Croatia in the context of Europe

Crop growing conditions
and trends in climate observations from the
EU MARS Crop Yield Forecasting System

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Stefan Niemeyer

Workshop "Climate Change Impact on Agriculture in Croatia"
Zagreb, 22 September 2020

Outline

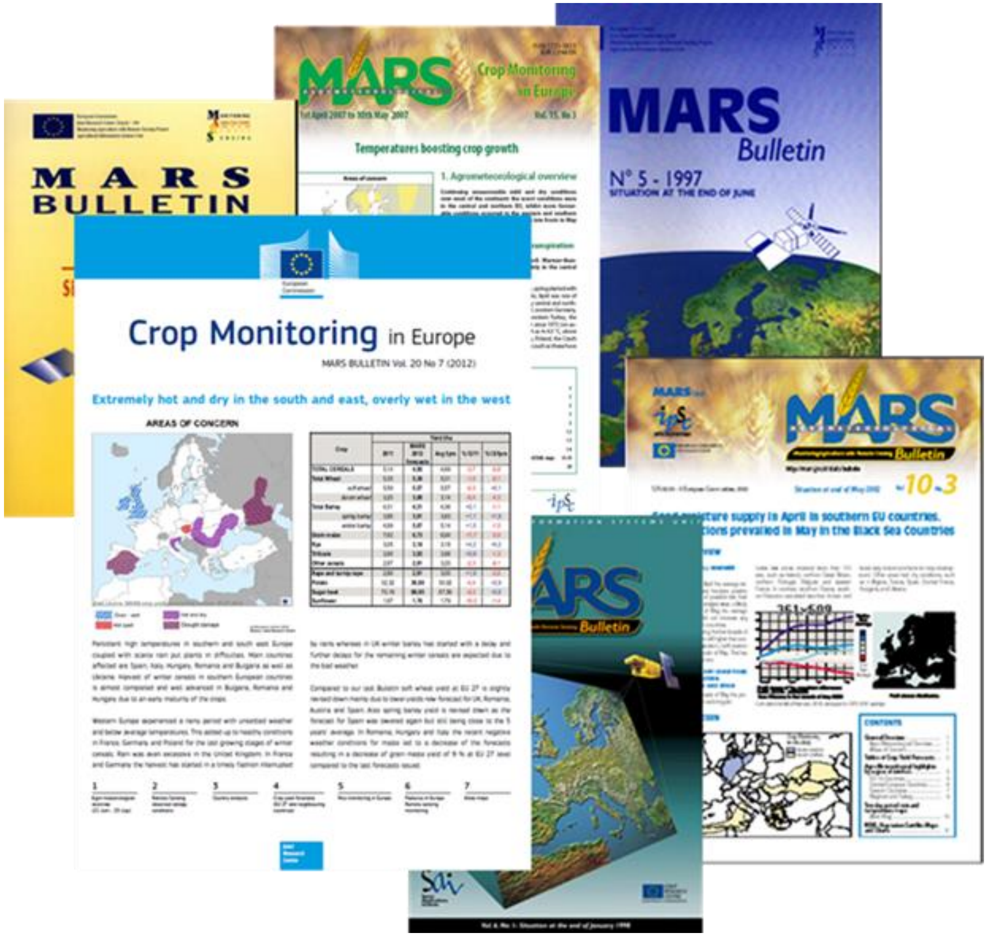
1. The JRC MARS Crop Yield Forecasting System
2. Crop Growing Conditions and Yield Forecasts for Croatia
3. Climate Trends in Agro-meteorological Observations
4. Climate Predictions and Impacts of Climate Change on Agriculture in Europe

European Commission

The MARS Crop Yield Forecasting System

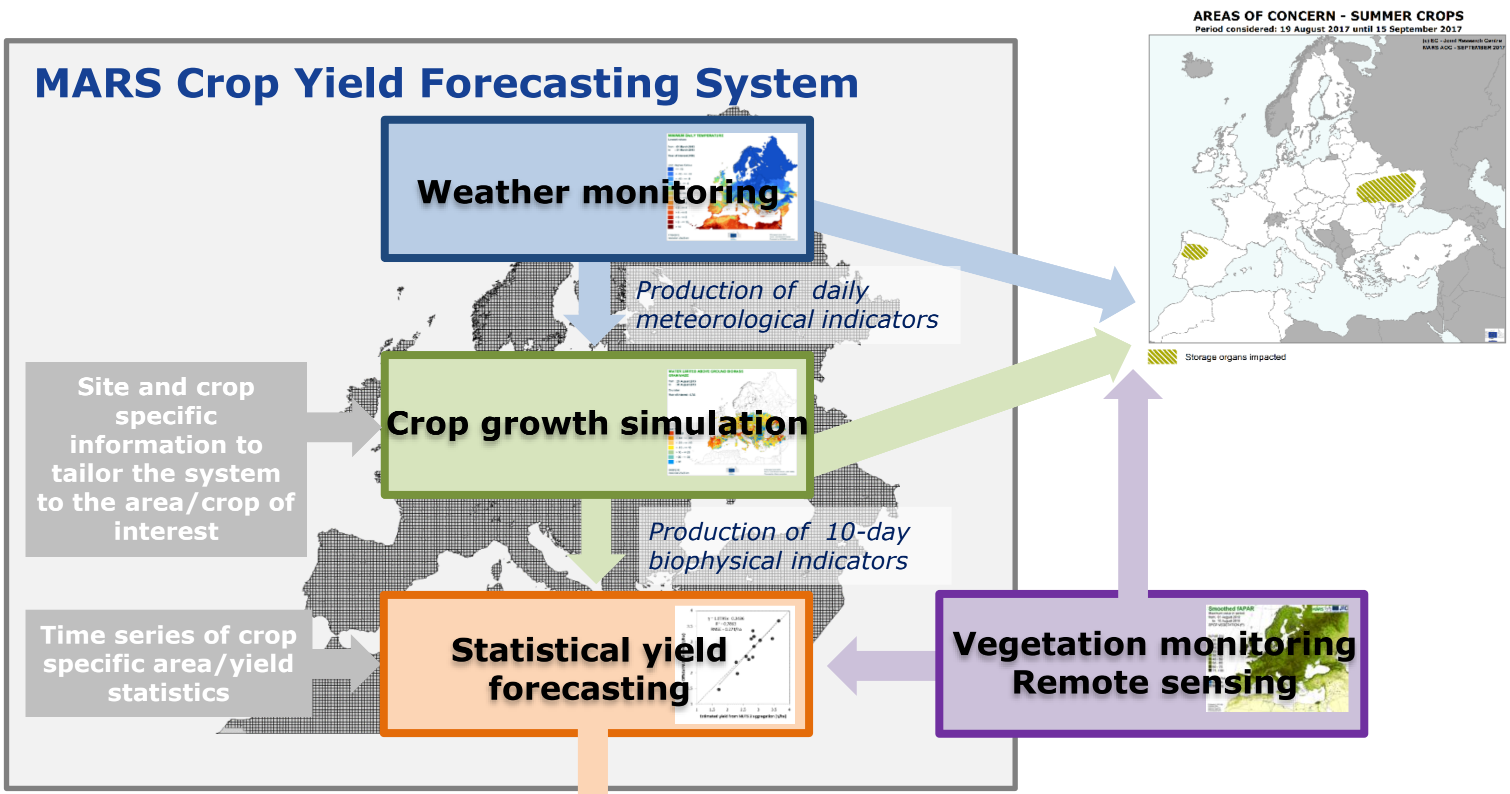
The Joint Research Centre is the European Commission's science and knowledge service

- Quantitative crop yield forecasts at national level
- Ad-hoc analysis of situations of extreme weather
- In close cooperation with DG AGRI and Eurostat
- **JRC MARS Bulletins** on Crop Monitoring in Europe
- Public dissemination, contributing to market transparency
- Timely, accurate, independent, established
- 28th edition in 2020



European Commission

The MARS Crop Yield Forecasting System



Expert judgement and decisions required

Crop Monitoring in E

Pre-press version
Issued: 27 April 202

JRC MARS Bulletin Vol. 28 No

European Commission

JRC MARS Bulletin
Crop monitoring in Europe
April 2020

Winter crops in good condition, despite lack of rain
Spring sowing and emergence challenged by dry conditions

Western Europe experienced one of the driest starts to spring since 1979 - after a very wet winter - with almost no rain since mid March. Large parts of Poland, Ukraine and Romania have also faced dry conditions since the end of winter. Winter crops in most of these regions are still in good condition, but more rain is needed to sustain a positive yield outlook. However, the very dry upper soil layers are having a negative impact on sowing and emergence of spring and summer crops. Persistent drought in Morocco resulted in poor crop yield expectations.

Cold spells at the end of March and beginning of April challenged sowing and emergence in a large region of central and south-eastern Europe.

A marked rainfall surplus, was welcomed in the Iberian Peninsula, Greece, Cyprus and south-eastern Turkey.

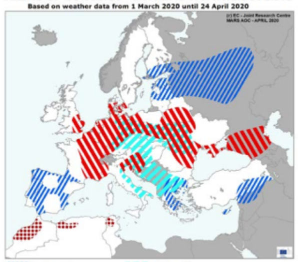
While labour availability remains a key concern, we have found no evidence that COVID-19 has had any major impact on the sowing of spring and summer crops. So far, the supply of seed, fertiliser and pesticides seems to be adequate and no immediate disruptions are expected.

The yield forecast presented in this issue of the Bulletin are still mostly based on historical trends, and bear a large margin of uncertainty associated with the rain deficit currently faced in large parts of Europe.

Content:
1. Agro-meteorological overview
2. Remote sensing – Observed canopy conditions
3. Pasture in Europe – Regional monitoring
4. Country analysis and sowing conditions
5. Crop yield forecasts
6. Atlas

Covers the period from 1 March until 15 April

AREAS OF CONCERN - EXTREME WEATHER EVENTS
Based on weather data from 1 March 2020 until 24 April 2020



Crop	Yield (t/ha)				
	Avg 5yrs	March Bulletin	MARS 2020 forecasts	% Diff 20/5yrs	% Diff March
Total Wheat	5.54	5.66	**5.65**	+1.9	-0.2
soft wheat	5.77	5.88	**5.87**	+1.7	-0.2
durum wheat	3.49	3.44	**3.43**	-1.5	-0.3
Total Barley	4.78	4.85	**4.86**	+1.6	+0.2
spring barley	4.02	4.02	**4.03**	+0.1	+0.2
winter barley	5.75	5.91	**5.92**	+2.9	+0.2
Grain maize	7.58	8.05	**8.04**	+6.0	-0.1
Rye	3.81	3.84	**3.92**	+2.7	+2.1
Triticale	4.04	4.14	**4.18**	+3.6	+1.0
Rape and turnip rape	3.09	3.18	**3.14**	+1.7	-1.3
Potato	32.4	34.3	**34.2**	+5.6	-0.3
Sugar beet	74.8	75.9	**75.9**	+1.5	+0.1
Sunflower	2.25	2.39	**2.39**	+6.4	+0.0

Issued: 24 April 2020

Joint Research Centre

Crop

Reduced yie
Dry conditions in wes

At EU level, the yield forecasts for almost all sum were revised downwards but remain above or ne year average. Compared to the figures reported i main downward revisions occurred for summe France, Romania, Bulgaria, Germany, the countries and Poland. Only the yield forecast for was revised upwards, as very favourable c prevailed in northern Italy and Hungary.

Large parts of western and northern central Eur been affected by a rain deficit since the beginni At the end of July, temperatures increased in thes and a heatwave of seven to ten consecutive days in the first half of August. The combination of t water supply and high temperatures negatively summer crops, with expected yield reductions. In Ukraine and eastern parts of Romania and Bul return of drought conditions negatively impacted crops, leading to the early senescence of m sunflower crops.

In contrast, surplus of precipitation benefited crops in many other parts of central Europe, as eastern Italy, and western Romania.

Contents:
1. Agrometeorological overview
2. Remote sensing – observed canopy conditions
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4. Country analysis
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Covers the period from 1 July to 15 August 2020

Pre-press version
Issued: 14 September 2020

JRC MARS Bulletin Vol. 28 No 9

European Commission

JRC MARS Bulletin
Crop monitoring in Europe
September 2020

Severe drought in south-eastern Europe
Overall, EU-level yield forecast for summer crops close to 5-year average

At EU level, the yield forecasts for all summer crops were revised downwards, most markedly for Romania, Bulgaria, and Greece.

In south-eastern Europe, severe drought conditions continued in eastern Romania, eastern Bulgaria, and southern Ukraine, with further negative impacts mainly on maize and sunflowers. Drought is now observed also in north-eastern Greece, the country's main sunflower production region; whereas in central Ukraine, a prolonged precipitation deficit started to impact maize.

In western Europe, following the heatwaves reported in August, temperatures dropped, but precipitation deficit continued in large parts of France, Belgium, Luxembourg, western Germany and southern Netherlands, further diminishing the yield expectations for summer crops in these regions (mainly maize, sugar beet and potatoes).

In Ireland and parts of the United Kingdom, frequent and abundant precipitation since mid-August negatively affected the ripening and harvesting of spring and winter cereals.

Favourable conditions prevailed in central and northern Europe. A surplus of precipitation benefited summer crops in northern Italy, Austria, Slovakia, Czechia, Poland and Belarus.

Contents:
1. Agrometeorological overview
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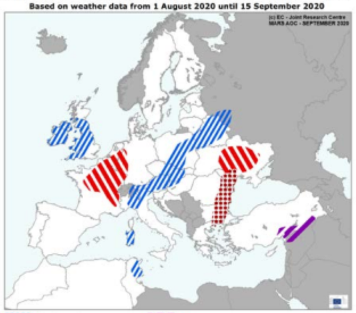
Covers the period from 1 August to 5 September 2020

AREAS OF CONCERN - EXTREME WEATHER EVENTS
Based on weather data from 1 August 2020 until 15 September 2020



Crop	Yield (t/ha)				
	Avg 5yrs	August Bulletin	MARS 2020 forecasts	% Diff 20/5yrs	% Diff August
Spring barley	4.02	4.39	**4.38**	+ 8.9	– 0.2
Grain maize	7.58	8.01	**7.83**	+ 3.3	– 2.2
Potato	32.4	33.1	**32.8**	+ 1.3	– 1.0
Sugar beet	74.5	73.5	**73.0**	– 2.1	– 0.7
Sunflower	2.25	2.39	**2.21**	– 1.5	– 7.5
Soybean	2.94	3.06	**3.05**	+ 3.7	– 0.3
Green maize	40.2	40.1	**40.0**	– 0.4	– 0.1
Rice	6.73	—	**6.86**	+ 1.8	—

Issued: 11 September 2020

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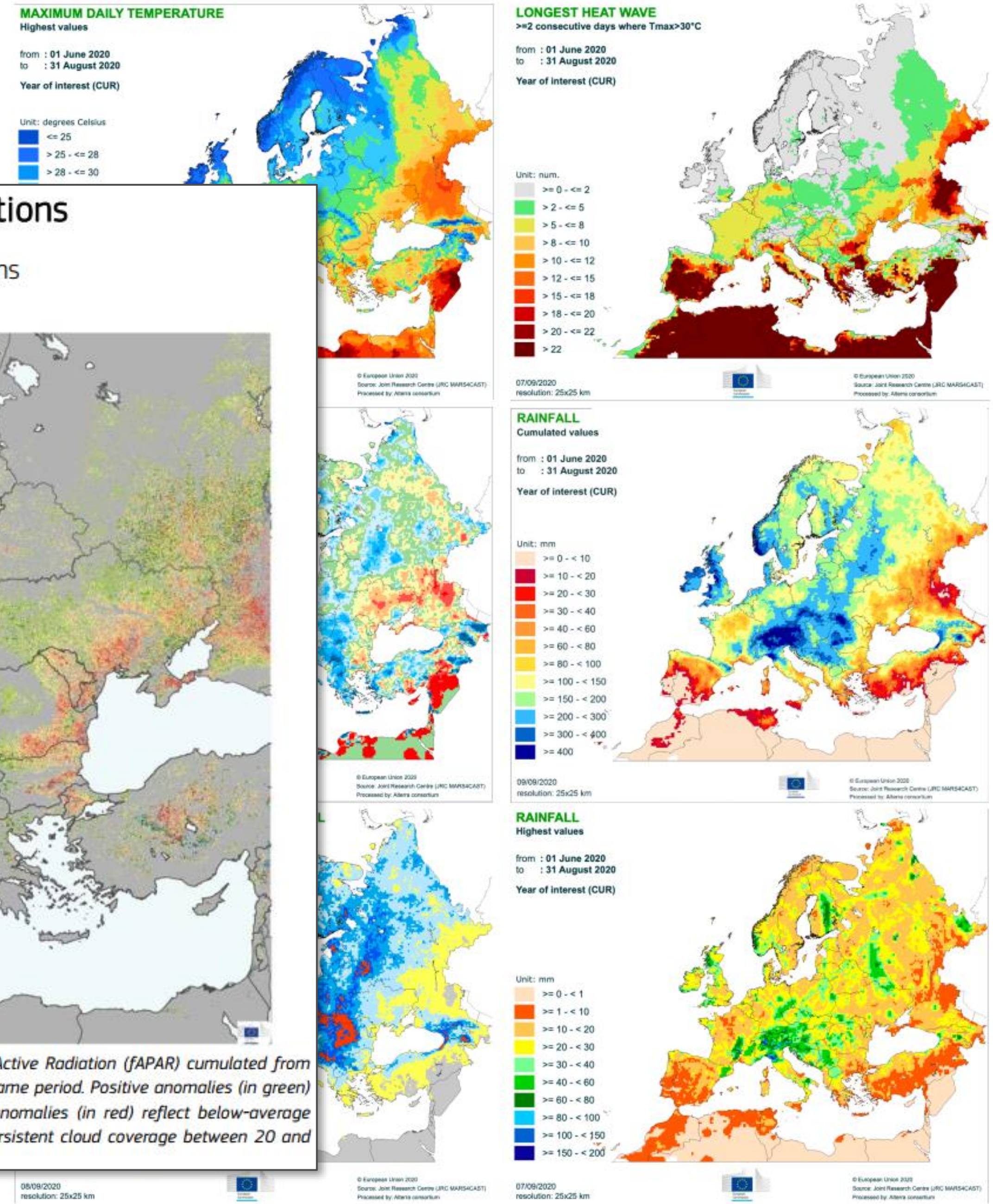
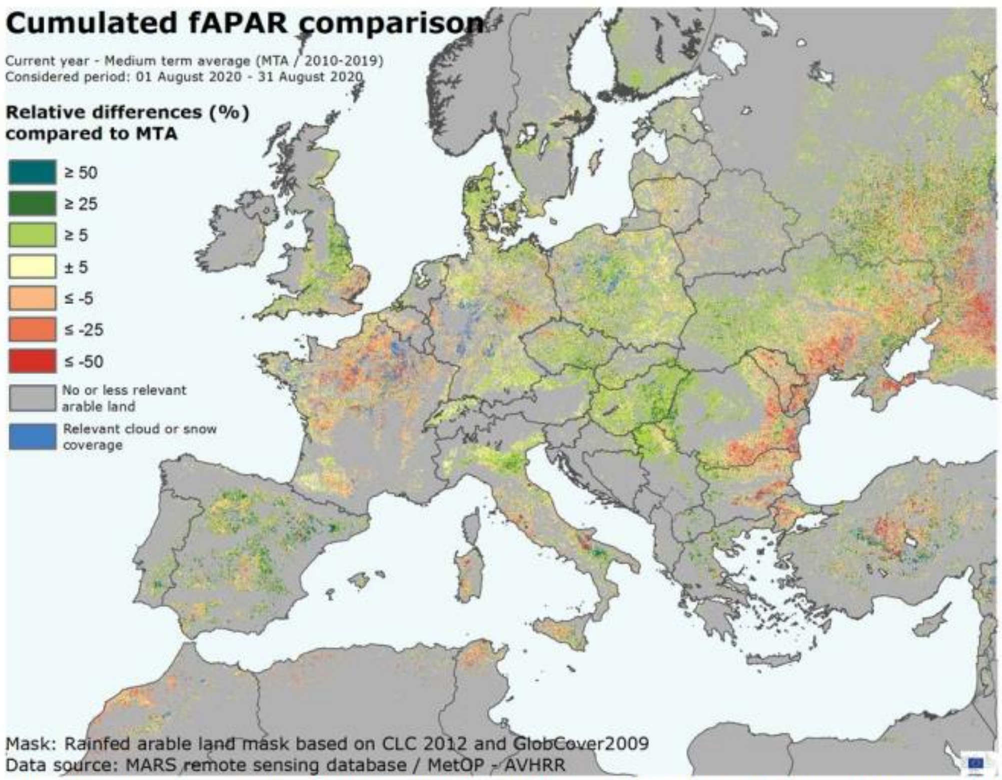
Crop Monitoring



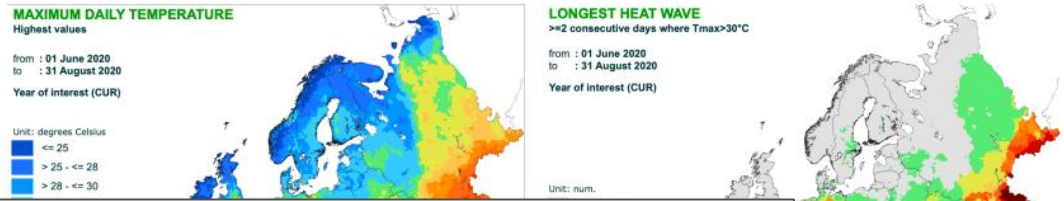
2. Remote sensing – observed canopy conditions

Drought affects summer crops in France and Black Sea regions



The map displays the differences between the fraction of Absorbed Photosynthetically Active Radiation (fAPAR) cumulated from 1 August to 31 August 2020, and the medium-term average (MTA, 2010-2019) for the same period. Positive anomalies (in green) reflect above-average canopy density or advanced crop development, while negative anomalies (in red) reflect below-average biomass accumulation or late crop development. Regions with no information due to persistent cloud coverage between 20 and 31 August are highlighted in blue.

Crop Monitoring



2. Remo

Drought aff

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≥ 50
≥ 25
≥ 5
± 5
≤ -5
≤ -25
≤ -5
No o arable
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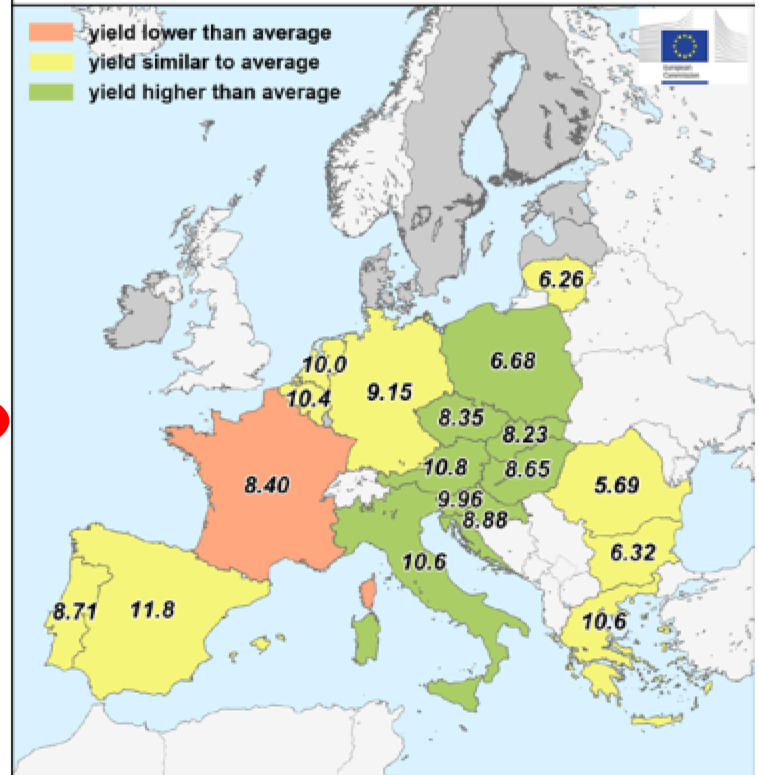
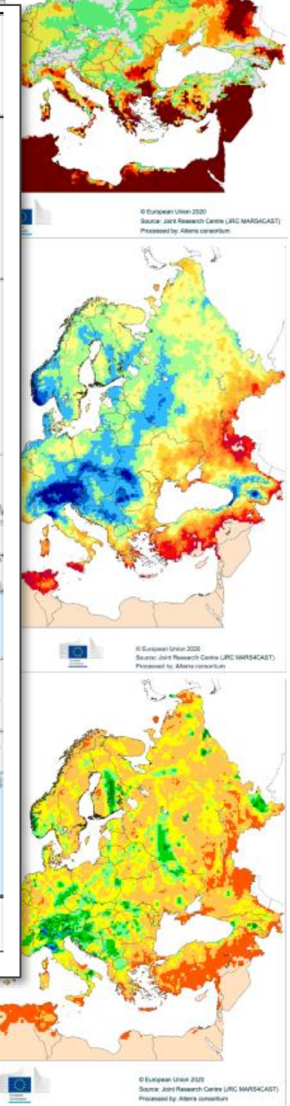
Country	Grain maize (t/ha)				
	Avg 5yrs	2019	MARS 2020 forecasts	%20/5yrs	%20/19
EU	7.58	7.90	**7.83**	+ 3.3	- 0.9
AT	10.1	10.4	**10.8**	+ 7.1	+ 3.7
BE	10.4	10.5	**10.4**	- 0.5	- 0.6
BG	6.48	7.11	**6.32**	- 2.4	- 11
CY	—	—	—	—	—
CZ	7.30	8.29	**8.35**	+ 14	+ 0.7
DE	9.21	8.81	**9.15**	- 0.6	+ 3.9
DK	—	—	—	—	—
EE	—	—	—	—	—
EL	10.3	10.6	**10.6**	+ 3.2	+ 0.2
ES	11.6	11.8	**11.8**	+ 2.2	+ 0.3
FI	—	—	—	—	—
FR	8.85	8.58	**8.40**	- 5.0	- 2.1
HR	7.87	9.01	**8.88**	+ 13	- 1.4
HU	7.50	8.05	**8.65**	+ 15	+ 7.4
IE	—	—	—	—	—
IT	10.2	10.0	**10.6**	+ 4.4	+ 6.5
LT	6.39	7.67	**6.26**	- 2.1	- 18
LU	—	—	—	—	—
LV	—	—	—	—	—
MT	—	—	—	—	—
NL	9.78	9.75	**10.0**	+ 2.3	+ 2.6
PL	6.09	5.62	**6.68**	+ 10	+ 19
PT	8.52	8.98	**8.71**	+ 2.2	- 3.1
RO	5.52	6.52	**5.69**	+ 3.0	- 13
SE	—	—	—	—	—
SI	8.85	9.27	**9.96**	+ 13	+ 7.4
SK	6.94	7.39	**8.23**	+ 19	+ 11

Grain maize — yield forecast 2020

MARS forecast versus average yield (t/ha) 2015—2019



MARS Bulletin Vol. 28 No 9 (2020)

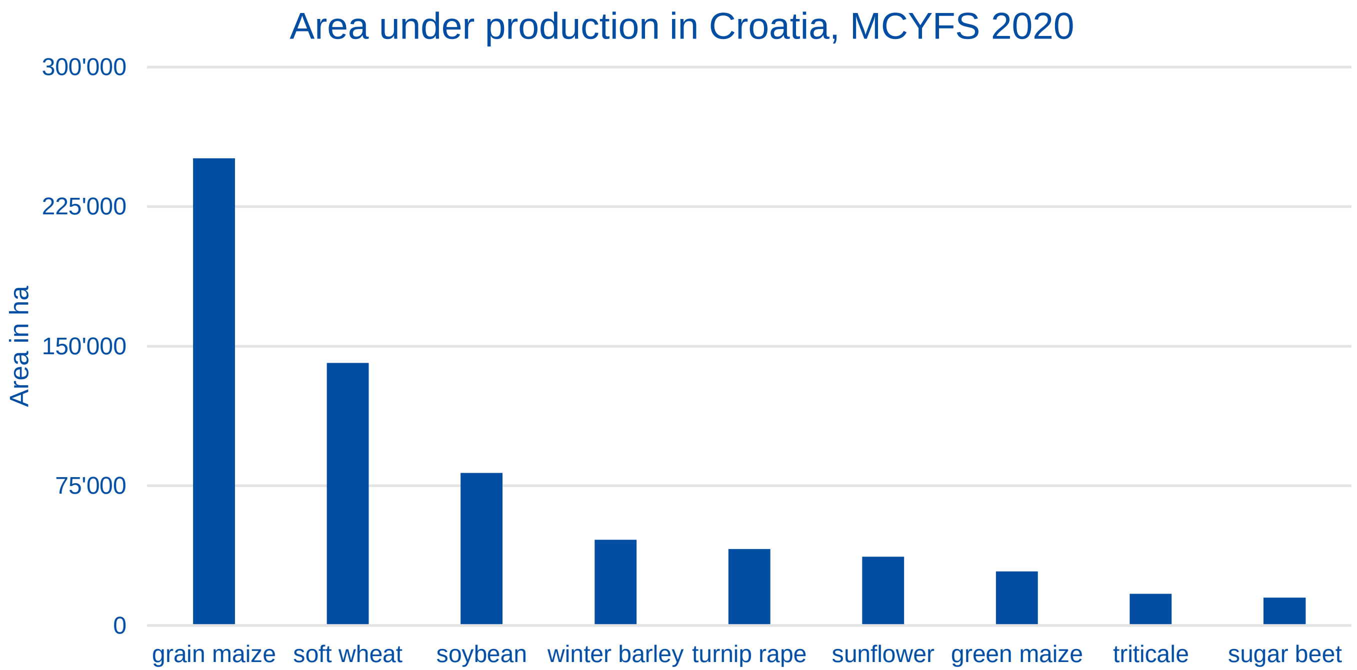


Mask: Rainf
Data source

The map displays
1 August to 31 August 2020, and the medium-term average (MTA, 2010-2019) for the same period. Positive anomalies (in green) reflect above-average canopy density or advanced crop development, while negative anomalies (in red) reflect below-average biomass accumulation or late crop development. Regions with no information due to persistent cloud coverage between 20 and 31 August are highlighted in blue.

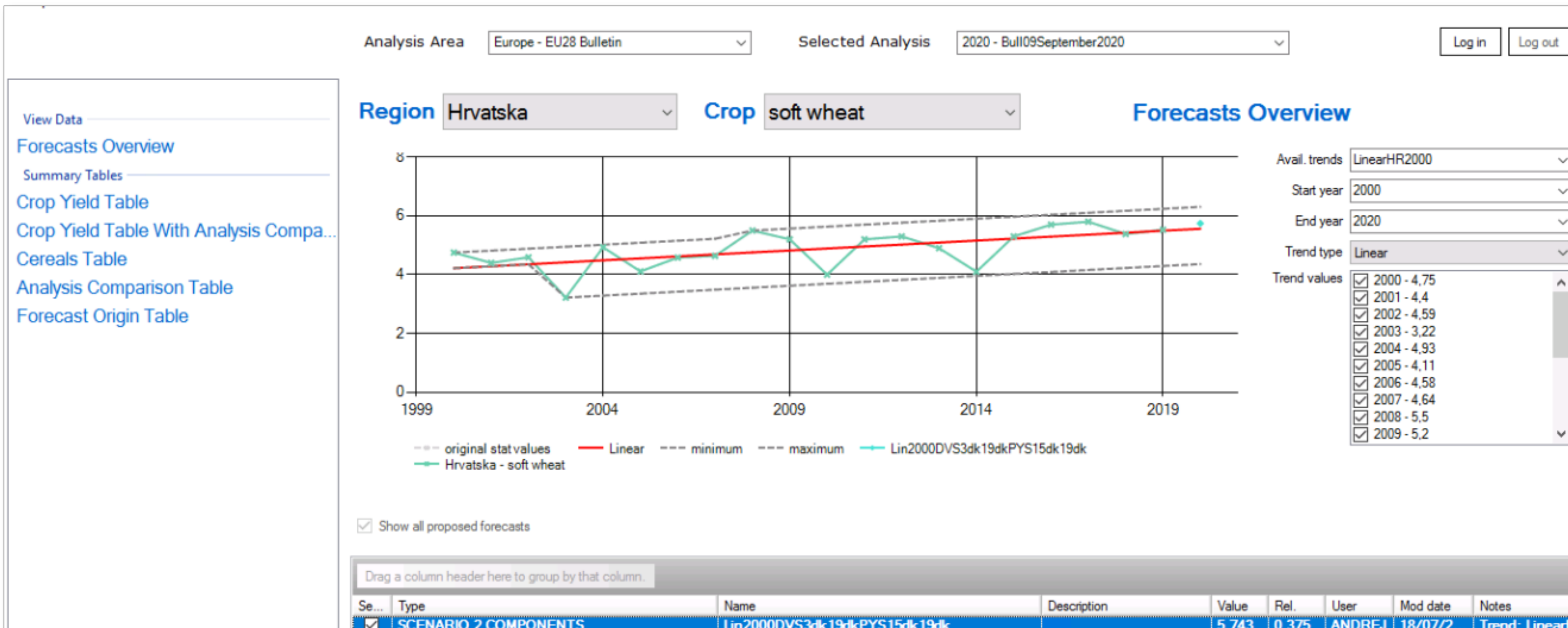
Crop Monitoring in Croatia

Quantitative crop yield forecasting, statistical infrastructure:



Crop Monitoring in Croatia

Quantitative crop yield forecasting, statistical infrastructure:



European Commission

Crop Monitoring in Croatia

JRC MARS Bulletin

Crop Monitoring in Europe

Vol 28

No. 3, 20 March 2020

Slovenia and Croatia

Exceptionally mild winter advanced winter crop development and spring field work

No. 4, 27 April 2020

Slovenia and Croatia

Persistent lack of precipitation accompanied by intensive cold spells

No. 5, 15 May 2020

Slovenia and Croatia

Dry conditions lowering winter crop yield outlook

No. 6, 12 June 2020

Slovenia and Croatia

Recent rainfall alleviated drought conditions

Crop Monitoring in Croatia

JRC MARS Bulletin
Crop Monitoring in Europe
Vol 28, No. 7

27 July 2020

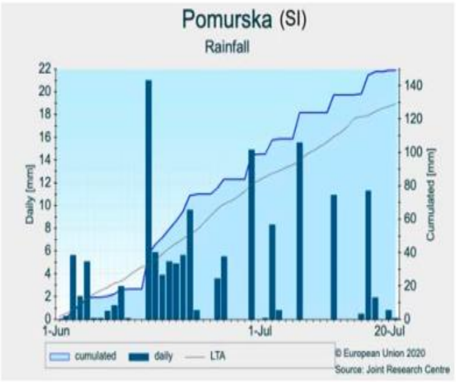
Slovenia and Croatia

Beneficial rainfall increased winter cereal yield outlook

Wetter-than-usual conditions prevailed in Slovenia. Croatia recently received beneficial rainfall, replenishing the weak soil moisture deficit in the eastern areas of the country. Despite the earlier spring drought conditions, a good winter wheat yield outlook is expected in both Slovenia and Croatia. Summer crops are generally in good conditions, especially due to recent rainfall.

Wetter-than-usual conditions prevailed in Slovenia and Croatia. Slovenia recorded a cumulative rainfall of above 150 mm, and over 200 mm in western and northern regions. The main agricultural regions of eastern Croatia received between 80 mm and 150 mm of rainfall. In the presence of seasonal temperatures, heat waves were largely absent during the analysis period. Nevertheless, in the eastern continental part of Croatia, there were up to 5 consecutive days with maximum temperatures above 30°C.

The end of June and the beginning of July saw little rainfall in eastern Croatia, providing good harvesting conditions for winter cereals. Winter cereal yield outlook is satisfactory in both countries, despite the drought conditions during spring; which, however, might have reduced grain quality (lower protein). The winter wheat yield outlook has been revised upwards for Croatia. Summer crops are generally in good condition; even though eastern Croatia suffered from a rainfall deficit at the end of June and beginning of July, recent rainfalls replenished the soil moisture deficit. The yield outlook for summer crops has been revised slightly upwards.



Crop Monitoring in Croatia

JRC MARS Bulletin

Crop Monitoring in Europe

Vol 28, No. 9

14 September 2020

Slovenia and Croatia

Positive outlook for summer crops

Slightly warmer-than-usual conditions, with rainfall around or above the LTA, provided good conditions for the ripening of summer crops. The crop yield outlook remains positive.

The analysis period has been slightly warmer than usual, with temperatures mainly between 1°C and 2°C above the LTA. Even though a longer warm spell of five to eight days was recorded in mid-August, the highest temperatures were recorded at the end of August when maximum temperatures peaked at 38°C in eastern Croatia. Rainfall was above the LTA in Croatia and western Slovenia. Rainfall cumulates reached from 80 mm in eastern Croatia to more than 150 mm in western Slovenia and north-western Croatia. Soil moisture levels for summer crops almost reached saturation in northern Croatia and Slovenia.

Summer crops are in good condition and slightly advanced in development. Grain maize has already reached or is approaching the maturity stage. Our crop yield forecasts have remained stable, largely on a level with the figures

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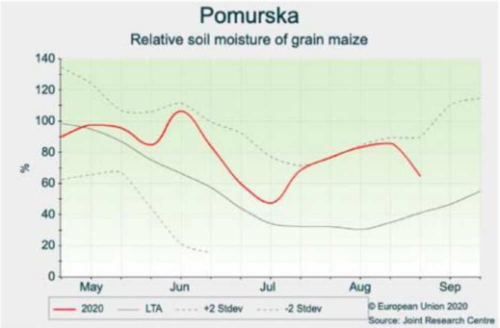
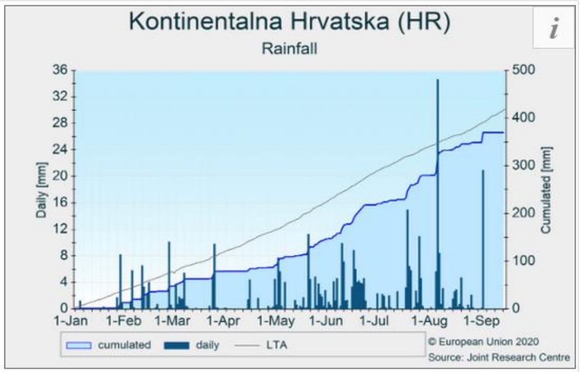
reported in the August issue of the Bulletin.

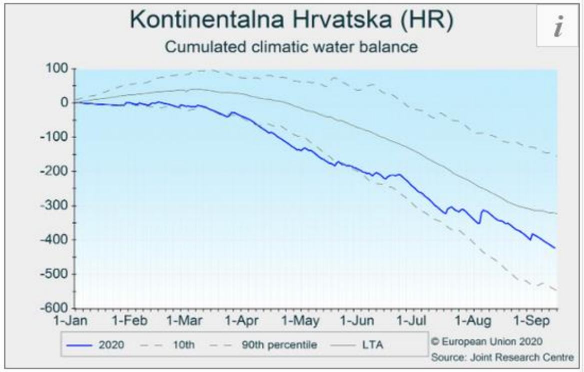


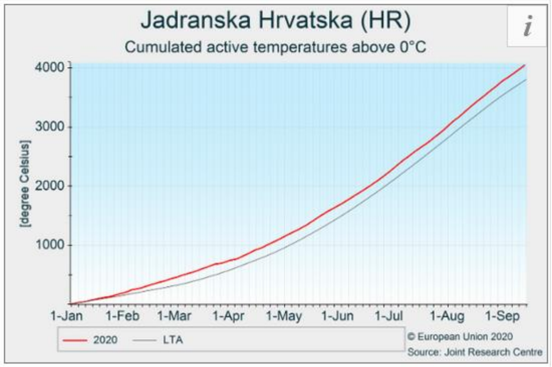
Crop Monitoring in Croatia

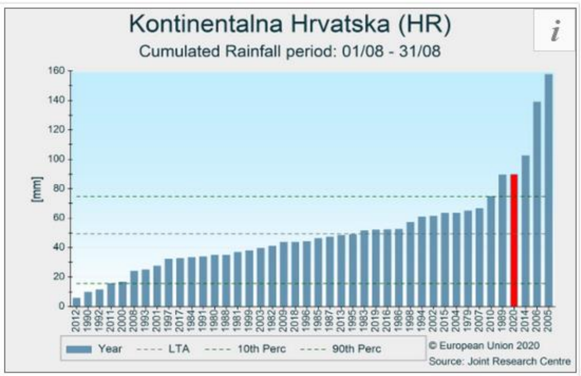


JRC MARS Explorer:

Regional weather observations 2020



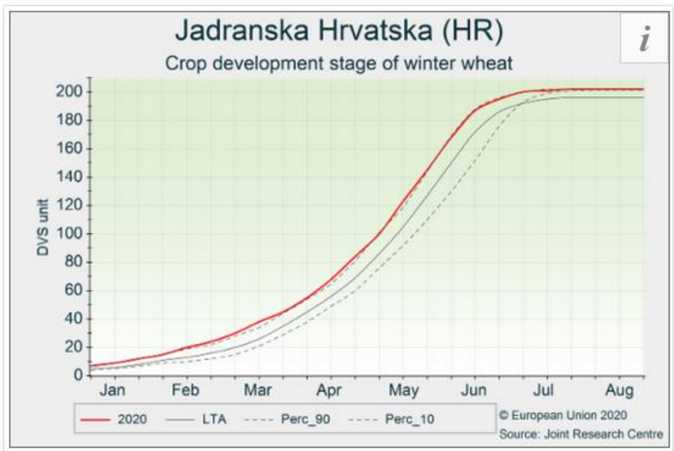


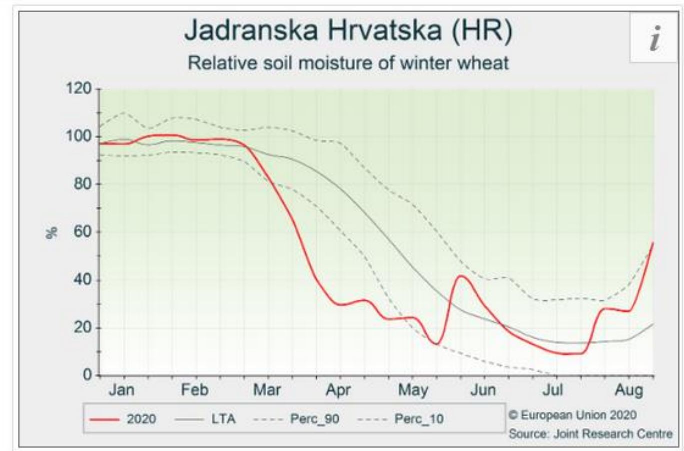


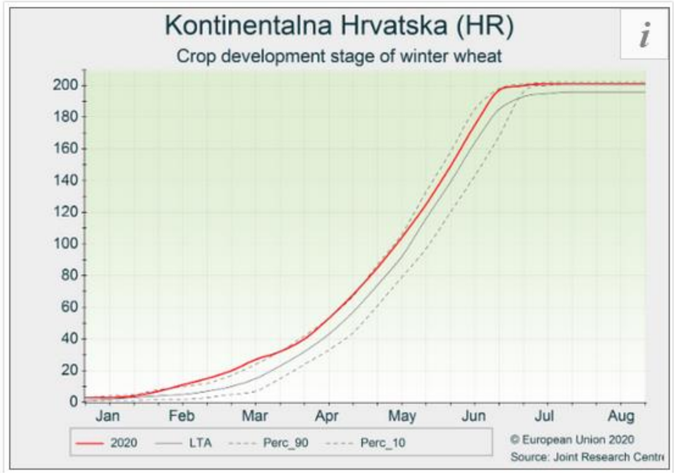
Crop Monitoring in Croatia

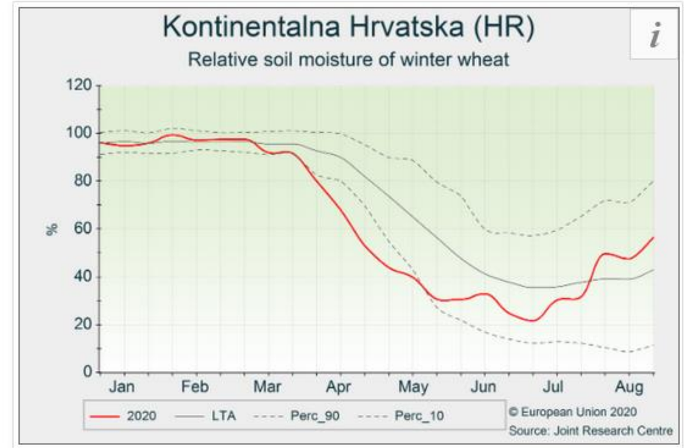
JRC MARS Explorer:

Regional crop growth parameters 2020





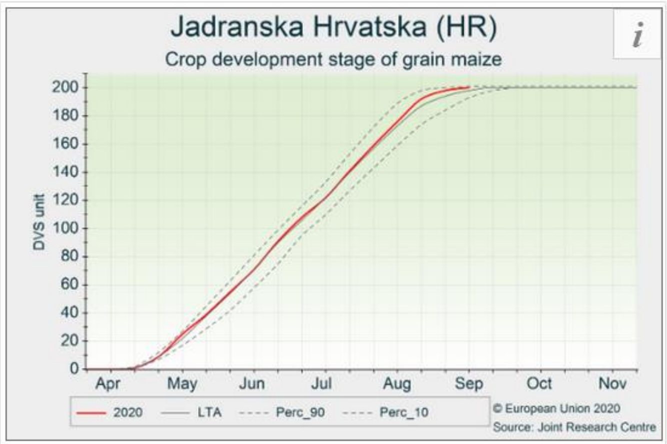


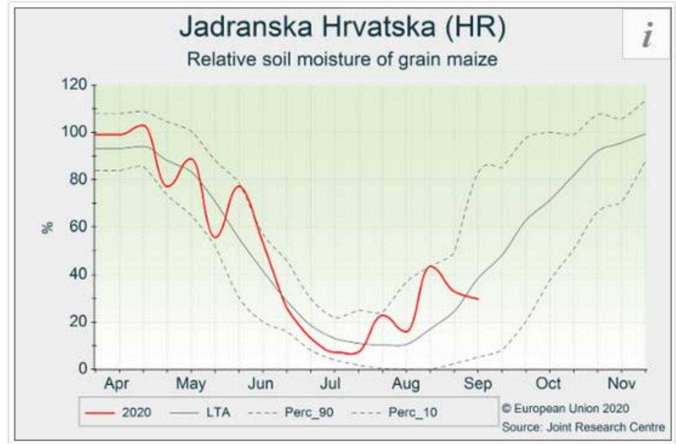


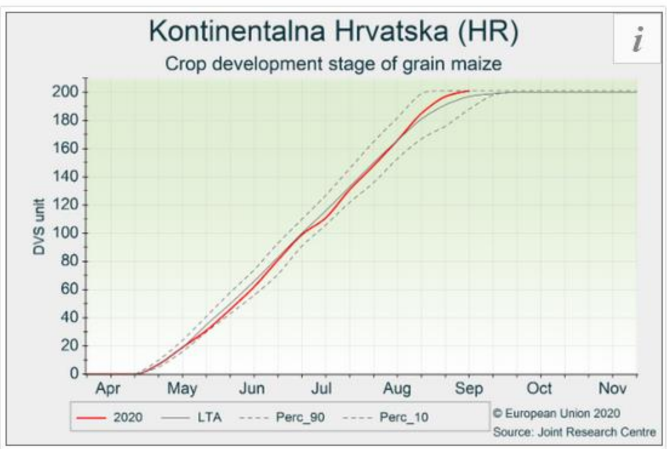
Crop Monitoring in Croatia

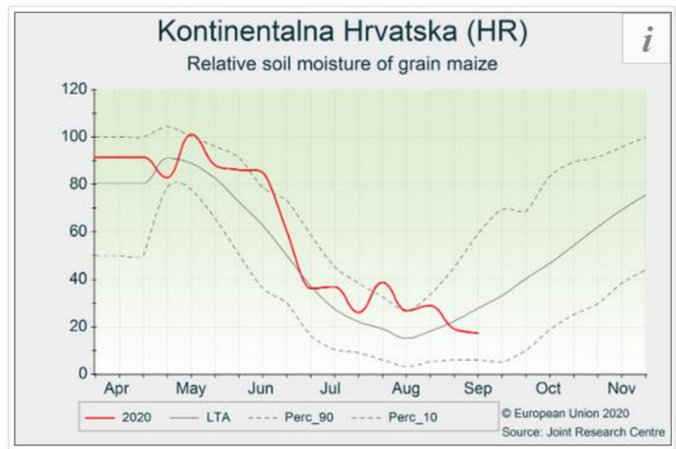
JRC MARS Explorer:

Regional crop growth parameters 2020





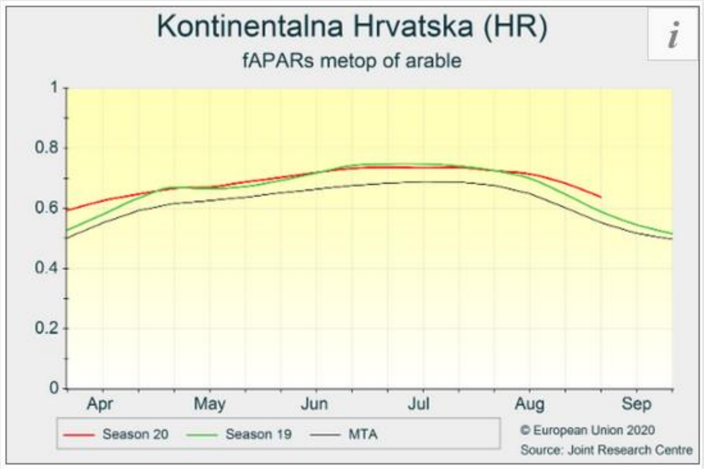




Crop Monitoring in Croatia

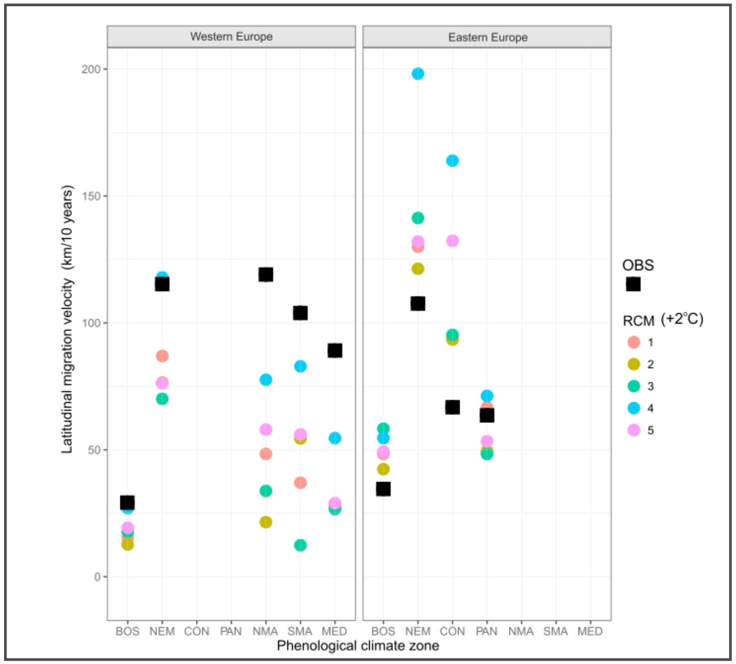
JRC MARS Explorer:

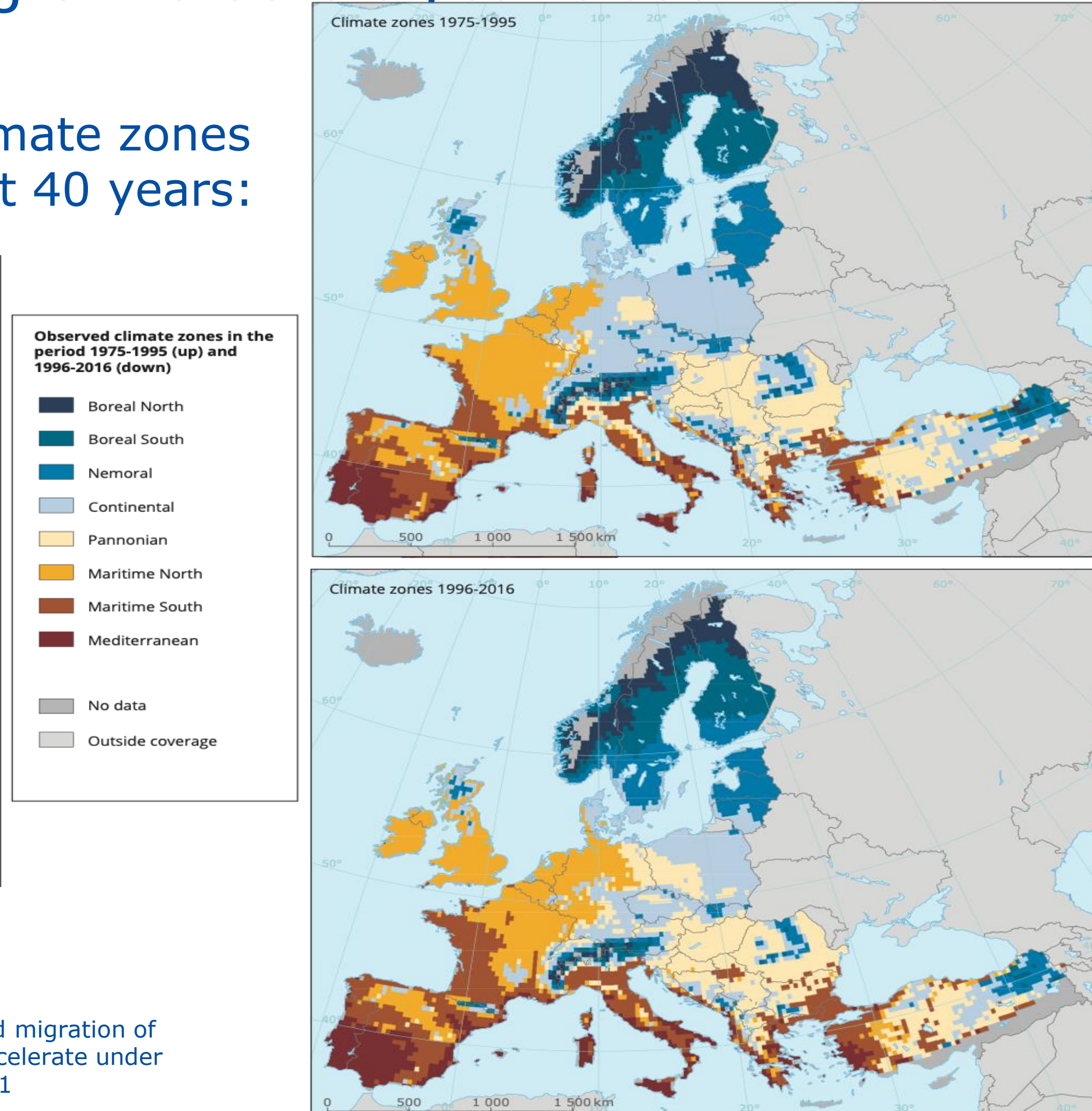
Regional remote sensing parameters
2020



Climate Trends in Agro-meteorological Observations

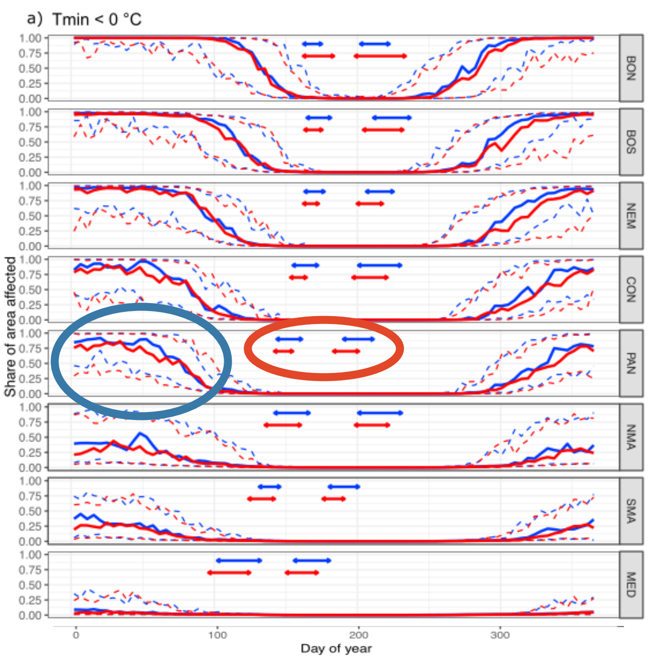
A northward shift of agro-climate zones has been observed in the last 40 years:





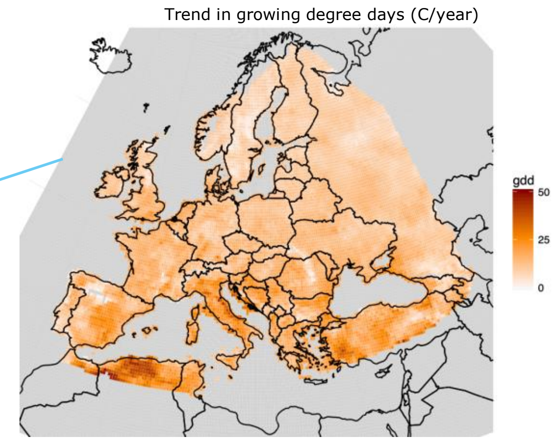
Ceglar, A., et al., 2019, Observed northward migration of agro-climate zones in Europe will further accelerate under climate change. Earths Future, 7, 1088-1101

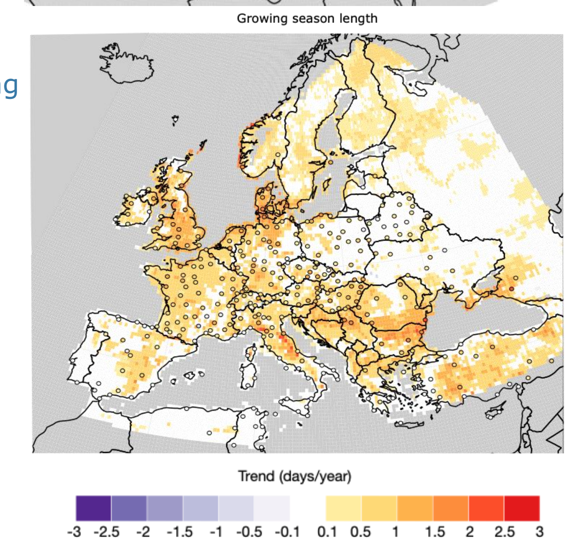
Climate Trends in Agro-meteorological Observations

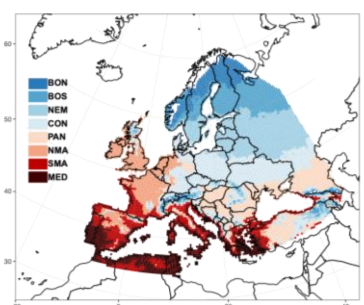


Changes in crop phenology (earlier flowering and harvest)

Higher exposure of vegetation to late spring frost due to earlier growing season onset





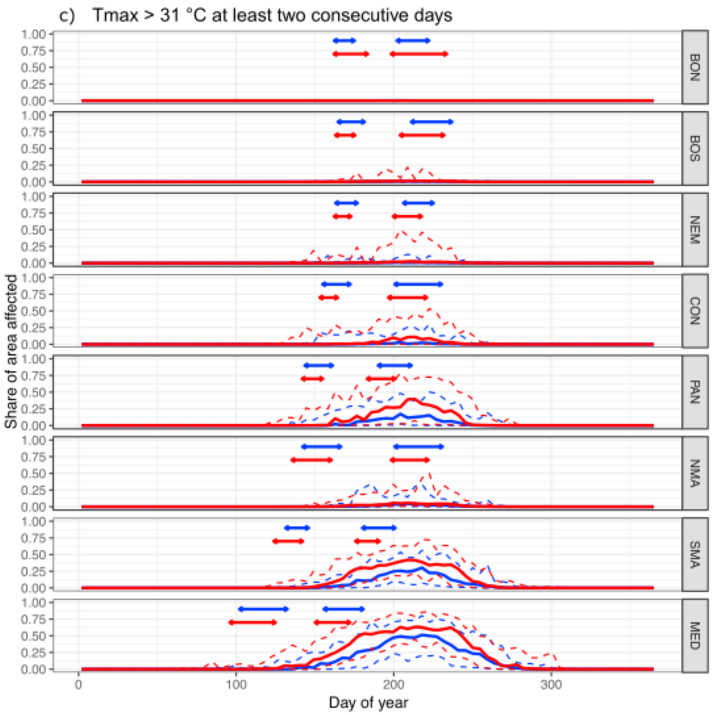


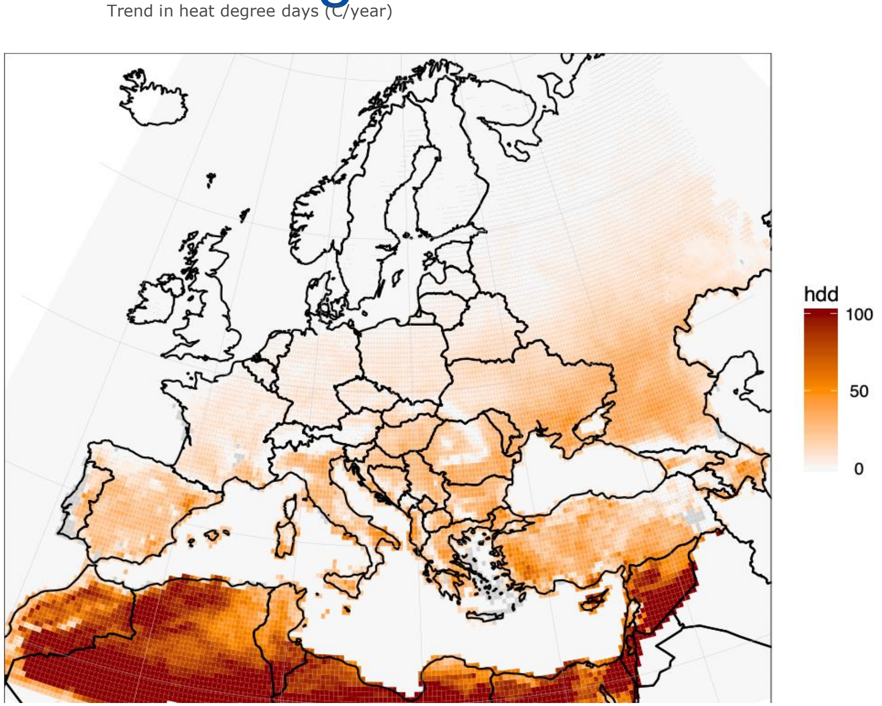
Temperature based indicators:

- Increase in duration of thermal growing season
- Increase in number of frost-free days

European Commission

Climate Trends in Agro-meteorological Observations





Heat stress during the most sensitive periods of crop growth has increased

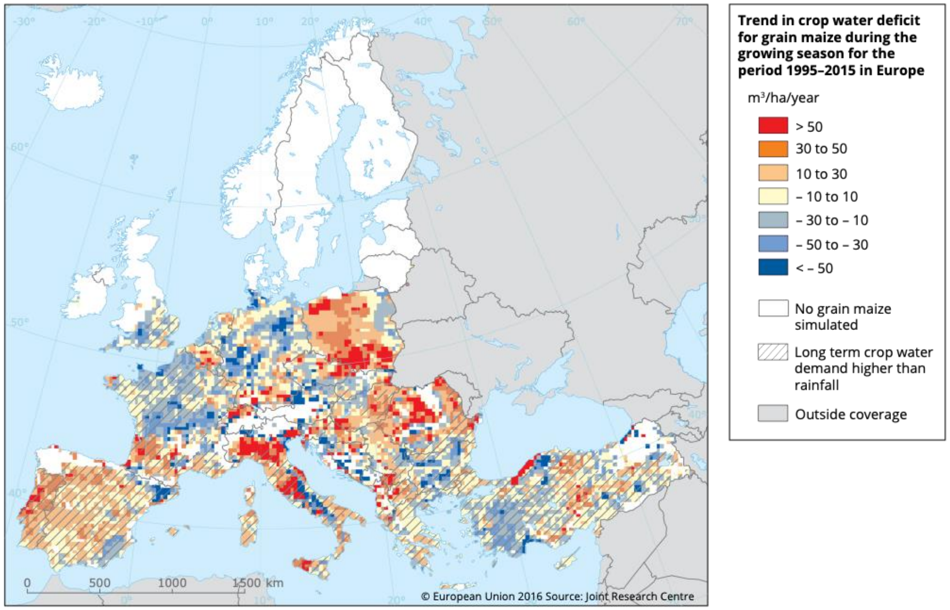
South-eastern Europe has experienced doubling of share of area affected by heat stress

Temperature based indicators:

- Areas affected by heat stress are getting larger (more pronounced in southeastern and southern Europe)

European Commission

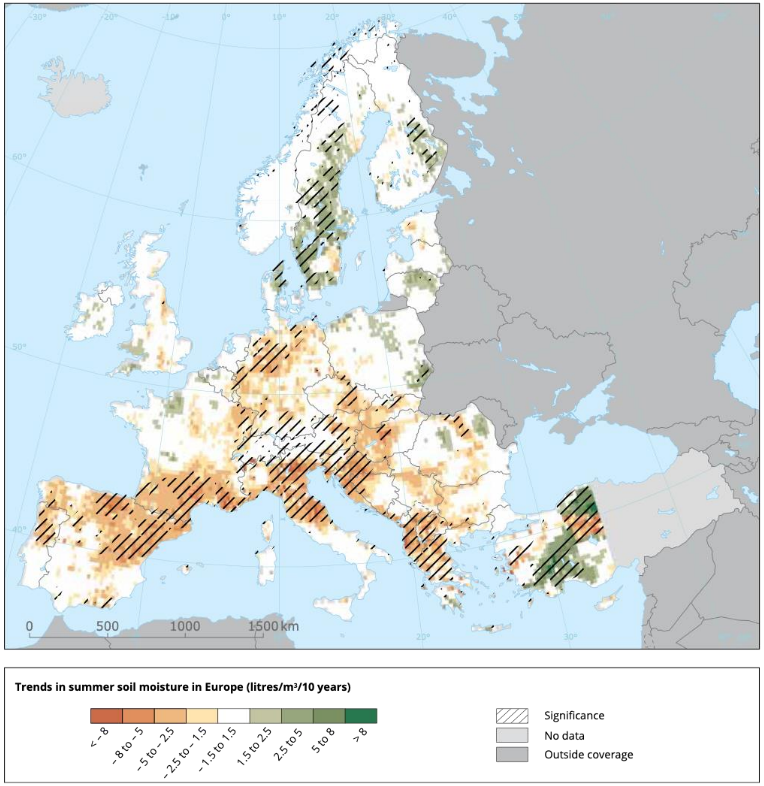
Climate Trends in Agro-meteorological Observations



Soil moisture has decreased particularly in south-eastern Europe, southwestern Europe and western France.

A significant increase in the crop water deficit for maize has been observed in large parts of southern and eastern Europe.

Increasing irrigation water demand.



Rainfall based indicators:

- Increased evapotranspiration rates have increased crop water requirements

European Environmental Agency, 2016. Climate change, impacts and vulnerability in Europe. An indicator-based report.

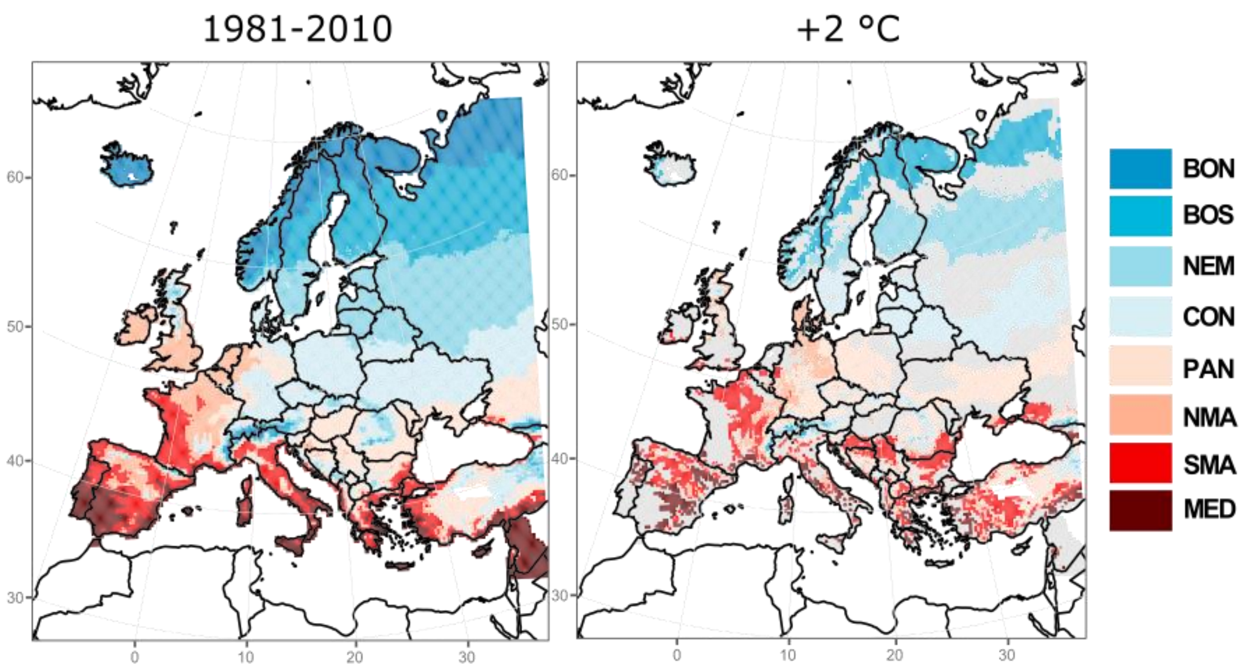
Climate Trends in Agro-meteorological Observations

Key messages:

- An increase in the duration of the thermal growing season has led to a northward expansion of the suitable areas
- Changes in crop phenology (earlier flowering and maturity)
- Impact on crop production and relative performance of different crop species and varieties
- Climate change led to an increase in the crop water demand and thus in the crop water deficit in large parts of southern and eastern Europe
- Negative trends in soil moisture in southern Europe
- Severity and area affected by climate extremes (heat waves, droughts) have increased; south-eastern Europe a hotspot region

European Environmental Agency, 2016. Climate change, impacts and vulnerability in Europe. An indicator-based report.

Climate predictions and impact of climate change on agriculture in Europe



1. Northward migration of agro-climate zones might be up to two times faster in the coming decades
2. Southeastern Europe will be characterised by substantially longer growing season length and active temperature sums
3. Area affected by heat stress will increase, while crops will be exposed to longer heat waves, most pronounced in southern and south-eastern Europe

High-resolution EURO-CORDEX data, bias adjusted:

Biophysical crop model simulations using the MCYFS modelling framework

Table 1
Climate Models From the High-Resolution EURO-CORDEX Simulations, Selected for This Study

Acronym	Institute	RCM	GCM	+2 ° C
RCM1	CLMcom	CCLM4-8-17	ICHEC-ECEARTH	2027–2056
RCM2	CLMcom	CCLM4-8-17	CNRM-CERFACS-CNRM-CM5	2033–2062
RCM3	IPSL-INERIS	WRF331F	IPSL-IPSL-CM5A-MR	2021–2050
RCM4	SMHI	RCA4	MOHC-HadGEM2-ES	2016–2045
RCM5	SMHI	RCA4	MPI-M-MPI-ESM-LR	2030–2059

Note. More details on EURO-CORDEX simulations are provided in Jacob et al. (2013). The last column (+2 ° C) indicates for the RCP8.5 scenario the 30-year period when an average global temperature increase of 2 ° C is reached compared to preindustrial period.

Ceglar, A., et al., 2019, Observed northward migration of agro-climate zones in Europe will further accelerate under climate change. Earths Future, 7, 1088-1101

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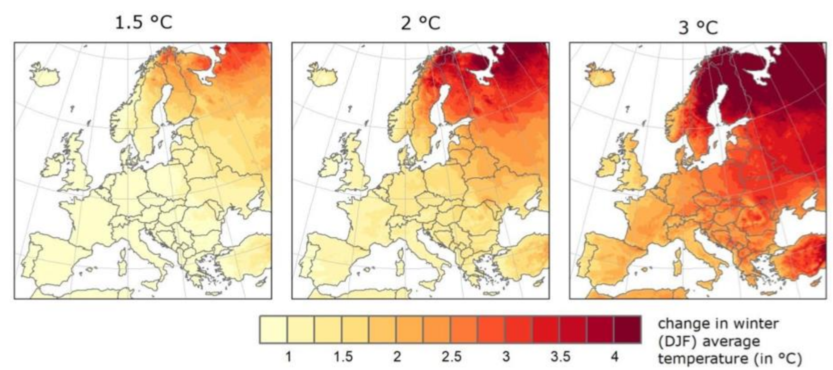
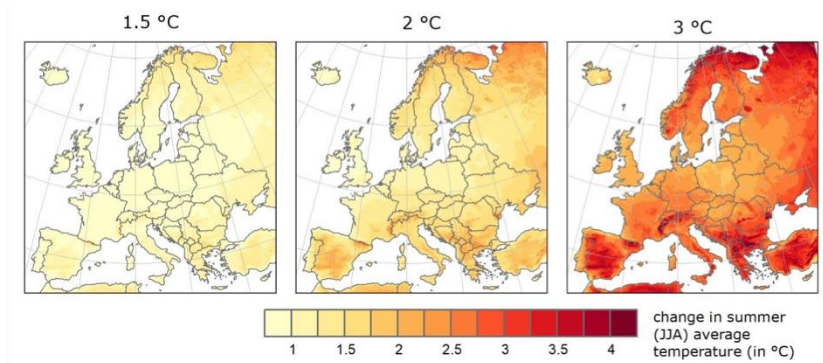
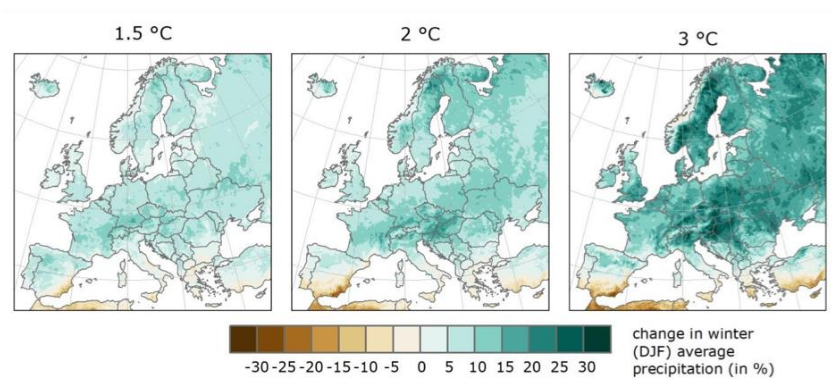
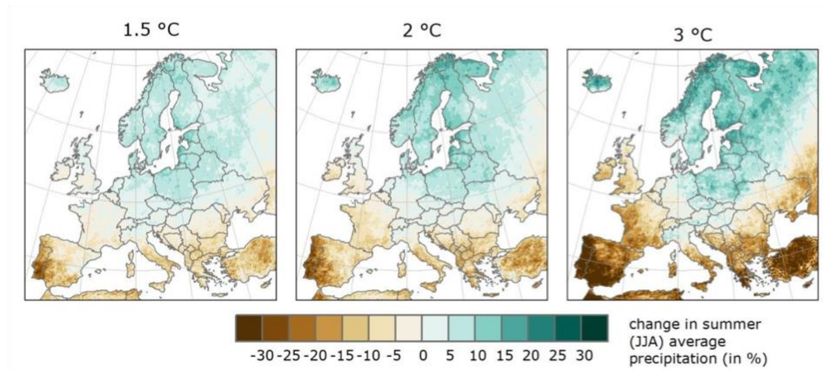
High-resolution EURO-CORDEX data, bias adjusted:

Change in winter summer temperature and precipitation under different global warming scenarios







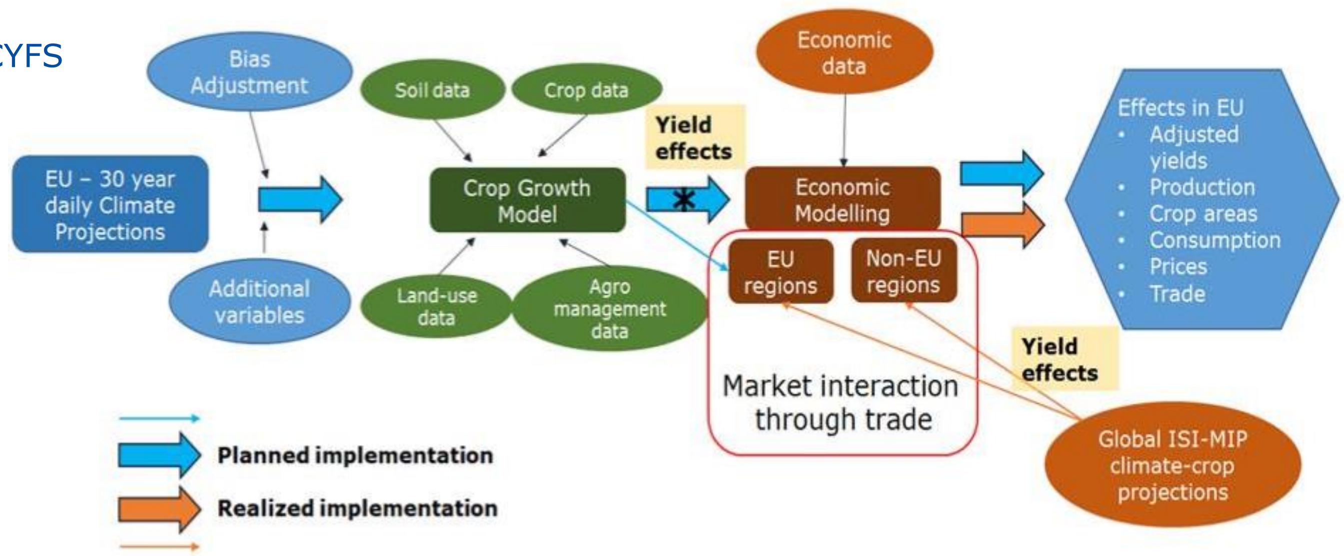


Feyen, L., et al., 2020. Climate change impacts and adaptation in Europe. JRC PESETA IV final report

Climate predictions and impact of climate change on agriculture in Europe

High-resolution EURO-CORDEX data, bias adjusted:

- PESETA IV crop model simulations
- Crop model simulation environment used under MCYFS
- Rainfed and fully irrigated situations
- Drought and heat stress
- CO2 fertilisation effect
- Main crops simulates at European level



(*) the regional crop model results have at this stage not been coupled with the regional-global economic model framework, but have been used for comparison of regional/global yield changes

Hristov, J., et al., 2020. Analysis of climate change impacts on EU agriculture by 2050. JRC PESETA IV project

Climate predictions and impact of climate change on agriculture in Europe

Impact on grain maize

Fully irrigated conditions:

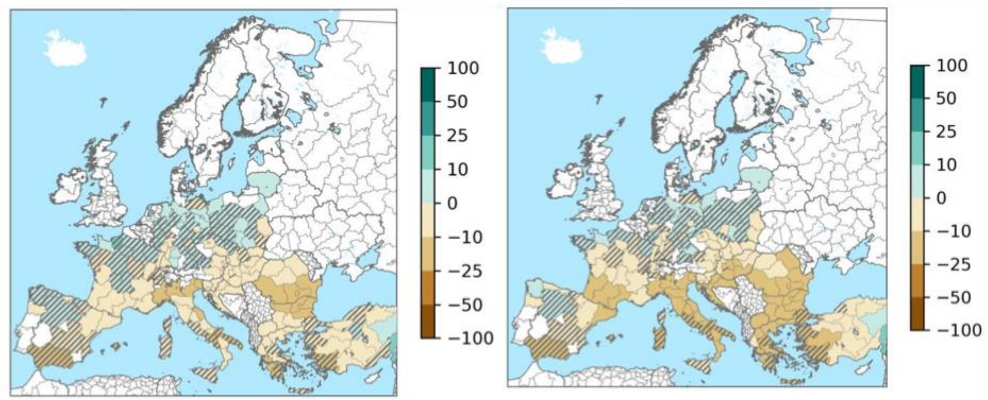


Figure 2. Ensemble mean changes of grain maize yield (% relative to the historical period) projected under the RCP8.5 for 1.5 oC (left panel) and 2 oC (right panel) warming conditions, and assuming irrigated conditions. Hatching denotes areas with low models' agreement (i.e. less than 66% of models agree in the sign of estimated changes).

Rainfed conditions:

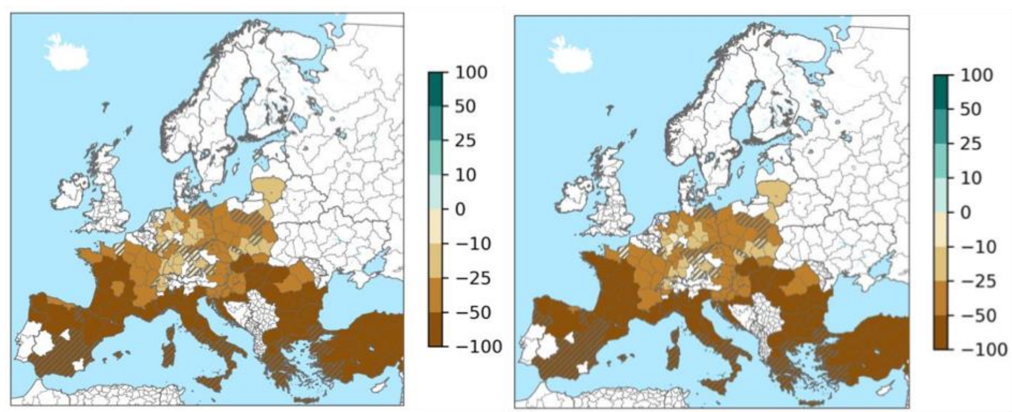


Figure 3. Ensemble mean changes of grain maize yield (% relative to the historical period) projected under the RCP8.5 for 1.5 °C (left panel) and 2 °C (right panel) warming conditions, assuming that no irrigation will be possible (i.e. rain-fed). Hatching denotes areas with low models' agreement (i.e. less than 66% of models agree in the sign of estimated changes).

Hristov, J., et al., 2020. Analysis of climate change impacts on EU agriculture by 2050. JRC PESETA IV project

Climate predictions and impact of climate change on agriculture in Europe

Impact on winter wheat

Rainfed conditions:

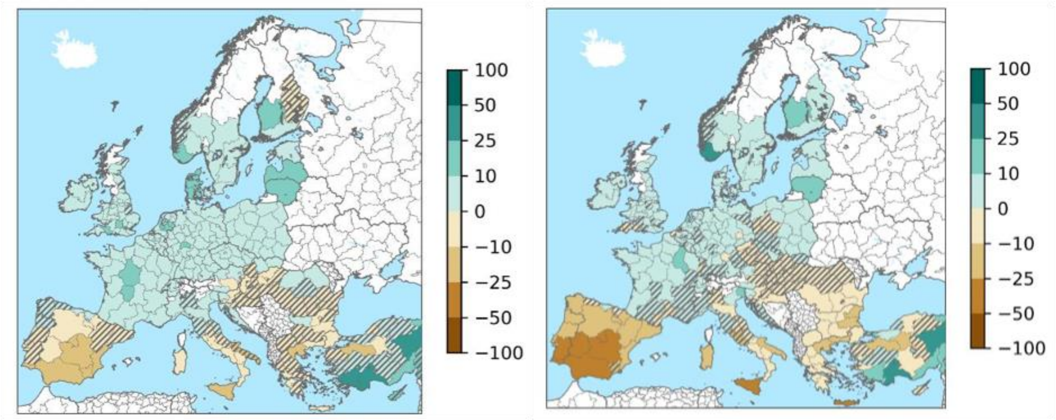


Figure 4. Ensemble mean changes of wheat yield (% relative to the historical period) projected under the RCP85 for 1.5 °C (left panel) and 2 °C (right panel) warming conditions under rain-fed (no irrigation) conditions. Hatching denotes areas with low models' agreement (i.e. less than 66% of models agree in the sign of estimated changes).

Hristov, J., et al., 2020. Analysis of climate change impacts on EU agriculture by 2050.
JRC PESETA IV project

Climate predictions and impact of climate change on agriculture in Europe

National/Regional level

- Integrating adaptation into farm advice
- Risk management insurance against weather and climate
- Improving efficiency of irrigation infrastructure
- Flood management and prevention

Farm level:

- Arable cropping
- Livestock farming
- Viniculture
- Horticulture

- Ecosystem compatible drainage
- Improve irrigation efficiency
- Precision farming
- HNV or organic farming
- Modification of crop calendars
- Cover crops
- Use of adapted crops
- Field margins
- No tillage or minimum tillage
- Crop diversification and rotation
- Breeding livestock for greater tolerance and productivity
- Improve pasture and grazing management
- Improve animal rearing conditions
- Prevention of climate change induced diseases for livestock
- Modifying fertilization and spraying applications
- Installation of greenhouses
- Protection and monitoring equipment
- Farm activity diversification

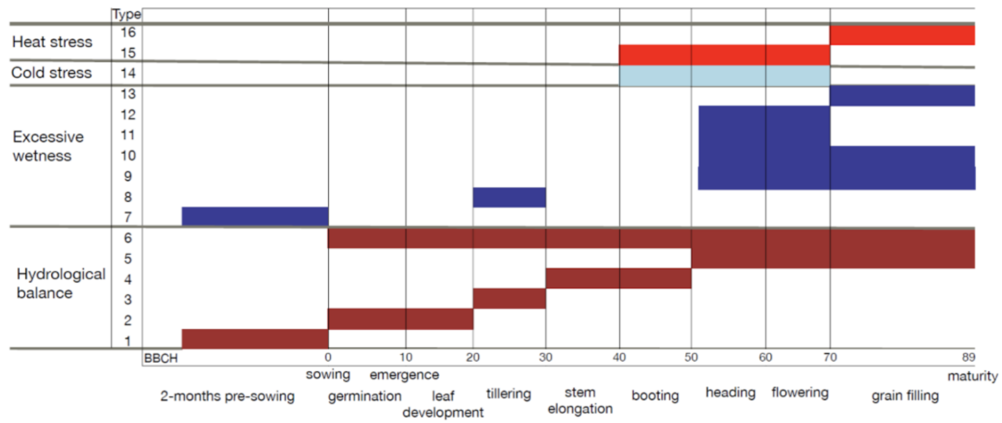
Adaptation will be crucial!

 European Environmental Agency, 2019. Climate change adaptation in the agricultural sector in Europe

Climate predictions and impact of climate change on agriculture in Europe

Adaptation will be crucial:

- Farm management
- Climate services - informed planning and anticipation of unfavourable conditions
- Co-design approach with experts and end-users



Type of weather/ climate data	Observed weather data, reanalyses	Ensemble weather forecast	Ensemble-based seasonal climate prediction	Ensemble-based decadal climate prediction	Long-term climate change projections
Nature of weather/climate prediction		Initial conditions problem			boundary value problem
Clisagri indicators	assessment of risks based on observed/measured field data (phenology, ocurrence of pests and diseases, crop yields, ...)	short-term risk assess-ment	risk assessment for entire growing season	risk assessment up to 10 years ahead	climate change risk assessment
Type of action	determination of risk thresholds	planning field inter-ventions	planning of sowing, selection of optimal variety, planning of fertilization and field interventions, disease treatment, planning of irrigation water use	crop breeding, strategic investments in farming ststems (e.g. infrastructures), adaptation	crop breeding, strategic investments in farms (e.g. infrastructures), suitability for crop growth, mid- to long-terrm adaptation

<- year | day | month | season

today | week | year | decade | century

Ceglar, A., et al., under review. Clisagri: an R package for agro-climate services. MEDGOLD project

Climate predictions and impact of climate change on agriculture in Europe

Key messages:

- Climate change will lead to northward expansion of areas suitable for several crops, increased crop water demand, more frequent extreme climate events
- Without adaptation wheat and maize yield will decrease in southern Europe and the crops produced will have reduced nutritional value
- Adaptation mechanisms at national/regional and farm levels
- Important role of:
  - CAP - support climate action, increase resilience and sustainability
  - Climate services, to provide climate informed agro-management planning and anticipation of unfavourable conditions
  - COPERNICUS - digital transformation of agriculture holdings, using earth observation

Hristov, J., et al., 2020. Analysis of climate change impacts on EU agriculture by 2050.
JRC PESETA IV project

Keep in touch

JRC MARS **Bulletins** on the JRC Science Hub:
https://ec.europa.eu/jrc/en/mars/bulletins

JRC MARS **Explorer**: http://agri4cast.jrc.ec.europa.eu/mars-explorer/

AGRI4CAST **Data** Portal: http://agri4cast.jrc.ec.europa.eu/DataPortal/

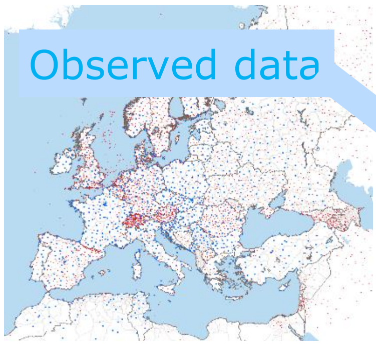
MARS Crop Yield Forecasting **System Wiki**:
https://marswiki.jrc.ec.europa.eu/agri4castwiki/

YouTube Videos on EU Crop Monitoring:
https://www.youtube.com/watch?v=YsJ2yh_MplI&list=PLGI5zHT2w7jBdaQWQTDxEQQKvmLlaRx_h&index=2

Thank you

Annex:

Meteorological infrastructure



Observed data

Near real time

Pan-European

Daily, 10- daily, monthly,

seasonal,

long term average

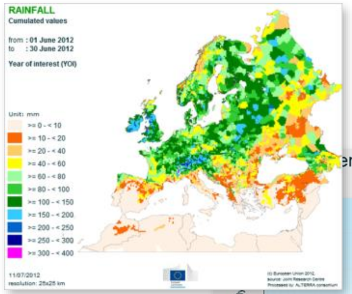
METEO DB

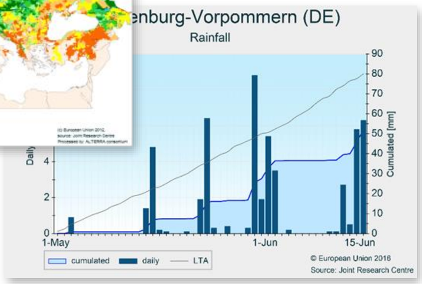
Gridded data

Aggregated data

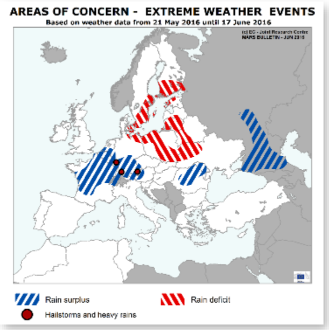
Weather forecast data

Temperature
Rainfall
Radiation
Vapour pressure
Windspeed
Evaporation
Evapotranspiration
Climatic water balance
Snow depth





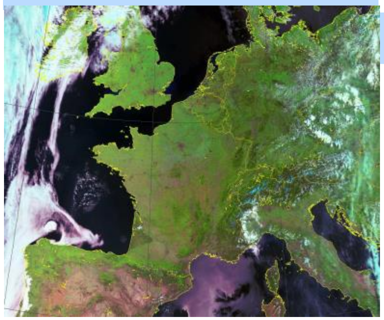
Agro-meteorological analysis
Crop growth models



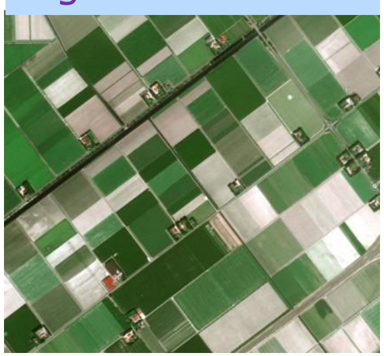
European Commission

Earth observation infrastructure

1km resolution



High resolution



Pan-European

Daily, 10- daily, monthly,

long term average

MARS DB

image repository

compositing

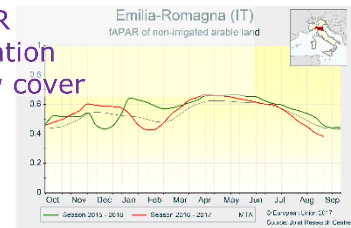
interpolation

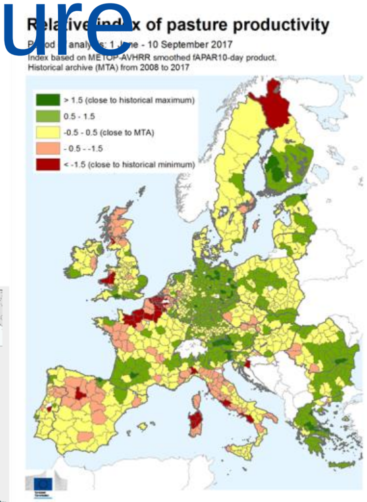
smoothing

indicator computation

information products

NDVI
fAPAR
Radiation
Snow cover

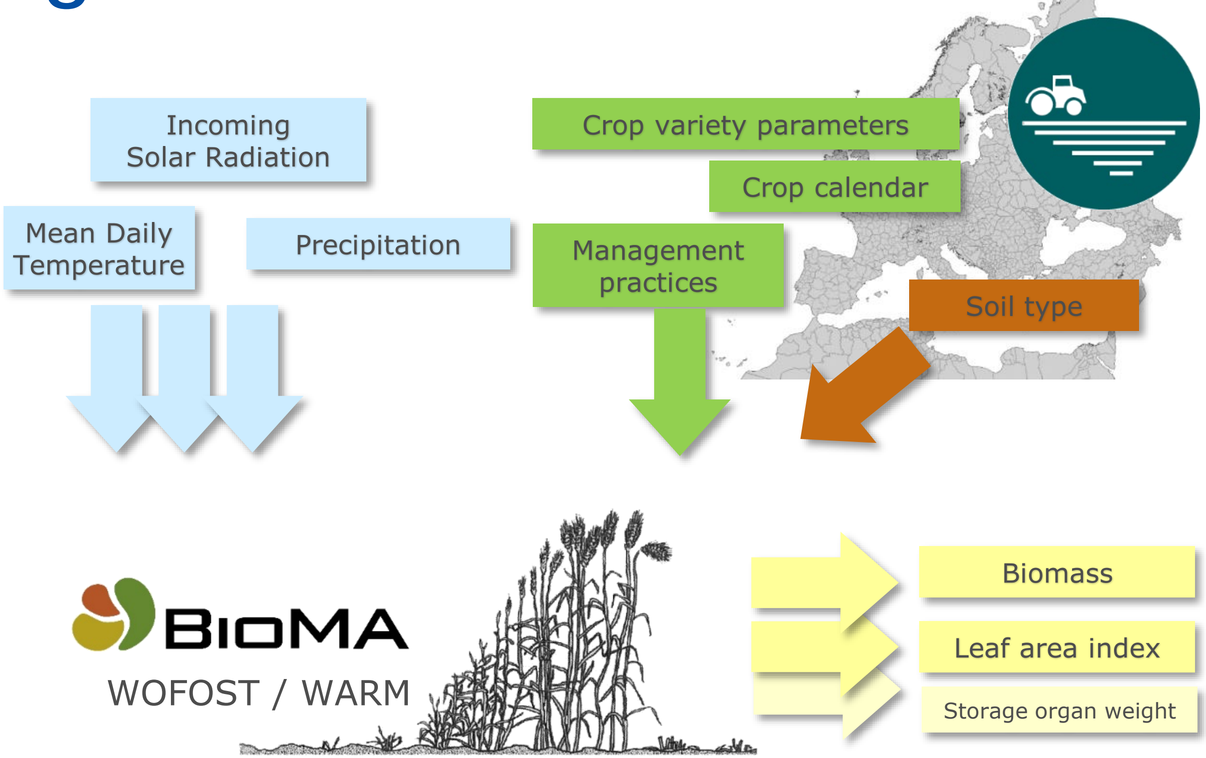




Qualitative
Independent source of measured biomass
Convergence of results

Quantitative
Crop yield forecasts (regional) based on RS derived vegetation state parameters only
Pasture productivity
Improvements meteorological infrastructure

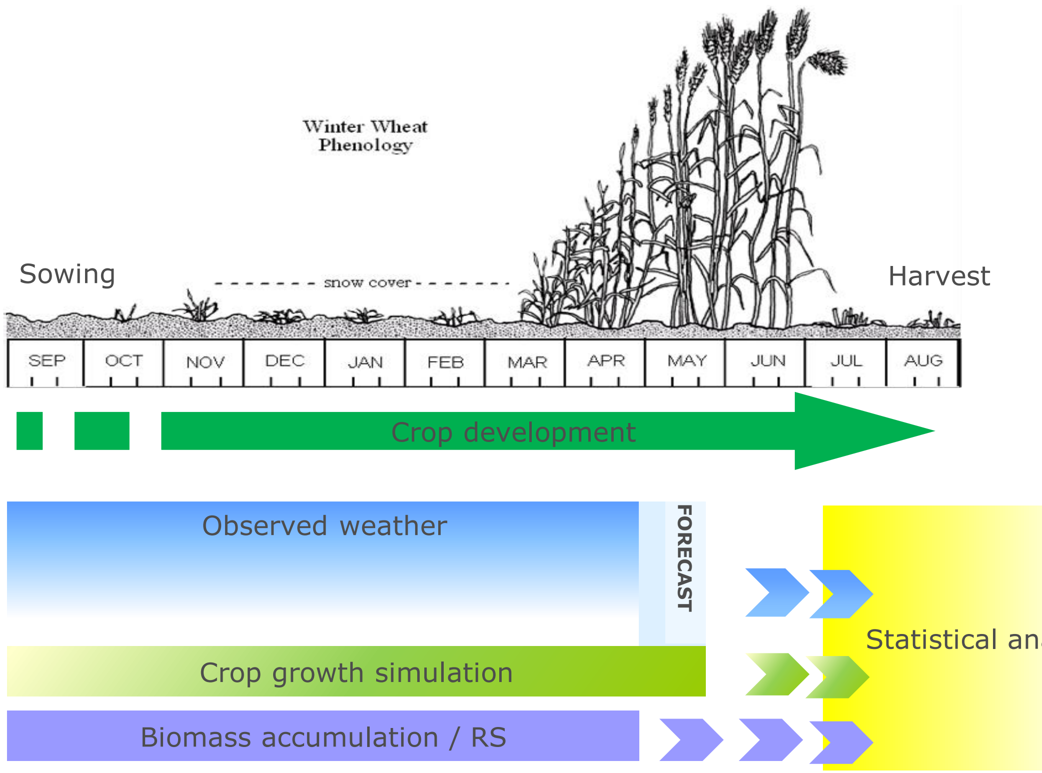
Crop growth model infrastructure

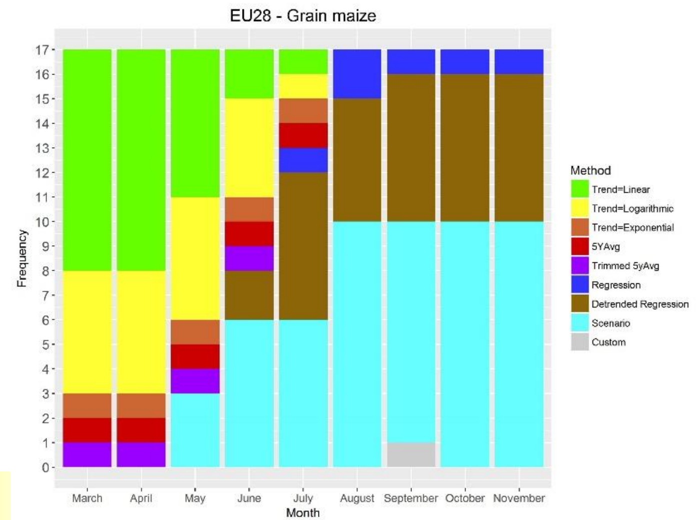


European Commission

Statistical infrastructure

Weather has a significant effect on crop yield, accounting for most of the inter-annual variability





European Commission

Forecast Accuracy 2018