Retention of As, Cu and Cr from CCA-treated wood products in select Florida soils

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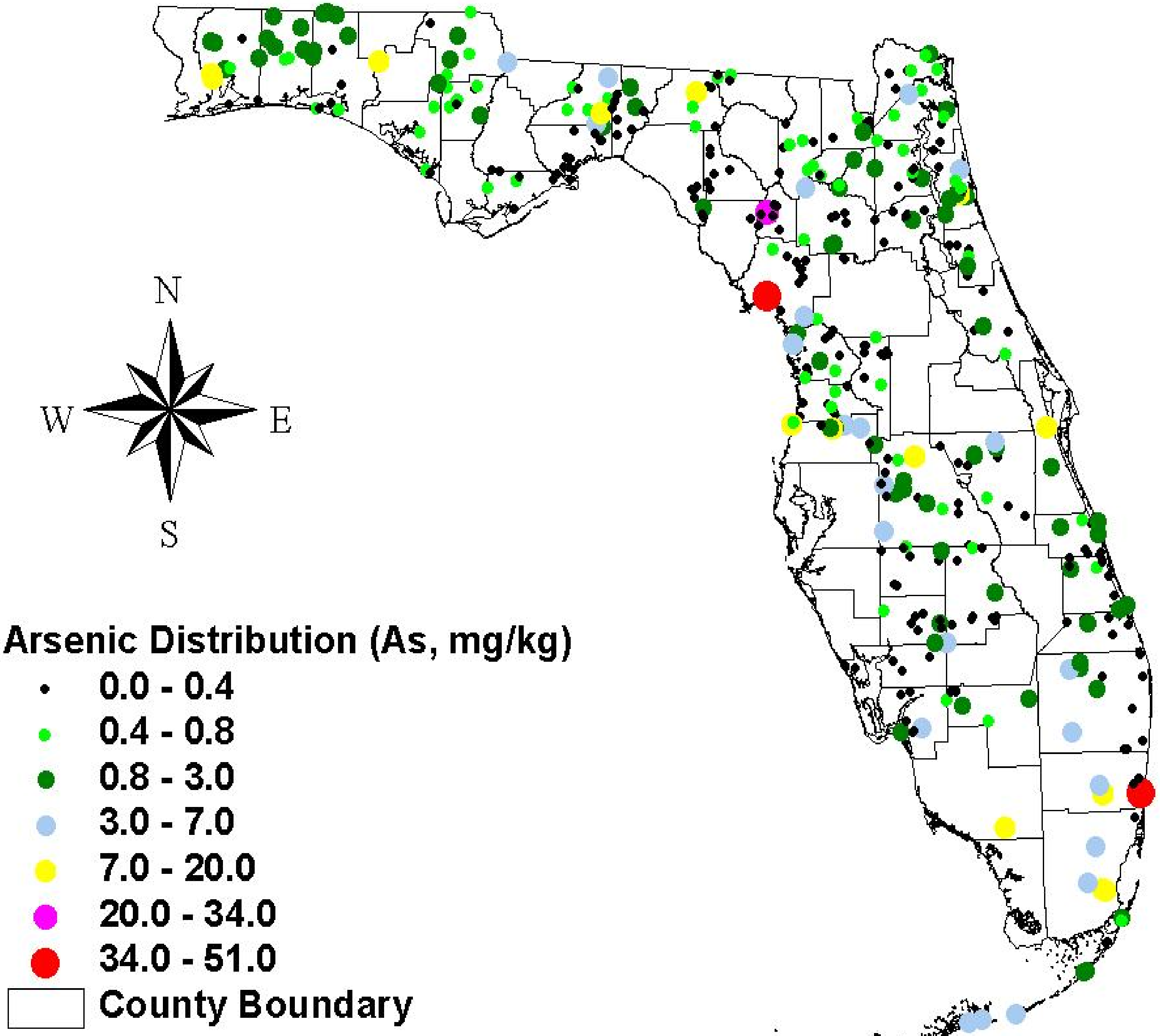
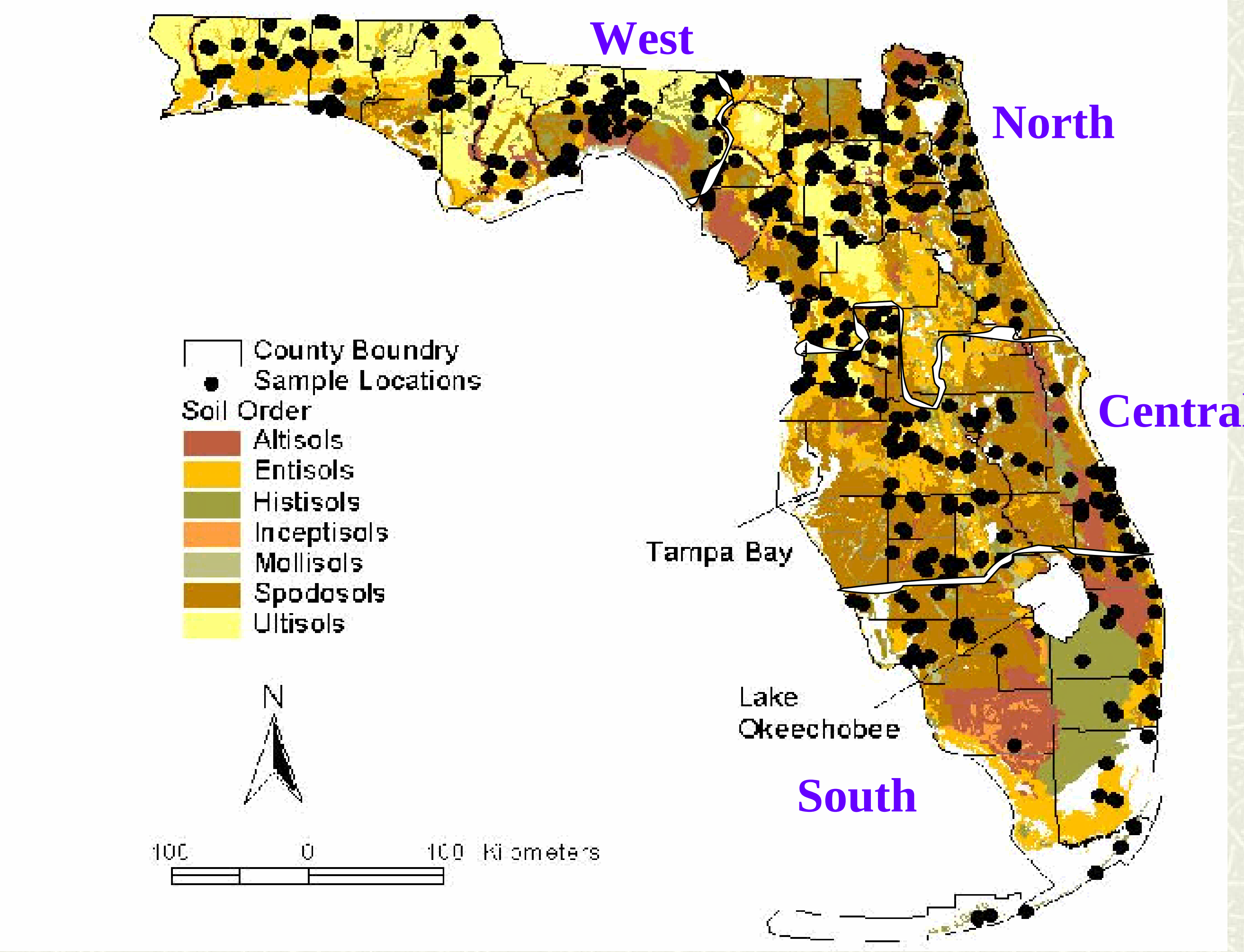
Arsenic uses through the ages

Distant Past	Arsenic bronzes Ornamental / painting Cosmetics Copper arsenic alloys
Recent to 19th Century	Pharmaceutical Medicinal Coloring agents
20th Century	Pesticides / Insecticides Cotton defoliant Growth promoter – pigs CCA-treated wood Wire alloys, electronics, & glassware

State soil [As] regulation survey (mg kg^{-1})

State	CO	OH	FL	TX	NJ	MT
Background	4-40	0-30	0-3	1-18	0-350	0-100
Residential CG	0.4	4	0.8	20	20	250
Industrial CG	4	9	3.7	200	20	500


N
W
E
S
Arsenic Distribution (As, mg/kg)
0.0 - 0.4
0.4 - 0.8
0.8 - 3.0
3.0 - 7.0
7.0 - 20.0
20.0 - 34.0
34.0 - 51.0
County Boundary



West
North
Central
South
County Boundry
Sample Locations
Soil Order
Altisols
Entisols
Histisols
Inceptisols
Mollisols
Spodosols
Ultisols
Tampa Bay
Lake Okeechobee
N
100
0
100 Kilometers

Florida Cities Comparisons

City	N	AM	GM
Miami	238	3.78	2.80
Fort Lauderdale	240	1.52	1.13
Daytona Beach	240	1.36	1.01
Gainesville	156	0.74	0.40

Methods

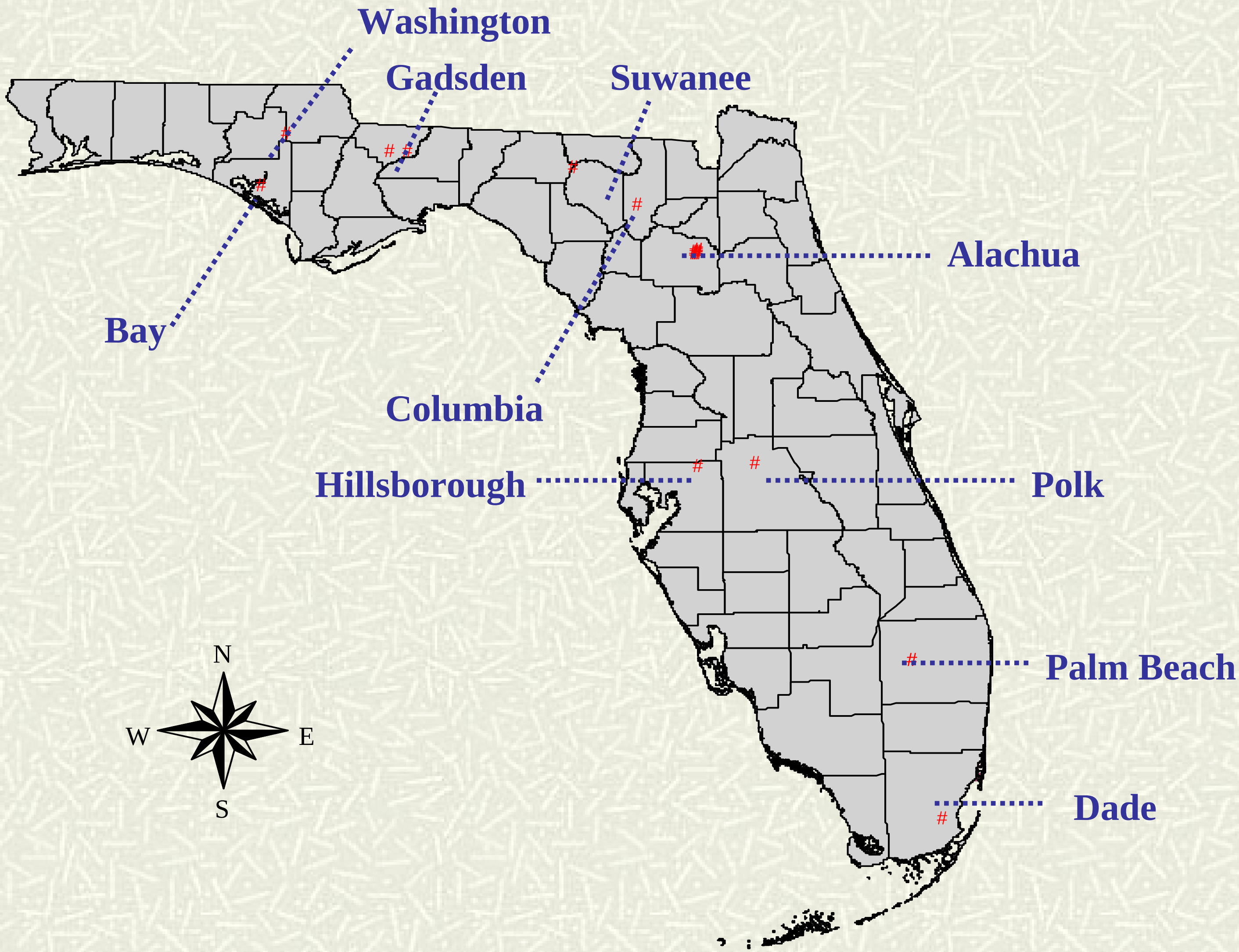
Collect soil samples from pre-selected areas

- included soils with CCA structures

Determine As, Cu and Cr adsorption / desorption

- include different soil horizons

Perform regression analyses using Fe, Al, clay and OM content



Sample collection points for the study

Sorption and desorption

Sorption:

add 10 mL of solution to 10g soil (5 concentrations)

centrifuge and determine concs in solution and in soil

Desorption:

leach with dilute KCl over a period of 6 weeks

measure As, Cu, Cr concentrations in aliquots

Other soil properties

Texture

pH

Cation exchange capacity

Ammonium extractable Fe and Al

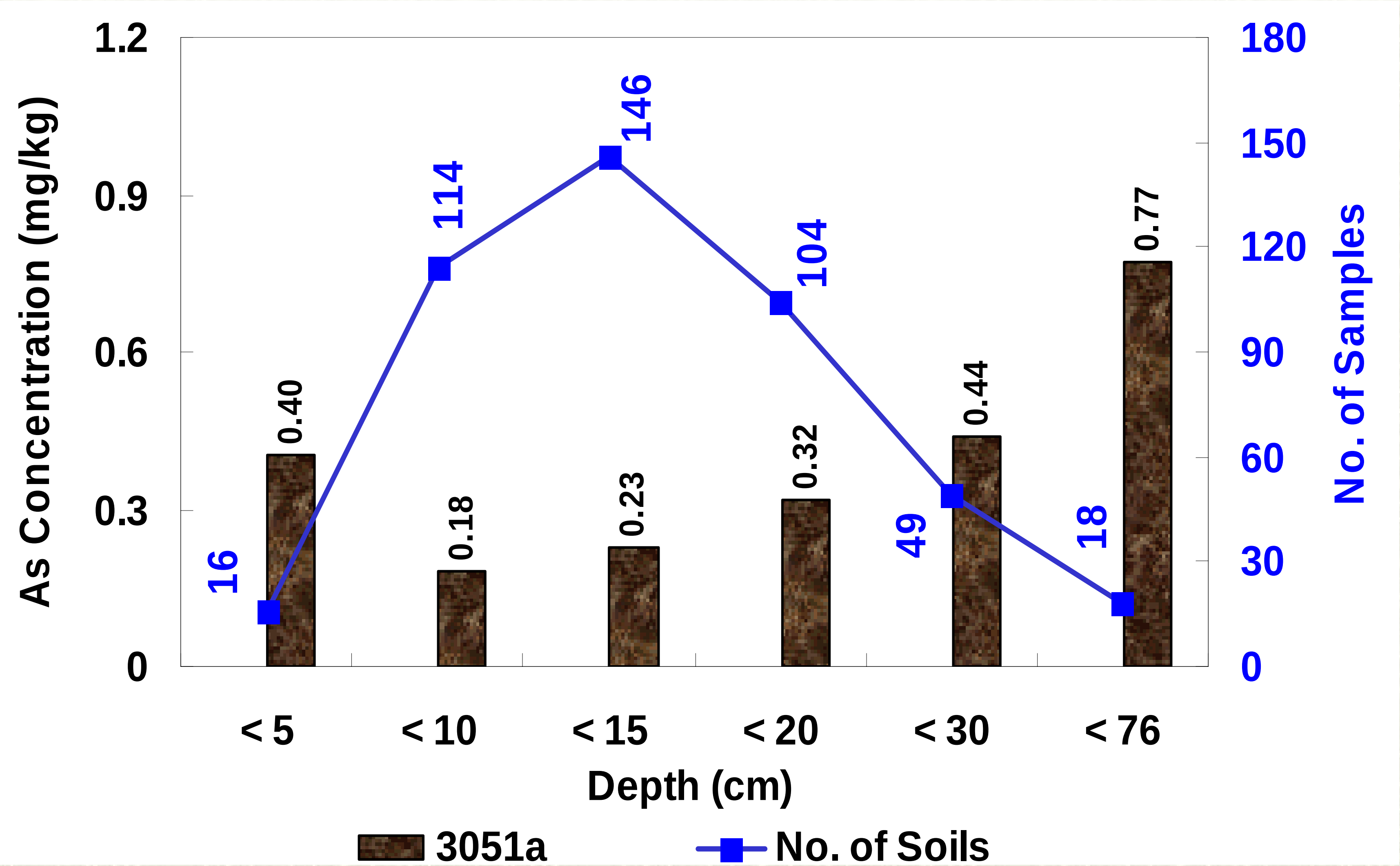
Soil organic carbon

Results / Observations

Results : *A horizon*

	Histosol	Marl	Spodosol	Ultisol	Entisol
pH	**6.9**	**7.9**	**4.8**	**5.2**	**6.0**
Initial [As]	**3.7**	**21.7**	**0.2**	**0.2**	**0.8**
Oxalate Fe	**550**	**3**	**95**	**84**	**494**
Subsurface	**550**	**3**	**200**	**650**	**170**

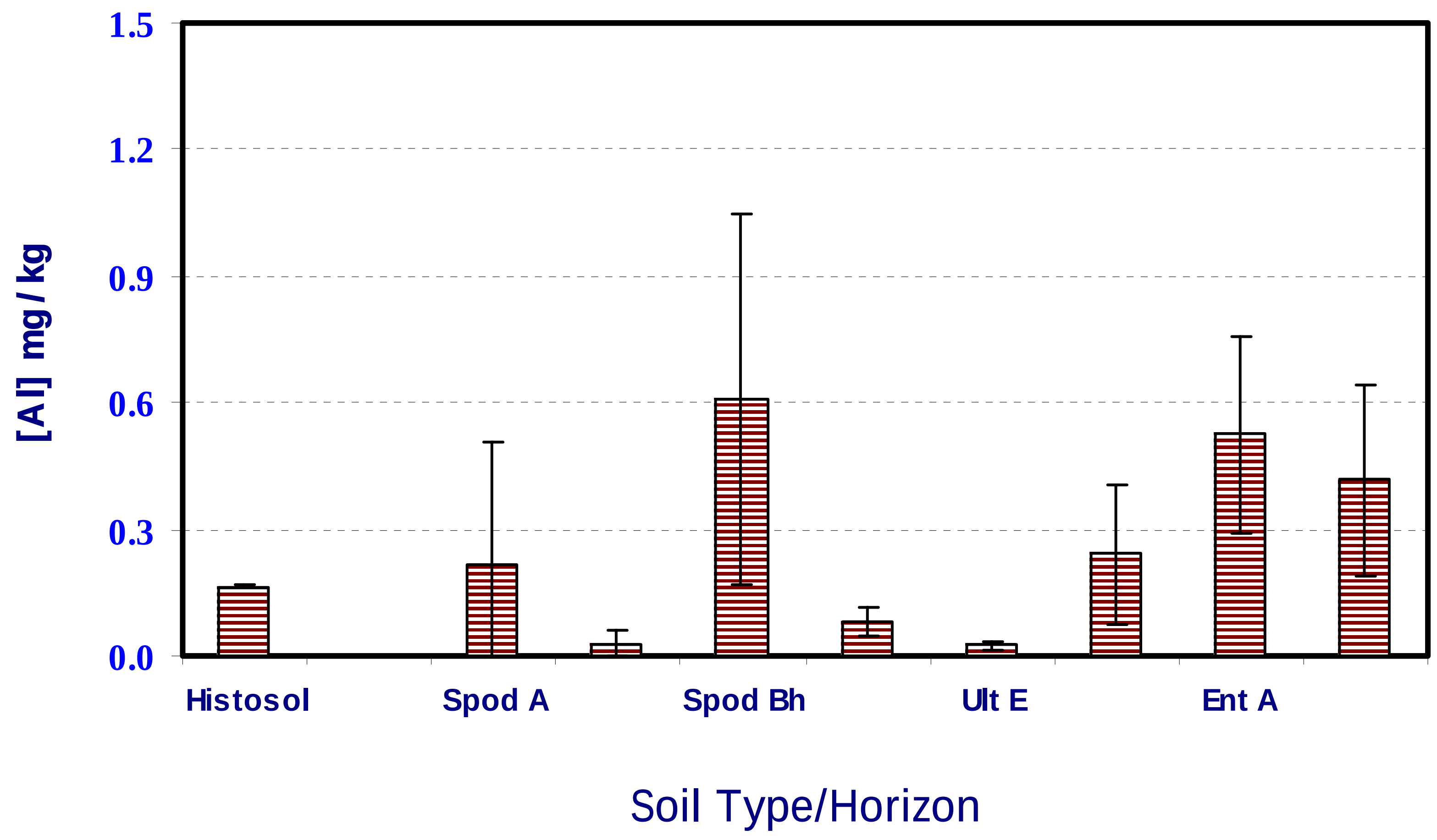
Arsenic concentrations at different depths



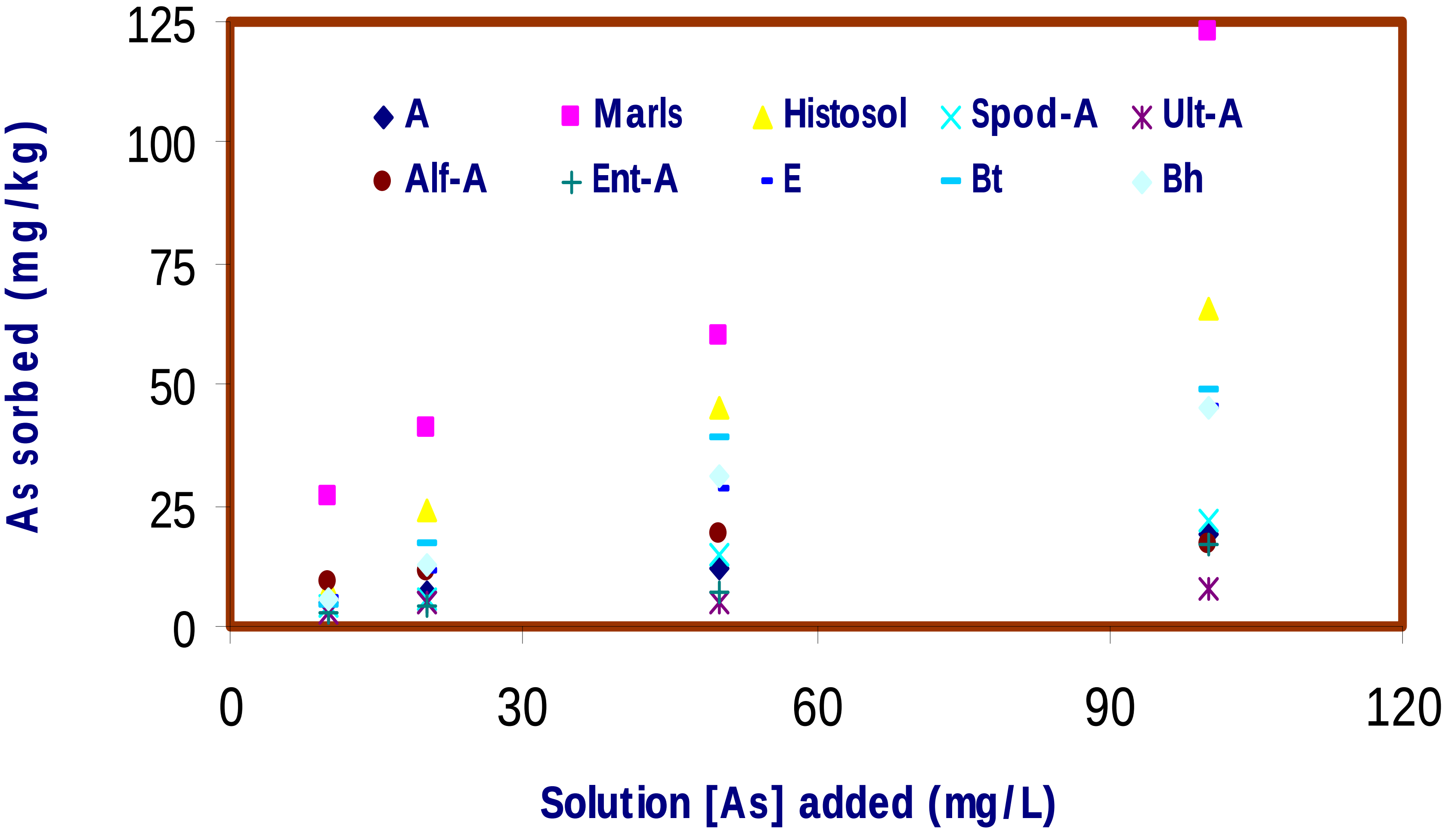
Results : *Coefficients of determination*

	Histosol	Marl	B_h	B_t	E
pH	**0.28**	**0.11**	**0.23**	**0.18**	**0.11**
Clay	**-**	**0.30**	**0.34**	**0.20**	**0.20**
Oxalate Fe	**0.46**	**0.06**	**0.26**	**0.28**	**0.31**
OC	**-**	**0.44**	**0.29**	**0.31**	**0.22**

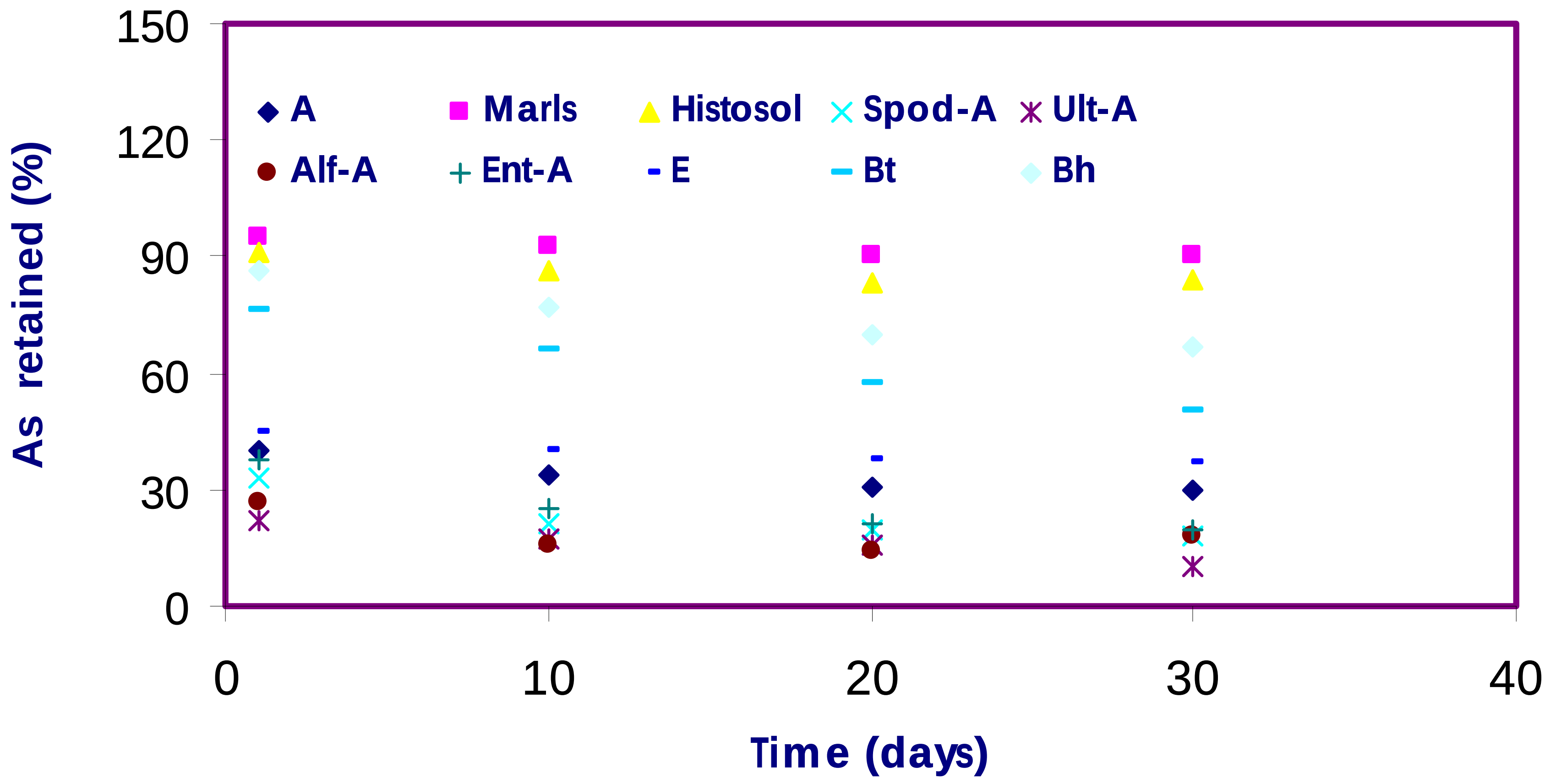
Variation of Fe ext. Al in select soils



Solution vs sorbed As

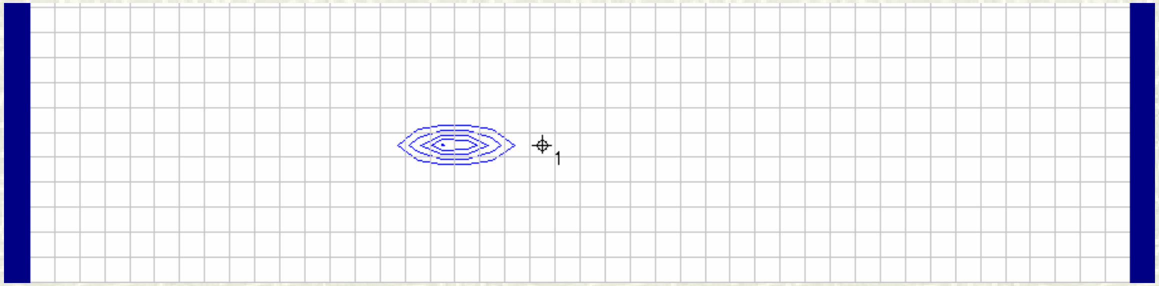


Sorbed As after leaching with KCl

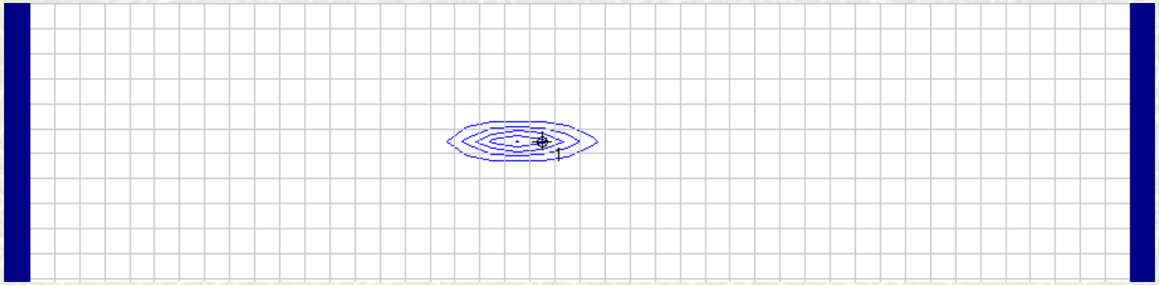


Numerical Simulation Modeling

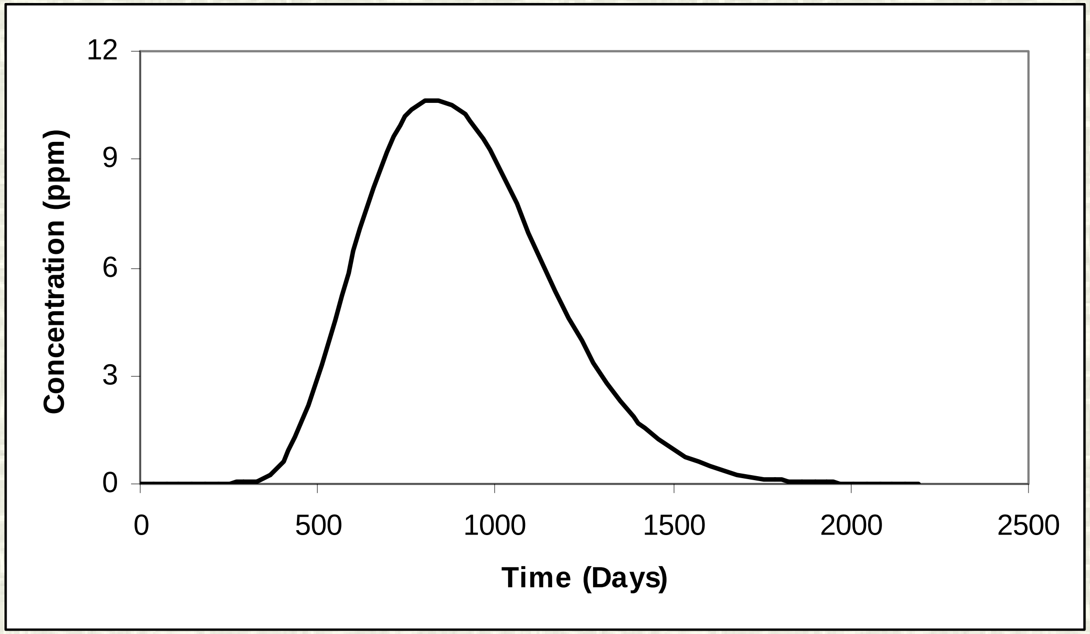
Pulse Input



After 1 yr

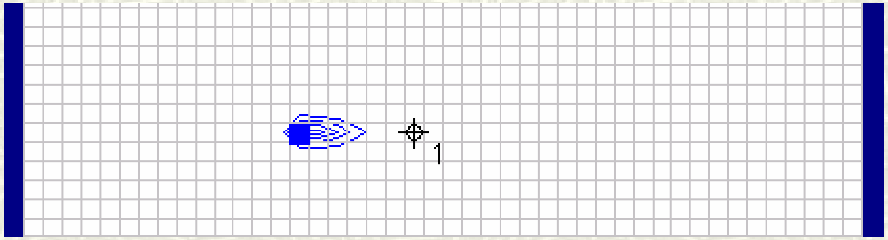


After 2 yr

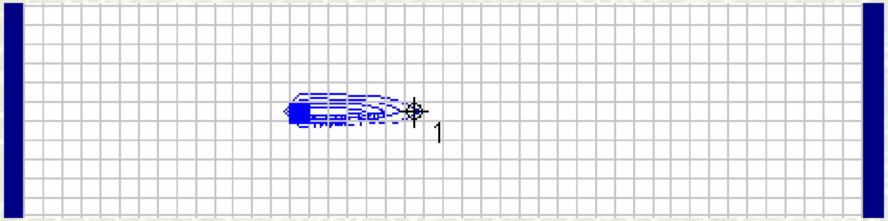


Numerical Simulation Modeling

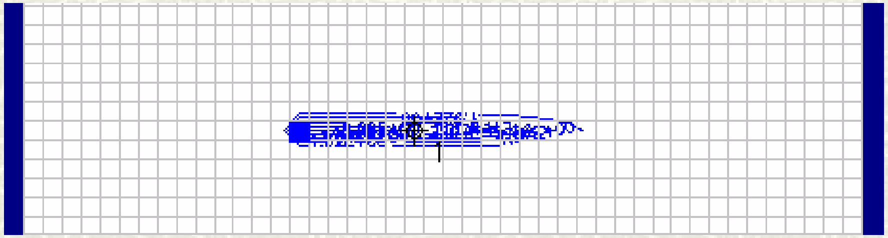
Continuous Input



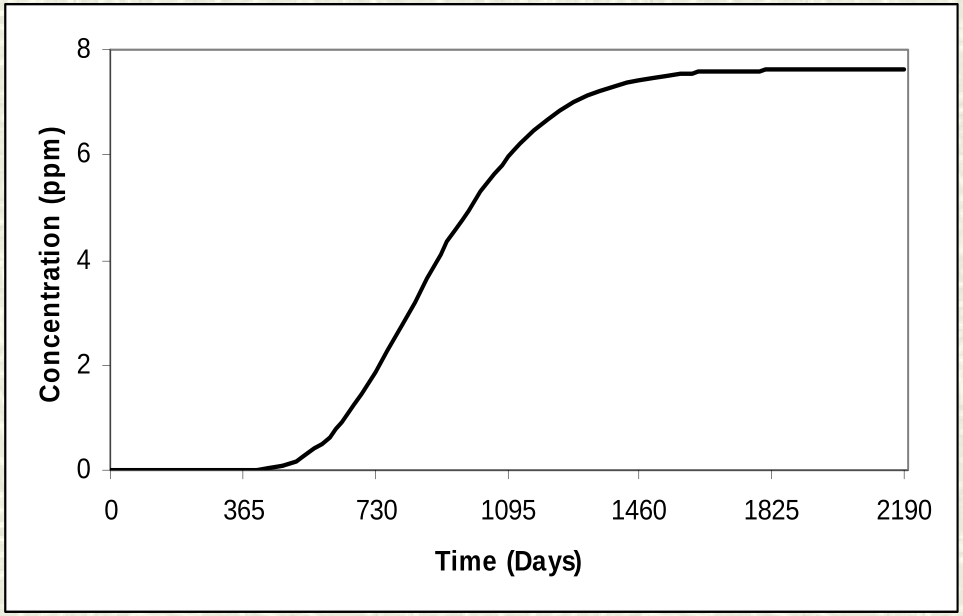
After 1 yr



After 2 yr



After 5 yr



Results

For surface soils:

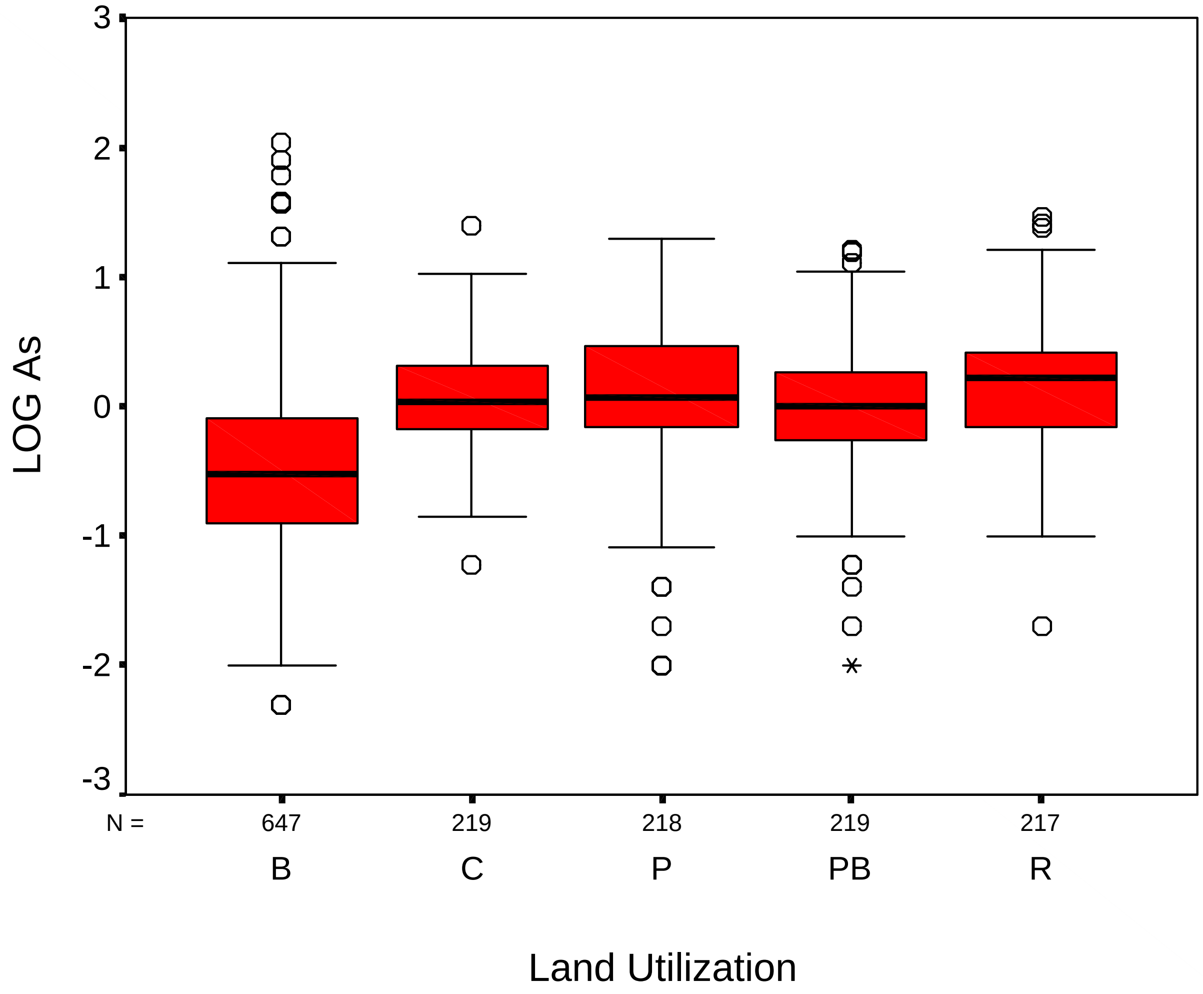
As retention decreased in order :

Marl > Histosol > Entisol = Ultisol = Spodosol

For subsurface horizons:

As retention decreased in order :

Marl > Histosol = Ultisol = Spodosol > Entisol



Note: Land Utilization without Cities
B – Background
C – Commercial
P – Parks
PB – Public Buildings
R – Residential

The background data point with value on 656 mg/kg was removed.

Summary

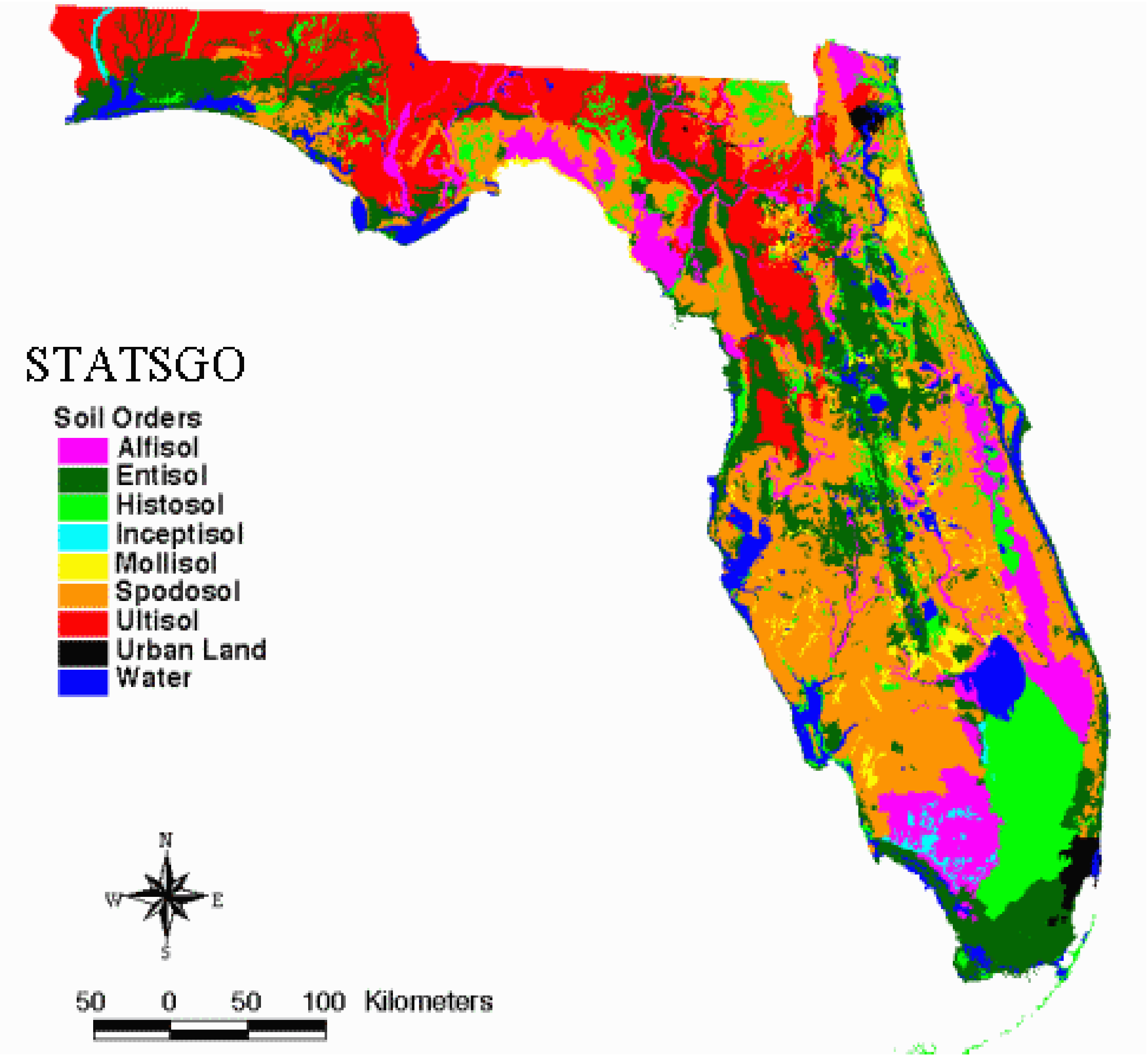
Surface horizons important

zone of maximum exposure

However, for protection of groundwater resources, subsurface horizons more important

zone of maximum retention

Should regulation be limited to surface soils?


STATSGO
Soil Orders
Alfisol
Entisol
Histosol
Inceptisol
Mollisol
Spodosol
Ultisol
Urban Land
Water
N
W
E
S
50 0 50 100 Kilometers