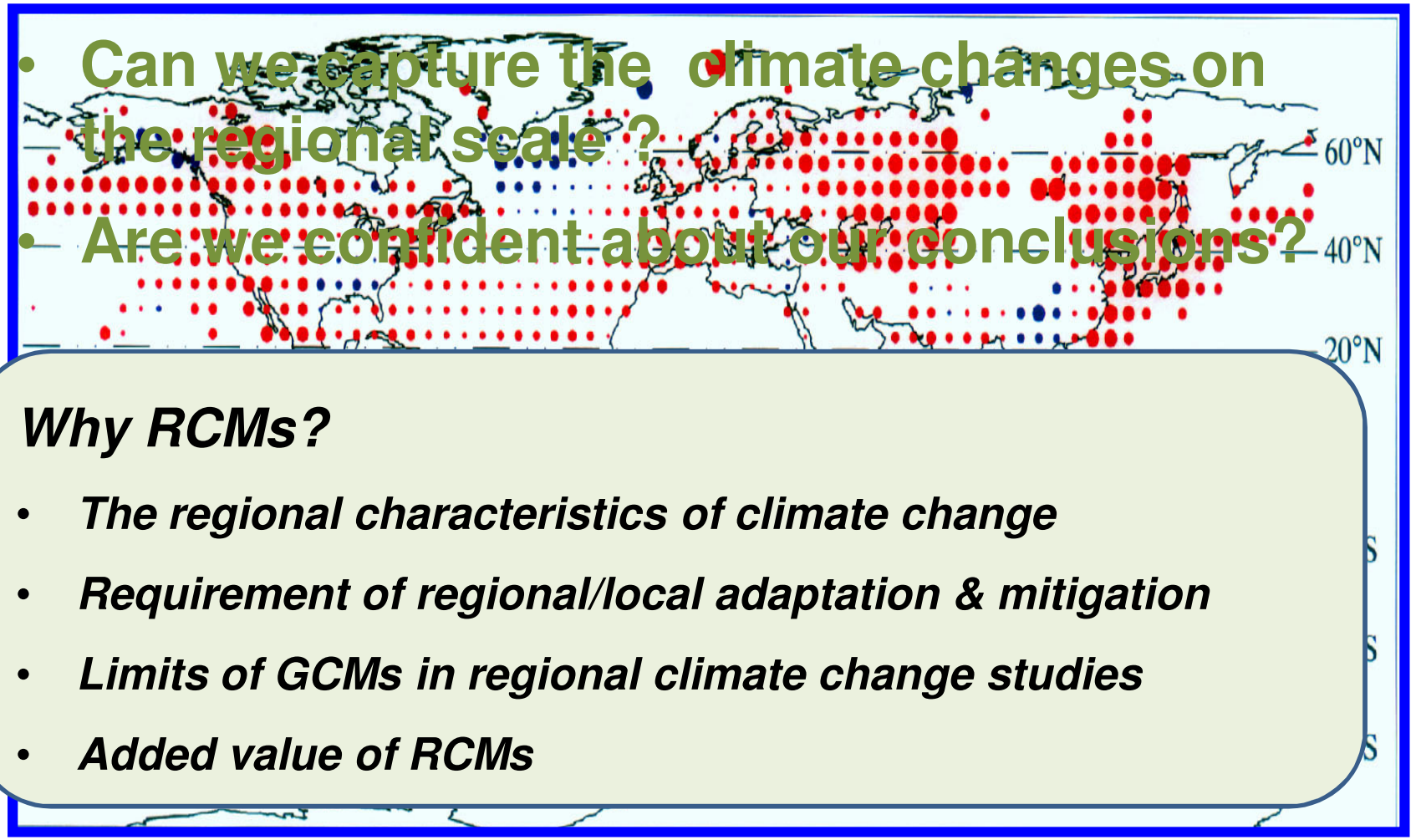
RMIP:
Regional climate Model Intercomparison Project

S. Wang, ***D. Lee, J. McGregor, W. Gutowski , K. Dairaku, X. Gao, S. Hong, Y. Wang, K. Kurihara, J. Katzfey***

Outlines

- **Background introduction**
- **Current climate simulation**
- **Asian regional climate projection**
- **Summary**

Climate is changing

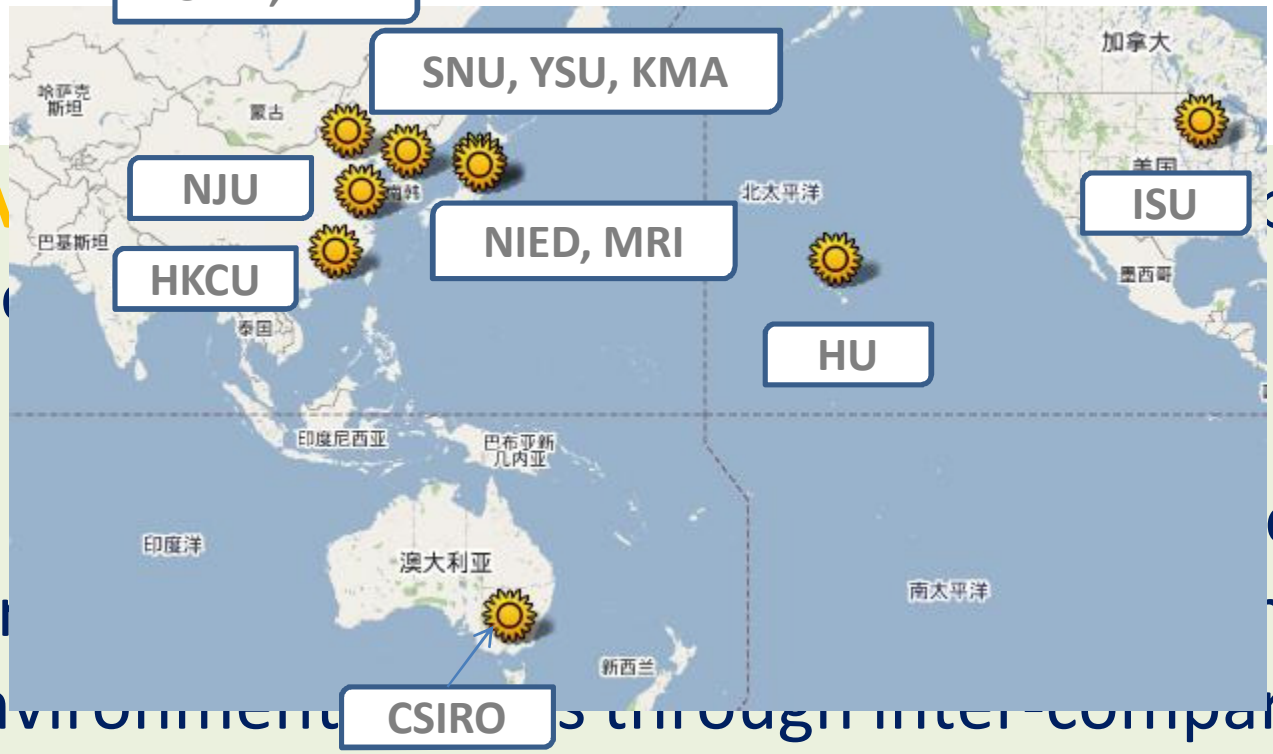


- Can we capture the climate changes on the regional scale ?
- Are we confident about our conclusions?

Why RCMs?

- ***The regional characteristics of climate change***
- ***Requirement of regional/local adaptation & mitigation***
- ***Limits of GCMs in regional climate change studies***
- ***Added value of RCMs***

History of Regional Collaboration



- RM parison
  Pr
- In ort the
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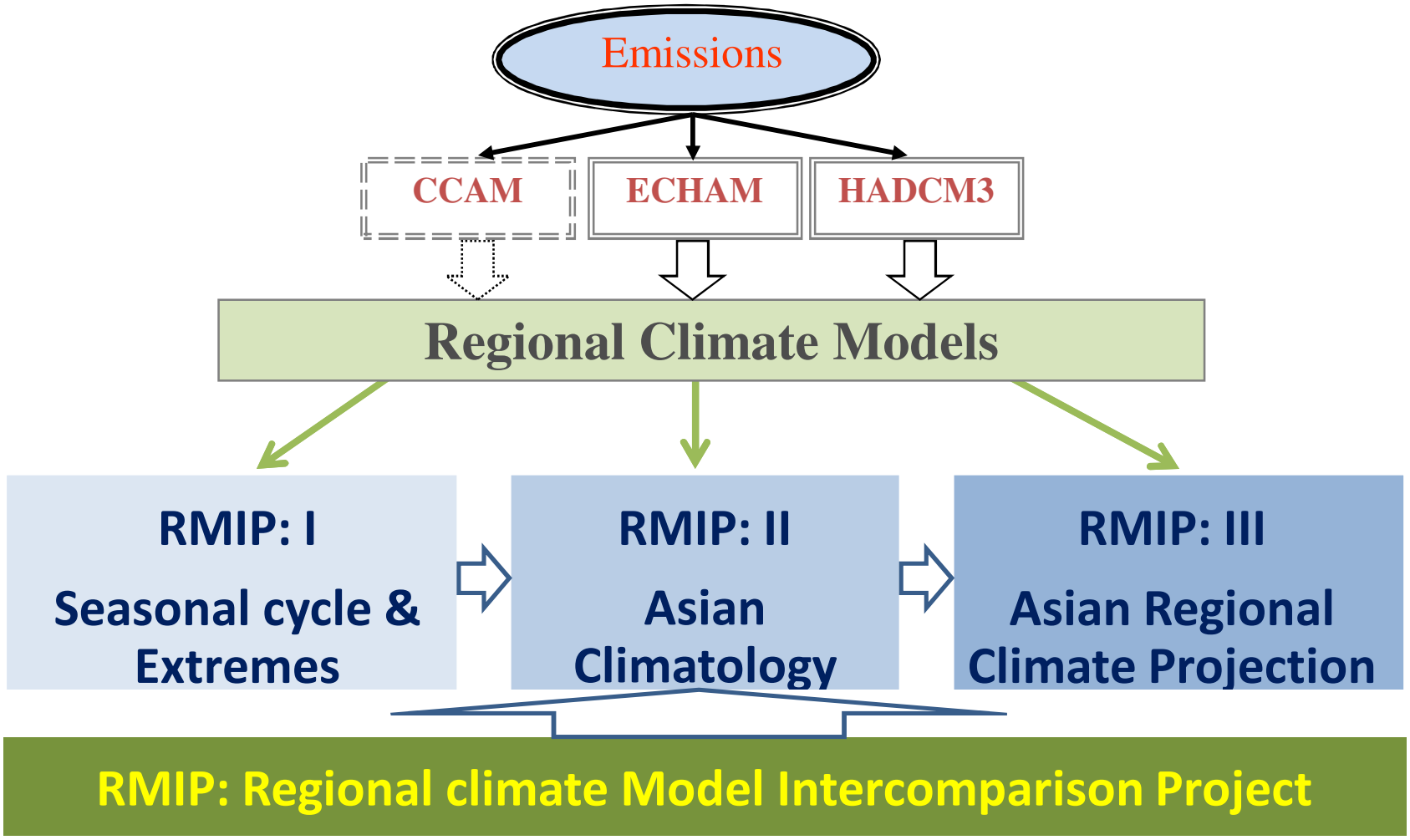
  environment s through inter-comparisons,

– universities, research institutes, government sponsored research agencies;

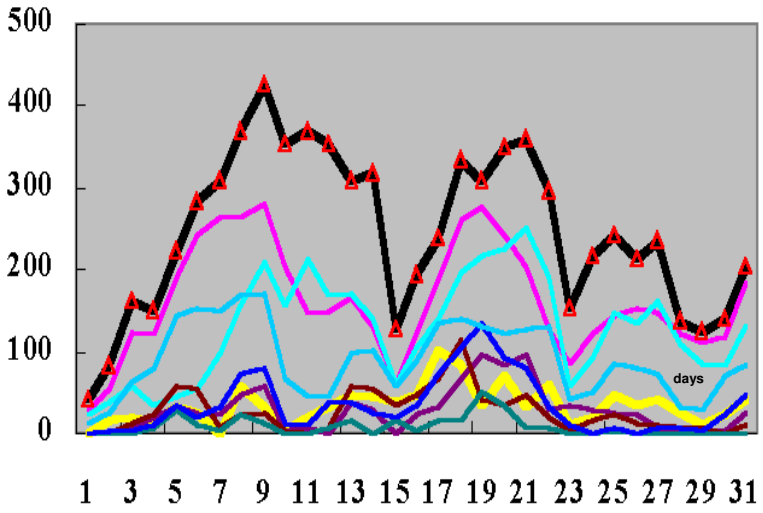
– scientists working on modelling, observation, *and end users*

Multi-RCM Ensemble System for Asian Climate

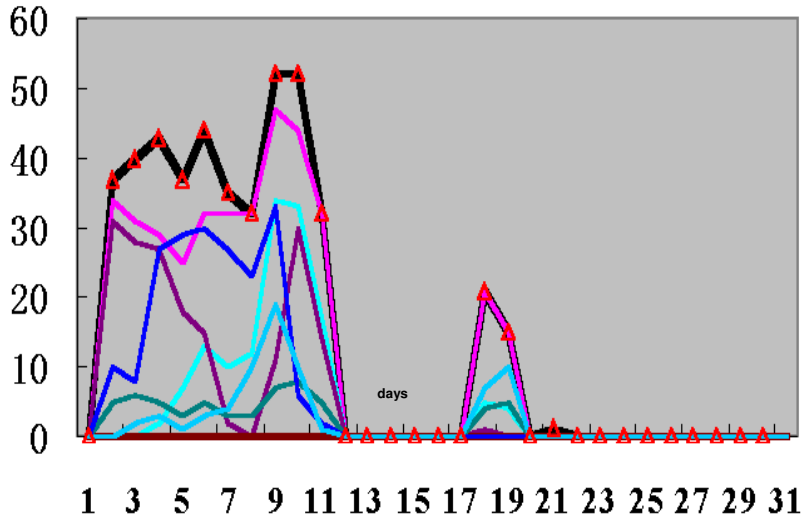


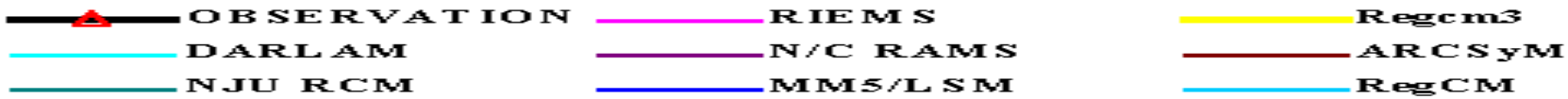
Simulation of the extreme heat in summer of 1997

Daily grid number with T_{max} above 35°C in the north of 35 N, July,1997

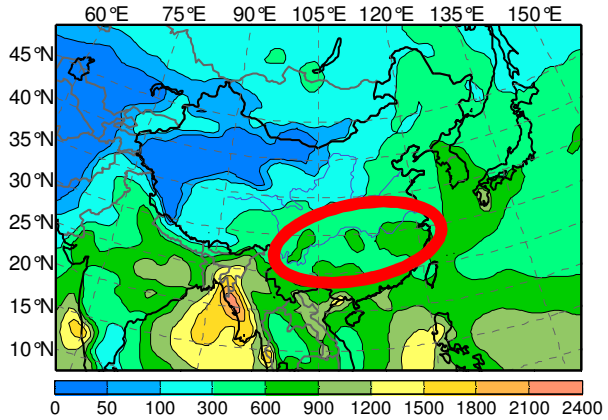


Daily grid number with T_{max} above 38°C in the south of 35 N, July,1997

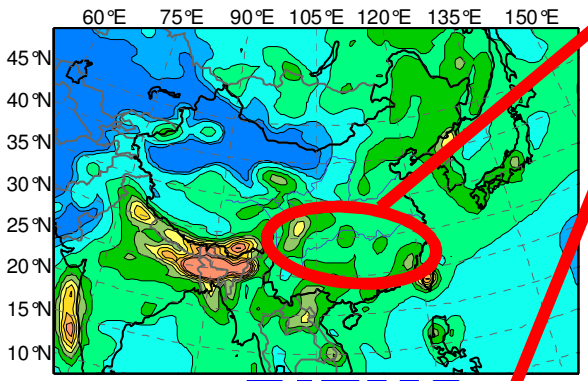


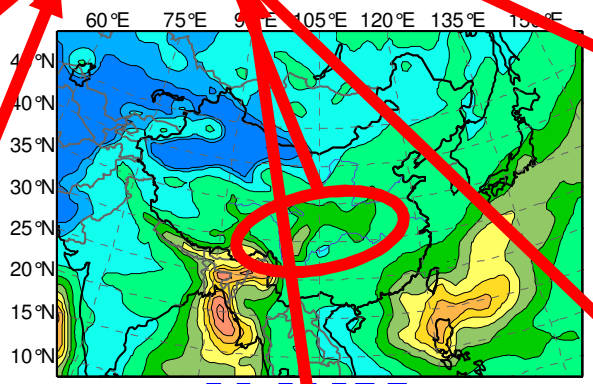


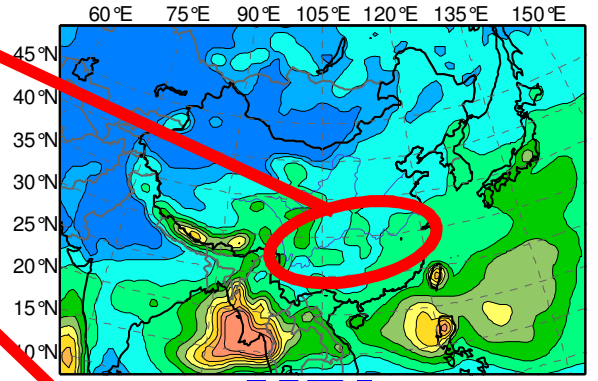
Summer Precipitation (1988-1997)

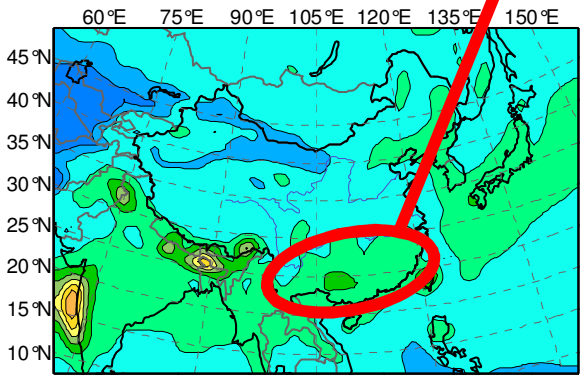


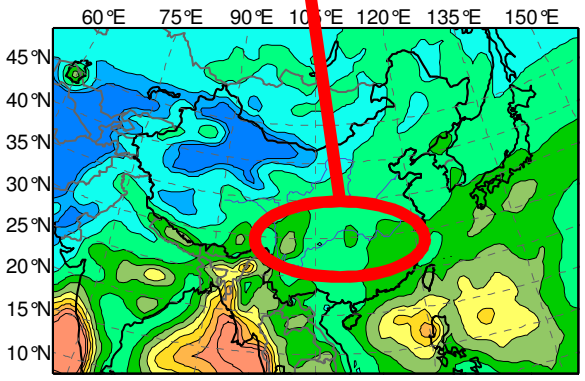
Northward shift

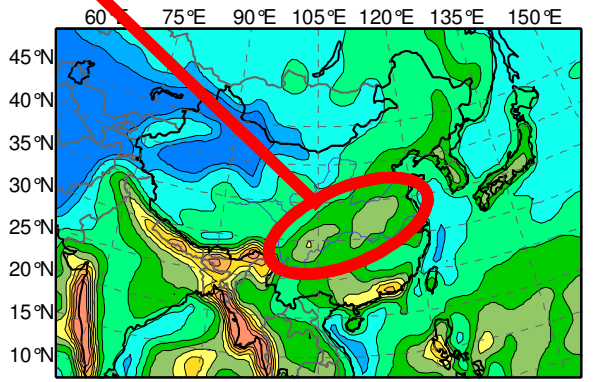




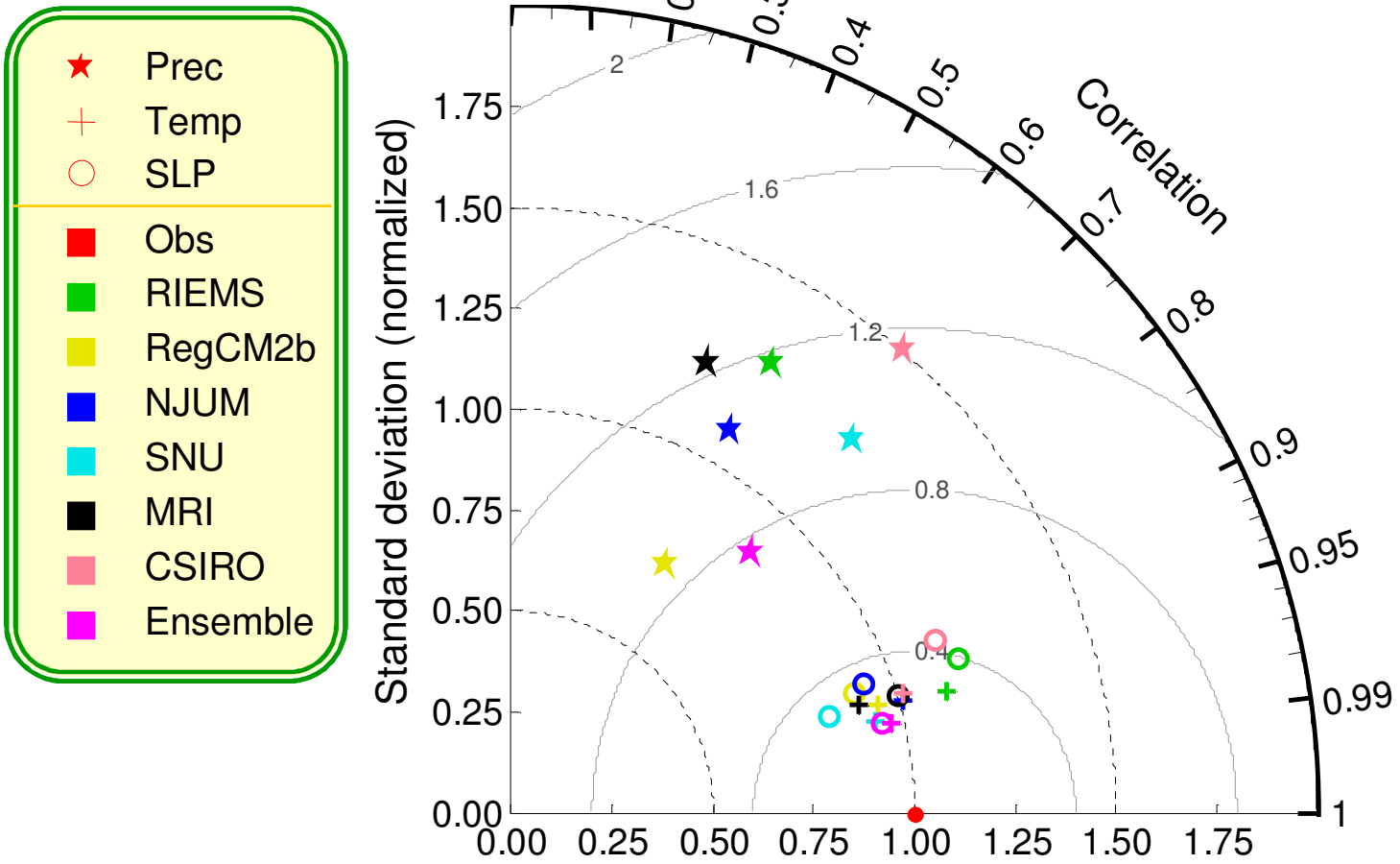








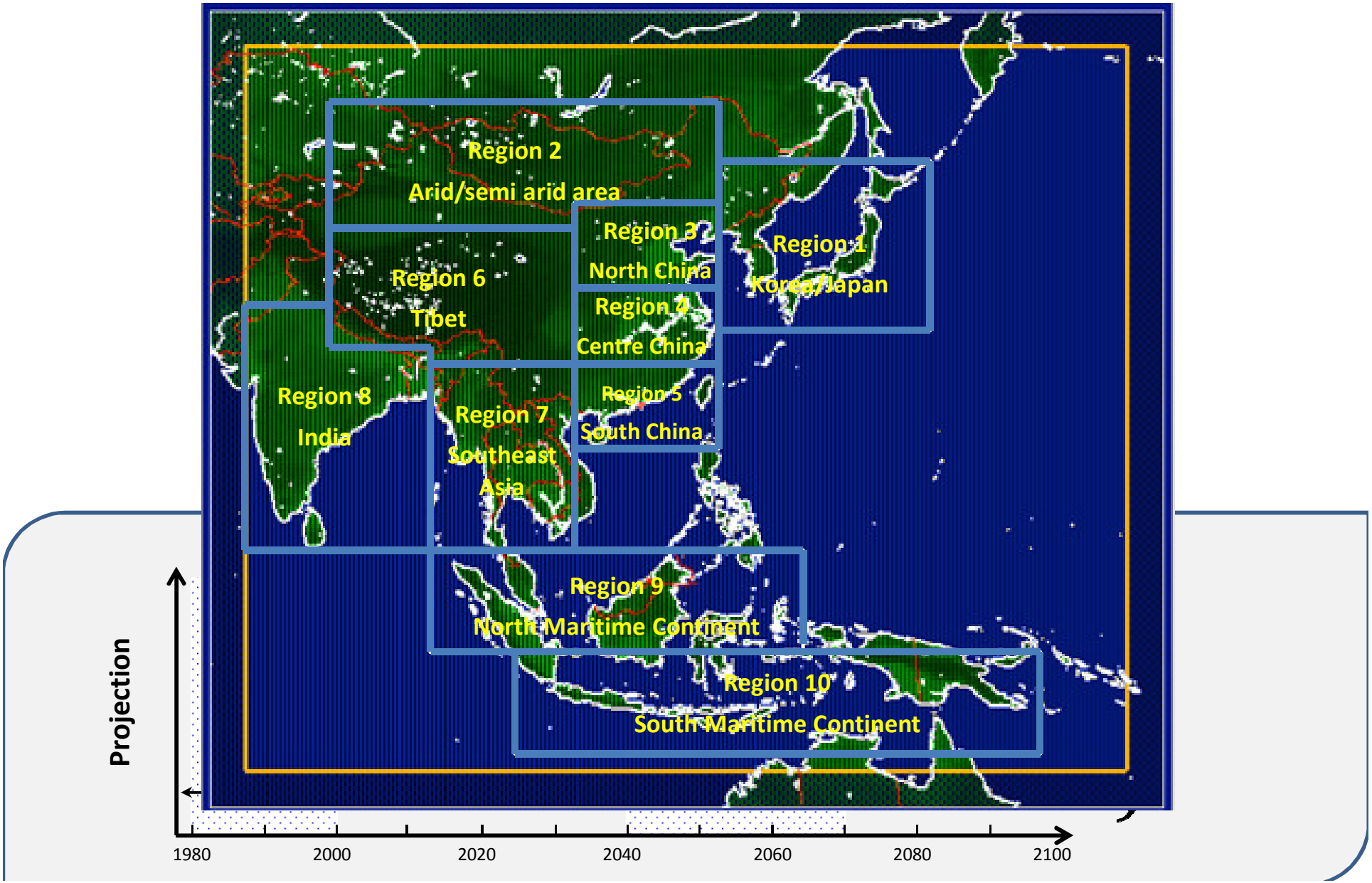
Taylor Diagram for T, P and SLP



Activities for RMIP III

- **Projecting high resolution regional climate change for 2040-2070 for Asia by using the ensemble of nice regional climate models;**
- **Based on the RCM simulations, detecting and assessing the sources and magnitudes of uncertainty in Asian climate change projection;**
- **Calculating the change and variance of controlling climate factors of Asian climate, i.e., Asian monsoon system, and its impacts on Asian climate;**
- **Exploring and developing new methods and techniques for treating ensembles of regional climate model outputs.**

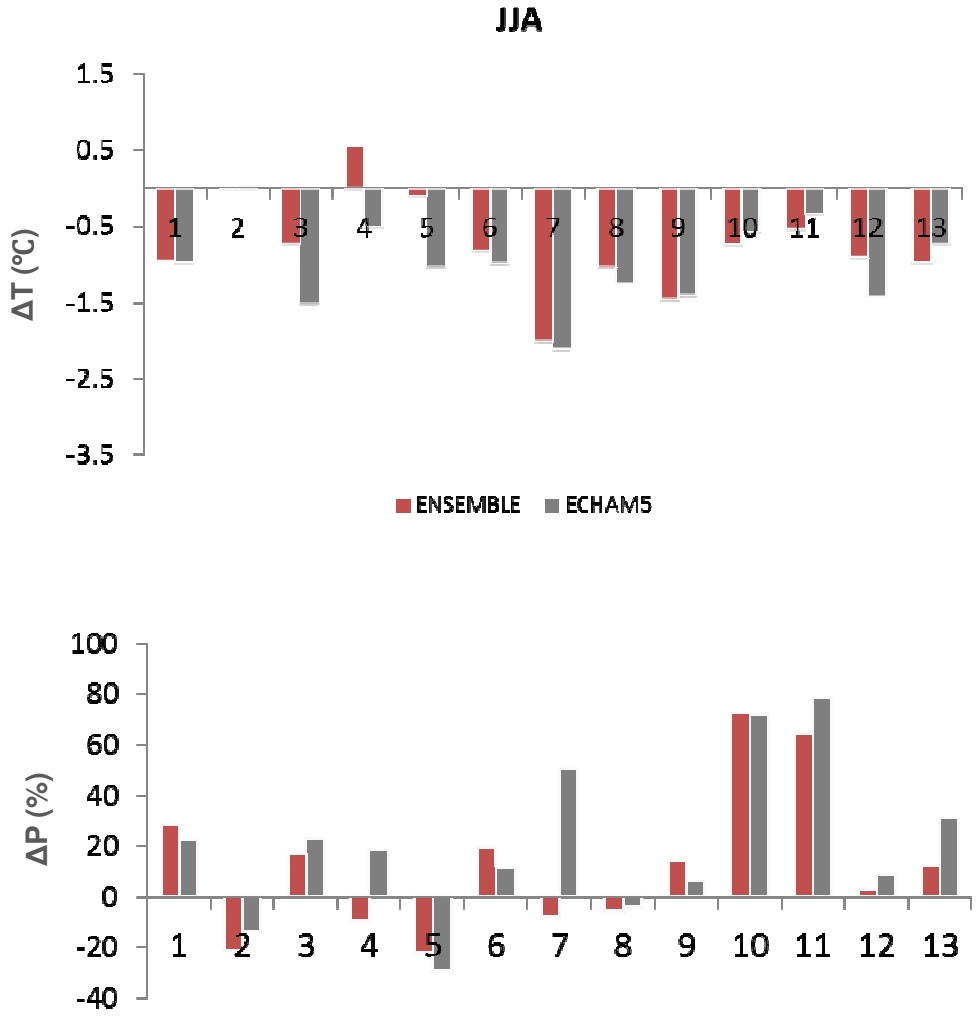
Domain，Time slices and Sub-regions



Data Availability

- Model Evaluation
- Climate Projection
  - ***Mean climate***
  - Extremes
    - Heat wave
    - Heavy Precipitation
  - Probability estimates and uncertainty analysis
    - the arithmetic mean, the weighted mean, multivariate linear regression, and singular value decomposition
    - REA, Bayesian…

Surface climate biases in different sub-regions



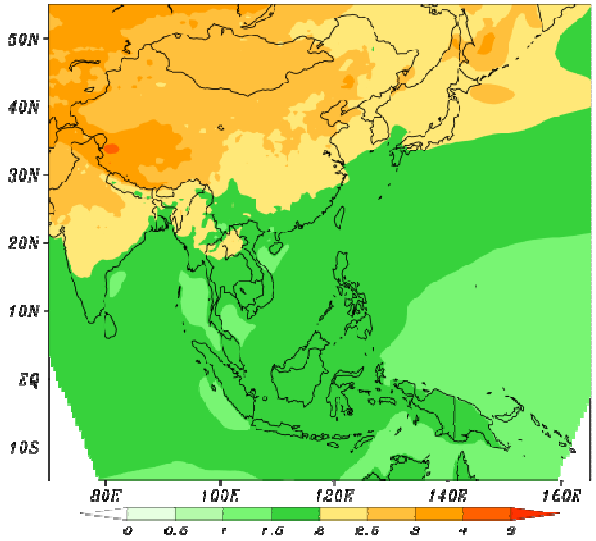
1, Asia
2, Korea/Japan
3, Arid/Semi arid area
4, North China
5, Center China
6, South China
7, Tibet
8, Southeast Asia
9, India
10, North Maritime
11, South Maritime
12, Land
13, Ocean

- **Colder than observation;**
- **Better performance than ECHAM5 over most sub-regions;**

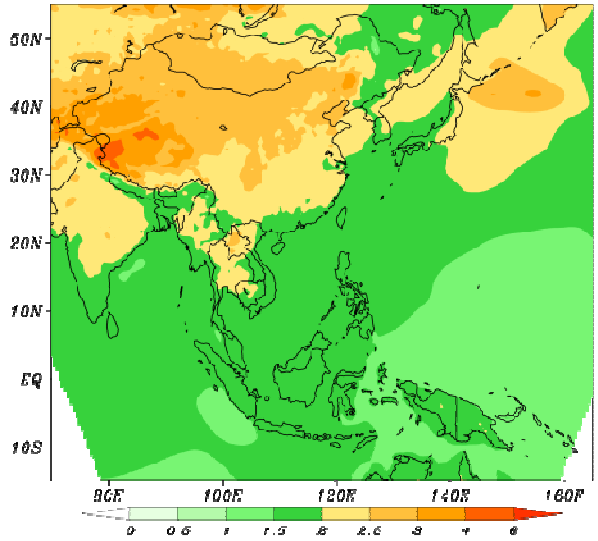
Surface Air Temperature Changes (℃)

	ANNUAL	JJA	DJF
Asia	1.96	1.92	*2.07*
Land	2.54	2.39	*2.86*
Ocean	1.70	1.72	*1.73*

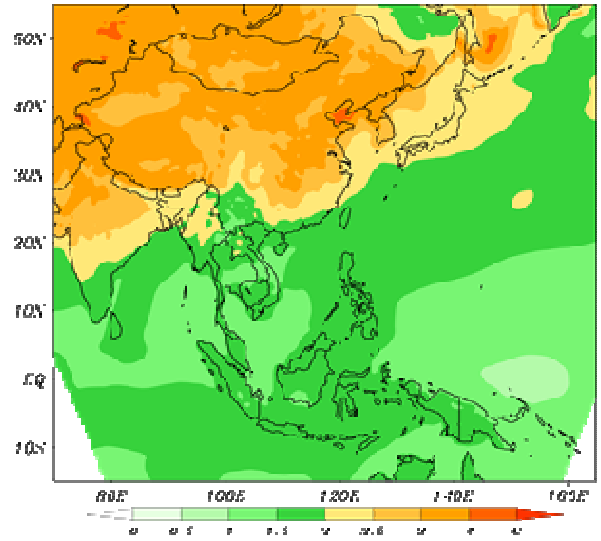
ANNUAL



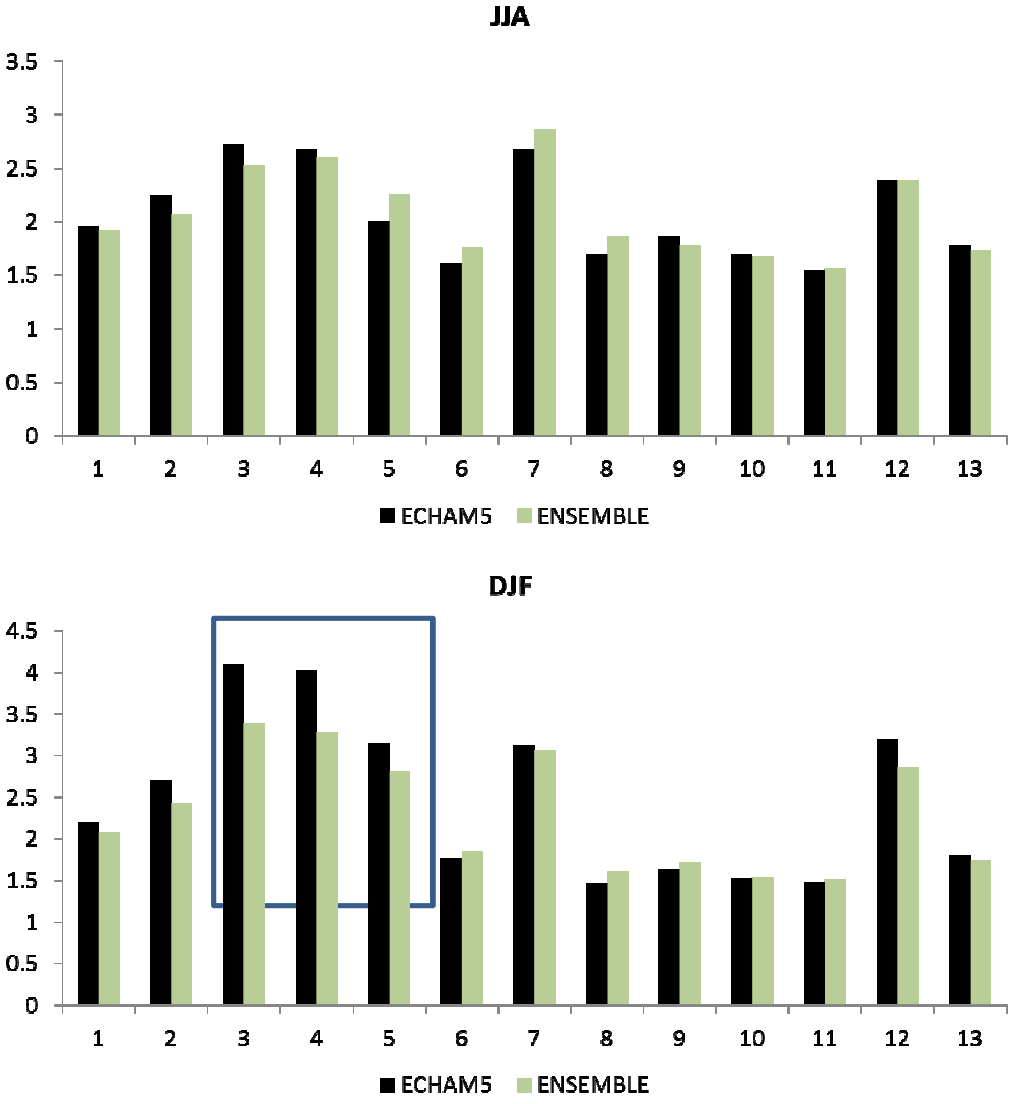
JJA



DJF



Temperature changes in different sub-regions



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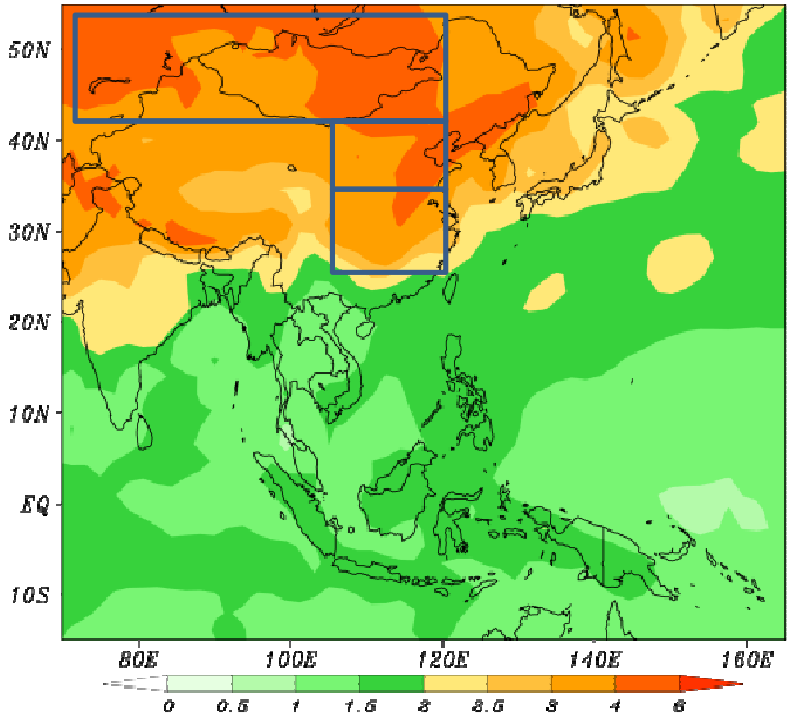
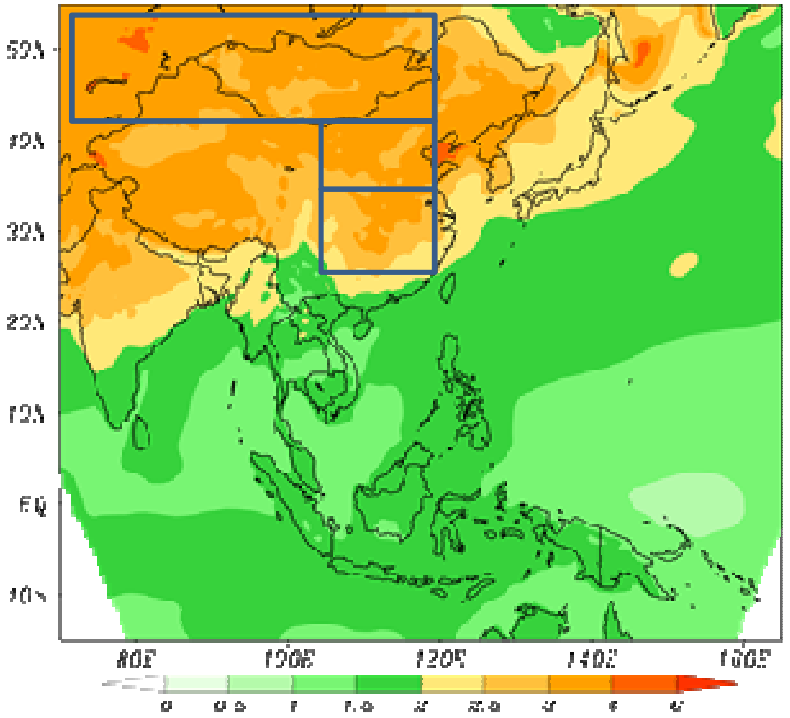
Winter Surface Air Temperature Changes (℃)

ECHAM5

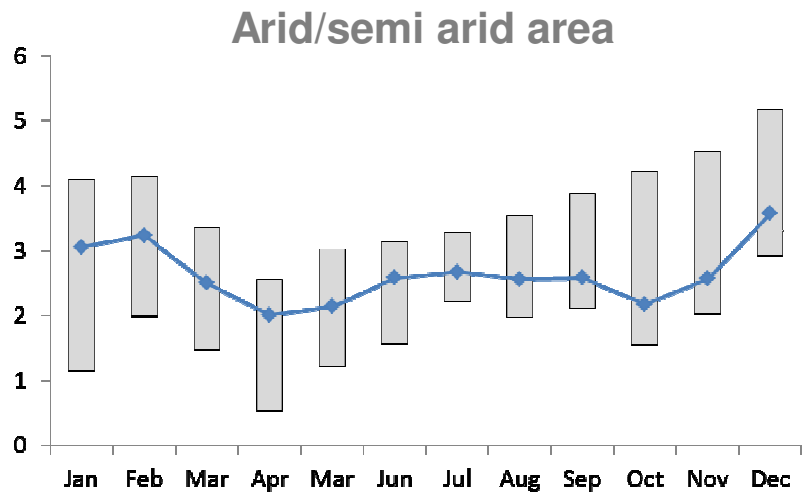


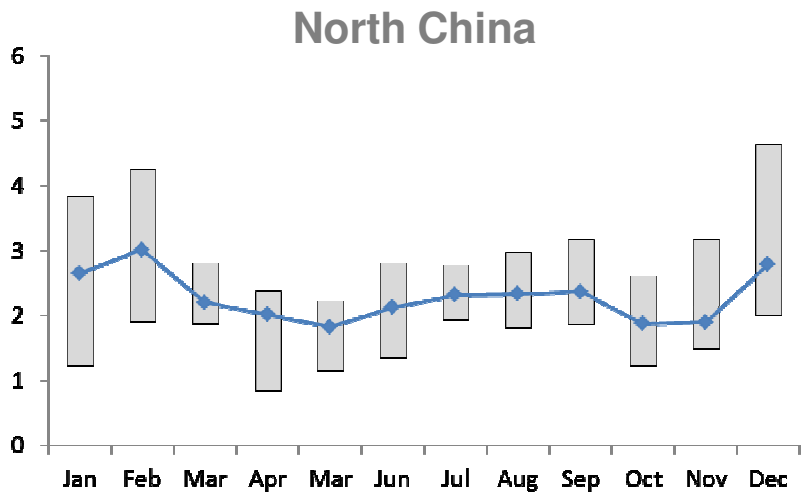
ENSEMBLE

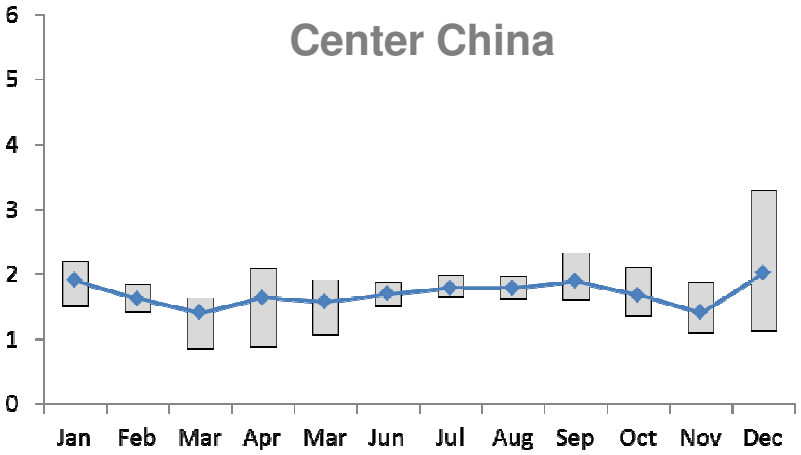


	ECHAM5	ENSEM.	Uncertainty Range (RMS diff. each model)	IV intermodel variations
Arid/semi arid	4.10	3.38	2.20~4.03	0.66
North China	4.02	3.28	2.03~4.06	0.75
Center China	3.15	2.81	1.72~3.92	0.81

Uncertainty in Temperature Projection



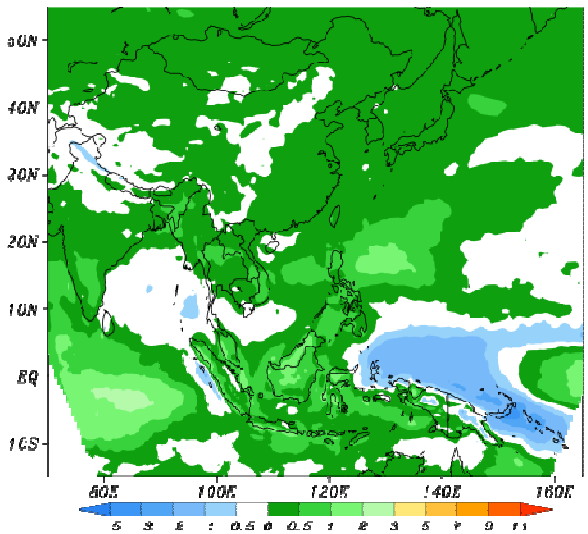




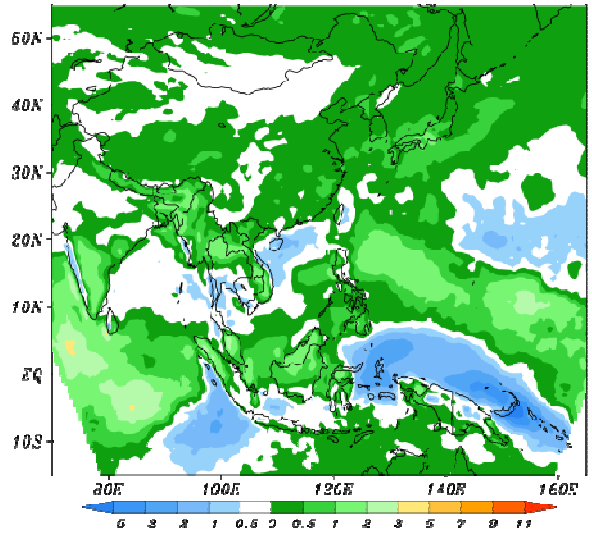
Total Precipitation Changes (mm/day)

	ANNUAL	JJA	DJF
Asia	0.13 (2.46%)	0.15 (2.40%)	0.16 (3.14%)
Land	0.12 (5.23%)	*0.20 (4.83%)*	1.53 (1.69%)
Ocean	0.13 (2.78%)	0.24 (3.21%)	*9.97 (2.69%)*

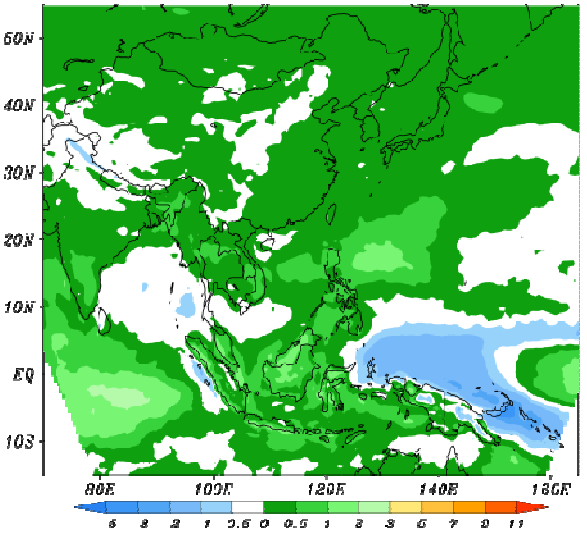
ANNUAL



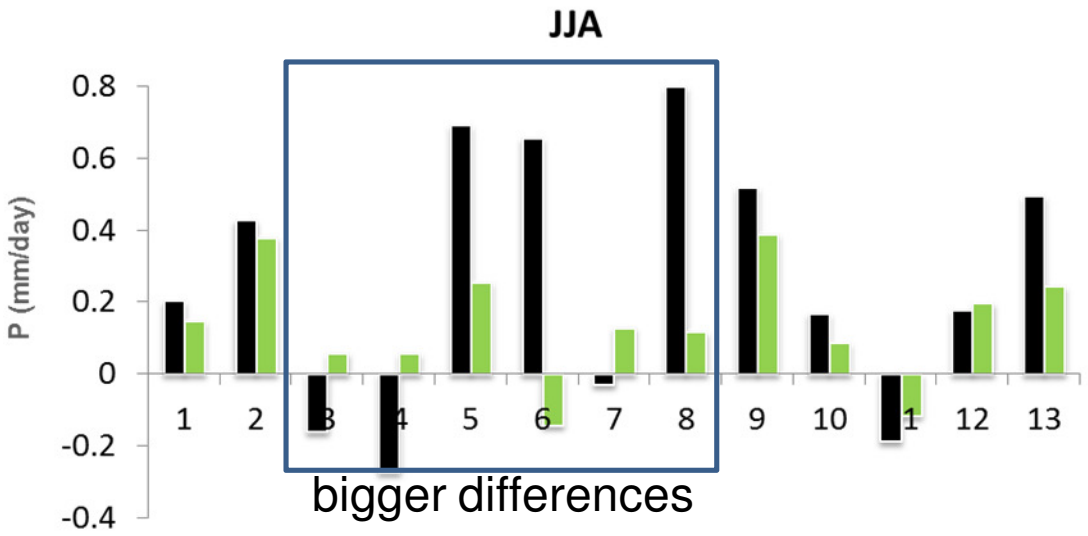
JJA



DJF



Precipitation changes in different sub-regions



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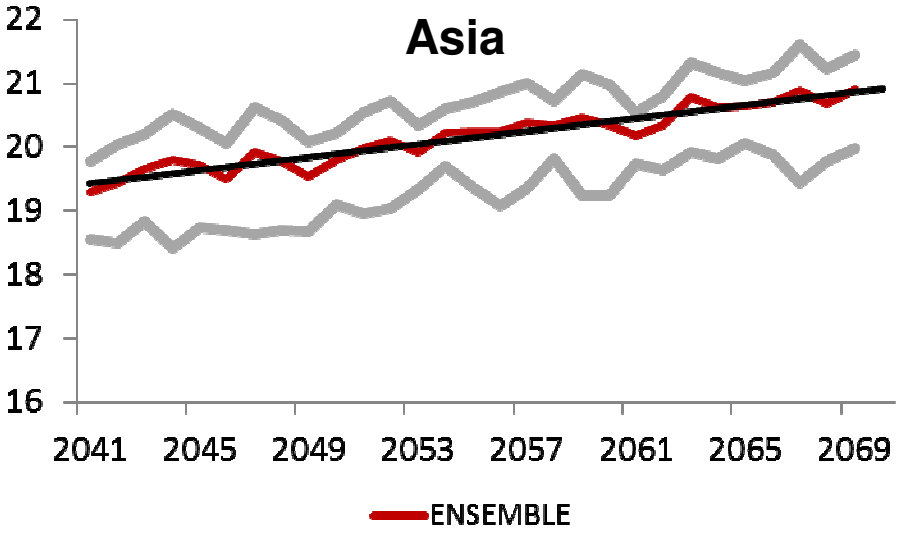
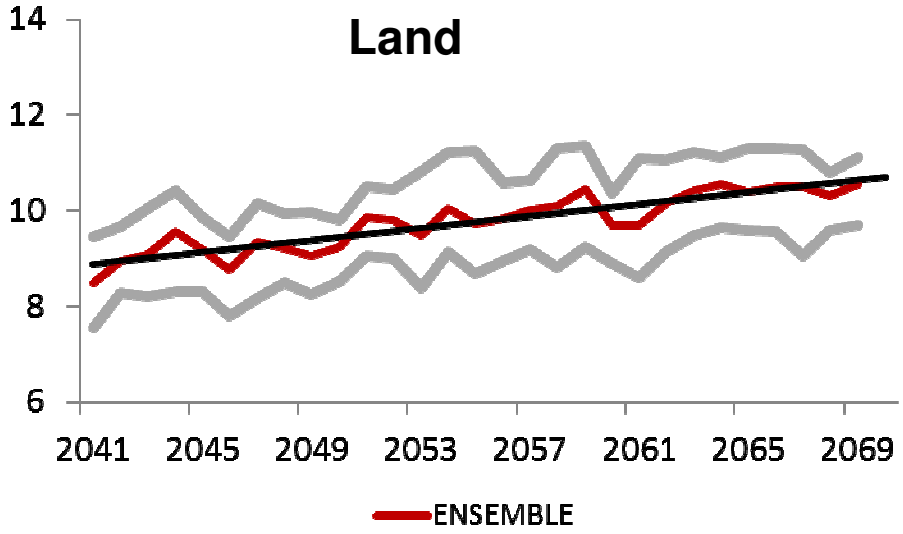
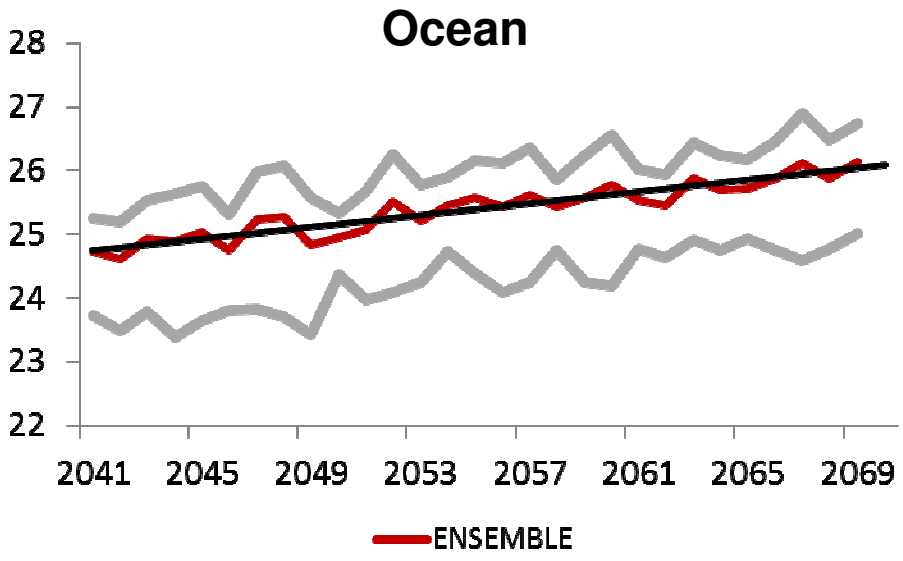
12, Land
13, Ocean

	ECHAM5	ENSEM.	Uncertainty Range	IV
Arid/semi arid	-0.16	0.06	-0.05~0.34	0.13
North China	-0.27	0.06	-0.18~0.54	0.22
Center China	0.69	0.25	-0.34~0.82	0.40
South China	0.66	-0.14	-0.48~0.27	0.24

Interannual variability for future climate by multi-RCMs







Annual T Trends for 2040-2070 (c/10yr)

	Ensemble
Korea/Japan	0.44
Arid/Semi arid area	0.63
North China	0.61
Center China	0.58
South China	0.50
Tibet	0.76
Southeast Asia	0.54
India	0.52
North Maritime	0.51
South Maritime	0.48

Summary

- RCMs show better performance than driving GCM over certain sub-regions
- For future climate, temperature will increase by up to 3C and show more warming in DJF and higher latitude;
- Asian precipitation will increase by 2.4%; most increase occurs over land in summer Season;
- Comparing to driving GCM, RCMs tend to have colder and drier future climate;

Current RMIP

- Data sharing
  - Data policy
  - Data server accessed through sftp
  - Project website under construction
- Publication
  - General paper
  - Scientific papers

Current RMIP

- Application
  - Development of an integrated climate change impact assessment tool for urban policy makers (UrbanCLIM) led by Yinpeng Li
    - **Development of high resolution climate change projections.**
    - **Development of an integrated impact assessment system**

Development of an integrated climate change impact assessment tool for urban policy makers (UrbanCLIM)

The main feature of the tool will be:

- Modular design to build on and link to existing models and related applications;
- Integrated analysis enabling testing of adaptation and mitigation options against socio-economic drivers, likely sectoral impacts, and existing goals for sustainable development;
- An open framework, allowing for multi-scale, multi-disciplinary impact assessment, which can be customized case-by-case to each city; Therefore this tool is potentially can be applied the wide area of APN community.
- Climate change uncertainty analysis building on GCM and RCM climate change scenarios;
- GIS integration, which is not heavily reliant on third party software;
- Visualization and further analysis options for the assessment results.

Future RMIP

- Application: urban or dryland
- Evolving into new projects
  - High resolution studies focussing on heavy precipitation: model performance, mechanisms and factors that control the change in extreme precipitation
  - High resolution simulations over urban areas

Future RMIP and CORDEX

- RMIP group members already involved with CORDEX East Asia activities;
- Collaboration between the East and South Asian groups with the support of APN and WCRP.

THANK YOU

Uncertainty in Precipitation Projection