INTEGRATED SINK ENHANCEMENT ASSESSMENT

INSEA PARTNERS

European soil database and verification of the changes of the organic carbon stock in mineral soils

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Outline

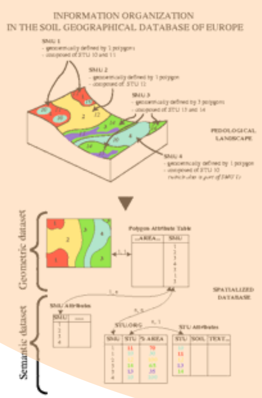
- European Soil Database
  - Status & relevance
  - Future
- Verification of the changes in carbon stock in mineral soil
  - Area-frame randomized soil sampling
  - Pedological substatialization
  - Field test
- Conclusions

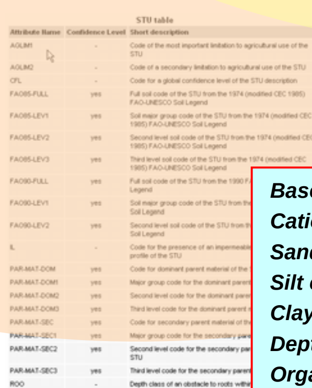
Components of the Soil Database & application to INSEA

SGDBE1M

(Soil Geographical Database of Eurasia at scale 1:1,000,000)

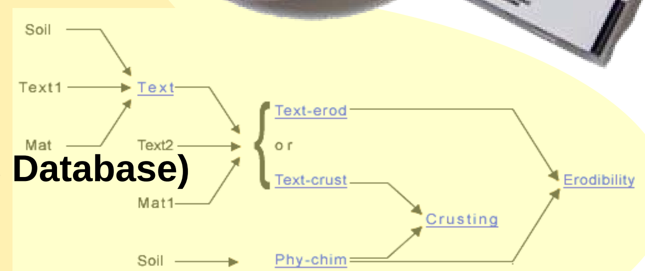
Polygons/1k raster
Soil mapping units
Soil typological units





PTRDB

(Pedotransfer Rules Database)



Bulk density
Sum of base ions

SPADE

(Soil Profile Analytical Database)

Base saturation
Cation exchange capacity
Sand content
Silt content
Clay content
Depth to rock
Organic carbon
Package density
Volume of stones

HYPRES

(Hydraulic Properties)

Wilting point
Field water capacities
Saturated conductivity
Hydrological soil groups

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SPADE – Data available

Country	STU's	SPADE 1	SPADE 2
Austria	30	0	0
Belgium & Luxemburg	139	55	221
Denmark	71	9	88
Finland	14	0	28
France	772	118	22
Germany	389	60	124
Greece	120	10	0
Ireland	100	17	0
Italy	168	21	295
Netherlands	49	20	78
Portugal	188	18	317
Spain	220	25	0
Sweden	356	0	0
UK	465	41	733
All countries	**3081**	**396**	**1906**

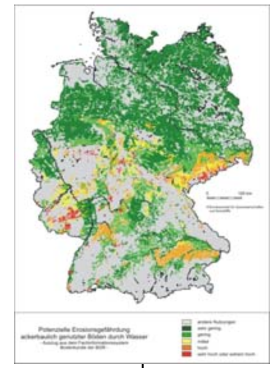
Based on: John Hollis (http://eusoils.jrc.it/esbn/esbn_meetings_plenary2005.html)

Starting from 2007 (FP7):
ESDAC- European Soil Data Centre

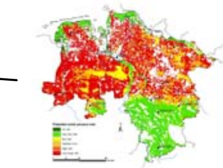
Data requirements → Data collection/ updating → Data management/ harmonization → Data dissemination

DG ENV, MS → European Soil Bureau Network

National Soil Data Centers



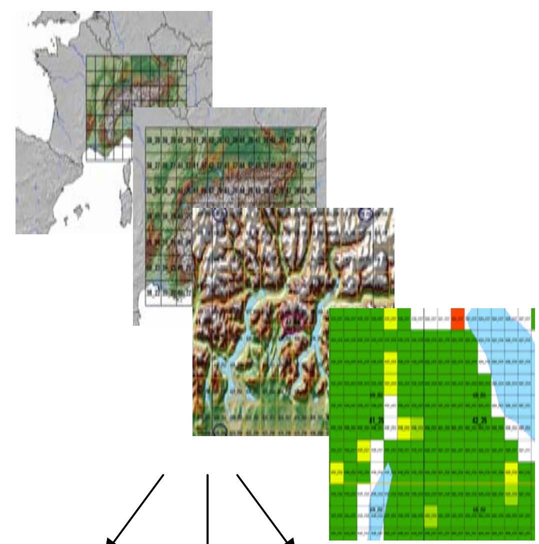
Regional Soil Data Centers



JRC

Qa and Qc → European Soil Information System

Multiscale European Soil Information System



Access over eu-geoportal: http://eusoils.jrc.it

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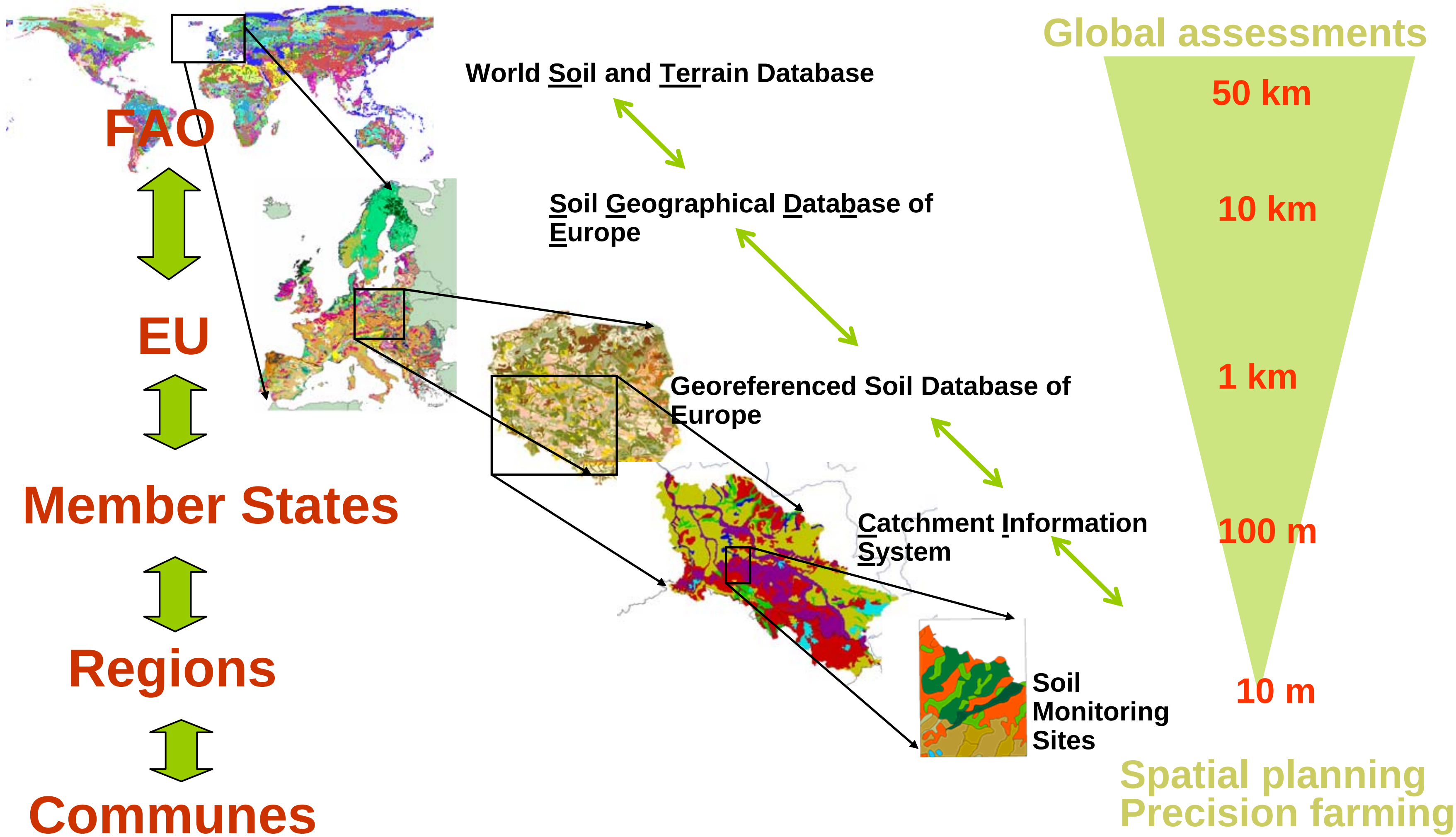
EUSIS - A nested soil information system for Europe

Different grid sizes give answers to different questions



INSPIRE standard grid

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Organic carbon is a universal soil quality indicator

(Upcoming Directive for Community action for the protection and sustainaable use of soil, based on EC COMMUNICATION (2002, 179))

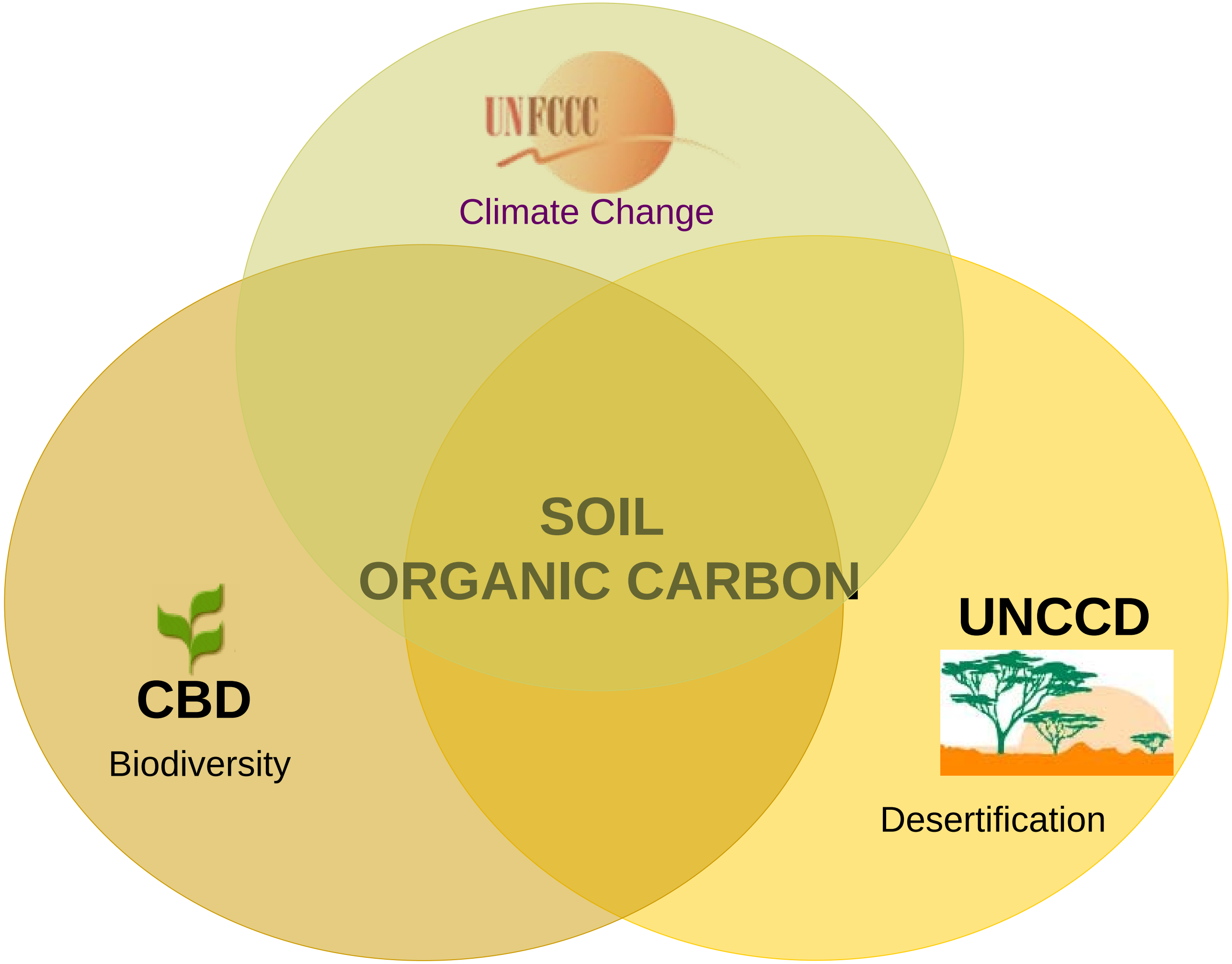
Driver of soil functions:

- Food and other biomass production
- Storing, filtering and transformation
- Habitat and gene pool
- Physical and cultural environment for humankind
- Source of raw materials

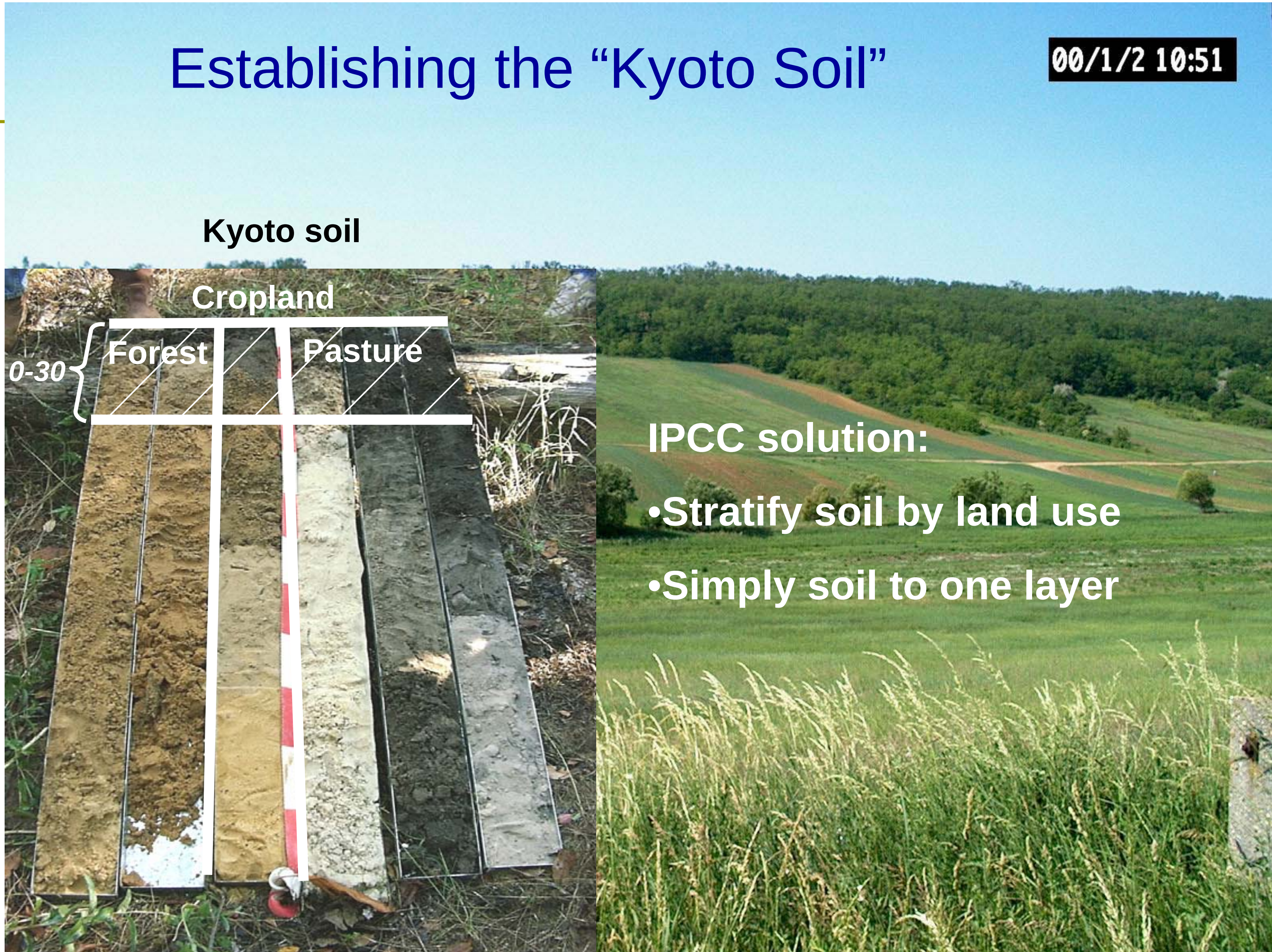
Indicator of soil threats:

- Erosion
- Decline in organic matter
- Soil compaction
- Salinisation
- Landslides

Soil organic carbon in global policies: Synergies between the 3 Rio Conventions



Establishing the “Kyoto Soil”



IPCC solution:

- **Stratify soil by land use**
- **Simply soil to one layer**

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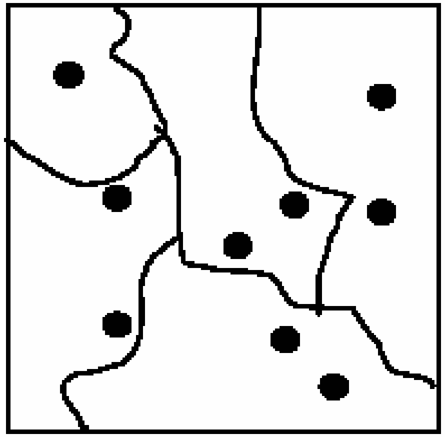
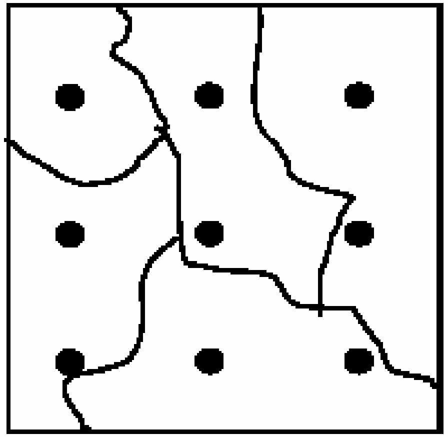
Soil sampling design (based on IPCC GPG, 2003)

Random layout

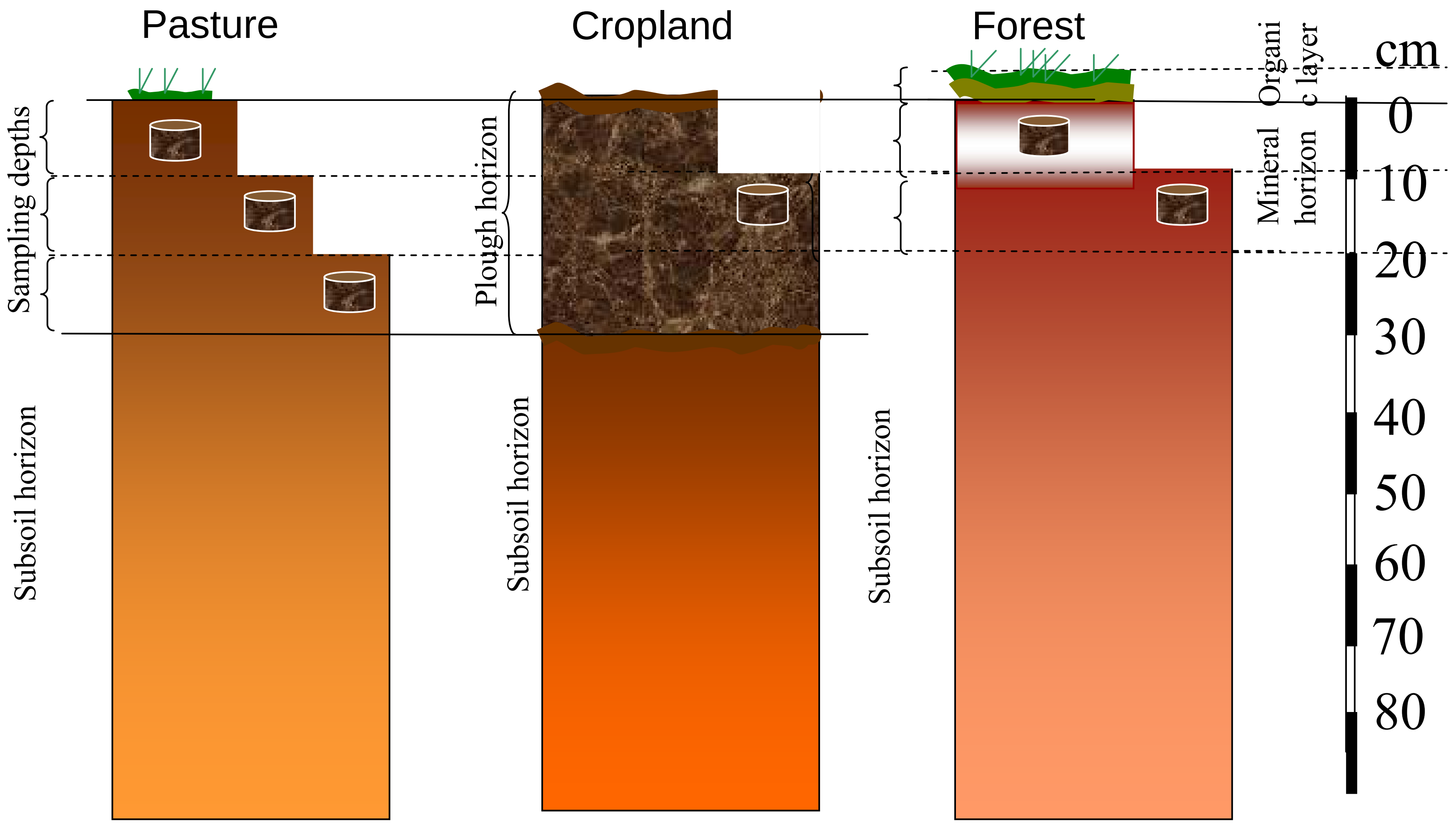


Systematic layout

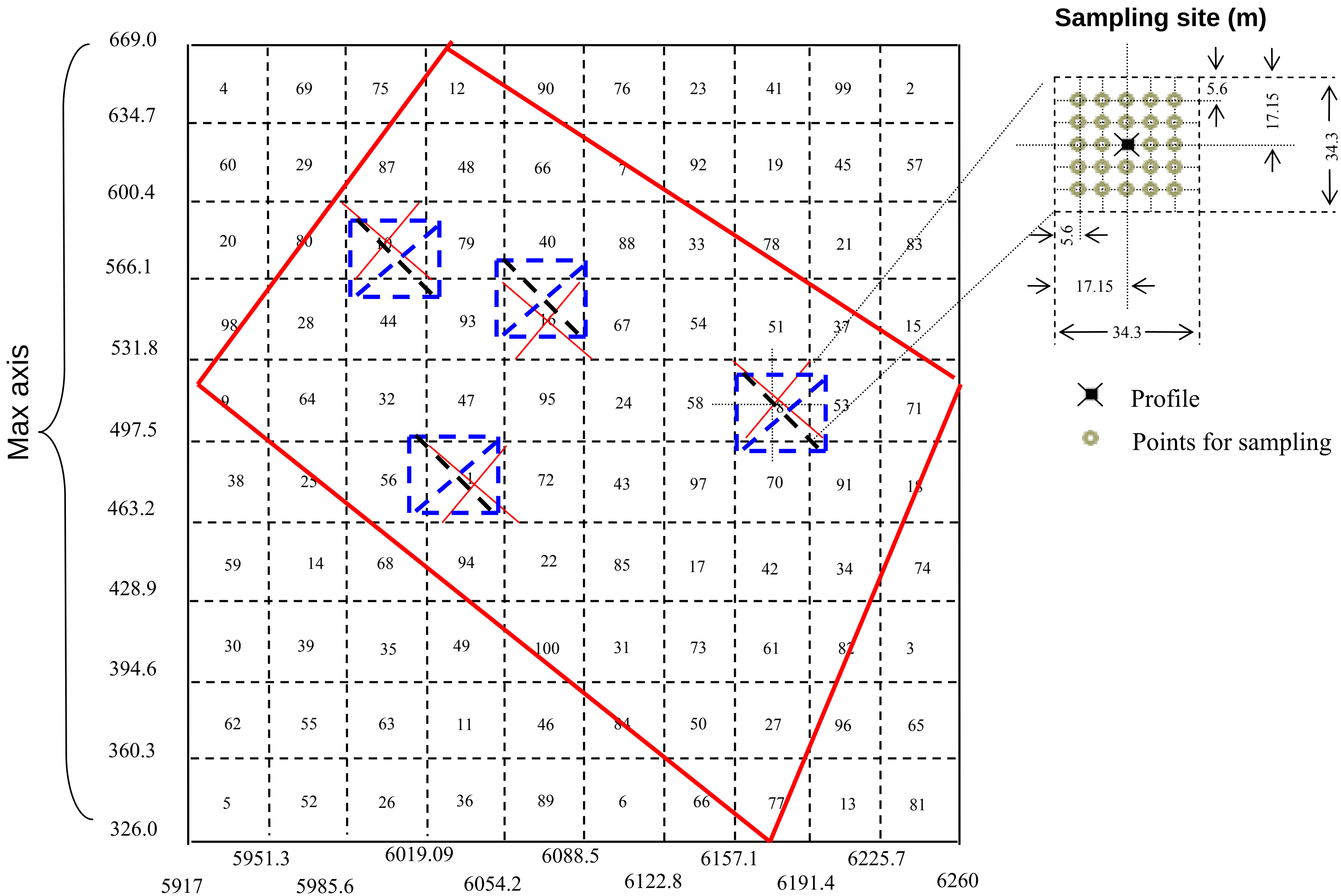


To define baseline C-stock and tackle spatial variability

Sampling substantialization, soil profiles



Randomized template to select sampling sites (simulation of the positioning error: red crosses (first) and blue cells (shifted) samplings)



Computation

Changes in C stock (ΔSOC_{stock}) is a difference between average reference and new measurement

$$\Delta SOC_{stock} = \overline{SOC}_{refstock} - \overline{SOC}_{new}$$

Uncertainty of the verification is characterized by standard error of the changes value $s(\Delta SOC_{stock})$

Changes are verified by:

$$\Delta SOC_{stock} \pm s(\Delta SOC_{stock})$$

Reproducibility (*RP*) is a difference in the averages resulting from two parallel samplings, which is an error of the sites positioning in the course of the repeated sampling.

$$RP(\%) = (\overline{SOC}_{new} / \overline{SOC}_{refstock})*100$$

I N S E A

Reproducibility: first and second (shifted) samplings

Profile, N	Depth, cm	C, %	Bulk density, g/cm3	Soil carbon density, kgC/m3	Carbon content for profile, tC/ha	Soil carbon stock, tC (area 4 ha)	Average soil carbon stock, tC (area 4 ha)	Difference in average carbon stocks between samplings, %
Cropland *Skeletic Cambisol*, first sampling								
C1S	0-25	2.43	1.29	7.86	n.a.*	314.4		
C22S		2.16	1.43	7.72	n.a.	308.8	301.1	
C8S		2.04	1.37	7.00	n.a	280.0		
		Cropland *Skeletic Cambisol*, second sampling						3
C1Ss	0-25	1.99	1.52	7.60	n.a.	304.0		
C22Ss		2.00	1.40	7.00	n.a.	280.0	292.0	
C8Ss		1.55	1.25	4.85	n.a	n.a.		

Source: Stolbovoy et al., 2006

I N S E A

Interpretation of the reproducibility

(1) Detectable minimum: changes bigger than 3 % of the initial C stock can be verified, e.g., if the stock is 70-80 tC/ha for the cropland Skeletic Cambisol the detectable min is 2.1-2.4 tC/ha;

(2) Selection of land management, e.g., only managements with the potential to gain more than 2.1-2.4 tC/ha can be applied and verified.

The laboratory cost

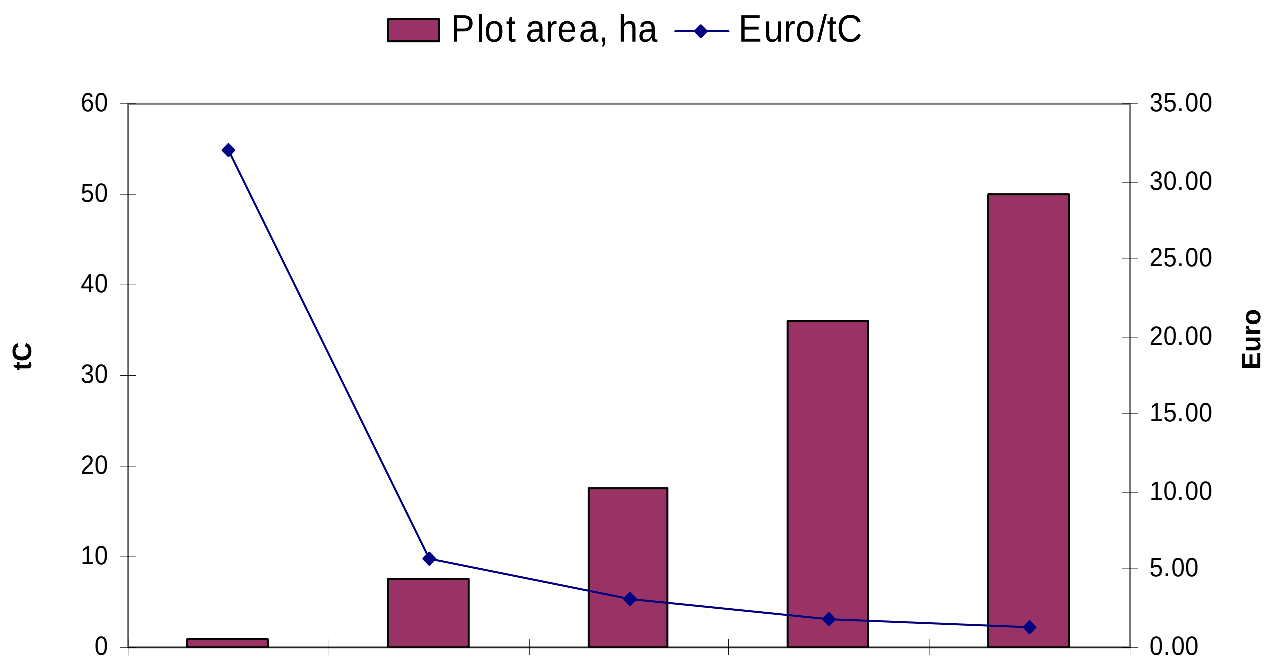
Conditions: the average C sequestration is 6tC (4ha plot); the laboratory cost of the C detection is 16 euro for sample.

Land cover	Conventional (IPCC, 2003)			Area-Frame Randomized Soil Sampling		
	Variability, %	Number of samples	Cost per tC	Variability, %	Number of samples	Cost per tC
Cropland	9	216	576	n.a.	3	8
Pasture	15	300	800	n.a	9	24

Source: Stolbovoy et al., 2006

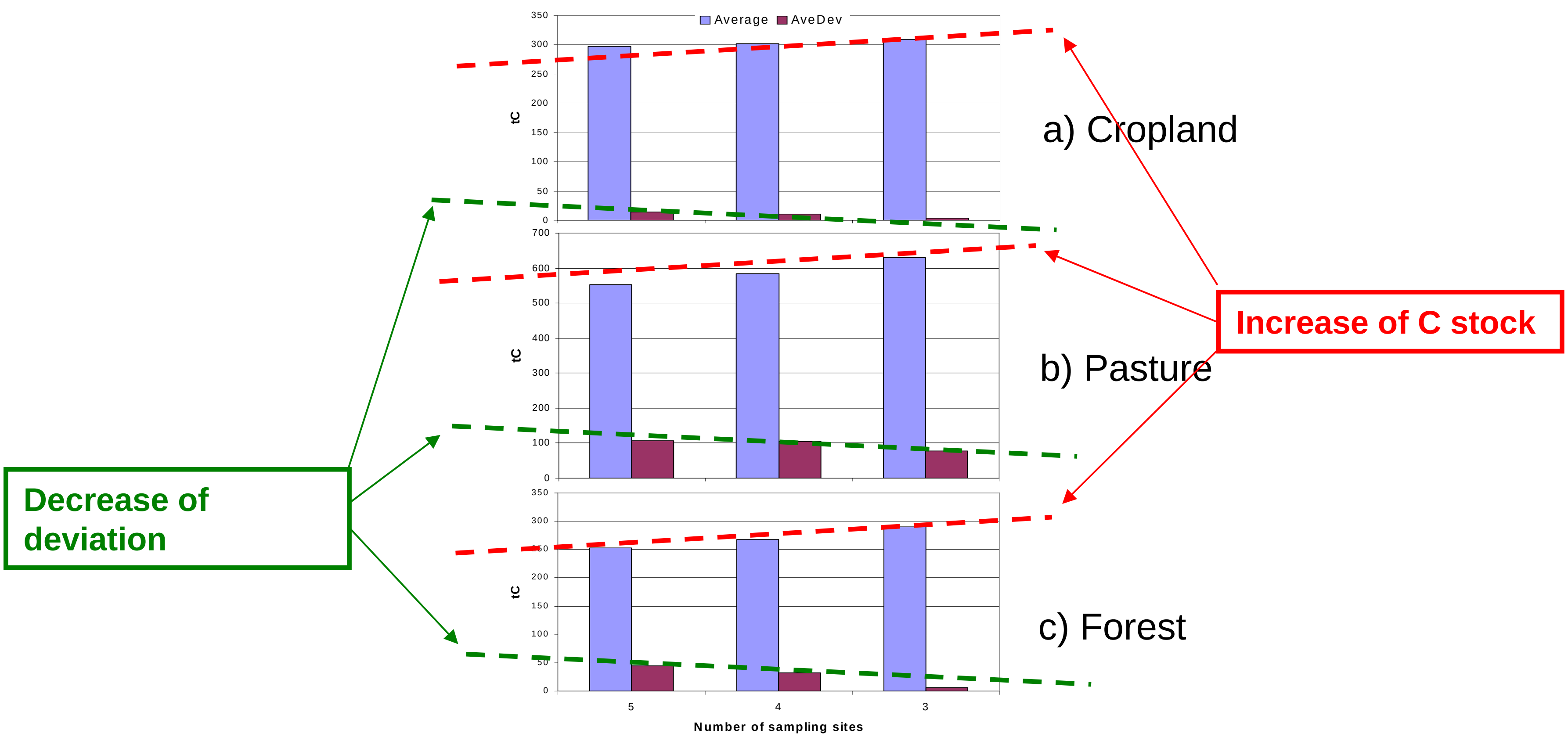
Dependence of the laboratory cost of C determination on the plot area of cropland

Conditions: average carbon sink is 1.5 tC/ha; the cost of lab determination is 16 euro per sample.



Source: Stolbovoy et al., 2006

Verification uncertainty: soil carbon stock (Average), average deviation (AveDev)



Source: Stolbovoy et al., 2006

Conclusions

- The European Soil Database meets demand of the very detailed biophysical models.
- The integration with other environment and socioeconomic data (INSPIRE), better soil characterization (European Soil Data Center) contribute to the DB performance in the future.

Conclusions con’t

- A new area-frame randomized soil sampling makes verification simple, transparent and low cost. The method allows easy programming and computation of the sampling procedure.
- Reproducibility test allows to establish minimum detectable amount of the carbon change and select relevant to this amount carbon management practices.
- The uncertainty of the detection declines with the soil saturation with carbon, which supports soil implementation for the carbon sequestration.

Thank you