Table S1 | Summary statistics of precipitation differences between storyline simulations and ERA5.

Country	N cells	ΔP (mm)	Spread (mm)	SNR (-)
Portugal	44	+4.0	0.48	8.3
Spain	245	-7.1	0.32	21.9
France	150	+0.3	2.0	0.15
Italy	161	-36.1	1.13	31.9
Bosnia	27	-38.1	2.46	15.5
Montenegro	7	-64.1	2.83	22.7
Albania	13	-17.1	1.19	14.3
Greece	62	-9.1	0.27	34.2

The table summarizes country-level differences in cumulative precipitation (ΔP) between the factual storyline ensemble mean and ERA5 for July–August 2025. ΔP is defined as:

$\Delta P = P_{storyline} - P_{ERA5}$

where P represents the total accumulated precipitation over the analysis period. Positive values indicate wetter conditions in the storyline simulations, while negative values indicate drier conditions relative to ERA5.

The column “Spread” denotes the ensemble spread in cumulative precipitation across storyline members, defined as the standard deviation of total precipitation across ensemble members. This provides a measure of internal variability within the storyline ensemble.

The signal-to-noise ratio (SNR) is defined as:

$SNR = |\Delta P| / spread$

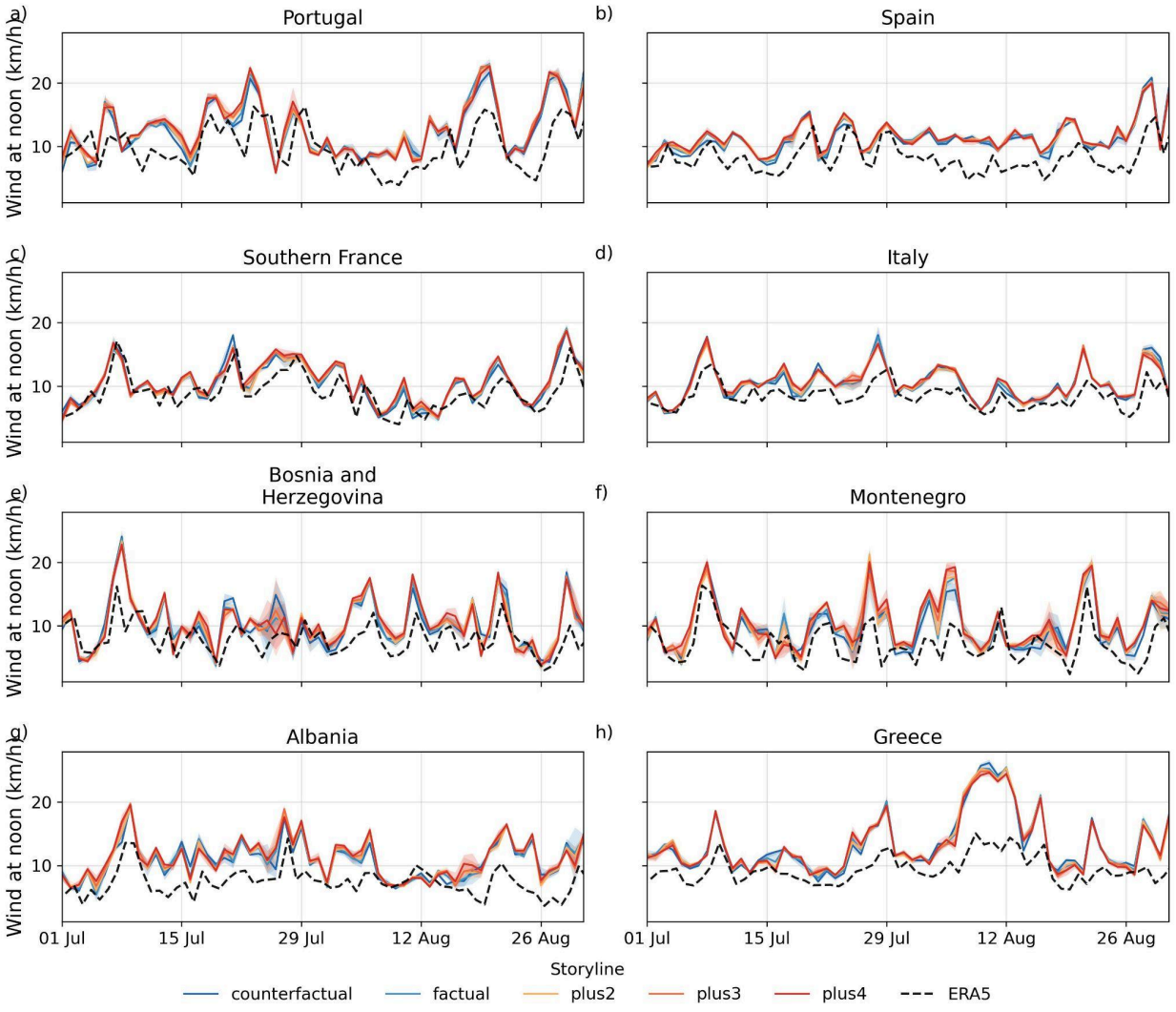
and quantifies the magnitude of the difference between storyline simulations and ERA5 relative to the ensemble variability. Values larger than 1 indicate that the difference exceeds internal variability, while higher values indicate increasingly robust differences.

The column “N cells” indicates the number of ECHAM6 grid cells contributing to each country-average. Countries with a small number of grid cells (e.g. Montenegro, Albania) are

more sensitive to spatial variability and may exhibit larger apparent differences due to limited spatial sampling.

Despite this, several countries with a large number of grid cells (e.g. Italy, Spain) also show high SNR values, indicating that the differences in precipitation between ERA5 and storyline simulations are robust and not solely an artifact of spatial sampling.

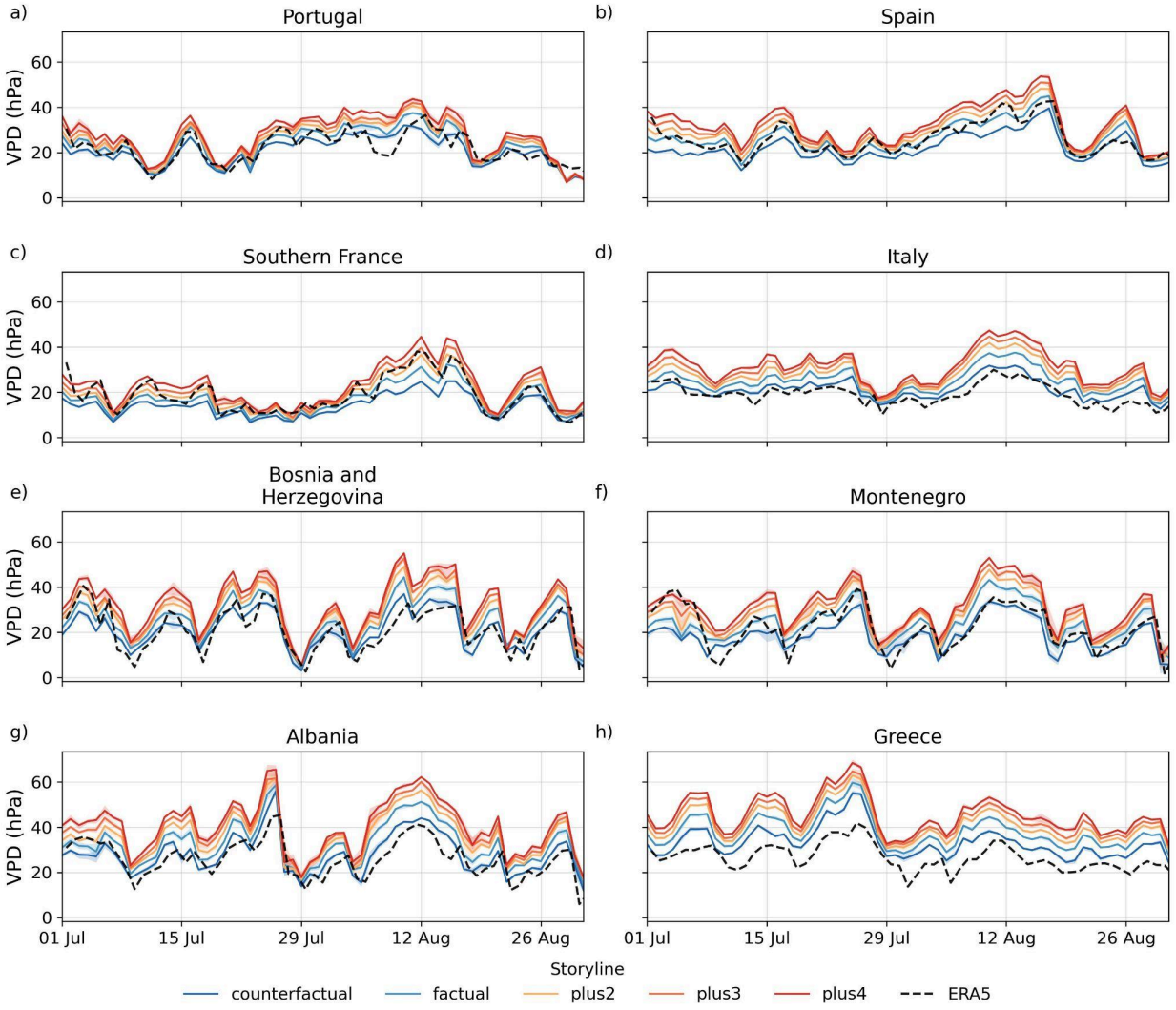
Figure S1 Country-mean near-surface wind at noon for July–August 2025.



Time series of daily country-mean wind speed at noon for the same set of Mediterranean countries as in Supplementary Figure X. Colored lines and shaded envelopes show the ensemble mean and range (min–max) across storyline members, and the dashed black line shows ERA5. Wind speeds are shown in km h^{-1}.

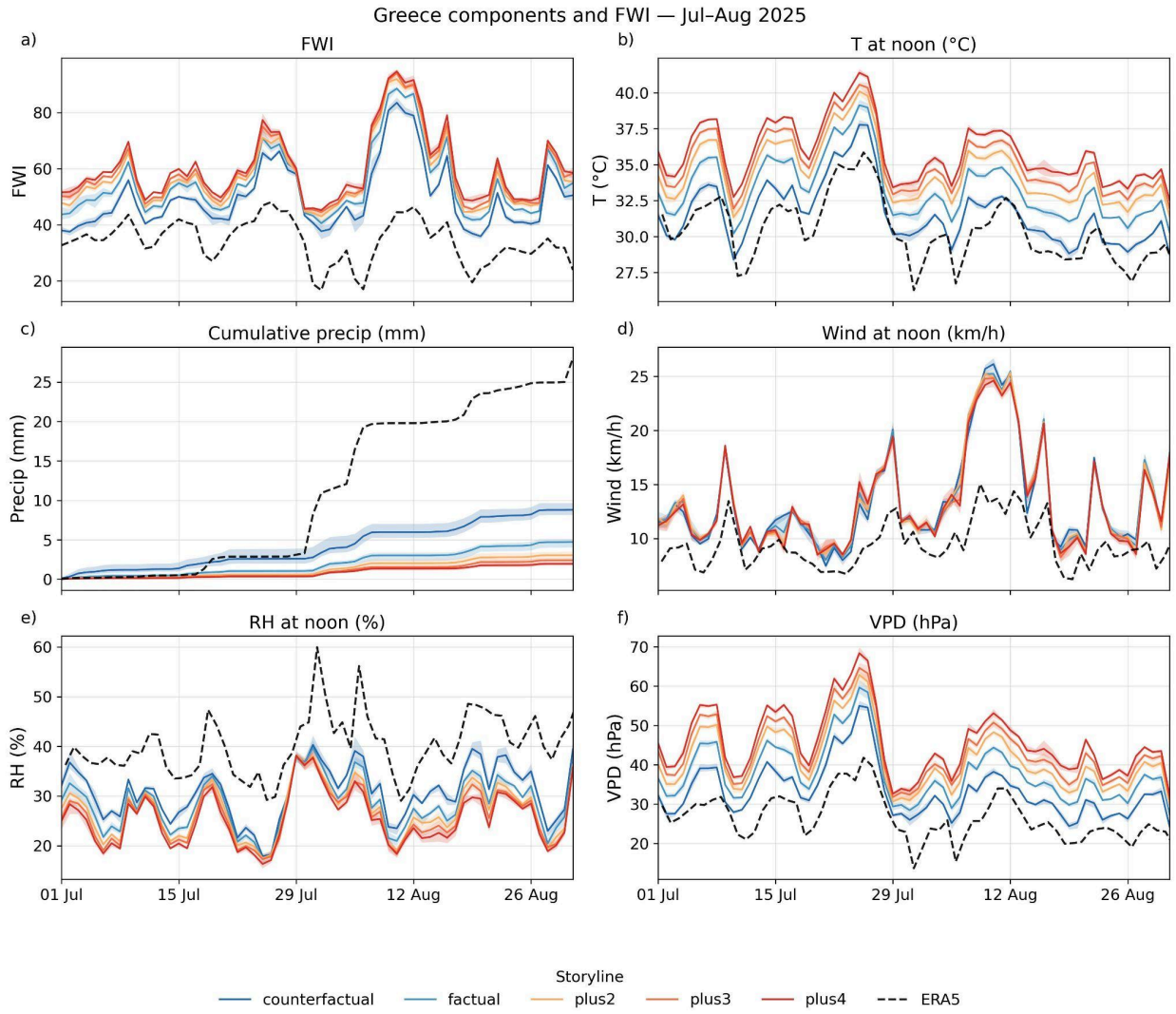
Overall, ERA5 and storyline simulations show comparable temporal variability and magnitude, consistent with the use of spectral nudging to constrain large-scale circulation. However, notable differences remain in some regions. In particular, over Greece, the storyline simulations exhibit a pronounced wind event in August that is not present in ERA5, indicating that regional wind differences may contribute to the enhanced fire weather conditions in the storyline simulations.

Figure S2 daily Vapour Pressure Deficit (VPD) per country in hPa



Time series of daily country-mean VPD for eight Mediterranean countries. Colored lines show the ensemble mean for each storyline (counterfactual, factual, +2 K, +3 K, +4 K), with shaded envelopes indicating the ensemble range (min–max across members). The dashed black line shows ERA5.

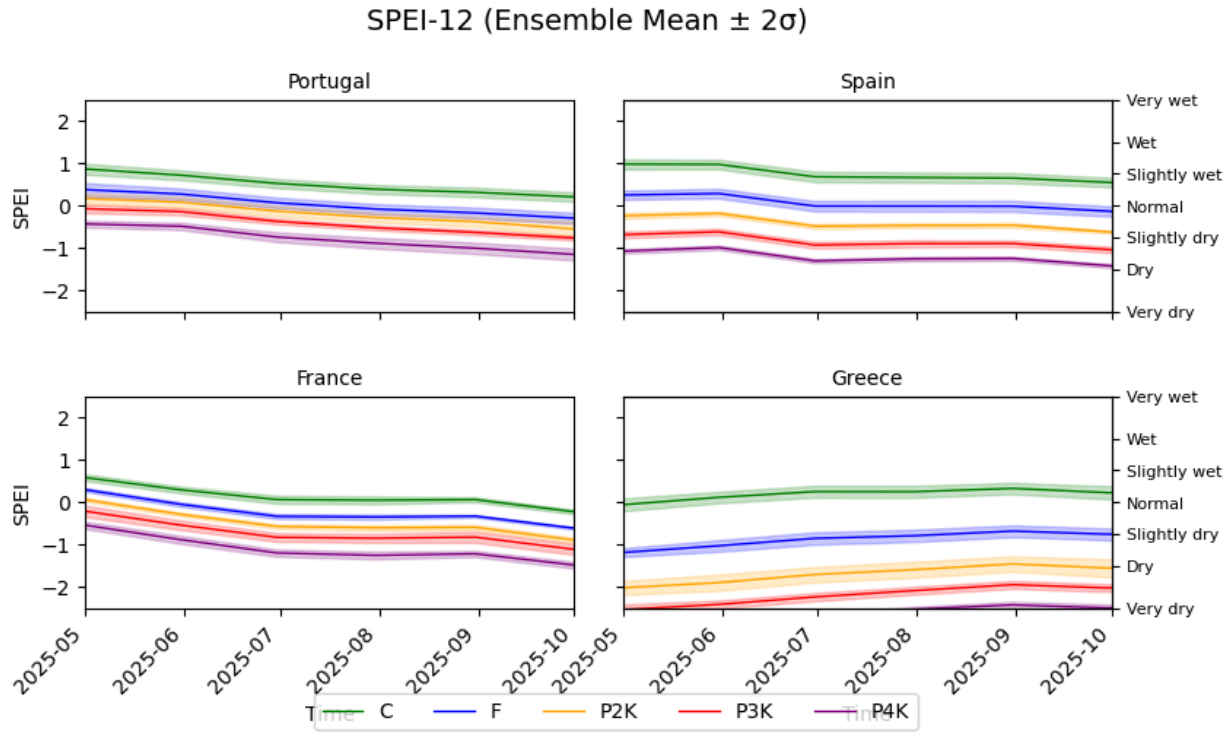
Figure S3 Country-mean fire weather components and FWI for Greece (July–August 2025)



Time series of daily country-mean Fire Weather Index (FWI), near-surface temperature at noon (T), cumulative precipitation, wind speed at noon, relative humidity at noon (RH), and vapour pressure deficit (VPD) for Greece. Colored lines show the ensemble mean for each storyline (counterfactual, factual, +2 K, +3 K, +4 K), with shaded envelopes indicating the ensemble range (min–max across members). The dashed black line shows ERA5.

Compared to other countries, Greece exhibits a coherent divergence between ERA5 and the storyline simulations across multiple variables, including higher temperatures, lower relative humidity, higher VPD, lower cumulative precipitation, and notably stronger wind speeds in the storyline simulations. In particular, a pronounced wind event in August is present in the storyline simulations but much weaker in ERA5, coinciding with the peak in FWI. This indicates that, in addition to thermodynamic differences, wind contributes to the enhanced fire weather conditions in the storyline simulations over Greece.

Figure S4 Country-mean SPEI-12 for selected Mediterranean countries (May–October 2025).



Time series of the 12-month Standardized Precipitation Evapotranspiration Index (SPEI-12) for Portugal, Spain, Southern France, and Greece. Colored lines show the ensemble mean for each storyline (counterfactual, factual, +2 K, +3 K, +4 K), with shaded envelopes indicating ±2 standard deviations across ensemble members.

Positive values indicate wetter-than-normal conditions, while negative values indicate drier-than-normal conditions, with commonly used thresholds indicated on the right axis. Across all countries, the storyline simulations show a progressive shift towards drier conditions with increasing warming levels, with the strongest drying signal in the +3 K and +4 K scenarios. Greece exhibits the driest baseline conditions and the largest absolute shift towards very dry conditions.