

## Extreme events in Europe: A new era of climate risk and adaptation needs

The [European Climate Change Adaptation Conference \(ECCA\)](#) is the leading European forum for sharing the latest science, policy, and practice on climate adaptation. The following press brief is designed to provide journalists and media with themes, research, data, and tools to tell impactful stories connecting science, policy, and society.

Europe is experiencing a new era of climate extremes, with 2024 marking the warmest year on record for the continent. The frequency, intensity, and impacts of extreme events – whether they are heatwaves, floods, droughts, or storms – are on the rise, underscoring the urgent need for robust adaptation strategies across all sectors and regions. Through the provision of data, research insights, story ideas, and expert perspectives CMCC researchers can help journalists explore a crucial aspect of the climate challenge: **adaptation**.

As a leading research center on climate science and impacts, CMCC plays a key role in advancing both the climate and economic modelling needed to better prepare and adapt to extreme events. From the application of novel machine learning and artificial intelligence techniques to improve the detection, causation, attribution, and [prediction of extreme events](#), to developing and running [high resolution climate models](#) and pioneering [new approaches](#) to improve local forecasts for heatwaves, floods, and extreme rainfall, CMCC's efforts offer concrete examples of how science and innovation can guide adaptation planning across Europe.

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### Data and trends on extreme events

Event Type	2024 Record Highlights	Long-term Trend
Heatwaves	Longest on record in SE Europe (13 days, 55% of region)	Increasing in frequency and intensity
Flooding	Most widespread since 2013; 30% of rivers above 'high' flood	Projected to worsen, especially with 1.5°C warming

Drought	Most severe in 12 years in SE Europe	More frequent, especially in Mediterranean
Economic Loss	€16.5 billion in Valencia flood alone	Rising year-on-year

Source: [Copernicus European State of the Climate Report 2024](#), CMCC analysis

## 2024: Europe's Warmest Year on Record

### Story ideas:

- **Bracing for the heat: How Europe can prepare for a world of record warming**
- **Twice as hot, twice the risk: The rising toll of heat-related deaths in Europe's warming climate**
- **Cutting-edge forecasting is revolutionizing early warnings for extreme weather**

### Key messages:

- **2024 was the hottest year ever recorded in Europe:** [Nearly 85%](#) of the continent experienced much warmer than average conditions and there is an [80% chance](#) that at least one of the next five years will exceed 2024 as the warmest on record.
- **Southeastern Europe endured the longest heatwave on record:** 13 consecutive days in July affecting [55%](#) of the region and resulting in record numbers of days with strong heat stress and tropical nights.
- **Marine heatwaves in winter, summer and autumn:** 2024 was the warmest on record for sea surface temperature in the Mediterranean, as well as the basin experiencing [246 marine heatwave](#) days.
- **Temperatures in Europe are rising at [twice the global average](#):** Projections suggest further increases in the frequency and intensity of extreme events.
- **Heat related fatalities on the rise:** Without adaptation, annual fatalities from extreme heat could reach 30,000 per year at 1.5°C global warming.

- **Urban populations feel the heat:** In 2018, there was a 33% increase in heat-related deaths in the EU compared to the 2000 to 2004 baseline, with a significant concentration in urban populations.

## Flooding and drought: Two sides of the same coin

### Story ideas:

- **Europe's water crisis balances between flood and drought**
- **Storm-proofing the future: How science is reinventing Europe's infrastructure for extreme weather**
- **The alarming decline of Europe's rivers in a changing climate**

### Key messages:

- **In 2024 Europe saw its most widespread flooding since 2013:** [30% of the river network](#) exceeded the “high” flood threshold and 12% surpassed “severe” levels.
- **Storm Boris (September 2024):** Three months' worth of rain fell in five days in parts of Poland, Germany, and Czechia, leading to catastrophic floods and significant economic losses.
- **European cities impacted by intense short term precipitation events causing flooding:** In Münster, Germany, 90 millimetres of rain fell in 7 hours, causing 72 million euros in damages in 2014; in Copenhagen in 2011, 135 millimetres of rain in 2 hours caused losses for more than 800 million euros; in October 2024, Valencia, Spain, recorded 771.8 mm of rain in 24 hours – the second highest daily total ever in Spain resulting in devastating impacts and over [€16.5 billion in losses](#).
- **Drought in southeastern Europe:** The most severe in 12 years, with 35% of rivers experiencing notably or exceptionally low flows.
- **Death toll due to flooding:** At least 335 people died and 413,000 were affected by extreme flooding in 2024 alone.

## The cost of extreme events

### Story ideas:

- **The evolving landscape of climate risk insurance and what it means for households and businesses.**

- **Who bears the brunt of extreme events?**
- **The links between rising temperatures, heatwaves, and public health crises in Europe.**

#### **Key messages:**

- **Escalating costs of climate extremes:** Single events can cause multi-billion-euro damages and threaten critical infrastructure, food security, and public health.
- **A new insurance landscape:** Rising unpredictability of climate extremes is [reshaping the insurance sector](#), presenting both challenges and opportunities for risk management and financial resilience.
- **Vulnerable communities are disproportionately affected by extreme events:** Equitable adaptation strategies and targeted support are needed to offset the unequal impacts of extreme events.
- **Economic toll of emissions:** Under a medium to high emissions scenario, expected annual damage from extreme events on EU energy infrastructure will be [4.2 and 8.2 billion EUR](#) in 2050 and 2080 respectively, roughly 7 and 15 times larger than today.
- **The impact on agricultural production:** Extreme climate conditions (including heatwaves, drought and heavy rain) may also trigger heavy yield losses in the agricultural sector, particularly in southern Europe due to higher temperatures affecting the length of the crop growing period and reducing plant biomass accumulation.
- **Tourism in a warming world:** Climate change is projected to change the climatic attractiveness of EU countries, increasing the appeal of northern European destinations and decreasing that of southern ones, which will become “too hot”.

## Wildfires on the rise

#### **Story ideas:**

- **Why wildfires are set to surge and what can be done about it**
- **Counting the economic cost of Europe's wildfire crisis**
- **How climate-smart solutions are redefining wildfire risk**

### Key messages:

- **Number of wildfires set to increase:** [Research](#) indicates a potential increase in wildfire events of up to 14% by 2030, 30% by the end of 2050 and 50% by the end of the century.
- **Climate change is part of the problem:** Wildfires affect approximately [400,000 hectares](#) annually in the EU, over 80% of which in southern Europe due to pronounced fire weather conditions exacerbated by climate change.
- **The economic toll of fire:** [In the EU alone, economic losses from wildfires in 2022 exceeded 2.5 billion euros.](#)
- **The Mediterranean region is the most impacted area in Europe:** Just five EU countries suffered around 80% of burnt surface area and [three of the worst fire seasons on record occurred in the last six years.](#)
- **Timely and accurate information are key to wildfire prevention:** The design, implementation and validation of strategies for preparedness and prevention, [including integrated technological and information platforms](#) for decision-makers are central to adaptation efforts.
- **Innovative climate insurance solutions:** [Integrating adaptation efforts and nature based solutions](#), as well as solutions for effective [land based carbon accounting and modelling](#), in insurance packages is emerging as a key strategy.

### Prediction and preparedness are key

CMCC has been at the forefront of advancing prediction capabilities for extreme weather events through a series of innovative, international projects that leverage artificial intelligence, high-resolution modeling, and operational forecasting.

### Story ideas:

- Science helps communities prepare for extreme weather events
- The rise of AI in extreme weather event prediction
- How Venice is leading the way in disaster risk preparedness

### Key messages:

- **Advances in machine learning:** Machine learning techniques can help [predict](#) short-term sea surface temperature and marine heatwaves more accurately in 16 regions of the Mediterranean Sea.
  - **AI revolutionizing weather and climate prediction:** A new state-of-the-art AI-driven European foundation model for Earth system science [integrates](#) advanced machine learning with high-performance computing to enhance the accuracy of weather and climate forecasts, particularly for extreme events such as floods and heatwaves. The outcomes are expected to benefit sectors like disaster management, renewable energy, and public health, and to provide open-source tools for the broader research community.
  - **New models give a more detailed view:** Climate models with [much finer spatial resolution](#) allow for more detailed and accurate simulations of extreme events like hurricanes, floods, and tropical cyclones. This helps stakeholders and decision makers understand the links between large-scale climate change and local extreme events, providing valuable data for impact studies and policy decisions.
  - **Understanding the causes of extreme events:** [Artificial intelligence](#) and machine learning are contributing to improved detection, causation, attribution, and [prediction of extreme events](#). AI frameworks can be used to analyze large climate datasets, enhancing [predictions](#) of extreme events such as tropical cyclones and heatwaves.
  - **Capacity building:** Ability to analyze and forecast extreme weather events can be fostered through [comprehensive training](#) on extreme temperature and precipitation events, the use of artificial intelligence for improved forecasting, and enhanced science communication on weather extremes. This is key to effective adaptation.
  - **Venice leads the way:** [Case studies](#) in the Italian city show that the best possible strategy to deal with extreme events is to use a portfolio of risk-management initiatives as there is a large uncertainty in predicting which hazard scenarios may occur in the future in this particular area, leaving the best option to build overall resilience of coastal systems in the face of a range of adverse events.
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## CMCC expert quotes

“The data is saying what we have felt on our skin for the past few summers. Since the early 1980s, the Mediterranean Sea has been warming at approximately 0.4°C per decade, which is faster than the global ocean average. This warming is leading to more frequent and severe marine heatwaves, especially in the last 20 years,” says CMCC researcher [Giulia Bonino](#).

“There has been a significant increase in the frequency, duration, and intensity of marine heatwaves in the Mediterranean over the past few decades,” says CMCC researcher [Ronan McAdam](#), who emphasizes that this will only worsen as greenhouse gas emissions continue to rise.

“Storm Boris was formed by a low-pressure system, technically speaking a cyclone, that passed over central Europe and then traveled down into the Mediterranean,” explains [Leone Cavicchia](#), CMCC researcher whose expertise lies in the study of climate extremes and modeling. “A new approach that is complementary to numerical models involves using machine learning and artificial intelligence to improve cyclone prediction,” says Cavicchia. “In the last few years the project [CYCLOPS](#) has used this approach to establish a connection between variables that predict certain extremes and their frequency.”

“Climate risks are interconnected and do not occur in isolation,” says CMCC researcher [Silvia Torresan](#). “If we don’t employ a multi-risk approach in the assessment and management of risks, we could adopt measures that address one problem but generate or amplify others.”

## Contacts

**CMCC experts are available for interviews and background briefings on all aspects of extreme events and climate adaptation in Europe.**

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