

Regional climate modelling with LMDZ

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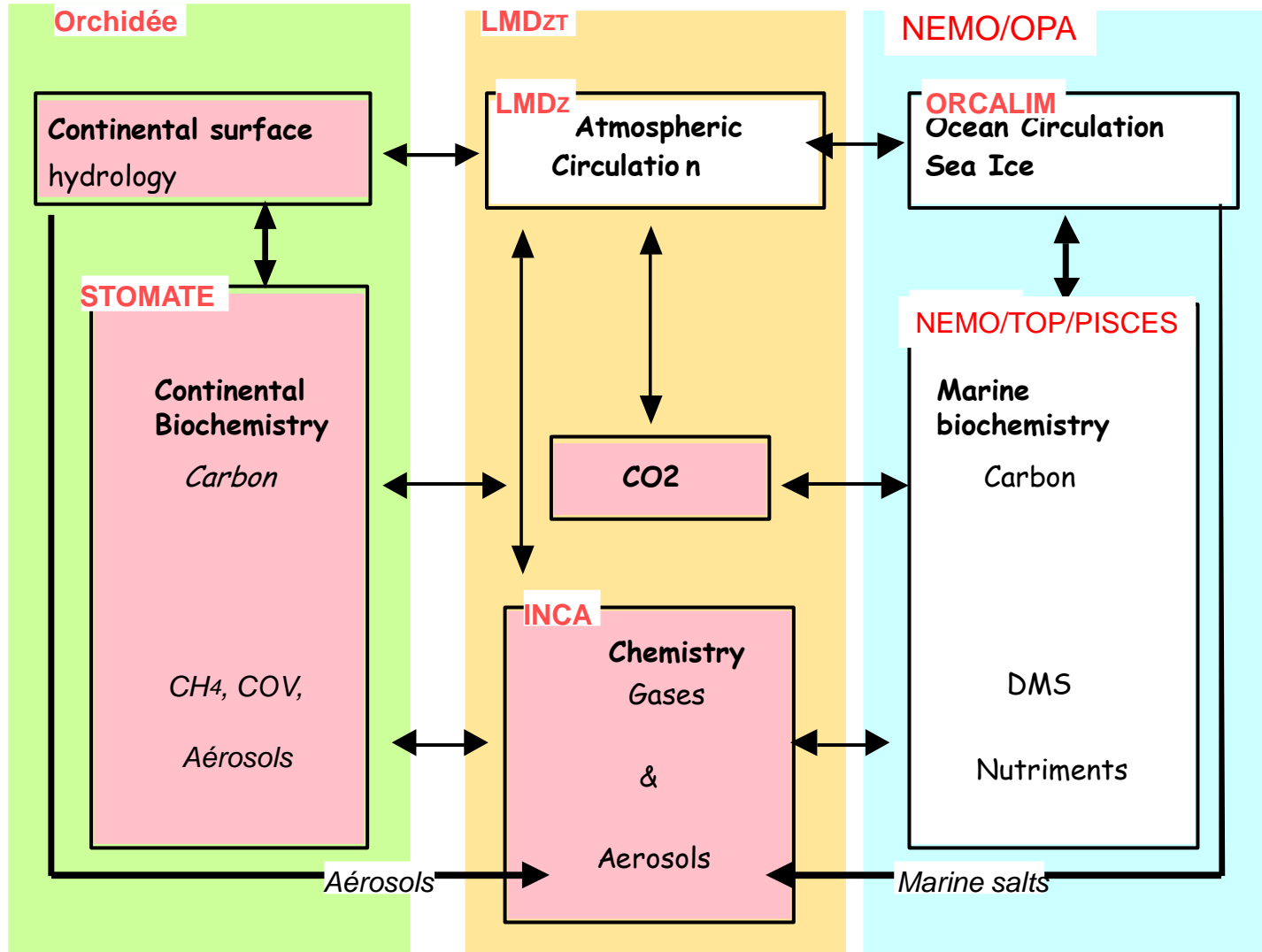
CNRS/UPMC, Paris, France

The IPSL Earth System Model

Continents

Atmosphere

Oceans

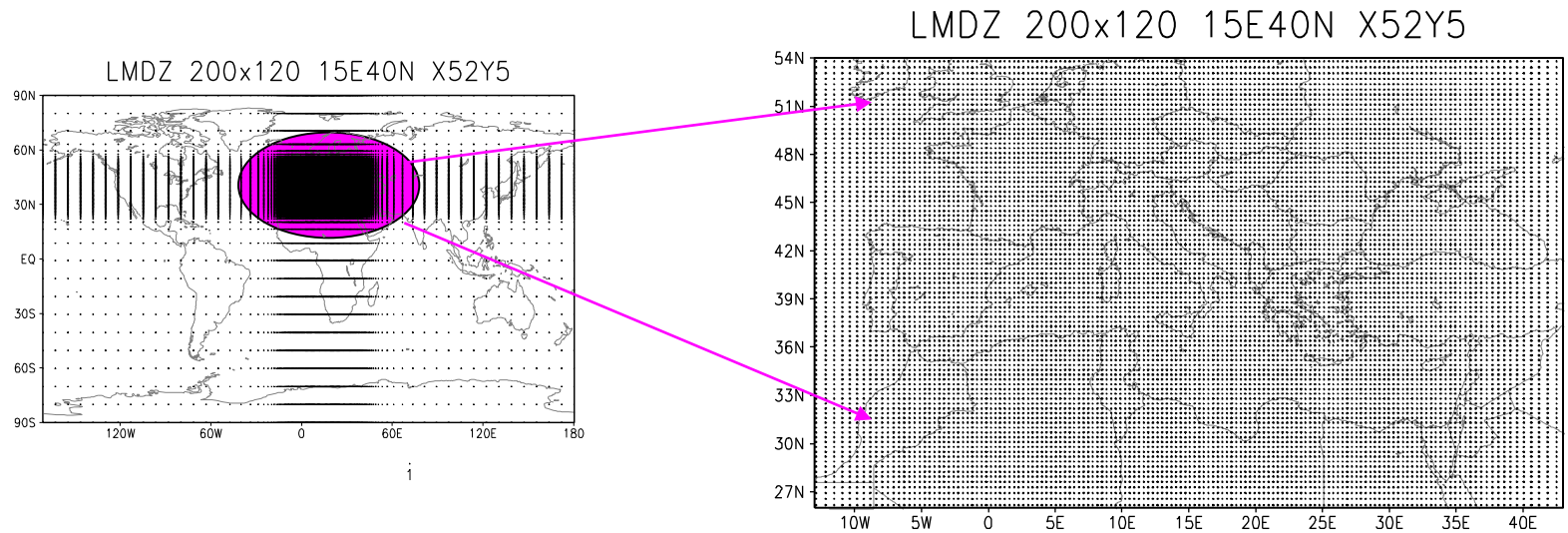


Physics

Carbon
Cycle

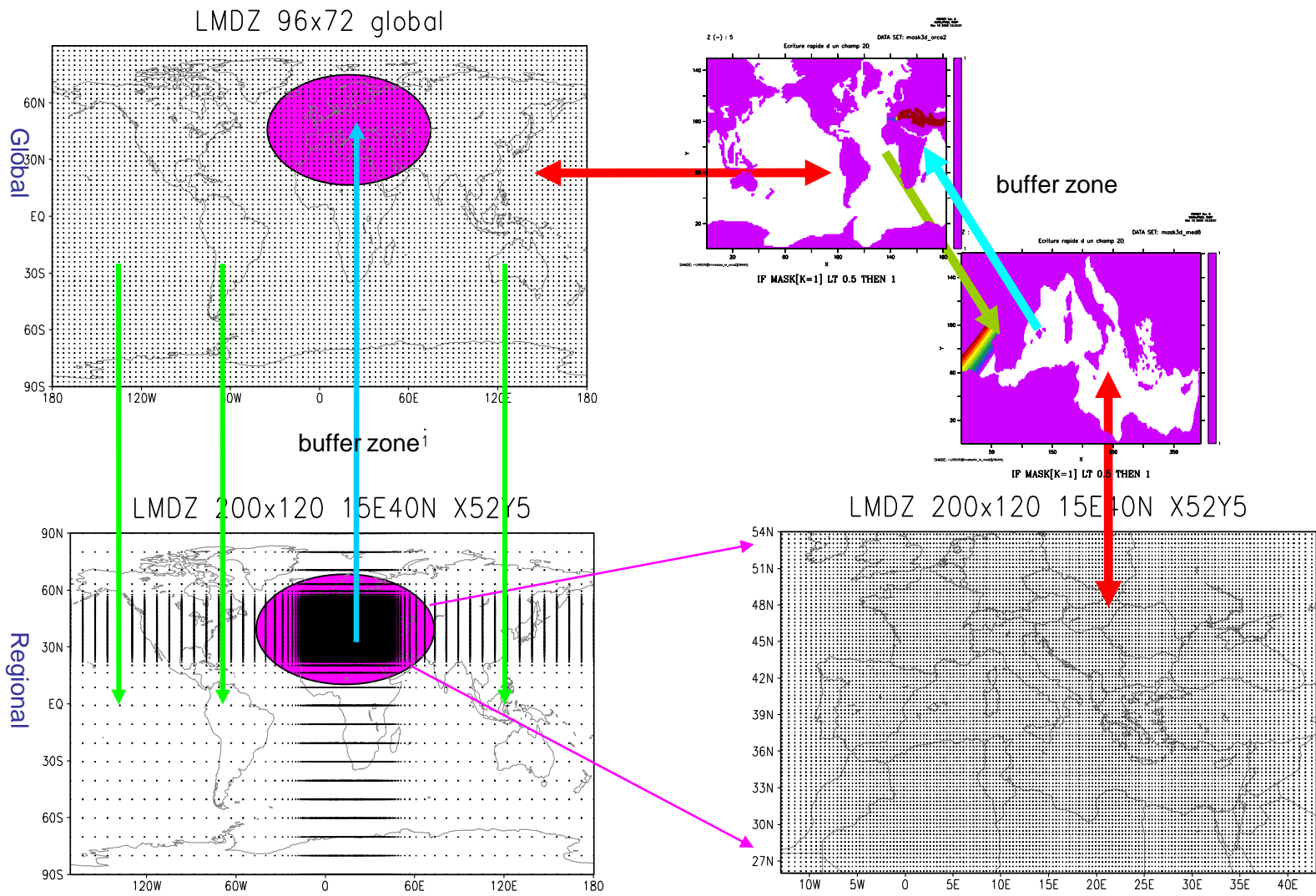
Chemistry

LMDZ-regional: Med version



- 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.

$$\frac{\partial X}{\partial t} = M(X) + \frac{X^a - X}{\tau}$$



- Global O-A coupled model: LMDZ-global / ORCA2
- Regional O-A coupled model: LMDZ-regional / MED8

- Two atmospheric models are coupled through buffer zones
- Two oceanic models are also coupled through buffer zones

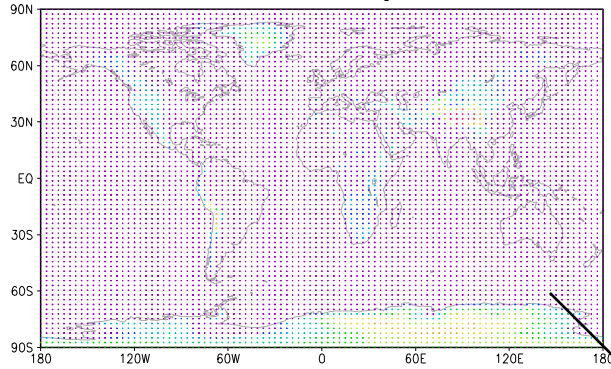
Schematic of the quadruple coupling in IPSL: M4

A downscaling study for France:

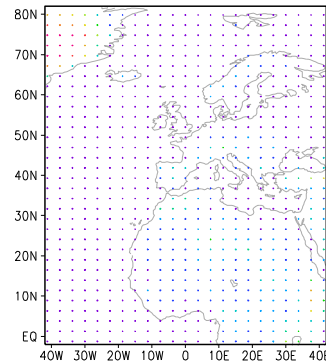
- Three versions: Global / Europe / France
- Two-way nesting between Global/Europe
- One-way nesting from Europe to France

LMDZ grid schemes for the whole earth (left), for Europe (middle) and for France (right) in three versions

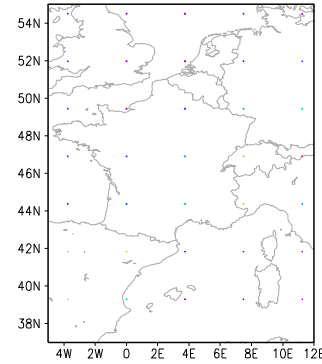
LMDZ 96x72 globe



LMDZ 96x72 globe

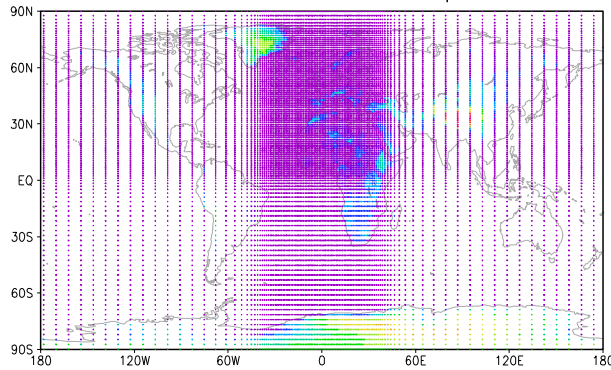


LMDZ 96x72 globe

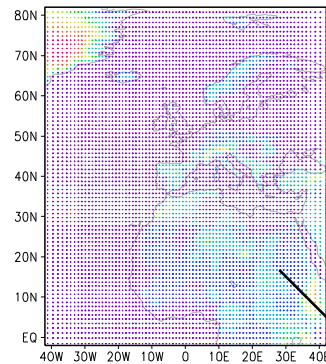


LMDZ Globe
(300 km)

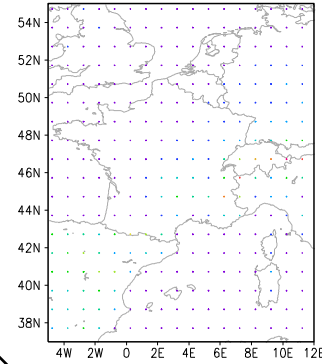
LMDZ 120x120 europe



LMDZ 120x120 europe

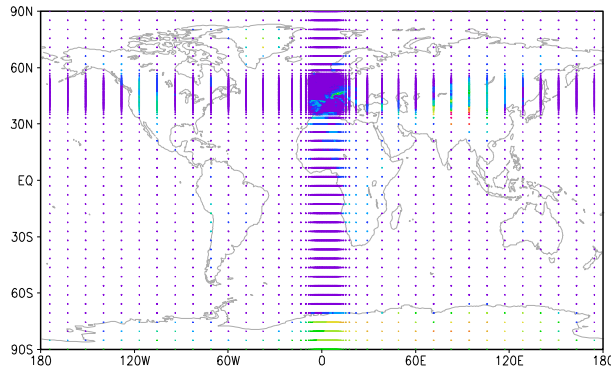


LMDZ 120x120 europe

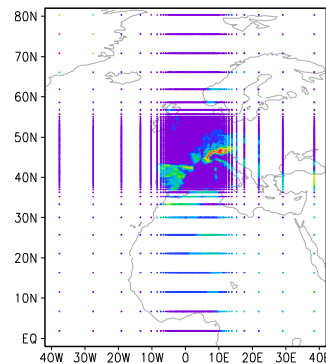


LMDZ Europe
(100 km)

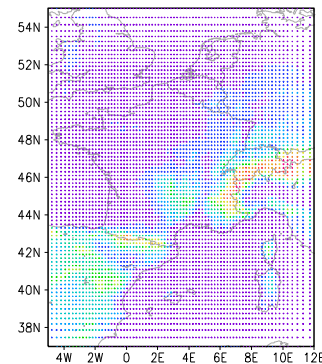
LMDZ 120x120 france



LMDZ 120x120 france



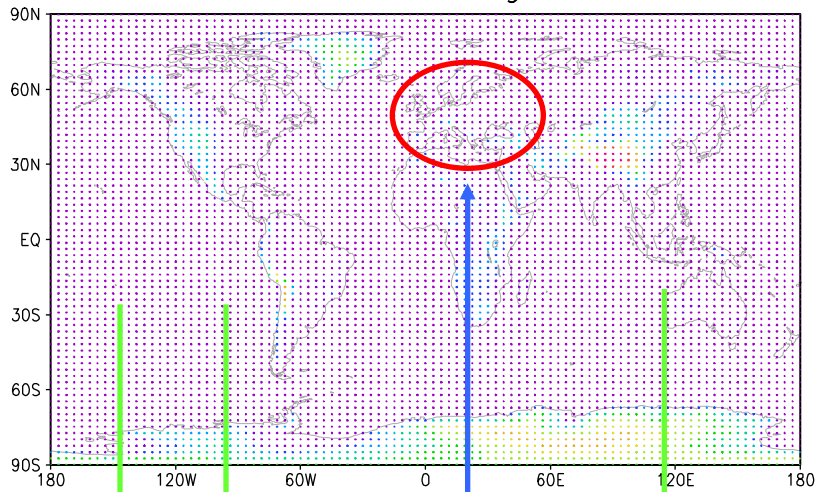
LMDZ 120x120 france



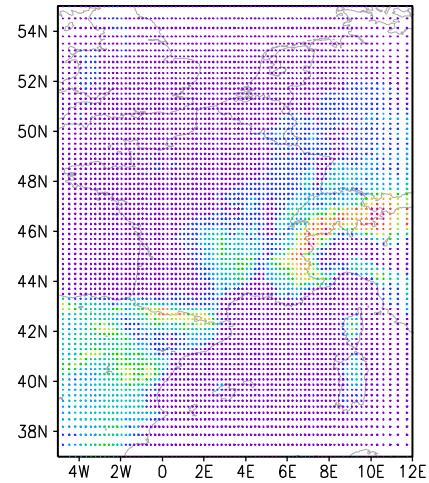
LMDZ France
(20 km)

Two-way nesting between LMDZ-regional and LMDZ-global

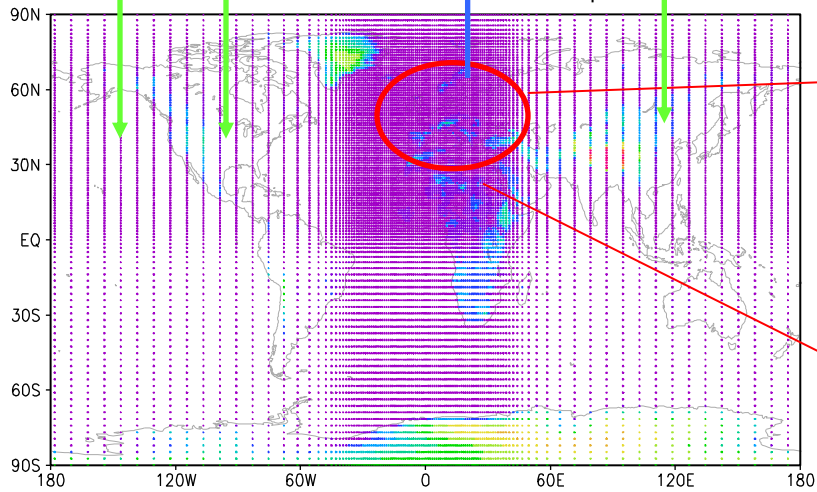
LMDZ 96x72 globe



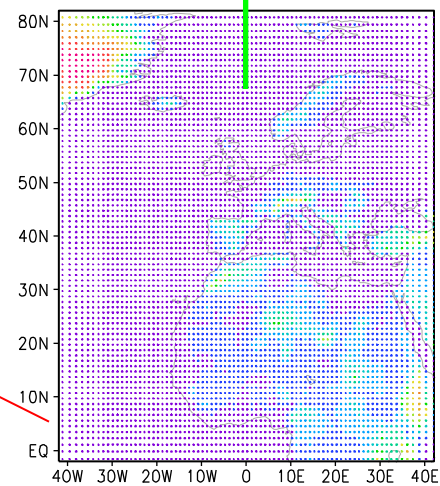
LMDZ 120x120 france



LMDZ 120x120 europe



LMDZ 120x120 europe

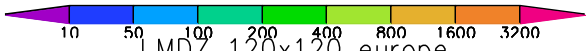
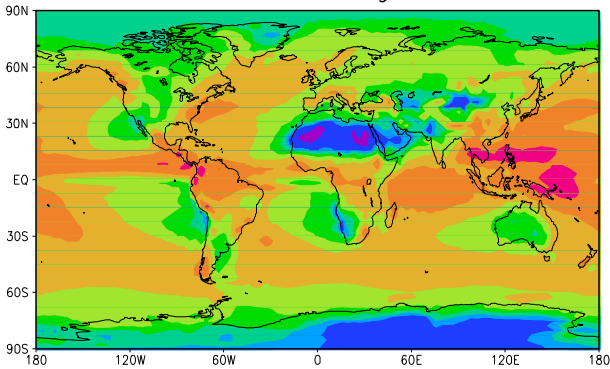


i

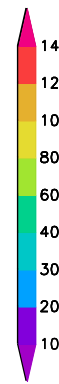
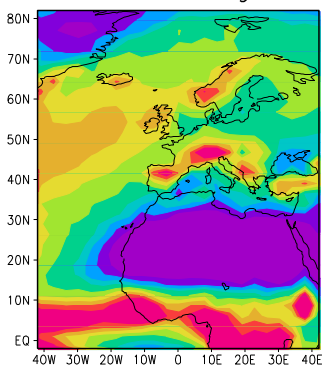
i

Annual-mean precipitation (mm) in three LMDZ models: Globe (top), Europe (middle) and France (bottom)

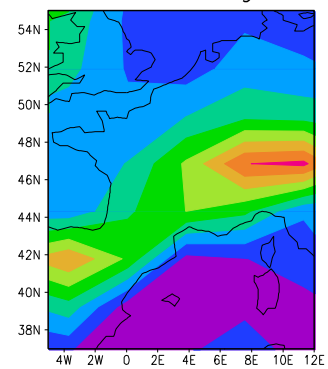
LMDZ 96x72 globe



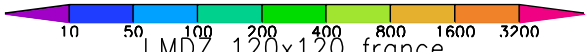
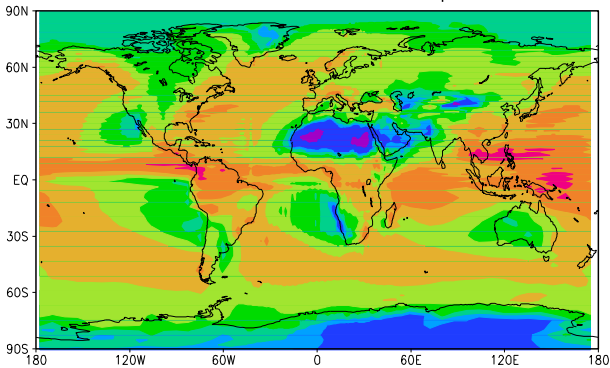
LMDZ 96x72 globe



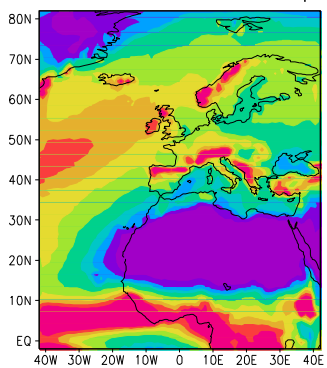
LMDZ 96x72 globe



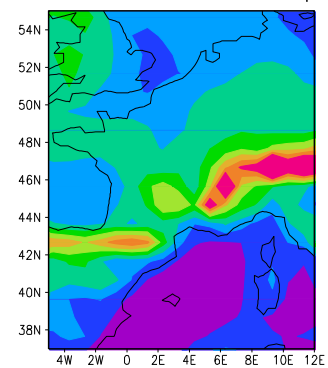
LMDZ 120x120 europe



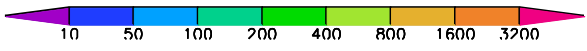
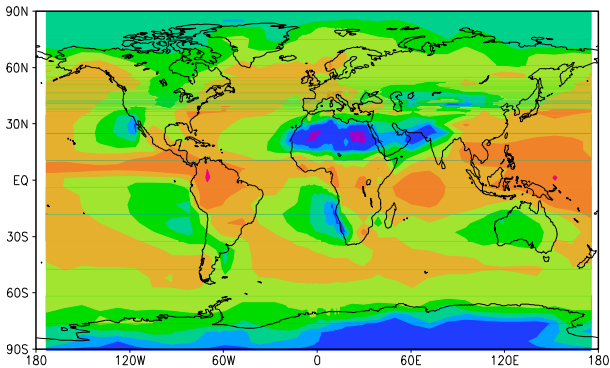
LMDZ 120x120 europe



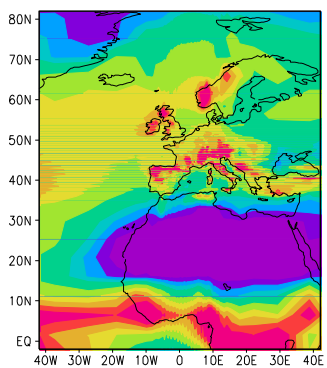
LMDZ 120x120 europe



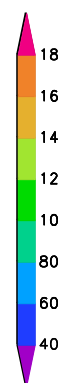
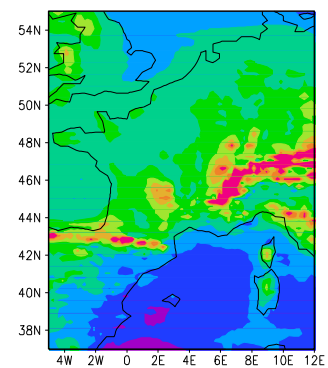
LMDZ 120x120 france



LMDZ 120x120 france



LMDZ 120x120 france



Pr (mm/jour), Tx(° C) et Tn (° C) pour un niveau de retour à 50 ans, à Marseille, observation et trois résolutions du LMDZ

Pr	Obs	300km	100km	20km
1961/1990	145	43	42	62
2021/2050	?	38	56	93

Tx	Obs	300km	100km	20km
1961/1990	38.9	32.2	34.7	35.6
2021/2050	?	36.0	36.9	37.5

Tn	Obs	300km	100km	20km
1961/1990	26.2	21.7	24.8	25.6
2021/2050	?	24.0	27.0	27.8

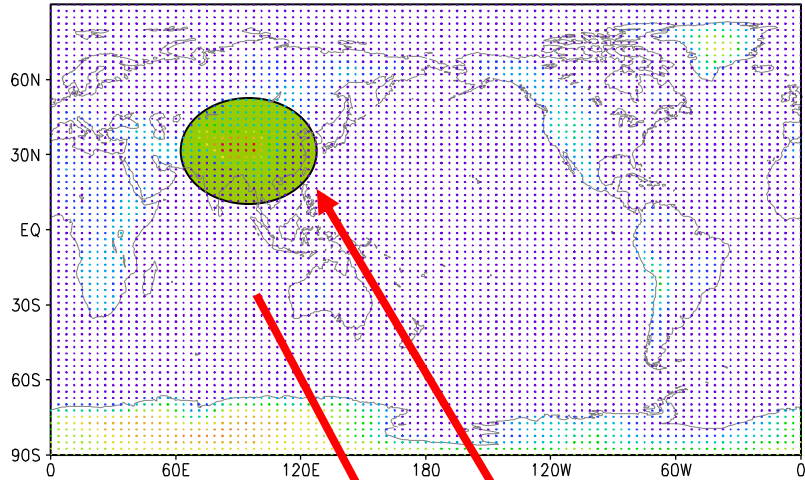
Pr: précipitations intenses

Tx: température maxi de jour

Tn: température de nuit chaude

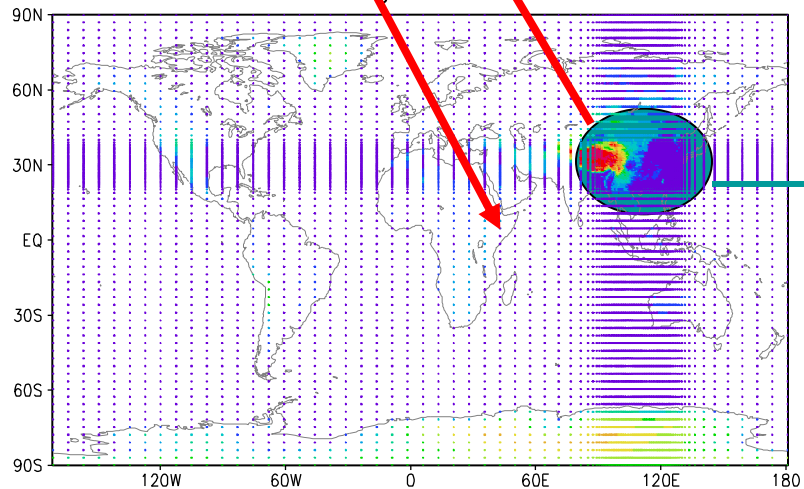
Two-way nesting between LMDZ-regional and LMDZ-global

LMDZ-global 96x72

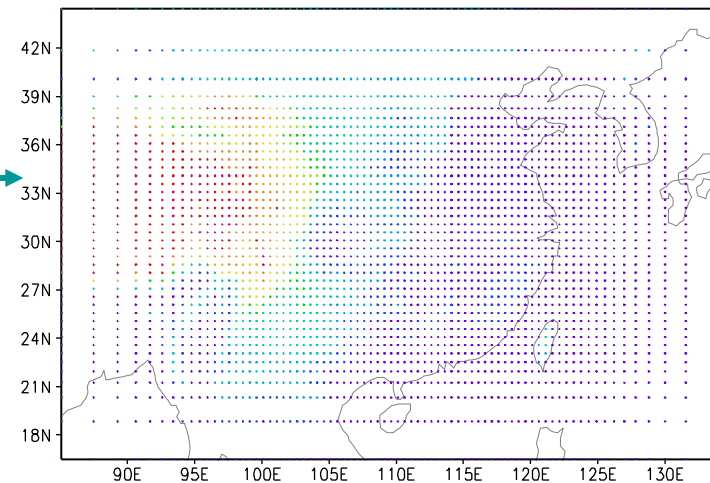


**LMDZ two-way nesting
(eastern China version)**

LMDZ-regional 120x90

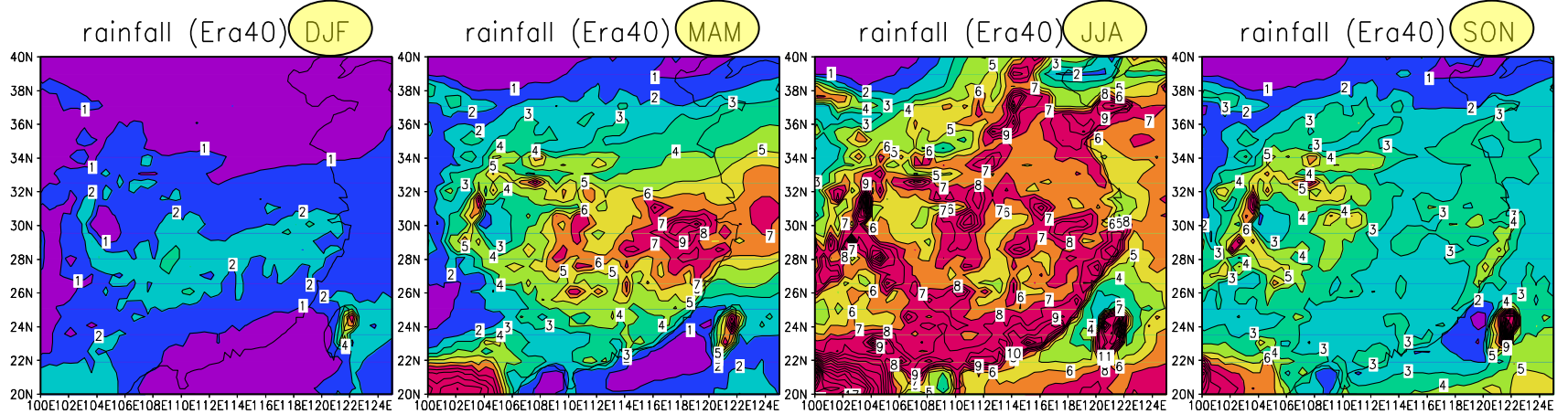
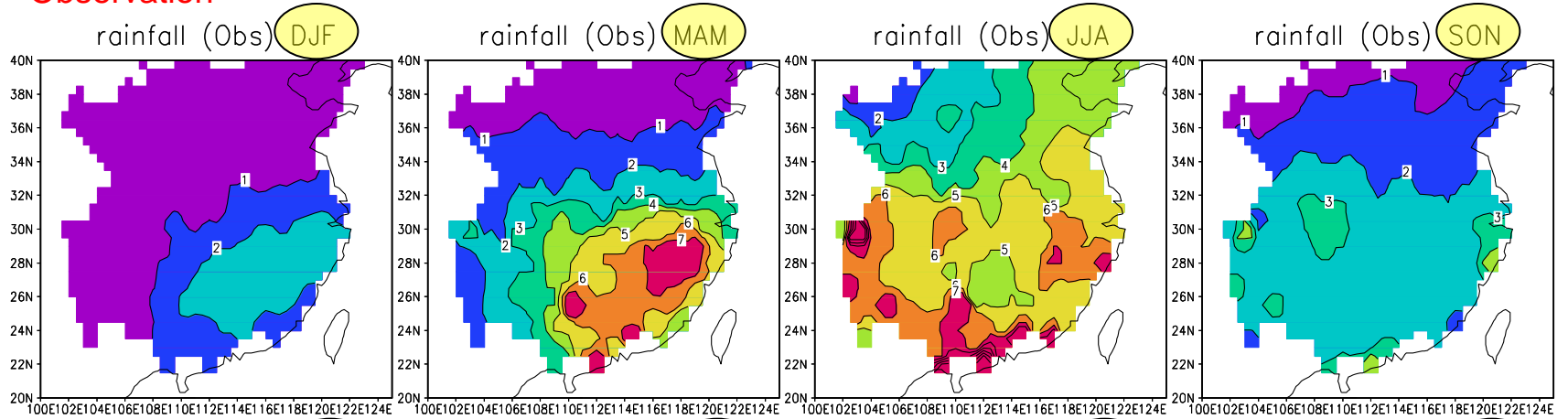


LMDZ-regional 120x90



Comparison of climatological rainfall (mm/day) DJF/MAM/JJA/SON

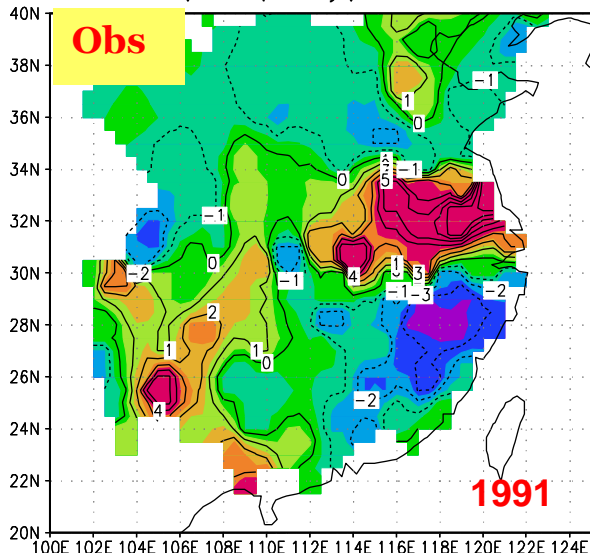
Observation



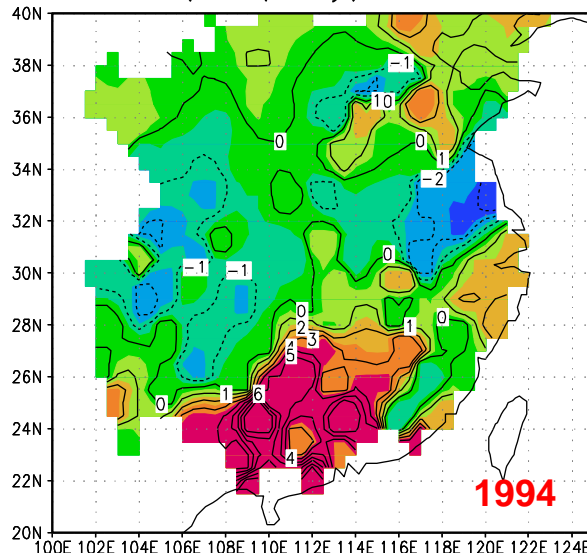
LMDZ-ERA40

Three flooding summer seasons in China: rainfall anomaly

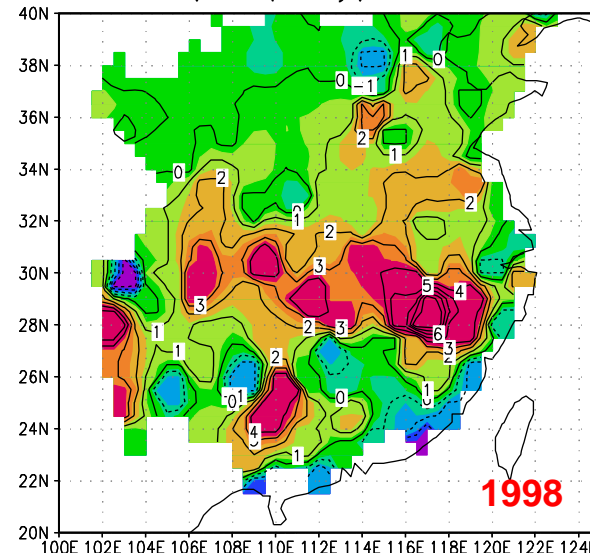
Obs (mm/day) JJA 1991



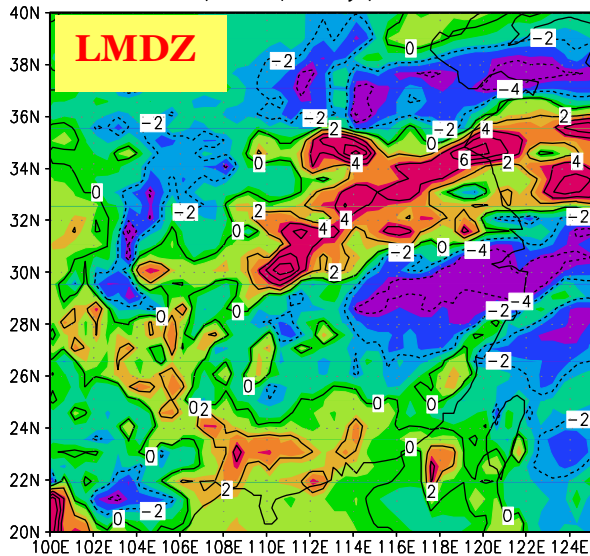
Obs (mm/day) JJA 1994



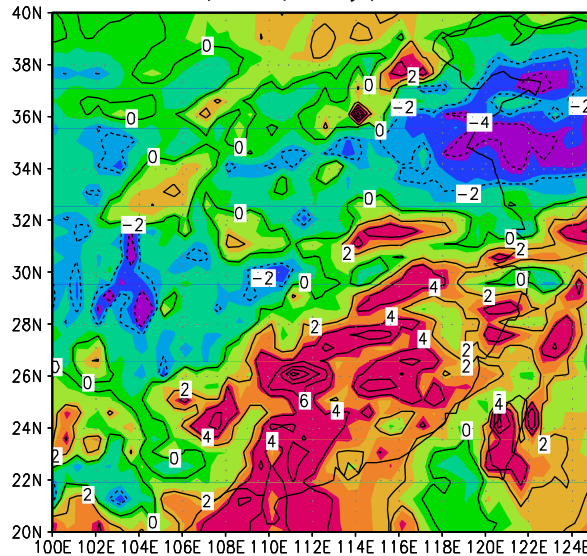
Obs (mm/day) JJA 1998



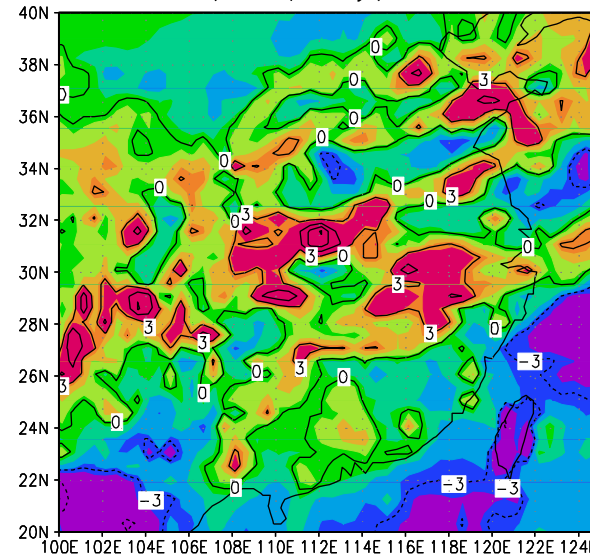
Era40 (mm/day) JJA 1991



Era40 (mm/day) JJA 1994

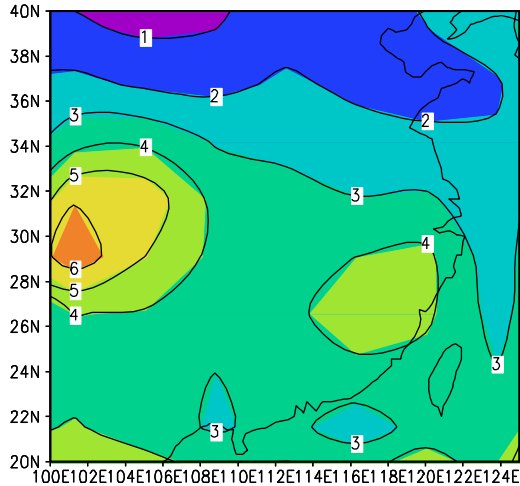


Era40 (mm/day) JJA 1998



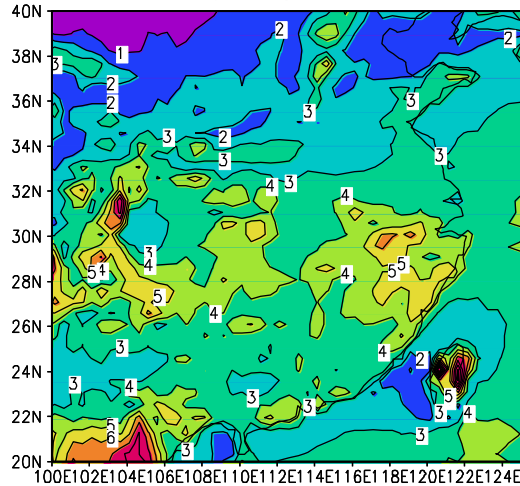
Annual-mean rainfall (mm/d) (top), and its future variation (bottom: 2050-2000)

rainfall (scenario000) YEAR



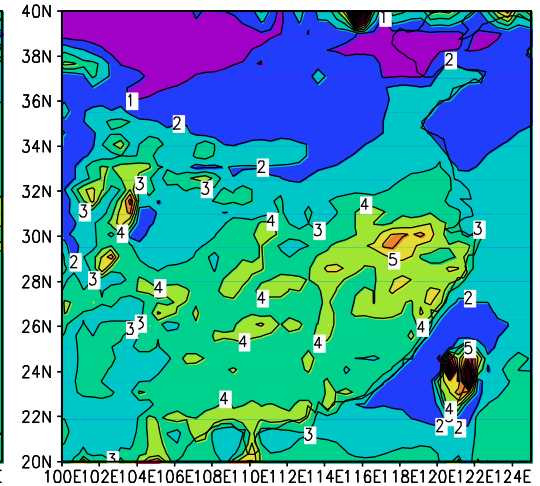
LMDZ-global

rainfall (yangzi000) YEAR



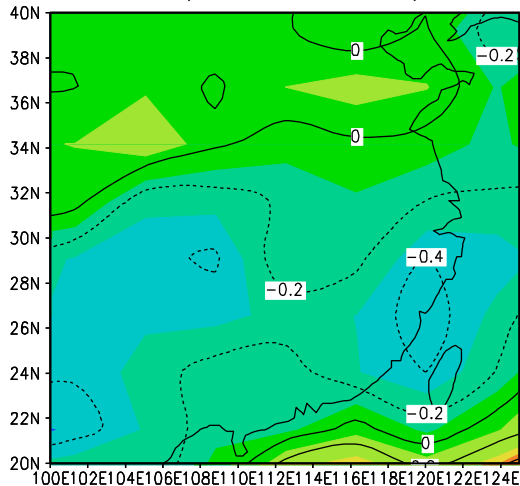
LMDZ-regional

rainfall(sn1yangzi000)YEAR

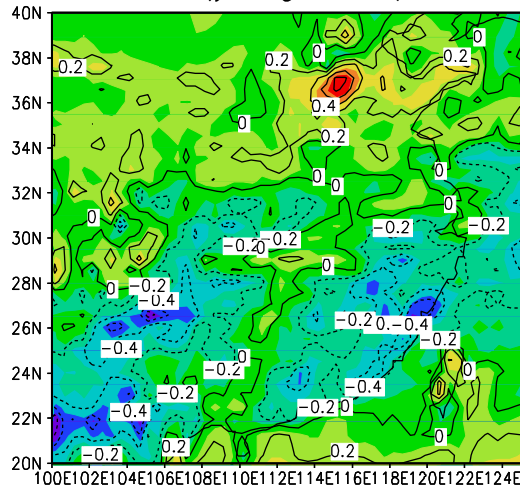


LMDZ-sn

rainfall (scenario101) YEAR



rainfall (yangzi101) YEAR



rainfall(sn1yangzi101)YEAR

