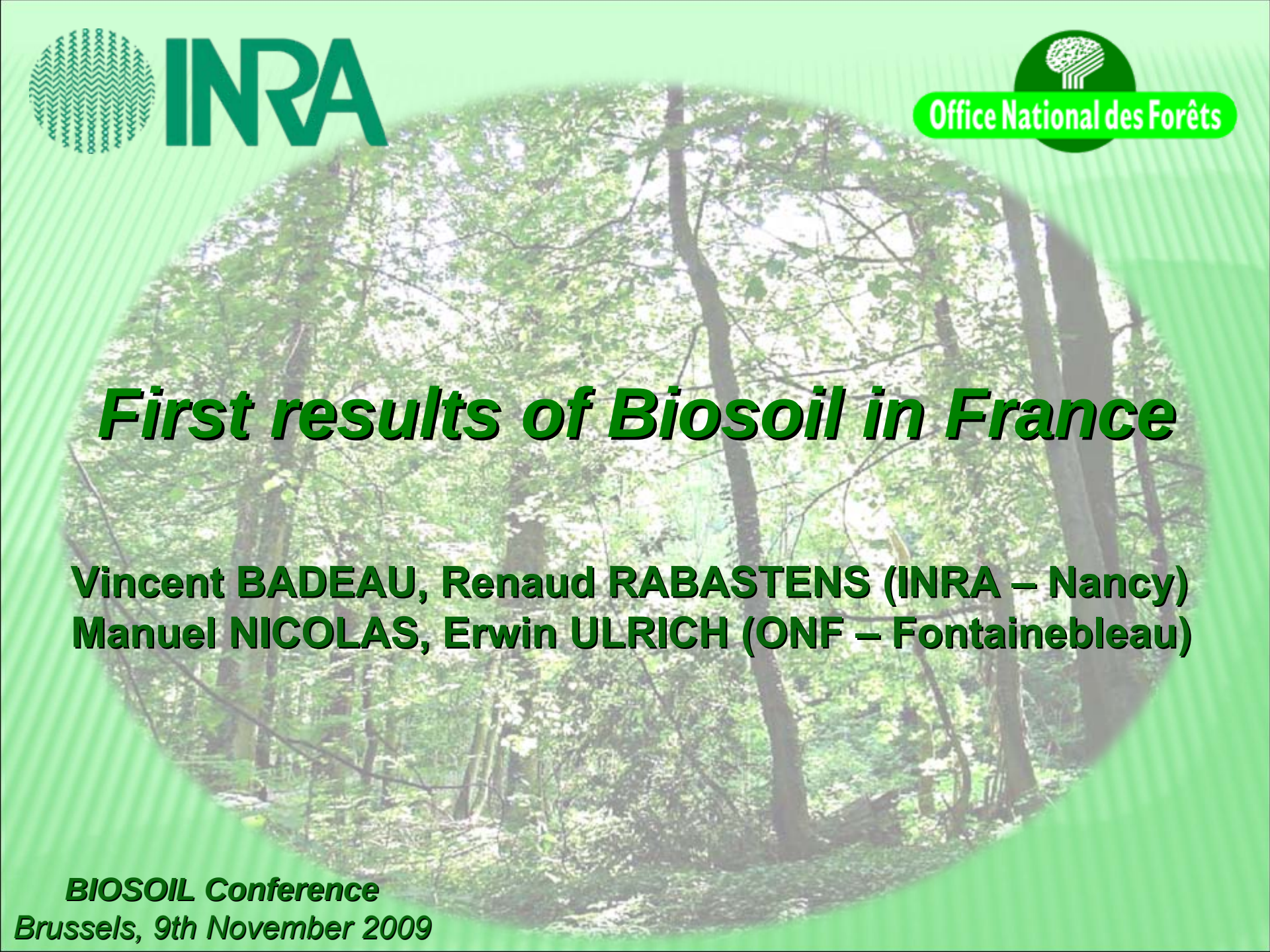


First results of Biosoil in France

Vincent BADEAU, Renaud RABASTENS (INRA – Nancy)
Manuel NICOLAS, Erwin ULRICH (ONF – Fontainebleau)

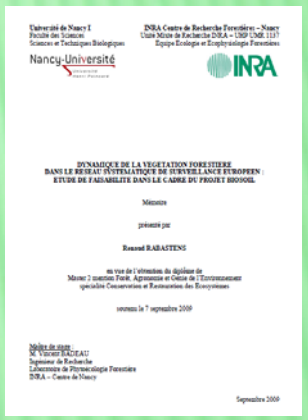
BIOSOIL Conference
Brussels, 9th November 2009

First comparisons between two campaigns

LEVEL 1 PLOTS:

Renaud RABASTENS (Master's degree – Nancy University – 6 months)

→ **Floristic inventories**
- homogenization of species names
- inconsistencies
- changes in floristic composition


Université de Nancy I
Faculté des Sciences
Sciences et Techniques Biologiques

Nancy-Université

INRA Centre de Recherche Forestière – Nancy
Unité Mixte de Recherche INRA – UHP UMR 1137
Equipe Ecologie et Ecophysiologie Forestières

INRA

DYNAMIQUE DE LA VEGETATION FORESTIERE
DANS LE RESEAU SYSTEMATIQUE DE SURVEILLANCE EUROPEEN :
ETUDE DE FAISABILITE DANS LE CADRE DU PROJET BIOSOIL

Mémoire

présenté par

Renaud RABASTENS

en vue de l'obtention du diplôme de
Master 2 mention Forêt, Agronomie et Génie de l'Environnement
spécialité Conservation et Restauration des Ecosystèmes

soutenu le 7 septembre 2009

Maître de stage :
M. Vincent BADEAU
Ingénieur de Recherche
Laboratoire de Phytoécologie Forestière
INRA – Centre de Nancy

Septembre 2009

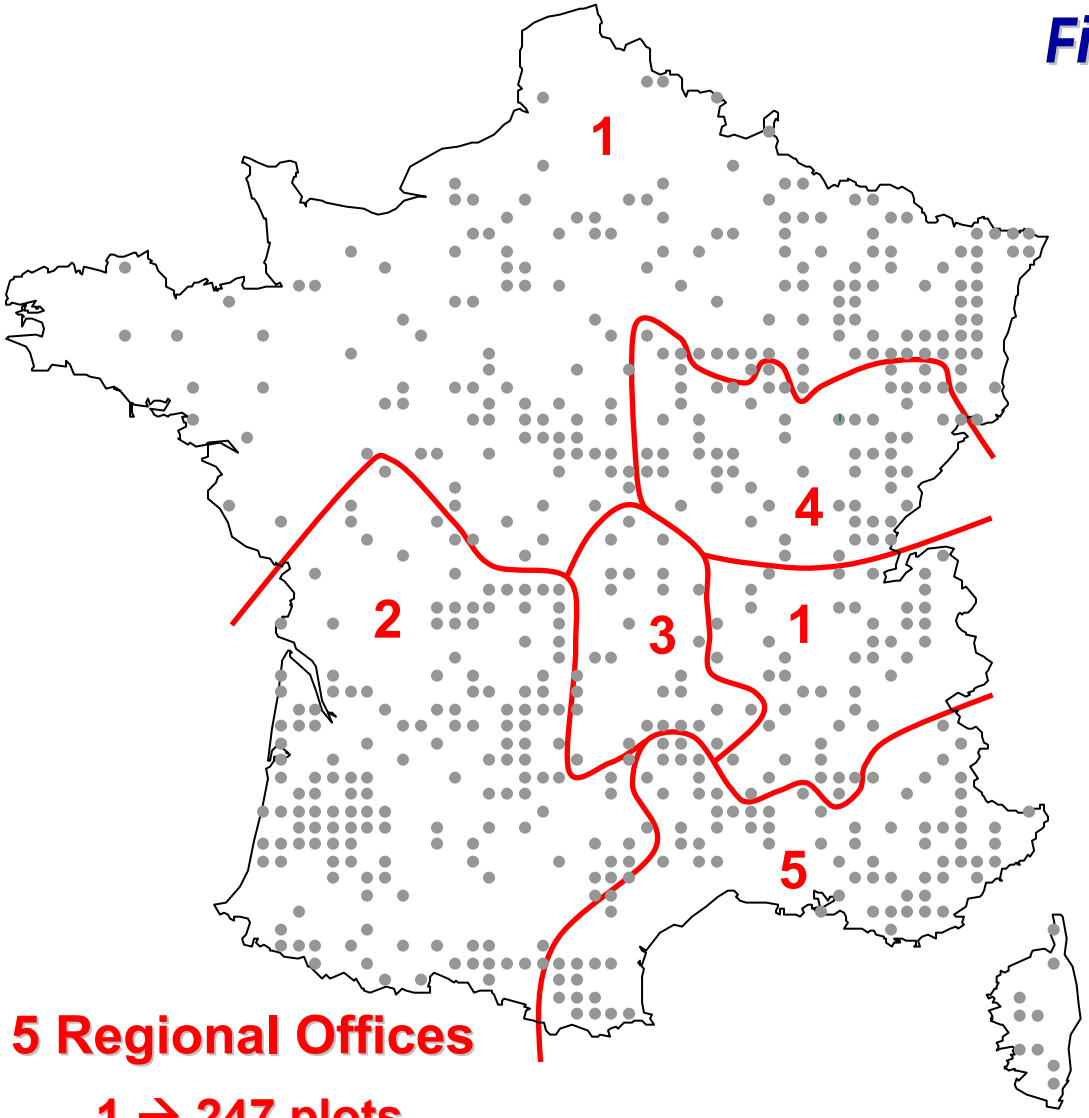
→ **Soil analyses**
- inconsistencies
- potential changes

LEVEL 2 PLOTS:

Manuel NICOLAS & Erwin ULRICH – National Forest Office
RENECOFOR network

→ **Soil analyses (10 sites)**

First Campaign (1993-1994)
ICP-Forests



5 Regional Offices

- 1 → 247 plots
- 2 → 152 plots
- 3 → 27 plots
- 4 → 60 plots
- 5 → 86 plots

573 level 1 plots

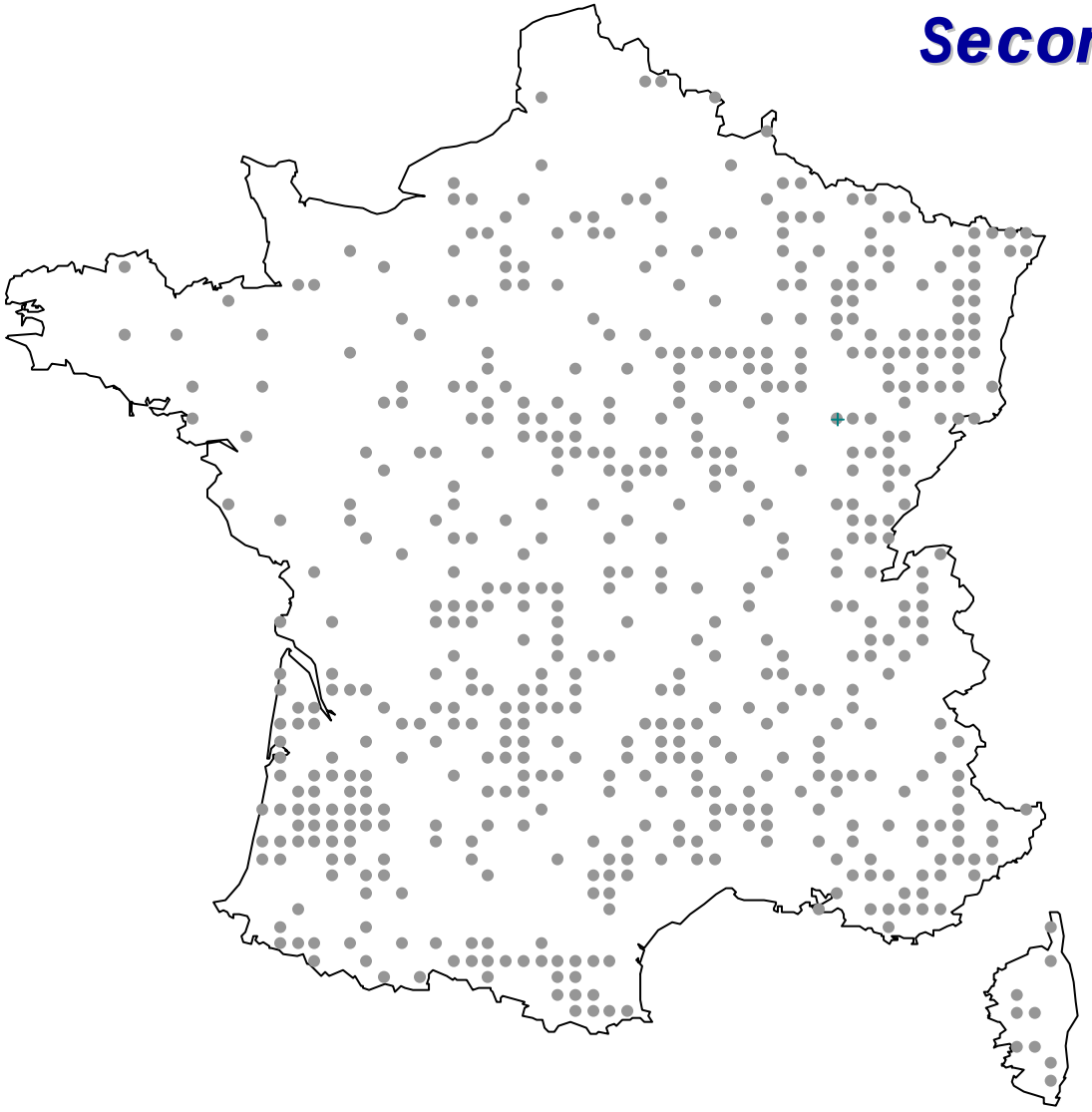
general informations
physical environment
soil description
floristic description
dendrometric measurements

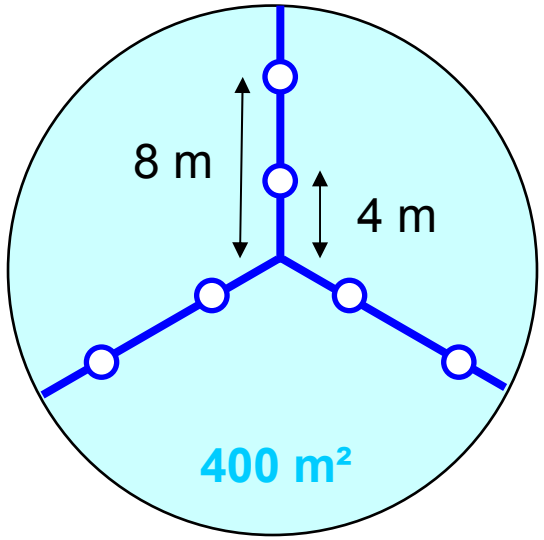
1 profile pit

1 sample / mandatory layer

L+F / H / M01 / M12 / M24 / M46

Second Campaign (2006-2007)
BIOSOIL





6 sub-samples

↓

1 composite sample / depth (±3kg)

↓

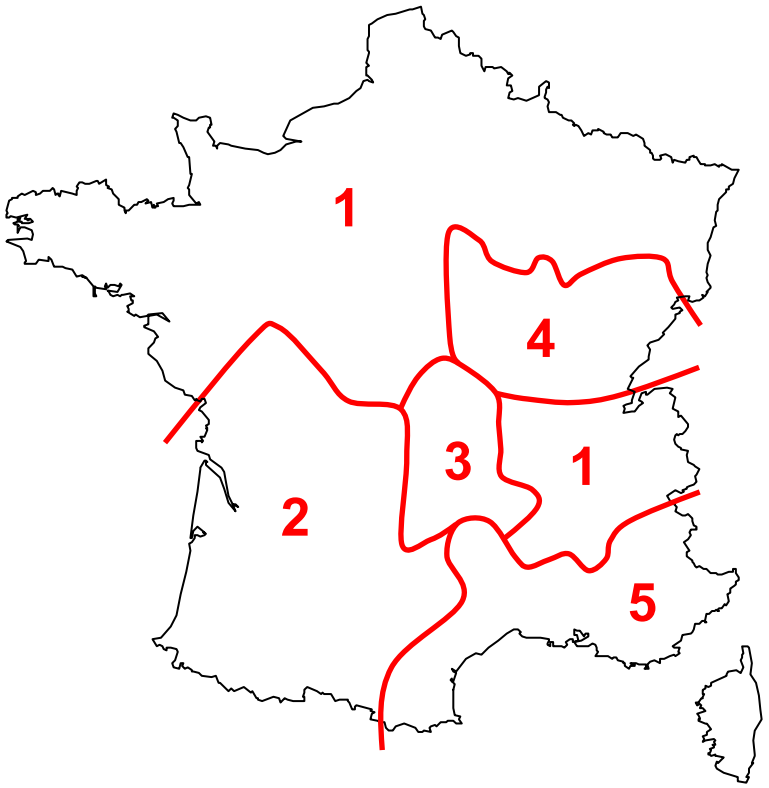
INRA – Arras (analyses)

↓

INRA – Orléans + JRC (results)

Field operations → National Forest Inventory
557 visited sites / 545 sampled

Floristic inventories



1st campaign → 956 species (21.5 / plot)
2nd campaign → 1046 species (28.5 / plot)

1	→ 24.1 / 28.3	→ +4.2	}	68%
2	→ 20.6 / 24.8	→ +4.1		
3	→ 23.1 / 32.4	→ +9.3	}	32%
4	→ 20.0 / 34.1	→ +14.1		
5	→ 17.0 / 30.4	→ +13.4		

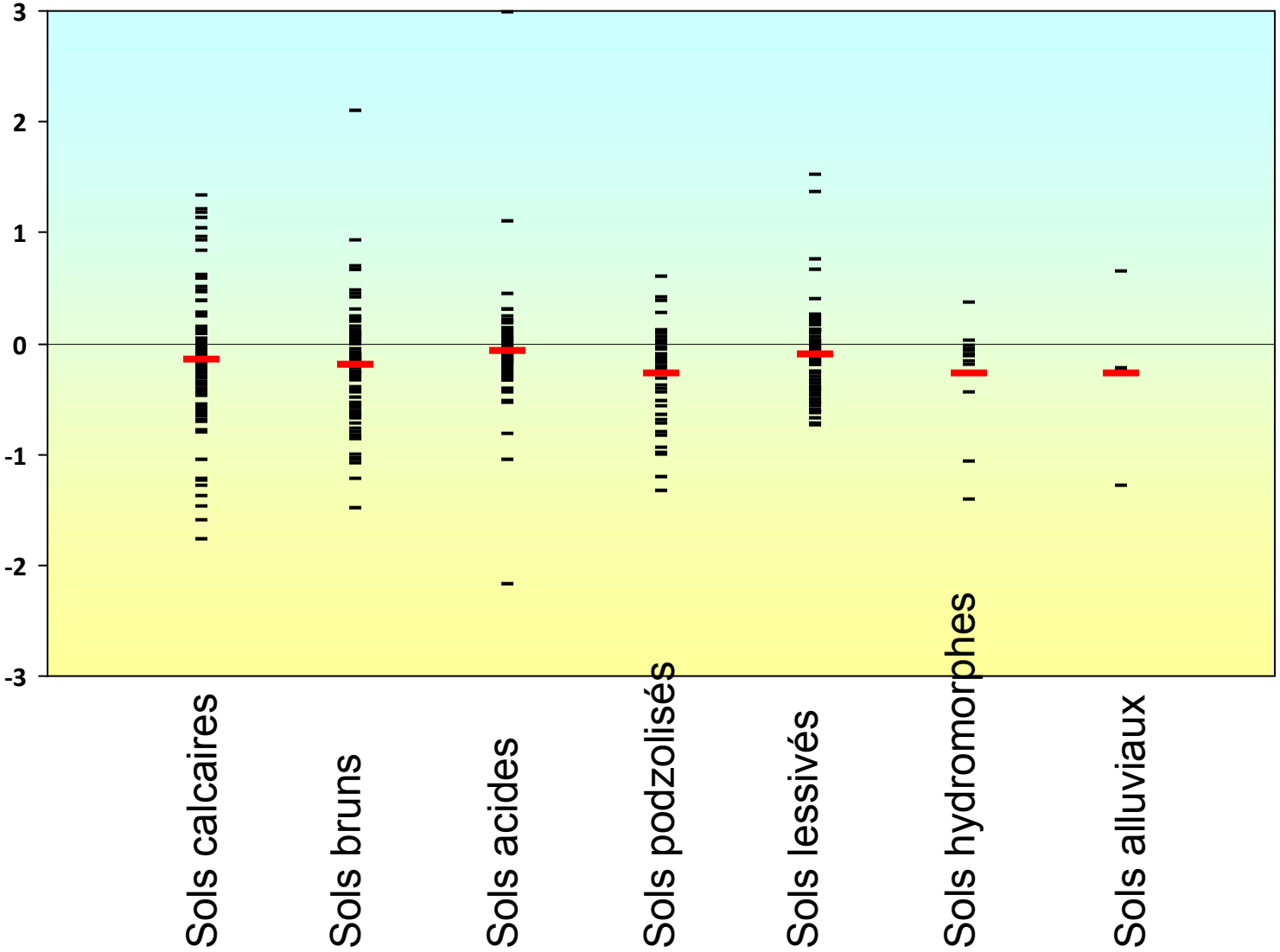
710 species common to both campaign

Ellenberg	L & K	↘	***
	N	↗	***
	T	↗	**
	R	↘	*
	F	=	
Gégout	C/N	↘	**
	pH & S/T	=	

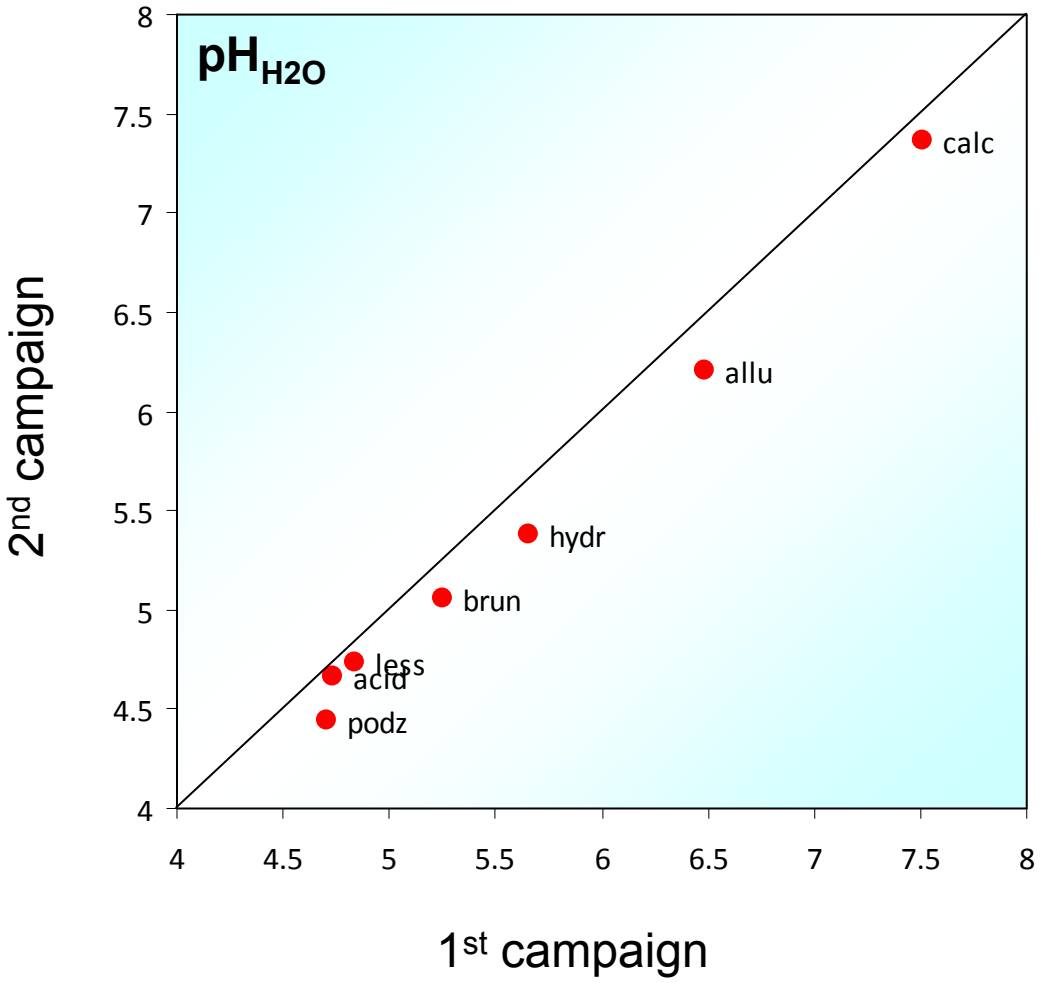
ΔpH_{H2O} – M12

(Camp_2 – Camp_1)

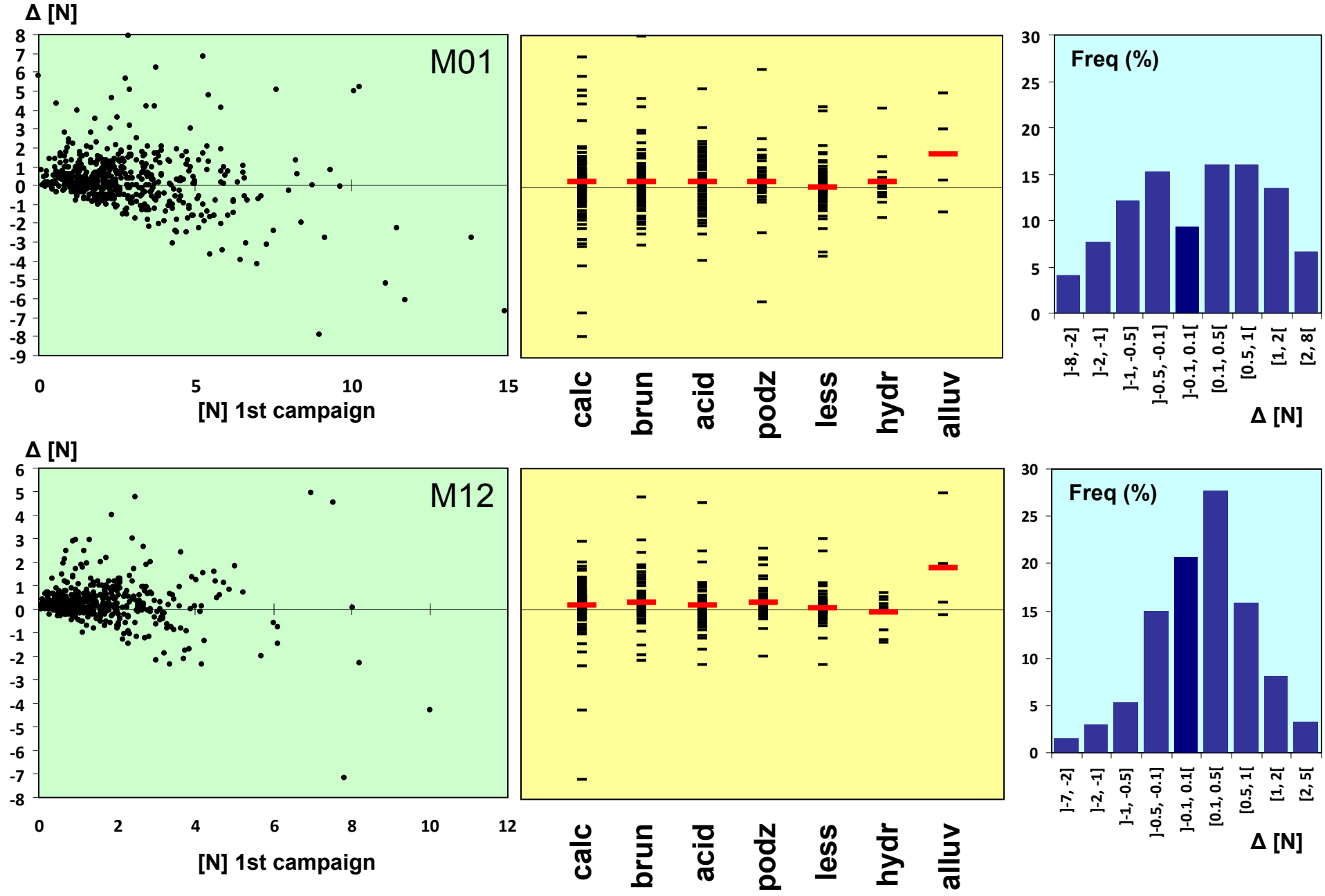
25% analyses with |ΔpH| > 0.5



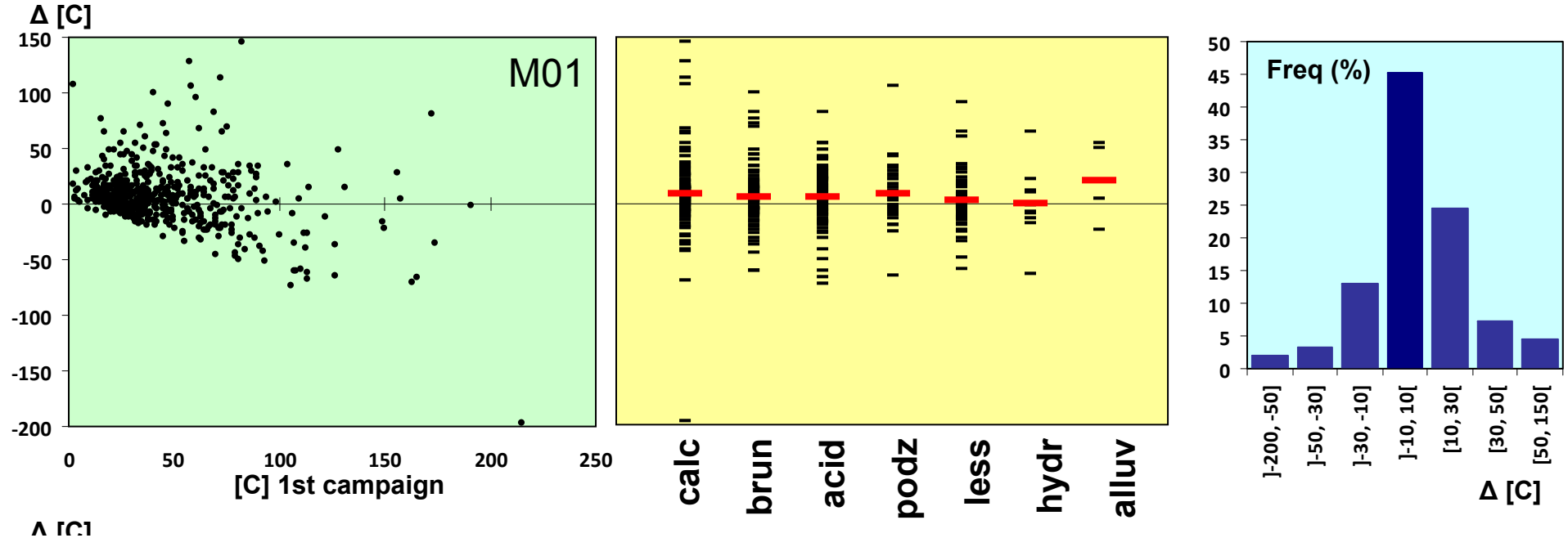
Soil analyses

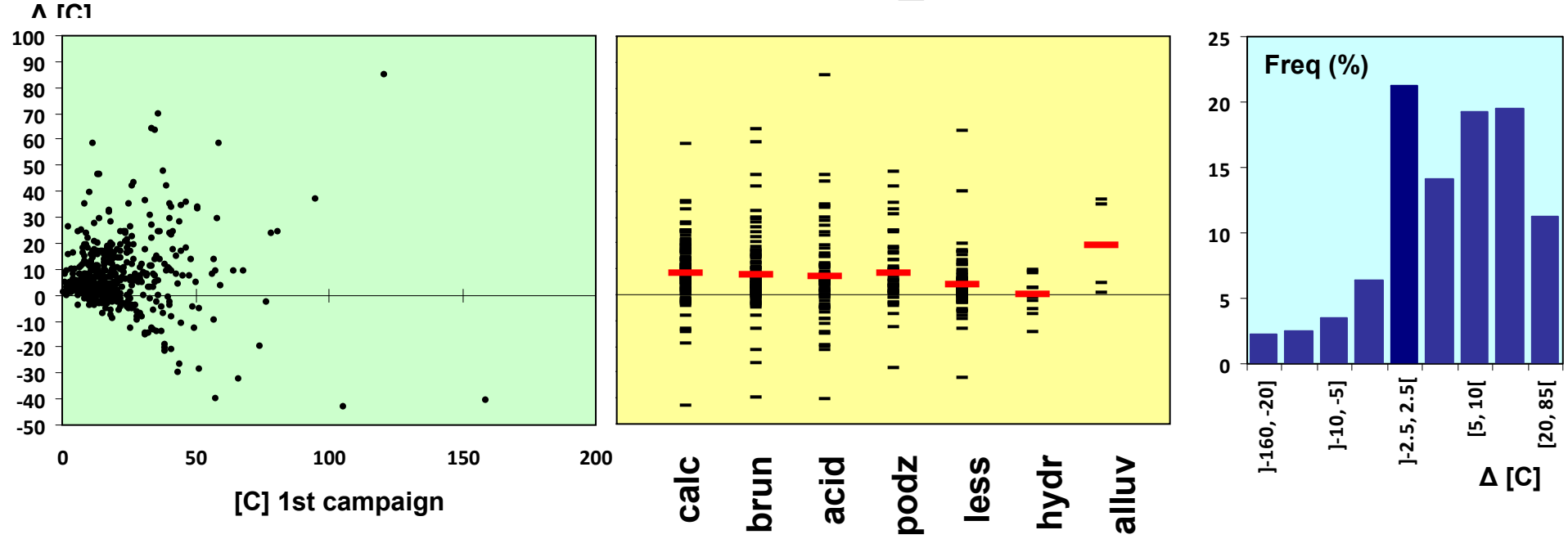


Nitrogen (g/kg)

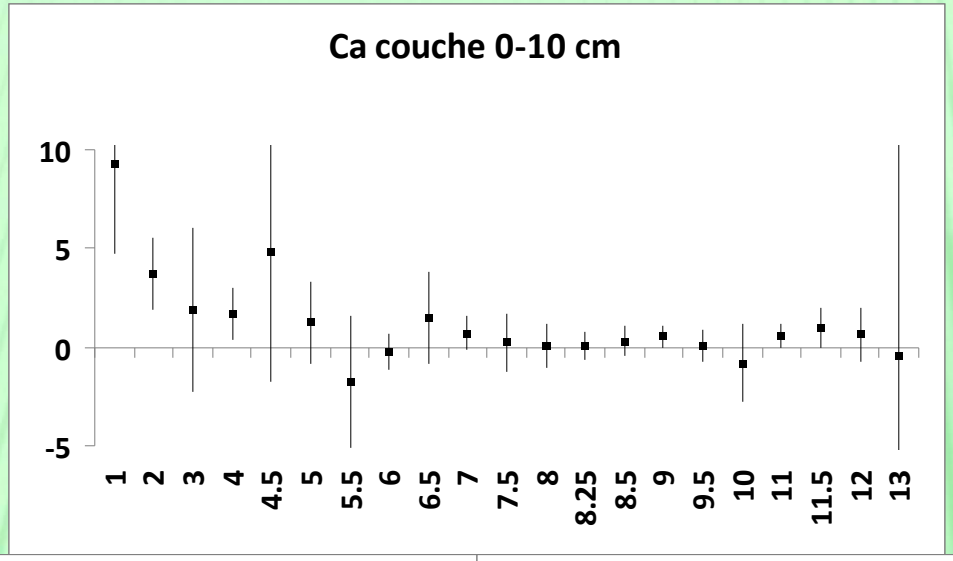


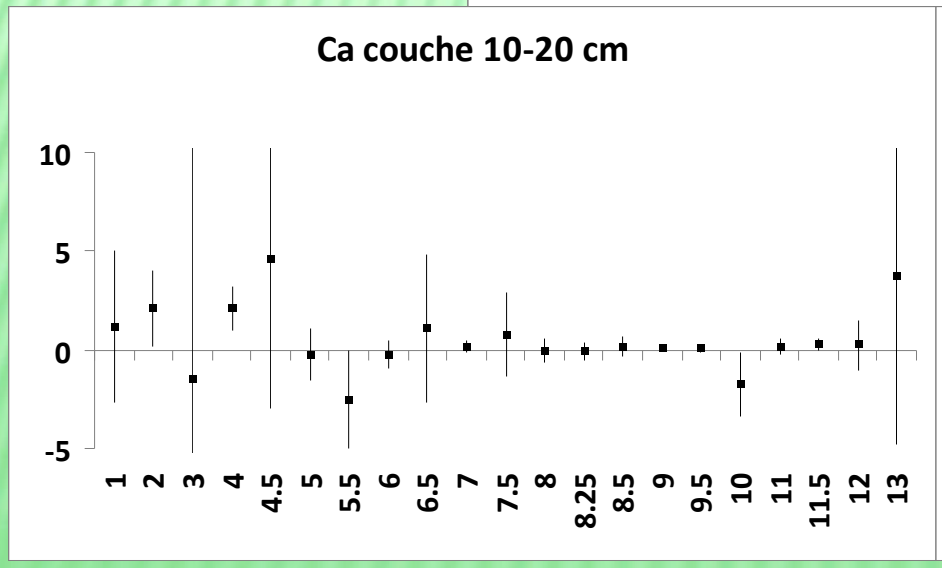
Carbon (g/kg)

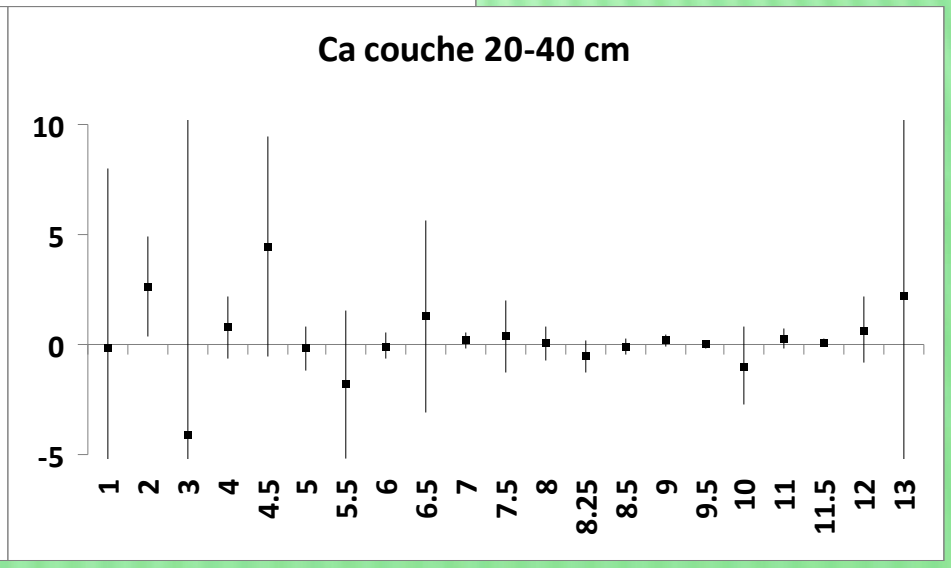

Δ [C]
M01
[C] 1st campaign
calc
brun
acid
podz
less
hydr
alluv
Freq (%)
]-200, -50]
]-50, -30]
]-30, -10]
]-10, 10[
[10, 30[
[30, 50[
[50, 150[
Δ [C]


Δ [C]
[C] 1st campaign
calc
brun
acid
podz
less
hydr
alluv
Freq (%)
]-160, -20]
]-10, -5]
]-2.5, 2.5[
[5, 10[
[20, 85[
Δ [C]

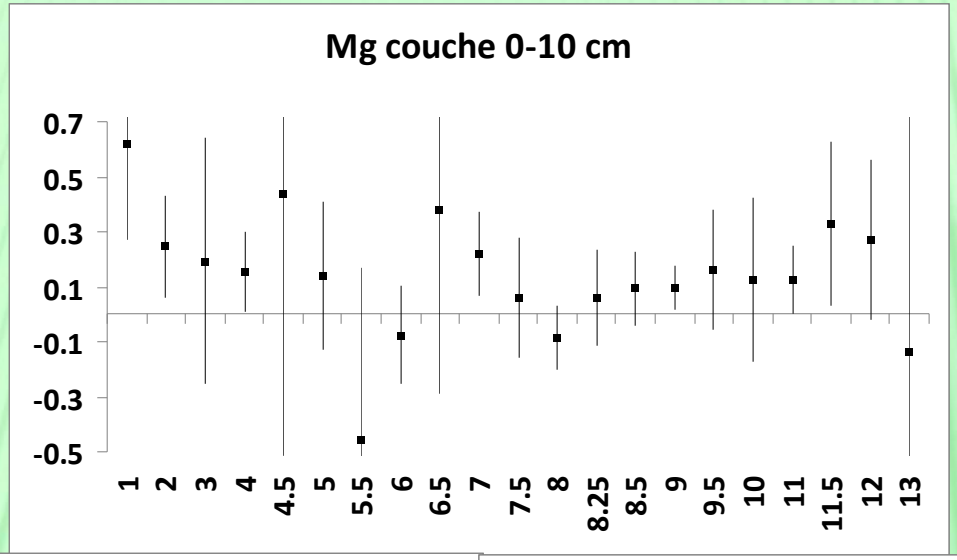
Calcium

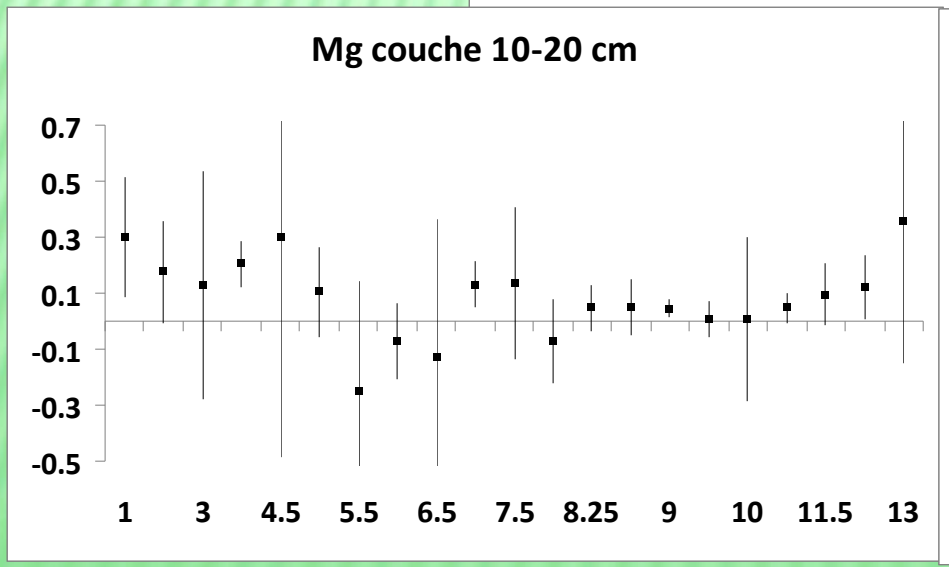

Ca couche 0-10 cm
10
5
0
-5
1
2
3
4
4.5
5
5.5
6
6.5
7
7.5
8
8.25
8.5
9
9.5
10
11
11.5
12
13

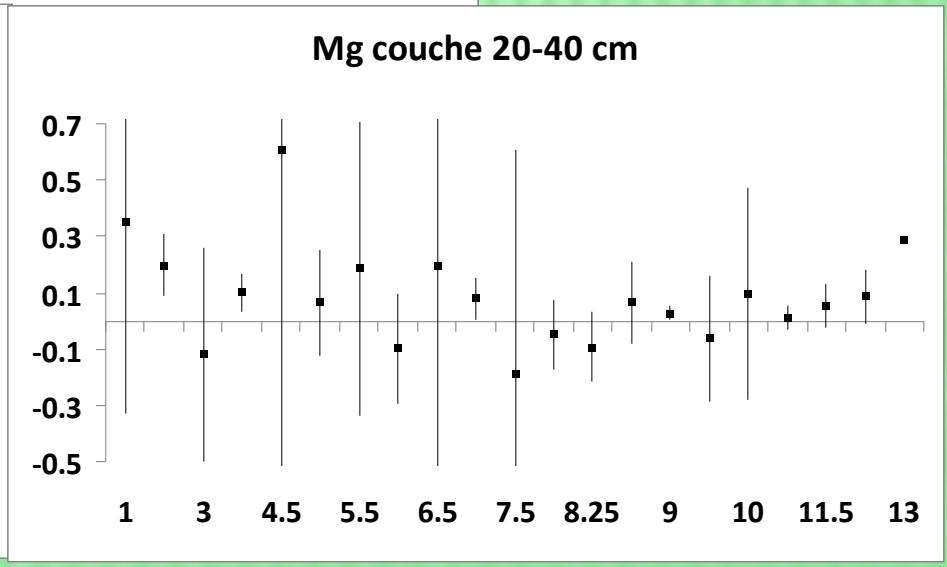

Ca couche 10-20 cm
10
5
0
-5
1
2
3
4
4.5
5
5.5
6
6.5
7
7.5
8
8.25
8.5
9
9.5
10
11
11.5
12
13


Ca couche 20-40 cm
10
5
0
-5
1
2
3
4
4.5
5
5.5
6
6.5
7
7.5
8
8.25
8.5
9
9.5
10
11
11.5
12
13

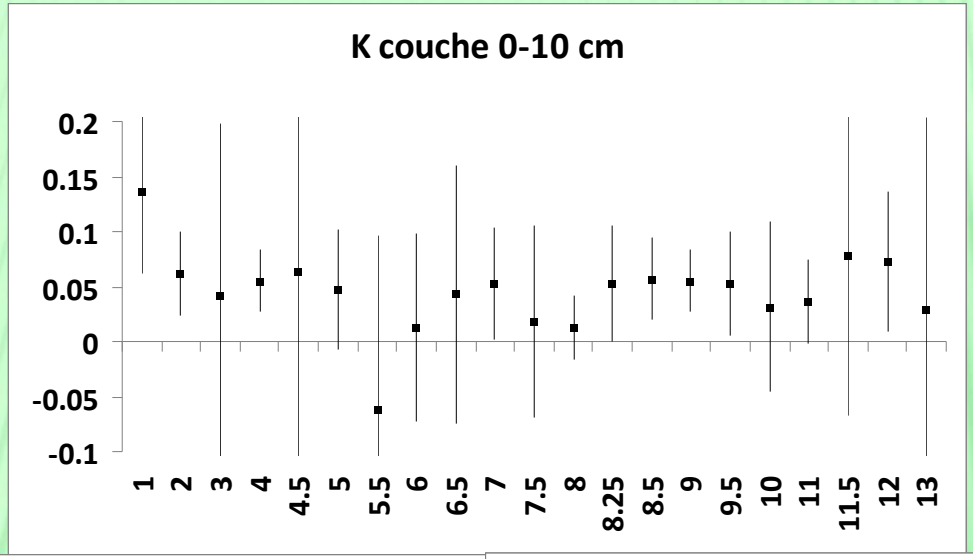
Magnesium

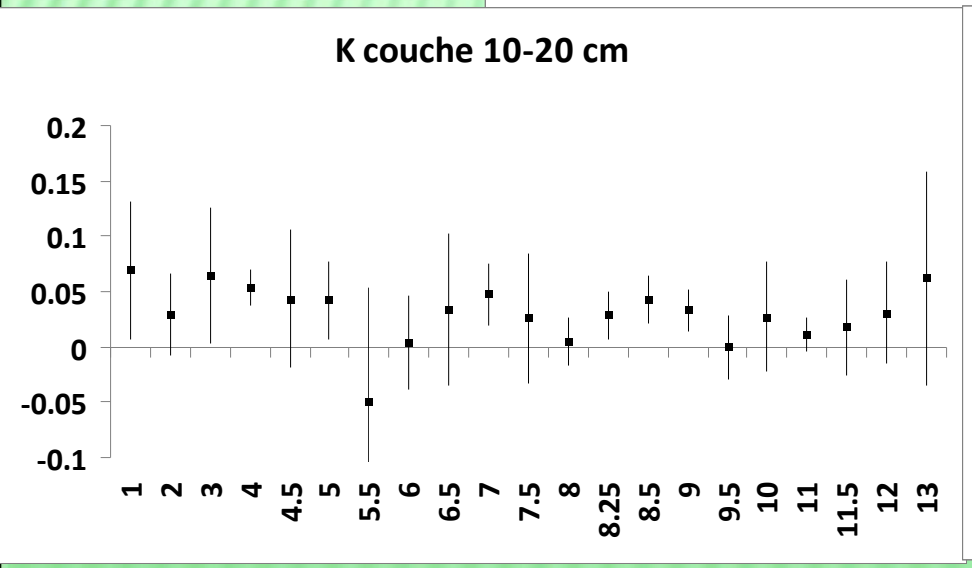

Mg couche 0-10 cm
0.7
0.5
0.3
0.1
-0.1
-0.3
-0.5
1
2
3
4
4.5
5
5.5
6
6.5
7
7.5
8
8.25
8.5
9
9.5
10
11
11.5
12
13

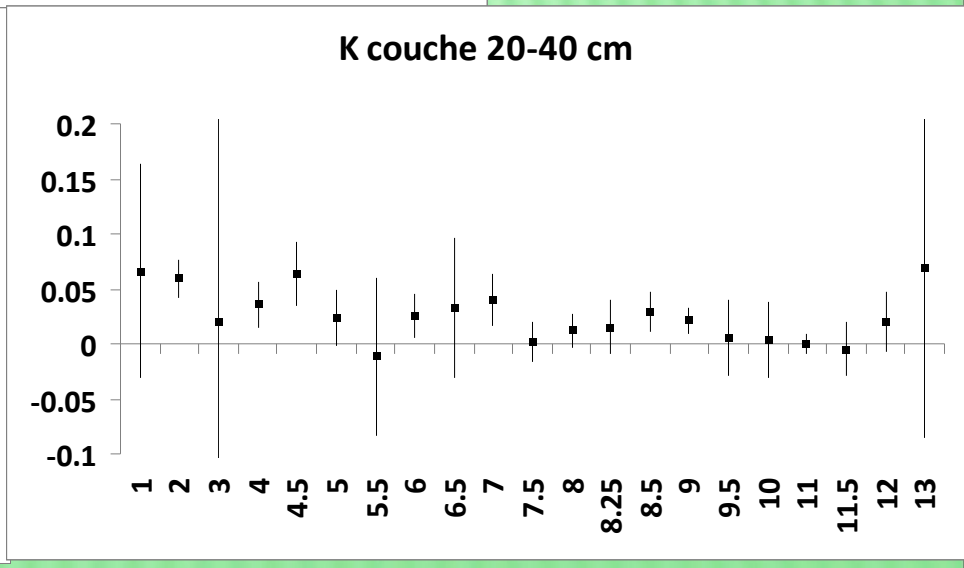

Mg couche 10-20 cm
0.7
0.5
0.3
0.1
-0.1
-0.3
-0.5
1
3
4.5
5.5
6.5
7.5
8.25
9
10
11.5
13


Mg couche 20-40 cm
0.7
0.5
0.3
0.1
-0.1
-0.3
-0.5
1
3
4.5
5.5
6.5
7.5
8.25
9
10
11.5
13

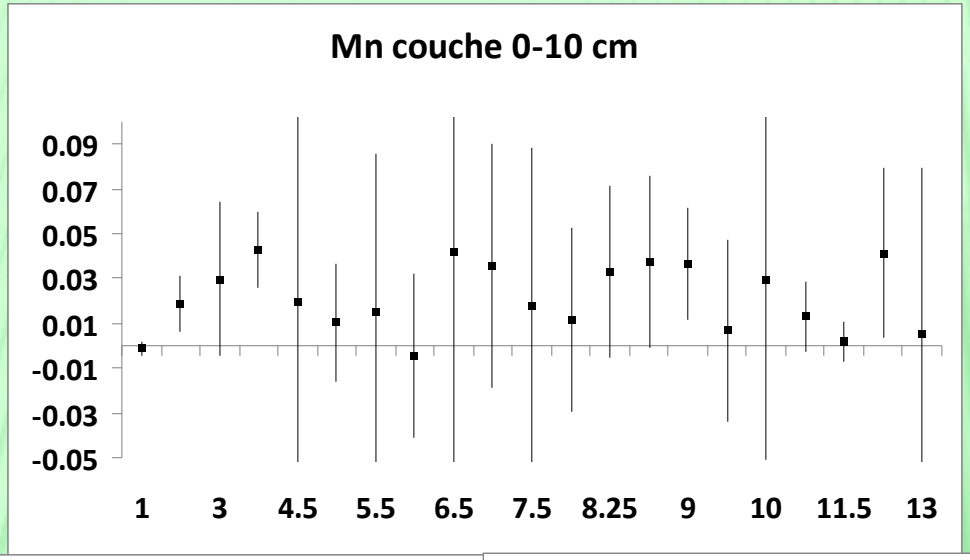
Potassium

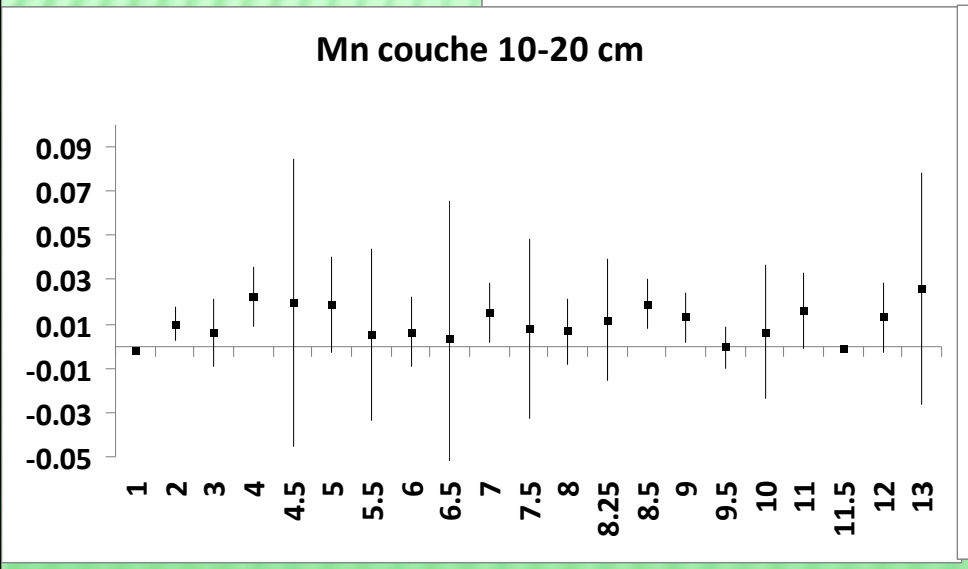

K couche 0-10 cm
0.2
0.15
0.1
0.05
0
-0.05
-0.1
1
2
3
4
4.5
5
5.5
6
6.5
7
7.5
8
8.25
8.5
9
9.5
10
11
11.5
12
13

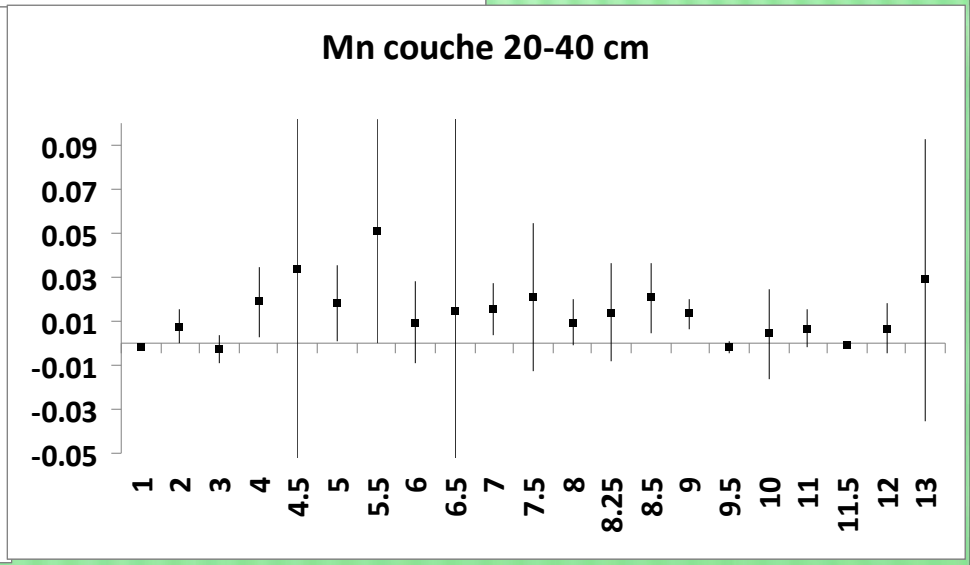

K couche 10-20 cm
0.2
0.15
0.1
0.05
0
-0.05
-0.1
1
2
3
4
4.5
5
5.5
6
6.5
7
7.5
8
8.25
8.5
9
9.5
10
11
11.5
12
13


K couche 20-40 cm
0.2
0.15
0.1
0.05
0
-0.05
-0.1
1
2
3
4
4.5
5
5.5
6
6.5
7
7.5
8
8.25
8.5
9
9.5
10
11
11.5
12
13

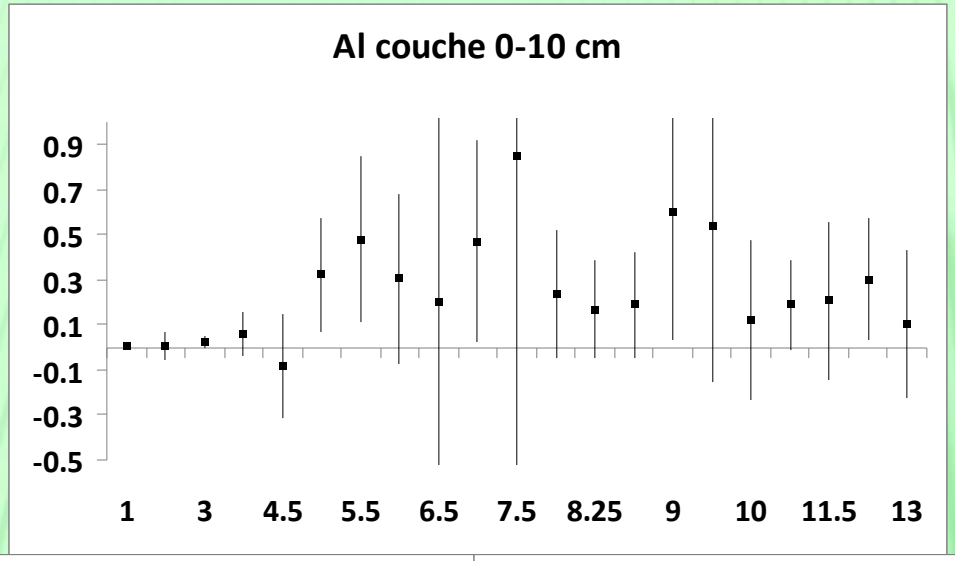
Manganese

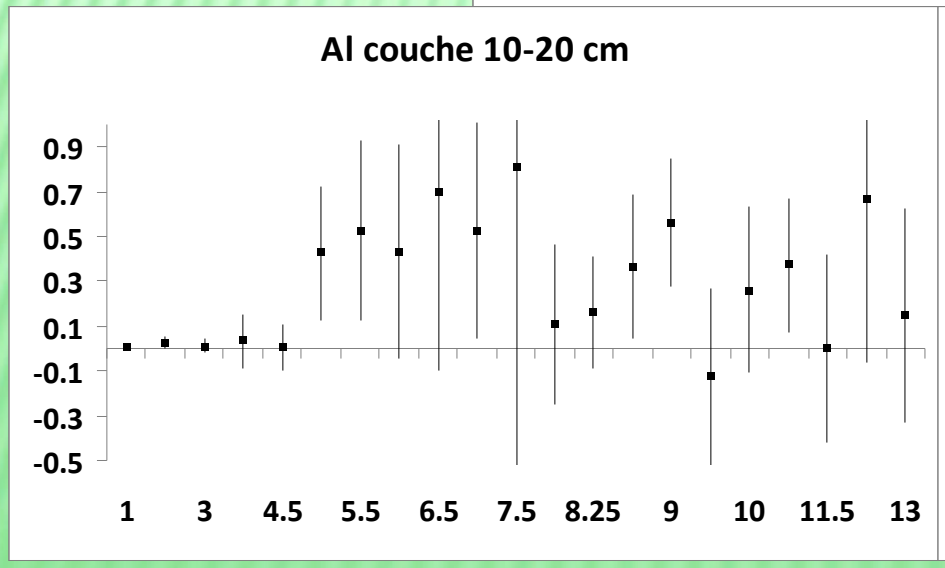

Mn couche 0-10 cm
0.09
0.07
0.05
0.03
0.01
-0.01
-0.03
-0.05
1
3
4.5
5.5
6.5
7.5
8.25
9
10
11.5
13

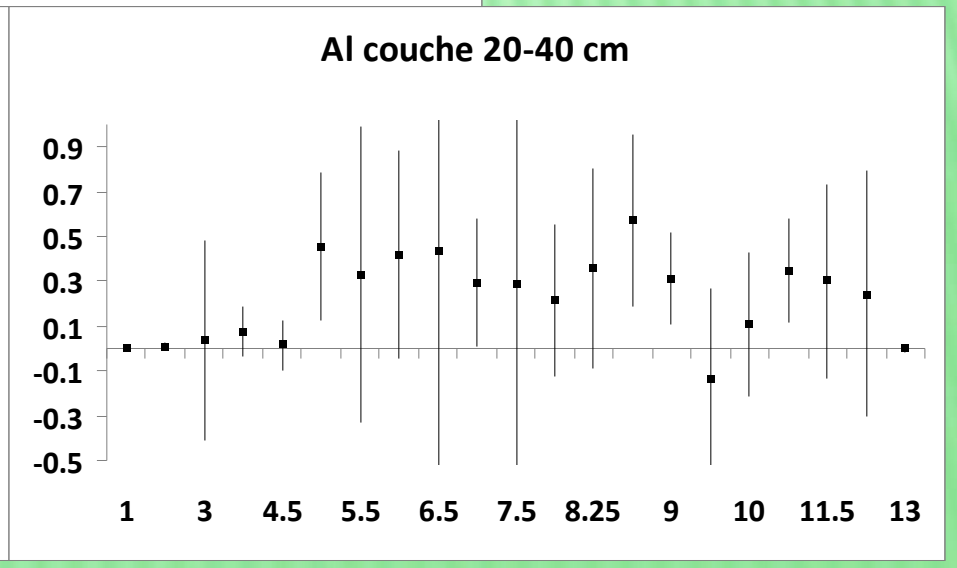

Mn couche 10-20 cm
0.09
0.07
0.05
0.03
0.01
-0.01
-0.03
-0.05
1
2
3
4
4.5
5
5.5
6
6.5
7
7.5
8
8.25
8.5
9
9.5
10
11
11.5
12
13

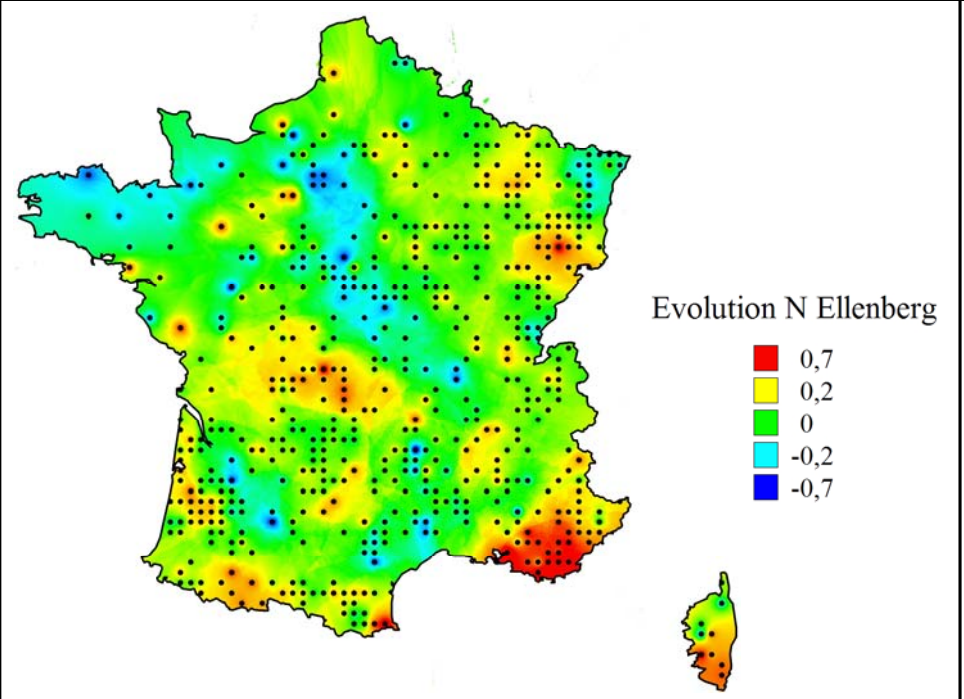

Mn couche 20-40 cm
0.09
0.07
0.05
0.03
0.01
-0.01
-0.03
-0.05
1
2
3
4
4.5
5
5.5
6
6.5
7
7.5
8
8.25
8.5
9
9.5
10
11
11.5
12
13

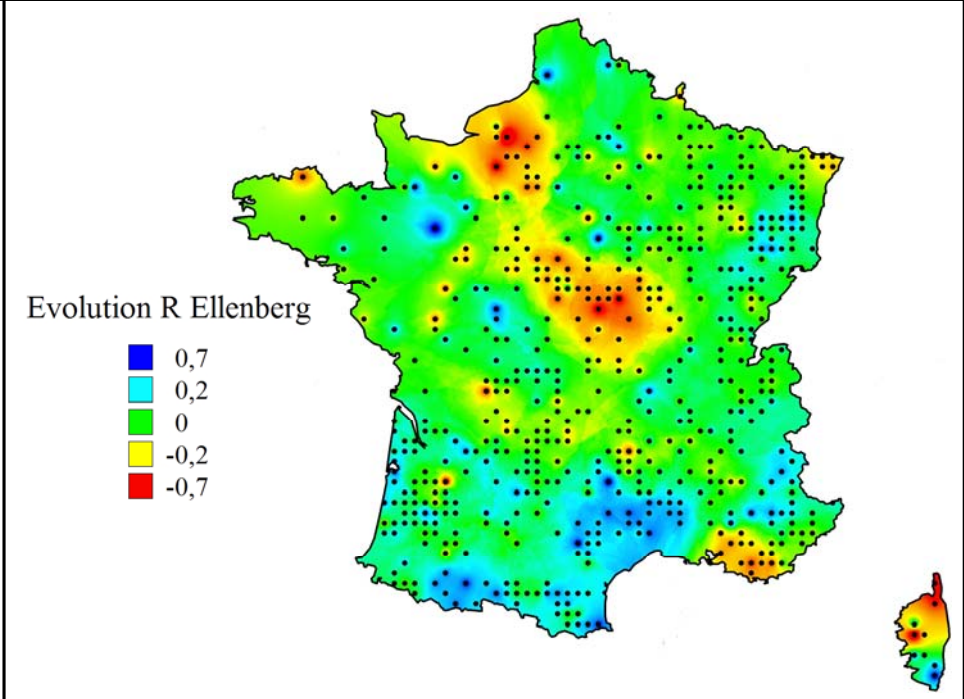
Aluminium

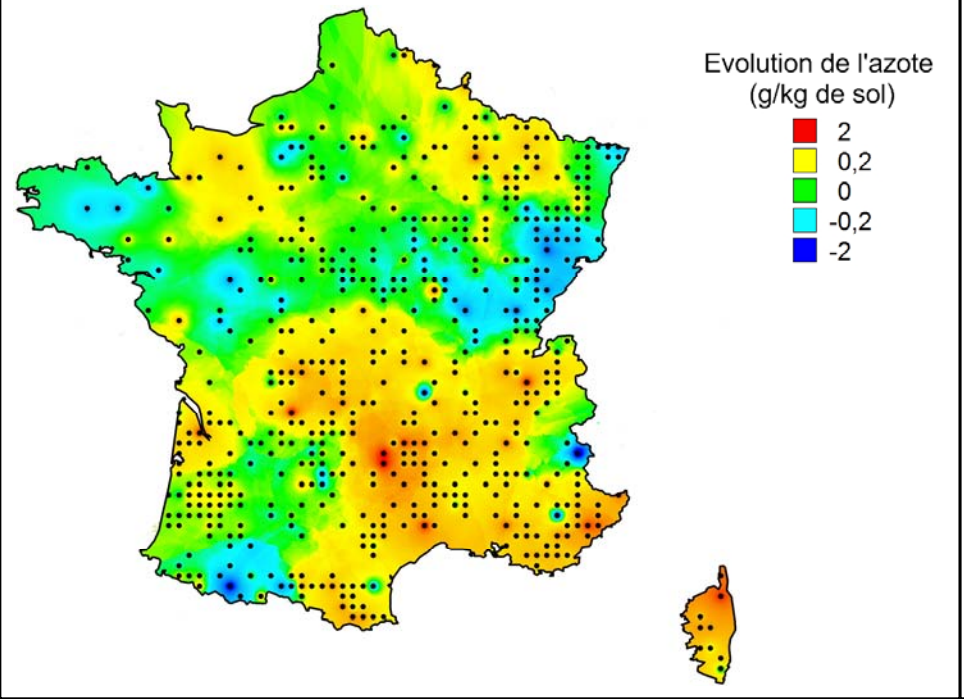

Al couche 0-10 cm
0.9
0.7
0.5
0.3
0.1
-0.1
-0.3
-0.5
1
3
4.5
5.5
6.5
7.5
8.25
9
10
11.5
13

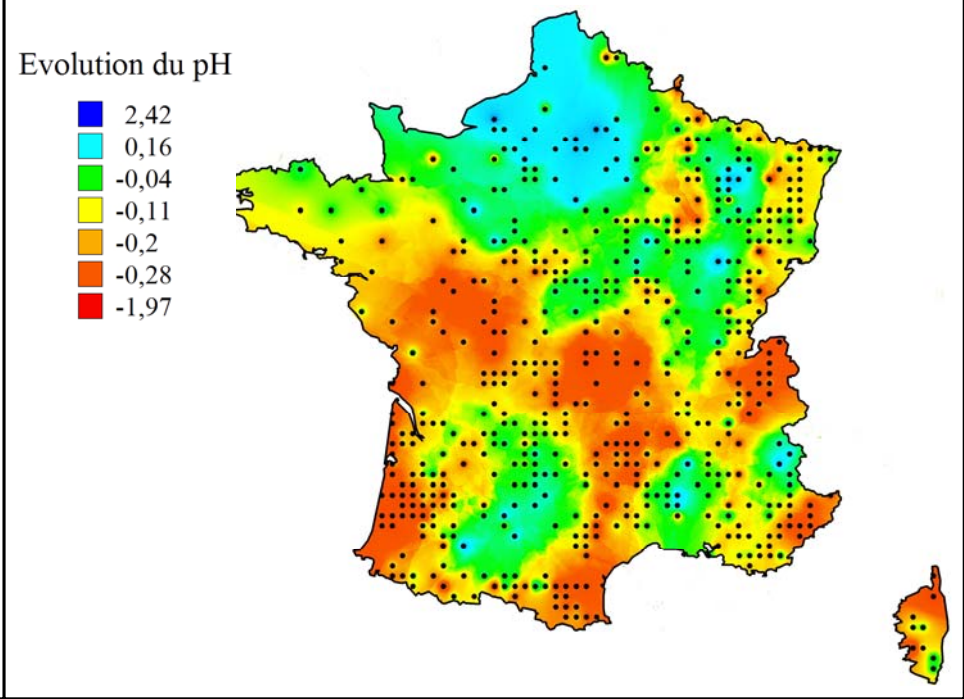

Al couche 10-20 cm
0.9
0.7
0.5
0.3
0.1
-0.1
-0.3
-0.5
1
3
4.5
5.5
6.5
7.5
8.25
9
10
11.5
13


Al couche 20-40 cm
0.9
0.7
0.5
0.3
0.1
-0.1
-0.3
-0.5
1
3
4.5
5.5
6.5
7.5
8.25
9
10
11.5
13


Evolution N Ellenberg
0,7
0,2
0
-0,2
-0,7


Evolution R Ellenberg
0,7
0,2
0
-0,2
-0,7


Evolution de l'azote
(g/kg de sol)
2
0,2
0
-0,2
-2


Evolution du pH
2,42
0,16
-0,04
-0,11
-0,2
-0,28
-1,97

Conclusions for the level 1 plots

- **Overall quality of Biosoil campaign probably > ICP-forest campaign**
  (more species + spatial variability + …)

- **Floristic inventories: temporal trends are consistent with previous french results but more specific analyses should be done**

- **Soil analyses:**
  - **huge variability in the evolution of the concentrations**
  - **global positif shift for all the elements and all the layers**

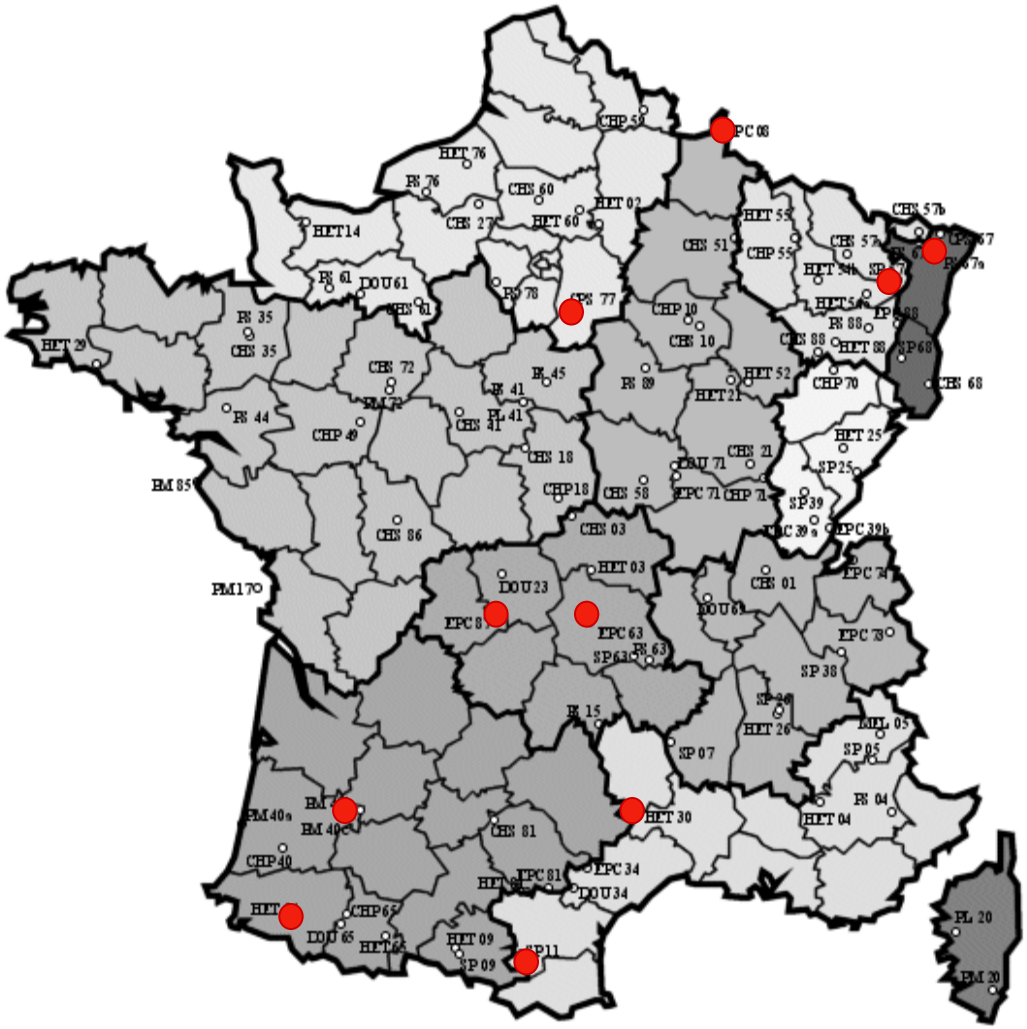
Temporal and spatial trends can not be clearly identified

Level II plots

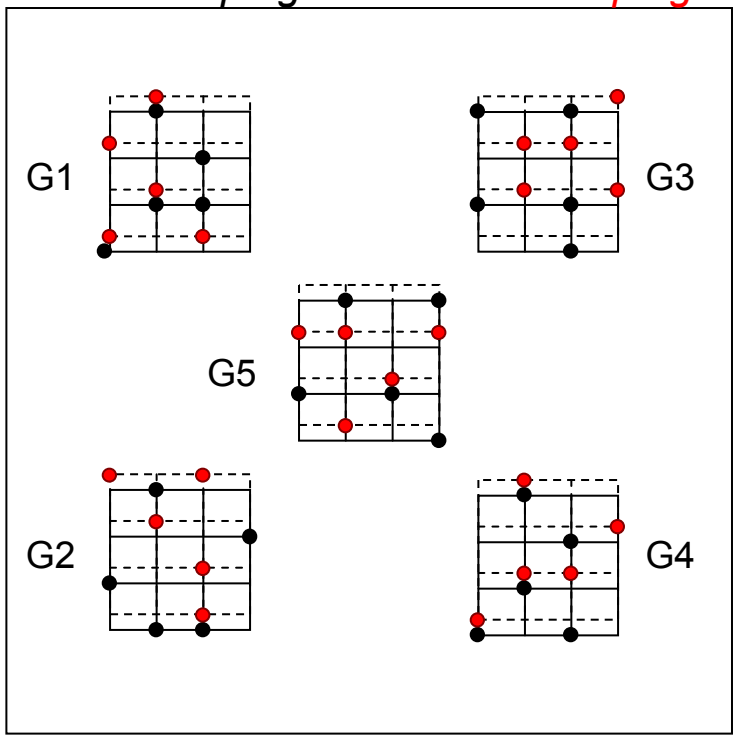
Manuel NICOLAS & Erwin ULRICH
RENECOFOR Network
National Forest Office

1st campaign – 1993 / 1995 - 102 plots sampled

Biosoil campaign – 2007 / 2008 - 10 plots re-sampled



• *1st campaign* • *2nd campaign*

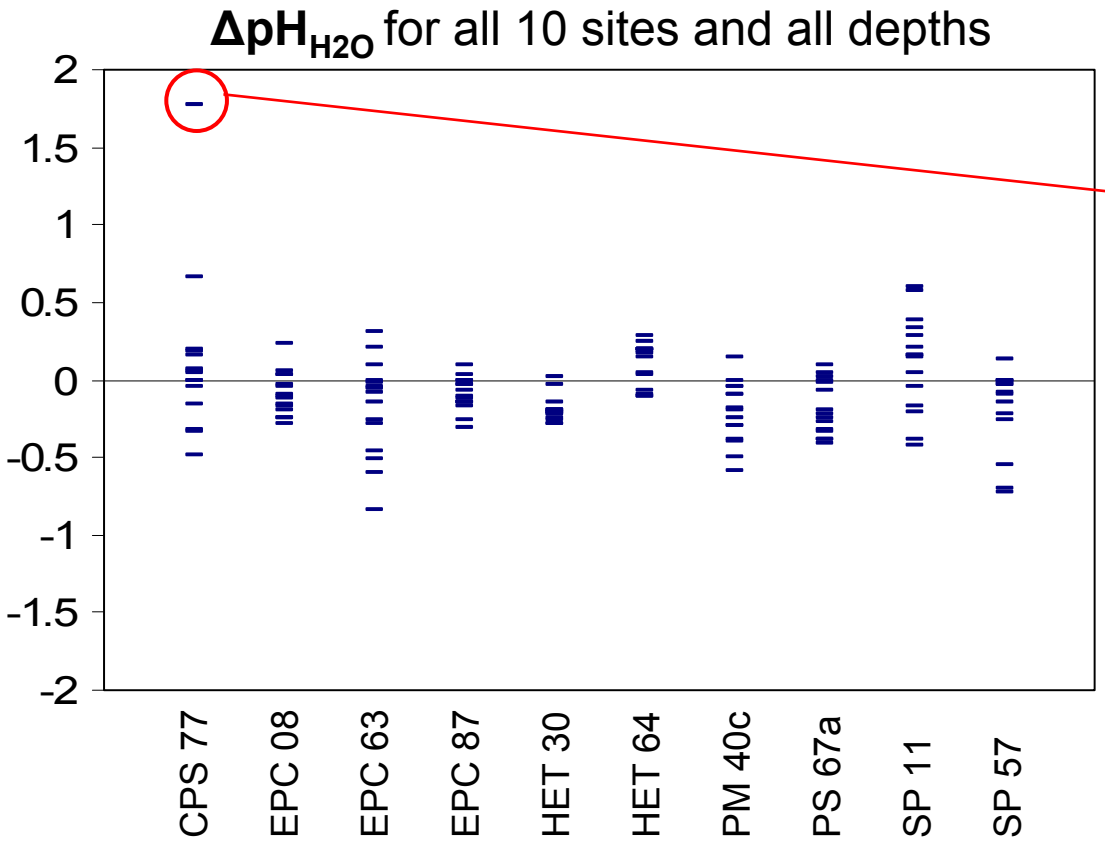


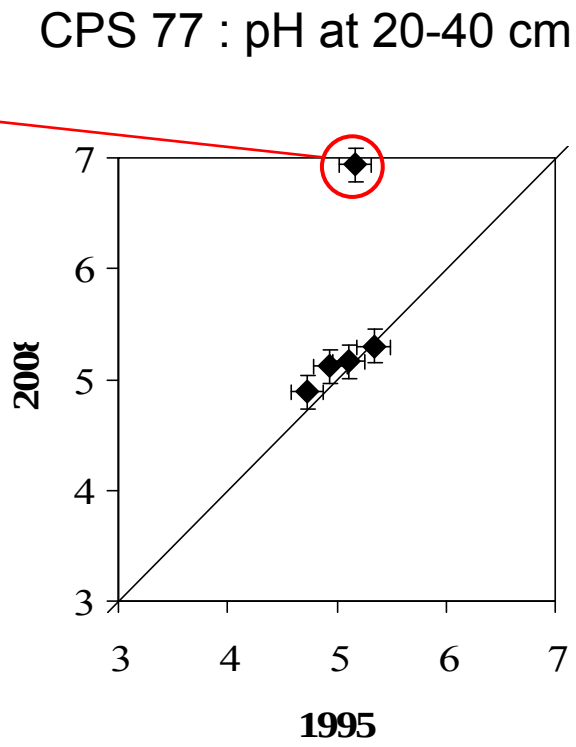
Same protocol for both campaigns:

25 samples grouped into 5 composites for analysis

x **3 depths** (0-10 ; 10-20 ; 20-40 cm)

Level II – General results : spatial variability



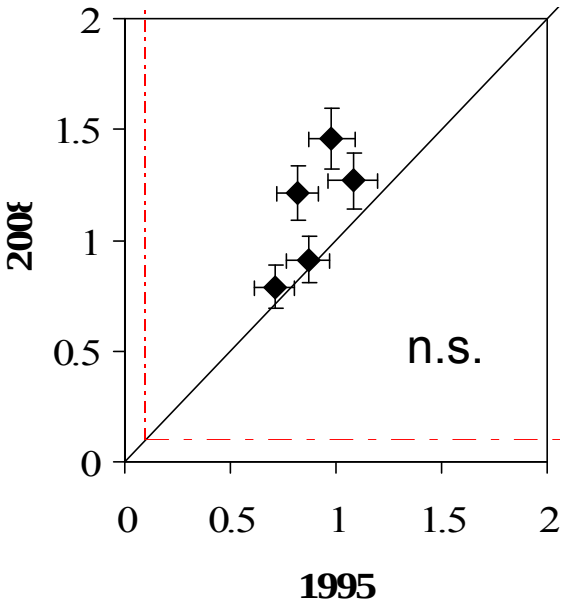


On level II, variability is also important

But spatial variability can be identified and taken into account for trend assessment

e.g. CPS 77 at 20-40 cm: ΔpH = +1.77 for one cluster, what can be explained by spatial variability of calcareous layer depth under sandy soil

Level II – General results : statistical test



Example : [H^+] graph for PS 67a plot at 0-10 cm depth

Dashed red line = laboratory detection threshold

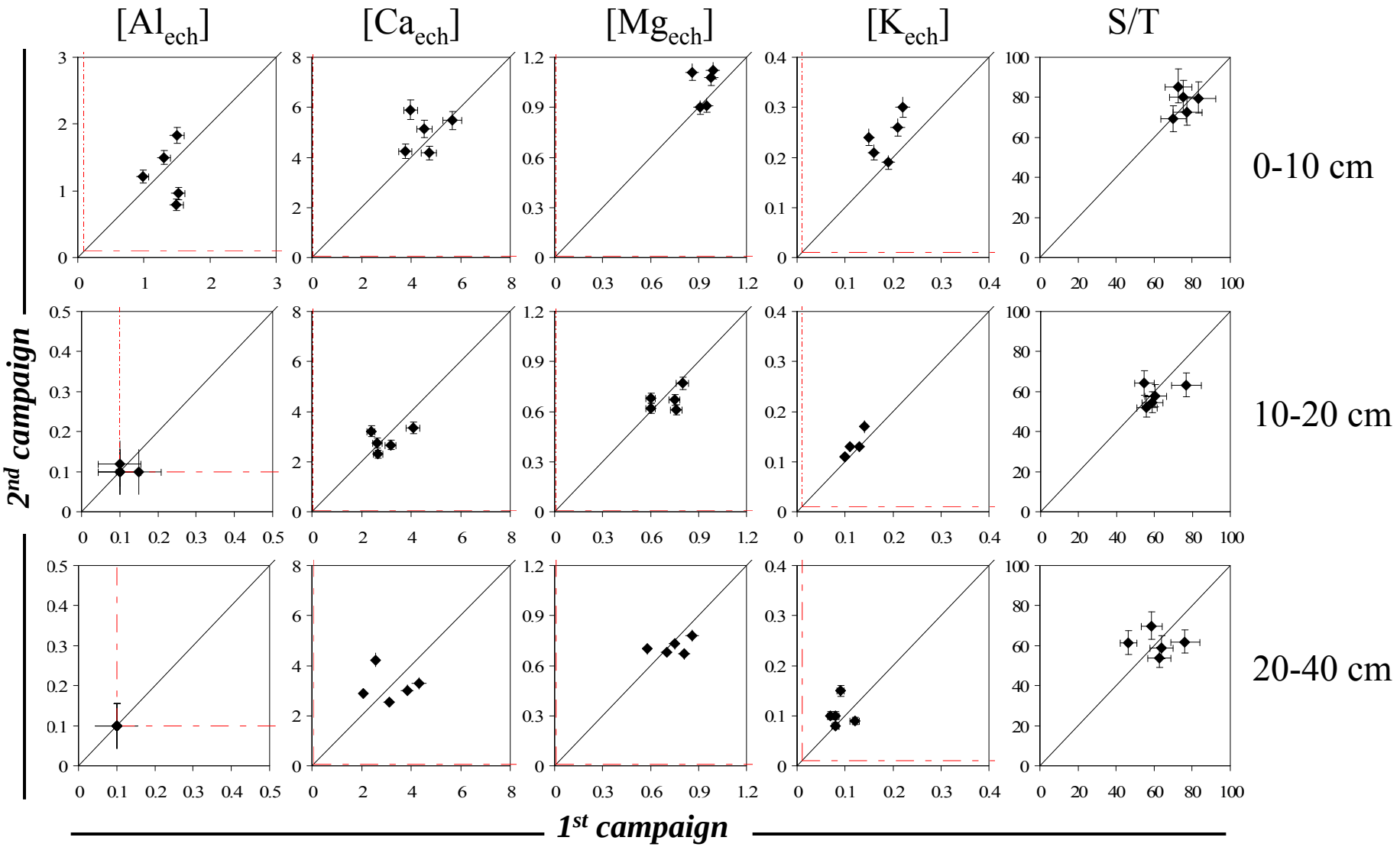
Error bars = laboratory measurement uncertainty

Non parametric test (Wilcoxon Mann Whitney for unpaired samples) applied in the most conservative case given by uncertainties

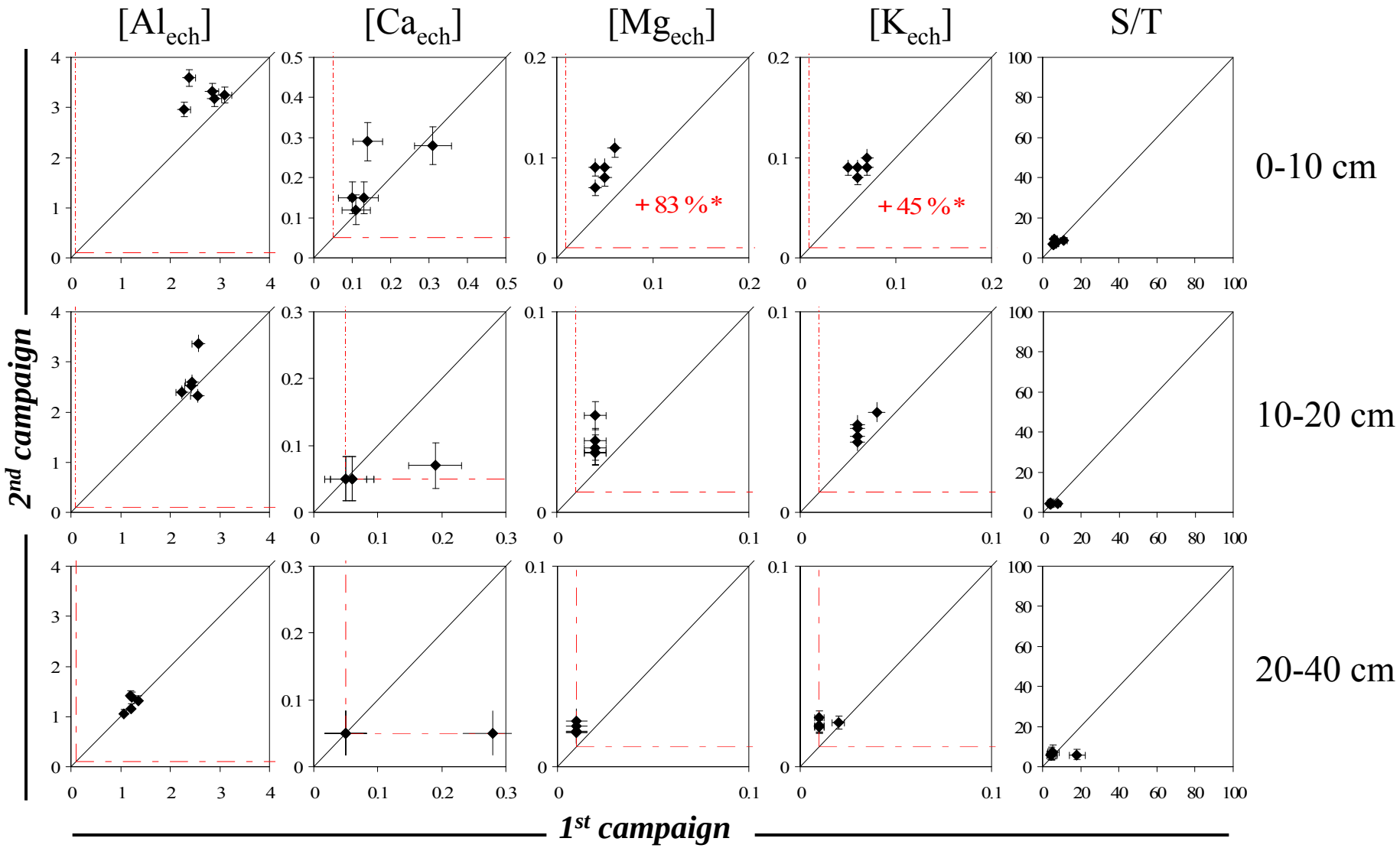
			Exchangeable elements												
	pH CaCl2	pH H2O	Al	H	Ca	Mg	K	Al+Mn+H	Ca+Mg+K	ECEC	S/T	C	N	C/N	*Sum*
CPS 77	0	0	0	0	0	0	0	0	0	0	0	1	1	0	*2*
EPC 08	0	0	0	1	0	0	0	0	0	0	0	0	0	0	*1*
EPC 63	0	0	3	0	1	1	0	2	1	1	1	3	1	0	*14*
EPC 87	0	0	0	1	1	1	0	0	1	0	1	1	0	0	*6*
HET 30	0	0	0	0	0	1	0	0	1	0	0	0	0	0	*2*
HET 64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*0*
PM 40c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*0*
PS 67a	0	0	0	0	0	1	1	0	0	0	0	0	0	0	*2*
SP 11	0	0	0	0	0	1	1	0	0	0	0	0	0	0	*2*
SP 57	0	0	0	1	0	0	1	0	0	0	0	0	0	0	*2*
Sum	*0*	*0*	*3*	*3*	*2*	*5*	*3*	*2*	*3*	*1*	*2*	*5*	*2*	*0*	*31*

31 significant changes *($p \leq 0.05$)* over 420 tests → **7,4 %**

Level II – Results : No changes detected in eutrophic/calcic soils (eg HET 64)

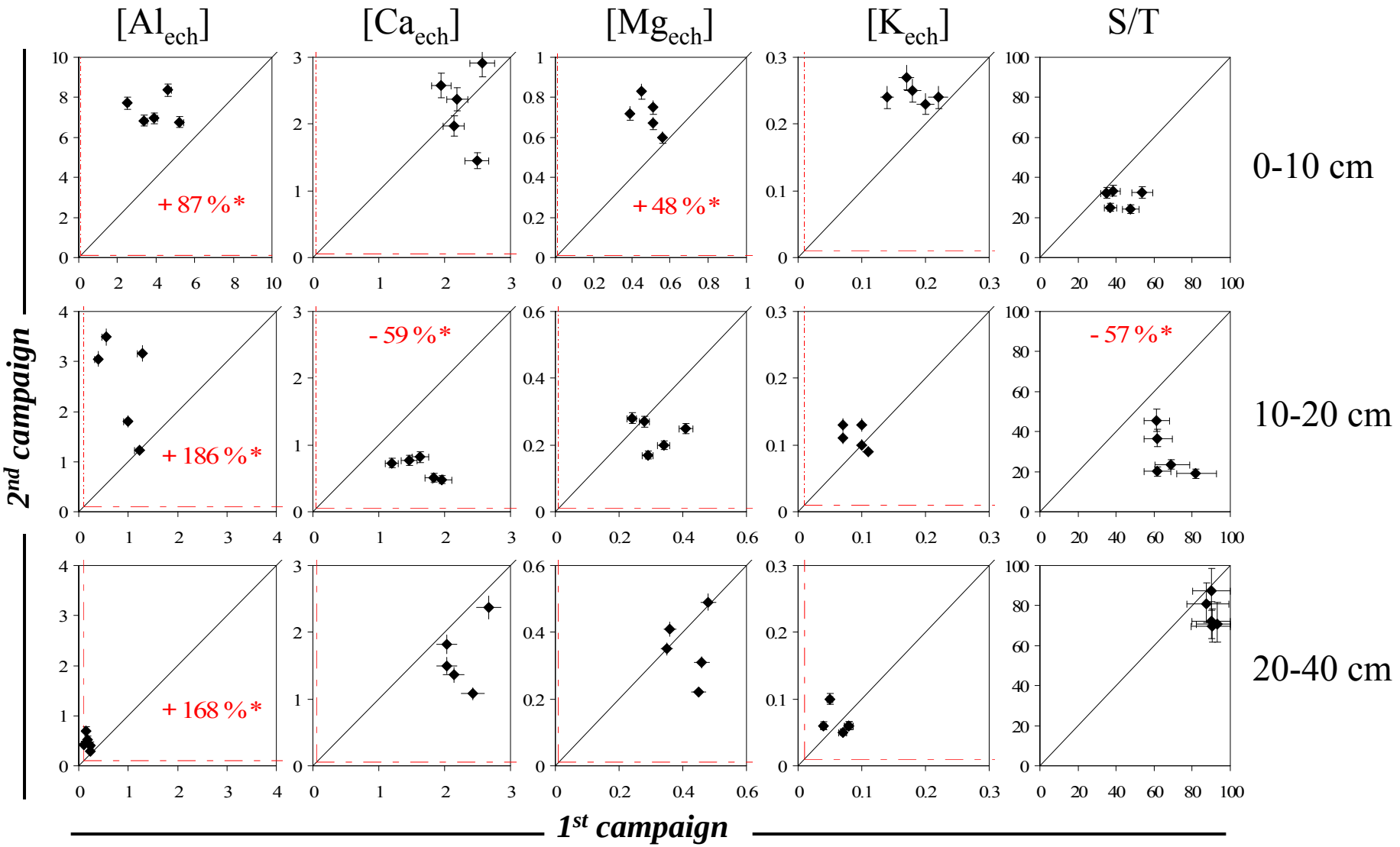


Level II – Results : Hypothetic change to nutrient unbalance in acid soils (eg PS 67a)



Slight increase of [Mg] & [K] and decrease of [Ca] → to be confirmed with further data

Level II – Results : Surprising significant nutrient loss on EPC 63 plot (Andosol)



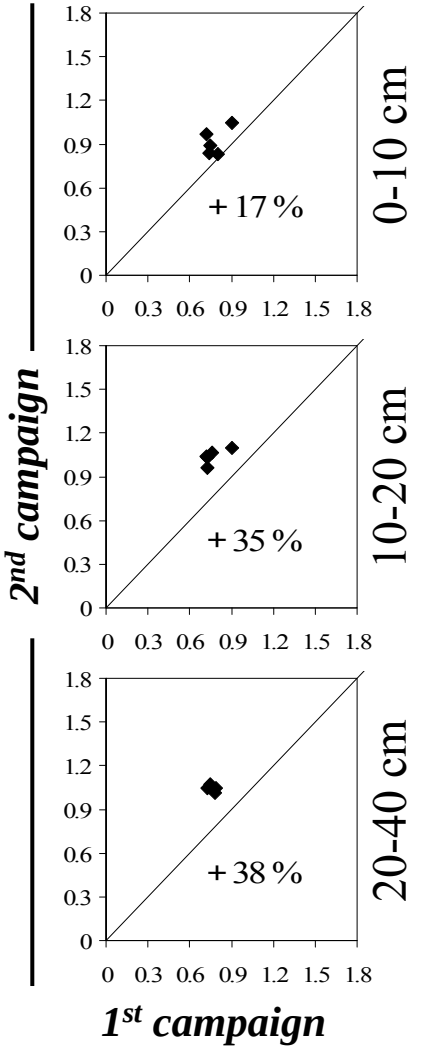
This might be explained by the loss of nutrients inherited from former agricultural inputs

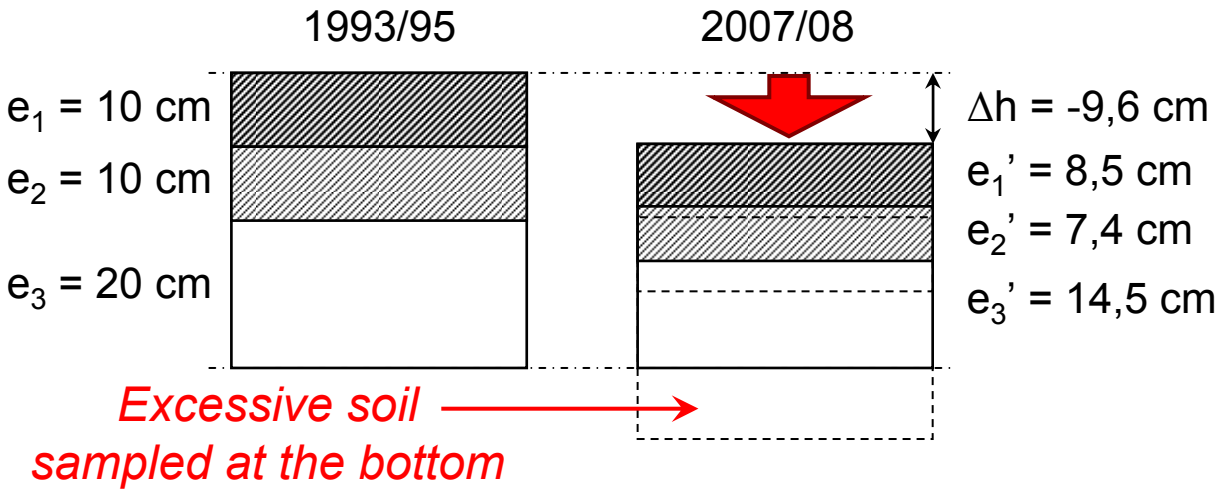
Level II – Discussion on increase of bulk density

Bulk density has increased on 4 plots / 10 re-sampled plots

This could be due to **soil compaction** for 3 of them (Norway spruce plantations)

E.g: EPC 08 plot





- Replicates and knowledge of harvesting events are necessary to identify the cause(s) of bulk density increase.

- If soil compaction, vertical movements must be integrated:
  - In the interpretation of concentration changes
  - In the calculation of nutrient stocks

→ But how the sampling method could be improved to better integrate management effects in long term monitoring ?

Conclusions for the level 2 plots

- **Overall quality of Biosoil campaign = 1st campaign**

- **High variability in the evolution of the concentrations**

  BUT

  spatial variability can be identified and taken into account

  Temporal trends can be identified

- **Only 10 re-sampled plots**

  Temporal trends can not be generalised
  Spatial trends can not be identified