

# JRC MARS Bulletin

## Crop monitoring in Europe

### December 2023

## Mixed effects of cold and wet start to winter

*In most parts of Europe, temperatures dropped abruptly at the end of November/early December, often accompanied by continued wetter-than-usual conditions. In large parts of central and northern Europe, temperatures reached distinctly negative values, while winter crops were still relatively vulnerable to frost due to the preceding warmer-than-usual conditions and late sowing.*

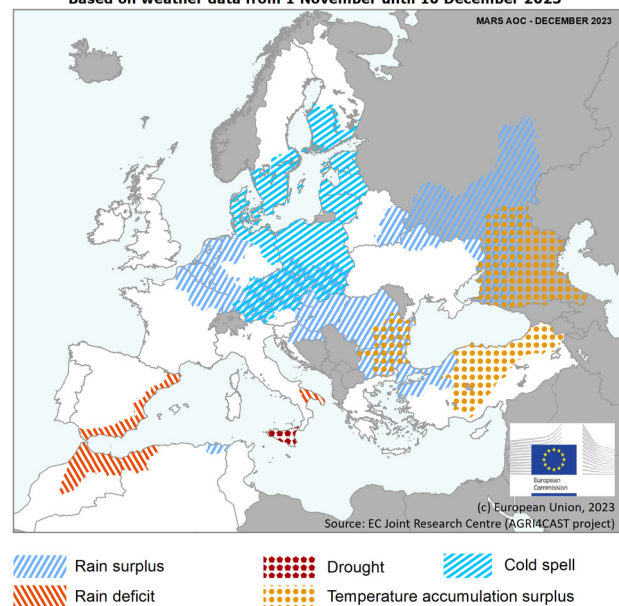
The cold spell in Finland and the Baltic countries, despite very low temperatures (locally down to  $-20^{\circ}\text{C}$ ), is expected to have had a limited crop impact, if any, due to an already well-established snow layer. In northern Germany, Denmark, southern Sweden, and northern Poland, the sudden drop in temperatures, combined with high soil water levels and the lack of an insulating snow cover is likely to have induced damage to winter crops locally. In south-eastern Germany, Austria, Czechia, southern Poland and Slovakia, potential damage was mitigated by snow fall, which regionally brought more than 20 cm of fresh snow to insulate plants from the cold. Overly wet conditions, partly accompanied by snow, disturbed the end of sowing, particularly for soft wheat, in northern France, the Benelux countries and western Germany. Planned sowings are unlikely to be fully achieved in these regions, which is expected to lead to an increase in the area of spring cereals. In France, about 10% of planned soft wheat areas remained unsown. High precipitation in southern central and eastern Europe had little or no negative impacts on crops. It was particularly beneficial in Romania and Bulgaria, where it

mitigated/ended the previous drought situation, which, together with above-average temperatures supported the establishment of the late sown winter crops. In Belarus, north-eastern Ukraine and European Russia, thick snow cover over winter wheat fields is providing adequate thermal insulation against severe cold events. This is not the case in the southernmost parts of European Russia, where high temperatures prevented snow accumulation as well as the build-up of frost tolerance.

A distinct rain deficit was observed along the Mediterranean coast of Spain and in southern Italy (*Puglia* and *Sicilia*). This is of particular concern in Sicily, where drought, together with a marked delay in sowing, resulted in underdeveloped winter cereals, notably durum wheat. In the Maghreb, a rainfall deficit negatively affects wheat and barley in their early vegetative stages in northern Morocco and, especially, western Algeria.

#### AREAS OF CONCERN - EXTREME WEATHER EVENTS

Based on weather data from 1 November until 10 December 2023



#### Contents:

1. Agrometeorological overview
2. Winter hardening
3. Atlas

Covers the period from 1 November until 10 December

# 1. Agrometeorological overview

## 1.1. Meteorological review (1 November – 10 December 2023)

*Warmer than usual in the south and colder than usual in the north, with abundant precipitation in many areas.*

**Warmer-than-usual conditions**, with daily mean temperatures between 0.5 °C and 2 °C (and up to 4 °C in several regions) above the 1991–2022 long-term average (LTA), were observed in the Iberian peninsula, most of France and Italy, the Balkan peninsula, Türkiye, central and eastern parts of Ukraine, and southern and eastern European Russia. In some of these regions, average daily temperatures ranked among the three warmest in our records since 1991.

**Significantly colder-than-usual conditions**, with temperature anomalies of between 2 °C and 4 °C (and in some areas as much as 8 °C) below the LTA were observed in Estonia, the Scandinavian peninsula and north-western European Russia. In these regions, average daily temperatures ranked among the three coldest in our records since 1991.

**Wetter-than-usual conditions** were observed in most parts of Europe. The most distinct anomalies (rainfall totals reaching more than 100% and in some regions more than 150% above the LTA) were observed in the Alps region, the Carpathians, in parts of the Balkan peninsula and Türkiye, and in the Black Sea region, as well as in central and southern Ukraine and European Russia. In many of these regions, the autumn ranked among the three wettest in our records since 1991.

**Dry conditions** (30 mm or less of rainfall) were observed along the Mediterranean coast of Spain and in northern Italy, Sicily, parts of central Türkiye and northern Scandinavia.

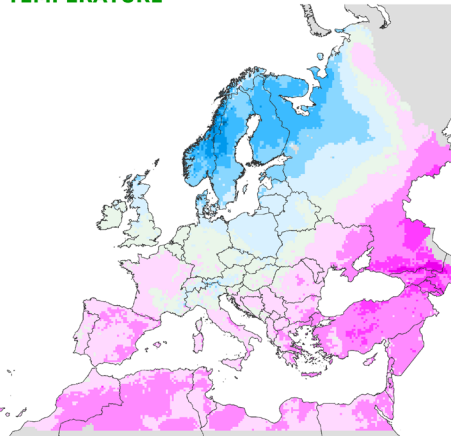
### AVERAGE DAILY TEMPERATURE

Averaged values

from: 01 November 2023  
to: 10 December 2023

Deviation:  
Year of interest - LTA

- Units: °C
- < -8 (cooler in YOI)
  - 8 - -6 (cooler in YOI)
  - 6 - -4 (cooler in YOI)
  - 4 - -2 (cooler in YOI)
  - 2 - -0.5 (cooler in YOI)
  - 0.5 - 0.5
  - 0.5 - 2 (warmer in YOI)
  - 2 - 4 (warmer in YOI)
  - 4 - 6 (warmer in YOI)
  - 6 - 8 (warmer in YOI)



12/12/2023  
Resolution: 25 x 25 km



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Source: EC Joint Research Centre (AGRI4CAST project)

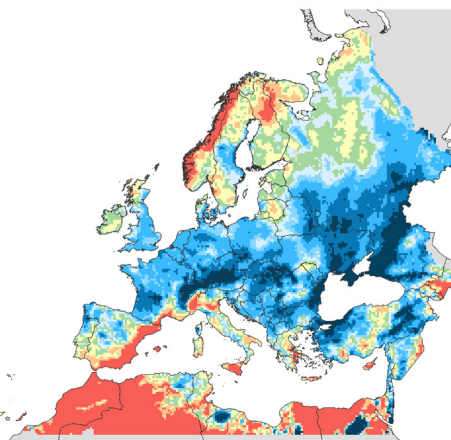
### RAINFALL

Cumulative values

from: 01 November 2023  
to: 10 December 2023

Deviation:  
Year of interest - LTA

- Units: %
- >= -100 - < -50
  - >= -50 - < -30
  - >= -30 - < -10
  - >= -10 - < 10
  - >= 10 - < 30
  - >= 30 - < 50
  - >= 50 - < 100
  - >= 100 - < 150
  - >= 150



12/12/2023  
Resolution: 25 x 25 km



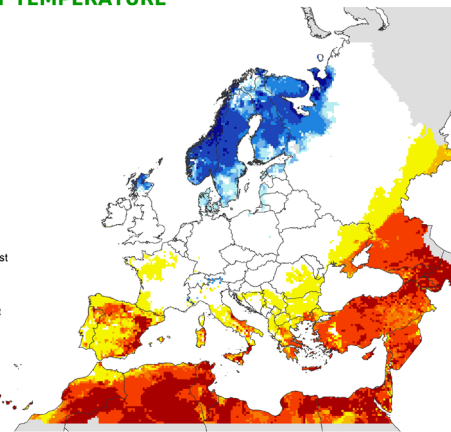
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Source: EC Joint Research Centre (AGRI4CAST project)

### AVERAGE DAILY TEMPERATURE

from: 01 November 2023  
to: 10 December 2023

Ranking since 1991

- Warmest year
- Second warmest
- Third warmest
- Fourth warmest
- From fifth to tenth warmest
- Others
- From fifth to tenth coldest
- Fourth coldest
- Third coldest
- Second coldest
- Coldest year



12/12/2023  
Resolution: 25 x 25 km



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Source: EC Joint Research Centre (AGRI4CAST project)

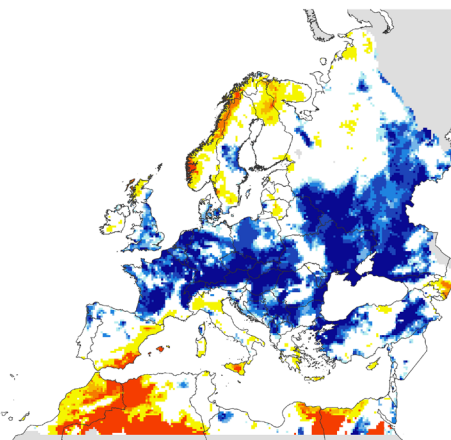
### RAINFALL

Cumulative values

from: 01 November 2023  
to: 10 December 2023

Ranking since 1991

- Driest year
- Second driest
- Third driest
- Fourth driest
- From fifth to tenth driest
- Others
- From fifth to tenth wettest
- Fourth wettest
- Third wettest
- Second wettest
- Wettest year



12/12/2023  
Resolution: 25 x 25 km



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Source: EC Joint Research Centre (AGRI4CAST project)

## 1.2. Autumn Review (September, October, November)

*The first half of autumn was characterised by warmer-than-average conditions in all of Europe and drier-than-average conditions in most areas; in the second half, above-average temperatures persisted in the Balkans and Black Sea region, while wetter-than-usual conditions prevailed in most of the continent.*

Considering the entire autumn season, **warmer-than-usual conditions** with respect to the LTA were observed in almost all of Europe. The most distinct positive temperature anomalies (2 °C to 4 °C above the LTA) were observed in eastern and northern parts of Spain and below 52° latitude in most other parts of Europe, as well as in parts of Türkiye and the Ural region of European Russia. In many of these regions, average daily temperatures ranked among the three highest in our records since 1991. **Colder-than-usual conditions**, with temperature anomalies of between 2 °C and 0.5 °C (and as much as 4 °C) below the LTA, were observed in Norway, most of Sweden and Finland, and north-western European Russia. In these regions, average daily temperatures ranked among the three coldest in our records since 1991.

**Drier-than-usual conditions** (precipitation anomalies of 50% or more below the LTA) were observed along the Mediterranean coasts of Spain and France, and in parts of Italy, Romania, Bulgaria, Greece and Türkiye. In some of these regions, the autumn ranked among the three driest on record since 1991.

**Wetter-than-usual conditions** (precipitation anomalies of 50% or more above the LTA) were observed in most other parts of Europe. In many of these regions, rainfall ranked among the three highest in our records since 1991. The most substantial positive rainfall anomalies (100% or more above the LTA) were observed in parts of the Iberian peninsula, France and Scotland, as well as in eastern Türkiye and parts of southern and eastern European Russia.

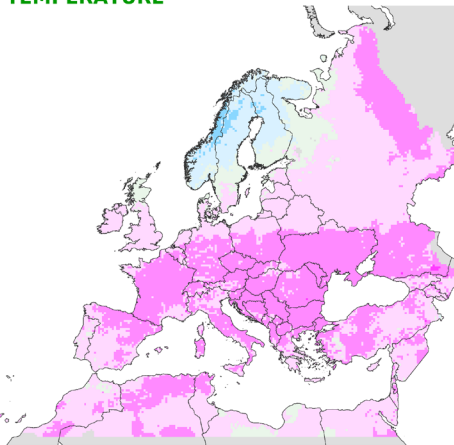
### AVERAGE DAILY TEMPERATURE Averaged values

from: 01 September 2023  
to: 30 November 2023

Deviation:  
Year of interest - LTA

Units: °C

- 4 - -2 (cooler in YOI)
- 2 - -0.5 (cooler in YOI)
- 0.5 - 0.5
- 0.5 - 2 (warmer in YOI)
- 2 - 4 (warmer in YOI)
- 4 - 6 (warmer in YOI)



11/12/2023  
Resolution: 25 x 25 km



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Source: EC Joint Research Centre (AGRI4CAST project)

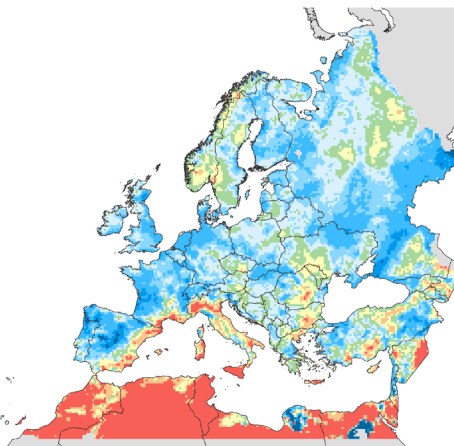
### RAINFALL Cumulative values

from: 01 September 2023  
to: 30 November 2023

Deviation:  
Year of interest - LTA

Units: %

- >= -100 - < -50
- >= -50 - < -30
- >= -30 - < -10
- >= -10 - < 10
- >= 10 - < 30
- >= 30 - < 50
- >= 50 - < 100
- >= 100 - < 150
- >= 150



11/12/2023  
Resolution: 25 x 25 km



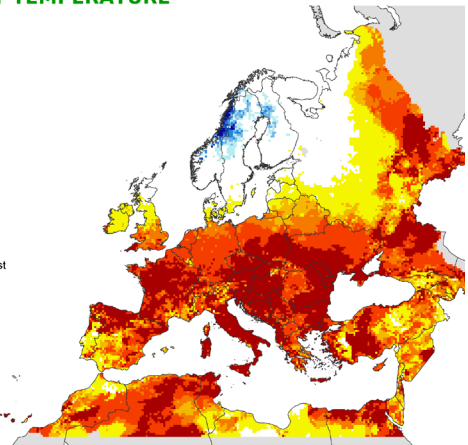
© European Union, 2023  
Source: EC Joint Research Centre (AGRI4CAST project)

### AVERAGE DAILY TEMPERATURE

from: 01 September 2023  
to: 30 November 2023

Ranking since 1991

- Warmest year
- Second warmest
- Third warmest
- Fourth warmest
- From fifth to tenth warmest
- Others
- From fifth to tenth coldest
- Fourth coldest
- Third coldest
- Second coldest
- Coldest year



11/12/2023  
Resolution: 25 x 25 km



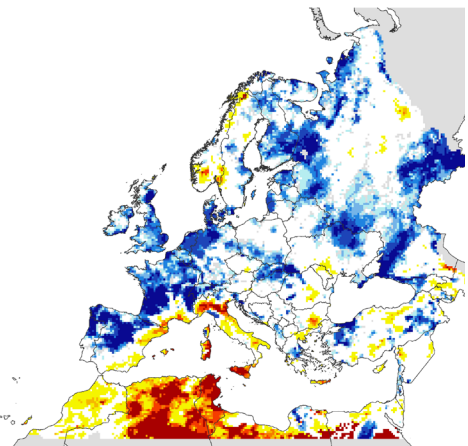
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Source: EC Joint Research Centre (AGRI4CAST project)

### RAINFALL Cumulative values

from: 01 September 2023  
to: 30 November 2023

Ranking since 1991

- Driest year
- Second driest
- Third driest
- Fourth driest
- From fifth to tenth driest
- Others
- From fifth to tenth wettest
- Fourth wettest
- Third wettest
- Second wettest
- Wettest year



11/12/2023  
Resolution: 25 x 25 km



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Source: EC Joint Research Centre (AGRI4CAST project)

### 1.3. Weather forecast (14 - 23 December)

Warmer than usual in most regions; rainy in mountainous areas and in the central and eastern Mediterranean region, bringing thunderstorms and heavy rains, while snowfall is forecast for northern Europe.

**Colder-than-usual conditions**, with average daily temperatures between 0.5 °C and 2 °C (locally down to 4 °C) below the LTA, are forecast for Portugal and parts of Spain.

**Warmer-than-usual conditions** are forecast for most of Europe. The most substantial positive anomalies, of between 2 °C and 6 °C above the LTA, are forecast for northern Bulgaria, parts of Türkiye and most of eastern Europe, including European Russia, with temperatures as much as 8 °C above the LTA in the Ural Mountains of European Russia.

**Dry conditions** (total precipitation of 3 mm or less) are forecast for most of the Iberian peninsula, northern Italy and the French Riviera.

**Wet conditions** (total precipitation between 10 mm and 90 mm) are forecast for most other parts of Europe. **Very wet conditions** (rainfall of 90 mm or more) are forecast for the northernmost parts of the Iberian Peninsula, and for Scotland, the Alps region, Norway and western and south-western Türkiye.

**The long-range weather forecast** points to a moderate likelihood of warmer-than-usual conditions, exceeding the 24-year climatological median by up to 2 °C in January and February in parts of southern Europe and by up to 1 °C until March in most of Europe. Precipitation of up to 50 mm above the 24-year climatological median is forecast for January for most of Europe.

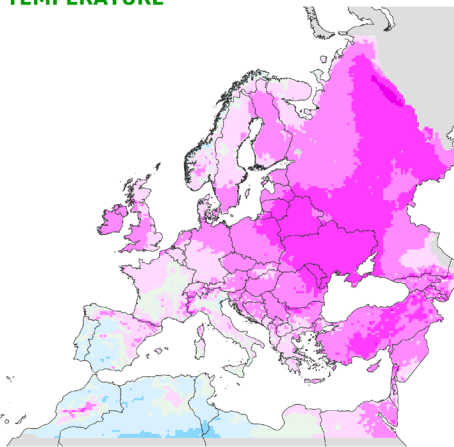
#### AVERAGE DAILY TEMPERATURE

Averaged values

from: 14 December 2023  
to: 23 December 2023

Deviation:  
Year of interest - LTA

- Units: °C
- 4 - -2 (cooler in YOI)
  - 2 - -0.5 (cooler in YOI)
  - 0.5 - 0.5
  - 0.5 - 2 (warmer in YOI)
  - 2 - 4 (warmer in YOI)
  - 4 - 6 (warmer in YOI)
  - 6 - 8 (warmer in YOI)



14/12/2023  
Resolution: 25 x 25 km



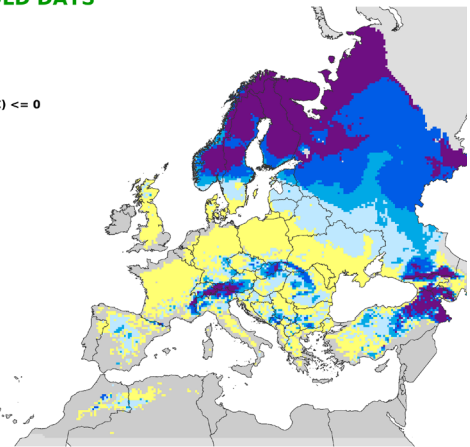
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Source: EC Joint Research Centre (AGRI4CAST project)

#### NUMBER OF COLD DAYS

from: 14 December 2023  
to: 23 December 2023

Period of interest  
Minimum temperature (°C) <= 0

- Units: days
- = 0
  - 1 - 3
  - 4 - 5
  - 6 - 7
  - 8 - 9
  - >= 10



14/12/2023  
Resolution: 25 x 25 km



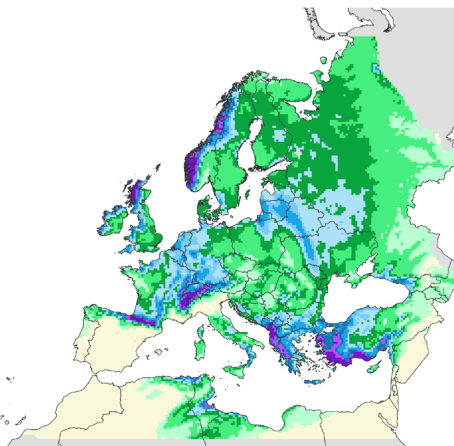
© European Union, 2023  
Source: EC Joint Research Centre (AGRI4CAST project)

#### RAINFALL

Cumulative values

from: 14 December 2023  
to: 23 December 2023

- Units: mm
- 0 - 3
  - 3 - 10
  - 10 - 20
  - 20 - 30
  - 30 - 40
  - 40 - 50
  - 50 - 70
  - 70 - 90
  - 90 - 110
  - > 110



14/12/2023  
Resolution: 25 x 25 km



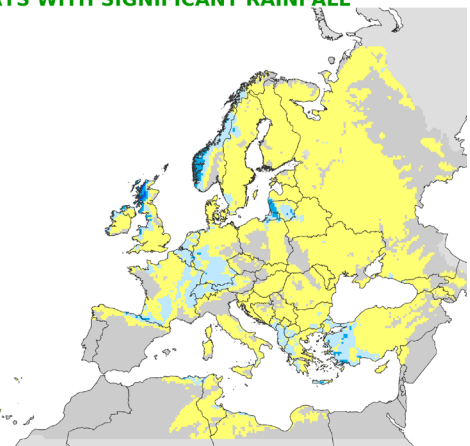
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Source: EC Joint Research Centre (AGRI4CAST project)

#### NUMBER OF DAYS WITH SIGNIFICANT RAINFALL

from: 14 December 2023  
to: 23 December 2023

Rain (mm) > 5

- Units: days
- = 0
  - 1 - 3
  - 4 - 5
  - 6 - 7
  - 8 - 9
  - >= 10

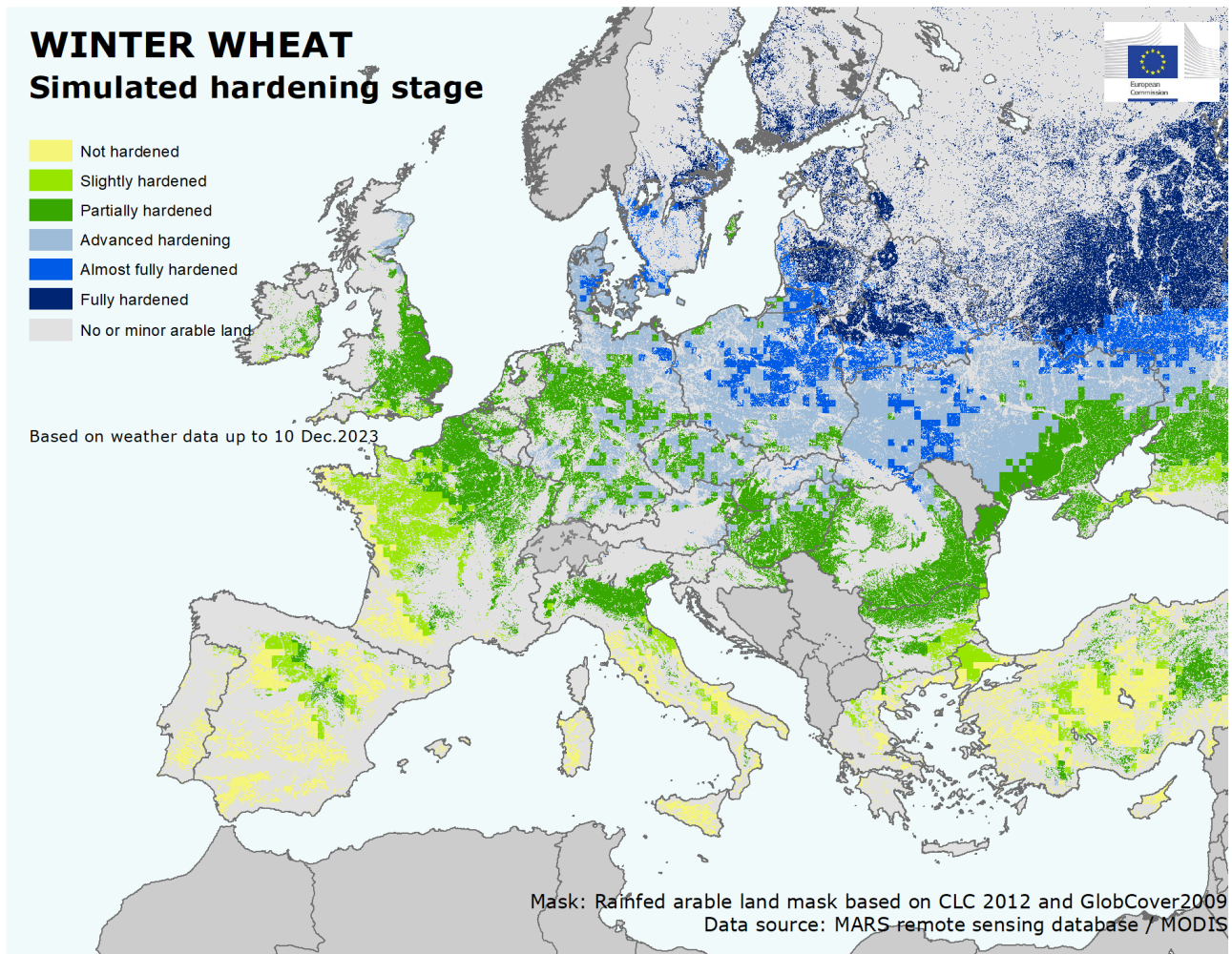


14/12/2023  
Resolution: 25 x 25 km



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Source: EC Joint Research Centre (AGRI4CAST project)

## 2. Winter hardening and frost kill



Hardening is the bio-physiological process whereby winter cereals gain low-temperature tolerance to withstand freezing conditions that occur during the winter dormancy period.

Relatively warm conditions prevailed during most of autumn in central and northern Europe. At the same time, delayed sowing (particularly of cereals) was reported, caused by overly wet conditions. Towards the end of the review period, two distinct cold spells occurred: the first, from 29 November to 2 December, around the Baltic Sea, with temperatures as low as  $-10^{\circ}\text{C}$  in Denmark, northern Germany and Poland; the second, from 2 to 5 December, in south-eastern Germany, northern Austria, Czechia and southern Poland, with temperatures as low as  $-15^{\circ}\text{C}$  accompanied by abundant snowfall.

Currently, our models indicate that winter crops are at least partially hardened in most frost-prone European countries, with crops at an advanced stage of hardening or fully hardened in the Scandinavian and Baltic countries, in Poland and in substantial parts of Germany, Austria, Czechia, Slovakia, Ukraine and Russia. On a European

level, our models suggest that hardening is slightly delayed compared with last year, mainly due to the relatively mild temperatures during most of autumn. It is worth noting that our models do not account for late sowing and could hence overestimate how advanced the hardening process is in the late-sown winter crops, which can therefore be expected to be more vulnerable to harsh winter conditions.

Considering these factors together, we expect the cold spells to have caused minor frost-related damage to late-sown winter crops in Denmark, southern Sweden, northern and south-eastern Germany, Austria, Czechia, Poland and Ukraine. Additional damage in these regions is likely to have occurred locally, where high precipitation led to waterlogged soils, which can lead to mechanical destruction of seedlings in the event of frost. The recent snowfall will have mitigated this damage thanks to the insulating properties of the snow layer. In addition, cold spells probably caused frost-kill damage in the southern part of the Volga okrug in Russia, as well as in central parts of Türkiye.

# 3. Atlas

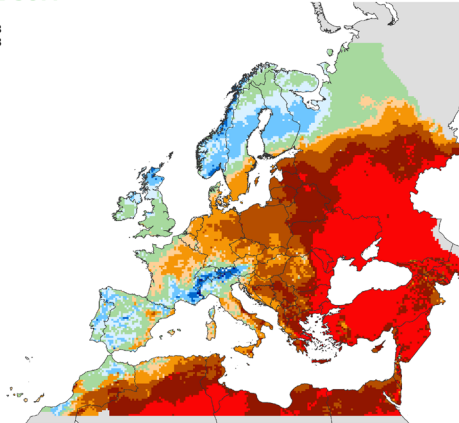
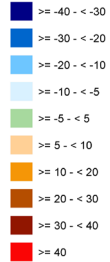
## Temperature regime

### TEMPERATURE SUM

from: 01 November 2023  
to: 10 November 2023

Deviation:  
Year of interest - LTA  
Base temperature: 0 °C

Units: °C



11/12/2023  
Resolution: 25 x 25 km



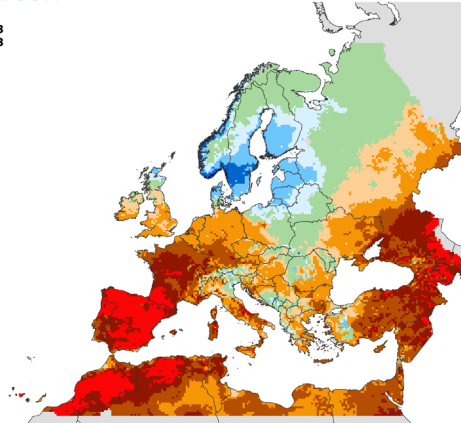
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Source: EC Joint Research Centre (AGRI4CAST project)

### TEMPERATURE SUM

from: 11 November 2023  
to: 20 November 2023

Deviation:  
Year of interest - LTA  
Base temperature: 0 °C

Units: °C



11/12/2023  
Resolution: 25 x 25 km



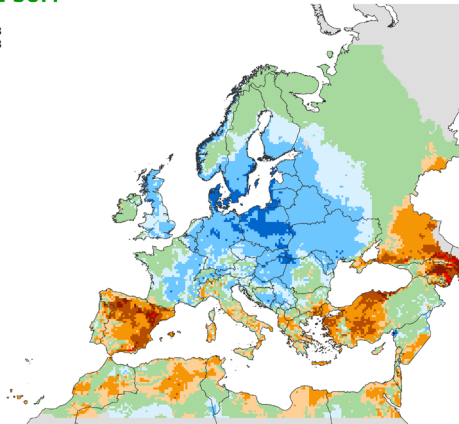
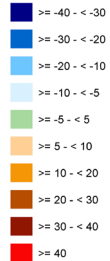
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Source: EC Joint Research Centre (AGRI4CAST project)

### TEMPERATURE SUM

from: 21 November 2023  
to: 30 November 2023

Deviation:  
Year of interest - LTA  
Base temperature: 0 °C

Units: °C



11/12/2023  
Resolution: 25 x 25 km



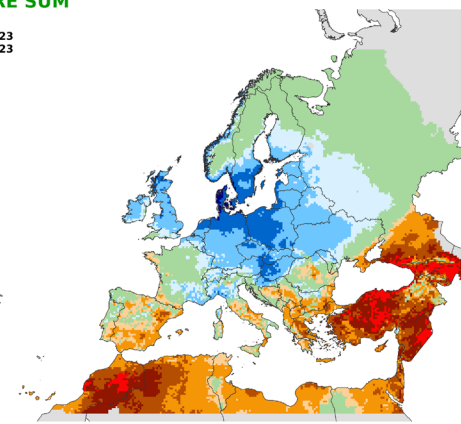
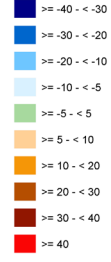
© European Union, 2023  
Source: EC Joint Research Centre (AGRI4CAST project)

### TEMPERATURE SUM

from: 01 December 2023  
to: 10 December 2023

Deviation:  
Year of interest - LTA  
Base temperature: 0 °C

Units: °C



11/12/2023  
Resolution: 25 x 25 km



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Source: EC Joint Research Centre (AGRI4CAST project)

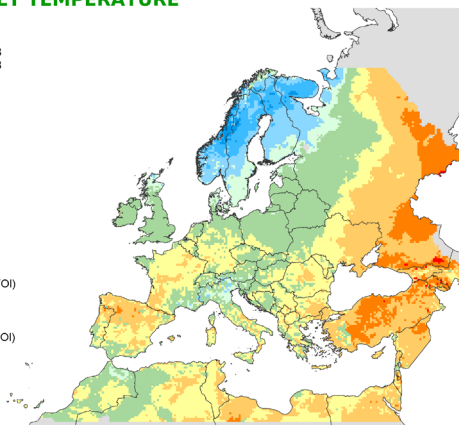
### MINIMUM DAILY TEMPERATURE

Averaged values

from: 01 November 2023  
to: 30 November 2023

Deviation:  
Year of interest - LTA

Units: °C



11/12/2023  
Resolution: 25 x 25 km



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Source: EC Joint Research Centre (AGRI4CAST project)

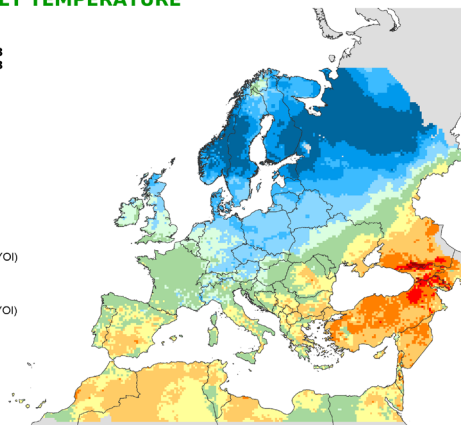
### MINIMUM DAILY TEMPERATURE

Averaged values

from: 01 December 2023  
to: 10 December 2023

Deviation:  
Year of interest - LTA

Units: °C



11/12/2023  
Resolution: 25 x 25 km



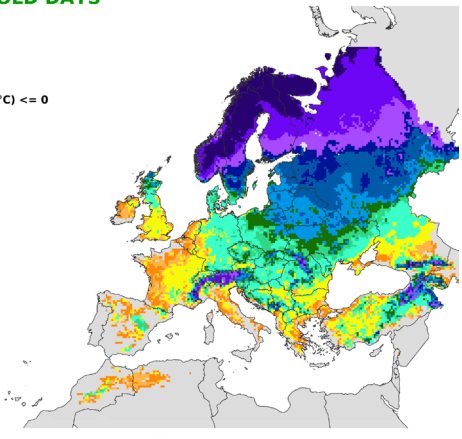
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Source: EC Joint Research Centre (AGRI4CAST project)

**NUMBER OF COLD DAYS**

from: **01 November 2023**  
to: **30 November 2023**

Period of interest  
**Minimum temperature (°C) <= 0**

- Units: days
- 0
  - > 1 - <= 2
  - > 2 - <= 5
  - > 5 - <= 8
  - > 8 - <= 10
  - > 10 - <= 13
  - > 13 - <= 15
  - > 15 - <= 18
  - > 18 - <= 20
  - > 20 - <= 25
  - > 25 - <= 30
  - > 30



11/12/2023  
Resolution: 25 x 25 km

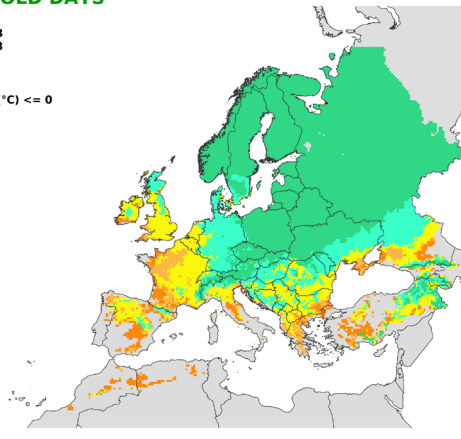
© European Union, 2023  
Source: EC Joint Research Centre (AGRI4CAST project)

**NUMBER OF COLD DAYS**

from: **01 December 2023**  
to: **10 December 2023**

Period of interest  
**Minimum temperature (°C) <= 0**

- Units: days
- 0
  - > 1 - <= 2
  - > 2 - <= 5
  - > 5 - <= 8
  - > 8 - <= 10



11/12/2023  
Resolution: 25 x 25 km

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Source: EC Joint Research Centre (AGRI4CAST project)

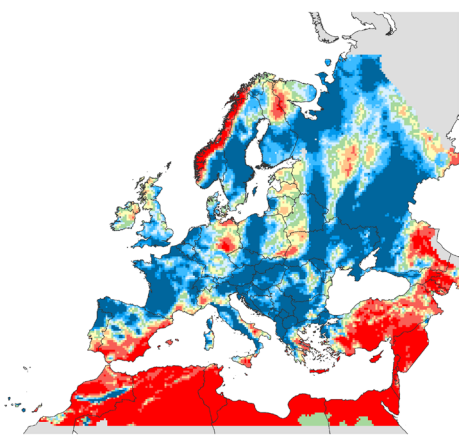
**Precipitation**

**RAINFALL**  
Cumulative values

from: **01 November 2023**  
to: **10 November 2023**

Deviation:  
**Year of interest - LTA**

- Units: %
- >= -100 - < -80
  - >= -80 - < -50
  - >= -50 - < -30
  - >= -30 - < -10
  - >= -10 - < 10
  - >= 10 - < 30
  - >= 30 - < 50
  - >= 50 - < 80
  - >= 80 - < 100
  - >= 100



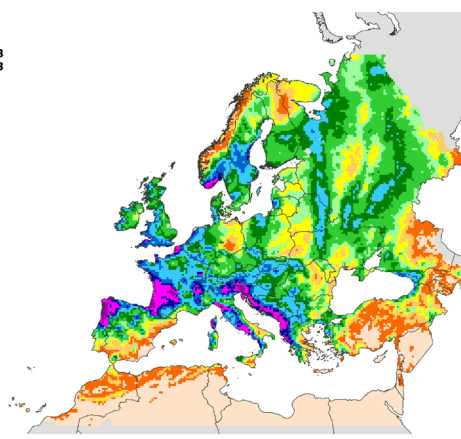
11/12/2023  
Resolution: 25 x 25 km

© European Union, 2023  
Source: EC Joint Research Centre (AGRI4CAST project)

**RAINFALL**  
Cumulative values

from: **01 November 2023**  
to: **10 November 2023**

- Units: mm
- >= 0 - < 1
  - >= 1 - < 5
  - >= 5 - < 10
  - >= 10 - < 15
  - >= 15 - < 20
  - >= 20 - < 30
  - >= 30 - < 40
  - >= 40 - < 60
  - >= 60 - < 80
  - >= 80 - < 100
  - >= 100 - < 150
  - >= 150



11/12/2023  
Resolution: 25 x 25 km

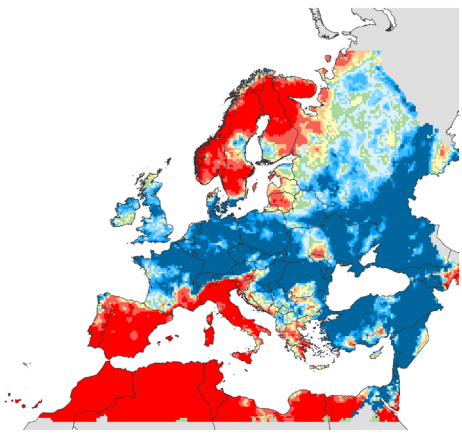
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Source: EC Joint Research Centre (AGRI4CAST project)

**RAINFALL**  
Cumulative values

from: **11 November 2023**  
to: **20 November 2023**

Deviation:  
**Year of interest - LTA**

- Units: %
- >= -100 - < -80
  - >= -80 - < -50
  - >= -50 - < -30
  - >= -30 - < -10
  - >= -10 - < 10
  - >= 10 - < 30
  - >= 30 - < 50
  - >= 50 - < 80
  - >= 80 - < 100
  - >= 100



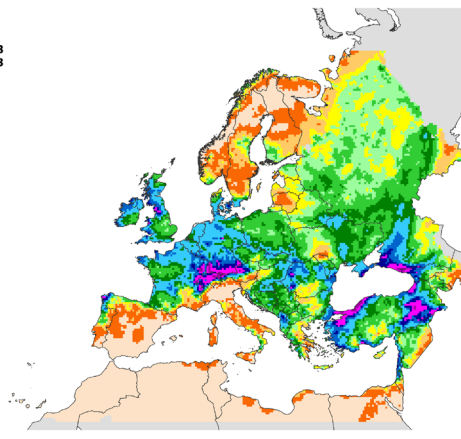
11/12/2023  
Resolution: 25 x 25 km

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Source: EC Joint Research Centre (AGRI4CAST project)

**RAINFALL**  
Cumulative values

from: **11 November 2023**  
to: **20 November 2023**

- Units: mm
- >= 0 - < 1
  - >= 1 - < 5
  - >= 5 - < 10
  - >= 10 - < 15
  - >= 15 - < 20
  - >= 20 - < 30
  - >= 30 - < 40
  - >= 40 - < 60
  - >= 60 - < 80
  - >= 80 - < 100
  - >= 100 - < 150
  - >= 150



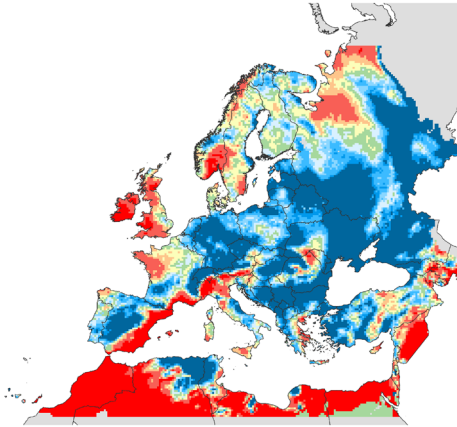
11/12/2023  
Resolution: 25 x 25 km

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Source: EC Joint Research Centre (AGRI4CAST project)

**RAINFALL**  
Cumulative values

from: 21 November 2023  
to: 30 November 2023

Deviation:  
Year of interest - LTA



11/12/2023  
Resolution: 25 x 25 km

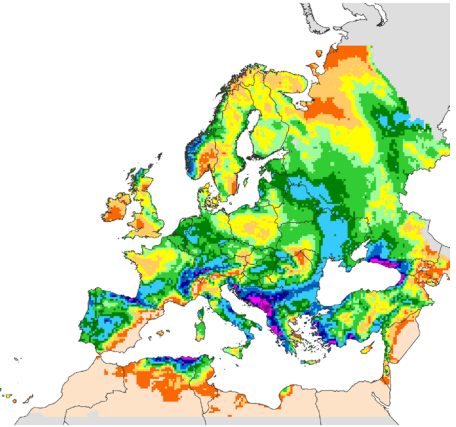
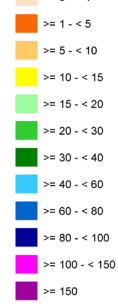


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**RAINFALL**  
Cumulative values

from: 21 November 2023  
to: 30 November 2023

Units: mm



11/12/2023  
Resolution: 25 x 25 km

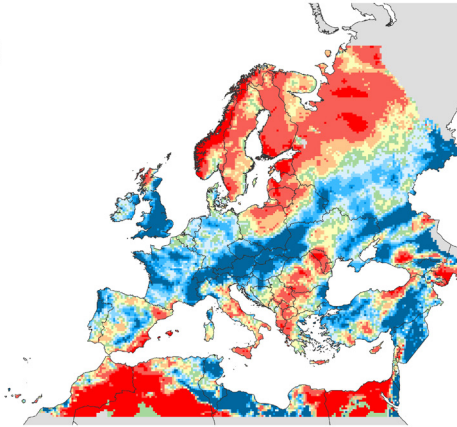


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**RAINFALL**  
Cumulative values

from: 01 December 2023  
to: 10 December 2023

Deviation:  
Year of interest - LTA



11/12/2023  
Resolution: 25 x 25 km

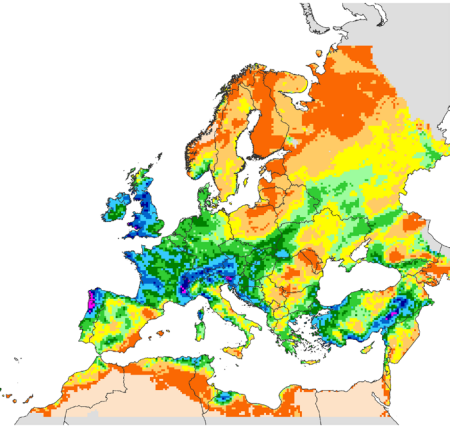
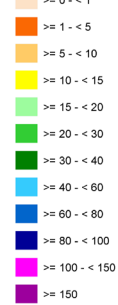


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**RAINFALL**  
Cumulative values

from: 01 December 2023  
to: 10 December 2023

Units: mm



11/12/2023  
Resolution: 25 x 25 km



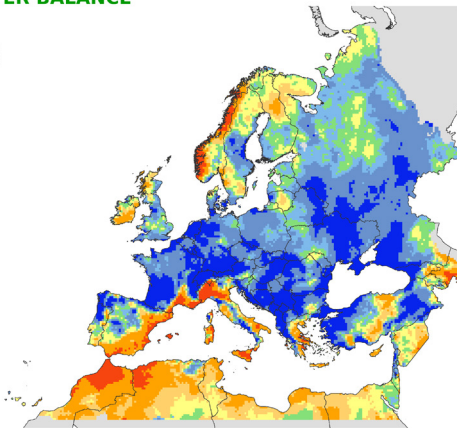
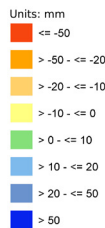
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# Climatic water balance

**CLIMATIC WATER BALANCE**  
Cumulative values

from: 01 November 2023  
to: 30 November 2023

Deviation:  
Year of interest - LTA



11/12/2023  
Resolution: 25 x 25 km

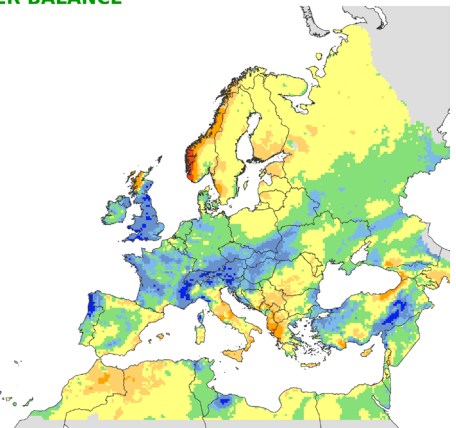


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**CLIMATIC WATER BALANCE**  
Cumulative values

from: 01 December 2023  
to: 10 December 2023

Deviation:  
Year of interest - LTA



11/12/2023  
Resolution: 25 x 25 km



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## JRC MARS Bulletins 2023

Date	Publication	Reference
23 Jan	Agromet analysis	Vol. 31 No 1
20 Feb	Agromet analysis	Vol. 31 No 2
20 Mar	Agromet analysis, pasture analysis, yield forecast	Vol. 31 No 3
24 Apr	Agromet analysis, remote sensing, pasture analysis, sowing conditions, yield forecast	Vol. 31 No 4
22 May	Agromet analysis, remote sensing, pasture analysis, sowing update, yield forecast	Vol. 31 No 5
19 Jun	Agromet analysis, remote sensing, pasture analysis, rice analysis, yield forecast	Vol. 31 No 6
24 Jul	Agromet analysis, remote sensing, pasture analysis, harvesting conditions, yield forecast	Vol. 31 No 7
21 Aug	Agromet analysis, remote sensing, pasture update, harvesting update, yield forecast	Vol. 31 No 8
18 Sep	Agromet analysis, remote sensing, pasture analysis, rice analysis, harvesting update, yield forecast	Vol. 31 No 9
23 Oct	Agromet analysis, pasture update, sowing conditions, harvesting update, yield forecast	Vol. 31 No 10
27 Nov	Agromet analysis, sowing update, harvesting update	Vol. 31 No 11
18 Dec	Agromet analysis	Vol. 31 No 12

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AGRI4CAST Resources are available at  
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### Analysis and reports

E. Tarnavsky, M. Rossi, A. Bussay, J. Morel, I. Biavetti, M. Bratu, I. Cerrani, M. Claverie, P. De Palma, D. Fumagalli, G. Manfron, S. Niemeyer, L. Nisini, L. Panarello, M. van den Berg, A. Zucchini

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### Edition

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### Technical note

The long-term average (LTA) used within this Bulletin as a reference is calculated on the basis of weather data from 1991-2022.

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