

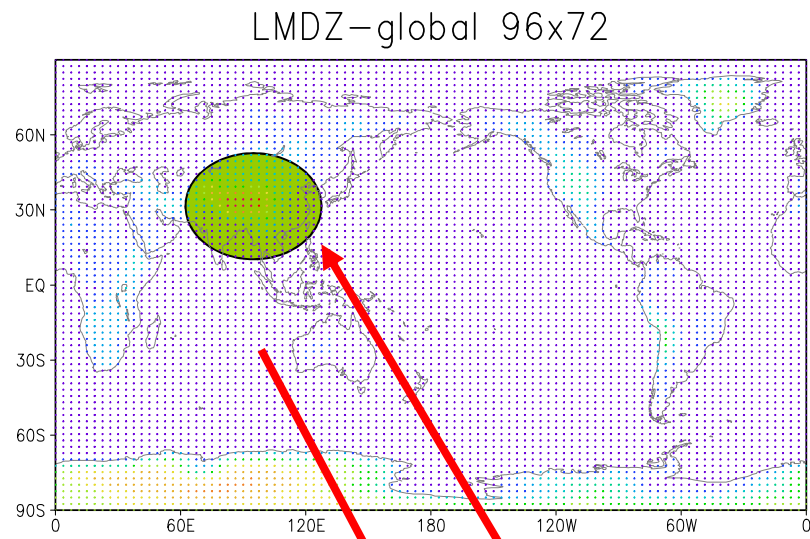
Land surface characteristics and regional climate change in China

Laurent Li (李肇新)

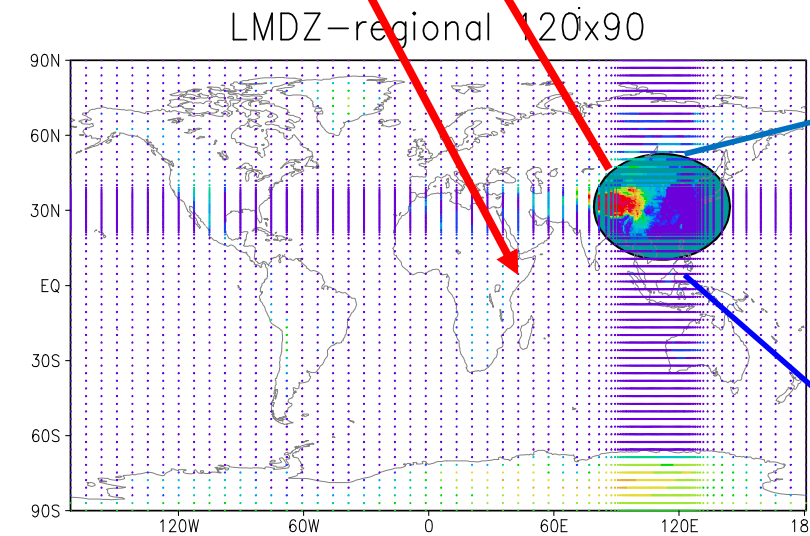
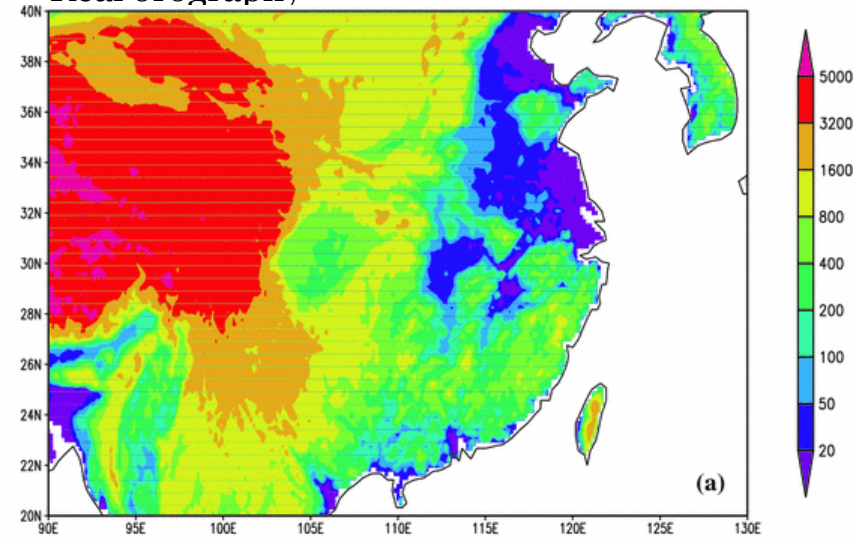
Laboratoire de Météorologie Dynamique (LMD)

Institut Pierre-Simon Laplace (IPSL)

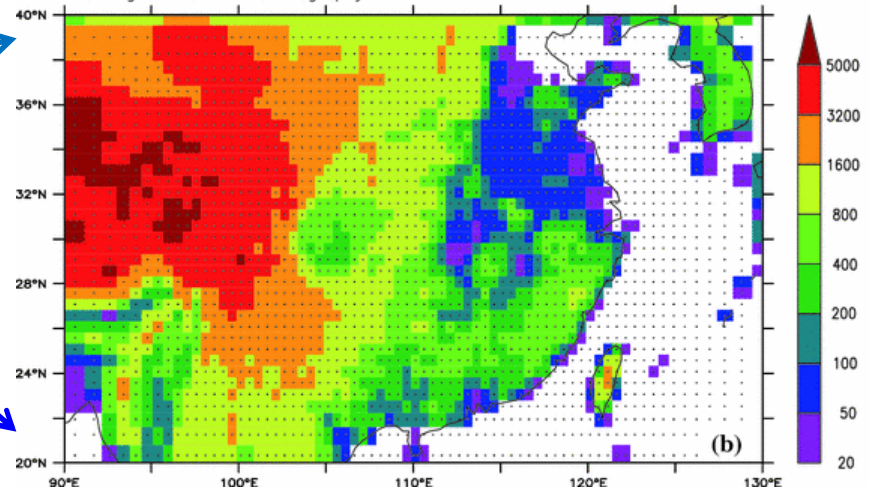
CNRS, Paris, France



Real orography



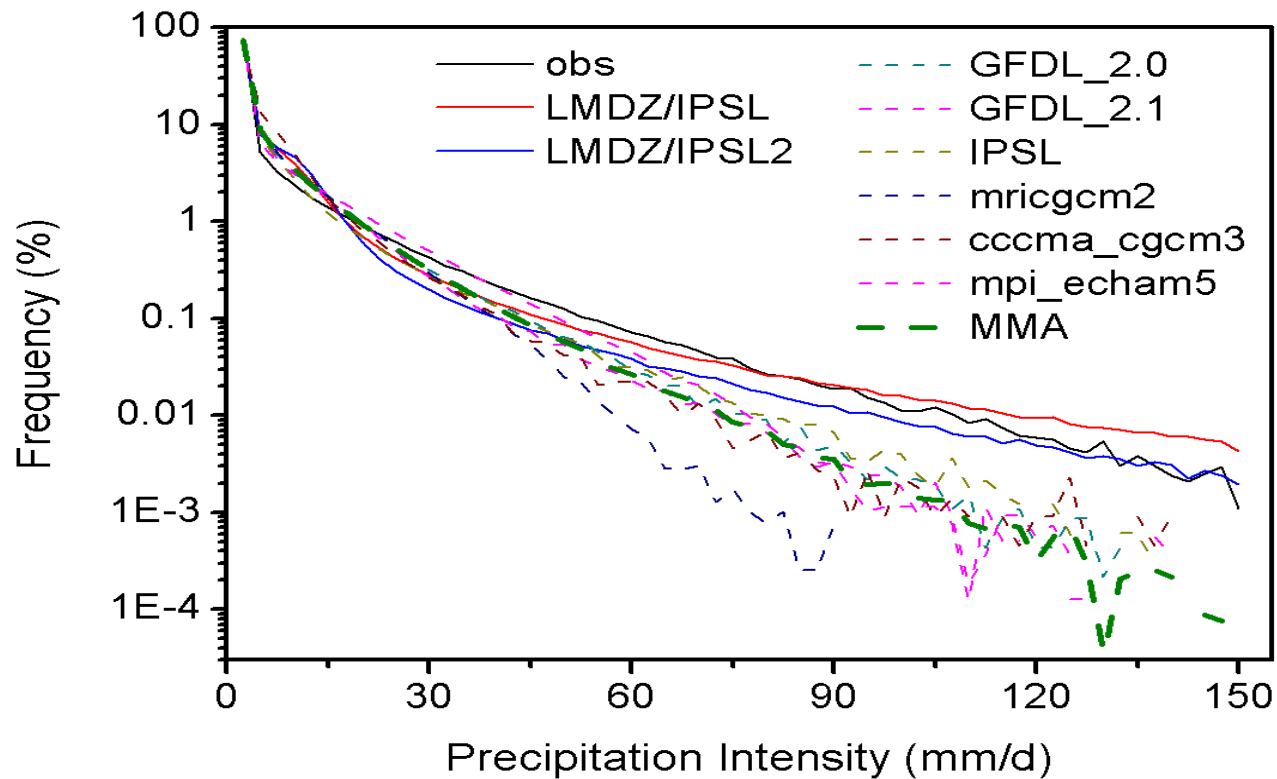
model grid and surface orography

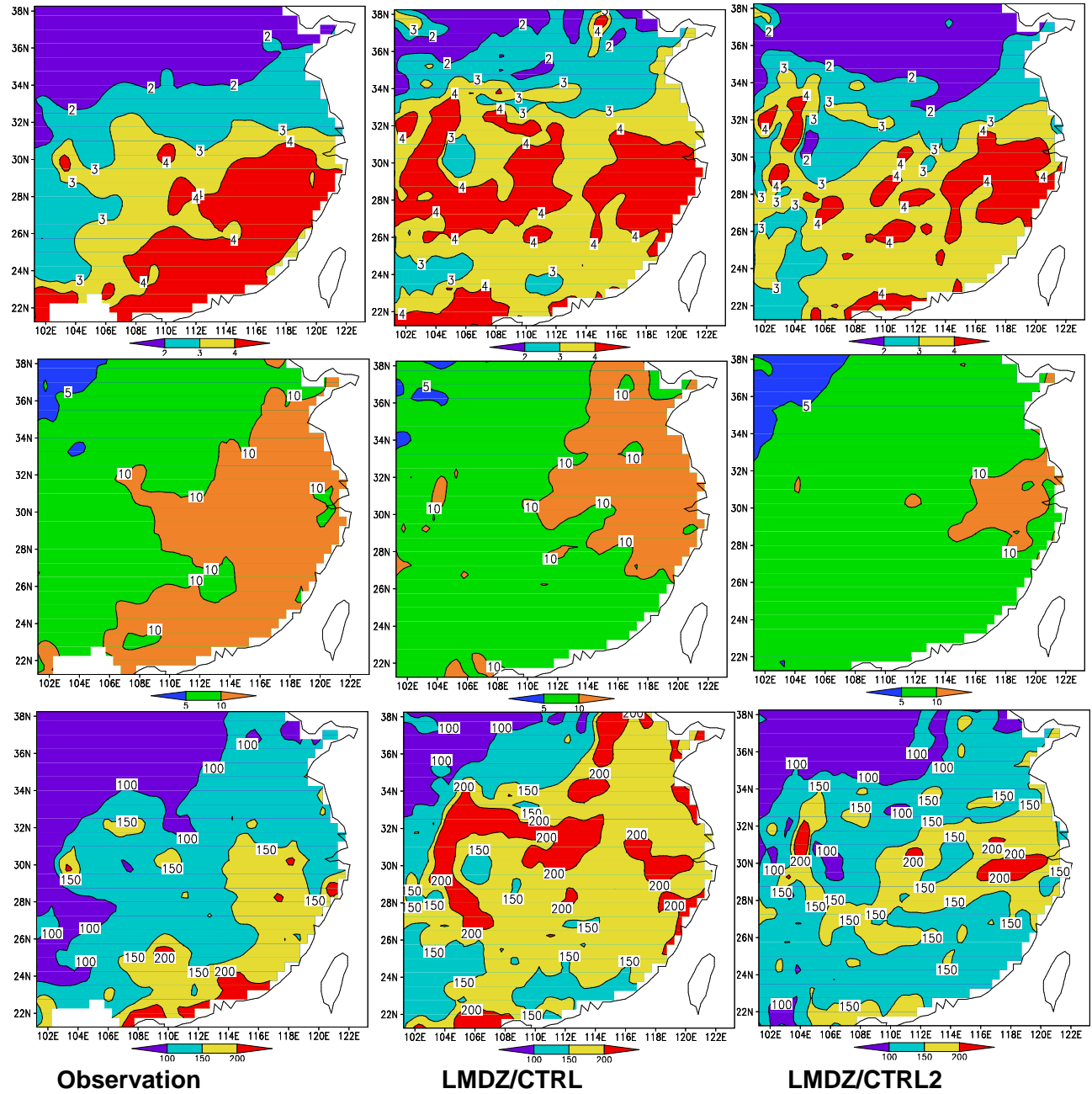


- LMDZregional is a global GCM with a zoom over Southeast China. Local resolution: 50 km.
- It is run as a regional climate model, with nudging conditions (every 6 hours) from a global model (LMDZ-g, ERA40, IPCC, etc.) at low resolution outside the zoom. The model is free to have its own behaviours inside the zoom.
- It is possible to do two-way nesting with LMDZ-global

Added values of
LMDZ-regional:
extremes

Spectral distribution of rainfall in southeast China, comparison between the observation, LMDZ/CTRL, LMDZ/CTRL2, and a few other coarse-resolution global models. Added values of high-resolution models can be clearly identified.

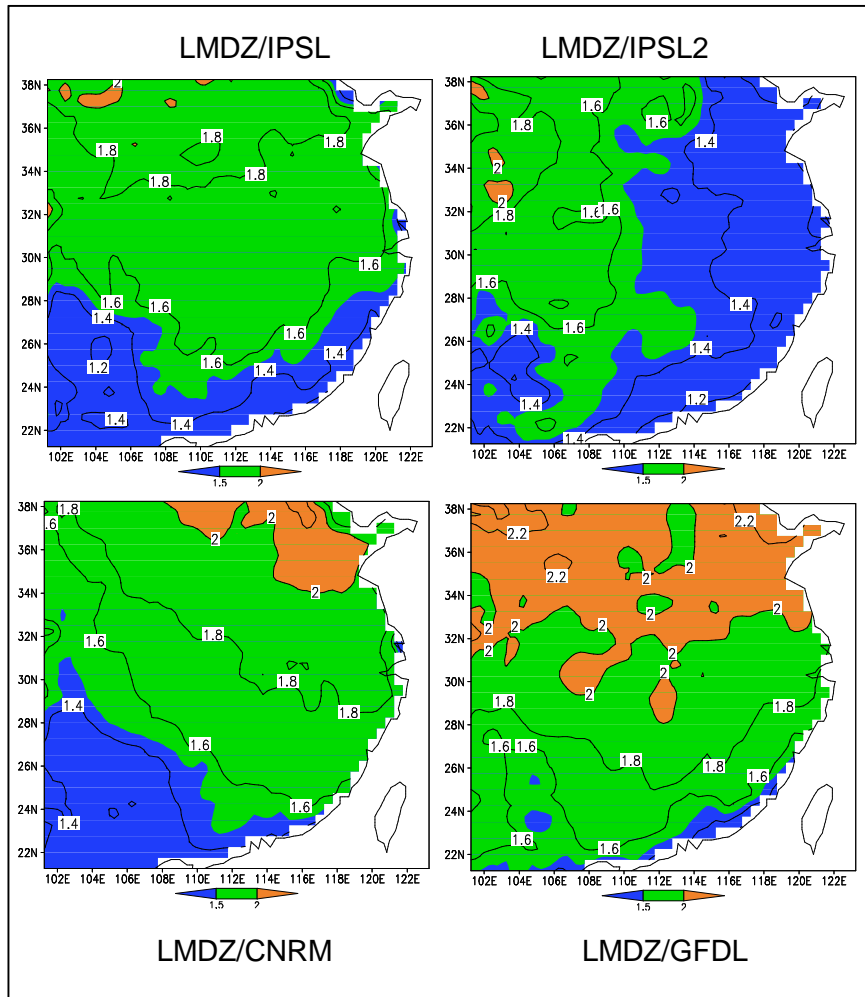




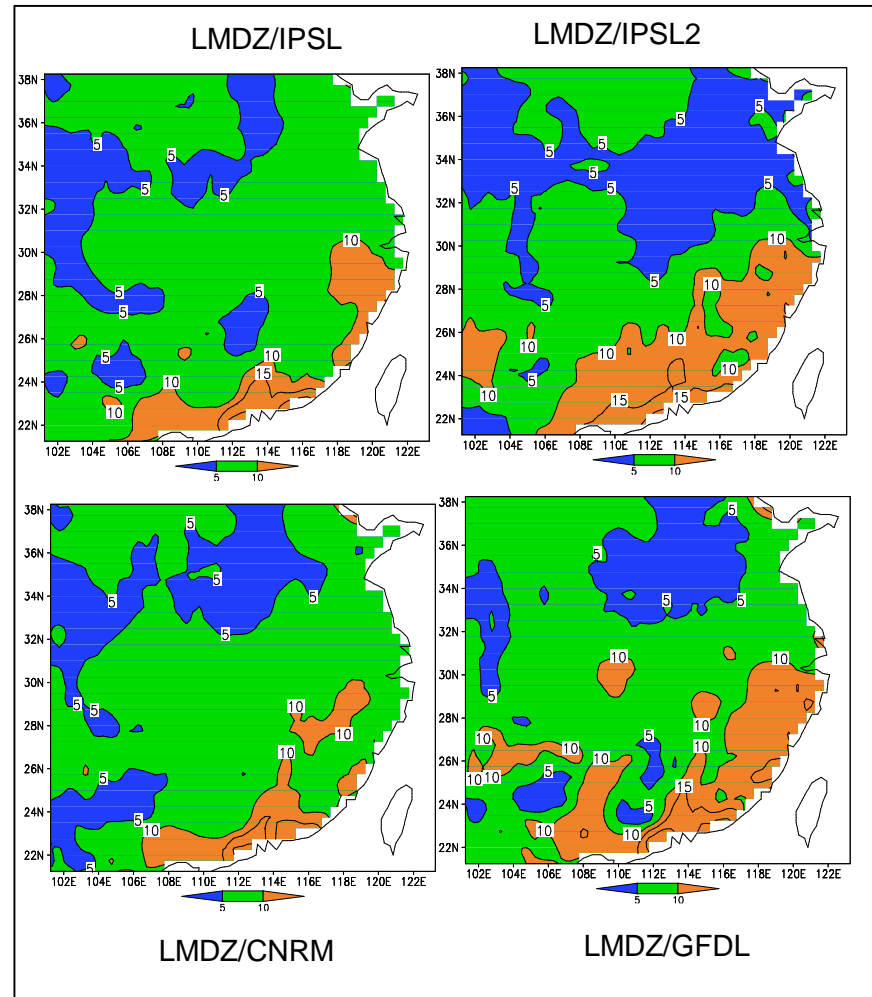
Pav: Annual-mean precipitation (mm/d)

SDII: Simple daily intensity index of precipitation (mm/d)

R5d: Maximum total precipitation from any consecutive 5 days (mm)

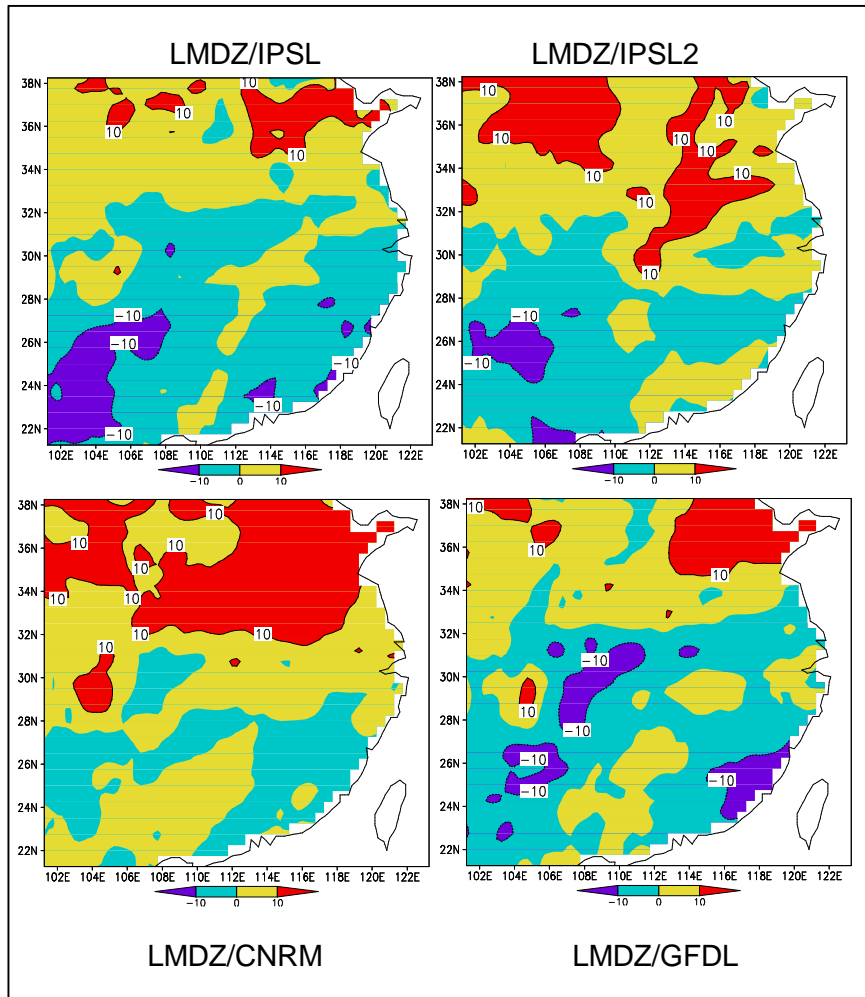


Tav

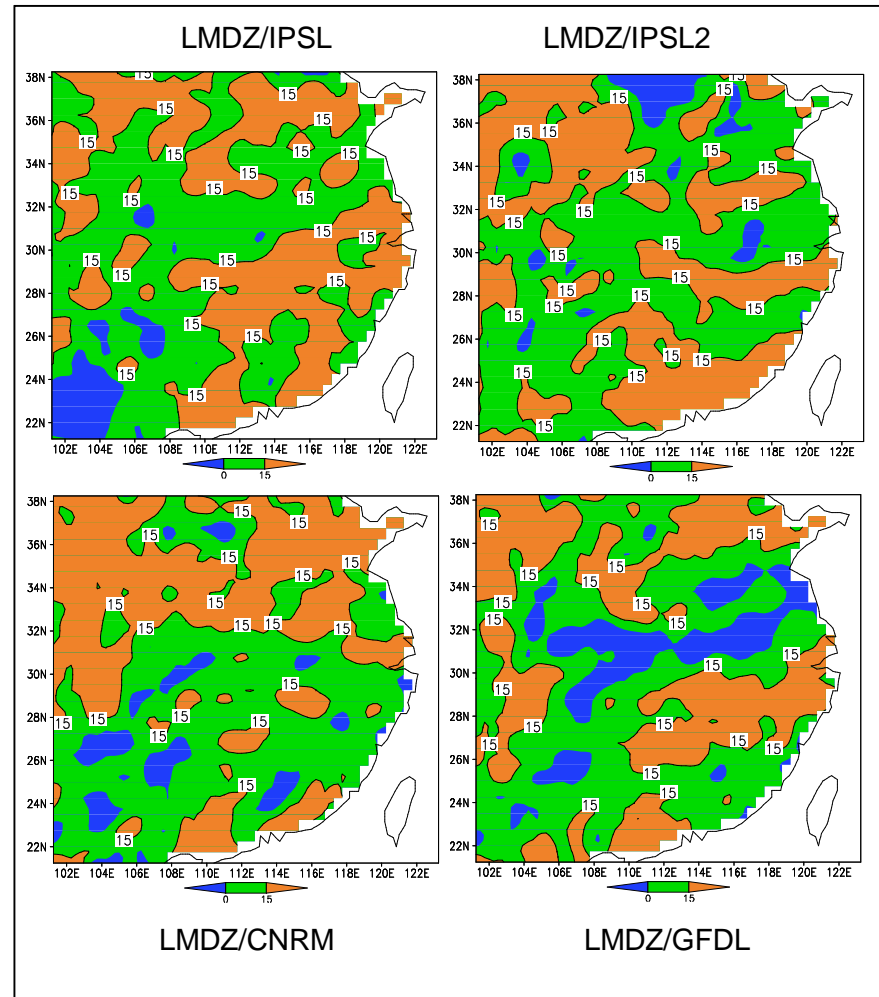


HD

Annual-mean changes (Future - Present) of surface air temperature (Tav) and heat-wave duration (HD)



Pav



R95t

Fractional changes (Future – Present, %) of annual-mean precipitation (Pav) and heavy rainfall proportion (R95t)

A numerical study on climate effect of the urbanization in the Yangtze River Delta

Motivation: The recent Chinese economic boom is accompanied by a massive urbanization in Eastern China, to the detriment of arable lands. What impacts are expected for climate at local and large scales ?

A sensitivity study:
Change agriculture land into bare soil

Agricultural regions of Mainland China



Source: Wikipedia / CIA

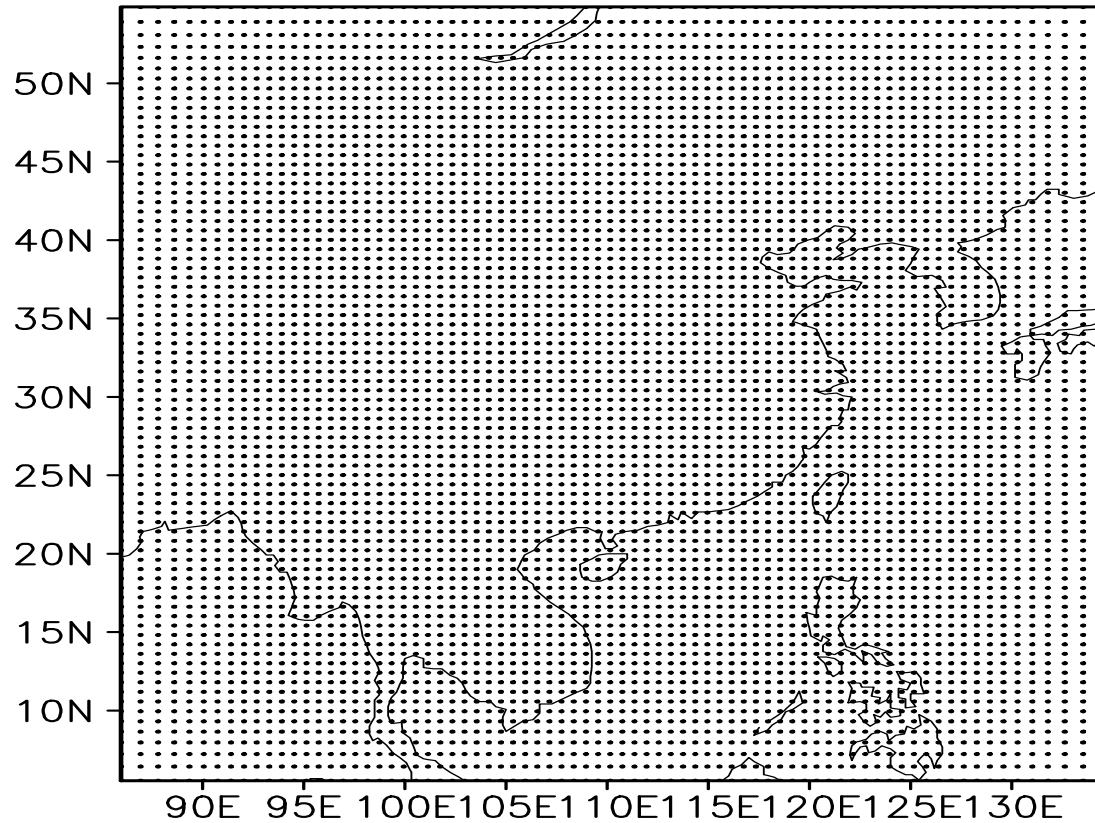
Vegetation types in ORCHIDEE:

1. Bare soil
2. Tropical broad-leaved evergreen
3. Tropical broad-leaved rain-green
4. Temperate needle-leaf evergreen
5. Temperate broad-leaved evergreen
6. Temperate broad-leaved summer green
7. Boreal needle leaf evergreen
8. Boreal broad-leaved summer green
9. Boreal needle leaf summer green
10. C3 grass
11. C4 grass
12. C3 agriculture
13. C4 agriculture

LMDZ-regional is driven, for lateral boundary, by ERA-Interim 4xdaily T, u, v, q from 1989 to 2009

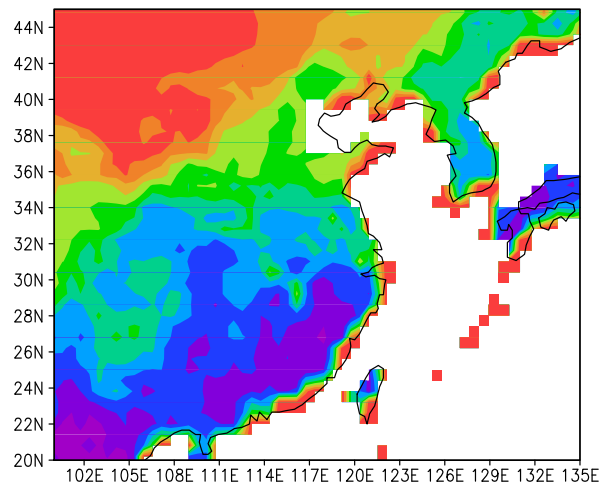
LMDZ-regional : lon (77) x lat (80), about 50 km

Model Grid

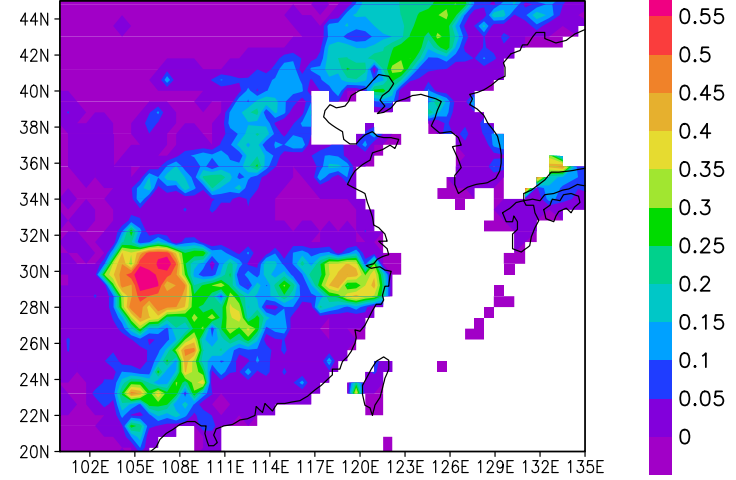


Fractions of bare soil, C3 and C4 agriculture

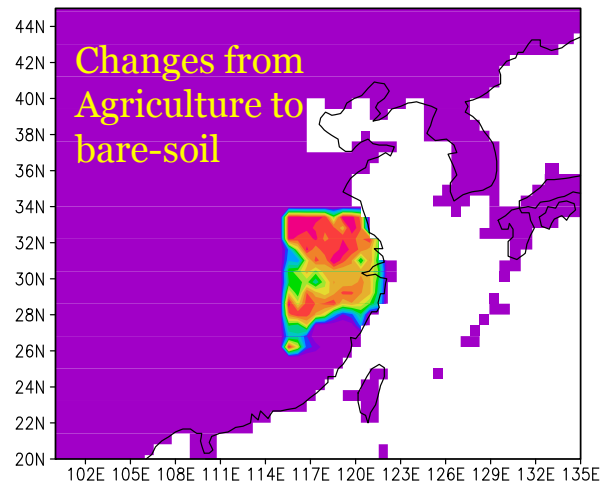
Bare soil fraction



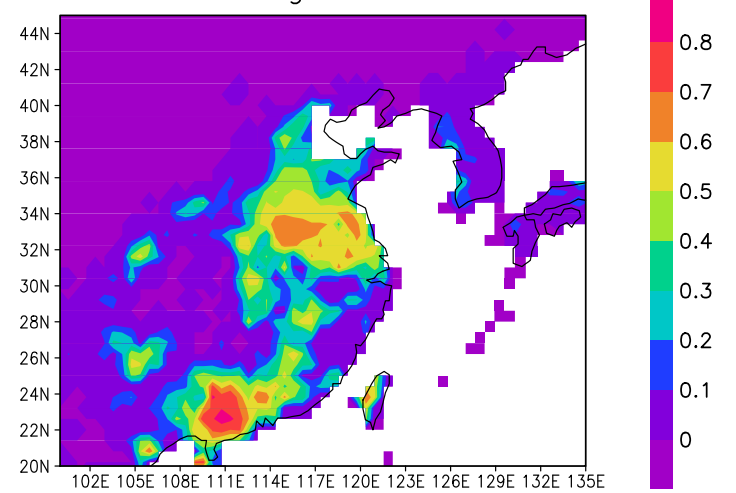
C3 agriculture



agriculture to bare soil

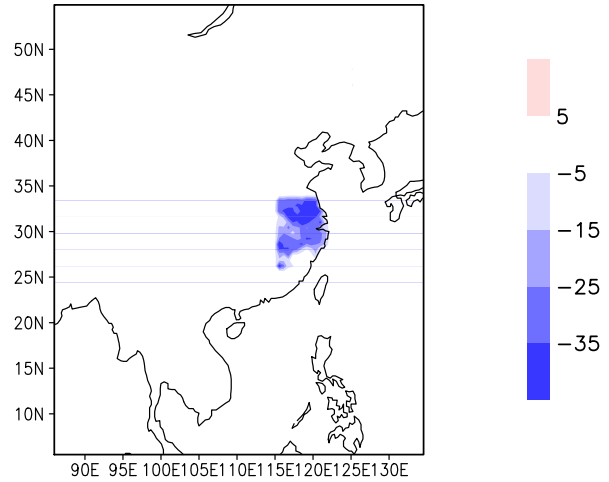


C4 agriculture



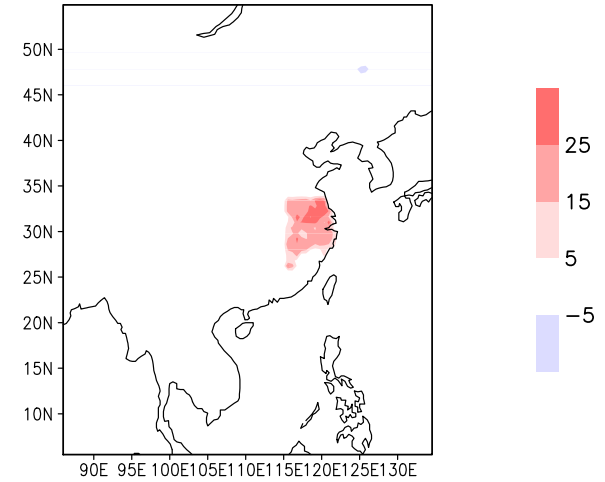
Changes in Latent heat flux

JJA-mean hfis Delta (W/m²)

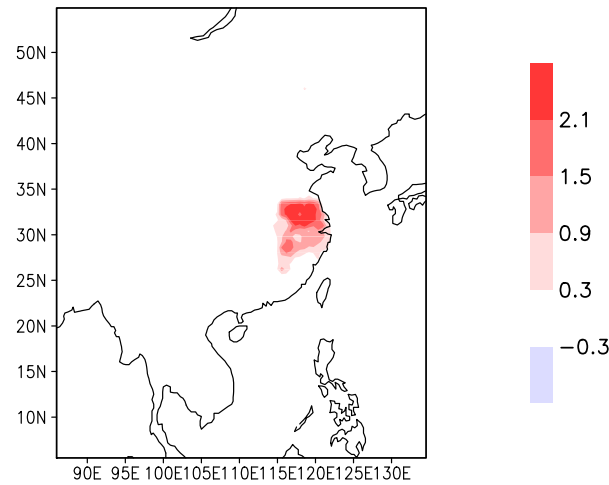


Changes in Sensible heat flux

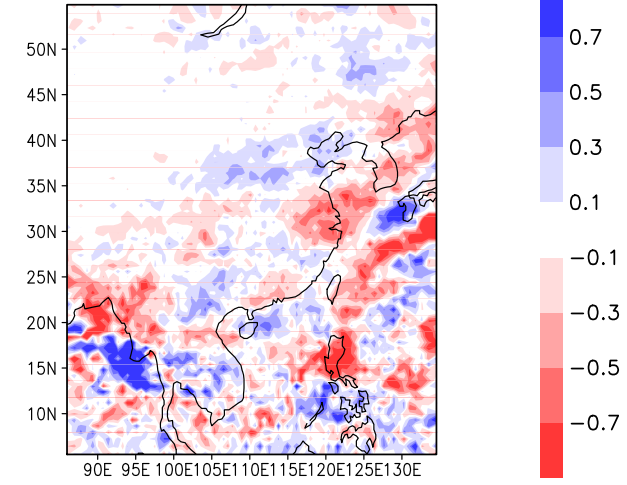
JJA-mean hfss Delta (W/m²)



JJA-mean tas Delta (K)



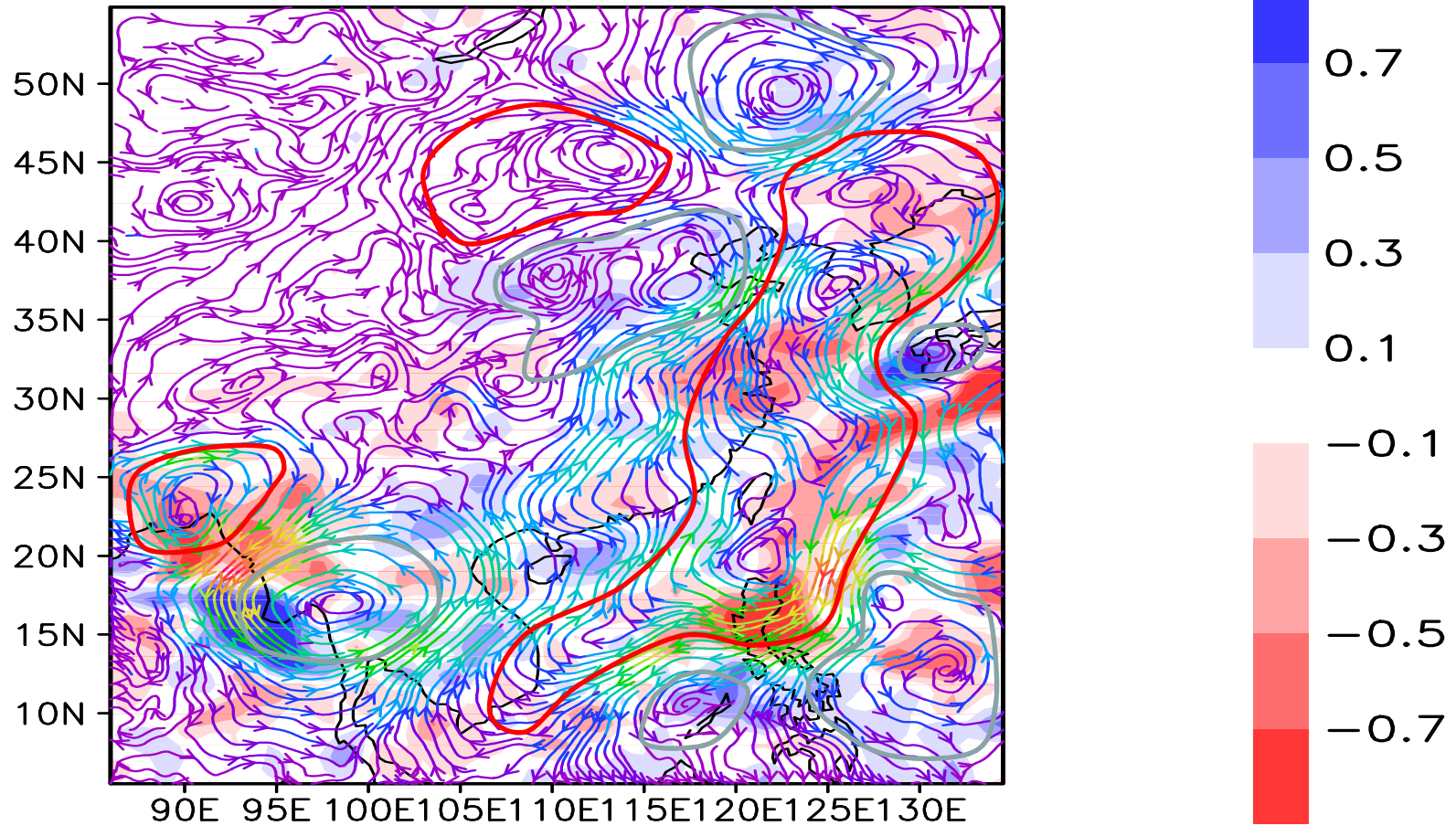
JJA-mean pr Delta (mm/day)



Changes in surf air temp

Changes in precipitation

Changes in precipitation (smoothed) and moisture transport JJA—mean pr and vq Delta

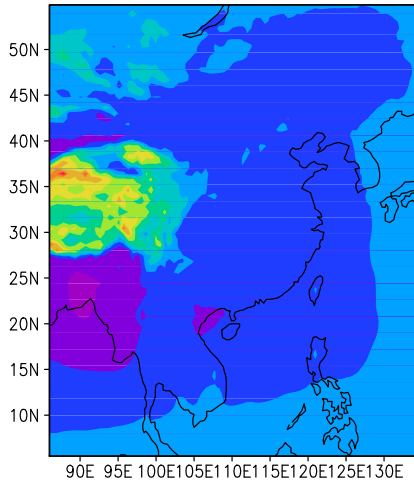


**Divergence and
anticyclonic circulation**

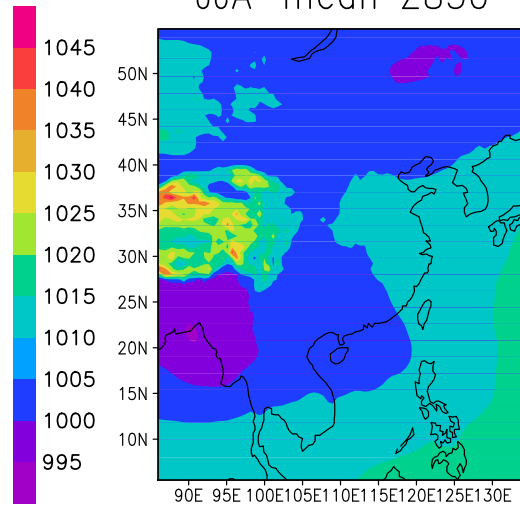
**Convergence and
cyclonic circulation**

JJA-mean fields (SLP, geop heights 850 and 200 hPa, upper) and changes (lower)

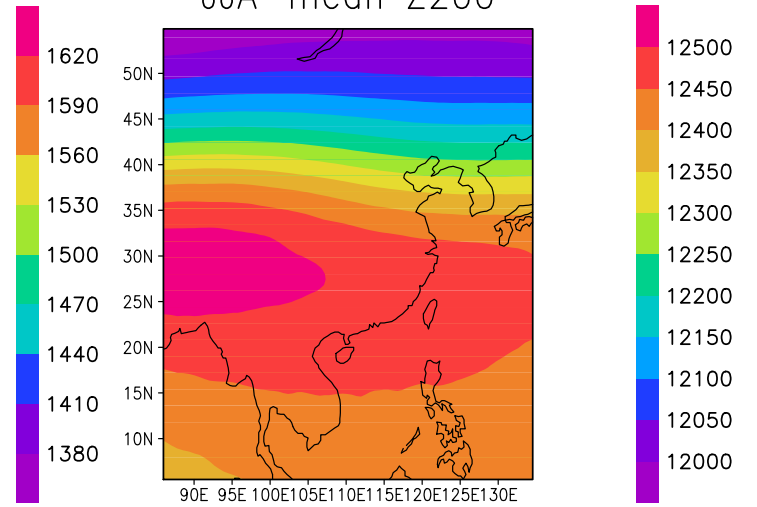
JJA-mean psl



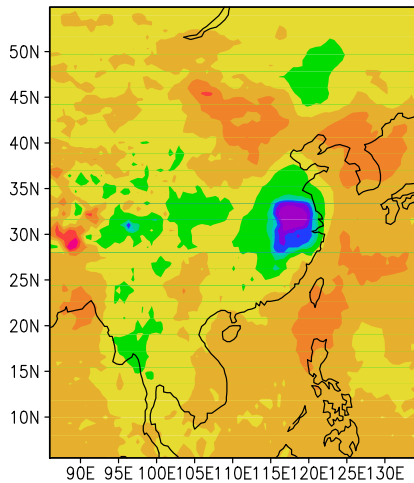
JJA-mean Z850



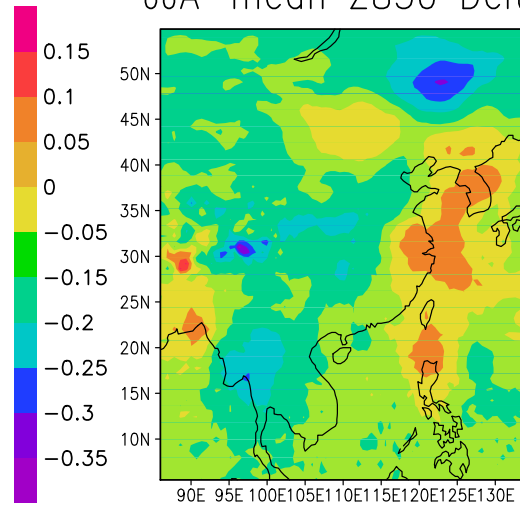
JJA-mean Z200



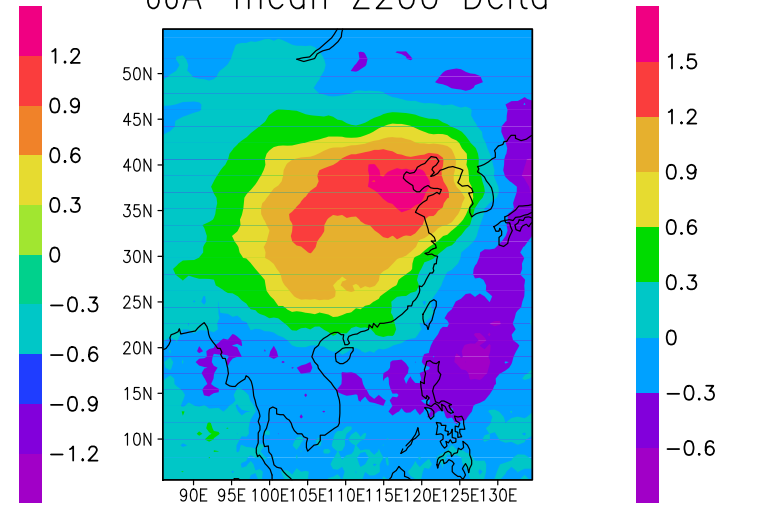
JJA-mean psl Delta



JJA-mean Z850 Delta



JJA-mean Z200 Delta



Sea-level pressure

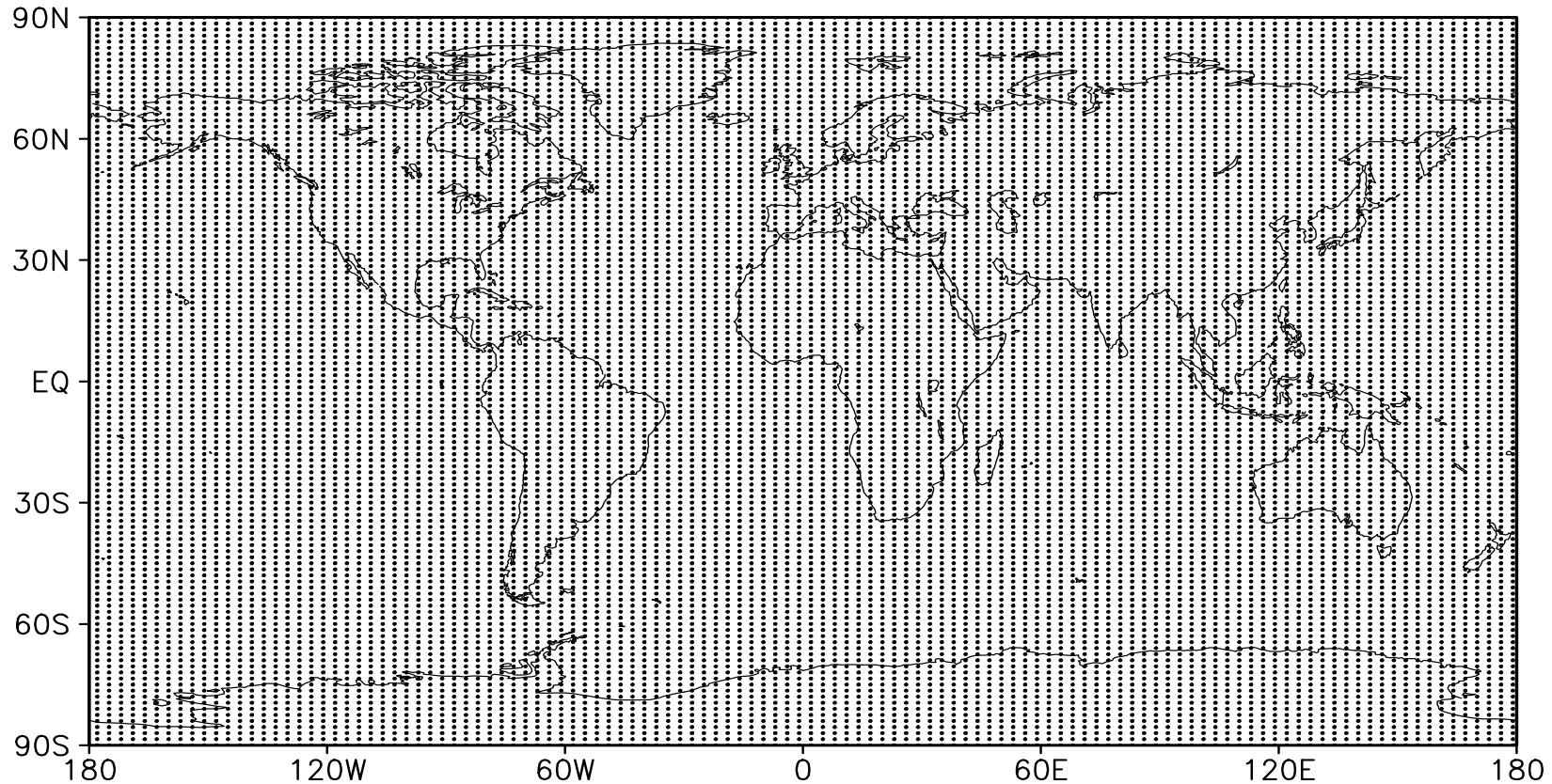
850-hPa geop height

200-hPa geop height

A weak baroclinic structure can be observed in the local domain

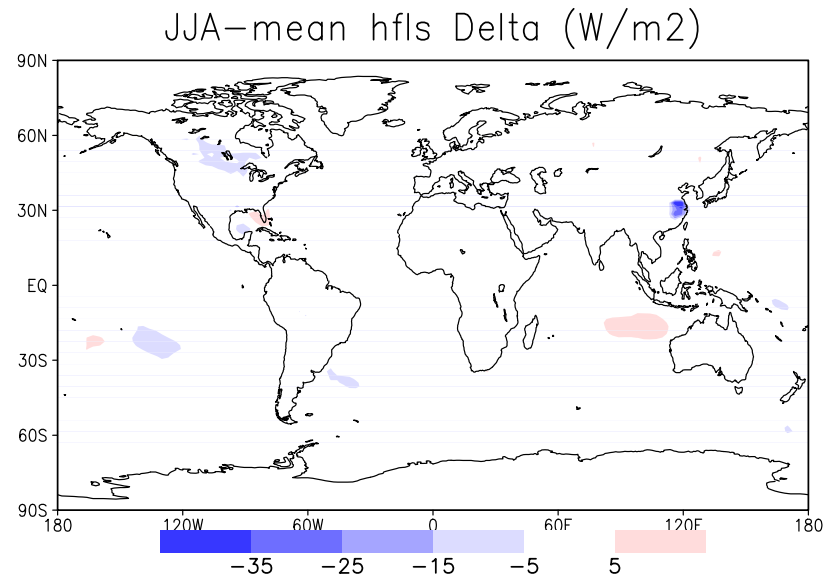
Same **model physics** and same **experimental design**, but there are no more boundary conditions from ERA-Interim. SST at the lower boundary is the observed one with interannual variability (**21 years: 1989 to 2009, 3 ensemble members**)

Model Grid

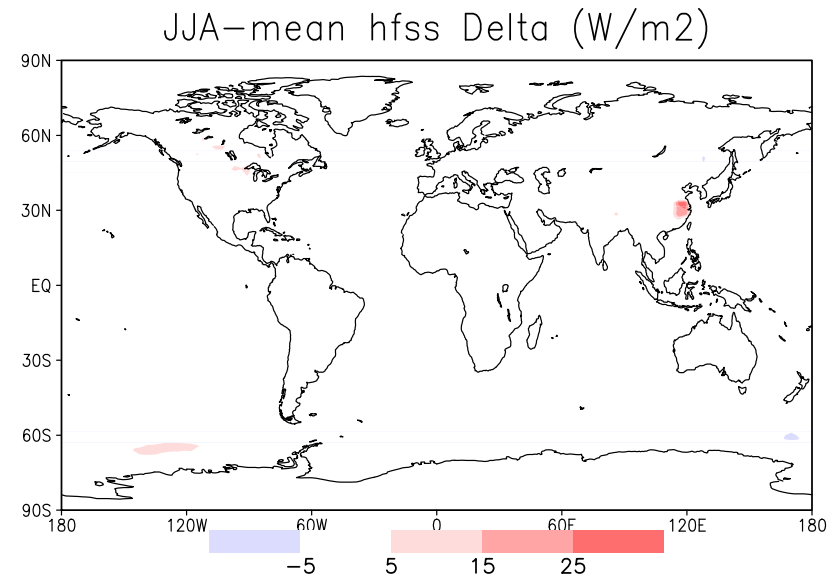


LMDZ-global: 120(lon) x 120(lat), about 200 km

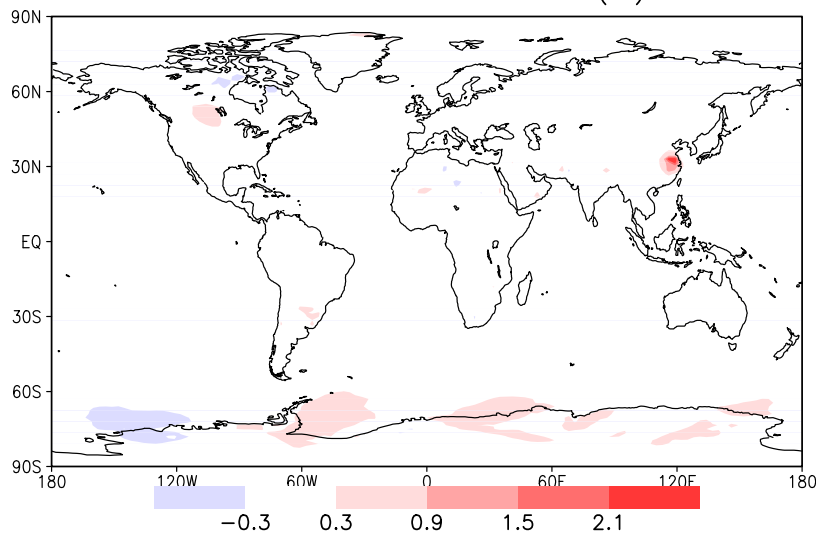
Changes in Latent heat flux



Changes in Sensible heat flux

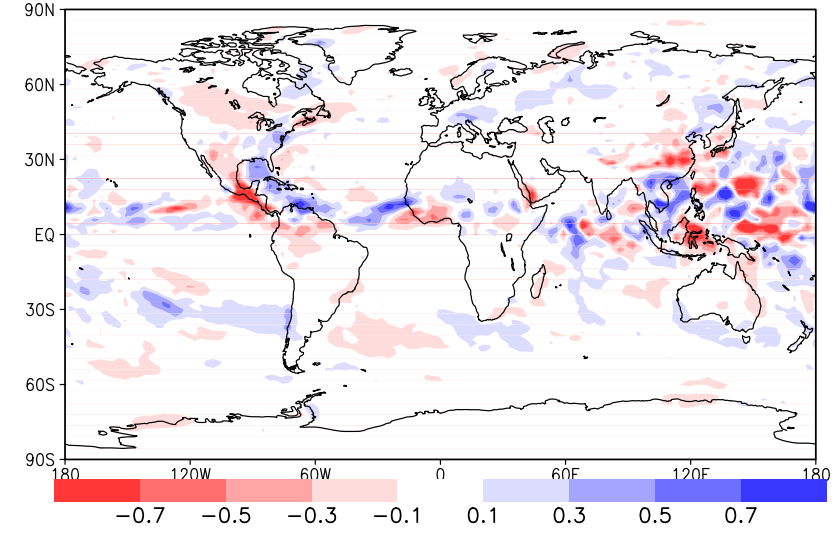


Changes in surf air temp

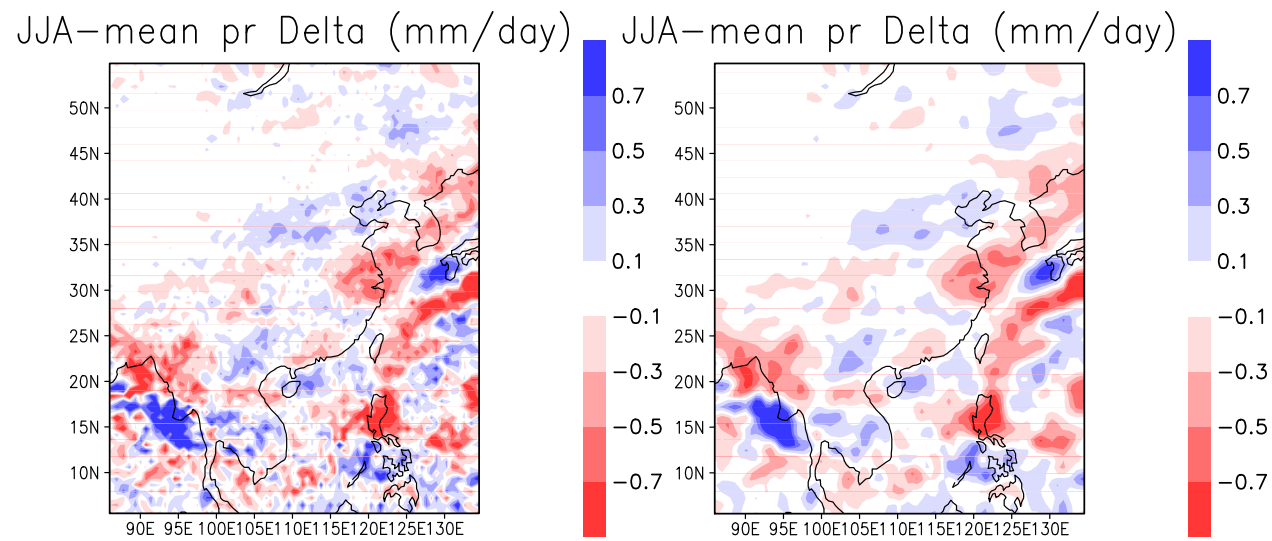
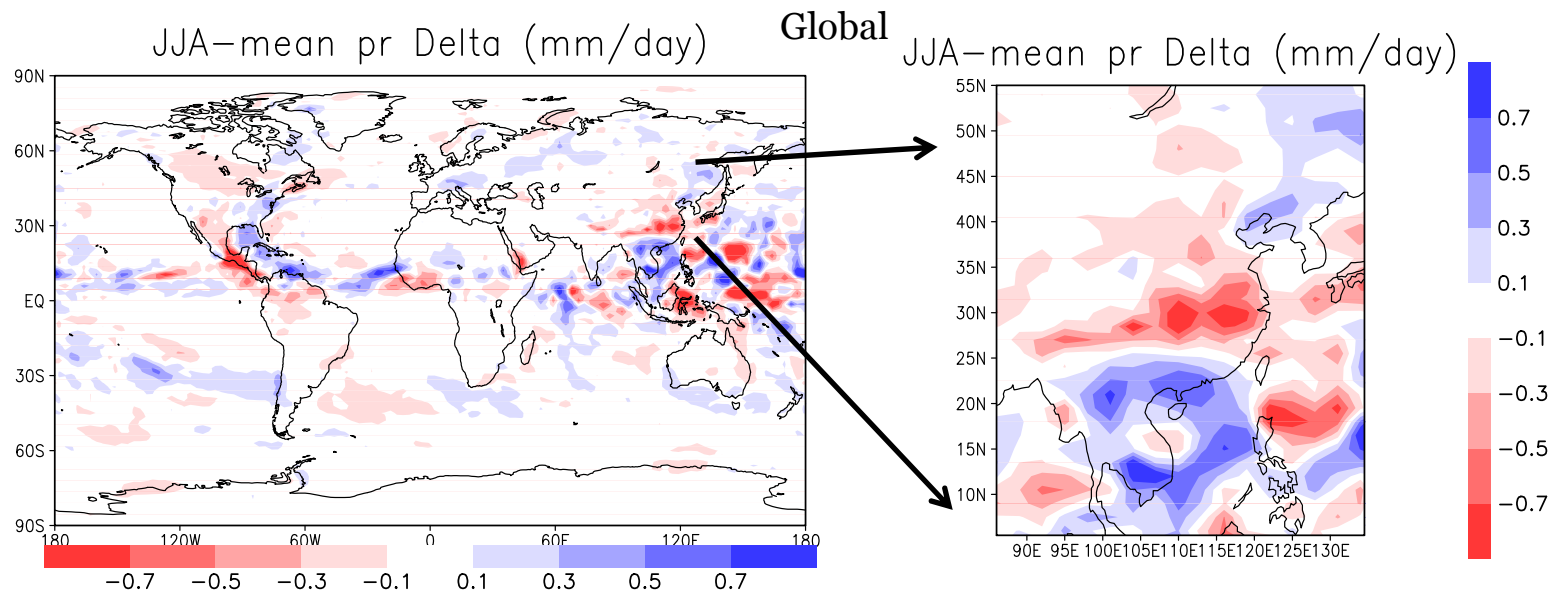


Changes in surf air temp

Changes in precipitation



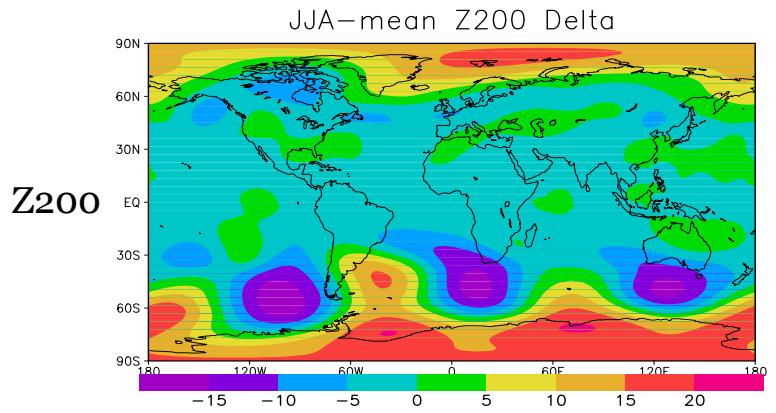
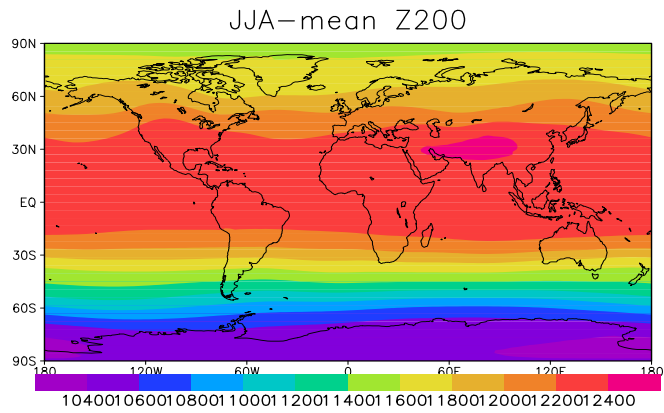
Changes in precipitation



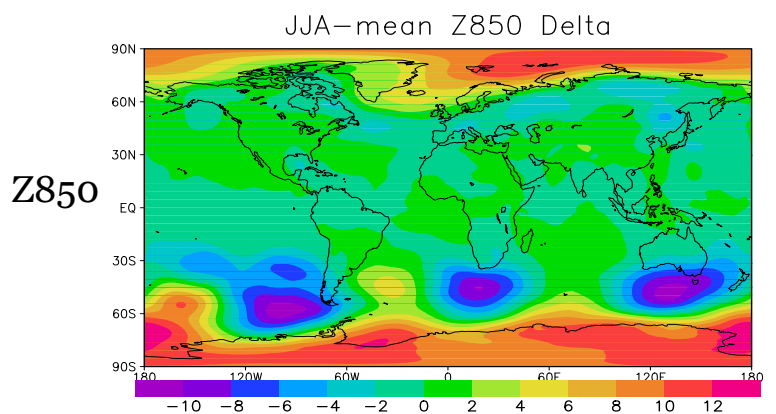
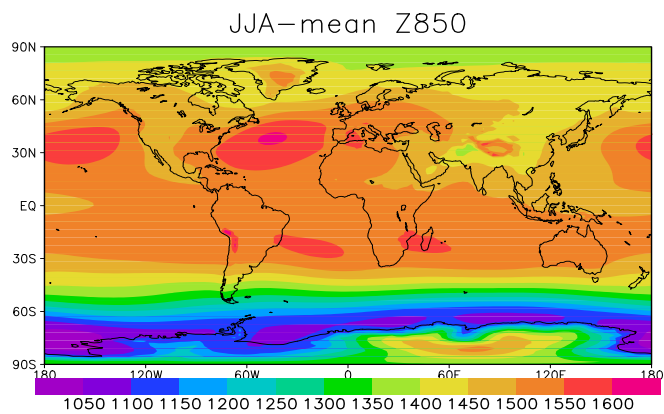
Raw

Regional

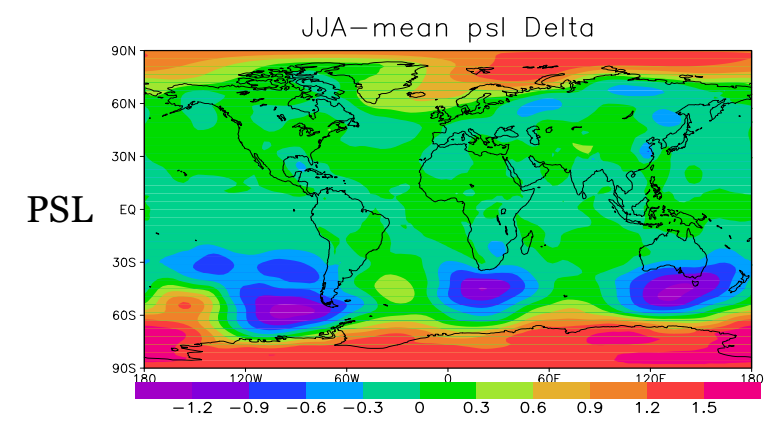
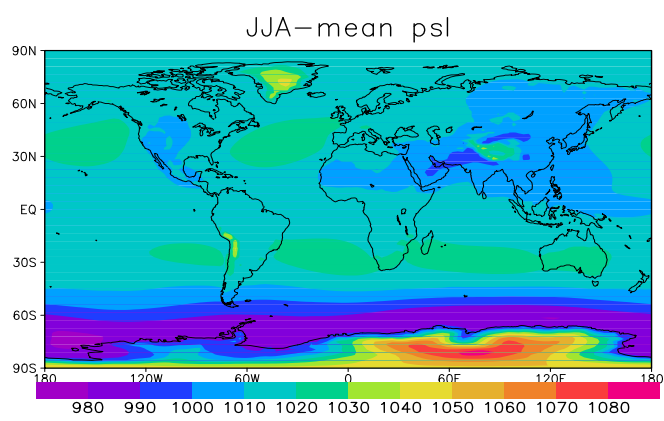
smoothed



Z200



Z850



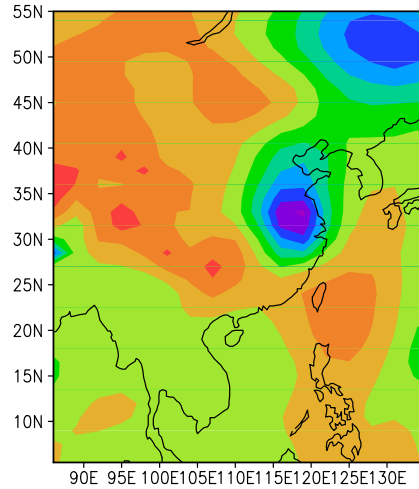
PSL

Control simulation

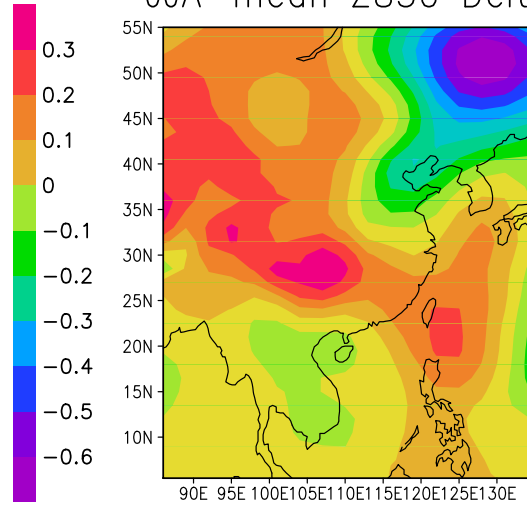
Anomalies

JJA-mean changes (SLP, geop heights 850 and 200 hPa) for global (upper) and regional (lower)

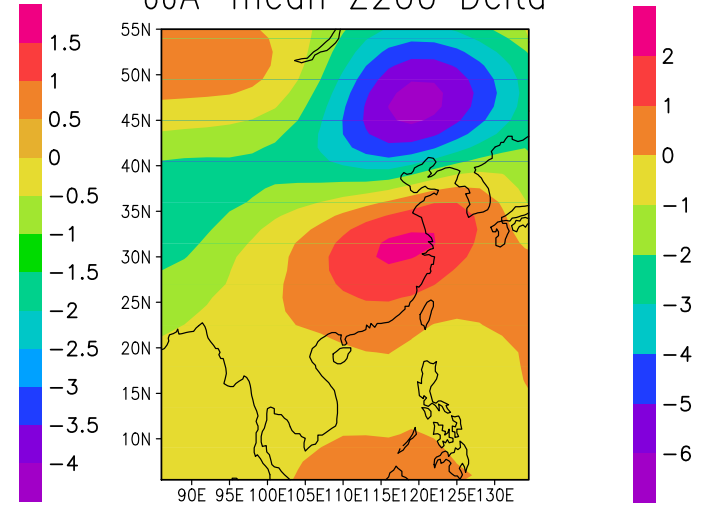
JJA-mean psl Delta



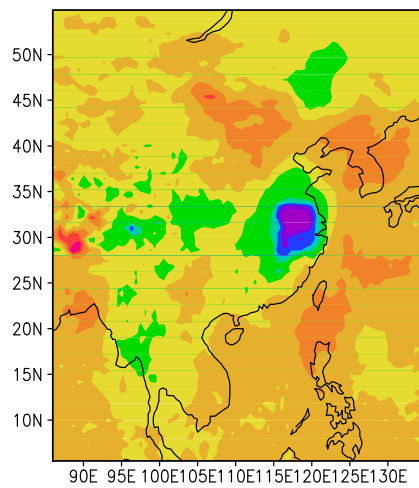
JJA-mean Z850 Delta



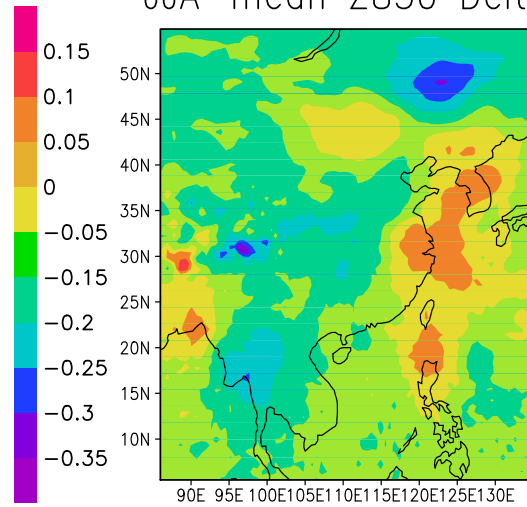
JJA-mean Z200 Delta



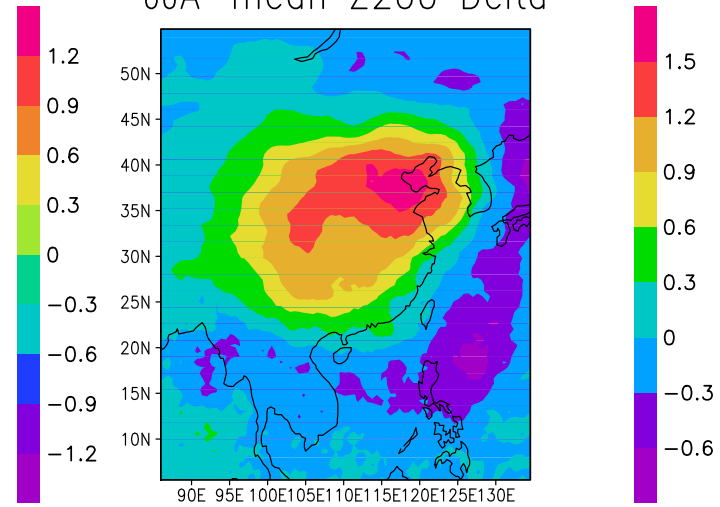
JJA-mean psl Delta



JJA-mean Z850 Delta



JJA-mean Z200 Delta



Sea-level pressure

850-hPa geop height

200-hPa geop height

Urbanization in the Yangtze river Delta :

- Local warming and drying effects.**
- Enhance the summer monsoon.**
- Global effects are difficult to assess.**

Surface air temperature variation (1997/2011 – 1982/1996) due to surface vegetation changes

