Climate activities at Météo-France

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WGNE meeting – 6 November 2012

Climate activities at Météo-France

- **Climate modelling**
  - The climate system model CNRM-CM is developped in collaboration with CERFACS and IPSL.
  - The atmospheric component ARPEGE-Climat is developped since the end of the 90s from the global weather forecast model ARPEGE resulting from the collaboration of Météo-France with ECMWF.
  - The variable resolution version of ARPEGE-Climat is used for regional climate variability and climate change studies.
  - The ALADIN-Climat limited area model is also a regional climate model developped since 2004 from the Météo-France weather forecast model ALADIN.
  - The NEMO-MED is an adaptation of the NEMO ocean model to the Mediterranean Sea developped in collaboration with IPSL/LOCEAN, ENSTA and Mercator Océan. It is used in uncoupled mode or coupled to regional climate models for regional climate variability and climate change studies.

Climate activities at Météo-France

- **Climate variability studies**
  - Analysis of tropical intraseasonal climate variability (MJO, ITCZ, West african monsoon,…).
  - Study of teleconnections (Eurasian spring snow and indian monsoon, tropical SST and west african precipitation, …).
  - Analysis of european climate variability (role of ocean-air interaction on weather regimes, impact of stratosphere on NAO variability and predictability, ….).
  - Study of extreme events (tropical cyclones, cold spells over Europe, intense precipitation events in the Mediterranean region, …).
  - ……

Climate activities at Météo-France

- **Climate change scenarios at the global scale**
  - Participation to CMIP5 simulation exercise with CNRM-CM5.1: about 9000 simulated years for model evaluation (control simulation, 20e century with different forcings, holocene, LGM), process understanding (CFMIP) and climate projections (RCPs).
  - Analysis of multimodel ensemble (transient climate response, cold spells over Western Europe, …).
  - Participation to COMBINE european project for the development of more accurate climate projections (ice-sheets coupling, interaction between surface processes and carbon cycle, …).
  - Development of CNRM-CM6 (understanding and correction of model systematic errors, coupling to biogeochemical cycle …).

Climate activities at Météo-France

- **Climate change scenarios at the regional scale scale**
  - Climate change senarios with ALADIN-Climat over Europe (ENSEMBLES, 25km) and over France (12km).
  - Estimate of multivariate probability density function of climate change (climate extreme indices vs temperature, precipitation vs temperature).
  - Analysis of the sources of uncertainties in regional climate projections.
  - Simulation of Mediteranean Sea variability with NEMOMED8 (Eastern Mediterranean Transient, convection).
  - Coupled atmosphere / Mediterranean Sea regional climate change scenarios
  - Participation to the CORDEX simulation exercise.
  - Participation to climate impact studies and scenario distribution for emerging climate services (DRIAS).

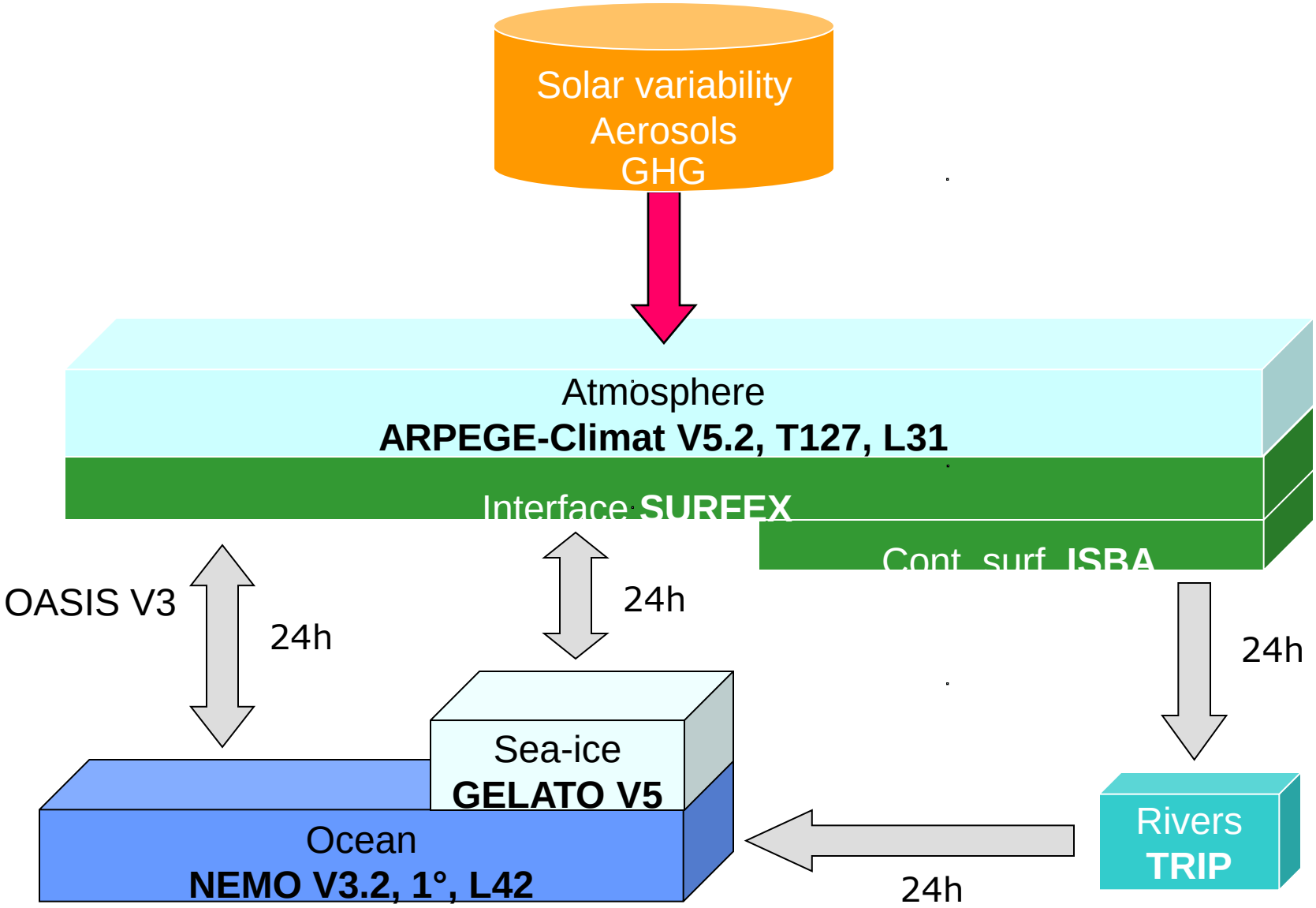
Climate activities at Météo-France

- **Detection and attribution studies**
  - Methodological development adapted to detection and attribution studies at the regional scale (« Regularized Optimal Fingerprint », « Temporal Optimal Fingerprint »).
  - Application of D&A to new variables at the global scale (salinity, continental evapotranspiration, …).
  - Application of D&A at the regional scale (France, Mediterranean area, …).

Climate activities at Météo-France

- **Climate prediction**
  - Participation to intercomparison exercises and projects at the european level (ENSEMBLES, SPECS) and at the international level (CHFP).
  - Development of an operational seasonal forecast system in the context of Eurosip.
  - Analysis of the role of initialisation, surface condition, horizontal and vertical resolution on the predictability.
  - Evaluation of seasonal prediction over specific regions (Africa, Mediterranean area, ..).
  - Development of ensemble forecast methodologies (stochastic forecast).
  - Study of the impact of the stratosphere on predictability from seasonal to decadal scales).

The CNRM-CM5.1 climate system model

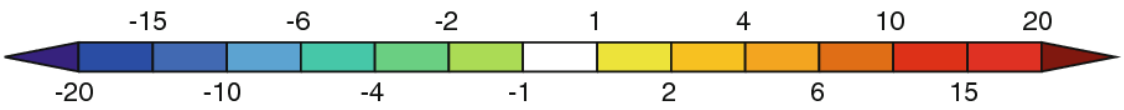


Mean sea level pressures differences to the ERA40 reanalysis averaged over the period 1970-1999 (Hpa)

CNRM-CM3 | CNRM-CM5.1

Winter

Summer

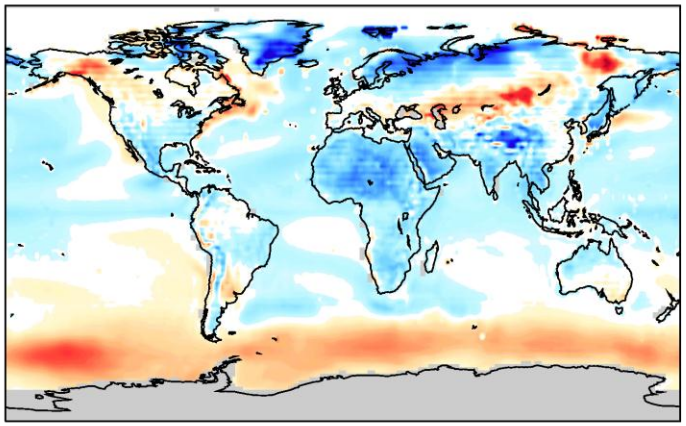


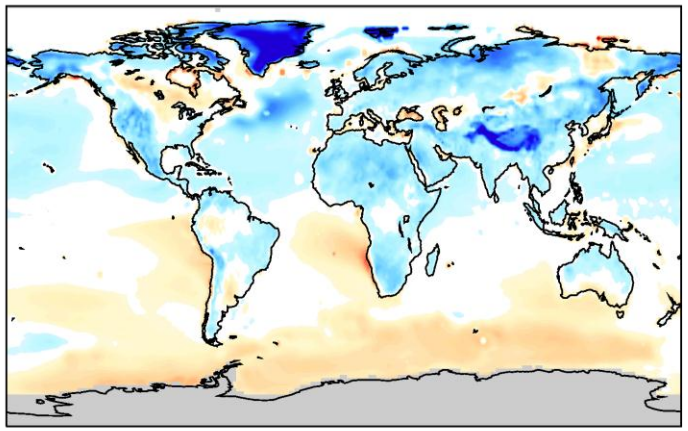
Voldoire et al.,CD, 2012

Surface temperature differences to the CRU and HadSST climatologies averaged over 1970-1999 (°C)

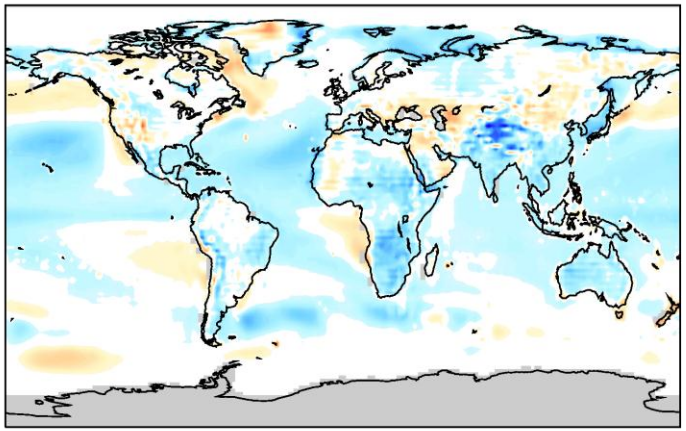
CNRM-CM3 | CNRM-CM5.1

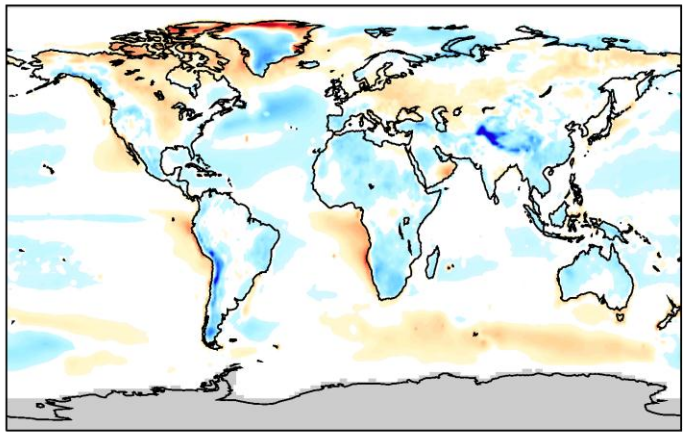
Winter

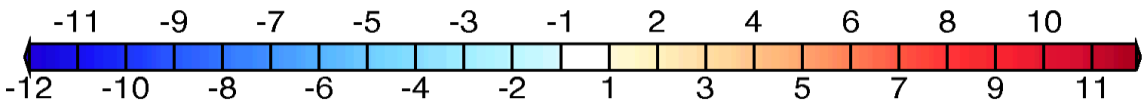




Summer



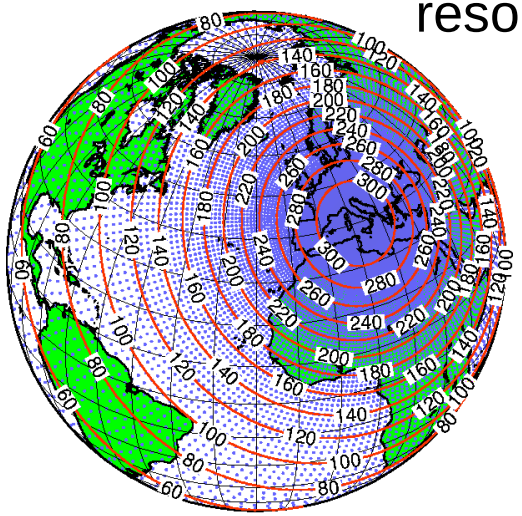




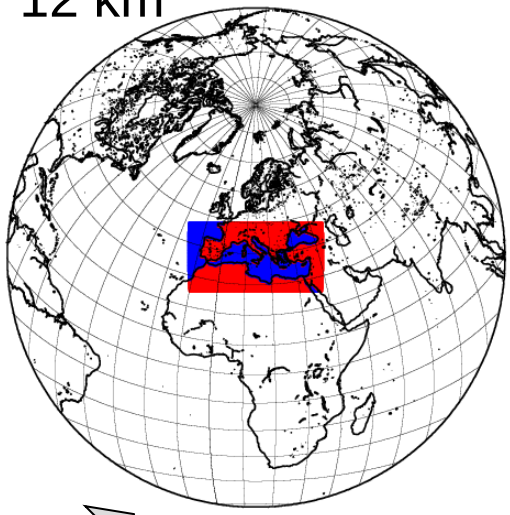
Voldoire et al.,CD, 2012

Climate models for regional climate modelling

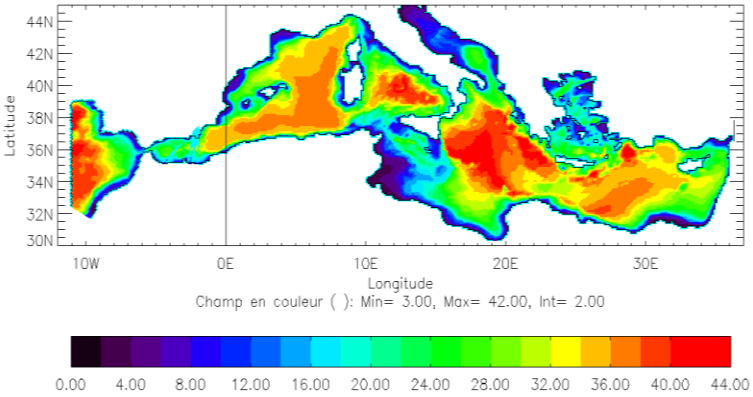
ARPEGE-Climat
resolution 50 km



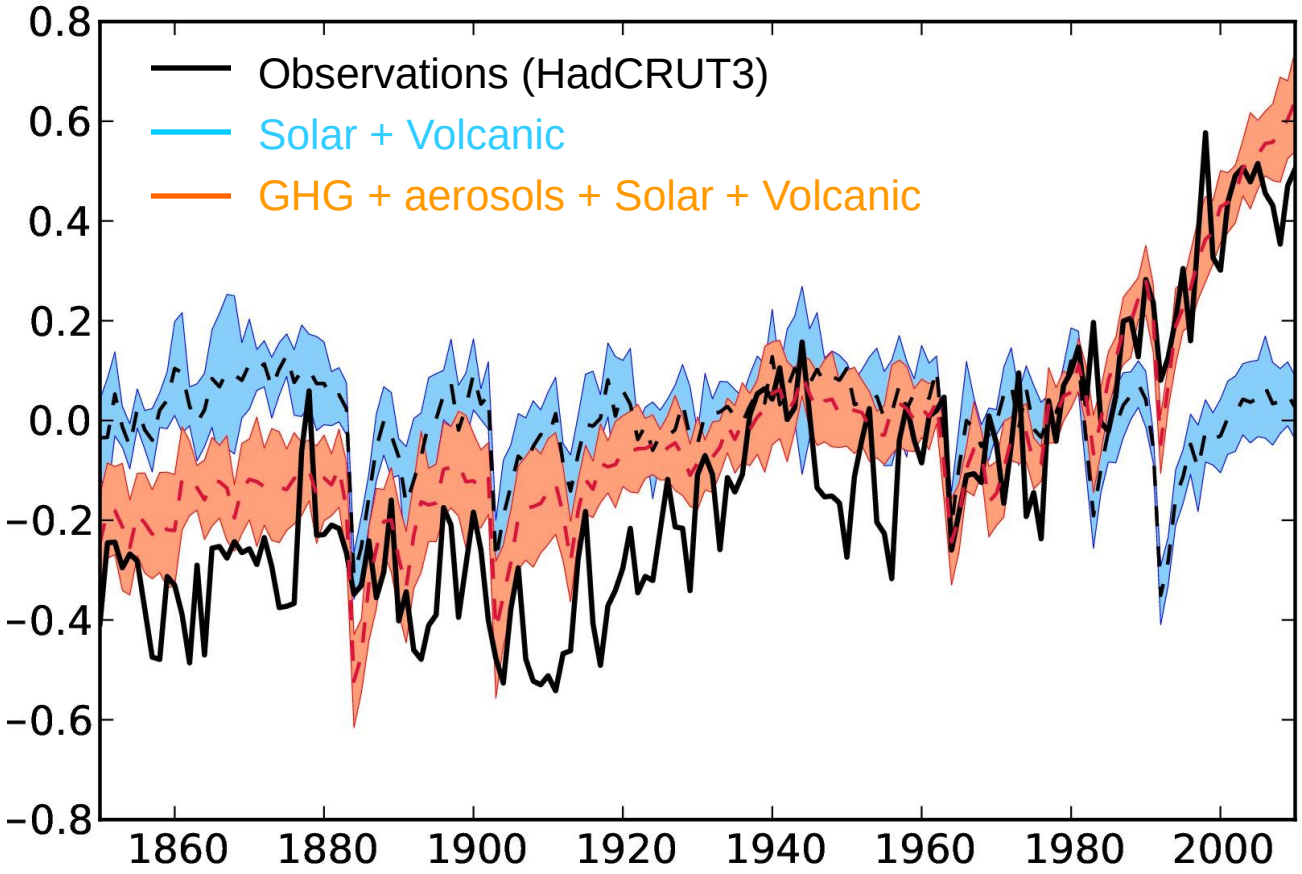
ALADIN-Climat
resolution 25 / 12 km



NEMOMED
resolution ~10 km

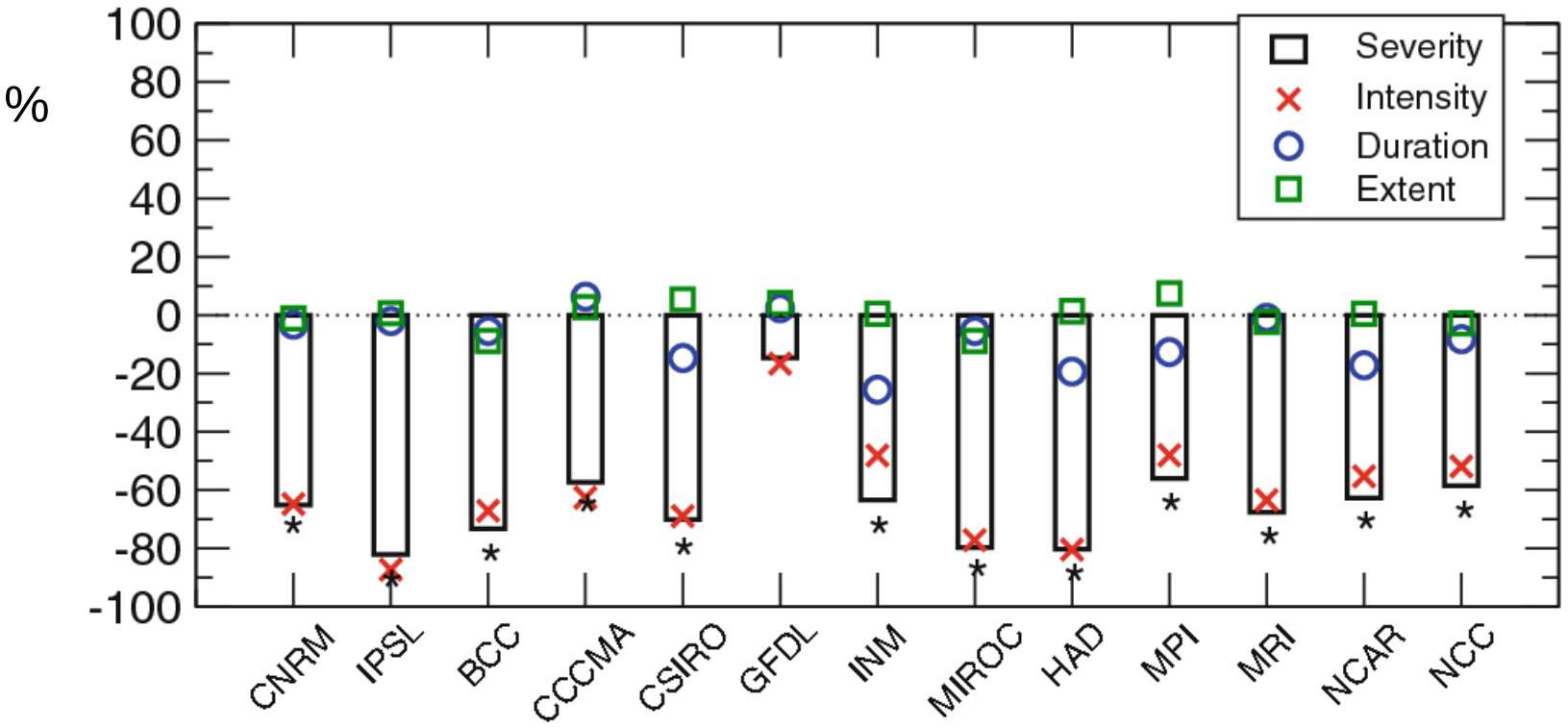


Observed and simulated mean surface temperature with different forcings over the period 1850-2010



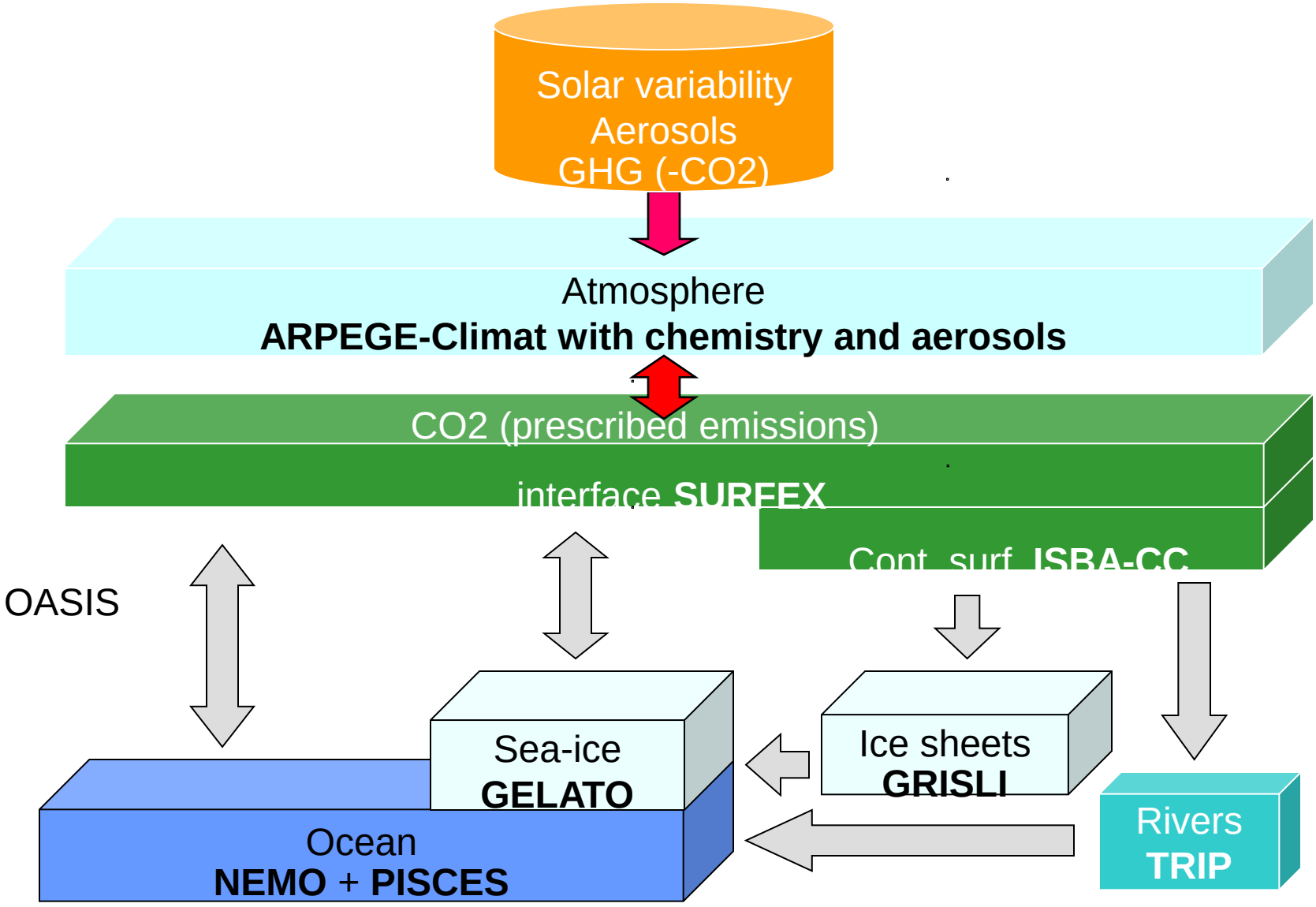
Severity of cold spell days in winter over Western Europe

RCP8.5 projections relative to present
2070-2099 / 1979-2008



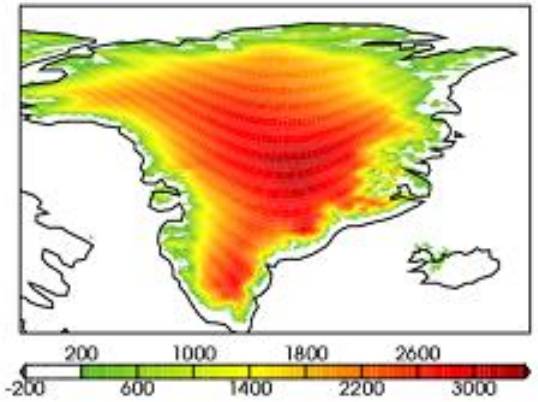
Peing et al., CD, 2012

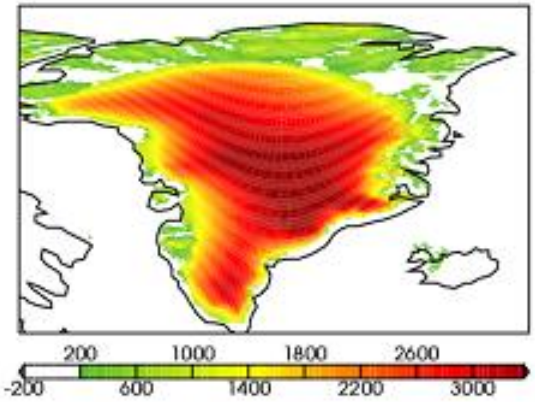
Towards CNRM-CM6



Simulation of ice sheet and sea level

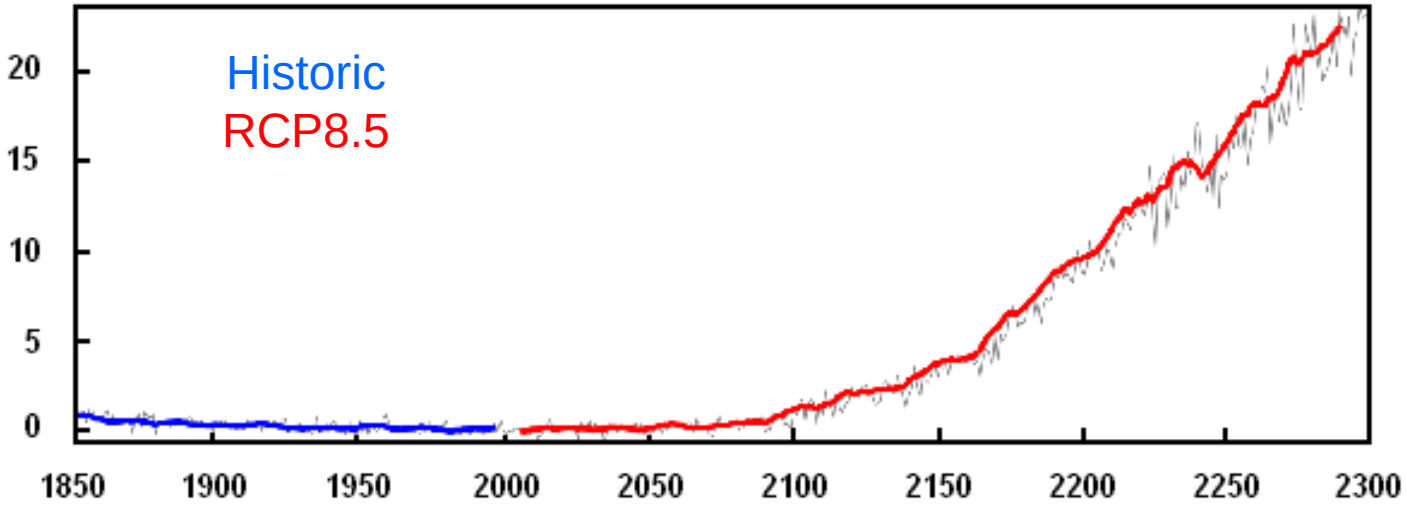
Observed present topography





Simulated topography after 125ky

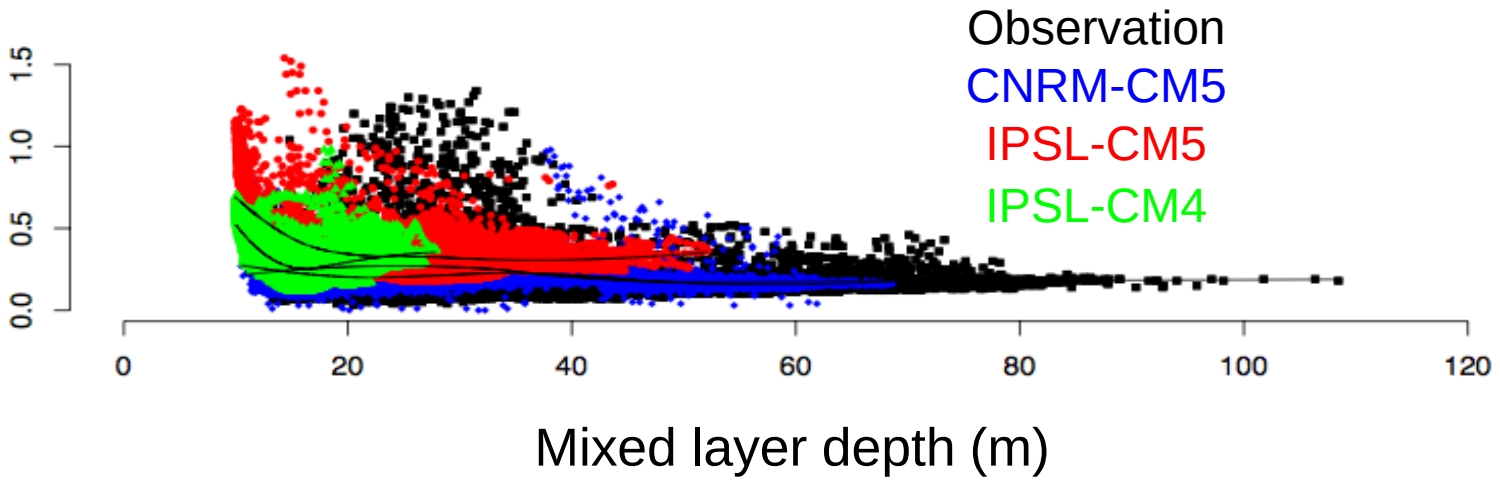
Contribution of Groenland inlandsis melting to sea level rise (mm/y)



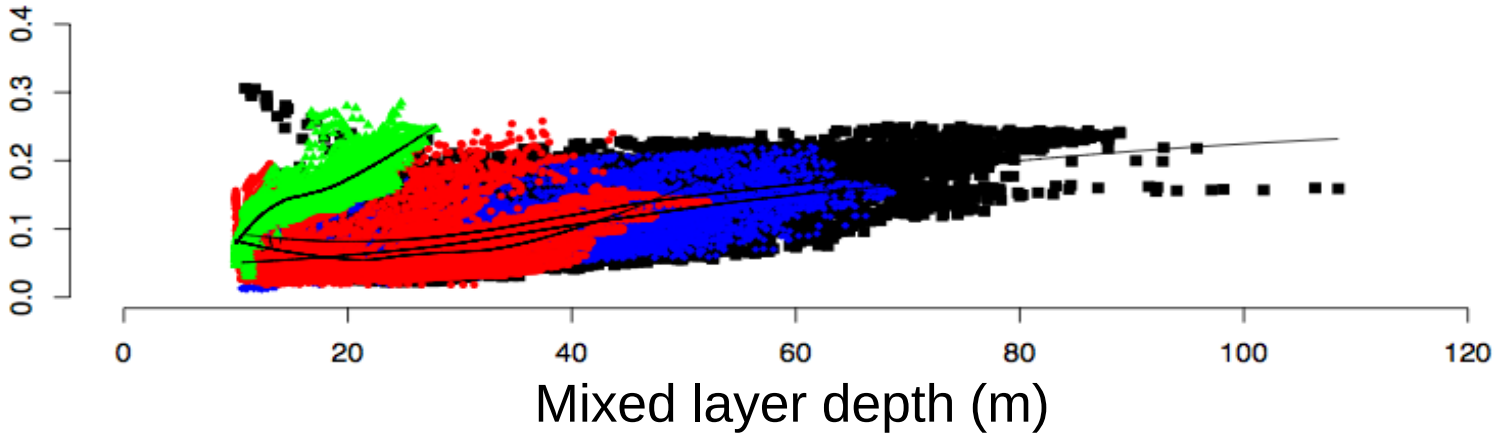
Geyer et al., in prep.

Simulated and observed surface chlorophyll and wind stress vs summer MLD in the Southern Ocean (<30° S)

Surface Chlorophyll (μgChl L^{-1})



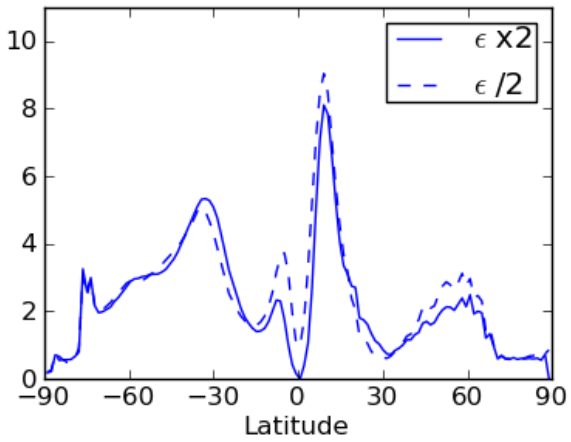
Wind stress (Pa)



Séférian et al., CD, 2012

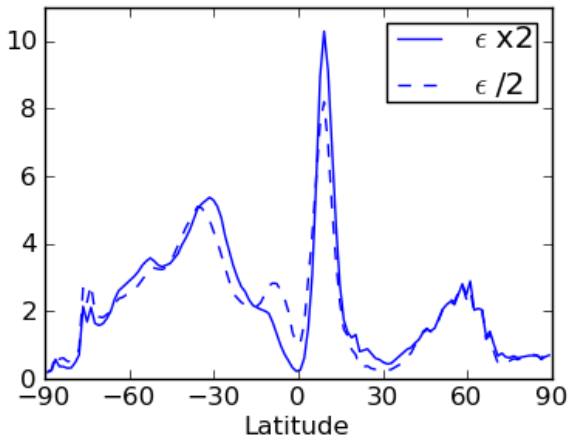
Simulated zonal mean precipitation : sensitivity to lateral entrainment in convective clouds

mm/day



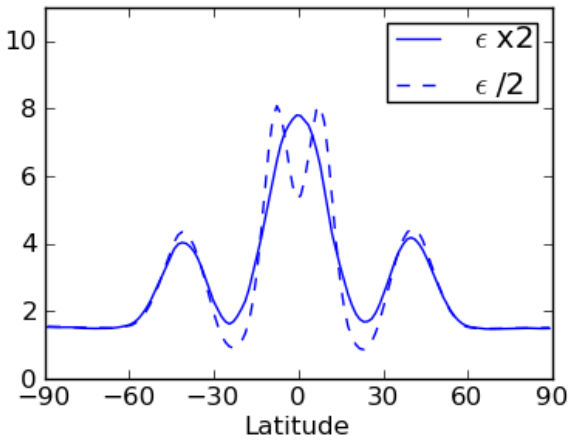
Coupled mode CMIP

mm/day



Uncoupled mode AMIP

mm/day

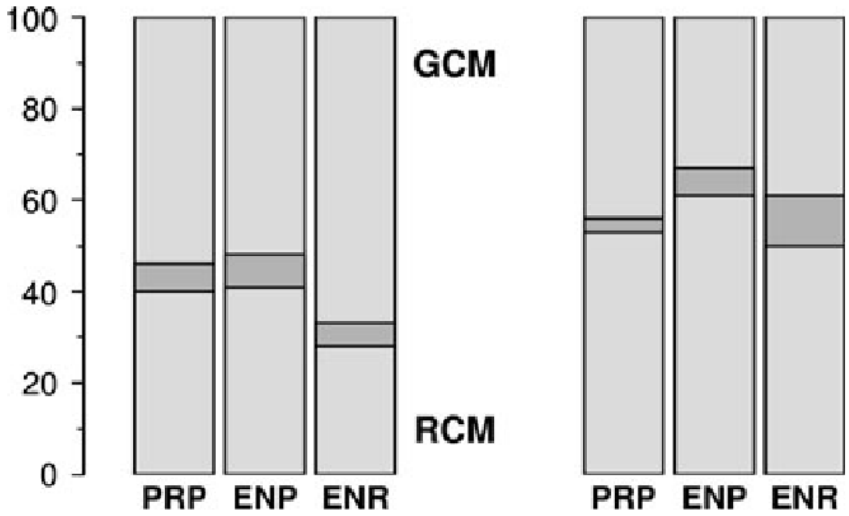


Aqua-planet mode

Oueslati and Bellon, sub., 2012

Uncertainties in regional climate projections over Europe

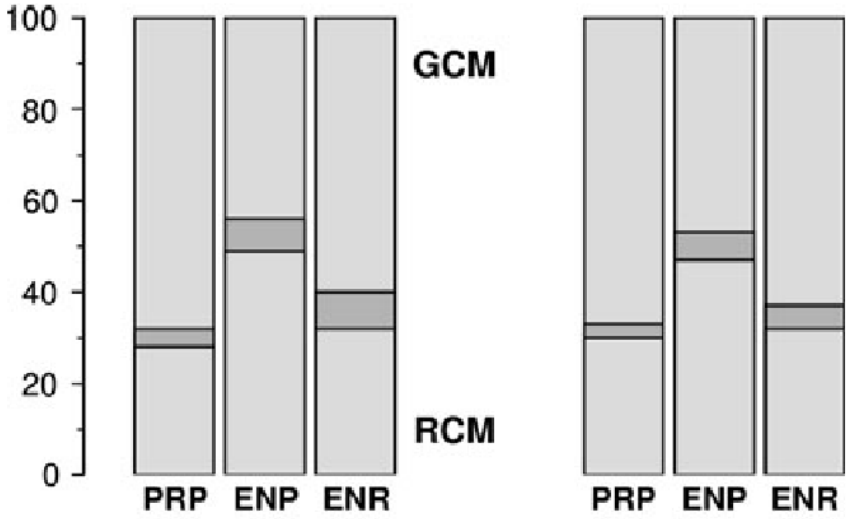
Winter Precipitation



Summer Precipitation

PRP: PRUDENCE, M1 2071-2100
ENP: ENSEMBLES, M1
ENR: ENSEMBLES, M2 2021-2050

Winter Temperature

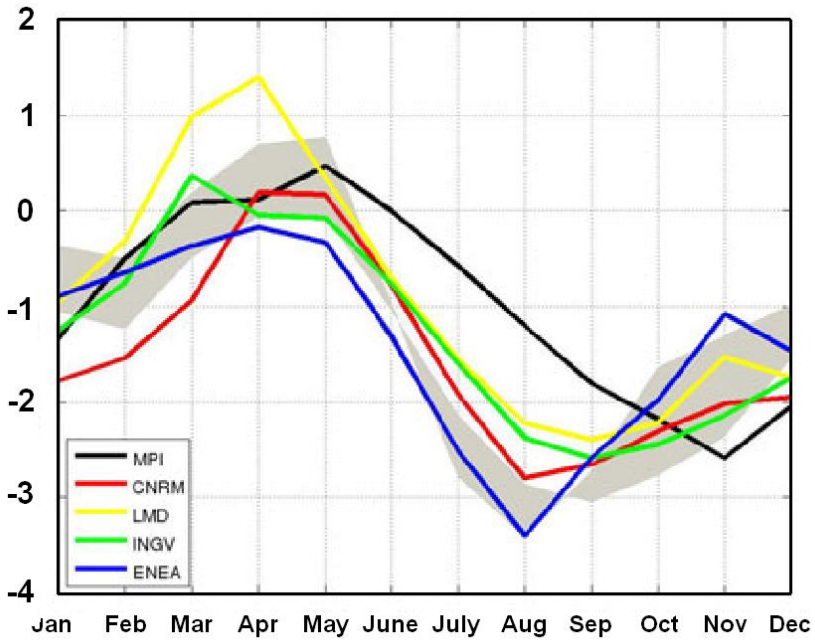


Summer Temperature

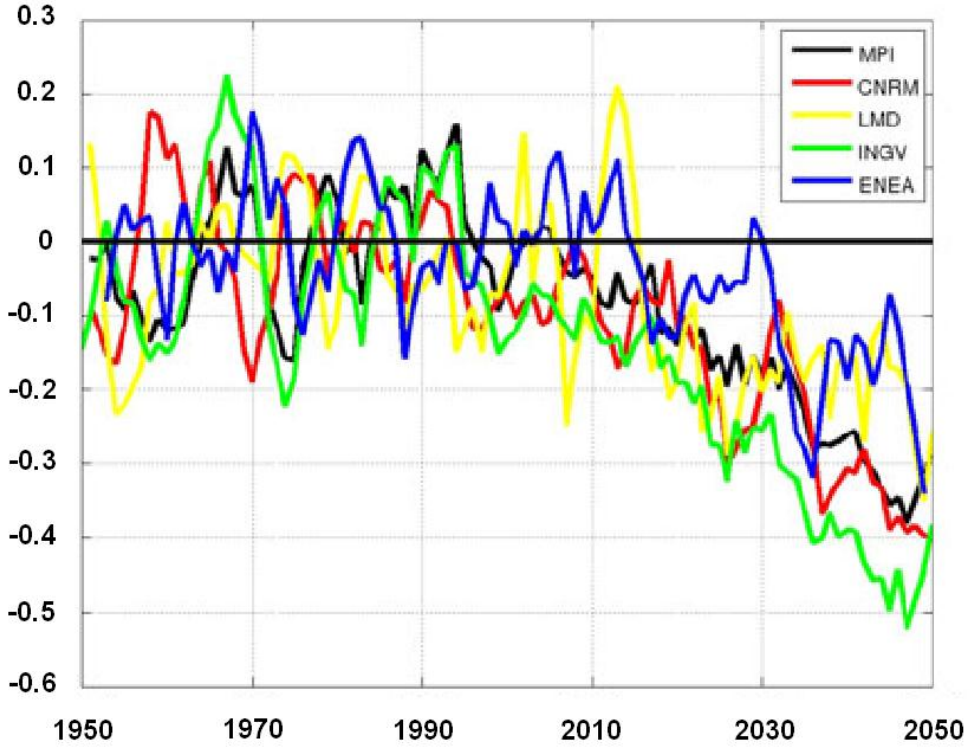
Déqué et al.,CD, 2012

Water budget over the Mediterranean Sea simulated by the coupled regional climate models of the CIRCE project

Annual cycle of the total water flux over 1961-1990 (mm/day)

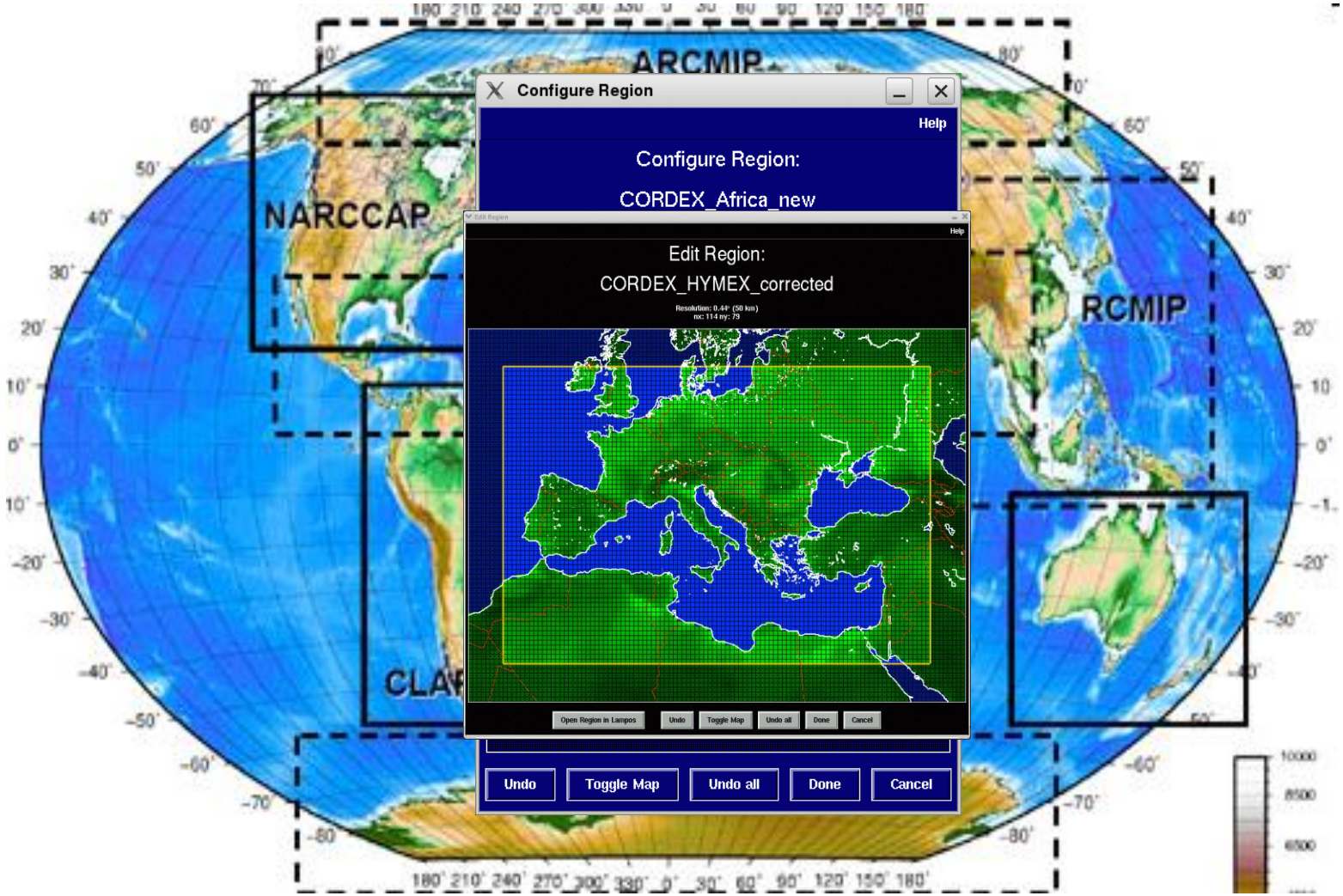


Anomaly of the total water flux / 1961-1990 (mm/day)



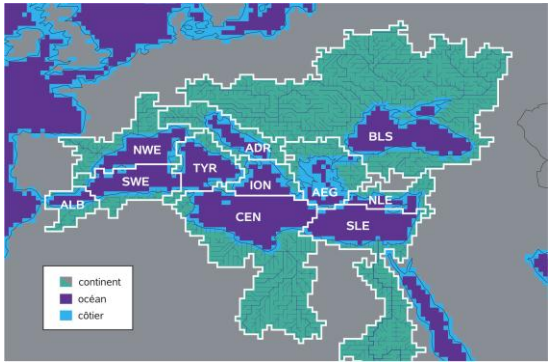
Dubois et al., CD, 2012

Participation to CORDEX intercomparison project

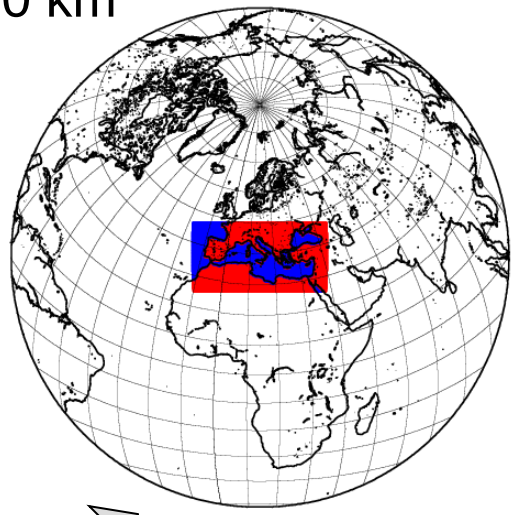


Towards a regional climate system model

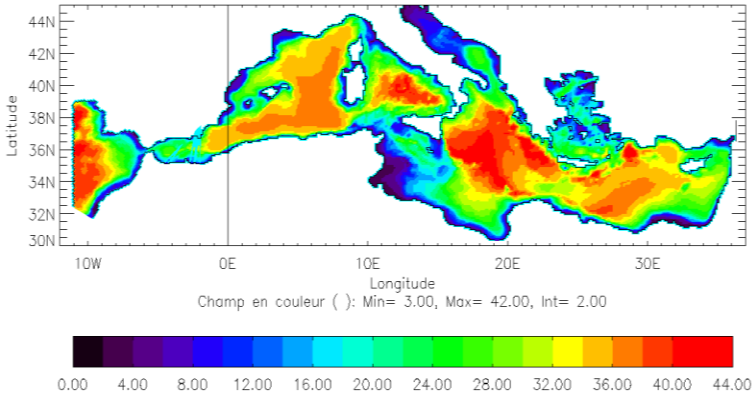
TRIP
résolution 50 km



ALADIN-Climat
résolution 50 km

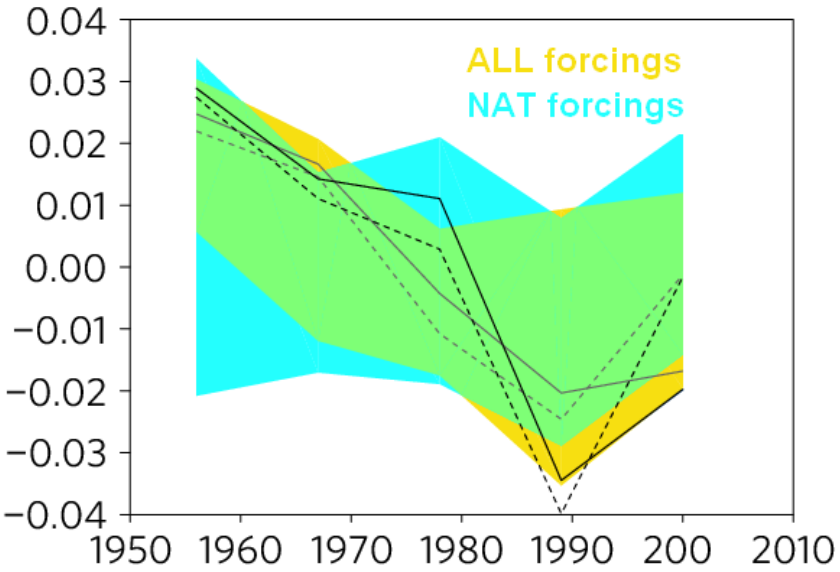


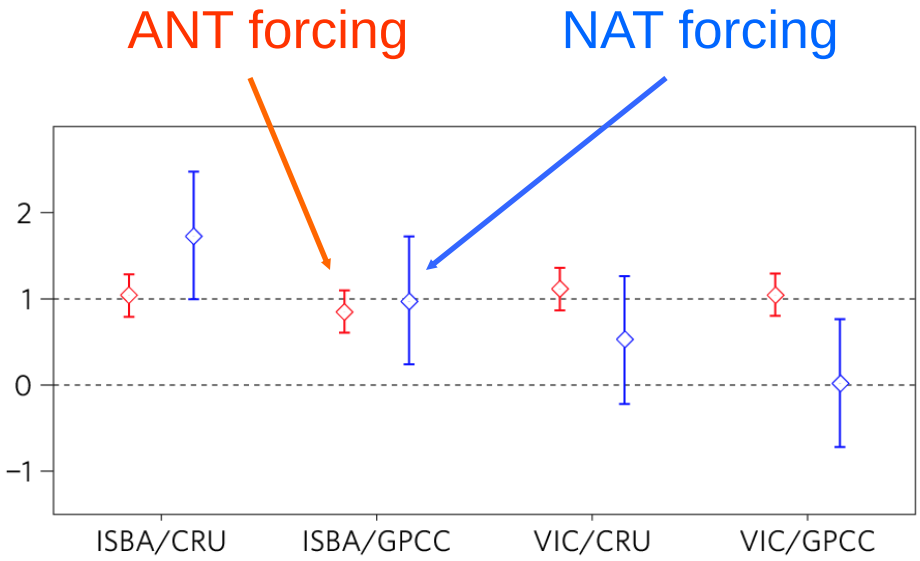
NEMOMED
résolution ~10 km



Anthropogenic influence in global evapotranspiration

Simulated and reconstructed tropical evapotranspiration



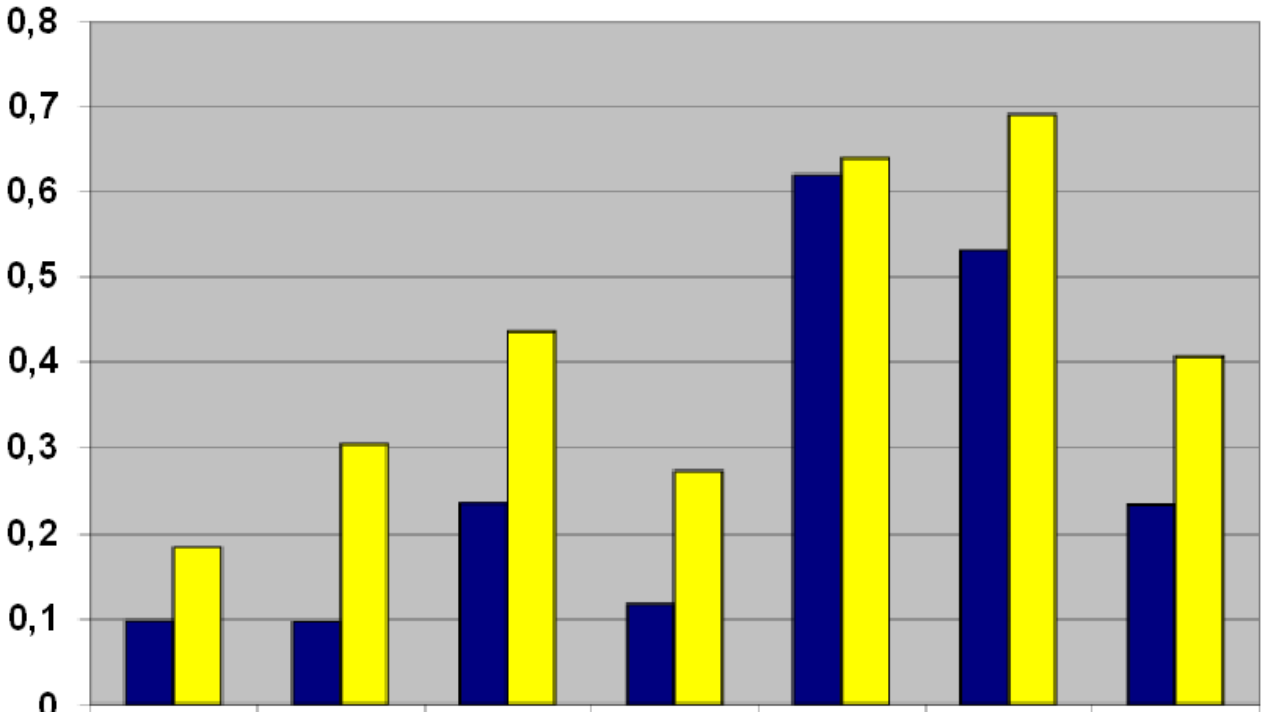


Scaling factor from optimal fingerprint analysis

Douville et al., NCC, 2012

Eurosip Meteo-France systems intercomparison

ACC T2m
JJA
1991-2011



	hnor	hsud	trop	glob	nino34	nino3	nino4
SYS3 (11)	0,097	0,096	0,236	0,117	0,62	0,532	0,234
SYS4 (15)	0,184	0,305	0,437	0,273	0,64	0,691	0,407

A stochastic method for improving seasonal prediction

RMS and ensemble spread for NH Z500

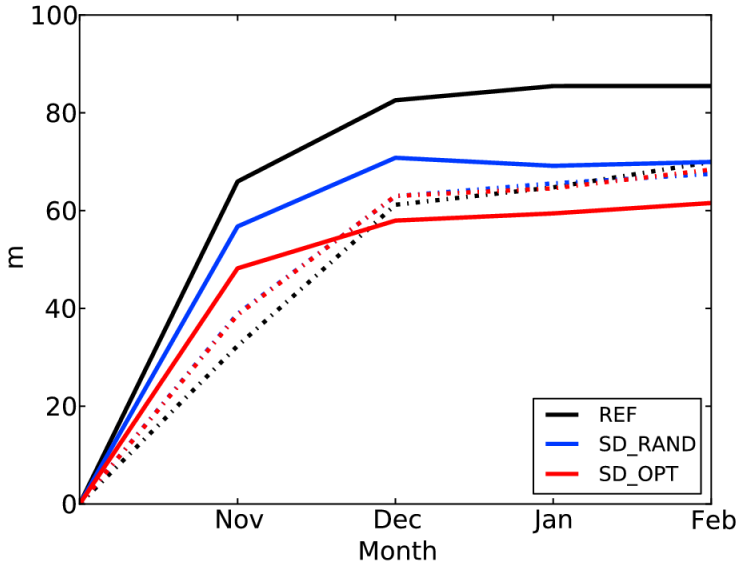


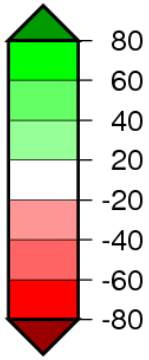
Table 1. Mean ACC Values for REF, SD_RAND and SD_OPT[a]

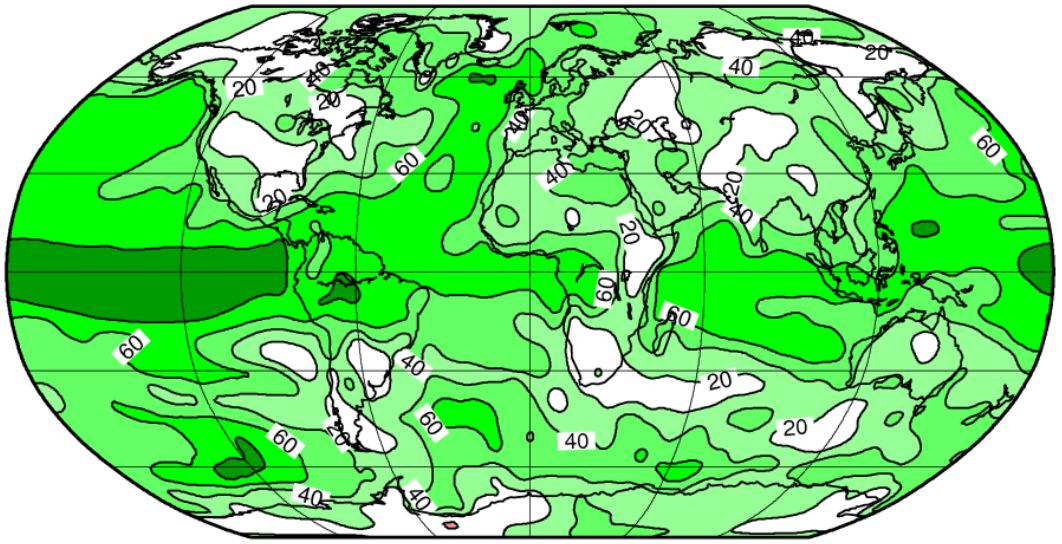
Region	Variable	REF	SD_RAND	SD_OPT
NH[b]	Z500	0.25	**0.37**	**0.65**
Tropics[c]	Precipitation	0.45	0.45	**0.52**
Tropics	T2m	0.47	0.47	**0.51**
Niño 3.4[d]	T2m	0.83	0.81	0.82

Batté and Déqué, GRL, 2012

Anomaly Correlation Coefficient for CNRM-CM T127L91
Winter forecast over the period 1979-2010

Temperature





Precipitation