



**Barcelona
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Centro Nacional de Supercomputación

Using global spectrally nudged storylines to attribute anthropogenic amplification of the 2024 Valencia DANA extreme precipitation event

Diego Campos, Katherine Grayson, Ramiro Saurral, Matías Olmo, and Francisco Doblas-Reyes

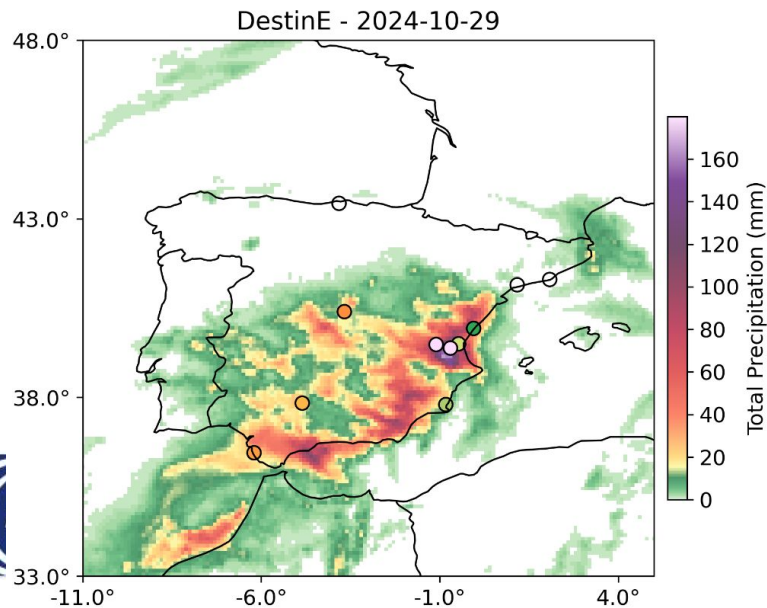
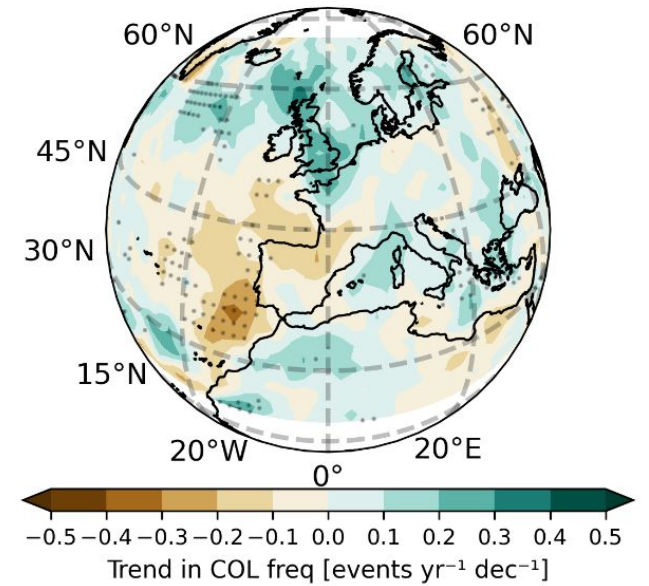
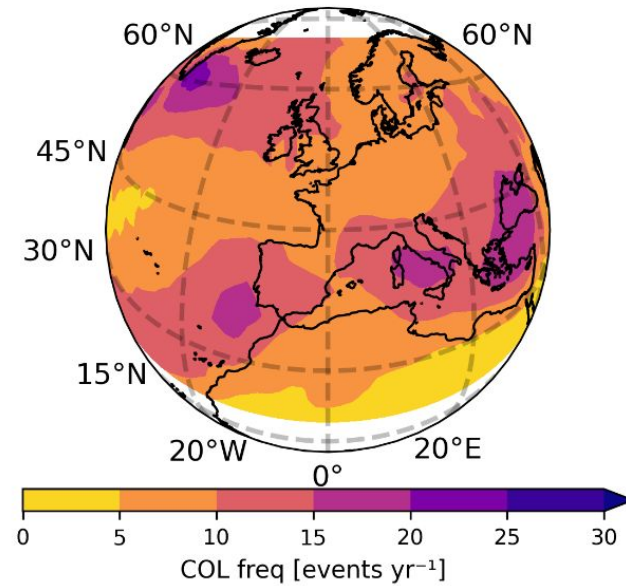
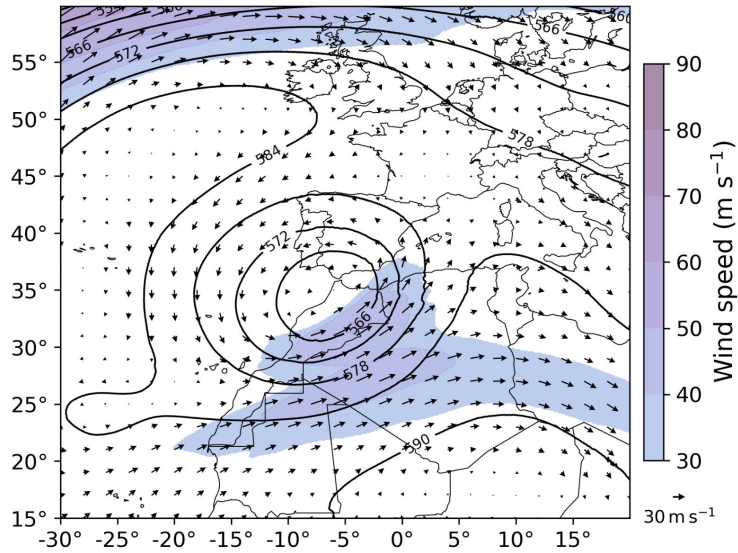
Earth Sciences Department, Barcelona Supercomputing Center

03 - 08 May 2026

EGU General Assembly 2026

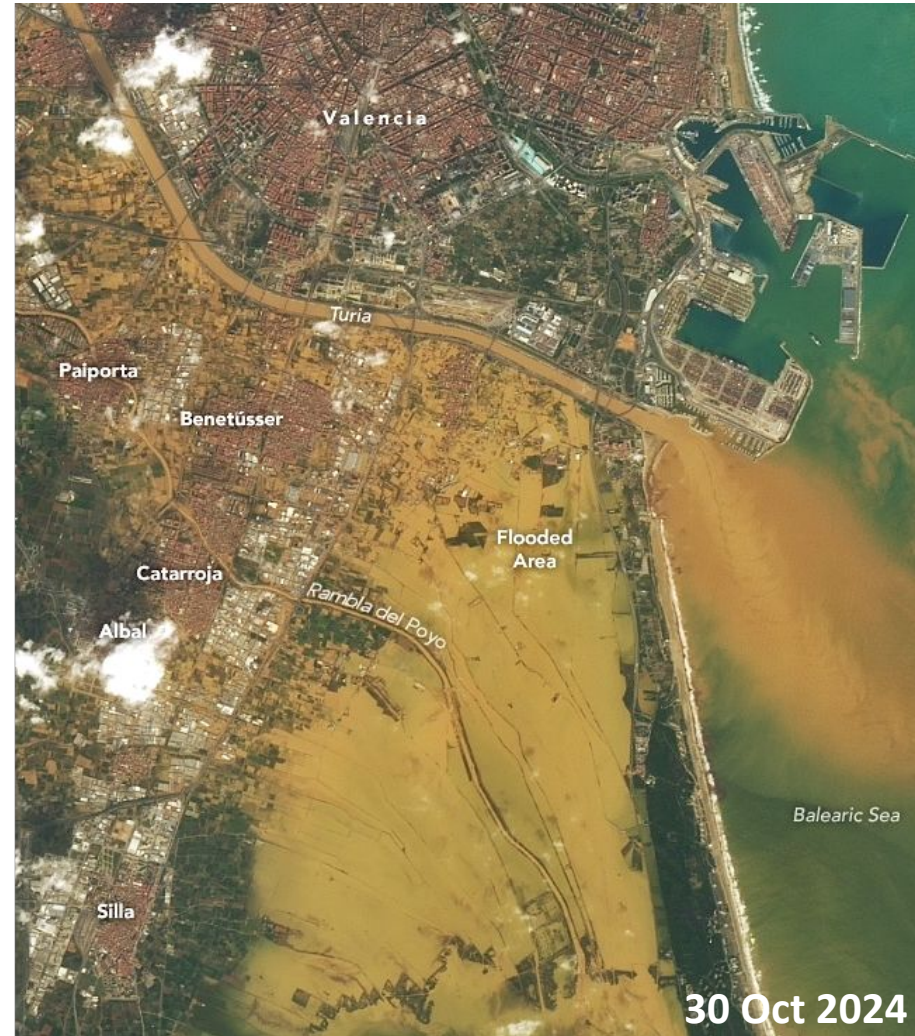
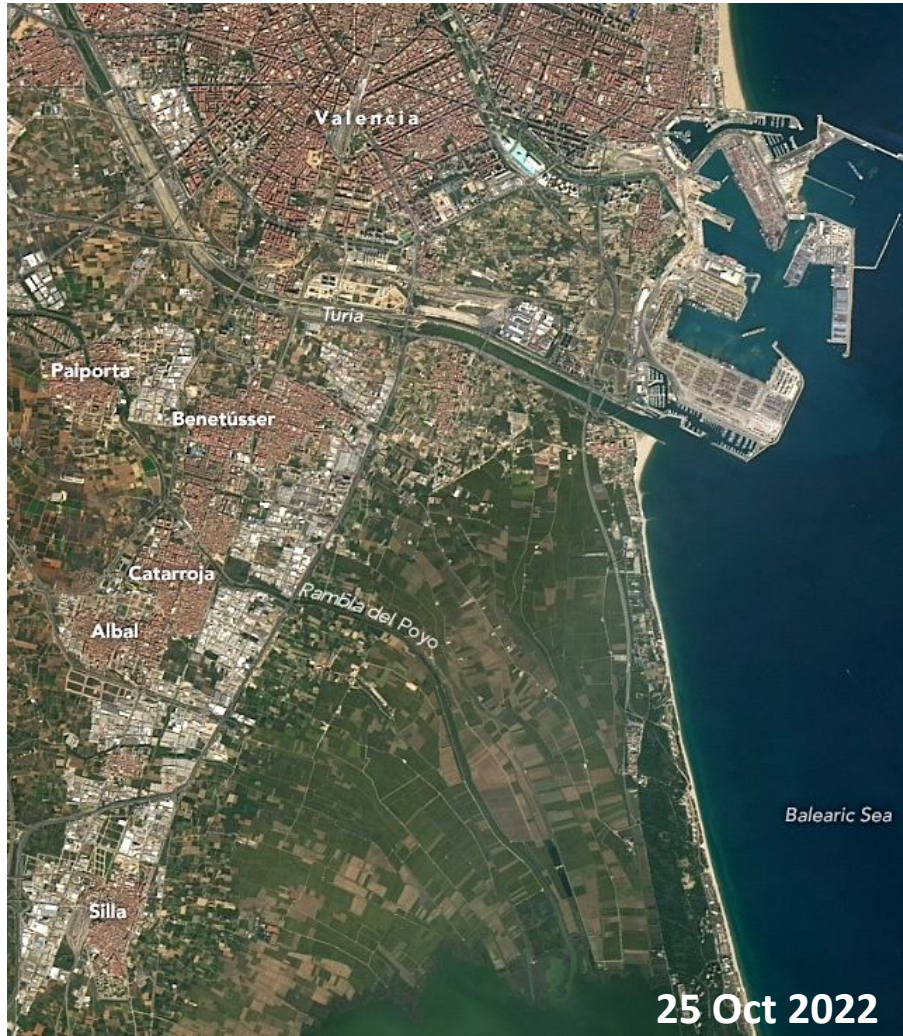
What happened in Valencia?

In late October 2024, a COL affected the southwestern Iberian Peninsula, a region that is a “hotspot” for COLs.



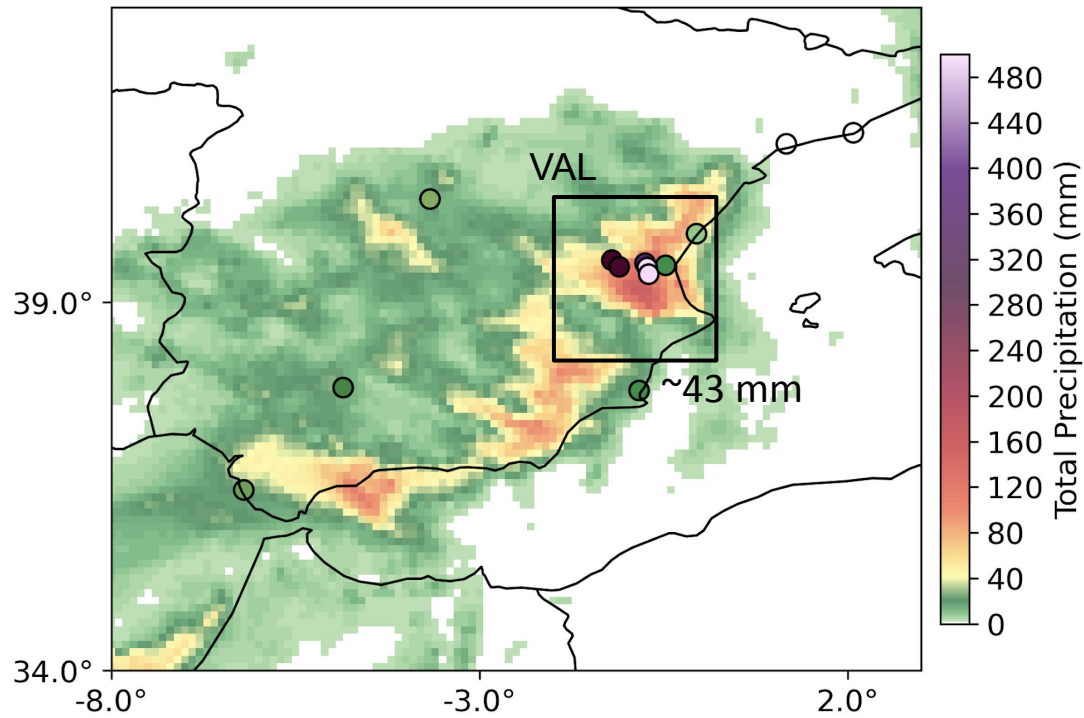
(Saurral et al., 2025)

The impacts were catastrophic

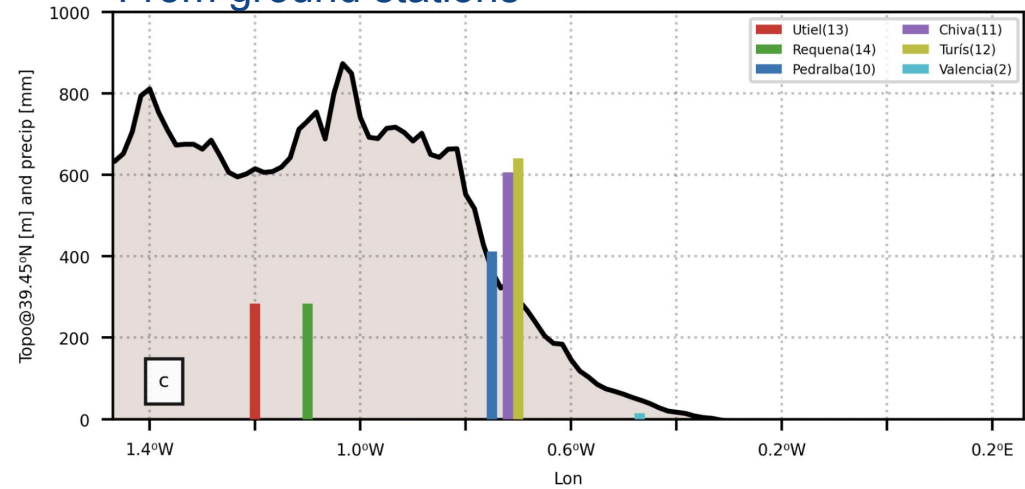


Observed and simulated precipitation

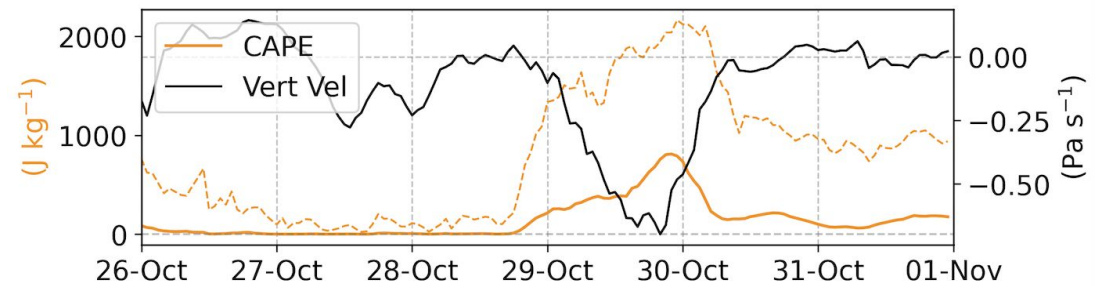
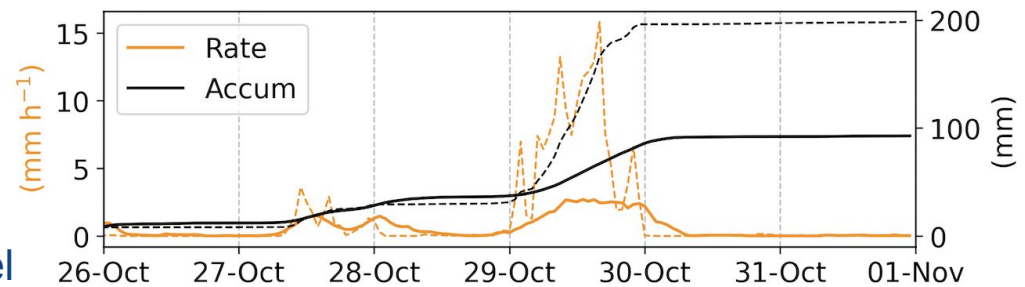
DestinE - 2024-10-29



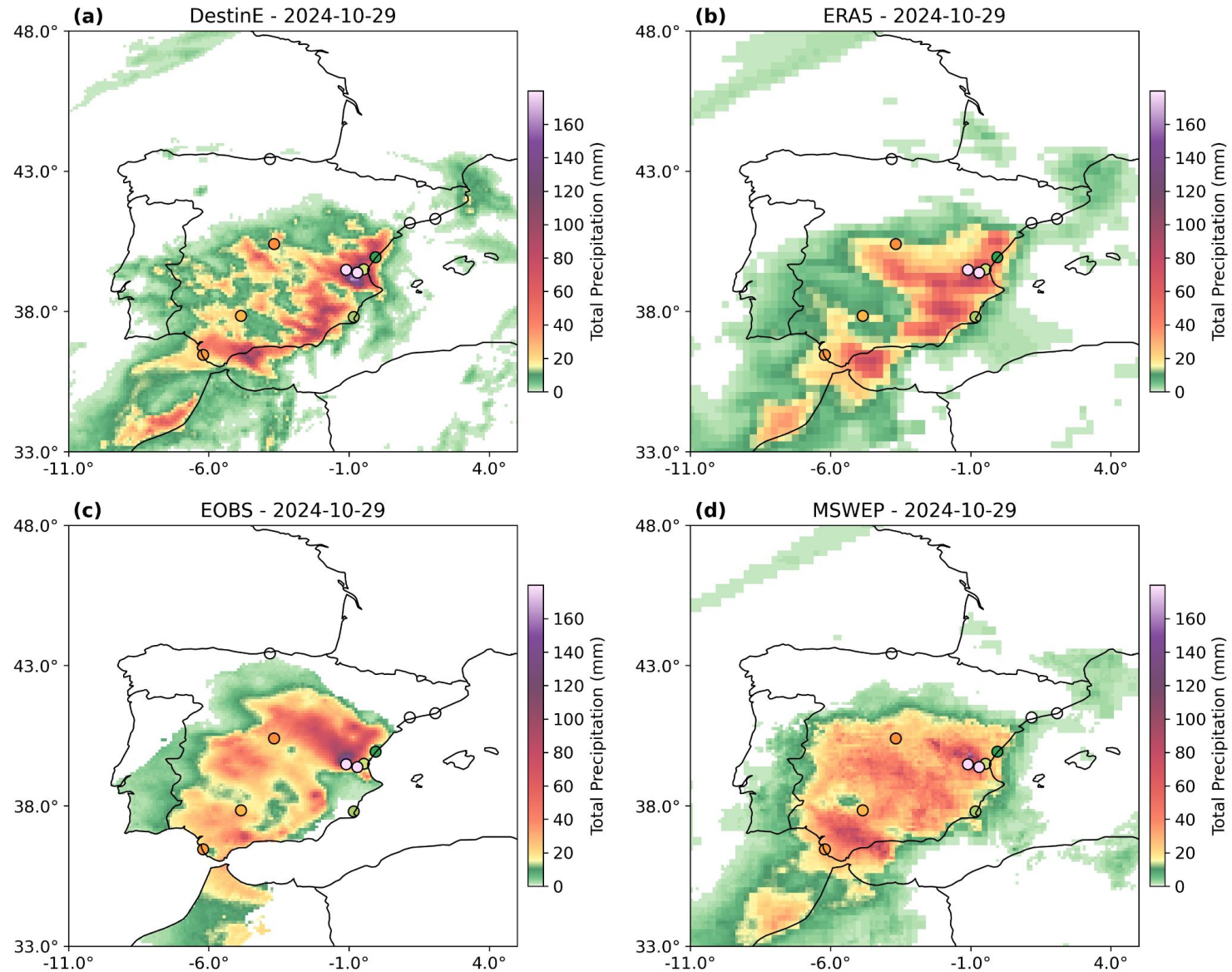
From ground stations



From the model

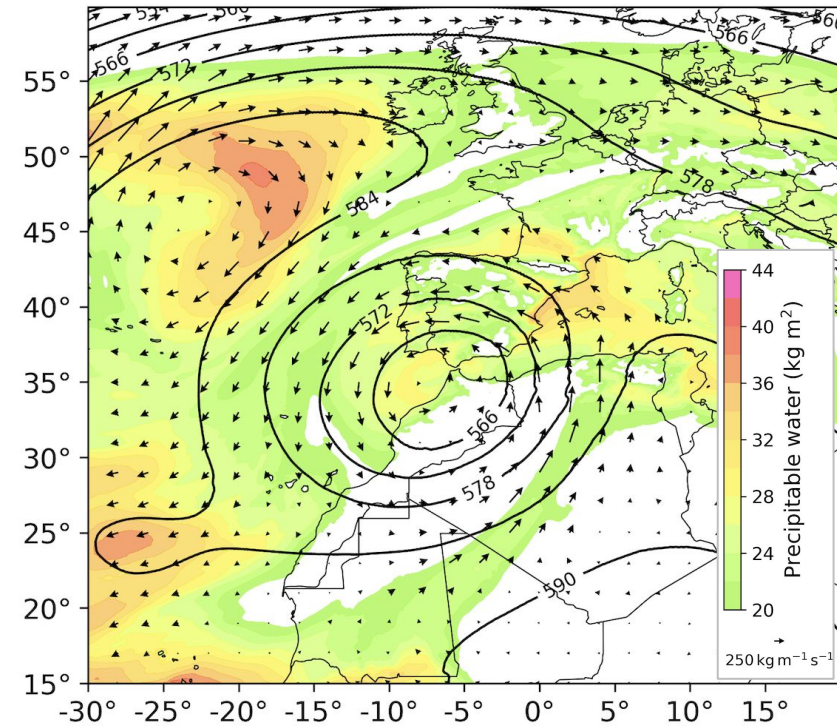


Observed and simulated precipitation



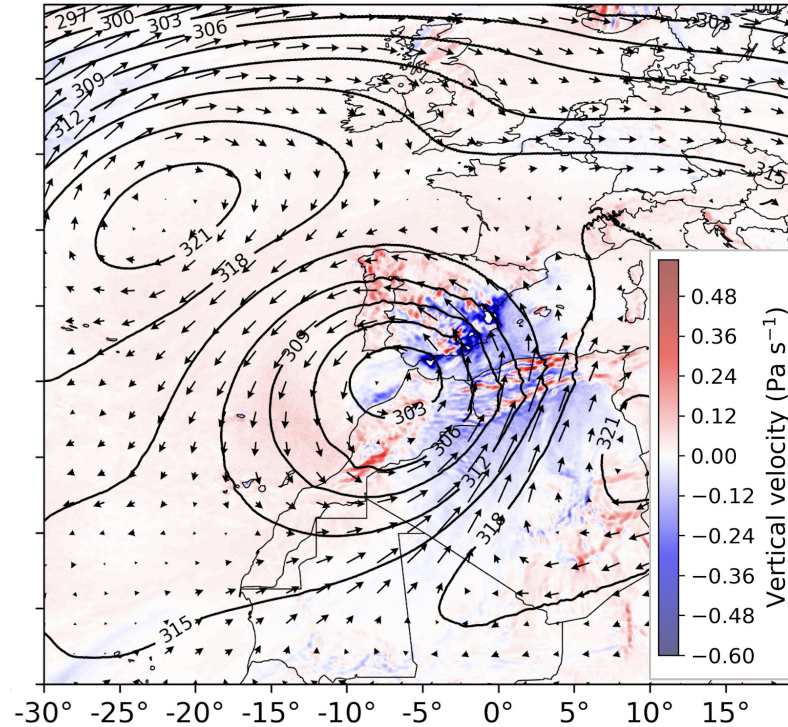
Synoptic environment

500-hPa GPH, PW, IVT



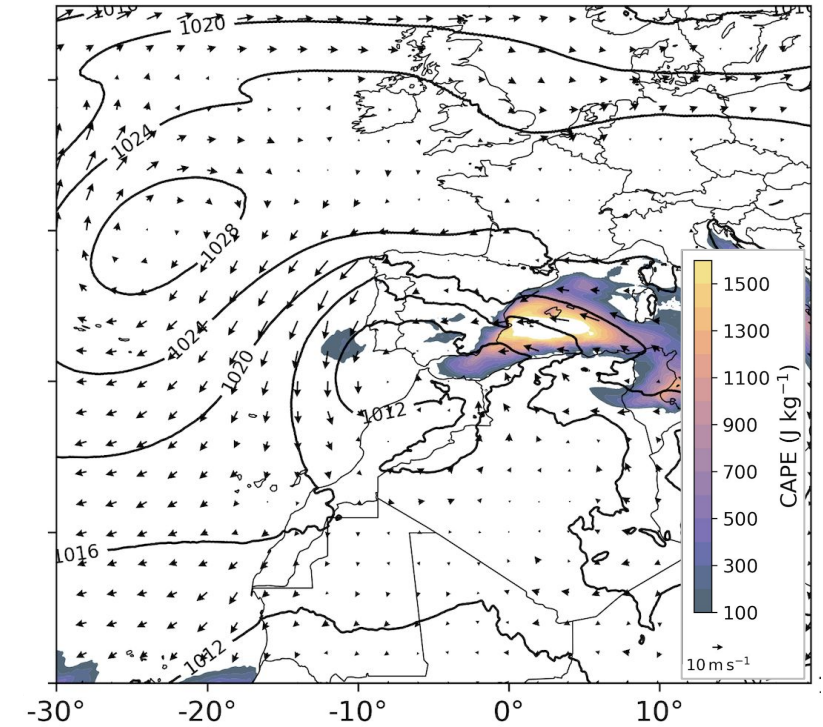
High values of PW in the Med
An AR-like from the south

700-hPa GPH, Vert Vel, Winds



South-westerly flow interacts with
the topography (upward motion)

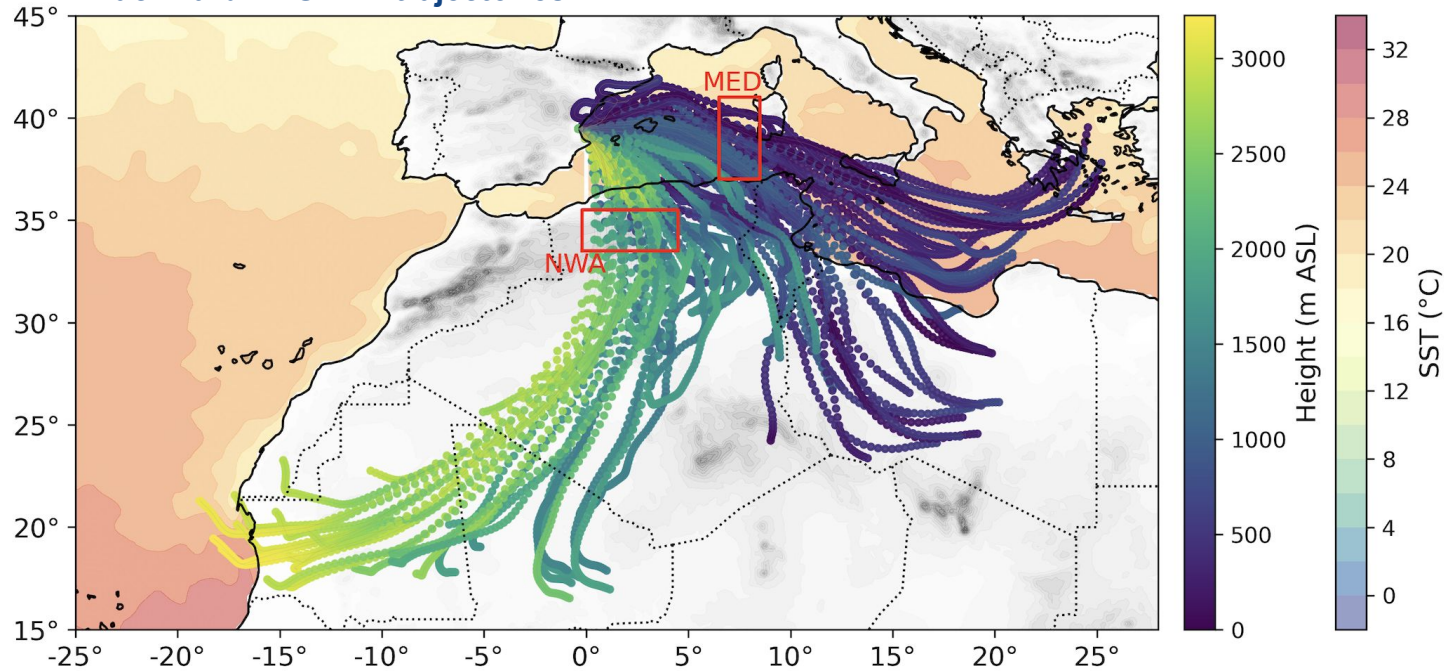
SLP, CAPE



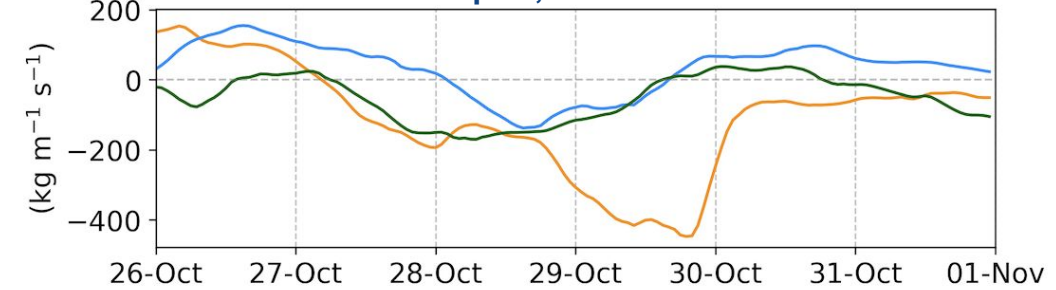
High values of CAPE in the Med

Two sources of moisture

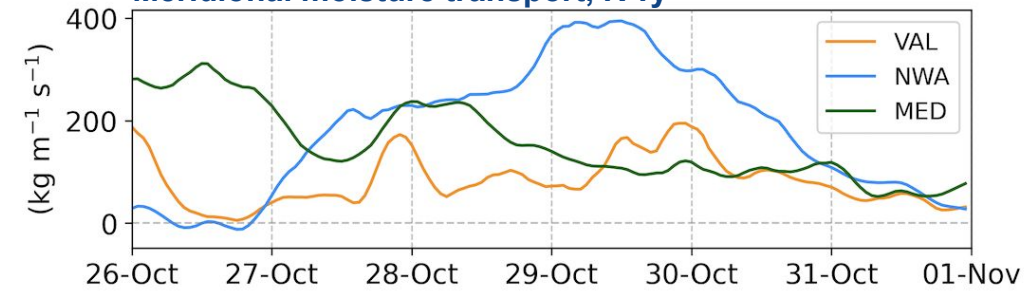
Backward HYSPLIT trajectories



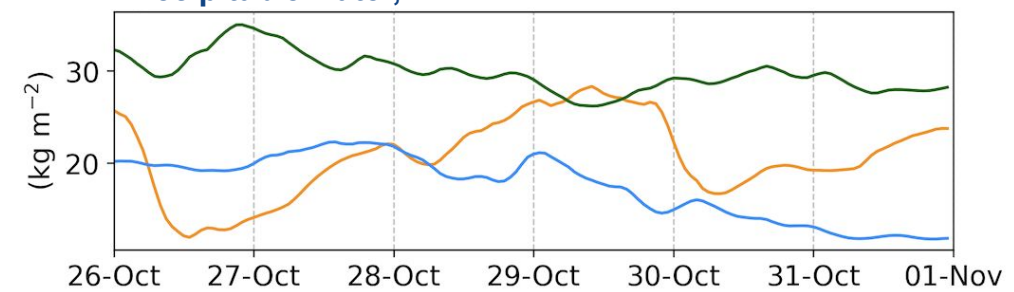
Zonal moisture transport, IVTx



Meridional moisture transport, IVTy



Precipitable water, PW



Research question

What was the role of global warming?

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

3, Centro de Investigaciones del Mar y la Atmósfera, CONICET-Universidad de Buenos Aires

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

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

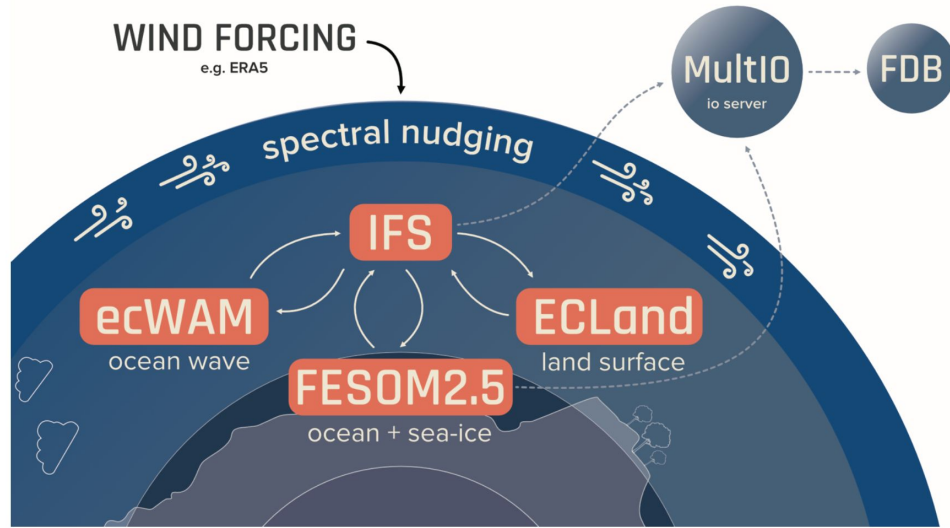
(Under review in WCD)

We wanted to say something about:

(i) The climatological context

(ii) The differences between a factual and a counterfactual scenario

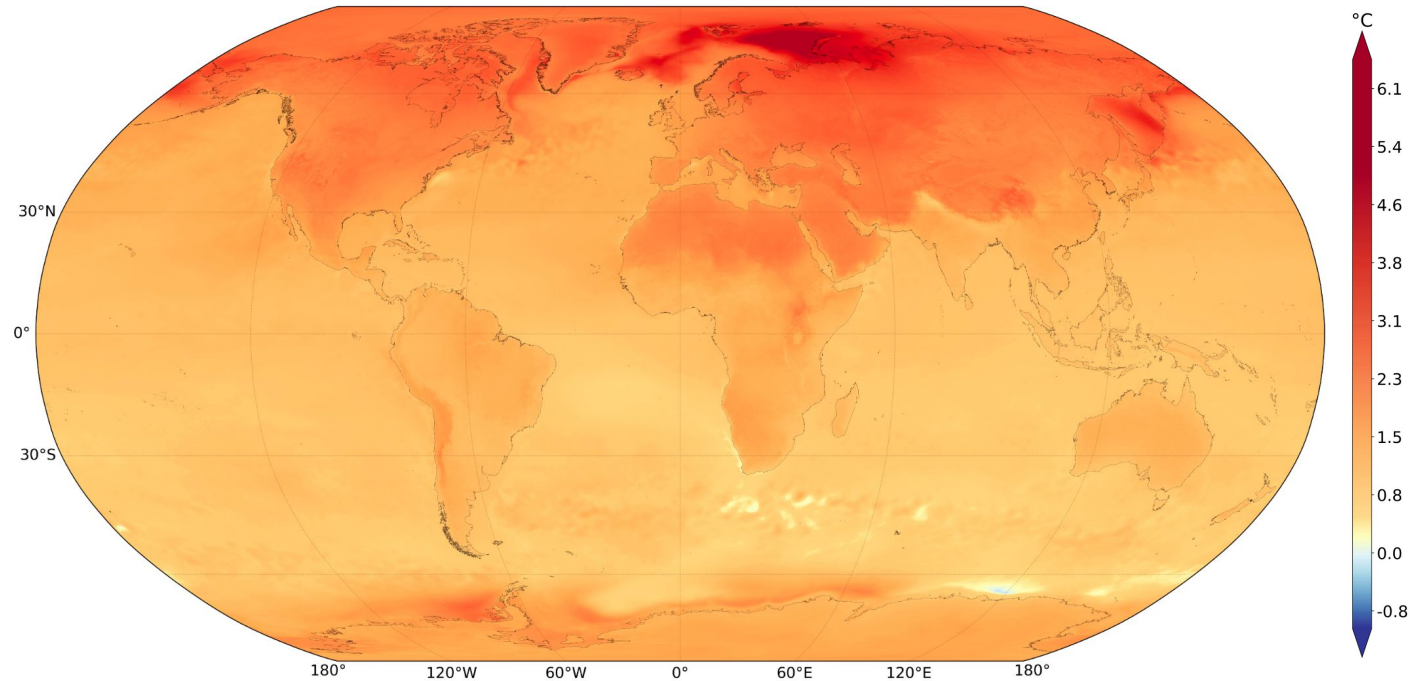
The storyline approach



Factual scenario: experiment with transient forcing (2017-present) from CMIP6-SSP3-7.0

Counterfactual scenario: experiment with fixed forcing (~1950) from CMIP6-historical

Mean surface temperature, Factual – Counterfactual (2018-2023)

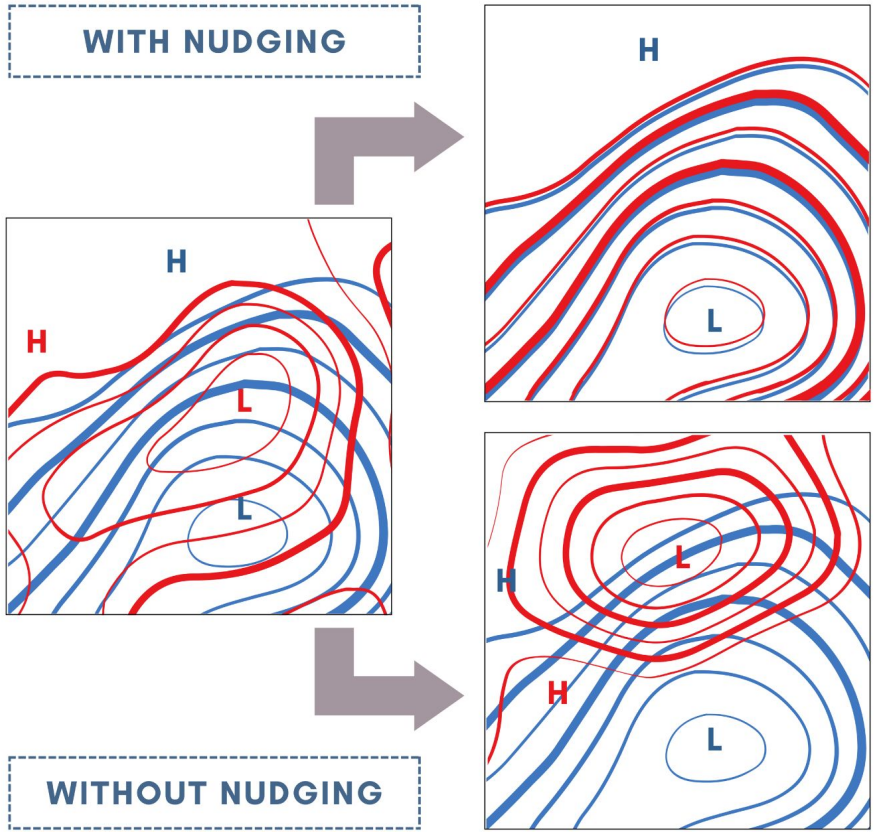


(John et al., under review)

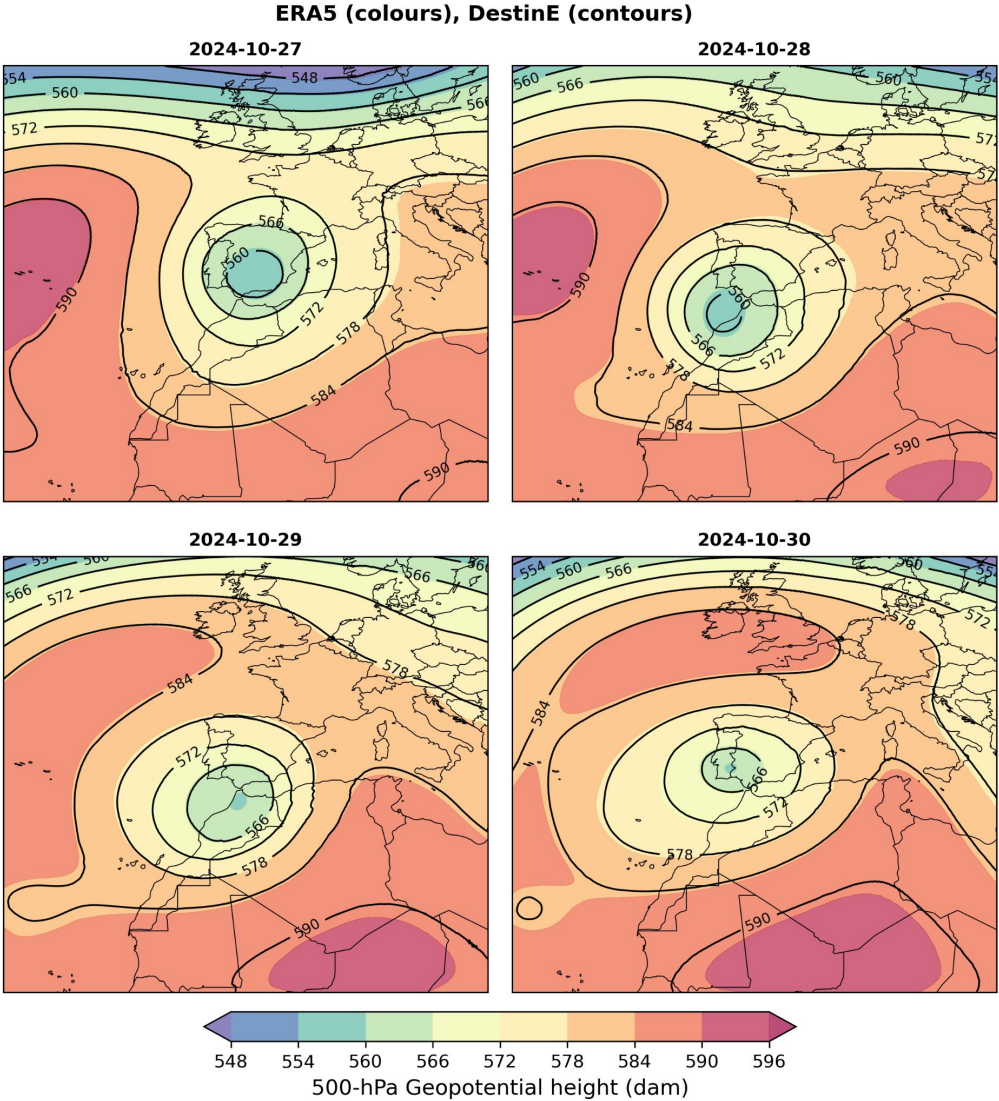
Global hourly outputs from 2017 to the present at ~9 km horizontal resolution.

5 ensemble members

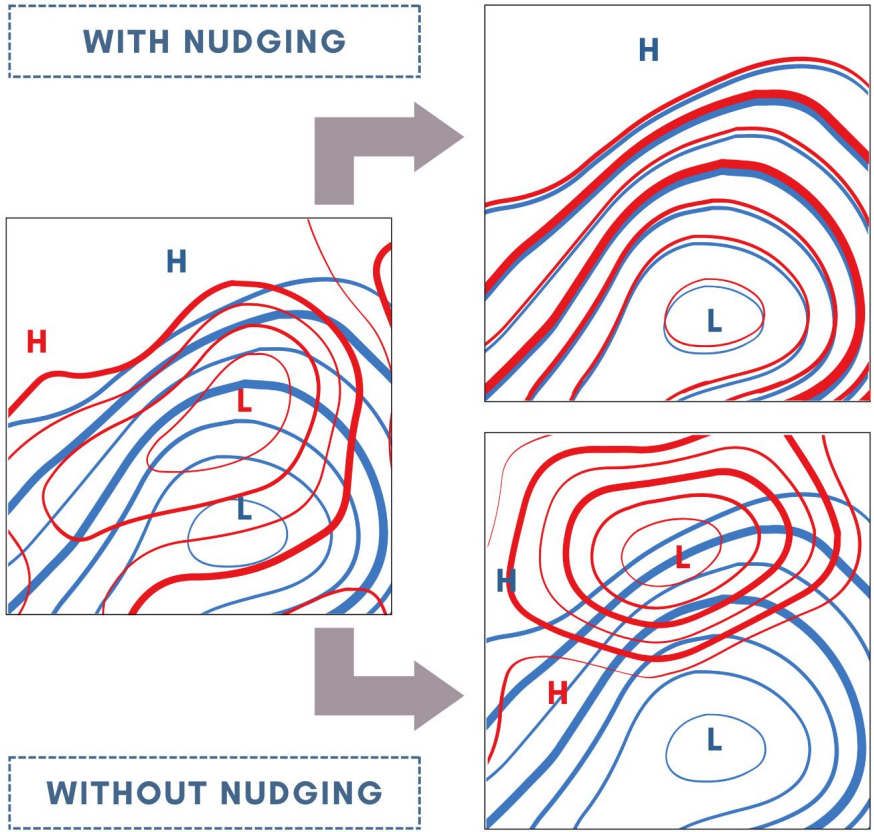
Simulations with spectral nudging



(John et al., under review)

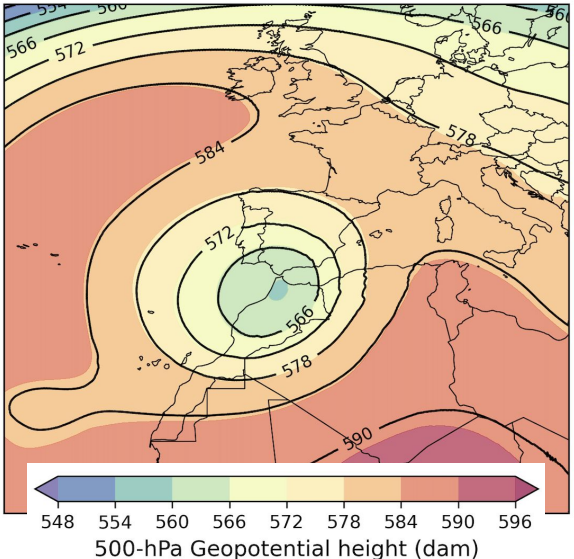


Simulations with spectral nudging

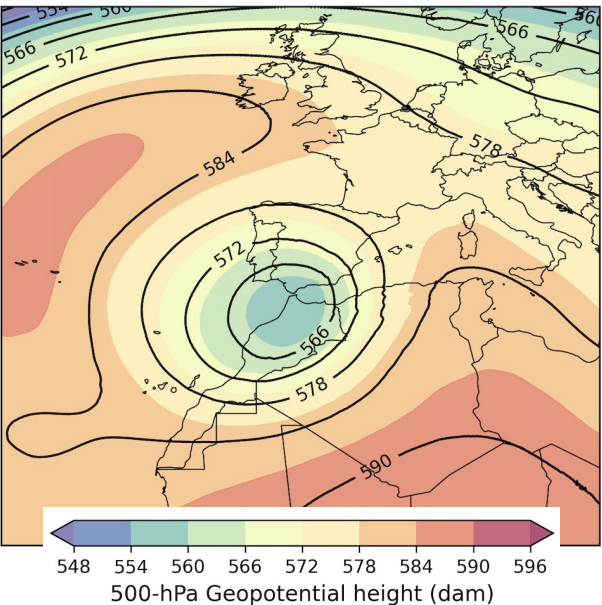


(John et al., under review)

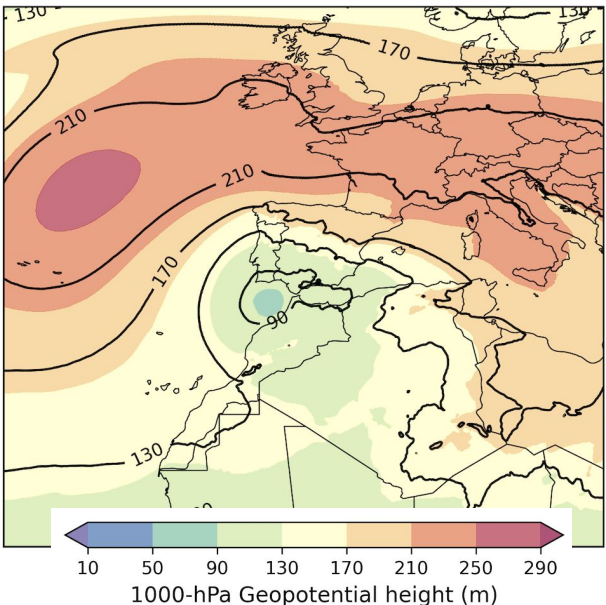
ERA5 (colours), DestinE (contours)



Counter (colours), Factual (contours)

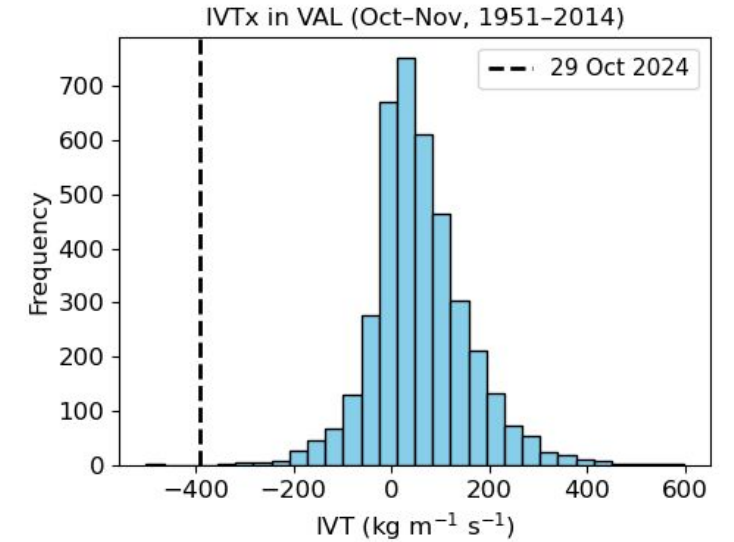
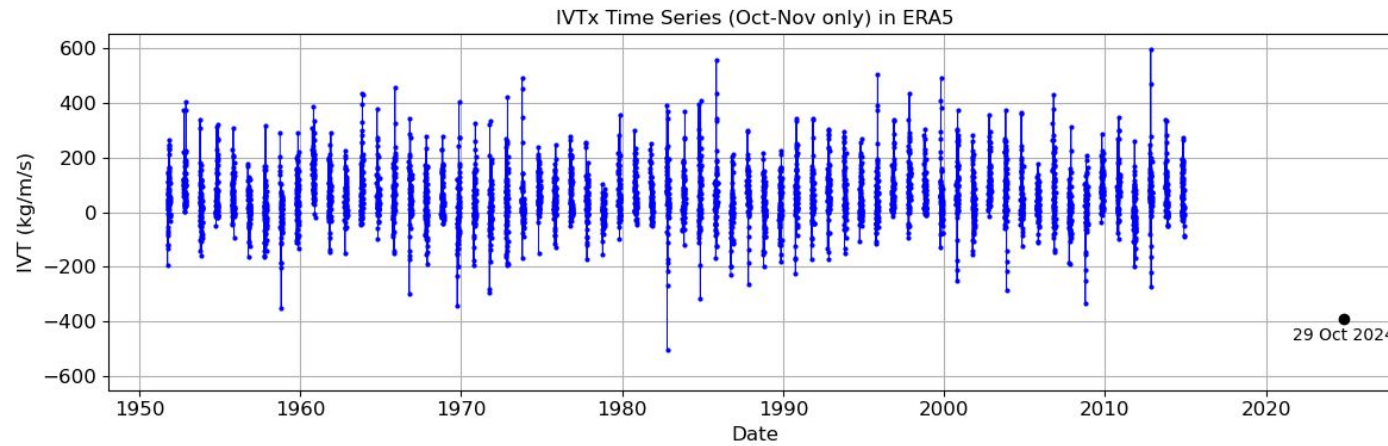


Counter (colours), Factual (contours)

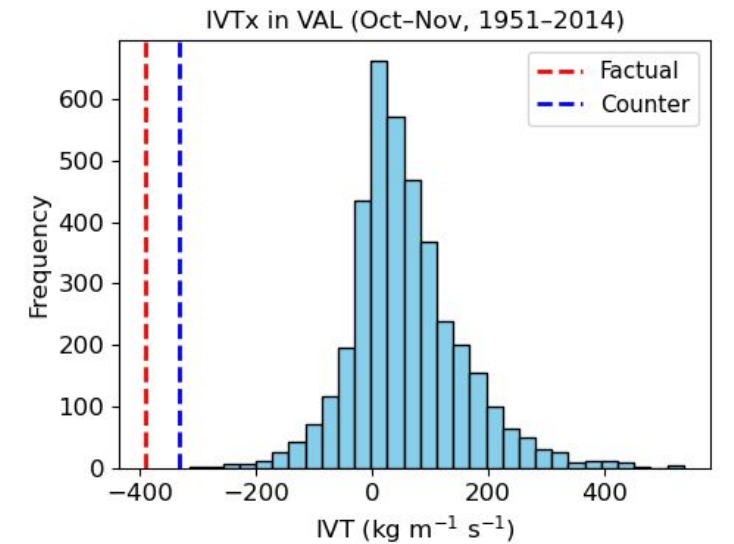
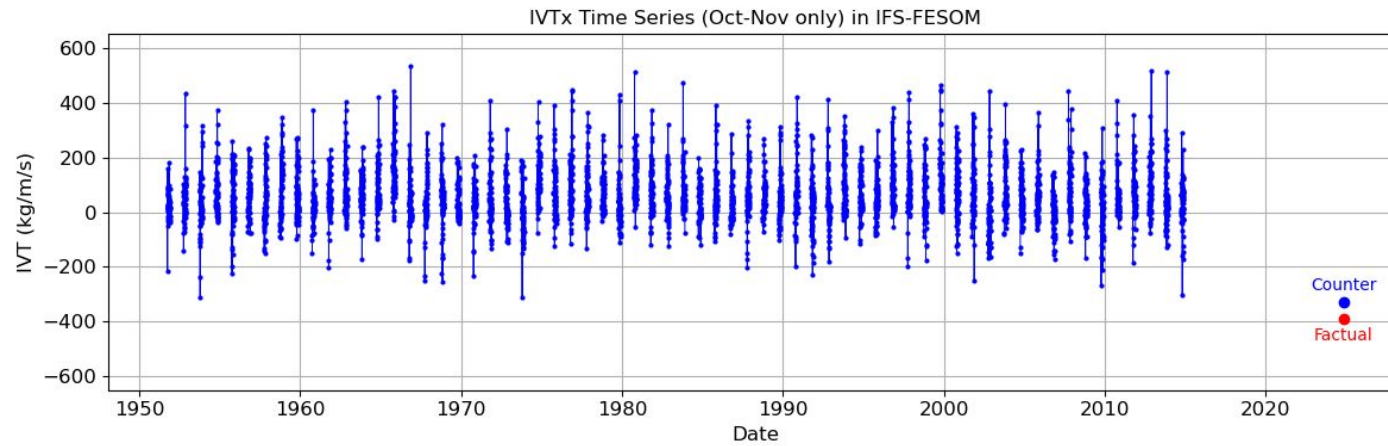


Climatological context

ERA5

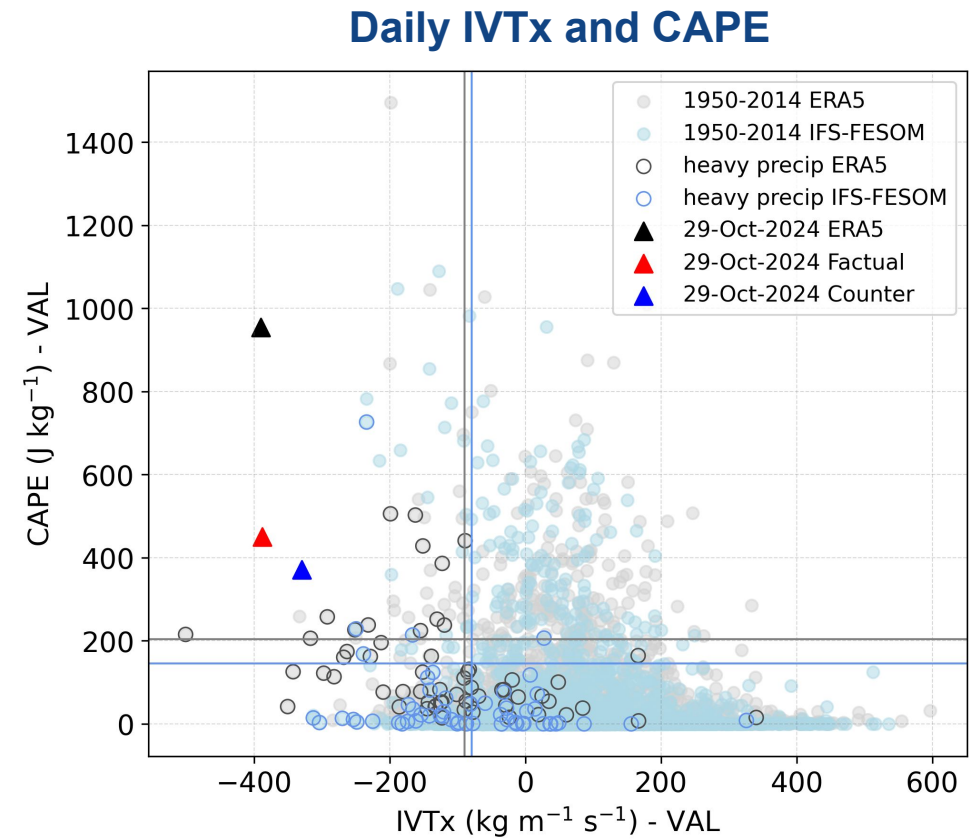
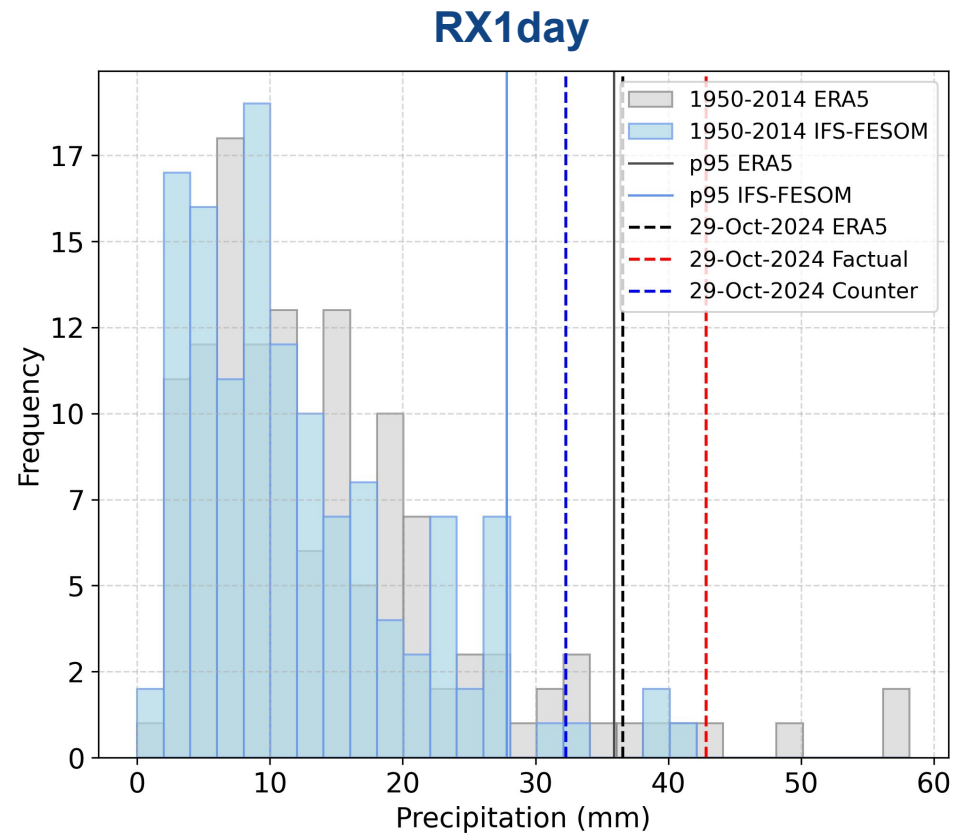


IFS-FESOM



Climatological context

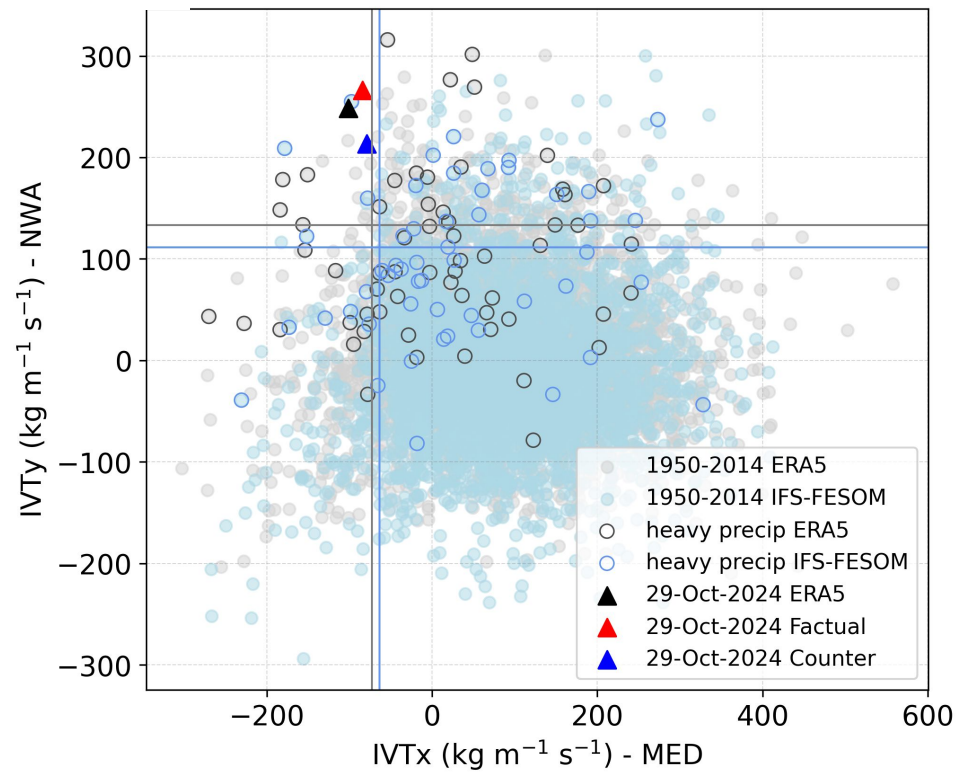
Using the Oct-Nov daily data from ERA5 and IFS-FESOM (free run) from 1950-2014



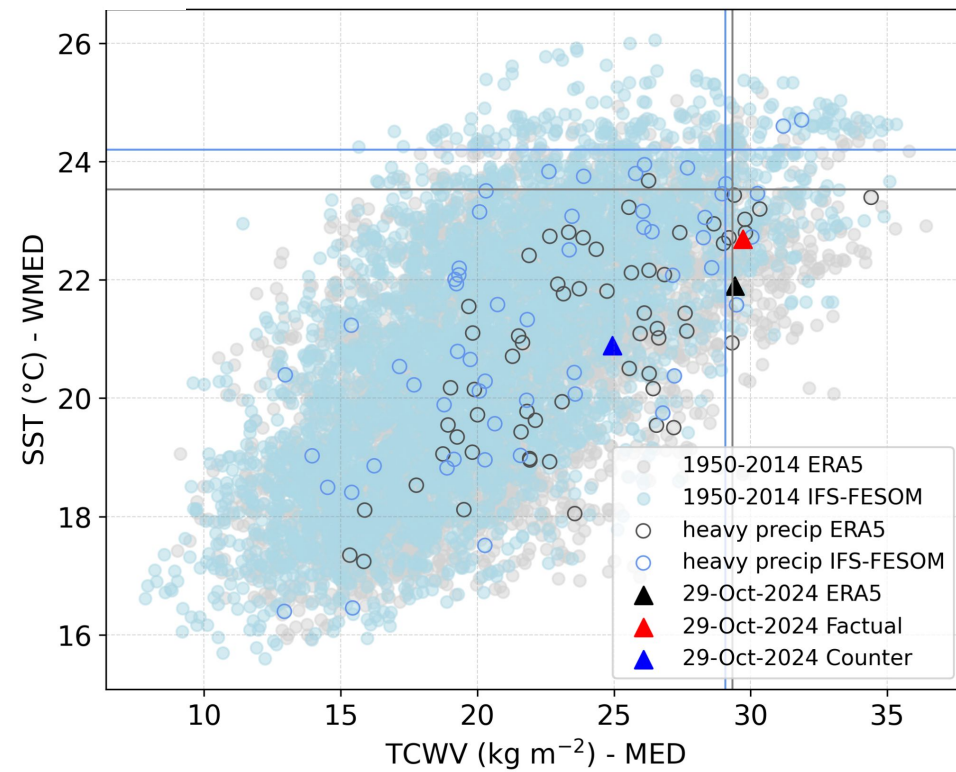
Climatological context

Using the Oct-Nov daily data from ERA5 and IFS-FESOM (free run) from 1950-2014

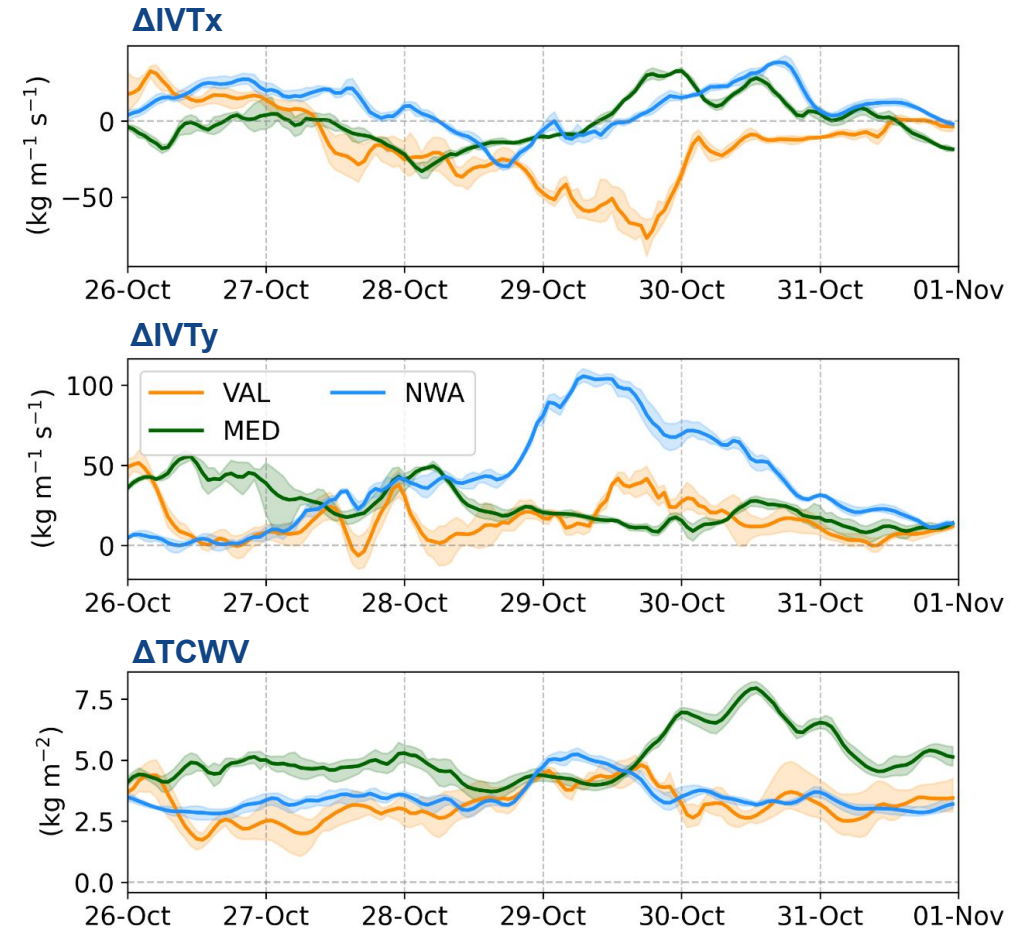
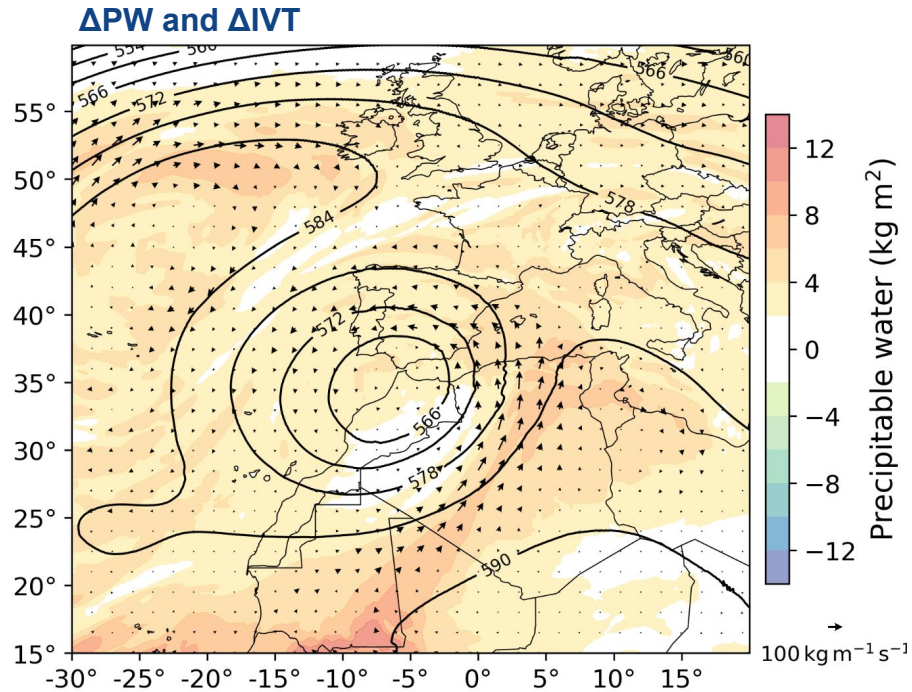
3-day mean IVTx and IVTy



3-day mean PW and SST

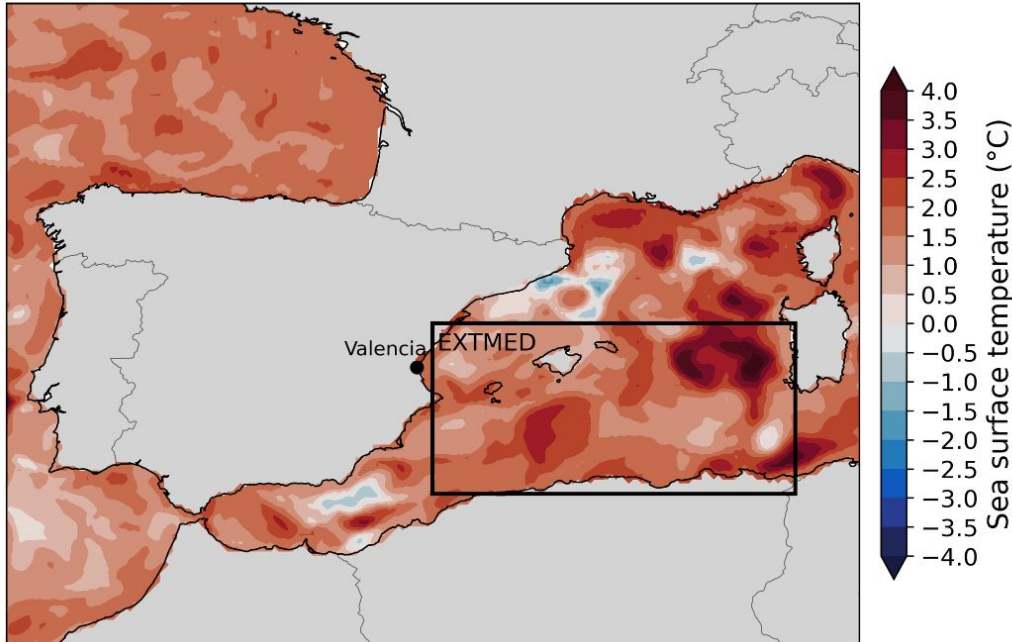


Attribution: Factual – Counterfactual

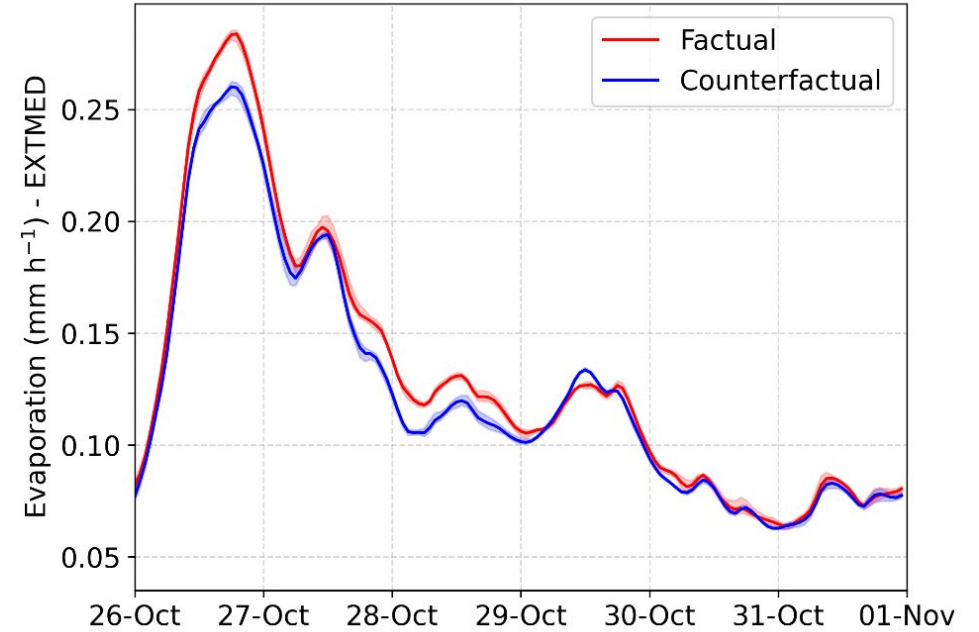


Attribution: Factual – Counterfactual

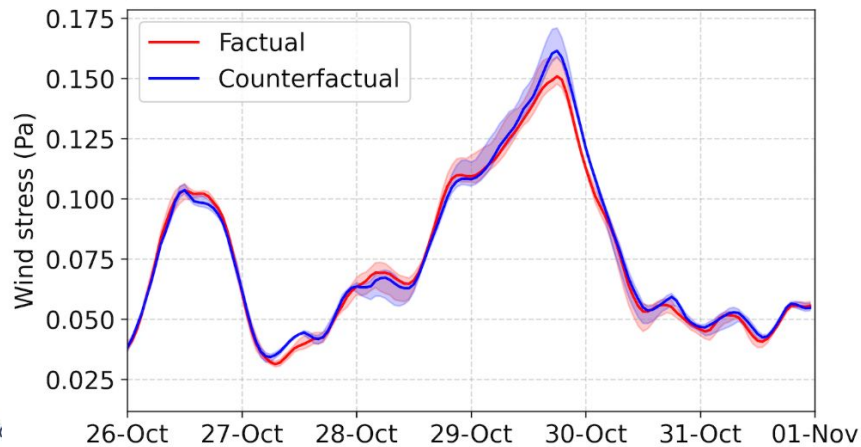
24-29 Oct mean Δ SST



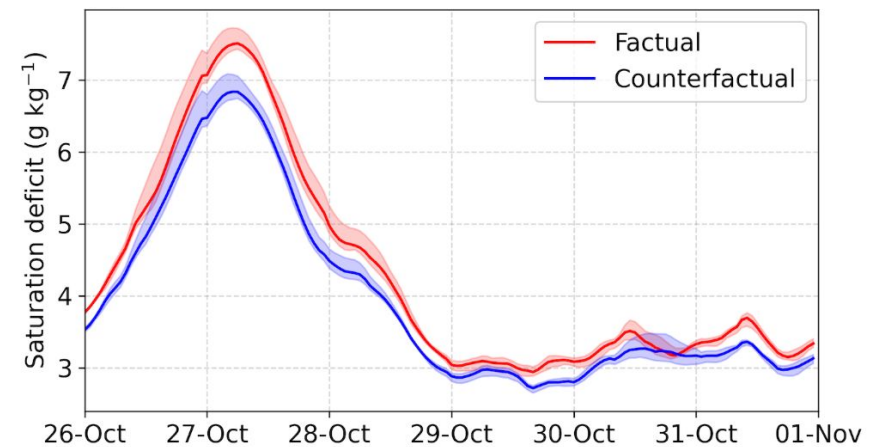
Evaporation



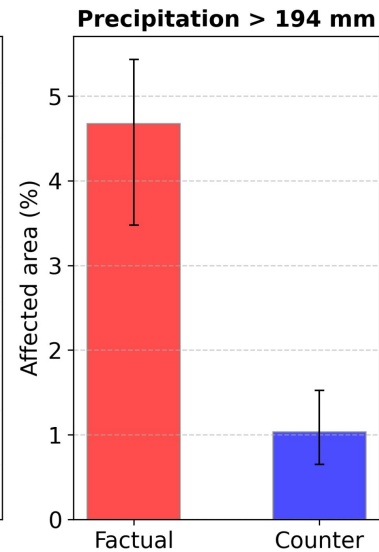
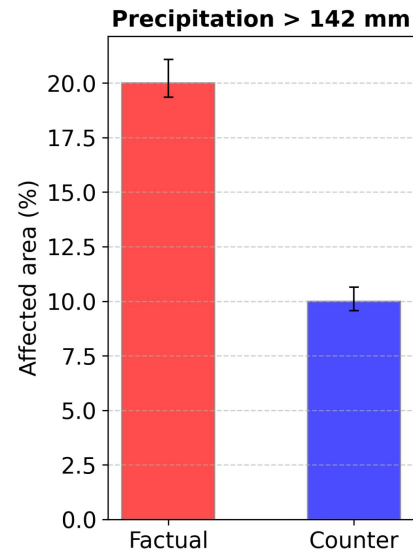
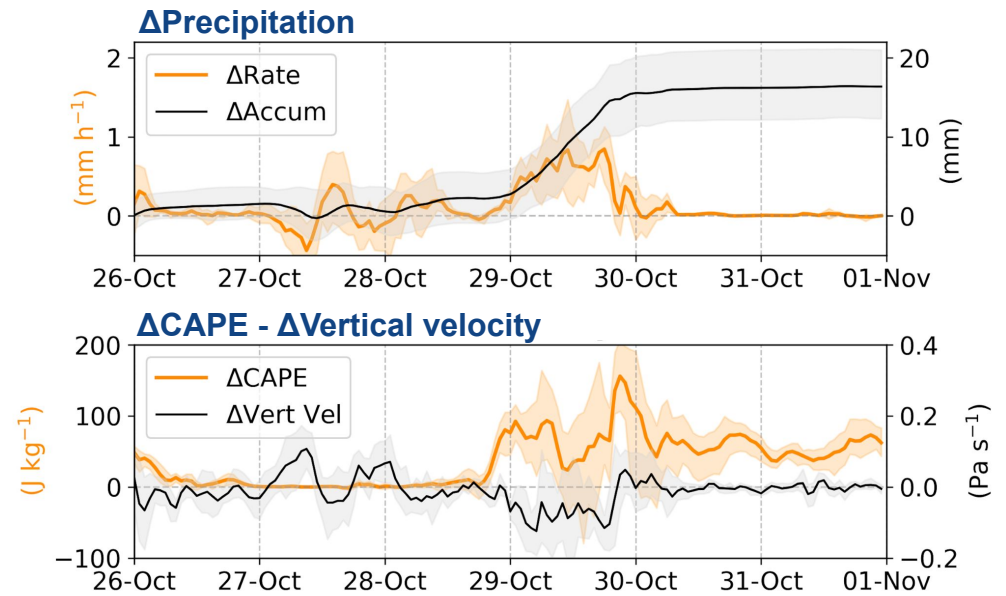
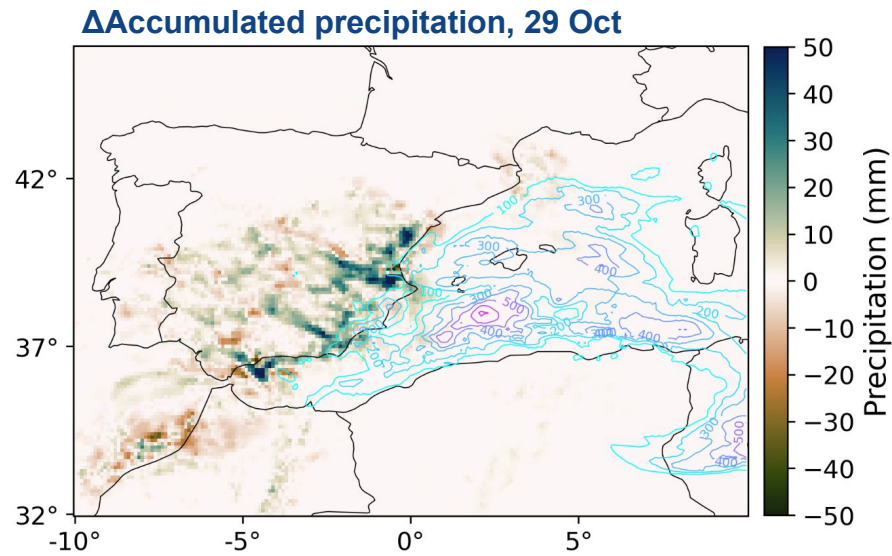
Wind stress



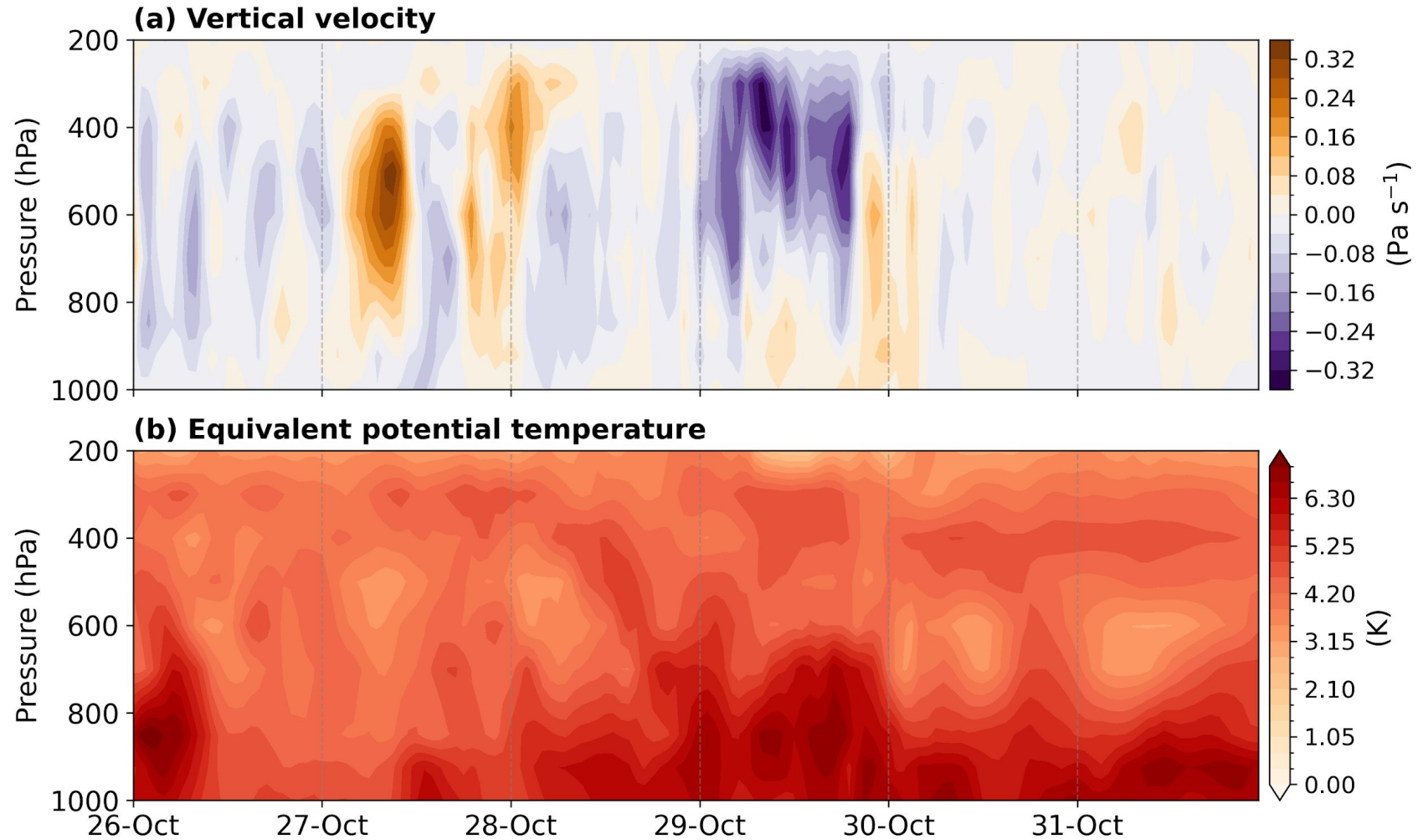
Saturation deficit



Attribution: Factual – Counterfactual



Attribution: Vertical structure

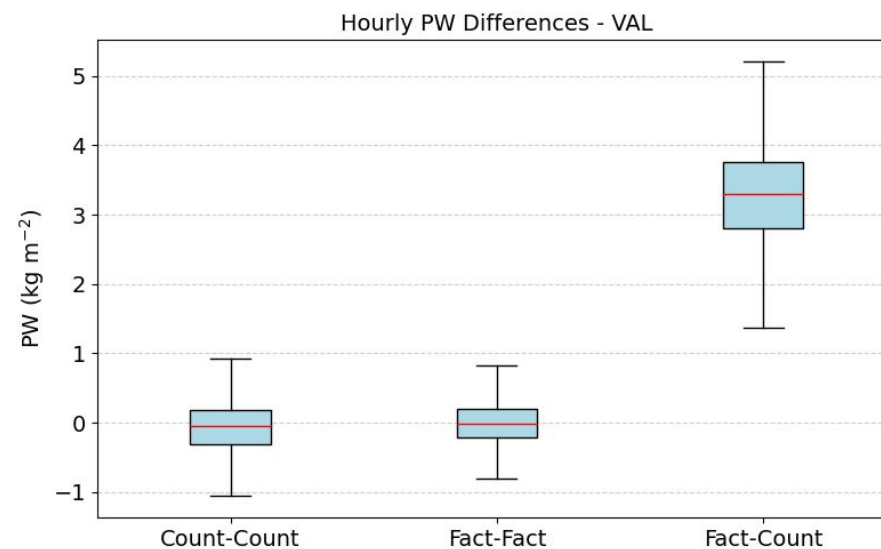
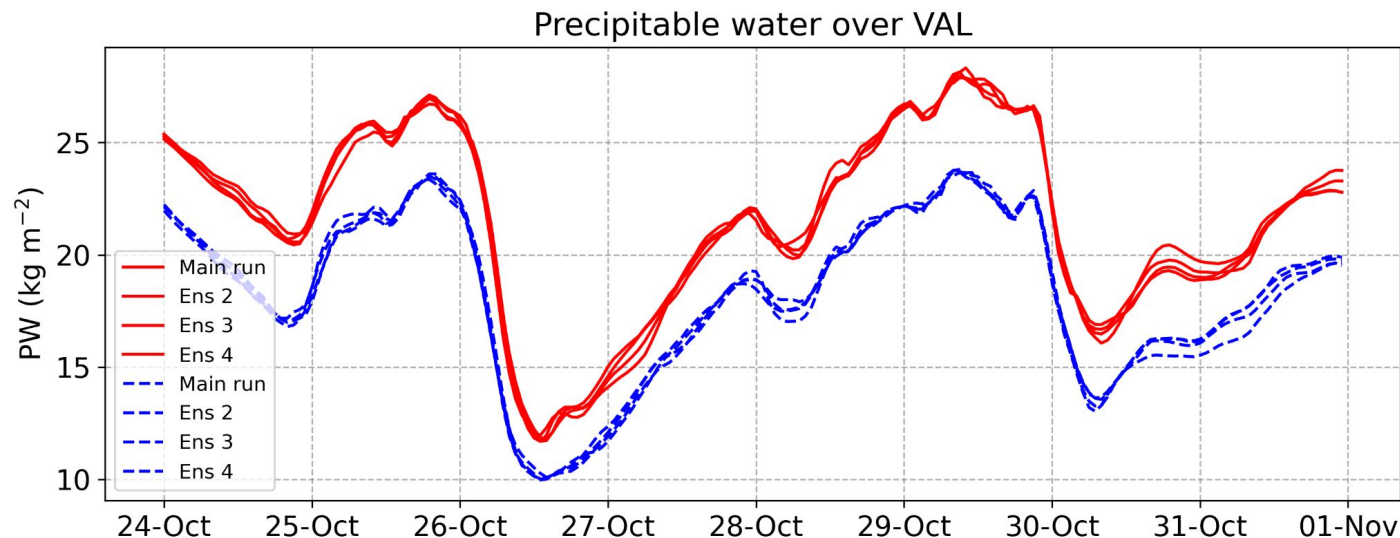


The use of ensemble members

Using 5 ensemble members in each scenario.

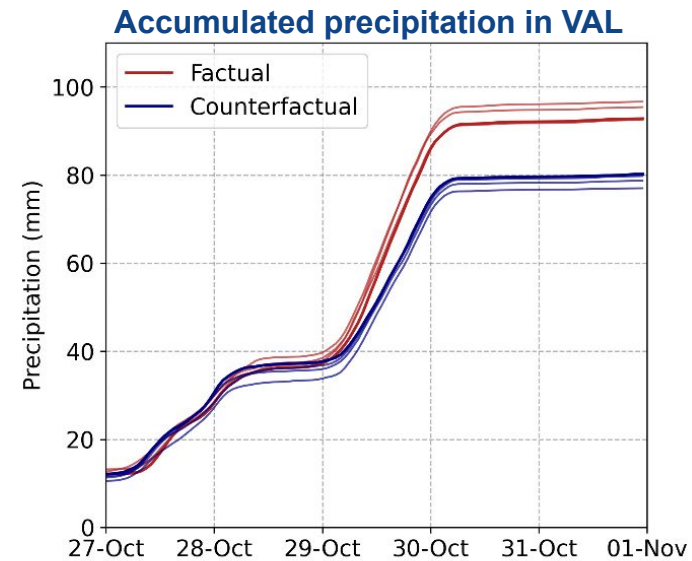
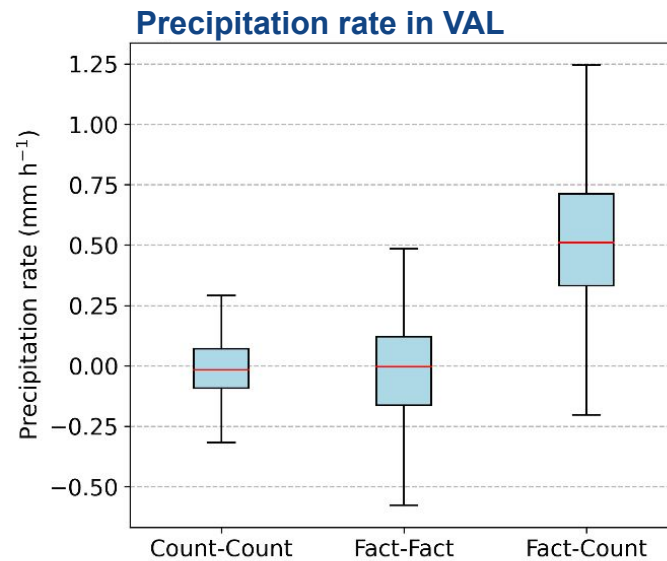
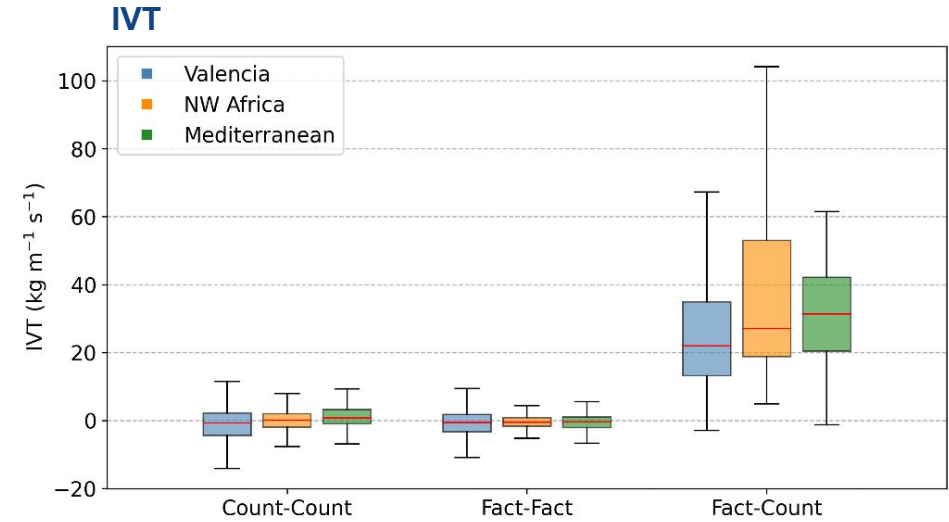
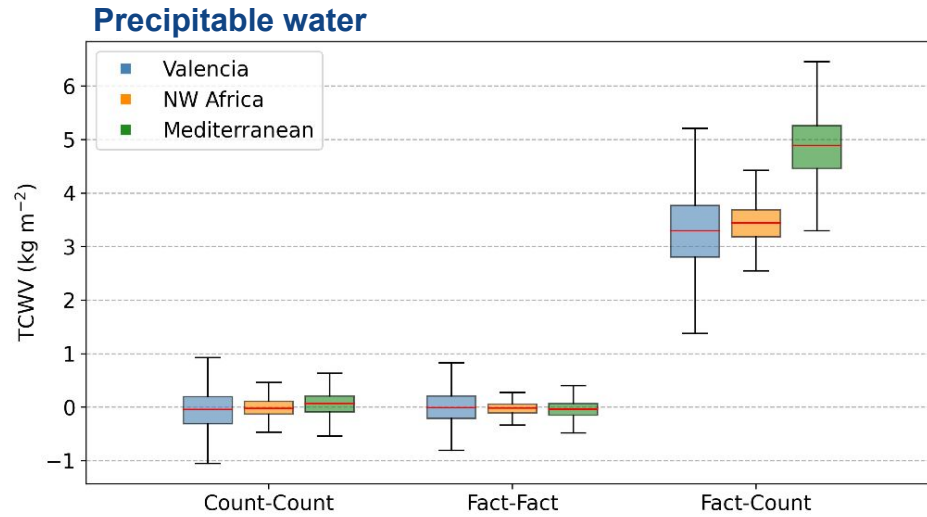
Ensemble members were made changing the nudging initialisation time.

Hourly differences between members were calculated.

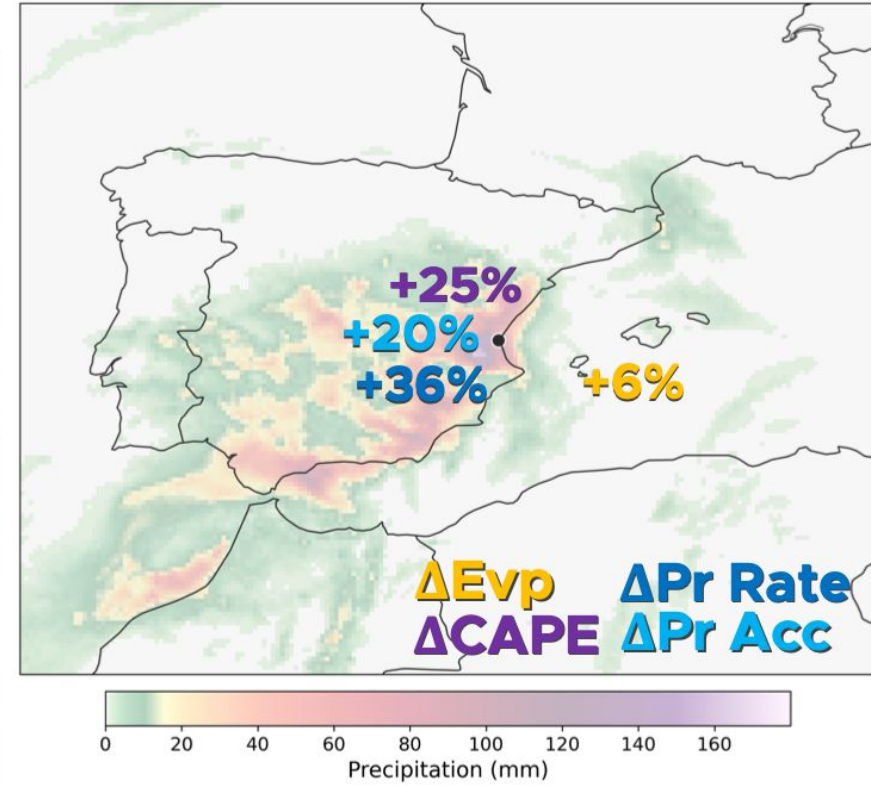
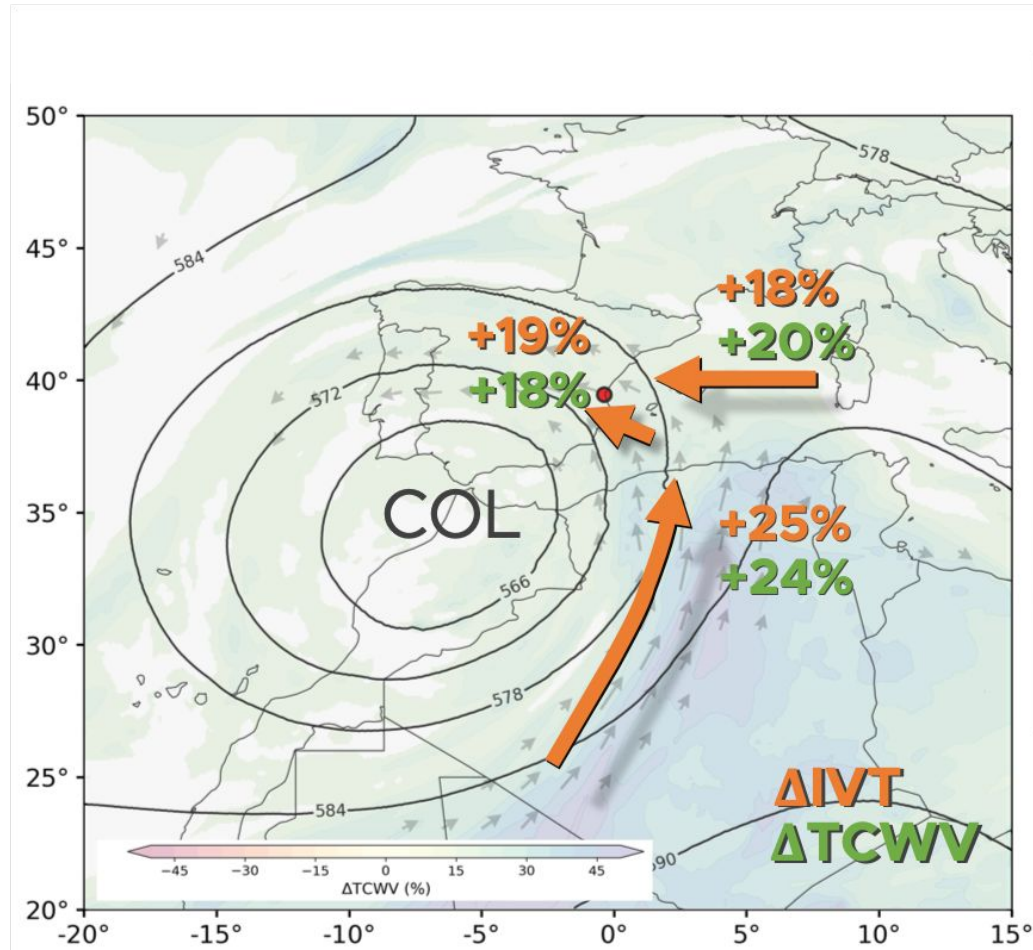


(after van Garderen et al. 2021)

Signal to Noise Ratio



Summary



$$\frac{\text{Factual} - \text{Counterfactual}}{\text{Counterfactual}} \times 100$$



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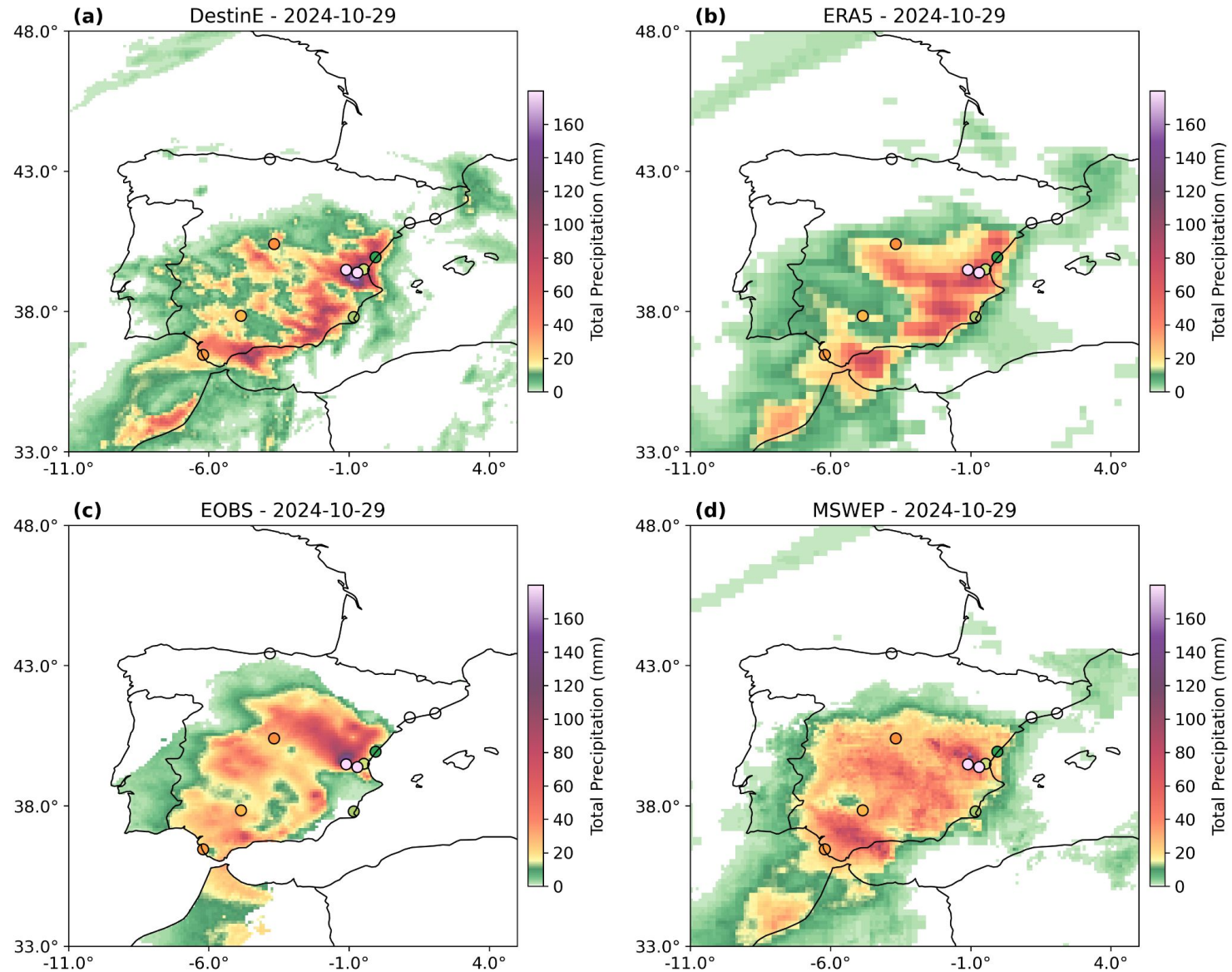
diego.campos@bsc.es

Earth Sciences Department, Barcelona Supercomputing Center

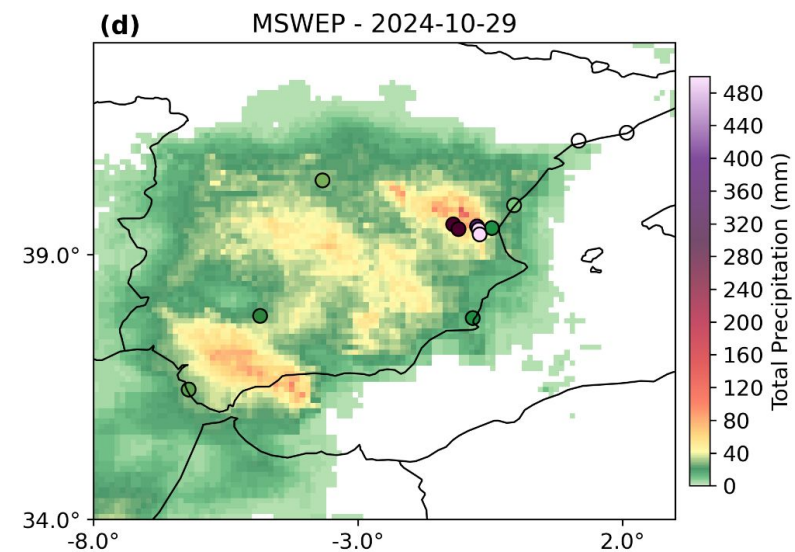
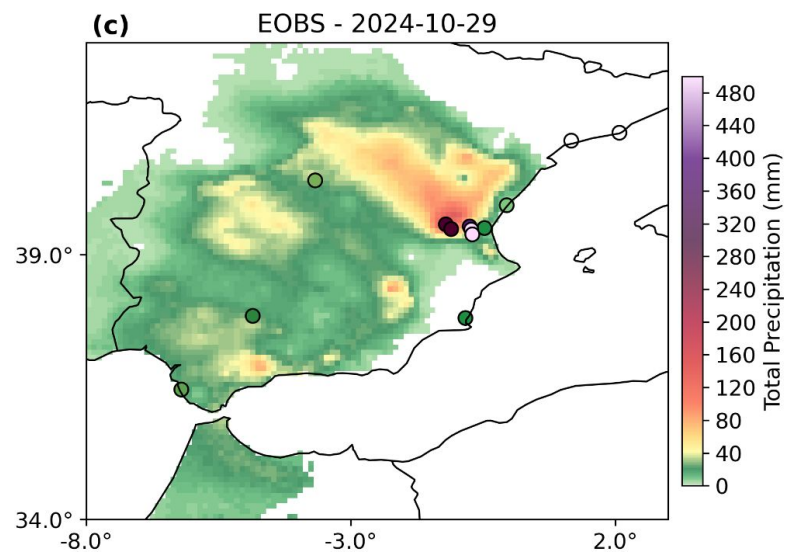
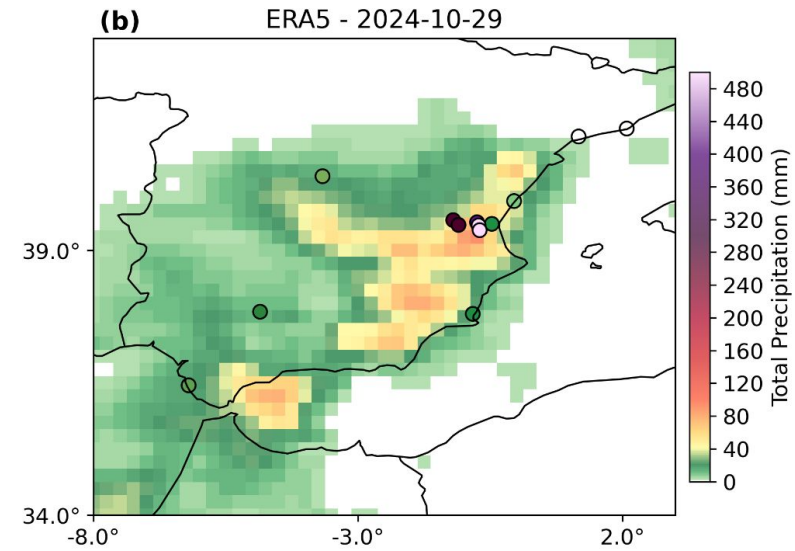
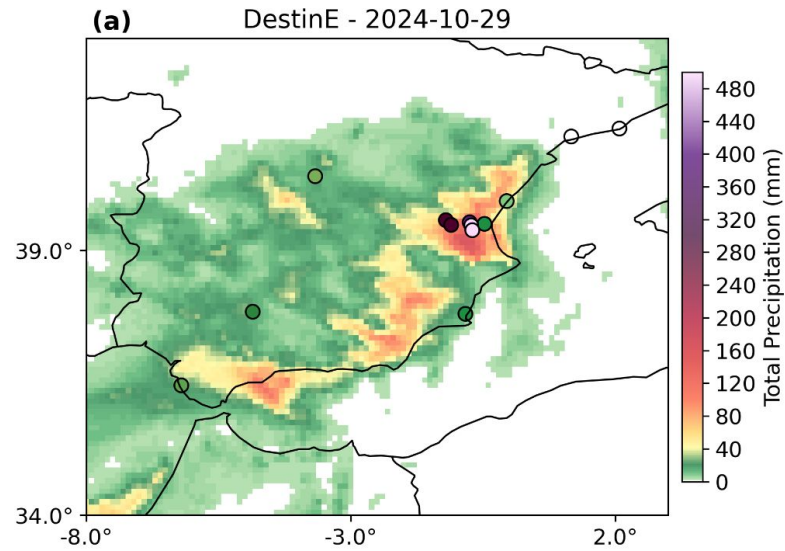
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Observed and simulated precipitation

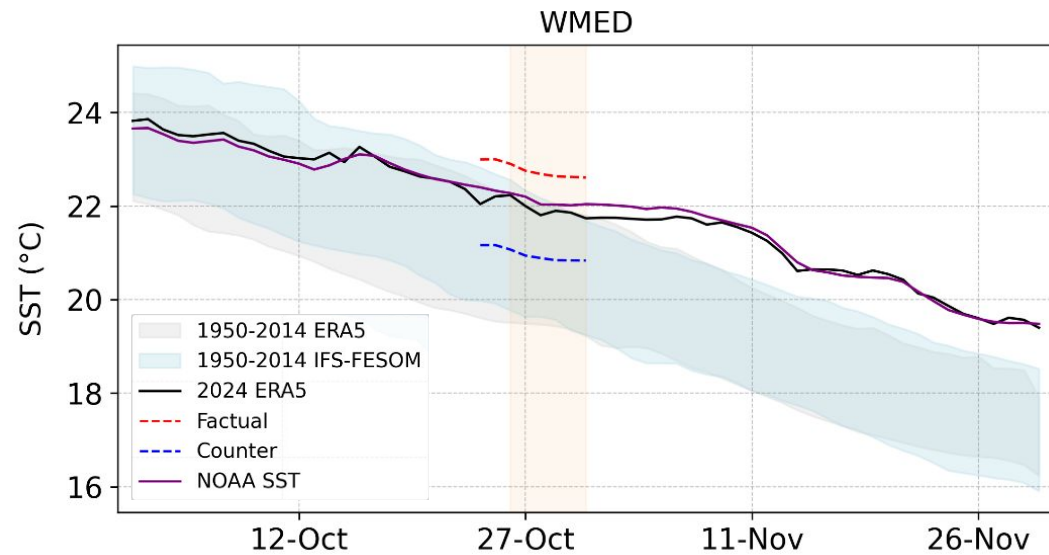


Observed and simulated precipitation

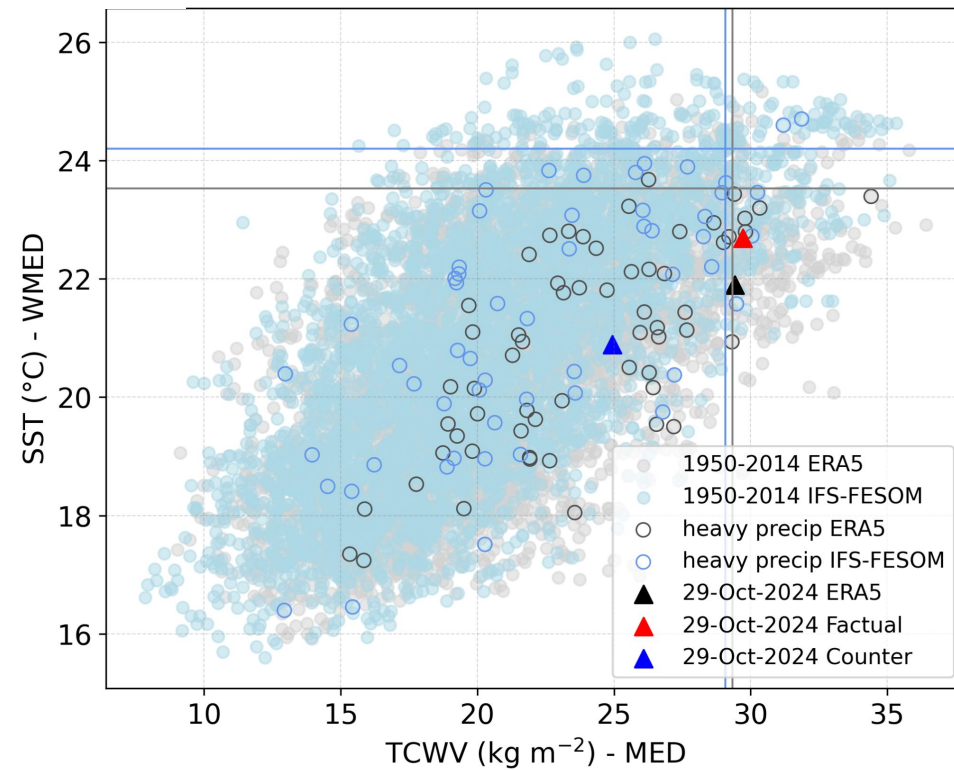


Climatological context

Using the Oct-Nov daily data from ERA5 and IFS-FESOM (free run) from 1950-2014

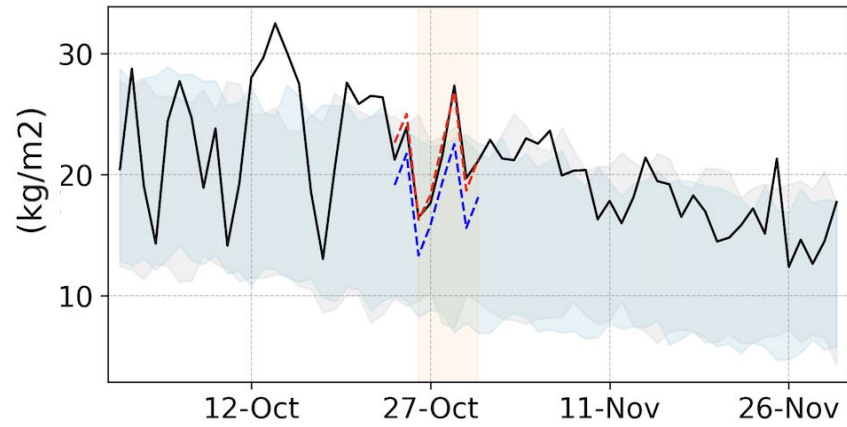


3-day mean PW and SST

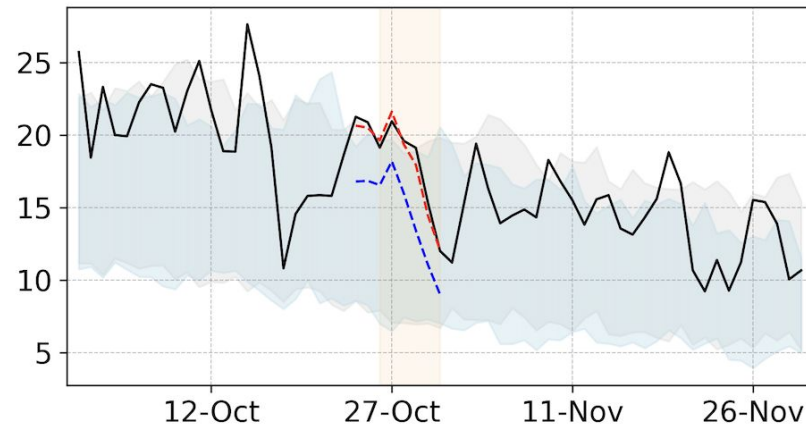


Climatological context

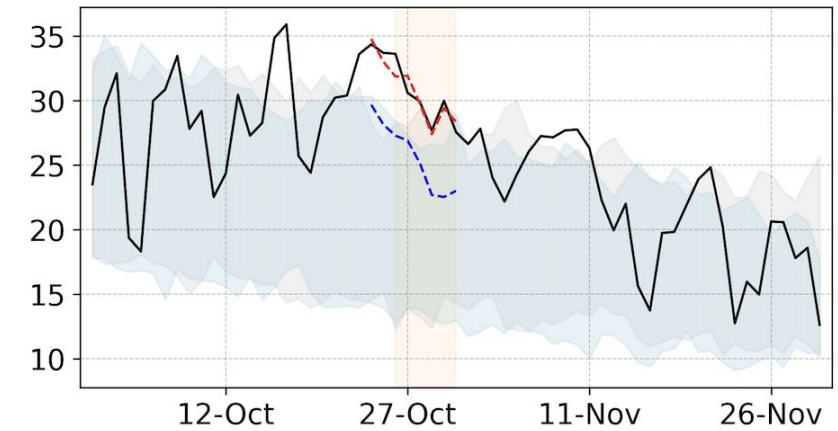
VAL



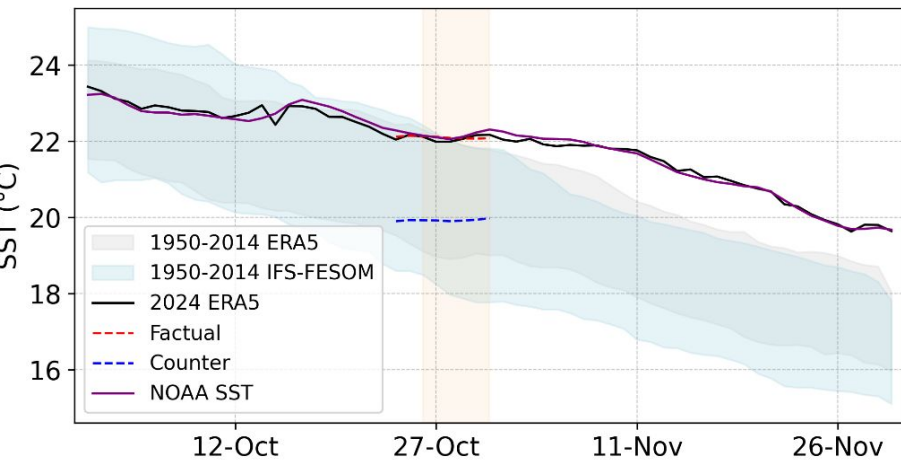
NWA



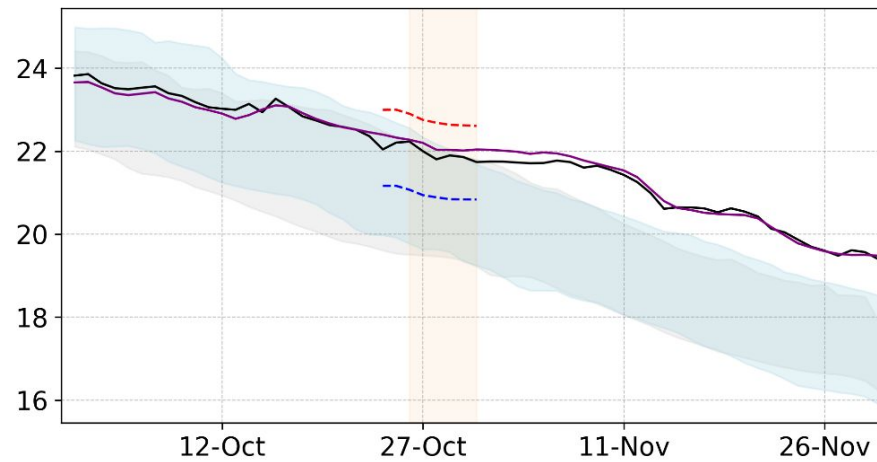
MED



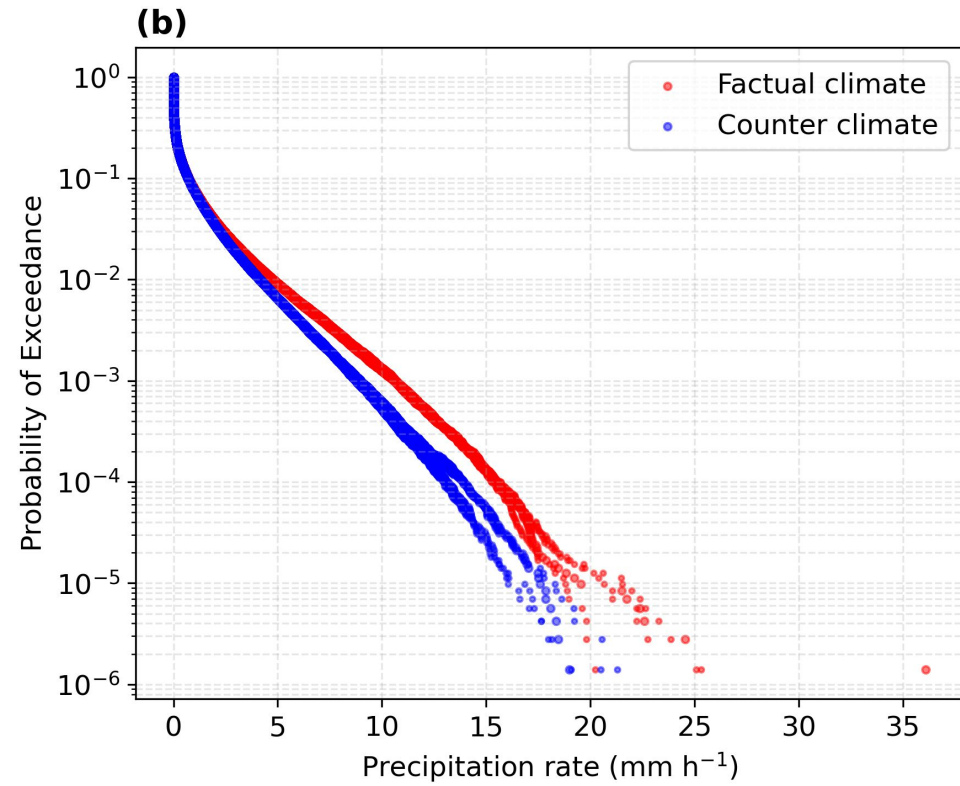
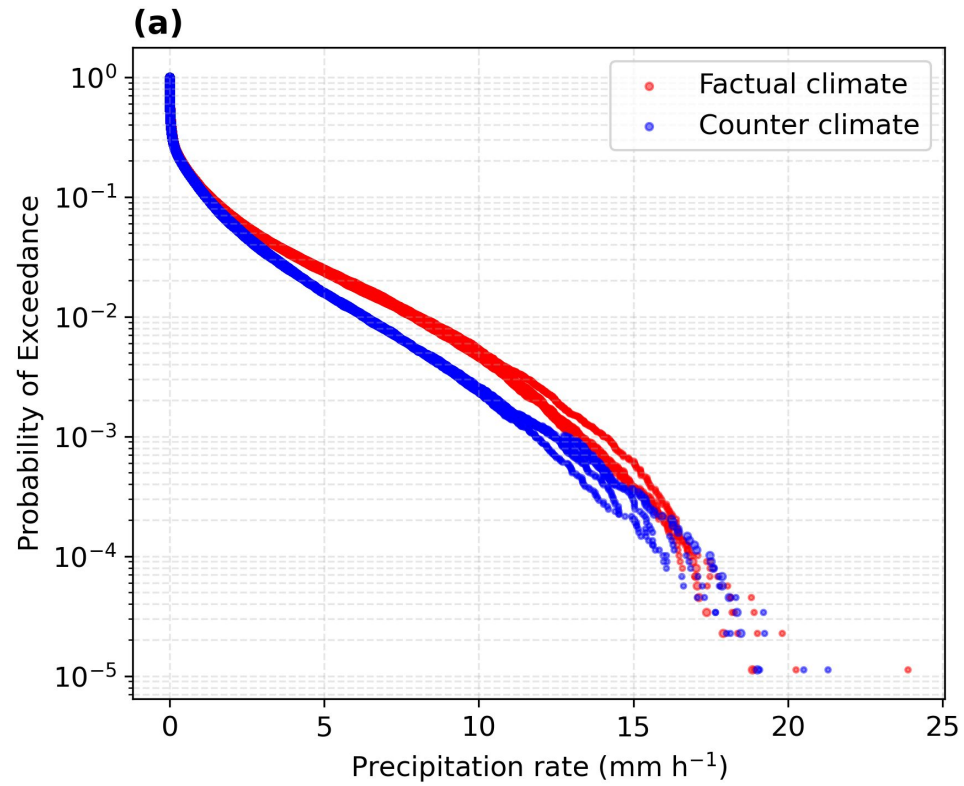
MED



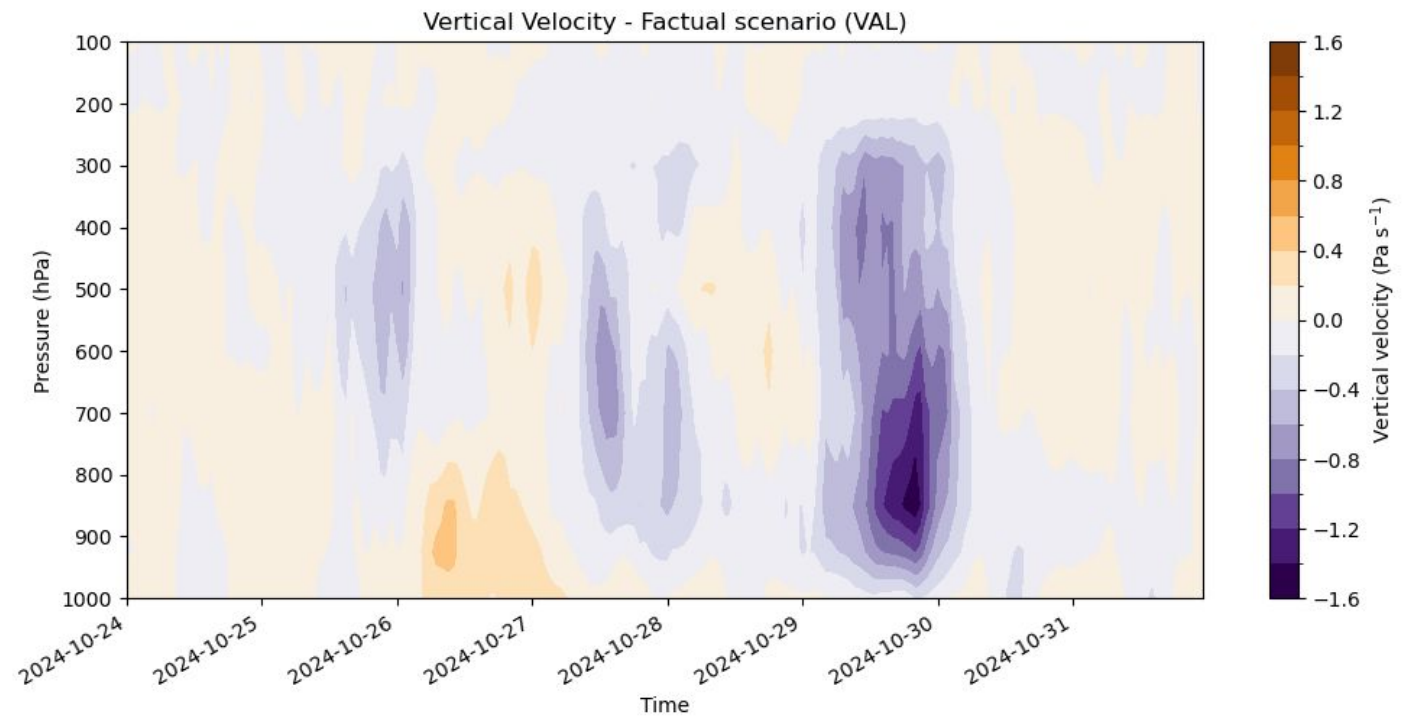
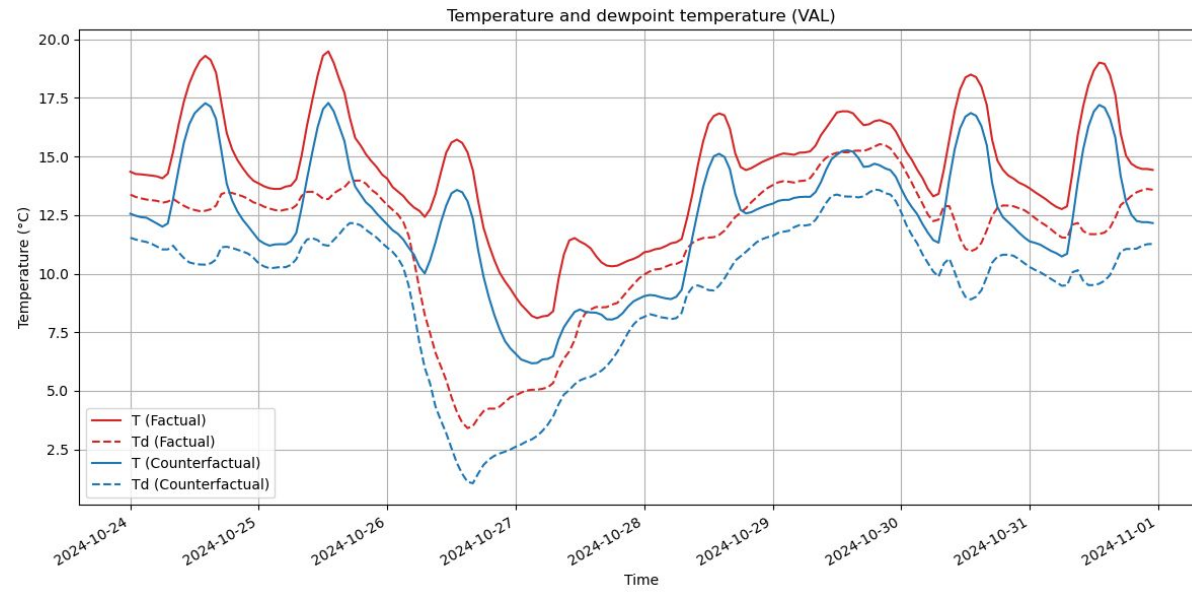
WMED



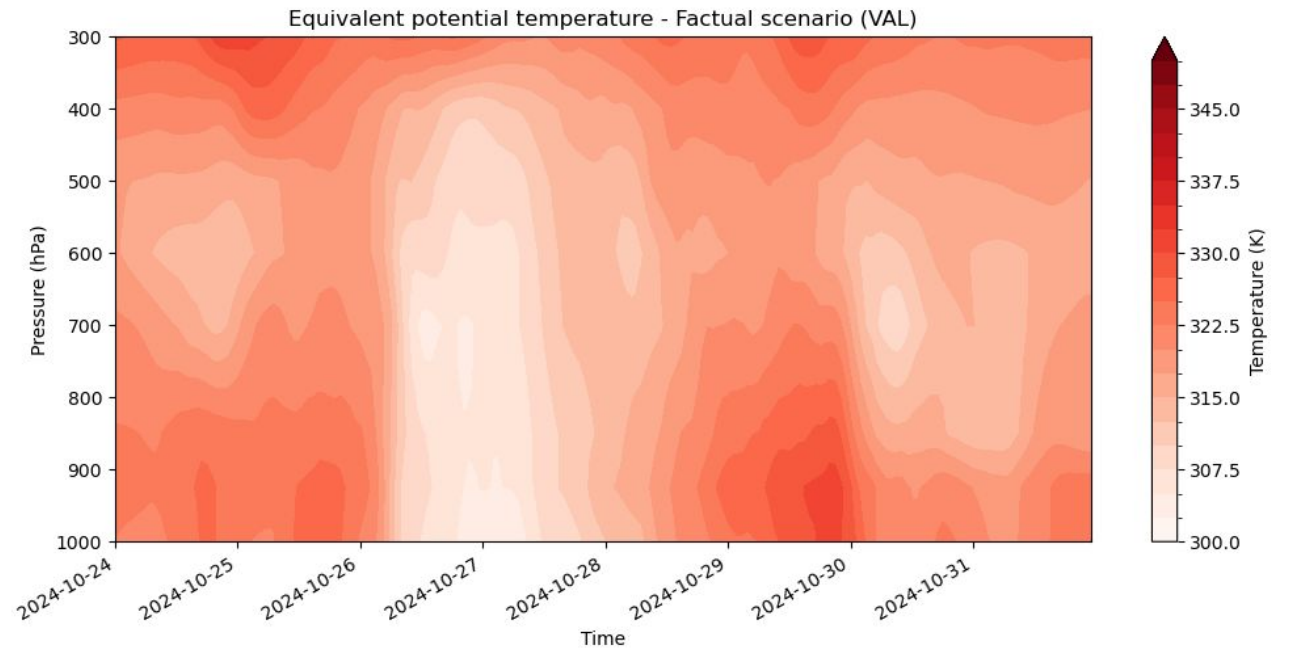
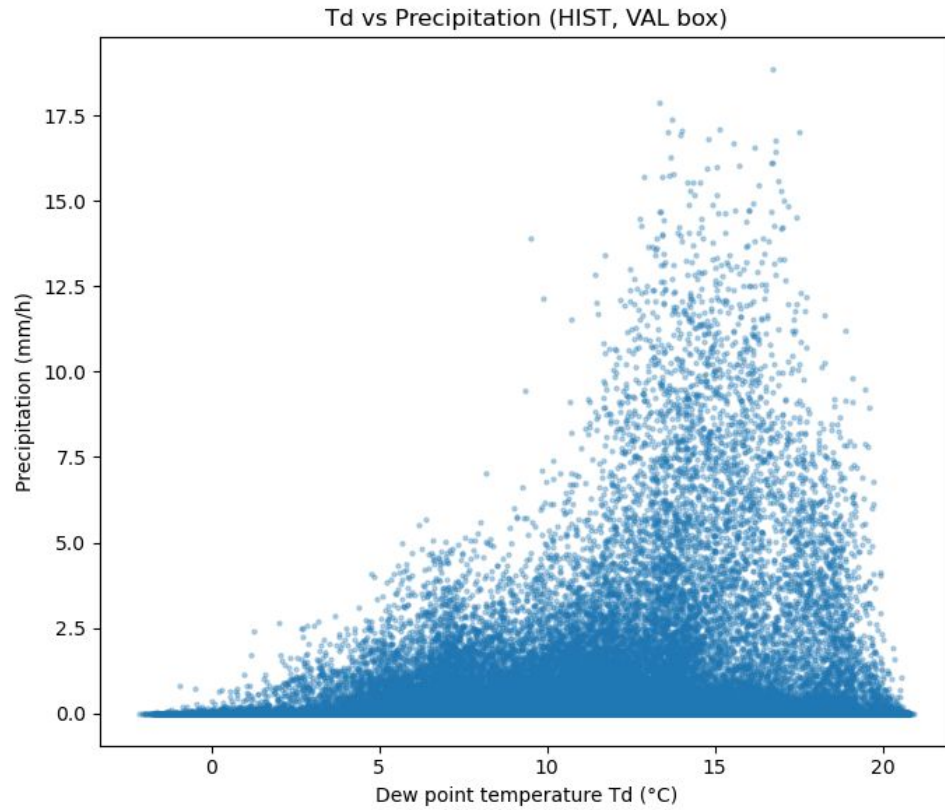
Hourly precipitation



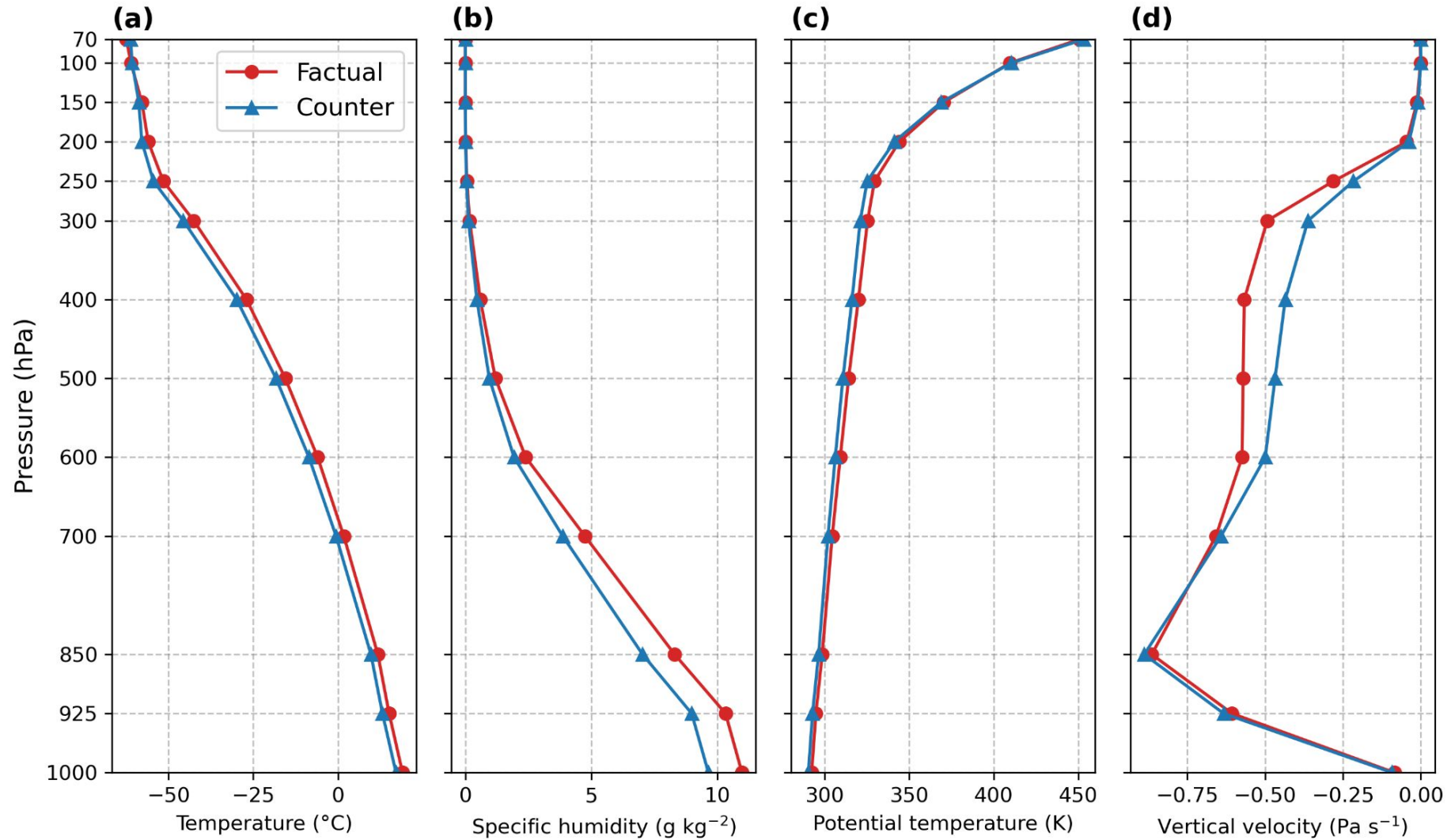
Td and Omega



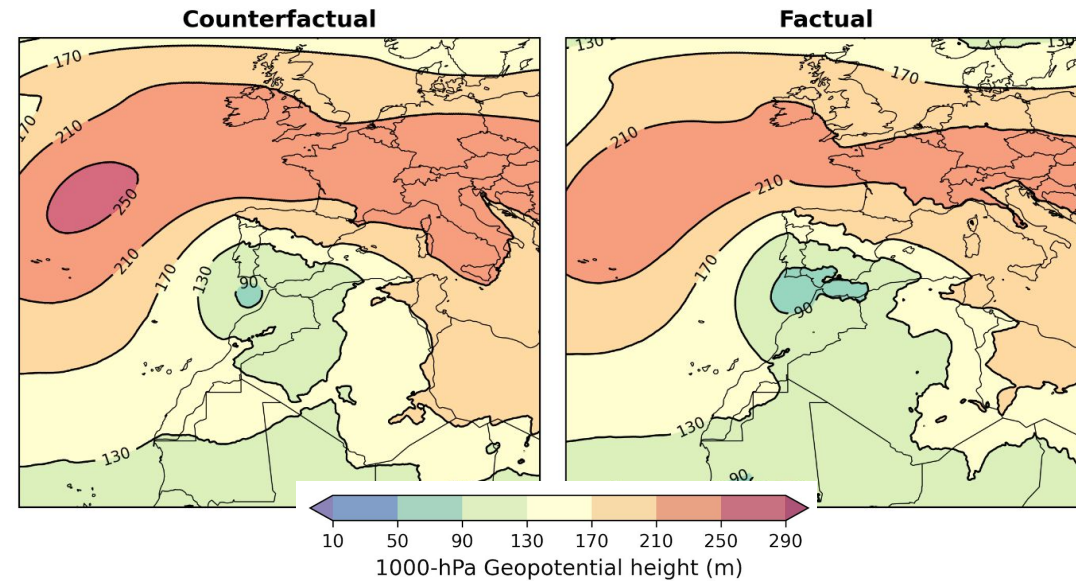
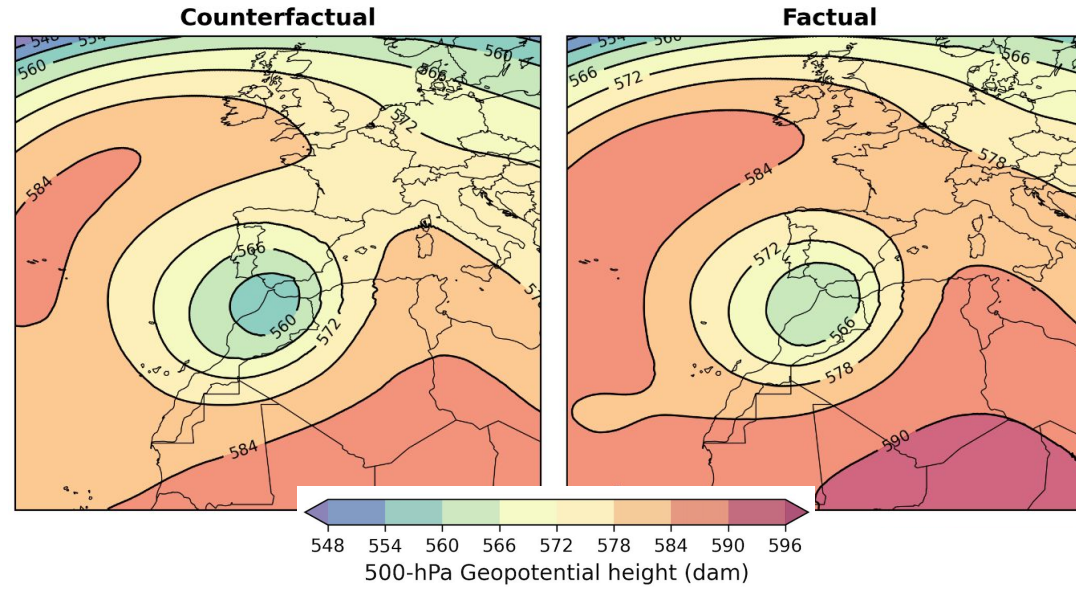
Td and precip



Vertical profiles

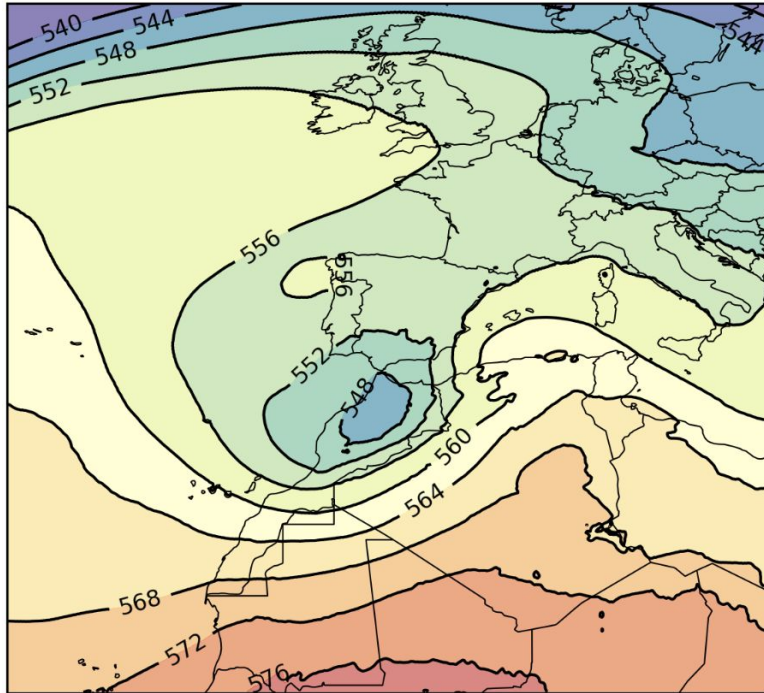


Geopotential height



Thickness

Counterfactual



Factual

