1st FSCC Soil Physical Ring Test 2009

Action C1-Soil-3(FI)

Nathalie Cools & Bruno De Vos

http://fscc.inbo.be

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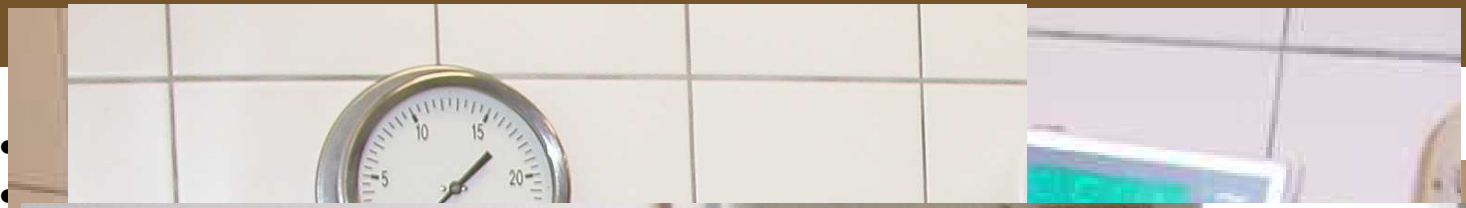


cm
1
5
10
33
10
25
153
10

Sample preparation of the artificial ring test sample

- Homogenisation by quartering
- Sieved at 1 cm to overcome heterogeneity caused by stoniness
- 30 x 5 = 150 sample rings: about 20 ring per tray
- All trays filled in the same way and compressed at 120 bar

Variation of the bulk density in the homogeneity test

volcc	100	180	300	100	300	*100*	300	100	300
TrayN.	1	1	1	2	2	*3*	3	4	4
Min	1304	1331	1354	1367	1364	*1351*	1382	1333	1384
1st Qu.	1371	1341	1379	1380	1368	*1380*	1388	1374	1433
Mean	1407	1368	1402	1396	1403	*1430*	1404	1399	1437
Median	1433	1369	1386	1390	1396	*1415*	1414	1384	1437
3rd Qu.	1451	1388	1426	1402	1432	*1456*	1417	1441	1447
Max	1466	1418	1473	1439	1457	*1551*	1418	1464	1484
Total N	11	7	6	5	5	*5*	5	5	5
Std Dev.	53.41	32.19	44.28	27.32	40.19	*77.90*	17.42	52.78	35.75
CV	3.80	2.35	3.16	1.96	2.86	*5.45*	1.24	3.77	2.49

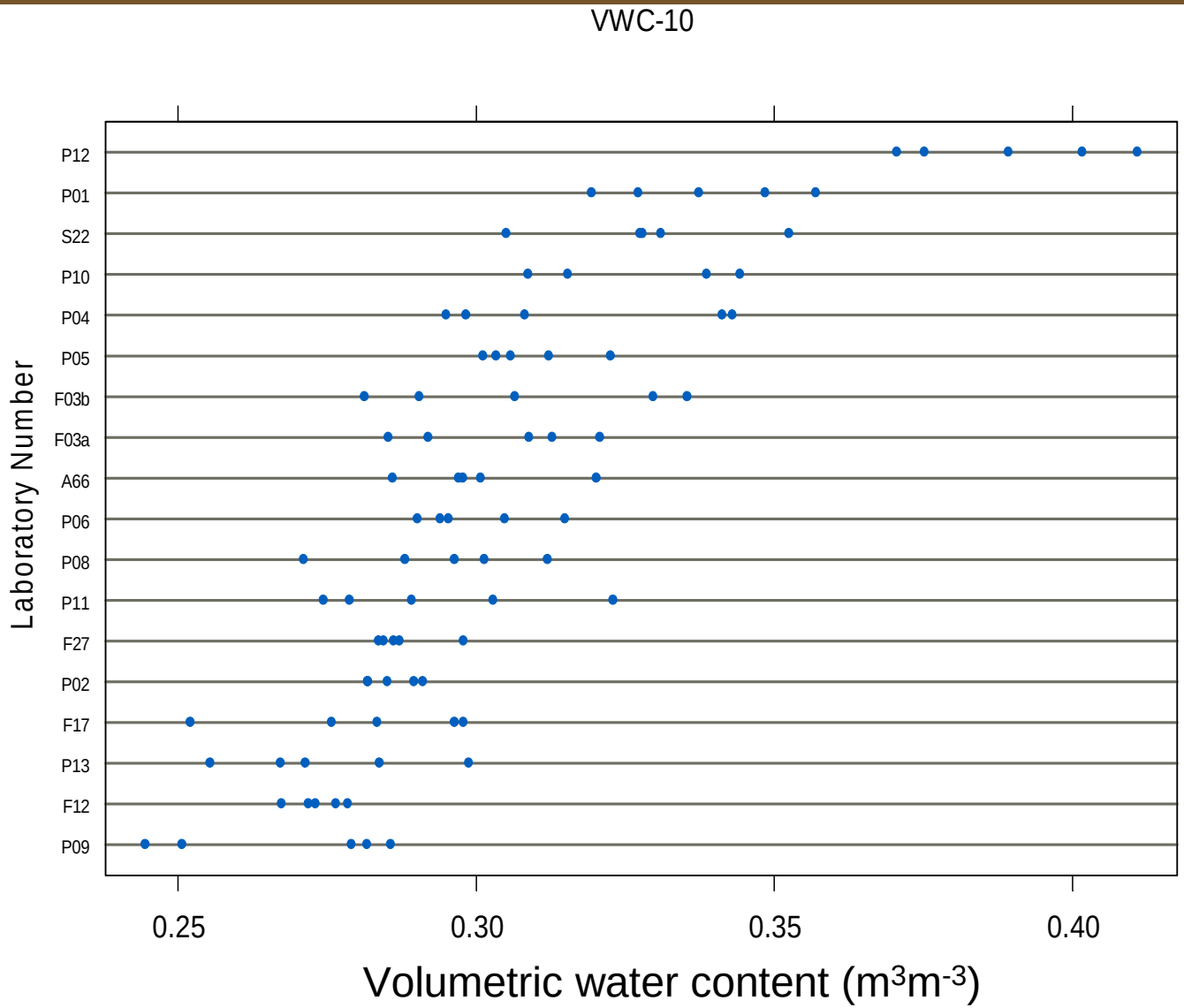
Damage to the samples due to (air ?) transport

Participation

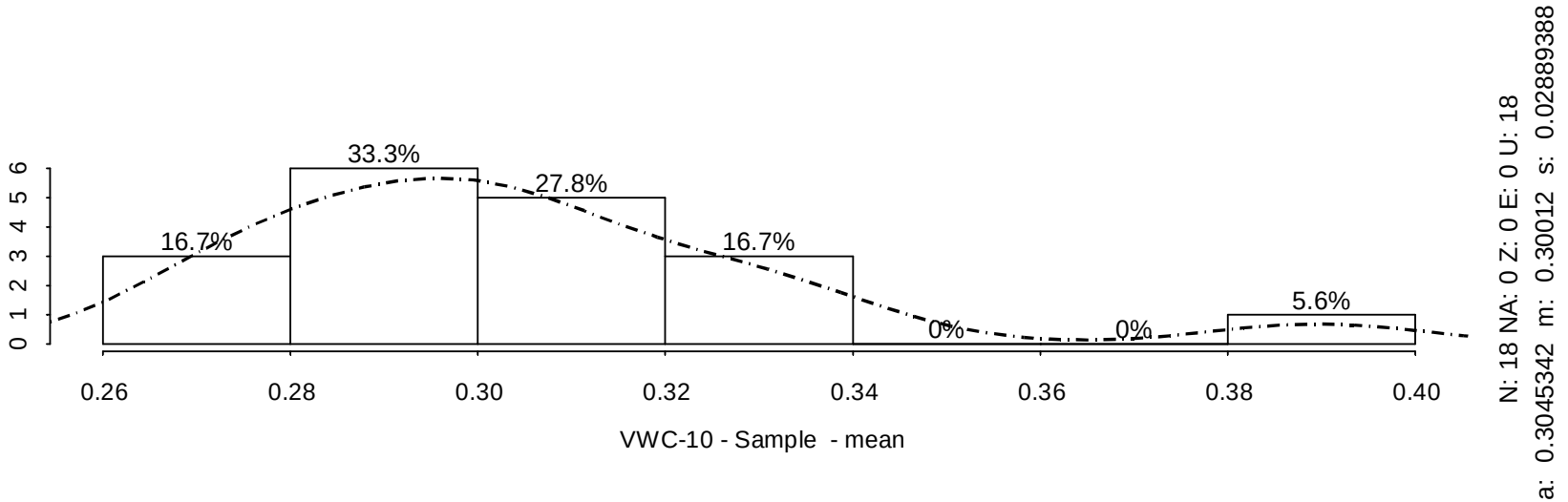
- Registration by 27 labs
- Results submitted by 23 labs
- 3 labs with 2 sets of rings (F03, F15 and F14)
- F15b reported as only lab at –50 kPa = pF 2.7 => not included in stat. analysis

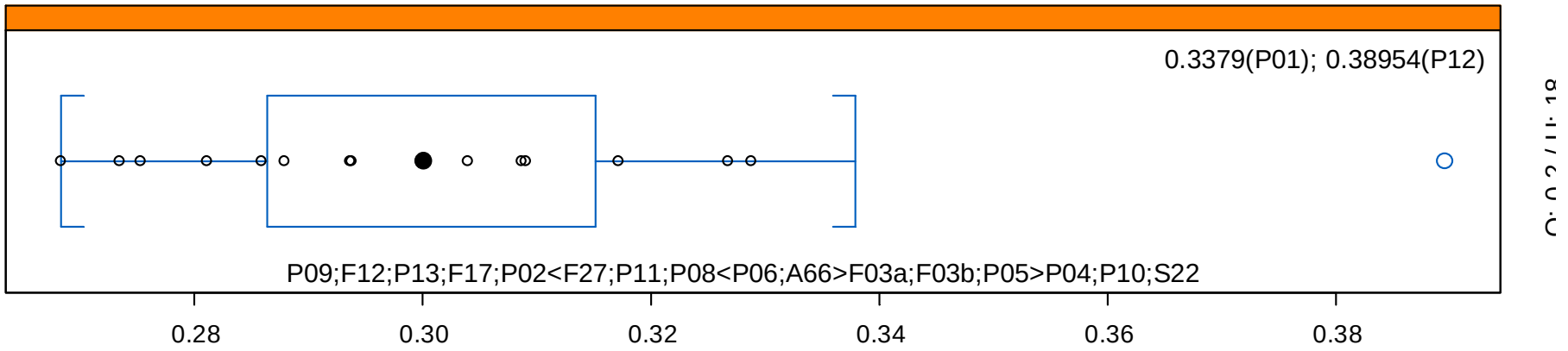
N° reported data	Parameter										
LabID	VWC-0	VWC-1	VWC-5	VWC-10	VWC-33	VWC-50	VWC-100	VWC-250	VWC-1500	dryBD	Total N° submitted results
Mand./Opt./ Not asked	M	M	M	O	M	Not asked	O	O	M	M	
A66	5	5	5	5	5		5		5	5	40
F03a	5	5	5	5	5		5	5	5	5	45
F03b	5	5	5	5	5		5	5	5	5	45
F10	5	5	5		5			5	5	5	35
F12	5	5	5	5	5		5	5	5	5	45
F15a		5	5		5					5	20
F15b						5					5
F17	5	5	5	5	5				5	5	35
F23	5	5	5		5				4	5	29
F27	5	5	5	5	5		5	5	5	5	45
P01	5	5	5	5	5				5	5	35
P02	5	5	5	5	5		5		3	5	38
P04	5	5	5	5	5		5		5	5	40
P05	5	5	5	5	5		5	5	5	5	45
P06	5	5	5	5	5		5	3	5	5	43
P08	5	5	5	5	5				5	5	35
P09	5	5	5	5	5		5		5	5	40
P10	4	4	4	4	4		4	4	4	4	36
P11	5	5	5	5	5		3	3	3	5	39
P12	5	5	5	5	5			5	5	5	40
P13	5	5	5	5	5		5		5	5	40
P14a	5	5	5						5	5	25
P14b					5		5	5	5	5	25
S01	5	5	5		5		5		5	5	35
S04	5	5	5		5				5	5	30
S22	5	5	5	5	5		5	5	5	5	45
Total N° data sets	23	24	24	18	24	1	16	12	24	25	935

Exploratory data analysis

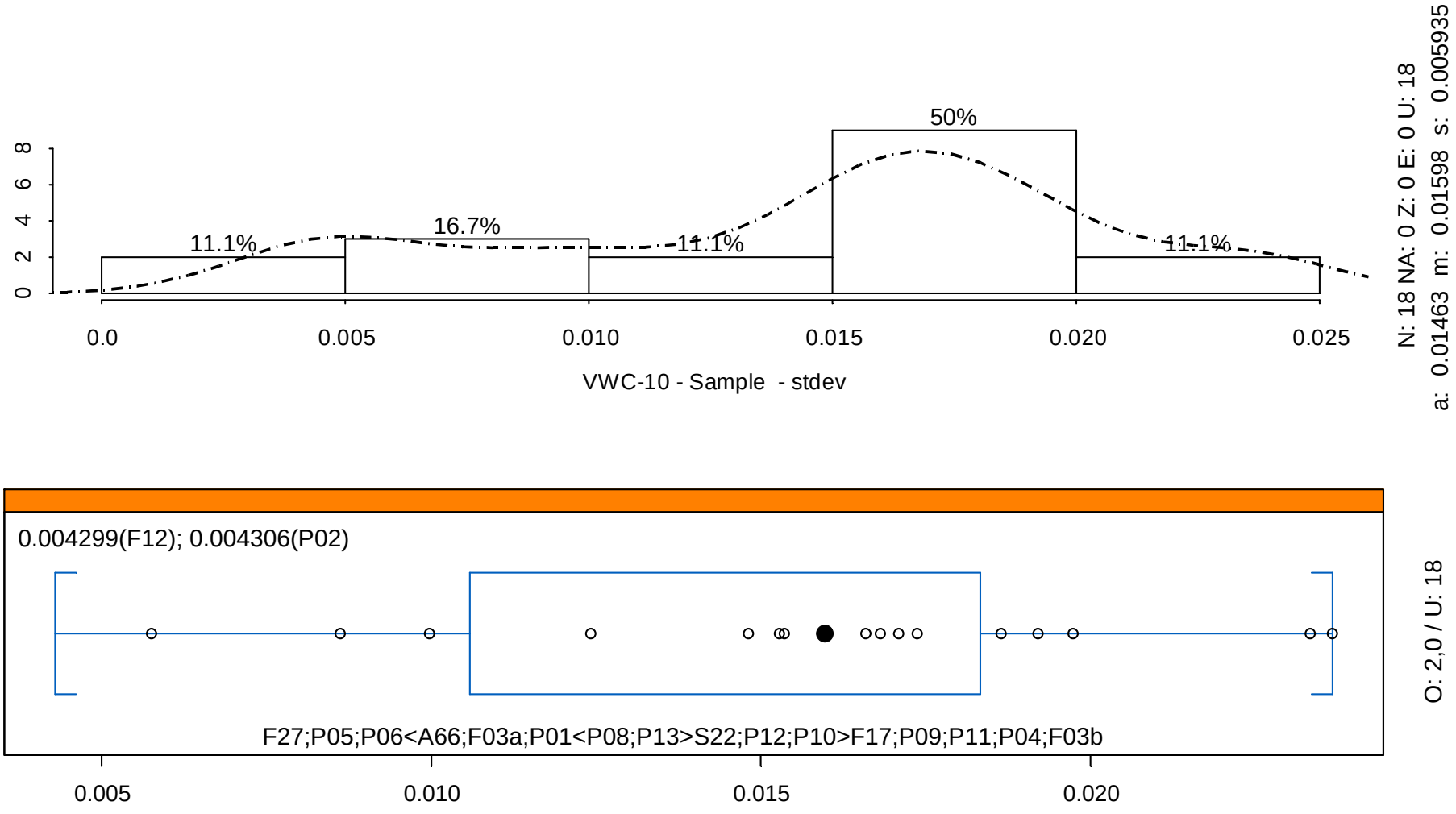


Histogram and boxplot of the mean VWC at – 10 kPa





Histogram and boxplot of the standard deviations of the VWC at– 10 kPa



Statistical data analysis

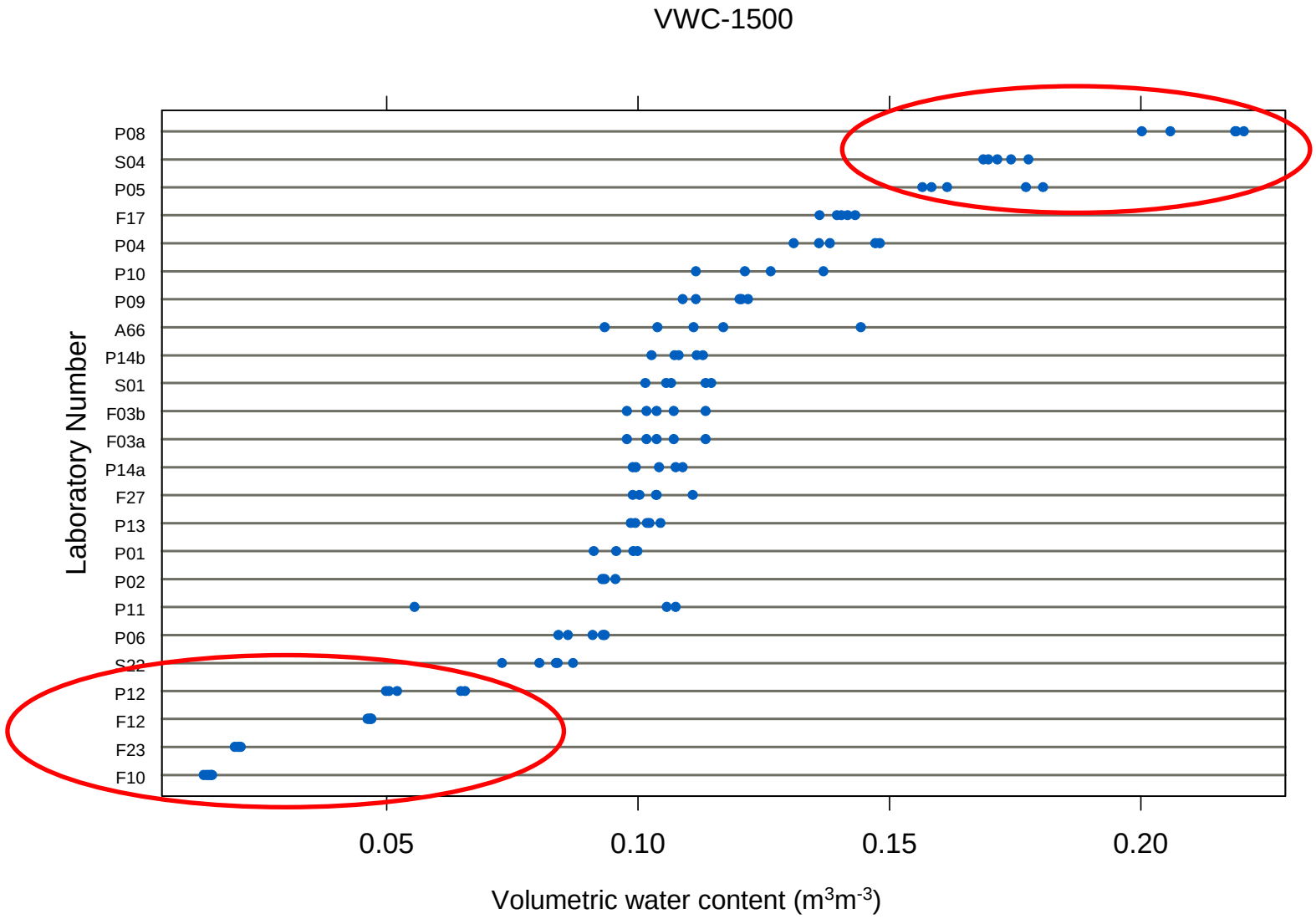
Parameter	Units	M/O	Excluded labs	Step	Tot N° results	N° Labs	General cleaned mean	CV
VWC0	$m^3.m^{-3}$	M	hkP12	2	109	22	0.43	6.42
VWC-1	$m^3.m^{-3}$	M	hP12	2	114	23	0.38	7.46
VWC-5	$m^3.m^{-3}$	M	hP12	2	114	23	0.34	9.54
VWC-10	$m^3.m^{-3}$	O	hP12	2	84	17	0.30	8.18
VWC-33	$m^3.m^{-3}$	M	hP12	2	114	23	0.25	8.68
VWC-100	$m^3.m^{-3}$	O	kP11;kP02	3	69	14	0.20	10.03
VWC-250	$m^3.m^{-3}$	O	kP11	2	52	11	0.15	19.12
VWC-1500	$m^3.m^{-3}$	M	kP11;kA66	3	106	22	0.11	42.32
dryBD	$kg.m^{-3}$	M		1	124	25	1431	4.53

% of variation between and within the labs

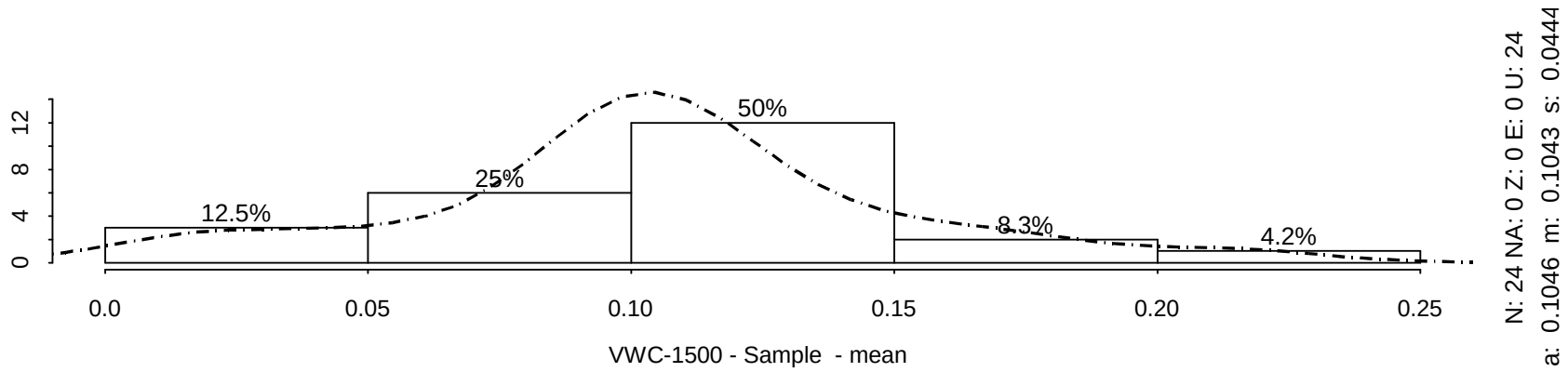
Parameter	CV(%)	% Between lab variance	% Within lab variance
VWC0	6.4	77	23
VWC-1	7.5	78	22
VWC-5	9.5	73	27
VWC-10	8.2	59	41
VWC-33	8.7	80	20
VWC-100	10.0	83	17
VWC-250	19.1	90	10
VWC-1500	42.3	98	2
dryBD	4.5	36	64

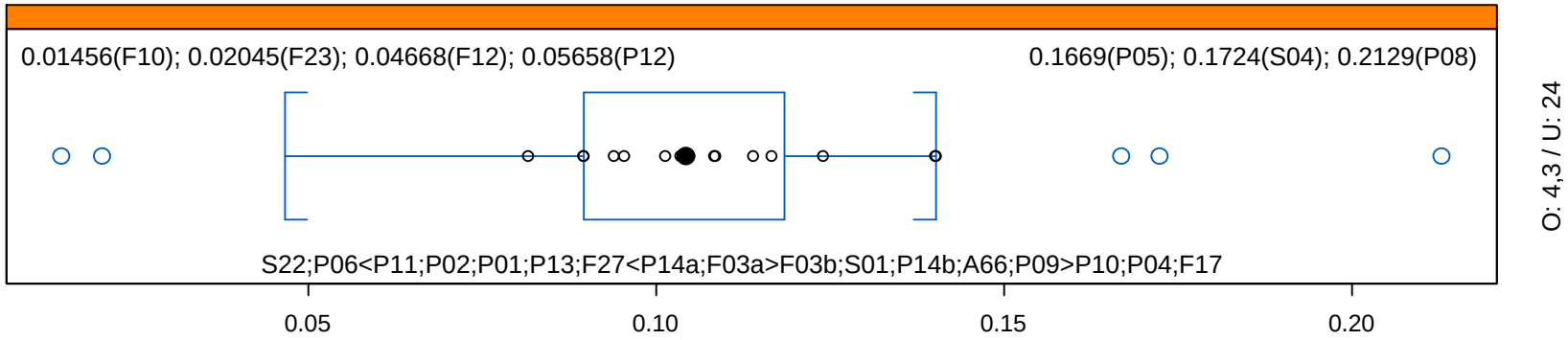
- Most of the variance due to between lab differences, except for dry BD
  - Sample had homogeneous BD
  - High potential to improve comparability between labs for VWC at – 250 and – 1500 kPa
  - Benefit of one central laboratory mainly for high suction/pressure levels

Dot plot of the VWC at – 1500 kPa

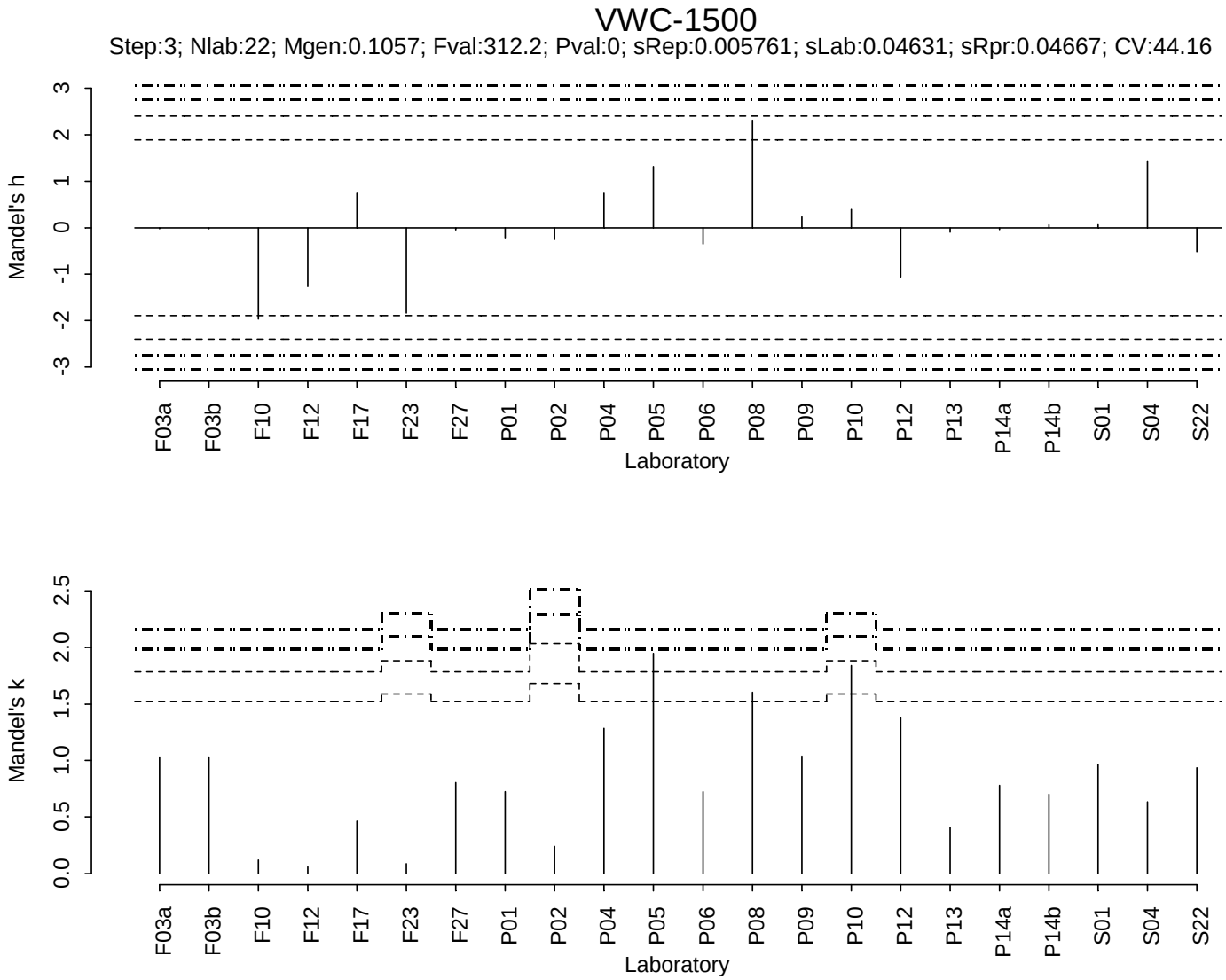


Histogram and dotplot of the mean VWC at – 1500 kPa



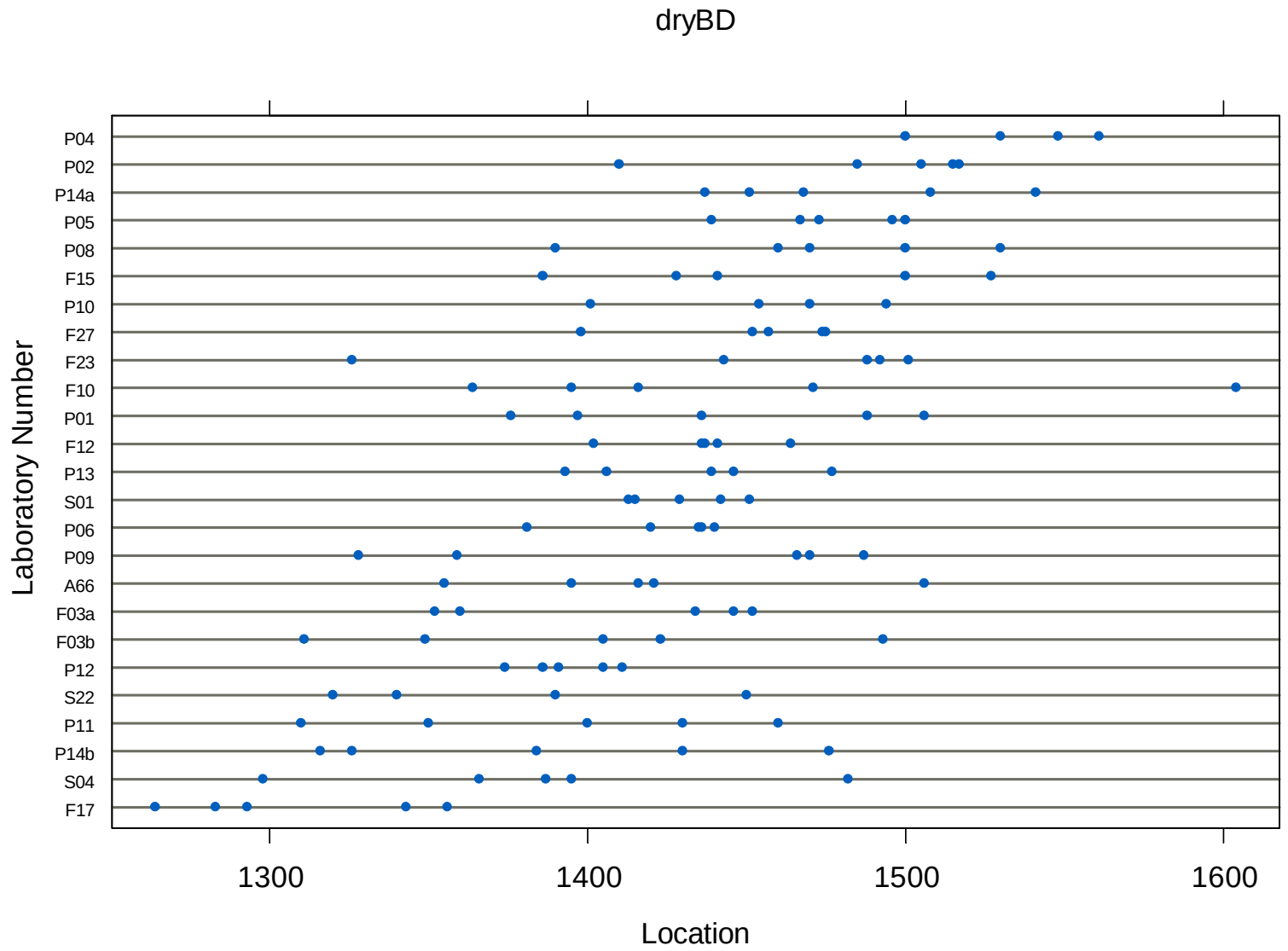


Mandel's h and k plots of the VWC at – 1500 kPa

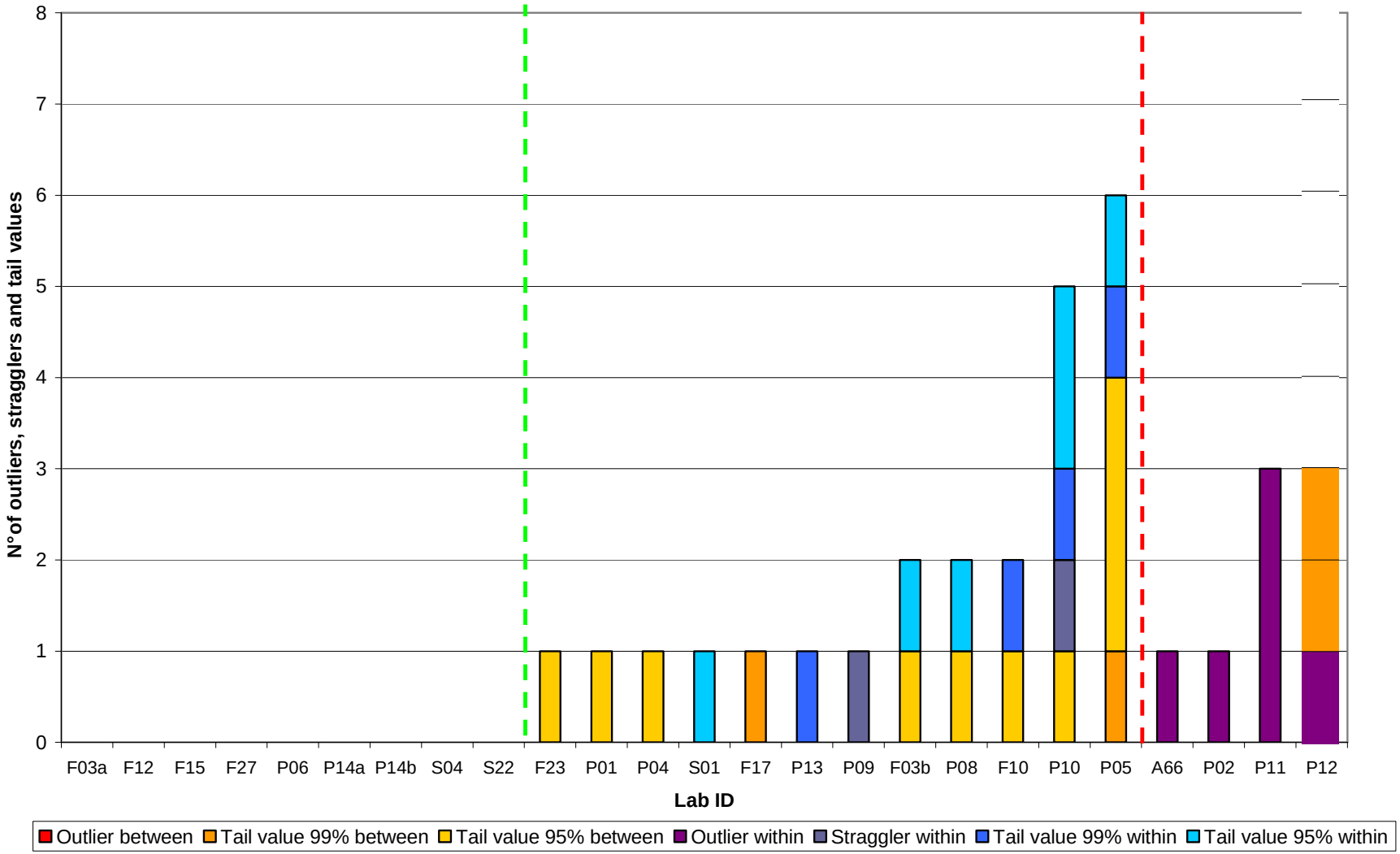


E: kP11;kA66

Variation of the dry bulk density in the ring test



Ranking of the labs



Statistical data analysis: after corrections by lab P12

Parameter	Units	M/O	Exluded labs	Tot N° results	N°labs	General cleaned mean	CV
VWC0	m^3m^{-3}	M	kP12	109	22	0.4316	6.42
VWC-1	m^3m^{-3}	M		119	24	0.3787	7.44
VWC-5	m^3m^{-3}	M		119	24	0.3373	9.44
VWC-10	m^3m^{-3}	O		89	18	0.2957	9.49
VWC-33	m^3m^{-3}	M		119	24	0.2450	9.17
VWC-100	m^3m^{-3}	O	kP11;kP02	69	14	0.1974	10.03
VWC-250	m^3m^{-3}	O	kP11	52	11	0.1449	25.37
VWC-1500	m^3m^{-3}	M	kP11;kA66	106	22	0.1057	44.16
dryBD	$kg\ m^{-3}$	M		124	25	1431	4.53

Too high !

CV should be below 15 %

Soil Water Retention Characteristic

SWRC determined on field samples compared to artificially compacted samples of the same soil horizon

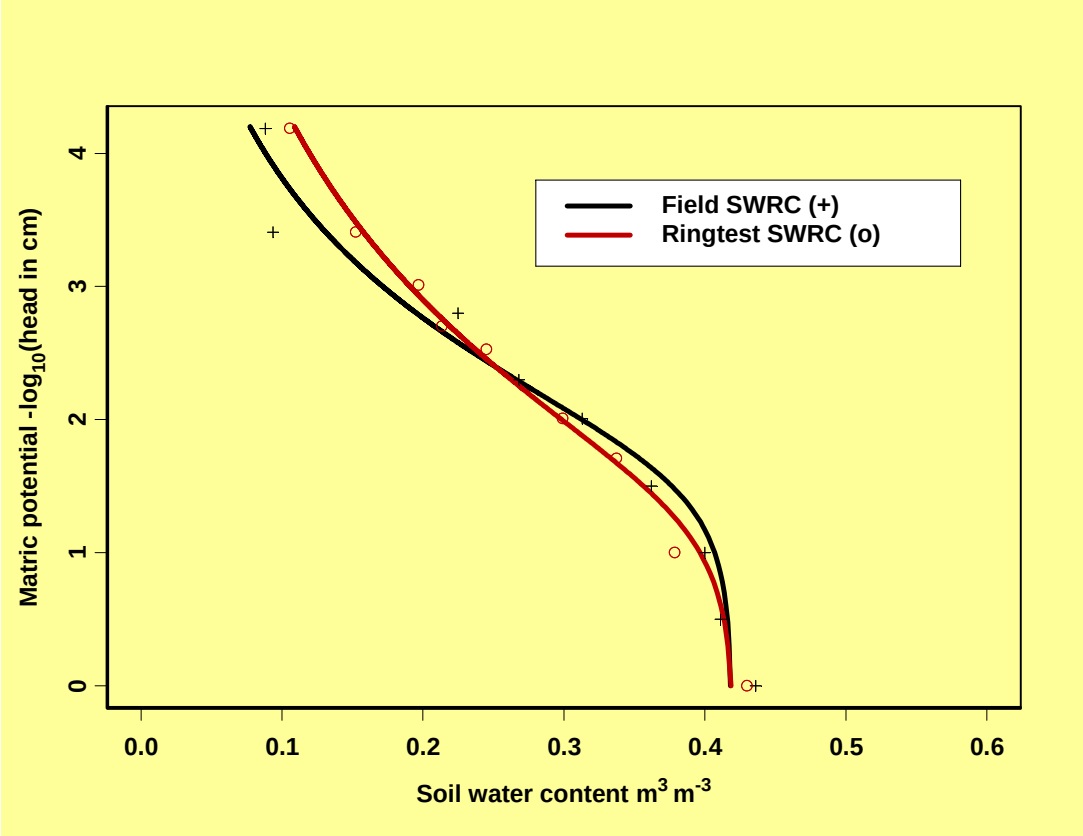
Bulk Density (kg m^{-3})

Sample	Mean	St. dev
Natural Bw hor.	1301	48
Artificial sample	1431	65

When compacted at 100 bar, BD of artificial sample is significantly greater.

Soil Water Retention Characteristic

Fitting the 4 parameter Van Genuchten equation with m=1-(1/n) to mean values

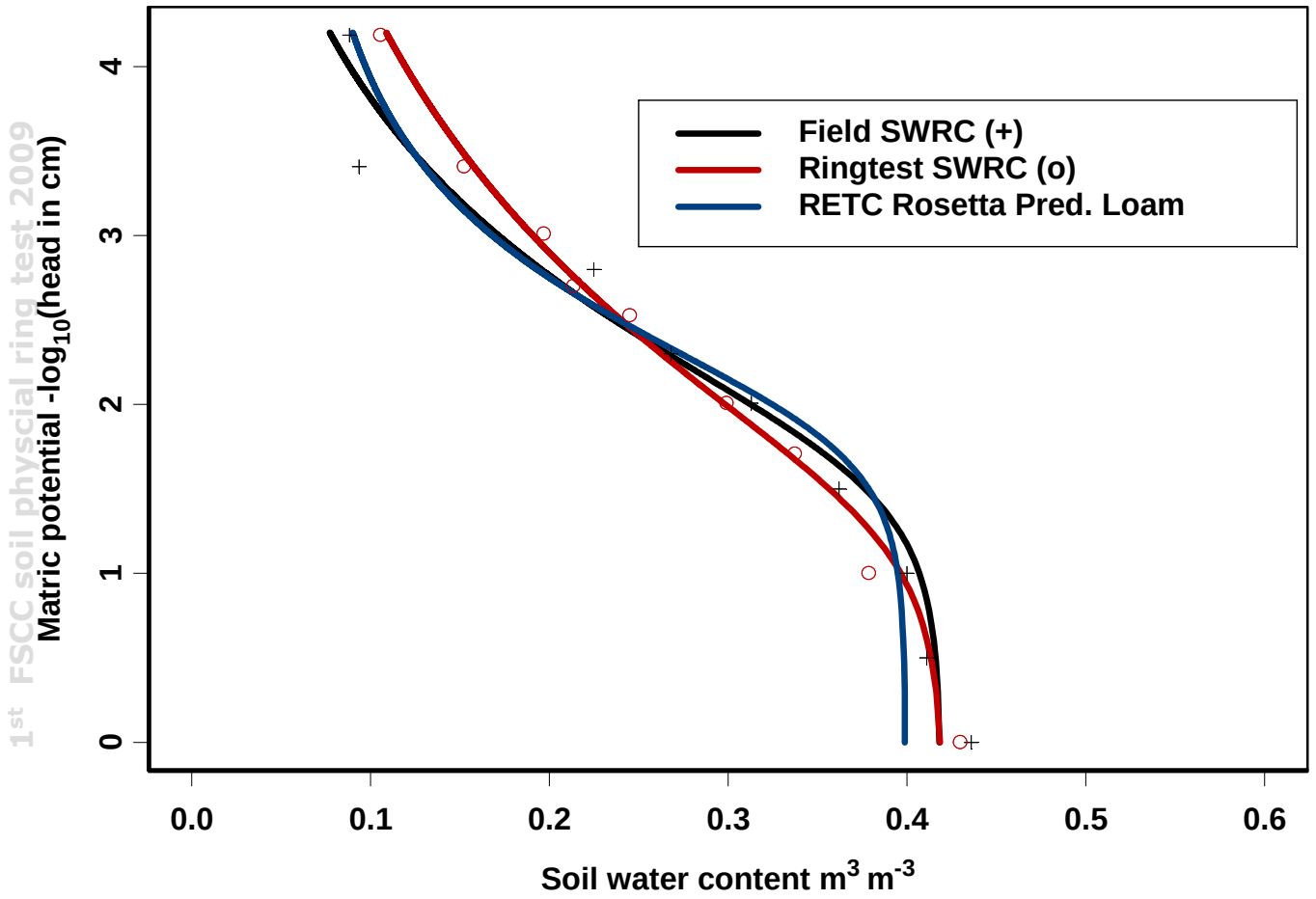


VG parameters mean and [CI95%]		
VG	Field	RT
θ_r	< 0.001	< 0.001
θ_s	0.4189 [.3847, .4531]	0.4204 [.3973, .4435]
α	0.0214 [-.0017, .0445]	0.0478 [.0141, .0815]
n	1.2899 [1.1735, 1.4046]	1.2038 [1.1677, 1.2398]

- Similar VG curves
- At pF 3.4 and 4.2 higher VWC in artificial sample

Soil Water Retention Characteristic

Prediction of VG parameters based on texture class using RETC Rosetta NN PTF



Neural network prediction based on texture class is close to VG fitted SWRCs

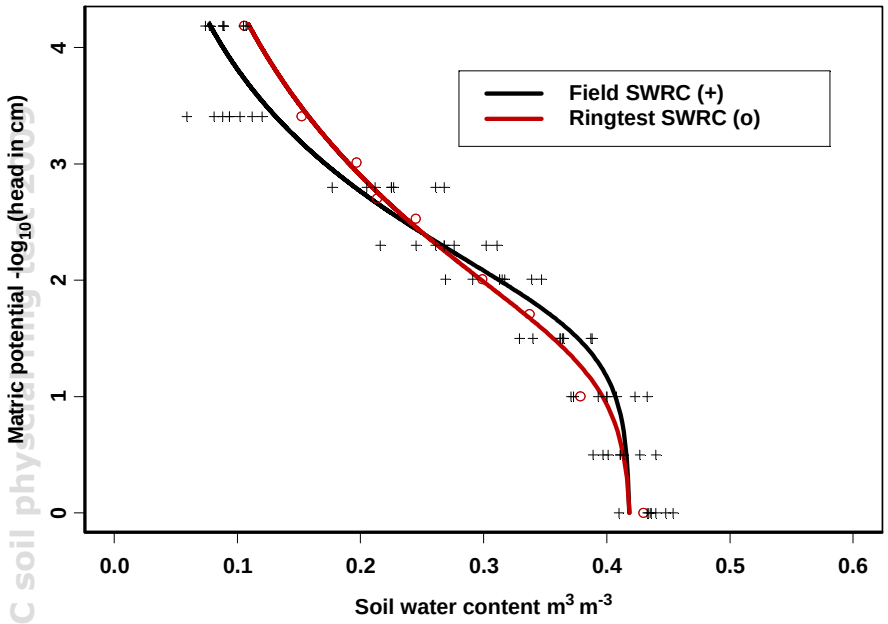
(some deviance for low pressures)

Should be checked for other texture classes !

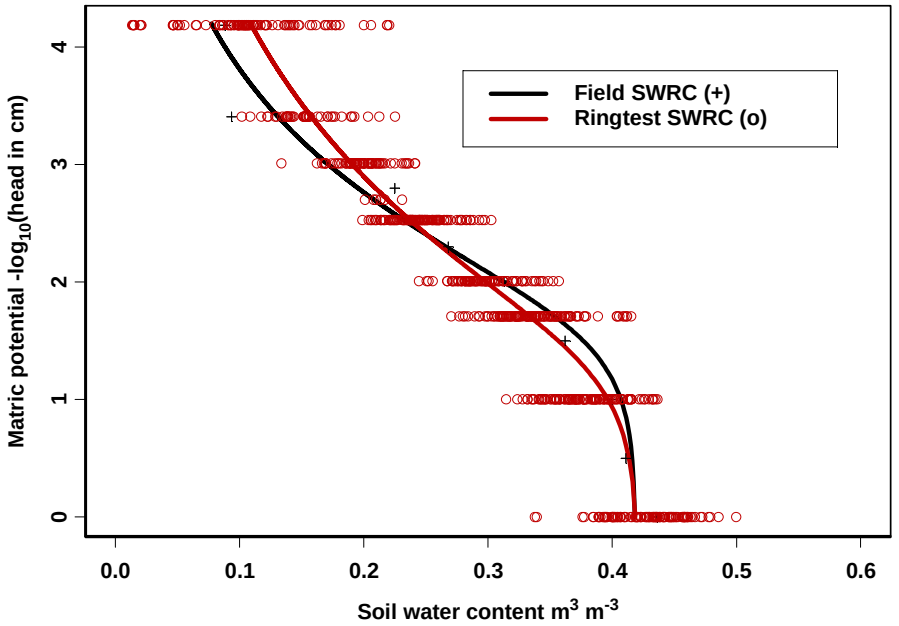
If good agreement for all text classes, still a need for measurements ?

Soil Water Retention Characteristic

Field versus ringtest variation of laboratory observations



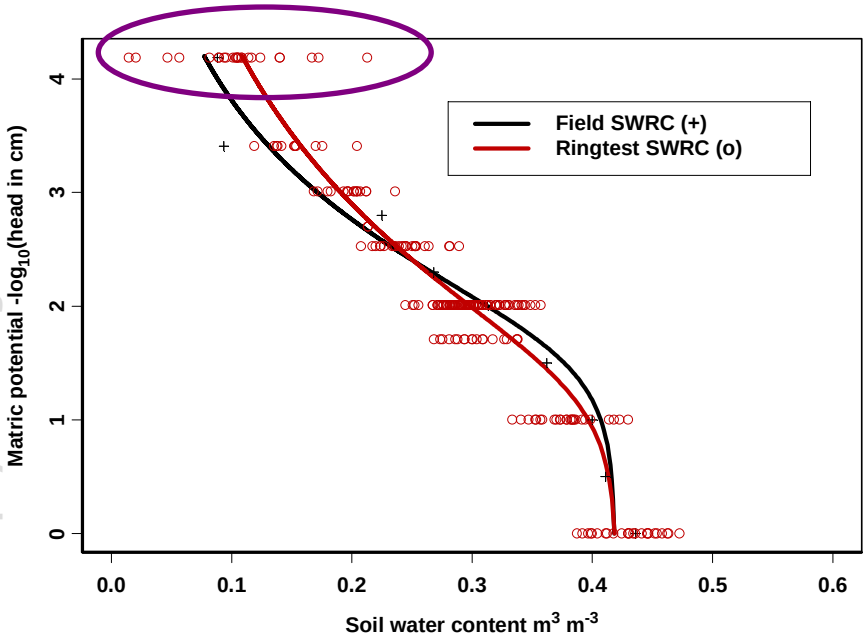
Variation within one lab for field sample

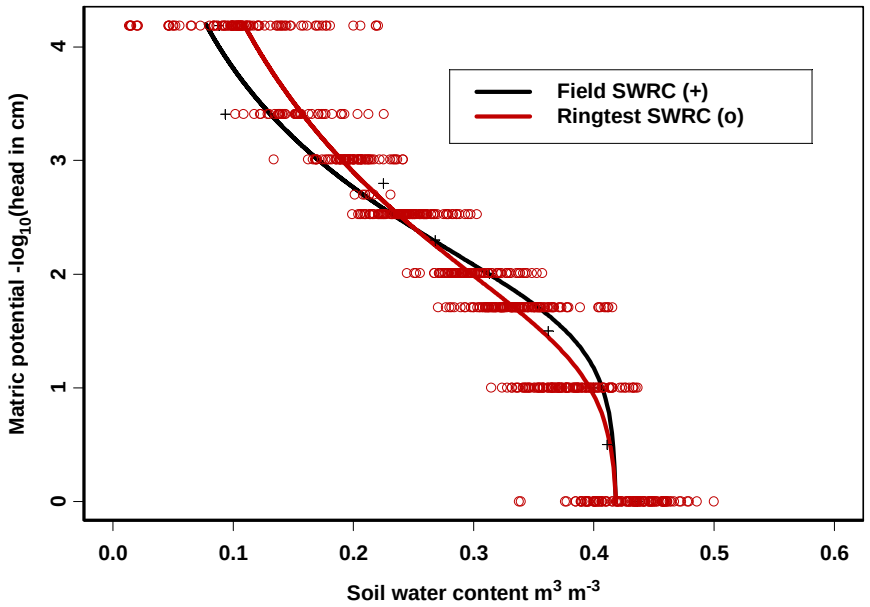


Variation of all measurements of all labs

Soil Water Retention Characteristic

Lab means versus single observations of RT sample





Variation among lab-means

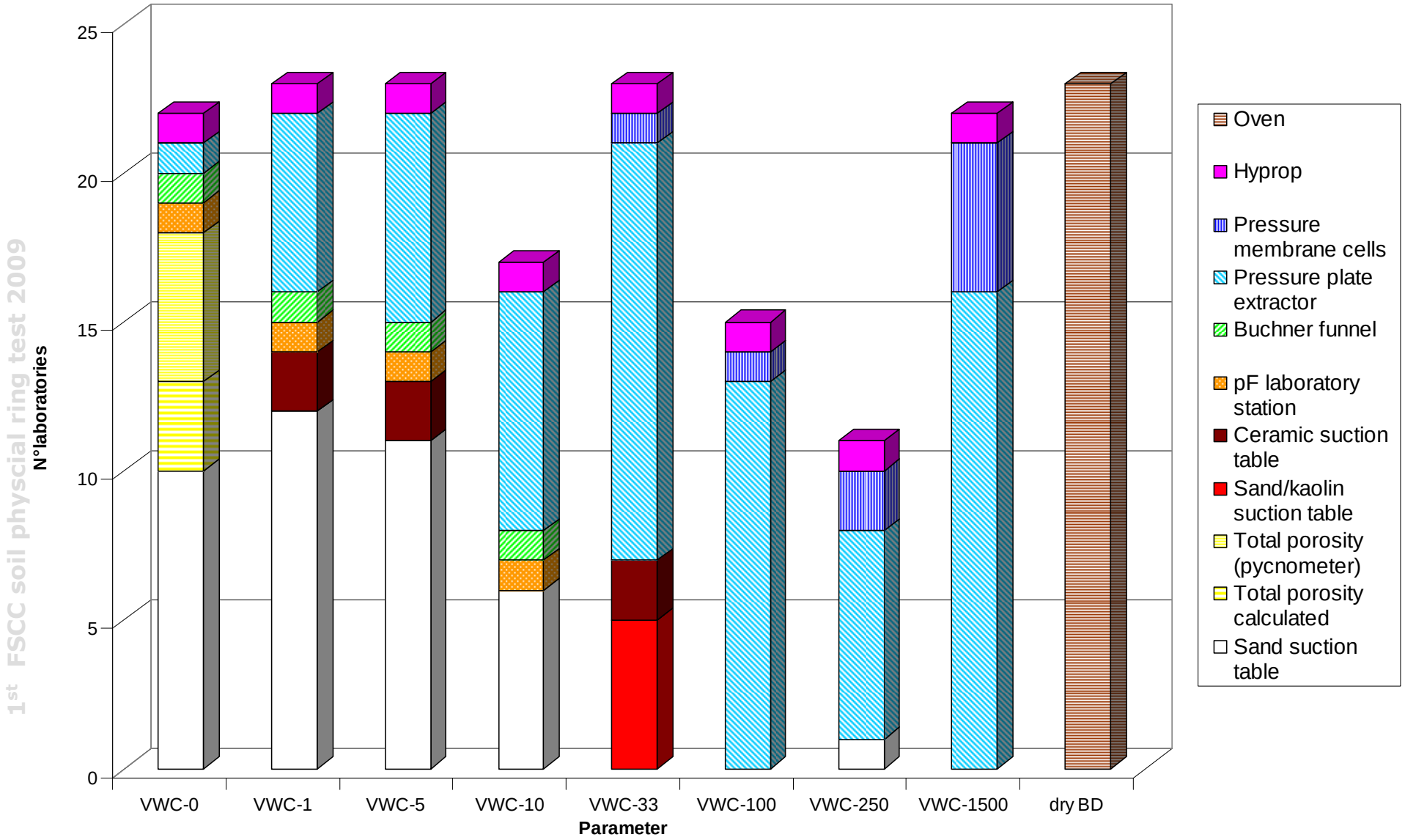
Variation of individual measurements of all labs

Soil Water Retention Characteristics

Between lab Variation in VG parameters and FC, PWP & AWC

Parameter	range	Median	Mean	CV (%)
θ_r	0 -0.15	0	0.0279	187
θ_s	0.3807 - 0.4579	0.4173	0.4216	5.7
α	0.0064 – 0.1500	0.0433	0.0646	81.8
n	1.1500 - 1.5672	1.2344	1.2617	8.1
θ_{FC}	0.202 – 0.251	0.236	0.238	7.8
θ_{PWP}	0.029 – 0.199	0.111	0.114	33.4
AWC	0.066-0.199	0.120	0.124	24.0

Applied methods and instruments



pF station with ceramic plate

Conclusions 1/2

- Good comparability amongst the labs:
  - 6 of the 9 variables: CV < 10 %
- At -250 and -1500 kPa clear need to improve
- Absolutely necessary for the FutMon database to measure the volumetric water content at predefined pressure heads
  - E.g. Lab P12
- Hyprop instrument:
  - No significant differences
  - Accepted but not promoted:
    - No measurement at 4.2 kPa which is very important
    - Time efficiency

Conclusions 2/2

- Bulk density measurements are quite accurate
  - Important for mass to volume conversions
- Average ringtest SWRC is similar to field sampled SWRC => artificial undisturbed samples are adequate
- Rosetta predicted Van Genuchten parameters based on texture class provides a good estimate of the SWRC
- Among labs, the VG parameter variation: $\theta_r > \alpha > \theta_{PWP}$
- Better performance of labs is expected for -1500 kPa results (PWP), because it affects also AWC
- 7 out of 23 labs perform badly for this matric head and they should assess the sources of this deviance and take adequate action
- A second physical ringtest would be beneficial to test improvements, based on field sampled cores taken in soils with variable texture classes

More information?

- Ring test reports and graphs can be downloaded from the FSCC homepage FSCC.inbo.be
  - Soil physical ring test (http://www.inbo.be/content/page.asp?pid=ringtest)
  - 6th FSCC Interlaboratory Comparisons and previous ones (http://www.inbo.be/content/page.asp?pid=EN_MON_FSCC_comparison)
  - FSCC soil reference material (http://www.inbo.be/content/page.asp?pid=EN_MON_FSCC_soil_reference_material)

Thank you for your attention