



Supplement of

Spatial structures of emerging hot and dry compound events over Europe from 1950 to 2023

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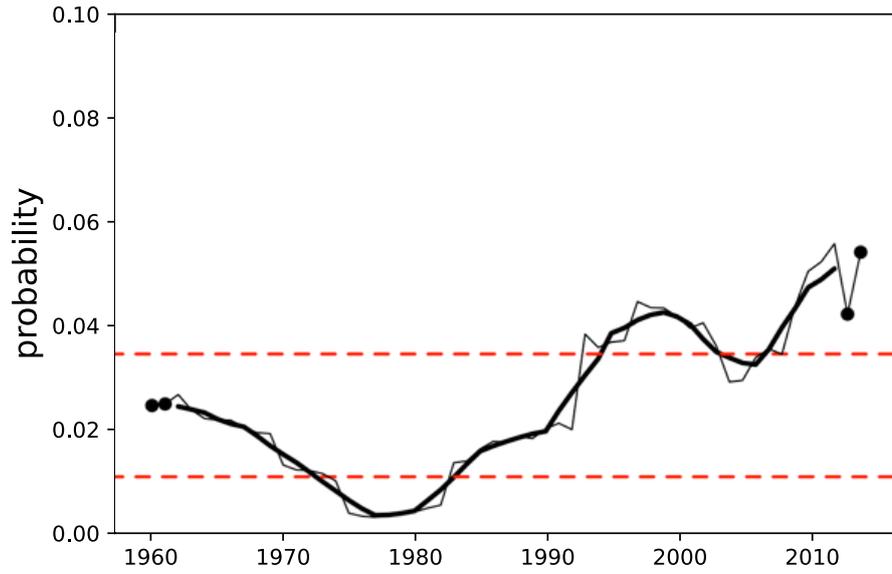


Figure S1. Compound event probability signal in Vilnius. The thick curve represents the smoothed signal (5-year window), and the thin line the original (unsmoothed) signal. The natural variability is given by the two dotted red lines.

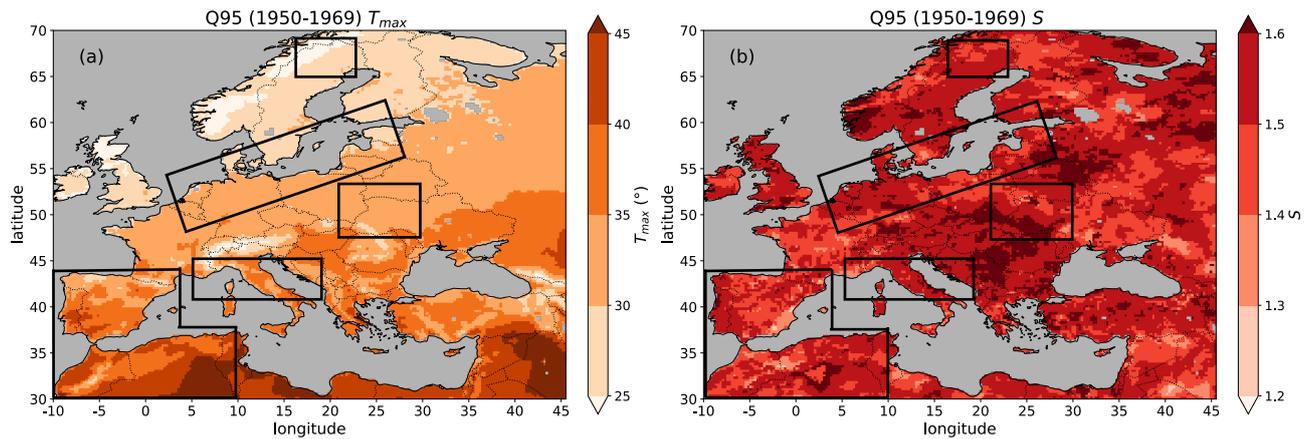


Figure S2. Thresholds used for the hot-dry CE study: 95th percentile of the two variables (a) T_{max} and (b) S during the baseline period.

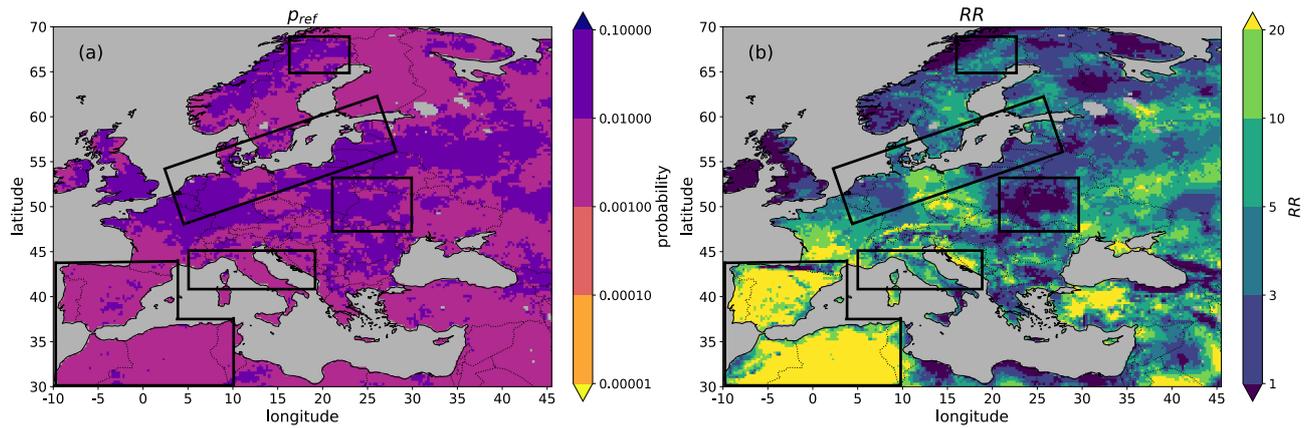


Figure S3. Maps of (a) hot-dry CE probability during the baseline period and (b) risk ratio, when both variables S and T_{max} exceed their 95th percentile during the baseline period.

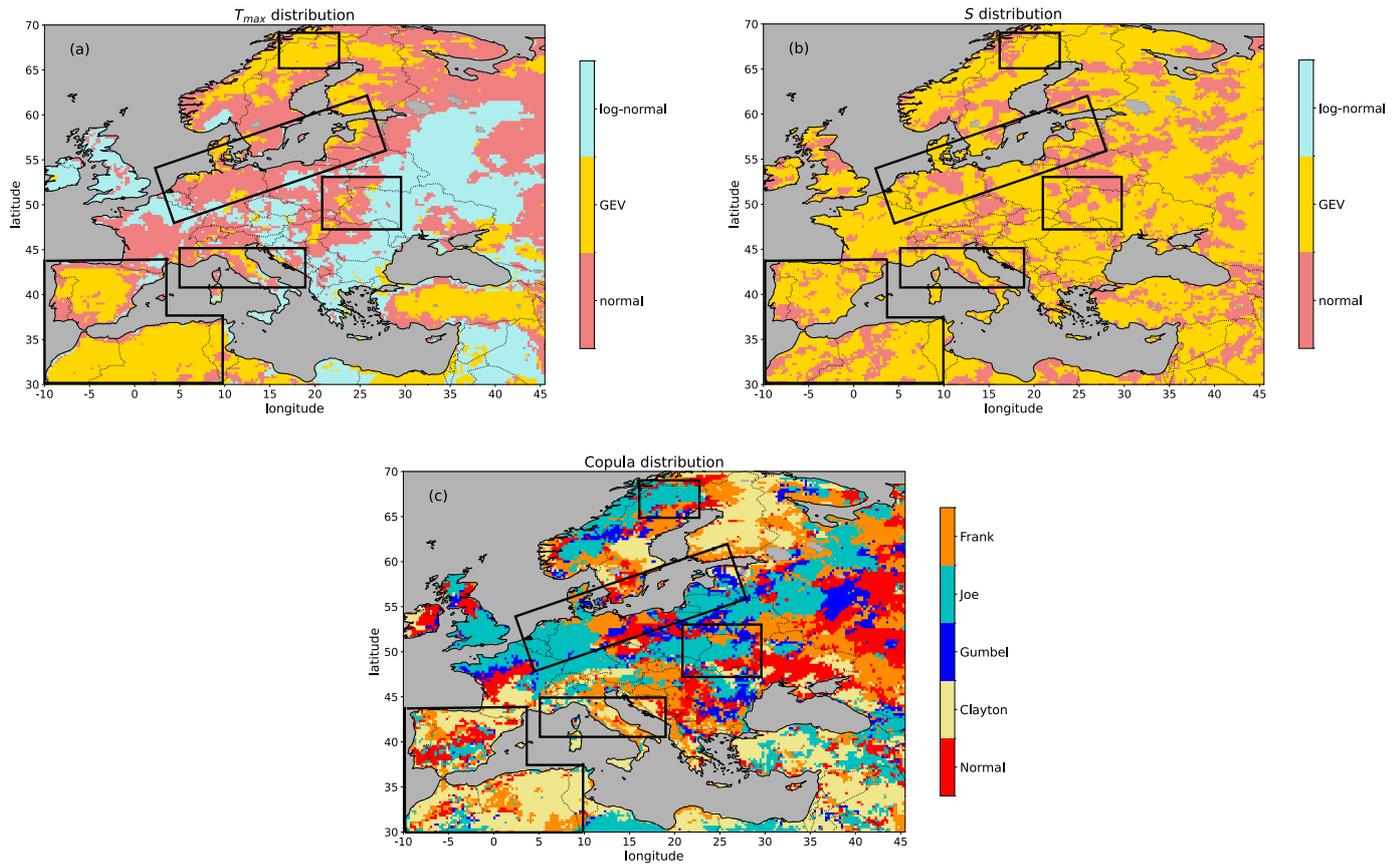


Figure S4. Selected distribution for (a) the temperature variable T_{max} , (b) the drought metric S and (c) the copula.

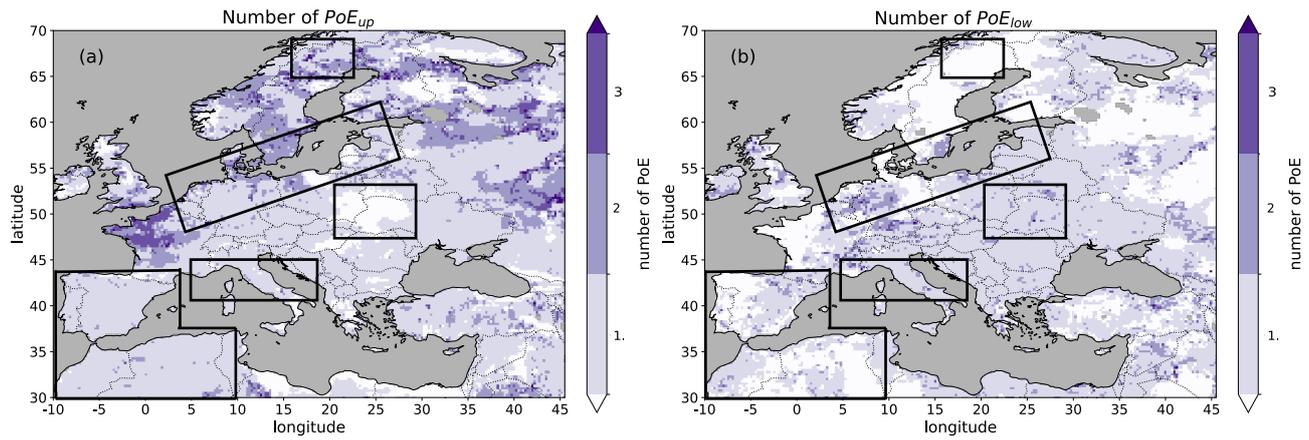


Figure S5. Number of (a) upper-PoE and (b) lower-PoE.

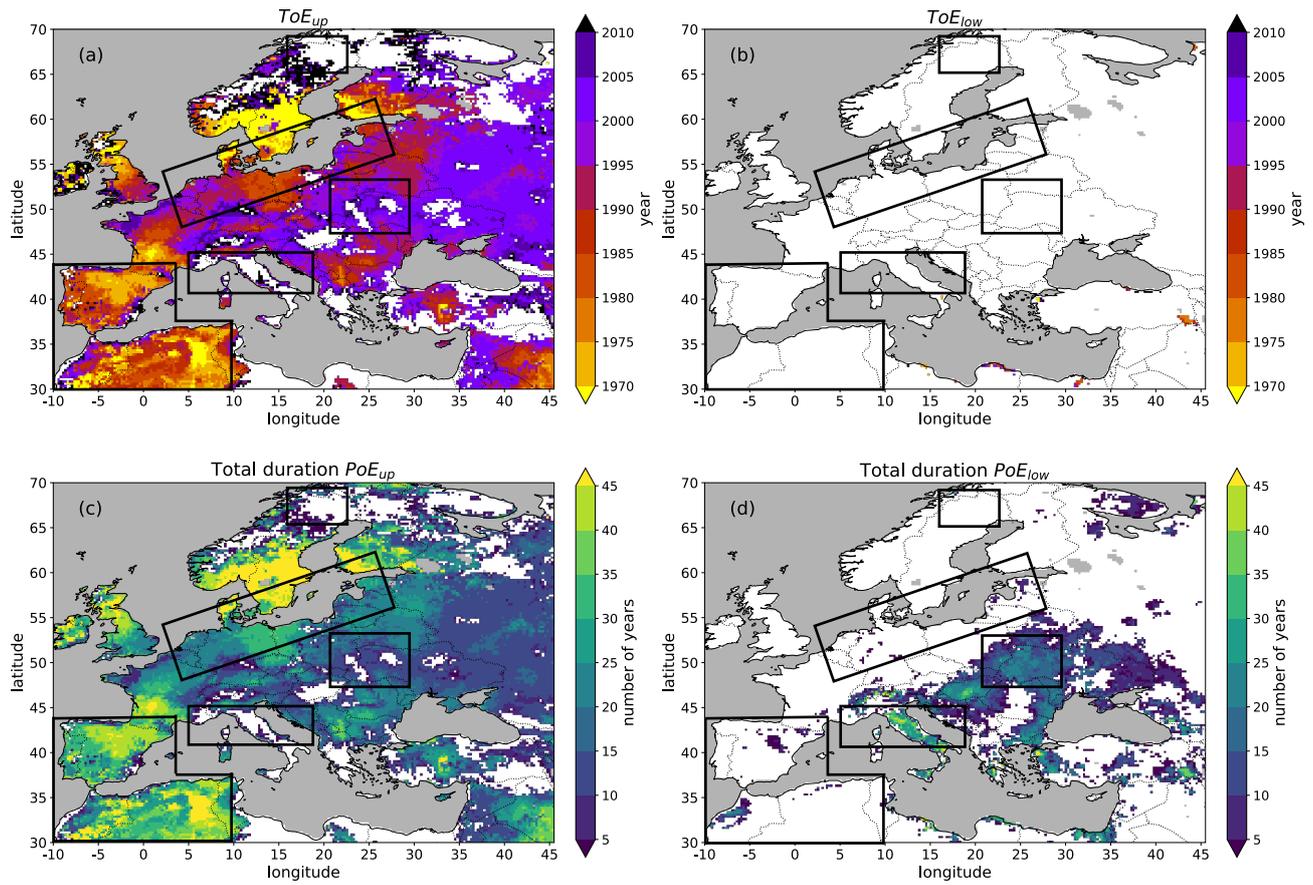


Figure S6. Maps of emergence features over the region under study, when the signal pr_{max} vary below the lower bound (left panels) or above the upper bound (right panels) of the natural variability. Date of (a) upper-ToE and (b) lower-ToE. Total duration of (c) upper-PoE and (d) lower-PoE. White color means either (a) no ToE_{up} , (b) no ToE_{low} , (c) no PoE_{up} , or (d) no PoE_{low} detected.

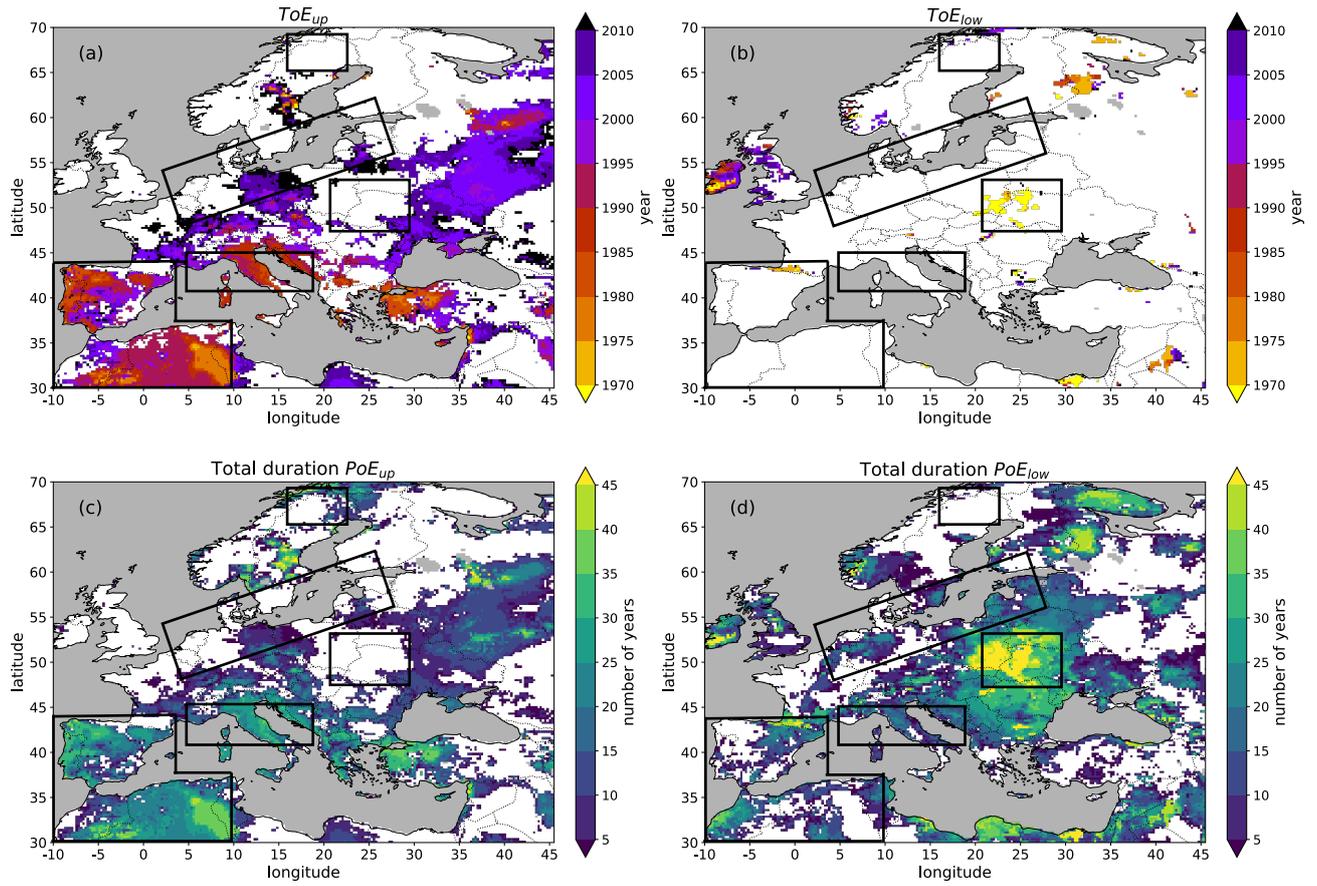


Figure S7. Maps of emergence features over the region under study, when the signal p_S vary below the lower bound (left panels) or above the upper bound (right panels) of the natural variability. Date of (a) upper-ToE and (b) lower-ToE. Total duration of (c) upper-PoE and (d) lower-PoE. White color means either (a) no ToE_{up} , (b) no ToE_{low} , (c) no PoE_{up} , or (d) no PoE_{low} detected.

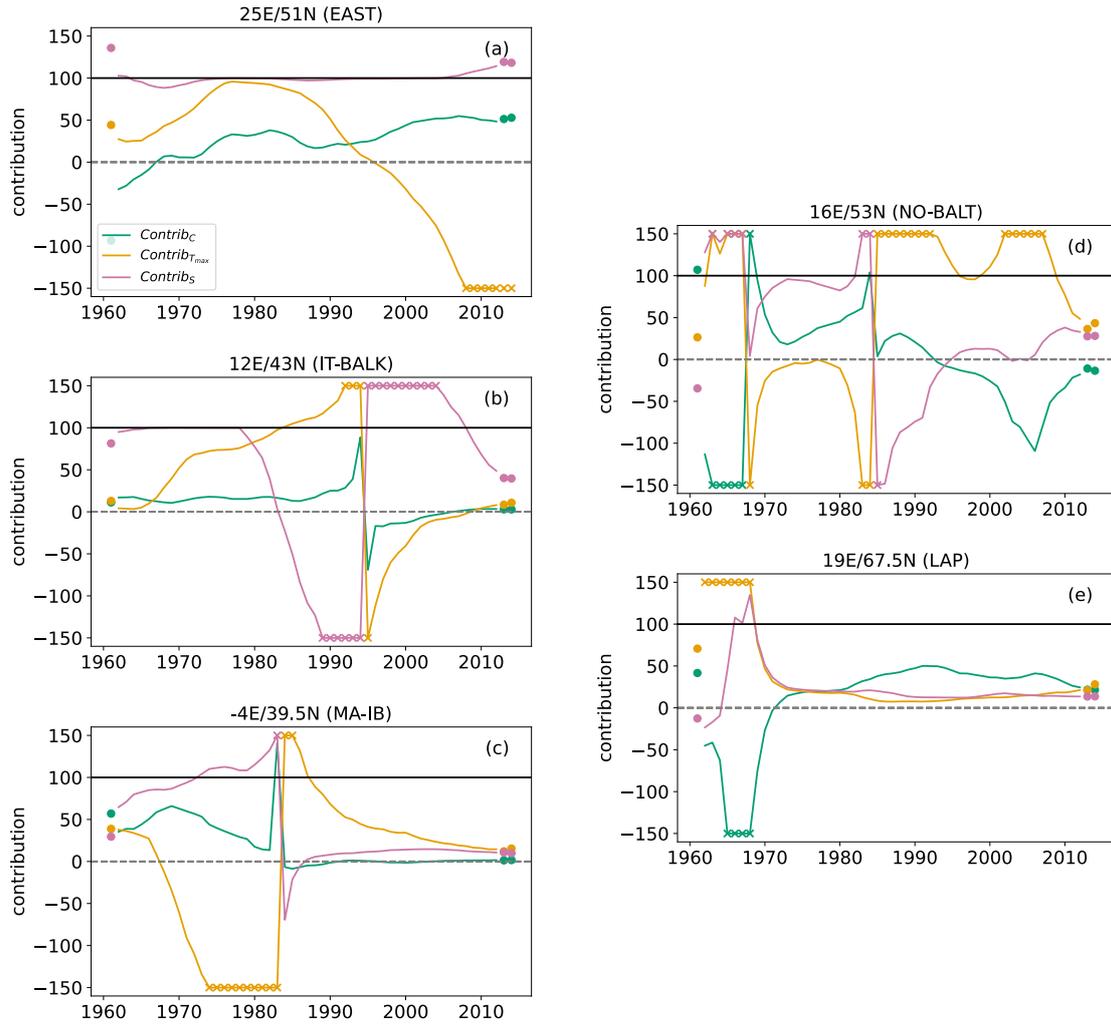


Figure S8. Evolution of each component's contribution in the five European studied areas. The contribution is computed on the smoothed signal using a 5-year window, then the two first and the two last years are marked with a point. Contributions associated to a change in the dependence, in the temperature index T_{max} , and in the drought index S are coloured respectively in green, orange and pink.

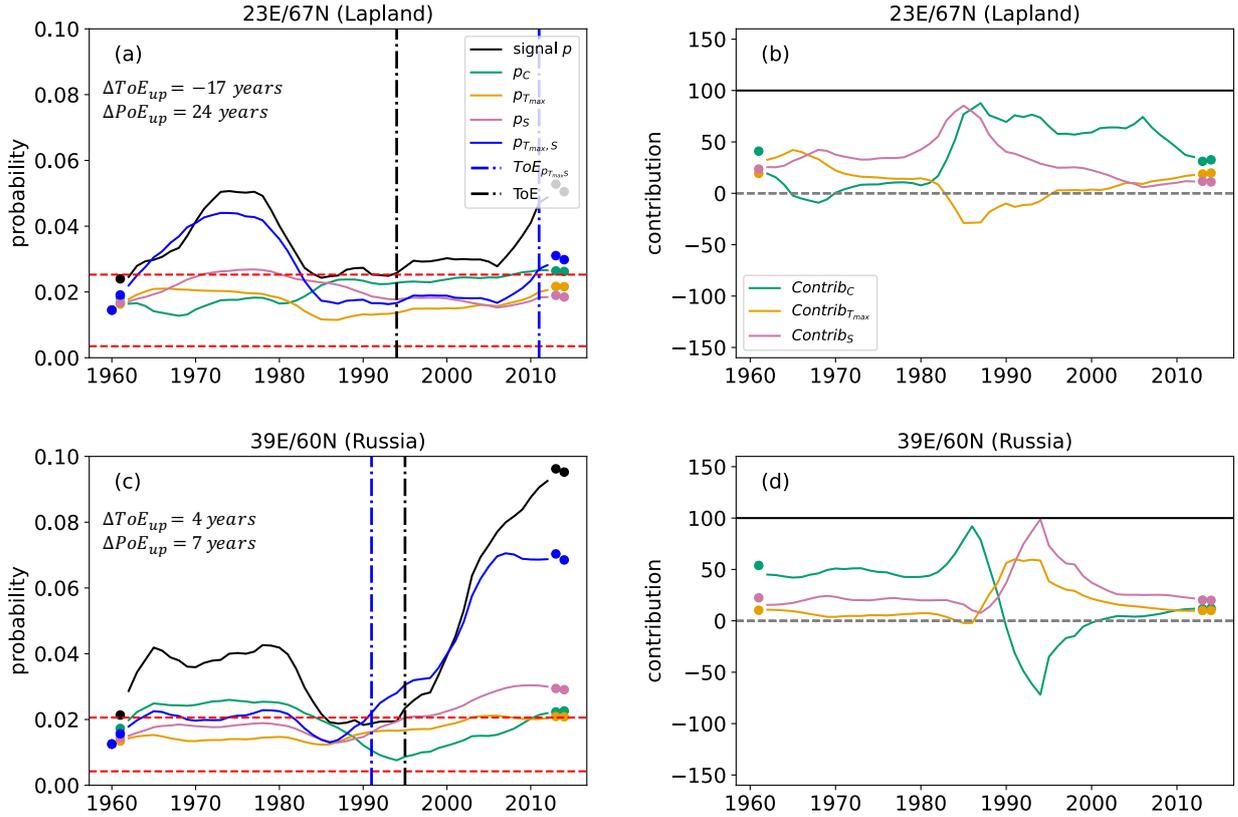


Figure S9. (a) and (c) Evolution of hot-dry CE probability when only one or two statistical component evolves (T_{max} and S marginals, and the dependence C). (b) and (d) Evolution of each statistical component contribution. Two examples are displayed: (a) and (b) at 23°E/67°N in Lapland; (c) and (d) at 39°E/60°N in Russia. CE probability and contributions associated to a change in the dependence, in the temperature index T_{max} , and in the drought index S are coloured respectively in green, orange and pink. CE probability when the dependence is constant is shown in blue. The year indicated on the x-axis is the middle of the 20y window. All signals are smoothed using a 5-year window; thus the two first and two last years cannot be used for smoothing, and are plotted with points.

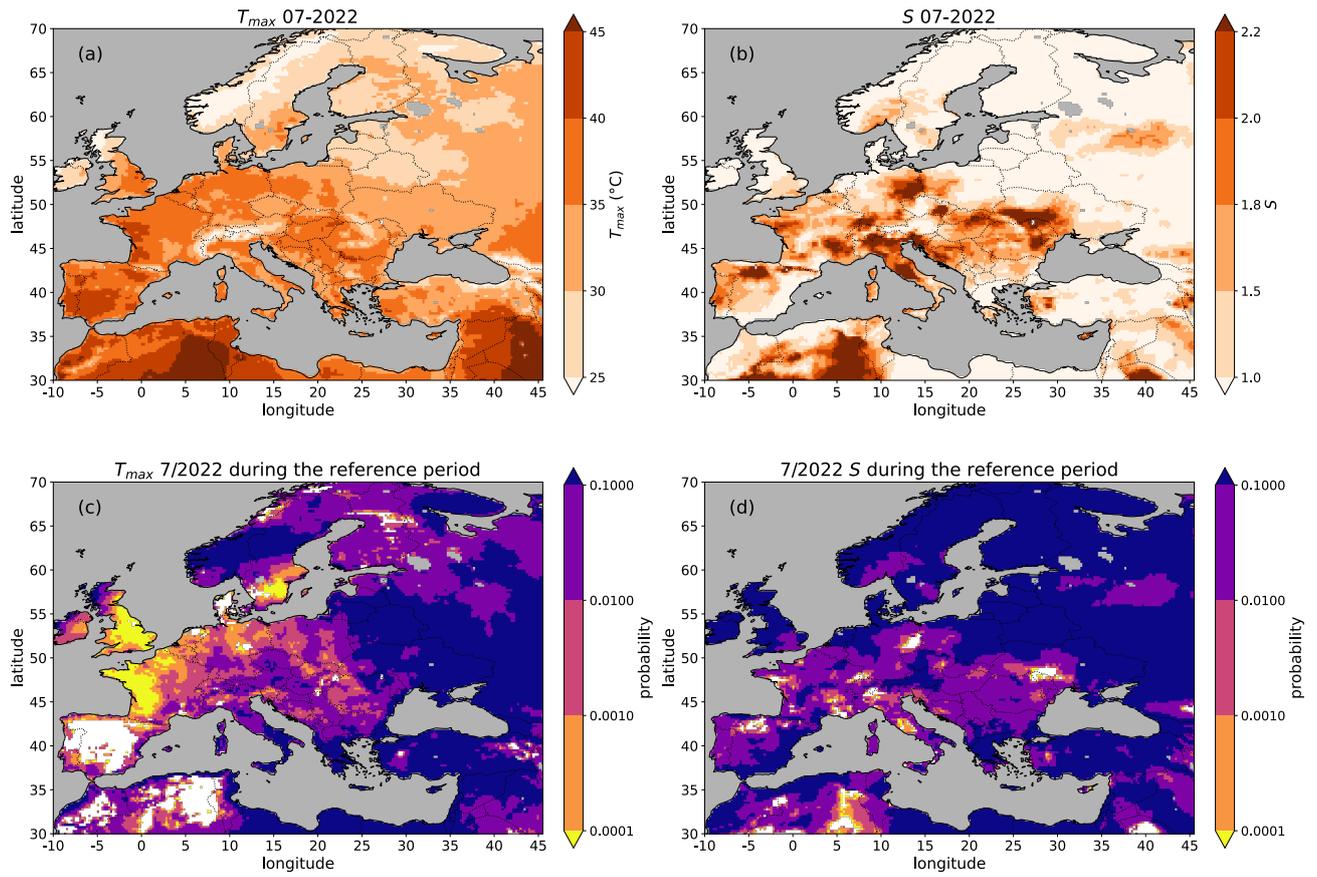


Figure S10. Univariate thresholds associated to the 7-2022 CE. (a) and (b) T_{max} and S during the event and (c) and (d) their corresponding probability during the reference period

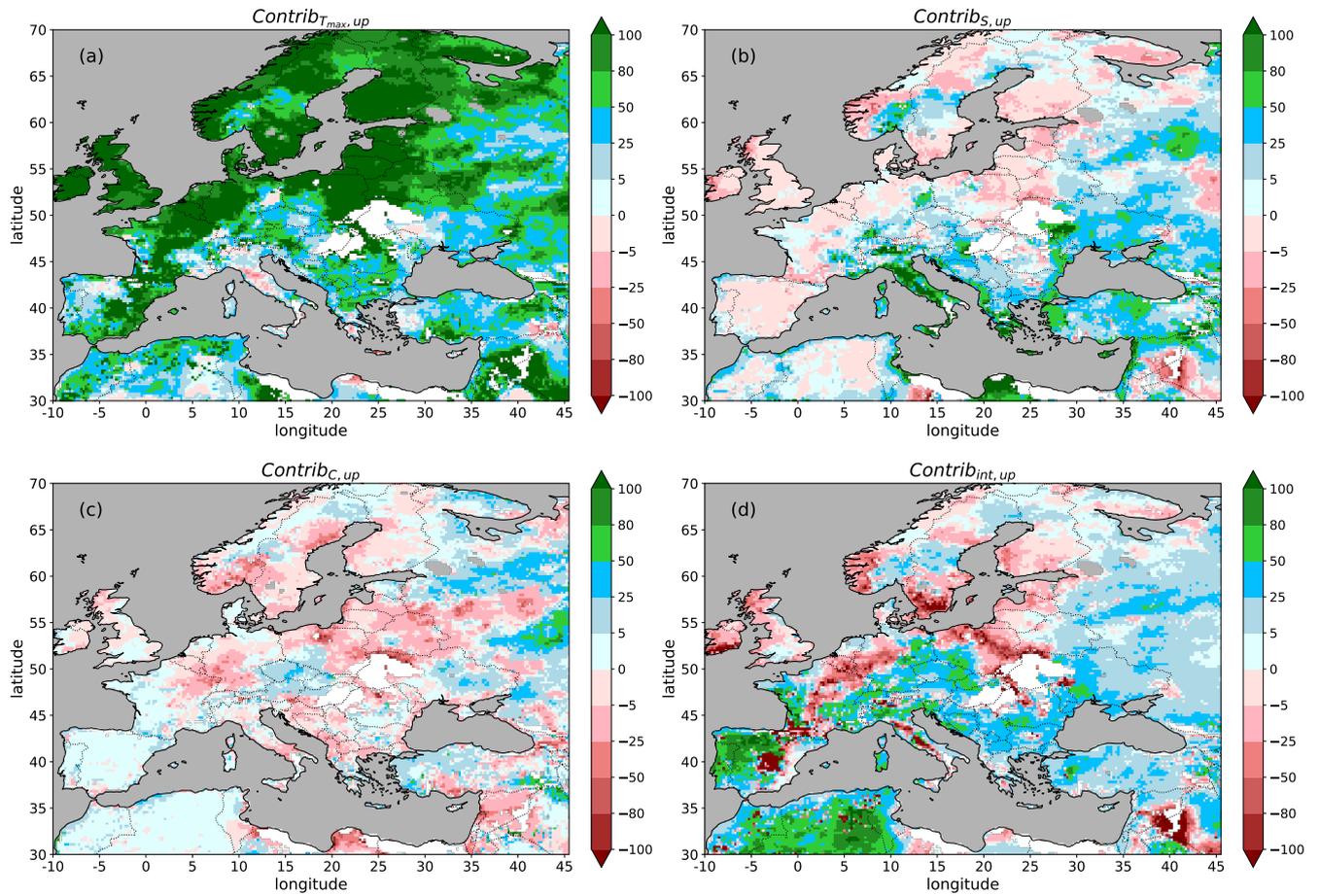


Figure S11. Contribution of each statistical component during upper-PoE for the 7-2022 event. Spatial patterns of (a) $Contrib_{T_{max}, upper}$, (b) $Contrib_{S, upper}$, (c) $Contrib_{C, upper}$ and (d) $Contrib_{int, upper}$

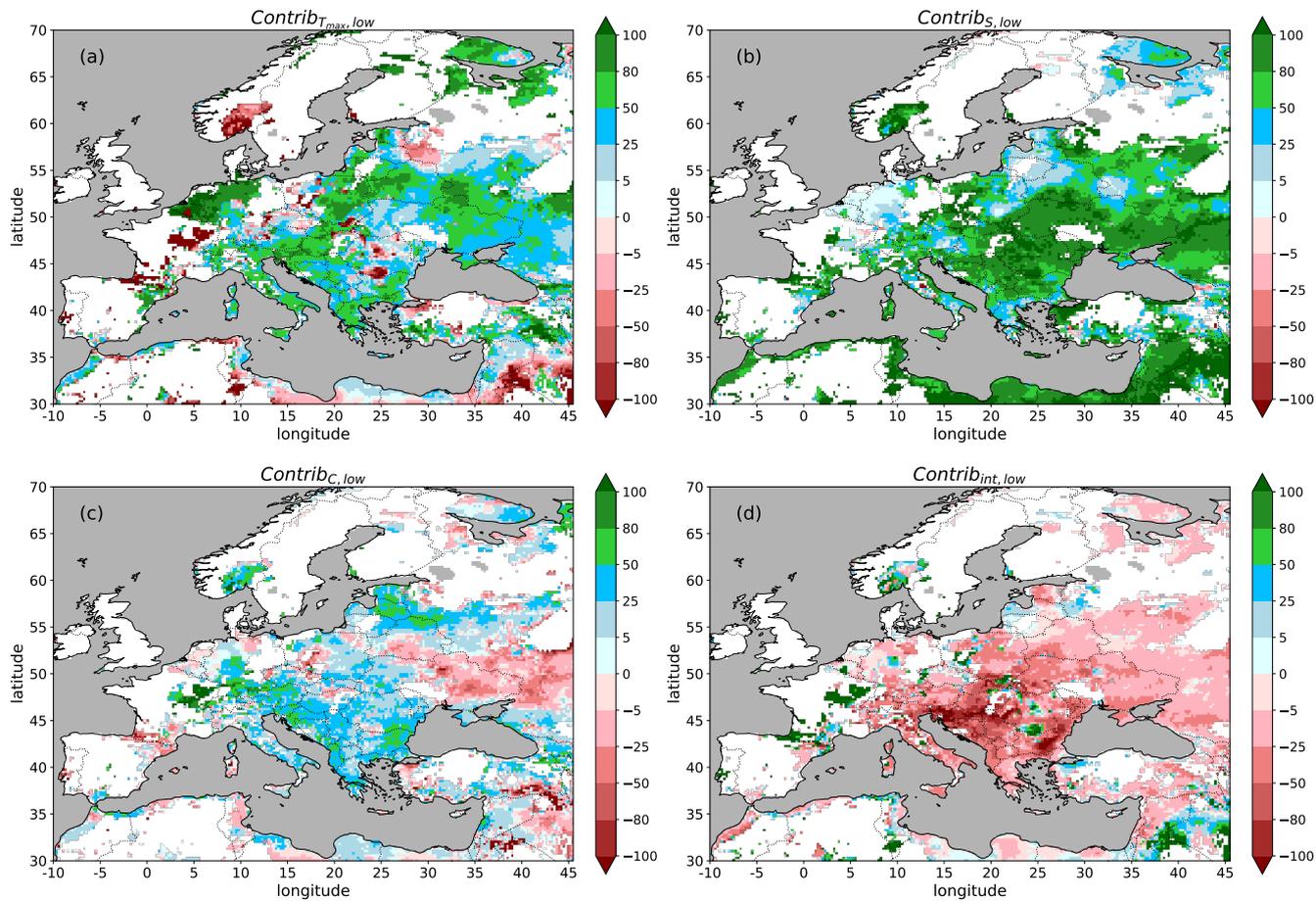


Figure S12. Contribution of each statistical component during upper-PoE for the 7-2022 event. Spatial patterns of (a) $Contrib_{T_{max}, upper}$, (b) $Contrib_{S, upper}$, (c) $Contrib_{C, upper}$ and (d) $Contrib_{int, upper}$