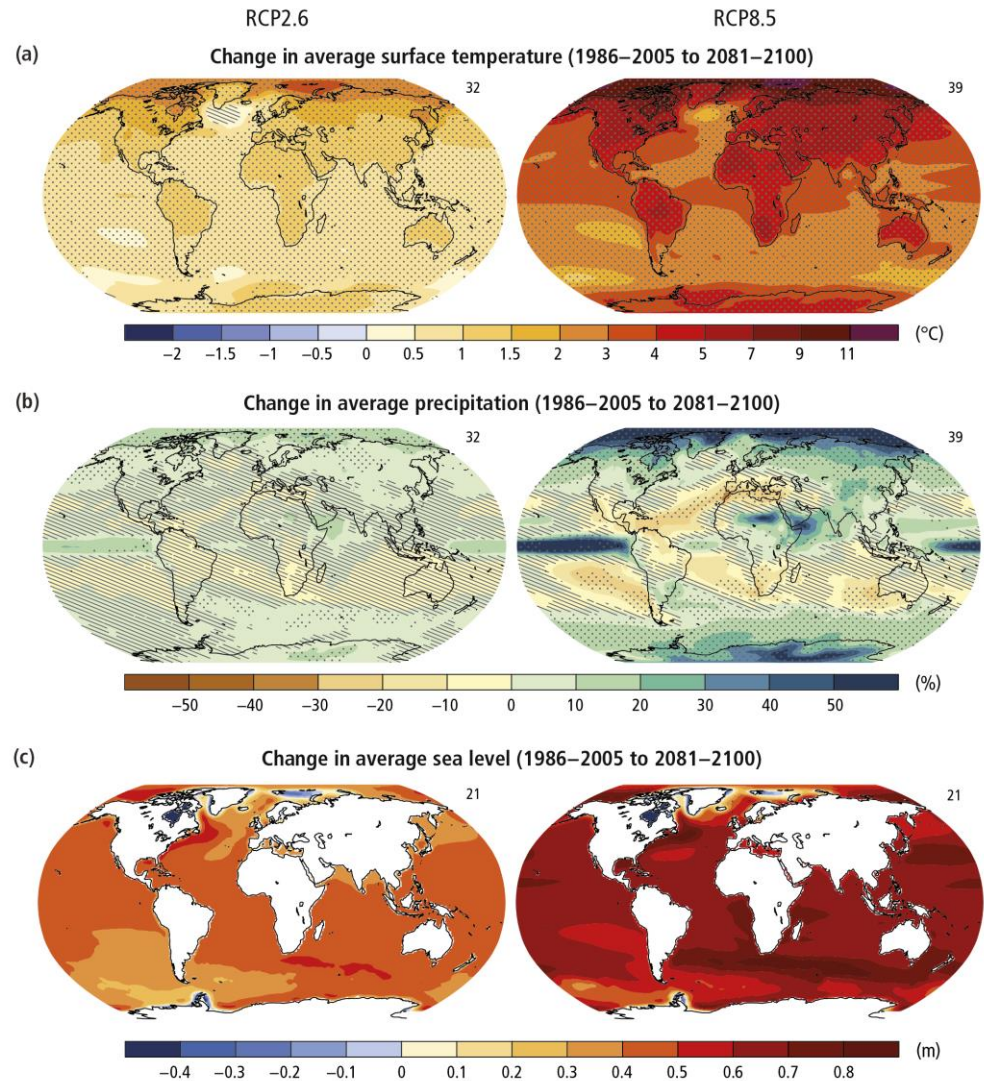

Water resources, scarcity and climate change. The case of Spain

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Introduction

Evidence and climatic projections suggest that water resources will be seriously affected by climate change in EU areas prone to water scarcity and droughts.



Source: 5th Evaluation Report (AR5) (IPCC, 2014)

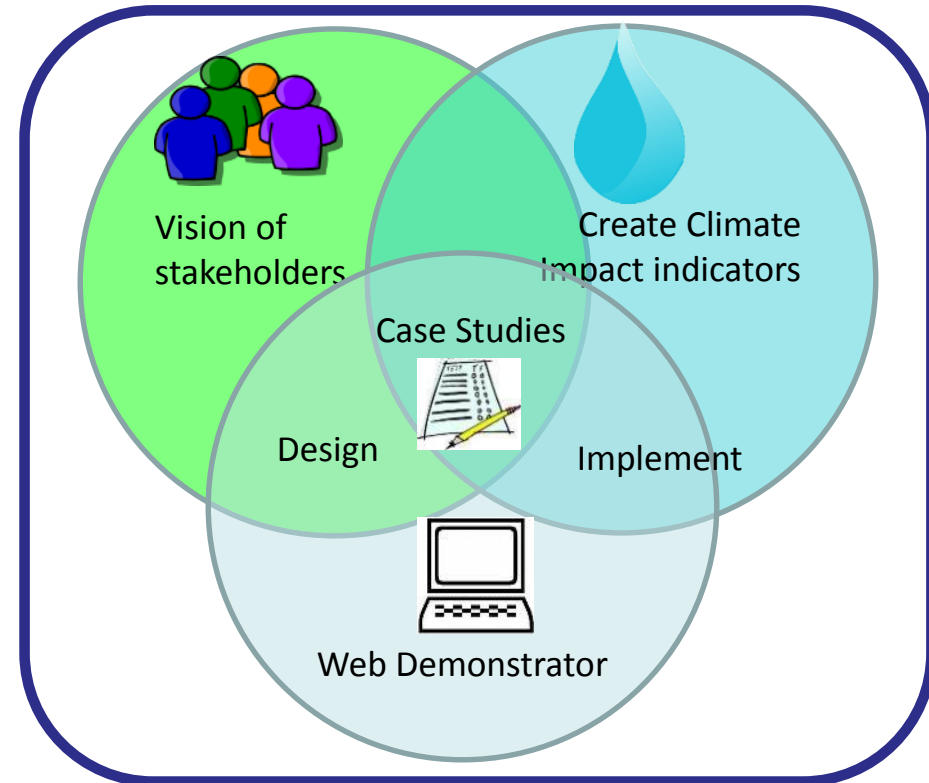
EU projects in water COPERNICUS Programme

EDGE project

Object: A pan-European hydro-climate impact indicators to users of the water sector to help them improve decision making as regards mitigation and adaptation strategies facing climate change.

EDgE will provide CC predictions and seasonal forecast for Europe

MENBO is a partner of the project



Climate scenarios of the Spanish Meteorological Service

The screenshot shows the AEMET website interface for climate scenarios. At the top, there are navigation links: "El tiempo", "Servicios climáticos", "Conócenos", "I+D+i", "Conocer más", "Empleo público y becas", "Datos abiertos", and "Sede electrónica". A search bar contains "Introduzca texto". Below the navigation is a header with the date "vie 11", "sáb 12", and "dom 13", and social media icons for mobile, home, menu, Facebook, Twitter, LinkedIn, YouTube, and RSS.

The main content area is titled "Datos diarios" and includes an information icon. Below the title is a paragraph: "Las proyecciones regionalizadas de cambio climático (también llamados escenarios) proporcionan información detallada sobre las mejores estimaciones del clima futuro de nuestro país, que constituyen un elemento imprescindible para llevar a cabo las evaluaciones de impactos y vulnerabilidad en los distintos sectores sensibles a las condiciones climáticas, y por tanto para diseñar políticas adecuadas de adaptación a sus efectos."

Below the paragraph are three tabs: "Proyección regionalización estadística", "Proyección regionalización dinámica", and "Datos observacionales". Underneath are four sub-tabs: "AR5-IPCC", "AR4-IPCC", "ENSEMBLES STREAM1", and "ENSEMBLES STREAM2".

The main selection area consists of five dropdown menus:

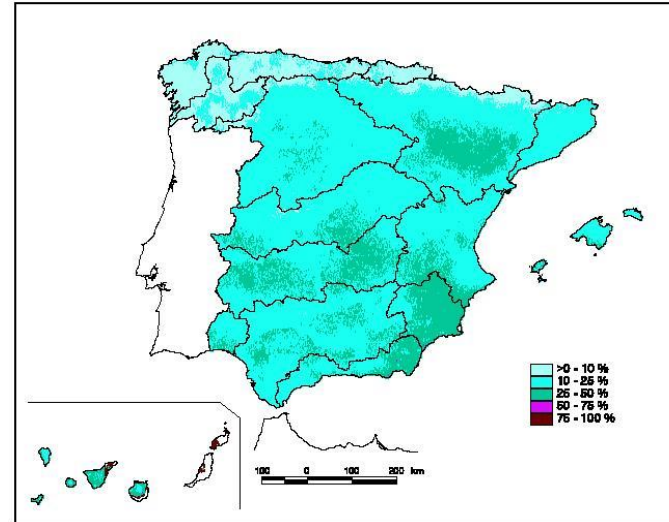
Metodo	Modelo	Escenarios	Variable	Periodo
Todos Análogos SDSM	Todos ACCESS1-0 ACCESS1-3 bcc-csm1-1 BNU-ESM CMCC-CESM CMCC-CM CMCC-CMS CNRM-CM5 CanESM2 CSIRO-Mk3.6.0	Todos HISTORICAL RCP4.5 RCP8.5 RCP6.0	Todos Precipitación Tmax Tmin	Todos 1961-2000 2006-2100

Below the dropdowns are two buttons: "BUSCAR" and "LIMPIAR".

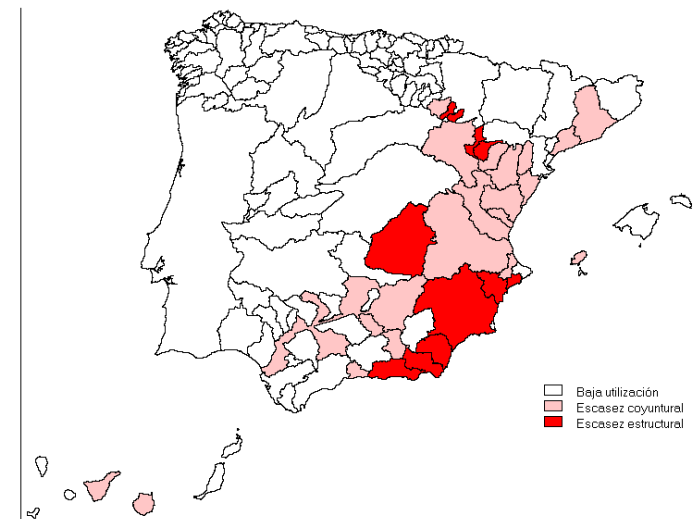
At the bottom of the content area is a disclaimer: "Las proyecciones climáticas se basan en resultados de modelos informáticos que implican simplificaciones de procesos físicos reales que actualmente no se comprenden totalmente. En consecuencia, la AEMET no asume responsabilidad por la precisión de las proyecciones climáticas aquí disponibles, ni por las interpretaciones, deducciones, conclusiones o acciones realizadas por cualquier persona en relación con esta información."

Droughts, scarcity and climate change

In Spain, the CC impacts will be aggravated in regions affected by frequent droughts and water scarcity and thus it will cause imbalances between water demand and resources.



Map of reduction of runoff with a decrease of 5% in the mean annual precipitation and increase of 1°C in the temperature (MMA, 2000)

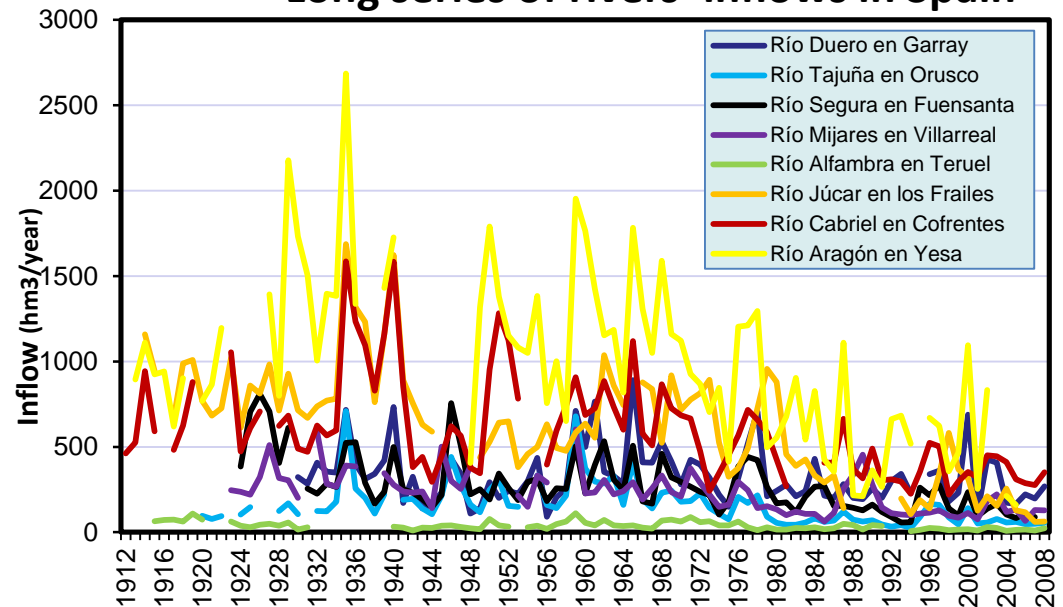


Map of Water Exploitation Index in Spanish water resource systems (MMA, 2000)

Detecting effects of climate change

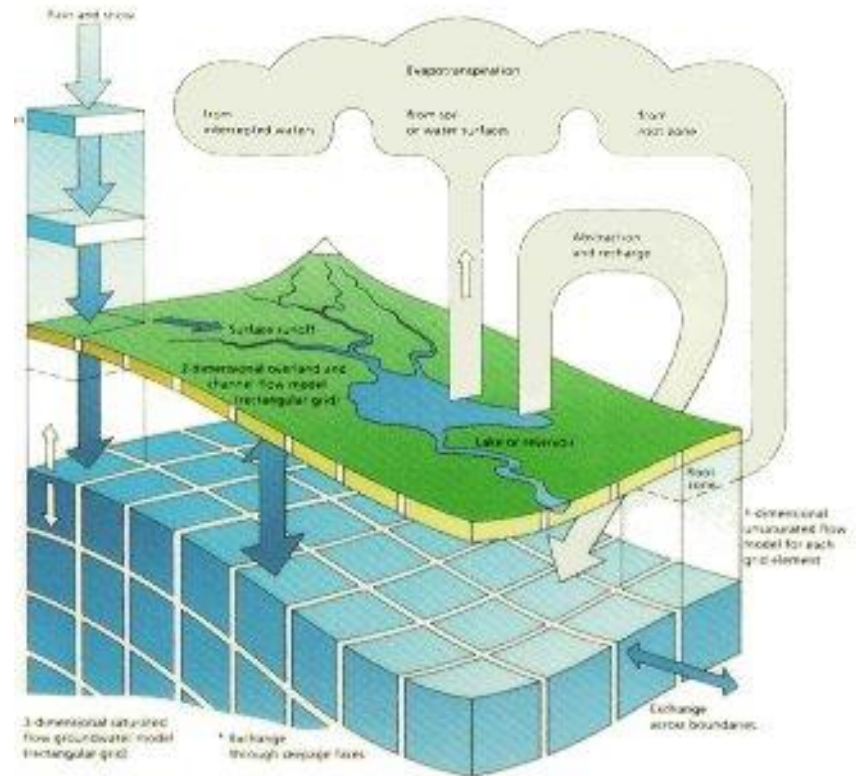
- Detecting CC effects on water resources is not an easy task.
- The natural variability of the hydrological regime and the abstractions for water uses makes it difficult to establish trends.

Long series of rivers' inflows in Spain

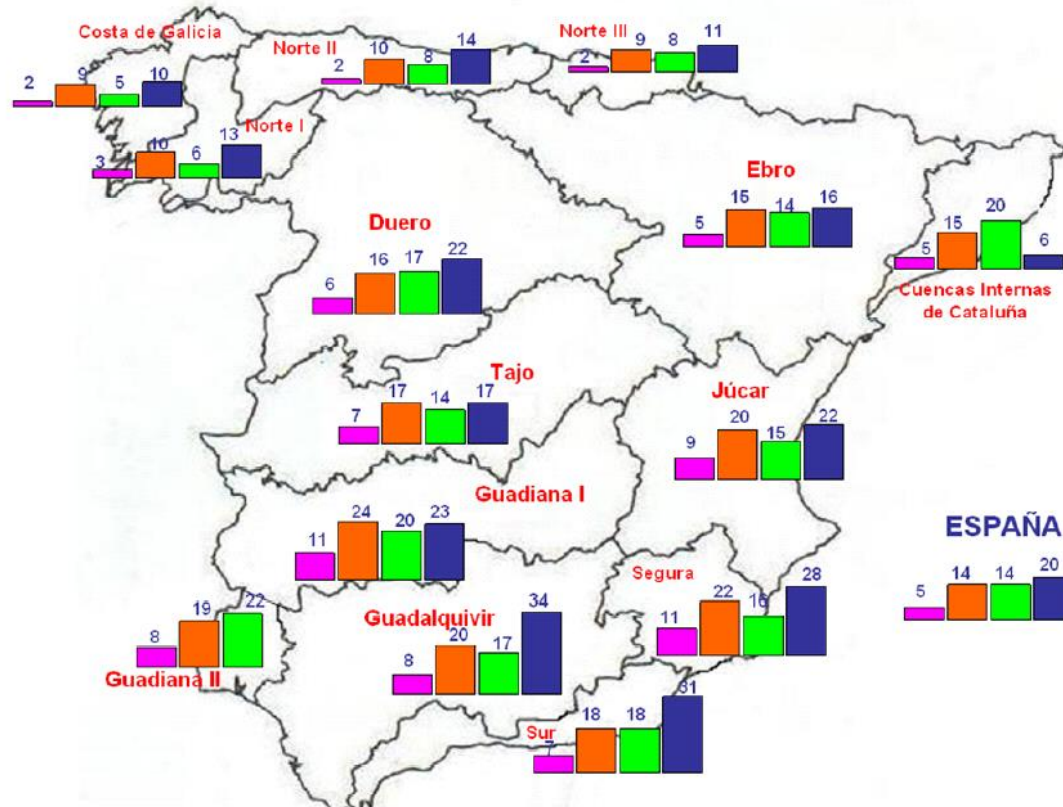


Hydrological modelling

- Need to evaluate the impact of climate change on water resources through hydrological modelling.
- Inputs: scenarios of climate change (P, T)
- Outputs: runoff, evapotranspiration, river inflows, aquifers recharge, soil moisture..



First studies about impact on water resources



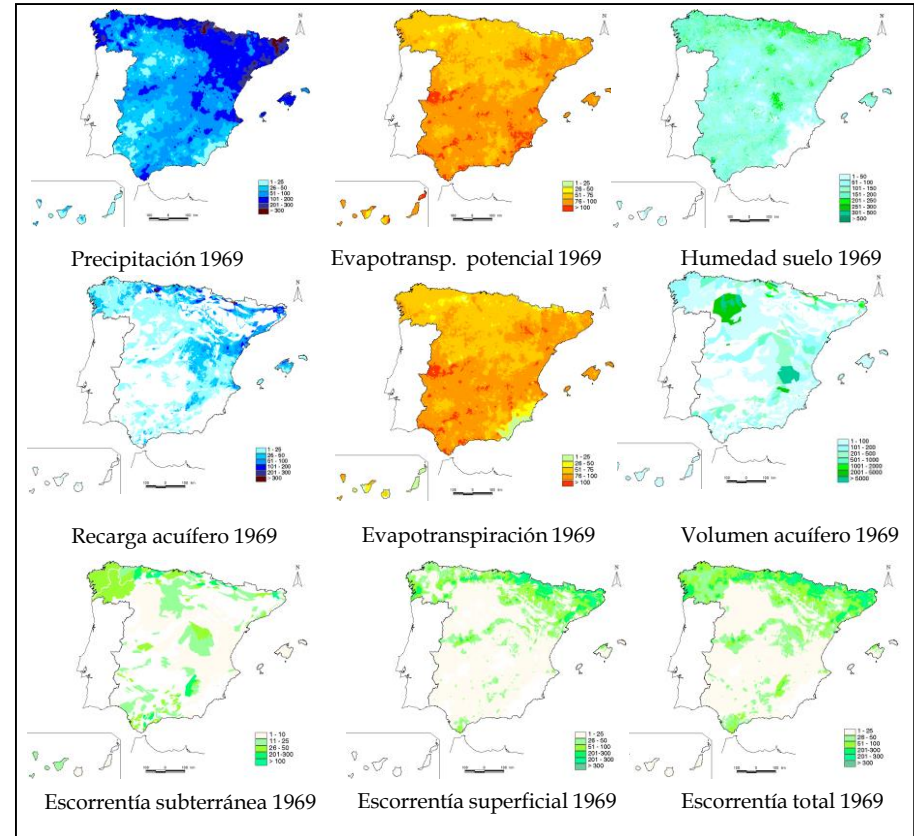
Estudio	Referencia	Escenario 1	Escenario 2	Escenario 3	Escenario 4
Año 2030					
CEDEX	CEDEX (1998)	T=(+1C)	T=(+1 C)	T=(Modelo Promes)	
Libro Blanco de España	MIMAM (2000)	P=(sin cambios)	P=(-5%)	P=(sin cambios)	
Fernández C.P.	Fernández (2002)				
Año 2060					
Ayala-Carcedo	Ayala et al (1996)				T=(+2,5 C) P=(-8%)

The Spanish Plan of Adaptation to CC

- Study of potential effects of climate change on:
 - The water resources in a natural regime
 - The water demands (irrigation, urban supply and industry)
 - The available water resources in the water resources systems.
 - The ecological status of water bodies.
- The Centre for Hydrographical Studies of CEDEX has carried out these studies for Directorate General for Water.

Impacts on water resources

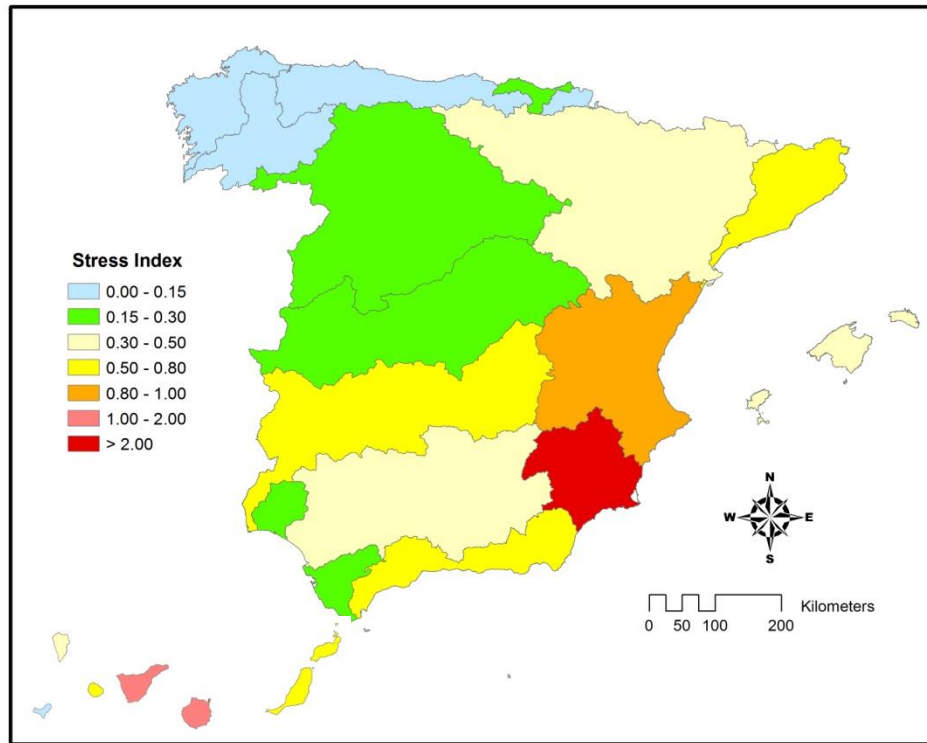
- Distributed hydrological model SIMPA (CEDEX, 1995)
- Inputs to the model:
Regionalised climate scenarios provided by the Spanish Meteorological Agency, AEMET
- Outputs from the model:
monthly maps of river inflows, aquifers recharge, actual evapotranspiration, soil moisture... with a resolution of 1 km x 1km



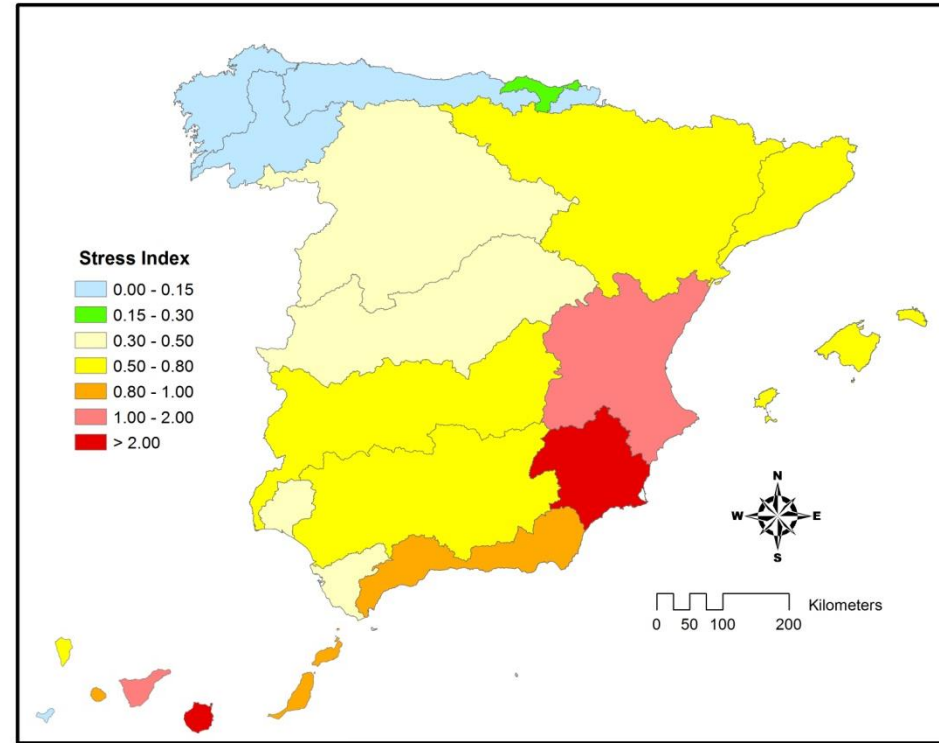
Impacts on water resources

- Scenario A2: reduction of runoff of 8% over the period 2011-2040, 16% between 2041-2070 and of 28% for the period 2071-2100.
- Scenario B2: reduction of runoff of 8% over the period 2011-2040, 11% during 2041-2070 and of 14% between 2071-2100.

Impacts on water resources



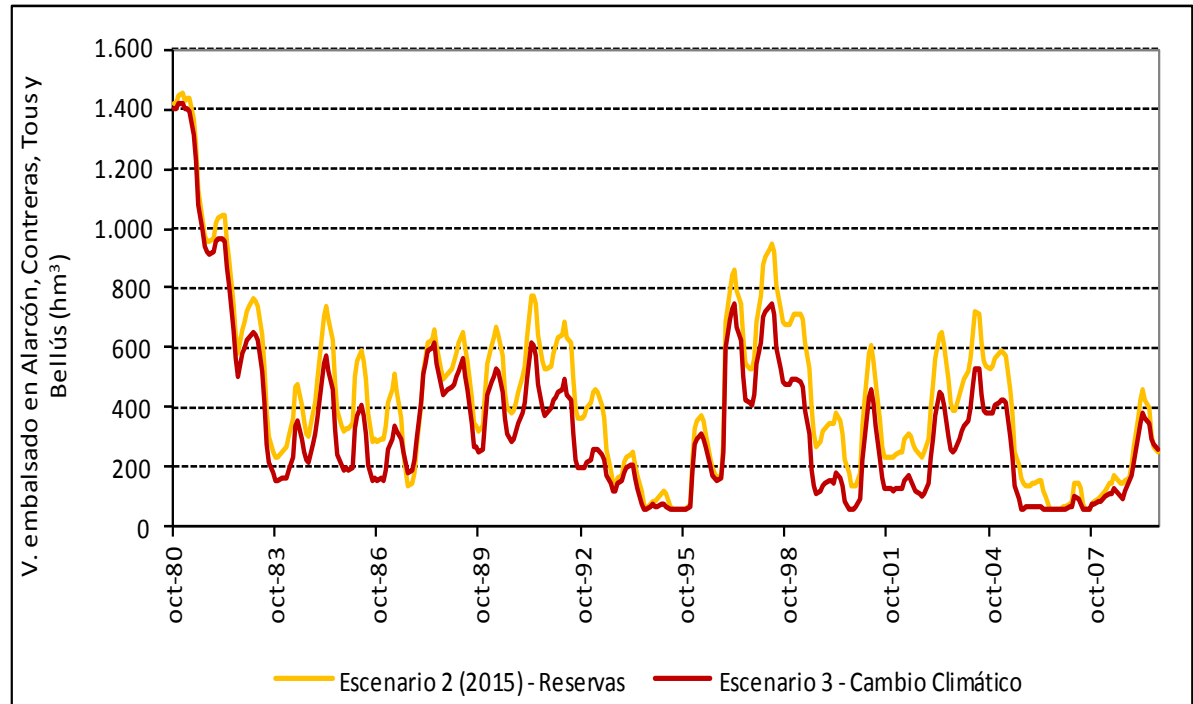
Current Water Exploitation Index (WEI)



Water Exploitation Index (WEI) 2041-2070
Scenario A2

The climate change in the water planning

In Spain, the RBMPs have considered the effects of climate change on natural water resources, as it is required in the Regulation of Hydrological Planning.



Scenario 3 includes, with respect to scenario 2, the effect of the reduction of inflows due to climate change and water reuse and modernisation of irrigation measures.

The way forward

- To make studies and information about climate change and effects available and accessible to all stake-holders.
- To incorporate the studies on the effects of the water demands and on the ecological status of water bodies in the river basin management plans.
- Develop studies in order to link the programme of measures of the plans to the impacts of Climate Change.