

# WATER DEMAND FOR AGRICULTURAL USE UNDER CLIMATE CHANGE SCENARIOS.



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## INTRODUCCION & OBJECTIVES

Given the decrease in water availability for agriculture caused by climate change (CC) in Mediterranean environments, it is necessary to use water efficiently in food production. As stated in the **PNACC (National Plan for Adaptation to Climate Change)**, knowing the water demand for agricultural use before and after adaptation to CC is essential, as well as optimizing basin monitoring.

In this line, the objective of this work is to **evaluate barley performance** under diverse **projected CC scenarios** and study the tendencies, allowing us to understand the response to rainfall patterns and temperature, considering different efficiency parameters and physiological stress.

Later, various selected CC adaptation strategies will be analysed at different levels of CC impact on the SCAB

## METHODOLOGY

• **Pilot case:** La Balisa sub-catchment (SCAB) covers 242 km<sup>2</sup> in the midlands of the Cega-Eresma-Adaja system, belonging to the Duero River Basin, in Segovia province

• **Water demand modeling:** Rainfed barley (critical economic and ecological importance in the study region) in SWAT (Soil and Water Assessment Tool).

• **WEATHER DATA:**

• **CC scenarios:** 2015-2099 period, six global climate models (GCMs) from the IPCC's AR6 for 2 scenarios (SSP 4.5 and SSP 8.5), regionalised and evaluated by the Spanish Meteorological Agency (AEMET), download from [AdapteCCa.es](http://AdapteCCa.es)

• **Calibrate periods:** data climate from Nava de la Asunción meteorological station from 2001 to 2014 (observed climate) and Ministry of Agriculture, Fisheries and Food (MAPA) yields for the same period.



## RESULTS & DISCUSSION

■ Average 2001-2014 ■ SSP 4.5 Scenario ■ SSP 8.5 Scenario

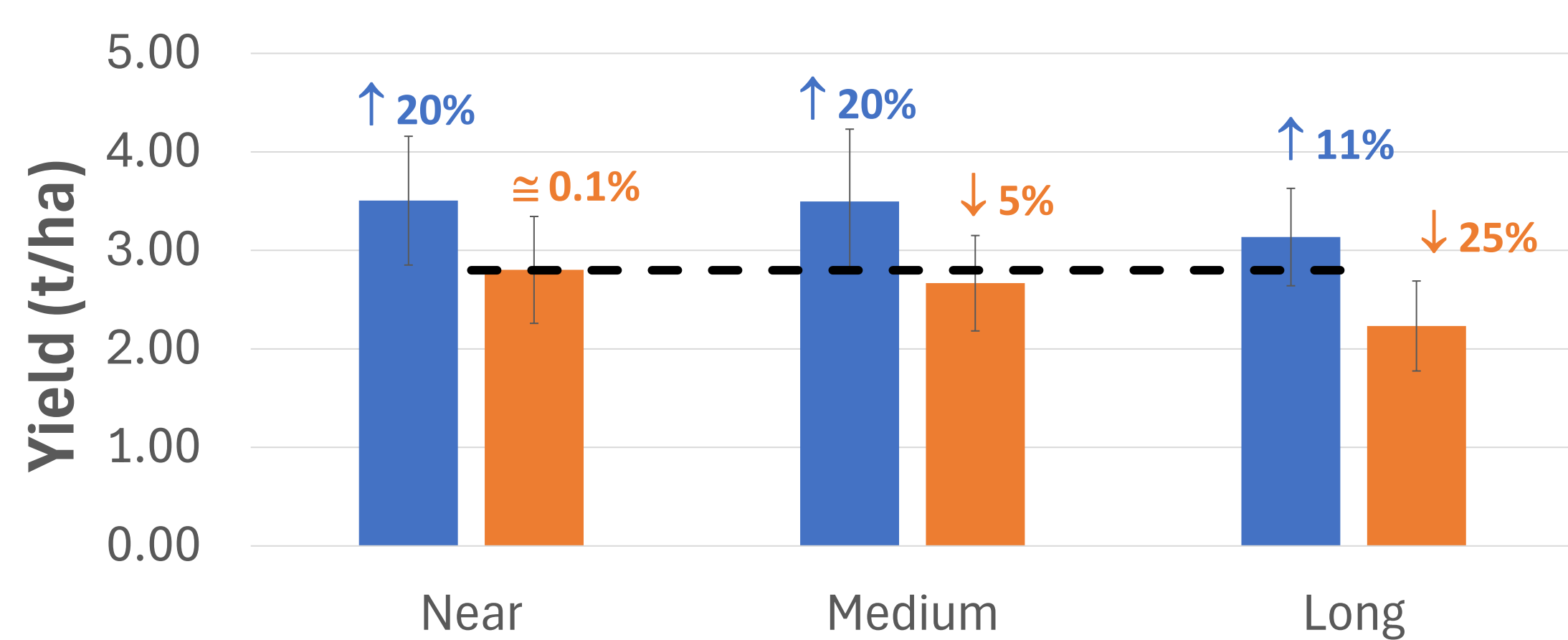


Figure 1. Barley yields average for near (2015-2039), medium (2040-2069), and long term (2070-2099)

### YIELD:

- Under SSP4.5, barley yield is projected to **increase**, primarily attributed to the fertilization effect of elevated CO<sub>2</sub>.
- For SSP8.5 scenario, barley yield shows a **decline**, so the benefits of CO<sub>2</sub> fertilisation are insufficient to counteract the adverse effects of higher temperatures, reduced water availability, and other stressors.

### REFERENCE EVAPOTRANSPIRATION (ET<sub>0</sub>)

- Under both climate projections ET<sub>0</sub> shows an apparent **increase**, with a particularly pronounced trend in SSP8.5. This increase in ET<sub>0</sub> reflects **higher water demand for crop transpiration and evaporation**, driven by rising temperatures and changes in atmospheric conditions. The trend is more significant in SSP8.5 due to the more extreme climate projections.

### ACTUAL BARLEY EVAPOTRANSPIRATION (ET<sub>a</sub>)

- The difference between trends in ET<sub>0</sub> and ET<sub>a</sub> reflects **the stress** suffered by barley, in special for SSP8.5, due to the increase in adverse conditions.

### WATER PRODUCTIVITY (the ratio of yield to water used)

- The water productivity (the ratio of yield to water used) exhibits a pattern similar to yield:
- In the SSP4.5 scenario, **increased** yields due to CO<sub>2</sub> fertilisation lead to improved water productivity, although the increased interannual variability complicates this relationship.
- In SSP8.5, despite the negative impact on yields, water productivity tends to **decrease** due to the combined stresses of higher temperatures and reduced water availability, which outweigh the benefits of CO<sub>2</sub> fertilisation.

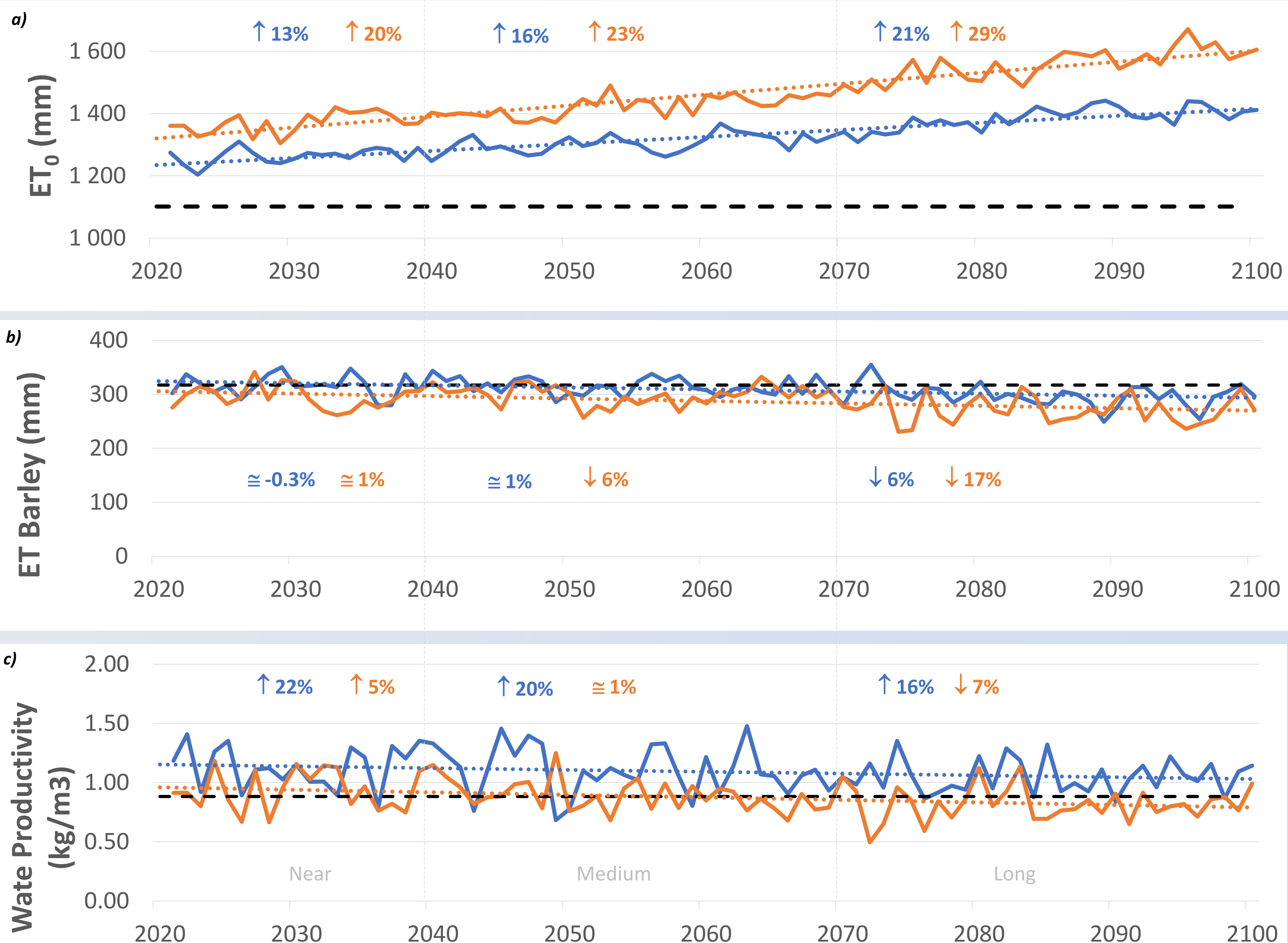


Figure 2. a) Simulated evapotranspiration (ET<sub>0</sub>), b) actual barley evapotranspiration (ET<sub>a</sub>) and c) Water productivity from 2021 to 2099. The dotted lines correspond to the linear regression.

## CONCLUSIONS

- Under SSP4.5, CO<sub>2</sub> fertilisation increases potential yield.
- In SSP8.5, extreme climatic conditions significantly reduce yields, overshadowing any benefits of CO<sub>2</sub> fertilisation.
- Increased reference evapotranspiration (ET<sub>0</sub>) under both scenarios highlights **greater water demand**.
- Adaptation measures are critical to sustaining barley production under CC. These include developing heat—and drought-tolerant varieties, optimising sowing dates, and adopting water-efficient practices.

