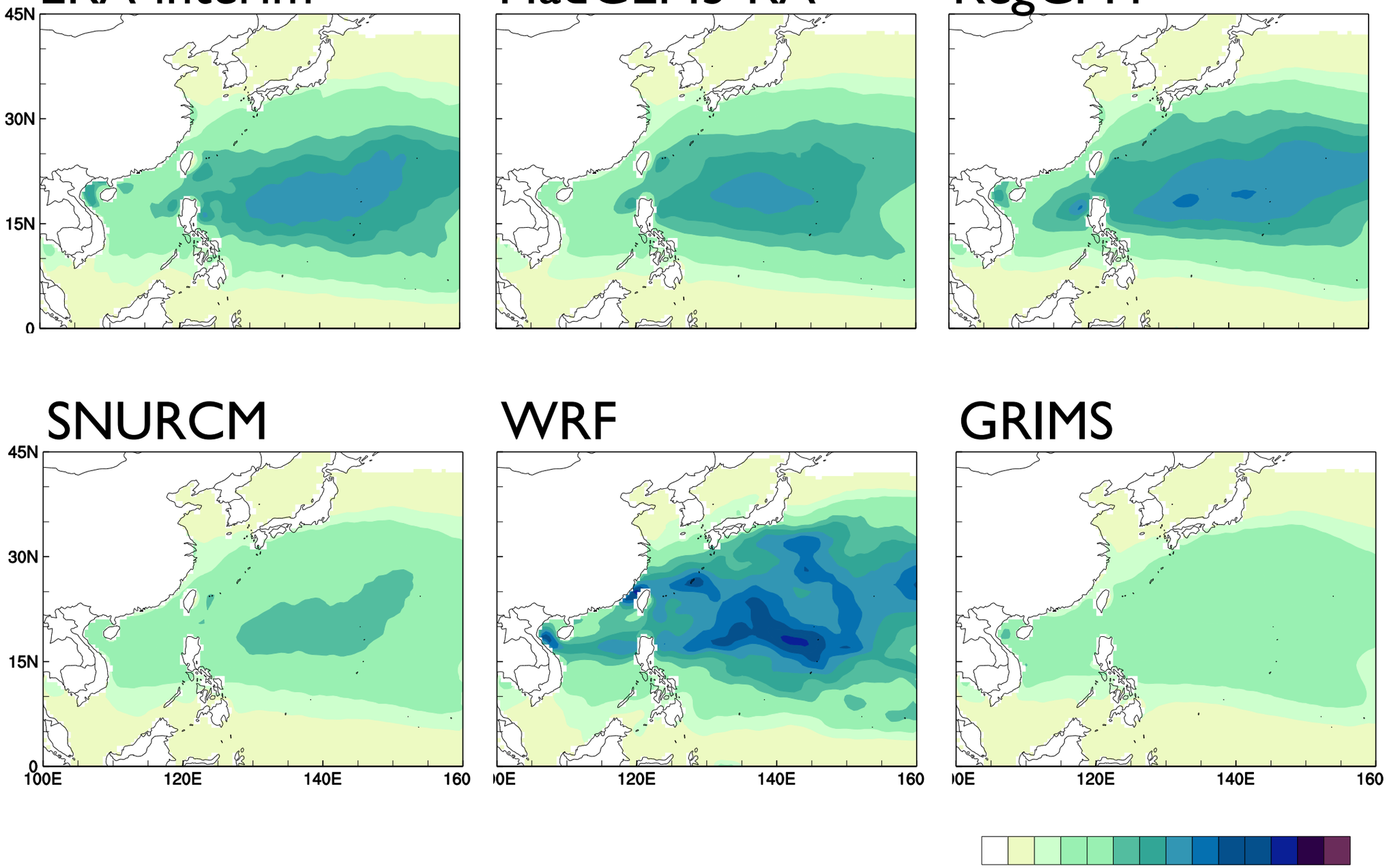


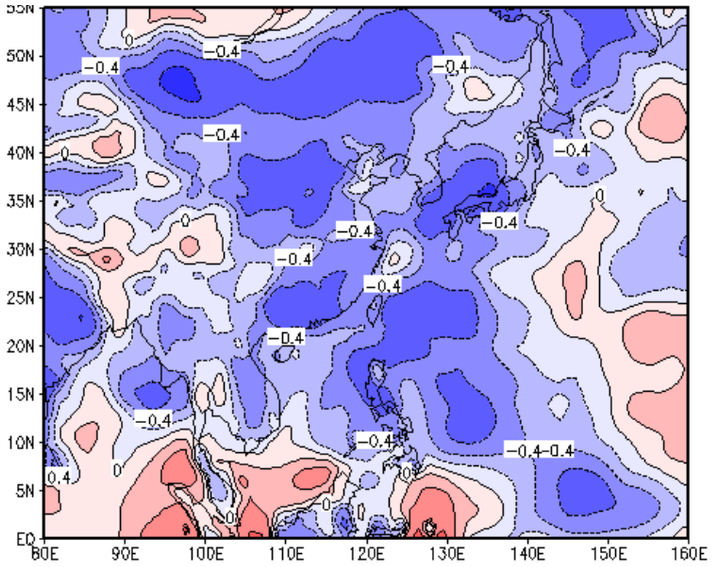
Genesis Potential Index (GPI)

$$GPI = \left|10^5 \eta\right|^{3/2} \left(RH/50\right)^3 \left(PI/70\right)^3 \left(1+0.1V_{shear}\right)^{-2}$$

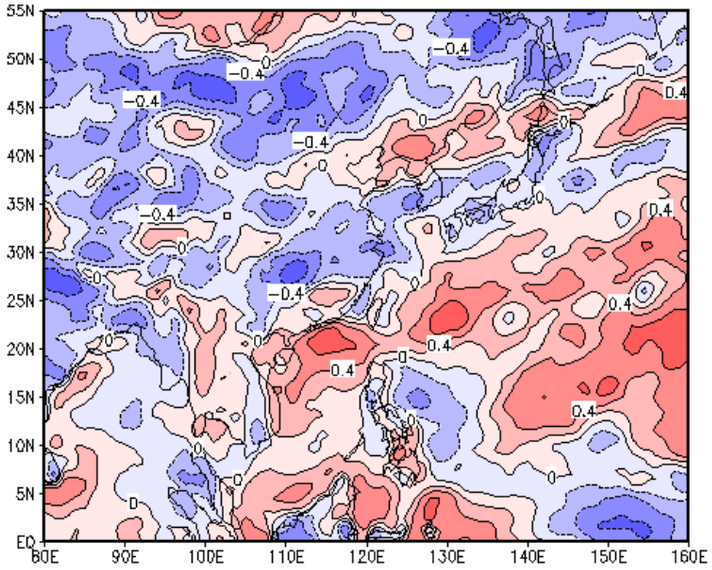


SFC. Temperature vs. Precipitation

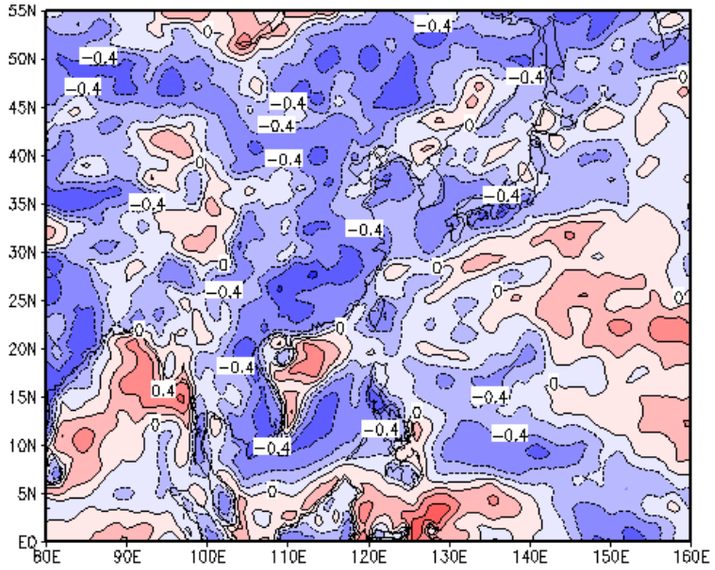
OBS (GPCP, ERA-interim)



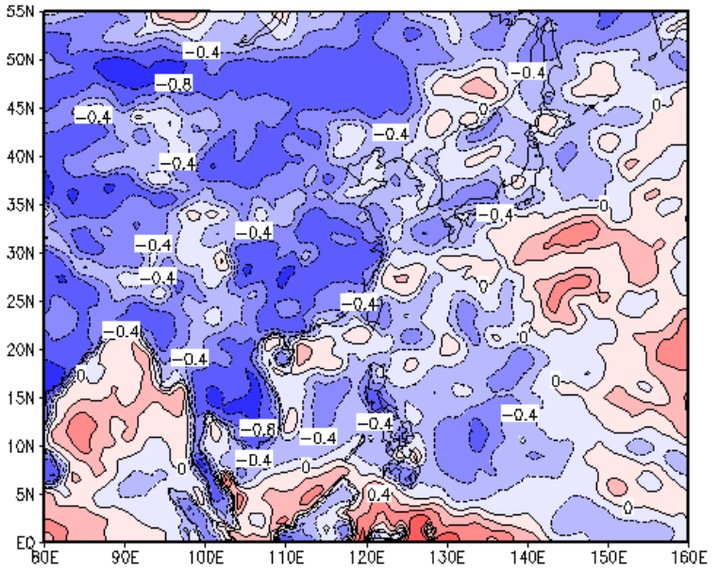
HadGEM3-RA



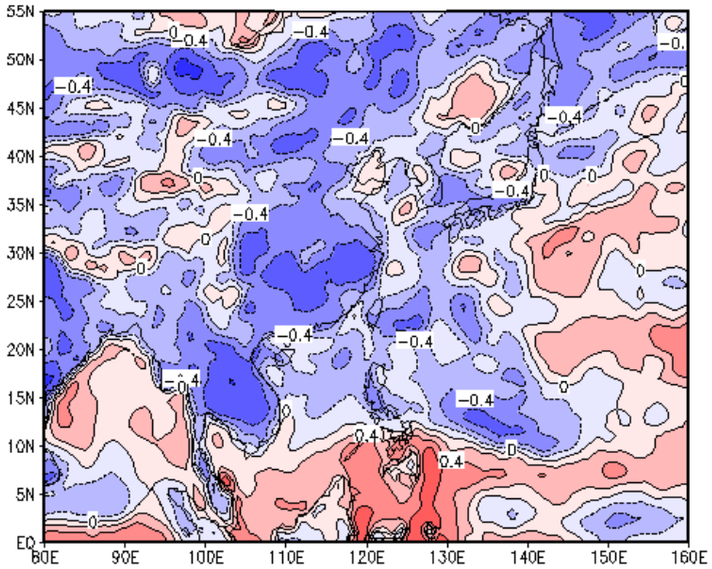
RegCM4



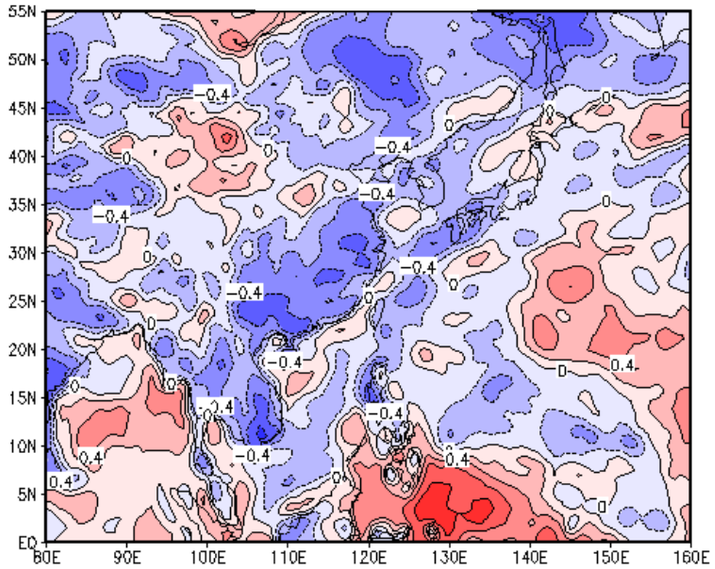
SNURCM

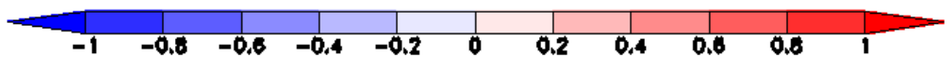


WRF

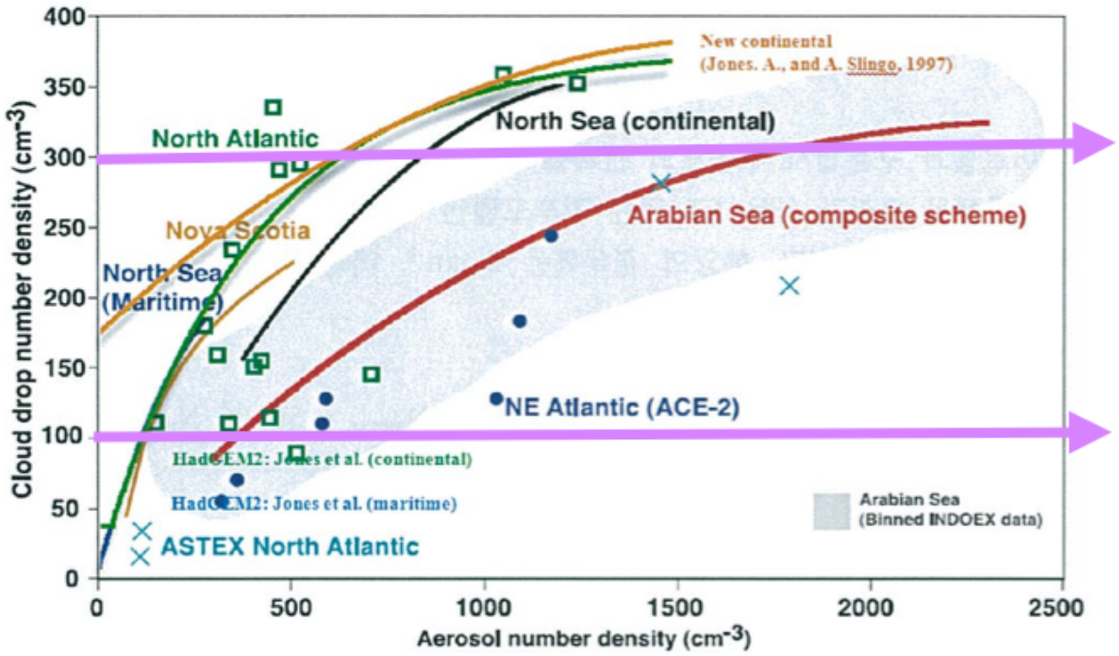


GRIMS





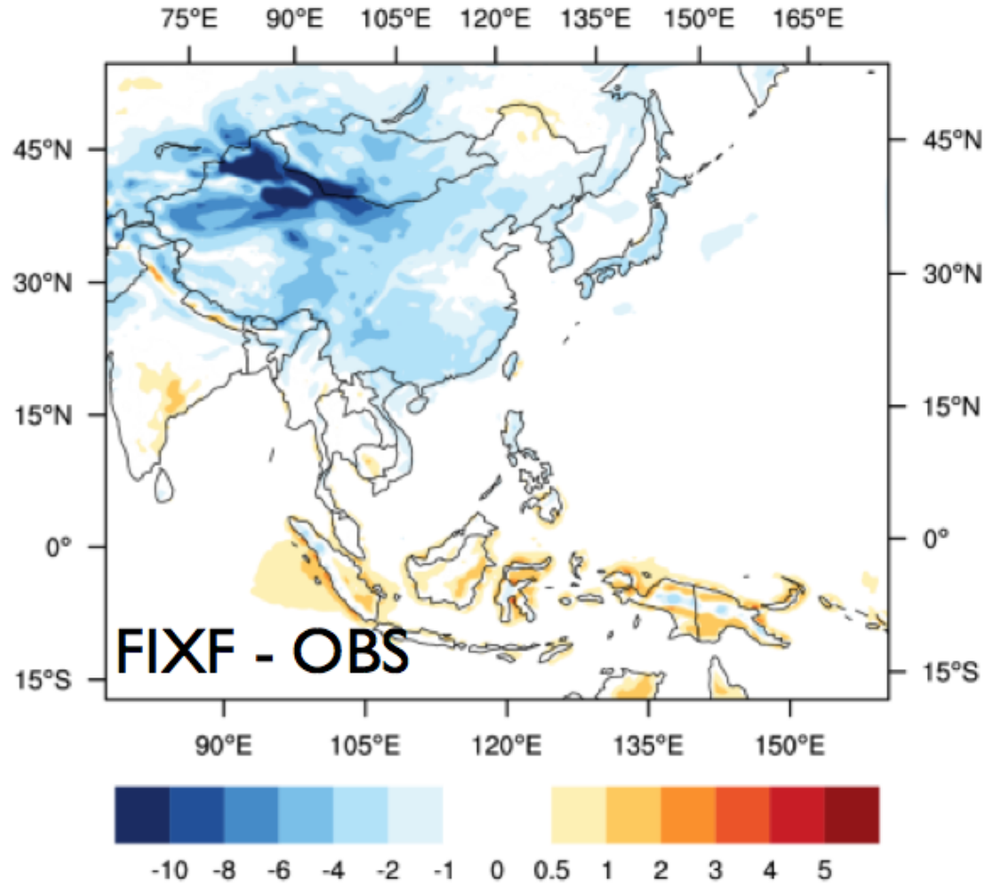
Impacts of Aerosol Forcing

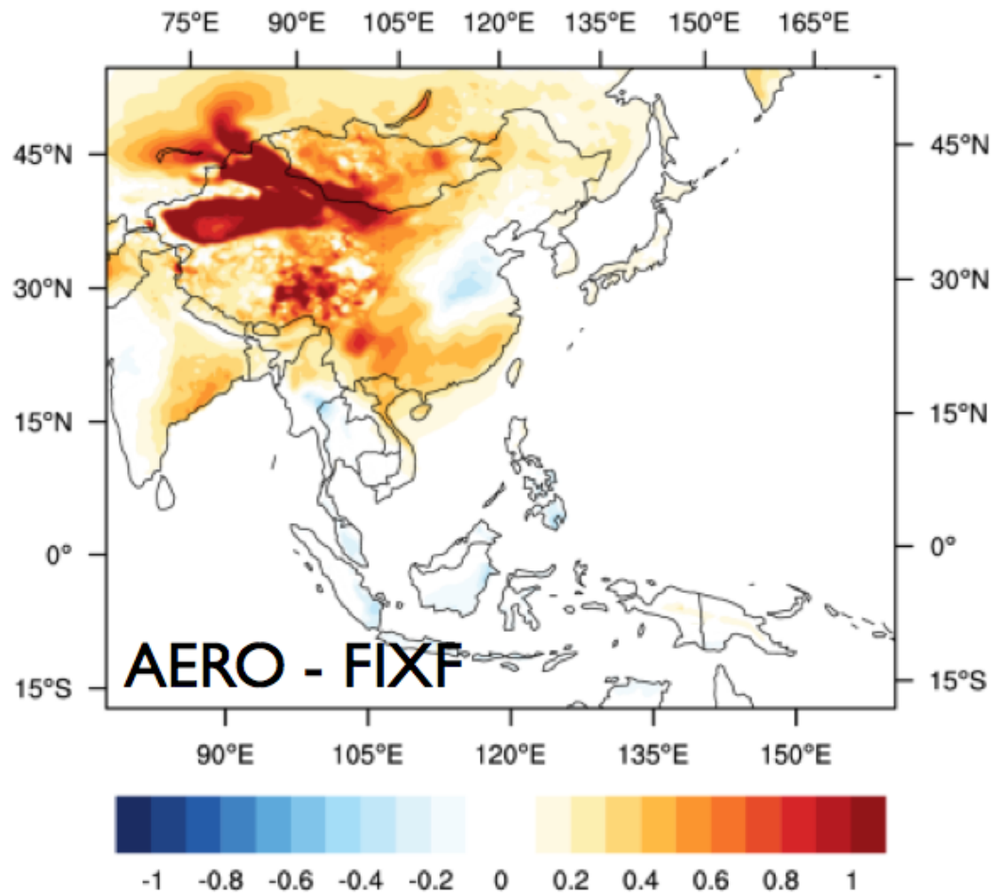


Ramarathan et al., 2001

land
(300 cm-3)

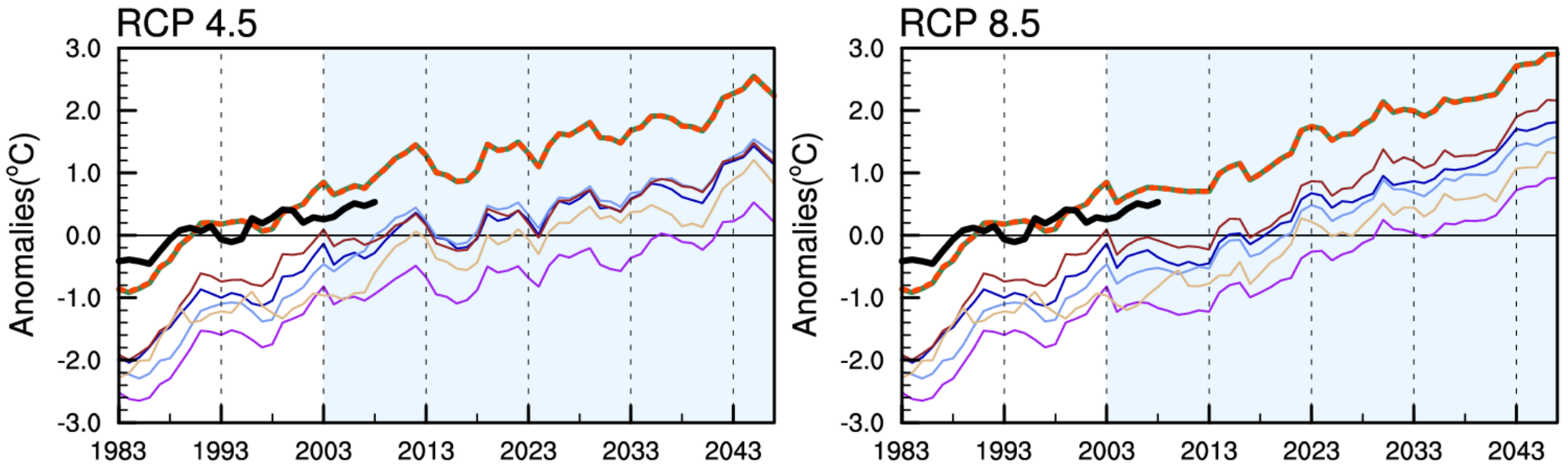
ocean
(100 cm-3)



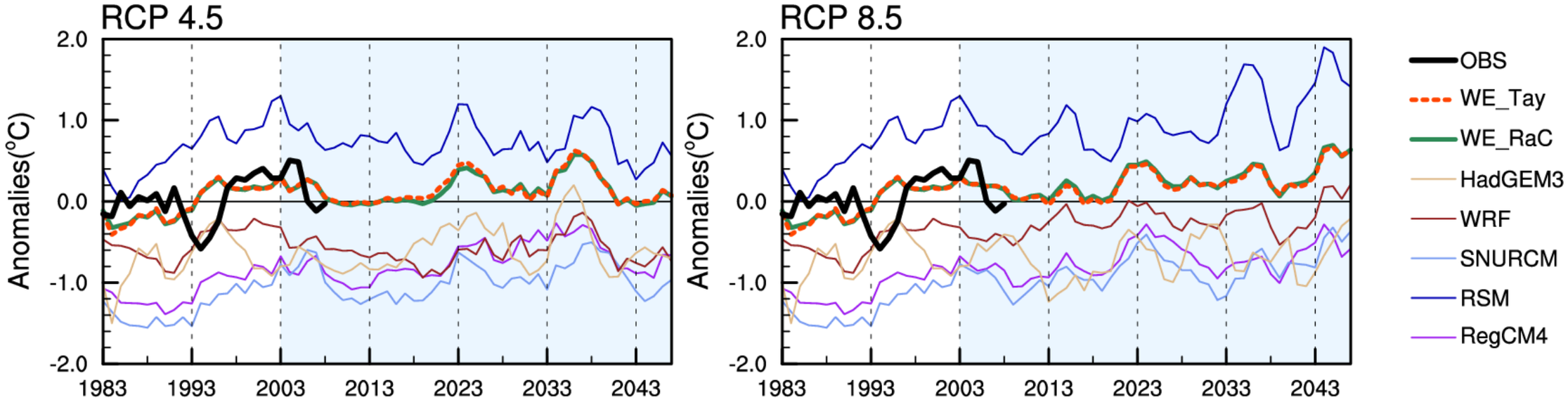


Annual mean time series
(9-year moving average)

<Temperature>

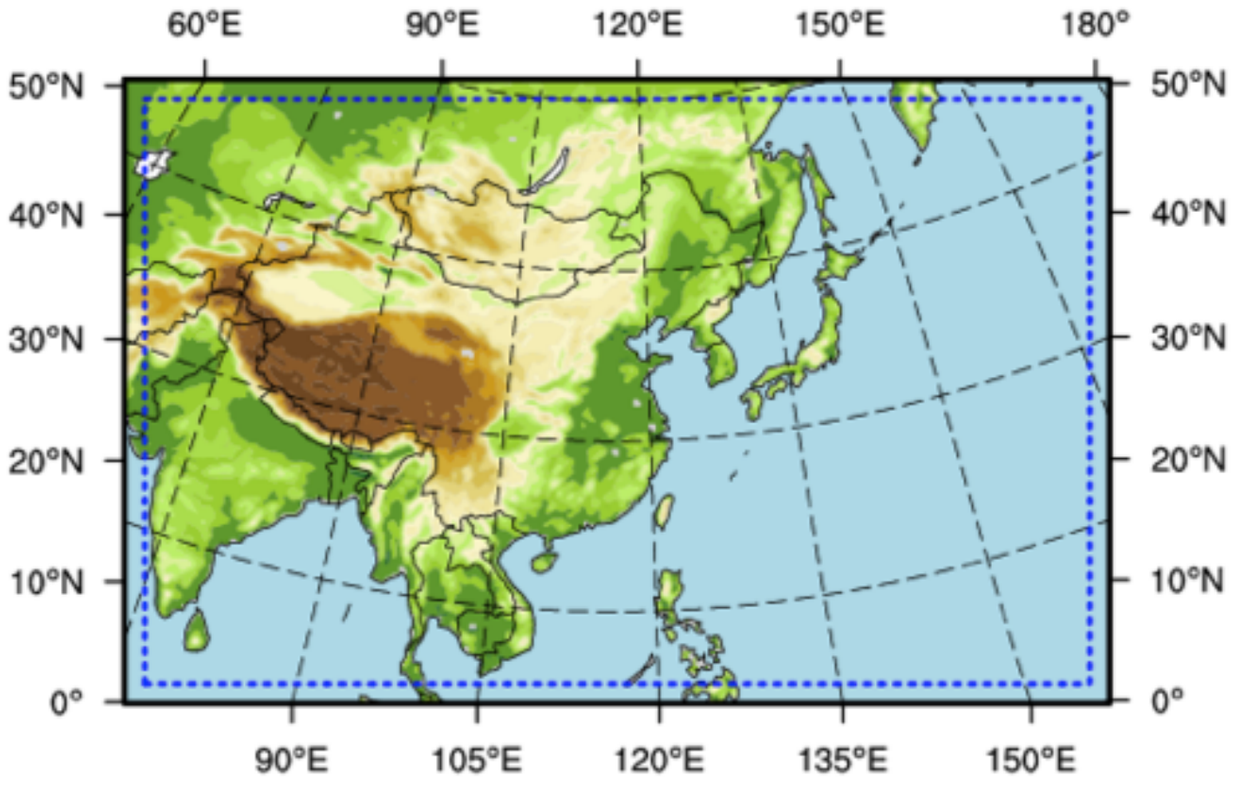


<Precipitation>



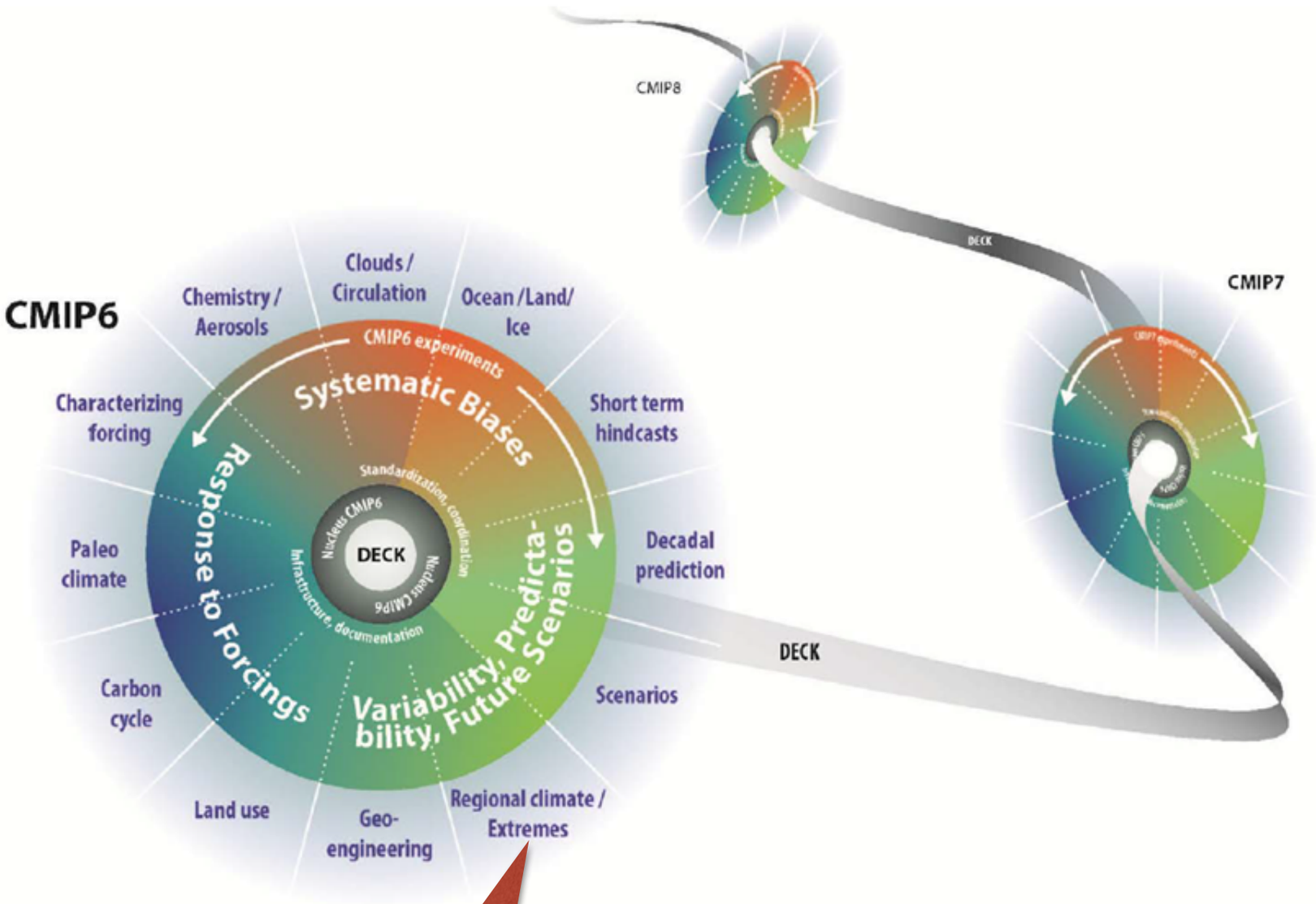
CORDEX-EA Phase II

- CORDEX-SAT and CORDEX-EA community decided to move toward Phase II with higher-resolution domain.
- Number of participating groups will be 12~15 from China, Japan, and Korea. A few more groups are possible to join from US and Australia.
- CORDEX submitted a proposal to WGCM for being one of the CMIP-endorsed MIPs.



Domain	Number of Grids	Resources
50 km (0.44 deg)	220 x 183	1
25 km (0.22 deg)	396 x 251	4.8
12 km (0.11 deg)	792 x 501	38

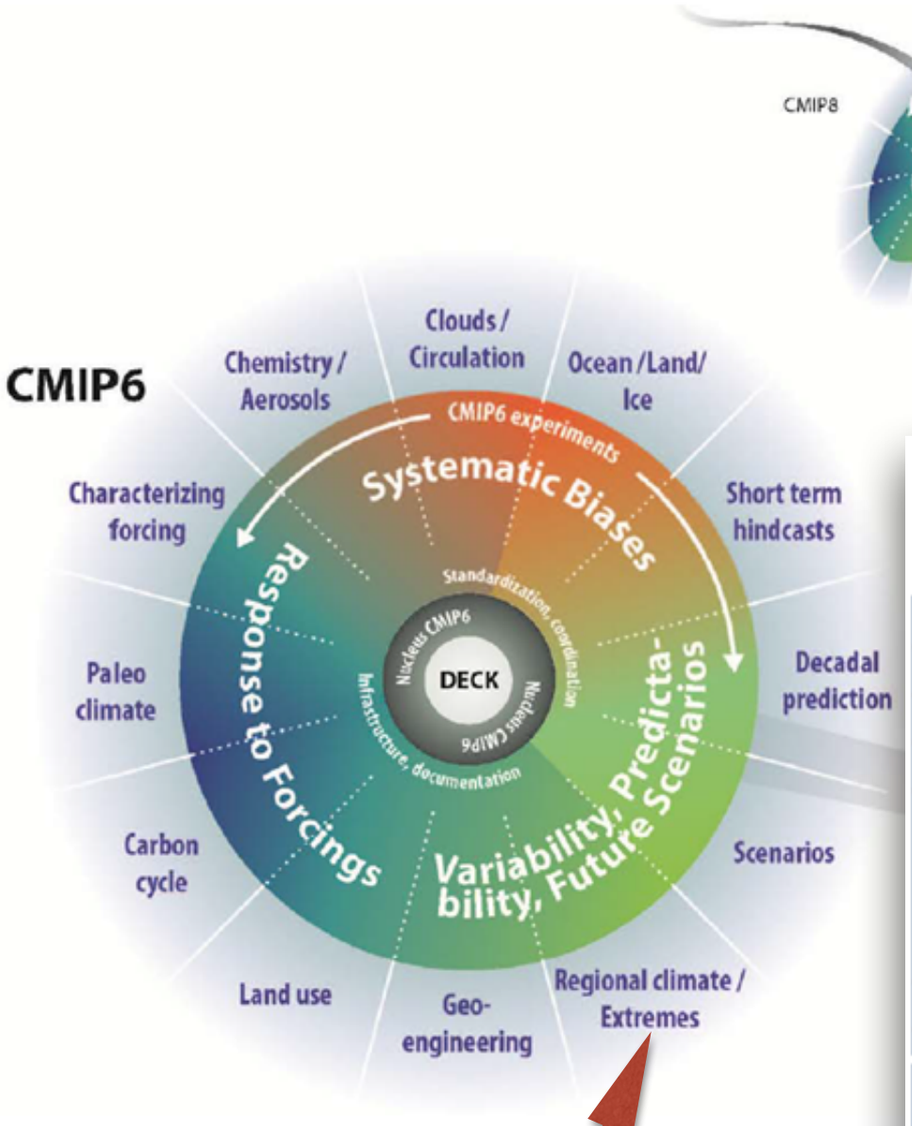
CMIP6 Structure and Timeline



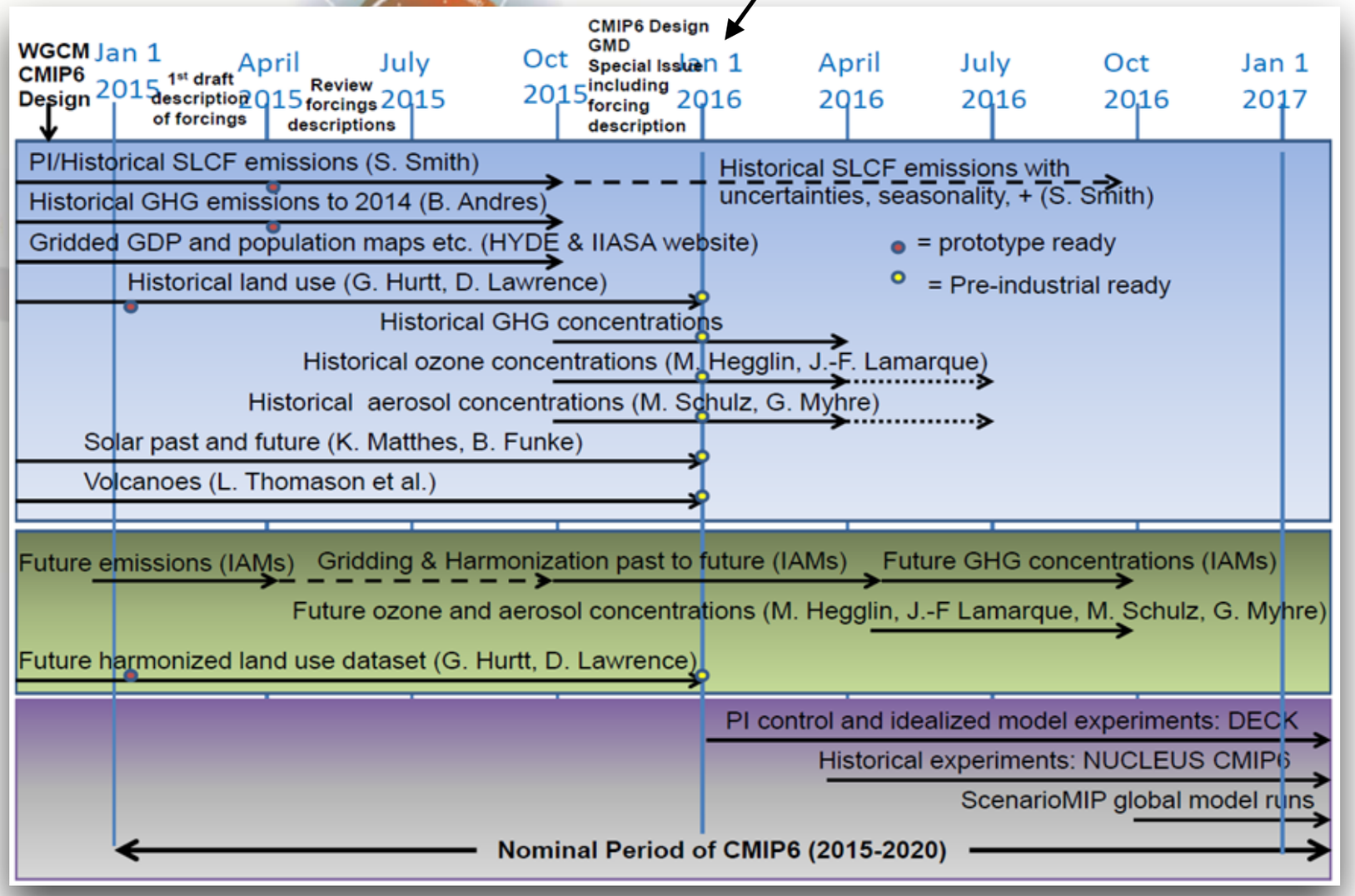
CORDEX
as a CMIP-endorsed MIP

CMIP6 Structure and Timeline

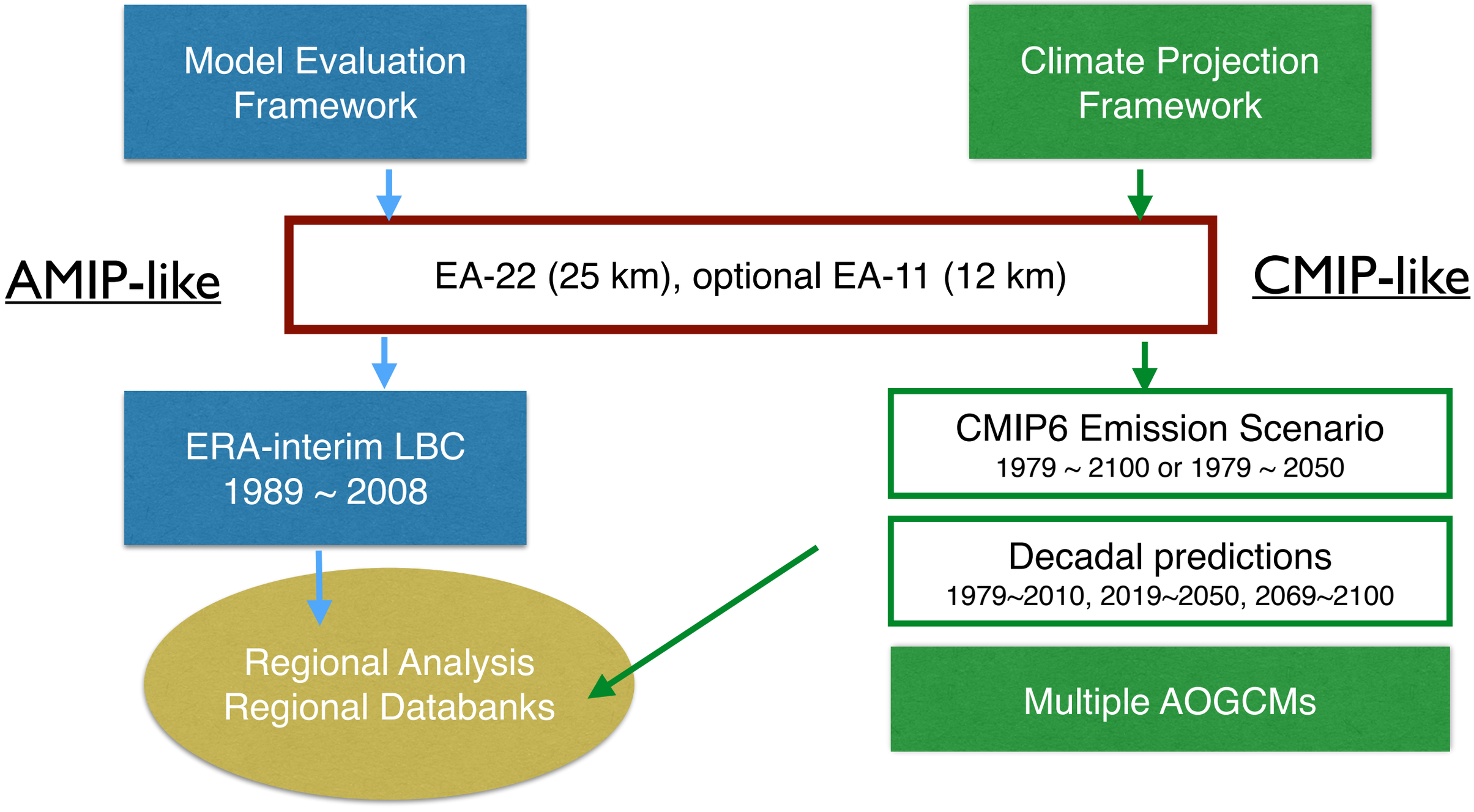
CMIP6 simulations will start in 2016 !!



CORDEX
as a CMIP-endorsed MIP



Experiments for CORDEX-EA Phase II



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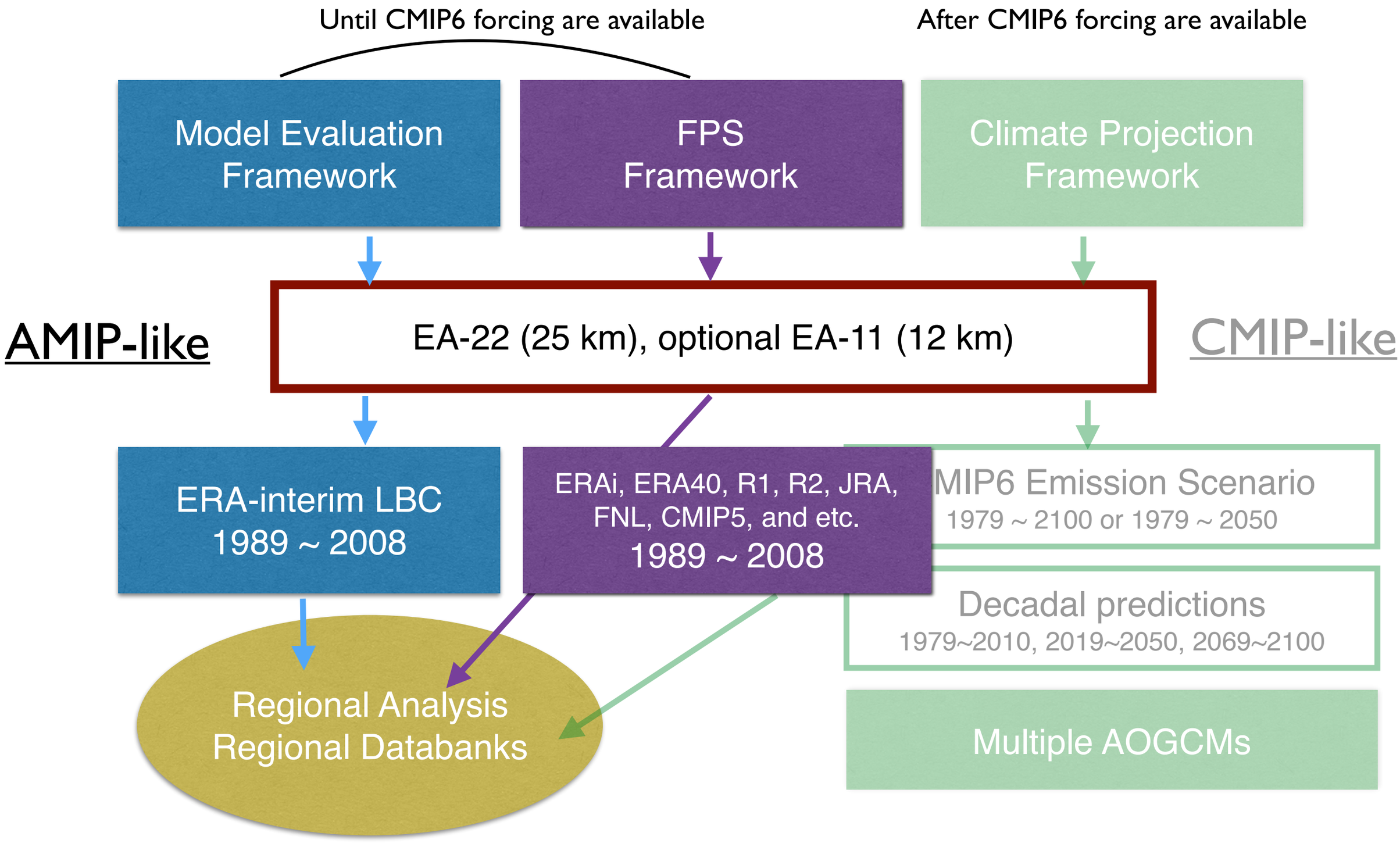


CORDEX Archives (not ESGF)

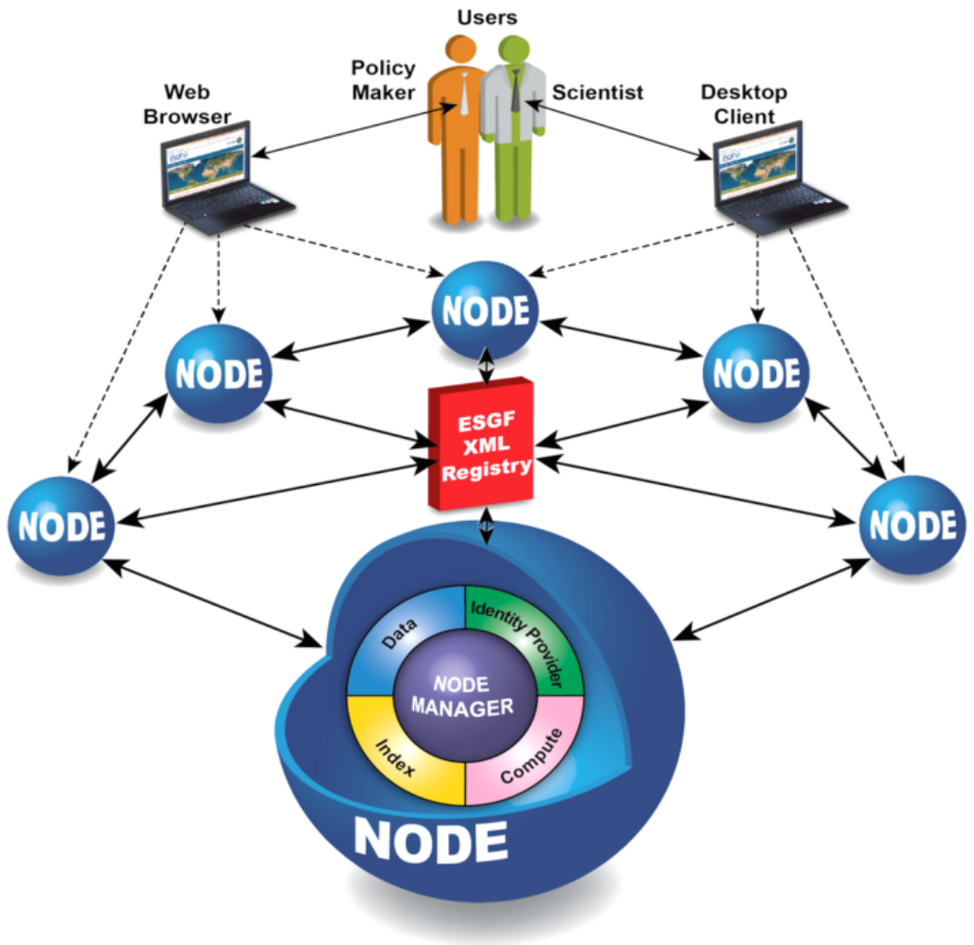
- MED-CORDEX (MED) - http://www.medcordex.eu
  - Users should be approved
  - TOU: "non-commercial only" for all simulations (web)

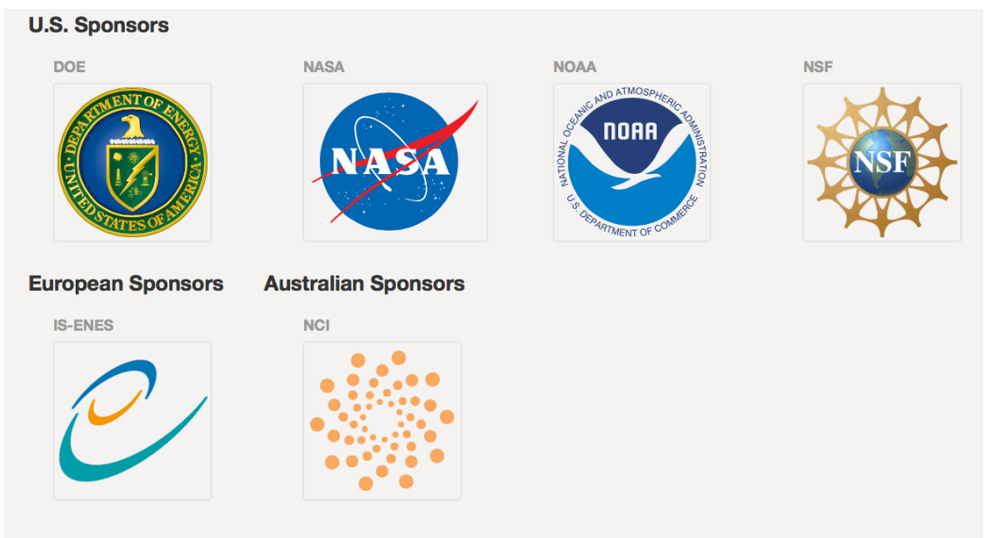
- East Asia (EAS) - http://cordex-ea.climate.go.kr
  - Register and download
  - TOU: "non-commercial only" for all simulations (pdf doc)

- South Asia (WAS) - http://cccr.tropmet.res.in/codex
  - Users should be approved
  - TOU: "non-commercial only" for all simulations (web)

- CCCma (Canada) - http://www.cccma.ec.gc.ca/data/canrcm/CanRCM4
  - Register and download
  - TOU: "unrestricted"
  - only CANRCM44: AFR, ARC, EUR, NAM, both 0.22 and 0.44deg

Earth System Grid Federation (ESGF)





- ESGF Peer-to-Peer (P2P) enterprise system is a collaboration for the management, dissemination, and analysis of model output and observational data.
- A component architecture expressly designed to handle large-scale data management for worldwide distribution.
- Model simulations, satellite observations, and reanalysis products are all being served from the ESGF P2P distribution data archive.

Summary

- CORDEX-Phase I experiments for East Asia region have been completed successfully, and their outputs are welcomed to be used by analysis groups as well as IAV sectors via http://cordex-ea.climate.go.kr
- Evaluation of the outputs are currently focusing on multi-model ensemble, monsoon evolution, and climate extremes including tropical cyclones.
- Multi-GCM/RCMs metrics are essential, and RCM should be further developed toward RCESM to capture more realistic features of monsoon front and tropical cyclones.
- Statistical downscaling and its application for IAV sectors are still limited only on nation-wide scale in Korea.
- Phase-II experiments with smaller domain but with higher-resolution are prepared by EA groups.

Thanks for your Attention!