# SUPPLEMENTARY INFORMATION
# Exacerbated fires in Mediterranean Europe due to anthropogenic warming projected with non-stationary climate-fire models

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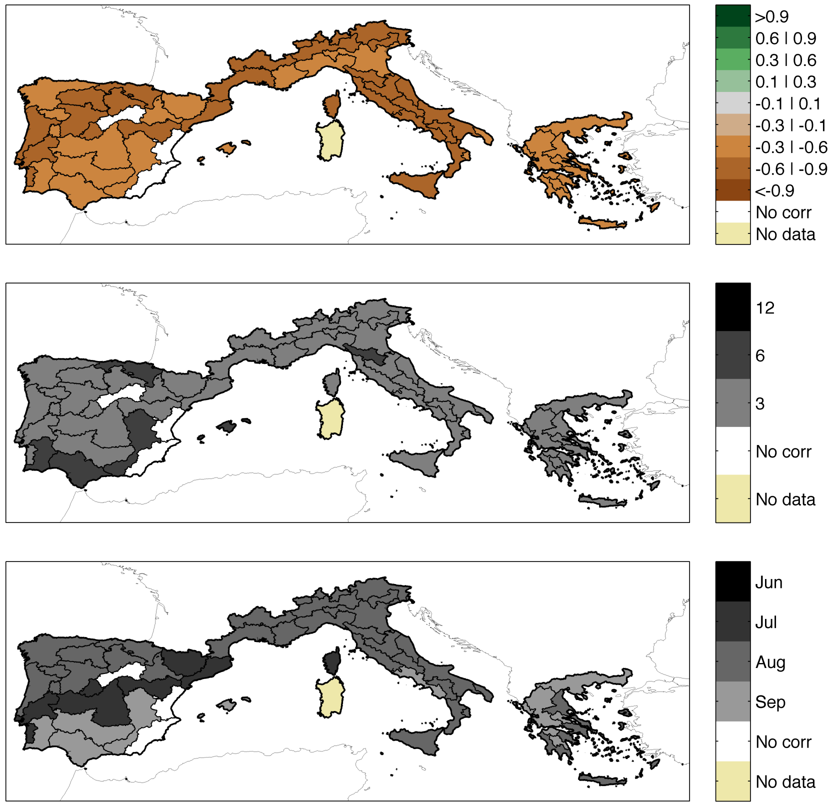
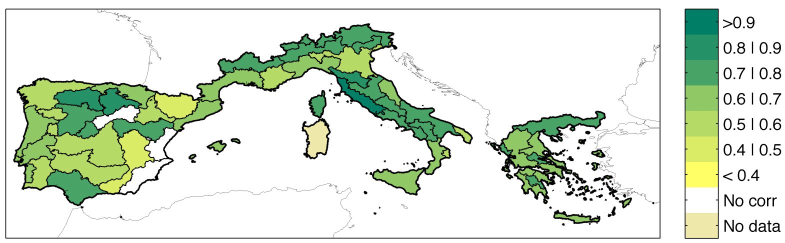
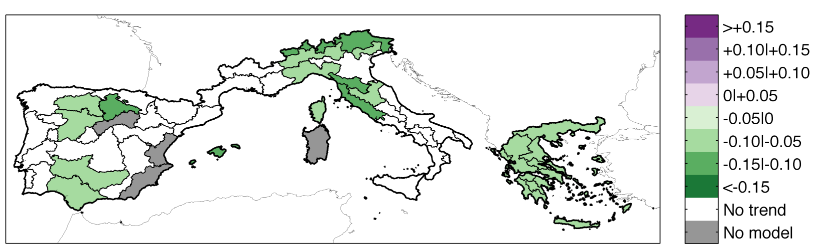


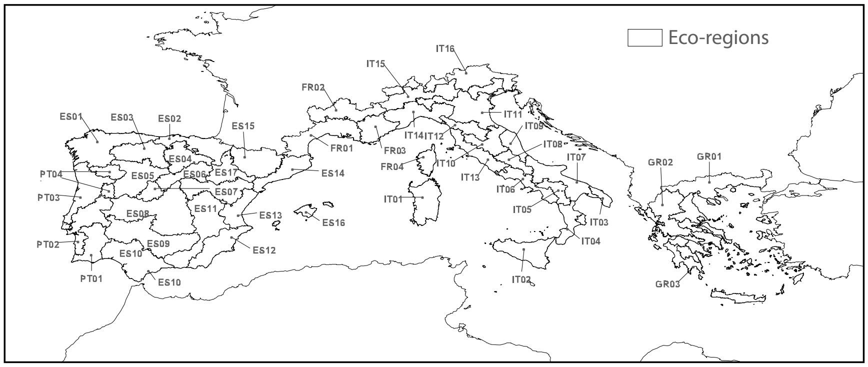

Supplementary Figure 1: Maximum significant correlation (in absolute value) between $\log(BA)$ and SPEI (first line); length of the period (3, 6 and 12 months; second line) and final month of accumulation of the SPEI for which the absolute value of the correlation is maximum (third line). Only correlations that are collectively significant from a False Discovery Rate test[1] are shown.



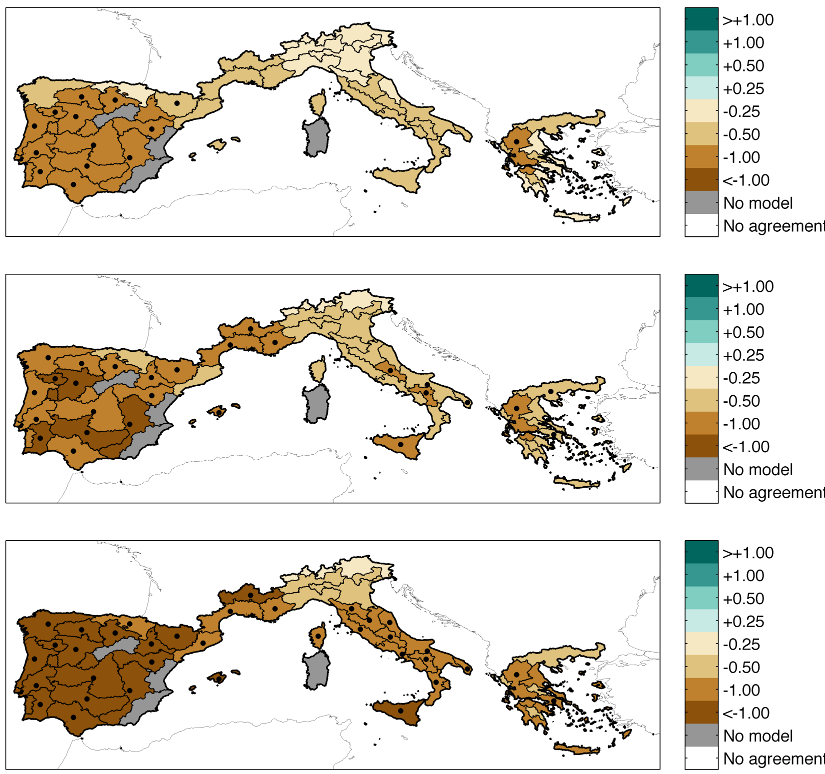

Supplementary Figure 2: Correlation between modelled and observed $\log(BA)$ for each eco-region.



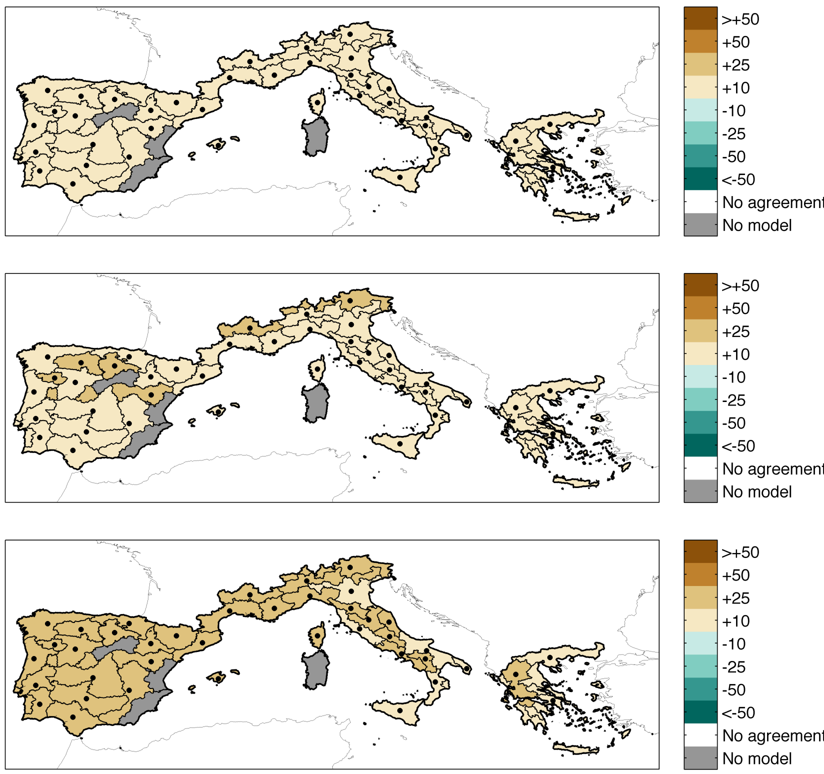

Supplementary Figure 3: Coefficient weights for the predictor time trend (i.e. the coefficient $\beta_3$ of Eq. 1 in the main paper).



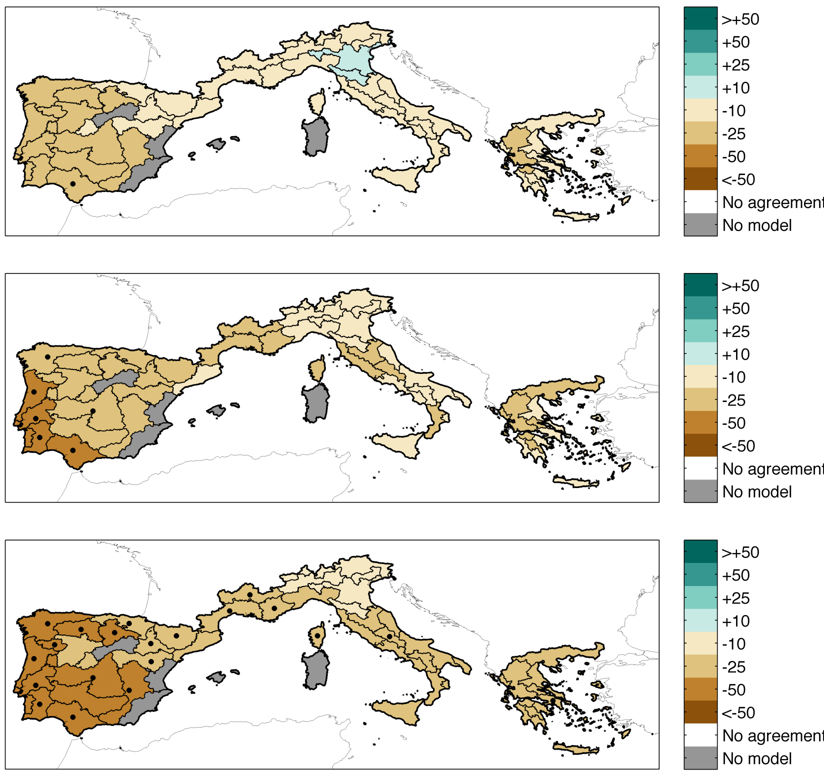

Supplementary Figure 4: Eco-regions and relative codes used in this study. See[2] and[3] for more details.




Supplementary Figure 5: Ensemble mean $SPEI_{sc}(m)$ (exact values of $sc$ and $m$ are available in Table 1) changes, with respect to 1971-2000, for the +1.5°C case (first line), the +2°C case (second line) and the +3°C case (third line). Dots indicate areas where at least 50% of the models show a statistically significant change and more than 66% agree on the direction of the change; coloured area (without dots) indicate that changes are small compared to natural variations; white regions (if any) indicate that no agreement between the RCMs is found (similarly to[4]).




Supplementary Figure 6: Ensemble mean PET changes (in percentage), with respect to 1971-2000, for the +1.5°C case (first line), the +2°C case (second line) and the +3°C case (third line). Dots indicate areas where at least 50% of the models show a statistically significant change and more than 66% agree on the direction of the change; coloured area (without dots) indicate that changes are small compared to natural variations; white regions (if any) indicate that no agreement between the RCMs is found (similarly to[4]).




Supplementary Figure 7: Ensemble mean PRE changes (in percentage), with respect to 1971-2000, for the +1.5°C case (first line), the +2°C case (second line) and the +3°C case (third line). Dots indicate areas where at least 50% of the models show a statistically significant change and more than 66% agree on the direction of the change; coloured area (without dots) indicate that changes are small compared to natural variations; white regions (if any) indicate that no agreement between the RCMs is found (similarly to[4]).

| Region | Model | RhoIN | RhoOUT |
|---|---|---|---|
| ES01 | $Y$=9.55-0.85 $\cdot SPEI_3(0,8)$ | 0.52 | 0.40 |
| ES02 | $Y$=5.21-1.14 $\cdot SPEI_6(0,8)$ | 0.70 | 0.66 |
| ES03 | $Y$=9.69-0.72 $\cdot SPEI_3(0,8)$-0.09 $\cdot T$ | 0.80 | 0.73 |
| ES04 | $Y$=7.51-1.08 $\cdot SPEI_3(0,8)$-0.11 $\cdot T$ | 0.85 | 0.80 |
| ES05 | $Y$=9.83-0.69 $\cdot SPEI_3(0,8)$-0.09 $\cdot T$ | 0.78 | 0.65 |
| ES07 | $Y$=7.42-1.26 $\cdot SPEI_3(0,7)$ | 0.74 | 0.68 |
| ES08 | $Y$=8.84-0.59 $\cdot SPEI_3(0,7)$ | 0.50 | 0.37 |
| ES09 | $Y$=9.30-0.51 $\cdot SPEI_3(0,9)$-0.08 $\cdot T$ | 0.59 | 0.47 |
| ES10 | $Y$=9.74-0.48 $\cdot SPEI_6(0,9)$-0.10 $\cdot T$ | 0.75 | 0.69 |
| ES11 | $Y$=7.02-0.85 $\cdot SPEI_6(0,9)$ | 0.50 | 0.41 |
| ES14 | $Y$=7.04-1.18 $\cdot SPEI_3(0,7)$ | 0.63 | 0.51 |
| ES15 | $Y$=6.11-0.88 $\cdot SPEI_3(0,7)$ | 0.49 | 0.37 |
| ES16 | $Y$=6.63-0.75 $\cdot SPEI_6(0,9)$-0.10 $\cdot T$ | 0.62 | 0.51 |
| ES17 | $Y$=5.77-0.94 $\cdot SPEI_3(0,8)$ | 0.56 | 0.47 |
| FR01 | $Y$=7.50-0.79 $\cdot SPEI_3(0,8)$ | 0.64 | 0.53 |
| FR02 | $Y$=5.17-1.20 $\cdot SPEI_3(0,8)$ | 0.71 | 0.67 |
| FR03 | $Y$=6.49-1.08 $\cdot SPEI_3(0,8)$ | 0.57 | 0.46 |
| FR04 | $Y$=9.13-1.06 $\cdot SPEI_3(0,7)$-0.10 $\cdot T$ | 0.76 | 0.69 |
| GR01 | $Y$=8.87-0.89 $\cdot SPEI_3(0,9)$-0.06 $\cdot T$ | 0.71 | 0.63 |
| GR02 | $Y$=8.66-0.80 $\cdot SPEI_3(0,9)$-0.07 $\cdot T$ | 0.69 | 0.64 |
| GR03 | $Y$=9.75-0.87 $\cdot SPEI_3(0,8)$-0.10 $\cdot T$ | 0.67 | 0.53 |
| IT02 | $Y$=9.23-0.60 $\cdot SPEI_3(0,8)$ | 0.67 | 0.59 |
| IT03 | $Y$=5.77-0.37 $\cdot SPEI_3(0,8)$ | 0.55 | 0.46 |
| IT04 | $Y$=9.01-0.58 $\cdot SPEI_3(0,8)$ | 0.64 | 0.57 |
| IT05 | $Y$=7.48-0.80 $\cdot SPEI_3(0,8)$ | 0.72 | 0.66 |
| IT06 | $Y$=8.56-0.66 $\cdot SPEI_3(0,9)$ | 0.77 | 0.72 |
| IT07 | $Y$=8.66-0.75 $\cdot SPEI_3(0,8)$ | 0.77 | 0.71 |
| IT08 | $Y$=6.07-1.16 $\cdot SPEI_3(0,8)$ | 0.74 | 0.68 |
| IT09 | $Y$=5.44-1.17 $\cdot SPEI_3(0,8)$ | 0.66 | 0.59 |
| IT10 | $Y$=7.14-0.90 $\cdot SPEI_3(0,8)$-0.08 $\cdot T$ | 0.77 | 0.70 |
| IT11 | $Y$=4.68-0.83 $\cdot SPEI_3(0,8)$ | 0.57 | 0.50 |
| IT12 | $Y$=7.56-1.24 $\cdot SPEI_6(0,8)$-0.13 $\cdot T$ | 0.82 | 0.76 |
| IT13 | $Y$=8.96-0.62 $\cdot SPEI_3(0,8)$-0.12 $\cdot T$ | 0.91 | 0.89 |
| IT14 | $Y$=8.12-0.64 $\cdot SPEI_3(0,8)$-0.09 $\cdot T$ | 0.66 | 0.61 |
| IT15 | $Y$=5.41-0.97 $\cdot SPEI_3(0,8)$-0.08 $\cdot T$ | 0.77 | 0.71 |
| IT16 | $Y$=5.58-1.22 $\cdot SPEI_3(0,8)$-0.15 $\cdot T$ | 0.80 | 0.73 |
| PT01 | $Y$=7.92-0.73 $\cdot SPEI_6(0,9)$ | 0.54 | 0.42 |
| PT02 | $Y$=9.38-0.87 $\cdot SPEI_3(0,7)$ | 0.69 | 0.63 |
| PT03 | $Y$=10.62-0.74 $\cdot SPEI_3(0,8)$ | 0.63 | 0.59 |
| PT04 | $Y$=9.71-0.60 $\cdot SPEI_3(0,8)$ | 0.59 | 0.53 |



Supplementary Table 1: Empirical SPEI-fire models (Eq. 1) for each eco-region (labelled according to Fig. S4) and the correlation for the reconstruction model (RhoIN: in-sample) and for the leave-one-out cross validation model (RhoOUT: out-of-sample).

| Institution | ESM | run | RCM |
|---|---|---|---|
| CLMcom | MOHC-HadGEM2-ES | r1i1p1 | CCLM4-8-17 |
| DMI | ICHEC-EC-EARTH | r3i1p1 | HIRHAM5 |
| KNMI | ICHEC-EC-EARTH | r1i1p1 | RACMO22E |
| KNMI | MOHC-HadGEM2-ES | r1i1p1 | RACMO22E |
| SMHI | CERFACS-CNRM-CM5 | r1i1p1 | RCA4 |
| SMHI | ICHEC-EC-EARTH | r12i1p1 | RCA4 |
| SMHI | IPSL-CM5A-MR | r1i1p1 | RCA4 |
| SMHI | MOHC-HadGEM2-ES | r1i1p1 | RCA4 |
| SMHI | MPI-ESM-LR | r1i1p1 | RCA4 |

Supplementary Table 2: EURO-CORDEX RCM models used in this study.

| | +1.5°-rcp45 | +2°-rcp45 | +3°-rcp45 | +1.5°-rcp85 | +2°-rcp85 | +3°-rcp85 |
|---|---|---|---|---|---|---|
| CNRM-CM5 | 2035-2064 | 2057-2086 | – | 2029-2058 | 2043-2072 | 2066-2095 |
| EC-EARTH | 2021-2050 | 2043-2072 | – | 2018-2047 | 2035-2064 | 2059-2088 |
| HadGEM2-ES | 2023-2052 | 2039-2068 | – | 2019-2048 | 2031-2060 | 2052-2081 |
| MPI-ESM-LR | 2019-2048 | 2042-2071 | – | 2016-2045 | 2034-2063 | 2060-2089 |
| IPSL-CM5A-MR | 2010-2039 | 2026-2055 | 2067-2096 | 2009-2038 | 2025-2054 | 2046-2075 |

Supplementary Table 3: Periods of each GCM for the three warming levels considered in this study.

## References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