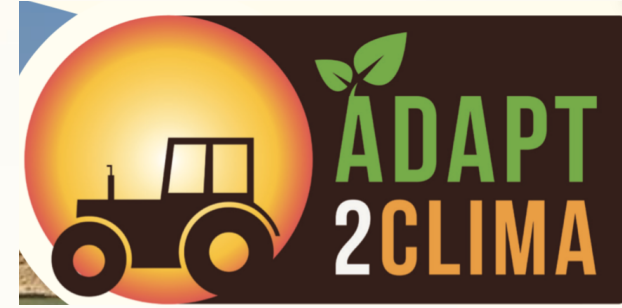


24-25 June
Heraklion, Crete



Future climate change: projections of indices relevant to agriculture in the Aegean region

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➤ Introduction

This work is part of the LIFETERRACESCAPE project that aims to demonstrate at the Aegean island of Andros the use of drystone terraces (a prominent element of the Mediterranean landscape) as green infrastructures resilient to climate change impacts and expanding to other Aegean and Mediterranean islands.

**The LIFETERRACESCAPE project
Coordinator: University of the Aegean**

Partners:

- Green Fund
- Hellenic Agricultural Organization - DEMETER (HAO-DEMETER)
- Municipality of Andros
- **National Observatory of Athens (NOA)**
- Research Committee - National and Kapodistrian University of Athens

Duration: 50 months (01/07/2017 - 31/08/2021)



- **Andros** selected Aegean islands

For millennia terraces allowed:

- the **cultivation** of marginal island areas with poor and particularly dry soils
- supported **local farming** communities,
- **reducing the soil erosion and wildfire risk**
- favoring **local biodiversity**.

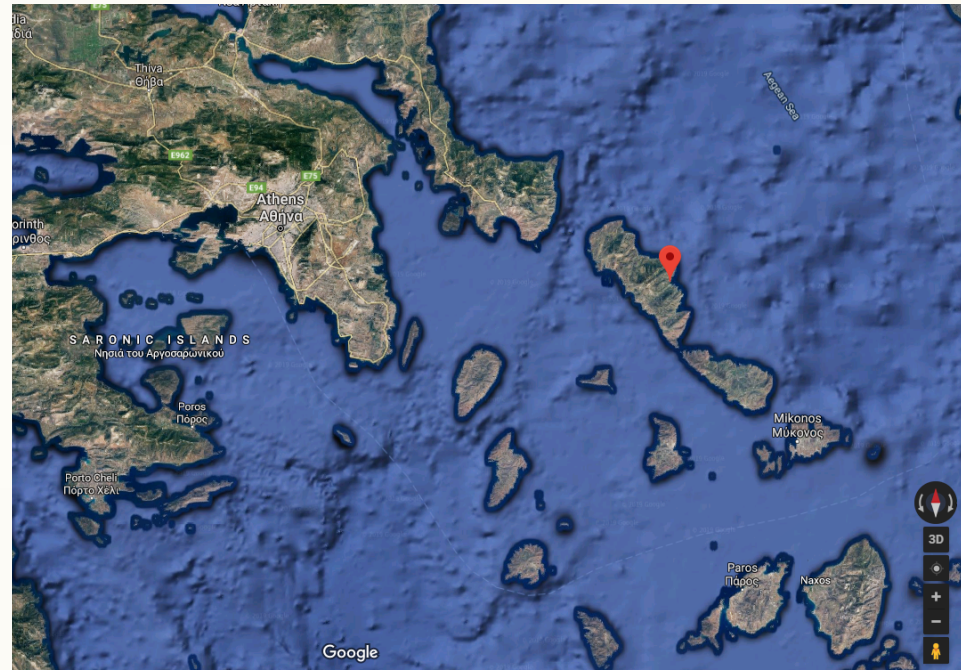


Photo by G. Kitsara

TERRACESCAPE project
will take advantage of the **climate adaptation** features of the **Land Stewardship practices to**

- improve **agricultural ecosystem resilience**,
- support a modern, extensive and **climate smart agricultural sector** for the **Mediterranean islands**, with benefits for local societies.

Climate Change

- **The islands of the Aegean** are areas with intense relief and low vegetation cover and are listed as a **region of high desertification risk**.
- The **impacts of climate changes**
(precipitation decrease, temperature increase, severe weather phenomena)

are expected to influence significantly
agricultural production
biodiversity
soil structure
water reserves
island landscape

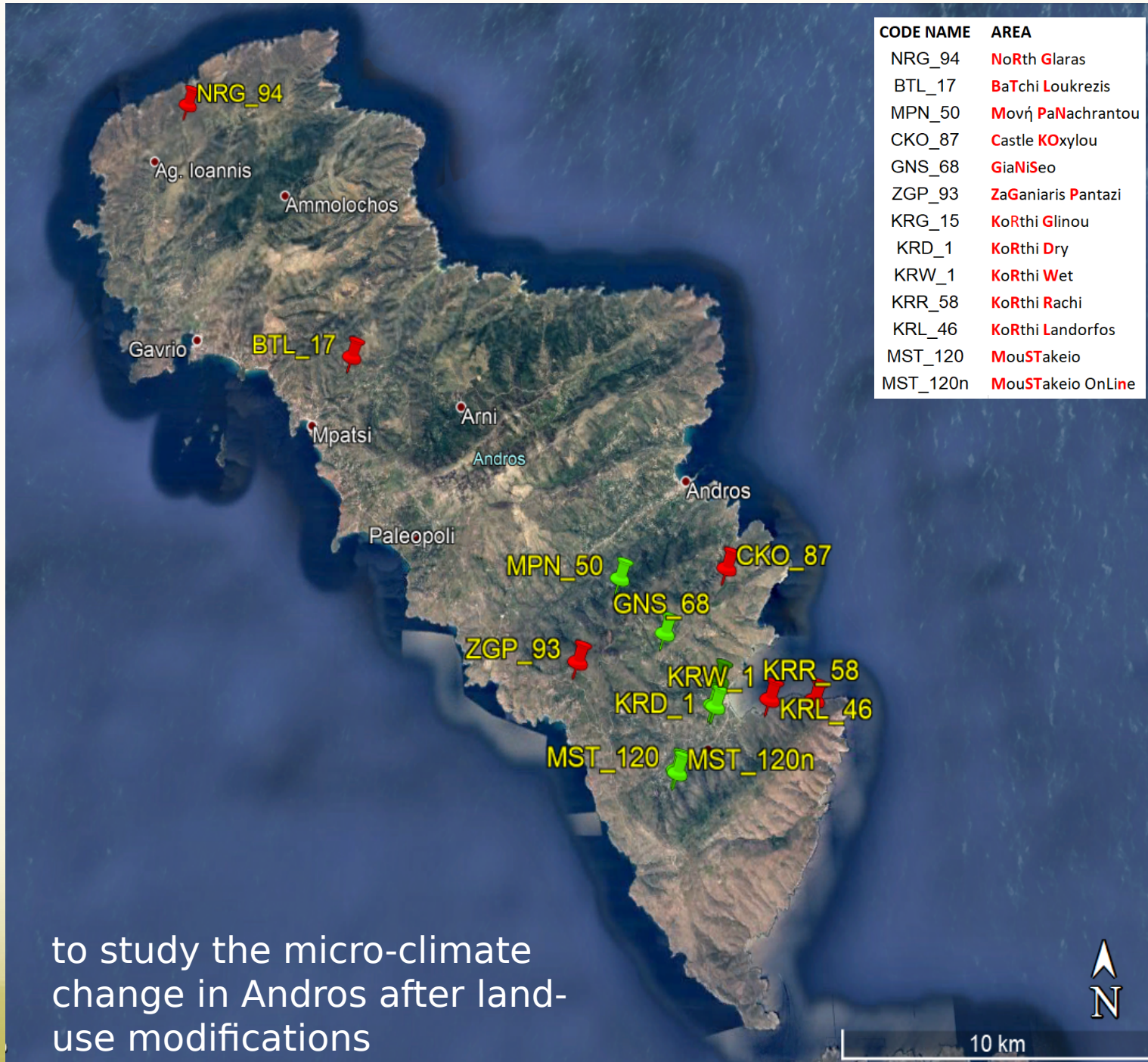
local economic activities (e.g agriculture, tourism)

➤ In this study

- For identifying **the most vulnerable regions and prioritize future interventions in the Aegean area** **potential future climate changes are examined using projections** derived from state-of-the-art **Regional Climate Model (RCM) simulations** developed within the framework of EURO-CORDEX (Coordinated Regional Climate Downscaling Experiment).
- In addition **valuable information**, based on **observational data** from installed meteorological stations, for selected areas in Andros island are used to provide a solid basis **for comparisons with changes projected** in frequency, duration and intensity for the future climate

7
meteorological
stations
have been
installed in
June 2018
(green points)

6 more
meteorological
stations
have been
installed in
May 2019
(red points)



➤ Results

ANDROS - JULY 2018 - MAY 2019 - Daily Values

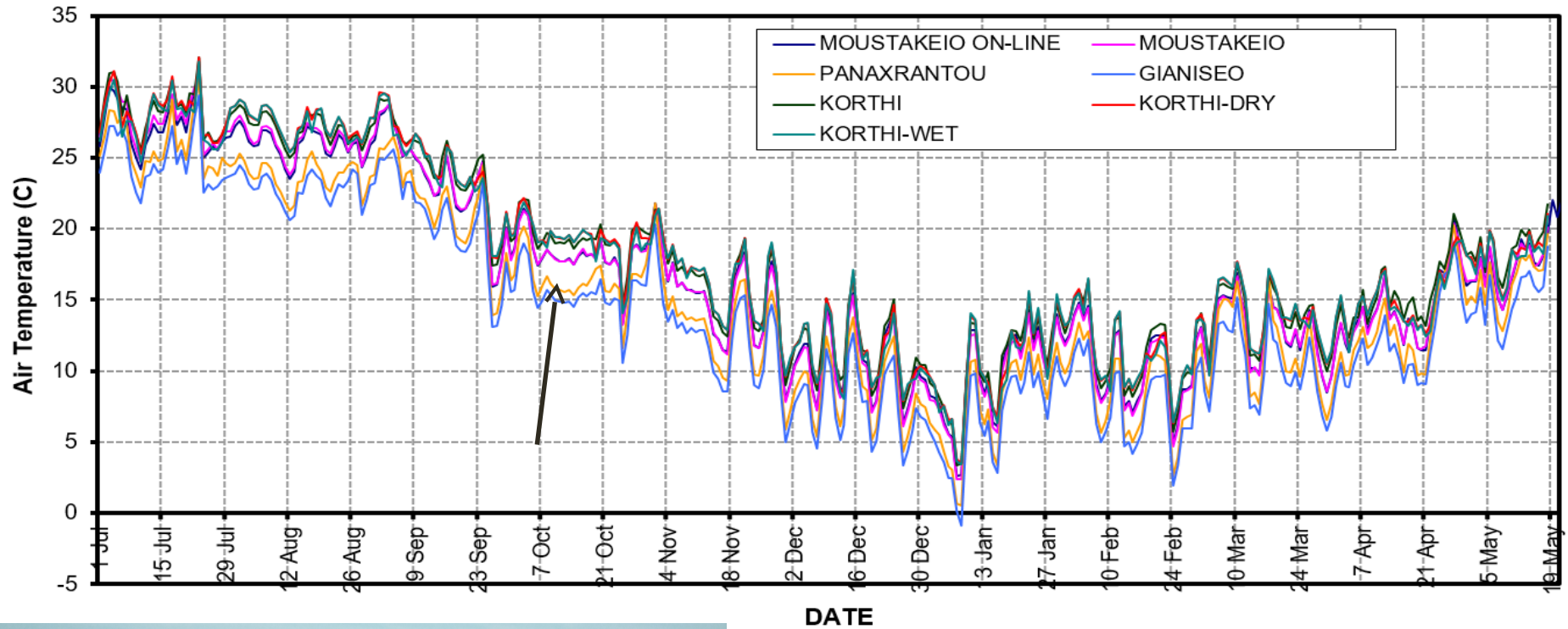
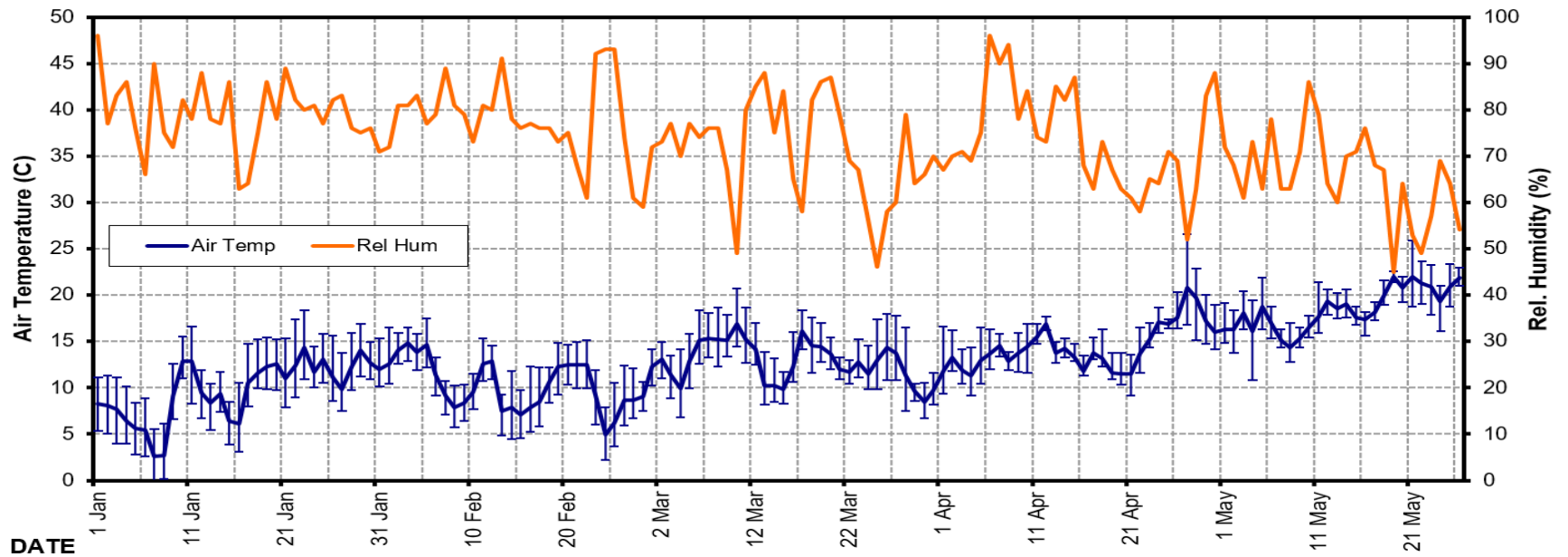


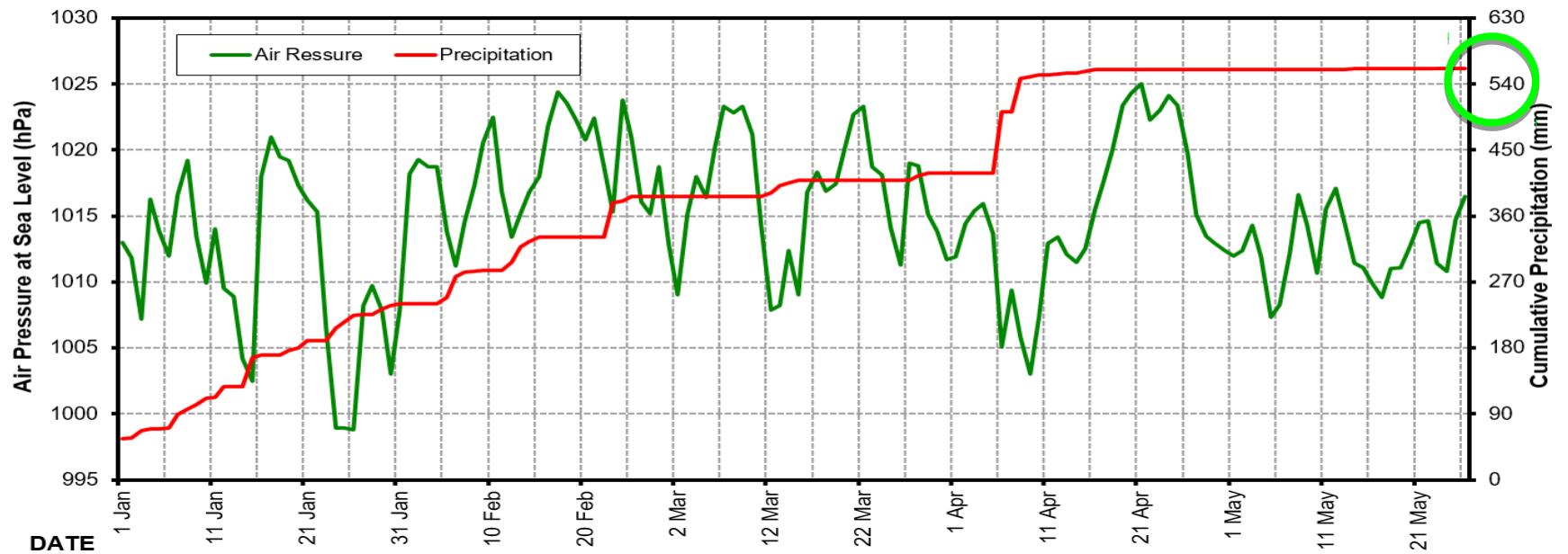
Photo by B. Psiloglou

Observations (1 year) from the 7 installed stations in Andros, pinpoint the seasonal variation for the air temperature (T) with an average T of about 21 ° C and a RH of 62%. Stations in higher altitude areas of the island, (Panachrantou Monastery and Giannissio), exhibit the lowest T and respectively the highest RH, as opposed to the stations at Ormos Korthi.

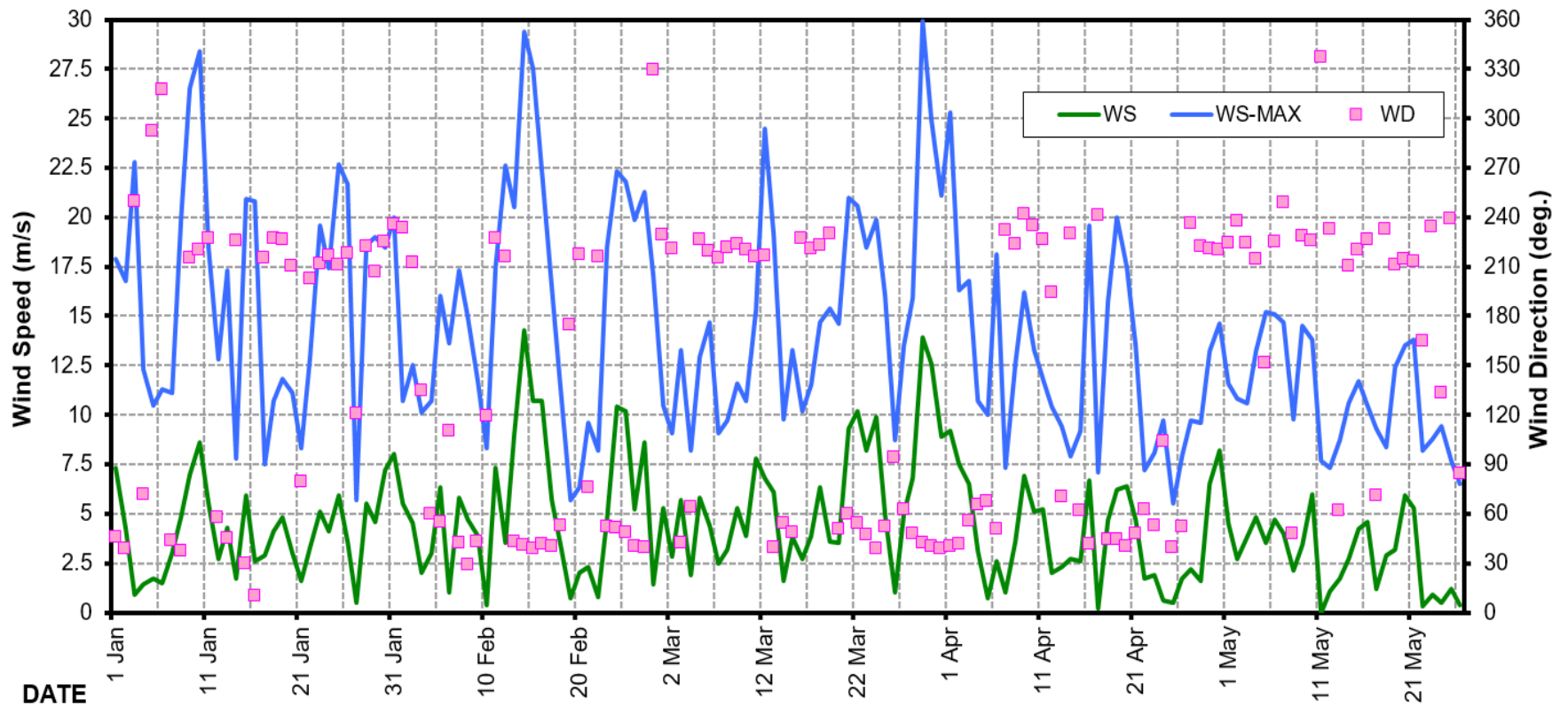
ANDROS - MOYSTAKEIO - JANUARY-MAY 2019 - Daily Values



ANDROS - MOYSTAKEIO - JANUARY-MAY 2019 - Daily Values



ANDROS - MOYSTAKEIO - JANUARY-MAY 2019 - Daily Values



Current climate and climate change projections

In order to identify the most vulnerable regions and prioritize future interventions,

changes in climatic indices based on the projections of **state-of-the-art regional climate model** are used to assess the **vulnerability of Andros and other Aegean islands to climate change.**

Regional Climate Model used



- **The RCA4 regional climate model SMHI with boundary conditions from the global HadGEM-ES model of the Met Office Hadley Centre (MOHC), from EURO-CORDEX database was found to give the best results for the Aegean region.**
- **Resolution:** ~12x12 km
- **Future predictions** were based on the 2 new IPCC emissions scenarios
 - RCP4.5** weak climate change mitigation scenario
 - RCP8.5** non-mitigation scenario with high emissions
- Control period: **1971-2000**
- Future periods: **2031-2060 (near future) and 2069-2098 (distant future).**

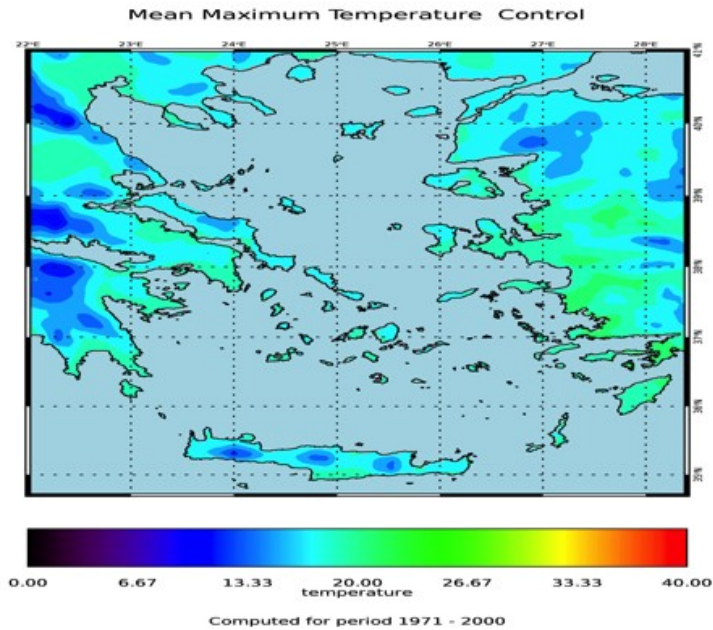


✓ Climatic indices relevant to agriculture for the Aegean region used

Climatic indices based to temperature and precipitation

- [1] Mean temperatures
- [2] Number of days with maximum temperature $T_{\max} > 30\text{ }^{\circ}\text{C}$ (hot days)
- [3] Number of days $T_{\max} > 35\text{ }^{\circ}\text{C}$ (heatwave),
- [4] Number of days with minimum temperature $T_{\min} > 20\text{ }^{\circ}\text{C}$ (tropical night)
- [5] Total Precipitation –PR
- [6] Highest 1-day precipitation amount
- [7] Highest 5-day precipitation amount
- [9] Heavy precipitation days ($\text{PR} > 10\text{mm/day}$)
- [10] Maximum length of dry spell (consecutive days $\text{PR} < 1\text{mm}$).

Annual Average Maximum Temperature



NEAR
FUTURE

DISTANT
FUTURE

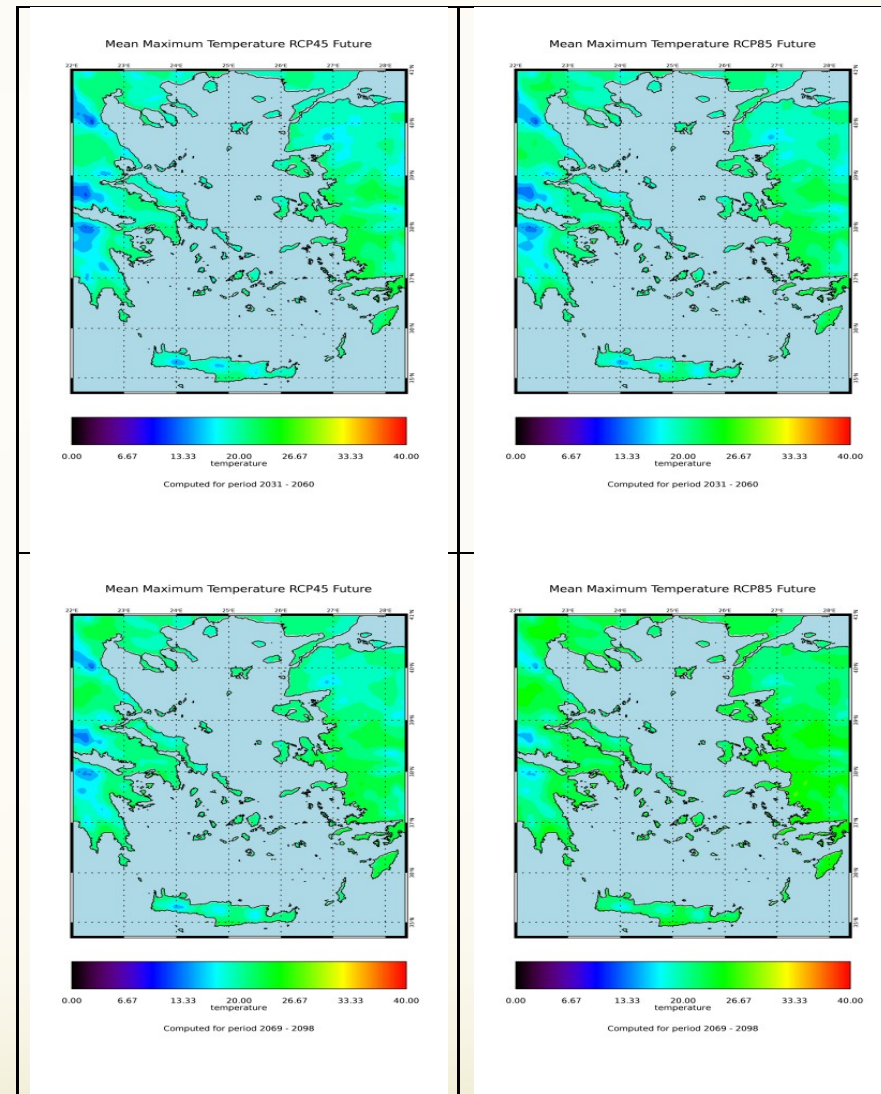
control period: around 20°C Dodecanese
14-19°C (Crete), 16-20° (Cyclades and
North Aegean)

near future: rises to about 22°C (RCP4.5)
or 23 °C (RCP8.5) for the Aegean -
(**increases of 2-4°C**)

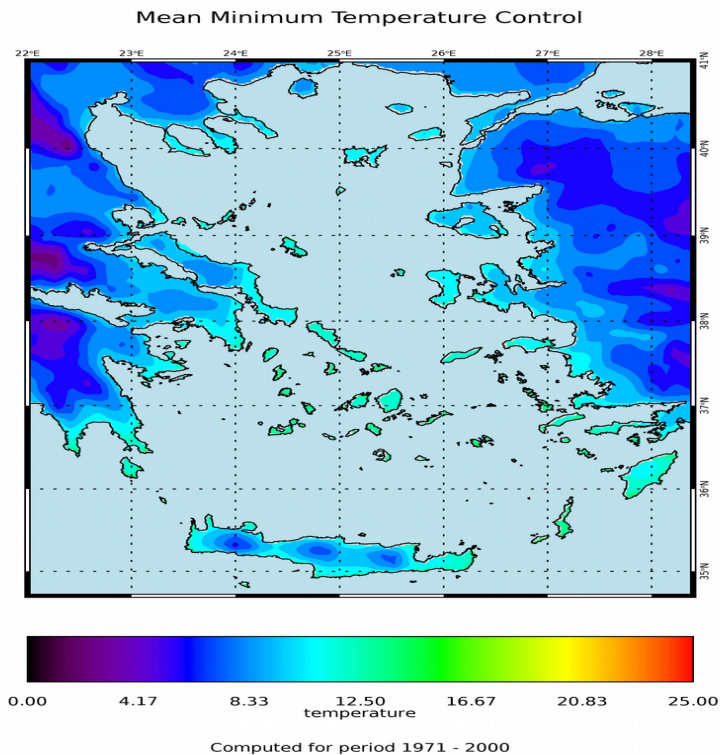
distant future: rises to 24°C (RCP 4.5) or
25°C (RCP 8.5) for Aegean area except for
the mountainous Crete-(**increases of 4-
6°C**)

RCP 4.5

RCP 8.5



Annual Average Minimum Temperature

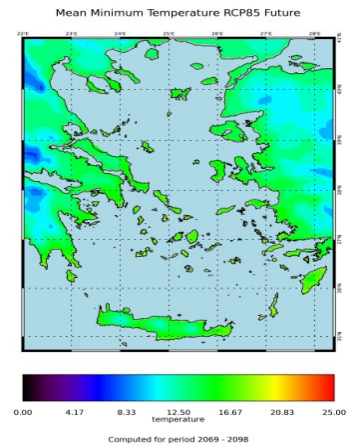
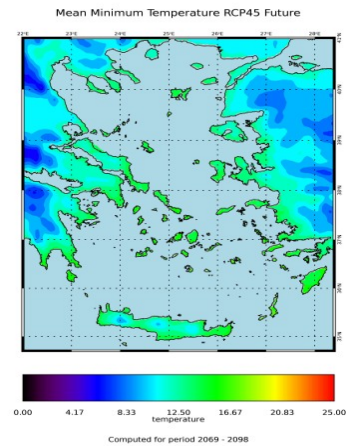
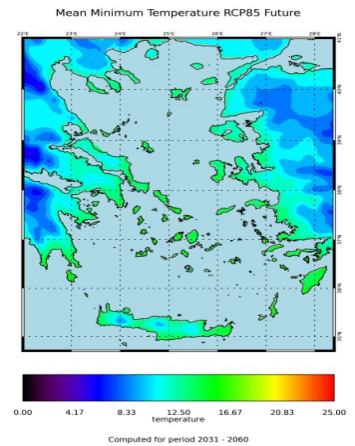
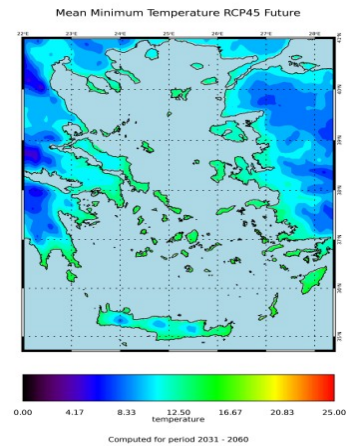


NEAR
FUTURE

DISTANT
FUTURE

RCP 4.5

RCP 8.5

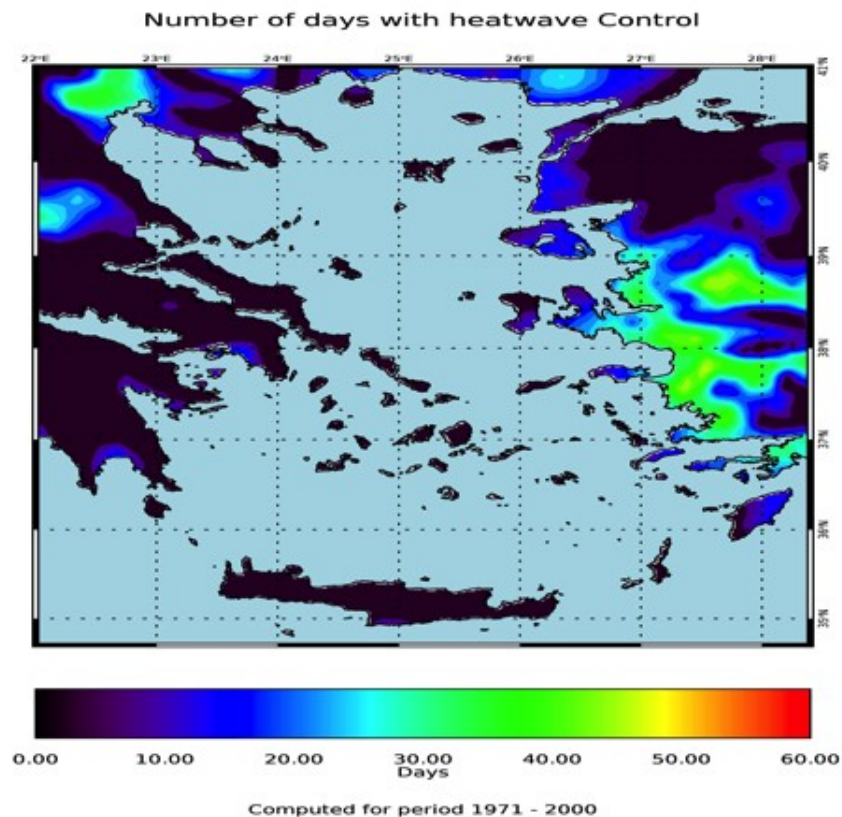


control period: 9 -11 °C
central regions of Crete and
the islands of North Aegean (Mitilini, Chios),
up to 12°C for Cyclades or Dodecanese.

near future period: 11-13 °C for Crete and North Aegean and 14°C or 15°C for
Cyclades or Dodecanese, respectively under both climate scenarios -(**increases of
~2°C**)

distant future: remain almost the same under the RCP 4.5 and
increase under the RCP 8.5 to 17°C for the Aegean region (increases of ~4°C)

Heatwave days ($T_{max} > 35^{\circ}\text{C}$)

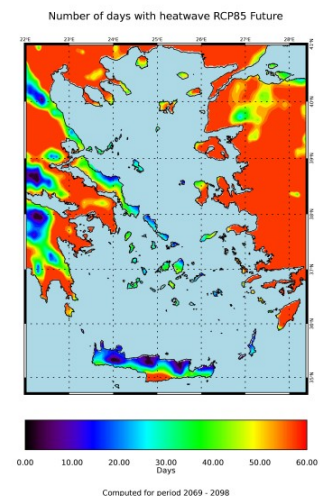
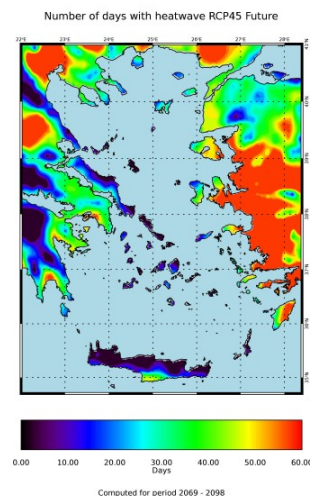
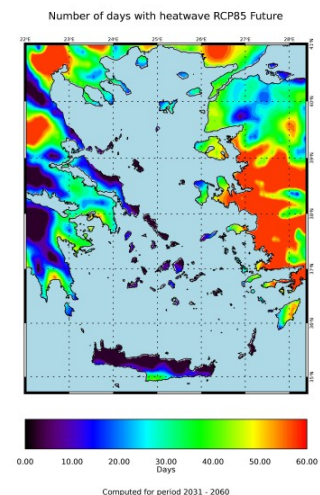
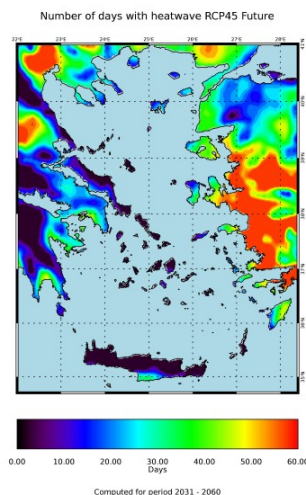


NEAR
FUTURE

DISTANT
FUTURE

RCP 4.5

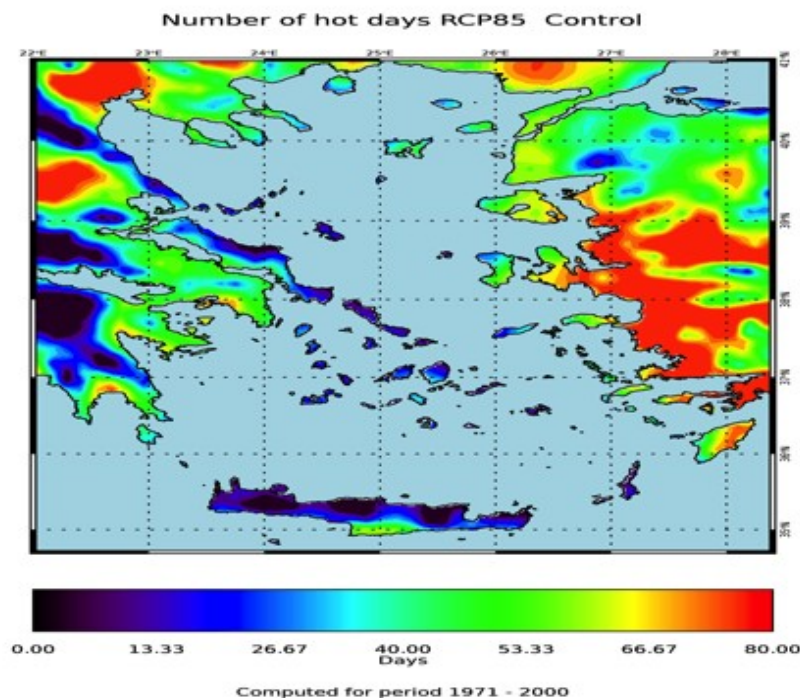
RCP 8.5



near future: increase to 2-6 d/y (Crete / Cyclades) and 15-30 d/y (Dodecanese / North Aegean) (both scenarios)

distant future: the greatest increases are shown under the RCP8.5 reach 25-30 (Crete & Cyclades) and 60 d/y (Dodecanese & North Aegean).

Number of hot days ($T_{\max} > 30^{\circ}\text{C}$)



NEAR
FUTURE

DISTANT
FUTURE

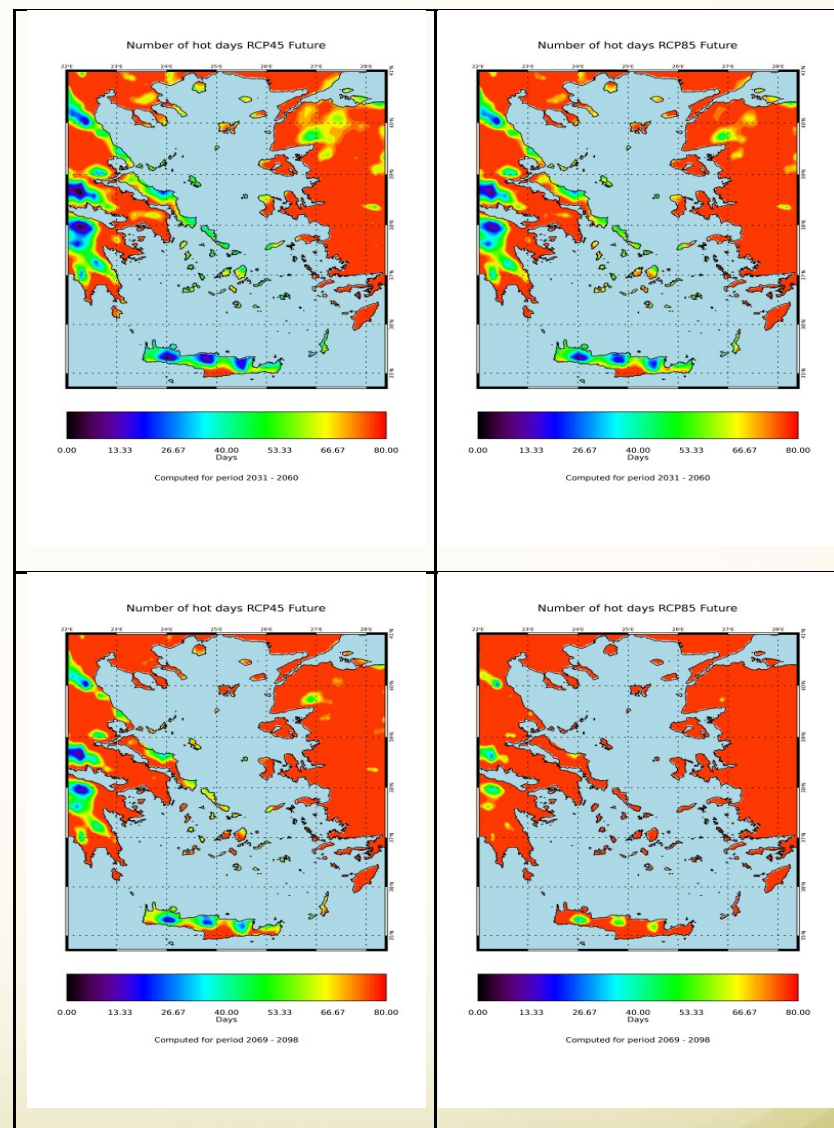
control period: between 5 d/y (mountainous Crete) and 65 (Rhodes)

near future: increases from 13 d/y to 50 d/y (Cyclades and Crete) from 55 d/y to 75 d/y for North Aegean and Dodecanese -(**increases of ~20d/y**)

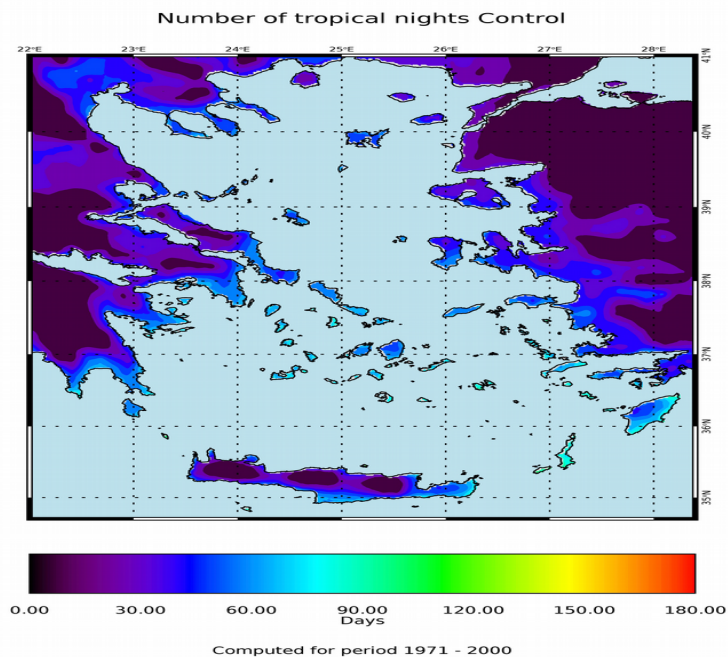
distant future: rises to 70 d/y for South Crete and Cyclades and 80 d/y for Dodecanese and North Aegean (RCP4.5) and close to 80 (RCP8.5). (**increases of ~40d/y**)

RCP 4.5

RCP 8.5



Number of tropical nights ($T_{min} > 20^{\circ}C$)

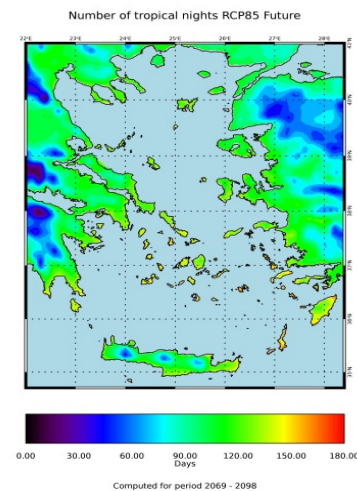
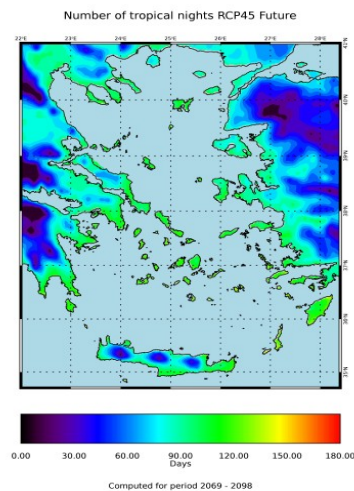
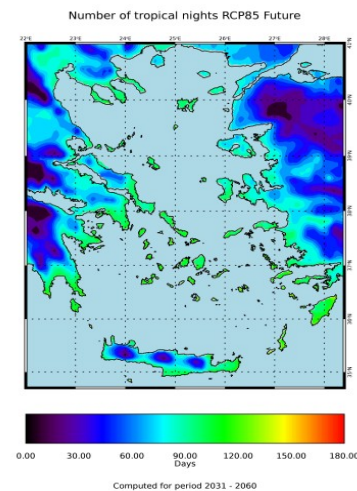
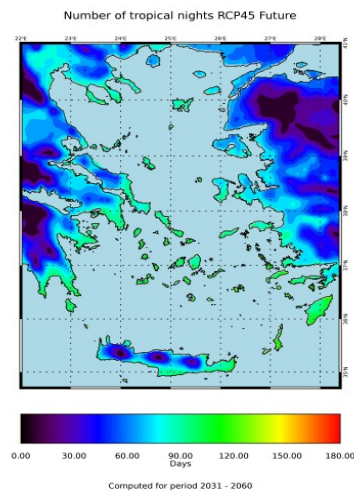


NEAR
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FUTURE

RCP 4.5

RCP 8.5



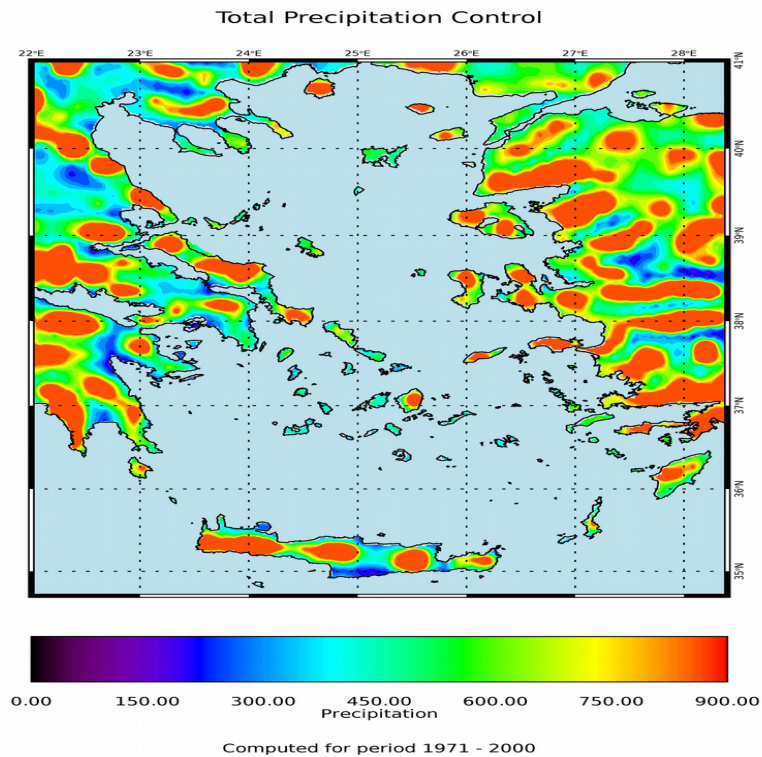
control period: 50 d/y (North Aegean, Crete) and 75 d/y (Dodecanese, South Cyclades).

near future: increase to 90 d/y (RCP4.5) or 100d/y (RCP8.5) all Aegean

distant future: rises to 110 (RCP4.5) and 140-160 (RCP8.5)

tropical nights are to double and triple in the near- to distant future for all Aegean Islands.

Total annual precipitation

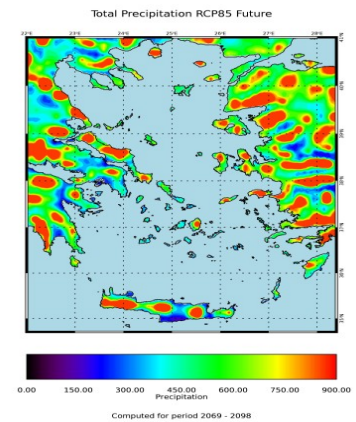
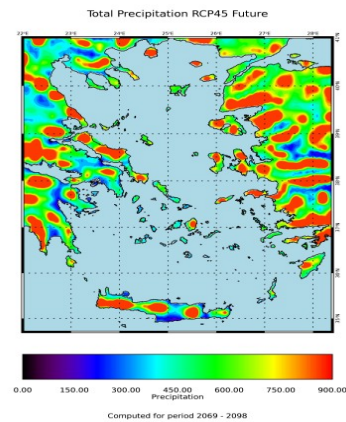
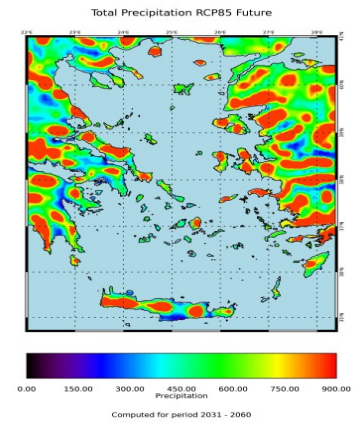
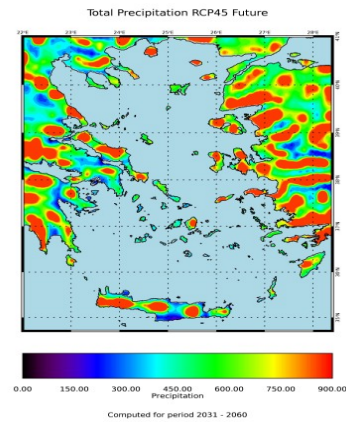


NEAR
FUTURE

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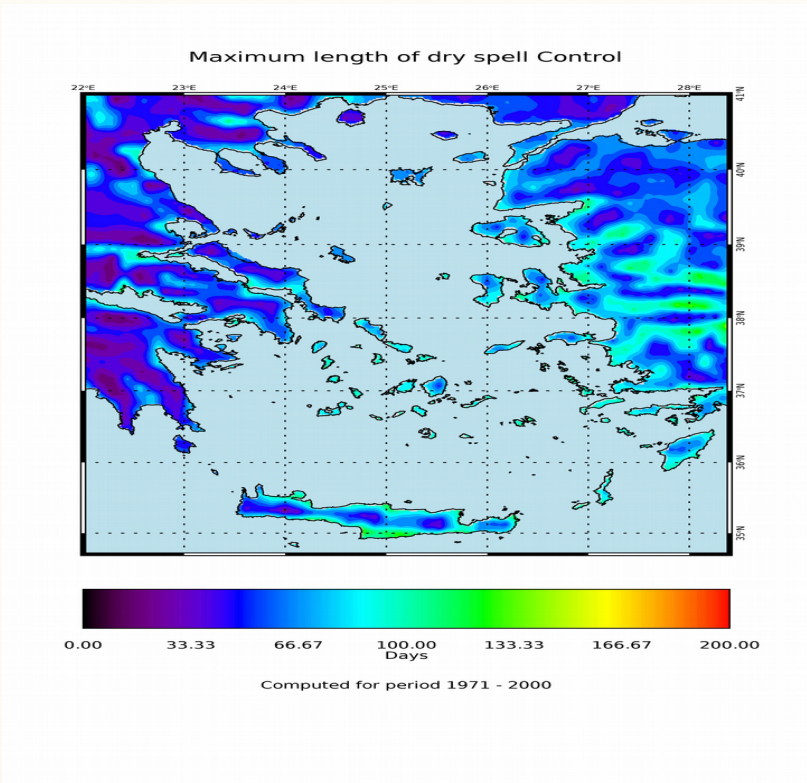
RCP 4.5

RCP 8.5



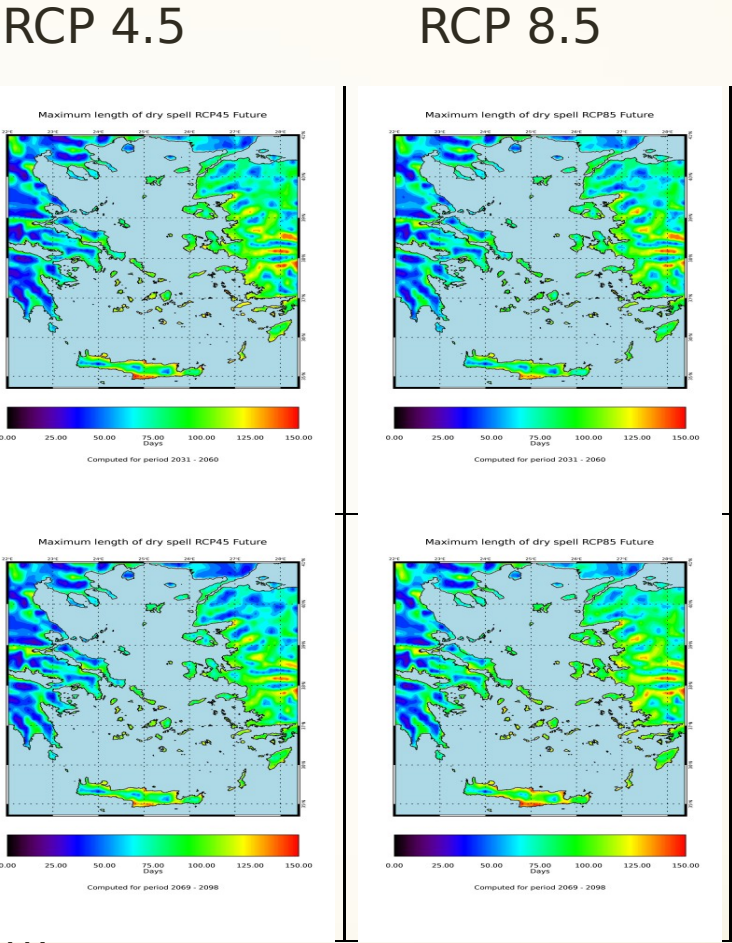
distant future: decrease significantly by 15-25%
large differences remain between- and within islands determined by geographical position (land sea boundaries) and mountain height

Maximum length of dry spell
(Maximum length of consecutive days with **PR<1mm**)



NEAR
FUTURE

DISTANT
FUTURE



control period: 66 days (North Aegean, Central Crete)
- 80 days (South Cyclades, Dodecanese)

near future: increases to 90 (North Aegean, Central Crete)
or 120 days (South Cyclades, Dodecanese) -RCP 4.5 and
to 110 days for (almost all Aegean) -RCP 8.5

distant future: 110 days Aegean, reaching the 130 days in
South Crete
(both scenarios).

large increases across the Aegean
- will double in the N Aegean /
Crete and increase by 50% in the
SE Aegean. under both RCP
scenarios



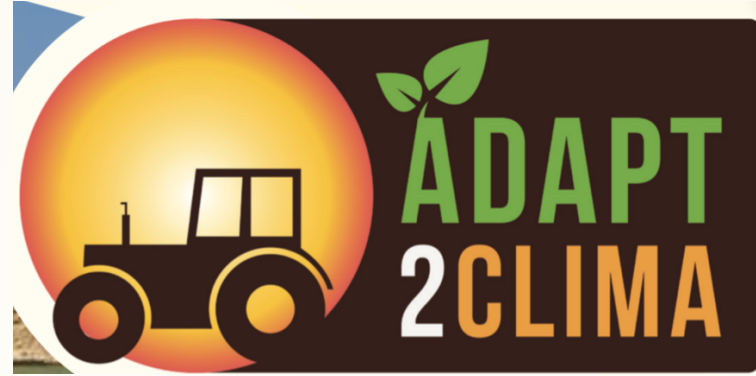
➤ Conclusions

- The results show annual **averaged Tmax and Tmin increases in the range of 4-6°C** across the **wider Aegean region in the near- and distant future**, especially under the RCP8.5.
- All **extreme temperature indices** are projected to **increase** considerably in the **future**.
- The **future vegetation cover and composition** is likely to **change** under influence of the **declining annual PR** and the **increasing length of dry spells**.
- Using the observational data from the meteorological stations already installed in the project, the anticipated improvement of the micro-climate of the areas after the land-use changes will be 'quantified', providing information on how frequent, long or intense an extreme event was in the past and how often it is expected to occur in the future.



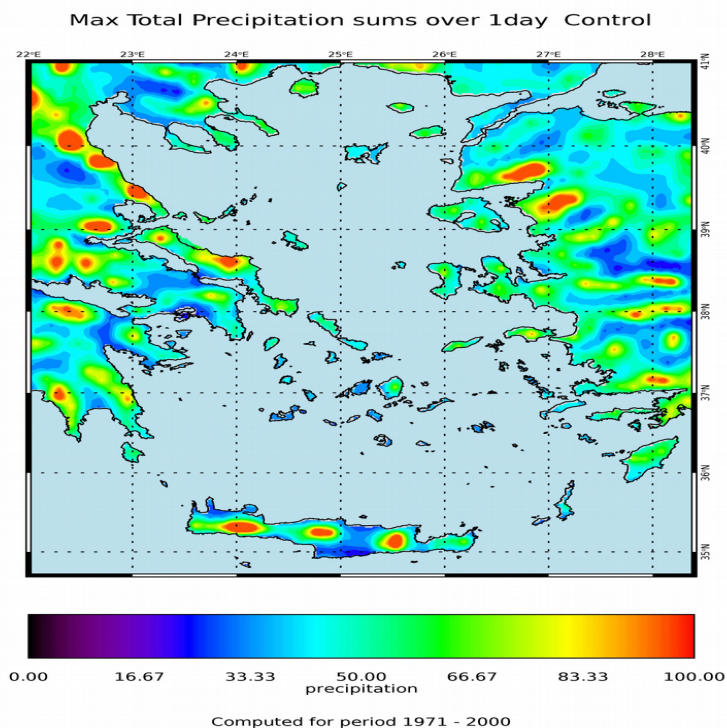
Photo by B. Psiloglou

heat and drought-resistant varieties of crops without the need for irrigation should be prioritized and promoted in climate-proof island



Thank you

Maximum 1-day precipitation amount



NEAR
FUTURE

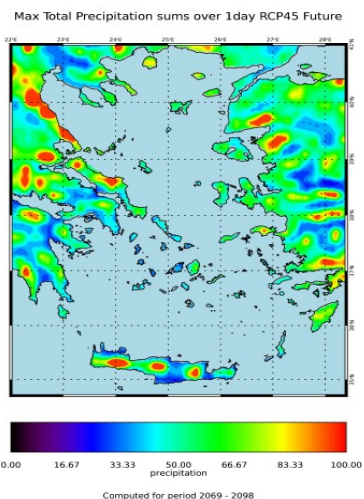
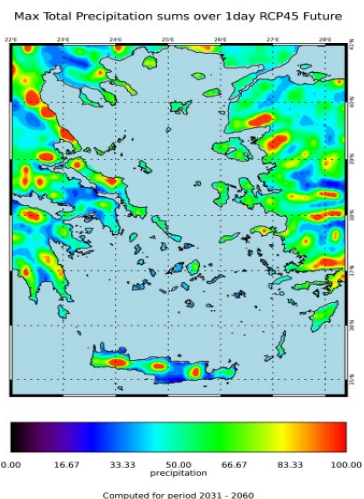
DISTANT
FUTURE

minor increase in the distant future.

control period: 35mm/y (parts of Crete and South Cyclades) or 55 mm/ (Aegean islands)

near future: negligible changes
distant future: increase per 10 mm/y (RCP 8.5)

RCP 4.5



RCP 8.5

