Impacts of land surface on climate in LMDZ

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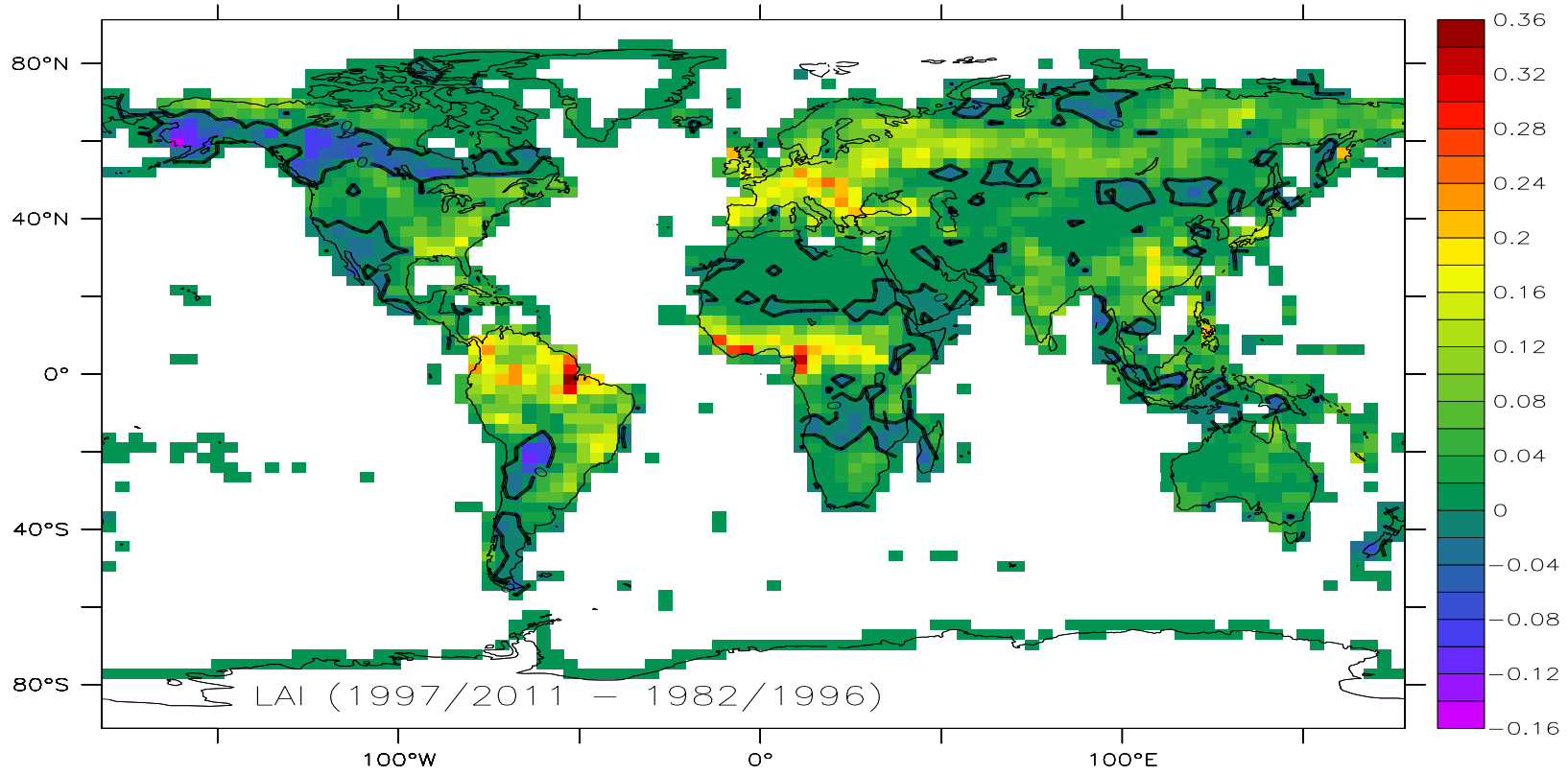
- Climate effects of land surface changes:
  - A general increase in global LAI;
  - Urbanization in East China
- Two configurations of LMDZ for China:
  - Downscaling in East China;
  - Two-way nesting in the Tibetan Plateau

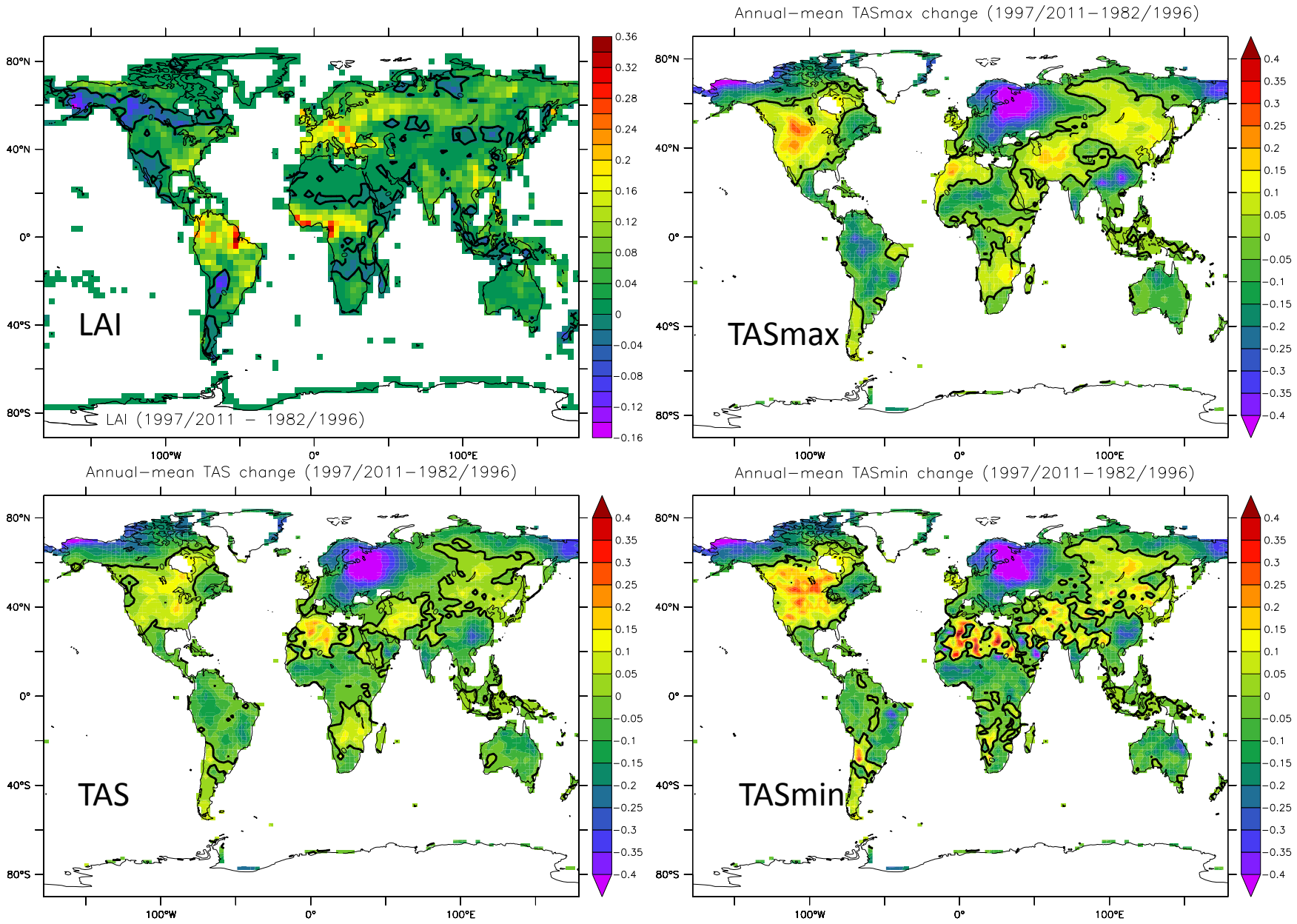
Climate effect of a general increase of LAI

Motivation: Global vegetation cover goes well during the last 30 years, due to global warming, CO2 fertilization, etc.

Are there any physical feedbacks to climate ?



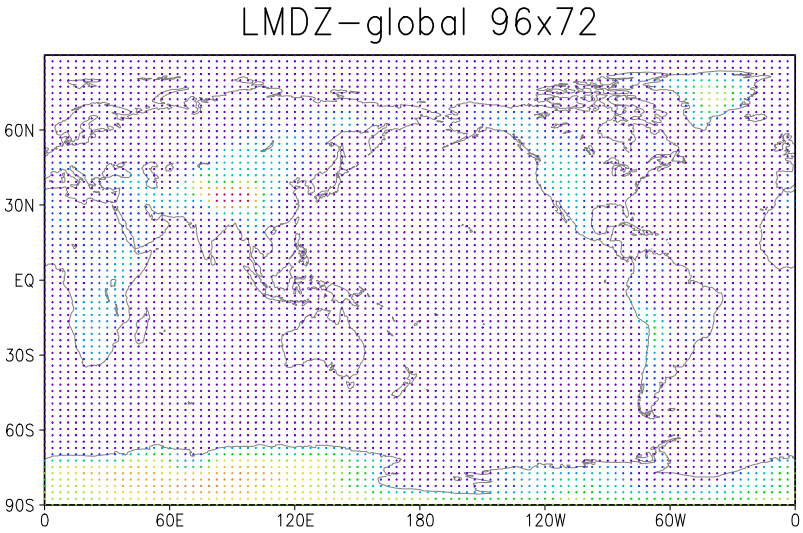
Annual-mean LAI changes (1997/2011 – 1982/1996)



Changes (1997/2011 – 1982/1996) of annual-mean LAI and TAS

Land-use, surface-atmosphere interaction :
Global model versus Regional model

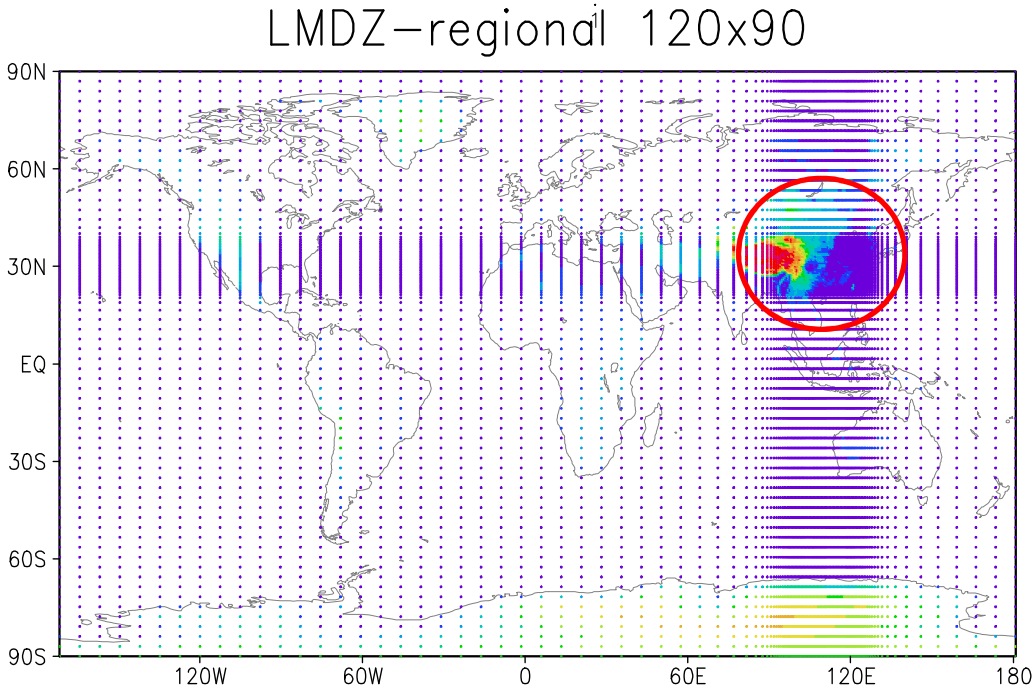
A case study of urbanization in East China

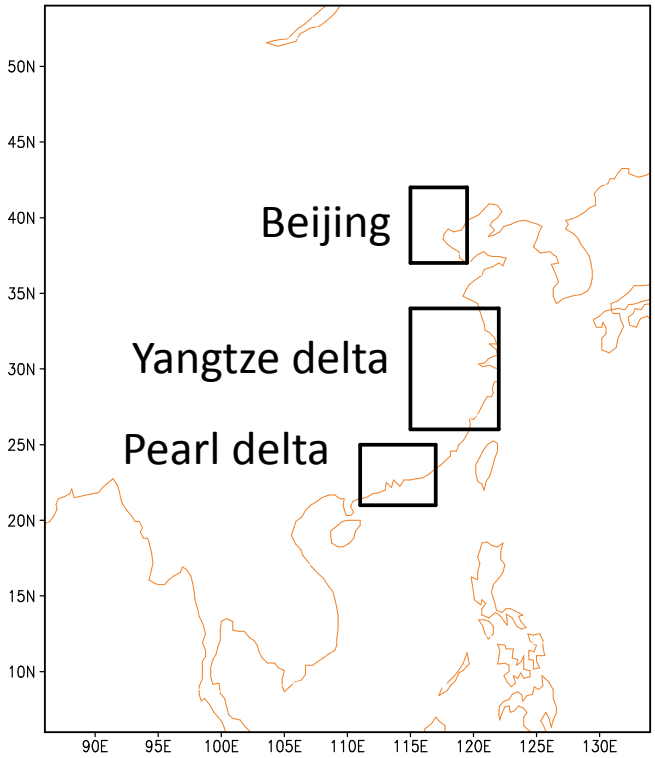


LMDZ-global: about 200 km

LMDZ-regional: about 60 km

Arable land converted to bare soil to mimic urbanisation. Two versions of LMDZ, global and regional, are used.





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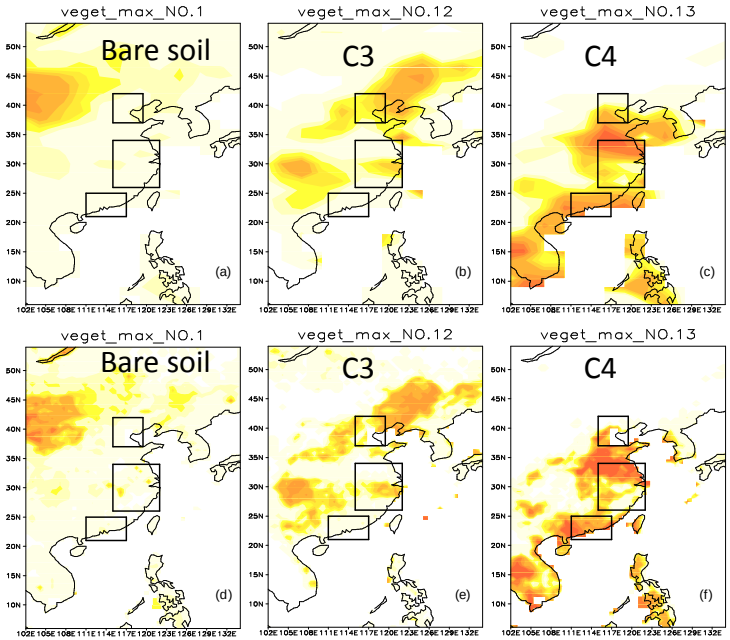
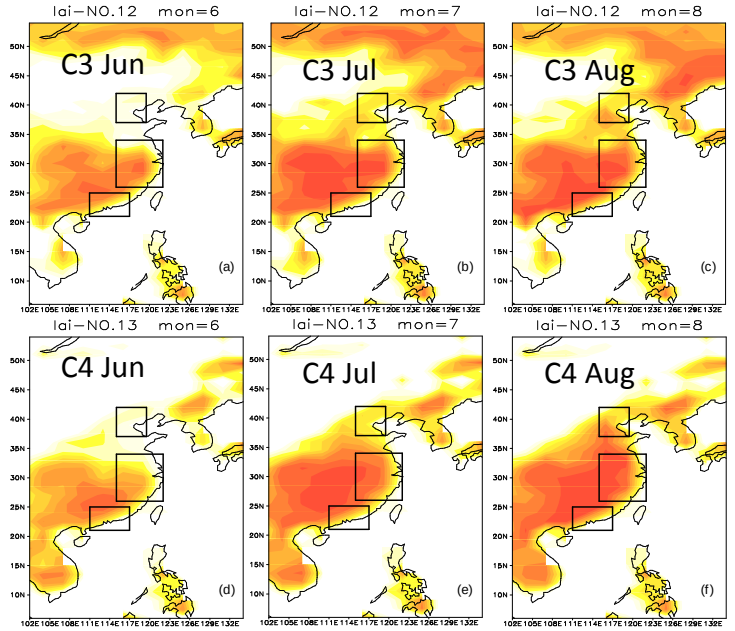


global

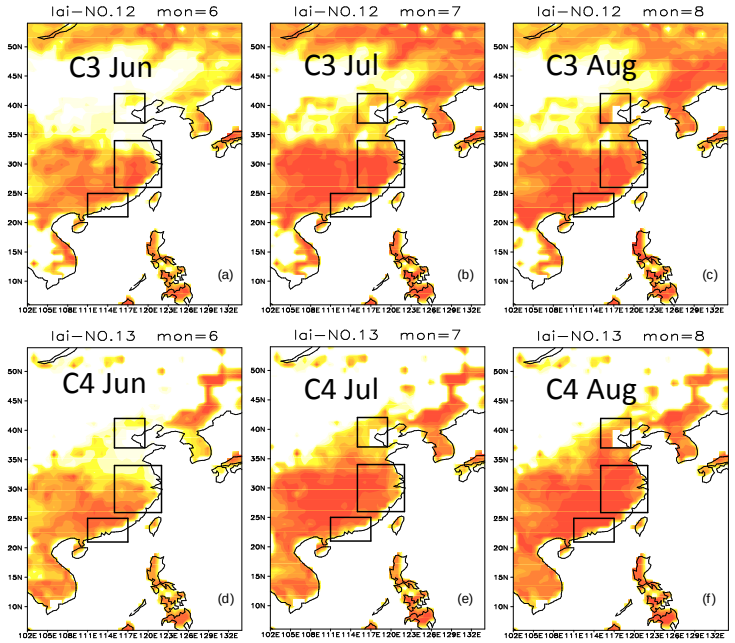
regional

Arable land converted to bare soil to mimic urbanisation. Global: 200km; Regional: 60km

	Pearl		Yangtze		Beijing	
	global	regional	global	regional	global	regional
Bare soil（%）	2.4	2.3	3.4	4.2	5.0	4.6
C3-agriculture（%）	2.3	3.3	10.6	12.3	23.1	26.1
C4-agriculture（%）	43.7	56.0	33.7	45.8	15.3	23.1
Land area(10^5 km2)	1.62	2.48	5.49	5.77	2.44	1.89
C3+C4 agri. area (10^5 km2)	1.41	2.32	4.24	4.33	1.32	1.37
Mean LAI	3.31	3.71	4.13	4.24	2.61	2.69

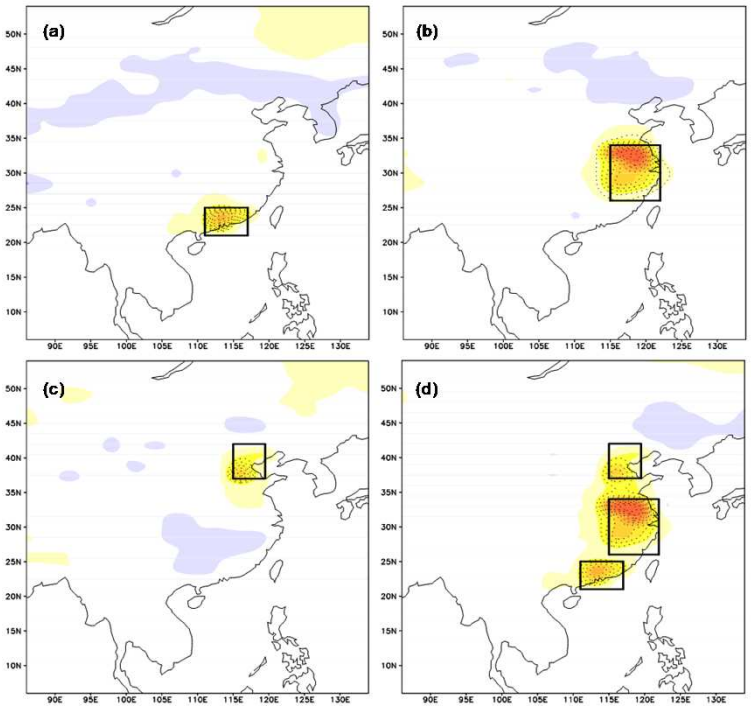


LAI global

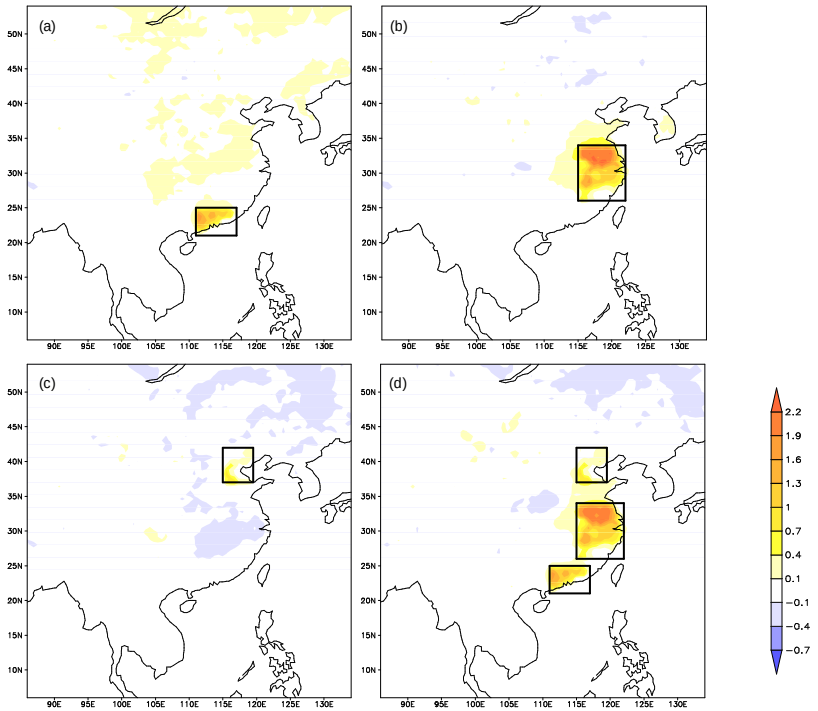


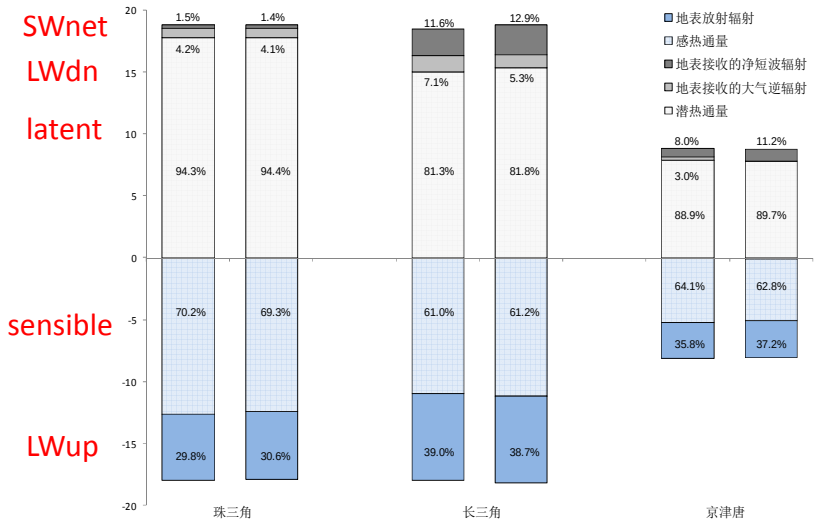
LAI regional

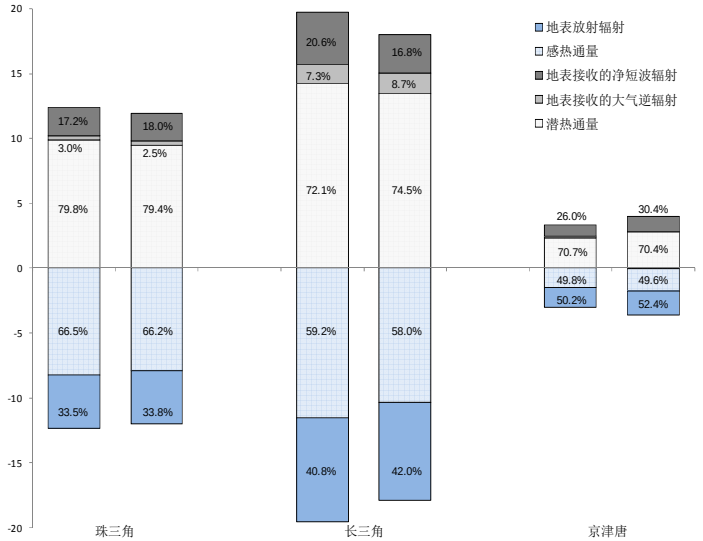
Global: changes in T2m



Regional: changes in T2m





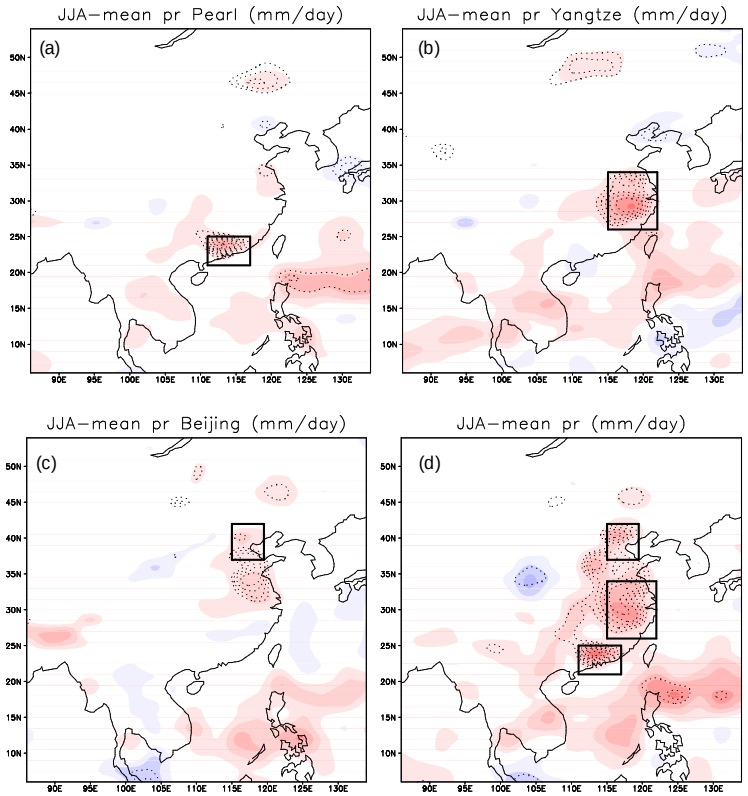


Global: changes in surface energy balance

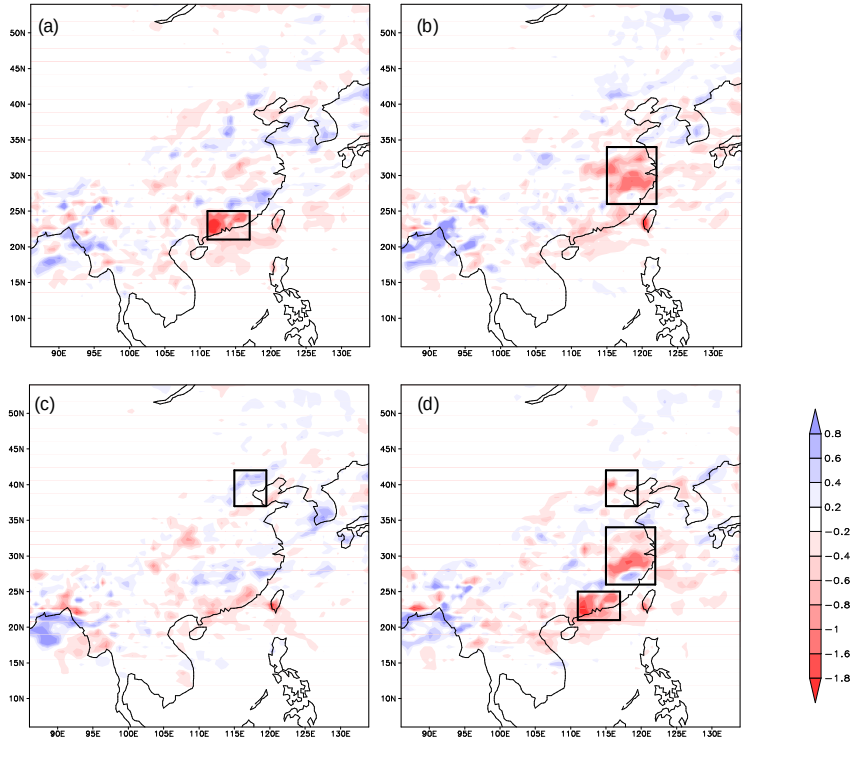
Regional: changes in surface energy balance

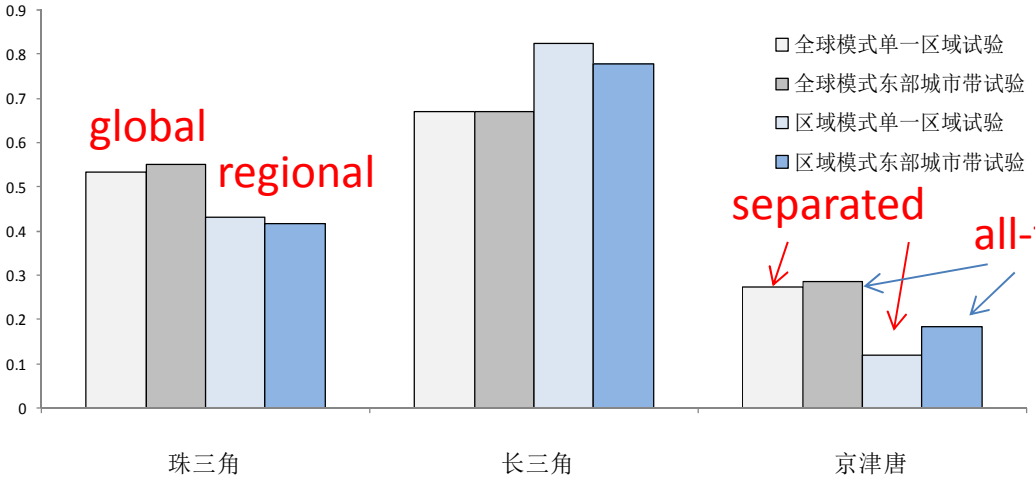
Changes in precip (mm/d)

Global

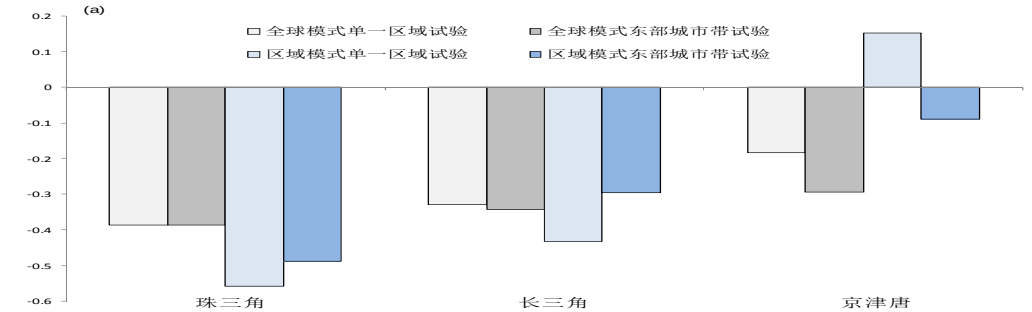


Regional

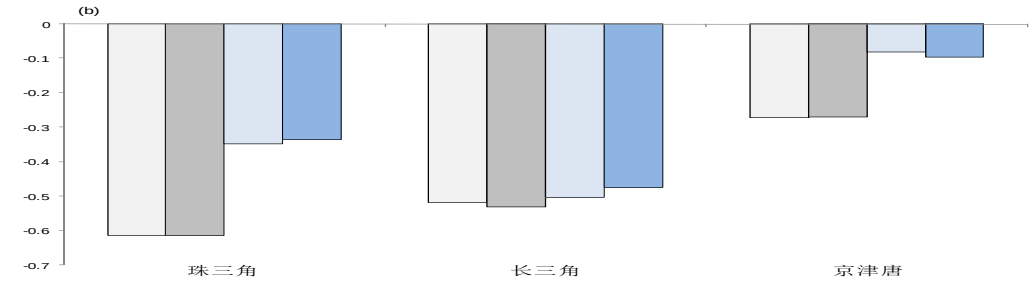




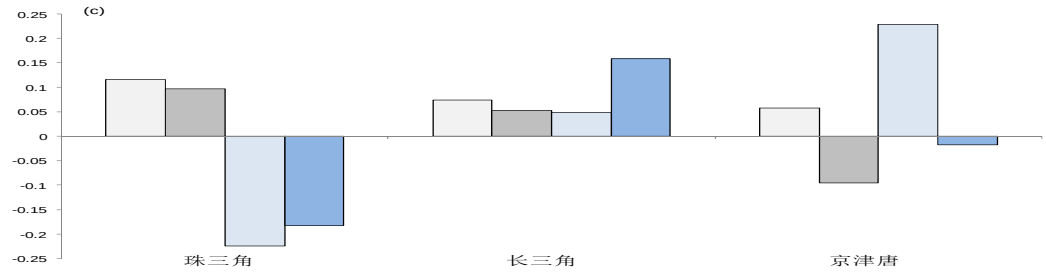
T2m (°C)



Precip (mm/d)



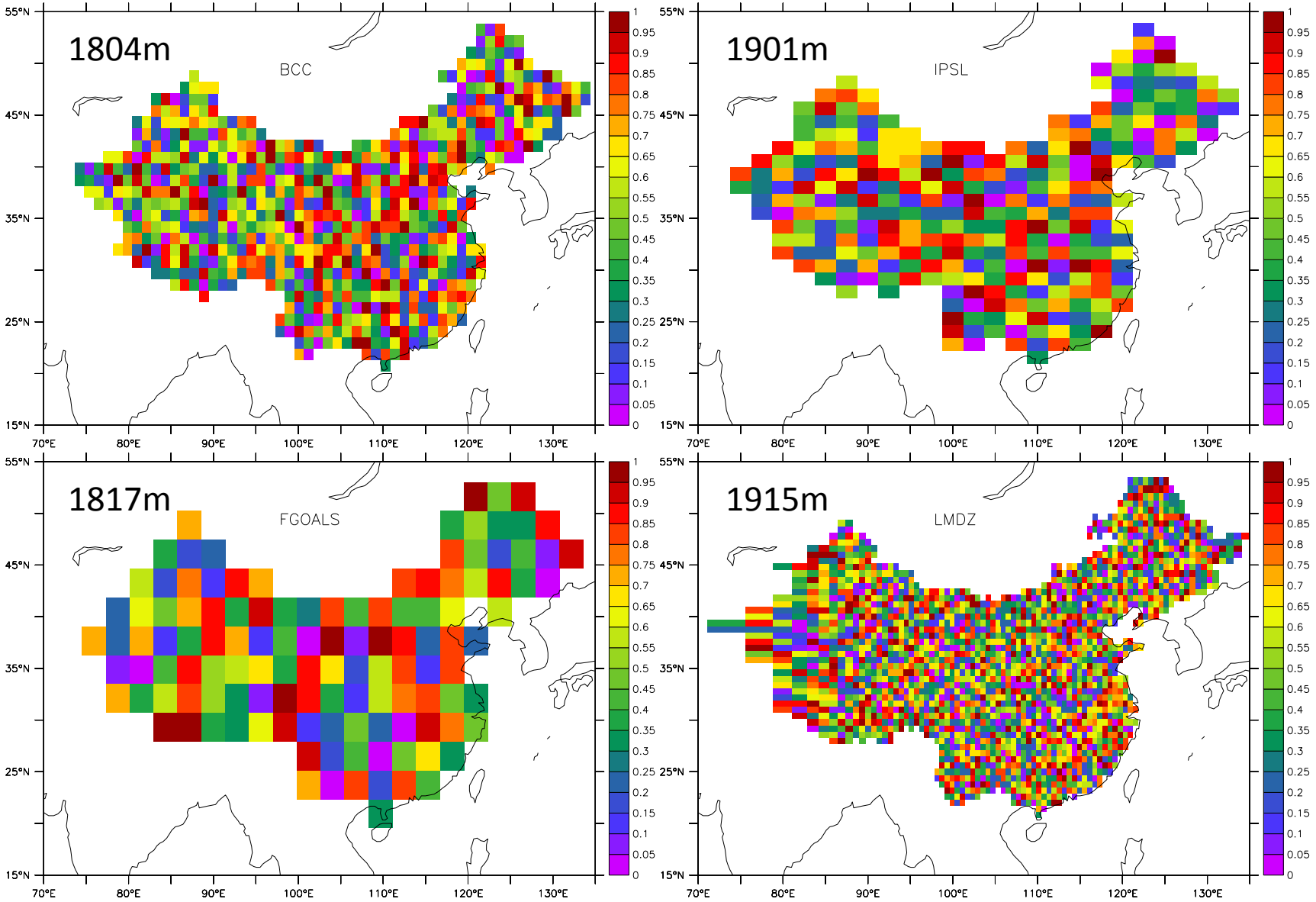
Evap



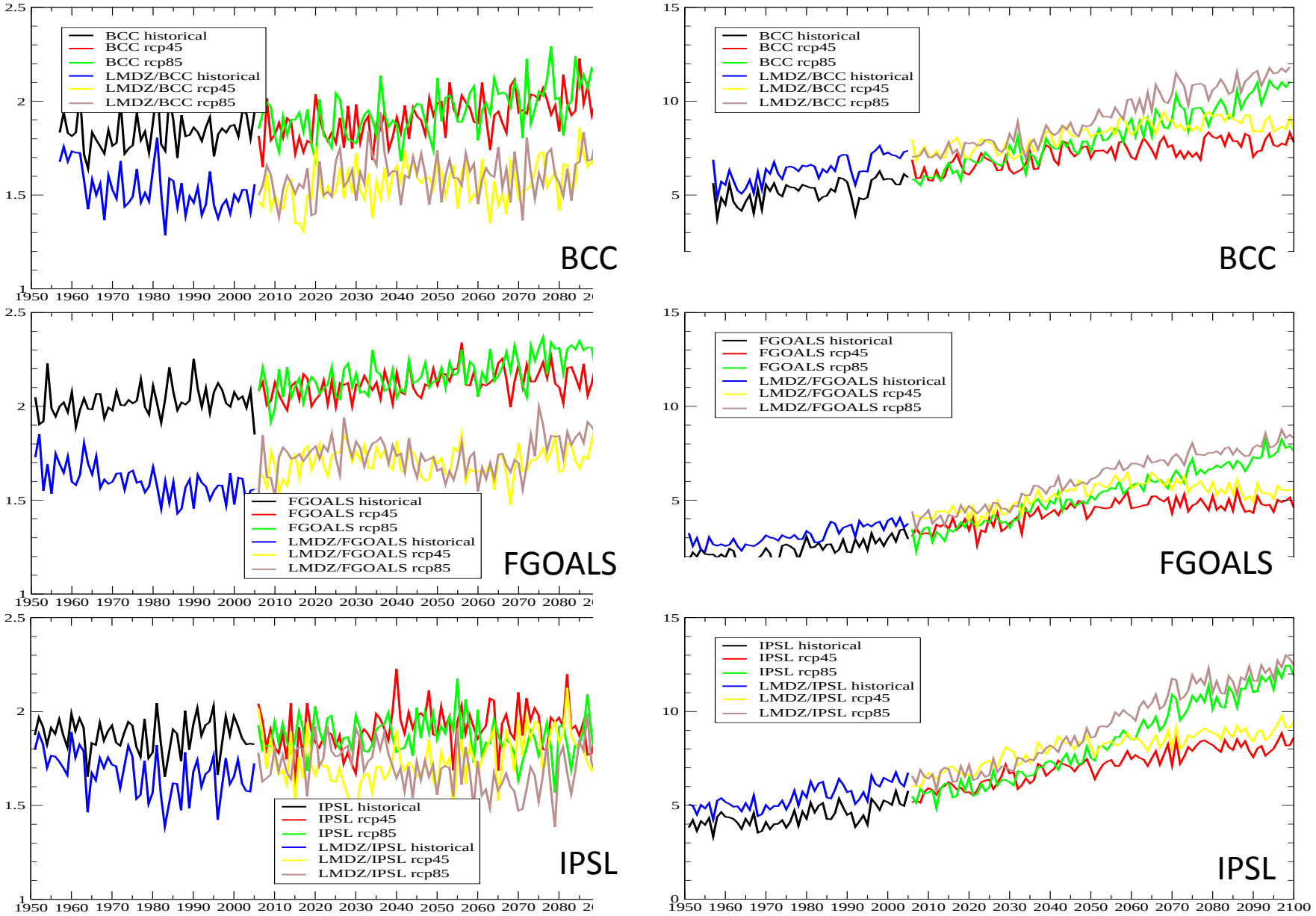
Water vapour convergence

Downscaling of climate change in China

Schematic of models grid in China

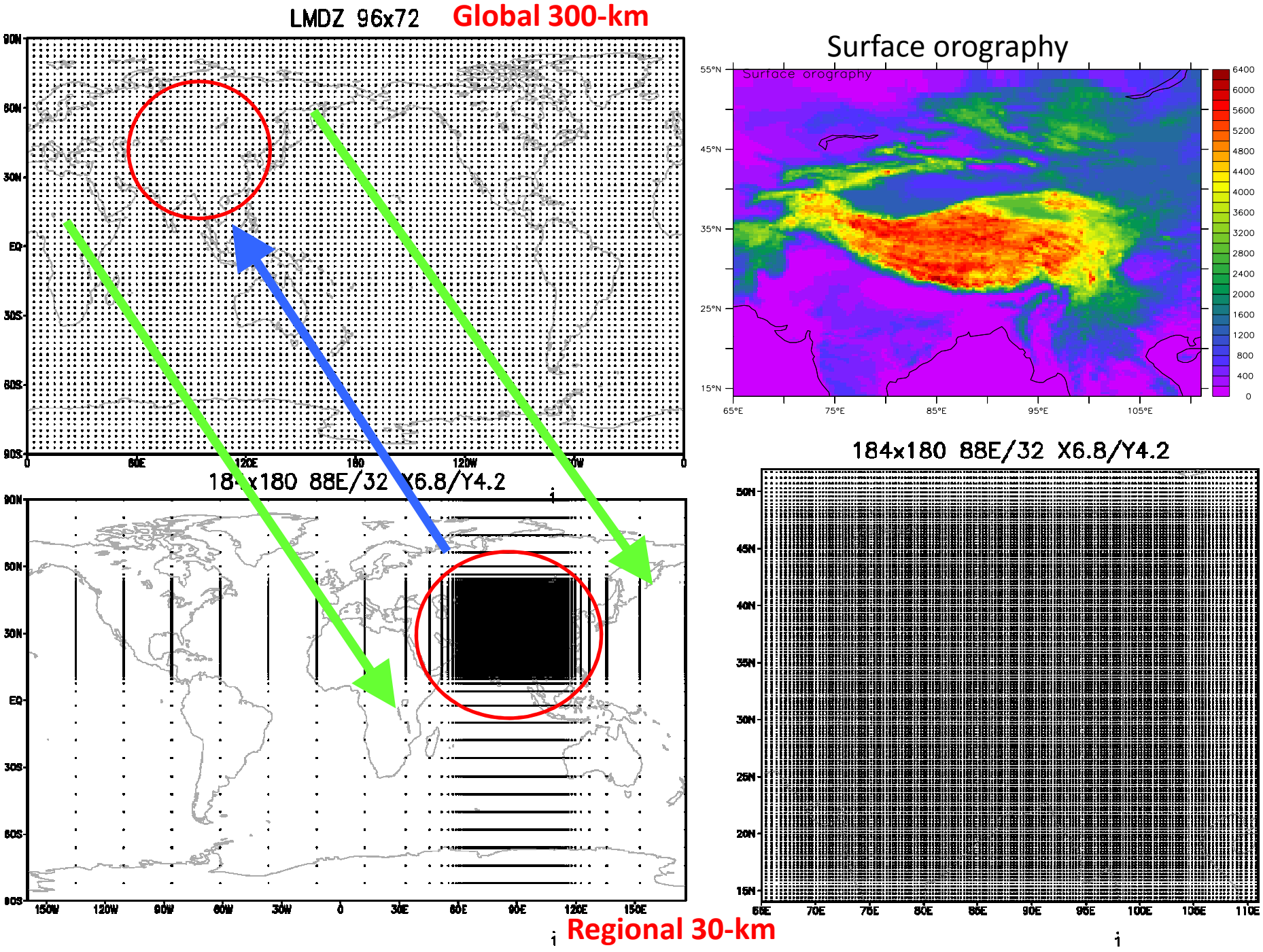


IPCC/CMIP5 runs: **historical** (1951-2005); **rcp4.5** (2006-2100); **rcp8.5** (2006-2100)

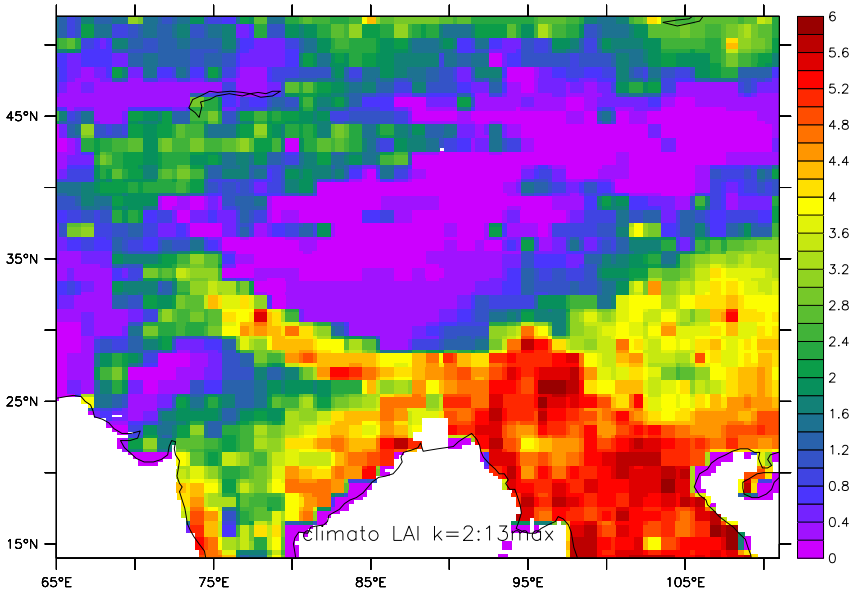


China-mean **rainfall** (mm/day, left) and surface air **temperature** (°C, right)
in global models and in LMDZ: historical, rcp4.5 and rcp8.5

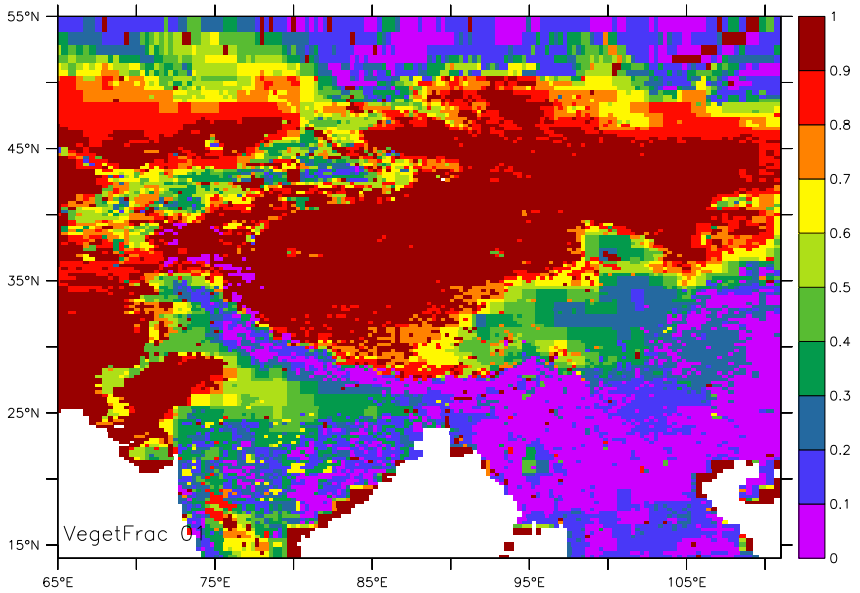
A two-way nesting climate system for the Tibetan Plateau

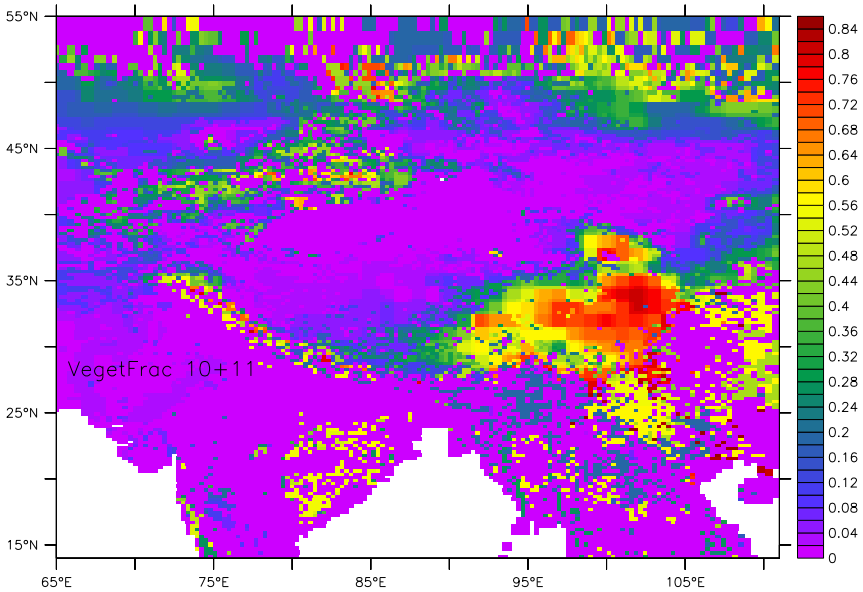

LMDZ 96x72
Global 300-km
Surface orography
Surface orography
184x180 88E/32 X6.8/Y4.2
184x180 88E/32 X6.8/Y4.2
Regional 30-km

LAI (annual and all-veget mean)

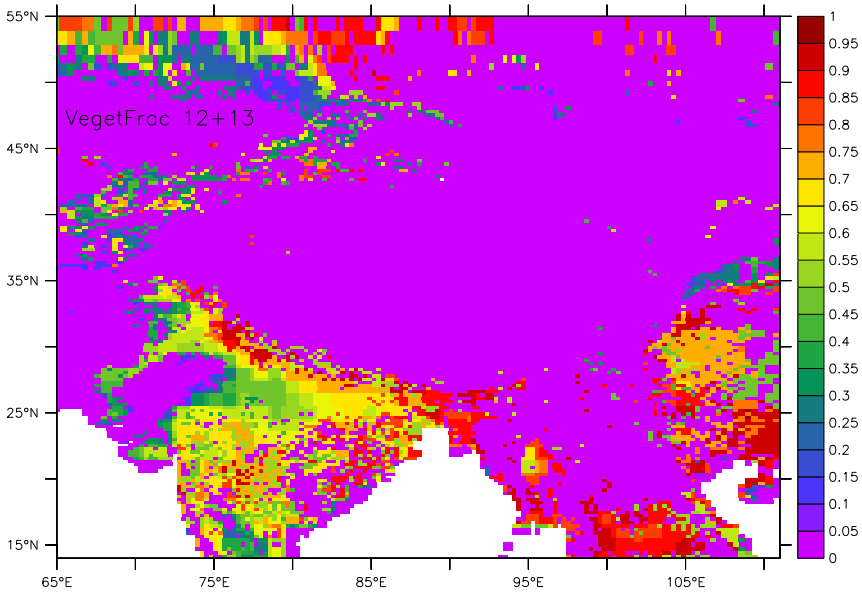


Orchidee: veget fraction 1 (bare soil)





Orchidee: veget fraction 10+11 (grass)



Orchidee: veget fraction 12+13 (crop)