# Adaptation to climate change impacts for Mediterranean islands' agriculture

# ADAPT2CLIMA

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# ADAPT2CLIMA Project

- **Coordinator:** National Observatory of Athens-Greece

- **Partners:**
  - National Technical University of Athens- Greece
  - Agricultural Research Institute - Cyprus
  - Institute of Biometeorology (IBIMET-CNR) - Italy
  - Region of Crete– Greece
  - Department of Agriculture, Rural Development and Mediterranean Fisheries, Region of Sicily, Italy

- **Duration: 43 months (1 October 2015 – 30 April 2019)**

# ADAPT2CLIMA Project

- **Implementation Areas:** Crete (Greece) , Cyprus, Sicily (Italy)




The islands were selected for two reasons :

- they figure among the most important cultivation areas at national level
- they exhibit similarities in terms of location (climate), size, climate change threats faced (coastal agriculture, own water resources), agricultural practices and policy relevance

# ADAPT2CLIMA Project

- **Six pilot areas**
  - the crops cultivated in these areas are typical of the Mediterranean agriculture, while representativeness is also enhanced due to the different climatic, hydrologic and soil conditions of each pilot area

- **Main crops**
  - olive trees
  - vineyards
  - vegetables
  - wheat/barley
  - potatoes



# Objectives and Scope

Build a solid knowledge base on the future climate changes and their impacts on the agricultural sector of three European islands in the Mediterranean basin, namely Crete (Greece), Sicily (Italy) and Cyprus

Reduce vulnerability and increase resilience of agriculture to climate change risks by assessing the effectiveness of the available adaptation measures

Development, implementation and demonstration of a decision support tool (ADAPT2CLIMA tool) for enabling well-informed decision-making for adaptation planning in agriculture

Development of climate change adaptation strategies for agriculture for the project implementation areas

Raising awareness of stakeholders and target groups on issues related to agriculture and climate change

# Policy Implication (I)

- The project clearly addresses the majority of EU policy priorities for 2014 of the "Climate change adaptation" priority area, through its objectives:

- Facilitate the development of adaptation strategies for agriculture with the deployment of a decision support tool for adaptation planning. The tool provides for better informed decision making by enhancing the knowledge base at national, regional and local level on:
  (i) climate change projections
  (ii) the assessment of vulnerability
  (iii) the assessment of the available adaptation options and
  (iv) the evaluation of the effectiveness of the adaptation measures.

- The tool is suitable for replication and transfer to all agricultural areas, provided that missing area-specific data are loaded to its database.

- The tool can also provide a useful addition to the European Climate-ADAPT platform.

# Policy Implication (II)

- Climate change vulnerability assessments will be carried out and adaptation strategies will be developed for the agricultural areas of the islands of Sicily, Cyprus and Crete, thus significantly increasing the sustainability and resilience of the agricultural sectors of the project islands to climate change.

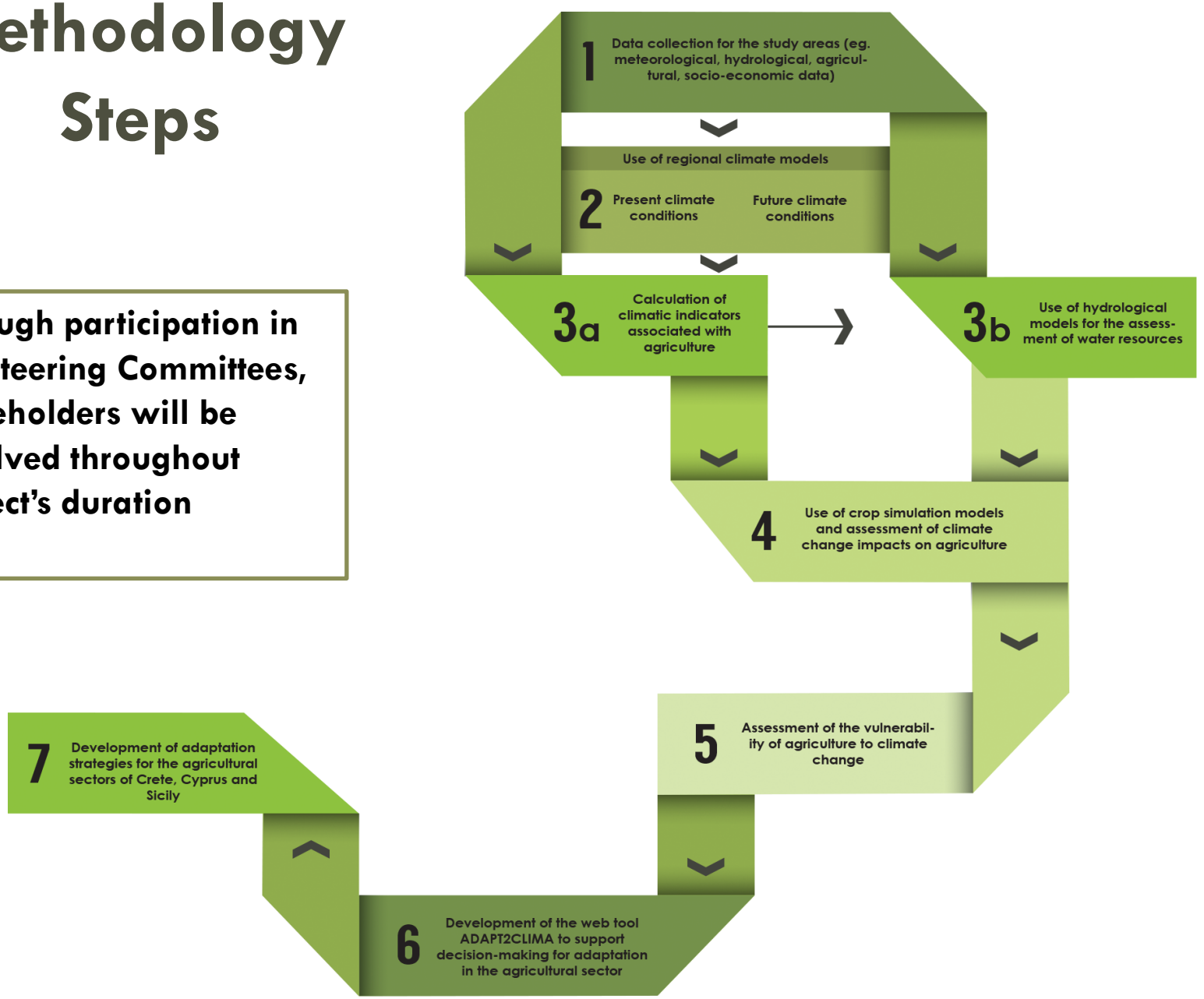
- The project promotes ecosystem-based adaptation solutions, as the available adaptation options will be evaluated against environmental, technical, economic and social criteria, and thus ecosystem-based solutions will be prioritized as a result of their high performance against these criteria.

- It also addresses several EU policy priorities of the priority area "Climate governance and information", as it foresees, inter-alia, to raise awareness on the cost-effectiveness of adaptation options with the use of the multi-criteria analysis method.

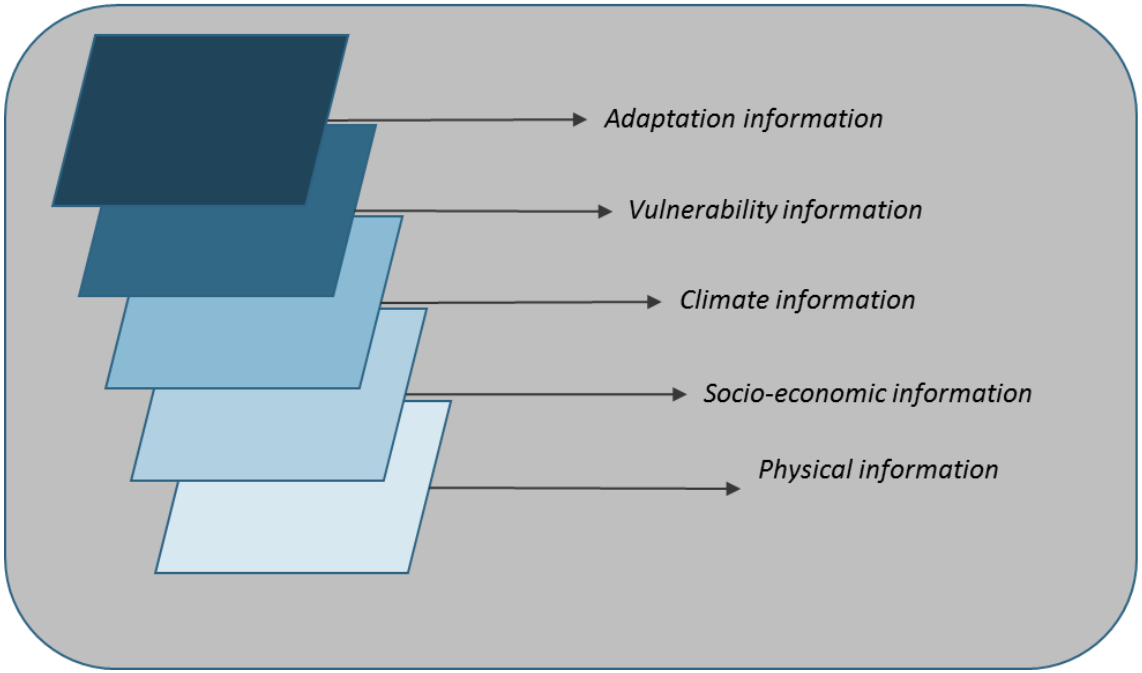
- The project aims to raise awareness of target audiences on climate change vulnerabilities and adaptation options.

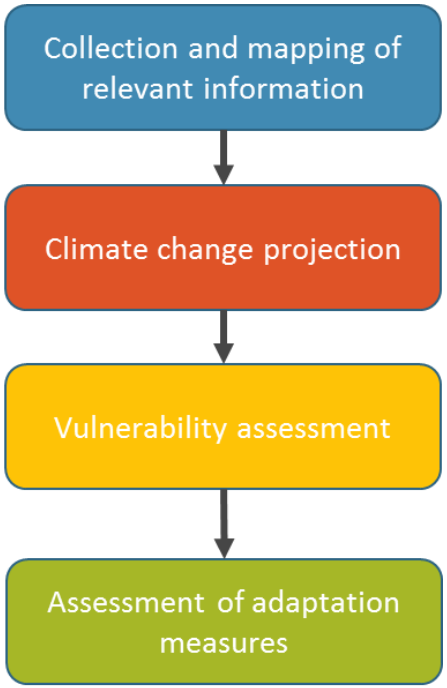
# Methodology Steps

**Through participation in the Steering Committees, stakeholders will be involved throughout project's duration**



# The concept behind the decision support tool ADAPT2CLIMA



# Main functions of the ADAPT2CLIMA tool

*The user will be able to explore through interactive visualization maps the following data for the project study areas :*

- **Climate change projections:** Display climate change parameters for different time periods and emission scenarios
- **Vulnerability assessment:** Display the degree of the vulnerability of a crop/agricultural area to climate change with the selection of relevant indices
- **Adaptation assessment:** Evaluation of adaptation measures and investigation of the potential for reducing vulnerability through the implementation of certain adaptation measures

# Stakeholders involvement

- Provide input for knowledge capitalization in each project area
- Evaluate of the available options for adapting agriculture to climate change
- Defining expectations and requirements on the features and characteristics of the tool
- Evaluate the ADAPT2CLIMA tool
- Participate in the demonstration events of the ADAPT2CLIMA tool
- Check the proposed adaptation measures, make suggestions for enhancing the adaptation strategy for each project area
- Communicate/disseminate project results

## ❖ Tool Development:

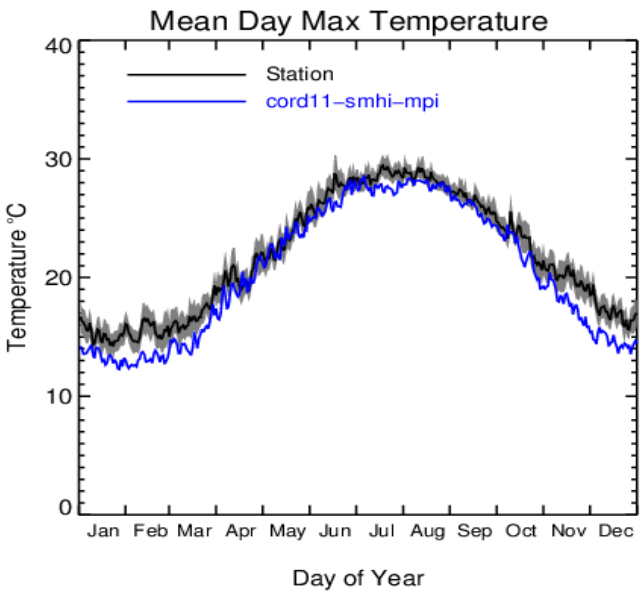
*Climate change projections*

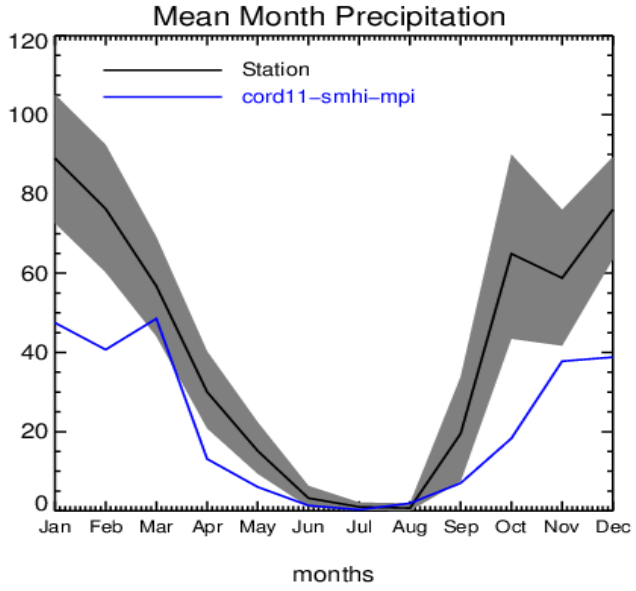
# Regional Climate Model

- RCM: MPI-RCA4 from CORDEX database
- Resolution: 12 km
- Control period: 1971-2000
- Future period: 2031-2060 (after consultation with stakeholders)
- RCPs: 4.5 and 8.5

# Regional climate models evaluation

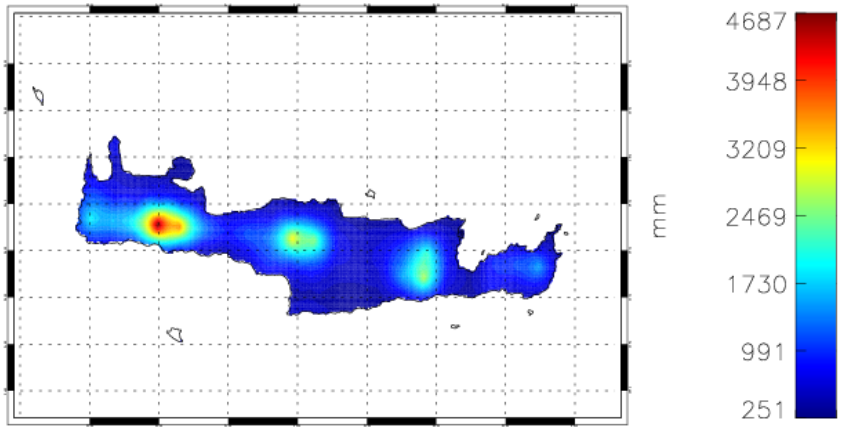
*Heraklion*



# Precipitation

Annual total rainfall

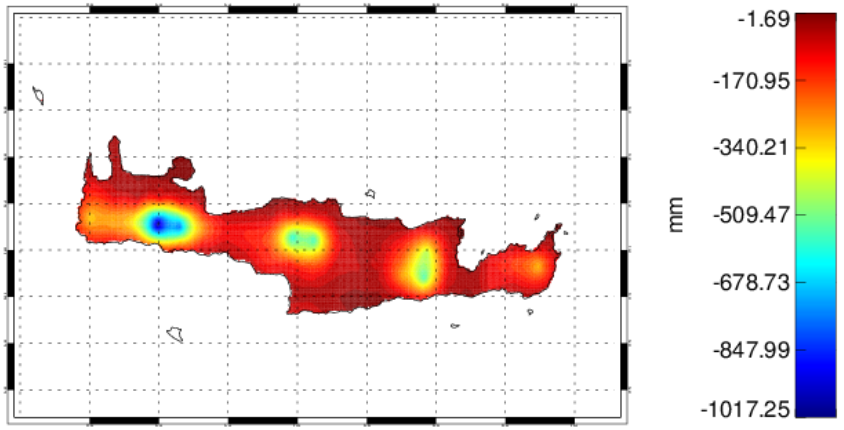



Computed for period 1981 - 2000

**Scenario RCP8.5**

**Scenario RCP4.5**

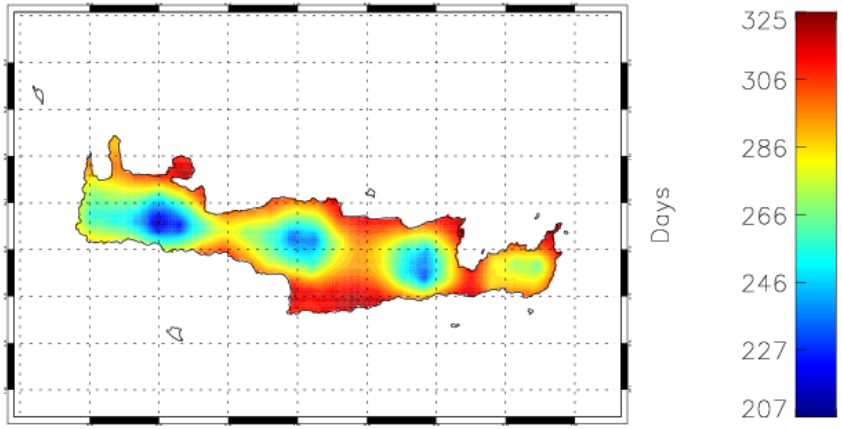
Annual total rainfall diff




2041-2060 average minus 1981-2000 average

# Precipitation

nb of dry days (RR < 1 mm)

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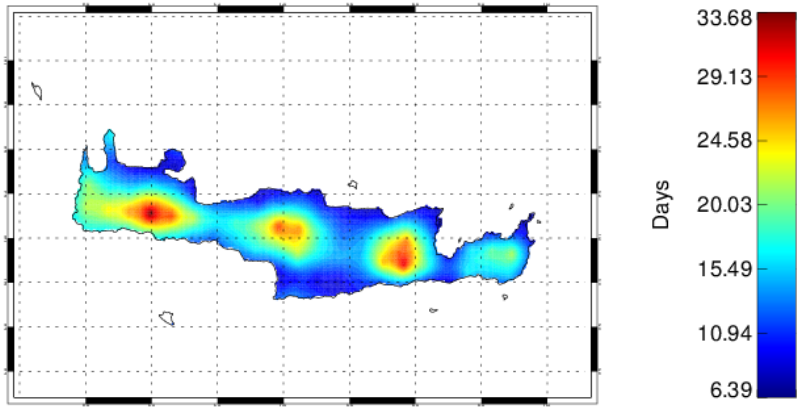
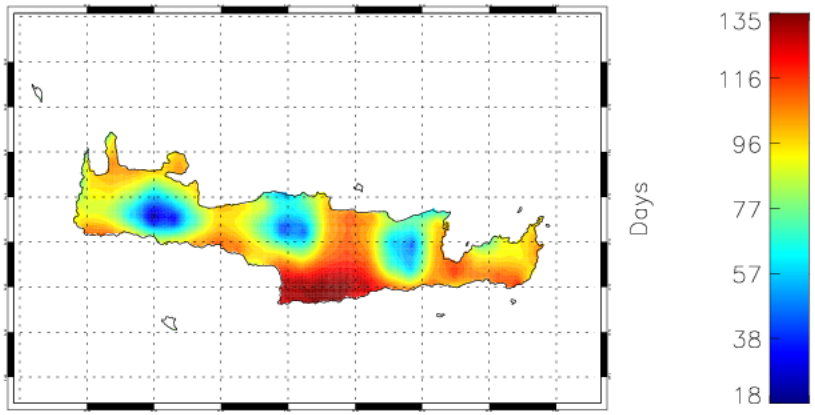



2041-2060 average minus 1981-2000 average

# Maximum temperature

nb of summer days (TMAX > 25 deg)

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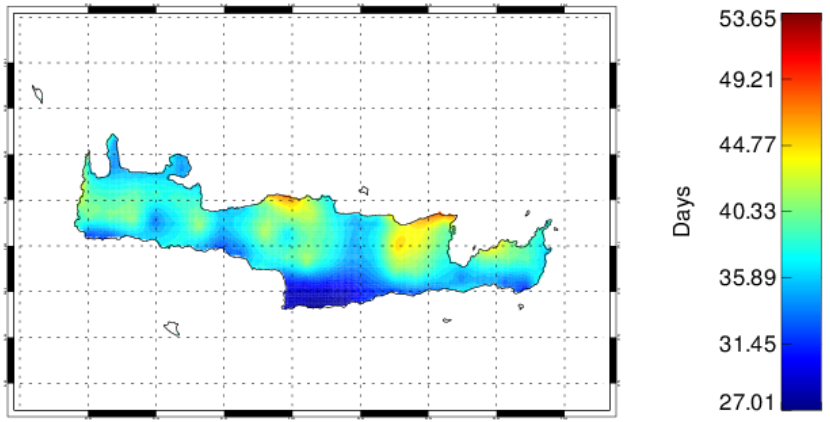
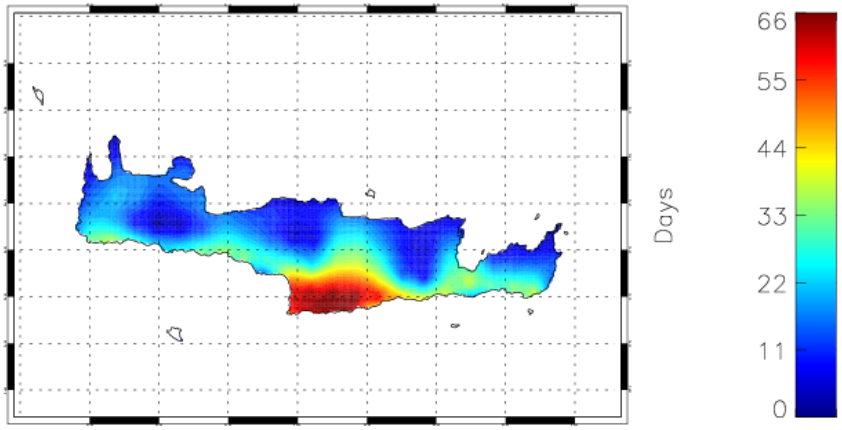



2041-2060 average minus 1981-2000 average

# Maximum temperature

nb of hot days (TMAX > 30 deg)

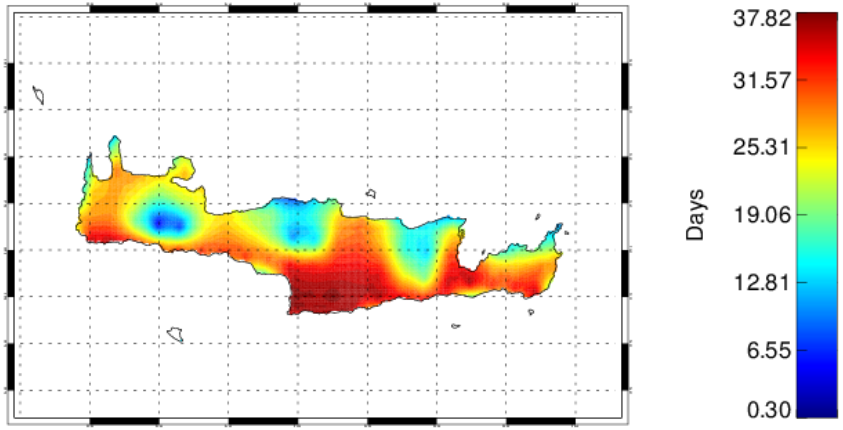



Computed for period 1981 - 2000

**Scenario RCP8.5**

**Scenario RCP4.5**

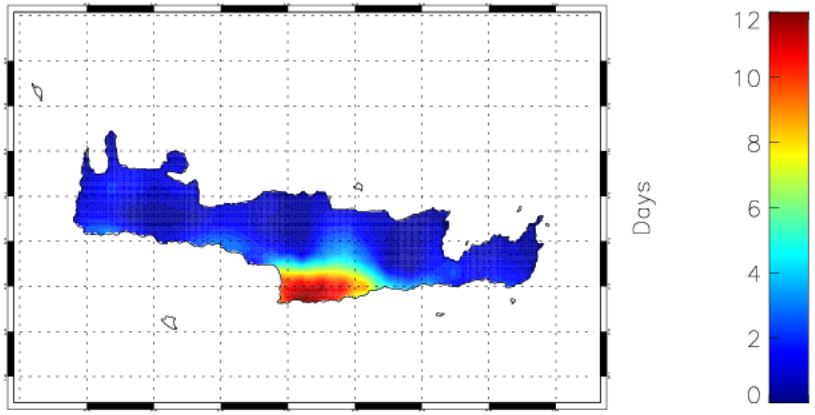
nb of hot days (TMAX > 30 deg) diff




2041-2060 average minus 1981-2000 average

# Maximum temperature

nb of heatwaves days (TMAX > 35 deg)

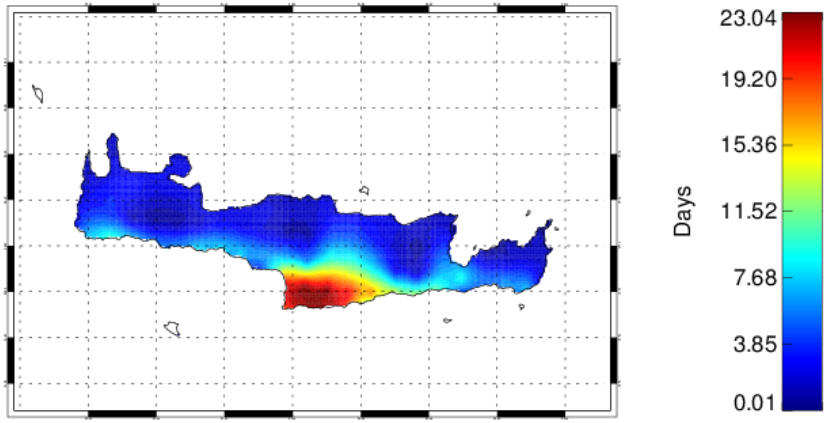



Computed for period 1981 - 2000

**Scenario RCP8.5**

**Scenario RCP4.5**

nb of heatwaves days (TMAX > 35 deg) diff




2041-2060 average minus 1981-2000 average

## ❖Tool Development:

## *Vulnerability assessment-hydrological and crop models*

# Climate change and its impacts on water resources

- **Hydrological and Groundwater flow and transport models** are developed to estimate climate change impacts on water resources **quantity** and **quality**

- Assessing future hydrological conditions, **adaptation measures** will be proposed in order to ensure future adequate freshwater volumes for irrigation purposes, such as **agricultural management practices** (e.g. irrigation, N fertilizers)

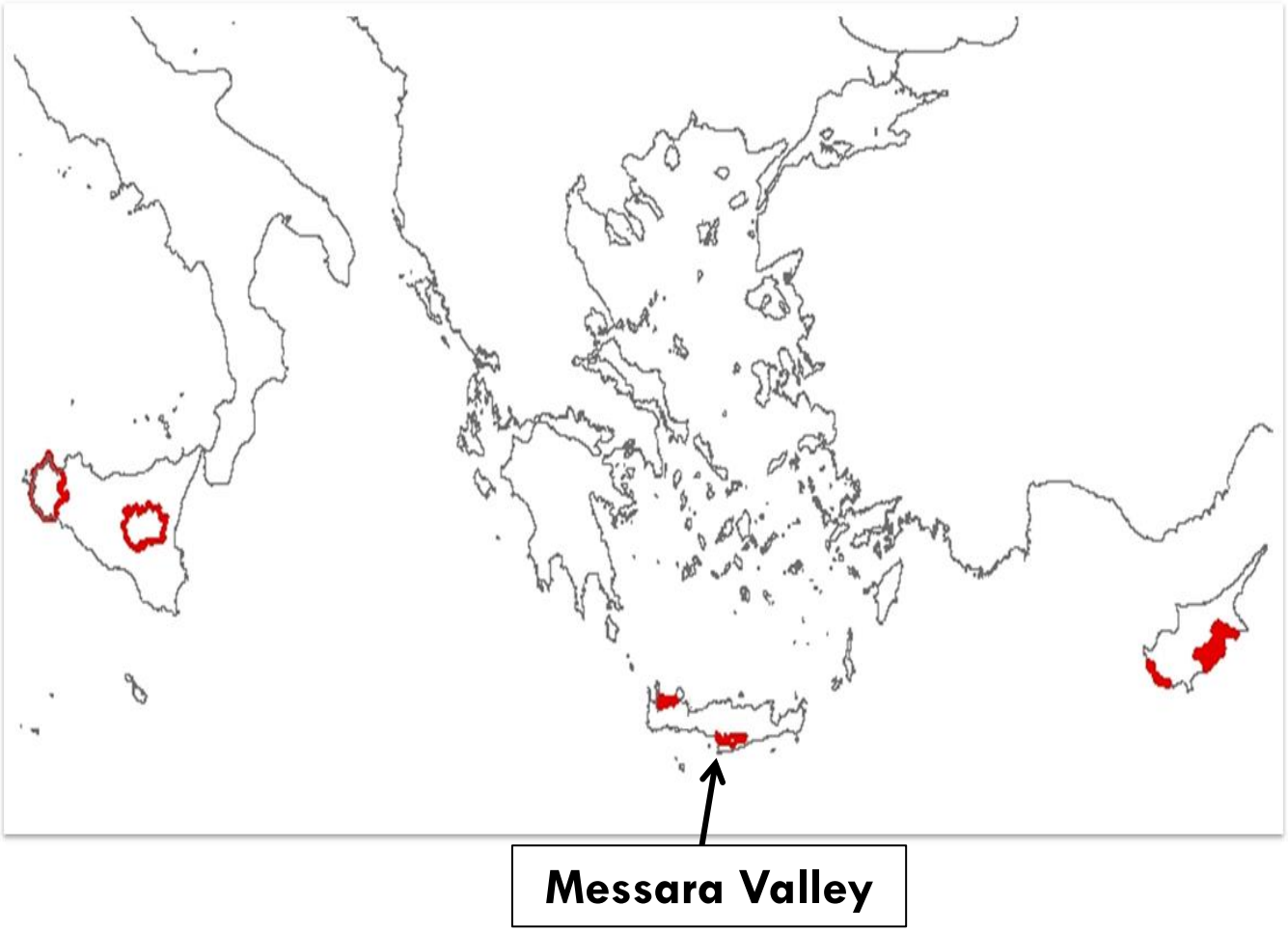
- Visual **MODFLOW** software is used for **groundwater flow and contaminant transport modeling**

- **Surface water flow** is approached with a **water balance** function

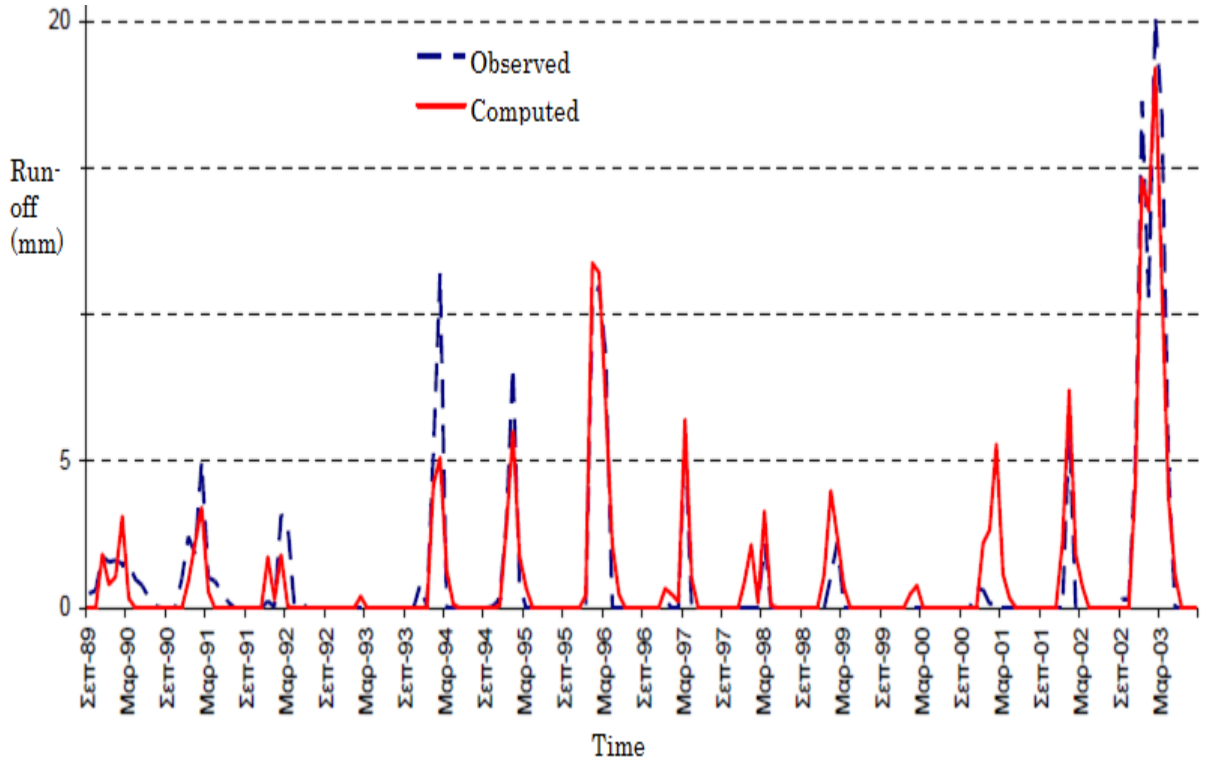
# Climatic data used as input to groundwater flow models

- Gridded **historical climate data** and some **future climate scenario data** are required as input to groundwater flow models
- **Precipitation** will be used as input to groundwater flow models, taking into account the **infiltration rate** of each soil type
- **Historical precipitation data** are required to **calibrate** and verify values of different hydro-geological or geochemical parameters (e.g. hydraulic conductivity)
- **Future precipitation data** for each climate scenario will be used in order to estimate the future **recharge** on the pilot aquifers. The outputs of the MODFLOW models will be used to evaluate the impact of **climate change effects** on groundwater aquifers, as well as the effectiveness of proposed **adaptation measures**
- For improving the accuracy of the groundwater models, **in-situ hydrological measurements** in each aquifer in two time period (wet and dry period) will be performed

# The ADAPT2CLIMA Pilot Aquifers

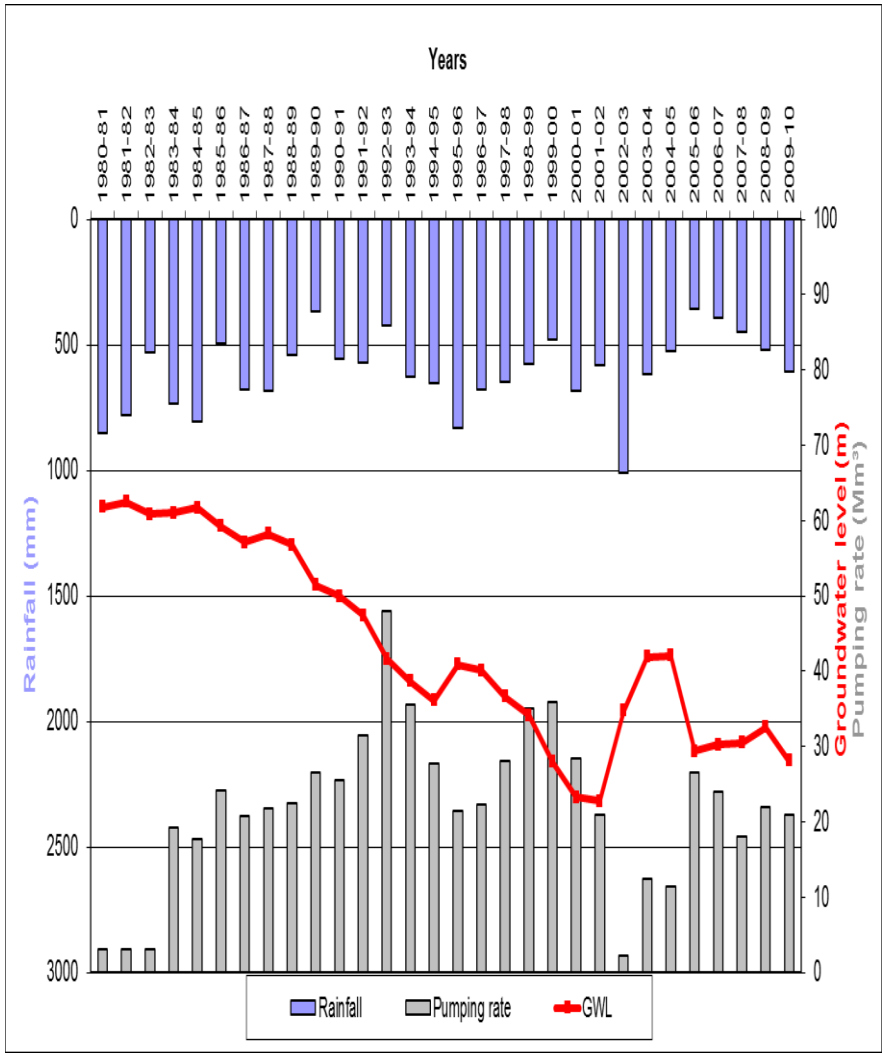


# Runoff simulation – Geropotamos River

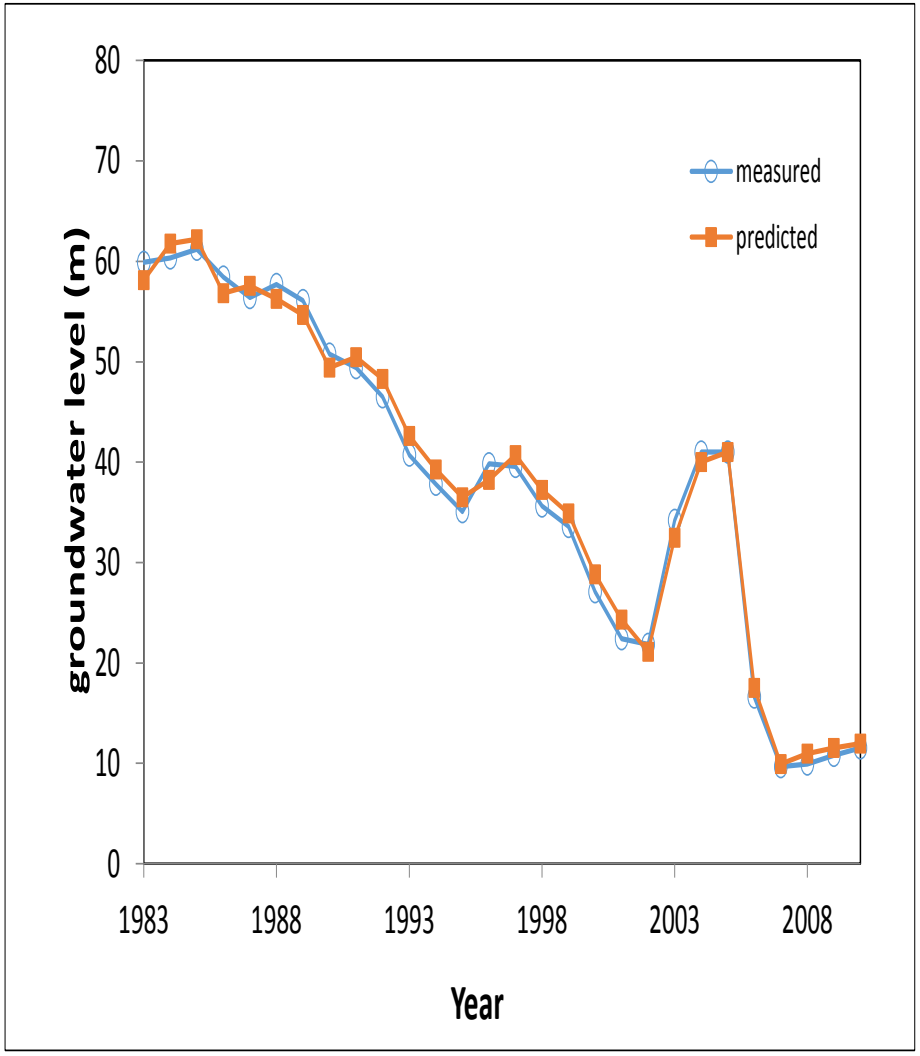



**Observed and Computed Runoff - Geropotamos River**

# Moires watershed




Significant depletion of the aquifer




Water-flow model calibration –40 borehole used as control points

# Model CropSyst setup

- Climatic input: air temperature, evaporation, global radiation, wind speed, relative humidity
- Soil texture was obtained from IIASA database
- In these simulations the effect of increased CO2 concentration on both radiation and water use efficiency was considered
- For olive trees, possible impact of heat stress on fruit thinning was not considered
- Sowing dates for winter barley were set to November 20th
- Sowing dates for spring barley were set to January 31st
- These data were kept constant for future projections
- Simulations were performed on areas actually covered by sowing crops/olives groves according to CORINE Land Cover

# Olive tree yield in RCP45 (2030-2060) with respect to present (1971-2000)


- Olive yield generally increased thanks to the combined effect of higher water use efficiency (WUE) and radiation use efficiency (RUE) in response to higher CO2 concentration

# Olive tree yield in RCP85 (2030-2060) with respect to present (1971-2000)


- The increase observed in RCP45 was even enhanced in RCP85 due to higher CO2 concentration

# Barley yield (late sowing-January) in RCP45 (2030-2060) with respect to present (1971-2000)


- Increased RUE and WUE were not able to compensate the negative effect of climate change on yield thas was affected by drought and a shorter growing period
- The highest impact was observed in Cyprus (<-20%) whereas in Crete and Sicily was limited in the range (0, -20%)

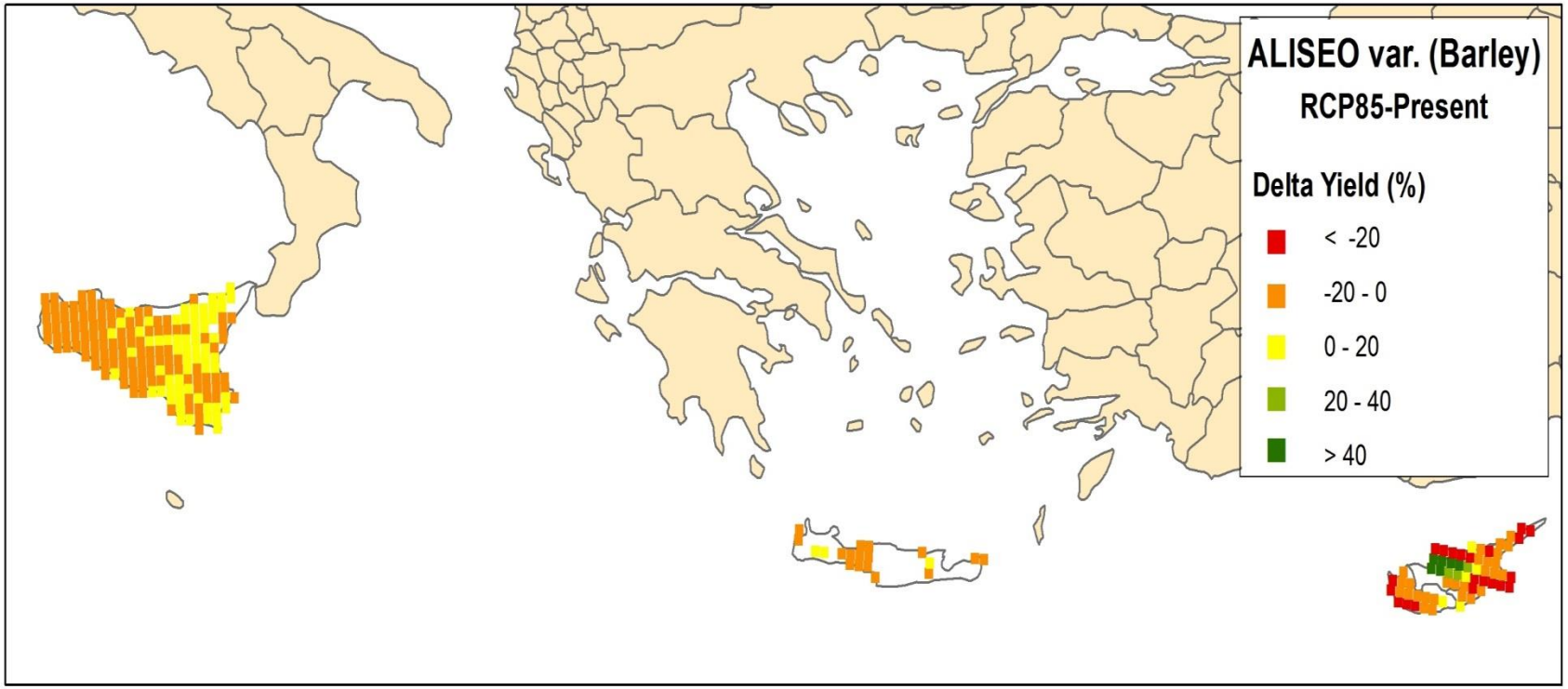
# Barley yield (advanced sowing-November) in RCP45 (2030-2060) with respect to present (1971-2000)


- The same resuls were obtained when considering an advanced sowing. The highest impact was observed in Cyprus (<-20%) whereas in Crete and Sicily was limited in the range (0, -20%)

# Barley yield (late sowing-January) in RCP85 (2030-2060) with respect to present (1971-2000)


- The highest impact was observed in Cyprus (<-20%) whereas in Crete and Sicily was limited in the range (0, -20%)

# Barley yield (advanced sowing-November) in RCP85 (2030-2060) with respect to present (1971-2000)




- Some positive effect was evident in eastern Sicily where advanced sowing resulted into an increased yield (0-20%) while negative impacts were observed in Crete and (0,-20%) and Cyprus (up to -20%) counterbalanced by some positive impacts (+20-+40%) in the inner part of the island

# Thank you for your attention!

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