

# Crop model predictions

## The impact of environment-dependent parameters

Michelle Viswanathan<sup>1</sup>, Tobias Weber<sup>1</sup>, Sebastian Gayler<sup>1</sup>, Juliane Mai<sup>2</sup>, Thilo Streck<sup>1</sup>

<sup>1</sup>Institute of Soil Science and Land Evaluation, Biogeophysics, University of Hohenheim, Germany

<sup>2</sup>Department of Civil and Environmental Engineering, University of Waterloo, Canada

### Introduction

- For robust predictions, parameterized crop models need to capture uncertainty and should be transferable to other sites with different environmental conditions.
- However, some parameters in the models may have an environment dependency.
- This leads to inaccurate predictions at uncalibrated sites.

### Materials and Methods

- Different cultivars of **silage maize**, were grown at sites in Kraichgau and the Swabian Alb, Germany between 2010 and 2016.
- Soil-crop-atmosphere model: **XN5** (Expert-N 5.0) software (Priesack 2006)
- Bayesian calibration** of the **SPASS** model (Wang 1997) was performed to observed **phenological development**, separately for each site-year.
- Posterior parameter distributions obtained after calibration to each site-year, were used to predict phenology at other site-years.
- Relation between prediction quality and environment were analysed.

### Objective

To determine if environmental dependency of crop model parameters has an impact on prediction quality.

### Hypothesis

Cultivars of the same ripening group have similar posterior parameter distributions and are good predictors of each other.

### Posterior parameter distributions

Six sensitive parameters influencing emergence, generative and vegetative development were used in Bayesian calibration.

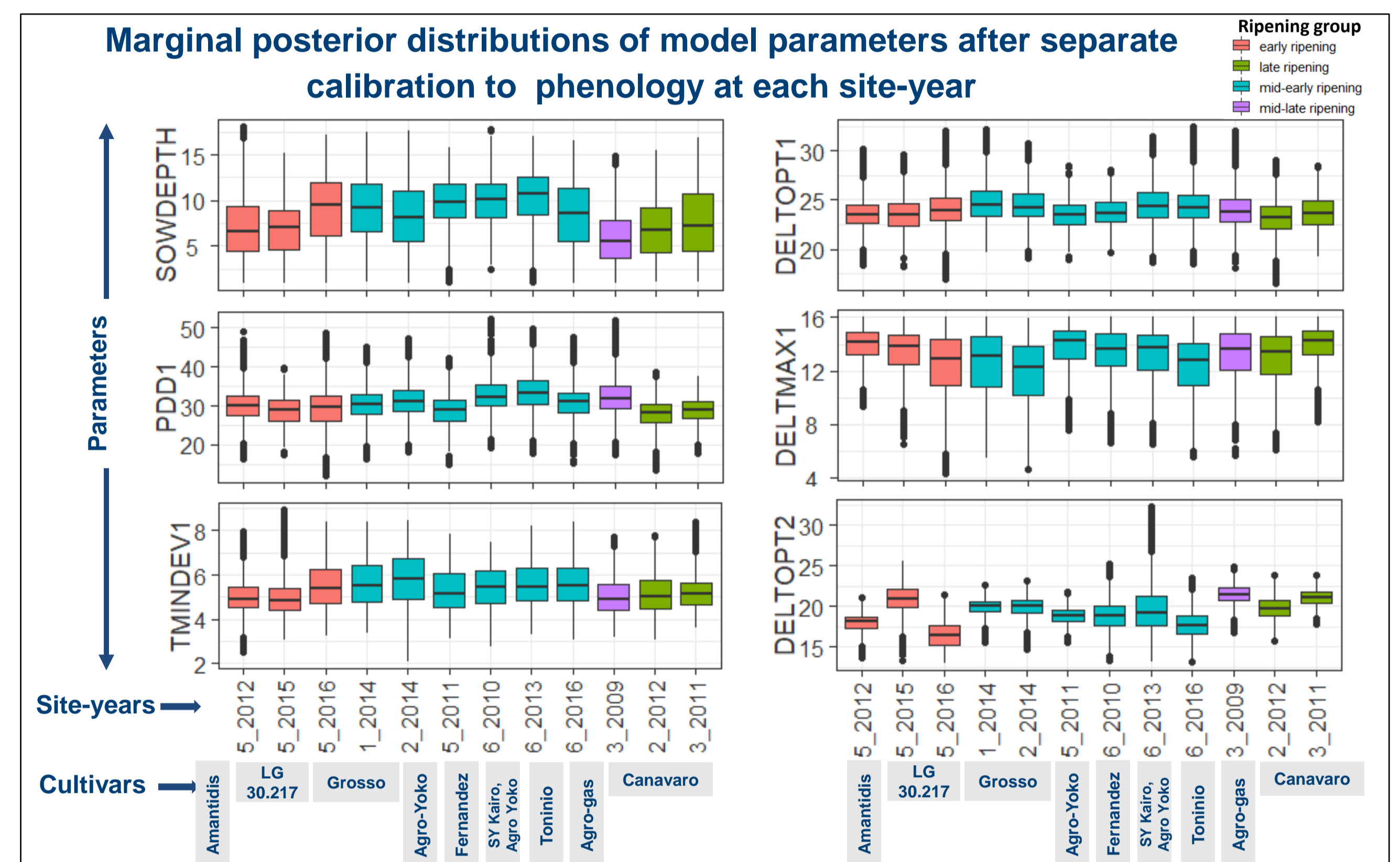
**Emergence:** Effective sowing depth (SOWDEPTH)

**Vegetative:** Physiological development days from emergence to anthesis (PDD1)  
Minimum temperature (TMINDEV1)

Difference between optimum and minimum temperature (DELTOPT1)  
Difference between maximum and optimum temperature (DELTMAX1)

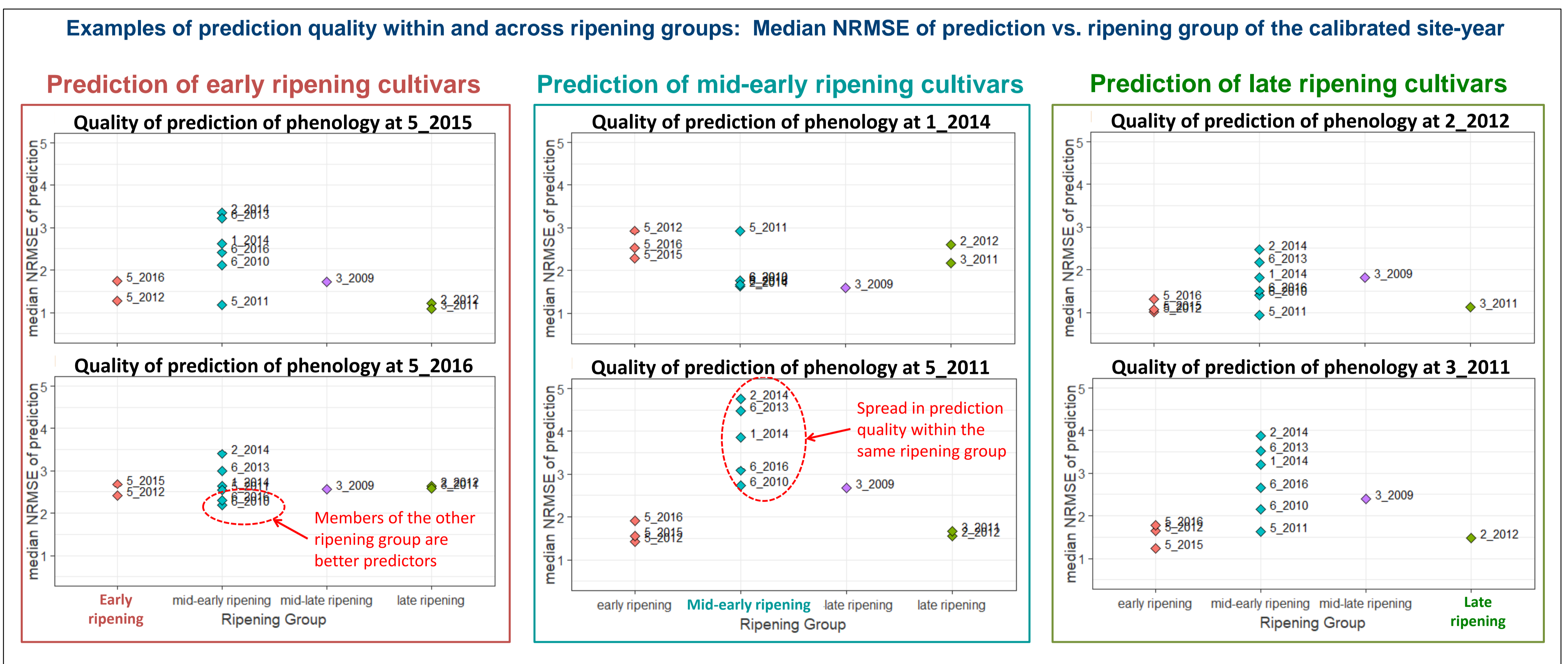
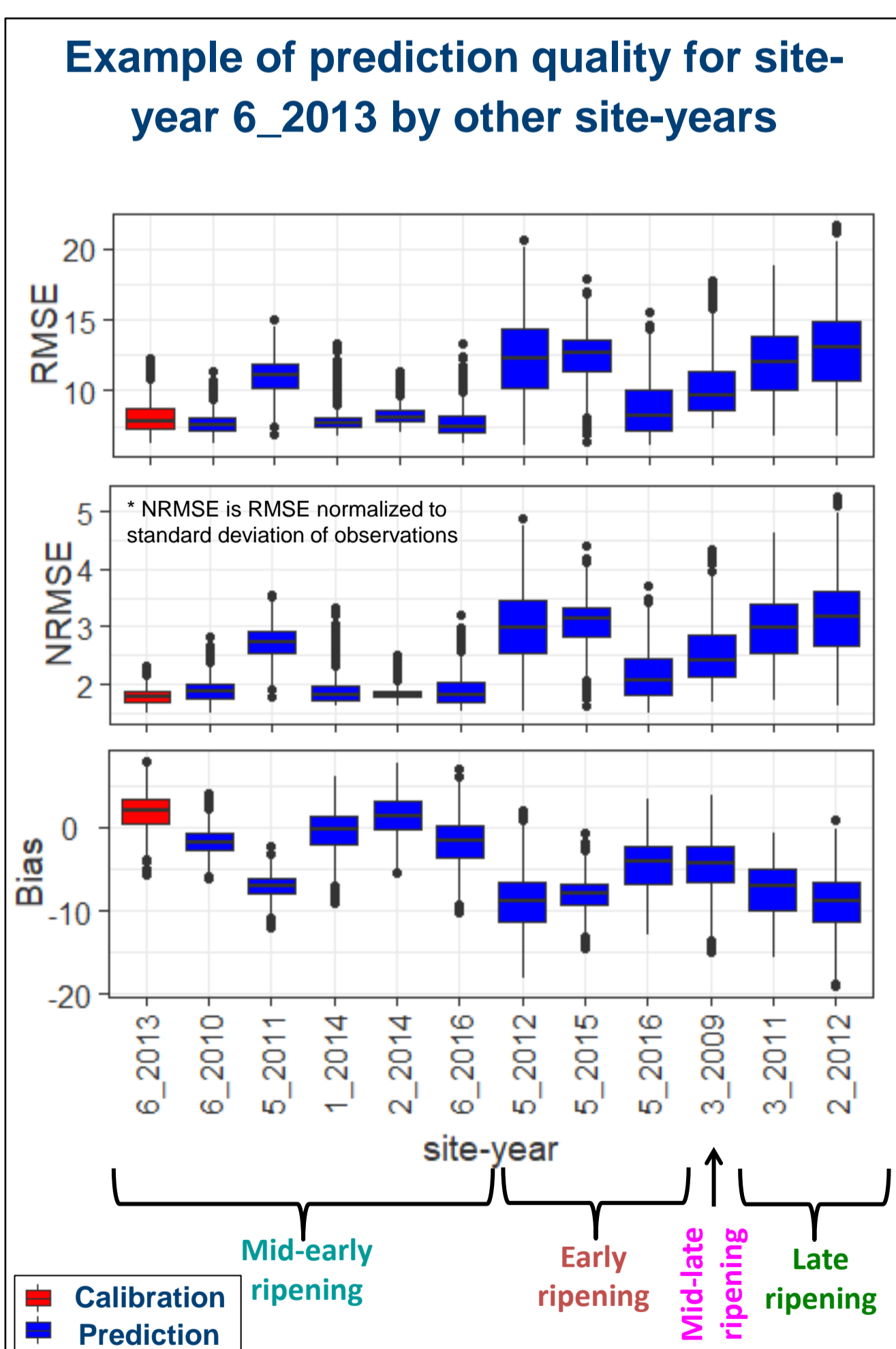
**Generative:** Difference between optimum and minimum temperature (DELTOPT2)

- Small differences are observed in the posterior parameter distributions after calibration to different site-years.
- As expected, some parameter distributions are different across ripening groups.
- However, differences are seen within some ripening groups.
- Differences are also seen between the same cultivar grown in different years.



### Prediction

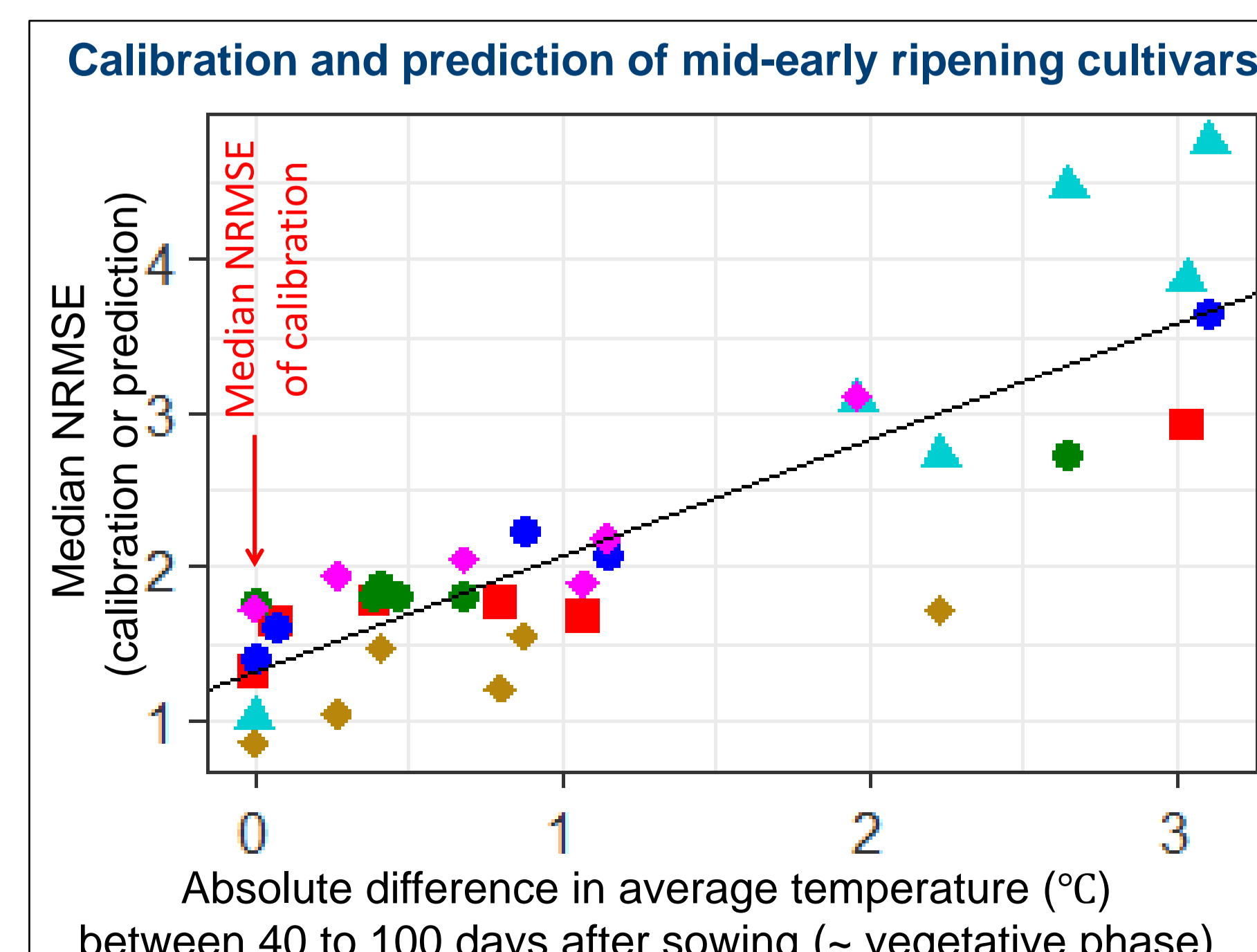
- Members of the same ripening group are not always better predictors than those from other ripening groups.
- A spread in the prediction quality is observed within the same ripening group.



**Preliminary conclusions and further work**  
The prediction quality of mid-early ripening cultivars by members of the same ripening group depends on the similarity in temperature during the vegetative phase of development.

Could this dependency arise due to:

- Other parameters that are incorrectly assumed to be known and kept constant during modelling?
- Inadequate process representation in the model?



The prediction quality (median NRMSE) is correlated with the absolute difference in average temperature between the calibration and prediction site-year in the vegetative phase of development.