



Climate Change

Global climate and extremes of 2018

Freja Vamborg, C3S team and friends

ECMWF, Copernicus Climate Change Service (C3S)



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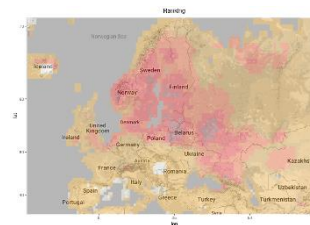
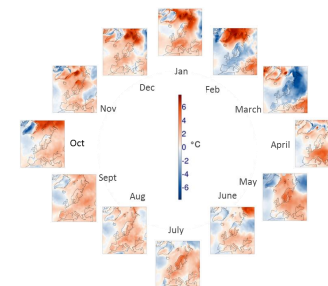
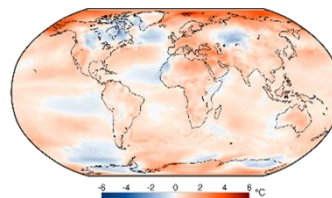
Outline

The Copernicus Programme



Climate of 2017

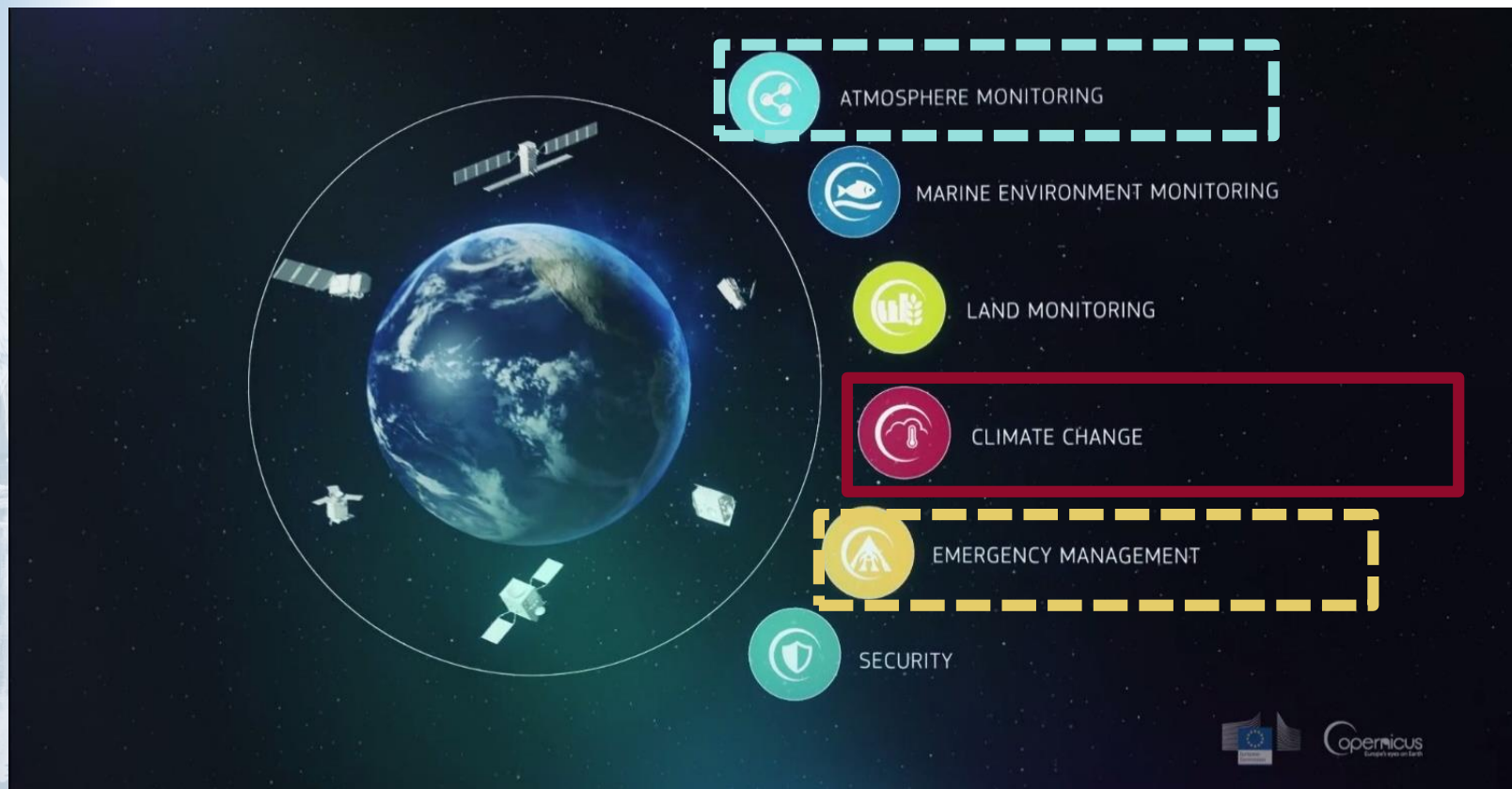
- Global temperatures
- Key events in Europe
- Impacts on ...





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Copernicus: Earth observations and information services

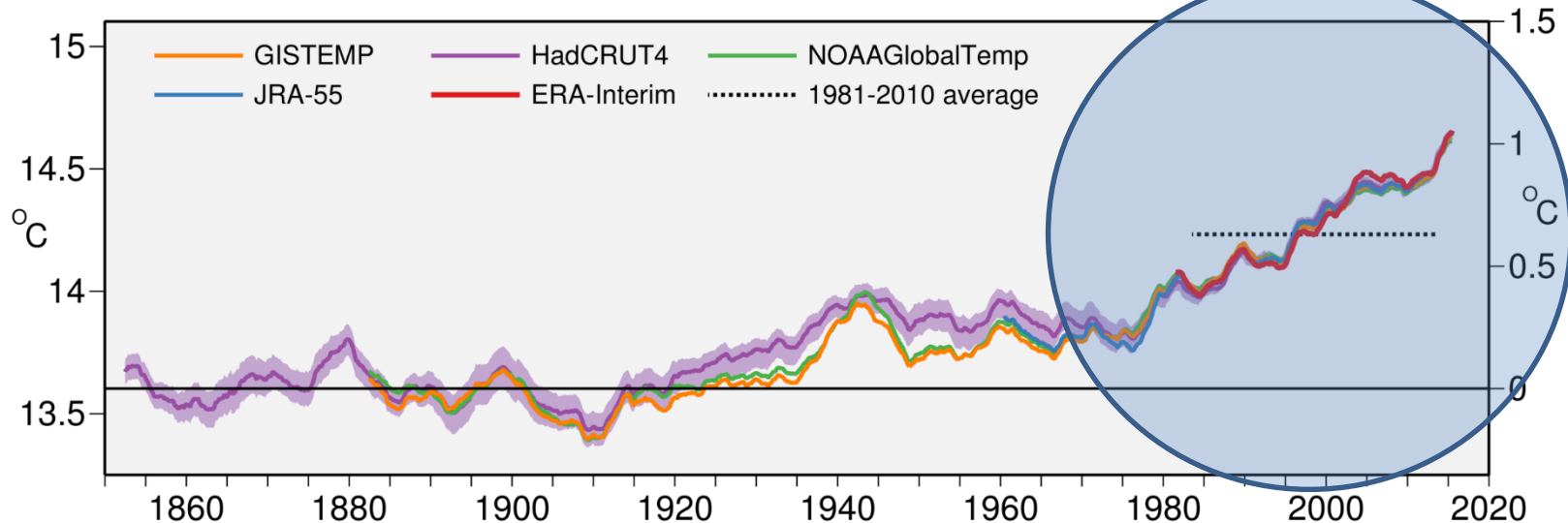




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Temperature increase since pre-industrial

Global 60-month average
temperature

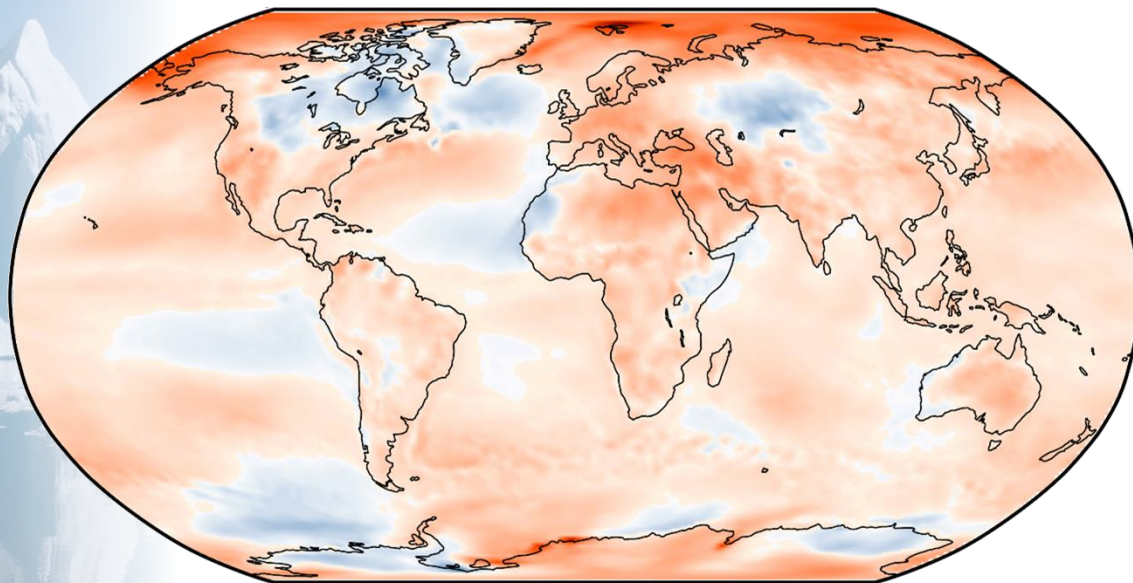




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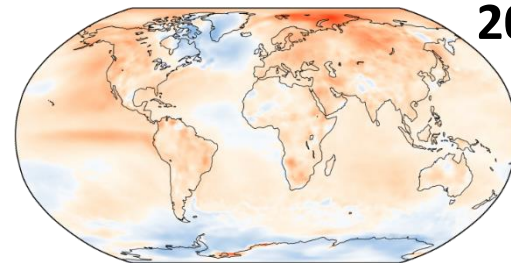
2018 - one of four warmest years on record

2018

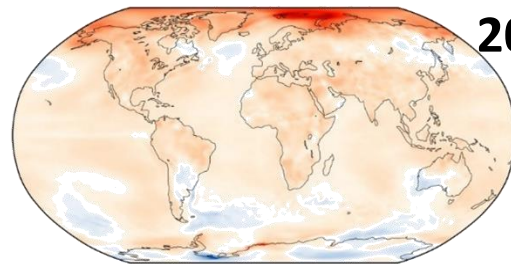


Average surface air temperature compared to 1981-2010

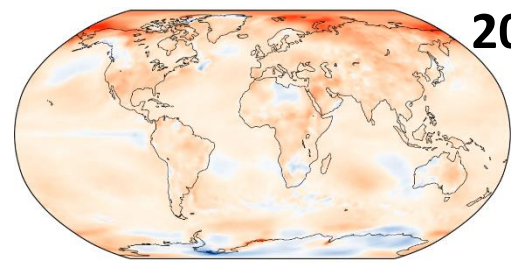
2015



2016



2017

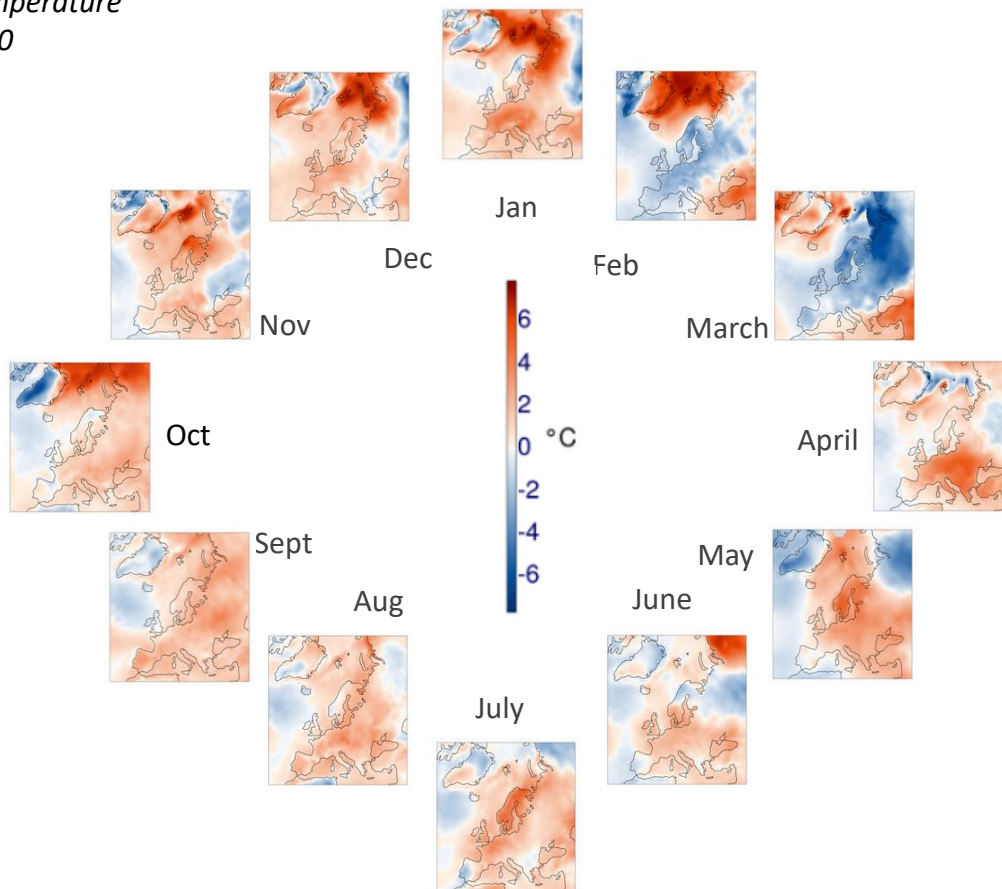




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A year of European temperature anomalies

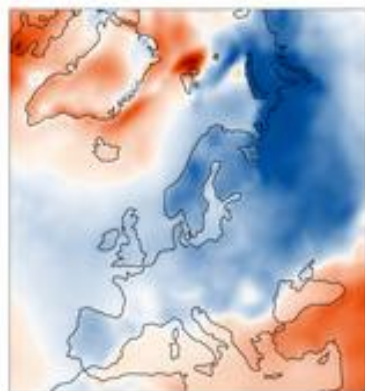
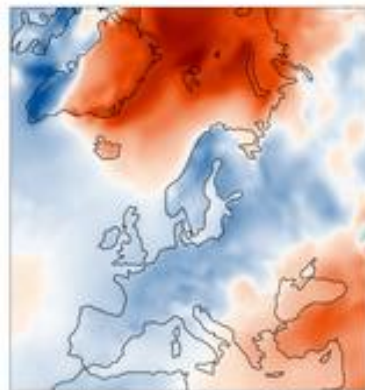
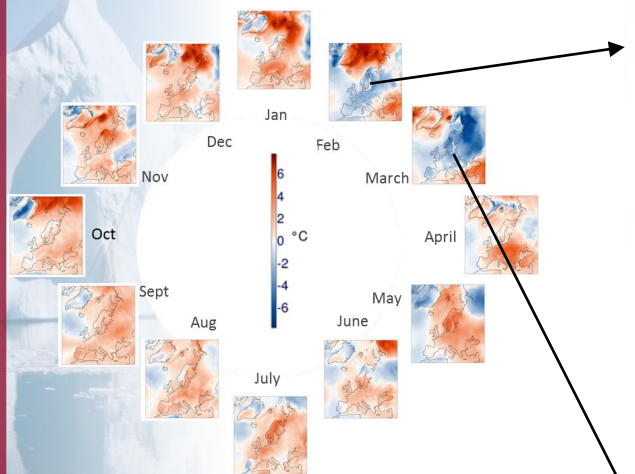
*Average surface air temperature
compared to 1981-2010*





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The beast from the East – cold across Europe



A wide-angle photograph of an Arctic scene. In the background, a large, rugged mountain peak is covered in a thick layer of snow, with some dark, rocky outcrops visible. The sky is blue with scattered white clouds. In the foreground, a body of water reflects the sky and the mountain. Several icebergs of various sizes are floating in the water, and some dark rocks are visible along the shoreline on the left.

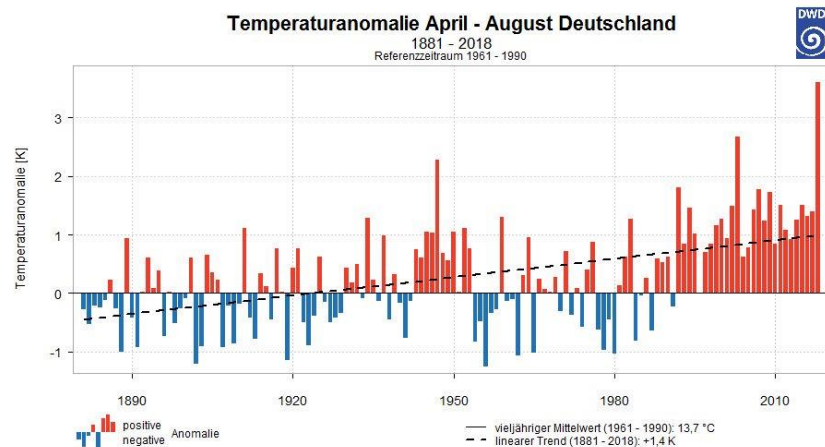
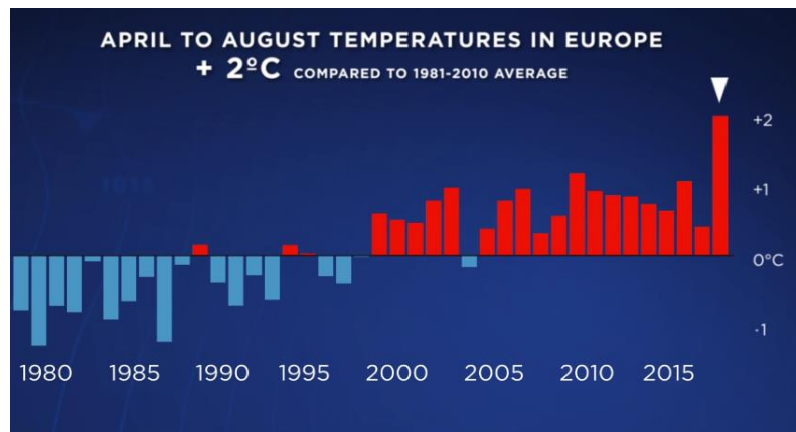
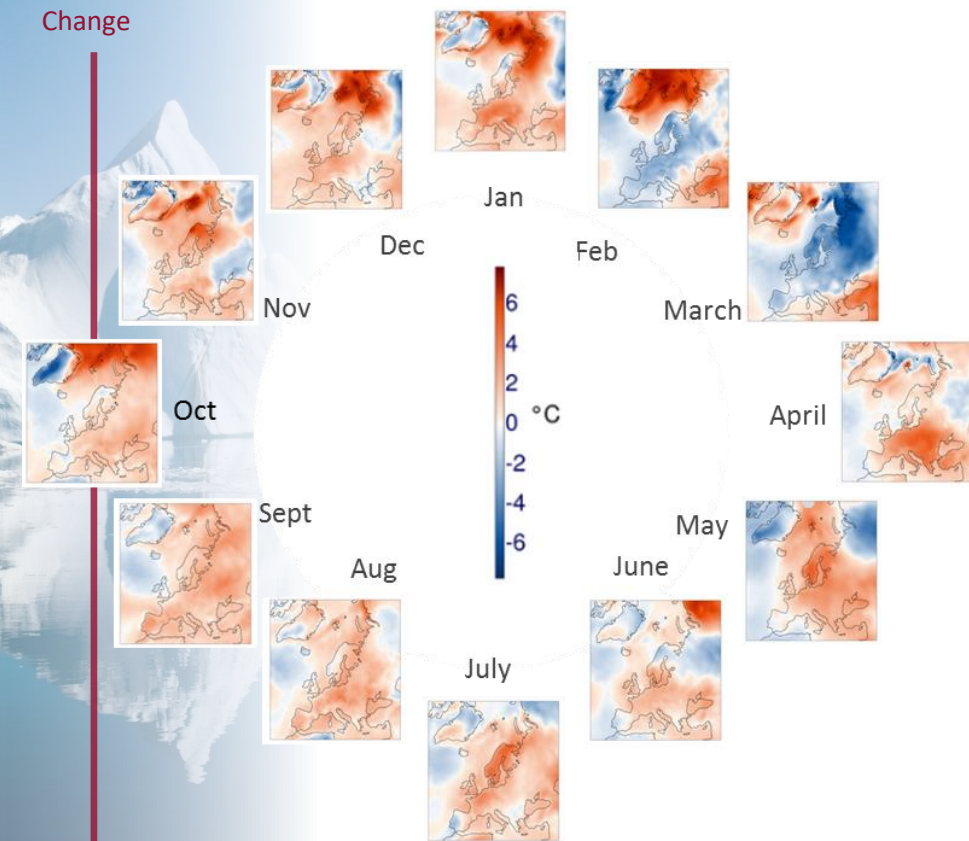
ARCTIC WARMER THAN EUROPE

climate update



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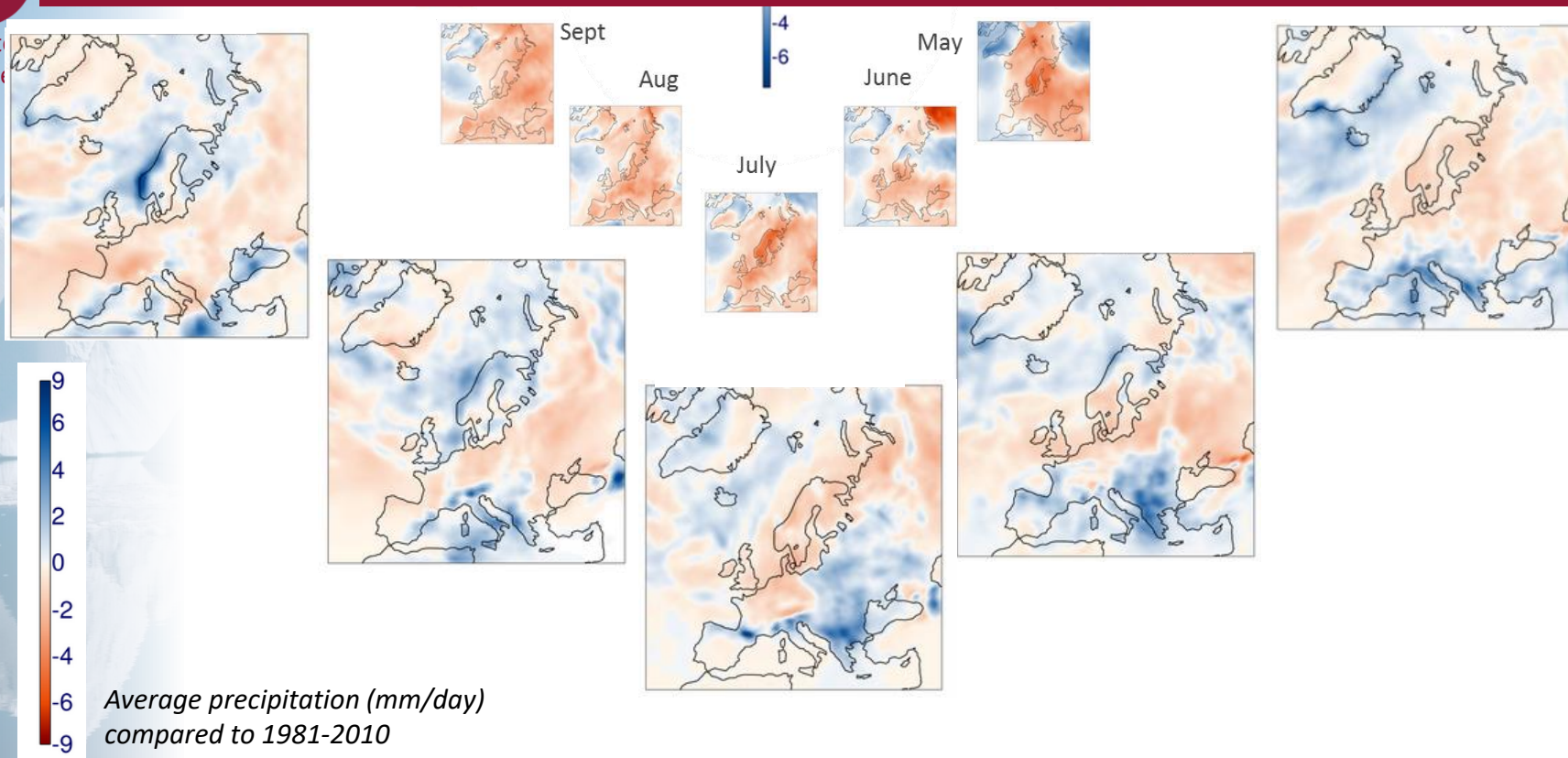
April to early Autumn - persistent warmth





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North/South saw a dry/wet divide





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Impacts on Alpine glaciers



Pizolgletscher in Eastern Switzerland

Photos by Matthias Huss, GLAMOS

- Snow-rich winter but very warm and very sunny summer
- mass loss in 2018 amongst top ten since the 1960s
- Many of the small glaciers in the Alps are disintegrating due to the extreme mass losses of the last years

Contribution from WGMS



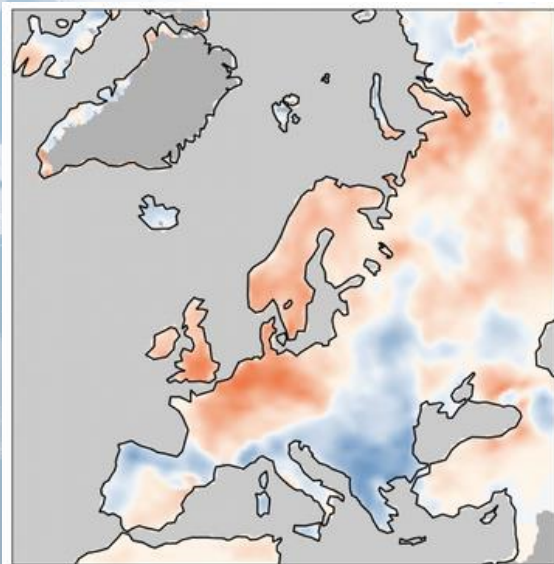


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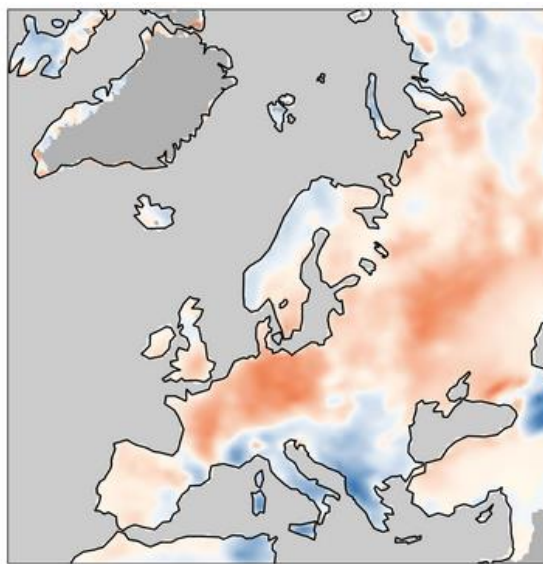
Impacts on Hydrology – Soil Moisture

- Very low soil moisture in northern and central Europe, much wetter than average in south

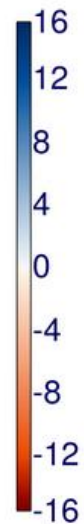
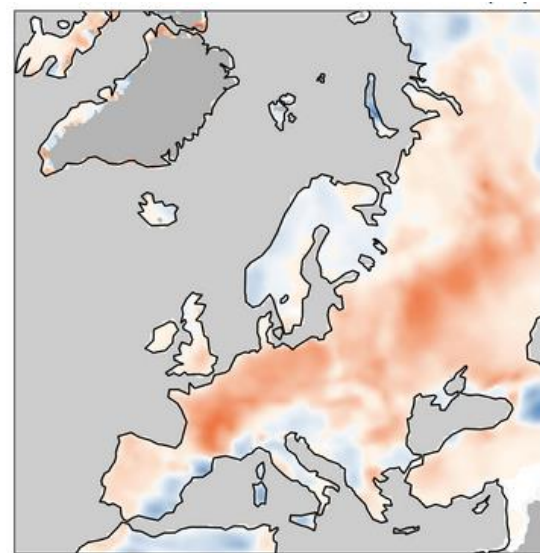
July



August



September



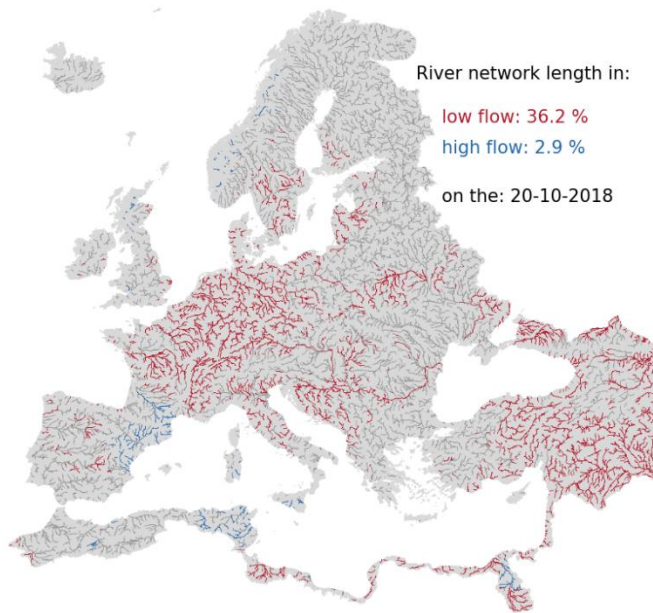
Average top layer soil moisture (%) compared to 1981-2010



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Impacts on Hydrology – River flow

- By end of summer Extremely low river flows, record-breaking in many central European rivers



Low (high) flow threshold is 10th (90th) percentile over 1991-2016. Produced as part of Copernicus Emergency Management Service

Cry me a river: Low water levels causing chaos in Germany

October 27, 2018 by David Rising



In this Oct 24, 2018 photo a cargo ship passes sandbanks near Kaub, Germany during historically low water on the river Rhine. A hot, dry summer has left German waterways at record low levels, causing chaos for the inland shipping industry, ... more ▾

Phys.org

Rivers with very lows flows

From: Shaun Harrigan, Louise Arnal (ECMWF, CEMS)

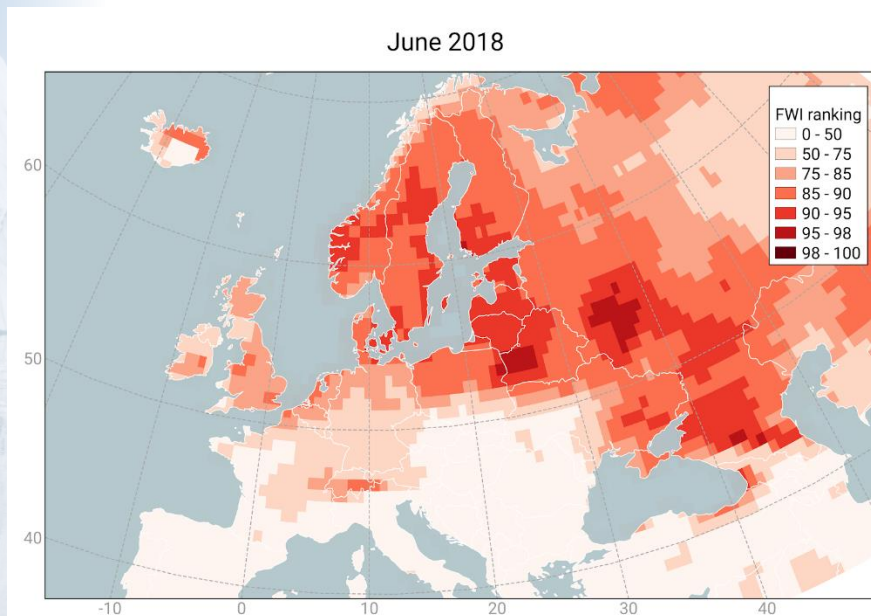




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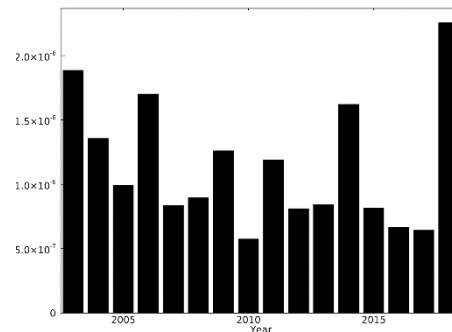
Impacts on Wildfire Activity

- Much above average fire danger across northern, central and eastern Europe

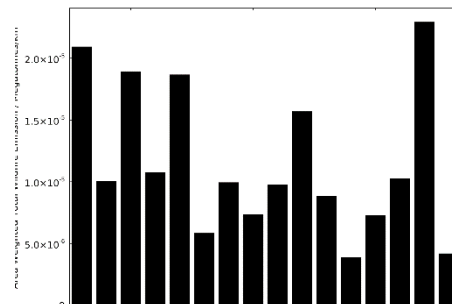


*Fire danger classes calculated with the
Global ECMWF Fire Forecast (GEFF) System
From: Claudia Vitolo (ECMWF, CEMS)*

North EU



South EU




Fire emissions

*From: Mark Parrington
(ECMWF, CAMS)*



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Monthly climate bulletins - first info 4th to 6th of each month

Implemented by ECMWF as part of The Copernicus Programme

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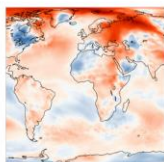
WHAT WE DO ▶ CLIMATE BULLETIN

Climate bulletins

Through our monthly maps, we present the current condition of the climate using key climate change indicators. We also provide analysis of the maps and guidance on how they are produced.

HIGHLIGHTS OF THE LATEST MONTHLY SUMMARIES MONTHLY CLIMATE UPDATE FEATURED STORY MONTHLY SUMMARIES

Monthly summaries



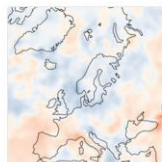
Surface air temperature

This series of monthly maps and charts, generated from ERA-interim data, covers



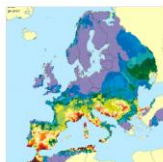
Sea ice

We produce sea-ice maps every month. Based on ERA-interim reanalysis data, these provide near real-time



Hydrological variables

This series of monthly maps and charts, based on ERA-interim data, covers several



Surface in-situ monitoring for Europe

Monthly and yearly State-of-the-European-climate reports provided

Monthly climate update

15TH OCTOBER 2018

In Europe, it was the warmest September on record. Portugal and western Spain were particularly warm.

Iceland, Ireland and Scotland saw generally cooler than average temperatures.

Japan was hit by two devastating storms, Jebi and Trami following rains, landslides, floods and record-breaking heat this year.

Strong tropical cyclone Mangkhut caused at least 134 fatalities in the Philippines, Hong Kong and China.



Featured story

29TH OCTOBER 2018



A stormy September

One of the **warmest summers on record** has come to an end with September full of storms. Modelling of historic storms can help prepare for such events. We use two of the recent storms to demonstrate the improvements we have made with the release of our new **dataset**.

[Read more](#)

➤ climate.copernicus.eu/climate-bulletins





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European State of the Climate – March/April each year



WHAT WE DO ► EUROPEAN STATE OF THE CLIMATE 2017

REPORT

European State of the Climate 2017

ABOUT CLIMATE IN 2017 HEADLINE CLIMATE INDICATORS CONTRIBUTORS

About

The European State of the Climate 2017 covers two main themes, the Climate in 2017 and Headline Climate Indicators.

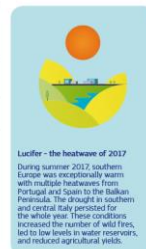
The key findings for each section can be found in the *European State of the Climate 2017 Summary*. The summary and the sections themselves are aimed at a non-expert audience interested in the climate events of

Focus Region: Southwest Europe

During 2017, the southwest of Europe stood out with high temperatures, drought and repeated wildfire events.

2017 was an exceptionally dry and warm year in the southwest of Europe

Annual temperatures were the highest on record and soil moisture was the lowest. In particular, spring and summer showed large positive temperature anomalies. Spring and summer were among the two warmest on record, both at close to 1.7°C above the 1981-2010 average. In large areas the hottest summer day was close to or even exceeded 40°C. The annual number of dry days was much below average. Soil moisture reached seasonal record lows in spring and autumn. Estimated annual total fire emissions were the highest since 2003, when records began.

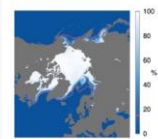


Lucifer – the heatwave of 2017

During summer 2017, southern Europe was exceptionally warm with multiple heatwaves from Portugal and Spain to the Balkan Peninsula. The drought in southern and central Italy persisted for the whole year. These conditions increased the number of wild fires, led to low levels in water reservoirs, and reduced agricultural yields.

Focus Region: European Arctic

During the final months of 2017, some land areas of the north Atlantic Arctic experienced monthly temperatures more than 6°C above the 1981-2010 average.



Sea ice cover for January 2017. The month with the year's largest anomaly in the European sector of the Arctic. The pink is deviates from the 1981-2010 average sea ice edge for the month.

Source: ERA-Interim, Copernicus Climate Change Service implemented by ECMWF

Surface air temperatures in the European sector of the Arctic have been increasing during the 40-year wealth of data available here. 2017 was the third warmest on record at 1.7°C above average, which is close to the second warmest year 2012. The warmest year recorded is 2016 with over 2°C above average. Despite temperatures at the beginning of 2017 not being record breaking, the sea ice area remained much lower than average during the first three months of the year. January showed the largest negative anomaly on record. During spring and summer the sea ice area was below the 1981-2010 average, but not exceptionally so. As for temperatures, the end of the year showed larger sea ice anomalies. September to December's anomalies are among the three lowest on record.

Image: Sea ice in the Arctic, ESA, ESA

Climate Indicators

The headline climate indicators show the long-term evolution of several key climate variables. These can be used to assess the global and regional trends of a changing climate. The arrows show the long-term increasing or decreasing trends of these indicators.

Temperature



Global: around 1.1°C increase since start of industrial era
Europe: around 1.8°C increase since latter half of the 19th century

*The estimated datasets covering all or parts of 1850 to 2017

The aim of the Paris Agreement is to limit global temperature rise to well below 2°C compared to the pre-industrial era, and to pursue efforts to limit it to 1.5°C. The latest five-year average global temperature is the highest on record, and it shows a warning of around 1.1°C since the start of the industrial era.

Greenhouse gases



Current rate of increase in abundance in air
CO₂: about 5 Ppt/year or 2.5 ppm/year
CH₄: about 0.4 Ppt/year
N₂O: about 1.8 Tpt/year

*Estimated net flux data for CO₂, N₂O, CH₄ covering 1975, 1990, 2000 to 2015

The estimated net surface fluxes into the atmosphere of the three greenhouse gases carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) have been increasing during recent decades. Anthropogenic emissions of CO₂ have been partly compensated by a natural fire sink into oceans and vegetation. It is estimated that Europe represents a vegetation sink for CO₂, but the relative magnitude of this sink has been decreasing since the 1990s.

Sea ice



Arctic: 2016 maximum and 2017 minimum area based on record
Antarctic: 2017 maximum and minimum area based on record

*Sea ice data recorded covering 1979-2017

Arctic sea ice area shows a downward trend that becomes persistent after the year 2000. In the Antarctic, variability rather than trend predominates. Spells of unusually above-average sea ice area occurred in 2007-2009 and 2013-2015, but Antarctic sea ice area has been substantially below average since September 2016.

Glaciers

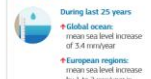


Global average: more than 20m of observed loss in ice thickness since 1960s
Europe: observed loss in ice thickness since 1960s ranges between 20m in south-western Scandinavia and 50m in the Alps

*Reference glacier network with more than 30 years of measured data

Glaciers both globally and in Europe have seen a strong and continued ice mass loss since around 2000. In the 20th century, the rate of mass loss was lower, including some periods of mass gain at regional and decadal scale.

Sea level



During last 25 years
Global ocean mean sea level increase of 3.4 mm/year
European regions: mean sea level increase by 1 to 2 mm/year in most coastal areas

*Sea level data recorded covering January 1993 to May 2017

Global mean sea level rise amounts to 3.4 mm during the last 25 years. This translates to a global increase in sea level of about eight centimetres. The regional trends during this period can deviate considerably from the global mean and in the European Seas, the sea level changes can differ in the open ocean and in coastal areas due to various geographical processes.

Image: Nonalutsk Glacier, Greenland. Taken by the Copernicus Sentinel 2A satellite (2017), ESA



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Implemented by ECMWF as part of The Copernicus Programme

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