

**Mediterranean Training Programme for the harmonization of
Early Warning Systems and operational instruments for
Monitoring Climate Change and Desertification**

The challenge of drought in the Mediterranean Region

(L. Genesio - IBIMET/CNR)

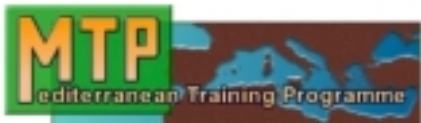
***Early Warning Systems for extreme events impact.
Managing drought for a sustainable development
July 3-14, 2006, IBIMET-CNR, Florence, Italy***



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)



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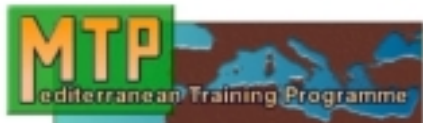


Characteristics of a complex systems

- 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

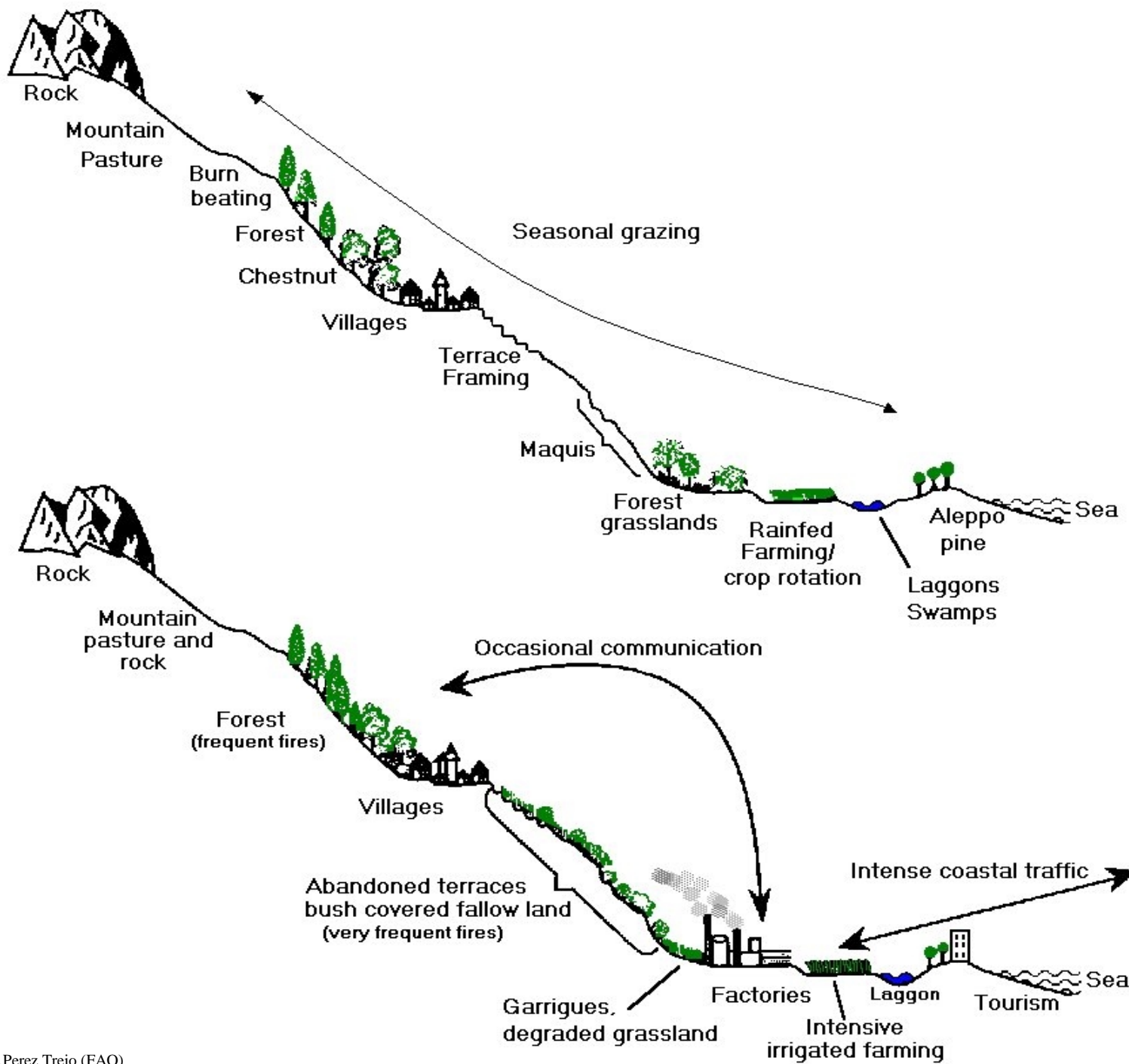
Drought in a changing structure of the territory



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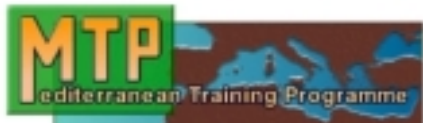


Characteristics of a changing territory

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

Dynamic patterns 2

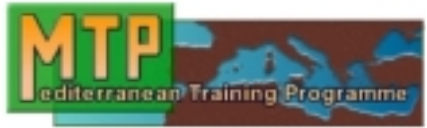
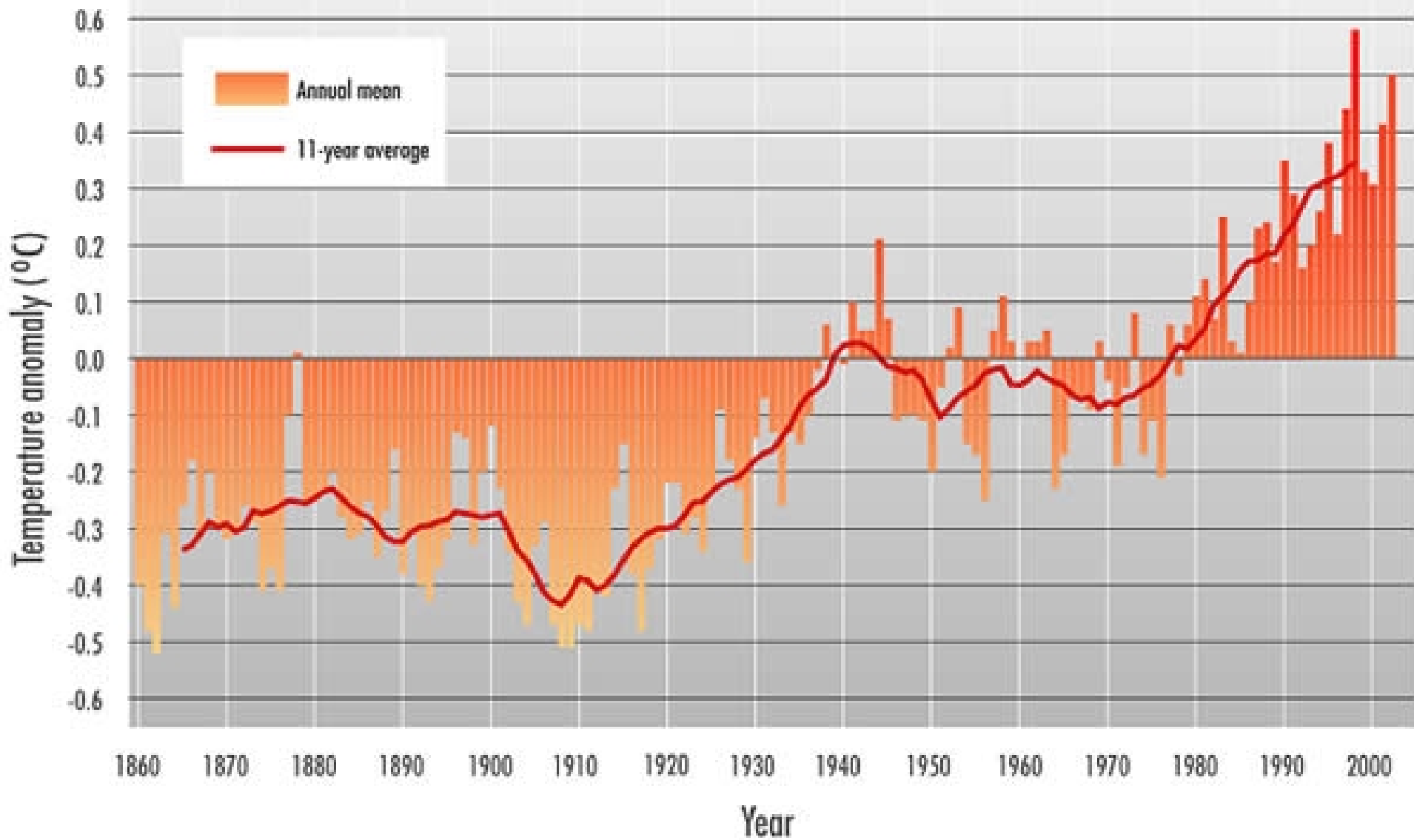
Drought in a changing environment



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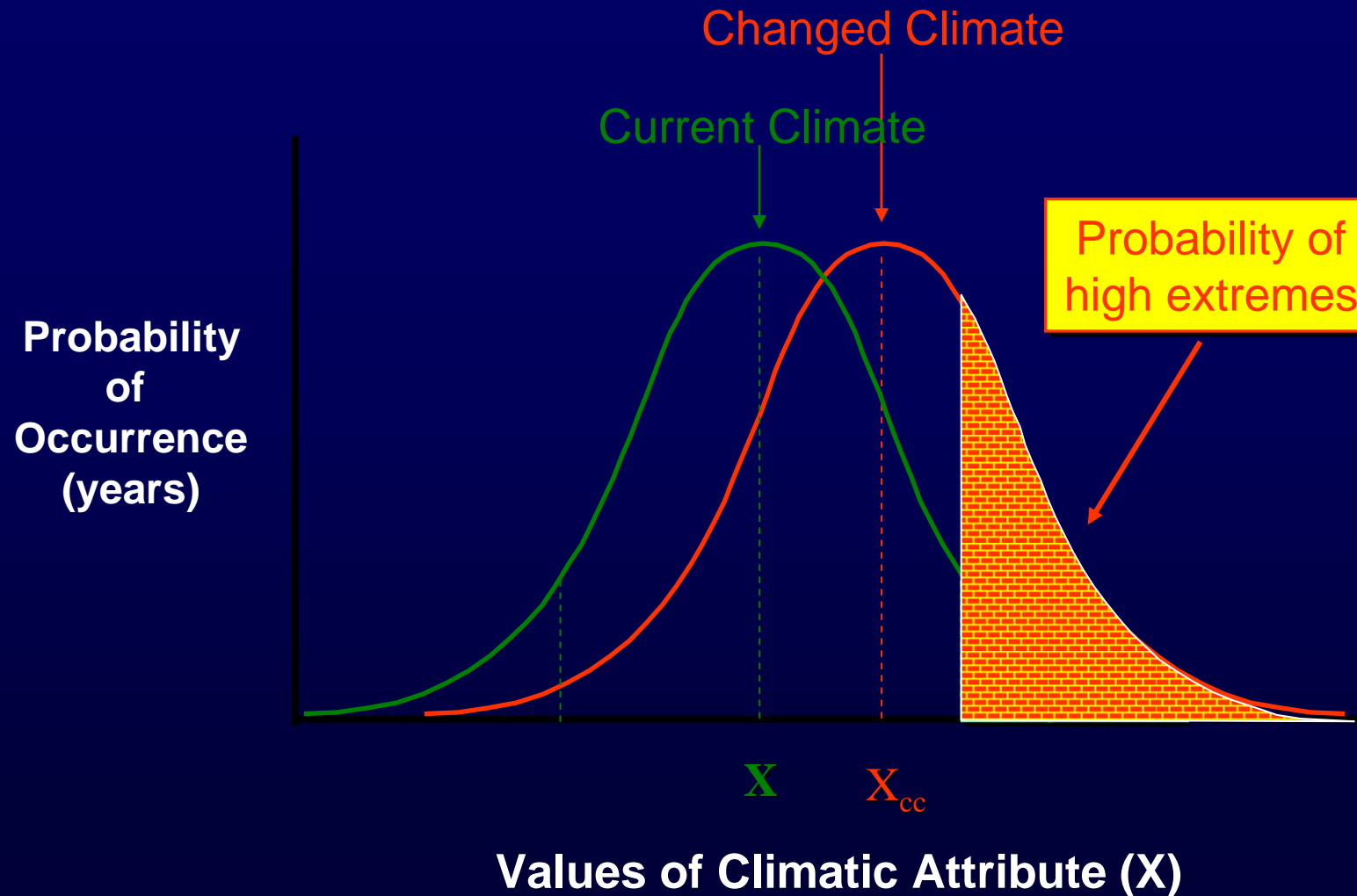




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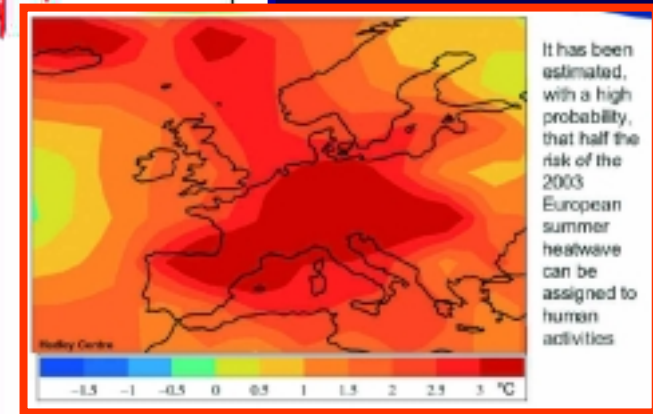
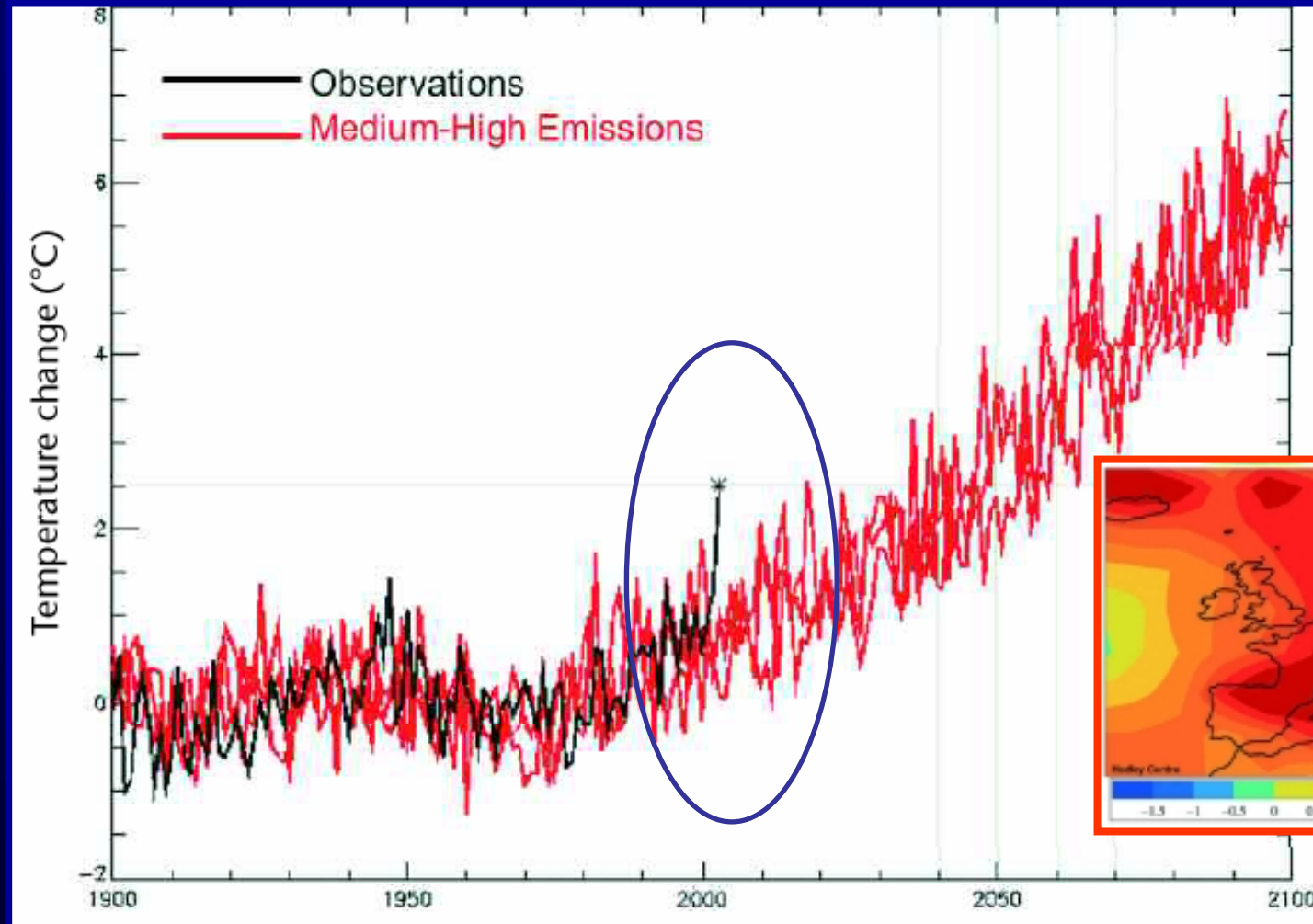


More energy in the climate system

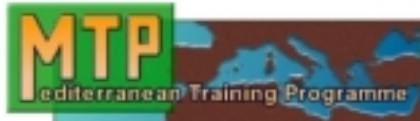


Barry Smit, (2001) Professor, University of Guelph, Canada IPCC, TAR, WG2, Ch.18

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



UK MetOffice - Hadley Centre for Climate Prediction and Research



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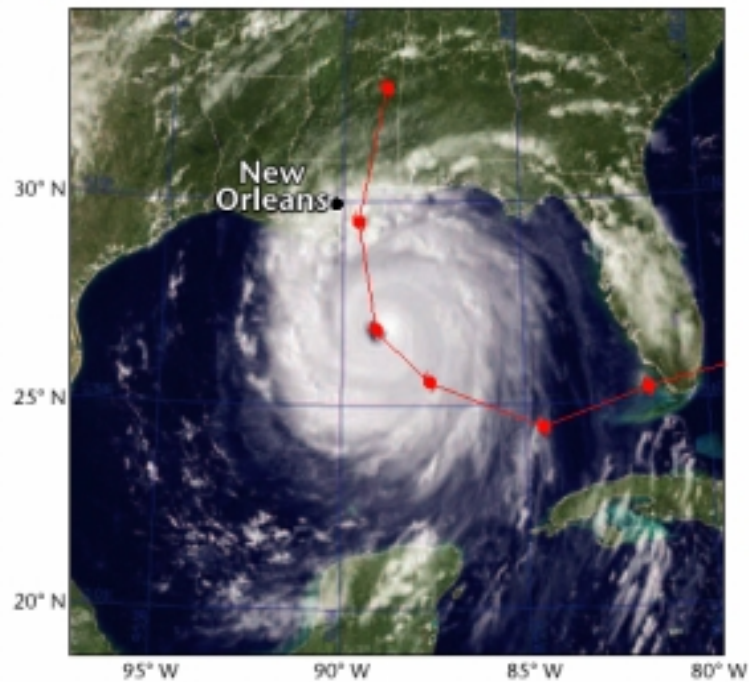
TEMPERATURE INCREASING IN 2100

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

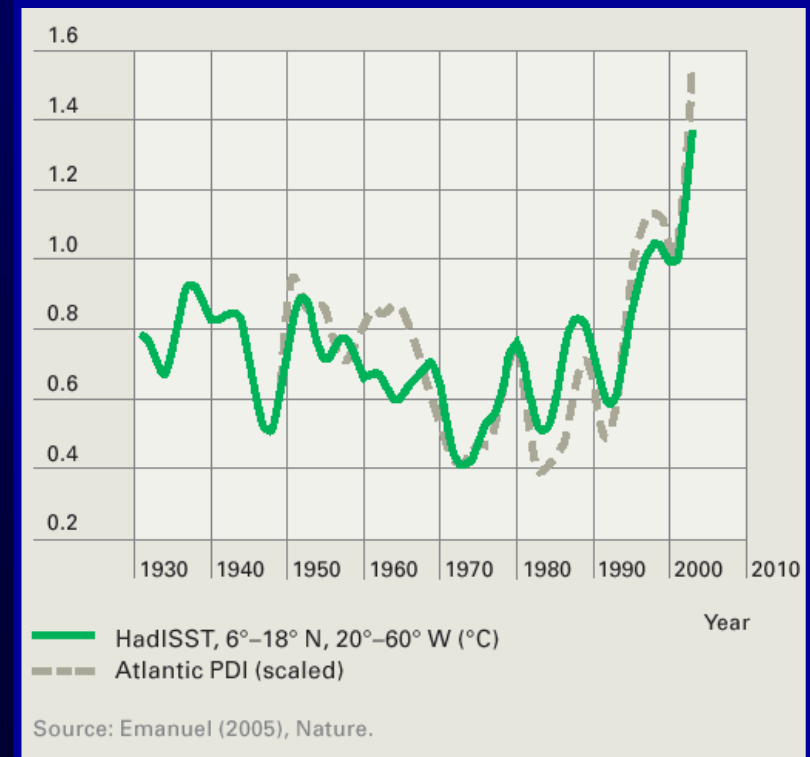
Source: Based on den Elzen and Meinhausen (2005).

Sea Surface Temperature and yearly Hurricanes intensity

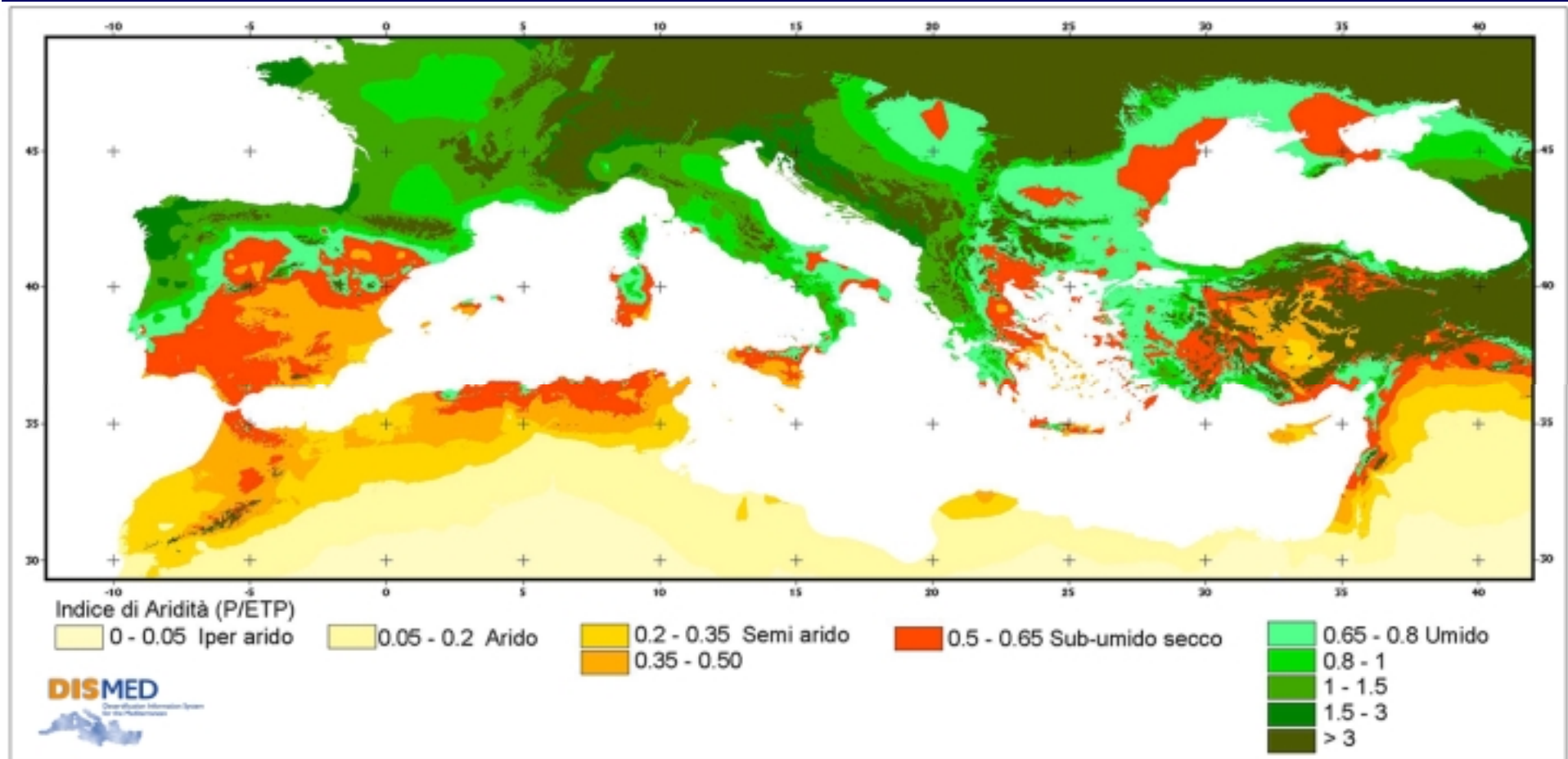
GOES-12 satellite image of Hurricane Katrina at 2045GMT on 28 August 2005, with the track of the storm superimposed⁴



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



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

Project : Land Use/cover Change

Source : UNCCD
 Mediterranean Basin Assessment (MBA)
 Land Use/cover change assessment (LCCA)
 Mediterranean Basin Assessment (MBA) LCCA
 Land Use/cover change assessment (LCCA)
 Planning period: 2000

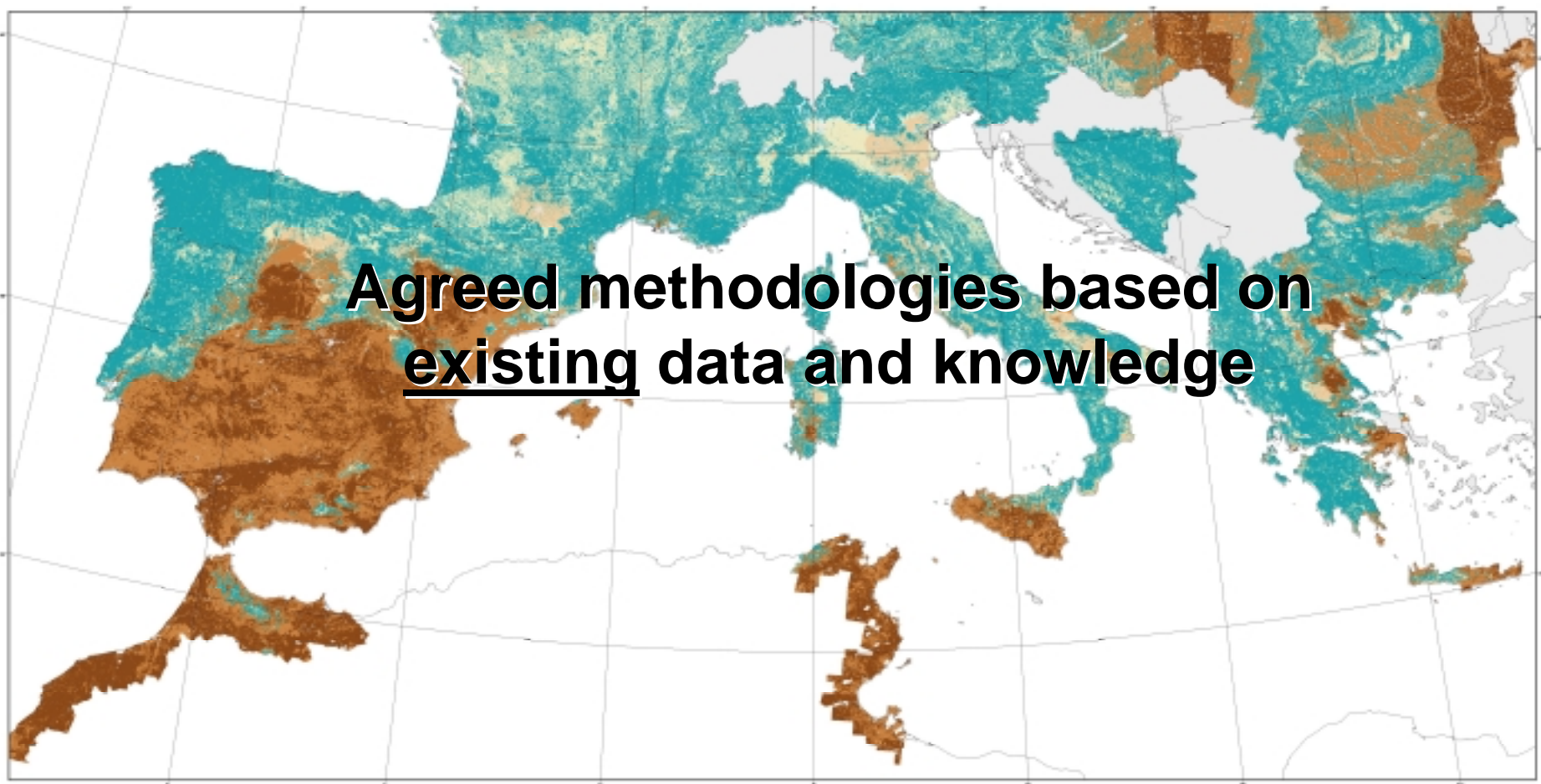
Data analysis and map elaboration:
 GIS/RS/Map
 Mediterranean Basin Assessment (MBA)
 Land Use/cover change assessment (LCCA)
 Mediterranean Basin Assessment (MBA) LCCA
 August 2005
 http://www.unccd.org

GIS sources:
 - Vegetation Data (Landsat TM)
 - Precipitation Data (GIS/RS/Map)
 - Soil Data (FAO/UNCCD)

Climate Data/Model sources:
 - Climate Data (GIS/RS/Map)
 - Climate Model (GIS/RS/Map)

Legend:
 Area
 0-1 Low sensitivity
 1-2 Moderate sensitivity
 2-3 High sensitivity

Legend:
 Area
 0-1 Low sensitivity
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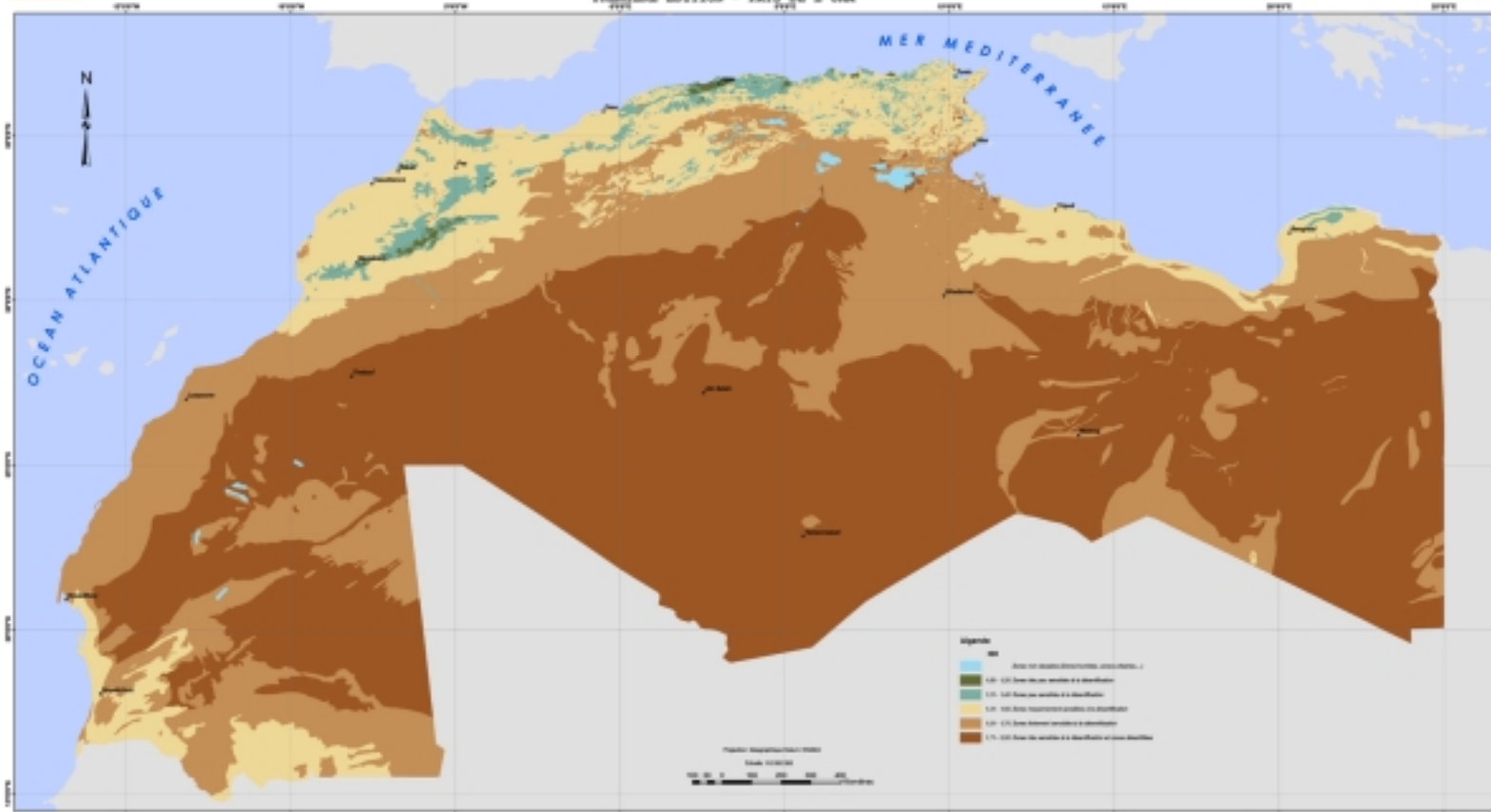


Agreed methodologies based on existing data and knowledge



CARTE DE SENSIBILITE A LA DESERTIFICATION DES PAYS DE L'AFRIQUE DU NORD

PREMIERE EDITION - PAYS DE L'UMA



Méthodologie
 Cette carte de sensibilité à la désertification est établie dans le cadre du projet DISMED. La méthodologie adoptée est celle définie par le programme régional adopté au sein du comité de haut niveau méditerranéen régional basé sur la combinaison de quatre critères : climat, végétation, altitude et géologie.

Ces facteurs sont évalués par des indicateurs de qualité qui quantifient leur aptitude à résister à la désertification :

- IQM : indice de qualité du sol
- IQV : indice de qualité de la végétation
- IQA : indice de qualité de l'altitude
- IQG : indice de qualité de la géologie.

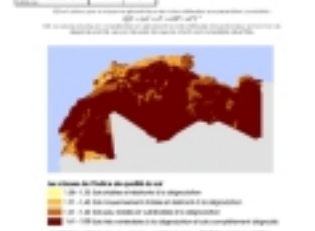
La sensibilité des terres à la désertification est évaluée par un indice de sensibilité (IS) qui est la somme géométrique des indicateurs de qualité obtenus :

$$IS = IQM + IQV + IQA + IQG$$

- Coordination :**
- Tunisie : DISMED
 - Espagne : DISMED
 - Algérie : DISMED
 - Liban : DISMED
 - Maroc : DISMED
 - Égypte : DISMED
 - Jordanie : DISMED
 - Israël : DISMED
 - Libye : DISMED
 - Syrie : DISMED
 - Émirats Arabes Unis : DISMED

Indice de qualité du sol

Indicateur	1	2	3	4
1 - Solonchaks	1	2	3	4
2 - Solonchaks salés	1	2	3	4
3 - Solonchaks salés	1	2	3	4
4 - Solonchaks salés	1	2	3	4
5 - Solonchaks salés	1	2	3	4



Indice de qualité de la végétation

Indicateur	1	2	3	4
1 - Zones à forte végétation	1	2	3	4
2 - Zones à forte végétation	1	2	3	4
3 - Zones à forte végétation	1	2	3	4
4 - Zones à forte végétation	1	2	3	4
5 - Zones à forte végétation	1	2	3	4



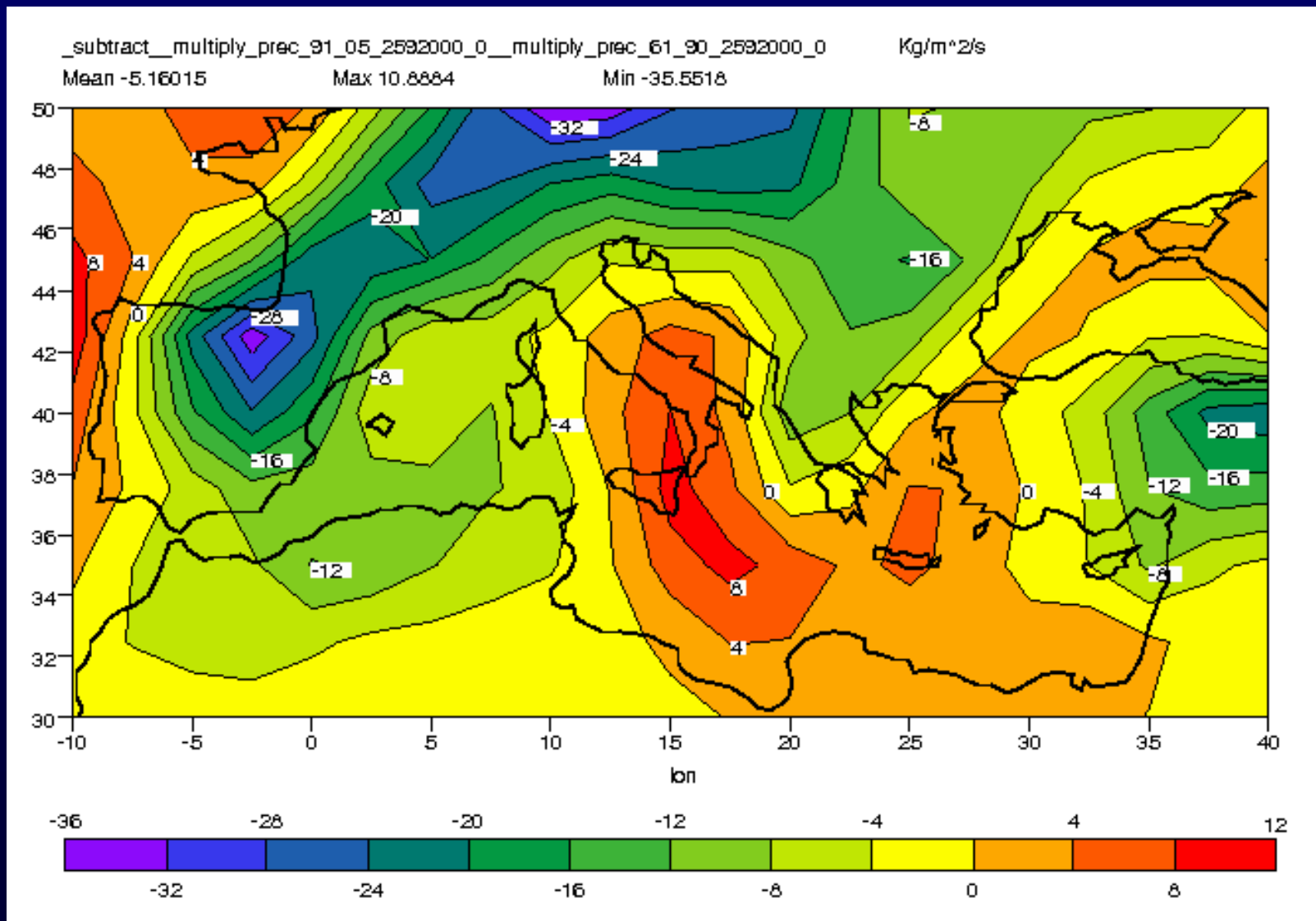
Indice de qualité de l'altitude

Indicateur	1	2	3	4
1 - Zones à forte altitude	1	2	3	4
2 - Zones à forte altitude	1	2	3	4
3 - Zones à forte altitude	1	2	3	4
4 - Zones à forte altitude	1	2	3	4
5 - Zones à forte altitude	1	2	3	4

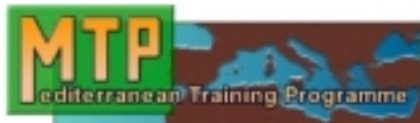


UNESCO

Rainfall 1961 -90 → 1991 - 2005



IBIMET CNR

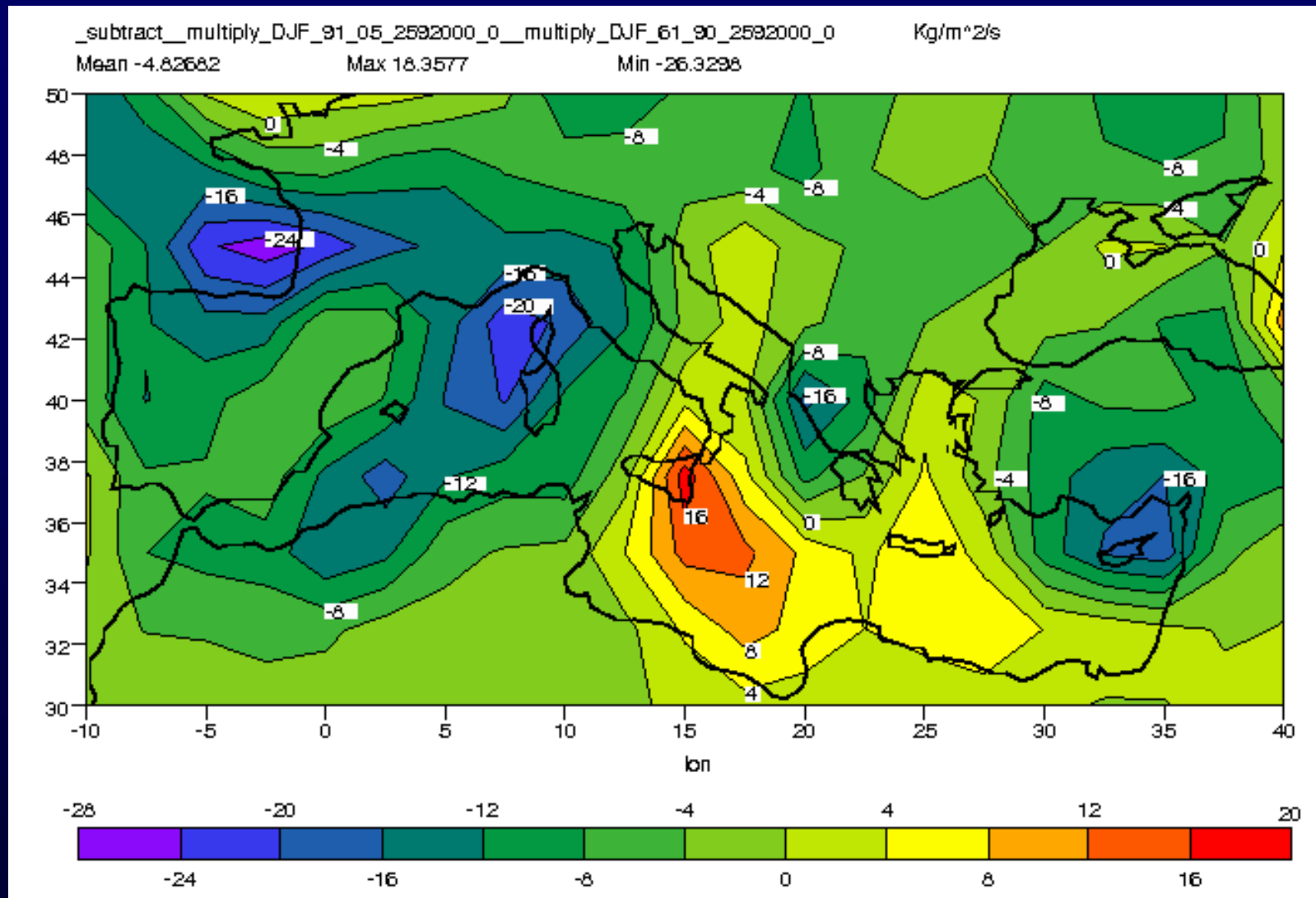


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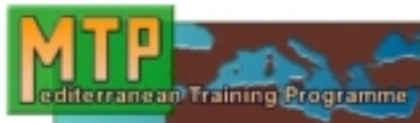


Rainfall DJF 1961 -90 → DJF 1991 - 2005



IBIMET CNR

Decrease in winter precipitation

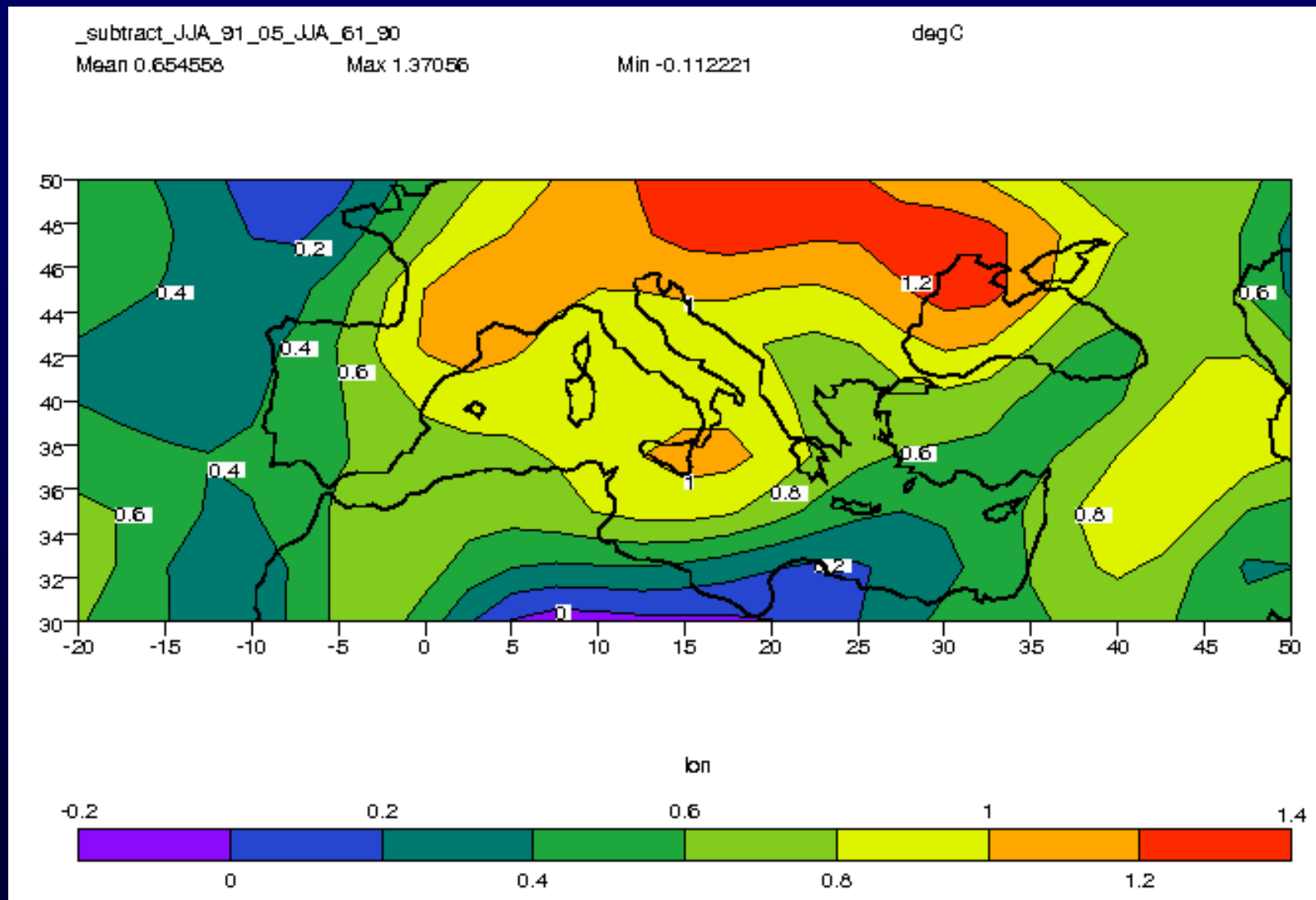


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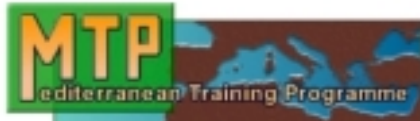
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Temperature JJA 1961 -90 → JJA 1991 - 2005



IBIMET CNR

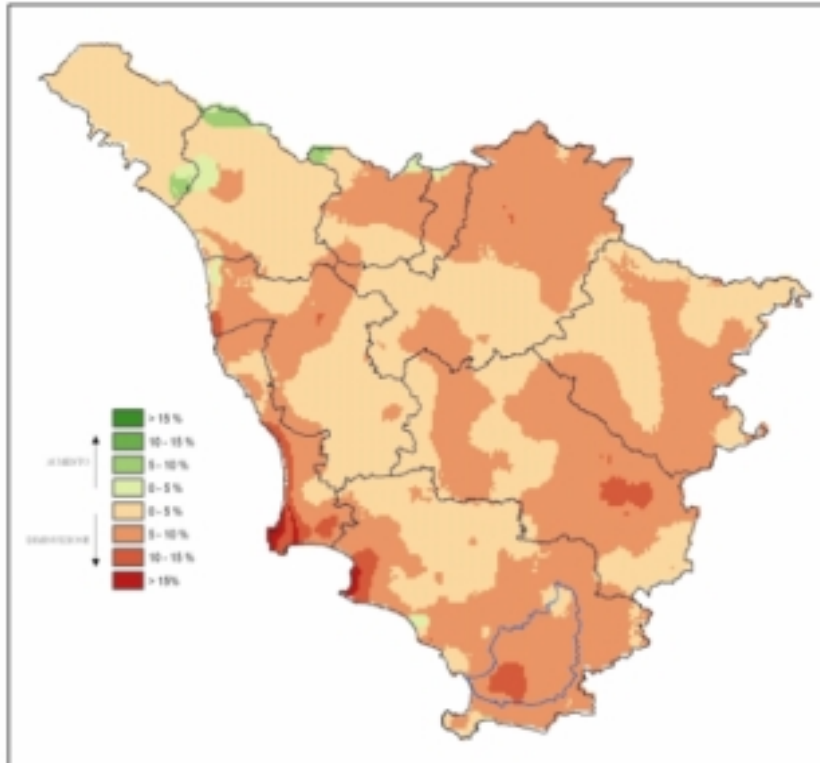


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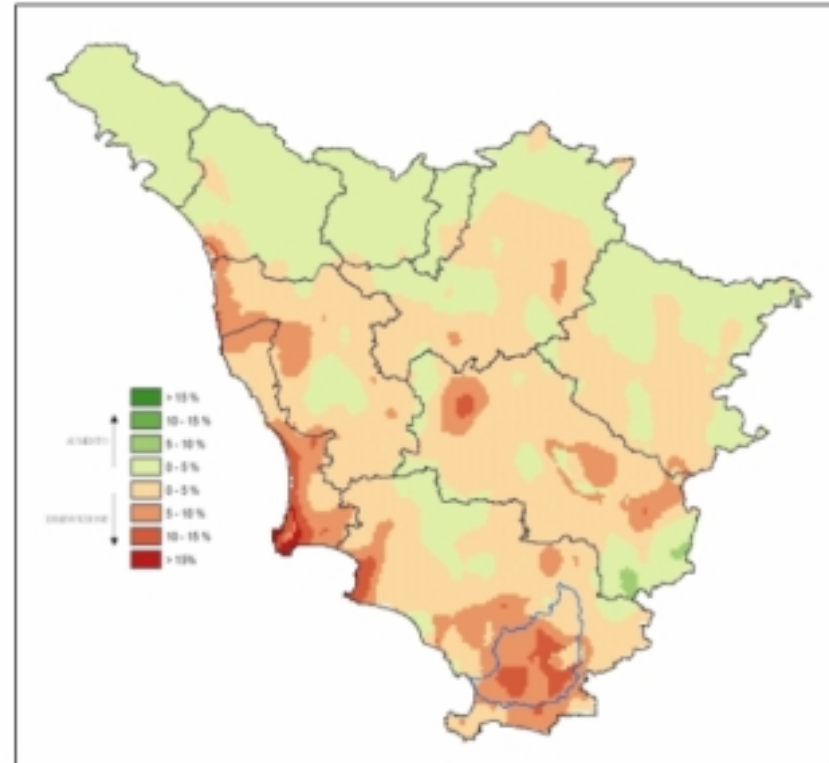
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Summer

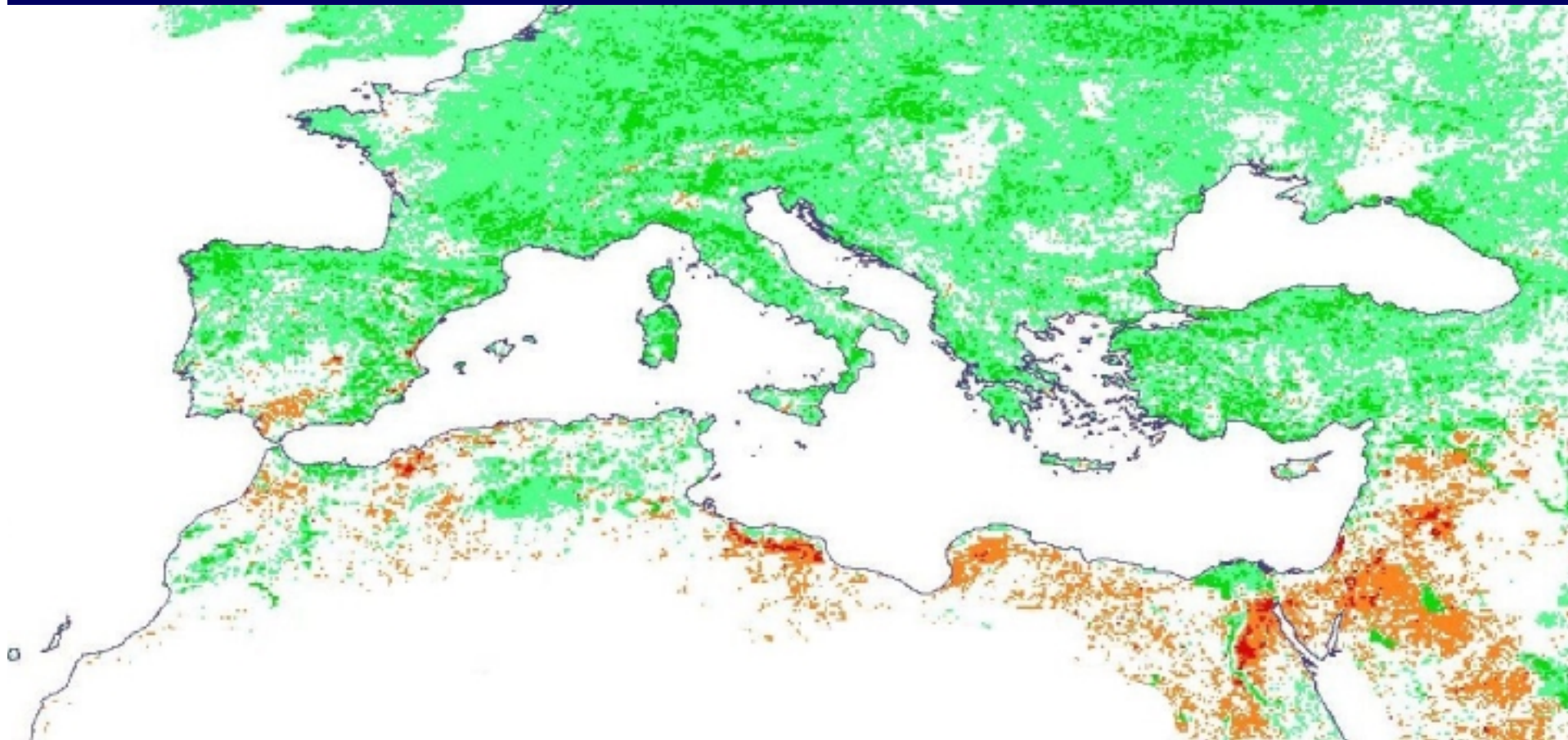


Spring



NDVI trends 1986 – 2003.

NDVI trends 1982-2000



Vegetation Sensitivity to Desertification

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

 Approximately Scale 1 : 10 000 000

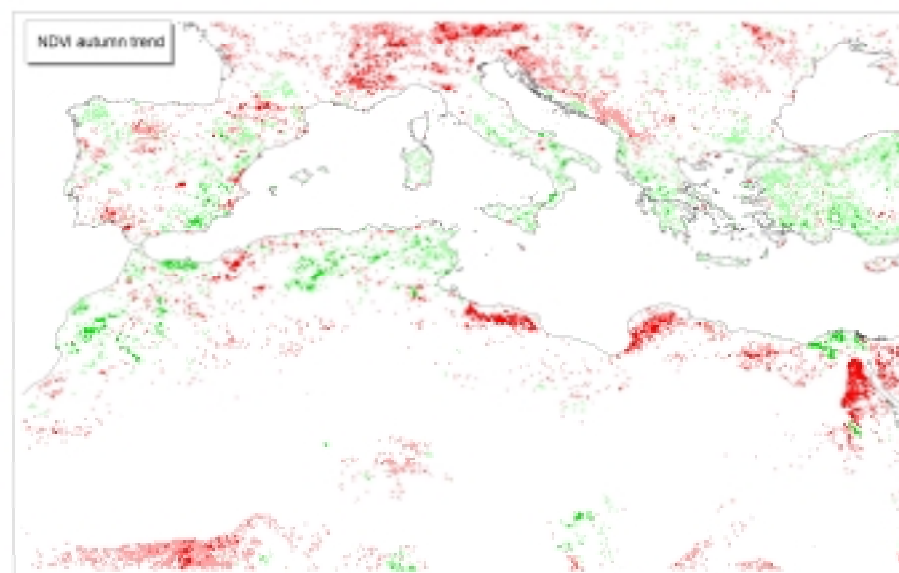
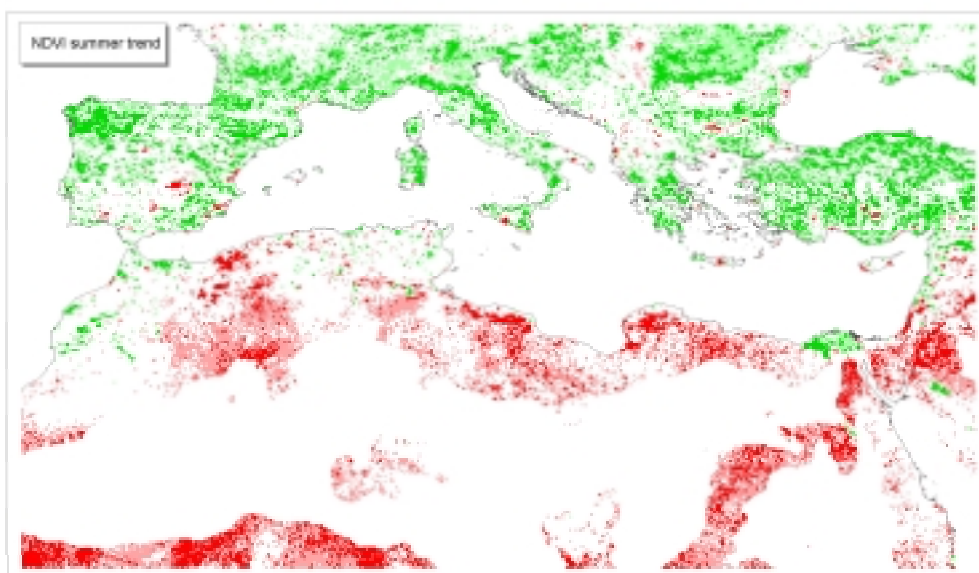
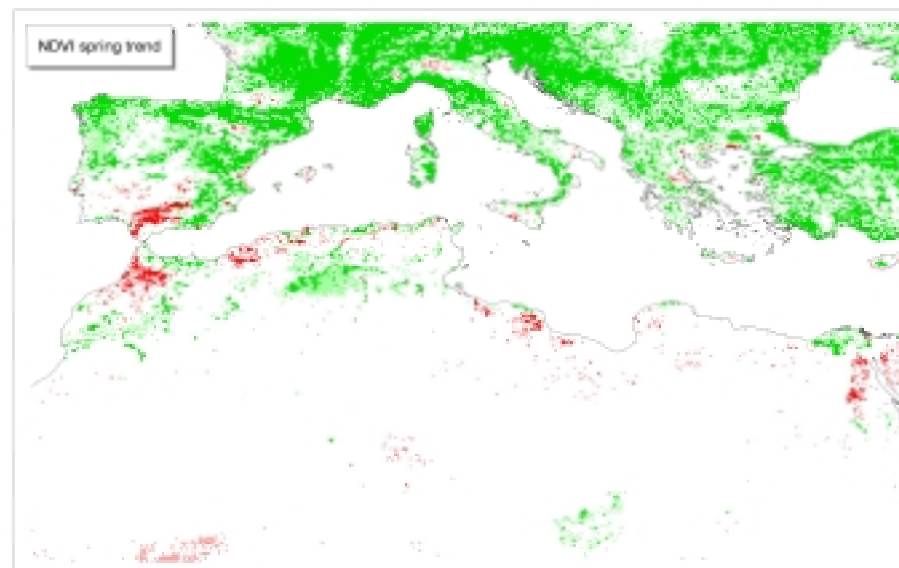
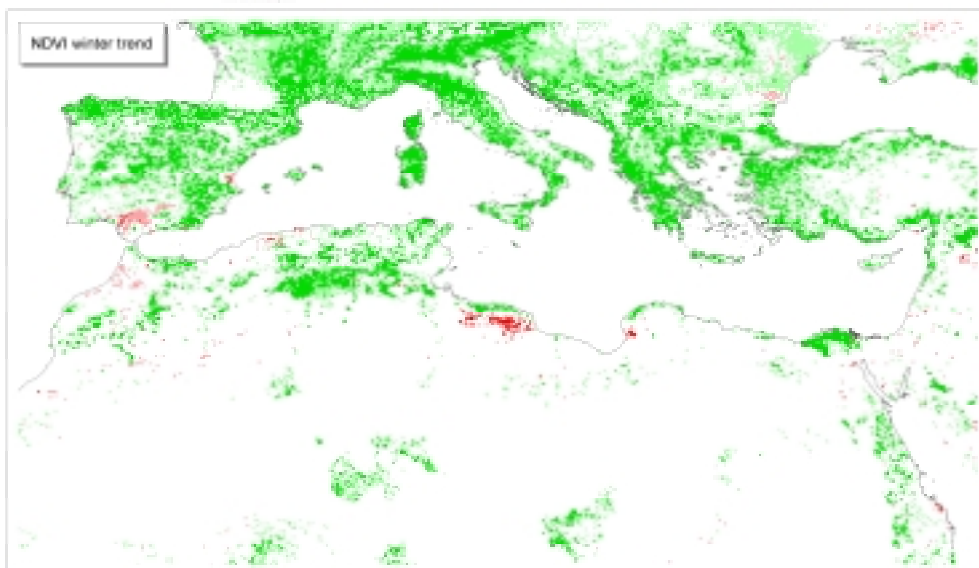
Data analysis and map elaboration:
DISMED-Team
Foundation for Applied Geography (FAG)
Institute of Geography of the National Research Council (IGAG)
Pisa, Italy - June 2001
Map obtained from the GIS

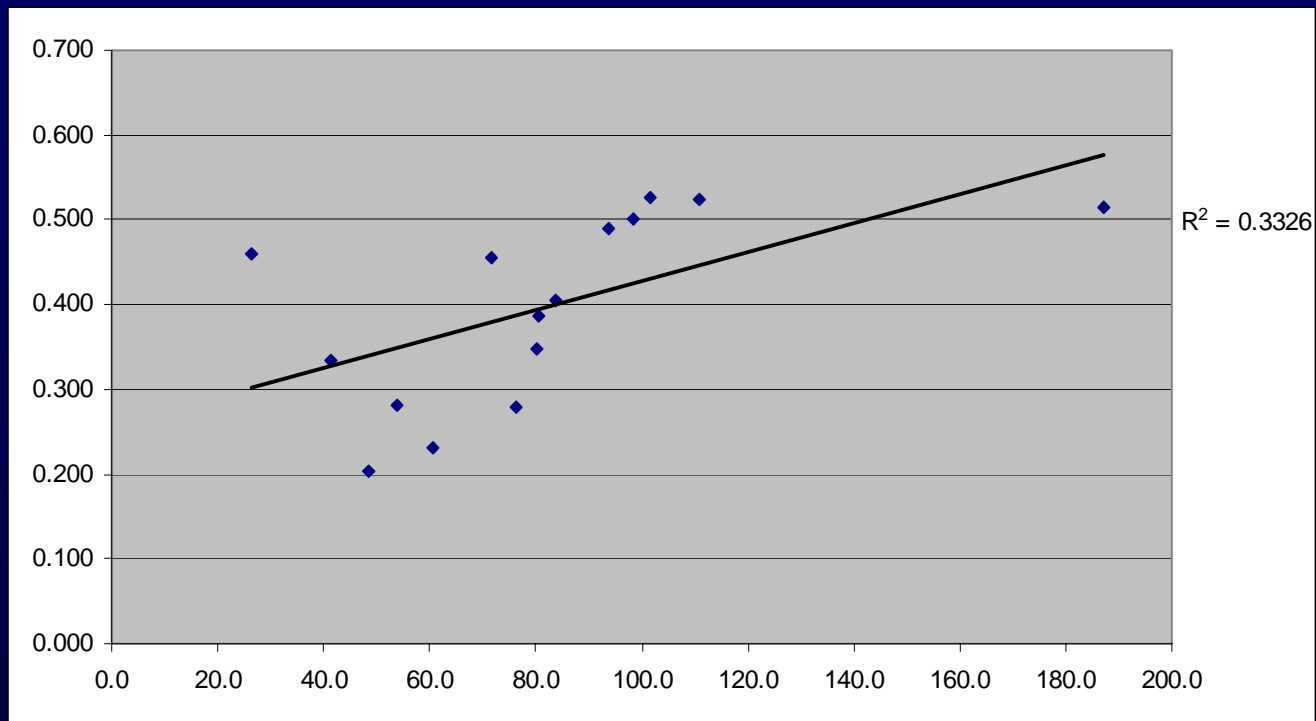
NDVI Trend Classification

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

Data collection procedures:
Satellite Monitoring
Global 1 km resolution
Global 1 km Trend Analysis
Global 1 km Trend
Area with trend value < 0.05 was not
classified as trend

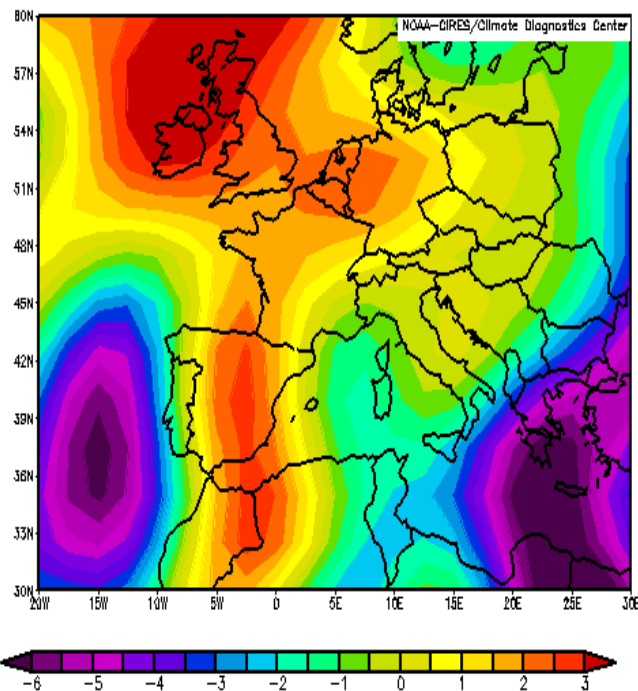
Data sources:
Copernicus
ESA Earth Observation Hub
ESA
ESA Earth Observation Hub
ESA Earth Observation Hub



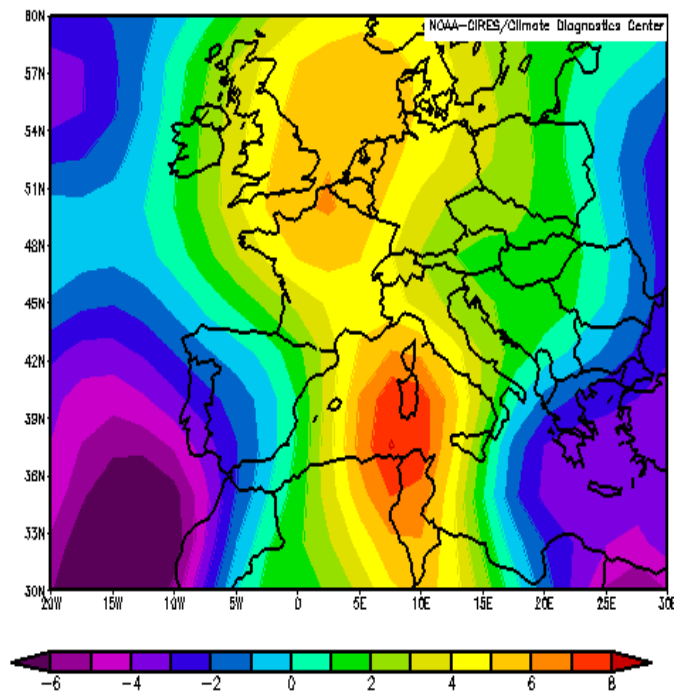


Regression of summer NDVI and winter precipitation

Increasing of summer "heat waves"

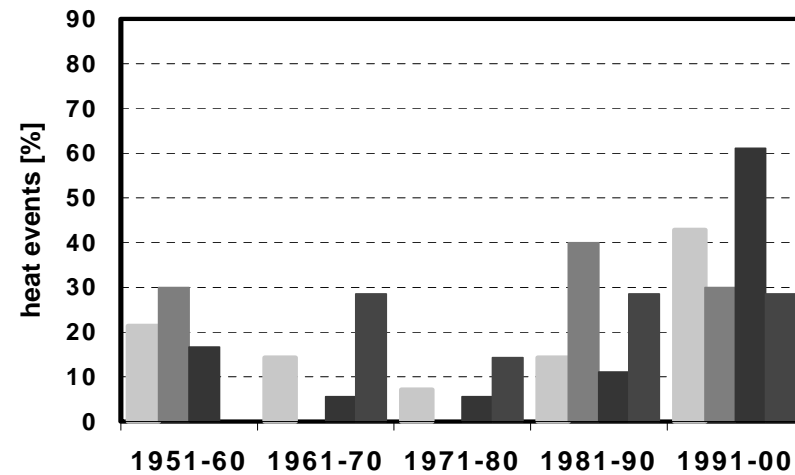
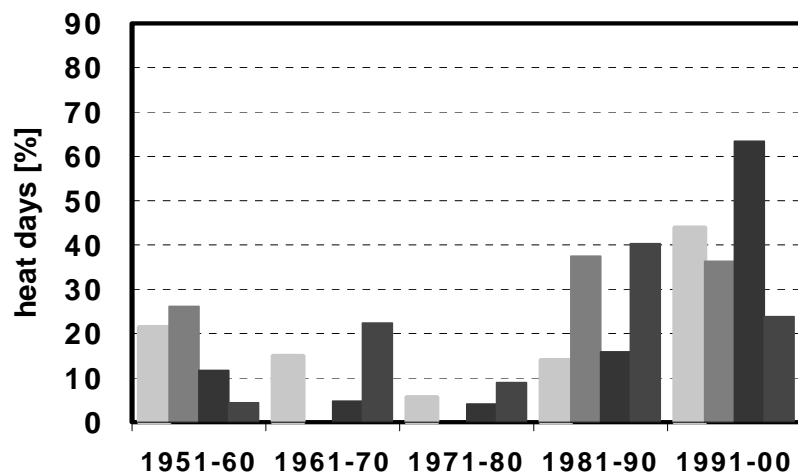


9 giorni consecutivi
nel giugno 2002
con $T_{max} > 34^\circ$



5 giorni consecutivi
nel maggio 2003
con $T_{max} > 30^\circ$

Distribution of summer heat waves (%)



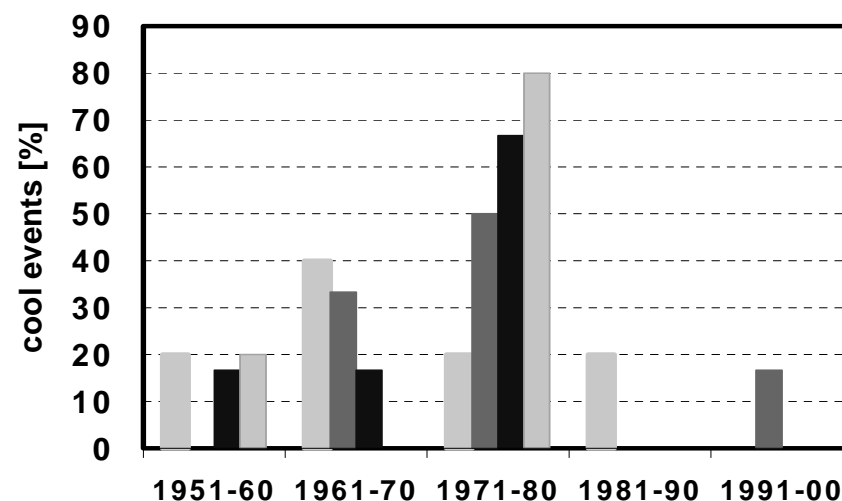
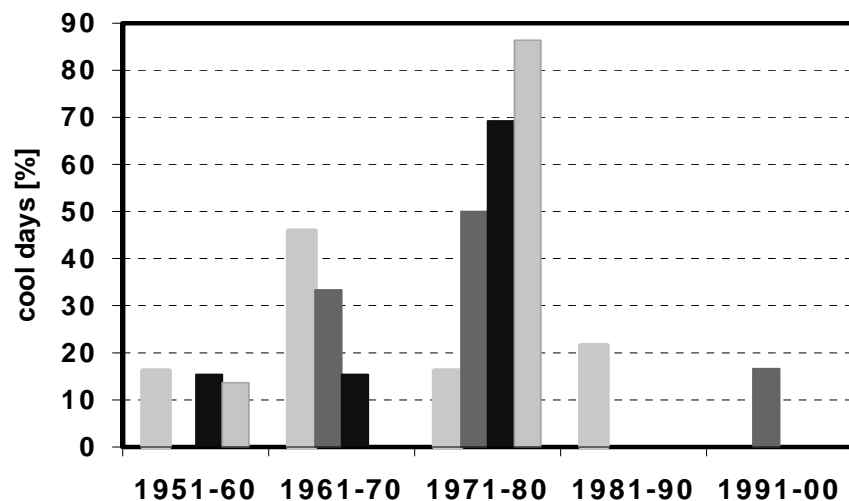
June

July

August

September

Ten days distribution of summer cold periods (%)



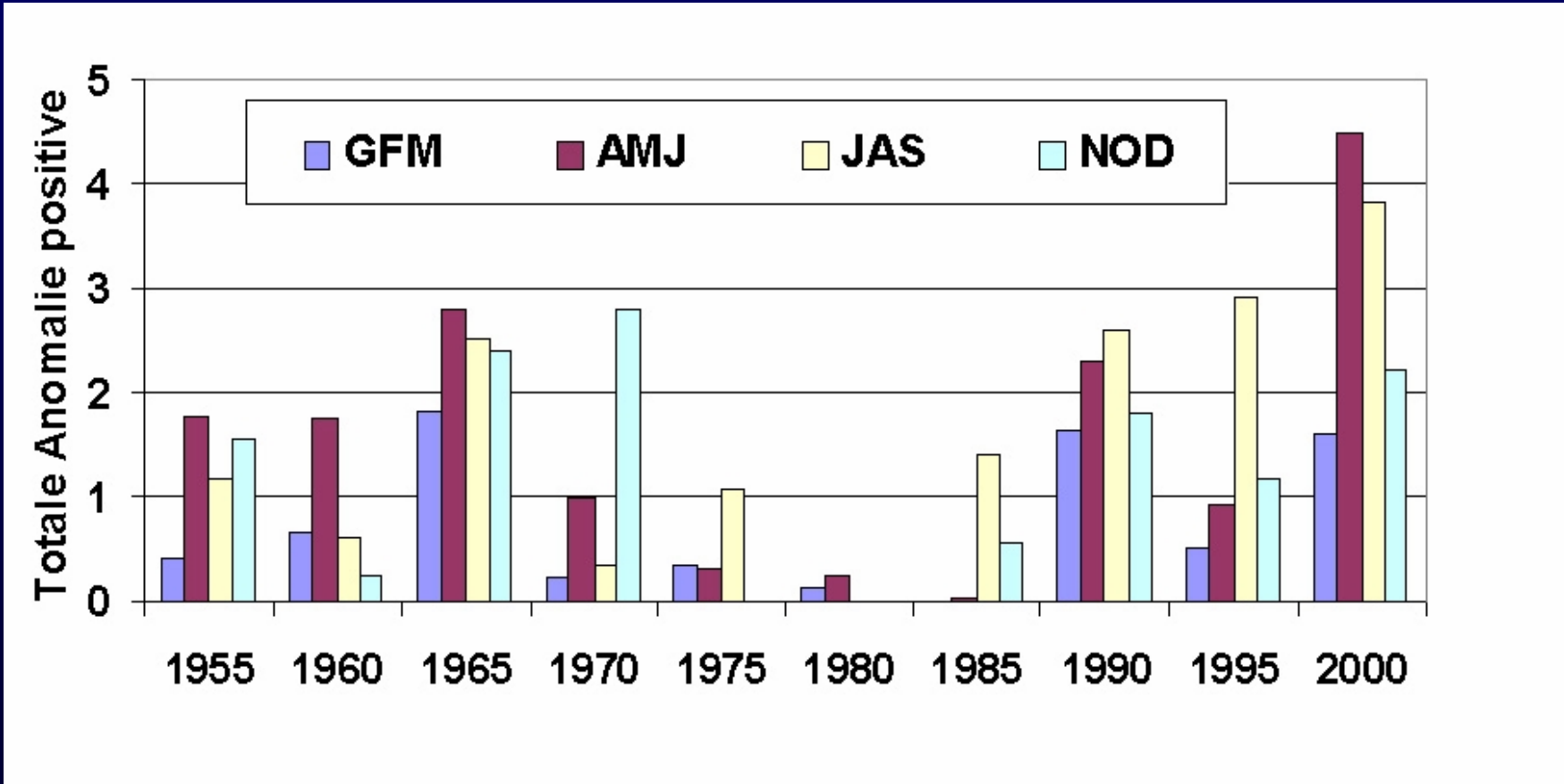
June

July

August

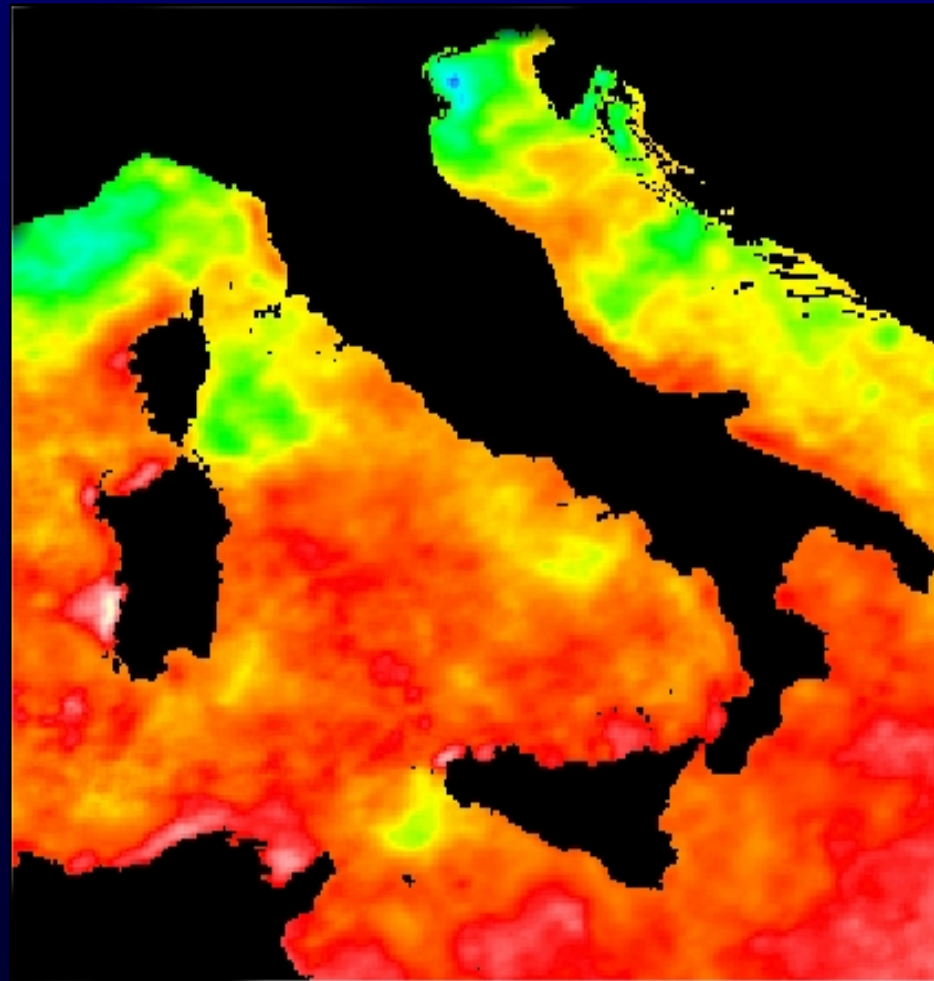
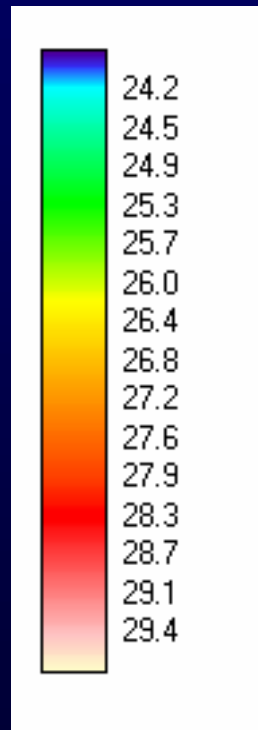
September

Increase of temperature positive anomalies of Mediterranean sea

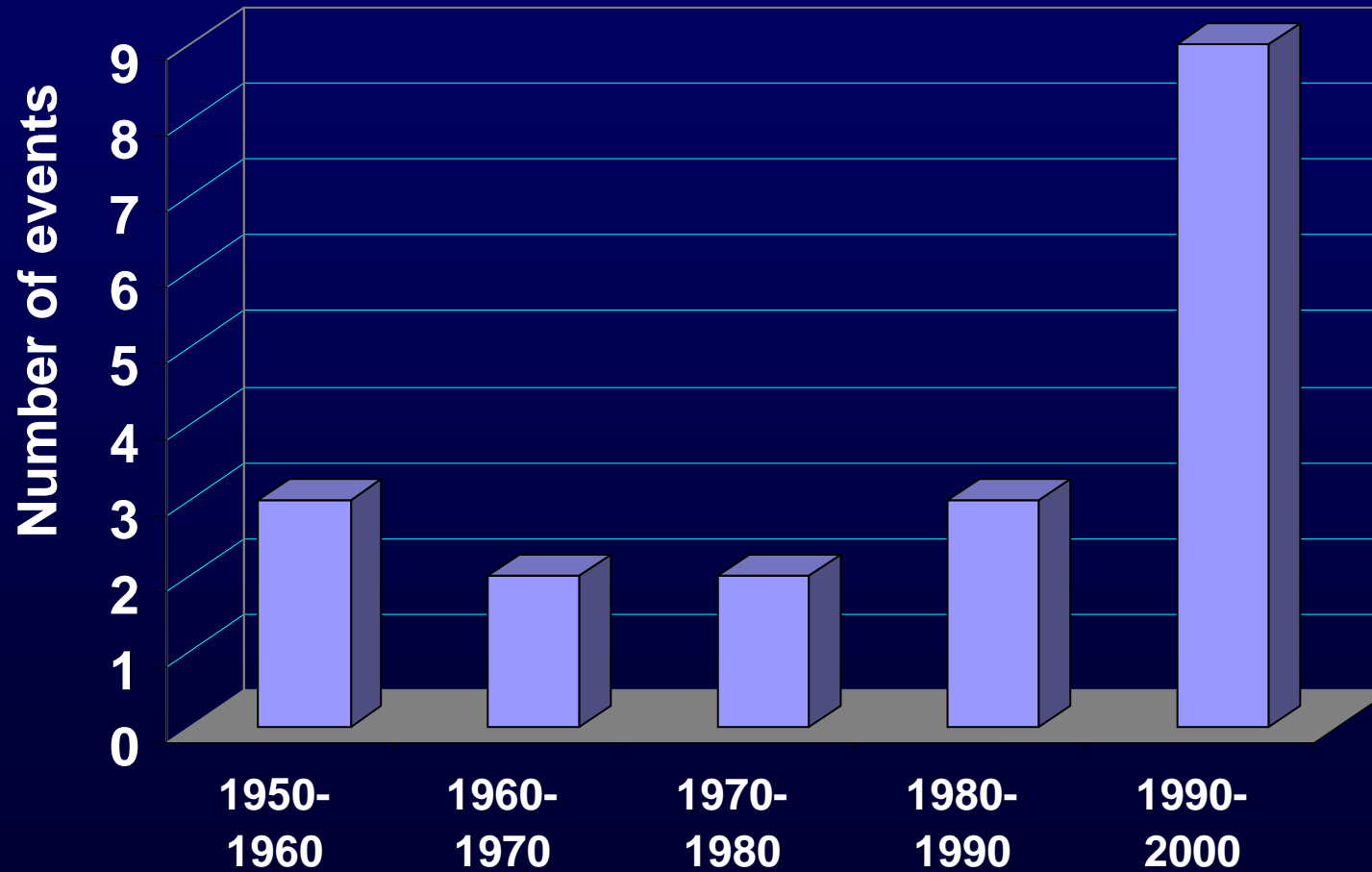


Sea temperature 15 september 2003

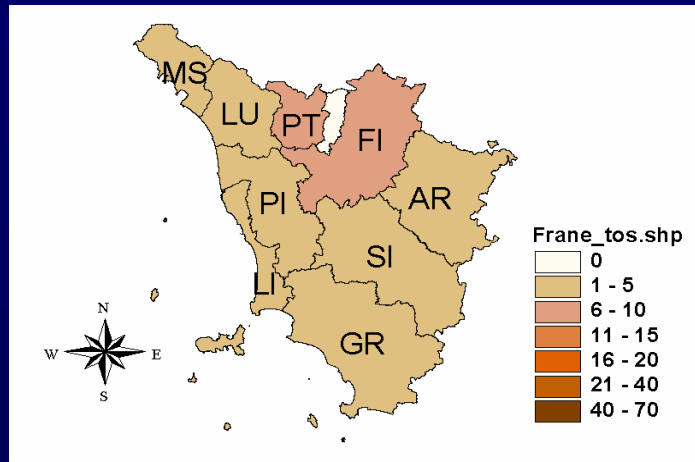
(Source: Lamma AVHRR NOAA 4km)



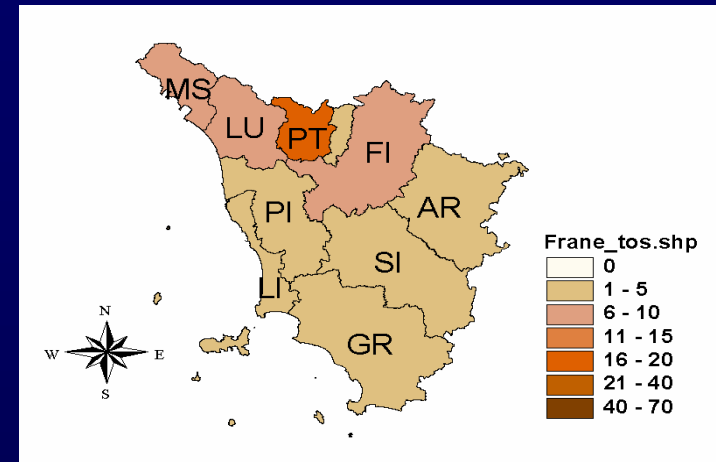
Extreme events in Italy



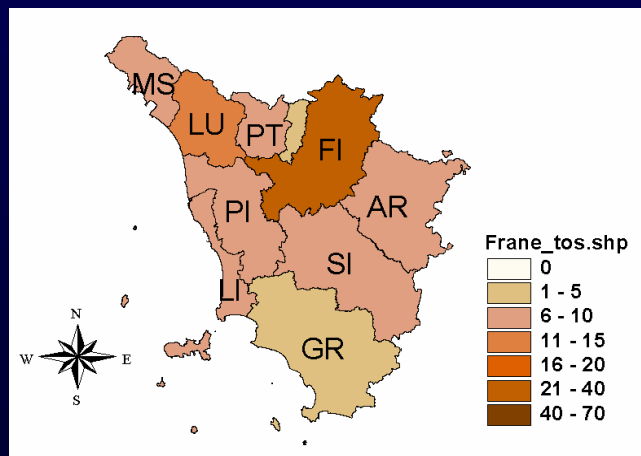
Drought + extreme rainfall events = erosion



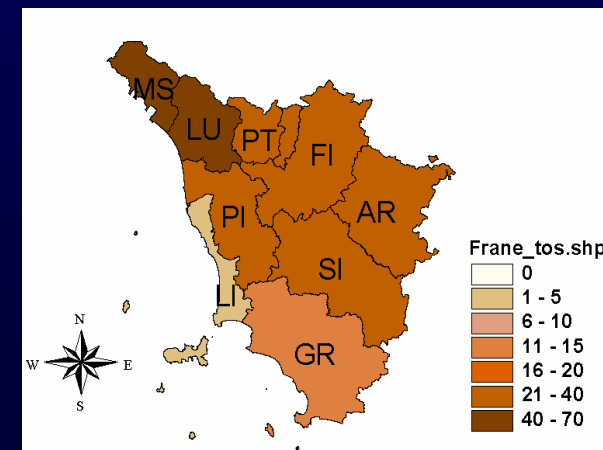
1961-70



1971-80

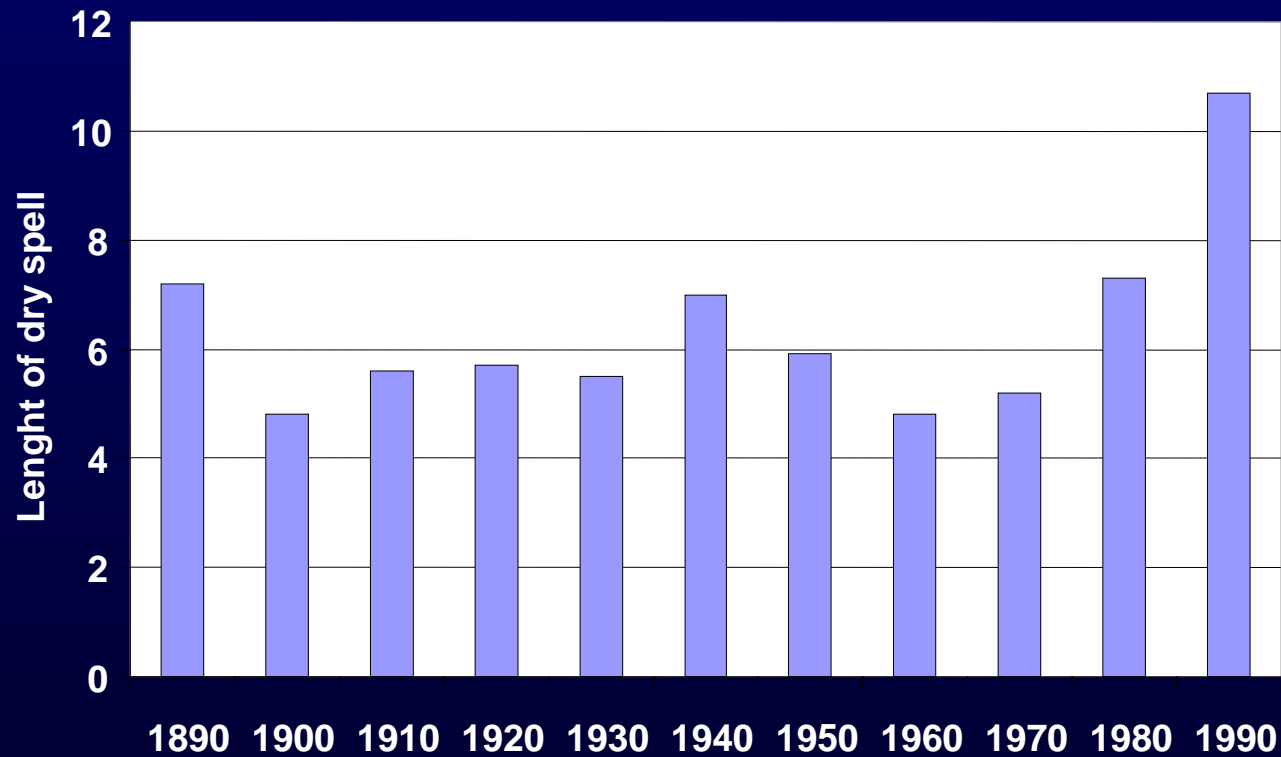


1981-90



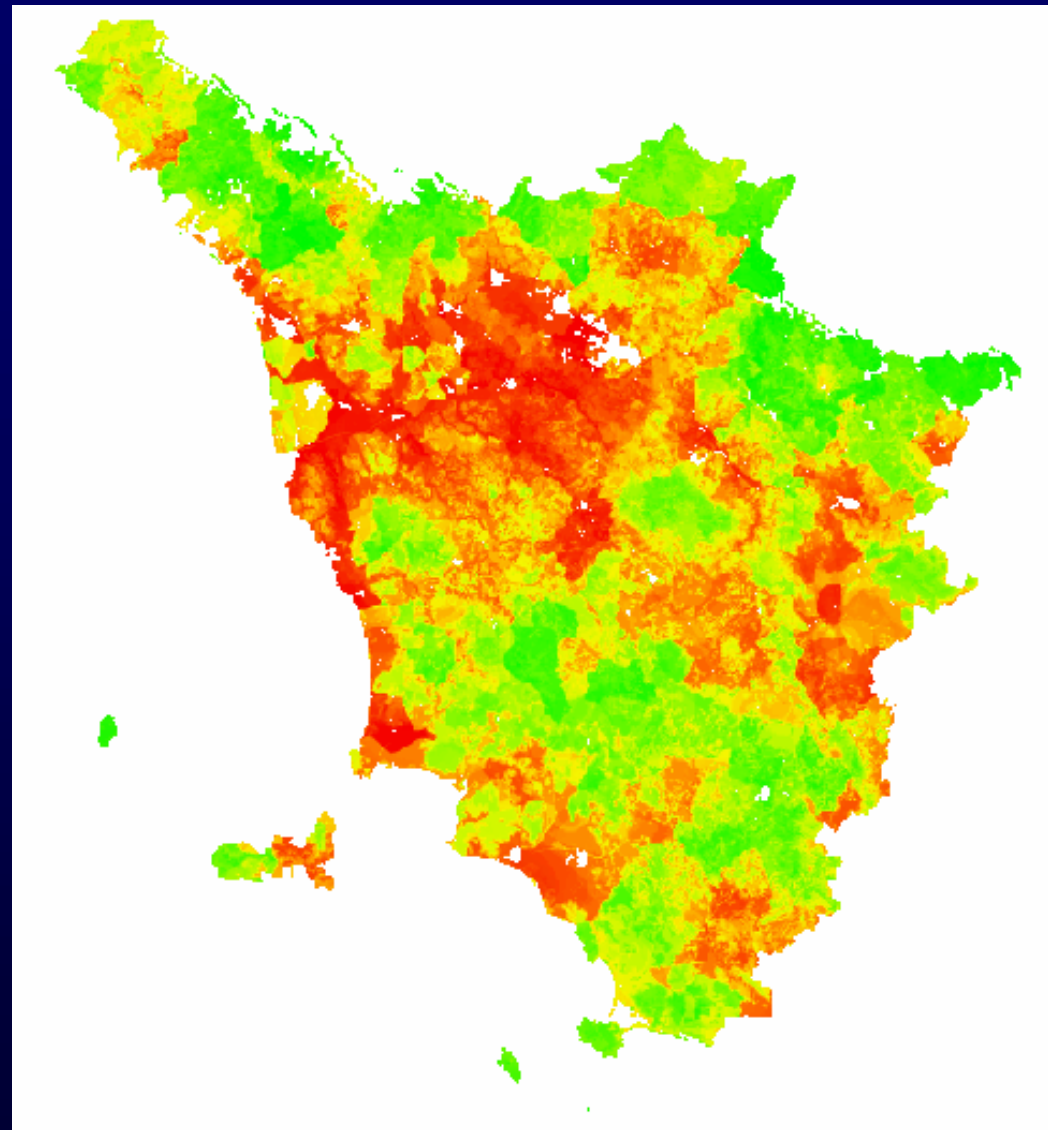
1991-2000

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



Drought in summer 2003

Damages to agriculture
in Tuscany : 250 mil. €



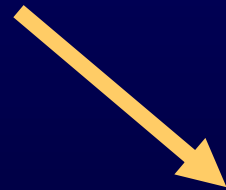
Changes in climate patterns and in the structure of the territory

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

Changes in the structure
of the territory



Increasing
Vulnerability



Climate Changes



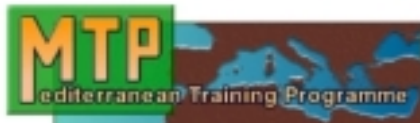
Extreme events



High impact
negatives events

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

WHY?

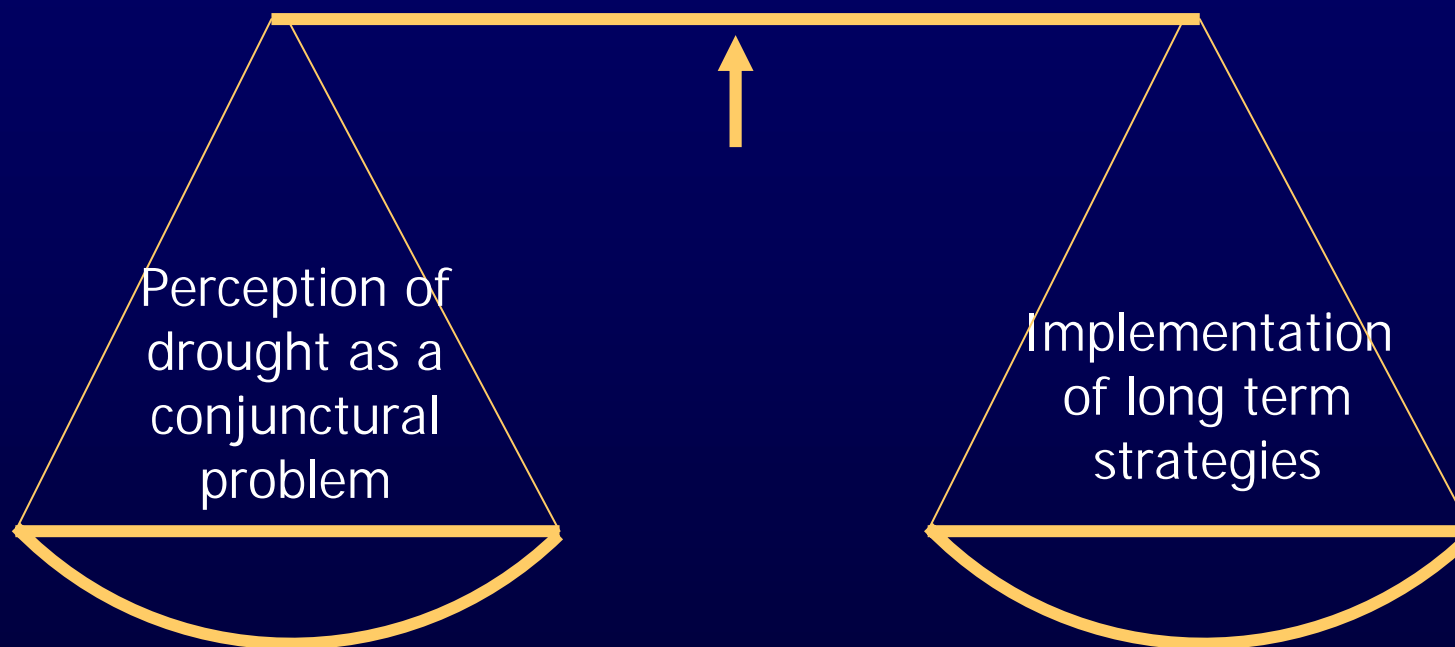


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The challenge of drought vulnerability in Mediterranean region



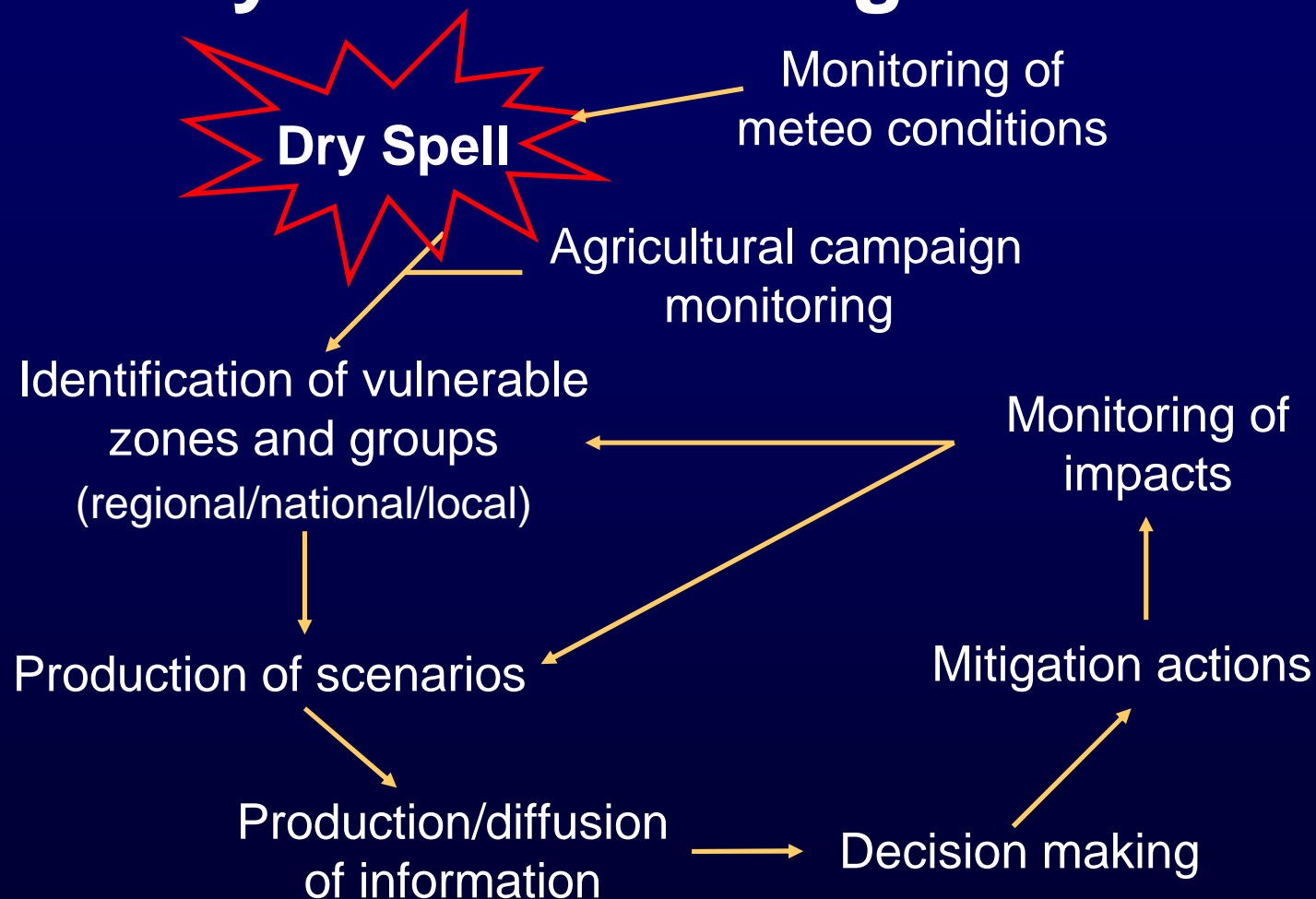
The role of information?

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

Research institutions are well networked but often produce information that is used only by research

IS IT A CLOSED CIRCLE?



Problems to be addressed at mediterranean level

DATA

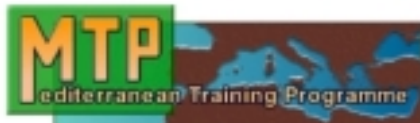
- sources of data and their update are not directly linked to existing drought warning systems
- the abundance of data does not translate into information

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



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THANK YOU