Phase 1 Climate Risk Assessment for Baixo Alentejo under the CLIMAAX Framework

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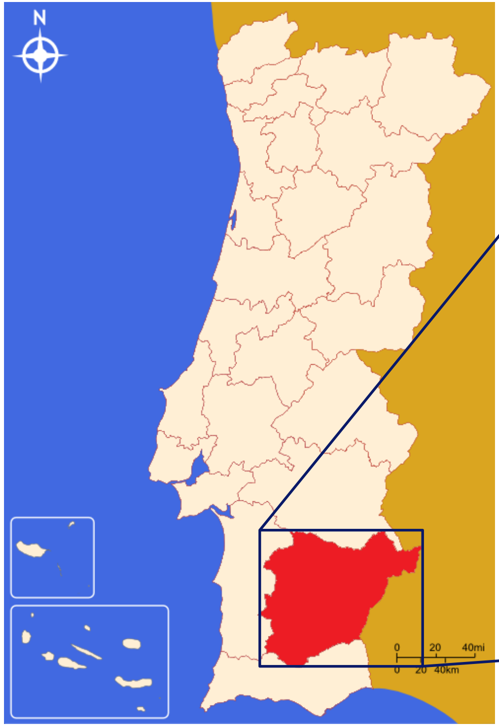
CLIMAAX
climate ready regions



Region of Baixo Alentejo

Located in the southern interior region of Portugal

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Introduction:

Baixo Alentejo is a predominantly rural region in southern Portugal, characterized by extensive agricultural activity and low population density. Its Mediterranean climate makes it particularly vulnerable to climate extremes, notably droughts, heatwaves and wildfires. Demographic challenges, including aging and depopulation, further constrain adaptive capacity.

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Introduction: Characteristics of the Region

- **Low population density** (114 887 inhabitants over 8 544.6 km2, ~14 people per square km)
- **Mediterranean climate** (Mean Annual Temperature between 15º and 17.5ºC, with a third of the year with maximum daily temperatures above 25ºC)
- **Annual precipitation unevenly distributed** between the seasons, with extreme high values during the Autumn and Winter seasons, and accentuated aridity during the Summer season.
- **Permanent mediterranean crops** are the main agricultural production is mostly (vineyards, olives, almond, etc.)
- **Artificial irrigation system** that serves around 130 000 ha of farmland, hugely invested in and in constant expansion.

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Workflows: Selected Hazards

Agricultural Drought

Selected due to high agricultural production and the importance of the region on Portugal's **main agricultural exports** (wine, almond, olives, cork, etc.).

Heatwaves

Selected due to the **extreme temperatures** associated with the region, especially during **Summer** months, the changes in temperature experienced year after year, and the predominant percentage of older, more vulnerable inhabitants in the region's population

Wildfires

Selected due to the **extreme temperatures associated with the region**, and the existence of a lot of land with trees and other more vulnerable vegetation, that comprise a lot of economical and ecological value, even with the relatively low frequence history of wildfires in the region.

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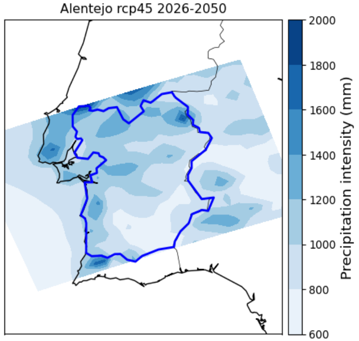
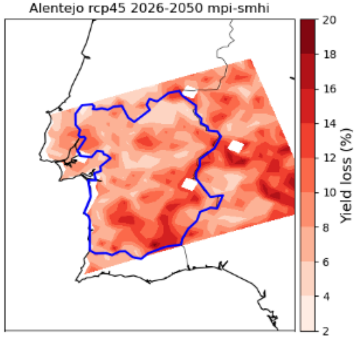
Agricultural Drought: Hazard

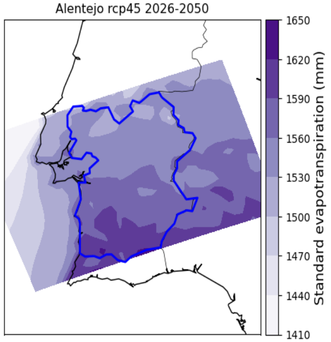
Cumulate precipitation intensity through the growing season



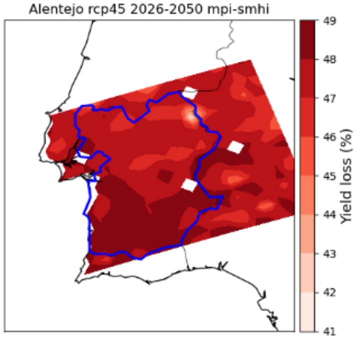
Barley yield loss from precipitation deficit



Cumulate standard evapotranspiration (ET0) through the growing season



Beans yield loss from precipitation deficit



- Workflow used **short-term projections** (2026–2050) under **RCP 4.5** (EuroCORDEX) for precipitation intensity during the growing season, etc.
- Workflow outputs calculated for the **NUTSII region of Alentejo**
- **Yield losses** calculated for every crop available in the current iteration of the Agricultural Drought workflow
- Yield losses show a **very high potential hazard** in non artificially irrigated crop and agricultural production on the region

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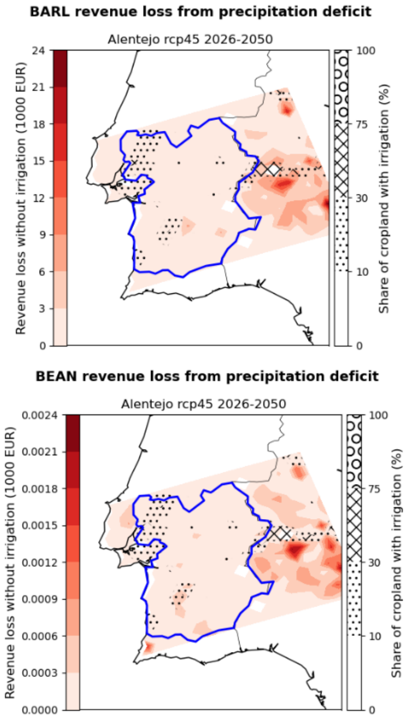
Agricultural Drought: Vulnerability



- Production data sourced from **MAPSpam 2010**, covering the available crops on the Agricultural Drought workflow
- Clear data limitations for the region of Baixo Alentejo (very low production values for all currently available crops)
- Resulted in very low economical and production risk, even with the high yield loss values

These risk results illustrate the need for this workflow to be given a much more local data focused to get meaningful results for the region (focus on mediterranean permanent crops, take into account the existing artificial irrigation systems, etc.)

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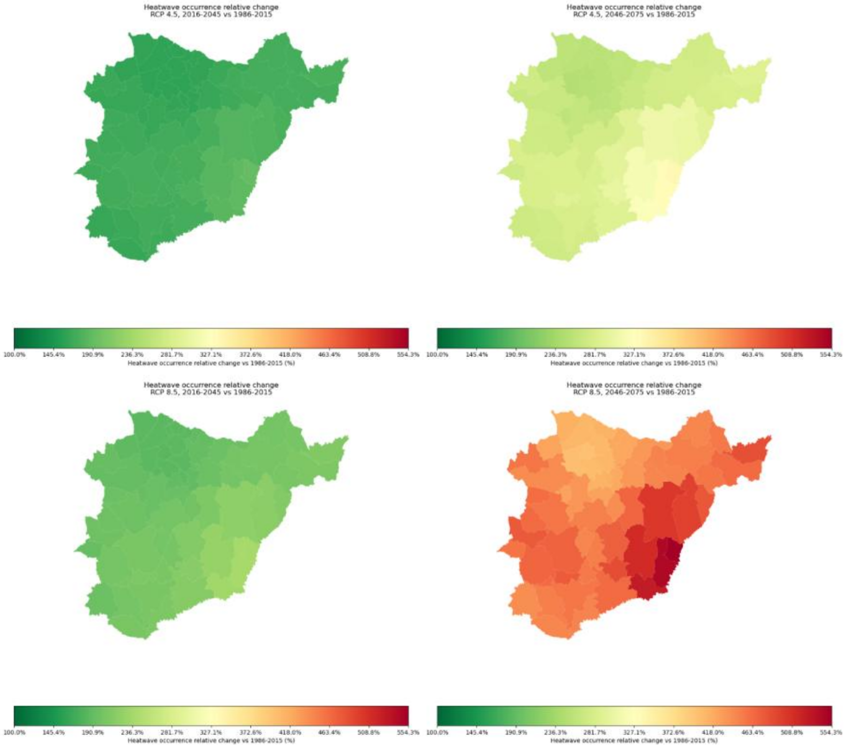
Heatwaves: Hazard

- Calculated using **EuroCORDEX** projections, for both **RCP 4.5 and 8.5** pathways, for two time periods, a shorter-term **2016-2045**, and a longer term **2046-2075.**
- Long-term evolution of the number of extreme heat days is around **350% for RCP 4.5-based** projections, and around **500% for RCP 8.5.**
- Evolution is somewhat **milder on the northwest** of the region, and is especially **accentuated** around the Vale do Guadiana area, in the **southeast.**



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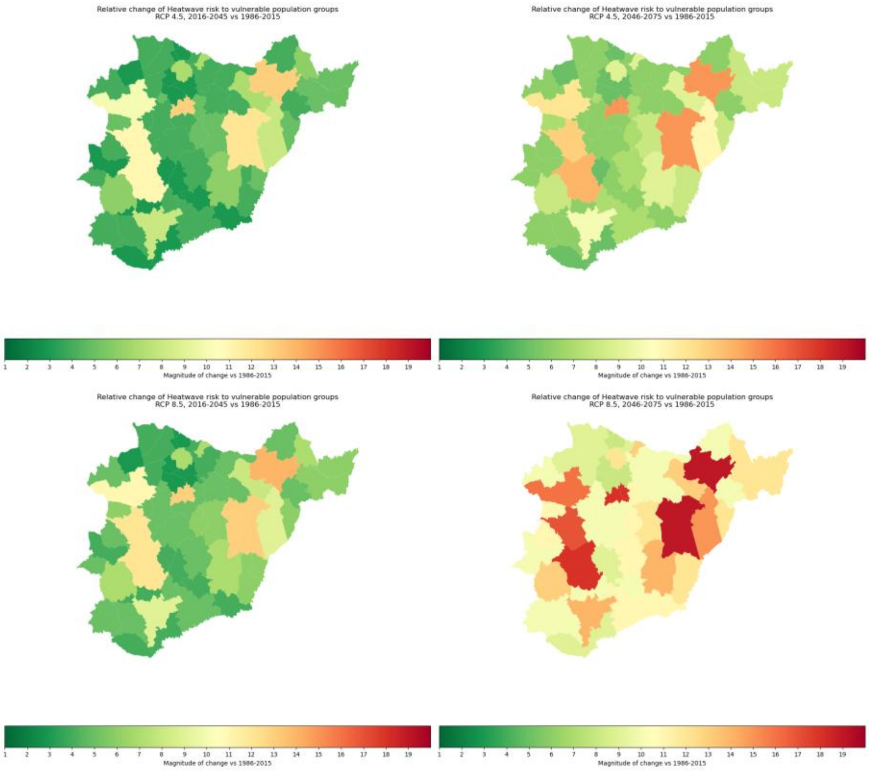
Heatwaves: Risk I

Based on a magnitude class classification, given a **hazard classification for heatwave occurrence evolution** and a **risk class for vulnerable population numbers**, resulting in a 1-20 classification of **population health risk.**

Classes for population risk were manually defined for each civil parish.



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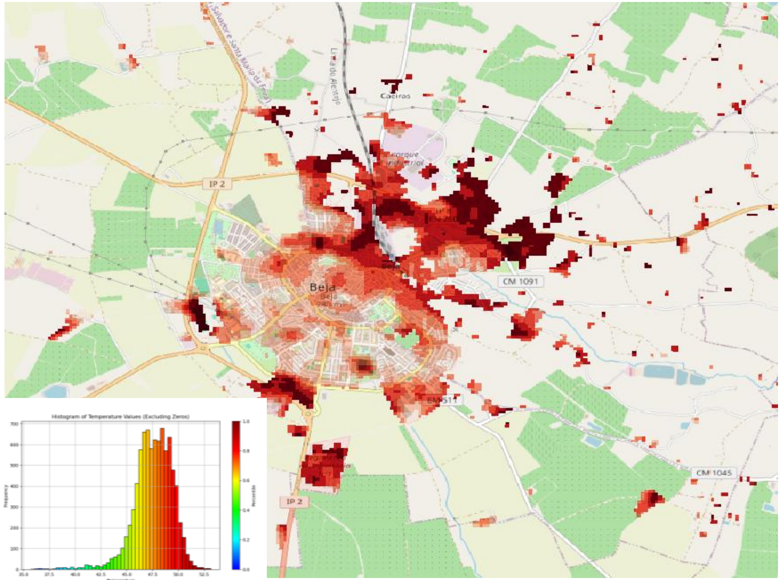
Heatwaves: Risk II

Land Surface Temperature was calculated using **Landsat 9 imagery** for the whole region, using data from the **Summer of 2024.**

These values were masked to **residential agglomerates**, and statistical values were calculated for each different city/town with a high population count

We were able to identify **more heat-prone areas** in residential agglomerates and to quantify how much the temperature deviated in these areas from the norm.



Land Surface Temperature map for the city of Beja (mean of temperature values around 40ºC)

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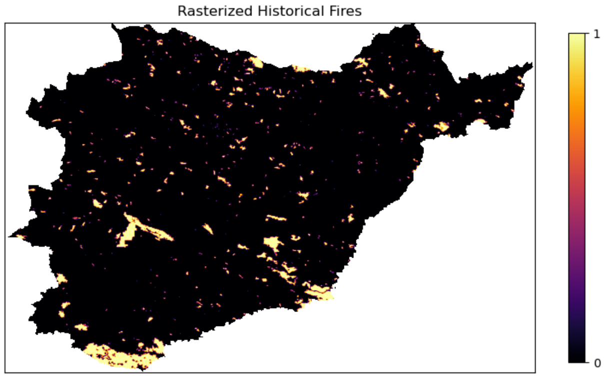
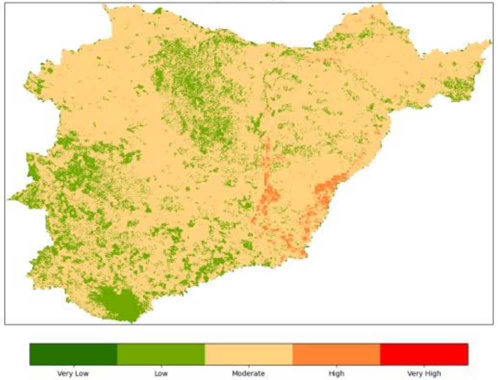
Wildfires:





Model Performance Metrics:

Accuracy:	0.969
Precision	0.887
Recall:	0.384
F1 Score:	0.536
ROC AUC:	0.932

The Wildfire machine learning workflow **didn't reach the expected results**, given an accentuated class imbalance on historical wildfire occurrences, not reaching expected model metrics during training.

During **phase 2**, we're studying the possibility of doing a machine learning model trained on the **national level using national-wide data.**

Also working with stakeholders to use local data alternatives with more fine-grained classes to the national reality.

We're also applying some data science techniques to better training performance, like class balancing, etc.

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Key Findings: Phase 1

- **Agricultural data mis-match**: CLIMAAX crop datasets don't include more permanent crops like olives, almond and vineyards, the region's main production.
- **Heatwave Evolution**: The region, while currently being one of the highest temperature regions in Portugal, shows the promise to worsen over time, and requires mitigation action regarding extreme temperatures.
- **Heat island identification**: Problematic heat-prone zones of residential towns/cities were identified and we're able to now study the effect of mitigating agents to formalize ways to combat this phenomenon
- **Wildfire model imbalance**: Few historic fire events produced poor machine-learning recall. Fortifying the need for better machine-learning modelling for this region

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