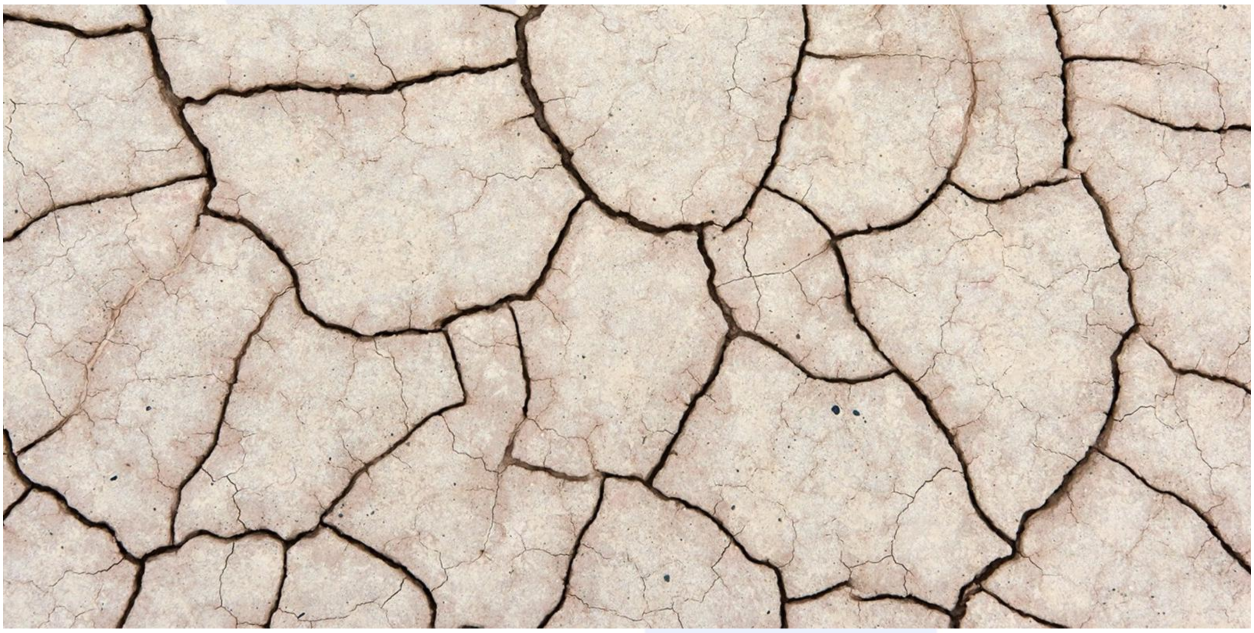
Joint Research Centre

Drought in South-Eastern Europe October 2025

GDO Analytical Report

Toreti, A., Bavera, D., Acosta Navarro, J., Barbosa, P., De Jager, A., Ben Aoun, W., Biavetti, I., Bussay, A., Claverie, M., Ficchi, A., Fioravanti, G., Grimaldi, S., Hrast Essenfelder, A., Kerdiles, H., Magni, D., Maianti, P., Mazzeschi, M., Mccormick, N., Niemeyer, S., Rembold, F., Salamon, P., Santos Nunes, S., Sedano, F., Seguini, L., Thiemig, V., Volpi, D.

2025



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Contents

Drought in South-Eastern Europe - October 2025

JRC Global Drought Observatory (GDO) of the Copernicus Emergency Management Service (CEMS) – GDO/EDO data up to 30/09/2025

Abstract

- Drought conditions have affected large parts of south-eastern Europe, the eastern Mediterranean, and the Black Sea since early 2025, with a partial and temporary recovery in late spring and another worsening in early summer, with concern for the coming months.
- Above-average temperatures in January 2025, coinciding with the beginning of rainfall deficits, sped up the onset of the drought, leading to dry soil moisture anomaly in the region.
- The Low-Flow Index (LFI) increased progressively from December 2024 to August 2025, affecting central and eastern Europe, Türkiye, and the Middle East.
- Impacts on vegetation were limited in spring when the warmer temperatures accelerated and anticipated vegetation grow, while in early summer adverse vegetation conditions emerged, peaking in July 2025, and continued into the autumn.
- The statistics on wildfires mirror the impacts of the aforementioned conditions on vegetation. Most of the countries in the area of interest recorded values of burnt area above the previous 18-year average.
- Seasonal forecasts point to a warmer-than-usual and severely dryer-than-usual 2025 autumn.
- The drought affected water resources and already caused significant yield losses of summer crops in Hungary, Romania, Bulgaria, Greece, Ukraine, and Türkiye, particularly for grain maize and sunflower.

Drought in South-Eastern Europe - October 2025

JRC Global Drought Observatory (GDO) of the Copernicus Emergency Management Service (CEMS) – GDO/EDO data up to 30/09/2025

1. Introduction

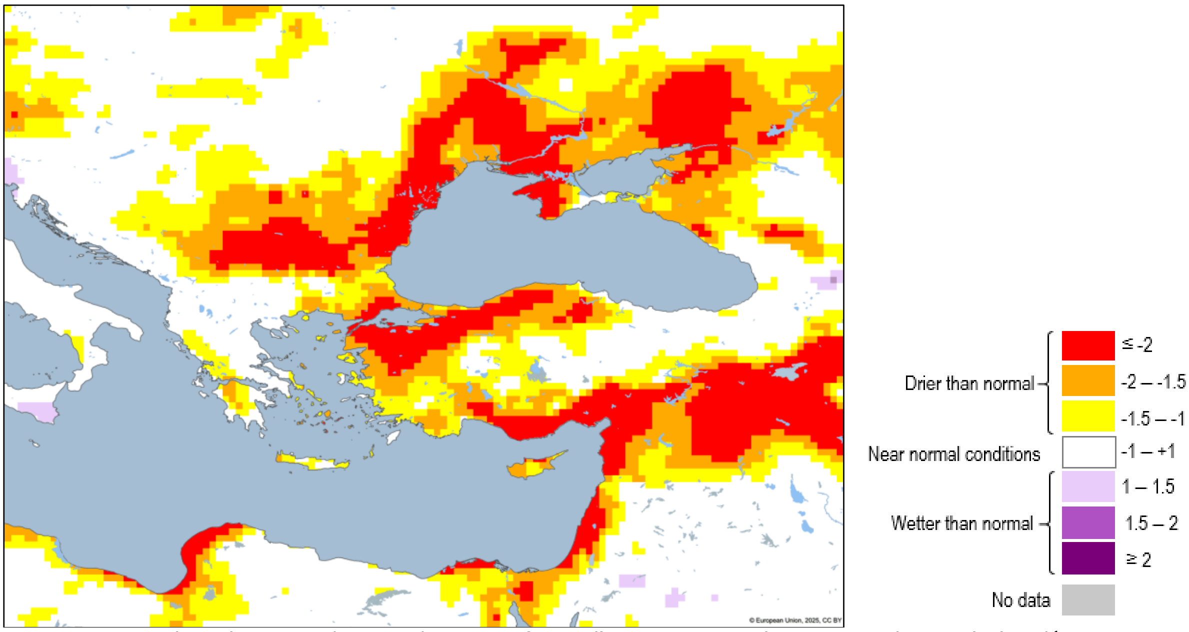
This study is part of the collection GDO analytical reports focused on the analysis of drought events affecting Europe as well as the other regions of the world.

These studies build on data and information retrieved and processed by the European and Global Drought Observatories (EDO and GDO) of the Copernicus Emergency Management Service (CEMS). The Observatories aim at detecting, monitoring, and predicting droughts by using a suite of indices and indicators characterising different aspects and phases of a drought. The information is usually complemented with additional sections on impacts, large-scale circulation, and other relevant factors.

2. Standardized Precipitation Index (SPI)[1]

Negative precipitation anomalies have been affecting many parts of south-eastern Europe, the eastern Mediterranean and the Black Sea. The SPI-9 (i.e. SPI for an accumulation period of 9 months)[2] shows dry conditions in most of the Balkans, south-eastern Ukraine, northern and south-eastern Türkiye, north-western Syria, and the eastern Mediterranean (Fig. 1).

Figure 1: Standardized Precipitation Index SPI-9 for the 9-month accumulation period ending on 30 September 2025[2].



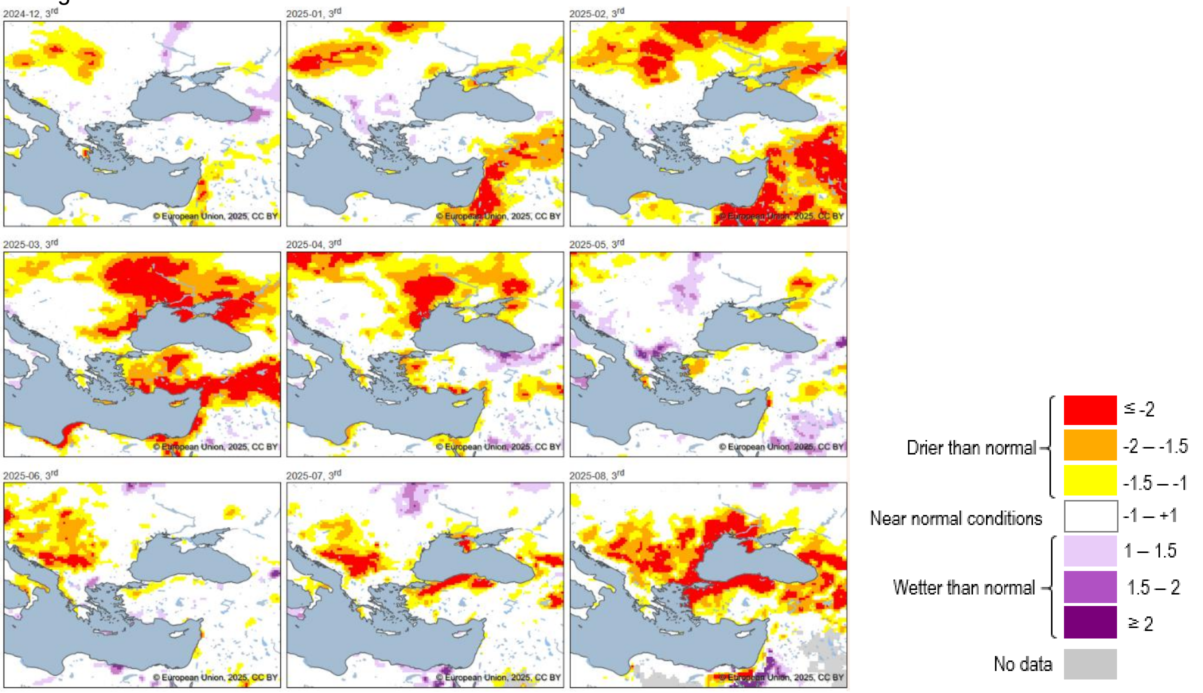
Data source: JRC based on ERA5 (ECMWF (European for Medium-Range Weather Forecasts) Reanalysis v5)[1].

Different phases of meteorological drought conditions occurred during the period from December 2024 to August 2025 (Fig. 2). After the onset in early winter, two different drought events in the northern Balkans and in the eastern Mediterranean rapidly increased and almost merged in early spring. From April 2025 to late May 2025, the SPI recovered to close-to-normal values. In summer, dry conditions appeared again, initially in the Balkans and then expanded and worsened over most of the Black Sea region, the Balkans and parts of the eastern Mediterranean.

[1] The data source for SPI is ERA5 (ECMWF Reanalysis v5): https://www.ecmwf.int/en/forecasts/dataset/ecmwf-reanalysis-v5

[2] For more details on the SPI, and the other GDO and EDO indicators of drought-related information used in this report, see the Appendix at the end of the document.

Figure 2: Standardized Precipitation Index SPI-3 for the 3-month accumulation period from December 2024 to August 2025[2].

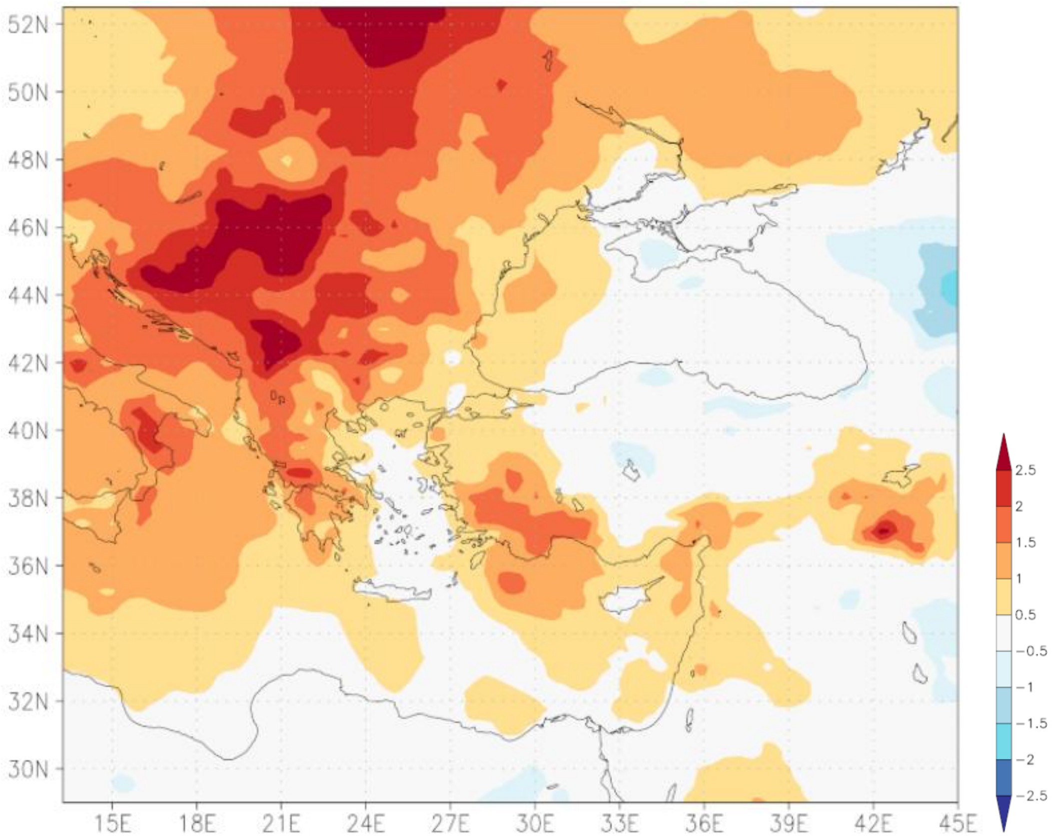


Data source: JRC based on ERA5[1].

3. Temperature

In September 2025, most of south-eastern Europe experienced warmer-than–average temperatures (baseline 1991-2020), with anomalies exceeding 2.5 °C above the average over the Balkans and western Ukraine. (Fig. 3).

Figure 3: Average temperature anomaly (ERA5, ECMWF (European Centre for Medium-Range Weather Forecasts) Reanalysis v5) computed for September 2025. Baseline 1991-2020.

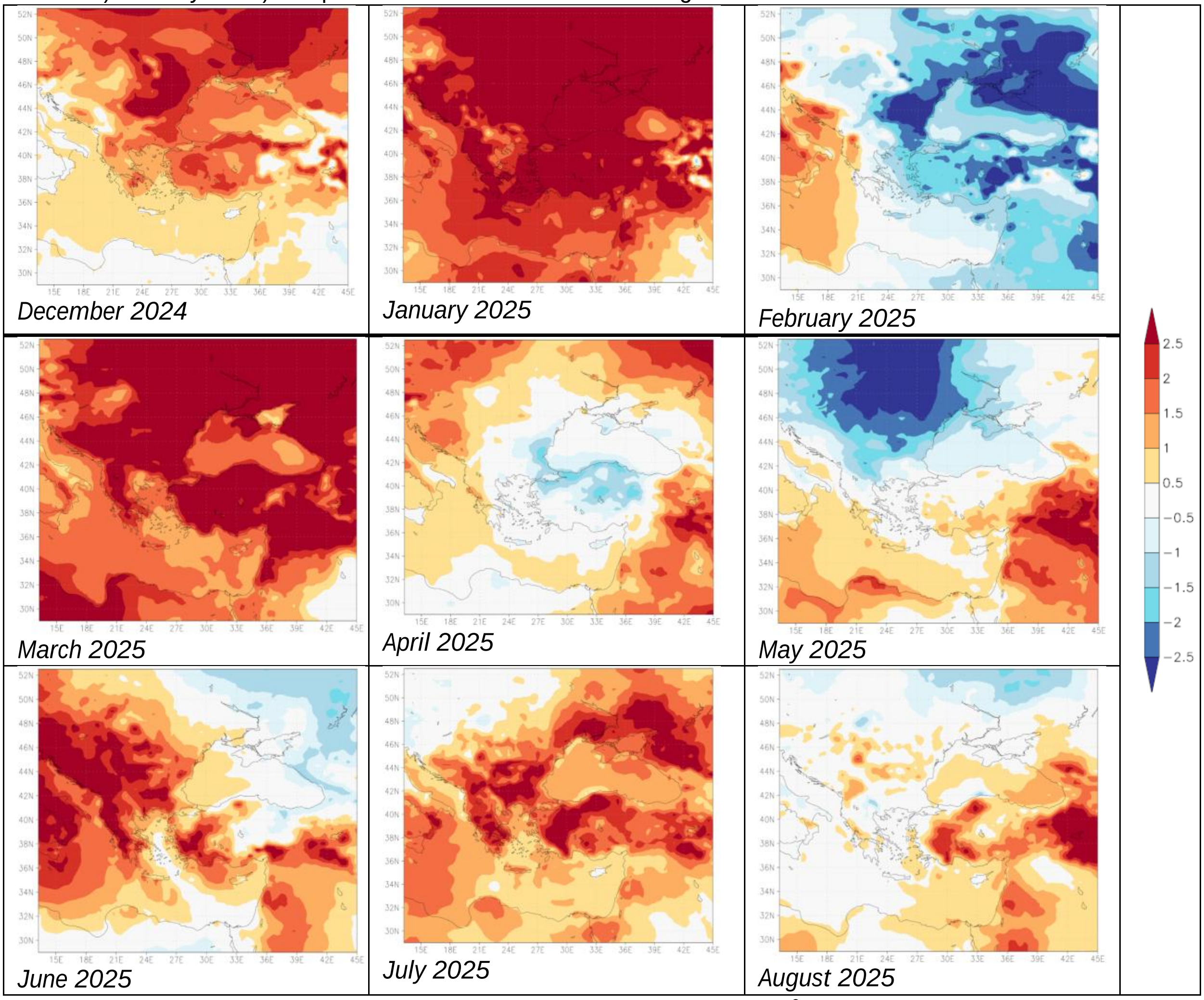


Source: The KNMI (Koninklijk Nederlands Meteorologisch Instituut) Climate Explorer.[3]

From December 2024 to August 2025, temperature has generally been well above average, with some exceptions mainly in February 2025 and May 2025. In winter, the highest anomalies were recorded in January with values above + 2.5 °C over large part of the region of interest. In early spring, similar conditions were observed, while summer featured similar extreme values of anomaly but more localized (Fig. 4). The warmest anomaly almost coincided with the peaks of the meteorological drought, exacerbating its severity.

[3] The KNMI Climate Explorer https://climexp.knmi.nl

Figure 4: Average temperature anomaly (ERA5, ECMWF (European Centre for Medium-Range Weather Forecasts) Reanalysis v5) computed from December 2024 to August 2025. Baseline 1991-2020.



Source: The KNMI (Koninklijk Nederlands Meteorologisch Instituut) Climate Explorer.[3]

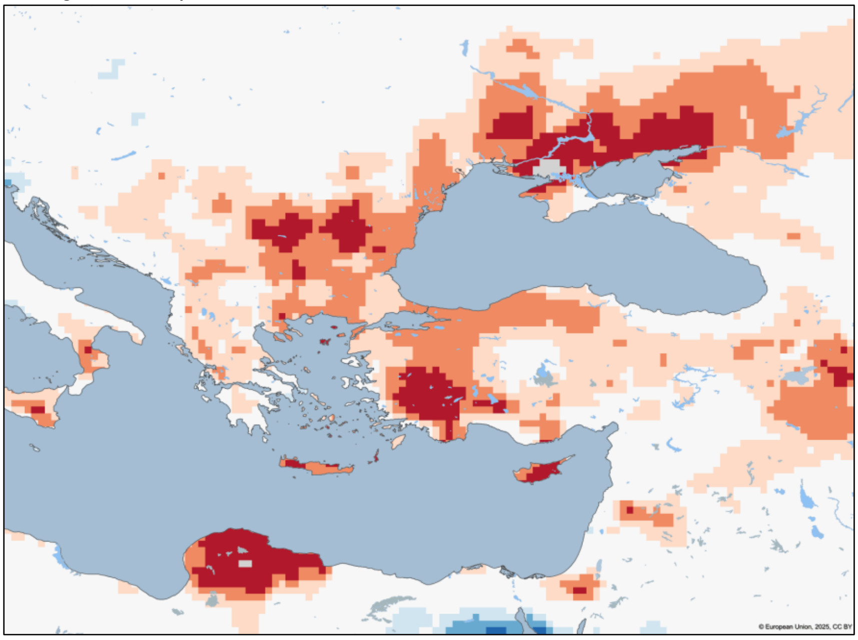
4. Standardized Precipitation Evapotranspiration Index (SPEI)[4]

SPEI combines precipitation and evapotranspiration information, thus providing a more comprehensive view on the combined effects of precipitation deficits and warmer-than-usual conditions.

As of late September 2025, SPEI data shows that the drought event is developing and worsening in the Black Sea region and the eastern Mediterranean, hitting severely the border between Romania and Bulgaria, western Türkiye, south-eastern Ukraine, and most of eastern Mediterranean islands. Close-to-average conditions are visible in Middle East. (Fig. 5).

[4] The data source for SPEI is ERA5

Figure 5: Standardized Precipitation Evapotranspiration Index SPEI-3 for the 3-month accumulation period ending on 30 September 2025.[5]

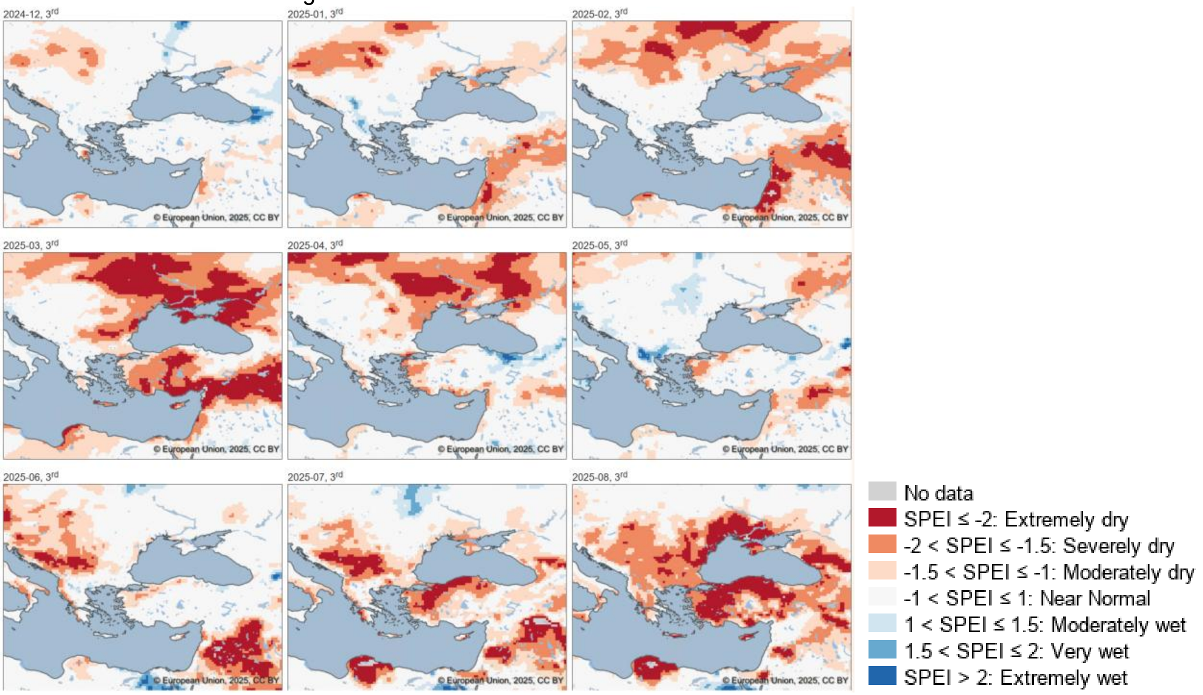


Data source: JRC based on ERA5.

The evolution in time of the SPEI-3 from December 2024 to August 2025 is shown in Figure 6. It reflects the SPI and the temperature analysis, and confirms the onset in the Balkans of a first severe drought event in early winter, its peak in early spring (hitting most of the region analyzed in this study), and the slow recovery in late spring, when some wetter-than-average signals appeared in eastern Europe, and eastern Türkiye. In summer, a second drought event developed and continuously worsened starting again from the Balkans and with a similar spatial and temporal evolution. The most affected regions are Ukraine, Türkiye, northern Syria, northern Iraq, the eastern Mediterranean, and Middle East. The similarity between the Standardized Precipitation Index (SPI) and the Standardized Precipitation Evapotranspiration Index (SPEI) suggests that the primary driver of this drought event was the precipitation deficit. However, warmer-than-average conditions contributed to exacerbating the drought.

[5] For more details on the SPEI, and the other GDO and EDO indicators of drought-related information used in this report, see the Appendix at the end of the document.

Figure 6: Standardized Precipitation Evapotranspiration Index SPEI-3 for the 3-month accumulation period from December 2024 to August 2025.[5]



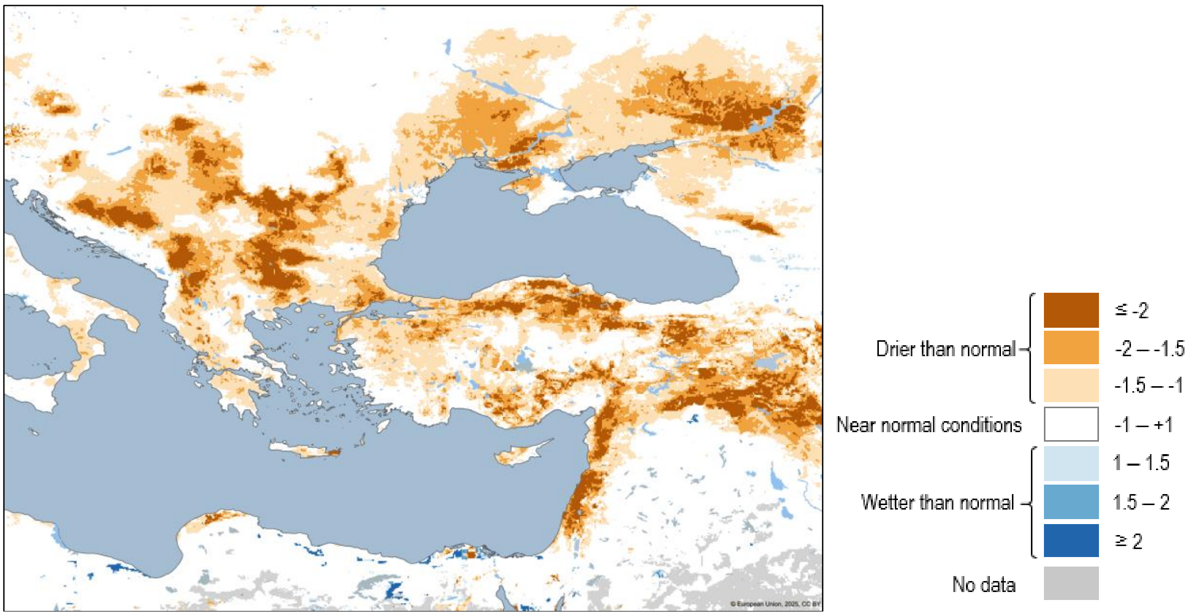
Data source: JRC based on ERA5.

5. Soil moisture

In late September 2025, soil moisture conditions have been drier-than-normal over the Balkans, the Black Sea, and the eastern Mediterranean (Fig. 7). These conditions are the result of a combination of extremely low precipitation and high temperatures in the previous months, particularly in late winter, early spring, and late summer 2025. The drier-than-normal soil moisture pattern is partially consistent with the precipitation deficit of the previous months (see Fig. 2) and of temperature anomalies driving the increased evapotranspiration (Figs. 3 and 4). In most of the cases, the regions with the strongest negative precipitation anomalies were also affected by positive temperature anomalies. These compound factors contributed to increase water loss from the soil due to stronger evapotranspiration potential.[6]

Concerning the evolution of soil moisture anomalies from December 2024 to August 2025 (Fig. 8), the initial phase is visible in Ukraine in early winter, together with the onset of the meteorological drought. Then drier-than-average conditions persisted in Ukraine, reaching a peak in mid-summer and slowly improving afterwards. The eastern Mediterranean had the same temporal evolution with less extreme and less severe conditions than the ones hitting Ukraine in spring. However, they are currently getting worse.

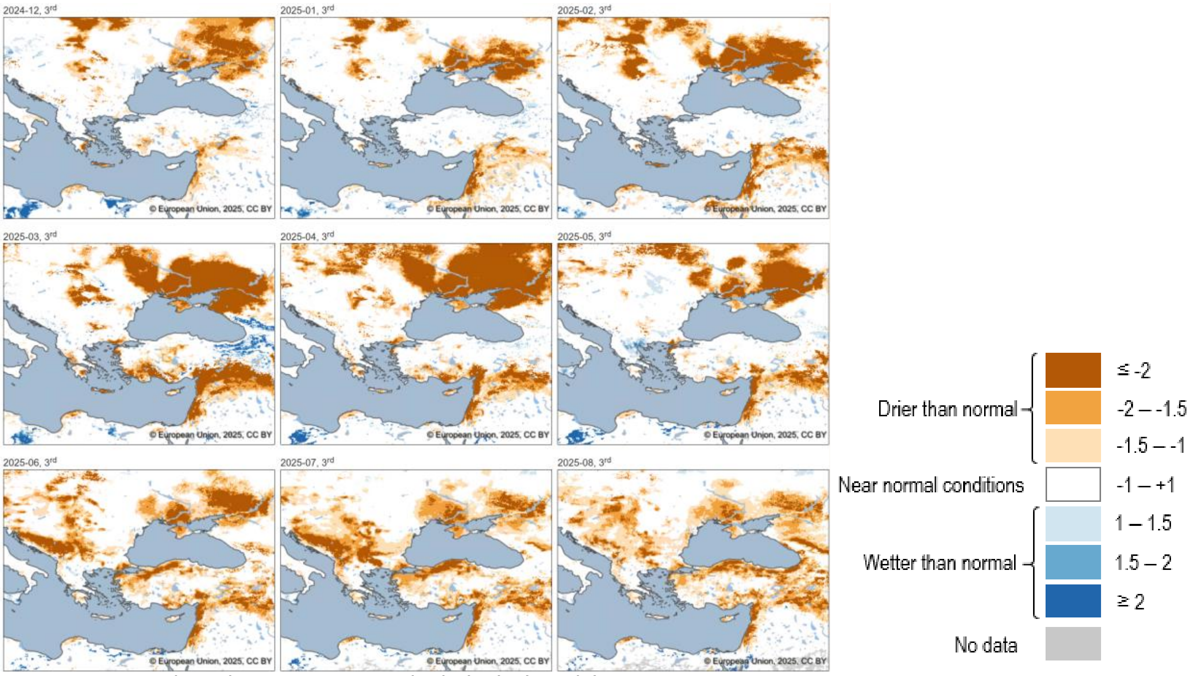
Figure 7: Soil Moisture Index Anomaly, late September 2025.[6]



Data source: JRC based on OS LISFLOOD hydrological model

[6] For more details on the Soil Moisture Anomaly, and the other GDO and EDO indicators of drought-related information used in the report, see the Appendix at the end of the document. Note that the maps of Soil Moisture Anomaly have been produced using a provisional product including only the modelled data from the OS LISFLOOD hydrological model used in GloFAS. A new updated version of the ensemble product is under development.

Figure 8: Soil Moisture Index Anomaly, 10-day periods from December 2024 to August 2025. [6]



Data source: JRC based on OS LISFLOOD hydrological model

6. Hydrology

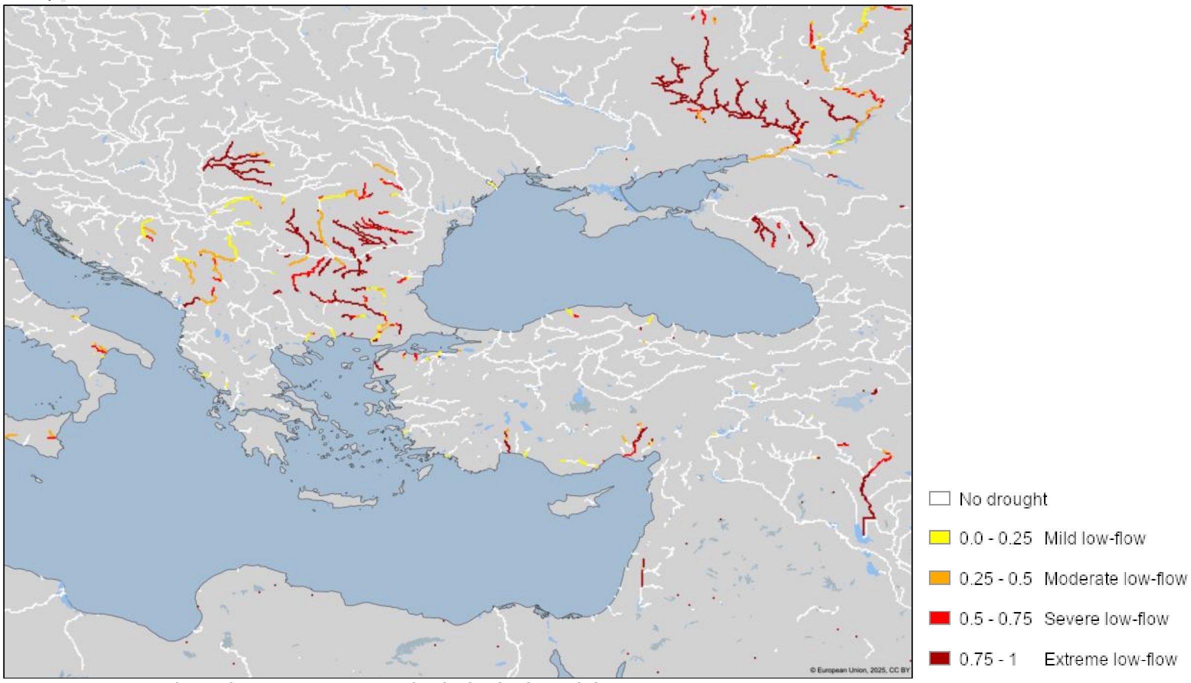
In late September 2025, the Low-Flow Index (LFI) [7] shows critical conditions mainly over eastern Ukraine, south-western Russia, Romania and Bulgaria. Additionally, some localized low-flow anomalies appear in river branches in the Balkans, southern Türkiye, Iraq, and southern Italy. (Fig. 9)[8].

The evolution of the LFI from December 2024 to August 2025, as illustrated in Figure 10, reveals a continuous and progressive increase in the extent and severity of low flow hazards until a peak in early summer (June 2025). Initially, low flow conditions were detected at the border between Romania and Bulgaria during the winter months but rapidly expanded to encompass wide areas of south-eastern Europe, eastern Ukraine and south-western Russia by late winter. Following a short and partial improvement in the Balkans and a severe worsening in Ukraine during spring, low flow conditions reached their peak severity and the largest spatial extent in early summer affecting most of the Balkans, Romania, Bulgaria and eastern Ukraine.

[7] For more details on the Low-Flow Index (LFI), and the other GDO and EDO indicators of drought-related information used in the report, see the Appendix at the end of the document.

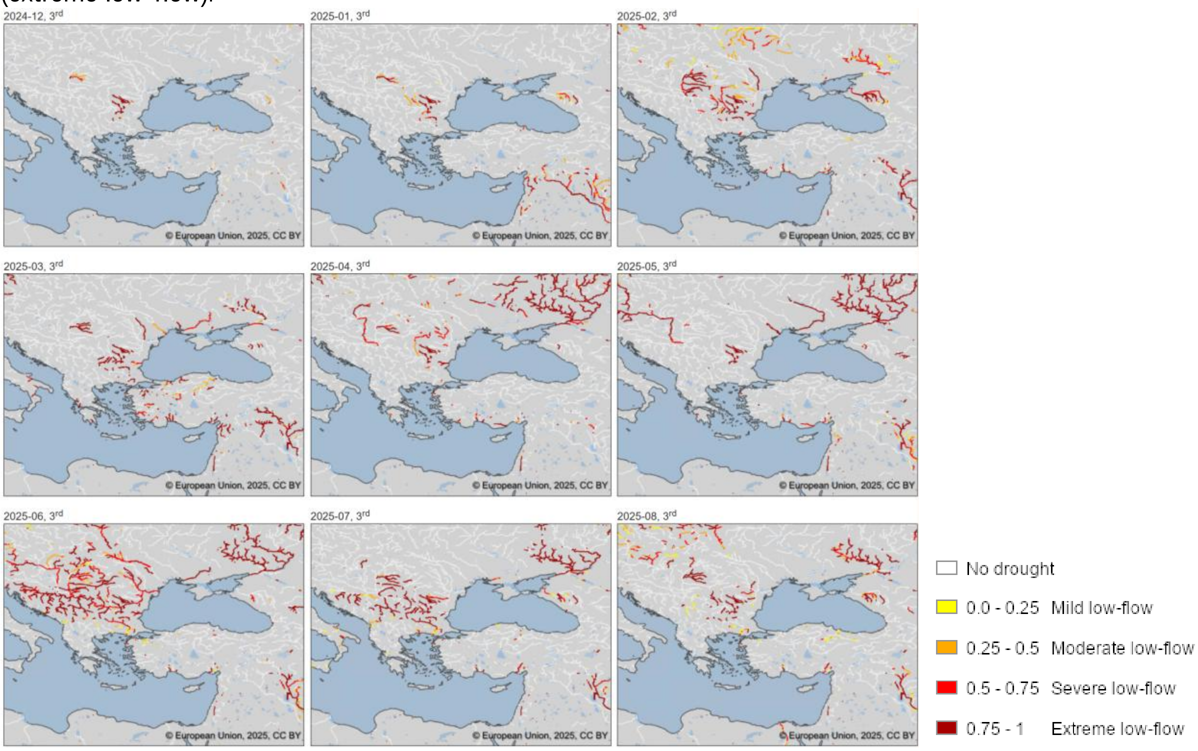
[8] The meteorological forcings may be characterized by temporal inconsistencies in areas with lower station coverage at the eastern domain of the Lisflood domain. Caution should be adopted when interpreting LFI in those areas.

Figure 9: Low-Flow Index (LFI) for late September 2025. LFI ranges from 0 (no drought) to 1 (extreme low-flow).[77]



Data source: JRC based on OS LISFLOOD hydrological model

Figure 10: Low-Flow Index (LFI) from December 2024 to August 2025. LFI ranges from 0 (no drought) to 1 (extreme low-flow).[7]



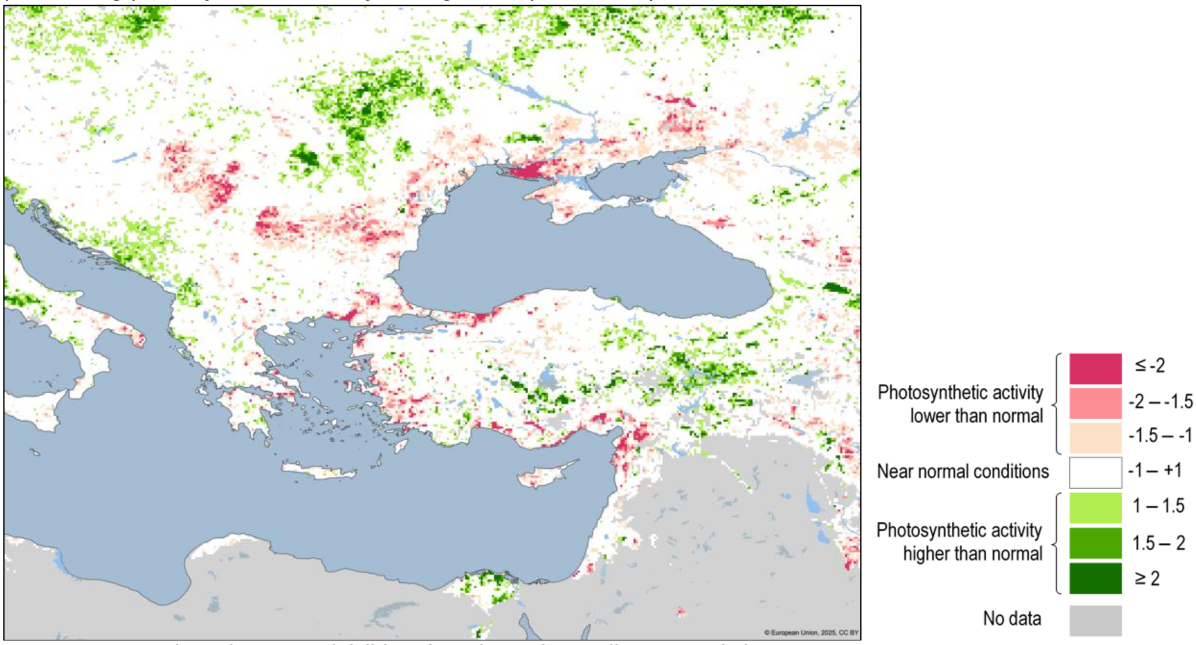
Data source: JRC based on OS LISFLOOD hydrological model

7. Vegetation biomass

In late September 2025, the satellite-derived fAPAR (Fraction of Absorbed Photosynthetically Active Radiation) anomaly indicator[9] shows close-to-normal vegetation conditions over almost the whole Black Sea region. However, southern Ukraine, southern Romania, northern Bulgaria, northern, western and southern Türkiye, and eastern Hungary are severely affected by below-average biomass accumulation as indicated by the fAPAR (Fig. 11).

The evolution of the fAPAR anomaly from December 2024 to August 2025 (Fig. 12) points to continuous and progressive worsening vegetation stress conditions. Winter was characterized by above average vegetation conditions revealing an anticipated grow thanks to the higher-than-average temperature (Fig 4) and sufficient rainfall. A worsening tendency is visible from late spring to mid-late summer in the Balkans and in the Black Sea regions.

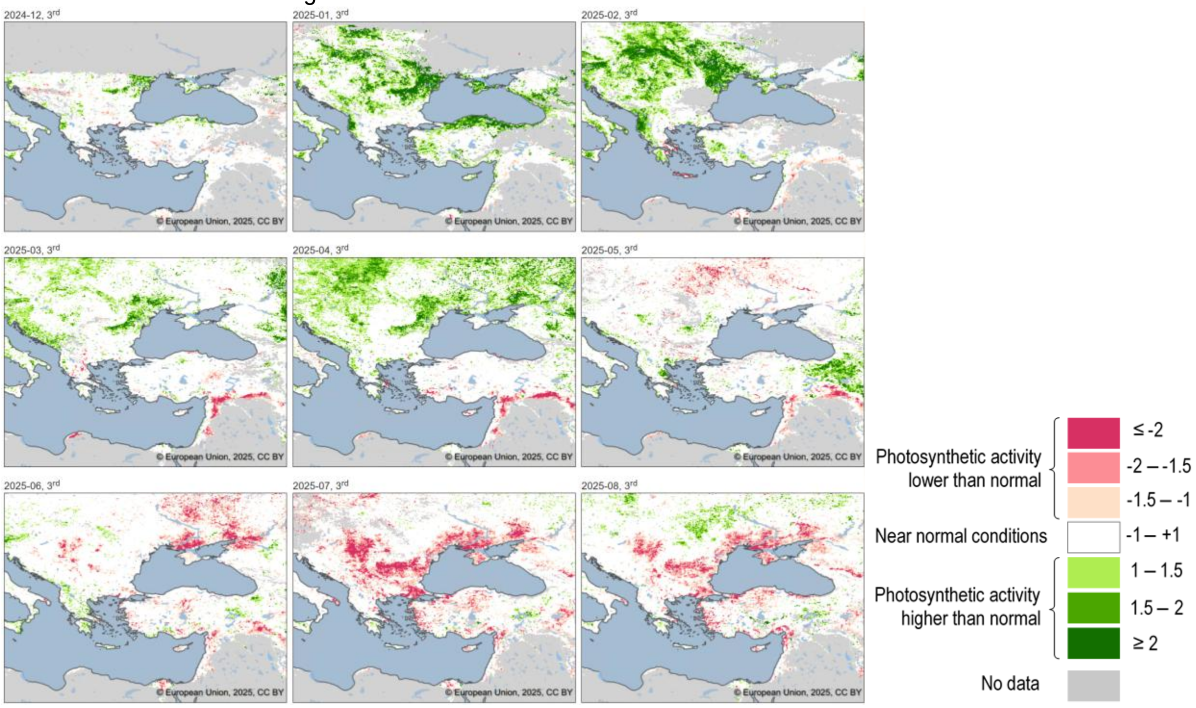
Figure 11: VIIRS (Visible Infrared Imaging Radiometer Suite) Satellite-derived fAPAR anomaly indicator (measuring photosynthetic activity of vegetation) in late September 2025.[9]



Data source: JRC based on VIIRS (Visible Infrared Imaging Radiometer Suite)

[9] For more details on the satellite-derived Fraction of Absorbed Photosynthetically Active Radiation (fAPAR) anomaly indicator, and the other GDO and EDO indicators of drought-related information used in the report, see the Appendix at the end of the document.

Figure 12: VIIRS Satellite-derived fAPAR anomaly indicator (measuring photosynthetic activity of vegetation) from December 2024 to August 2025.[9]

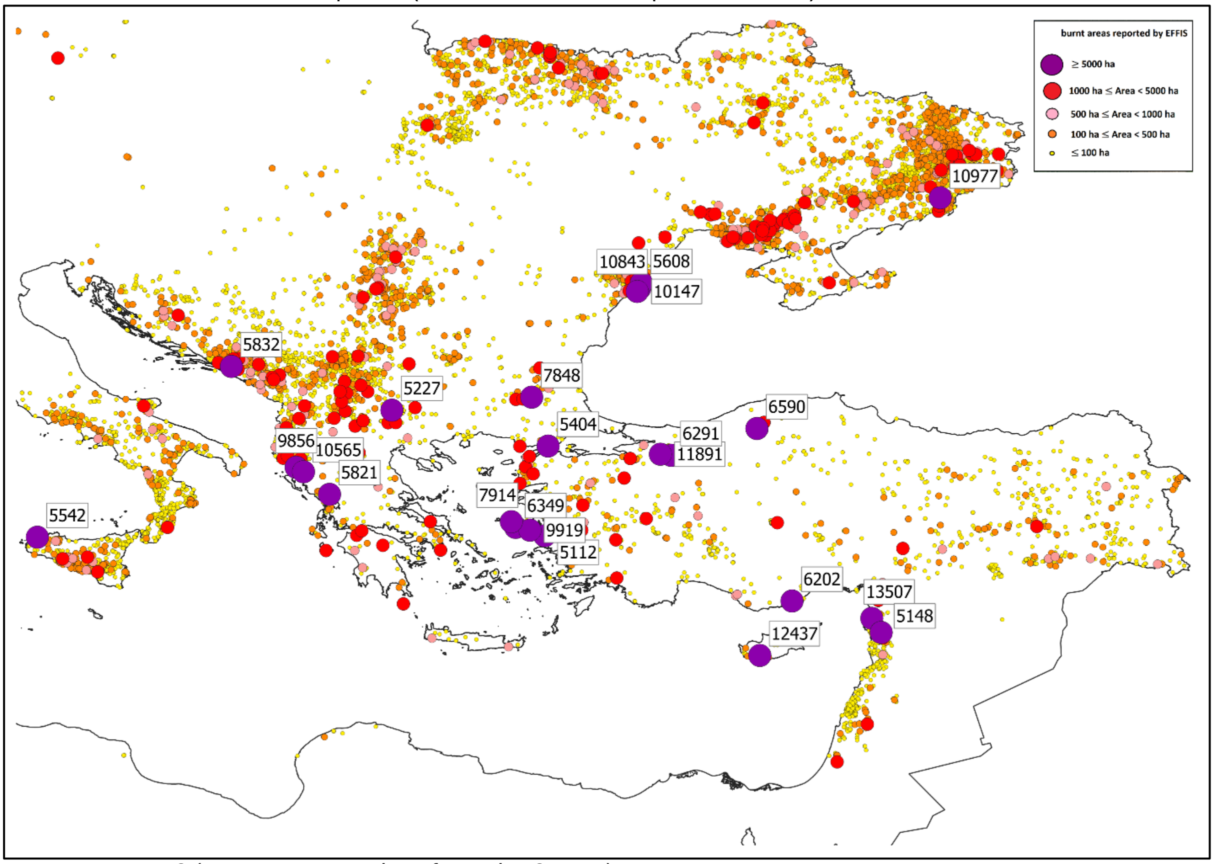


Data source: JRC based on VIIRS (Visible Infrared Imaging Radiometer Suite)

8. Wildfires

Within the time window of analysis (December 2024 – September 2025, Fig. 13) the countries in the area of interest were all affected by large wildfire events covering at least an area of 5000 ha. Although the majority of those took place during the 2025 summer season, winter and spring also proved to be fairly eventful. Syria recorded the biggest event overall (13507 ha), which took place in the Mediterranean region and close to the border with Türkiye.

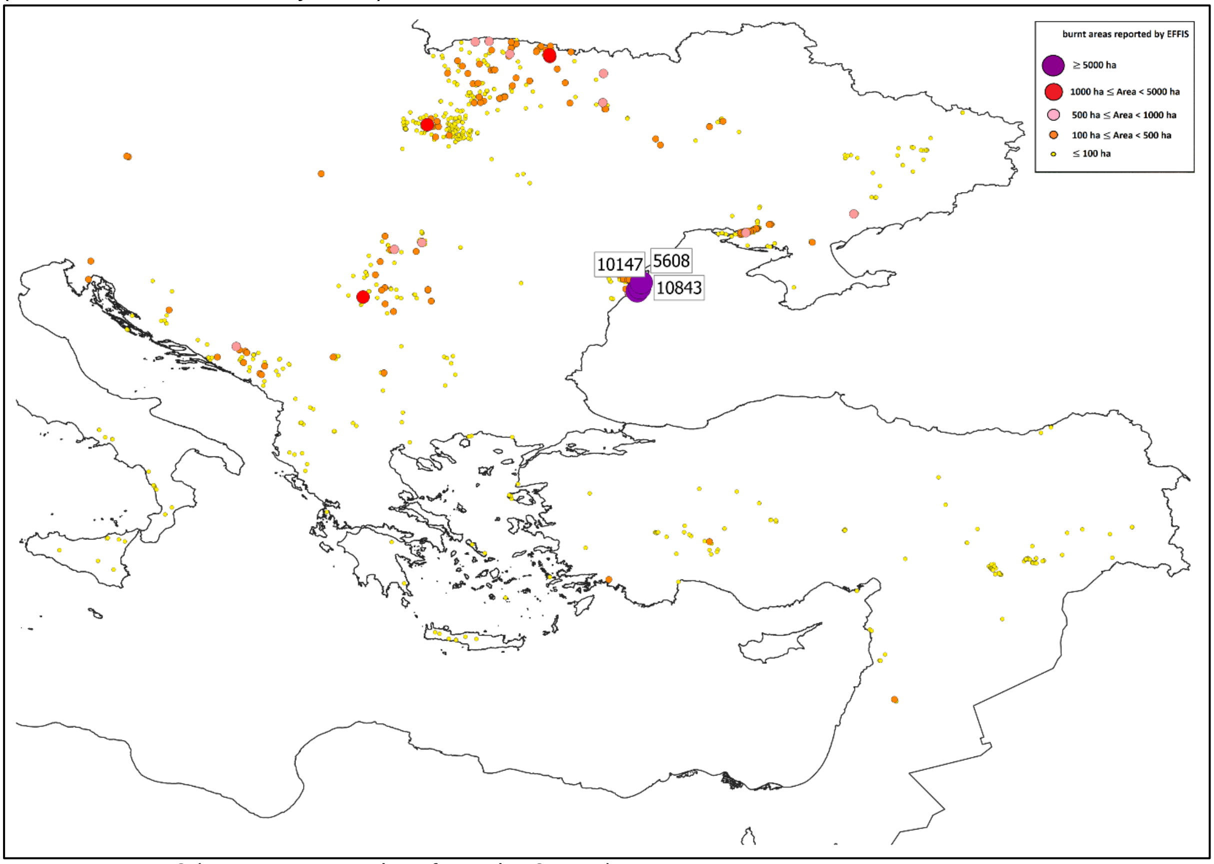
Figure 13: Classification of the fire events recorded by EFFIS (European Forest Fire Information System) on the area of interest within the period (December 2024 – September 2025)



Data source: EFFIS (European Forest Fire Information System)

The winter months (Fig. 14) were less affected by wildfires in all the countries except Romania, which recorded a total of 51498 ha of burnt area. Most of the events took place in the delta of the Danube River during February, but other significant events happened in the western side of the country in December and January. The second most affected country was Ukraine, in particular on its north-western side.

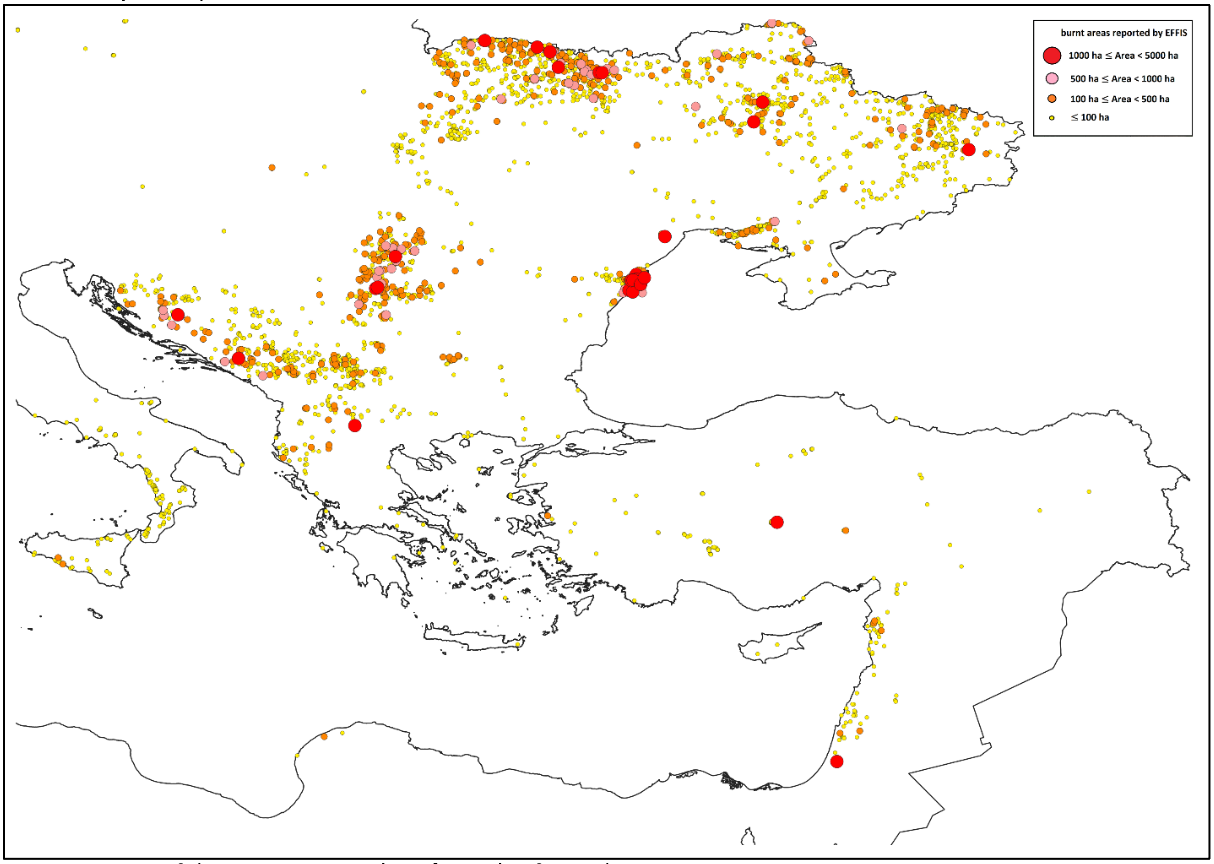
Figure 14: Classification of the fire events recorded by EFFIS on the area of interest within the period (December 2024 – February 2025)



Data source: EFFIS (European Forest Fire Information System)

The spring months (Fig. 15) did not experience major events (no events over 5000 ha were recorded), but the number of wildfires remained high. As in the winter months, the most affected country in the EU was Romania, which recorded a total of 73455 ha with the biggest events in the Danube Delta and the western part of the country. Equally, Ukraine was hit by a widespread set of fire events that covered 127708 ha mainly in the northern part of the country.

Figure 15: Classification of the fire events recorded by EFFIS on the area of interest within the period (March 2025 – May 2025)



Data source: EFFIS (European Forest Fire Information System)

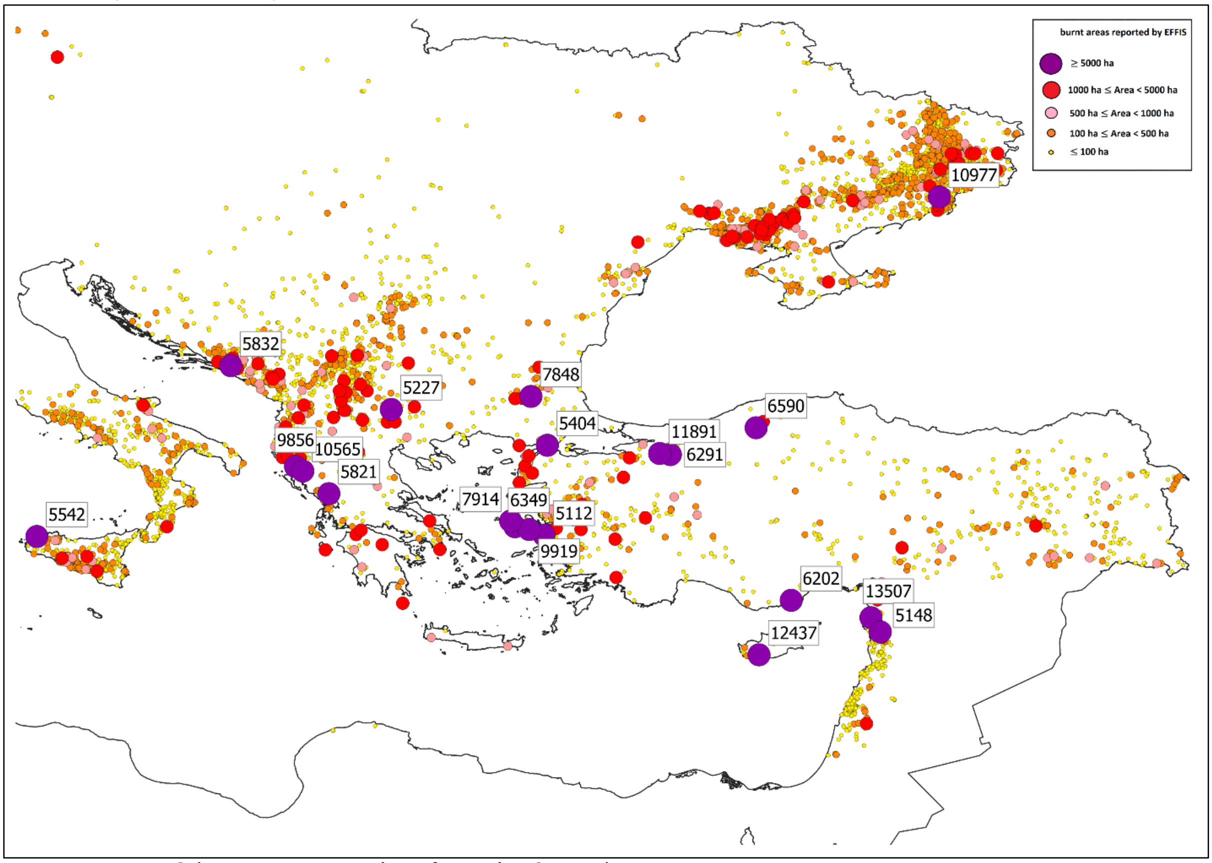
Most countries in the area of interest registered burnt areas above the average during the 2025 summer (from the beginning of June to the end of September, Fig. 16). Only Greece recorded values in line with the previous 18-years average. In all the other countries, the amount of burnt area was well above the respective averages.

Romania maintained an above-average level for most of the year; however, the summer season was exceptionally low in terms of burnt area, with only 8991 ha burnt, a value substantially lower than the 124953 ha recorded by the end of June. The most affected country in the area of interest in this time window was Ukraine, with a total amount of burnt area of 361940 ha, mainly in the eastern part, along the war front.

The second most affected was Türkiye, which recorded an amount of 147370 ha of burnt area (151563 ha since December 2024). The majority of the events over 5000 ha took place on the western coast, but the biggest one took place in the north, around 100 km south of Istanbul, covering an area of 11891 ha.

Other noticeable events took place in southern Albania (two events of around 10000 ha each), southern Bulgaria (almost 8,000 ha) at the border with Türkiye, North Macedonia (more than 5000 ha), Greece (almost 6000 ha in the Epirus region), and Cyprus (12437 ha) which was affected by the largest event ever recorded in the country since the beginning of EFFIS monitoring in 2000.

Figure 16: Classification of the fire events recorded by EFFIS on the area of interest within the period (June 2025 – September 2025)



Data source: EFFIS (European Forest Fire Information System)

9. Large-scale drivers

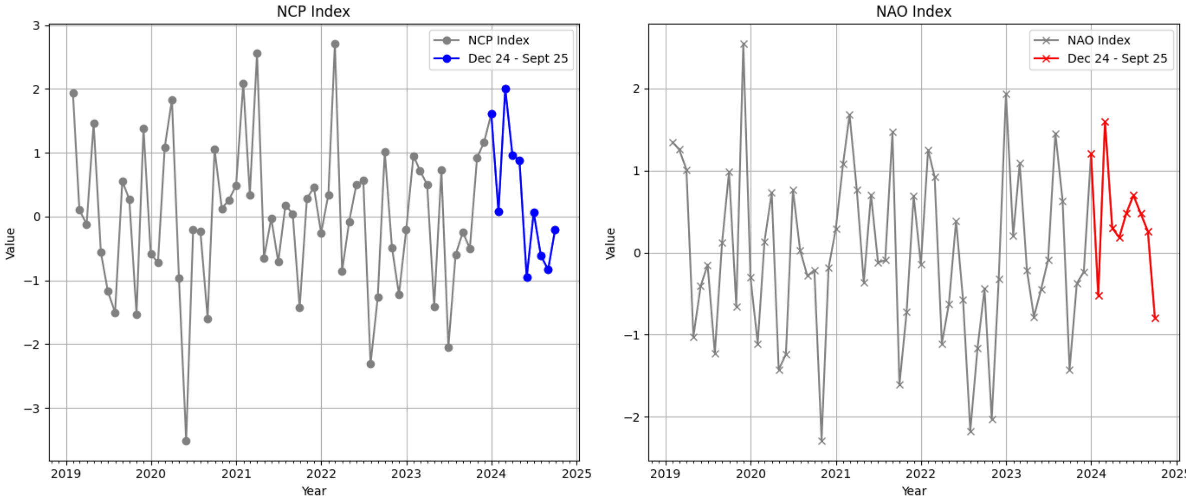
Large-scale atmospheric circulation patterns triggering the aforementioned conditions over the region are various, complex and likely intermittent throughout the year. Although there may be several drivers, two dominant modes of variability can be inferred from recent literature[10], which summarizes the large/scale circulation patterns and teleconnections that drive precipitation variability in the Balkans, Anatolia and the Middle East. The first one is the well know North Atlantic Oscillation (NAO) which predominantly measures the relative north-south pressure gradient between the high-pressure region of the subtropics (Azores) and low-pressure region of the mid/high latitudes (Iceland). Positive values of the NAO index typically point to below average precipitation in the Mediterranean region. The effects of the NAO in southeastern Europe are generally strongest during the winter. The second mode of variability is the North Sea-Caspian Pattern (NCP) which measures the relative pressure gradient from west (North Sea) to east (Caspian). It is also known as the East Atlantic/Western Russian pattern. In its positive phase, this index is associated with enhanced flow of

[10] Müller-Plath, G., Lüdecke, HJ. & Lüning, S. Long-distance air pressure differences correlate with European rain. Sci Rep 12, 10191 (2022). https://doi.org/10.1038/s41598-022-14028-w

air from the northeast into the region, with cooler-than-usual temperatures and above-average precipitation[11].

Figure 17 shows the monthly timeseries of the NCP and NAO indices since 2019. In general, the indices do not show extreme values in the period of interest. Only in December 2024 and February 2025 both indices exhibit values above one standard deviation. Only the NAO was in a phase that would favour dry conditions and may have partially explained the drought that peaked in March. Other possible tropical drivers such as the Indian Ocean Dipole or the El Niño Southern Oscillation were in neutral or close to neutral phases. To summarize, no clear large-scale driver appears to be the main cause of the drought. Drivers not considered here or more local natural atmospheric processes could also explain the dry conditions.

Figure 17: Monthly timeseries of the NCP (left) and the NAO (right) from January 2019 to September 2025. The NCP Index is estimated following the Kutiel and Benaroch (2002)[11] definition, while the NAO Index is based on rotated principal component analysis[12].



Data source: NCP has been derived from ERA5. NAO has been retrieved from NOAA

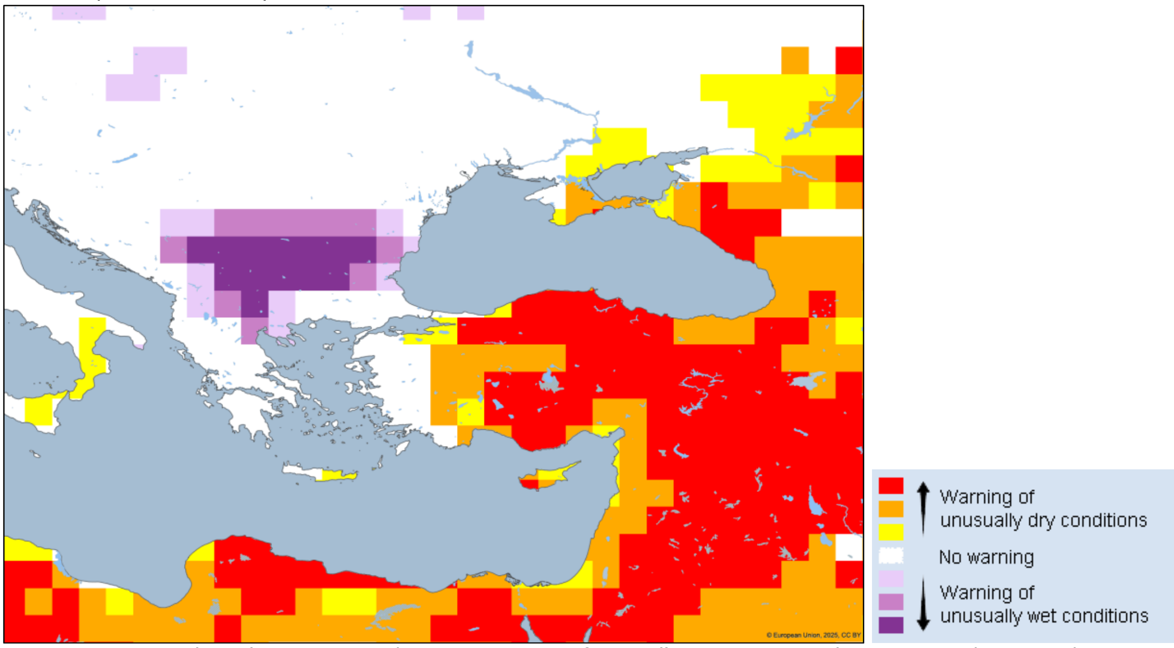
10. Seasonal forecast

Severely drier-than-average conditions are forecasted from October to December 2025 by the multi-system ensemble (Fig. 18) over the southern and eastern regions of this study. The driest conditions are predicted over Türkiye, Syria, Jordan, Iraq, Iran and south-western Russia. Over those regions critical conditions may persist exacerbating the drought hazard. Wetter-than-average conditions are predicted for most of the Balkans, this may give relief to those regions reducing the drought hazard for the coming months. There is in general a good agreement among the single systems that compose the multi-system ensemble, even if some local differences are present and point to a certain prediction uncertainty.

[11] Kutiel, H., Benaroch, Y. North Sea-Caspian Pattern (NCP) – an upper level atmospheric teleconnection affecting the Eastern Mediterranean: Identification and definition. Theor Appl Climatol 71, 17–28 (2002). https://doi.org/10.1007/s704-002-8205-x

[12] https://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_ao_index/history/method.shtml

Figure 18: Multi-system Indicator for Forecasting Unusually Wet and Dry Conditions, October - December 2025, based on dynamic forecasting systems from eight producing centres: ECMWF (European Centre for Medium-Range Weather Forecasts), CMCC (Centro Euro-Mediterraneo sui Cambiamenti Climatici), DWD (Deutscher Wetterdienst), ECCC (Environment and Climate Change Canada), Météo France, NCEP (USA National Centers for Environmental Prediction), UKMO (UK Meteorological Office), BOM (Bureau of Meteorology, Australia). The baseline period is 1993-2016.[13]

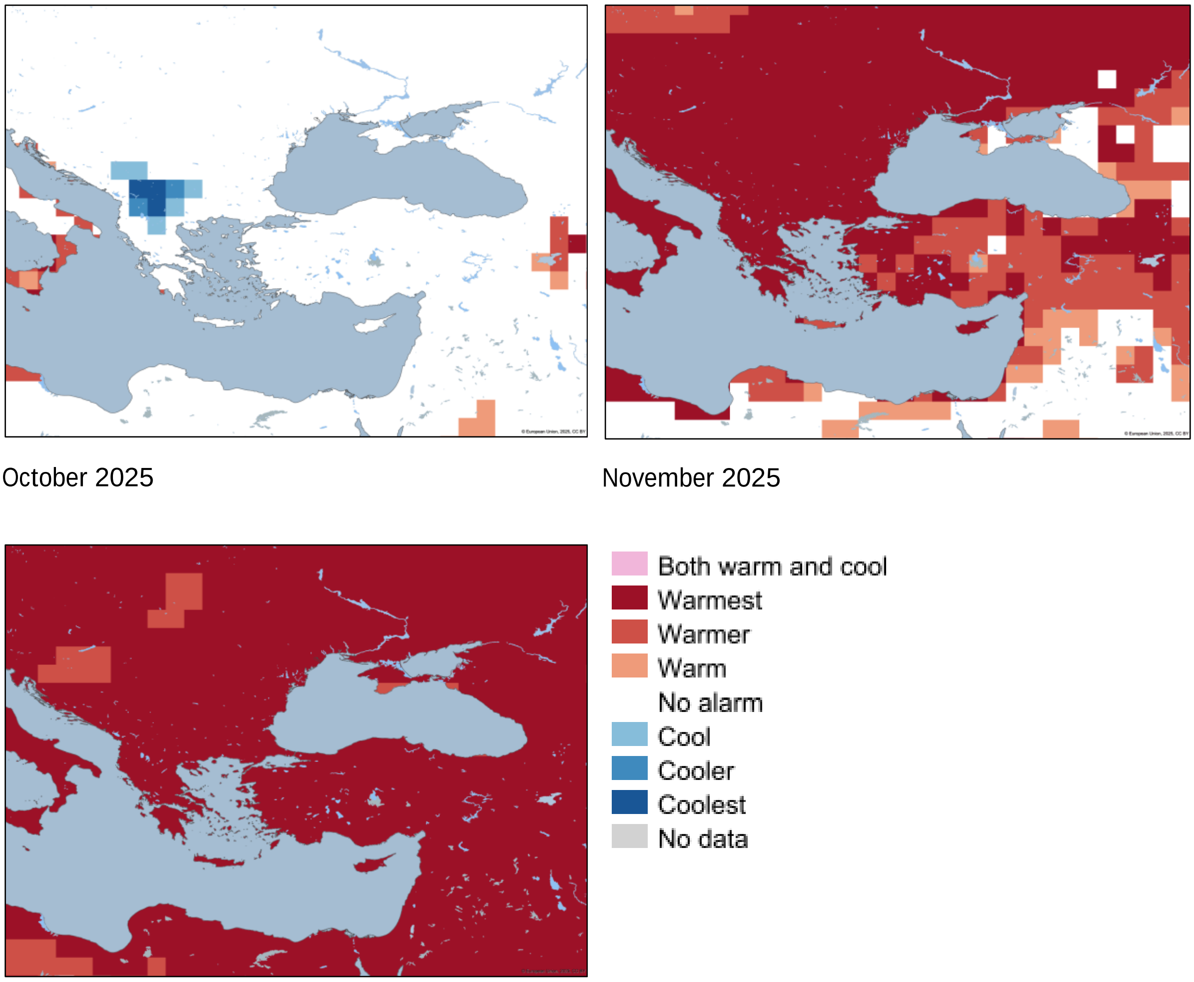


Data source: JRC based on ECMWF (European Centre for Medium-Range Weather Forecasts), CMCC (Centro Euro-Mediterraneo sui Cambiamenti Climatici), DWD (Deutscher Wetterdienst), ECCC (Environment and Climate Change Canada), Météo France, NCEP (USA National Centers for Environmental Prediction), UKMO (UK Meteorological Office), BOM (Bureau of Meteorology, Australia)

The multi-system Indicator for Unusual Warm and Cool Conditions (Fig. 19) points to a small likelihood of warm/cool spell events in October 2025 throughout the whole region. The likelihood of warm spell activity increases significantly for November covering most of the region with the most extreme warning, except for parts of Anatolia and the Middle East that show less severe warning. In December 2025 almost the whole area of interest is predicted to have a very high likelihood of warm spell activity.

13 For more details on the Indicator for Forecasting Unusually Wet and Dry Conditions, and the other GDO and EDO indicators of drought-related information used in the report, see the Appendix at the end of the document.

Figure 19: Multi-system Indicator for Forecasting Unusual Warm and Cool Conditions of October 2025 lead times ranging from 0 to 2 months (i.e. October, November and December 2025), based on eight components (baseline 1993 - 2016)



October 2025

November 2025

December 2025

Data source: : JRC based on ECMWF (European Centre for Medium-Range Weather Forecasts), CMCC (Centro Euro-Mediterraneo sui Cambiamenti Climatici), DWD (Deutscher Wetterdienst), ECCC (Environment and Climate Change Canada), Météo France, NCEP (USA National Centers for Environmental Prediction), UKMO (UK Meteorological Office), BOM (Bureau of Meteorology, Australia)

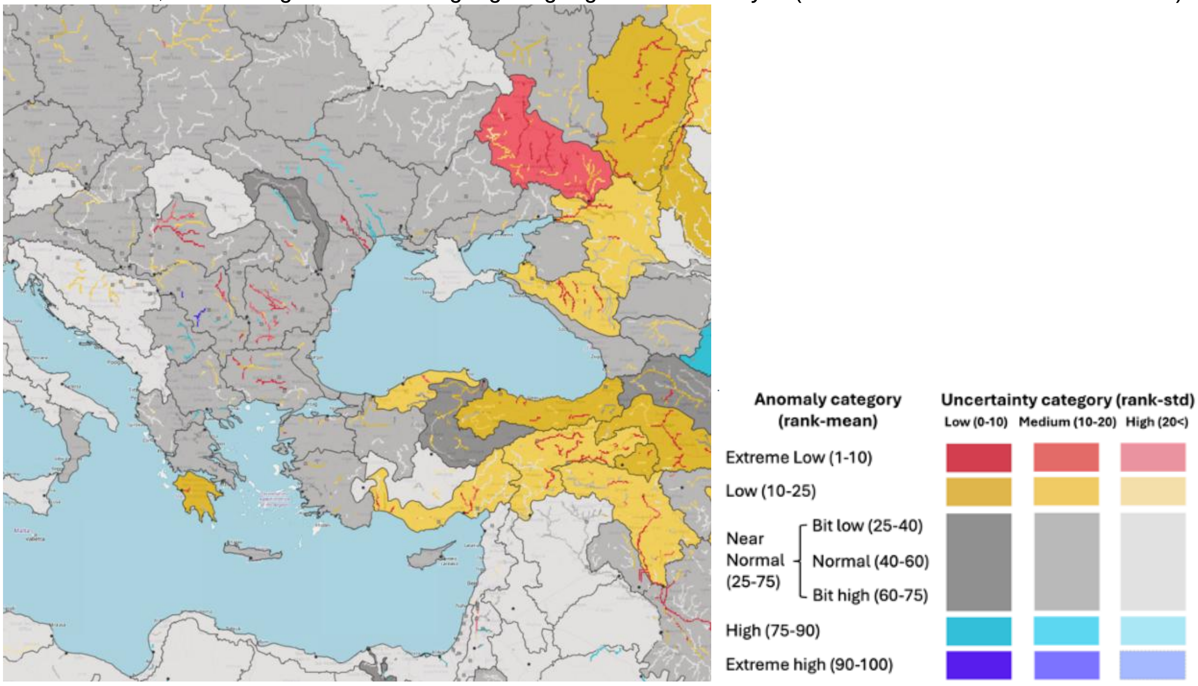
Based on the Copernicus Climate Change Service (C3S) seasonal forecasts[14] (not shown here), warmer than usual conditions are likely to occur in south-eastern Europe, the Black Sea and the eastern Mediterranean up to December 2025.

As shown in Figure 20, most of the eastern part of the region analysed in this study is expected to have low flows in October 2025. For Eastern Ukraine are predicted extreme low flow conditions, while southern Greece, most of Türkiye, and south-western Russia will be under low flow conditions. This

[14] https://climate.copernicus.eu/seasonal-forecasts

suggests that the drought event is in a stable and critical phase. Additionally, some rivers in Romania, Türkiye, and south-western Russia are expected to be affected by extreme low flow anomaly.

Figure 20: Seasonal forecast flow anomaly and uncertainty for October 2025 step within the 7 months simulation run from October 2025 to April 2026, information aggregated by basin. Different colours indicate the anomaly category (extreme low to extreme high), while the colour intensity shows the confidence level in the anomalies, with the lighter colours highlighting higher uncertainty.[15] (See also the Technical Note below).



Data source: : JRC based on OS LISFLOOD hydrological model

Technical Note:

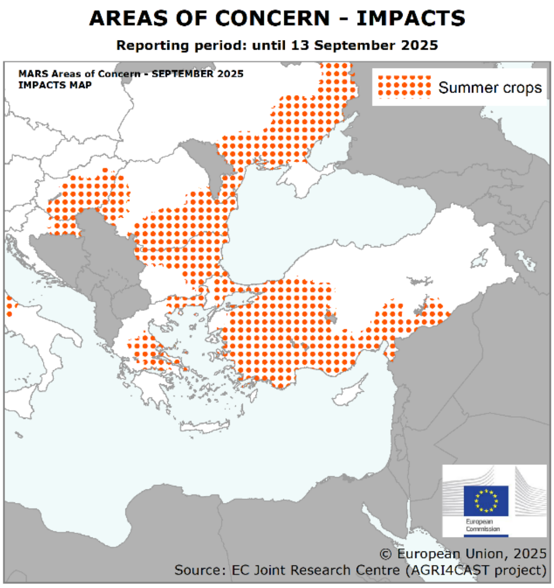
- The analysis results shown in Fig. 20 are based on the OS LISFLOOD hydrological model outputs driven by 51 ensemble members of the ECMWF SEAS5 seasonal forecast. Specifically, the forecast anomaly and uncertainty signals are derived by comparing the GloFAS hydrological forecast driven by ECMWF SEAS5 (Seasonal Forecasting System 5) to the 99-value percentile climatology. The climatology is generated using ECMWF SEAS5 reforecasts over a 20-year period.[15] More information on OS LISFLOOD: De Roo et al., 2000. "Physically based river basin modelling within a GIS: the LISFLOOD model". Hydrological Processes, 14, 1981–1992. Additional and updated information: Open Source Lisflood (https://ec-jrc.github.io/lisflood/)
- The regions (aggregated basins) displayed in Fig. 20 are a subset of 204 aggregated basins within the GloFAS (Global Flood Awareness System) domain, the basin delineation was done semi-automatically, and the basin borders align with the 0.05 degree OS LISFLOOD river network in GloFAS. This allows large-scale variability in weather to be captured, and forecast information to be summarized.

[15] Source: The CEMS European Flood Awareness System (EFAS): https://www.efas.eu, documentation at EFAS sub-seasonal and seasonal forecasting - Copernicus Emergency Management Service - CEMS - ECMWF Confluence Wiki

11. Reported agricultural impacts

According to the JRC MARS (Monitoring Agricultural ResourceS) Bulletin of September 2025[16], the Anomaly Hotspots of Agricultural Production (ASAP) bulletin of September 2025[17] and GEOGLAM (Group on Earth Observation Global Agricultural Monitoring) Crop Monitor bulletins of August and September 2025[18] summer drought conditions have been prevalent in several regions, including south-eastern Europe, the Black Sea region, the eastern Mediterranean, the Caucasus and the Middle East as well as western Maghreb. Countries such as Bulgaria, eastern Croatia, Hungary, and Romania have experienced persistent drought, resulting in irreversible yield losses of summer crops, especially in rainfed areas. South-eastern Ukraine has also suffered from drought, with below-average yields mainly affecting sunflower grown in this part of the country. Winter crops were impacted locally, too, but have only a small share in national production. The southern district of Russia has seen reduced yields. The eastern Mediterranean region has also been affected by drought and lack of irrigation water, resulting in low summer crop yields in Greece, Türkiye and Syria. Notably in Türkiye, drought, together with cold conditions, affected also winter crops. The Caucasus regions of Georgia, Armenia, and Azerbaijan also experienced negative impacts on crops. In the Middle East, Syria and northern Iraq have been impacted by one of the most severe droughts in decades while northeastern Iran and Lebanon also suffered from dry conditions. Weather forecasts for October suggest above-average precipitation in south-eastern Europe, bringing relief to the depleted soil moisture and improving sowing conditions for the coming season. Below-average rainfall is expected in the northern and northwest regions of the Middle East, which may worsen drought conditions in the region.

Figure 21: Map of areas of concern for crop impacts according to the JRC MARS (Monitoring Agricultural ResourceS) Bulletin of September 2025[16]



Data source: JRC MARS (Monitoring Agricultural ResourceS)

[16] JRC Publications Repository - JRC MARS Bulletin - Crop monitoring in Europe - September 2025 - Vol. 33 No 8

[17] https://agricultural-production-hotspots.ec.europa.eu/

[18] https://www.cropmonitor.org/

- Hungary: A moderate precipitation deficit characterised Hungary until late May. June prevailed to be the driest and second hottest since 1901. From early July, crop water supply conditions of maize and sunflower turned to be critical in the south-eastern regions of the country. During the cardinal flowering period, summer crops suffered from severe water scarcity despite some sporadic rainfall events. The heatwaves of August intensified the drought situation and further deteriorated the crop conditions, reducing the yield expectations. About 100 000 ha of grain maize were converted to harvest as silage to save it from total losses on the Hungarian Great Plain. Latest grain maize and sunflower yield forecast is around 5.36 t/ha and 2.45 t/ha respectively, well below the 5-year average. The yield loss is quite severe in the case of grain maize (despite better grain maize yields of western Hungary), resulting in a total production of only 4-4.5 million tons, which is 20-30% below average.

- Romania: After a record-high season for winter cereals with excellent growing conditions in winter and spring, Romania expects a below-average harvest of summer crops in the southern and western regions due to drought starting in summer 2025. Limited rainfall and frequent hot days have been affecting the growth of summer crops from mid-June onward. Some rainfall events improved the crop water supply in northern Romania in July, but the most important southern crop producing regions remained dry. Soil moisture reserves declined further in July, affecting the critical flowering and grain-filling stages. The hot and dry weather also adversely affected the fertilization of grain maize ears. High temperatures accelerated the development of summer crops, induced early leaf senescence, and shortened the grain-filling period. In southern and south-western Romania, drought conditions persisted throughout August and September. The size of the drought distressed area is estimated to reach about 1 million ha, however the central and northern area of Romania experienced more adequate growing conditions for summer crop. Yield outlook is 3.15 t/ha for grain maize, -22% compared to fve-year average, while sunflower yield expectation is only 1.49 t/ha, remaining below the average by 20%. Still dry soils in September delayed the sowing of rapeseed, but abundant rain in the first half of October brought relief and allowed for finalizing the sowing.

- Bulgaria: A slight soil moisture deficit and hot spells in June could not hamper winter crop biomass accumulation and grain formation anymore, and thanks to the good growing conditions and sufficient rainfall during spring, winter crop yields exceeded well the five-year average. Summer crops, however, experienced extremely hot and dry conditions. Water supply deteriorated quickly in June and became a limiting factor for the reproductive stages of grain maize and sunflower. Heat stress caused by frequent heatwaves (maximum temperature in the range of 35-42 °C) resulted in heat stress during the flowering and early grain-filling period, shortened the crop cycle and significantly limited the biomass accumulation. Early senescence of the crop canopy also considerably reduced photosynthetic activity. Yield expectations are very low, as for sunflower of about 1.70 t/ha, comparable with the previous catastrophic year. The grain maize yield is expected below 3 t/ha, the lowest harvest since 2007.

- Greece: When soil moisture started to decrease in arable land in late May as rainfall became scarce and temperature increased, winter crops were already close to the end of their growth cycle and did not suffer major impacts, resulting in above-average winter crop yields, especially during wheat with 7 % above the five-year average. Drought conditions developed during summer, when the lack of rainfall limited summer crop growth in non-irrigated fields, particularly in Thessalia, Anatoliki Makedonia kai Thraki, and Sterea Ellada. In areas where sufficient irrigation water was available, such as in Dytiki Makedonia, Kentriki Makedonia and Dytiki Ellada, summer crops withstood the drought impacts and remain in fair condition. Overall yields of sunflower, grain maize and potatoes are expected around 5 % below the five-year average as a consequence of the drought.

- Ukraine: Drought conditions severely affected summer crops in southern Ukraine, particularly in Odes'ka, Mykolayivs'ka, Khersons'ka, Zaporiz'ka, and Dnipropetrovs'ka oblasts. Persistent rainfall deficits since early spring combined with high temperatures from June to August depleted soil moisture reserves and sharply limited crop and canopy development. Grain maize and sunflower were the most affected in these areas, with remote-sensing data showing one of the lowest biomass accumulations over the last five years and locally visible signs of crop failure.
  In Mykolayivs'ka and Odes'ka, maize yields declined to around 2.6–3.2 t/ha, 20–30 % below the five-year average. Sunflower yields dropped about 10–20% across the southern and eastern regions, particularly in Odes'ka and Zaporiz'ka. Overall, the southern oblasts recorded the weakest summer crop performance in Ukraine. On the contrary, very favorable conditions were observed in the north and west of the country where water availability and the absence of any severe thermal stress was sufficient to support good crop development of grain maize and soybean. Resulting spring and summer crop yields at national level are expected below average due to the drought conditions only for rapeseed and sunflower.

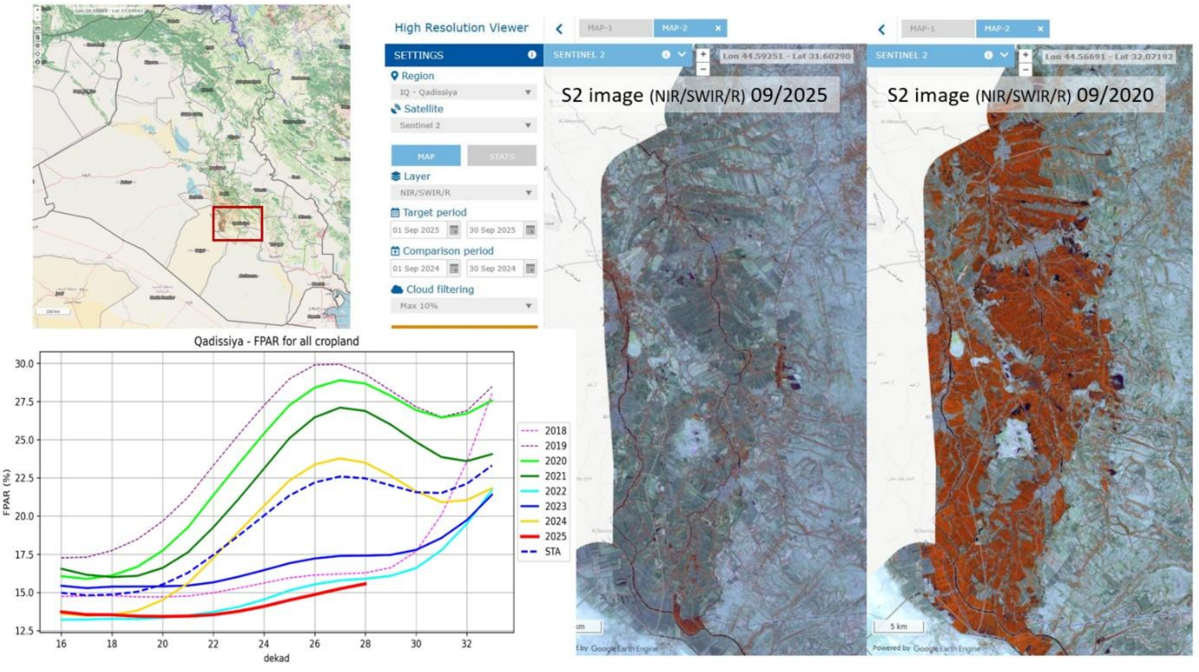
- Türkiye: Drought conditions persisted in most of the agricultural regions and throughout most of the agricultural season. In south-eastern Anatolia, winter crops were already suffering from dry and cold conditions in early spring, due to very limited precipitation during winter, but conditions worsened close to summer as precipitation was lower than usual or absent. In western and central Anatolia, winter crops in May had still favorable conditions despite the dry winter and the cold spell of February. Since then, rainfall has been scarce again, and repeated heatwaves have further exacerbated soil moisture deficits. While the impacts in June were still limited mainly to western Anatolia, by July winter crops in central and eastern Anatolia and in the main agricultural regions along the Black Sea were also showing impacts of the water deficit. Furthermore, the availability of water for irrigation was insufficient to sustain the full yield potential of summer crops, reducing yield expectations for soybean and maize, notably in the Mediterranean and Aegean regions. At country scale, yield forecasts for winter crops decreased below the five-year average at –5.6 % for barley, –10.7 % for durum wheat and –4.1 % for soft wheat. Yield forecasts for summer crops – namely grain maize and soybean are well below the 2024 yields, by –7.3 % and –6.8 % respectively, for grain maize still in line with the five-year average..

- Syria: Rainfall has been very poor during the winter cereals season, in particular in December-January across the country; notably the western half of the country (from Aleppo, Idleb and Hama to Dara) received the lowest January-May rainfall since 1991. This poor rainfall resulted in the lowest crop biomass since 2002 in Aleppo, Idleb, Hama and

Hassakeh[19]. Harvest of wheat and barley finalized in June with only 40% of the 5-year average output according to FAO (Food and Agriculture Organization of the United Nations) GIEWS[20] (Global Information and Early Warning System on Food and Agriculture), as a result of one of the worst droughts in decades, combined with domestic unrest at the end of 2024 (at the time of winter cereals sowings).

- Iraq: in northern Iraq (Ninewa, the main cereals producing governorate, Dahuk and part of Erbil) winter cereals production was also strongly affected by dry conditions from December to March while winter cereals conditions were better for the centre and the south of the country, probably thanks partly to irrigation[21]. However, rice cultivation, that starts in June, was banned in the main rice producing governorates (Najaf and Qadissiya - see figure 22) to save water for drinking and essential household needs, as in 2018, 2022 and 2023, when it triggered farmers' protest[22].

Figure 22: ASAP FPAR time profiles for the summer season of years 2018 - 2025 in Qadissiya (left) and S2 false colour composite images of September 2025 (centre) compared with September 2020 (right) showing the impact of the ban on rice cultivation (red colours correspond to green fields, i.e. rice fields) in Qadissiya.



Data source: JRC Anomaly Hotspots of Agricultural Production (ASAP) and Sentinel 2 satellite data

- Lebanon: winter cereals biomass has been below average since the start of season especially in the main producing areas (Balbek Hermel governorate and part of the Bekaa governorate) as a result of below average rainfall at the start of season from November to February (unfortunately the wet episode of end December – 112 mm received versus 40 mm

[19] https://agricultural-production-hotspots.ec.europa.eu/countryAllAssessments.php?cntry=238

[20] https://www.fao.org/giews/countrybrief/country.jsp?code=SYR

[21] https://agricultural-production-hotspots.ec.europa.eu/countryAllAssessments.php?cntry=118

[22] https://english.aawsat.com/business/5193551-iraqi-farmers-protest-cultivation-ban-amid-drought

on average - was followed by a particularly dry January with only 35% of the normal rainfall received). This low rainfall combined with a reduced planted area, not only due to drought, resulted in a cereal harvest estimated at 50% of the average output by FAO GIEWS[23].
A relevant example of the hydrological drought impact can be seen by comparing the Taanayel Lake conditions in the Beqaa Valley in 2022 (Fig. 23, left) and in 2025 (Fig. 23, right), highlighting significant changes in water levels and surface area. This comparison illustrates the lake response to drought, due to reduced rainfall and increased evaporation.

Figure 23: Taanayel Lake, Beqaa Valley, Lebanon in 2022 (left) and in 2025 (right). © Pauline Korban CCBY4.0

[23] https://www.fao.org/giews/countrybrief/country.jsp?code=LBN

Appendix: GDO and EDO indicators of drought-related information[24]

The Standardized Precipitation Index (SPI) provides information on the intensity and duration of the precipitation deficit (or surplus). SPI is used to monitor the occurrence of drought. The lower (i.e., more negative) the SPI, the more intense is the drought. SPI can be computed for different accumulation periods: the 3-month period is often used to evaluate agricultural drought and the 12-month (or even 24-month) period for hydrological drought, when rivers fall dry and groundwater tables lower.

The Standardized Precipitation Evapotranspiration Index (SPEI) indicates how the climatic water balance (precipitation minus potential evapotranspiration) deviates from the climatological average over a given rainfall accumulation period. The indicator is suitable and commonly used for detecting and characterizing meteorological and agricultural droughts, particularly in a context of compounding high temperatures and precipitation deficit. The longer accumulation periods are related to more persistent droughts and may give information also in terms of hydrological drought.

Lack of precipitation induces a reduction of soil water content. The Soil Moisture Index Anomaly provides an assessment of the deviations from normal conditions of root zone water content. It is a direct measure of drought associated with the difficulty of plants in extracting water from the soil.

The Low-Flow Index (LFI) is based on daily river water discharge simulated by the LISFLOOD hydrological model. It captures consecutive periods of unusually low streamflow. It compares the consequent water deficit during those periods with historical climatological conditions.

The satellite-based fraction of Absorbed Photosynthetically Active Radiation (fAPAR) monitors the fraction of solar energy absorbed by leaves. It is a measure of vegetation health and growth. Negative fAPAR anomalies with respect to the long-term average are associated with negative impacts on vegetation.

The Multi-system Indicator for Forecasting Unusually Wet and Dry Conditions provides early risk information at global scale. The indicator is computed from forecasted SPI-1, SPI-3, and SPI-6 derived from eight components: ECMWF (European Centre for Medium-Range Weather Forecasts), CMCC (Centro Euro-Mediterraneo sui Cambiamenti Climatici), DWD (Deutscher Wetterdienst), ECCC (Environment and Climate Change Canada), Météo France, NCEP (USA National Centers for Environmental Prediction), UKMO (UK Meteorological Office), BOM (Bureau of Meteorology, Australia).

The Multi-system Indicator for Forecasting Unusual Warm and Cool Conditions provides an early warning of extreme temperature conditions over the world based on accumulated intensity of daily temperature exceedances of the forecast with lead times ranging from 0 to 3 months. These are derived from the forecasted daily maximum and minimum temperatures relative to the 10th/90th percentile of the climatology provided by eight components: ECMWF (European Centre for Medium-Range Weather Forecasts), CMCC (Centro Euro-Mediterraneo sui Cambiamenti Climatici), DWD (Deutscher Wetterdienst), ECCC (Environment and Climate Change Canada), Météo France, NCEP (USA National Centers for Environmental Prediction), UKMO (UK Meteorological Office), BOM (Bureau of Meteorology, Australia). The early warning is plotted only when and where the forecast is considered robust (with at least 40% of the ensemble members associated with extreme forecasts) and associated with relative extreme values (based on hindcasts). The colours indicate the return period of the intensity and the coherency of the ensemble members of the forecast model according to the reference period that spans from 1993 to 2016.

[24] For more details on the GDO and EDO indicators: https://drought.emergency.copernicus.eu/data/factsheet

Glossary of terms and acronyms

- ASAP: Anomaly Hotspots of Agricultural Production
- BOM: Bureau of Meteorology, Australia
- C3S: Copernicus Climate Change Service
- CMCC: Centro Euro-Mediterraneo sui Cambiamenti Climatici
- CEMS: Copernicus Emergency Management Service
- DWD: Deutscher Wetterdienst
- EC: European Commission
- ECCC: Environment and Climate Change Canada
- ECMWF: European Centre for Medium-Range Weather Forecasts
- EDO: European Drought Observatory
- EFAS: European Flood Awareness System
- EFFIS: European Forest Fire Information System
- ERA5: ECMWF Reanalysis v5
- EU: European Union
- FAO: Food and Agriculture Organization
- fAPAR: Fraction of Absorbed Photosynthetically Active Radiation
- GDO: Global Drought Observatory
- GEOGLAM: Group on Earth Observation Global Agricultural Monitoring
- GIEWS: Global Information and Early Warning System of FAO
- GloFAS: Global Flood Awareness System
- JRC: Joint Research Centre
- KNMI: Royal Netherlands Meteorological Institute
- LFI: Low-Flow Index
- MARS: Monitoring Agricultural ResourceS
- NAO: North Atlantic Oscillation
- NCEP: National Centers for Environmental Prediction (United States of America)
- NCP: North Sea-Caspian Pattern
- SEA5: Seasonal Forecasting System 5
- SMA: Soil Moisture Anomaly
- SPEI: Standardized Precipitation Evapotranspiration Index
- SPI: Standardized Precipitation Index
- UKMO: United Kingdom Met Office
- VIIRS: Visible Infrared Imaging Radiometer Suite

GDO and EDO indicators versioning

The GDO and EDO indicators appear in this report with the following versions:

GDO, EDO indicator	Version
▪ Soil Moisture Index (SMI) Anomaly (SMA)	v.3.0.1
▪ fAPAR (fraction of Absorbed Photosynthetically Active Radiation) Anomaly (VIIRS)	v.3.0.0
▪ Low-Flow Index (LFI)	V.3.1.0
▪ Multi-system Indicator for Forecasting Unusual Warm and Cool Conditions	v.1.0.0
▪ Multi-system Indicator for Forecasting Unusually Wet and Dry Conditions	v.2.0.0
▪ Standardized Precipitation Evapotranspiration Index (SPEI)	v.1.0.0
▪ Standardized Precipitation Index (SPI) (ERA5)	v.2.0.0

Check https://drought.emergency.copernicus.eu/download for more details on indicator versions.

Distribution

For use by the ERCC and related partners, and publicly available for download at GDO website: https://drought.emergency.copernicus.eu/reports

List of Figures

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Drought in South-Eastern Europe - October 2025

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