

Table of Contents

Executive summary – Update to August 2018.....	1
Combined Drought Indicator (CDI)	2
Precipitation and Standardized Precipitation Index (SPI).....	2
Temperature	4
Soil Moisture Anomaly (SMA).....	5
Low Flow Index (LFI).....	7
Vegetation Productivity (fAPAR) Anomaly	8
Reported impacts of the current drought and high temperatures	8
Information sources.....	10

Executive Summary – Update to August 2018

This document builds on the previous report published in July 2018 by EDO¹, please refer to it for more insight on the precipitation pattern and causes that led to the ongoing drought.

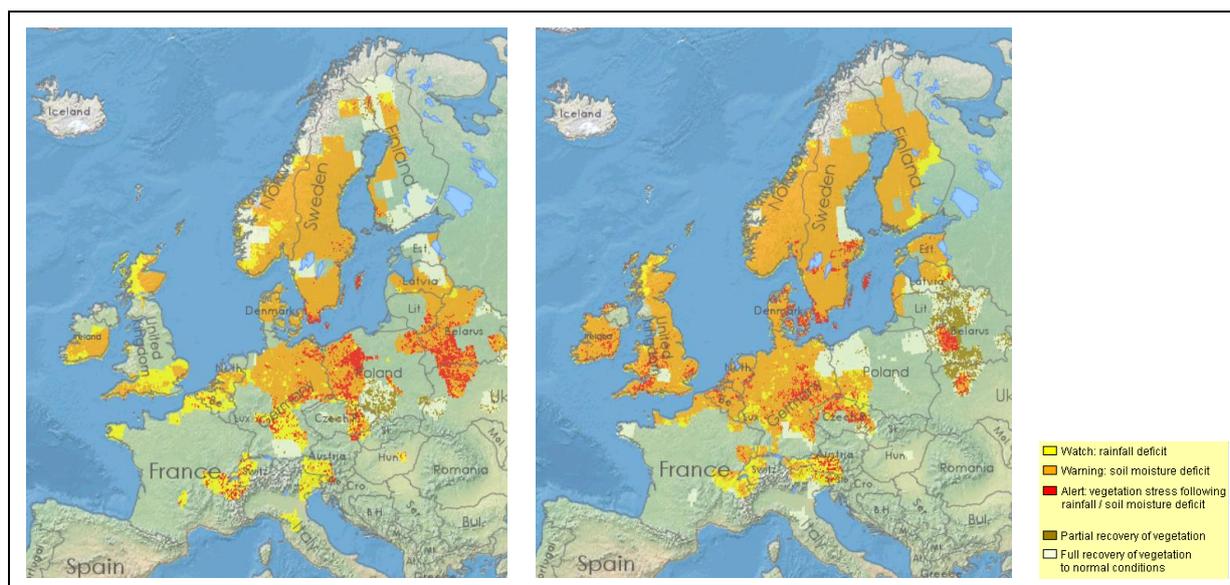
- Recorded precipitation during July was below or much below normal in many areas of north-central Europe, and around average or above elsewhere.
- Soil moisture deficits worsened in central Europe, and improved slightly in parts of Scandinavia, the UK and Ireland. Elsewhere, deficits persisted at the level of June.
- Water levels in rivers dropped in central Europe. In particular, flows decreased for long sections of the Rhine and its tributaries, with consequent issues for transportation.
- Sustained heatwaves were recorded in several locations, but most remarkable in the Iberian Peninsula.
- Fire hazard increased or stayed at the maximum across most of Europe.
- In combination with high temperatures, drought affected the agriculture, energy and water transportation sectors. High water temperatures further led to impacts on water quality and fish populations.

¹ http://edo.jrc.ec.europa.eu/documents/news/EDODroughtNews201807_Central_North_Europe.pdf

Combined Drought Indicator (CDI)

EDO's Combined Drought Indicator (CDI) is based on the analysis of precipitation, soil moisture and the fraction of Absorbed Photosynthetically Active Radiation (fAPAR), to identify areas that are at potential risk to suffer drought, areas where drought manifests through a significant soil moisture deficit, and areas where vegetation is already affected by drought conditions. Finally, areas in the process of recovery to normal conditions after a drought episode are shown.

Compared to the previous assessment at the end of June, the situation worsened over Scandinavia, and significantly over Ireland and the UK, where the drought affected areas extended over Wales and mid-northern England and intensified in the previously affected areas. Drought-affected areas further extended to south-west Germany as well as to northern France, while the situation improved in Poland and Belarus. In the other areas, the CDI remained stable with minor geographical shifts (**Figure 1**).



21st to 30st of June 2018

21st to 31st of July 2018

Figure 1: The Combined Drought Indicator (CDI) for the last dekad of June 2018 (left) and the last dekad of July 2018 (right).

Precipitation and Standardized Precipitation Index (SPI)

A persistent condition of high pressure (anticyclone) resulted in a prolonged period of sunny and dry weather over most of central and northern Europe. **Figure 2** shows the monthly precipitation totals for selected stations across Europe, demonstrating that rainfall has been consistently lower than normal for several months. **Figures 3** shows the SPI Indicator, which measures precipitation anomalies with respect to the long-term historic rainfall record for

July 2018 (**Figure 3, left**) and for the accumulation period May to July 2018 (**Figure 3, right**). The lower (more negative) the SPI, the more intense is the drought.

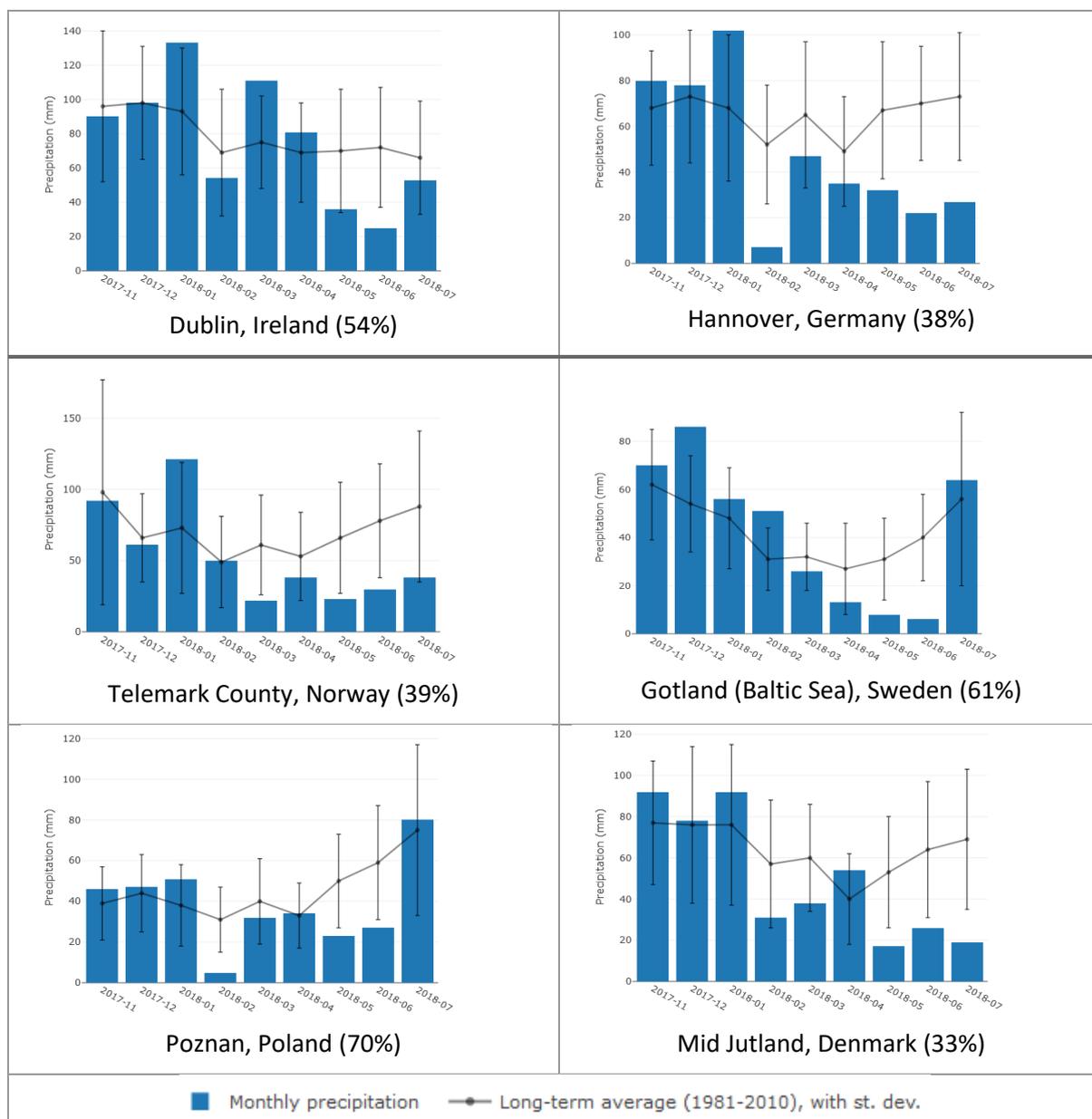


Figure 2: Monthly precipitation form November 2017 to July 2018 in selected locations. Percentage of total precipitation compared to the expected average of trimester May-July is shown in parentheses. Bars show observed monthly precipitation (mm). Lines show long-term monthly average with one standard deviation.

July recorded abundant precipitation to the drought-affected regions on the southeast of the Baltic Sea, and about normal values for southern Norway, Ireland and the UK. On the contrary, southern Sweden, Denmark (esp. Jutland), Belgium, the Netherlands, central

Germany and parts of Czech Republic received less or much less rainfall than the long term average for the same month (**Figures 2 and Figure 3, left**).

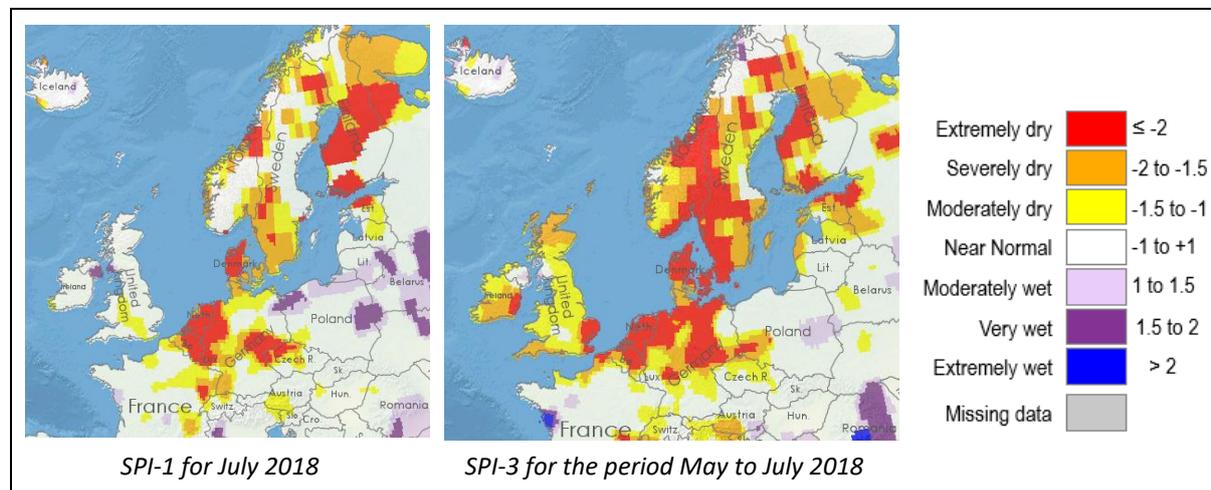


Figure 3: Standardized Precipitation Index (SPI), showing the precipitation anomalies with respect to the long-term average.

The precipitation anomaly for the trimester May-July 2018 (SPI-3, **Figure 3 right**) shows a relief to the drought affected regions on the southeast of the Baltic Sea, which is due to the precipitation in July. However, compared to the situation reported in the previous report from July 2018, the precipitation deficit generally increased over southern Sweden, central Germany, Ireland and all the areas surrounding the North Sea.

Temperature

High temperatures massively increase the rate of evaporation of water from the surface, and cause a much higher water demand for consumption. Therefore, heatwaves contribute substantially to drought severity, even in absence of strong rainfall deficits.

At the end of July, high temperature anomalies were recorded for several consecutive days along a belt crossing Europe from south-west to north-east (**Figure 4**), up to about a week for most locations.

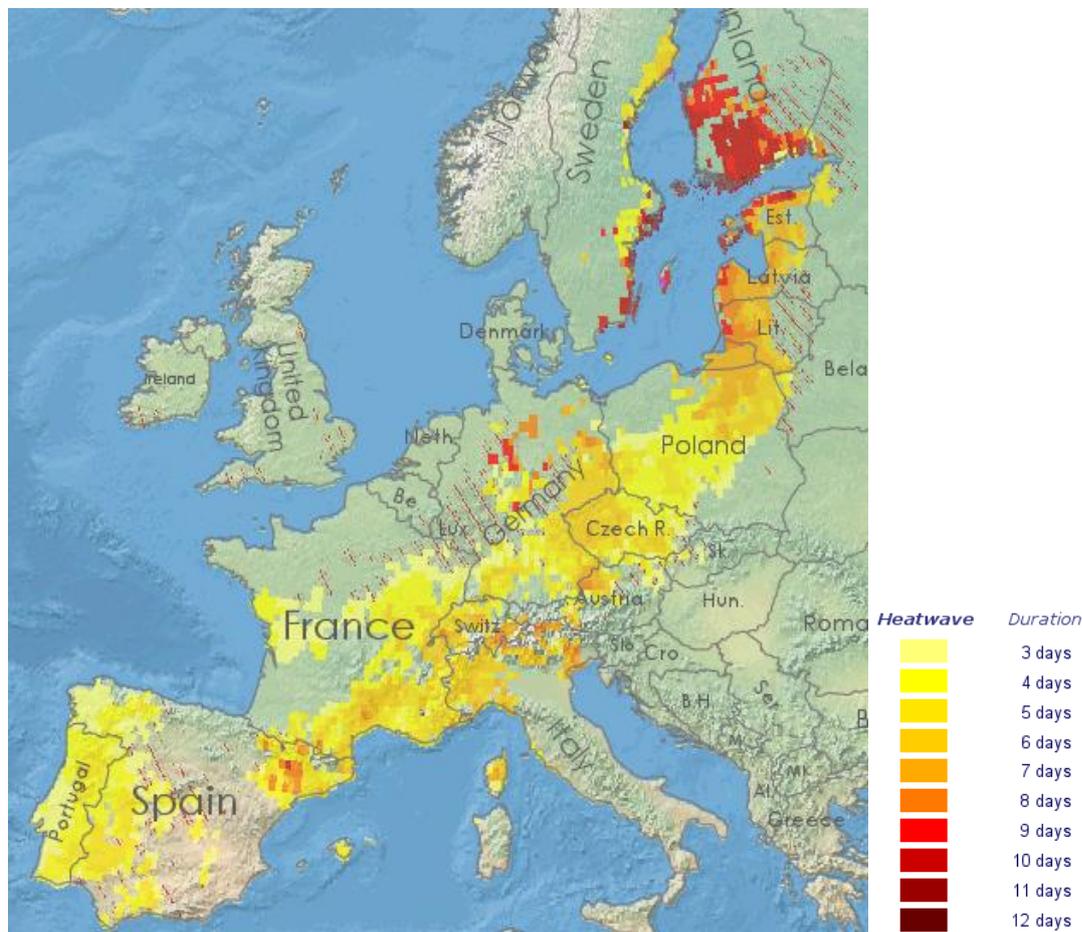


Figure 4: Duration of temperature anomalies as of 3rd of August 2018. A heatwave is mapped when a minimum of three consecutive days record temperatures above the long-term 95 percentile threshold. The map shows the number of consecutive days with temperatures above this threshold. Areas hatched with red lines are above the threshold since less than three consecutive days.

Soil Moisture Anomaly (SMA)

The Soil Moisture Anomaly (SMA) indicator provides an assessment of the top soil water content, which is a direct measure of drought conditions, specifically the difficulty for plants to extract water from the soil.

Compared to mid-July (**Figure 5**), soil moisture recovered to a varying degree in the UK, Ireland and Scandinavia in early August (**Figure 6**) and projections suggest a further recovery to mid-August (**Figure 7**). On the other hand, the soil moisture deficit spread further in central Europe towards south and west (France, Switzerland, Czech Republic, and Austria). No recovery is foreseen for Germany and the Benelux region up until mid-August.

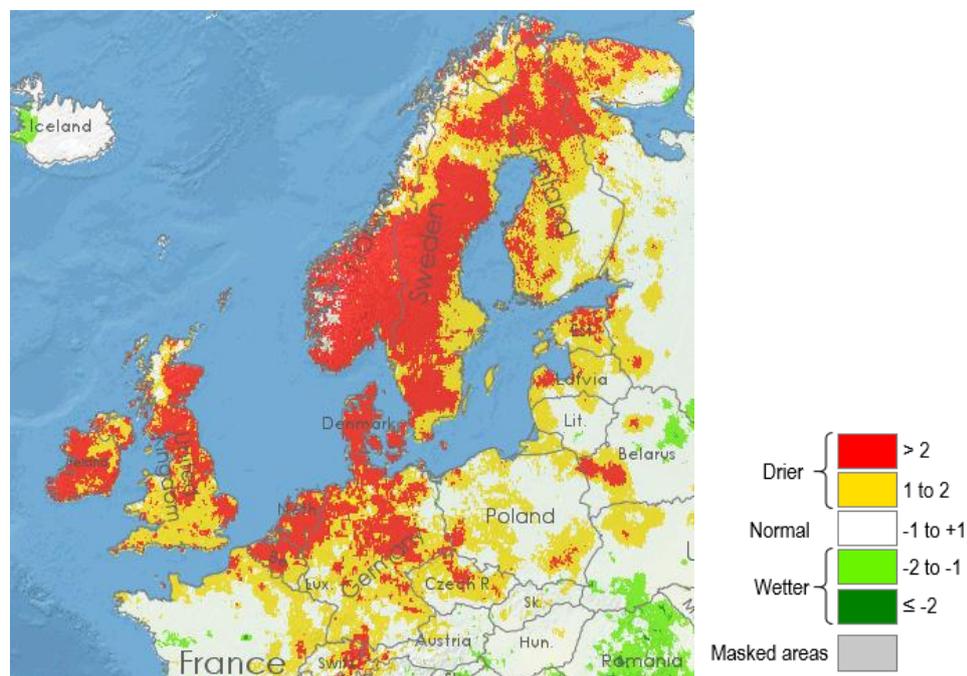


Figure 5: Soil Moisture Anomaly in central and northern Europe, in mid-July 2018.

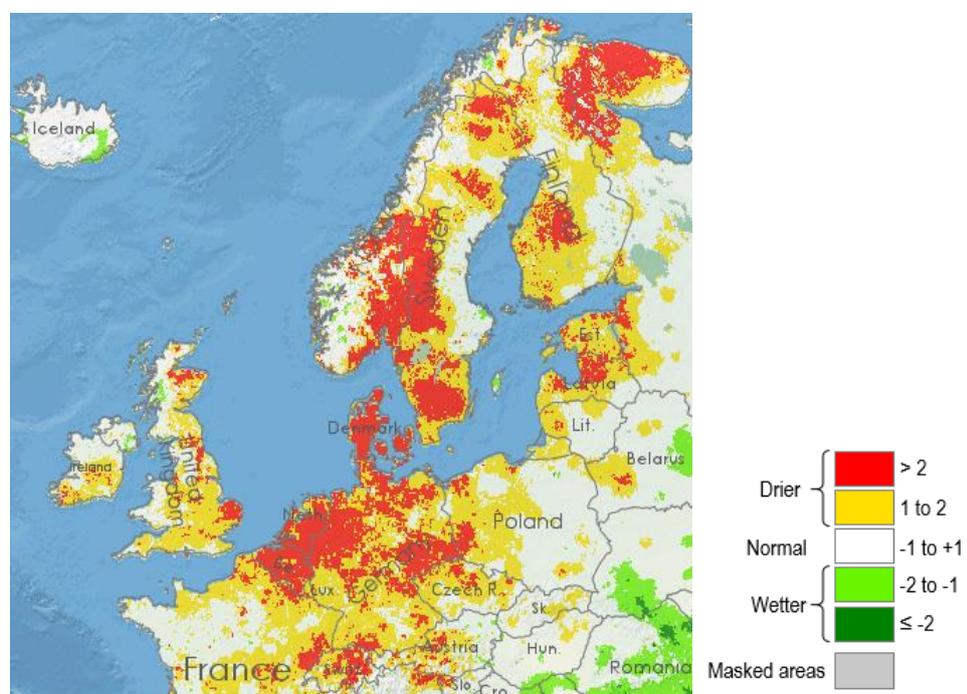


Figure 6: Soil Moisture Anomaly in central and northern Europe, on 6th of August 2018.

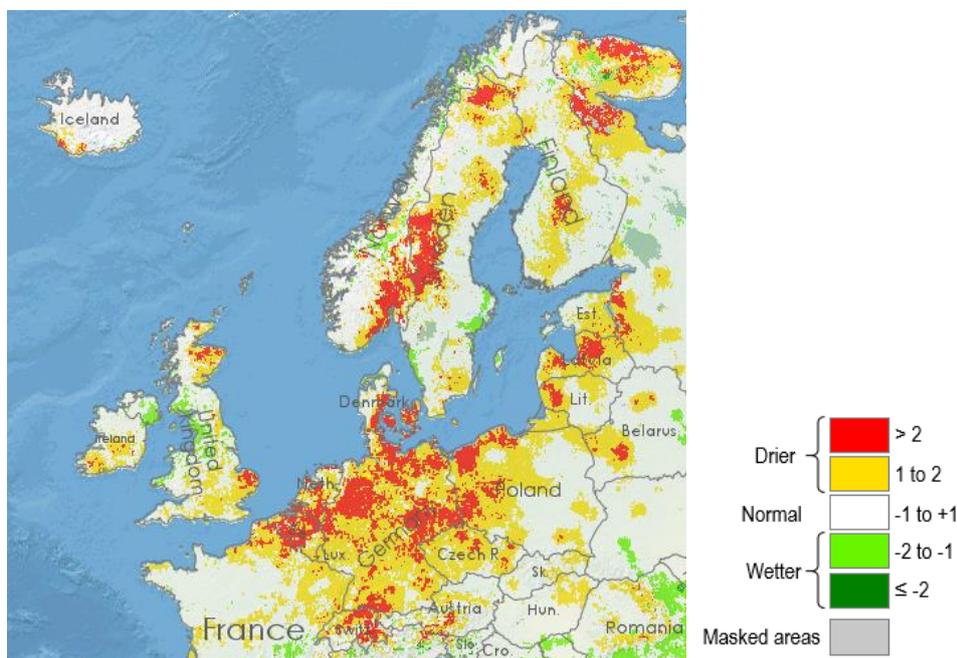


Figure 7: Soil Moisture Anomaly in central and northern Europe, projected to 15th August 2018.

Low Flow Index (LFI)

The Low Flow Index is an indicator of hydrological drought, and is based on the total water deficit of the river discharge, when the latter drops below a threshold. **Figure 8** shows the situation for the first and last dekads of July, indicating a strong and consistent situation of low flows for the main rivers across the Scandinavian Peninsula, a situation that worsened slightly since the first half of July. In central Europe, the pattern of low flows shifted slightly westwards and intensified further. Notably, long sections of the Rhine, Meuse, Weser, Elbe and their tributaries reach the highest level of hazard.

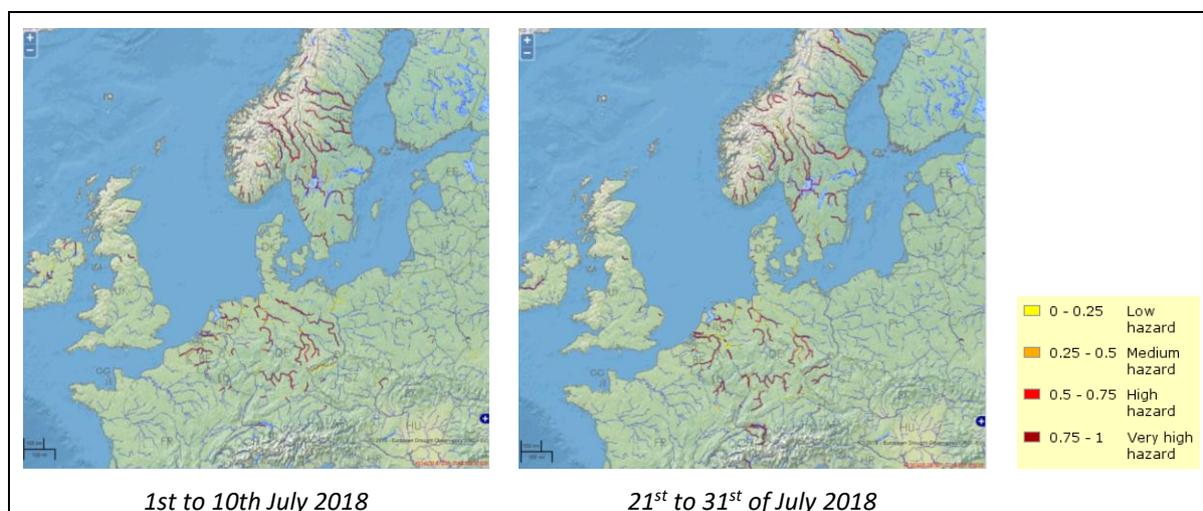


Figure 8: Low-Flow Index (LFI), situation at beginning (left) and end (right) of July 2018.

Vegetation Productivity (fAPAR) Anomaly

The satellite-measured fraction of Absorbed Photosynthetically Active Radiation (fAPAR) represents the fraction of the sun's energy that is absorbed by leaves. fAPAR anomalies, specifically negative deviations from the long-term average, are a good indicator of drought impacts on vegetation (**Figure 9**).

Compared to the last dekad of June, at the end of July a negative fAPAR anomaly emerged in Ireland, Wales and south-west England. In general, over drought-affected areas of continental Europe, the index shifted downwards. The only meaningful signs of improvement are limited to Poland.

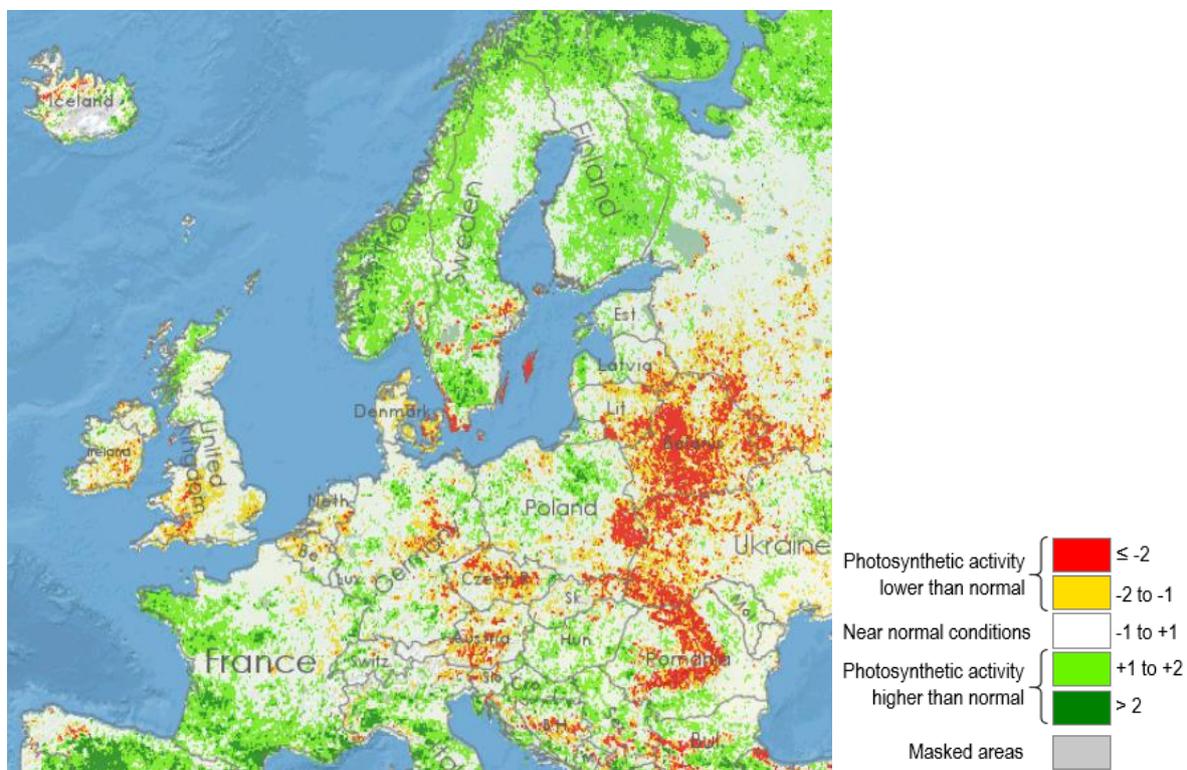


Figure 9: fAPAR anomaly for the period 21-30 July 2018.

Reported impacts of the current drought and high temperatures

In comparison to the briefing provided in the previous report¹, during July fire hazard extended further. Sweden called for international help to fight wildfires². The alert level is at the maximum in southern Europe as well (notably Portugal and Spain). For further

² <https://nordic.businessinsider.com/firemen-from-9-european-countries-help-sweden-fight-wildfires-that-are-impossible-to-extinguish--and-theres-no-end-in-sight-to-the-extreme-weather-->

information and insight about wildfires, please refer to the European Forest Fire Information System (EFFIS) portal³.

In Ireland and the UK, both temperatures and rainfall in July were within the normal fluctuations for the period, although the cumulated deficit is expected to persist^{4 5} and water restrictions have not been lifted⁶. Restrictions have also been enforced in France⁷.

Concerning agriculture in the drought-affected zones, some national governments are discussing aid to farmers amid damage claims^{8 9 10 11 12 13}. In addition, the livestock sector is affected due to a lack of fodder¹⁴. Yield for winter and spring cereals were confirmed as seriously reduced by the dry and hot weather that followed up in July. For detailed information and yield forecasts for specific crops, please refer to the latest MARS bulletin from 23 July 2018¹⁵.

Due to the decreasing levels of water, transportation capacity on the river Rhine, Danube and other rivers is reduced¹⁶.

The heatwave in the second half of July, summed to the ongoing drought, has imposed restrictions or shutdown to nuclear power plants in France¹⁷, Sweden¹⁸, Finland, Germany¹⁹ and Switzerland²⁰.

Due to the high water temperatures in lakes and rivers, water quality impacts and impacts on fish populations have been recorded in Germany^{21 22}

³ <http://effis.jrc.ec.europa.eu/>

⁴ <https://www.met.ie/forecasts/farming#>

⁵ <https://www.theguardian.com/environment/2018/jul/26/farmers-across-uk-braced-for-heavy-rain-and-thunderstorms>

⁶ <https://www.independent.ie/irish-news/water-restrictions-likely-to-remain-until-october-37198828.html>

⁷ <https://www.thelocal.fr/20180808/france-brings-in-water-restrictions-following-heatwav>

⁸ <https://www.bloomberg.com/news/articles/2018-07-30/sweden-unveils-crisis-package-to-help-drought-stricken-farmers>

⁹ <https://www.dw.com/en/no-immediate-federal-help-for-drought-hit-german-farmers-agriculture-minister-says/a-44878449>

¹⁰ <https://www.thelocal.dk/20180808/danish-agriculture-loses-millions-to-drought>

¹¹ <https://www.dagbladet.no/nyheter/regjeringen-kan-ikke-love-mer-na/70083244>

¹² <http://www.thenews.pl/1/12/Artykul/375616,Aid-for-Polish-farmers-hit-by-drought-floods>

¹³ <https://news.err.ee/850341/rural-affairs-committee-meets-to-discuss-mitigating-of-drought-damages>

¹⁴ <https://af.reuters.com/article/commoditiesNews/idAFL5N1UX4CN>

¹⁵ <https://ec.europa.eu/jrc/sites/jrcsh/files/jrc-mars-bulletin-vol26-no07.pdf>

¹⁶ <http://uk.businessinsider.com/r-low-water-hinders-rhine-danube-river-shipment-in-germany-2018-7?IR=T>

¹⁷ <https://uk.reuters.com/article/uk-france-nuclearpower-weather/frances-edf-halts-four-nuclear-reactors-due-to-heatwave-idUKKBN1KP0EV>

¹⁸ <https://nordic.businessinsider.com/record-summer-heat-forces-swedish-nuclear-reactor-to-be-closed-->

¹⁹ <https://www.zdf.de/nachrichten/heute/hitze-am-rhein-atomkraftwerke-fahren-leistung-runter-100.html>

²⁰ <http://www.neimagazine.com/news/newseuropes-heatwave-affects-npps-6271432>

²¹ <http://www.tagesschau.de/inland/hitzewelle-107.html>

²² <https://www.tagesschau.de/inland/rhein-wasserstand-101.html>

Information sources

- European Drought Observatory (EDO) - European Commission, Joint Research Centre
- Global Drought Observatory (GDO) - European Commission, Joint Research Centre
- Media News (European Media Monitor and other sources)

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ⁱⁱ Joint Research Centre of European Commission