Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Torkans effekter på skörd i Sydsverige

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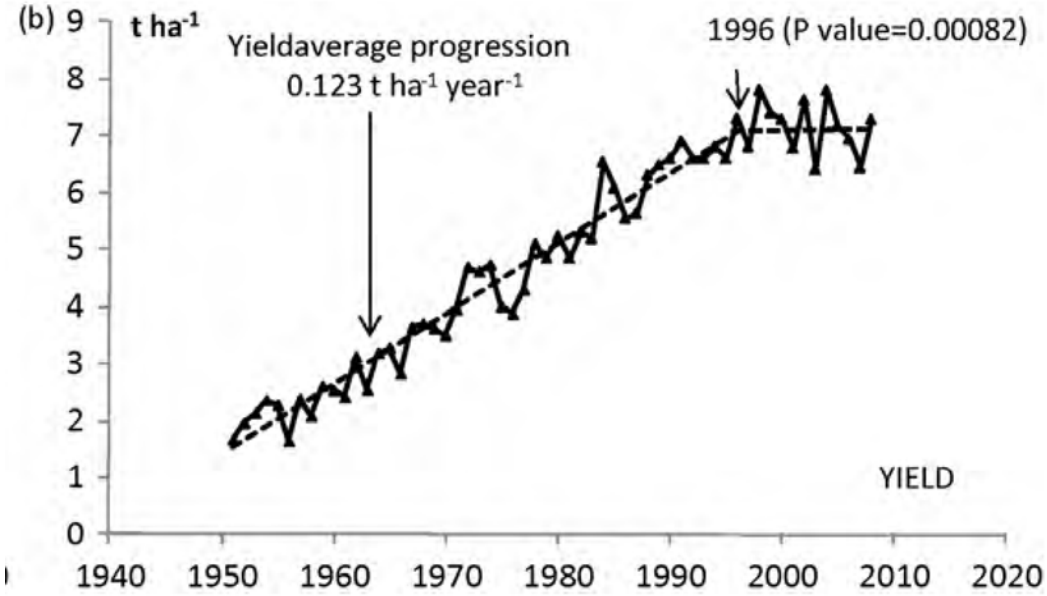
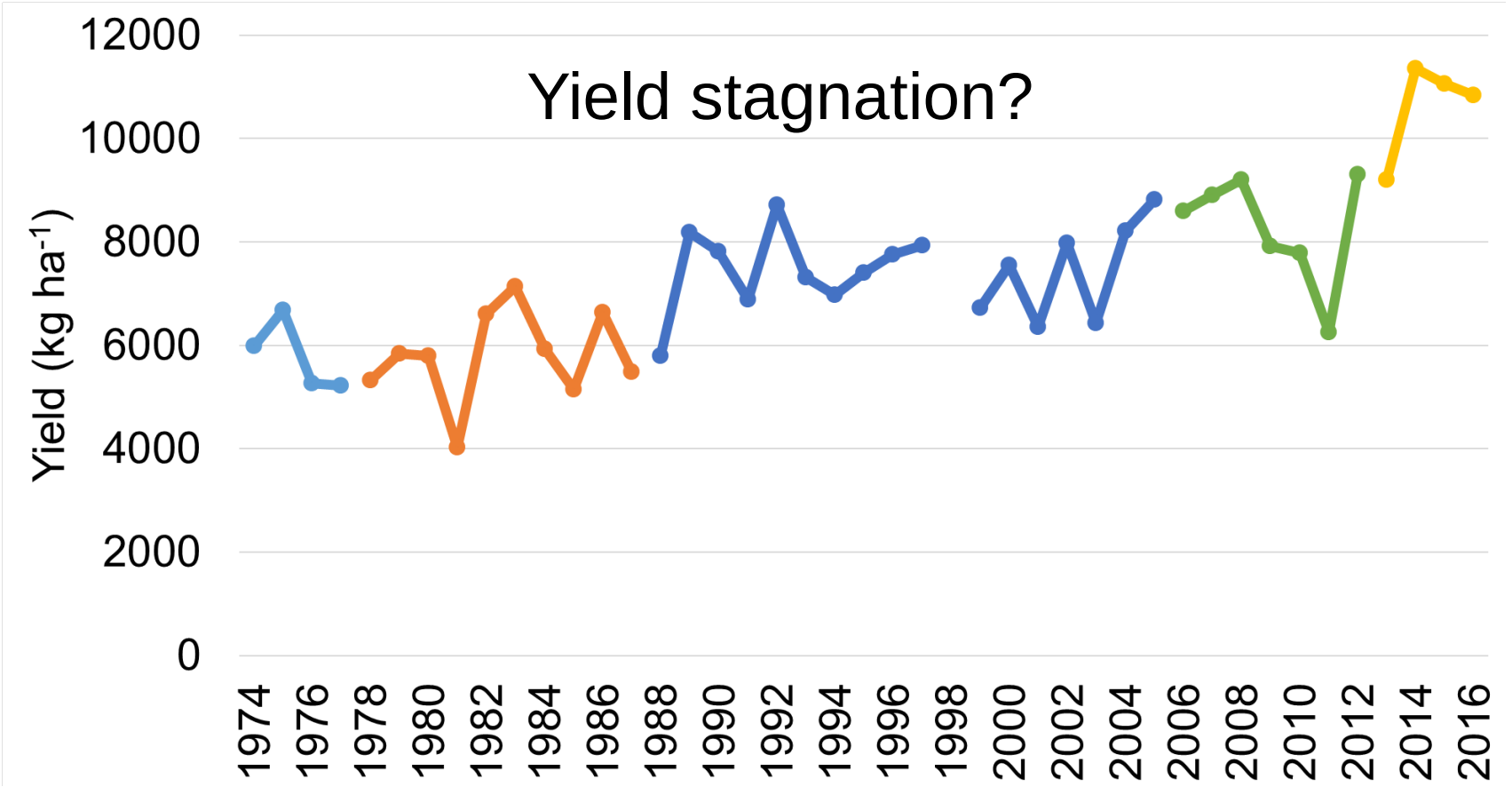
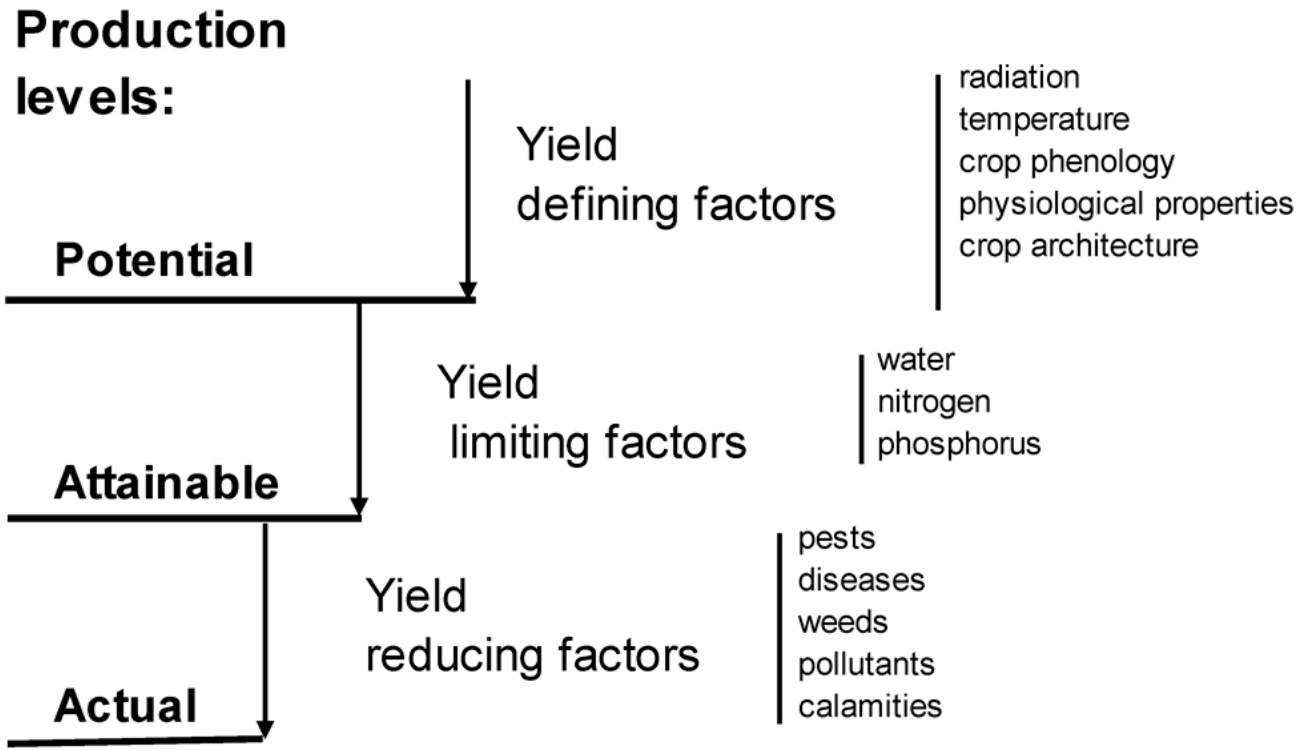
Introduction

- Cereals are a major crop in Europe, and significant gains in terms of yield were accomplished during the last decades. However, as with other major crops worldwide, the yield increment rate is decreasing despite optimizations in terms of nutrients management, phytosanitary conditions and genotypes.



Annual evolution of bread wheat yield in France. Source: N. Brisson et al. / Field Crops Research 119 (2010) 201–212


Yield stagnation?
Yield (kg ha-1)
12000
10000
8000
6000
4000
2000
0
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016



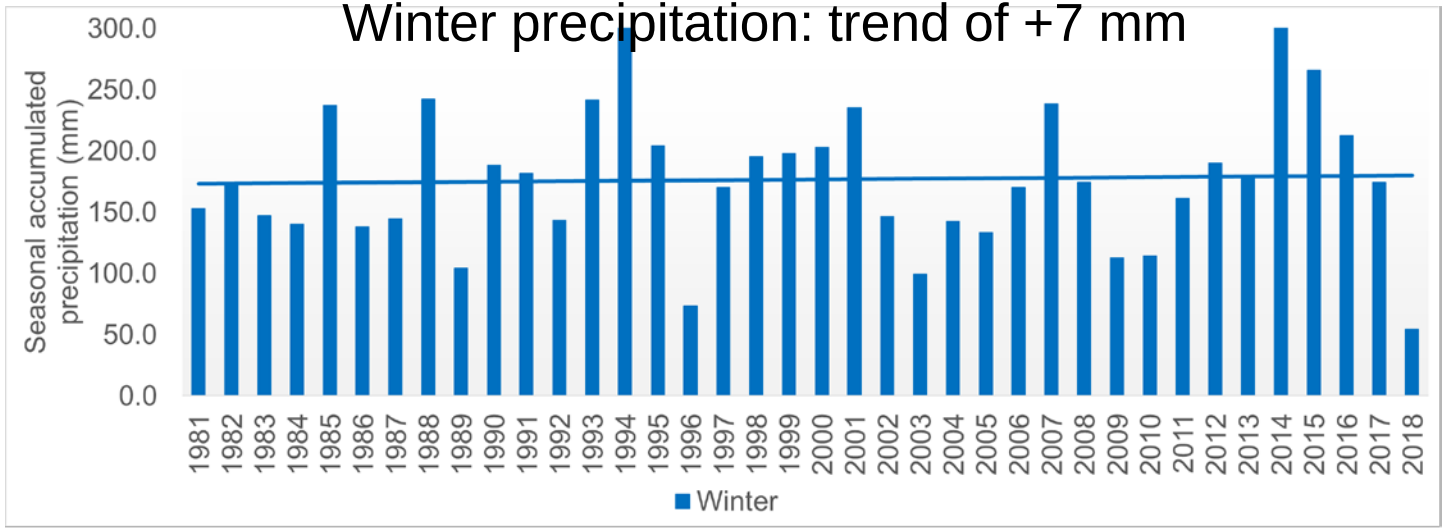
Rabbinge, 1993; van Ittersum and Rabbinge, 1997

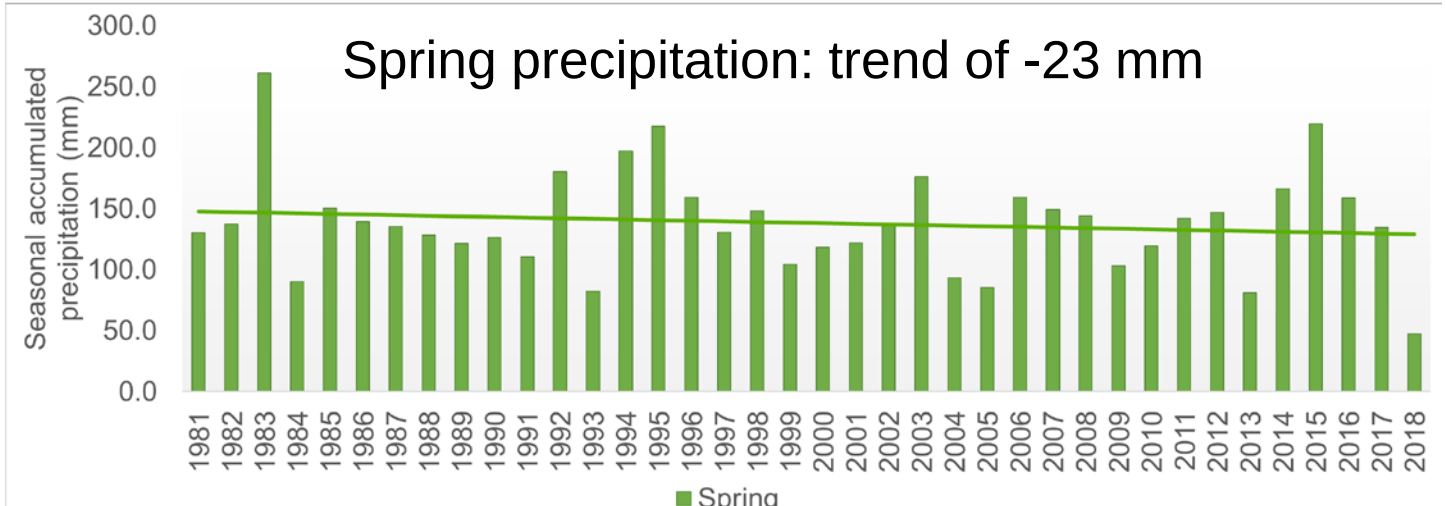
Drought

- Drought refers to a temporary decline in water availability;

- Drought is a gradually developing event, so a precise determination of its onset and end is difficult;

- For crop production, intra-seasonal limitation is important, not total precipitation amount.





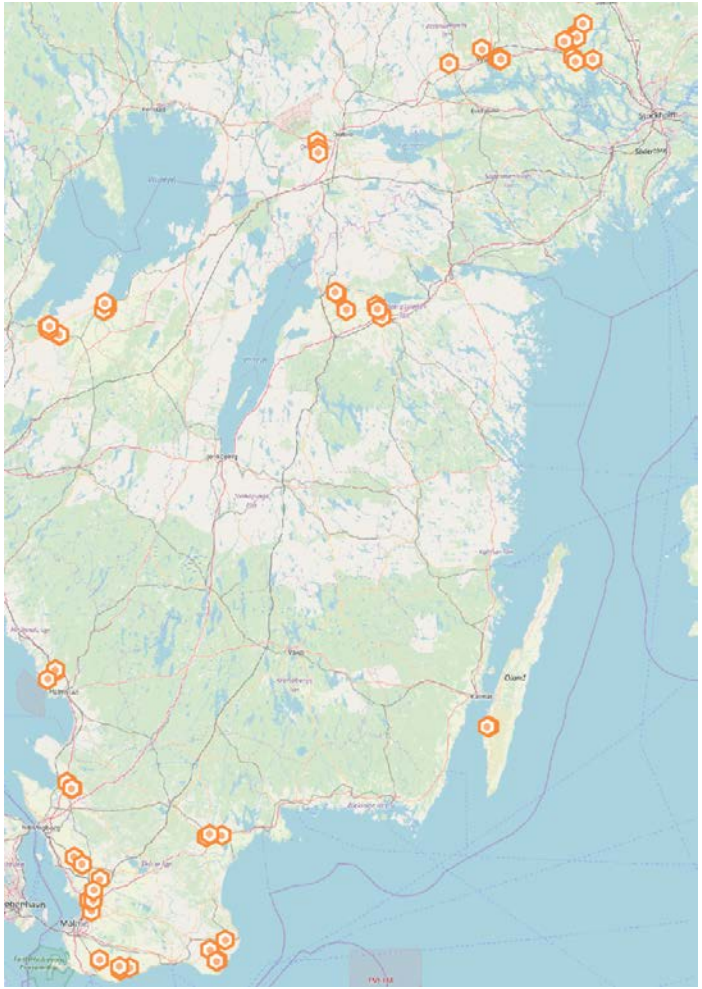
Ängelholm weather station

Objective

- To analyze the drought of 2018 impact on cereals (focus on winter wheat and barley), so as to understand how does it affects yield.

Methodology

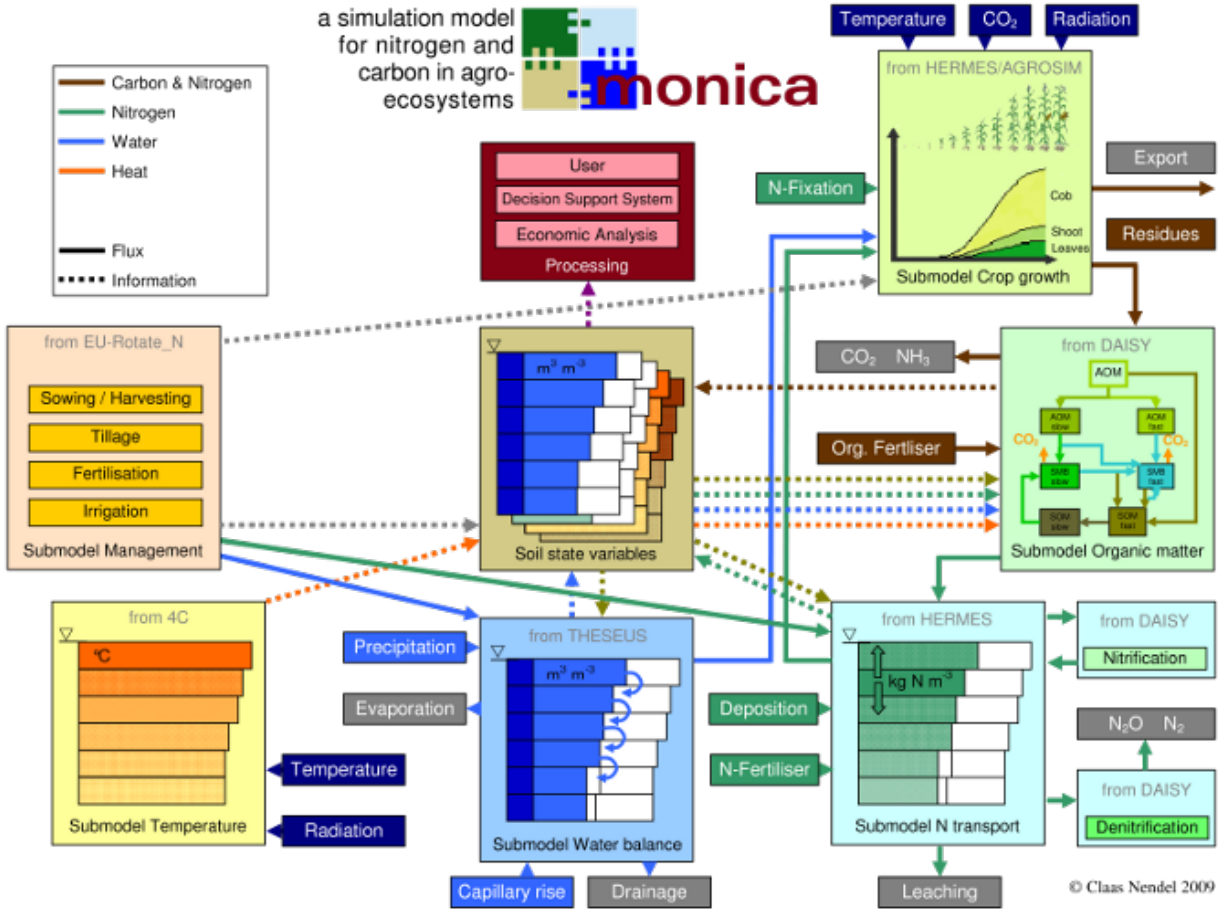
- Study site:



Methodology

- DSSAT crop model
- Calibration data:
  - Field diseases monitoring with phenology (Jordbruksverkets)
  - Yields (Jordbruksstatistisk årsbok 1965-2012)
  - Yields (Sortval 1967-2016, Andersson, A. (2013))
- Soil data:
  - Sveriges geologiska undersökning/WISE
- Weather data:
  - LANTMET and SMHI

Example of a biophysical, process-based model (MONICA)



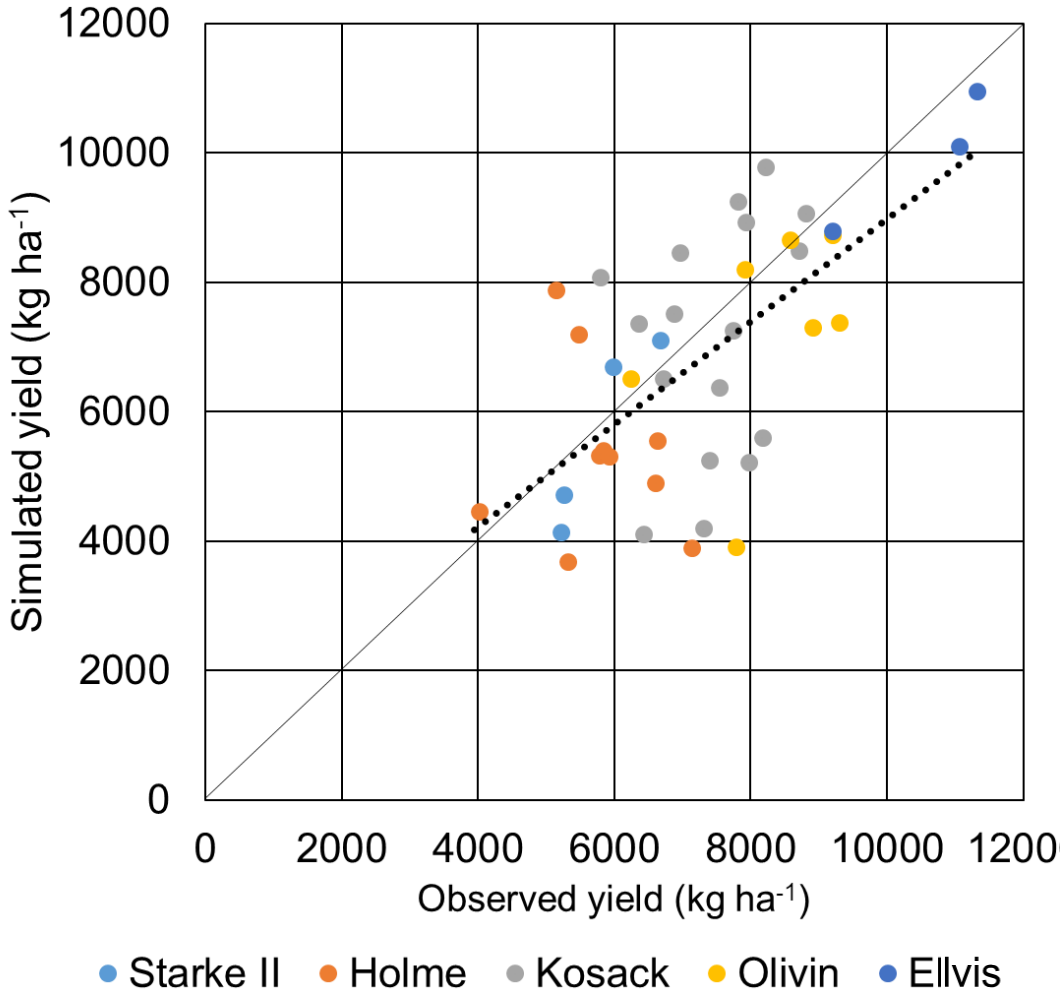
Cultivars calibration/validation

- Calibration: depending on the available information
  - Generalized Likelihood Uncertainty Estimation.
- Validation: comparison against observations of yield.

Validation

(only for wheat now)

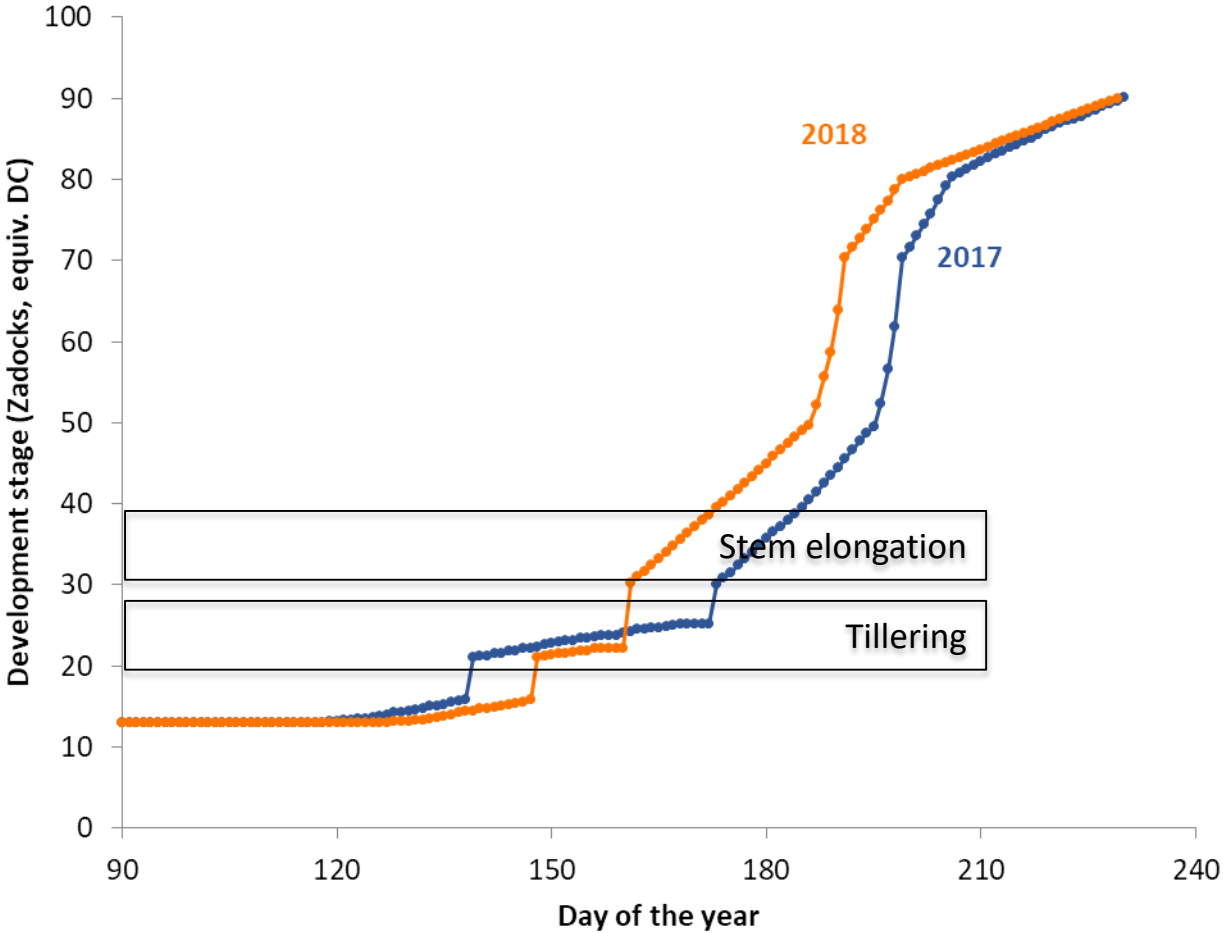
	RMSE	R^2	IA	MAE
Starke II	13%	0.89	0.02	691
Holme	18%	0.16	0.06	913
Kosack	19%	0.15	0.02	1157
Olivin	9%	0.55	0.04	533
Ellvis	6%	0.92	0.06	585
TOTAL	16%	0.62	-0.04	903
1:1	0%	1.00	0.00	0.00



Results

Temperature

- Warmer-than-average conditions were present across much of Sweden during May 2018, with several locations experiencing their warmest May on record;
  - Stockholm, set a new maximum May temperature of 16.1°C.
  - On May 30th, the maximum temperature soared to 31.1°C in Göteborg—this was the highest daily maximum temperature in Sweden since 1911 when Nora in Västmanland had 31.3°C (NOAA, 2018).



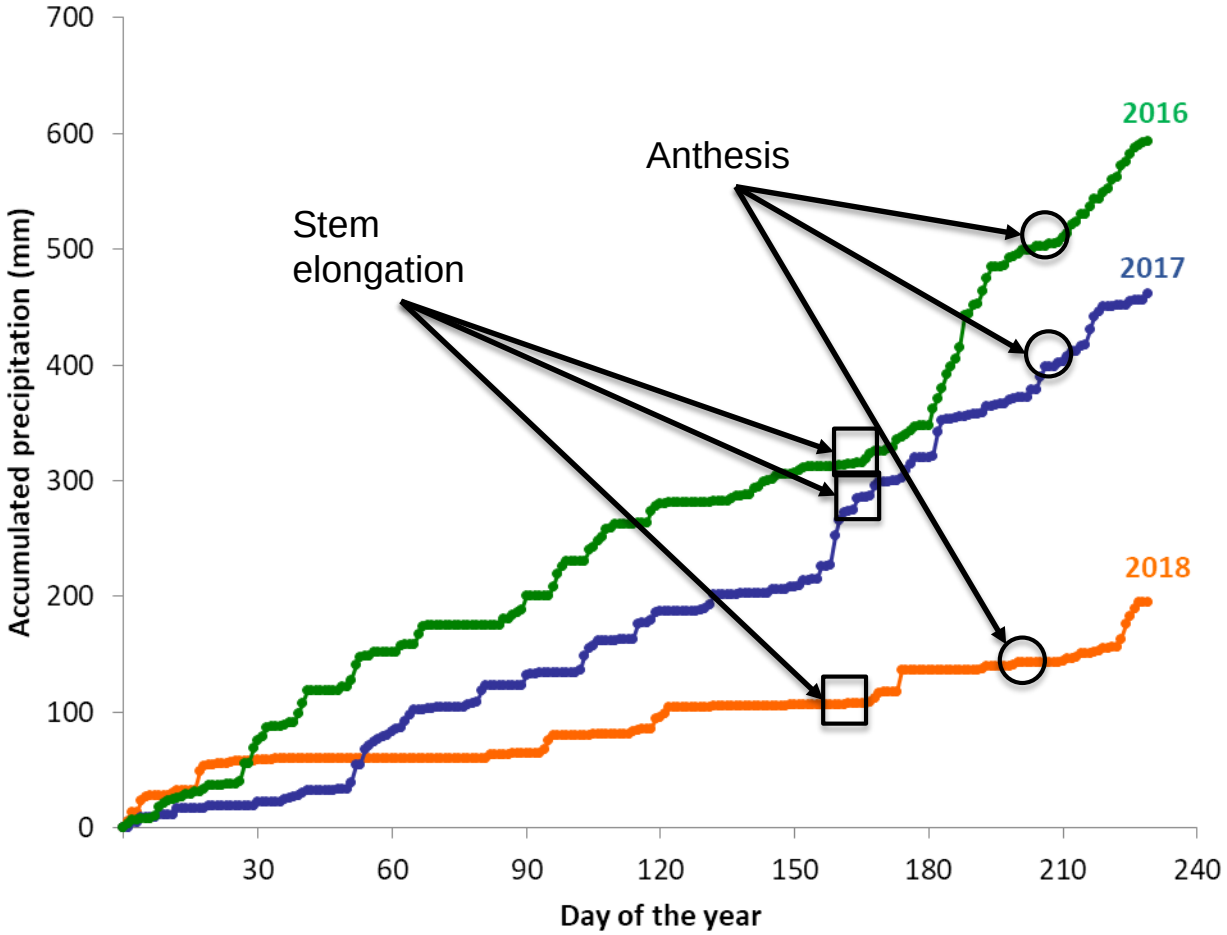
Comparison of the phenology of barley in Southwestern Sweden in 2017 and 2018. Note that the 2018 season (orange line) experienced an advancement in the phenology.

Results

Precipitation

- In 2018, drier-than-average conditions affected much of Sweden during May 2018. Several locations had record or near-record dry conditions.
  - Visby, Gotland, had its driest May since records began in 1859, with a precipitation total of 1.7 mm for May 2018.

Average accumulated precipitation during the cropping season in Southwestern Sweden (2016-2018)



Effects on crop yield

- Field data from 1174 experiments conducted in Sweden between 2016 and 2018 indicate a **consistent reduction** in the current yields.

- Overall, the 2018 yield of winter wheat and malting barley was 32% lower than the previous year.

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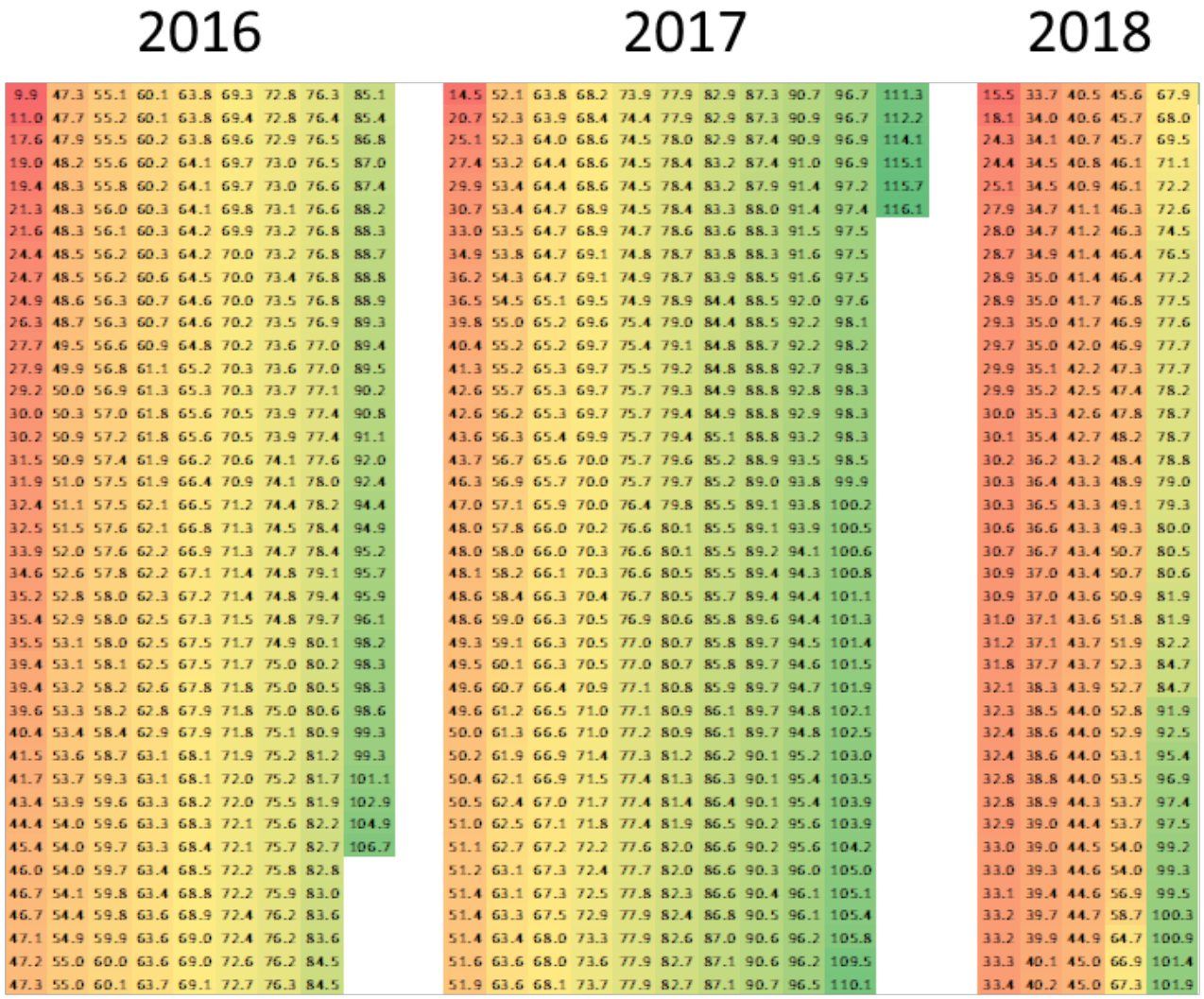
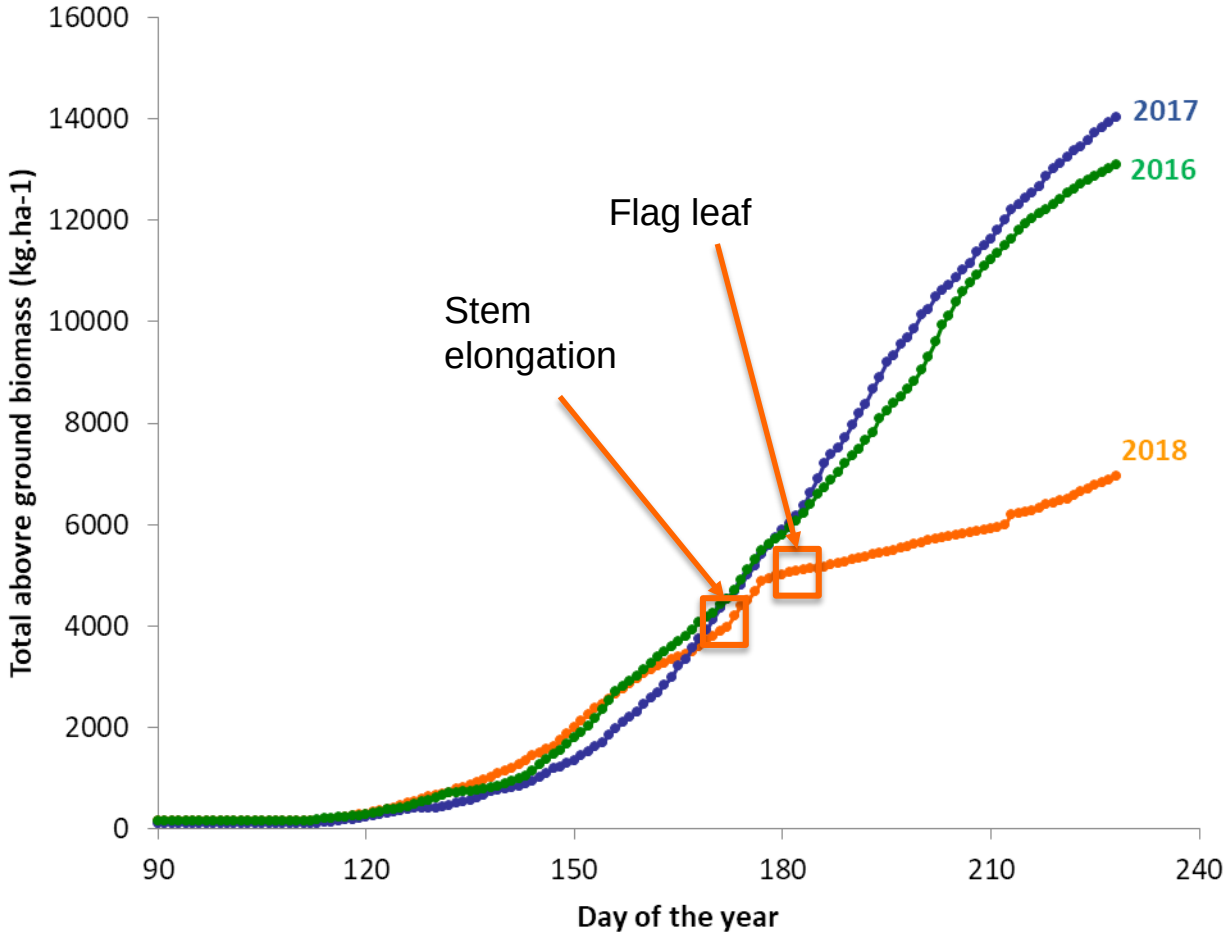
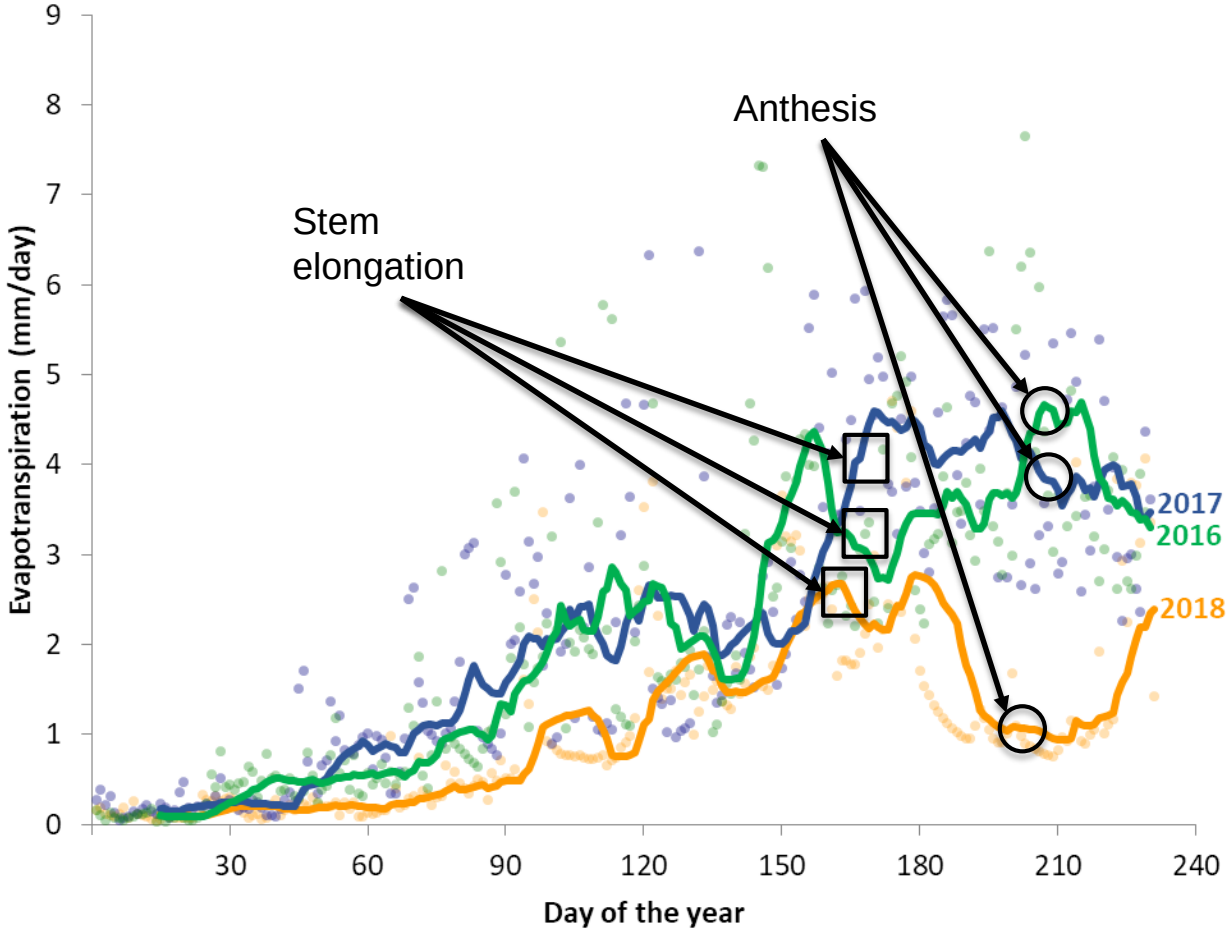


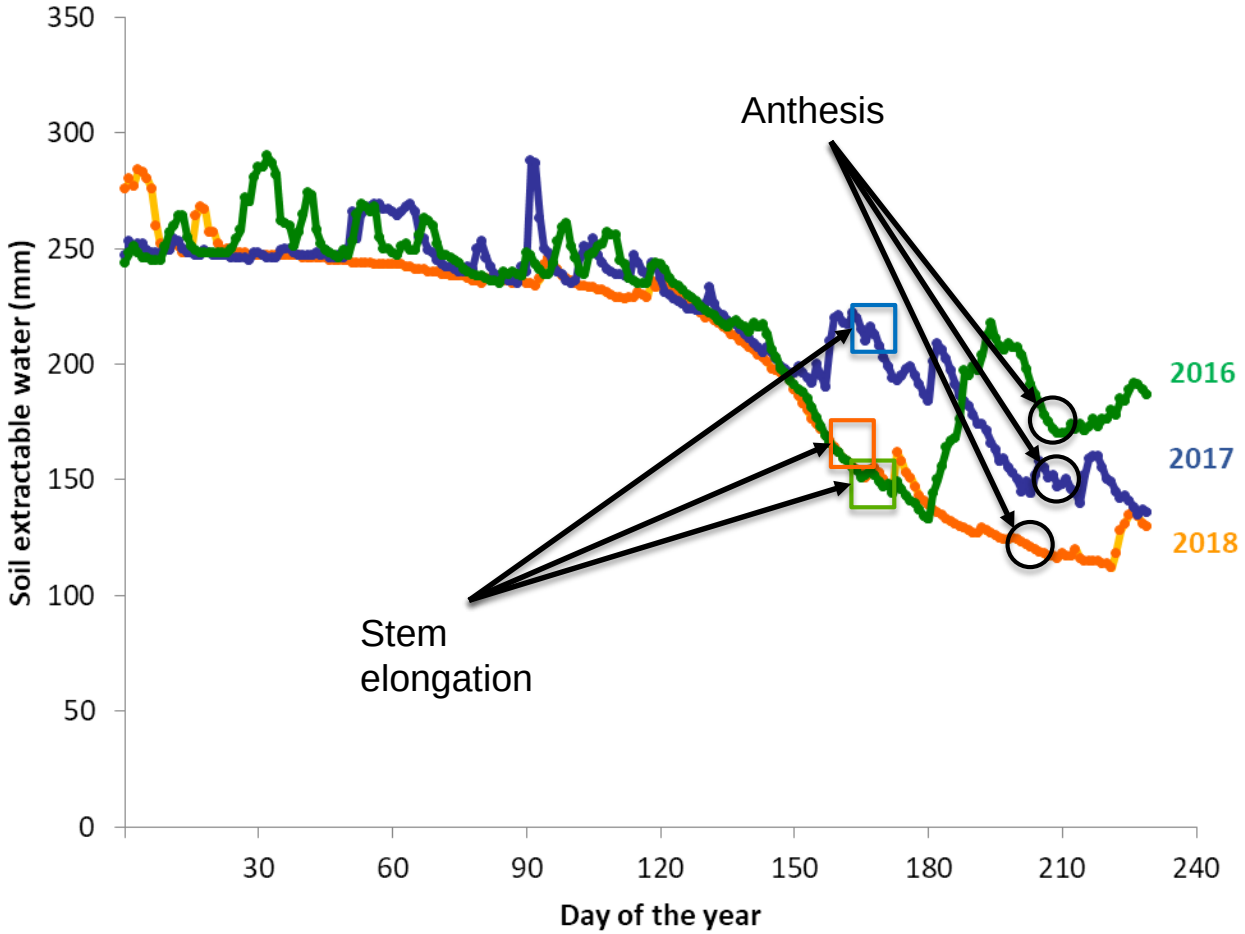
Yields from experiments of winter wheat and barley across Sweden. Source: NFTS.

Daily total aboveground biomass from wheat in 2016, 2017 and 2018.





Daily evapotranspiration of wheat in 2016, 2017 and 2018.



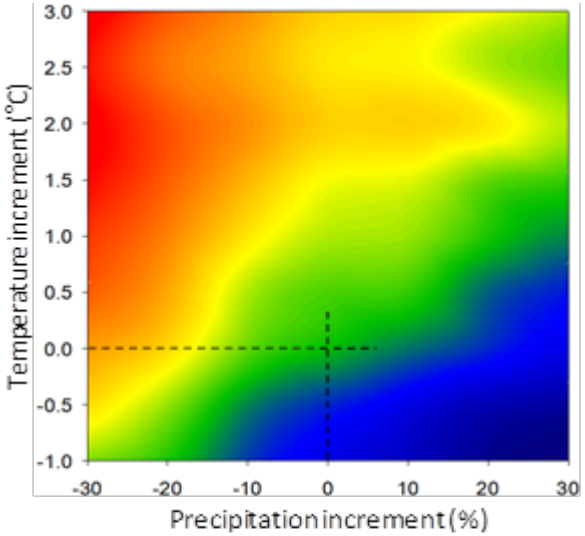
Soil extractable water in 2016, 2017 and 2018.

Next steps

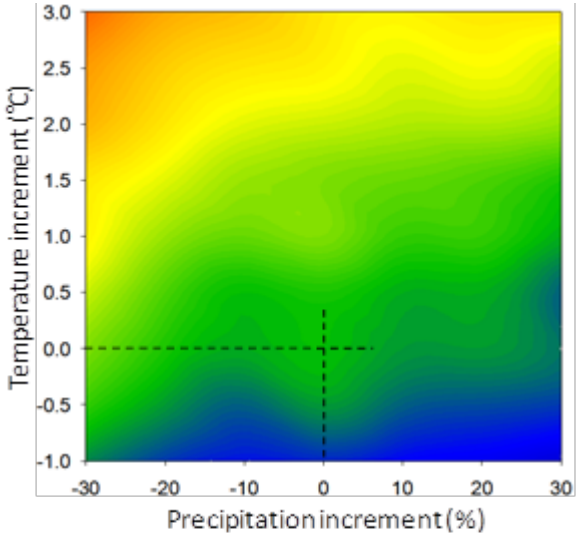
- Fine calibration of crop models to the Swedish cultivars and sites;
- Modelling the effect of:
  - Site (soil characteristics and weather)
  - N management (form, amount, number of applications)
  - Cultivar (different thermal sums)

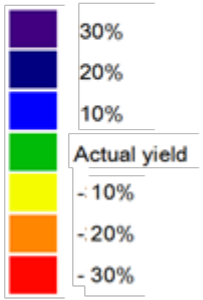
- Target parameters:
  - Yield
  - Grain protein content
  - Susceptibility to abiotic stresses

Cultivar Y



Cultivar X

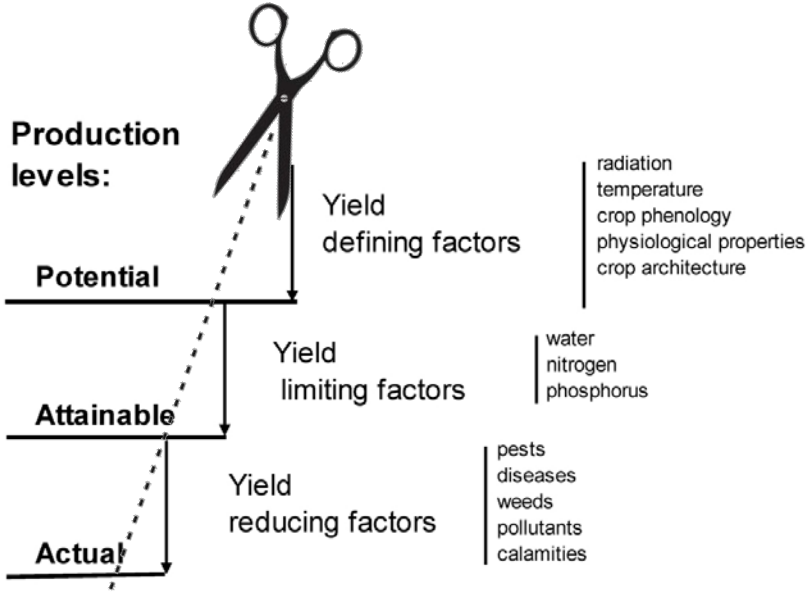




Example: yield changes by variating temperature and precipitation according cultivar.

Final remarks

- Drought impacted yields by:
  - Reducing photosynthesis;
  - Reducing the absorption of nutrients;
  - Increasing plant temperature;



- High temperatures exacerbate the effect of drought:
  - By increasing the evapotranspiration;
  - By reducing the length of important phenological stages (such as tillering, stem elongation or grain filling).

Final remarks

- Susceptibility of the crop to drought is different depending on the phenological stage;
- Cultivars can differ regarding thermal sum – and this is an important decision aspect;
- Quality aspects are also affected:
  - N accumulation rate ≠ carbohydrate rate → imbalance in uptake = protein levels?

Tack!

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Crop Production Ecology

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