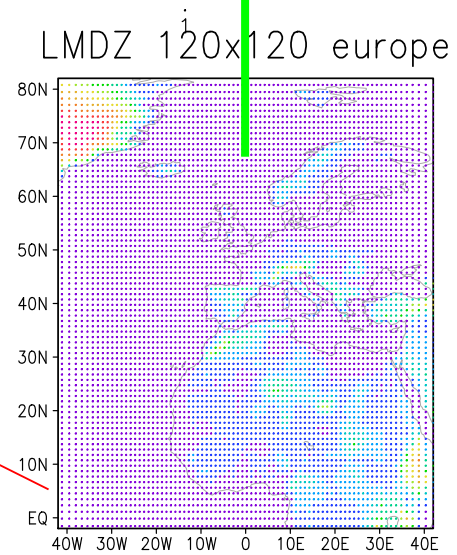
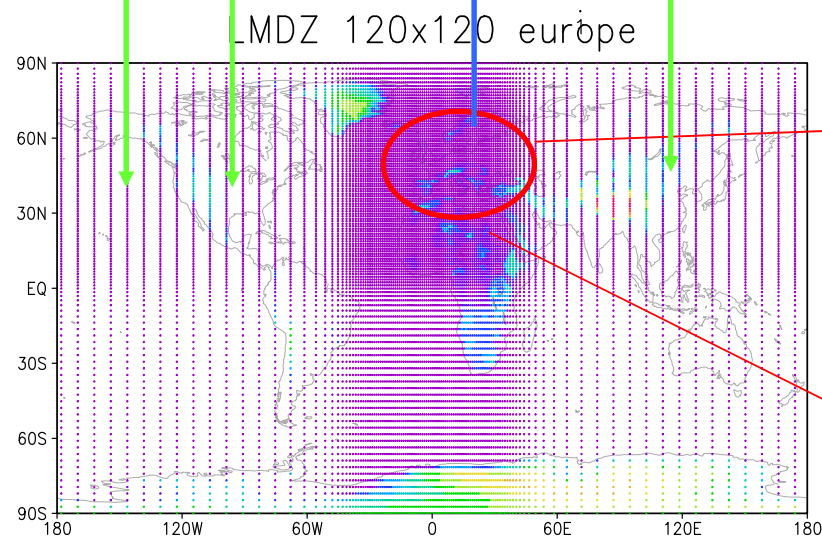
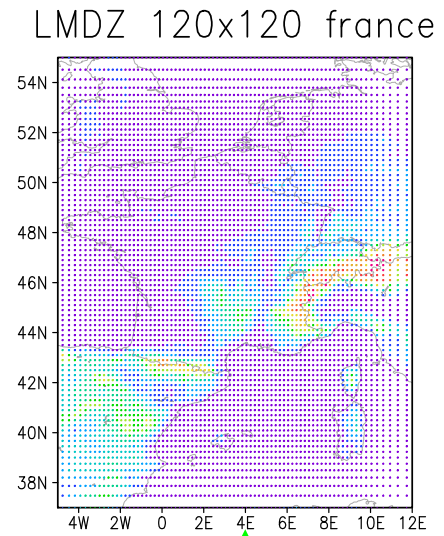
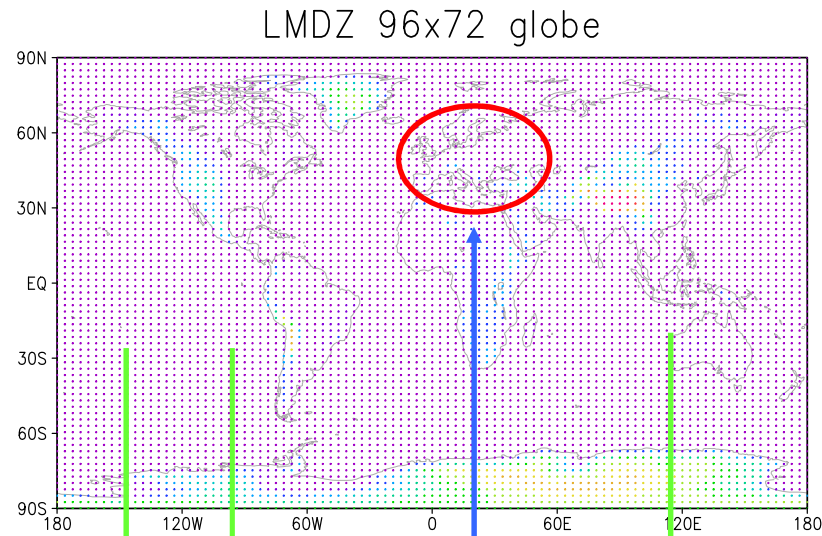


Two schemes are possible for climate downscaling:

Use global coupled model output to guide the regional model. No correction can be performed. One may suffer from drifts of the global model, in comparison to observed climate.

Run the atmospheric component of the global coupled model and use then the output to guide the regional model. One can use observed SST to run control simulation (so more realistic), and differential SST for climate-change simulation. This scheme can be run in Two-way nesting.

Scheme of three models running coupled

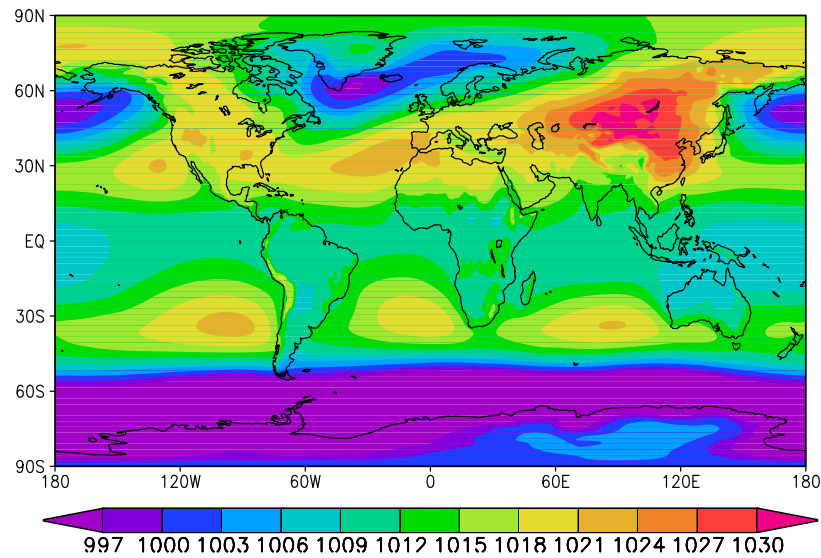


Model validation.

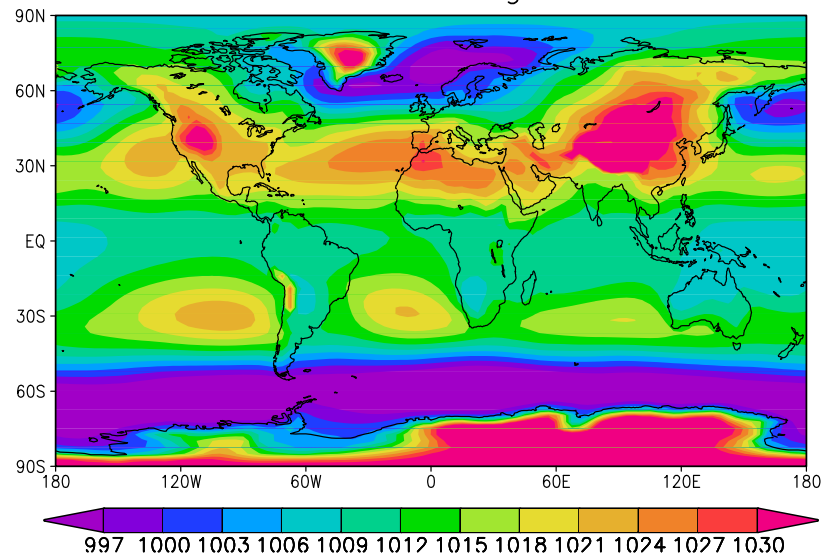
Improvement of simulated climate with corrected SST

DJF SLP

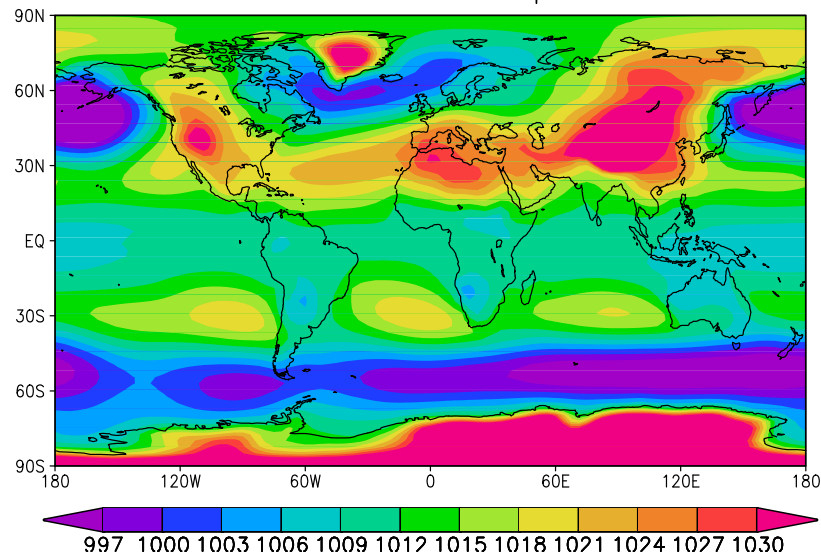
ERA-I 480x240



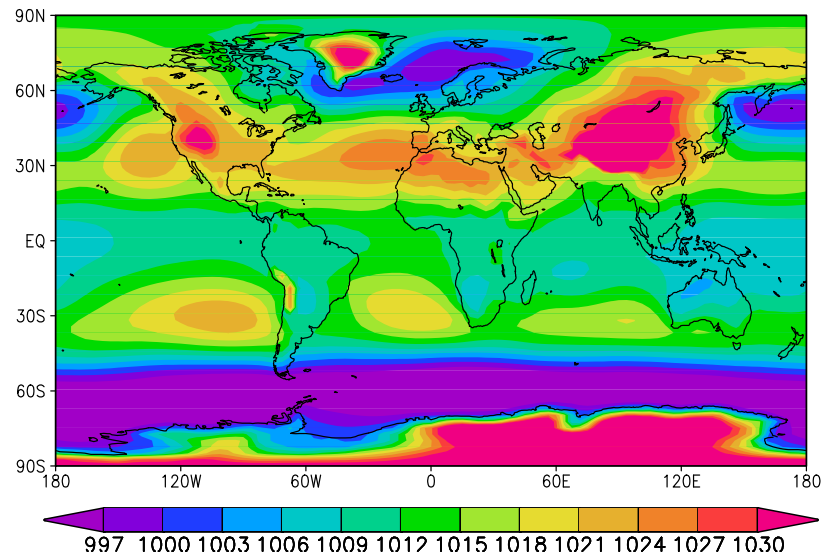
LMDZ 96x72 global



LMDZ 96x72 ipsl

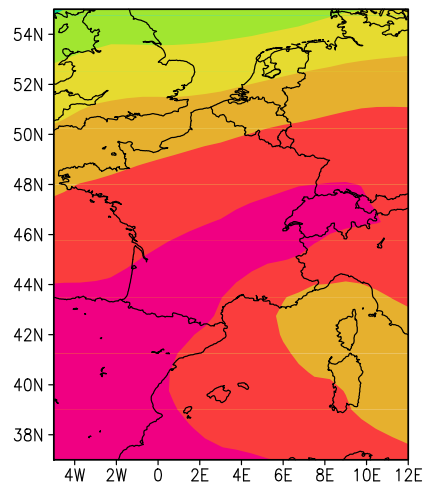


LMDZ 120x120 master

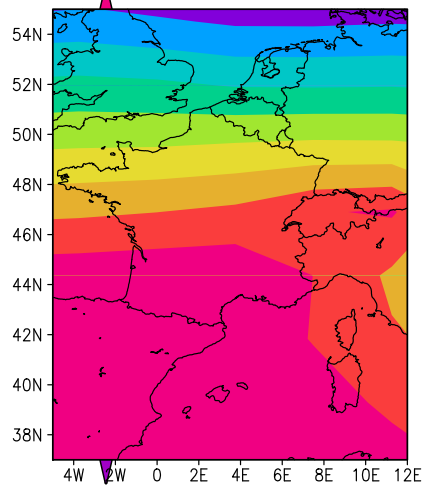


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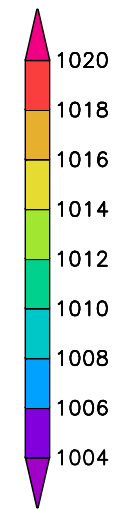
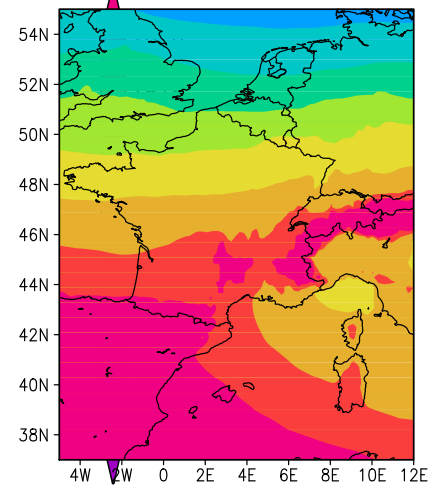
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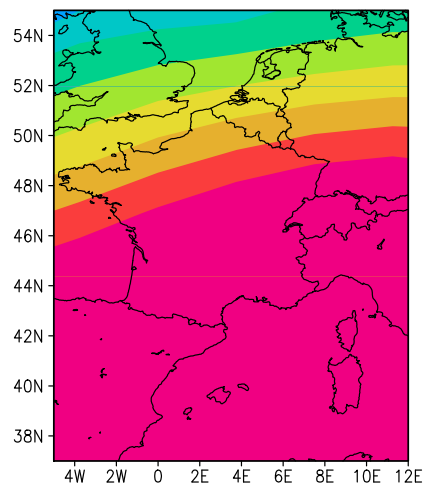
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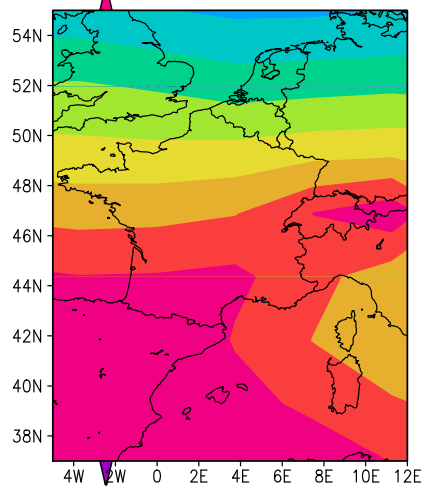
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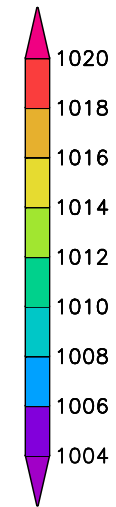
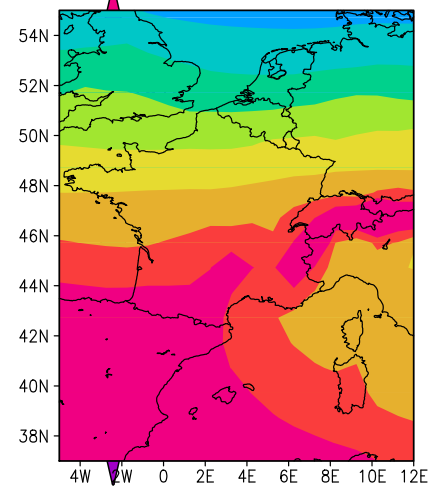
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LMDZ 96x72 master

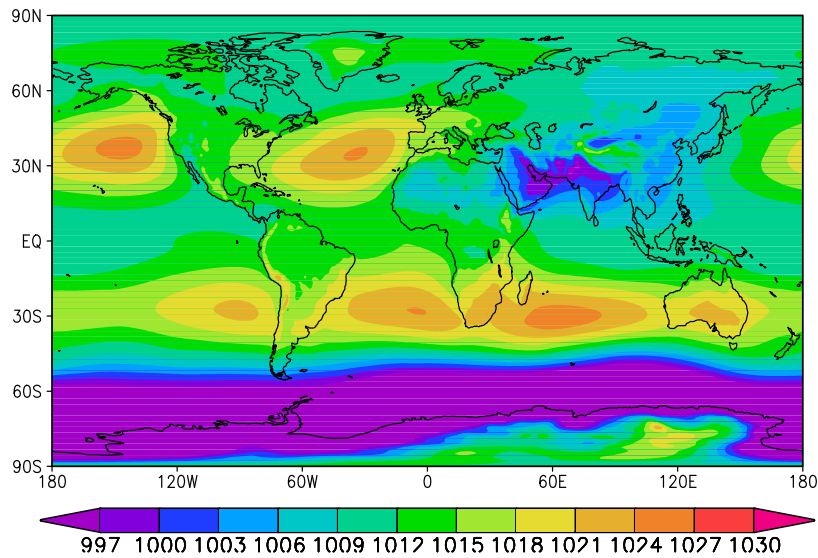


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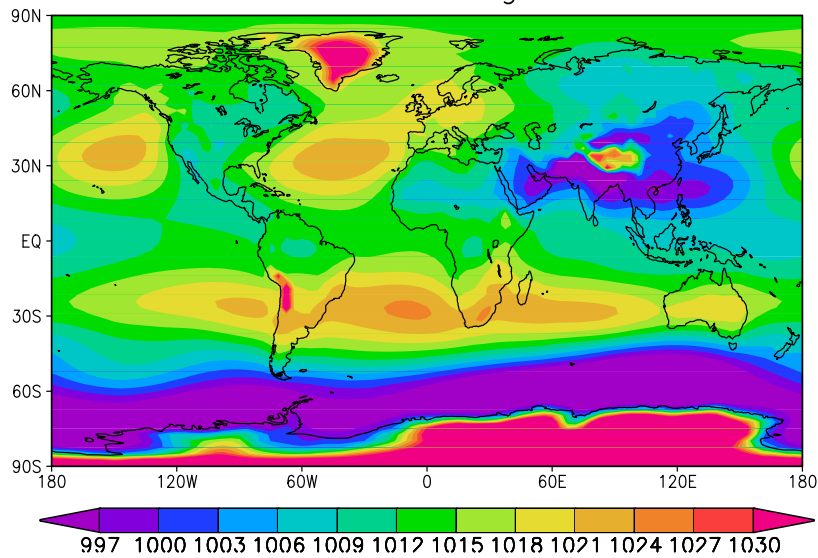


JJA SLP

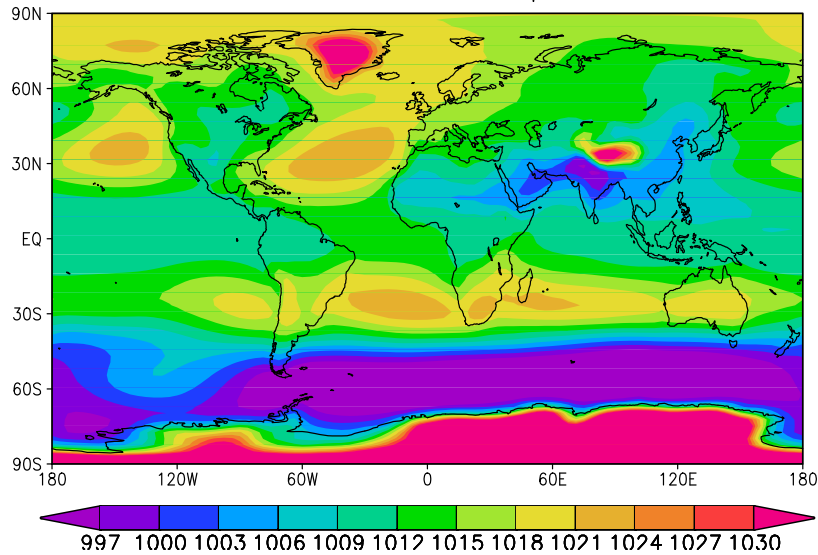
ERA-I 480x240



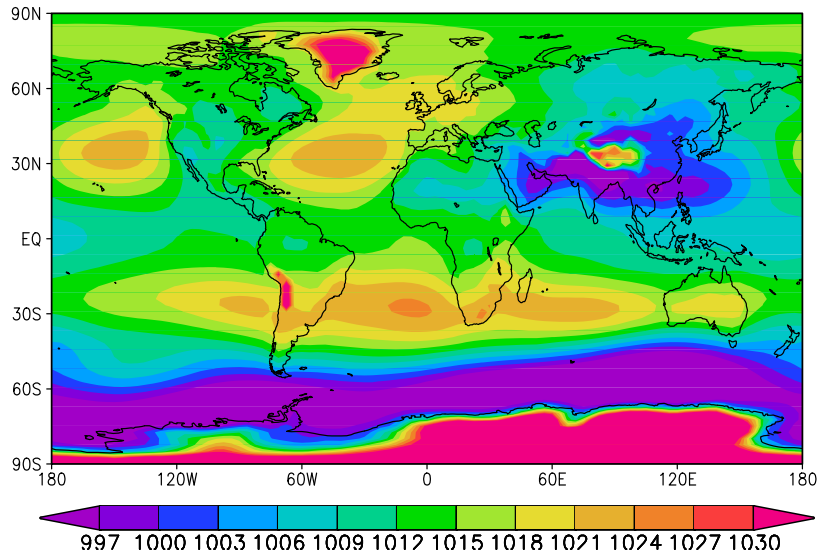
LMDZ 96x72 global



LMDZ 96x72 ipsl

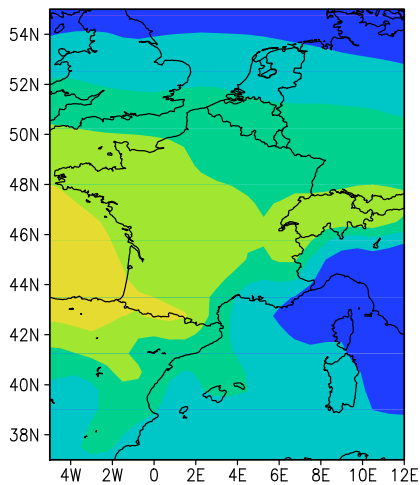


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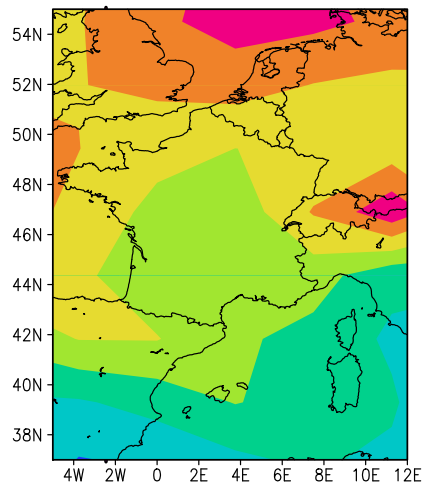


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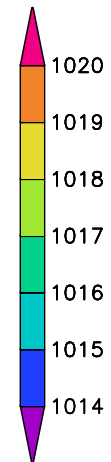
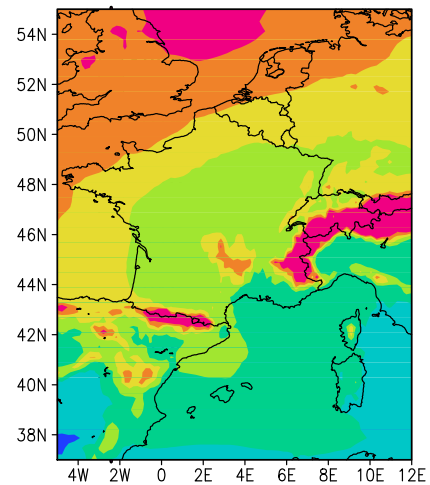
ERA-I 480x240



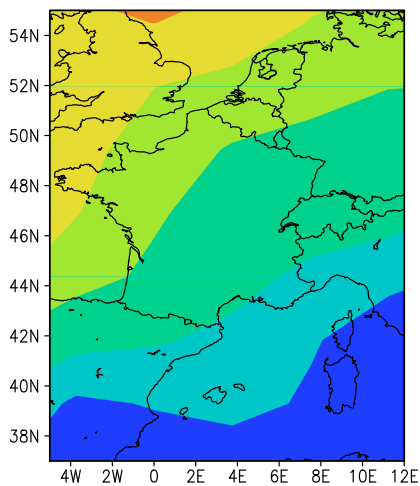
LMDZ 96x72 global



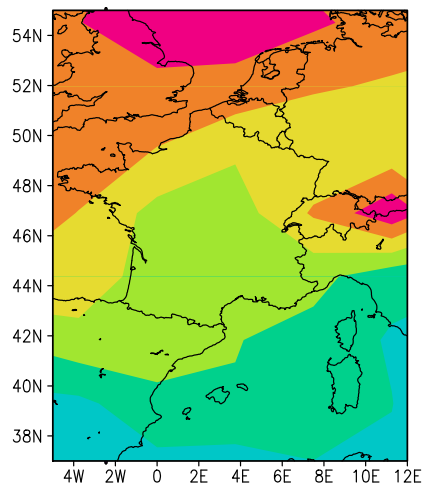
LMDZ 120x120 france



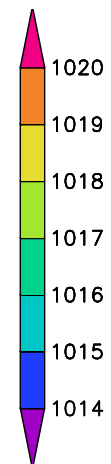
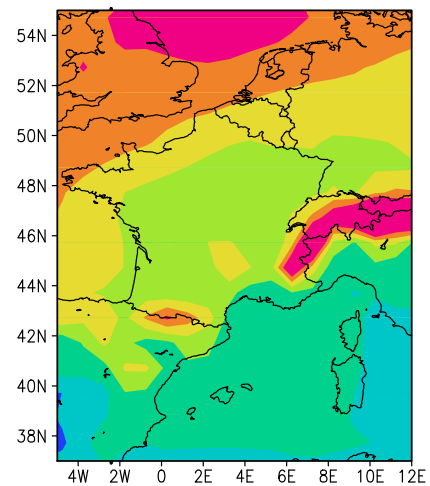
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LMDZ 96x72 master

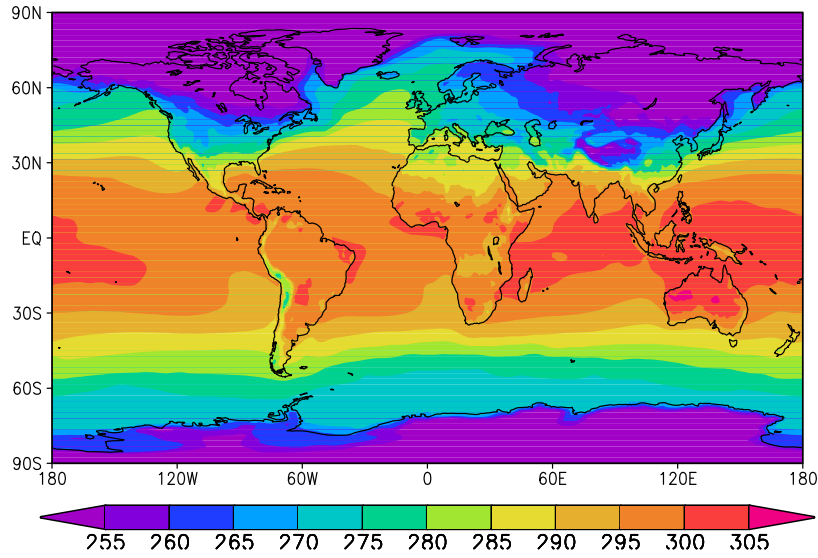


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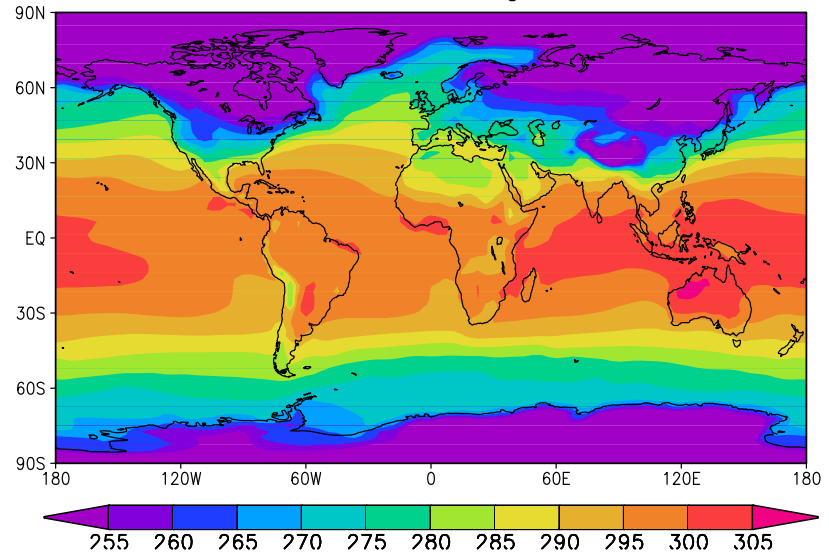


DJF T2m

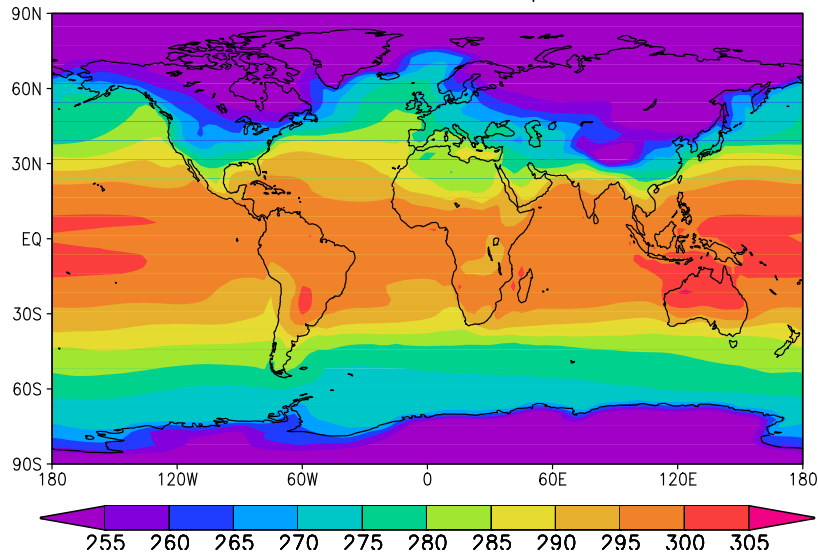
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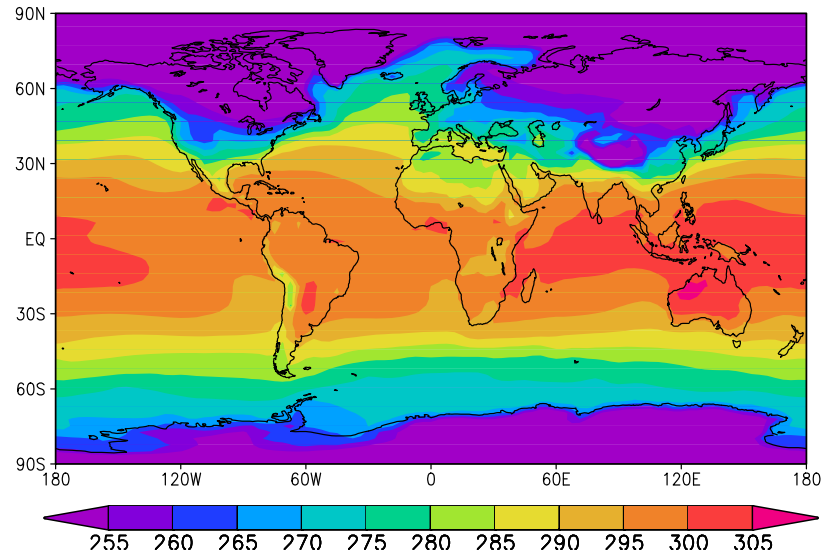
LMDZ 96x72 global



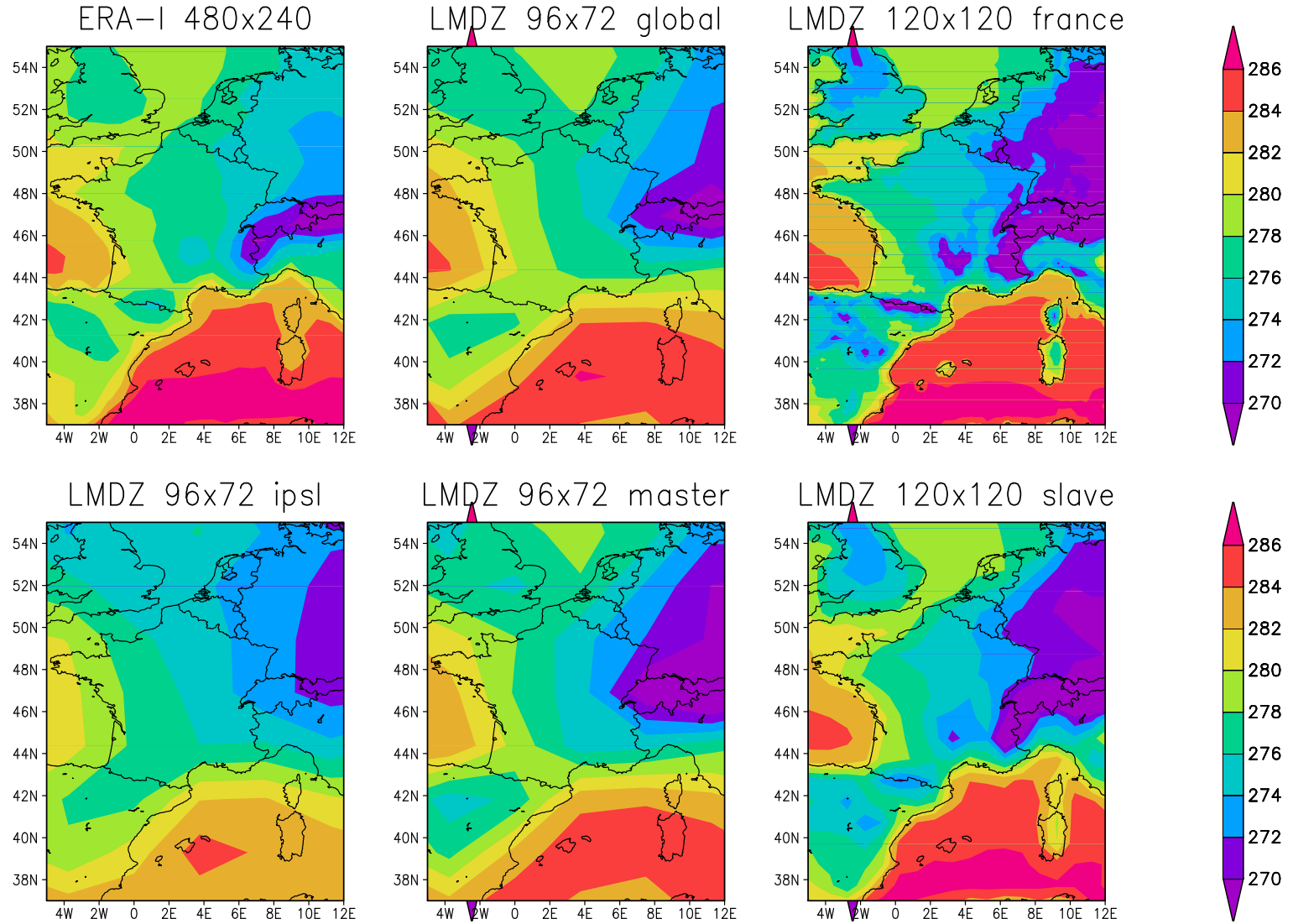
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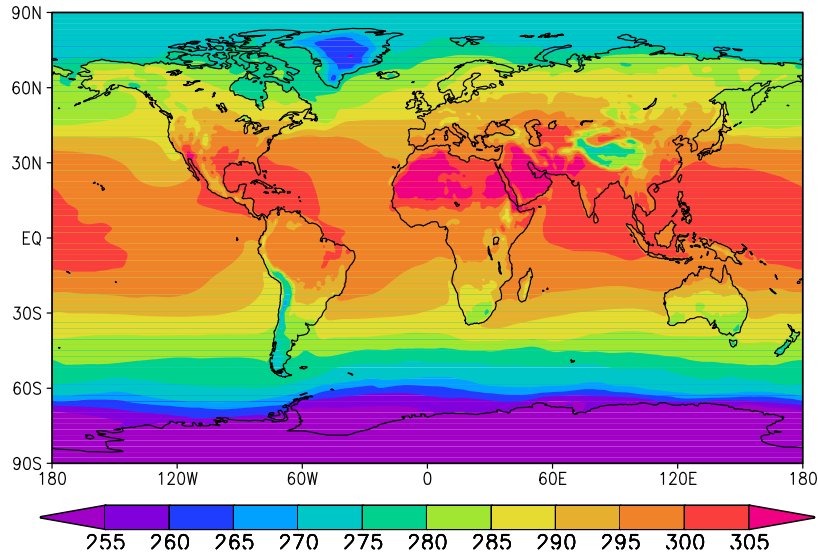


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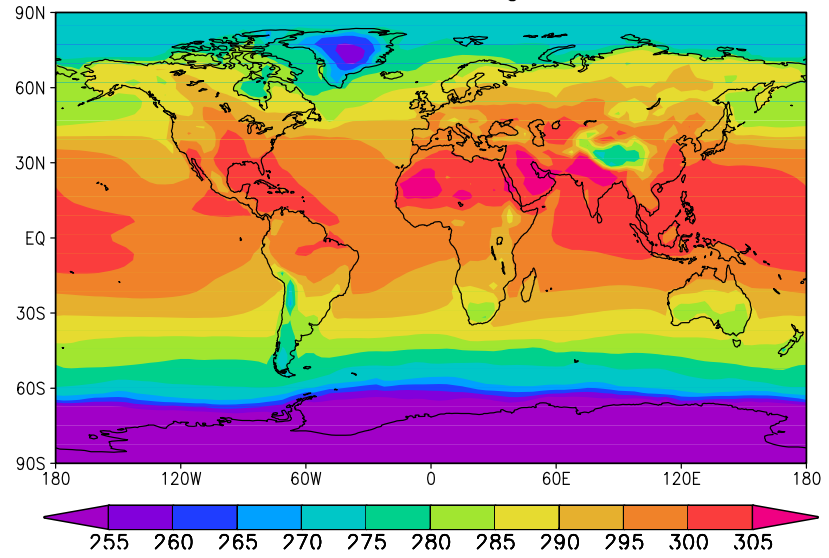


JJA T2m

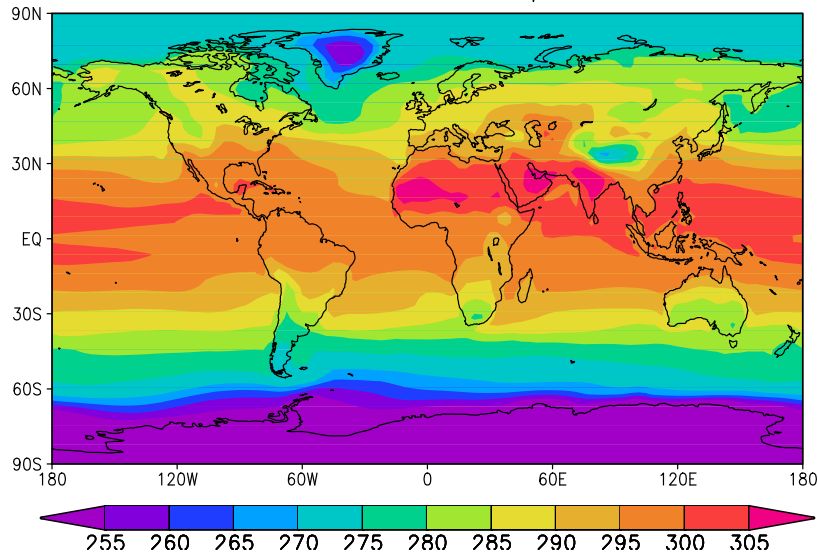
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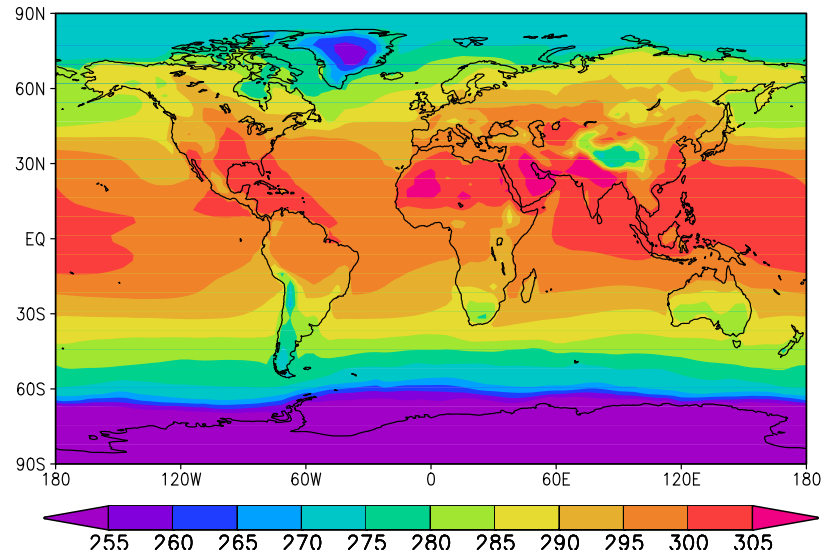
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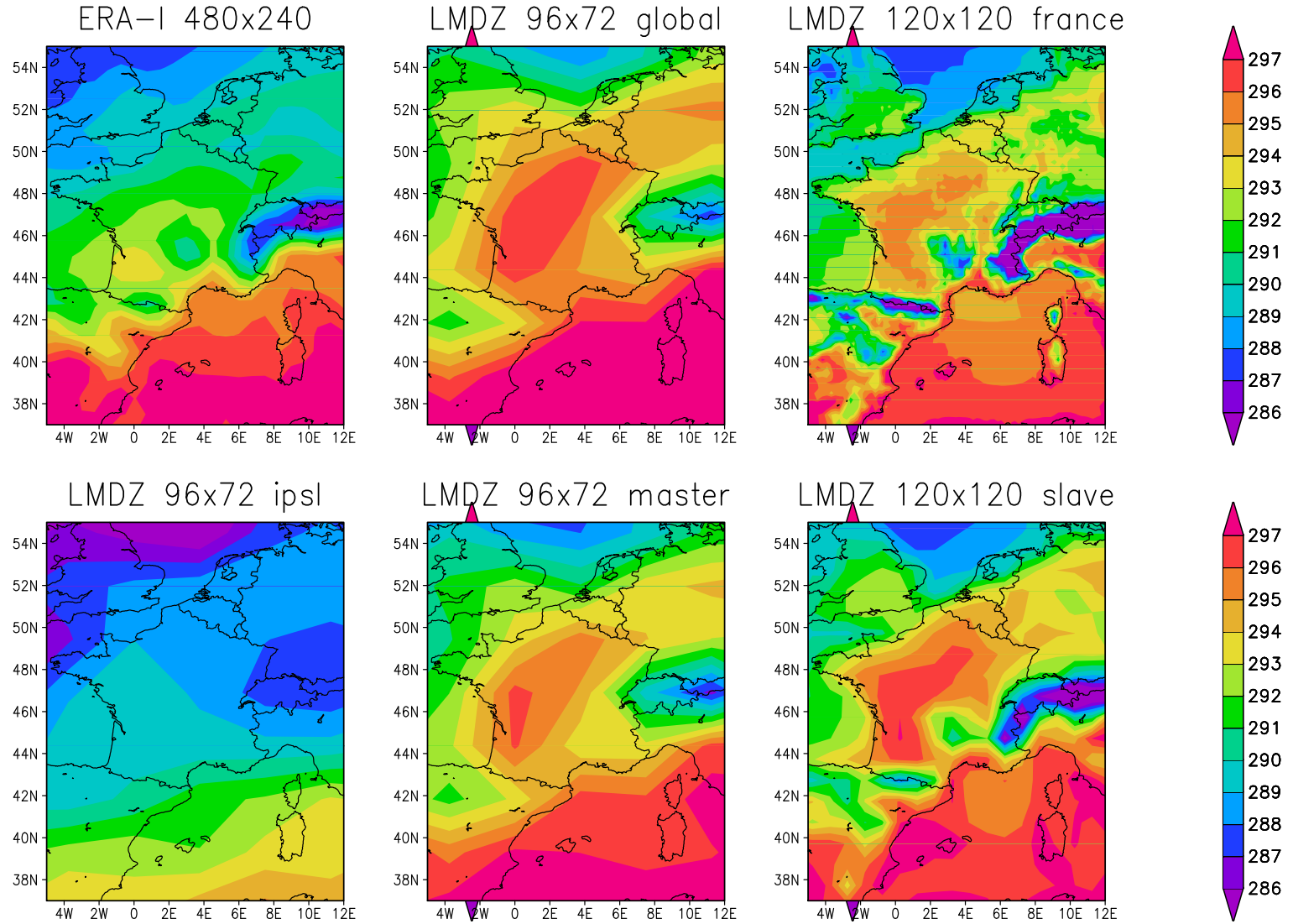
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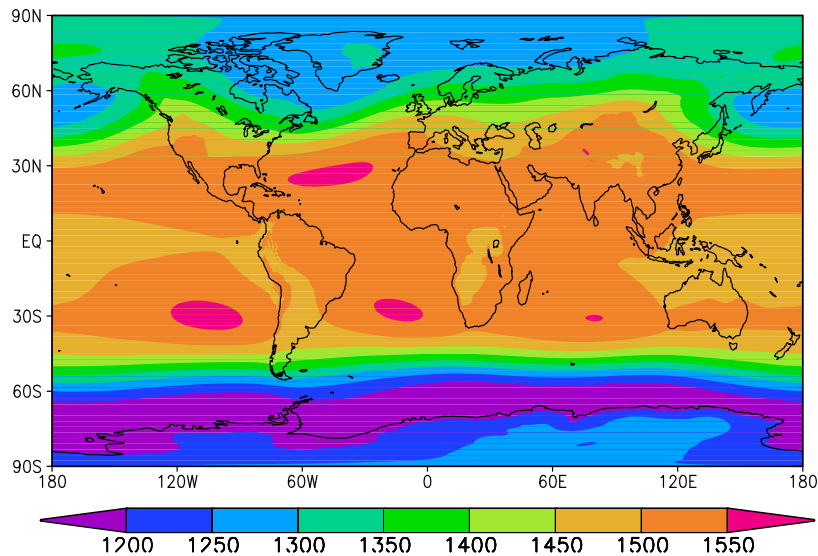
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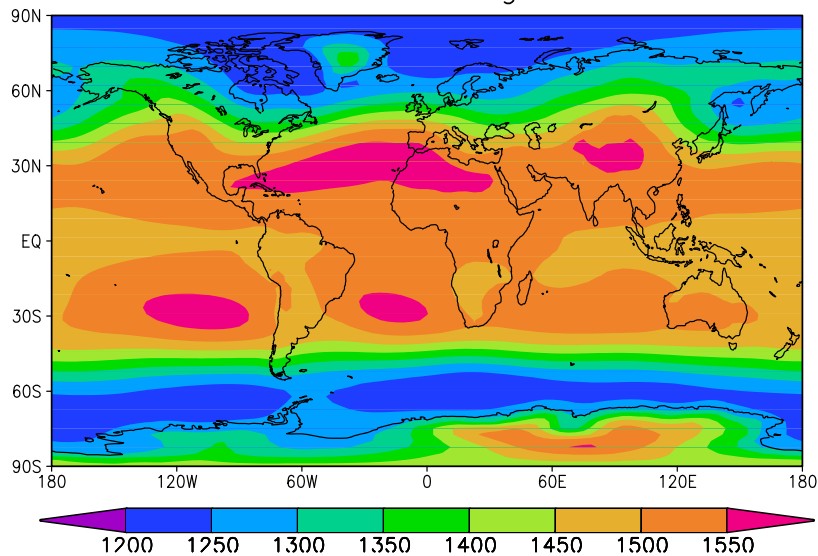


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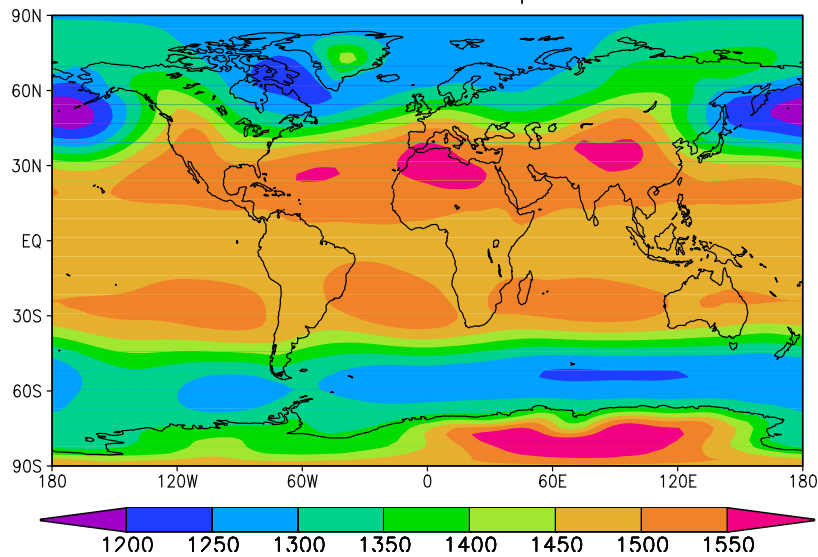


DJF Z850

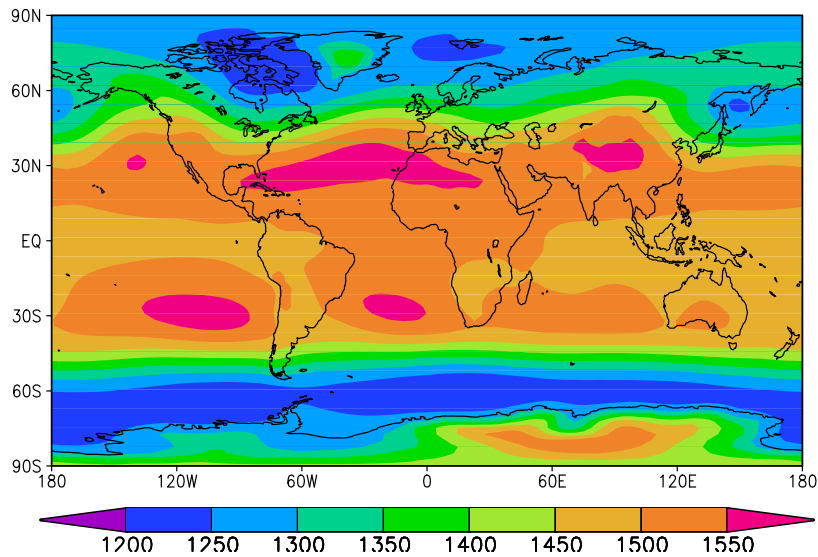
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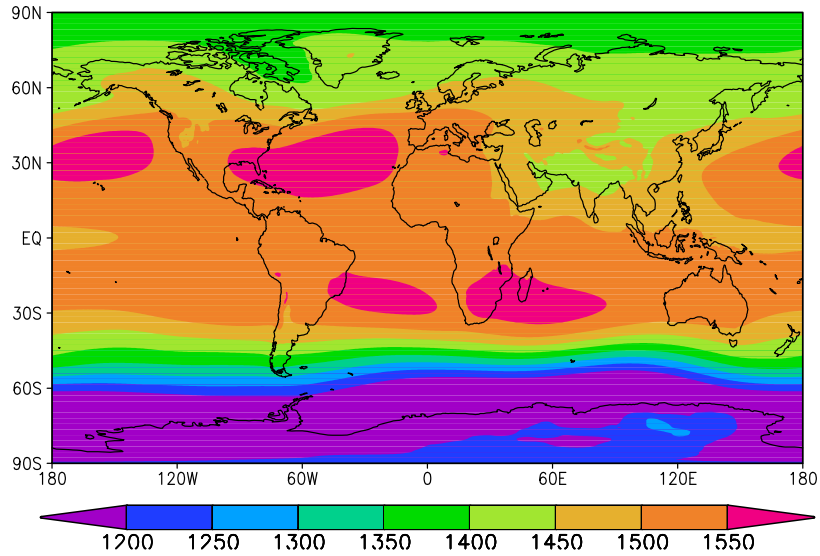
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LMDZ 120x120 master2

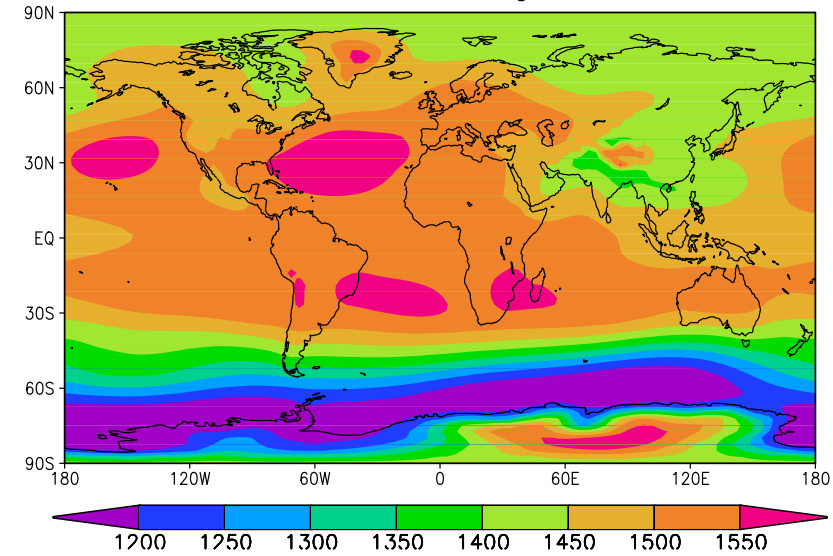


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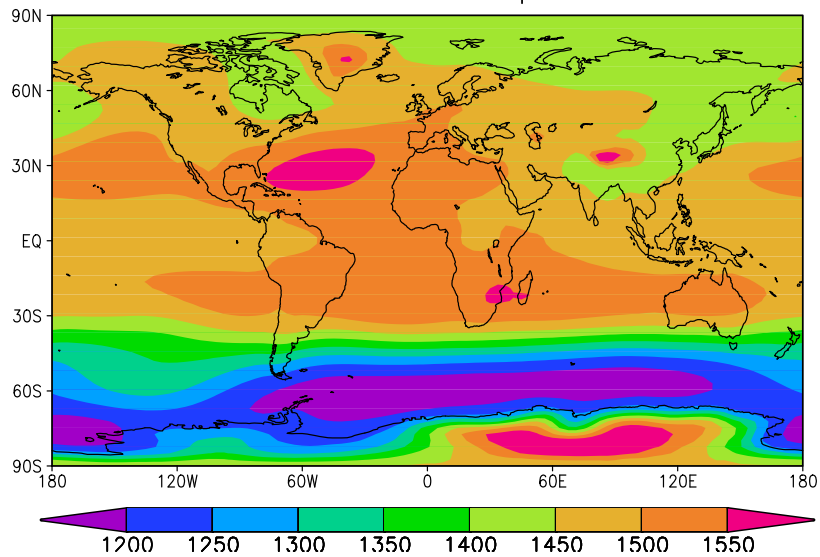


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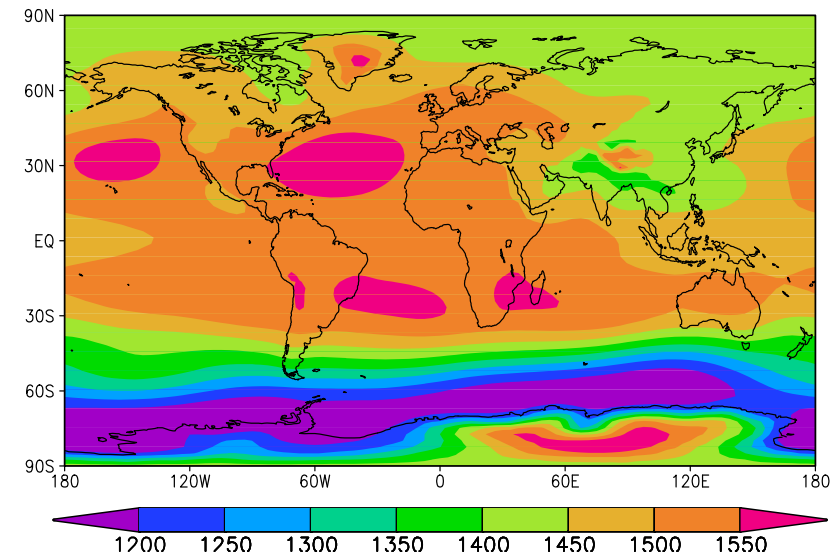
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LMDZ 96x72 ipsl2

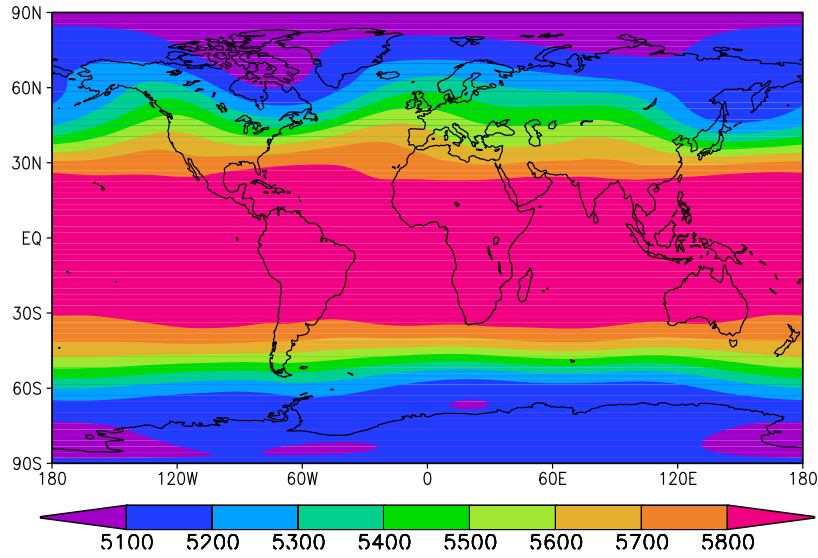


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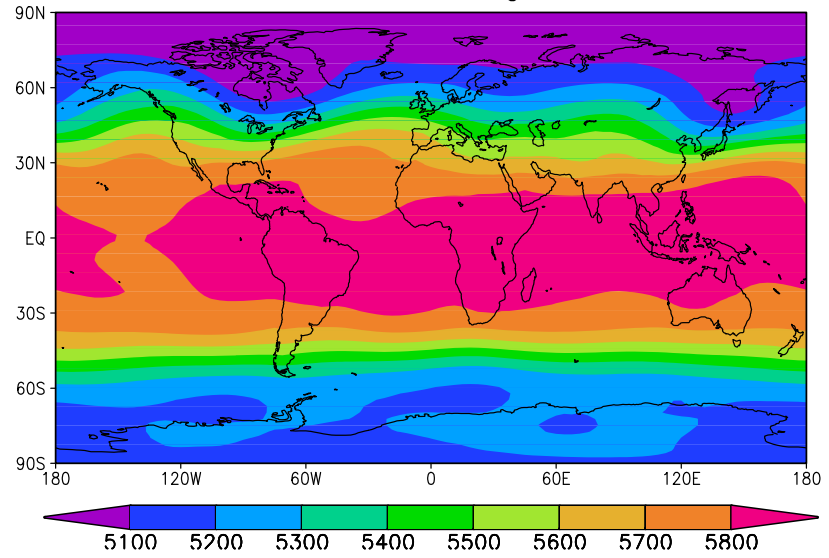


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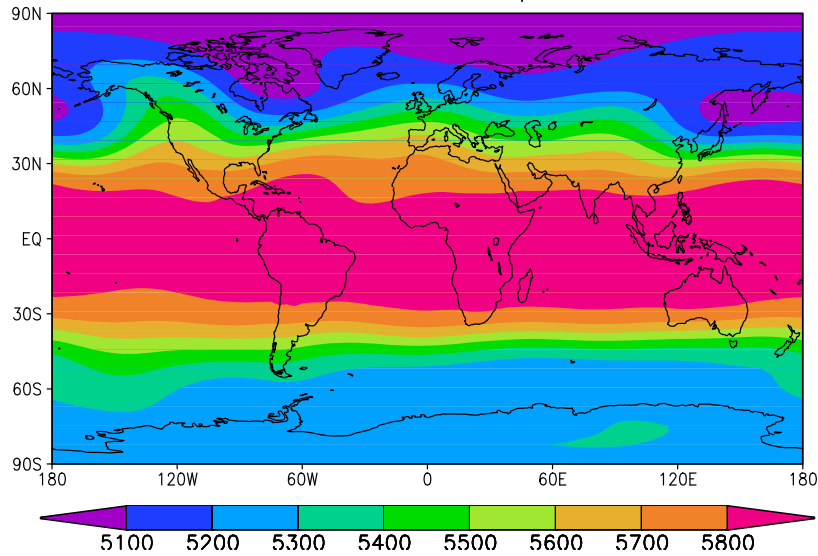
ERA-I 480x240



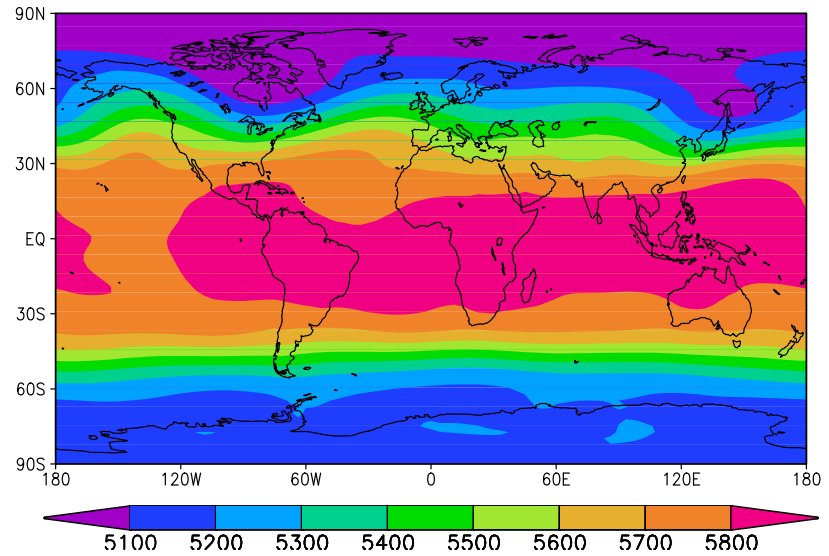
LMDZ 96x72 global



LMDZ 96x72 ipsl2

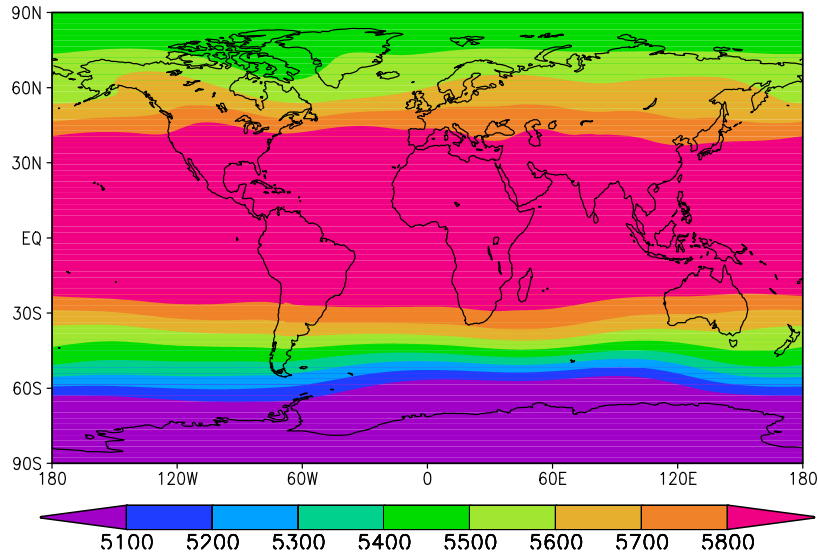


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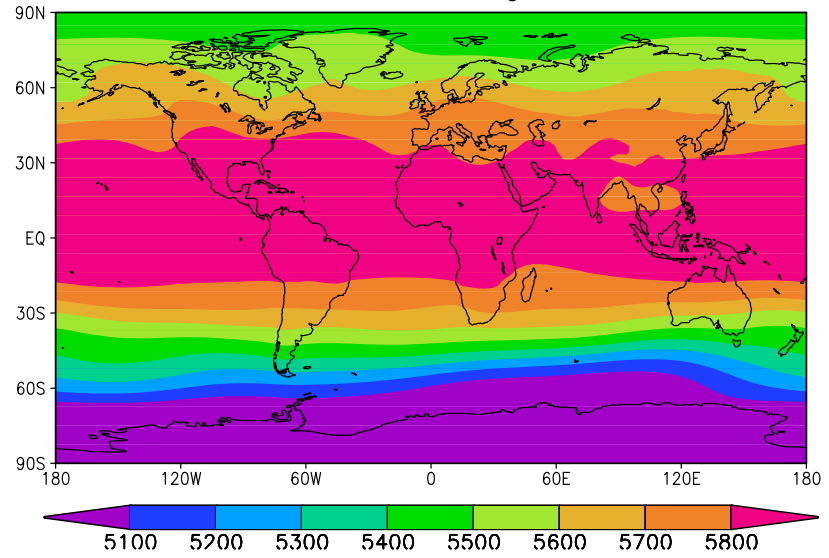


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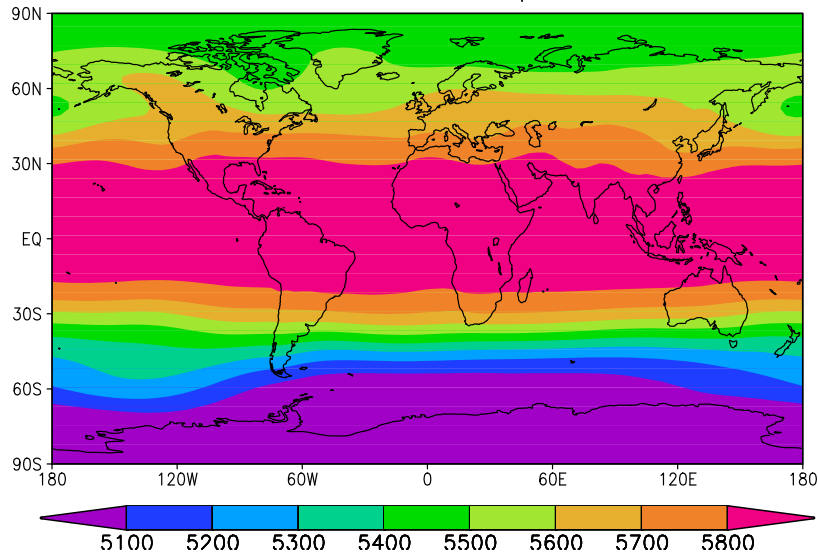
ERA-I 480x240



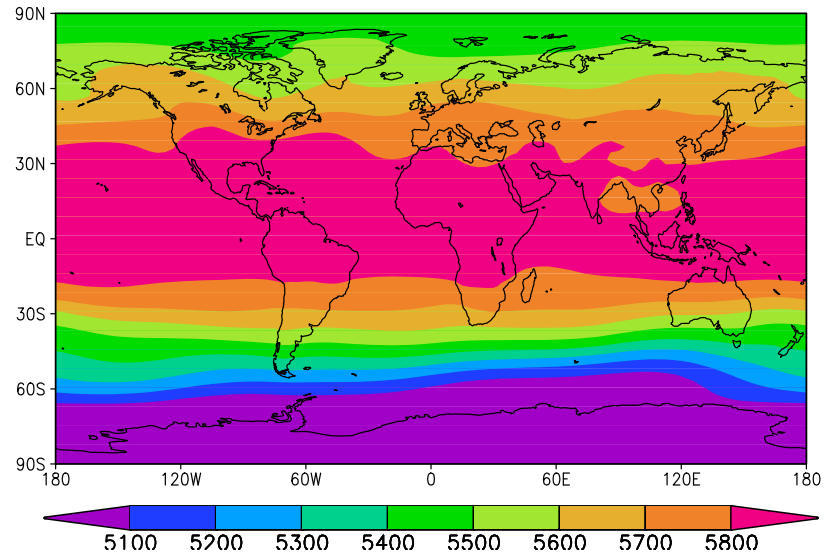
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LMDZ 96x72 ipsl2



LMDZ 120x120 master2



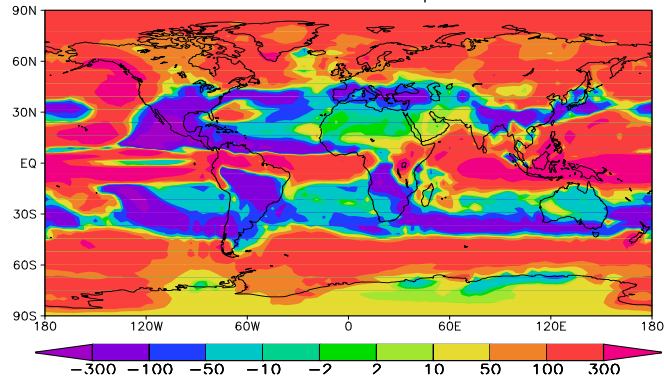
Two downscaling chains, Master/Slave/France and Global/Regional, show consistent relationship between Global scale and Regional scale.

Two-way nesting does show up-scaling effects.

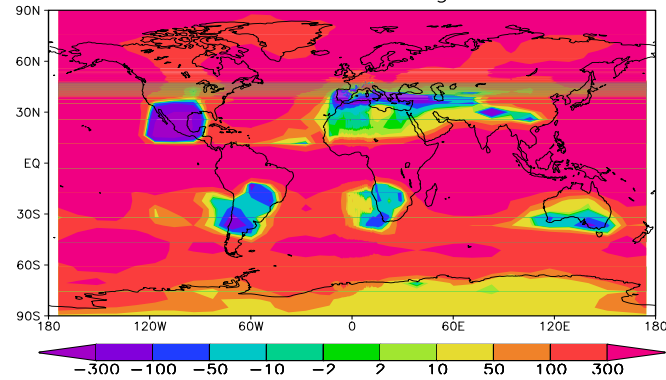
The two chains reveal significant differences in terms of climate change. This seems caused by excitation of different intrinsic modes which are in relation with the basic state of the model (SST).

Annual Delta precipitations

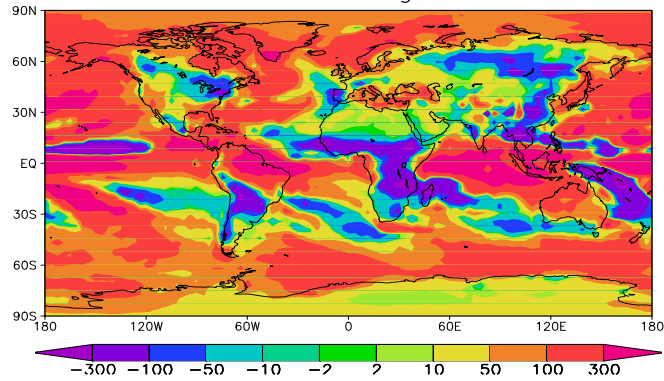
LMDZ 96x72 ipsl2



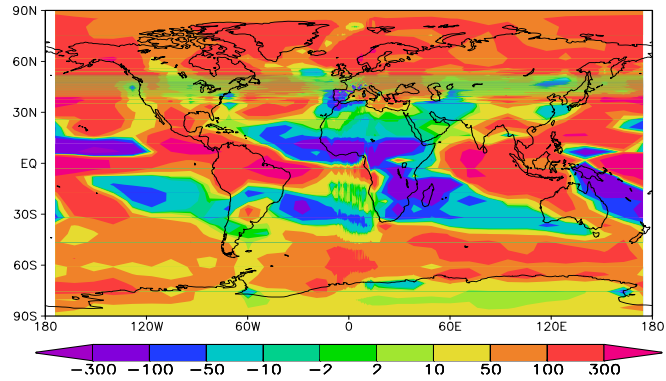
LMDZ 120x120 regional2



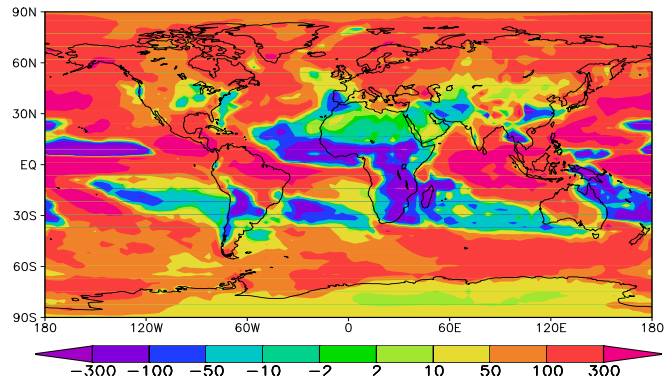
LMDZ 96x72 global2



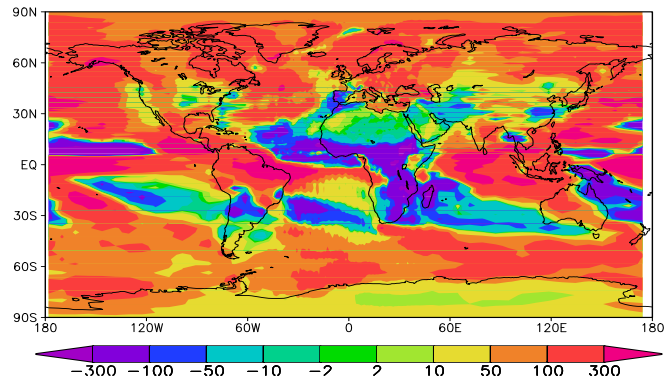
LMDZ 120x120 france2



LMDZ 96x72 master2

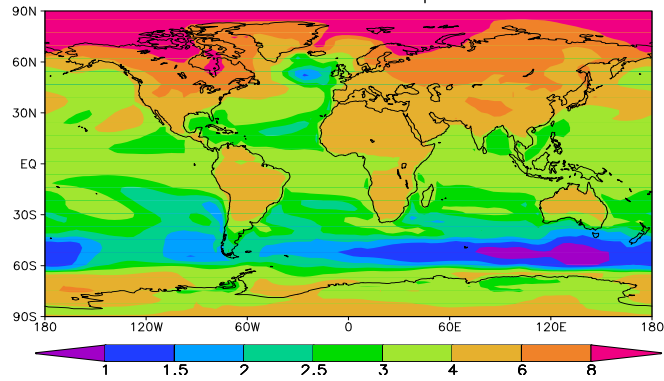


LMDZ 120x120 slave2

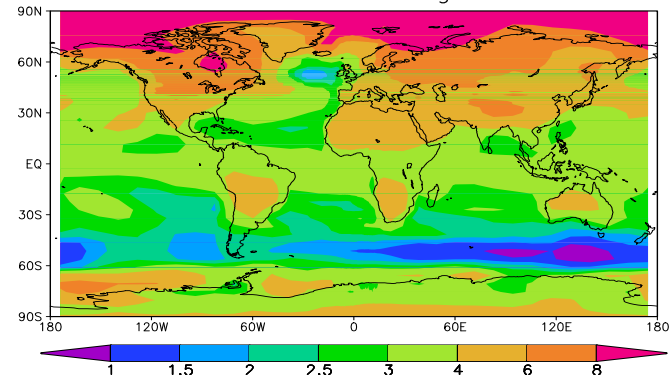


Annual Delta T2m

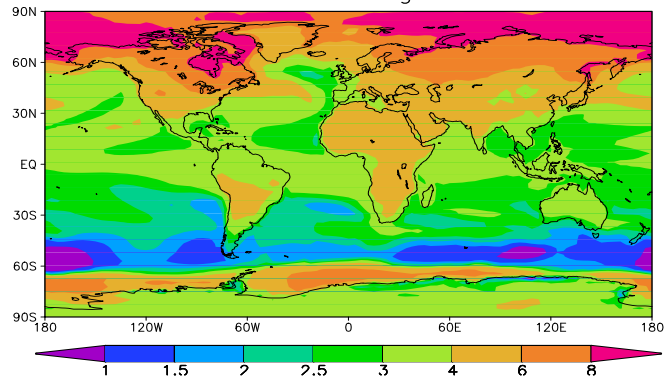
LMDZ 96x72 ipsl2



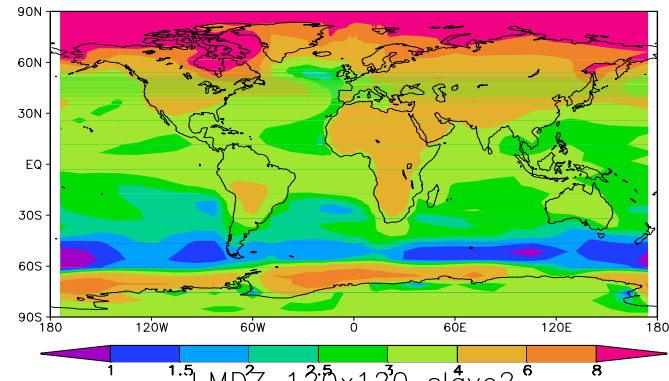
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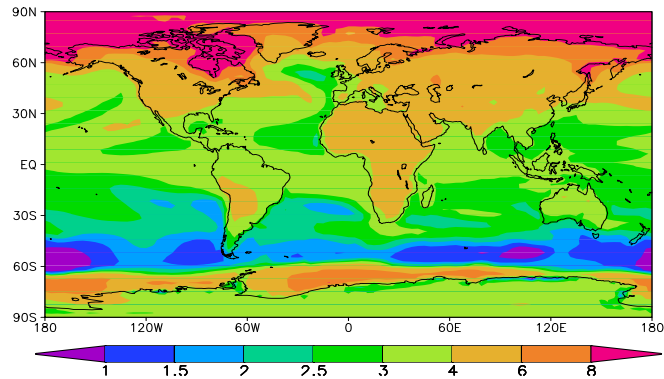
LMDZ 96x72 global2



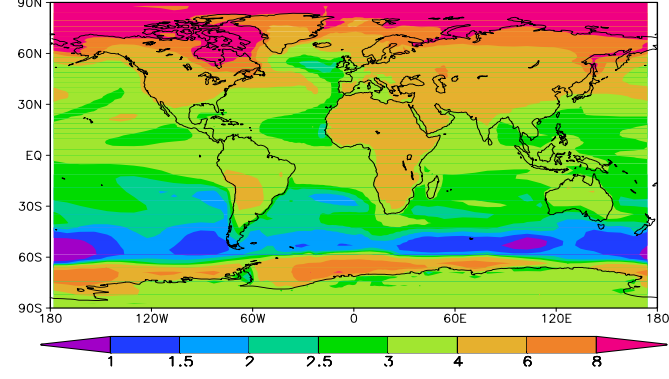
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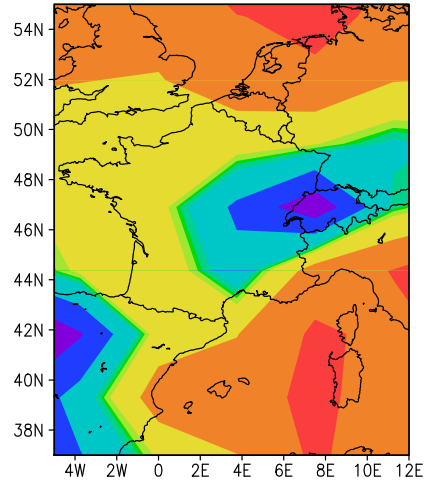


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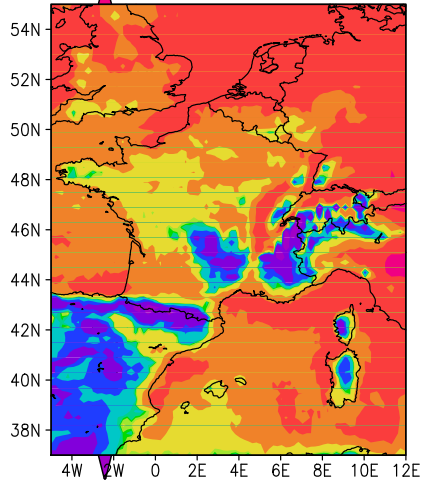


Annual Delta precipitations

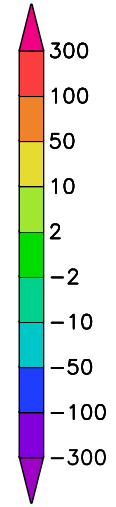
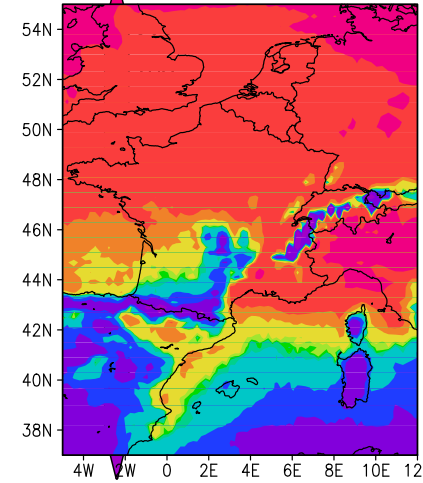
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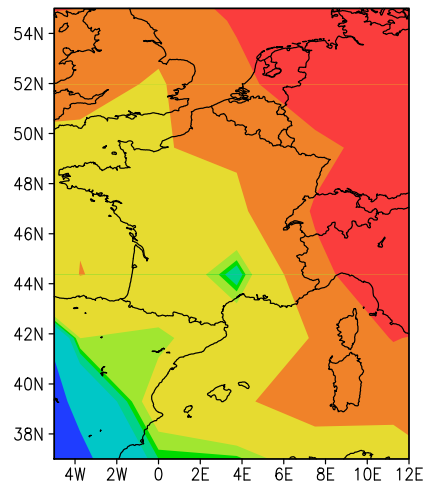
LMDZ 120x120 france2 LMDZ 120x120 regional2



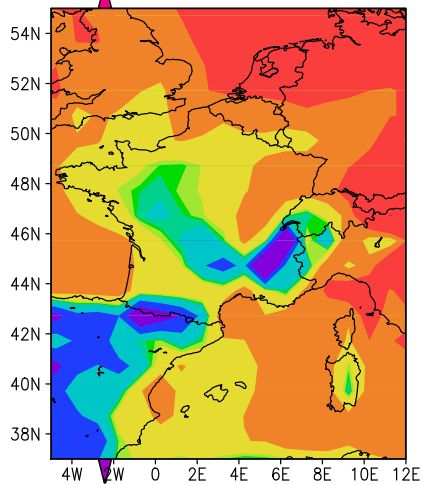
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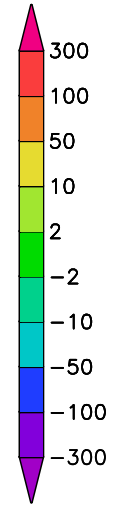
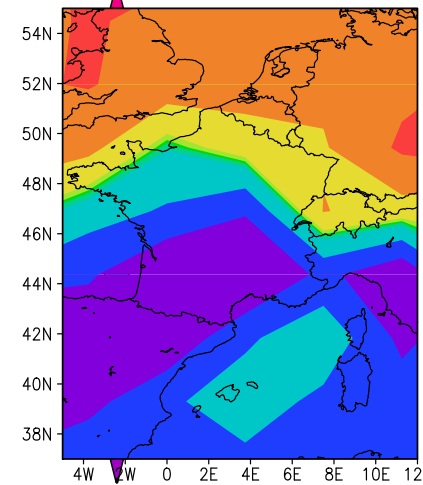
LMDZ 96x72 master2



LMDZ 120x120 slave2

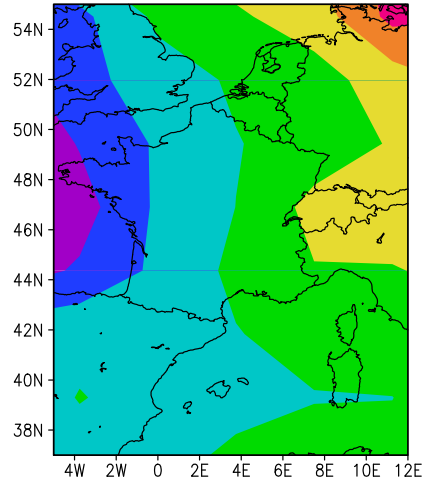


LMDZ 96x72 ipsl2

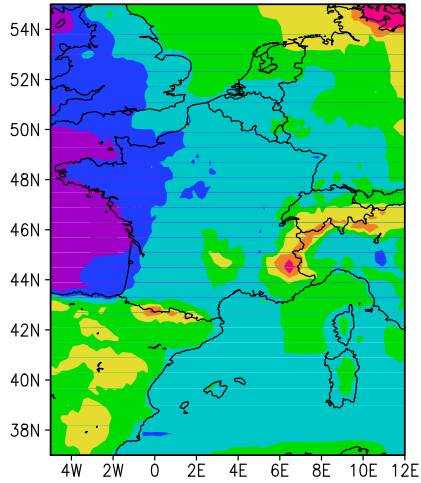


Annual Delta T2m

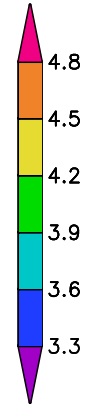
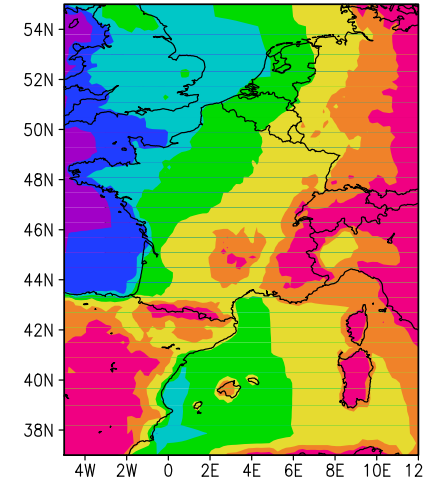
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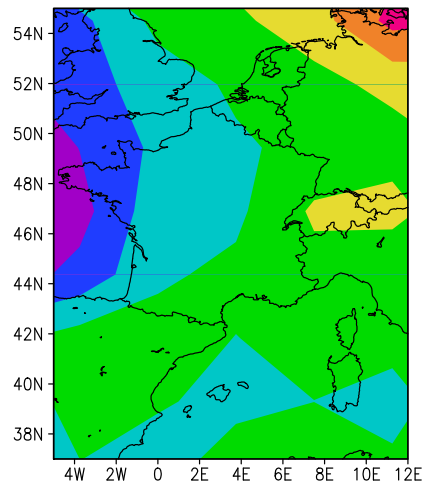
LMDZ 120x120 france2



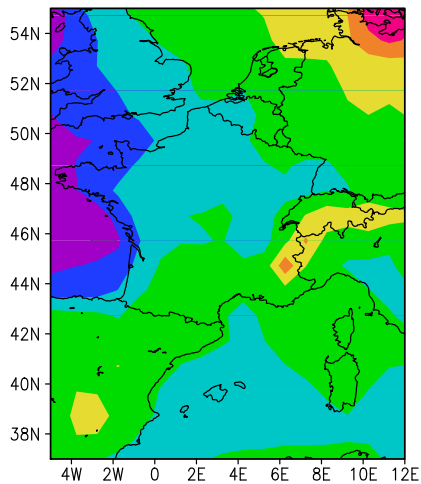
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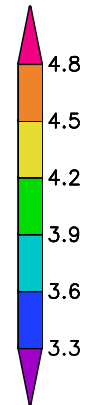
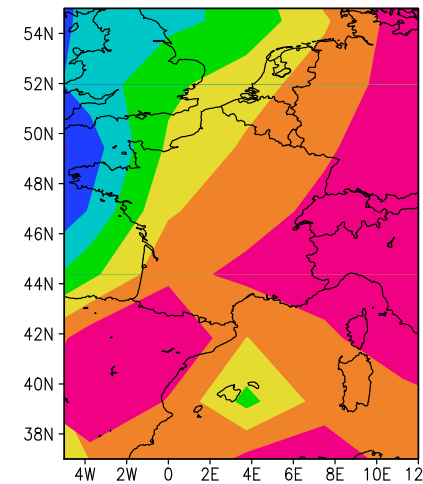
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LMDZ 120x120 slave2

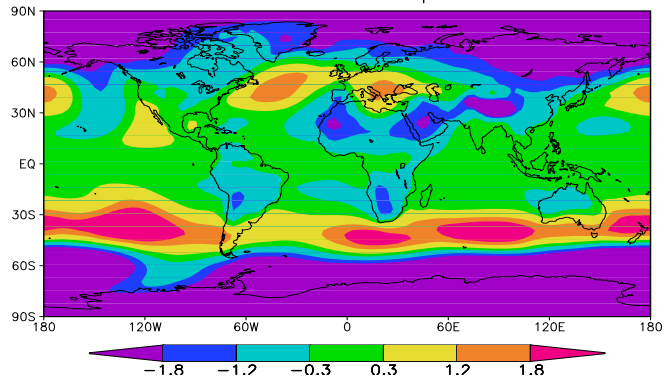


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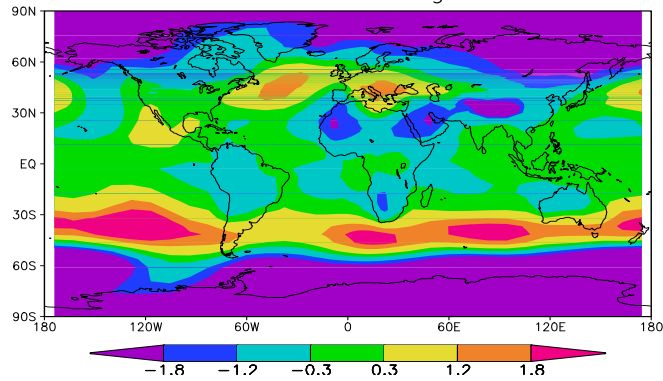


Annual Delta SLP

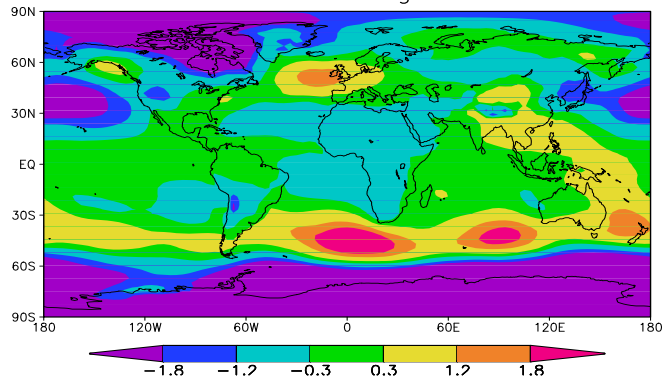
LMDZ 96x72 ipsl2



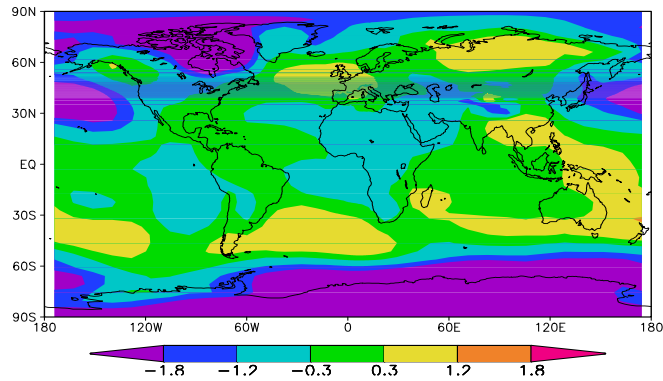
LMDZ 120x120 regional2



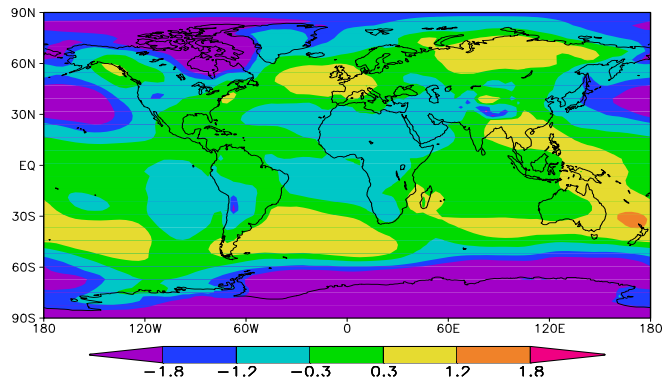
LMDZ 96x72 global2



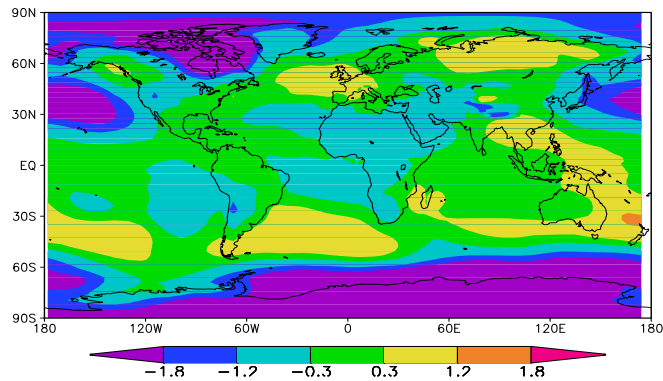
LMDZ 120x120 france2

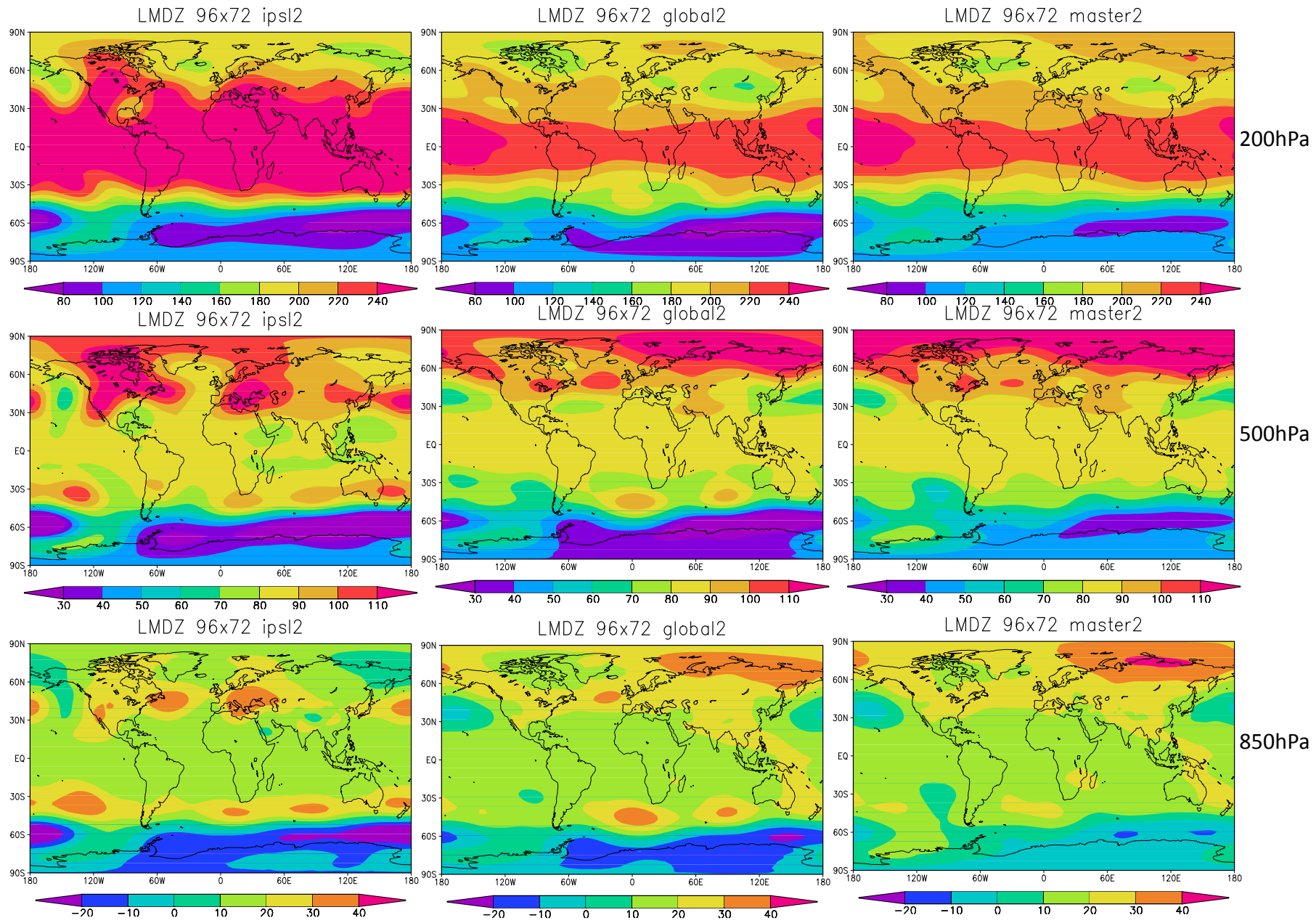


LMDZ 96x72 master2



LMDZ 120x120 slave2



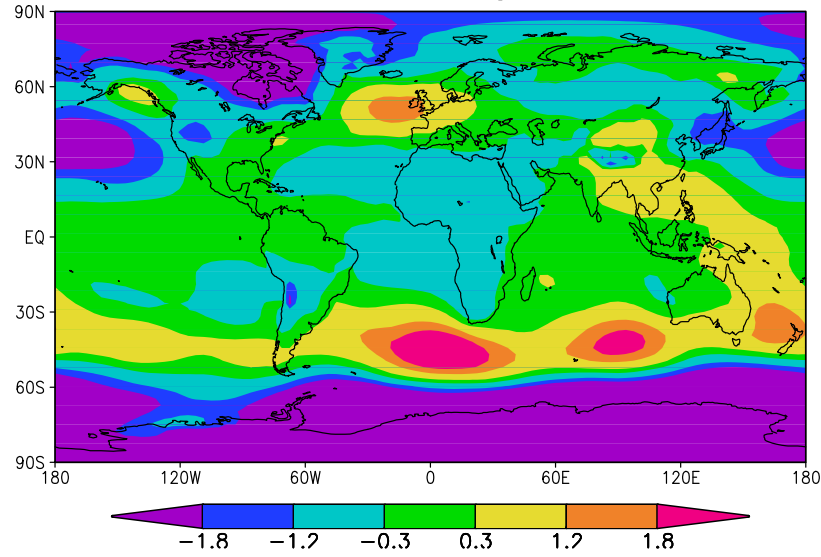


Annual Delta geopotential

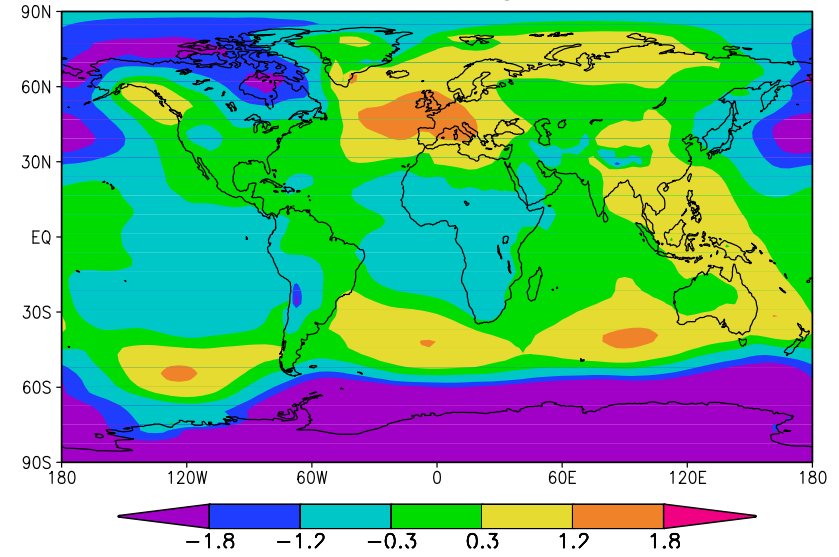
At regional scale, climate change signal is relatively independent on the global amplitude, but rather an excitation of intrinsic modes. IPSL and CNRM show different warming amplitude, but very close rainfall pattern. So is the comparison between 2050 and 2100.

Annual Delta SLP

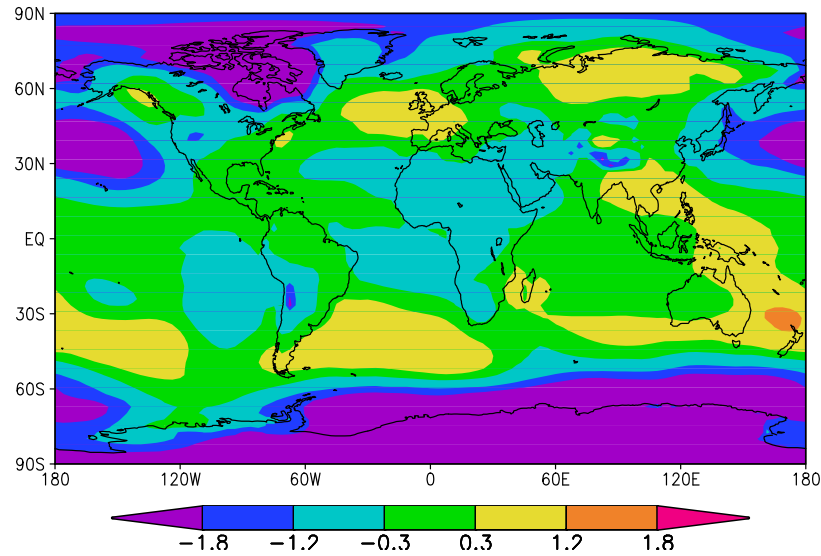
LMDZ 96x72 global2



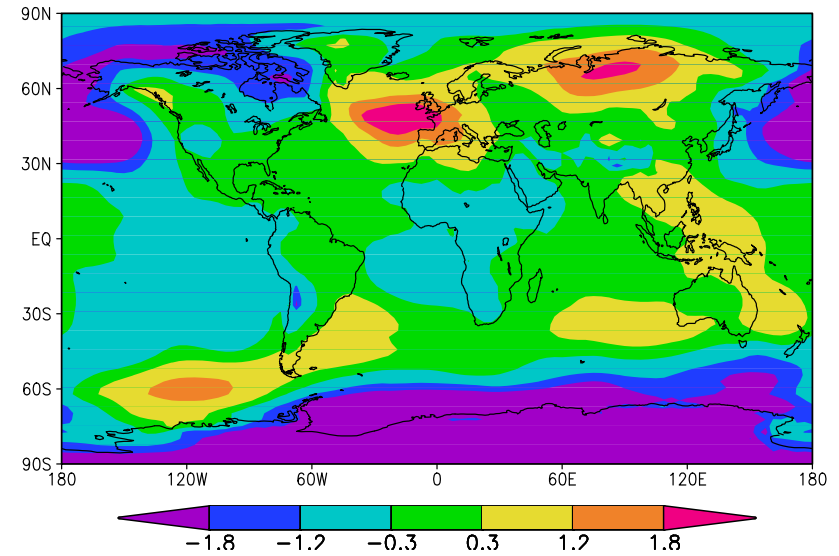
LMDZ 96x72 global4



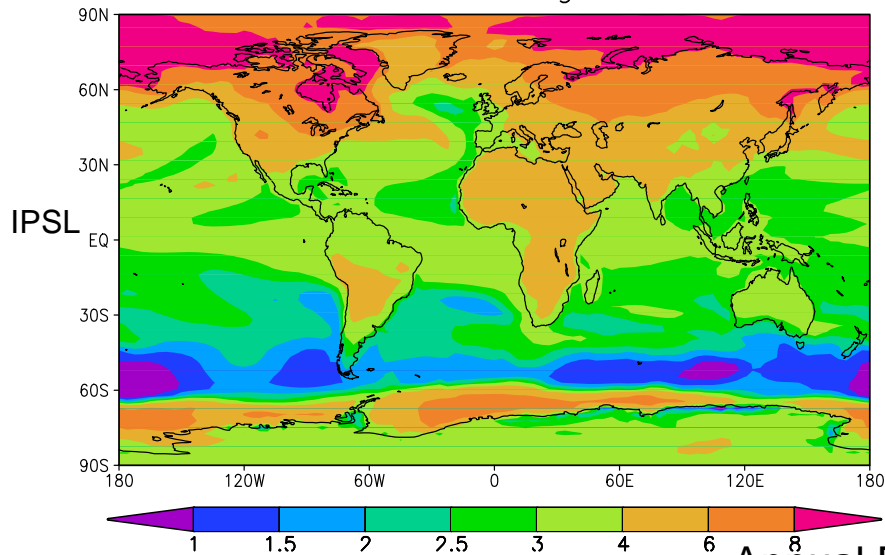
LMDZ 96x72 master2



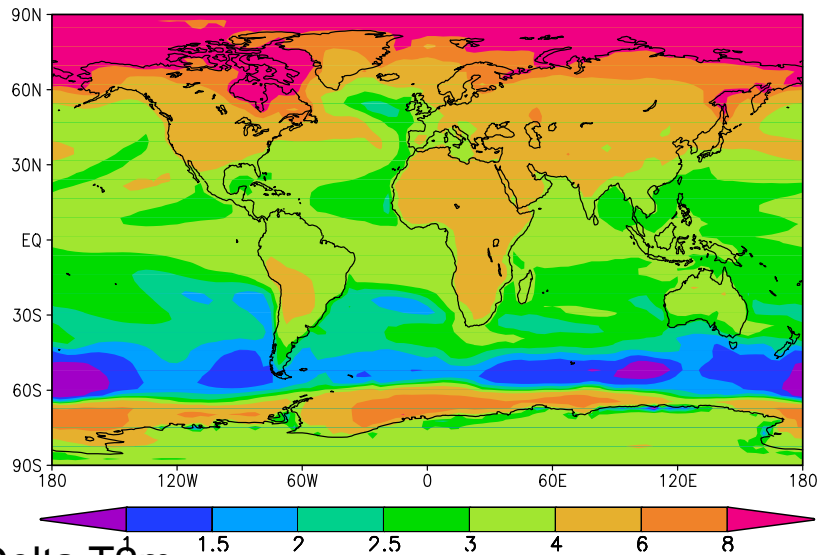
LMDZ 96x72 master4



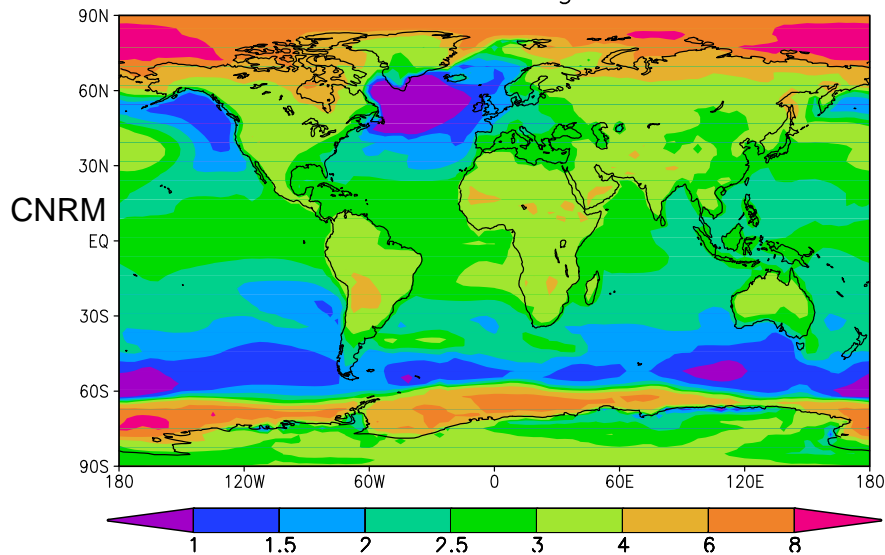
Forced by Delta SST from IPSL-CM4
LMDZ 96x72 global2



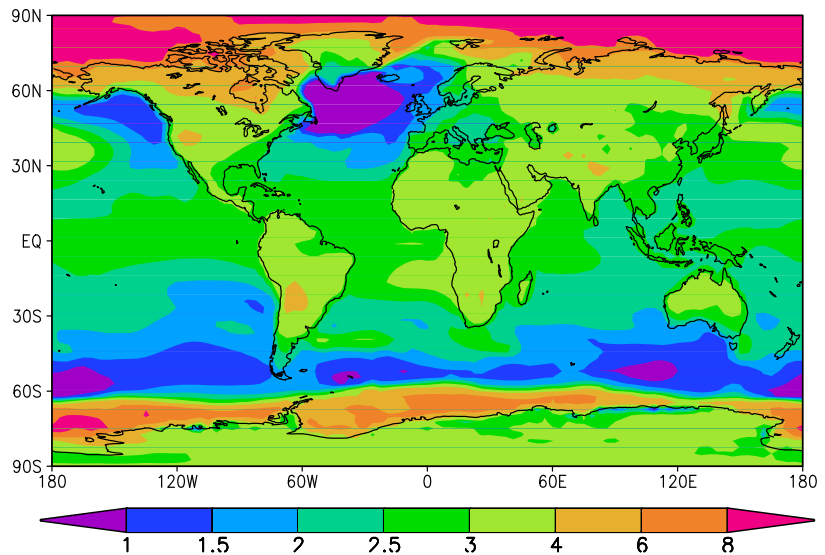
LMDZ 96x72 master2



LMDZ 96x72 global4



LMDZ 96x72 master4

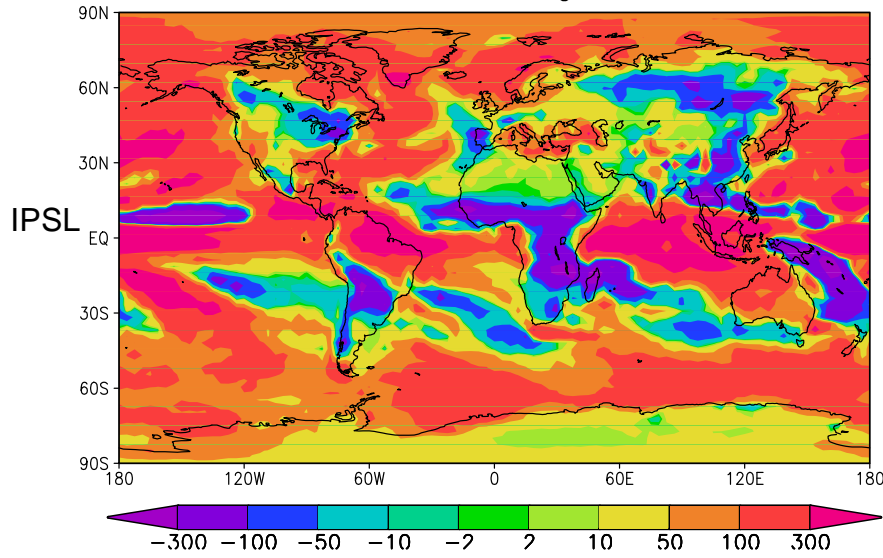


Forced by Delta SST from CNRM-CM4

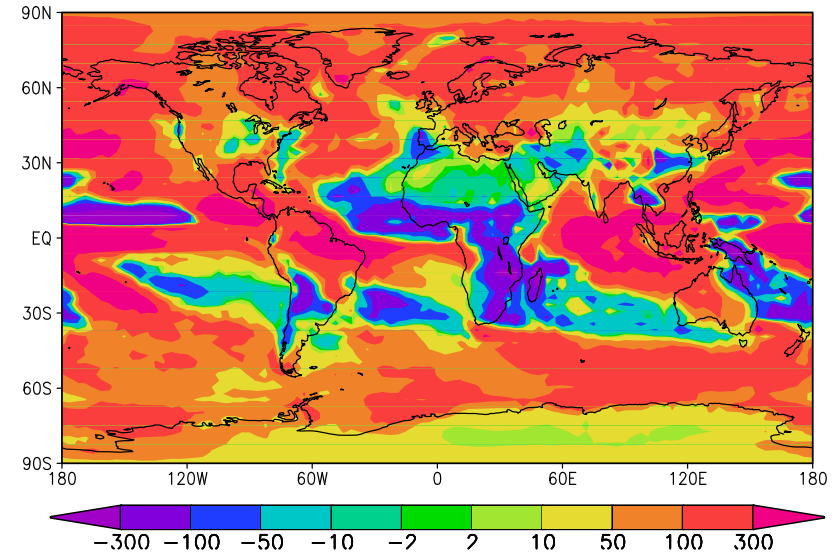
Annual Delta precipitations

Forced by Delta SST from IPSL-CM4

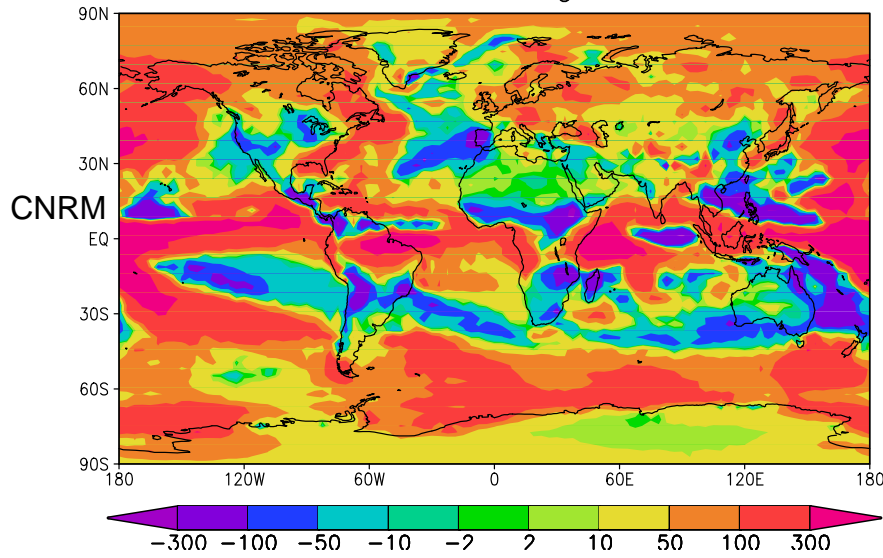
LMDZ 96x72 global2



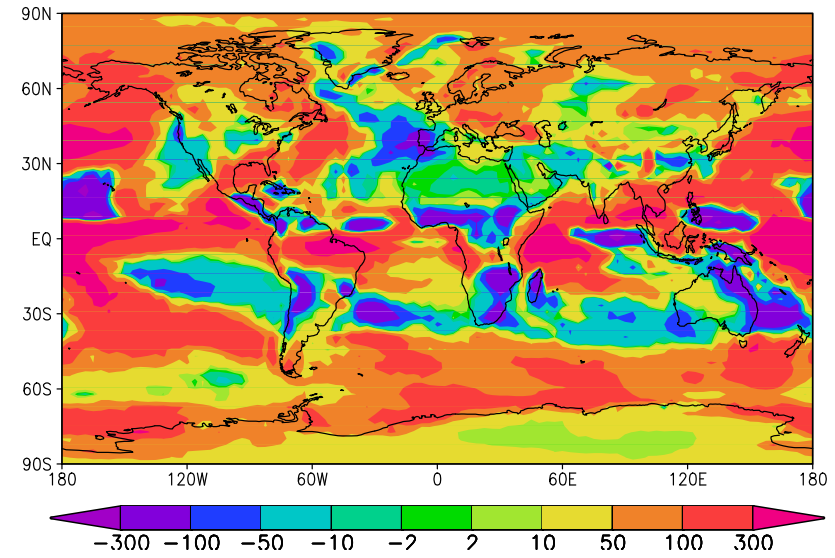
LMDZ 96x72 master2



LMDZ 96x72 global4

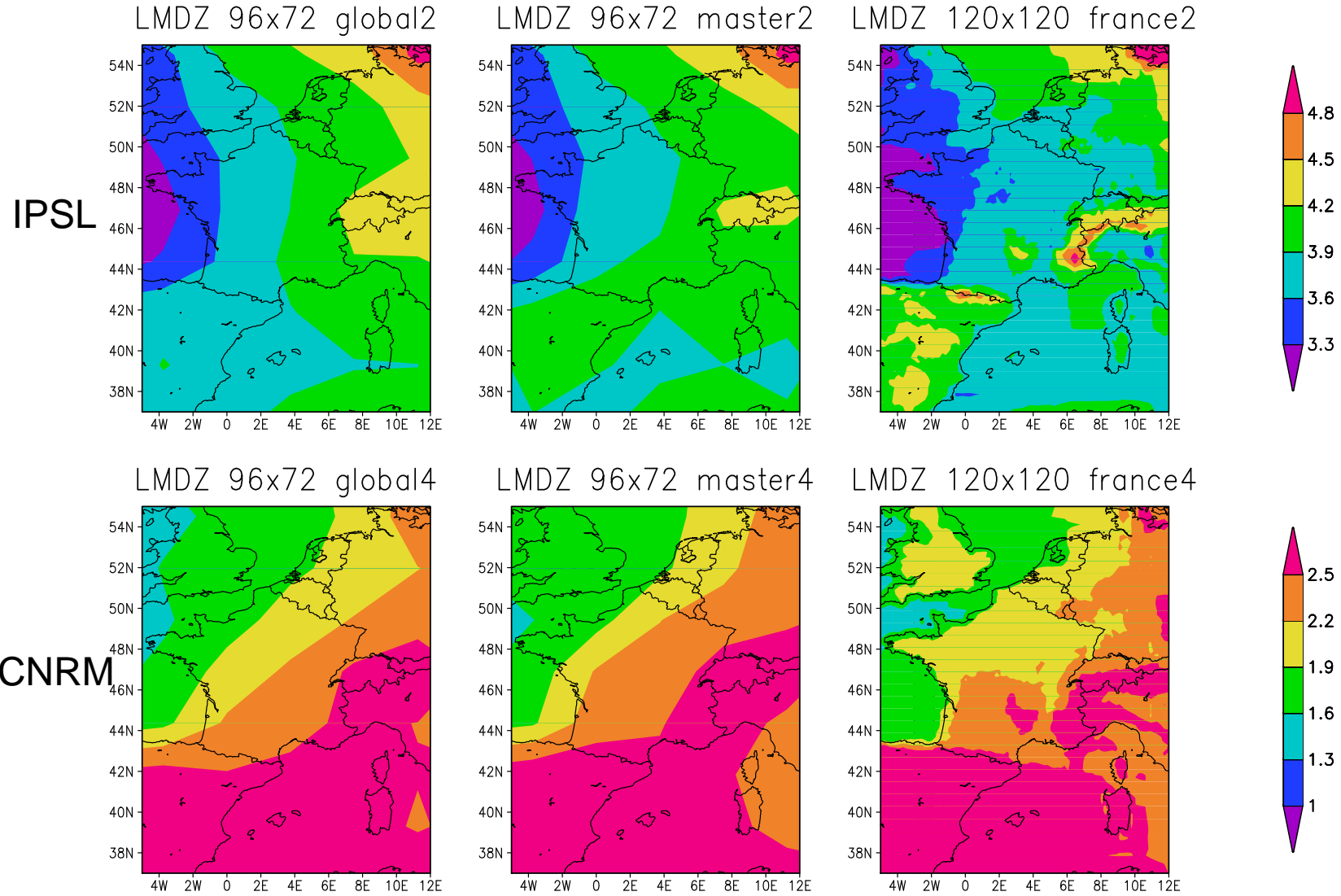


LMDZ 96x72 master4

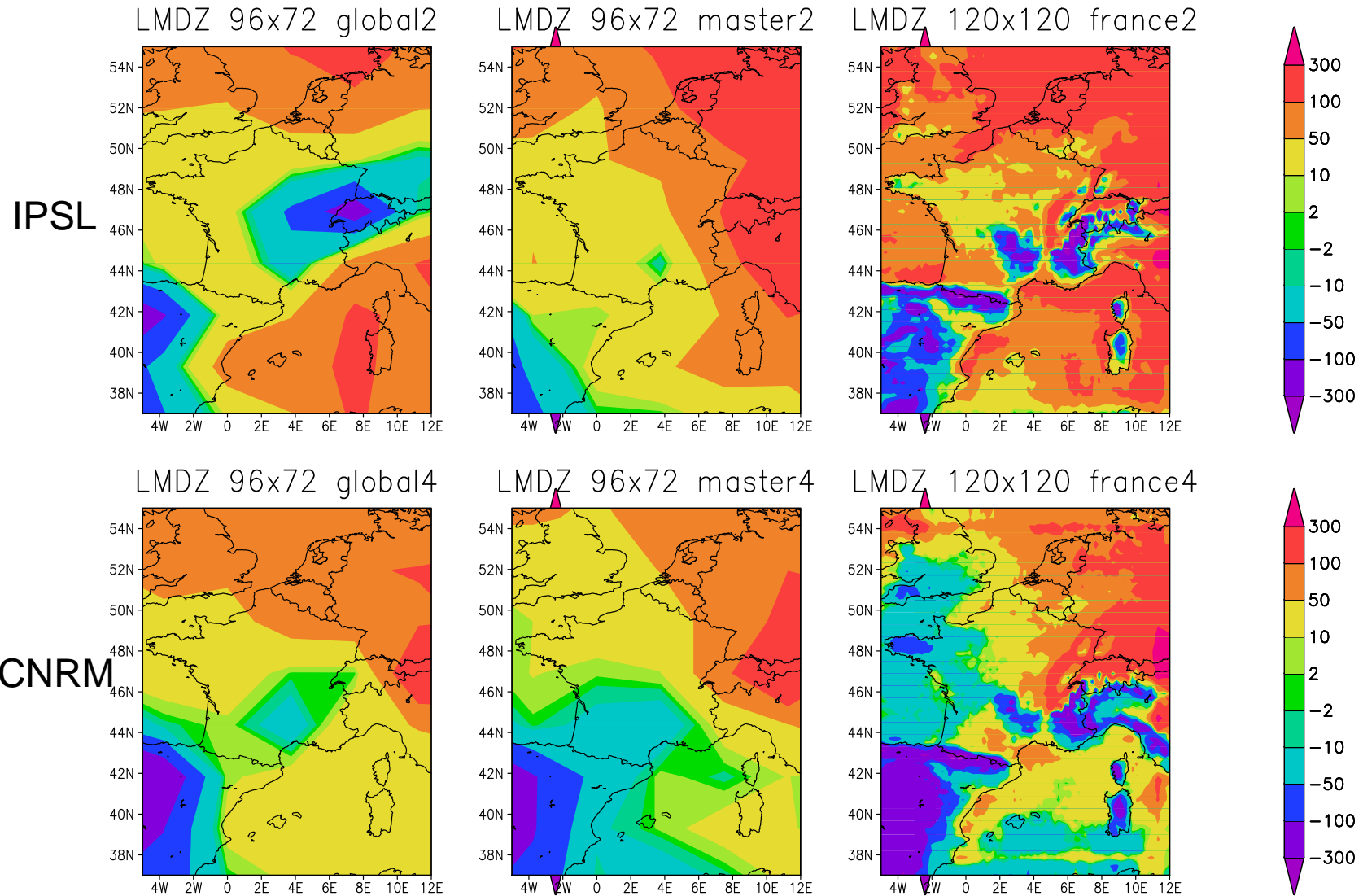


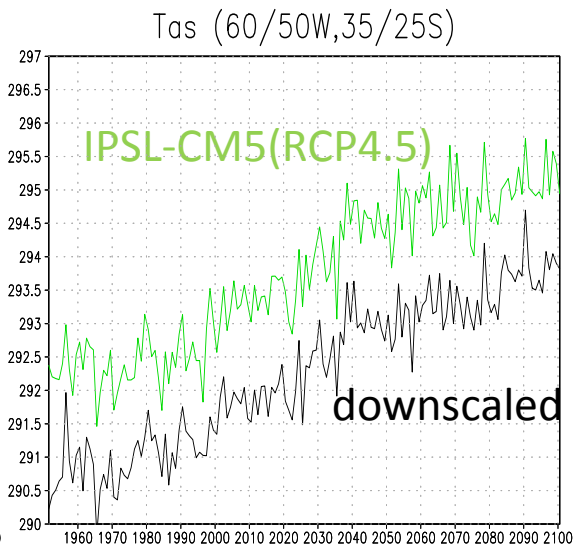
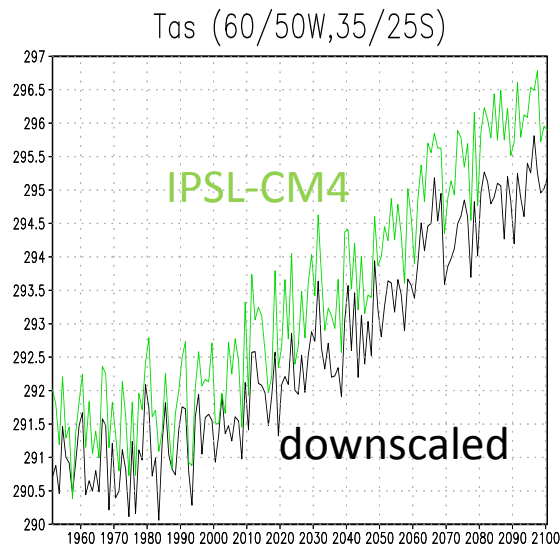
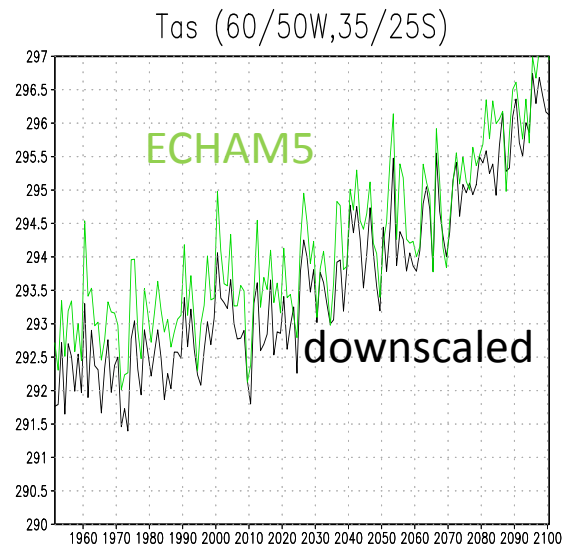
Forced by Delta SST from CNRM-CM4

Annual Delta T2m

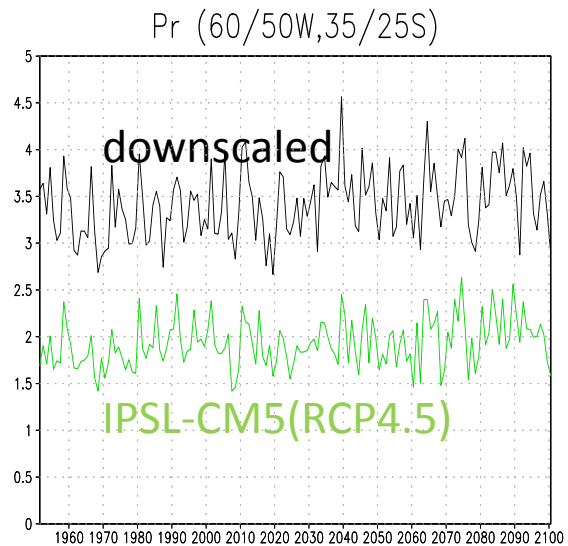
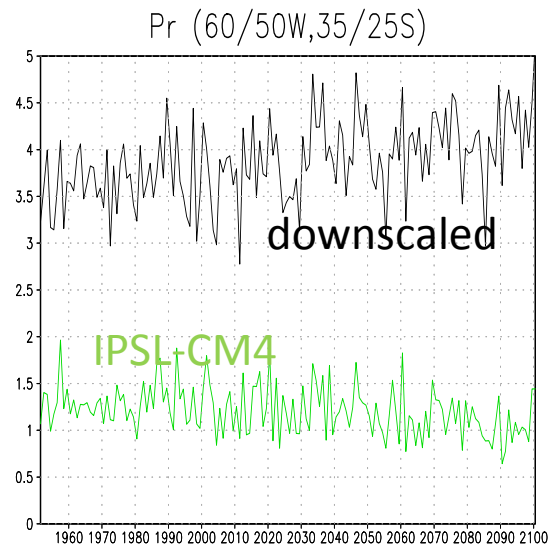
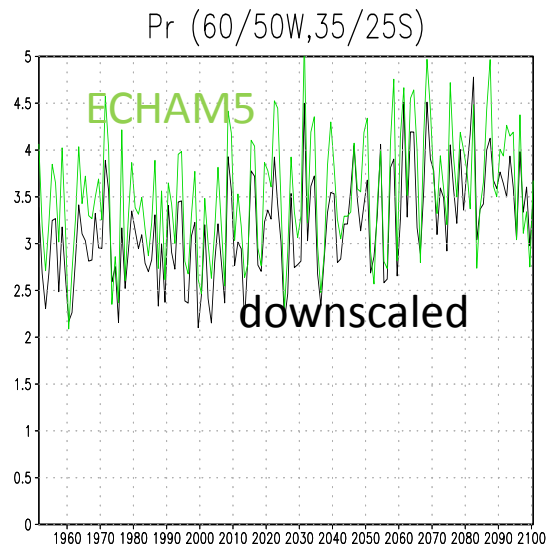


Annual Delta precipitations





Tas



Pr

LMDZ-sudam used to downscale two A1B scenarios (IPSL-CM4 et ECHAM5) and an RCP4.5 scenario (IPSL-CM5) from 1951 to 2100 . Surface air temperature and precipitation rate for La Plata Basin (60/50W,35/25S).