

The October 2024 Extreme Precipitation Event over Valencia: Storyline Attribution of the Synoptic-Scale Thermodynamic Drivers

Diego A. Campos^{1,2}, Katherine Grayson¹, Ramiro I. Saurral^{1,3,4,5}, Sebastian Beyer⁶, Amal John⁶, Matías Olmo¹, Francisco Doblas-Reyes^{1,7}

¹Barcelona Supercomputing Center, Barcelona, Spain

²Facultat de Física, Universitat de Barcelona, Barcelona, Spain

³CONICET-Universidad de Buenos Aires. Centro de Investigaciones del Mar y la Atmósfera (CIMA), Buenos Aires, Argentina

⁴Facultad de Ciencias Exactas y Naturales, Departamento de Ciencias de la Atmósfera y los Océanos, Universidad de Buenos Aires, Buenos Aires, Argentina

⁵CNRS-IRD-CONICET-UBA. Instituto Franco-Argentino para el Estudio del Clima y sus Impactos (IRL 3351 IFAECI), Buenos Aires, Argentina

⁶Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung (AWI), Bremerhaven, Germany

⁷Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain

Correspondence to: Diego A. Campos (diego.campos@bsc.es)

Table S1: Registered precipitation on the 29th of October 2024 in ground stations from the AEMET (<https://www.aemet.es/>) and AVAMET* (<https://www.avamet.org/>) agencies.

Name	Location	Precipitation (mm)
Madrid-Retiro	40.4°N – 3.7°W	33.4
Valencia Airport	39.5°N – 0.5°W	51.2
Barcelona-El Prat	41.3°N – 2.1°E	88.3
Santander-Parayas	43.4°N – 3.8°W	68.9
Murcia-San Javier	37.8°N – 0.8°W	27.2
Córdoba Airport	37.8°N – 4.9°W	45.3
Reus Airport	41.2°N – 1.2°E	82.5
Cádiz Observatory	36.5°N – 6.2°W	102.6
Castellón-Almazora	39.9°N – 0.1°W	116.0
Pedralba-Cueva del Ternero *	39.5°N – 0.8°W	469.0
Chiva *	39.5°N – 0.7°W	641.1
Turís *	39.4°N – 0.7°W	682.2
Utiel este *	39.6°N – 1.2°W	324.0
Requena *	39.5°N – 1.1°W	319.2

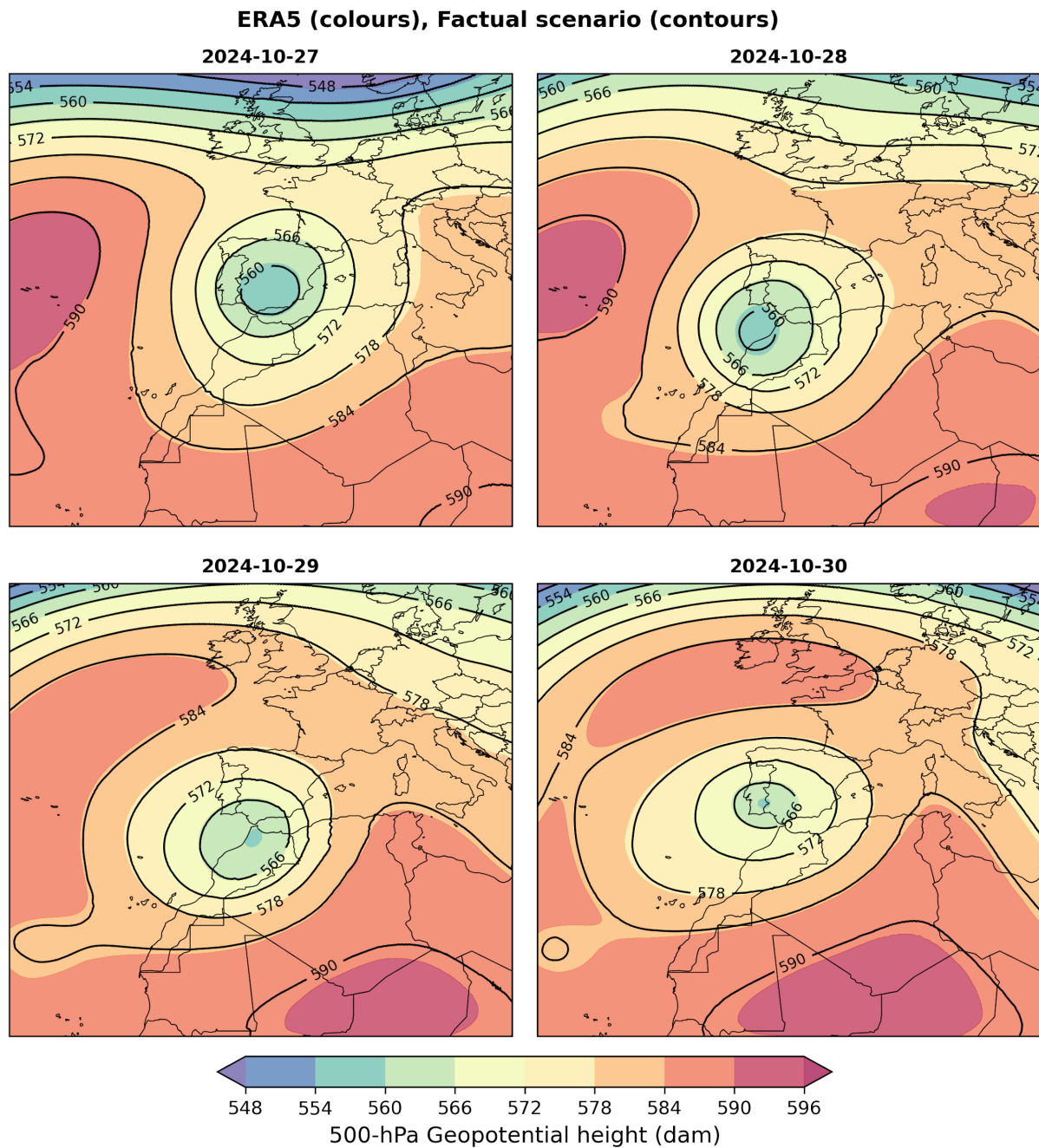


Figure S1: Evolution of daily 500-hPa geopotential height from 27 October to 30 October 2024. ERA5 reanalysis in colours and the Factual scenario from DestinE ClimateDT in contours.

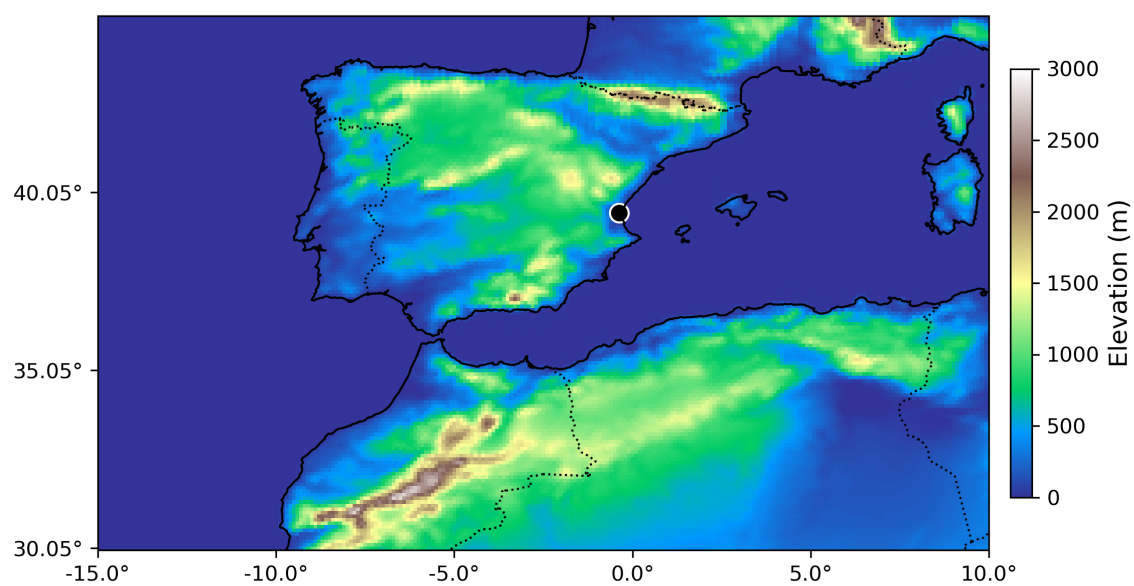


Figure S2: Topography (in m) over the Iberian Peninsula and northern Africa in the IFS model used in the DestinE ClimateDT storyline experiments.

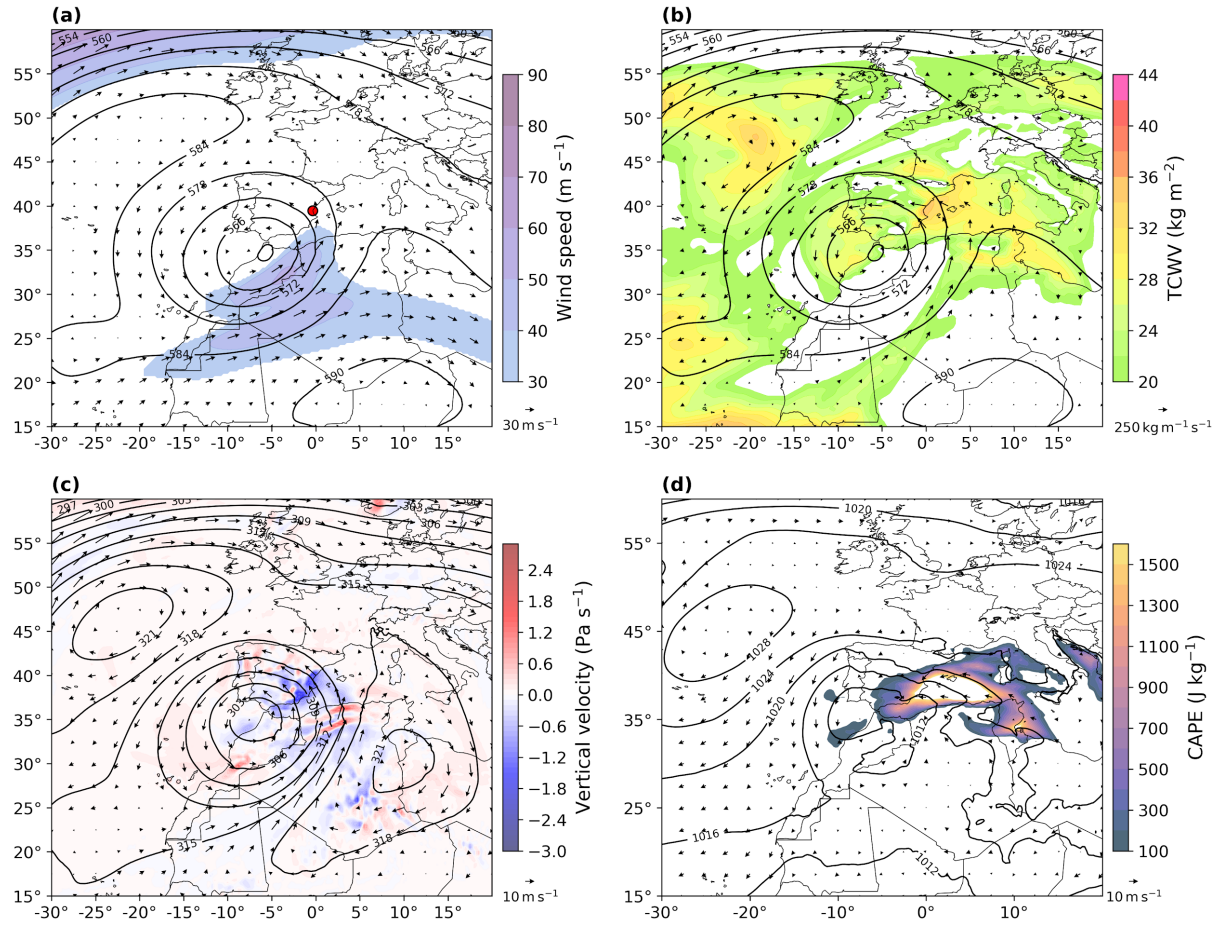


Figure S3: Daily composite for the 29 October 2024 from ERA5 for (a) 500-hPa geopotential height (contours, dam), 300-hPa wind (arrows, m s^{-1}) and wind speed (colours, m s^{-1}), (b) 500-hPa geopotential height (contours, dam), integrated water vapour transport (IVT, arrows, $\text{kg m}^{-1} \text{s}^{-1}$) and total column water vapour (TCWV, colours, kg m^{-2}), (c) 700-hPa geopotential height (contours, dam), 700-hPa wind (arrows, m s^{-1}) and 700-hPa vertical velocity (colours, Pa s^{-1}), and (d) mean sea level pressure (MSLP, contours, hPa), 1000-hPa wind (arrows, m s^{-1}) and convective available potential energy (CAPE, colours, J kg^{-1}). The red dot on (a) shows the approximate location of Valencia.

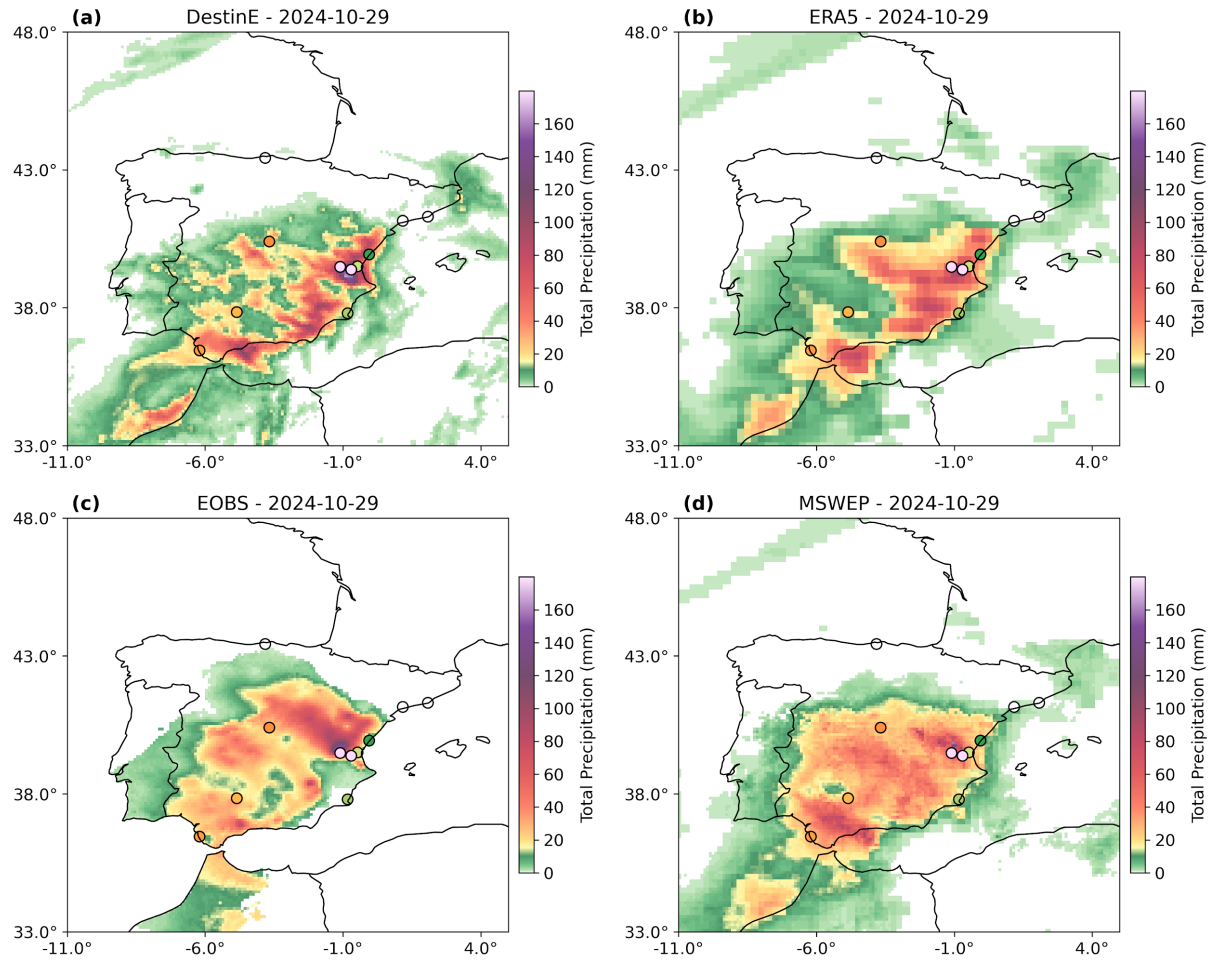


Figure S4: Daily accumulated precipitation over the Iberian Peninsula during 29 October 2024 in (a) the Factual scenario of the DestinE ClimateDT simulation, (b) ERA5 reanalysis, (c) E-OBS, and (d) MSWEP. Dots in all panels show a subset of the ground stations shown in [Table S1](#).

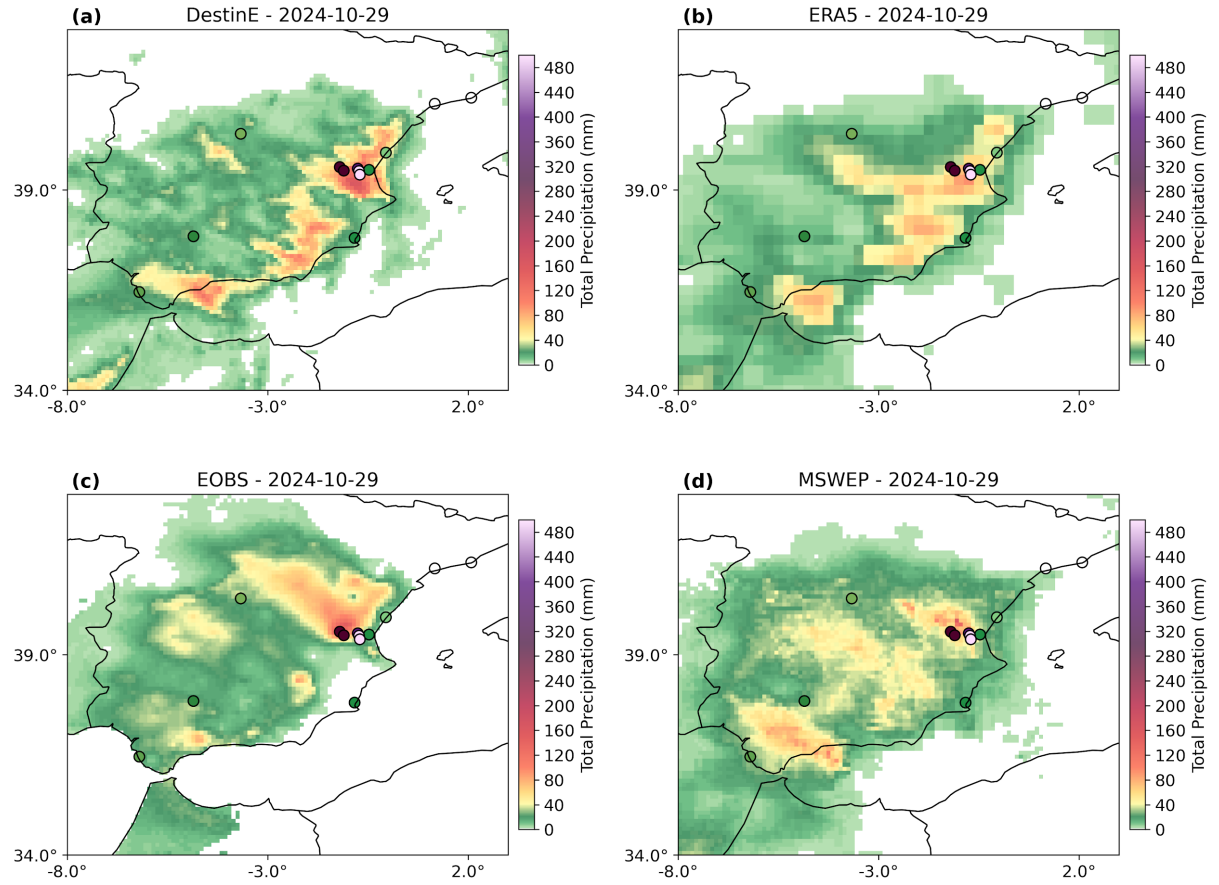


Figure S5: Daily accumulated precipitation over Valencia during the 29 October 2024 in (a) the Factual scenario of the DestinE ClimateDT simulation, (b) ERA5 reanalysis, (c) E-OBS, and (d) MSWEP. Dots in all panels show a subset of the ground stations shown in [Table S1](#).

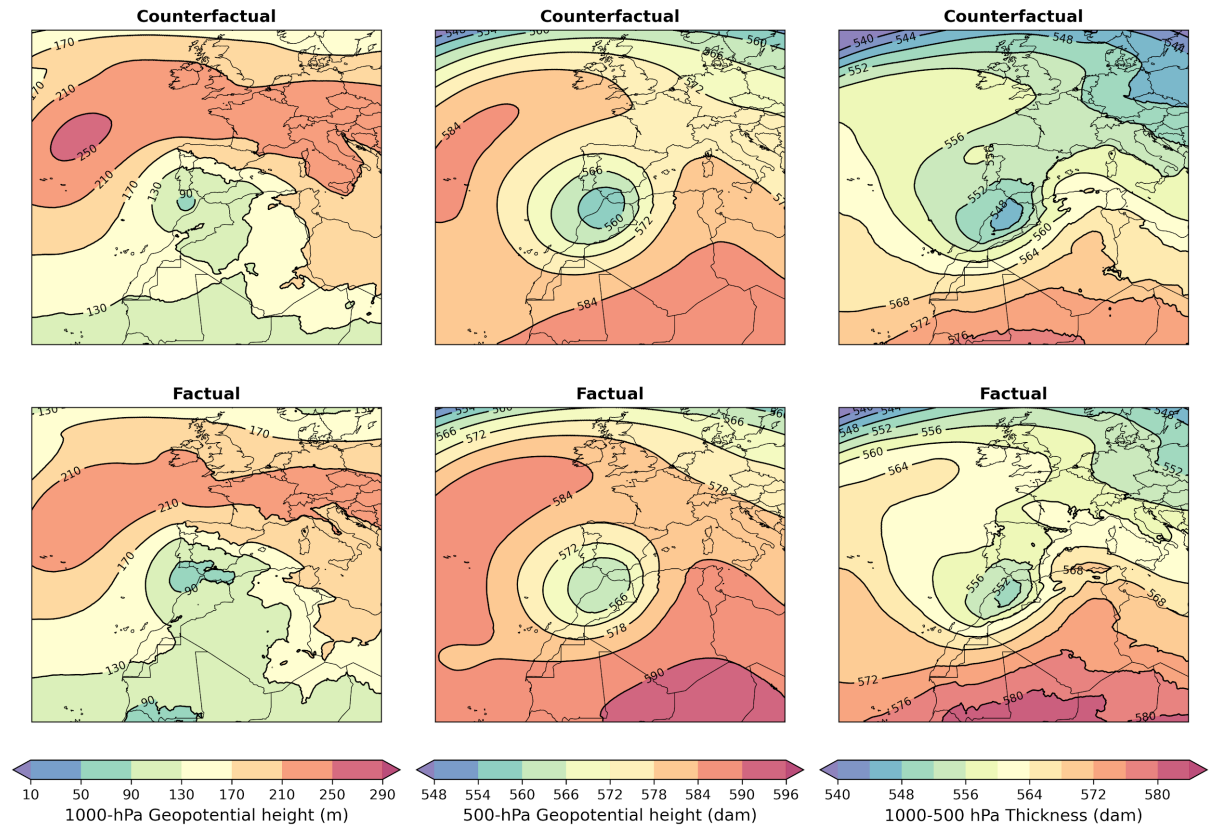


Figure S6: 29 October 2024 daily mean 1000-hPa geopotential height (left), 500-hPa geopotential height (centre) and 1000-500 thickness (right) for the Counterfactual scenario (above) and the Factual scenario (below).

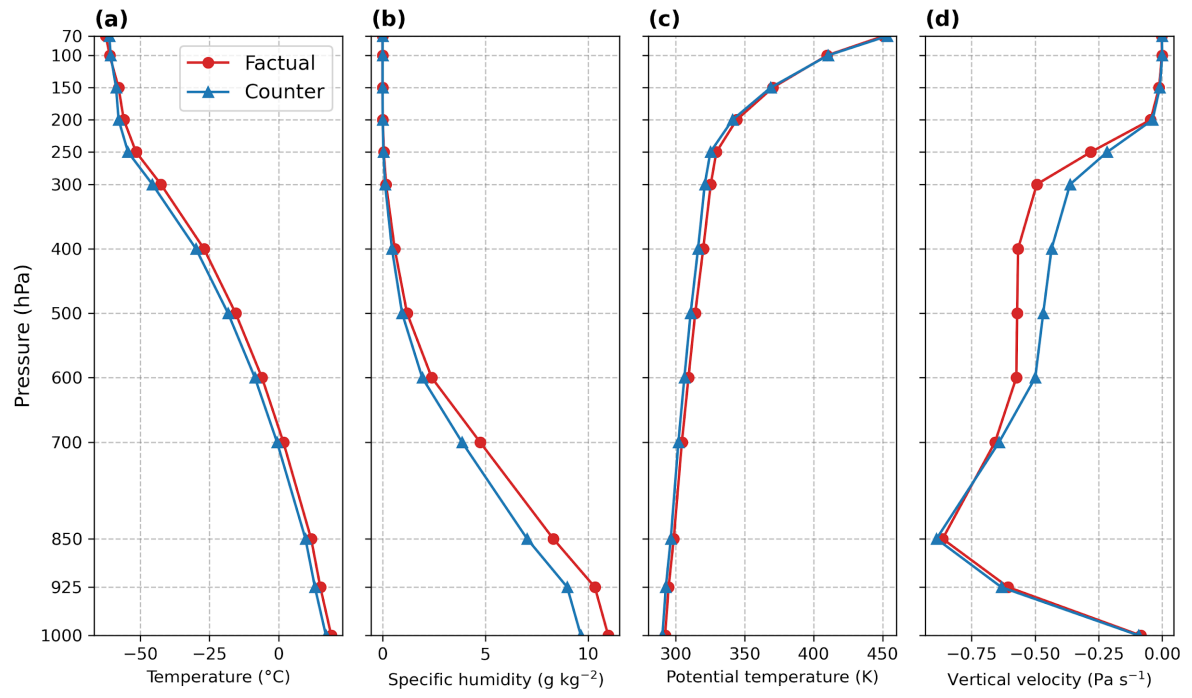


Figure S7: 29 October 2024 daily mean vertical profile over the Valencia region (VAL box) from the Factual (red) and Counterfactual (blue) scenarios for (a) temperature, (b) specific humidity, (c) potential temperature, and (d) vertical velocity.

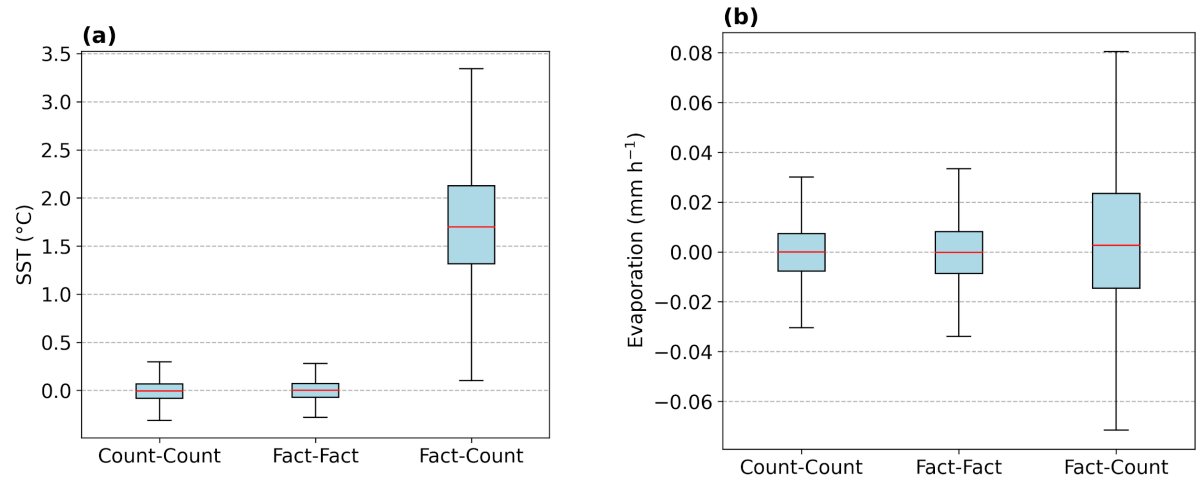


Figure S8: Distribution of hourly differences between ensemble members for the Counterfactual scenario (Count–Count), the Factual scenario (Fact–Fact), and between scenarios (Fact–Count) for (a) sea surface temperature (SST) and (b) evaporation over the EXTMED region.

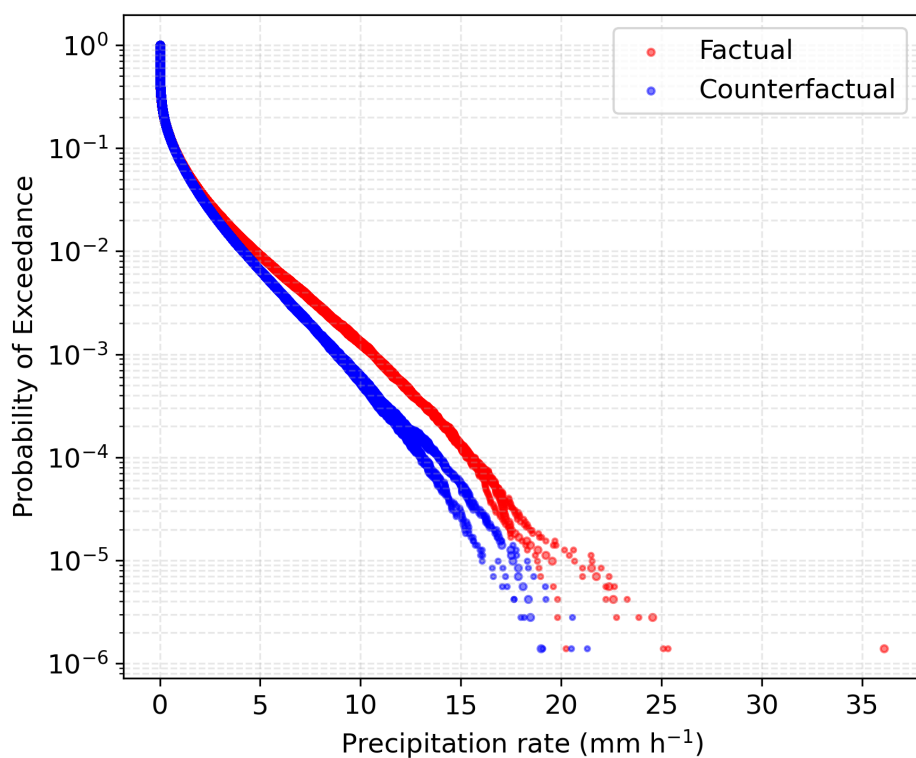


Figure S9: Hourly precipitation in all the grid cells of the Factual (red) and Counterfactual (blue) DestinE ClimateDT simulations over southern Spain (36.25°–41.5°N; 6.75°W–0.25°E) from 24 October to 31 October.