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**Smart control of the climate resilience**
in European coastal cities

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TÉCNICO LISBOA

# Policy Brief

# Heatwaves in Portugal: Understanding, Mitigation, Adaptation

## Summary


- This policy brief summarises a comprehensive analysis* of heatwaves in mainland Portugal from October 1980 to September 2021, utilising high-resolution ERA5-Land daily temperature data. The study aims to address the increasing occurrence of heatwaves in Portugal, a phenomenon that will be exacerbated by climate change.
- Key findings include a noticeable upward trend in both minimum and maximum temperatures (Tmin and Tmax) heatwave days, with notable spatial variations across different regions of Portugal.
- The results emphasise the urgent need for effective adaptation and mitigation strategies to alleviate the negative impacts of extreme temperatures on public health, agriculture, energy consumption, and ecosystem functioning. Additionally, recommendations for climate capacity building and raising public awareness are highlighted.


## Introduction

Heatwaves (often associated with extreme heat warnings) are becoming more frequent and intense worldwide, posing significant challenges to societies and ecosystems (see Box 1). Portugal has experienced severe heatwaves in recent years, with notable impacts on various sectors. However, the absence of local long-term temperature records impedes comprehensive analysis and monitoring of heatwaves. To address this gap, the study utilises high-resolution ERA5-Land daily temperatures. Its goal is to offer insights into the frequency, intensity, and spatial distribution of heatwaves in Portugal, crucial for developing effective adaptation and mitigation strategies to address the adverse effects of such extreme events.

**Policy briefs** offer information on current issues, presenting precise recommendations to contribute to ongoing policy discussions.

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### Box 1. Definitions:

**Heatwave** is a prolonged period of exceptionally hot weather, typically marked by either Tmax or Tmin surpassing specific thresholds for several consecutive days (e.g. three or more days). Throughout a heatwave, temperatures may persist significantly above average, presenting risks to human health, particularly vulnerable groups such as the elderly, young children, and individuals with pre-existing health conditions.

**Extreme Heat Warnings** (also known as orange or red alerts) are issued by meteorological agencies such as the IPMA (*Instituto Português do Mar e da Atmosfera*) during periods of exceptionally high temperatures. These alerts represent a severe risk to human health due to extreme heat conditions, typically associated with prolonged heatwaves.

*Adapted from the IPMA website.* https://www.ipma.pt/en/index.html

*This policy brief is based on: Espinosa, L.A.; Portela, M.M.; Moreira Freitas, L.M.; Gharbia, S. Addressing the Spatiotemporal Patterns of Heatwaves in Portugal with a Validated ERA5-Land Dataset (1980–2021). *Water* 2023, 15, 3102. https://doi.org/10.3390/w15173102

## Methodology

This study employs validated high-resolution ERA5-Land daily temperature data covering a 41-year period from October 1980 to September 2021. Nine climatological locations across Portugal are selected for analysis. The Heatwave Magnitude Index (HWMI) is utilised to identify heatwave events based on temperature thresholds, with a focus on both Tmin and Tmax. The methodology ensures robust analysis and accurate representation of heatwave occurrences in Portugal, providing valuable insights for climate change awareness.

## Research, Results, and Conclusions

The analysis reveals a significant increase in the frequency of both Tmin and Tmax heatwave days across Portugal over the 41-year period. Spatial variations are observed, such as the higher number of Tmax heatwave days in the northern and interior regions compared to the coastal areas (see Figure 1). The study emphasises the importance of utilising high-resolution reanalysis datasets like ERA5-Land for comprehensive heatwave analysis, overcoming limitations of traditional ground-based datasets. The findings underscore the urgency of implementing proactive measures to mitigate the impacts of heatwaves, including enhancing temperature monitoring and forecasting, developing early warning systems, implementing urban heat island mitigation strategies, and promoting sustainable practices.

## Policy Recommendations

**1. Enhance Temperature Monitoring and Forecasting:** Invest in continuous monitoring and data processing to enhance the accuracy and timeliness of temperature predictions, thus improving early intervention during heatwaves and raising awareness of climate risks.
**2. Implement Early Warning Systems:** Establish comprehensive heatwave early warning systems at national and regional levels, integrating meteorological data, health indicators, and vulnerability assessments to ensure timely dissemination of alerts and advisories to the public and relevant stakeholders.
**3. Mitigate Urban Heat Island Effect:** Implement urban planning strategies such as expanding green spaces, improving building insulation, and advocating for reflective surfaces to mitigate the urban heat island effect and decrease heat-related health risks.
**4. Promote Sustainable Practices:** Encourage sustainable practices such as reducing greenhouse gas emissions, promoting energy-efficient technologies, and adopting climate-resilient agricultural practices to mitigate the long-term impacts of climate change and reduce the frequency and intensity of heatwaves.

## Expected Outputs

- Improved public health outcomes through proactive heatwave preparedness and response measures.
- Enhanced resilience of critical infrastructure and ecosystems to extreme heat events.
- Reduced economic losses associated with heatwave-related impacts on agriculture, energy consumption, and tourism.
- Improved quality of life and well-being for vulnerable populations through targeted interventions and community engagement.

**To conclude, proactive measures to tackle the growing frequency and intensity of heatwaves in Portugal are crucial for safeguarding public health, preserving ecosystems, and enhancing resilience to climate change.** By implementing the recommended policies and strategies presented here, the impacts of heatwaves can be mitigated, thus contributing to a more sustainable and resilient future.

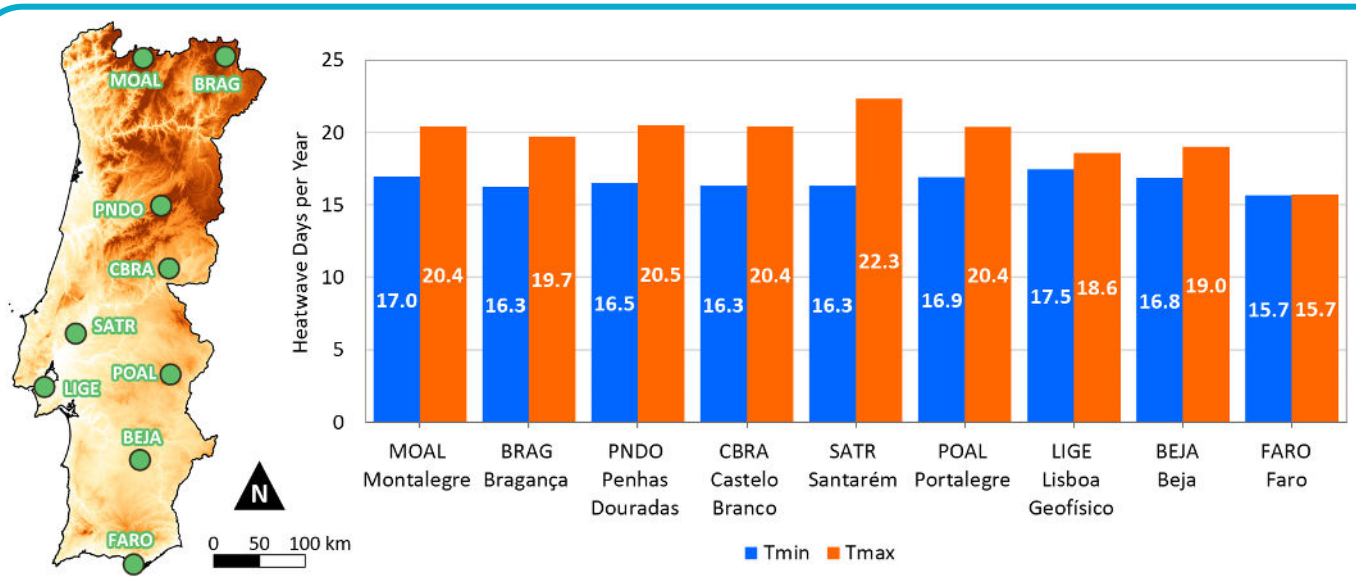


**Figure 1.** Mean annual number of Tmin and Tmax heatwave days from 1980 to 2021 at nine illustrative locations.