

# European State of the Climate 2020



Climate Change

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ECMWF, Copernicus Climate Change Service (C3S)

And many colleagues in C3S and beyond

ECMWF UEF 1-4 June 2021





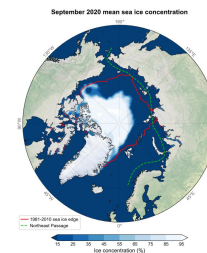
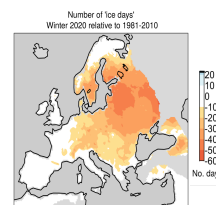
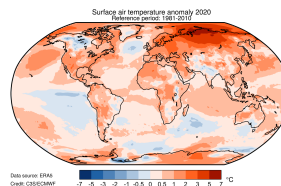
# Outline

## ➤ Background and methods



## ➤ Results

- Globe
- Europe
- Arctic



## ➤ Outlook



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# European State of the Climate 2020 – 4<sup>th</sup> edition of annual report

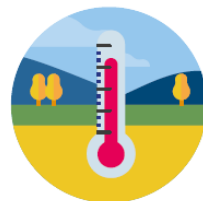


Full report online

With contributions from across C3S, the Copernicus services, NMHSs, Universities and research institutions, as well as other monitoring activities



Globe  
Europe  
Arctic










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# Data and methods

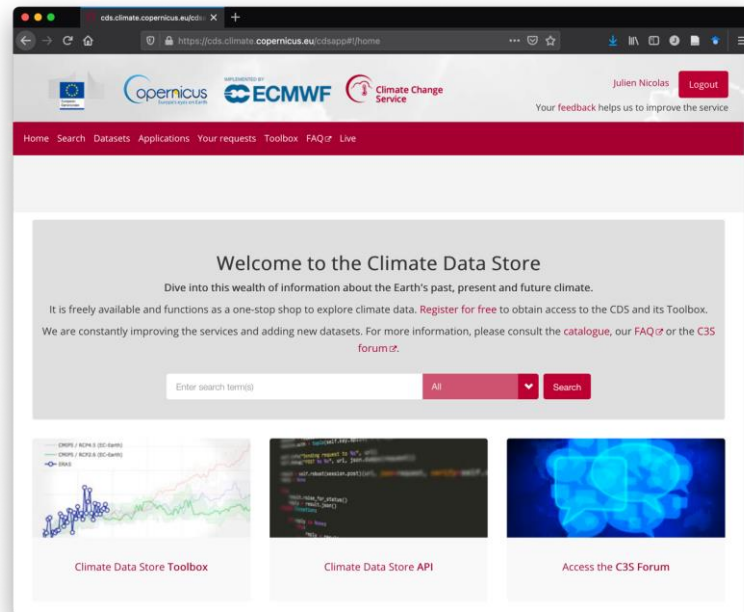
## Data sources....

 <b>Satellites</b> Providing information about Earth's surface and its atmosphere from space.	 <b>Reanalysis</b> Using a combination of observations and computer models to recreate historical climate conditions.
 <b>In situ</b> Measurements from an instrument located at the point of interest, such as a land station, at sea or in an aeroplane.	 <b>Model-based estimates</b> Using the laws of physics and statistics to build large-scale models of environmental indicators.

## Reference period: 1981-2010

 By comparing 2020 against a **reference period**, we can see how the year fits within a longer-term context. Generally, the reference period used is **1981–2010**, but where less extensive data records are available, more recent and shorter periods are used.

## ...freely available in the **Climate Data Store**



The screenshot shows the homepage of the Climate Data Store (CDS). The header includes logos for Copernicus, ECMWF, and Climate Change Service, along with a user profile for Julien Nicolas and a Logout button. A navigation bar contains links for Home, Search, Datasets, Applications, Your requests, Toolbox, FAQ, and Live. The main content area features a welcome message: "Welcome to the Climate Data Store. Dive into this wealth of information about the Earth's past, present and future climate. It is freely available and functions as a one-stop shop to explore climate data. Register for free to obtain access to the CDS and its Toolbox. We are constantly improving the services and adding new datasets. For more information, please consult the catalogue, our FAQ or the C3S forum." Below this is a search bar with the placeholder "Enter search term(s)", a dropdown menu set to "All", and a "Search" button. At the bottom, there are three featured tiles: "Climate Data Store Toolbox" with a line graph, "Climate Data Store API" with a code editor, and "Access the C3S Forum" with a blue abstract image.



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# Approach – from Overview information to data



**EUROPEAN STATE OF THE CLIMATE**  
SUMMARY 2020

EUROPEAN STATE OF THE CLIMATE | THEMATIC  
**Warm winter**

Home / What's new / Climate Indicators / European State of the Climate / 2020 / Warm winter

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**KEY FINDINGS**

- Winter in northeastern Europe was exceptionally warm, with once-averaged winter temperatures nearly 1.5°C higher than the previous record.
- The area of Europe where the daily maximum temperature stays above freezing in winter was the largest on record, in keeping with a general increase since the early 1950s.
- Sea ice cover in the northern part of the Baltic Sea and the Gulf of Finland was exceptionally low.
- The number of snow days was exceptionally low in the area around the southern Baltic Sea.
- The number of days with 'very strong' and 'strong' cold stress during daytime was the lowest on record.

In 2020, Europe saw its warmest year, winter and autumn on record. The largest difference relative to the 1981–2020 reference period was observed in winter over northeastern Europe. There, exceptionally mild winter temperatures had large impacts on many other parts of the climate system in the region.

**Warm winter temperature**

North-east Europe DJF temperature anomalies (1950–2020)

**Datasets used in 'The global context in 2020'**

The majority of information for this section builds on data available for 2020 for the CIS Climate Indicators. The page 'Climate Indicators - About the Data' describes these in detail. The following additional datasets are used.

**Fast Track CAMS greenhouse gas product: Data | Documentation**

The operational chain of the CAMS greenhouse gas product is now paralleled with quarterly 'Fast Track' experimental analyses of the column-average CO<sub>2</sub> dry air-mole fraction (XCO<sub>2</sub>) retrieved from the second Orbiting Carbon Observatory (OCO-2), a satellite that was launched in 2014. The term 'Fast Track' reflects the fact that the satellite observations are available faster than most surface measurements, but the surface 0h-level inversion remains the CAMS reference product due to slightly lesser performance in the comparison with independent atmospheric measurements, as reported in the product documentation.

Used in the 'Greenhouse gas' subsection.

**Datasets used in 'Europe 2020' and 'Arctic 2020'**

**ERAS**

ERAS 1979–2020: Data | Documentation  
ERAS pre-calculated statistics and adjustment: Data | Documentation

ERAS is a global atmospheric reanalysis from 1979 (1950 preliminary) onwards, updated with a delay of approximately five days. The two report the 'monthly means of daily means' are used. The native horizontal grid is ~25 km (reused Gaussian grid ICI202), but data can be lat/long grid. ERAS is used for surface and upper-air air temperature, precipitation, soil moisture, mean sea level pressure, upper-air wind.

Due to some losses during production, which affected the surface air temperature data over the Great Lakes in the USA, an adjusted version and available in the second data entry above, which also includes pre-calculated statistics of climatologies and anomalies for different reanalyses for CIS monthly bulletin, goes back to 1979 and is the one used for ERAS surface air temperature, precipitation and soil moisture.

**ERAS surface air temperature**

ERAS surface air temperature is defined on all of the domain and over all surfaces; all values are shown in maps, while area averages over Used in Europe 2020: Temperature, Warm winter, Arctic 2020: Temperature, Sea Ice, Heat in Siberia, Cold winter and record ozone depletion.

**ERAS Q10hPa temperature**

Home Search Datasets Applications Your requests Toolbox FAQ? Live

**ERAS hourly data on single levels from 1979 to present**

Overview Download data Quality assessment Documentation

**Product type**

Reanalysis  Ensemble members  Ensemble mean  Ensemble spread

**Variable**

At least one selection must be made

Popular

- 10m u-component of wind
- 2m dewpoint temperature
- Mean sea level pressure
- 10m v-component of wind
- 2m temperature
- Mean sea level direction

**Contact**  
copernicus-support@ecmwf.int

**Licence**  
Licence to use Copernicus Products

**Publication date**  
2018-05-14

**References**  
Citation  
DOI: 10.24381/cds.adbb20d47

**Related data**

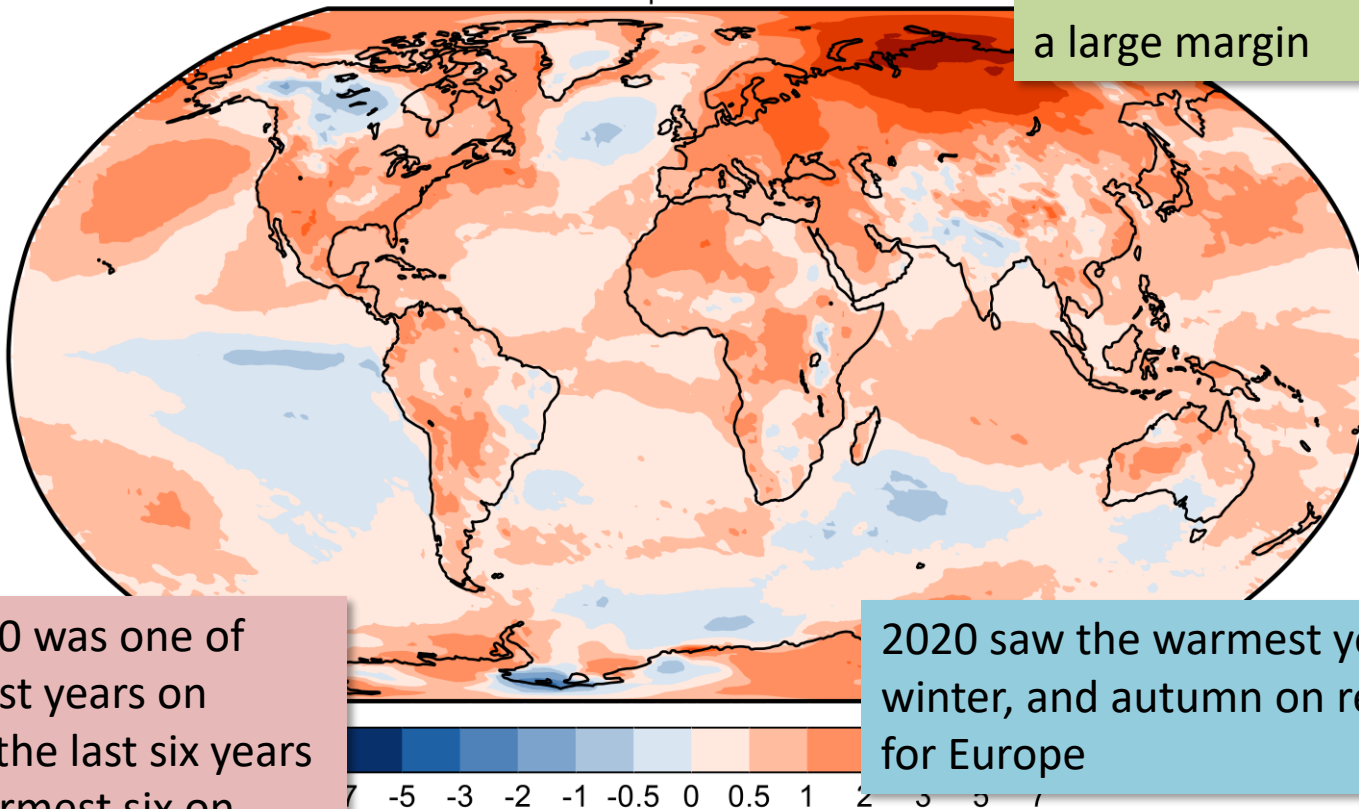




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## Surface air temperature anomaly 2020 Reference period: 1981-2010

2020 was the warmest year  
on record in Arctic Siberia by  
a large margin



Globally, 2020 was one of three warmest years on record, with the last six years being the warmest six on record

2020 saw the warmest year, winter, and autumn on record for Europe



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## Greenhouse gases continued to rise during 2020

Preliminary estimates from satellite data indicate that during 2020 concentrations of CO<sub>2</sub> have increased by 0.6% and CH<sub>4</sub> by 0.8%

For CO<sub>2</sub> a slightly lower rate than in recent years, while for CH<sub>4</sub> it is higher



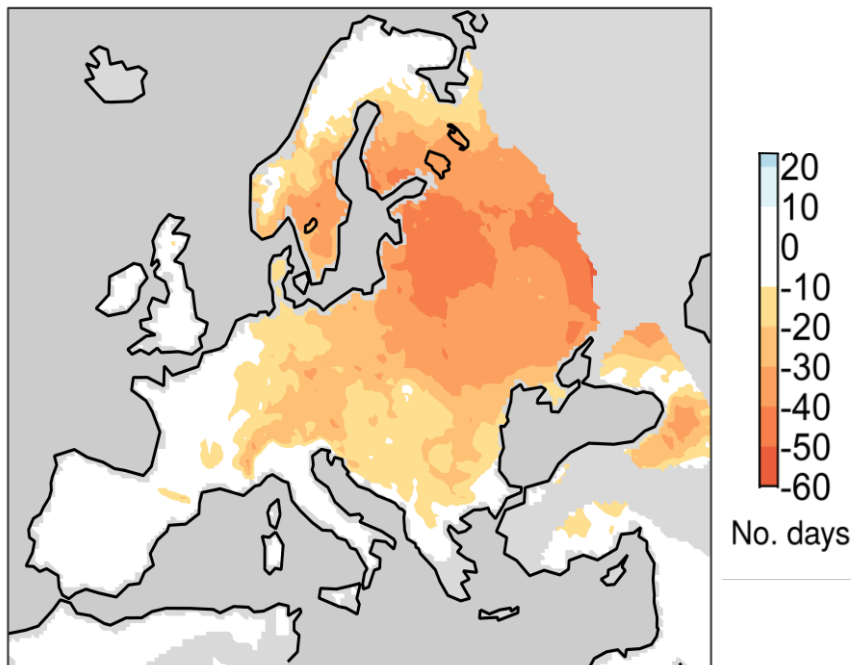


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## Warm winter (December 2019 – February 2020)



Number of 'ice days'  
Winter 2020 relative to 1981-2010



'Ice days': days with max T below 0

Northeastern Europe winter temperatures nearly 1.9°C higher than the previous record.

The area of Europe where the daily maximum temperature stayed above freezing in winter was the largest on record.

Baltic sea ice cover very low and few snow days





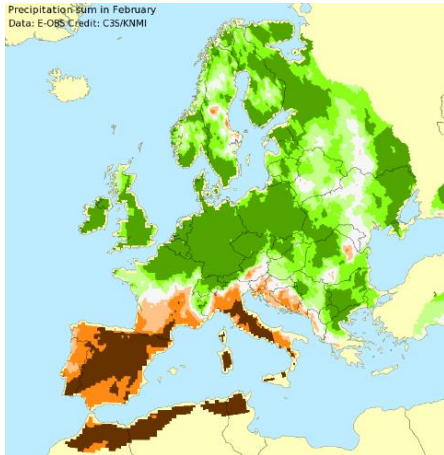
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# From a wet winter to a dry spring

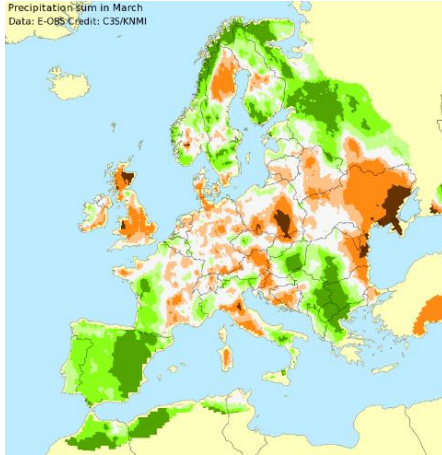


## Precipitation totals in February, March and April compared to 1981-2010

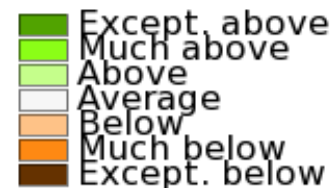
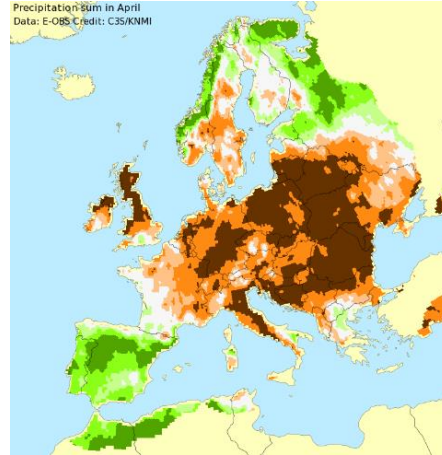
Precipitation sum in February  
Data: E-OBS Credit: C3S/KNMI



Precipitation sum in March  
Data: E-OBS Credit: C3S/KNMI



Precipitation sum in April  
Data: E-OBS Credit: C3S/KNMI



Discernible impacts on soil moisture, river discharge, vegetation

Strong transition in the River Rhine Basin

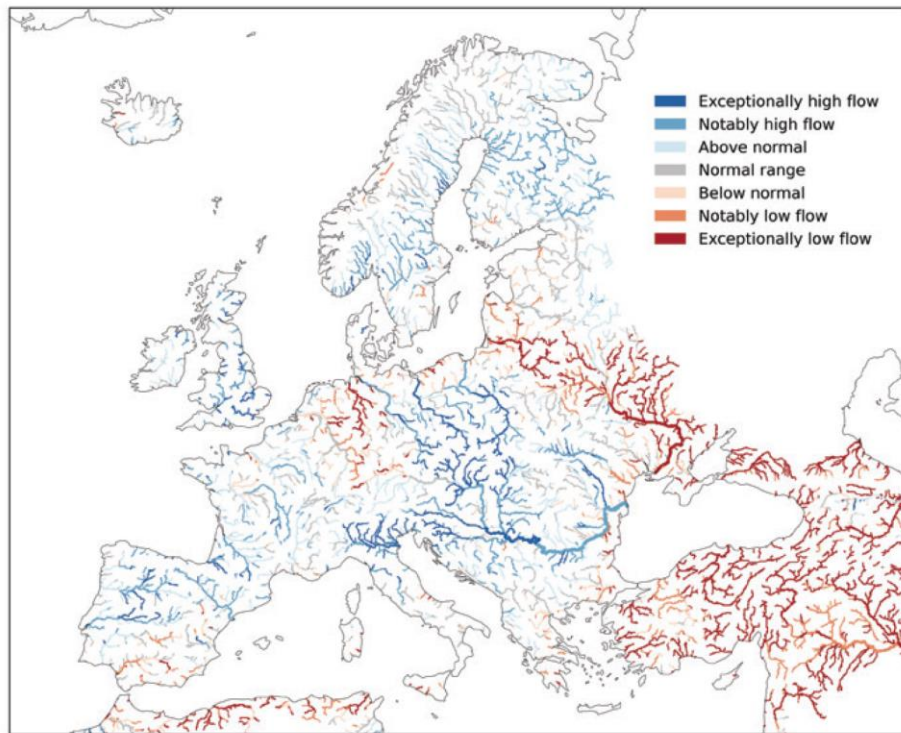


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# Storm Alex – October 2020



## River discharge October 2020



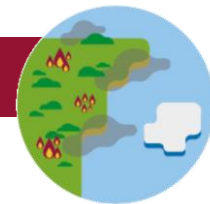
Many one-day accumulated precipitation records in the UK, Brittany and in the southern Alps broken.

Locally the daily precipitation totals were more than three times the typical October average

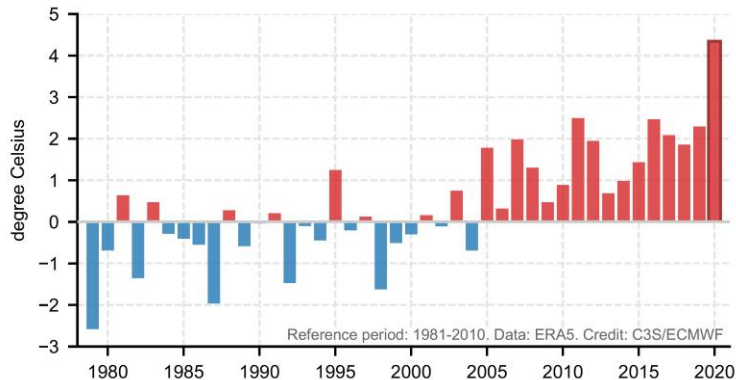
Storm Alex led to above-average river discharge over large parts of western Europe



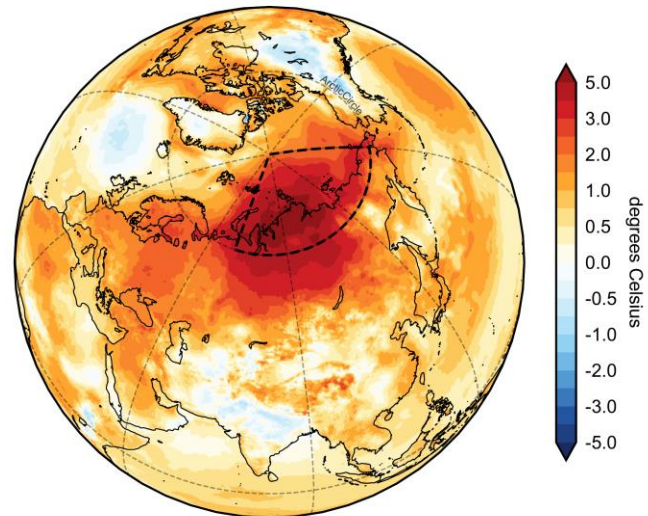
# Arctic Siberia – an exceptional year



Annual surface temperature anomalies  
for Arctic Siberia



Surface temperature anomaly for 2020



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

The 2020 mean temperature averaged over Arctic Siberia was 4.3°C above average, by far the largest on record.

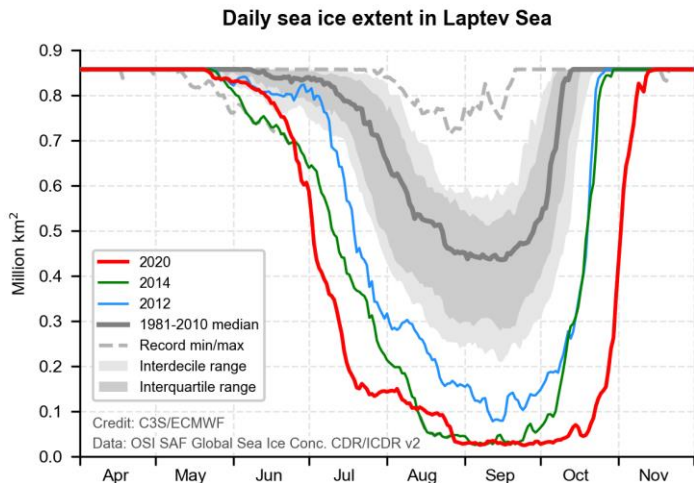
Low snow cover, dry conditions and record-breaking wildfires



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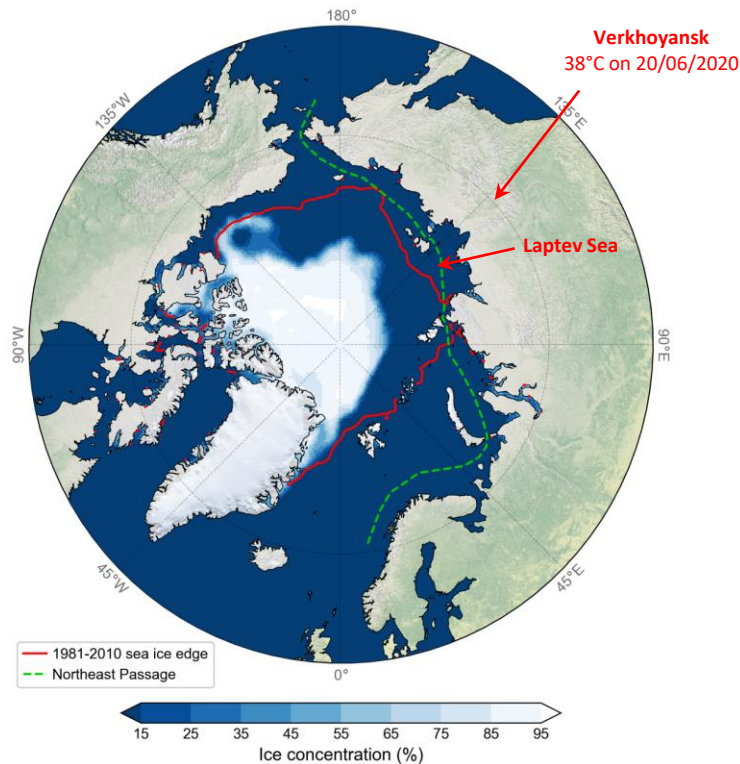
# Arctic Siberia – an exceptional year



September 2020 Arctic sea ice extent 2nd lowest on record (behind 2012) at 35% below the 1981–2010 average.

Sea ice extent at record low levels along the Siberian coast from July through October.

**September 2020 mean sea ice concentration**





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# Outlook

## Ongoing work

- Stronger connection between the report and the CDS
  - Datasets
  - Applications
- Harness new mature datasets from across C3S (and other Copernicus services)

## User-driven evolution

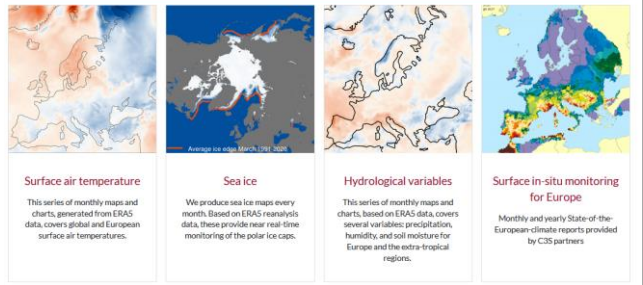
- Small consultation workshop with key stakeholders in June
- Landscape review



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# Find out more

## Monthly summaries



[Home](#) / [What we do](#) / [Climate bulletin](#) / [European State of the Climate](#)

YEARLY REPORT AND ASSESSMENT OF THE CLIMATE IN THE EUROPEAN REGION

## European State of the Climate

The European State of the Climate (ESOTC) is an annual report compiled by the Copernicus Climate Change Service (C3S), implemented by the European Centre for Medium-Range Weather Forecasts (ECMWF) on behalf of the European Commission. The ESOTC's findings are based on data and expertise from across the C3S community, as well as other Copernicus services and external partners. The ESOTC is published soon after the main data collection for the previous year has concluded. It provides an analysis of the monitoring for Europe for the past calendar year, with descriptions of climate conditions and events. In addition, it explores the associated fluctuations in key climate variables and indices from across all parts of the Earth system. Further, the ESOTC gives updates on key global climate indicators for Europe and the rest of the world.

Globe  
Europe  
Arctic



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[climate.copernicus.eu/climate-indicators](https://climate.copernicus.eu/climate-indicators)

[climate.copernicus.eu/esotc/2020](https://climate.copernicus.eu/esotc/2020)

