

Modélisation du changement climatique en France: évolution des événements extrêmes

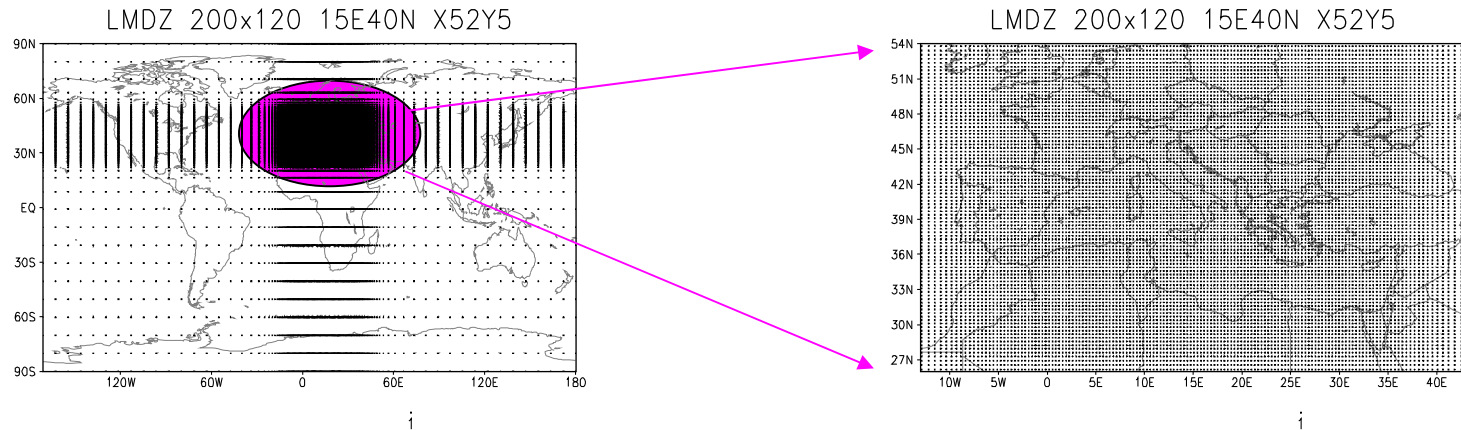
Laurent Li

Laboratoire de Météorologie Dynamique (LMD)

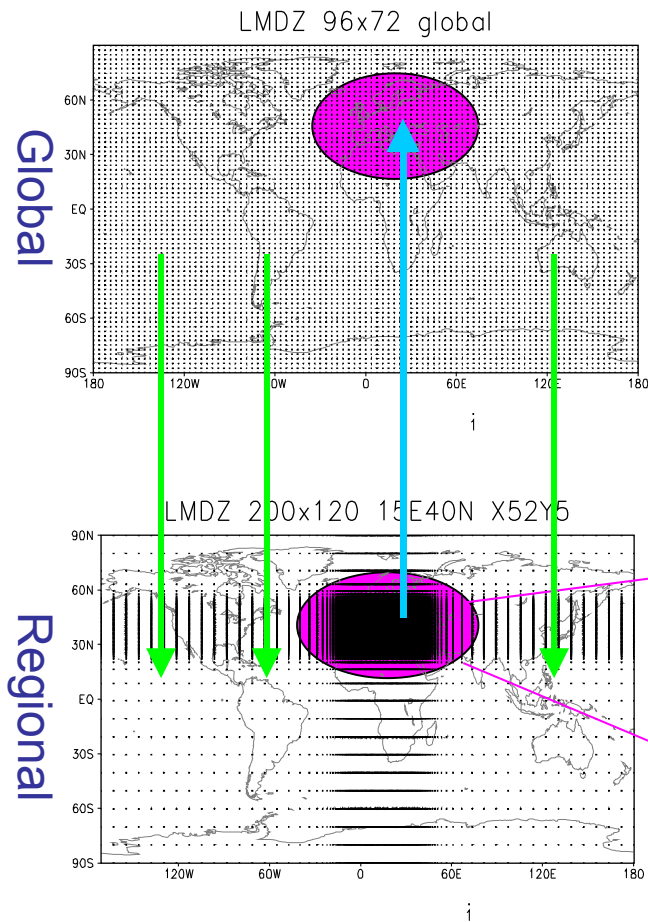
Institut Pierre-Simon Laplace (IPSL)

CNRS/UPMC, Paris

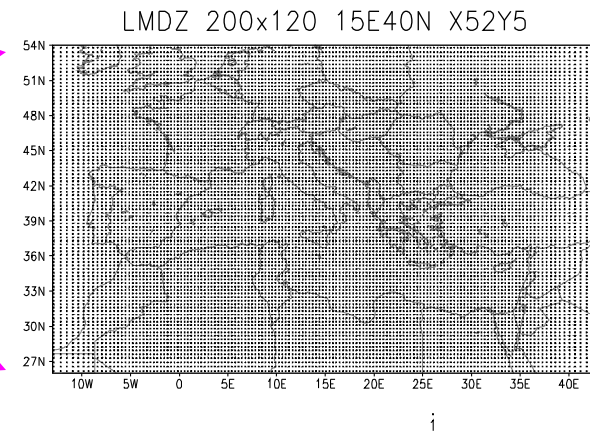
LMDZ-Mediterranean model



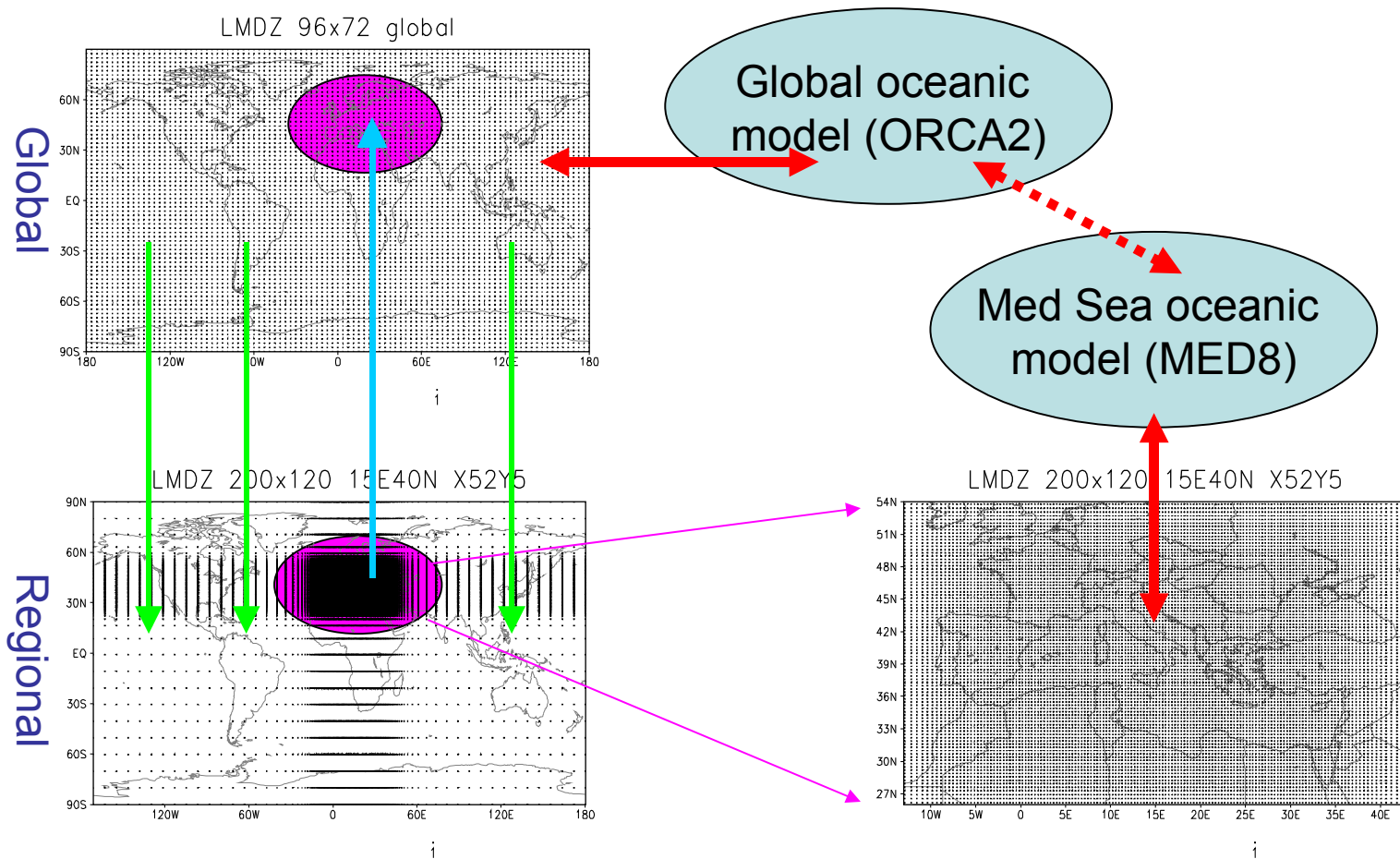
- LMDZ-Med is a global atmospheric GCM with variable grid and a zoom over the Mediterranean basin. **Local resolution: 30 km.**
- It is run as a regional climate model, with **nudging conditions** (every 6 hours) from a global model (LMDZ-g, ERA40, IPCC, etc.) at low resolution outside the zoom. The model is free to have its own behaviours inside the zoom.



Two-way (self-) nesting between LMDZ-regional and LMDZ-global



Schematic of the two-way nesting for an optimal treatment of scale interaction



Schematic of the quadruple coupling in IPSL

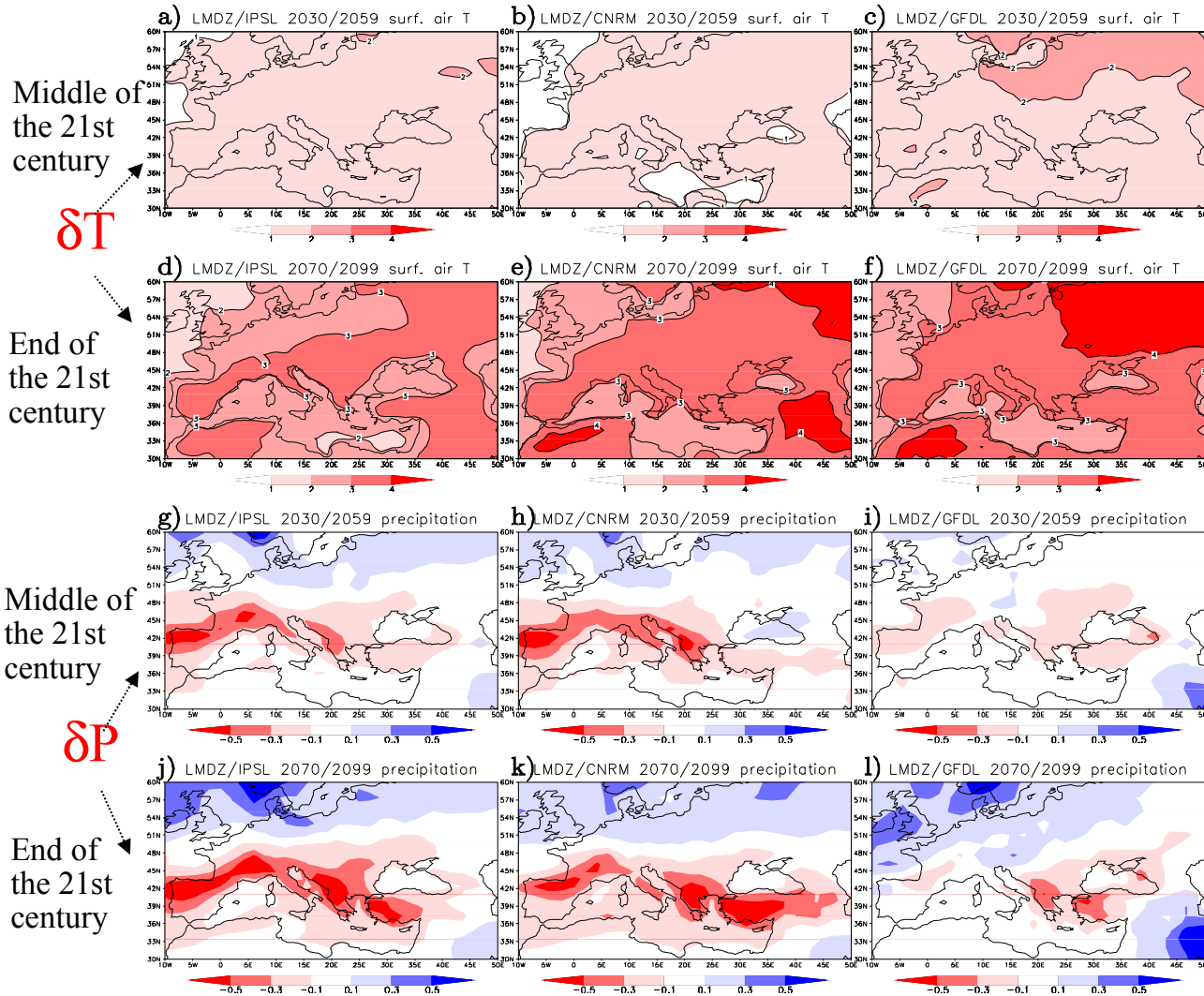
Un exemple de régionalisation en Méditerranée

IPCC-A2 scenarios regionally-enhanced with LMDZ-Med

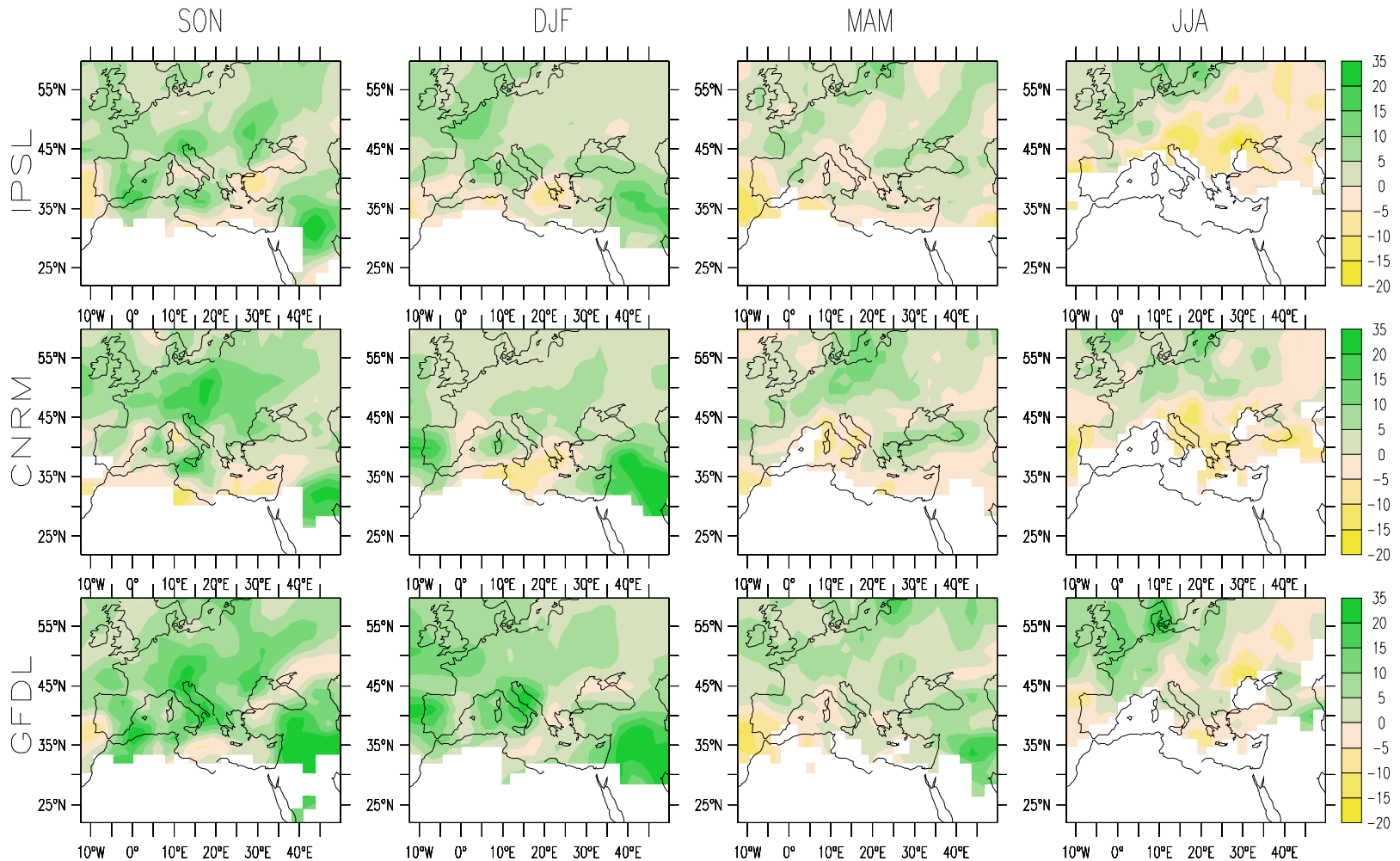
IPSL

CNRM

GFDL



Changes (2070/2099 minus present) of seasonal extreme precipitations (30-year return values, from GEV distribution). Units: mm/day

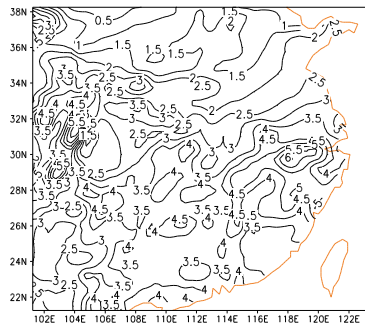
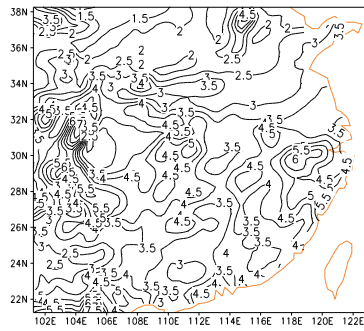
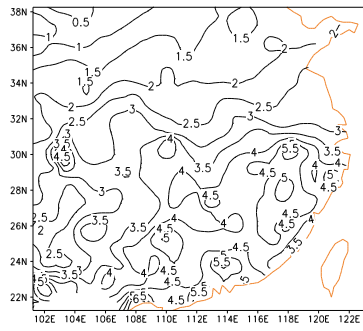


Un exemple de régionalisation en Chine

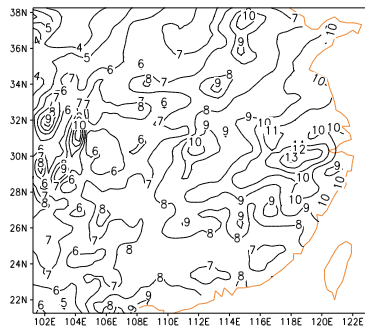
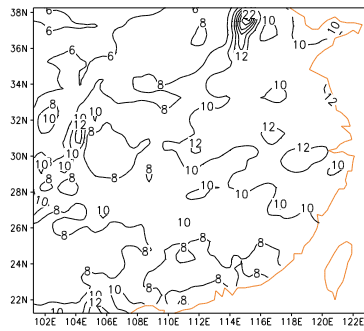
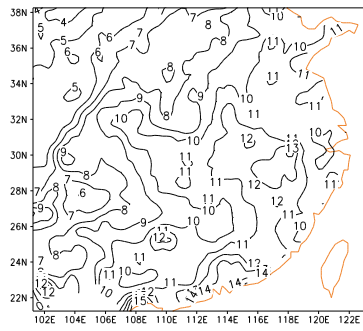
Diagnostics of Daily Temperature and Precipitation

Indices	Definition	Unit
Mean temperature (T_{av})	Average temperature on all days in a season or a year	°C
Mean precipitation (P_{av})	Average precipitation on all days in a season or a year	mm/day
Mean maximum temperature (T_{xav})	Average maximum temperature in a season or a year	°C
Mean minimum temperature (T_{nav})	Average minimum temperature in a season or a year	°C
Frost days (FD)	Total number of frost days (days with minimum temperature $< 0^{\circ}\text{C}$)	days
Heat wave duration index (HWD)	Percentile-based Heat Wave Duration, 90th percentile	days
Simple daily intensity index (SDII)	Wet-day intensity, mean precipitation on days with precipitation $\geq 1\text{mm}$	mm/day
Maximum 5-day precipitation total (R5d)	Maximum total precipitation from any consecutive 5 days	mm
Heavy rainfall proportion (R95t)	Fraction of total rainfall from events $>$ long-term 95th percentile	%

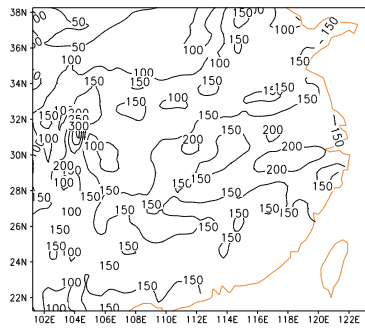
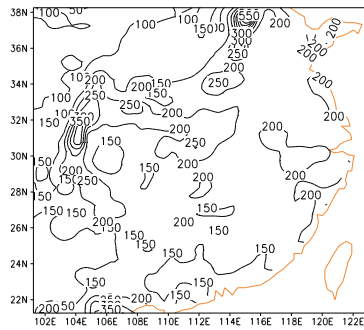
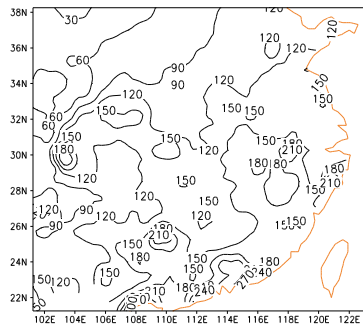
Validation of LMDZ-regional in terms of Pav, SDII and R5d



Pav



SDII



R5d

Obs

LMDZ/IPSL

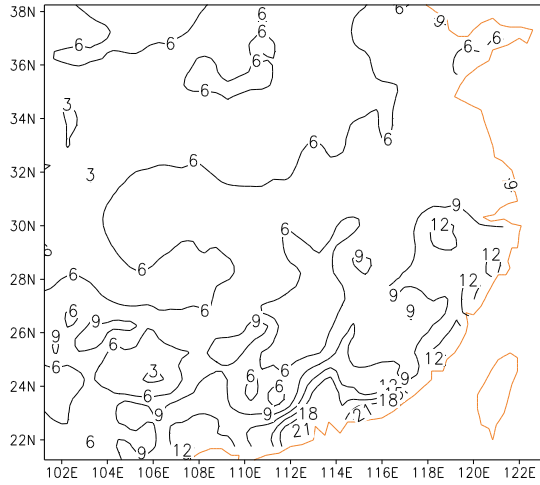
LMDZ/IPSL2

Bias of LMDZ-regional Control Simulation averaged for southeast China
(Results of two-way nesting in parenthesis)

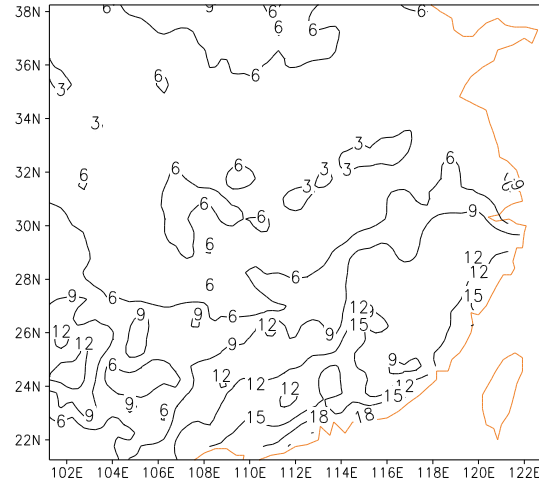
	Temperature-based (modeled – observed)					Precipitation-based (modeled – observed) / observed %			
	Tav (°C)	Tmax (°C)	Tmin (°C)	HW (days)	FD (days)	P	SDII	R5d	R95t
DJF	-4.5 (-2.6)	-4.4 (-2.5)	-5.7 (-3.7)	—	26.0 (16.6)	24.1 (43.8)	13.8 (10.7)	30.7 (44.9)	21.9 (19.6)
JJA	-1.8 (-1.0)	-2.6 (-1.4)	-1.8 (-1.2)	0.2 (0.5)	—	17.1 (-2.9)	-11.9 (-30.8)	25.3 (-13.9)	31.1 (-2.3)
Annual	-3.0 (-1.5)	-3.2 (-1.7)	-3.4 (-2.3)	0.6 (1.6)	44.5 (30)	16.9 (-0.7)	-4.0 (-17.5)	35.5 (6.8)	27.2 (9.6)

HWD (2050-2000)

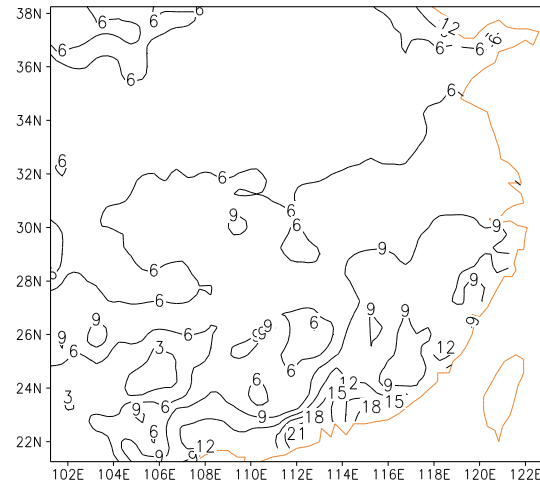
LMDZ/IPSL



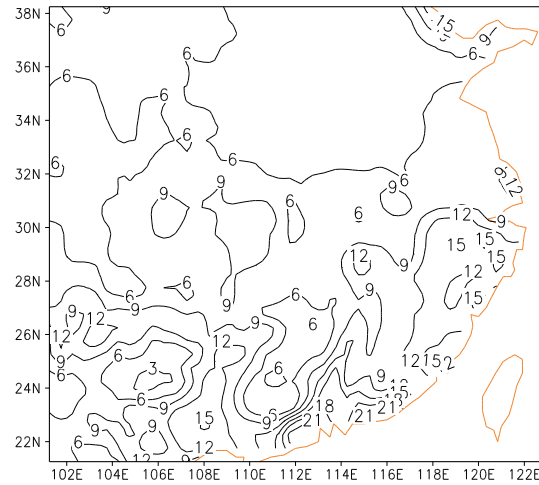
LMDZ/IPSL2



LMDZ/CNRM

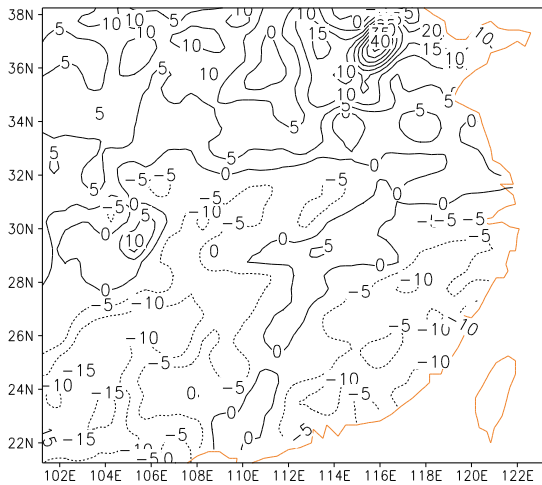


LMDZ/GFDL

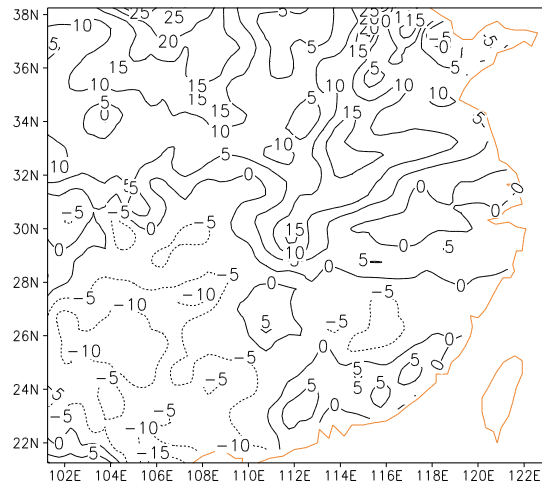


Pav (2050-2000)

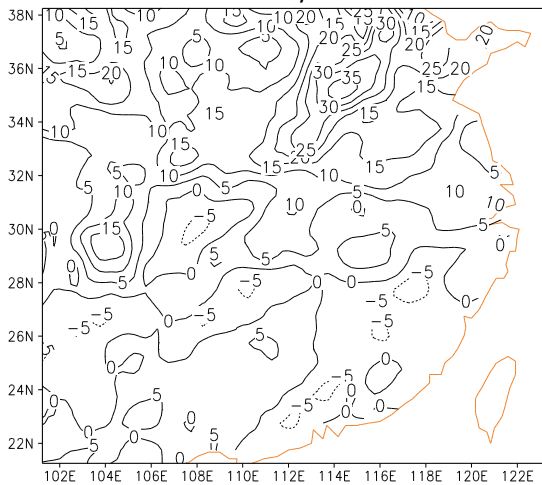
LMDZ/IPSL



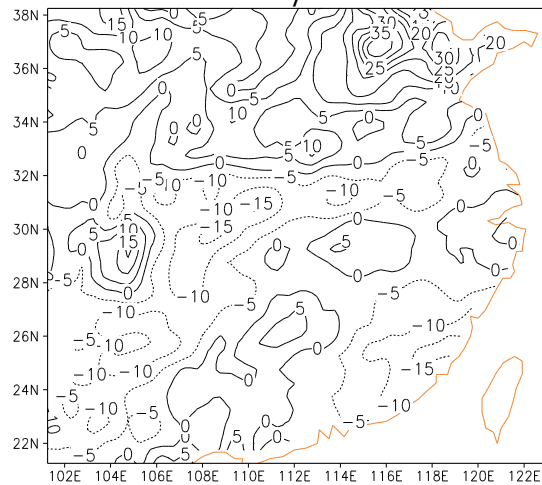
LMDZ/IPSL2



LMDZ/CNRM

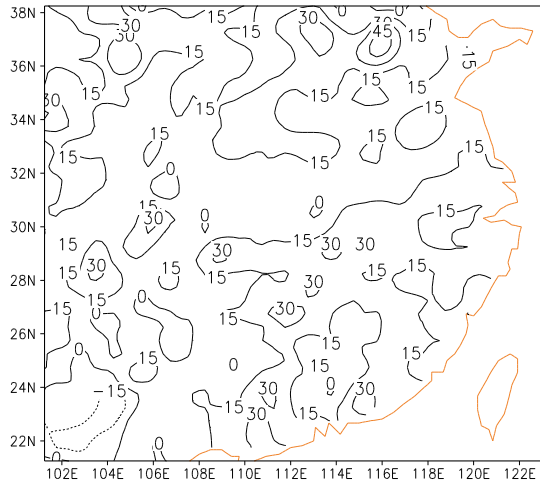


LMDZ/GFDL

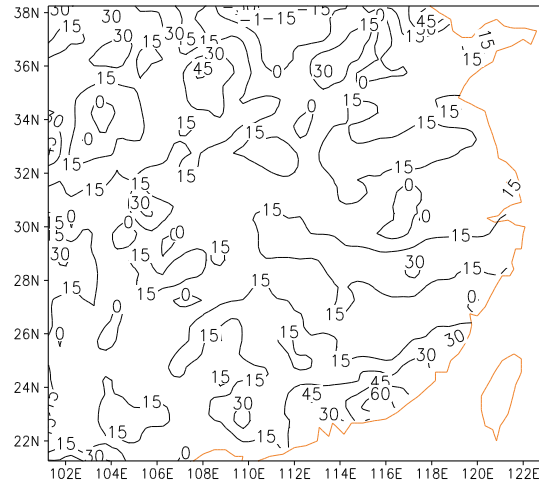


R95t (2050-2000)

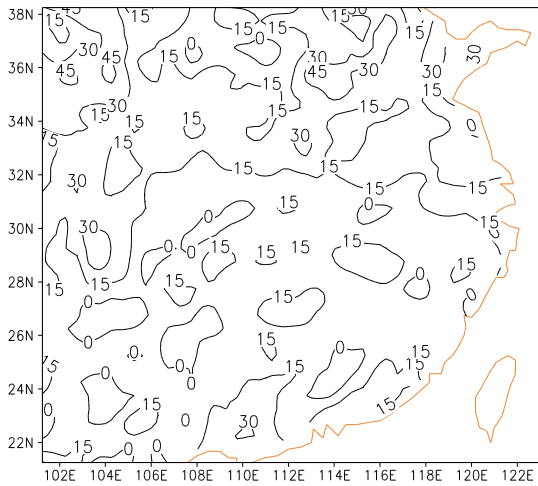
LMDZ/IPSL



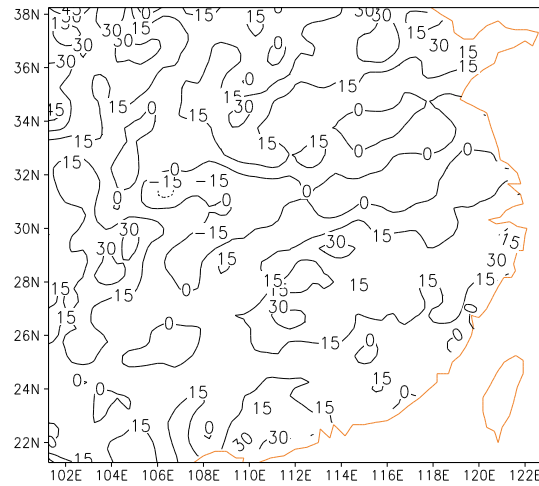
LMDZ/IPSL2



LMDZ/CNRM



LMDZ/GFDL



A réaliser pour le projet ANR-SCAMPEI

- Mettre en place un modèle à résolution de 12 km pour la France
- Simulation du climat actuel
- Simulations du climat futur (deux périodes: milieu et fin du 21^e siècle)
- Analyse des résultats en terme d'événements extrêmes (température, précipitation, vent)