World Meteorological Organization
Weather · Climate · Water

EGYPTIAN METEOROLOGICAL AUTHORITY

"Climate change outlook over the Mediterranean from the science respective"

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MEDCOF SCOPING MEETING (MADRID, SPAIN, 12 – 14 JUNE 2013)

The Mediterranean encompasses many countries and cultures

The climate of the Mediterranean

Atlantic storms

Temperate-Wet

Topography

Local cyclogenesis

Land-Atmosphere Interactions

Coastlines

Ocean heat source

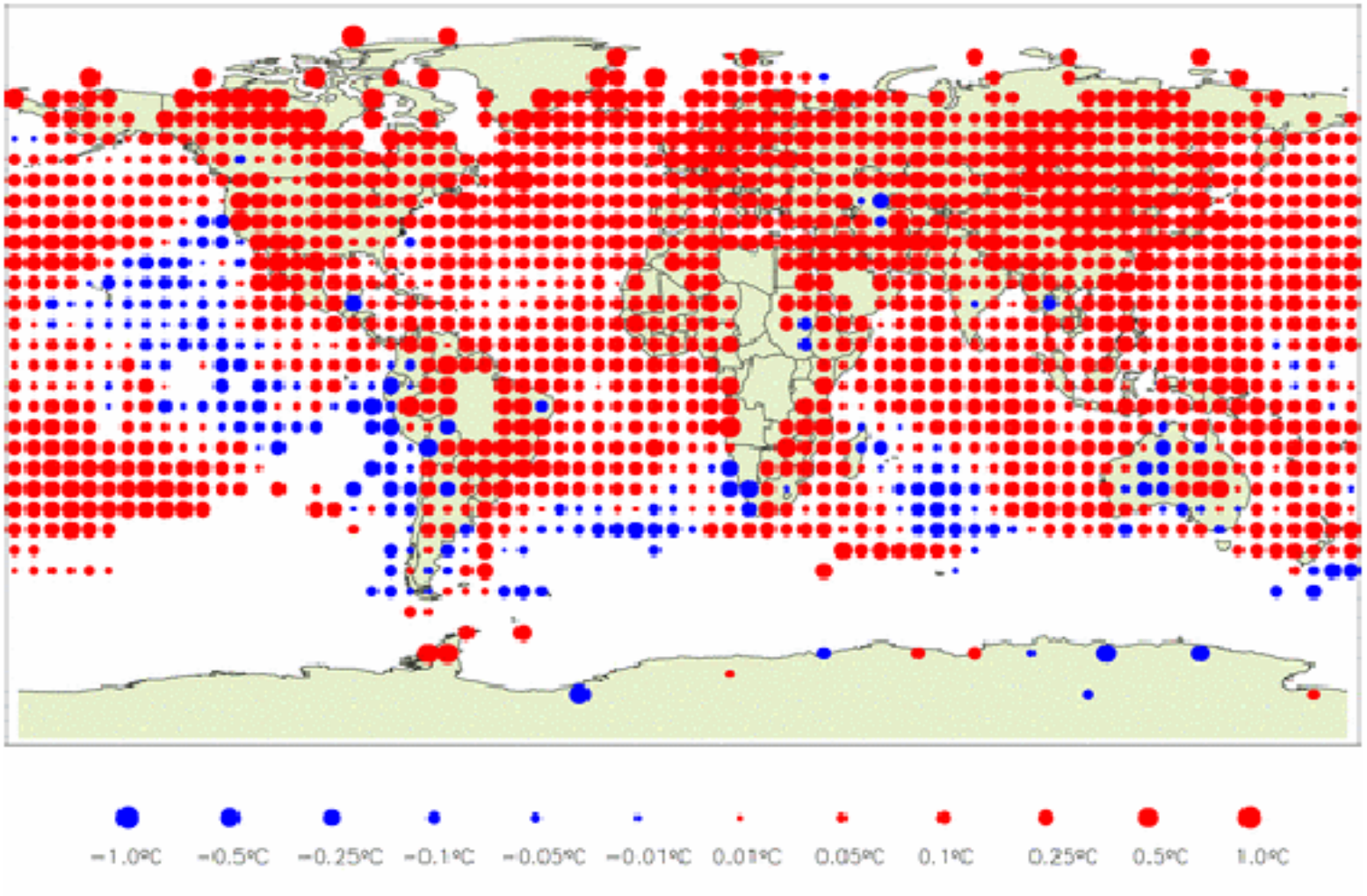
Atmospheric aerosols and desert dust

Marked seasonality
Cold wet winters
Warm dry summers

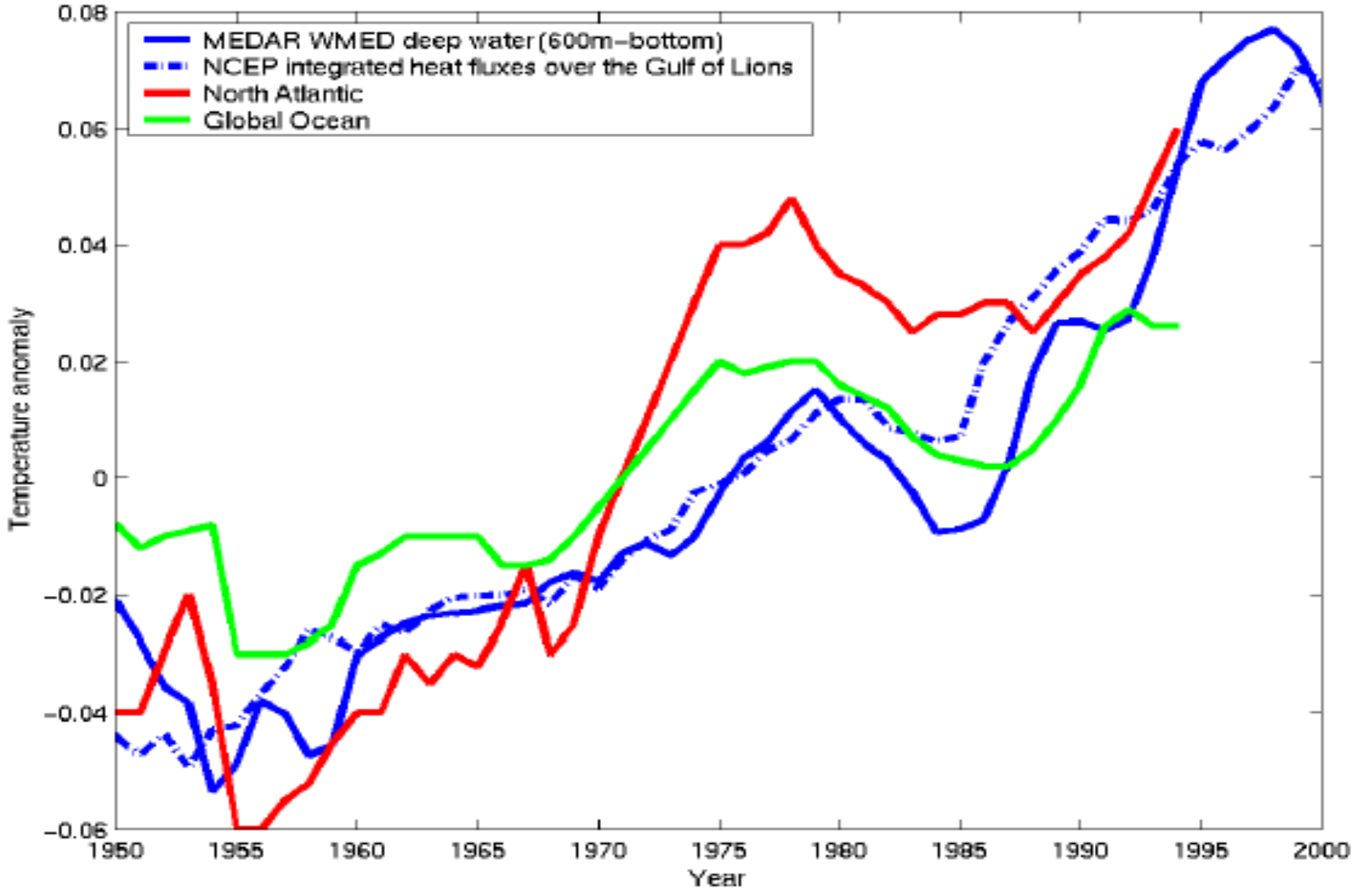
Marked spatial variability

Hot - Dry

Temperature change 1979-2003

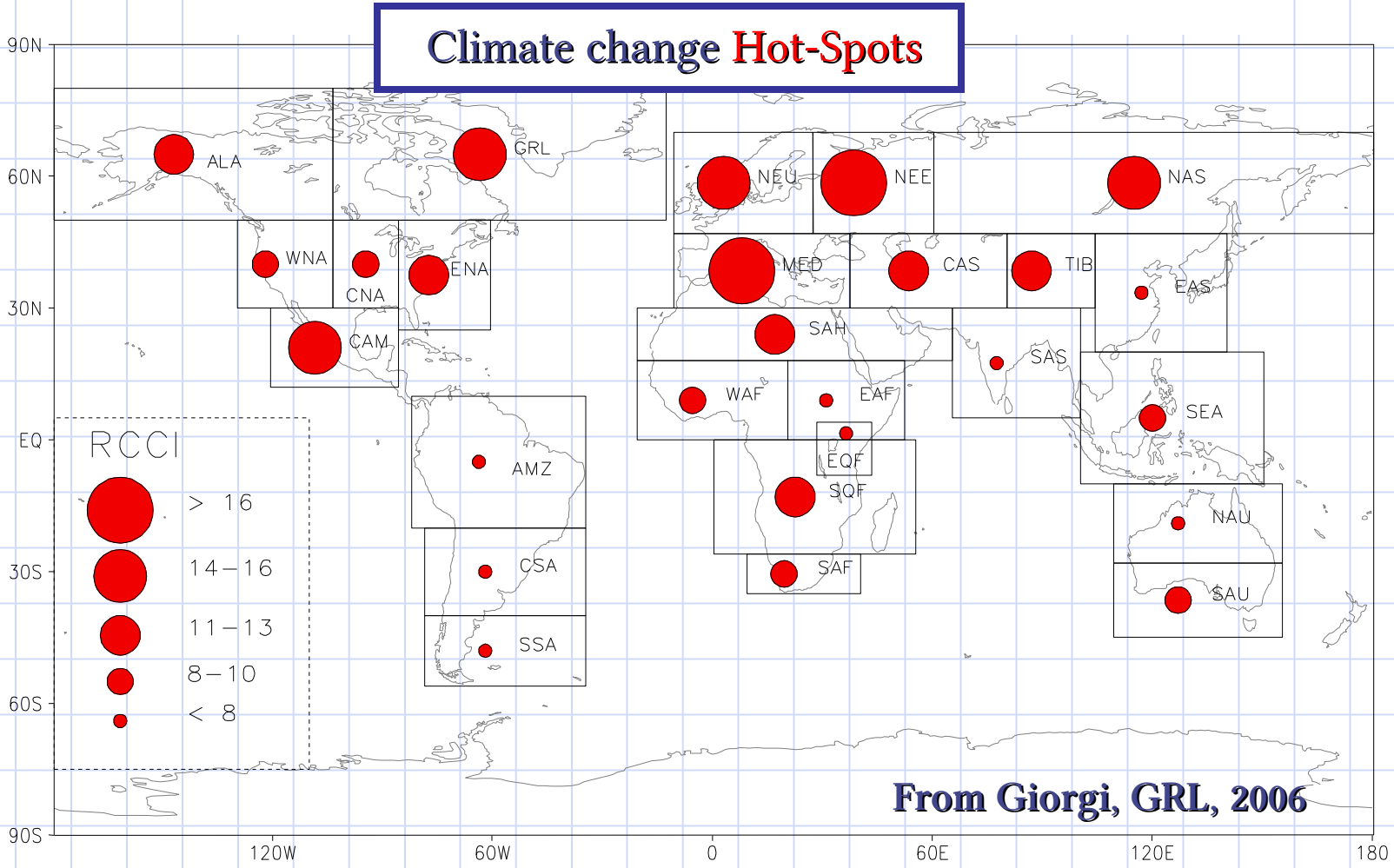


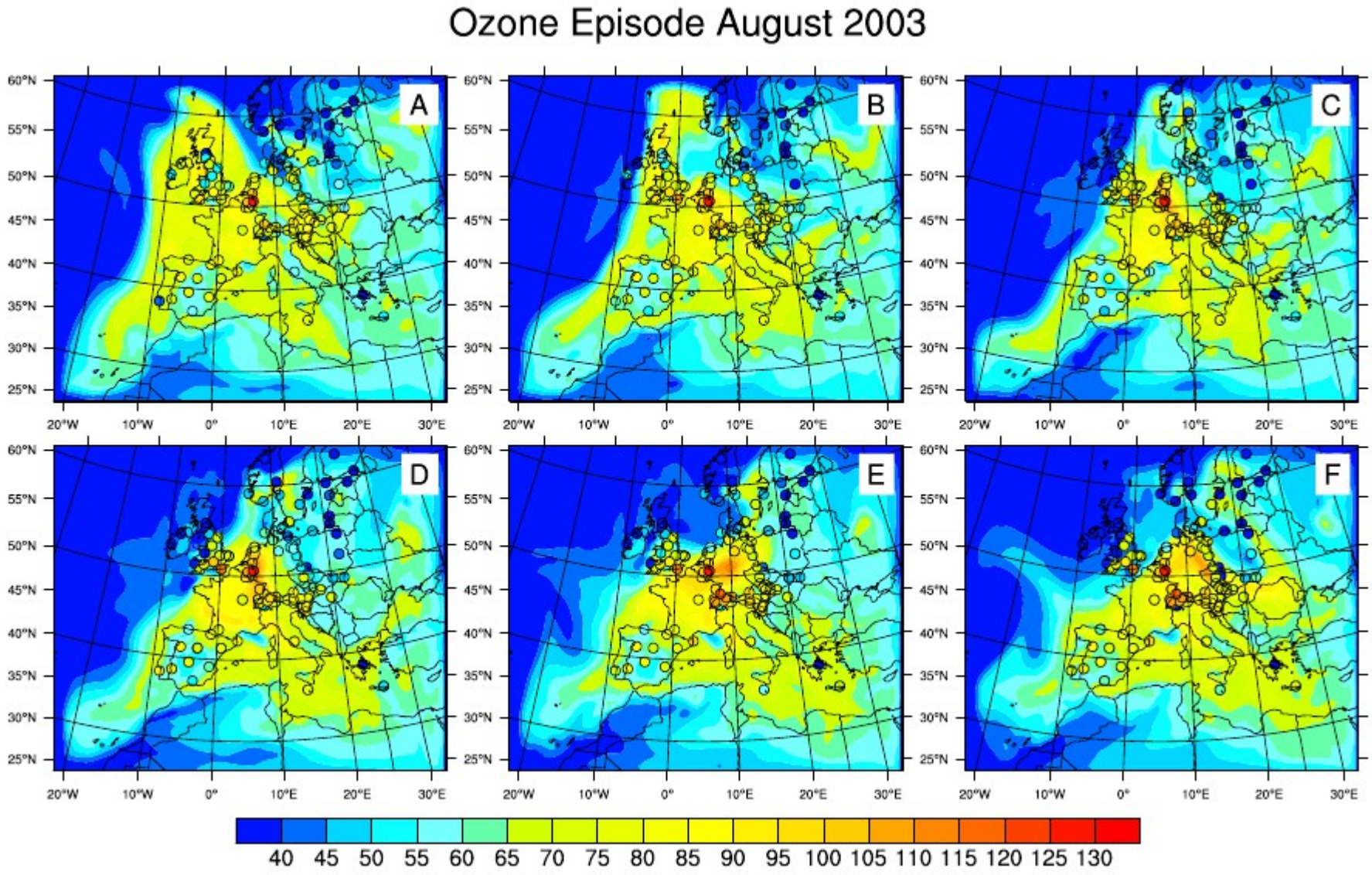
Change in Mediterranean water temperature



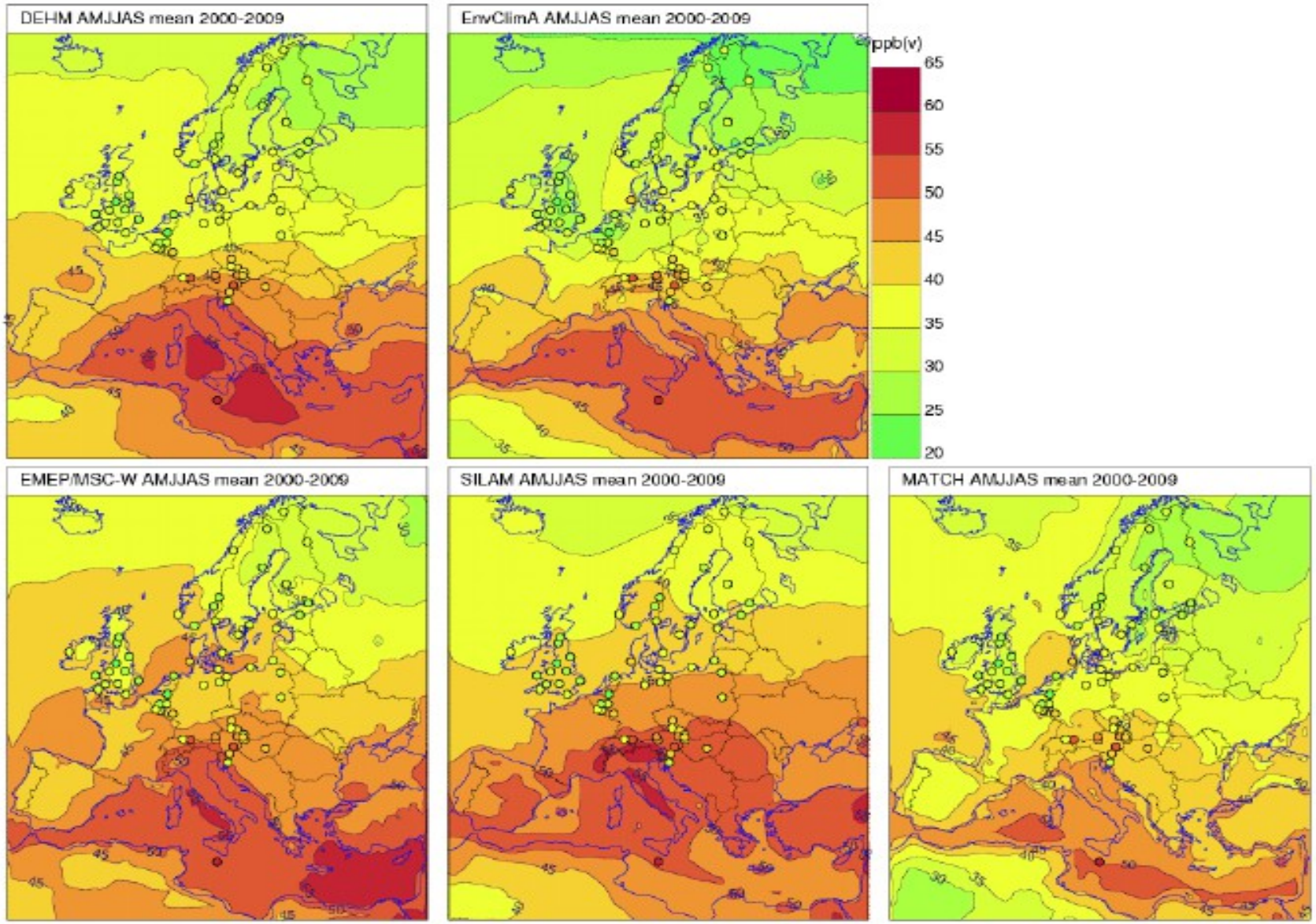
The Mediterranean appears to be particularly responsive to global change

We cannot ignore this problem



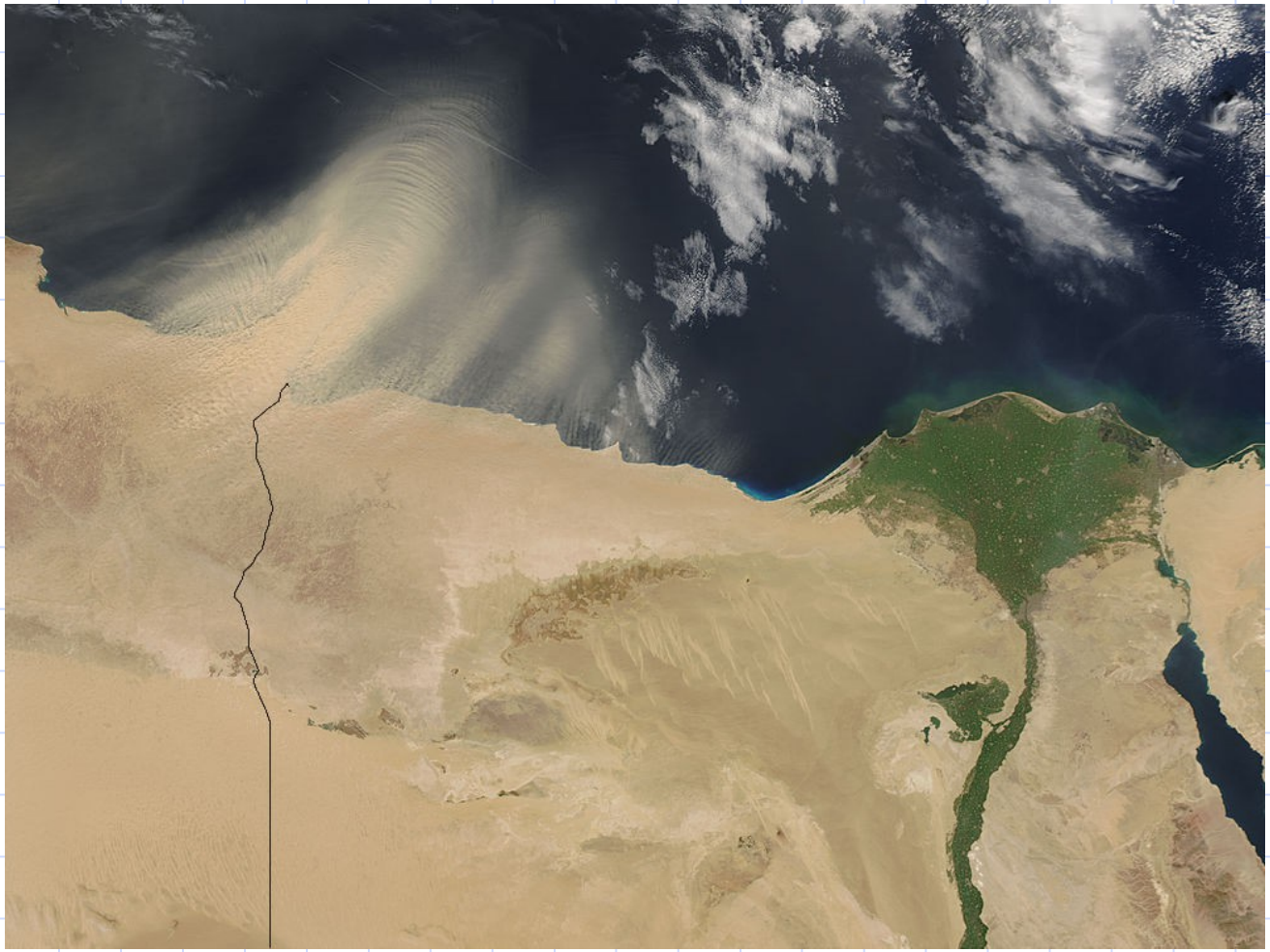


Evolution of the ozone concentration field through the first two weeks of August 2003 corresponding to the core of the August2003 heat wave. Each panel displays a concentration field in ppb at 14 h UT on (a) 1 August, (b) 4 August, (c) 8 August, (d) 10-August, (e) 12 August, (f) 16 August. EMEP station locations are shown in circles with observed ozone concentrations (colour of circle following contour legend).



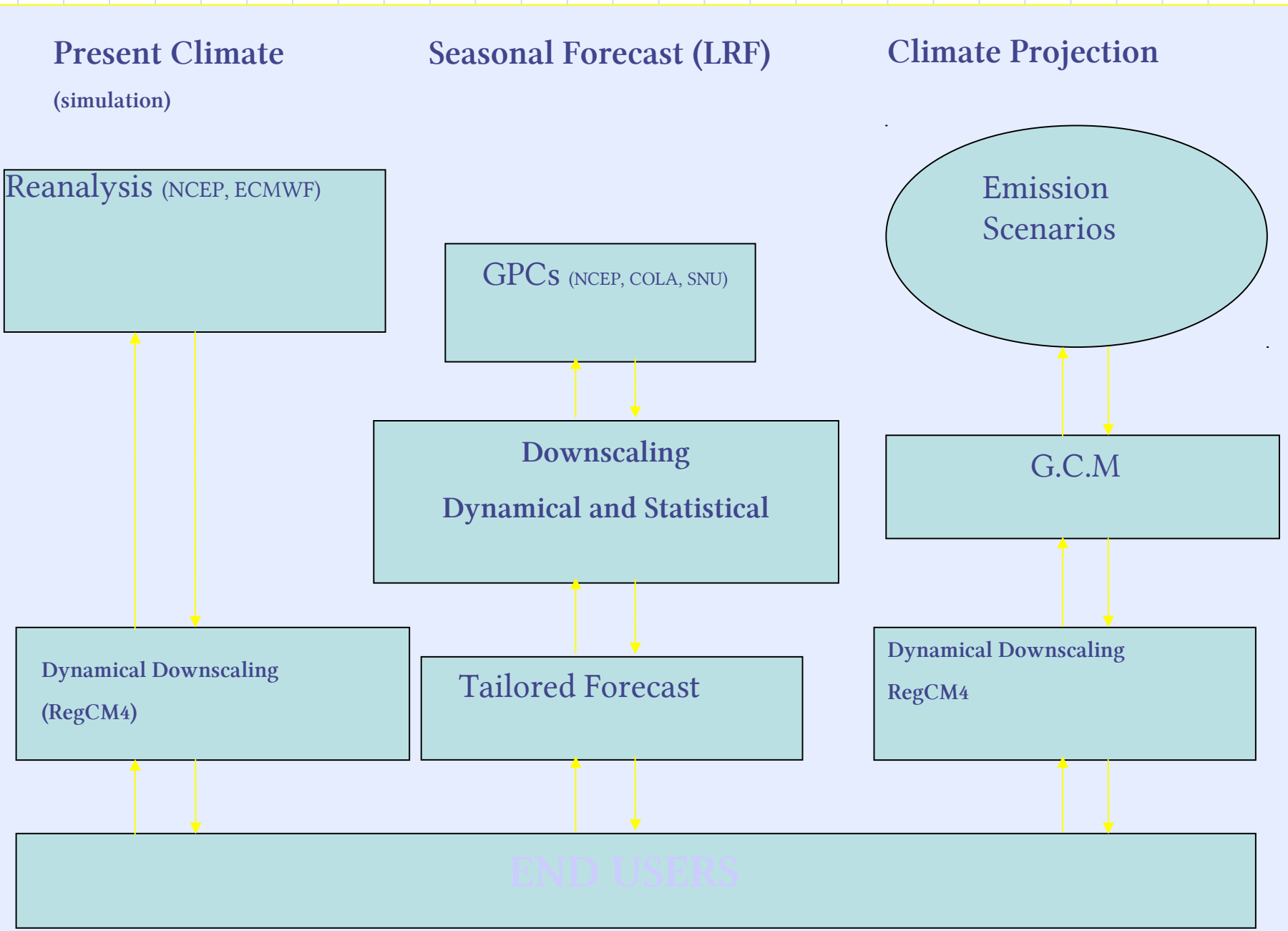
Simulated April–September average O3 concentration at the lowest model level for the period 2000–2009. Coloured circles indicate the observed values at the stations used in the model evaluation.

Emissions: Dust



- Zakey et al. (2006) RegCM Dust scheme with CLM meteorology
- 4 size bins

Credit: Jacques Descloitres, MODIS Rapid Response Team, NASA/GSFC, 28 Feb 2005


Present Climate
(simulation)
Seasonal Forecast (LRF)
Climate Projection
Reanalysis (NCEP, ECMWF)
GPCs (NCEP, COLA, SNU)
Emission Scenarios
Downscaling
Dynamical and Statistical
G.C.M
Dynamical Downscaling
(RegCM4)
Tailored Forecast
Dynamical Downscaling
RegCM4
END USERS

RegCM: Model Description Climate Core

- **Dynamics:**

MM5 Hydrostatic (Grell et al 1994)
Non-hydrostatic (MM5 or WRF, in progress)

- **Radiation:**

CCM3.6.6 (Kiehl 1996)
RRTM (in progress)

- **Large-Scale Clouds & Precipitation:**

SUBEX (Pal et al 2000)

- **Cumulus Convection:**

Grell (1993) + FC80 Closure
Anthes-Kuo (1977)
MIT/Emanuel (1991)
Betts-Miller (1993)
STRACO (in progress)

- **Boundary Layer:**

Holtslag (1990)

- **Nesting:**

Numerous GCM/Reanalysis Interfaces
One-way nesting

- **Biogenic Emiss:**

MEGANE (Twffic, 2010)

- **Tracers/Aerosols:**

Qian et al (2001) – sulfur chem.
Solmon et al (2005) – BC/OC chem.
Zakey(2006,2008) – dust/ sea salt
Shalaby (2010) – gas-phase chem.
(vectoized vers. by Twffic)

- **Land Surface:**

BATS1e (Dickinson et al., 1993)
SUB-BATS (Giorgi et al., 2003)
CLM (Dai et al., 2003, Dai & Bi, in progress)
IBIS (Foley; Winter in progress)

- **Ocean Fluxes:**

BATS1e (Dickinson et al., 1993)
Zeng et al (1998)
Air-Sea Coupling (MITogcm, OASIS coupler, in progress)

- **Computations:**

User-Friendly
Multiple Platforms
Parallel Code

RegCM: Model Description Environment Core

Chemistry:
Condensed CBM-Z gas-phase chemistry (Zaveri and Peters, 1999).

Solver:
Radical balance method (RBM) by (Sillman et al., 1991) and (Barth et al., 2002)

Photolysis rates:
Tropospheric Ultraviolet-Visible Model (Madronich and Flocke, 1999) with cloud cover correction by (Chang et al., 1987)

Dry deposition:

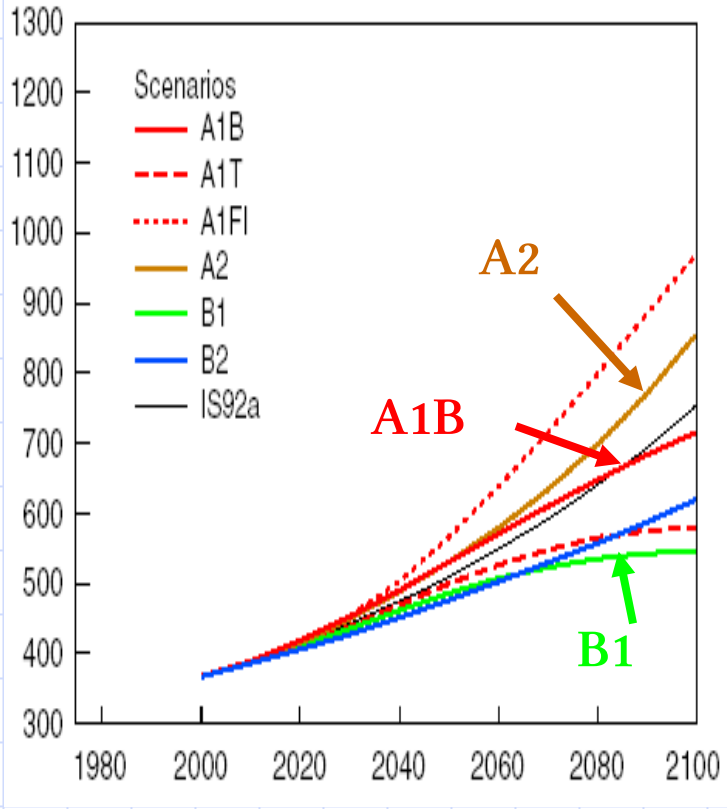
- "big leaf" multiple resistance model with aerodynamic, quasi-laminar layer, and surface resistance for 31 gaseous species.
- uptake resistance for vegetation, soil, water, snow and ice (20 land-use types).
- stomata and non-stomata resistances

The Multi Global Model Ensemble (MGME)

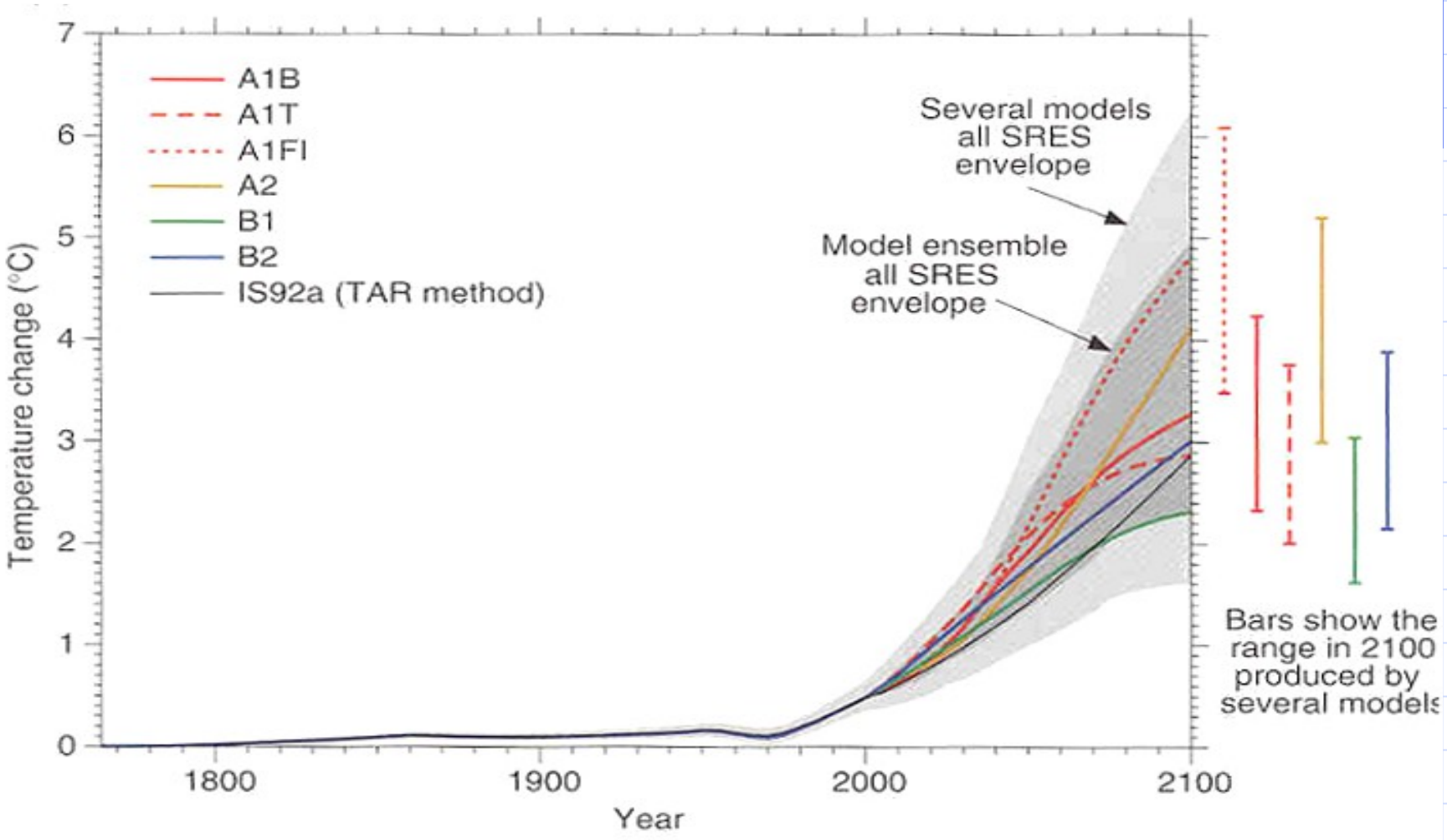
Models and simulations

Model	20 Cent.	A1B	A2	B1
BCCR-BCM2-0	1	-	1	1
CCMA-3-T47	5	4	2	4
CNRM-CM3	1	1	1	1
CSIRO-MK3	2	1	1	1
GFDL-CM2-0	3	1	1	1
GFDL-CM2-1	3	1	1	-
GISS-AOM	2	2	-	2
GISS-EH	5	4	-	-
GISS-ER	1	2	1	1
IAP-FGOALS	3	3	-	2
INMCM3	1	1	1	1
IPSL-CM4	1	1	1	1
MIROC3-2H	1	1	-	1
MIROC3-2M	3	3	3	3
MIUB-ECHO-G	5	3	3	3
MPI-ECHAM5	3	2	3	3
MRI-CGCM2	5	5	5	5
NCAR-CCSM3	8	6	4	8
NCAR-PCM1	4	3	4	2
UKMO-HADCM3	1	1	1	1

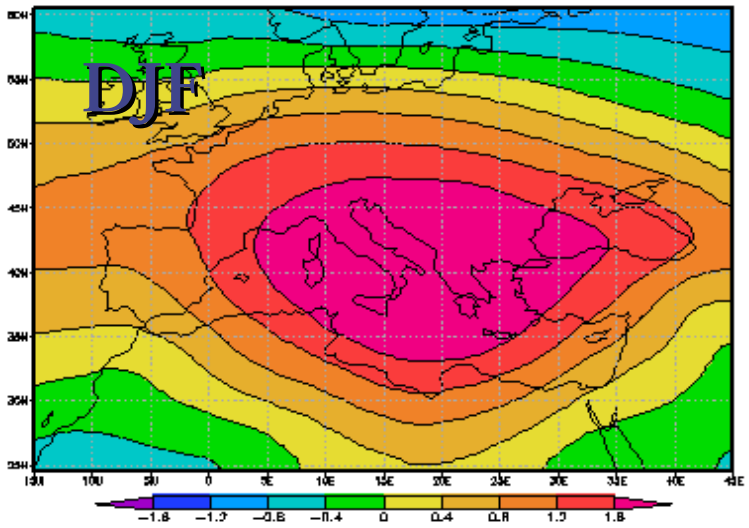
Scenarios

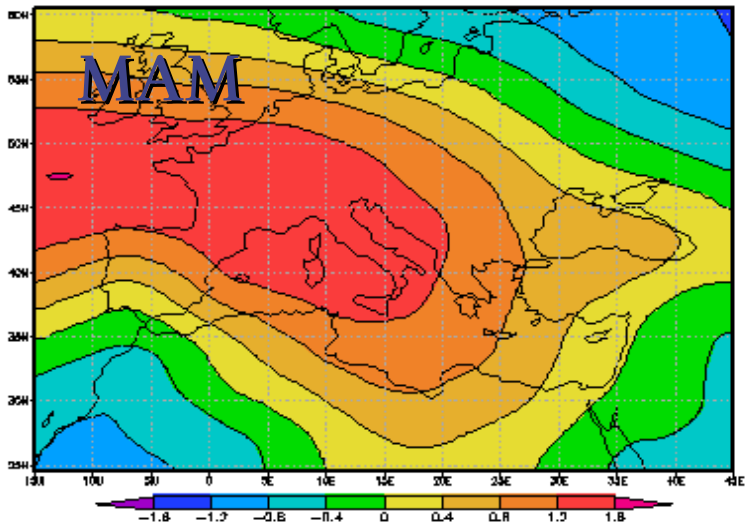


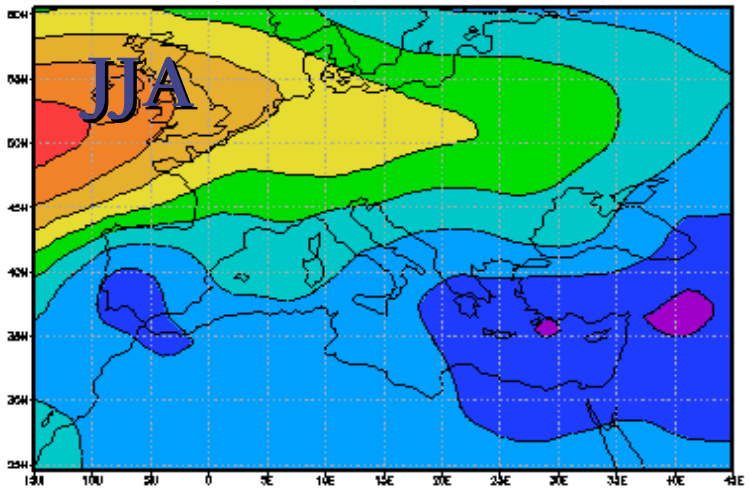
Observed and projected Global temperature change (IPCC 2001)

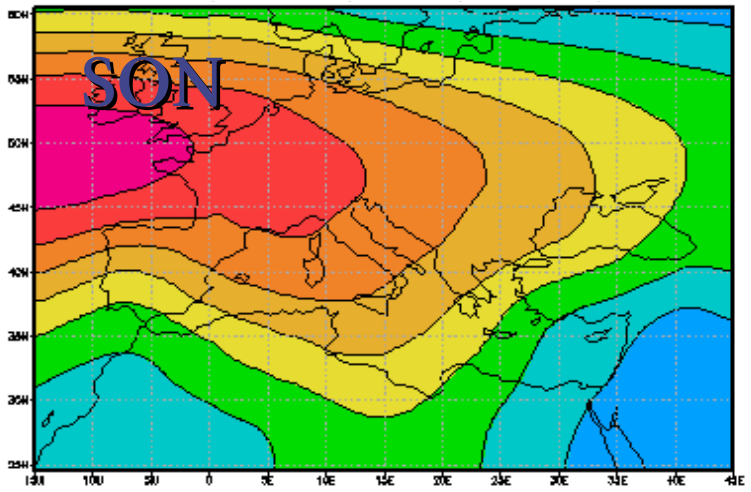


SLP change (mb, 2071-2100 minus 1961-1990), ensemble average, A1B scenario

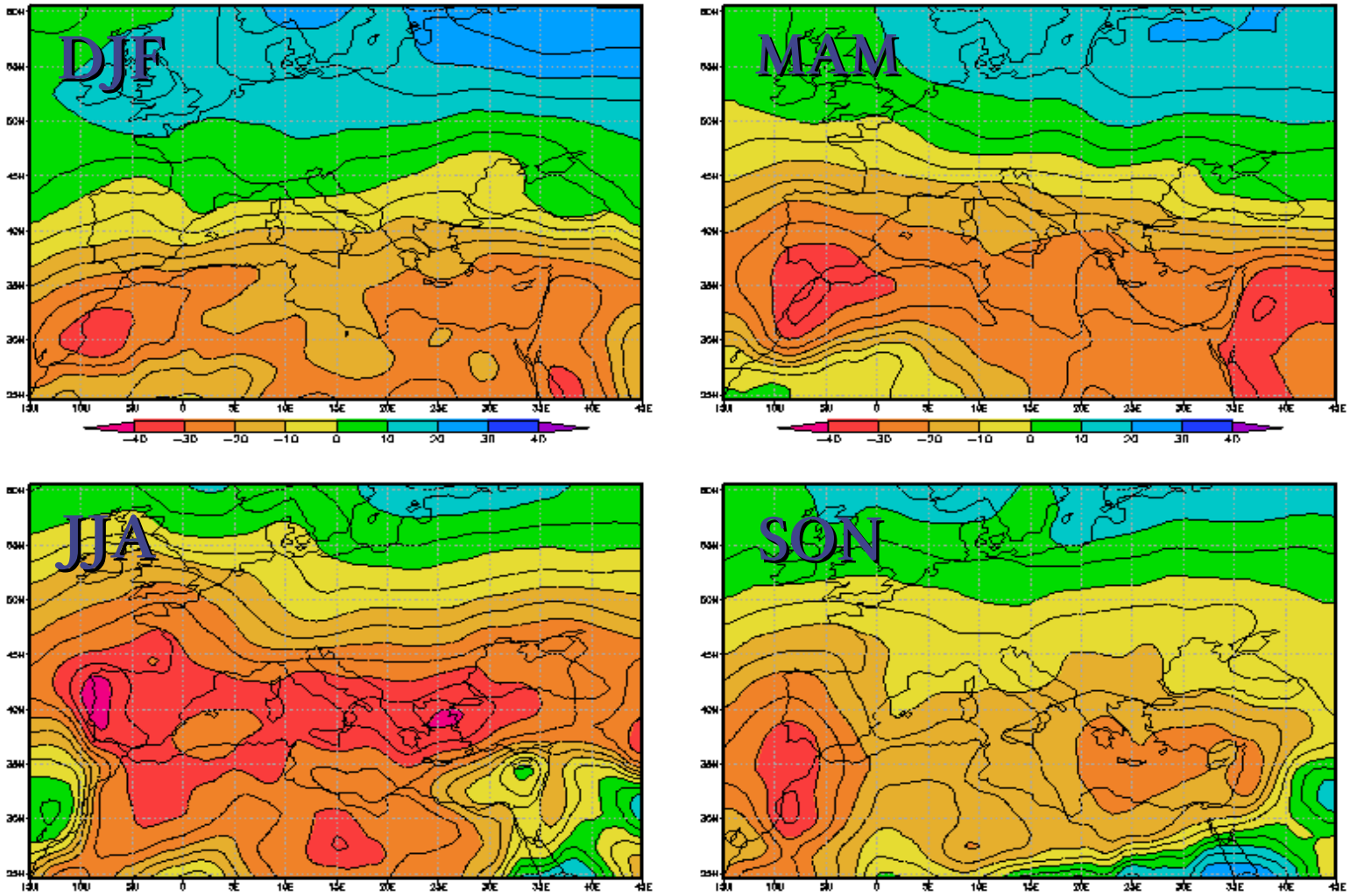




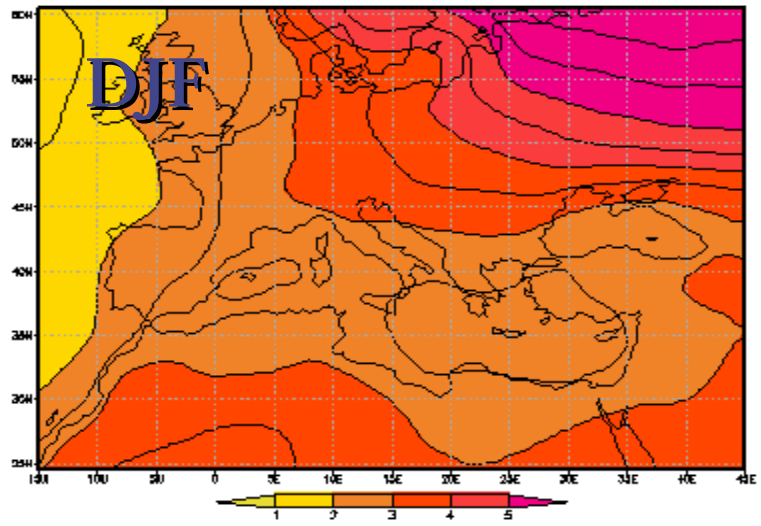


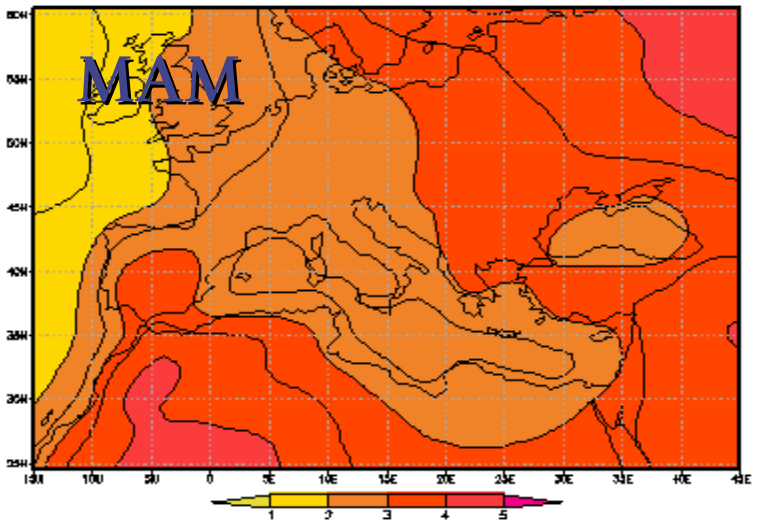


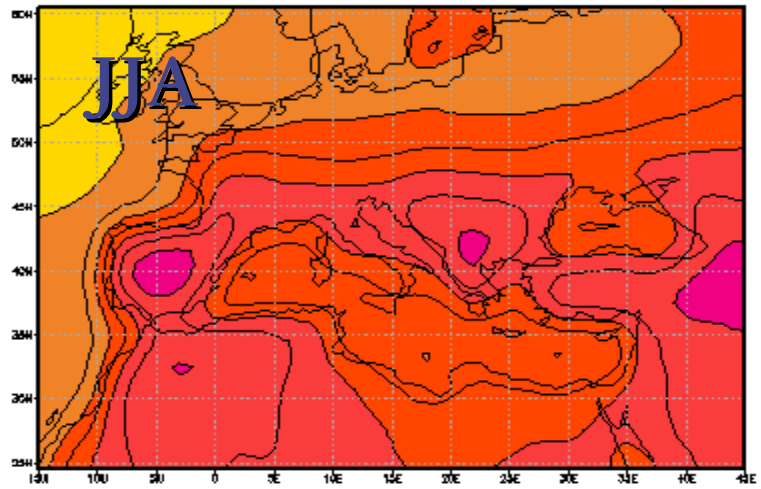
Precipitation change (%, 2071-2100 minus 1961-1990), ensemble average, A1B scenario

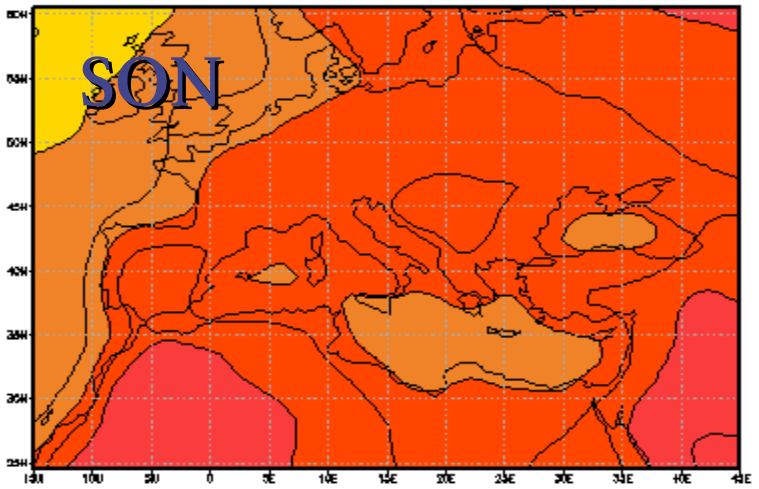


Temperature change (C, 2071-2100 minus 1961-1990), ensemble average, A1B scenario

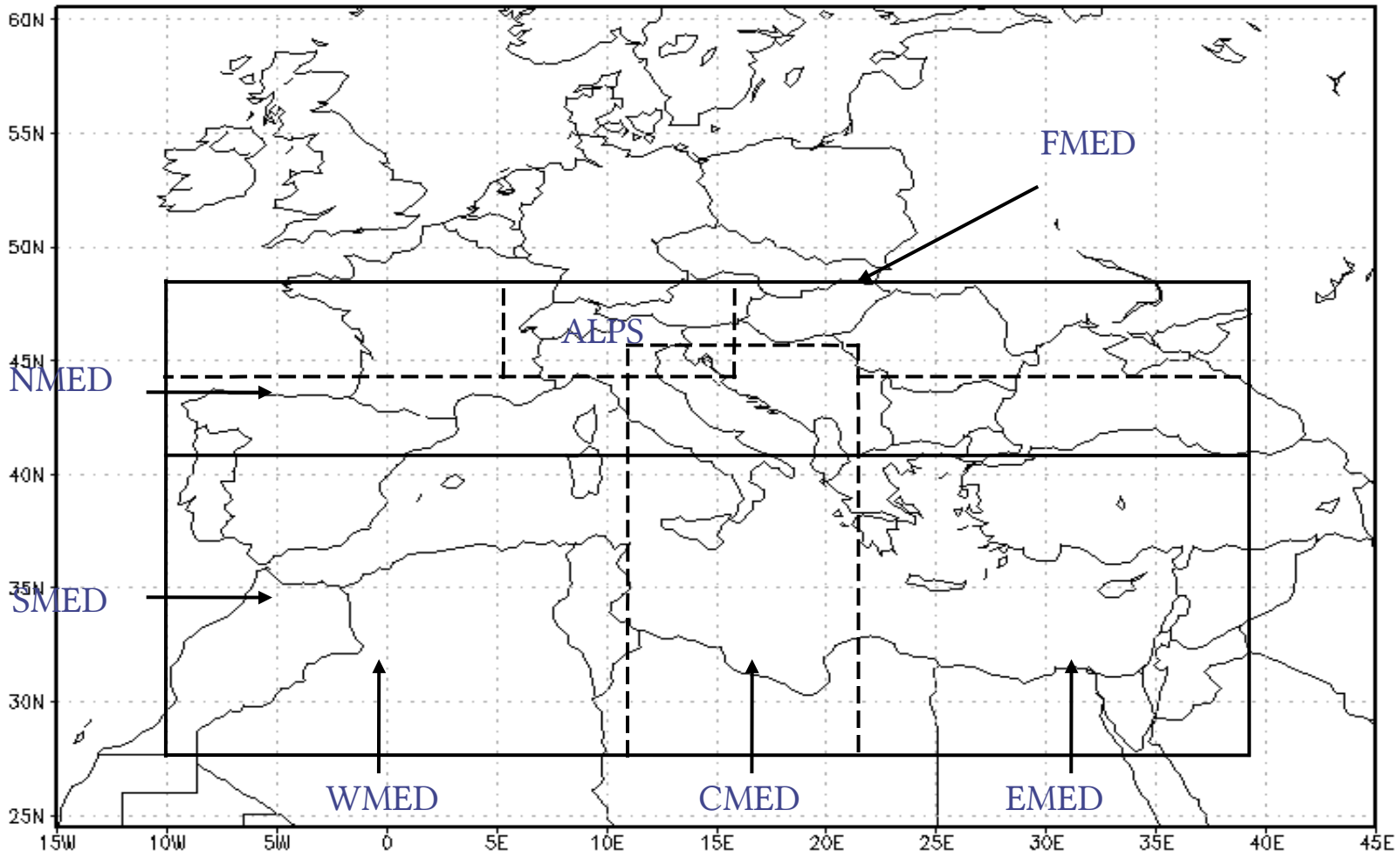






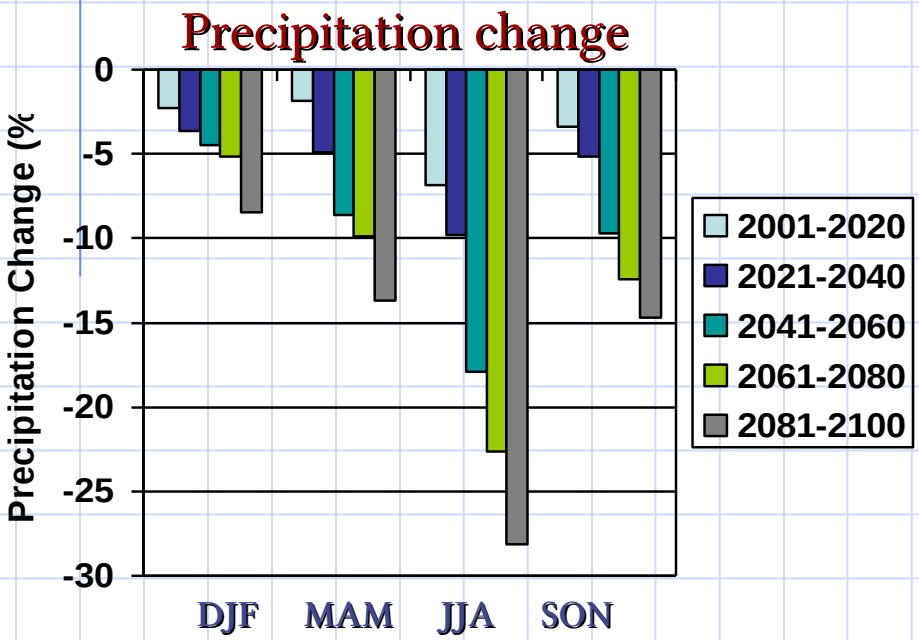


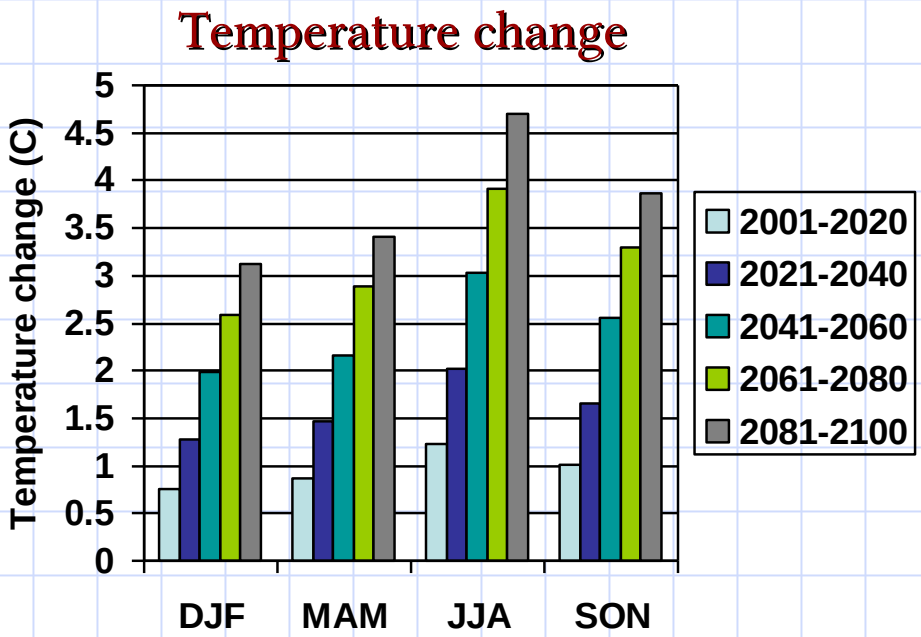
Mediterranean sub-regions



Ensemble average change as as a function of time

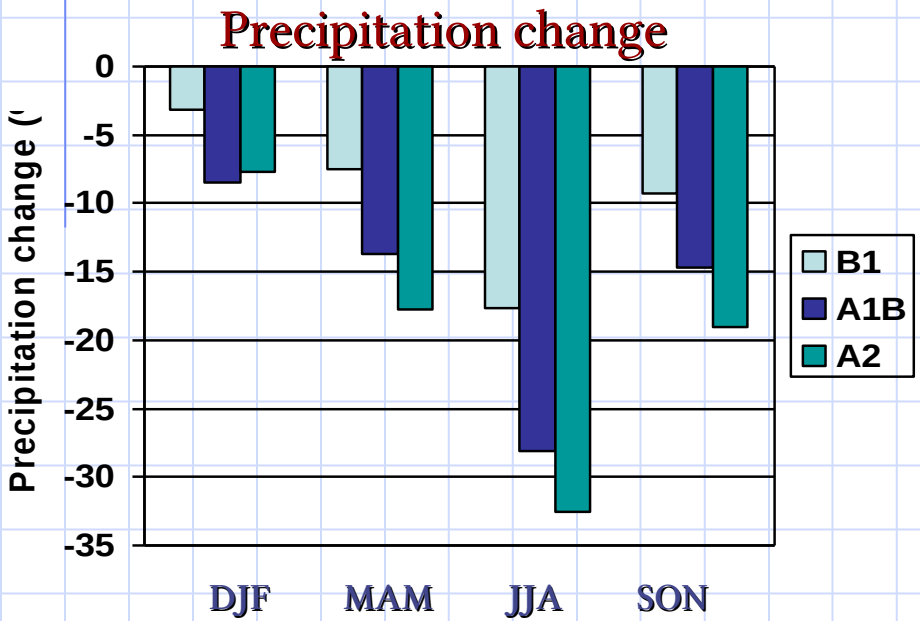
Full Mediterranean, A1B scenario

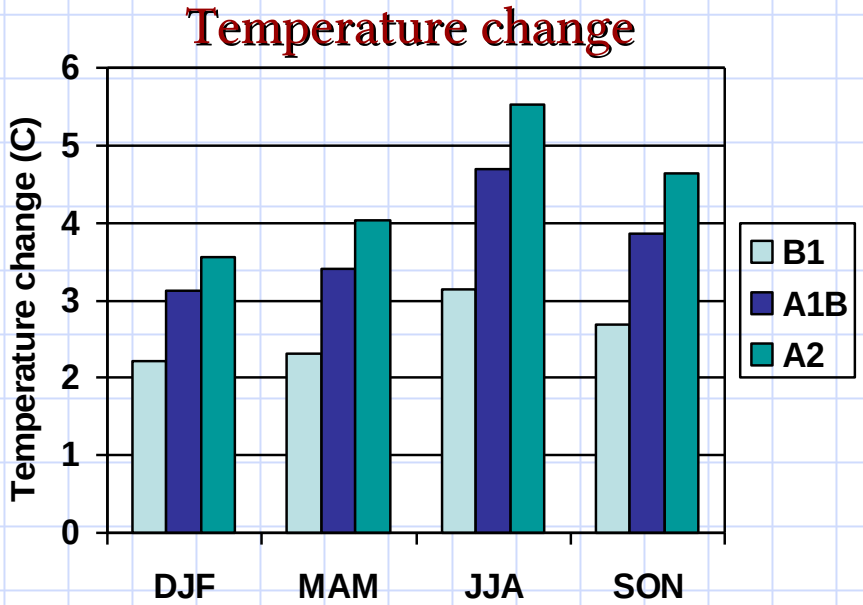




Ensemble average change as as a function of emission scenario

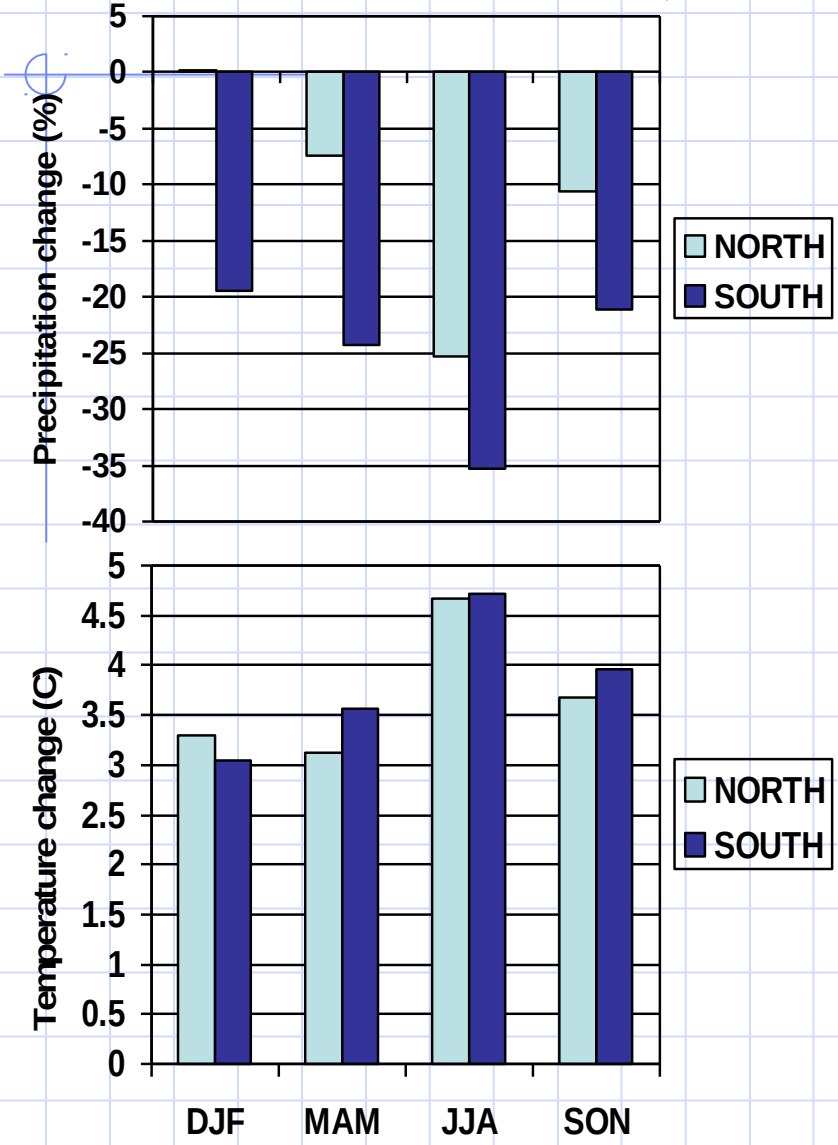
Full Mediterranean, (2081-2100) – (1961-1980)

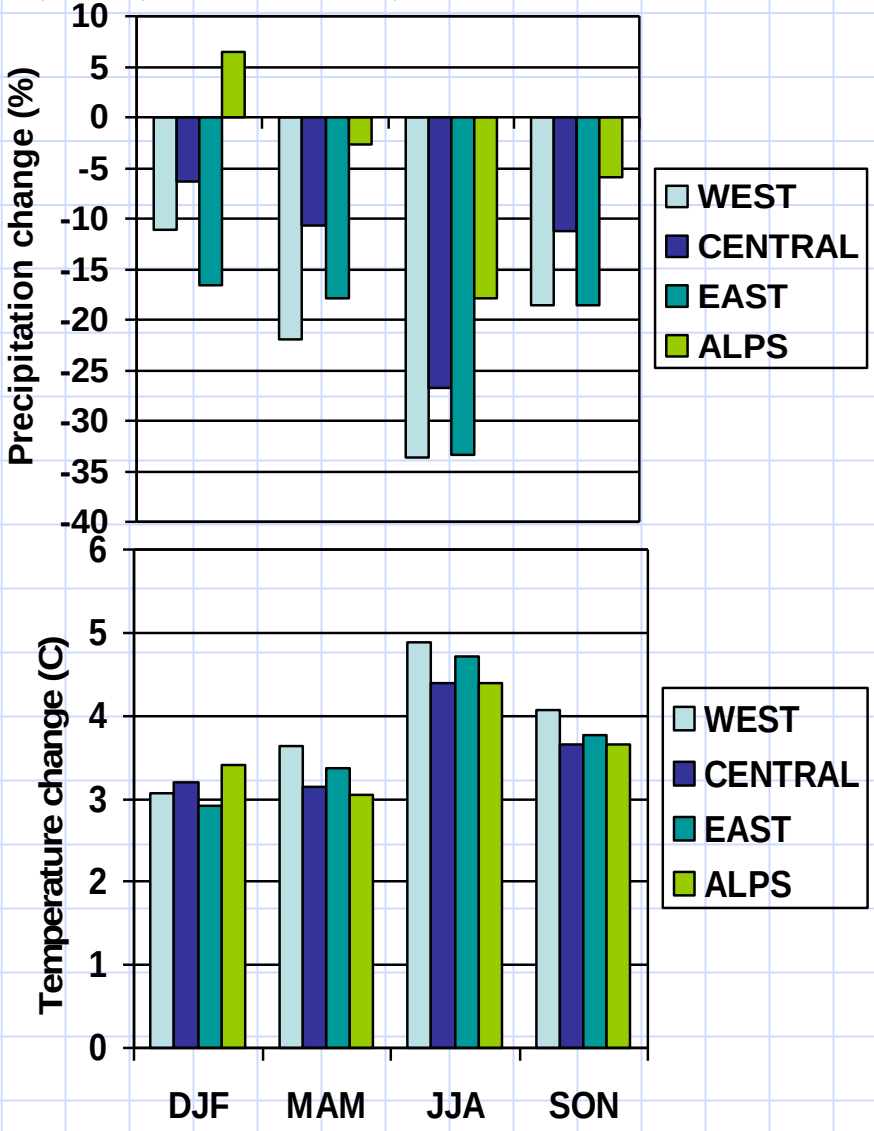


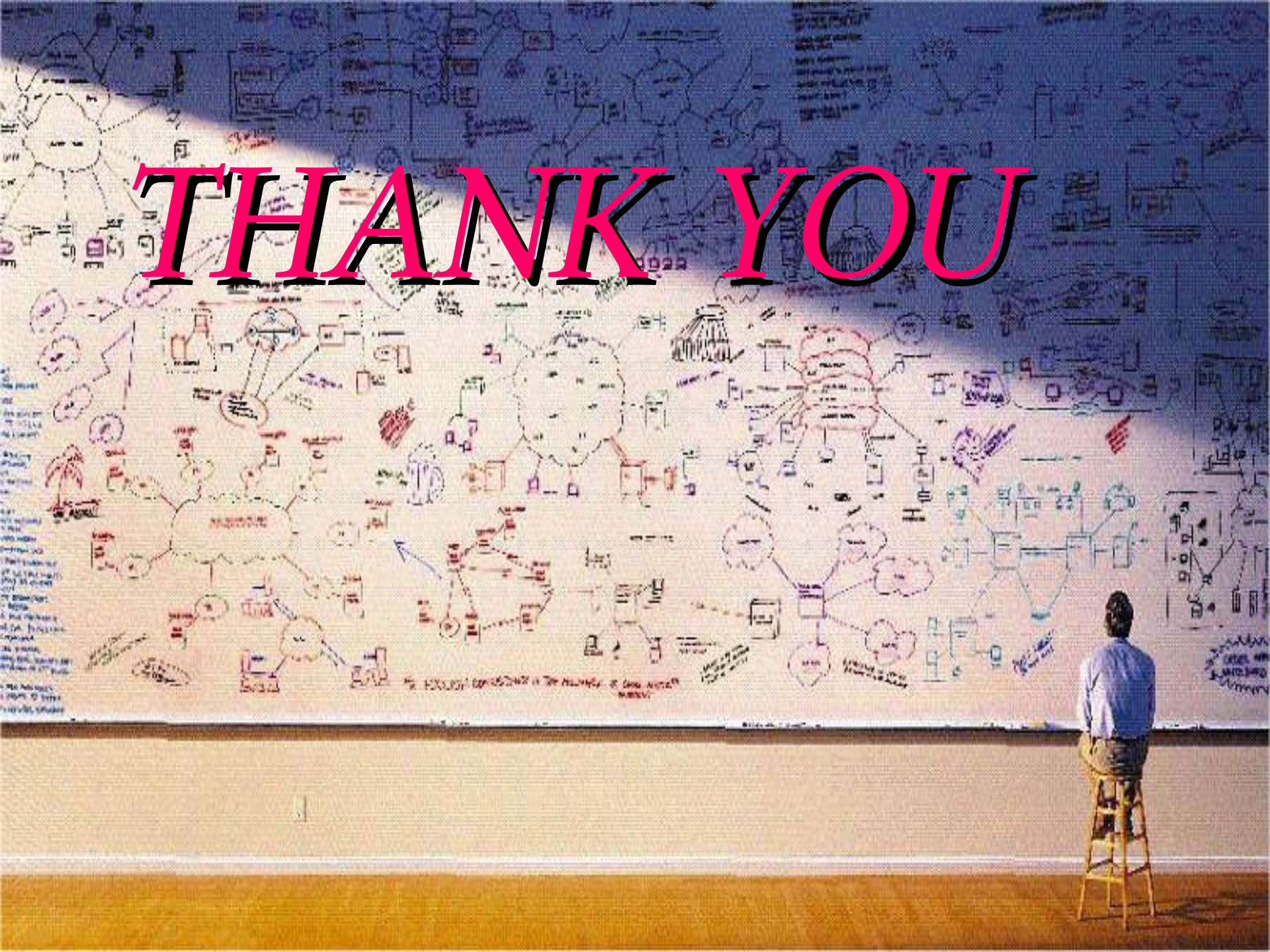


Average change for different sub-regions

A1B, (2081-2100) – (1961-1980)






THANK YOU