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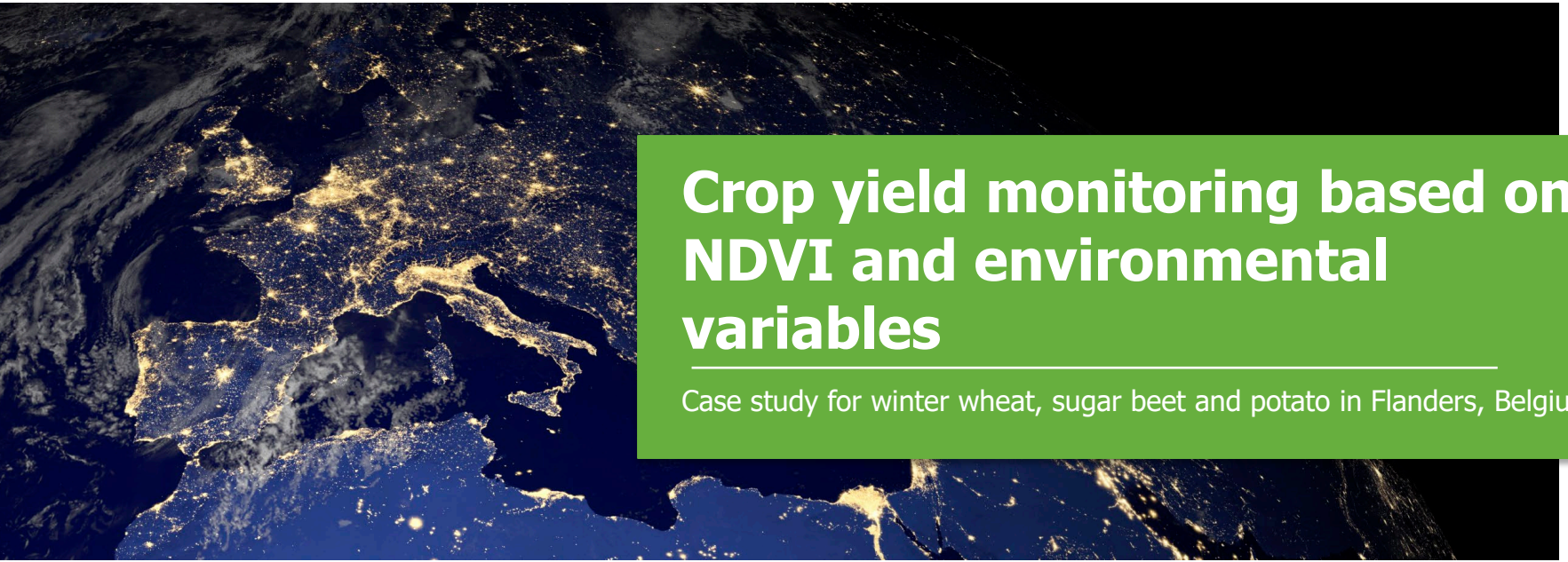

Crop yield monitoring based on NDVI and environmental variables

Case study for winter wheat, sugar beet and potato in Flanders, Belgium

Living Planet Symposium, Bonn 2022

crop yield monitoring

- Evaluate management choices
- Identify potential threats
- Enhance potential opportunities
- …

- Decision making
- Strategic planning
- …

- Insurance companies
- Agricultural service businesses
- Breeding companies
- …

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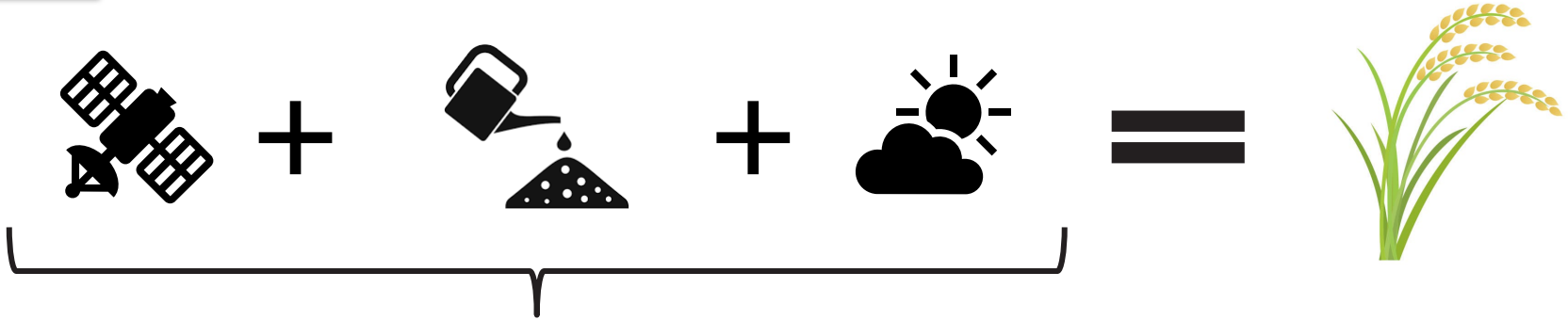
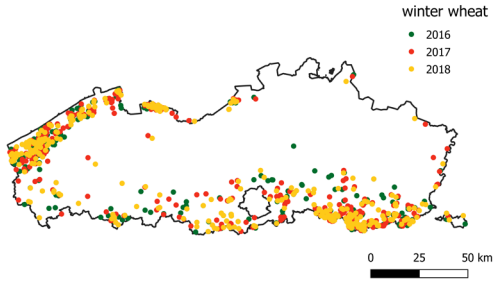
crop yield monitoring with NDVI and environmental variables

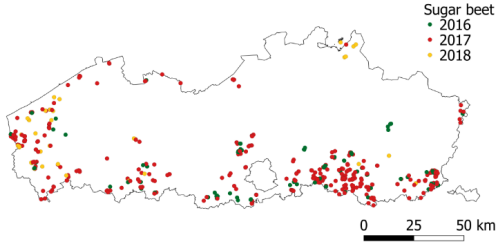


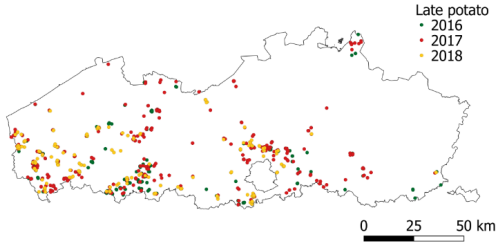
Use case: modeling winter wheat, sugar beet and late potato yield in Flanders, Belgium (data from 2016/2017/2018)

- Remotely sensed vegetation indices: NDVI → Sentinel-2 accessed via OpenEO
- Soil water depletion → AquaCrop
- Weather data → RMI

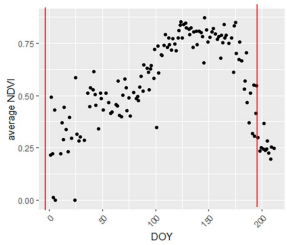
Empirical crop yield model (random forest)



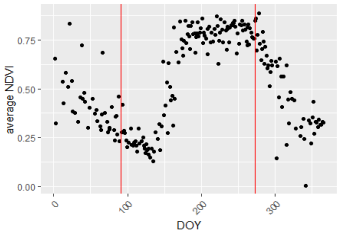




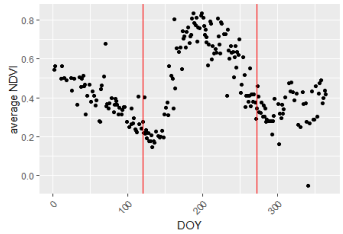
Winter wheat

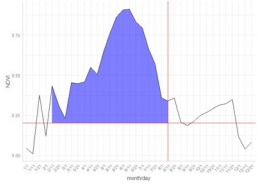


Sugar beet



Late potato





NDVI integral

Monthly soil water depletion (for sugar beet and late potato)

Monthly P and Tmax

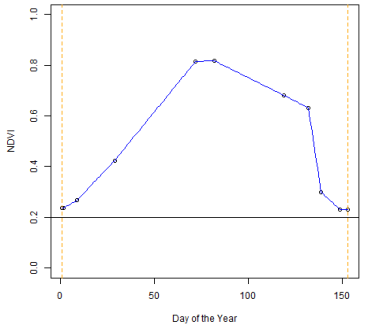
Satellite information from openEO

- https://openeo.org/
- Platform to **access**, **process** and **download** satellite information
  - No need to download huge tiles
  - Big collection of satellite data (see: https://hub.openeo.org/)
  - Different programming languages (R/python/JavaScript)

Example: calculate average NDVI of an agricultural field

openEO

- Remove pixels affected by clouds
- Extract data from particular time range
- Calculate average value at field level for each time point



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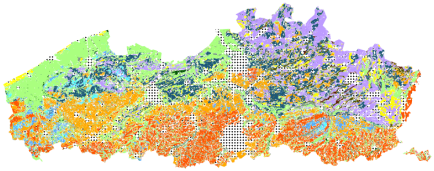
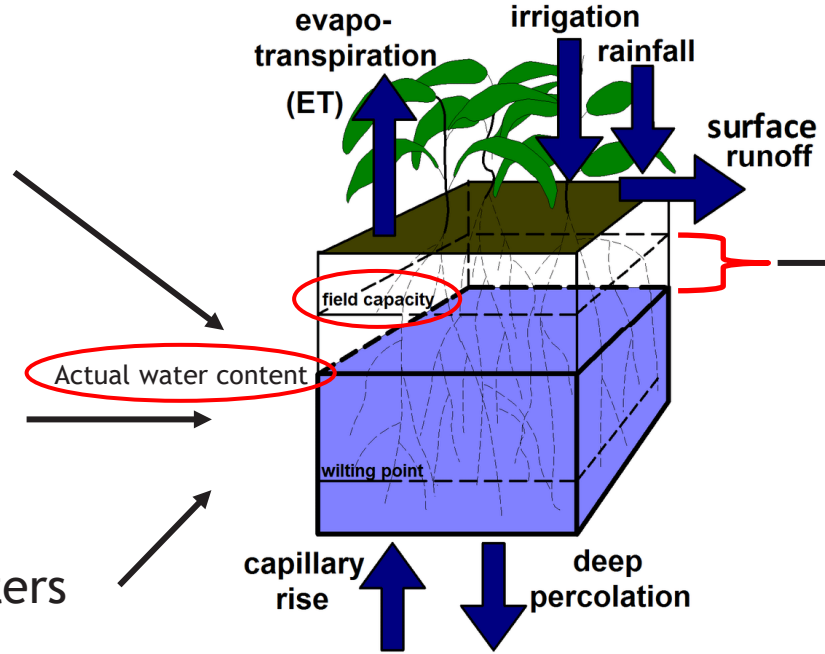
Soil water depletion: AquaCrop



WRB: soil texture

Daily weather data

Crop specific parameters

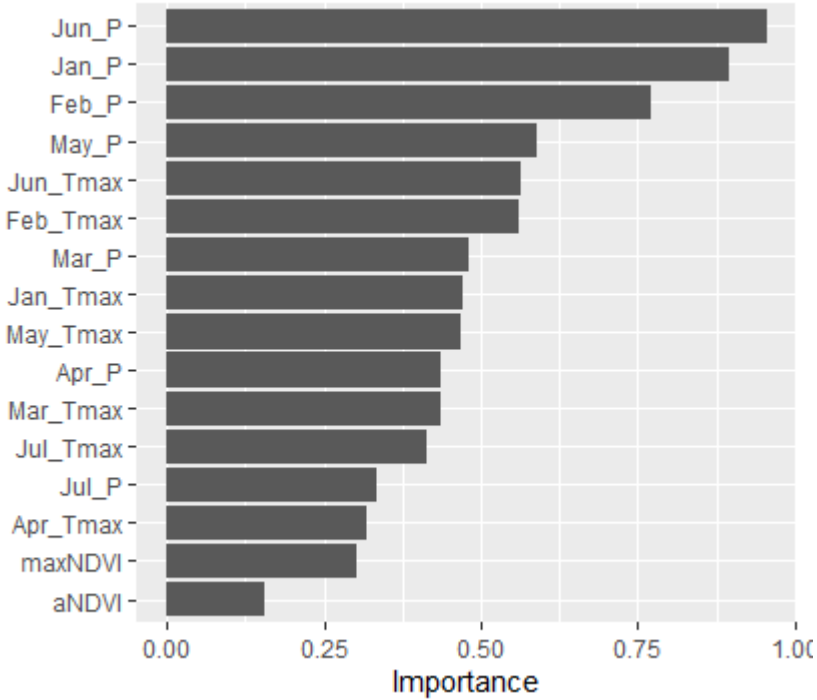


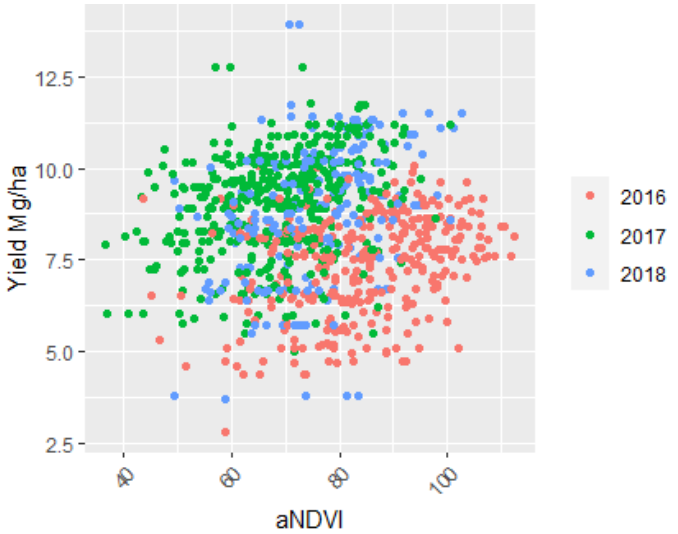
Root zone soil water depletion

https://pypi.org/project/aquacrop/

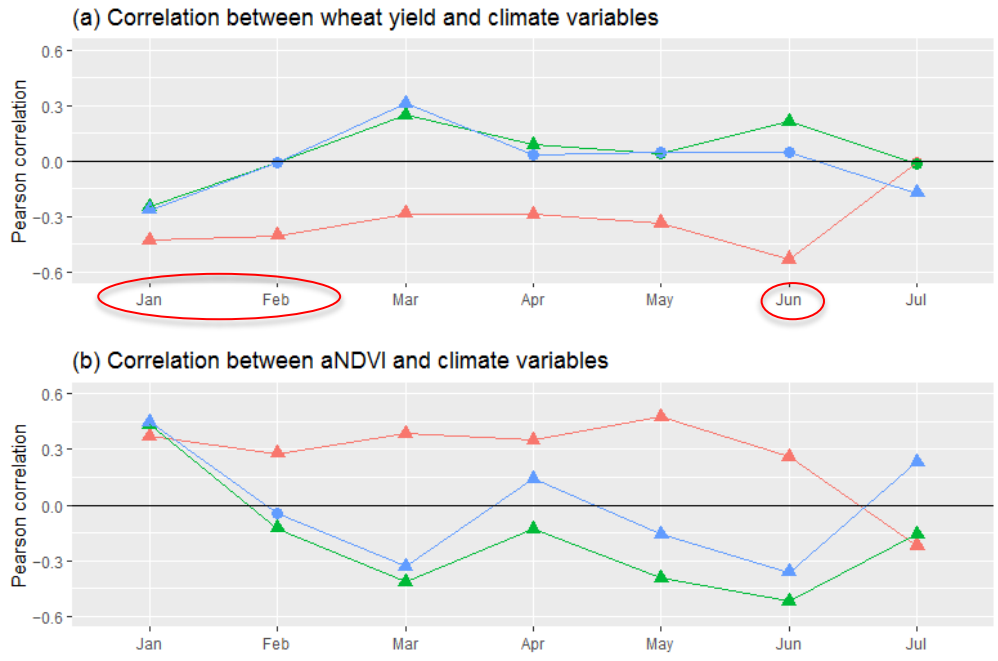
Model results: winter wheat

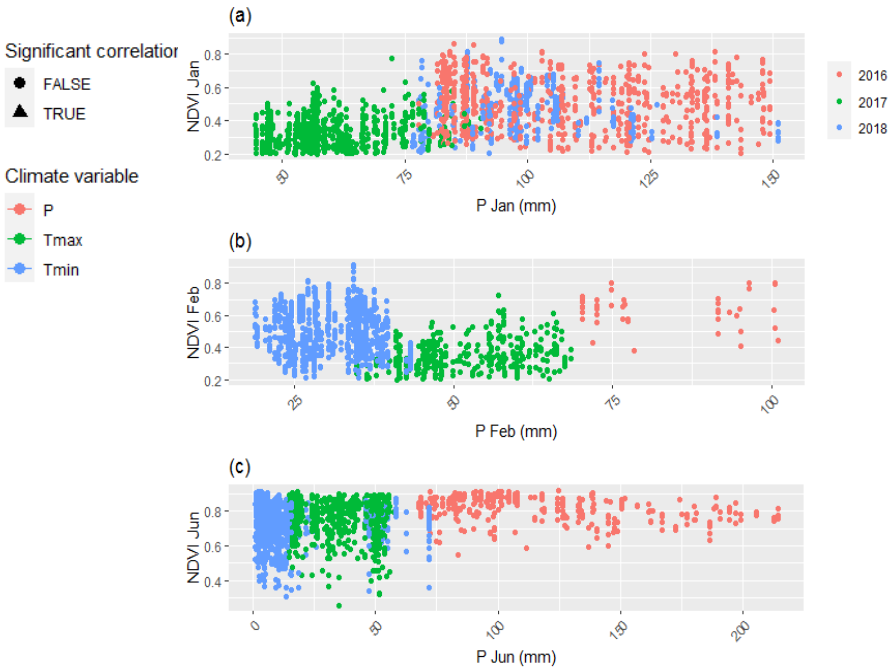
Feature importance of random forest





Winter wheat: why was NDVI not a good predictor?





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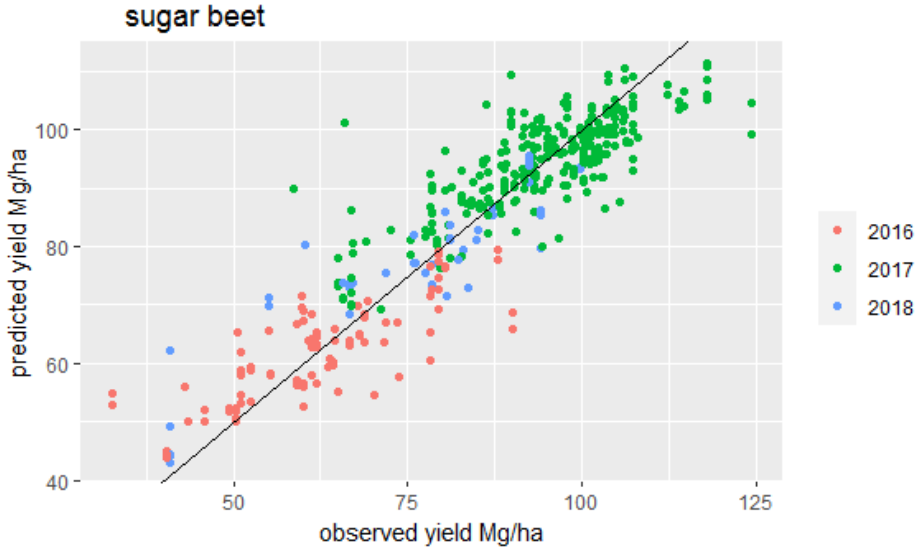
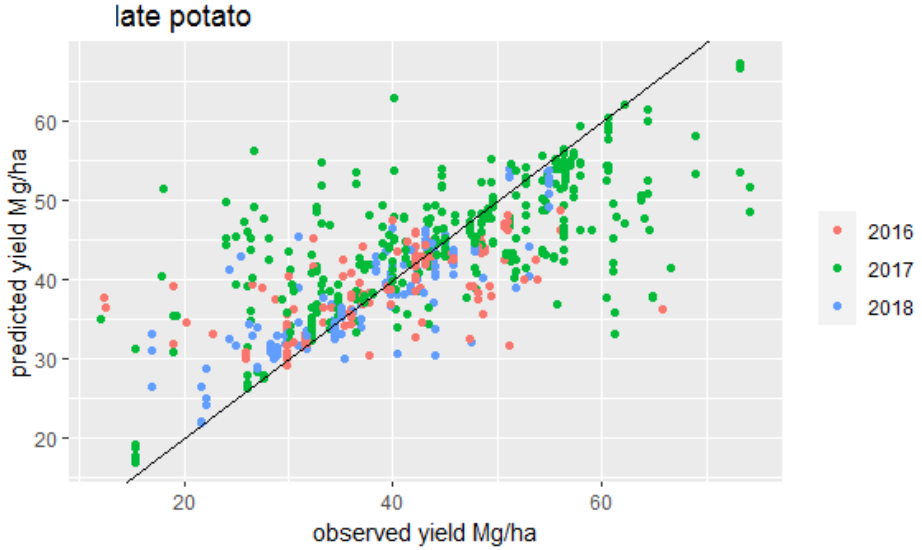
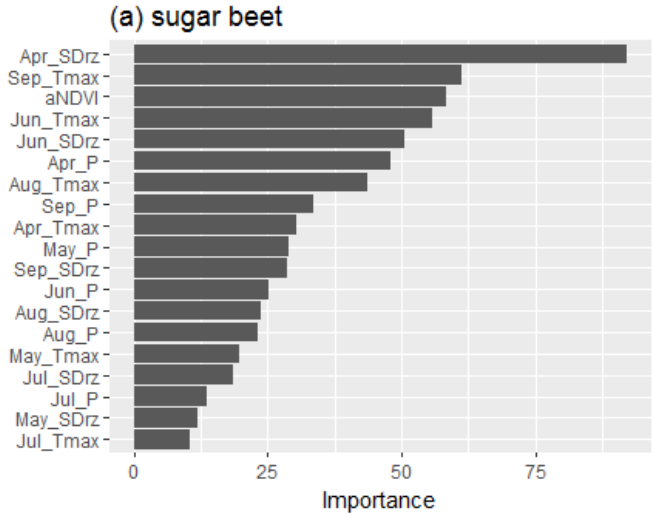
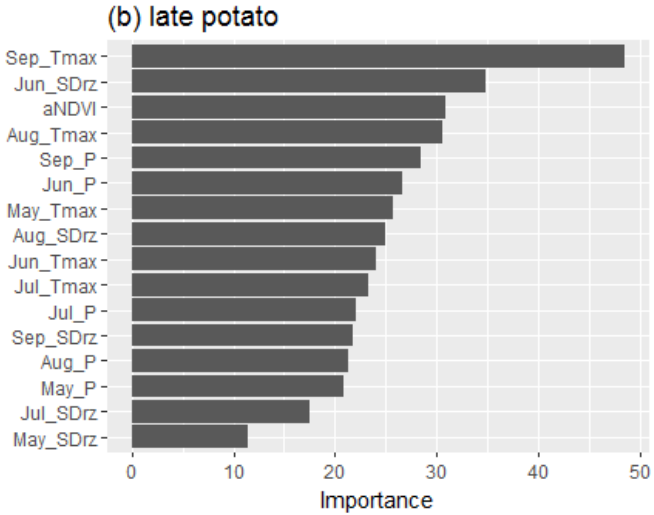
Model results: sugar beet and late potato



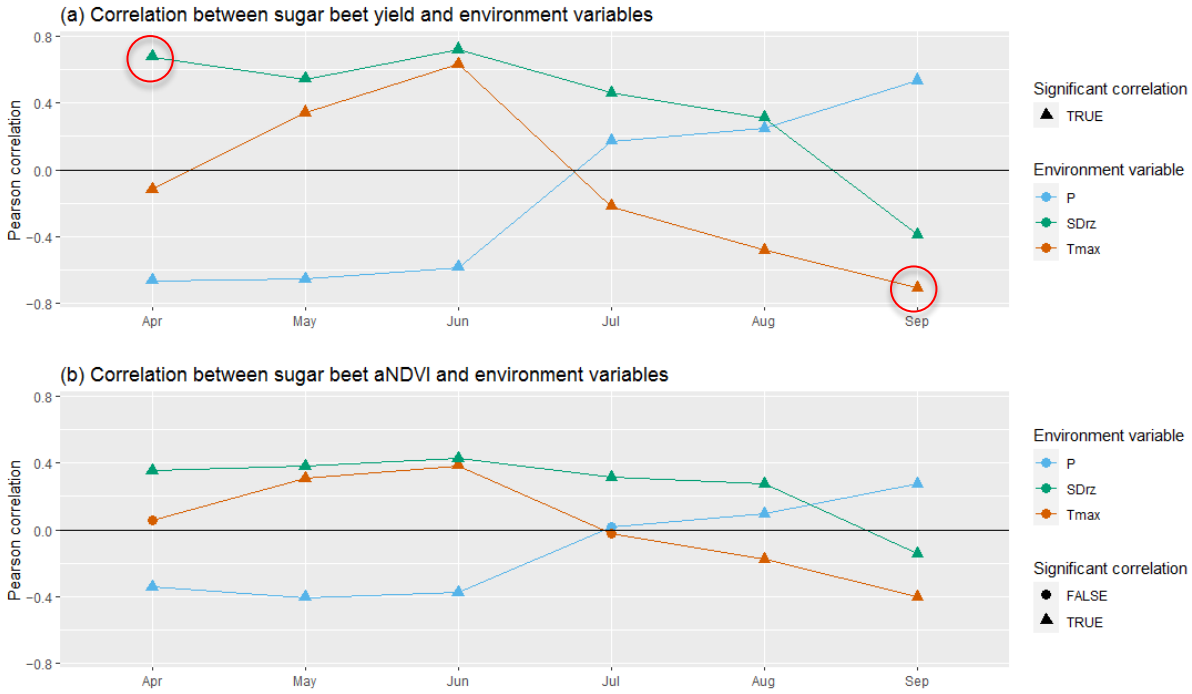


Evaluation of variable importance

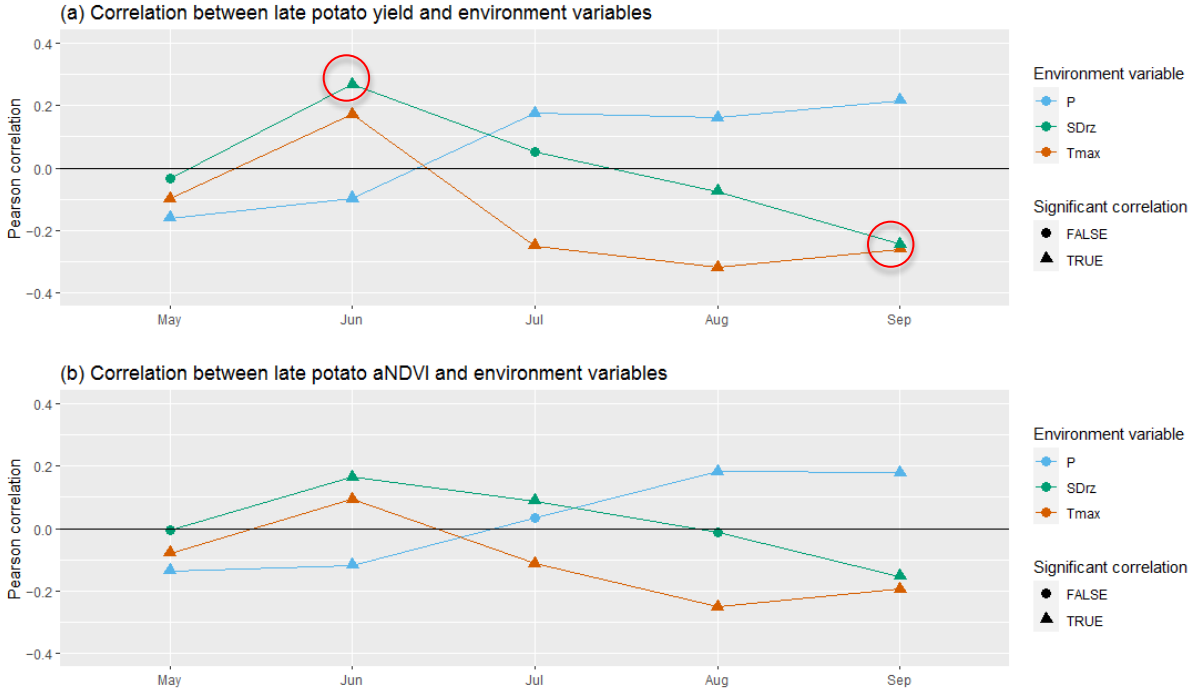


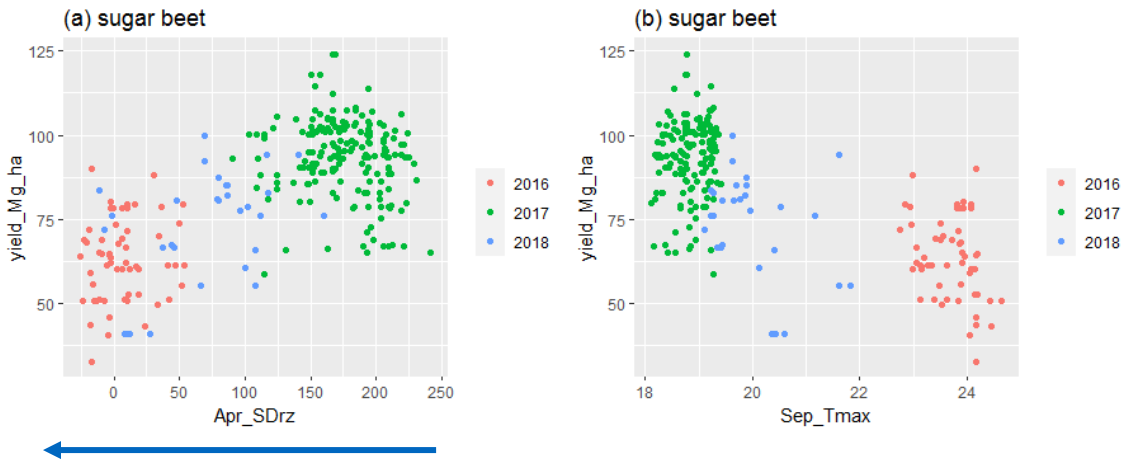


Correlation plots: sugar beet

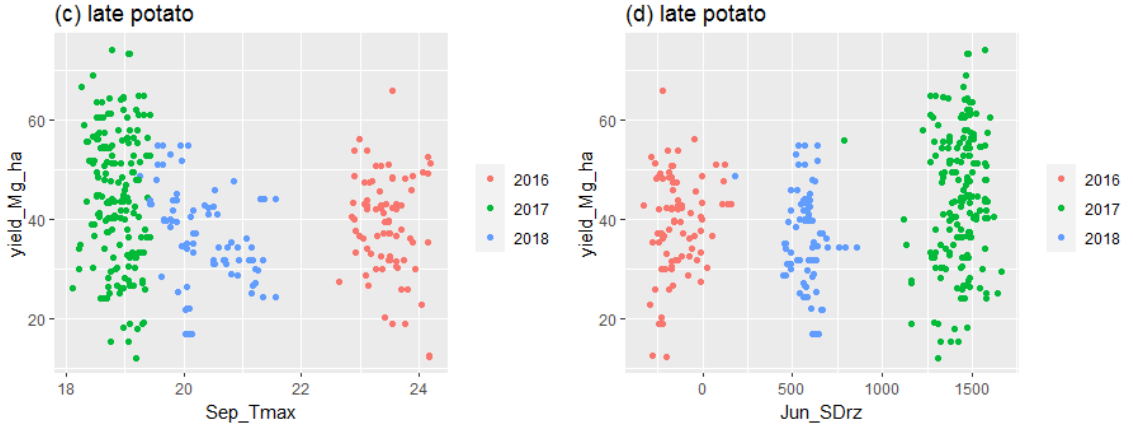


Correlation plots: late potato





Soil gets more and more saturated



Soil gets more and more saturated

Conclusions

- NDVI needs to be sensitive enough to yield affecting environmental variables to be able to use it in crop models
- Weather information explains large part of crop yield variability
- Modelled soil water depletion explains part of the crop variability of sugar beet and late potato yield in Flanders
- Transferability of data driven EO based crop yield models
  - Crop yield models should be based on data from multiple years to be robust to year-to-year weather variability
  - Wide range of environmental conditions should be included in data driven models

Vannoppen, A.; Gobin, A. Estimating Farm Wheat Yields from NDVI and Meteorological Data. Agronomy ***2021****, 11, 946.* *https://doi.org/10.3390/agronomy11050946*.

Vannoppen, A.; Gobin, A. Estimating Yield from NDVI, Weather Data, and Soil Water Depletion for Sugar Beet and Potato in Northern Belgium. Water 2022, 14, 1188. *https://doi.org/10.3390/w14081188*

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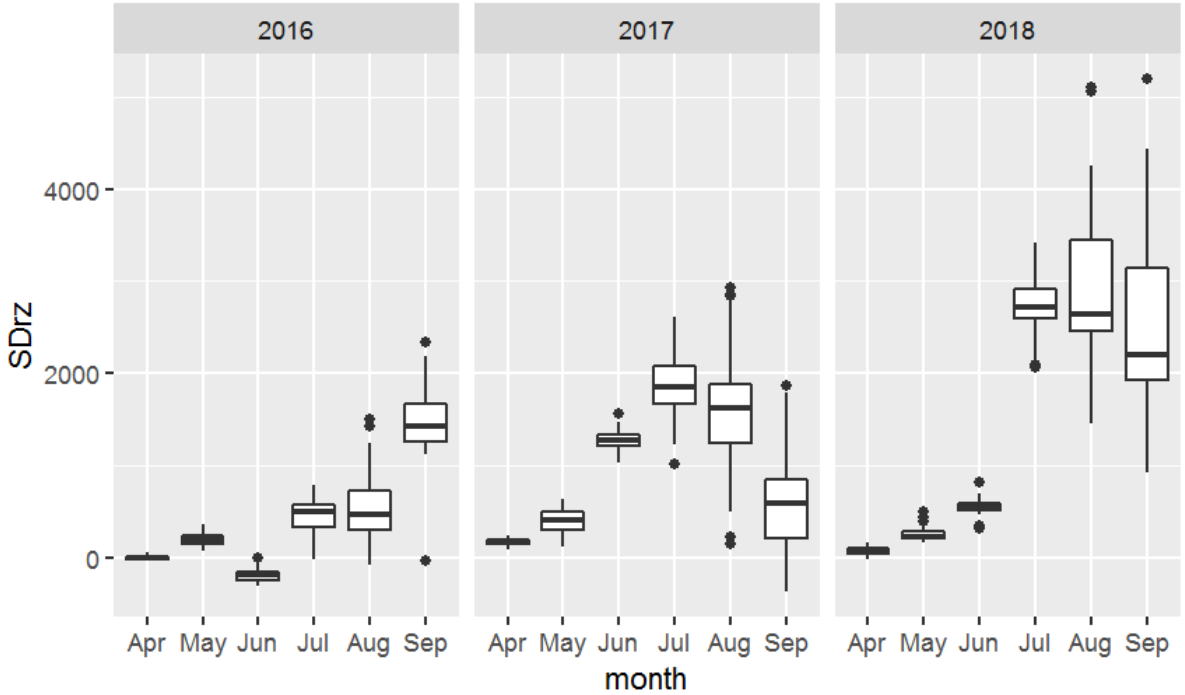
Sugar beet soil water depletion



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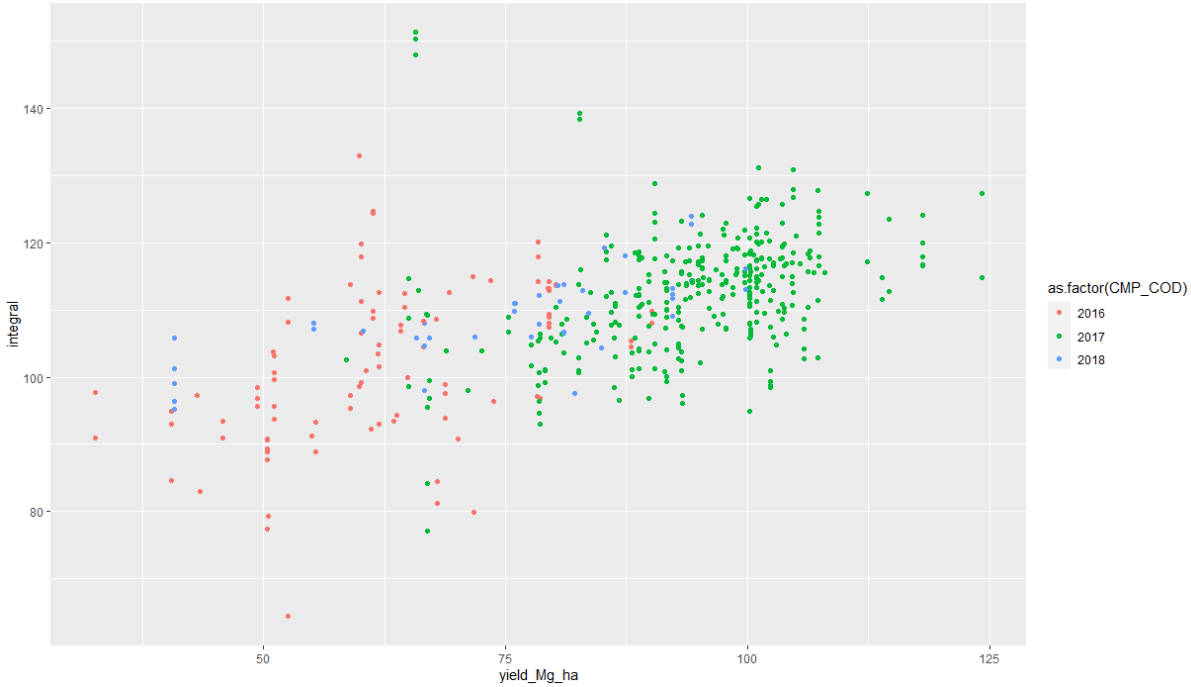
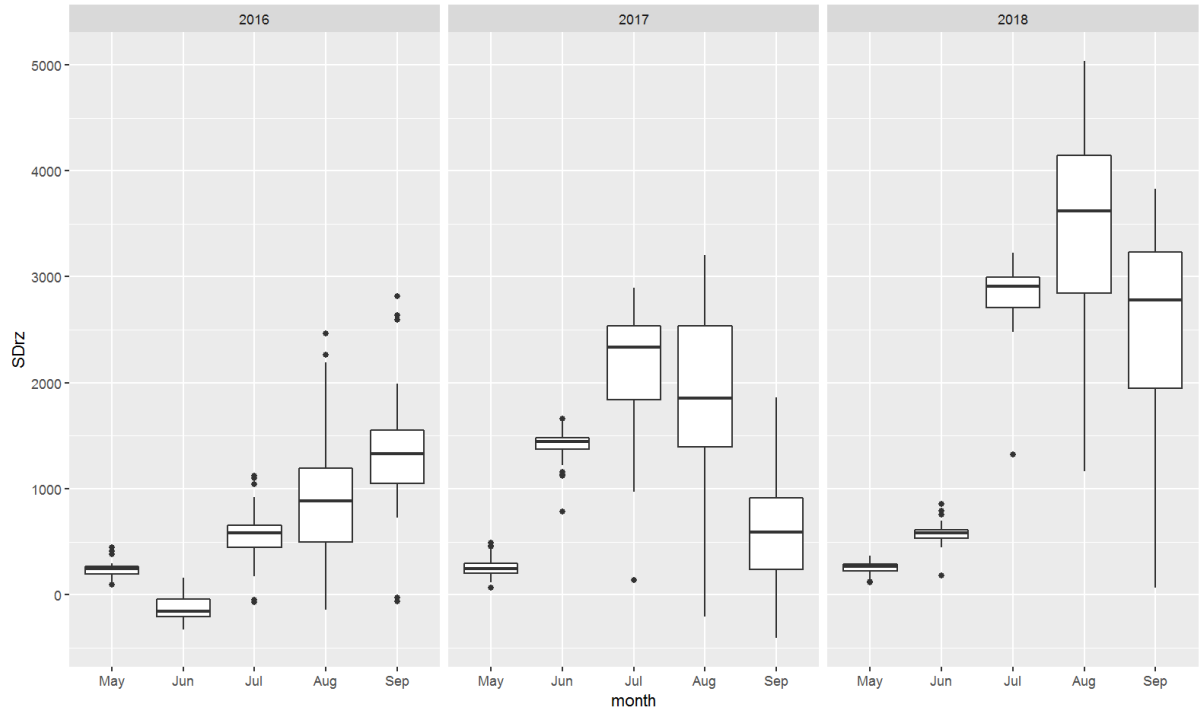
Sugarbeet aNDVI versus yield



Late potato soil water depletion



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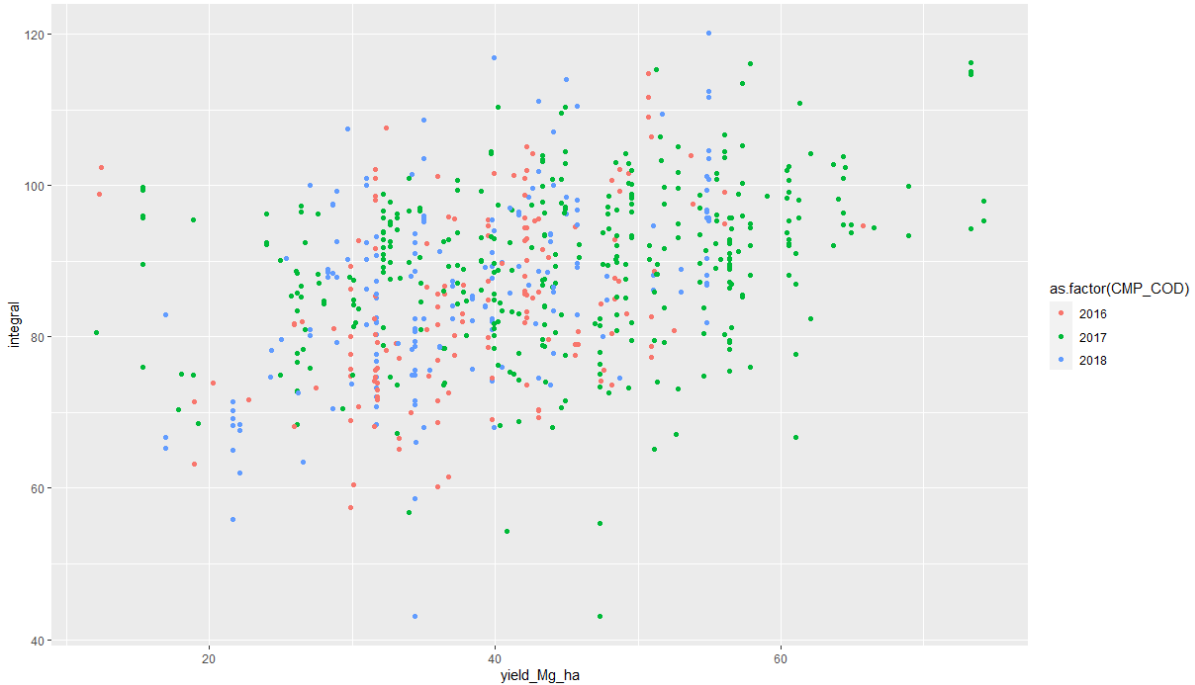
Late potato aNDVI versus yield