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The future of the Portuguese fire danger under climate change

Severe Impacts of Inaction

Climate change is driving changes in temperature and humidity, propelling droughts and heatwaves, resulting in exacerbated meteorological fire danger. If no action is taken, megafires will be more frequent.

Significant benefits of adaptation

Adaptation measures could help avoiding up to 68% of the economic costs in a no-action scenario.



RNA2100

The RNA2100 project aims to support public policy exercises of adaptation to climate change, at different levels of territorial intervention in Portugal. RNA2100's main aims include the characterization of climate change physical and socioeconomic impacts on the Portuguese most vulnerable domains, the assessment of financial costs and needs, and the implementation of a *National Spatial Planning Policy Programme*.
<https://rna2100.apambiente.pt/>

Fire danger projections

When assessing extreme meteorological fire danger across Mainland Portugal, an average total of **15** days per summer was identified. Projections indicate a significant escalation, with estimates reaching **30–40** days (2041–2070 under RCP4.5), **40–50** days (2041–2070 under RCP8.5), and up to **70** days (2071–2100 under RCP8.5) during the summer season. The most impacted regions appear to be northeastern Portugal, followed by the central belt of the country, while coastal areas exhibit lower susceptibility. The likelihood of ignition correlates directly with the severity of meteorological danger, with the probability of megafires, akin to the 2017 Pedrógão Grande, **more than doubling** by 2041–2070 under all scenarios. This probability amplifies further, surpassing **2.5-fold** under RCP8.5. By 2071–2100, the frequency of such megafires may exceed **3.5 times**, particularly under RCP8.5.

The benefits of adaptation

As climate change intensifies, forest fires grow in frequency and severity. To mitigate these risks, proactive adaptation strategies are crucial. Implementing robust forest management practices like controlled burns and fuel reduction, alongside early detection systems and community education, can bolster resilience. Integrating climate projections into planning ensures long-term viability. Considering the economic toll of wildfires, investing in adaptation proves financially prudent. By comparing adaptation costs with potential losses from inaction, it's evident that proactive measures offer significant benefits, safeguarding ecosystems, lives, and economies from escalating fire threats.

Storylines for Portugal



Awareness

This strategy focuses on raising awareness and implementing measures to reduce fire occurrences. It involves randomly reducing 50% of Fire Risk Points (FRPs) associated with Fire Weather Index (FWI) values exceeding the sample median. While showing promise in reducing fire incidents under moderate conditions, its widespread implementation demands substantial resources.

Examples of awareness strategies include community outreach programs, public service announcements, partnerships with stakeholders, fire danger mapping and communication, and training and capacity building.

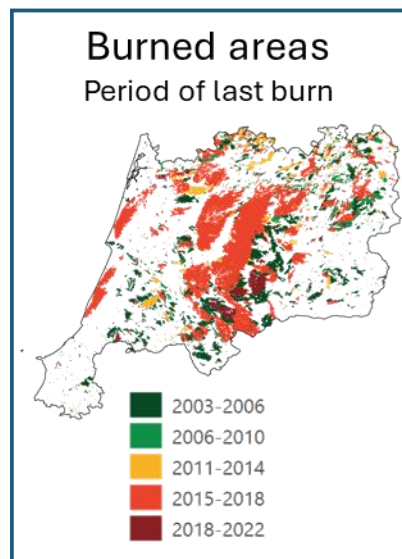
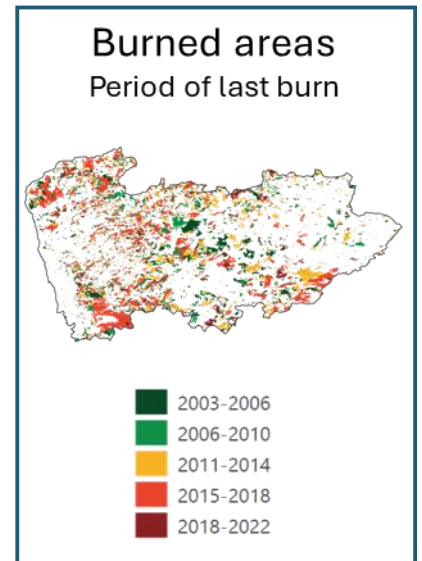
Awareness + Coercive

This strategy combines awareness-building efforts with coercive measures to reduce fire occurrences. The reduction percentage varies based on Fire Weather Index (FWI) percentiles, with higher reductions in regions experiencing extreme fire weather conditions. It demonstrates a notable impact on reducing fires in areas facing severe fire risk.

Norte

The assessment carried out for the Norte region revealed a projected significant increase in the number of extreme fire danger days. For the RCP4.5 **more +16 (+19) days** in extreme fire danger for the mid- (end-) century are projected with respect to the historical values.

Slighter changes for the RCP2.6 are projected, from additional **+7 to +8 days**, and for the RCP8.5 the number of extreme fire danger days can escalate more **+40** at the end of the century, **more than tripling the 15-days mark** observed in the historical climate.



Centro

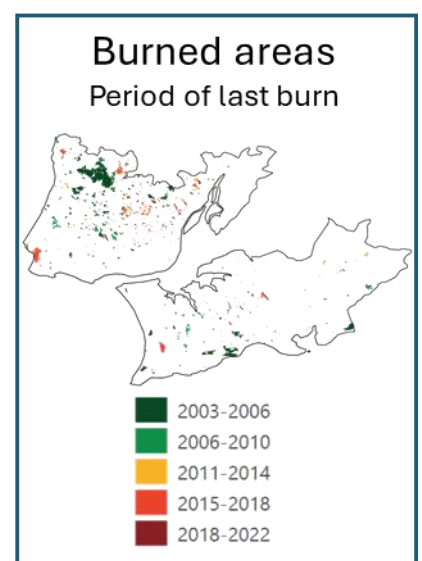
The assessment carried out for the Centro region revealed a projected significant increase in the number of extreme fire danger days. For the RCP4.5 **more +14 (+17) days** in extreme fire danger for the mid- (end-) century are projected with respect to the historical values.

Slighter changes for the RCP2.6 are projected, from additional **+6 to +7 days**, and for the RCP8.5 the number of extreme fire danger can escalate more **+35** at the end of the century, **more than tripling the 15-days mark** observed in the historical climate.

Lisbon Metropolitan Area

The assessment carried out for the Lisbon Metropolitan Area (AML) revealed a projected significant increase in the number of extreme fire danger days. For the RCP4.5 **more +10 (+12) days** in extreme fire danger for the mid- (end-) century are projected with respect to the historical values.

Slighter changes for the RCP2.6 are projected, from additional **+4 days**, and for the RCP8.5 the number of extreme fire danger can escalate more **+25** at the end of the century, **almost tripling the 15-days mark** observed in the historical climate.



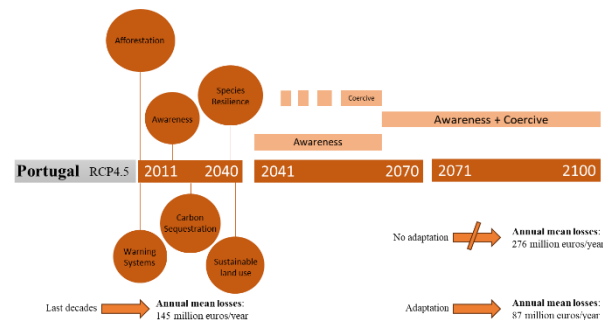
Coercive

This strategy focuses solely on coercive measures to reduce fire occurrences. It involves randomly reducing 95% of Fire Risk Points (FRPs) in very high Fire Weather Index (FWI) conditions. By targeting extremely intense fires during critical fire weather, it effectively addresses severe fire risk situations, albeit requiring focused resources. This approach aims to rapidly mitigate fire hazards during periods of extreme fire weather, thereby minimizing the potential for catastrophic fire events.

The targeted reduction of FRPs in high-risk conditions necessitates strategic allocation of firefighting resources, comprehensive monitoring systems, and efficient response mechanisms to ensure timely intervention and containment of fires.

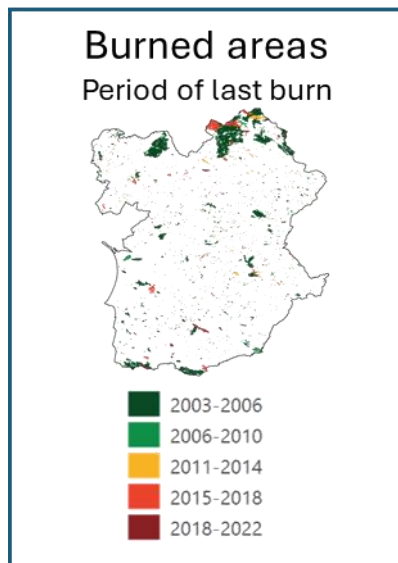
Adaptation pathways

Potential sequences of adaptation measures which can be implemented progressively, depending on future projected dynamics. Produced for each NUTSII region, storylines recognize the increased need for awareness and coercive strategies particularly in the Norte and Centro regions as soon as by 2050.



Storylines for Portugal

Alentejo



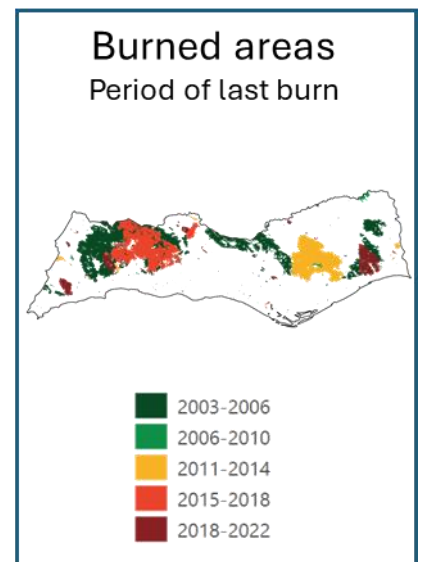
The assessment for the Alentejo region revealed that it is projected a significant increase in the number of extreme fire danger days. For the RCP4.5 more **+12 (+14) days** in extreme fire danger for the mid- (end-) century are projected with respect to the historical values.

Slighter changes for the RCP2.6 are projected, from additional **+4 to +5 days**, and for the RCP8.5 the number of extreme fire danger days can escalate more **+29** at the end of the century, **almost tripling the 15-days mark** observed in the historical climate.

Algarve

The assessment for the Algarve region revealed that it is projected a significant increase in the number of extreme fire danger days. For the RCP4.5 more **+8 (+10) days** in extreme fire danger for the mid- (end-) century are projected with respect to the historical values.

Slighter changes for the RCP2.6 are projected, from additional **+3 to +5 days**, and for the RCP8.5 the number of extreme fire danger days can escalate more **+20** at the end of the century, more than **doubling the 15-days mark** observed in the historical climate.



Methodology	Contact information	Virgílio A. Bento (vabento@ciencias.ulisboa.pt) Carlos da Camara (cdcamara@ciencias.ulisboa.pt)
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Projections of temperature, precipitation, humidity, and wind speed under the Paris mitigation scenario (RCP2.6), moderate mitigation scenario (RCP4.5), and high emissions scenario (RCP8.5) were used to estimate enhanced Fire Weather Index (FWIe) towards 2100, which was used to develop a statistical model than allows to compute the probability of ignition along the Portuguese forests and shrublands. The reported costs of large wildfires in the 5 NUTS II regions were used to extrapolate inaction costs into the future. Finally, each strategy (awareness, awareness + coercive, and coercive) impact on the cost (adaptation cost) was calculated accordingly.