Future projections of climatic indices relevant to agriculture for Crete, Cyprus and Sicily in the framework of ADAPT2CLIMA project

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Project Partners

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- **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
The overall aim of the LIFE ADAPT2CLIMA (LIFE14 CCA/GR/000928) project is to increase knowledge on the vulnerability of EU Mediterranean agriculture to climate change and to support decision making for adaptation planning.

- **Duration:** 53 months (1 Oct. 2015 – 29 Feb. 2020)
- **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
Methodology: Climatic information

• Regional Climate Models (EURO-CORDEX):
  – MPI-ESM-LR/RCA4
  – HadGEM2-ES/RCA4
  – CNRM-CM5/RCA4
  – CNRM-CM5/ALADIN (v5.2)

• Resolution: ~12x12 km

• Control period: 1971-2000

• Future period: 2031-2060 (after consultation with project’s stakeholders)

• RCPs: 4.5 and 8.5 scenarios
Methodology: Evaluation of RCMS

We also performed an evaluation of the Regional Climate Simulations against E-OBS v13 (resolution 0.22°) for the period 1971-2000 and for the Essential Climate Variables (Temperature and Precipitation). The advantage of E-OBS is its spatial (entire European land surface) and temporal (1950-2012) coverage, which makes it ideal for an approximate evaluation of RCM-simulated temperature and precipitation characteristics over Europe.
Methodology: Evaluation of RCMS

Three evaluation metrics to seasonal (winter: DJF, spring: MAM, summer: JJA, autumn: SON) and annual mean values of temperature (daily maximum (TX), daily minimum (TN)) and precipitation for all experiments.

- **BIAS**: the difference (model – reference) of spatially averaged climatological annual or seasonal mean values for Sicily, Crete and Cyprus (relative difference for precipitation).
- **TCOIAV**: temporal correlation of interannual variability between model and reference time series of spatially averaged annual or seasonal mean values of a selected subregion.
- **RIAV**: ratio (model over reference) of temporal standard deviations of interannual time series of spatially averaged annual or seasonal mean values of a selected subregion.
Methodology: Evaluation of RCMS (TX, TN) 
Spatial and temporal means

Sicily (left column): a cold bias for all models and all seasons is revealed for TX, (top row) and TN (bottom row) temperatures. The coldest bias is pronounced in summer (JJA) reaching about **-12 to -14 °C** for all models while in winter (DJF) the lowest cold bias is calculated for TX (**-2 to -4 °C**). For TN the cold bias is lower for all models and is less than -2 °C. It should be noted that the CNRM global climate model driven simulations are mostly located at the cold end of the model range for the examined temperatures.
Methodology: Evaluation of RCMS (TX, TN)

Crete (middle column):

The models exhibit a variable behavior with no clear pattern of a warm or a cold bias. Regarding TX, all models in most of seasons exhibit a warm bias less than 2 °C while for TN a cold bias is mostly pronounced for most of the models. Nevertheless, two models the MPI-SMHI and the MPI-MOHC exhibit the lowest bias whereas the CNRM driven simulations are the coldest in the range of the models.
Cyprus (right) column): with the exception of the CNRM-ALADIN the rest of the models exhibit a warm bias for TN in the range of 0.6-6 °C. The highest warm bias for TN in DJF and SON. As far as TX is concerned the models mostly exhibit a cold bias in the range of about -1 to -5 °C. It should be noted again the behavior of CNRM-ALADIN which for all variables and for all seasons shows a systematic underestimation of the observations.
**Methodology: Evaluation of RCMS (PRECP)**

Spatial and temporal means

**Sicily:** the maximum bias for all seasons and for most of the models is less than 100%. Special cases are the **CNRM-ALADIN** with an extreme positive bias in JJA and the **MOHC-RCA4** which shows the lowest biases when compared to the observed precipitation.

**Crete:** the bias is less 150% for most of the seasons with the models exhibiting a low spread of biases. Special case is JJA where a wider spread of bias is shown with the highest deviation from observations calculated for the **CNRM-ALADIN**.

**Cyprus:** the bias is less 100% for most of the seasons with the models exhibiting a low spread of biases. Special case is again JJA where a wider
Methodology: Evaluation of RCMS (PRECIP)

Interannual variability
Methodology: Evaluation of RCMS (TX)

Interannual variability

In most of the cases the model that seems to capture better the temporal pattern of the observations in terms of correlation coefficient and RMS error, higher and lower values respectively, is the MOHC-SMHI model.
Climatic indicators

Maximum temperature (TX) / Minimum temperature (TN)
- Annual/seasonal TX,TN
- Monthly count of days when TX, TN
  o Wheat: TX>30°C (flowering); TN<3°C (late frost);
  TN<13°C (grain development)
  o Barley: TX>30°C; TN<8°C
  o Olive tree: TX>40°C; TN< -8°C, -3°C
  o Olive tree: TX>30°C (for May)
  o Grapevine: TX>30°C; TN< 0°C; TX>35°C
  o Potato: TX>25°C; TN<8°C
  o Tomato: TX>25°C; TN<8°C

Precipitation
- Annual/seasonal total precipitation
- No of dry days

Thresholds defined in collaboration with the stakeholders
Changes from 2.4-3.1°C in the northern part of the island and 2.8-3.7°C in the southern part and high elevation areas.
In the future climate, high elevation areas in both future scenarios show changes up to 6 days/yr while in low elevation areas up to 15 days/year.

Number of days with $T_{max}>25^\circ C$ related to fruit development.
Average Winter Tmin related to plant treatment and harvest changes ranging between 1.5-1.9°C under RCP4.5 (top right) while under RCP8.5 slightly higher increases up to 2.1°C (bottom right) are predicted.
Number of dry days related to plant treatment and crop management increase of 3 to 10 days/yr is shown for the RCP4.5 in low elevation areas, while higher increases between 12 to 20 days/yr are expected in high elevation areas. Regarding RCP8.5, the increases range from 3 to 10 days/yr in lowlands and from 8 to 24 in high elevation areas.
Projections for Cyprus

MOHC- RCA4 (RCP8.5)

Application of plant treatments and crop management related to fruit development (potato)
Projections for Sicily

MOHC- RCA4 (RCP8.5)

Application of plant treatments and crop management related to grain development (wheat)
Pilot Areas

Crops
- olive trees
- vineyards
- wheat/barley
- potatoes

Crops
- vineyards
- wheat

Crops
- olive trees
- vineyards
- tomatoes
Please select the following parameters for an interactive representation of the climatic variable.

Select Region: Crete  
Select Area: Messara  
Select Parameter Category: TMAX  
Select Parameter: number of days Tmax GT 25 degree...  

Submit

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