Copernicus
Europe's eyes on Earth

European State of the Climate 2017

Summary

European Commission

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IMPLEMENTED BY
ECMWF

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Welcome to European State of the Climate 2017

Welcome to the summary of the *European State of the Climate 2017*, compiled by the Copernicus Services at the European Centre for Medium-Range Weather Forecasts (ECMWF), the Climate Change Service (C3S) and the Atmosphere Monitoring Service (CAMS).

Image: Summer storms and sea currents in Calabria taken from the International Space Station, ©ESA/NASA

To meet the challenge of global climate change, accurate, reliable and timely data are key. The Copernicus Services at ECMWF routinely monitor data on a global scale, including surface air temperature, precipitation, sea ice area and atmospheric greenhouse gases.

The findings are based on measurements from satellites and ground stations, and on data from global 'reanalyses', a consistent combination of computer modelling and multiple data sources. The information builds on the current C3S monthly climate bulletin, an easily readable, free online resource. It extends these to include further sources of data, and draws on the scientific expertise of the Copernicus community.

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.

Image: Aurora over Icelandic lake, ©ESA/C.Gauna

Surface temperature | Sea ice area | Precipitation | Soil moisture | Greenhouse gases

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

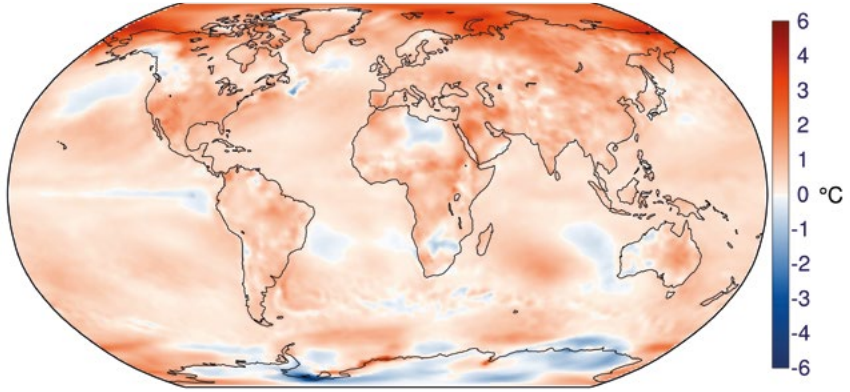
Spring was one of the warmest on record in southwestern Europe, at close to 1.7°C above the 1981-2010 average.

- The Climate in 2017 discusses the annual and seasonal climate of last year in comparison with the 1981-2010 climate reference period. It concentrates mainly on Europe, including two focus regions: the European sector of the Arctic and the southwest of Europe, where it highlights a specific event: the 'Lucifer' heat wave.
- Headline Climate Indicators focuses on long-term key indicators for global and regional climate change.

The *European State of the Climate 2017* is available online at climate.copernicus.eu/CopernicusESC Additional information on global aspects can be found in the 2017 WMO Statement, which Copernicus contributes to.

Climate in 2017

Surface air temperatures for 2017 were higher than the average for 1981-2010 over most areas of land and ocean.



17 out of 18 of the warmest years on record occurred in the 21st century

7 May 2017

31 August 2017

Images: Before and after images of Portugal burn scars, from Sentinel-3A satellite, ©ESA

Global temperature

↑0.5°C

2017 global average temperature, 0.5°C higher than the 1981-2010 average

2017 was the warmest non-El Niño calendar year on record and one of the three warmest years overall

The highest surface air temperature anomalies were recorded in the Arctic but much of North America, southwestern Europe, the Middle East, northwestern and central Africa, eastern and southern Asia, and offshore of West Antarctica were also well above average.

Lower than average surface air temperatures were experienced over a few land and oceanic areas. These included the equatorial eastern Pacific Ocean, where La Niña conditions prevailed early and late in the year, and some regions of Antarctica.

European temperature

↑0.8°C

2017 European average temperature, 0.8°C higher than the 1981-2010 average

It was the fifth or sixth warmest year, depending on the dataset considered

Europe's annual mean temperature, as well as maximum and minimum temperatures, were above average for all land areas. During winter, Scandinavia was particularly warm, and the following seasons were well above average in most of central and southern Europe. Below average temperatures were most prominent during winter in the southeast of the continent. The Iberian Peninsula was warmer than average in all seasons.

Above: Surface air temperature anomaly (°C) for 2017, relative to the 1981-2010 average.
Source: ERA-Interim. Credit: Copernicus Climate Change Service implemented by ECMWF

European dry and wet indicators

↓0.02mm/day

2017 European average precipitation, 0.02mm/day below the 1981-2010 average

2017 annual precipitation was close to average, but soil moisture was the second lowest on record

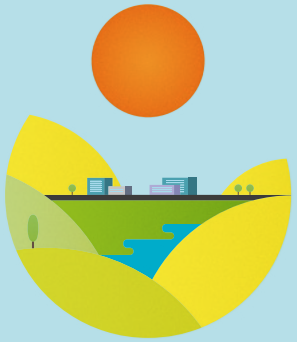
2017 saw very dry conditions in the southwest of Europe, whereas large parts of the region around the Baltic Sea saw wet conditions. During spring, above-average precipitation increased the soil moisture to the south of the Baltic Sea. By summer, due to further precipitation, the positive soil moisture anomaly covered most of the region around the Baltic Sea. During autumn, this region (as well as large area south of it) saw above average precipitation and soil moisture. The *Focus Region: Southwest Europe* outlines the dry situation in the southwest in more detail.

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 rainy 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.

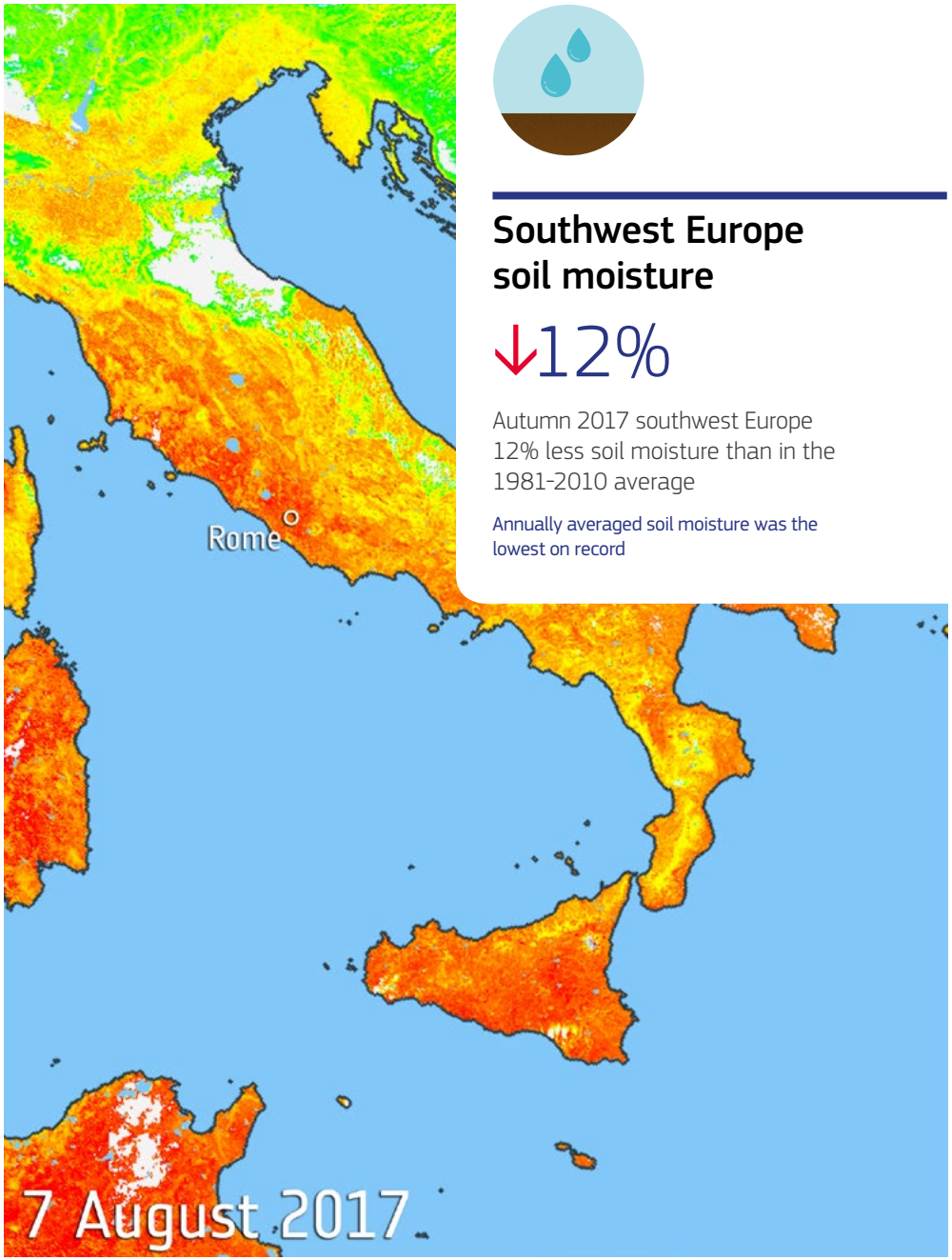


Image: European Remote Sensing satellite (ERS1) over Europe (2017), ©ESA

Southwest Europe soil moisture

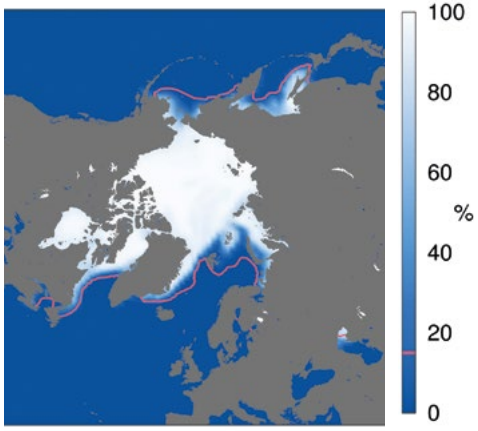
↓12%

Autumn 2017 southwest Europe 12% less soil moisture than in the 1981-2010 average

Annually averaged soil moisture was the lowest on record

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 line denotes the 1981-2010 average sea ice edge for the month.

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

Surface air temperatures in the European sector of the Arctic have been increasing during the 40 years-worth of data analysed 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 Ocean, ©ESA

European Arctic sea ice

↓600,000 sq km

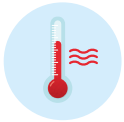
2017 January European Arctic average sea ice area 600,000 sq km below the 1981-2010 average

2017 saw the lowest January sea ice area for the European Arctic on record

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



↑**Globe:** around 1.1°C increase since start of industrial era

↑**Europe:** around 1.8°C increase since latter half of the 19th century

*Five temperature 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 warming of around 1.1°C since the start of the industrial era.

Greenhouse gases

Current rate of increase in abundance in air.

↑**CO_2:** about 5 PgC/year or 2.5 ppm/year

↑**CH_4:** about 0.4 PgC/year

↑**N_2O:** about 18 TgN/year

*Estimated net flux data for CO_2, N_2O, CH_4 covering 1979, 1996, 2000 to 2016

The estimated net surface fluxes into the atmosphere of the three greenhouse gases carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) have been increasing during recent decades. Anthropogenic emissions of CO_2 have been partly compensated by a natural flux (sink) into oceans and vegetation. It is estimated that Europe represents a vegetation sink for CO_2, but the relative magnitude of this sink has been decreasing since the 1990s.

Sea ice

↓**Arctic:** 2016 maximum and 2012 minimum area lowest on record

Antarctic: 2017 maximum and minimum area lowest on record

*Sea ice data record covering 1979-2017

Arctic sea ice area shows a downward trend that becomes prominent after the year 2000. In the Antarctic, variability rather than trend predominates. Spells of markedly 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 2m in southwestern Scandinavia and 34m in the Alps

*Reference glacier network with more than 30 years of ongoing observations

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

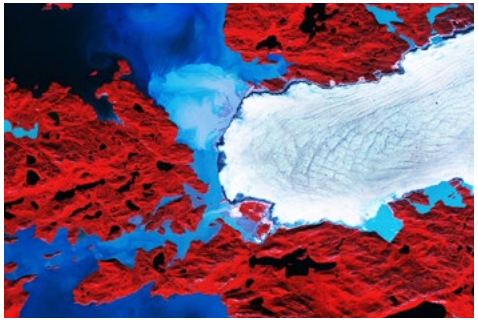
↑**Global ocean:** mean sea level increase of 3.4 mm/year

↑**European regions:** mean sea level increase by 1 to 2 mm/year in most coastal areas

*Sea level data record covering January 1993 to May 2017

Global mean sea level rise amounts to 3.4 mm/yr 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 geophysical processes.

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



Vital environmental data for a changing world

The European Centre for Medium-Range Weather Forecasts (ECMWF) has been entrusted by the European Commission to implement two of the services of the Copernicus Programme: the Copernicus Climate Change Service (C3S) and the Copernicus Atmosphere Monitoring Service (CAMS). Further, ECMWF provides support to the Copernicus Emergency Management Service (EMS).

Climate Change Service

The Copernicus Climate Change Service (C3S)

The Copernicus Climate Change Service (C3S) combines observations of the climate system with the latest science to develop authoritative, quality-assured information about past, current and future states of the climate in Europe and worldwide.

Atmosphere Monitoring Service

The Copernicus Atmosphere Monitoring Service (CAMS)

The Copernicus Atmosphere Monitoring Service (CAMS) provides continuous data and information on atmospheric composition to help policymakers, businesses and citizens address these environmental concerns.

Find out more

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