

Forest Soil Condition in Europe

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a Life+ co-financed project for the "Further Development and Implementation of an EU-level Forest Monitoring System".

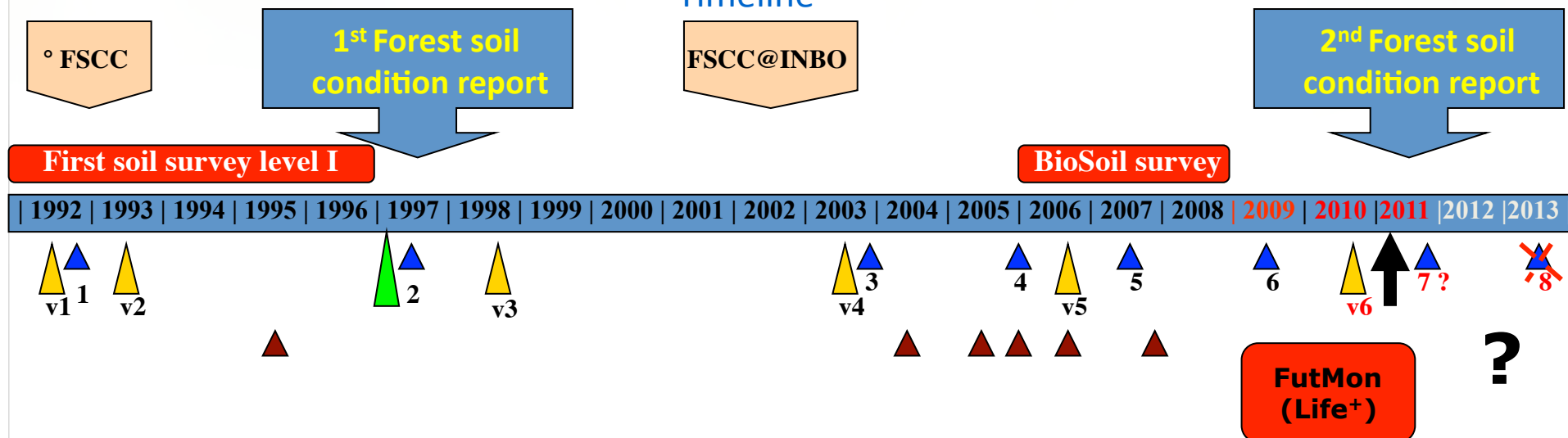


The project coordination centre is situated at the Institute for World Forestry, Hamburg, Germany.

- History of EU forest soil surveying
- BioSoil plot network
- BioSoil⁺ soil database
- 2nd Soil Condition report
- Evaluation results
 - Soil classification
 - Carbon and C:N index
 - Soil acidity
 - Trace metals in forest floors
- Conclusions
- Recommendations

History of Forest Soil Surveying at the European level

Timeline



-  Manual update
-  Data integrity rules
-  Ringtest event
-  Field Training courses

- Periodicity soil survey (~12 yrs)
- Intense preparation prior to BioSoil survey 2006 – 2008
- Elaboration of revised manual during FutMon in 2010
- What brings the Future ??



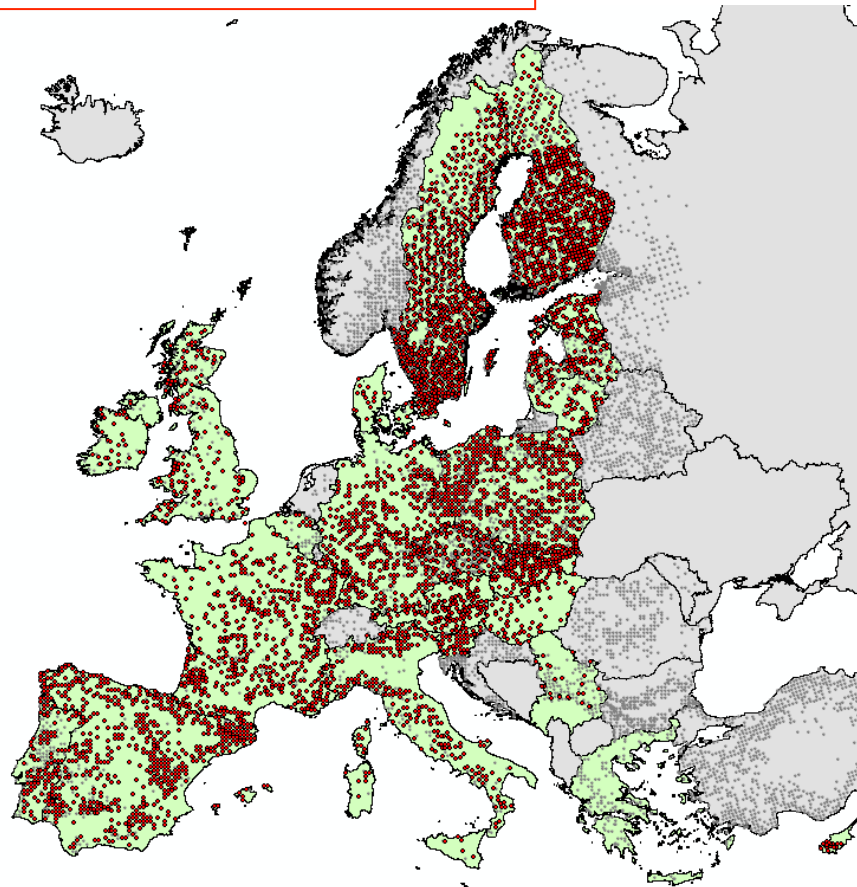
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Largest forest/soil survey grid of Europe



Level I – pan European grid

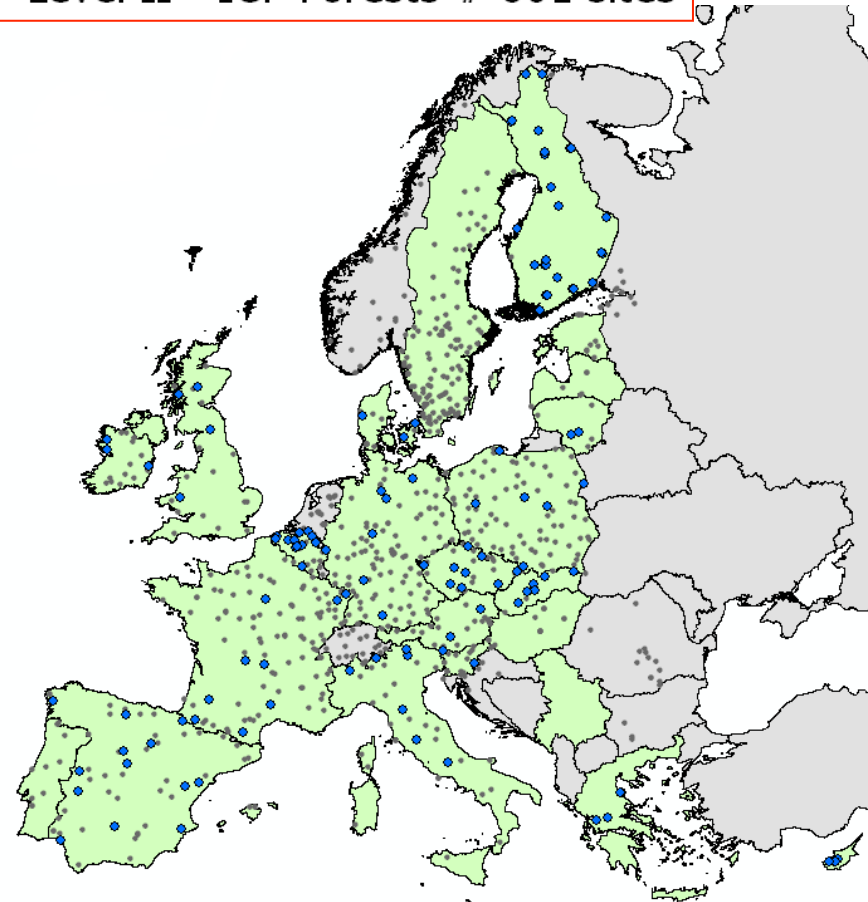
- Level I - BioSoil # 4926
- Level I - ICP Forests # 11705



Natura 2000 BioSoil LI sites: 2027 (41%)

Level II - Intensive monitoring

- Level II - BioSoil # 127 sites
- Level II - ICP Forests # 801 sites



Natura 2000 BioSoil LII sites: 79 (62%)

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A newly assembled and completed BioSoil⁺ soil Dbase

- Since the validated BioSoil database was not available from DG JRC for FutMon evaluations, a working database was assembled from all national BioSoil databases, referred to as BioSoil⁺
- With the help of national soil experts, BioSoil data are substantially completed, corrected and further validated under FutMon.

		BioSoil ⁽¹⁾	BioSoil ⁺
Countries	Countries	21	23
	Fed.States	31	33
Sites	Level I	4033	4926
	Level II	131	127
Layers	Level I	20617	26180
	Level II	1780	2659
Variables	Layer	51	51
	Horizon	48	48

In BioSoil⁺:

- Data added from Poland, Serbia
- 4 HU plots only in BioSoil
- Coordinates were corrected
- Variables added (e.g. coarse fragments data of AT)
- Ongoing process



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2nd Forest Soil Condition Report

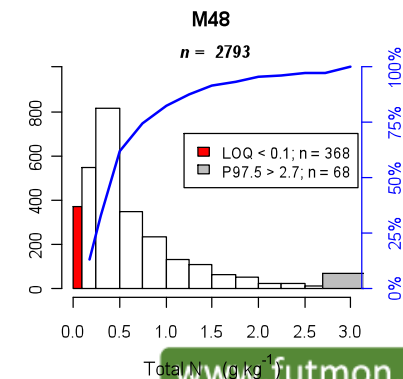
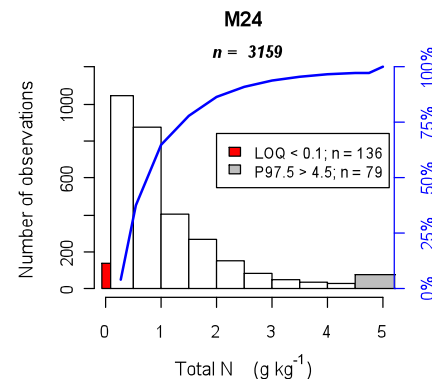
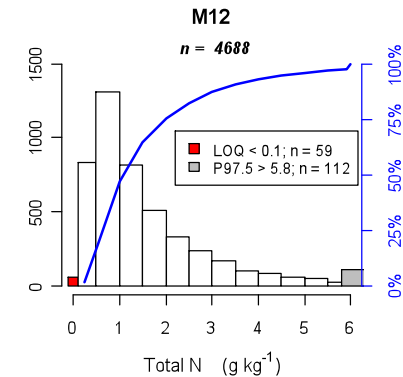
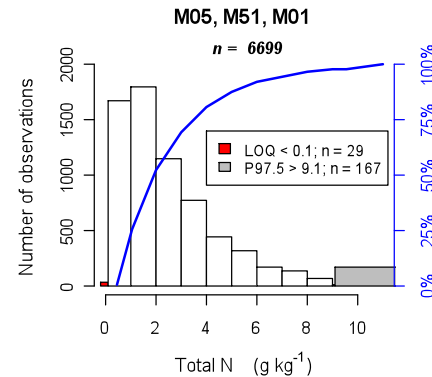
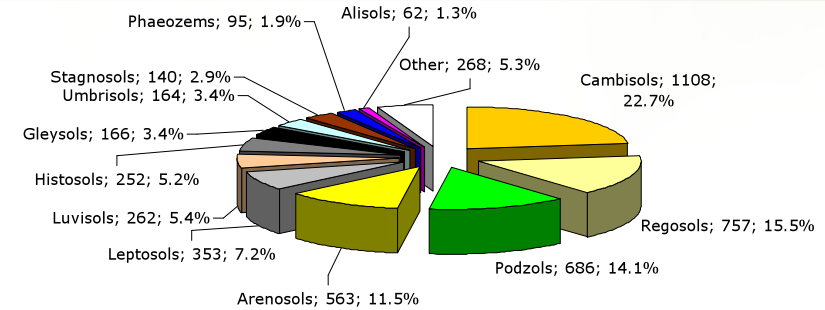


MAIN FutMon DELIVERABLE

Introduction
Background
Objectives

Part I: Description and analysis of the BioSoil⁺ soil data

Part II: Thematic studies



Conclusions

Recommendations

References

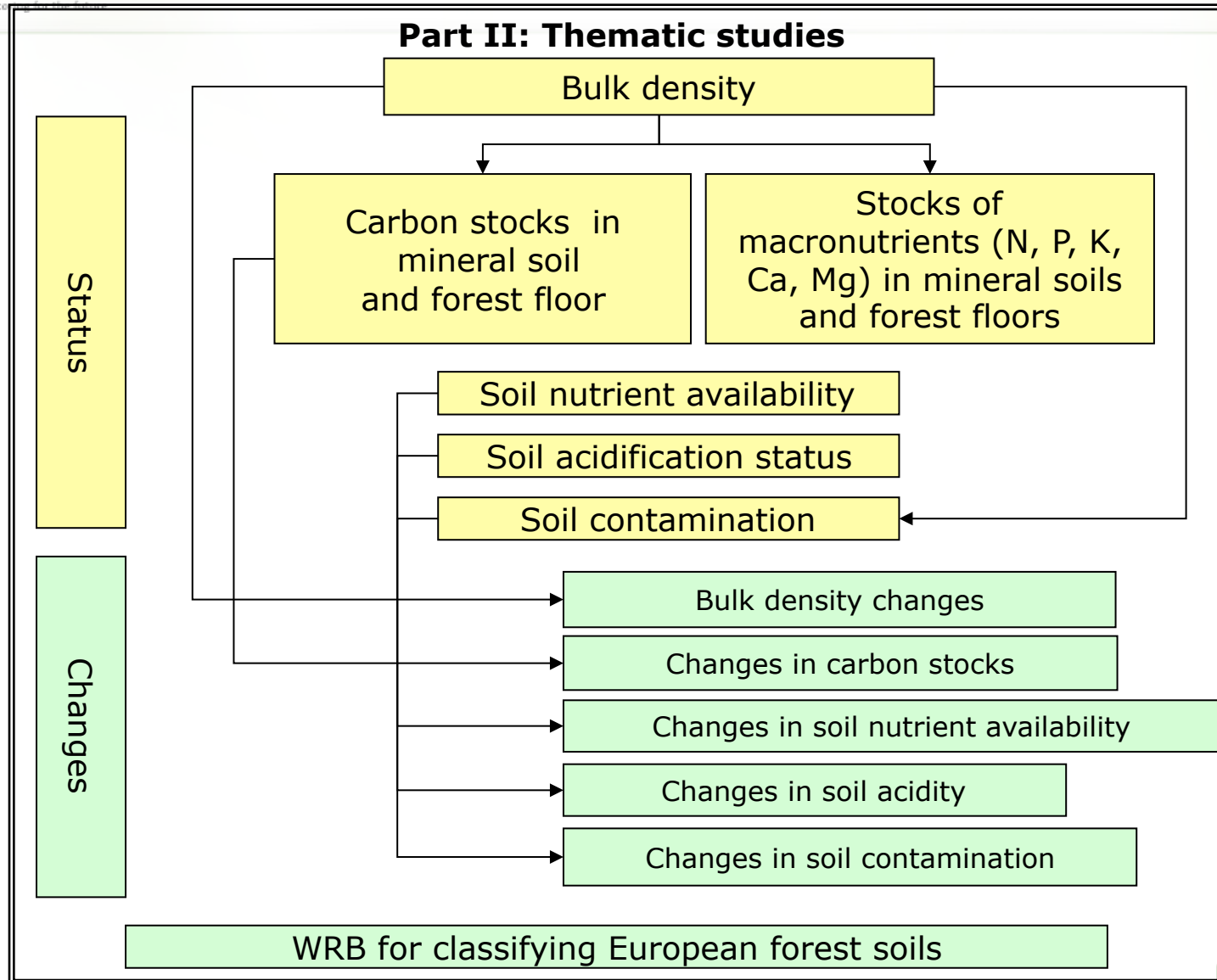
Annexes

- Data summary Tables
- Geodata (maps)



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2nd Forest Soil Condition Report



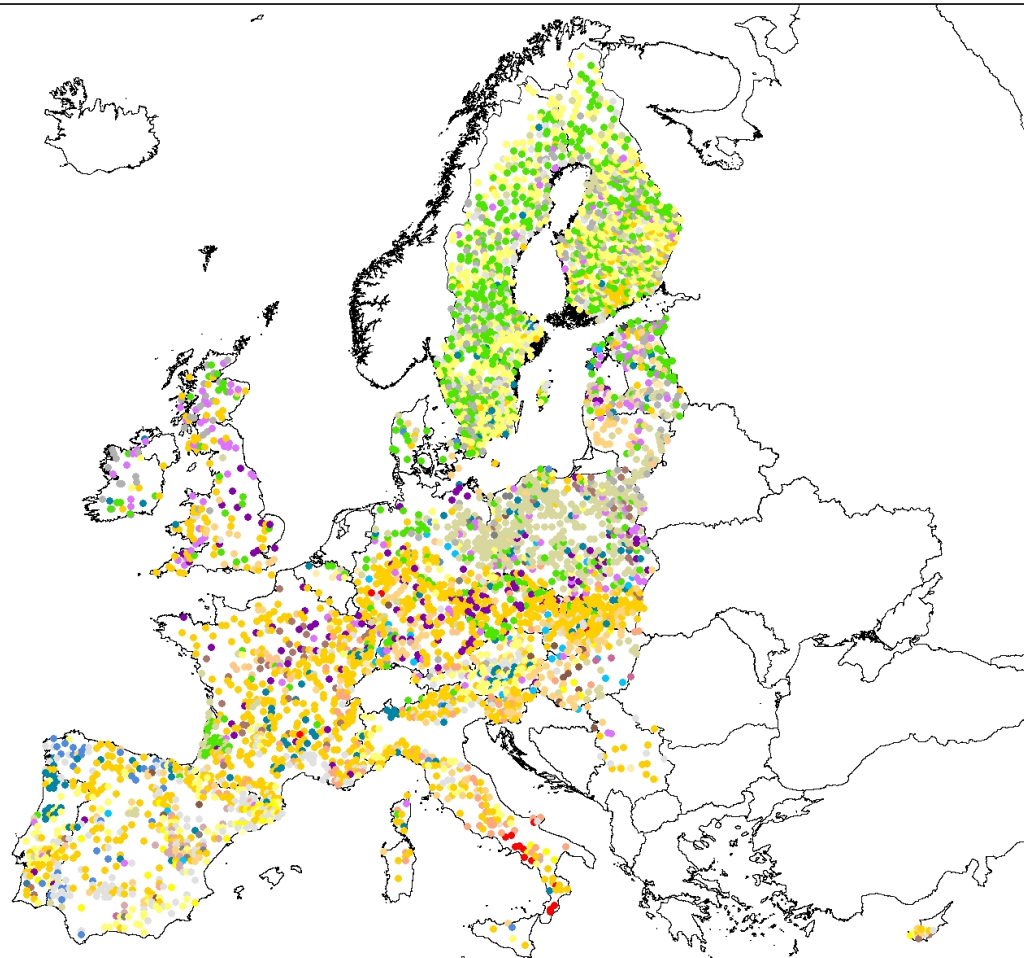
Harmonised soil typology shows high diversity of forest soils

FUTMON validated soil types on nearly 5000 forest plots according to the World Reference Base for Soil Resources (WRB):

- WRB is the common scheme of soil databases of the European Union
- Soil types envisage soil variability across European forests
- Soil type is an important integrated input parameter in ecological modelling

Reference Soil Group

- Albeluvisols
- Acrisols
- Alisols
- Anthrosols
- Arenosols
- Anthrosols
- Chernozems
- Calcisols
- Cambisols
- Fluvisols
- Gleysols
- Gypsisols
- Histosols
- Kastanozems
- Leptosols
- Luvisols
- Lixisols
- Phaeozems
- Planosols
- Plinthosols
- Podzols
- Regosols
- Stagnosols
- Technosols
- Umbrisols
- Vertisols



Of the 32 major Reference soil Groups described at world scale, 26 have been described on the large scale plots



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Identification of Forest soil Carbon stocks and their uncertainty



- Calculations based on both reported and completed data
- SOC stocks in Forest floor*, Mineral and Organic soil compartments, fully accounting for BD, stoniness & soil depth.
- Use of Profile depth distribution functions to estimate stocks at 30 cm and 1 m-depth/lithic contact (IPCC guidelines)

Average Carbon Stocks
Level I based

Compartment	N	Depth cm	Mean stock t C ha ⁻¹	CI _{95%} mean t C ha ⁻¹
Forest Floor	4225	-	21.4	20.4 – 22.5
Mineral Soil	4029	0 – 30	64.3	62.9 – 65.7
	4017	0 – 100	108	106 - 111
Peat Soil	226	0 – 30	208	196 – 219
	225	0 – 100	633	596 - 667

Relative to the 1 m SOC stock, 60% of SOC is stored in the top 30 cm; FFCs is 1/5 of mineral soil; Peat stocks are ~6 times SOC in mineral soils



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Distribution of Carbon stocks in forest floors, mineral & peat soils

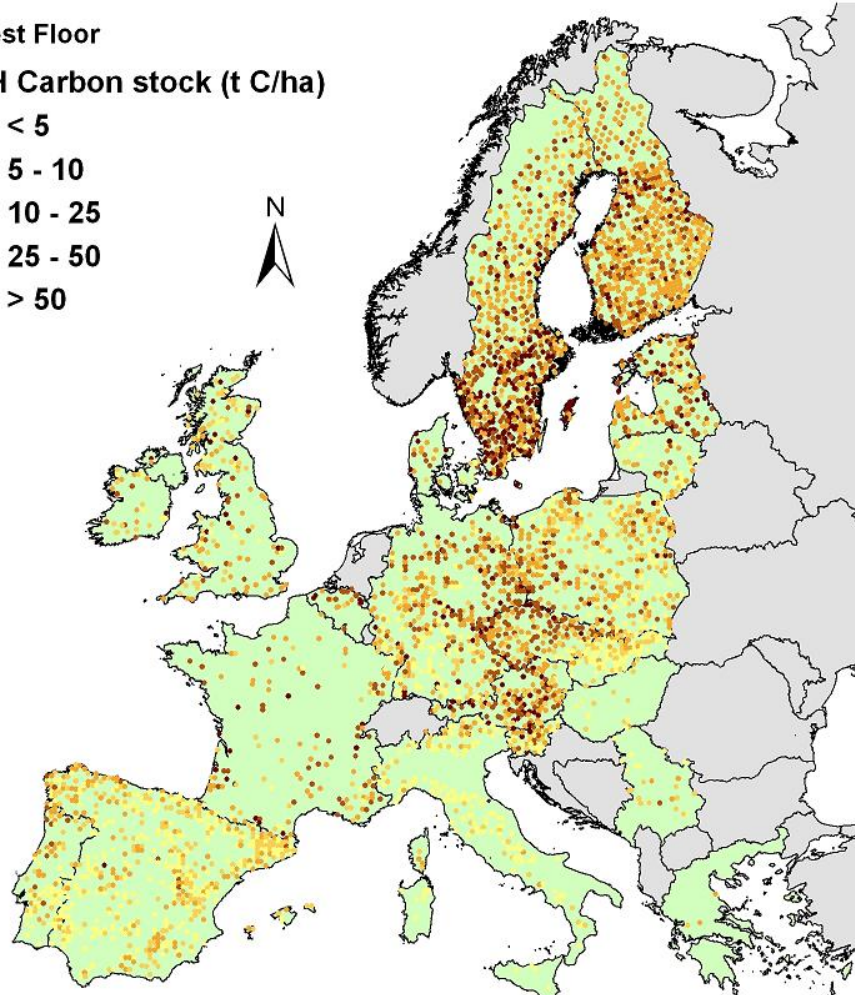


25 - 50 t C ha⁻¹ in Nordic Forests

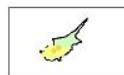
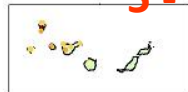
Forest Floor

OFH Carbon stock (t C/ha)

- < 5
- 5 - 10
- 10 - 25
- 25 - 50
- > 50



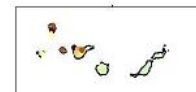
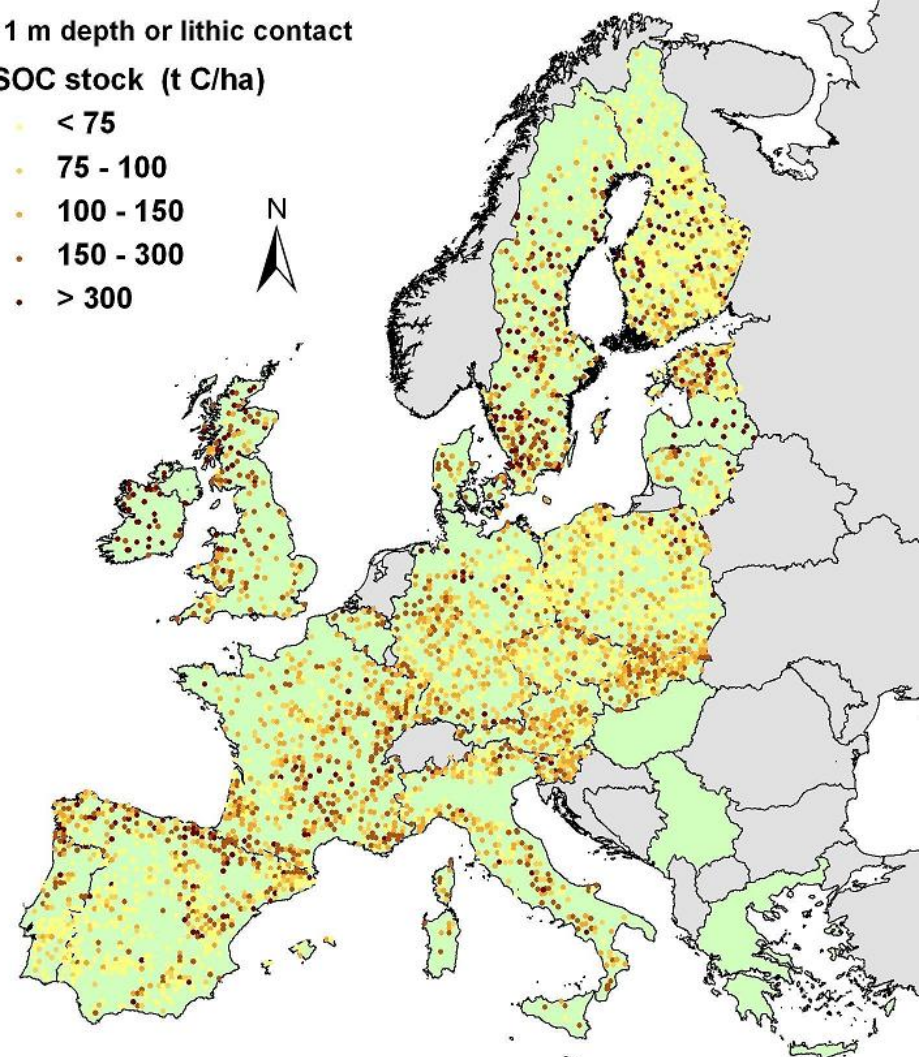
5 - 25 t C ha⁻¹ in Mediterranean



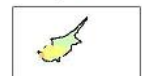
Soil till 1 m depth or lithic contact

SOC stock (t C/ha)

- < 75
- 75 - 100
- 100 - 150
- 150 - 300
- > 300



Canary Islands (Spain)

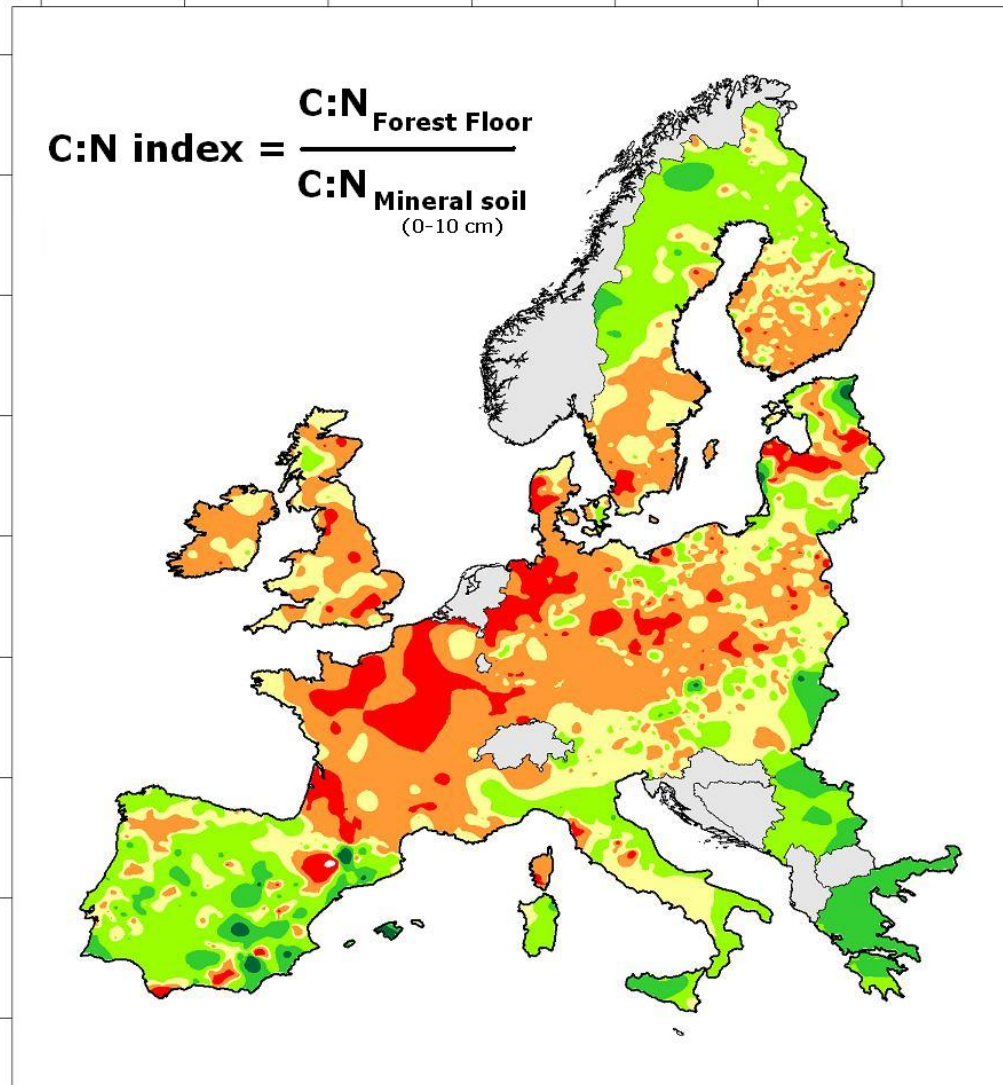


Cyprus

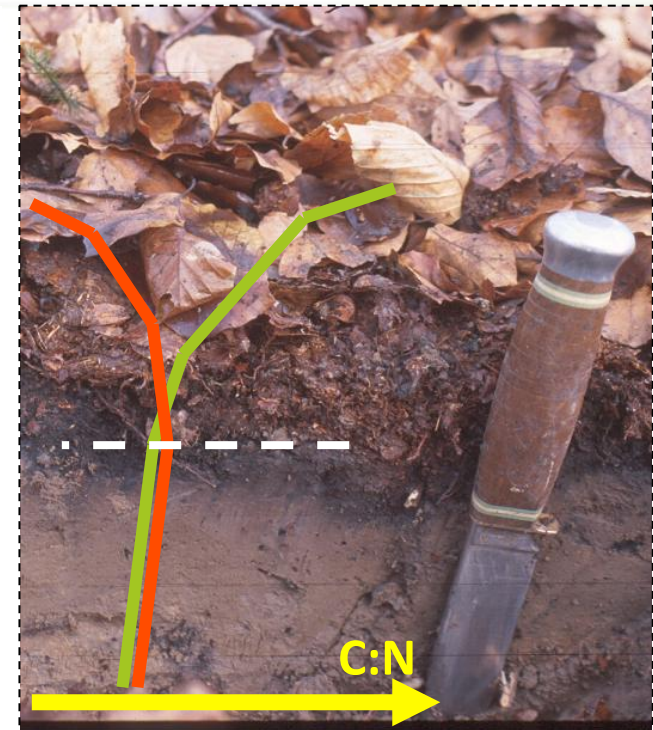
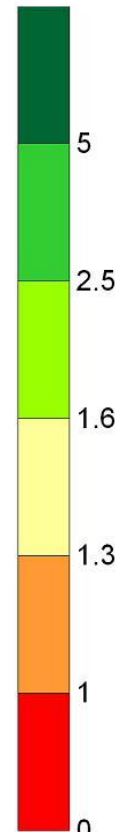


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Excess Nitrogen inputs evidenced by regional small C:N index values



C:N index



Risks for nitrate leaching from the soil into ground- and surface waters, leading to eutrophication.

Affected areas (C:N index < 1) are indicated in red



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Forest soils both acidify and recover

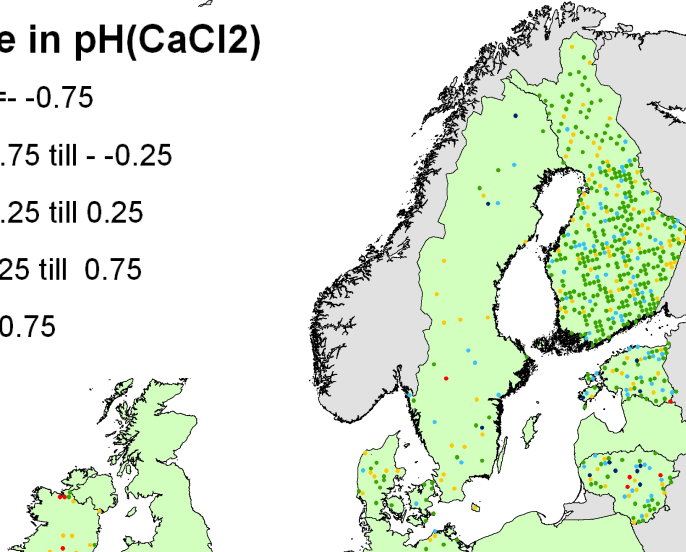


Two parameters are considered and compared with 1st Forest Soil Condition Survey (1997):

1. **Soil pH** = indicator of acidity status (combination of natural and human influences)
2. **Base Saturation** = indicator of reserve of bases and so resistance against acidification

Change in pH(CaCl₂)

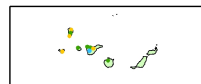
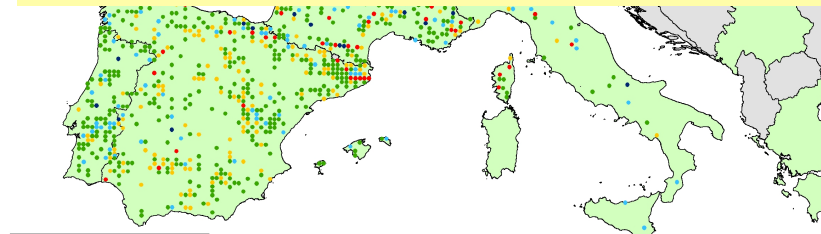
- ≤ -0.75
- -0.75 till -0.25
- -0.25 till 0.25
- 0.25 till 0.75
- > 0.75



pH changes shown for upper 10 cm of mineral soil

➤ *On average there is a mean decrease of soil pH of 0.03 pH units over a monitoring period of 10 - 15 years*

➤ *The pH in extremely acid forest soils (pH < 4.0) 'recovered' but further decreased when pH > 4.0*



Canary Islands (Spain)



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Changes in base saturation are consistent with pH changes



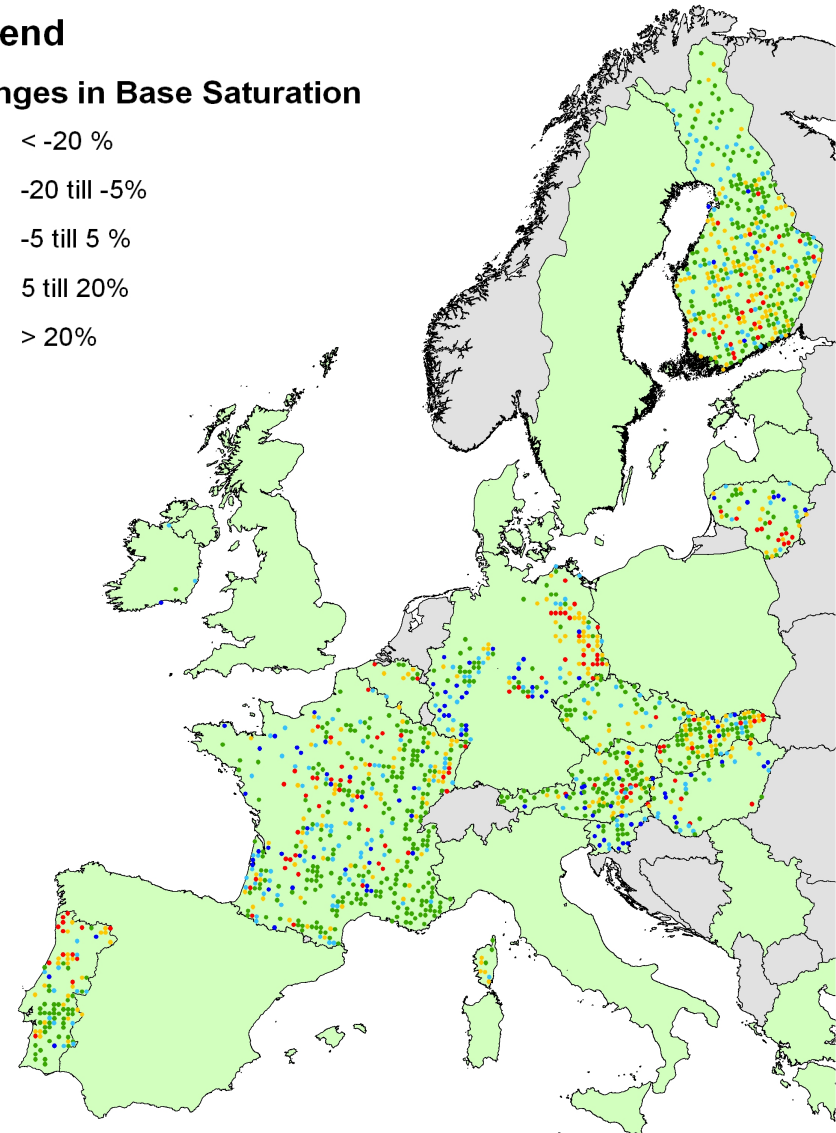
Overall the Base Saturation (BS) did not change compared to first inventory, though:

- The BS increased in acid forest soils (BS < 20%) and decreased in forest soils with BS > 20%.
- The percentage of plots with BS < 20% decreased from 48% in first survey to 28% in second survey.

Legend

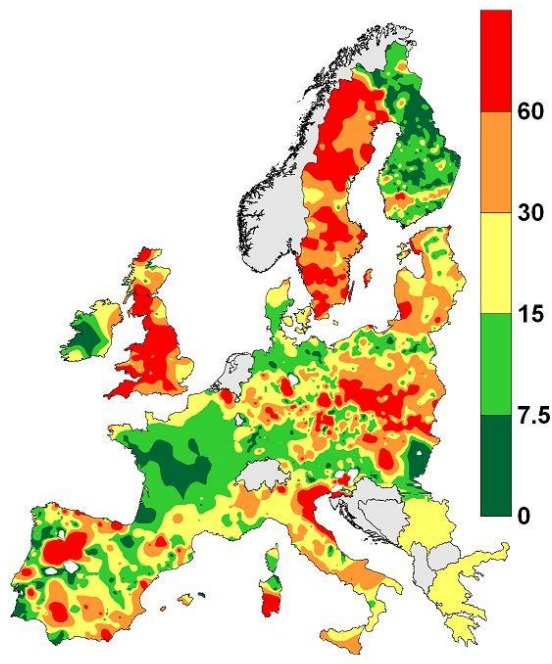
Changes in Base Saturation

- < -20 %
- -20 till -5%
- -5 till 5 %
- 5 till 20%
- > 20%

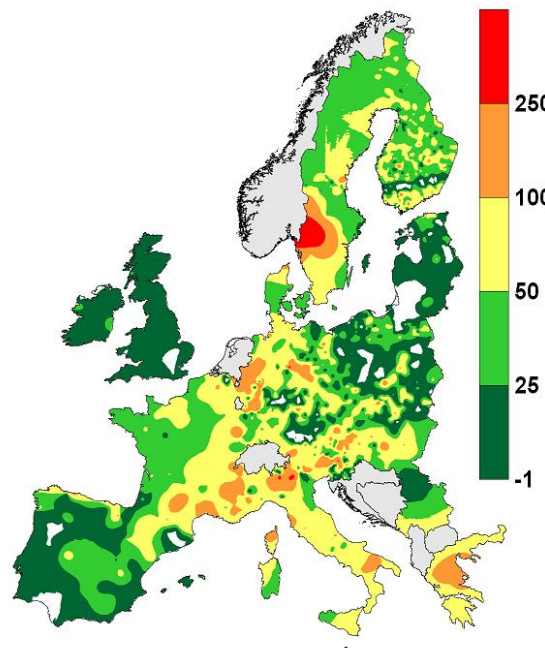


Forest floors: an archive for trace metal contamination

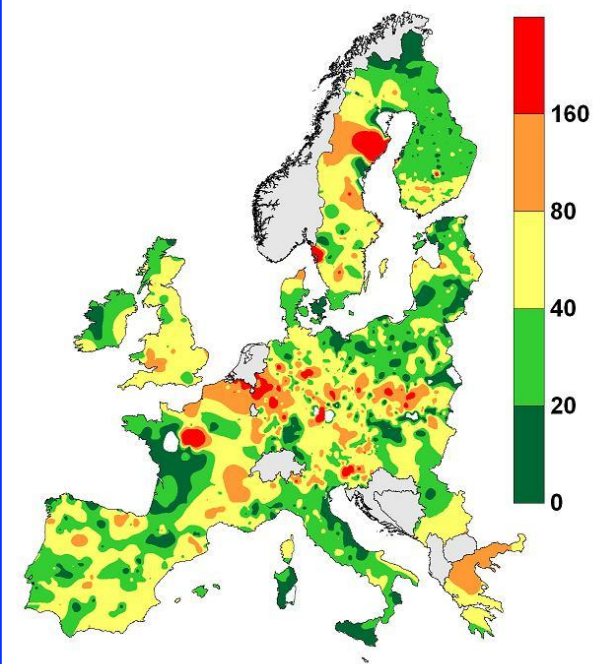
Forest Floor Cu (mg/kg)



Forest Floor Zn (mg/kg)



Forest Floor Pb (mg/kg)



- Mapping concentration levels of 8 trace metals in OFH layers
- Actual levels are sum of natural background concentration (parent material) and input from anthropogenic factors (pollution)
- An EU evaluation scheme (critical levels) is developed for soil ecotoxicological risk assessment



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Concluding messages



- With the help of national soil experts, numerous corrections and additions have been made to BioSoil data: BioSoil⁺
- Forest soils are now well characterised, but the EU picture still contains blank areas and needs further completion
- European forest soils are diverse: of 32 RSGs described at world scale, 26 have been described at the large scale plots
- The 2nd Forest Soil Condition report synthesises all available data and evaluates carbon and nutrient stocks, acidification and contamination levels across Europe
- BioSoil⁺ sets a reference for further forest ecosystem monitoring endeavours and is a sound basis for EU reporting (e.g. MCPFE)
- Further scientific exploration of this database and links with other forest components will at least take a decade



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Some recommendations



- BioSoil⁺ data should be further completed for specific countries, variables and depths, especially at intensive monitoring plots (LII)
- Integration of the current BioSoil⁺ database with previous/other pan-European forest soil databases is essential
- To monitor changes in overall forest soil condition, conducting a EU wide survey each 10 - 15 yrs is highly recommended
- Strict implementation of harmonised methods outlined in the updated ICP forests manual is crucial to detect real temporal changes and to ensure transnational comparison
- Please read the 2nd Forest Soil Condition Report carefully, which will be released end of September 2011



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*We greatly acknowledge the cofinancing of Life+
and the Flemish Region and all Soil Experts
from 'BioSoil' countries for their strong support*

Thank you for your kind attention !