





## Working Group on Climate Change (WG1)

# Climate change impact on water resources and adaptation in Spain

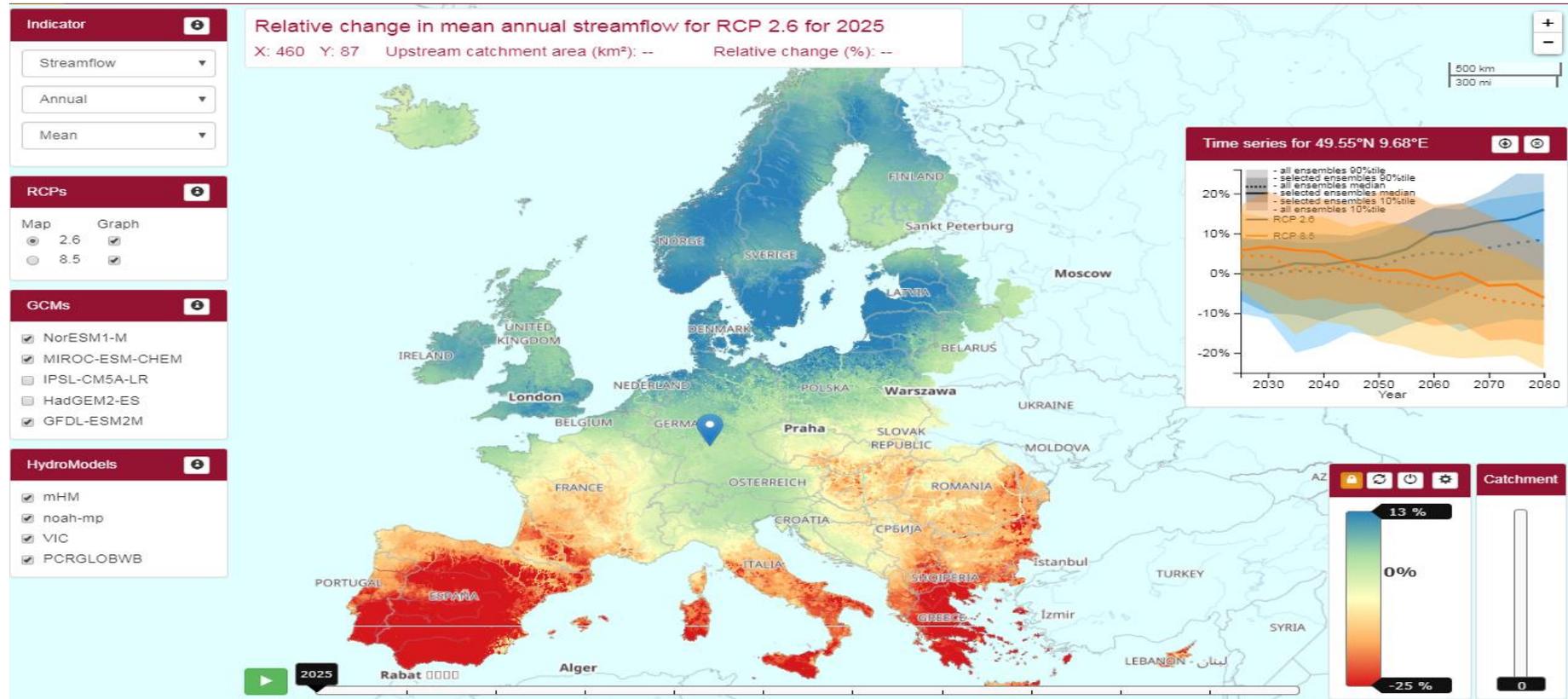
Teodoro Estrela

Mediterranean Network of Basin Organisations (MENBO)

# Water in the Mediterranean region

- The consequences of water scarcity in the Mediterranean region can be aggravated by climate change in the future.
- Evidence and climatic projections suggest that water resources will be seriously affected by climate change in the Mediterranean region.
  - Changes in temperature and precipitation impact on water resources.
  - In Spain the climatic projections and hydrological simulations show a significant decrease on water resources and a greater frequency of droughts.

# EDGE project of COPERNICUS Climate Programme of UE



<http://edge.climate.copernicus.eu/>

**NorESM1-M:** The Norwegian Earth System Model,

**MIROC-ESM-CHEM:** Japan

**IPSL-CM5A-LR:** IPSL Earth System Model: France

**HadGEM2-ES:** UK Hadley Center

**GFDL-ESM2M:** USA NOAA, Geophysical Fluid Dynamics Laboratory, Princeton University

**mHM:** Germany

**noah-mp:** USA, NASA-NOAA (TOPMODEL)

**VIC :** USA University of Washington

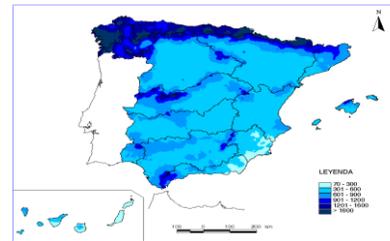
**PCRGLOBWB:** Utrecht University (Netherlands)

# The Spanish Plan of Adaptation to CC

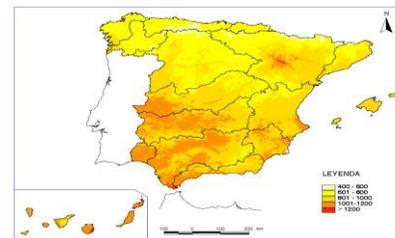
- Study of potential effects of climate change on:
  - The water resources in a natural regime
  - The water demands (irrigation, urban supply and industry)
  - The available water resources in the water resources systems.
  - The ecological status of water bodies.
- The Centre for Hydrographical Studies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

Hydrological SIMPA model has been used to assess the impact on water resources.

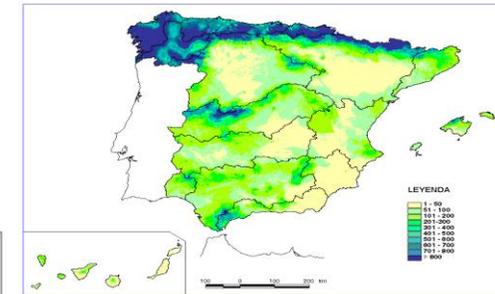
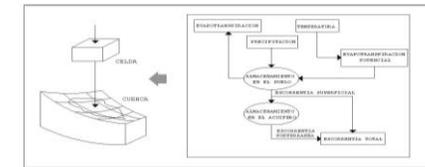
- Inputs: Climatic projections of Spanish Meteorological Agency.
- Outputs: hydro-meteorological maps on monthly scale (evapotranspiration, soil moisture, surface runoff, aquifer recharge,...) with a 1 km x 1 km resolution.



Precipitación media anual(mm/año)

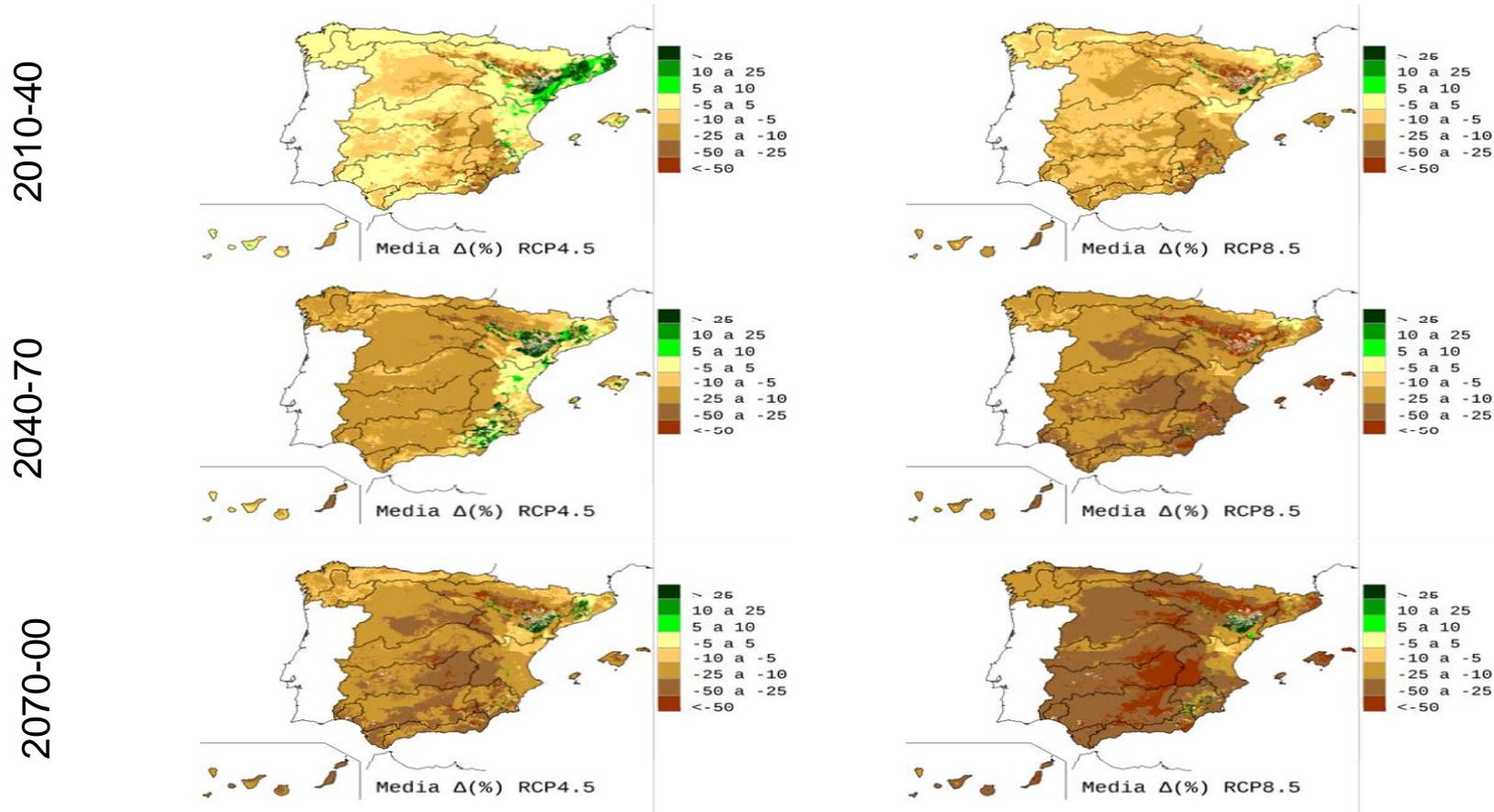


Evapotranspiración potencial media anual (mm/año)



Escorrentía media anual (mm/año)

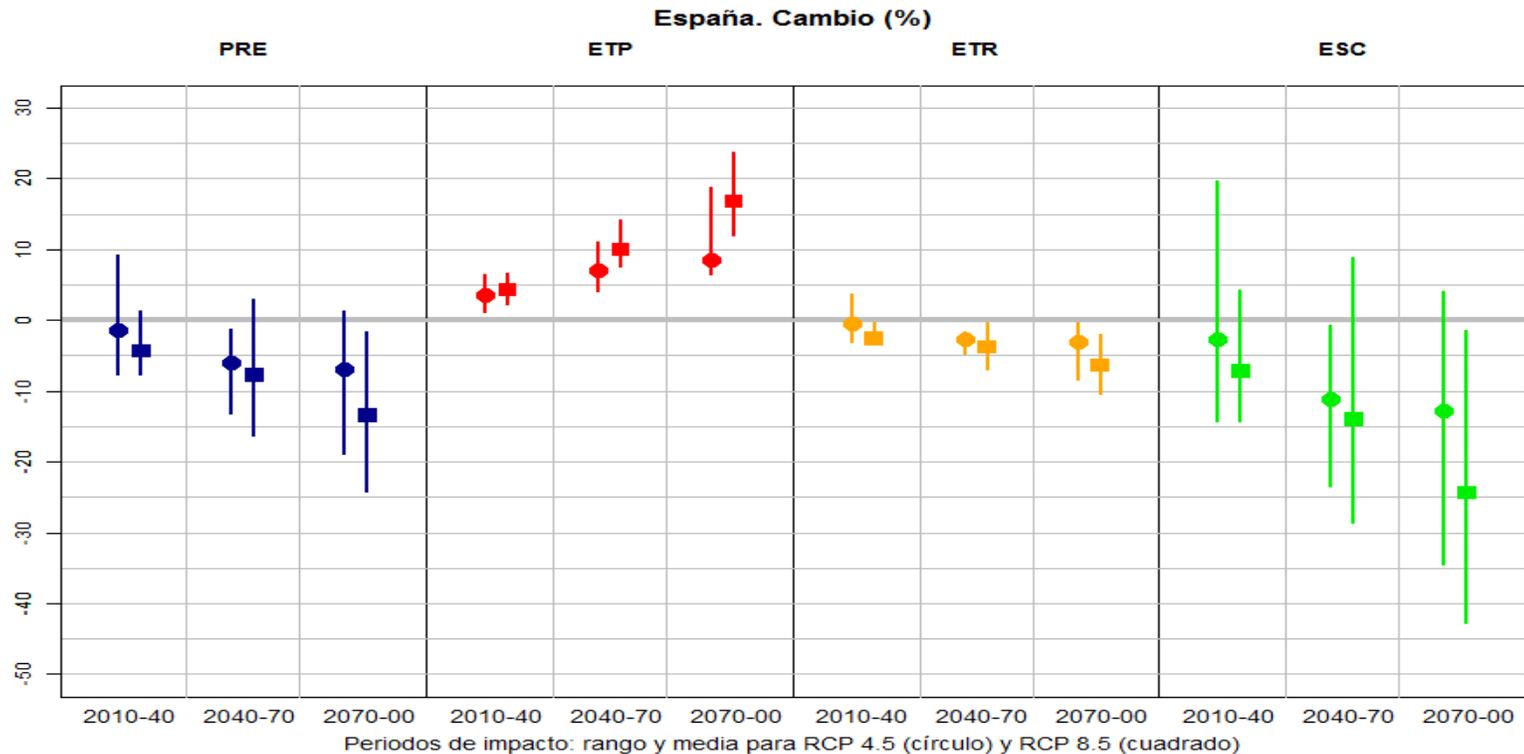
# Impacts of climate change on the hydrological cycle in Spain



Changes in runoff (mean values for several models)

Source: CEDEX(2017). Evaluación del Impacto del Cambio Climático en los Recursos Hídricos y Sequías en España

# Impacts of climate change on the hydrological cycle in Spain



## Main results:

- Reduction in rainfall.
- Increase in PET.
- Reductions in runoff.
- Increase the frequency of droughts.

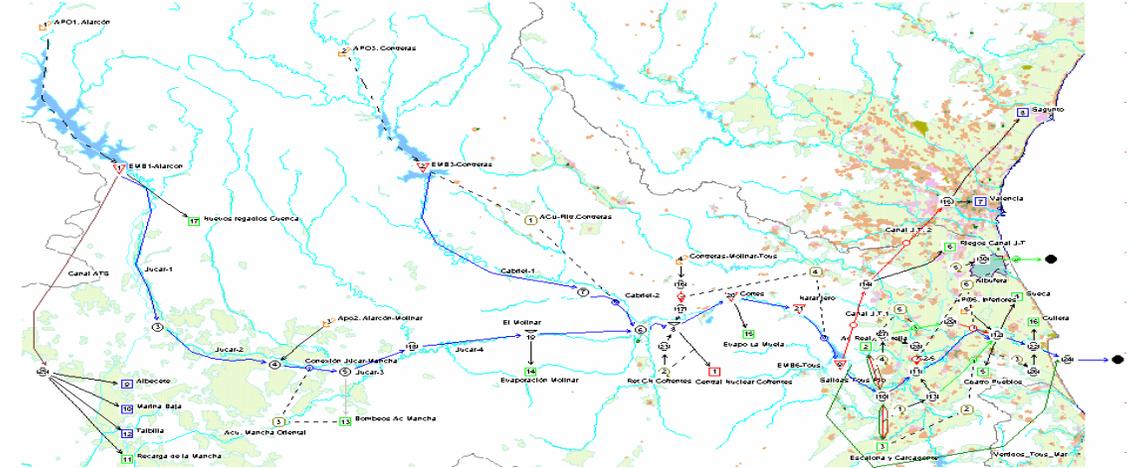
Source: CEDEX (2017). Evaluación del Impacto del Cambio Climático en los Recursos Hídricos y Sequías en España

# Climate change in water planning

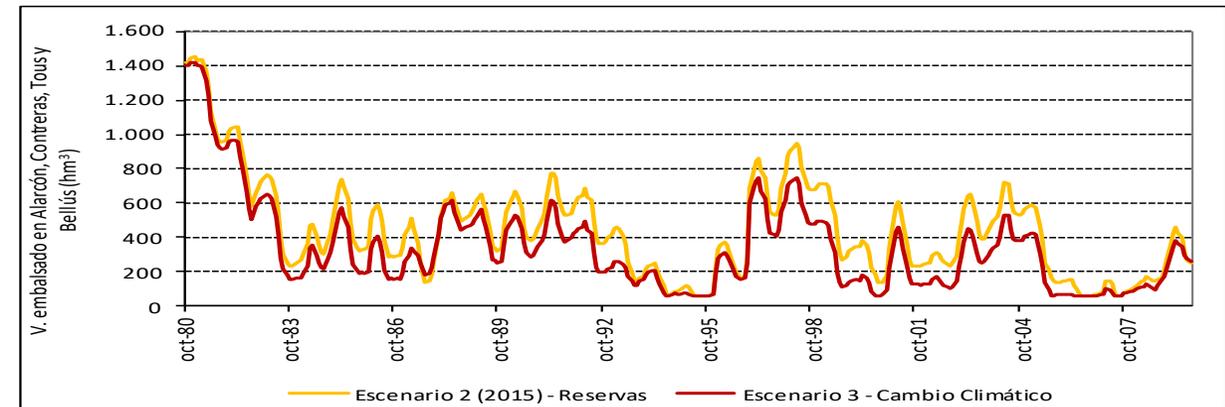
- CC studies have been regulated in the Royal Decree 907/2007 and in the Water Planning Instruction (OM ARM/2656/2008), where it is indicated that water balances corresponding to different CC scenarios must be carried out in the river basin management plans.
- Studies of impact of climate change in water resources systems and measures for adaptation have been developed in river basin management plans in Spain.

# CC impact in the RBMP of Júcar RBD

- Impacts of CC have been studied for year 2033.
- Mean annual runoff reduction of about 12%.
- In several water resources systems will be difficult to supply water demands, especially for irrigation.



Júcar simulation model



Effects on reservoir storage

# Future action lines

- Develop specific river basin adaptation plans in the framework of the river basin management plans.
- Improve the consistency of programmes of measures of river basin management plans with the impacts of climate change.

Thank you very much for your attention!

# Climate change in hydrological planning

- CC impact studies on water resources have been taken into account in the hydrological plans of the first and second planning cycles from the Water Framework Directive.
- donde se indica que deben estimarse los recursos hídricos correspondientes a distintos escenarios de CC y realizar los balances en los sistemas de recursos. Their contents are regulated in the Hydrological Planning Regulation (RD 907/2007) and in the Technical Instruction for Hydrological Planning (OM ARM / 2656/2008), stating that water resources corresponding to different CC scenarios must be estimated and balances in the resources systems must be carried out.

# Climate Change adaptation measures

- Compliance with the targets of the United Nations SDG-6: Sustainable water management and sanitation, in particular
  - Increase water-use efficiency and ensure sustainable withdrawals to address water scarcity.
  - Implement integrated water resources management.

# Climate Change adaptation measures

- Improve efficiency in supply networks, as well as energy efficiency and sustainability in the irrigation modernisation.
- Develop sustainable projects of hydraulic works that can be integrated in the environment.
- Incorporate the effects of climate change in hydraulic works design.



Modernisation works in Acequia Real del Júcar



Reversible hydroelectric use - Cortes La Muela

# Climate Change adaptation measures

- Design integrated water resources systems: surface and groundwater, reclaimed water, desalinated water, etc.
- Adapt resources systems to climate change: less availability and greater irregularity of resources.
- Develop CC adaptation plans and integrate them in the River Basin Management Plans.
- Develop Real-Time Information Systems and Decision Support Systems.



Membranes of reverse osmosis in the Mutxamel desalination plant



Control panel of the integral water cycle in Valencia



8<sup>th</sup>  
World Water  
FORUM

Brasilia-Brazil  
2018

Sharing Water

Organization



MINISTRY OF THE  
ENVIRONMENT



Support

