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Supporting materials for the presentation CIRCLE workshop,
July 4th 2005, Paris

GICC-MedWater

Impacts of anthropogenic climate change on the water cycle of the Mediterranean basin

(http://www.lmd.jussieu.fr/~li/gicc_medwater/index.html)

A project supported by the French National programme GICC (Gestion et Impact du Changement Climatique) 2003-2006

A joint project of IPSL (Paris) and Meteo-France (Toulouse), with collaboration of MEDIAS (Toulouse)

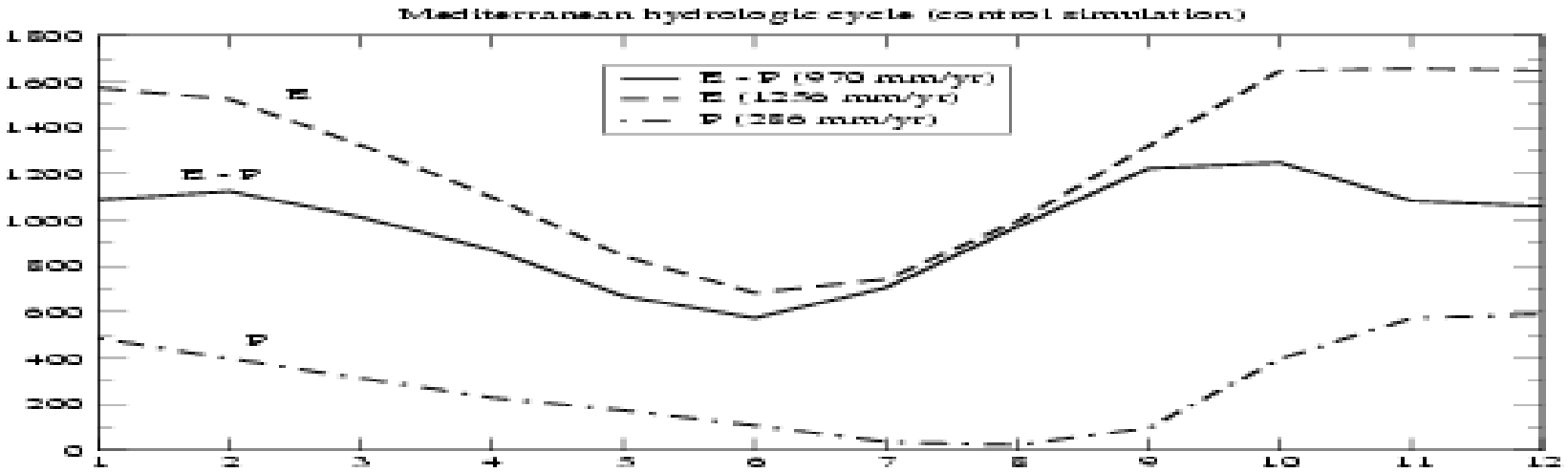
Mediterranean Sea (2.5×10^6 km^2) (Courtesy of DLR)

Water budget of the Mediterranean Sea

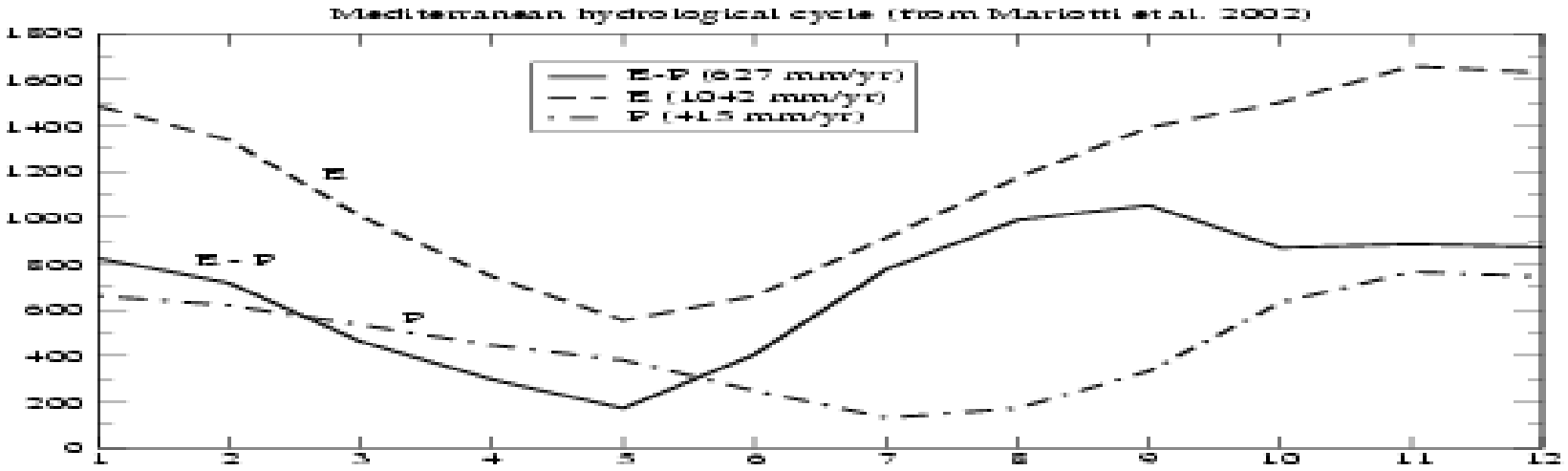
(annual estimation, mm/yr)

E: evaporation:	1100
P, precipitation:	400
E-P:	700
R, river discharge:	100 (8100 m3/s)
B, Black Sea:	75
G, Gibraltar:	525

Mediterranean Sea hydrological cycle
LMDZ and observation-based estimation (Mariotti et al. 2002)

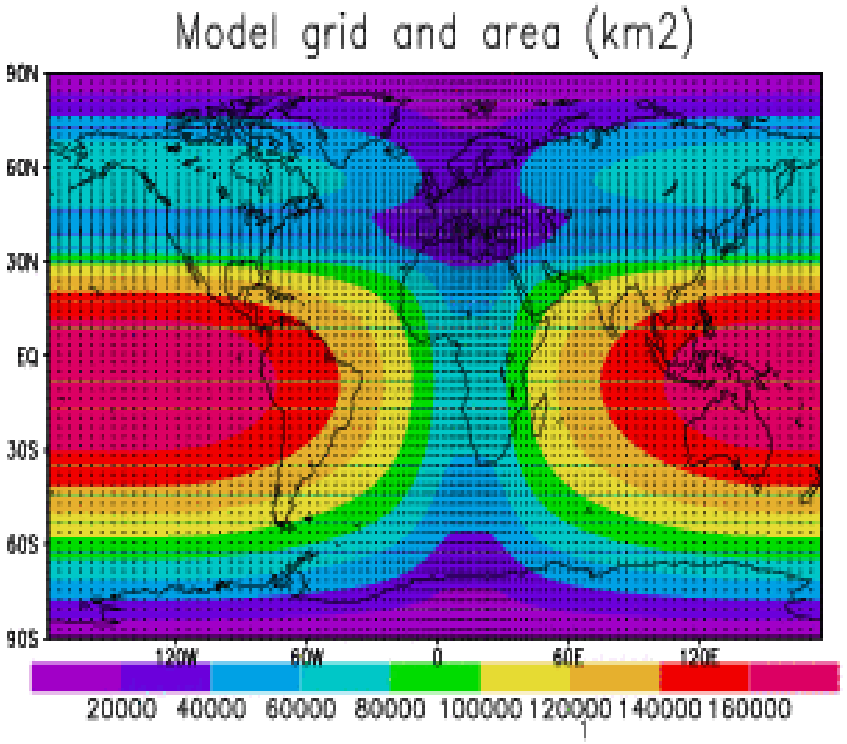


LMDZ

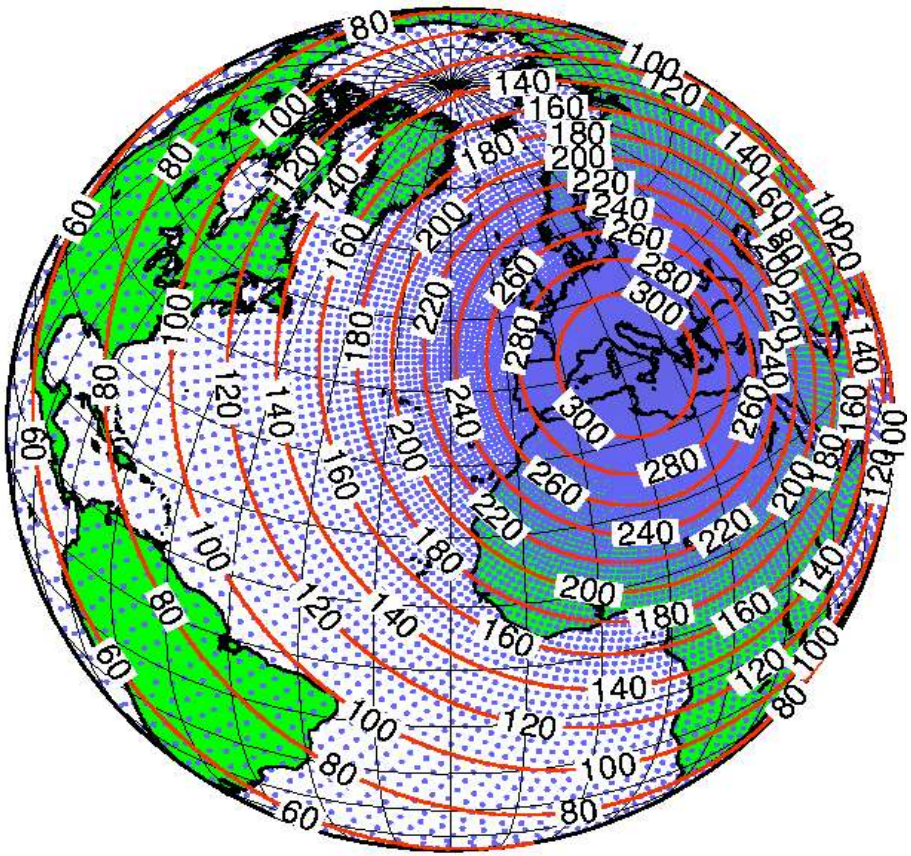


Obs.

Regional projections of climate scenarios (models used)

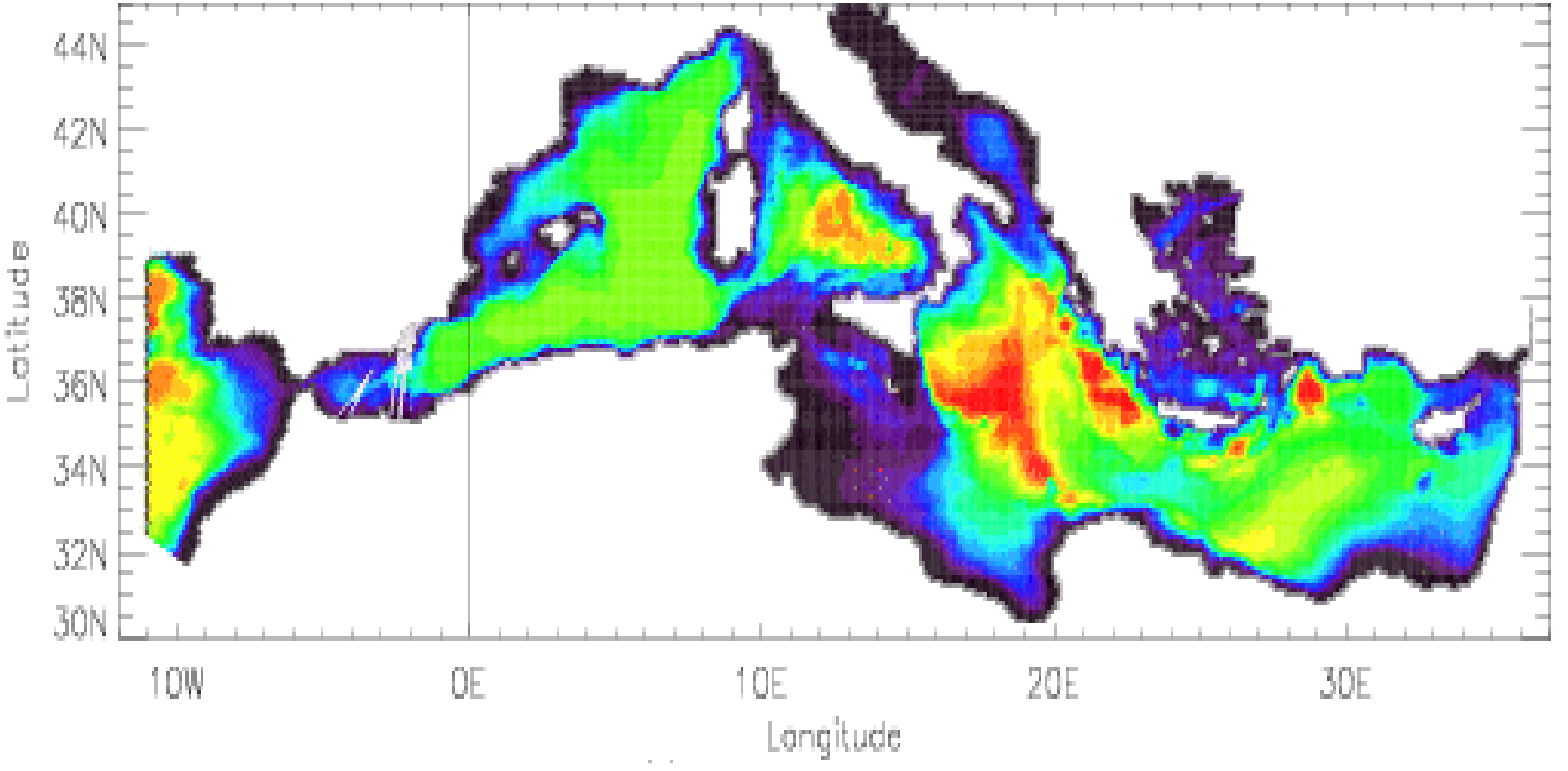


LMDZ-Mediterranean
(IPSL, Paris)

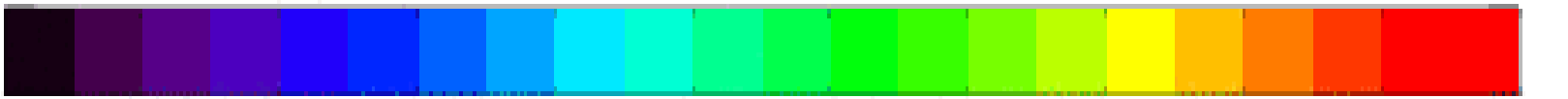


Arpege-Mediterranean
(Météo-France, Toulouse)

MED8: 1/8° (12km), 43 vertical levels



bathymetry



Regional scenarios performed in MedWater

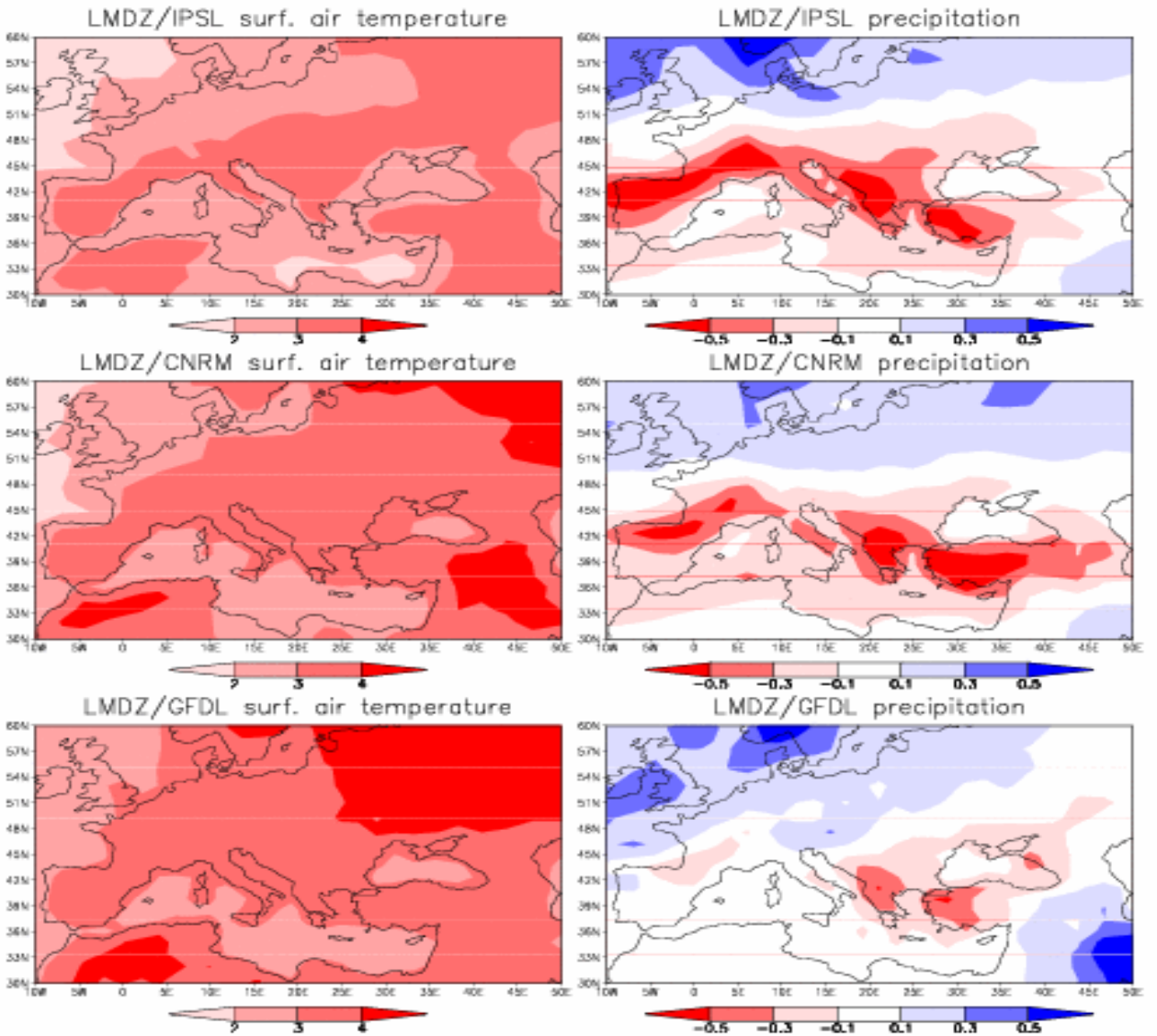
Simulation	Période	Conditions
LMDZ/CTRL	1970/1999	Control simmulation
LMDZ/IPSL	2070/2099	Emission scenario A2 / Global climate model IPSL
LMDZ/CNRM	2070/2099	Emission scenario A2 / Global climate model CNRM
LMDZ/GFDL	2070/2099	Emission scenario A2 / Global climate model GFDL
Arpege/CTRL	1970/1999	Control simulation
Arpege/CNRM	2070/2099	Emission scenario A2 / Global climate model CNRM

Changes of surface air temperature and precipitation in LMDZ

LMDZ/IPSL

LMDZ/CNRM

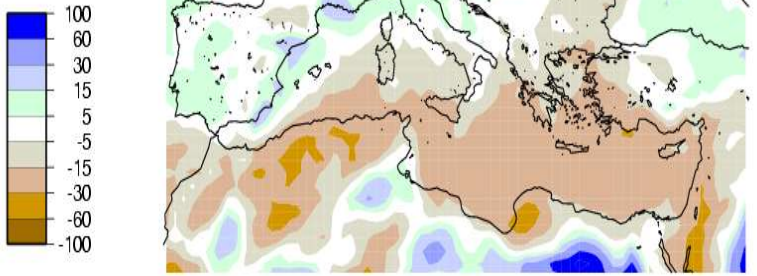
LMDZ/GFDL



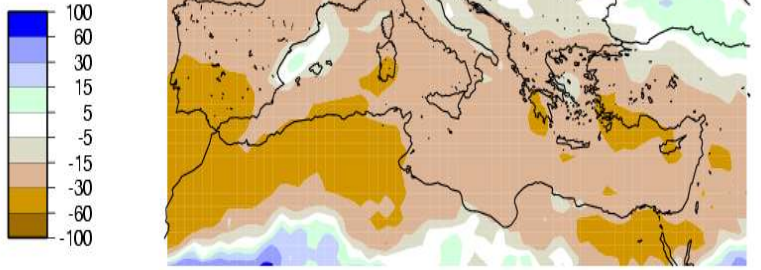
T

P

Relative changes of precipitation in Arpege for 2100

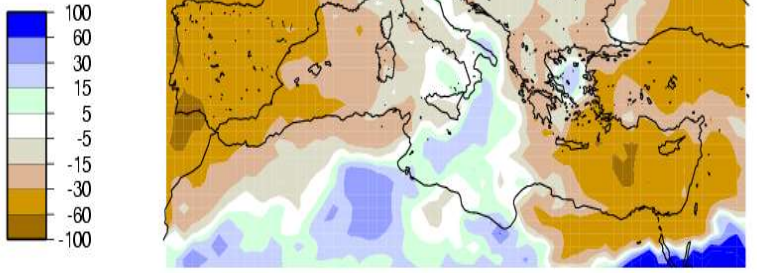


Winter

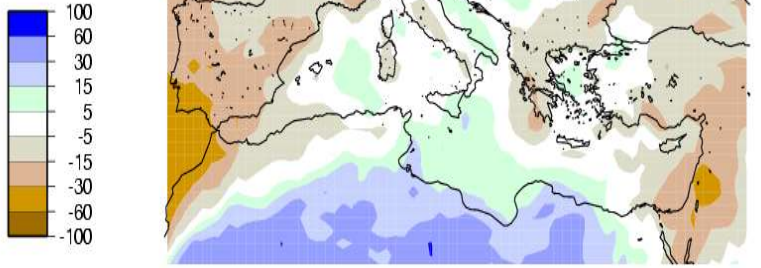


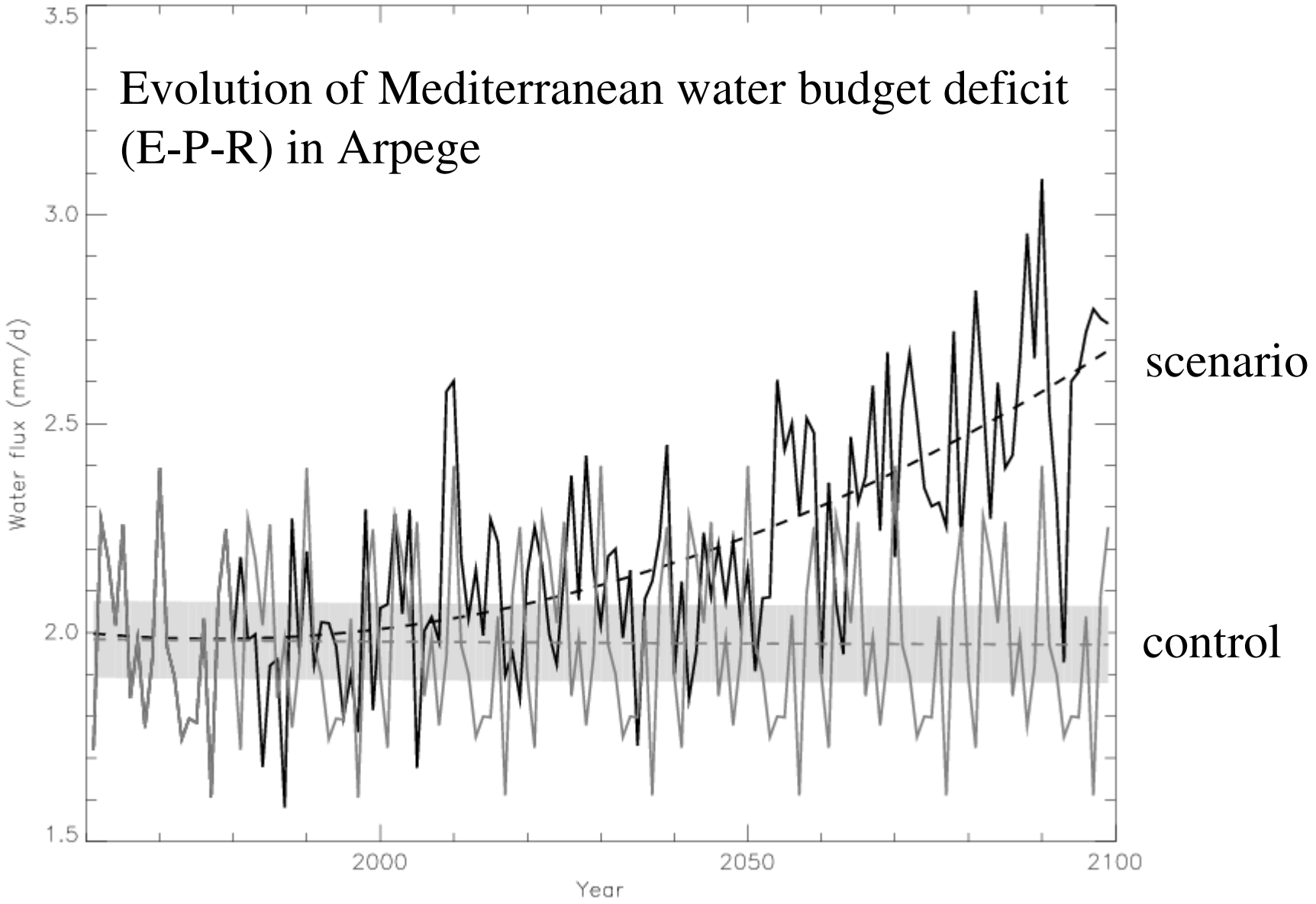
Spring

Summer



Automne




Evolution of Mediterranean water budget deficit (E-P-R) in Arpege
3.5
3.0
2.5
2.0
1.5
Water flux (mm/d)
2000
2050
2100
Year
scenario
control

Changes (2100-2000) of water and heat budgets for the 4 scenarios (IPCC-A2) and for the whole Med. Sea

	LMDZ/IPSL	LMDZ/CNRM	LMDZ/GFDL	Arpège/CNRM
E (mm/year)	39	57	-7	120
P (mm/year)	-57	-74	-20	-60
E-P (mm/year)	96	131	13	180
Heat budget(W/m2)	3,6	5,8	11,9	4,9

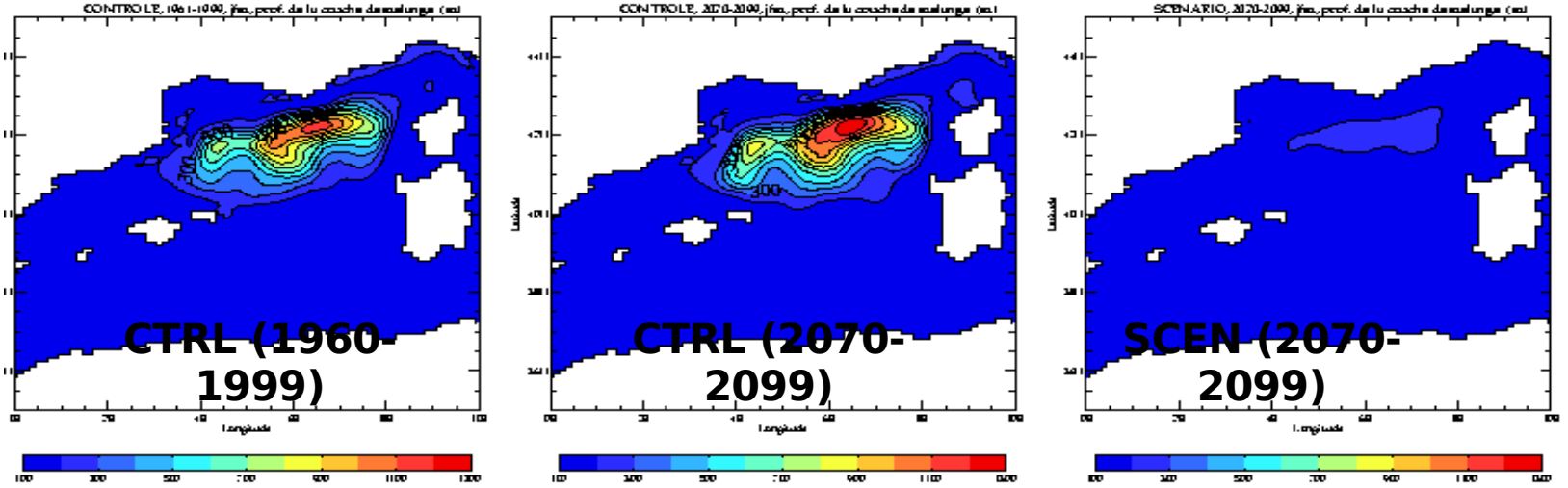
Both water deficit and heat budget increase

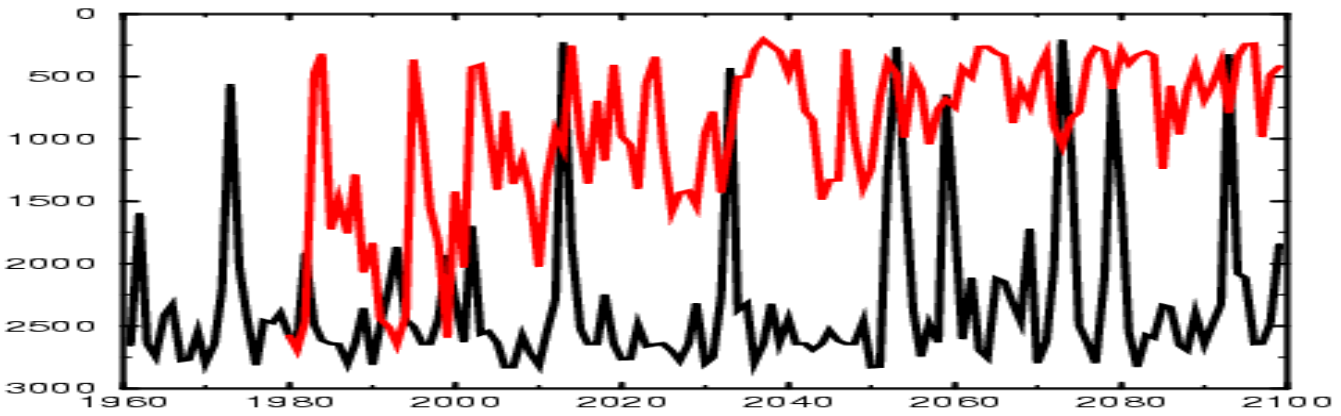
T and S in control simulations LMDZ, Arpege and their variations (2100-2000) for the 4 scenarios

	Temperature (°C)			Salinity (PSU)		
	total	0/250m	250m/bot	total	0/250m	250m/bot
LMDZ/CTRL	13,91	15,33	13.79	38,59	38,43	38,66
Arpege/CTRL	13,2	14,2	13,1	38,61	38,27	38,66
LMDZ/IPSL	0,31	1,25	0,15	0,02	0,08	0,00
LMDZ/CNRM	0,43	1,81	0,20	0,02	0,09	0,00
LMDZ/GFDL	0,49	2,13	0,22	0,02	0,07	0,00
Arpege/CNRM	1,0	2,0	0,8	0,18	0,31	0,16

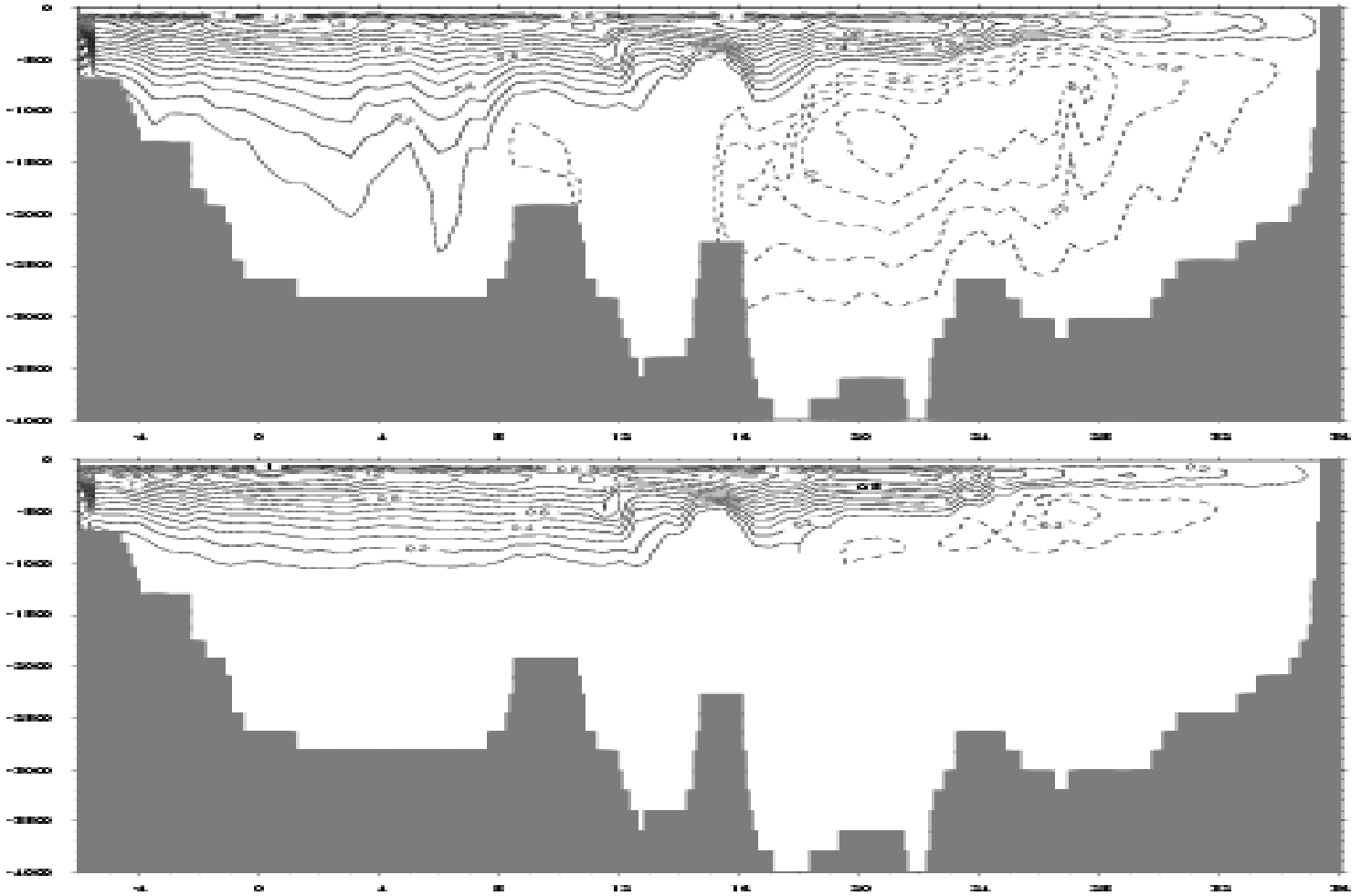
Increase of both temperature and salinity in the Med. Sea

Mixed layer depth in the Gulf of Lion: drastic decrease of the Mediterranean convection





Mediterranean zonal overturning stream function



2000

2100

Decrease of MAW, LIW and EMDW.

WMDW also decreases, but it is not visible here

Water fluxes in the Gibraltar Strait and their properties in control run and the 4 scenarios for 2100

	Surface inflow			Deep outflow		
	transport	temper.	salinity	transport	temper.	salinity
LMDZ/CTRL	0,656 Sv	16,44°	36,45 psu	0,656 Sv	13,53°C	38,256
LMDZ/IPSL	0,586 Sv	16,46°	36,45 psu	0,586 Sv	14,68°C	38,41
LMDZ/CNRM	0,529 Sv	16,60°	36,44 psu	0,529 Sv	15,10°C	38,39
LMDZ/GFDL	0,506 Sv	16,69°	36,44 psu	0,506 Sv	15,37°C	38,35
Arpege/CTRL	1,18 Sv	15,69°C	36,35 psu	1,18 Sv	12,43°C	38,28 psu
Arpege/CNRM	1,09 Sv	17,09°C	36,54 psu	1,09 Sv	14,44°C	38,72 psu

Decrease of both inflow and outflow in the Gibraltar Strait.

Warmer and saltier outflow water exported from the Med. Sea

Future development (MedWater-II): Regional coupled climate system modelling

Cooperations, in particular:

1) Extension to other models (atmosphere and ocean)

2) Extension to other communities
(impact-oriented and academic research-oriented)