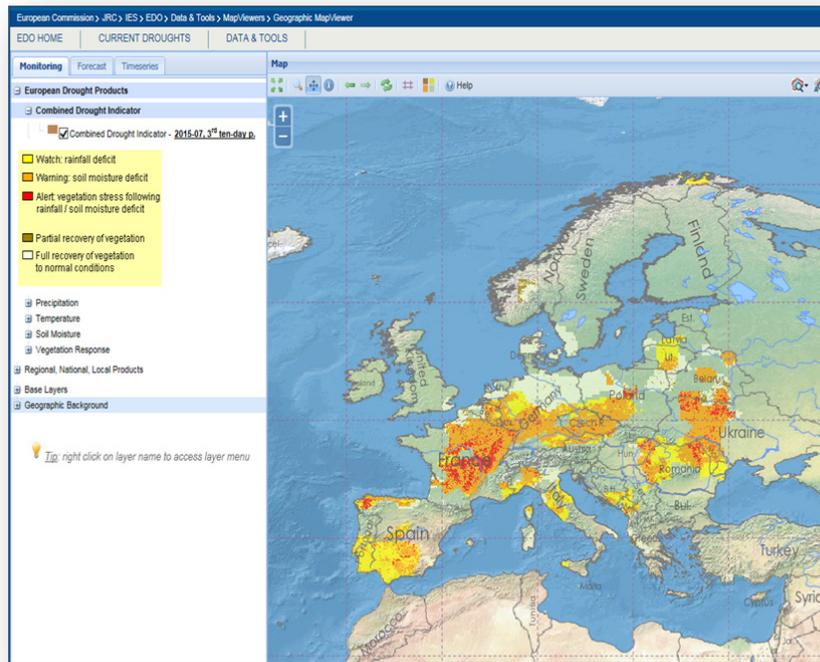


European Drought Observatory (EDO) Drought News August 2015

(Based on data until 31 July 2015)



EDO Combined Drought Indicator (CDI) – Situation on 31 July 2015

<http://edo.jrc.ec.europa.eu>



August 2015

EDO Drought News

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Summary

Similarly to the summer of 2003, a large part of the continental EU was affected by a severe drought in June and July 2015, as a consequence of the combination of rain shortages and very high temperatures which resulted in high plant water requirement (evapotranspiration) levels. France, Benelux, Germany, Hungary, the Czech Republic, northern Italy, and northern Spain experienced particularly exceptional conditions.

The prolonged rainfall shortage (since April) and the temperature anomalies in July caused a severe drought which affected soil moisture content and vegetation conditions. Furthermore, the areas with the largest rainfall deficits also recorded exceptionally high maximum daily temperatures: in some cases these reached record values.

Another characteristic of this period was the persistence of the thermal anomalies: in the entire Mediterranean region, and particularly in Spain, the heat wave was even longer than that of 2003, with maximum daily temperatures consistently above 30°C for durations of 30 to 35 days (even more than 40 days in Spain).

The impact of these meteorological conditions on vegetation cover became evident in the satellite data from June, and became more marked towards the end of July, when the areas affected by unfavourable thermal and hydrological conditions clearly emerged with negative anomalies of the fraction of Absorbed Photosynthetically Active Radiation (fAPAR), a proxy of the vigour of the vegetation canopy.

The prolonged period of reduced rainfall supplies and high temperatures negatively affected many environmental and production sectors. In fact, newspapers and electronic media widely reported on restrictions to civil and industrial water uses, losses in agricultural production (a shortened crop cycle for rain-fed and irrigated crops, impacts on cattle production, etc.), reductions or even the complete cessation of inland water transportation, increases in forest wildfires, impacts on forestry (e.g. reduced biomass accumulation, insect attacks and diseases), limitations to energy production (hydropower and cooling), increased energy consumption for cooling, human health impacts, and others. However, positive impacts were also reported in the areas of tourism and open-air activities, viticulture, and solar energy production.

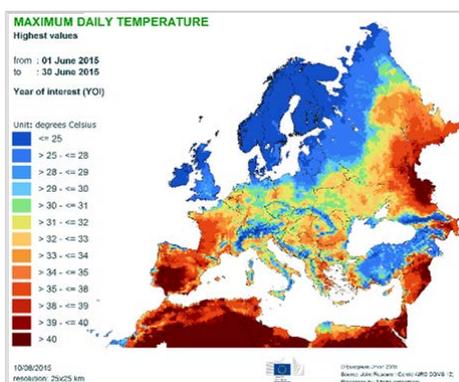
Weather conditions in the coming months will be crucial for most of the abovementioned sectors. At this point of time, ECMWF¹ forecasts for September 2015 predict warmer than average conditions over most of Europe (excluding the Iberian Peninsula) and drier than average conditions for most of central and northern Europe, whilst more abundant rains are forecast for the Mediterranean region.

¹ European Centre for Medium-Range Weather Forecasts, Reading, UK

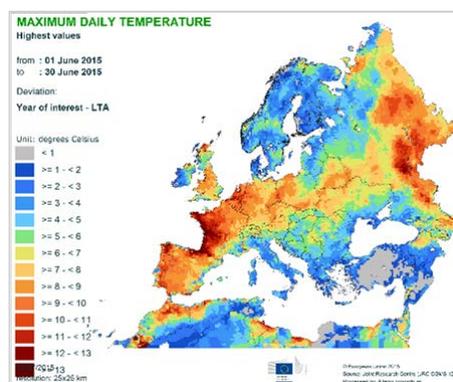
Temperature Analysis

Since the beginning of June 2015, almost the entire European continent experienced temperatures that were significantly above the seasonal norm. In June, Spain, Benelux, Germany and France recorded maximum daily temperatures that were 8 to 10°C above expected values. Conditions got even worse in July, with absolute maximum daily values above 34-35°C in almost the entire EU and absolute maximum temperatures that were well above 40°C in many areas (e.g. 47.3°C in Apulia, 46.5°C in Andalucia, 46.2°C in southern Bulgaria and southern Romania, 45.7°C in Alentejo, 44.7° in Sicily). Moreover, several areas in Germany, Benelux, France, Spain, Italy and even in Austria, the Czech Republic, the UK and Sweden recorded their highest maximum daily temperatures for July since 1975.

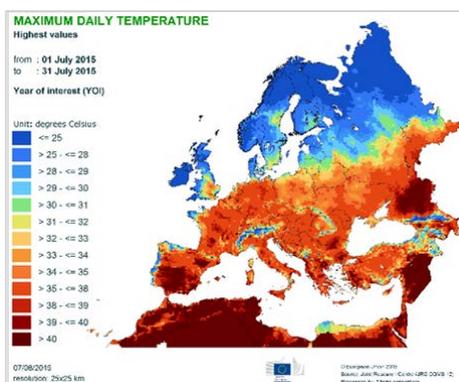
Maximum Temperatures



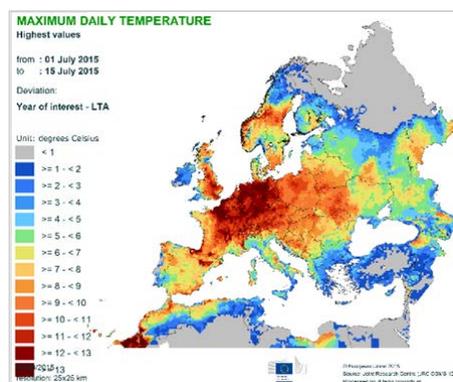
Absolute daily maximum temperatures in June 2015



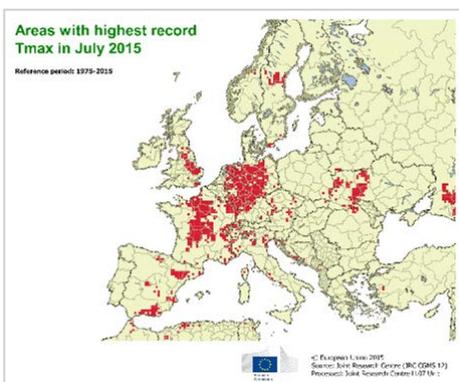
Daily maximum temperatures in June 2015 minus the Long-term Average (LTA)



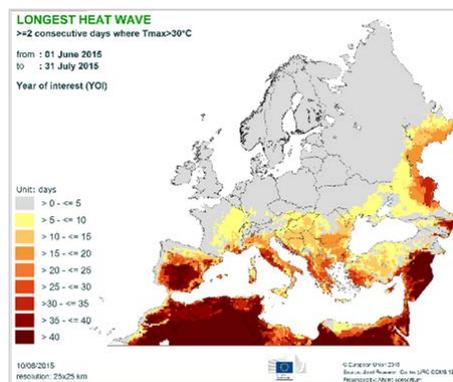
Absolute daily maximum temperatures in July 2015



Daily maximum temperatures in the first half July 2015 minus the LTA



Areas with highest record Tmax observed in July 2015



Longest heat wave in 2015

Figure 1: Temperatures and heat waves in June and July 2015. Source: JRC-MARS database.

Rainfall Analysis

The preliminary analysis of cumulated rainfall for the period 1 April - 31 July 2015 (Figure 2), clearly highlights the areas affected by the rainfall shortage, which are localised in France, Benelux, western Germany, northern Italy, northern Spain, the Czech Republic, Poland, Ukraine and Belarus. In these areas, the rainfall deficit was greater than 100-130 mm, representing a reduction of about 50-60%, and in some cases even 80%, compared to the long-term average.

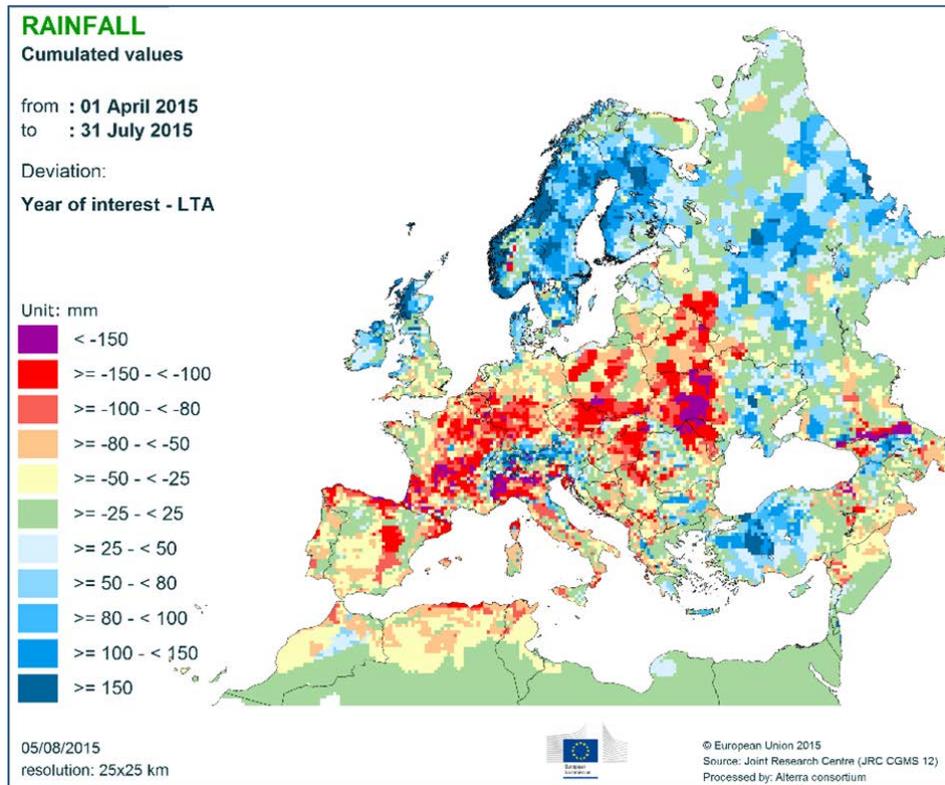
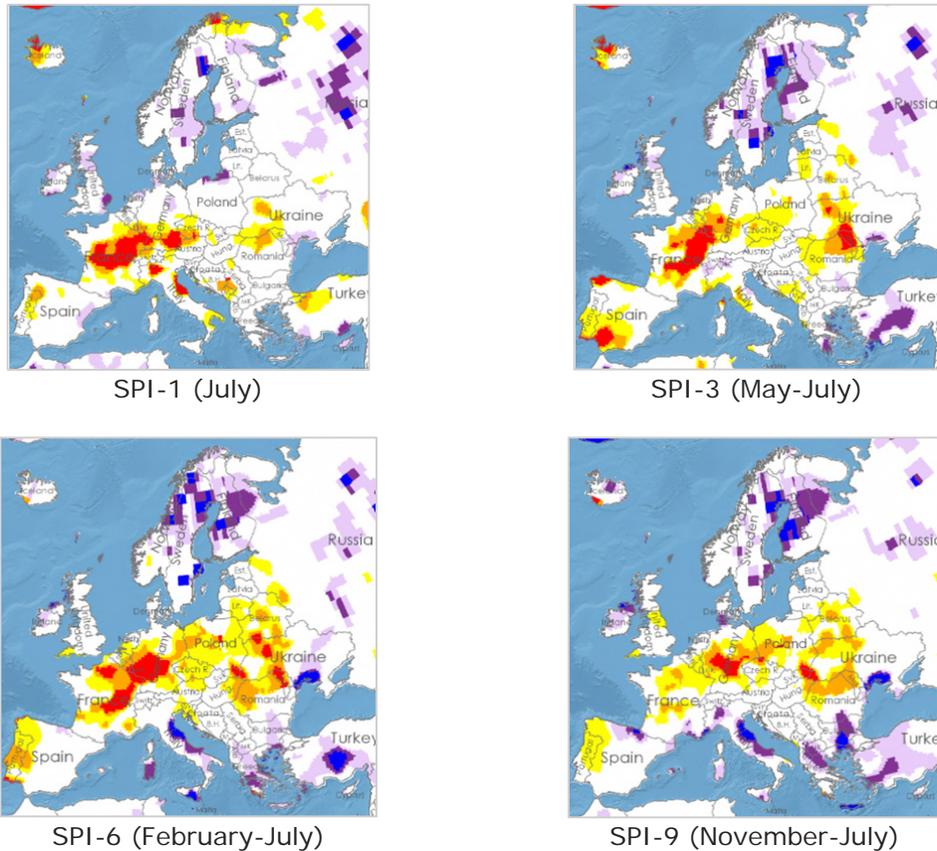


Figure 2: Map of departures (in mm) from the Long-term Average (LTA) of cumulated rainfall between April and July 2015. Source: JRC-MARS database

This analysis is also confirmed by the Standardized Precipitation Index (SPI), which provides a measure of the severity of rainfall deficits for different rainfall accumulation periods (see Figure 3). These maps show that the rainfall deficit persisted during a long period in Germany, Poland, France, Benelux, Portugal, and Spain, resulting in significantly reduced river discharges with likely impacts on energy production (hydropower and cooling), inland water transportation, tourism, agriculture, and river ecology.

Precipitation Anomalies



SPI Value	Class	Colour
$SPI \geq 2.00$	Extreme wet	Blue
$1.50 < SPI \leq 2.00$	Severe wet	Purple
$1.00 < SPI \leq 1.50$	Moderate wet	Light purple
$-1.00 < SPI \leq 1.00$	Near normal	White
$-1.50 < SPI \leq -1.00$	Moderate dry	Yellow
$-2.00 < SPI \leq -1.50$	Severe dry	Orange
$SPI < -2.00$	Extreme dry	Red

Figure 3: Standardized Precipitation Index (SPI) for 1-, 3-, 6- and 9-month rainfall totals to the end of July 2015. Source: JRC-EDEA database (EDO).

The graphs in Figure 4 below show the percentage of the territory affected by different drought severity classes between August 2014 and July 2015 for selected regions of Europe. They show the temporal dynamics of the territory affected (see Figure 3 for severity classes).

The graphs highlight that large portions of different regions in France (generally >50%, and in the case of Picardie the whole territory), Germany, and Benelux were affected by meteorological droughts (rain shortages) of different levels of severity between April and July 2015. The situation in Galicia (north-western Spain) is particularly serious, as the drought has persisted since the summer of 2014, with significant impacts on the hydrological system.

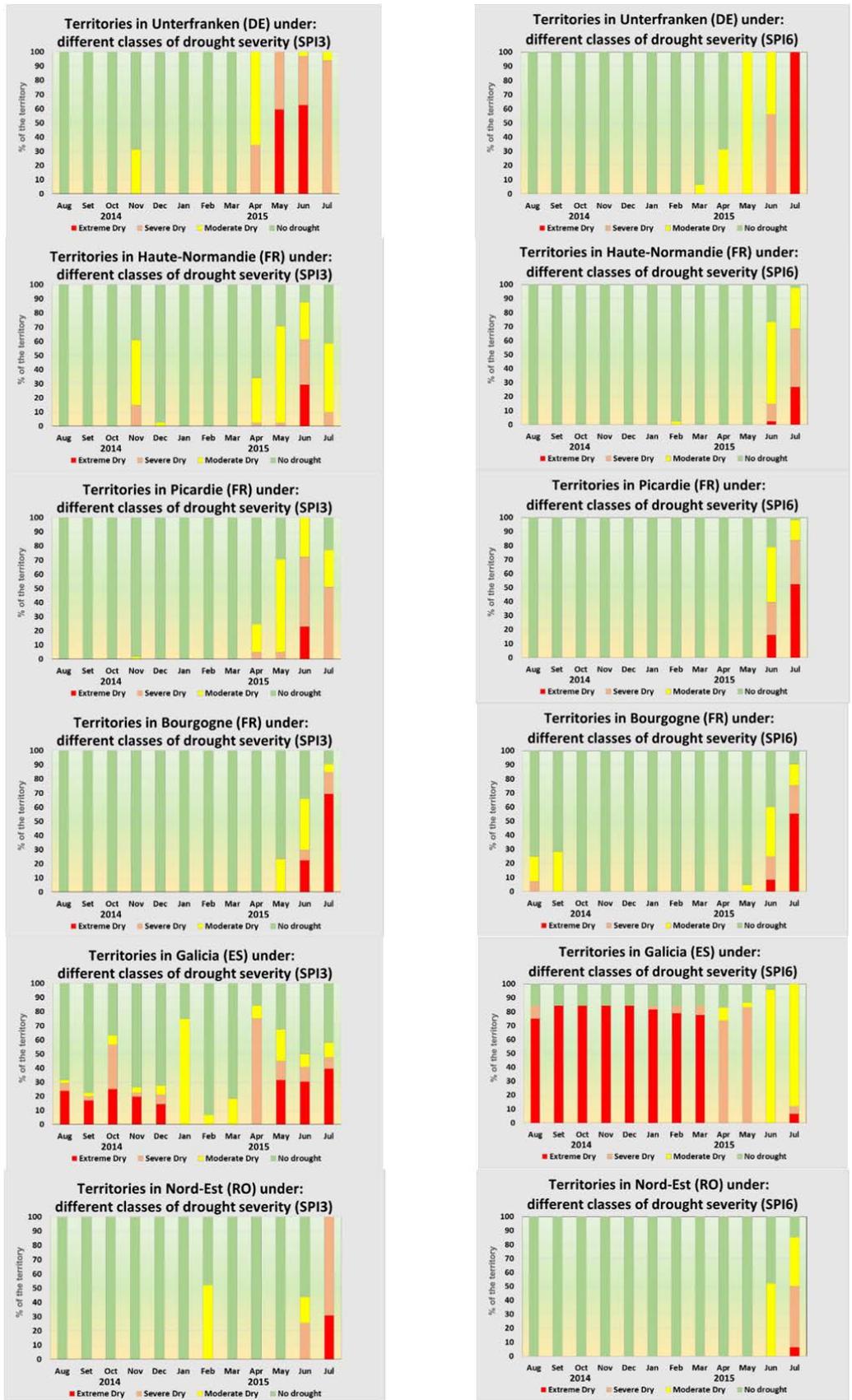


Figure 4: Standardized Precipitation Index (SPI) for 3- and 6-month rainfall accumulation for different regions in Europe. Source: JRC-EDEA database (EDO).

Evapotranspiration and Climatic Water Balance

Due to the anomalous and persistently high temperatures in June and July 2015, the plant water requirements were also very high in many areas of the EU; in France, Germany, Northern Italy, Spain and the Czech Republic, the absolute and relative differences between actual and long-term average potential evapotranspiration were greater than 80 mm (1 mm = 10 m³/ha), and 40% and 50%, respectively. In particular, the plant water requirements in these areas during the first half of July were 40-50% higher than seasonal values (see Figure 5).

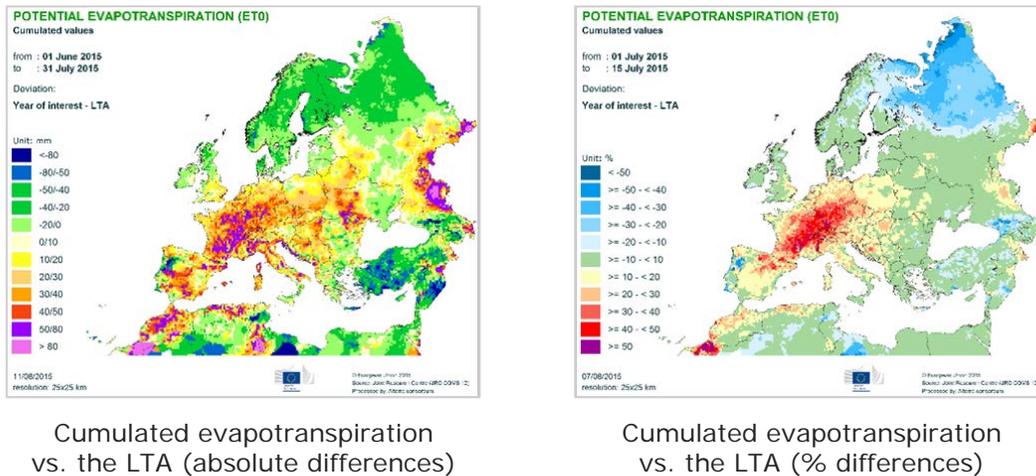


Figure 5: Absolute and relative differences between actual and long-term average evapotranspiration for the period June to July 2015. Source: JRC-MARS database.

The difference between cumulated potential evapotranspiration and the cumulated rainfall for the same period determined a very large deficit in the climatic water balance. In extended areas, this deficit was in the order of 100 to 150 mm during June and July, and sometimes even greater than 150 mm. In relative terms, the deficit was more than double the seasonally expected values for July.

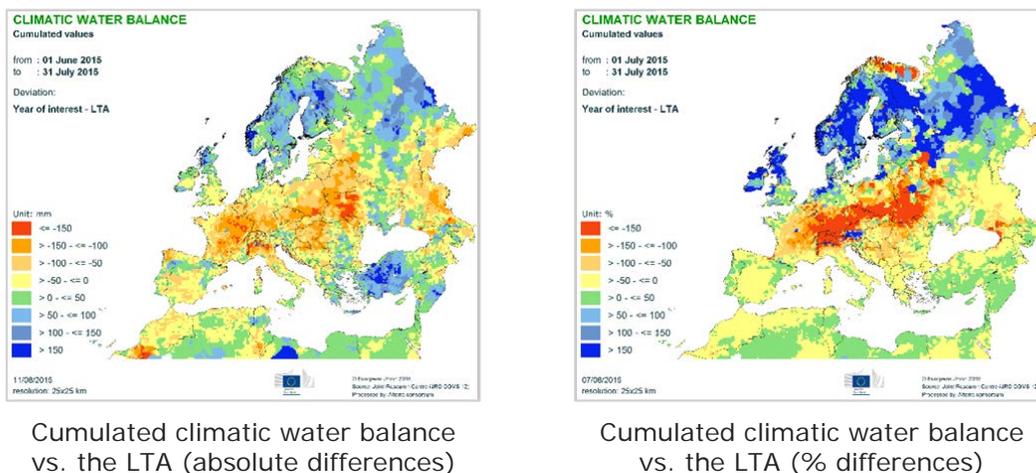
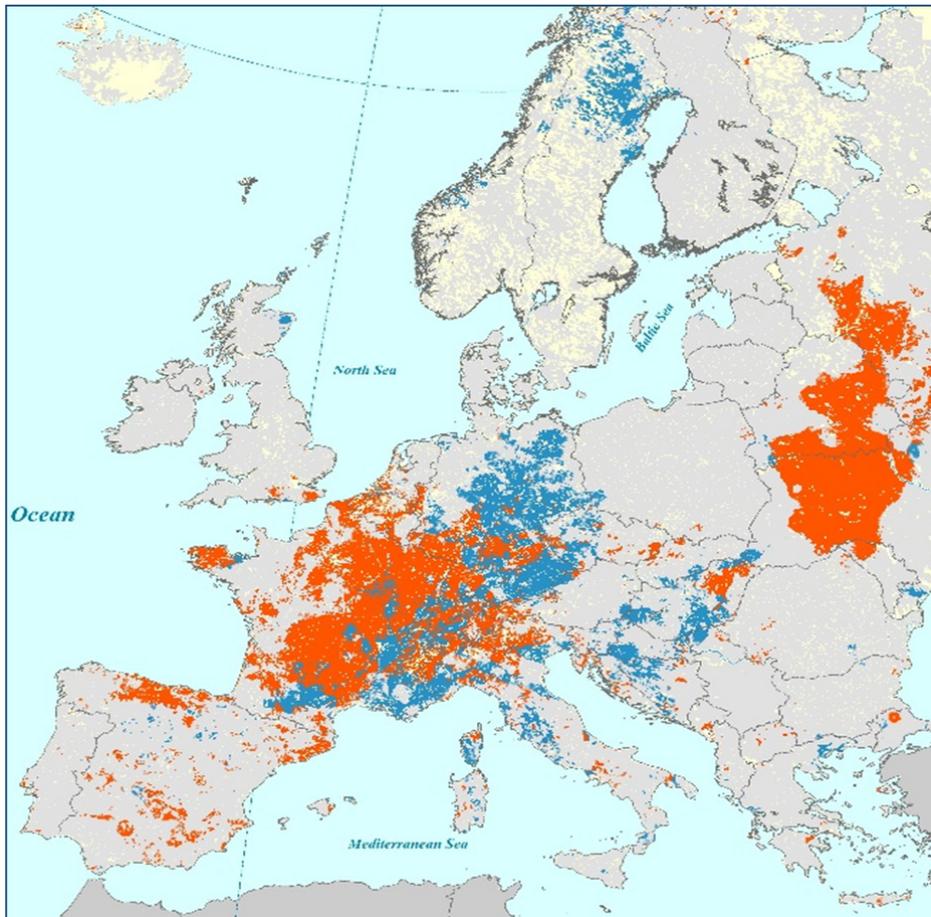


Figure 6: Absolute and relative differences between actual and long-term average evapotranspiration for the period June to July 2015. Source: JRC-MARS database.

Soil Moisture Analysis

The combination of rainfall shortages, exceptionally high temperatures and the consequent high plant water requirements has had a significant impact on the soil moisture content over large areas. Extended areas of France, Benelux, Germany and parts of Spain, Italy, Hungary and the Czech Republic experienced their lowest soil moisture levels since 1990.

The analysis of the soil moisture maps resulting from the JRC's LISFLOOD distributed hydrological model provides clear evidence of the areas suffering from severe soil moisture deficits (Figures 7 and 8).



*Figure 7: Areas with the lowest soil moisture content since 1990 in July 2015 (in red) and in July 2003 (in blue).
Source: JRC-EDEA database (EDO)*

Moreover, the temporal evolution of the soil moisture Drought Severity Index (DSI) clearly shows the progression of the anomalous soil water conditions since late April 2015, with extreme values (reddish colours) already occurring in May in the Iberian Peninsula and progressive expanding to almost the whole continental part of the EU (Figure 9). The maximum extension of the most severe conditions occurred during the second dekad of July (11 to 20 July 2015).

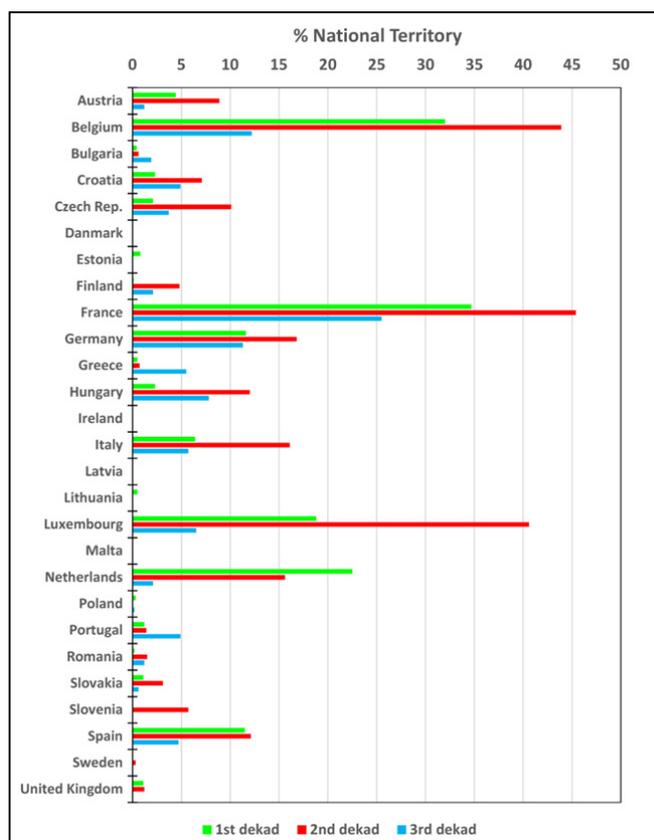


Figure 8: Percentage of national territory with the lowest soil moisture content since 1990 in July 2015 (1st dekad: day 1 to 10, 2nd dekad: day 11 to 20, 3^d dekad: day 21 to end of month).

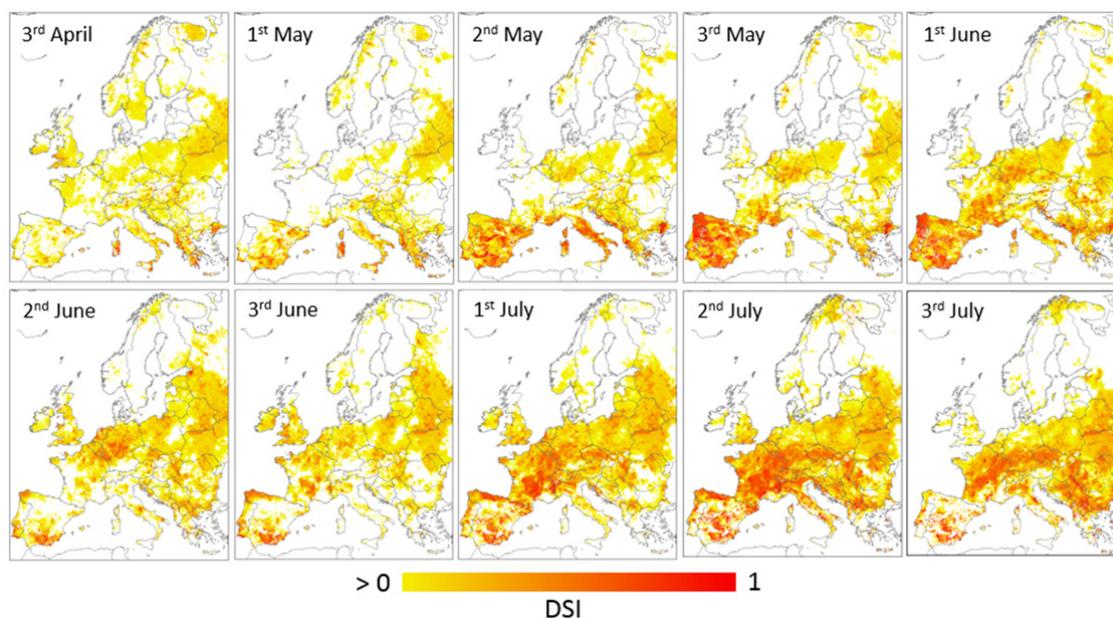


Figure 9: Maps of the soil moisture Drought Severity Index (DSI) for 10-day periods (dekads) from the 3rd dekad of April to the 3rd dekad of July 2015. Source JRC-EDEA Data Base (EDO).

A detailed spatial analysis of the simulated soil moisture content highlights the exceptionally low values of soil moisture during the three months of May to July. Figure 10 presents

examples of the most affected areas where similar conditions rarely or never occurred before.

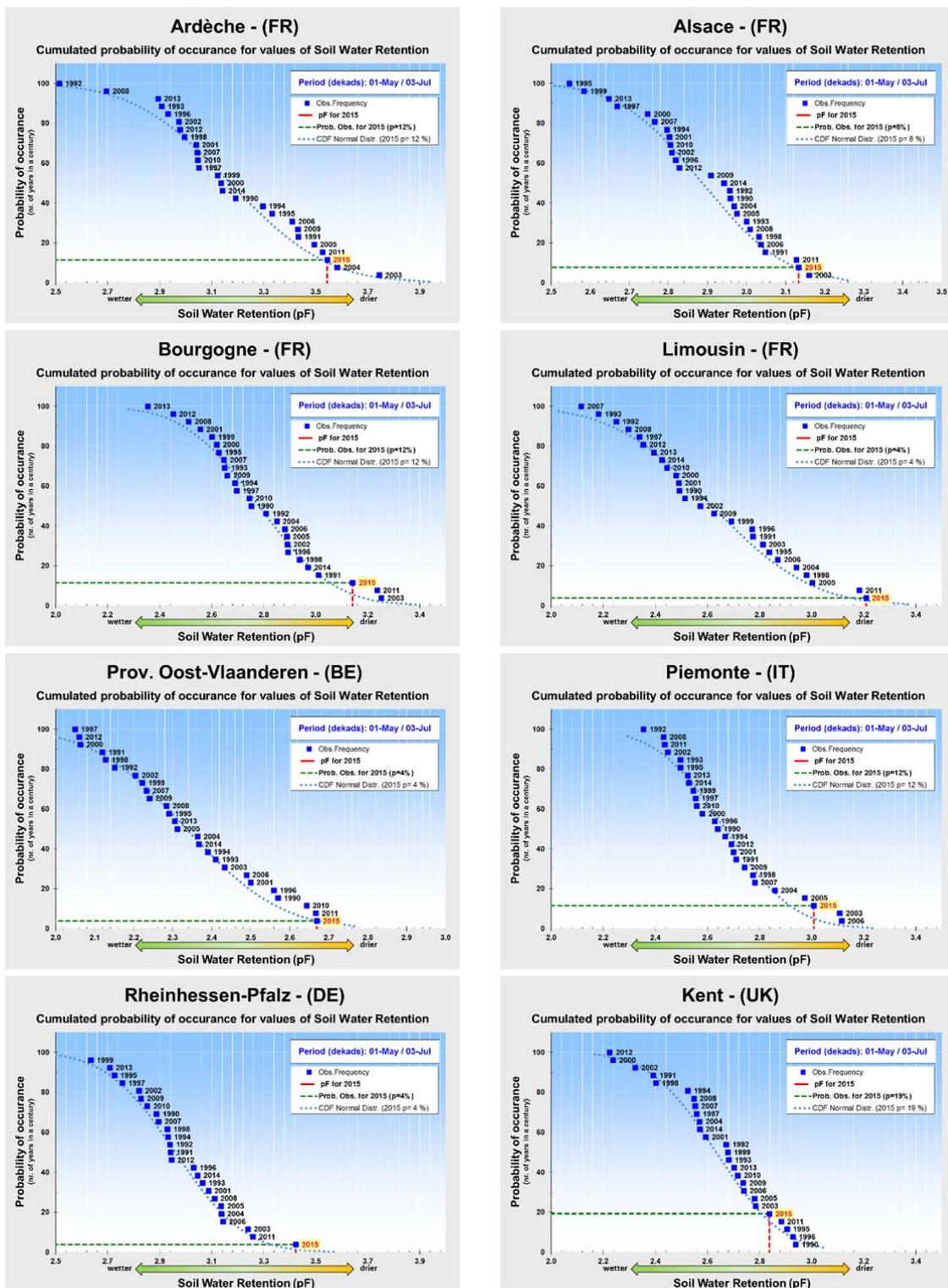


Figure 10: Graphs of the cumulated probability of the occurrence of average soil water retention values in July (higher pF values represent drier conditions). Source JRC-EDEA Data Base (EDO).

Vegetation Status

The effect of both the drought and the high temperatures on the condition of the vegetation cover (natural and cultivated) is shown in Figure 11. The maps show anomalies in the fraction of Absorbed Photosynthetic Active Radiation (fAPAR), which provides a proxy for the photosynthetic activity of vegetation biomass. Anomalies are calculated with respect to the 2001–2014 average.

A progressive appearance of negative anomalies (**reddish areas**) is evident in France, Germany, Benelux, the UK, northern Spain, northern Italy and locally in the eastern EU countries. On the contrary, better than expected vegetation conditions (**greenish areas**) appear in southern Italy and Greece.

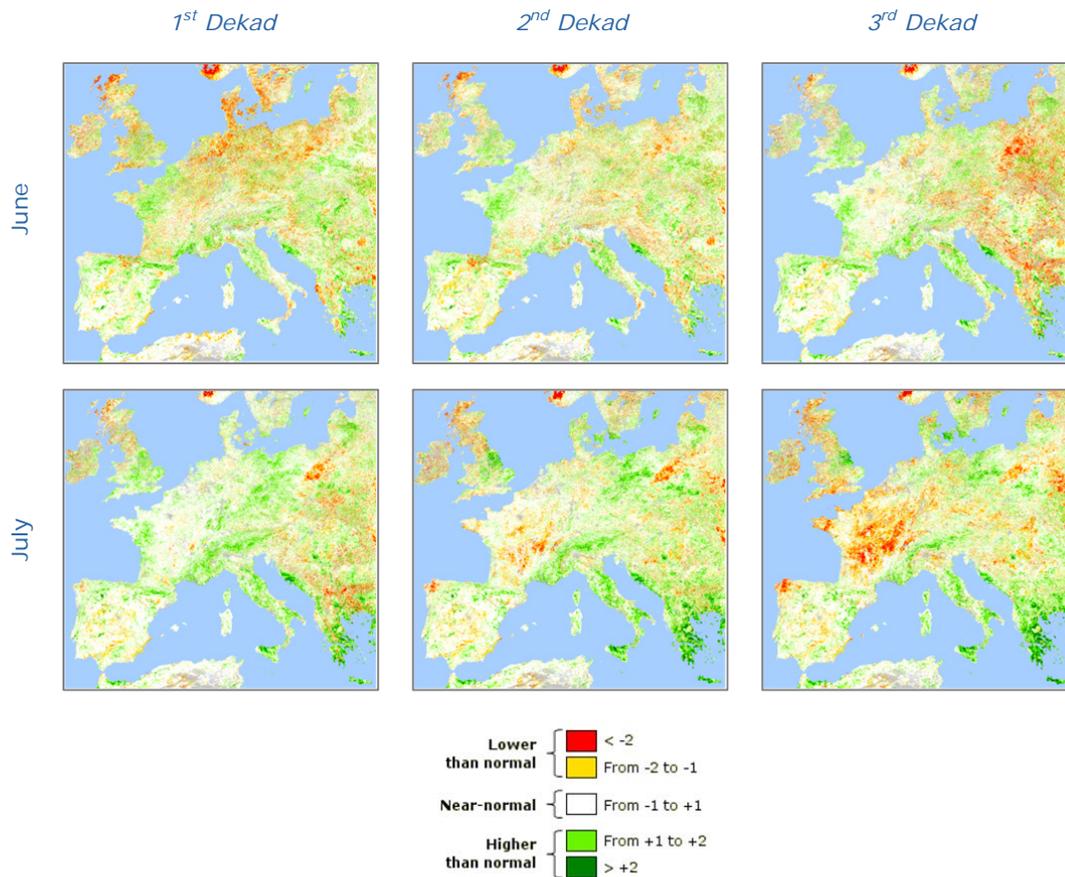


Figure 11: Maps of the anomalies of the fraction of Absorbed Photosynthetically Active Radiation (fAPAR), a proxy of the vigour of the vegetation canopy. Source JRC-EDEA Data Base (EDO).

As the effects of the weather conditions on vegetation are generally cumulative and delayed in time, weather conditions during August and September will be even more important to determining the further decline or prompt recovery of vegetative growth.

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