

# State of the Climate in Europe 2021

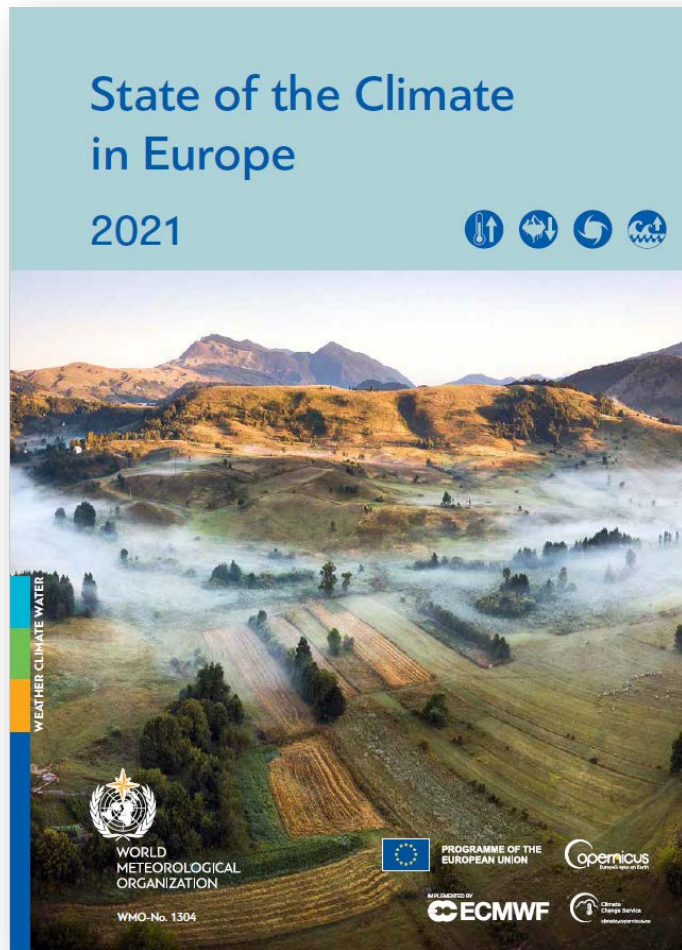
**Prof. Petteri Taalas**  
Secretary-General

World Meteorological Organization

**Dr. Carlo Buontempo**  
Director

Copernicus Climate Change Service

# Report on the State of the Climate in Europe 2021



The 2021 Europe SoC report is the first in the series.

A joint collaboration between WMO and EU Copernicus Climate Change Service.

## Collaborative effort

- **45** Europe NMHSs
- **6** UN agencies (FAO, WHO, UNECE, UNDRR, UNICEF, WMO)
- **10+** International organisations and research centres
- **50+** International and regional experts

## Authoritative science-based information

- Physical science
- High-impact weather and climate events and risks
- Climate action and climate policy, mitigation and adaptation strategies

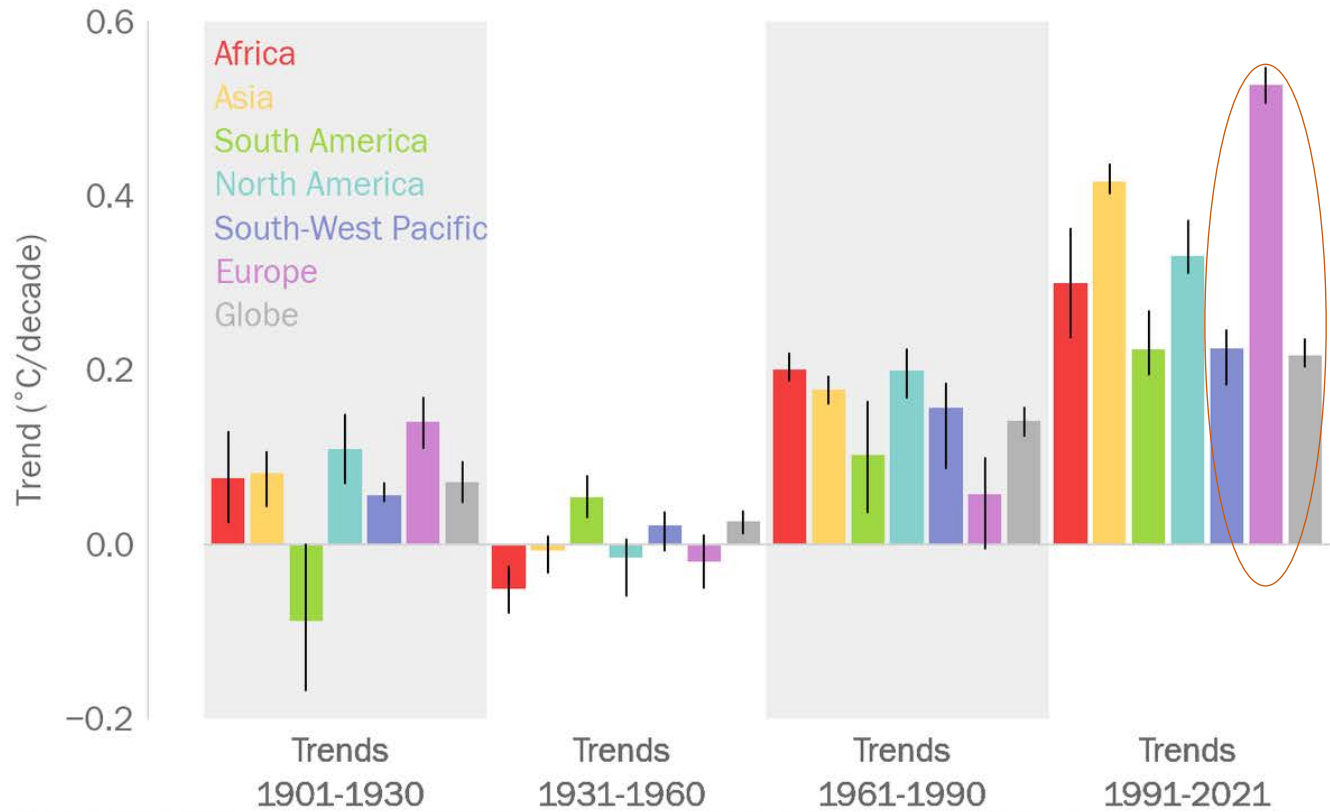
Note: The report complements the findings of the IPCC reports, the WMO State of the Global Climate in 2021 and the Copernicus European State of the Climate 2021 report

An aerial photograph of a mountain range. The peaks are rugged and covered in snow. A large glacier is visible in the middle ground, flowing down a valley. The lower slopes are green and rocky. The sky is clear and blue.

**Climate indicators**

**Extreme and high-impact events**

# Europe has warmed significantly over the last 30 years



During the **1991-2021** period, the temperatures over Europe warmed at an average rate of about **+0.5 °C per decade**, more than **twice the global average**

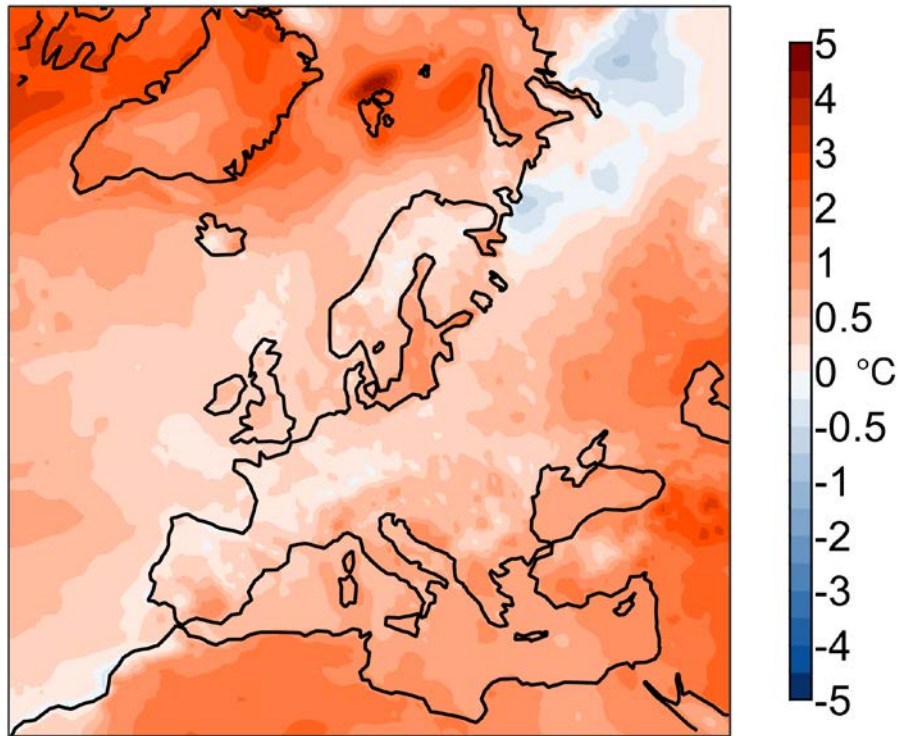
**It is the fastest warming of all the WMO Regions**

*Decadal temperature trends across WMO regions from 1901-2021.*

Source: UK Met Office. Data sets: HadCRUT5, NOAA GlobalTemp, GISTEMP, Berkeley Earth, ERA5 and JRA-55

# The 2021 annual mean temperature for Europe ranked between sixth and tenth highest on record

2021 mean surface air temperature anomaly



Reference period: 1981-2010, Data source: ERA5, Credit: C3S/ECMWF

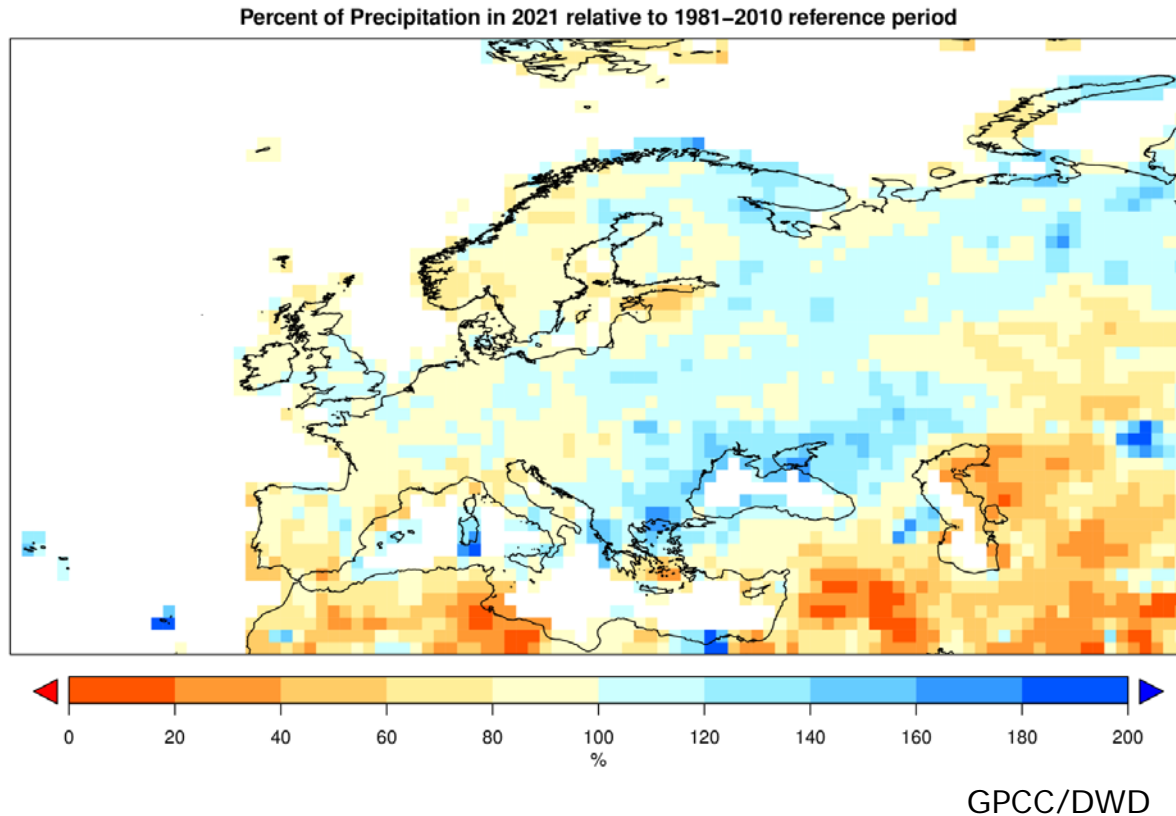
0.90 °C [0.76 °C–1.00 °C] above the 1981–2010 average

1.44 °C [1.30 °C–1.61 °C] above the 1961–1990 average

Highest annual temperature anomalies >2.0 °C (1981-2010):

- European part of the Arctic
- Parts of Greenland
- Eastern Türkiye
- Southern Caucasus and
- Parts of the Middle East

# Precipitation close to normal in 2021 in Europe as a whole, however with some spatial contrasts



Precipitation in 2021 was **above average** (1981-2010) in Central and Eastern Europe, but insufficient to compensate for deficits from the previous three years.

**Below-average** in other areas such as the Iberian Peninsula and the Alpine region, where it was the second or third consecutive drier-than-normal year.



WMO OMM



PROGRAMME OF  
THE EUROPEAN UNION

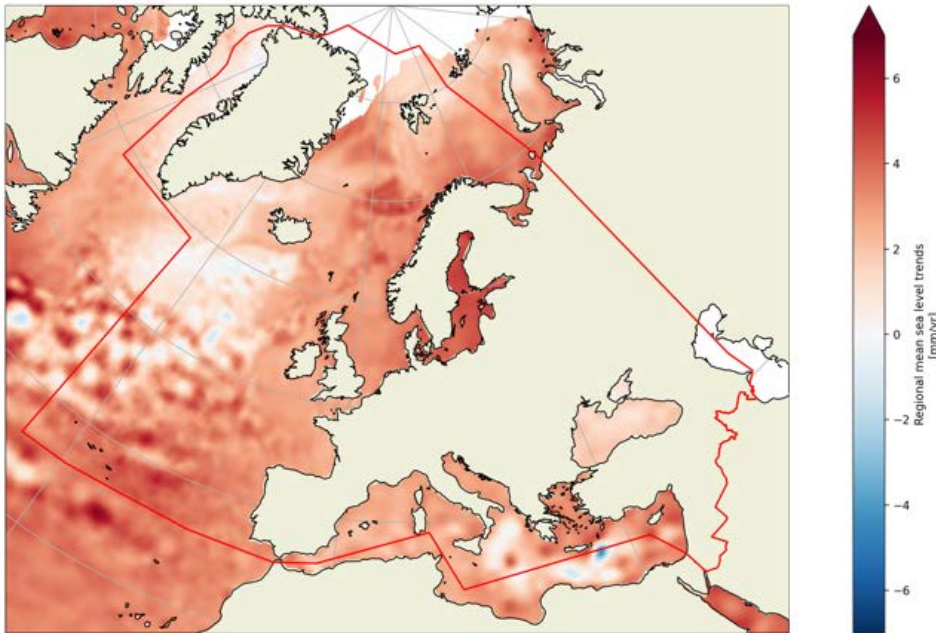


IMPLEMENTED BY



# Europe's oceans are warming and sea levels are rising

Sea-level trends (mm/year) from 1993 to 2021



Source: CMEMS/C3S

## Sea Surface Temperature (SST)

2021 was between the sixth and eighth warmest year for European-averaged SST on record

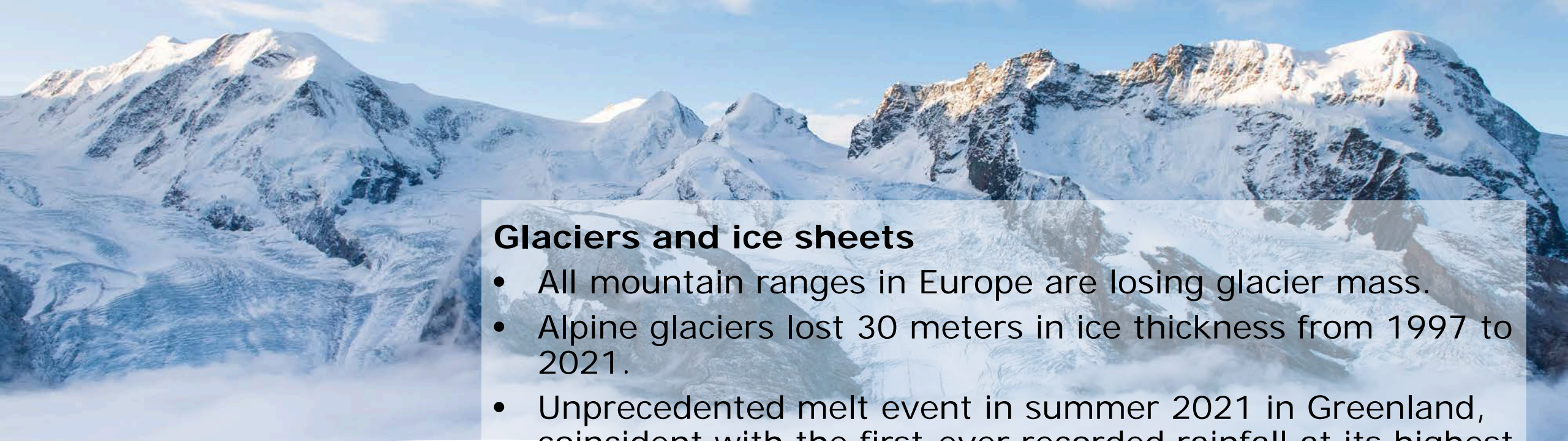
## Ocean Heat Content (OHC)

For the period 2005-2021 ocean heat increased in some areas, in particular the Mediterranean Sea, while other areas saw a negative trend.



## Sea level

In most areas is increasing around 2–4 mm/year. The Baltic Sea exhibits one of the highest sea level trends, at greater than 4 mm/year.



## Glaciers and ice sheets

- All mountain ranges in Europe are losing glacier mass.
- Alpine glaciers lost 30 meters in ice thickness from 1997 to 2021.
- Unprecedented melt event in summer 2021 in Greenland, coincident with the first-ever recorded rainfall at its highest point, Summit station.

## Europe's cryosphere continues to lose mass

### Sea ice

- Record minima daily sea ice extent of the European Arctic sector reached in September.
- A significant contributor to these low values was the record low sea ice conditions in the Greenland Sea from July to September.



WMO OMM



PROGRAMME OF  
THE EUROPEAN UNION



IMPLEMENTED BY



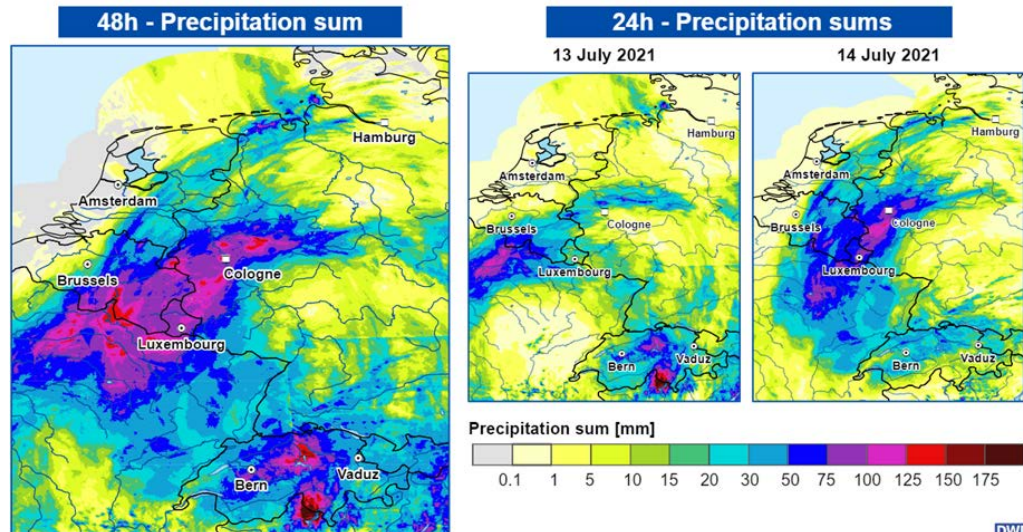


# Major Extreme Events

## Heavy precipitation and floods

- Central Europe experienced some of its **most severe flooding** on record in mid-July.
- Rainfall up to **241 mm in 22 hours**.
- Worst-affected areas were **western Germany and eastern Belgium**.
- Extreme **river flooding**, many towns inundated.
- **Water levels** in rivers exceeded **historical records**.

Extreme rainfall over Benelux countries and western Germany,  
Precipitation sums: 13 July, 05:50 UTC - 15 July 2021, 05:50 UTC



Precipitation data: Radar data. Graphic credits: © Deutscher Wetterdienst 2022 (Last update: 27.07.2022).  
Geodata: © GeoBasis-DE/BKG 2020 (Last update: 01.01.2020).

Deutscher Wetterdienst  
Wetter und Klima aus einer Hand



# Major Extreme Events

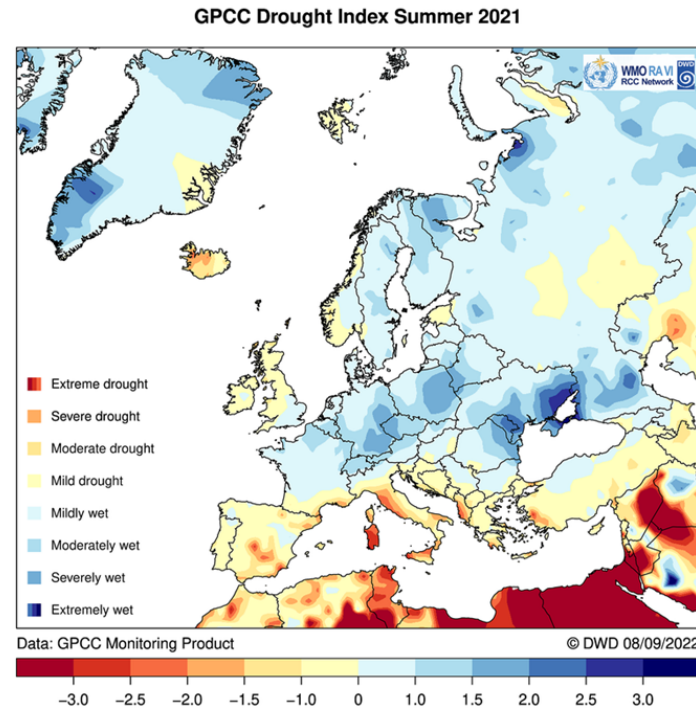
## Drought, Heat and Wildfires

### Drought

- Moderate to severe summer drought in much of the Mediterranean region.

### Wildfires

- **Major wildfires** across the Mediterranean region, especially southern Türkiye, Italy and Greece.



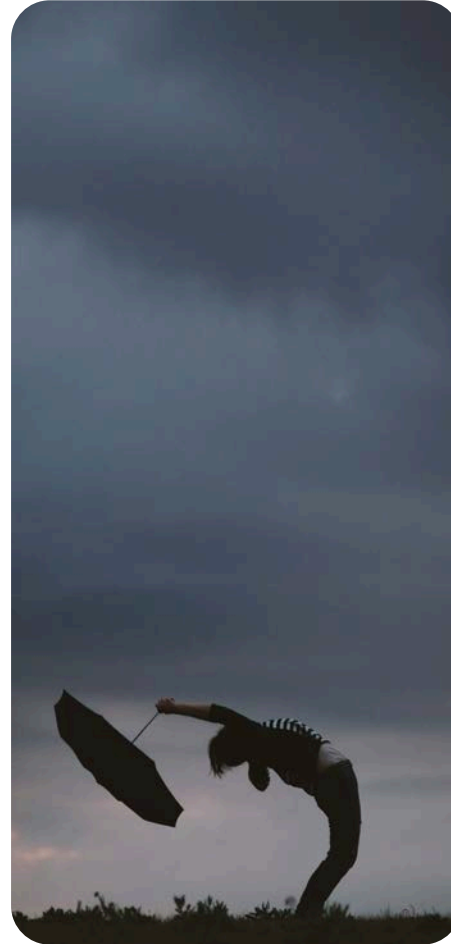
### Extreme heat

- Heat waves in many parts of Europe with many new local and some national records.
- **New provisional heat record** for continental Europe in Sicily (southern Italy) at 48.8 °C in August 2021.
- Heat even in the north (highest ever recorded August temperature in Iceland: 29.4 °C).

# Major Extreme Events

## Cold spells and snow

- A **severe snowstorm (Storm Filomena)** hit many parts of Spain from 7 to 10 January, followed by a week of freezing air temperatures.
- Significant **snowstorm** and low temperatures in the second week of February in Central Europe.
- An unusual **spring cold outbreak** affected many parts of Europe in early April, such as France, Poland, Switzerland, Slovenia, United Kingdom.



## Severe storms with strong winds

- **Storm Zyprian** in northwestern France on 5 July 2021. Gusts up to 146 km/h at the west coast of Brittany, new local record for July.
- **Storm Aurore** on 20-21 October in southern England, France, Central Europe. Gusts up to 175 km/h at the English Channel, new October record.
- **Storm Arwen** brought severe winds across the UK overnight on 26 to 27 November 2021.
- **Cyclone Carmel** over the eastern Mediterranean in mid-December. Landfall in Israel, gusts up to 110 km/h.

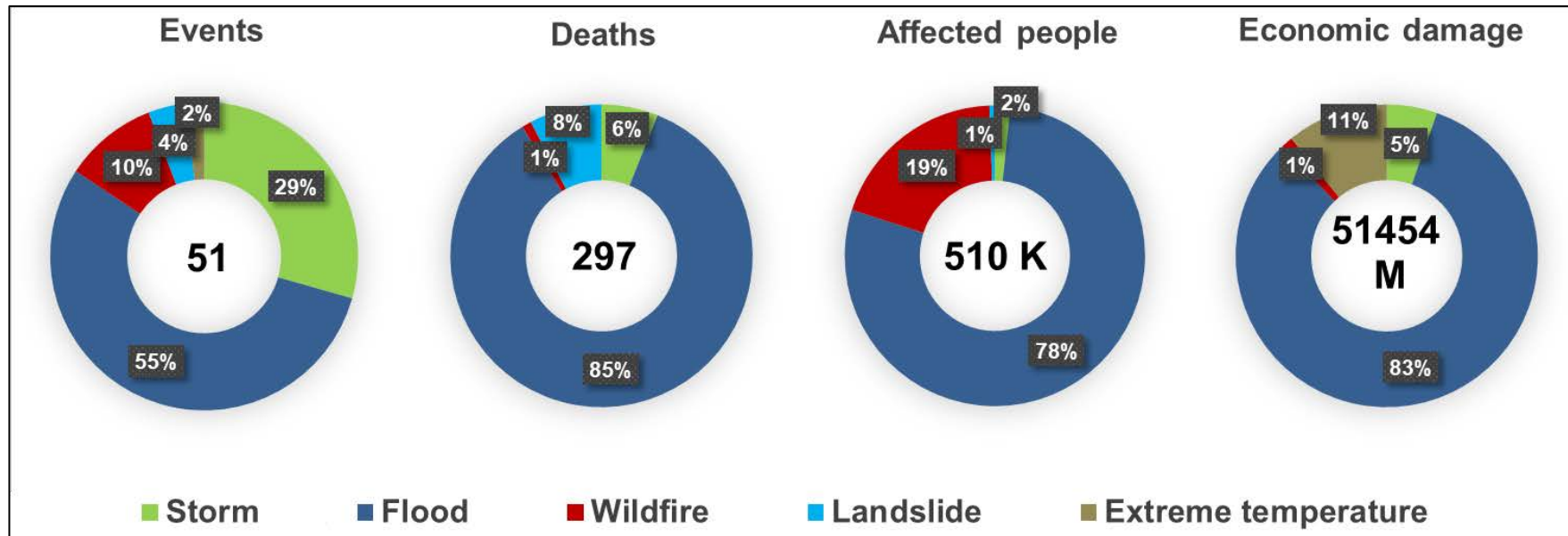
A scenic view of a mountain peak at sunset. The sky is a gradient of orange and yellow, transitioning into a deep blue. Below the horizon, a vast sea of white, fluffy clouds stretches across the landscape. In the foreground, a dark silhouette of a mountain ridge is visible, with a group of people standing on it, looking out over the clouds. The overall atmosphere is serene and majestic.

**Climate-related impacts and risks**

**Climate policy and climate action**

# Affected population and damage in 2021 in Europe

- **51** meteorological, hydrological and climate hazard events reported in Europe, 84% being flood and storm events.
- **297 fatalities** and around 510 000 people directly affected.
- **US\$ 51500 million** total economic damage.



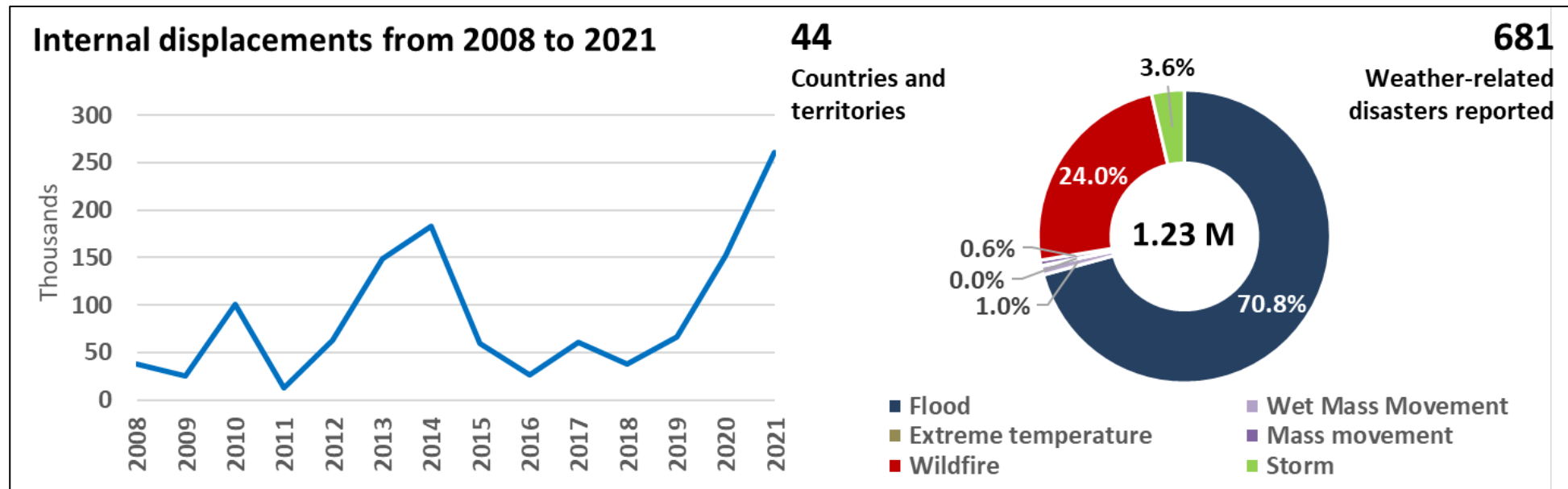
Based on EM-DAT data

**Floods** had the highest share of total in terms of:

- Fatalities (85%)
- Affected population (78%)
- Economic damage (83%)

# Displacements

- In 2021 about 260 000 displacements, the highest number since start of data series in 2008 and more than three times the 2008-2020 average.
- Between 2008 and 2021, more than 1.23 million displacements triggered by 681 climate, weather and other natural disasters in Europe.
- Most due to impacts of floods (70.8%) and wildfires (20.4%).



WMO OMM

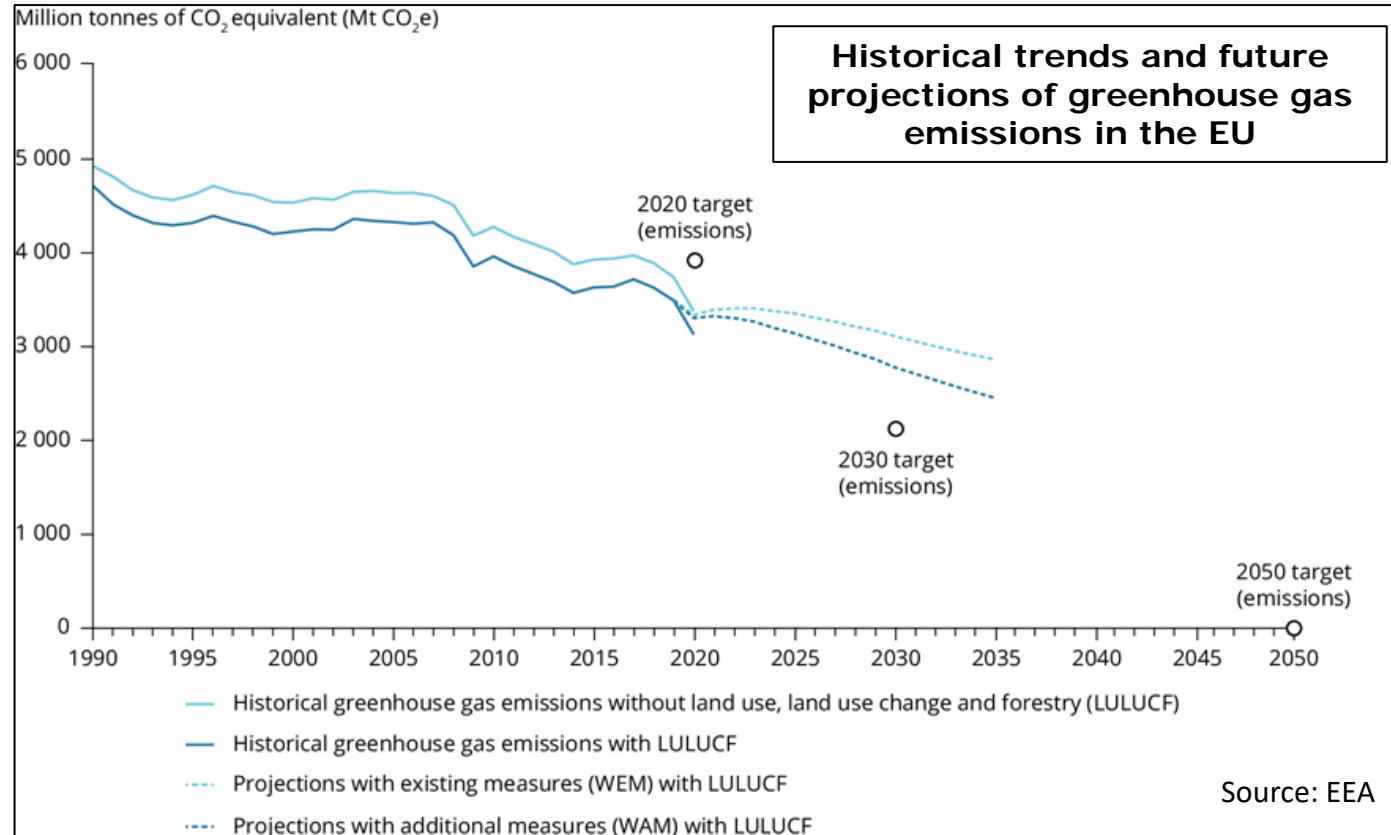


PROGRAMME OF  
THE EUROPEAN UNION



# Climate Policy & Action: GHG emissions

Greenhouse gas emissions in the EU decreased by 31% between 1990 and 2020, exceeding the EU's 2020 target by 11%



**Further implementation of impactful policies and measures will be important to bring the new 2030 target within reach (net reduction of 55%).**



WMO OMM



PROGRAMME OF  
THE EUROPEAN UNION

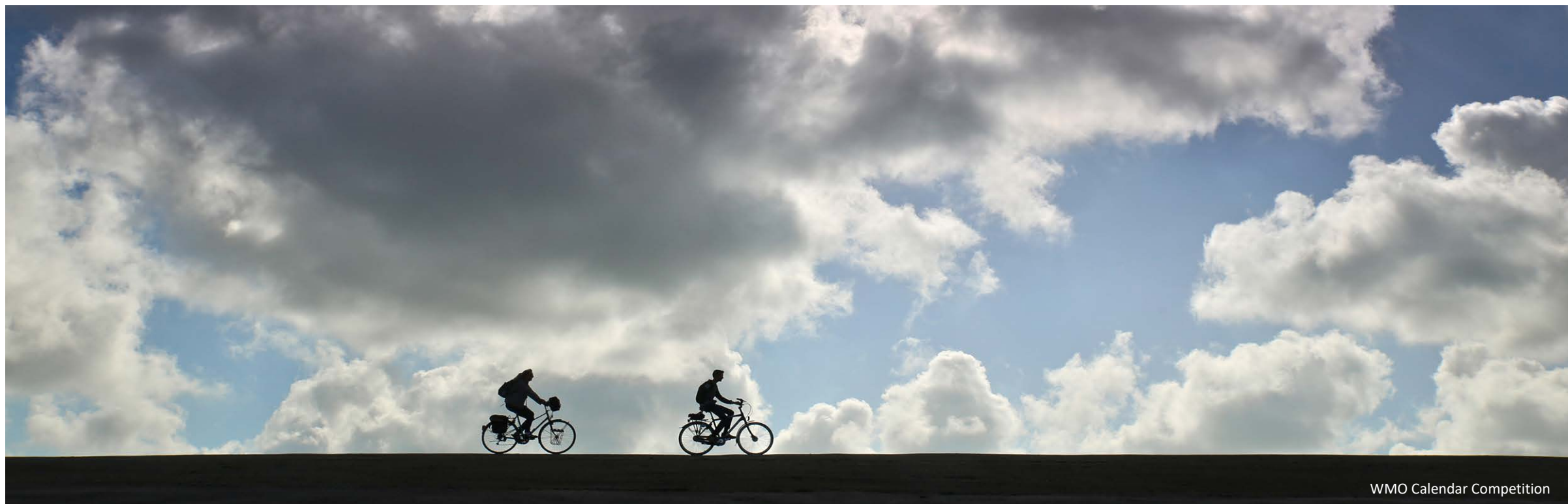


IMPLEMENTED BY



# Climate Policy & Action: NDCs

Mitigation to climate change has already been a primary focus in Europe as reflected in countries Nationally Determined Contributions (NDCs), highlighting **energy supply, agriculture, waste, and land use, land-use change and forestry (LULUCF) as top mitigation priorities.**

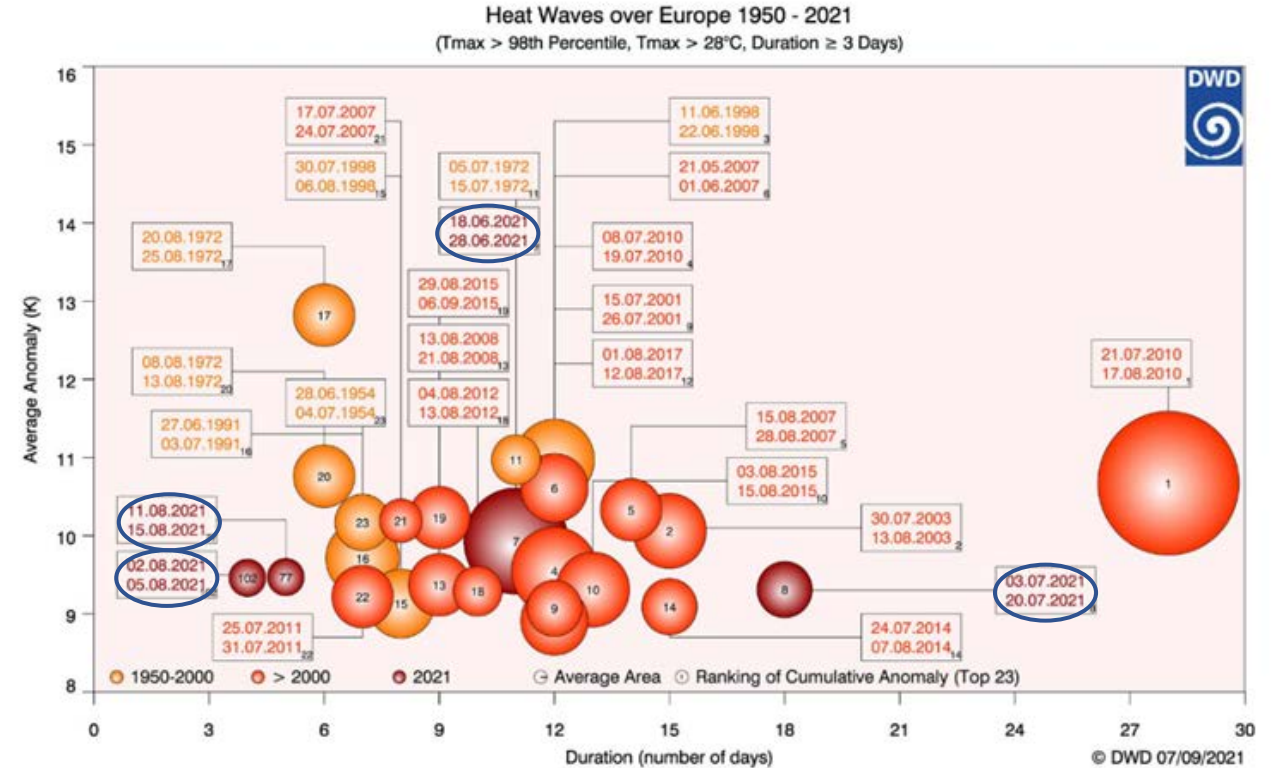


WMO Calendar Competition



# Climate Policy & Action: Heatwaves

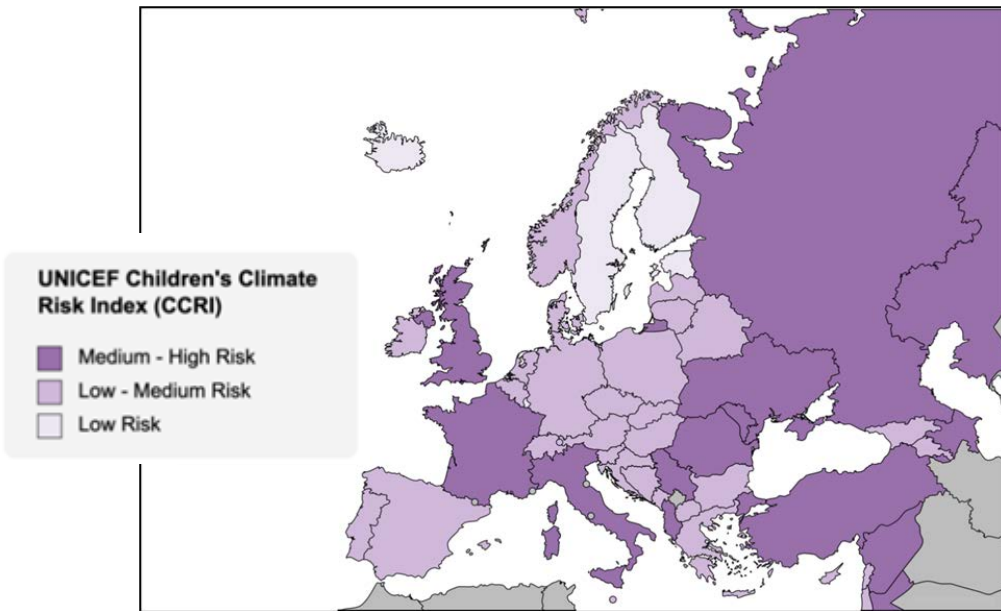
- Since 1950 out of the 23 most severe heatwaves 16 occurred after 2000, including four in 2021.
- Heatwaves have become more frequent and also more severe, with serious impacts, for example, on health and mortality.



**Comprehensive heat-health action plans and early warning systems have been shown to save lives and strengthen the resilience of communities and people to cope with extreme heat.**

# Climate Policy & Action: Children

According to the UNICEF Children's Climate Risk Index, nearly 125 million children in Europe live in 'medium to high' risk countries.



(Note: medium to high risk is the third of five levels of classification used globally).

The NDCs are also an important mechanism to **protect children and youth** from the impacts of climate change.



Call for action on making climate policy child and youth sensitive and mainstreaming DRR and climate change adaptation into primary and secondary school curricula and education legal frameworks.



WMO OMM



PROGRAMME OF  
THE EUROPEAN UNION



IMPLEMENTED BY



# Climate Policy & Action: Net-zero carbon society



Efforts to address the health risks associated with climate change are also progressing slowly and insufficiently.

**Transitioning to a net-zero carbon society could bring a range of near- and long-term health gains.**

About 138 000 premature deaths could be avoided per year through reduced carbon emissions, potentially resulting in savings of US\$ 244–564 billion.

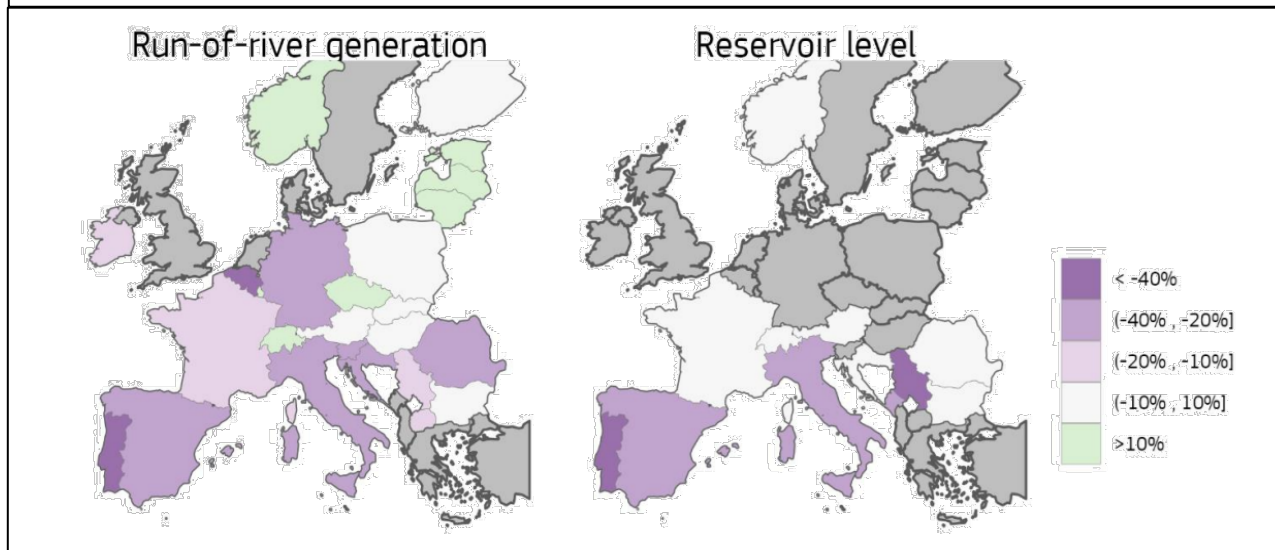


# Climate services and early warnings for the energy sector

Increasing need for effective weather, water and climate services, and early warning systems for the energy sector in a changing climate

## Drought impact in hydropower generation

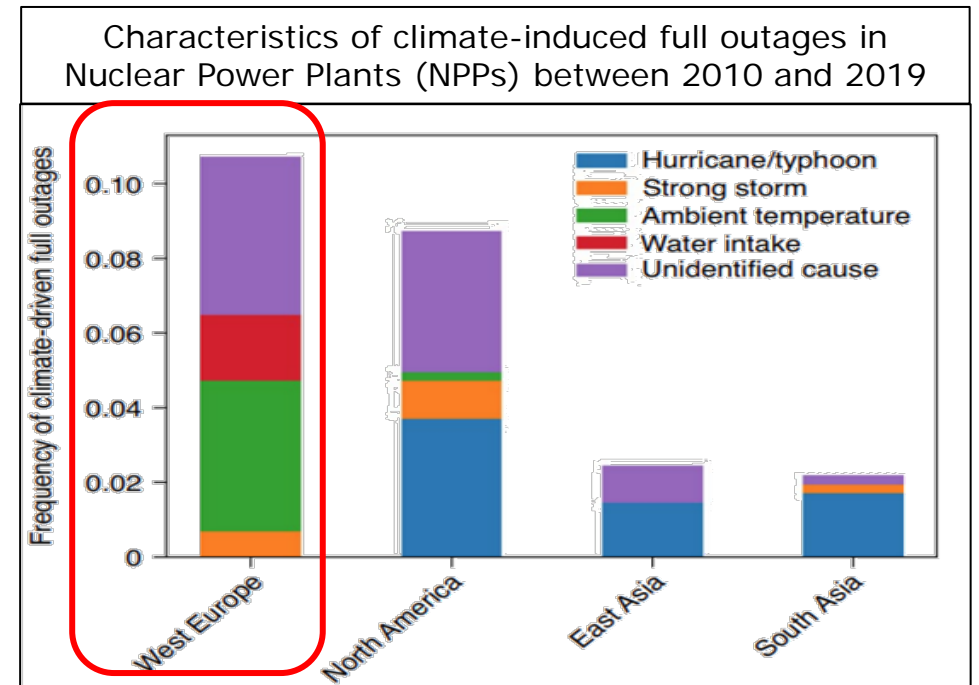
Difference (%) between the cumulative hydropower run-of-river generation and storage levels for June 2022 compared to June 2015-2021 average



Source: [GDO-EDODroughtNews202207\\_Europe.pdf \(europa.eu\)](#) and <https://transparency.entsoe.eu/>

The low level of European hydropower reservoirs may exacerbate the current situation of the European power markets, which are already experiencing record-breaking wholesale prices.

## Increase in ambient temperature is the largest contributor to climate-linked full outages in Western Europe (mainly France)



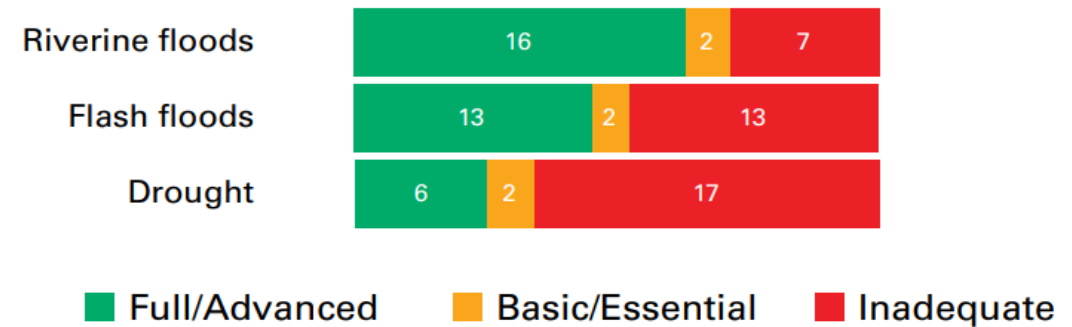
Ahmad, A., Nature Energy 6, 755–762 (2021). <https://doi.org/10.1038/s41560-021-00849-y>

# 75% of people in Europe are covered by early warnings, although some hydrological capacities need improving

75 000 in 100 000 people are covered by early warnings



Number of WMO Members in Europe with early warnings available to the population at risk, by hydrological hazard type (data reported by 34 out of 51 Members)

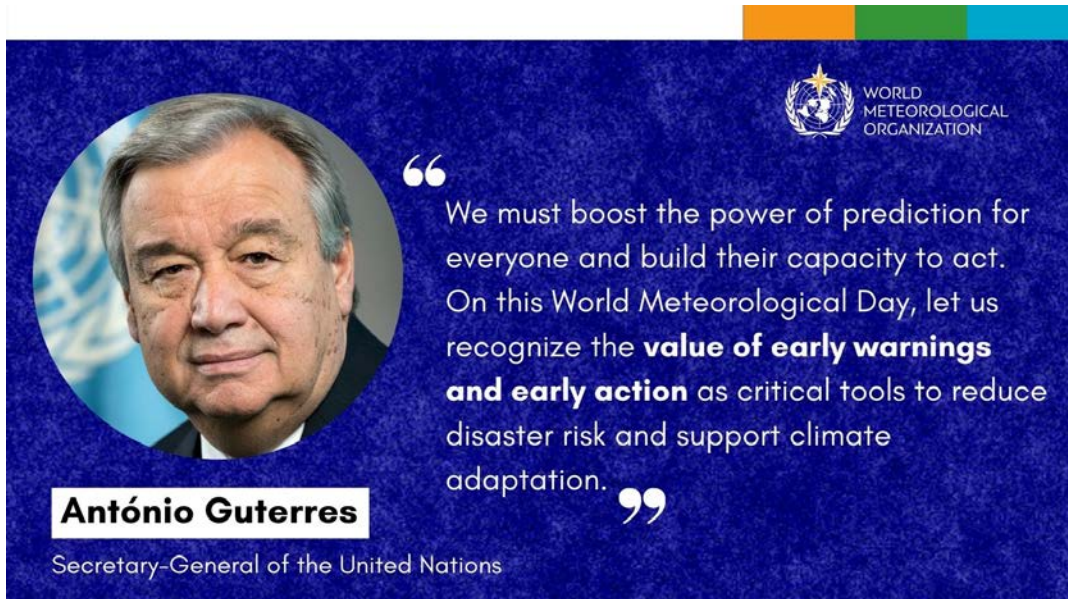


## Why is it important to improve?

In the last 50 years (1970–2019) from all weather, water and climate disasters in Europe:

- 38% were floods
- 6 of Top 10 largest economic losses were related to floods

# Globally, EWS must protect everyone within five years



UN Secretary-General António Guterres has tasked WMO to lead the effort and present an action plan to achieve this goal at the UN climate change conference, COP 27, in Sharm el-Sheikh, Egypt, 6-18 November 2022.

WMO is leading international efforts through the United Nations Global Early Warning Initiative to strengthen Earth system observations and monitoring, predictive and warning capabilities.

The **new plan** seeks to build on existing WMO activities and partnerships, including:

- WMO Global Multi-hazard Alert System (**GMAS**)
- The Climate Risk and Early Warning Systems Initiative (**CREWS**)
- Global Framework for Climate Services (**GFCS**)
- Systematic Observations Financing Facility (**SOFF**)



WMO OMM



PROGRAMME OF  
THE EUROPEAN UNION



“The cumulative scientific evidence is unequivocal: Climate change is a threat to human well-being and planetary health. Any further delay in concerted anticipatory global action on adaptation and mitigation will miss a brief and rapidly closing window of opportunity to secure a liveable and sustainable future for all (very high confidence)”. IPCC AR6 WG2





WMO Calendar Competition

شكرا لكم  
Thank you  
Gracias  
Merci  
Спасибо  
谢谢



WMO OMM



PROGRAMME OF  
THE EUROPEAN UNION



IMPLEMENTED BY

