The challenge of drought in the Mediterranean Region

(L.Genesio - IBIMET/CNR)

Early Warning Systems for extreme events impact.
Managing drought for a sustainable development
July 3-14, 2006, IBIMET-CNR, Florence, Italy

Mediterranean is a complex systems

"The Mediterranean basin represents one of the world's most complex systems, as it includes countries bearing many different characteristics in terms of economic structures and productive systems, as well as of ecosystems and culture. The Mediterranean countries developed and are still developing on the basis of a long history of interaction and integration."

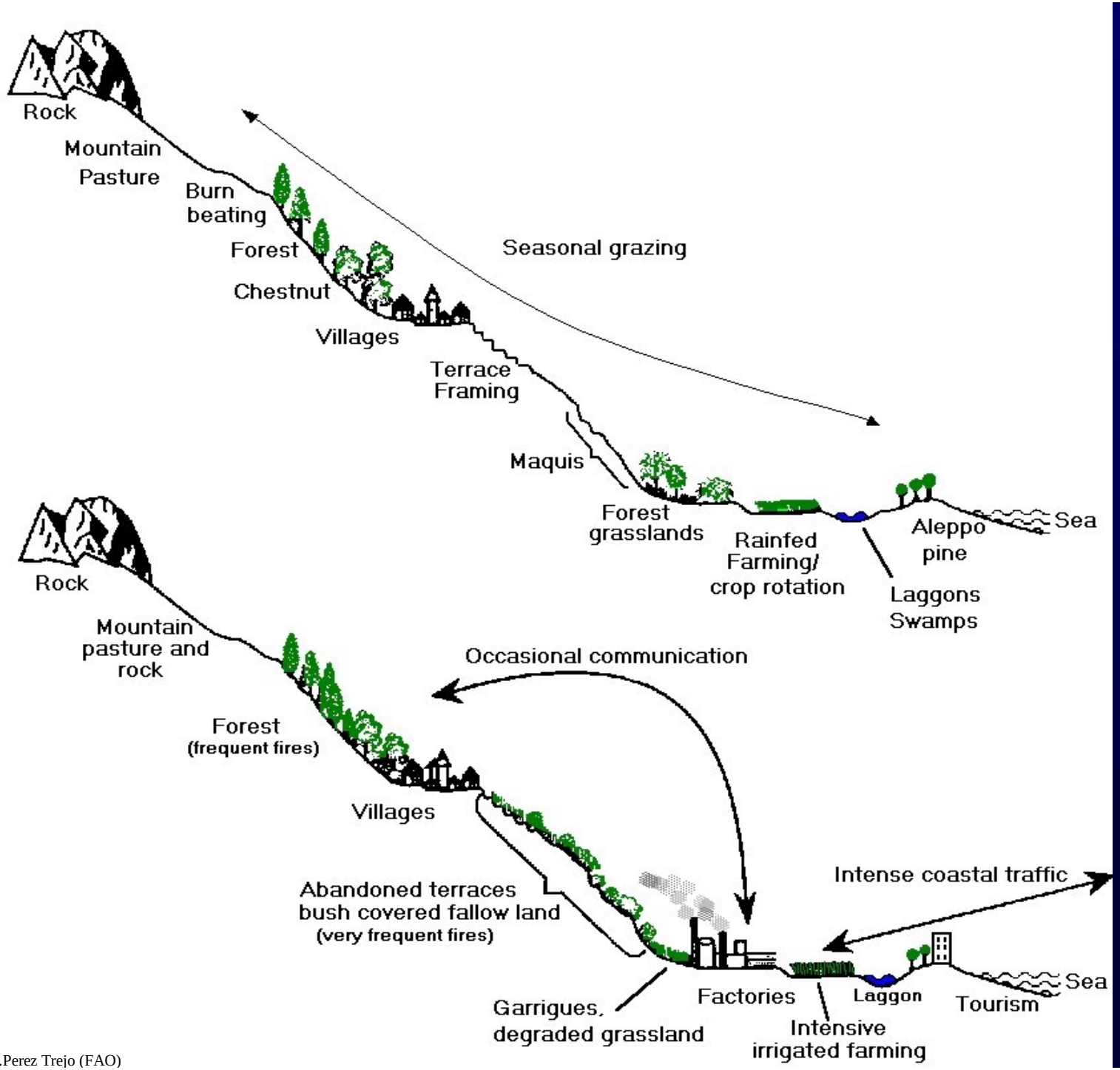
(DISMED Project Executive Summary, 2000)

Characteristics of a complex systems

- Complex systems are dynamic
- The evolution of complex systems is strongly determined by spatial patterns
- The dynamics of complex systems tend to be unpredictable, non-determinate
- The interactions among processes of complex systems can produce structural (qualitative) changes

Dynamic patterns 1

Drought in a changing structure of the territory



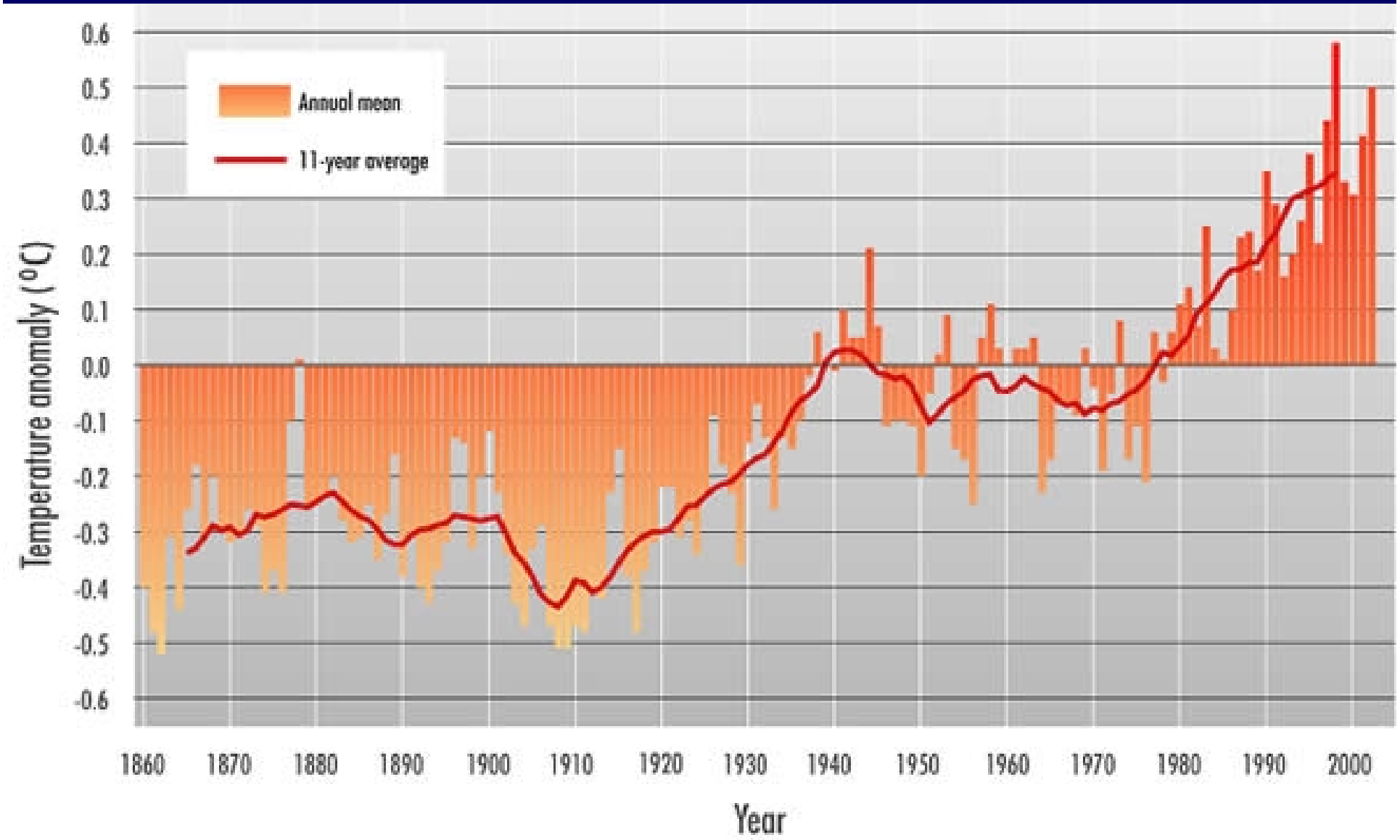
F.Perez Trejo (FAO)

Characteristics of a changing territory

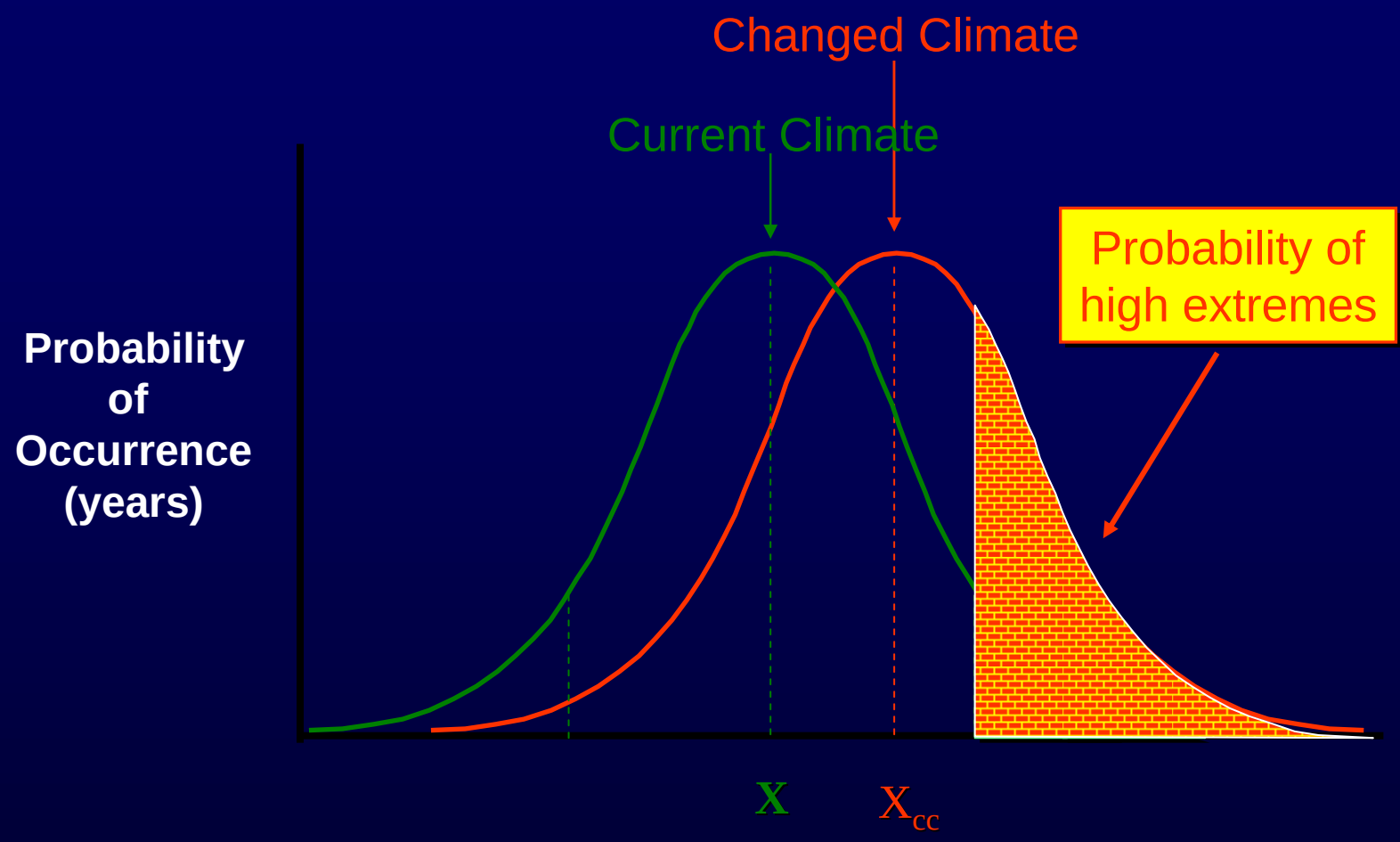
- Intensive market-driven agricultural production
- Intensive and non-linear exploitment of natural ressources
- Loss of flexibility
- Increase of vulnerability
- Energy intensive/dependent societies

Dynamic patterns 2

Drought in a changing environment

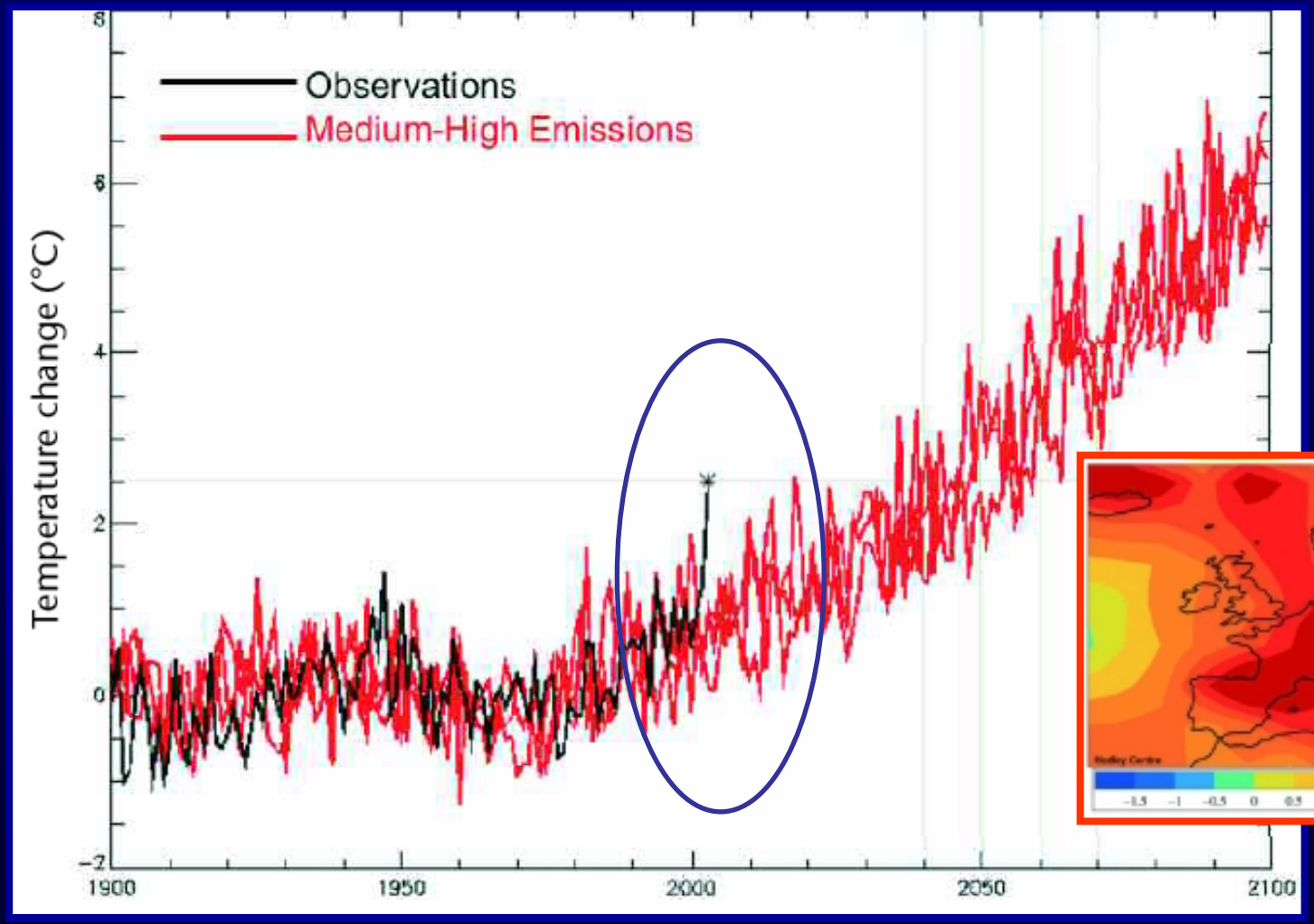

Annual mean
11-year average
Temperature anomaly (°C)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
Year

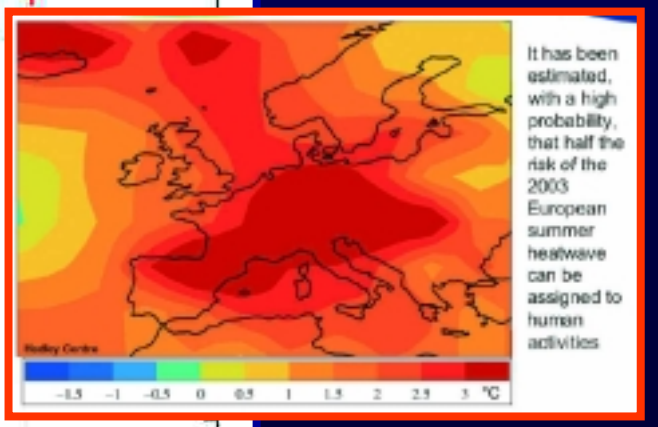
More energy in the climate system



Barry Smit, (2001) Professor, University of Guelph, Canada IPCC, TAR, WG2, Ch.18

Summer 2003 temperatures will be normal for 2040, and cold for 2060





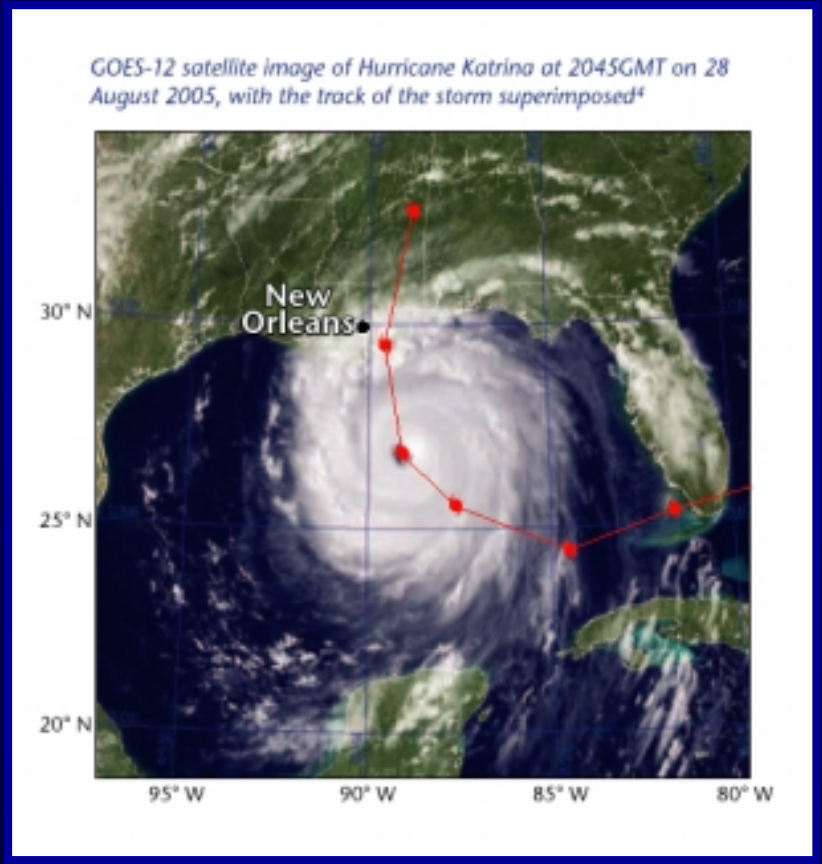
UK MetOffice - Hadley Centre for Climate Prediction and Research

TEMPERATURE INCREASING IN 2100

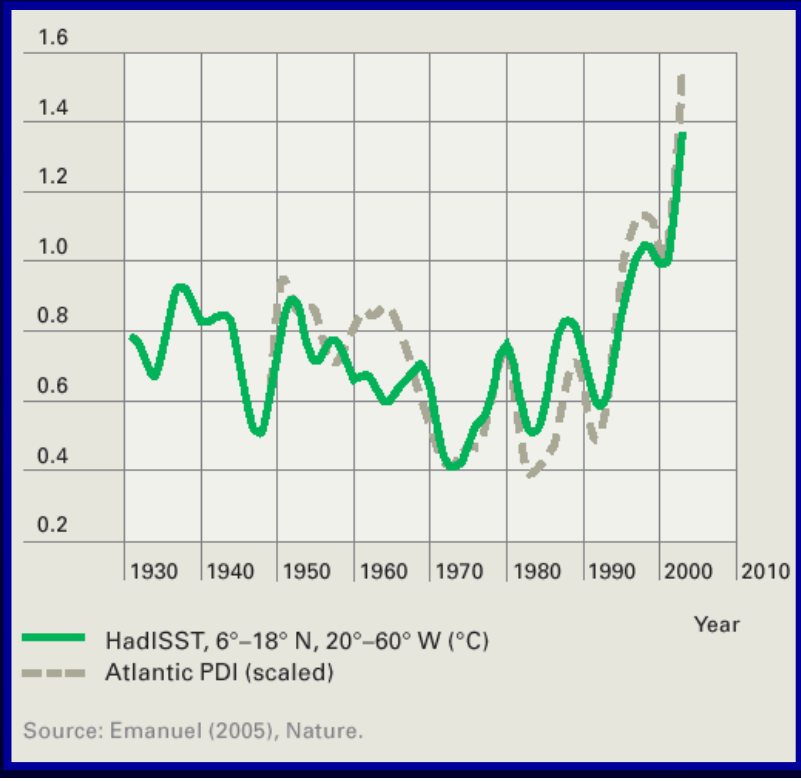
Level of stabilization (CO_2 eq)	temperature increase GCM(IPCC 2001)	Temperature increase GCM(Hadley Centre 2004)
400 ppm	1.2 – 2.5 °C	1.6 – 2.8 °C
450 ppm	1.3 – 2.7 °C	1.8 – 3.0 °C
550 ppm	1.3 – 3.2 °C	2.2 – 3.6 °C

Source: Based on den Elzen and Meinhausen (2005).

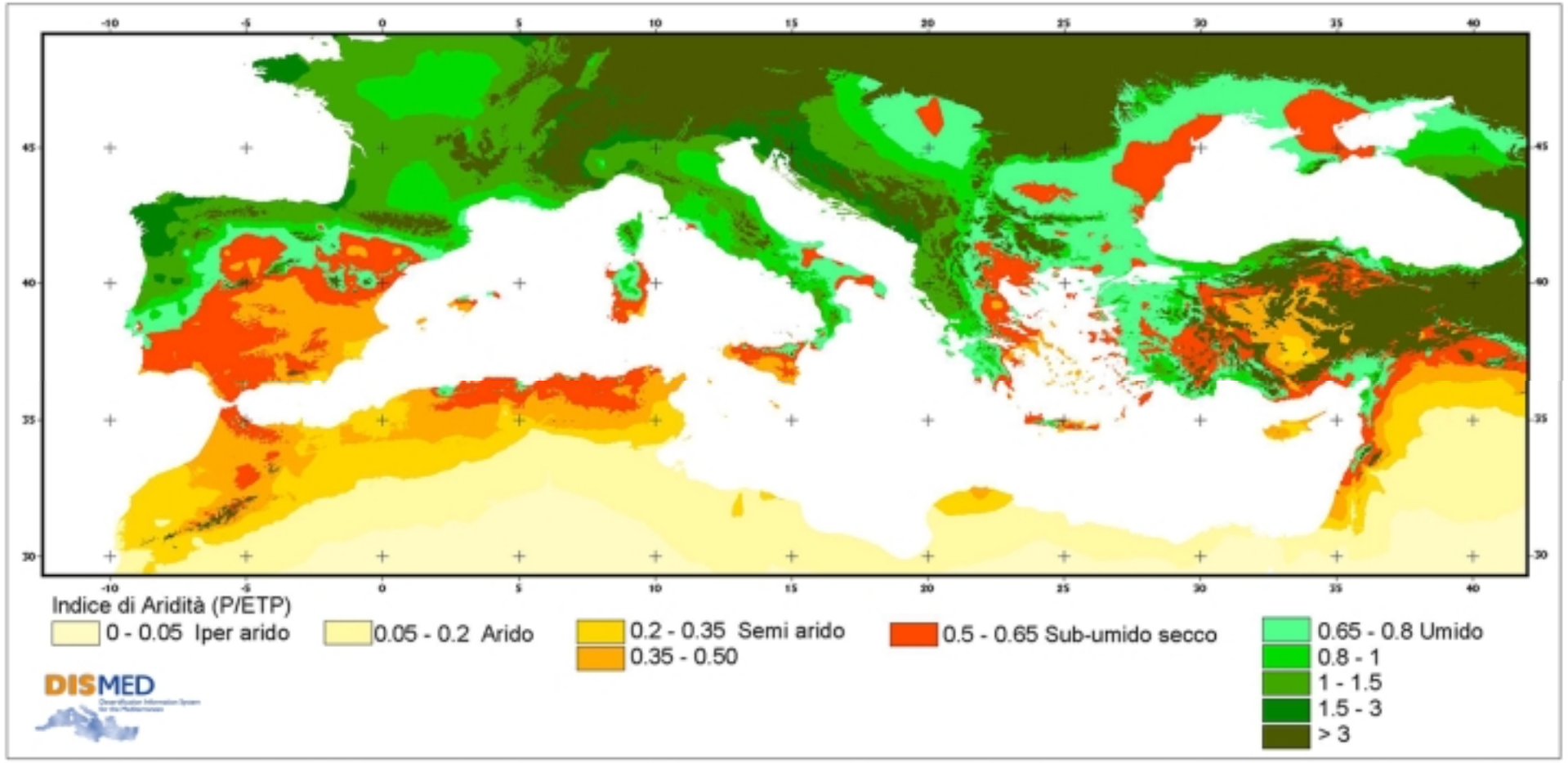
Sea Surface Temperature and yearly Hurricanes intensity



PDI (Power Dissipation Index) Cyclones wind energy



Reference context for the Mediterranean basin



Aridity Index classification % (Rainfall / PET)*

	hyper arid < 0.05	arid 0.05 - 0.2	semi-arid 0.2 - 0.5	sub-humid dry 0.5 - 0.65	humid > 0.65
Algeria	67.74	17.88	10.42	3.50	0.45
Egypt	77.61	22.38	0.01	-	0.01
France	-	-	-	-	100.00
Greece	-	-	2.07	13.73	84.20
Italy	-	-	0.16	5.38	94.46
Libya	68.87	27.36	3.76	-	-
Morocco	0.06	24.74	51.89	16.25	7.06
Portugal	-	-	1.21	31.38	67.41
Spain	-	0.66	21.36	37.09	40.89
Tunisia	1.11	51.37	26.30	18.22	3.00
Turkey	-	-	6.63	13.44	79.92

(DISMED Project)

* based on UNEP classification

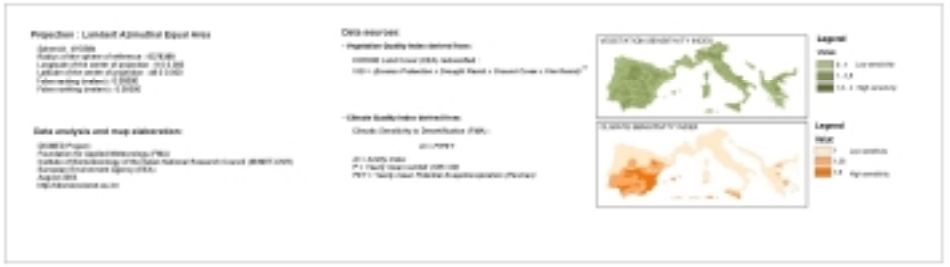
DISMED
Desertification Information System for the Mediterranean

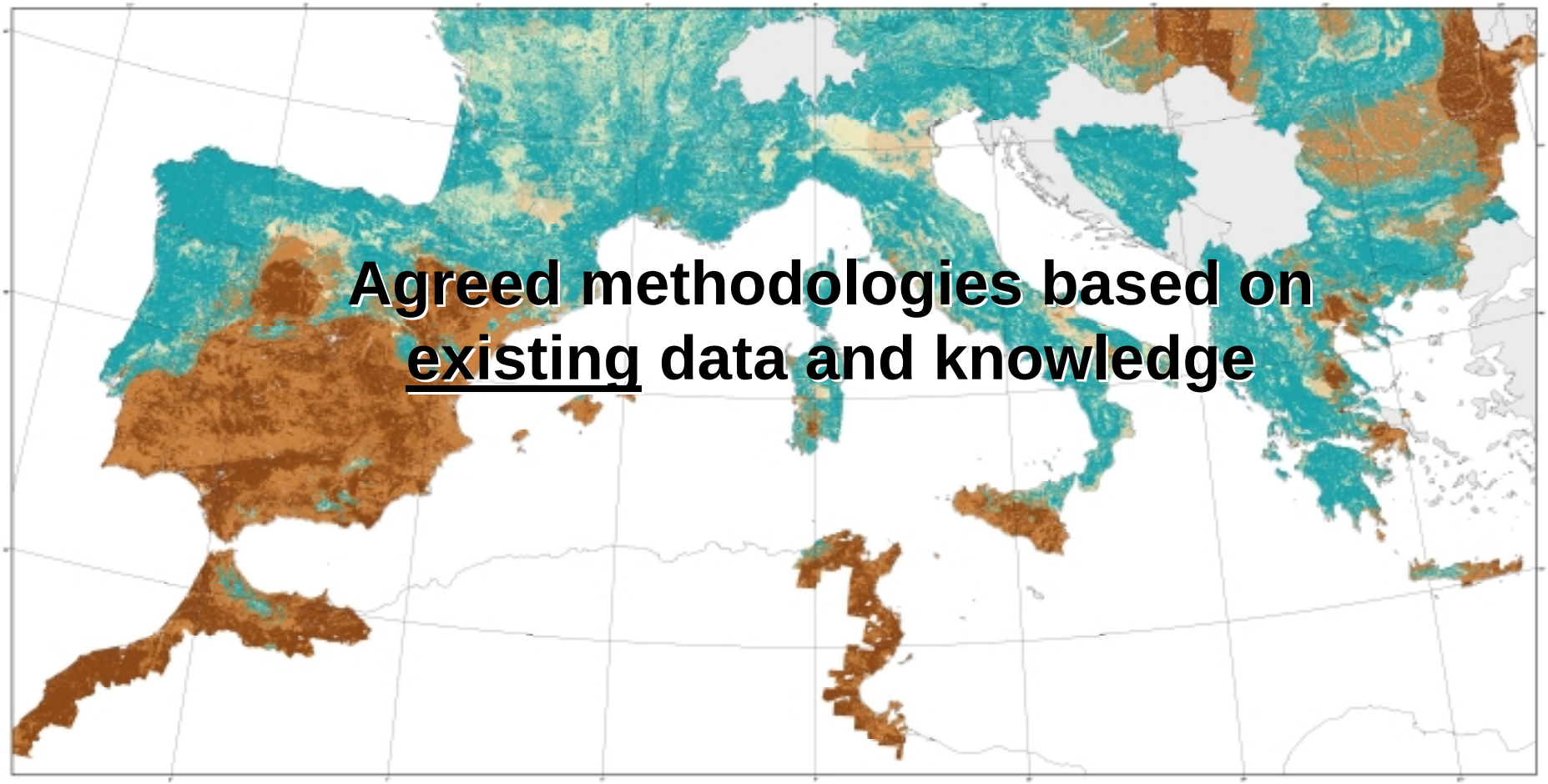
Map of Sensitivity to Desertification and Drought in the Mediterranean Basin

Scale 1:3000000

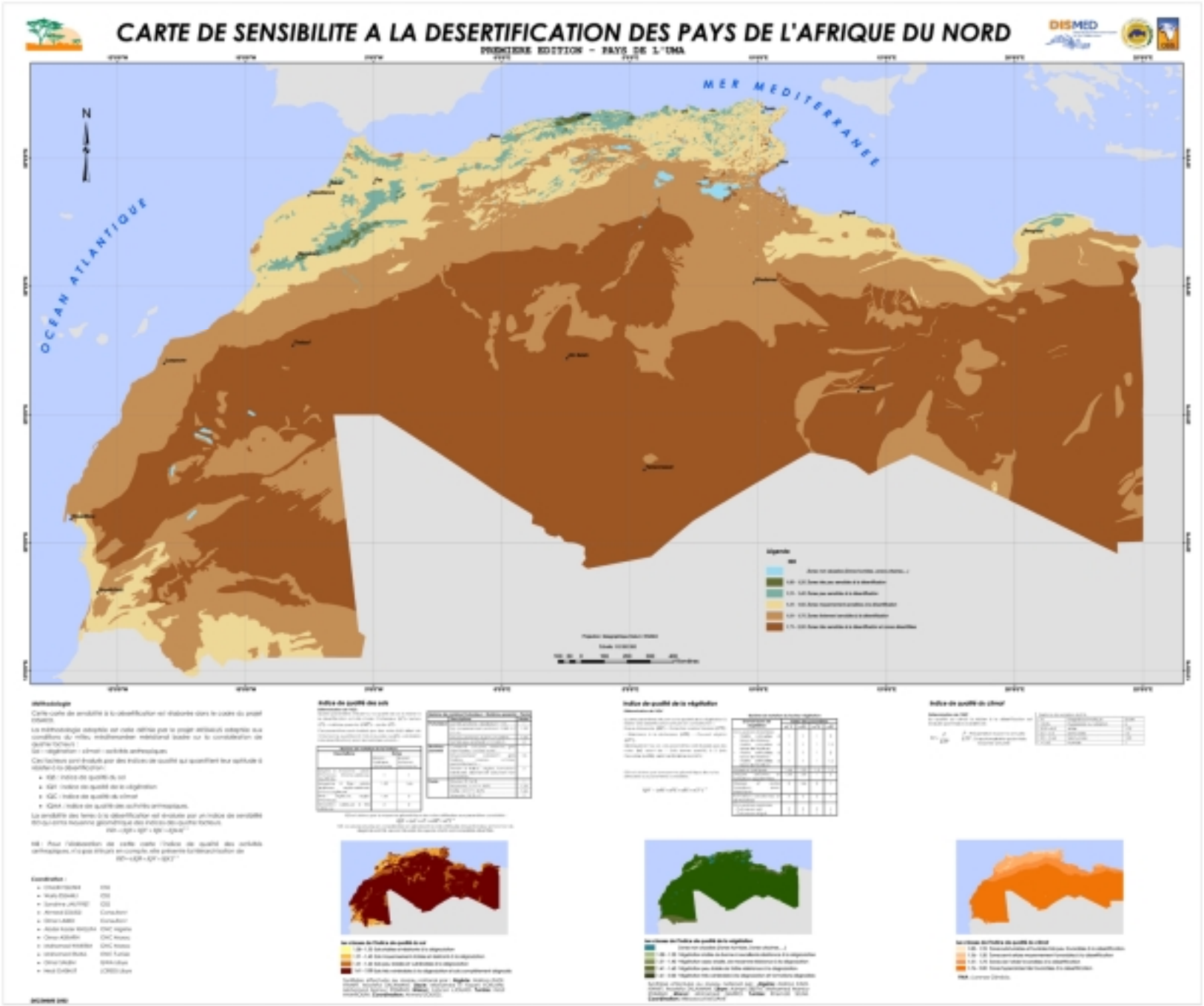
Vegetation and Climate sensitivity to desertification

Vegetation and Climate Sensitivity
No sensitivity
Low sensitivity
Moderate sensitivity
High sensitivity
Very high sensitivity
No Data / out of study area / incomplete data

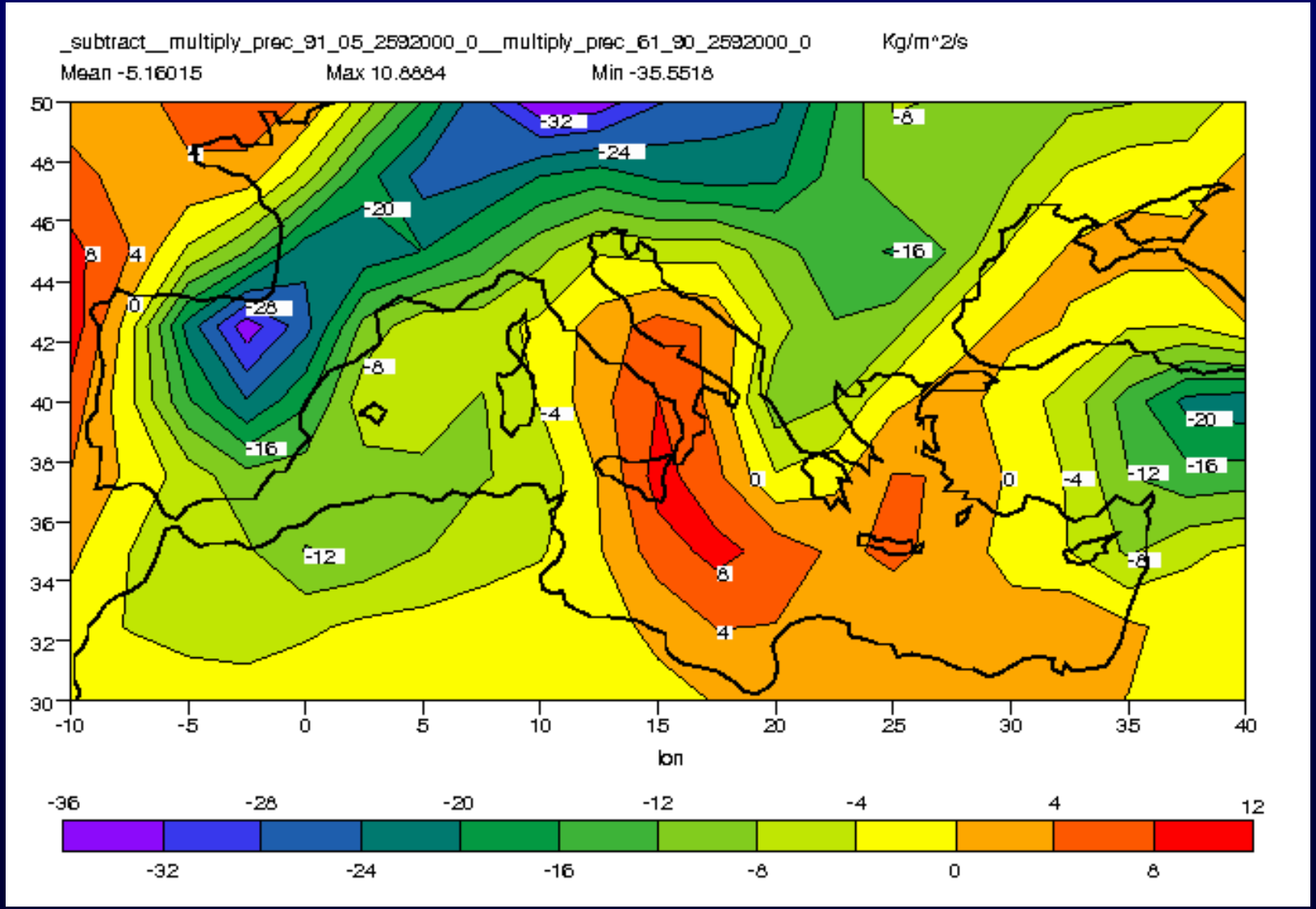




Agreed methodologies based on existing data and knowledge

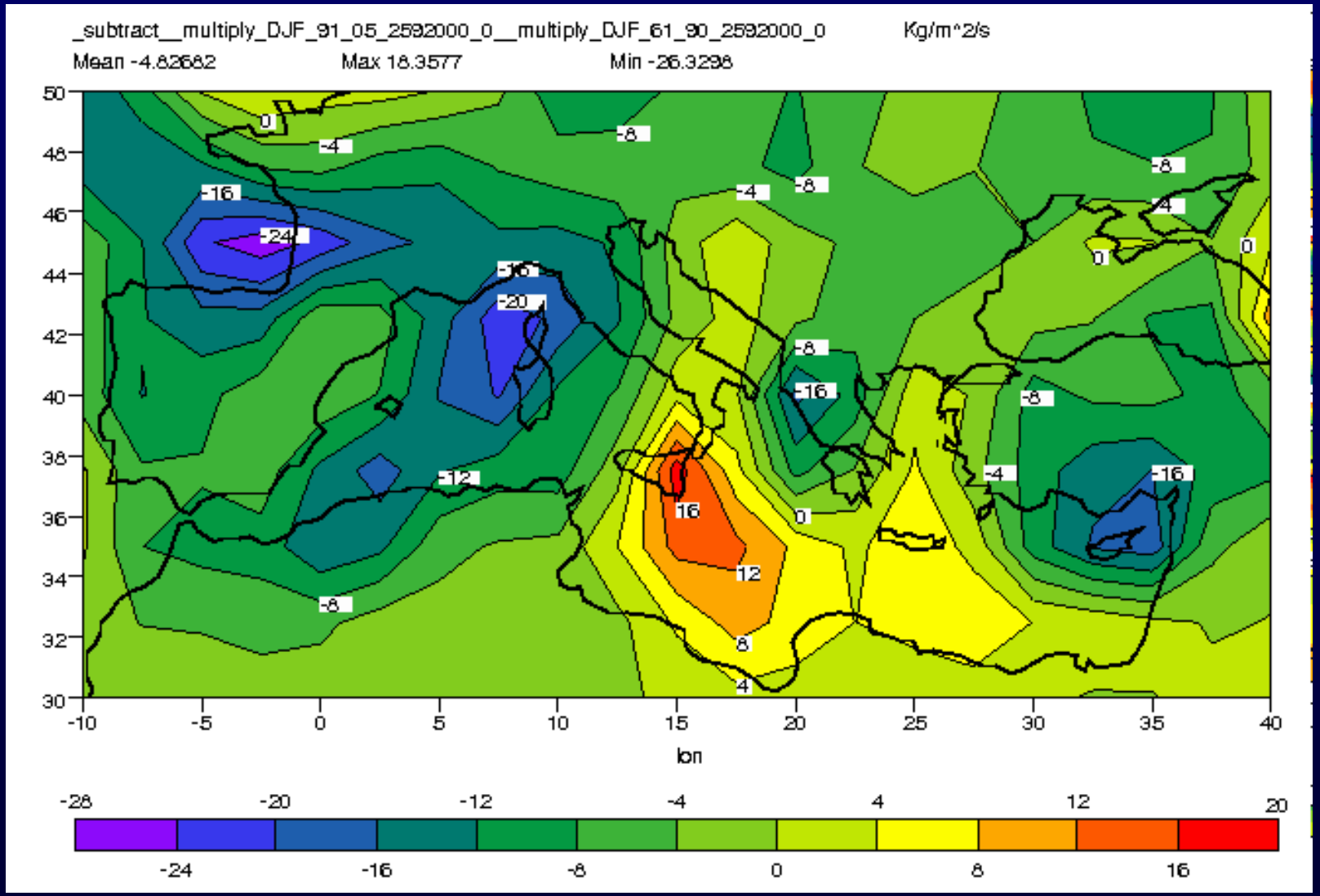

CARTE DE SENSIBILITE A LA DESERTIFICATION DES PAYS DE L'AFRIQUE DU NORD
PREMIERE EDITION - PAYS DE L'UMA
DISMED
MER MEDITERRANEE
OCEAN ATLANTIQUE
N

Rainfall 1961 -90 ⟶ 1991 - 2005



IBIMET CNR

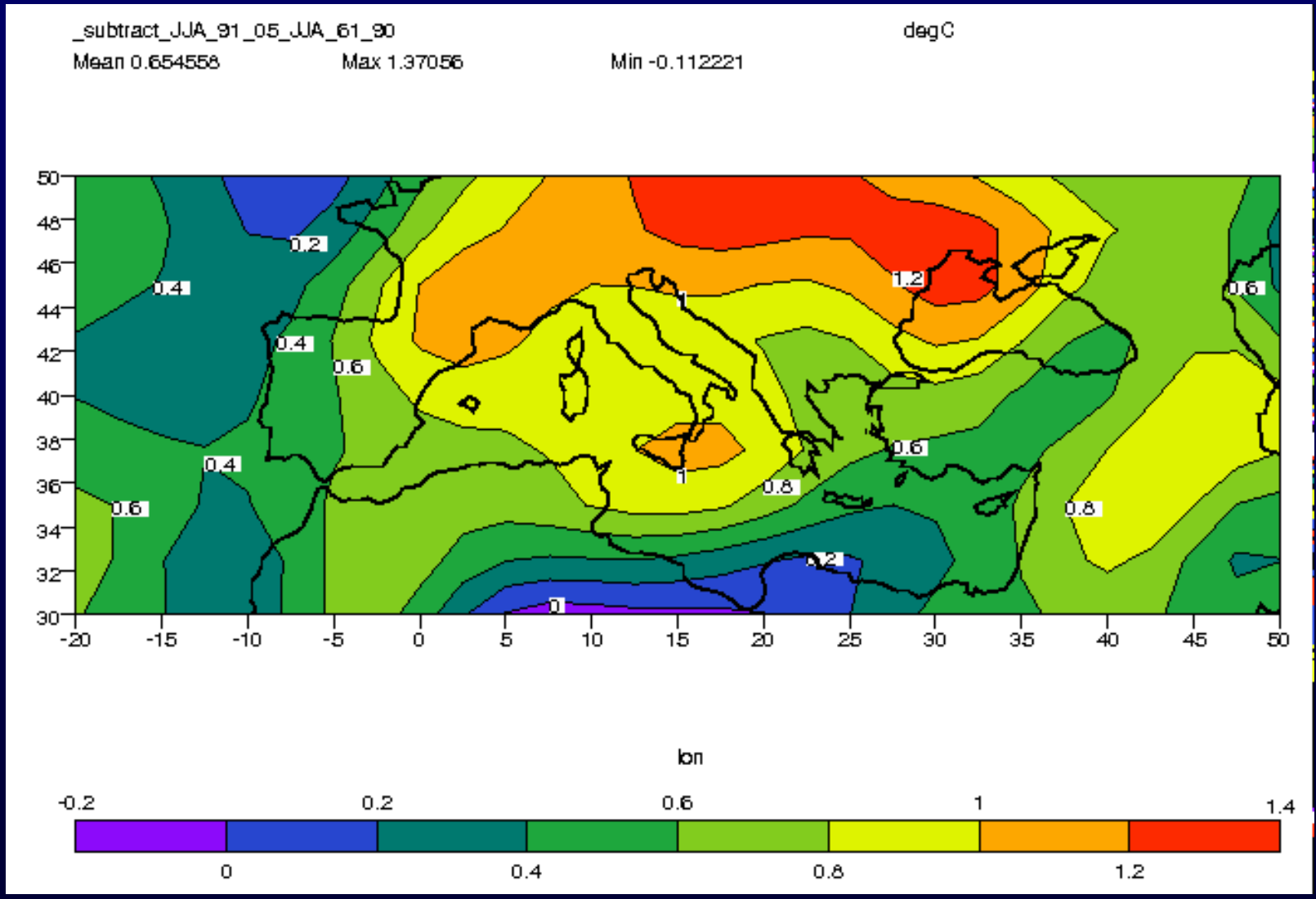
Rainfall DJF 1961 -90 ⟶ DJF 1991 - 2005



IBIMET CNR

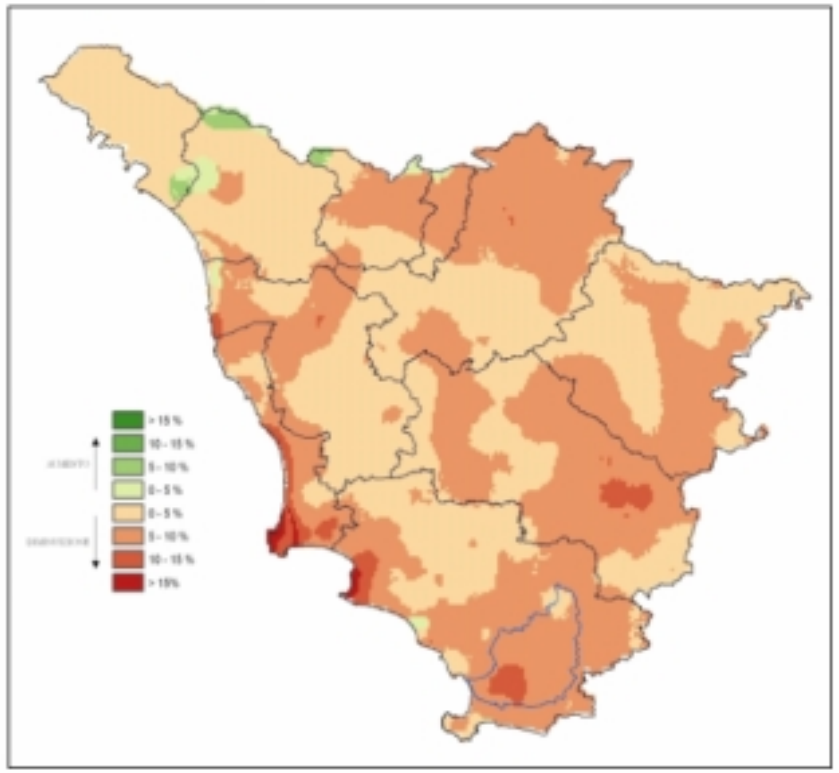
Decrease in winter precipitation

Temperature JJA 1961 -90 ⟶ JJA 1991 - 2005

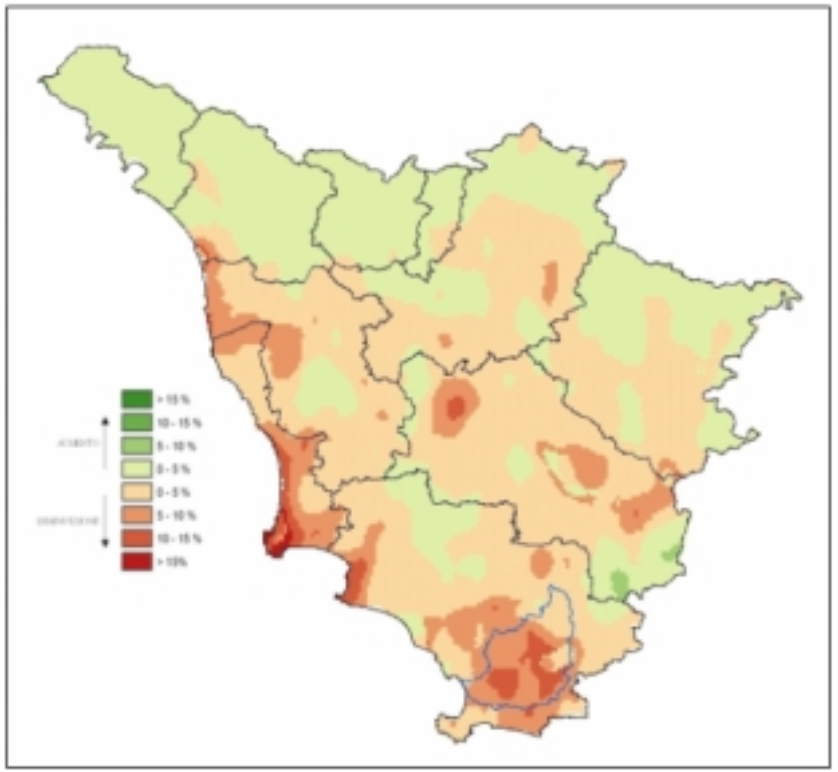


IBIMET CNR

Summer

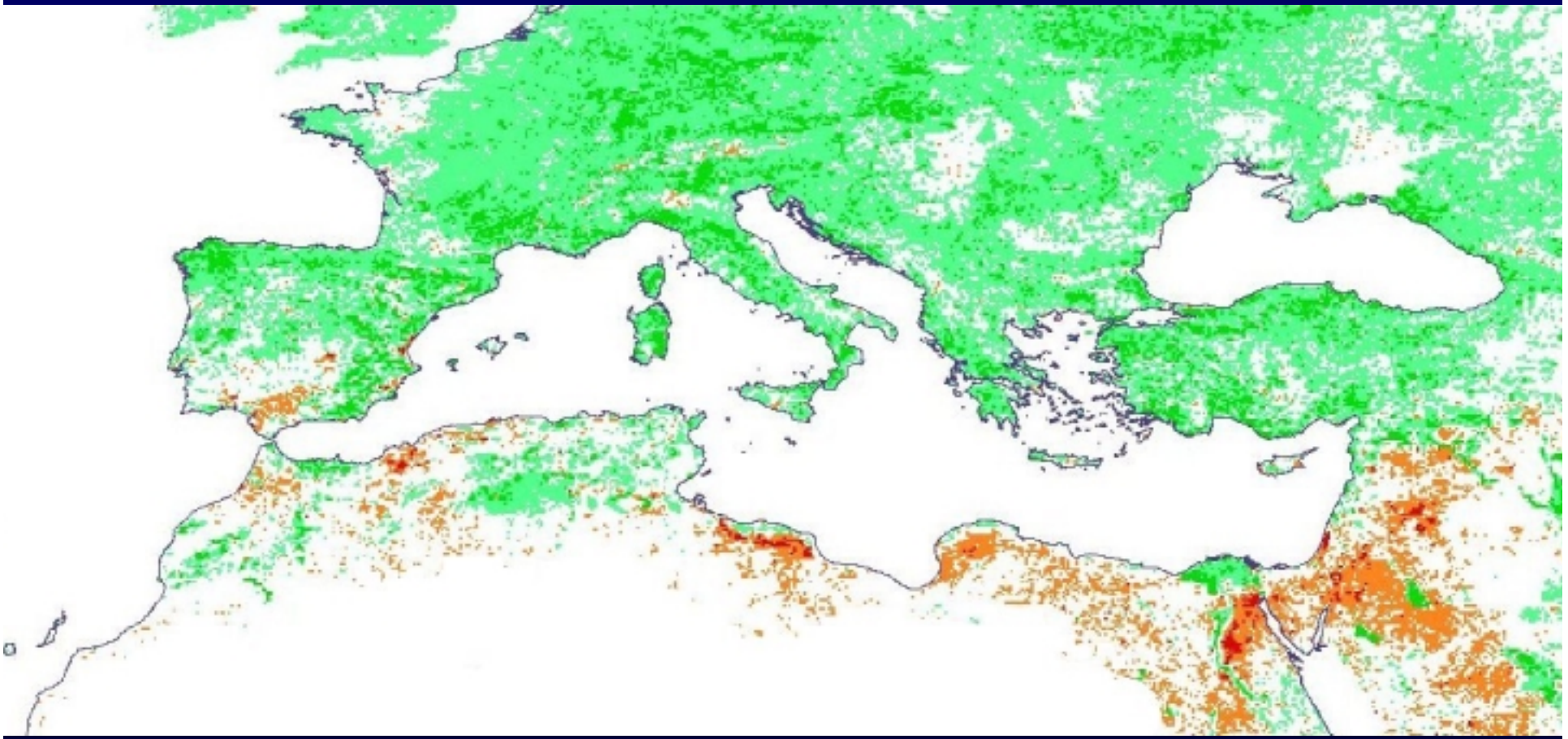


Spring



NDVI trends 1986 – 2003.

NDVI trends 1982-2000



DISMED
Desertification Information System for the Mediterranean

Vegetation Sensitivity to Desertification

Normalized Difference Vegetation Index (NDVI)
Seasonal Trend Analysis 1982 - 2000

Unprojected data - Approximate Scale 1 : 10.000.000

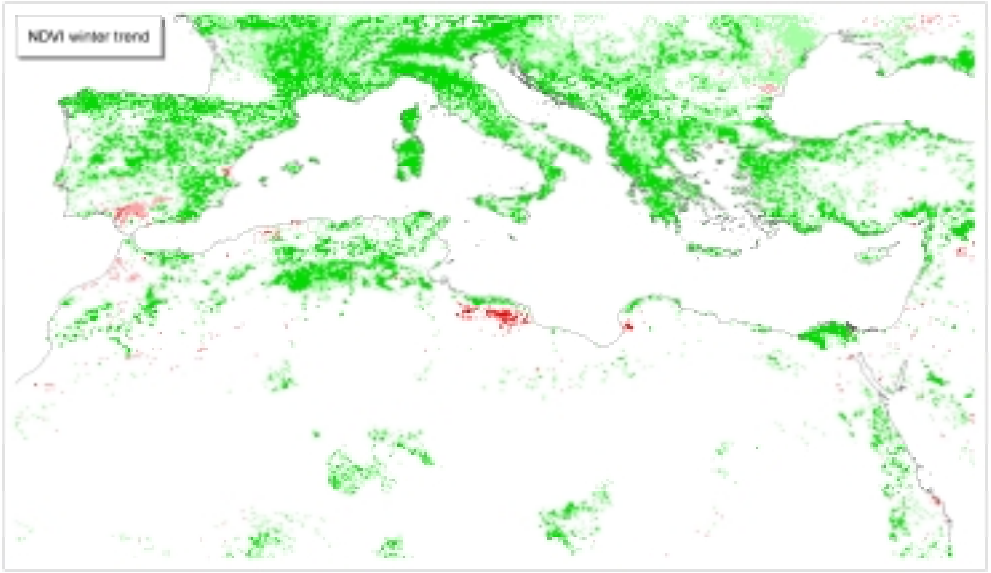
Data analysis and map elaboration:

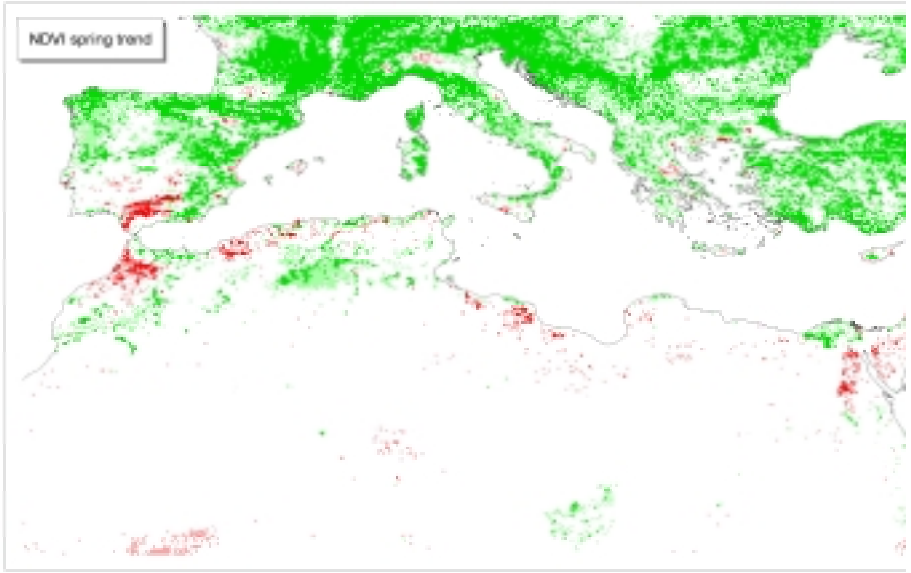
NDVI Trend Classification

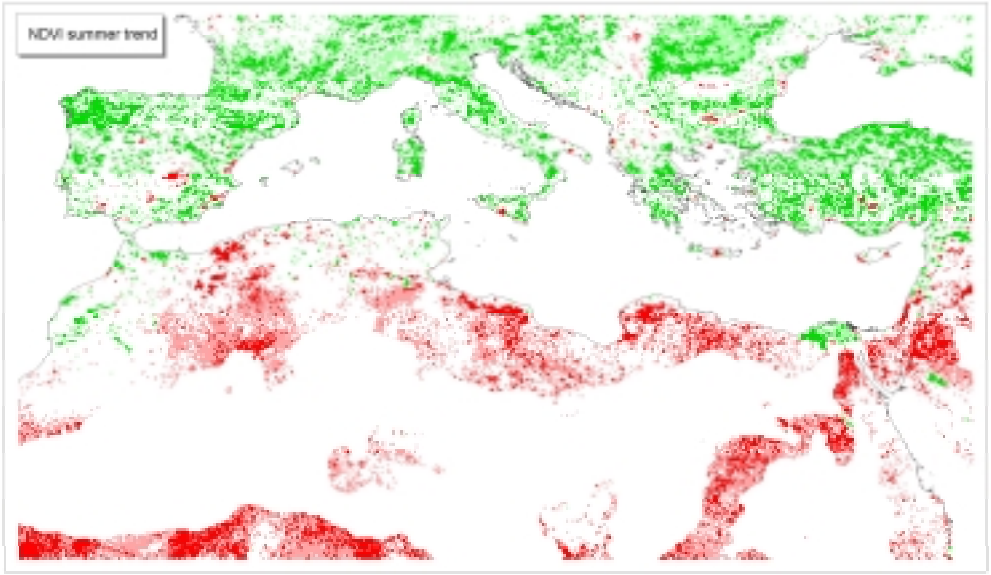
- highly Negative Trend
- Negative Trend
- No Trend
- Positive Trend
- highly Positive Trend

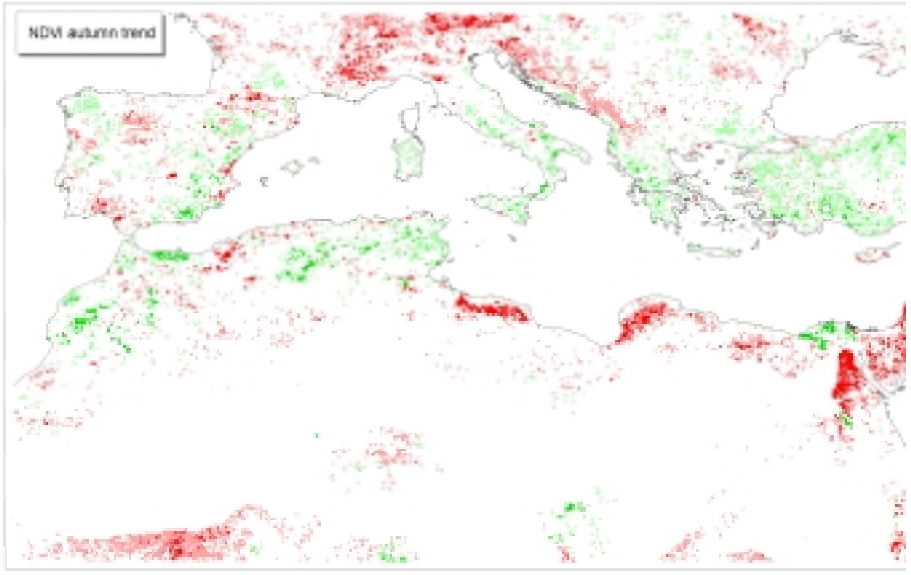
Data elaboration procedures:

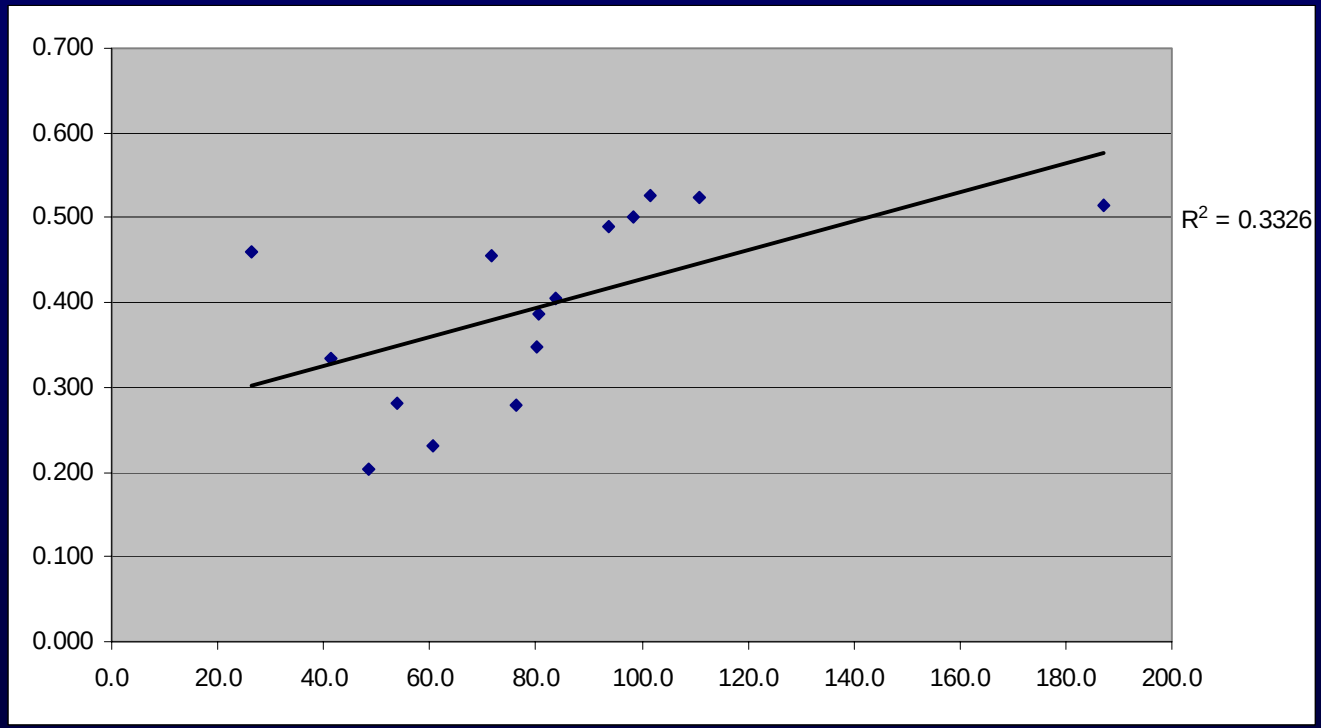
Data sources:





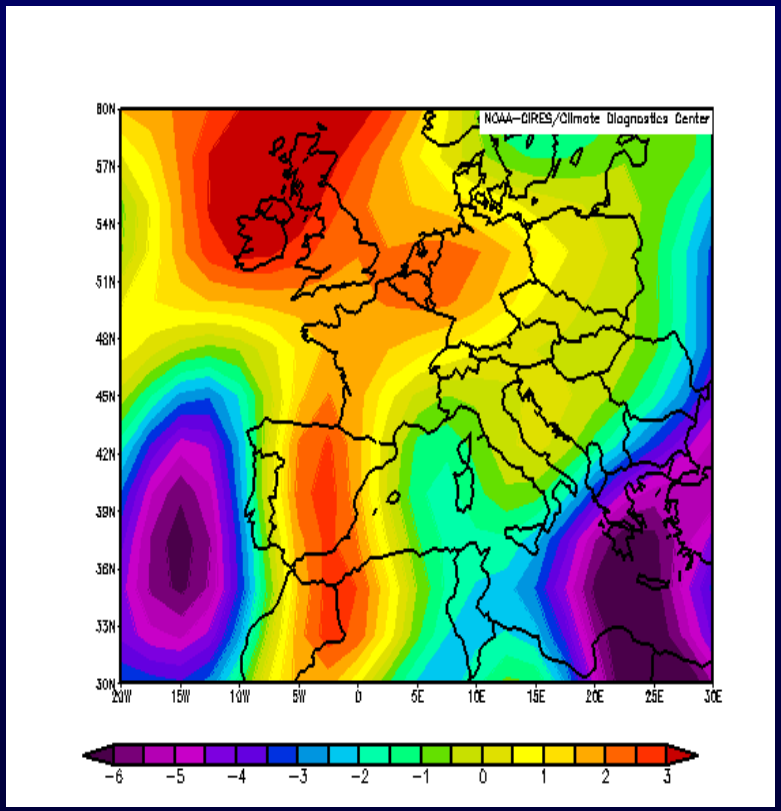




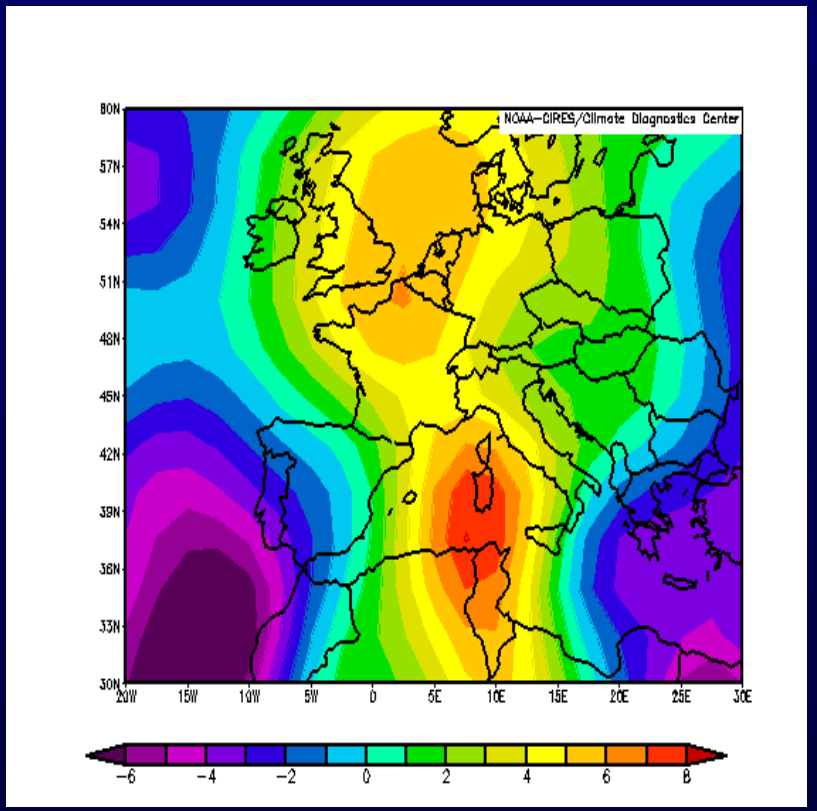


Regression of summer NDVI and winter precipitation

Increasing of summer “heat waves”

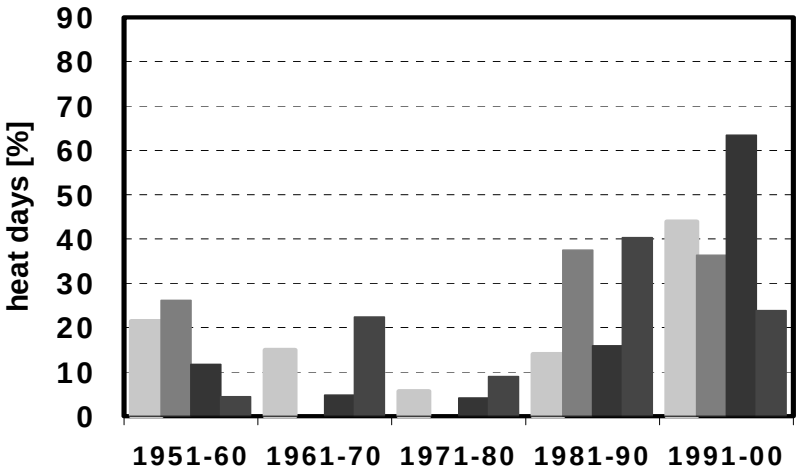


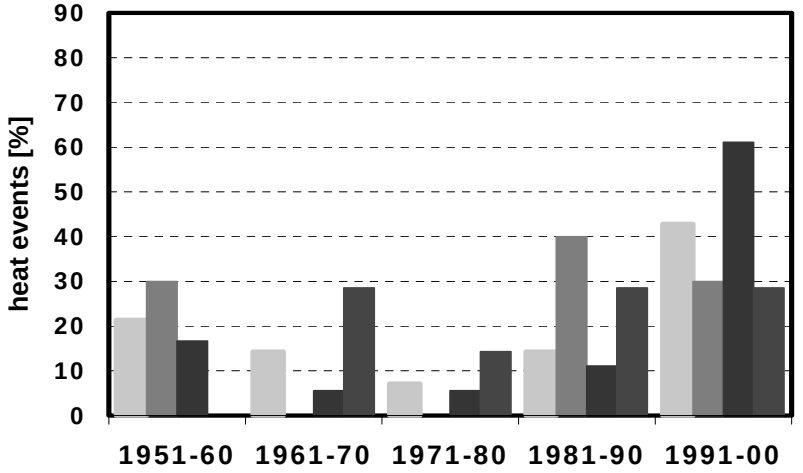
9 giorni consecutivi nel giugno 2002 con Tmax >34°



5 giorni consecutivi nel maggio 2003 con Tmax >30°

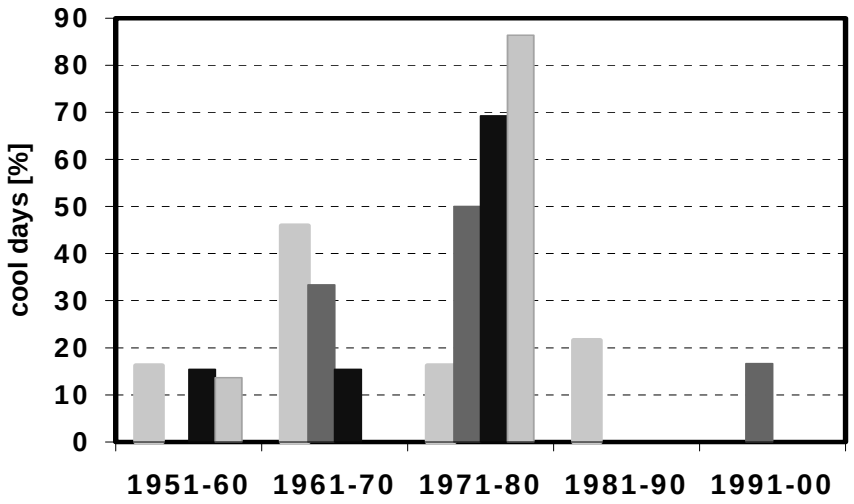
Distribution of summer heat waves (%)

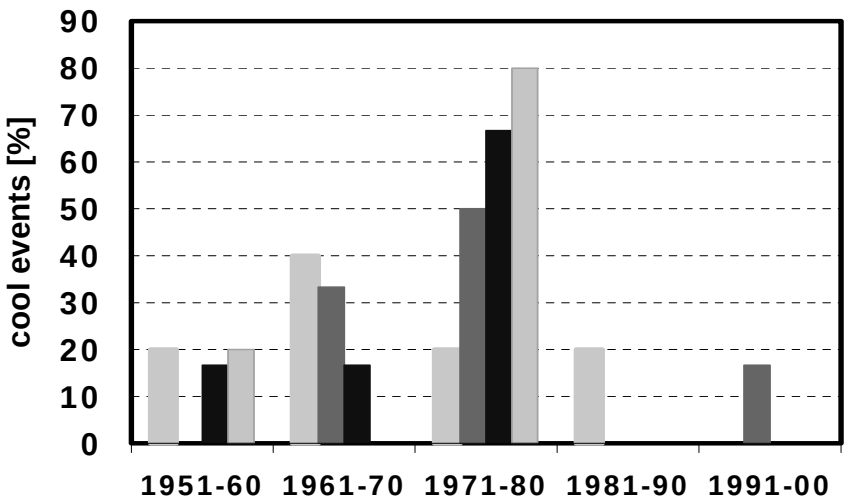




June | July | August | September

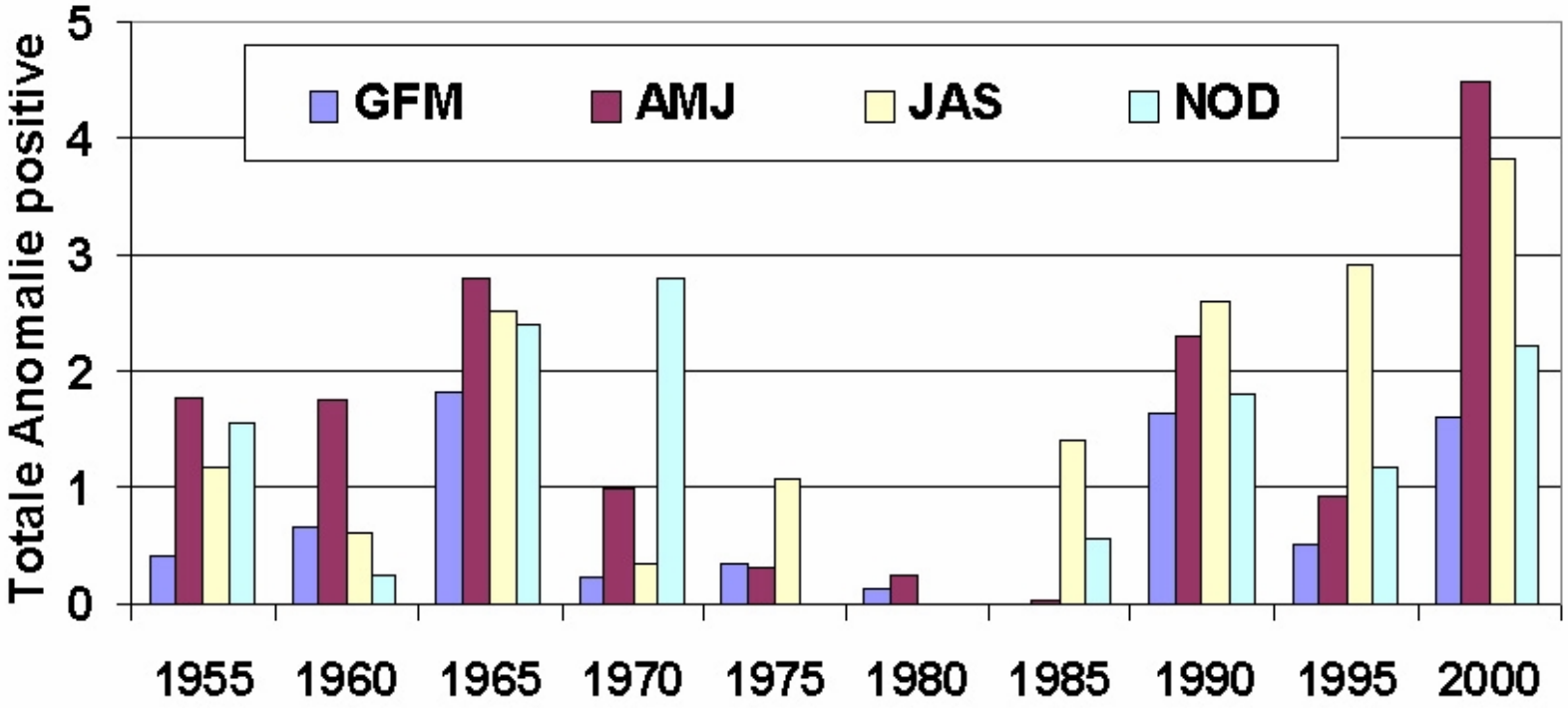
Ten days distribution of summer cold periods (%)



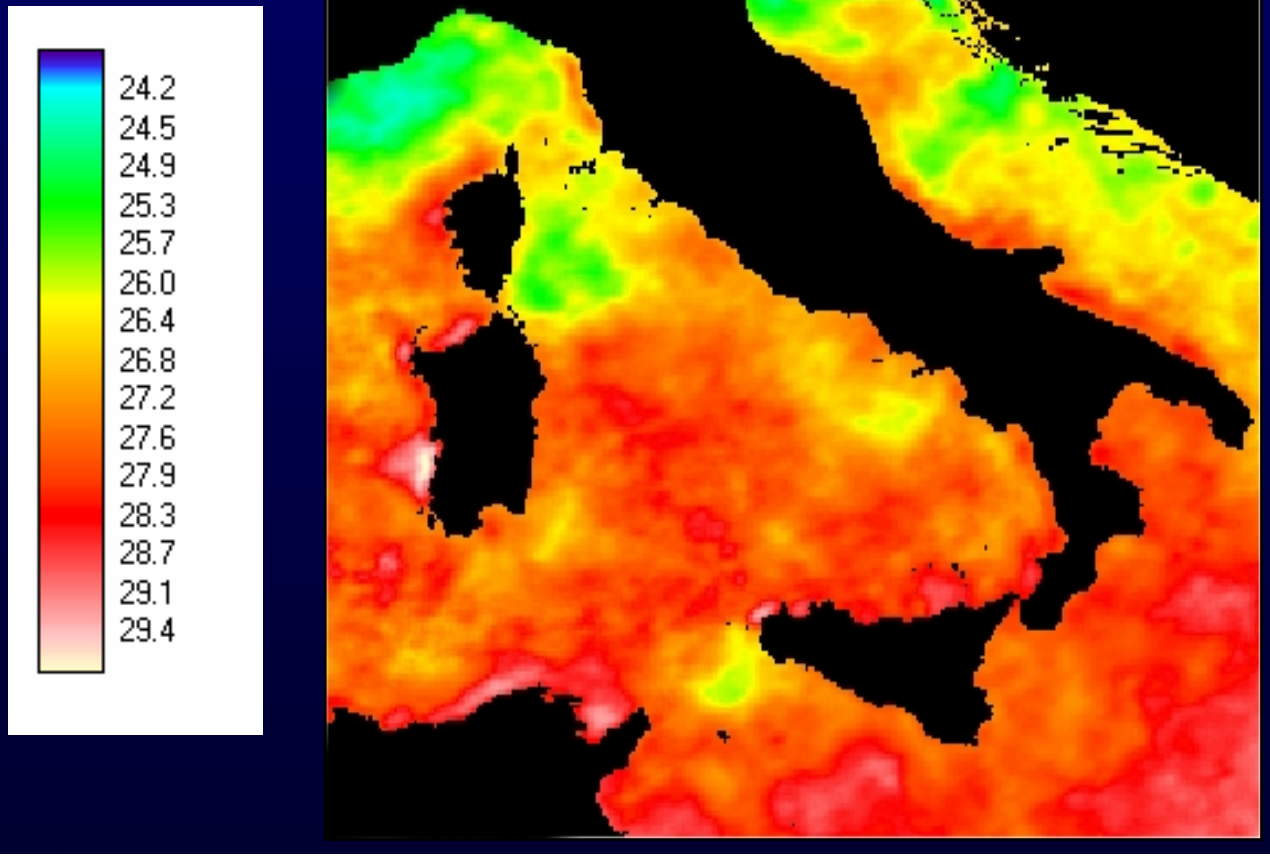


June | July | August | September

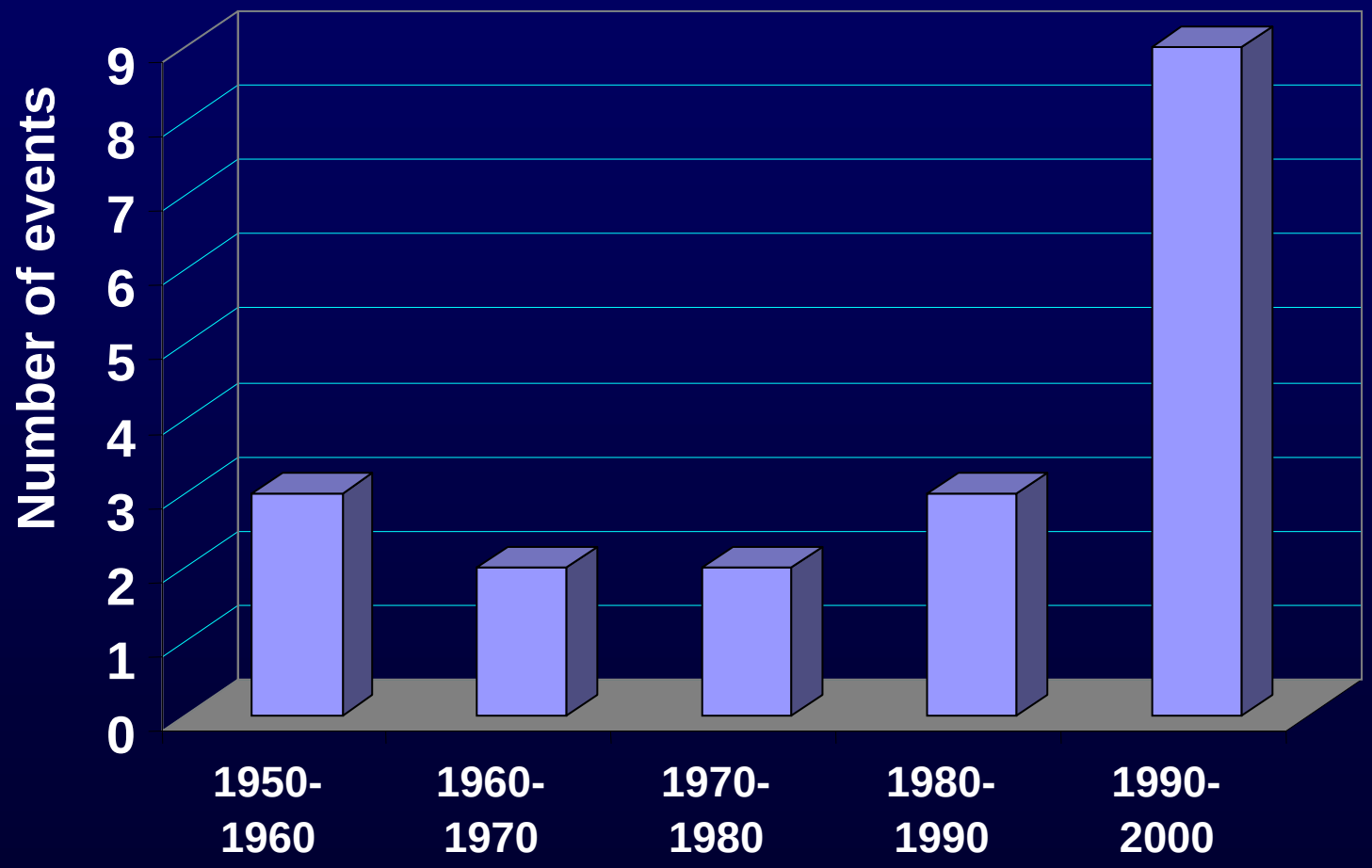
Increase of temperature positive anomalies of Mediterranean sea



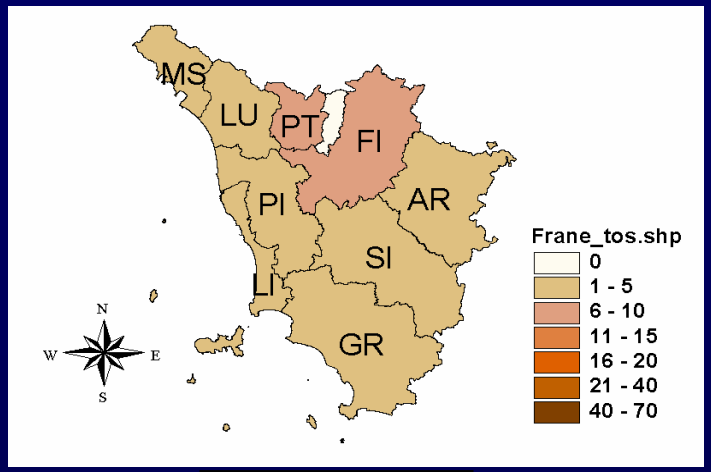
Sea temperature
15 september 2003
(Source: Lamma AVHRR NOAA 4km)



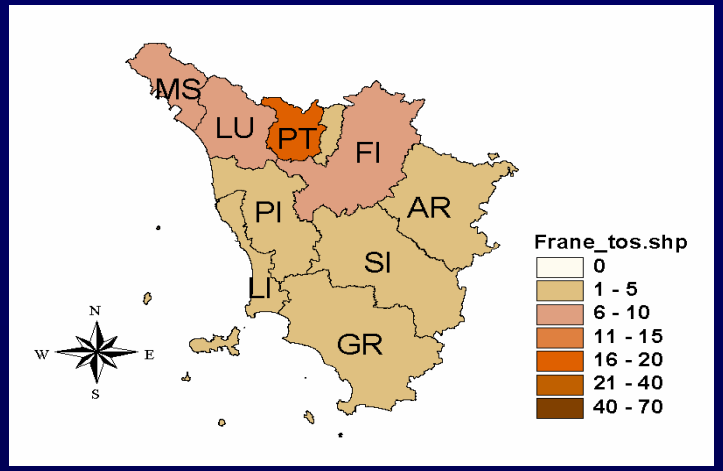
Extreme events in Italy



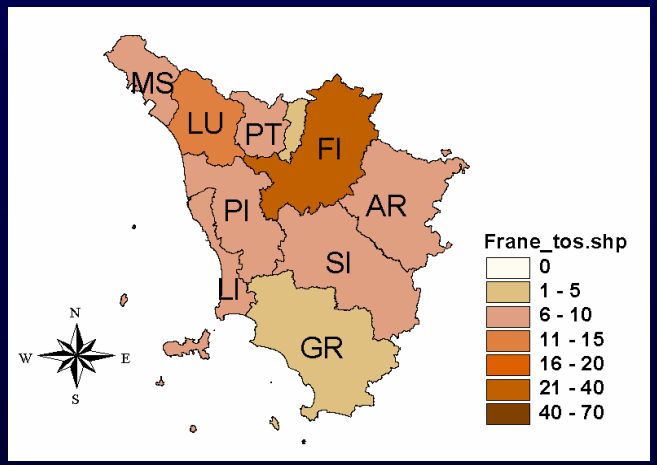
Drought + extreme rainfall events = erosion



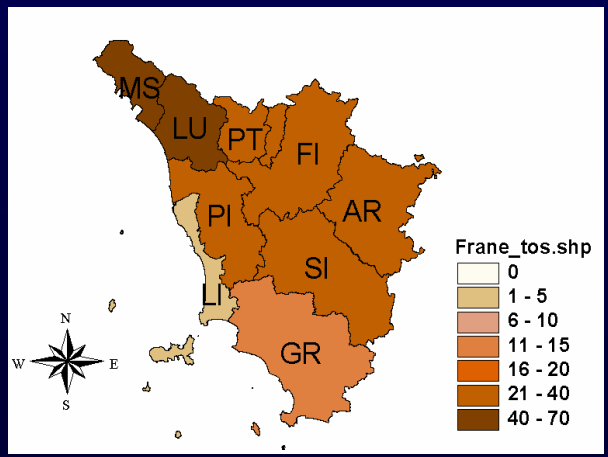
1961-70



1971-80

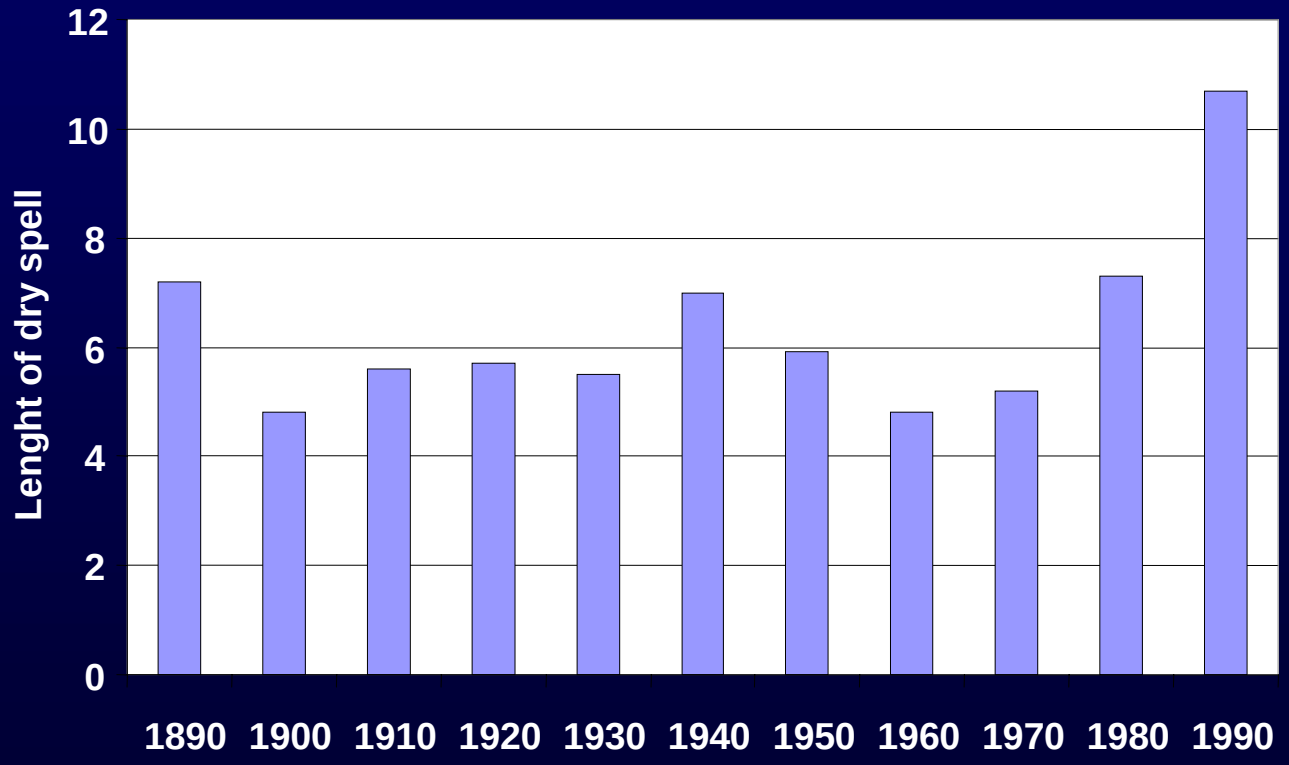


1981-90



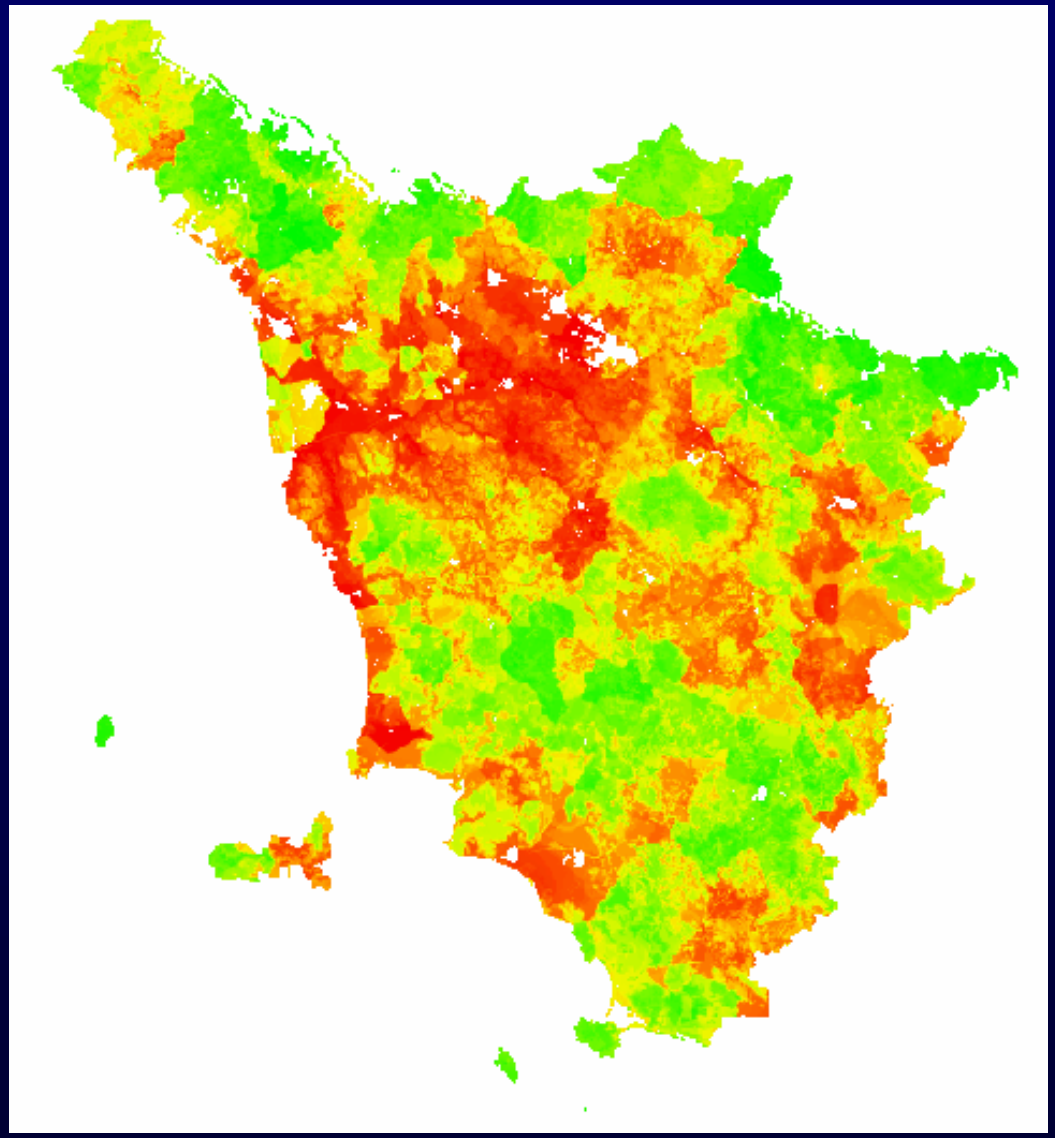
1991-2000

Winter drought (1890-1990)
Average lenght of winter dry spell



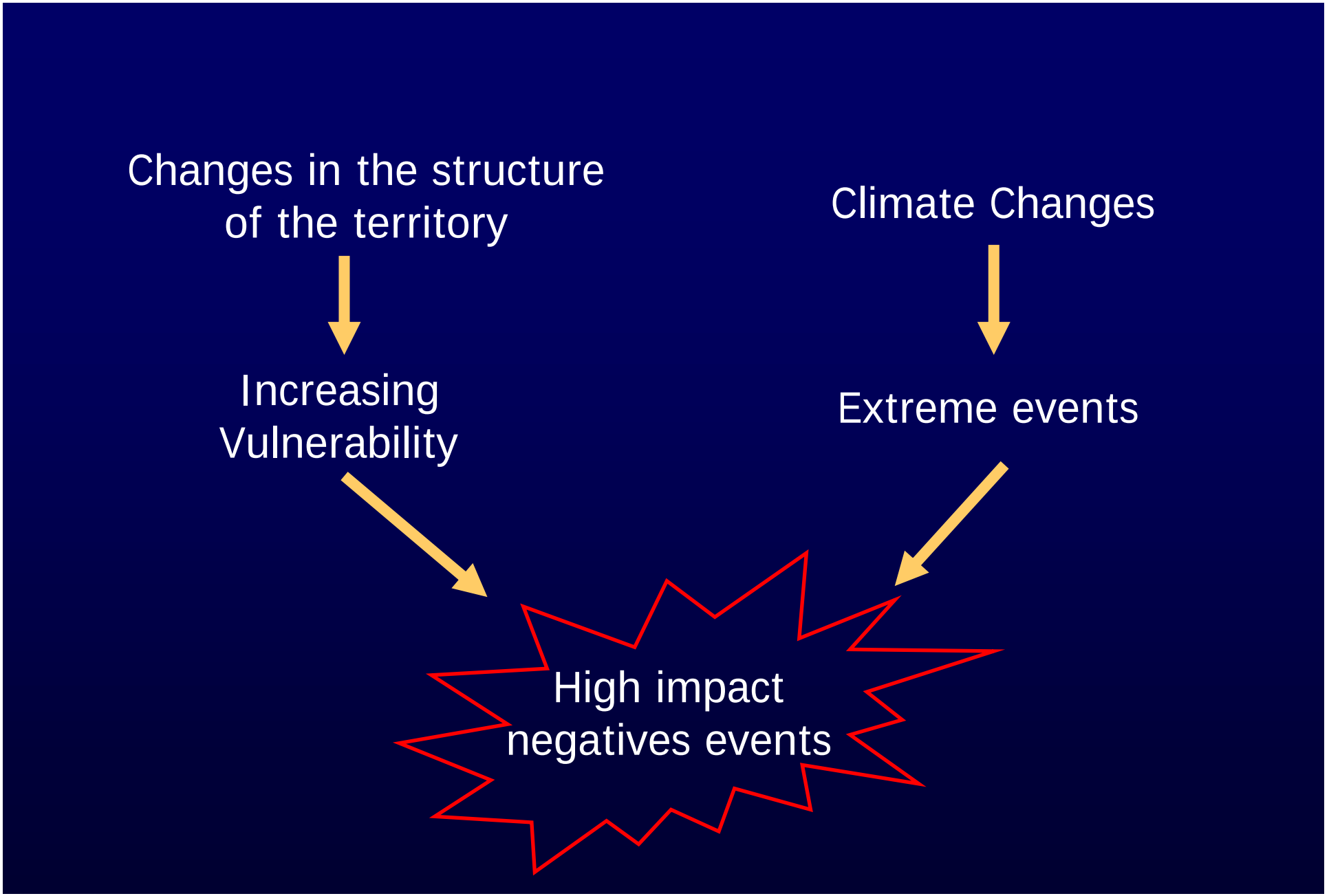
Drought in summer 2003

Damages to agriculture in Tuscany : 250 mil. €



Changes in climate patterns and in the structure of the territory

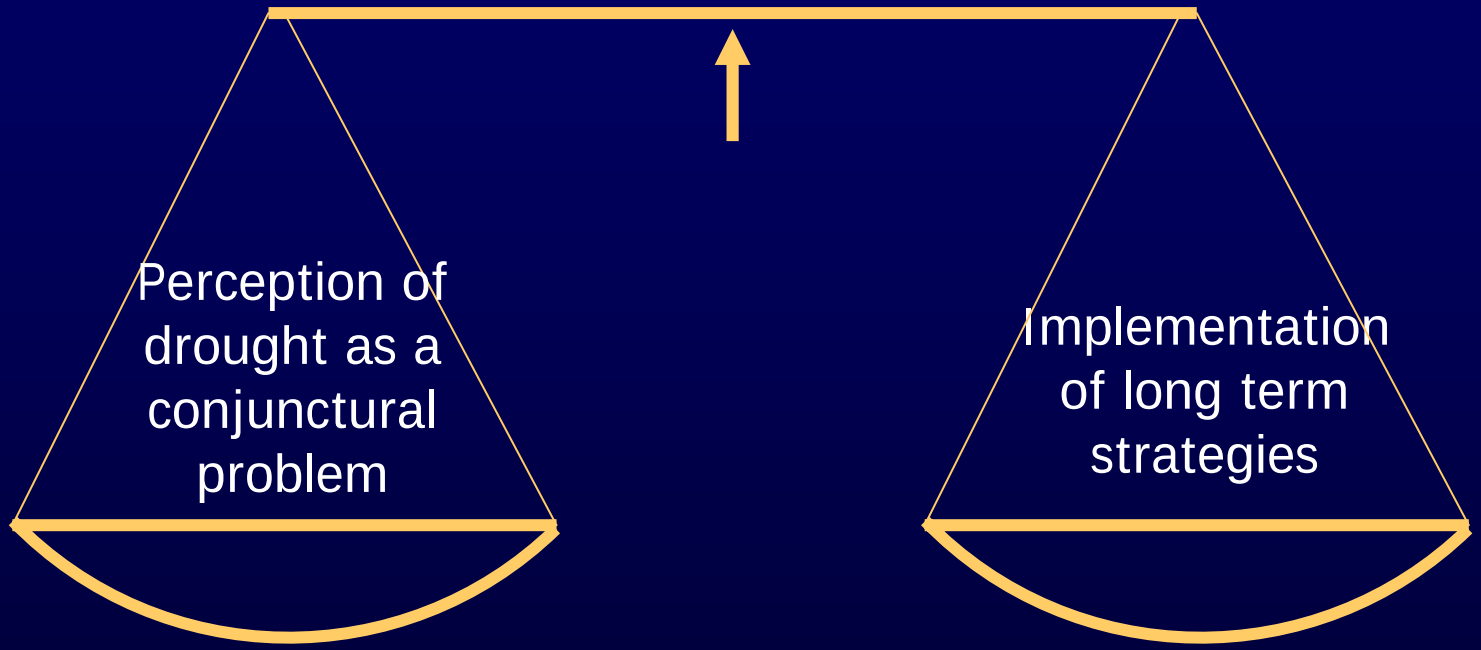
- Increase of extreme events
- Persistence of phenomena
- Seasonal modificaitions
- Impacts on a non-flexible territorial structure (over-exploitation)


Changes in the structure of the territory
Climate Changes
Increasing Vulnerability
Extreme events
High impact negatives events

Difficulty in planning effective adaptation and mitigation strategies taking into account the vulnerability of the territory and climate changes

WHY?

The challenge of drought vulnerability in Mediterranean region



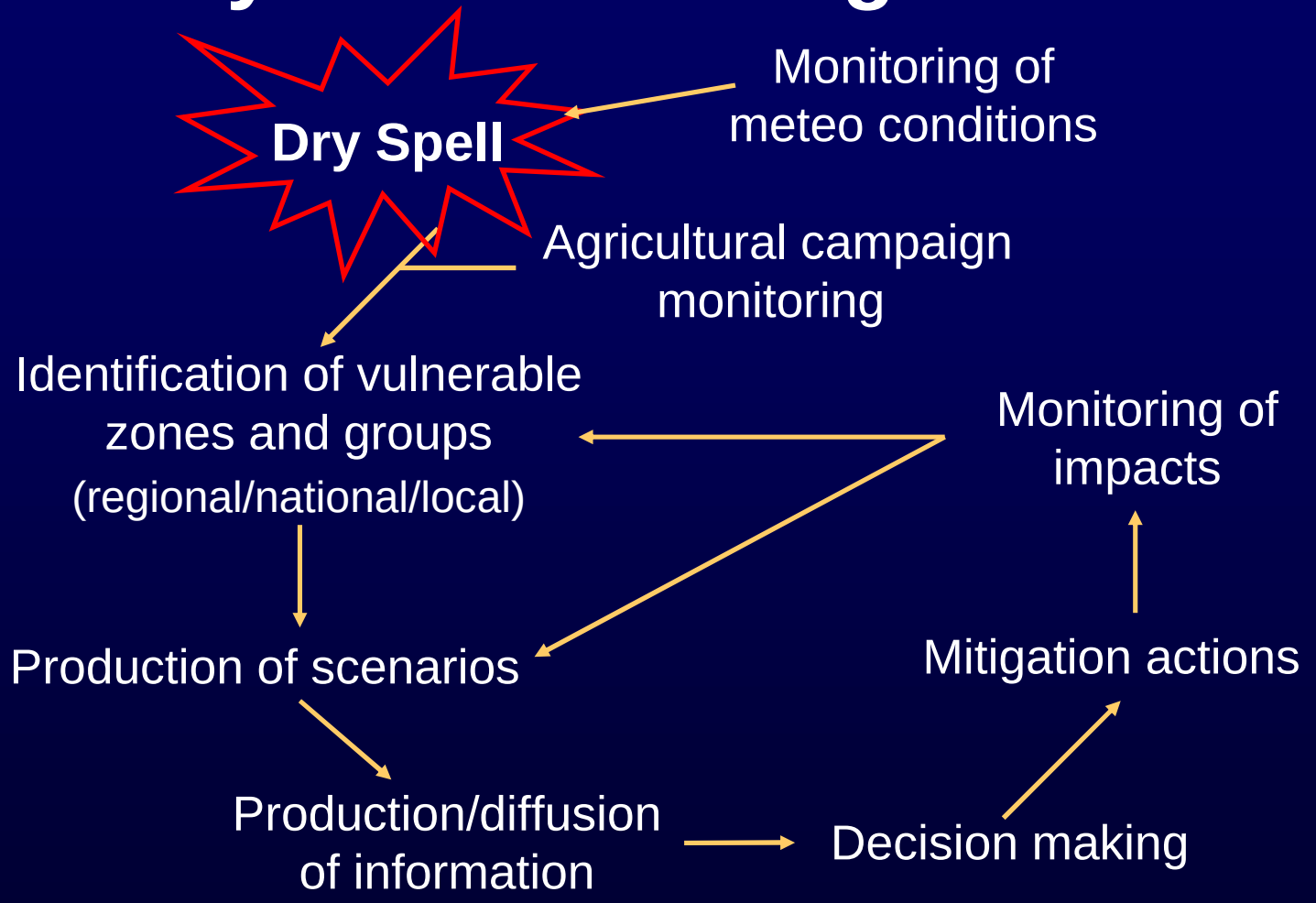
The role of information?

The Role and Responsibility of Scientific Knowledge and Information

Relevant and timely knowledge and information are essential for formulating and implementing policies and programmes, and for decision-making at all levels.

Are we able to adopt effective adaptation and mitigation strategies ?

Information flow for an information system for drought control



Networking and knowledge exchange

Problems to be adressed at mediterranean level

DATA

- sources of data and their update are not directly linked to existing drought warning systems

- the abundance of data does not translate into information

METHODOLOGIES/ANALYSIS

- low prognostic value for structural analysis

- few real time impact scenarios/few EWS

- low level of standardization of information produced

- low level of information for the large public

POLICIES

-Emergency approach vs long term planning


THANK YOU