

Definition and early identification of droughts in Spain

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*Ministry of Public Works- Ministry of
Environment (Spain)*

Drought and water deficiency: from research to policy making

Palermo, 8-9 October 2004

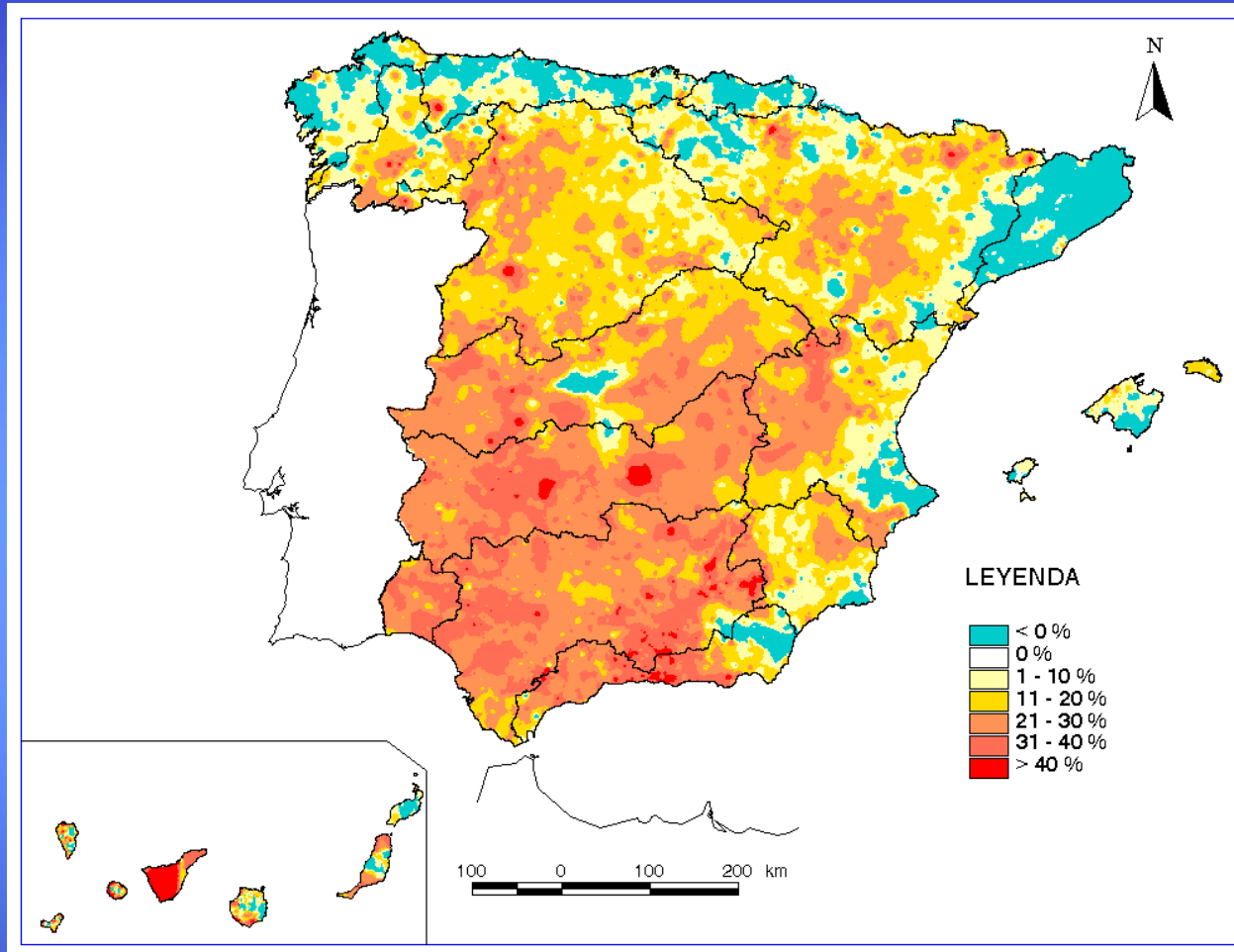


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- Drought definition in Spain
- Early identification of droughts
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Introduction

- Lack of a generally accepted definition for droughts
- Terms Confusion: Aridity, Water shortages, Water stress...
- Otherwise than floods, a drought is difficult to characterise.
- No general agreement in the starting and ending dates.



Percentile deficit of precipitation in Spain during 1990-95 drought

Source: CEDEX for White Paper on Water in Spain

Introduction

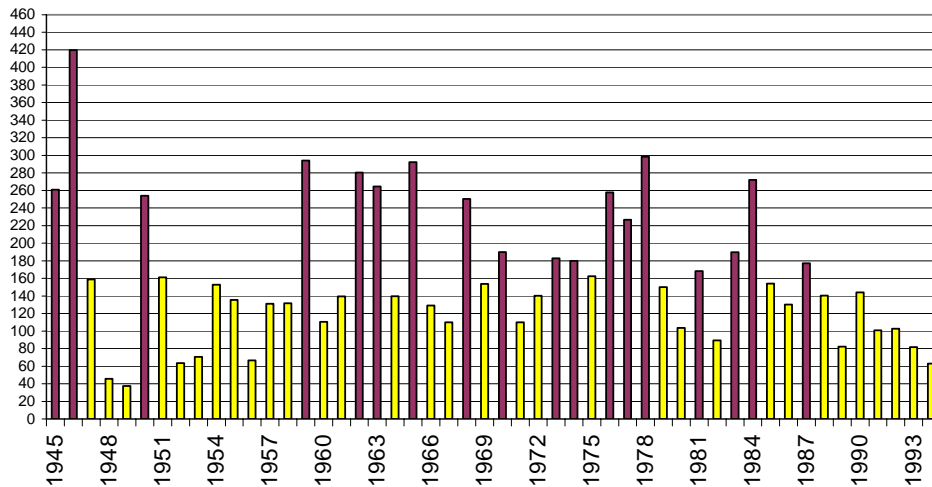
- Some impacts:
 - Water supply restrictions (up to 30%) in cities as Granada, Jaen, Sevilla, Málaga, Toledo.
 - Irrigation restrictions in Guadalquivir and Guadiana.
 - Measures were implemented in 1992-93 as:
 - New groundwater abstractions (i.e. Granada changes from 100% surface water to 100% groundwater supply).
 - Use of non conventional resources: Re-use (Benidorm), Desalination plants (Murcia), Shipment Transport (Cadiz)
 - 1990-95 Drought was identified too late

Introduction

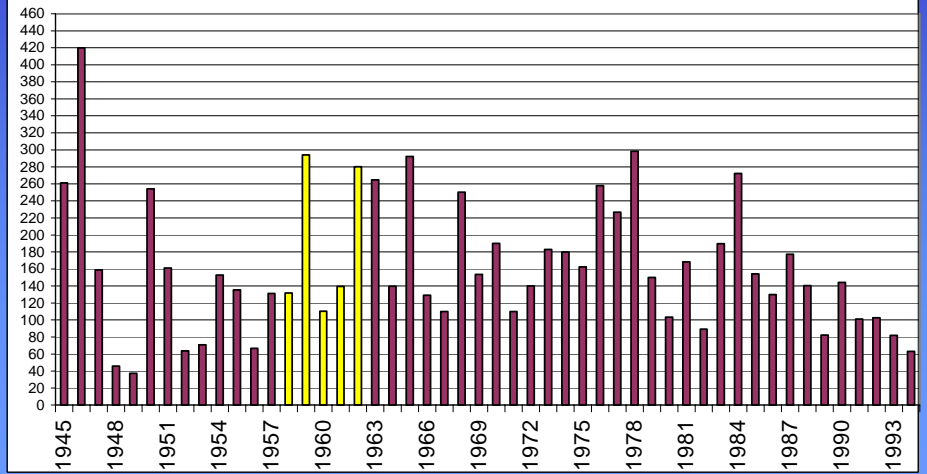
- Lack of a drought definition generally accepted has consequences that go beyond the academic interests:
 - Emergency measures in Spain
 - Derogations in Water Framework Directive (Art.4.6) *“Temporary deterioration in the status of water shall not be in breach of the requirements of this Directive if is the result of circumstances of natural cause...in particular prolonged droughts.”*

Droughts Identification (*a posteriori*)

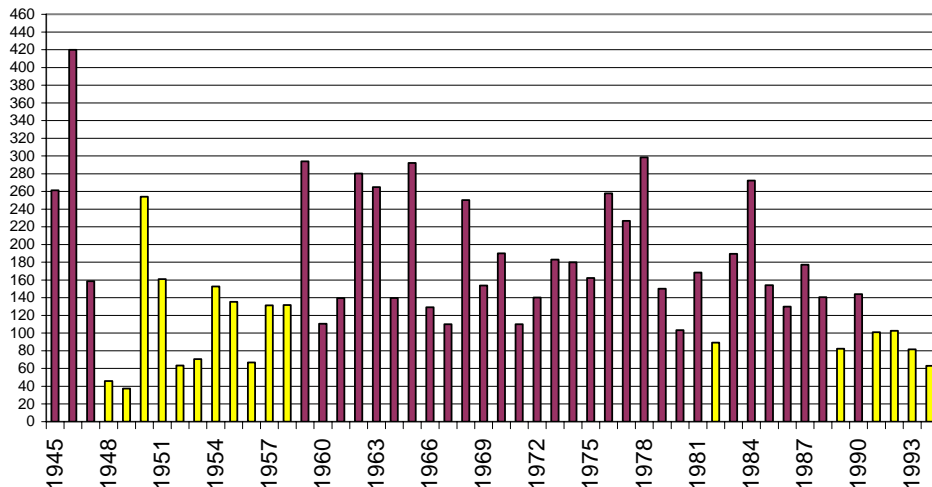
APORTACIONES ANUALES (hm³)
Criterio valor umbral. Años de sequía en amarillo



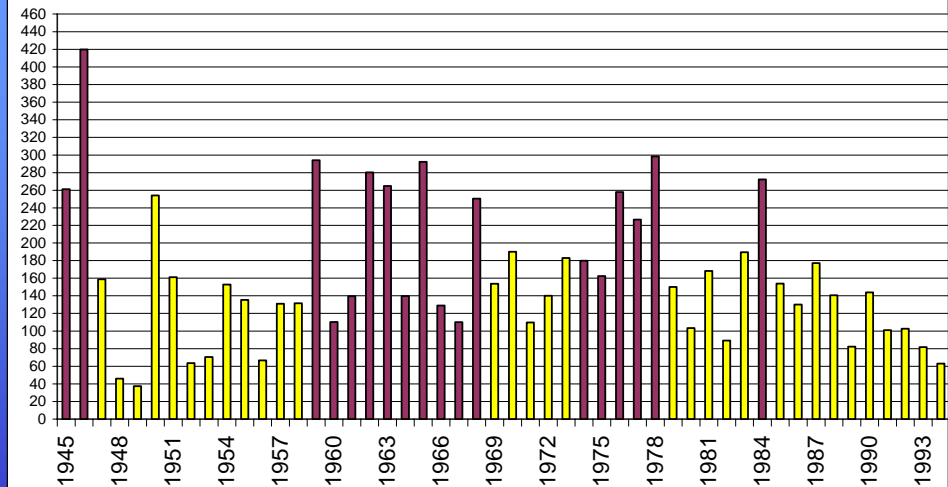
APORTACIONES ANUALES (hm³)
Criterio valor acumulado. Años de sequía en amarillo



APORTACIONES ANUALES (hm³)
Criterio compuesto. Años de sequía en amarillo



APORTACIONES ANUALES (hm³)
Medias móviles de orden 3. Años de sequía en amarillo

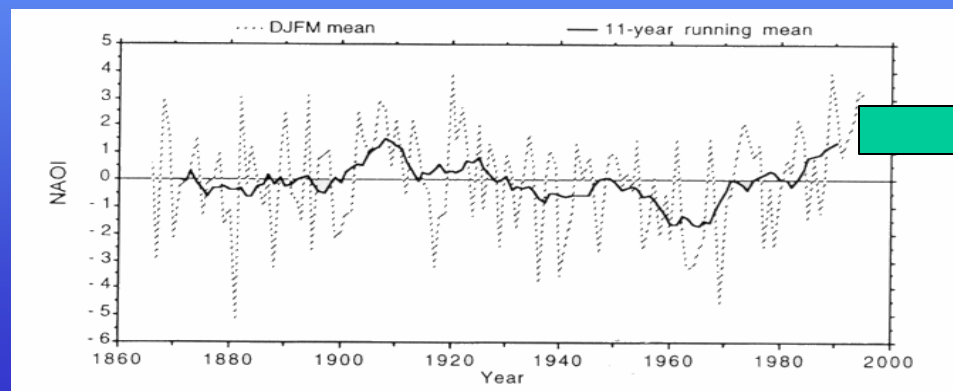
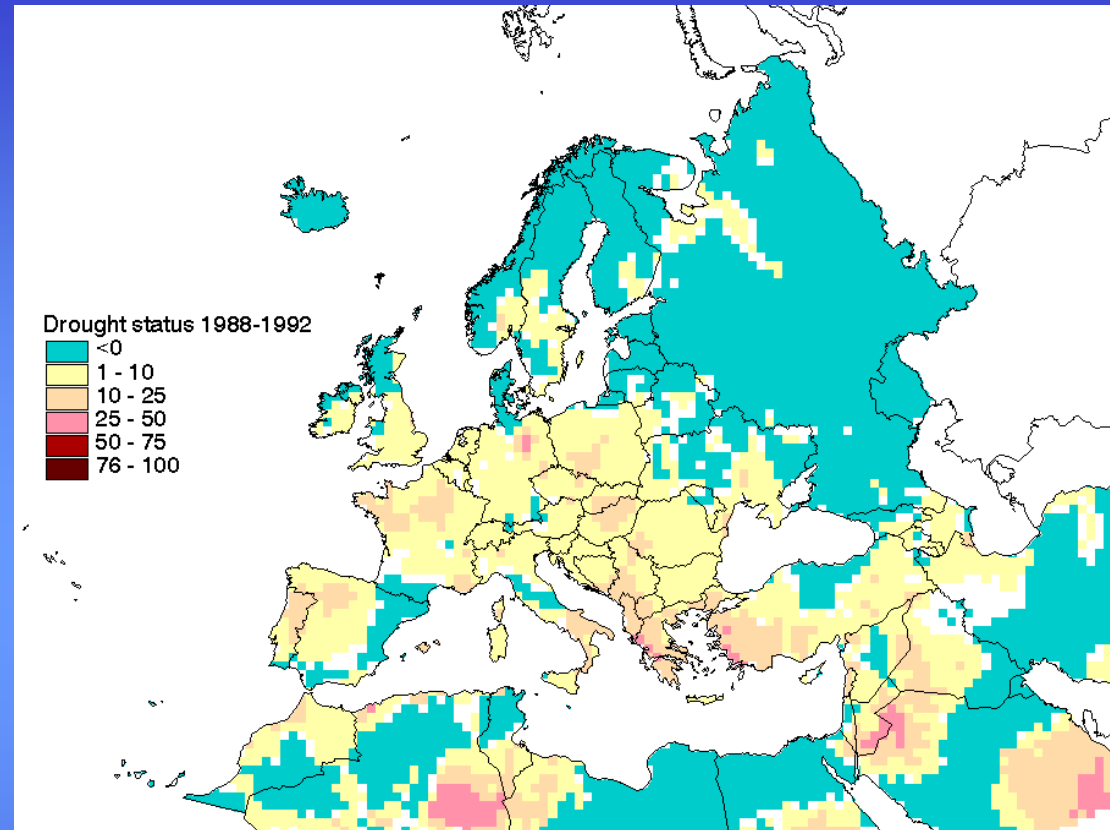


Early identification

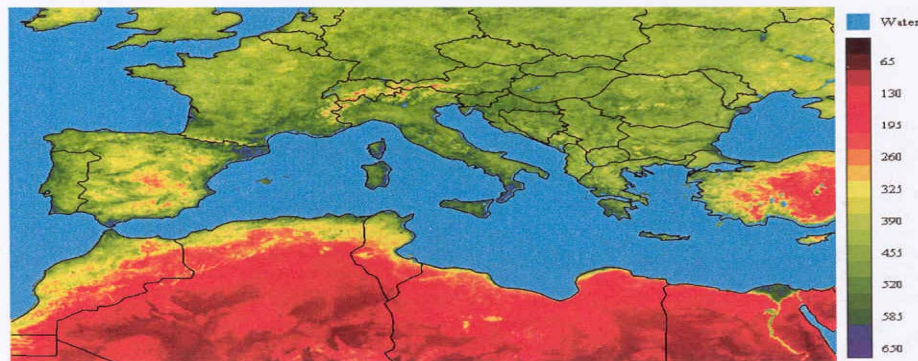
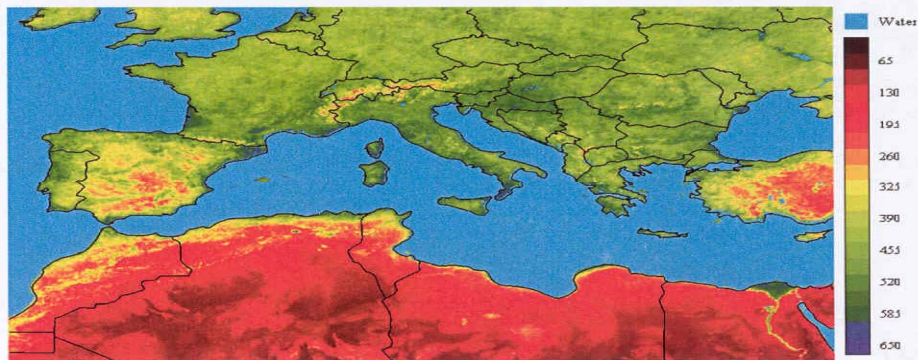
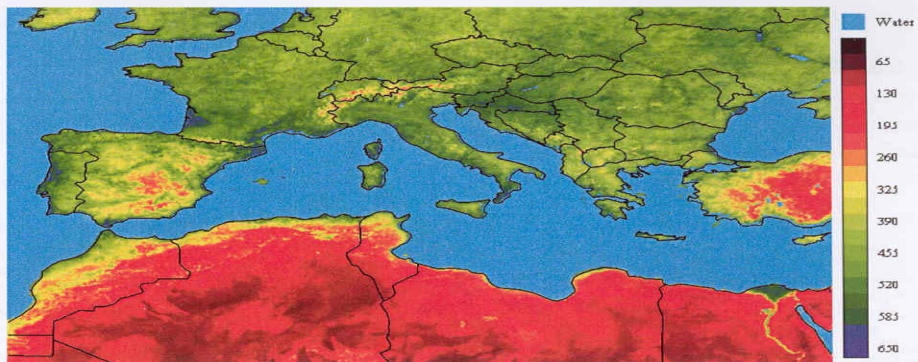
- NAO Index
- Remote sensing
- Simple indicators

NAO Index

NAO Positive:
Cold and dry
winters in
Mediterranean
countries



Remote Sensing



Actual evapotranspiration (mm)

Source: EWBMS, 2001

Hydrological years:

1993/1994 (top)

1994/1995 (middle)

1995/1996 (bottom)

Remote Sensing (Crops identification)

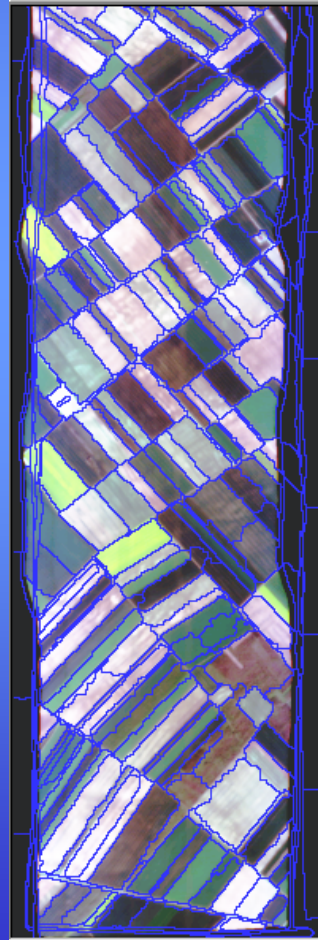
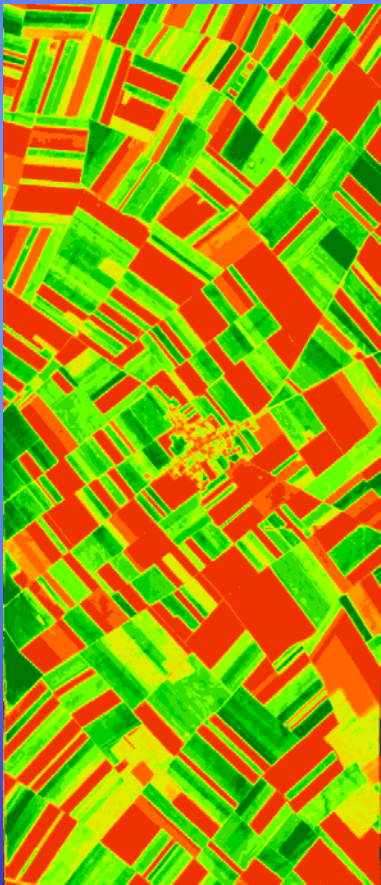
Optical
spectral

Biophysical
Information

Segmentation

Classification

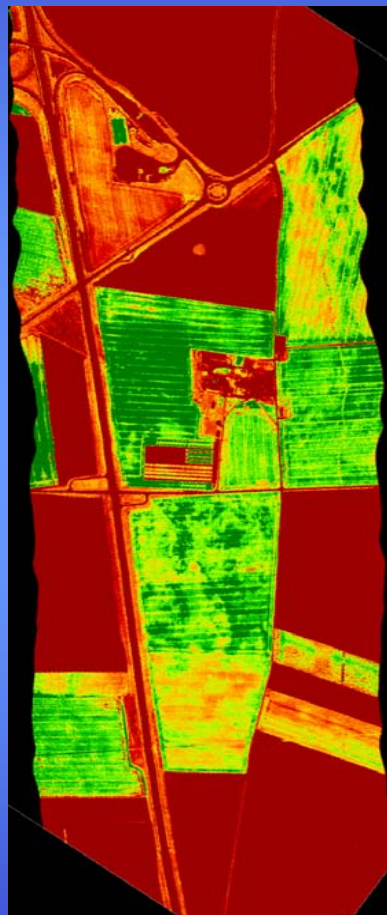
Fuzzy logic Rules
based on
Leaf Area index,
Leaf angle,
Flower indice...



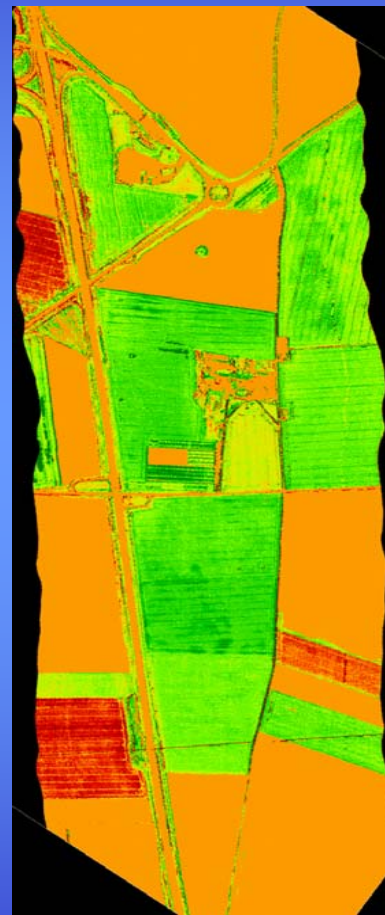
Remote Sensing (Leaf inclination)



True color view



LAI



Leaf Inclination (°)



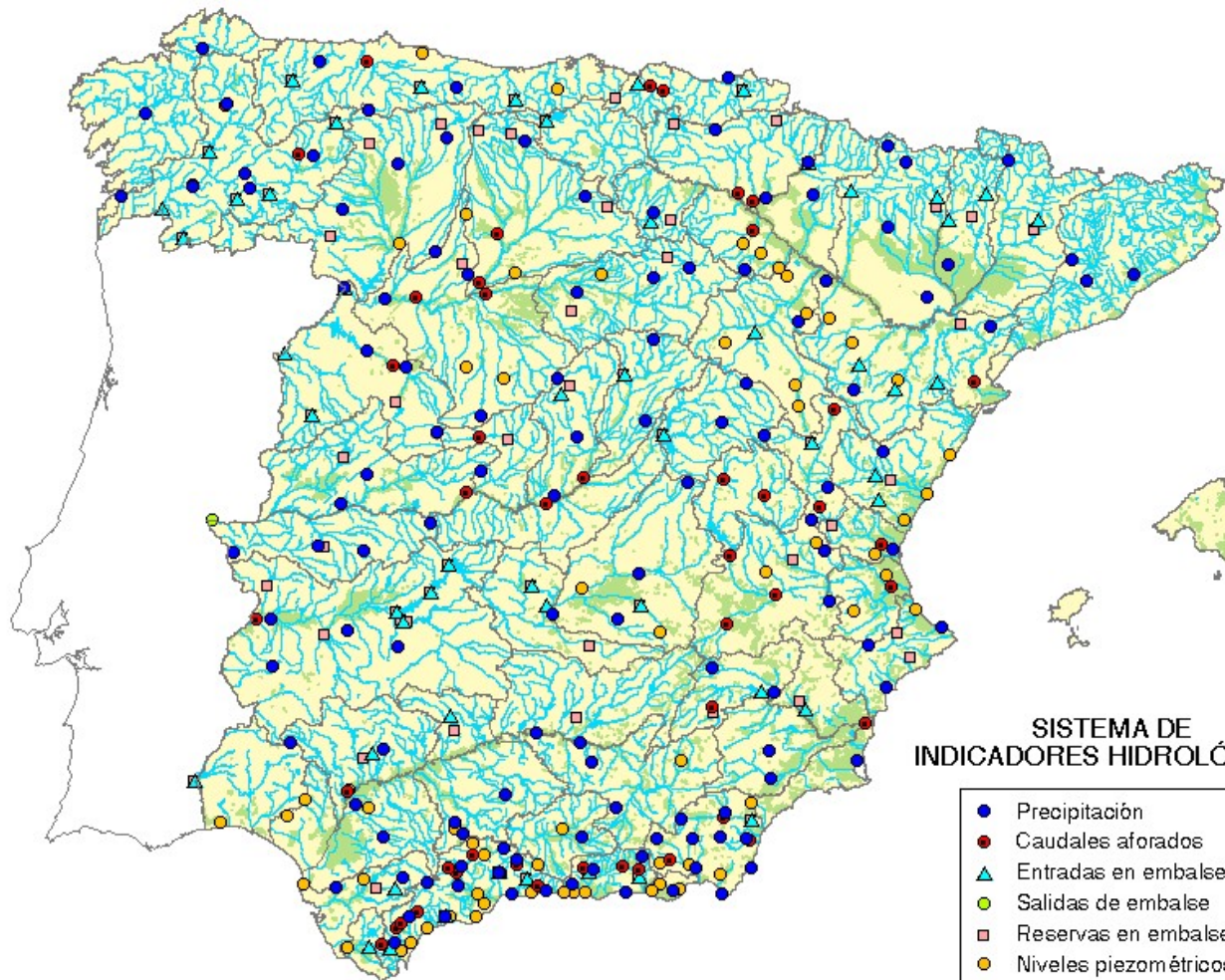
Simple indicators

Use of Hydrological indicators at national scale

- Definition of key areas (units) in the catchment for the generation of water resources.
- Selection of one indicator (or group) to describe the water resources evolution in the unit
- Indicator data collection
- Development of maps for drought identification at different time scales
- Maps to be available in Internet



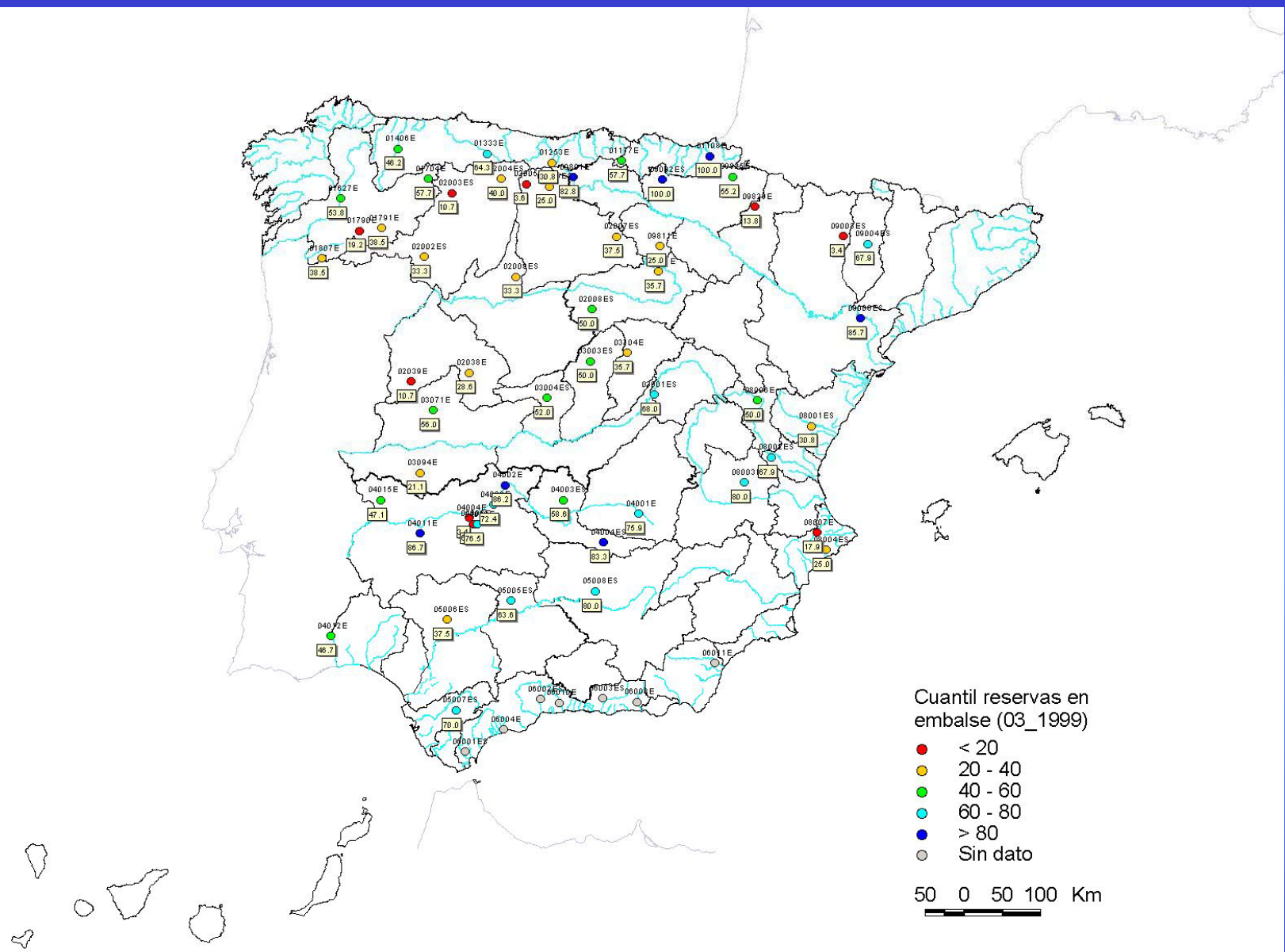
Areas for drought identification

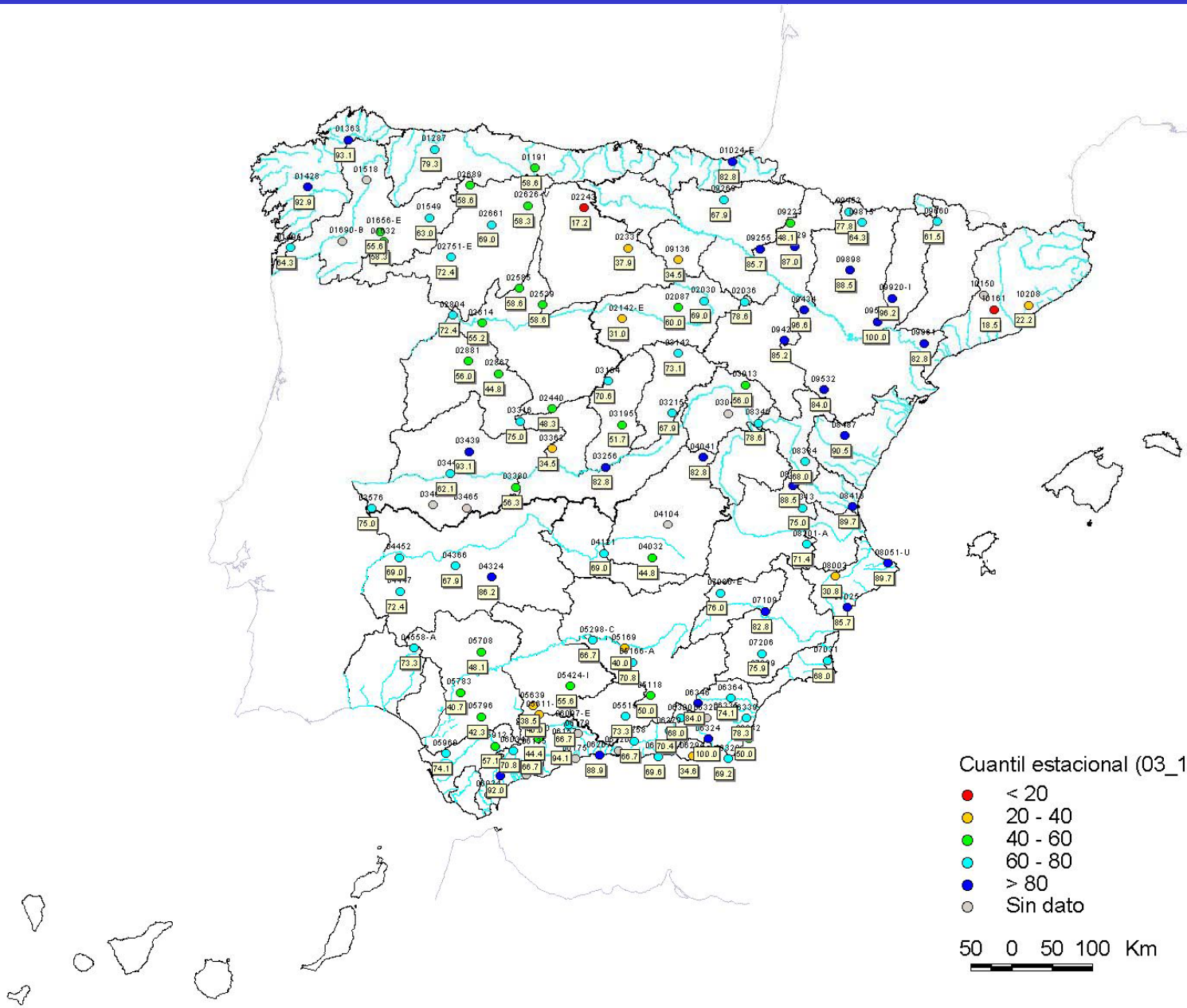


**SISTEMA DE
INDICADORES HIDROLÓGICOS**

- Precipitación
- Caudales aforados
- ▲ Entradas en embalse
- Salidas de embalse
- Reservas en embalse
- Niveles piezométricos

100 0 100 km

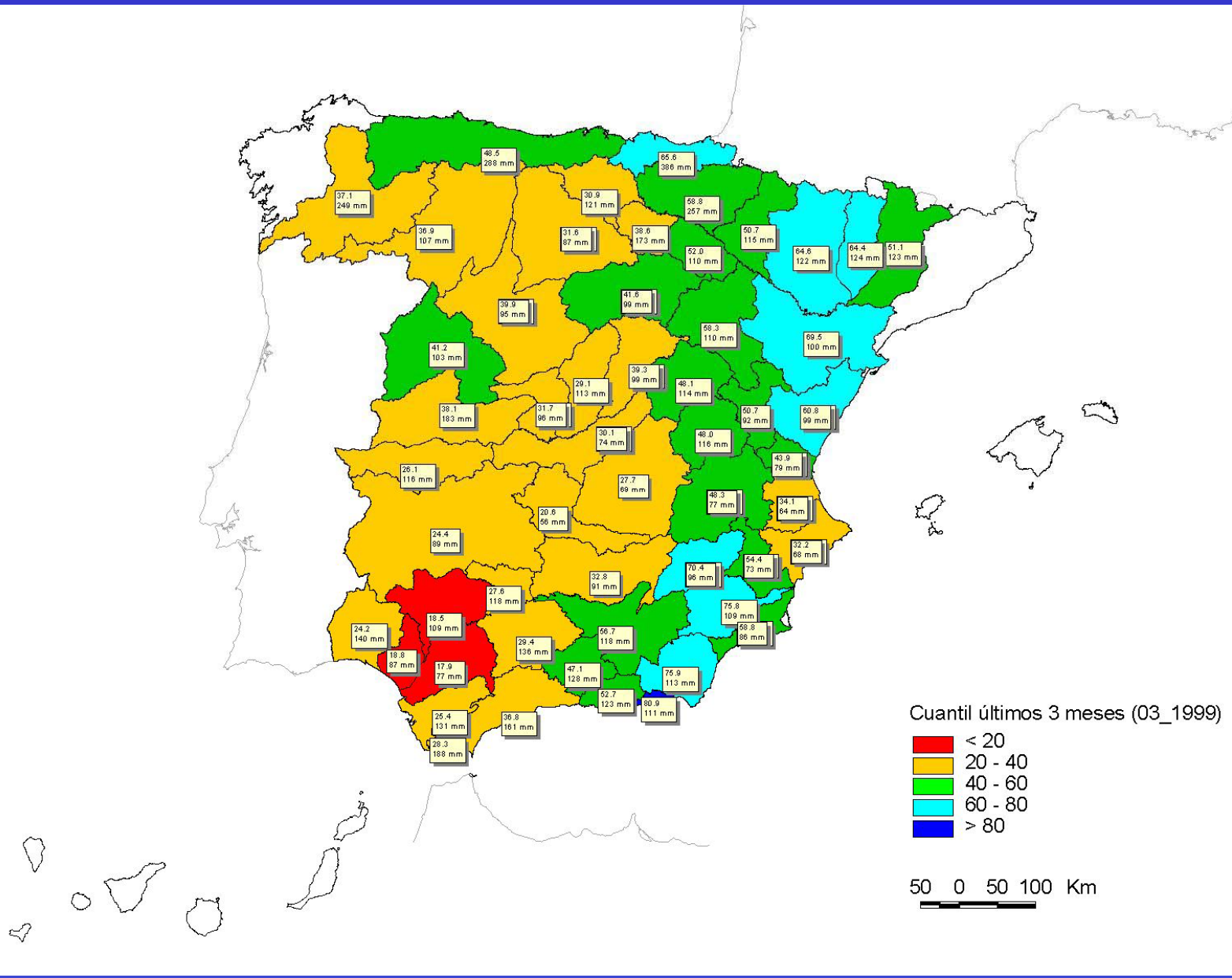


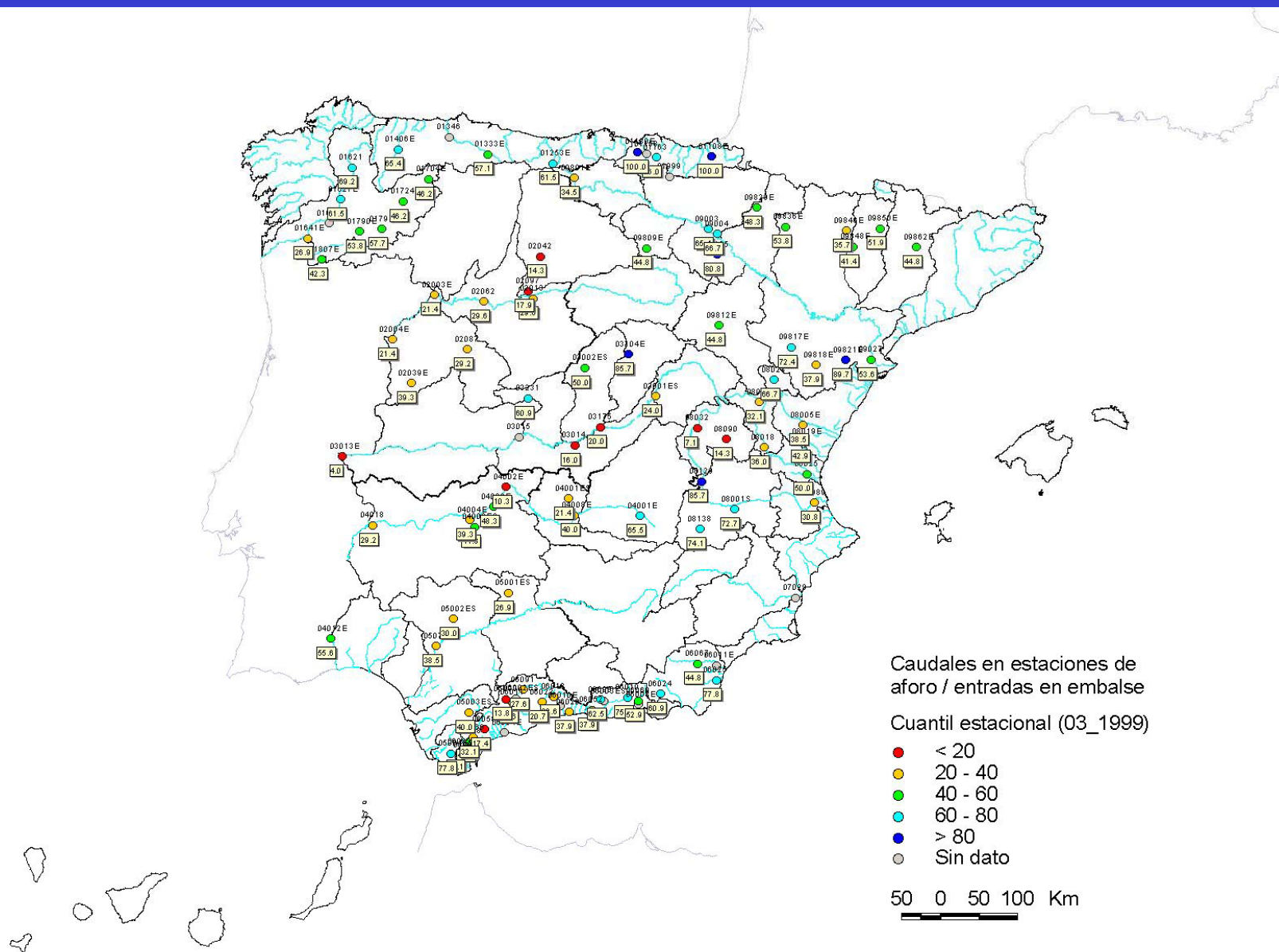


Cuantil estacional (03_1999)

- < 20
- 20 - 40
- 40 - 60
- 60 - 80
- > 80
- Sin dato

50 0 50 100 Km



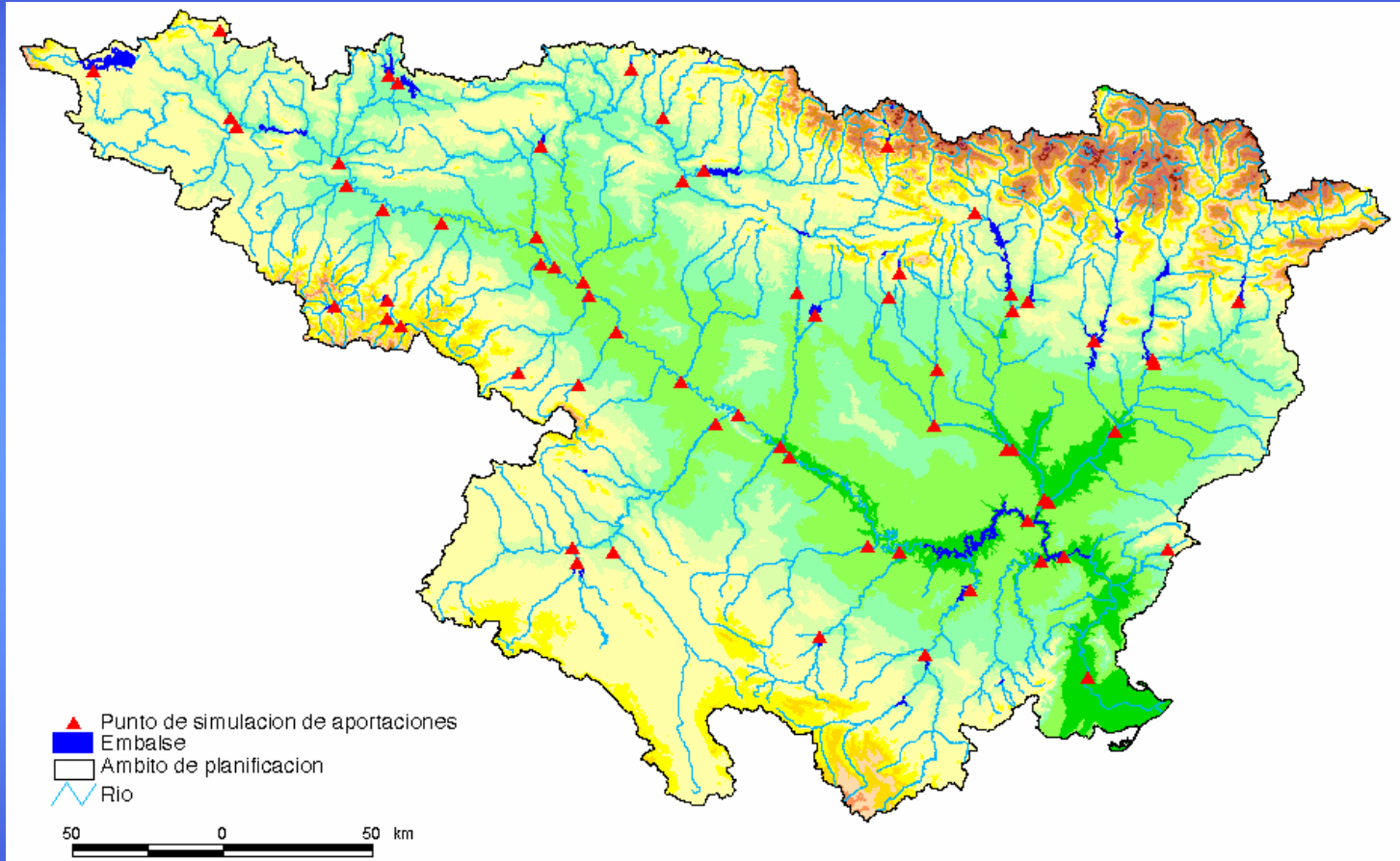


Decision Support Systems

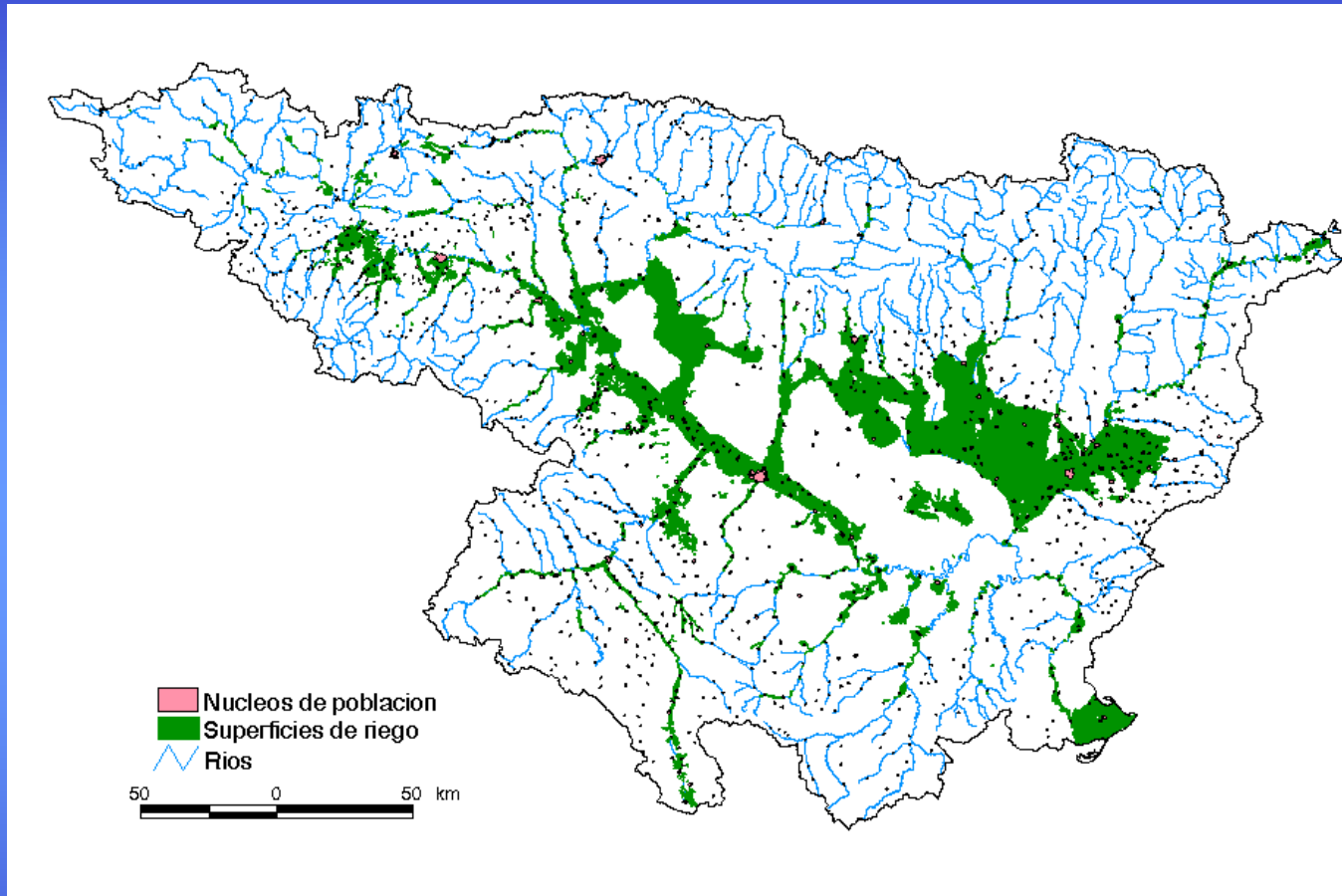
- Early identification is not enough.
- Decision Support Systems for:
 - Droughts characterisation for design
 - Water systems operation under risk

Decision Support Systems

- Operation of Water Systems under risk is a key element
- Research from the Polytechnic University of Valencia (Sánchez Quispe, Andreu, Solera).
- Development of models that can make a risk assessment in different water resources and demands scenarios.

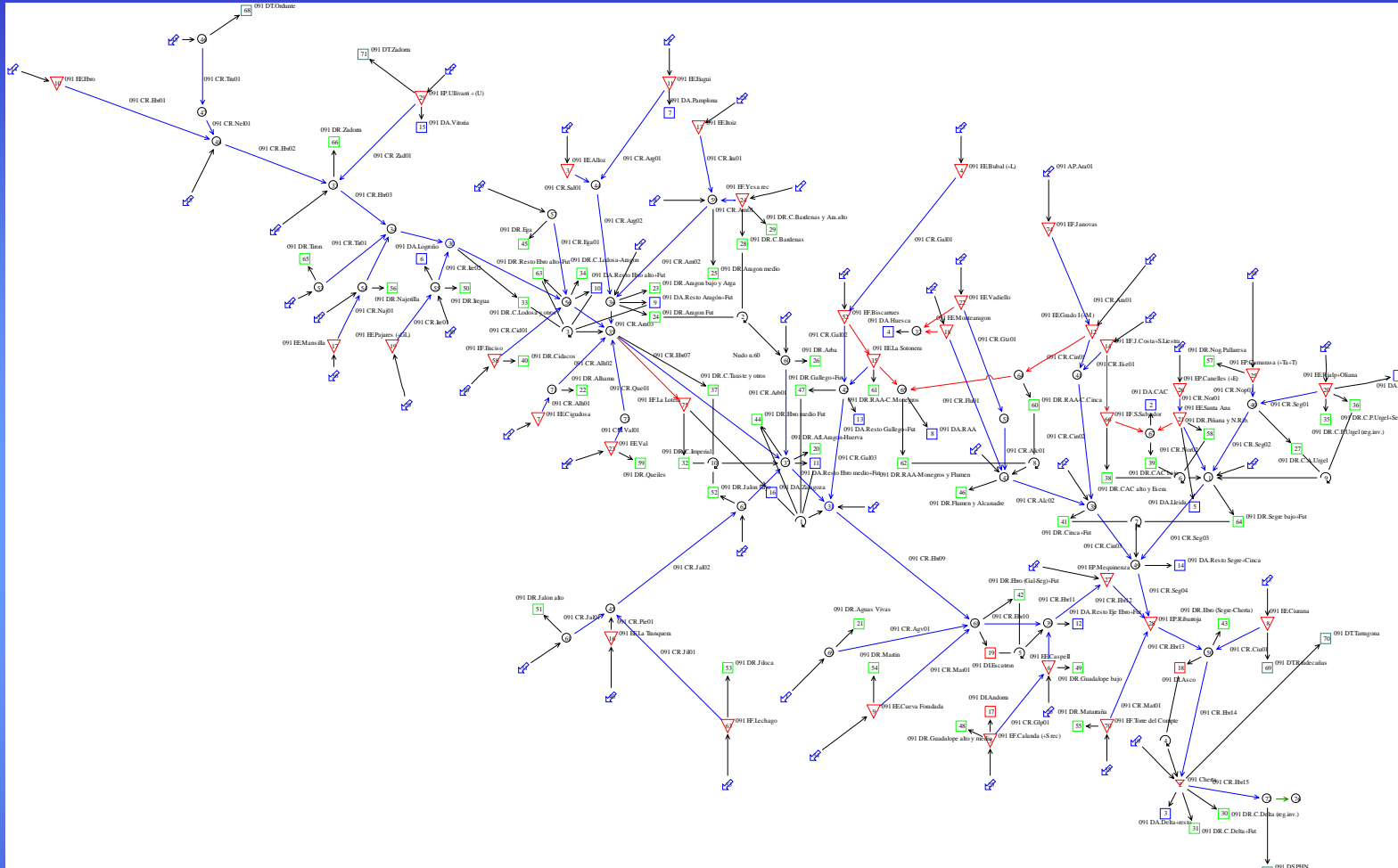


Water resources



Water demands distribution

Network : Infrastructures, abstraction points, etc



Main Input: Water stocks in aquifers and reservoirs, flows in rivers , abstractions .

Main Output: System fail probability

Prevention

- Operational management of droughts in water stress prone areas has to be developed under the general measures of water resources management
- Water planning is the key process
 - Prevention
 - Crisis management