

Tree physiology

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Introduction

In recent decades, drought-driven tree mortality has become widespread, particularly in Mediterranean ecosystems (Lemus-Canovas et al., 2024), where prolonged drought accelerates forest-to-shrubland transitions (Coughlan de Perez et al., 2022). Detecting **early-warning signals** of tree decline is therefore essential for anticipating ecosystem changes and guiding conservation.

We investigated massive 2023 mortality event in Aleppo pine (*Pinus halepensis*) at the Garraf Massif (NE Iberian Peninsula).



Figure 1: Mortality zone, Garraf 2024

This episode of drought-driven tree mortality from 2023 was reported in the Catalan news. Despite the rains of recent months, the effects of the drought remain visible.

Climatic data

Climatic data were obtained from the meteorological station at El Prat Airport, which has recorded weather variables since 1950 (Prohom et al., 2023). These are the trends of temperature and precipitation for the period 1950-2022.

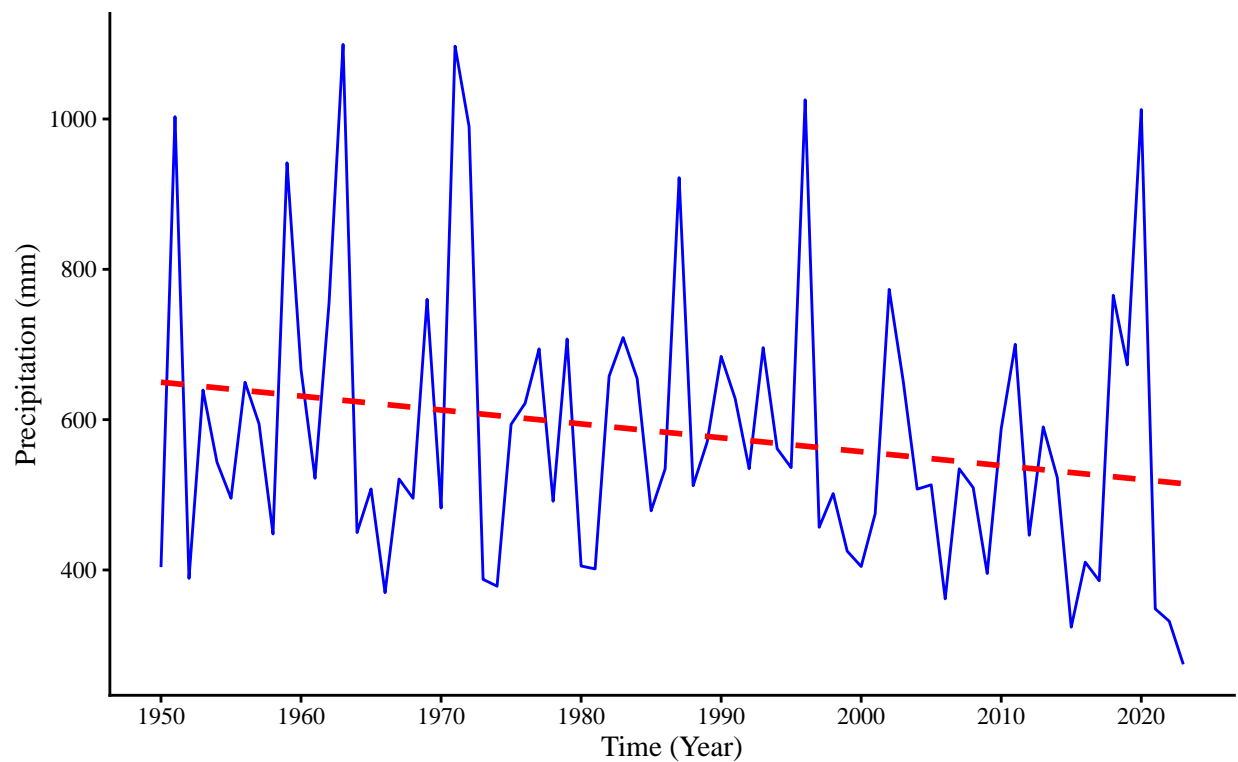
```
##
## S'està adjuntant el paquet: 'dplyr'

## Els següents objectes estan emmascarats des de 'package:stats':
##
##   filter, lag

## Els següents objectes estan emmascarats des de 'package:base':
##
##   intersect, setdiff, setequal, union
```

Precipitation trend at Aeroport del Prat (1950–2023)

$$y = -1.85x + 4254.14 \quad | \quad R^2 = 0.043 \quad \text{ns}$$

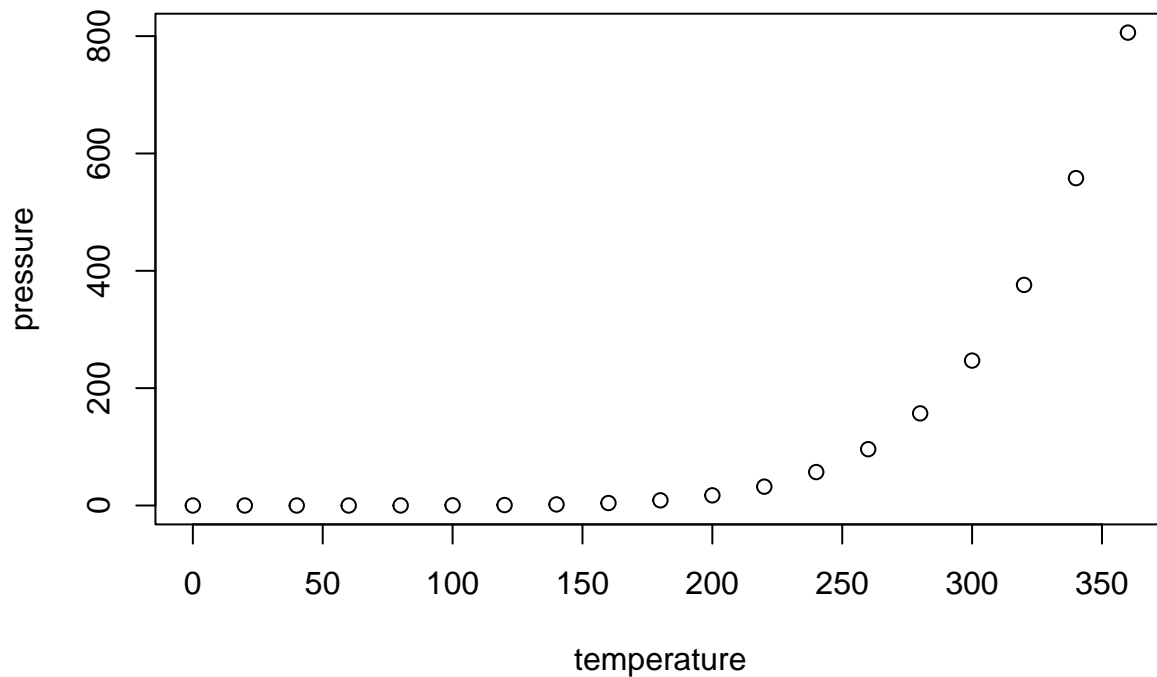


```
##      speed      dist
## Min.   : 4.0    Min.   : 2.00
## 1st Qu.:12.0    1st Qu.: 26.00
```

```
## Median :15.0    Median : 36.00
## Mean   :15.4    Mean    : 42.98
## 3rd Qu.:19.0    3rd Qu.: 56.00
## Max.   :25.0    Max.    :120.00
```

Including Plots

You can also embed plots, for example:



Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.

```
##Bibliography
```

- Coughlan de Perez, E., Harrison, L., Berse, K., Easton-Calabria, E., Marunye, J., Marake, M., Murshed, S. B., Shampa, & Zauisomue, E.-H. (2022). Adapting to climate change through anticipatory action: The potential use of weather-based early warnings. *Weather and Climate Extremes*, 38, 100508. <https://doi.org/10.1016/j.wace.2022.100508>
- Lemus-Canovas, M., Insua-Costa, D., Trigo, R. M., & Miralles, D. G. (2024). Record-shattering 2023 Spring heatwave in western Mediterranean amplified by long-term drought. *Npj Climate and Atmospheric Science*, 7(1), 25. <https://doi.org/10.1038/s41612-024-00569-6>
- Prohom, M., Domonkos, P., Cunillera, J., Barrera-Escoda, A., Busto, M., Herrero-Anaya, M., Aparicio, A., & Reynés, J. (2023). CADTEP : A new daily quality-controlled and homogenized climate database for Catalonia (1950–2021). *International Journal of Climatology*, 43(11), 4771–4789. <https://doi.org/10.1002/joc.8116>