

Supplementary Material

Compound Hot-Dry and Cold-Wet Dynamical Extremes Over the Mediterranean

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1 Supplementary Data

To improve the robustness of our results we make use of two additional reanalysis datasets from the European Centre for Medium-Range Weather Forecasts (ECMWF) over the 1979-2018 period. These are: ERA-Interim with horizontal resolution of 0.75° (Dee et al., 2011) and ERA5 10-member ensemble (0.5°) (C3S, 2017), hereafter termed "ERA5 ensemble". The Mediterranean (MED) domain follows the "Full Mediterranean (FMED)" region described in Giorgi and Lionello (2008). For ERA-Interim, we use $27.75\text{--}48.00^\circ\text{N}$, $9.75\text{W--}39.00^\circ\text{E}$, whereas for the ERA5 ensemble we use $28.00\text{--}48.00^\circ\text{N}$, $9.50\text{W--}39.00^\circ\text{E}$. To study compound events, we compute daily Tmax, Tmin and TP, based on 6-hourly data from ERA5 ensemble and 12-hourly data from ERA-Interim. We also use daily SLP mean, computed by averaging the 6-hour ERA-Interim and ERA5 ensemble datasets. For ERA5 ensemble, we compute the 10-member ensemble mean for all the dynamical systems metrics and variables of interest.

2 Supplementary Figures

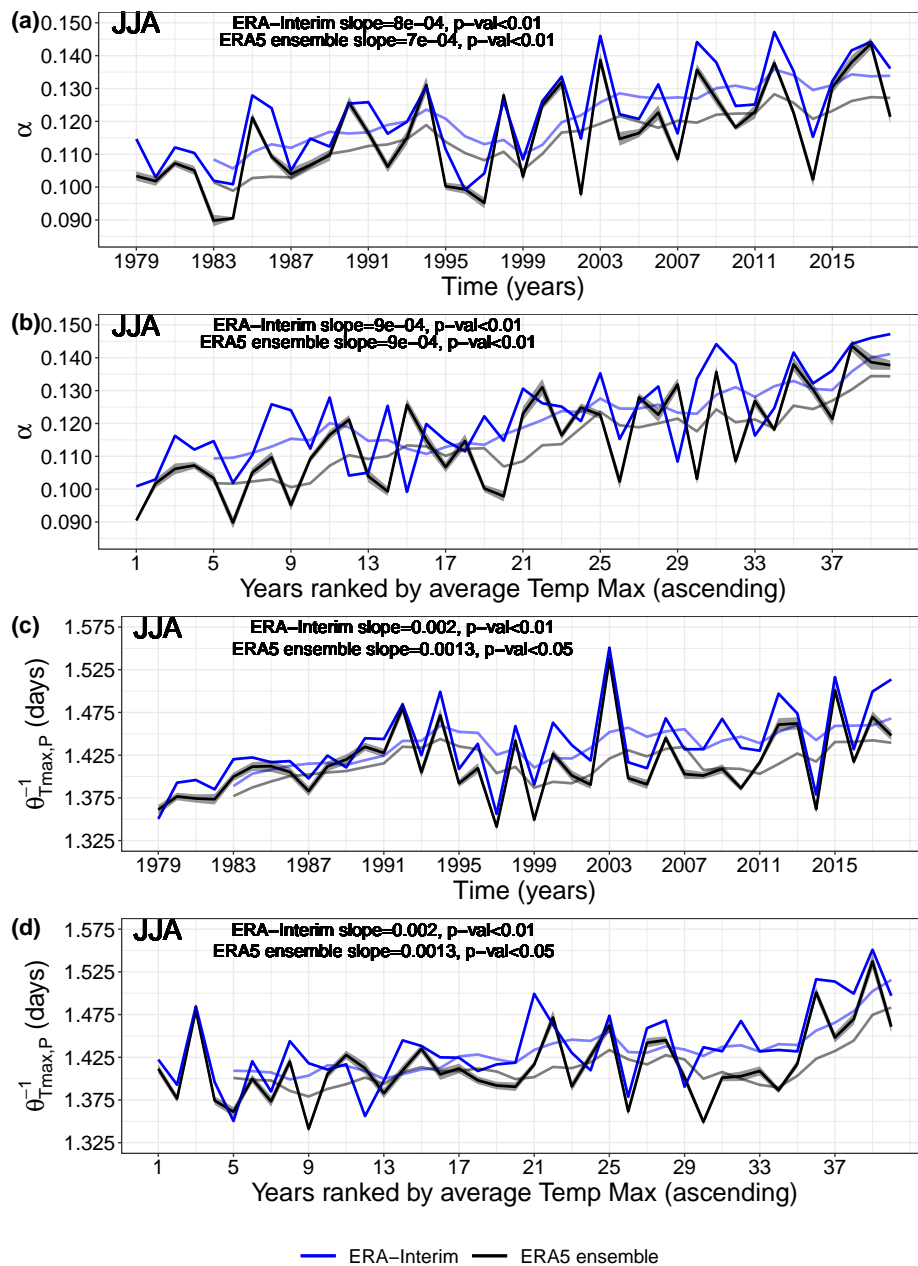


Figure S1. As Figure 1 but for ERA-Interim (blue) and ERA5 ensemble mean (black). Grey shaded lines represent the 95% confidence intervals (c.i.) of the ERA5 ensemble mean.

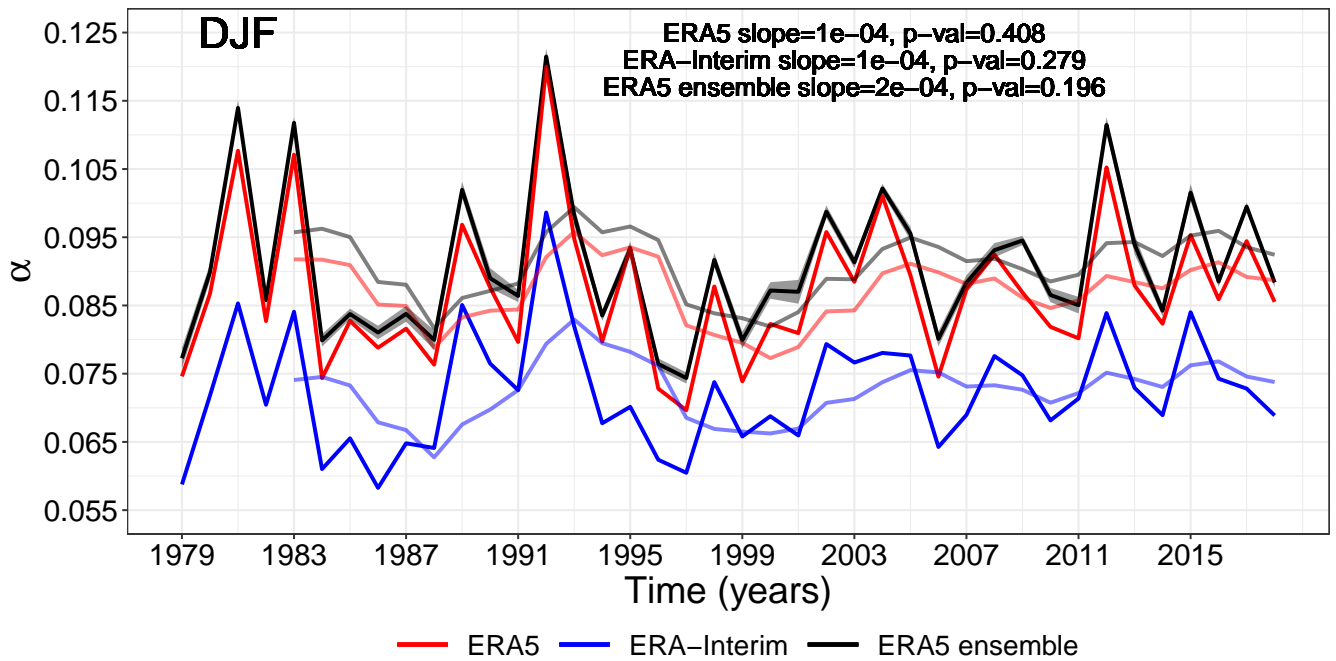


Figure S2. As Figure 1a but for winter December-January-February (DJF) and α computed from Tmin and TP.

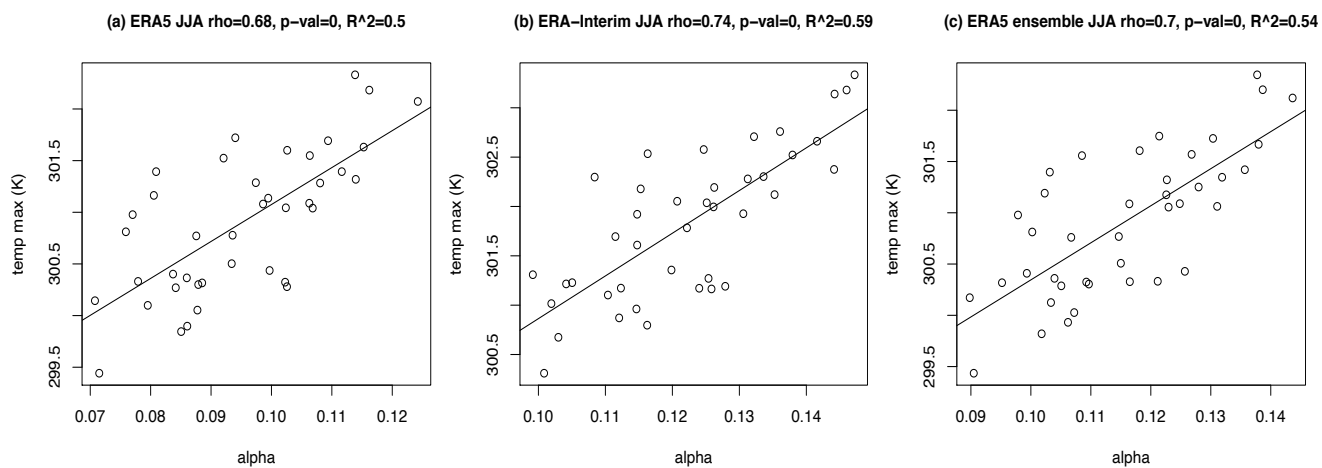


Figure S3. Linear regressions and Spearman's correlation tests between JJA mean Tmax and JJA co-recurrence ratio (α) within the 1979-2018 period over the MED. (a) ERA5; (b) ERA-Interim; and (c) ERA5 ensemble mean. Spearman's rho correlation coefficient, relative p-value and coefficient of determination (R^2) are shown for each reanalysis product.

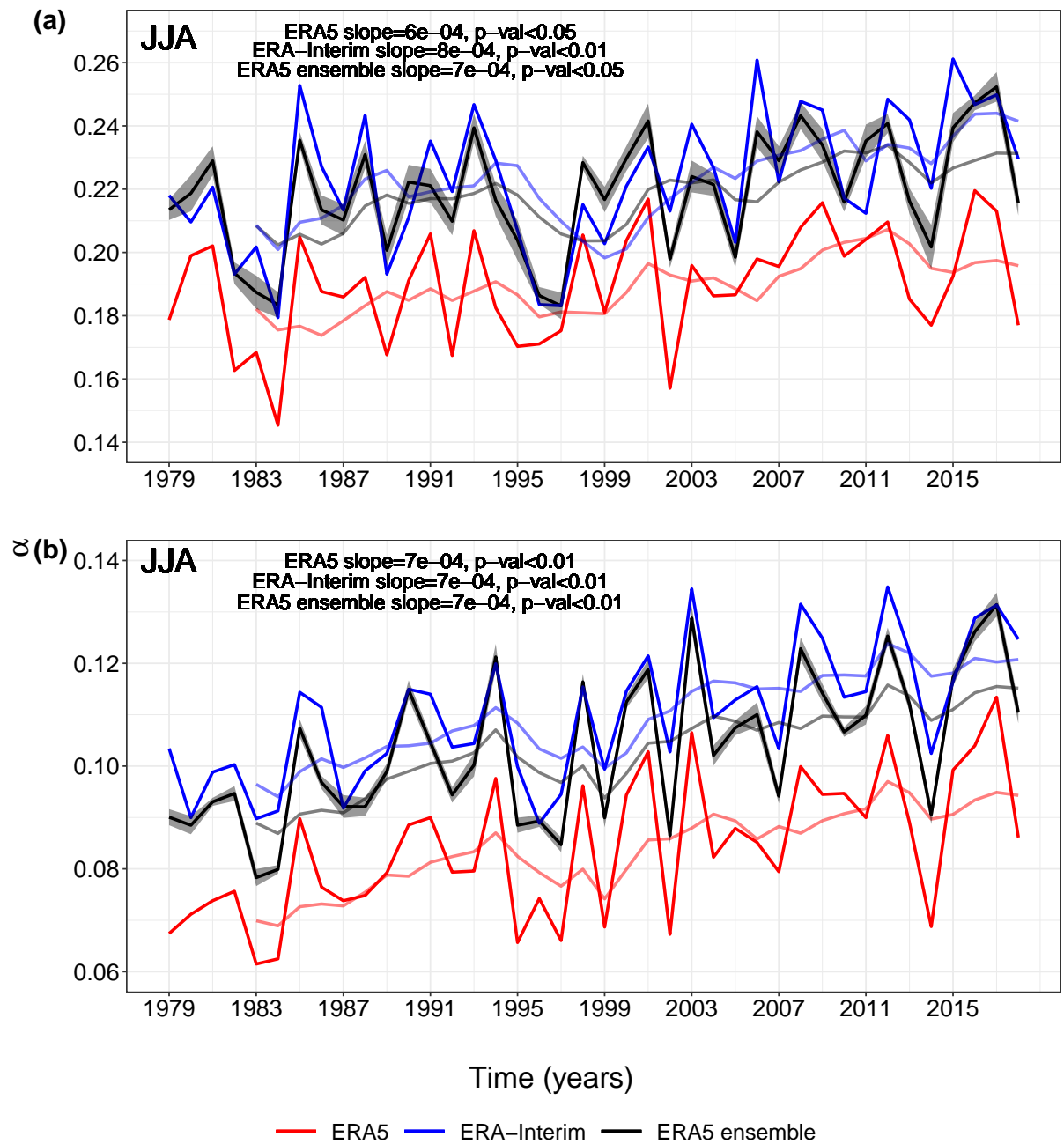


Figure S4. As Figures 1a and S1a but for (a) compound dynamical extremes (CDE, α values $> 90^{th}$ quantile) and (b) non-CDE (α values $\leq 90^{th}$ quantile).

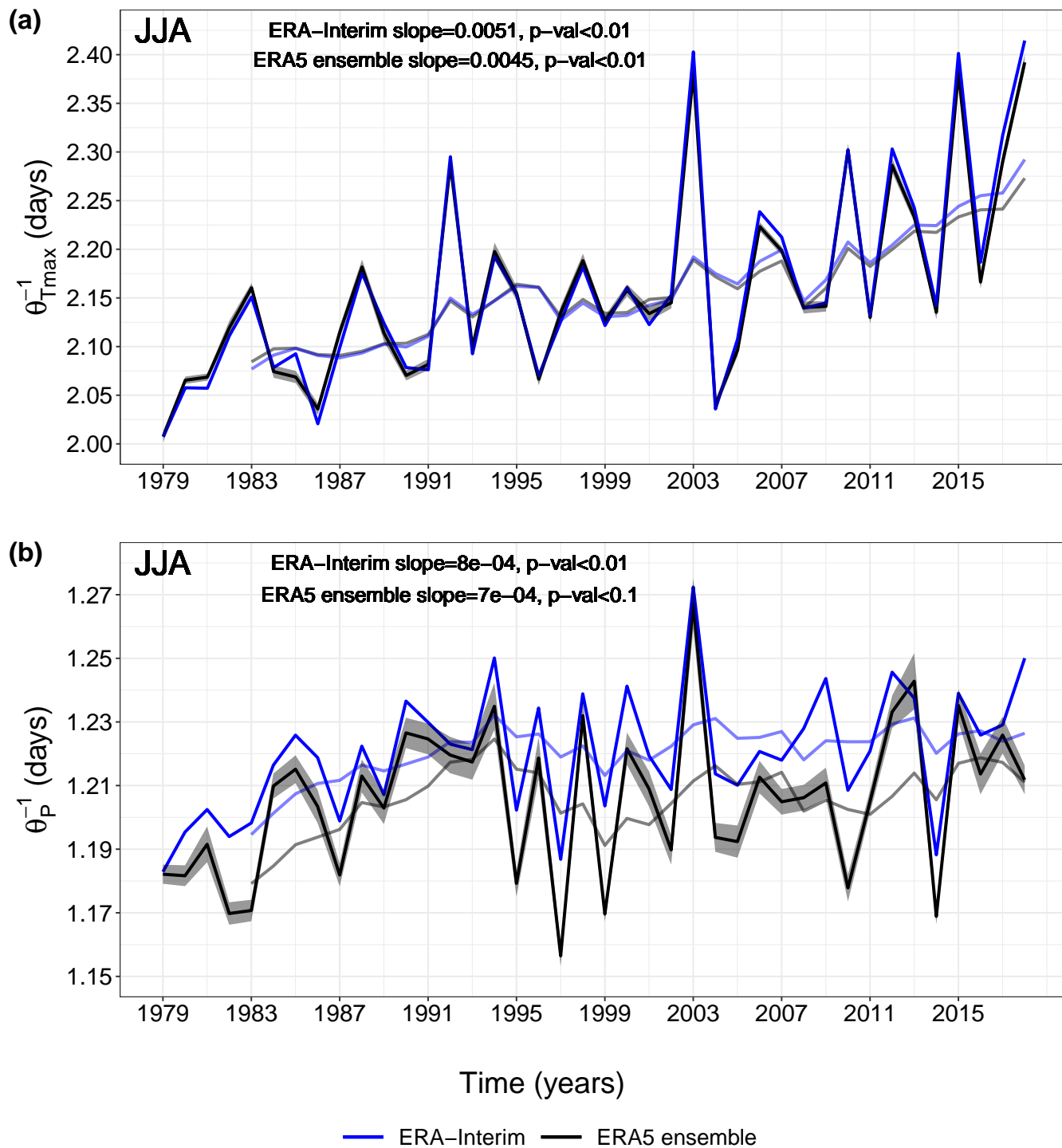


Figure S5. As Figure 2 but for ERA-Interim (blue) and ERA5 ensemble mean (black).

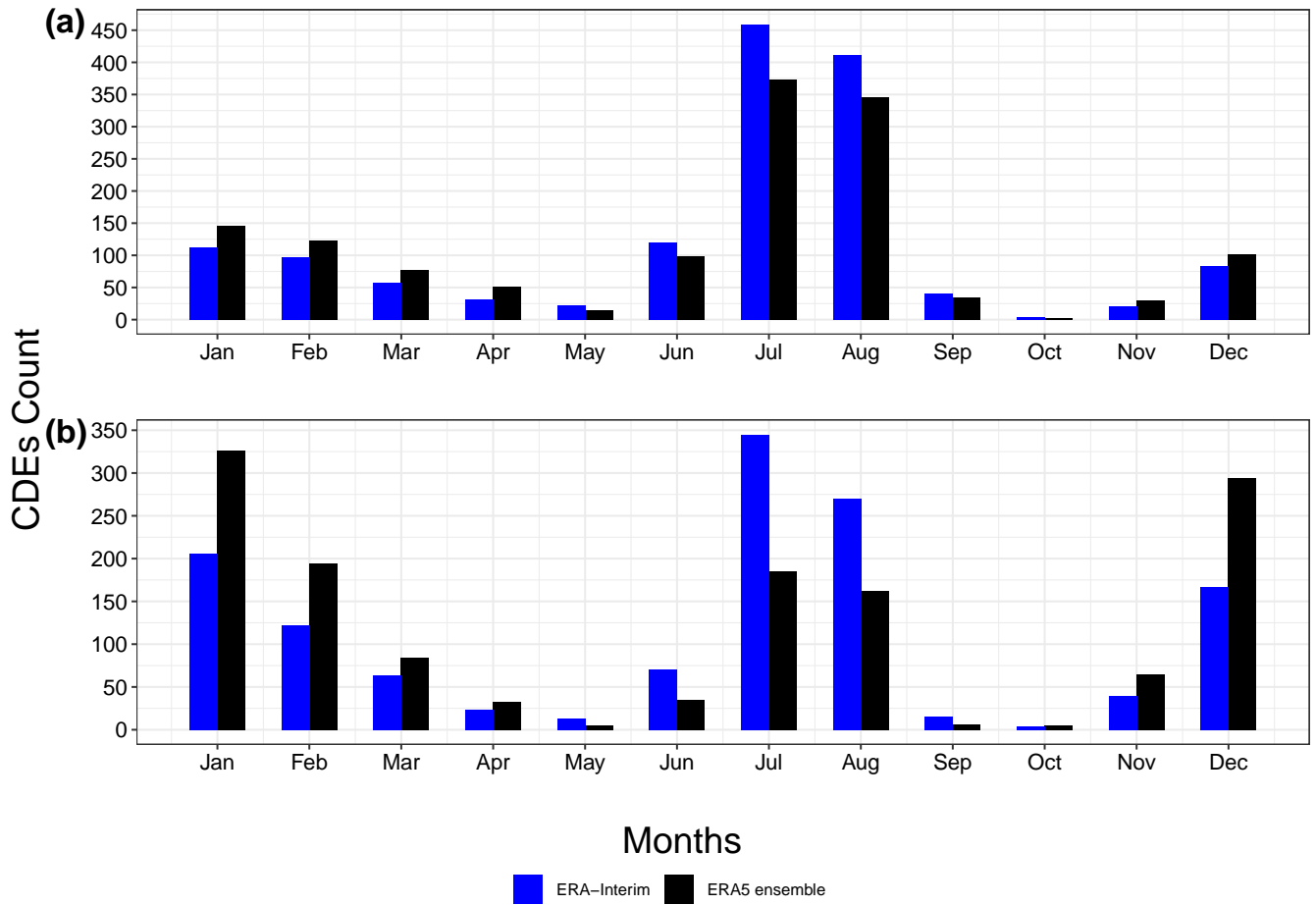
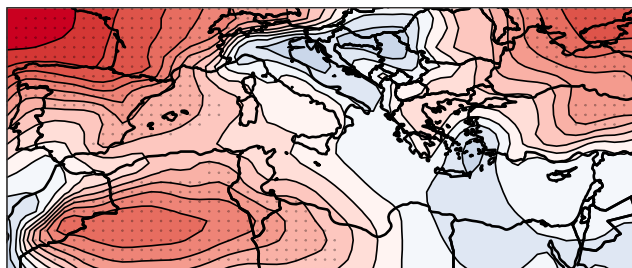


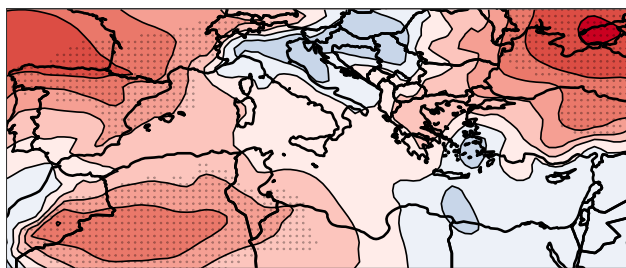
Figure S6. As Figure 3 but for ERA-Interim (blue) and ERA5 ensemble mean (black).

(a) ERA-Interim JJA



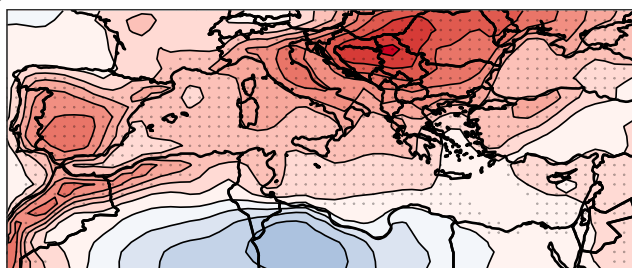
SLP (hPa) Anomaly Means 0.0 0.5

(b) ERA5 ensemble JJA



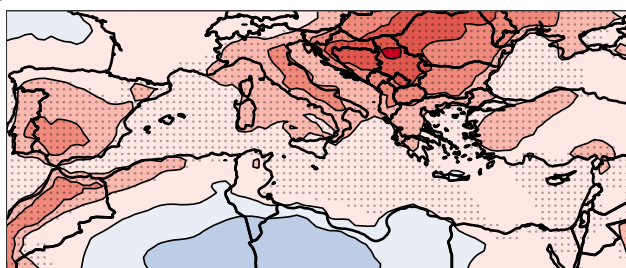
SLP (hPa) Anomaly Means 0.0 0.5 1.0

(c) ERA-Interim JJA



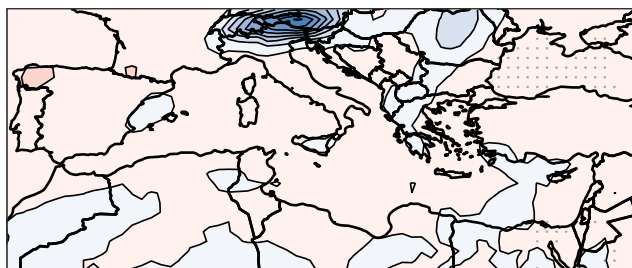
Tmax (K) Anomaly Means -0.5 0.0 0.5 1.0 1.5

(d) ERA5 ensemble JJA



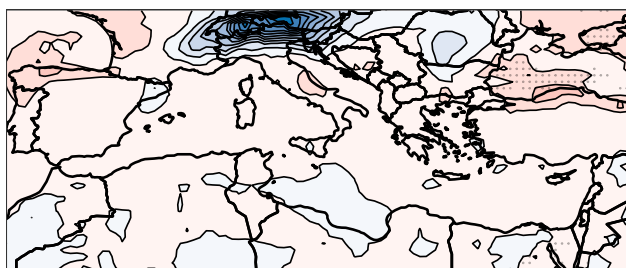
Tmax (K) Anomaly Means -0.5 0.0 0.5 1.0 1.5 2.0

(e) ERA-Interim JJA



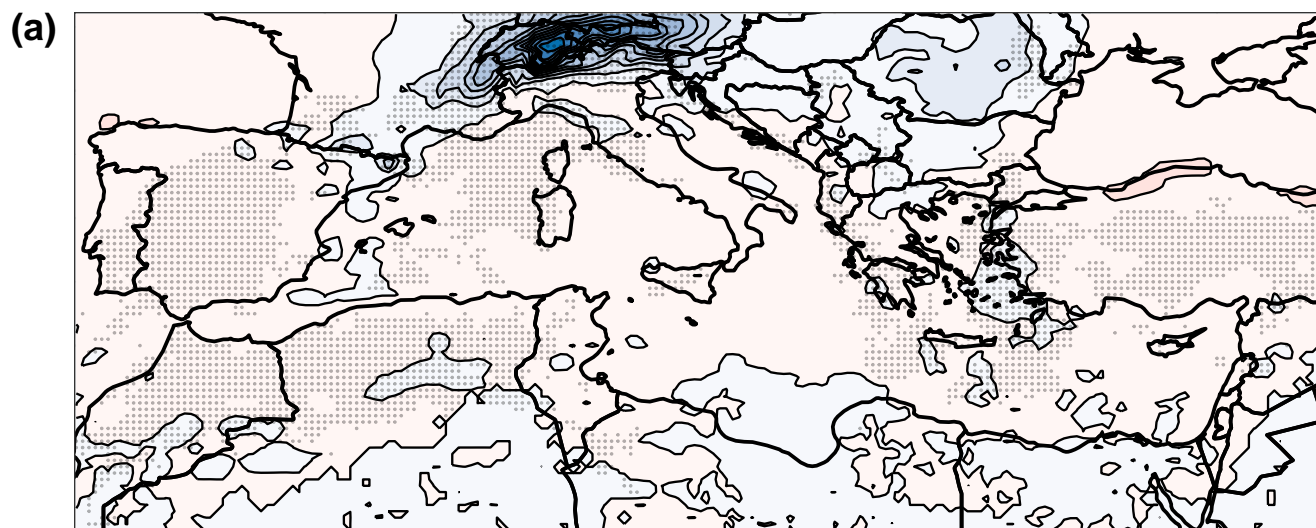
P (mm) Anomaly Means 0 1 2 3

(f) ERA5 ensemble JJA



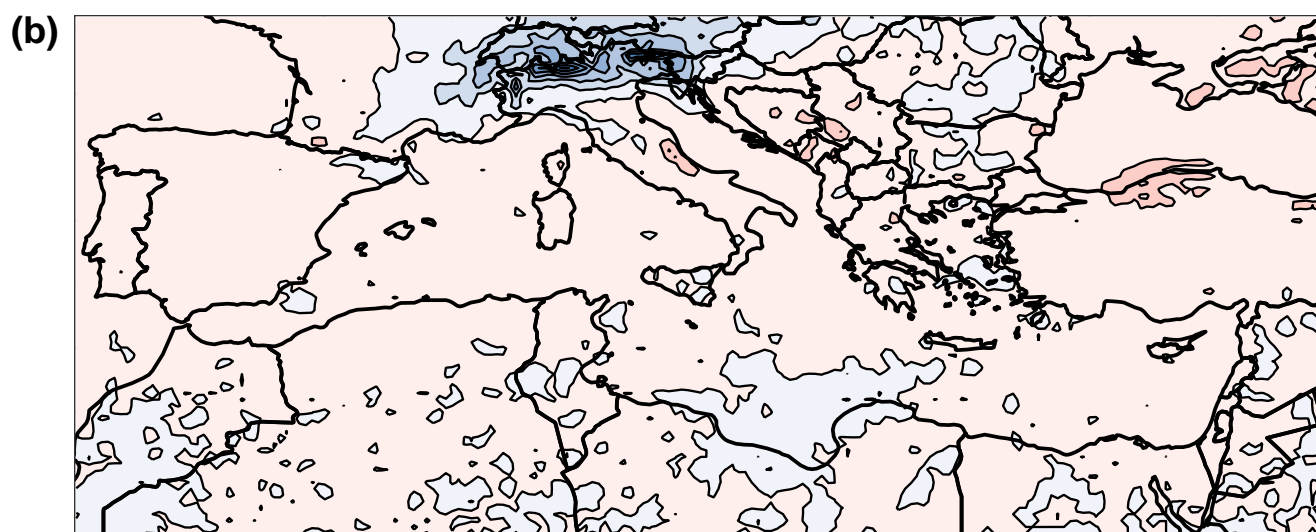
P (mm) Anomaly Means -0.5 0.0 0.5 1.0 1.5

Figure S7. As Figure 4a,c,e but for (a), (c), (e) ERA-Interim and (b), (d), (f) ERA5 ensemble mean.



LS P (mm) Anomaly Means

0.00 0.25 0.50

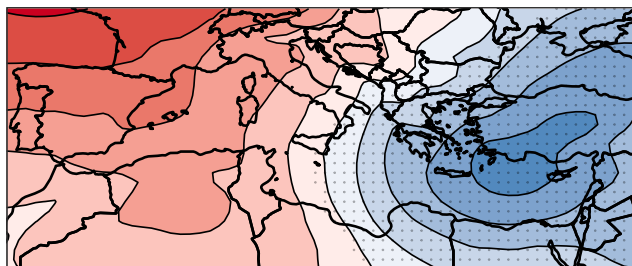


C P (mm) Anomaly Means

-0.25 0.00 0.25 0.50

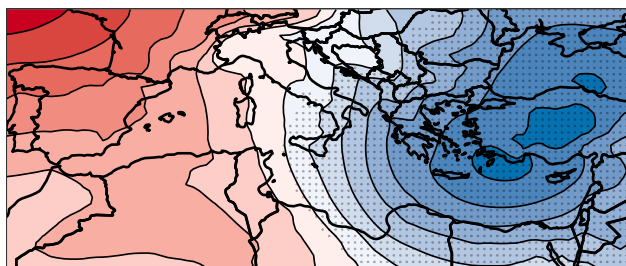
Figure S8. As Figure 4e but for daily anomaly means of (a) large-scale total precipitation (mm) and (b) convective total precipitation (mm).

(a) ERA-Interim DJF



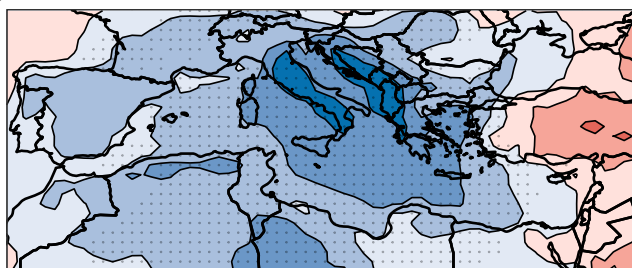
SLP (hPa) Anomaly Means -4 -2 0 2 4

(b) ERA5 ensemble DJF



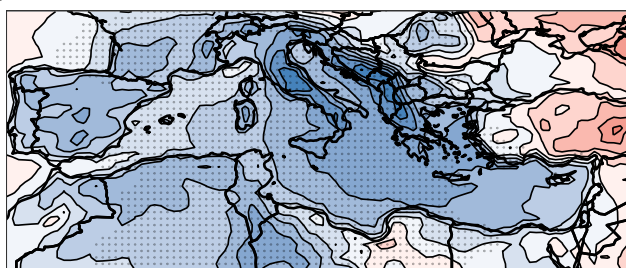
SLP (hPa) Anomaly Means -3 -2 -1 0 1 2 3

(c) ERA-Interim DJF



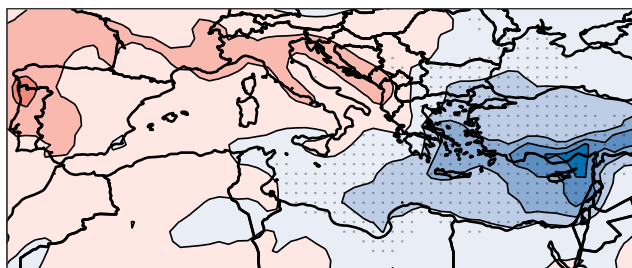
Tmin (K) Anomaly Means -1.5 -1.0 -0.5 0.0 0.5 1.0

(d) ERA5 ensemble DJF



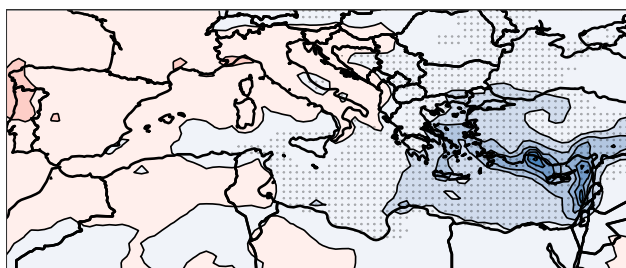
Tmin (K) Anomaly Means -1.0 -0.5 0.0 0.5

(e) ERA-Interim DJF



P (mm) Anomaly Means -2 0 2 4

(f) ERA5 ensemble DJF



P (mm) Anomaly Means 0 1 2 3

Figure S9. As Figure 4b,d,f but for (a), (c), (e) ERA-Interim and (b), (d), (f) ERA5 ensemble mean.

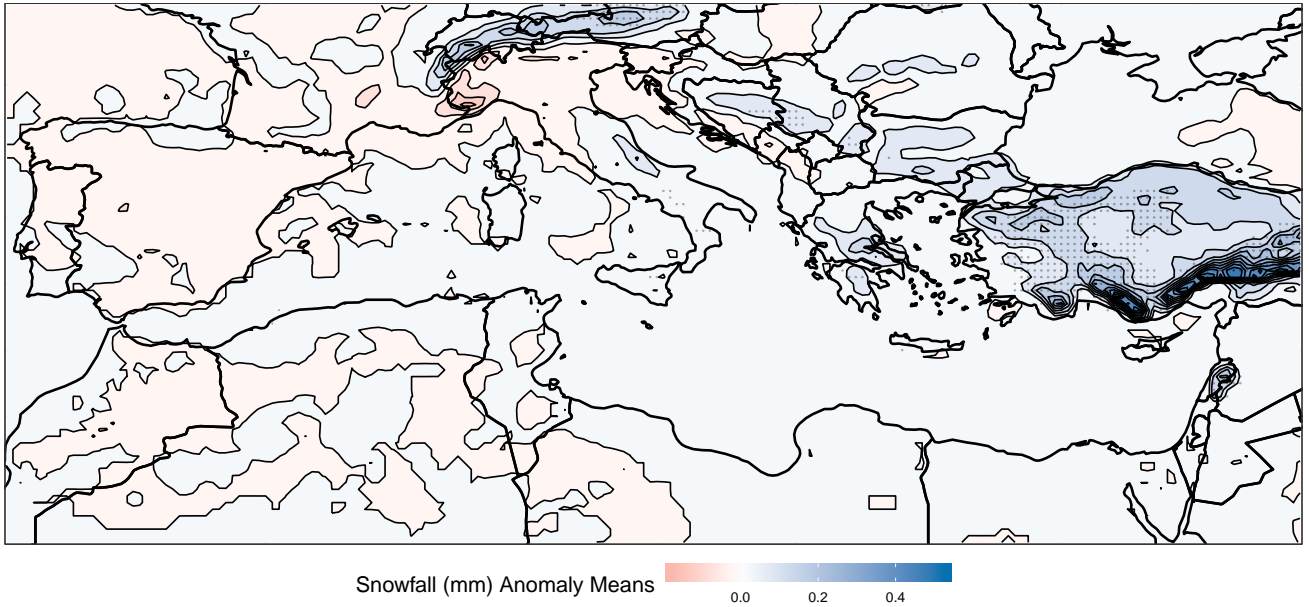


Figure S10. As Figure 4f, but for snowfall anomaly means (mm).

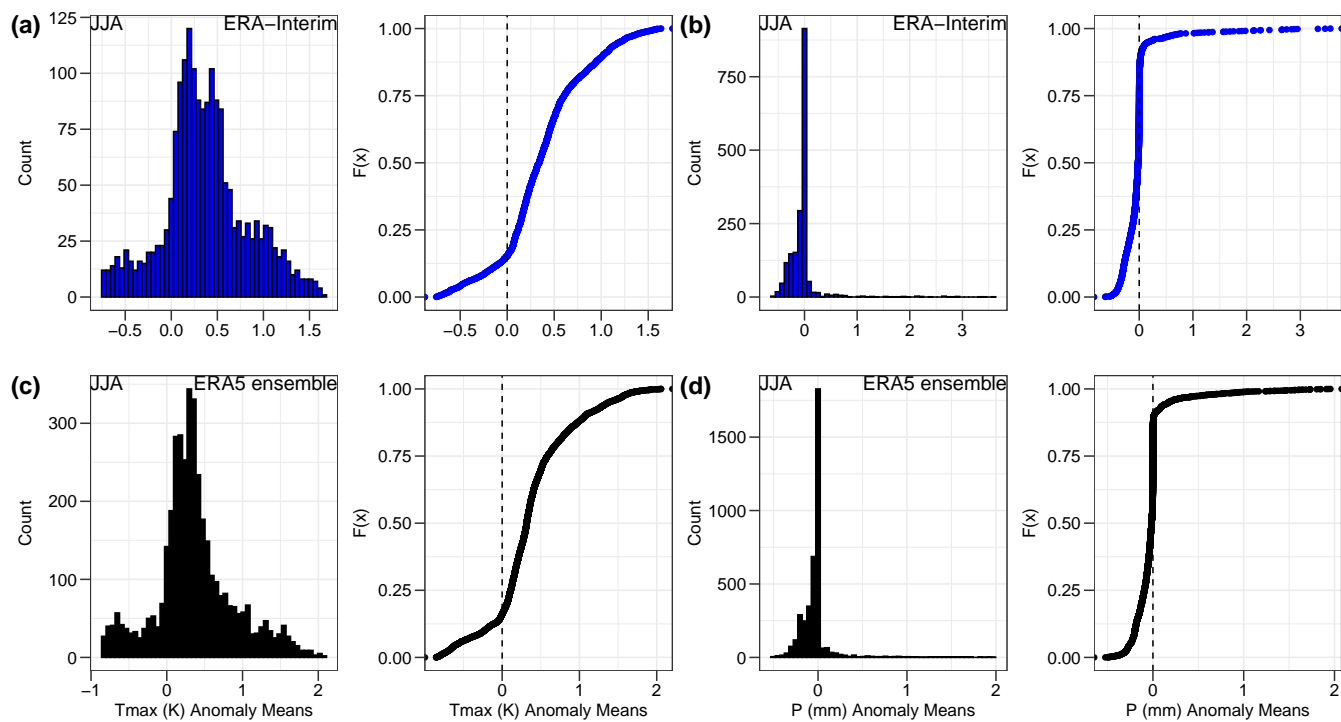


Figure S11. As Figure 5a-b but for (a)-(b) ERA-Interim (blue) and (c)-(d) ERA5 ensemble mean (black). The anomaly means correspond to the ones in Figure S7c-f.

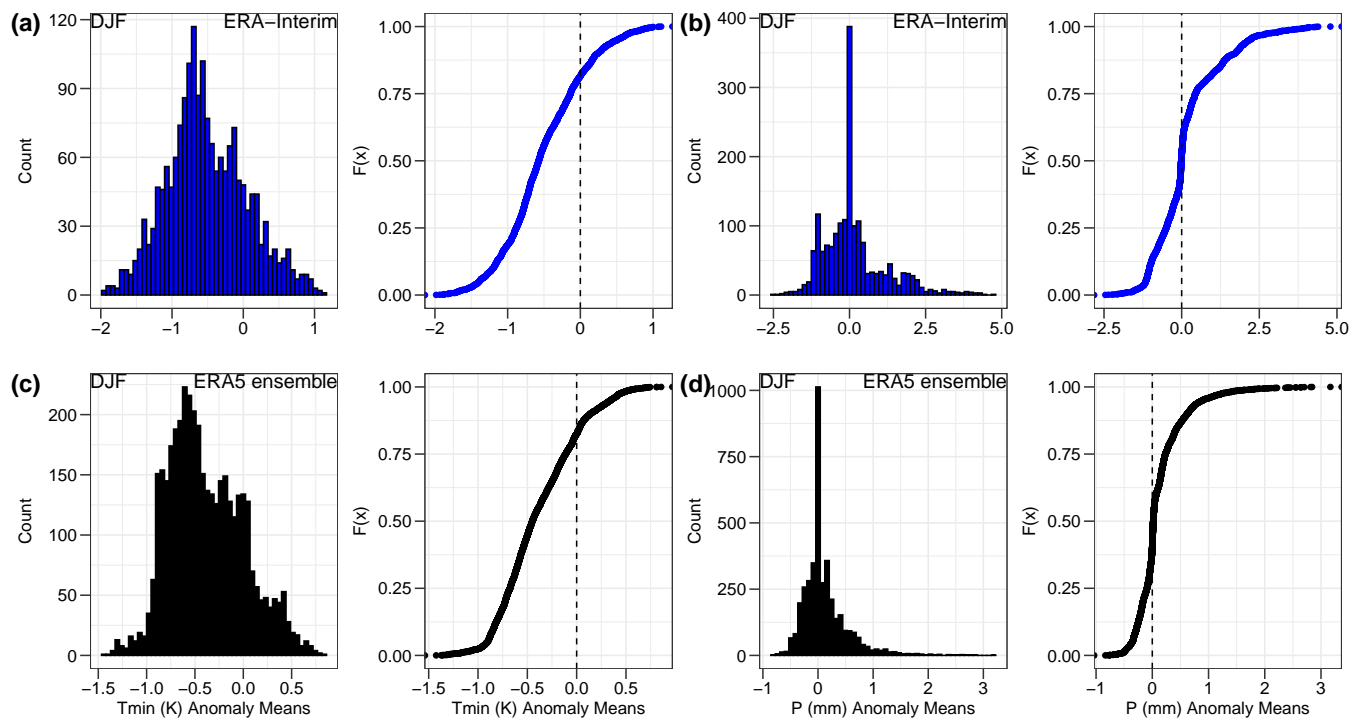
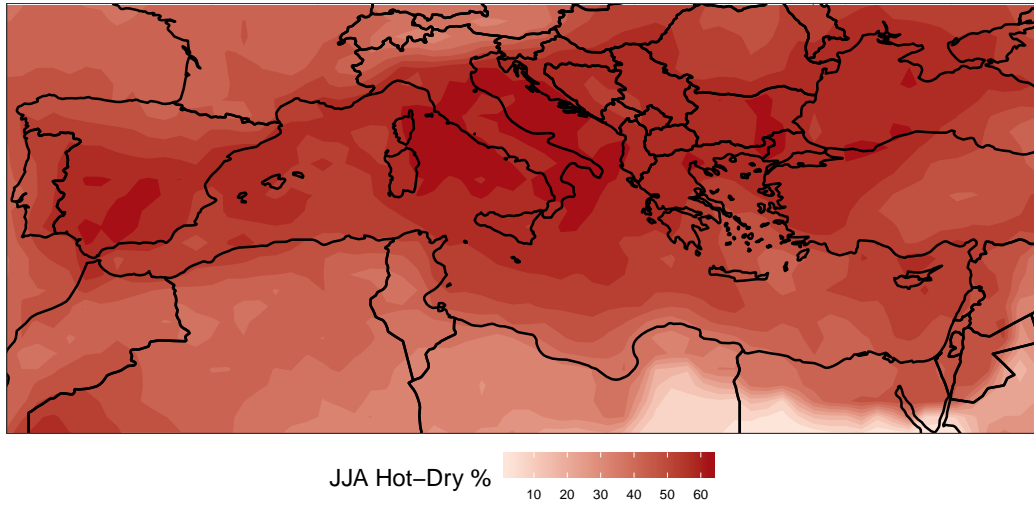


Figure S12. As Figure 5c-d but for (a)-(b) ERA-Interim (blue) and (c)-(d) ERA5 ensemble mean (black). The anomaly means correspond to the ones in Figure S9c-f.

(a) ERA-Interim



(b) ERA5 ensemble

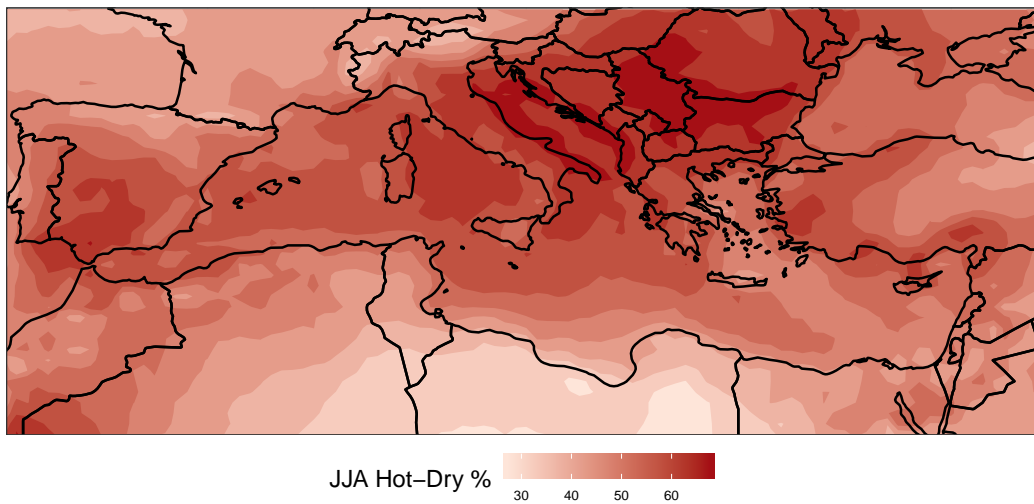
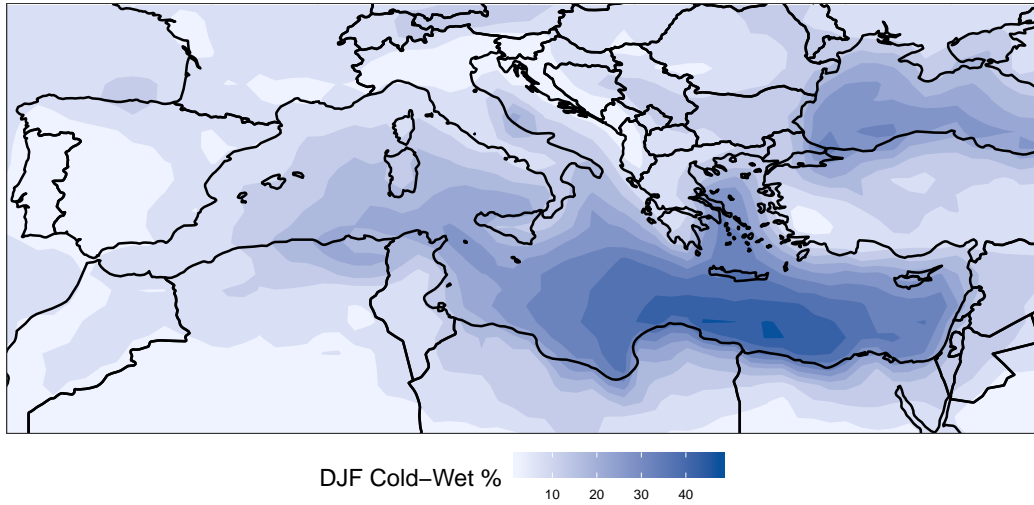


Figure S13. As Figure 6a but for (a) ERA-Interim and (b) ERA5 ensemble mean.

(a) ERA-Interim



(b) ERA5 ensemble

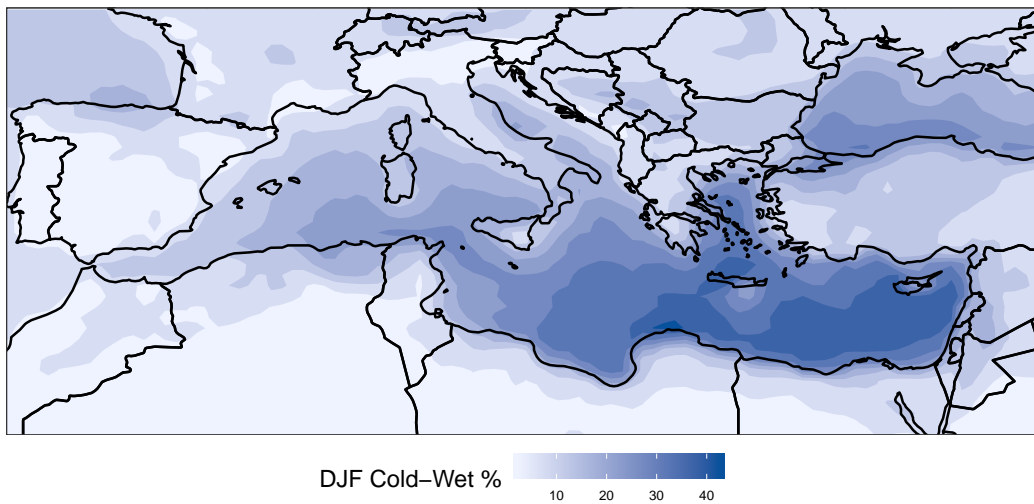


Figure S14. As Figure 6b but for (a) ERA-Interim and (b) ERA5 ensemble mean.

References

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