COPERNICUS THEMATIC WORKSHOP

Post-event windstorm context from C3S

ERA5-derived tracks, footprints and severity indicators

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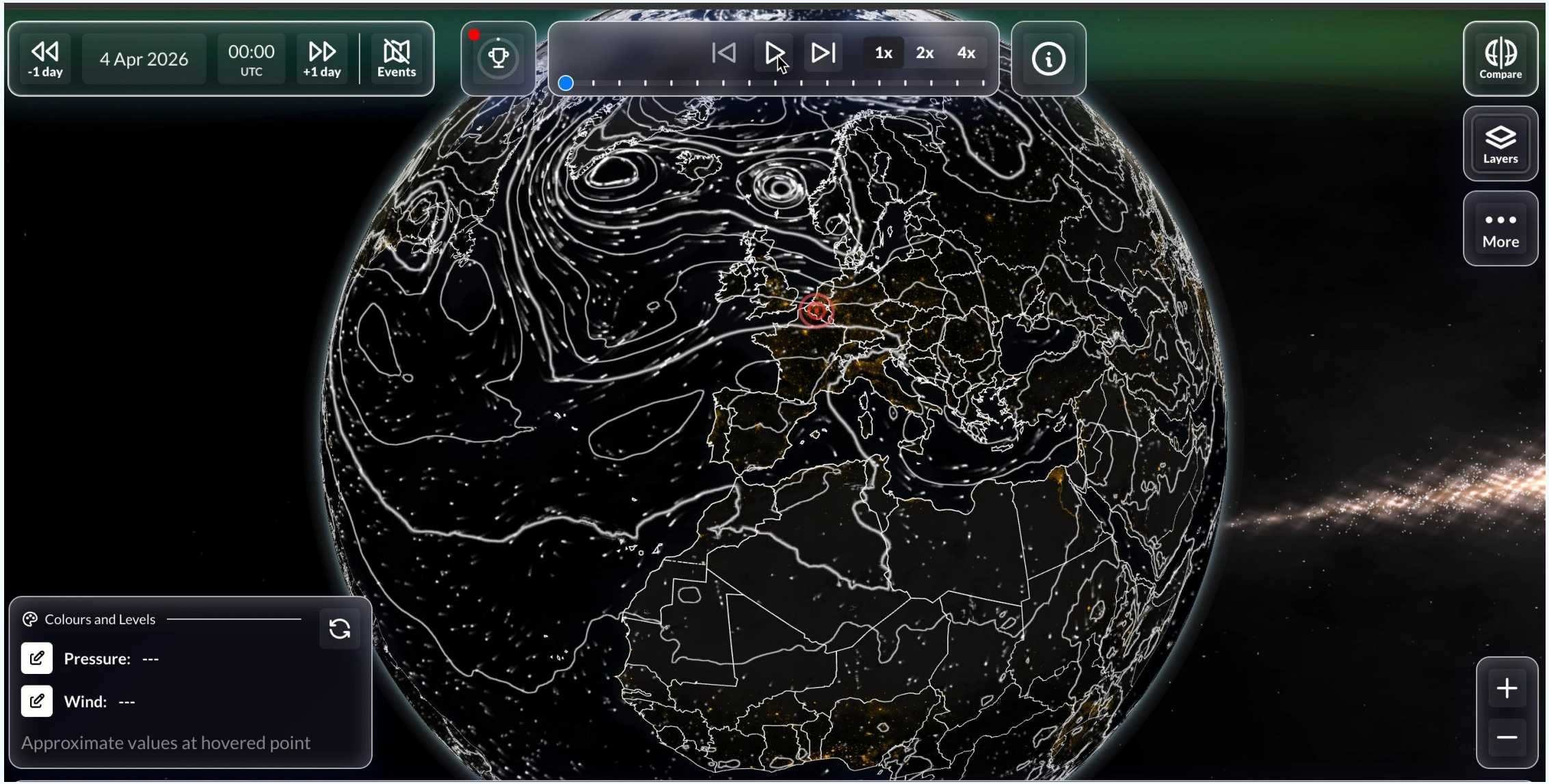
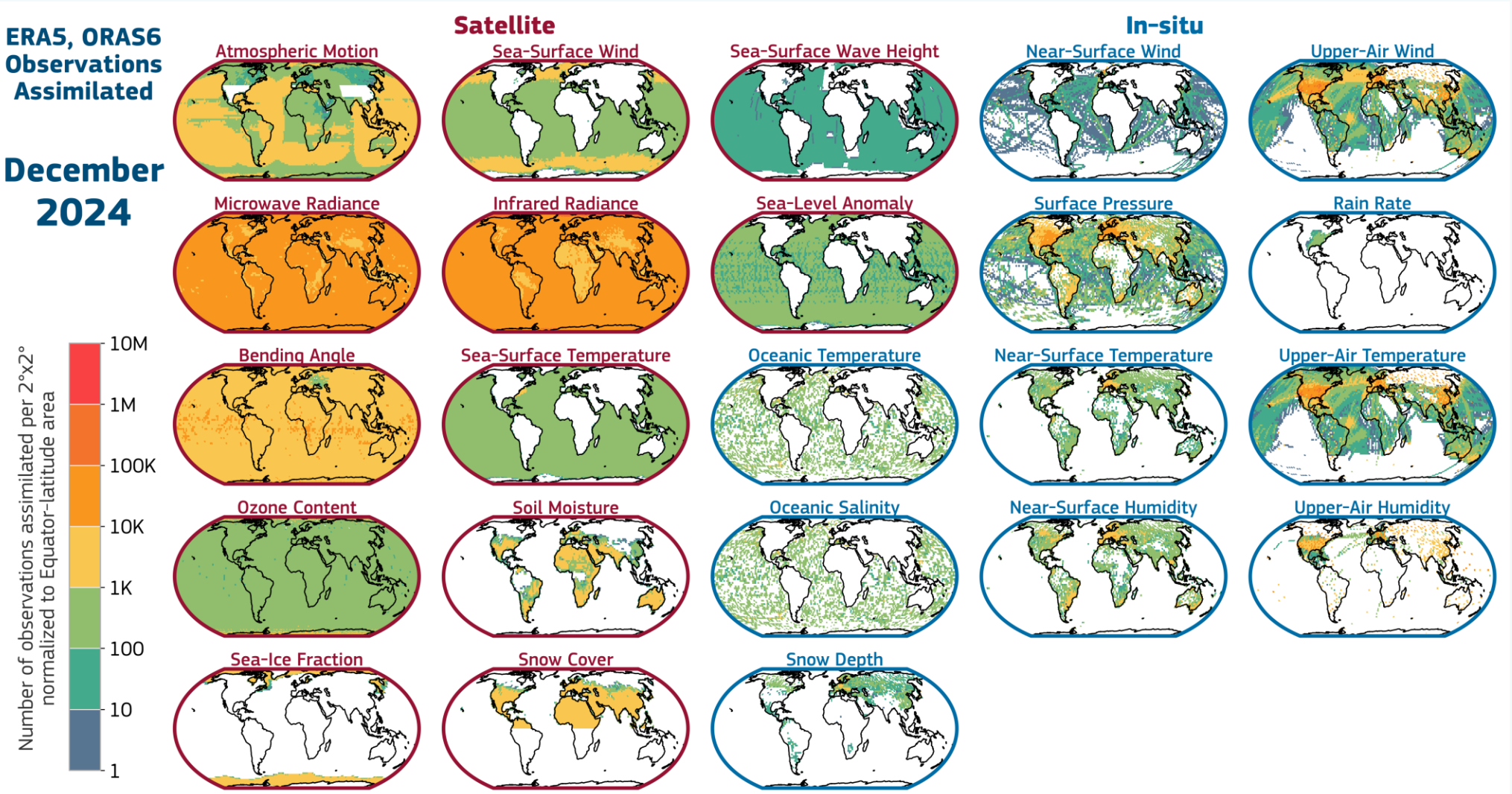
Copernicus
Europe's eyes on Earth



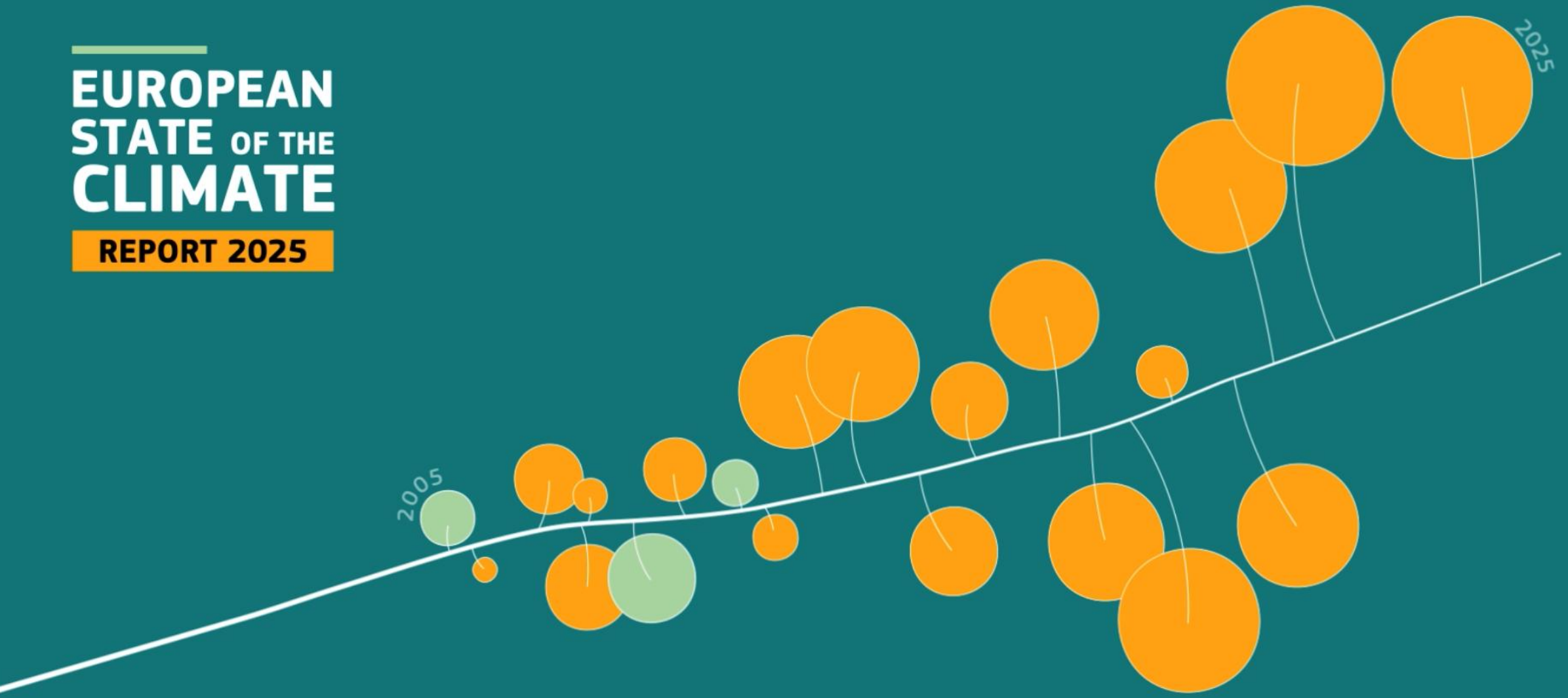
https://weather-replay.climate.copernicus.eu/

Observations: Enablers of reanalyses



EUROPEAN STATE OF THE CLIMATE

REPORT 2025



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https://climate.copernicus.eu/ESOTC

Key events in 2025

Heatwaves impacted Europe from the **Mediterranean** to the **Arctic Circle**.

Extreme precipitation and flooding were **less widespread** than in recent years.

Weather and climate events can impact **biodiversity**.

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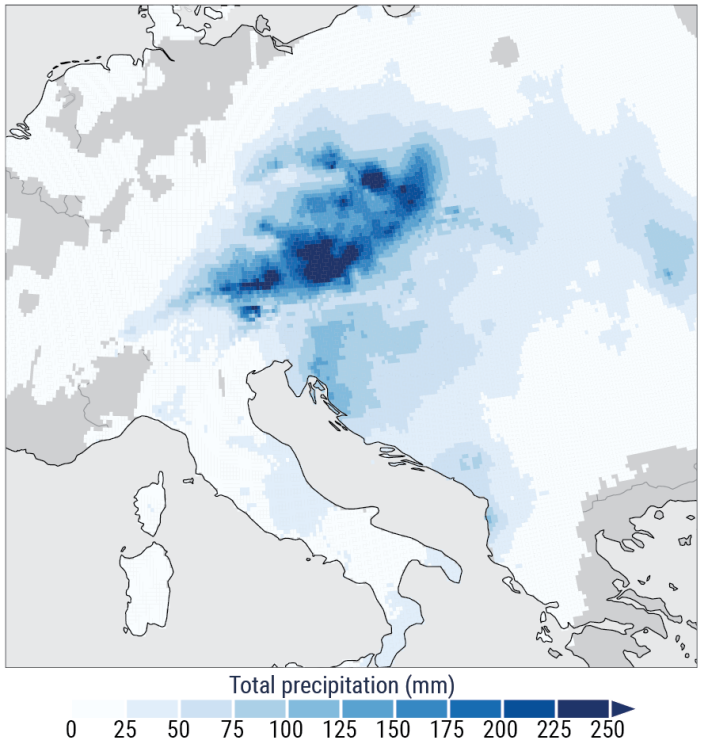
Storm Boris, in 2024

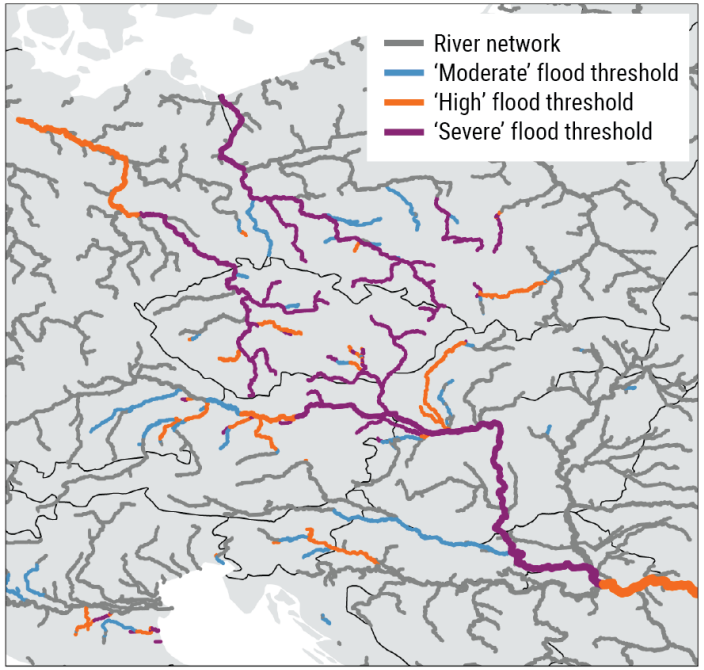
European State of the Climate (ESOTC) 2024 report

Precipitation and river flooding – September 2024, Storm Boris

Precipitation totals during Storm Boris, 12–16 September 2024



Rivers where flow exceeded flood thresholds from 12–21 September 2024



Data: E-OBS (left) and EFAS (right) • Credit: KNMI/C3S/ECMWF (left), CEMS/C3S/ECMWF (right)

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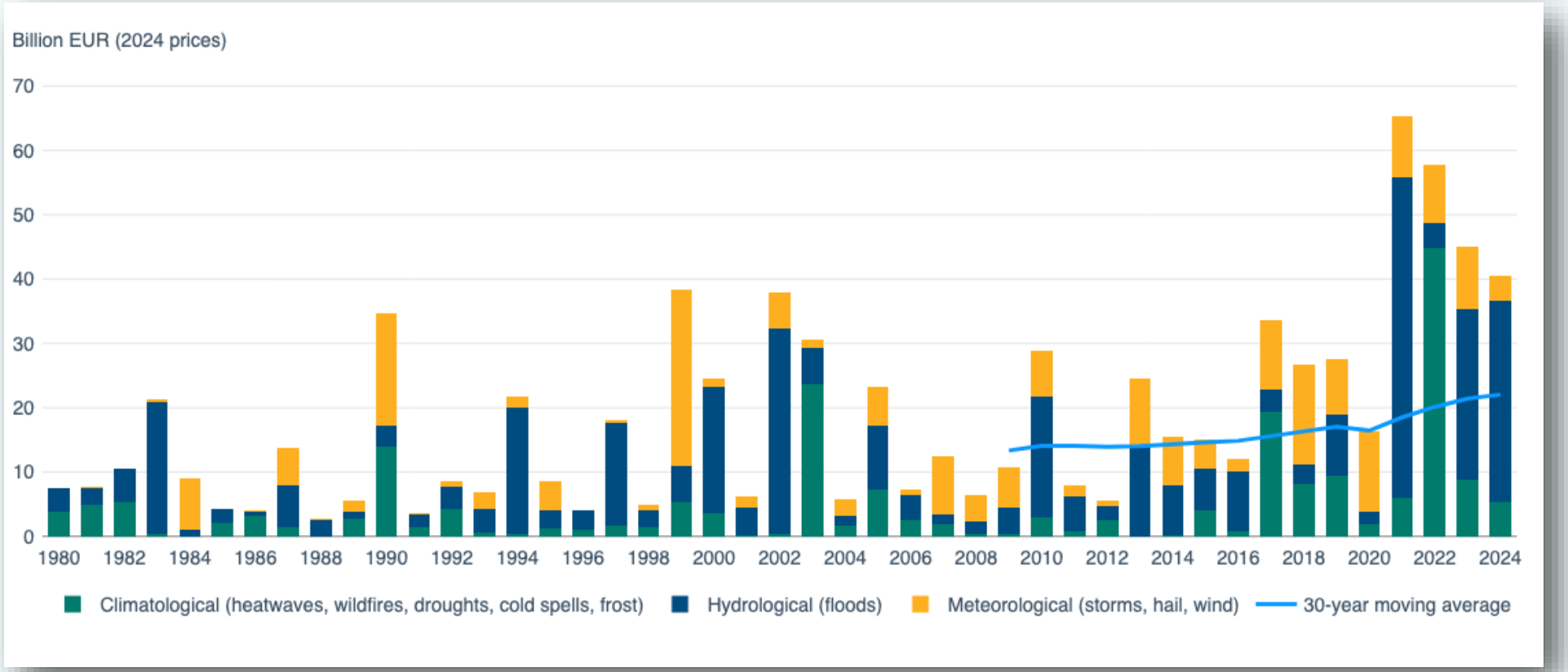
Annual economic losses

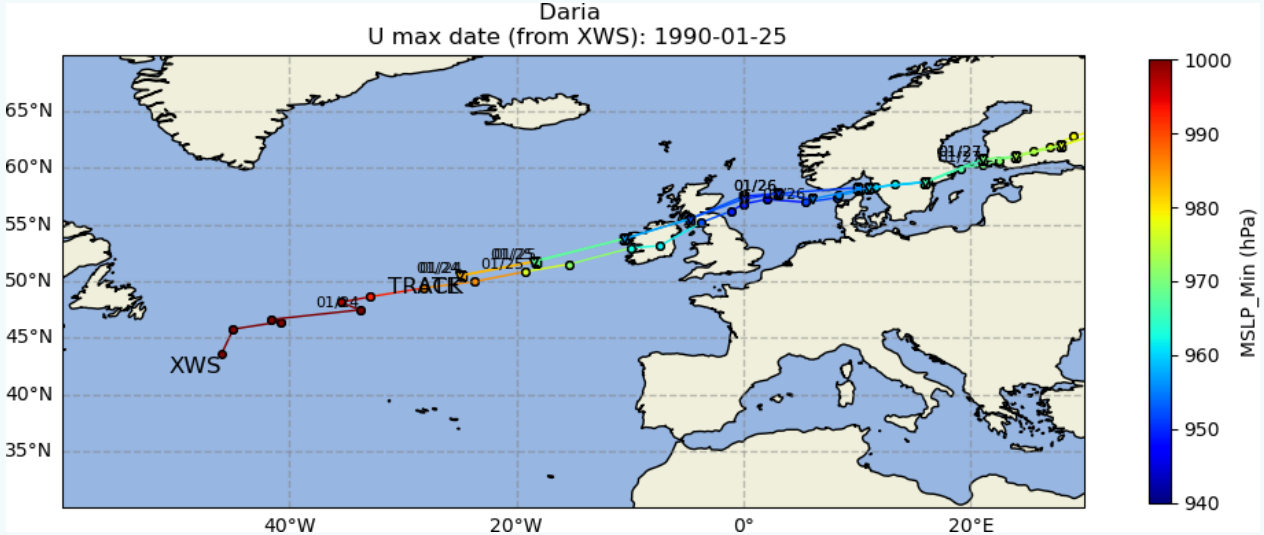


Economic losses, pressure public finances, and affect asset values, credit risk and investment decisions

Are we prepared for current level of climate risk?

Source: European Environment Agency (04 Nov. 2024): Annual economic losses caused by weather-and climate-related extreme events in the EU Member States

C3S European Windstorm Products



What is it?

- Provides a catalog of European windstorm tracks and footprint(*) using ERA5 reanalysis data.
- Tracks windstorms linked to Extra-Tropical Cyclones (ETCs) with two algorithms: TempestExtremes and TRACK.
- Automates operational product updates and offers a user-friendly interface for data exploration.
- Estimation of Storm Severity Index

Where?

Europe: Latitude [25°N - 66°N]; longitude[30°W – 80°E]

(*) ETC Footprints: the maximum value of 10m-height wind gust during an event. This value is calculated for each grid point across a 72-hour period, centered around the time when the tracking algorithm identifies the peak wind speed at 925 hPa over land, within a 3° radius from the track center

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In collaboration with: cmcc Centro Euro-Mediterraneo sui Cambiamenti Climatici · B-Open

Is it reliable?

Validation:
European windstorm tracks are derived using two independent algorithms:
TRACK

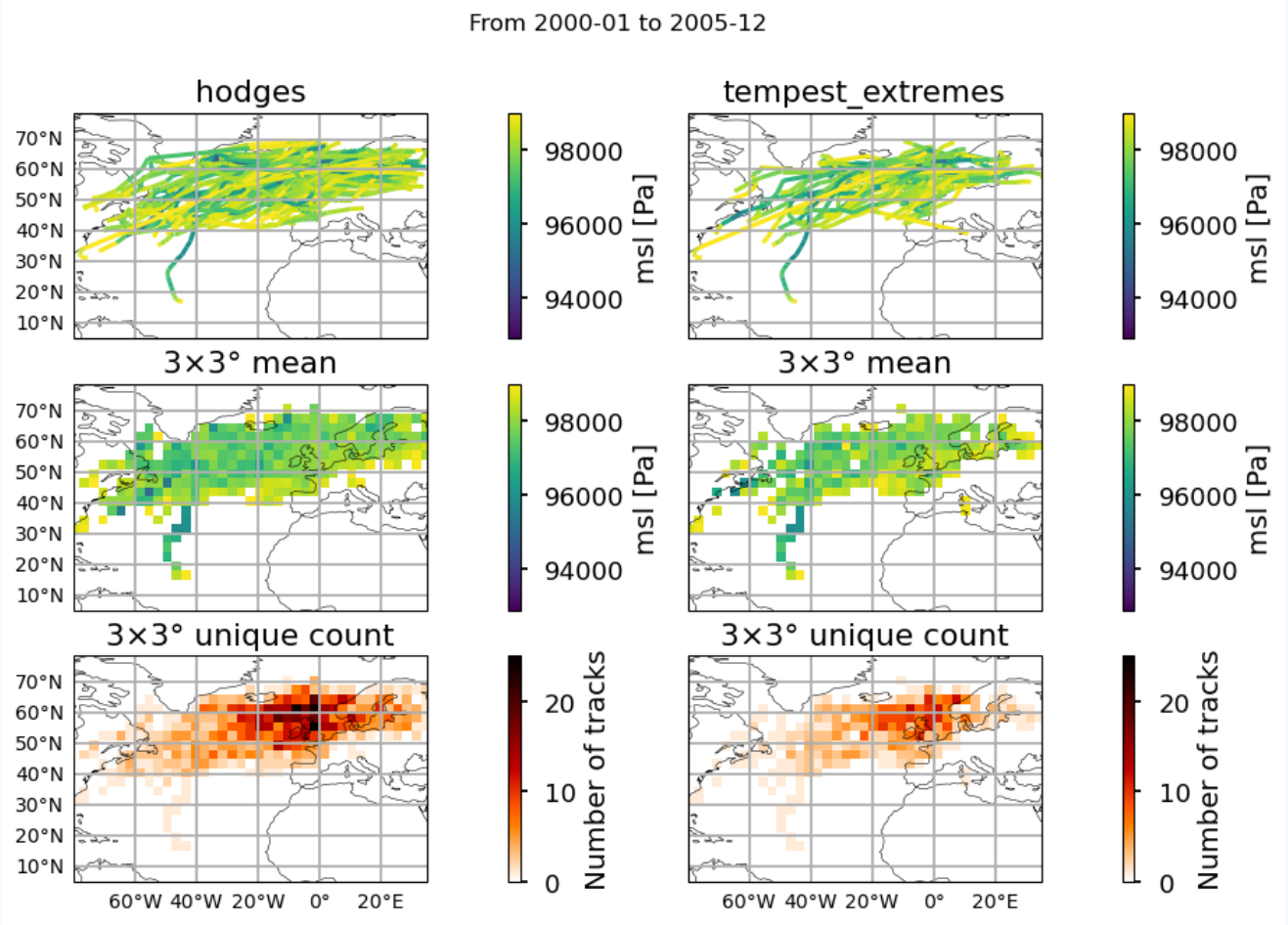
- Uses 3-hourly **850 hPa relative vorticity** to identify and follow cyclone tracks.
  Tracks are filtered by **duration, distance travelled, and region**.

TempestExtremes

- Uses 6-hourly **mean sea-level pressure** to detect cyclone centres.
  Tracks are filtered by **lifetime, movement, and region**.

Why compare them?

- Agreement between the two methods increases confidence in the windstorm catalogue.
  Differences help identify uncertainty in storm detection and tracking.



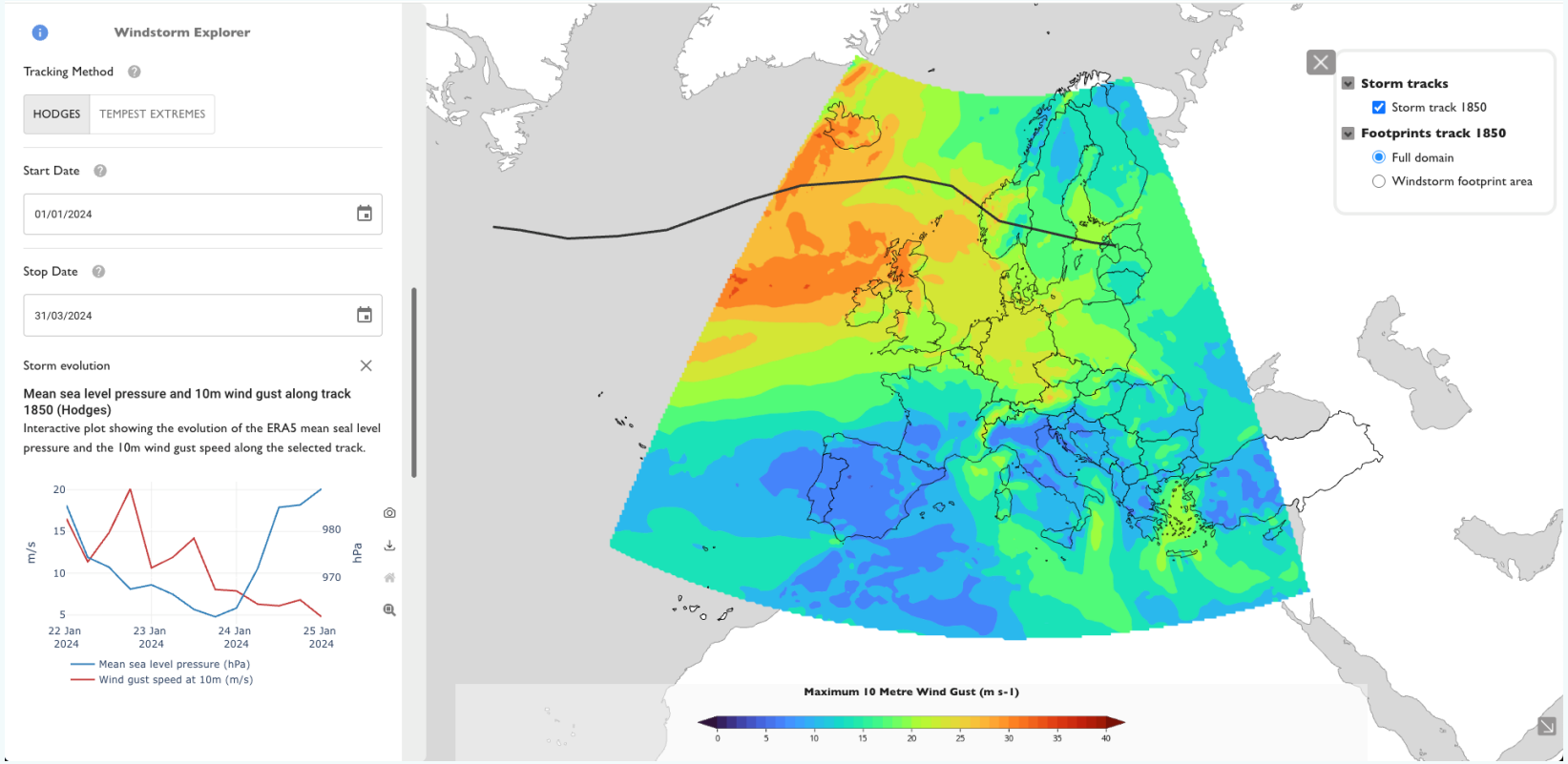
Comparison between TRACK and Tempest Extremes algorithms, from January 2000 to December 2005 over area

Why it matters?

Insurance sector wants to know about past & current windstorms for:

- Risk assessment & pricing:
- Loss prevention
- Portfolio management
- Forecasting and preparedness

- **Upcoming develeopments**: Expanding focus to support catastrophe modeling community
- Joint storm surges and windstorm events
- Expanding geographical scope and timescales

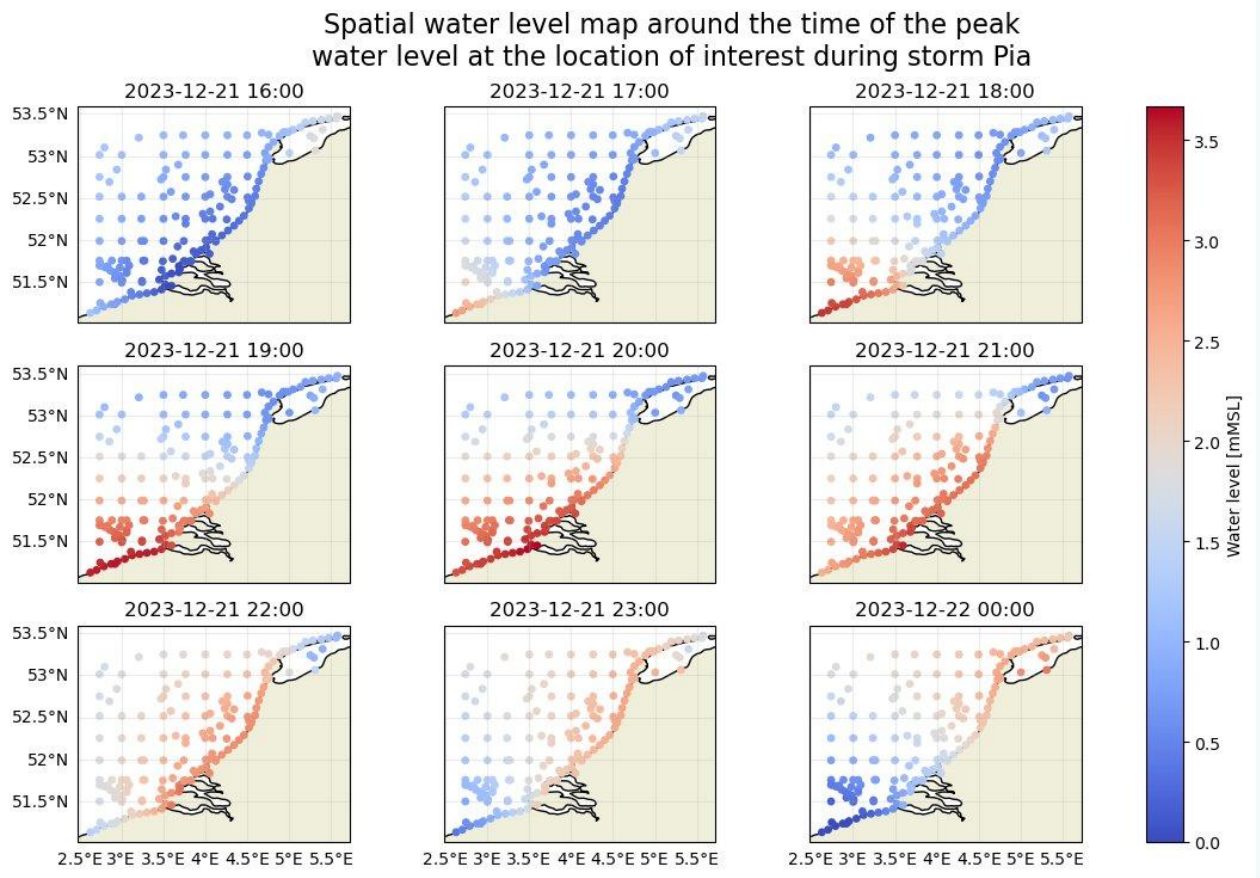


In collaboration with:

What's next

Joint windstorm–storm surge products
New event-based diagnostics will link European windstorms with storm surge and coastal water-level extremes.
They will support:

- **Compound hazard analysis**
  Co-occurrence and joint severity of extreme winds and elevated coastal water levels.
- **Insurance-relevant metrics**
  Joint exceedance frequency, joint return periods, and conditional probabilities.
- **Case-study workflows**
  Demonstrators and Jupyter notebooks for coastal risk assessment.
- **Data**
  ERA5-forced global tide and surge modelling, complemented by climate projection indicators from the CDS catalogue.



Thank you!

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