

# Climate Services, for climate-resilient energy systems

Chris Hewitt

Director, WMO Climate Services Branch

Formerly Head of International Climate Services, Met Office, UK  
Honorary Professor, University of Southern Queensland, Australia  
Honorary Professor, University of Bristol, UK



**WMO OMM**

World Meteorological Organization

Organisation météorologique mondiale

# Contents

1. Introduction to climate services
2. The Global Framework for Climate Services
3. Example flagship products in support of decision- and policy-making
4. Concluding remarks

# “Climate Services”?

Climate information is being used in decision-making and risk management world-wide

**Climate services are the provision and use of climate information to assist decision-making**

- Must respond to user<sup>†</sup> needs
- Need to be based on scientifically credible information and expertise
- Require appropriate engagement between the users and providers with an effective access mechanism

<sup>†</sup> Users could include policy makers, decision makers, governments, public sector, private sector, general public, ...



# Timescales

## 1. Past and current climate

observations and monitoring, climatologies

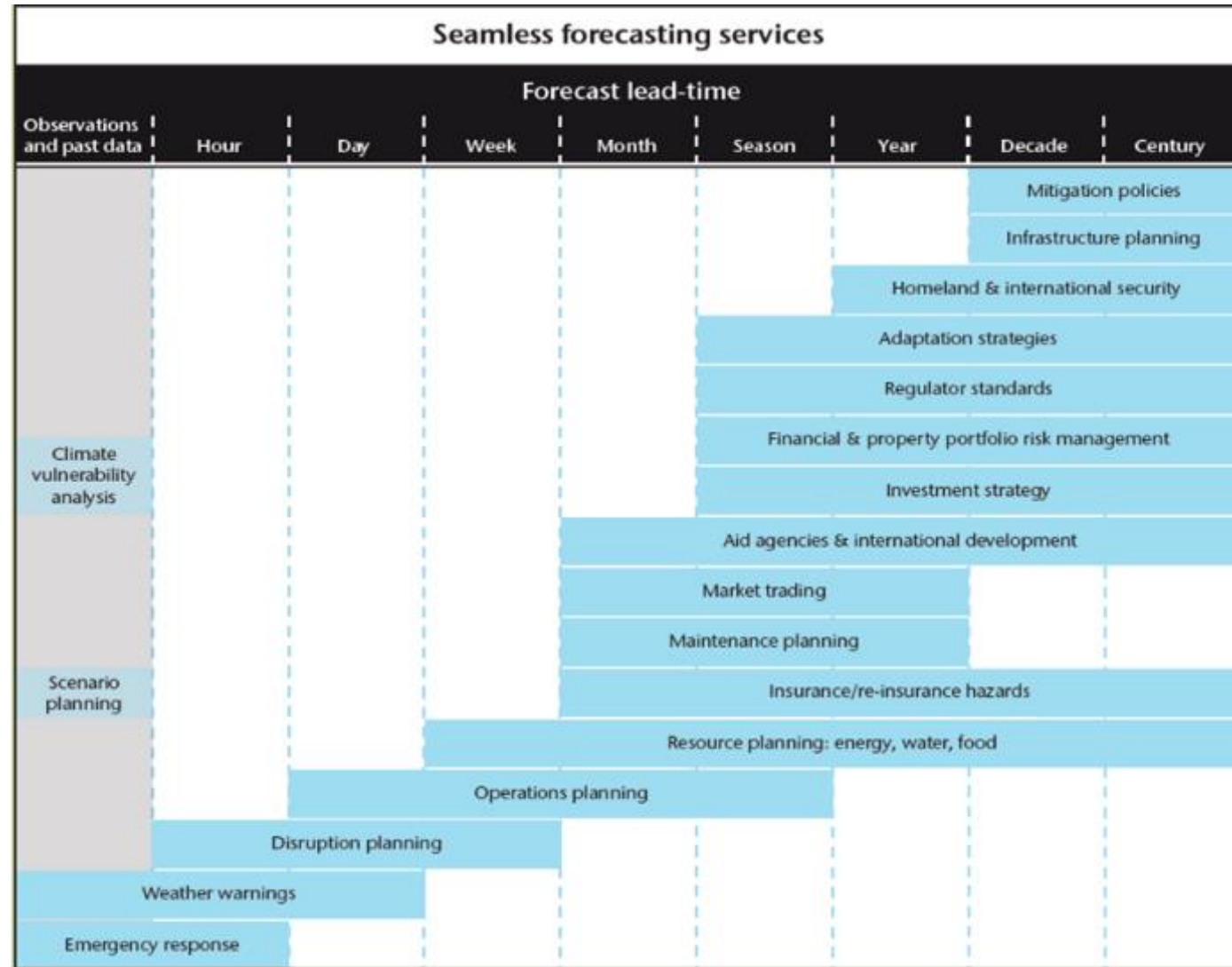
## 2. Near-term future climate

month-season-decade predictions

## 3. Long-term future climate

multi-decadal projections

*Often an overlap with weather services*



# Contents

1. Introduction to climate services
- 2. The Global Framework for Climate Services**
3. Example flagship products in support of decision- and policy-making
4. Concluding remarks

*Vision: enable society to better manage the risks and opportunities arising from climate variability and change*

1

## Strengthen climate service capacity and capability, particularly in NMHSs

- Improve availability of, access to, and use of, climate information, providing scientific and technical support
- Establish National Frameworks for Climate Services, and National Climate Fora, and link to regional structures



2

## Support climate policy and finance with authoritative scientific information

- Produce regular reports and advice to support adaptation and mitigation (such as Global and Regional State of Climate reports; State of Climate Services; ENSO Bulletins; Climate Updates)
- Provide tools and expertise to help incorporate climate science into actions and investments



3

## Develop Standards, Quality Management and Training

- Assess and develop Climate Service capacities (basic ⇒ essential ⇒ full ⇒ advanced) and needs
- Produce guidance on standards and competencies (through WMO's SERCOM and INFCOM)



4

## Develop the climate services value chain/cycle

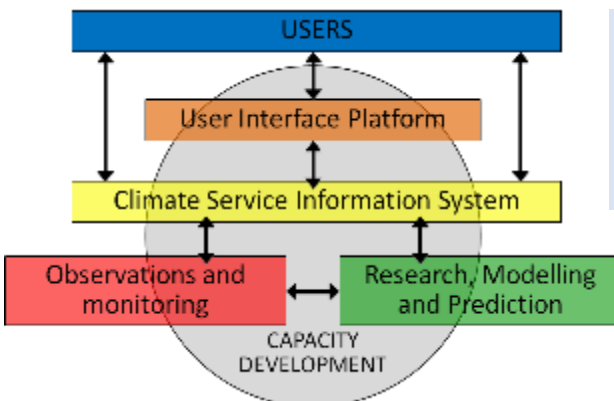
- Scientific capability (including Obs., data, WCRP) ⇔ climate services information ⇔ user engagement
- Generate value and enable actions



5

## Improve visibility and effectiveness of GFCS, promote coordination

- Climate services are essential for society. Needs global-regional-national coordination
- Provide a forum for stakeholder communication, knowledge sharing, collaboration



*Vision: enable society to better manage the risks and opportunities arising from climate variability and change*

1

## Strengthen climate service capacity and capability, particularly in NMHSs

- Improve availability of, access to, and use of, climate information, providing scientific and technical support
- Establish National Frameworks for Climate Services, and National Climate Fora, and link to regional structures



2

## Support climate policy and finance with authoritative scientific information

- Produce regular reports and advice to support adaptation and mitigation (such as Global and Regional State of Climate reports; State of Climate Services; ENSO Bulletins; Climate Updates)
- Provide tools and expertise to help incorporate climate science into actions and investments



3

## Develop Standards, Quality Management and Training

- Assess and develop Climate Service capacities (basic ⇒ essential ⇒ full ⇒ advanced) and needs
- Produce guidance on standards and competencies (through WMO's SERCOM and INFCOM)



4

## Develop the climate services value chain/cycle

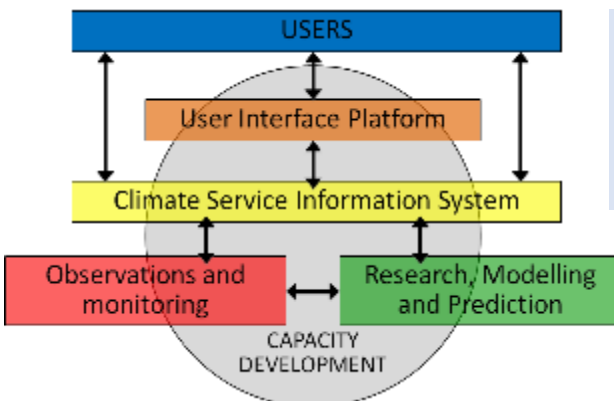
- Scientific capability (including Obs., data, WCRP) ⇔ climate services information ⇔ user engagement
- Generate value and enable actions



5

## Improve visibility and effectiveness of GFCS, promote coordination

- Climate services are essential for society. Needs global-regional-national coordination
- Provide a forum for stakeholder communication, knowledge sharing, collaboration

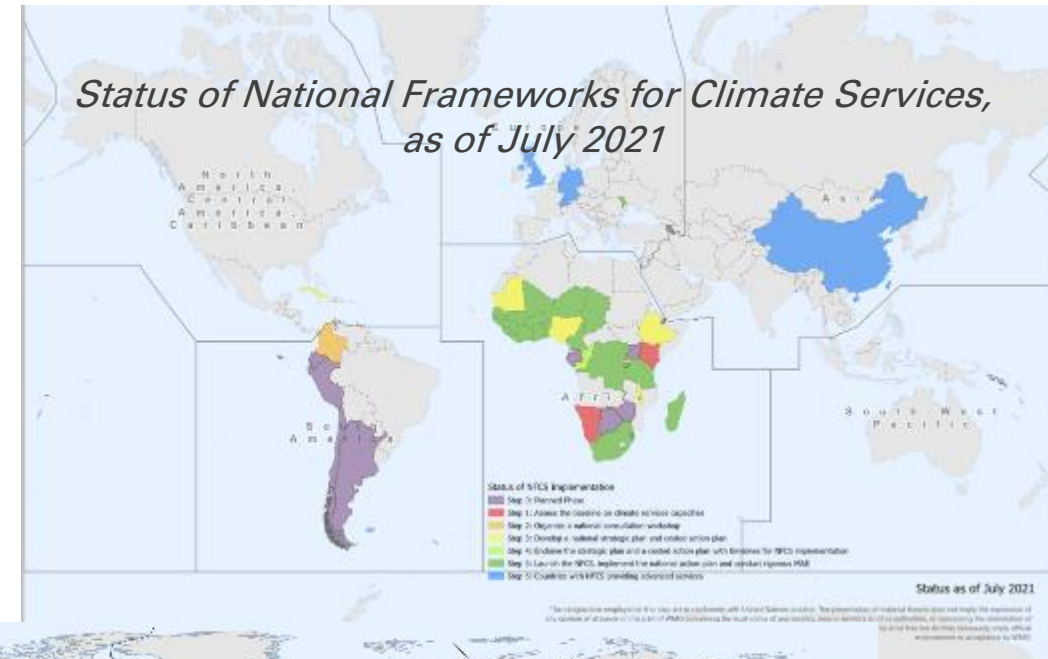


# National level: National Frameworks for Climate Services

## National Climate Forums

National Frameworks: coordination, governance, collaboration to improve the **development, delivery and use of climate services at country level** to support decision-making

National Forums: National platforms for dialogue for the design of **tailored climate information** to the national context and **translation of key messages** for users



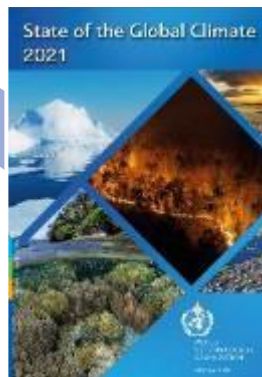


# Contents

1. Introduction to climate services
2. The Global Framework for Climate Services
3. Example flagship products in support of decision- and policy-making
  - State of the Climate Reports (Global, and Regional)
4. Concluding remarks

# GFCS Flagship Climate reports produced by WMO and partners

Global



Annual



5 year



Decadal

Regional



WMO  
Statements  
on Climate

- State of the Climate reports provide authoritative information on key climate indicators and high-impact events
- Updates on annual and longer-term changing climatic conditions
- Build on operational monitoring systems globally, regionally and nationally
- Wide-ranging contributions (from Regional Climate Centres, NMHSs, UN organizations, international partners)

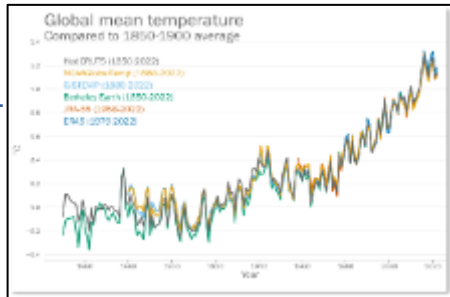
# Global Key Climate Indicators

Range of indicators giving a more comprehensive picture of the overall state of the global climate system

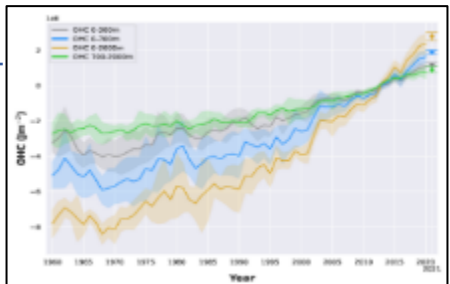
Characteristics: Relevance; Representativeness; Traceability; Timeliness; Data adequacy

## Temperature and Energy

### Surface Temperature

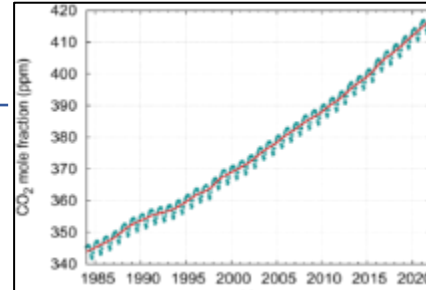


### Ocean Heat



## Atmospheric Composition

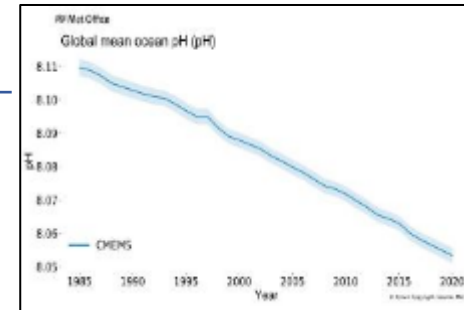
### CO2



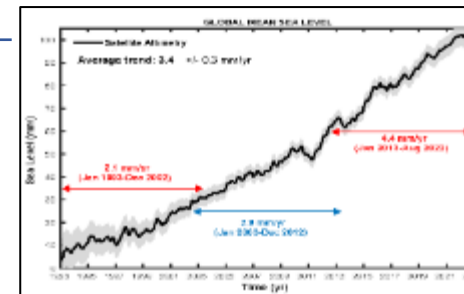
## Global State of the Climate 2022

## Ocean and Water

### Acidification

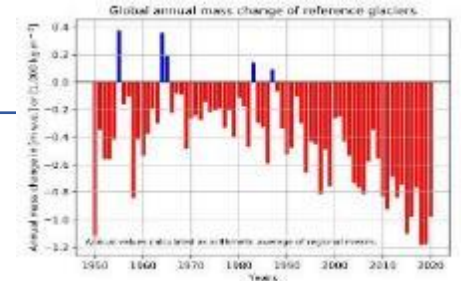


### Sea level

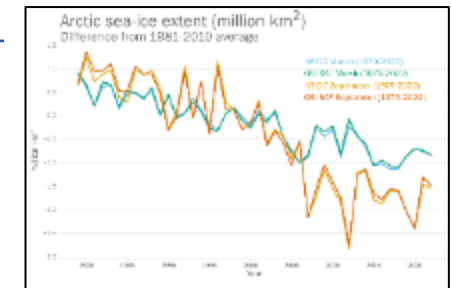


## Cryosphere

### Glaciers



### Arctic and Antarctic Sea Ice Extent



# State of the Climate in Europe 2022



- Launched on 19 June 2023, at European Climate Change Adaptation Conference
- This one has a focus on renewable energy

*“Wind and solar power represented 22.3% of European Union electricity in 2022, overtaking fossil gas (20%) for the first time. More electricity was generated by these two renewable resources than by any other power source. Monitoring and understanding their temporal and spatial variability is increasingly important due to the growing importance they have for the European energy mix.”*

*“Climate information is an important element of improving the resilience and operations of energy systems. While 80% of WMO Members in Europe are providing some climate information for the energy sector, less than 50% provide monthly to seasonal climate predictions for the energy sector, bringing to light the untapped potential of NMHSs in supporting energy transition and greater climate resilience of the energy sector.”*

## Key messages



Europe is the fastest-warming of all the WMO regions, warming twice as much as the global average since the 1980s. In 2022, the annual average temperature was between the second and fourth highest on record, depending on the data set used, and summer was the warmest. In many countries in western and south-western Europe, 2022 was the warmest year on record.



Precipitation was below average across much of the region in 2022. It was the fourth dry



Drought also affected much of the region, particularly during spring and summer. The combination of dry conditions and extreme heat fuelled numerous wildfires and the second largest burnt area in the region on record. Large wildfires occurred in France, Spain, Portugal, Slovenia and Czechia.



Storms and floods led to dozens of fatalities, with many cases of localized flooding from intense rainfall, a derecho (a long-lived band of thunderstorms and destructive winds) that affected parts of southern and central Europe in August, and three successive storms in one week of February in north-west Europe.



Despite the year being characterized by warm conditions, some areas were affected by cold spells and heavy snowfall, including Türkiye, the Syrian Arab Republic, Greece and Montenegro. A widespread cold spell also affected much of northern and western Europe in December. Reykjavik, Iceland, recorded the coldest December for 100 years.



Wind and solar power represented 22.3% of European Union electricity in 2022, overtaking fossil gas (20%) for the first time. More electricity was generated by these two renewable resources than by any other power source. Monitoring and understanding their temporal and spatial variability is increasingly important due to the growing importance they have for the European energy mix.



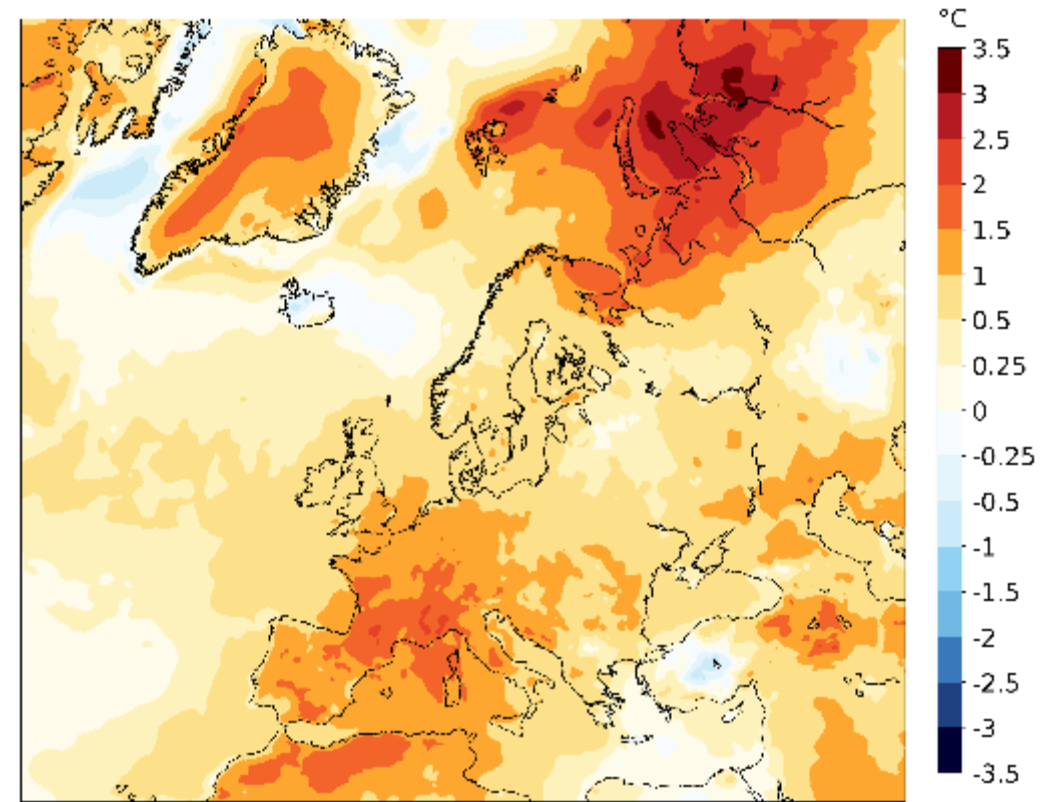
Climate information is an important element of improving the resilience and operations of energy systems. While 80% of WMO Members in Europe are providing some climate information for the energy sector, less than 50% provide monthly to seasonal climate predictions for the energy sector, bringing to light the untapped potential of NMHSs in supporting energy transition and greater climate resilience of the energy sector.

temperature reached 40 °C in the United Kingdom for the first time, with a reading of 40.3 °C in Coningsby on 19 July.

# Temperature

- Annual average temperatures in 2022 were above the 1991–2020 average by more than 0.5 °C; only north-western Iceland and a small part of Türkiye saw temperatures slightly below average.
- The largest positive deviations from the average, greater than 1 °C, occurred across the European part of the Arctic, and in the south-western parts of the region.
- **Many countries in western and south-western Europe had their warmest year on record.**

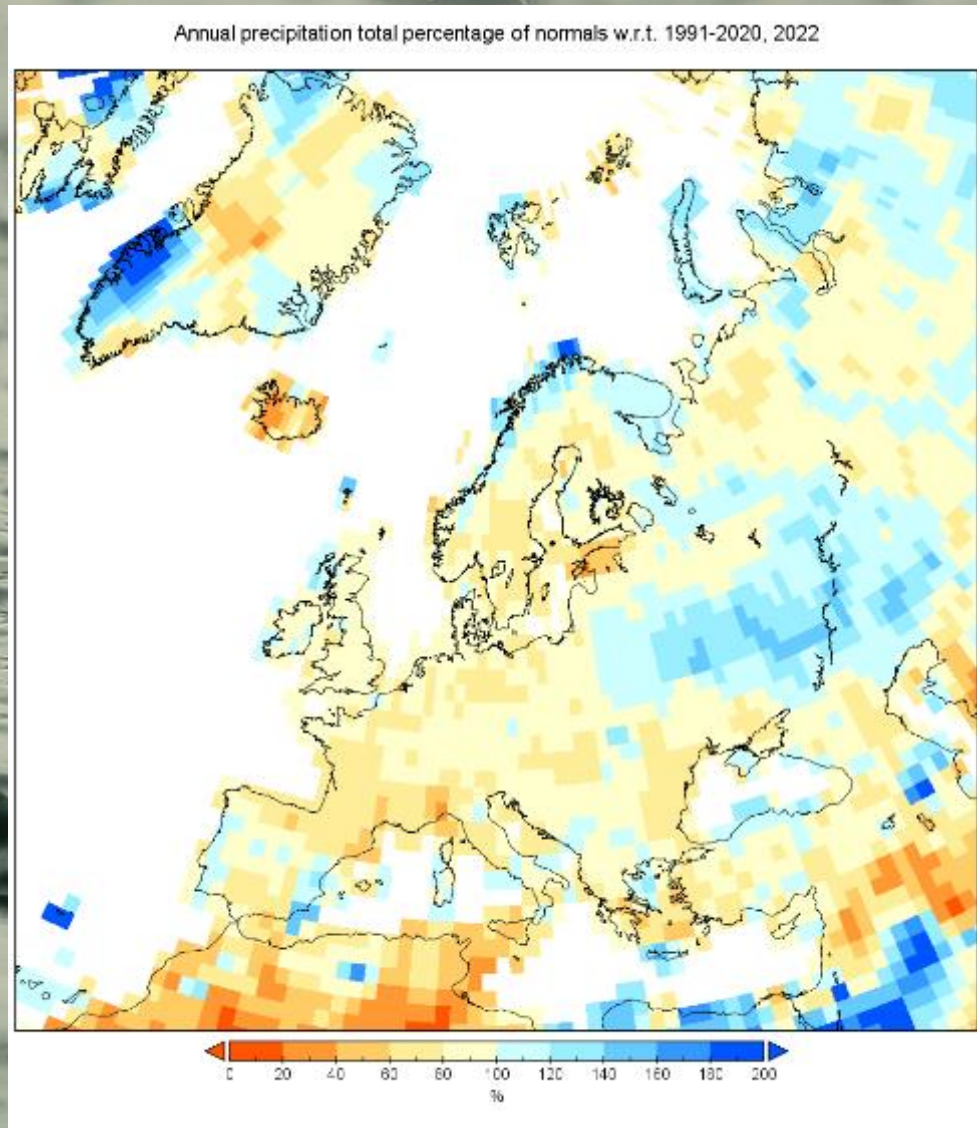
2022 mean temperature anomaly



**2022** was reported as the **warmest year** in:

- Belgium
- France
- Germany
- Ireland
- Italy
- Luxembourg
- Portugal
- Spain
- Switzerland
- United Kingdom

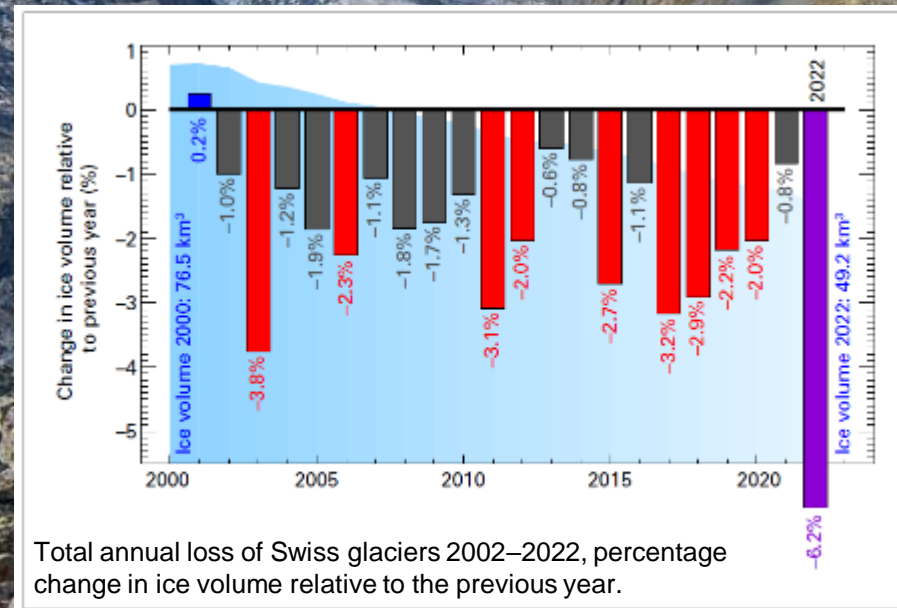
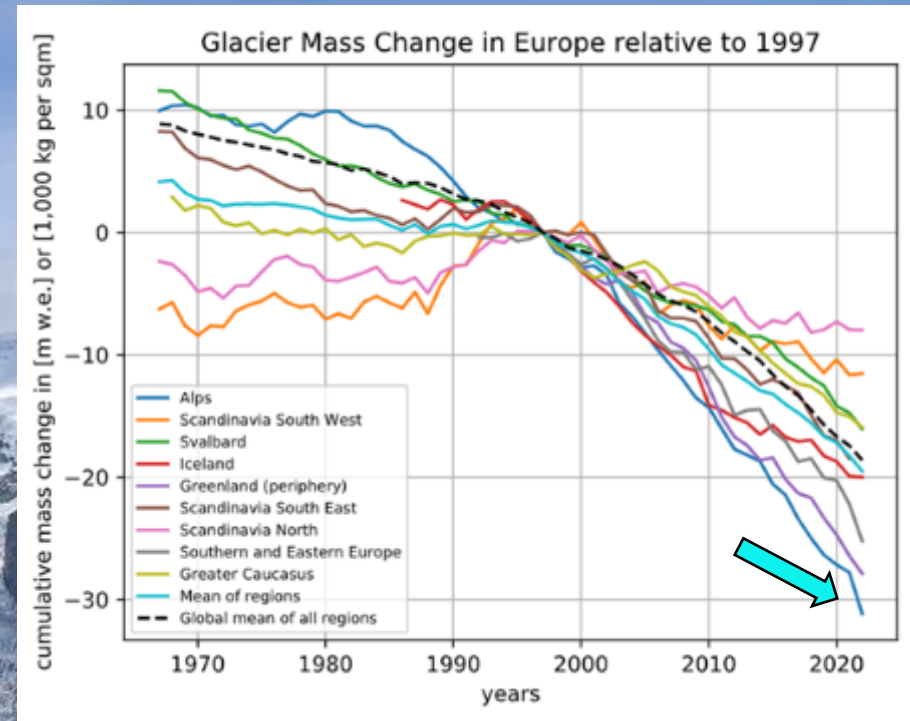
# Precipitation



- In 2022 most of the region had below-average precipitation (reference period 1991-2020).
- Largest deficits occurred in the south of the Gulf of Finland, in southern France and north-west Italy, and across the islands in the Aegean Sea and the Middle East.
- France had the second driest year on record.

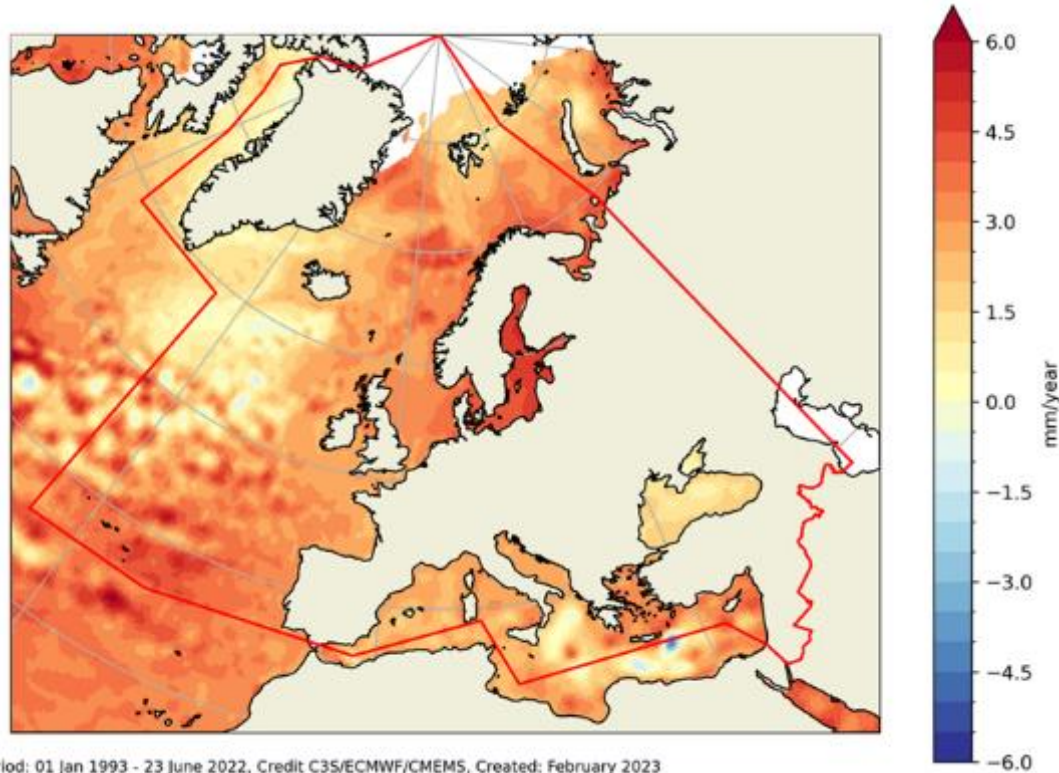
# Glaciers

- In Europe, glaciers lost a volume of about **880 km<sup>3</sup>** of ice from **1997 to 2022**.
- Low snow amounts during winter, deposition of Sahara dust during spring, followed by an exceptionally warm summer contributed to **record glacier melting in the European Alps in 2022** (more than 3 m water equivalent in one single year).
- Mass losses in the Alps were far beyond the range of historical variability.



Total annual loss of Swiss glaciers 2002–2022, percentage change in ice volume relative to the previous year.

Source: Matthias Huss based on Glacier Monitoring Switzerland, 2022. Figure from WMO Global SoC 2022



# Sea level rise

- The rise in sea level, as seen from satellites, varies across the region. Since 1993, sea level trends are mainly positive, with most areas showing increases of about 2-4 mm/year (compared with a global rate of  $3.4 \pm 0.3$  mm/year).
- These variations can affect coastal communities, where sea-level variations can be superimposed on the effects of land subsidence, increasing the risk from coastal inundation for those exposed and vulnerable.





# Extreme events and their impacts

WMO Europe (Regional Association 6) Members reported more than two hundred extreme events, the most impactful include:

1



Heatwaves and wildfires

2



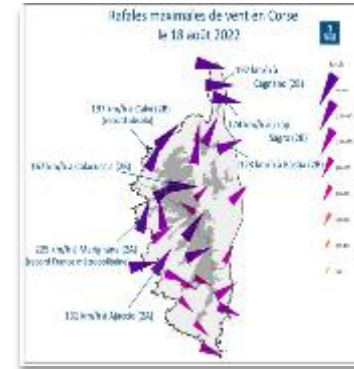
Drought

3



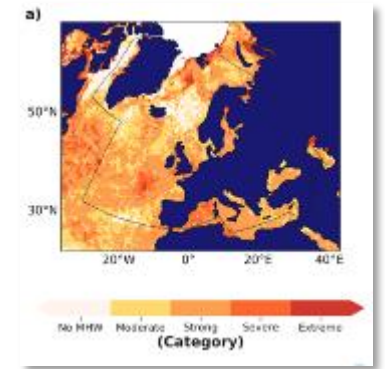
Heavy precipitation and floods

4



Severe windstorms

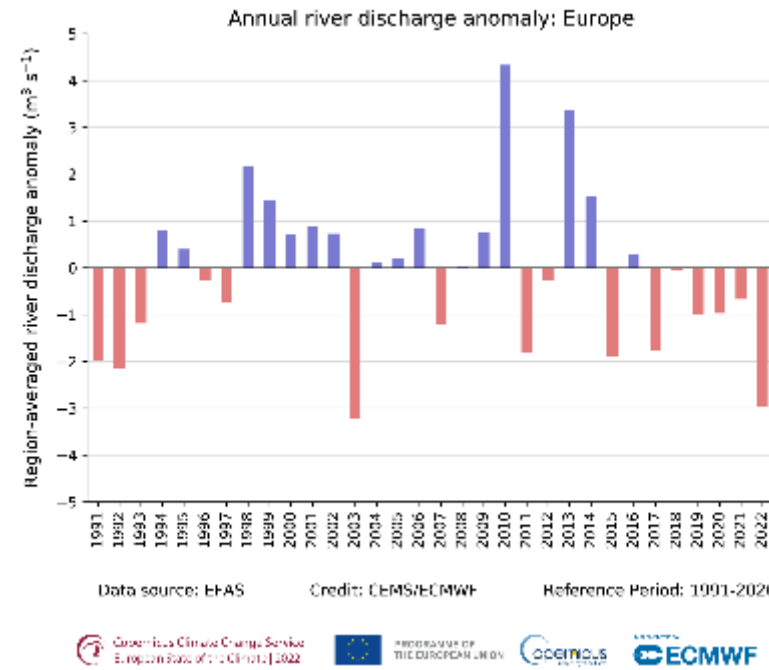
5



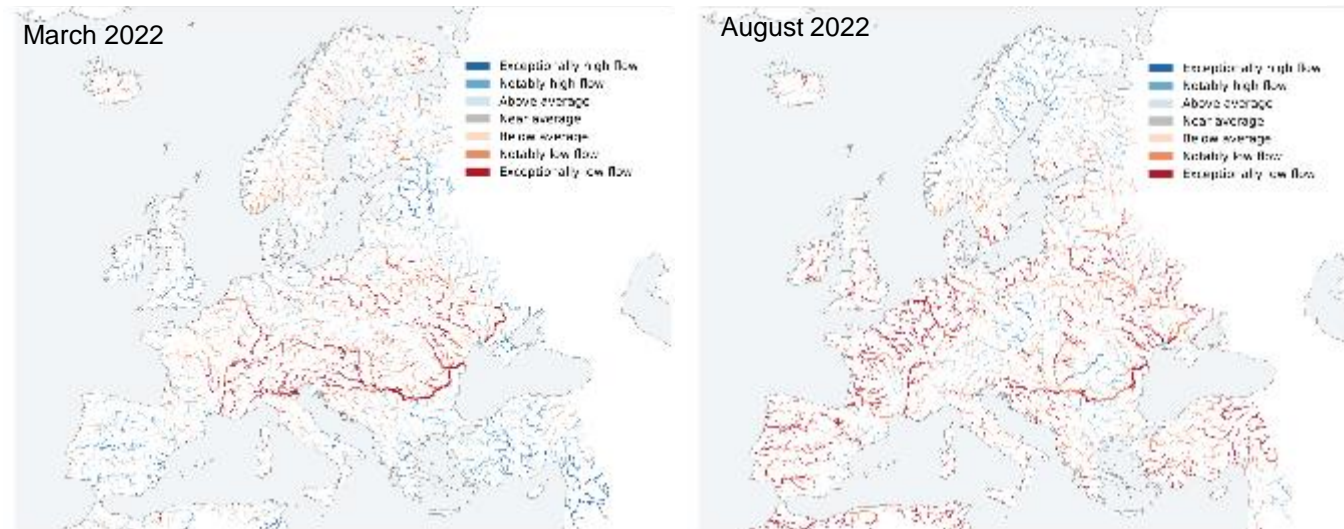
Marine heatwaves

# Drought

- Low flows were recorded in some of Europe's major rivers. Water reserves (lakes, reservoirs) also suffered from lack of precipitation.
- Several locations on the Rhine River registered new local record low water levels.
- Low water levels on the River Po affected crop production and allowed seawater to intrude almost 40 km inland, affecting river ecosystems.
- Insufficient water availability led to a reduction in both hydro- and thermo-electric power production.



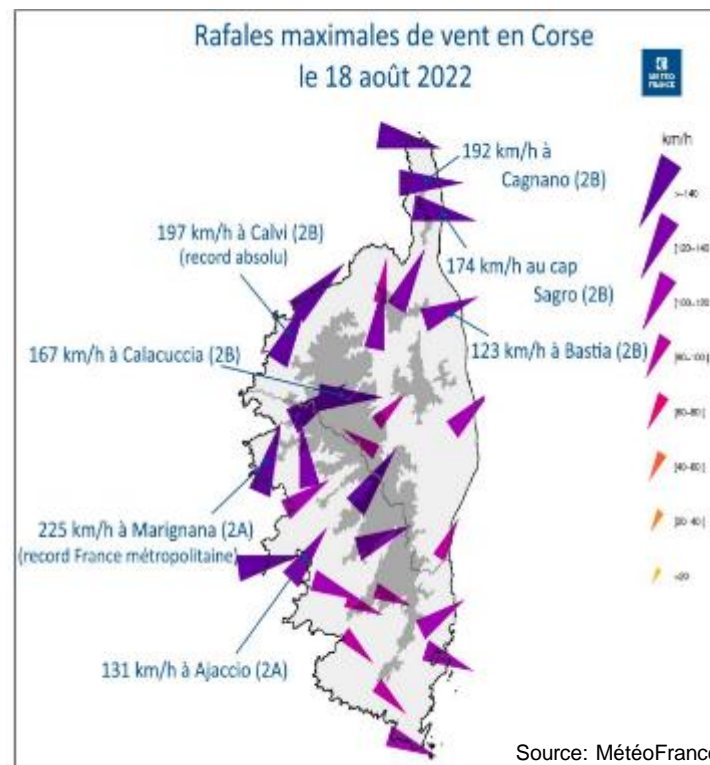
Average river discharge anomalies (1991–2020 reference period)



# Severe windstorms

- **Storm Malik**, on 29–30 January, affected northern and central Europe leading to at least six deaths.
- **Storm Eunice**, on 18 February, impacted Ireland, England and Wales, leaving more than a million households without power and seven deaths.
- An **exceptional *derecho*** affected parts of southern and central Europe on 18 August. In Corsica, wind gusts of 225 km/h were recorded, the strongest on record for metropolitan France. Five deaths were reported.

Maximum wind gusts on 18 August 2022 in Corsica



Arcus cloud over island of Corsica, on 18 August 2022



Credit: Paolini Photography

# Climate policy and climate action in the energy sector

- Renewable energies
- Nuclear energy
- Climate services for the energy sector

Photographer: Aleksandar Gospić  
Location: Velebit, Croatia  
WMO 2023 Calendar Competition



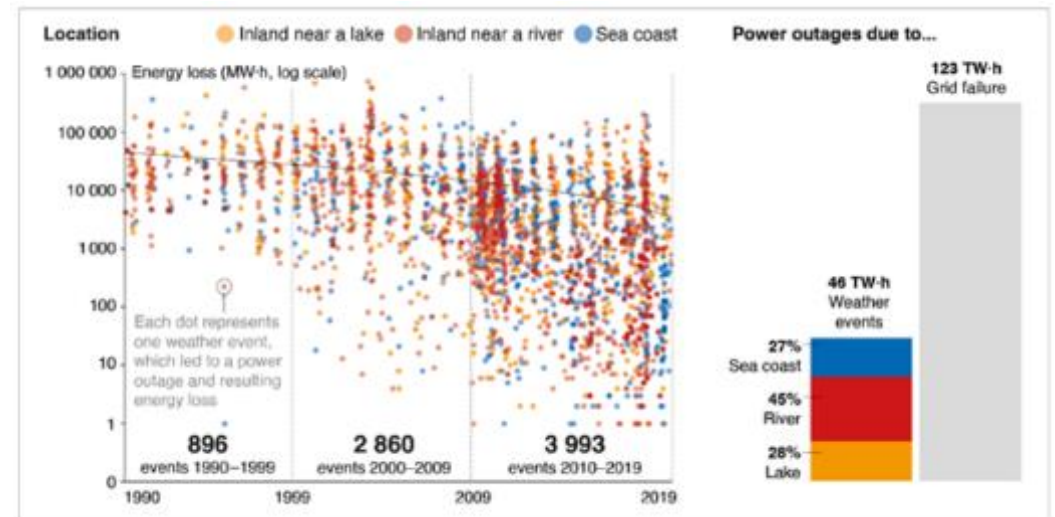
PROGRAMME OF  
THE EUROPEAN UNION



# Nuclear energy

- Globally, occurrences of severe weather disrupting the operation of nuclear power plants increased five-fold in three decades, between 1990 and 2019, with an acceleration since 2009.
- In western Europe, low river flows, but mainly the increasing temperatures and hot extremes are the largest contributors to climate-linked full Nuclear Power Plants (NPPs) outages.
- In a changing climate, climate impact data and scenarios, and climate and energy system modelling are increasingly necessary to support decision-making and risk management.

Reported global power outages in nuclear power plants due to extreme or severe weather events, 1990–2019



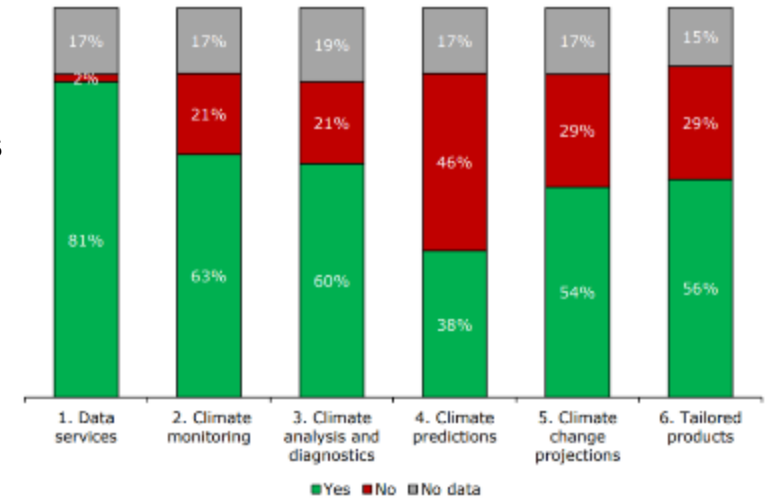
Source: WMO 2022 state of climate services Energy, based on IAEA

# Climate services for the energy sector

- **Climate services play a key role supporting global energy transition to achieve net zero.**
- Provision and use of climate information in decision-making includes data collection, monitoring, analysis, predictions and projections of climate variables.
- There is untapped potential of Europe NMHSs in supporting energy transition. While 81% of WMO Members in Europe provide some climate information for the energy sector, only 38% provide monthly to seasonal climate predictions for this sector.



Percentage of European NMHSs providing climate services to the energy sector, by type of product



# Contents

1. Introduction to climate services
2. The Global Framework for Climate Services
3. **Example flagship products in support of decision- and policy-making**
  - State of the Climate Reports (Global, and Regional)
  - **Energy sector-specific reports (Roberta Boscolo's talk tomorrow)**
4. Concluding remarks

# Integrated Weather and Climate Services in Support of Net Zero Energy Transition

Best Practices from the WMO Commission for Weather,  
Climate, Water and Related Environmental Services and  
Applications

2023 edition

WEATHER CLIMATE WATER



WORLD  
METEOROLOGICAL  
ORGANIZATION

WMO-No. 1312



# 2022 STATE OF CLIMATE SERVICES

## ENERGY



WEATHER CLIMATE WATER





# Contents

1. Introduction to climate services
2. The Global Framework for Climate Services
3. **Example flagship products in support of decision- and policy-making**
  - State of the Climate Reports (Global, and Regional)
  - Energy sector-specific reports (Roberta Boscolo's talk tomorrow)
  - **ENSO updates**
  - **Global multiannual climate forecast updates**
4. Concluding remarks

# El Niño/La Niña Update

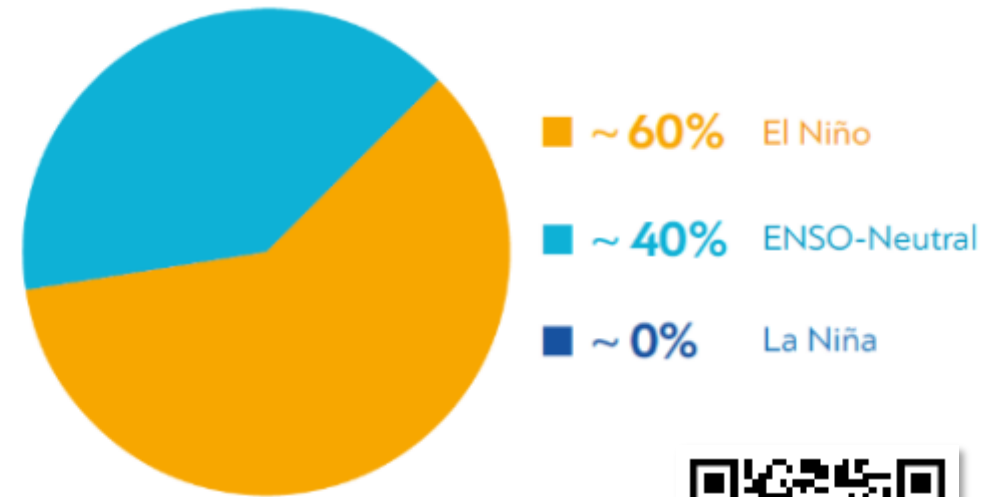
## Press release – Prepare for El Niño

Issued on 3 May 2023

*“There is a 60% chance for a transition from ENSO-neutral to El Niño during May-July 2023, and this will increase to about **70% in June-August** and **80% between July and September.**”*

*“The development of an El Niño will most likely lead to a new spike in global heating and increase the chance of breaking temperature records.”*

*“This highlights the need for the **UN Early Warnings for All initiative** to keep people safe.”*



# Global Annual to Decadal Climate Update

## Press release – Global temperatures set to reach new records in next 5 years

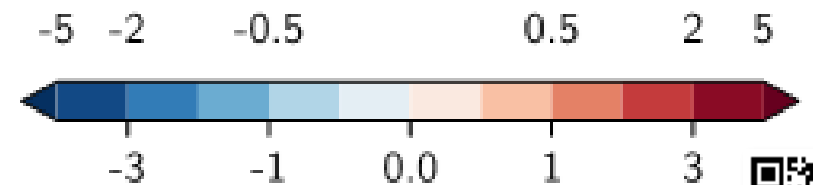
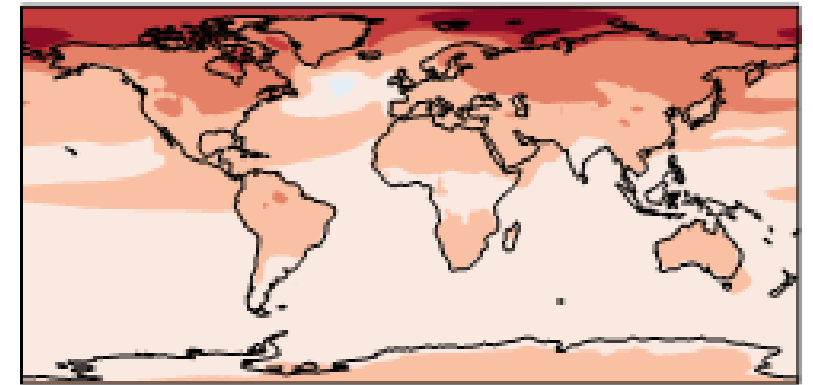
Issued on 17 May 2023

*“There is a **66% chance** that annual global surface temperature will **temporarily** exceed 1.5°C above pre-industrial levels for at least one of the next five years.”*

*“There is a **98% likelihood** that **at least one of next five years will be the warmest on record.**”*

*“El Niño and climate change will likely combine to fuel global temperature increase.”*

*“Arctic heating is predicted to be more than three times higher than the global average.”*



Near-surface temperature anomalies  
for November-March 2023-2027  
(climatological period: 1991-2020)



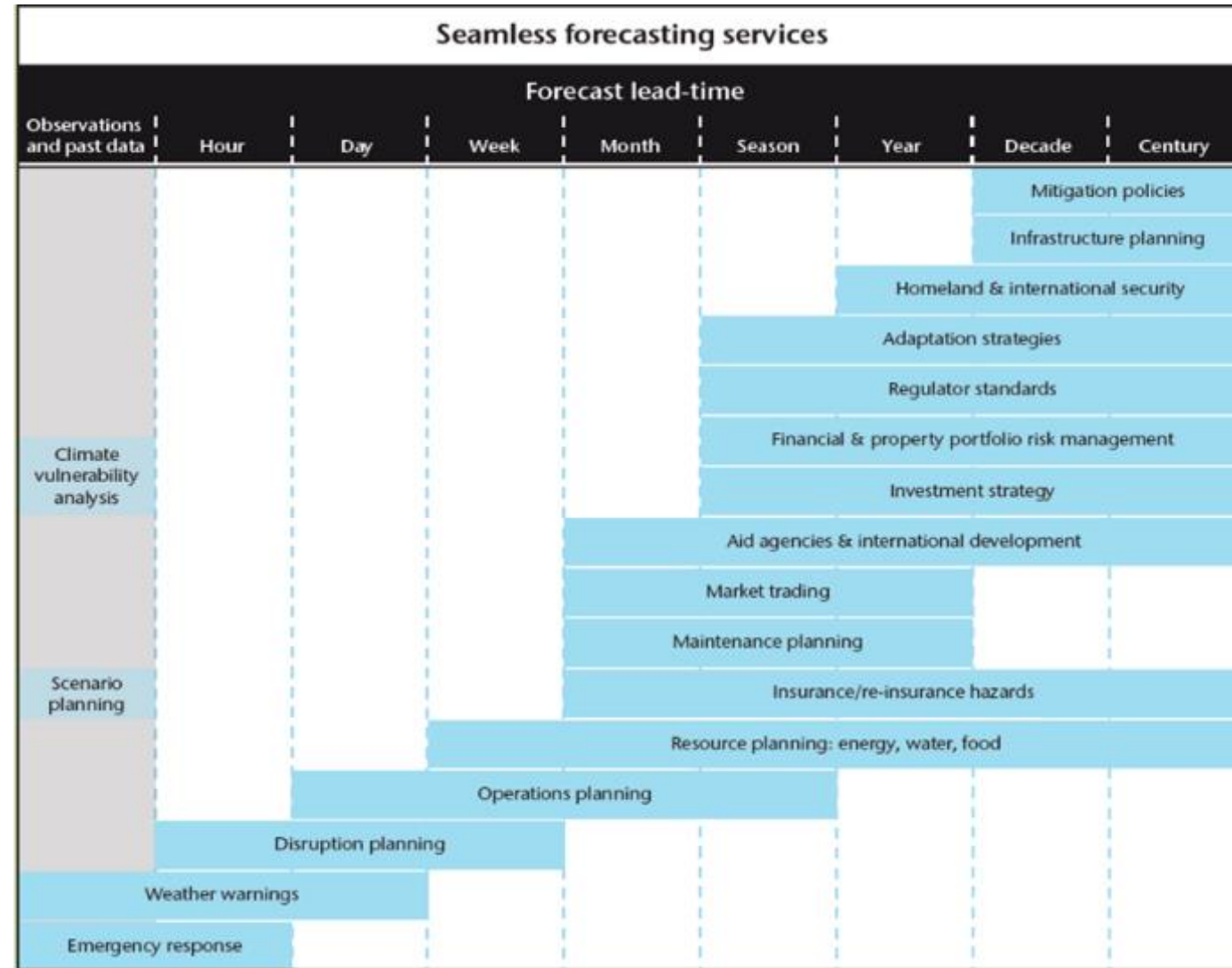
# Contents

1. Introduction to climate services
2. The Global Framework for Climate Services
3. Example flagship products in support of decision- and policy-making
4. **Concluding remarks**

# Timescales

1. Past and current climate  
observations and monitoring, climatologies
2. Near-term future climate  
month-season-decade predictions
3. Long-term future climate  
multi-decadal projections

*Often an overlap with weather services*



# Timescales

## 1. Past and current climate

observations and monitoring, climatologies

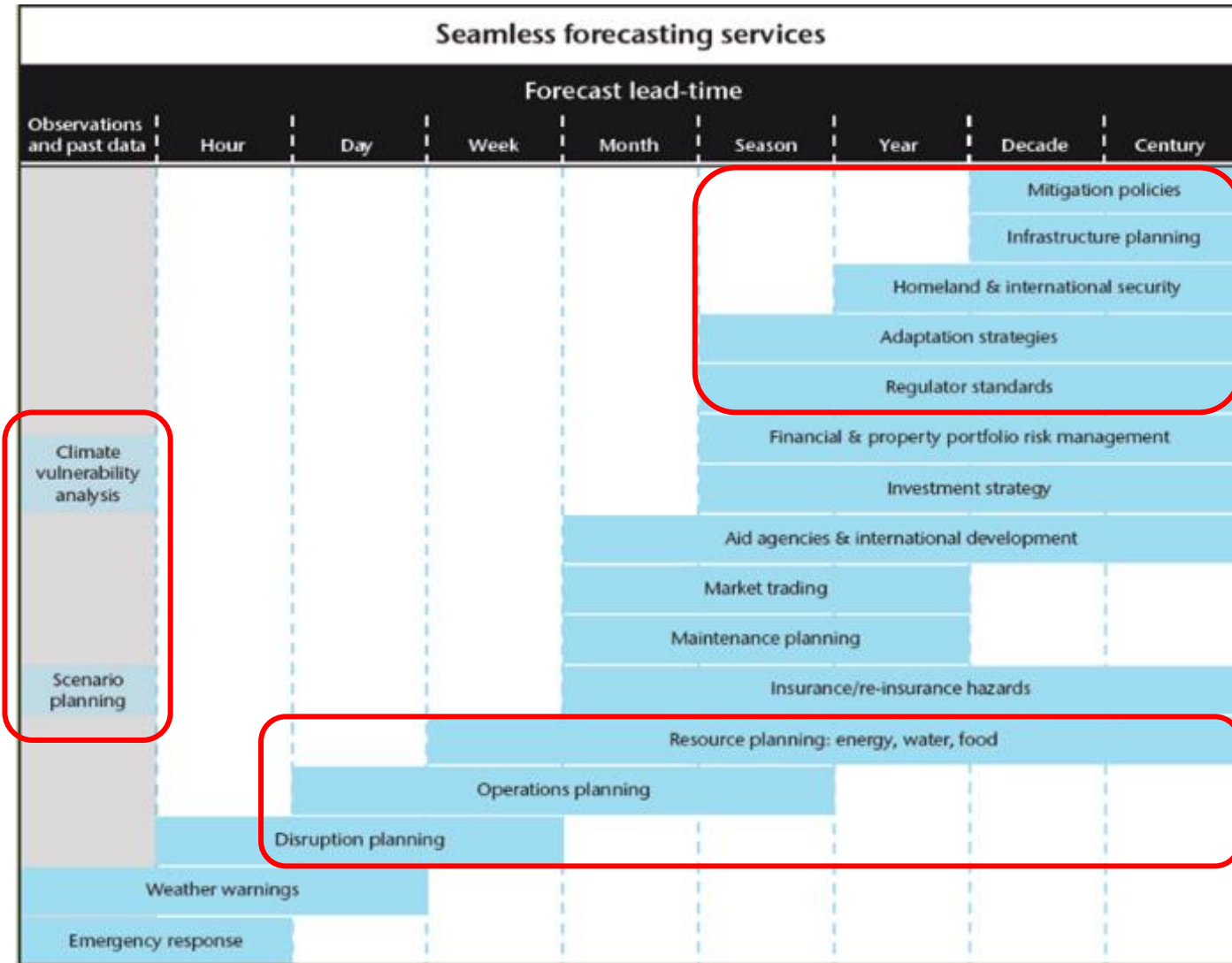
## 2. Near-term future climate

month-season-decade predictions

## 3. Long-term future climate

multi-decadal projections

*Often an overlap with weather services*



# Some challenges for climate services:

- Only worth delivering if it is to be used to influence an outcome
- Coordination and engagement – Time-consuming, but beneficial
- Requirements versus capability – Often a big gap
- The concept of “users” – Who are they? What do they need?
- The role and importance of other disciplines – e.g. social science
- Capabilities and capacities – Providers and users





Thank you



WMO OMM

World Meteorological Organization  
Organisation météorologique mondiale