

### Table of Contents

Executive Summary – update to September 2018 .....	1
Combined Drought Indicator (CDI) .....	1
Precipitation and Standardized Precipitation Index (SPI).....	2
Soil Moisture Anomaly (SMA).....	5
Low Flow Index (LFI).....	6
Vegetation Productivity (fAPAR) Anomaly .....	7
Reported impacts of the current drought .....	8
Information sources.....	9

### Executive Summary – update to September 2018

This document builds on the previous reports published in July<sup>1</sup> and August<sup>2</sup> 2018 by EDO; please refer to those for more insight on the precipitation pattern that led to the ongoing drought and earlier reported impacts.

- Compared to late July and August, the extent of the drought shrank, but further intensified over central Europe.
- Recorded precipitation during August were again below or much below normal across central and northern Europe, and around average or just slightly above average elsewhere.
- Water flows remain very low in many major rivers flowing through central Europe.
- The outlook for soil moisture at the beginning of October is negative for most of Europe.
- There are concerns for inland waterways, due to the decreasing river levels, as well as for industries relying on freshwaters for their operations. Livestock sector is under pressure due to the lack of fodder.

### 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

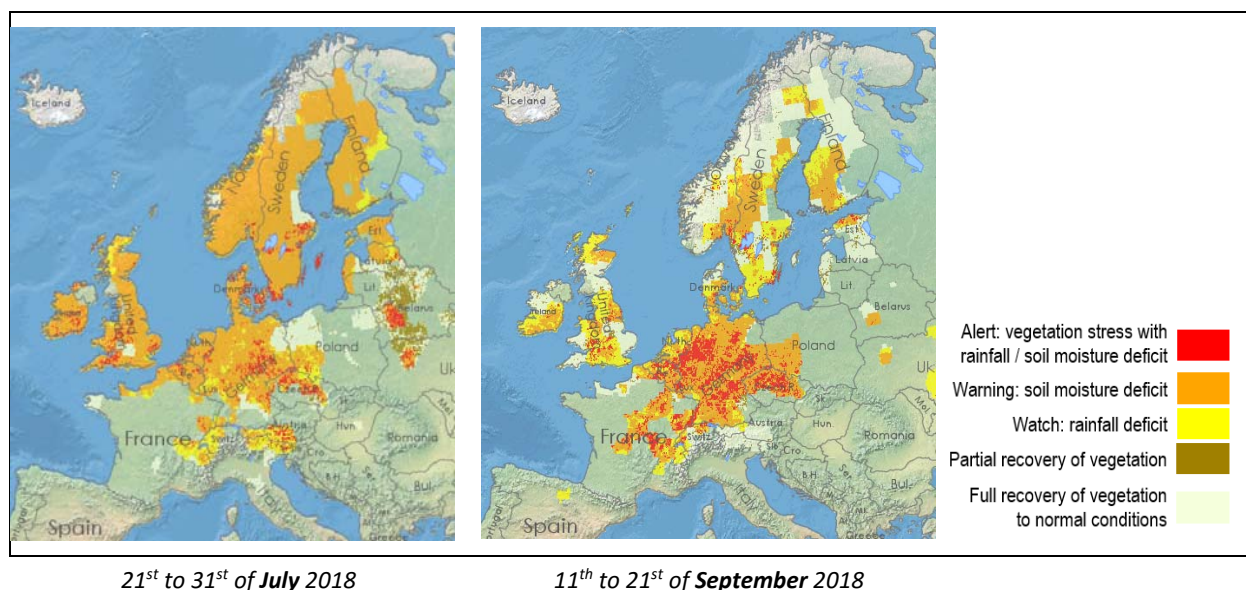
---

<sup>1</sup> [http://edo.jrc.ec.europa.eu/documents/news/EDODroughtNews201807\\_Central\\_North\\_Europe.pdf](http://edo.jrc.ec.europa.eu/documents/news/EDODroughtNews201807_Central_North_Europe.pdf)

<sup>2</sup> [http://edo.jrc.ec.europa.eu/documents/news/EDODroughtNews201808\\_Central\\_North\\_Europe.pdf](http://edo.jrc.ec.europa.eu/documents/news/EDODroughtNews201808_Central_North_Europe.pdf)

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. Areas in the process of recovery to normal conditions after a drought episode are also shown.

From the end of July into the mid of September, the situation improved over Scandinavia, east of the Baltic Sea, and Ireland and the UK. However, in central Europe the CDI suggests a further intensification of drought, expanding further towards central France (**Figure 1**).



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

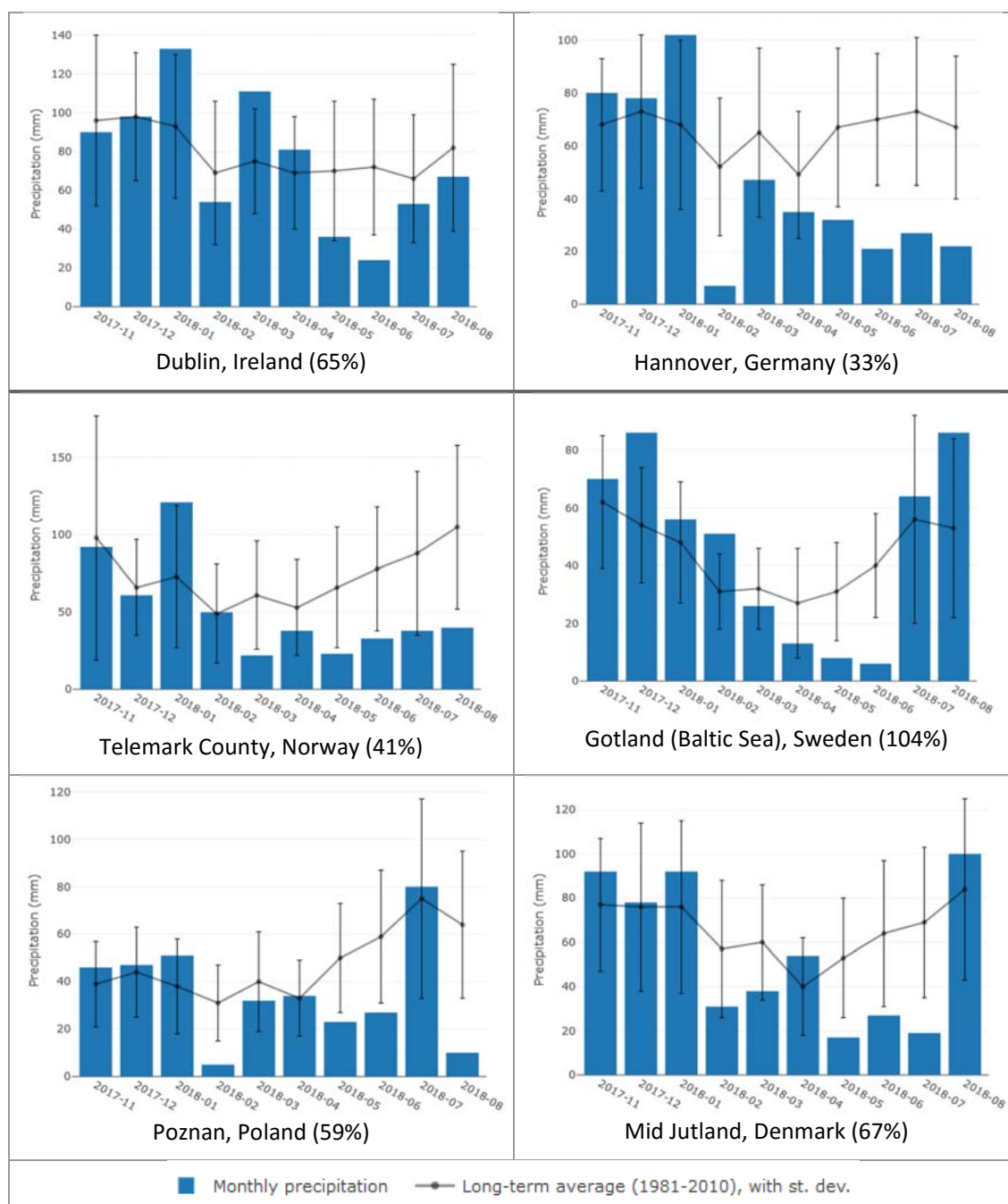
### Precipitation and Standardized Precipitation Index (SPI)

**Figure 2** shows the monthly precipitation totals for selected locations across Europe. For the fourth month in a row, most of Germany received much less precipitation than normal. A similar pattern was observed for southern Scandinavia, northern Bohemia (Czech Republic), Belgium and the Netherlands. Elsewhere, normal or above average precipitation compensated only partially the water deficit from previous months.

# EDO Analytical Report

## Drought in Central-Northern Europe – September 2018

JRC European Drought Observatory (EDO), 28 September 2018



**Figure 2:** Monthly precipitation from November 2017 to August 2018 in selected locations. Percentage of total precipitation compared to the climatological average of trimester June-August are shown between brackets. Bars show observed monthly precipitation (mm). Lines show the long-term monthly average with one standard deviation.

The SPI measures precipitation anomalies based on the long-term records. The lower (more negative) the SPI, the more intense is the drought. With few marginal exceptions, no regions

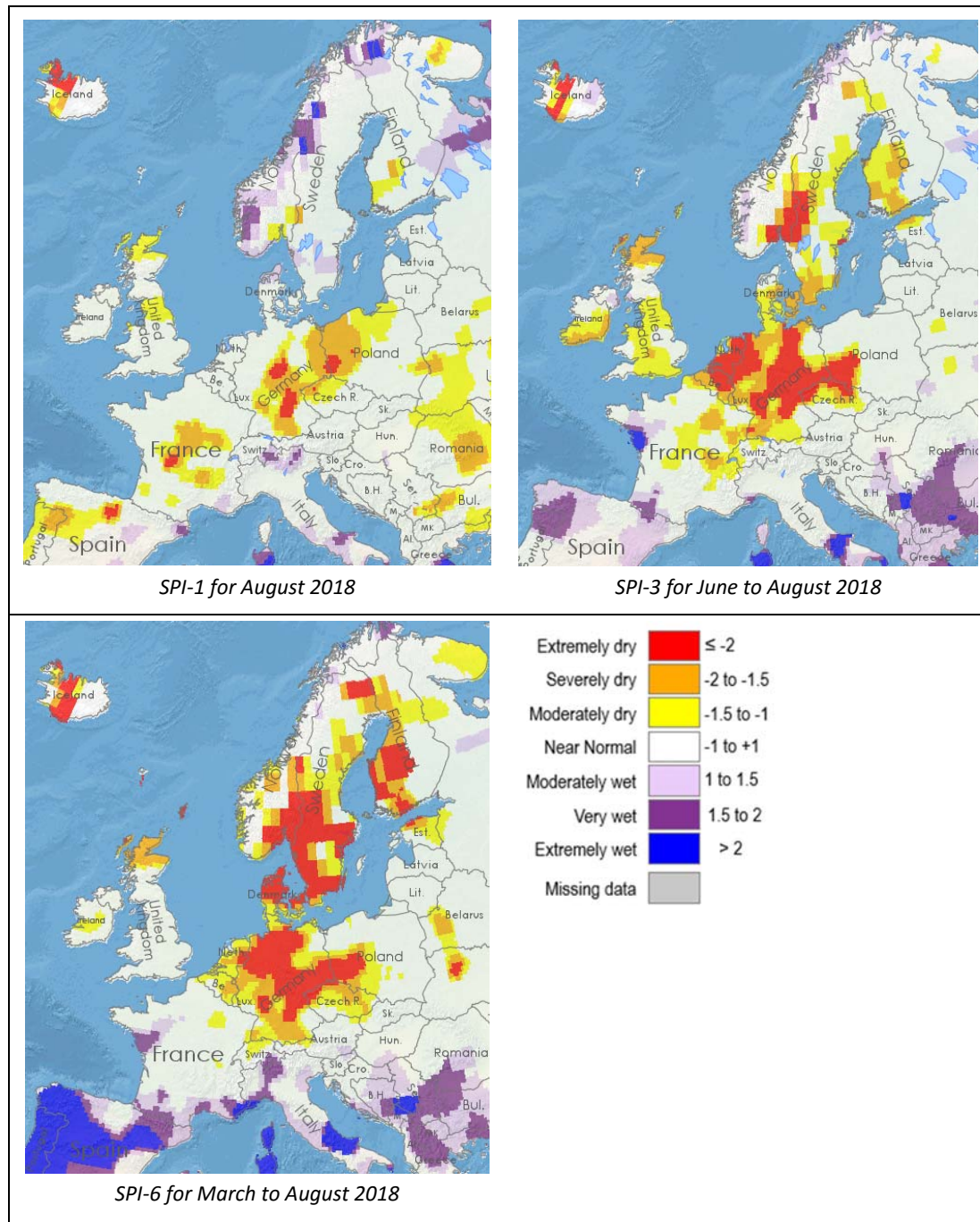
# EDO Analytical Report

## Drought in Central-Northern Europe – September 2018

JRC European Drought Observatory (EDO), 28 September 2018



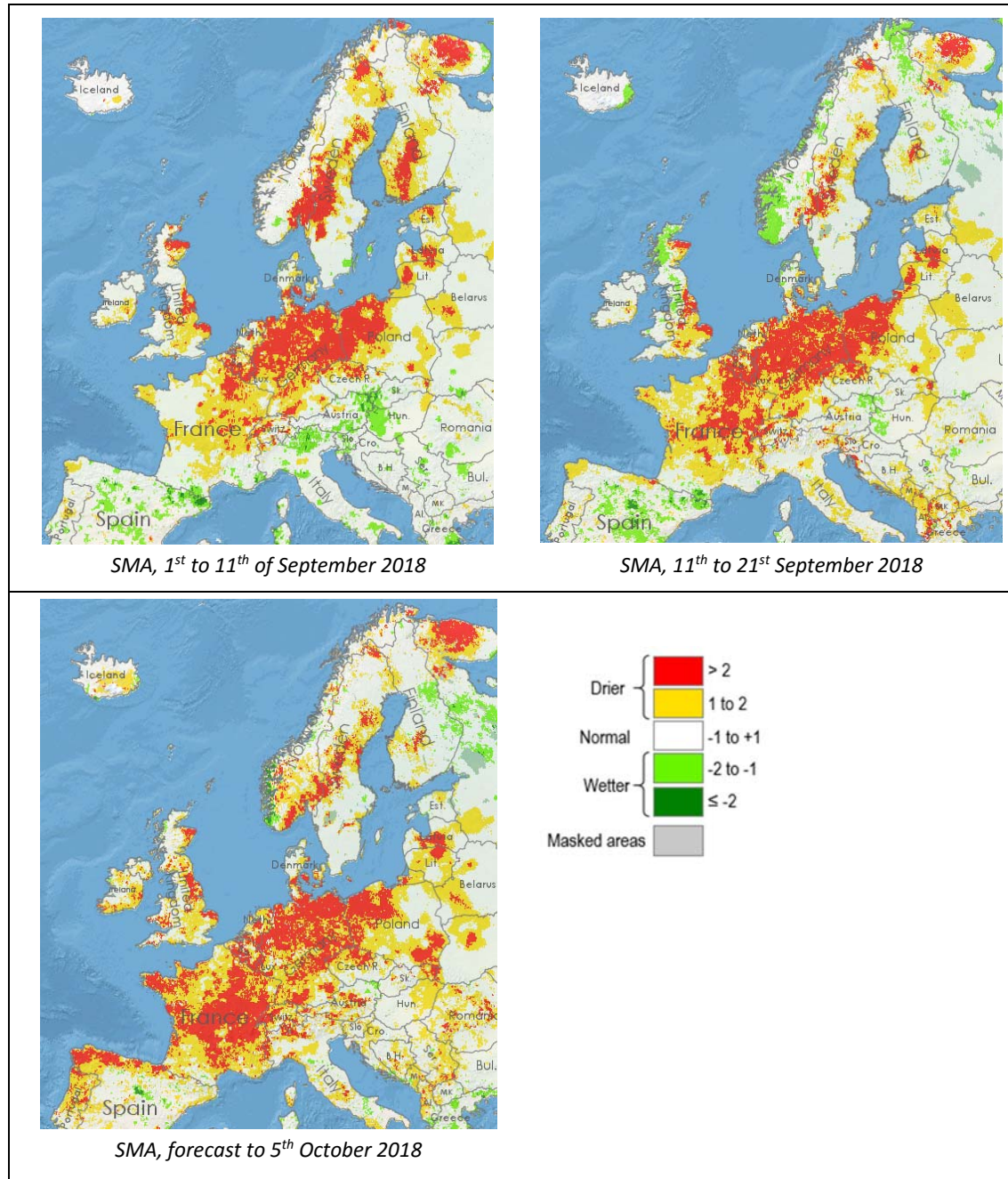
received higher than average precipitation in August, more often less (**Figure 3**, upper left). Accordingly, most of central and northern Europe retains a negative or very negative value of SPI over an accumulation period of three and six months (**Figure 3**, right and lower left).



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

### Soil Moisture Anomaly (SMA)

The Soil Moisture Anomaly (SMA) indicator shows the deviation of the top soil water content from the climatological reference. It provides a measure of drought conditions, specifically the difficulty for plants to extract water from the soil.



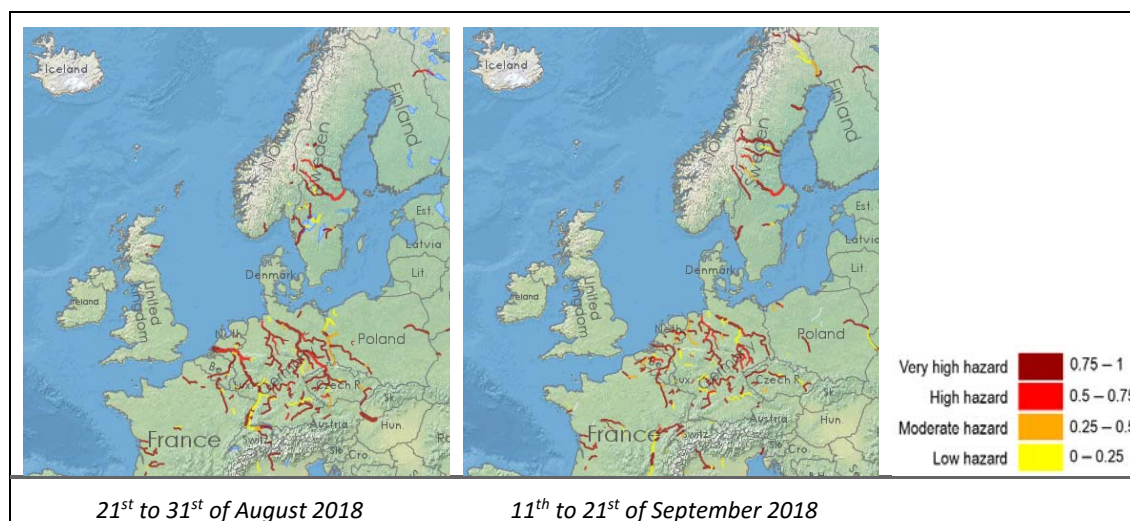
**Figure 5:** Soil moisture anomaly (SMA) in central and northern Europe,

After some slight and local recovery in August, soil moisture receded again to very low levels over most of Central and northern Europe regions, already hit by the drought (**Figure 5**, upper left). Moreover, in the second dekad of September dryness expanded further south and west to France, the UK and, to a lesser extent, Italy and southern Balkans (**Figure 5**, right). The outlook is negative for the beginning of October, with soil moisture deficits of varying degree spreading over almost all of Europe (**Figure 5**, bottom left).

### Low Flow Index (LFI)

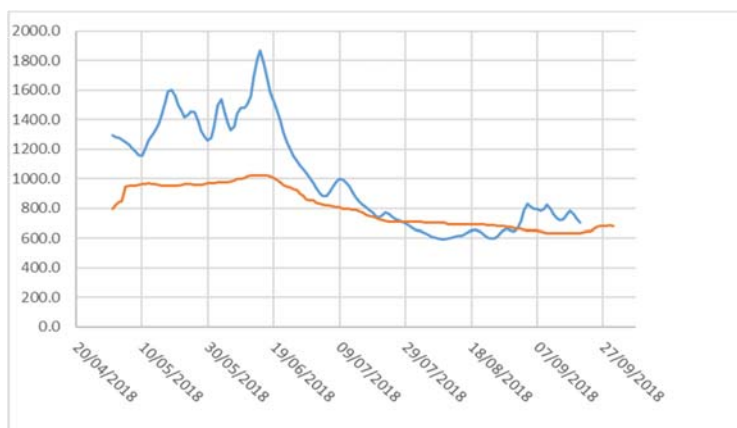
The Low Flow Index is an indicator of hydrological drought and is based on the total water deficit of the river discharge, when the latter drops below a threshold.

River flows reached a minimum in most central European rivers during late August and overall the index did not recover throughout mid-September (**Figure 6**). Long sections of the Meuse, Weser, Elbe, Main and their tributaries reached the highest hazard class for low flow. River segments in France, the Rhône in particular, joined the ensemble of rivers exposed to hydrological drought.



**Figure 6:** Low-Flow Index (LFI), situation at beginning of August (left) and of September (right) 2018.

The Rhine shows an improvement compared to August; this is true in terms of long-term records of water flows, as the modelled values for the second dekad of September recovered and did not exceed anymore the critical threshold to signal a hydrological drought, albeit still floating very close (**Figure 7**). However, this does not exclude impacts related to minimum absolute flows requirements. Furthermore, a high variability in flow rates may contribute to underestimate the severity of the drought by the index, dragging downwards the critical threshold of flow.

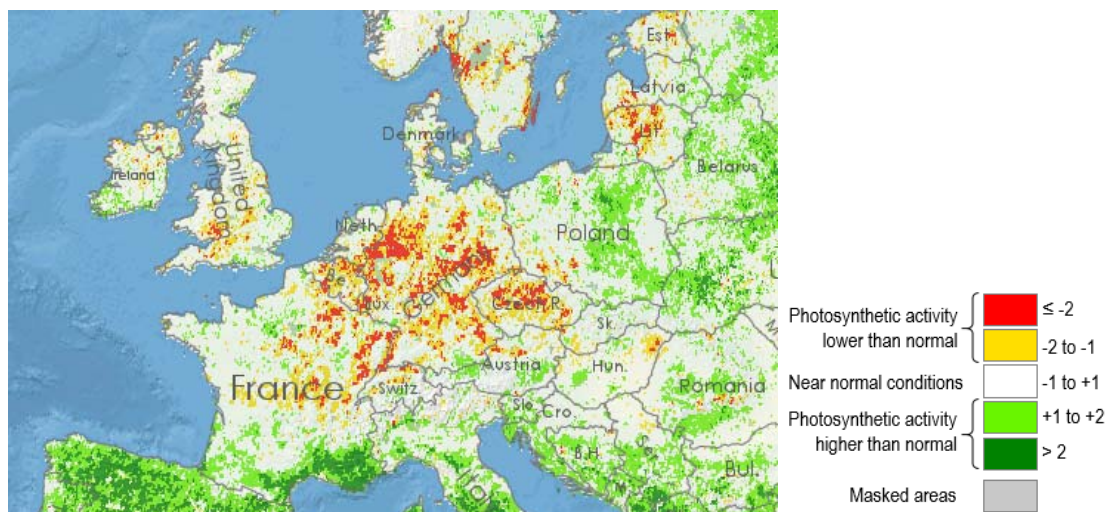


**Figure 7:** Volumetric flow rate ( $m^3/s$ ) from a sample point on the river Rhine (blue line) compared to the critical low-flow threshold identifying a drought event (orange line).

### 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 8**).

At the beginning of September, a negative fAPAR anomaly appeared widely distributed in dense patches from central France to south-west Poland and north of the Alps, a pattern quite consistent with the areas most affected by the lack of precipitation in the previous months. The indicator shows improvements in all of Denmark and parts of Belgium, the Netherlands and United Kingdom, but worsens in the north-eastern quarter of France.



**Figure 8:** fAPAR anomaly for the period 1-11 September 2018.

### Reported impacts of the current drought

A brief overview of impacts was provided in the previous reports. Currently, low water levels affecting waterways in central Europe caused significant disruptions to logistics and a rise in transportation costs<sup>3 4 5</sup>. Drought affected industries too, forcing some installations that rely on water from rivers to interrupt their operations, jeopardizing full employment<sup>6</sup>. Some analyses claim rallies in energy production costs as well<sup>7</sup>.

In general, across Europe there are concerns about the lack of drought mitigation measures, which may entail unforeseen costs to adapt and potentially water supply disruptions<sup>8 9 10</sup>.

Concerning agriculture, for crop-specific information and yield forecasts, please refer to the latest MARS bulletin from 17 September 2018<sup>11</sup>.

On top of damages to crops, after the end of the harvest season, the livestock sector is suffering the most, due to lack of fodder<sup>12 13</sup>, which may drag down the revenues for farmers in the next months.

Meanwhile, broad estimates of economic losses and risks are being reported and compensations schemes are implemented at national and European level<sup>14 15 16 17 18 19</sup>.

---

<sup>3</sup> [https://www.icis.com/resources/news/2018/09/20/10260916/rhine-transportation-woes-continue-for-chems-water-levels-simply-too-low-/](https://www.icis.com/resources/news/2018/09/20/10260916/rhine-transportation-woes-continue-for-chems-water-levels-simply-too-low/)

<sup>4</sup> <https://www.reuters.com/article/us-europe-weather-hungary-shipping/water-levels-in-danube-recede-to-record-lows-hindering-shipping-in-hungary-idUSKCN1L71DH>

<sup>5</sup> <https://www.dutchnews.nl/news/2018/08/rhine-shipping-reduced-as-river-registers-lowest-ever-recorded-level/>

<sup>6</sup> <https://af.reuters.com/article/commoditiesNews/idAFL5N1VX1VH>

<sup>7</sup> <https://www.montelnews.com/en/story/swedish-nuclear-output-could-slump-to-33-next-week/929397>

<sup>8</sup> <https://www.gov.uk/government/news/national-drought-group-chairmans-statement-september-2018>

<sup>9</sup> <https://www.radio.cz/en/section/business/government-pours-more-money-into-water-saving-program>

<sup>10</sup> <https://www.estrepublicain.fr/edition-de-vesoul-haute-saone/2018/09/21/secheresse-la-crise-s-intensifie>

<sup>11</sup> <https://ec.europa.eu/jrc/sites/jrcsh/files/jrc-mars-bulletin-vol26-no09.pdf>

<sup>12</sup> <https://www.businesstimes.com.sg/energy-commodities/europes-livestock-sector-stricken-by-widespread-drought> (Source: AFP)

<sup>13</sup> <https://www.straitstimes.com/world/europe/northern-europes-livestock-sector-stricken-by-drought> (Source: AFP)

<sup>14</sup> [http://europa.eu/rapid/press-release\\_IP-18-5301\\_en.htm](http://europa.eu/rapid/press-release_IP-18-5301_en.htm)

<sup>15</sup> <https://www.reuters.com/article/us-eu-crops/eu-crop-monitor-trims-maize-sugar-beet-yields-again-after-drought-idUSKCN1LX1QI>

<sup>16</sup> <https://www.dagbladet.no/nyheter/bondene-enige-med-staten-om-krisepakke-for-torkerammede-bonder/70155119>

<sup>17</sup> <https://phys.org/news/2018-07-sweden-farmers-historic-drought.html> (Source: AFP)

<sup>18</sup> <https://www.independent.co.uk/news/uk/home-news/uk-weather-latest-news-updates-food-price-increase-extreme-conditions-a8509471.html>

<sup>19</sup> <http://www.thenews.pl/1/9/Artykul/381040,Drought-in-Poland-caused-damage-worth-billions-report>



### 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)

**Distribution:** For use by the ERCC and related partners.

**Authors:** Masante D.<sup>i</sup>, Vogt J.<sup>ii</sup>, Cammalleri C.<sup>ii</sup>, Spinoni J.<sup>ii</sup>, Barbosa P.<sup>ii</sup>

**Disclaimer and Legal Notice:** This report has been produced by the Joint Research Centre (JRC), and is a product under constant development and may change at any time without notice. It was generated using Copernicus Emergency Management Service information (2018). The views expressed may not be regarded as an official position of the European Commission (EC) in any circumstances. National borders are purely a graphical representation, only intended to be indicative, and do not reflect the official position of the EC. Neither the EC nor any person acting on behalf of the Commission are responsible for the use that might be made of this report.

---

<sup>i</sup> Arcadia SIT, 27029 Vigevano (PV), Italy

<sup>ii</sup> Joint Research Centre of European Commission