Stics Performance Evaluation Report : Wheat

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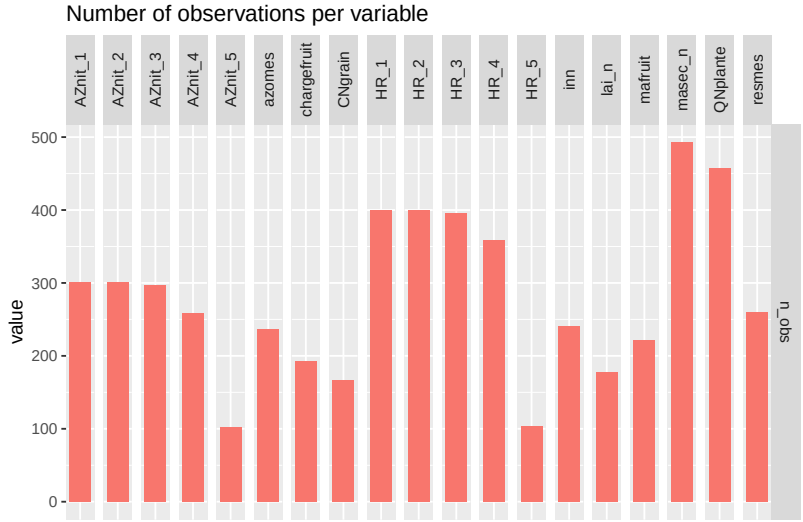
STICS version: V10.1

IdeSTICS version: r2017

Number of USMs: 222

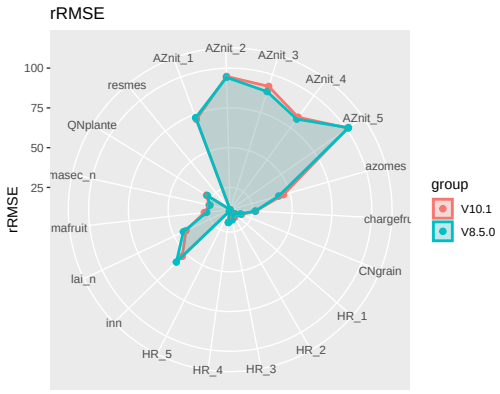
Number of cultivars: 9

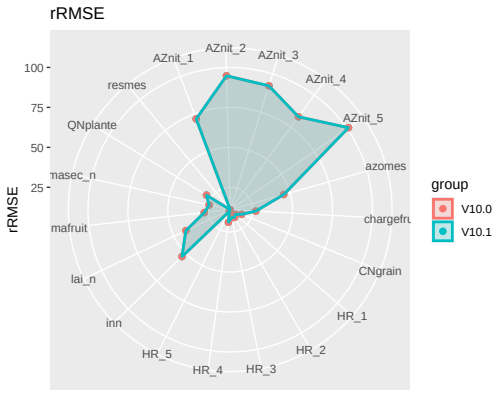
Cultivars names: Arminda, Talent, Thesee, Soissons, Promentin, Sideral, Thésarmin, Thétalent, Shango



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

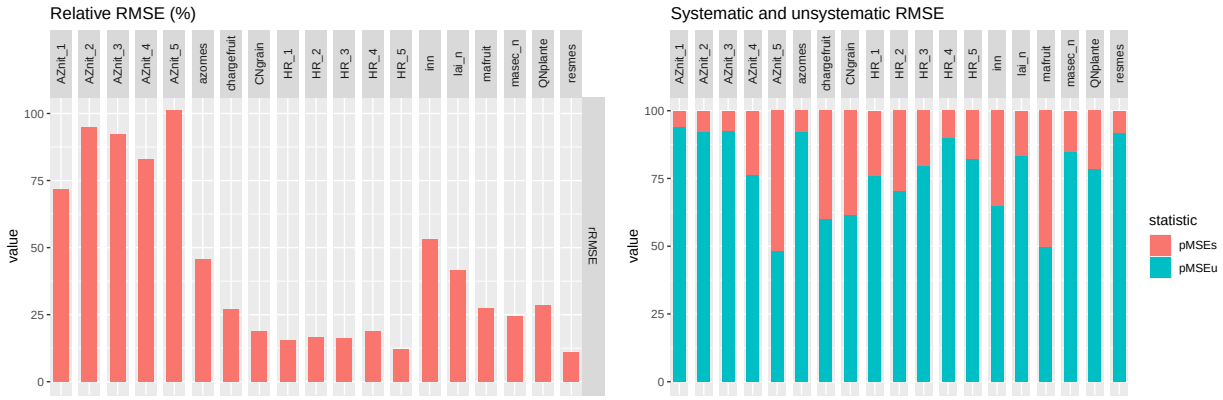
Evolution of performances with respect to previous versions





rRMSE obtained with the new version 10.1 are very similar to those obtained with former versions 10.0 and 8.5.0 for all observed variables. They were slightly increased wrt version 8.5.0 for soil nitrogen content of layers 3 and 4 (AZnit_3, AZnit_4) and total soil nitrogen content (azomes) but improved for LAI (lai_n) and NNI (inn). These differences are due to changes in the wheat plant file associated to version 10.0: new values were proposed for some parameters impacting root simulation to take advantage of the new formalisms introduced in this version. This has significantly improved the simulation of the roots compared to the values found in the literature (see Annex section).

Global analysis

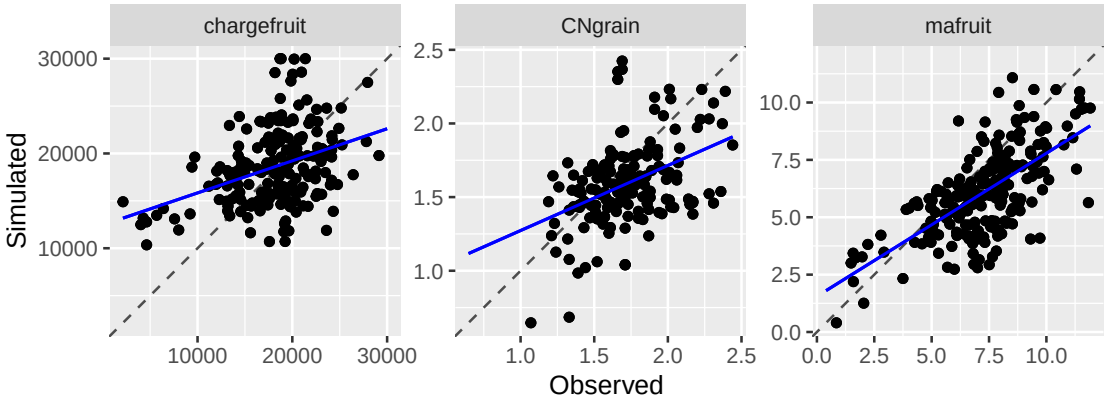


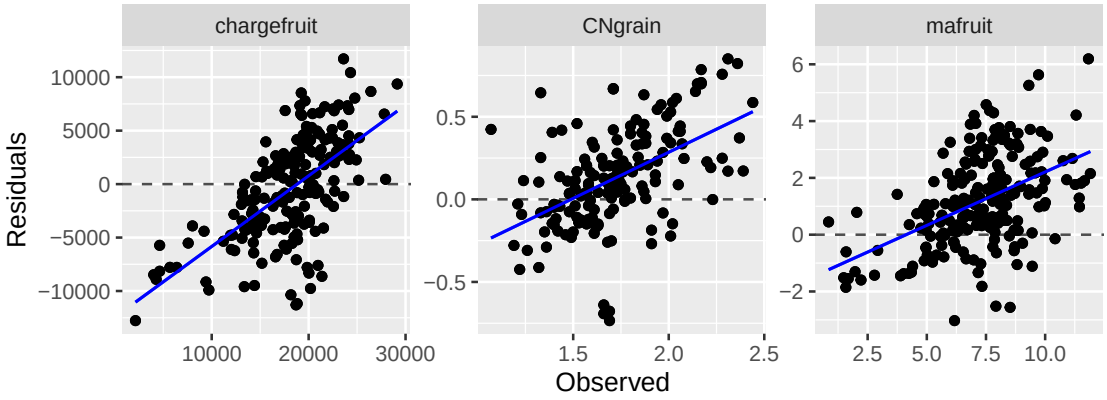
- Relative RMSE (rRMSE):
  - are generally fairly good for crop growth, nitrogen exportation by the plant and water content (below 30%),
  - higher for lai (about 45%),
  - very high for aznit in the different layers with an increasing rRMSE with soil depth while azomes is relatively fairly good (about 45%).
- 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, aznit 5, inn, chargefruit, and cngrain (pRMSEs close to pRMSEu).

Yield elaboration

	mafruit	chargefruit	CNgrain
n_obs	222.00	193.00	166.00
mean_obs	7.27	18038.32	1.72
mean_sim	6.09	18557.46	1.59
CV_obs	27.94	25.53	15.90
CV_sim	31.06	22.09	17.68
RMSE	1.99	4878.91	0.32
rRMSE	0.27	0.27	0.19
pMSEs	0.50	0.40	0.38
pMSEu	0.50	0.60	0.62
EF	0.04	-0.13	-0.40
Bias	-1.18	519.14	-0.13

- 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).

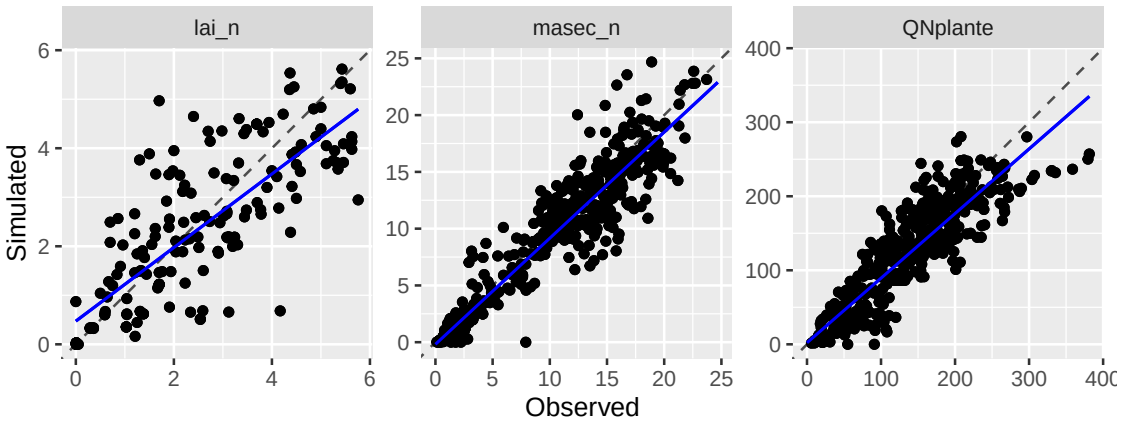


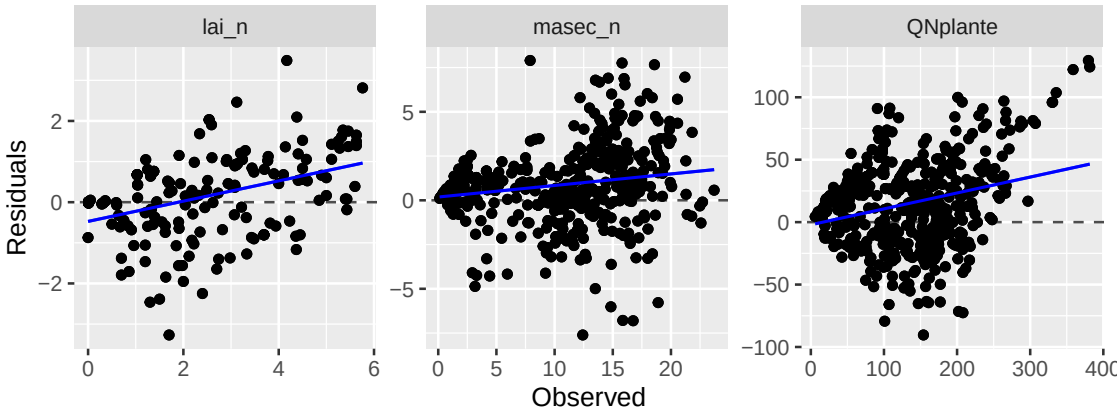

chargefruit
CNgrain
mafruit
Residuals
Observed
10000
5000
0
−5000
−10000
0.5
0.0
−0.5
6
4
2
0
−2
10000
20000
30000
1.5
2.0
2.5
2.5
5.0
7.5
10.0

Growth dynamic

	lai_n	masec_n	QNplante
n_obs	177.00	493.00	457.00
mean_obs	2.49	9.31	132.99
mean_sim	2.34	8.52	118.17
CV_obs	64.76	69.45	55.29
CV_sim	65.64	75.12	61.27
RMSE	1.04	2.28	37.81
rRMSE	0.42	0.25	0.28
pMSEs	0.17	0.15	0.21
pMSEu	0.83	0.85	0.79
EF	0.58	0.88	0.74
Bias	-0.15	-0.79	-14.82

- 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).

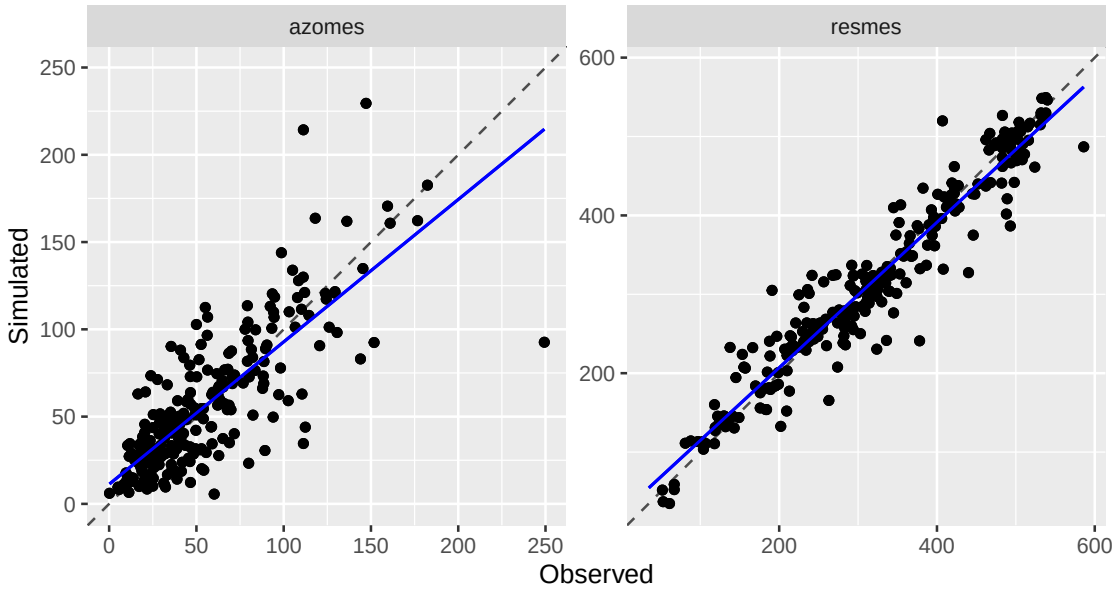


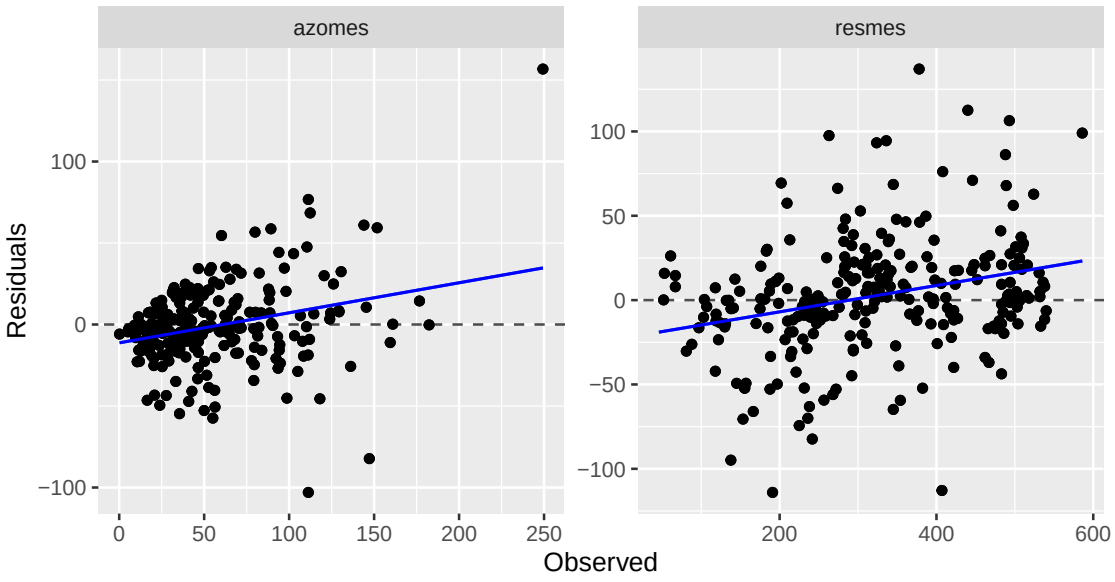

lai_n
masec_n
QNplante
Residuals
Observed
2
0
−2
5
0
−5
100
50
0
−50
−100
0
2
4
6
0
5
10
15
20
0
100
200
300
400

Water and nitrogen soil content

	resmes	azomes
n_obs	260.00	236.00
mean_obs	319.22	56.03
mean_sim	316.86	56.95
CV_obs	39.67	69.55
CV_sim	38.35	70.69
RMSE	35.11	25.69
rRMSE	0.11	0.46
pMSEs	0.08	0.08
pMSEu	0.92	0.92
EF	0.92	0.56
Bias	-2.36	0.91

- 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.



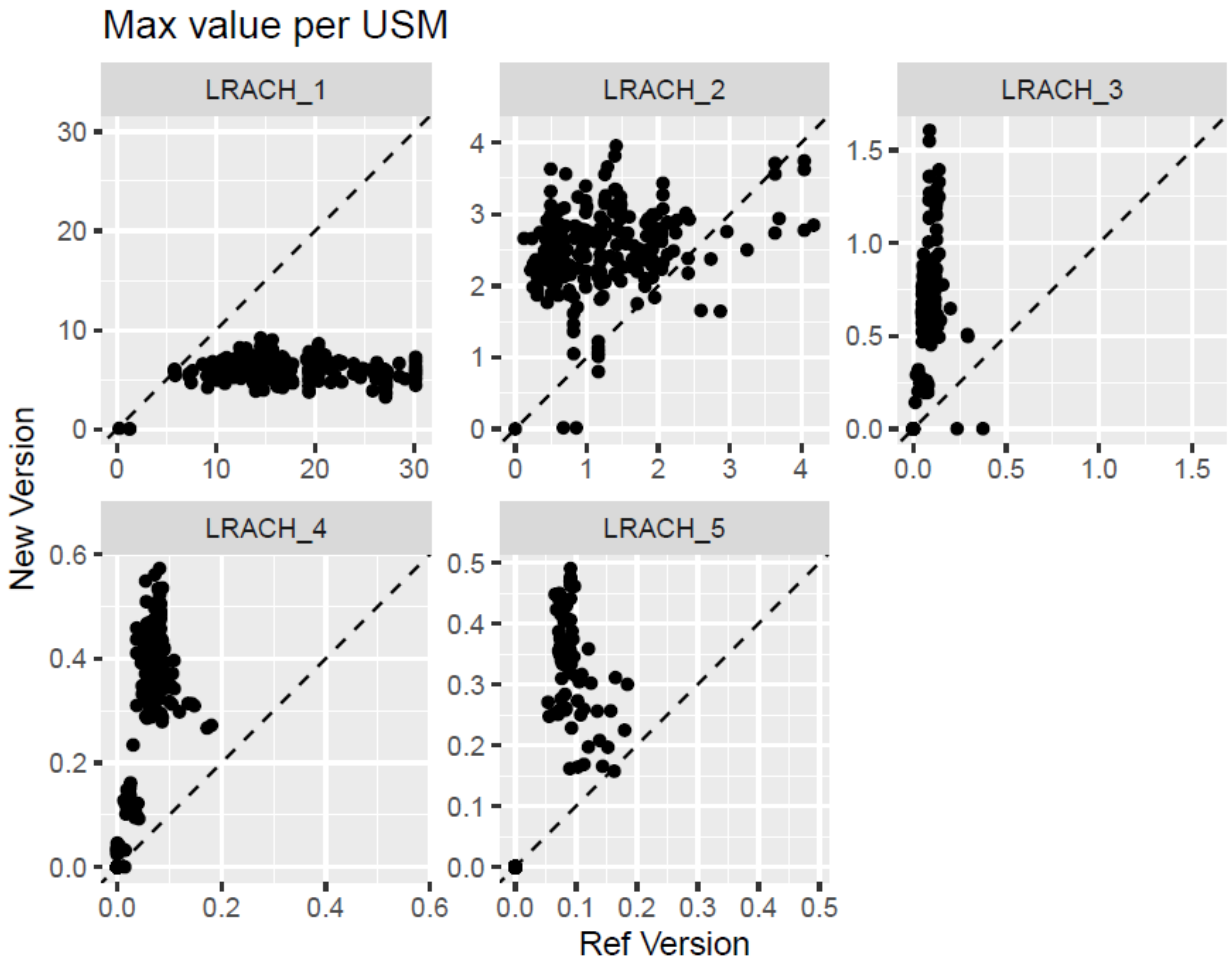

azomes
resmes
Residuals
Observed
100
0
−100
50
−50
0
50
100
150
200
250
200
400
600

Conclusion

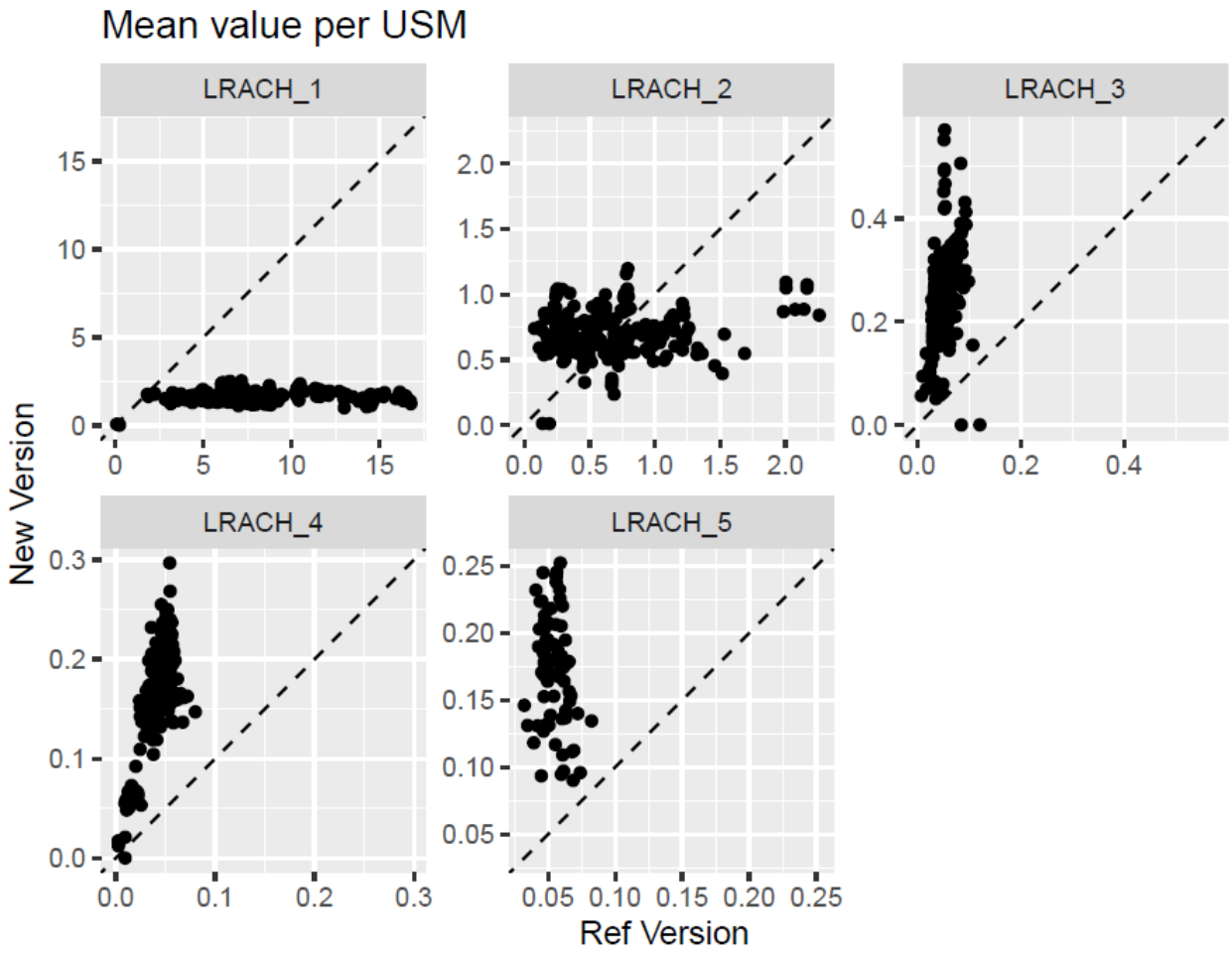
Overall model performance is relatively good:

- 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.

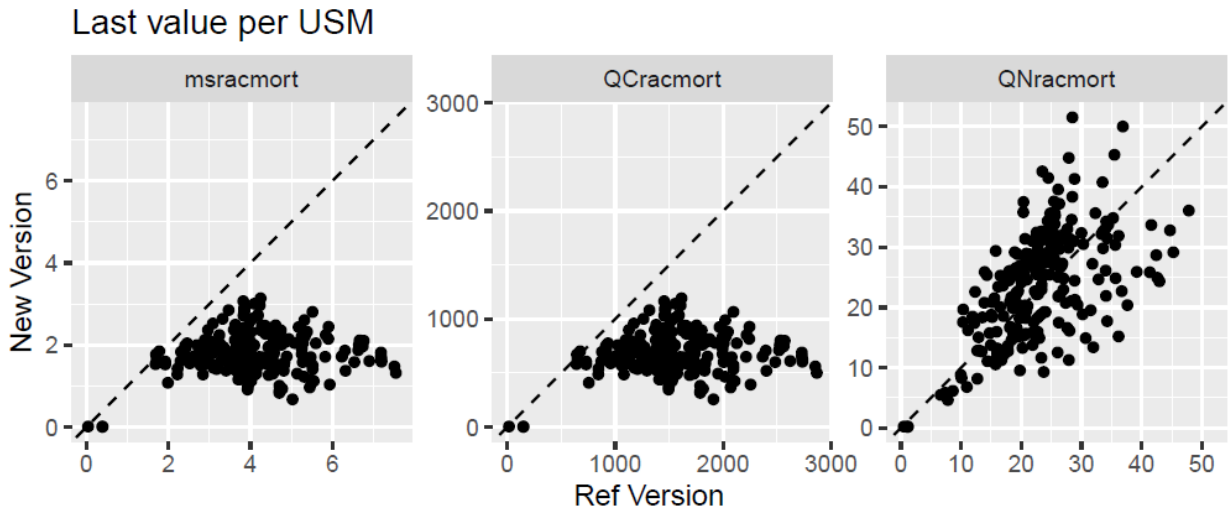
Annex



This figure presents the highest root density (LRACH, cm/cm3) simulated during each USM for each soil layer, with the v10.0.0 (New Version) and the v9.2 (Ref Version). Root density could be very high in the first soil layer with the v9.2 and very low in deeper layers. With the new v10.0.0, root density is still higher in the upper than in the lower soil layers but the values are more in accordance with literature data.



This figure presents the mean root density (LRACH, cm/cm3) simulated during each USM for each soil layer, with the v10.0.0 (New Version) and the v9.2 (Ref Version). The same observation can be made than with the previous figure.



This figure presents, with the v10.0.0 (New Version) and the v9.2 (Ref Version), i) the total amount of root

produced during each USM and returned to soil at harvest (msracmort, tMS/ha), ii) the total amount of root carbon returned to soil at harvest (QCracmort, kgC/ha) and, iii) the total amount of root nitrogen returned to soil at harvest (QNracmort, kgN/ha). The amount of nitrogen in roots is relatively similar in the two versions, but the biomass and the amount of carbon are lower with the new version. The results of the new version are also closer to the available literature data.