EurAqua Conference 2008
Thursday 23 - Friday 24 October 2008
Oslo, Norway

Water scarcity and drought: The ongoing process to link science and policy

R. Pagnotta & M. Vurro
IRSA-CNR
Via Reno 1, 00198 Roma -I
Via F. De Blasio 5, 70123 Bari -I

Water Research Institute
National Research Council

Outline

- The EurAqua experience
- Water Scarcity and Droughts Expert Network
- The North- and South-European contexts and climate change threats
- Water scarcity and drought: the Italian paradigm
- Science-Policy-Strategy: the Spanish way
- Water scarcity and drought: linking science and policy

The EurAqua experience

- Position paper, 2004


DISCUSSION DOCUMENT

Towards a European Drought Policy

Prepared by the EurAqua network
of Europe's leading freshwater
research organizations

EurAqua

Conclusions

1. Drought as an important and common characteristic of the European environment,
2. The major economic, social and environmental costs of European droughts,
3. The need for a specific European Drought Policy, within the context of long term sustainable use of water resources in Europe,
4. The need to integrate drought into a wide range of other EU policies and
5. The need for specific drought mitigation measures (drought forecasting, monitoring, research and knowledge sharing) at European level.

Water Scarcity and Droughts Expert Network
(European Water Directors)

First Interim report

Status box

Version no.: 2.0 Date: November 2006

Author(s): European Commission

Background:

Following the presentation of a first analysis of water scarcity and drought issues during the last Water Directors meeting in June 2006 and the Environment Council meeting on 27 June 2006, Member States asked for further discussions on specific measures

The Commission proposed to come back with an in-depth assessment identifying the magnitude of the problems linked to water scarcity and drought and the size of the residual gaps in the implementation of EU existing policies.

In June, Water Directors agreed to ask the Water Scarcity & Drought Group to support the Commission's further analysis and data collection and to fill the gaps identified by Member States and the Commission. An interim report was scheduled for November 2006, to be discussed by Water Directors.

This document is the first interim report requested in June, presented for discussion to the Water Directors on 30 November 2006;

Contacts: sylvie.detoc@ec.europa.eu and stephanie.croguennec@ec.europa.eu

Water Scarcity and Droughts Expert Network (European Water Directors)

- July, 2007. Communication from the Commission to the Council and the European Parliament. “Addressing the challenge of water scarcity and droughts in the European Union, Impact Assessment”.
  - Stakeholders and interested parties took an active part in the drafting of the Communication.
  - In September 2008, a stakeholder conference on water scarcity and droughts took place in Zaragoza (Spain) as part of the Commission's work to report on how the implementation of the options it presented in 2007 was progressing throughout the EU.
- November, 2007. “Drought Management Plan report. Including Agricultural, Drought Indicators and Climate Change Aspects” (Tech.Rep. 2008-023)
  - General guidelines to develop DMPs as powerful tools to alleviate drought impacts (Indicators and thresholds, Measures, Organizational framework)
- Water Information System for Europe, WISE

  http://ec.europa.eu/environment/water/quantity/scarcity_en.htm

Water Scarcity and Droughts Expert Network (European Water Directors)

- November, 2007. Policy paper on the "Exemptions to the environmental objectives under the WFD", part of the Common Implementation Strategy
  - Article 4.4 (extension of deadlines), 4.5 (less stringent objectives) and 4.6 (temporary deterioration)
  - Annex III: background information on Prolonged Droughts.

- April, 2007. "Mediterranean water scarcity and drought report" (Tech.Rep.2007-009) by the MED WS&D WG
  - Environmental water use, sustainable management and public participation (drought risk management strategies);
  - Knowledge as a key aspect for a sustainable management of water resources (water scarcity = data scarcity);
  - Need for a deeper analysis of measures to be implemented in the River Basin Management Plan / Drought Management Plan.

Water Scarcity and Droughts Expert Network

(European Water Directors)

Monitoring drought: indices and exemptions

Meteo-climatic indices

Precipitation, temperature

Water Supply

Hydrological indices

Piezometric levels artificial reservoir levels, river streamflow, spring outflow

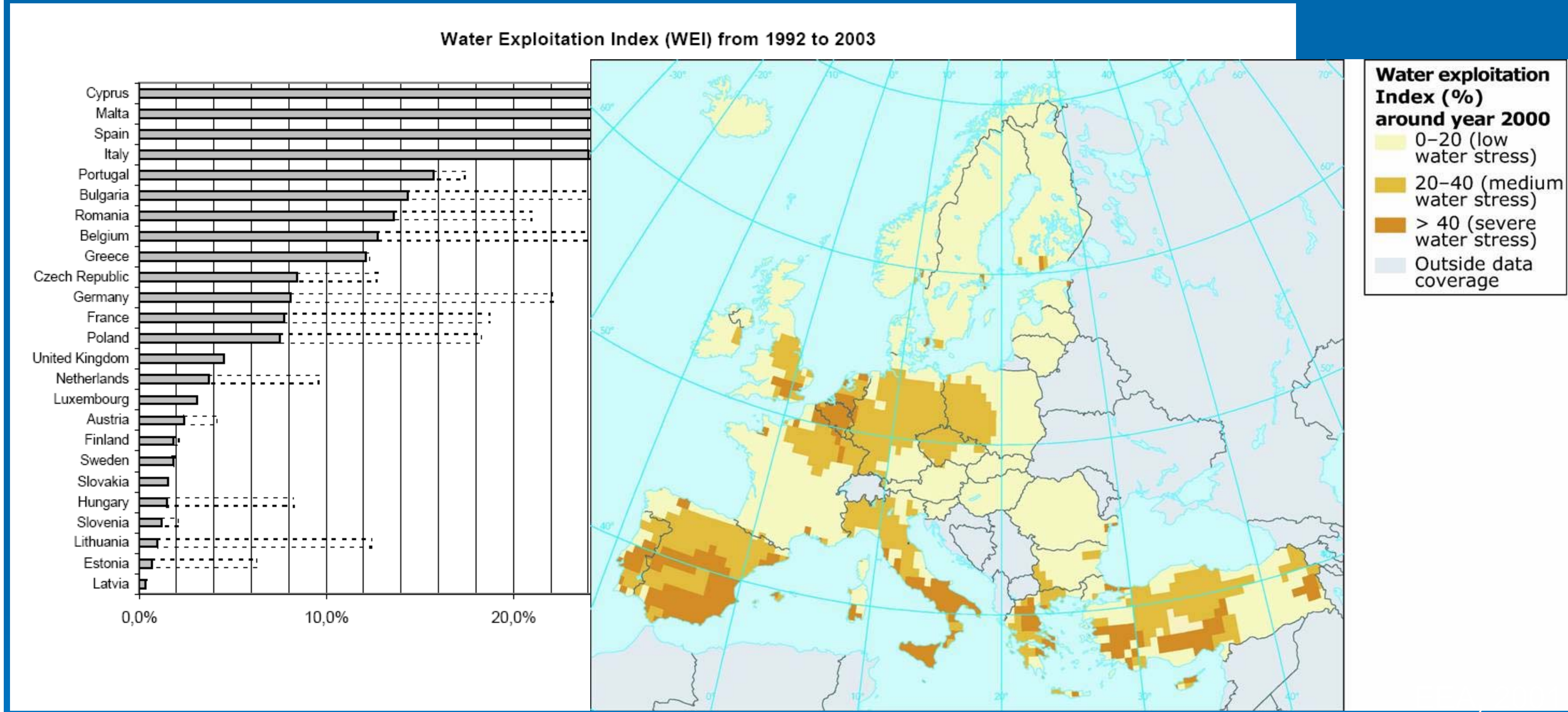
Water Supply

Management

Socio-economic indices

Impacts on the socio-economic systems

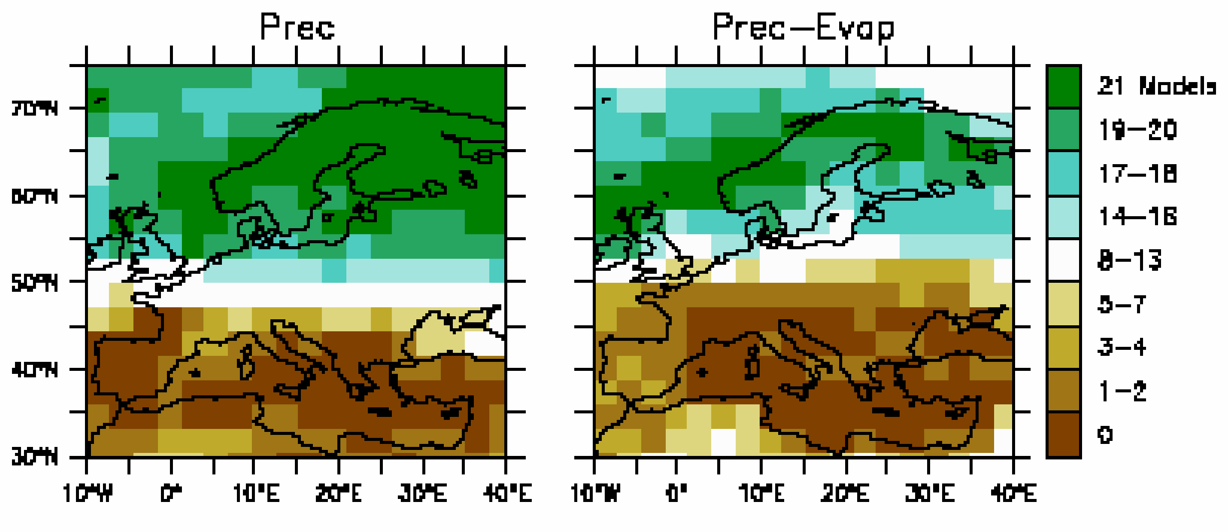
The North- and South-European contexts and climate change threats



- <u>National</u> values do not reflect the possible high <u>regional </u>pressures on water resources.
- Drought events (perception, damage, monitoring, mitigation,…) are apparent <u>from the local to river basin scale</u>.

The North- and South-European contexts and climate change threats

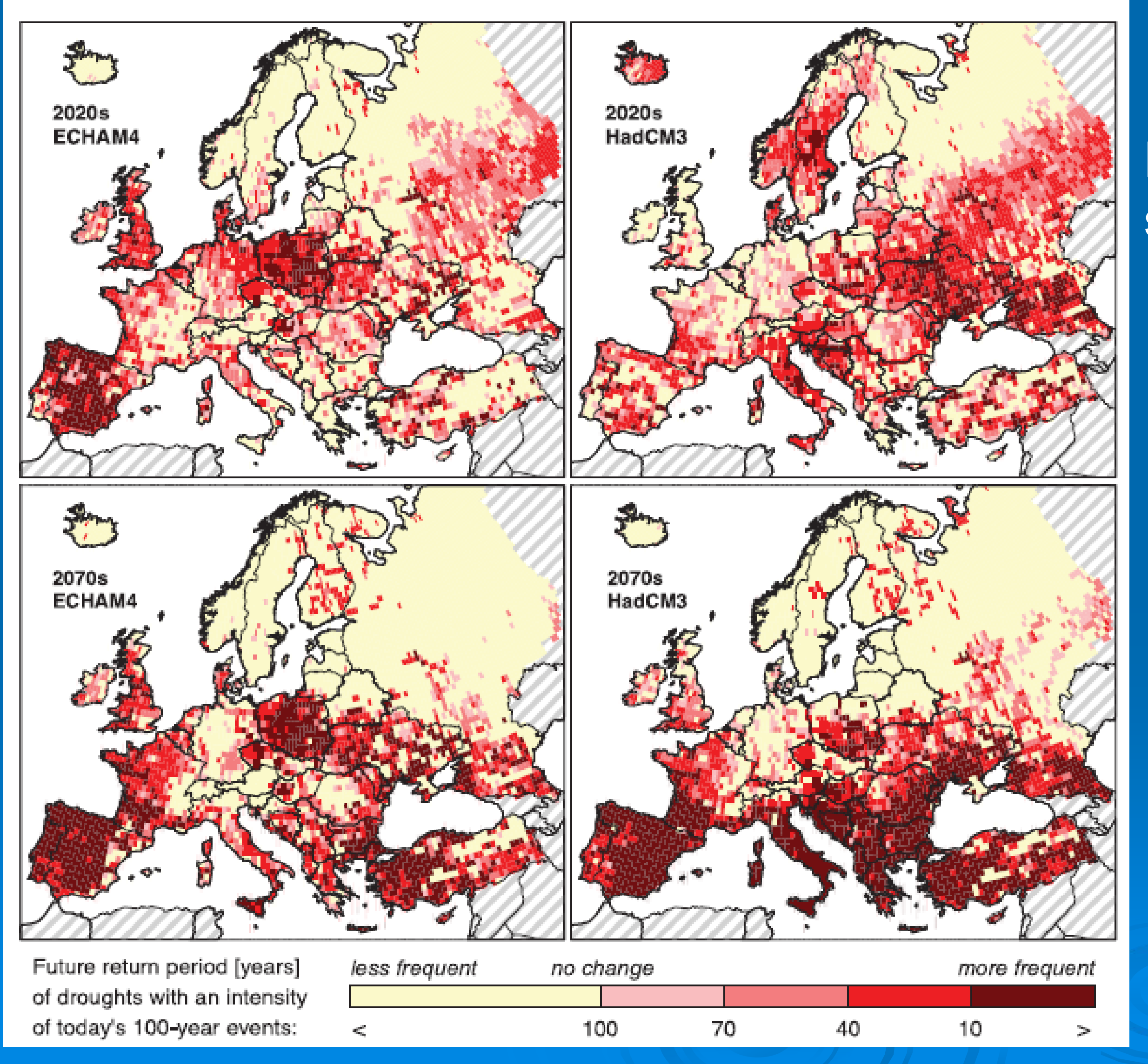
- Characteristics of droughts have <u>varied significantly</u> from one region to another, as regards their extent, duration, season and severity.
- <u>The pattern of droughts over time</u> and their extent across Europe, from northern to southern regions, reveals that all of the European territory may potentially be faced with such events.
- Climate change is influencing the baseline of present drought issues, with potential impacts on water quantity and quality.



Number of GCM models (over 21 considered by IPCC) predicting precipitation increase (left) and increase of the P-E difference (right) under the A1B scenario between the periods 1980-1999 and 2080-2099.

[IPCC WG I, 2007; Fig. S11.1]

The North- and South-European contexts and climate change threats



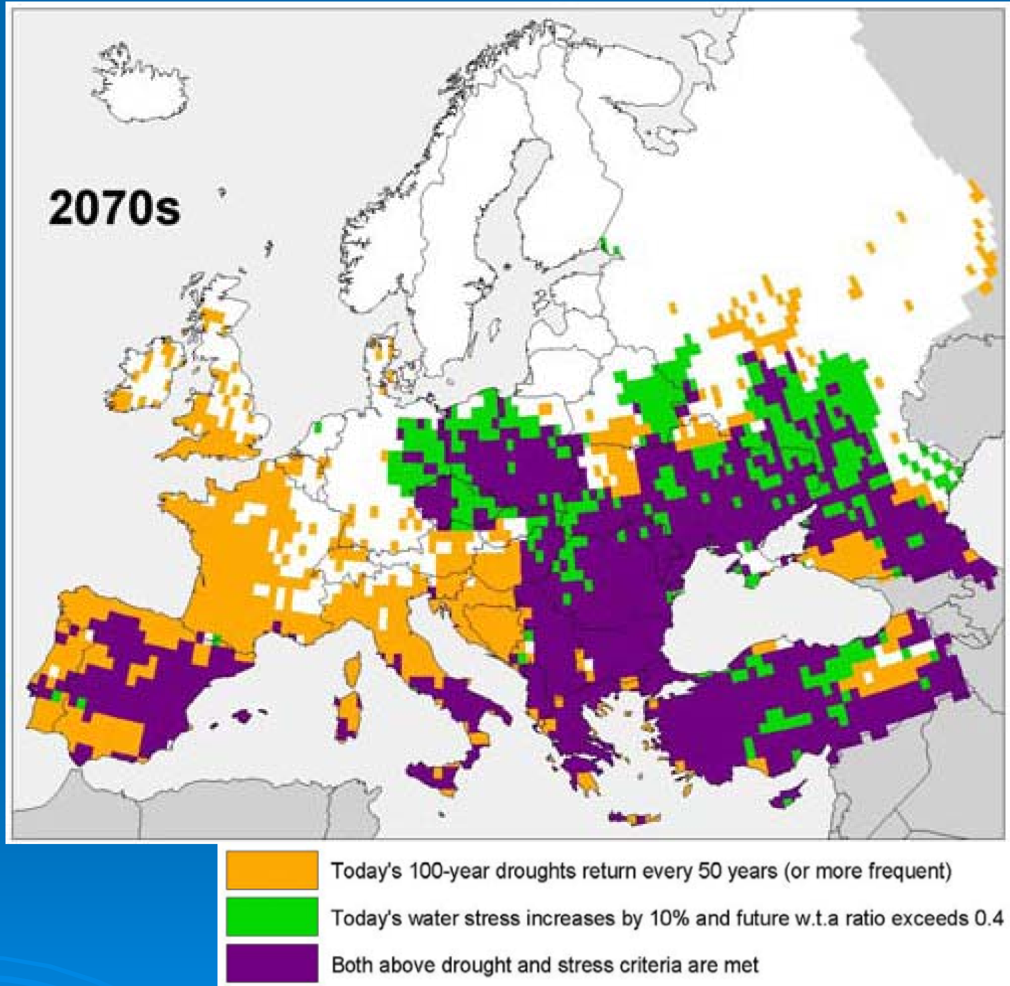
Recurrence period of severe droughts

[Lehner, B., P. Döll, J. Alcamo, H. Henrichs and F. Kaspar, 2005b: Estimating the impact of global change on flood and drought risks in Europe: a continental, integrated assessment. *Climatic Change*, **75**, 273-299)]

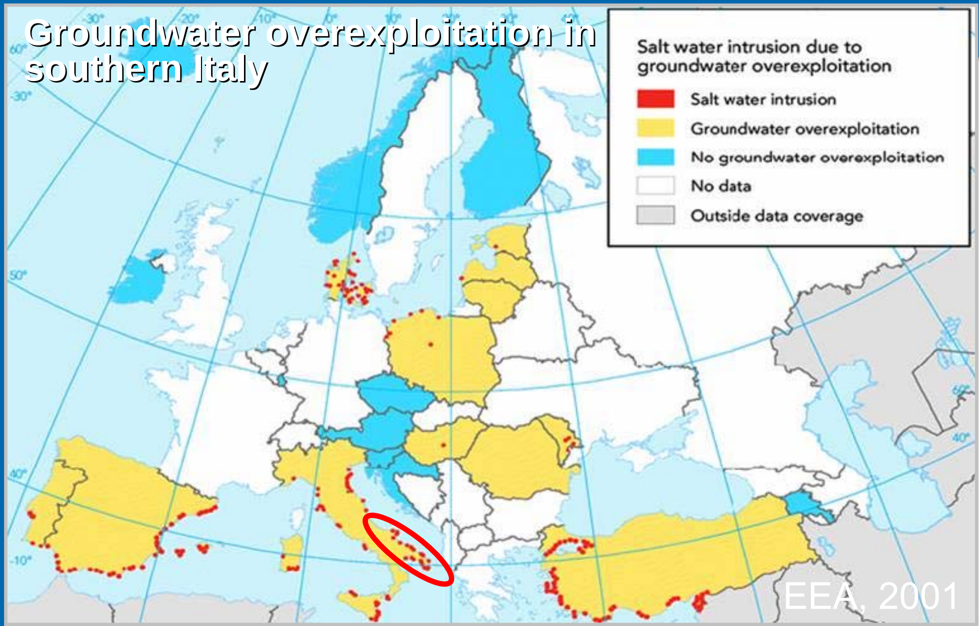
Water scarcity and drought: the Italian paradigm

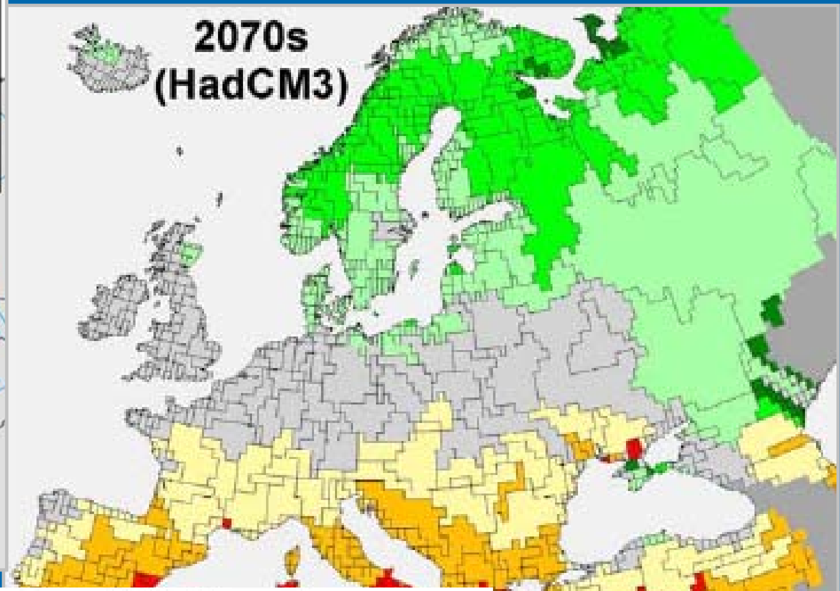
Characteristic

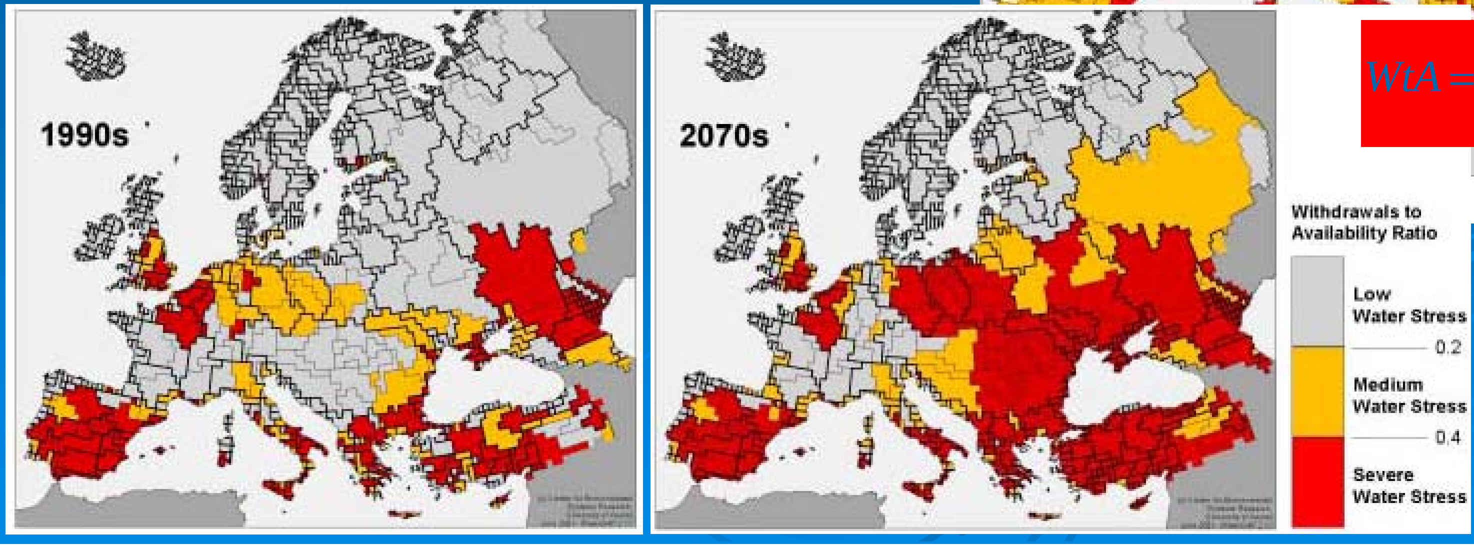
- Avg. Annual rainfall in the last 3 decades ranging from 700 to 900 mm/yr (avg. Over EU 650 -700 mm/yr). Total rainfall volume is between 220 and 280 Km^3/yr.
- Potential water resources volume is 150 Km^3/yr unevenly distributed due to climatological and geomorphologic features.
- According to present day infrastructures the available volume for human consumption is about 50 Km^3/yr.
- Present day water stress condition is high. Locally the water stress is severe.
- Increasing water demand and decreasing availability will generate diffuse unsustainable water resource exploitation.



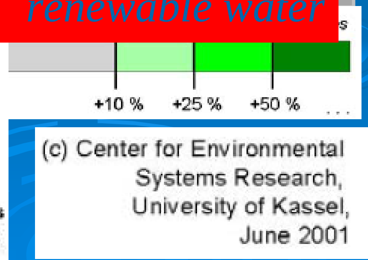
Water scarcity and drought:
the Italian paradigm







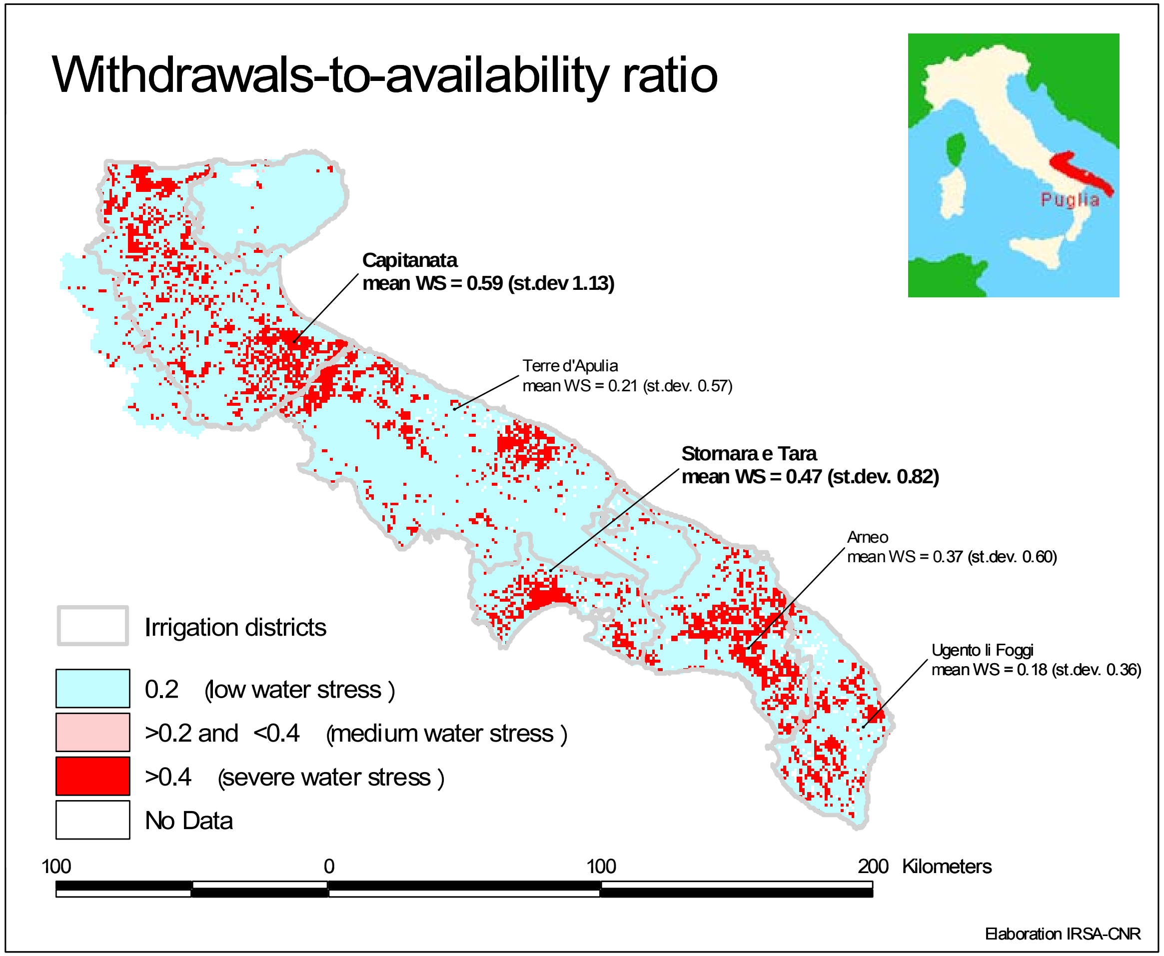
$$WtA = \frac{withdrawals}{renewable\ water}$$



Severe Water Stress:
Groundwater Protection Measures for the Apulia region

State of the art (2007)

- The assessment of GW abstraction using agro-hydrologic modeling
- Assessment of natural GW recharge rate,
- Identification of present GW stress and safe yield
- Evaluation of the pressures coming from existent WW treatment plants
- Set-up of high resolution monitoring network (in progress).



Water use	Drinking	Agricultural	Industrial
TOTAL 1.688 Mm³	546 Mm³ (32%)	812÷1.121 Mm³ (~59%)	142 Mm³ (8%)
Regional resources Extra-regional resour.	23% **76%**	**78%** 22%	85% 15%
Surface water bodies	**54%**	24%	15%
Springs	**23%**	1%	26%
Groundwater bodies	23%	**75%**	59%

WtA = 0.41

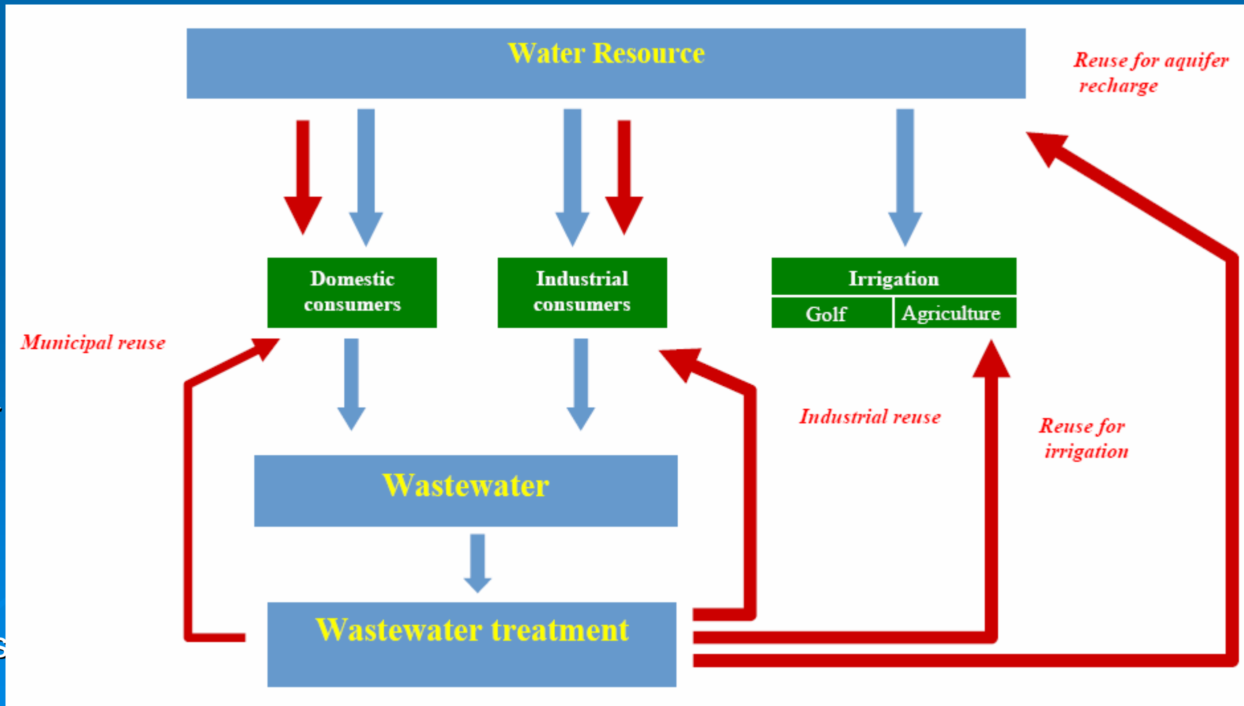
Precipitation	Surface runoff	Groundwater recharge	Evapotranspiration
11.900 Mm³ (615 mm)	1.893 Mm³ (16%) (98 mm)	2.185 Mm³ (18%) (113 mm)	7.822 Mm³ (66%) (404 mm)

Severe Water Stress:
Groundwater Protection Measures for the Apulia region

Linking science and policy for future IWRM

- Complete reception of the WFD concerning the artificial recharge of GW reservoir (paragraph 4, annex VI part B). Suggested for the recovery of quality-depleted aquifers (sea-water intrusion).
- Integrated strategy combining water reuse projects with water restriction rules established by the Regional Master Plan for water protection.
- A charging system based on abstracted volume metering is under study ('user pays' principle).
- The principle of environmental cost is invoked for groundwater abstraction at water stressed areas.
- WW reuse + artificial recharge yield substantial environmental benefit that justify the major cos of advanced water treatment.

COASTAL REGION	BARI	BRINDISI	LECCE	TARANTO	total
Irrigation demand Mm³	59.3	56.4	83.2	105.8	304.6
Irrigation with reclaimed water Mm³	**29.8 (50%)**	**9.8 (17%)**	**20.4 (24%)**	**20.6 (19%)**	**80.4 (26%)**
Residual GW abstraction Mm³	29.5	46.7	62.8	85.2	224.2
Surplus of reclaimed water Mm³	81.9	12.5	42.1	25.9	162.4



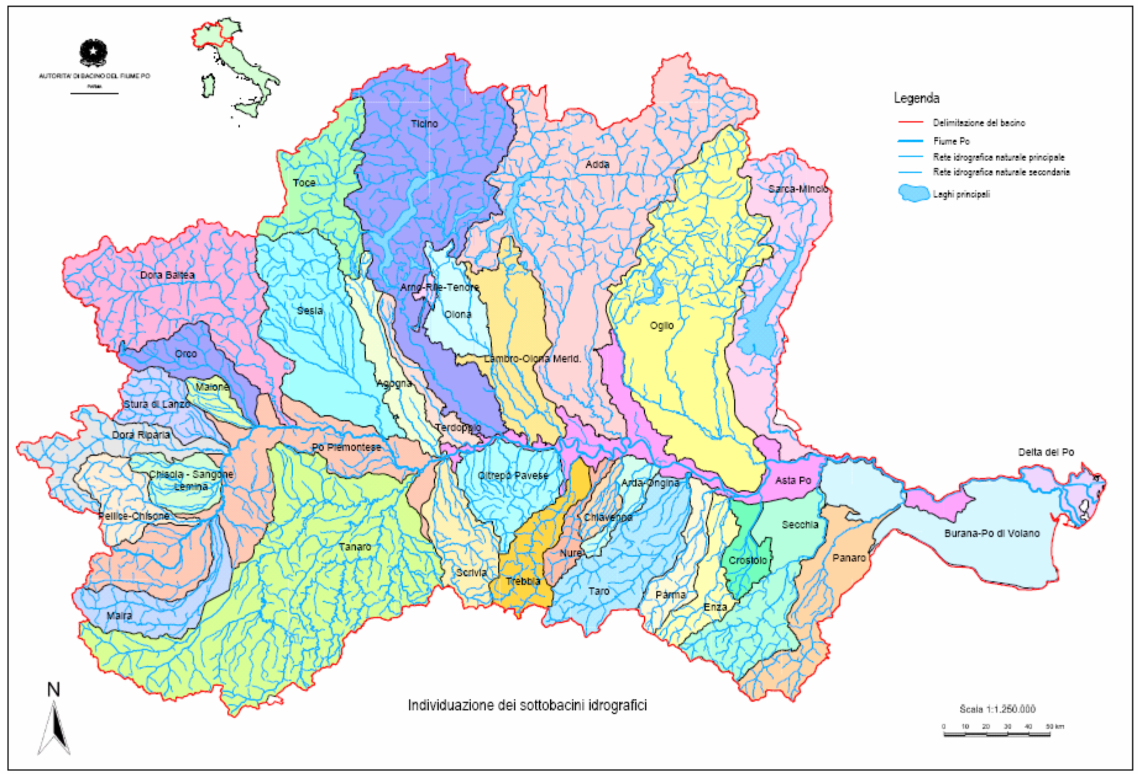
Emerging drought events in the sub-alpine Po valley: 2001, 2003, 2006, 2008

Anthropogenic pressures	Surface abstractions	Groundwater abstractions	Total licensed abstraction
15,7 M inhabitants 114 M inhab. pollution load	25,1 km^3 (54%)	5,3 km^3 (59%)	1.850 m^3/s (126%)

Catchment	Precipitation	Surface runoff	Groundwater recharge	Evapotranspiration
71.057 km^2	77,7 km^3 (1108 mm)	46,5 km^3 (60%) (665 mm)	9 km^3 (11,6%) (128,5 mm)	22,2 km^3 (28,6%) (317 mm)

Crisis management committee

- 2003 snow deficit triggered general water shortage amplified by hydro-power plants operations (black-out in August 2003).
- The complex system of managing authorities, including energy, water regulation, civil protection, irrigation districts, and stakeholders, worked on a real-time basis.
- Timely information among all actors allowed effective decision making based on the hydrological system response.
- Shared decisions and effective communication with the population were key elements for the acceptance of water restrictions in a large area.
- Good lesson learned (with big losses). Now move from the crisis management approach to the **risk management** approach.

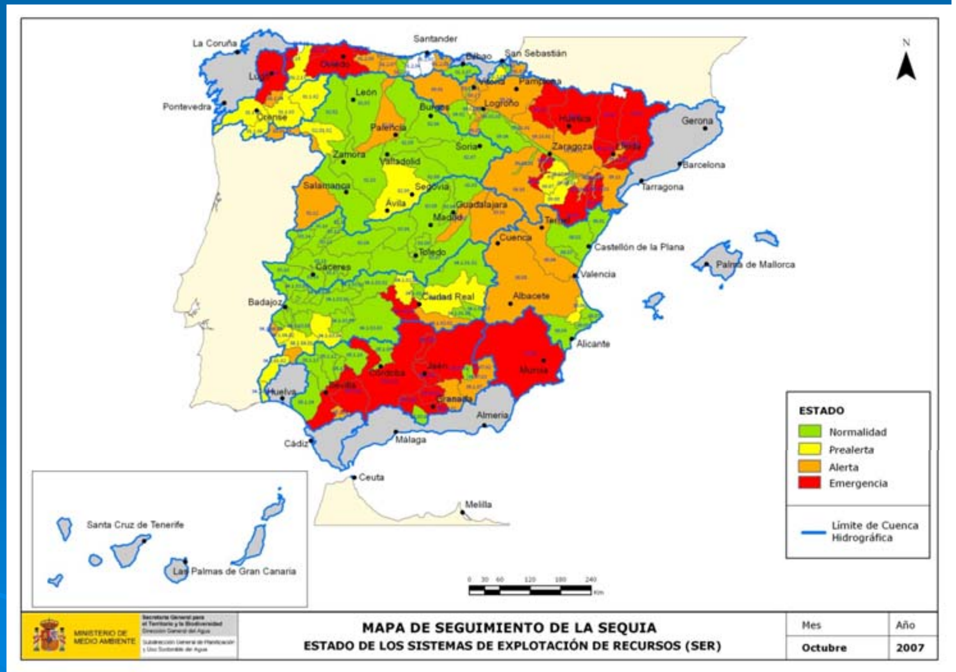


Science-Policy-Strategy: the Spanish DMP

Focuses on drought in the planning process

- DMPs are supplementary to the River Basin Management Plans.
- The new Water Act (2001) introduces flexible water use priority listing through Water Bank (waiving of rights).
- Global **Hydrological Indicators System** (HIS). The HIS is elaborated using different parameters (inflows, outflows and storage in reservoirs, flow river gauges, precipitation and piezometric levels) for each management system.
- HIS adopts informative indicators combining hydrologic and available water resources status:
  - Identification of the **origin areas** of resources associated to specific **demand units,**
  - Selection of indicators types according to their representativity in the resources supply (precipitation, river flow, reservoir storage, piezometric levels).

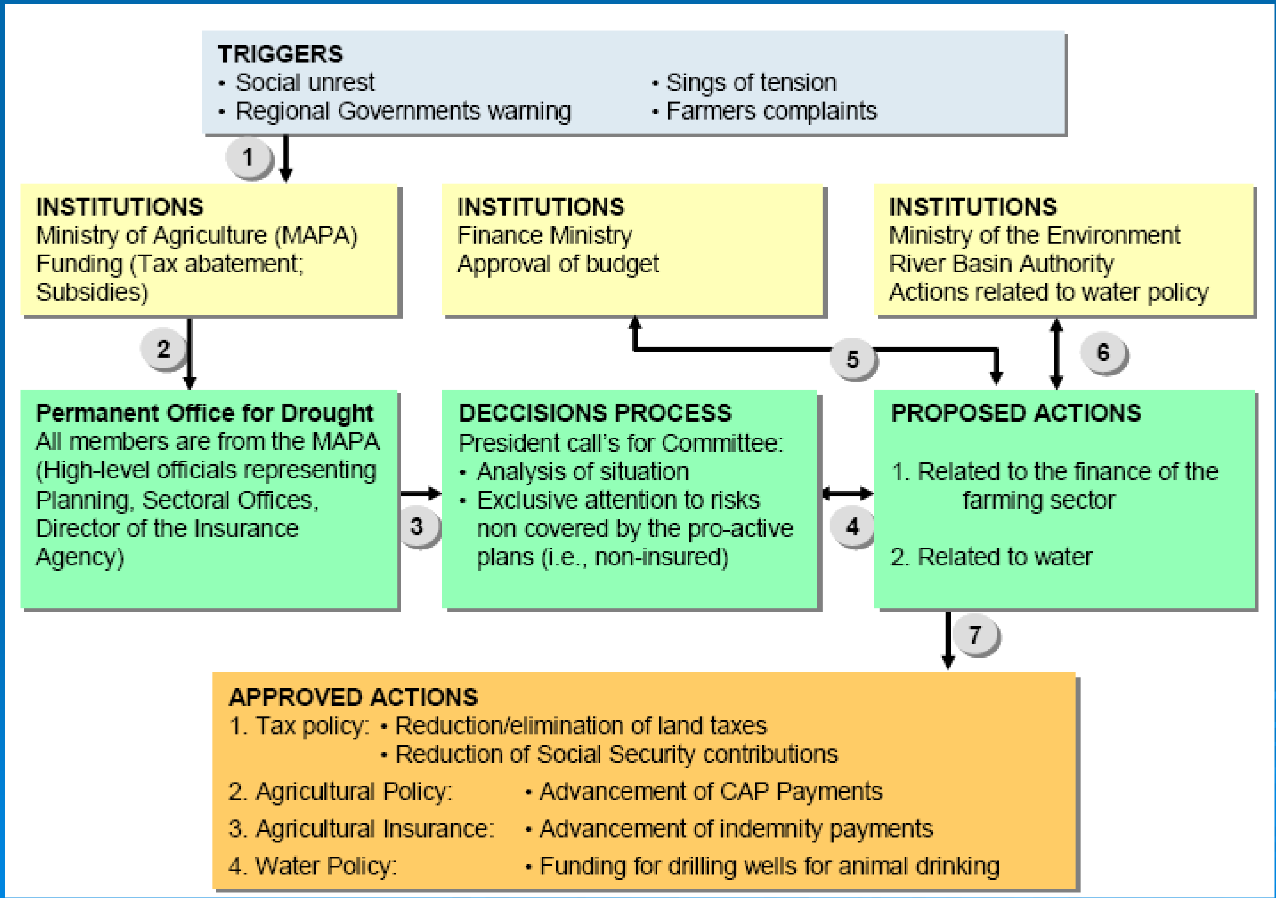
TYPES OF MITIGATION MEASURES							
Indicator	1-0.5	0.5-0.4	0.4-0.3	0.3-0.2	0.2-0.15	0.15-0.1	0.1-0
Status	Normal	Pre-alert		Alert		Emergency	
Objective	Planning	Information-control		Conservation		Restrictions	
Type of measure	Strategic			Tactics		Emergency	



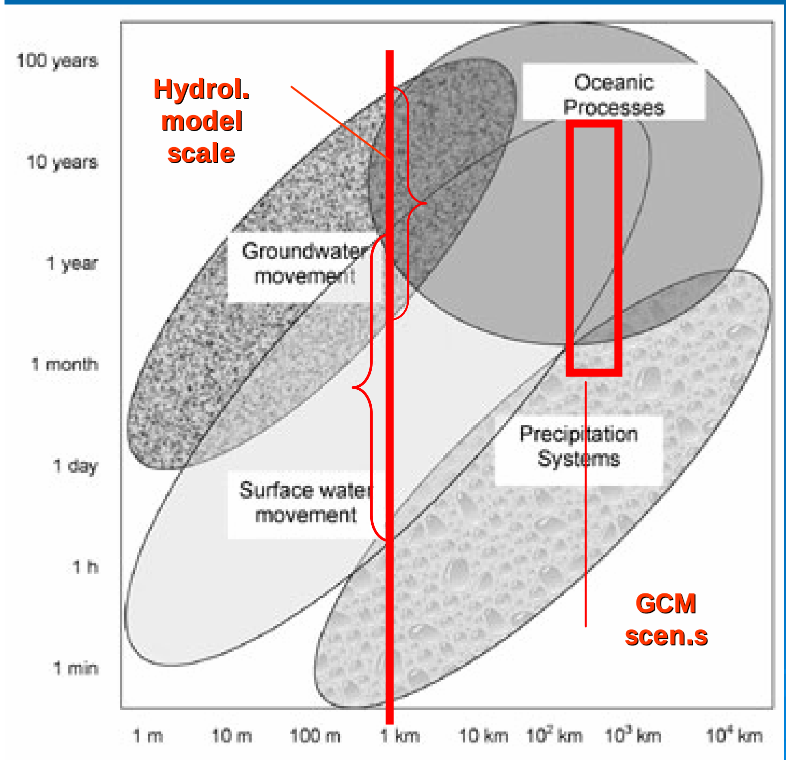
Science-Policy-Strategy: the Spanish DMP

The drought management process

- HIS is prodromic to the drought impacts on the social and economic level
- Timely actions may alleviate level of damage.



Water scarcity and drought: linking science and policy



1. **Downscaling of climate scenarios**

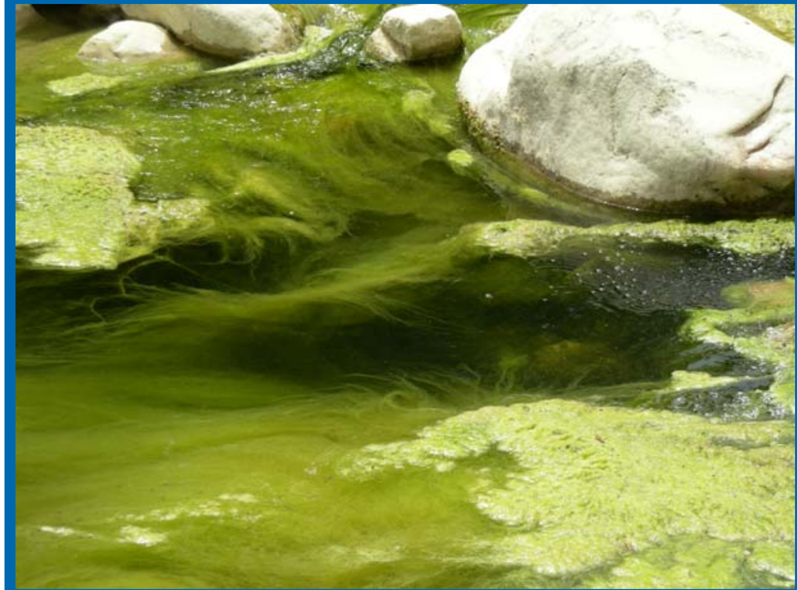
   Identifying local climate scenarios for impact analysis, implies the definition of more detailed local scenarios by 'downscaling' GCMs results or by high-resolution GCMs.

   Linking science and policy =

   bridging the space-time gap

   producing reasonable climate projections including extremes in precipitation and temperature analyze climate change signal from altered regime.

Water scarcity and drought: linking science and policy



2. Impact assessment

including water resource availability and variability,

water demand scenarios,

complex environmental feedbacks affecting water resources (availability/demand) including ecology

societal feedbacks (migrations, land-use)

Linking science and policy =

developing suitable model tools

Water scarcity and drought: linking science and policy

3. Adaptation:

initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects.

Examples are suitable land-use planning to meet water availability, reduce water demands, increase efficiency of infrastructures, etc.

Linking science and policy =

evaluation of response scenarios

Water scarcity and drought: linking science and policy

4. **Mitigation:**

   Feasible mitigation options as regards the environmental geography.

   Synergistic actions require integrated policies to effectively reduce greenhouse gas emissions and enhance sinks.

Linking science and policy =

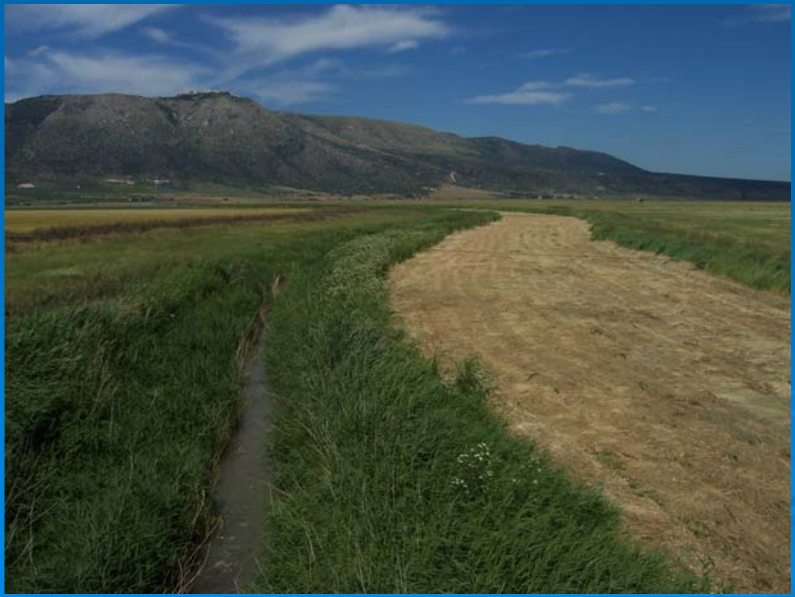
evaluation of response scenarios

Water scarcity and drought: linking science and policy

5. Monitoring:

Timely and shared information on drought evolution must be circulated. Not only concerning climate anomalies but more importantly on water resources stage and undertaken actions.

Agreed indicators systems and thresholds are necessary to identify a prolonged drought. Need for effective trans-boundary monitoring network.



Linking science and policy =

assist in network development and operation

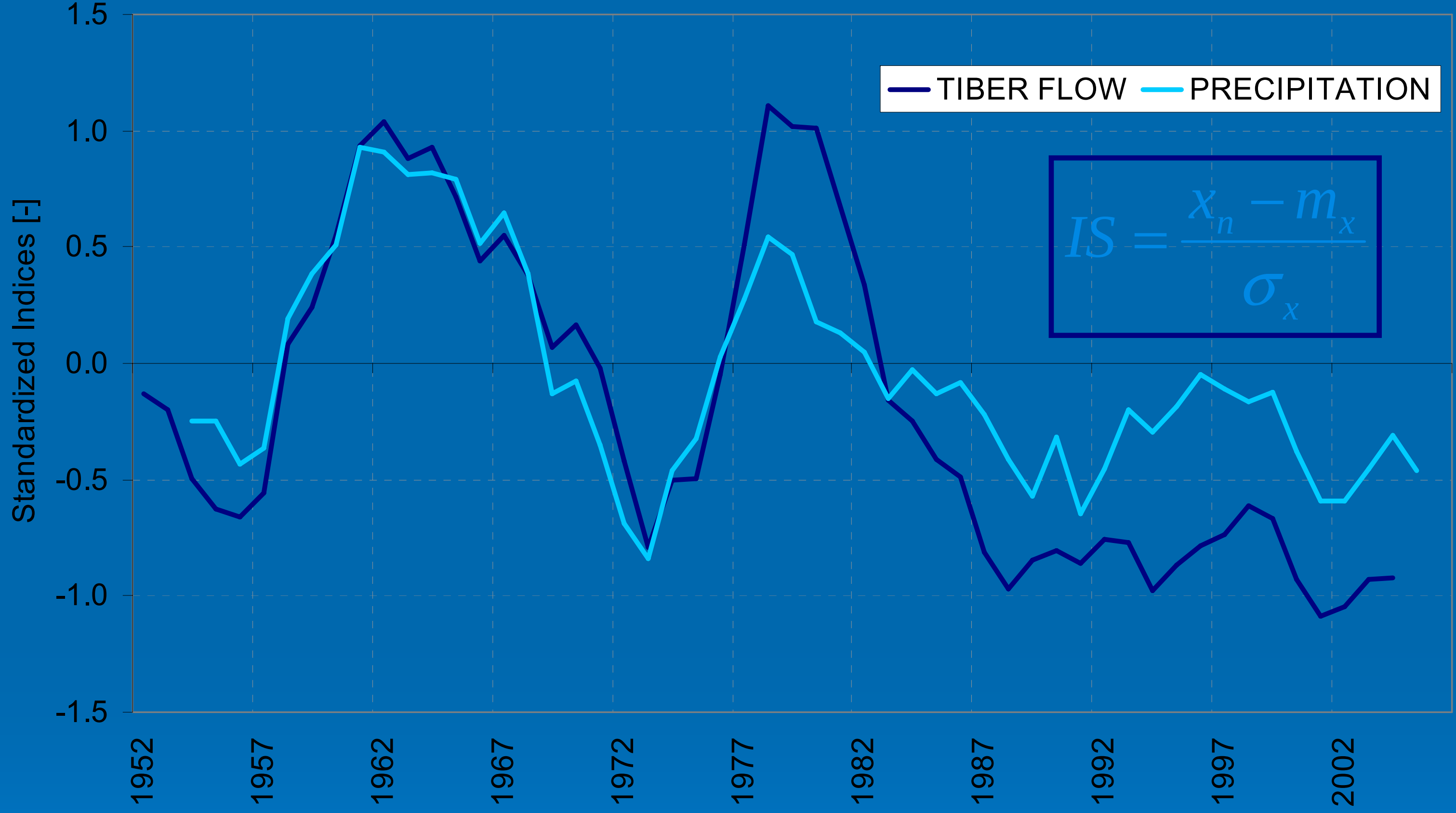

Thanks for your
kind attention
Thanks to I. Portoghese, E. Preziosi and E. Romano for discussing and helping in the preparation of this presentation.

The North- and South-European contexts and climate change threats

Linking science and policy: Major problems on the field

- The spatial and temporal distribution of water resources across Europe is one of the main drivers of water scarcity and droughts.
- Water pricing policies generally do not reflect the level of sensitivity of water resources at local level. The 'user pays' principle is hardly implemented.
- Inappropriate land-use planning and water allocation between economic sectors result in imbalances between water needs and existing water resources.
- Drought events have often been resolved by a crisis management approach dictated by a lack of timely preparedness for extreme events.
- The impacts of economic and social development on water resources may be of the same order of magnitude as changes in water availability due to climate change.
- South-Eastern countries might be the area with the greatest increase in pressure on its water resources in the coming decades.
- The WFD provides all the tools needed to achieve sustainable water management. However, implementing these tools (in particular water pricing and cost recovery) in the most effective way remains a challenge.

The Tiber Basin experience
The main watercourses

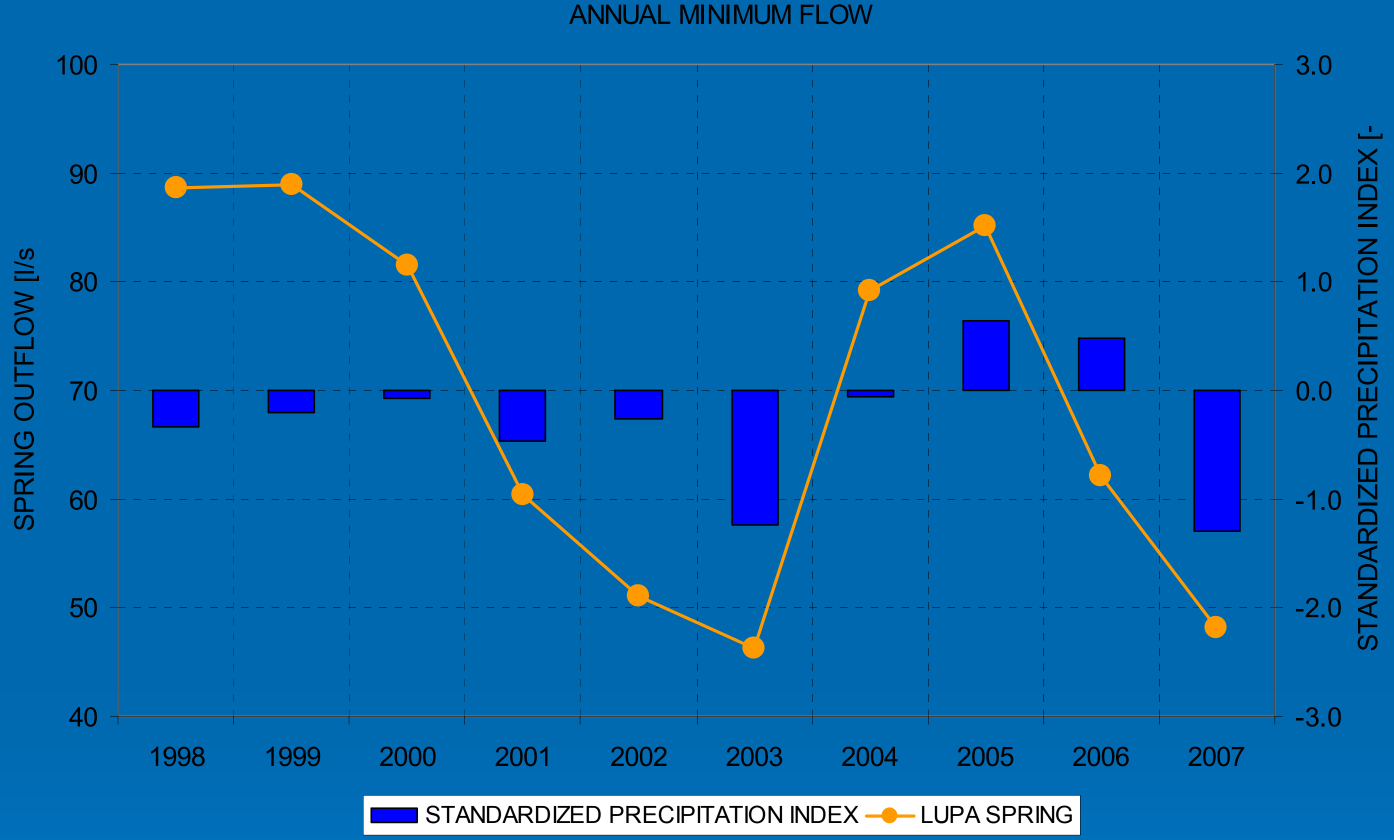


During the last 20 years — Standardized Index of precipitation ≈ - 0.25

Standardized Index of flow ≈ - 0.80

Are we in drought conditions?

The Tiber Basin experience
The small springs



During the last 10 years Standardized Index of precipitation ≈ - 0.25 – -1.25

Spring minimum outflow ≈ 90 – 45 l/s

Are we in drought conditions?

How can we take into account the demand?

Science-Policy-Strategy: the Spanish way

Indicators of water supply (precipitation, piezometric and reservoir levels, watercourses flow)

“Weights” assigned on the ground of the average water demand

ALARM THRESHOLD

Problem definition & Definition problem

- Water scarcity
- Aridity
- Drought
- Water shortage
- Desertification
- Water stress
- Climate change impacts
- Adaptation
- Mitigation
- Water Policy
- Water Planning
- Water Management Strategy

- Drought Severity
- Frequency of occurrence
- Climate variability
- Climate trends
- Natural/anthropogenic
- Water stressed regions
- Impact assessment and prediction
- Prediction uncertainty
- Monitoring & detection
- MS shared methodologies
- Intersectorial DMPs