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RCC Network



Annual Bulletin on the Climate in WMO Region VI

– Europe and Middle East –

2021



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Malta
Moldova
Montenegro
Netherlands
North Macedonia
Norway
Poland
Portugal
Romania
Serbia
Slovakia
Slovenia
Sweden
Switzerland
Türkiye
Ukraine
United Kingdom

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1. Introduction

The Annual Bulletin on the Climate in WMO Regional Association VI (RA VI Europe with 50 Members) provides an overview of climate characteristics and phenomena in Europe (as defined by the area of the WMO RA VI region, see 1.1) for the preceding year. It is mainly based on dedicated national reports from RA VI National Meteorological and Hydrological Services (NMHSs) as well as general climate monitoring information from their official websites. The Annual Bulletin provides an excellent example of international collaboration across cultural and political borders since its first publication in 1994. The Annual Bulletin is seen as a regional contribution to WMO's climate system monitoring, complementing and detailing well-known regular global assessments, such as WMO's annual "State of the Global Climate" (WMO 2022, WMO-No.1290), the "State of the Climate" published in the Bulletin of the American Meteorological Society (BAMS, Bissolli 2022), and the new regional "State of the Climate in Europe" report (WMO 2022, WMO-No.1304), published jointly by WMO and Copernicus in 2021. The evolution of the RA VI Regional Climate Centre Network (RCC Network) allowed adding a couple of RA VI-wide maps in order to provide a certain degree of consistency across the information and the national borders. Otherwise, basic methodologies for, and operations of, climate monitoring activities still differ among the various RA VI NMHSs. Maps and information compiled in this Annual Bulletin are the result of a selection process and are mainly taken from reports, maps and statistics provided by the NMHSs, websites of NMHSs as well as the webpages of the RA VI RCC Network ([RCC website](#)). The Annual Bulletin is intended to serve primarily NMHSs in the RA VI Region but it might also be interesting for public institutions, research institutes, universities and others.

This Annual Bulletin includes three parts: the annual, seasonal and monthly survey of the state of the climate in 2021. The long time series of temperature, precipitation and sunshine duration provided by NMHSs in order to illustrate long-term variability up to 2021 (previously presented in section 5) are made available on [the RA VI RCC webpages of DWD](#).

Notes:

Maps of the RA VI RCC Network are based on the following data sources:

- Temperature: CLIMAT data and ship observations provided by the Global Collecting Centre (GCC), operated by the Deutscher Wetterdienst
- Precipitation: Global Precipitation Climatology Centre (GPCC; Schneider et al. 2018), operated by the Deutscher Wetterdienst
- Sunshine: Meteosat Satellite data (introduced in 2018).

1.1. Definition of subregions

The following subregions are used in this bulletin, encompassing the listed WMO Members:

Western Europe (6 countries):

Ireland, United Kingdom, Netherland, Belgium, Luxembourg, and France

Central Europe (7 countries):

Germany, Switzerland, Austria, Poland, Czech Republic, Slovakia, and Hungary

Nordic and Baltic Region (9 countries/territories):

Denmark, Estonia, Finland, Greenland, Iceland, Latvia, Lithuania, Norway, and Sweden

Iberia (3 countries):

Andorra, Portugal, and Spain

Central Mediterranean region (12 countries):

Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Italy, Malta, Monaco, Montenegro, North Macedonia, Serbia, and Slovenia

Eastern Europe (6 countries):

Belarus, European Russia, Moldova, Romania, Ukraine, and western Kazakhstan

Middle East (5 countries):

Cyprus, Israel, Jordan, Lebanon, and Syria

Türkiye and South Caucasus (4 countries):

Armenia, Azerbaijan, Georgia, and Türkiye

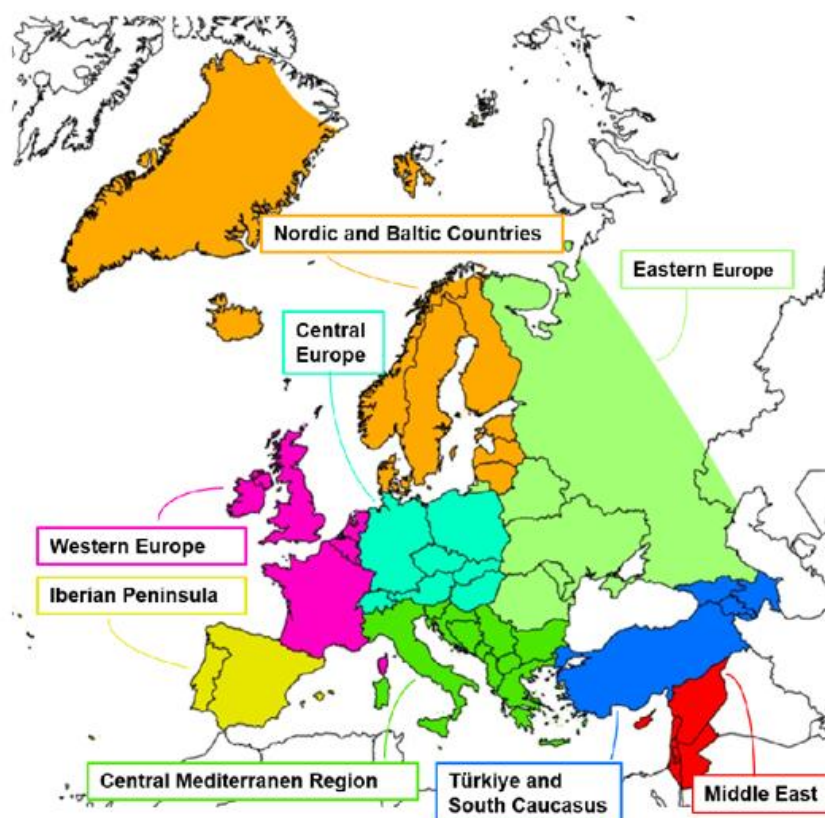


Figure 1-1: Map with the eight sub-regions of the RA VI Region used in this bulletin.

1.2. The climate in 2021 – Overview

Unless stated otherwise, 1991–2020 is the base period used throughout this report.

1.2.1. Anomalies

Temperature

Based on the data provided by the WMO RA VI RCC Node on Climate Monitoring (RCC-CM), the RA VI land areas experienced their seventh warmest year since 1981 with an anomaly of +0.5 °C. Most of the RA VI region had anomalies of close to normal between –1.0°C and +1.0°C. Only some eastern and southeastern parts of the RA VI Region experienced temperatures of more than 1 °C above normal, for example southern Greece, most of Turkey, west Kazakhstan and the Caucasus region. All regions experienced close to normal or warmer than normal temperatures in all seasons, except for winter and especially spring when Central and Western Europe experienced colder-than-normal temperatures. In winter, anomalies close to +2° C occurred in the Central Mediterranean Region, the Middle East and Türkiye and South Caucasus. In summer, Eastern Europe saw the largest anomalies with temperatures around 2 °C above normal.

Precipitation

In 2021, precipitation totals were slightly above normal over the land areas of the RA VI Region on average. It was the tenth wettest year since 1981. Generally, drier-than-normal conditions dominated over southern and western parts of the Iberian Peninsula, Iceland¹, southern Norway, Estonia¹, the Middle East and southern Türkiye. In the West and North of the Black Sea, precipitation totals were much higher than normal.

Sunshine Duration

The sunshine duration in 2021 was mostly around normal with anomalies between –200 hours to +200 hours (+/-5%). Sunshine totals were much lower than normal in eastern Spain, Germany, western Poland, and southeastern United Kingdom. Much higher-than-normal sunshine totals occurred in Slovakia and Hungary, southern Norway, Syria and southeastern Türkiye. Especially the Middle East was sunnier than normal in all seasons of the year 2021.

1.2.2. Selected significant events

- Exceptionally high temperatures occurred in southern Europe in summer, especially in July, with many local records being broken. During the warm spell, heavy wild fires occurred in Greece and Türkiye.
- A series of heavy storms bringing exceptionally high amounts of precipitation affected especially Western and Central Europe during the months of May to July. In July, heavy flooding occurred in Austria, Croatia, Italy, Germany, Switzerland and the Benelux states.

The two events are described in more detail in section 3.6. More events can be found in sections 4.5 and 4.6.

¹ The RCC annual precipitation anomaly map for 2021 shows large negative anomalies for Estonia and Iceland, as it did in 2020 when it turned out that these anomalies do not correctly represent the anomalies reported by the respective NMHSs. It is likely that also this year's anomalies are too dry. The issue is likely related to incorrect decoded real-time data used for the grid generation. As a result, these grid point values may deviate considerably from actual precipitation totals.

2. Annual survey

The climate of 2021 was characterised by a broad range of spatial and temporal anomalies outlined in section 1.2. This section presents an overview of the spatial patterns of mean annual climate conditions in 2021 and anomalies related mainly to the normal period 1991–2020 of the selected climate variables: sea level pressure, surface air temperature, precipitation, sunshine duration and snow. Long-term trends in temperature and precipitation indices are presented in section 2.7. Section 3 and 4 present the seasonal and monthly patterns and statistics for selected climate variables including also reports from individual countries. The long time series of temperature, precipitation and sunshine duration provided by NMHSs in order to illustrate long-term variability up to 2021 (previously presented in section 5) are available on the [RA VI RCC-CM webpage](#).

2.1. Sea level pressure

Generally, the average air pressure patterns over the RA VI were dominated by higher-than-normal pressure over Greenland, Iceland and the Norwegian Sea with anomalies values between +2 hPa and +4 hPa. This means that the Icelandic Low was, on yearly average, weaker than normal, a pattern that is associated with winds blowing cold polar air from the north over northern and northwestern Europe. The anomaly map also shows that for most parts of the RA VI Region pressure patterns were as only slightly different from normal with anomalies between -2 hPa and +2 hPa., (Figure 2-1).

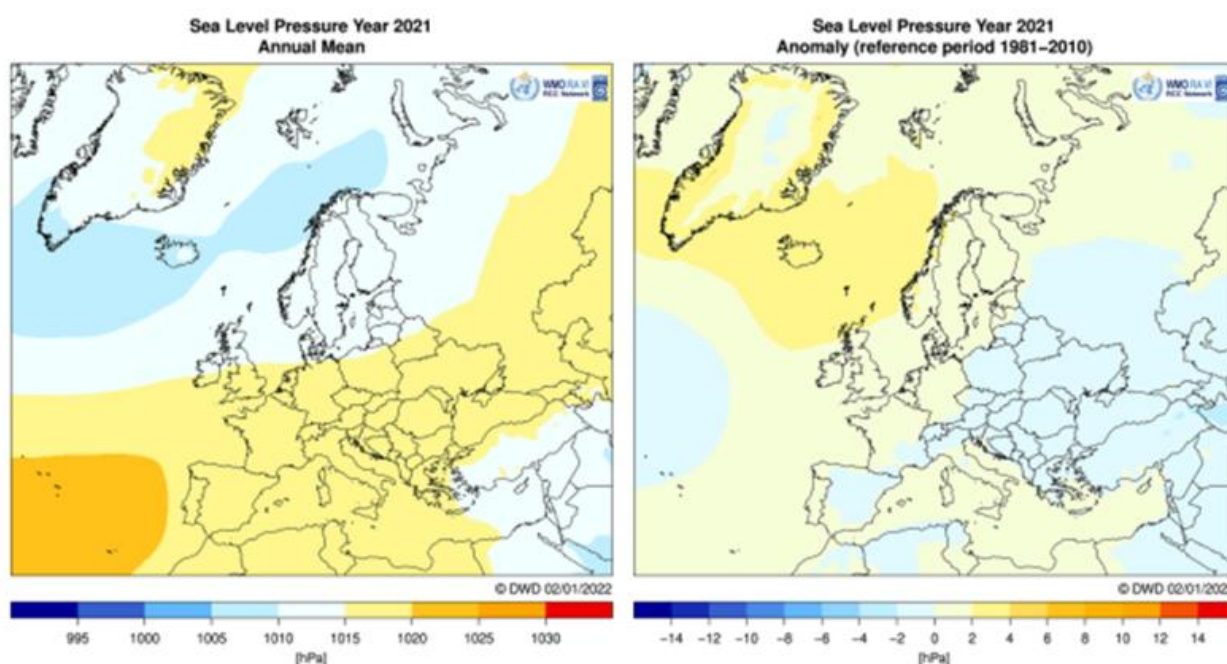


Figure 2-1: Annual mean sea level pressure in hPa (left) and anomalies in hPa relative to 1981–2010 (right) for the year 2021. Source: [RCC-CM website](#).

2.2. Temperature

In 2021, most of the RA VI Region experienced slightly positive or close to normal temperature anomalies. Only Greenland and an area in southeastern and easternmost parts of the RA VI Region had positive anomalies higher than +1 °C (see also Figure 2-2). For several countries, the year 2021 proved to be among the five warmest on record: Armenia +2.1 °C, Cyprus +1.3 °C, Israel +0.8 °C, Jordan +1.3 °C and Türkiye +1 °C (see also Table 2-1).

According to the temperature data provided by the RCC-CM, the average temperature for the RA VI land areas for the year 2021 was +0.5 °C above normal, the seventh warmest on record.

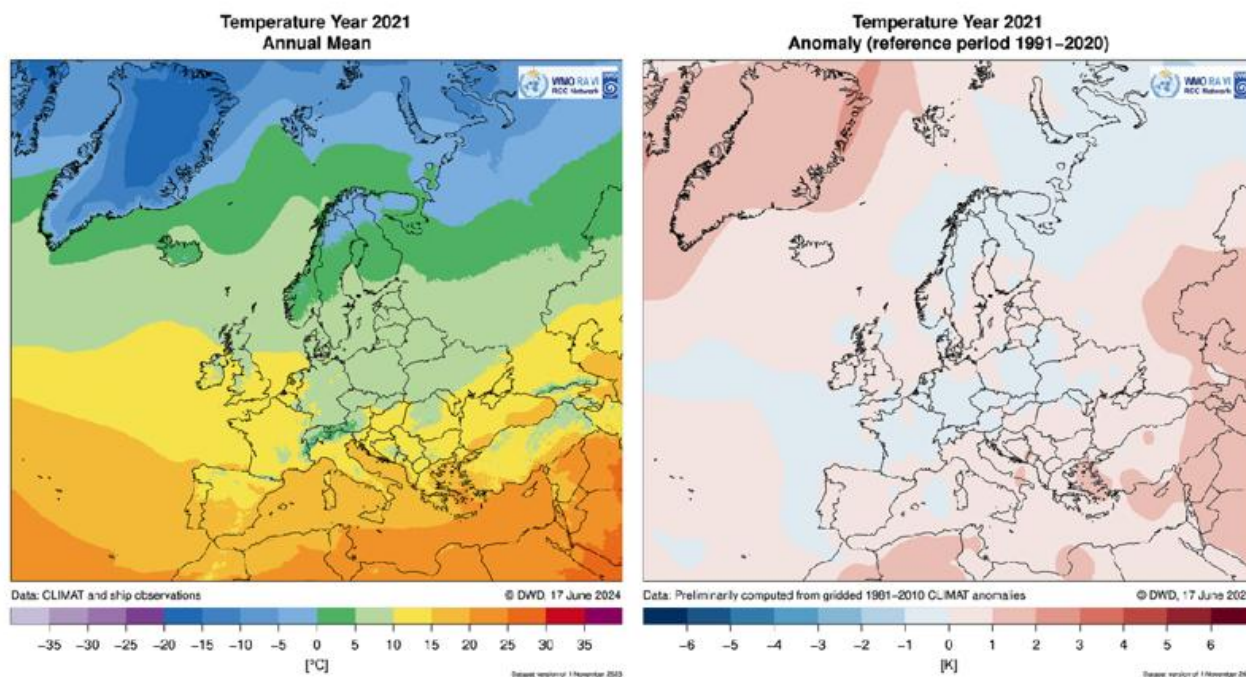


Figure 2-2: Annual mean temperature in °C (left) and anomalies in °C relative to 1991–2020 (right) for the year 2021. Source: [RCC-CM website](#).

When looking at the specific sub-regions, the year 2021 was characterized by slightly-above-normal temperatures for **Western Europe** with anomalies between 0.0 °C and +2.0 °C. Mean annual temperature anomaly for Western Europe was around normal (+0.02 °C). Just like the annual mean, the seasonal means were either close to zero or slightly positive. Only the spring season finished with a negative anomaly of -1.1 °C.

Central Europe had an overall anomaly of -0.1 °C for 2021. As for Western Europe, all seasons were warmer than normal except for the spring season during which temperature anomalies were below -1.0°C for the whole region.

Temperatures across the **Nordic and Baltic Countries** were mostly close to normal in 2021 with an overall anomaly very close to zero (+0.03 °C). All seasons means were also close to normal except for the summer, which saw temperatures of 1.3 °C above normal due to a heatwave especially hitting Estonia, Latvia and Finland.

Over the **Iberian Peninsula**, the year was slightly warmer than normal with anomalies between 0.0 °C and +1.0 °C. In Spain, especially the winter months had positive anomalies (+0.54 °C), while the other seasons were around normal. In Portugal, all seasons were slightly above normal, while the winter had negative anomalies (-0.55 °C).

The year was slightly warmer than normal for the **Central Mediterranean region** with anomalies up to +1.0 °C. The regional annual mean temperature anomaly was +0.5 °C. Greece saw anomalies up to +1.7 °C in the southern region. Sarajevo (Bosnia and Herzegovina) had its sixth warmest year with an anomaly of +0.6 °C. The highest annual anomaly value in this region was reported by Montenegro with +1.05 °C.

Eastern Europe saw anomalies up to +2.0 °C. Overall, the annual mean anomaly was around normal (+0.3 °C) with largest anomalies occurring over West-Kazakhstan (+1.5 °C) resulting in the fifth warmest year on record. While the winter was colder than normal, the other seasons were near normal to much warmer than normal. The summer showed the highest anomalies (+2.0 °C).

In the **Middle East**, temperatures were warmer than normal with anomalies up to +2 °C. The annual mean temperature anomaly for the whole region was +1.23 °C with all seasons significantly warmer than normal. For Cyprus (+1.3 °C w.r.t. 1981–2010) and Israel (+0.8 °C) the year ranked as third and fourth warmest years on record.

Overall, the year was warmer than normal in **Türkiye and South Caucasus** with an average anomaly of +0.95 °C. For Armenia and Türkiye, the year 2021 ranked as the third and fourth warmest respectively (Armenia with +2.1 °C w.r.t. 1961–1990, Türkiye with +1 °C). In Georgia, 2021 ranked as the sixth warmest year with an anomaly of +1.0 °C.

Globally, 2021 was among the seven warmest years since records began in the mid-to-late 1800s (Dunn et al. 2022, WMO 2022). global mean temperature for 2021 was between +0.21° and +0.28°C above the 1991–2020 average (Dunn et al. 2022) according to six global temperature datasets consisting of four independent global in situ surface temperature analyses and two global atmospheric reanalyses and 1.11 ± 0.13 °C above the 1850–1900 pre-industrial average (WMO 2022).

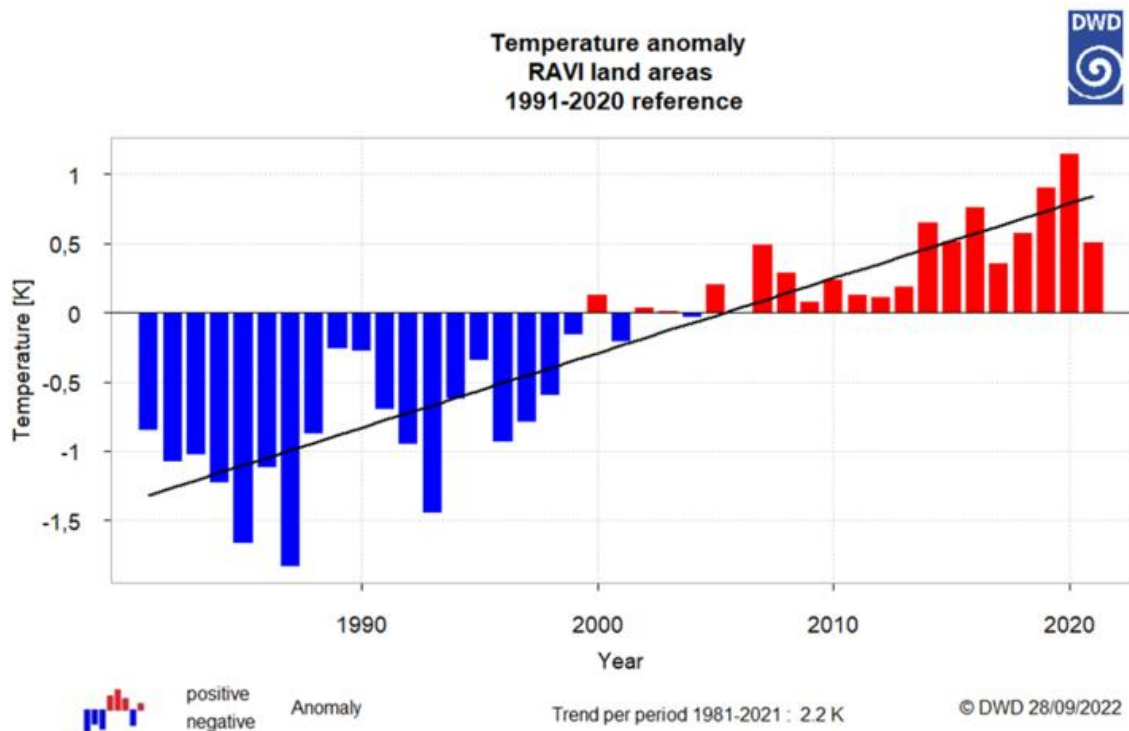


Figure 2-3: Annual temperature anomalies in °C relative to 1991–2020 for the years 1981–2021 for the RA VI land areas based on CLIMAT. Source: DWD.

Table 2-1: Rank statistics and anomalies of annual temperature in 2021 as reported by the National Meteorological and Hydrological Services (NMHSs). Information about all-time temperature records as provided by the individual NMHSs can be found here: [RCC-CM Temperature records in Europe \(RA VI\)](#)

Country	Rank (warmest/ coolest)	Annual Anomaly [°C]	Reference period	start of time series
RA VI Region	7 (warmest)	+0.5	1991–2020	1981
Albania	-	-	-	-
Armenia	3 (warmest)	+2.1	1961–1990	1935
Austria	18 (warmest)	+1.2	1961–1990	1961
Azerbaijan	-	-	-	-
Belarus	18 (warmest)	+0.6	1981–2010	1981-
Belgium (Uccle)	164 (coolest)	-0.3	1991–2020	1833
Bosnia and Herzegovina (Sarajevo)	6 (warmest)	+0.6	1991–2020	1961
Bulgaria	12 (warmest)	+0.4	1991–2020	1930
Croatia (Zagreb)	14 (warmest)	+1.0	1981–2010	1981
Cyprus	3 (warmest)	+1.3	1981–2010	2000
Czech Republic	24 (warmest)	-0.3	1991–2020	1961
Denmark	26 (warmest)	+0.4	1981–2010	1874
Estonia	15 (warmest)	+0.3	1991–2020	1961
Finland	32 (warmest)	-0.1	1991–2020	1900
France	20 (warmest)	+0.4	1981–2010	1900
Georgia	6 (warmest)	+1.0	1991–2021	1956
Germany	21 (warmest)	-0.1	1991–2020	1881
Greece	-	+0.9–1.7	1971–2000	-
Greenland (Nuuk)	21 (warmest)	+1.3	1981–2010	1784
Hungary	19 (warmest)	+0.1	1991–2020	1901
Iceland	-	+0.2	1991–2020	-
Ireland	8 (warmest)	+0.34	1991–2020	1900
Israel	4 (warmest)	+0.8	1991–2020	1950
Italy	7 (warmest)	+1.4	1961–1990	1961
Jordan (Amman Airport)	2 (warmest)	+1.3	1991–2020	1923
Kazakhstan	5 (warmest) -	+1.5	1991–2020	1941
Latvia	20 (warmest)	+0.2	1991–2020	1924
Lebanon	-	-	-	-
Lichtenstein	-	-	-	-
Lithuania	21 (warmest)	-0.1	1991–2020	1961
Luxembourg	42 (warmest)	-0.6	1991–2020	1838
Malta	-	-1.6	-	-
Moldova (Chisinau)	12 (warmest)	-0.2	1991–2020	1886
Montenegro	-	-	-	-
Netherlands (De Bilt)	21 (warmest)	-0.1	1991–2020	1901
North Macedonia	14 (warmest)	+0.7	1981–2010	1981
Norway	28 (warmest)	-0.1	1991–2020	1900
Poland	22 (warmest)	-0.1	1991–2020	1951
Portugal	25 (warmest)	+0.4	1971–2000	1931
Romania	9 (warmest)	+0.2	1991–2020	1961
Russia	-	-	-	-

Country	Rank (warmest/ coolest)	Annual Anomaly [°C]	Reference period	start of time series
Serbia	16 (warmest)	+0.5–1.2	1981–2010	1951
Slovakia	18 (warmest)	–0.1	1991–2020	1951
Slovenia	18 (warmest)	+0.8	1981–2010	-
Spain	10 (warmest)	+0.5	1981–2010	1961
Switzerland	21 (warmest)	+0.3	1881–2010	1864
Sweden	26 (warmest)	+1.8	1860–1900	1860
Türkiye	4 (warmest)	+1.0	1991–2020	1971
Ukraine	-	+0.6	1981–2010	-
United Kingdom ²	18 (warmest)	+0.14	1991–2020	1884

² Statistics are based on [v.1.1.0.0 of HadUK-Grid](#)

2.3. Precipitation

Over large parts of the RA VI Region, the annual precipitation was about normal with anomalies between -10 and $+10$ mm per month. Positive anomalies between $+10$ and $+30$ mm per month mainly occurred in the region around the Black Sea and Greece (see also **Figure 2-4**). Negative Anomalies between -10 and -30 mm per month occurred in southern and western Spain and Portugal, southern France, northern Italy, Norway, Estonia, in the southern and eastern part of Türkiye and in Syria. Larger negative anomalies are visible over Iceland³ and southern Norway with values up to -70 mm per month. For Türkiye, 2021 was among the five driest years since start of time series (see also **Table 2-2**).

Western Europe as a whole saw slightly drier-than-normal conditions (94% of normal). Most countries reported close-to-normal precipitation amounts. For Belgium (Uccle) it was, however, the seventh wettest year since 1833 with absolute anomalies of 201.7 mm.

The sub-region **Central Europe** was similar to Western Europe with precipitation amounts around normal (98% of normal) and only small parts of Germany, Austria and Hungary seeing slightly lower-than-normal precipitation totals.

The **Nordic and Baltic countries** saw normal amounts of precipitation in most parts. Exceptions were southern Norway, Iceland and Estonia. Reykjavik (Iceland) saw drier than normal condition, receiving only 765.3 mm which corresponds to 87% of normal precipitation. For Akureyri, however, the annual total was 636.4 mm, 111% of normal which is not reflected on the GPCC-based annual precipitation maps.

The **Iberian Peninsula** as a whole saw lower-than-normal amounts of precipitation (84% of normal), especially in the western and southern part (less than 80% of normal in large parts).

The **Central Mediterranean region** saw near or slightly above-normal precipitations amounts, on average 105% of normal. Above-normal precipitation occurred around the Aegean Sea, southern Bulgaria, and Albania, where totals were between 125% to 167% of normal. Lower-than-normal amounts of precipitation occurred over northern Italy.

The anomalies in **Eastern Europe** were also mostly around normal. Southern parts of European Russia and also areas around the Black Sea saw larger-than-normal amounts of precipitation, 125% to 167% of normal.

The **Middle East** experienced mostly below-normal precipitation amounts, the region as a whole only 50% of normal precipitation.

Türkiye and South Caucasus saw on average slightly drier-than-normal conditions with 92% of normal precipitation. Lower-than-normal amounts particularly occurred in southern Türkiye. Armenia was also much drier than normal and the year 2021 ranked as seventh driest since 1934.

³ The RCC annual precipitation anomaly map for 2021 shows large negative anomalies for Iceland. Although the Icelandic Meteorological Office reported that 'the year 2021 was relatively dry in all parts of the country', the anomalies appear to be less pronounced. Therefore, the annual anomalies as shown in the map are most likely too dry.

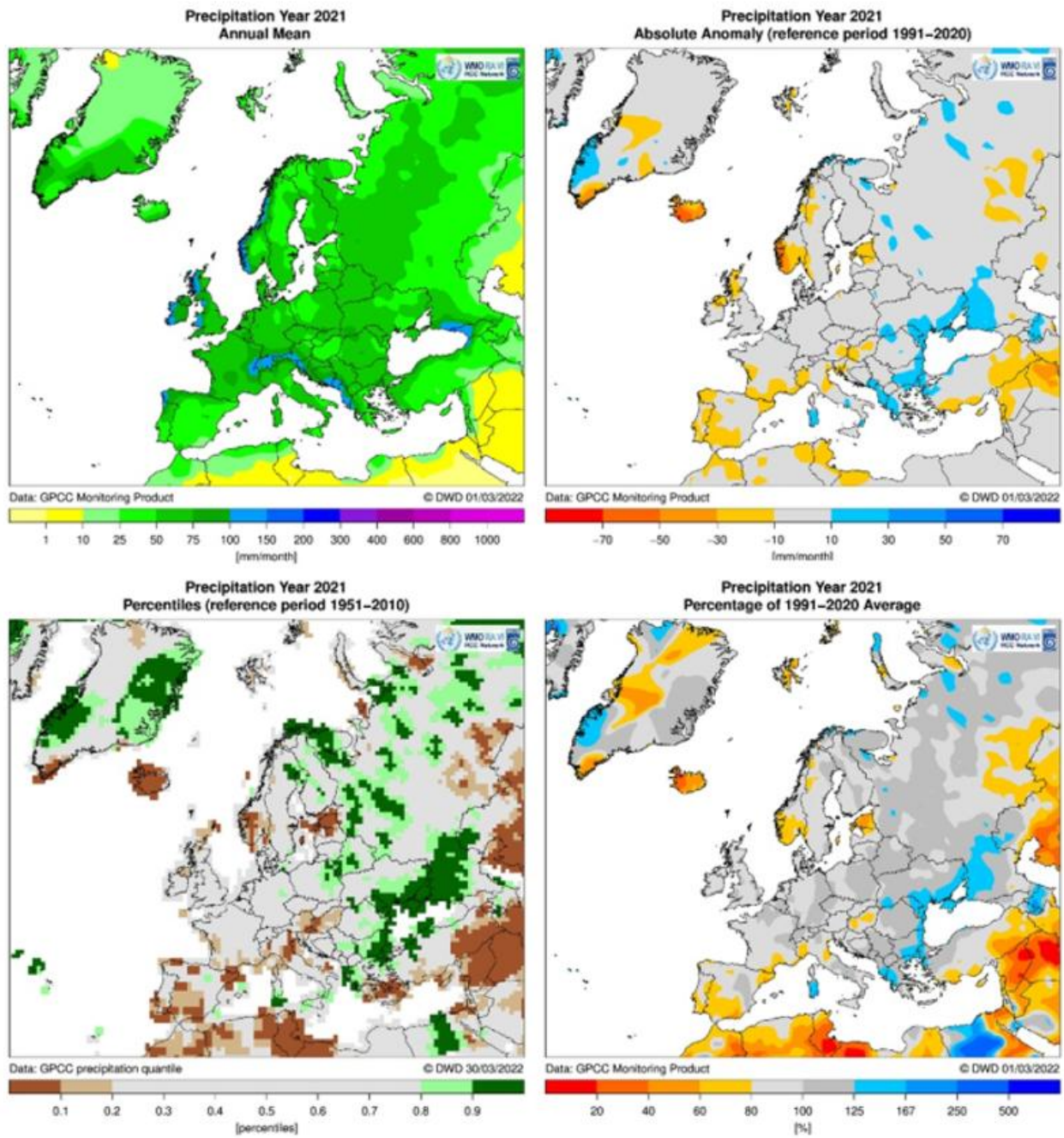


Figure 2-4: Annual total precipitation (left, top), precipitation anomalies in mm per month relative to 1991–2020 (right, top) and percentiles relative to 1951–2010 (left, bottom) as well as percentage of precipitation in % (right, bottom) relative to 1991–2020 for the year 2021. Source: [RCC-CM website](#).

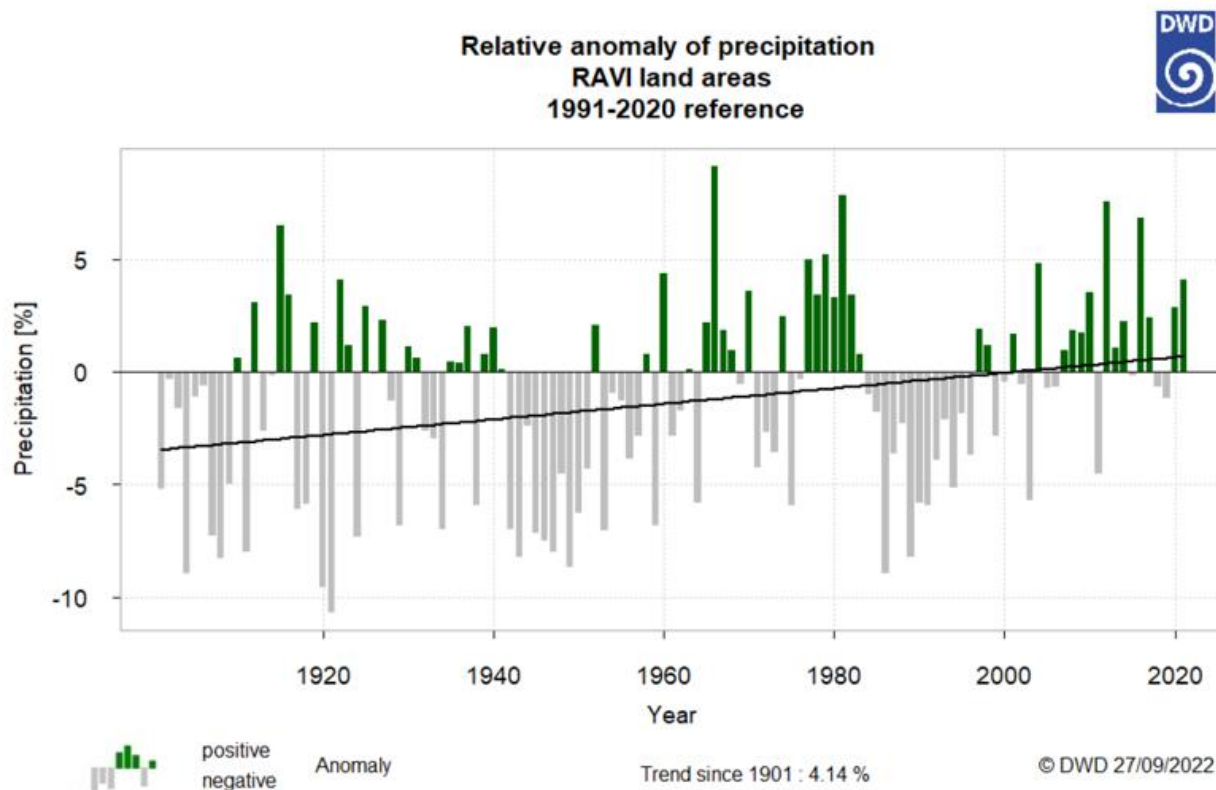


Figure 2-5: Annual precipitation anomalies for the years 1901–2021 for RA VI (land area; source: DWD).

Table 2-2: Rank statistics and anomalies of annual precipitation anomalies in 2021 as reported by the National Meteorological and Hydrological Services (NMHSs).

Country	Rank (driest/wettest)	Annual Anomaly [mm]	Reference period	start of time series
RA VI Region	11 (wettest)	+26.4	1991–2020	1901
Albania	-	-	-	-
Andorra	-	-	-	-
Armenia	7 (driest)	-121.9	1961–1990	1934
Austria	12 (driest)	-60.2	1961–1990	1961
Azerbaijan	-	-	-	-
Belarus	12 (wettest)	+70.8	1981–2020	1945
Belgium (Uccle)	7 (wettest)	+201.7	1991–2020	1833
Bosnia and Herzegovina (Sarajevo)	27 (wettest)	+32.3	1991–2020	1961
Bulgaria	10 (wettest)	+131.5	1991–2020	1930
Croatia (Zagreb)	13 (driest)	-72.9	1981–2010	1981
Cyprus	41 (driest)	-52.0	1961–1990	1902
Czech Republic	-	0.0	1991–2020	1961
Denmark	42 (wettest)	-2.3	1981–2010	1874
Estonia	21 (driest)	-46.0	1991–2020	1961
Finland	15 (wettest)	+25.3	1991–2020	1961
France	33 (driest)	-7.4	1981–2010	1958
Georgia	34 (wettest)	+26.0	1991–2021	1956
Germany	53 (driest)	+12.2	1991–2020	1881
Greece	-	-	-	-

Country	Rank (driest/ wettest)	Annual Anomaly [mm]	Reference period	start of time series
Hungary	-	-125.0	1991–2020	1901
Iceland	-	-	-	-
Ireland	41 (wettest)	-72.2	1991–2010	1941
Israel	24 (driest)	-65.0	1991–2020	1950
Italy	25 (driest)	-62.0	1961–1990	1961
Jordan (Amman Airport)	23 (driest)	-38.2	1991–2020	1922
Kazakhstan	-	-	-	-
Latvia	55 (driest)	-9.3	1991–2020	1924
Lebanon	-	-	-	-
Lichtenstein	-	-	-	-
Lithuania	26 (wettest)	+1.0	1991–2020	1961
Luxembourg	52 (wettest)	+54.5	1991–2020	1854
Malta	-	-	-	-
Moldova (Chisinau)	16 (wettest)	+111.0	1991–2020	1891
Montenegro	-	-	-	-
Netherlands (De Bilt)	38 (wettest)	+6.6	1991–2020	1906
North Macedonia	11 (wettest)	+104.1	1981–2010	1981
Norway	50 (wettest)	-116.1	1991–2020	1900
Poland	25 (wettest)	+16.2	1991–2020	1951
Portugal	17 (driest)	-197.5	1971–2000	1931
Romania	22 (wettest)	+24.4	1991–2020	1961
Russia	-	-	-	-
Serbia	15 (wettest)	92–144% (of normal)	1981–2010	1951
Slovakia	28 (driest)	-21.0	1981–2010	1961
Slovenia	-	-	-	-
Spain	14 (driest)	-70.3	1981–2010	1961
Svalbard	-	+1.0	1991–2020	1900
Sweden	-	-	-	-
Switzerland	47 (driest)	+40.1	1981–2010	1864
Syria	-	-	-	-
Türkiye	11 (driest)	-48.6	1991–2020	1971
Ukraine	-	+72.2	1981–2010	-
United Kingdom ⁴	120 (driest)	-58.7	1991–2020	1836

⁴ Statistics are based on v.1.1.0.0 of HadUK-Grid

2.4. Sunshine duration

For most parts of the RA VI region, the anomalies were between -200 and $+200$ hours. There were isolated areas with more pronounced negative anomalies up to -500 hours in the Mediterranean Sea. Negative anomalies were also found in northern Germany, over the North Sea, south of Iceland, in the northern part of the Black Sea and in the western part of the Mediterranean Sea. More pronounced positive anomalies between $+200$ and $+500$ hours were found in eastern Türkiye, southern Norway, over the coast of France and partly in Slovakia and Hungary. In particular, some central parts of the North Atlantic, southern Norway, parts of Hungary and the southeastern part of the RA VI Region saw more sunshine in contrast to the European continent with sunshine durations above the highest decile. In contrast, parts of the Mediterranean Sea and parts of the North Atlantic had a smaller duration of sunshine in contrast to the European Continent with a duration below the lowest decile (Figure 2-6). Annual and seasonal average anomalies of sunshine duration are shown in Table 3-6.

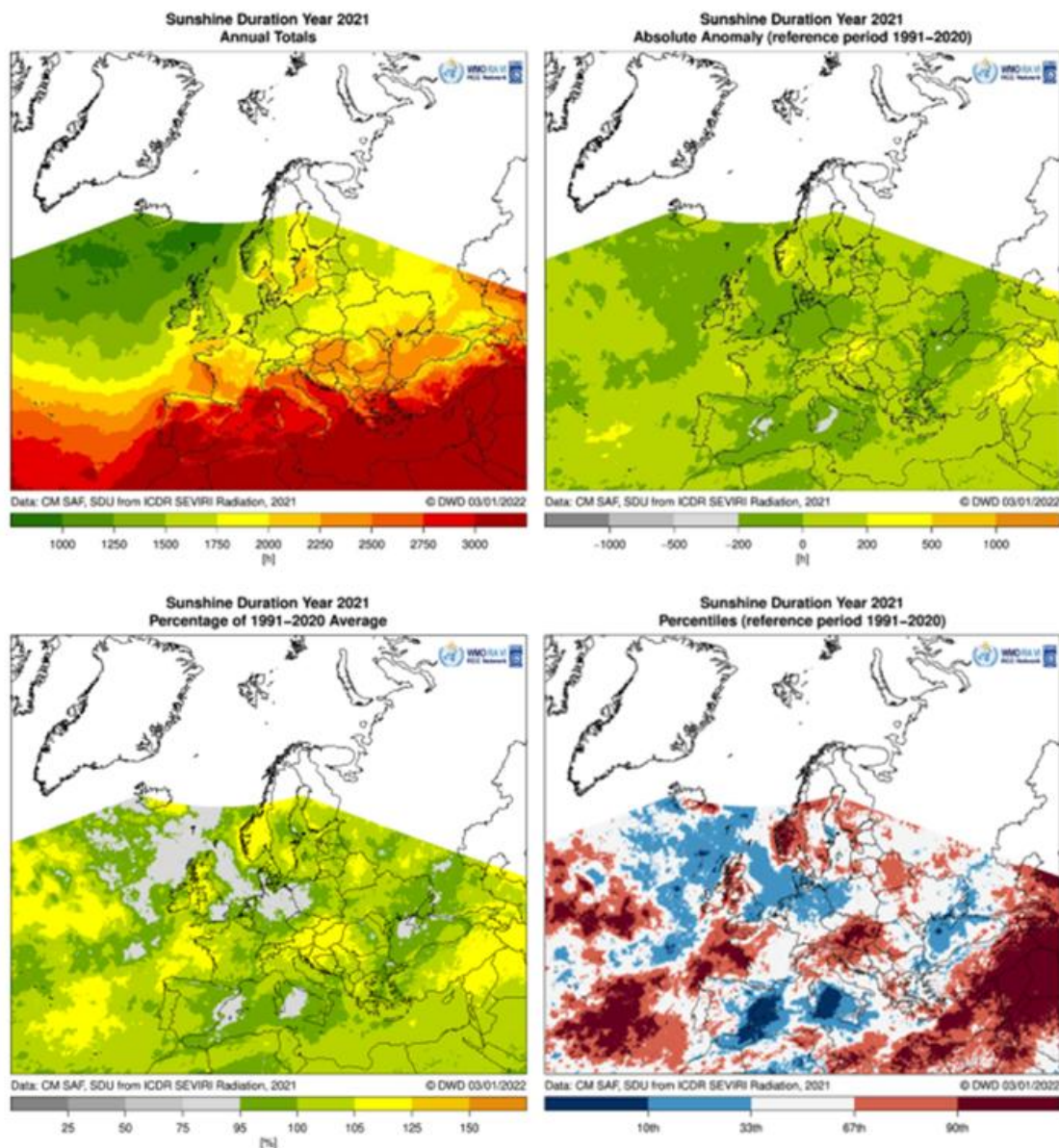


Figure 2-6: Annual sum of sunshine duration in hours (upper left) as well as absolute anomalies in hours (upper right), percentiles (lower left) and percentages of the long-term mean (lower right) relative to 1991–2020 for the year 2021. Source: [RCC-CM website](#).

In **Western Europe**, the sunshine duration was slightly above normal with an overall anomaly of +16.22 hours. The reason for this was a very sunny spring which partly got cancelled out by a summer with below normal sunshine duration.

Central Europe was divided in two parts, the northern part with negative anomalies and the southern part with positive anomalies. The anomalies ranged from -200 up to +500 hours in parts of Austria, Hungary and Slovakia. That's why the annual mean anomaly for the whole was around normal with only +6.43 hours.

The anomalies of the **Central Mediterranean Region** were between -200 and +200 hours respectively. The annual sunshine duration anomaly for the whole region was 52 hours above normal, because of sunny spring and summer months.

Eastern Europe had very normal sunshine durations in almost all seasons. Summer and autumn had seen slightly more sun than normal while winter and spring had slightly negative anomalies, therefore the annual sunshine duration anomaly was slightly positive with a value of +10 hours.

The **Iberian Peninsula** was divided in a sunnier east and a less sunny west with values of -200 up to +200 hours respectively. The annual sunshine duration anomaly for the whole region was 17 hours below normal, making the Iberian Peninsula the only region with negative annual anomalies.

The **Middle East** was very sunny in winter and spring with values around 80 hours above normal. Therefore, the annual sunshine duration anomaly was 176 hours above normal. Anomalies of up to +500 hours were found in Syria.

The anomaly of the **Nordic and Baltic countries** was 40 hours above normal. That was due to a summer with above normal sunshine duration anomalies. Southern Norway saw anomalies in the range between +200 and +500 hours above normal.

In **Türkiye and South Caucasus**, the sunshine duration anomaly was 108 hours above normal. In 2021, winter and spring were distinctively more sunny than normal. Eastern Türkiye and South Caucasus saw anomalies of up to +500 hours of sunshine duration.

2.5. Drought situation

When looking at the Global Precipitation Climatology Centre Drought Index (GPCC-DI, Ziese et al. 2014) as a metric for characterizing meteorological drought, the RA VI Region was mostly mildly wet. The southwestern part of the RA VI Region saw severe drought in some regions but mostly only mild drought. Mild drought conditions occurred as well in eastern Austria, Hungary and Italy. Similar conditions also prevailed in southern Norway with a drought class of mild drought. The Middle East experienced in some regions severe drought. Western Kazakhstan saw conditions ranging from mildly to moderately wet (Figure 2-7).

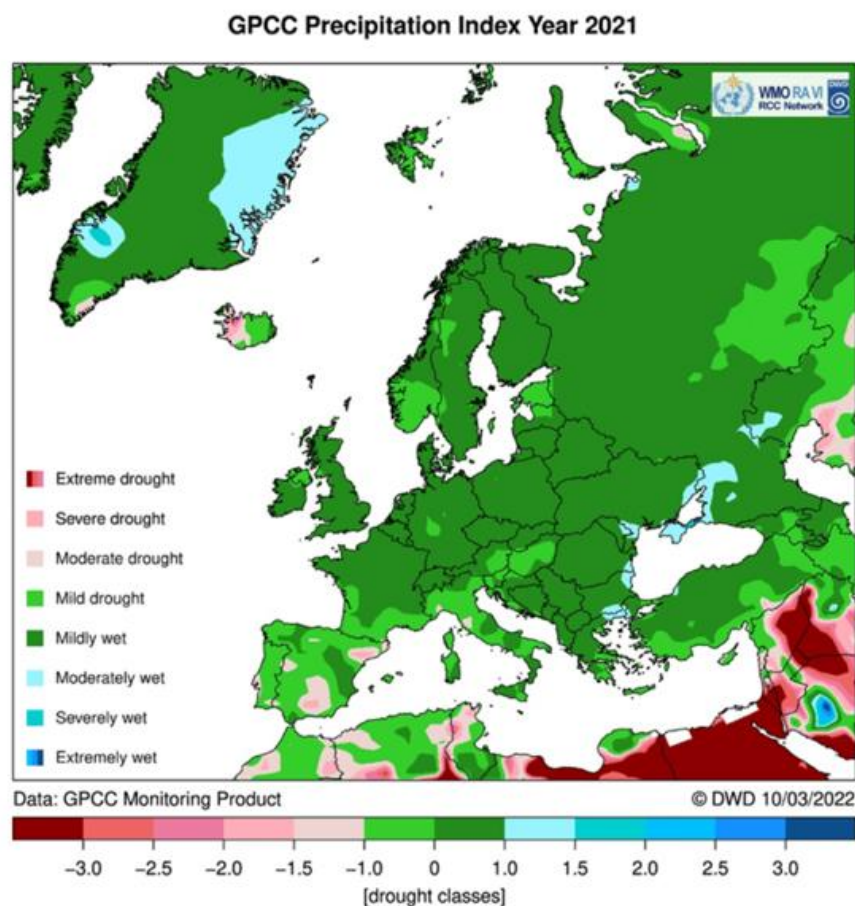


Figure 2-7: Annual GPCC -DI (GPCC-Drought Index) in drought classes relative to 1961–1990 for the year 2021. Source: [RCC-CM website](#).

2.6. Snow cover

In **January**, most parts of the RA VI Region were affected by snow. Countries with absolutely no snow were Ireland, Portugal, western France and the Middle East. Northern Europe and a band from Russia to the Alps mostly experienced 26 to 31 days of snow. Slovenia and Switzerland characterized January as extremely wet with snowfall mostly in the mountains. The countries around the Mediterranean Sea saw only partly snow. Spain was covered by snow in the centre and small parts of this region was snow-covered the whole month. Portugal experienced snow in lower elevation regions on 9 January. Larger regions in eastern Türkiye were also covered the whole month. The rest of the RA VI Region had seen snow on some days of January.

February was similar to January but with less snow in the southern part of the RA VI Region compared to January. Spain had almost no snow days in February and the snow days in Italy and

the Balkan region were less than in January. Southern Germany and the Benelux states had six to ten days of snow. In addition, Germany reported many stations with new snow depths of at least 25 cm.

In **March**, snow fell mainly in the northern and eastern part of the RA VI Region. Sweden was divided in two parts: a northern part with snow days the whole month and a southern part with no snow days. Western Europe was mainly without snow and in Central Europe the Alpine region was covered with snow the whole month. In addition, parts of Poland and the Czech Republic had one to five days of snow. The Balkan region was affected by snow on five to twenty days. Eastern Türkiye and the South Caucasus had seen snow partly even 26 to 31 days.

In **April**, the snow days decreased in most parts of the RA VI Region. In northern Russia the number of snow days mostly ranged from six to twenty days. In some mountainous regions in Central Europe snow cover was observed on up to 31 days. Eastern Türkiye had also some regions with up to 31 snow days. Scandinavia had almost everywhere 31 snow days except for southern Sweden and southern Finland.

In **October**, the northern part of the RA VI Region saw snow days. In Norway, northern Sweden and Finland it was around 20 snow days and in northern Russia there were around 10 snow days. Parts of the Alps and the Caucasus had also seen partly snow in October.

The snow days in **November** increased. Parts of Central and Western Europe had one to five snow days. The Iberian Peninsula had seen snow in some parts for over 10 days. Five days with snow were also found in some regions in the Balkan area.

In **December**, Western Europe received almost no snow. In the countries around the Mediterranean Sea, some parts had seen snow on around 10 days. The eastern part of Central Europe received snow on around 20 days. The northern part of the RA VI Region and Russia had snow days the whole month.

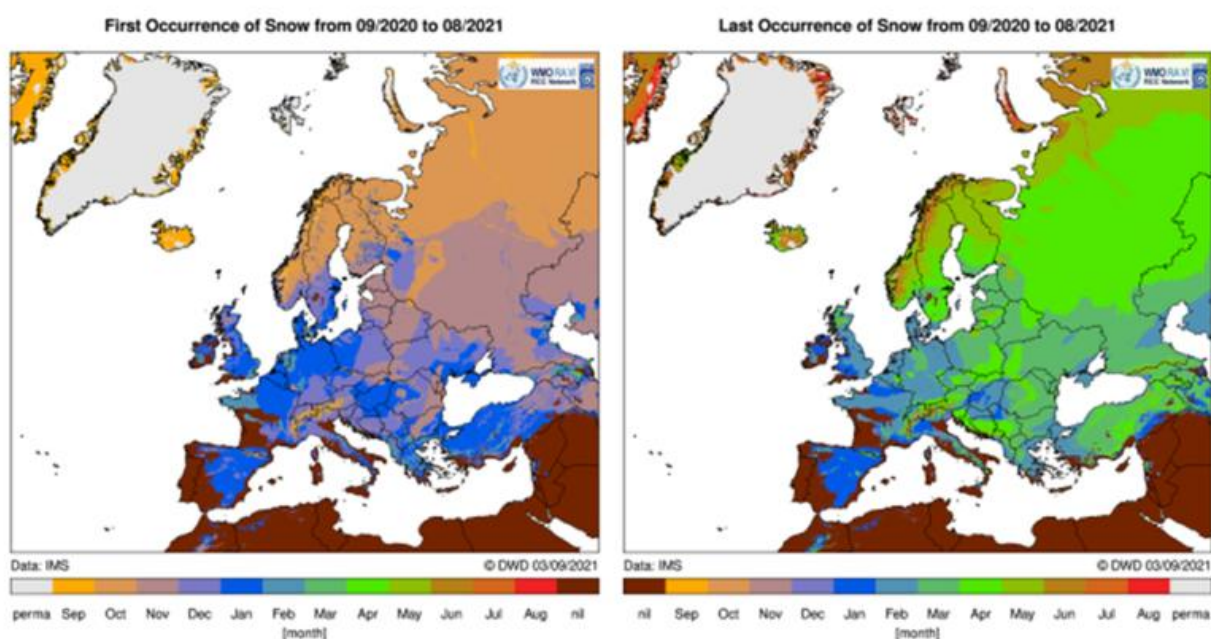


Figure 2-8: First occurrence of snow (left) and last occurrence of snow (right) during the snow season 2020/2021 from 09/2010 to 08/2021. Source: [RCC-CM website](#).

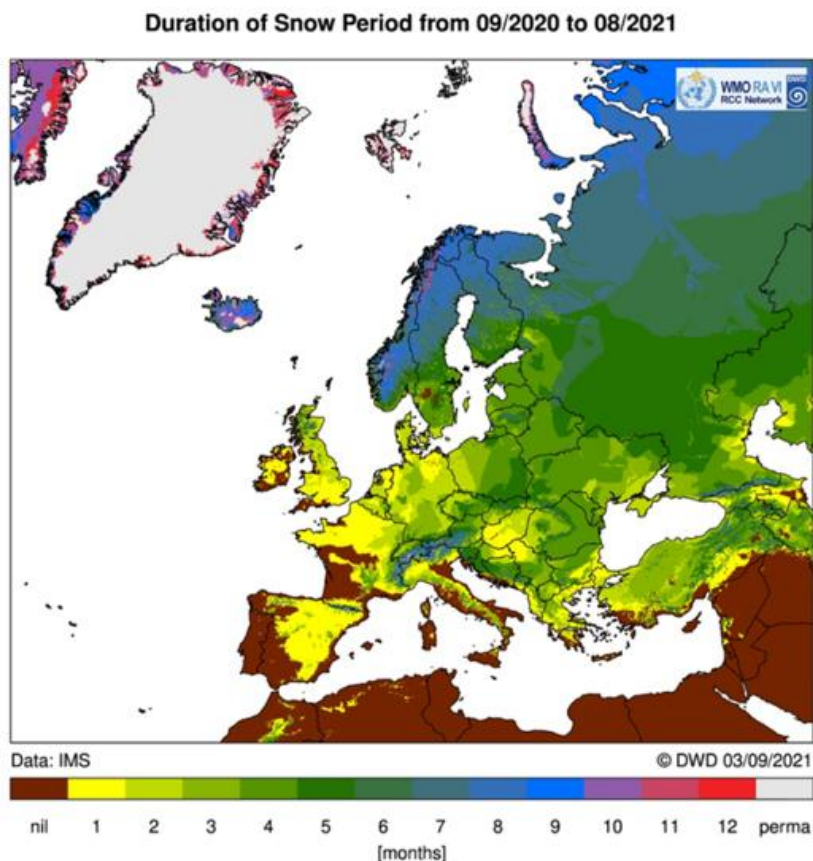


Figure 2-9: Duration of snow cover in the snow season 2020/2021 (from 09/2020 to 08/2021).
Source: [RCC-CM website](#).

2.7. Selected climate indices for 2021

This section presents selected temperature and precipitation indices calculated based on the SYNOP-based GPCP (Global Precipitation Climatology Centre; [GPCP Website](#)) Product. Annual climate index maps are shown as well as anomaly maps (with respect to 1981–2010). The following climate indices are considered:

1. **Number of Summer Days:** count of days where TX (daily maximum temperature) $\geq 25\text{ }^{\circ}\text{C}$
2. **Number of Tropical Nights:** count of days where TN (daily night temperature) $\geq 20\text{ }^{\circ}\text{C}$
3. **Precipitation Days:** count of days where RR (precipitation) $\geq 1\text{ mm}$
Precipitation below 1 mm/day has no effect on vegetation because it normally evaporates on the same day and is locally affected.
4. **Very Heavy Precipitation Days:** count of days where RR (precipitation) $\geq 20\text{ mm}$

The **number of summer days** was around normal in Western Europe and western parts of Central Europe. Italy and its islands had up to 50 more summer days than normal. The Balkan Peninsula and Eastern Europe also saw more summer days than normal (+20 to +30 days) same as parts of Türkiye (+20–30 days) and the Caucasus region (>+50 days). Only parts of the Iberian Peninsula, France, Belgium and the Netherlands had over large parts less summer days than normal (–10 to –30 days).

The **number of tropical nights** was around normal in large parts of the RA VI Region. Only the Mediterranean region and the areas north of the Black Sea experienced between 30 and 50 days more tropical nights than normal.

The amount of **precipitation days** was around normal in large parts of the RA VI Region with mostly 100–150 precipitation days. Slightly positive anomalies (+20 to +40 days) occurred in smaller areas in Spain, Italy and Germany. There were up to 60 days more of precipitation days north of the Black Sea and in parts of northern European Russia. Southeastern Türkiye and adjacent areas had less precipitation days (–20 days) than normal.

Very heavy precipitation days occurred especially in a band stretching from the Alps over the coastal regions of the Balkan States to northern Greece. Here, the number of days ranged mostly between 6 and 18 days, only local up to 30 days. Also, the coast of Norway and the region north of the Black Sea experienced up to 30 days with very heavy precipitation. Whereas the coast of Norway, the Alpine Region and Italy had fewer heavy precipitation days than normal (–9 days), the other areas with very heavy precipitation had positive anomalies (+6 to +9 days). Parts of the Iberian Peninsula, France, Germany and Türkiye had less heavy precipitation days than normal with anomalies of –6 to –9 days.

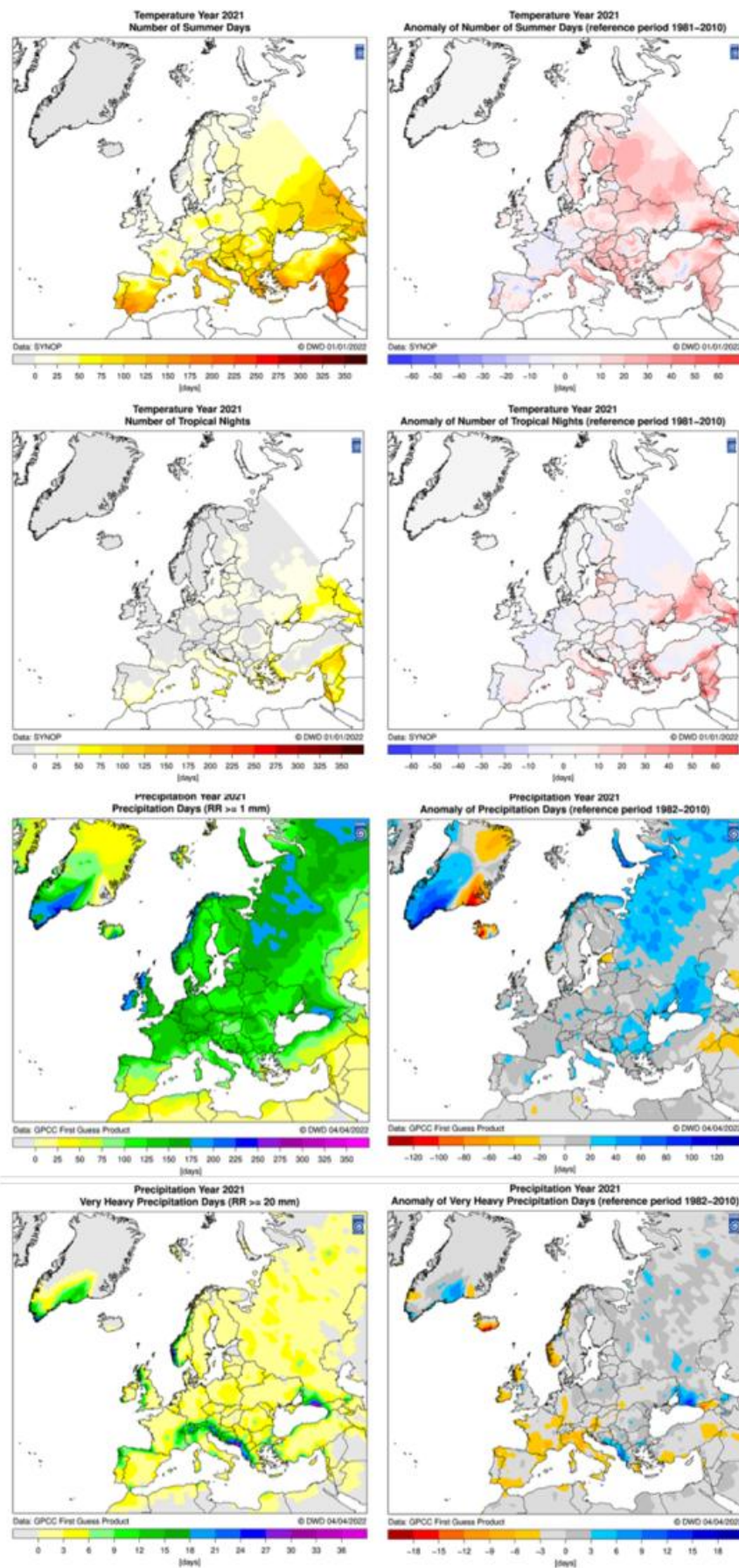


Figure 2-10: Selected SYNOP-based Climate Indices for 2021 (left) and their anomalies (right) with respect to the 1981 to 2010 reference period (Source: DWD).

3. Seasonal survey

This section presents an overview of the spatial patterns of seasonal mean climate conditions in 2021 and anomalies related mainly to the normal period 1981–2010 of the following selected climate variables: sea level pressure, circulation indices, surface temperature, precipitation and sunshine duration.

3.1. Sea level pressure and circulation indices

In **winter 2020/2021**, the pressure pattern was dominated by a pronounced positive anomaly over the northern part of the RA VI Region (+2 to +14 hPa) with a maximum in the region of the Barents Sea and lower-than-normal pressures occurred over Central and Western Europe with anomalies of up to –6 hPa in Western Europe. Accordingly, the seasonal averages for AO and NAO show are negative (see Table 3-1). The Polar/ Eurasia Pattern was also strongly negative (–1.58). The described pressure pattern favoured the flow of cold polar air towards northern Europe and Siberia, and thus below-average temperatures over these regions.

In **spring**, the Icelandic Low was shifted northeast to the Barents Sea and the Azores High extended to Greenland. Therefore, positive pressure anomalies were found over Iceland. These positive anomalies extended to the Mediterranean Sea. The anomalies of the eastern part of the RA VI Region were slightly negative with a maximum between –6 and –8 hPa over the Barents Sea respectively. The dominant circulation pattern was the Scandinavian pattern (SCA with a value of –1.05). The values of the northern hemisphere teleconnections were low because of opposite signs in the spring months.

In **summer**, the anomalies were mostly around normal (anomalies between –2 and +2 hPa). Both the Icelandic Low and Azores High were shifted northward, therefore positive pressure anomalies occurred in Russia and in the region between Norway, Scotland. The East Atlantic Pattern (EA) and the East Atlantic/ West Russia Pattern (EA/WR) were dominant with opposite signs.

In **autumn**, anomalies were not significantly different from normal in most parts of the RA VI Region, except for the Arctic region, where anomalies between +6 and +8 hPa occurred. In addition, higher-than-normal pressures occurred east of Ireland with anomalies between +4 and +6 hPa.

Table 3-1: Seasonal mean values of selected northern hemisphere teleconnection indices standardized to the 1981–2010 reference. Blue and orange colours indicate index values being lower than 0 and greater than 0 respectively.

Season	AO	NAO	EA	EA/WR	SCA	POL
Winter 2020/2021	–1.8	–0.82	0.13	–0.54	0.98	–1.58
Spring 2021	0.58	–0.81	0.31	0.44	–1.05	–0.02
Summer 2021	0.42	0.22	1.42	–1.54	–0.01	0.4
Autumn 2021	–0.1	–0.79	0.55	–0.03	–0.36	–0.32

Note that all values are standardized with the reference 1981 to 2010. North Atlantic Oscillation (NAO); East Atlantic Pattern (EA); East Atlantic/West Russia Pattern (EA/WR); Scandinavia Pattern (SCA); Polar/Eurasia Pattern (POL); Arctic Oscillation (AO). Sources: [NOAA CPC Indices](#) and [NOAA CPC Monthly AO Index](#).

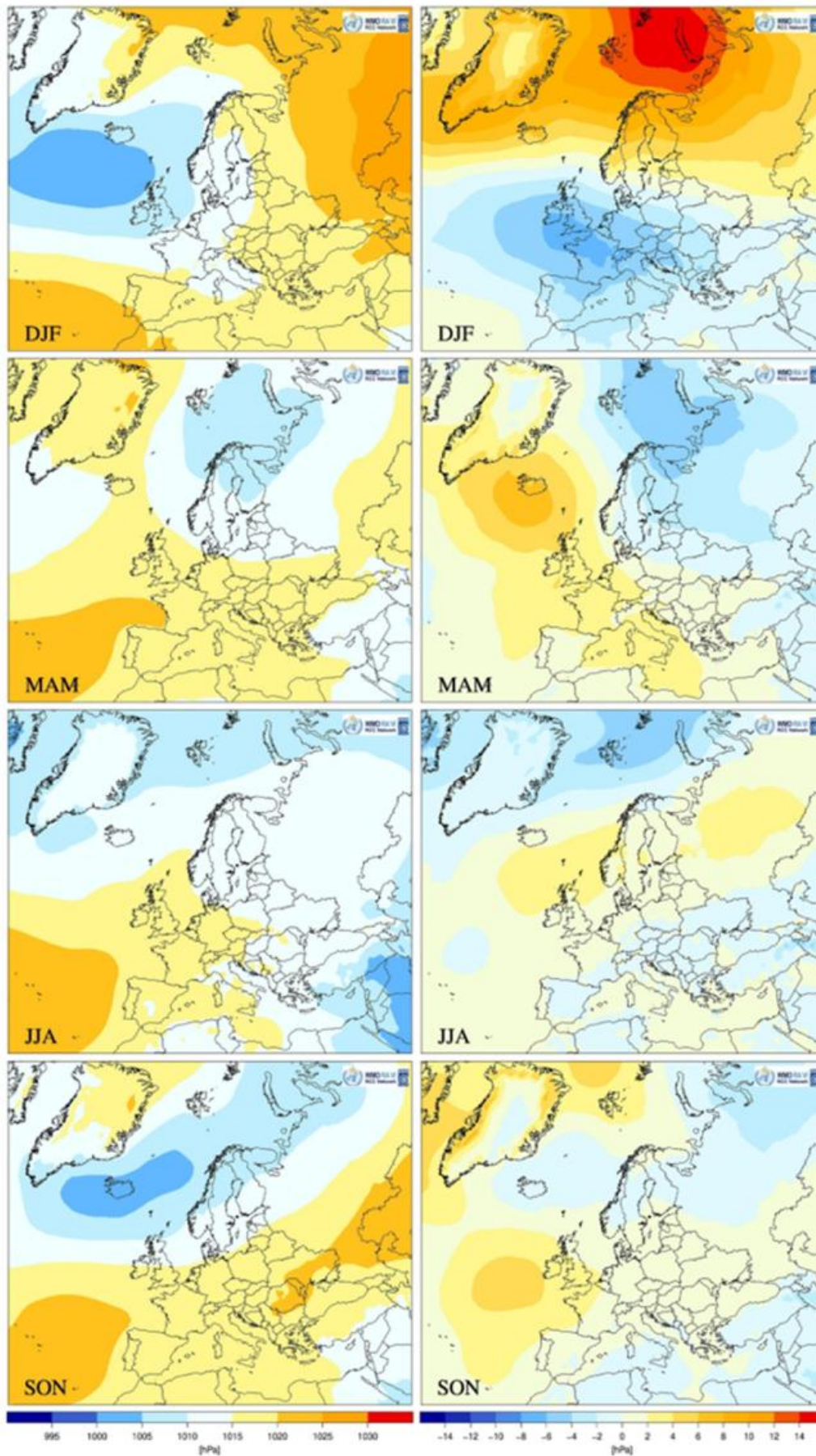


Figure 3-1: Seasonal sea level pressure in h Pa (left) and anomalies in h Pa relative to 1981–2010 (right) for winter (DJF), spring (MAM), summer (JJA) and autumn (SON) 2021. Winter values relate to December 2020 – February 2021. Source: [RCC-CM website](#).

3.2. Temperature

In 2021, the mean annual temperatures were higher than normal in most of the RA VI Region with anomalies ranging from -0.1 °C in Central Europe to $+1.2$ °C in the Middle East. In winter 2020/21 and autumn, the anomalies were positive for most sub-regions with highest anomalies occurring in Türkiye and South Caucasus ($+2.0$ °C). In spring, significantly negative anomalies occurred in Central Europe (-1.7 °C) and Western Europe (-1.1 °C) and the Central Mediterranean Region (-0.9 °C) as seen in *Fehler! Verweisquelle konnte nicht gefunden werden.*

Table 3-2: Seasonal and annual area average temperature anomalies in °C for each sub-region in the year 2021 (reference period: 1991–2020; definitions of the sub-regions see Figure 1-1).

Region	Year	Winter	Spring	Summer	Autumn
Central Europe	-0.1	+0.6	-1.7	+0.7	+0.4
Central Mediterranean Region	+0.5	+1.8	-0.9	+1.1	+0.3
Eastern Europe	+0.3	-0.8	+0.2	+2.0	0.0
Iberian Peninsula	+0.3	+0.5	+0.1	0.0	0.0
Middle East	+1.2	+1.8	+1.7	+0.9	+1.8
Nordic and Baltic Countries	0.0	0.0	+0.2	+1.3	+0.3
Türkiye and South Caucasus	+1.0	+2.0	+1.0	+0.8	+0.2
Western Europe	0.0	+0.4	-1.1	+0.1	+0.4

Winter 2020/2021 was warmer than normal in most parts of the RA VI Region. It was particularly warm in Türkiye and South Caucasus ($+2.0$ °C), the Central Mediterranean Region ($+1.8$ °C) and in the Middle East ($+1.8$ °C). In these regions, for some countries (Bosnia and Herzegovina, Bulgaria, Croatia, Israel Jordan and Serbia) the winter season 2021 ranked as one of the five warmest on record. In the Central Mediterranean Region, temperatures anomalies in some countries were close to $+3$ °C (Bulgaria, Serbia and Montenegro). Similar anomalies occurred also in the Arctic region, especially Svalbard ($+2.8$ °C). Only Eastern Europe was colder than normal (-0.8 °C).

In **spring**, both strongly positive and strongly negative anomalies occurred. The anomalies ranged from -1.7 °C in Central Europe to $+1.7$ °C in the Middle East. In Türkiye and South Caucasus region ($+1.0$ °C), spring 2021 was among the five warmest spring seasons in Türkiye ($+2.0$ °C) and Armenia ($+2.5$ °C). Especially warm spring temperatures occurred in Jordan and Syria with anomaly values close to $+2.0$ °C. In contrast, the Czech Republic and Croatia saw their fourth and fifth coolest spring season on record respectively, with anomaly values of -2.1 °C and -1.2 °C (see *Fehler! Verweisquelle konnte nicht gefunden werden.*). Western Europe was also significantly colder than normal with an anomaly of -1.1 °C.

Summer 2021 was remarkably warmer than normal in most regions. Only the Iberian Peninsula and Western Europa had around normal conditions (with anomalies value close to zero). The largest anomalies occurred in the Eastern Europe with $+2.1$ °C. Especially Kazakhstan had much warmer-than-normal temperatures ($+3.3$ °C), which were the highest summer anomalies of all countries considered. High anomalies also occurred in the Central Mediterranean Region ($+1.1$ °C) and the

Nordic and Baltic Countries (+1.3 °C). For many countries in the RA VI Region, summer 2021 was among the top five warmest summers (see Table 3-3). For Armenia, Estonia, Latvia and Lithuania it was even the warmest summer since the start of the time series. Portugal, on the contrary, experiences its fifth coldest summer on record with an anomaly of -0.1 °C.

Temperature anomalies in autumn were close to zero or positive, similar to summer, but they were less pronounced. Anomaly values ranged from normal conditions over the Iberian Peninsula to +1.8 °C in the Middle East. Autumn 2021 was among the five warmest in Denmark (+1.5 °C), Ireland (+1.2 °C), Türkiye (+0.7 °C) and the United Kingdom (+1.2 °C). For Ireland, it was even the warmest autumn since records began.

Table 3-3: Seasonal rank statistics for temperature (2020/2021) as provided by the NMHSs including countries with rankings among the top 5 (ranks 1–5) since start of the time series.

Country	Rank	Anomaly [°C]	Reference period
winter			
Bosnia and Herzegovina (Sarajevo)	3 (warmest)	+2.6	1991–2020
Bulgaria	2 (warmest)	+2.6	1991–2020
Croatia (Zagreb)	5 (warmest)	+2.8	1981–2010
Israel	3 (warmest)	+0.5	1991–2020
Jordan (Amman Airport)	3 (warmest)	+1.9	1991–2020
Romania	2 (warmest)	+2.7	1991–2020
Serbia	3 (warmest)	+3.0	1981–2010
spring			
Armenia	5 (warmest)	+2.5	1961–1990
Croatia (Zagreb)	5 (coldest)	-1.2	1981–2010
Czech Republic	4 (coldest)	-2.1	1991–2020
Jordan (Amman Airport)	2 (warmest)	+2.0	1991–2020
Türkiye	4 (warmest)	+2.0	1991–2020
summer			
Armenia	1 (warmest)	+2.5	1961–1990
Belarus	2 (warmest)	+2.0	1961–1990
Bosnia and Herzegovina (Sarajevo)	2 (warmest)	+1.8	1991–2020
Bulgaria	5 (warmest)	+0.9	1991–2020
Croatia (Zagreb)	5 (warmest)	+2.3	1981–2010
Estonia	1 (warmest)	+2.2	1991–2020
Finland	2 (warmest)	+1.8	1991–2020
Georgia	2 (warmest)	+1.4	1991–2020
Hungary	5 (warmest)	+1.2	1991–2020
Italy	5 (warmest)	+2.7	1961–1990

Country	Rank	Anomaly [°C]	Reference period
Jordan (Amman Airport)	5 (warmest)	+1.0	1991–2020
Latvia	1 (warmest)	+2.1	1991–2020
Lithuania	1 (warmest)	+1.9	1991–2020
North Macedonia	3 (warmest)	+1.7	1981–2010
Poland	4 (warmest)	+1.0	1991–2020
Portugal	5 (coldest)	-0.1	1971–2000
Serbia	5 (warmest)	+1.9	1981–2010
Slovakia	5 (warmest)	+1.8	1991–2020
Sweden	5 (warmest)	+2.5	1860–1900
autumn			
Denmark	5 (warmest)	+1.1	1991–2020
Ireland	1 (warmest)	+1.2	1991–2020
Türkiye	5 (warmest)	+0.7	1991–2020
United Kingdom ⁵	3 (warmest)	+1.1	1991–2020

⁵ Statistics are based on [v.1.1.0.0 of HadUK-Grid](#)

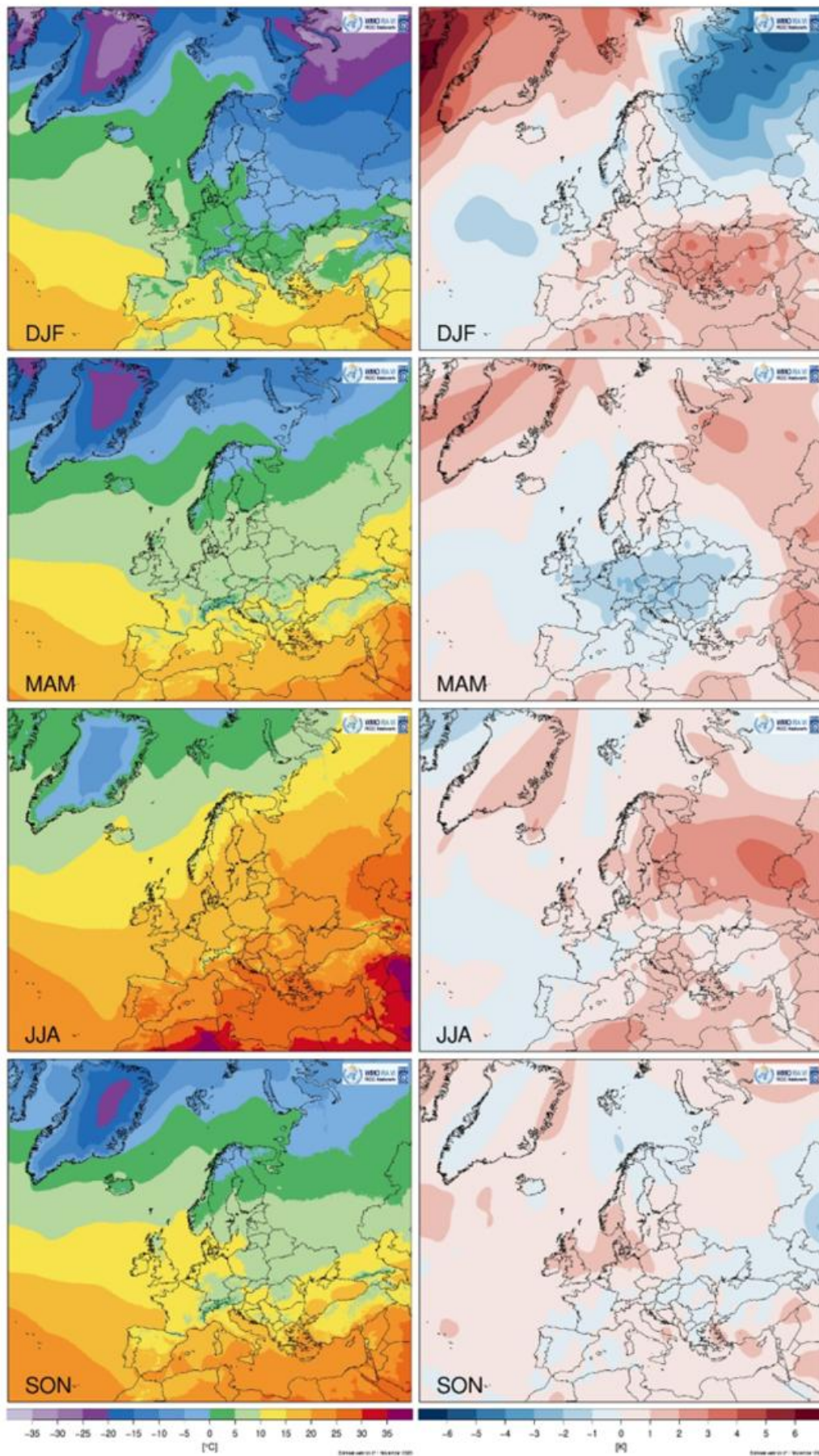


Figure 3-2: Seasonal mean temperature in °C (left) and anomalies in K relative to 1991–2020 (right) for winter (DJF), spring (MAM), summer (JJA) and autumn (SON) 2021. Winter values relate to December 2020 – February 2021. Source: [RCC-CM website](#).

3.3. Precipitation

In 2021, the average precipitation varied between each region from around 50% (% of normal precipitation) in the Middle East to 109% in Eastern Europe. Eastern Europe and the central Mediterranean region were wetter than normal. All the other regions were drier than normal in 2021. For several countries 2021 ranked among the top five of the wettest or driest years since start of the time series (see Table 2-2.) and several also reported seasons ranking among the top five of the wettest or driest since start of the time series (see Fehler! Verweisquelle konnte nicht gefunden werden.).

Table 3-4: Seasonal and annual average of precipitation anomalies over land areas in % for each sub-region in the year 2021 (reference period: 1991–2020; definitions of the sub-regions see Figure 1-1).

Region	year	winter	spring	summer	autumn
Central Europe	98	101	99	116	68
Central Mediterranean Region	105	160	86	75	103
Eastern Europe	109	109	119	104	94
Iberian Peninsula	84	103	68	104	77
Middle East	50	66	32	126	29
Nordic and Baltic Countries	87	81	98	84	100
Türkiye and South Caucasus	92	95	86	104	80
Western Europe	94	116	91	101	82

In winter 2020/2021, the Central Mediterranean region was distinctively wet with precipitation totals of up to 160% of normal amounts. In addition, Western Europe was wetter than normal with precipitation totals of up to 116% of normal amounts and Eastern Europa also slightly above normal (109%). In the Nordic and Baltic countries, the precipitation anomalies were mixed with positive anomalies of up to 250% of normal amounts in the south of Greenland and negative anomalies of up to only 20% of the normal values. Especially the Baltic countries had distinctively less precipitation than normal. For the whole domain, precipitation was less than normal (81%). The Iberian Peninsula was wetter than normal in the northwest and drier the southeast, which results in around normal precipitation for the whole area. The Middle East and Türkiye were severely dry with up to 20% of normal amounts. In contrast, South Caucasus was wetter than normal with precipitation totals of 500% of normal amounts. This results again in around normal precipitation for the domain of Türkiye and South Caucasus. Central Europe's precipitation was around normal.

Spring in the Northeast of the RA VI Region was wetter than normal with anomalies of up to 167% of the normal amount (see Figure 3-3). For Lithuania and Türkiye spring 2021 ranked among the top five of the wettest springs since start of measurements. The south of the RA VI Region was drier than normal. Especially in the Middle East saw largely precipitation totals of only 20% of the normal amounts. The mean value of the Middle East was 32% of the normal amount. For Italy and Spain, spring 2021 ranked among the five driest since start of measurements. Western and Central Europa as well as the Nordic and Baltic countries were mostly around normal.

In **summer**, a band, stretched from around the Black Sea over Poland to France, was wetter than normal (see **Figure 3-3**). In the north of the Black Sea were precipitation totals of 250% of the normal amounts. For Belgium and Greenland, summer 2021 was the wettest summer since starts of measurements, for Luxembourg it was among the five wettest. In contrast, for Serbia, Croatia and Bosnia and Herzegovina, summer 2021 was among the five driest since starts of measurements.

In **autumn**, most of the RA VI Region was drier than normal. Especially the Middle East was dry with precipitation totals of only 29% of normal. For Moldova and the Czech Republic it was the second driest autumn since start of measurements. The Central Mediterranean region, the Nordic and Baltic countries and European Russia had around normal conditions.

Table 3-5: Seasonal rank statistics for precipitation (2020/2021) as provided by the NMHSs including countries with rankings among the top 5 (ranks 1–5) since start of the time series.

Country	Rank	Anomaly [mm]	Reference period
winter			
Bulgaria	4 (wettest)	98.1	1991–2020
Greenland (Nuuk)	2 (wettest)	203.8	1981–2010
Italy	3 (wettest)	109	1961–1990
Serbia	4 (wettest)	-	-
spring			
Italy	5 (driest)	-66	1961–1990
Lithuania	5 (wettest)	41	1991–2020
Spain	4 (driest)	-56.4	1981–2010
Türkiye	4 (wettest)	-23.4	1991–2020
summer			
Belgium (Uccle)	1 (wettest)	176.5	1991–2020
Bosnia and Herzegovina (Sarajevo)	5 (driest)	58.4	1991–2020
Croatia (Zagreb)	5 (driest)	-114.6	1981–2010
Greenland (Nuuk)	1 (wettest)	176.2	1981–2010
Luxembourg	2 (wettest)	134.2	1991–2020
Serbia (Zlatibor)	4 (driest)	-	-
autumn			
Czech Republic	2 (driest)	-63.4	1991–2020
Moldova (Chisinau)	2 (driest)	-118	1991–2020

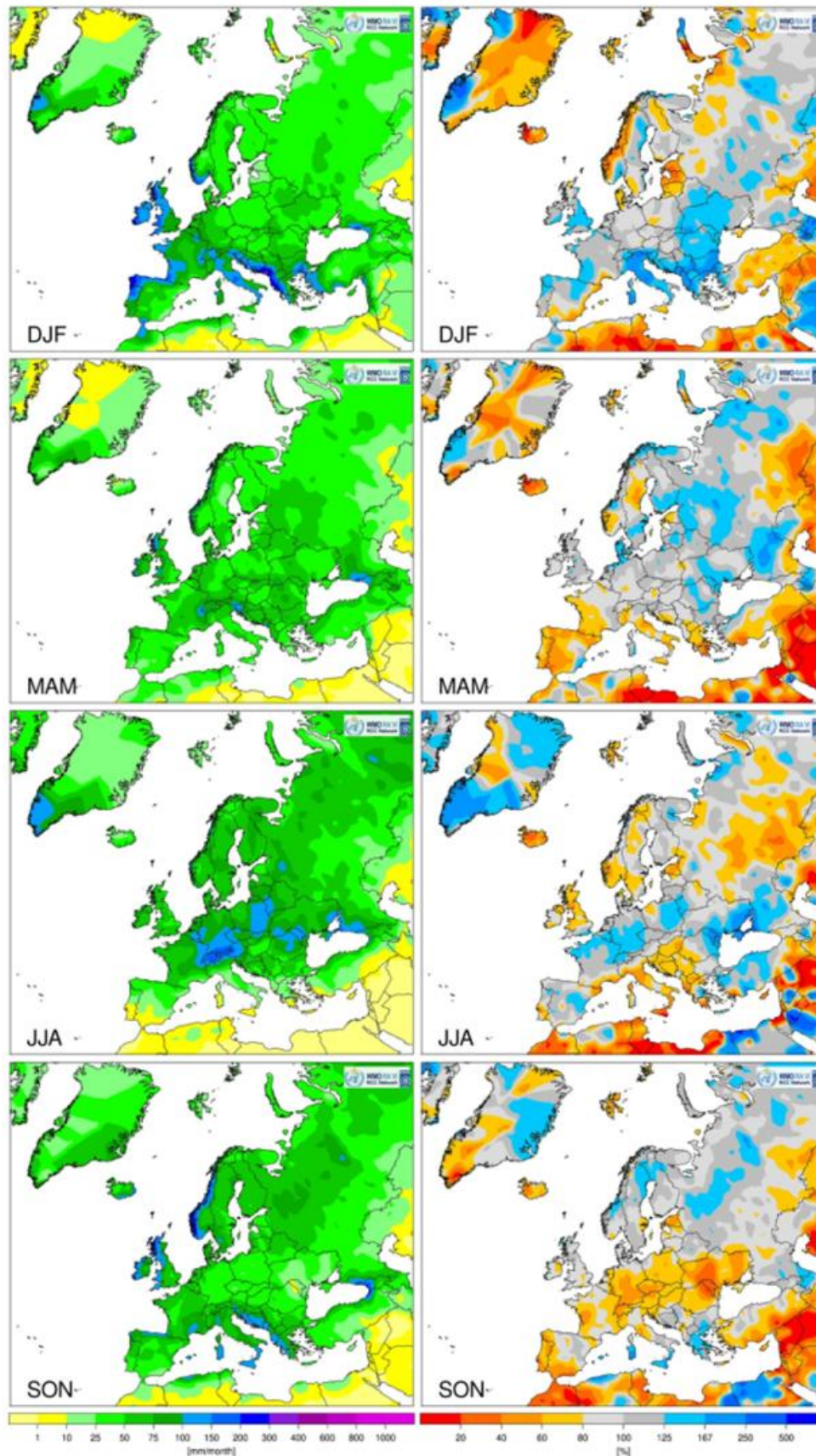


Figure 3-3: Seasonal total precipitation in mm per month (left), and relative anomalies in % of the average for 1991–2020 (right) for winter (DJF), spring (MAM), summer (JJA) and autumn (SON) 2021⁶. Winter values relate to December 2020 – February 2021. Source: [RCC-CM website](#).

⁶ Similar to the RCC annual precipitation anomaly maps shown in 2.3, the RCC seasonal precipitation maps may also not correctly represent the totals and anomalies observed for Estonia and Iceland. See ¹⁾ on p.7.

3.4. Sunshine duration

The sunshine duration in the year 2021 was mostly above normal with absolute anomalies of up to 176 hours in the Middle East. The only region with less sunshine than normal was the Iberian Peninsula with anomaly values of –17 hours (see **Figure 3-4**).

Table 3-6: Seasonal and annual average of sunshine duration anomalies over land areas in hours for each sub-region in the year 2021 (reference period: 1991–2020; definitions of the sub-regions see **Figure 1-1**).

Region	Year	Winter	Spring	Summer	Autumn
Central Europe	+6	–10	–35	+14	+41
Central Mediterranean Region	+52	–20	+37	+29	–16
Eastern Europe	+10	–2	–6	+15	+14
Iberian Peninsula	–17	–57	+9	–9	+27
Middle East	+176	+80	+83	+12	+22
Nordic and Baltic Countries	+40	+3	+11	+45	–21
Türkiye and South Caucasus	+109	+67	+61	–8	+6
Western Europe	+16	–22	+57	–45	+17

In **winter 2020/2021**, the Middle East and Türkiye and South Caucasus were sunnier than normal with values up to 80 hours above normal. The Nordic and Baltic Countries had seen around normal sunshine with an anomaly of +3 hours. Negative anomalies were found in all the other sub-regions of the RA VI Region. The negative values ranged between –2 hours in Eastern Europe and –57 hours on the Iberian Peninsula (see Fehler! Verweisquelle konnte nicht gefunden werden.). A narrow band of anomalies up to –200 hours extended from Portugal to northern Italy. Türkiye and Syria were exceptionally sunny with absolute anomalies of up to +200 hours (see Fehler! Verweisquelle konnte nicht gefunden werden.).

In **spring 2021**, the anomalies were positive in most sub regions. Exceptions were Central Europe with –35 hours and Eastern Europe with –6 hours. The Middle East had the largest anomalies with 83 hours more than normal (see **Figure 3-4**). Estonia was distinctively less sunny than normal with absolute anomalies of up to –200 hours in eastern parts. Exceptionally sunny was the Atlantic coast of France and Norway with anomalies of up to 200 hours above normal (see **Figure 3-4**).

In **summer**, the Nordic and Baltic countries had seen distinctively more sun than normal with anomaly values of +45 hours. Distinctively less sunny was Western Europe with anomalies of –45 hours. Especially northern France had anomalies of up to –100 hours in some parts. The rest of the RA VI Region had only small anomalies.

Autumn was dominated by a band of positive anomalies from the Atlantic Ocean over Spain and France to the Ukraine. In some of parts of this band were anomalies of up to 200 hours above normal. All other parts of the RA VI Region, except for Türkiye and the Middle East, had slightly negative values. Therefore, the only distinct anomalies were found in Central Europe with values of +41 hours.

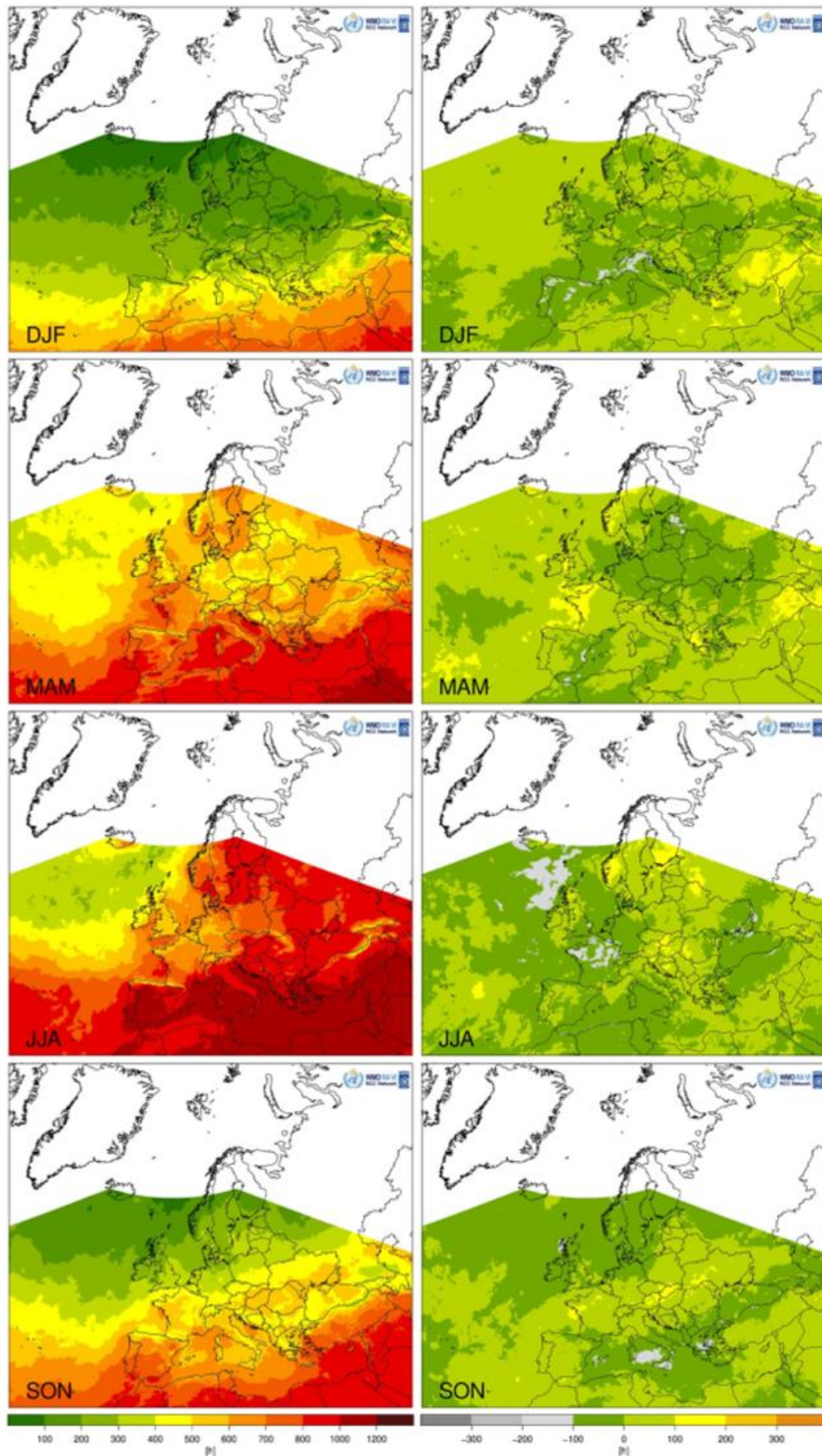


Figure 3-4: Seasonal sunshine duration in hours (left) and absolute anomalies in hours relative to 1991–2020 (right) for winter (DJF), spring (MAM), summer (JJA) and autumn (SON) 2021. Winter values relate to December 2020 – February 2021. Source: [RCC-CM website](#).

3.5. Drought

In 2021, most regions in the RA VI showed mildly dry to mildly wet conditions on average. Severe to extreme drought signals only appeared in the Middle East, parts of Spain, Iceland, Greenland and north of the Black Sea. However, some more pronounced drought conditions were observed on seasonal scale (see also **Figure 3-5**).

In **winter 2020/2021**, the RA VI Region had mostly seen mild drought to mild wet conditions with GPCC-DI values ranging from -1 to +1. Moderately wet conditions occurred partly in the United Kingdom, France, Greenland and southern Norway. Moderately to severely wet conditions had been partly in the Balkan region and Italy. Moderate to severe drought were in western Iceland, Estonia, the Middle East (Syria) and western Kazakhstan.

Spring was dominated by mild drought and mild wet conditions. Moderate drought was found in parts of Spain. Up to extreme drought occurred in western Iceland and the Middle East. In contrast, it was severely wet in southwestern Russia and the southern Caucasus.

In **summer**, the coastal region of the Mediterranean region had moderate to severe drought conditions. The Middle East, especially Syria, had extremely drought. Most parts of Central Europe had moderate to severely drought. Heavy rainfall occurred in Poland and therefore in August occurred the second most abundant rainfall since 1966. In addition, moderate to extreme wet situations occurred north of the Black Sea. At some meteorological stations in eastern Ukraine, the monthly rainfall reached the historical record. It had been moderately wet in parts of Sweden and in the north of Finland.

In **autumn**, most parts had mild drought to mild wet conditions. Especially Central Europe had mild drought. In and around Moldova, there was moderate to severe drought. This kind of precipitation is in Moldova observed every 15 to 30 years. Just like spring and summer, the Middle East had again mostly extreme drought.

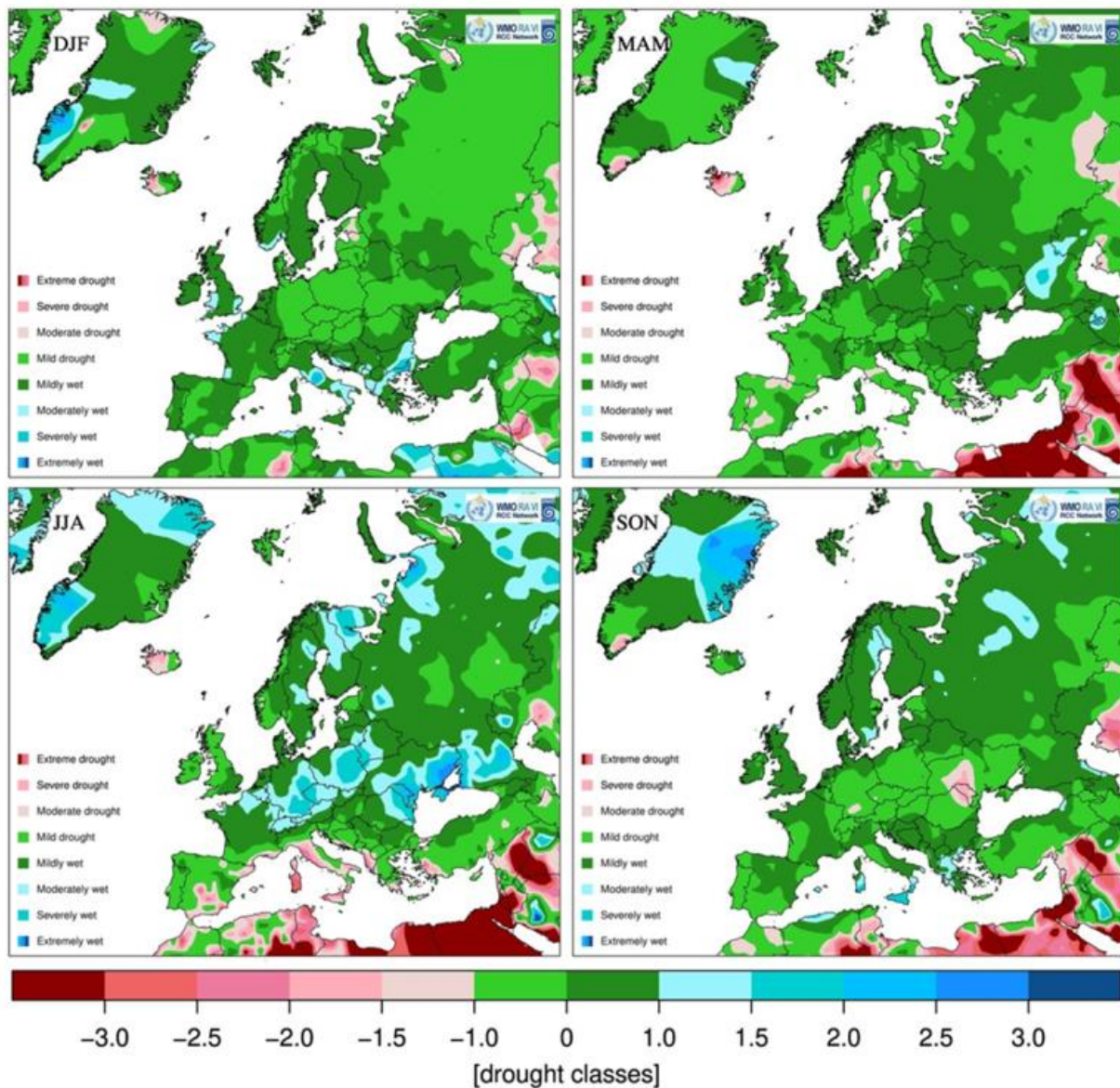


Figure 3-5: Seasonal GPCC-DI (Drought Index) in drought classes relative to 1961–1990 for winter (DJF), spring (MAM), summer (JJA) and autumn (SON) 2021. Winter values relate to December 2020 – February 2021. Source: [RCC-CM website](#).

3.6. Selected contributions by NMHSs

3.6.1. Heatwaves and wild fires in Greece and Türkiye in summer

(Contribution from the Hellenic National Meteorological Service, Greece, and from the Turkish State Meteorological Service)

Heat waves in Greece

During summer 2021, warmer than normal conditions dominated in Greece. It was the second warmest summer since 1960 (together with summer 2007) and was characterized by long episodes of heatwave.

During the period from 22 June to 2 July 2021, heat wave conditions prevailed on the Greek mainland. High temperatures for the season were observed during that period, with the maximum exceeding 42 °C in some places.

August 2021 was the warmest August on record with an average temperature of +28.8 °C, about 2.3 °C above the 1981–2010 average. The largest positive temperature anomalies of at least +3.0 °C occurred across the northern and central mainland and the southeastern Aegean islands (Figure 3-6). The first 10 days of August has been characterized by a culmination of a heat wave, which had begun at the end of July. During 28 July to 11 August 2021, Greece experienced prolonged heat wave conditions. The main feature was the long duration of the heat wave episode, as well as the very high temperatures. During that heat wave episode, several stations had daily maximum temperature above 39 °C for 8–11 consecutive days (e.g Argos and Serres stations 11 and 10 consecutive days respectively; Larisa, Hellinikon, Astros and Tithorea stations 8 consecutive days). The highest daily maximum temperatures were observed mainly during the period from 1–5 August 2021, when several stations of the Greek mainland recorded daily maximum temperature greater than 45 °C.

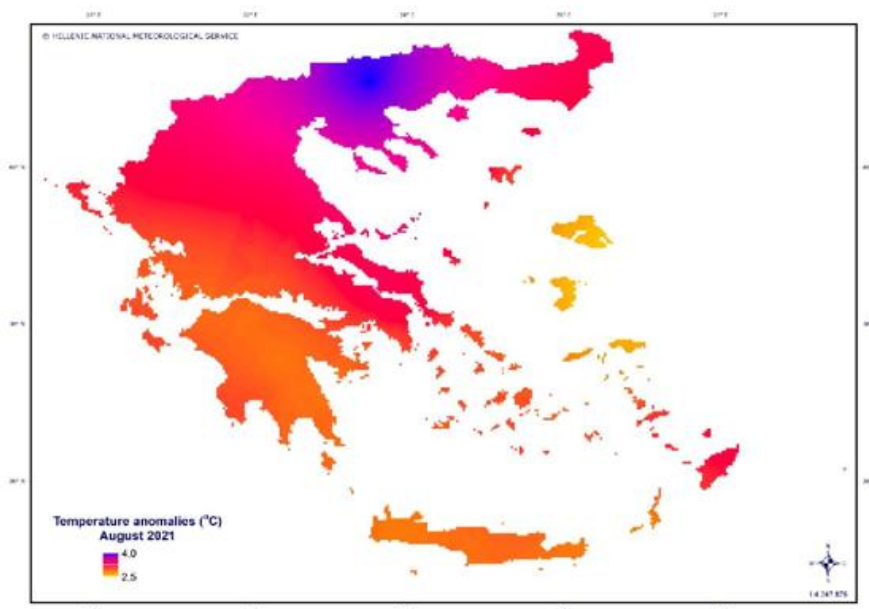


Figure 3-6: Mean temperature anomalies (°C) for August 2021 in Greece according to the 1971-2000 climatology. Source: Hellenic National Meteorological Service, Greece.

Wildfires in Greece

During 3–23 August 2021, due to the heat wave conditions, a number of wildfires spread across the country. The largest and most destructive fires raged in the island of Evia (an area of 50 887.6 ha burnt according to Copernicus - [Copernicus Website](#)), in Attiki (north of Athens) and the Peloponnese

causing thousands of evacuations, destroying hundreds of thousands of hectares of land and forest along with a number of houses and businesses, while there were two casualties. According to EFFIS (European Forest Fire Information System - EFFIS Website) 108 602 ha burnt during 3–23 August and 130 058 ha burnt in total in the year 2021, 570% of the average burnt area of 2008–2020.

Forest Fires in Türkiye

The forest fires in Türkiye started in Manavgat, Antalya on 28 July 2021 and spread to 197 locations in 44 provinces, and lasted until 12 August. During the fires, 3 people died, 271 people were injured, some hundred thousand hectares of forest and residential areas were burnt, thousands of animals died and thousands of tourists and citizens had to be evacuated (Figure 3-7).



Figure 3-7: Forest fire in Manavgat/Antalya (Türkiye) on 28 July 2021. Source: Turkish State Meteorological Service.

3.6.2. Heavy Rainfall in parts of Western/ Central Europe from May to July

(Contribution from *Deutscher Wetterdienst*, Germany, and from the *Federal Office of Meteorology and Climatology*, Switzerland)

During the months May to July a series of heavy rain events affected especially Western and Central Europe locally causing severe floods. In May, monthly totals were exceptionally above average over United Kingdom, the Netherlands and parts of Switzerland seeing more than twice the normal amounts. In June, France and Switzerland were hit by convective events bringing heavy rain, hailstorms and gusty wind, locally causing flash floods with severe damage. Monthly precipitation totals in July were well above the long-term mean in central and western Europe with the highest precipitation totals being observed in the Alps and over Central Europe, where monthly totals were exceptionally above normal. Much of the large rain amounts in Central and Western Europe were related to the low-pressure system *Bernd*, which brought regionally very pronounced heavy rainfall events especially in Germany, northeastern parts of France, Belgium and the Netherlands, leading to severe flash flooding, particularly in the western regions North Rhine-Westphalia and Rhineland-Palatinate.

Germany

After several episodes of heavy rain, low pressure system *Bernd* caused persistent or recurring heavy precipitation. The central parts of the state were affected locally, but the western part of Rhineland-Palatinate and the southern half of North Rhine-Westphalia were affected extensively. As a result, there were initially local outbreaks of small streams and flash floods. As precipitation continued, medium-sized and larger rivers such as the Ahr, Emscher, Erft, Kyll, Lippe, Prüm, Ruhr, Rur, Sieg and Wupper also burst their banks. This resulted in widespread flooding from the Eifel region (Rhineland-Palatinate) through the Rhineland and the Ruhr region to southern Westphalia (North Rhine-Westphalia). In addition to immense property damage, more than 160 people (as of 21 July 2021) lost their lives. With the departure of depression *Bernd*, the eastern Erzgebirge, Lusatia and Berchtesgadener Land were also affected. Here, too, heavy precipitation occurred, leading to regional flooding. More Information in German can be found on the [DWD Website](#).

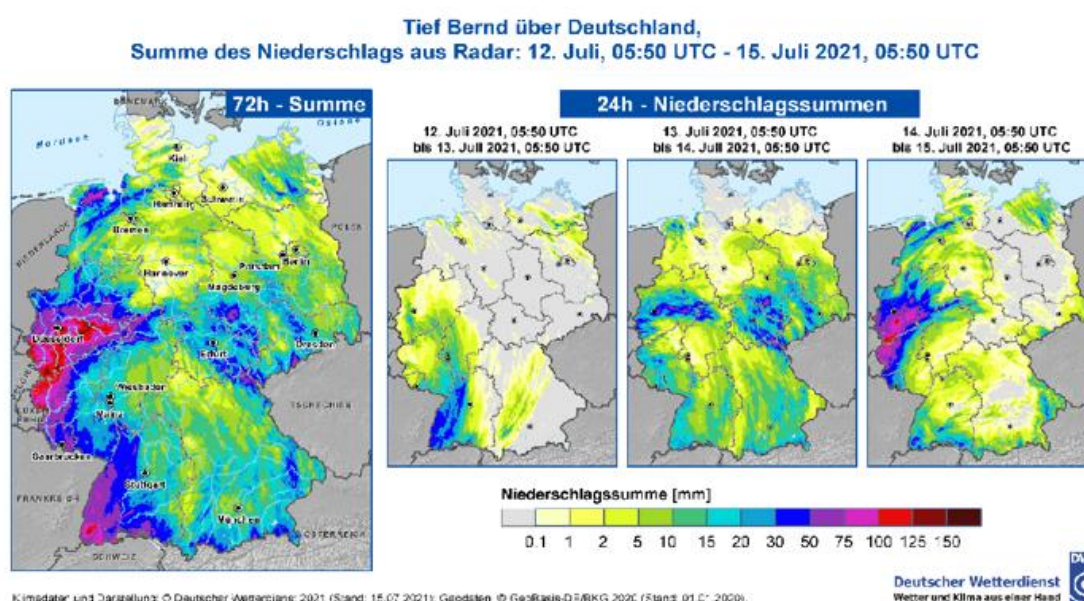


Figure 3-8: Precipitation analysis based on RADOLAN for the duration stage 24 hours and 72 hours, respectively, until 15 July 2021 05:50 UTC (07:50 CEST). Colours indicate total precipitation in mm.
Source: DWD, Hydrometeorology

Switzerland

July 2021 in Switzerland was exceptionally wet. The month was characterized by persistent humid and unstable atmospheric conditions, which led to widespread thunderstorms with heavy precipitation, hailstorms and squalls. Except for central and southern Grisons, precipitation totals throughout Switzerland exceeded 180% of the 1981–2010 norm. At numerous stations, long-term precipitation records were clearly exceeded. The national average of 197% of the 1981–2010 norm was the wettest July since measurements began in 1864.

Long hailstorms crossed large parts of Switzerland, as in June. July counted eight hail days across Switzerland. Some places in Ticino and along the central and eastern main ridge of the Alps were even hit by hail on four days.

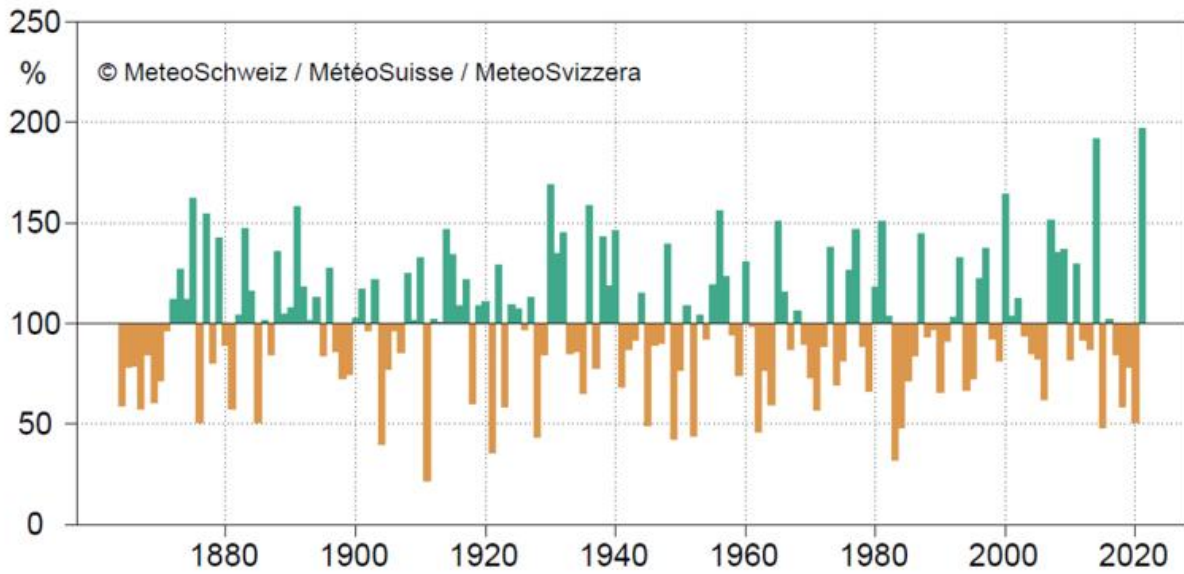


Figure 3-9: Long-term course of July precipitation in Switzerland. The deviation from the norm 1981–2010 is shown. Conditions that are too wet are shown in green, those that are too dry in brown. Source: MeteoSchweiz.

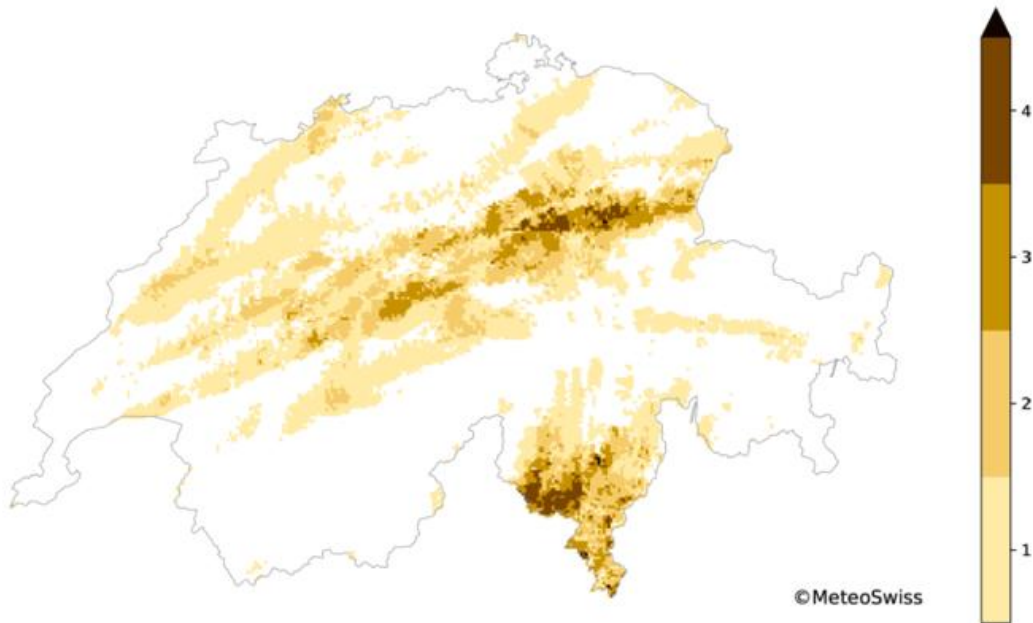


Figure 3-10: Number of hail days in Switzerland in July 2021. Source: MeteoSchweiz

4. Monthly survey

The following monthly survey integrates relevant information from the Monthly Bulletins 2021 on the Climate in WMO Region VI - Europe and Middle East (available on [RCC-CM Website](#)). It contains highlights, means and anomalies of sea level pressure, temperature, precipitation and sunshine duration for each month as well as monthly overviews of extremes and notable events.

4.1. Sea level pressure and circulation indices

This chapter about atmospheric circulation provides information on selected northern hemisphere teleconnection indices relevant for WMO RA VI and discusses influences of circulation patterns upon anomalies and outstanding events. The information is based on the "Monthly Bulletins on the Climate in WMO RA VI" and was completed by reports of the NMHSs. The discussion partly refers to atmospheric circulation patterns in the mid-/ upper troposphere not shown here (see [NOAA NCEI Products](#) and [NOAA CPC Products](#)).

Table 4-1: Monthly values of selected northern hemisphere teleconnection indices standardized to the 1981–2010 reference including the Arctic Oscillation, for January to December 2021.

Year	Month	AO	NAO	EA	EA/WR	SCA	POL
2020	12	-1.74	-0.37	-0.8	-1.11	2.33	0.09
2021	1	-2.48	-1.8	-0.04	-1.34	0.31	-1.59
2021	2	-1.19	-0.29	1.22	0.83	0.31	-3.23
2021	3	2.11	0.36	-0.18	2.98	-0.93	0.63
2021	4	-0.2	-1.69	0.31	-0.43	-1.16	-0.2
2021	5	-0.16	-1.1	0.8	-1.22	-1.06	-0.5
2021	6	0.84	1.08	1.02	-1.77	-0.11	0.86
2021	7	0.62	0.06	2.16	-0.49	1.48	0.84
2021	8	-0.22	-0.49	1.08	-2.37	-1.4	-0.51
2021	9	-0.25	-0.06	1.7	0.53	-0.14	-0.96
2021	10	-0.14	-1.98	0.86	-0.62	-0.18	-0.52
2021	11	0.1	-0.33	-0.91	0.01	-0.77	0.51
2021	12	0.2	0.18	-0.06	-0.04	0.32	-0.51

North Atlantic Oscillation (NAO); East Atlantic Pattern (EA); East Atlantic/West Russia Pattern (EA/WR); Scandinavia Pattern (SCA); Polar/Eurasia Pattern (POL); Arctic Oscillation (AO)

Sources: [NOAA CPC Indices](#) and [NOAA CPC Monthly AO Index](#).

In **January**, the pressure distribution was dominated by the Arctic Oscillation (AO), which was strongly negative for most of January with a monthly mean value of -2.5 and tied to 1960 for the seventh lowest January value since 1950. In addition, the EA/WR, the NAO and the POL were also noticeably negative with values between -1 and -2. The negative NAO and AO phases were primarily associated with a ridge near Greenland and troughs over the North Atlantic and western Europe resulting in much higher than normal surface pressure over the Arctic and much lower than normal surface pressure over the European continent.

February: The general situation over Europe was driven by higher-than-normal pressure from Greenland to Scandinavia extending southward till the eastern Mediterranean with anomalies up to +14 hPa and lower than normal pressure over the North Atlantic with largest anomalies exceeding -14 hPa. This situation resembled a negative NAO phase, but both pressure features were farther north than during typical negative NAO phases. The observed daily NAO was therefore indeed only weakly pronounced during the entire month with weak negative values during the first half and weak positive values during the second half. The monthly mean was weakly negative (-0.29). Outstanding was the value of the POL with -3.23.

The dominant climate pattern in **March** was a strongly positive Arctic Oscillation (AO) with two pronounced peaks occurring on 11 and 24 March with daily AO values exceeding 5 and 4 respectively. The monthly mean AO value (2.11) was the fifth highest March value on record (NOAA National Centers for Environmental Information, State of the Climate: Synoptic Discussion for March 2021, retrieved from [NOAA March 2021 Synoptic Discussion](#)). In Addition, the value of the EAWR Pattern was also remarkably high (2.98). The general situation over Europe was driven by higher than normal pressure over the Atlantic and across Western and Central Europe as well as the Mediterranean Region with anomalies up to +8 hPa and lower than normal pressure from Greenland to Scandinavia and northern Russia with largest anomalies (up to -12 hPa) over Greenland and northern Russia.

The daily NAO fluctuated between near zero and negative values throughout **April**. The monthly mean was negative with a value of -1.69. The negative NAO was driven by a strong ridge extending from Greenland to Northwestern Europe and a trough over the central Atlantic. Its amplitude was limited somewhat because the trough was relatively weak and the ridge was often farther south than would be typical for a negative NAO. In addition, the SCA value was slightly less small as the NAO but still significant. Overall, April 2021 was characterized by lower than normal mean sea surface pressure over the subtropical North Atlantic and over the Norwegian Sea extending to northern Scandinavia. Higher than normal mean sea surface pressure occurred over the northern Atlantic Ocean expanding from Greenland over Central Europe southeastwards with weak positive anomalies over the eastern Mediterranean region. As a consequence, a northerly flow dominated most of the month generating descents of cold polar air, which resulted in strongly negative minimum temperatures over large parts of the RA VI domain.

The general situation over Europe in **May** was driven by higher than normal pressures from Greenland to the Norwegian Sea and from the subtropical North Atlantic to the western Mediterranean basin. Conversely, pressures were lower than normal over most parts of the European continent with largest pressure anomalies occurring over southern Scandinavia, the United Kingdom and Ireland. This resulted in negative daily NAO values for most of May, and a negative monthly mean (-1.1). Even smaller was the value of the EAWR with -1.22. The SCA was slightly higher than the NOA (-1.06). These three Patterns were dominant in February. This caused much of western, central and northern parts of the RA VI domain to be affected by cyclonic weather situation, whilst in the east a southerly air flow brought warm air far to northern latitudes at the west flank of a relatively intense Russian high.

The general meteorological situation over Europe in **June** was driven by lower than normal pressure near Greenland and in the southeast of the RA VI Region (for example Southern European Russia and Türkiye) and higher than normal surface pressure across the southern North Atlantic and almost

the entire European continent. Largest positive anomalies (> 6 hPa) occurred in the northeast, over southern Finland, Estonia and northern Russia. In June the NAO and the EA were moderately positive with values around one and the EAWR was even more negative with a value of -1.77 . This did result in a far extension of the Azores High into central Europe and the Azores High being particularly strong with pressures up to 1 030 hPa. Especially in Russia the pressure anomalies respectively to normal were noticeable with values of $+4$ hPa to $+6$ hPa. The Icelandic Low did extend in to the Barents Sea and even had his maximum there with pressures around 1 000 hPa. The anomalies respectively to normal reached values of -8 hPa to -10 hPa in the Barents Sea.

In **July** the pressure distribution showed a lower than normal pressure over the Arctic region with anomaly values of -8 hPa to -10 hPa. In addition, the mean sea level pressure south of Iceland was slightly higher than normal with $+2$ hPa to $+4$ hPa. The Azores High was only apparent near mid of the month and therefore weaker pronounced than normal. The NAO and the AO both were slightly positive, but the dominant Pattern in July was the EA with values of 2.16. For large parts of the RA VI Region, July 2021 was characterized by recurring severe weather, bringing heavy precipitation, accompanied at times by thunderstorms with hail and gusty winds.

In **August**, the pressure distribution was dominated by the Azores High which extends far to the North Sea and the Norwegian Sea. Withal the strength of the Azores High is normal for August. The Icelandic Low was located close to the southern coast of Greenland and was slightly weaker than normal. Warm air from the North Atlantic flowed to Iceland and Greenland, causing exceptionally warm spells there. Conversely, cold Arctic troughs advanced to Western and Central Europe. The Russian High was much more intense than normal, extending far into the European part of Russia. Therefore, warm subtropical air came under high-pressure influence over much of European Russia.

In **September**, surface pressures were higher than normal over almost all of Europe, especially from Scandinavia to the south-east of the European continent. Conversely, they were lower than normal over northern Iceland, due to a pronounced Iceland low. This "Scandinavian blocking" situation favoured the predominance of sunny, warm and dry weather over large parts of Western and Central Europe and the central Mediterranean region with few disturbed passages from the Atlantic. On the other hand, in a south-westerly flow, some intense stormy waves affected the southwestern part of the RA VI Region. They were accompanied by heavy rain, causing flooding and significant damage in places. The daily NAO and AO were both weak during most of September, but got clearly negative near beginning and end of the month. The daily NAO even reached some of its most negative values on record near the end of the month. For both indices the monthly mean was negative, with -0.21 (NAO) and -0.25 (AO). The dominant circulation pattern was the EA pattern with a value of 1.7.

In **October**, pressures were higher than normal over most of the RA VI Region, especially over the eastern part of the European continent (large extension of the Russian High) and over the Arctic. Lower than normal pressures occurred over the North Atlantic, Scandinavia, Iceland, Great Britain and Ireland, as well as over the central and eastern Mediterranean region. With a south-westerly flow, warm and moist air moved from the North Atlantic over North-western Europe to Scandinavia. Due to higher than normal pressures reaching into the Arctic, the daily AO was negative or near zero for most of the month except for a period of positive values later in the month. The monthly mean was near zero. The daily NAO was negative throughout October (due to high pressure over

Greenland), with most negative values occurring at the beginning and around the middle of the month.

In **November** the pressure distribution was dominated by the extended Azores High which connects with the Russian High. The Azores High was very distinct with pressures of 1 025 hPa to 1 030 hPa in the central part which was shifted slightly to the north. The Icelandic Low was shifted northeast and extended from Iceland to the northern Part of Russia. The anomalies illustrate that the Azores High was strengthened in comparison to normal with values of up to 14 hPa. These positive anomalies extended far till Iceland. Negative Anomalies were found over northern Russia with values of -4 hPa to -10 hPa. Central and eastern Europa had slightly negative Anomalies. In November all circulation patterns were close to neutral. Over large parts of the RA VI Region anticyclonic weather conditions prevailed most the month with high pressure reaching out from the Azores High over Germany until Eastern Europe. Cyclonic activity, on the contrary, dominated at the beginning and at the end of month bringing intense rain including storms and at the end of month also snow fall. Accordingly, the NAO was negative near the beginning and end of the month with positive values near the middle of the month. The monthly mean was near zero. The daily AO was positive for most of the first two-thirds of the month and negative near the end of the month. The monthly mean was near zero.

In **December** the pressure distribution is dominated by a strong Icelandic Low and Azores High which extends over northern Africa and connects with the Russian High. The core of the Iceland low is very distinct with a pressure of 995 hPa. The anomalies verify that the Icelandic low was strengthened because of negative Anomalies of up to -6 hPa to -8 hPa. It also showed that the Arctic region had a higher pressure than normal with anomalies of +6 hPa to +8 hPa. The anomalies of the Icelandic Low were connected with the anomalies of the eastern European region where the values were up to -4 hPa to -6 hPa. In December all circulation patterns were around neutral. In a west to northwest flow, the weather was very unsettled until 10 December and at the end of the month. On the other hand, winter anticyclonic conditions set in during the middle of the month with many clouds and sometimes fogs over the northern half and generous sunshine in the south.

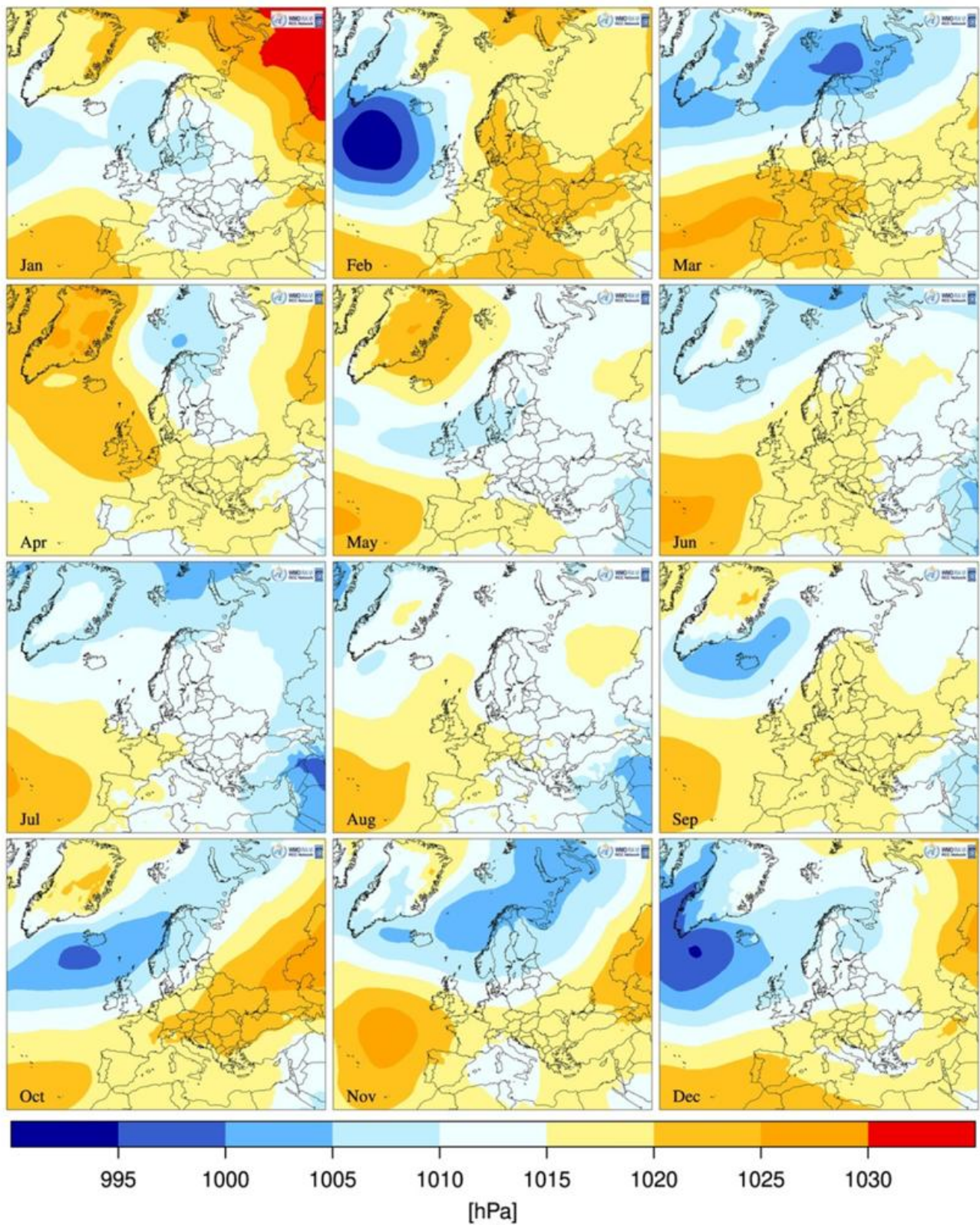


Figure 4-1: Monthly mean sea level pressure in h Pa for each month of the year 2021. Source: [RCC-CM website](#).

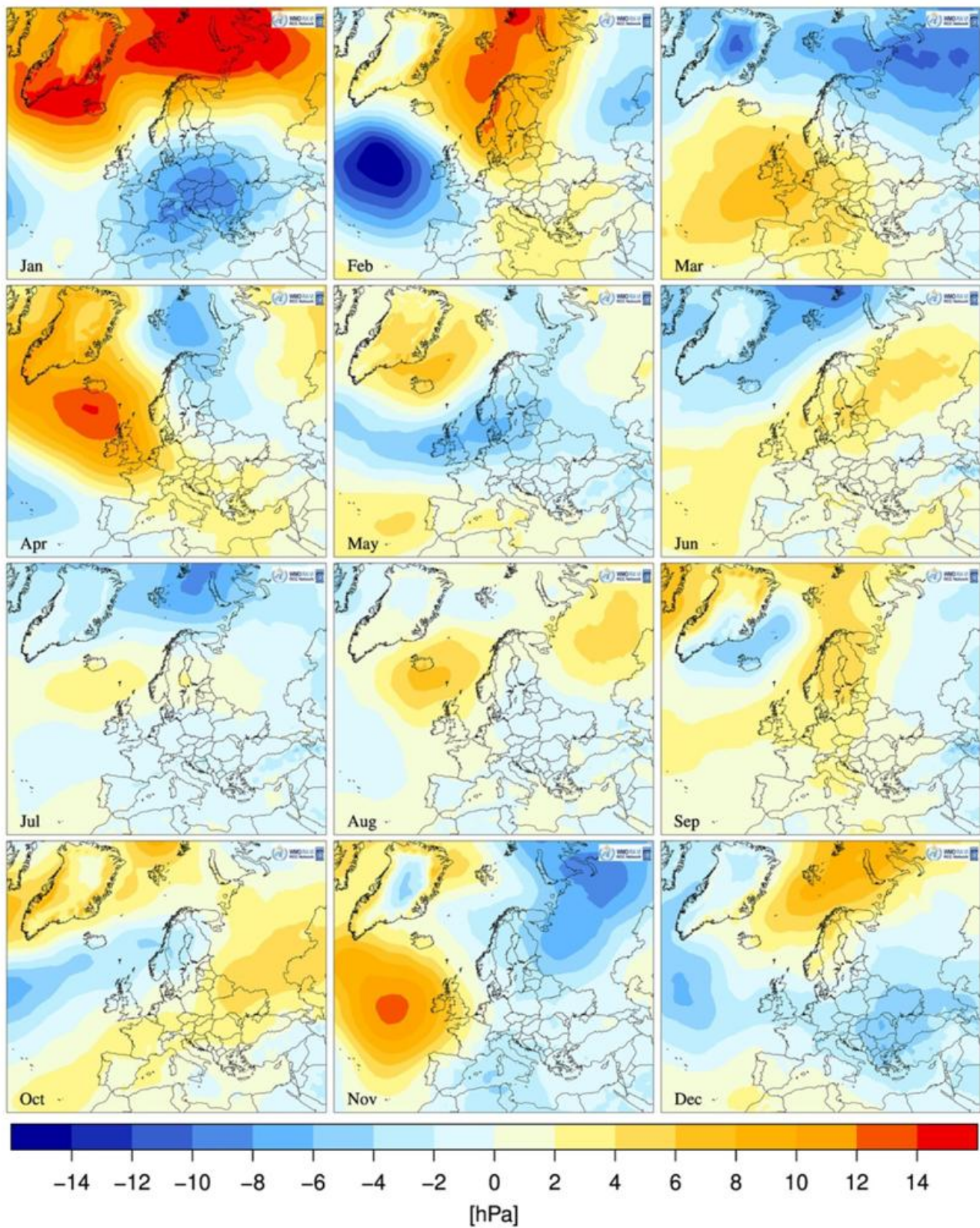


Figure 4-2: Monthly anomalies of sea level pressure in h Pa relative to 1981–2010 for each month of the year 2021. Source: [RCC-CM website](#).

4.2. Temperature

In most of the months and sub-regions, it was warmer than normal, but there were also months with sub-regions experiencing significantly negative anomalies for example during the spring months as can be seen from Fehler! Verweisquelle konnte nicht gefunden werden.. Especially in June and July, temperatures were much warmer than normal across the RA VI Region except for the Iberian Peninsula. Largest anomalies occurred in the Middle East in May with temperatures about 3 °C warmer than normal. But also in June several sub-regions (Central Europe, Eastern Europe and Nordic and Baltic Countries) saw anomalies close to +2.5 °C.

Table 4-2: Monthly area average temperature anomalies in °C for each sub-region in the year 2021 (reference period: 1991–2020; definitions of the sub-regions see Figure 1-1).

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Central Europe	+0.1	0.0	0.0	-2.8	-2.1	+2.5	+1.1	-1.5	+0.9	+0.1	+0.4	+0.3
Central Mediterranean Region	+1.3	+2.0	-0.8	-1.6	-0.2	+1.0	+1.5	+0.8	+0.8	-1.1	-1.1	+1.1
Eastern Europe	+0.7	-3.3	-0.6	+0.3	-0.6	+2.5	+2.1	+1.5	-1.8	+0.1	+1.7	-0.9
Iberian Peninsula	-0.9	+2.2	0.0	+0.2	0.0	-0.2	-0.3	+0.4	+0.5	+0.7	-1.2	+1.6
Middle East	+1.8	+1.8	+0.6	+1.8	+2.9	+0.3	+1.3	+1.2	-0.2	+0.6	+1.9	+0.9
Nordic and Baltic Countries	-1.3	-1.4	+1.3	-0.2	+0.3	+2.4	+2.0	-0.6	-0.4	+1.5	-0.1	-2.3
Türkiye and South Caucasus	+2.0	+2.0	-0.7	+1.4	+2.2	+0.4	+1.1	+0.9	-0.5	-0.7	+1.8	+1.3
Western Europe	-0.9	+1.4	+0.2	-1.6	-1.7	+1.2	0.0	-0.8	+1.6	+0.3	-0.6	+1.0

In January, the temperature anomalies ranged from -1.3 °C over the Iberian Peninsula to +2.01 °C in Türkiye and South Caucasus region. Higher-than-normal temperatures occurred over the southeastern parts of the RA VI Region with anomalies mostly between +1.5 °C to +2 °C and over the Arctic with anomalies (w.r.t. 1981–2010) partly exceeding +4.0 °C (Greenland and Spitsbergen). Ny-Ålesund had an average temperature of -7.9 °C, which is 2.4 °C above normal. The average temperature at Svalbard Airport was -7.8 °C, which is 3.3 °C above normal. On the Hope, the monthly temperature was -4.2 °C, which is 4.8 °C above normal. In Moldova, abnormally mild weather was reported in the first decade of the month, the average decadal air temperature ranged from +1.9 °C to + 5.6 °C, being 5.9 °C to 7.5 °C higher than the norm values (1981–2010), which is reported on average only once in 10–20 years. Several countries reached temperature anomalies which ranked among the five warmest since begin of measurements: Cyprus, Israel, Jordan and Türkiye.

In the central Iberian Peninsula, anomalies of up to -3 °C were found. For Portugal, January 2021 was the fourth coldest since begin of measurements. The cold conditions from the end of December with the Jetstream displaced to the south continued through most of January 2021 in Western Europe. Lower-than-normal temperatures occurred also over the northwestern parts of the RA VI domain with largest anomalies over Sweden and Norway with temperatures up to 5 °C below average. In Norway, the monthly temperature for the whole country was 3.3 °C below normal, and the month became the coldest January since 2010. The mean temperature for the United Kingdom was 2.2 °C, which is 1.62 °C below the 1981–2010 long-term average, making it the coldest January

since 2010 as well. In Spain, January presented a very marked contrast between the temperatures of the first fortnight, which was extremely cold, resulting in the coldest first fortnight of January since 1985, and the second, in which temperatures were well above the usual values for the time of year. As a result, there were numerous record low temperatures during the first fortnight and record high temperatures in the last days of the month. For Europe as a whole, the temperature for January 2021 was within 0.1 °C of the 1991–2020 average (Copernicus) and +1.59 °C warmer than the 1910–2000 average according to NOAA NCEI (National Centers for Environmental information) data (retrieved from [NOAA CAG](#)).

The monthly mean temperature for February ranged between –3.3 °C over Eastern Europe to +2.2 °C over the Iberian Peninsula. Temperature was colder than normal over the northern part of the RA VI domain, especially over Northern Russia, where negative temperature anomalies larger than –6 °C occurred. The southern part of the RA VI domain, especially the Iberian Peninsula, and the Arctic, on the contrary, saw warmer than normal temperatures with anomalies over the Arctic exceeding +5 °C. At Ny-Ålesund and Svalbard Airport, for example, average temperatures of –6.1 °C and –6.6 °C were observed, which is 5.1 °C and 5.0 °C above normal respectively. The Iberian Peninsula as a whole had an anomaly of +2.2 °C. For both Portugal and Spain, February 2021 ranks among the five warmest February months since begin of measurements.

Parts of central Europe saw considerable variation in temperatures during the month of February. After a sudden stratospheric warming event in January and a significant weakening of the polar vortex, cold arctic air moved into northern parts of Europe in early February 2021 and a sharp air mass border developed over Europe with very cold air in the northern half and warm air in the south. Later, the cold air moved also down to the southeast. The cold wave lasted for the first two weeks and especially the second week was very intense with new records for minimum temperature being set. At the end of the month, warm air moved into Central and Northern Europe. Daily temperature maxima above 20 °C were registered in several places in Germany and Austria on six consecutive days, partly new local February records of maximum temperature were set and the longest duration on record of such a warm spell in February was recorded. Other countries also reported new February records for maximum temperature. In some countries, new national records were even set, for example in Sweden, Poland, Slovenia, Croatia. In Sweden, it was the coldest February since 2010 in parts of Götaland. February started with a prolonged cold wave but then very mild air flowed up over the country around the 19 February. During the last week of the month, it was record hot in many places in Götaland and Svealand with many station records being set. A new national February record was recorded in Kalmar with 17.0 °C on the 25 February. For Europe as a whole, the temperature was around 0.26 °C warmer than the 1981–2010 average according to Copernicus (based on ERA 5 reanalysis land and ocean) and +1.62 °C above the long-term mean (w.r.t. 1910–2000 average, land only) according to NOAA NCEI data (retrieved from [NOAA CAG](#)).

In March, monthly mean air temperatures below the long-term means occurred in southeastern Europe, around the Black Sea, and over Russia and western Kazakhstan, while the Middle East and northern and western parts of the RA VI domain saw positive temperature anomalies. Largest positive anomalies occurred over the Arctic region and Scandinavia with values close to or exceeding +2 °C. For Norway, the monthly temperature was 1.7 °C above normal (2.9 °C above the old standard of 1981–2010). Warmest temperatures occurred in the inland, where some stations had anomalies of about 3 °C above normal. Jan Mayen was the warmest station with an average

temperature of $-2.8\text{ }^{\circ}\text{C}$ ($0.9\text{ }^{\circ}\text{C}$ above normal). Kvitøya was the coldest with $-14.5\text{ }^{\circ}\text{C}$ on average (no normal yet). Ny-Ålesund had an average temperature of $-9.1\text{ }^{\circ}\text{C}$, which is $2.5\text{ }^{\circ}\text{C}$ above normal. The average temperature at Svalbard Airport was $-9.7\text{ }^{\circ}\text{C}$, which is $2.3\text{ }^{\circ}\text{C}$ above normal. At Hopen, the monthly temperature was $-8.3\text{ }^{\circ}\text{C}$, which is $2.2\text{ }^{\circ}\text{C}$ above normal. Bjørnøya ended $1.1\text{ }^{\circ}\text{C}$ above normal, with an average temperature of $-4.3\text{ }^{\circ}\text{C}$. In Sweden, March offered mild weather throughout the country. Towards the end of the month, a couple of stations in south-eastern Sweden broke their heat records for March. 30 March became very hot in southern Sweden: Norrköping in Östergötland, Öland's northern cape and Harstena in Östergötland broke their heat records for March. The month's preliminary highest observed temperature was $19.7\text{ }^{\circ}\text{C}$ at Harstena on the Östgötakusten coast and in Oxelösund in Sörmland. During a short warm episode at the end of the month, local and national records were also broken in Germany and Belgium. In Germany, the last three days of March were unusually warm with the maximum temperature exceeding $22\text{ }^{\circ}\text{C}$. On 30 March, stations from the Moselle to the Odenwald reported the first summer day of the year (with a maximum temperature at least $25\text{ }^{\circ}\text{C}$). The Rheinau-Memprechtshofen station (southwestern part of Germany) reported a Germany-wide March record of $27.2\text{ }^{\circ}\text{C}$ (DWD measuring network). In Uccle, the absolute record for the highest maximum temperature was broken on both 30 and 31 March with $23.9\text{ }^{\circ}\text{C}$ (previous record: $22.7\text{ }^{\circ}\text{C}$ in 1968, measurements taken since 1892). For Europe as a whole, the temperature for March was within $0.1\text{ }^{\circ}\text{C}$ of the 1991–2020 average according to the Copernicus Climate Change Service/ECMWF (based on ERA 5 reanalysis land and ocean, [Copernicus Climate Change Service](#)) and $+1.27\text{ }^{\circ}\text{C}$ above normal (w.r.t. 1910–2000 average, land only) according to NOAA NCEI data (see [NOAA CAG](#)).

Due to several cold waves, **April 2021** as a whole was a very outstandingly cold and frosty month particularly in Western and Central Europe resulting in monthly mean air temperatures $1\text{--}2\text{ }^{\circ}\text{C}$ below normal. Already after the first two thirds of the month, many places e.g. in the United Kingdom and in Switzerland had seen at least twice as many frosty nights than on average, and new records of the number of frost days were recorded in many places e.g. in France and Austria. The number of frost days in Germany was nearly 13 days on average, the highest since 1929. April 2021 was the coldest April in France, Switzerland and Austria for at least 20 years, in the Netherlands and Belgium for 35 years and in Germany even for 40 years (for mean temperature), while the minimum temperatures in France were the lowest since 1986. In the Czech Republic, April 2021 was the fifth coldest April since 1961 (together with April 1977) with an anomaly of $-2.5\text{ }^{\circ}\text{C}$ (w.r.t 1981–2010). Due to the colder than normal conditions, vegetation development was clearly behind usual conditions in the affected regions. While it was cold in parts of Western and Central Europe, other parts of RA VI saw an outstanding warming at the same time, especially eastern parts and in the Arctic region. Ny-Ålesund had an average temperature for April of $-6.8\text{ }^{\circ}\text{C}$, which is $1.9\text{ }^{\circ}\text{C}$ above normal. The average temperature at Svalbard Airport was $-6.1\text{ }^{\circ}\text{C}$, which is $2.7\text{ }^{\circ}\text{C}$ above normal. At Hopen, the monthly temperature was $-4.9\text{ }^{\circ}\text{C}$, which is $3.1\text{ }^{\circ}\text{C}$ above normal. In the east, parts of European Russia experienced an extreme warm spell in mid-April. Its capital Moscow registered $22.6\text{ }^{\circ}\text{C}$ on 13 April 2021, the highest temperature for that day of year since 1881. Such high temperatures usually occur during early June in this place. During the second half of April 2021, warm subtropical air expanded from North Africa to the Middle East and later to the entire eastern Mediterranean and Caucasus region. Temperatures reached near-record levels on 19 April with $42.6\text{ }^{\circ}\text{C}$ at the agrometeorological Tzvi Station in Israel, $35.6\text{ }^{\circ}\text{C}$ in Jerusalem, $38.0\text{ }^{\circ}\text{C}$ at Damascus in Syria, $36.5\text{ }^{\circ}\text{C}$ at Amman in Jordan, and over $35\text{ }^{\circ}\text{C}$ in Türkiye. On 20-21 April, temperatures above

30 °C were recorded in the Caucasus region with 30.1 °C in Vladikavkaz in southern European Russia, 31.2 °C in Batumi in Georgia, 30.8 °C in Zakataly in Azerbaijan, and 31 °C at Kapan in Armenia (700 m a.s.l.). For Europe as a whole, the temperature for April 2021 was 0.9 °C below the 1991–2020 average according to Copernicus/ECMWF (ERA5 data) and 0.29 °C above the 1910–2000 average according to NOAA NCEI (see [NOAA CAG](#)). According to both data sources, it was the coldest April since 2003.

The monthly mean temperature for May was lower than normal over large parts of Europe, especially over Central Europe with anomalies around –2 °C. Exceptionally below normal were monthly average and maximum temperatures over the Czech Republic and Austria. In Austria, May 2021 was 2.5 °C colder than the long-term average and ranks among the 80 coldest May months since 1767. May 2021 in the Czech Republic was strongly below normal, the average monthly air temperature of 10.7 °C was 2.5 °C lower than normal. Together with May 1970, it ranks as the seventh coldest May in the period since 1961. The United Kingdom saw the coldest May since 1996 with a mean temperature of 9.3 °C, which is 1.5 °C below the 1981–2010 long-term average. Southeastern and the eastern parts of the RA VI domain, on the contrary, saw warmer than normal mean temperatures in May with anomalies up to +3 °C in the Middle East and even larger over eastern parts of Russia and West Kazakhstan. In Spain, anomalies close to +2 °C (1981–2010) were observed in central and eastern Andalusia, in parts of Castilla-La Mancha and the interior of the region of Valencia and Murcia. For the eastern Mediterranean region, the heatwave, which already began in mid-April 2021, continued in May 2021. This resulted in average May temperatures 2–3 °C above normal in Israel and even more than 3 °C above normal (1981–2010) in Jordan and Syria. The stations Sedom in Israel and Ghor El Safi in Jordan, both located in the Dead Sea region more than 300 m below sea level, recorded 44.6 °C each on 5 May 2021. For Israel as a whole, May 2021 ranked among the five warmest in the last 70 years (since start of measurements). For Türkiye it was the warmest May since start of measurements, for Cyprus and Jordan it was among the top five. Later in the month, the heat expanded further north until central European Russia and west Kazakhstan. Therefore, May 2021 was also extremely warm (as the one of last year) in Russia with largest anomalies (+4 °C to +6 °C and larger) being observed in the areas from the Volga Region to the Pacific Ocean, including the Arctic region. In the Volga region, May even finished as warmest May in the history of meteorological observations since 1891. The national monthly record for May (and also seasonal record for spring) was broken on 22 May 2021 in Khasavyurt (Dagestan county) with 39.7 °C. In West Kazakhstan, May temperatures were also unusually warm with anomalies of +4.5 °C. The largest anomaly (+6.6 °C) was observed at the meteorological station (MS) of Kulsary in the Atyrau region. New records were set at more than 80 meteorological stations and even the 40 °C threshold was exceeded on 23 May (40.5 °C) in Novyj Ushtogan. The South Caucasus countries were also affected by the heat: a maximum of 36.6 °C was recorded in Georgia in Ambrolauri (550 m a.s.l.) and 35.7 °C in Akhaltsikhe (1,000 m a.s.l.) on 21 May 2021. In Armenia, 36.1 °C were reached in the capital Yerevan (850 m a.s.l.) the same day, a new local monthly May record of maximum temperature. Also, May as a whole was the warmest since start of measurements. For Europe as a whole, the temperature for May 2021 was slightly cooler than normal according to ERA5 (Copernicus) with an anomaly of –0.46 °C and slightly warmer than the 1910–2000 average according to the NOAA NCEI data (see [NOAA CAG](#)) with an anomaly of +0.41 °C respectively.

The monthly mean temperature for **June** was warmer than normal in most parts of the RA VI domain, especially over the northeastern part where anomalies larger than +4 °C occurred. Parts of the southeast (west of the Black Sea) and Portugal, on the contrary, saw lower than normal temperatures with anomalies up to -1 °C. In Finland, June 2021 was record-breaking or exceptionally warm in most parts of the country with temperatures 3–6 °C above long-term averages. June 2021 finished as warmest June in the history of Finnish measurement. The average temperature throughout the country was a record high of about 16.5 °C. This exceeds the previous record of 1953 by as much as 0.3 °C. In the south of Finland, there were more than 10 hot days more than usual. The average temperature of 19.3 °C measured in Helsinki-Kaisaniemi was the highest in the history of measurement that began in 1844. In Sweden, June 2021 was also much warmer than normal especially in the south-eastern part of the country, where it was partly a record hot June. The warmest period occurred in the middle of the month. Then Målilla in Småland with 34.6 °C had the highest June temperature in Sweden since 1947. Temperatures in France were 2 °C above normal with an average temperature of 20.3 °C, making June 2021 the fifth warmest June since 1900. For Serbia it was the sixth warmest June since 1951 and the second warmest for Novi Sad and Kikinda since 1948 and fourth warmest for Belgrade since 1888.

Heat waves affected many parts of the RA VI domain throughout the month with new station and national records being set at many stations. In mid-June, a large heat wave propagated from Southwestern to Northeastern Europe. In France, temperatures were particularly warm from 11 to 18 June when they were more than 4 °C above the 1981–2010 average (averaged over France). Already on 13 June, 34.3 °C were measured in Magadino in southern Switzerland (Ticino region) and 35.1 °C in Milano (northern Italy). On 20 June, up to 40.5 °C were recorded in Sardinia (Olbia), a new local June record, in Caltagirone in Sicily even 45 °C on 24, 29 and 30 June, probably the highest in Europe in 2021 so far. Malta noted a new national June record (dating back to 1923) on 30 June at 41.5 °C. In Poland, daily maxima reached 36.1 °C on 20 June. 35 °C were also exceeded in the Czech Republic (Plzen 35.9 °C) the same day and some new local daily maximum records were noted on 17–19 June. In the last days of June, the heat zone shifted mainly to eastern parts of RA VI leading to new June records being set for example across the Balkans. Slovenia recorded the highest maximum that month at 36.2 °C on 24 and 29 June, and some local records. In Croatia, 37.0 °C was measured in Grič (part of Zagreb) on 29 June. Since 1861, when the measurements began, this happened only twice in June, in 1935 and in 2021. In Sarajevo, capital of Bosnia-Herzegovina, the daily maximum increased from day to day up to 38.3 °C on 24 June (new June record), Banja Luka in the Srpska Republic had even 38.8 °C that day, Mostar 40.2 °C on 23 June. June as a whole was the third warmest since start of measurements. Maxima in Greece even exceeded up to 42 °C on 26 June, new records were set at 9 stations.

Particularly outstanding was the heat wave in European Russia. Some local all-time records of maximum temperature were set, e.g. 34.3 °C in the north in Petrozavodsk (west coast of Lake Onega) on 22 June, beating even all values of the last large Russian heatwave in July 2010 in this place. Many local monthly records for June were registered, among them in St. Petersburg (35.9 °C) and in Moscow (34.8 °C) on 23 June, both stations with time series of at least 120 years of length. Colder than normal temperatures only occurred in an area reaching from eastern Romania over Bulgaria until Western Türkiye and in westernmost parts, namely over Iceland and Portugal. Ankara saw the coldest June nights of the last 30 years from 4 to 6 June with daily minima dropping to around 7 °C. Iceland was hit by unseasonal snowstorm and cold in the northern and eastern parts

mid of the month. For Europe as a whole, June 2021 was the second warmest June on record behind 2019 with temperatures +1.5 °C and +2.36 °C (relative to 1910–2000) and +2.04 °C (relative to 1981–2010) above normal according to ERA5 (Copernicus), the NOAA NCEI data (see [NOAA CAG](#)) and the RCC RA VI temperature data respectively.

July was mostly warmer than normal with largest anomalies occurring over northeastern Europe (like in June), especially over the Baltic countries and Belarus. The warmer-than-normal temperatures resulted from several heatwaves occurring throughout the month. From 2 to 12 July a heatwave hit Scandinavia and the Baltic Countries with temperatures exceeding 30 °C even in Lapland, partly new records were set. The long duration of this heatwave was exceptional: 11 days on a row with temperatures above 30 °C in Lithuania, the longest duration since the beginning of the measurements in 1961. Tropical nights occurred north of the polar circle in Murmansk, in Northwest-Russia, on 8 July. According to the statistics from the Finnish Meteorological Institute, July was unusually or exceptionally warm in most parts of the country. The average monthly temperature varied from 21 °C in the southern and southeastern part of the country to about 14 °C in northern Lapland. The average temperature was generally 3–4 °C, in Lapland 1–3 °C above the long-term average. In Latvia, the average air temperature in July was +21.5 °C, which is 3.7 °C above normal. As a result, July 2021 is jointly the warmest July on record (since 1924) together with July 2010. In July, 55 maximum air temperature records were broken, of which five were decade-long maximum air temperature records. In Lithuania, the average air temperature in July was 22.1 °C (+3.8 °C anomaly) - this was the hottest July since 1961. The hottest so far was 2010, at 21.5 °C. In Estonia, average air temperature was 21.2 °C which is 3.4 °C higher than normal. The average air temperature in Belarus for July 2021 was 22.5 °C, which is 4.1 °C higher than normal (1981–2010), making July the second warmest since 1881 (behind July 2010). Another heatwave occurred end of July over Türkiye and southern Caucasus, southern European Russia with partly new records between 20 and 21 July. 20 July 2021 was the hottest day on record at Tbilisi, Georgia. With a maximum temperature of 40.6 °C, it beat its record set 3 years ago. In southern European Russia, even 43.7 °C was measured at Malye Derbety (a village near Volgograd) on 21 July. Daily minima were as high as 28 °C. Türkiye recorded a new national record of highest temperature in Cizre on 20 July with 49.1 °C. Over central and western (southwestern) parts of the RA VI domain, temperatures were partly colder than normal, for example over Portugal and France. Across France, the average temperature of 20.7 °C was 0.1 °C below normal (1981–2010). The mean value of the average air temperature for Portugal was 21.54 °C, –0.63 °C lower than the 1971–2000 normal value, being the fifth lowest value since 2000 (lowest in 2018: 21.15 °C). For Europe as a whole, it was the second warmest July on record according to both the Copernicus ERA5 data and the NOAA NCEI data (retrieved on 14 October 2021 from [NOAA CAG](#) with anomalies of +1.4 °C and +2.39 °C respectively. According to the RA VI temperature data, it was second warmest July for RA VI land areas behind 2010.

August: The monthly mean temperature was lower than normal over Western and Central Europe, Scandinavia and the Baltic countries with largest anomalies occurring over Germany and the Czech Republic where temperatures were partly more than 2 °C below normal. Over the rest of the RA VI Region monthly temperatures were higher than normal, especially in the east. Over central and southern parts of Russia, monthly average temperatures were 3 °C to 4 °C above normal. These resulted from abnormally hot weather persisting during the first two decades of August all over the

European Territory of Russia. Unprecedented maxima of air temperatures were recorded in the Volga Region, Bashkiria, Cis-Urals and southern Urals, with the temperatures reaching between +35 °C and +40 °C for several days in a row. For European Russia as a whole, August was the fifth warmest since the beginning of regular meteorological observations in 1891. The western part of Kazakhstan also saw temperature anomalies larger than +4 °C, in some places even larger than +5 °C. At many stations, the temperature values fell within the 5% of the highest temperatures observed in August. The largest anomaly (+5.8 °C) was observed at Aksai. New records for maximum temperature were set at 27 weather stations. The Mediterranean region was affected by several heat waves in August as well, some of them extreme. Intense heatwaves developed particularly across Spain, southern Italy, Greece, and western Türkiye, but also in Albania, North Macedonia, southern Serbia, and Bulgaria. Temperatures were extremely high, reaching the low to mid-40s °C in many regions. In Greece, the first five days of August were the hottest part of one of the most significant heat wave episodes of the last 35 years. At many stations, new temperature records were set. Large forest fires occurred in areas affected by the strong heat. For Türkiye, August 2021 was the sixth hottest August in the last 50 years. In Iceland, August was also unusually warm, especially in the northeast and east of the country. The month was the warmest since the beginning of measurements at several stations, for example in Akureyri, Stykkishólmur, Bolungarvík, Hveravellir and Grímsey. The highest temperature of the month was 29.4 °C at Hallormsstaður which is the highest temperature ever measured in the country in August. According to the temperature data provided by the RCC-CM, the average temperature for the RA VI Region for August 2021 was 1.2 °C above normal (1981–2010). The European-average temperature for August 2021 was near normal at only 0.02 °C below the 1991–2020 average according to Copernicus (ERA5) data and +1.12 °C above normal (relative to 1910–2000) according to the NOAA NCEI data (retrieved on 17 December, 2021 from [NOAA CAG](#)). August 2021 finished being the coolest since August 2014 (Copernicus) and 2008 (NOAA NCEI) respectively. The average June–August temperature for Europe was 0.96 °C above normal according to the ERA5 data (Copernicus) which marks the warmest boreal summer in this data record. According to the NOAA NCEI data (retrieved on December 17, 2021 from [NOAA CAG](#)) the summer temperature was +1.97 °C higher than normal (relative to 1910–2000) and thereby the fourth warmest on record.

In **September**, the monthly mean temperature was warmer than normal over Western and Central Europe and the Iberian and Western Balkan Peninsulas with largest anomalies occurring over northwestern parts of France and the United Kingdom where normal values of air temperatures were exceeded by 2 °C. For the United Kingdom, the mean temperature was 14.7 °C, which is 1.8 °C above the 1981–2010 long-term average. This was only slightly cooler than August's mean temperature, and ranks it as the second warmest September in a series from 1884. In France, temperatures were 2.0 °C above normal (1981–2010), making September 2021 the seventh warmest September since 1900. Colder-than-normal temperatures occurred in the East of the RA VI Region affecting Finland, Russia, the Baltic countries, Belarus and Ukraine. In European Russia, the abnormally hot summer gave way to cold autumn temperatures during the first days of September. Frosts in the areas from Murmansk to Volgograd came as early as on the fifth of the month. The average air temperature was 2–3 or more degrees below normal in the first decade. As a result, this September was the coldest in European parts of Russia for the past 25 years since 1996. In Finland, September was cooler than usual across the country with air temperatures 1–3 °C colder normal. Similar anomalies were reported from Latvia, Estonia and Belarus. According to the

temperature data provided by the RCC-CM, the average temperature for the RA VI land areas for September 2021 was slightly below normal (1981–2010), the coolest since 2008. Europe as a whole was 0.96 °C warmer than the 1910–2000 average according to the NOAA NCEI data (retrieved from [NOAA CAG](#)). According to Copernicus Climate Change Service/ECMWF (ERA 5), the European-average temperature for September 2021 was the coolest September since 2013, being 0.2 °C below normal.

October: The monthly mean temperature was warmer than normal over the northern parts of the RA VI domain including the Arctic with the largest anomalies occurring over parts of Scandinavia and Finland with temperatures 2 °C to 3 °C warmer than normal. Temperatures were colder than normal in the southern parts except for the Iberian Peninsula and the Middle East where temperatures were also 1 °C to 2 °C above normal. Averaged over the entire RA VI Region, October 2021 was +0.8 °C warmer than the 1981–2010 average. The previous four October months were all warmer than in 2021, so it was the coldest October since 2016. Land areas of RA VI were +0.6 °C warmer, sea areas +0.9 °C (compared to the 1981–2010 average). For Europe as a whole, the temperature for October 2021 was +0.1 °C above the 1991–2020 average according to Copernicus Climate Change Service and +1.0 °C warmer than the 1910–2010 average according to NOAA NCEI. October 2021 was the twentieth warmest October in Europe in the period since 1910 in the NOAA NCEI time series. In Norway, the monthly temperature for the whole country was 1.9 °C above the 1991–2020 normal, and the month was the eighth warmest in a series dating back to 1900. Largest anomalies occurred in the inland, Trøndelag and Møre and Romsdal where several stations had deviations of between 3 and 4 °C above normal. Mora station in Sweden (Dalarna region in central Sweden) had its warmest month of October since 2000, Abisko (Norrbotten, northern Sweden) had a record warm October day on 4 October 2021 with a daily maximum at 16.2 °C. In Finland, the average temperature in the southern and central part of the country was mainly 2–3 °C above normal. The highest temperature of the month, 15.6 °C, was measured at Pori railway station on the first day of October. Almost the same highest temperature in October 2021 was registered in Iceland (15.3 °C in Kvískerjar on the 13 October). Denmark recorded 19.9 °C in Omø (Storebæltas) as highest temperature this month, while frost occurred only partly in Denmark (0.2 frost days on average, 1991–2020 normal is 2.2 frost days). The Baltic countries also saw warmer-than-normal temperatures. Daily maximum air temperature records of 16 monitoring stations in Latvia were broken in October 2021 and five daily maximum air temperature records were repeated, values reached up to above 18 °C, in Lithuania even up to 19 °C, in Belarus 21 °C. In the United Kingdom and Ireland, temperature anomalies were smaller than in Scandinavia (mainly between +1 and +2 °C). However, Phenix Park in Dublin County (Ireland) had an anomaly at +2.1 °C and its warmest October, also its highest maximum for October since 2011 at 20.4 °C. Three stations in Ireland had their warmest October even since 2001, including Dublin Airport. There was no air frost reported in Ireland, but less than half of stations reported ground frost. There was also no frost in De Bilt in the Netherlands (normal is one frost day), but also no warm days (maximum at least 20 °C) either (normal is 2). However, there was light frost in other parts of the Netherlands (Twenthe, Eil) in the night to 16 October and 20.2 °C was reached in Westdorpe on 19 October. In Uccle (Belgium), the monthly maximum was 18.9 °C, but this was the lowest October maximum since 2003 in this place. Also, here, no frost in Uccle, but elsewhere in the country slight frost (down to –2.4 °C). Luxembourg-Findel Airport, too, saw no air frost that month (but light ground frost). Germany was mainly warmer than the 1991–2020 normal in the north and colder in the south. However, a daily

maximum of 27.5 °C was reached in Munich City on 3 October due to foehn. Austria, too, recorded above 25 °C (summer day) as highest maximum that month. Nevertheless, it was the coldest October in the lowlands of Austria since 2016, mainly due to a cold period on 6–15 October. The Czech Republic noted summer days at 10 stations, also Poland, Slovakia and Hungary had summer days, mostly on 4–5 October 2022. Temperatures above 27–29 °C were recorded in the Balkans (e.g. Bosnia-Herzegovina, Serbia) on the same days. Bulgaria reported above 27 °C even later on 22 October in the Varna region, but on the other hand, it was the coldest October month in Bulgaria since 2011. In Türkiye, there was even a new local October minimum record at one station (–9.9 °C in Horasan, Erzurum Province in northeastern Türkiye). In the first decade of October 2021, the weather was abnormally cold in southern and central European Russia where the decade-averaged temperature anomalies reached –2.0 °C to –4 °C or lower, with new daily minima recorded in the Smolensk, Tambov, Tula, Oryol, Belgorod and Moscow Regions as well as in the republics of Tatarstan and Udmurtia. At the end of the month, frosts occurred in the Southern and North Caucasian Federal Districts with minima at –4 °C to –10 °C or below. In general, frosts in European Russia were not uncommon in October, but the unprecedented temperature highs were also observed: for example, in the Murmansk Region and the Komi Republic in the north in the first half of the month, and in the northwest and centre of European Russia in the second half of October. Record-breaking low temperatures were observed in Belarus and in the west of Ukraine; frosts as cold as –5 °C and below were recorded. First frosts already on 1 October were recorded also in Moldova in some northern and central districts of the country, ending the active vegetation of agricultural crops 1–2 weeks earlier than usual. In Israel, it was warmer than usual particularly by the middle of the month with maxima of 34–38 °C in the north and 35–40 °C in the south of the country. However, it was mostly cooler than normal in the second half of the month.

November: The monthly mean temperature was warmer than normal over most parts of the RA VI Region, particularly in eastern parts with temperatures more than 2 °C warmer than normal from northern Russia and the Baltic states in the north until the Middle East in the south. Largest anomalies occurred over northern Russia and western parts of Türkiye with monthly temperatures locally 3 °C above normal. For Belarus, November 2021 was the fifth warmest on record since 1945 with an anomaly of +2.4 °C (compared to 1981–2010). The north of Scandinavia and the southwest (Iberian Peninsula and France), on the contrary, saw colder than normal monthly temperatures with anomalies mostly between –1.0 °C to –2.0 °C. For the RA VI Region as a whole, it was the coldest November since 2017, with an average temperature 1.0 °C warmer than normal (1981–2010). For Europe as a whole, the temperature for November 2021 was warmer than normal according to both Copernicus (ERA5) and the NOAA NCEI data (retrieved on January 14, 2022 from [NOAA CAG](#)) with an anomaly of +0.5 °C and 1.32 °C (relative to 1910–2000) respectively. According to these datasets, it was also the coolest November since 2017 for Europe. When looking at the season average (September–November), it turns out that the average temperature for the RA VI land areas was +0.7 °C above the 1981–2010, for Europe it was +0.16 °C above the 1991–2020 norm according to the ERA5 data (Copernicus) and +1.03 °C above normal with respect to the 1910 to 2000 average according to the NOAA NCEI data (retrieved on 14 January 2022 from [NOAA CAG](#)).

December 2021 saw a notable temperature contrast across the RA VI Region, with warmer than normal conditions in the west and south as well as in the Arctic and colder than normal conditions in the northeast. In Finland, December 2021 was colder than usual in the whole country in some parts

even exceptionally cold. The average temperature for the month was 1.2 °C below normal. In Sweden, temperatures were around 2.0°C below normal in northern parts. The lowest temperature of the month was -43.8 °C and was recorded in Naimakka which is a new December record for Naimakka and the lowest temperature recorded in Sweden as a whole since 1986 when it was -45.0 °C in Stenudden in Lapland. In Norway, the monthly temperature for the whole country was 1.25 °C below normal, largest anomalies occurred in Troms and Finnmark, where several stations had deviations of 4–5 °C below normal. For Norway, December 2021 was the coldest December since 2012. Estonia, Latvia and Lithuania experienced colder than normal conditions as well with averaged monthly temperatures 2–3 °C below normal. European parts of Russia experienced a huge contrast in temperatures in the first decade of December, with decade-averaged air temperatures being abnormally cold in the north (with anomalies ranging between -5 °C and -7 °C) and abnormally warm in central parts and the south (with anomalies up to +5 °C). This contrast is also reflected in the month averages. The warmer-than-normal conditions in the south extended till Kazakhstan, which saw monthly temperatures 2 °C to 4 °C warmer than normal (w.r.t. 1981–2010). In parts of the Arctic, anomalies were even larger. These resulted from an exceptional warming mid of the month due to warm subtropical air moving very far to the north. In Greenland, daily maximum temperatures rose above 8 °C at many stations, even up at 77 degrees northern latitude. The Arctic stations Jan Mayen, Svalbard airport and Ny-Ålesund reported monthly mean temperatures of 2.4 °C, 2.8 °C and 3.7 °C above normal respectively. At the end of the month, warm subtropical air from the southwest flowed into Western and Central Europe, with new daily maxima of Year's Eve temperatures observed in the United Kingdom, France, Germany, Spain, and the Netherlands. In a number of places, the temperature exceeded +20 °C. According to the temperature data provided by the RCC-CM, the average temperature for the RA VI land areas for December 2021 was 1 °C above normal (w.r.t. 1981–2010), the coldest since 2016. Europe as a whole was 0.89 °C warmer than the 1910–2000 average according to the NOAA NCEI data (retrieved from [NOAA CAG](#)). According to Copernicus Climate Change Service/ECMWF (ERA 5), the European-average temperature for December 2021 was the coolest September since 2012, being 0.21 °C below the 1991–2020 average.

Table 4-3: Rank statistics, monthly average temperature and anomalies (in °C) from several countries of the RA VI for the individual months 2021 including countries with rankings among the top 5 (ranks 1–5) since start of the time series.

Country	Rank	Value (°C)	Anomaly (°C)	Reference period	Start of time series
January					
Cyprus	3 (warmest)	12.0	+2.0	1981–2010	2000
Israel	5 (warmest)	11.8	+1.9	1991–2020	1950
Jordan (Amman Airport)	4 (warmest)	8.3	+1.9	1991–2020	1923
Portugal	4 (coldest)	8.0	-0.8	1971–2000	1931
Türkiye	2 (warmest)	2.7	+2.7	1981–2010	1971
February					
Portugal	5 (warmest)	11.7	+1.7	1971–2000	1931
Spain	3 (warmest)	9.5	+2.5	1981–2010	1961
March					
-	-	-	-	-	-
April					
Armenia	1 (warmest)	8.9	+4.0	1961–1990	1935
Croatia (Zagreb)	4 (coldest)	9.8	-1.6	1981–2010	1981
Czech Republic	5 (coldest)	5.4	-3.1	1991–2020	1961
Jordan (Amman Airport)	3 (warmest)	16.7	+2.5	1991–2020	1923
Romania	5 (coldest)	7.3	-2.5	1991–2020	1961
May					
Armenia	1 (warmest)	12.5	+2.9	1961–1990	1935
Croatia (Zagreb)	5 (coldest)	14.7	-1.8	1981–2010	1981
Cyprus	3 (warmest)	22.5	+2.6	1981–2010	2000
Israel	3 (warmest)	25.0	+2.0	1991–2020	1950
Jordan (Amman Airport)	2 (warmest)	22.9	+2.9	1991–2020	1923
Türkiye	1 (warmest)	19.3	+2.2	1991–2020	1971
June					
Armenia	1 (warmest)	17.6	+4.2	1961–1990	1935
Austria	3 (warmest)	17.5	+2.4	1991–2020	1767
Belgium (Uccle)	5 (warmest)	18.6	+1.9	1991–2020	1833
Bosnia and Herzegovina (Sarajevo)	3 (warmest)	20.5	+1.9	1991–2010	1961
Croatia (Zagreb)	3 (warmest)	23.3	+3.7	1981–2010	1981
Cyprus	4 (coldest)	23.8	-0.2	1981–2010	2000
Czech Republic	3 (warmest)	18.8	+2.3	1991–2020	1961
Finland	1 (warmest)	16.5	+3.7	1991–2020	1900
France	5 (warmest)	20.3	+2.0	1981–2010	1900
Hungary	3 (warmest)	21.9	+2.1	1991–2020	1901
Italy	4 (warmest)	21.5	+3.2	1961–1990	1961
Latvia	1 (warmest)	18.9	+3.6	1991–2020	1924
Lithuania	2 (warmest)	19.2	+3.3	1991–2020	1961
Netherlands (De Bilt)	1 (warmest)	18.2	+2.0	1991–2020	1901
Norway	5 (warmest)	11.5	+2.3	-	-
Poland	2 (warmest)	19.3	+2.5	1991–2020	1951
Portugal	5 (coldest)	19.4	0.0	1971–2000	1931
Russia (Moscow)	3 (warmest)	20.5	+3.9	-	1891
Slovakia	2 (warmest)	20.1	+2.4	1991–2020	1951
Slovenia	3 (warmest)	-	+3.4	1981–2010	-

Country	Rank	Value (°C)	Anomaly (°C)	Reference period	Start of time series
Sweden	2 (warmest)	-	+3.4	1860–1900	1860
Switzerland	5 (warmest)	14.4	+2.5	1981–2010	1864
July					
Belarus	2 (warmest)	22.5	+4.1	1981–2010	1881
Bosnia and Herzegovina (Sarajevo)	3 (warmest)	23.0	+2.5	1991–2020	1961
Bulgaria	3 (warmest)	23.8	+1.8	1991–2020	1930
Croatia (Zagreb)	3 (warmest)	24.0	+2.5	1981–2010	1981
Cyprus	4 (warmest)	28.4	+1.8	1981–2010	2000
Iceland (Akureyri)	1 (warmest)	14.3	+3.1	1991–2020	1880
Israel	4 (warmest)	28.4	+0.9	1991–2020	1950
Italy	4 (warmest)	23.2	+2.3	1961–1990	1961
Latvia	1 (warmest)	21.5	+3.7	1991–2020	1924
Lithuania	1 (warmest)	22.1	+3.8	1991–2020	1961
North Macedonia	4 (warmest)	24.3	+2.2	1981–2010	1981
Poland	3 (warmest)	20.9	+2.1	1991–2020	1951
Portugal	5 (coldest)	21.5	-0.6	1971–2000	1931
Romania	3 (warmest)	22.5	+2.0	1991–2020	1961
Serbia	2 (warmest)	-	-	1981–2010	1951
Slovakia	1 (warmest)	21.3	+1.9	1991–2020	1951
Sweden	5 (warmest)	-	+3.4	1860–1900	1860
Türkiye	2 (warmest)	26.3	+1.3	1991–2020	1971
August					
Bulgaria	4 (warmest)	23.3	+1.4	1991–2020	1930
Cyprus	2 (warmest)	28.7	+2.0	1981–2010	2000
Greece	1 (warmest)	28.8	+2.3	1981–2010	-
Iceland (Akureyri)	1 (warmest)	14.2	+3.4	1991–2020	1880
Israel	3 (warmest)	29.2	+1.4	1991–2020	1950
Jordan (Amman Airport)	2 (warmest)	27.4	+2.1	1991–2020	1923
North Macedonia	1 (warmest)	24	+2.3	1981–2010	1981
September					
Cyprus	2 (warmest)	28.7	+2	1981–2010	2000
Ireland	1 (warmest)	15.3	+1.7	1991–2020	1950
Italy	4 (warmest)	19.7	+2.1	1961–1990	1961
Portugal	4 (coldest)	20.4	+0.1	1971–2000	1931
United Kingdom ⁷	2 (warmest)	14.7	+1.8	1991–2020	1884
October					
North Macedonia	2 (coldest)	9.4	-2.5	1981–2010	1981
November					
Belarus	5 (warmest)	3.3	+2.4	1981–2010	1945
Cyprus	3 (warmest)	18.1	+2.6	1981–2010	2000
Israel	4 (warmest)	20.4	+2.0	1991–2020	1950
Portugal	4 (coldest)	11.2	-1.2	1971–2000	1931
Türkiye	3 (warmest)	11.4	+2.1	1991–2020	1971
December					
Portugal	4 (warmest)	11.7	+1.7	1971–2000	1931
Spain	3 (warmest)	8.5	+1.9	1981–2010	1961

⁷ Statistics are based on v.1.1.0.0 of HadUK-Grid

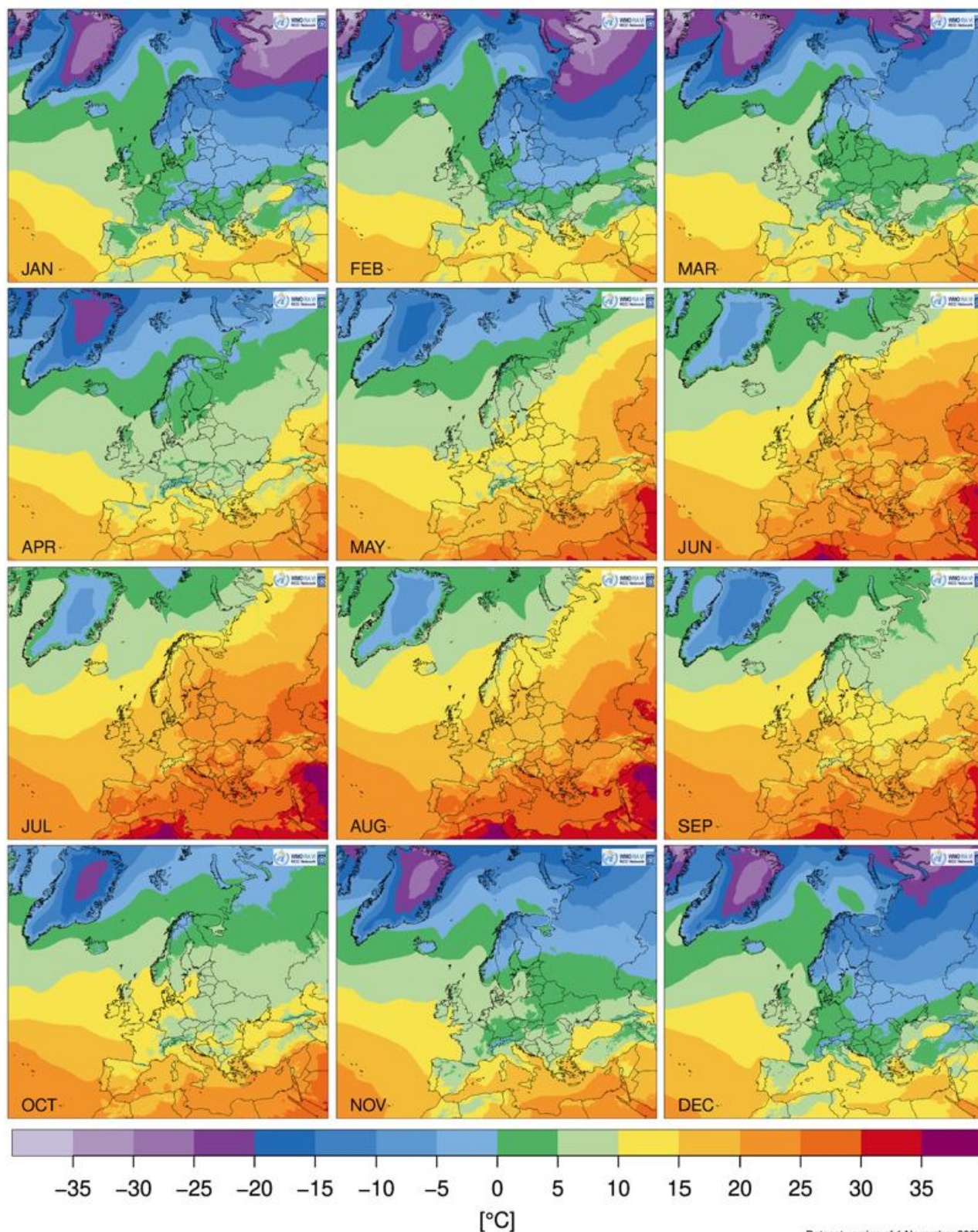


Figure 4-3: Monthly mean temperature in °C for each month of the year 2021. Source: [RCC-CM website](#).

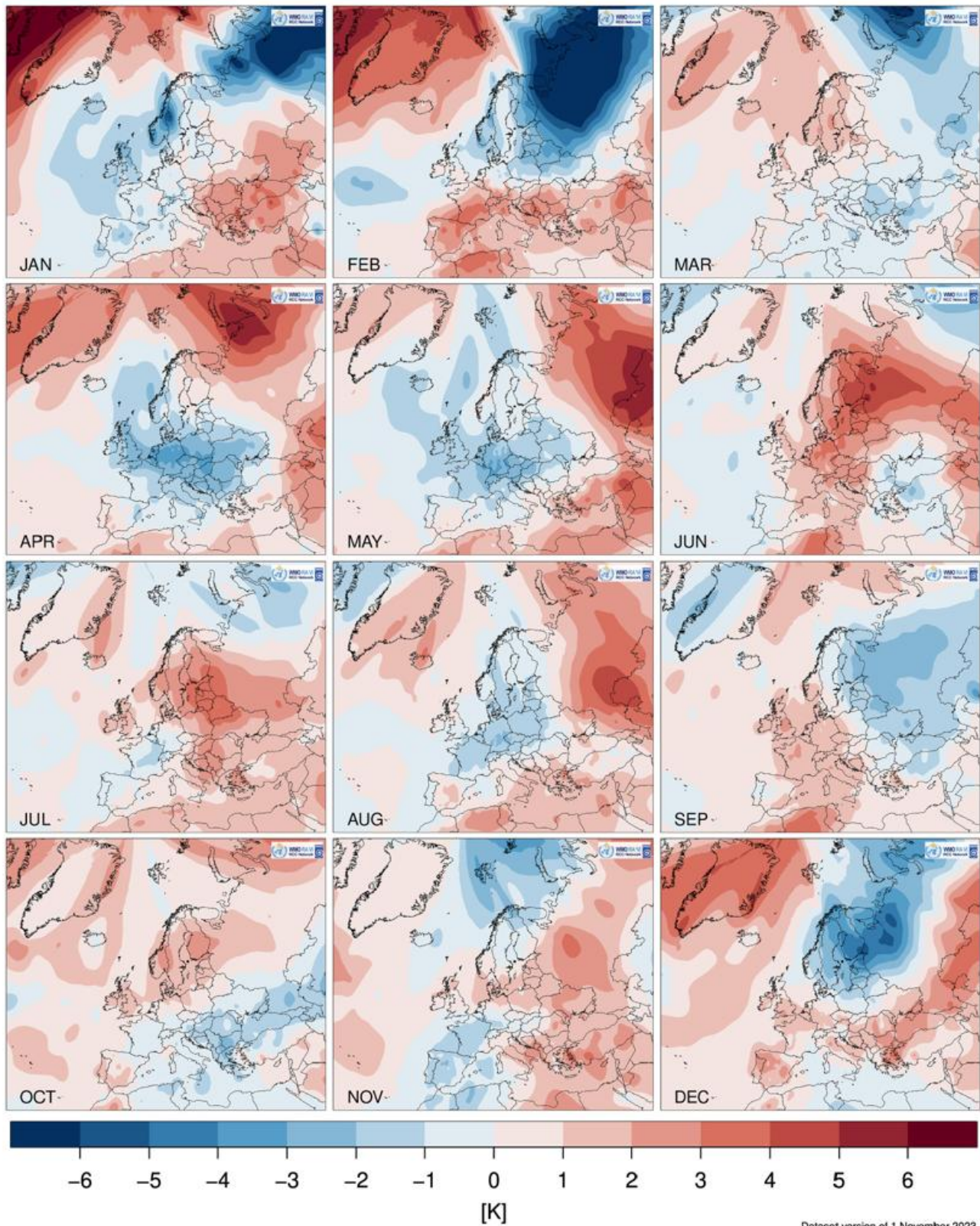


Figure 4-4: Monthly anomalies of temperature in °C relative to 1991–2020 for each month of the year 2021. Source: [RCC-CM website](#).

4.3. Precipitation

Annual precipitation in 2021 was near normal over large parts of the RA VI Region. Only the Middle East was much drier than normal (50% of normal precipitation). The individual months reveal a lot variability in the course of the year (see **Table 4-4**) that started with mostly wetter than normal conditions in January and February. These were followed by drier conditions in spring and beginning summer over large parts of the domain. Autumn brought even drier conditions especially to Central and Western Europe and the Mediterranean and Balkans.

Table 4-4: Monthly area average precipitation anomalies in % for each sub-region in the year 2021 (reference period: 1991–2020; definitions of the sub-regions see Figure 1-1).

Region	Jan	Feb	Mar	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
Central Europe	126	90	64	88	128	88	114	152	56	55	94	91
Central Mediterranean Region	226	82	87	93	73	75	81	72	51	133	115	137
Eastern Europe	132	127	101	130	125	109	81	119	114	57	114	125
Iberian Peninsula	111	132	30	109	60	146	55	66	124	62	68	71
Middle East	76	66	44	26	6	28	130	170	112	13	40	51
Nordic and Baltic Countries	84	64	83	88	114	72	70	113	90	130	79	59
Türkiye and South Caucasus	127	77	138	62	56	92	102	157	100	70	75	100
Western Europe	121	89	70	51	142	118	117	72	80	103	62	102

In January, wetter than normal conditions prevailed over most parts of the RA VI domain. Exceptionally wet (> 90th percentile) conditions occurred especially over the Eastern Europe (Ukraine, Belarus, Russia) and partly also over western and southern Europe (UK, France, Switzerland, Italy, Balkan peninsula). In some regions of Switzerland, January was once again really wintry. Frequent snowfall caused days with snow cover in deep layers. In eastern Switzerland, there was one of the strongest snowfalls since the beginning of the measurement, locally with record amounts. In Chur, with a total of 150 cm of snowfall, the fourth highest monthly sum fell since the beginning of the survey in 1888. Precipitation amounts reach 200% to 300% of the standard 1981–2010 in large parts of Switzerland in January. Several measurement sites also reported over 300% of the norm. The largest surplus was registered by Rothenbrunnen in Domleschg, Vaduz and Zermatt with around 340% of the norm. In western Switzerland, on the alpine south side and in the Upper Engadin, the January sums were mostly between 120 and 200%, locally also slightly above 200% of the norm. In many measuring sites, it was the rainiest month of January for at least 60 years. Several measuring sites with well over 100-year measuring series registered the second to fourth highest January precipitation sum since the beginning of the measurement. In the United Kingdom, rainfall was 113% of average, and some parts of northwest and northeast England, the east Midlands and the south-east had over twice the normal amount, but it was drier than average over much of central and western Scotland. January 2021 ranks as the wettest for Serbia in the period from 1951 to 2021. Precipitation totals relative to the normal for the 1981–2010 base period ranged from 94% in Sremska Mitrovica to 551% in Leskovac. Based on the percentile method, precipitation sums in the eastern, southern and parts of central and western Serbia were in the extremely wet category.

Veliko Gradiste observed a record-breaking number of days with precipitation, total of 25 days, thereby breaking the previous record of 23 days set in 1963 and 2019. Leskovac recorded 5 days with precipitation sums of 20 mm and above thereby setting the new January record. In Spain, during the first ten days of the month, rainfall was very abundant in most of the Spanish territory, resulting in the form of snow in large inland areas on 8 and 9 January. The accumulated precipitations in the decade were higher than 100 mm at some place along the Cantabrian, Andalusian Mediterranean coast, center of the Valencian Community and Balearic and Canary archipelagos. Drier than normal conditions occurred over Norway, Iceland, western parts of the Iberian Peninsula and in the area neighbouring the Caspian Sea. In Norway, the monthly precipitation was 55% of normal, and the month was also the driest January since 2010. It was driest in northern Norway where a number of stations had less than 10% of the normal precipitation. The driest stations were Saltdal - Nordnes (Nordland) with 0.5 mm (1% of normal), Ski bottom II (Storfjord, Troms and Finnmark) with 1.1 mm (3% of normal) and Nordnesfjellet (Kåfjord, Troms and Finnmark, 697 m a.s.l.) with 1.3 mm (4% of normal) precipitation.

The monthly mean precipitation totals for **February** were above normal over parts of the west and in the east. Abundant rainfall occurred in northern and western parts of Iberia with new daily records being set at several Portuguese stations at the beginning of February. Several heavy rain events occurred throughout the month in Spain resulting in locally in monthly totals up to two to three times the monthly precipitation. Ukraine and Russia experienced exceptionally wet conditions with precipitation falling as snow. Snow depths locally reached record levels. Due to a blocking high-pressure area expanding towards Central Europe, Atlantic low-pressure systems followed increasingly southerly tracks causing heavy precipitation with flooding in various parts of the Mediterranean region especially hitting parts of Greece, Türkiye and Albania and also eastern Jordan. Exceptionally dry conditions, on the contrary, prevailed over southern Sweden and the Baltic countries. The total amount of precipitation in Latvia in February was 11.2 mm, which is 70% below the monthly norm (36.8 mm) (1981–2010). In Estonia, the average monthly rainfall was 17 mm which is 44% of the normal (long-term average is 39 mm).

In **March**, dry conditions prevailed in most parts of the RA VI domain. Monthly precipitation totals much below the long-term means occurred especially in Iceland, Sweden, Finland, Central Europe, the Iberian Peninsula, northern Italy, northern Ukraine up to central European Russia. No or exceptionally below normal precipitation (<10th percentile) fell in central Spain, northern Portugal, southern France, northern Italy, southern Slovakia, up to southern parts of central European Russia. In Spain, precipitation was below 25% of the normal value in large parts of Galicia, southern half of Castilla y León, Extremadura, Aragón, and inland Andalusia. In Portugal, the average value of the amount of precipitation in March, 15.3 mm, corresponded to only 25% of the 1971–2000 average. There was no occurrence of precipitation over a large part of the month throughout the territory, except on 4, 5, 11 and 12 March. In France, rainfall was on average nearly 50% below normal. Generally, less than 10 days of rain were recorded, and even less than 5 days in the Mediterranean regions, i.e. 2 to 8 days less than normal. Rainfall totals, mostly below 50 mm, were more than 25% below normal over most of the country. It exceeded 75% from the east of the Hérault to the Ardèche and the PACA region, as well as over the Roussillon and the east of the Aude and more locally in the Landes and Haute-Corse with less than 20 mm, or even less than 5 mm from the Gard to the Var, not exceeding 1.8 mm in Arles (Bouches-du-Rhône). For France, March 2021 ranks among the

10 driest months of March over the period 1959–2021. In Tuscany, Italy, the month of March 2021 was exceptionally dry, with an overall average rainfall deficit of over 90% in the ten major cities, making it the third driest March since 1955. Especially on the plains, it rained less than a tenth of what usually falls in this period. In most of the central areas of the region and along the coast, the monthly accumulations did not exceed 5 mm. Only on the northern slopes were there slightly more significant accumulations of up to 50 mm, but these quantities were also well below those typical of the period. Austria and Switzerland saw a very dry March as well. In Austria, March 2021 was 50% drier than normal in the Austria-wide evaluation. Especially in the south of Austria, there was almost no rain or snow at all. For example, ZAMG (the Austrian meteorological service) recorded only one to two millimetres of precipitation in the Carinthian towns of Kötschach-Mauthen, Döllach and Obervellach in the entire month. In Switzerland, the southern side of the Alps and the Engadin saw the largest deficits with mostly less than 30% of the norm. Locally, the values even remained below 10% of the 1981–2010 norm. Monthly precipitation totals above the long-term means, in contrast, were reported in the southeast around the Black Sea and in the northwest along the western coast of Norway and Scotland. In both regions, the monthly amounts were partly even exceptionally above normal. Romania, Moldova and the southeast of Ukraine saw monthly precipitation totals of 1.5–2.5 times the normal. The precipitation often came in the form of snow. Heavy snowfalls were observed in Scotland, Türkiye and Romania. In Switzerland, the northern side of the Alps experienced a wintry spell with a continuing influx of polar air towards the middle of the month. Snow fell several times down to low altitudes. In the mountains, there was one metre or more of fresh snow in some regions. The highest peak in Germany (Zugspitze, 2 960 m) received 60 cm of snow in just 24 hours on 14–15 March and 100 cm in 48 hours on 14–16 March. Further snowfall occurred in the following week, and after having received 50 cm more, the absolute depth reached 450 cm on 22 March. The largest ever-measured depth in March in this place was 680 cm in 1948, March normal 1981–2010 is 295 cm. Other peaks in Germany received 40–70 cm within 3 days (14–17 March 2021), locally more, similarly in Switzerland. The Swiss station Andermatt (1 438 m a.s.l.) measured 98 cm in 72 hours (13–16 March), well below the largest 3-day snowfall in this place ever registered with 208 cm in April 1975. In the Italian Aosta Valley (3 000 m), 50–60 cm fresh snow was registered on 15–16 March 2021, 40 cm–50 cm in Chamonix-Mont-Blanc in the French Alps on 14–15 March. In the European Territory of Russia, the Krasnodar Territory, Dagestan, the Lower Volga Territory, the Rostov Region and Kalmykia received heavy snowfalls as well during the third decade of the month which is exceptionally that late for March. In some locations, up to 25–40 mm of precipitation accumulated in the form of snow and sleet. In the southern parts the precipitation amounts exceeded the normal values by 2–2.5 times.

In **April**, monthly precipitation totals were above the long-term means in parts of Scandinavia, east and southeast Europe, and the Iberian Peninsula. Exceptionally low monthly precipitation totals were observed over northwestern Europe and over the southeast of RA VI. For the United Kingdom, April was not only an unusually cold but also an unusually dry month. Many areas were very dry, with rainfall totals reaching only 29% of the long-term average, making it the driest April since 1980 and fourth driest in a series from 1910. In Germany, April 2021 was significantly drier than the multi-year average, with only 25 mm of rainfall in some areas, which is less than 50% of normal amounts in southern Germany. Norway received on a national basis 10% more precipitation than normal, but dry conditions prevailed in the eastern mountains, especially in the hinterland and the bay. In this area, a number of stations received from 75% to 90% less precipitation than normal e.g. Hamar -

Stavsberg 1.7 mm (6% of normal) and Fagernes (Nord-Aurdal, Innlandet) 2.1 mm (8% of normal). Some western parts, on the contrary, received much more precipitation than normal with some stations reporting from 200 to up to 300% more precipitation than normal, e.g. Ørnedalen on Nordmøre (Hustadvika, Møre and Romsdal) 231.4 mm (184% of normal), Eresfjord (Molde, Møre and Romsdal) 227.5 mm (254% of normal), Nuvsvåg (Loppa, Troms and Finnmark) 227.2 mm (206% of normal).

In terms of precipitation, May was mostly wetter than normal over Europe, especially in the east and parts of Central and Western Europe, where monthly totals were exceptionally above average. In the United Kingdom, nearly all areas had a wet month, with only parts of western Scotland having near or below average rainfall, and many places from eastern Scotland to Wales and southwestern England had well over double their normal May rainfall, making it provisionally the United Kingdom's fourth wettest May in a series from 1862, with 171% of average. In the Netherlands, May was a very wet month as well, with a total of 90 mm rainfall across the country compared to 55 mm on average. In De Bilt, 104.4 mm fell, together with 1987 good for tenth place in the ranking with the wettest months of May. More than twice the monthly quantity fell on an extensive scale in the centre and north of the country, locally even 140–150 mm in Friesland and South Holland. Especially further inland there were often heavy showers with thunderstorms, hail, gusts of wind and locally a lot of precipitation in a short time. In Latvia, the total amount of precipitation in May was 88.3 mm, which is 75% above the monthly norm (50.4 mm). In Finland, particularly in the southern part of the country, several new station-specific rainfall records were recorded. The highest rainfall of the month, 122.8 mm, was measured at Nokia's Tottijärvi. Lower than normal precipitation totals occurred over southern parts of RA VI, especially over southern Italy, Greece and Türkiye, where less than 50% of normal precipitation amounts were observed. In some parts, no precipitation fell at all. In Spain, May 2021 has been very dry in terms of precipitation, with an average precipitation of 34 mm, which represents 57% of the normal value for the month (reference period: 1981–2010). This was the twelfth driest May since the beginning of the series in 1961, and the sixth driest in the 21st century. Precipitation was below 50% of the normal value in large parts of Galicia, the Cantabrian coast, Aragon, Catalonia, Valencia, Castile and Leon, Castile-La Mancha, Madrid, Extremadura and Andalusia. According to preliminary estimates the area average precipitation in May for Cyprus was 0 mm, which is the lowest rainfall recorded in Cyprus for the specific month since 1941. May precipitation in Türkiye was only 50% of normal amounts (1981–2010). The drought affected particularly the Aegean, Mediterranean and Southeastern Anatolia Regions, where the precipitation deficits exceeded 80% of normal. In Northern Europe, it was Iceland which saw unusually low precipitation all over the country, with partly less than 20% of normal amounts.

During the month of June, heat waves with dry and sunny weather dominated in large parts of Europe but were temporarily interrupted by periods of thunderstorms forming within the warm air masses due to occasional low-pressure influence. These convective events brought heavy rain, hailstorms and gusty wind, locally causing flash floods with severe damage in western and southeastern parts of the RA VI domain. In some parts, these events resulted in exceptionally above normal monthly totals, as for example over France, Switzerland and areas neighbouring the Black Sea. In France, June 2021 ranks as the fourth wettest June in the last 50 years with monthly totals exceeding 150% of average precipitation amounts. From the Belgian border to the north of Auvergne and the Atlantic coast, as well as in Alsace, it often reached 1.5 to 2.5 the normal value, and locally up to 3.5 from Touraine to Poitou-Charentes and Gironde, as well as on the tip of the Cotentin.

Monthly records were broken. The precipitation total for Spain was 49.8 mm, which represents 147% of the average precipitation (reference period: 1981–2010 making it the fourteenth wettest June since the beginning of the series in 1961, and the second in the 21st century. Drier than normal conditions prevailed in the northwestern and northern parts (for example the UK, Sweden and Baltic countries), over the Italian and Balkan peninsula with partly less than 40% of normal precipitation. For Serbia it was the third driest June since 1951 and the driest on record for Sremska Mitrovica and Valjevo.

July: Monthly precipitation totals were above the long-term mean in central and western Europe as well as around the Black Sea. The highest precipitation totals were observed in the Alps and over Central Europe, where monthly totals were exceptionally above normal. Much of the large rain amounts in Central and Western Europe were related to the low-pressure system *Bernd*, which brought regionally very pronounced heavy rainfall events especially in Germany, northeastern parts of France, Belgium and the Netherlands, leading to severe flash flooding, particularly in the western regions North Rhine-Westphalia and Rhineland-Palatinate. Precipitation totals exceeded 100 mm in 72 hours over a large area in western Germany, regionally 150 mm in 24 hours, at 1 station (Hagen) even 241 mm in 22 hours. Within a few hours or days, an average of 1.5–2 times the average precipitation in July related to the reference period 1991–2020 was achieved over entire river catchment areas. In Belgium, in Uccle, a monthly total of 166.5 mm of precipitation was recorded (normal: 76.9 mm). This value largely beats the previous record for the current reference period (133.8 mm in 2000). However, since observations began in 1833, the absolute record remains that of 1942, with 196.5 mm. The highest daily amount in July 2021 in Uccle fell on 15 July. A total of 58.9 mm was measured on that date. In the rest of the country, the heaviest rainfall was observed on 14 July. On that day, four of the stations in the IRM network measured more than 100 mm. The highest amount was recorded in Hockai (Stavelot), with 179 mm. The large amounts of rainfall in the middle of the month led to a lot of flooding. The provinces of Liège, Namur and Luxembourg were particularly affected and only the west of the country was spared. The regional averages of the monthly precipitation amount in the country were slightly lower than normal in the northwest of the country and largely above normal in the other regions. They ranged from about 90% of normal at the coast to about 240% of normal in the Entre-Sambre-et-Meuse region. In South Limburg, the Netherlands, in particular, there also was an extremely high amount of precipitation and major flooding occurred. Averaged over the country, in July there was around normal amount of precipitation, 80 mm against 78 mm normal. In the entire eastern half of the country, July was a wet month with locally 130–140 mm. South Limburg clearly stands out with 150–200 mm and around Heerlen even more than 230 mm of precipitation. However, the 3-day period from 13–15 July was the crowning glory with locally more than 150 mm in South Limburg in 48 hours, more than twice the normal monthly amount. The Black Sea region, too, experienced some heavy rain events with flooding, especially in the Krasnodar region in Russia, on the Crimea Peninsula and in northeast Türkiye. Drier than normal conditions prevailed in northern and eastern Europe and Iceland. No or almost no precipitation fell around the Mediterranean Sea. In Iceland, July was dry over most of the country and precipitation was about a third to half of the average precipitation. Precipitation in Reykjavík was 26.5 mm, which is about 50% of the average precipitation from 1991 to 2020. Precipitation in Akureyri was 12 mm, which is about 35% of the average precipitation from 1991 to 2020. Average rainfall in Estonia was 50 mm which is 75% of the norm. In Belarus, during the month of July, 66 mm of precipitation fell on average in the republic, which amounted to 78% of the climatic

norm. Precipitation spread over the territory of the country extremely unevenly. The smallest amount of precipitation fell on the territory of the Vitebsk region (northeastern part of the country) — an average of 27.1 mm in the region (33% of the climatic norm).

August: Monthly precipitation was below normal over Western Europe, southern Norway, West Kazakhstan and in the Mediterranean Basin. In France, precipitation was 30% to 70% lower over most of the country and over 70% lower over Corsica. On average, over the country and over the month, the deficit reached 40%, ranking this month of August as the sixth driest since 1959. In Türkiye, the Aegean Region (western part) saw an 80% decrease in precipitation and in many areas of the western half of Kazakhstan it was extremely dry and in many places there was no rain at all during the whole month. In Iceland, the month of August was unusually dry in the northeast and east and relatively dry in most other parts of the country. Akureyri received only 7 mm of precipitation, which is only about 15% of normal precipitation amounts. It was the smallest amount measured in Akureyri in August since 1960. At Höfn in Hornafjörður, 19.1 mm of precipitation was measured, which is the lowest amount that has ever been measured there. Central Europe, Finland, the Baltic region, and the Russian and Turkish Black Sea regions, on the contrary, experienced a much wetter than average August. A large low-pressure area caused heavy rain in regions in Northern and Central Europe in mid-August 2021. In Finland, especially in the area from Northern Ostrobothnia to Central Finland and Northern Savonia, precipitation was exceptionally high in some places. Belarus received 120.7 mm of precipitation which corresponds to 180% of the climatic norm. Most precipitation fell in the Brest region, namely 153.3 mm which corresponds to 247% of the climatic norm. In Poland, the southeastern part saw as well monthly totals of 2–3 times the normal amounts. Like in July 2021, heavy rainfalls were observed in the Black Sea region in August 2021 as well, in particular in the coastal regions of Russia and Türkiye. These resulted to a large extent from the Medistorm *Falchion* that formed over the north-central Black Sea on 11 August 2021 before making landfall in Russia on 13 August. While western parts of Türkiye saw a large precipitation deficit, the central northern parts recorded two to three times more precipitation than normal.

In **September**, monthly precipitation totals were below the long-term means over Central Europe, Italy and the Balkan Peninsula. Germany received 36 mm of precipitation, 42.2% less than in the reference period 1961–1990. September 2021 was thus the tenth driest September in Germany since 1901 and the fourteenth driest since 1881, making it one of the very dry September months in terms of precipitation. In Uccle, Belgium, only 26 mm of precipitation was recorded in September, corresponding to less than 40% of normal amounts (normal: 65.3 mm). This is in sharp contrast to the preceding three wet summer months during which more than 100 mm of precipitation was recorded each month. In the Netherlands, September was very dry as well, especially along the coast. The observed average amount of precipitation of 28.6 mm corresponds to only 40% of normal amount (73 mm). It was even extremely dry along the coast until the last few days of the month. Until 26 September, not one millimetre of rain fell at KNMI station Rotterdam. Until then, the other coastal stations also had only a few millimetres of precipitation. In the rest of the country, precipitation amounts differed greatly due to the showery character. In Austria, it rained 52% less than in an average September. This made it the driest September since 1975 and the twelfth driest in measurement history. Iberia and the east (Belarus and neighbouring areas of the Black Sea), on the contrary, saw a wetter than average September. In Belarus, 90.3 mm of precipitation fell on average, which corresponds to 151% of the climatic norm. Most precipitation fell on the territory of the Mogilev

region — an average of 115.1 mm in the region which corresponds to 198% of the climatic norm. Türkiye saw precipitation totals of twice the normal amounts in the inner parts of the country and around Giresun. In Portugal, precipitation total for September was 66.8 mm, corresponding to 159% of the normal value from 1971–2000. This was the fourth highest value since 2000 (highest in 2014, 112.6 mm). In the European part of Russia, precipitation in September was normal or above-normal in with the exception of the north-western areas. In the central and southern regions normal amounts were exceeded by 1.5–2 times or more.

Monthly precipitation totals in **October 2021** also showed sharp contrasts within the RA VI Region. It was much wetter than normal from Northwestern Europe (northwestern France, Ireland, United Kingdom, Low countries) to Scandinavia and northern European Russia. Two more wetter-than-normal areas were to be found in the southeast, one over southern Italy and the Balkan Peninsula, the other one near the Caspian Sea (eastern Caucasus region). In between, an area with below-normal precipitation extended along the high-pressure zone from Iberia over Central Europe and northern Italy to Eastern Europe and west Kazakhstan. Also dry was the eastern Mediterranean subregion (central Türkiye, Cyprus and the Middle East), mostly with no precipitation at all or very little, which is not usual so late in the year at least in Türkiye and northern parts of the Middle East. In Norway, on a national basis, 50% more precipitation fell than normal. A number of stations in Vestland, Møre og Romsdal, Trøndelag and inland received 100%–150% more precipitation than normal. A new rainfall record for monthly precipitation in Bergen-Florida at 624.1 mm in October 2021 exceeded the previous record of 1983 of 586 mm. Countrywide, it was the third wettest October since beginning of the series in 1900, behind 1983 and 1967. In Sweden, October was rainy especially in the northern parts of the country where several precipitation records were broken, both in daily and monthly precipitation. Karungi in Norrbotten recorded a monthly total of 220.4 mm, the largest monthly total ever regardless of the month of the year at this station (measurements since 1960). The month's largest daily total in Sweden at 62.2 mm was measured in Haparanda (also Norrbotten) on 15 October, a new record in daily precipitation for October in the province of Norrbotten since at least 1945. In northern Finland (Lapland), it rained more than three times more than average. Monthly rainfall was over 100 mm and record high in many places. According to preliminary data, the highest rainfall in northern Finland in October 2021 was 197.9 mm in Tornio Torp. The wettest areas in the United Kingdom were southern Scotland, Cumbria, the northwest corner of Wales, and southern England, with many places above 150% of average, and the United Kingdom overall had 128% of average October rainfall. Monthly rainfall totals in Ireland ranged from 75.2 mm (95% of its long-term average) at Phoenix Park, Dublin County to 265.7 mm (151%) at Newport, Mayo County (its wettest October since 2011). Both Valentia Observatory, Co Kerry (264.9 mm, 150%) and Belmullet, Co Mayo (222.4 mm, 152%) had their wettest October since 2000. The monthly precipitation in Akureyri in northeast Iceland was the second highest that has been measured there in October (164.8 mm, more than twice the 1991–2020 normal, behind October 1995), mainly due to heavy rain at the beginning of the month. It was less rainy in Reykjavík in the southwest of the country (55.1 mm). October 2021 was also a very wet month in De Bilt (Netherlands) with 145 mm against 81 mm as normal, good for a ninth place in the list of wettest October months. Uccle in Belgium even recorded its second wettest October month at 121.1 mm after October 1998.

Precipitation in October 2021 was below-normal in large parts of Switzerland. Less than 50% of normal fell in northern parts of the country and in parts of the Alps, locally less than one third of the normal amount. Austria saw its driest October for 16 years (since 2005) with 53% of the 1991–2020 normal. In the Czech Republic, a monthly average of 19 mm represented 44% of the 1981–2010 normal, Hungary reported 52% on average (normal: 51 mm). In France, rainfall was on average more than 10% lower than normal, but there were a few heavy rain events in parts of the country at the beginning and at the end of the month. Monthly accumulations often reached one and a half to twice the normal in northwestern France from the Lille region to eastern Brittany and the Nantes region, as well as very locally over eastern Corsica, and sometimes up to three times the normal in southeastern mainland France from the Cévennes to western Provence, with 252.3 mm in Marseille (Bouches-du-Rhône) or 877.8 mm in Villefort (Lozère). Also, in Spain, the spatial distribution of precipitation was inhomogeneous. While most of the country was dry (75% of normal precipitation or less), central parts of Spain received partly more than twice the normal due to heavy rain especially in the third decade of the month. Similarly, precipitation was also spatially very variable in Portugal. Monthly totals in Portugal varied between 1 and 273 mm, percentages of normal (here 1971–2000) between 6% and 188%, highest in central parts of the country. Italy also was mostly dry in northern and central parts, but with intense local heavy rain events, among them almost 900 mm rain in 24 hours in Liguria (see event section below). On the other hand, it was rainy in southern Italy and Malta. A monthly total of 246 mm was recorded in Malta, three times the October normal, and it was the third wettest October in Malta since 1922 after the years 1951 and 1957. The rain in Malta came after 12 consecutive drier-than-average months. More than half of the month's total rainfall descended during the last week of October 2021, when Medicane Apollo was active (see event section). In southeastern Europe, southwestern Slovenia and the Ljubljana Basin were especially dry, where precipitation did not exceed 40% of normal precipitation. In parts of Slovenian Istria fell less than 15% of the normal. Bulgaria had a relatively large monthly rainfall in October 2021. The monthly totals were mostly between 130% and 530% (Pazardzhik) of the norm. October 2021 was the rainiest of all October months since 2004. The most abundant precipitation was around 12 October in eastern Bulgaria, when 24-hour precipitation totals of up to 20–60 mm had been reached. The largest 24-hour amount of precipitation was measured in Veselie, Burgas region, on 13 October (85 mm). In Greece, very large amounts of precipitation affected the Ionian area and a few parts of the mainland mainly due to two intense low-pressure systems (see event section). Cyprus was mainly dry with only 6.7 mm on average (20% of normal) over the whole month, in spite of heavy rainfall and thunderstorms on 30 October, which affected Larnaca and Nicosia districts. Precipitation in most of Russia was scarce during this October. As regards the European part, the normal amounts were significantly exceeded in the republics of the North Caucasus only, by two or more times in places. Heavy rains passed along the Black Sea coast of the Caucasus, bringing 60–130 mm of rainwater per day at the beginning of the month. On the other hand, there was a severe shortage of precipitation especially in the Volga and south federal districts; in some places, the monthly precipitation totals were as low as 10%–20% of the normal amount. Belarus, too, saw a shortage of precipitation with a monthly total of only 14.5 mm, which is 29% of normal), in the Gormel region even 3.9 mm or 8% of normal; it was only the second time since 1945 that such a low amount was noted. Also, west Kazakhstan was very dry, precipitation was absent during the whole month in some places, the same in some northern districts of Moldova. In the Ukraine, precipitation was very unevenly distributed in time and space: in the first and third decades, not a single drop of precipitation

fell throughout the country, and only in the second decade (13–15 October) did heavy rains pass from Mykolayiv to Chernihiv Oblast. The decadal sum in this area was 430% of the decadal norm. As a result, the monthly amount of precipitation throughout the territory, except for the above-mentioned basins where heavy rain occurred, was 2%–20% of the monthly norm. On most rivers of Ukraine, due to a significant deficit of precipitation, low water levels were measured, especially in the Carpathians. The amounts of rain in October 2021 in Israel were small and reached several mm in the north and centre of the country, locally above 10–15 mm, partly with thunderstorms. In the central mountains it dropped only 1–2 mm in October (the long-term average is 10–20 mm). The lack of rain is not unusual considering that the previous October (2020) was even completely rainless.

November: Monthly precipitation totals were below the long-term means in large parts of Western and Central Europa as well as over Iberia and in southeast. Portugal saw its driest 3 November since 1931 with precipitation totals much lower than the long-term mean value. Almost all districts saw totals below 25% of normal. The largest deficit was reported from Castelo Branco, where only 2% of normal precipitation amounts were registered. In the United Kingdom and Ireland, November was a dry month as well: In Ireland, several stations reported their driest November on records with deficits ranging between 20% to 50%, among them stations with time series going back till 1942. The United Kingdom as a whole had 63% of average November rainfall. Largest deficits with less than 20% of normal were registered for London and much of southern England. The central parts of the Mediterranean Region and the northeast, on the contrary, experienced a wetter than average November. Exceptionally wet conditions occurred over northern European Russia and over the Mediterranean Islands, with monthly precipitations totals up to 1.5 to 3 times the normal amounts. For example, over the eastern half of Corsica with 272.5 mm at Durban-Corbières (Aude) and 445.5 mm at Isolaccio-di-Fiumorbo (Haute-Corse). There were 14 to locally 21 days of rain over eastern Corsica, 5 to 10 days more than normal. Also, in Croatia, most parts experienced wetter than normal conditions with 328.9 mm being reported for the stations of Hvar corresponding to 331% of normal. Although precipitation accumulations for France were on average, more than 30% lower than normal, Corsica and the southeast were affected by several intense rainstorms. Monthly precipitation totals reached 1.5 to 3 times normal amounts from the south of Hérault to the Pyrénées-Orientales and the east of Ariège as well as over the eastern half of Corsica with 445.5 mm at Isolaccio-di-Fiumorbo (Haute-Corse) and 272.5 mm at Durban-Corbières (Aude). There were 14 to locally 21 days of rain over eastern Corsica and the Pyrenees, 5 to 10 days more than normal. Eastern parts of Türkiye (Eastern and Southeastern Anatolia) also experienced much drier than normal conditions with deficits of 30% to 65%.

December: Monthly precipitation totals were above the long-term means in the southeastern parts of the in the RA VI Region. Parts of the Ukraine, Romania, Bulgaria, Serbia and Moldova even experienced exceptionally wet conditions getting 2–3 times the normal precipitation amount. In the Ukraine, precipitation was distributed unevenly over the territory and in time. In general, in December fell on the flat territory of the country 32–90 mm (1–2.3 monthly norms), in the Carpathian region 80–251 mm (1.1–2.8 monthly norms). For Serbia it was third wettest December and a record wet December for Cuprija, Veliko Gradiste and Kopaonik, second wettest December for Belgrade, Smederevska Palanka and Pozega. In the southwestern part of the RA VI Region as well as in Türkiye and Israel, heavy rain events locally led to large monthly accumulations. In France, monthly

rainfall reached 2–3 times the normal amount in some places in the northern Rhône-Alpes and the central Pyrenees: 217.4 mm were measured in Tarbes (Hautes-Pyrénées), 235.7 mm in Ciboure (Pyrénées-Atlantiques) and 283.2 mm in Albertville (Savoie), even larger amounts were observed over the central Pyrenees, the Northern Alps as well as over the western Pyrenees. Over the rest of the RA VI Region, normal or drier than normal conditions prevailed, largest deficits occurred in Scandinavia, the Baltic countries and Iceland as well as over Spain, northern Italy and the Middle East. In Finland, the west and central part of the country and North Ostrobothnia were most affected by the unusually dry conditions, in some places it was even exceptionally dry. For Norway, it was the driest December since 2012. A number of stations in eastern Norway received from 75 to 90% less rainfall than normal. In Iceland, Reykjavík received around normal rainfall, whereas in Akureyri and Stykkishólmur, the total rainfall for the month was 46.8 mm and 45 mm respectively, representing about 64% and 53% of normal precipitation amounts. Accumulated precipitation in December was below the normal value in almost all of Spain as a whole. On the Mediterranean side, the month was very dry in the Júcar, Segura and Eastern Pyrenees basins, all receiving less 20% of their normal precipitation amounts.

Table 4-5: Rank statistics, monthly average precipitation and anomalies (mm) from several countries of the RA VI for the individual months in 2021, only including countries with rankings among the top 5 (ranks 1–5) since start of the time series.

Country	Rank	Value (mm)	Anomaly (mm)	Reference period	Start of time series
January					
Bulgaria	1 (wettest)	136.5	+87.1	1991–2020	1930
North Macedonia	1 (wettest)	158.4	+109.1	1981–2010	1981
Romania	4 (wettest)	68.0	+30.0	1991–2020	1961
February					
Latvia	5 (driest)	11.2	–29.1	1991–2020	1924
Lithuania	5 (driest)	11.0	–31.3	1991–2020	1961
Türkiye	5 (driest)	32.9	–45	1991–2020	1971
March					
Georgia	4 (wettest)	109.0	+34	1991–2020	1956
Spain	4 (driest)	17.0	–29	1981–2010	1961
April					
Armenia	5 (driest)	35.7	–35.3	1961–1990	1935
Ireland	2 (driest)	25.4	–56.5	1991–2020	1941
Russia (Moscow)	3 (wettest)	91.0	+45	-	1903
Türkiye	4 (driest)	30.7	–46.6	1991–2020	1971
United Kingdom	5 (driest)	20.6	–51.1	1991–2020	1836
May					
Denmark	2 (wettest)	107.5	+59.0	1981–2010	1874
Georgia	3 (driest)	49.0	–44	1991–2020	1956
Latvia	4 (wettest)	88.3	+37.9	1991–2020	1924
Lithuania	1 (wettest)	103.0	+50	1991–2020	1961
Moldova (Chisinau)	4 (wettest)	101.0	+48	1991–2020	1891
Türkiye	1 (driest)	21.6	–59	1991–2020	1971
United Kingdom ⁸	2 (wettest)	121.4	+50.4	1991–2020	1836

⁸ Statistics are based on [v.1.1.0.0 of HadUK-Grid](#)

Country	Rank	Value (mm)	Anomaly (mm)	Reference period	Start of time series
June					
Armenia	1 (driest)	19.3	-51.7	1961–1990	1935
Austria	3 (driest)	74.0	-42.0	1961–1990	1961
Bosnia and Herzegovina (Sarajevo)	4 (driest)	27.4	-60.4	1991–2020	1961
France	5 (wettest)	103.5	+36.1	1981–2010	1958
Georgia	5 (driest)	62.0	-35.0	1991–2020	1958
Greenland (Nuuk)	3 (wettest)	161.5	+100.9	1981–2010	1784
Hungary	1 (driest)	15.7	-56.3	1991–2020	1901
Ireland	5 (driest)	31.4	-53.5	1991–2020	1941
Italy	3 (driest)	31.0	-30.0	1961–1990	1961
Serbia	3 (driest)	-	-	1981–2010	1951
Slovakia	1 (driest)	31.5	-55.0	1981–2010	1961
Slovenia	1 (driest)	-	-	-	1961
July					
Armenia	3 (wettest)	52.7	+8.7	1961–1990	1935
Belgium (Uccle)	5 (wettest)	166.5	+89.6	1991–2020	1833
Luxembourg	1 (wettest)	193.3	+127.5	1991–2020	1854
Switzerland	1 (wettest)	256.1	+126.1	1981–2010	1864
August					
Finland	2 (wettest)	113	+44.0	1991–2020	1961
Lithuania	2 (wettest)	143	+66.0	1991–2020	1961
Poland	2 (wettest)	140.1	+73.9	1991–2020	1951
Portugal	5 (driest)	3.8	-9.9	1971–2000	1931
Slovakia	3 (wettest)	132.1	+57.7	1981–2010	1961
September					
Austria	3 (driest)	49	-44.0	1961–1990	1961
Czech Republic	4 (driest)	23	-38.0	1991–2020	1961
Georgia	1 (wettest)	184	+100.0	1991–2020	1956
Greenland (Nuuk)	4 (driest)	7.8	-82.4	1981–2010	1784
Portugal	4 (wettest)	66.2	+24.1	1971–2000	1931
October					
Bulgaria	4 (wettest)	114.6	+56.3	1991–2020	1930
Malta	3 (wettest)	246	>164.2	1981–2010	1922
Finland	3 (wettest)	99	+39.0	1991–2020	1961
Moldova (Chisinau)	3 (driest)	2	-44.0	1991–2020	1891
North Macedonia	4 (wettest)	136.7	+71.0	1981–2010	1981
Norway	3 (wettest)	204	+68.0	1991–2020	1900
Slovakia	3 (driest)	12.3	-37.5	1981–2010	1961
November					
Bosnia and Herzegovina (Sarajevo)	1 (wettest)	218.7	+134.4	1991–2020	1961
Portugal	3 (driest)	18.9	-90.5	1971–2000	1931
December					
Romania	2 (wettest)	82.7	+39.4	1991–2020	1961
Serbia	3 (wettest)	-	-	1981–2010	1951

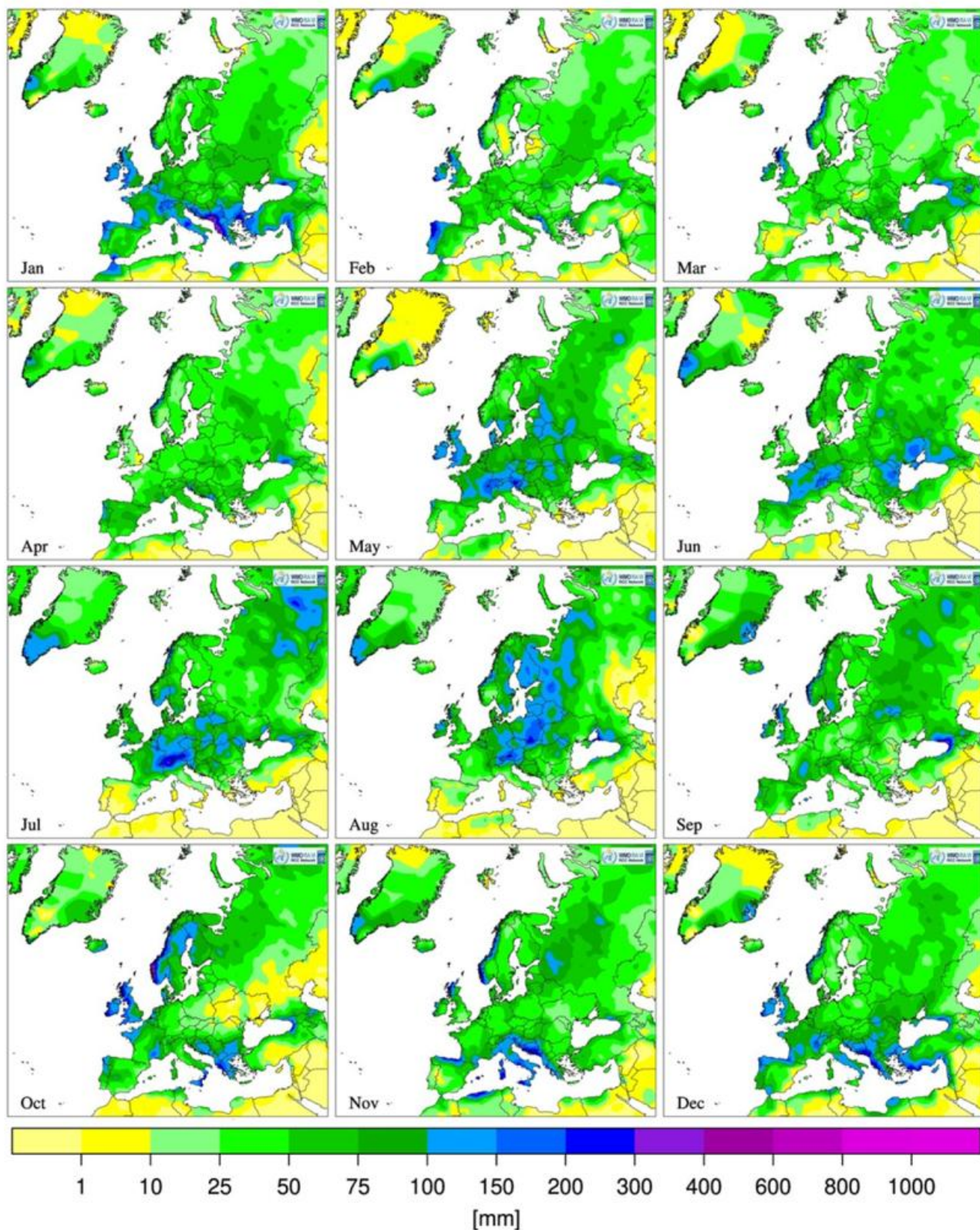


Figure 4-5: Monthly mean precipitation in mm/month for each month of the year 2021. Source: [RCC-CM website](#).

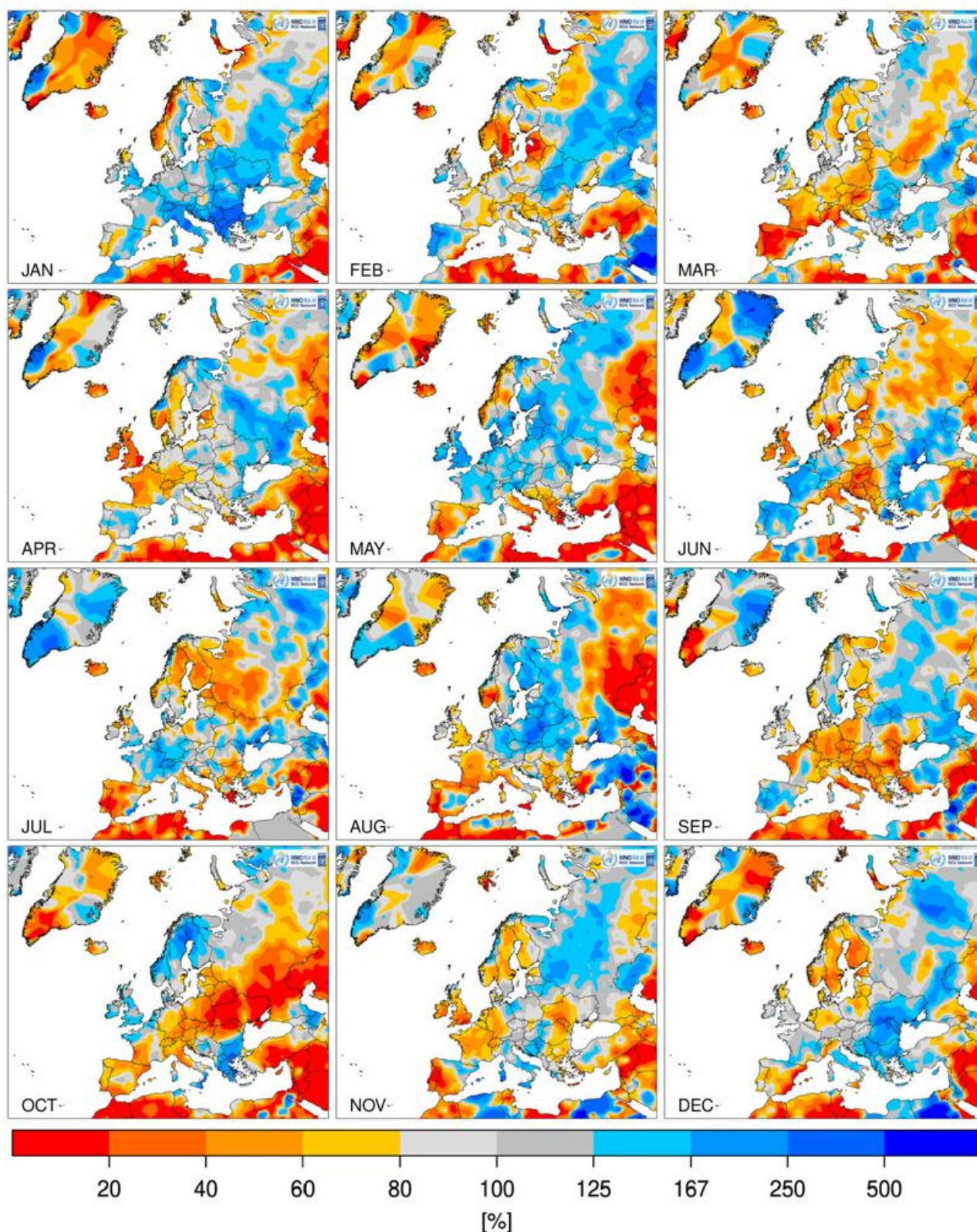


Figure 4-6: Monthly precipitation anomalies in % of the average for 1991–2020 for each month of the year 2021⁹.
Source: [RCC-CM website](#).

⁹ Similar to the RCC annual and seasonal precipitation maps, the RCC monthly precipitation maps may not correctly represent the anomalies observed for Estonia and Iceland. The issue is likely related to incorrectly decoded real-time data used for the grid generation. As a result, these grid point values may deviate considerably from actual precipitation totals.

4.4. Sunshine duration

In 2021, monthly sunshine duration anomalies were around normal in most months and sub-regions (Table 4-6). Distinctively positive anomalies were found in Central Europe in June, Türkiye and South Caucasus in May and Western Europe in April. Strongly negative anomalies occurred in May and August in Central Europe and for the Iberian Peninsula in February. For the whole year, only Türkiye and the South Caucasus and the Middle East had distinct positive anomalies of 109 hours and 176 hours above normal (see Table 3-6).

Table 4-6: Monthly area average sunshine duration anomalies in hours for each sub-region in the year 2021 (reference period: 1991–2020; definitions of the sub-regions see Figure 1-1).

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Central Europe	-20	+18	+18	-14	-39	64	-4	-47	+17	+32	-7	-11
Central Mediterranean Region	-17	+24	+20	-3	+20	+18	0	+11	+12	-11	-16	-5
Eastern Europe	-7	+2	+12	-11	-6	+2	+22	-9	-17	+22	+9	-8
Iberian Peninsula	-20	-27	+24	-36	+21	-17	+1	+7	-26	+30	+23	+2
Middle East	+26	+31	+14	+28	+41	+15	+3	-6	5	+5	+11	+2
Nordic and Baltic Countries	-1	+9	+1	+21	-11	+27	+27	-9	-14	-7	-1	-3
Türkiye and South Caucasus	+11	+34	-5	+6	+60	3	-10	-2	-16	+6	+11	+10
Western Europe	-10	+4	+20	+50	-13	0	-21	-24	0	+22	-5	-7

In January, most parts of the RA VI domain saw below normal sunshine duration and normal to below normal radiation in January. In Switzerland, for example, the sunshine duration in January was between 60% and 90% of the 1981–2010 norm. In northwestern Switzerland, in the Jura and in the Upper Valais, the sunshine duration remained locally below 50% of the norm. In the UK, sunshine was 95% of average, but with a marked contrast between below-average sunshine over most of England and Wales, and well-above-average sunshine in Scotland and Northern Ireland. Only the Middle East had above normal sunshine durations.

February was sunnier than normal in most parts of the RA VI domain. Especially over parts of Central and Northern Europe, the Italian and Balkan Peninsula as well as over the eastern Mediterranean. Largest anomalies were observed in Türkiye and the Middle East for example, which experienced 50 to 100 more sunshine hours than normal. In Sweden, February was sunnier than normal in most of the country. Karlskrona had a record number of hours of sunshine with 127 hours and Hoburg with 117 hours. In Lithuania, February was also very sunny, with a mean sunshine duration of 108 hours. In Latvia, on the coast of the Gulf of Kurzeme and in the north-east of the country, the duration of sunshine was up to 20 hours longer than normal, the south-west of Latvia even received 20-60 hours more sunshine than normal, locally even above. For Estonia, the average of the mean sunshine duration for February was 76 hours which is 121% of the norm. Western parts of the RA VI domain, on the contrary, received less sunshine than normal, for example Ireland, Portugal and Spain. In Spain, accumulated insolation during February was more than 10% below the normal value in most of the northern half of the peninsula and in the west of the regions of

Extremadura and Andalusia. The minimum sunshine value was recorded in Bilbao/airport with 66 accumulated hours, followed by Hondarribia Malkarroa with 77 hours. In mainland Spain and the Balearic Islands, the highest value corresponded to Almería/airport with 213 hours.

In terms of sunshine, **March** was sunnier than normal in western and central parts of the RA VI domain and some areas in the east, with 50 and more sunshine hours more than normal over Belgium and parts of France, Italy and Russia corresponding to a radiation surplus up to 30 W m^{-2} . In France, sunshine was in excess over almost the entire country, often by more than 10% in the southern half and by more than 25% in the northern half. Sunshine duration was more than 30% above normal in Lorraine and from Poitou-Charentes to the north-west and the Belgian border, with the exception of north-west Brittany. Locally, the surplus even exceeded 50% from the Pays de la Loire to Basse-Normandie and the Pas-de-Calais, with 5 to 7 more sunny days than normal. (The sun shone for 196 hours in Caen (Calvados), 197 hours in Rennes (Ille-et-Vilaine), 198 hours in Le Touquet (Pas-de-Calais), 203 hours in Le Mans (Sarthe), 207 hours in Angers (Maine-et-Loire) and 213 hours in Nantes (Loire-Atlantique), all remarkable values.). In Belgium, the beginning and end of the month were particularly sunny. In Uccle, the sun shone for a total of 166 hours 36 minutes (standard: 125 hours 45 minutes). This high level of sunshine is also reflected in the low number of days without sunshine. There was only one day with no sunshine in Uccle, as was the case in 2003 (norm: 5.3 days). Only in March 2014 did the sun shine every day (measurements taken since 1981). The rest of the RA VI domain saw close to average sunshine conditions with anomalies ranging within +20 and -20 sunshine hours.

April was more sunny than normal over much of northwestern Europe with 50 to 100 sunshine hours more than normal and radiation surpluses greater than 40 W m^{-2} . In the UK, sunshine was well above average everywhere, especially across northern England and southern Scotland, with 152% of average overall, narrowly beating 2020 to become the sunniest April in a series since 1919. In Uccle, Belgium, the sun shone a total of 199 hours (normal: 171 hours). The Middle East also saw sunnier conditions than normal with surpluses in sunshine hour of up to 50 hours. For the rest of the RA VI domain the number of sunshine hours was close to normal or below normal.

Sunshine duration in **May** was well below normal in the rainy low-pressure area in the middle latitudes, except for Ireland, which received 2%–19% more sunshine than normal, and western France. In the United Kingdom, sunshine was rather below average for most areas except Northern Ireland, with 86% of average for the United Kingdom overall, similarly the Netherlands with 89%, and Uccle in Belgium (86%). Further to the continent, the deficits were larger: Estonia received 80% of the normal sunshine, similarly Germany (81%), Luxembourg (83%). Particularly dull was Denmark. With only 140 hours of sunshine that month, this was 96 hours or 41% less than the 1991–2020 normal, placing this month as the fourth dullest May in around 100 years since start of measurements in 1920. In contrast, the southern parts of RA VI were mostly sunny in May 2021. Much of Spain had an excess of more than 10% of sunshine that month, Portugal, Italy and much of the Balkan Peninsula (except the north) similar. Greece and eastern Türkiye even had a higher surplus of more than 125%, northeastern Türkiye even 150% of the long-term average, corresponding to around 100 hours more than usual.

June was more sunny than normal over much of eastern parts of the RA VI domain with 50 to 100 sunshine hours more than normal and radiation surpluses greater than 50 W m^{-2} . Eastern Türkiye and the Southern Caucasus region also saw sunnier than normal conditions with surpluses

in sunshine hour mostly between 20 and 50 hours, partly even above. For the rest of the RA VI domain the number of sunshine hours were close to normal or below normal. Largest sunshine duration deficits were recorded in areas neighbouring the Black Sea, for example in parts of the Ukraine, Romania, Bulgaria and western parts of Türkiye with mostly 20 to 50 hours less sunshine than normal.

July was sunnier than normal over most of the eastern parts of the RA VI Region as well as over the northwest (UK, Ireland, Iceland) with up to 50 to 100 sunshine hours more than normal and radiation surpluses of up to 30 W m^{-2} to 40 W m^{-2} . In Finland, July was also clearly sunnier than usual in the whole country, even unusually sunny in the south. The highest amount of sunshine was accumulated in Parainen Utö, 394 hours, which is about 70 hours more than the average in July. The last equally sunny July has been in the southern and central part of the country in 2006. In Iceland, sunshine hours in Akureyri were measured at 243.9, which is 91.4 hours above the average for the years 1991 to 2020. As many as these sunshine hours have never been measured in Akureyri in July. The previous record of sunshine in July in Akureyri was from 1929, 238.6 hours. Western and Central Europe saw less sunny than normal conditions, especially over France where largely 10% less sunshine hours than normal were recorded, regionally the sunshine hour deficit exceeded even 20% corresponding to a deficit in radiation of 40 W m^{-2} . In Belgium, in Uccle, the sun only shone for 170 h 09 min over the whole month (normal: 203 h 14 min), thus more than 30 hours less than normal. In the Netherlands, with an average of 196 hours of sunshine across the country compared to 222 hours normally, July was on the gloomy side as well.

August was less sunny than normal over Western, Central and parts of Eastern Europe as well as over eastern parts of Türkiye with up to 50 to 100 sunshine hours less than normal and radiation deficits of up to 30 to 40 W m^{-2} . Germany received 156.7 sunshine hours, which is 55.3 hours or 26.1% less than the 1991–2020 average. In the UK, August was less sunny than normal as well, especially in central and eastern England where some stations had their dullest August in records going back 60 or more years. For the rest of the RA VI Region, the number of sunshine hours was close to normal or above normal. Largest surpluses were registered in southern Norway, over northern Spain, the Balkans and the South Caucasus.

September was more sunny than normal over many regions in parts of Western, Central and Eastern Europe with up to 50 to 100 sunshine hours more than normal and radiation surpluses of up to 30 to 40 W m^{-2} occurring over southern Germany and Austria. For Germany as a whole, the area average of sunshine duration was 174.3 hours. This is 17.5 hours or 11.2% more than normal and 24.7 hours or 16.5% more than the 1961–1990 average. In the south of Germany, 25% to 50% more sunshine hours than normal were recorded. In Austria, September brought 29% more sunshine hours than normal, making it one of the ten sunniest since continuous sunshine records began in 1925. In Uccle, Belgium, the sun shone for a total of 192 h 15 min (normal: 154 h 28 min) in September making it the third sunniest month of 2021, just behind June (201 h 34 min) and April (198 h 38 min). In the Netherlands, it was very sunny in the south, but gloomy in the north. In the south of the country, Beek registered 207.3 hours of sun compared to the normal of 157 hours. In De Bilt the sun shone for 178.2 hours compared to 152.8 hours normally. For the rest the number of sunshine hours were close to normal or below normal. Largest deficits occurred over Iberia and Russia and Türkiye.

The sunshine and global radiation distribution corresponded much to that of precipitation in **October**. The dry high-pressure zone from Iberia to Eastern Europe received over 20 hours of sunshine more than normal, in some parts (France, Czechia, Slovakia, Ukraine) even a surplus of more than 50 hours. In percent, France had a sunshine excess of more than 25% of the 1991–2020 normal in most parts of the mainland, partly even more than 50% with new monthly October records. It was the sixth sunniest October in Geneva (Switzerland) since beginning of measurements in 1897. Large parts of western and north-western Switzerland recorded 130%–170% of the 1981–2010 normal sunshine. Parts of Spain had also more than 130% with monthly durations up to around 300 hours (e.g. 296 hours in Córdoba). In contrary, it was relatively dull in northwestern Europe and Scandinavia (especially in northern parts), with the exception of Ireland (110% of normal at Shannon Airport). In Sodankylä (Finland), the sun shone for 23 hours, which was the lowest in the 68-year data. The central Mediterranean region, especially southern Italy and the Balkan Peninsula, was also dull with deficits partly larger than –20 hours or –50 hours.

November was more sunny than normal over large parts of Eastern Europe and Iberia as well as over parts of France with up to 50 to 100 sunshine hours more than normal and radiation surpluses of up to 20 to 30 $W m^{-2}$. The northeastern part of France also saw a surplus of sunshine duration with up to 60% more sunshine hours than normal. For the rest, the number of sunshine hours were close to normal and below normal. Largest deficits occurred over Mediterranean region with –50 to –100 sunshine hours less than normal over parts of Italy and the Balearic Islands.

December was mostly less sunny than normal over northern parts of the RA VI Region with generally up to 20 sunshine hours less than normal and radiation deficits of up to 10 $W m^{-2}$. In southern parts of the RA VI Region, on the contrary, the number of sunshine hours was mostly above normal with largest surpluses in sunshine hours and radiation occurring over Türkiye and the southern Caucasus region, where up to 100 hours more sunshine and up to 30 $W m^{-2}$ more than normal were registered. In France, sunshine was very generous in the southern half of the country but often insufficient in the northern half. From the southwest to Isère and locally in the Var, the sunshine duration was 25% to 50% above normal. In Spain, the positive sunshine hours anomalies exceeded 30% in Burgos, eastern Cantabria, Bizkaia and some parts of Catalonia.

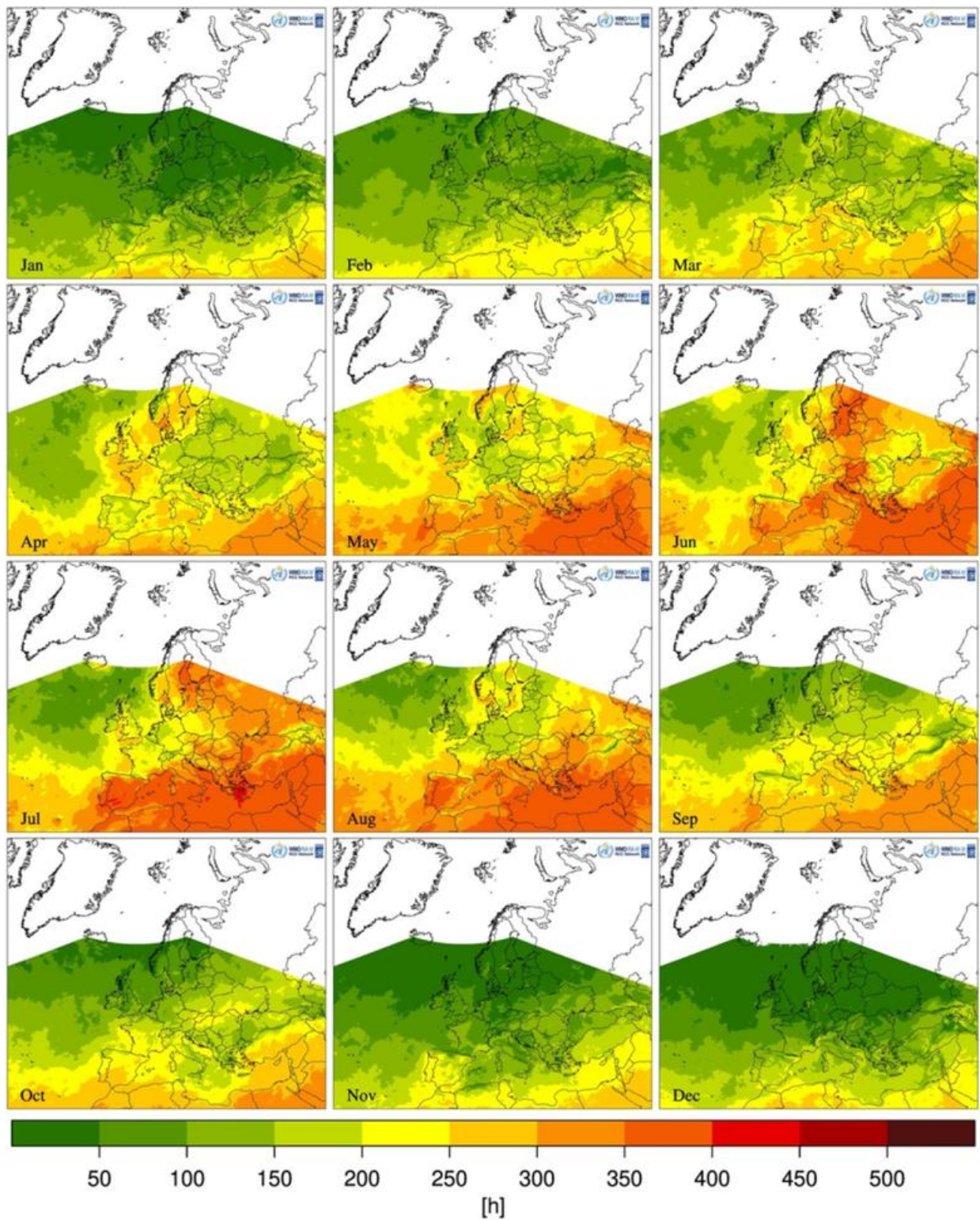


Figure 4-7: Mean sunshine duration in hours for each month of the year 2021. Source: [RCC-CM website](#).

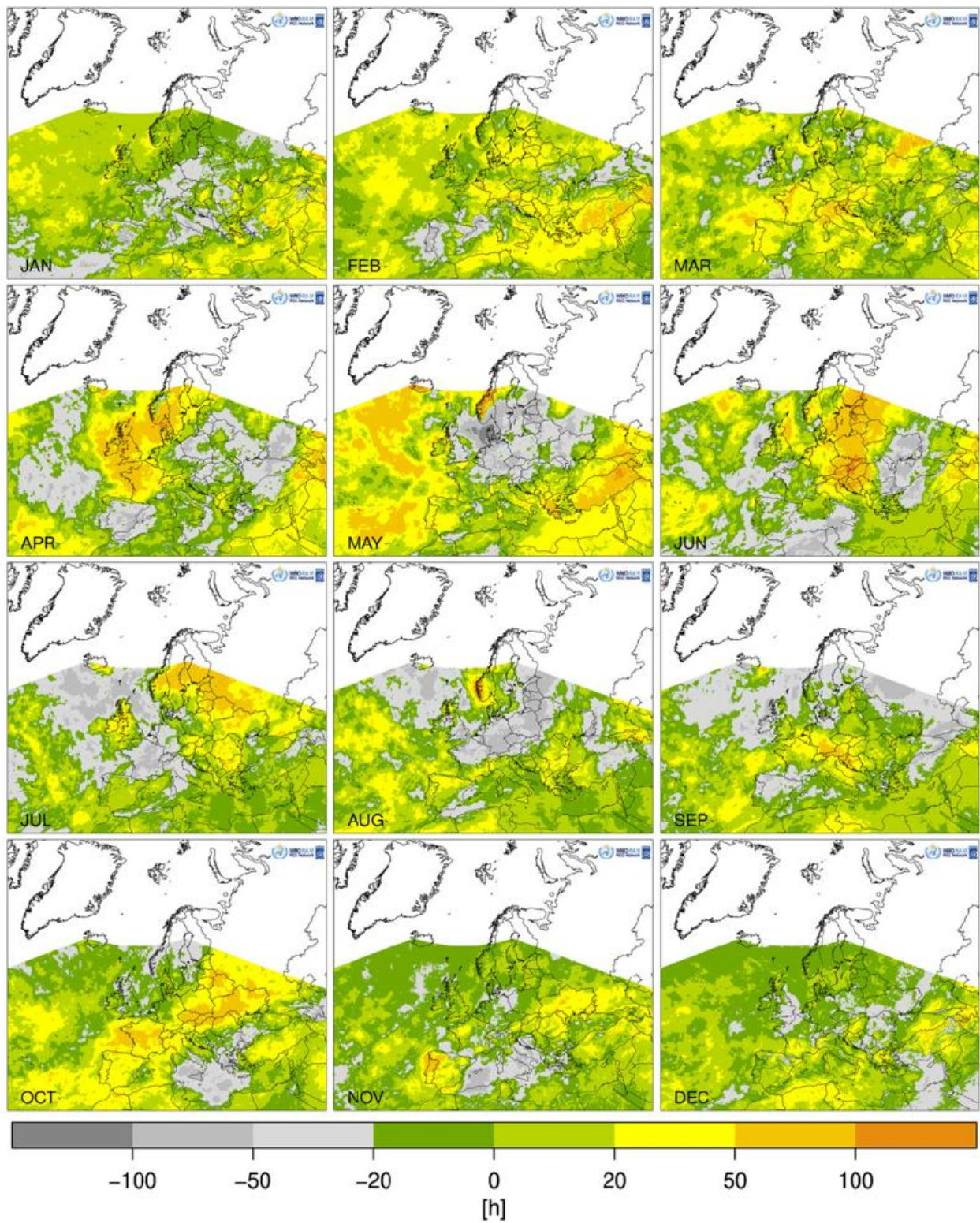


Figure 4-8: Monthly anomalies of sunshine duration in hours relative to 1991–2020 for each month of the year 2021. Source: [RCC-CM website](#).

4.5. Monthly maps of selected significant climate anomalies and events

The following maps are based on different data (as noted in the legends in parentheses), and are meant to summarize weather conditions in each month of the year 2021. The Monthly Event Maps contain information about the extreme anomalies of temperature, precipitation and wind gusts. Points are calculated from station data and represent the number of very warm or cold days, the locations of strong wind gusts ($\geq 32 \text{ m s}^{-1}$) and days with precipitation. If more than one extreme anomaly occurs at the same location, the point is subdivided into several different colours. Coloured areas are based on interpolated gridded data for temperature (land and ocean) and precipitation (only land areas). If more than one extreme anomaly occurs at the same grid, the area is shaded.

4.5.1. January

Several winter storms affected Southwestern Europe in early January 2021, bringing very low temperatures, abundant snowfall and heavy rain with flooding particularly to Spain, but later also further in the east. In mid-January 2021, heavy snowfall occurred first in Scandinavia, then further south in the Alpine region. Cold air from Russia extended to the Balkans and even down to Greece in mid-January 2021.

A storm low developed over the North Atlantic and reached Northwestern Europe on 19 January 2021. It extended also to Scandinavia and Central Europe and even far south to Spain and Portugal. The minimum pressure fell down to 950 hPa. Gusts up to 110–190 km h^{-1} were recorded on 21–22 January at exposed locations in Central Europe, the United Kingdom and Scandinavia, and around 70 km h^{-1} in the lowlands, in regions influenced by Mistral winds (Spain, southern France with Corsica) even above 200 km h^{-1} . Further lows followed, causing heavy precipitation over 200 mm in 24 hours in the Alpine and Balkan regions. On 18 January, severe flooding occurred also in Syria with particular impact on large refugee camps in the north of the country.

At the end of month (24–31 January), heavy precipitation and snowmelt caused a high-water situation in Western and Central Europe. Atlantic low-pressure systems brought warm and moist air and significant precipitation.

4.5.2. February

In early February 2021, a sharp air mass border developed over Europe with very cold air in the northern half and warm air in the south. Later, the cold air came also down to the southeast. At the end of the month, the warm air moved also to Central and Northern Europe with many new February records (Sweden, Poland, Slovakia, Slovenia and Croatia).

Especially Western Europe was affected by several Atlantic low-pressure systems in the first week of February 2021 causing heavy rain and flooding particularly in France, and snowstorms in the United Kingdom, the Netherlands and Germany. In southern parts, in contrast, Saharan dust came in.

With extension of a blocking high-pressure area with a cold air mass into Central Europe, Atlantic low-pressure systems followed increasingly southerly tracks causing heavy precipitation with flooding in various parts of the Mediterranean region (Italy, Albania, Greece, Türkiye and Jordan).

The cold wave in Europe in the second week of February 2021 was accompanied by heavy snowfalls in Russia, reaching record level. When the cold wave extended from Eastern Europe to the south, precipitation fell as heavy snow within an intense low-pressure area over the eastern Mediterranean

(named Medea in Greece) on 13–18 February 2021. Especially parts of Greece and the Middle East were affected.

4.5.3. March

March 2021 was characterized by some late wintry cold waves, first in European Russia, later also in parts of Central and Southern Europe, and even in Türkiye and Romania. Some outstanding temperature minima were recorded ($< -30\text{ °C}$ in European Russia), though far from new records, and some heavy snowfall events in southeastern Europe and Türkiye.

After quite a quiet storm season in Central Europe in winter 2020/21, three storms passed Northwestern and Central Europe in the second week of March 2021.

In the last days of March 2021, much of Europe was under high-pressure influence. Warm subtropical air flowed into western parts of the high-pressure area especially to Western and Central Europe. Combined with long sunshine duration, partly new local March records of maximum temperature were reached in large parts of Europe (Spain, Portugal, France, Italy, Germany, Belgium, Luxembourg, Netherlands, Austria, Slovenia, Czech Republic and Switzerland).

4.5.4. April

Soon after a record-warm end of March, a broad flow of cold air came over the North Sea to Europe on 5–8 April 2021, starting on Easter Monday, partly with unseasonal snowfalls and much frost damage on vegetation. The corresponding low-pressure area was unusually deep with a reading of 963.7 hPa on 5 April in Överkalix-Svartbyn in northern Sweden, the fourth deepest measured in Sweden in April. Some more cold waves followed that month, resulting in the coldest April for decades of years in several countries in Western and Central Europe.

While it was cold in parts of Western and Central Europe, other parts of RA VI saw an outstanding warming at the same time, especially eastern parts. Parts of European Russia experienced an extreme warm spell in mid-April. In the second half of April 2021, warm subtropical air expanded from North Africa to the Middle East and later to the entire eastern Mediterranean and Caucasus region.

A short-time heavy rain event occurred in Tuscany region in northwestern Italy on 12 April 2021 within an intense low-pressure area. A strong hailstorm hit the region around Lucca. Up to 183 mm of rain (Stazzema station) fell, floods occurred in the historic centre of Lucca and landslides blocked several provincial roads.

4.5.5. May

A heat wave in the eastern Mediterranean region, which began already in mid-April 2021, continued also in May 2021 with quite high temperatures for the season, expanded to Greece and Italy, and later also to the South Caucasus, southern and central European Russia and west Kazakhstan.

The cold wave, which affected much of Europe during the whole month of April 2021, continued into May 2021. Mainly Northern, Western and Central Europe were concerned. After a short interruption after the first week, the cold weather continued also later in the month.

A low-pressure system, quite large and intense for the season, brought gusts up to hurricane force to exposed places in Western and Central Europe on 4–5 May 2021. Highest gusts in Germany on mountains were 140 km h^{-1} on Brocken. France had a reading of 133 km h^{-1} the same day in

Boulogne-sur-Mer, a new local monthly May wind. In Switzerland, only 83.9 km h⁻¹ were recorded in Zurich/Kloten, but it was a new May record as well. The highest gust in the Czech Republic was 137 km h⁻¹ on Sněžka Mountain. In Hungary, a near-hurricane gust at 114 km h⁻¹ was recorded in Budapest on János Hill on 5 May 2021. This was a new national daily wind record for a 5 May.

On 8–13 May 2021, warm air from Africa flowed into Europe east of a low-pressure system. France experienced a short-time heat event on 8 May, Germany on 9 May 2021, other countries in Central and Northeastern Europe the following days.

Some regional or local, but remarkable heavy rain events occurred in various parts of Europe, especially in the first half of the month. Especially Poland, France, Romania and Slovakia were affected.

4.5.6. June

Several heat waves passed over various parts of Europe throughout the month. A first one reached Northern Europe at the very beginning of the month. In mid-June, a large heat wave propagated from Southwestern to Northeastern Europe. In late June, further heat affected mainly eastern parts of RA VI Region.

Although heat waves dominated that month in the RA VI Region, there were a few cold events noteworthy. The nights of 4–5 June and 5–6 June 2021 were the coldest June nights of the last 30 years in Ankara (Türkiye). Daily minima dropped to 7.4 °C in central Ankara on both days, and down to around 0 °C in the surroundings. On 13 June, unseasonal snow and sleet covered the northern and eastern parts of Iceland.

Heat waves with dry and sunny weather in various parts of Europe in June 2021 were temporarily interrupted by periods of thunderstorms, which formed within the warm air masses due to occasional low-pressure influence. These convective events caused local flash floods with severe damage. Large parts of the RA VI Region were affected: Spain, France, Switzerland, Benelux countries, Germany, Croatia, Türkiye, Greece, European Russia, Ukraine, United Kingdom, Czech Republic, Poland, Italy, Romania and Bulgaria.

4.5.7. July

An extreme flooding event took place in a large part of Europe in mid-July 2021. It started on 9 July in the United Kingdom, continued the following week in Central Europe, and finally in Italy and the Balkans. Particularly affected was western Central Europe, especially western parts of Germany and eastern parts of Belgium with more than 200 fatalities and much material damage due to large river flooding. In the following weeks, some more localized storms and heavy rain events occurred.

There were some heat waves, especially in Northern, Eastern and Southeastern Europe. The beginning of July was quite warm especially in Northern Europe. Some places recorded daily maxima above 30 °C, which were partly new records. Warm air reached the United Kingdom and Ireland during a high-pressure situation in late July 2021. In late July, there was a heat wave also in southeastern parts of RA VI Region (Türkiye, South Caucasus and southern European Russia).

The Black Sea region experienced some heavy rain events with flooding, especially in the Krasnodar region in Russia, on the Crimea Peninsula and in northeastern Türkiye. In the last week of July, another heatwave, more extended than the previous ones, came to the Mediterranean region by inflow of warm air from the African continent (known as Scirocco wind).

Storm *Zyprian* passed Brittany, the western peninsula of France on 5 July with strong gusts. The highest was 146 km h^{-1} at Plougonvelin, located at the west coast of Brittany. This was a new local record for July. The strong gusts were caused by interaction with a jet stream branch in the upper atmosphere. Many trees were downed; around 4 000 households were cut off from power supply the next morning. Such an event with even stronger gusts at some locations was observed last time more than 50 years ago in July 1969.

4.5.8. August

August 2021 was characterized by several heat waves in the Mediterranean region, some of them extreme. Intense heatwaves developed particularly across Spain, southern Italy, Greece, and western Türkiye, but also in Albania, North Macedonia, southern Serbia, and Bulgaria. Temperatures were extremely high, reaching above $40 \text{ }^{\circ}\text{C}$ in many regions. Large forest fires occurred in areas affected by the strong heat. Iceland and Greenland saw a long warm spell, particularly in mid and late August 2021.

While the Mediterranean region was under heat during much of the month, Northern and Western Europe experienced some cold spells at the same time due to Arctic air intrusion. The station Latnivaara northwest of Gällivare (northern Sweden) had a reading of $-4.0 \text{ }^{\circ}\text{C}$ in the night to 3 August, which was unusually cold so early in the season.

Like in July 2021, heavy rainfalls were observed in the Black Sea region in August 2021 too, especially in coastal regions of Russia and Türkiye. The warm water of the Black Sea triggered the rainfalls. The Mediterranean Cyclone Centre had classified a low-pressure area that formed over the north-central Black Sea on 11 August 2021 as Medistorm *Falchion*. *Falchion* was moving slowly to the northeast on 12 August before making landfall in Russia on 13 August. Mediterranean tropical-like cyclones usually form over the Mediterranean Sea, but they can also develop over the Black Sea.

A large low-pressure area caused heavy rain in regions in Northern and Central Europe in mid-August 2021. Especially outstanding were heavy rain events in central Sweden and in the Alpine region.

Some small lows brought heavy convective precipitation in Spain and southern France on 24 and 25 August 2021.

At Tiszavasvár station (northeastern Hungary), observers measured a gust of 121 km h^{-1} , which set a new highest national daily gust record. The gust occurred near thunderstorms, which developed at a cold front. Such strong gusts are rare in Hungary in contrary to many other parts of Europe.

4.5.9. September

Some heavy rain events with flash flooding occurred in southern Europe in September 2021, namely in eastern and southern Spain, southern France, northern Italy and later in the month in Slovenia.

Western Europe experienced a warm airflow in early September, causing a September heat wave, which reached even far north the western parts of Scandinavia (Norway, Sweden).

In mid-September, it started snowing in northern Scandinavia (Sweden, Finland), and the snow line fell remarkably in the Alps and the Pyrenees mountains.

Cold air flowed into Eastern and Southeastern Europe in late September 2021. The night to 24 September was a very cold night in Southeastern Europe, partly with frost in middle altitudes. In Serbia, daily minima reached 0.7 °C at Vranje (433 m a.s.l.), in Bulgaria 2.7 °C in the capital Sofia (586 m), in North Macedonia –1.8 °C at Berovo (834 m). It was even cold in northern Greece with –1.0 °C at Florina (650 m) and 1.0 °C at Kastoria Airport (660 m). The reading in Florina was a new national September record for lowest temperature at stations below 1 000 m altitude (official main station network). The private network of automatic meteorological stations of the National Observatory in Athens recorded even –1.4 °C in Vlasti (also located in the north of Greece).

4.5.10. October

Some heavy rain events affected especially France, Italy and Greece throughout October 2021. The first one was in northwestern France at the very beginning of the month. After that, some intense low-pressure areas developed over the Mediterranean, bringing extreme record-breaking precipitation particularly to southern France, Italy and Greece, to a lesser extent also to eastern Spain.

Between a low-pressure area in Western Europe and a high-pressure area over Russia, warm air flowed from the western Mediterranean over the Alps up to Scandinavia on 2–4 October 2021, causing some new local temperature records. Later, on 20 October, another warm spell occurred in Central Europe due to a south-westerly flow.

A powerful autumn storm named *Aurore* by Météo France brought severe weather to France, Germany, Netherlands, Belgium, Czech Republic, Poland, the Channel Islands, and parts of southern England on 20 and 21 October 2021. This was the year's first violent autumn storm in Western and Central Europe. Uprooted trees in France, Germany, the Netherlands, and England disrupted a large number of rail services.

The second half of the month brought unusually high precipitation to Northern Europe, e.g. in Sweden and later in the United Kingdom.

4.5.11. November

Heavy rain events occurred in the western and central Mediterranean region and the Balkans. In the first week, Bosnia and Herzegovina were most affected. In the second week, Medistorm *Blas* remained over the western Mediterranean during several days and brought high amounts of rain, particularly to the islands in the basin. Further rains followed in the remainder of the month.

The Mediterranean region, but also parts of Eastern Europe experienced an intense warm spell in the first week of November 2021.

Heavy snowfall was seen in the southern, central and eastern Alps in Switzerland on 4 November 2021. Fresh snow of 20–40 cm was widespread above 1 000–1 500 m altitude, locally more than 50 cm. Snow fell even in valleys in the Graubünden region down to 700 m altitude. The station Segl-Maria in the Upper Engadin valley (also Graubünden, around 1 800 m a.s.l.) recorded its second highest daily snowfall in November since beginning of measurements in 1864 with 56 cm. November snowfall of more than 50 cm occurred only five times during the last 100 years at this station.

In the last days of November 2021, cold Arctic air arrived in northern Scandinavia, leading to the first cold wave of the cold season 2021/2022. The lowest temperature was measured in the morning of

28 November in Nikkaluokta (Sweden) at $-37.4\text{ }^{\circ}\text{C}$, which became the lowest November temperature in Sweden since 1980. Norway recorded $-36.7\text{ }^{\circ}\text{C}$ as lowest value the same day in Kautokeino (Troms and Finnmark region), the lowest November temperature since 2002.

Two large-scale storms affected Western and Central Europe at the end of this month, a third one hit western Türkiye.

Thick fog in Moscow from 1 to 3 November 2021 caused hundreds of flights to be cancelled in one of the biggest travel disruptions to impact the Russian capital in a decade. Visibility was quickly reduced to 100 m or less when the fog first settled across the city. Observations from across the city showed that the visibility fell to near zero for as much as 14 consecutive hours. At several locations, temperatures fell below freezing overnight, which may have also led to ice forming on some surfaces.

4.5.12. December

Early in the month, cold Arctic air flowed into northern European Russia and Scandinavia south of the high-pressure system *Xavielle* (named in Central Europe).

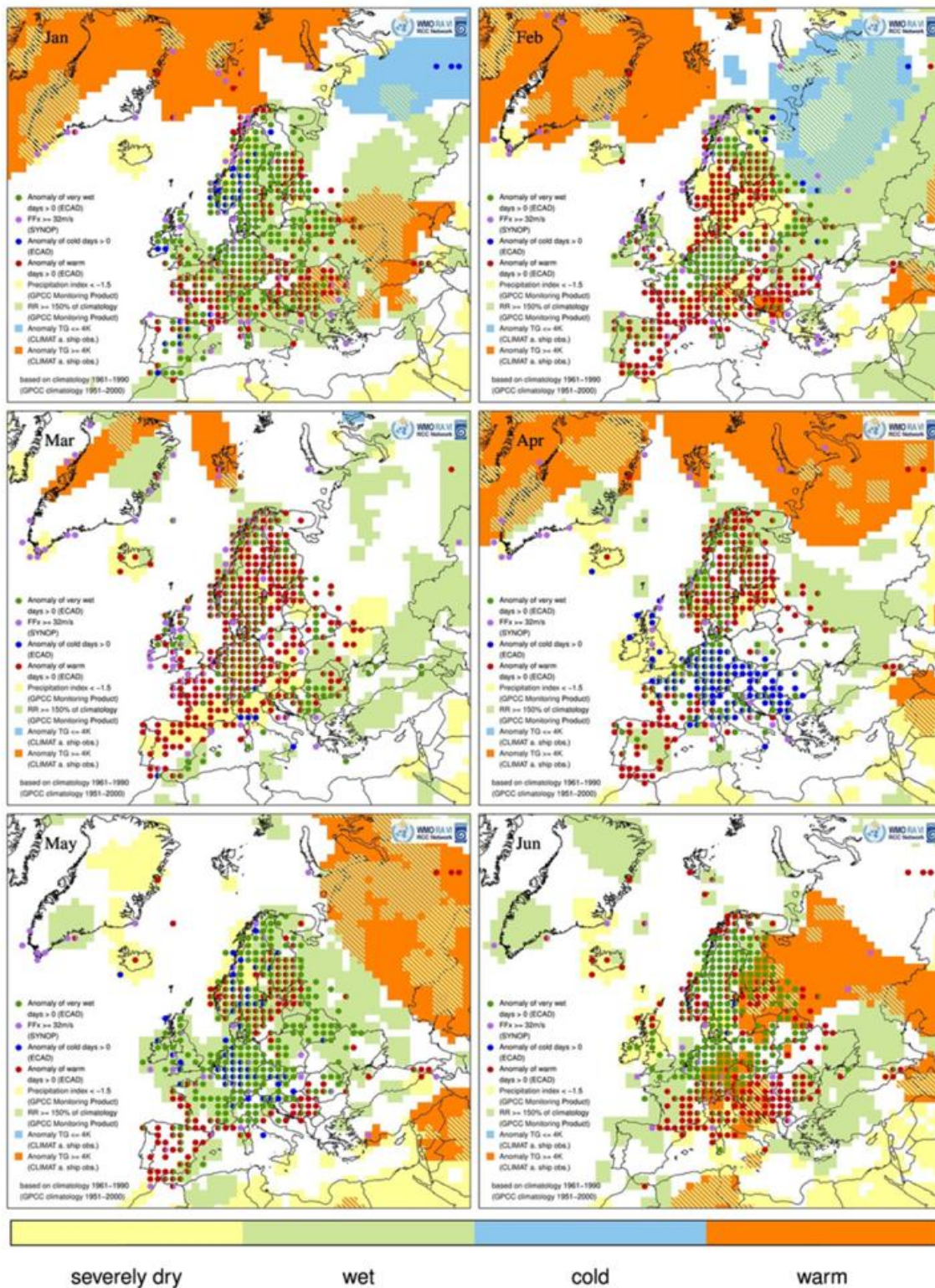
Through the whole month, warm spells occurred in various parts of the RA VI Region.

Two storms occurred at the beginning of the month. Although not extreme, severe storm gusts had some impact. Another storm affected Ireland on Christmas.

A low-pressure system from the North Atlantic affected northern Spain and southwestern France from 9 December 2021, causing flooding and high snow accumulation.

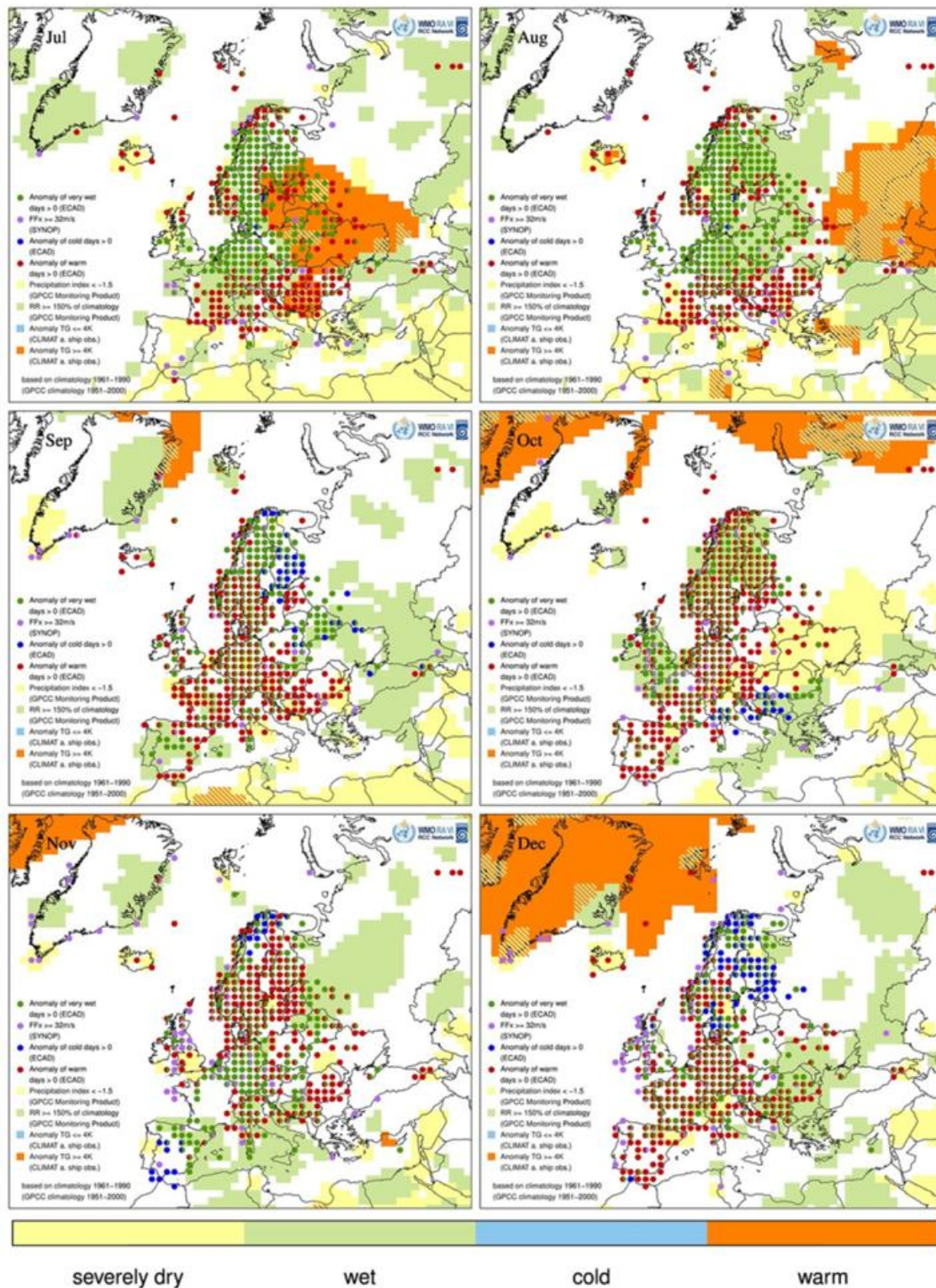
Several heavy snowfall events were also reported from the Alps and from southeastern parts of the RA VI Region, especially in Serbia and Greece.

Some intense low-pressure systems developed over the eastern Mediterranean late in the month and brought some intense rain particularly to Israel and southwestern Türkiye.



- Anomaly of very wet days > 0 (ECAD)
 - Wind gusts ($\geq 32 \text{ ms}^{-1}$) (SYNOP)
 - Anomaly of warm days > 0 (ECAD)
 - Anomaly of cold days > 0 (ECAD)
 - Anomaly of TG $\leq -4 \text{ K}$ (CLIMAT and ship obs.)
 - Anomaly of TG $\geq 4 \text{ K}$ (CLIMAT and ship obs.)
 - Precipitation index < -1.5 (GPCC)
 - RR $\geq 150\%$ of climatology (GPCC)
- Based on climatology 1961-1990 (GPCC climatology: 1951-2000)

Figure 4-9: Monthly maps of climate extremes for the months January to June 2021; RR = daily total precipitation, TG = daily mean temperature. Source: [RCC-CM website](#).



● Anomaly of very wet days > 0 (ECAD) ■ Anomaly of TG ≤ -4 K (CLIMAT and ship obs.)
● Wind gusts (≥ 32 ms⁻¹) (SYNOP) ■ Anomaly of TG ≥ 4 K (CLIMAT and ship obs.)
● Anomaly of warm days > 0 (ECAD) ■ Precipitation index < -1.5 (GPCC)
● Anomaly of cold days > 0 (ECAD) ■ RR ≥ 150% of climatology (GPCC)

Based on climatology 1961-1990 (GPCC climatology: 1951-2000)

Figure 4-10: Monthly maps of Climate Extremes for the months July to December 2021; RR = daily total precipitation, TG = daily mean temperature. Source: [RCC-CM website](#).

4.6. Selected contributions by NMHSs

4.6.1. Wettest January on record for Serbia

(Contribution from Republic Hydrometeorological Institute of Serbia)

January 2021 ranks as the wettest on record for Serbia as a whole in the period from 1951 to 2021 (*Figure 4-11*). January 2021 ranks as the wettest on record for Crni Vrh, Kopaonik, Sjenica, Negotin, Kraljevo, Kursumlija, Cuprija, Nis, Leskovac, Zajecar, Dimitrovgrad and Vranje (*Table 4-7*) since the record-keeping began.

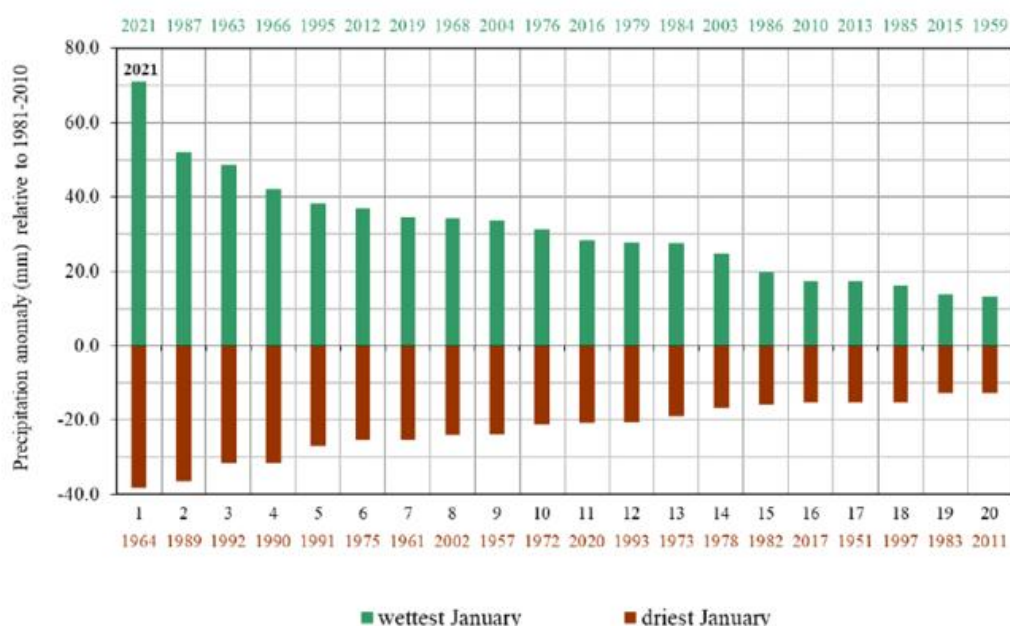


Figure 4-11: Top 20 wettest (green) and driest (brown) January precipitation anomalies (mm) relative to 1981–2010 sorted in descending order from left to right. Source: Republic Hydrometeorological Institute of Serbia.

The maximum January daily precipitation sums were exceeded on January 11 in Kraljevo, Kursumlija, Cuprija, Nis, Leskovac, Dimitrovgrad and Vranje (*Table 4-7*).

Table 4-7: Record-breaking monthly and daily precipitation sums for January. Source: Republic Hydrometeorological Institute of Serbia.

Station	Monthly sum (mm)	Previous maximum (year)	Daily sum (mm)	Previous maximum (day/year)
Crni Vrh	115.2	100.3 (2004)	-	-
Negotin	137.1	113.4 (1953)	-	-
Sjenica	160.9	133.8 (2003)	-	-
Kraljevo	135.9	108.5 (1976)	40.8	34.9 (29/1987)
Kopaonik	208.8	144.1 (1968)	-	-
Kursumlija	153.5	124.2 (1935)	44.0	36.4 (2/1995)
Cuprija	124.6	114.2 (2012)	32.6	31.6 (14/1949)
Nis	178.6	101.3 (2016)	51.6	24.6 (24/2015)
Leskovac	229.3	112.3 (1995)	64.1	30.1 (24/2015)
Zajecar	136.0	105.6 (2016)	-	-
Dimitrovgrad	212.9	137.3 (1963)	67.9	40.8 (1/1966)
Vranje	162.5	109.8 (2003)	52.4	41.0 (5/1940)

4.6.2. Below average January temperatures across Ireland
(Contribution from the Irish Meteorological Service, Ireland)

All mean air temperatures for January were below normal (relative to 1981–2010) across the country. Deviations from mean air temperature ranged from $-1.6\text{ }^{\circ}\text{C}$ ($3.3\text{ }^{\circ}\text{C}$, $3.7\text{ }^{\circ}\text{C}$ and $4.0\text{ }^{\circ}\text{C}$ mean temperature) at Ballyhaise, Co Cavan, Markree, Co Sligo and Athenry, Co Galway respectively to $-0.5\text{ }^{\circ}\text{C}$ ($3.5\text{ }^{\circ}\text{C}$ mean temperature) at Knock Airport, Co Mayo (**Figure 4-12**). Mean temperatures for the month ranged from $3.3\text{ }^{\circ}\text{C}$ at both Ballyhaise, Co Cavan ($1.6\text{ }^{\circ}\text{C}$ below its LTA) and Mullingar, Co Westmeath ($1.3\text{ }^{\circ}\text{C}$ below its LTA) (both their coldest January since 2011) to $6.4\text{ }^{\circ}\text{C}$ ($1.1\text{ }^{\circ}\text{C}$ below its LTA) at Sherkin Island, Co Cork (its coldest January since 2011). The month's highest temperature was reported at Phoenix Park, Co Dublin on Thursday, 28 January, with a temperature of $13.3\text{ }^{\circ}\text{C}$. The month's lowest air minimum was recorded on Saturday, 9 January, at both Mullingar, Co Westmeath and Dunsany, Co Meath with $-8.2\text{ }^{\circ}\text{C}$ while the lowest grass minimum was $-12.9\text{ }^{\circ}\text{C}$ reported at Oak Park, Co Carlow, also on Saturday (9 January). All stations reported air and ground frost during the month. The number of days with ground frost ranged from 9 days at Malin Head, Co Donegal to 22 days at Moore Park, Co Cork. The number of days with air frost ranged from 3 days at Mace Head, Co Galway to 16 days at Mount Dillon, Co Roscommon. 22 stations had their coldest January since 2011.

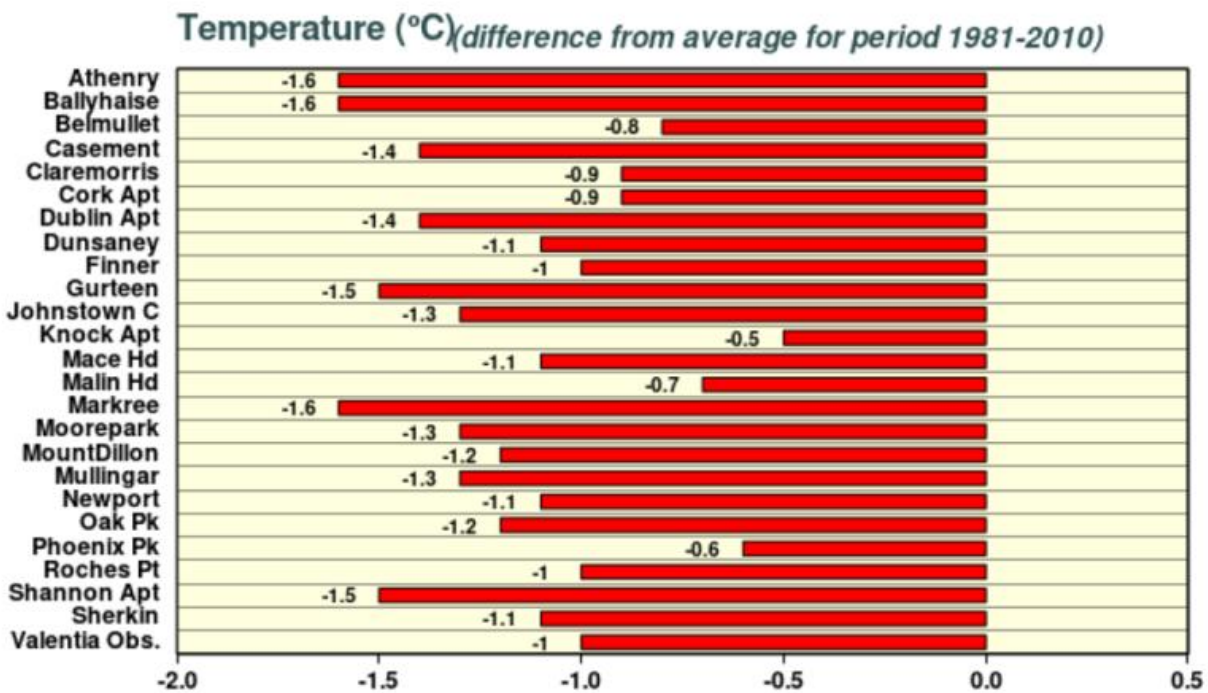


Figure 4-12: Temperature anomalies in $^{\circ}\text{C}$ for January for stations in Ireland, reference period 1981–2010.

4.6.3. Exceptional dry spell in the first half of January in Israel
(Contribution from Israel Meteorological Service)

For almost three weeks, from the 23 December to the 12 January, there was no rainfall in Israel. Such a long dry spell during the winter season is very exceptional. In the past, there have been similar cases, even longer, but they tended to occur, mostly during months, which are not part of the major winter months (November–December or February–March).

Long dry spells during the central winter months have occurred in the past, but mostly they were not total and did not include the entire country, for example: 15 January till the 10 February 2015

(25 days), but during this episode, there were a few rains in the North; a long episode from the middle of December 2013 till the end of March 2014, during which was an extreme lack of rains, but it was not completely dry; 23 to 25 days in two cases in the 50's, but with a little rain in the North.

The only additional case, of a total dry spell during the central winter Months, occurred 50 years ago, from the 19 December 1970 till the 9 January 1971, but it lasted 21 to 22 days.

4.6.4. Large temperature contrasts in Germany in February (Contribution from Deutscher Wetterdienst, Germany)

At the beginning of February, Germany was in a zonal flow. Along a prominent air mass boundary separating cold polar air in the north from mild air in the south, precipitation fell – on the north side as snow, in the middle as freezing rain and on the south side as rain. Precipitation was particularly intense from 7 to 11 September. Subsequently, large areas were covered by a blanket of snow. Several lowland stations (below 350 m a.s.l.) reported new February records, and in some cases also annual records for total snow depth. In the second week of February, the air mass boundary shifted southward and continental cold air flowed into the south. Several stations in central Germany registered new monthly minimum temperature records. In mid-February, a warm front almost completely cleared the very cold air and unusually mild subtropical air flowed into Germany with a southwesterly current, which, with the help of solar radiation, led to a significant rise in temperature. Numerous stations set new February records for maximum temperature. Several stations reached the 20 °C mark - from 20 to 25 January, maxima of ≥ 20 °C were measured on six consecutive days in Germany. Subsequently, a cold front caused a significant drop in temperature and February ended cloudy in the north and sunny in the south under the influence of high pressure.

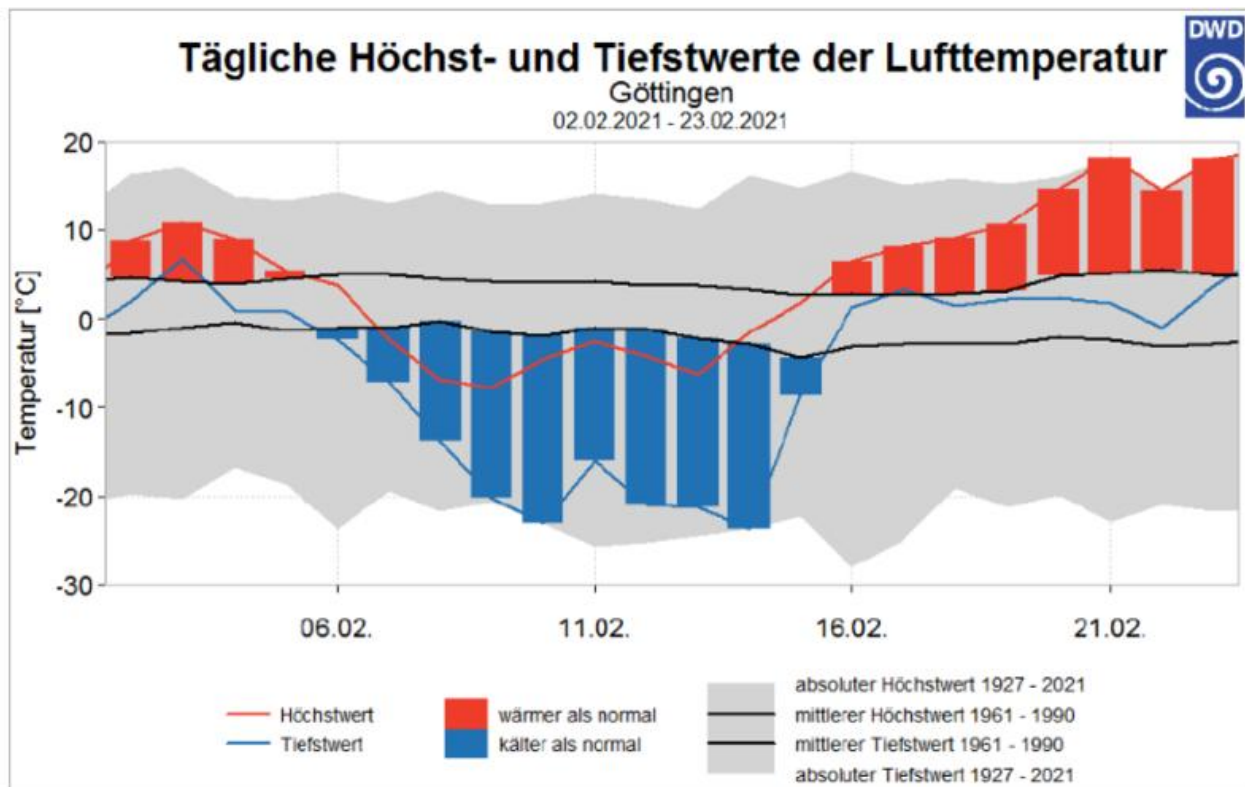


Figure 4-13: Daily maxima (red) and minima (blue) of the air temperature at the station Göttingen between 2 and 23 February 2021. Source: DWD, Imbery et al. 2021.

When comparing the minimum temperatures of the very cold phase with the maximum temperatures of the very warm phase, temperature differences of more than 40 °C were observed. At the station in Göttingen, the one-week temperature difference reached a new national record. There, the temperature rose from -23.8 °C (minimum temperature on 14 February 2021) to 18.1 °C (maximum temperature on 21 February 2021) within 7 days, thus reaching a difference of 41.9 K (Figure 4-13). At seven other DWD stations, a temperature difference of 40 °C or more was recorded within a week during this period.

4.6.5. Cold spell in the Czech Republic in April (Contribution from Czech Hydrometeorological Institute)

In the Czech Republic, temperatures in April 2021 were strongly below normal: the average monthly air temperature of 5.4 °C was 2.5 °C lower than normal (w.r.t. 1981–2010). Together with April 1977, it was the fifth to sixth coldest April in the period since 1961. A colder April than in 2021 was last recorded in 1997. In the territory of Bohemia, the average monthly air temperature (5.2 °C) was 0.6 °C lower than in the territory of Moravia and Silesia (5.8 °C). The average daily air temperature in the Czech Republic remained below the normal value of 1981–2010 for most of the month (Figure 4-14).



Figure 4-14: Average daily air temperature in the Czech Republic in April 2021 compared to 1981–2010. Blue indicates the Temperature in April in °C and red indicates the normal Temperature form 1981–2010. Source: Czech Hydrometeorological Institute.

April 2021 started with warmer-than-normal temperatures. The warmest day was on 1 April, when the deviation of the average air temperature exceeded the normal by almost 7 °C. Over 70% of the stations of the standard CHMI network measured a daily maximum air temperature higher than 20.0 °C. At 10 stations in the south of Moravia and in Ostrava, Poruba, a single April summer day

was recorded (daily maximum air temperature 25.0 °C and higher). After this warm start a significant cooling followed. The average daily air temperature in the Czech Republic fell most significantly below the normal value in the period 6–8 April and 13–17 April. It was coldest on 6 April, when the average daily air temperature was almost 8 °C lower than normal. On this day, all stations of the CHMI standard network measured a minimum air temperature of less than 0 °C. The coldest temperature was recorded on 9 April at the Horská Kvilda station, where the daily minimum temperature dropped to –16.5 °C. If we also consider stations outside the standard CHMI network, the lowest daily temperature of –18.8 °C was measured at the Rokytická slat' station (Klatovy district) on the same day. The historically lowest April air temperature of –22.0 °C was measured on 1 April 2020 by the Kořenov, Jizerka (Jablonec nad Nisou district) stations and on 9 April 2003 by the Horská Kvilda station; considering also stations outside the standard CHMI network, the lowest daily minimum of –24.8 °C was registered on 9 April 2003 at the Kvilda-Perla station, Jezerní slat (Prachatice district).

4.6.6. Very cold, very wet and very gloomy May in the Netherlands (Contribution from the Royal Netherlands Meteorological Institute)

With an average temperature of 11.2 °C compared to the long-term average of 13.4 °C, May was a very cold month. This puts the month 'only' in 23rd place in the list of coldest May months, but after the particularly cold April it can still be called exceptional. If we look at the coldest April-May combinations, April and May 2021, with a combined average temperature of 9.0 °C, are good for fourth place. It was also the third month that was too cold in a row and that has not happened since May 2013. The last very cold May dates from 2010 with 10.5 °C.

May had a cold start with sunny and driest weather (see **Figure 4-15**). Where it cleared the nights were cold and inland the local light froze. In the night to 3 May, the lowest temperature of the month was reached in Ell with –2.0 °C.

In the period from 3 to 5 May, an active ocean depression moved via Great Britain and the North Sea to Scandinavia, making the weather with us turbulent with a lot of precipitation and wind. The wind was especially strong on 4 May, with a stormy wind on the coast and heavy gusts of wind up to about 90 km/h throughout the country. In the following days there was a cold north-westerly current in which troughs with showers regularly passed and maximum temperatures in the northwest barely exceeded 10 °C, about 4 to 5 degrees below normal. In the meantime, it cleared up and in the night to 8 May it still froze with little wind in the east.

On 8 May, we entered the warm sector of a deep low-pressure area to the west of Ireland, bringing in tropical air with a southerly current, and temperatures soaring. After a cloudy and rainy May 8, we had to deal with warm and unstable air on 9 and 10 May, in which sunny periods and strong thunderstorms alternated. 9 May became the hottest day of the month, with a summer day just short of a summer day in De Bilt: 24.9 °C. In the south and east, this was successful in many places and the highest temperature of the month was reached in Arcen with 27.7 °C.

After the passage of the cold front on 10 May, a northwesterly current brought us back into cool polar air, in which slow-moving showers left quite a bit of precipitation in places. In between there was also room for the sun, especially on 12 and 13 May, and with little wind there was sometimes (dense) fog at night. Afternoon temperatures of about 18 °C gradually gave way to maxima around 14 °C. The differences were sometimes large, for example on the 14th it was barely 10 °C in the north, while in

Limburg it was still 18 °C. Beginning May 15, we found ourselves near a spinning low-pressure area filled with cold unstable air for several days, with numerous showers each day at temperatures around or slightly below normal.

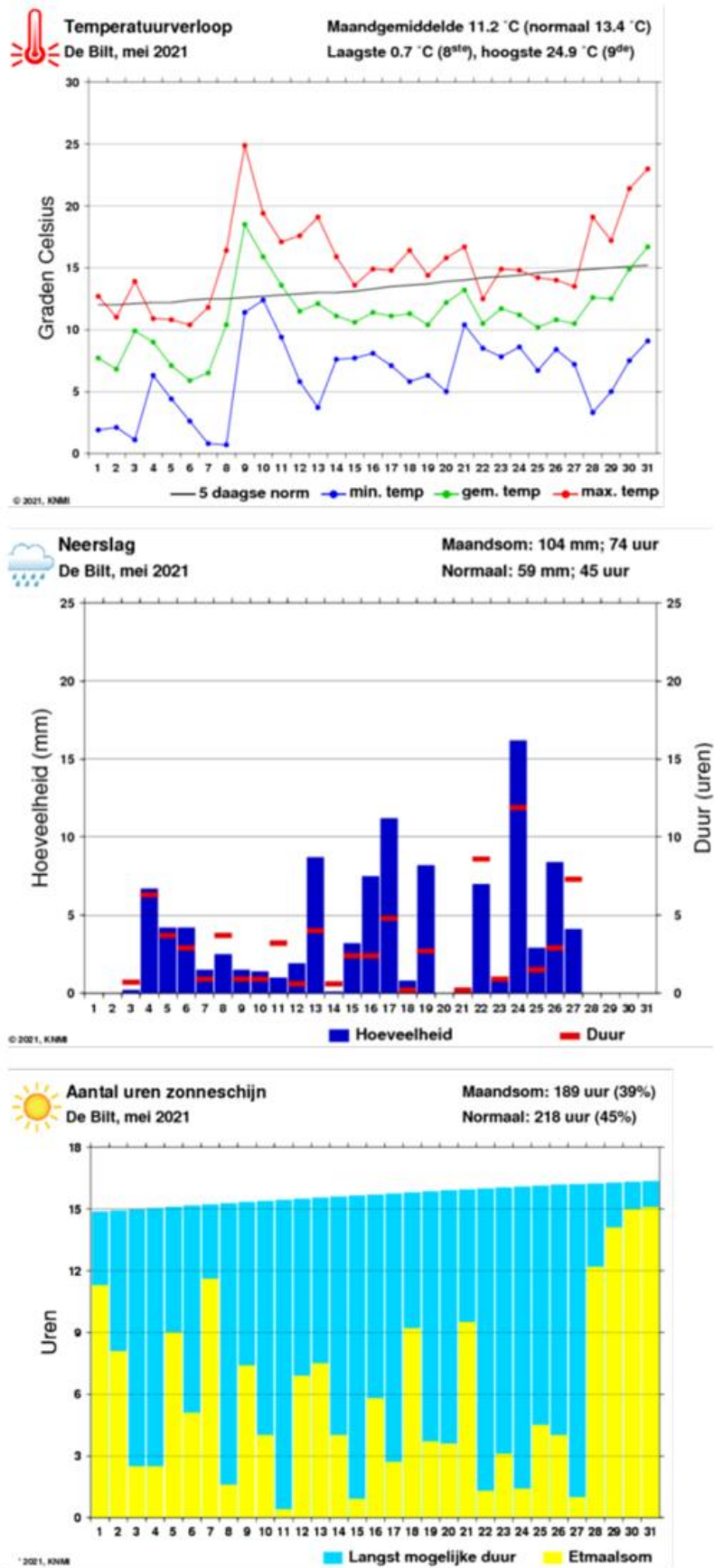


Figure 4-15: Daily temperature, precipitation and sunshine during May 2021 in De Bilt. Source: KNMI.

4.6.7. Warm spell in Lithuania in June

(Contribution from Lithuanian Hydrometeorological Service)

In June, the average air temperature in Lithuania (**Figure 4-16**) was 19.2 °C (+3.3 °C anomaly): from 18.5 °C in Laukuva (+3.6 °C anomaly) to 19.5–19.7 °C in the south-western part (anomaly between +3,2 °C and +3.7 °C). It was the second warmest June since 1961, the warmest in 2019. The highest air temperature ranged from 31.1 °C to 34.0 °C. The highest air temperature records in Lithuania were reached on days 20, 22 and 23: 33.1 °C (Alytus), 33.6 °C (Stone) and 34.0 °C (Rokiskis). From 18 to 24 June the heat continued. At individual meteorological stations, it lasted from 3 to 7 days. In June, 19–23 tropical nights were observed when the air temperature at night did not fall below 20 °C. The hottest night was on the 21st, in Nida with 23.1 °C.

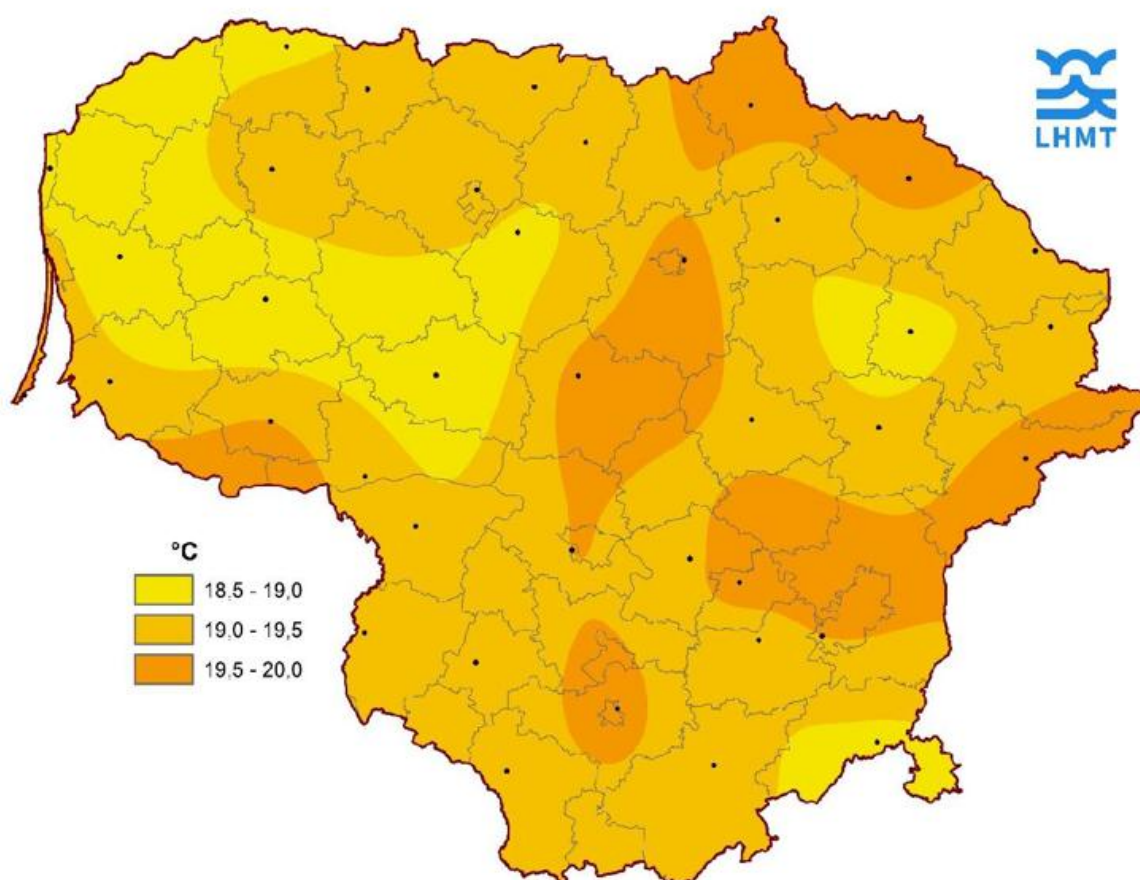


Figure 4-16: Temperature in Lithuania in °C for June 2021. Source: Lithuanian Hydrometeorological Service

4.6.8. Drought conditions in Croatia in June 2021

(Contribution from Meteorological and hydrological service, Croatia)

Deviations in the amount of precipitation in June 2021 compared to the normal 1981–2010 range from 0.2% of the multi-year average in Šibenik, where precipitation was only traces (0.1 mm), to 38% in Lastovo (13.1 mm). The analysis of deviations in precipitation amounts for June 2021, expressed as a percentage (%) of the multi-year average, shows that precipitation amounts at all stations were significantly below the average.

Precipitation conditions in Croatia in June 2021, expressed in percentiles, are described in more detail in the following categories (see **Figure 4-17**): extremely dry (wider area of Slavonski Brod, central Croatia, mountainous Croatia except Gospić area, Istria, northern Croatian coast, Šibenik area), very dry (eastern Croatia except surroundings of Slavonski Brod, the surroundings of Rab,

the Gospić area, northern Dalmatia, the northern mainland of central Dalmatia and Vis) and arid (central Dalmatia except the northern mainland and Vis, southern Dalmatia).

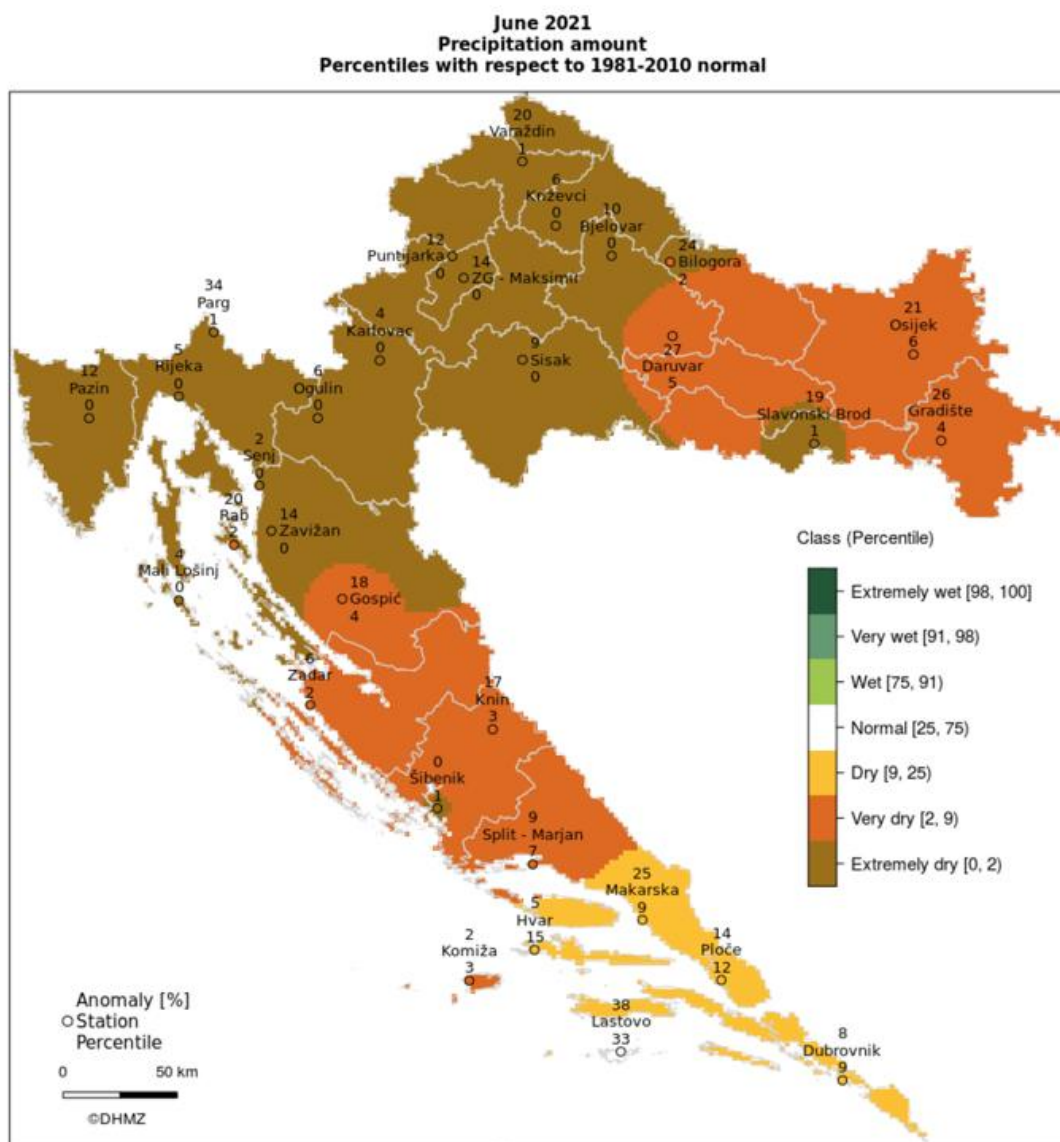


Figure 4-17: Precipitation totals and percentiles in June 2021 compared to 1981–2010 for Croatia.

4.6.9. Very hot period between 10 and 17 August in Portugal (Contribution from Portuguese Institute for the Sea and the Atmosphere)

Due to the transport of a warm and dry air mass into the territory of Portugal, very high maximum temperature values occurred in August, mainly between 13 and the 15 August with values above 40 °C (extremely hot days) in 10% to 20% of the weather stations (Figure 4-18). The highest temperature value was recorded in Reguengos (South region), 44.3 °C on the 14 August.

Tropical nights (minimum air temperature values equal to or greater than 20 °C) occurred at more than 10% of the stations from 13 to 17 August, especially in the southern region and namely in Algarve, with more than 30% of the stations with tropical nights on 14 August.

There was a heat wave with 6 to 9 days duration in the North and Centre inner regions, Tagus Valley and some places in Alentejo.

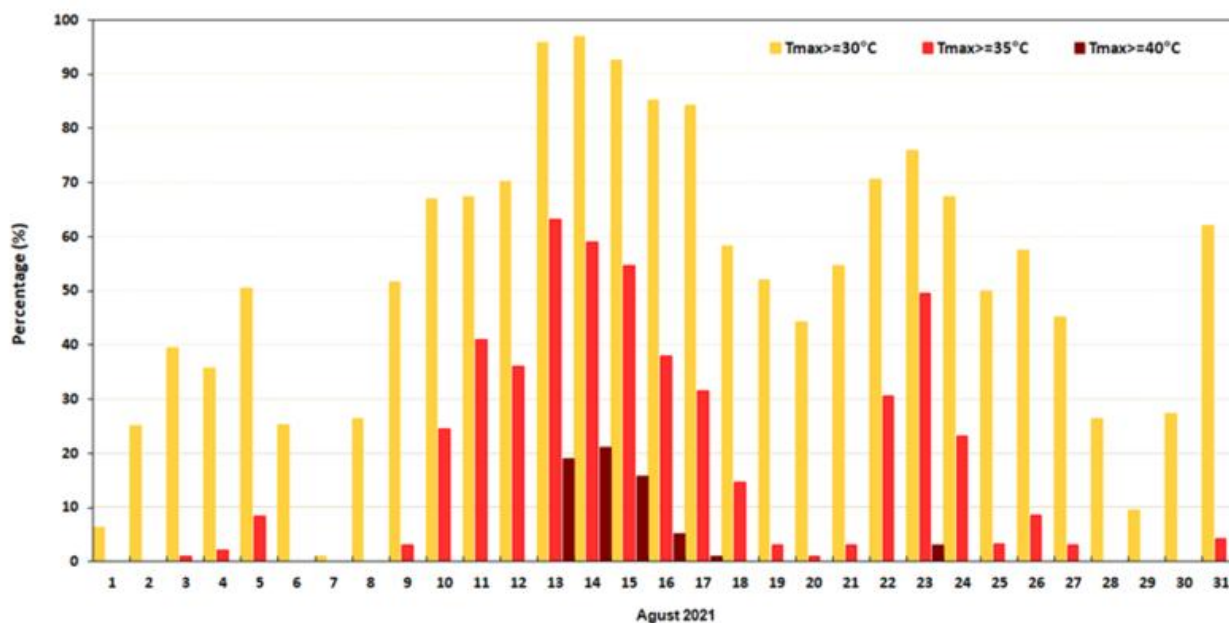


Figure 4-18: Percentage of stations with maximum air temperature values ≥ 30 °C, 35 °C and 40 °C observed in August 2021 in mainland Portugal (total stations: 95). Source: Portuguese Institute for the Sea and the Atmosphere.

6. References to national reports

Note: Primary information sources are the annual reports of RA VI Members, which are kindly provided by RA VI NMHSs. The names of Members, which contributed to the 2021 edition of the Bulletin, are listed on page 3 above. Many contributions or additional information may as well be found on the web, see below.

Austria: Zentralanstalt für Meteorologie und Geodynamik (**ZAMG**), Vienna, [Annual Climate Reports](#)

Belgium: The Royal Meteorological Institute of Belgium (**KMI**), [Klimatologisch overzicht](#)

Bosnia and Herzegovina: Federal Meteorological Institute (**METEObiH**), [Analiza-godina](#)

Croatia: Meteorological and Hydrological Service (**DMHZ**) [Annual reports](#)

Denmark: Danish Meteorological Institute (**DMI**), [Veiret i Danmark](#)

Denmark: Danish Meteorological Institute (**DMI**), [Storms in Denmark since 1891](#)

Estonian Weather Service: [Estonian Bulletin](#)

Finnish Meteorological Institute (FMI) [Press release archive](#)

France: Météo-France, Toulouse [Bilan climatiques](#)

Germany: Deutscher Wetterdienst (**DWD**), [Annual, Seasonal and Monthly Summary](#)

Greece: Hellenic National Meteorological Service, [Climatology extreme](#)

Greece: National Observatory of Athens, [Meteorological bulletin](#)

Hungarian Meteorological Service (**OMSZ**), [Climate retrospective](#)

Icelandic Met Office: [The weather in Iceland 2021-Climate summary](#)

Ireland: The Irish Meteorological Service (**MET Éireann**), [Weather Summary](#)

Israel Meteorological Service (**IMS**): [Weather summary in Israel](#)

Italy: Institute for Environmental Protection and Research (**ISPRA**) - System for Climate Data Collection and Dissemination (SCIA), [ISPRA SCIA Website](#); [RAPPORTOCLIMA2021](#)

Latvian Environment, Geology and Meteorology Centre [Monthly bulletins](#)

Lithuanian Hydrometeorological Service (**Lhmt**) [Monthly Reviews](#)

Luxembourg: MeteoLux, Bilans climatologiques annuels ([Annual climate assessments](#))

Moldova: State Hydrometeorological Service (**SHS**), [Caracterizarea conditiilor meteorologice si agrometeorologice din anul](#)

Montenegro: Institute of Hydrometeorology and Seismology (IHMS) [Annual reports](#)

Netherlands: Royal Netherlands Meteorological Institute (**KNMI**), [Jaaroverzicht van het weer in Nederland](#)

Netherlands: Royal Netherlands Meteorological Institute (**KNMI**), [Zware stormen in Nederland sinds 1910](#)

Norway: Det Norske Meteorologiske institutt (**DNMI**), [Klimatologisk månedsoversikt](#)

Poland: Institute of Meteorology and Water Management (**IMGW**), [CLIMATE OF POLAND 2021](#)

Portugal: Instituto portuguesa do mar e da atmosfera (**ipma**), [Bolletim Climatológico Anual](#)

Romania: Administrația Națională de Meteorologie, [Monitorizare climatica](#)

Russia: Russian Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet) - Hydrometeorological Research Center of Russian Federation (Hydrometcenter of Russia): [Climate information](#)

Serbia: Republic Hydrometeorological Service of Serbia (**RHMZ**) [Annual Bulletin for Serbia](#)

Slovakia: Slovak Hydrometeorological institute (**SHMU** Slovenský hydrometeorologický ústav) [Bulletin Meteorológia a Klimatológia](#)

Slovenia: Slovenian Environment Agency (**ARSO**, Agencija Republike Slovenije za okolje): [Mesečni bilten ARSO](#)

Slovenia: Unusual events <http://meteo.arso.gov.si/met/sl/climate/natural-hazards/>
Spain: Agencia Estatal de Meteorología (**AEMET**), [Resumen anual climatológico](#)
Spain: Agencia Estatal de Meteorología (**AEMET**), [Olas de calor en España desde 1975](#)
Spain: Agencia Estatal de Meteorología (**AEMET**), [Olas de frío en España desde 1975](#)
Swedish Meteorological and Hydrological Institute (**SMHI**), [Året \(year\)](#)
Swedish Meteorological and Hydrological Institute (**SMHI**), [Månadens väder](#)
Switzerland: Federal Office of Meteorology and Climatology **MeteoSwiss**, [Klimabulletin](#)
Türkiye: Turkish State Meteorological Service (**TSMS**), [Bulletin](#)
United Kingdom: **Met Office** [Climate summaries](#) and [State of the United Kingdom Climate 2021](#) in RMetS

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8. Abbreviations

Abbreviation	Meaning
AO	Arctic Oscillation (circulation indices)
BAMS	Bulletin of the American Meteorological Society
CLIMAT	Monthly climatological data provided by the NMHSs via GTS
DWD	Deutscher Wetterdienst (National Meteorological Service of Germany)
EA	East Atlantic Pattern (circulation indices)
EA/WR	East Atlantic/West Russia Pattern (circulation indices)
ECA&D or ECAD	European Climate Assessment & Dataset, located at Royal Netherlands Meteorological Institute (KNMI)
EMCC	Eastern Mediterranean Climate Centre
E-OBS	Daily gridded observational dataset for precipitation, temperature and sea level pressure in Europe based on ECA&D information
GCC	Global Collection Centre operated by the Deutscher Wetterdienst
GHCN	Global Historical Climate Network
GPCC	Global Precipitation Climatology Centre located at the Deutscher Wetterdienst
GTS	Global Telecommunication System
ISPRA	Istituto Superiore per la Protezione e la Ricerca Ambientale (Italian National Institute for Environmental Protection and Research)
JRC	Joint Research Centre of the European Commission
KNMI	Koninklijk Nederlands Meteorologisch Instituut (Royal Netherlands Meteorological Institute)
maxT	Maximum temperature
m a.s.l.	Meter above sea level
NAO	North Atlantic Oscillation (circulation indices)
NMHSs	National Meteorological and Hydrological Services
POL	Polar/Eurasia Pattern (circulation indices)
PDSI	Palmer Drought Severity Index
RCC	Regional Climate Centre
RCC-CM	Regional Climate Centre on Climate Monitoring
RR	daily total precipitation
RR1	count of days where $RR \geq 1$ mm
SCA	Scandinavia Pattern (circulation indices)
SCE	Annual snow cover extent
SU	Number of summer days
SYNOP	Surface synoptic or weather observations provided by the NMHSs via GTS
TG	Daily mean temperature
TN	Daily minimum temperature
TX	Daily maximum temperature
UK	United Kingdom
WCDMP	World Climate Data and Monitoring Programme
WMO RA VI	WMO Regional Association VI (Europe and Middle East)
WMO	World Meteorological Organization
WW	Number of warm and wet days