

The European Commission's science and knowledge service

Joint Research Centre

The application of spectral information for operational soil monitoring in Europe and in the World

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DG JRC.D.3

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Soils (ITPS)*

*Co-Chair of the IPBES Land Degradation and
Restoration Assessment (LDRA)*



European Commission

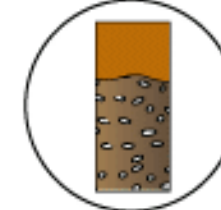
Land



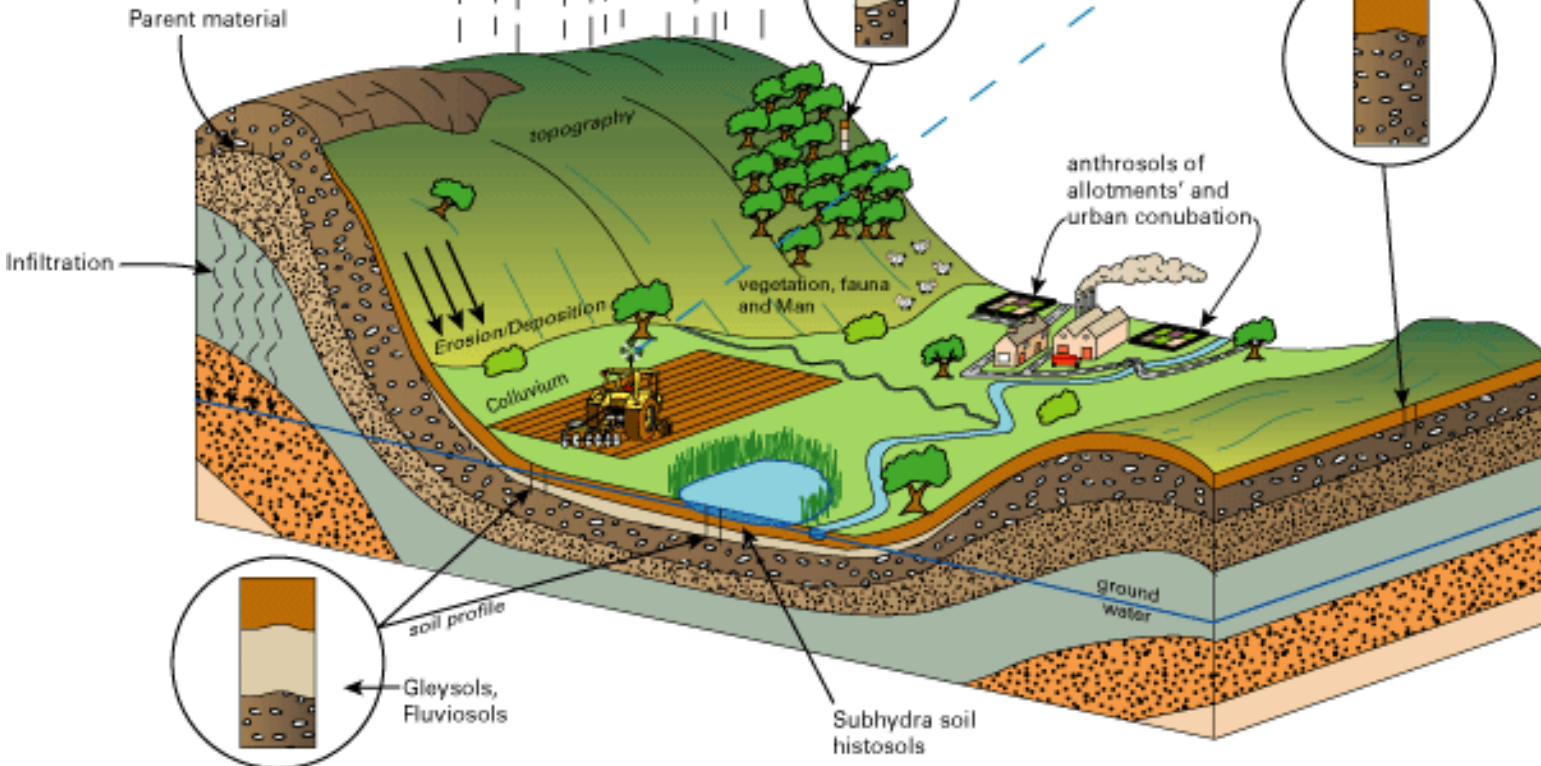
climate



Podsol



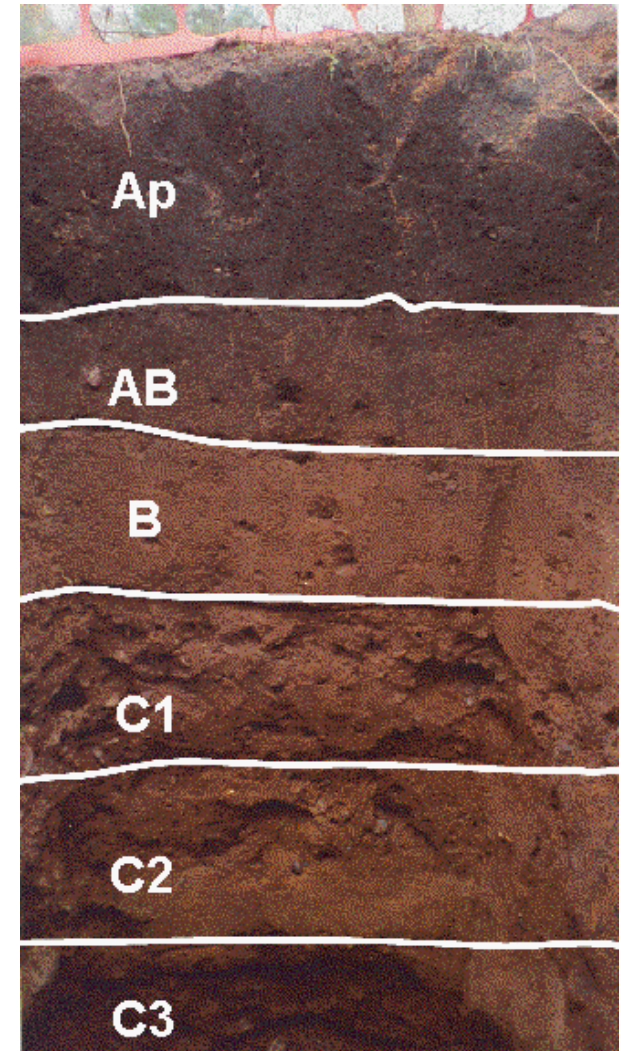
Regsol



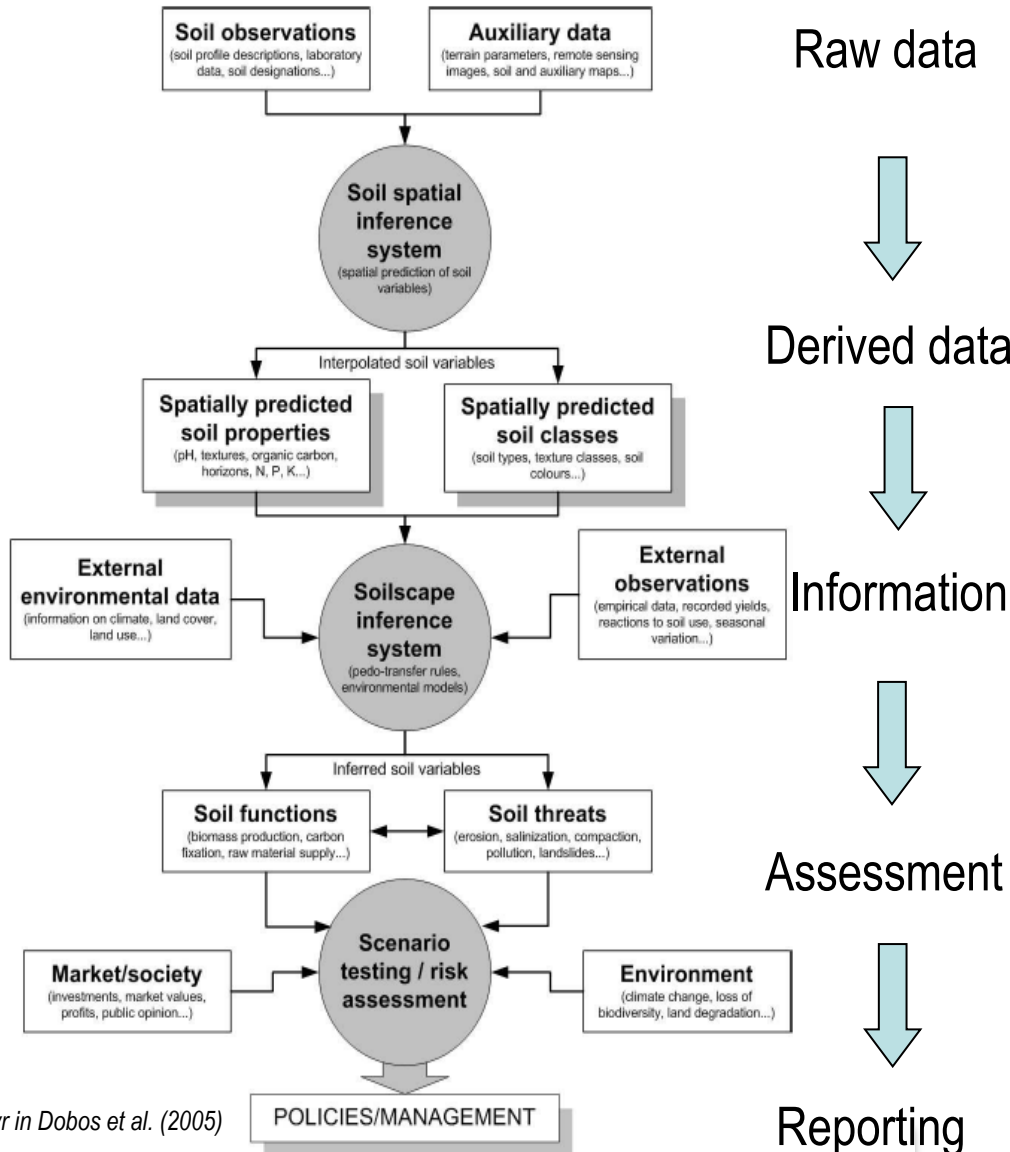
Soil



To study soils you need to dig a pit:



From raw data to policy relevant information



JRC Scientific and Technical Reports
Addressing soil degradation in EU agriculture: relevant processes, practices and policies
Report on the project Sustainable Agriculture and Soil Conservation (SASC)
Editors: Steefel Loonen, Shafiqul Kabir, Guy, Wilco Buijs
Authors: Soils Project Team
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JRC REFERENCE REPORTS
The State of Soil in Europe
A contribution of the JRC to the European Environment Agency's Environment State and Outlook Report (ESOR) 2012
A. Jans, F. Panfili, O. Sarrat, B. Bhandari, C. Bock, O. Simeoni, C. Goffé, M. Elward, J. Henck, B. Heubron, S. Jeffrey, A. Lantieri, L. Nanni, L. Nizzolandi, C. Orlowski, J. E. Poretsky, M. Poretsky, T. Srinivasan, G. Tardieu, M. Van den Enden, M. Van Lancker, F. Verheijen, E. Vitarino, V. Vignati

JRC, iijk, ies, JRC

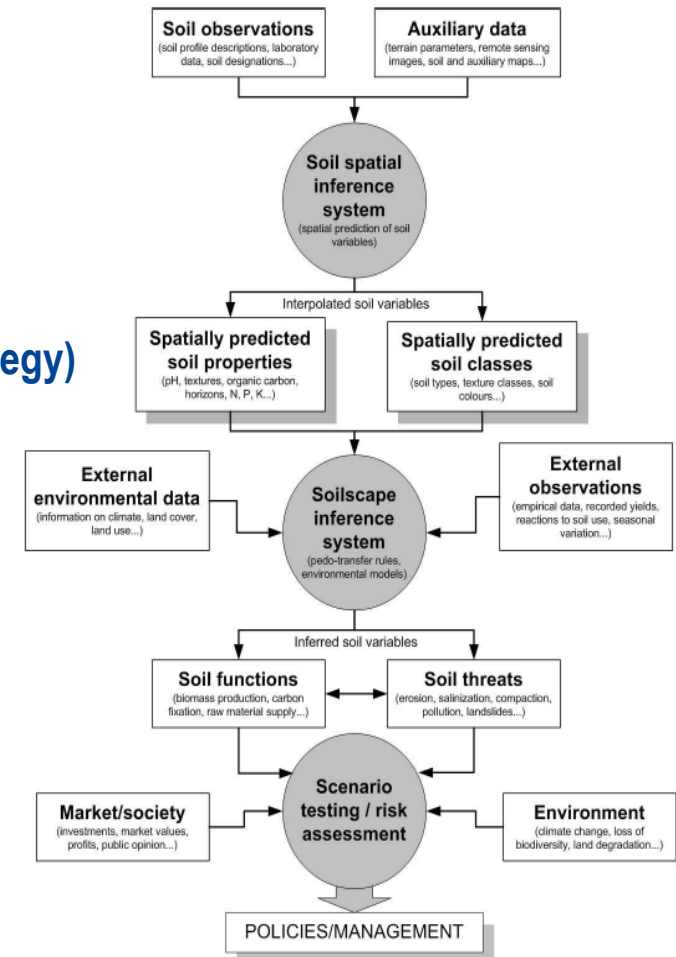
After Mayr in Dobos et al. (2005)

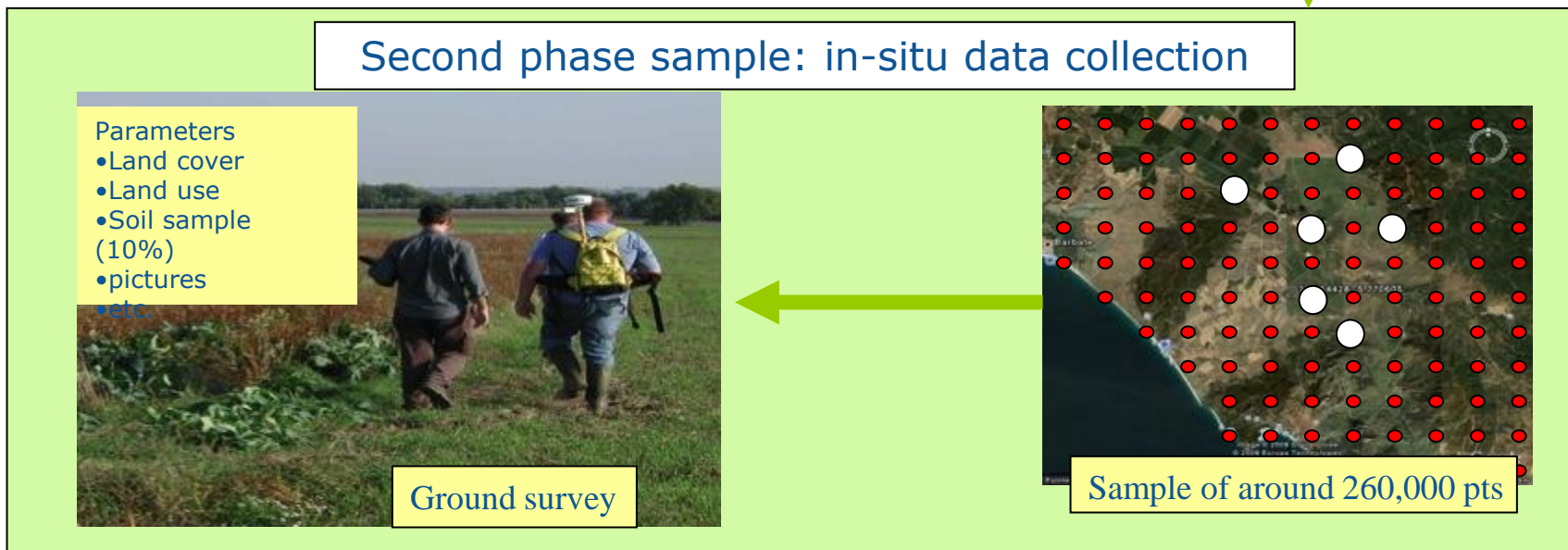
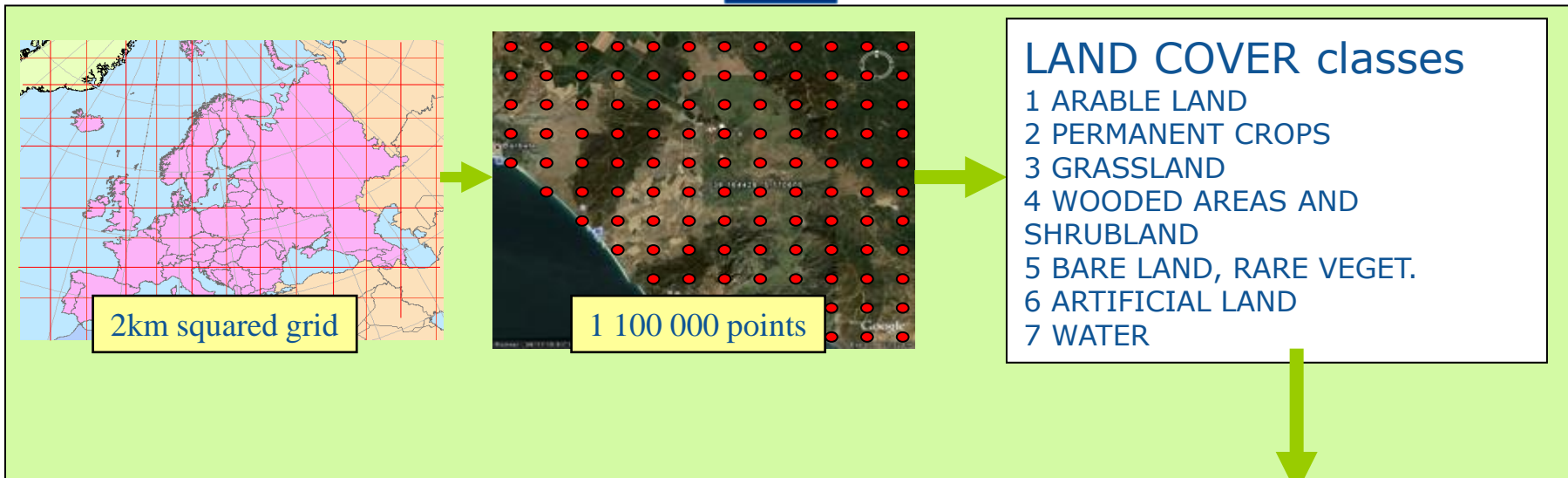
Providing Policy Relevant Soil Data and Information to Commission Services



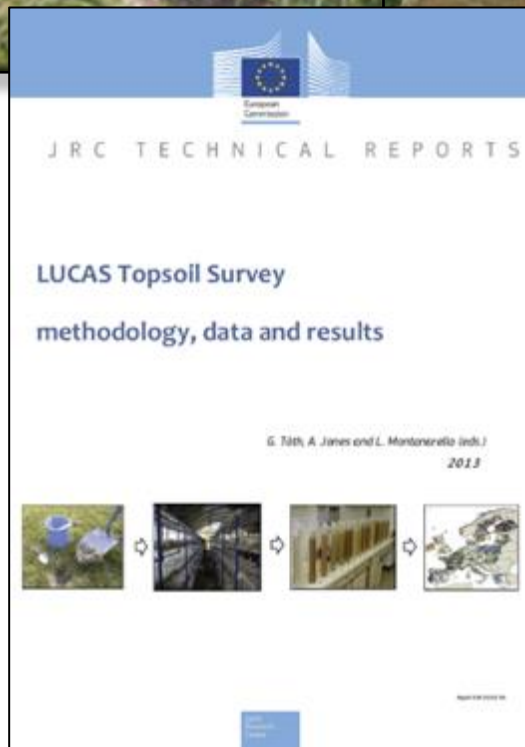
Main Soil Related EU Policy Areas served by the JRC SOIL Activities:

- EU Soil Thematic Strategy
- Common Agricultural Policy (CAP)
- Climate Change Policy (Post-Kyoto debate, LULUCF)
- Energy Policy (Renewable Energies Directive)
- Industrial policy (Fertilizers Regulation)
- Biodiversity (Nature) Protection Policy (EU Biodiversity Strategy)
- Water Protection Policy (WFD, Groundwater Directive)
- Forest Protection Policy (Forest FOCUS, ICP Forest)
- Regional Policies (INTERREG)
- Food Safety (PPR Registration, EFSA)
- Food Security (FAO)
- Development Policy (ACP-Observatory)
- Waste Policy (Biowaste Directive, Sewage Sludge Directive)
-etc.





LUCAS SOIL: TRAINING, SUPPORT MATERIAL, DATA AND RESULTS



LUCAS Soil sampling

Field guide



A Equipment for soil sampling

- 1) a spade;
- 2) a trowel (small spade);
- 3) a bucket;
- 4) 2 bags per sample (25x40cm and 40x60cm);
- 5) 2 printed plastic labels per sample (with code of the point);
- 6) 2 ties per sample (to close the bags);
- 7) a big box to store and transport samples;
- 8) mail the samples.

B Sampling locations

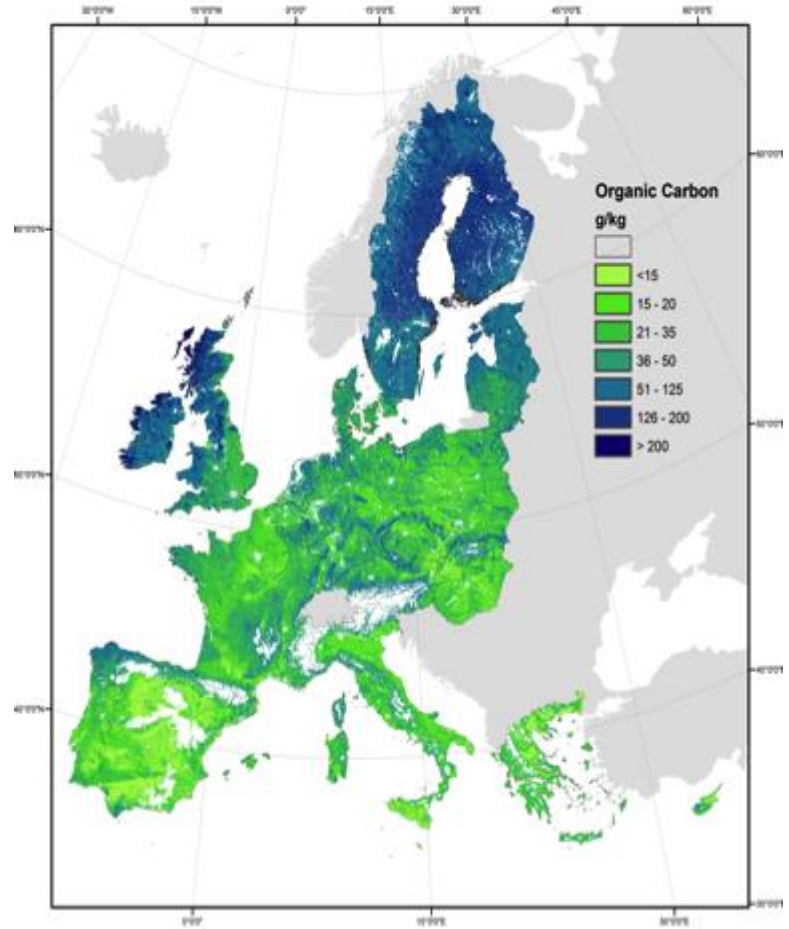
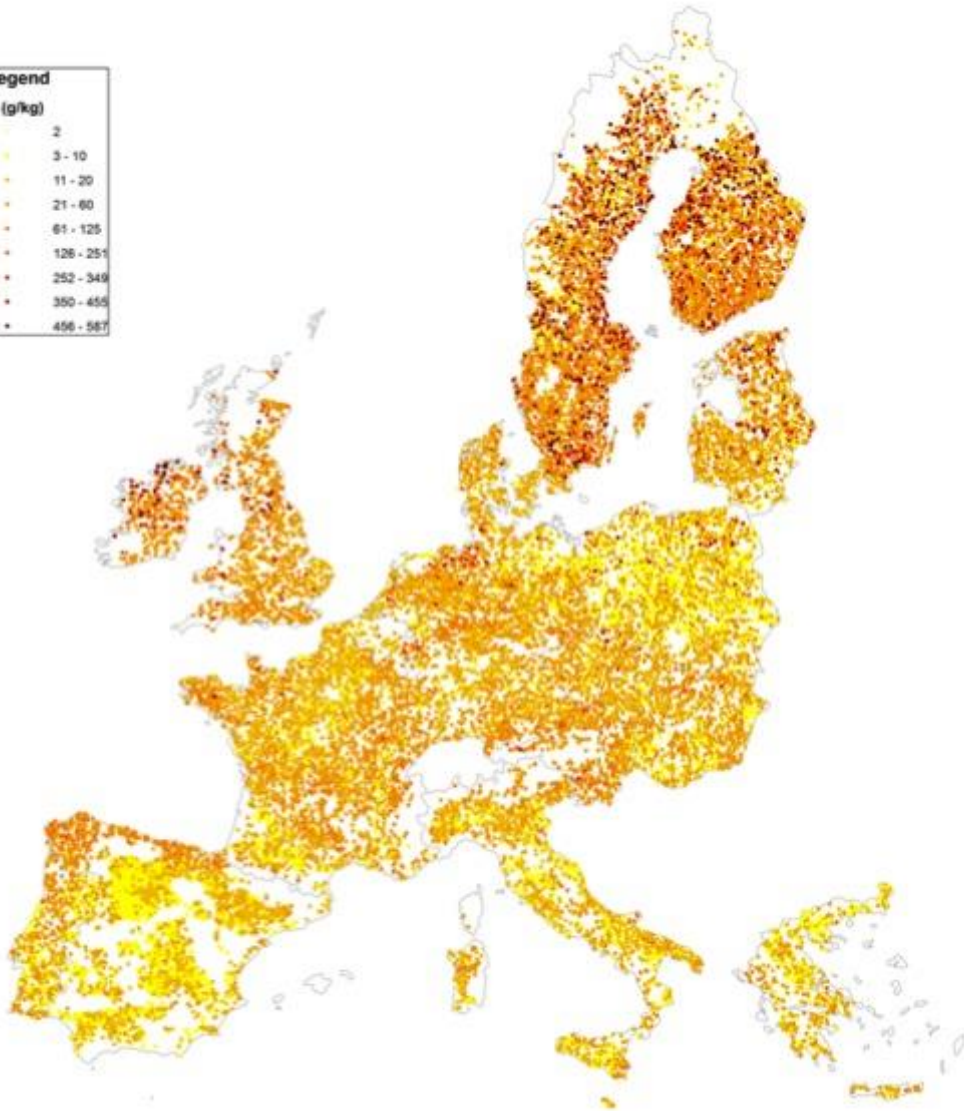
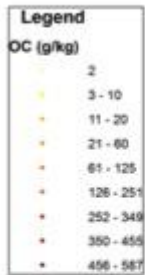


If in one of the 5 locations it is not possible for any reason (accessibility problems, coverage – trees, houses etc.) walk along the intermediate line until you find a suitable location or walk less than 2m from central point to take the sub sample.

C Sampling

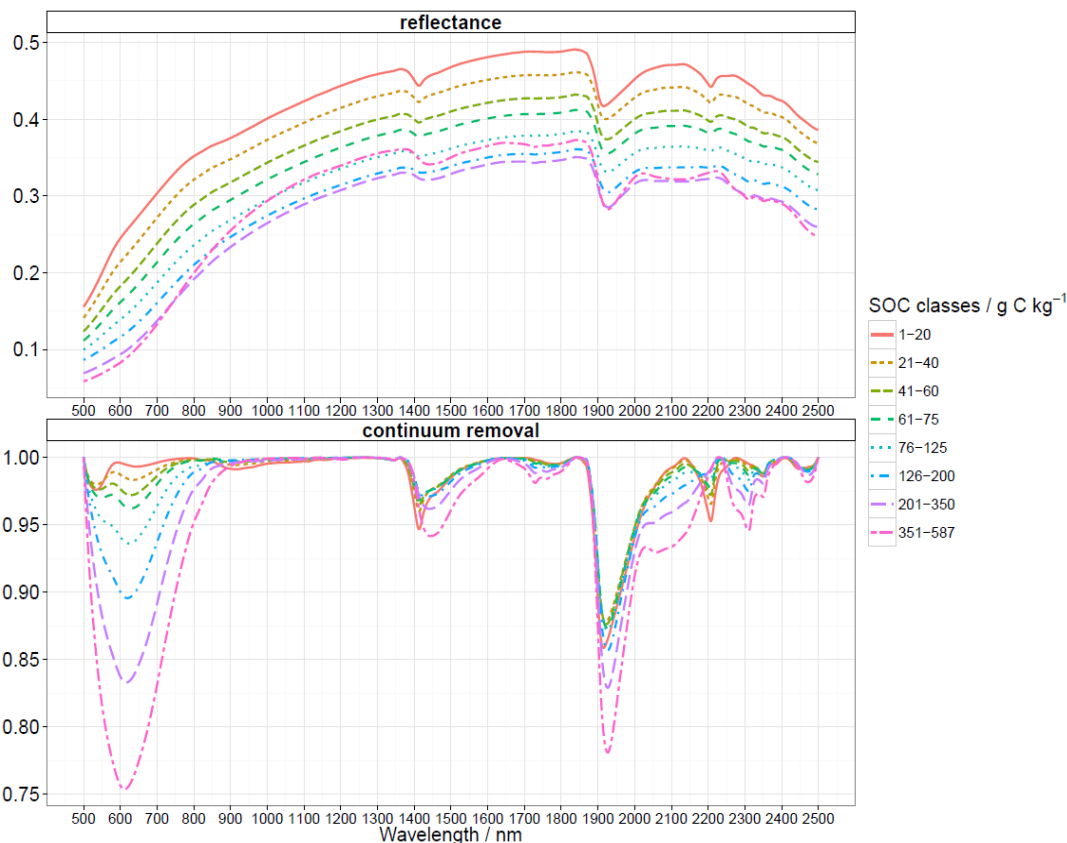
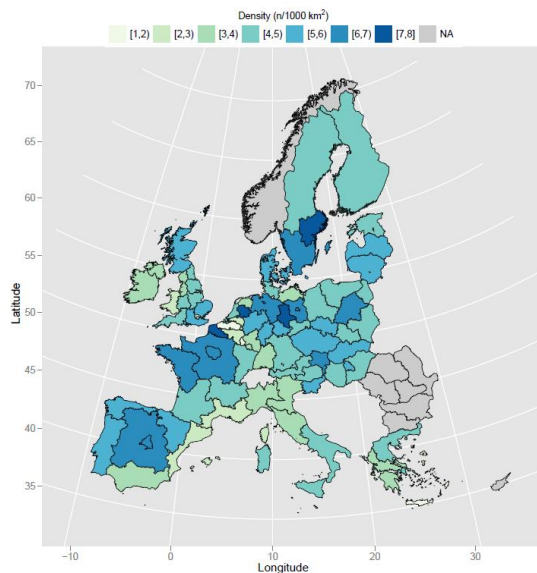


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Distribution of 19,879 LUCAS land areas/points and their level of organic carbon (OC) content in the topsoil layer (0-30 cm).

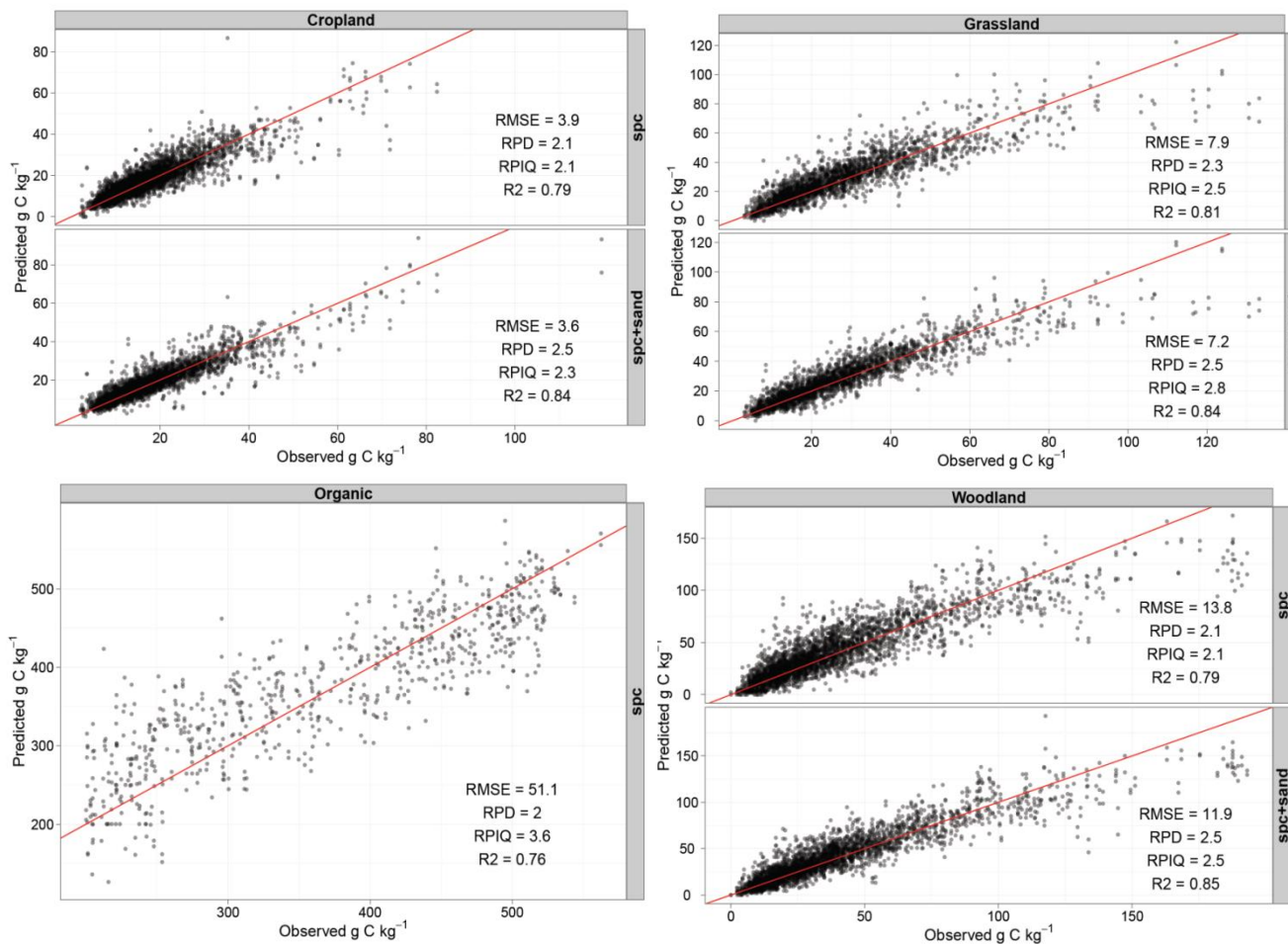
The LUCAS spectral library



- Current status:
 - 23 European countries
 - ~20,000 high quality spectral readings
 - Metadata: Clay, silt, sand, OC, pH, CEC, CaCO₃, Geographical coordinates, land use, etc

Creation of four subsets: Cropland, Grassland, Woodland, and Organic soils

Best SOC predictions



- **LOCAL approach is based on spectral similarities, and attempts to create meaningful partitions of the spectral library**
- **The combined use of other covariates and spectra in the selection procedure of the predicting neighbours produces more accurate results than using only spectra**
- **The prediction accuracy (RMSE) ranges between:**
 - **cropland soils: 3.6 g C kg⁻¹**
 - **grassland soils: 7.9 g C kg⁻¹**
 - **woodland soils: 11.9 g C kg⁻¹**
 - **organic soils: 51.1 g C kg⁻¹**
- **Importance to work with wide and homogenous spectral libraries**

Soil sample collection 2015

COUNTRY	Soil samples
AT	571
BE	146
BG	679
CY	81
CZ	445
DE	1759
DK	226
EE	201
EL	644
ES	4055
FI	1175
FR	3050
HR	122
HU	429
IE	197
IT	1653
LT	365
LU	13
LV	327
MT	3
NL	177
PL	1515
PT	447
RO	1102
SE	1957
SI	153
SK	230
UK	758
Total	22480

- Samples have been taken in:
 - LUCAS points already sampled in 2009/2012 (altitude <1000 m)
 - New LUCAS points located at altitude greater than >1000 m
- Sampling methodology: same as in 2009/2012



Analyses of soil samples 2015

CORE PARAMETERS
Coarse fragments
Particle-size distribution
Clay content
Silt Content
Sand Content
pH(CaCl ₂)
pH(H ₂ O)
Electrical conductivity
Organic carbon
Carbonate content
Phosphorus content
Total nitrogen content
Extractable potassium content
Cation exchange capacity

ADDITIONAL PARAMETERS
Multispectral analysis
X-ray diffraction

Planned start date of analysis: December 2016

CORE PARAMETERS			
Parameter	Unit	Decimals	N° samples to analyse
Coarse fragments	%	0	6,700
Particle-size distribution (FAO, 2006)	-	-	
Clay content	%	0	6,700
Silt Content	%	0	6,700
Sand Content	%	0	6,700
pH(CaCl ₂)	-	1	22,500
pH(H ₂ O)	-	2	22,500
Electrical conductivity	mS/m	2	22,500
Organic carbon	g/kg	1	22,500
Carbonate content	g/kg	0	22,500
Phosphorus content	mg/kg	1	22,500
Total nitrogen content	g/kg	0	22,500
Extractable potassium content	mg/kg	1	22,500
Cation exchange capacity	cmol(+)/kg	1	22,500

The number of samples to analyse in the table is illustrative.

*Multispectral analysis in circa 22500 samples
X-ray diffraction in 400 samples*



**European Commission – Global Soil Partnership
SOIL SPECTROSCOPY:
THE PRESENT AND THE FUTURE OF SOIL MONITORING**

**FAO Headquarter Rome – Italy
4-6 December 2013 – World Soil Day**

Creation and analysis of large scale spectral libraries

Soil spectroscopy to monitor the state of soil resources

Harmonization of the protocol for the collection of laboratory spectra

DETAILS : <http://www.fao.org/globalsoilpartnership/events/detail/it/c/174779/>

PLAN OF ACTION FOR PILLAR FOUR OF THE GLOBAL SOIL PARTNERSHIP

Adopted by the



GSP Plenary Assembly

**Enhance the quantity and quality of soil data
and information: data collection (generation), analysis,
validation, reporting, monitoring and integration
with other disciplines**

PILLAR FOUR WORKING GROUP:

- **AFRICA:** Martin Yemefack,
- **ASIA:** Ganlin Zhang
- **EUROPE:** Rainer Baritz,
- **GSP SECRETARIAT (FAO):** Ronald Vargas
- **LATIN AMERICA:** Aracely Castro,
- **MIDDLE EAST AND NORTH AFRICA:** Rachid Moussadek,
- **NORTH AMERICA:** Jon Hempel,
- **SOUTH-WEST PACIFIC:** Neil McKenzie (Chair)

PLAN OF ACTION FOR PILLAR FIVE OF THE GLOBAL SOIL PARTNERSHIP

Adopted by the



GSP Plenary Assembly

**Harmonization of methods, measurements and indicators
for the sustainable management and protection
of soil resources**

**Providing mechanisms for the collation, analysis and exchange
of consistent and comparable global soil data and information**

PILLAR FIVE WORKING GROUP:

- **CHAIR:** Rainer Baritz
- **ASIA:** Hakki Erdogan, Kazumichi Fujii and Yusuke Takata
- **EUROPE:** Marco Nocita, Bernd Bussian and Niels Batjes,
- **NORTH AMERICA:** Jon Hempel
- **SOUTH WEST PACIFIC:** Peter Wilson
- **SECRETARY:** Ronald Vargas

Plenary assembly

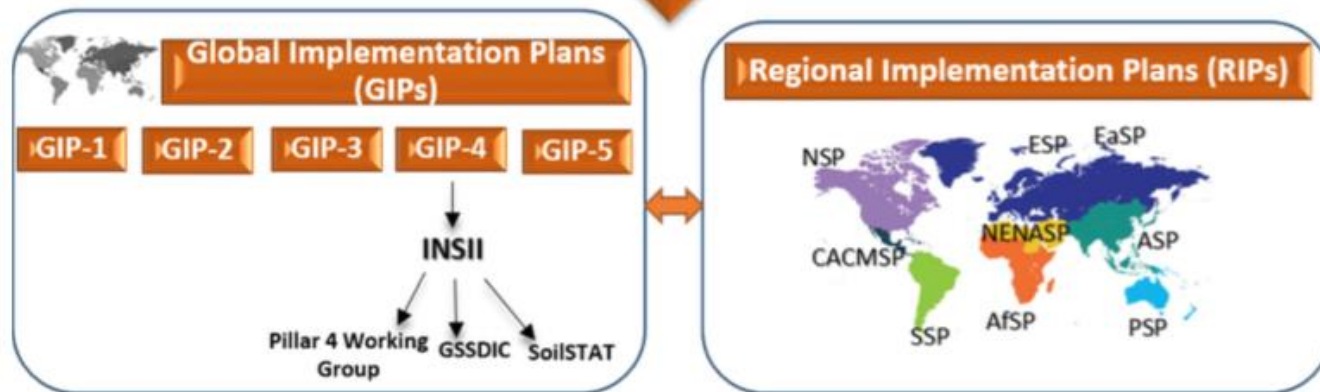
GSP Secretariat

ITPS

Endorsed Plans of Action (PA)



Implementation



Thank you for your interest!



itps
INTERGOVERNMENTAL TECHNICAL
PANEL ON SOILS

<http://esdac.jrc.ec.europa.eu>