

Simulating potato growth and nitrogen uptake in eastern Canada with the STICS crop model

René Morissette¹, [Guillaume Jégo](#)¹, Gilles Bélanger¹, Athyna Cambouris¹, Judith Nyiraneza², Bernie Zebarth³

Agriculture and Agri-Food Canada, ¹Quebec, ²Charlottetown, and ³Fredericton Research Centers

Introduction

The ability of process-based crop models to adequately predict yield and N uptake of potato for a large range of fertilization rates under the conditions of eastern Canada has never been tested.

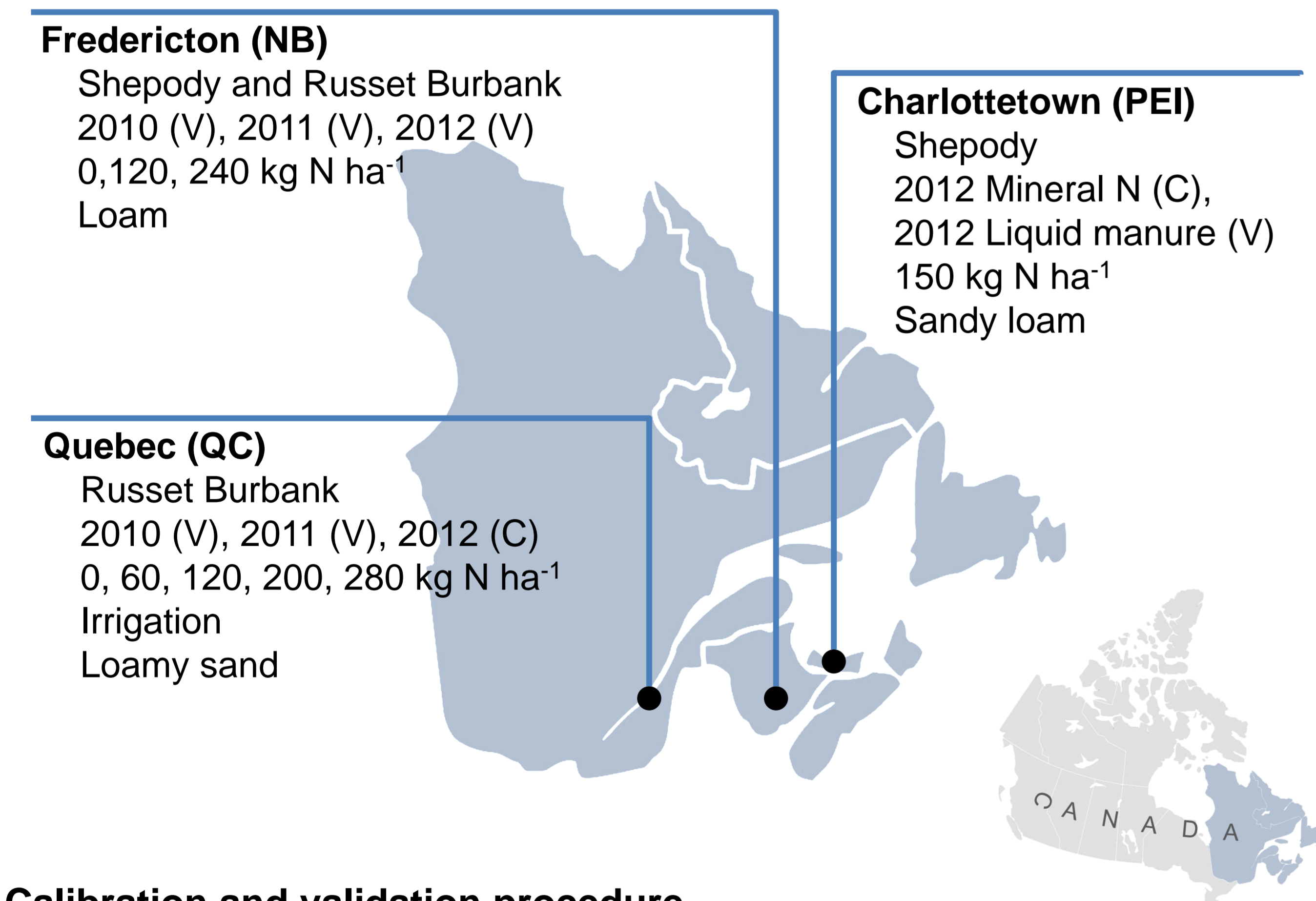
Our objectives were 1) to calibrate and validate the **STICS crop model** for the cultivars **Shepody** (determinate, mid-season maturity) and **Russet Burbank** (indeterminate, late maturity) with cultivar-specific critical N curves, and 2) to evaluate the model performance with several critical N curves.

Materials and methods

Simulateur multi-disciplinaire pour les Cultures Standard (STICS v8.41; Brisson *et al.*, 2008): a generic soil-crop model.

Model calibration and validation on leaf area index (LAI), plant and tuber biomass, plant and tuber N uptake.

Calibration (C) and validation (V) with data from 3 sites.

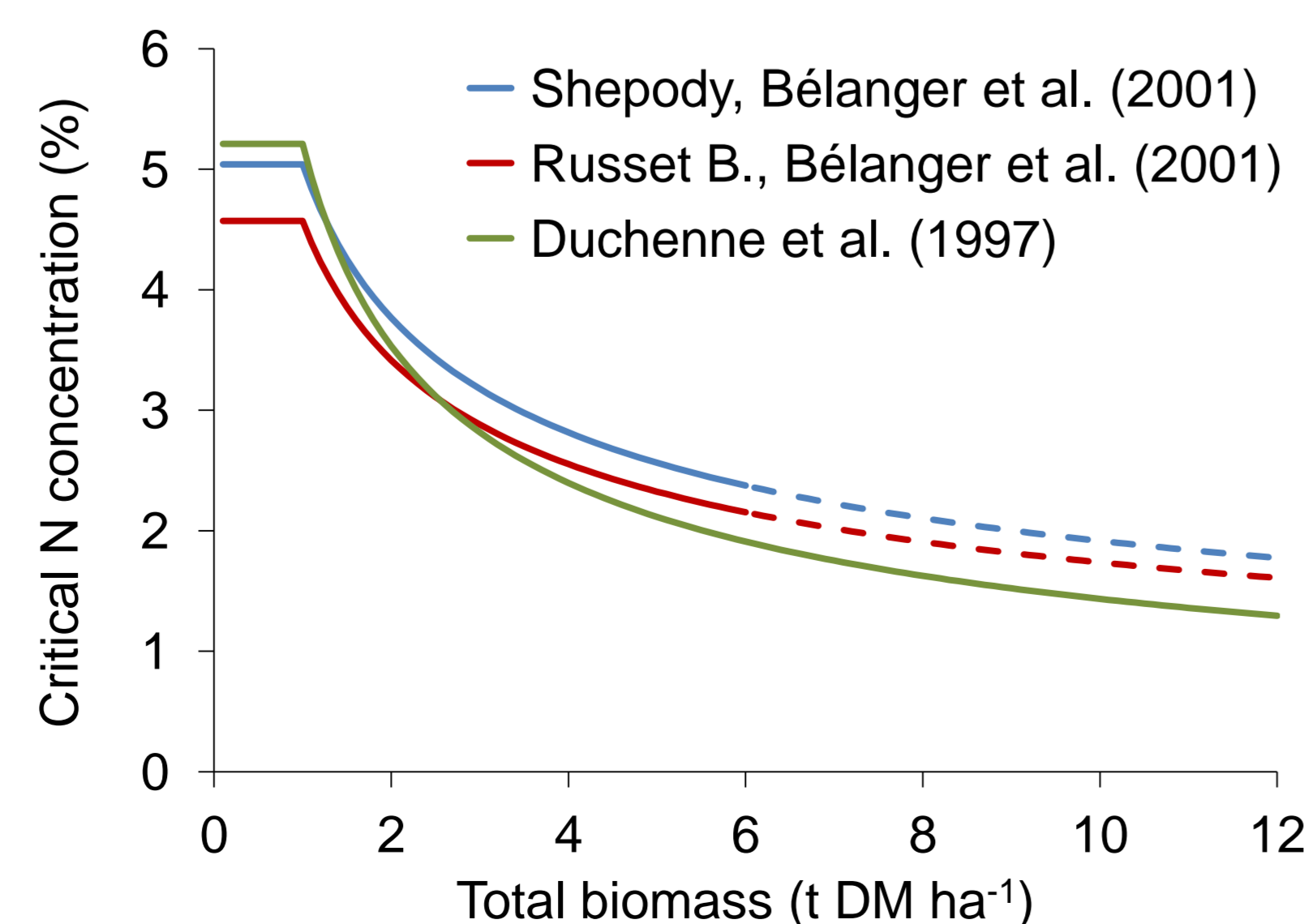


Calibration and validation procedure

- Simulation with default parameters (Bintje cultivar) to identify parameters to be calibrated.
- Calibration of general parameters and cultivar-specific parameters using cultivar-specific critical N curves (Bélanger *et al.* 2001).
- Validation with different data sets.
- Evaluation of model performance with common critical N curve defined by default in STICS for potato (Duchenne *et al.*, 1997).

Statistical criteria used

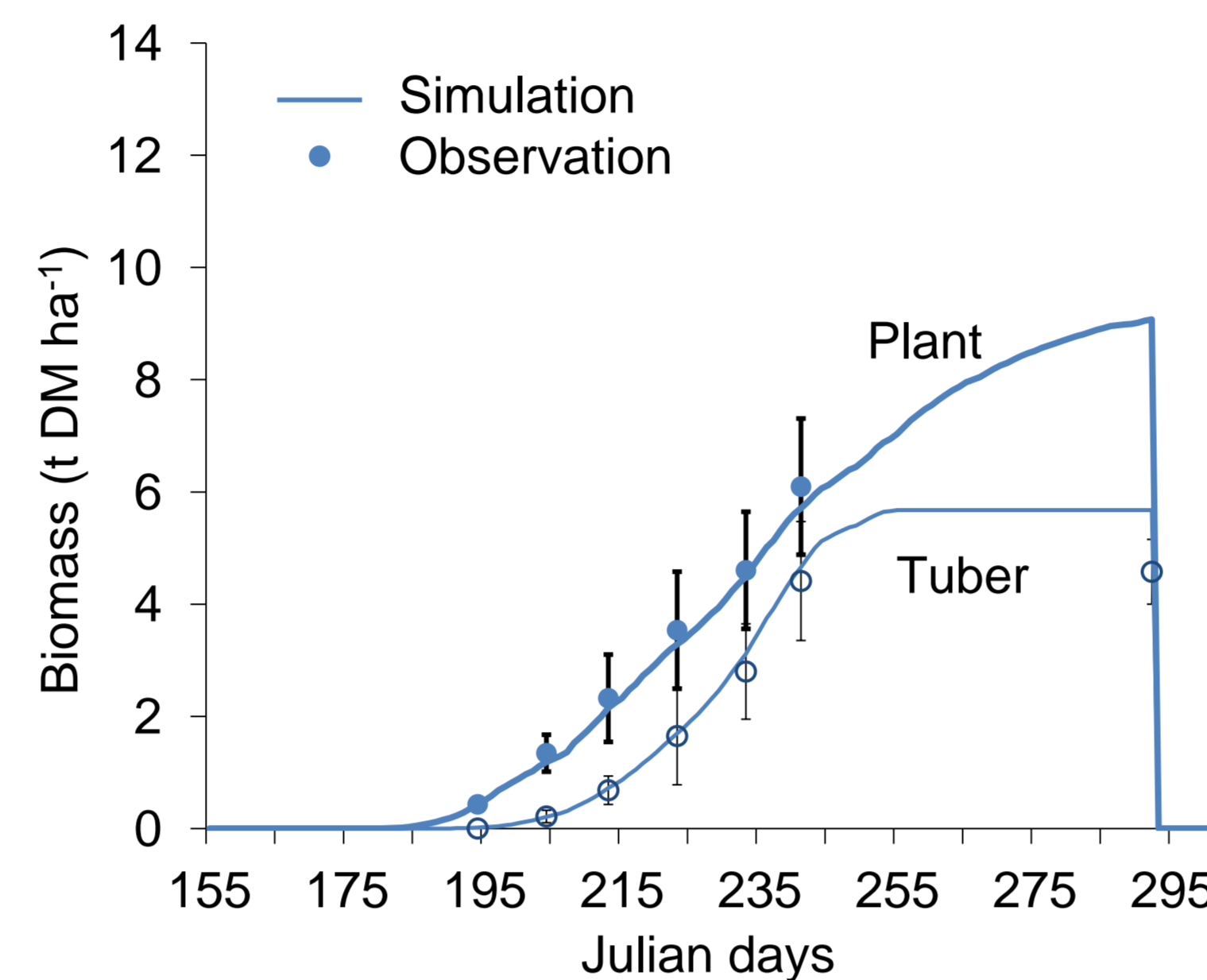
Normalized RMSE (NRMSE)
Systematic and unsystematic RMSE (RMSEs and RMSEu)
Normalized Mean Error (NME)



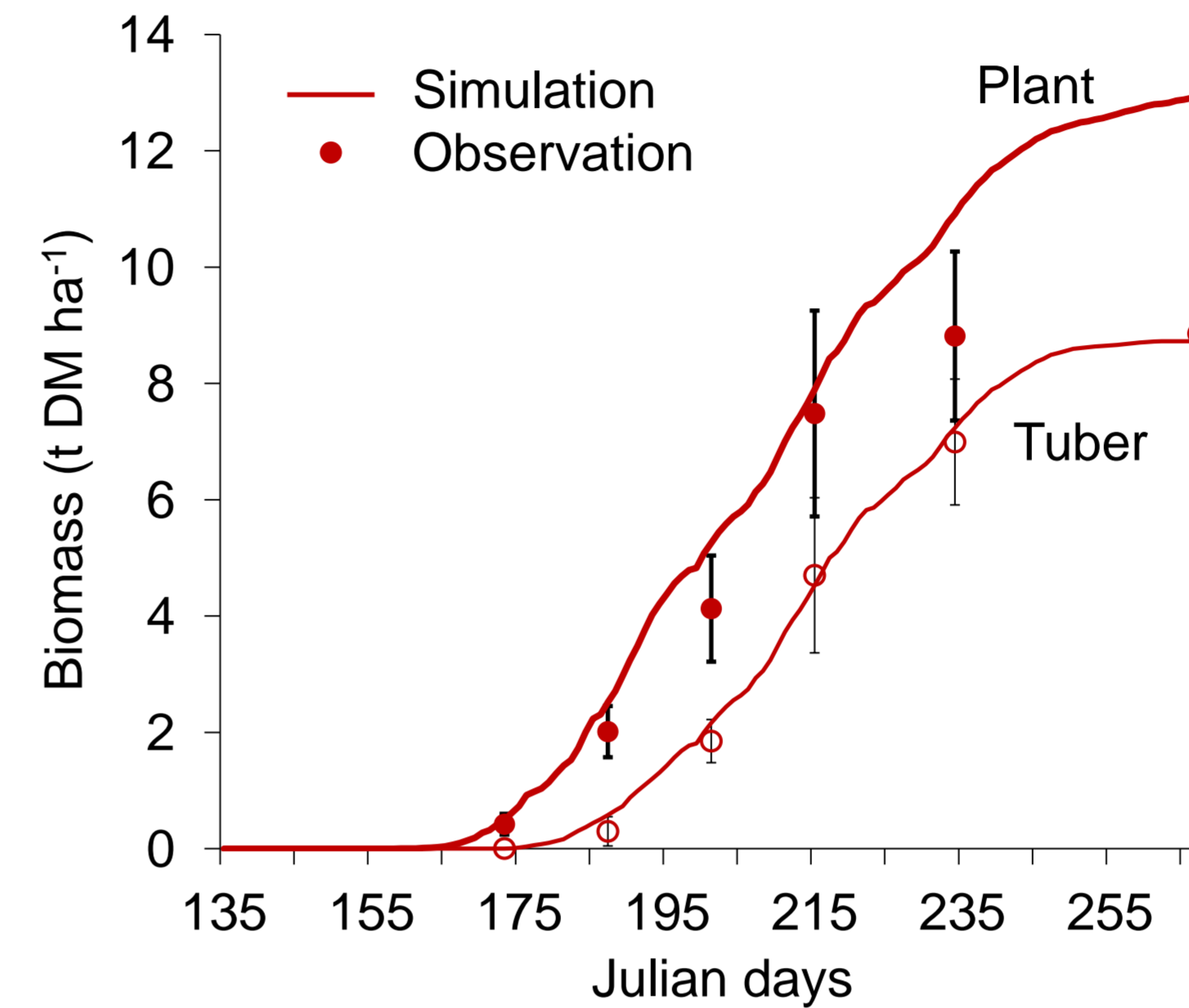
Results

Calibration

Shepody (150 kg N ha⁻¹)

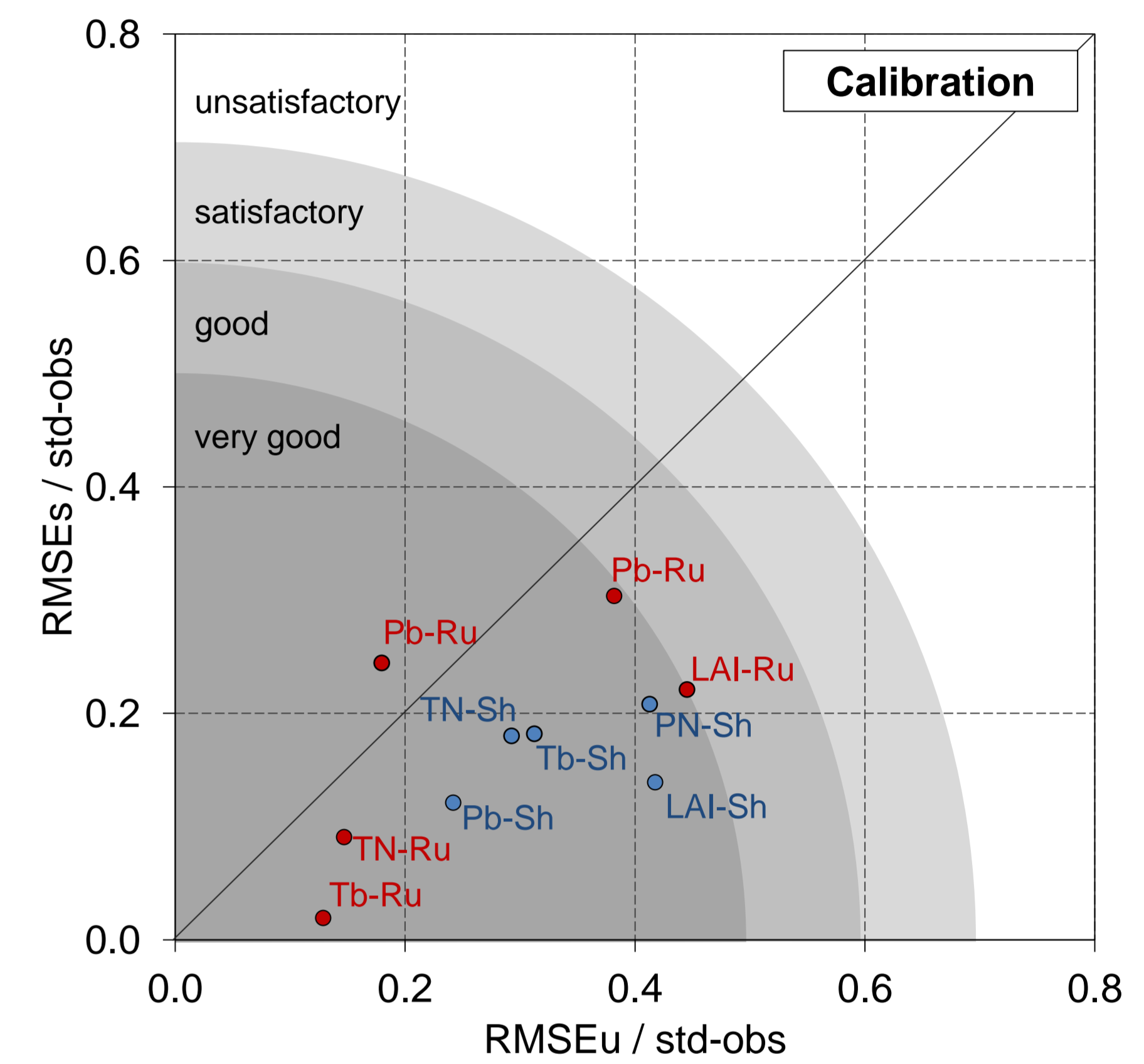


Russet Burbank (200 kg N ha⁻¹)

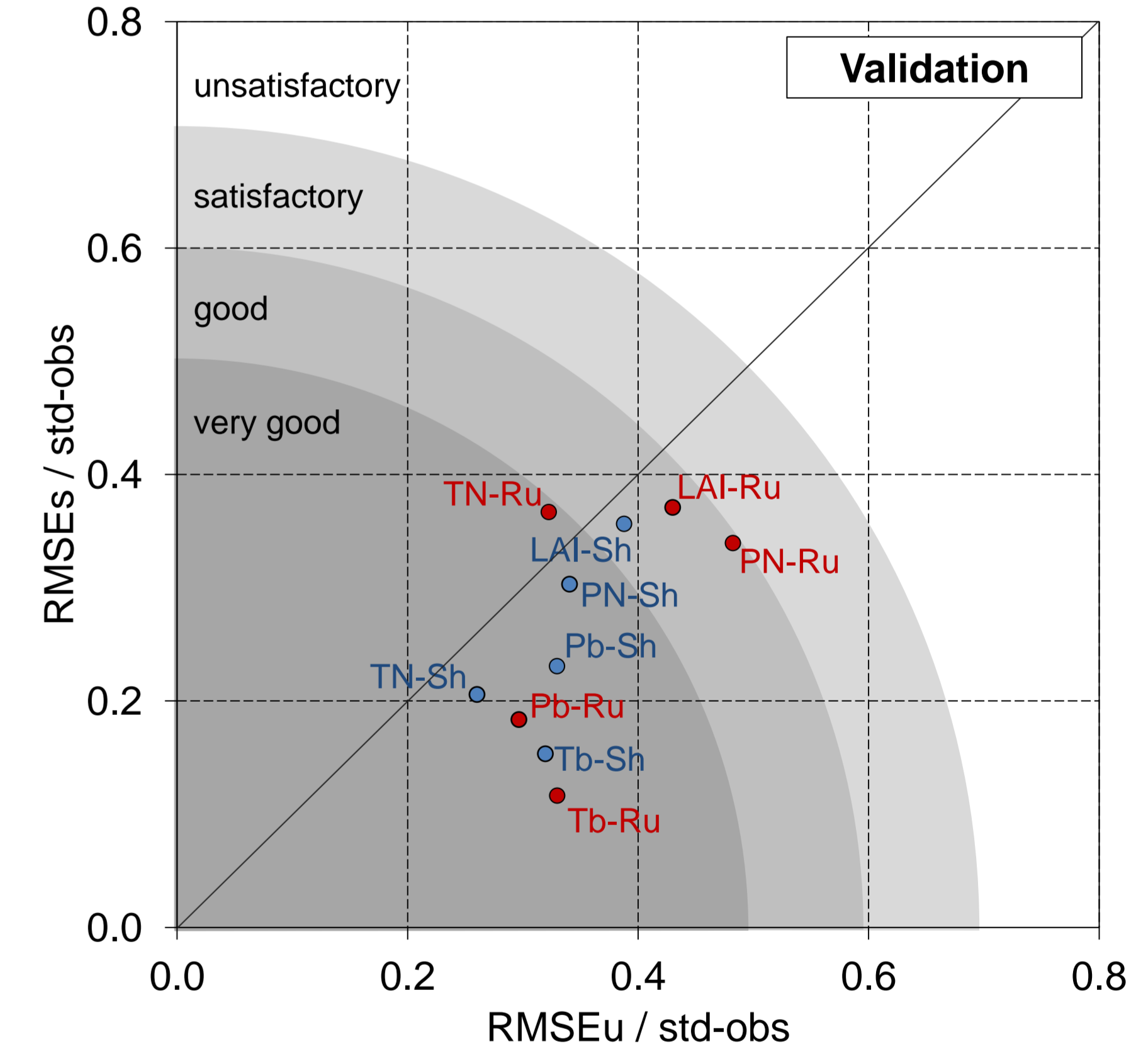
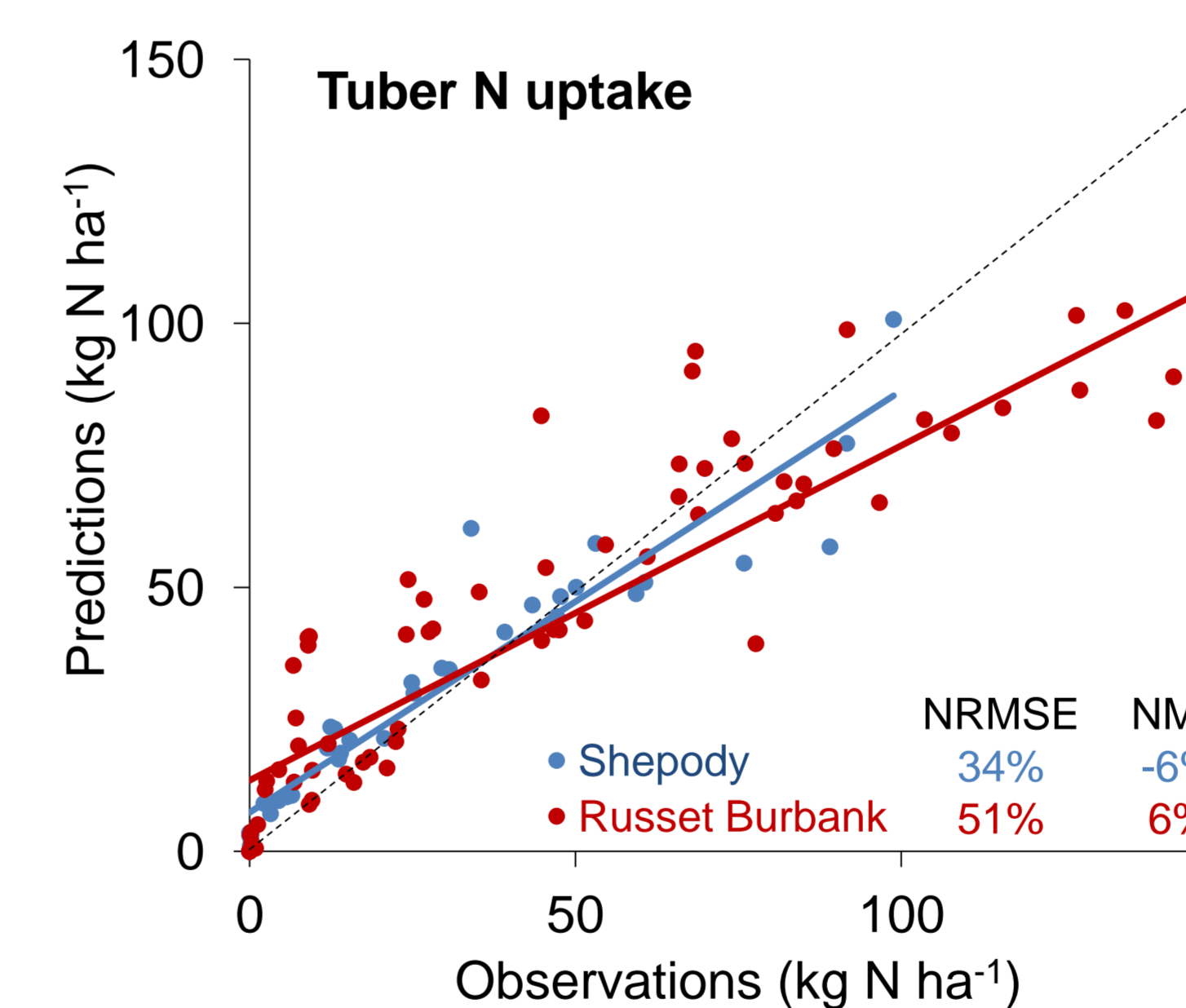
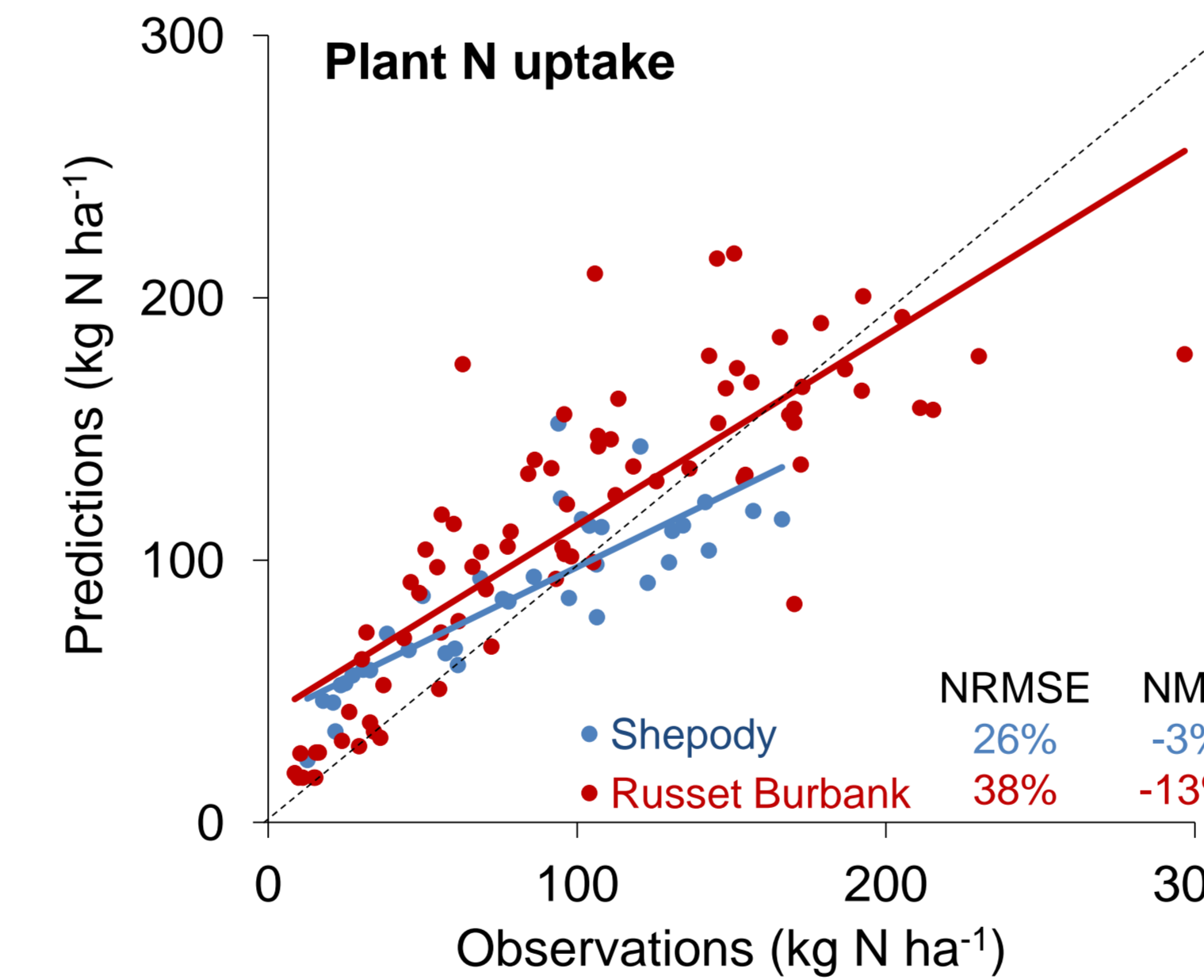
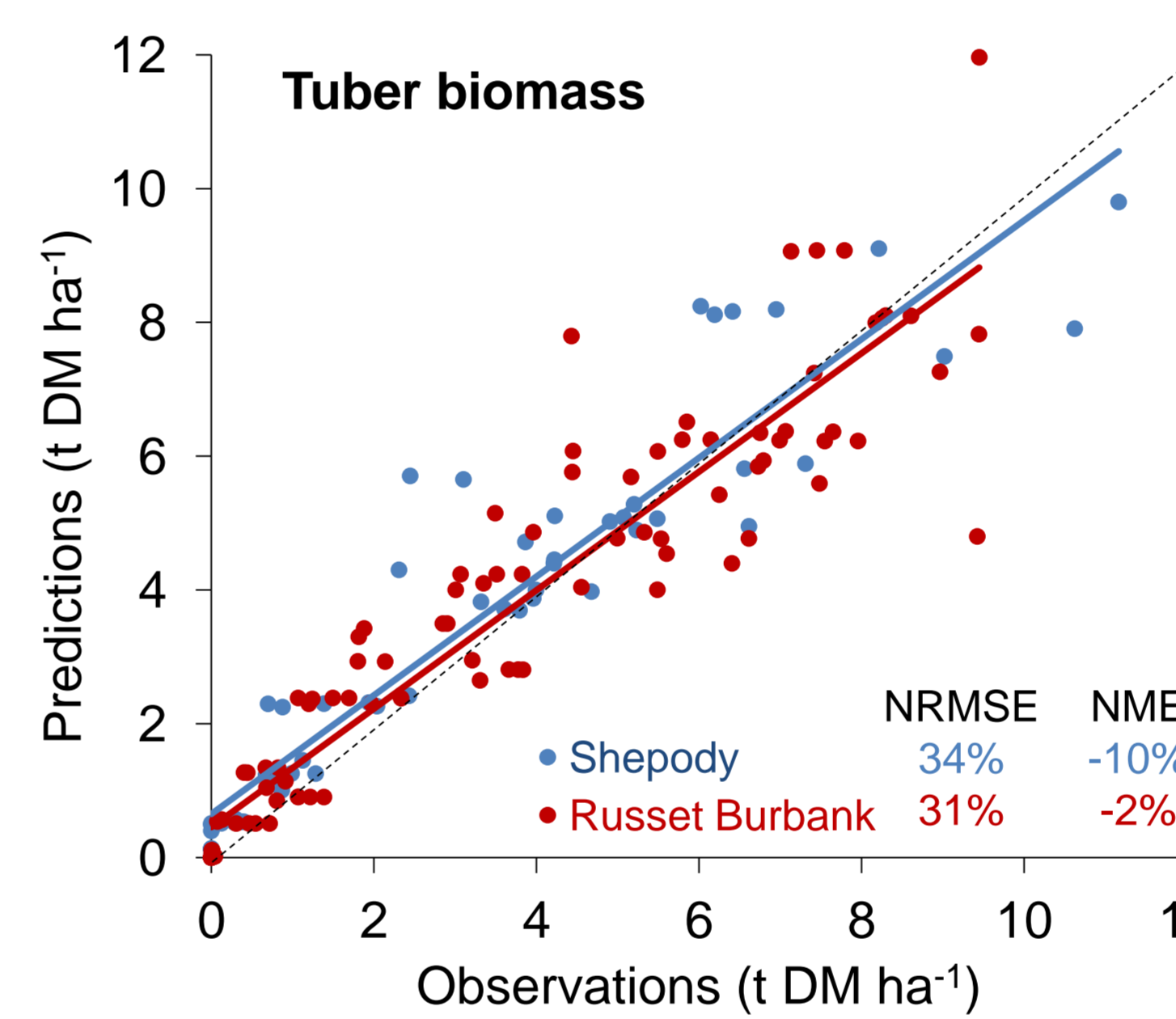
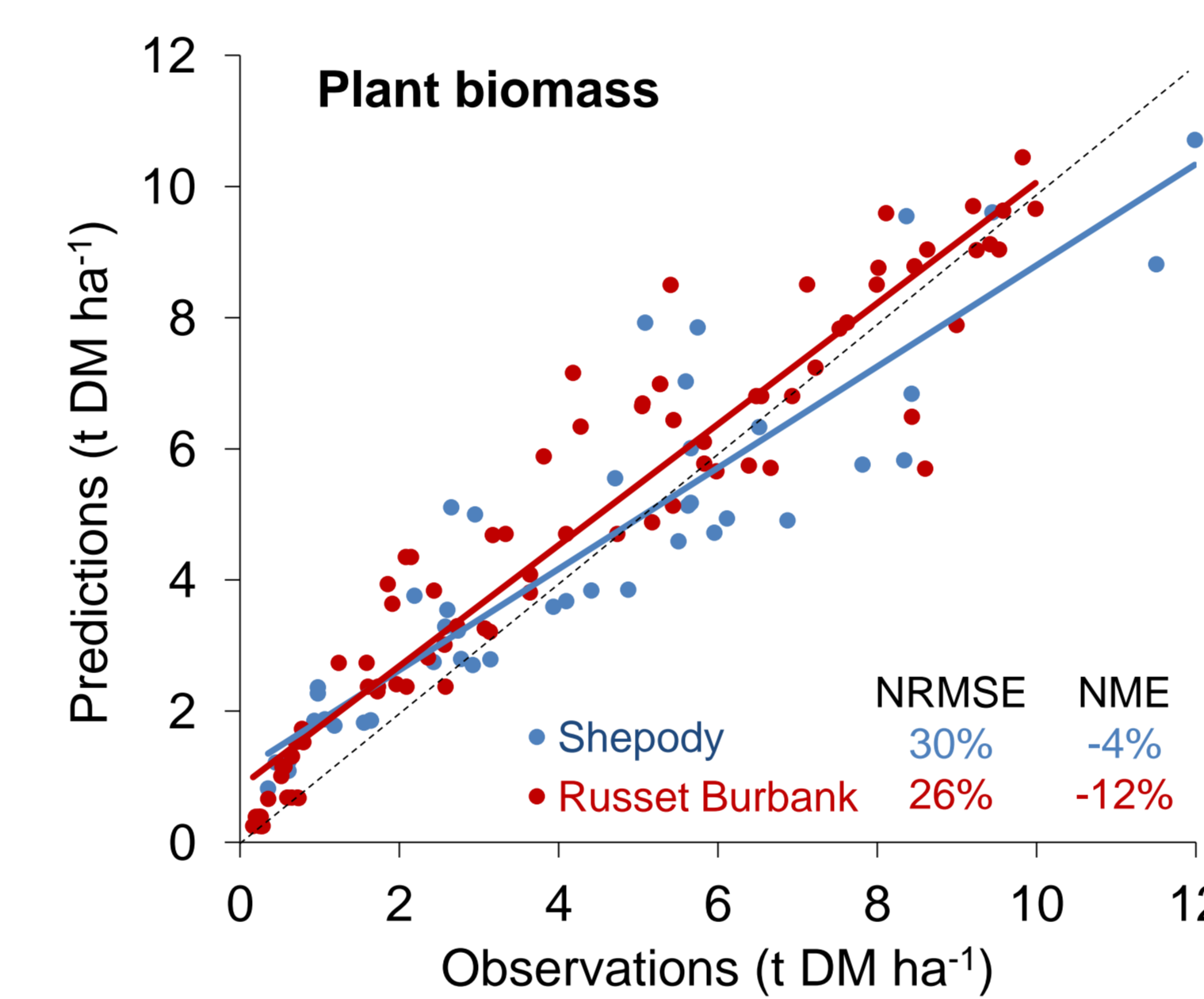


Graphical representation of the model performance.

RMSEs: model bias (specific); RMSEu: data dispersion error (unspecific). Normalization by the standard deviation allows the comparison of variables with different units. Scale values from Moriasi *et al.* 2007. Variables prefixes: LAI (leaf area index), Tb (tuber biomass), Pb (plant biomass), TN (tuber N uptake), and PN (plant N uptake). Cultivars suffixes: Sh (Shepody) and Ru (Russet Burbank).



Validation (All validation sites, years, and N rates)



Model NRMSE (%) for calibration and validation with cultivar-specific critical N curve and validation with common curve.

Critical N curve	Calibration	Validation	Validation
	Cultivar-specific		Common
Shepody			
LAI	19	16	19
Plant biomass	18	30	33
Tuber biomass	31	34	38
Plant N uptake	20	26	34
Tuber N uptake	36	34	43
Russet Burbank			
LAI	20	24	26
Plant biomass	22	26	29
Tuber biomass	11	31	34
Plant N uptake	26	38	38
Tuber N uptake	16	51	64

Conclusions

- Good to very good validation performance for LAI, biomass, and N uptake. Results comparable to other studies on potato in North America.
- Small model bias (RMSEs < RMSEu) compared to the global error.
- Lower bias for biomass prediction than for N uptake and LAI.
- Using a cultivar-specific critical N curve slightly improved model performance, especially for N uptake.

References

Brisson *et al.* 2008. Conceptual basis, formalisations and parameterization of the STICS crop model. *Bélanger et al.* 2001. *Am. J. Potato Res.*, 78(5): 355-364. *Duchenne et al.* 1997. *Potatoes*. In: *Diagnosis of the nitrogen status in crops*. Springer-Verlag, Berlin: pp: 119-130. *Moriasi et al.* 2007. *Transaction of the ASABE*, 50(3): 885-900.