# STICS Performance Evaluation Report: Winter Wheat

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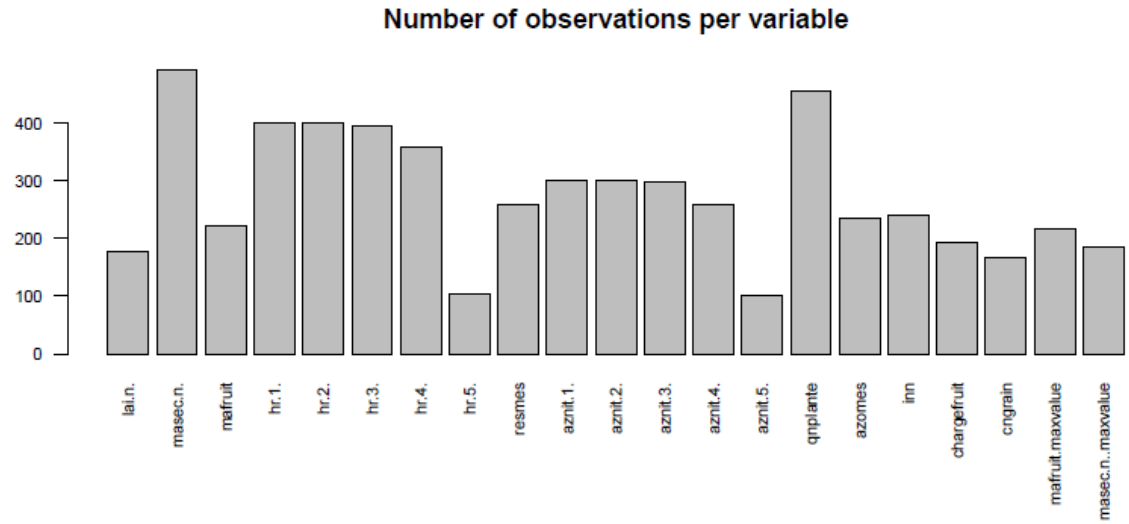
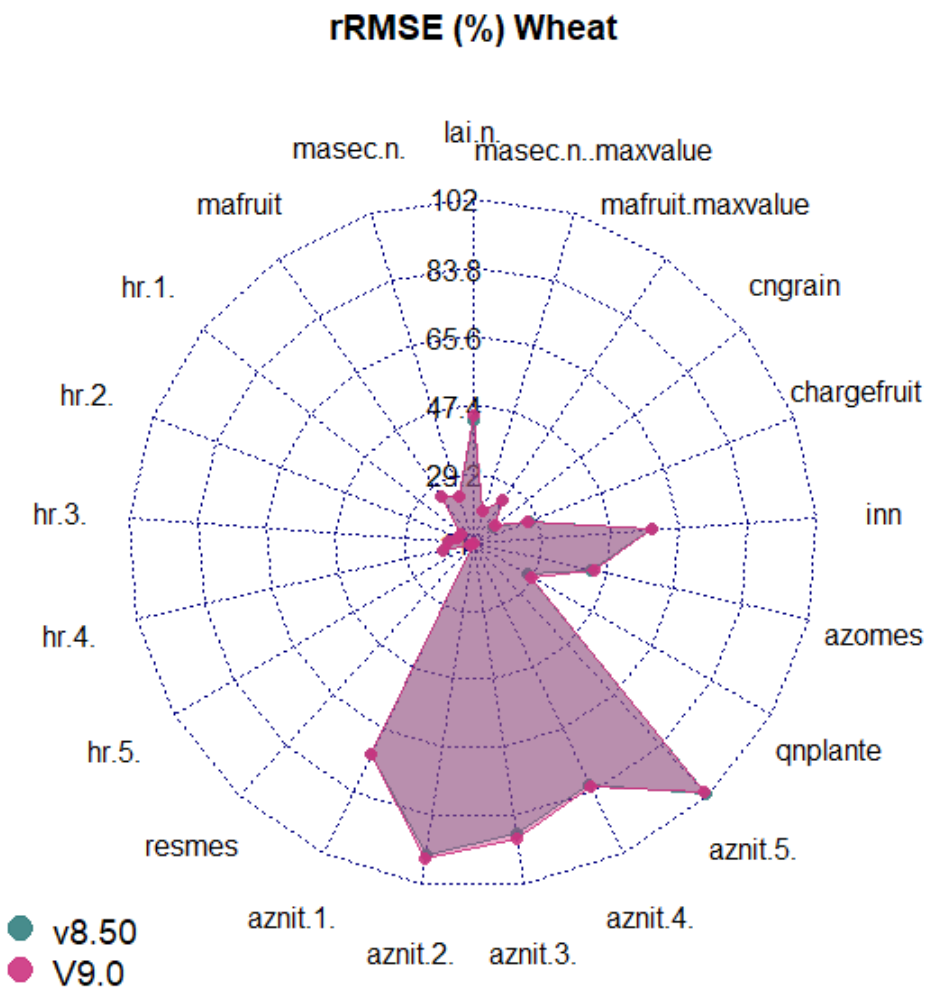
JavaSTICS version: 1.41
STICS version: 9.0
IdeSTICS version: r1220
Number of USMs: 222
Number of cultivars: 9
Cultivars names: Arminda, Talent, Thesee, Soissons, Promentin, Sideral, Thésarmin, Thétalent, Shango



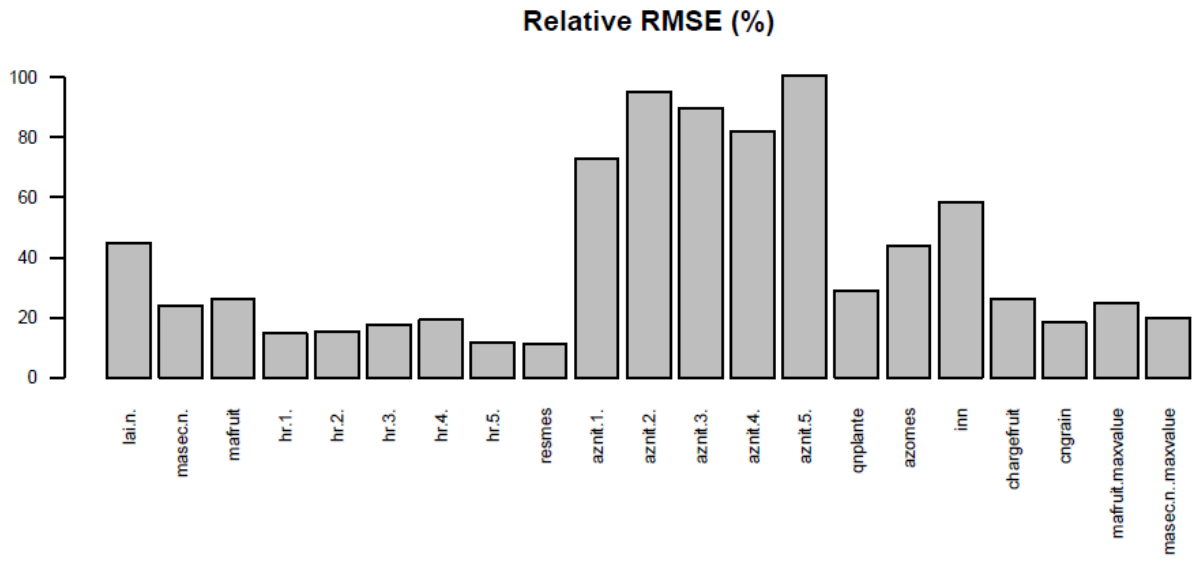

The evaluation dataset includes 222 USMs not used for model calibration, 9 cultivars and a large number of observations (>90) for all evaluated variables.

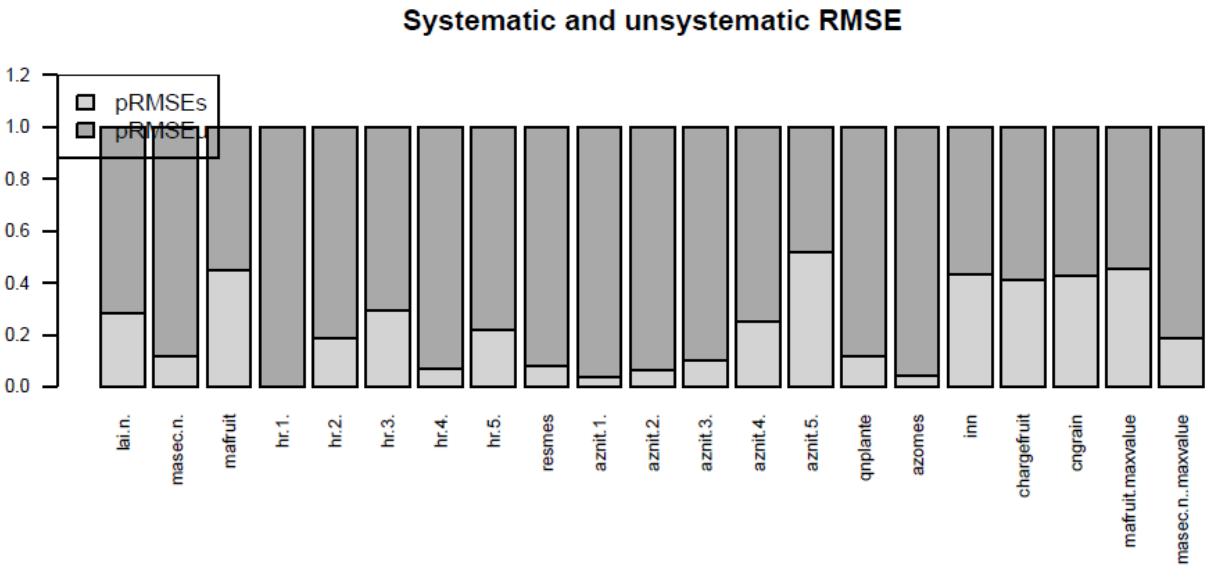
## Evolution of performances with respect to former version 8.50




rRMSE obtained with the new version 9.0 are very close to those obtained with the former version V8.50 for all observed variables.

## Global analysis




**Comments:**

- Relative RMSE (rRMSE):
  - are generally fairly good for crop growth, nitrogen exportation by the plant and water content (below 30%),
  - higher rRMSE for *lai* (rRMSE ≈ 45%),
  - very high for *aznit* in the different layers with an increasing rRMSE with soil depth while *azomes* is relatively fairly good (rRMSE ≈ 44%).
- Bias:
  - no major systematic bias in model predictions compared to dispersion (rRMSEu > rRMSEs) for growth dynamic, *hr1-5*, *aznit 1-4*, *resmes*, *azomes* and *QNplante*,

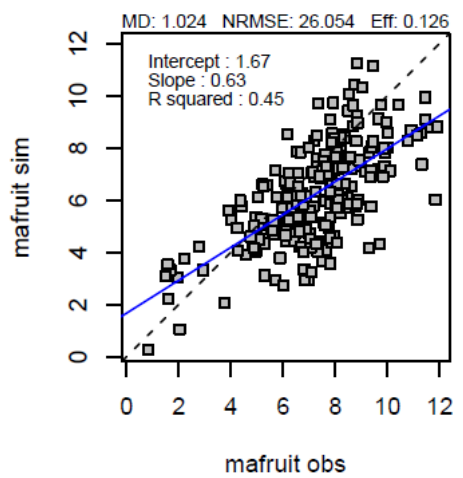
- moderate systematic bias compared to dispersion are observed for *mafruit*, *mafruit.maxvalue* (i.e. *mafruit* at harvest), *aznit 5*, *inn*, *chargefruit*, and *cngrain* (pRMSEs close to pRMSEu).

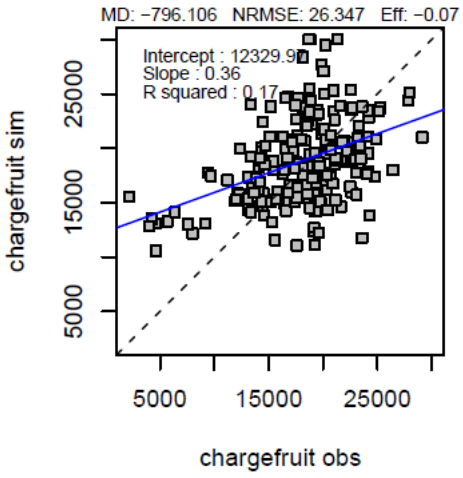
## Yield elaboration

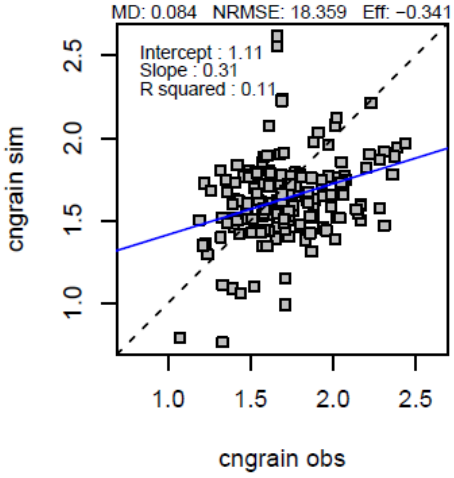
| | mafruit | chargefruit | cngrain |
|---|---|---|---|
| number-of-usm | 216 | 193 | 166 |
| number-of-observations | 222 | 193 | 166 |
| Mean-of-measurements | 7.27 | 18038 | 1.72 |
| CV-measurements | 28 | 26 | 16 |
| CV-simulations | 30 | 21 | 16 |
| RMSE | 1.90 | 4753 | 0.32 |
| rRMSE (%) | 26.05 | 26.35 | 18.36 |
| pRMSEs | 0.45 | 0.41 | 0.43 |
| pRMSEu | 0.55 | 0.59 | 0.57 |
| Mean-difference (M) | 1.02 | -796.11 | 0.08 |
| Relative error (%) | 10.88 | -14.32 | 3.34 |

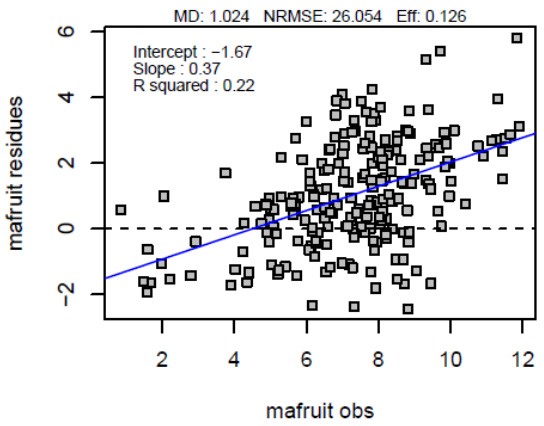
**Comments:**

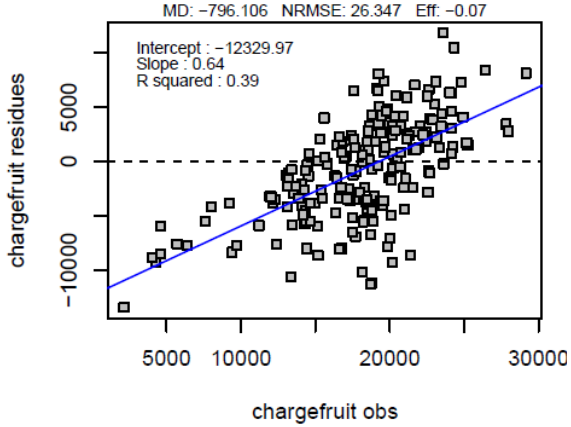
- Bias level is medium for *mafruit* and shows that model underestimates the observations. A doubt is emitted about the harvest index prediction. This observation emerges from the fact that *masec* is pretty much well simulated.
- *chargefruit* and *cngrain* have similar levels of systematic errors w.r.t. dispersion. On average *cngrain* is underestimated by the model, while *chargefruit* is overestimated. *cngrain* being underestimated has a greater consequence in terms of quality of the grain and the overall N balance.
- The variability of all three variables is quite well simulated (CV-measurements and CV-simulations are close).
- There are correlations between residues and observations for the three variables (see graphs next page).

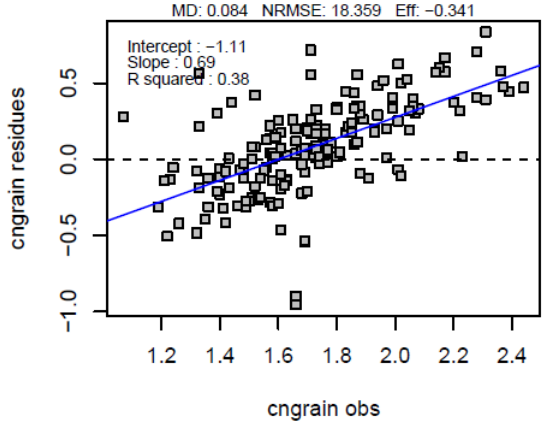

MD: 1.024 NRMSE: 26.054 Eff: 0.126
Intercept : 1.67
Slope : 0.63
R squared : 0.45
mafruit sim
mafruit obs


MD: −796.106 NRMSE: 26.347 Eff: −0.07
Intercept : 12329.9
Slope : 0.36
R squared : 0.17
chargefruit sim
chargefruit obs


MD: 0.084 NRMSE: 18.359 Eff: −0.341
Intercept : 1.11
Slope : 0.31
R squared : 0.11
cngrain sim
cngrain obs


MD: 1.024 NRMSE: 26.054 Eff: 0.126
Intercept : −1.67
Slope : 0.37
R squared : 0.22
mafruit residues
mafruit obs


MD: −796.106 NRMSE: 26.347 Eff: −0.07
Intercept : −12329.97
Slope : 0.64
R squared : 0.39
chargefruit residues
chargefruit obs

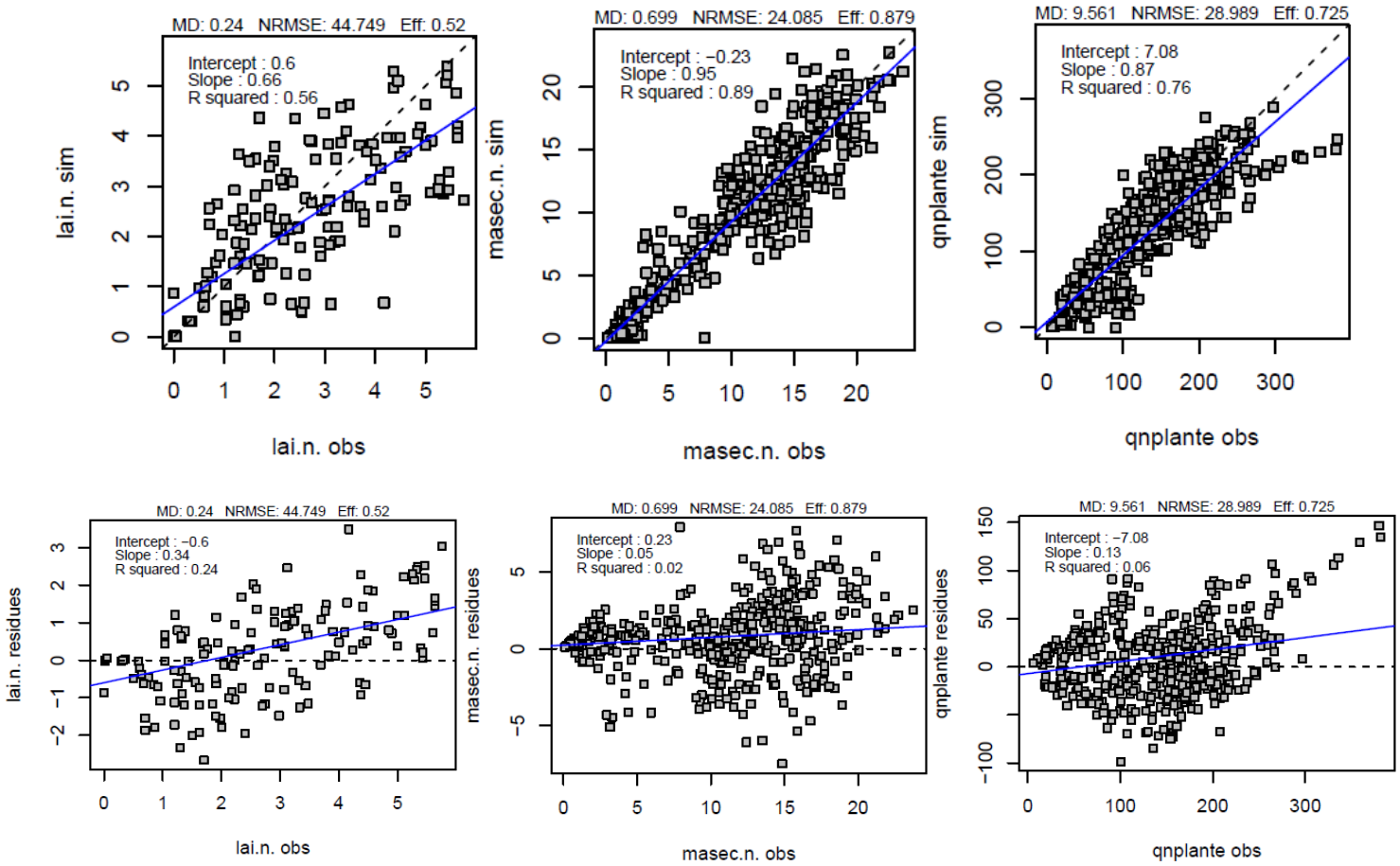

MD: 0.084 NRMSE: 18.359 Eff: −0.341
Intercept : −1.11
Slope : 0.69
R squared : 0.38
cngrain residues
cngrain obs

## Growth dynamic

| | lai | masec | QNplante |
|---|---|---|---|
| number-of-usm | 39 | 188 | 157 |
| number-of-observations | 177 | 493 | 457 |
| Mean-of-measurements | 2.49 | 9.31 | 132.99 |
| CV-measurements | 65 | 69 | 55 |
| CV-simulations | 63 | 75 | 60 |
| RMSE | 1.11 | 2.24 | 38.55 |
| rRMSE (%) | 44.75 | 24.09 | 28.99 |
| pRMSEs | 0.28 | 0.12 | 0.12 |
| pRMSEu | 0.72 | 0.88 | 0.88 |
| Mean-difference (M) | 0.24 | 0.70 | 9.56 |
| Relative error (%) | -4.47 | 18.51 | 9.17 |

**Comments:**

- *QNplante* and *masec* are fairly well predicted.
- Systematic bias in model predictions is low compared to dispersion but the total variability of all three variables is quite well simulated.
- Almost no correlation between residues and observations for *masec* and *QNplante* (except for a few underestimated situations), but there is correlation for *lai* (see graphs next page).

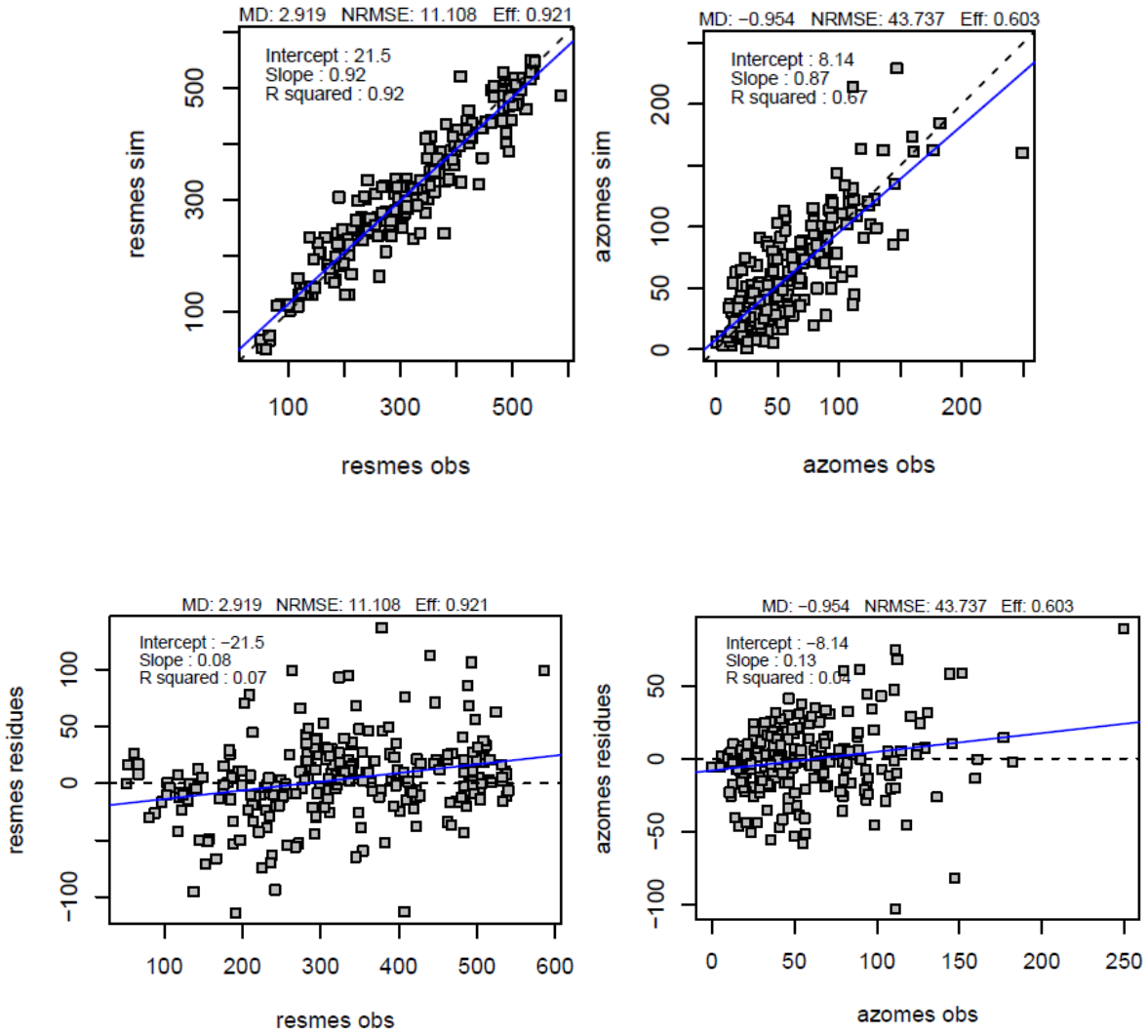

MD: 0.24 NRMSE: 44.749 Eff: 0.52
Intercept : 0.6
Slope : 0.66
R squared : 0.56
lai.n. sim
lai.n. obs
MD: 0.699 NRMSE: 24.085 Eff: 0.879
Intercept : −0.23
Slope : 0.95
R squared : 0.89
masec.n. sim
masec.n. obs
MD: 9.561 NRMSE: 28.989 Eff: 0.725
Intercept : 7.08
Slope : 0.87
R squared : 0.76
qnplante sim
qnplante obs
MD: 0.24 NRMSE: 44.749 Eff: 0.52
Intercept : −0.6
Slope : 0.34
R squared : 0.24
lai.n. residues
lai.n. obs
MD: 0.699 NRMSE: 24.085 Eff: 0.879
Intercept : 0.23
Slope : 0.05
R squared : 0.02
masec.n. residues
masec.n. obs
MD: 9.561 NRMSE: 28.989 Eff: 0.725
Intercept : −7.08
Slope : 0.13
R squared : 0.06
qnplante residues
qnplante obs

## Water and nitrogen soil content

| | resmes | azomes |
|---|---|---|
| number-of-usm | 111 | 100 |
| number-of-observations | 260 | 236 |
| Mean-of-measurements | 319.22 | 56.03 |
| CV-measurements | 40 | 70 |
| CV-simulations | 39 | 73 |
| RMSE | 35.46 | 24.51 |
| rRMSE (%) | 11.11 | 43.74 |
| pRMSEs | 0.08 | 0.04 |
| pRMSEu | 0.92 | 0.96 |
| Mean-difference (M) | 2.92 | -0.95 |
| Relative error (%) | -0.51 | -22.76 |

**Comments:**

- Soil water content is fairly well predicted with small rRMSE and very low systematic bias.
- Soil nitrogen content (*azomes*) is relatively well predicted compared to *aznit1-4* but quite poorly predicted compared to soil water content. It however also has a very small systematic bias.
- The total variability of both variables is quite well simulated.


MD: 2.919 NRMSE: 11.108 Eff: 0.921
Intercept : 21.5
Slope : 0.92
R squared : 0.92
resmes sim
resmes obs
MD: −0.954 NRMSE: 43.737 Eff: 0.603
Intercept : 8.14
Slope : 0.87
R squared : 0.67
azomes sim
azomes obs
MD: 2.919 NRMSE: 11.108 Eff: 0.921
Intercept : −21.5
Slope : 0.08
R squared : 0.07
resmes residues
resmes obs
MD: −0.954 NRMSE: 43.737 Eff: 0.603
Intercept : −8.14
Slope : 0.13
R squared : 0.04
azomes residues
azomes obs

# Conclusion

Overall model performance is relatively good:

- Yield elaboration variables have low rRMSE but significant biases and quite poor efficiencies.
- Growth dynamic variables are well simulated (although rRMSE of *lai* is a bit high).
- Soil water content is very well predicted. Total soil nitrogen content is relatively well predicted although errors on nitrogen content per soil layer are high.
- Largest errors are often due to a small number of USMs.