ISSN 1831-9424

European Commission

JRC Technical Report

# Drought in the western Mediterranean May 2023

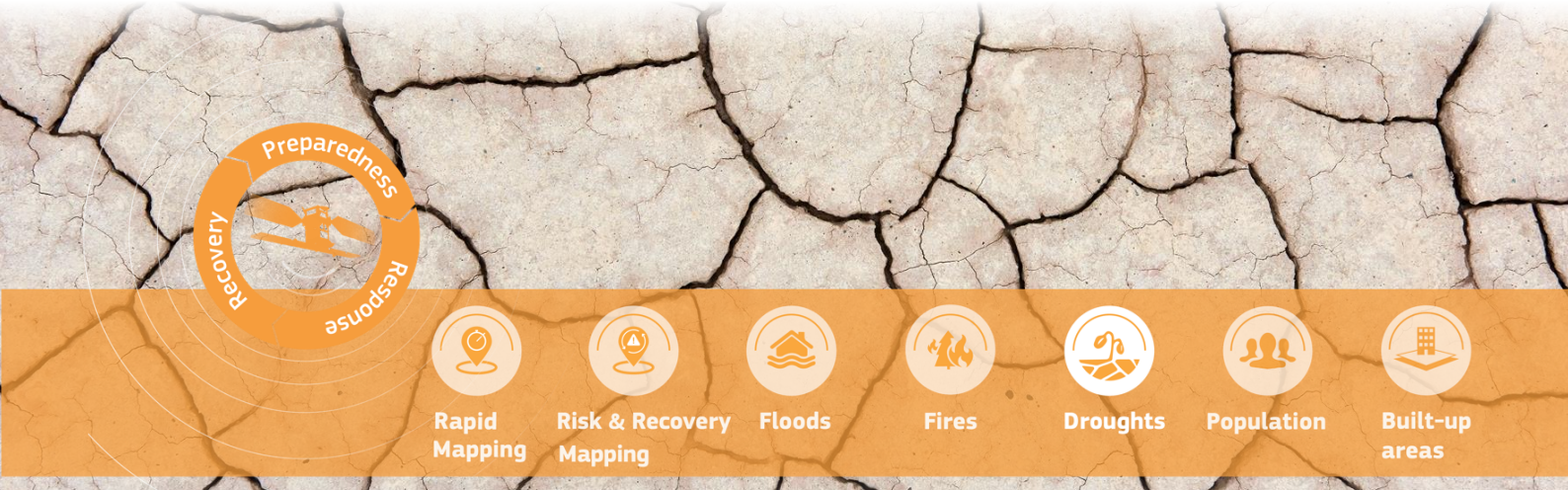
*GDO Analytical Report*

Copernicus Europe's eyes on Earth

Emergency Management Service

Toreti, A., Bavera, D., Acosta Navarro, J., Arias Muñoz, C., Barbosa, P., de Jager, A., Di Ciollo, C., Fioravanti, G., Grimaldi, S., Hrast Essenfelder, A., Maetens, W., Magni, D., Masante, D., Mazzeschi, M., McCormick, N., Salamon, P.

2023




Joint Research Centre

EUR 31555 EN

Contact information
Name: Andrea Toreti
Address: Via E. Fermi 2749, I-21027 ISPRA (VA), Italy
Email : Andrea.TORETI@ec.europa.eu

EU Science Hub
https://joint-research-centre.ec.europa.eu

JRC134081

EUR 31555 EN

PDF ISBN 978-92-68-04518-3 ISSN 1831-9424 doi:10.2760/883951 KJ-NA-31-555-EN-N

Luxembourg: Publications Office of the European Union, 2023



How to cite this report: Toreti, A., Bavera, D., Acosta Navarro, J., Arias Muñoz, C., Barbosa, P., de Jager, A., Di Ciollo, C., Fioravanti, G., Grimaldi, S., Hrast Essenfelder, A., Maetens, W., Magni, D., Masante, D., Mazzeschi, M., McCormick, N., Salamon, P., *Drought in the western Mediterranean May 2023*, Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/883951, JRC134081.

# Drought in the western Mediterranean - May 2023

JRC Global Drought Observatory (GDO) of the Copernicus Emergency Management Service (CEMS) – GDO/EDO data up to 20/05/2023

Executive summary ..... 1
Combined Drought Indicator (CDI) ..... 1
Standardized Precipitation Index (SPI) ..... 2
Temperature ..... 3
Soil moisture ..... 6
Vegetation biomass ..... 7
River Flow ..... 9
Large-scale atmospheric conditions ..... 10
Observed precipitation ..... 11
Seasonal forecast ..... 12
Reported impacts ..... 13
*Appendix: GDO and EDO indicators of drought-related information* ..... 14
*Glossary of terms and acronyms* ..... 15
*GDO and EDO indicators versioning* ..... 15
*Distribution* ..... 16
*List of Figures* ..... 16
*Authors* ..... 17

# Drought in the western Mediterranean - May 2023

JRC Global Drought Observatory (GDO) of the Copernicus Emergency Management Service (CEMS) – GDO/EDO data up to 20/05/2023

## Executive summary


- A severe drought is affecting the western Mediterranean, due to a persistent lack of precipitation and positive temperature anomalies for more than one year, and following exceptionally dry and warm late winter and spring conditions. Substantial negative anomalies of soil moisture, river flow and vegetation biomass have triggered extensive warning and alert conditions as signalled by the EDO's Combined Drought Indicator.
- Both in northern Africa and in the Iberian Peninsula, severe impacts on crops have been reported, with reduced and delayed sowing, and well below average yield forecast.
- Seasonal forecasts point to warmer than average early summer conditions over the western Mediterranean. Precipitation forecasts are characterized by higher spatial variability and uncertainty, even if a signal of wetter than normal conditions emerges in northern Africa. Close monitoring and proper water use plans are required, as summer 2023 currently has a high risk of being a critical period with respect to water resources.


## Combined Drought Indicator (CDI)

Dry conditions associated with severe impacts on the availability of water resources are affecting the western Mediterranean. The 2023 late spring conditions are worse than those in 2022, when a severe-to-extreme drought developed over Europe affecting water resources, agriculture and energy productions. [1]

The Combined Drought Indicator for mid-May 2023 shows widespread warning-to-alert conditions in Spain and Portugal, the southern Pyrenees, southern France, north-western Italy, Sardinia, and northern Africa (Fig. 1). [2]

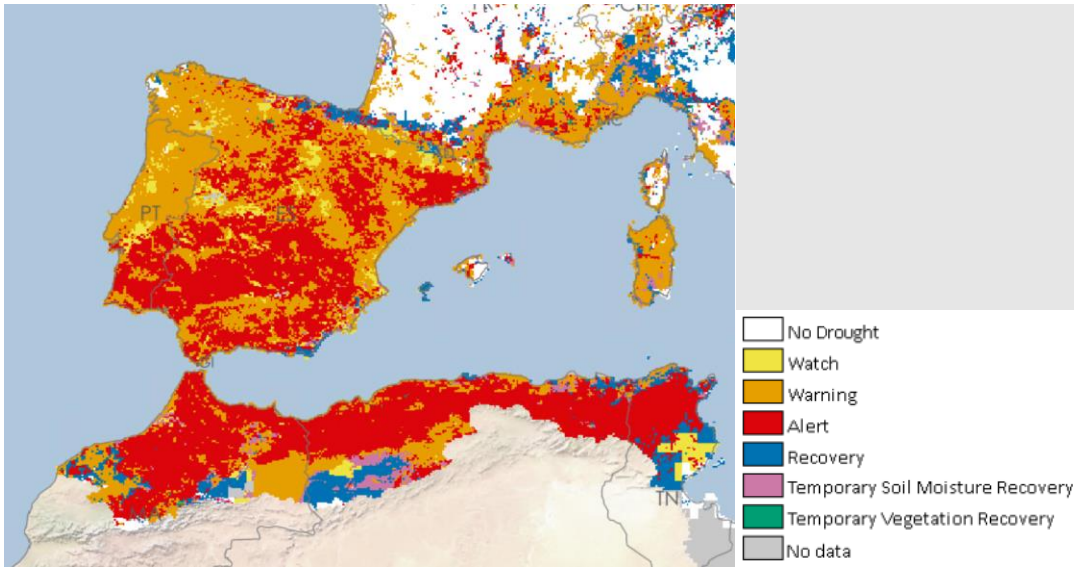



Figure 1: The Combined Drought Indicator (CDI), based on a combination of indicators of precipitation, soil moisture, and vegetation conditions, for mid-May 2023.[2]

[1] GDO/EDO Analytical Reports: https://edo.jrc.ec.europa.eu/documents/news/GDO-EDODroughtNews202204_Europe.pdf; https://edo.jrc.ec.europa.eu/documents/news/GDO-EDODroughtNews202207_Europe.pdf

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

# Drought in the western Mediterranean - May 2023

JRC Global Drought Observatory (GDO) of the Copernicus Emergency Management Service (CEMS) – GDO/EDO data up to 20/05/2023

The persistent lack of precipitation and warmer-than-average conditions have led to negative soil moisture and river flow anomalies, particularly in the Maghreb and in central-southern Iberian Peninsula. Vegetation and crops in the middle of the growing season have been significantly affected. The current situation may be exacerbated in the summer if warmer-than-average temperature and negative precipitation anomalies persist.

Figure 2 highlights the severity of the 2023 drought, looking at mid-May conditions, over central-southern Iberian Peninsula and northern Africa, with respect to 2021 and 2022. In 2021, CDI showed close to normal conditions in those regions, except northern Algeria. In 2022, drought affected western Maghreb, Portugal and northern Spain. In mid-May of 2021 and 2022, drought was more severely affecting other regions of Europe.[1]

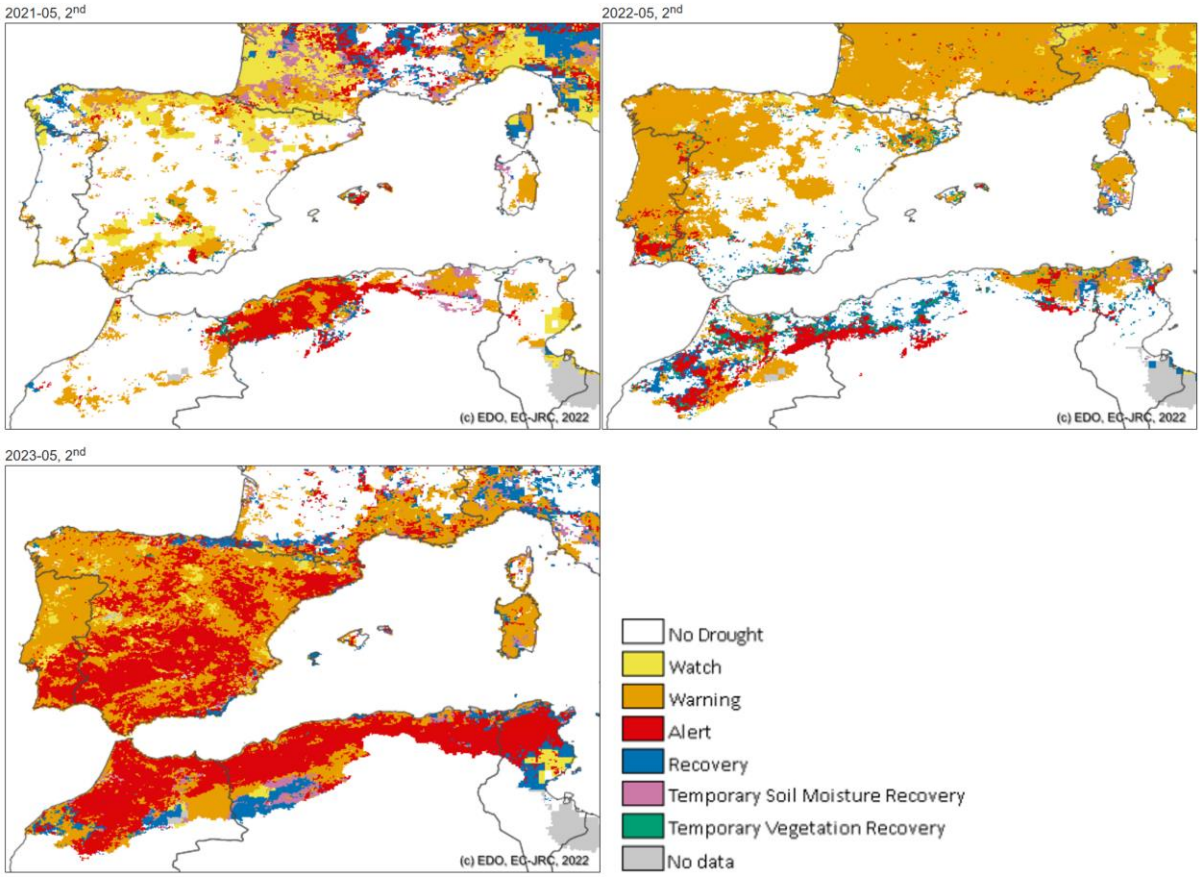



Figure 2: *The Combined Drought Indicator (CDI), based on a combination of indicators of precipitation, soil moisture, and vegetation conditions, for mid-May of 2021 (top-left), 2022 (top-right), and 2023 (bottom-left).*[2]

## Standardized Precipitation Index (SPI)

Persistent negative anomalies of precipitation have been affecting many parts of the western Mediterranean for more than a year. The SPI-12 (i.e. SPI computed for an accumulation period of 12 months) shows dry anomalies in most of northern Africa, central-southern Iberian Peninsula, the Pyrenees, and north-western Italy (Fig. 3). The SPI-3 (i.e. an accumulation period of 3 months) shows that the spring has been extremely dry in most of the Iberian Peninsula and northern Morocco (Fig. 4).[3]

[3] 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.

# Drought in the western Mediterranean - May 2023

JRC Global Drought Observatory (GDO) of the Copernicus Emergency Management Service (CEMS) – GDO/EDO data up to 20/05/2023

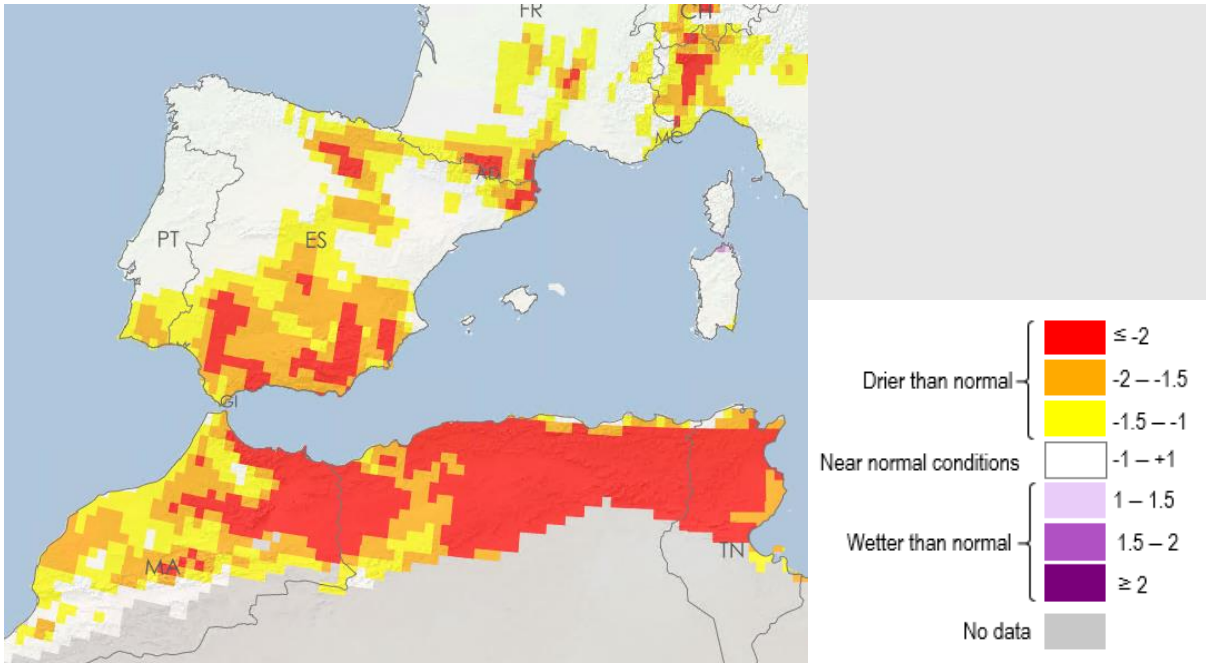



Figure 3: Standardized Precipitation Index (SPI-12), for the 12-month accumulation period ending in April 2023.[3]

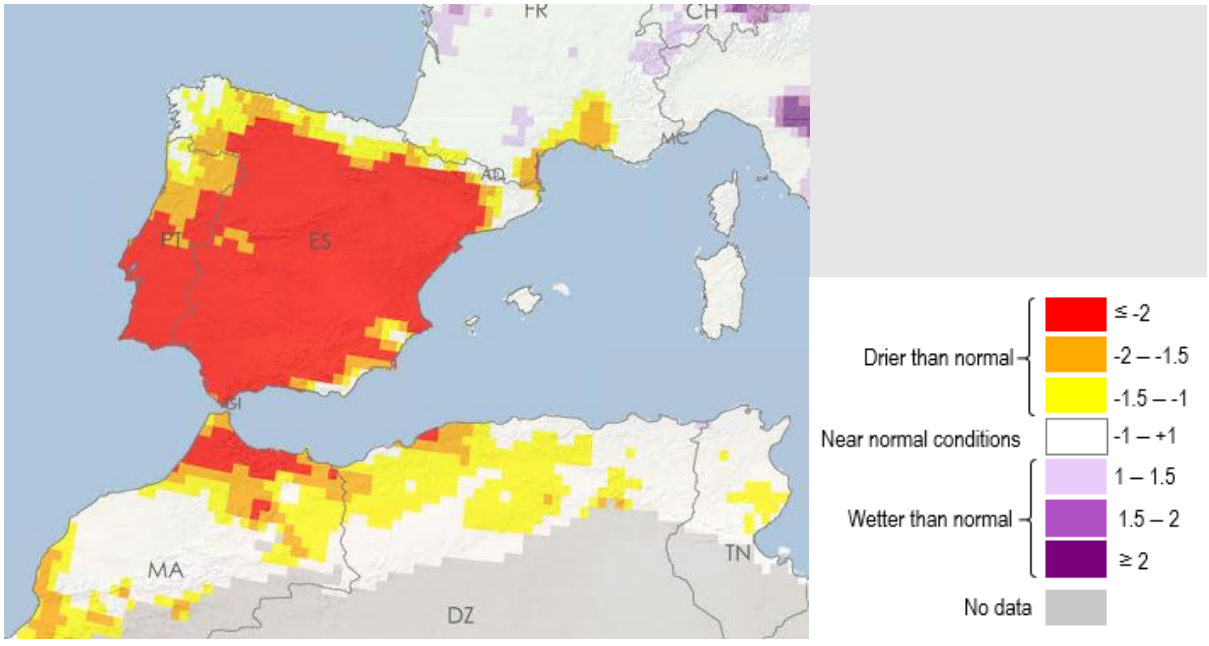



Figure 4: Standardized Precipitation Index (SPI-3) for the 3-month accumulation period ending on 20th May 2023.[3]

## Temperature

Most of the western Mediterranean experienced above-average temperatures from May 2022 to April 2023. In many places the yearly average temperature anomaly is 1.5 °C higher than average (1991-2020 baseline) and reaches values above 2.5 °C in northern Morocco, Algeria, southern Spain, southern France, and northern Italy (Fig. 5).

# Drought in the western Mediterranean - May 2023

JRC Global Drought Observatory (GDO) of the Copernicus Emergency Management Service (CEMS) – GDO/EDO data up to 20/05/2023

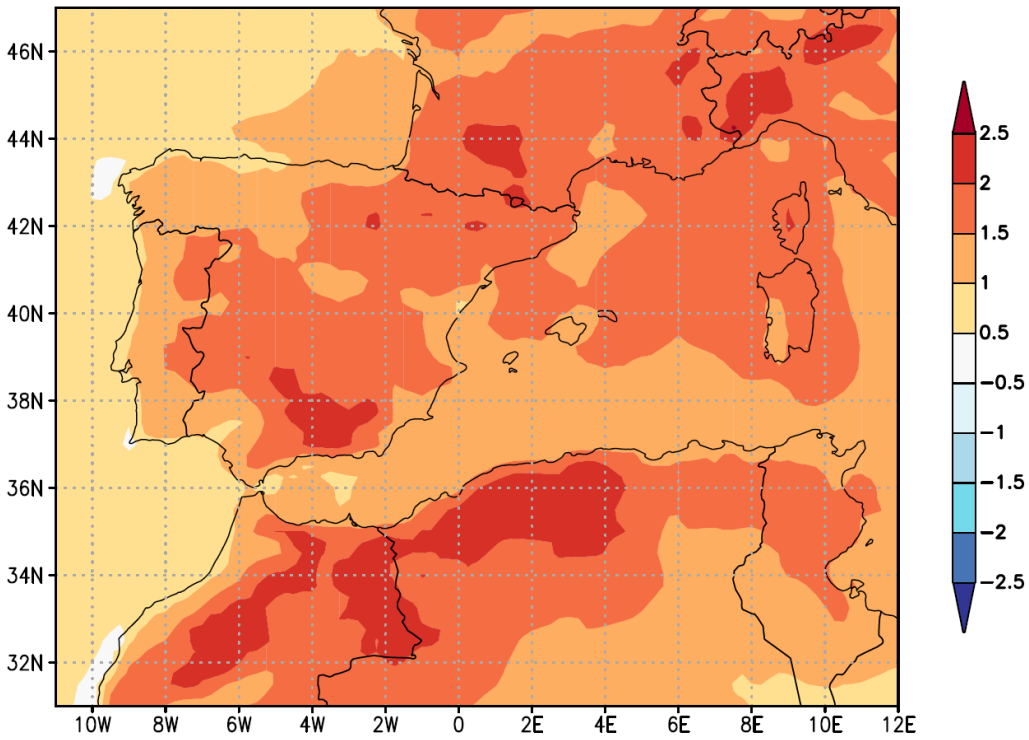



Figure 5: *Yearly average temperature anomaly (ERA5) computed for the period May 2022 to April 2023 (baseline 1991-2020). Source: The KNMI Climate Explorer.*[4]

In April 2023 the already warmer-than-average temperatures were exacerbated by intense heatwaves reaching anomalies higher than 4 °C compared to the 1991-2020 baseline over central-southern Iberian Peninsula and northern Morocco. The whole Iberian Peninsula and the Maghreb experienced anomalies higher than 2 °C (Fig. 6). These long-lasting and intense heatwaves worsened the effect on soil moisture content of the precipitation deficit.

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

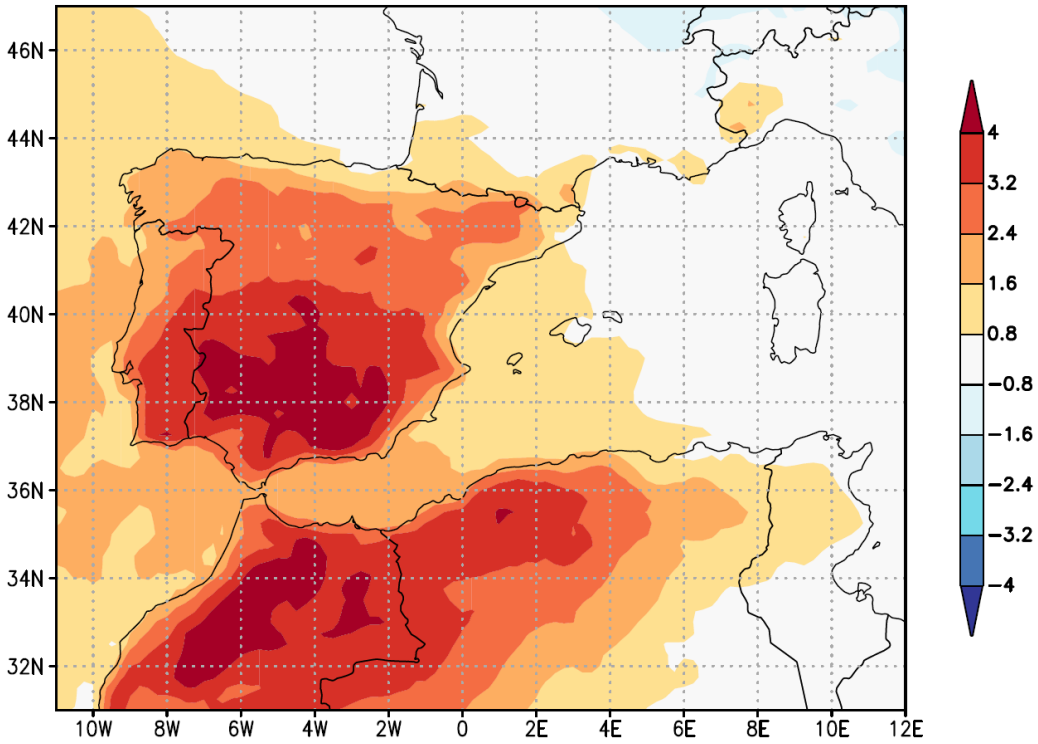



Figure 6: *Monthly average temperature anomaly (ERA5) computed for April 2023 (baseline 1991-2020). Source: The KNMI Climate Explorer.*[4]

On 28th April 2023, a severe, broad and long-lasting heatwave hit both the Iberian Peninsula and the Maghreb. According to the Heat and Cold Wave Index (HCWI)[5], the heatwave had a duration longer than 10 days in southern Spain and central Morocco (Fig. 7).

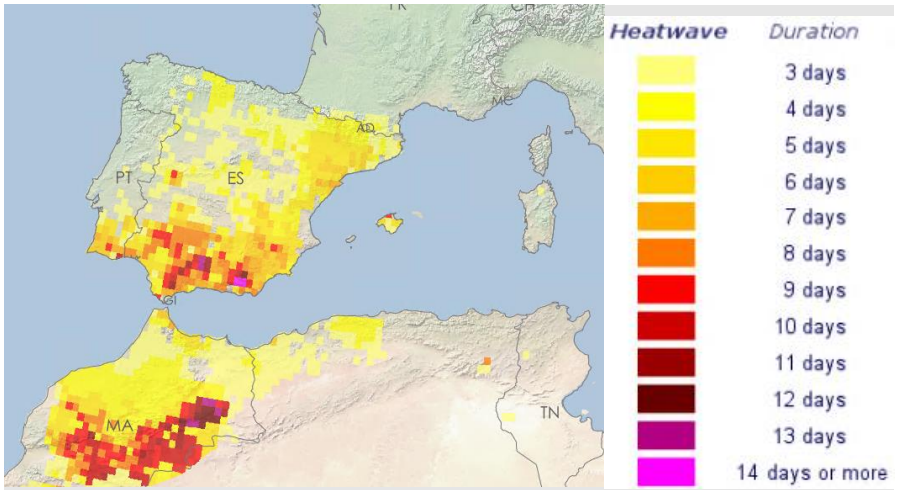



Figure 7: *Duration (in days) of the identified heatwave, according to the Heat and Cold Wave Index (HCWI). Yellow to purple colours represent increasing duration. Map issued for 28th April 2023.*[5]

[5] For more details on the Heat and Cold Wave Index (HCWI), and the other GDO and EDO indicators of drought-related information used in this report, see the Appendix at the end of the document.

## Soil moisture

In mid-May 2023, the Soil Moisture Anomaly was remarkably negative in the Iberian Peninsula, southern France, north-western Italy, Sardinia, northern Morocco, and northern Algeria (Fig. 8). This is a result of a combination of low precipitation and high temperatures in the previous months. The drier-than-normal soil moisture pattern is consistent with the precipitation deficit of the previous months (i.e. SPI-3, see Fig. 4). The regions with the strongest precipitation anomalies were also affected by high temperatures, which contributed in accelerating the water loss from the soil. Large areas show a Soil Moisture Anomaly below -2, corresponding to the driest class of the GDO indicator (Fig. 8).[6]

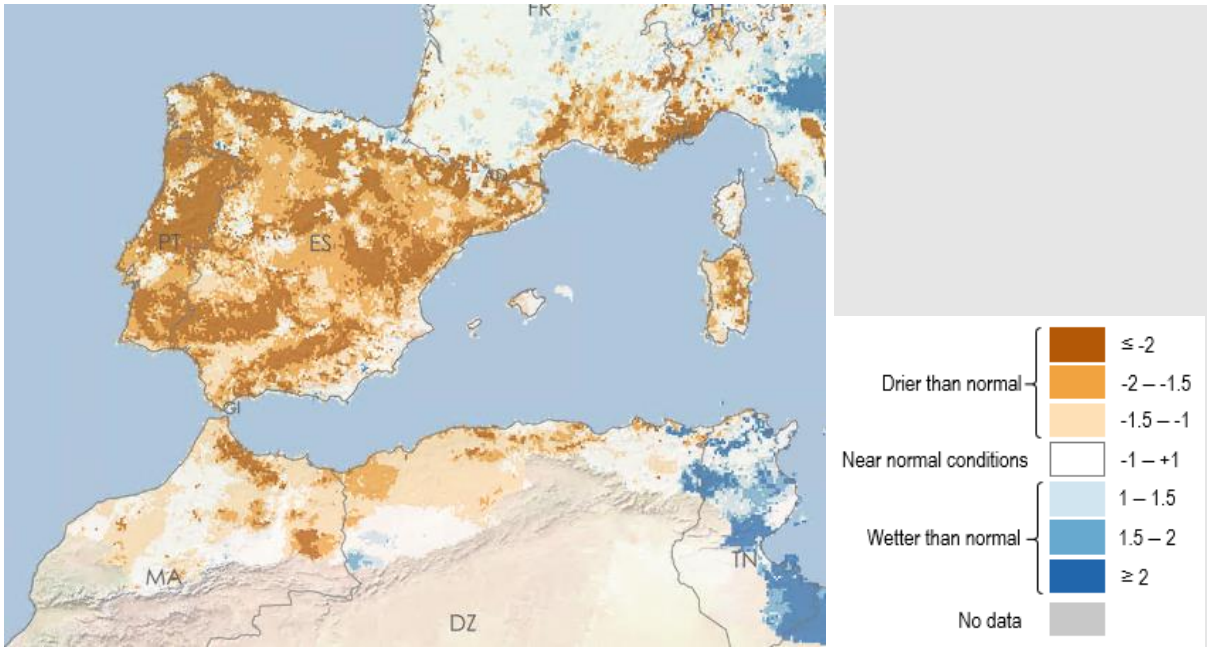



Figure 8: *Soil Moisture Anomaly for mid-May 2023.*[6]

The evolution of the Soil Moisture Anomaly, as shown in Figure 9, clearly highlights the severity, extent, and persistence of the dry conditions over the western Mediterranean. Wetter-than-normal soil conditions occurred only in June 2022 in central-northern Africa and in mid-winter in the Iberian Peninsula. The driest months were from May to August 2022 and April 2023. These starting conditions for the coming summer are critical for the crop growing season.

[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.

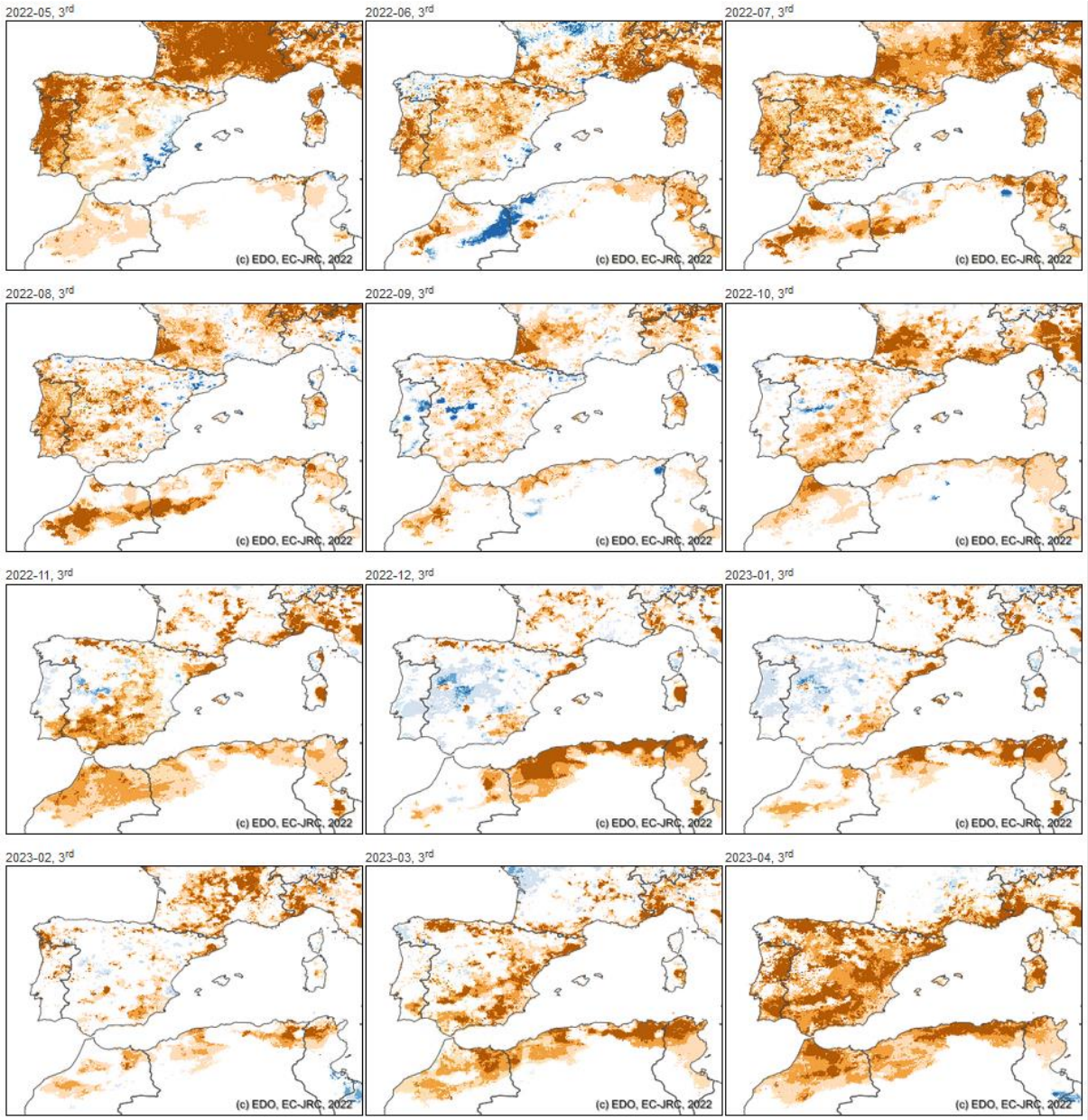



Figure 9: *Soil Moisture Anomaly from May 2022 to April 2023.*[6]

## Vegetation biomass

In mid-May 2023, the satellite-derived fAPAR anomaly indicator shows severe vegetation stress over the Iberian Peninsula (except for northern Portugal), northern Africa, and central-southern France (Fig. 10). These critical and widespread conditions are due to the combined severe lack of precipitation and higher-than-normal temperatures. [7]

[7] For more details on the satellite-derived 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.

# Drought in the western Mediterranean - May 2023

JRC Global Drought Observatory (GDO) of the Copernicus Emergency Management Service (CEMS) – GDO/EDO data up to 20/05/2023

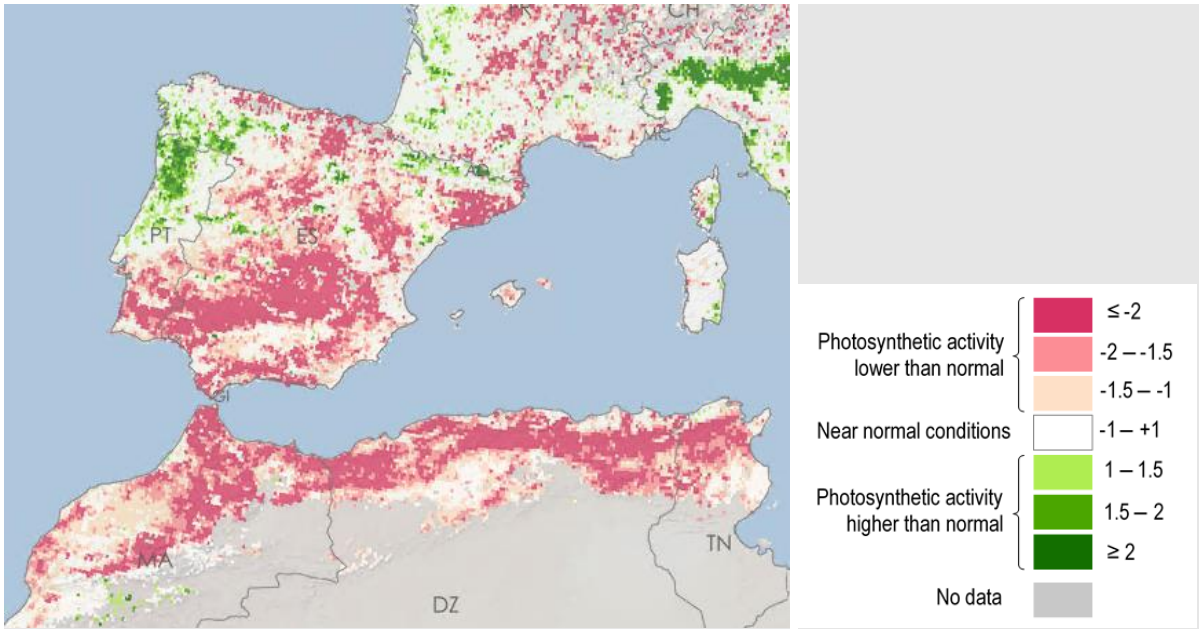



Figure 10: *Satellite-derived fAPAR anomaly indicator (measuring photosynthetic activity of vegetation), for mid-May 2023.*[7]

The evolution of the fAPAR anomaly from January to April 2023, shown in Figure 11, indicates a slow but progressive worsening of the vegetation stress in the Iberian Peninsula, starting from central Spain and expanding to southern Spain and Portugal. In northern Africa at the beginning of 2023 vegetation conditions were already critical mainly in central Maghreb (see also the GDO Report "Drought in the Magrheb and Türkiye – February 2023").[8] Subsequently, vegetation conditions have progressively worsened and expanded to the whole northern Africa region.

Dedicated information concerning agricultural yield forecast for Europe can be found in the JRC MARS Bulletin[9].

[8] GDO Report "Drought in the Magrheb and Türkiye – February 2023": https://edo.jrc.ec.europa.eu/documents/news/GDO-EDODroughtNews202302_Maghreb_Turkiye.pdf

9 https://joint-research-centre.ec.europa.eu/monitoring-agricultural-resources-mars/jrc-mars-bulletin_en

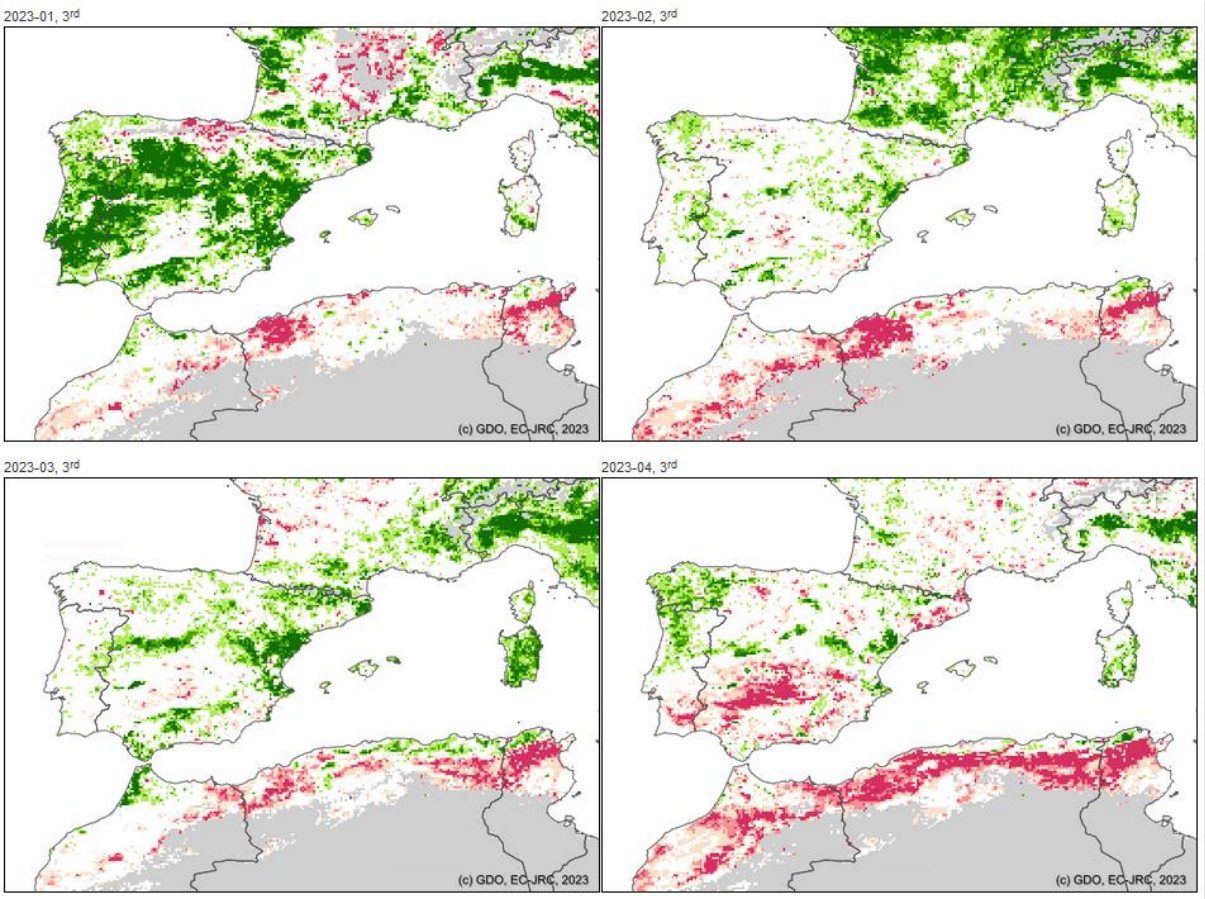



Figure 11: *Satellite-derived fAPAR anomaly indicator (measuring photosynthetic activity of vegetation), for the end of each month from January to April 2023.* [7]

## River Flow

At the beginning of May 2023, the Low-Flow Index (LFI) shows critical hazard values mainly over central-southern Spain, southern France, north-western Italy, and northern Africa (Fig. 12). The flow reduction clearly correlates with the severe lack of precipitation of the last months, as shown by the SPI-3 (Fig. 3).[10]

At the same date in 2021, river flows were close to normal values with only local exceptions in southern Spain, north-western Algeria, and southern Tunisia (Fig.13 left). In 2022 central Europe (France, and northern Italy in particular) were severely affected by river flow reduction. Less pronounced anomalies were visible in central Portugal and north-eastern Algeria (Fig. 13 right).

10 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.

# Drought in the western Mediterranean - May 2023

JRC Global Drought Observatory (GDO) of the Copernicus Emergency Management Service (CEMS) – GDO/EDO data up to 20/05/2023

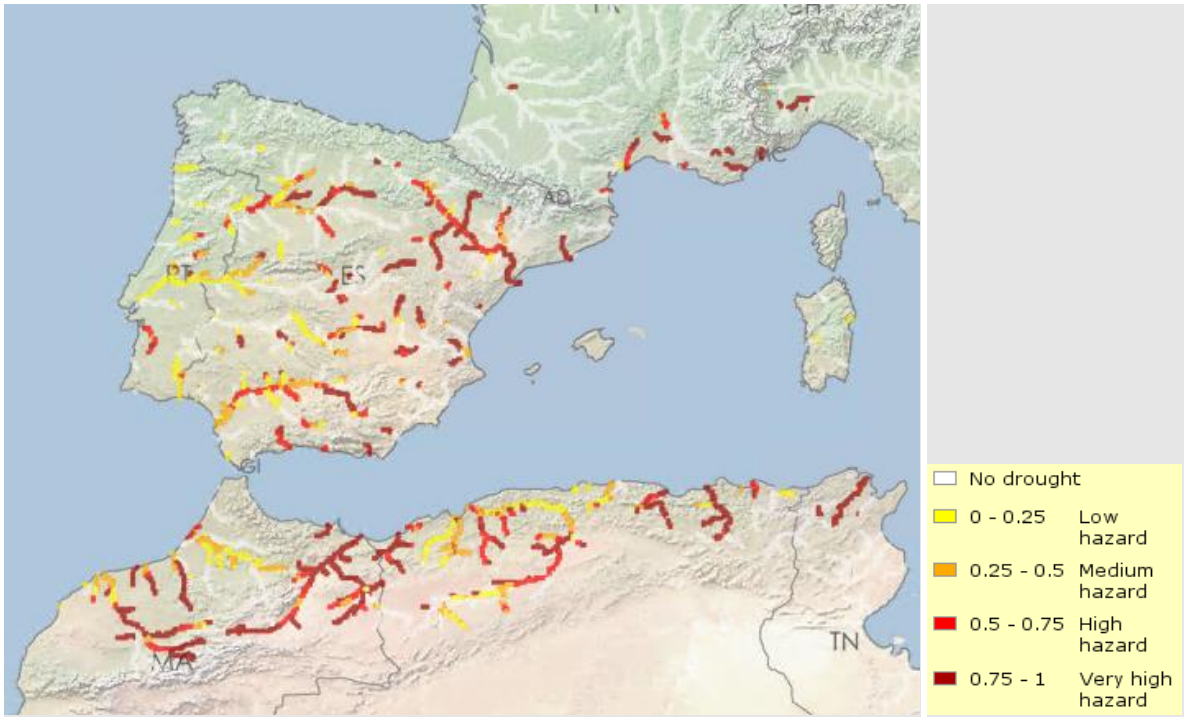



Figure 12: *Low-Flow Index (LFI) for mid-May 2023. LFI ranges from 0 (no drought) to 1 (very high drought hazard).*[10]

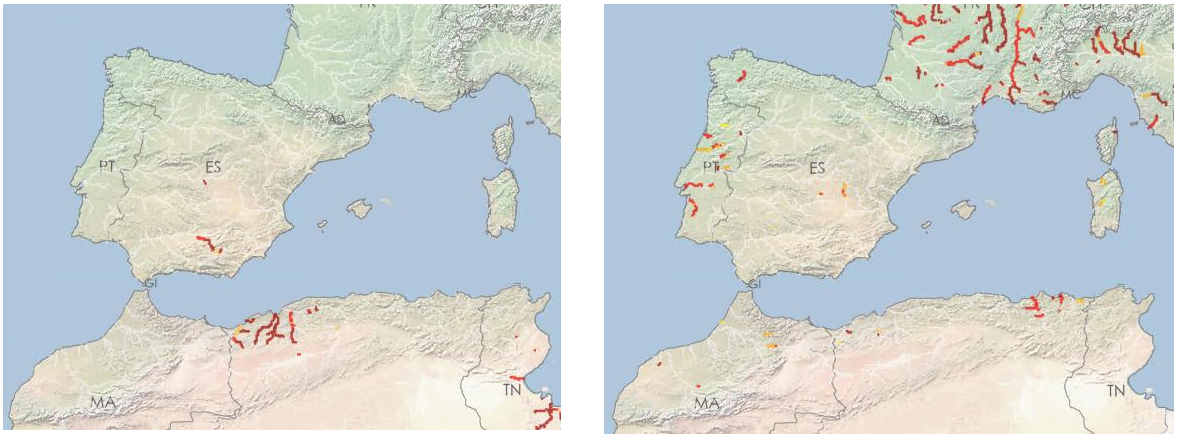



Figure 13: *Low-Flow Index (LFI) for mid-May 2021 (left) and 2022 (right). LFI ranges from 0 (no drought) to 1 (very high drought hazard).*[10]

## Large-scale atmospheric conditions

The past 3 months (i.e. from March to May 2023) have been characterized by anomalous anticyclonic circulation over the Iberian Peninsula and the western Maghreb, as part of a large-scale stationary wave pattern featuring cyclonic anomalies near the North Pole and subpolar North Atlantic, and anticyclone anomalies in the Canadian Archipelago / Greenland, Iberia / western Maghreb and western Russia (Fig. 14). The precipitation deficits (Fig. 4) and the above average temperatures (Figs. 6 and 7) during the boreal spring of 2023 are both most likely a response to the persistent anticyclonic circulation which displaces the storm systems coming from the North Atlantic and lead to stagnant air conditions in the western Mediterranean.

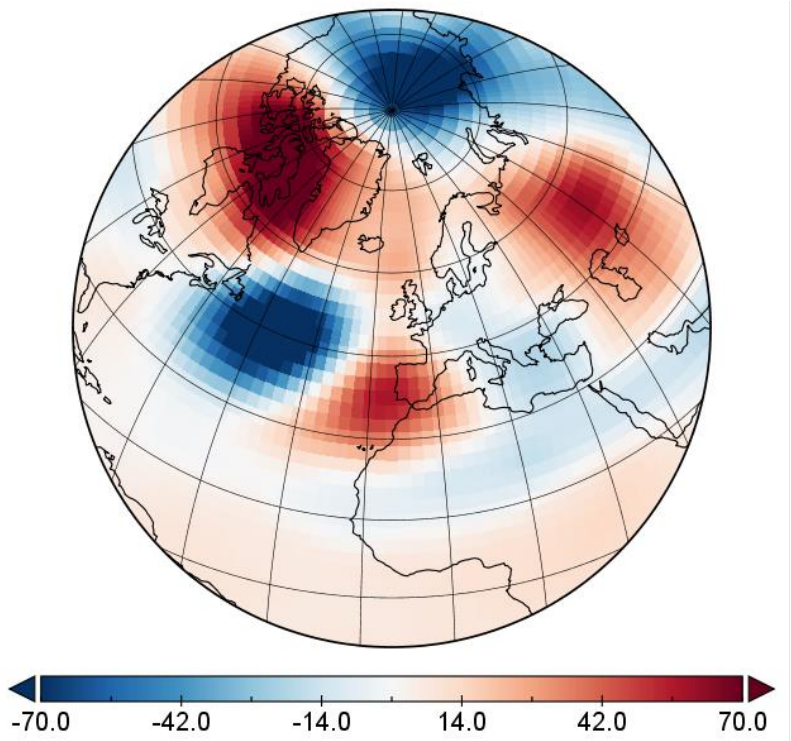



Figure 14*: Geopotential height anomaly (m) at 500 hPa for the period 1.3.2023 – 27.5.2023. The reference climatology is 1991-2020. Data source: NCEP reanalysis.*[11]

## Observed precipitation

During the period 18 to 31 May 2023, from 30 to more than 100 mm precipitation have been observed over central-southern Spain, Pyrenees, southern France, north-western Italy, and northern Africa (Fig 15). This has improved the soil moisture anomaly in corresponding regions with higher precipitation, and could give partial and temporary relief to vegetation in the subsequent weeks. Nevertheless, the precipitation amount is not enough to counterbalance the strong and persistent deficit cumulated in the previous months.

[11] US National Centers for Environmental Prediction (NCEP): http://www.ncep.noaa.gov

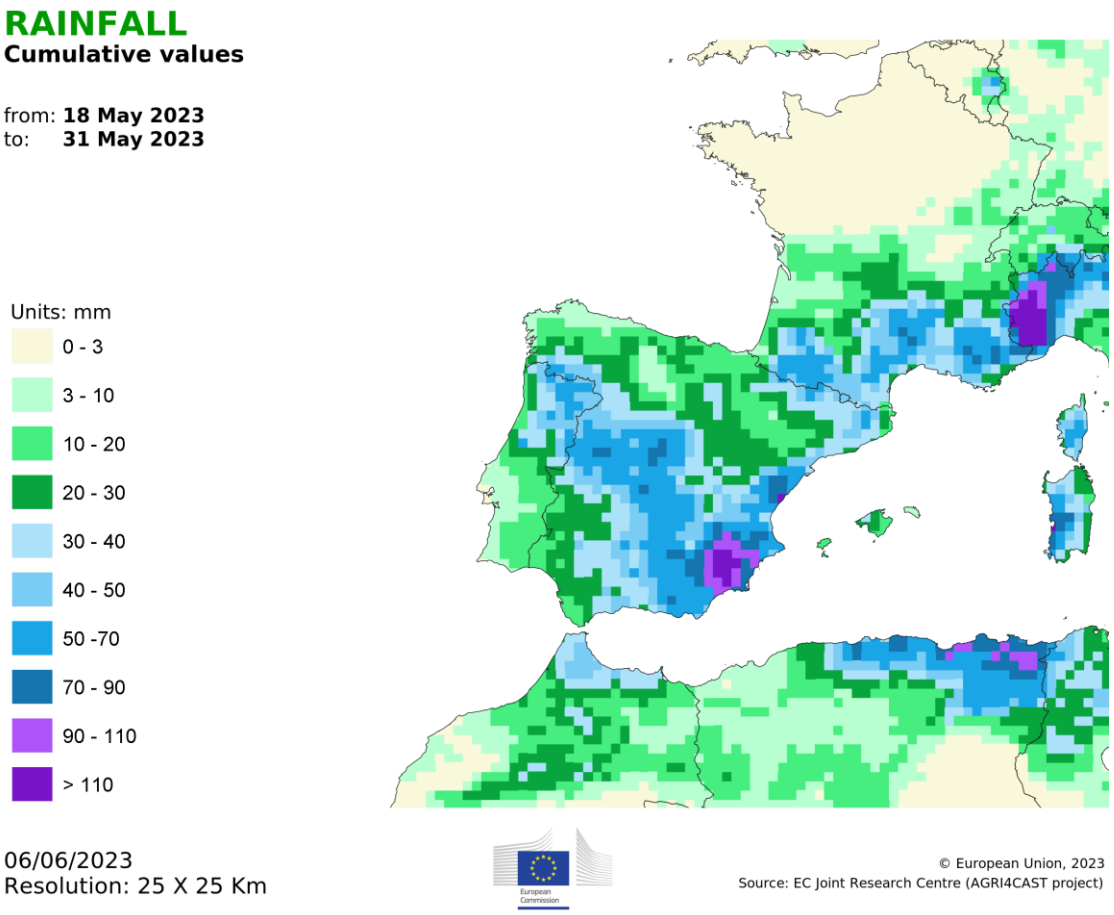



Figure 15*: Cumulative precipitation from 18 to 31 May 2023. Source: EC JRC AGRI4CAST project.*[12]

## Seasonal forecast

From May to July 2023, drier than average conditions (compared to the 1981-2016 baseline) are predicted in the Iberian Peninsula and northern Morocco, as shown in Figure 16. Close to average or slightly wetter conditions are predicted for southern France, northern Italy, Tunisia, Algeria, and southern Morocco. According to the Copernicus C3S seasonal forecasts[13], up to August 2023 warmer than usual conditions are likely to occur in the western Mediterranean, with large positive anomalies and higher values over the Iberian Peninsula, Algeria, Tunisia, and the Mediterranean islands. Precipitation forecasts are for close to average conditions, or slightly wetter mainly in northern Africa, However, some variability between models is evident. Close monitoring is required to better understand the impacts expected for the coming season.

[12] https://agri4cast.jrc.ec.europa.eu/

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

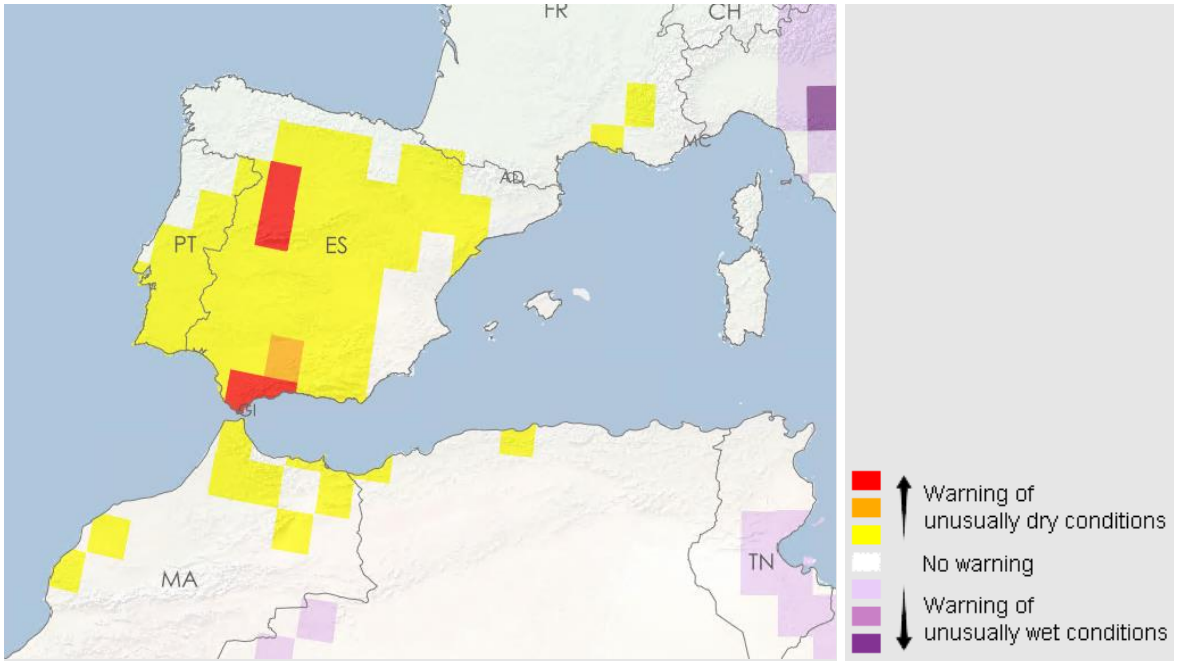



Figure 16: *Indicator for Forecasting Unusually Wet and Dry Conditions, for May to July 2023 (based on ECMWF SEAS5).*[14]

## Reported impacts

In May 2023 the Global JRC Mars Bulletin reported that the drought in the Maghreb was the worst seasonal drought in recent decades. Yield forecast worsened further and are well-below average levels. As the severe drought in March and April affected the winter cereals, crop flowering failures are likely to occur in Morocco, Algeria and Tunisia. [15]

In May 2023, the European JRC Mars Bulletin reported that the intensified drought conditions in the Iberian Peninsula worsened the yield forecast well below 2022 values. Winter and spring crops have been affected, and the canopy resembles summer conditions. Winter crops will only be partially harvested as grain. Part of these has been harvested already as fodder. Areas sown with summer crops are substantially reduced. [16]

Water reservoir storage in Spain is already below the level of the same period in 2022, corresponding to less than half of the total capacity.[17] In Portugal water storage is still good, generally close to the capacity, worsening in the southern regions. [18]

[14] 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.

[15] JRC MARS Bulletin - Global outlook - Crop monitoring European neighbourhood - Morocco, Algeria, Tunisia, Libya and Egypt - May 2023 https://publications.jrc.ec.europa.eu/repository/handle/JRC133197

[16] JRC MARS Bulletin - Crop monitoring in Europe - May 2023 - Vol. 31 No 5 https://publications.jrc.ec.europa.eu/repository/handle/JRC133185

[17] https://www.embalses.net/

[18] https://sir.dgadr.gov.pt/reservas

About 90% of Portugal is affected by drought. Severe conditions are hitting 20% of the territory, five times more than in the previous year. The most affected regions are in northern and central Portugal, Alentejo, and the eastern part of the Algarve in the south. According to the Portuguese Farmers Confederation, cereal production and livestock are the most affected sectors. In Spain, the lack of precipitation is making water management more complex, in particular in Andalusia where water reservoirs are at about 25% of capacity.[19]

In Spain, the water level of the Tagus (the longest river in Iberian Peninsula) dropped to an extremely low depth. The government decided to modify the water management, limiting the flow to the south-eastern Levante. The scarce water resources and the difficult management could severely affect agriculture.[20]

Spain, Portugal, Morocco and Algeria have all broken temperature records during April 2023. Temperatures of almost 39 °C were recorded in Spain, above 41 °C in Morocco and 40 °C in Algeria. Spain has not only recorded its warmest April in 2023, but also its driest since 1961.[21]

## *Appendix: GDO and EDO indicators of drought-related information*

The Combined Drought Indicator (CDI) of the European Drought Observatory (EDO) is used to identify areas that may be affected by agricultural drought. The CDI is derived by combining the Standardized Precipitation Index (SPI), the Soil Moisture Index Anomaly (SMA), and the FAPAR anomaly. Areas are classified according to three primary drought classes: (1) "Watch", indicating less than normal precipitation; (2) "Warning", indicating that also soil moisture is in deficit; (3) "Alert", indicating that also vegetation shows signs of stress. Three additional classes – i.e. "Recovery", "Temporary Soil Moisture Recovery" and "Temporary FAPAR Recovery" – identify the stages of drought recovery processes in terms of impacts on soil moisture and vegetation.

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 Heat and Cold Wave Index (HCWI) is used to detect and monitor periods of extreme-temperature anomalies (i.e., heat and cold waves) that can have strong impacts on human activities, health and ecosystem services such as sprouting of crops. It is based on the persistence for at least three consecutive days of events with both daily minimum and maximum temperatures (Tmin and Tmax) above the 90th percentile daily threshold (for heat waves) or below the 10th percentile daily threshold (for cold waves). For each location, the daily threshold values for Tmin and Tmax are derived from a 30-year climatological baseline period (1991-2020), using the GloFAS/ERA5 derived temperature data.

Lack of precipitation induces a reduction of soil water content. The Soil Moisture 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.

[19] https://www.reuters.com/world/europe/severe-drought-spreads-portugal-officials-seek-eu-help-2023-05-10/

[20] https://www.euronews.com/green/2023/05/03/murcias-farmers-fear-desertification-as-spain-cuts-water-supplies-from-river-tagus

[21] https://www.france24.com/es/minuto-a-minuto/20230505-la-reciente-ola-de-calor-en-espa%C3%B1a-y-portugal-atribuible-al-cambio-clim%C3%A1tico-seg%C3%BAn-los-expertos

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 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 Indicator for Forecasting Unusually Wet and Dry Conditions provides early risk information for Europe. The indicator is computed from forecasted SPI-1, SPI-3, and SPI-6 derived from the ECMWF seasonal forecast system SEAS5.

Check https://edo.jrc.ec.europa.eu/factsheets for more details on the GDO and EDO indicators.

## *Glossary of terms and acronyms*

| | |
|---|---|
| ASAP | Anomaly Hotspots of Agricultural Production |
| CEMS | Copernicus Emergency Management Service |
| EDO | European Drought Observatory |
| EC | European Commission |
| ECMWF | European Centre for Medium-Range Weather Forecasts |
| ERA5 | ECMWF Reanalysis v5 |
| ERCC | European Emergency Response Coordination Centre |
| fAPAR | Fraction of Absorbed Photosynthetically Active Radiation |
| GDO | Global Drought Observatory |
| GloFAS | Global Flood Awareness System |
| GRACE | Gravity Recovery and Climate Experiment |
| JRC | Joint Research Centre |
| LFI | Low-Flow Index |
| MARS | Monitoring Agricultural Resources |
| SMA | Soil Moisture Anomaly |
| SPI | Standardized Precipitation Index |
| TWS | Total Water Storage |
| 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* |
|---|---|
| ▪ Combined Drought Indicator (CDI) | *v.3.0.1* |
| ▪ Low-Flow Index (LFI) | *v.2.1.0* |
| ▪ Soil Moisture Index (SMI) Anomaly (SMA) | *v.2.1.2* |
| ▪ fAPAR (fraction of Absorbed Photosynthetically Active Radiation) Anomaly (VIIRS) | *v.1.0.0* |
| ▪ Indicator for Forecasting Unusually Wet and Dry Conditions | *v .1.1.0* |
| ▪ Standardized Precipitation Index (SPI) | *v.1.0.0* |
| ▪ Heat and Cold Wave Index (HCWI) | *v.1.0.0* |

Check https://edo.jrc.ec.europa.eu/download for more details on GDO and EDO indicator versions.

# Drought in the western Mediterranean - May 2023

JRC Global Drought Observatory (GDO) of the Copernicus Emergency Management Service (CEMS) – GDO/EDO data up to 20/05/2023

## Distribution

*For use by the ERCC and related partners, and publicly available for download at GDO website: https://edo.jrc.ec.europa.eu/reports*

## List of Figures

Figure 1: The Combined Drought Indicator (CDI), based on a combination of indicators of precipitation, soil moisture, and vegetation conditions, for mid-May 2023.[2] ..... 1
Figure 2: The Combined Drought Indicator (CDI), based on a combination of indicators of precipitation, soil moisture, and vegetation conditions, for mid-May of 2021 (top-left), 2022 (top-right), and 2023 (bottom-left).[2] ..... 2
Figure 3: Standardized Precipitation Index (SPI-12), for the 12-month accumulation period ending in April 2023.[3] ..... 3
Figure 4: Standardized Precipitation Index (SPI-3) for the 3-month accumulation period ending on 20th May 2023.[3] ..... 3
Figure 5: Yearly average temperature anomaly (ERA5) computed for the period May 2022 to April 2023 (baseline 1991-2020). Source: The KNMI Climate Explorer. ..... 4
Figure 6: Monthly average temperature anomaly (ERA5) computed for April 2023 (baseline 1991-2020). Source: The KNMI Climate Explorer.[4] ..... 5
Figure 7: *Duration (in days) of the identified heatwave, according to the Heat and Cold Wave Index (HCWI). Yellow to purple colours represent increasing duration. Map issued for 28th April 2023.* [5] ..... 5
Figure 8: Soil Moisture Anomaly for mid-May 2023. [6] ..... 6
Figure 9: Soil Moisture Anomaly from May 2022 to April 2023.[6] ..... 7
Figure 10: Satellite-derived fAPAR anomaly indicator (measuring photosynthetic activity of vegetation), for mid-May 2023.[7] ..... 8
Figure 11: Satellite-derived fAPAR anomaly indicator (measuring photosynthetic activity of vegetation), for the end of each month from January to April 2023. [7] ..... 9
Figure 12: Low-Flow Index (LFI) for mid-May 2023. LFI ranges from 0 (no drought) to 1 (very high drought hazard).[10] ..... 10
Figure 13: Low-Flow Index (LFI) for mid-May 2021 (left) and 2022 (right). LFI ranges from 0 (no drought) to 1 (very high drought hazard).[10] ..... 10
Figure 14: Geopotential height anomaly (m) at 500 hPa for the period 1.3.2023 – 27.5.2023. The reference climatology is 1991-2020. Data source: NCEP reanalysis. ..... 11
Figure 15: Cumulative precipitation from 18 to 31 May 2023. Source: EC JRC AGRI4CAST project. ..... 12
Figure 16: Indicator for Forecasting Unusually Wet and Dry Conditions, for May to July 2023 (based on ECMWF SEAS5) ..... 13

# Drought in the western Mediterranean - May 2023

JRC Global Drought Observatory (GDO) of the Copernicus Emergency Management Service (CEMS) – GDO/EDO data up to 20/05/2023

## *Authors*

European Commission, Joint Research Centre, Dir. E Space, Security & Migration, Disaster Risk Management Unit - Drought Team

*Toreti A.*[i] *(Team Leader)*
*Bavera D.*[ii]
*Acosta Navarro J.*[i]
*Arias Muñoz C.*[iii]
*Barbosa P.*[i]
*de Jager A.*[i]
*Di Ciollo C.*[iv]
*Fioravanti G.*[i]
*Hrast Essenfelder A.*[i]
*Maetens W.*[i]
*Masante D.*[i]
*Magni D.*[ii]
*Mazzeschi M.*[iv]

European Commission, Joint Research Centre, Dir. E Space, Security & Migration, Disaster Risk Management Unit - Floods Team

*Salamon P.*[i] *(Team Leader)*
*McCormick N.*[i]
*Grimaldi S.*[i]



[i] European Commission Joint Research Centre, Ispra, Italy
[ii] Arcadia SIT, Vigevano, Italy
[iii] NRB, Italy
[iv] Uni Systems, Luxembourg

GETTING IN TOUCH WITH THE EU

### In person

All over the European Union there are hundreds of Europe Direct centres. You can find the address of the centre nearest you online (european-union.europa.eu/contact-eu/meet-us_en).

### On the phone or in writing

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

— by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

— at the following standard number: +32 22999696,

— via the following form: european-union.europa.eu/contact-eu/write-us_en.

FINDING INFORMATION ABOUT THE EU

### Online

Information about the European Union in all the official languages of the EU is available on the Europa website (european-union.europa.eu).

### EU publications

You can view or order EU publications at op.europa.eu/en/publications. Multiple copies of free publications can be obtained by contacting Europe Direct or your local documentation centre (european-union.europa.eu/contact-eu/meet-us_en).

### EU law and related documents

For access to legal information from the EU, including all EU law since 1951 in all the official language versions, go to EUR-Lex (eur-lex.europa.eu).

### Open data from the EU

The portal data.europa.eu provides access to open datasets from the EU institutions, bodies and agencies. These can be downloaded and reused for free, for both commercial and non-commercial purposes. The portal also provides access to a wealth of datasets from European countries.

# Science for policy

The Joint Research Centre (JRC) provides independent, evidence-based knowledge and science, supporting EU policies to positively impact society

**EU Science Hub**
joint-research-centre.ec.europa.eu

@EU_ScienceHub
EU Science Hub - Joint Research Centre
EU Science, Research and Innovation
EU Science Hub
@eu_science

Publications Office
of the European Union