

Climate change and possible adaptation strategies in Emilia-Romagna

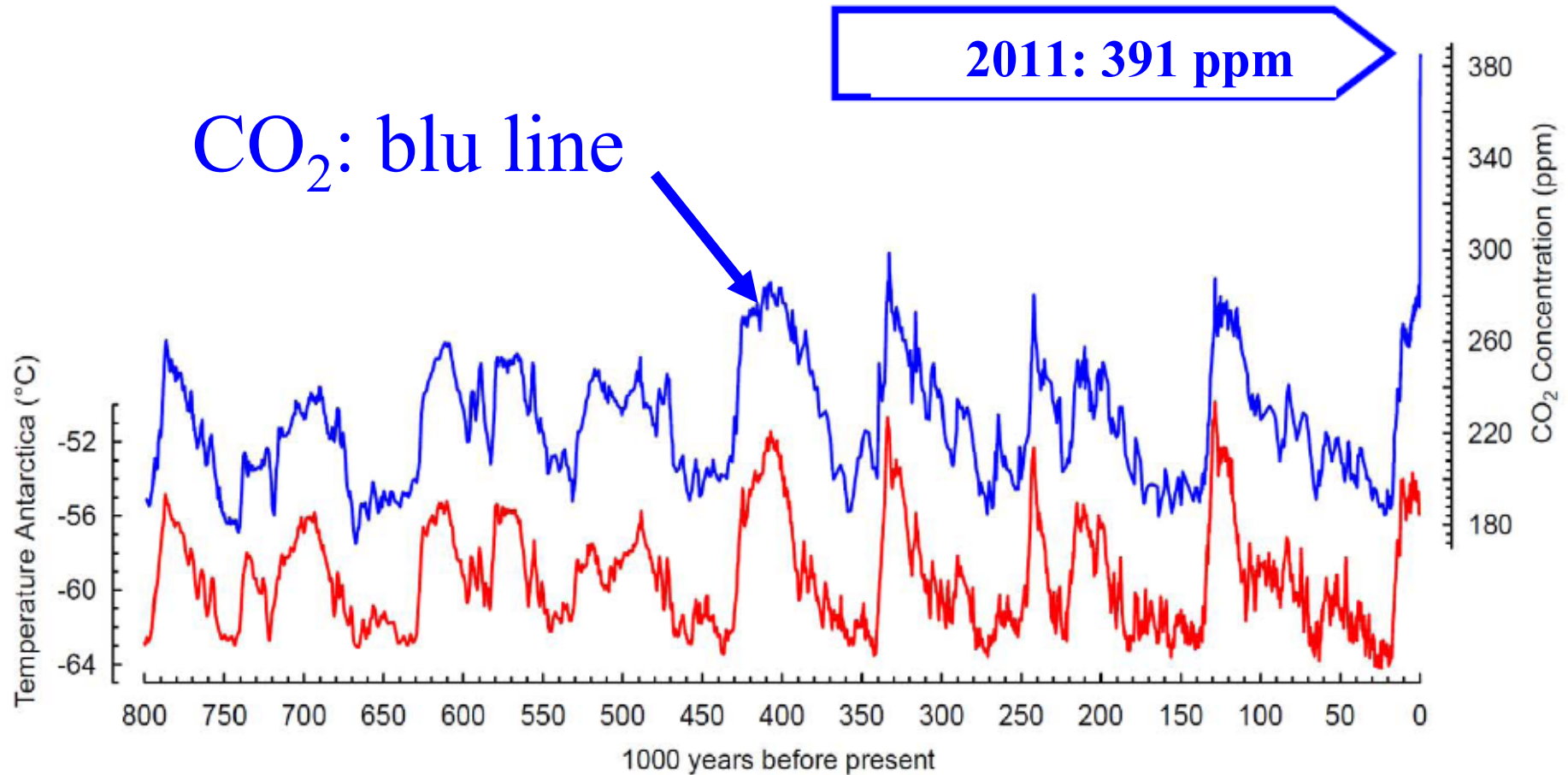
7th EUREGEO - Bologna, 12-15 June

Stefano Tibaldi

ARPA Emilia-Romagna



CO₂: Higher levels and more rapid increase



(Siegenthaler et al., 2005; Lüthi et al., 2008, NOAA)

Current global climate change



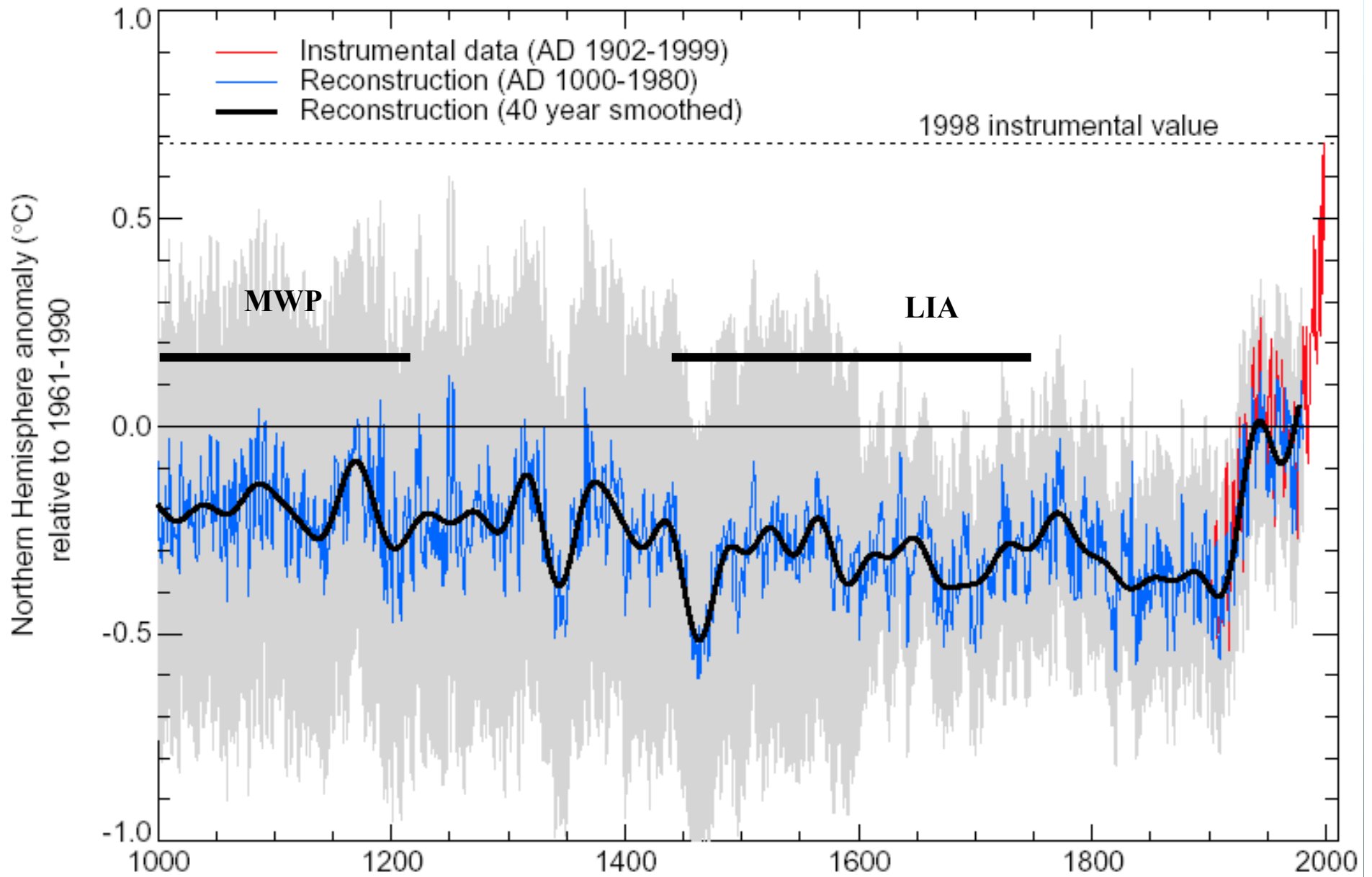


Figure 5: Millennial Northern Hemisphere (NH) temperature reconstruction (blue) and instrumental data (red) from AD 1000-1999. Smoother version of NH series (black), and two standard error limits (gray shaded) are shown. [Based on Figure 2.20.]

GEOGRAPHICAL DISTRIBUTION OF DECADAL TEMPERATURE INCREASE IN THE LAST 25 YEARS

Ground level

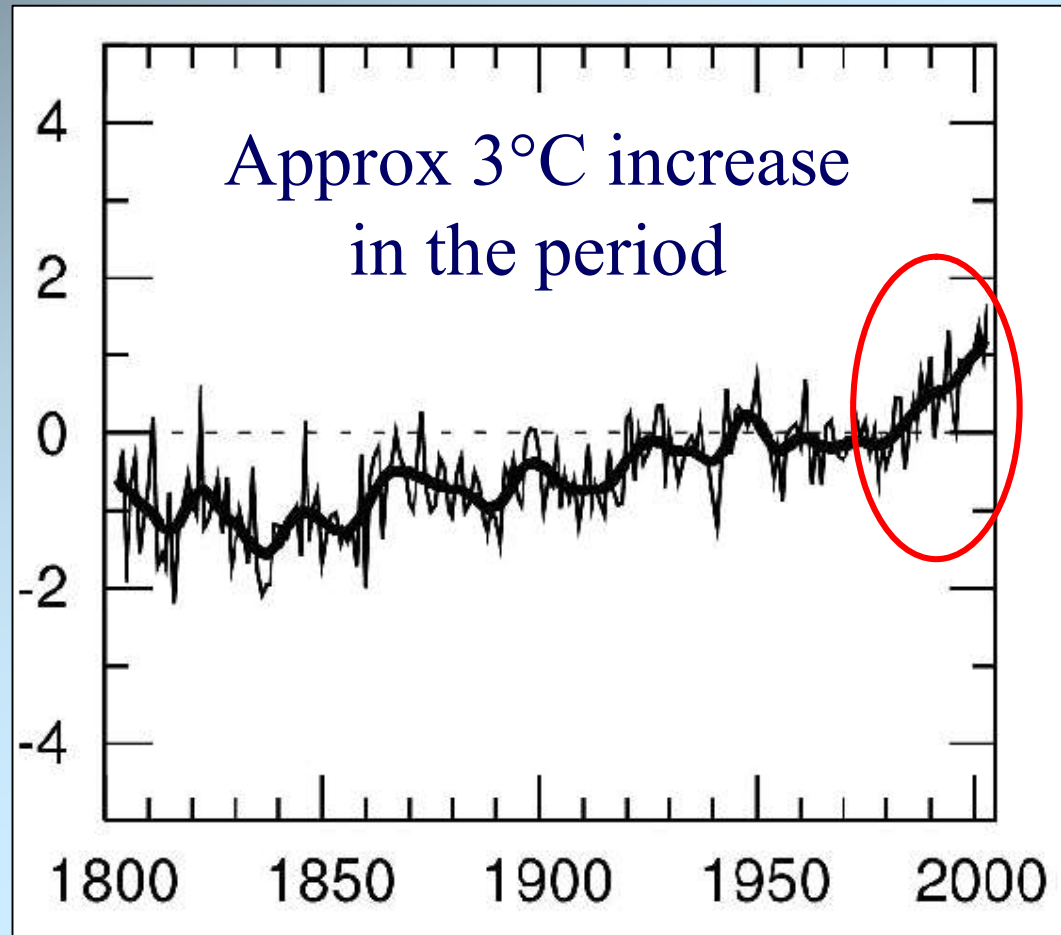
Troposphere

°C/decade

Climate change in Italy



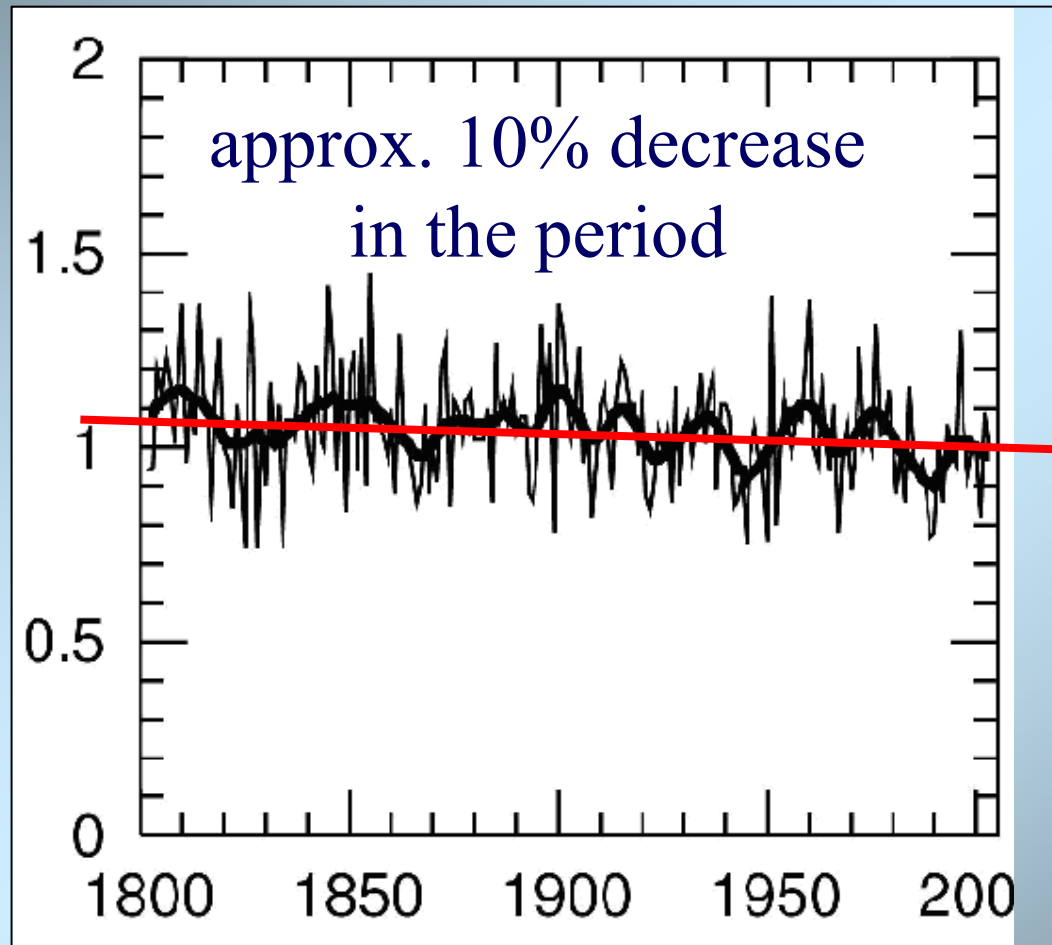
Temperature, °C



Brunetti M, Maugeri M, Monti F, Nanni T. 2006. *Temperature and precipitation variability in Italy in the last two centuries from homogenised instrumental time series.*

Int. J. Climatol, 26, 345-381

Precipitation, ratio to total period mean value

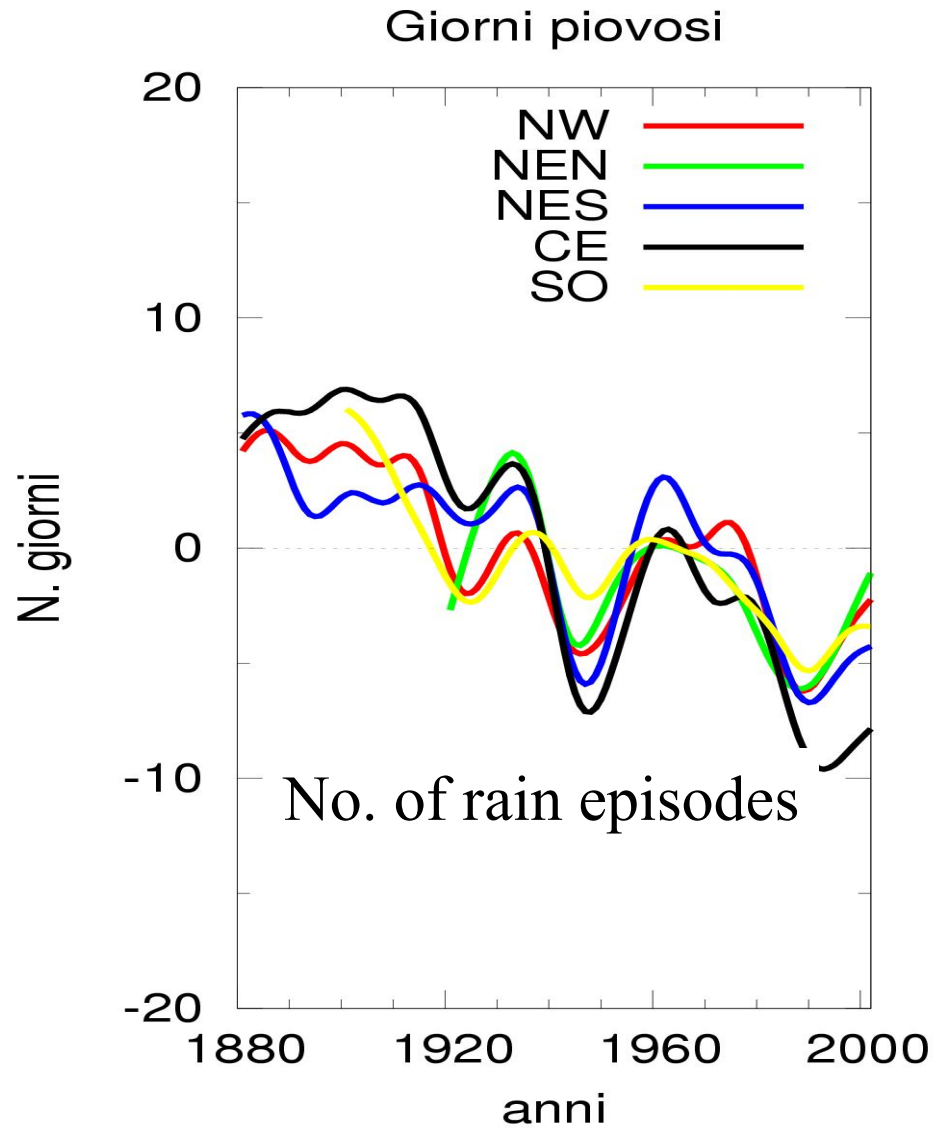


Brunetti M, Maugeri M, Monti F, Nanni T. 2006. *Temperature and precipitation variability in Italy in the last two centuries from homogenised instrumental time series.*

Int. J. Climatol, 26, 345-381

So-called “tropicalization” of precipitation regimes

Data source: National Research Council



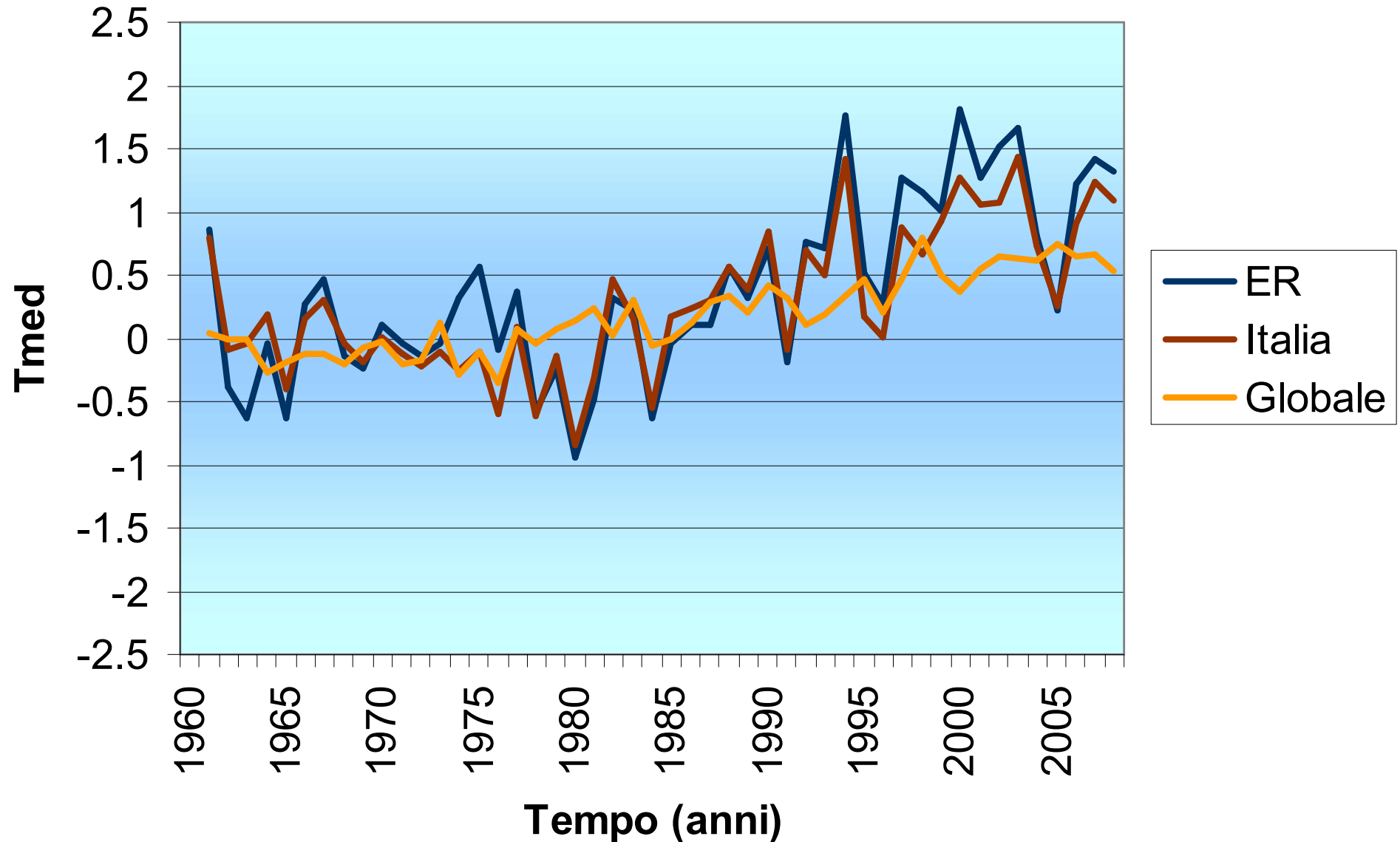
Rain intensity



Local CC

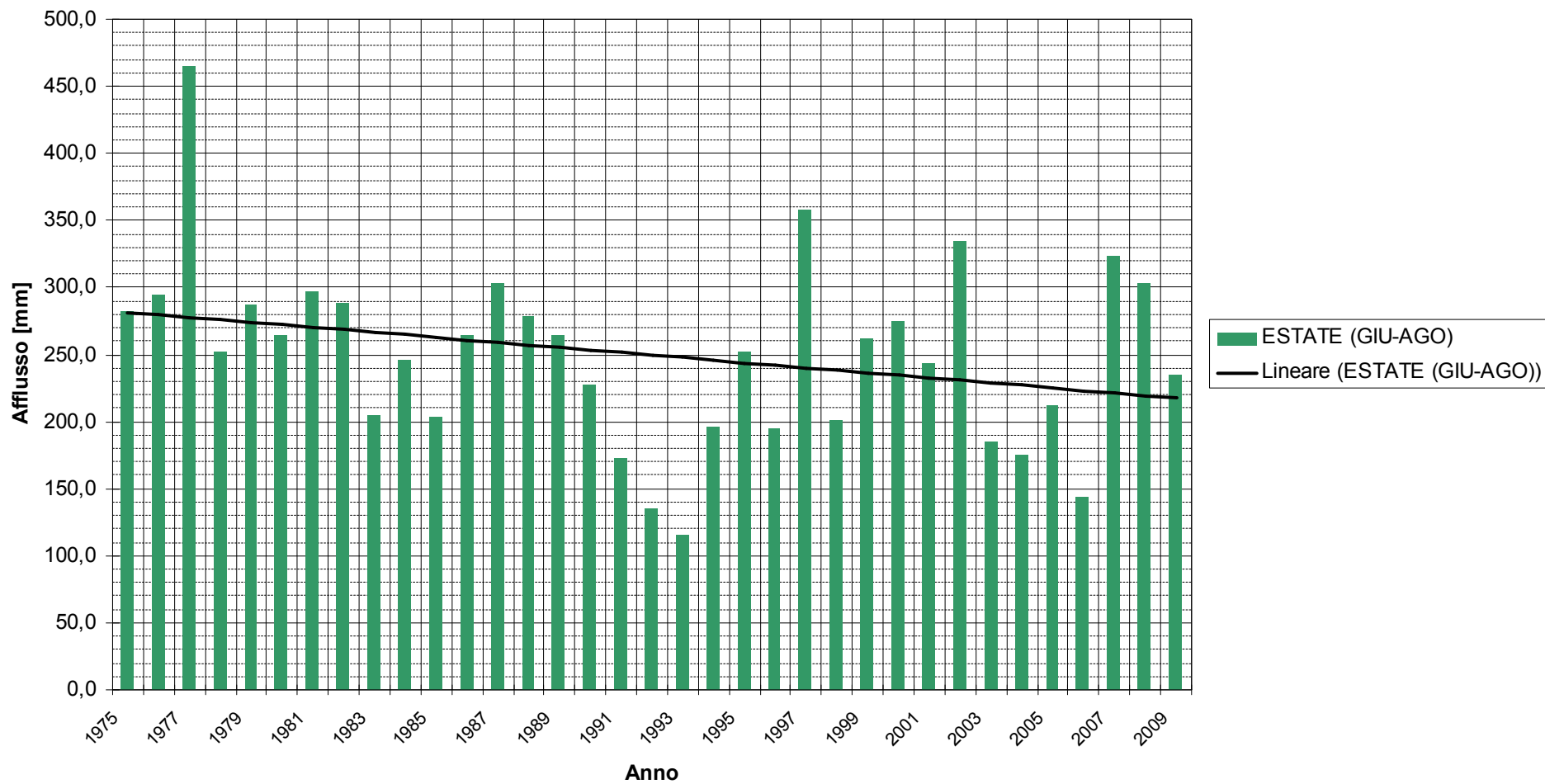
Observed trends (50y), global, Italy, Emilia-Romagna

Temperature anomaly, annual mean

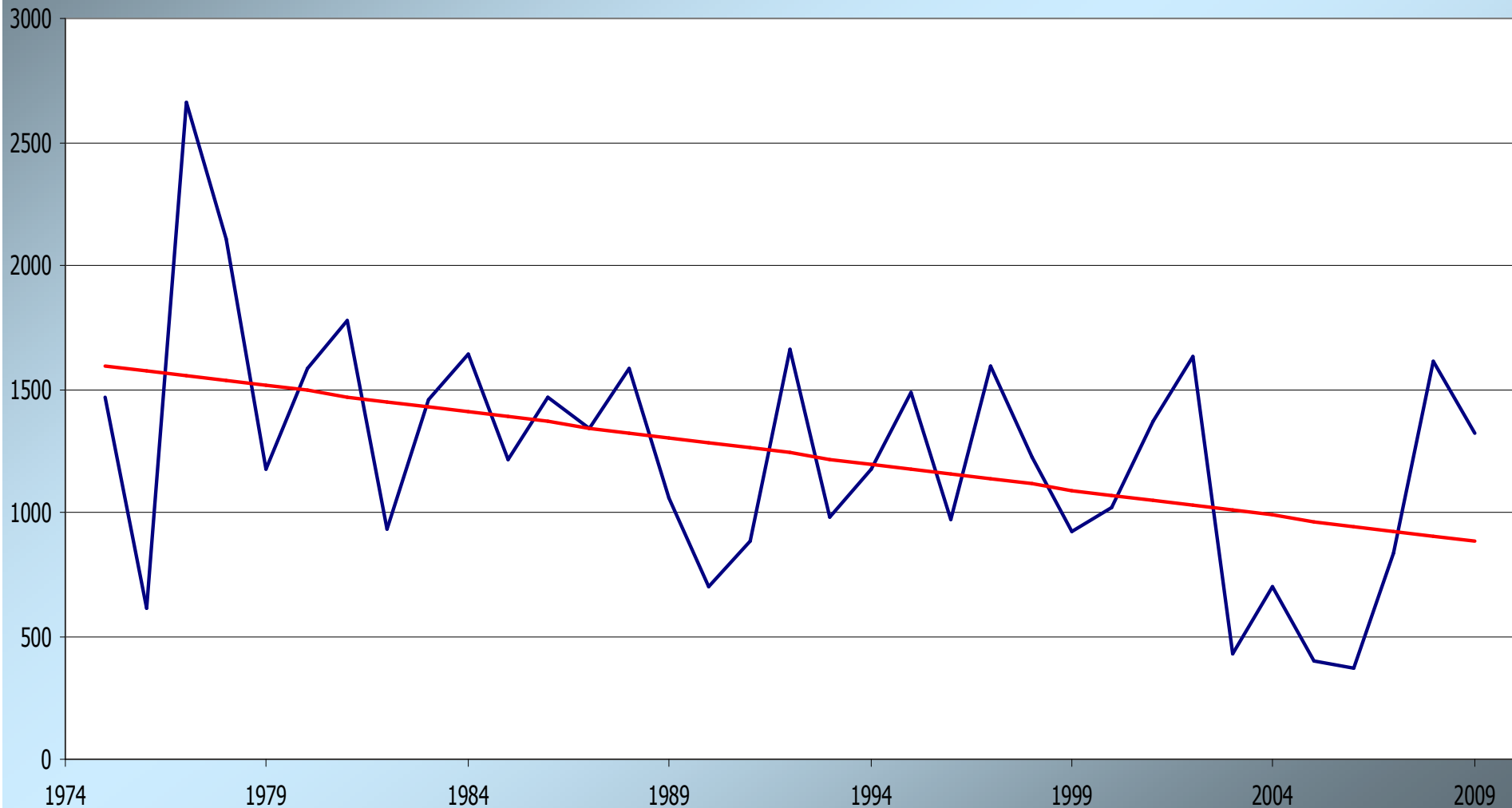


The Po river basin

SUMMER RAINFALL REDUCTION IN THE PO BASIN 1975-2009 (JJA) 20-25%



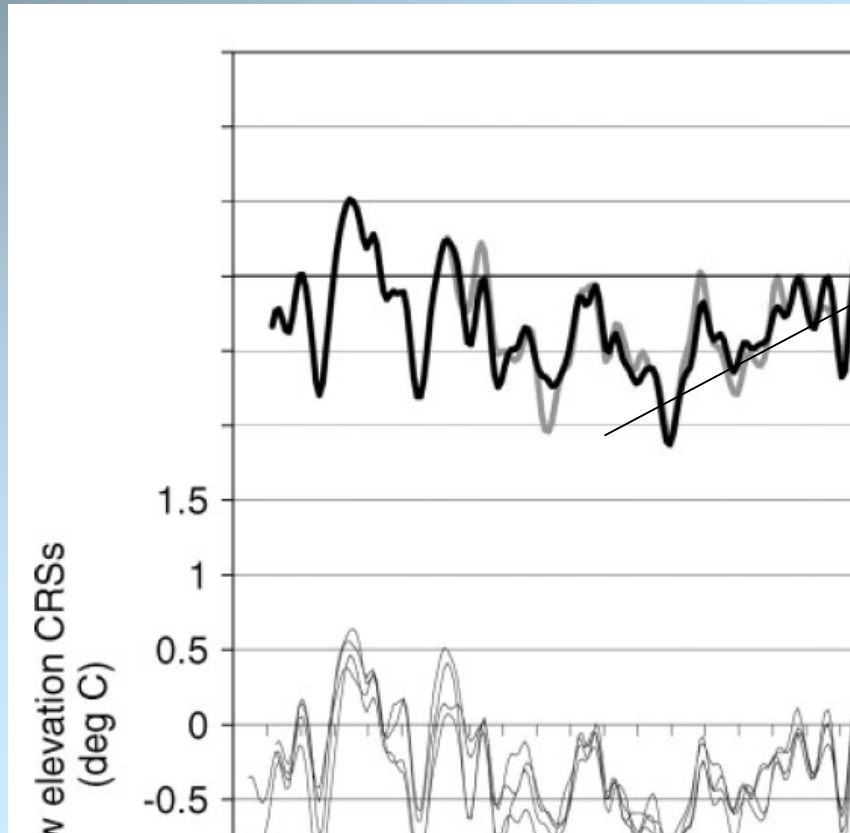
Summer (JJA) discharges at Po basin closure,
Pontelagoscuro, (40-45% reduction)
1975-2009 (m³/s) (No reduction in autumn!)



A dramatic landscape photograph featuring a large, dark, and textured storm cloud formation dominating the upper two-thirds of the frame. The sky is filled with various shades of grey and blue, with some lighter patches where the sun is breaking through. Below the storm, a bright orange and yellow glow from the setting or rising sun is visible on the horizon. In the foreground, a paved road curves from the bottom left towards the center, leading the eye into a lush green field of crops, likely corn. The overall mood is one of natural power and atmospheric tension.

What about alpine glaciers and
Mediterranean sea-level?

Temperature increase in the Alpine region (1760-2000)



From
Auer et al. 2006

Examples of Alpine glaciers retreat

Pizzo Bernina, 1978



Pizzo Palú - 1978



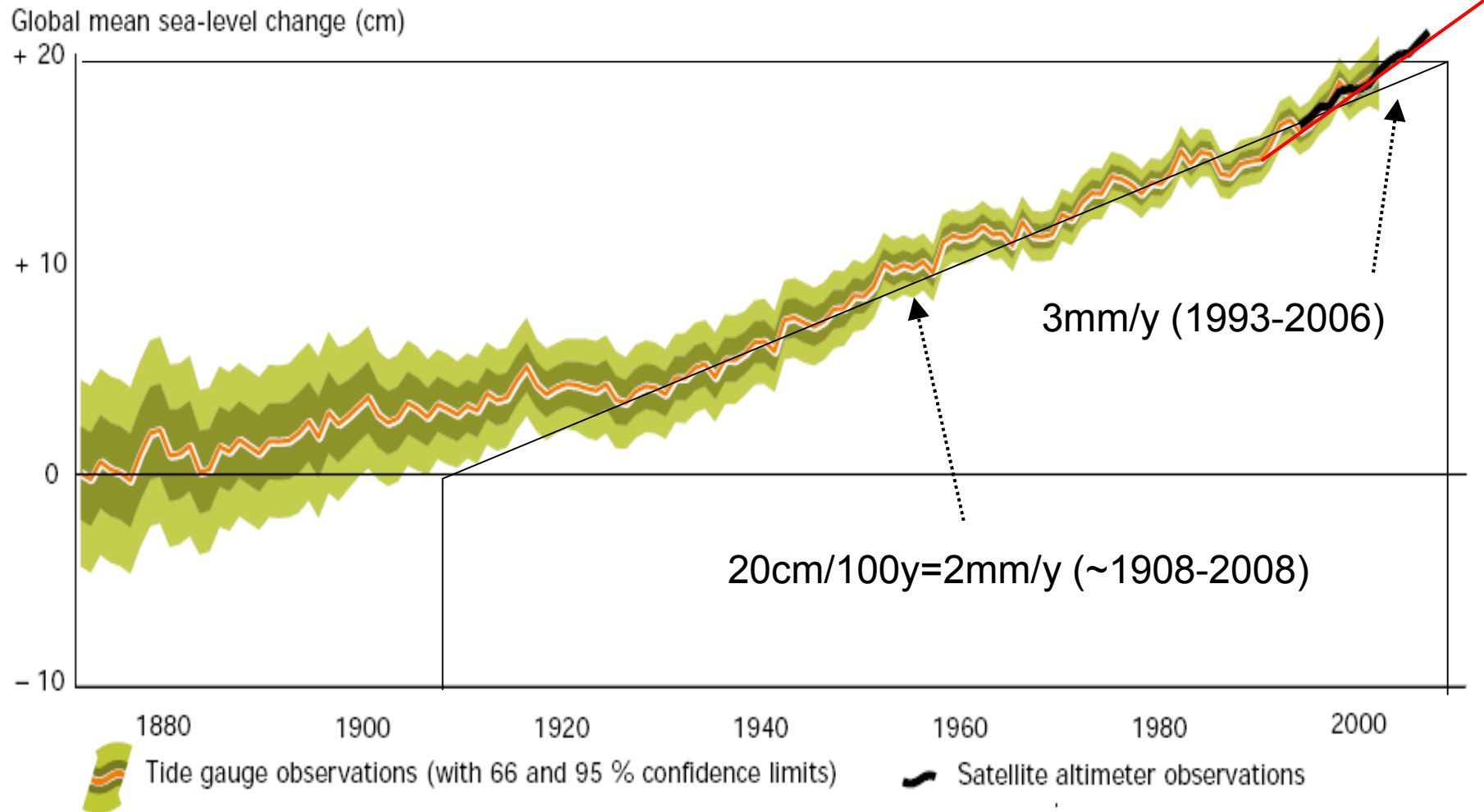
Pizzo Bernina, 2003



Pizzo Palú - 2003

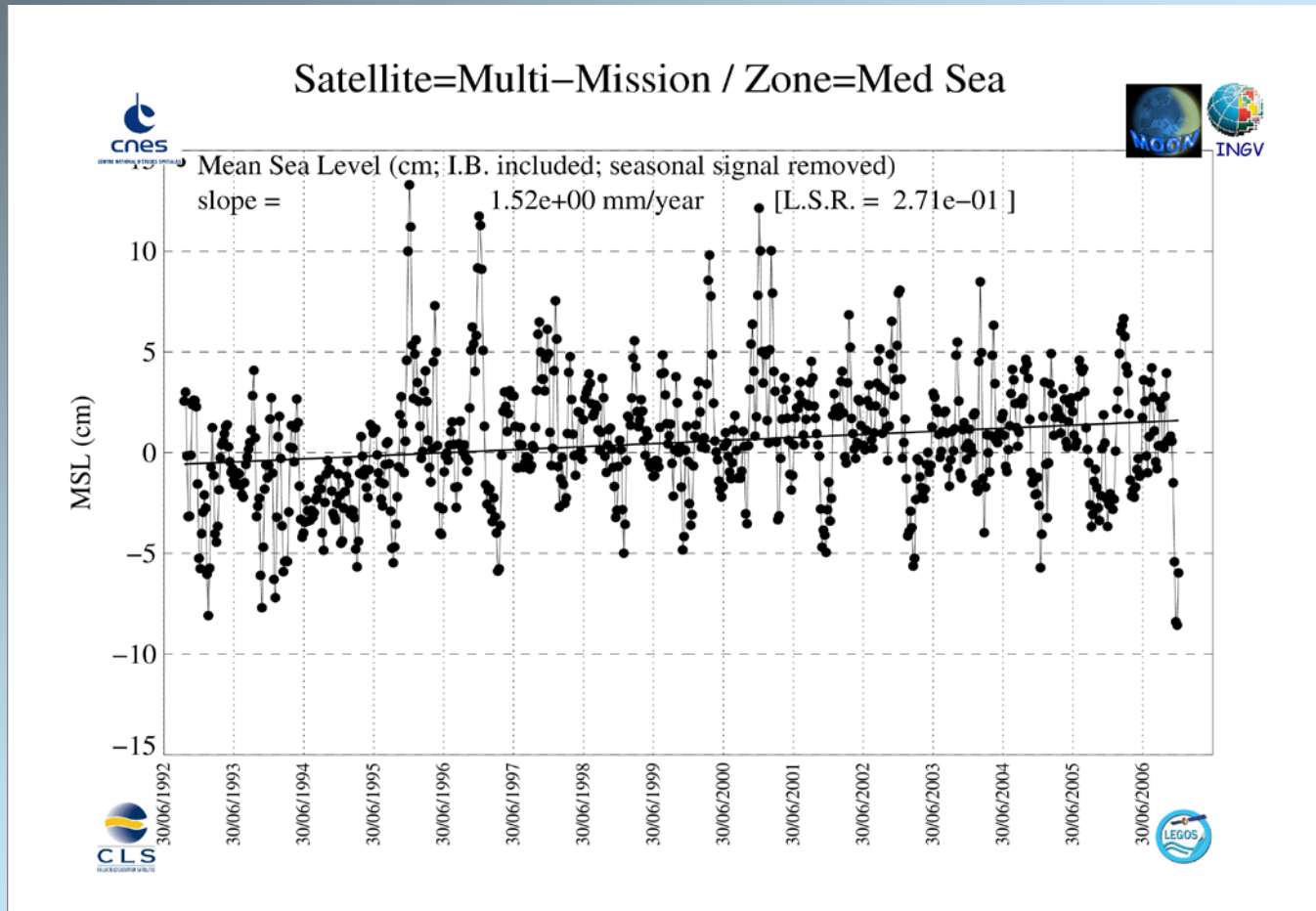


Figure 5.19 Changes in global sea level 1870–2006



Source: Church and White, 2006 (<http://maps.grida.no/go/graphic/trends-in-sea-level-1870-2006>).

From satellite altimetry, the Mediterranean sea-level is rising approx. at a rate which is about a half of the one of the global oceans (<1.5mm/y).



1992

2007

Temperature and salinity in the Mediterranean

Comprehensive Medatlas (2002) data set analysis

Rixen et al., 2006

Western Med

Eastern Med

T anom (°C)

S anom (psu)

Heat cont. anom (10^{20} J)
Salt cont. anom (10^{13} psu m³)

A quick look at the future:
from global to local climate
change projections

IPCC GLOBAL PROJECTIONS: TEMPERATURE

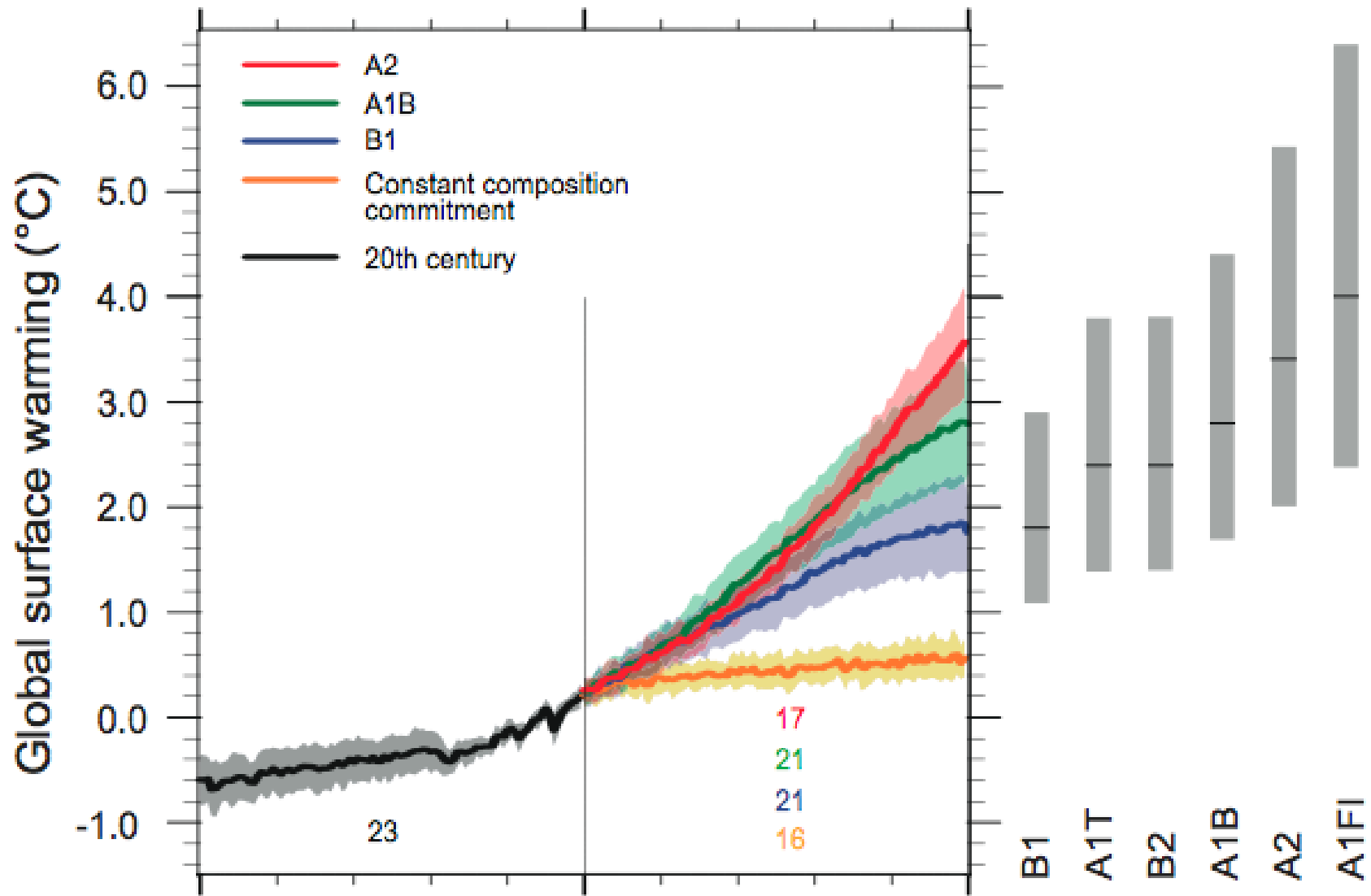


Figura 1: Variazione della temperatura media annua entro la fine del secolo¹

Temperatura: variazione della temperatura media annua [°C]

Temperature: change in mean annual temperature [°C]

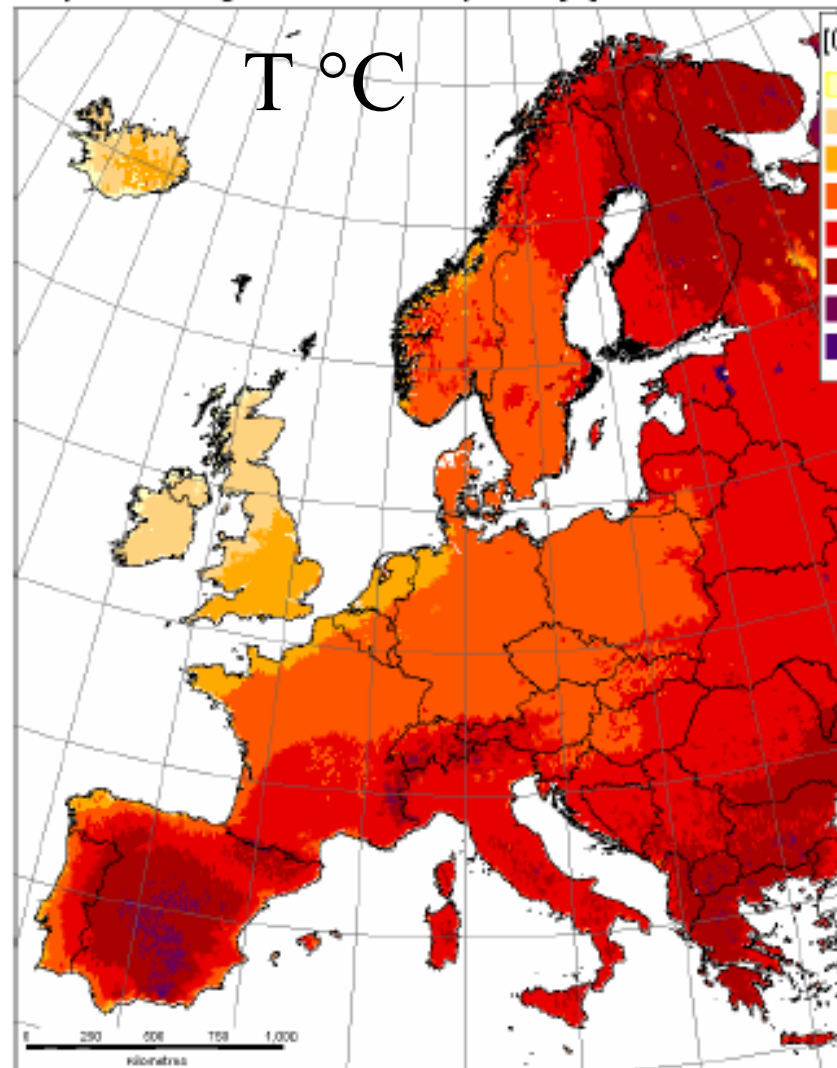
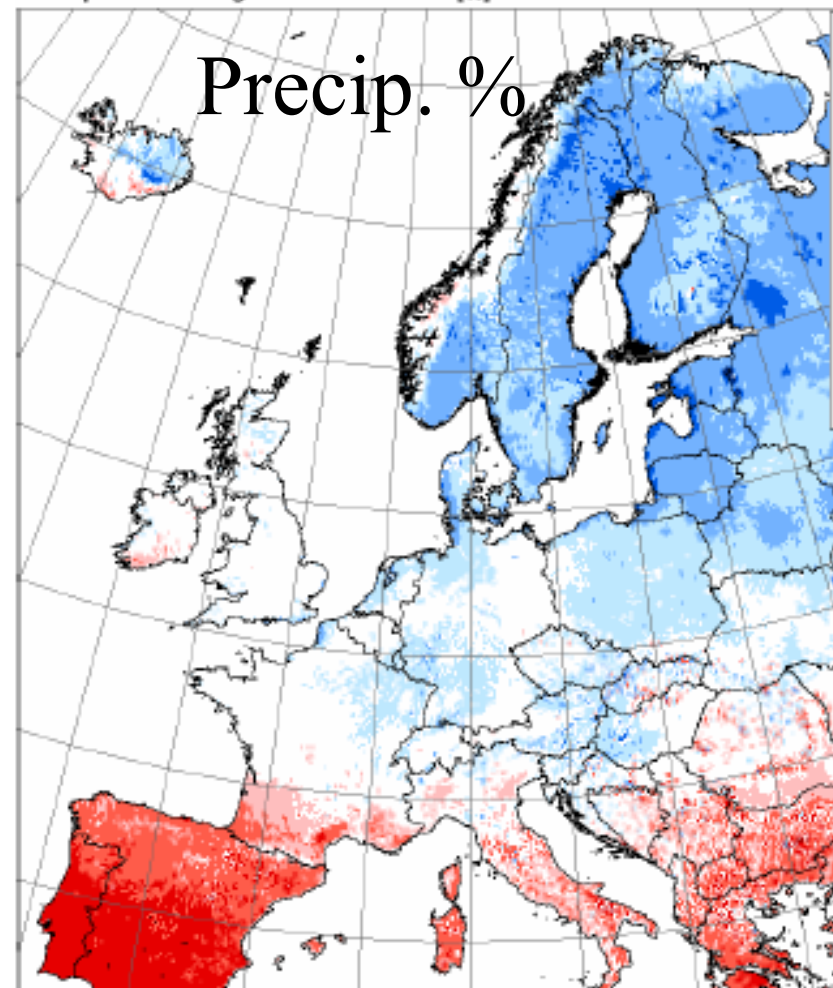


Figura 2: Variazione delle precipitazioni medie annue entro la fine del secolo

Precipitazioni: variazione del volume annuo [%]

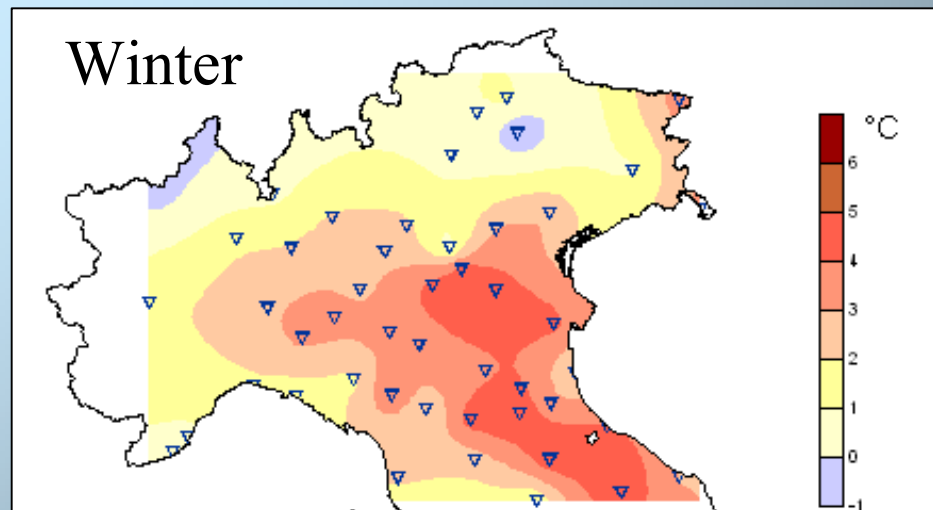
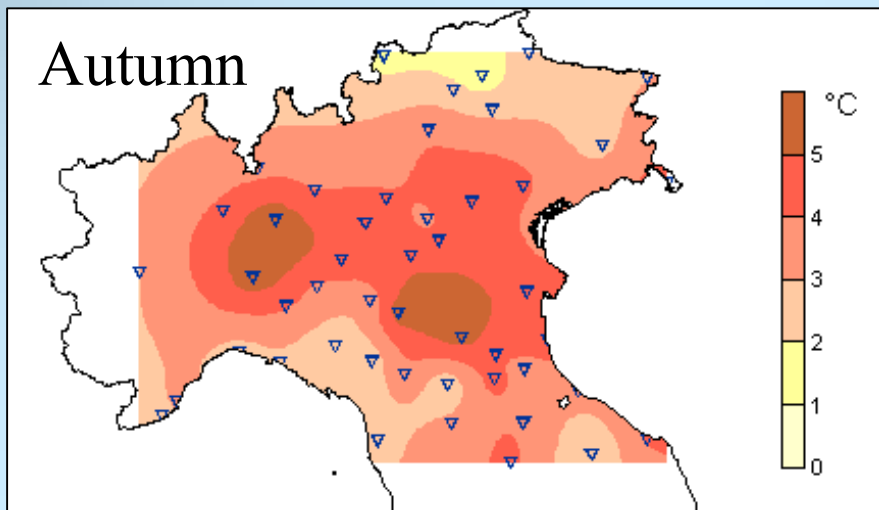
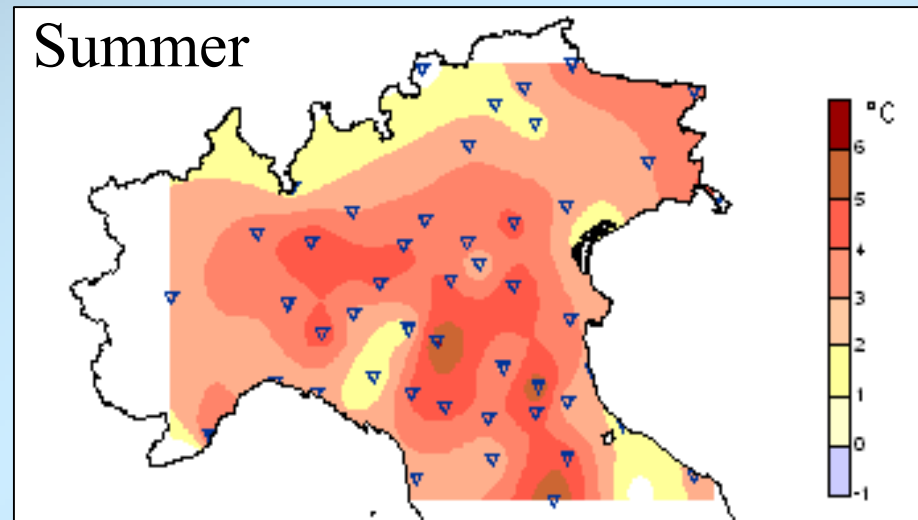
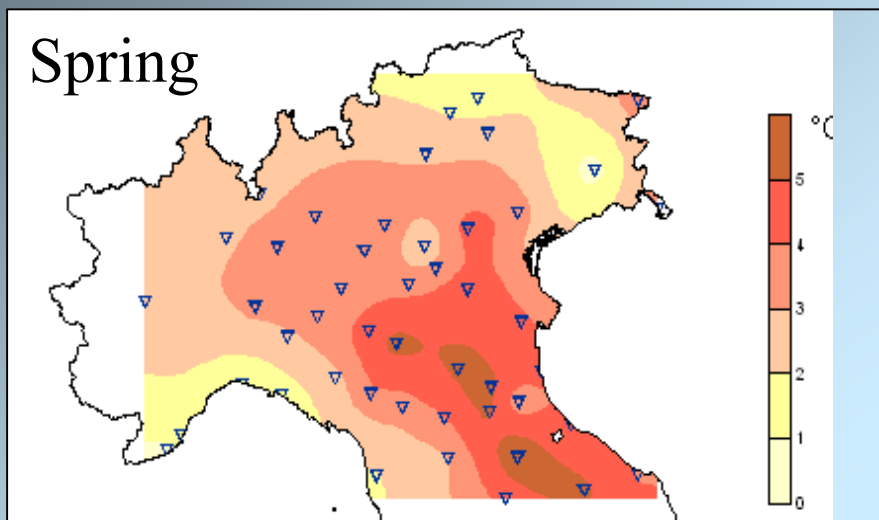
Precipitation: change in annual amount [%]



¹ Le figure 1 e 2 si basano sullo scenario A2 contenuto nel rapporto speciale sugli scenari di emissione

A2 Scenario: (2071-2100) – (1961-1990)

Projections of North Italian Climate Change (T)
A2 Scenario (2071:2100)-(1961:1990)



Climate projections based on climate models are today very reliable and trustworthy and anticipate a vision of the current century with trends very similar to the trends we are experiencing now (at least until the end of the century): foreseen **impacts** require that, together with **mitigation**, **adaptation** will be necessary to minimize negative consequences and to exploit opportunities, if any.

Possible impacts of climate change in the Mediterranean area

Important CC impacts in the Mediterranean area (1/2)

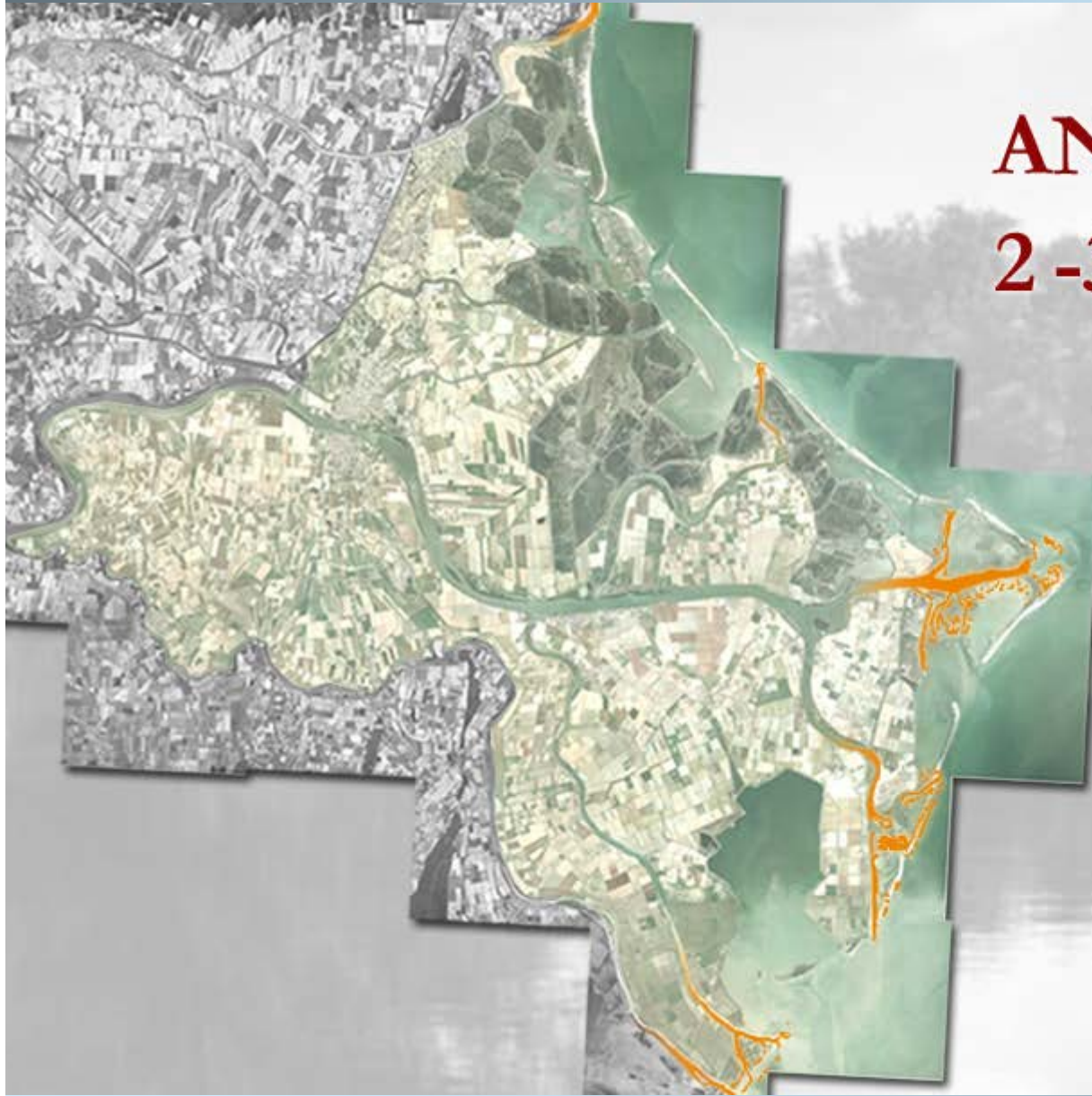
- Increased hydro-geological risk in areas already very exposed.
- Alterations in the hydrological cycle of the Po river leading to increased risks in opposing directions (short-term droughts and salt intrusions in the delta in winter-spring-summer and flooding in autumn).
- Negative consequences on water availability (water scarcity) leading to increased competition for water among different social sectors.
- Reduced snowfalls with negative consequences on water availability and winter tourism.
- Increased coastal erosion and salt water intrusion in river deltas.

Important CC impacts in the Mediterranean area (2/2)

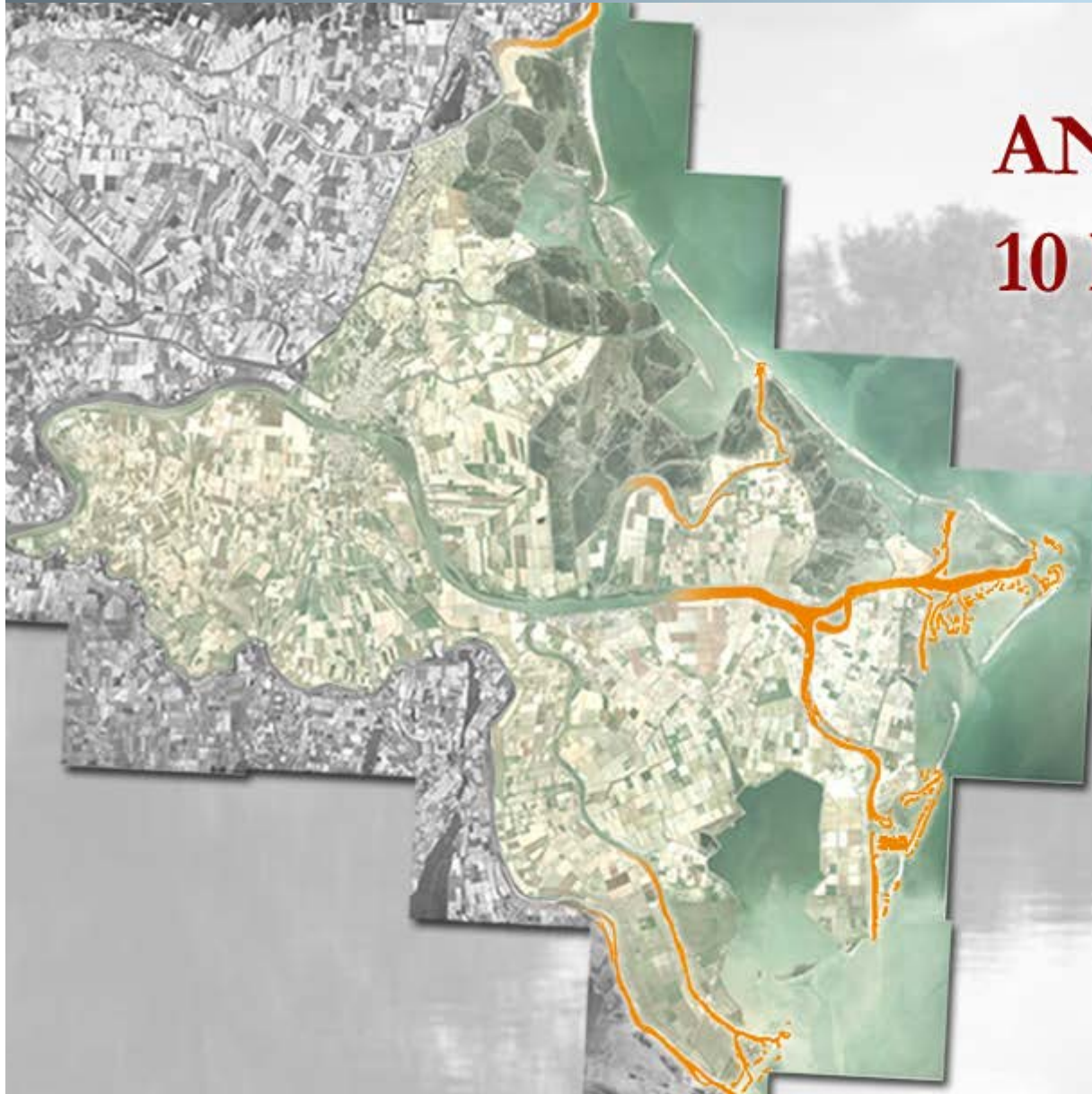
- Increased frequency and intensity of heat waves with increased associated health risks and suffering of summer tourism
- Increased risk of forest fires in dry and/or hot seasons
- Increased risk of vector borne diseases (e.g. from tiger mosquitos).
- Reduced agricultural yields and product quality.
- Increased energy consumption for cooling in summer season.
- Increased ozone pollution in summer.

Climate change and the salt wedge intrusion in the Po delta

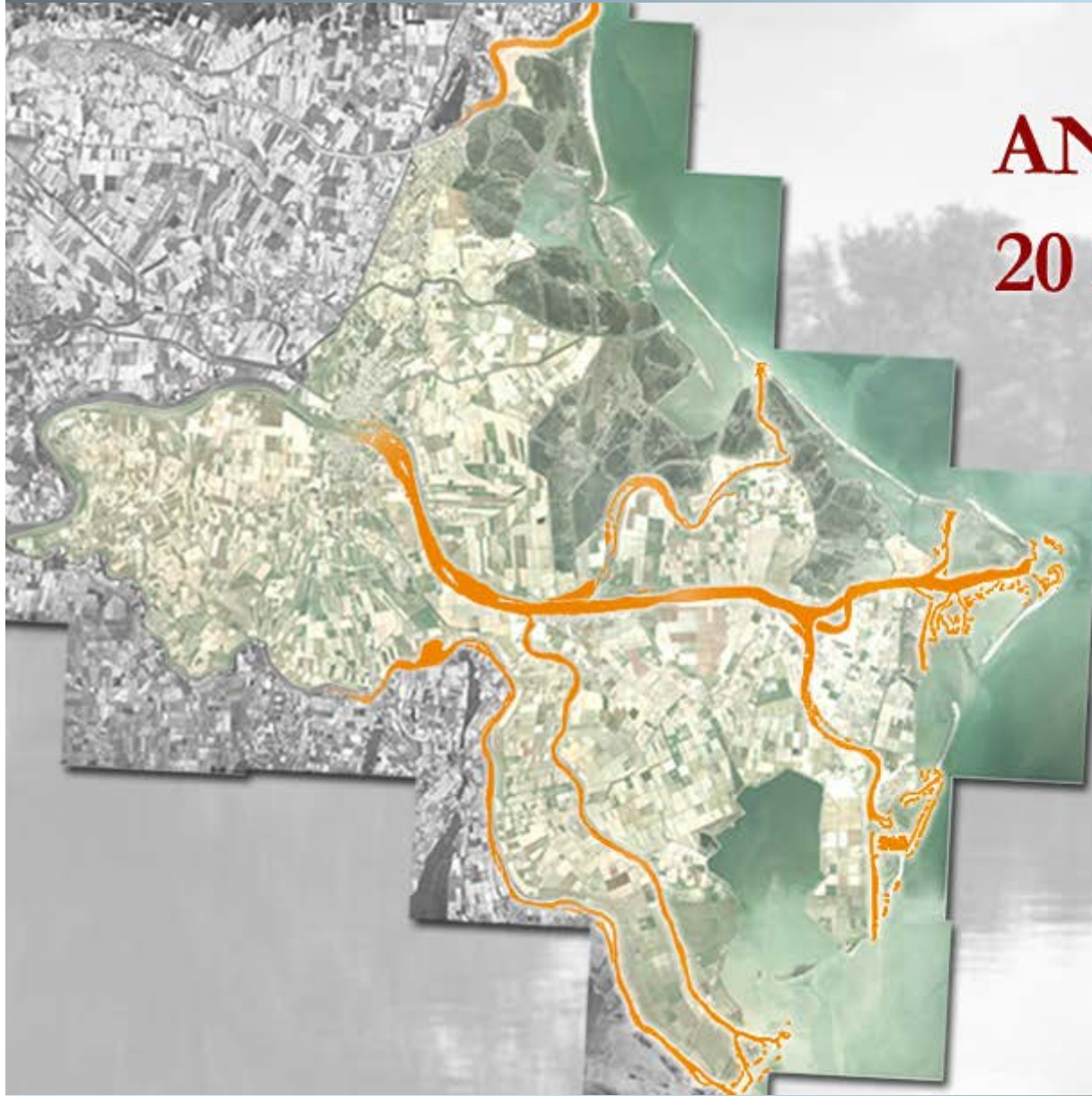
ANNI 50' - 60'
2 -3 Km dalla foce



ANNI 70' - 80'
10 Km dalla foce



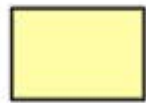
ANNI 2000
20 Km dalla foce



Size of current problem with discharge between 250 and 300 m³/s

SITUAZIONE ATTUALE

20.000 ha



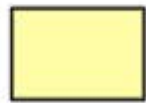
**AREA SOFFERENTE PER LA
RISALITA DEL CUNEO SALINO
PER Q TRA 250 E 300 m³/s**



Size of current problem with discharge between 180 and 200 m³/s

SITUAZIONE ATTUALE

30.000 ha



**AREA SOFFERENTE PER LA
RISALITA DEL CUNEO SALINO
PER Q TRA 250 E 300 m³/s**

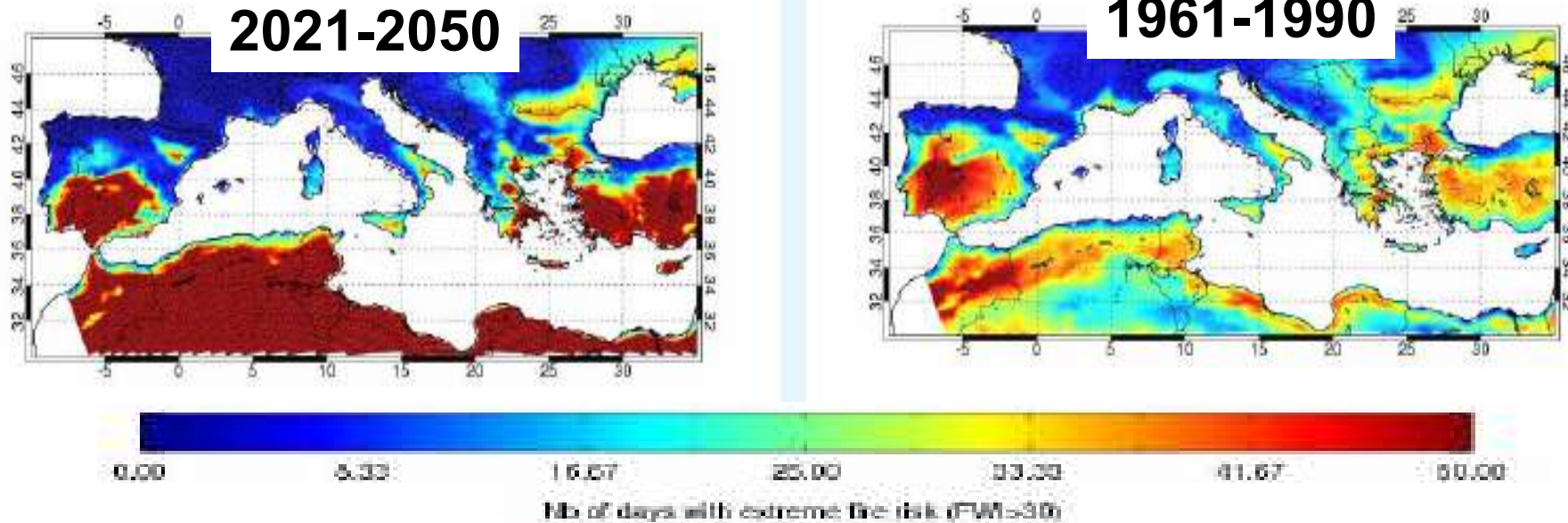


**AREA SOFFERENTE PER LA
RISALITA DEL CUNEO SALINO
PER Q TRA 180 E 200 m³/s**



FOREST FIRE RISK INCREASE

Number of days with FWI>30



During the period 1961-1990 40-50 dd/y were observed with high forest fire risk index, in Southern Spain, Turkey and Western Greece. In 2021-2050 an increase of 15-20 dd/y is foreseen, with an extension of high index values to other areas (e.g. southern Italy). Little variability among RCMs, signal is robust.

RISK OF WHEAT PRODUCTION DECREASE

Probability of production lower than the 20th percentile value of base period (1990-2010)

9 Assessments of climate change impacts

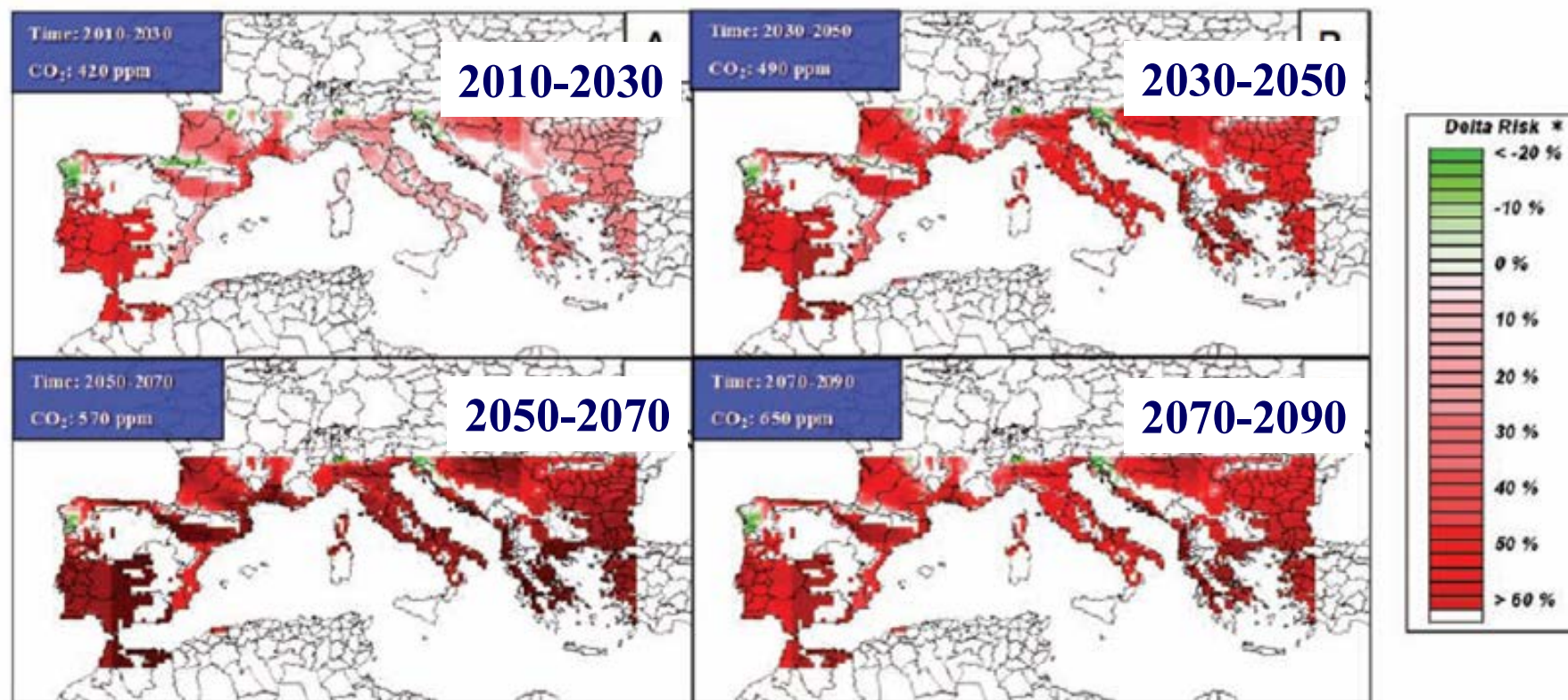


Figure 9.23: Spatial plots of changes in durum wheat risk of yield shortfall by: (a) 2010-2030, (b) 2031-2050, (c) 2051-2070 and (d) 2071-2090, relative to the baseline (1961-1990). Shortfall is defined as yields below the 20th percentile yield calculated for the present-day period 1990-2010.

HEAT WAVES INCREASE

Scenarios of variation of the Heat Index No. of days when HI >40.7 – Summer (JJA)

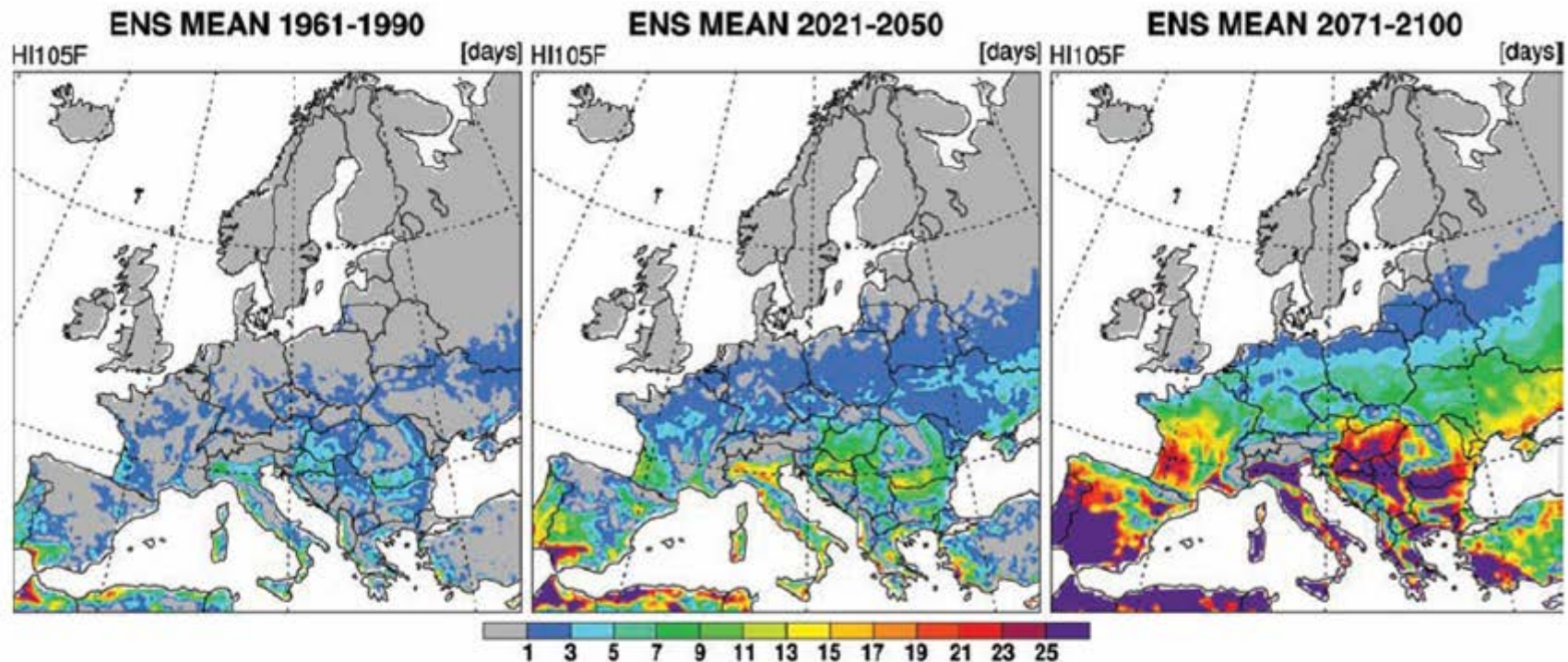


Figure 6.21: Projected average number of summer days exceeding the apparent temperature (heat index) threshold of 40.7°C (105°F). Ensemble mean summer (JJA) days as simulated by five ENSEMBLES RCM runs (MPI, KNMI, HC, ETH, C4I) are shown.

CWT frequencies

Change in heating and cooling energy requirement scenarios: turnover point already reached

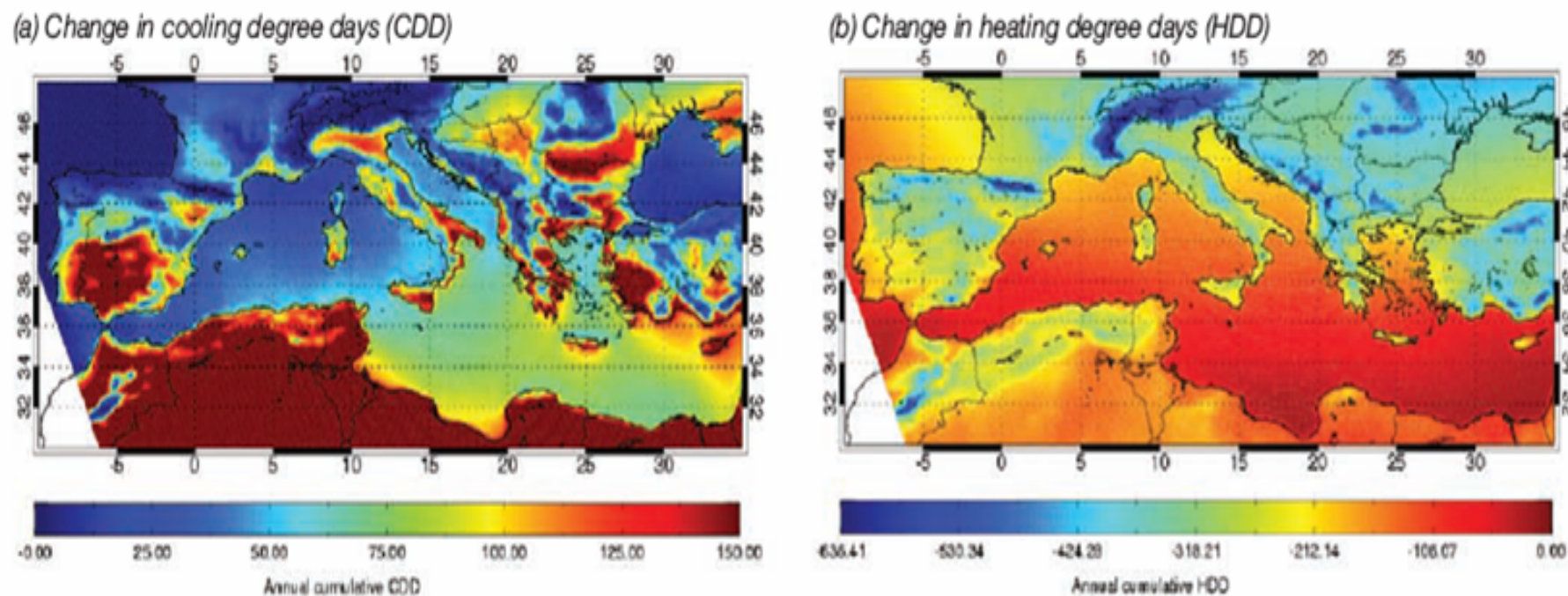
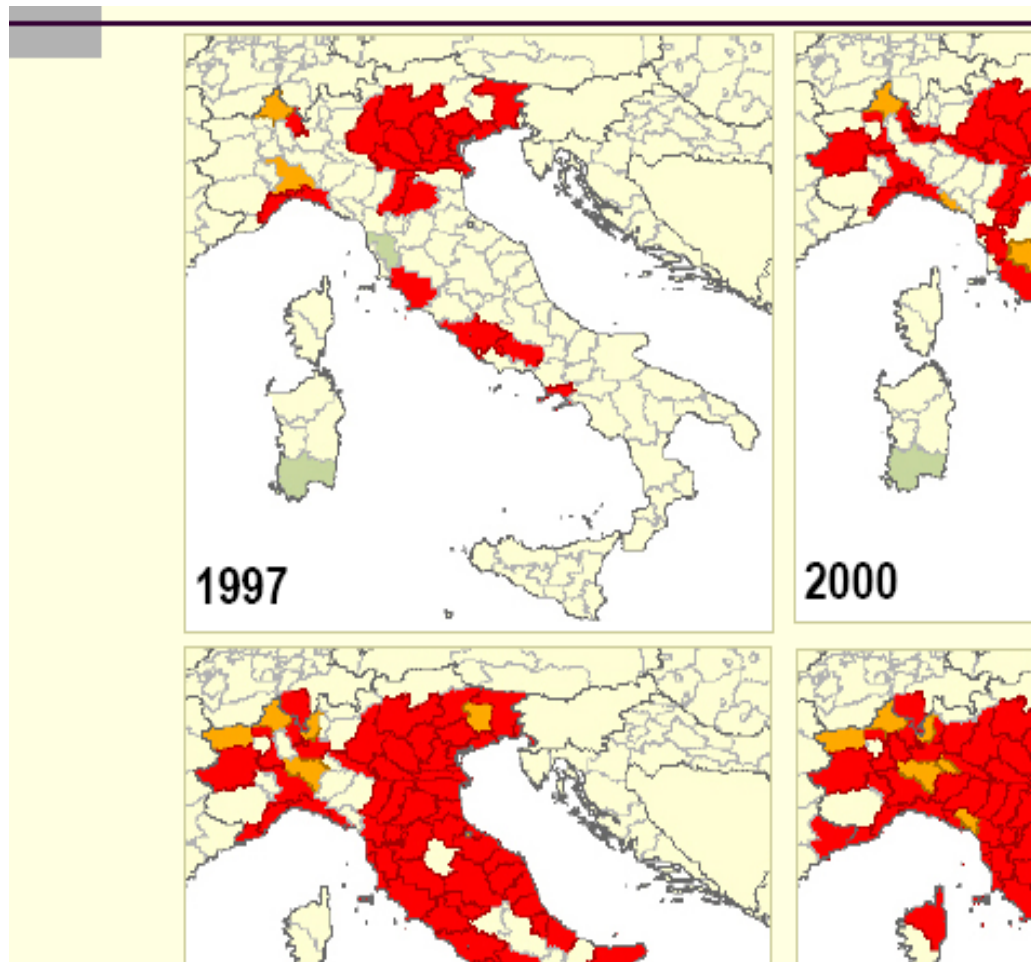


Figure 9.14: Projected change in potential annual energy demand between 1960–1989 and 2021–2050 for (a) cooling and (b) heating, based on accumulated temperature (°Cd).

Vector borne diseases: tiger mosquito diffusion

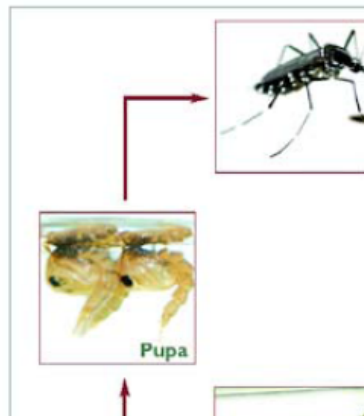


The Chikungunya epidemic



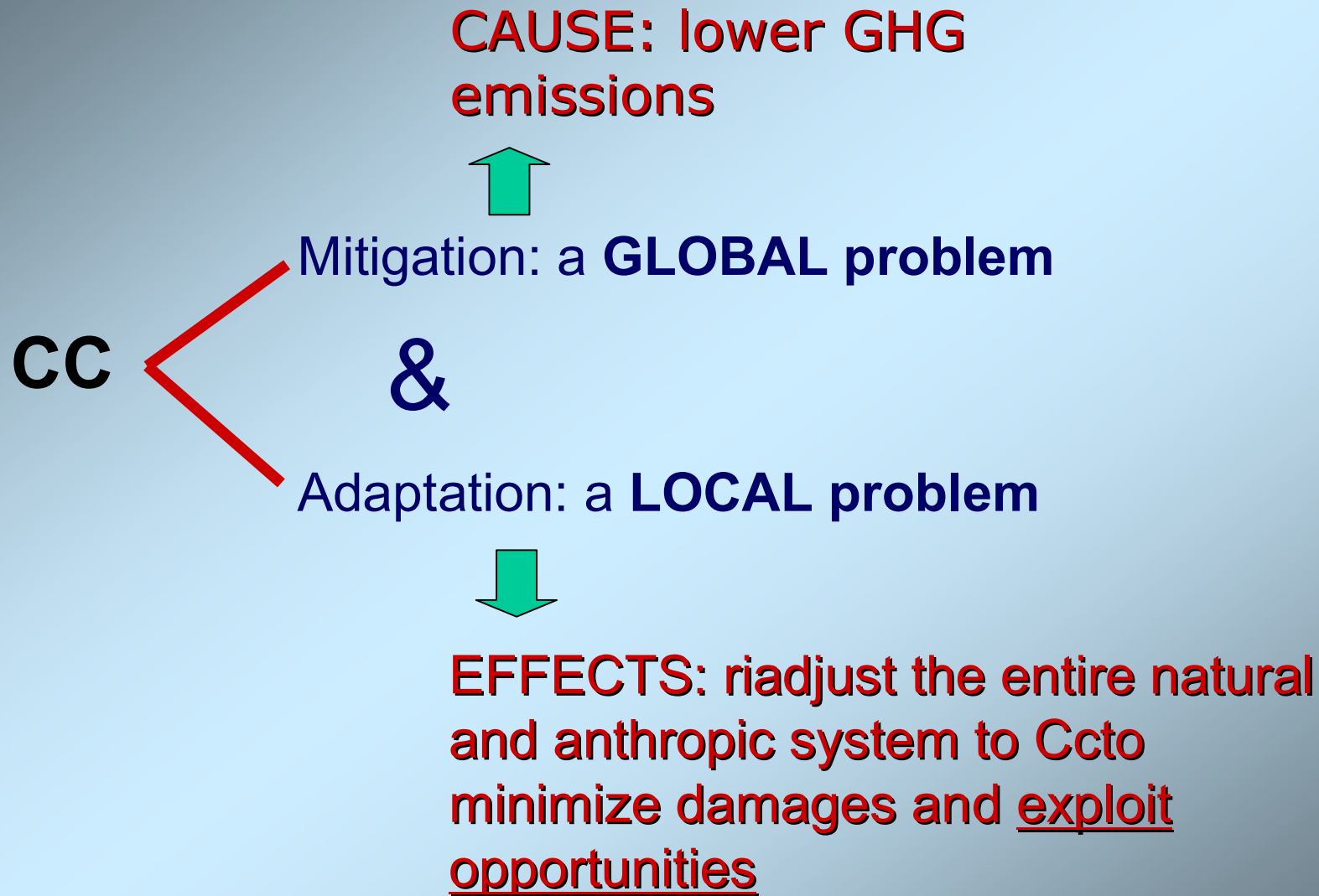
The disease vectors: tiger mosquitos

Ordine: Ditteri
Genere: Aedes
Specie: Albopictus



What next?

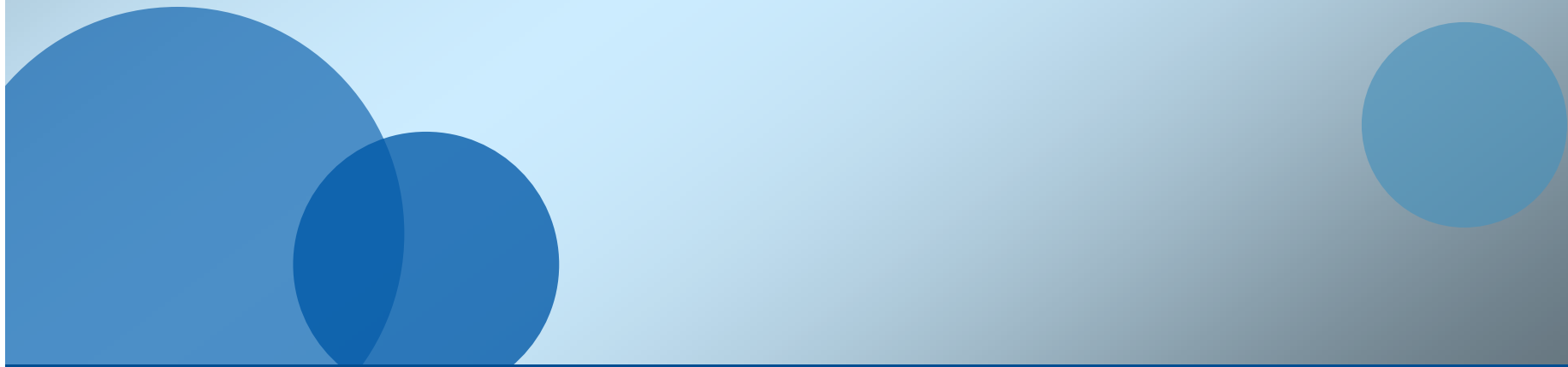
Mitigation and adaptation



**Strategies and actions to
adapt to climate change in
Emilia-Romagna**

Adaptation

- very effective in the short term, but when climate change becomes large, options decrease and associated costs increase
- effective adaptation measures are very dependent from specific factors, including geographic location and population and property exposure
- very dependent upon the degree of acceptance by the external context



Types and forms of adaptation

infrastructural and technological

Long time to completion

High costs of investment

High impacts on environment and population

non-infrastructural or "soft"

Shorter time to completion

Negligible costs, often included in socio-economical development

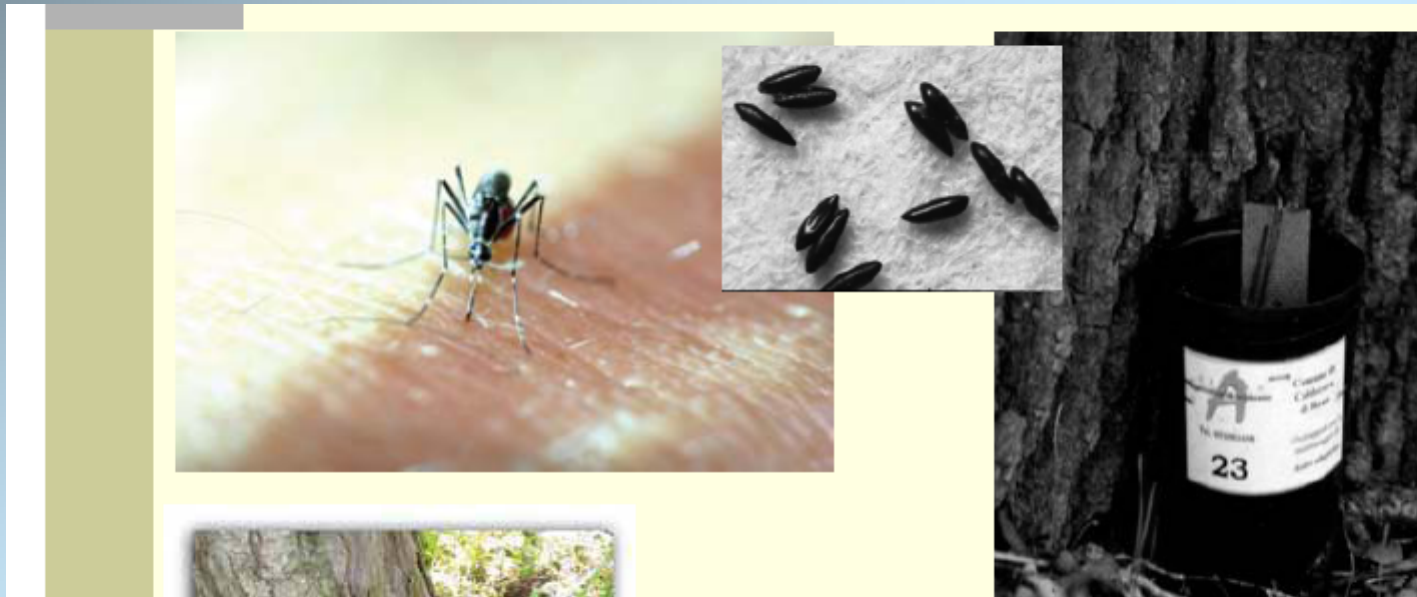
Applicable also in insufficient knowledge conditions

The EU White Paper on Adaptation to Climate Change (2009) had the aim of drawing a common reference frame for national adaptation strategies and plans: Italy is very, very late in producing a national strategy, but has recently been moving, at last (!)

Possible concrete adaptation strategies for Emilia-Romagna

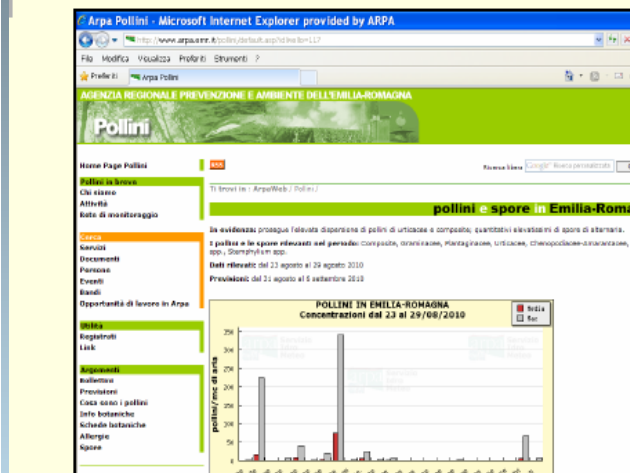
- **Health**: mid- and long-term planning of actions to prevent consequences of heat waves, of increased health risk due to vector borne diseases, increased pollen allergies, etc.
- **Water resources**: improved water systems maintenance, diversification of water supply sources, increased water systems interconnections, small water basins
- **Hydrogeological risk**: on a short timescale improving of monitoring and forecasting capabilities, on a longer timescale better climate-conscious territorial planning, promotion of a better use of territory (reforestation, relocation of settlements, increased room to rivers, expansion reservoirs...)
- **Agriculture**: modified agronomical practices(eg. optimisation of irrigation practices), transition to less hydrodemanding coltures, technological innovation (irrigation technologies, new cultivars, etc)
- **Territorial and urban planning**: increase of climate-conscious urban planning and increased use of bioarchitecture
- **Coastal areas**: beach nourishment, protection of wild coastal sectors, conservation of dunes
- **Territory**: improved knowledge of territorial vulnerability and better use of territorial resources to combat desertification
- **Biodiversity**: protection of natural environmental areas, wetlands, transition water zones, maintenance of parks and protected areas

Examples of contributions of ARPA to adaptation measures of the Emilia-Romagna regional government: tiger mosquito surveillance programme

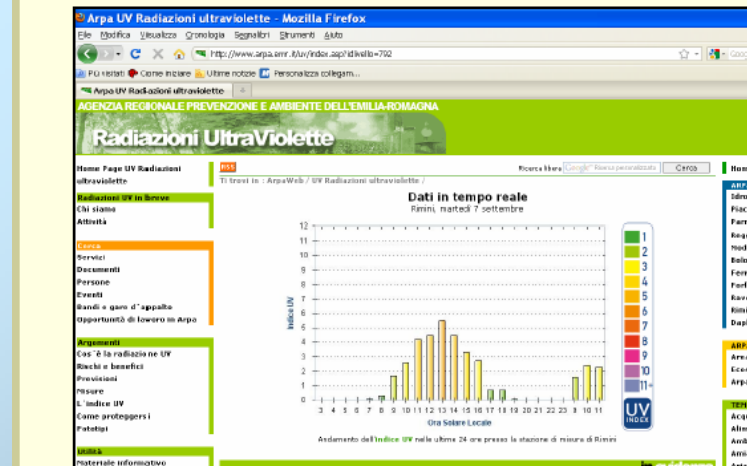


Examples of contributions of ARPA to adaptation measures of the Emilia-Romagna regional government: monitoring of pollens and of UV radiation

Monitoraggio pollinico



La radiazione ultravioletta



Examples of contributions of ARPA to adaptation measures of the Emilia-Romagna regional government: forecasts of heat waves

Arpa Rischio calore - Windows Internet Explorer

http://www.arpa.emr.it/disagio/index.asp?idlivello=97

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LE PREVISIONI RELATIVE AL DISAGIO BIOCLIMATICO ESTIVO SONO SOSPENSE

Il servizio di previsione è sospeso e **riprenderà il 15 Maggio 2011**. Rimangono disponibili sul sito gli andamenti dell'indice di Thom per l'estate 2010 e per gli anni precedenti e diverse sezioni contenenti documentazione varia sulla tematica. Di seguito viene proposto un **esempio dimostrativo** del servizio.

Emissione del 27 agosto 2010

Legenda

NO DISAGIO	DEBOLE DISAGIO	DISAGIO	FORTE DISAGIO
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Previsione per oggi 27 agosto

Previsione per domani 28 agosto



sintesi prodotti

Prev. Regionale Prev. Provinciali Dati Estate 2010 Dati Storici

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- Alimenti
- Ambiente e salute
- Amianto polveri e fibre
- Aria

start Bovini Oltre il Reno.ppt Arpa Rischio calore - ...

IT 19.00

Examples of contributions of ARPA to adaptation measures of the Emilia-Romagna regional government: monitoring of drought and desertification

Arpa Siccità e desertificazione - Windows Internet Explorer

http://www.arpa.emr.it/siccita/?idlivello=120

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Siccità e desertificazione

arpa
agenzia regionale prevenzione e ambiente dell'emilia-romagna

Home Page Siccità e desertificazione

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Portate fluviali e precipitazioni in Emilia-Romagna

portate aggiornate al 19/09/2010
precipitazione aggiornate al 19/09/2010

Precipitazioni cumulate nelle Macroaree

- Sopra la media
- Nella media
- Sotto la media
- Dato mancante

Portate affluenti del Po

- Normale o superiore
- Criticità
- Dato mancante o scala in aggiornamento

Portate fiume Po

- Sopra la media
- Sotto la media
- Dato mancante

Macroaree
Province
Fiumi

[NOTA: in caso di difficoltà nel visualizzare i grafici si consiglia di aprire i collegamenti in una nuova finestra o tab. [tasto destro del mouse]

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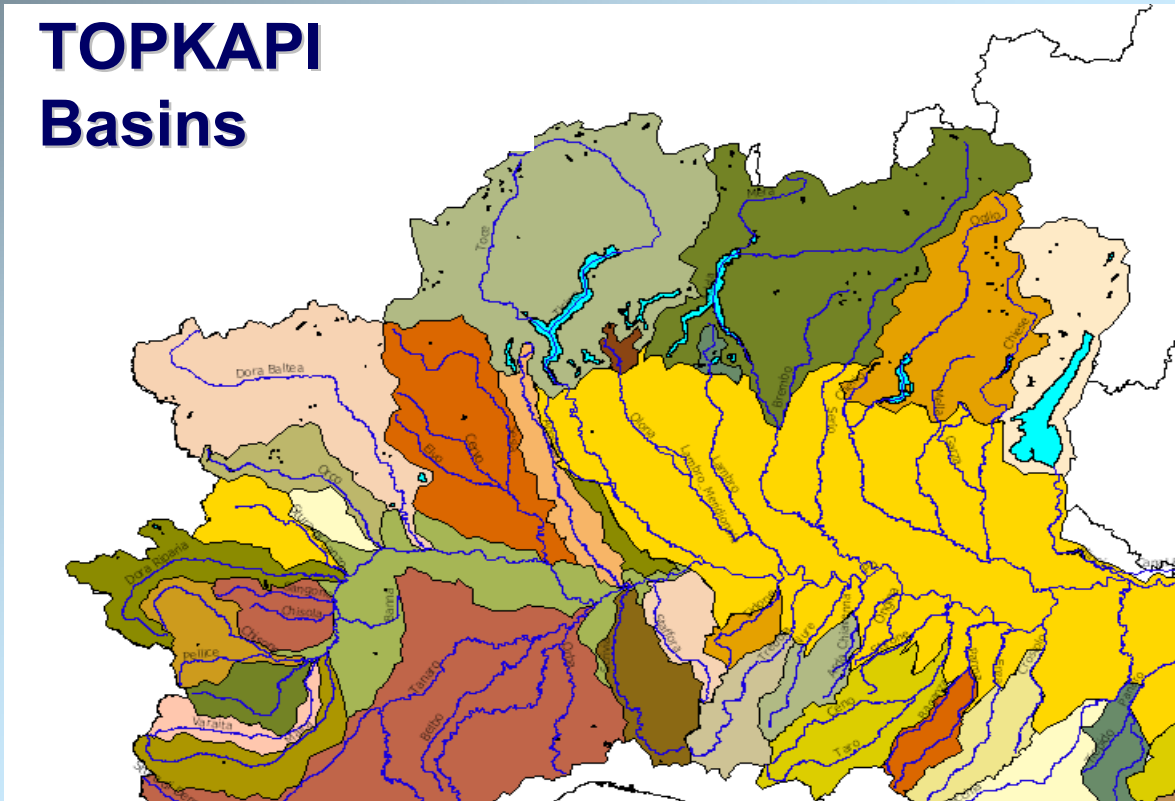
TEMI AMBIENTALI

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- Ambiente e salute
- Amianto polveri e fibre
- Aria
- Balneazione

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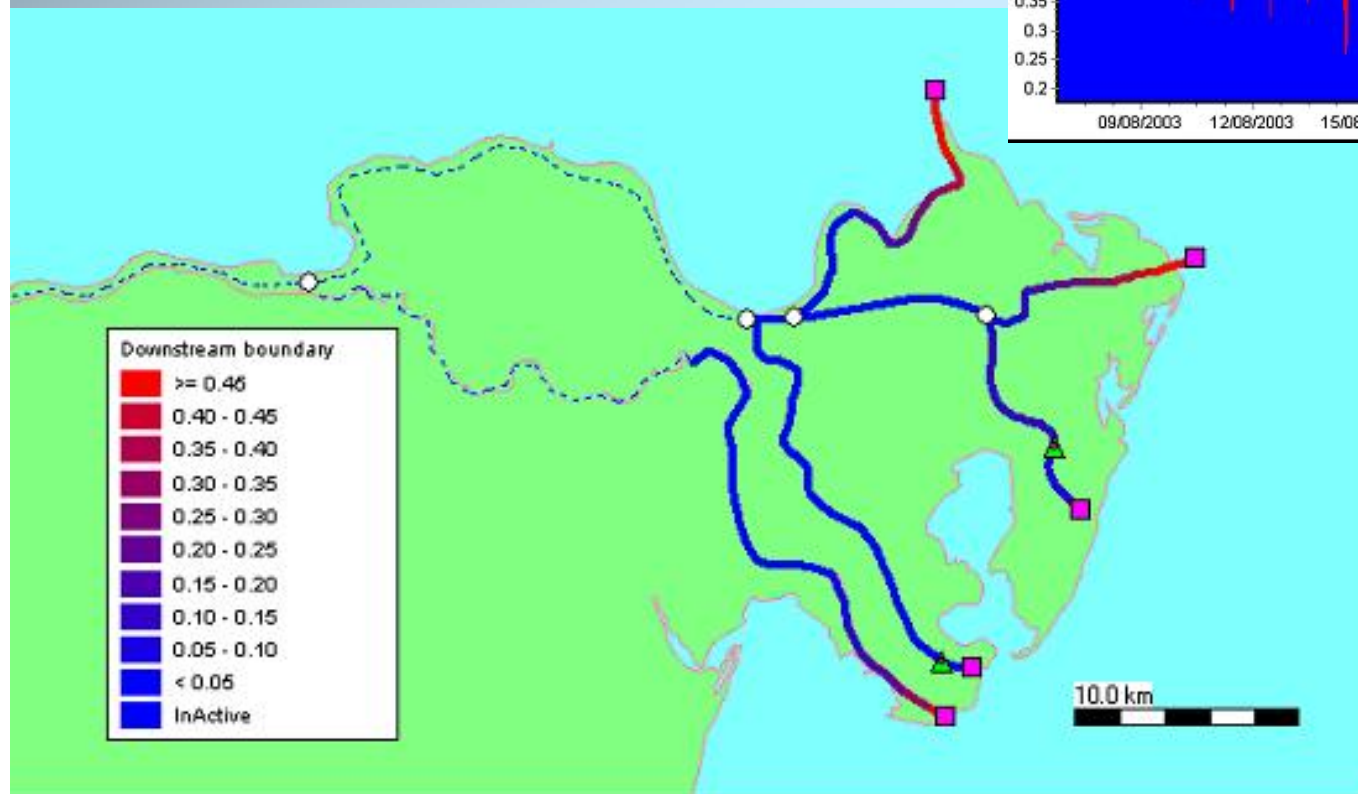
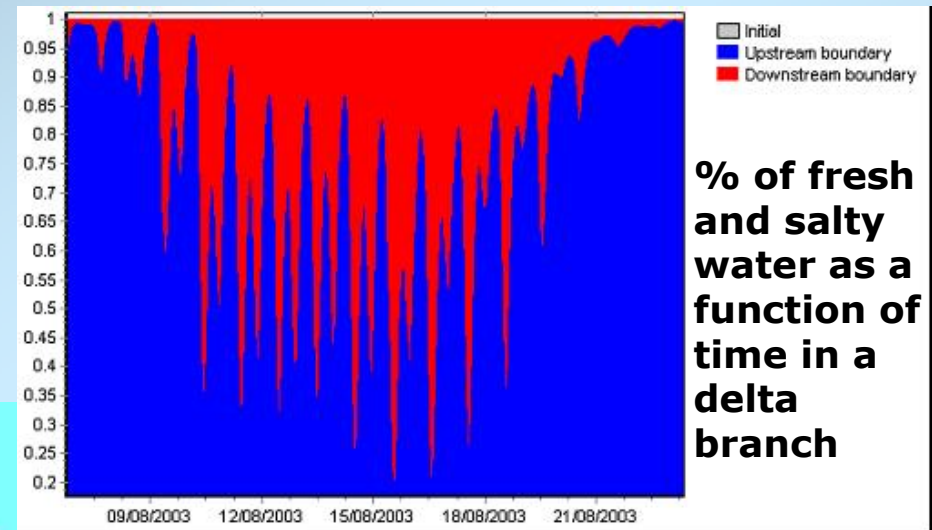
Examples of contributions of ARPA to adaptation measures of the Emilia-Romagna regional government: modelling of Po basin to manage flooding risk

TOPKAPI Basins



Examples of contributions of ARPA to adaptation measures of the Emilia-Romagna regional government: modelling of Po basin during drought episodes

Simulation of salt intrusion by Sobek & DELWAQ



Thank you
for your
attention

<http://www.arpa.emr.it/>

