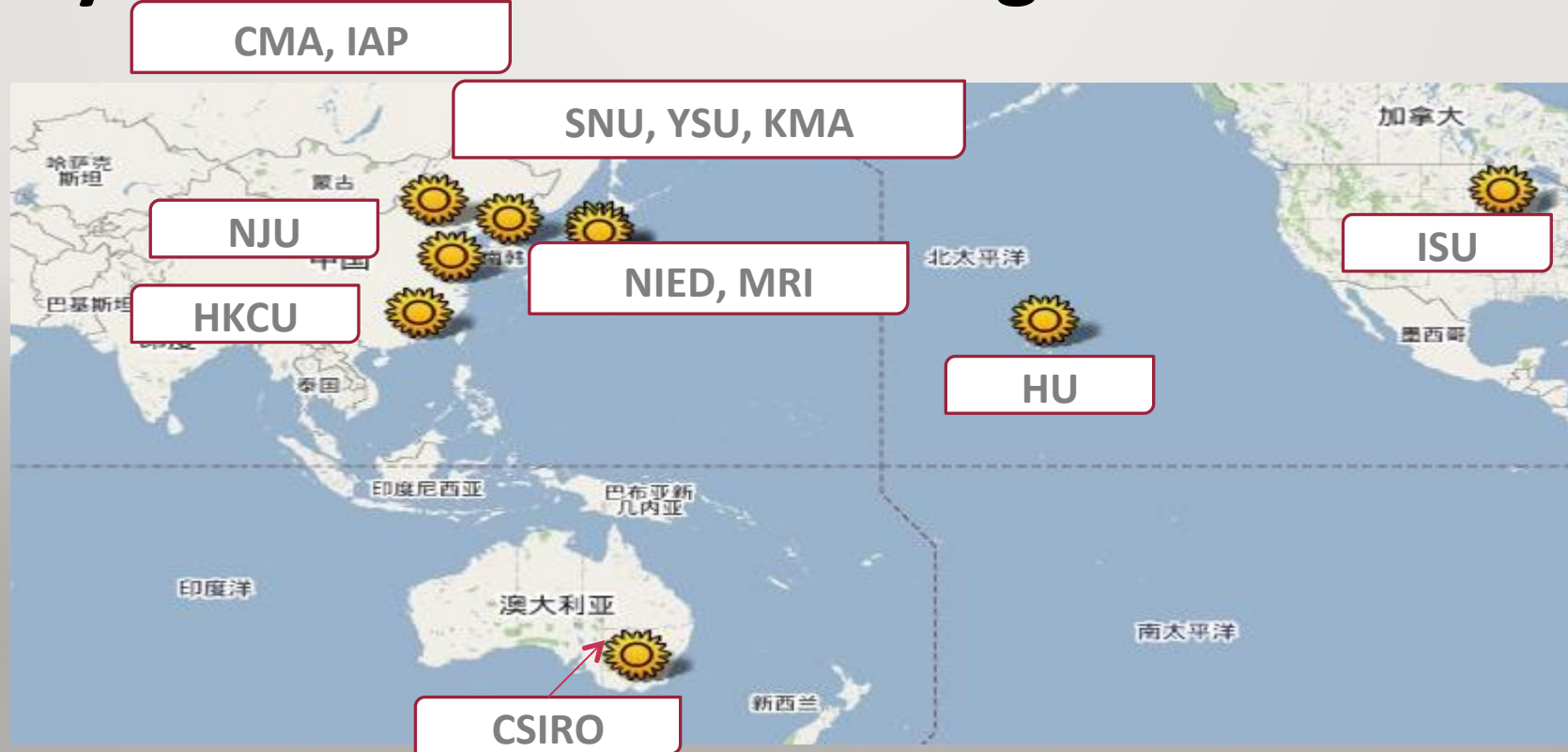


Multi-model Intercomparison in Asia: *From RMIP to TPEMIP*

Shuyu Wang, Jianping Tang, Xiaorui Niu, and Pinhong Hui
Nanjing University

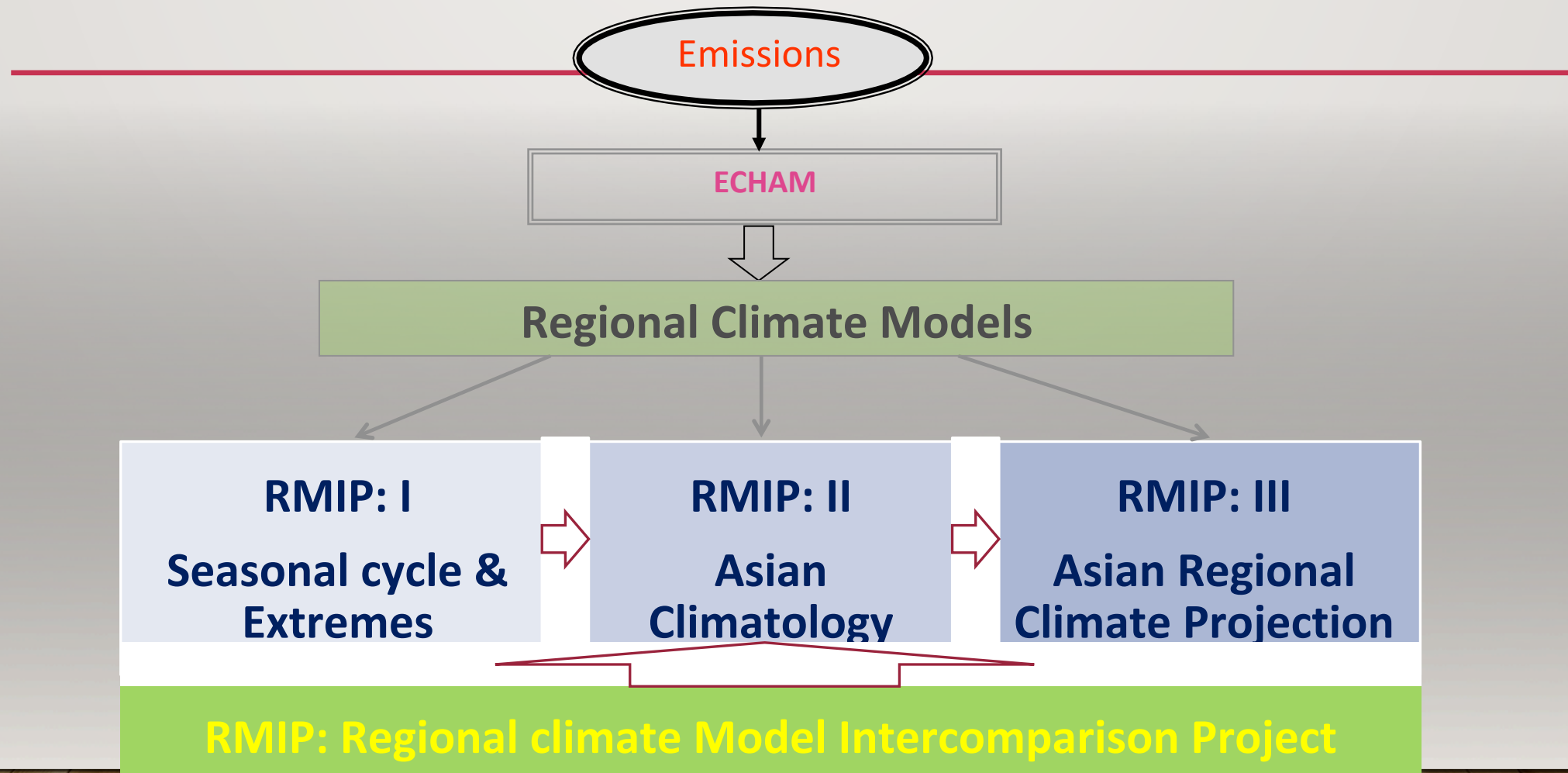
wsy@nju.edu.cn

History of Collaboration on Regional Climate Studies



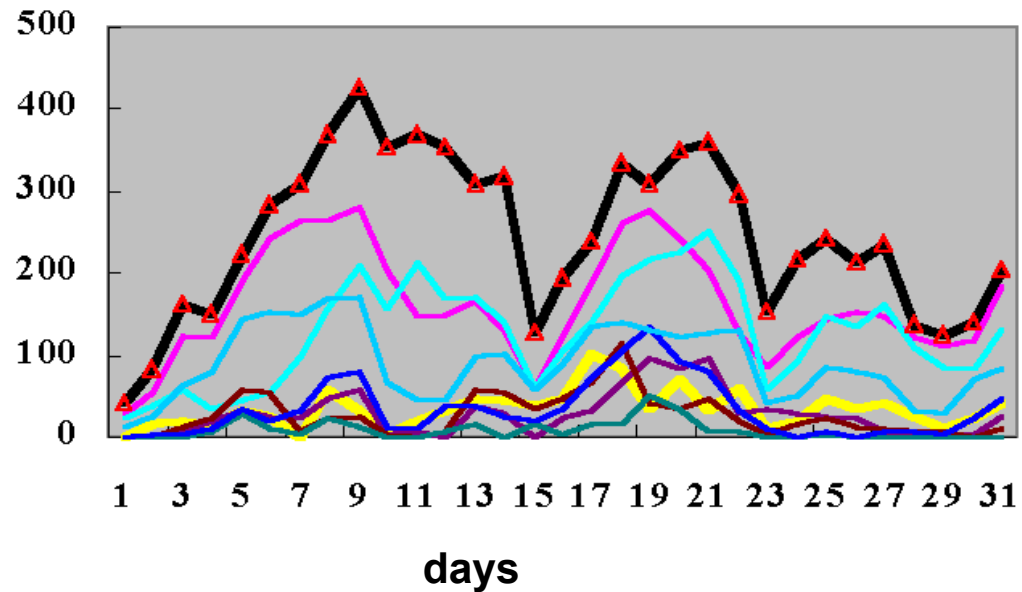
- universities, research institutes, international projects, and government sponsored research agencies;
- collaboration involving scientists working on modelling, observation, and end users;
- *From RMIP to CORDEX, to TPEMIP*

RMIP: Regional Climate Model Intercomparison Project for Asia

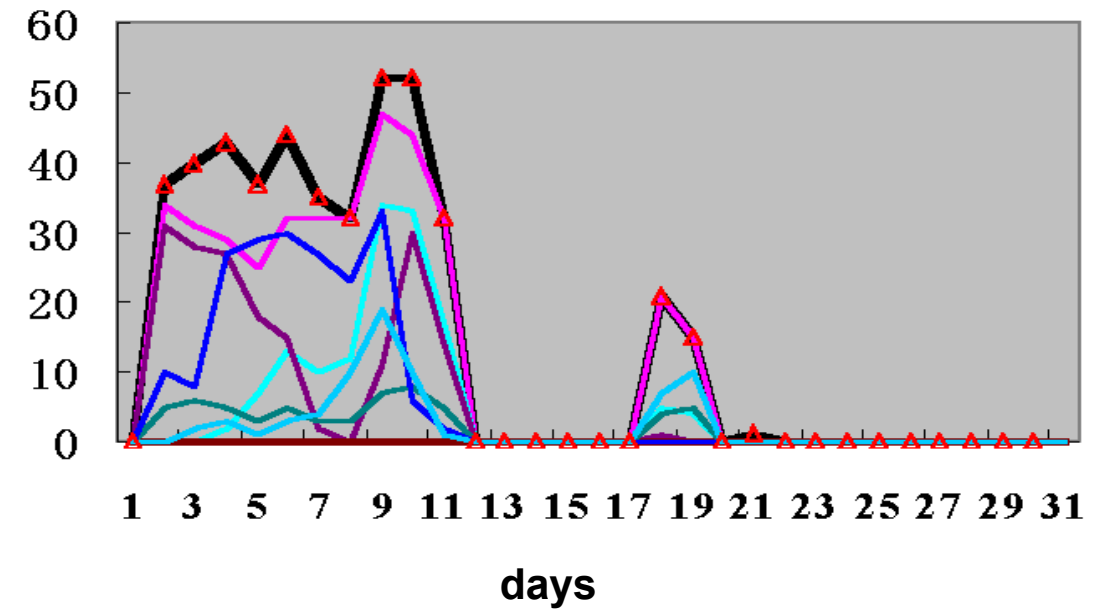


RMIP model simulated process of heatwave of July, 1997

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

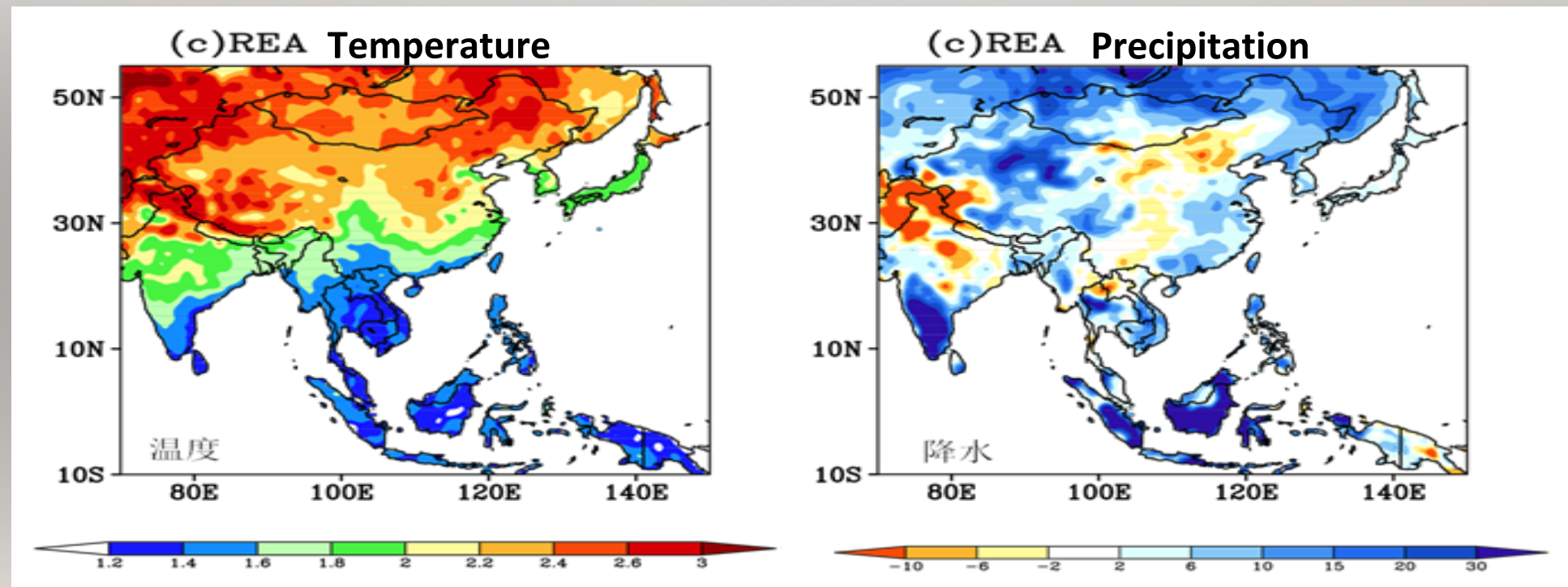


Daily grid number with T_{\max} above 38°C in the south of 35 N, July, 1997



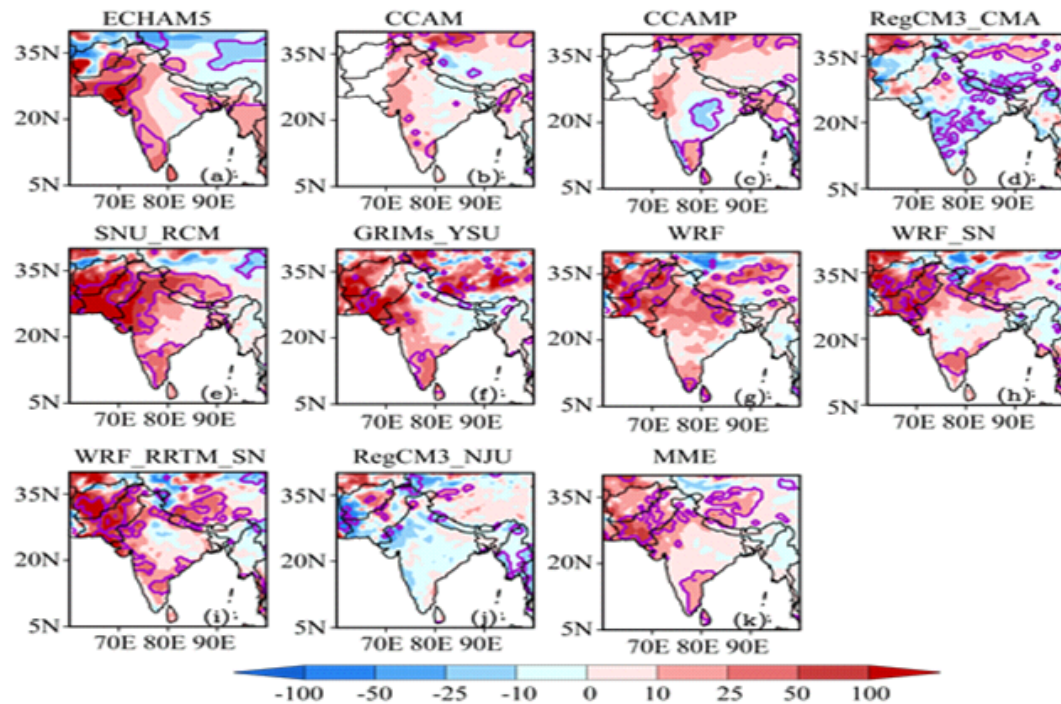
—▲— OBSERVATION	— RIEMS	— Regcm3
— DARLAM	— N/C RAMS	— ARCSyM
— NJU RCM	— MM5/LSM	— RegCM

***RMIP Projected Regional Climate Change
for 2040-2060 under A1B Scenario relative to 1981-2000***

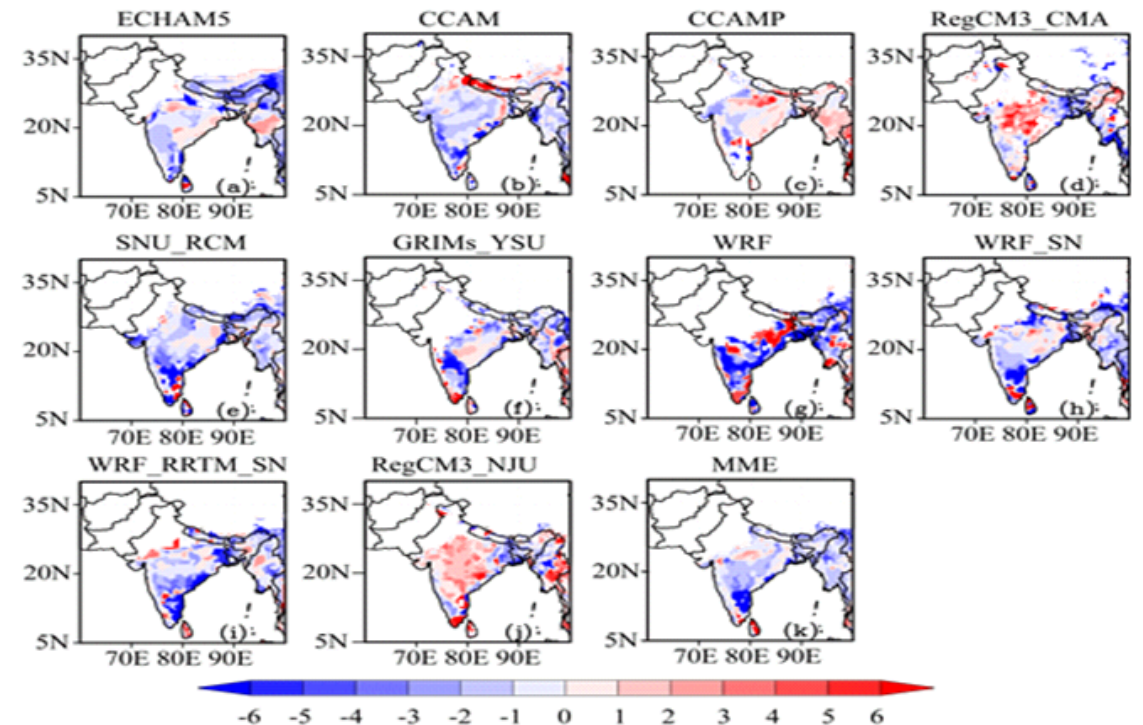


RMIP Projected Changes in Indian Summer Monsoon for 2040-2060 under A1B Scenario relative to 1981-2000

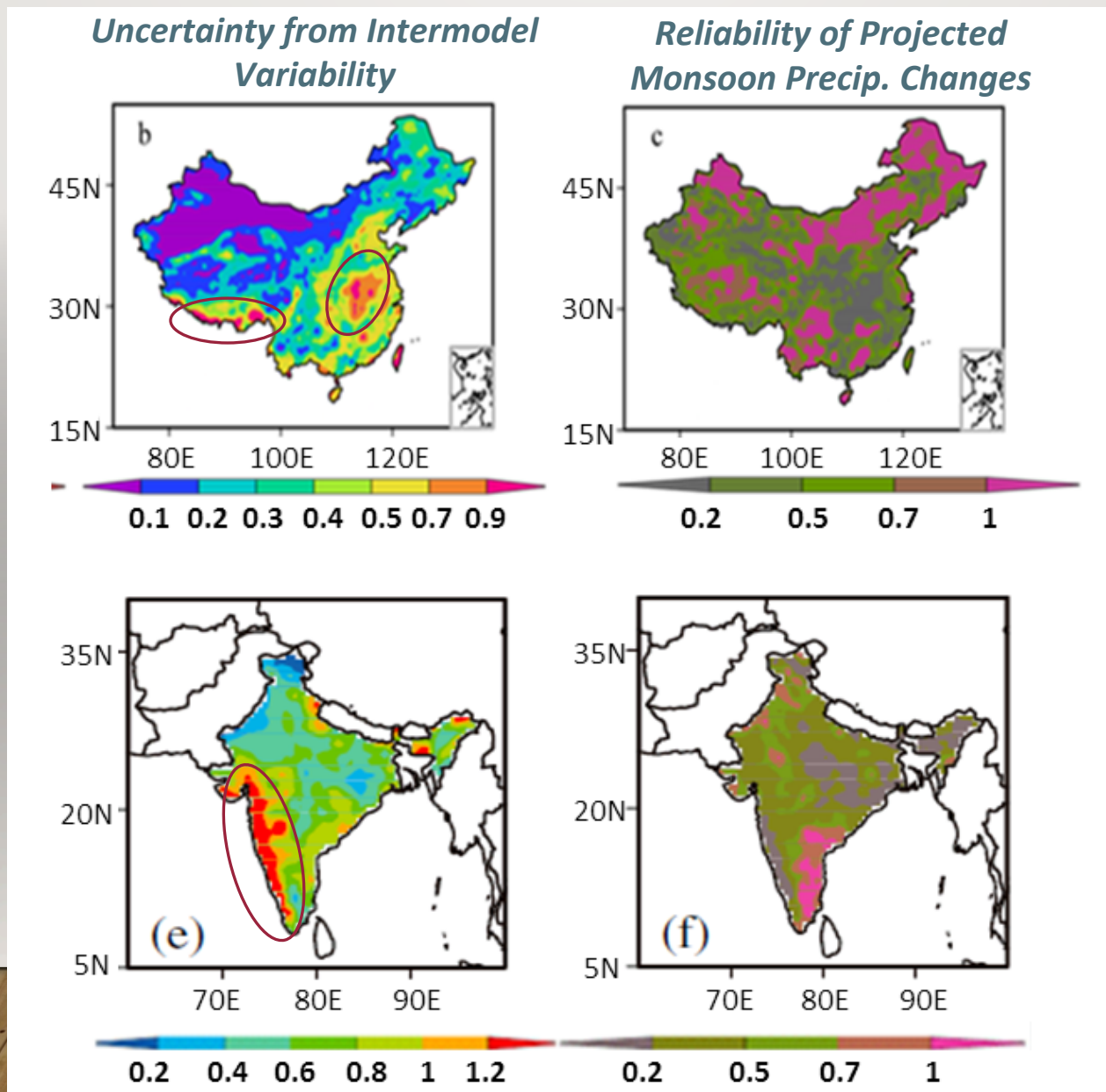
Change of ISM Precipitation in mm



Change of ISM Onset in pentad



Uncertainty in RMIP's Asian Summer Monsoon Precip. Projection



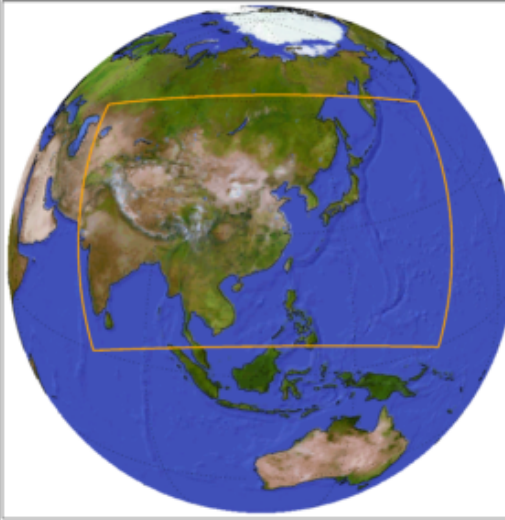
CORDEX: The Coordinated Regional Climate Downscaling Experiment

Goals:

- *To better understand relevant regional/local climate phenomena, their variability and changes, through downscaling;*
- To evaluate and improve regional climate downscaling models and techniques;
- To produce coordinated sets of regional downscaled projections worldwide;
- To foster communication and knowledge exchange with users of regional climate information

CORDEX Asia Domains: East Asia, South Asia, Centre Asia, SouthEast Asia

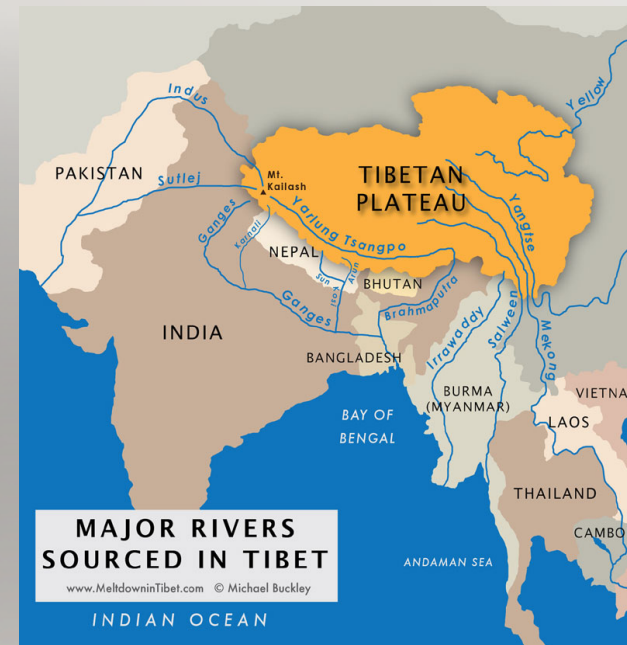
CORDEX East Asia Modeling Activities



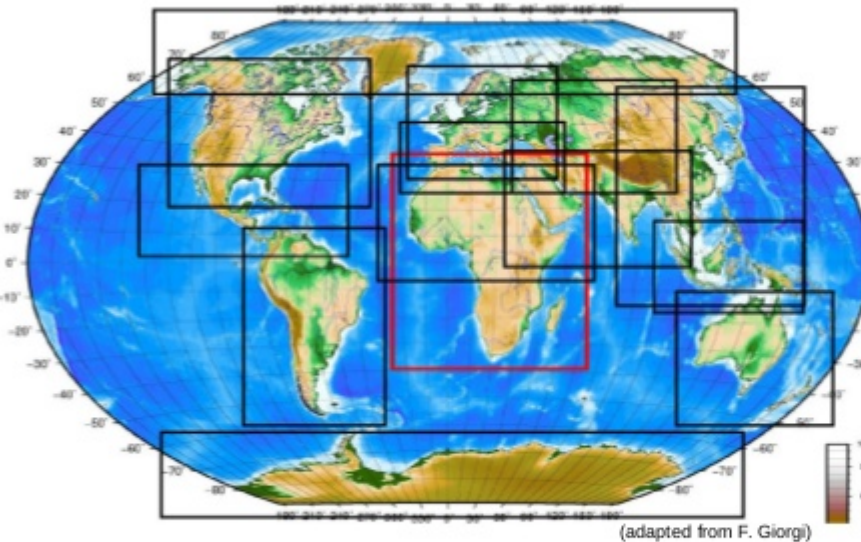
	RegCM4	WRF	MM5	CCLM	HadGEM3-RA	NHRCM	CCLM5.0	ReGCM3	FROALS	WRF	RegCM4.3	RegCM4.4	LMDZ
ERA-Int	25km	25km	25km	0.22	0.22	20km	0.44			25km	25km	25km	
HadGEM2-AO	†25km		†25km	†0.22	0.22								
	25km		25km		0.22								
MPI-ESM-LR	25km		25km	†0.22	0.22								
		†25km	†25km	†0.22	†0.22								
GFDL-ESM2M		25km		0.22									
		25km	†25km	0.22	†0.22								
EC-EARTH	†25km	†25km			†0.22								
	†25km	†25km			†0.22								
MRI-AGCM60							0.44					25km	
							0.44			25km	25km	25km	
MPI-ESM-LR_r1						20km	0.44						
							0.44					25km	
CNRM-CM5												25km	
												25km	0.6X0.6
HadGEM2-ES							0.44			25km	25km		
							0.44			25km	25km		
FGOALS-g2							0.44					25km	
							0.44					25km	0.6X0.6
CSIRO-MK3.6								50km	50km				
NorESM1-M												25km	
												25km	
BCC-CSM1													0.6X0.6
Institution	Kongju National Univ.	Busan National Univ.	Ulsan National Institute of Science and	Pohang Univ. of Sience and Technology	National Institute of Meteorological Science	MRI	HZG	Institute of Atmospheric Sciences, CAS	Institute of Atmospheric Sciences, CAS	Nanjing University	Nanjing University	Institute of Atmospheric Sciences, CAS	Nanjing University of Information and

Provided by CORDEX
EA modeling groups

Tibetan Plateau for Regional Climate and Natural Resources



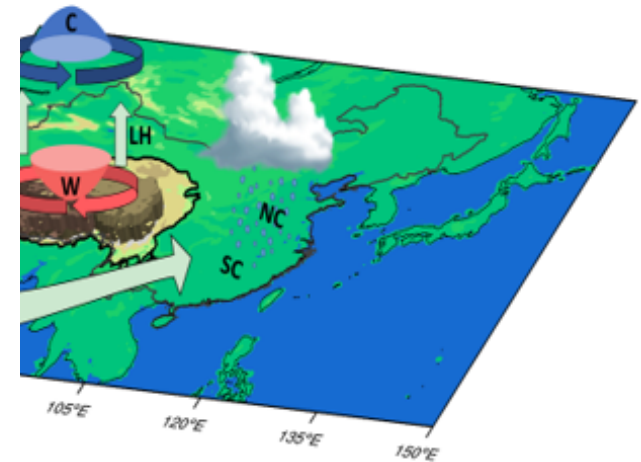
Regional climate simulations: WCRP CORDEX



14 domains with a resolution of $0.44^\circ \times 0.44^\circ$ (approx. $50 \times 50 \text{ km}^2$)

High resolution simulations with $0.11^\circ \times 0.11^\circ$ (approx. $12 \times 12 \text{ km}^2$) for Europe

CORDEX data available via Earth System Grid Federation: <https://esgf-data.dkrz.de/search/cordex-dkrz/>

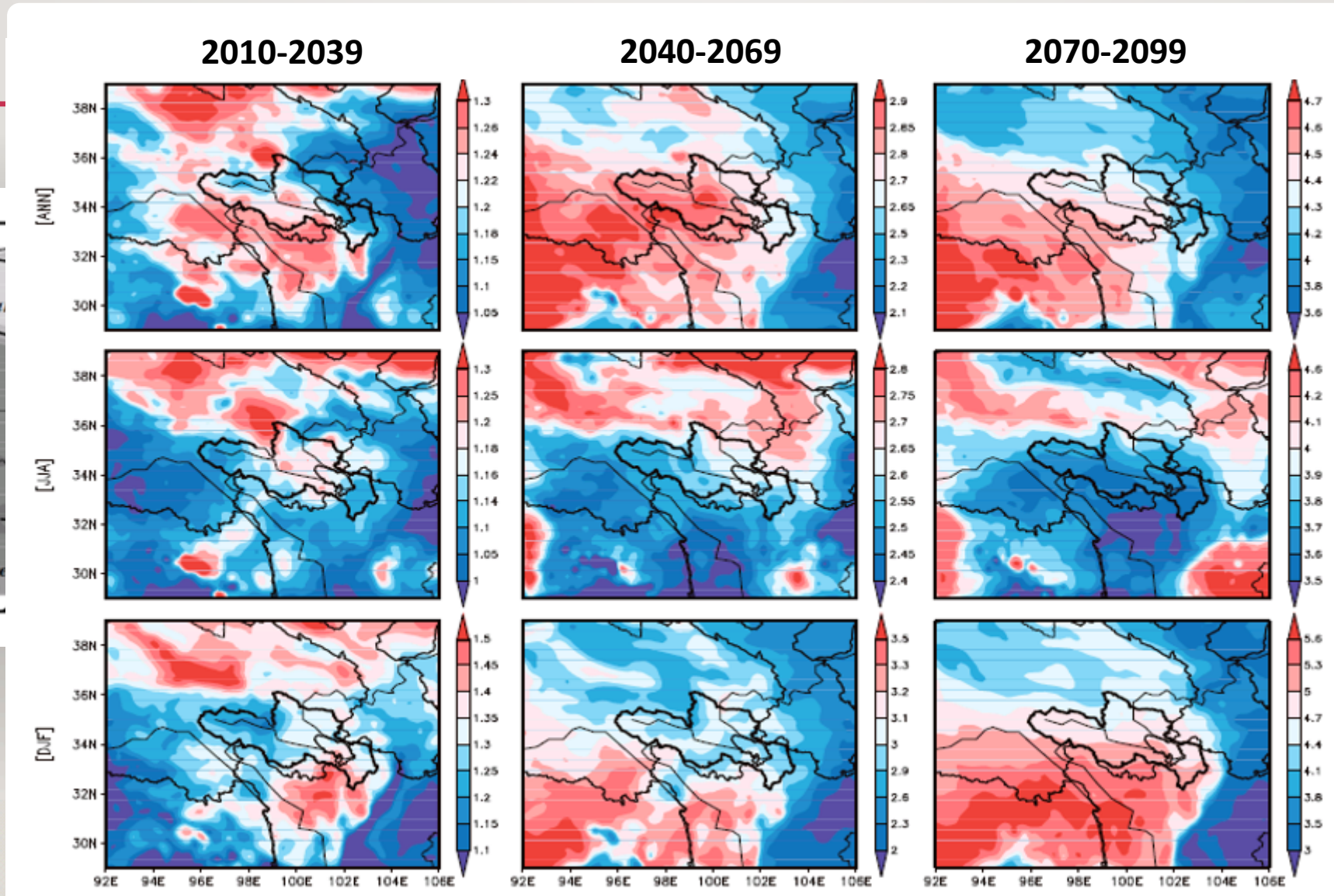
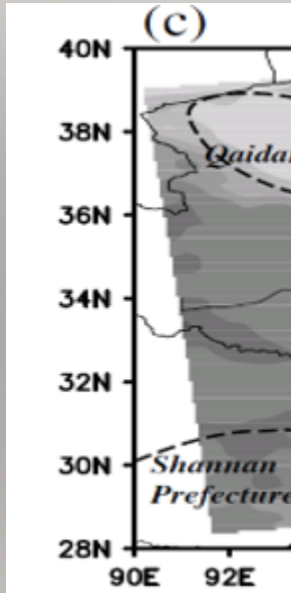


Tibetan Plateau under a Warming Climate

- The TP has undergone significant warming during the recent decades.
- The surface processes are important in regional climate changes at various time scales over Tibetan Plateau.
- The warming has been affecting regional cryospheric melt and hydrological cycles greatly.
- The permafrost area and the soil freeze depth have generally decreased in the TP during past 4 decades.
- Long-term soil temperature measurements indicated that the lower altitudinal limit of permafrost moved up by 25 m in the north of the TP during the 1980s, 1990s, and 2000s and between 50 and 80 m in the south of the TP during the 1990s and 2000s.

(Source: Yao et al., 2018, BAMS)

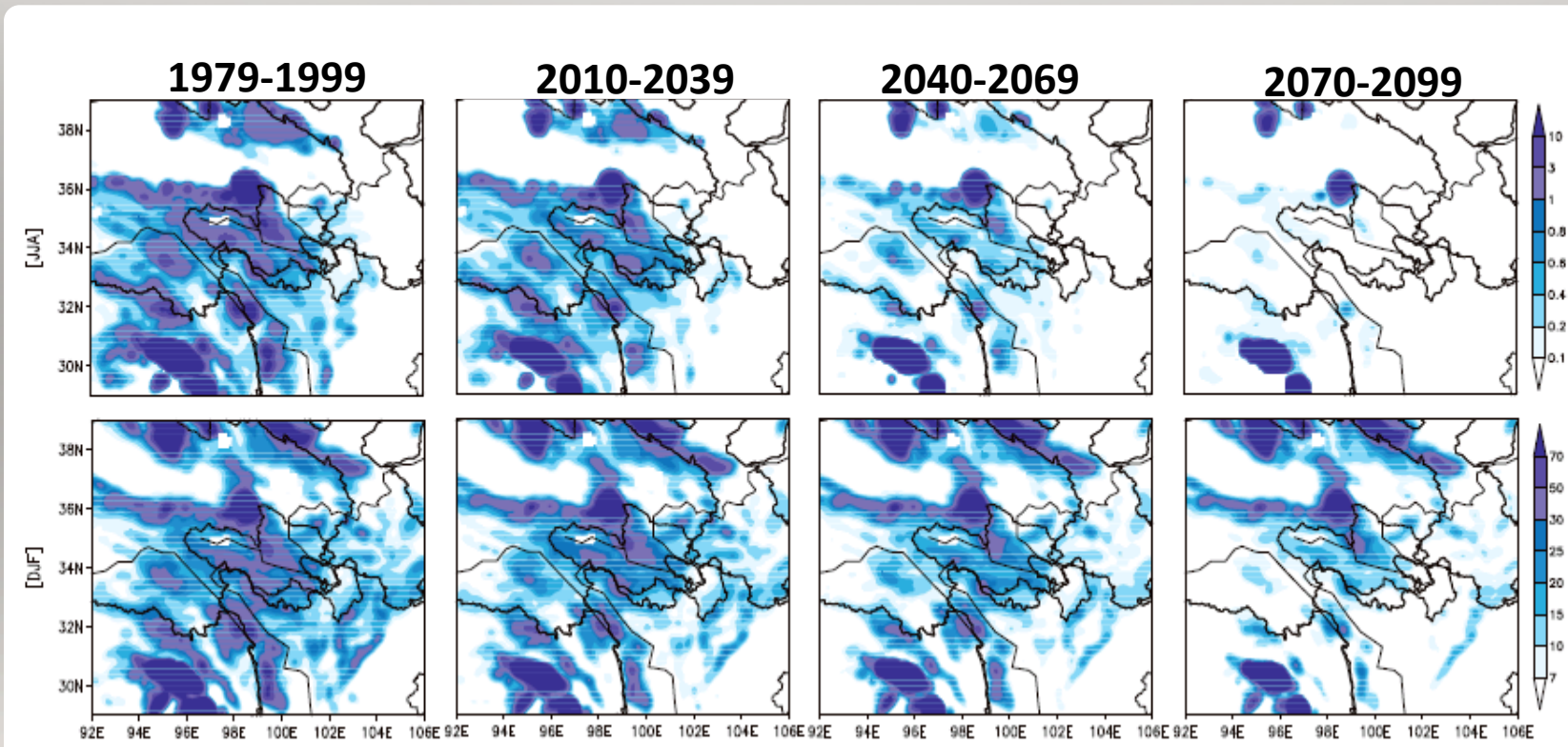
Projected *temperature changes* relative to 1970–1999 using 15-km ReGCM3 (unit: °C)



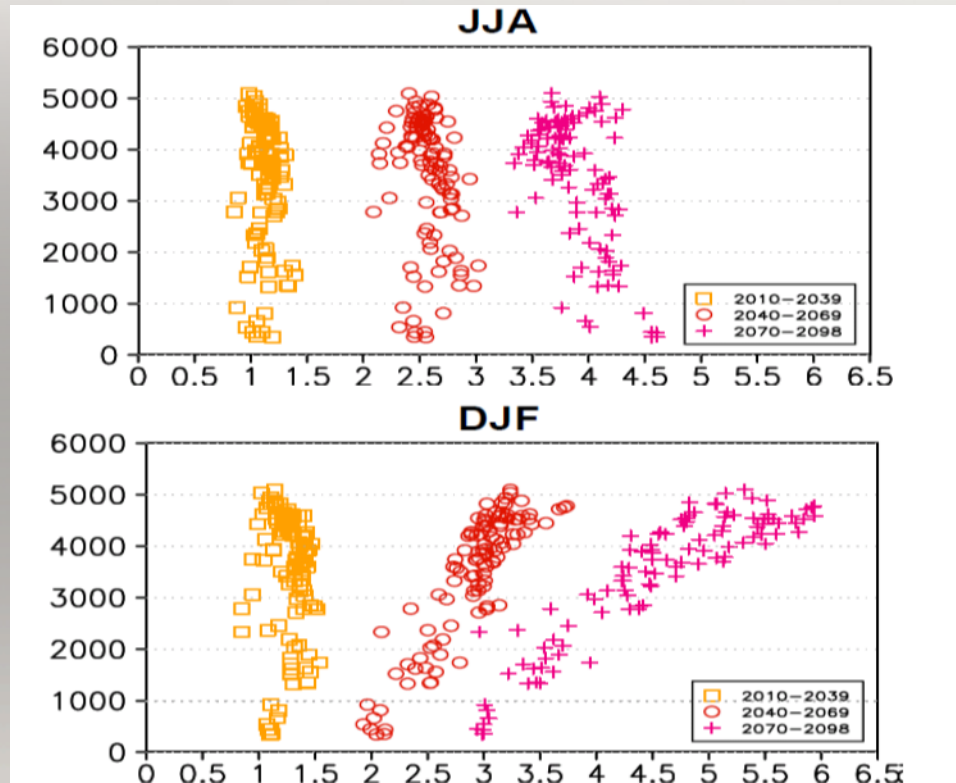
99/2010-2098

5

Snow water equivalent for the current period (1970–1999) and in the 21st century (2010–2098) produced by 15-km ReGCM3 (unit: mm)

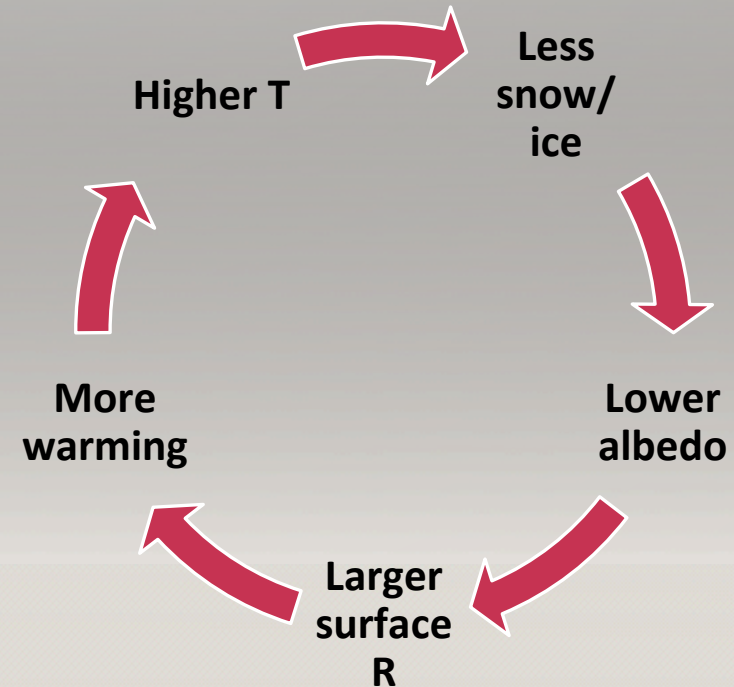


Relationship between **seasonal temperature change** and **elevation** Under the different stages of warming

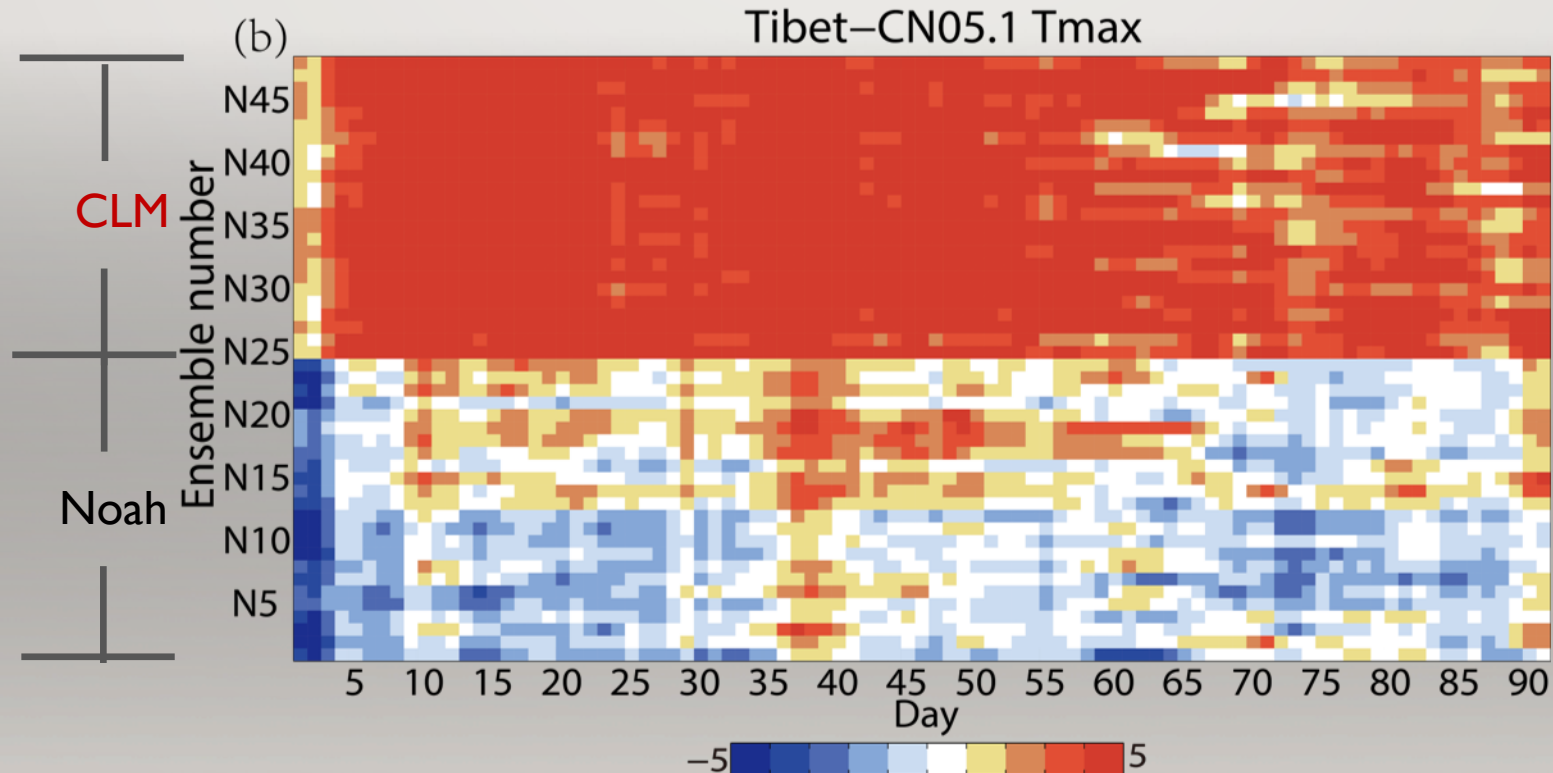


No **altitude dependence** of JJA warming;

For DJF, **higher altitude regions experience stronger warming** with the evolution of projection time.

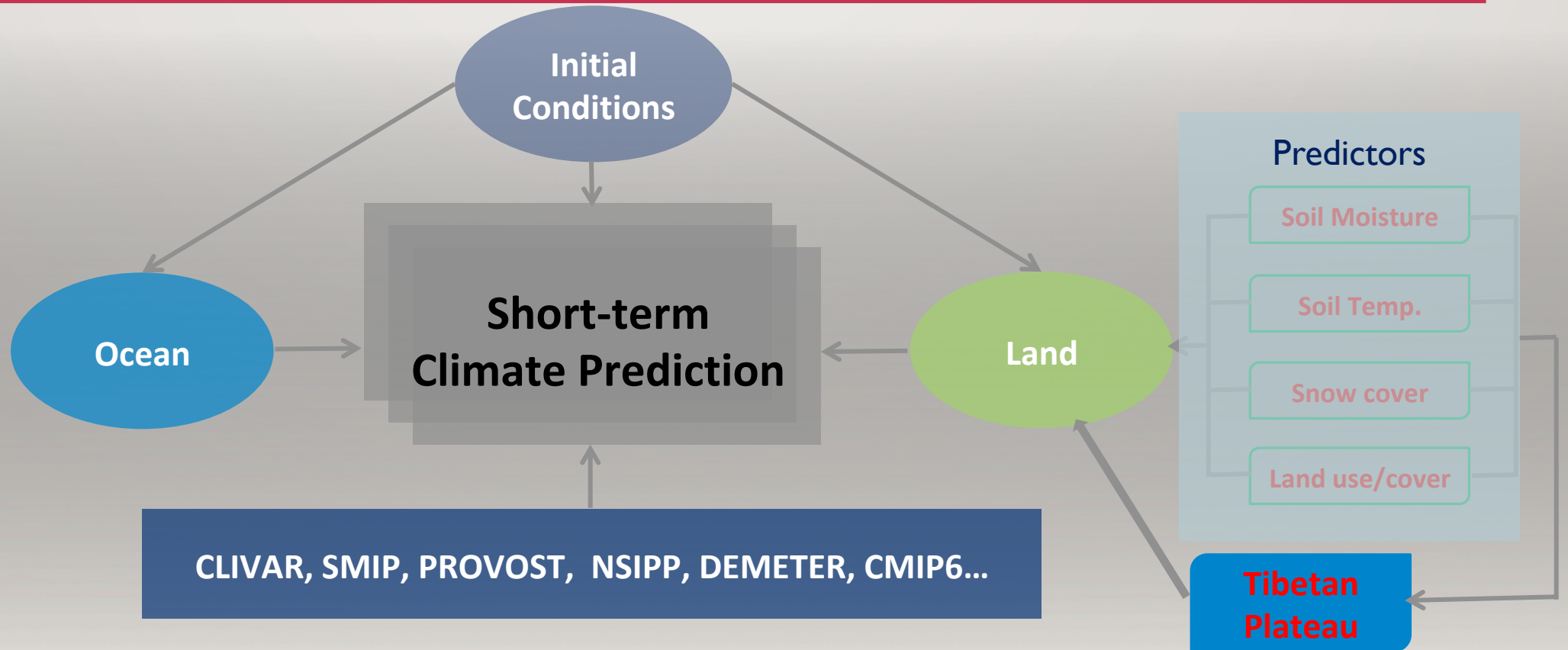


Sensitivity of Surface Climate to Model' s Land Surface Scheme



- With the unique geographic and atmospheric structure, the TP surface processes play an important role in regional climate. The basic atmospheric, land thermal and dynamic characteristics over TP as well as their relationships with Asian monsoon based on recently available data sets were an important subject in TP research.

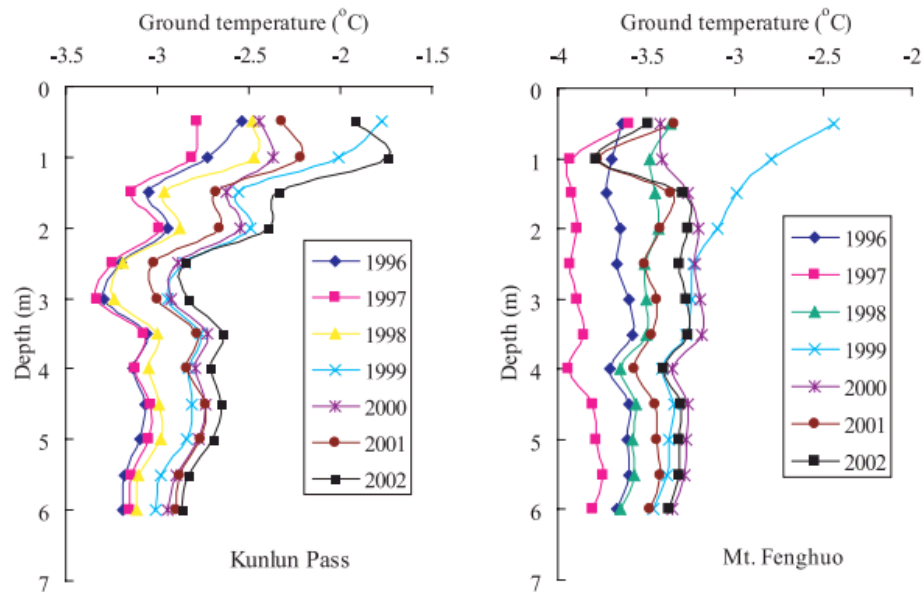
Importance of Tibetan Plateau to Subseasonal-to-Seasonal Climate Variability



TPEMIP: the Third Pole Experiment Multi-Model Intercomparison

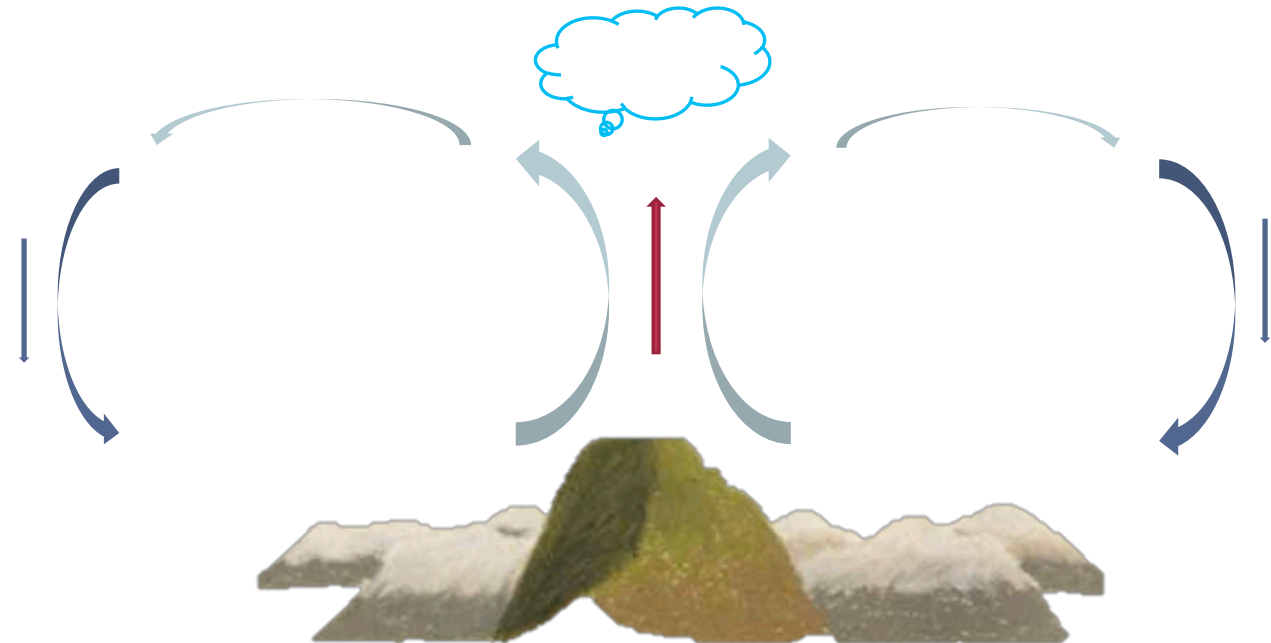
Soil Temperature of TP on Intraseasonal-to-seasonal Climate Prediction over East Asia

Observed Warming of Soil over Tibet



Evolution of permafrost temperatures at Kunlun Pass and Mt. Fenghuo from 1996 to 2002.

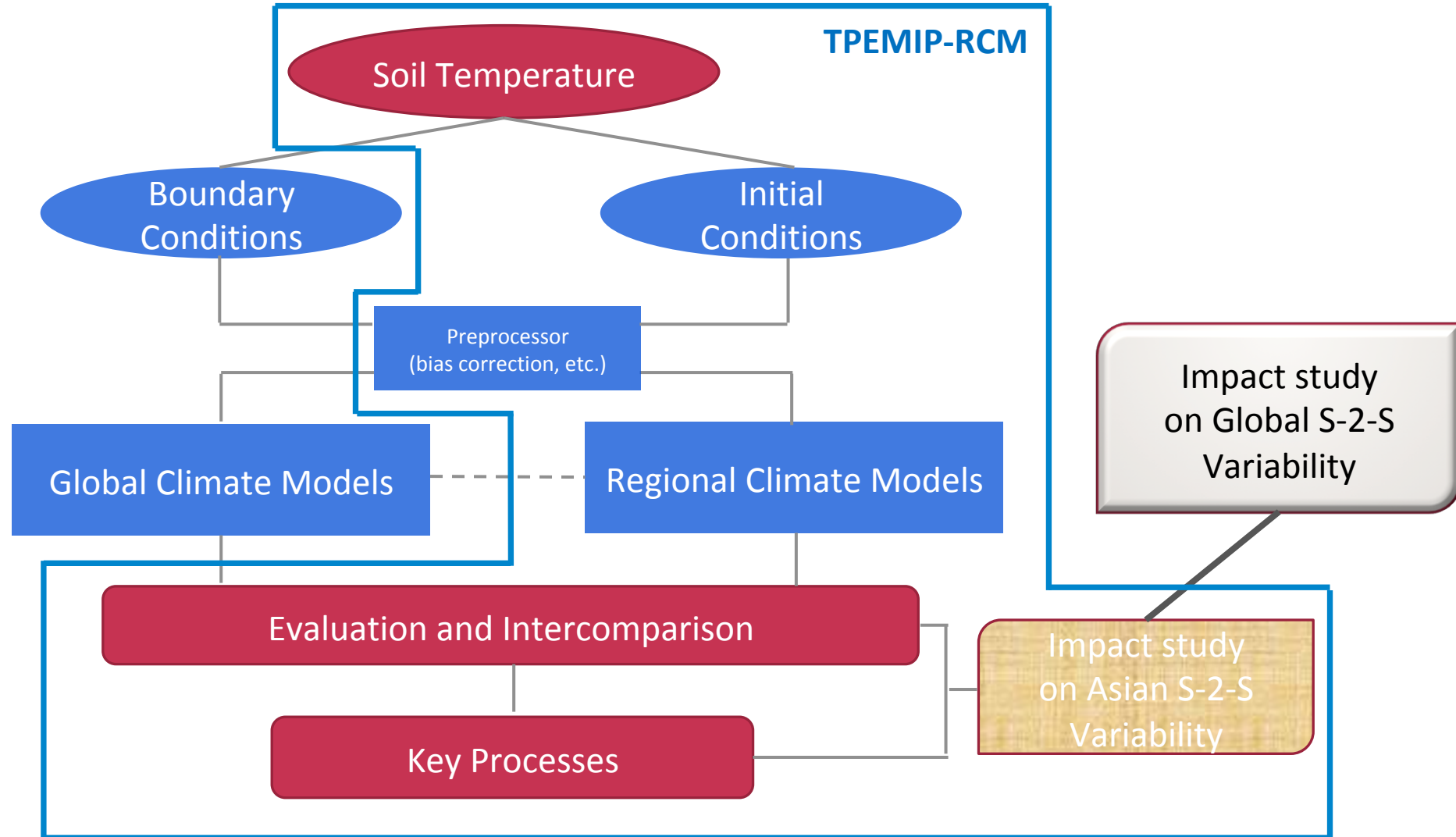
Impact of Warming Surface on Regional Climate



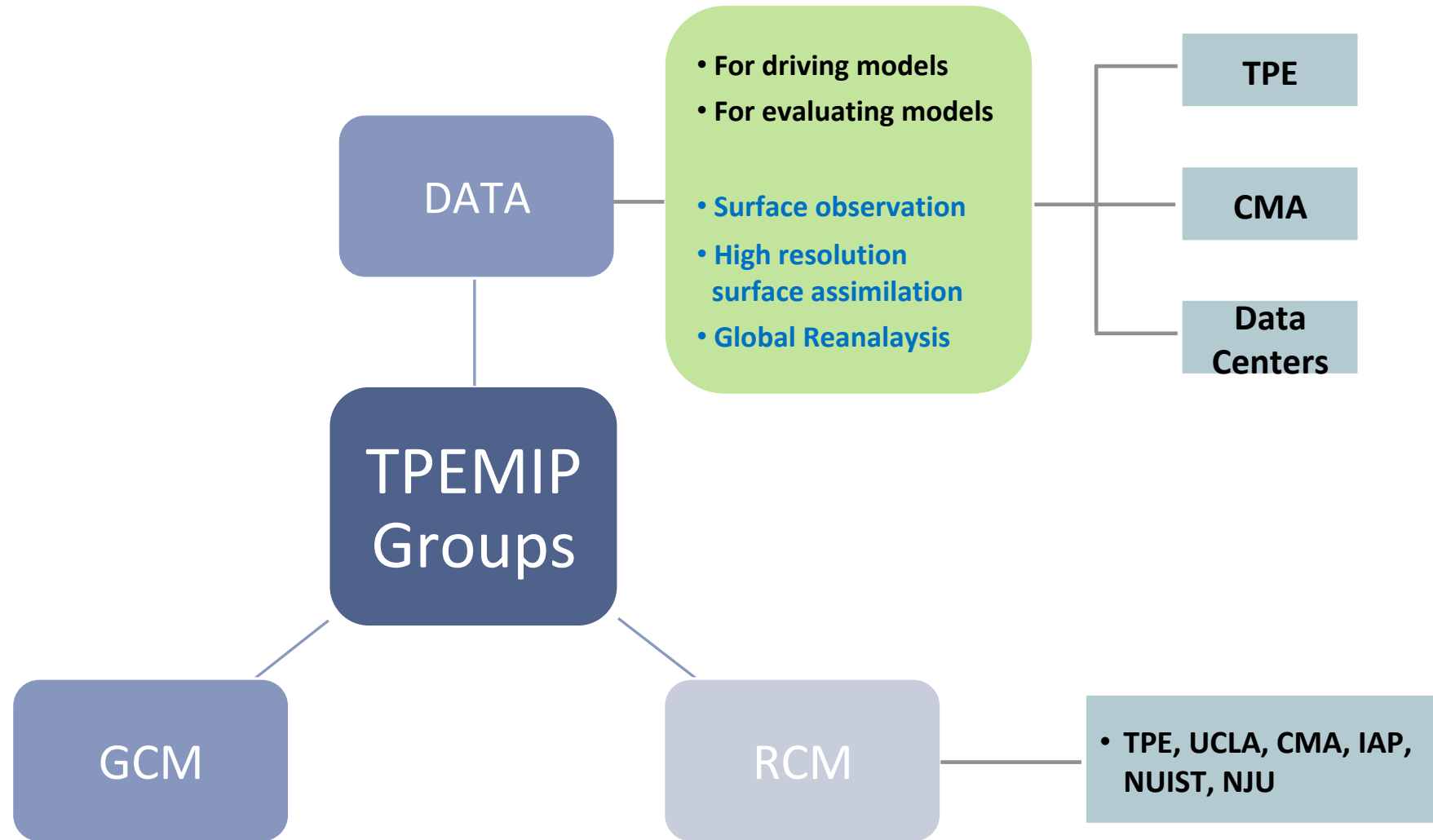
Objectives of TPEMIP

- Evaluate the performances of current climate models for their simulation of subseasonal-to-seasonal variations over TP and surrounding area;
- Identify the uncertainty in the TP observed ground temperature and hydrological cycles from station data, reanalysis data, and assimilated data;
- Investigate the impact of ground temperature of TP on the subseasonal-to-seasonal predictability, and examine the controlling mechanisms;
- Explore the interactions between TP snow cover, aerosol and climate at various temporal-spatial scales;

TPEMIP Framework

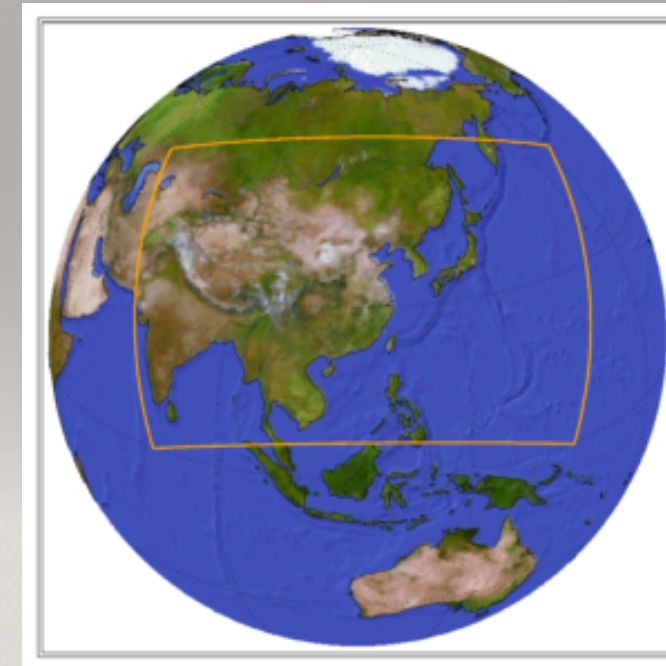
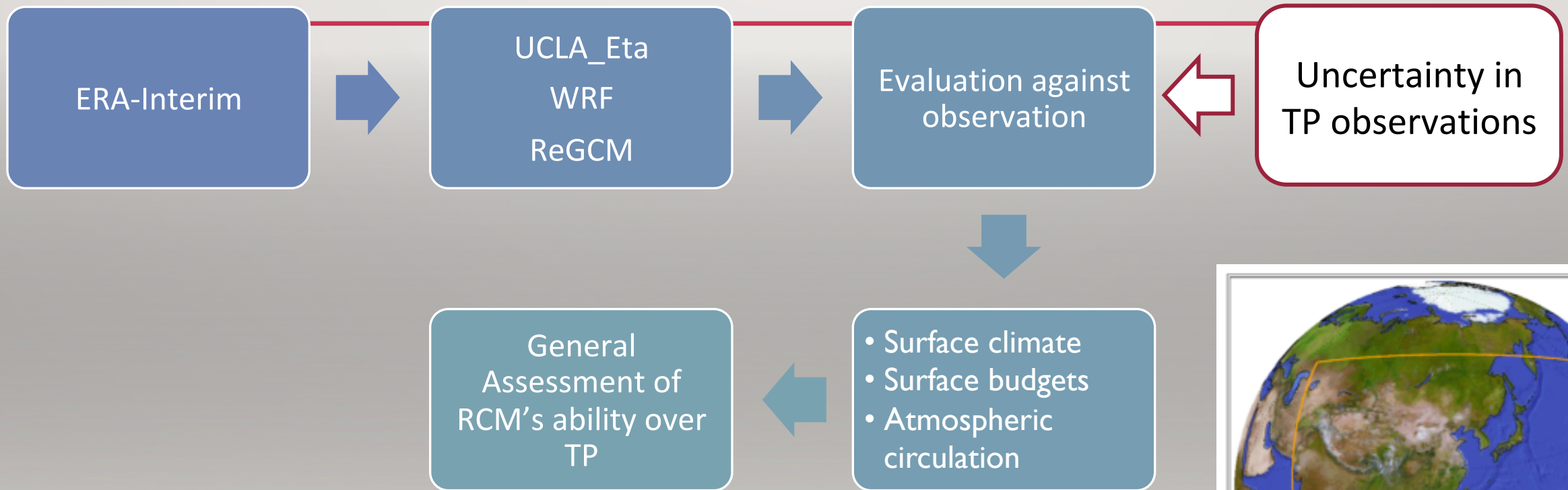


TPEMIP Structure



Activity I of TPEMIP-RCM

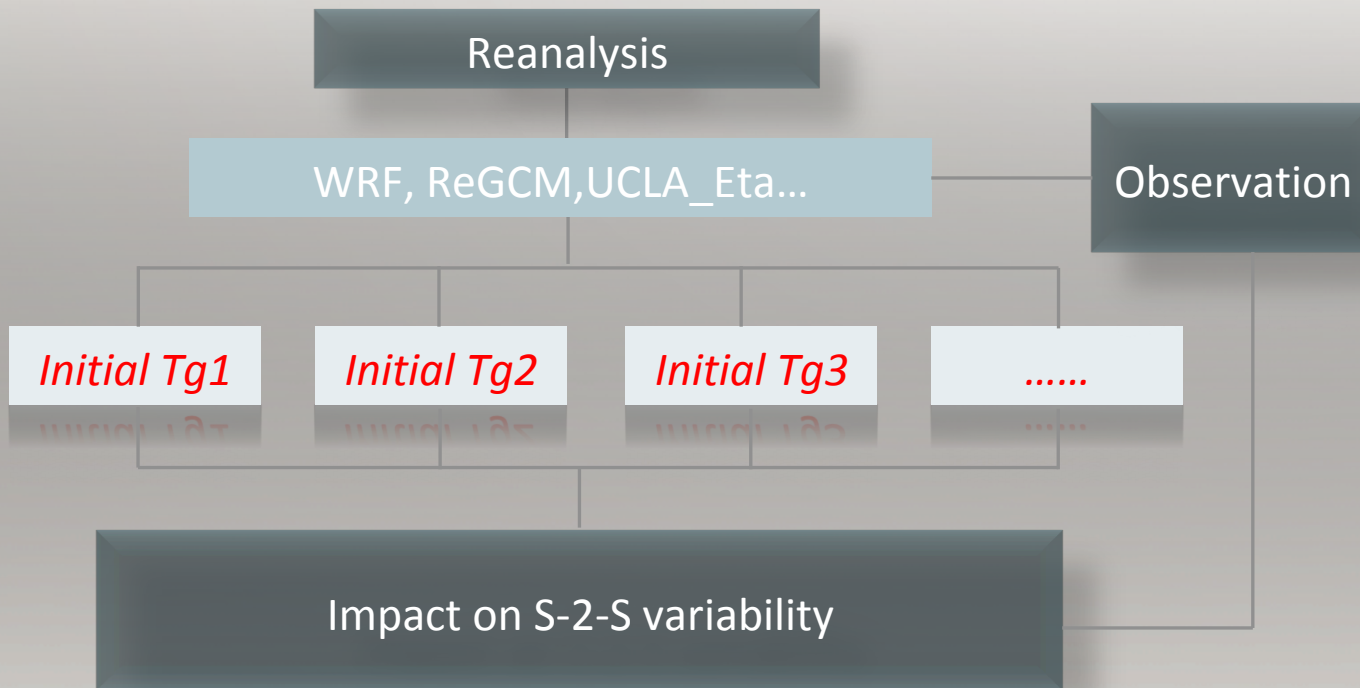
Multi-RCM Intercomparison of TP climate over variable time scales



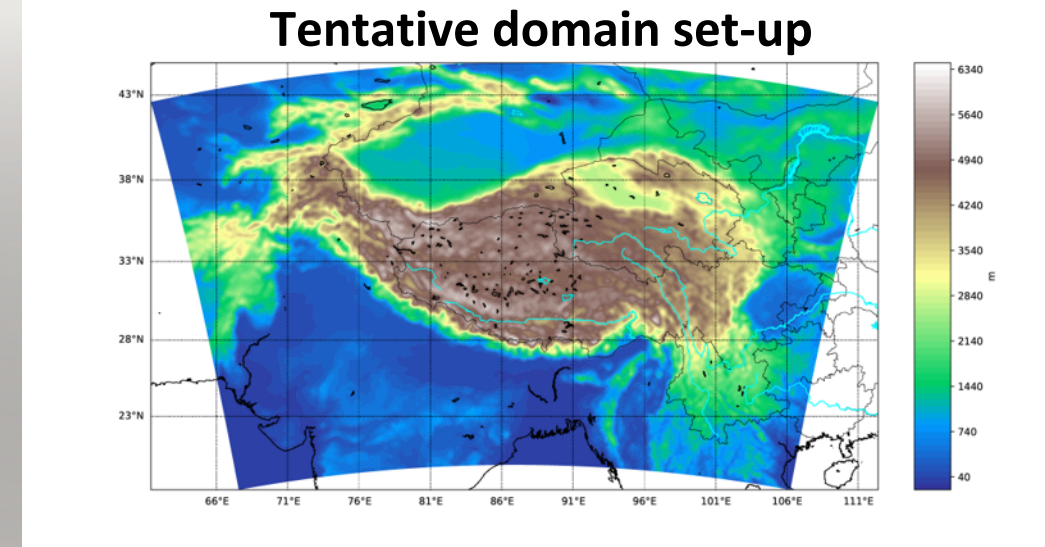
- To evaluate the regional models for their simulation over Tibetan Plateau;

Activity II of TPEMIP RCM

Impact of TP soil temperature anomaly on regional climate



- To investigate the impacts of ground temperature on S-2-S regional predictability.



Domain Center	32.3N, 86.9E
Resolution	15km x 15km
Grid points	275 x 185
Truelats	20N and 45N
Standard lon	86.9

Following Activities of TPEMIP-RCM

- **Impact of TP soil temperature anomaly on S-2-S prediction over EASM**
- **Impact of TP soil temperature anomaly on S-2-S prediction at global scale**

**Thank you
for your attention**
για την παρουσίαση