

Preliminary Results of a Europe-wide Survey on Soil Organic Carbon Levels



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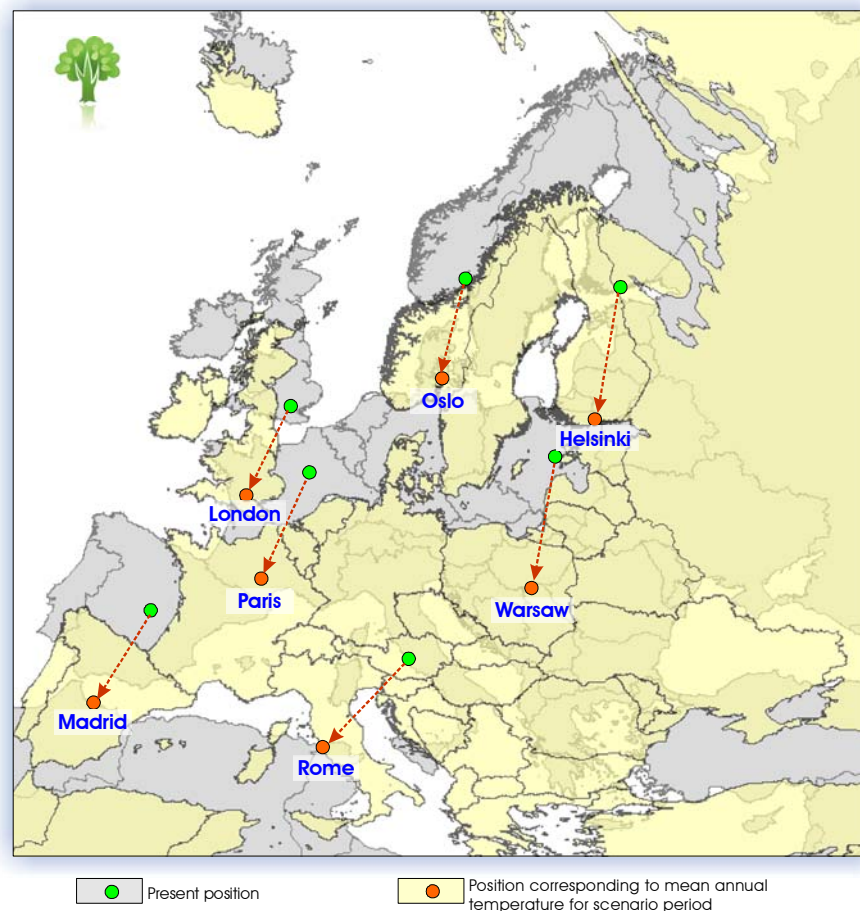
Climate Change

Temperature Effect

Geographic position of Europe, indicating major cities, at the end of the 21st century.

Based on the changes in mean annual temperature of the period 2071-2100 as compared to the period 1960-1990.

Based on data provided by the Danish Climate Centre, Danish Meteorological Institute according to the IPCC A2 scenario.

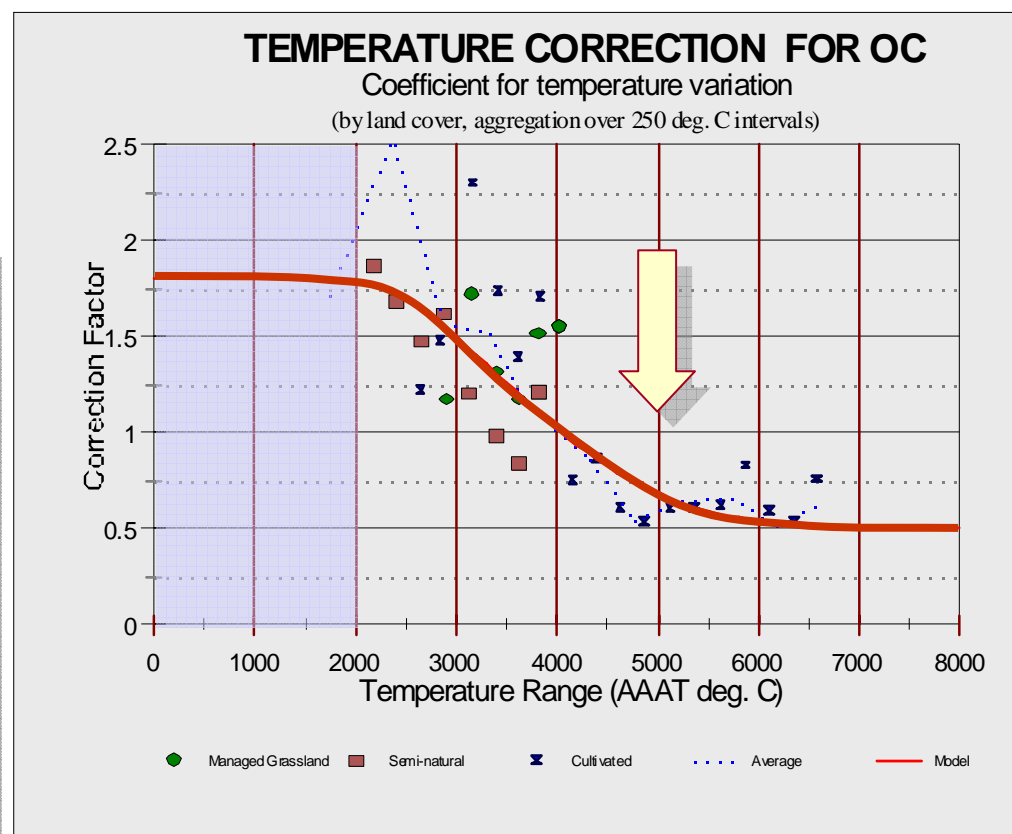


End-of Century Temperature Equivalent

Temperature Effect on Soil Organic Carbon

Assumption

Within belts of uniform moisture conditions and comparable vegetation, the average total organic matter in soils increases by 2 to 3 times for each 10°C fall in mean temperature.



Temperature Function for SOC Content

BioSoil Demonstration Project

Forest Focus (Regulation (EC) No. 2152/2003)

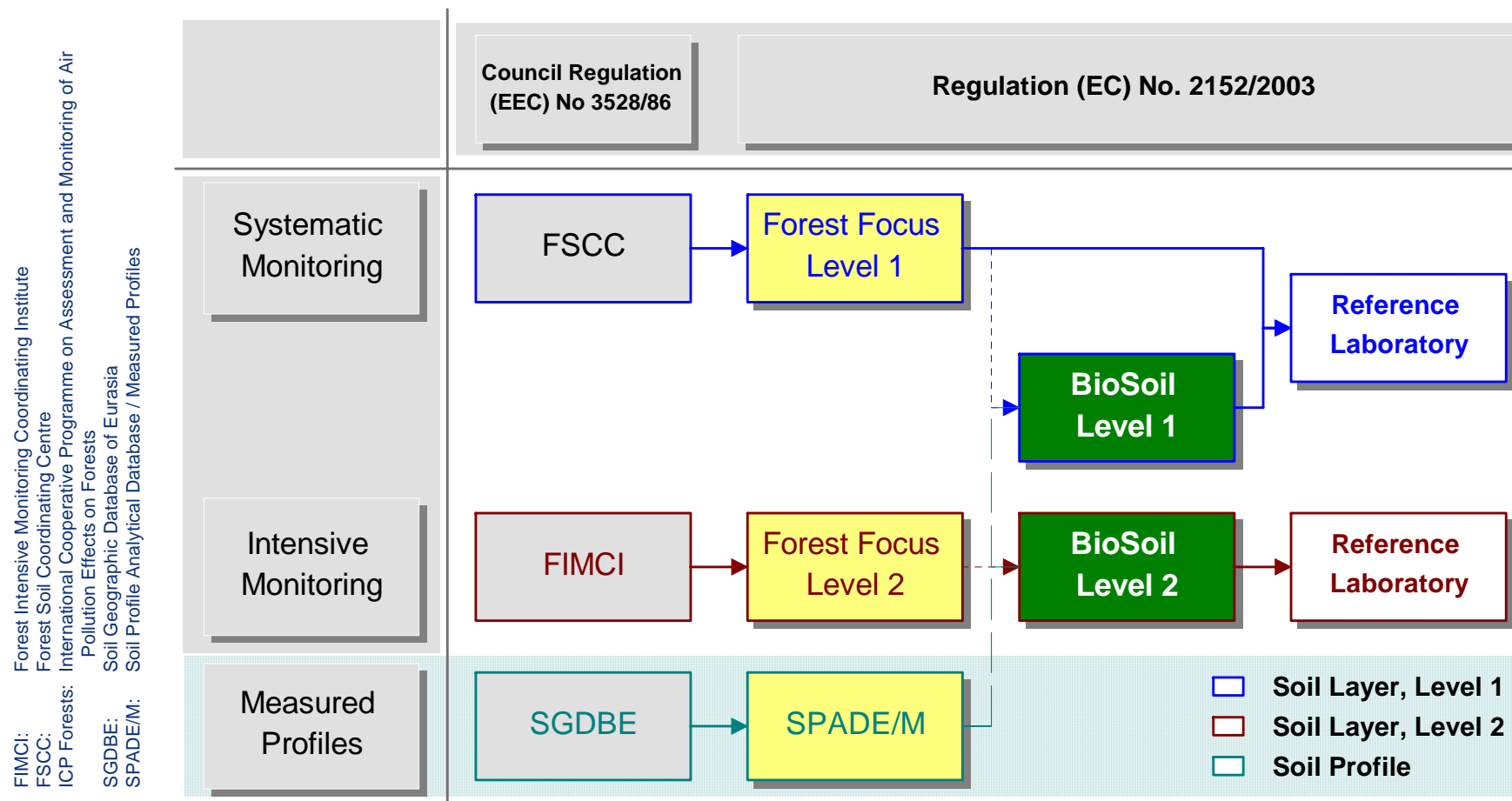
Project Aims

Provide harmonized soil and biodiversity data and contribute to research and forest related policies.

Evaluation of Consistency of Biosoil data

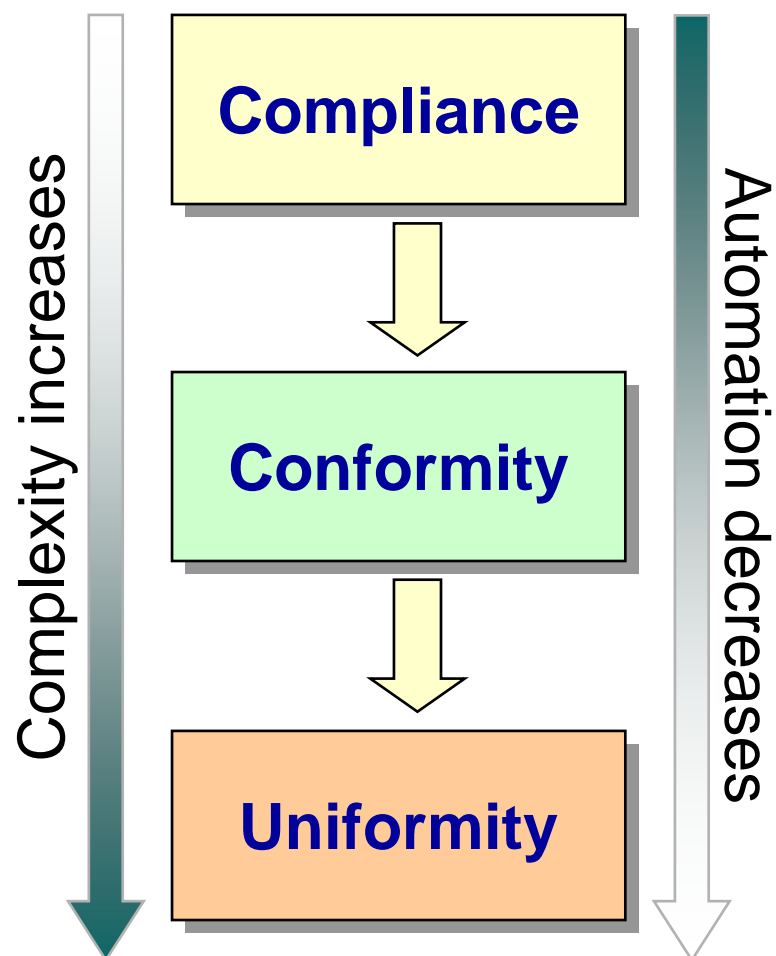
- Spatial variability at country level.
- Temporal variability to previous survey.
- Influence of laboratory methods on observed values.

Soil Surveys linked to BioSoil



Historic and Current Soil Surveys

Data Validation Procedure

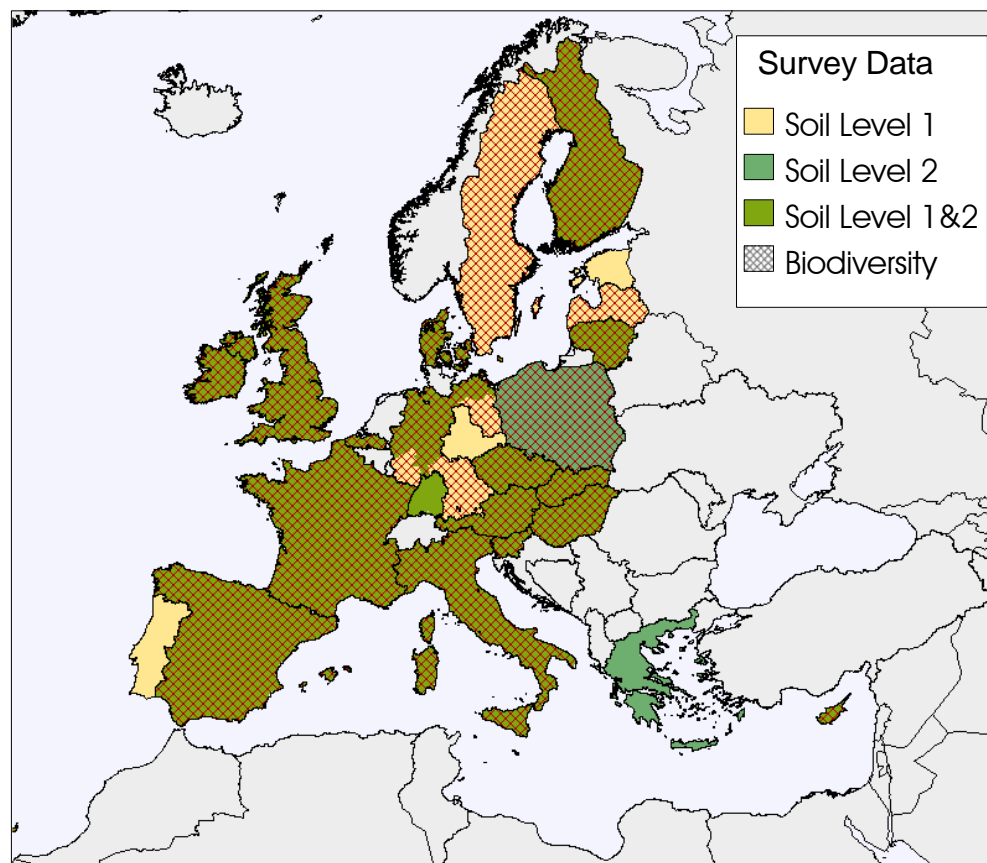


- Verification of Formal Aspects
Errors lead to data being rejected, need to be resubmitted.
- Evaluation of Data Value
Errors lead to data being re-assessed by NFC.
- Analysis of Data Comparability
Warnings on systematic differences lead to message to NFC.

BioSoil Survey Participants

Soil Sampling

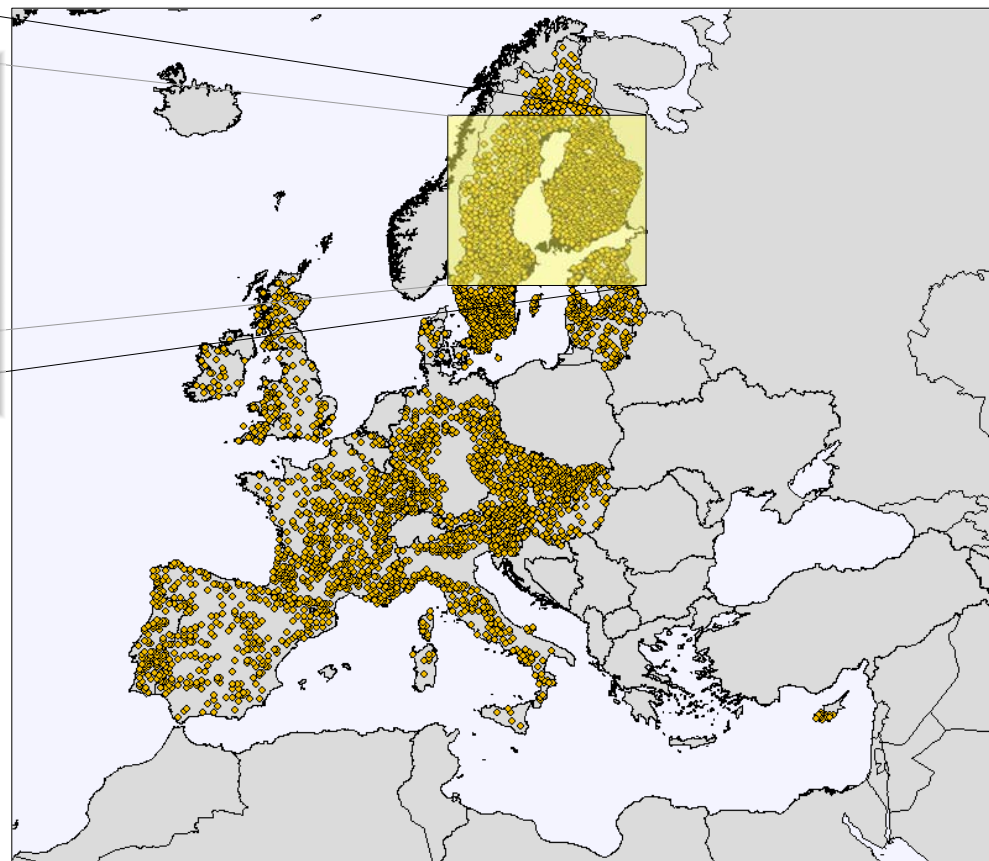
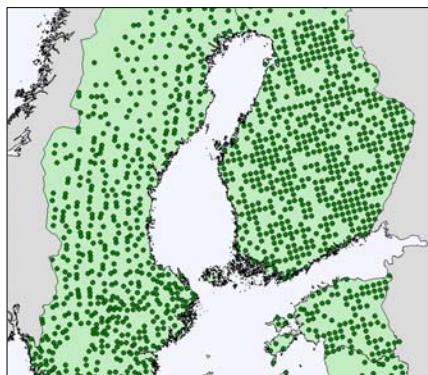
No. of countries:	22
No. of NFCs:	31
No. of Plots:	4,034
with reference	4,026
Plots within NFC area:	
no buffer area	3,544
buffer of 3km	3,551



BioSoil Participating NFCs

Distribution of Level 1 Survey Plots

Plot Location



- Nominal arrangement in 16 x 16 km grid on forest land.
- Use of ICP Forests Level 1 plots.

BioSoil/Soil Level 1 Sample Plots

Sampling Methods



Litter

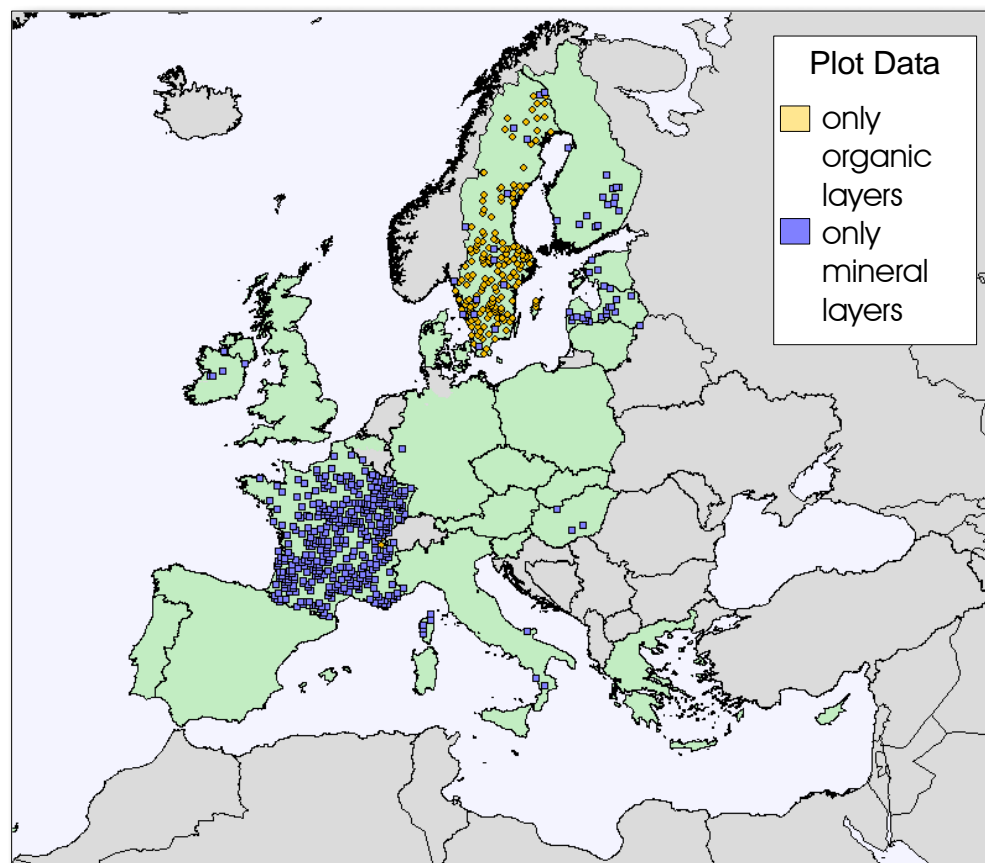
Organic

Mineral (cm)

0	–	5
5	–	10
10	–	20
20	–	40
40	–	80

Two methods applied:

- pedological horizons
- fixed depth

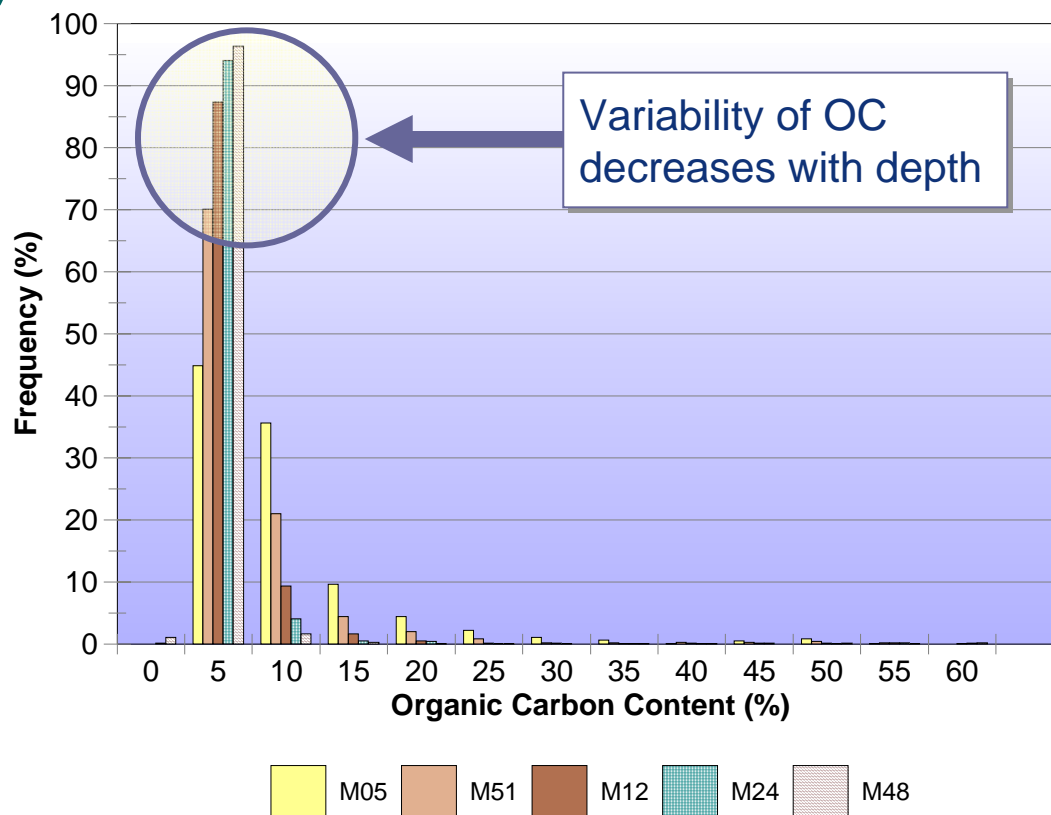


Level 1 Plots with Only Organic or Mineral Layers

Image from E. Micheli in: Jones, A., V. Stolbovoy, C. Tarnocai, G. Broll, O. Spaargaren and L. Montanarella (2010) Soil Atlas of the Northern Circumpolar Region. Publication Office of the European Union, Luxembourg, 144 pp.

Organic Carbon Content in Soil Stratum

Frequency Distribution



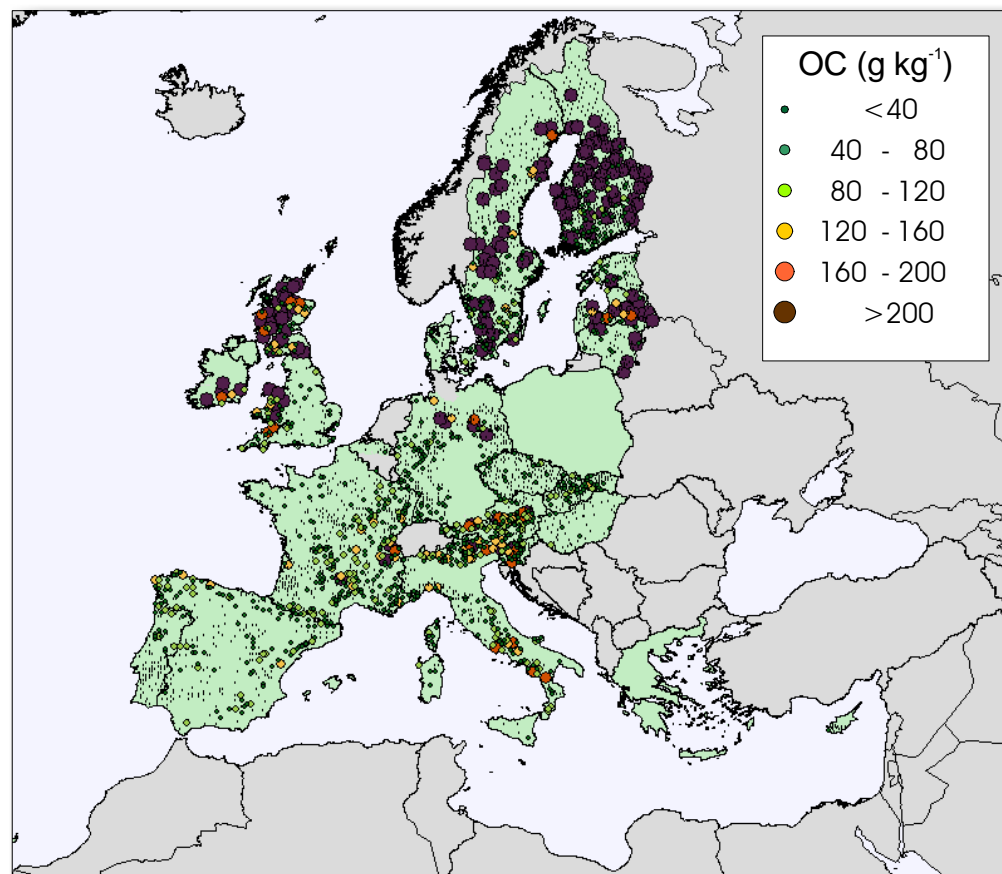
Distribution of Organic Carbon Content in Soil Stratum

Organic Carbon Content in Soil Stratum

Level 1 Plot Data

Distribution follows
European map of topsoil
organic carbon content.

Areas with peat show plots
high OC content.



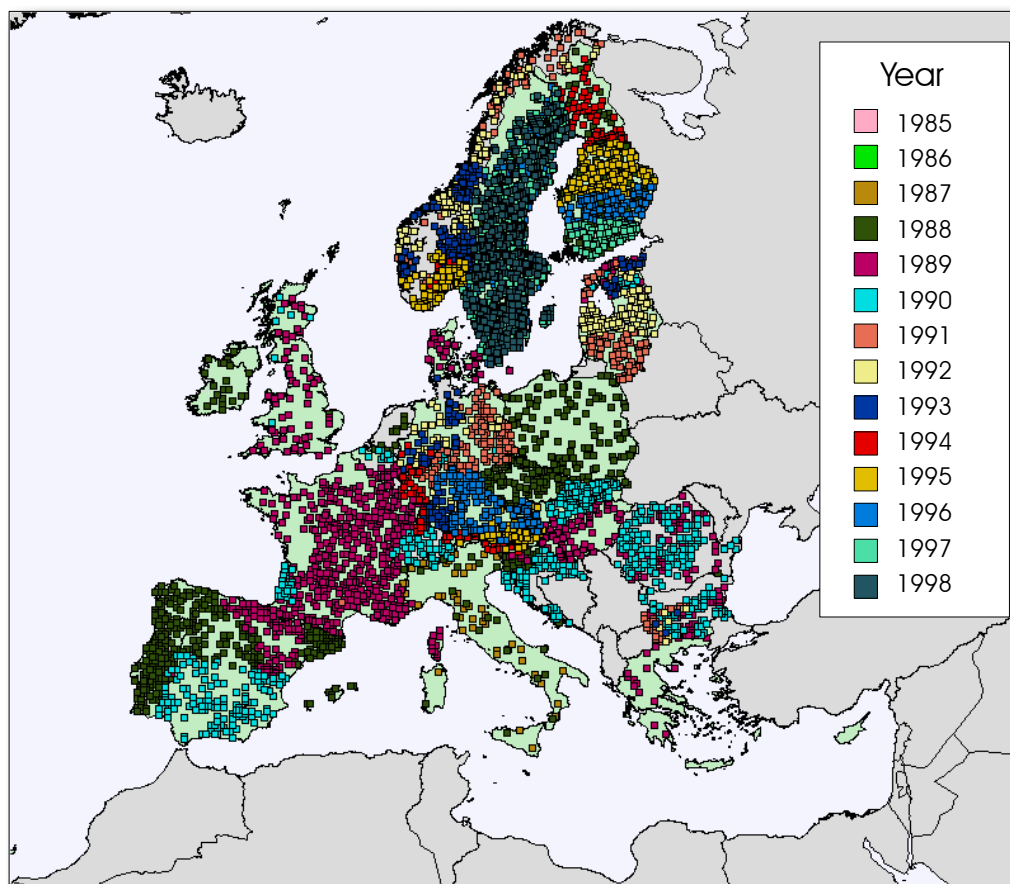
Organic Carbon Content in Soil Layer on Level 1 Plots

Survey Years of 1996 Soil Data

Temporal Range

Database contains surveys performed over 13 years.

In some countries surveys were carried out over several years.



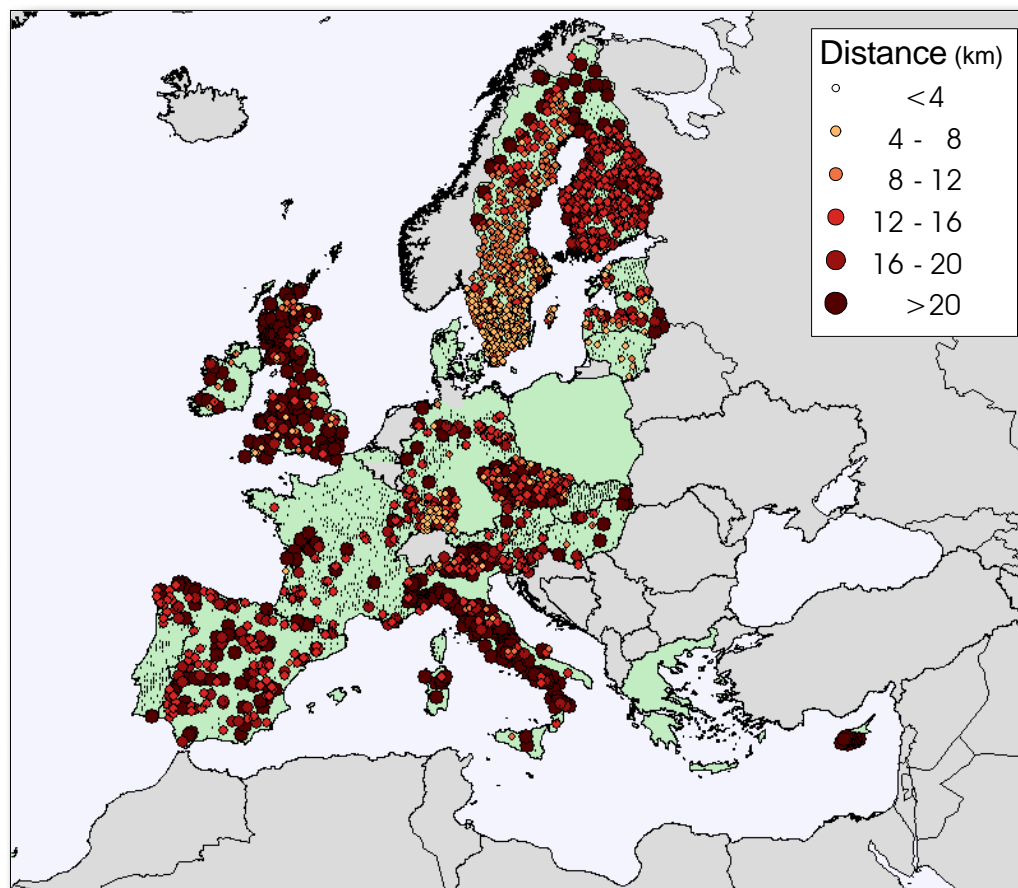
Soil Survey Year on ICP Forests Level 1 Plots

1996 vs. 2006 Soil Survey

Geographic Co-location

Identification of previous plot by geographic position is not apparent:

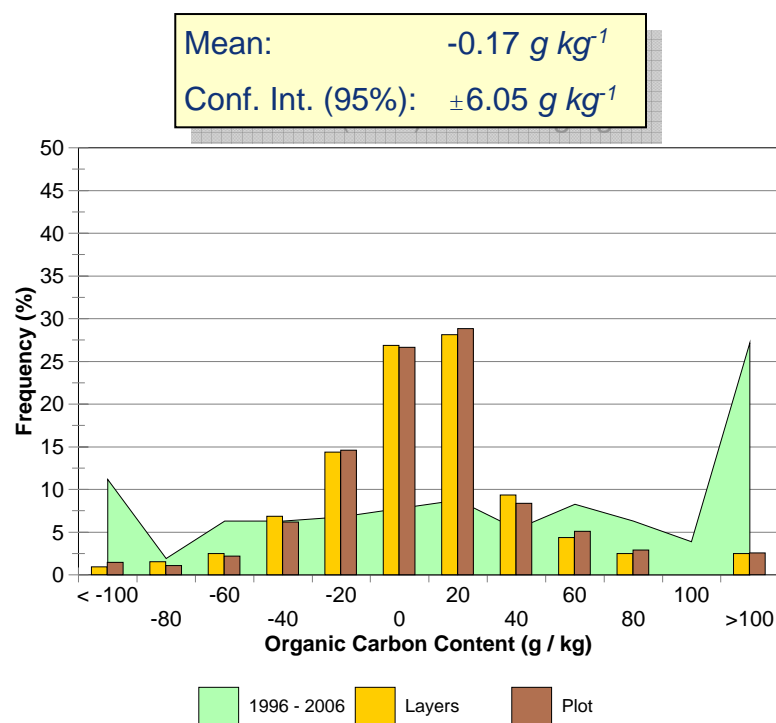
- new plots installed;
- coordinates of existing plots modified;
- systematic shift introduced.



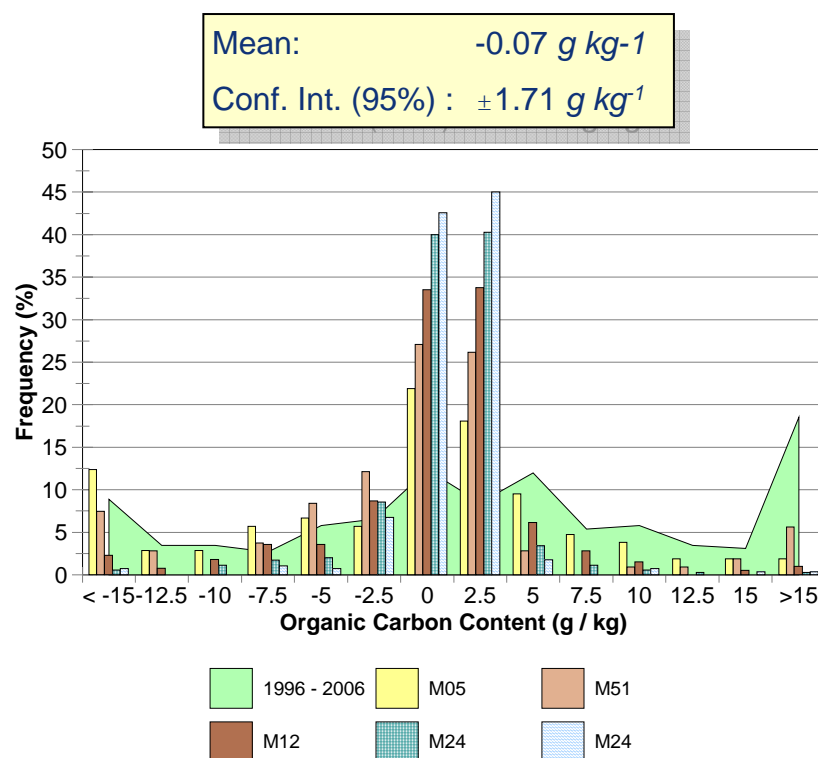
Distance of BioSoil Plot to ICP Forests Plot

2006 Soil Survey vs. Central Laboratory

Difference in Organic Carbon Content



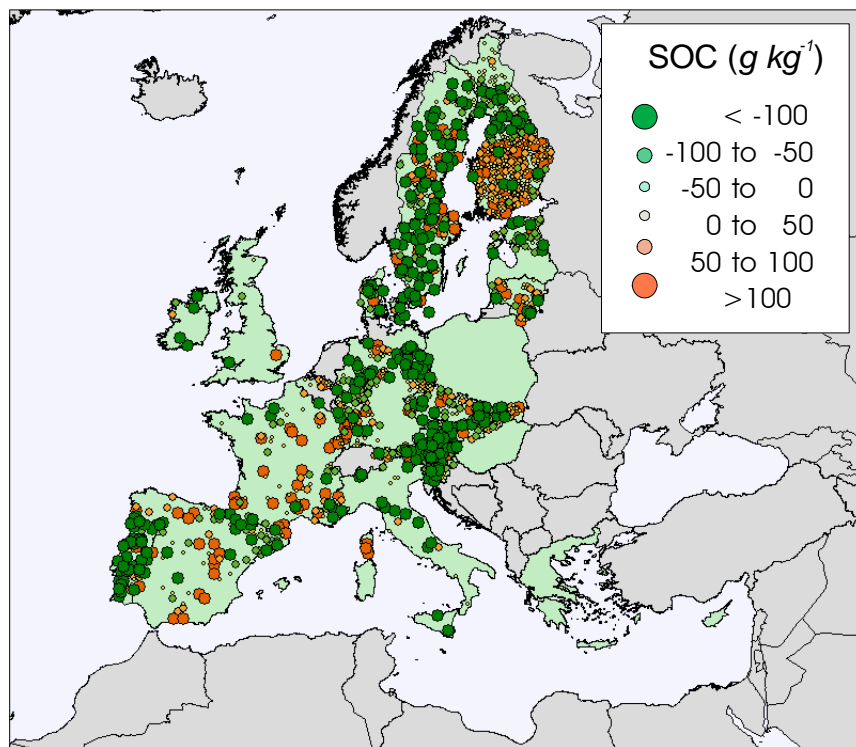
Organic Layers (g kg^{-1})



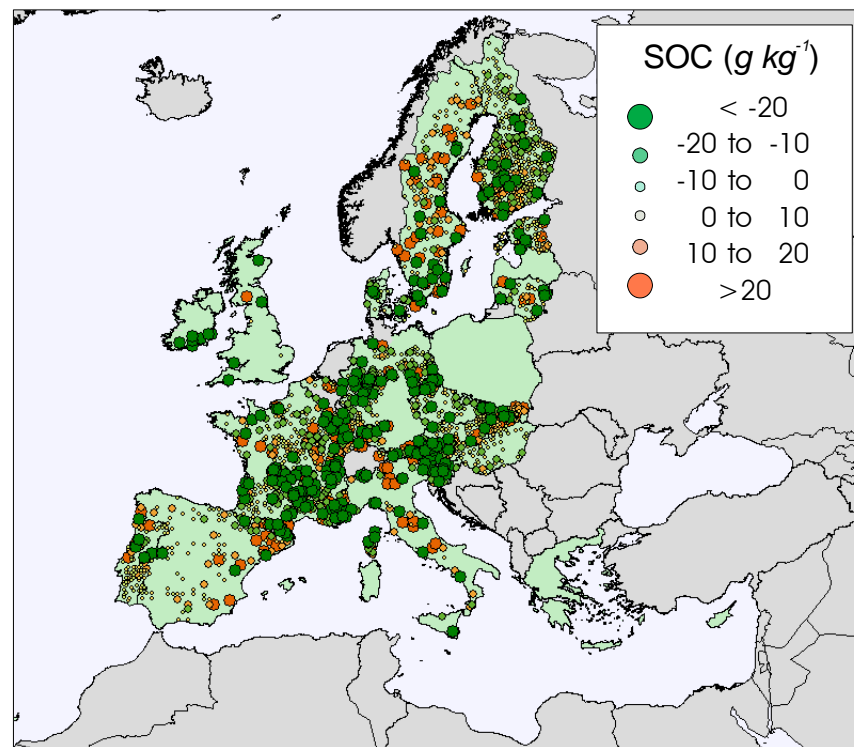
Mineral Layers (g kg^{-1})

1996 vs. 2006 Soil Survey

Change in Organic Carbon in Organic and Mineral Layer



Organic Layers



Mineral Layers

Demonstration Project Findings

Methodology & Analysis

- ⇒ Common Survey Manual compiled (with ICP Forests).
- ⇒ Revisit same plots and allow identification of plots.
- ⇒ Data QA essential.

Detection of Change in SOC after 10 years (1996 – 2006)

- ⇒ Significant difference from Central Lab. $\pm 0.61 / 0.17$ % for SOC content.
- ⇒ Significant change in SOC was detected for organic & mineral layers.
- ⇒ Attributing change to a specific condition is not evident.

- Instrument variations: $< 0.1\%$ ¹.
- Laboratory measurement error: $< 1-2\%$ ¹.
- Average annual rate of change in SOC content (0-15 cm): -0.5% ².

¹ Olsen, C. (2009) Soil Inventories for Carbon Assessment. NRCS GHGIS workshop – Sandia Labs. May 21, 2009

² Bellamy, P.H., P.J. Loveland, R.I. Bradley, R.M. Lark and J.D. Kirk (2005) Carbon losses from all soils across England and Wales. Nature, Vol. 437/8. Sept. 2008. pp 245-248.