Meeting of the economic board of the sugar market observatory

Overview of the JRC MARS Crop Yield Forecasting System

Brussels, DG-AGRI

9 November 2021

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Objectives and purpose

- Provide independent, timely, and accurate crop yield forecasts for the EU and its neighbourhood, thus contributing to the transparency of market information.

- Provide *ad-hoc* analysis of extreme weather situations and their impacts on agriculture.

Directly implements
Article 22 of REG(2013)1306 on Monitoring Agricultural Resources (MARS)
The new CAP proposal includes a corresponding Article

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Key products

- JRC MARS Bulletin - Crop monitoring in Europe (since 1992, monthly)

- JRC MARS Bulletin - Crop monitoring European neighbourhood (since 2017, 2 times per year for 5 regions).

- Data, maps and graphs on AGRI4CAST resource portal

- *Results of ad-hoc* analysis following requests from DG AGRI, sometimes published as Bulletin updates.
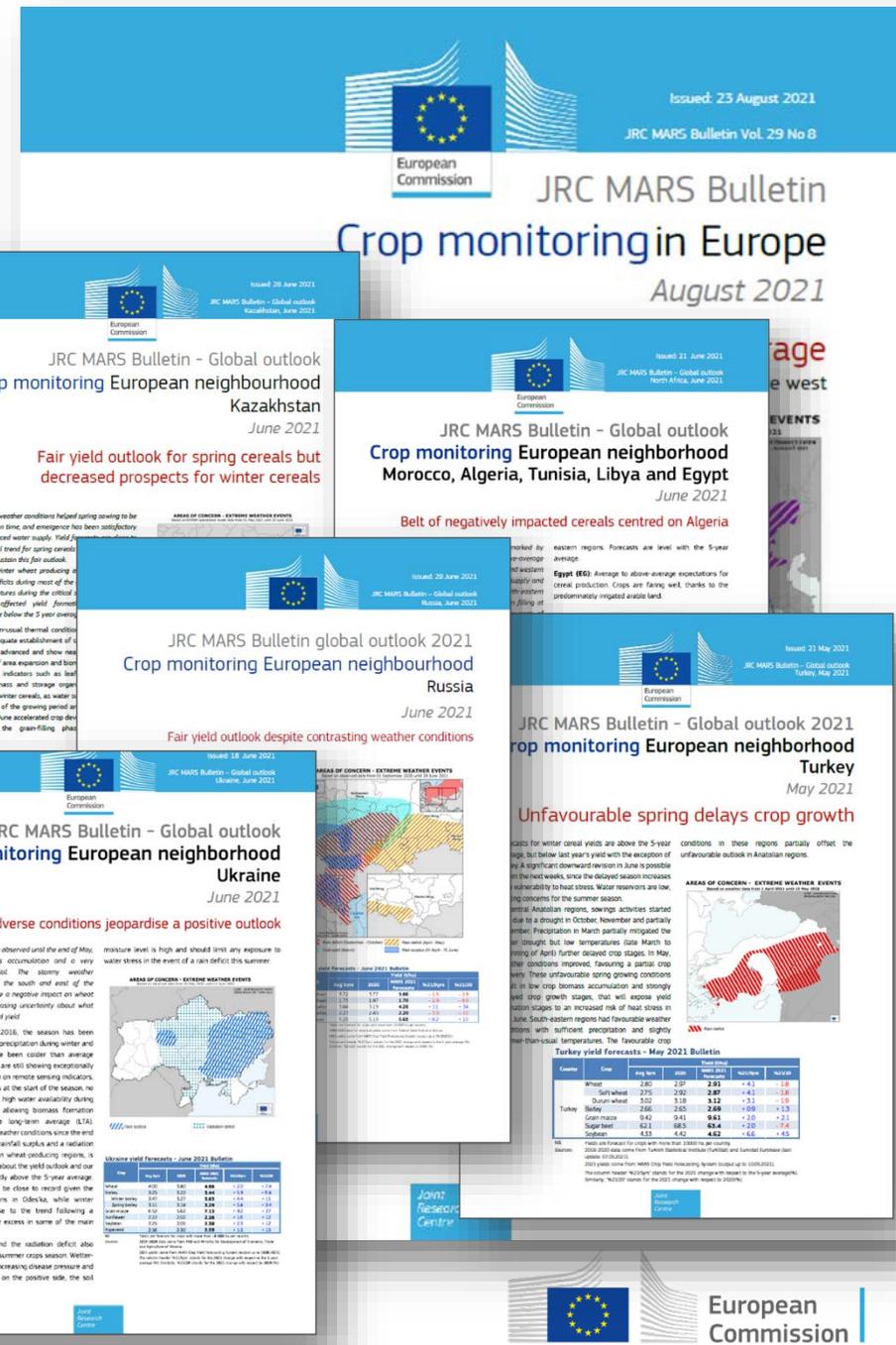
Key products – Bulletins contents

- Agrometeorological overview
  - ✓ Areas of concern (synthesis of findings)
  - ✓ Frost damage (December – March)
  - ✓ Weather review and weather forecast
- Sowing and/or harvesting conditions
- Remote sensing – arable land
- Pasture conditions
- Country analysis, weather & main crops
- Crop yield forecasts at national level
- Atlas maps (weather data and crop simulation results)

MCYFS

A model and data driven decision support system

System design

Weather monitoring

Production of daily meteorological indicators

Site and crop specific information to tailor the system to the area/crop of interest

Crop growth simulation

Production of 10-day biophysical indicators

Time series of crop specific area/yield statistics

Statistical yield forecasting
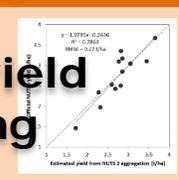
Vegetation monitoring Remote sensing

AREAS OF CONCERN – SUMMER CROPS
Period considered: 19 August 2017 until 15 September 2017
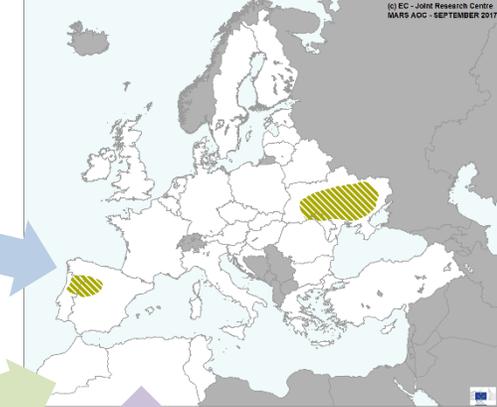
Analyst is key
System is data demanding
No unique answer
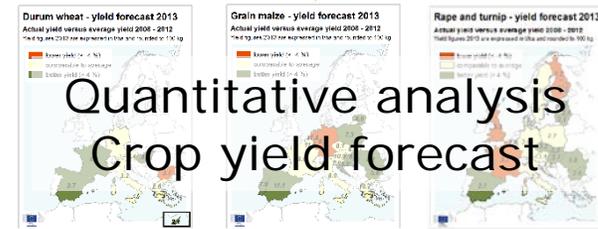
Quantitative analysis
Crop yield forecast

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System design – Meteorological infrastructure

Observed data

Weather forecast data
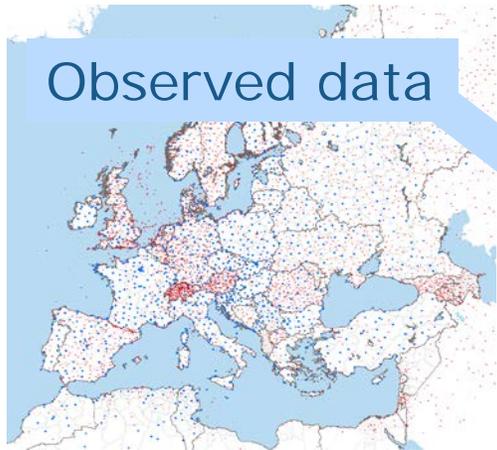
Near real time

Pan-European

Daily, 10- daily, monthly,

seasonal,

long term average

METEO DB

Gridded data

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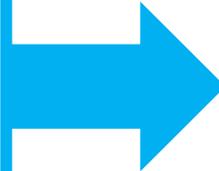
Temperature
Rainfall
Radiation
Vapour pressure
Windspeed
Evaporation
Evapotranspiration
Climatic water balance
Snow depth

✓ Agro-meteorological analysis
✓ Crop growth models

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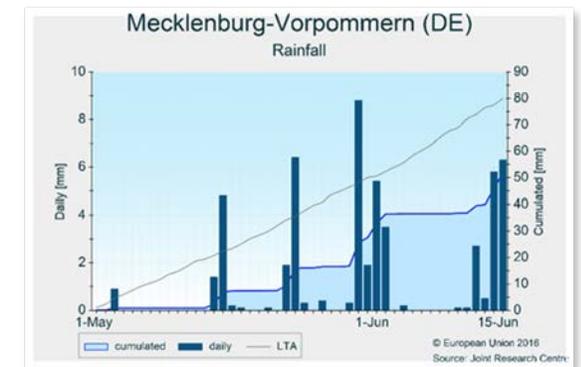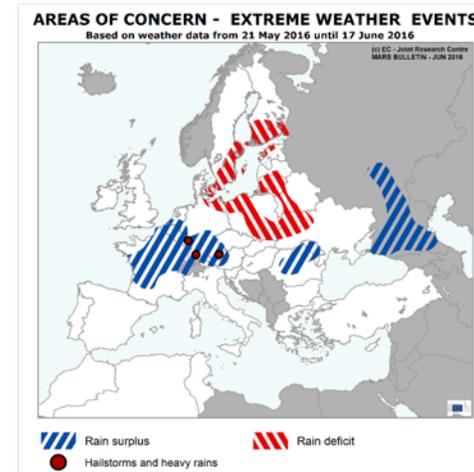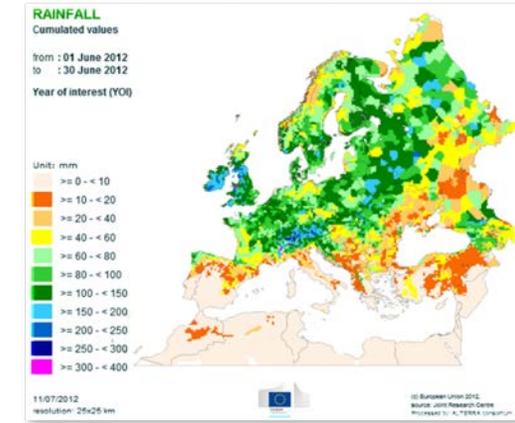
System design – Earth Observation infrastructure

- Independent observations of canopy responses

- Self standing system

- Vegetation indicators

- Biophysical variables

- Considerable time series available

Sensors and products:
- COPERNICUS Global Land Service
- METOP AVHRR
- MODIS

**Qualitative
Time series analysis – anomalies**

Emilia-Romagna (IT)
fAPAR of non-irrigated arable land

Relative index of pasture productivity
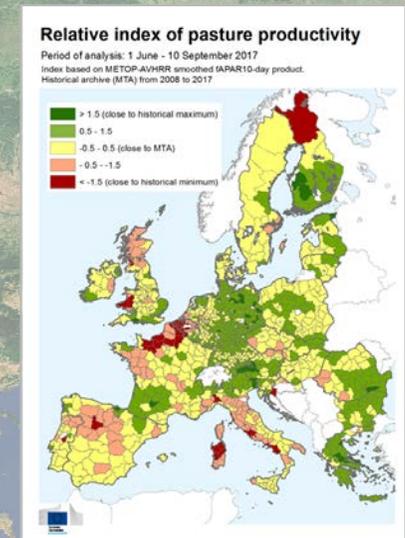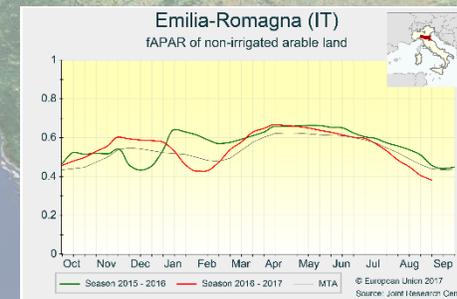
**Quantitative
Crop yield forecasts
(regional)
Pasture productivity**

System design – crop simulation infrastructure

Incoming Solar Radiation

Mean Daily Temperature

Precipitation

Crop variety parameters

Crop calendar

Management practices

Soil type

BioMA
WOFOST / WARM

Crop development

Biomass

Leaf area index

Soil moisture content

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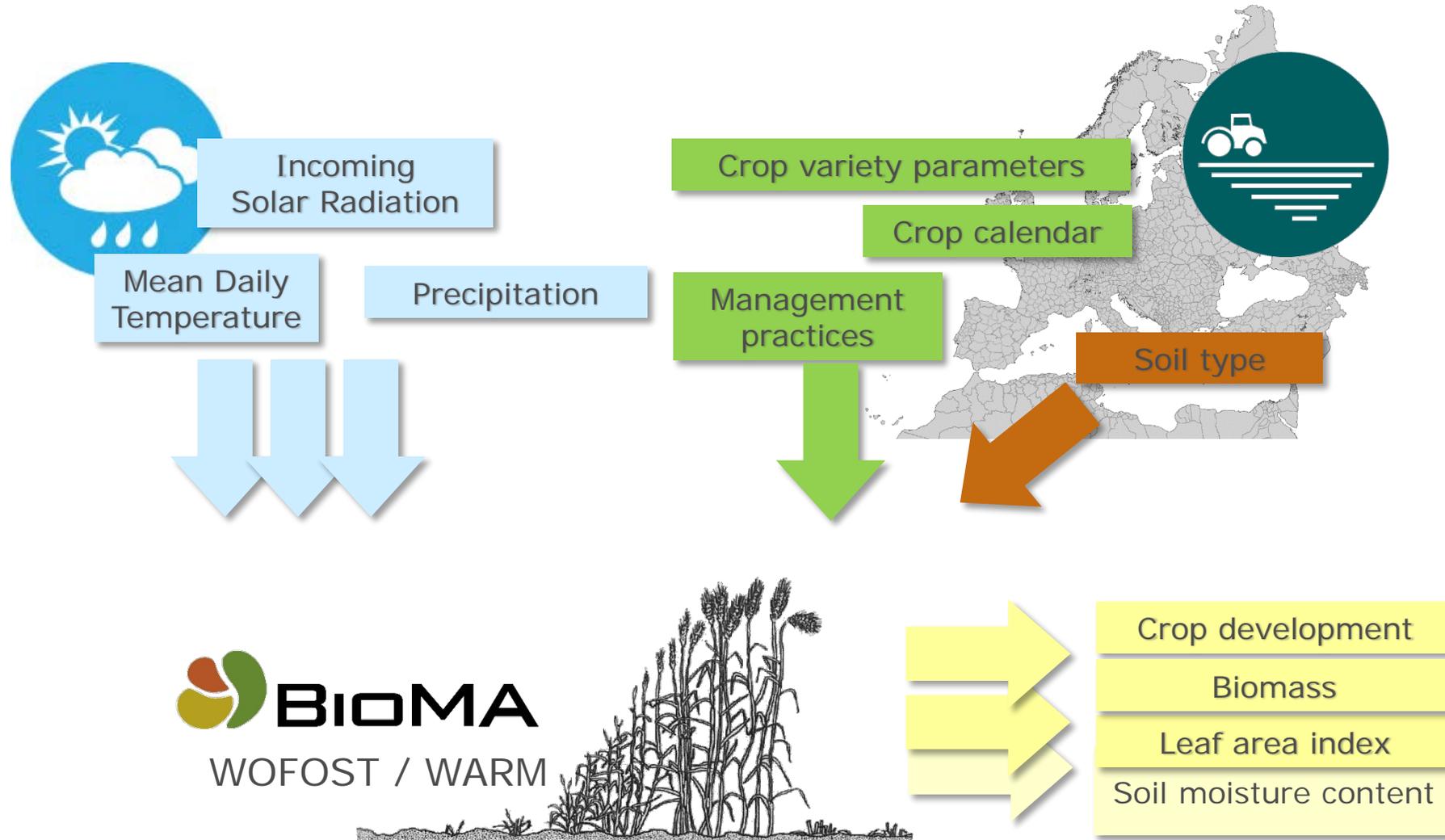
System design – Statistical infrastructure

Sowing

Harvest

Crop development

Observed weather

FORECAST

Crop growth simulation

Biomass accumulation / RS
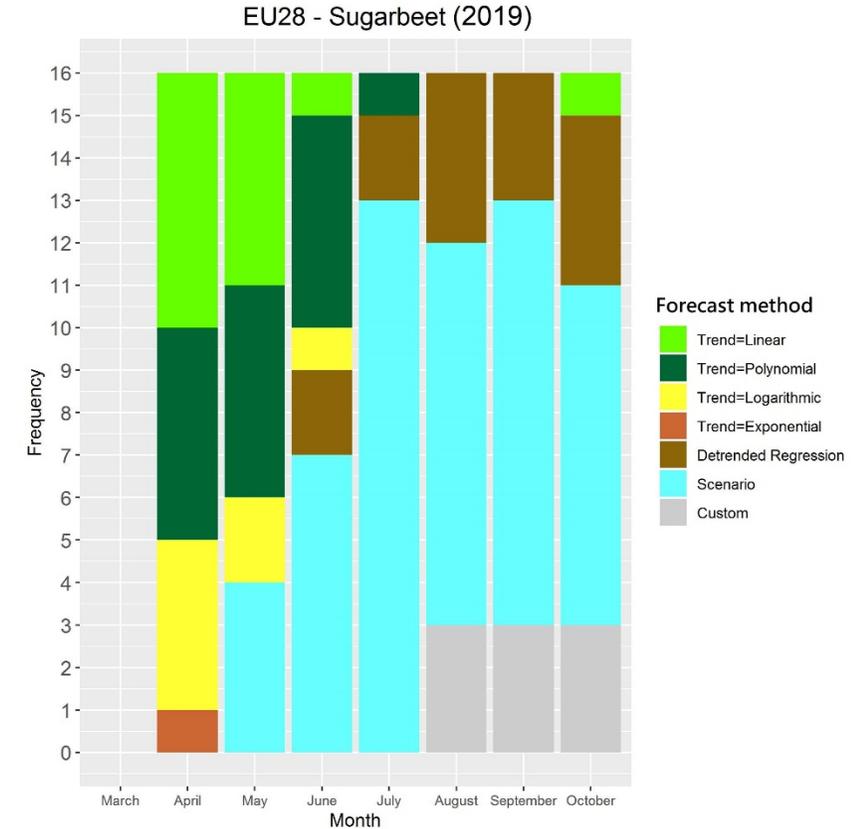
Statistical analysis + analyst expertise = published **FORECAST**

EU28 - Sugarbeet (2019)

Forecast method
- Trend=Linear
- Trend=Polynomial
- Trend=Logarithmic
- Trend=Exponential
- Detrended Regression
- Scenario
- Custom

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Use and users

- Main customer: DG AGRI
    - Input to crop balance sheets
    - Reporting to AMIS
    - Awareness of adverse (weather) situations impacting crops in specific regions

- Other users (donwloaders)
    - Ca. 1000 downloads per month
    - More than two thirds from private sector (trade, producers' organisations, finance, journalism)
    - Rest from public sector (ministries, research & education)

Private

Trade (34%)
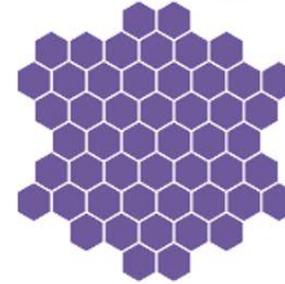
Farming/Farmers' organization (17%)

Finance Insurance (7%)

Journalism (7%)

Other (3%)

Public

EU Institution (2%)

National Government (Ministry) (7%)

University, Research Institute (22%)
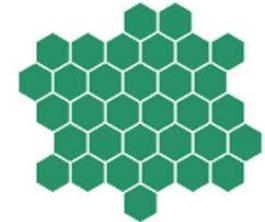
Quality assessment

- Annual QA since 2014 (against preliminary and final statistics)
- Year-to-year performance (to assess structural improvements)
- In-season performance (to assess changes in accuracy during a season)
- Performance during extremes (system limits)
- Examples for sugar beet on the right (EU27+UK) and in the following slide (France, Germany)
- Discrepancy (%) expressed on the y-axis (green bars), as JRC MARS September forecast, minus actual yields reported by Eurostat.

EU 27+UK

EU 27+UK

France

Germany

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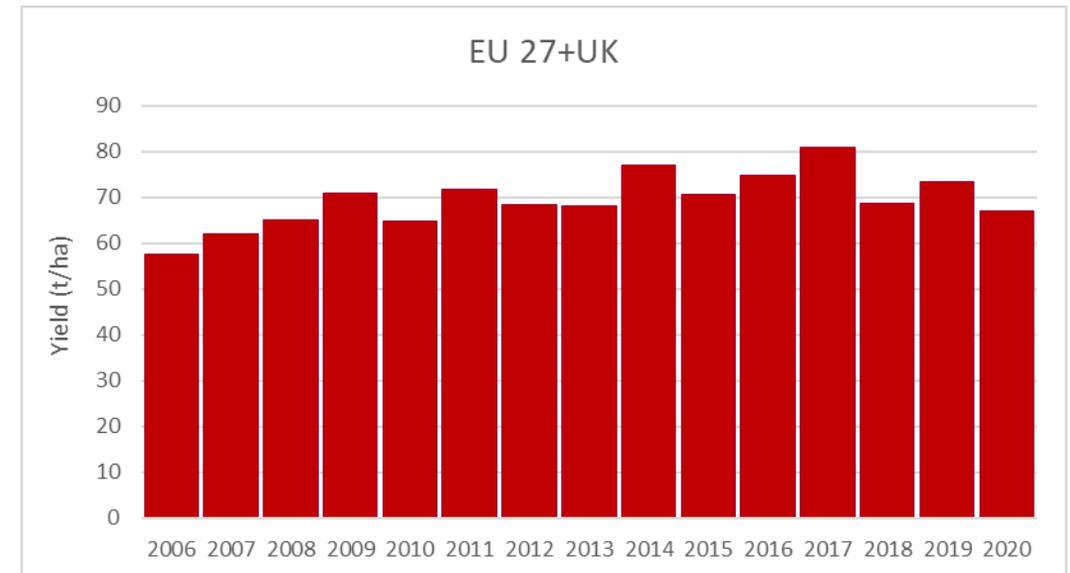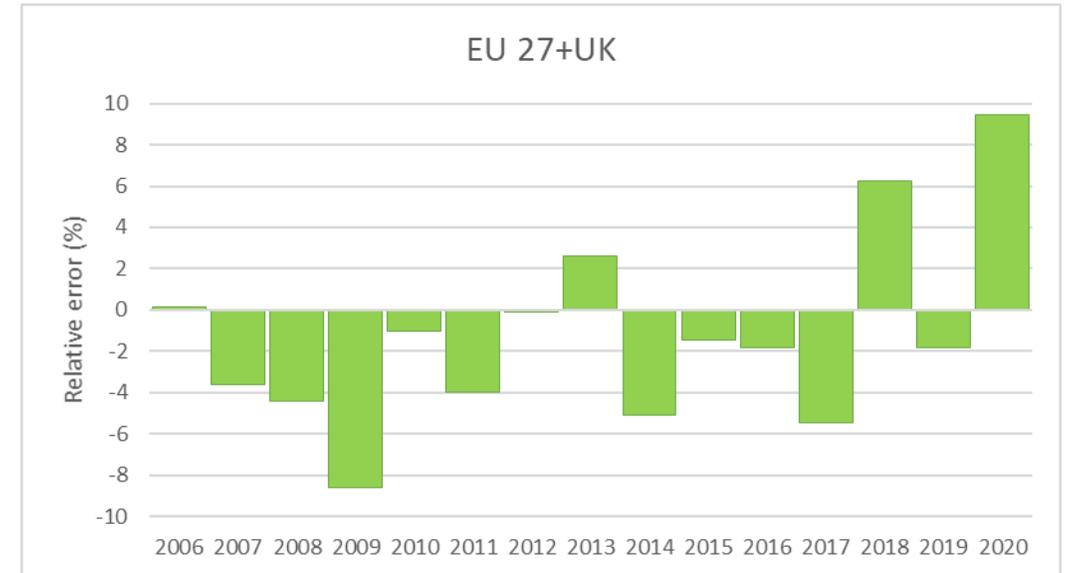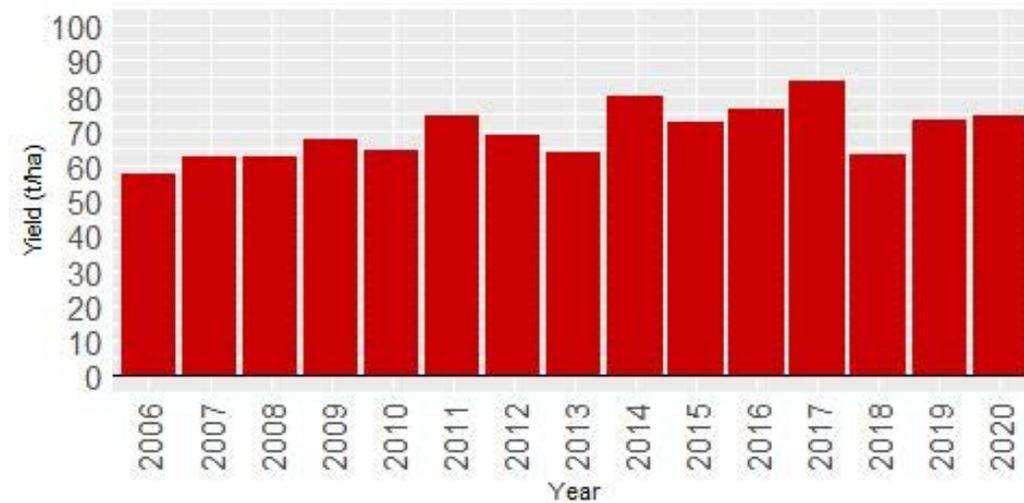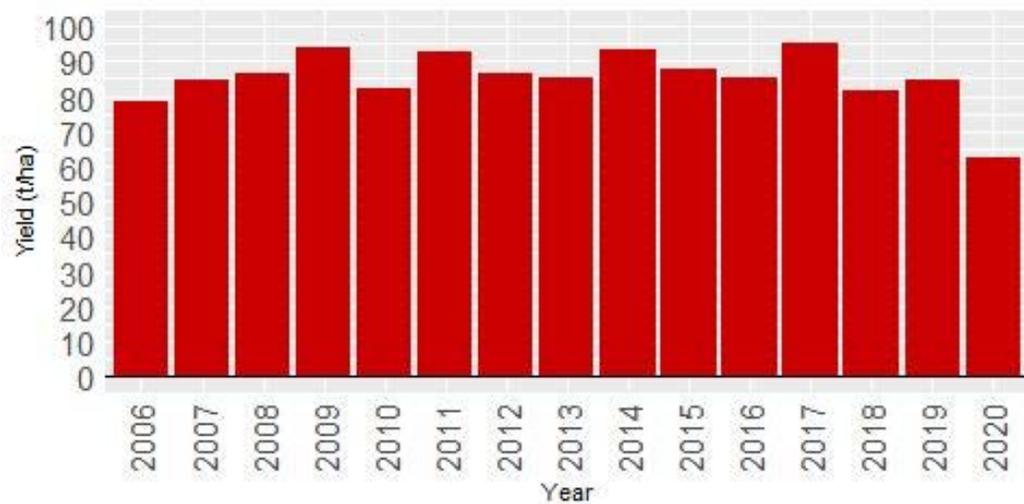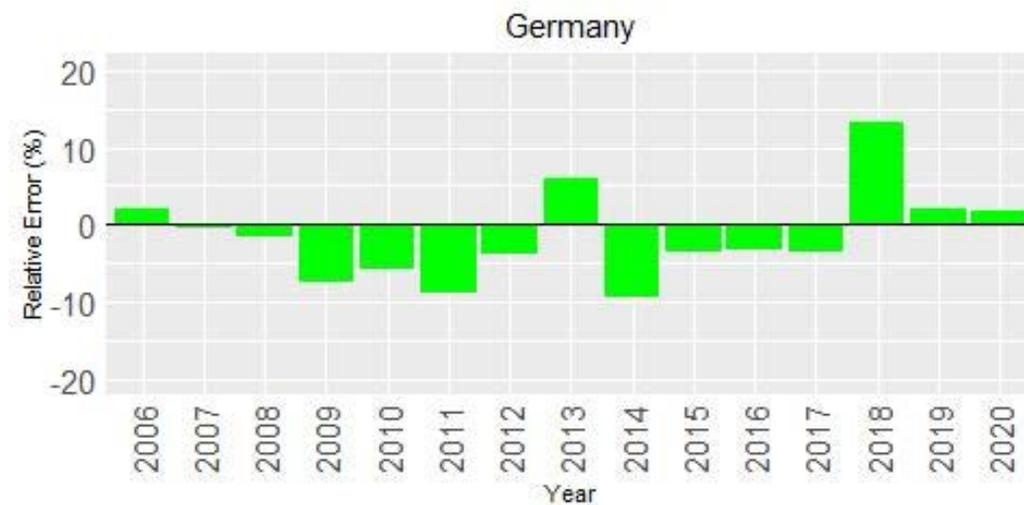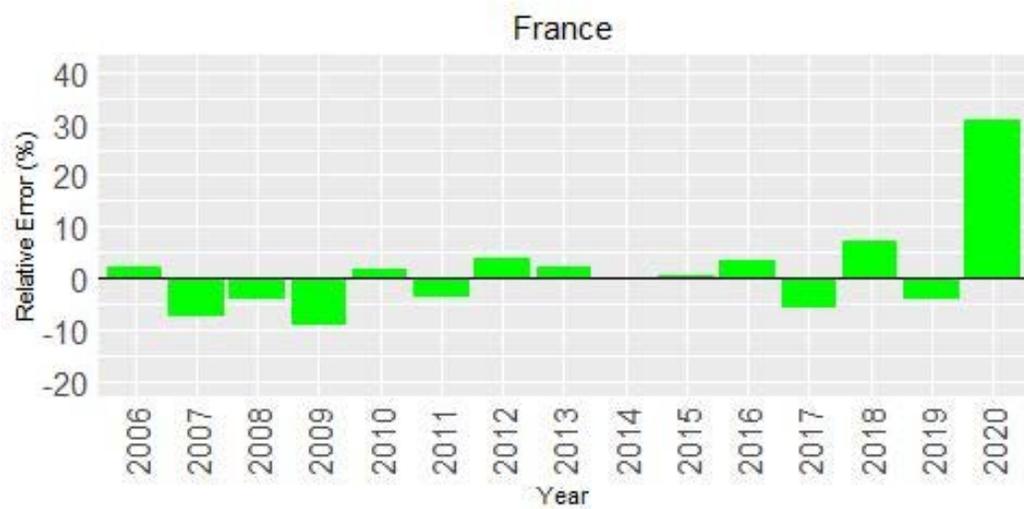
Quality assessment (in-season performance)
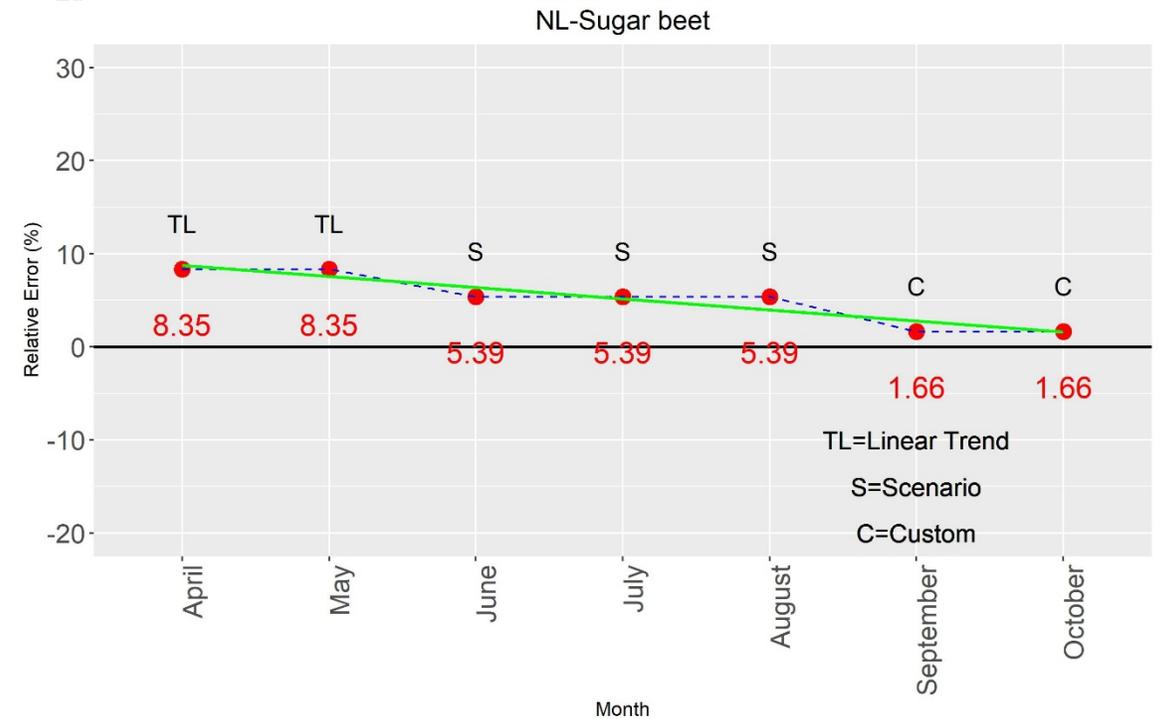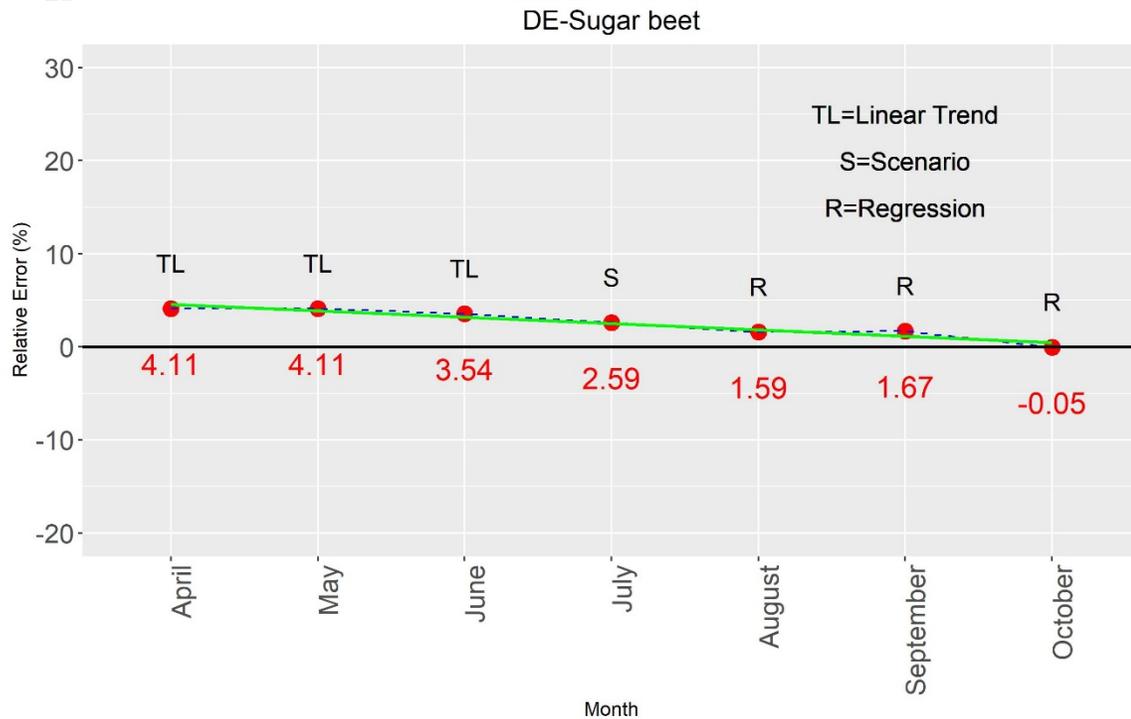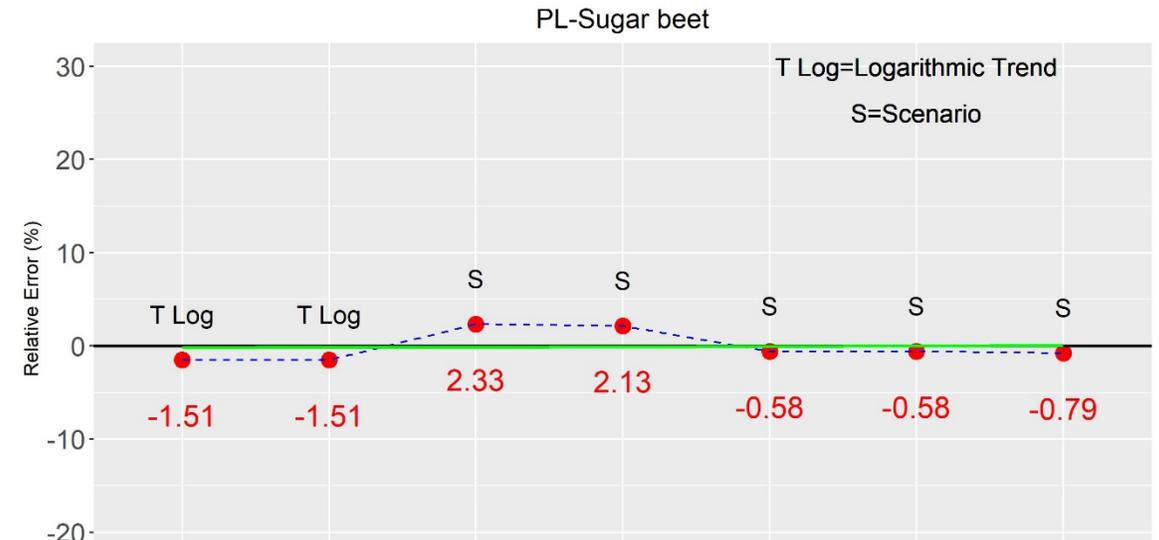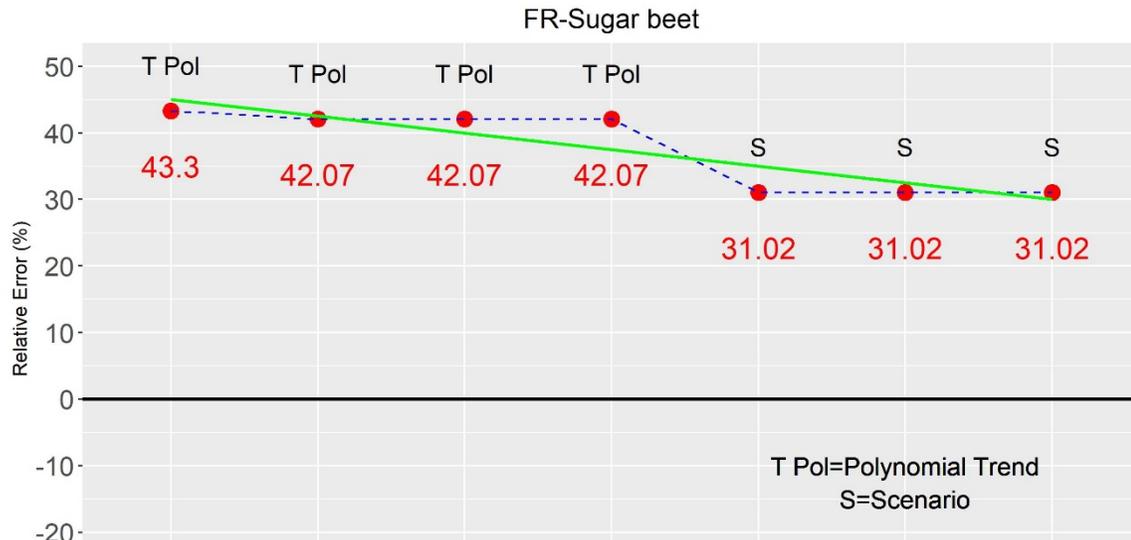
Potential improvements of the system

Improvement	Requirements
More refined weather and soil input data	None (is currently being implemented)
Forecast sugar yields in addition to beet yields	Time series of historical data on sugar contents
Use actual sowing dates to initialize the crop growth model	Timely availabiltiy of actual data at subnational level
Regional (subnational) crop yield forecasting	(historical) data availability
Crop-specific remote sensing analysis	Timely availability of parcel data / timely satellite detection of crops
Use seasonal weather forecast for large-scale weather patterns.	Further proof of concept; investments in hardware and software

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Thank you

Authors:

on behalf of the MARS4CAST team (JRC D.05)

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The JRC MARS Bulletin is available at
https://ec.europa.eu/jrc/en/mars/bulletins

Weather and crop related data, maps and graphs are available at:
http://agri4cast.jrc.ec.europa.eu

Contact: JRCMARSBULLETIN@ec.europa.eu

JRC MARS Bulletins

Crop monitoring in Europe and neighbouring countries