

**National Climate Bulletin and the assessment of the SEECOF-25
Climate state outlook for the 2021 summer season**

DIVISION of CLIMATOLOGY – APPLICATIONS
HELLENIC NATIONAL METEOROLOGICAL SERVICE

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Part A

1. Temperature

1.1. Analysis of the 2021 summer air temperatures anomalies for Greece

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 1).

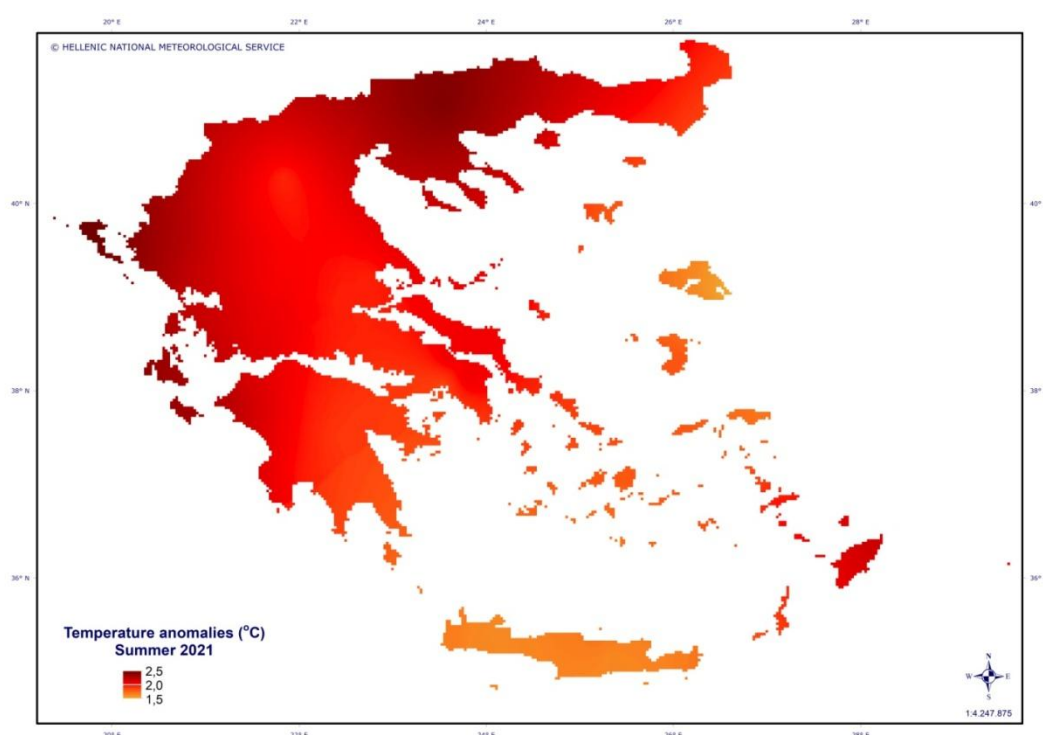


Figure 1. Mean temperature anomalies (°C) for summer 2021 in Greece according to the 1971-2000 climatology.

The summer average mean temperature anomalies in Greece from 1960 to 2021 are given in Figure 2. It is noticeable that the summer mean temperature remained relative low before 1992 and then started to rise and reached a local peak in 2012, which was the warmest summer on record. Summer of 2021 and 2007 were the second warmest summers on record. In summer 2003 the average mean temperature anomaly exceeded 1.5°C for the first time over the last 62 years; eight times the mean temperature anomaly reached or exceeded 1.5 °C since then.

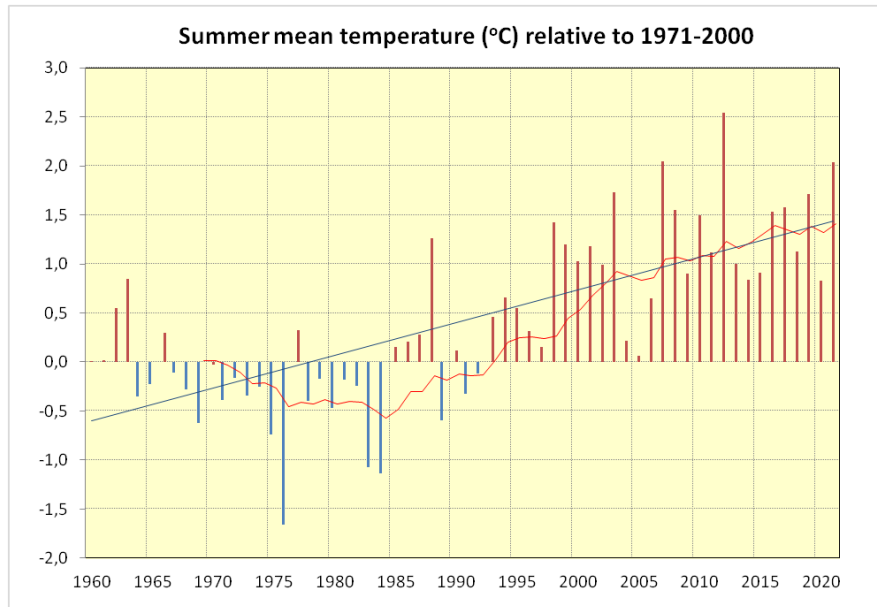


Figure 2. Summer 2021 (June through August) averages of mean surface air temperature anomalies for Greece (taking into account 31 stations) relative to 1971-2000. The red line indicates the ten-year moving average, and the blue line indicates the long-term linear trend.

In order to quantify the observed seasonal temperatures in terms of cold, warm and normal, we have used the percentile method. The percentiles were calculated for each station and are based on homogenized mean temperature series for the period 1971-2000. According to percentile ranks (Figure 3) **extremely warm** conditions prevailed over Greece (93.3 % of the examined stations) during summer 2021.

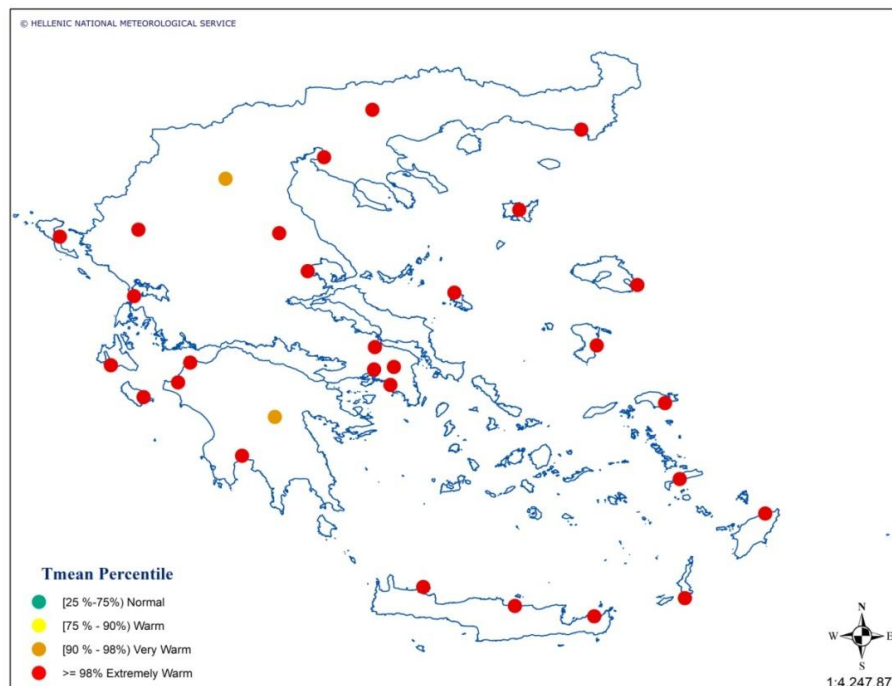


Figure 3. Mean temperature percentiles for summer 2021 (based period 1971-2000).

1.2. Verification of the SEECOF-25 summer 2021 temperature outlook for Greece

The seasonal forecast for summer 2021 (issued in Spring 2021) had suggested that the mean temperature would be above normal in mainland areas with the greatest temperature anomaly (above 2 °C) occurring in the north northeast and central Greece (Figure 4). Verifying the seasonal forecast for summer (although this is relative to the 1981-2010 normal values): The seasonal forecast was successful for most parts of the country.

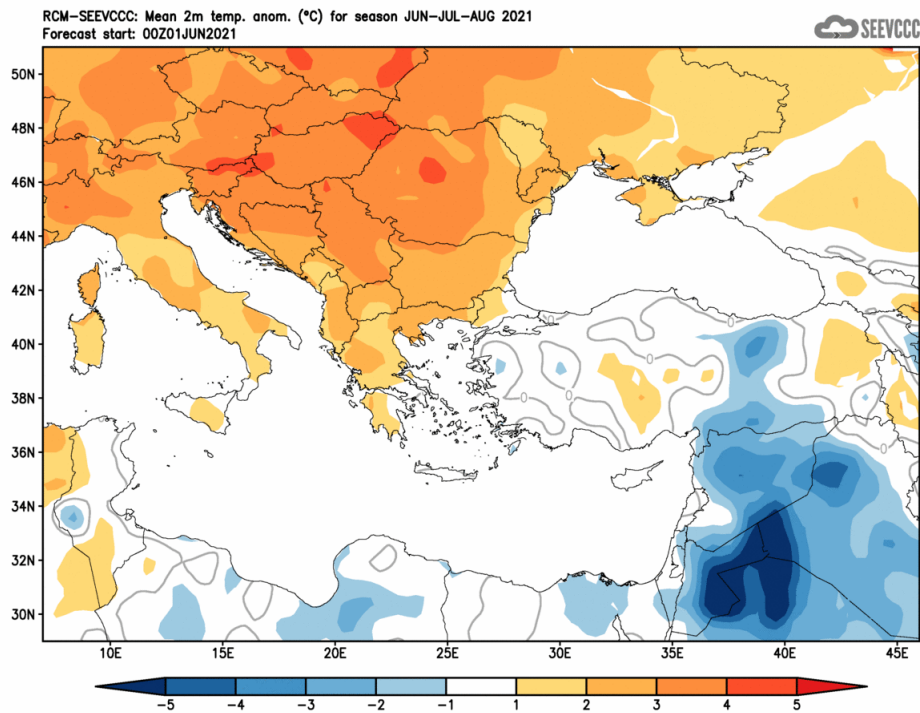


Figure 4. Outlook mean temperature anomaly (relative to 1981-2010) for summer 2021.

The consensus outlook statement of SEECOF-25 for summer 2021 mentioned that the whole area of Greece was likely to experience above average summer temperatures relative to the period 1981-2010 (zone 1: 20% below normal, 30% around normal, 50% above normal) (Figure 5).

Verifying the seasonal forecast for summer (although this is relative to the 1981-2010 normal values): the prediction was successful, because the summer mean temperatures varied above normal across the country.

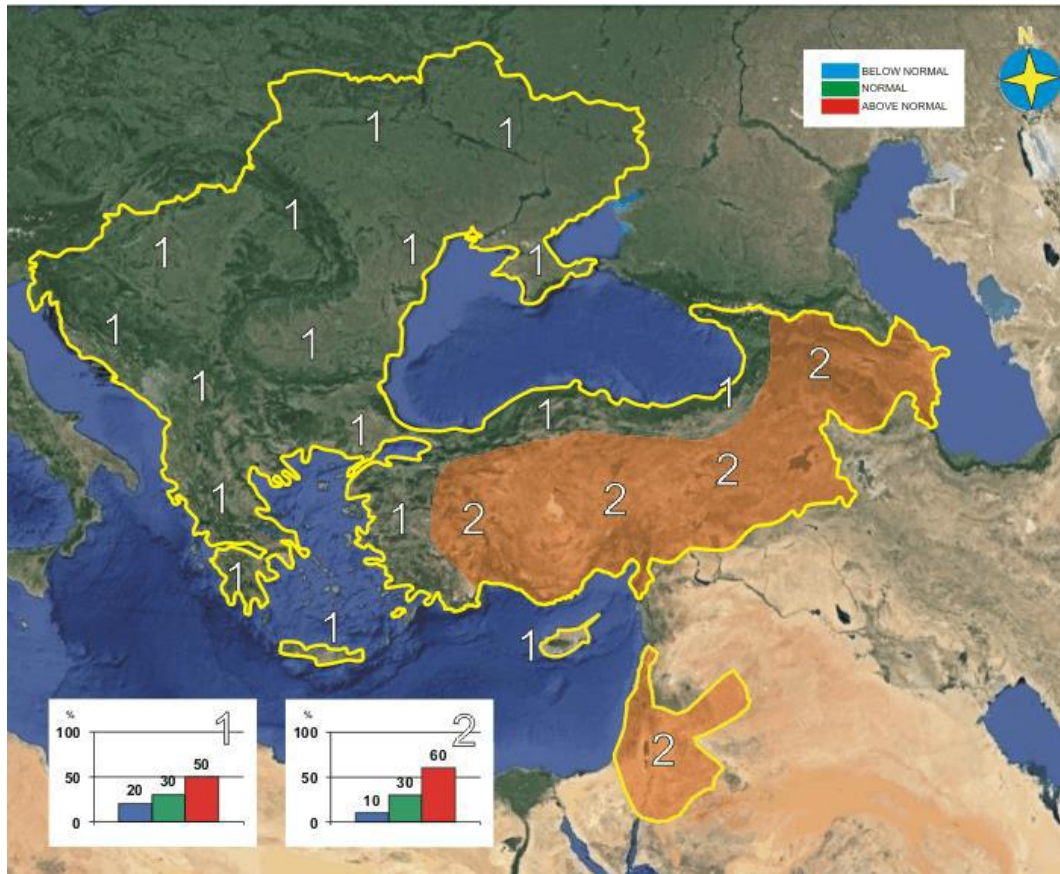


Figure 5. SEECOF-25 graphical presentation of the 2021 summer temperature outlook.

Part B

2. Precipitation

2.1. Analysis of the 2021 summer precipitation anomalies in Greece

The analysis of seasonal precipitation amounts throughout Greece is based on data from 30 meteorological stations distributed evenly in the country.

Total precipitation amounts across island areas this summer were typically less than 10 mm for much of this region. Near to normal or dryer than normal conditions prevailed in mainland. However, wetter than normal conditions with locally higher amounts of up to 80mm were observed, especially in the areas of Thrace, Thessaly and east Peloponnese. Total precipitation in these areas accounted for more than 170 % of normal values according to 1971-2000 (Figure 6).

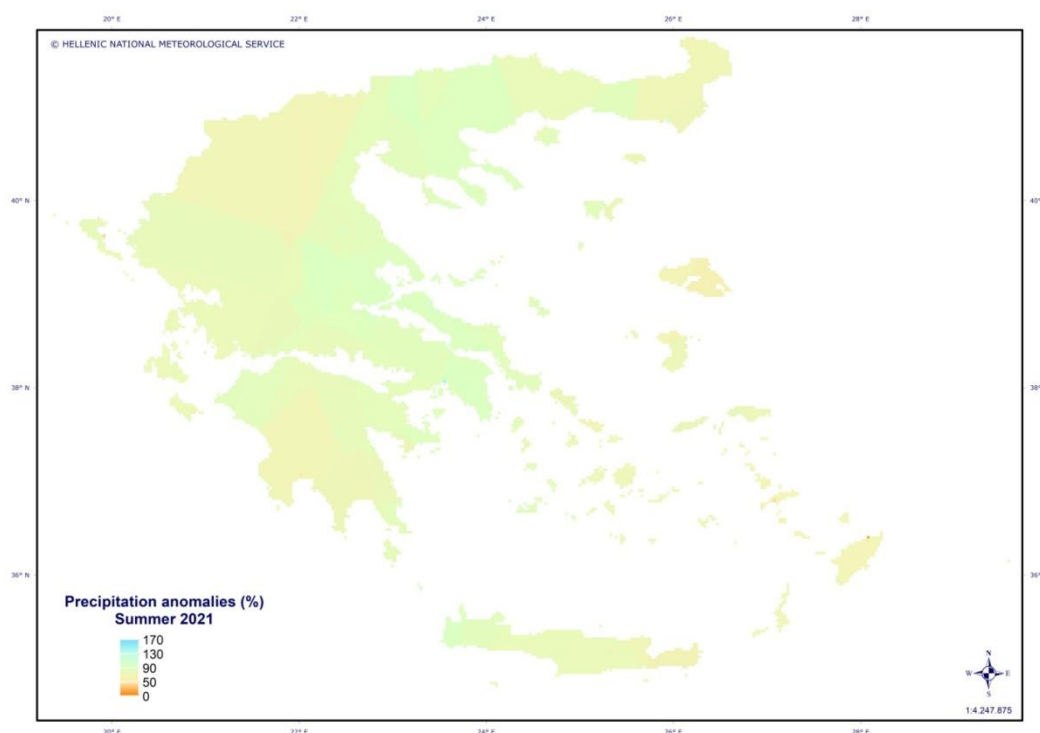


Figure 6. Outlook summer 2021 precipitation anomalies (relative to 1971-2000) given in percentages.

In order to quantify the observed precipitation height in terms of wet, dry and normal we have used the percentile method. The percentiles were calculated for each station and are based on homogenized precipitation series for the period 1971-2000.

According to percentile ranks (Figure 7) precipitation amounts for summer 2021 have been described by the following categories:

- Normal conditions prevailed in 19 stations (63.3 % of the examined stations).

- Wet to very wet conditions 6 stations (20 % of the examined stations).
- Dry to very dry conditions 5 stations (16.7 % of the examined stations).

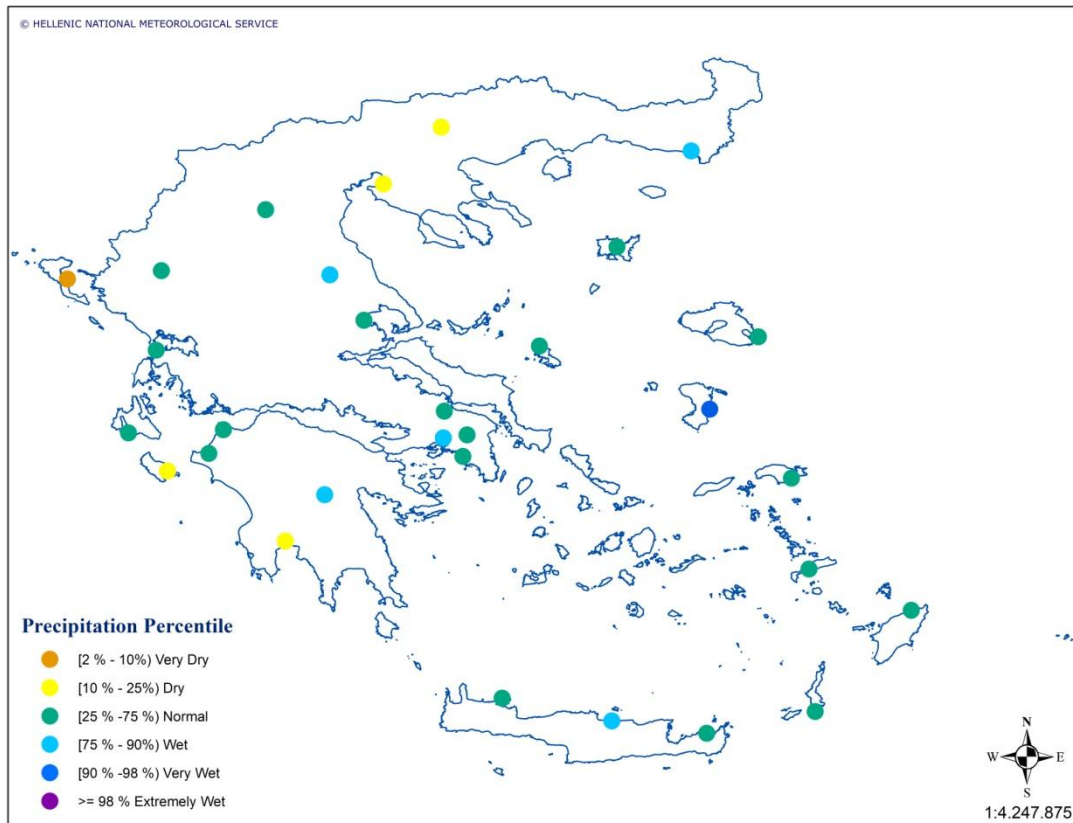


Figure 7. Precipitation percentiles for summer 2021 (based period 1971-2000).

2.2. Verification of the SEECOF-25 summer 2021 precipitation outlook for Greece

The seasonal outlook forecast (issued in Spring) for summer 2021 precipitation had predicted a dry summer for most parts of the country, with accumulated precipitation below normal values, except of a small area in the central Macedonia where the precipitation was ranged above normal values (Figure 8).

Verifying the seasonal forecast for summer (although this is relative to the 1981-2010 normal values): in general, the seasonal forecast was successful only for few parts of the country (e.g Ionian islands).

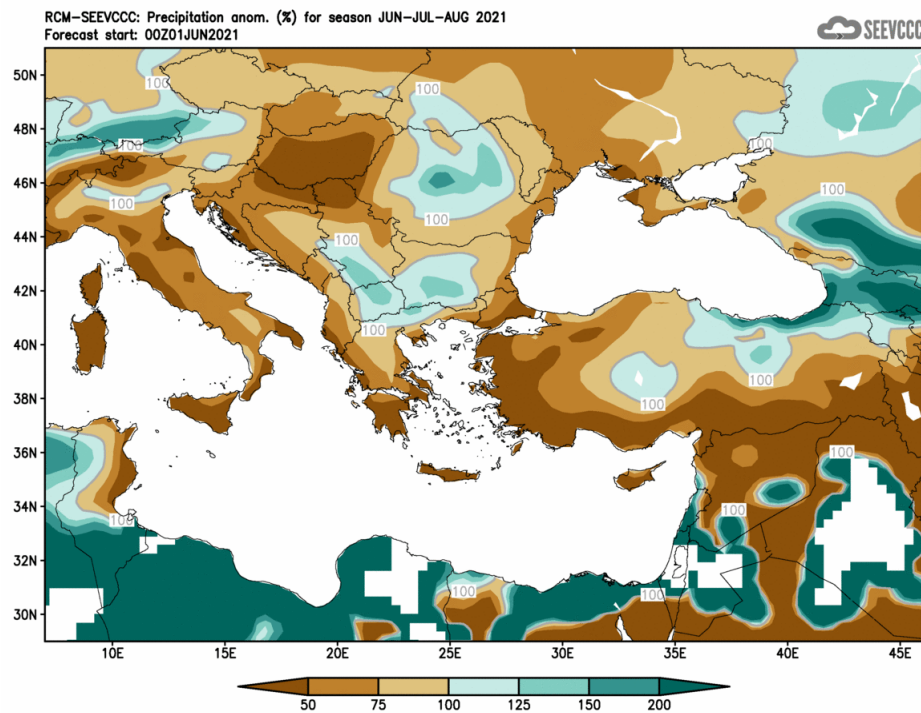


Figure 8. Outlook precipitation anomaly (relative to 1981-2010) for summer 2021.

According to SEECOF-25, there was high uncertainty regarding the summer precipitation sums in Greece, where probabilities for below-, near- or above-average conditions were approximately equal (zone 2: 33% below normal, 34% around normal, 33% above normal, in Figure 9). It should be noted that it was not possible to forecast summer precipitation totals for Crete.

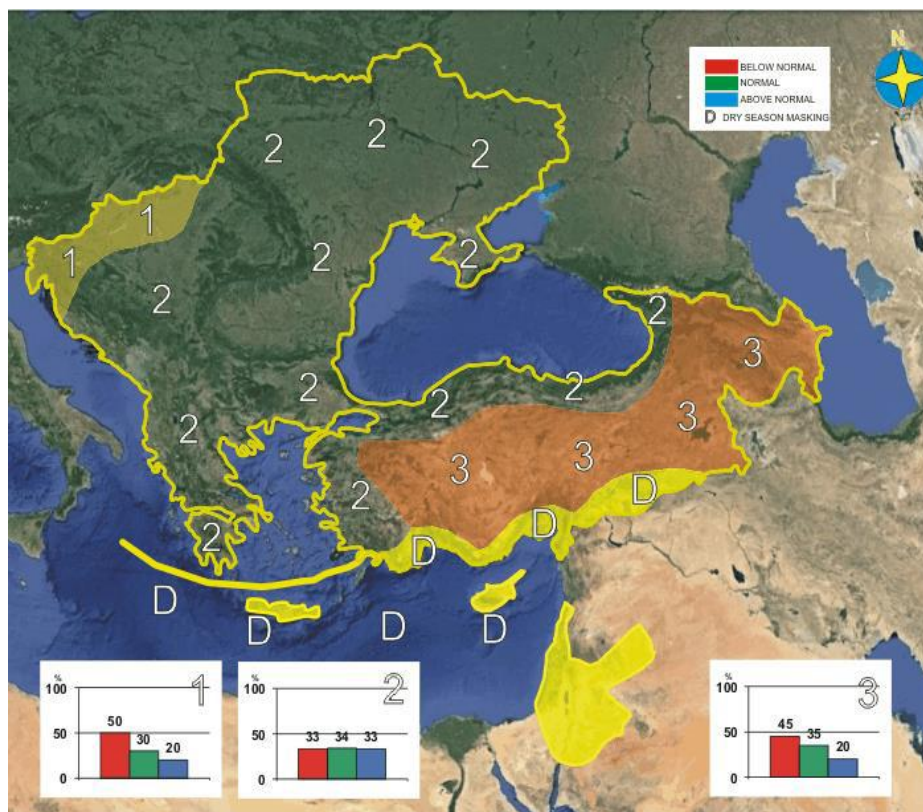


Figure 9. SEECOF-25 Graphical presentation of the 2021 summer precipitation outlook.

Table 1. Seasonal air temperature and precipitation sums - Ranks

Summer 2021		Seasonal air temperature (°C)					Seasonal precipitation sums (mm)			
Station	Rank*	33	50	66	Observed value	Rank**	33	50	66	Observed Value
Thessaloniki	1	25.4	25.8	26.1	28.0	27	54.2	64.3	84.7	32
Helliniko	1	26.6	26.8	27.3	29.0	22	7.6	16.6	21.9	6
Souda	1	25.5	25.7	26.0	27.4	10	0.1	1.4	3.4	3.6
Argostoli	1	24.7	25.1	25.4	27.5	22	11.9	15.3	24.5	10

*Rank: period 1971-2000 (warmest season)

**Rank: period 1971-2000 (highest seasonal precipitation)

Table 2. Verification of the SEECOF-25 Climate Outlook in Greece for Summer 2021.

Country	Seasonal temperature		Seasonal precipitation		High Impact Events
	Observed	SEECOF-25 climate outlook for temperature	Observed	SEECOF-25 climate outlook for precipitation	
Greece	Above normal (relative to the period 1971-2000) for the whole area of the country.	Above normal for the whole area of Greece.	Wetter than normal values (1971-2000) in the areas of Thrace, Thessaly, east Peloponnese and areas in the central and eastern Crete, where total precipitation in these areas accounted for more than 170 % of normal values (1971-2000). Drier than normal values in the rest of the country.	Probabilities for below-, near- or above-average conditions are approximately equal (zone 2: 33% below normal, 34% around normal, 33% above normal).	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 °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 °C for 8-11 consecutive days (e.g Argos and Serres station 11 and 10 consecutive days

					respectively; Larisa, Hellinikon, Astros and Tithorea stations 8 consecutive days). The highest daily maximum temperature were observed mainly during the period 1-5/8/2021, where several stations of Greek mainland recorded daily maximum temperature $\geq 45^{\circ}\text{C}$ (e.g on 03.08.2021 Argos station located in east Peloponnese recorded maximum temperature 46.3°C). Also the minimum temperature values in many stations reached and exceeded 29°C. Moreover the automatic weather station Kythira recorded the highest daily minimum temperature 34.7°C on 04.08.2021. Due to the heat wave conditions, a number of wildfires spread across the country that had to battle devastating blazes for nearly two weeks. The largest and most destructive fires were raged in the island of Evia (50887,6 ha burnt area according to Copernicus - https://emergency.copernicus.eu/mapping/list-of-components/EMSR527), in Attiki (north of Athens) and the southern Peloponnese region, 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) 128300 ha were burnt in year 2021 up today, i.e 613 % above the average burnt area of 2008-2020.
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