



**COST Action 734**

**Major results of  
crop model  
comparisons**

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in co-operation with

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# Objectives of the crop model comparisons

**OVERALL GOAL:** To compare crop growth simulation models for predicting yield and yield variability in response to climatic factors and possible adaptation options (shift in sowing, irrigation, nitrogen management, cultivar changes)

- ***Objectives of (1) winter wheat and (2) spring barley model comparisons across different sites in Europe:***
  - To perform blind test of widely used crop models – mimicking common situation of model use in CC impact assessments for larger areas

# Three model comparisons under WG4

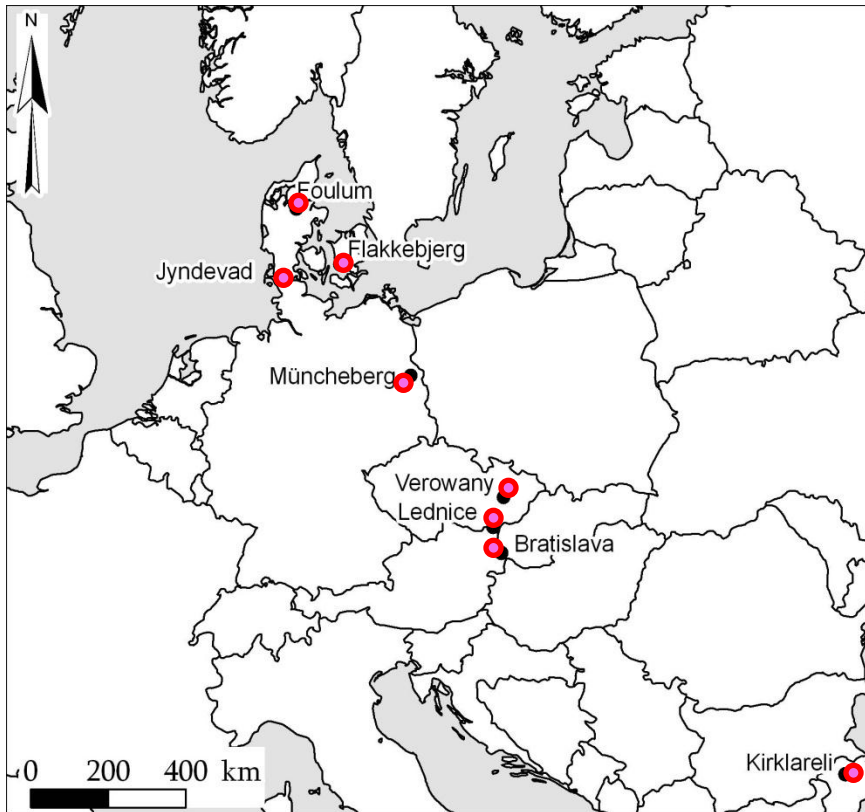


	Winter wheat	Barley	Barley in Jokioinen
Focus	Model performances at different climates and sites	Model performances at different climates and sites	Model performances with different N levels
Approach	Blind test, minimum calibration	Blind test, minimum calibration	More thorough calibration allowed
Number of study sites	8	7	1
Total number of growing seasons	49	45	3 (with 6 N treatments)
Number of models included	8	9	11 (+ CROPSYST with 2 modeller groups)
Status	Accepted for publication	Active writing phase	Results compiled

# Study sites

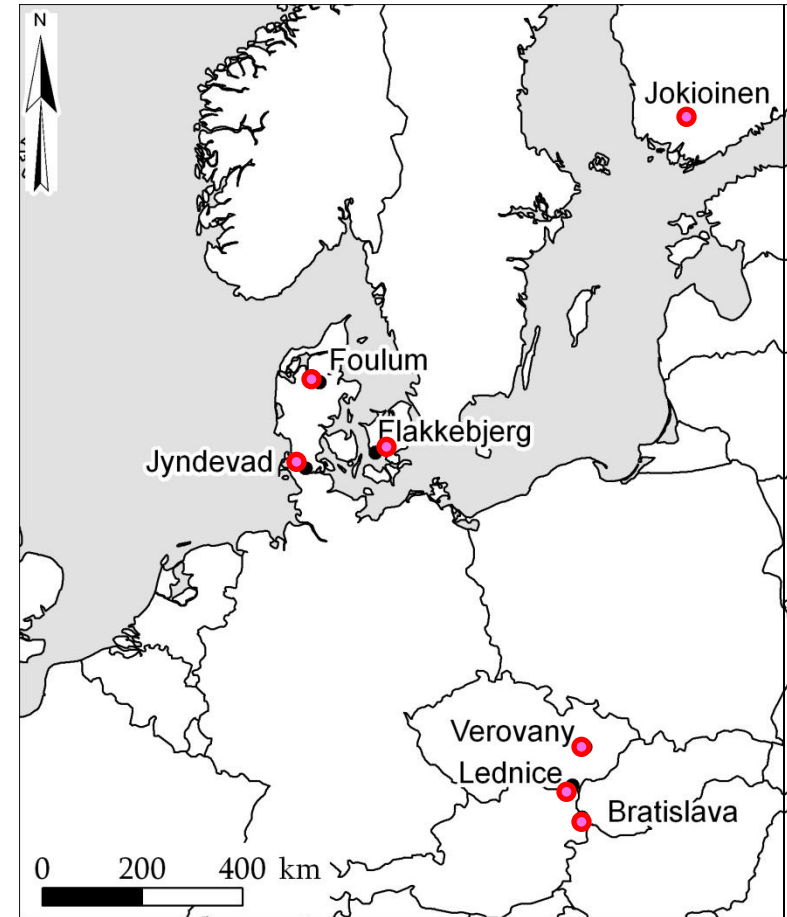
## Winter wheat

- 8 study sites
- 49 growing seasons



## Barley

- 7 study sites
- 45 growing seasons



- Only previously unpublished experimental data included
- Years with severe yield-reducing factors (pests, diseases or lodging) excluded

# Models included

1. APES (*Donatelli et al. 2010*)
2. CROPSYST (*Stöckle et al., 2003*)
3. DAISY (*Hansen, 2000*)
4. DSSAT-CERES (*Jones et al., 2003*)
5. FASSET (*Berntsen et al. 2003*)
6. HERMES (*Kersebaum, 1995*)
7. **MONICA (*Nendel, 2011*) - for barley only**
8. STICS (*Brisson et al., 2003*)
9. WOFOST (*Boogaard et al., 1998*)

# Input information provided

- Weather
- Soil properties
- Crop and soil management
- Important stages (dates of sowing, emergence, flowering, ripening, harvest) of all growing seasons for rough calibration of the models for each cultivar

# Simulation

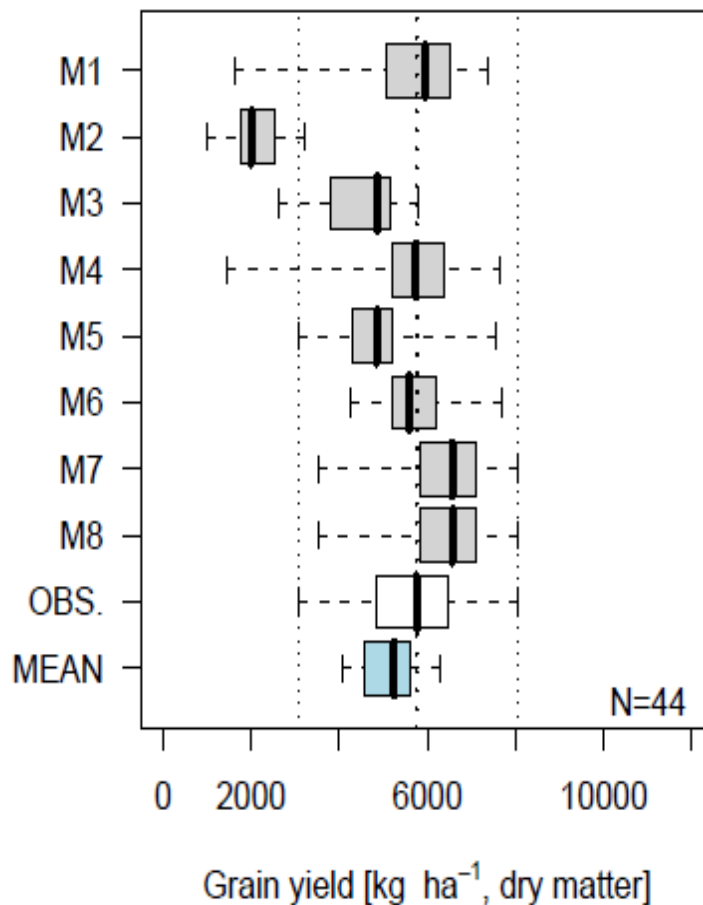


# results asked for

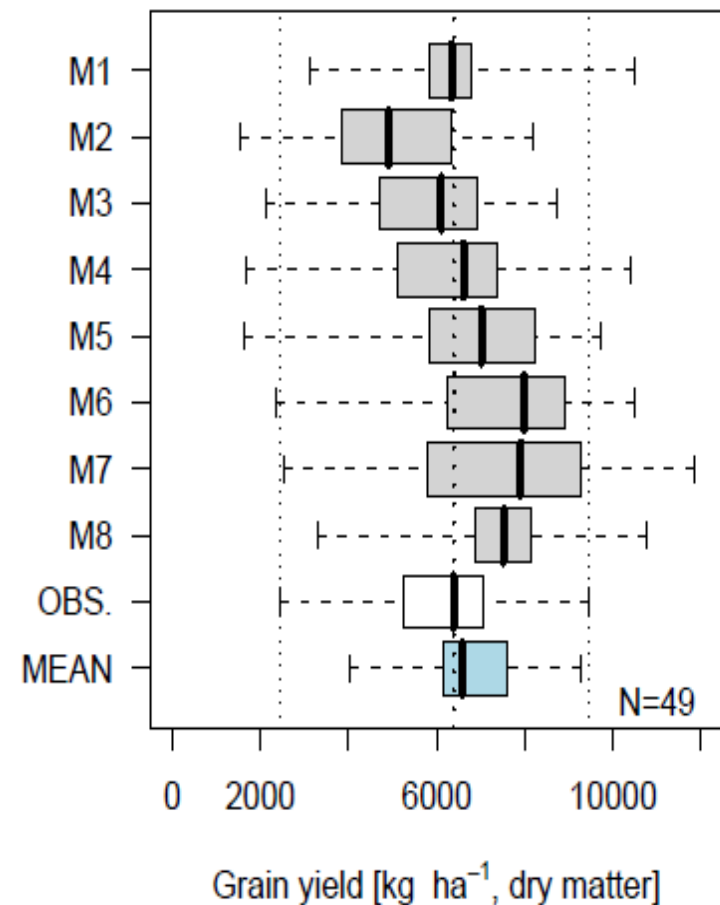
- Grain yield – thorough comparison with measured values
- (Maximum) above-ground biomass
- (Maximum) below-ground biomass
- (Maximum) above-ground N-uptake
- Maximum rooting depth
- Phenology
- Dynamic variables
  - Above-ground biomass
  - Evapo-transpiration
  - Soil moisture
  - LAI

# Results: Spring Barley and Winter wheat across all sites and seasons

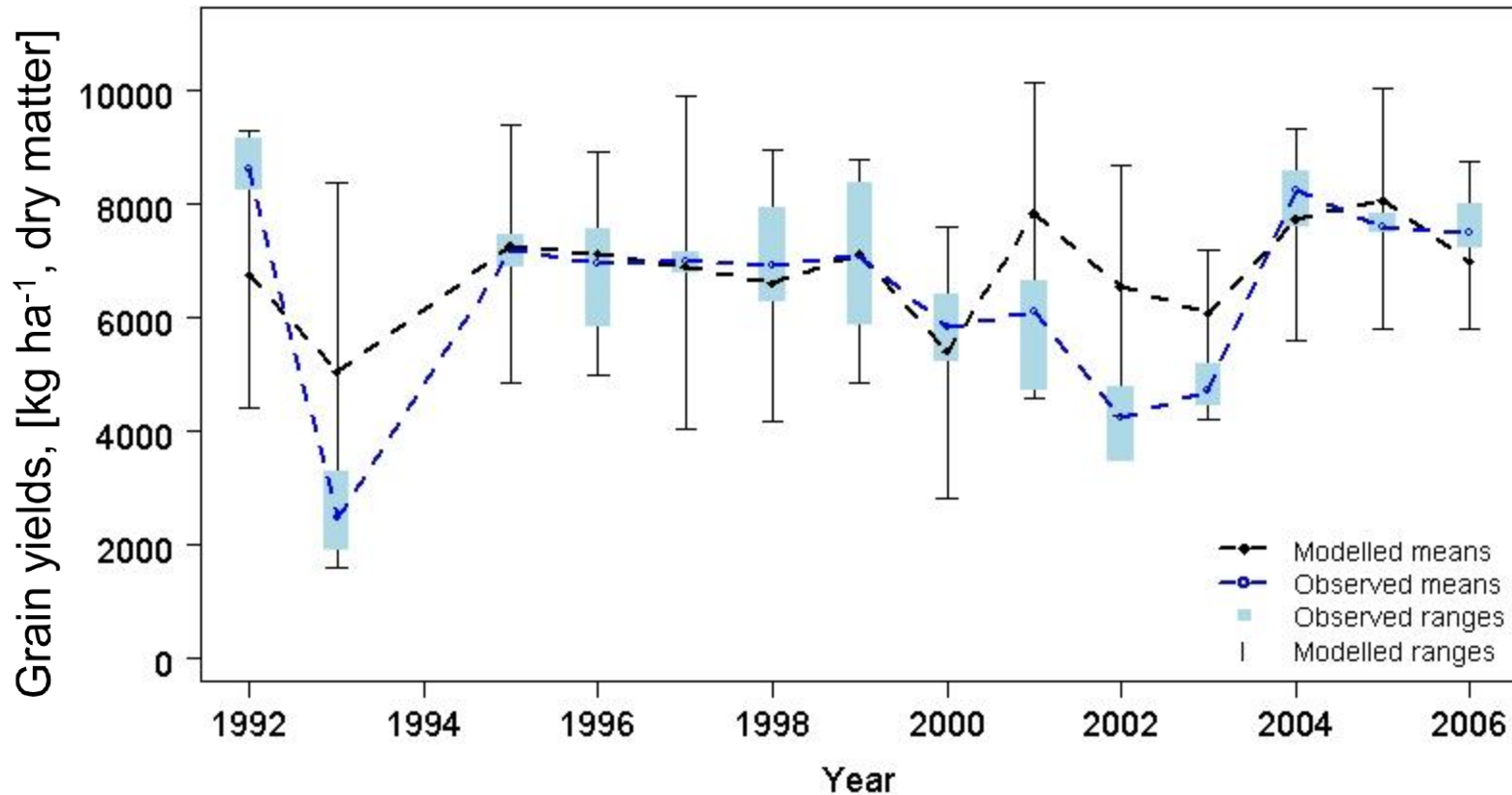
Barley



Winter wheat

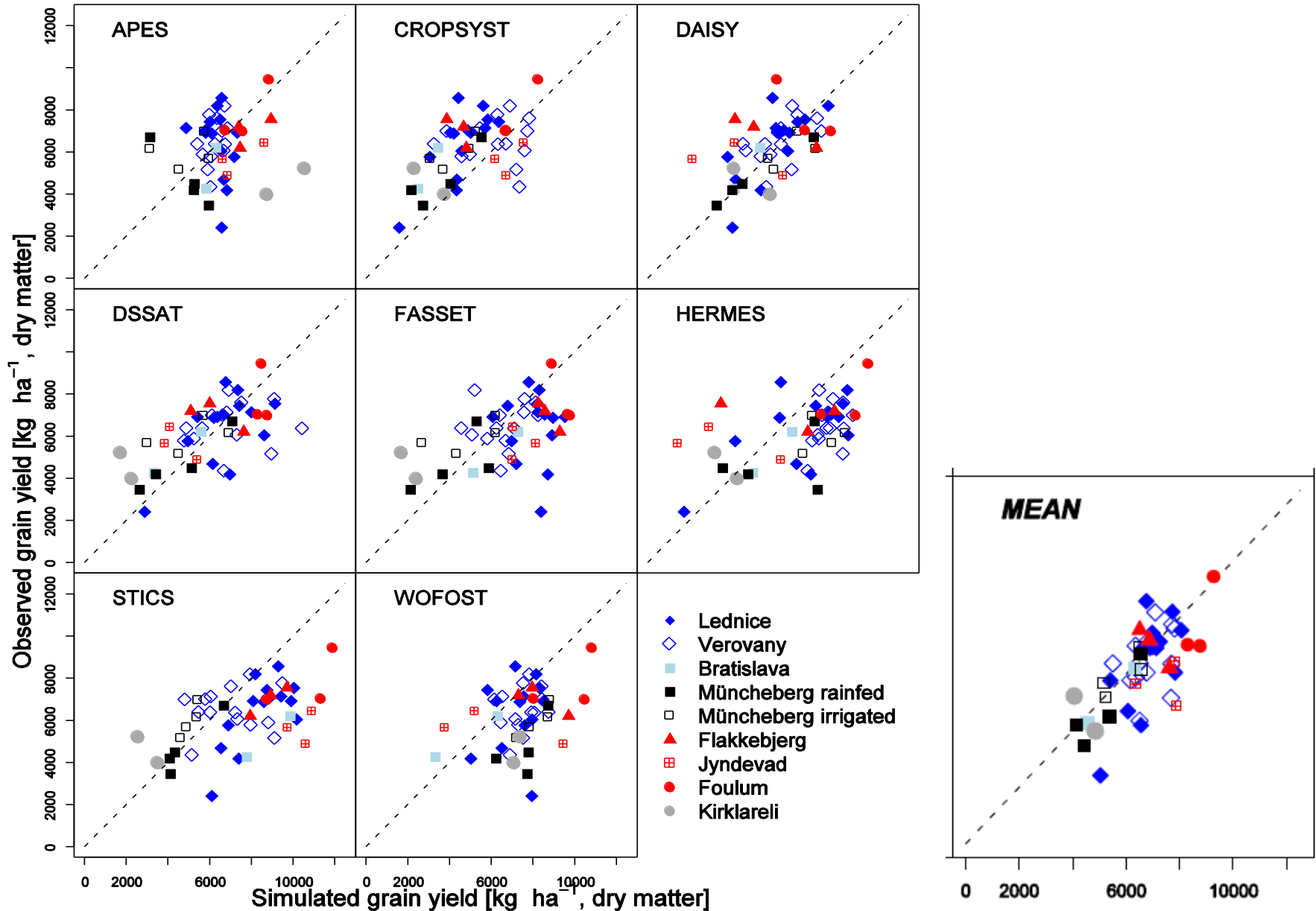


# Results: Multi-model means for single sites (winter wheat, Lednice)

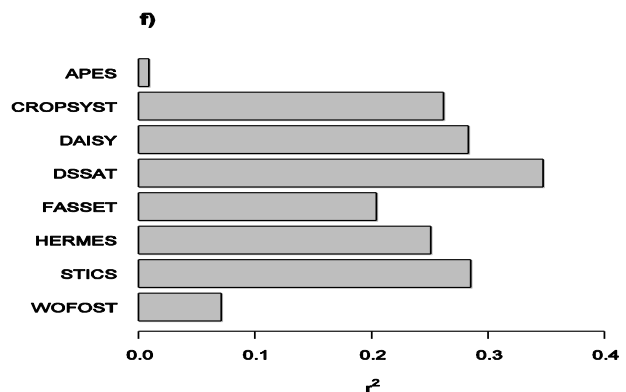
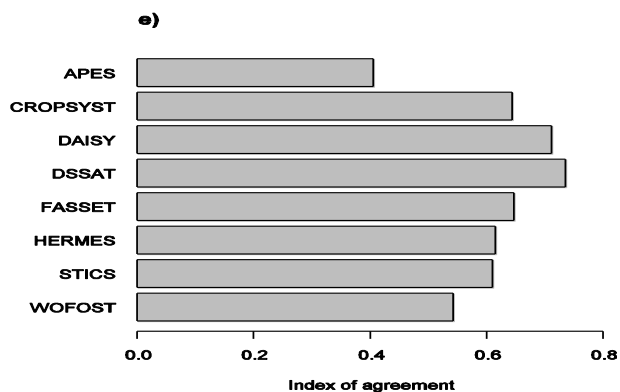
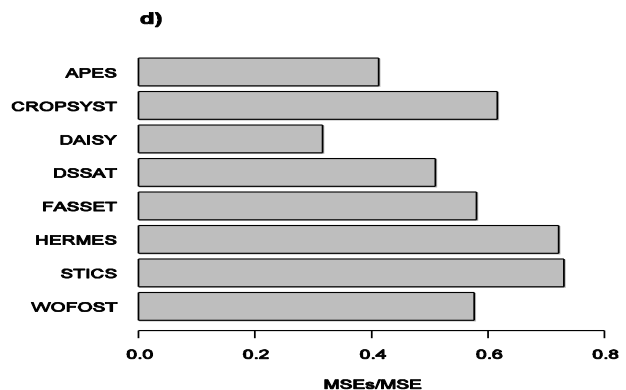
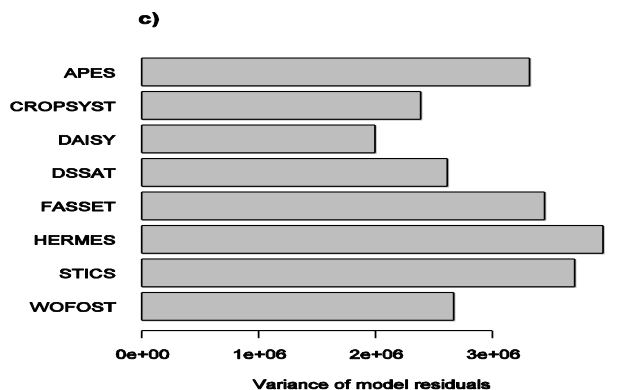
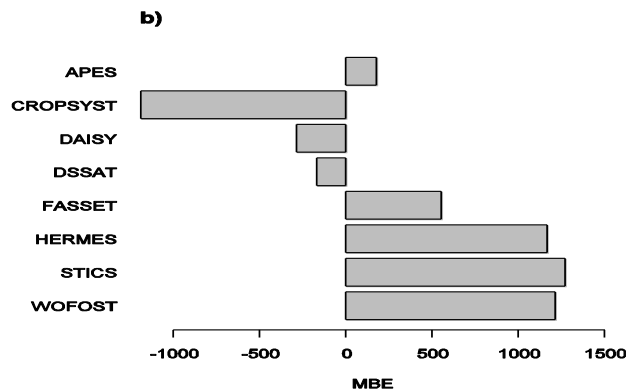
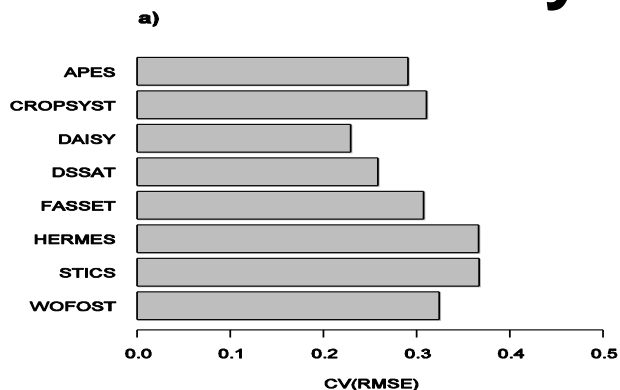




# Simulated and observed grain winter wheat yield estimates [kg ha<sup>-1</sup>, dry matter] for all sites and seasons

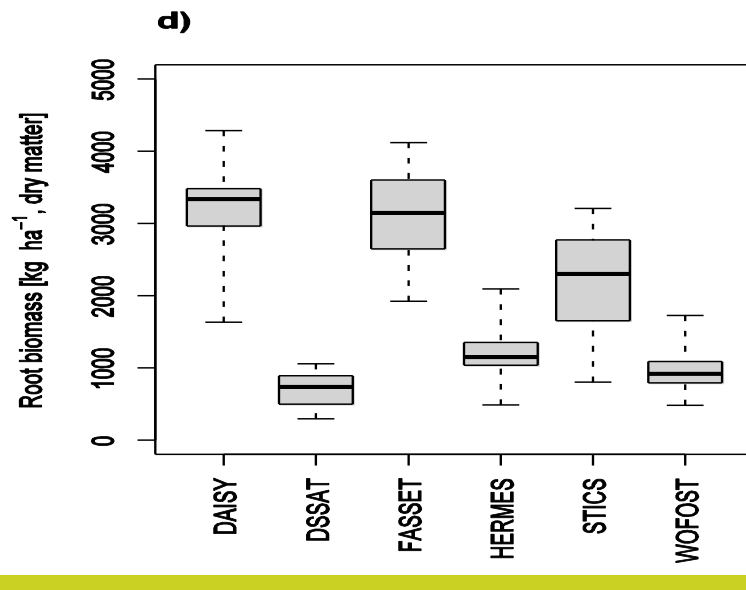
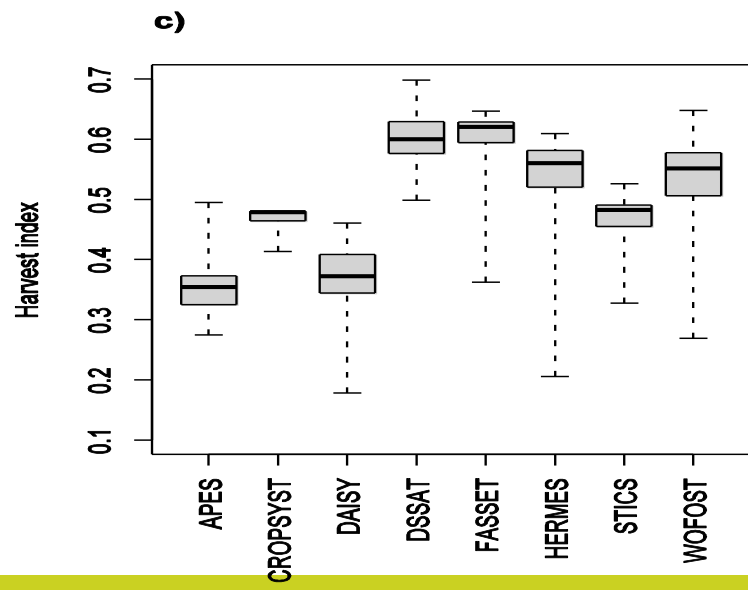
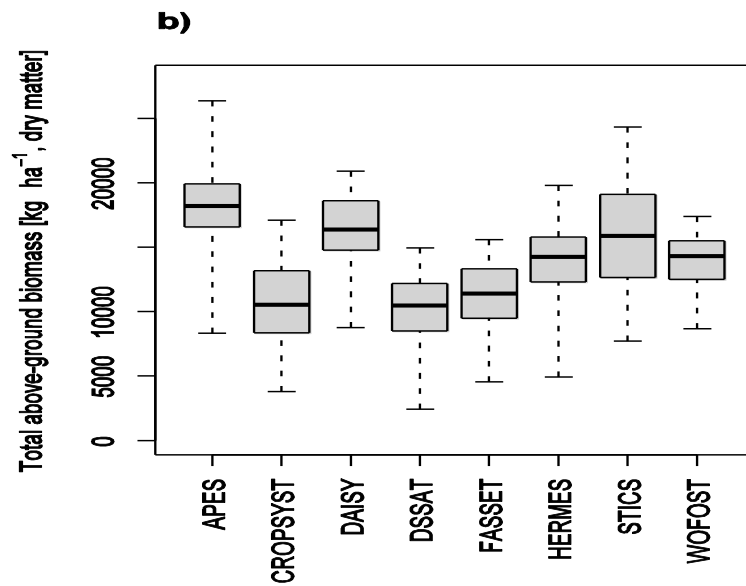
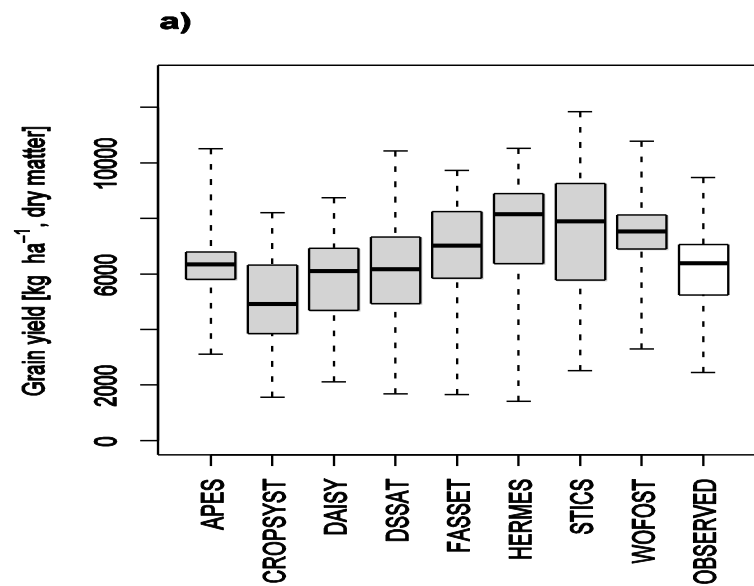


# Model performance statistics for winter wheat yields

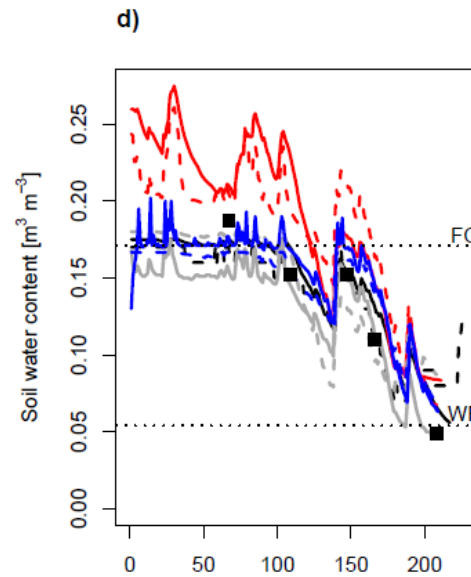
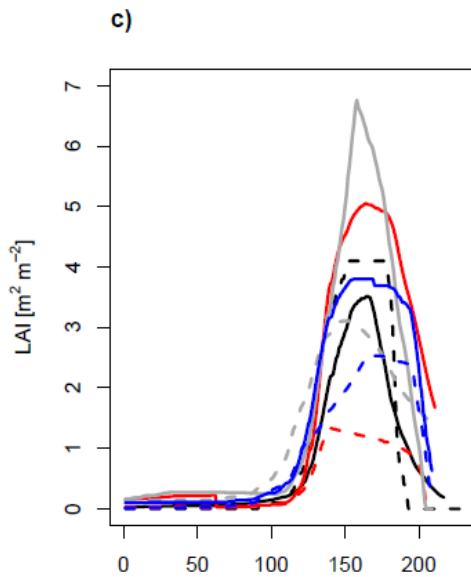
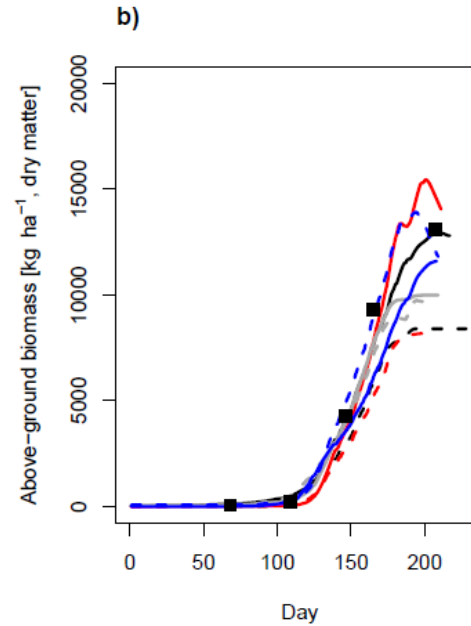
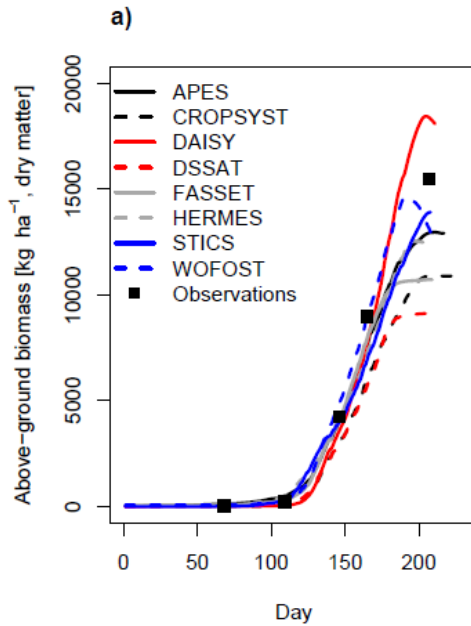


- (a) normalized root mean square error CV(RMSE) [0,1],
- (b) mean bias error (MBE),
- (c) variance of model residuals,
- (d) systematic error (MSEs/MSE) [0,1],
- (e) index of agreement (IA) [0,1],
- (f) least-squares coefficient of determination ( $r^2$ ) [0,1].

WINTER WHEAT: Box-and-whisker plots of observed and simulated grain yields (a), and simulated maximum above-ground biomass estimates (b), harvest indices (c) and root biomass estimates (d) (N=49).



# Simulation results along growing season



Winter wheat at  
Müncheberg study site  
in year 1994

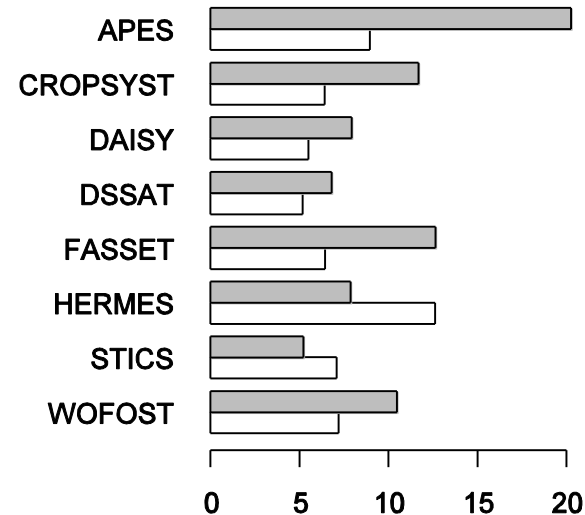
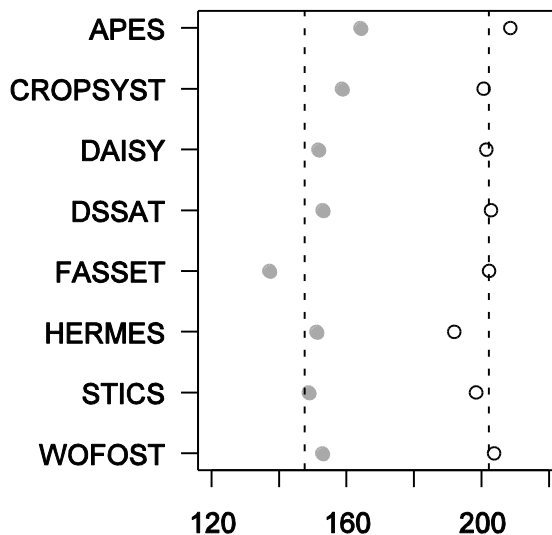
- (a) total above-ground biomass of irrigated
- (b) total above-ground biomass of rainfed (b) treatments,
- (c) leaf area index (LAI)
- (d) soil moisture content averaged over 0 - 90 cm layer

# Phenology

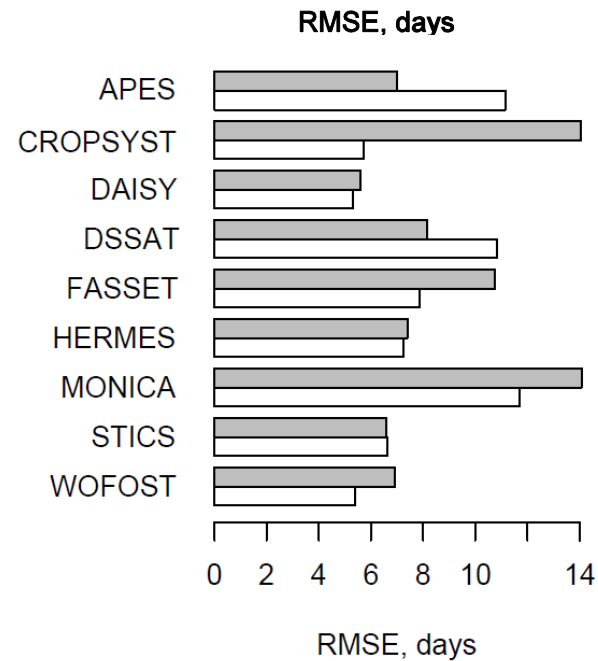
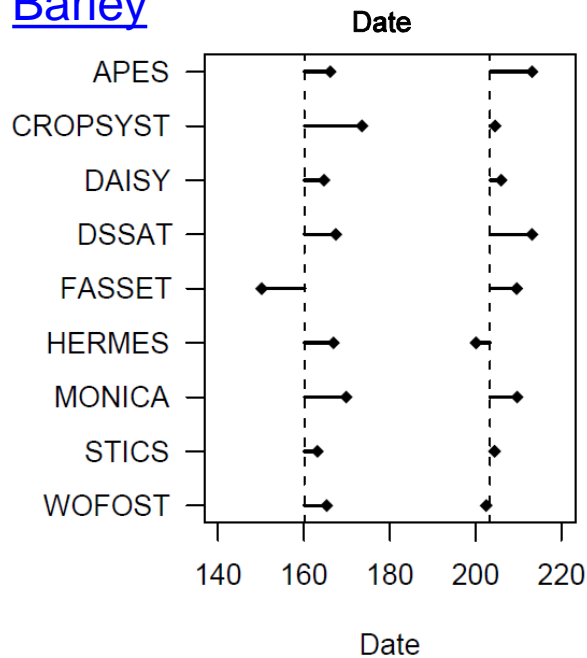
## Winter wheat



b)



## Barley



# Conclusions



- Application of crop simulation models with restricted calibration leads to a high degree of uncertainty about climate impacts on yield and yield variability.
- None of the models could be termed robust and accurate in terms of yield prediction across different environments and for different crop cultivars.
- Good prediction of crop yield for some models came at the cost of overestimating or underestimating harvest index or total biomass.
- The mean model predictions were in good agreement with observed yields.
- An obvious constraint to all model development and improvement is the availability of comprehensive, long-term datasets for calibrating and validating models for various crop cultivars.

A vast field of golden-brown wheat, with a dense foreground of white daisies and yellow flowers. The text "Thank you!" is centered in the middle of the image.

Thank you!