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ΜΕΤΕΩΡΟΛΟΓΙΚΗ
ΥΠΗΡΕΣΙΑ
HELLENIC NATIONAL METEOROLOGICAL SERVICE

Annual Bulletin on the Climate in Greece 2021

Hellenic National Meteorological Service
Climate, Environment and Meteorological Observations Division
Department of Climatology
A. Mamara, E. Chatziapostolou, N. Karatarakis
Email: anna.mamara@hnms.gr, eleni.chatziapostolou@hnms.gr,
karatarakis@hnms.gr

Notable weather and climate events in Greece 2021

There were few significant weather and climate events in 2021 including floods, heavy snowfall, heat waves and wildfires.

Heavy Precipitation, Storms and Floods

- On **11 to 12 January**, 2021 intense rainfall in the area of Evros, in northeastern Greece (Thrace), caused extensive flooding phenomena, overflowing torrents and traffic problems on the road Feres - Alexandroupoli at the height of the airport, while a bridge collapsed in Soulfi. Alexandroupoli met.station recorded 198.5 mm of rain in 7.30 hours (222.8mm in 24 hours i.e 490 % of the long range monthly average and 408.5 mm monthly precipitation height, which is a historical record).
- On **01 to 02 February**, 2021 intense rainfall in the area of Evros, in northeastern Greece (Thrace), caused severe floods in the areas around the river, extensive damage to private and public property and led to 1 death. Alexandroupoli met.station recorded 175.5 mm of rain in 8.30 hours (193 mm in 24 hours i.e 370 % of the long term monthly average and 220.3 mm monthly precipitation height).
- During **07 to 11 October** 2021 a severe weather system named the ''Athina'' brought heavy rain and strong gusts across the country, particularly in the Ionian Islands, Thessaly and Evia. Many ship operations in the Ionian Sea were affected by the storm and all primary and secondary schools in Corfu and Paxos were closed. Several landslides disrupted traffic along the areas of Pyli and Kalabaka while strong winds downed trees that damaged cars in Thessaloniki. Evia had significant damage to its roads, as well as flash floods that briefly halted transportation.
- During **13 to 16 October** 2021 a severe weather system named ''Ballos'' brought torrential rains, thunderstorms and strong wind gusts. It initially hit the Ionian islands and the west of the country and then it spread to the rest of the country. Heavy rainfall caused many disruptions in transportation, along with the storm-spawned flash floods. Athens received high amount of precipitation in just few hours (N.Filedelfeia station in the centre of Athens reported 111.8 mm in three and a half hours) and all primary and secondary schools closed. 1 casualty was recorded.
- During **22 November to 13 December** 2021 successive disturbances in the upper atmospheric flow pattern caused severe thunderstorms, heavy rainfalls, gale force winds and affected the whole country mainly Ionian islands, west and northeast regions. Floods, landslides, property damages and 2 casualties were recorded.
- During **18 December to 19 December** 2021 barometric low named ''Carmel'' caused rainfalls and thunderstorms across eastern parts of Greece as well as gale force winds across Aegean islands; however ''Carmel'' didn't cause any significant impacts.

Snowfall

- During **13 to 17 February** 2021 heavy snowfall hit most parts of Greece. With the exception of the Ionian Islands and the west coasts, it even snowed in coastal areas of east mainland, the Aegean islands and Crete, where it rarely snows. The total duration of snowfall in Attica was 36 hours, with the strongest intensity in the center of Athens. The storm disrupted most public transportation in the country. Thousands of households were left without electricity due to downed trees, especially in Attica and the island of Evia. Four casualties were recorded.

Heat Wave

- During the period **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 in some places exceeding 42 ^{o}C.

- 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 ^{o}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 1-5/8/2021, where several stations of Greek mainland recorded daily maximum temperature greater than 45 ^{o}C.

Wildfires

- During **03 to 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 (50,887.6 ha burnt area according to Copernicus - https://emergency.copernicus.eu/mapping/list-of-components/EMSR527), 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 - https://effis.jrc.ec.europa.eu) 108,602 ha were burnt during 3-23 August and 130,058 ha were burnt in year 2021, i.e 570 % the average bunt area of 2008-2020.

1. Annual Survey

This section presents an overview of the spatial patterns of mean annual climate conditions in 2021 and anomalies related mainly to the normal period 1971-2000 of the following basic climate variables: temperature and precipitation.

1.1 Temperature

Warmer than normal conditions prevailed in Greece during 2021. Mean annual temperature anomalies relative to the respective annual average for the period 1971-2000, ranged between 0.9 °C and 1.7 °C. The greatest positive departures from normal values occurred in southeast Aegean and Dodecanese islands (Figure 1). The beginning of the year experienced large positive anomalies for the first two months and especially during January mean monthly temperatures anomalies exceeded 3.0 °C over northeast Greece. The warmest month in the year was August during which mean monthly temperatures ranged 2.3 to 4.0 °C above normal values (1971- 2000). Also, very large positive anomalies of above 2.0 °C occurred during July. On the contrary, the largest negative temperature anomalies of below -1.5°C occurred during October which was a cold month in most of Greece.

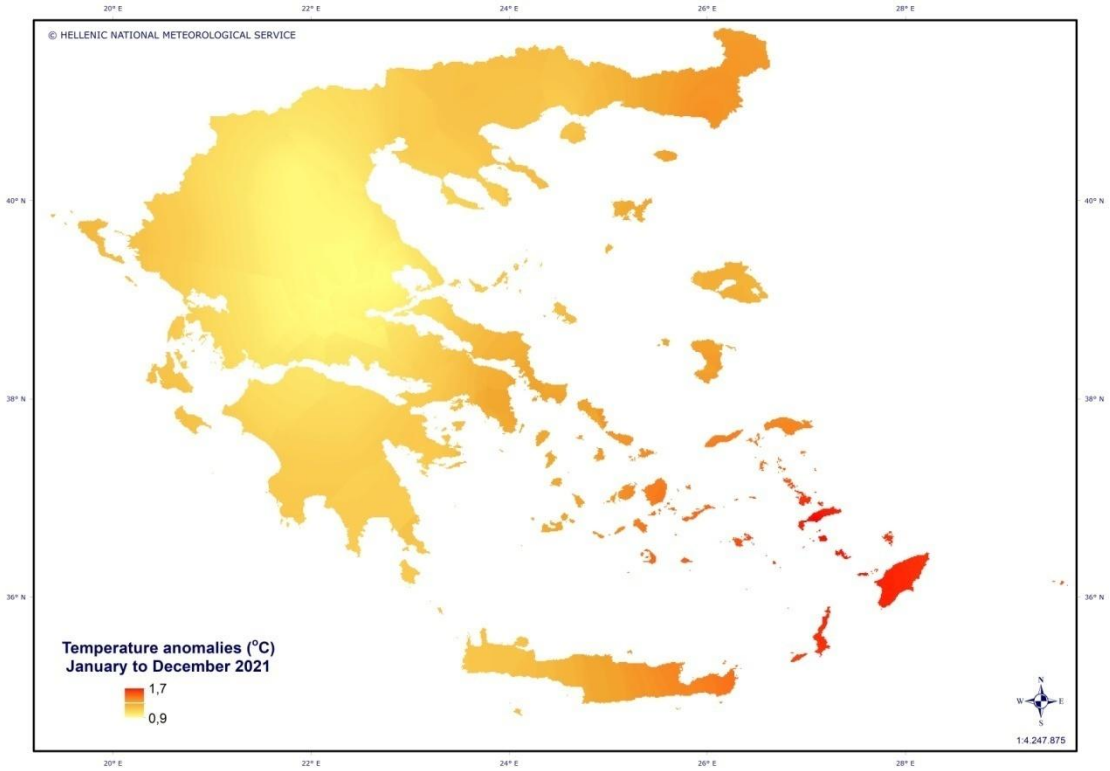


Figure 1 *Annual mean temperature anomalies (°C) in 2021 in Greece according to the 1971-2000 climatology.*

1.2 Precipitation

In 2021, wetter than normal conditions prevailed in west and north Greece and especially in the areas of Eastern Macedonia and Thrace, where total precipitation accounted for more than 200 % of normal values (1971-2000). On the contrary, drier than normal conditions prevailed in south Aegean islands, Crete and Dodecanese islands, where total precipitation accounted for less than 80 % of normal values (1971-2000). Figure 2 shows the annual precipitation anomalies, with respect to 1971-2000.

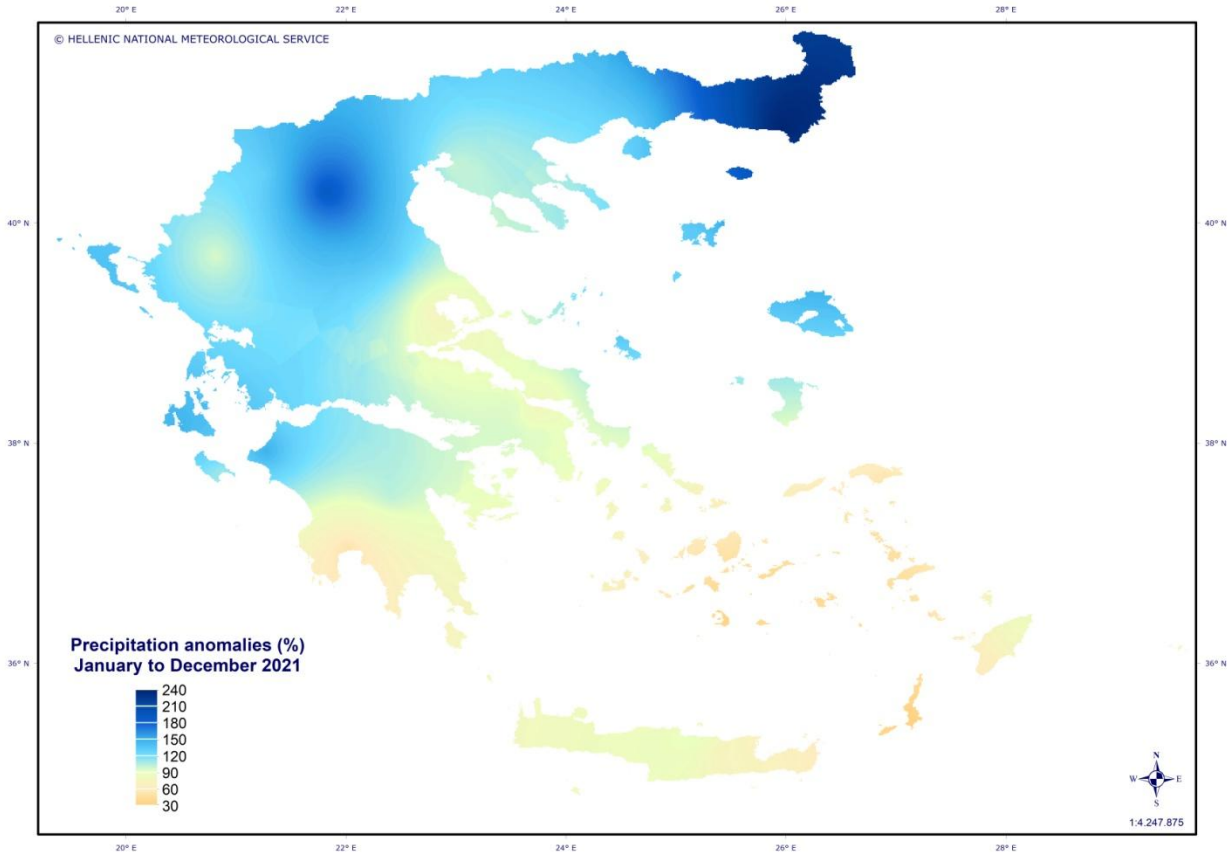


Figure 2. *Annual precipitation anomalies in 2021 in Greece (%) compared to 1971-2000 climatology.*

2. Seasonal Survey

This section presents an overview of the spatial patterns of seasonal mean climate conditions in 2021 in Greece and anomalies related mainly to the normal period 1971-2000 of the following basic climate variables: temperature and precipitation.

2.1 Temperature

Mean temperature in **winter of 2020/2021** ranged from +5.6 °C to +15.0 °C. The greatest mean temperature values were recorded over the southeast areas (east Crete, Dodecanese islands) and the lowest ones over north mainland (Figure 3). Temperature in winter 2020/21 in Greece was above normal values compared to the 1971-2000 climatology. The departure of mean air temperature from the normal values (1971-2000), in this winter ranged from 1.5 °C to + 3.5 °C, with the greatest positive anomalies occurring mainly in the northeastern parts of the country (Figure 4).

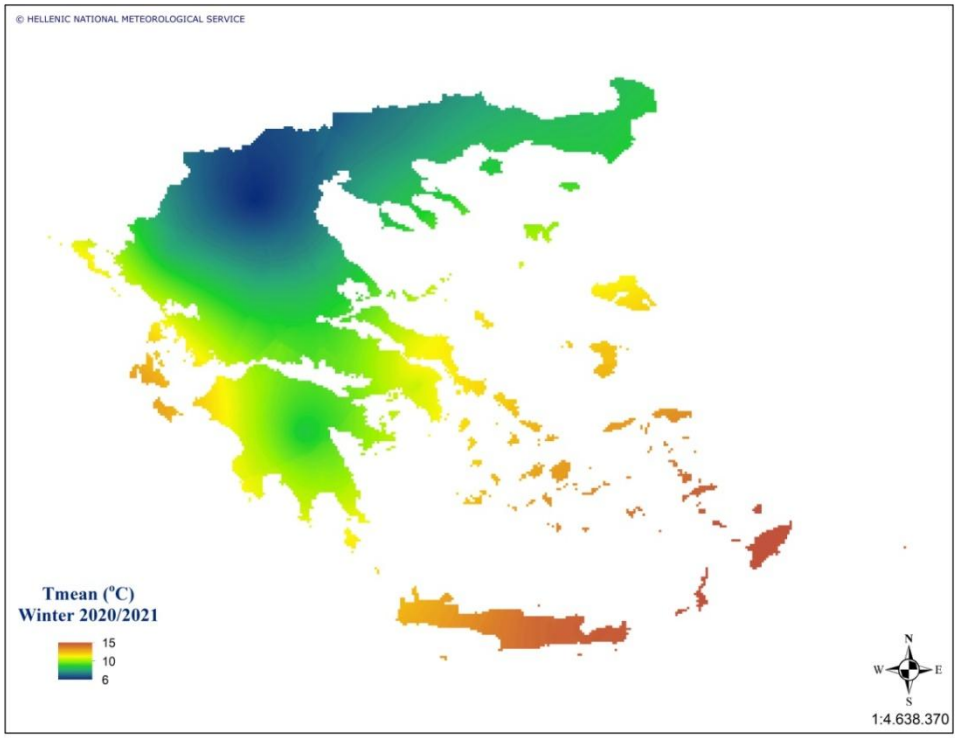


Figure 3. *Mean temperature (°C) in Winter 2020/21 in Greece.*

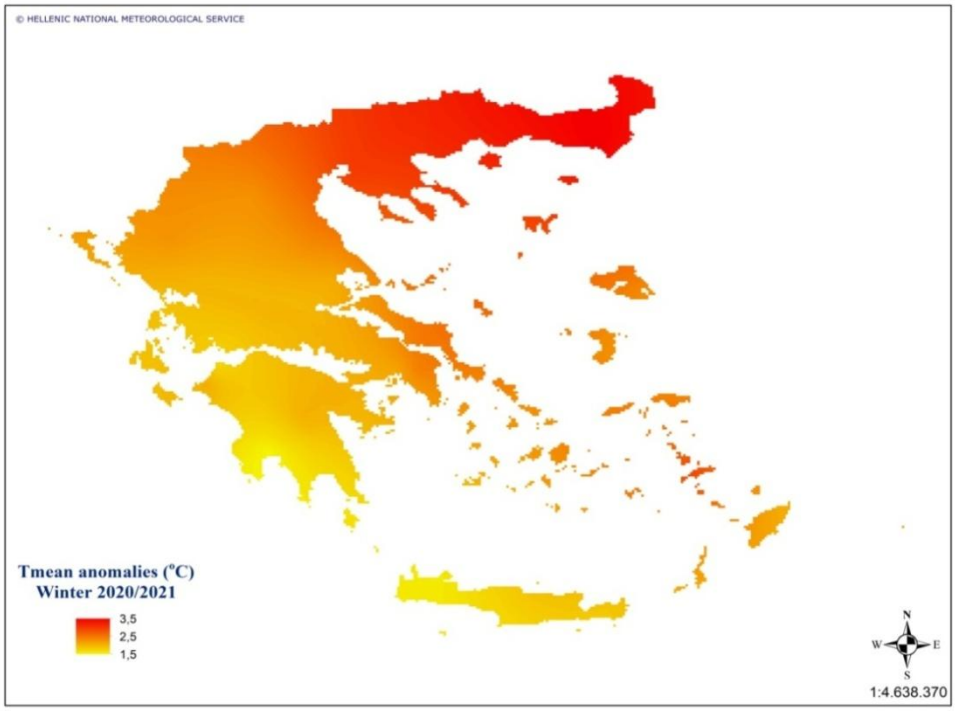


Figure 4. *Mean temperature anomalies (°C) for winter 2020/21 in Greece according to the 1971-2000 climatology.*

Above average temperatures dominated in Greece during **spring 2021**. Mean temperatures ranged from +0.4 ^{o}C to +1.6 ^{o}C above seasonal temperature normal values (Figure 5). The greatest positive anomalies are found over southern and southeastern parts of the country and especially in Attica, south Peloponnese, Crete, Cycladic and Dodecanese islands.

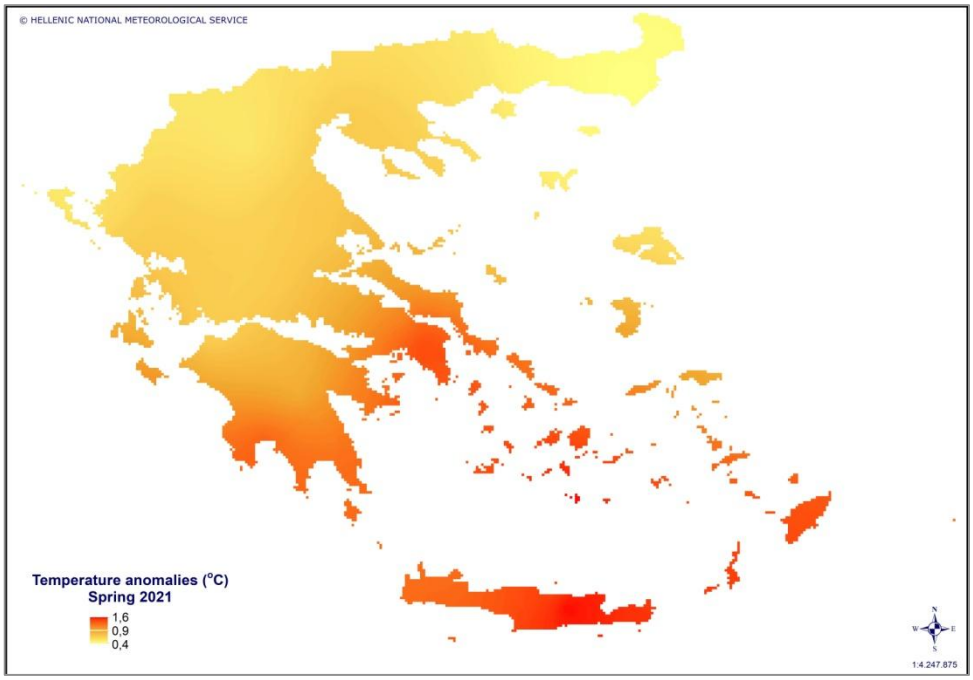


Figure 5. *Mean temperature anomalies (°C) for spring 2021 in Greece according to the 1971-2000 climatology.*

Warmer than normal conditions dominated in Greece during **summer 2021**, that was characterized by long episodes of heat wave. Summer mean temperature anomalies ranged from +1,4 °C to +2,6 °C above normal values (long term data series of 31 meteorological stations were used to derive summer average mean temperature for the whole country). The highest positive anomalies occurred in the central Macedonia, Epirus and the Ionian and Dodecanese islands (Figure 6).

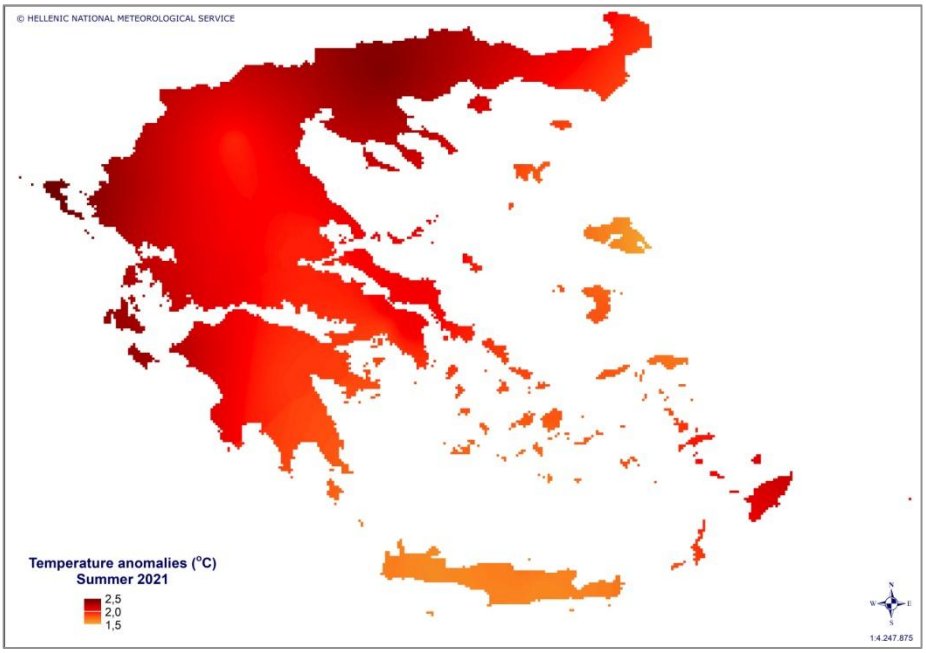


Figure 6. *Mean temperature anomalies (°C) for summer 2021 in Greece according to the 1971-2000 climatology.*

The average summer mean temperature anomalies in Greece from 1960 to 2021 relative to 1971-2000 and 1981-2010 are given in Figure 7. The summers of 2021 and 2007, were the second hottest summers on record. The average summer temperature (taking into account 31 HNMS meteorological stations) was about +27.5 °C, i.e about +2,1 °C above normal values 1971-2000 and almost +1,5 °C above normal values 1981-2010. The summer mean temperature remained relative low up to 1992, and then started to rise and reached a local peak in 2012 which was the warmest summer on record, with an average mean temperature anomaly of above 2 °C. During the last decade (2012-2021), the average mean temperature anomaly reached or exceeded 1.5 °C, five times with respect to normal values 1971-2000 and two times compared to 1981-2010 normal values.

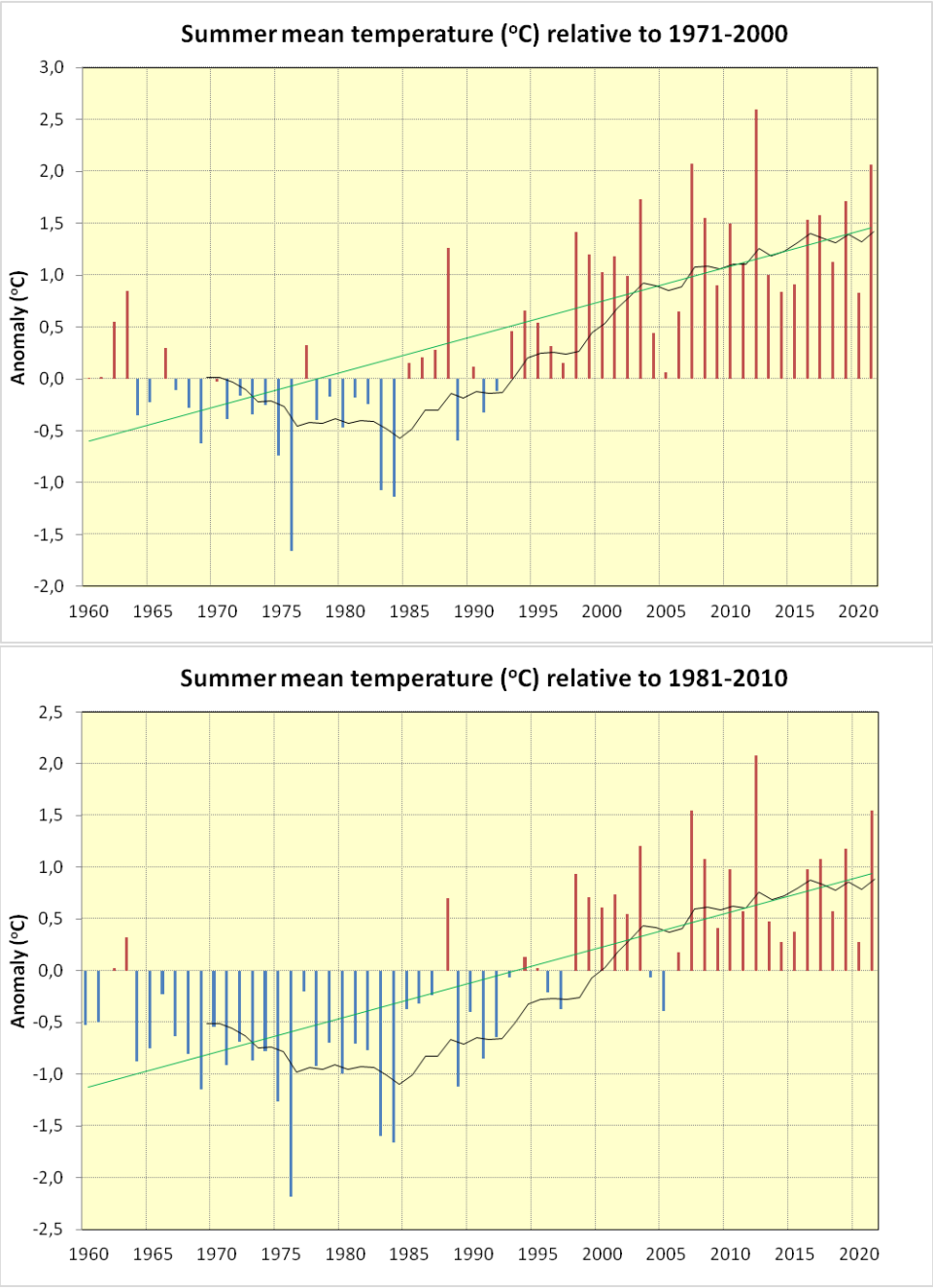


Figure 7. *Summer 2021 (June through August) averages of mean surface air temperature anomalies for Greece (taking into account 31 stations) relative to 1971-2000 (above) and 1981-2010 (below). The black line indicates the ten-year moving average, and the green line indicates the long-term linear trend.*

The **autumn** mean temperature in Greece was near or above normal values (1971-2000). The autumn experienced positive temperature anomalies for the first and last month and negative ones during October. The highest positive mean temperature anomalies of above 1 ^{o}C were found in Dodecanese and southeast Aegean islands.

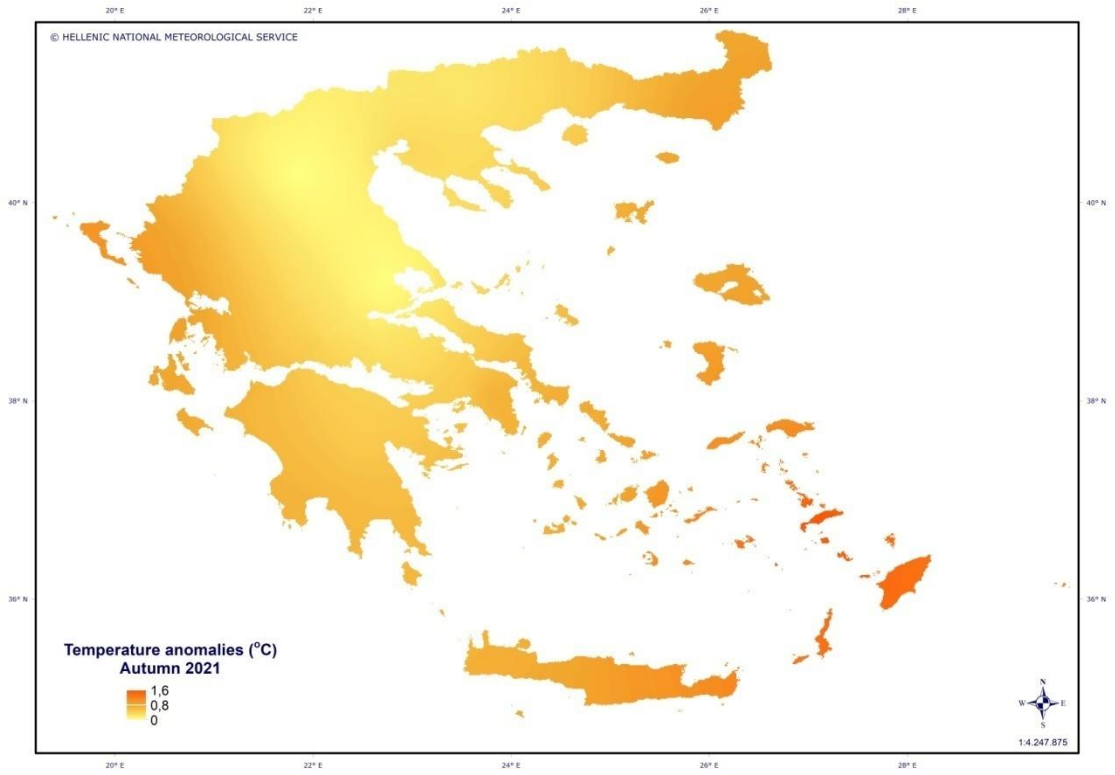


Figure 8. *Mean temperature anomalies (°C) for autumn 2021 in Greece according to the 1971-2000 climatology.*

2.2 Precipitation

Winter of 2020/21 was wetter than normal in the west, north and northeast regions and drier than normal in the south Aegean islands. The winter 2020/21 precipitation anomalies ranged from 52% to 430 % with the greatest anomalies occurring in the areas of Thrace and central Macedonia (Figure 9).

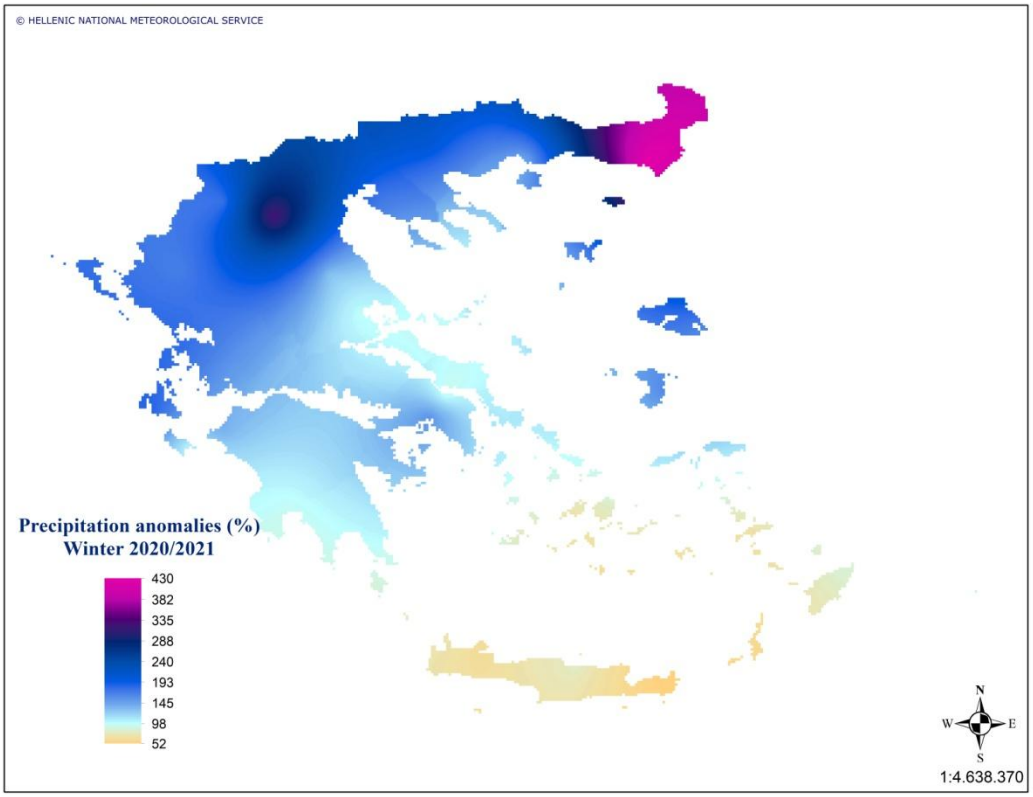


Figure 9. *Winter 2020/21 precipitation anomalies in Greece (compared to 1971-2000 climatology) given in percentages (%).*

Spring of 2021 was drier than normal in most parts of the country, while it was near normal in the areas of west Macedonia, Thessaly, the northeastern Aegean islands and western Crete. On the other hand, it was wetter than normal in the areas of eastern Macedonia and Thrace, where spring precipitation totals accounted for more than 130 % of normal values (1971-2000) (Figure 10).

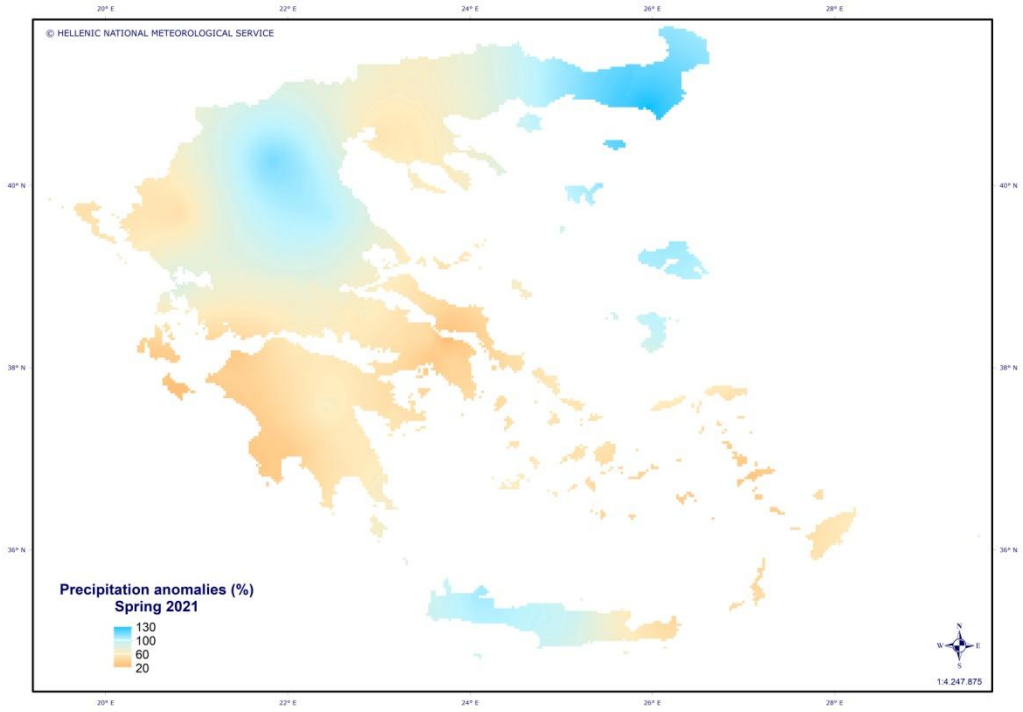


Figure 10. *Spring 2021 precipitation anomalies in Greece (compared to 1971-2000 climatology) given in percentages (%).*

Summer in Greece is generally dry, however local showers or isolated thunderstorms, mainly during June led to above average summer precipitation in Thrace, northeastern Aegean islands, Thessaly and eastern Crete, where total precipitation accounted for more than 130 % of 1971-2000 normal values (Figure 11). The summer 2021 was dryer than normal in the rest of the country.

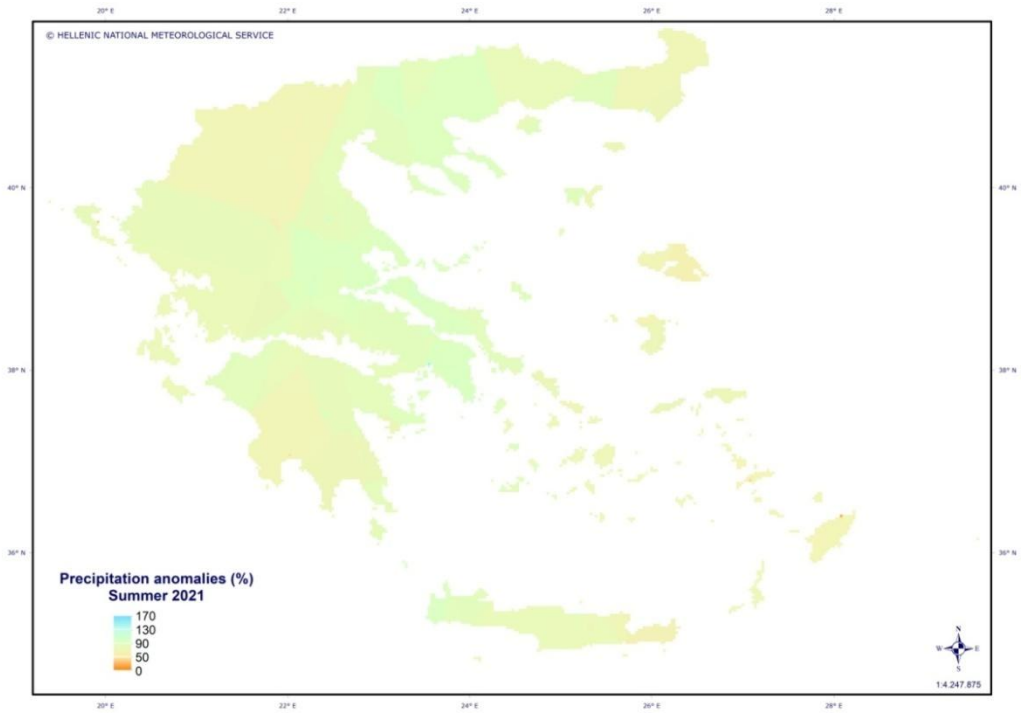


Figure 11. *Summer 2021 precipitation anomalies in Greece (compared to 1971-2000 climatology) given in percentages (%).*

Autumn 2021, was wetter than normal in most of Greece except south and southeast Aegean islands, Crete and Dodecanese islands, where total precipitation accounted for less than 50 % of normal values (1971-2000). On the contrary, Ionian and Sporades islands and locally north areas received high precipitation amounts and total precipitation accounted for more than 180 % of normal values (1971-2000) (Figure 12).

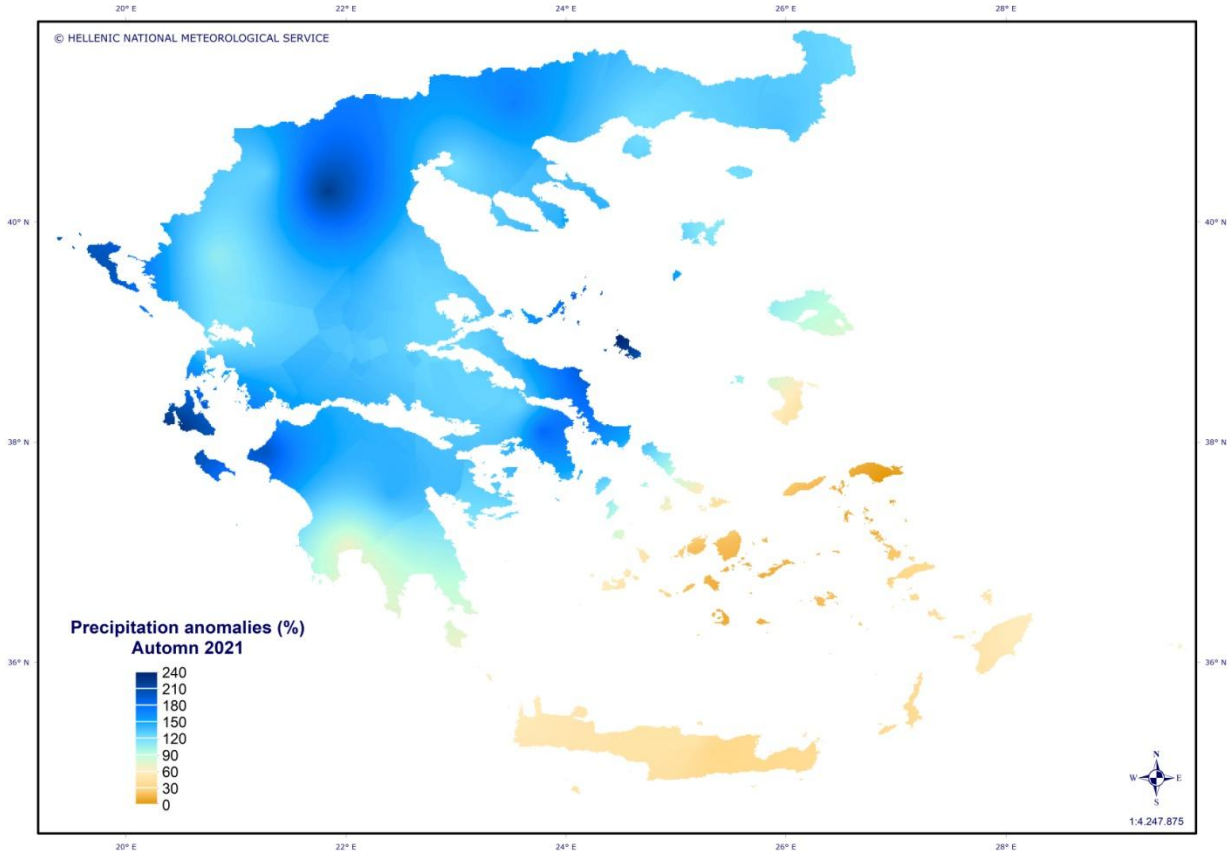


Figure 12. *Autumn 2021 precipitation anomalies in Greece (compared to 1971-2000 climatology) given in percentages (%).*

3. Monthly Survey

This section contains notable weather and climate events, high impacts events as well as monthly means and anomalies of temperature and precipitation in 2021 in Greece.

3.1 January

Warm and extremely wet conditions prevailed in north Greece, mainly in east Macedonia and Thrace where total precipitation accounted for more than 800 % of normal values (Figure 13). On the contrary, drier than normal conditions prevailed in Dodecanese and south Aegean islands and Crete. Alexandroupoli station located in east Macedonia and Thrace, recorded total monthly precipitation 408.6 mm i.e 8-9 times above the normal value, ranking this January as the wettest January on record (Figure 14).

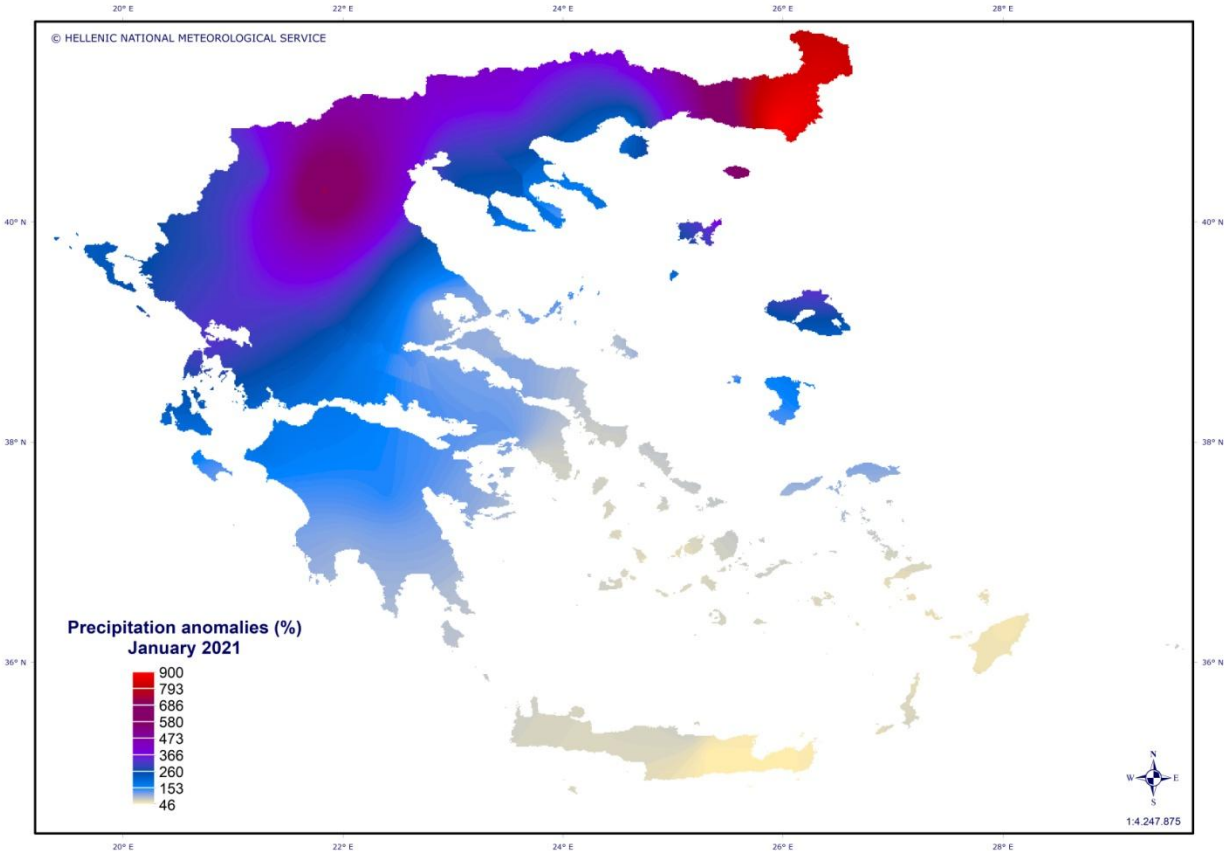


Figure 13. *January 2021's precipitation anomalies in Greece (compared to 1971-2000 climatology) given in percentages (%).*

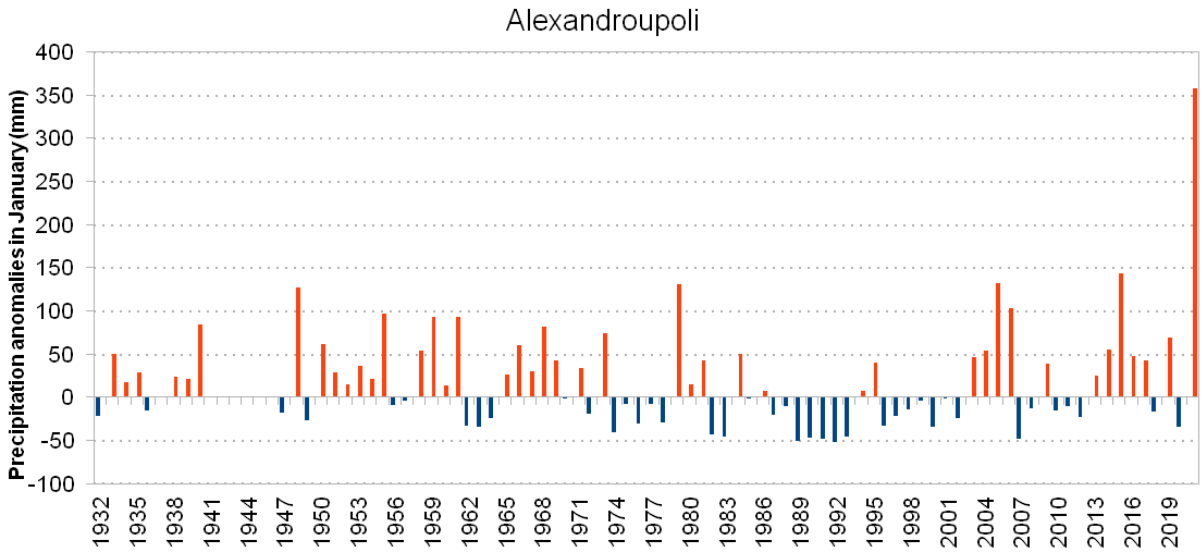


Figure 14. *Precipitation anomalies in January (mm)- Departures from 1981-2010 normal values; blue bars show precipitation values which are below the 1981-2010 average and red bars above this mean value.*

In January 2021, there were above-average temperatures across Greece. Pronounced above-average temperatures of at least +2.5 to 3.0 °C occurred across east Macedonia and Thrace and northeast Aegean islands. (Figure 15).

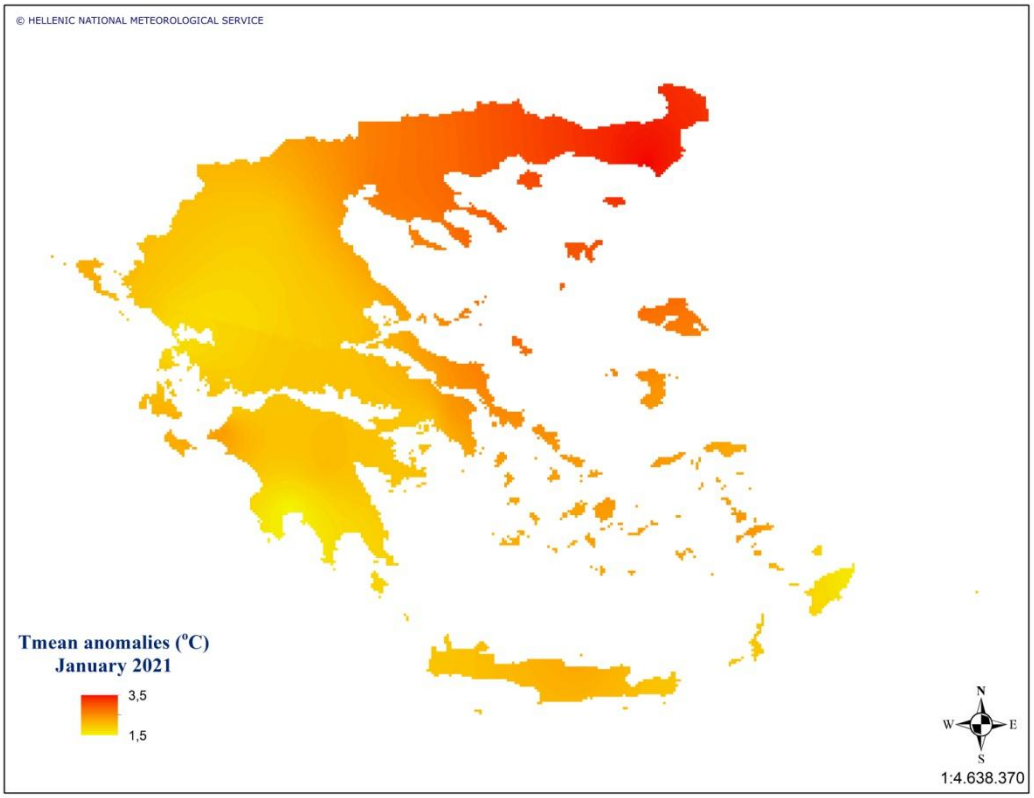


Figure 15. *January 2021's mean temperature anomalies (°C) in Greece according to the 1971-2000 climatology.*

3.2 February

February 2021 indicated a notable precipitation contrast across Greece, with precipitation deficit in many areas, mainly in central and south parts and precipitation surplus over Thrace (Figure 16). After January, Alexandroupoli station recorded again high precipitation amount 220.3mm, i.e 4.5 times above the 1981-2010 normal value, ranking this February as the wettest February on record (Figure 17).

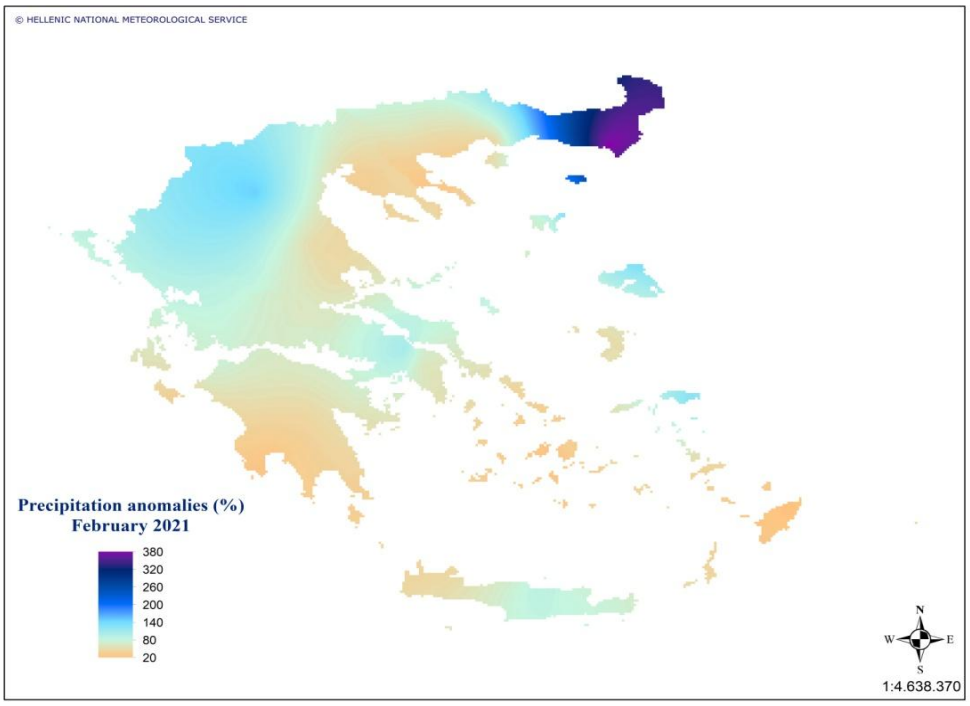


Figure 16. *February 2021's precipitation anomalies in Greece (compared to 1971-2000 climatology) given in percentages (%).*

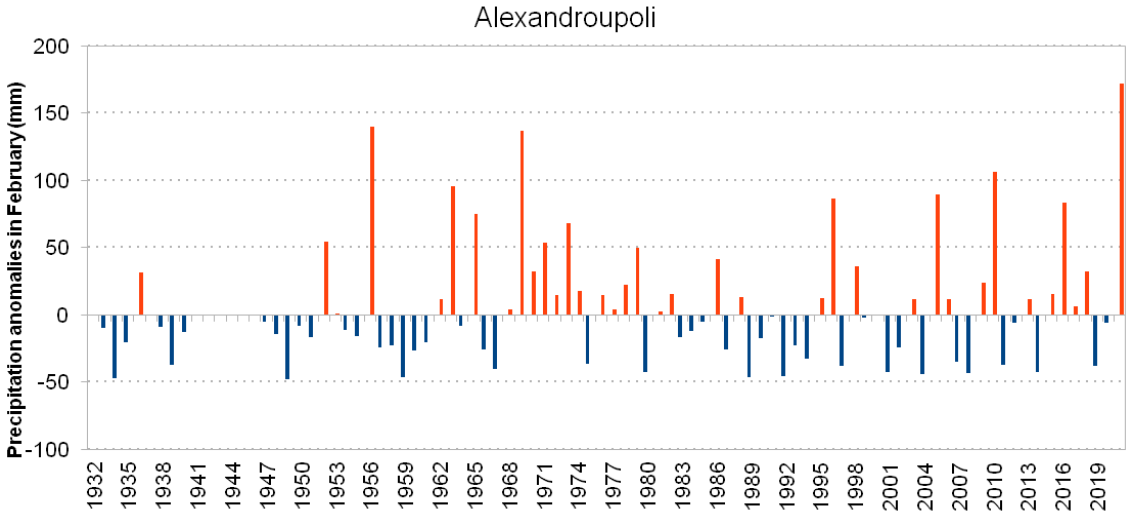


Figure 17. *Precipitation anomalies in February (mm)- Departures from 1981-2010 normal values; blue bars show precipitation values which are below the 1981-2010 average and red bars above this mean value.*

Warmer-than-average conditions occurred across Greece during February 2021. The most notable warmer-than-average February 2021 temperatures of at least +2.0°C were recorded across central and east Macedonia and Thrace and southeast Aegean islands (Figure 18).

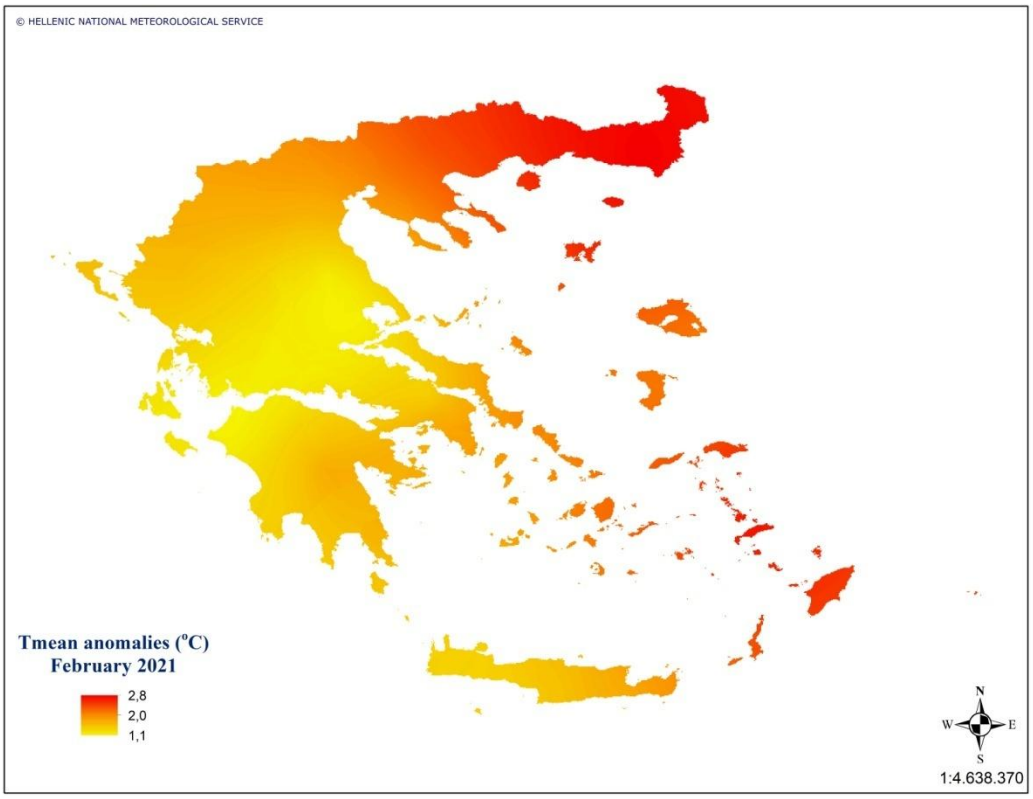


Figure 18. *February 2021's mean temperature anomalies (°C) in Greece according to the 1971-2000 climatology.*

3.3 March

In March 2021, near to normal or slightly above average temperatures prevailed across Attica and the southern parts of the country, while slightly below average temperatures occurred across the northern areas, mainly west Macedonia (Figure 19). Precipitation was moderately lower than the 1971-2000 average over most of west and south Greece. Conversely, above average precipitation was recorded over a few regions in the central and north mainland, with the largest anomalies in Thessaly (Figure 20).

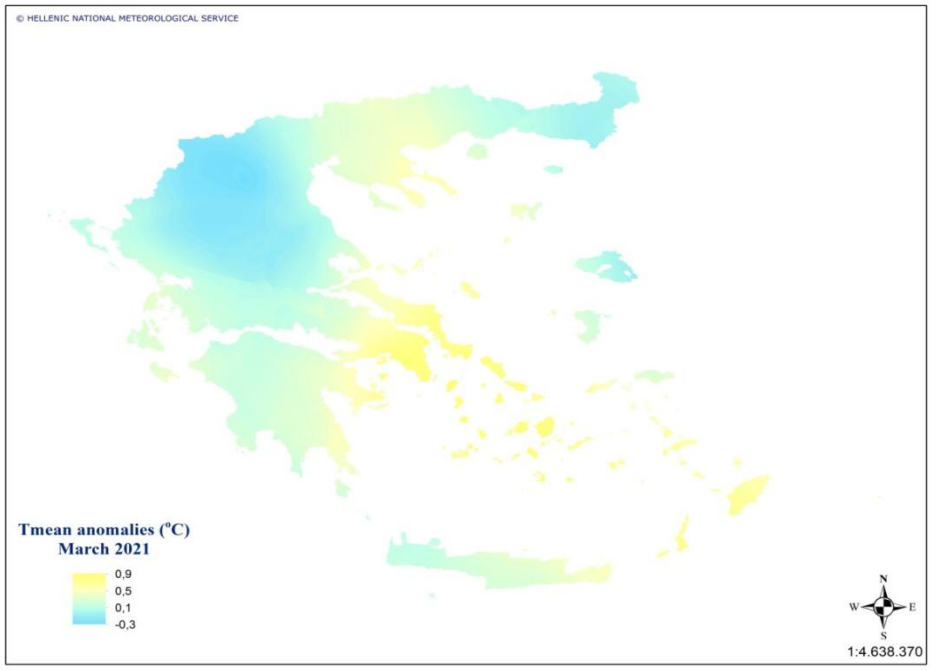


Figure 19. *March2021's mean temperature anomalies (°C) in Greece according to the 1971-2000 climatology.*

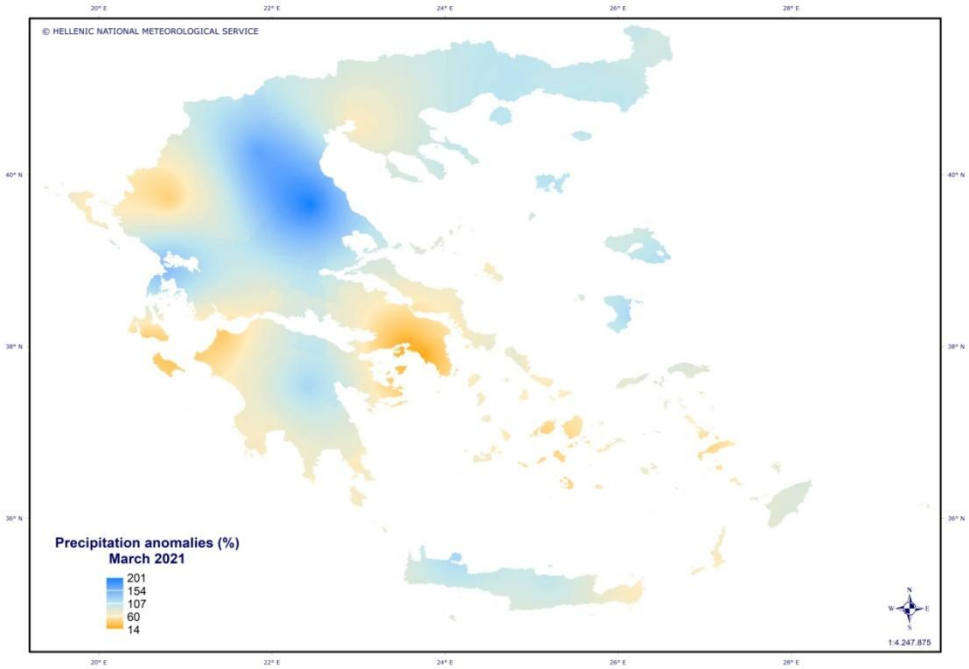


Figure 20. *March 2021's precipitation anomalies in Greece (compared to 1971-2000 climatology) given in percentages (%).*

3.4 April

In April 2021, most of Greece experienced drier-than-average conditions; precipitation was notably below the 1971-2000 average over the southwestern areas and the Dodecanese islands (Figure 21). In terms of temperature, April registered as slightly colder than average over north-northeastern Greece and warmer than average over southern parts (Figure 22).

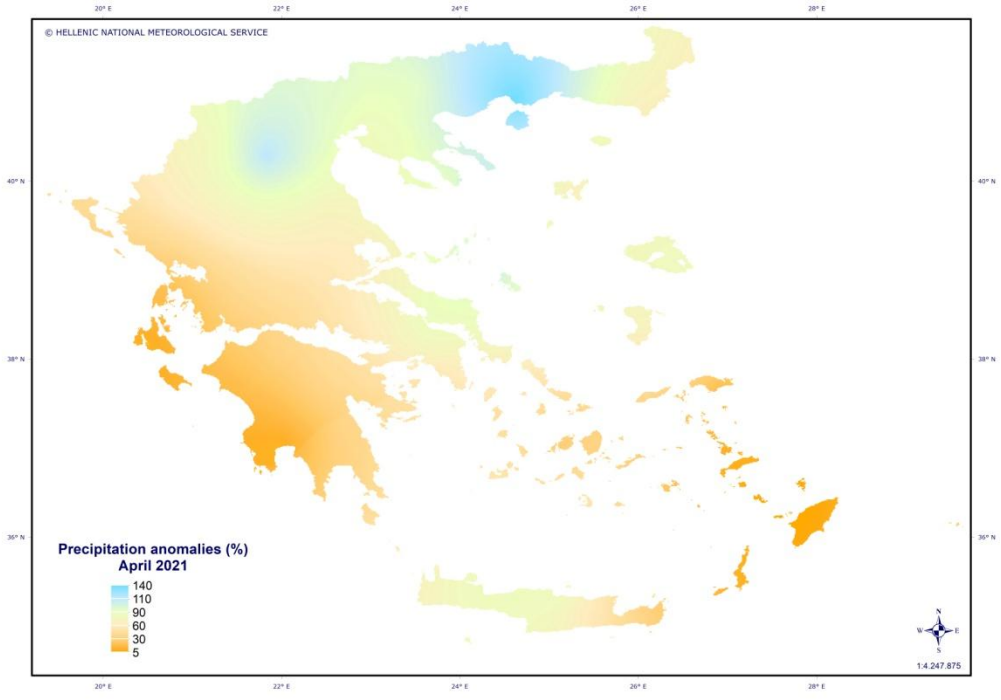


Figure 21. *April 2021's precipitation anomalies in Greece (compared to 1971-2000 climatology) given in percentages (%).*

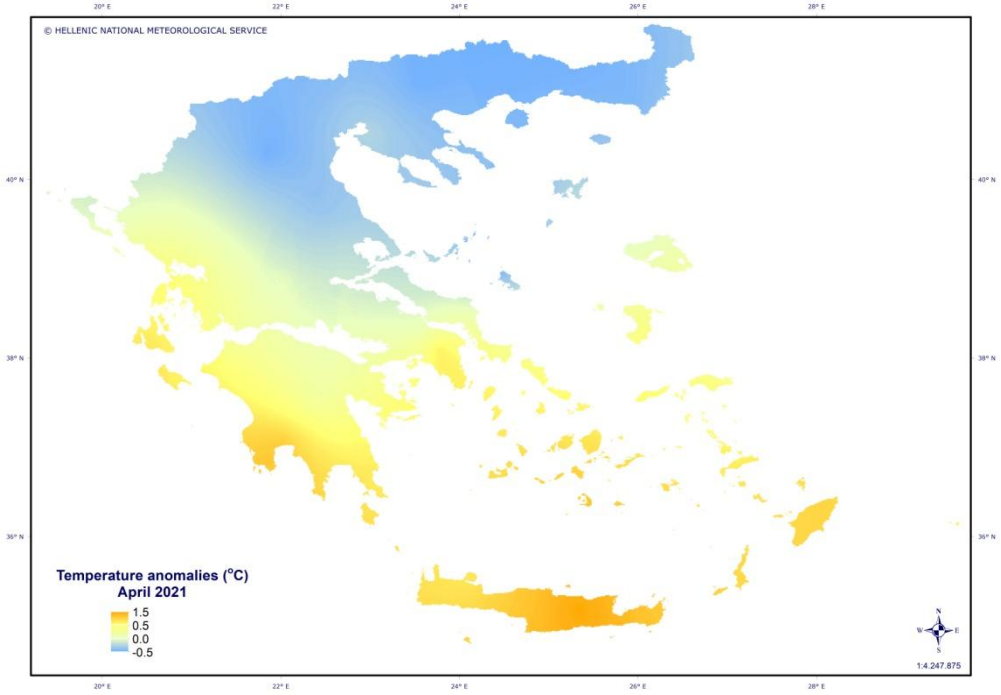


Figure 22. *April 2021's mean temperature anomalies (°C) in Greece according to the 1971-2000 climatology.*

3.5 May

In May 2021, there was a striking contrast in precipitation pattern across Greece. Most of Greece experienced much drier-than-average conditions; precipitation was notably below the 1971-2000 average accounting less than 50% of normal values, over Attica, Peloponnese and south Aegean islands. Conversely, over Thrace, total precipitation was 2.5 times above normal values (Figure 23). In terms of temperature, warmer-than-average conditions occurred across the whole country. The most notable warmer-than-average temperatures of at least +2.0°C were located across the central and east mainland, Crete, and the south Aegean islands (Figure 24).

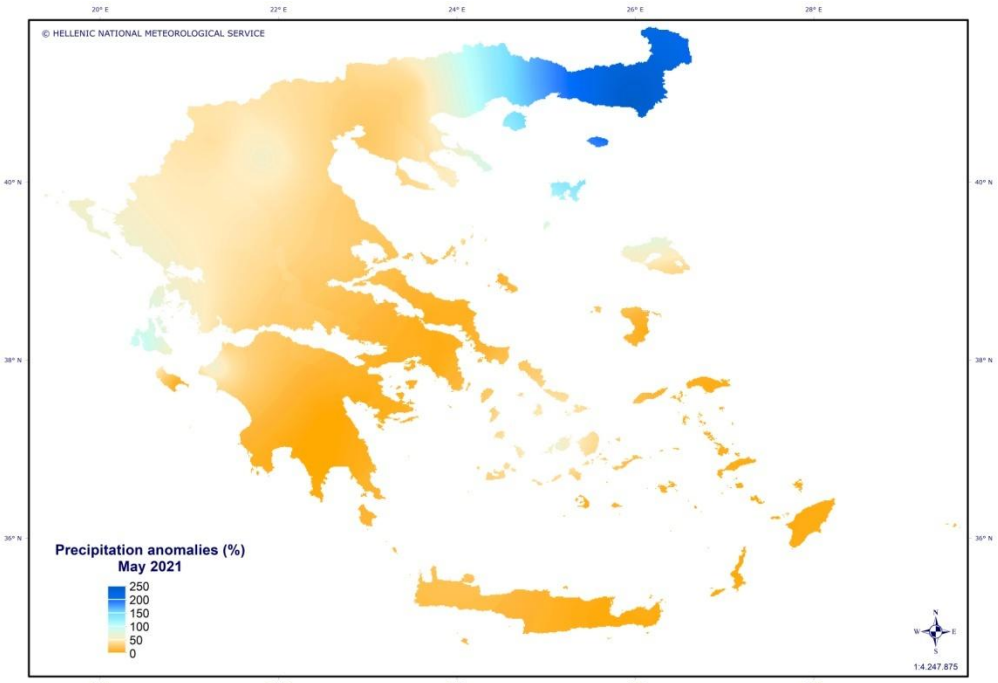


Figure 23. *May 2021's precipitation anomalies in Greece (compared to 1971-2000 climatology) given in percentages (%).*

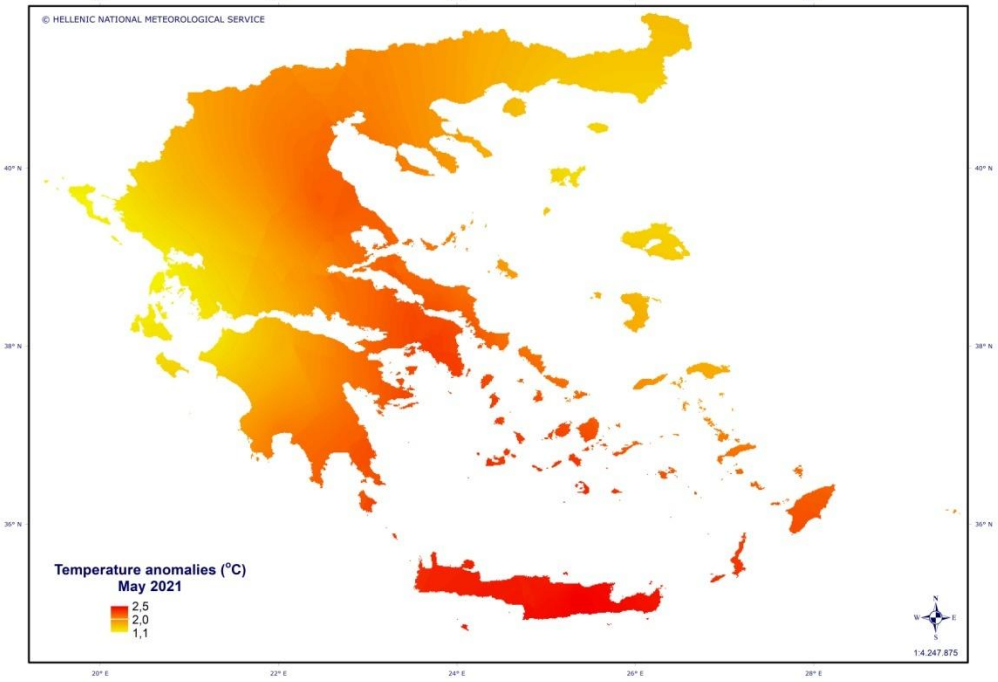


Figure 24. *May 2021's mean temperature anomalies (°C) in Greece according to the 1971-2000 climatology.*

3.6 June

June 2021 doesn't rank among the top-10 warmest Junes, however above average temperatures were recorded across the country. The country's average monthly temperature (taking into account 32 meteorological stations) was 24.9 °C, about +0.8 °C above 1971-2000 normal values. The greatest positive temperature anomalies of at least +1.5 °C occurred across west Greece (Figure 25). At the end of June (22 June to 2 July 2021) heat wave conditions prevailed on the Greek mainland and several stations recorded maximum temperatures above 42 °C.

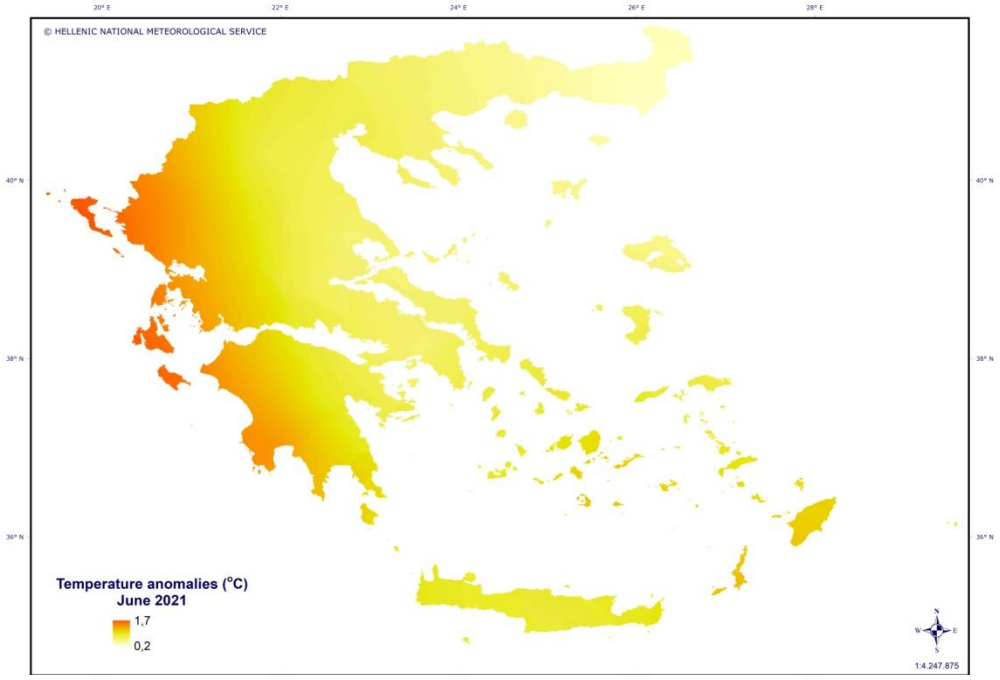


Figure 25. *June 2021's mean temperature anomalies (°C) in Greece according to the 1971-2000 climatology.*

Few showers and isolated thunderstorms led to large precipitation anomalies in regions of southeast mainland and east Macedonia.

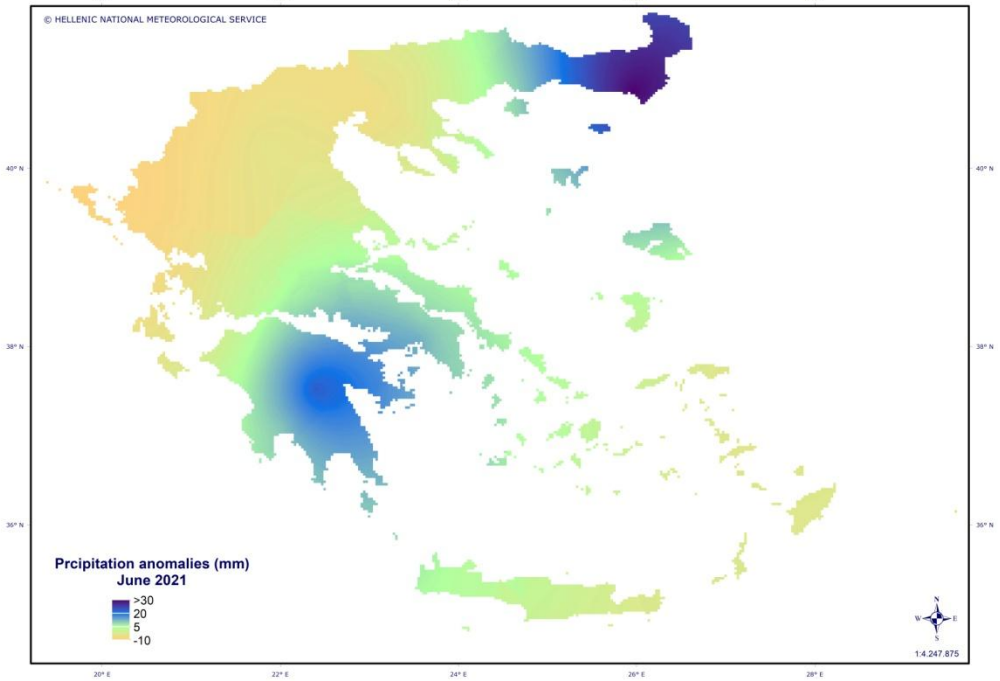


Figure 26. *June 2021's precipitation anomalies (mm) according to the 1971-2000 climatology.*

3.7 July

July 2021 is regarded as the second warmest July on record, with an average temperature of +28.7 ^{o}C, about +2.5 ^{o}C above 1971-2000 normal values. The greatest positive temperature anomalies of at least +2.5 ^{o}C occurred across mainland and Ionian islands (Figure 27).

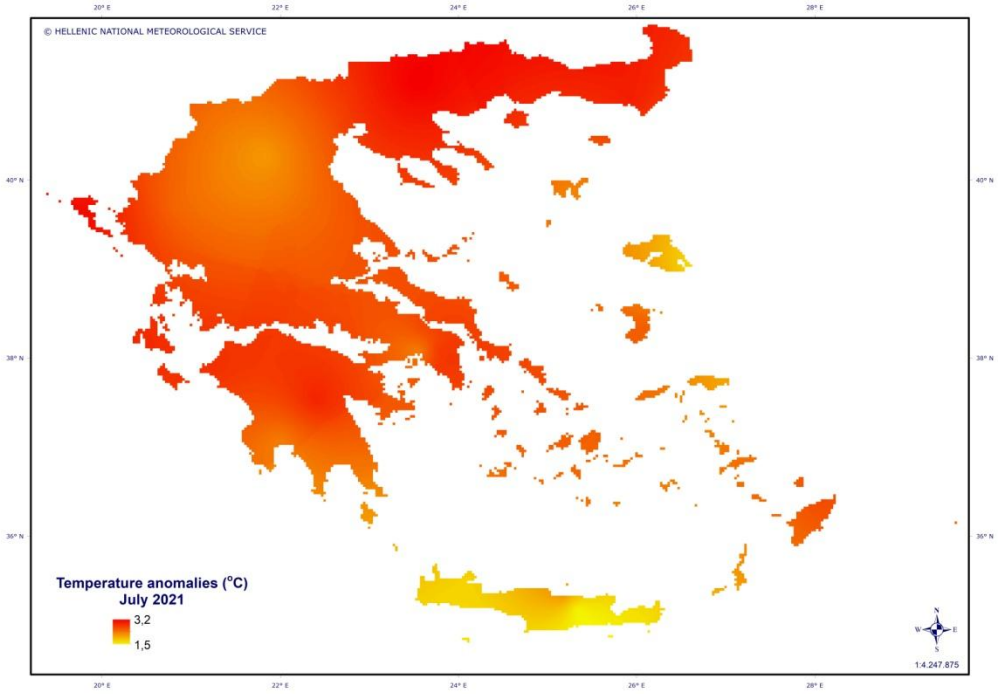
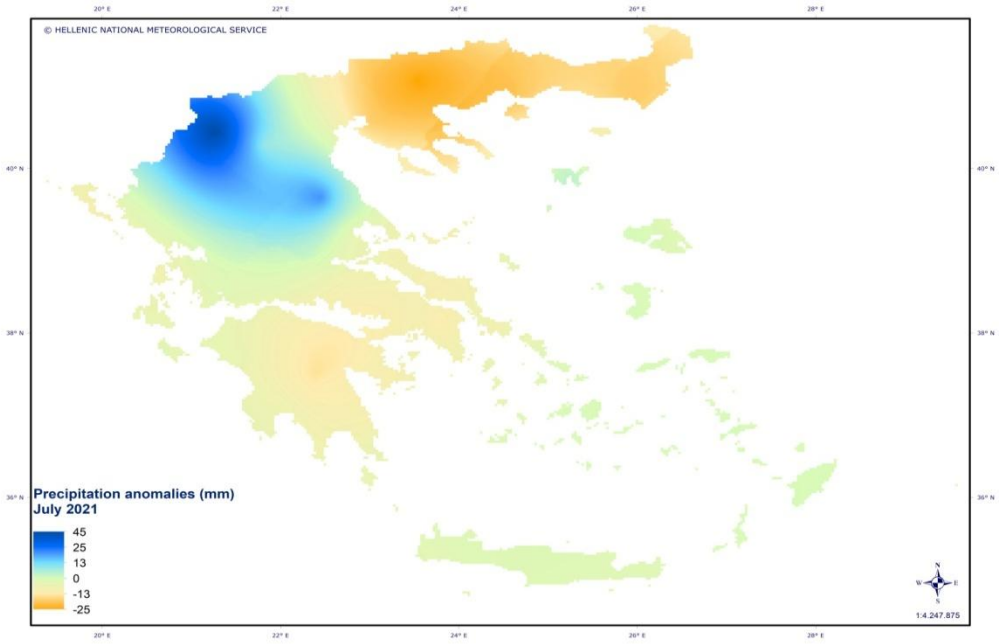


Figure 27. *July 2021's mean temperature anomalies (°C) in Greece according to the 1971-2000 climatology.*



Most of Greece experienced normal or below normal precipitation. However few isolated thunderstorms over west Macedonia and Thessaly resulted to above normal monthly precipitation.

Figure 28. *July 2021's precipitation anomalies (mm) according to the 1971-2000 climatology.*

3.8 August

August 2021 is considered as the warmest August on record with an average temperature of +28.8 °C, about +2.9 °C above 1971-2000 normal values and +2.3 °C above 1981-2010 normal values. The greatest positive temperature anomalies of at least +3.0 °C occurred across north and central mainland and southeast Aegean islands (Figure 29). The first 10days of August has been characterized by a culmination of a heat wave, which had begun at the end of July. During that prolonged heat wave episode, many stations had recorded 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 1-5/8/2021, where several stations of Greek mainland recorded daily maximum temperature greater than 45 °C.

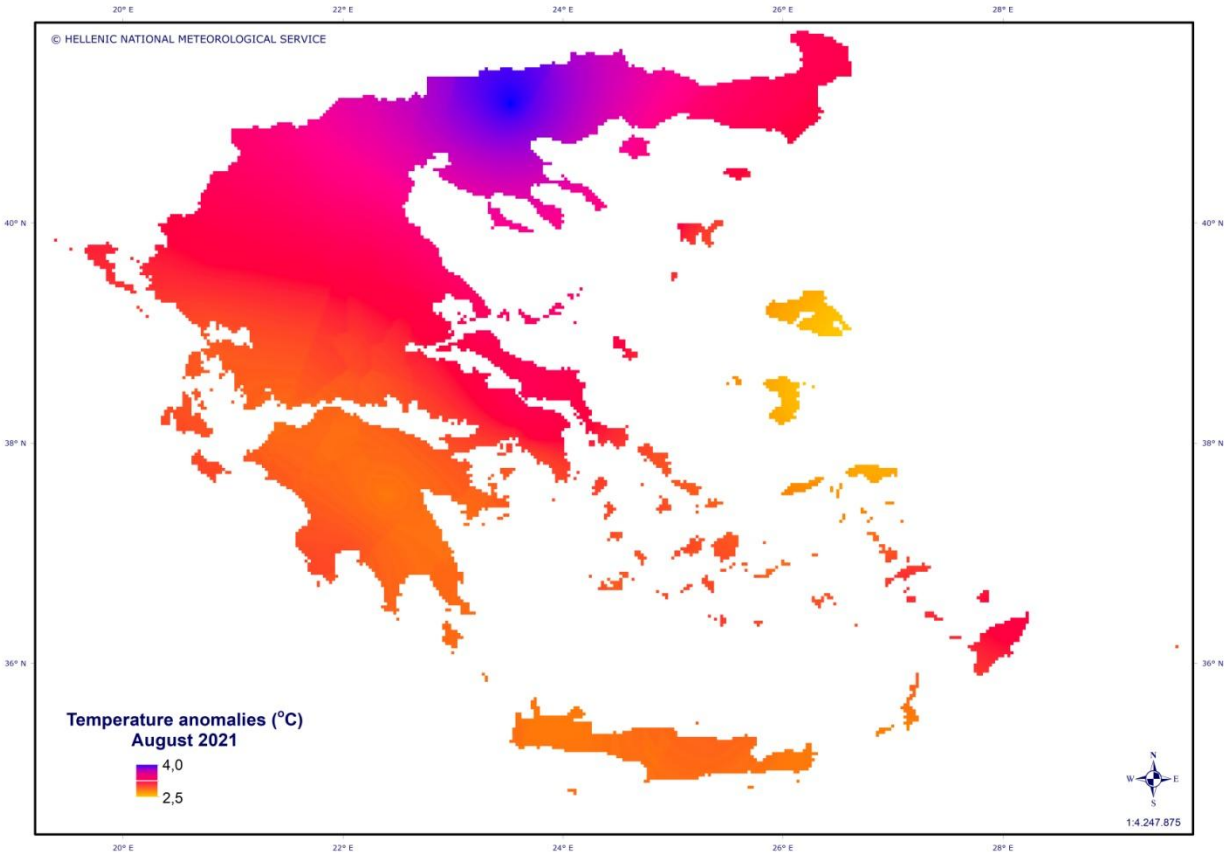


Figure 29. *August 2021's mean temperature anomalies (°C) in Greece according to the 1971-2000 climatology.*

3.9 September

In September 2021 slightly warmer than average conditions prevailed across Greece. Mean temperatures were 1.0-1.5 ^{o}C above normal values across south Aegean islands and Crete (Figure 30). In terms of precipitation, the overall monthly pattern indicates precipitation deficit across many regions, however in some instances (Sporades and Dodecanese islands, west Crete and locally in central mainland) precipitation was above normal values (Figure 31).

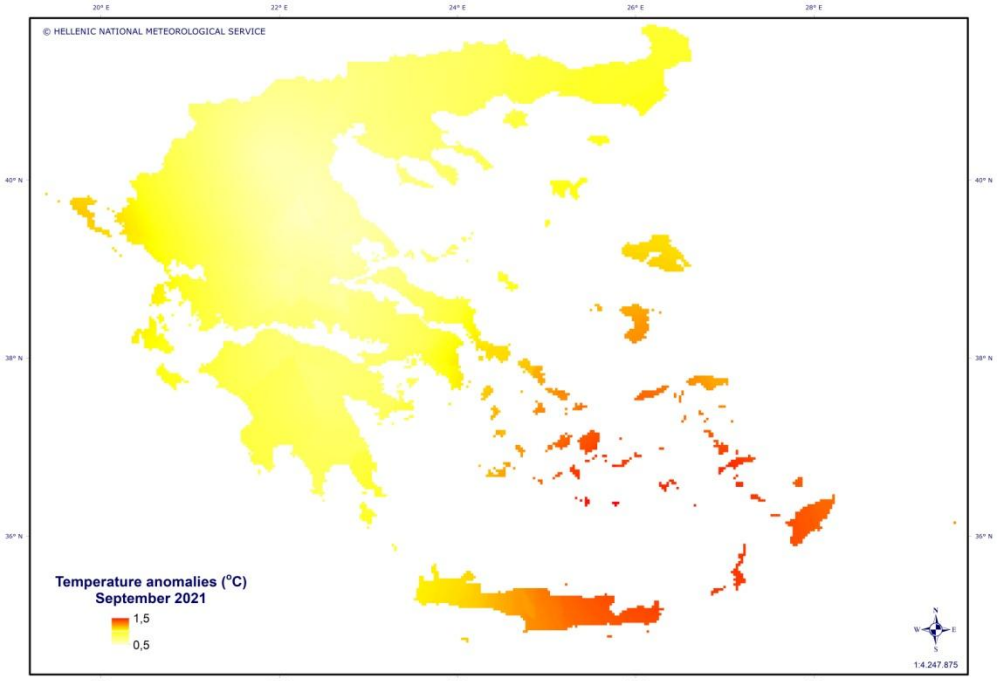


Figure 30. *September 2021's mean temperature anomalies (°C) in Greece according to the 1971-2000 climatology.*

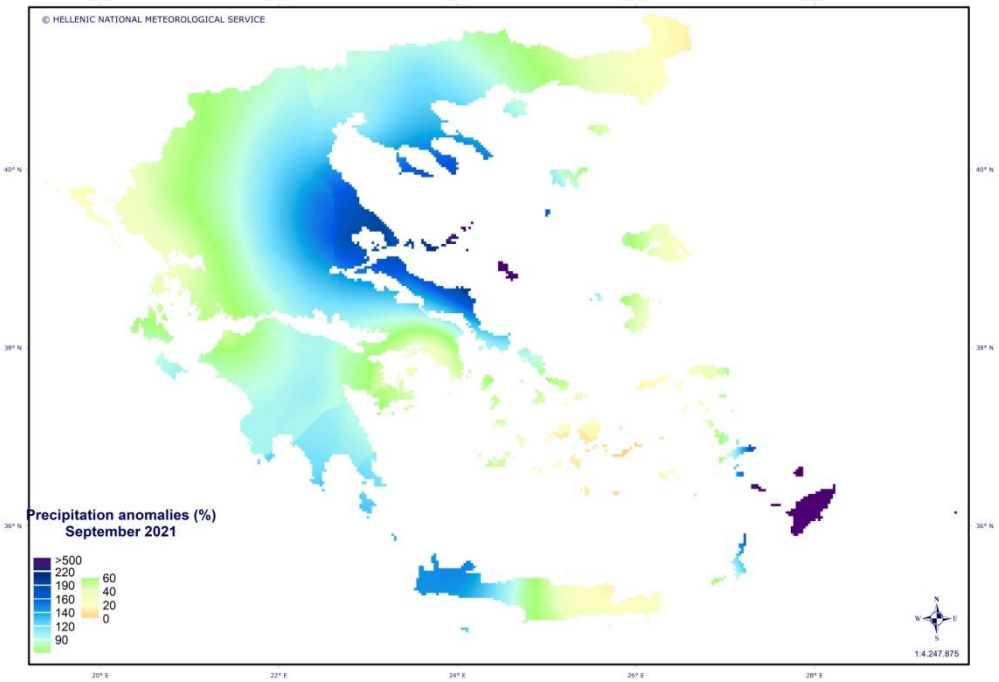


Figure 31. *September 2021's precipitation anomalies in Greece (compared to 1971-2000 climatology) given in percentages (%).*

3.10 October

October 2021 was wetter than normal across most of Greece. Two severe weather systems brought heavy rains and thunderstorms, particularly in the Ionian Islands and north and central areas where precipitation heights accounted for more than 250 % of normal values (Figure 32).

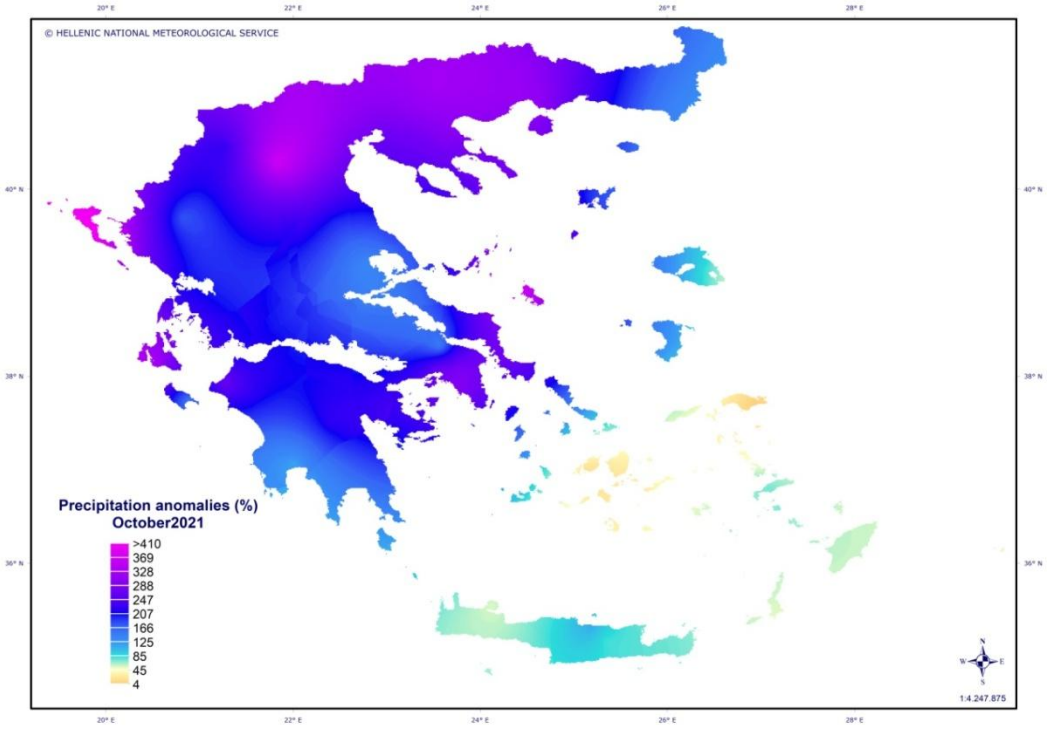


Figure 32. *October 2021's precipitation anomalies in Greece (compared to 1971-2000 climatology) given in percentages (%).*

Remark: Kerkyra station in the Ionian Sea experienced its wettest October since 1901, reporting 563 mm which is 4.4 times above the average 1981-2010 October precipitation height (Figure 33).

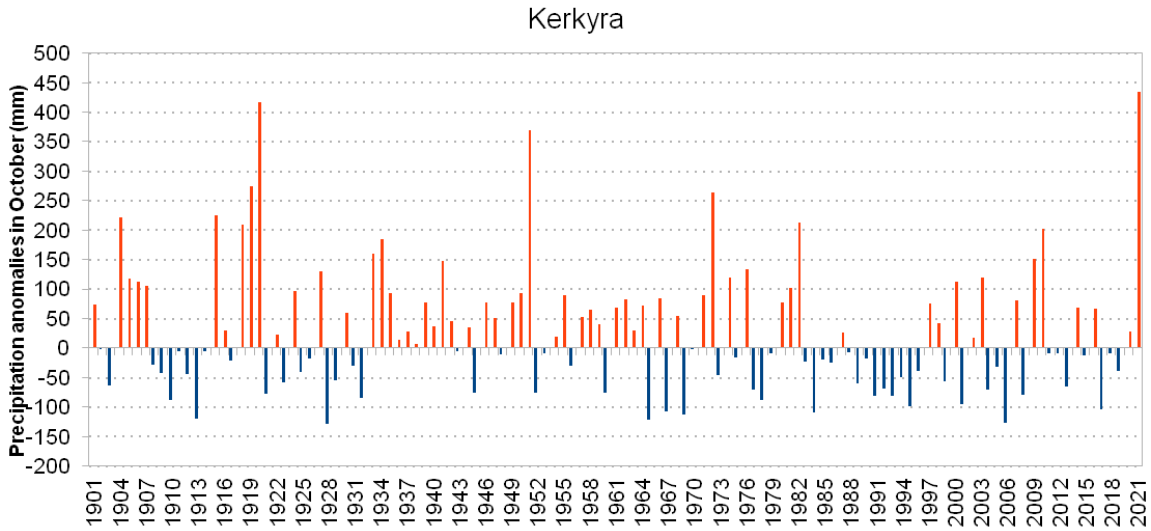


Figure 31. *Precipitation anomalies in October (mm)- Departures from 1981-2010 normal values; blue bars show precipitation values which are below the 1981-2010 average and red bars above this mean value.*

Colder than average was October 2021; the largest negative temperature anomalies of below -1.5°C occurred across north and central mainland (Figure 34).

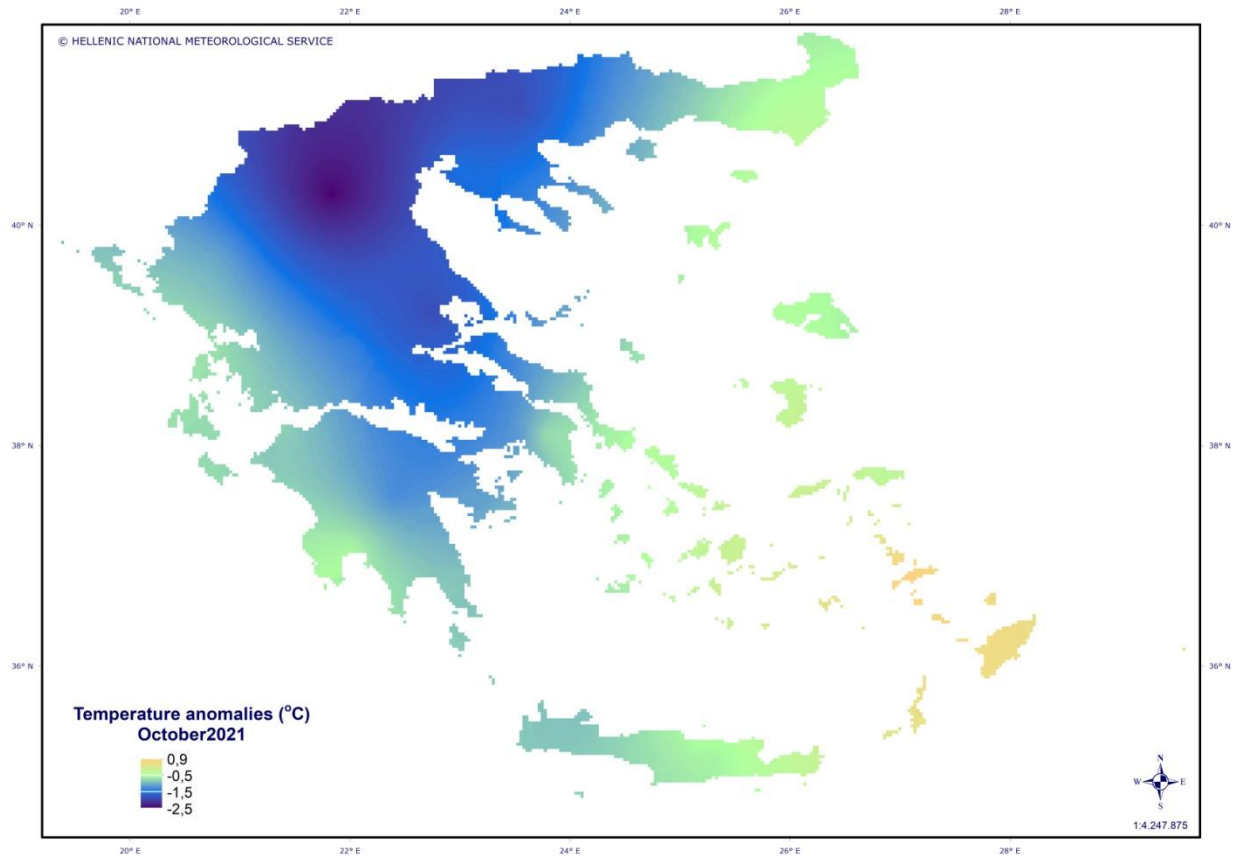


Figure 34. *October 2021's mean temperature anomalies (°C) in Greece according to the 1971-2000 climatology.*

3.11 November

November 2021, was warmer than average in the whole country. Temperatures reached 3°C above 1971-2000 average over Kerkyra and Rhodes islands (Figure 35). In November 2021, wetter-than-average conditions established in Ionian islands as well as in few places of mainland, where several floods occurred and total precipitation accounted for more than 150 % of the 1971-2000 average. In the rest of the country, it was drier than average, particularly in the south and southeast regions (Figure 36).

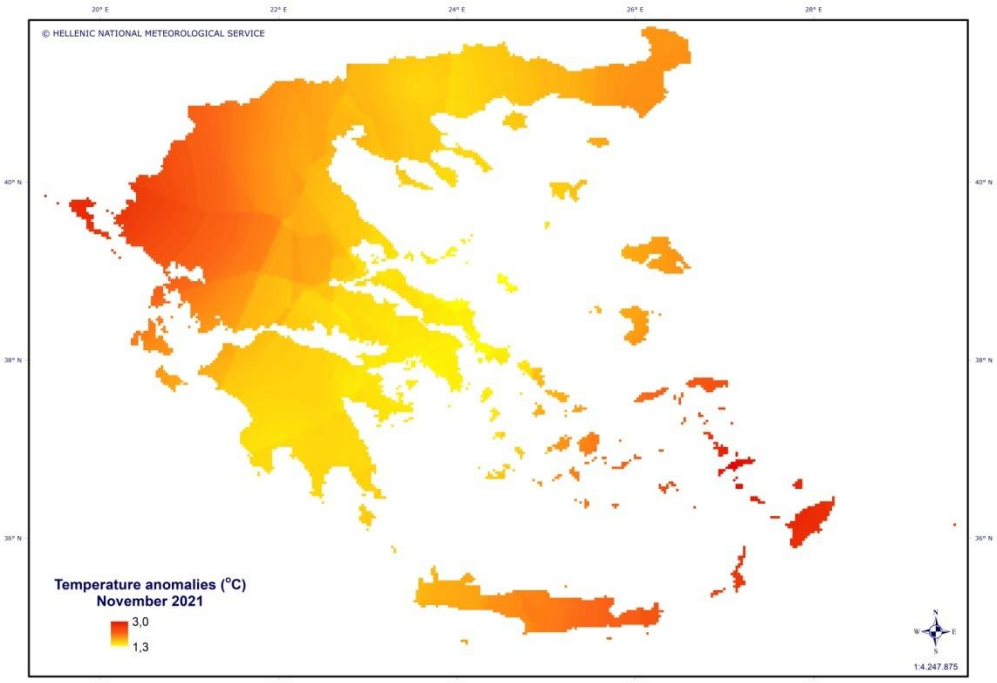


Figure 35. *November 2021's mean temperature anomalies (°C) in Greece according to the 1971-2000 climatology.*

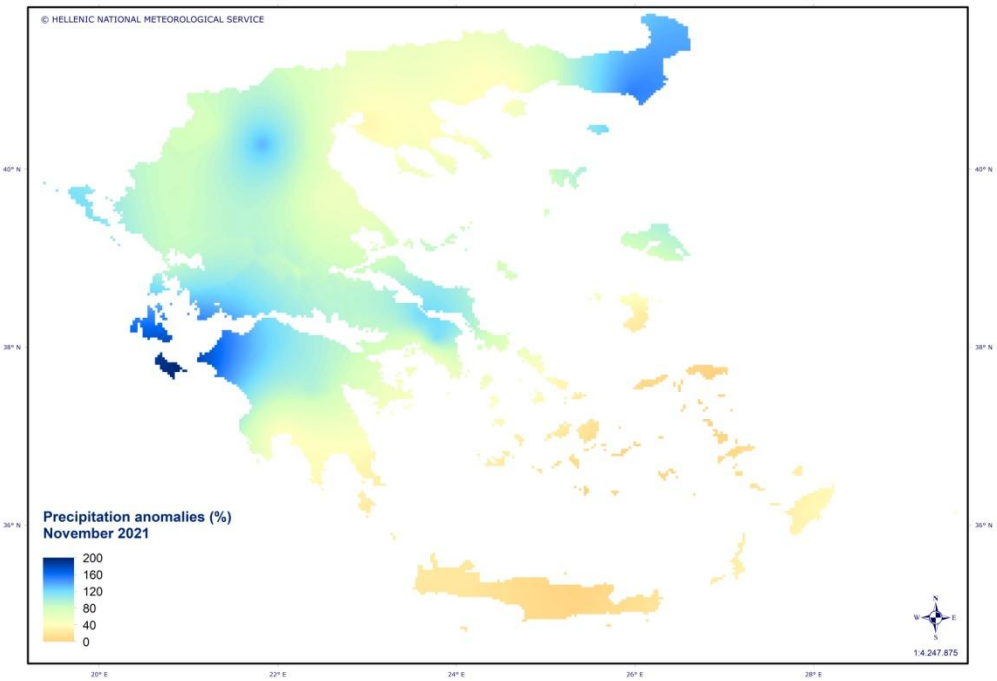


Figure 36. *November 2021's precipitation anomalies in Greece (compared to 1971-2000 climatology) given in percentages (%).*

3.12 December

In December 2021, mean temperatures were near to normal values and only across north Greece the anomalies were of at least 1.0 °C above 1971-2000 average (Figure 37). In terms of precipitation, it was wetter than 1971-2000 average over most of Greece. The greatest anomalies of at least 1.5 times the normal values are found over north and west Greece, Crete and few east Aegean islands. In contrast, drier than average conditions established in some regions: parts of east-southeast mainland (Figure 38).

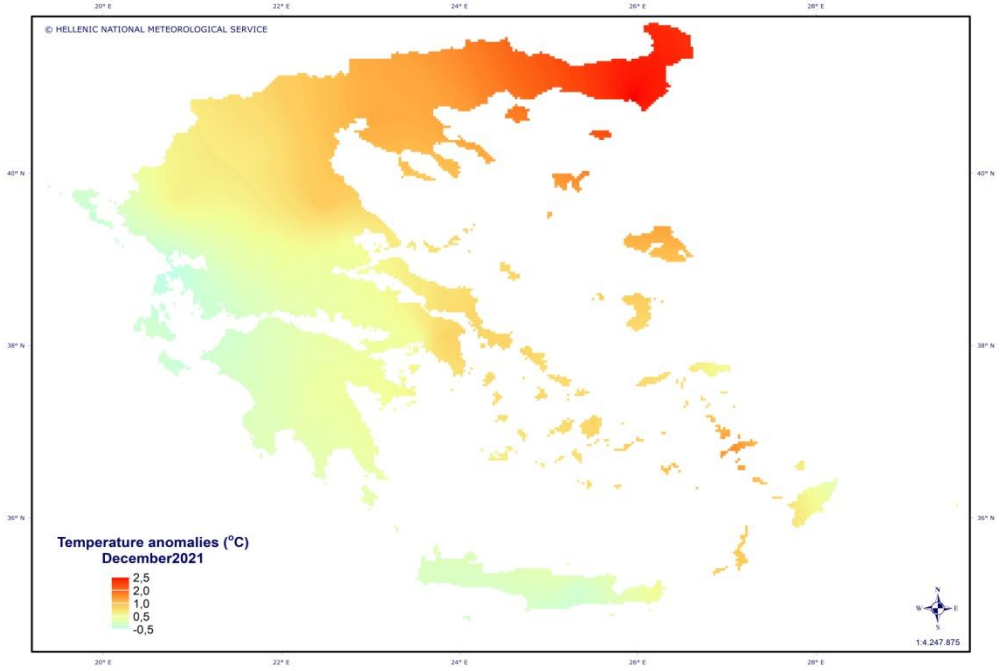


Figure 37. *December 2021's mean temperature anomalies (°C) in Greece according to the 1971-2000 climatology.*

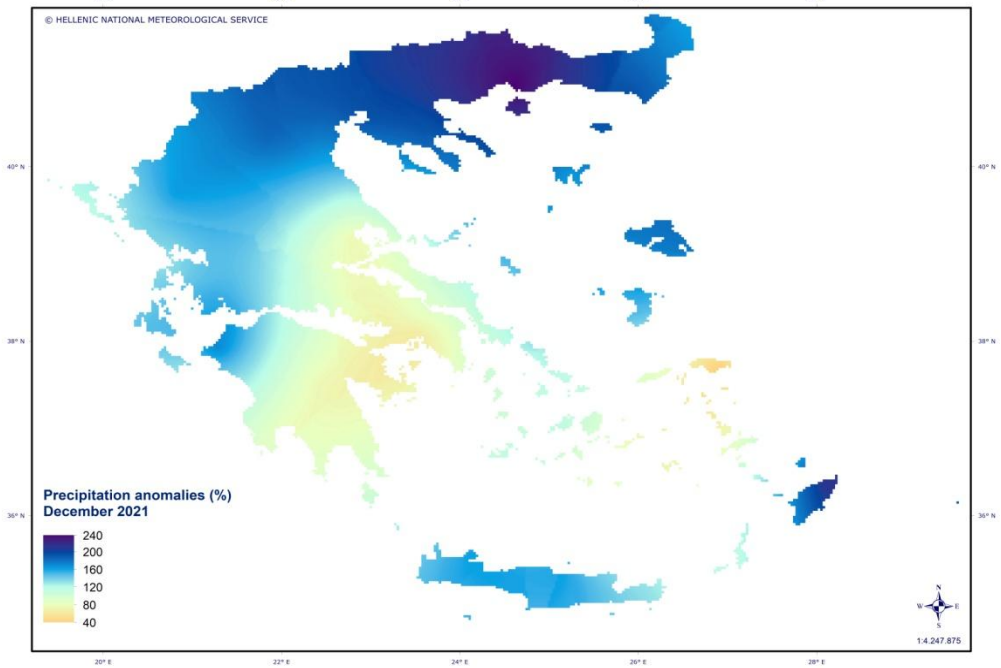


Figure 38. *December 2021's precipitation anomalies in Greece (compared to 1971-2000 climatology) given in percentages (%).*