Sampling protocol for the next LUCAS Soil Module

Organized by EUSO Technical Working Group on Monitoring

10/12/2025

European Commission

WEBEX Webinar

- Meeting is being recorded
- Please edit your profile with name and affiliation. Click 'three dots' at the end your name.
- All microphones are muted for the presentation.
- Any questions? Write in chat or raise hand!

Agenda

10:00 – 10:05: Opening – Arwyn JONES, Mirco BARBERO

10:05 – 10:15: The LUCAS soil module and the Directive on Soil Monitoring and Resilience – Arwyn JONES

10:15 – 10:50: Proposal for the in-situ sampling protocol of the next LUCAS soil module– Carmen SANCHEZ GARCIA, Maeva LABOUYRIE, Elise VAN EYNDE, Alberto ORGIAZZI, Arwyn JONES

10:50 – 11:25: Questions and discussion (ALL)

11:25 – 11:30: Closing (Arwyn JONES)

The LUCAS Soil Module

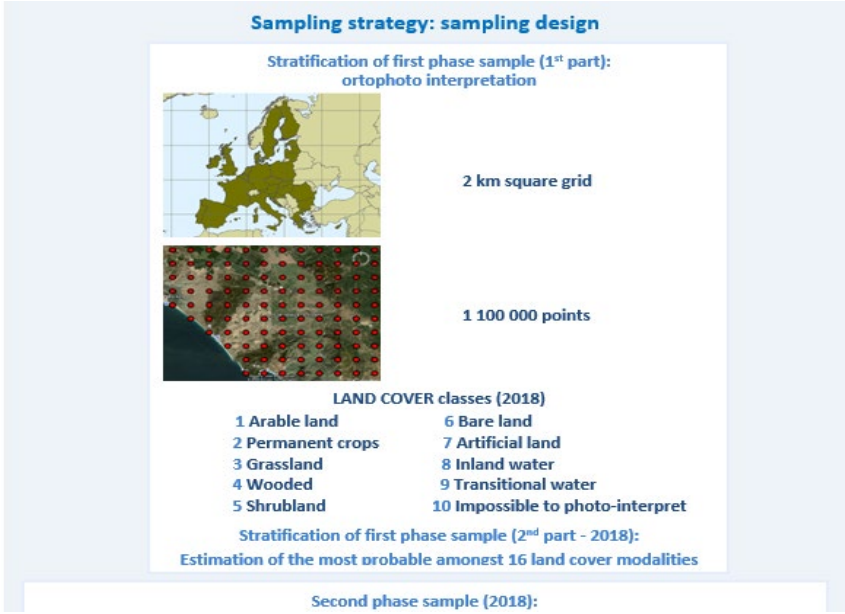
The **L**and **U**se/**C**over **A**rea frame **S**urvey

The Land Use/Cover Area frame Survey (LUCAS) is a harmonised *in situ* land cover and land use data collection exercise over the EU.

Organised on a regular basis since 2001 by the Statistical Office of the European Union (EUROSTAT)

An *in situ* survey implies that data are gathered through direct observations made by surveyors on the ground.

Based on a standardised survey methodology - sampling plan, classifications, data collection processes and statistical estimators



The **L**and **U**se/**C**over **A**rea frame **S**urvey

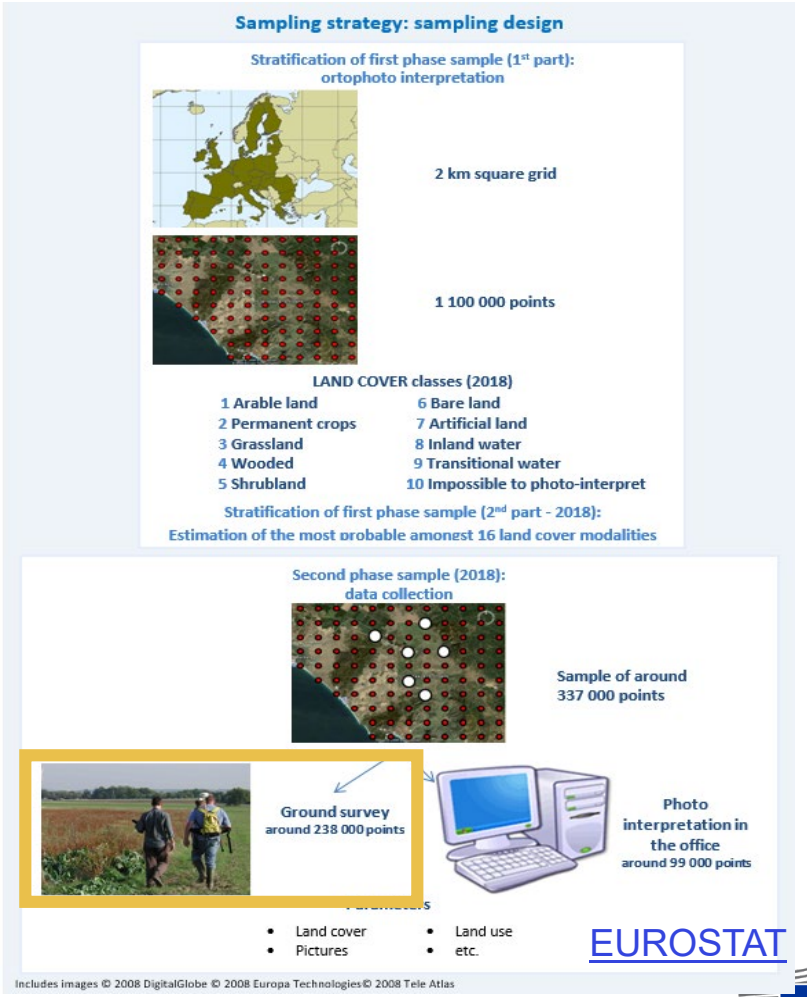
Two phase survey

First phase

- 1.1million different points
- spaced 2 km apart in the four cardinal directions
- each point is photo-interpreted and assigned a pre-defined land cover class.

Second phase

- sample of points, the field sample, drawn from the stratified first phase sample.



The LUCAS Soil Module

Early 2000s

2009

2012

2015

2018

2022

2025

2027 ?

LUCAS field surveyor
(Ispra, 2022)

Today

Standard sample

Samples are air-dried for **chemical and physical properties**

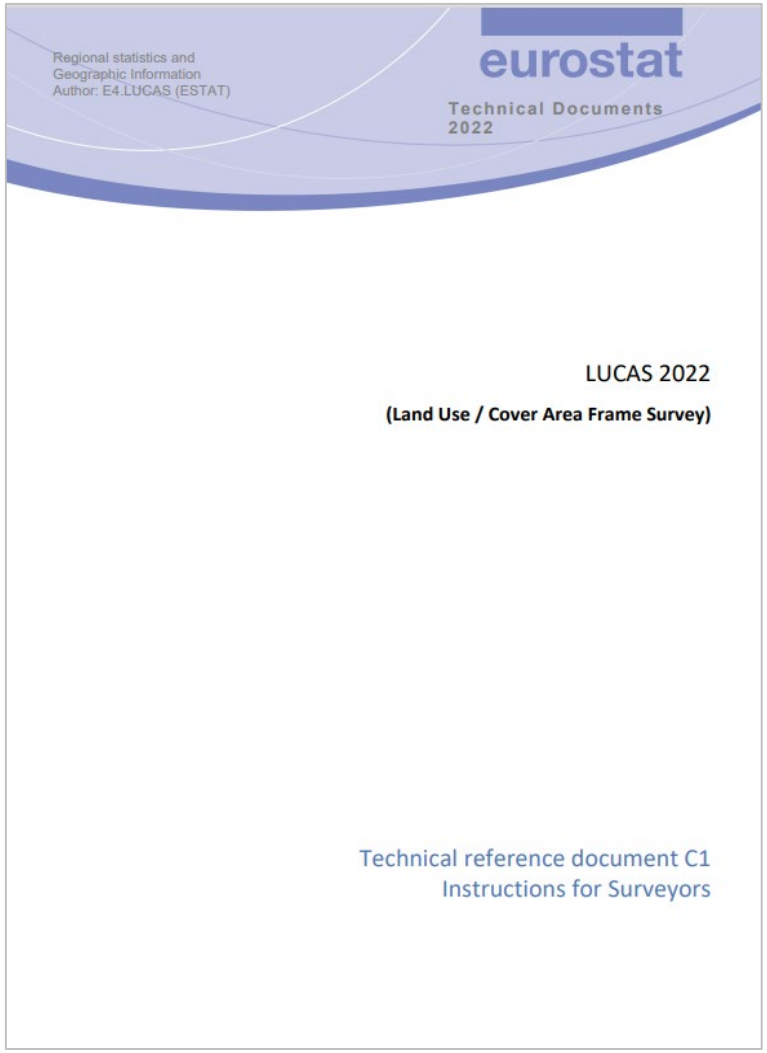
Bio sample

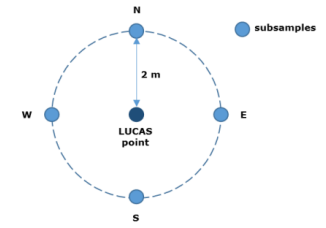
Cold transport to analyse fresh sample for **biodiversity** (since 2018)

Bulk sample

Fresh weight measured on field, air-dried for calculation of **bulk density and soil moisture**

LUCAS Soil Module Sampling Protocol



***2** Take a composite sample of at least 500g of soil*	 © European Union, CC BY 4.0 Figure 8-122. A minimum of 500 gr (≥ 0.5kg) of topsoil should be collected. The quantity of 500 g should be representative of a larger area. For this reason, the soil sample should be a composite one, resulting from the mixture of ideally 5 (at least 3) subsamples. The first subsample will be taken in the LUCAS point, the other subsamples will be taken at a distance of 2 meters following the cardinal directions (North, East, South, West).
ATTENTION	In some cases, the soil being sampled will be an organic soil or peat. In these
from the surface	upper part of the soil can remain in the sample, as it is difficult to remove it completely. nt and the boundary between litter and the soil mineral soil is not exposed within 30 cm of the be sampled (up to a maximum of 30 cm from
	 © 2017, European Union, CC BY 4.0 Figures 8-147. a  © 2017, European Union, CC BY 4.0 Figures 8-147. b
***6** Drive the ring into soil*	Before beginning the sampling, make sure that the marks of depth increments are visible in the blade of the spade. Gently press the metallic ring, bevelled edge down, into the soil so that the top of the ring is flush with the soil surface. If needed, this can be done with the help of a mallet. In this case, place a block of wood on top of the metal ring and tap the wood with the mallet in order to avoid compaction of soil and protect the ring. Avoid pushing the ring in too far as the soil will compact.  © 2017, European Union, CC BY 4.0 

The Soil Monitoring Law

Recital 45|
The Commission should assist and support Member States, at their request, in monitoring their soil health by continuing to carry out and enhancing regular in situ soil sampling and related soil measurements (LUCAS soil) as part of the LUCAS carried out in accordance with Regulation (EC) No 223/2009 of the European Parliament and of the Council (19). For that purpose, and subject to the agreement of Member States, **LUCAS is to be enhanced and upgraded to fully align it with the specific quality requirements to be met for the purposes of this Directive.** In order to alleviate the administrative and financial burden, Member States should be allowed to take into account the soil health data collected under LUCAS. Those soil health data should be made available to Member States in a timely manner. The Member States thus supported should make the necessary legal arrangements to ensure that the Commission can carry out such in situ soil sampling, including on privately owned land, and in compliance with applicable Union or national law

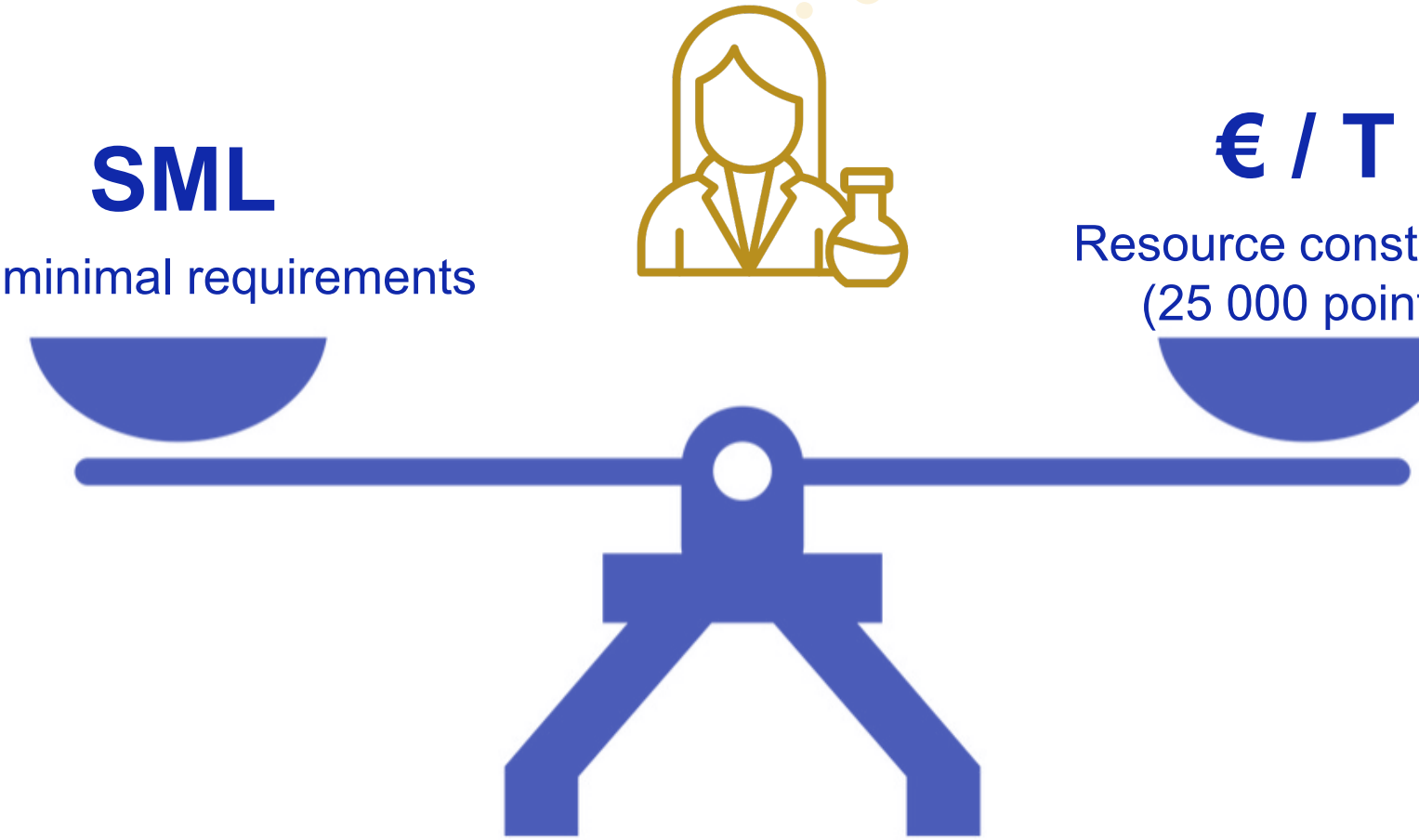
Directive - EU - 2025/2360 - EN - EUR-Lex

The scope for next LUCAS Soil

SML Annex I & Annex II
Forest floor
Deeper layers,
Soil type & genetic horizons, …

SML

Sets minimal requirements



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Resource constraints
(25 000 points)

SML requirements – adapt LUCAS soil protocol

Annex II – 2. Field sampling survey

- When **soil composite samples** are taken, they shall be a mixture of at least **5 subsamples**
- When sampling in non-forested areas, residues shall be removed from the surface
- When sampling in forested areas, the forest floor, if relevant subdivided into **litter and organic layers, shall be sampled separately and the thickness and weight** shall be recorded
- Samples or subsamples for the composite sample shall be taken to a depth **of at least 30 cm** where possible
- **Bulk density samples** shall be undisturbed samples taken at the relevant depth, including below **30 cm for subsoil**
- **Biodiversity** samples taken on at least 5 % of the points
- Information such as **soil type** and if possible **genetic horizons** shall be recorded.

Proposal for sampling protocol for LUCAS Soil Module 2027

Proposal for a next LUCAS soil sampling protocol

PROTOCOL FOR ALL LAND COVERS EXCEPT WOODLANDS

WOODLAND PROTOCOL

Pictures taken from Soil Atlas of Europe, 2005

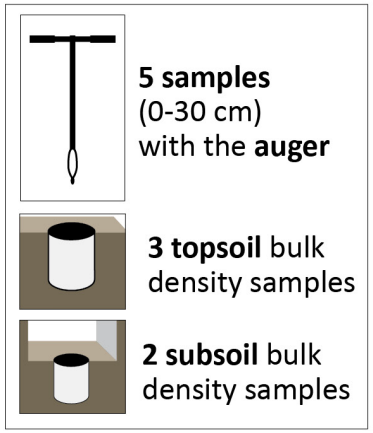
General steps before starting the sampling

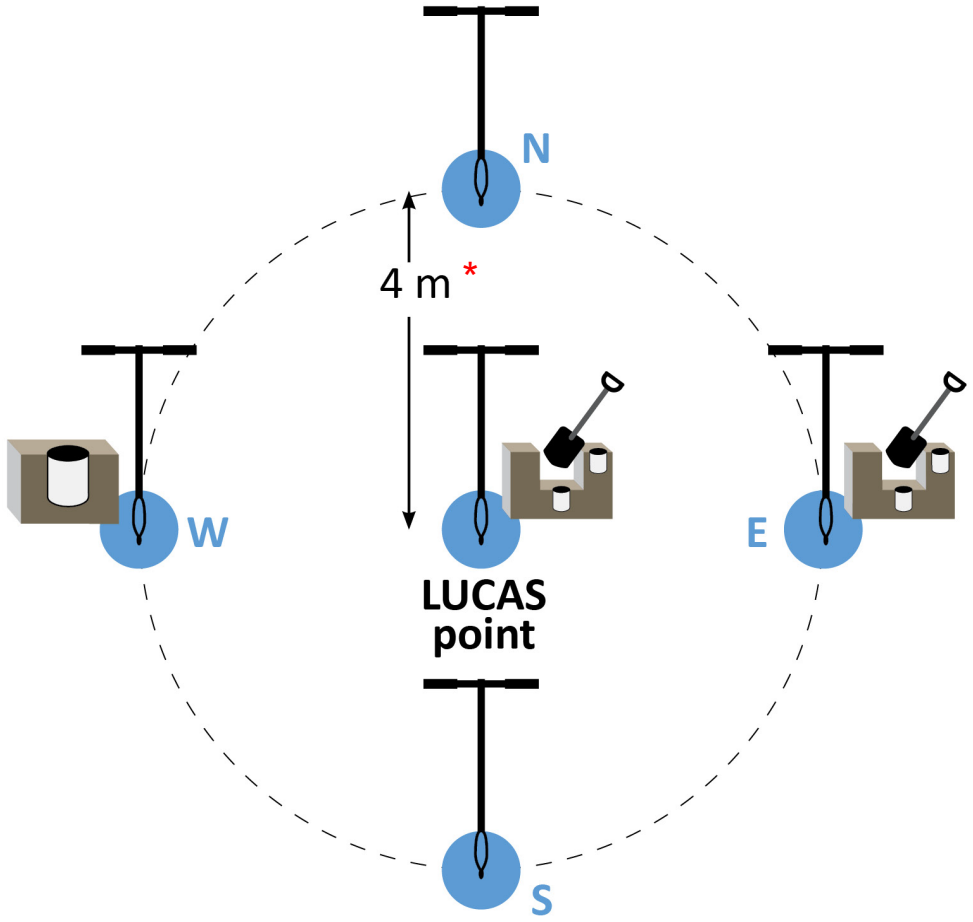
- Clean the sampling material with water, removing residues of soil
- In case it is a biodiversity point, clean the material with alcohol and wear gloves during sampling
- If the soil is organic or peat soil, it shall not be sampled when saturated with water

Protocol for all land covers except woodlands

The following samples shall be taken:

- **Standard sample**: using the soil auger, a composite sample of 5 sub-samples
- In case needed, **a biodiversity sample** shall be collected from same composite sample
- 3 **topsoil bulk density samples** (0 – 10 cm)
- 2 **subsoil bulk density samples** (below 30 cm)

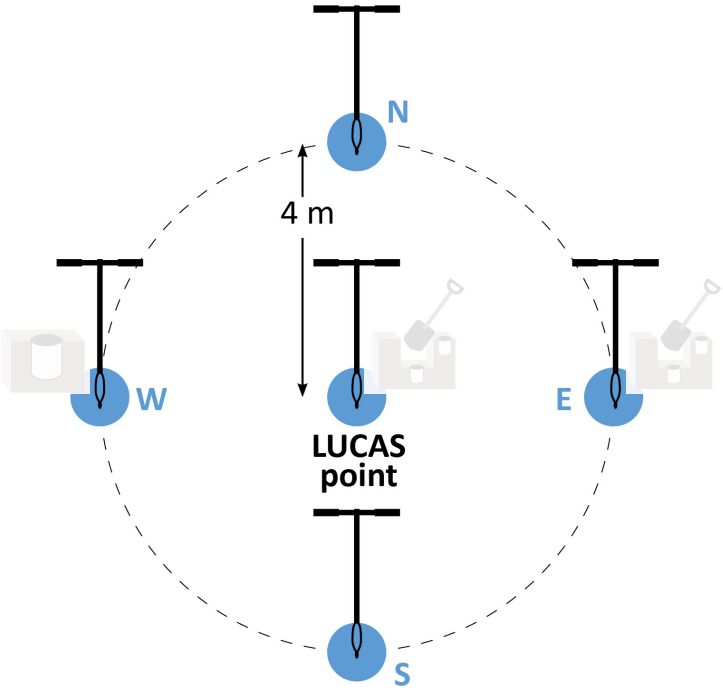




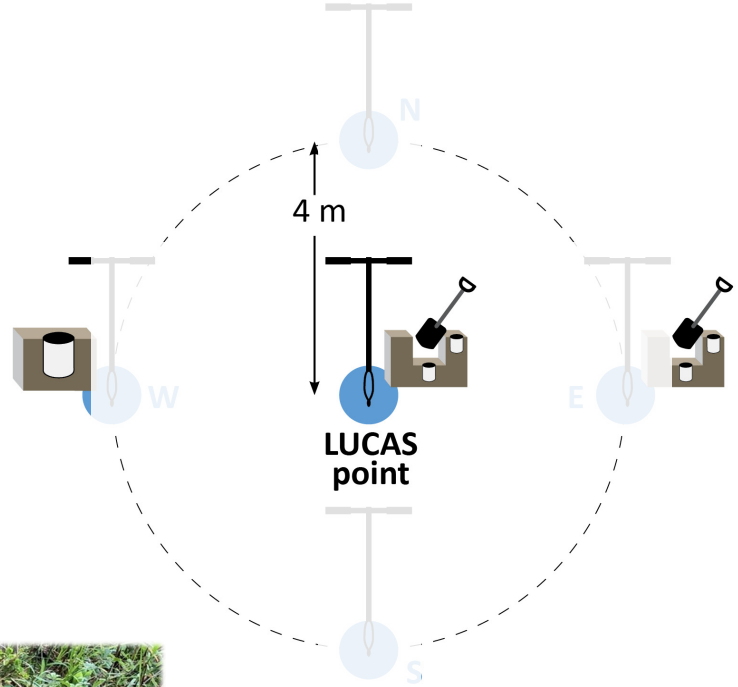
*Radius increased from 2 to 4 m to be more in line with MS schemes

Protocol all land covers except woodlands

1. Always remove vegetation residues, grass and litter using a spade or by hand.
2. Take 5 sub-samples with the auger (0 – 30 cm) to form a composite sample



Protocol all land covers except woodlands



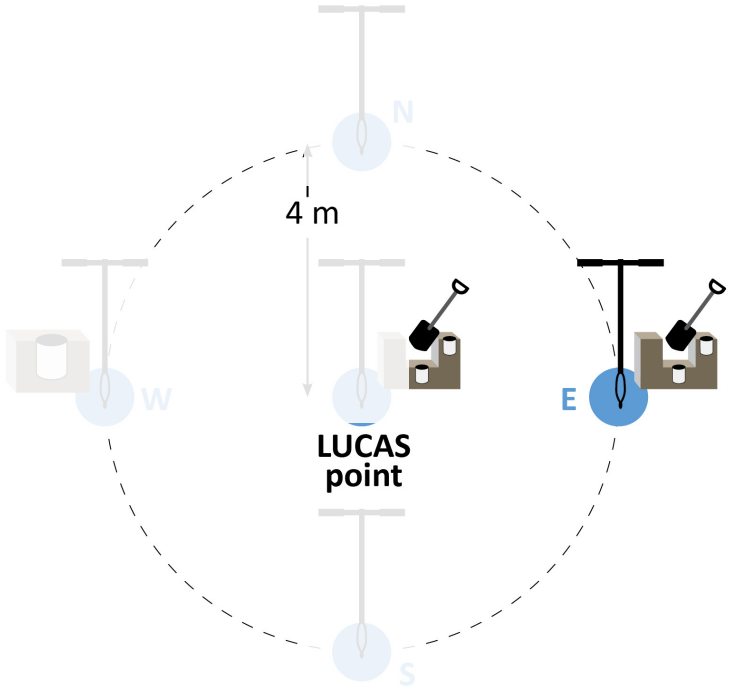
3. Take 3 separate topsoil bulk density samples

Procedure:

1. Dive the ring into the topsoil (0 – 10 cm)
2. Put the lid on it
3. Use the mallet and a wooden block
4. Remove the ring with the shovel
5. Put the sample in the bag
6. Do this two other times (East, West)

Protocol all land covers except woodlands

4. Take 2 subsoil bulk density samples below 30 cm depth



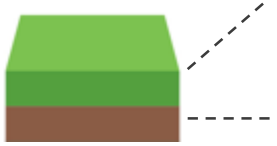
Procedure:

1. Dig a square hole with the spade that is 30 cm deep and from which each side is 2 spades wide
2. Dive the ring into the subsoil at the bottom of the hole
3. Use the mallet and the wooden block
4. Put the lid on the ring
5. Remove the ring carefully using the shovel
6. Put the sample in the plastic bag
7. Repeat this one more time and put the sample in the plastic bag

Protocol for woodlands

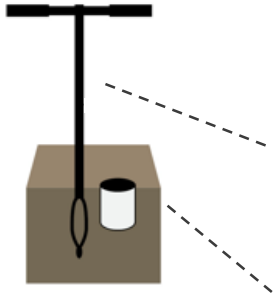
When sampling in forested areas, the forest floor, if relevant subdivided into **litter and organic layers, shall be sampled separately and the thickness and weight** shall be recorded

Overview of protocol for woodlands



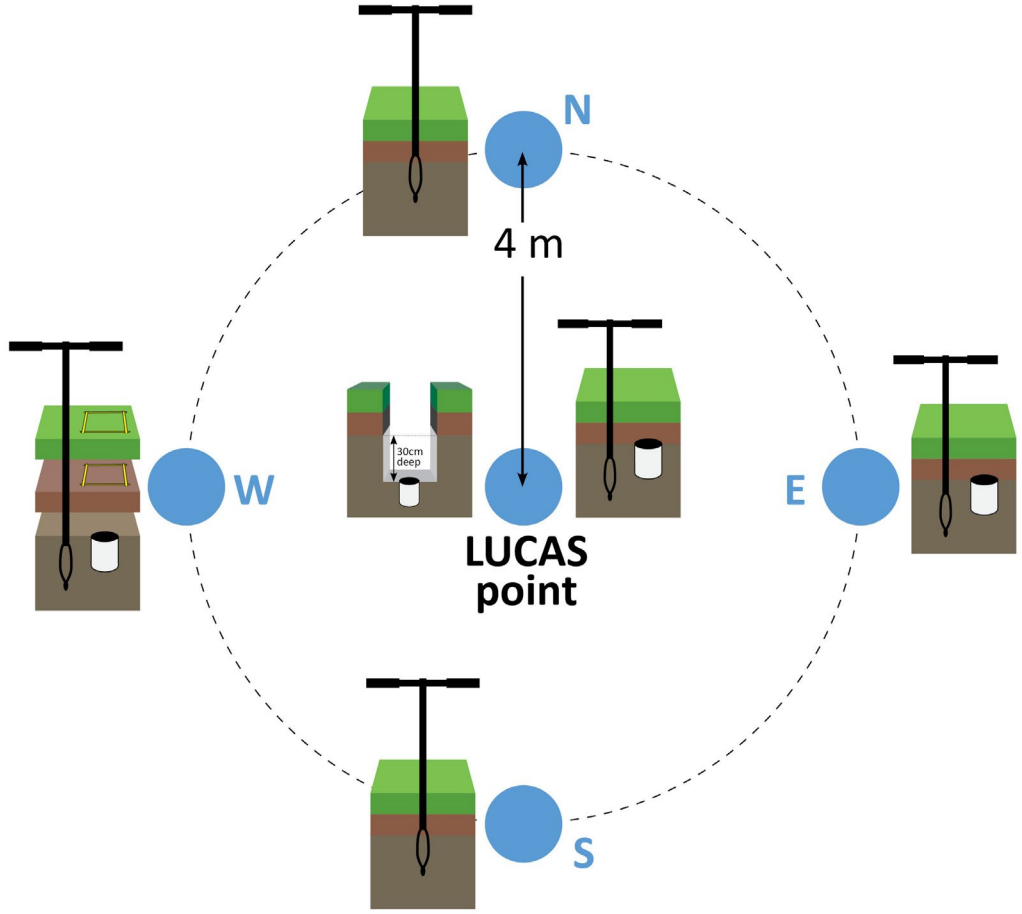
The following samples shall be taken:

- **1 litter layer sample** made of 5 sub-samples (if litter layer > 1 cm thick)
- **1 organic layer sample** made of 5 sub-samples (if organic layer 2 – 30 cm thick)



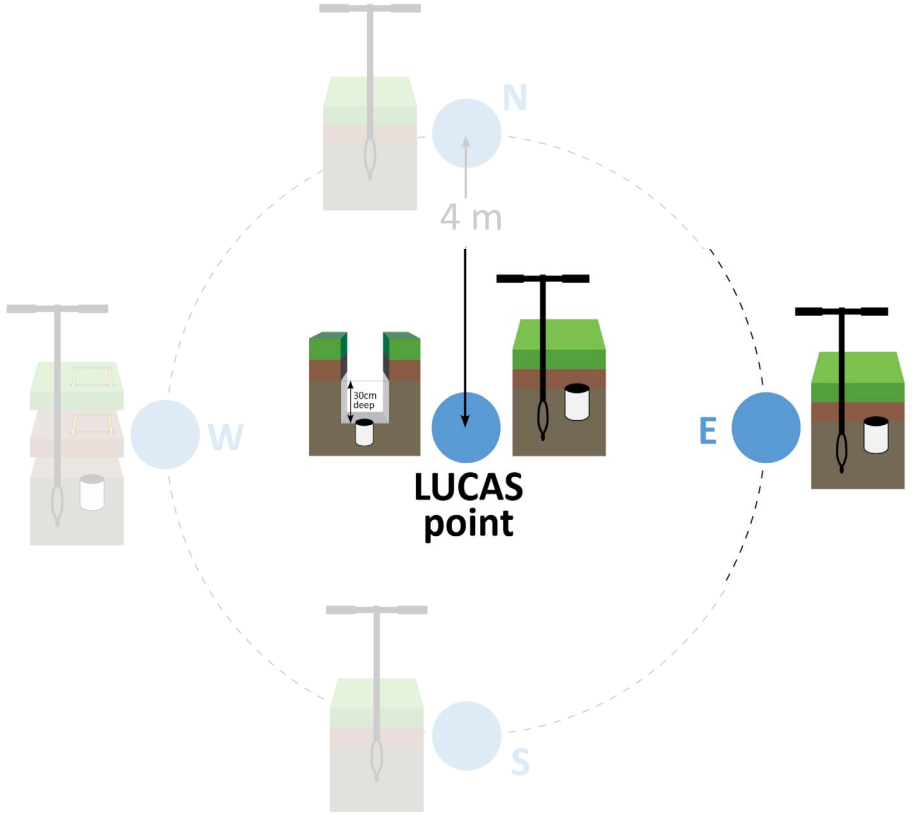
At one of the points, the litter and organic layer is collected with a frame (noting depth and weight). Needed for stocks calculation

- **Standard sample:** made of 5 sub-samples 0 – 30 cm in mineral layer using the soil auger
- **3 topsoil bulk density samples** (0 – 10 cm in mineral layer)
- **1 subsoil bulk density sample** (below 30 cm in mineral layer)



Protocol for woodlands

1. At the LUCAS point, assess the depth of the organic layer (scraping)



IF **organic layer is not present or shallower than 2 cm:** the organic layer does not need to be sampled separately but needs to be discarded before taking the standard sample

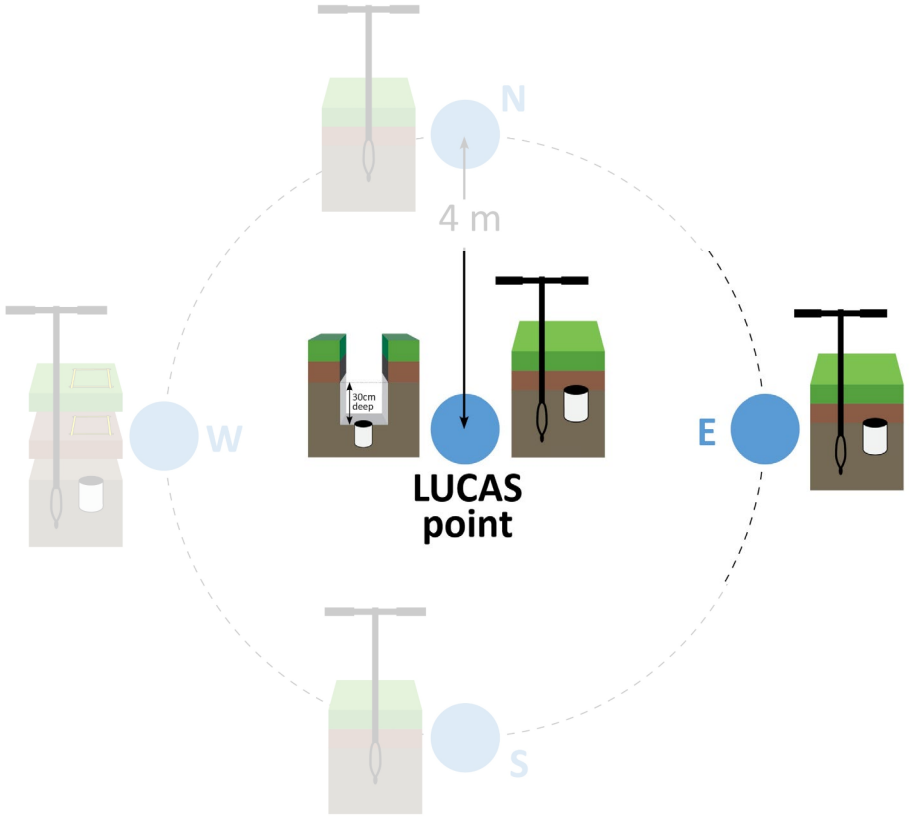
IF **organic layer > 30 cm deep:** no distinction shall be made between the organic and mineral layer

Protocol for woodlands with organic layer 2 – 30 cm **LUCAS** and **EAST** points:

2. Collect the **litter layer** (about 2 handfuls)

If litter layer < 1 cm thick: discard litter layer but remove before taking the other samples

3. Collect the **organic layer** (if it is between 2 – 30 cm deep). About 2 trowels

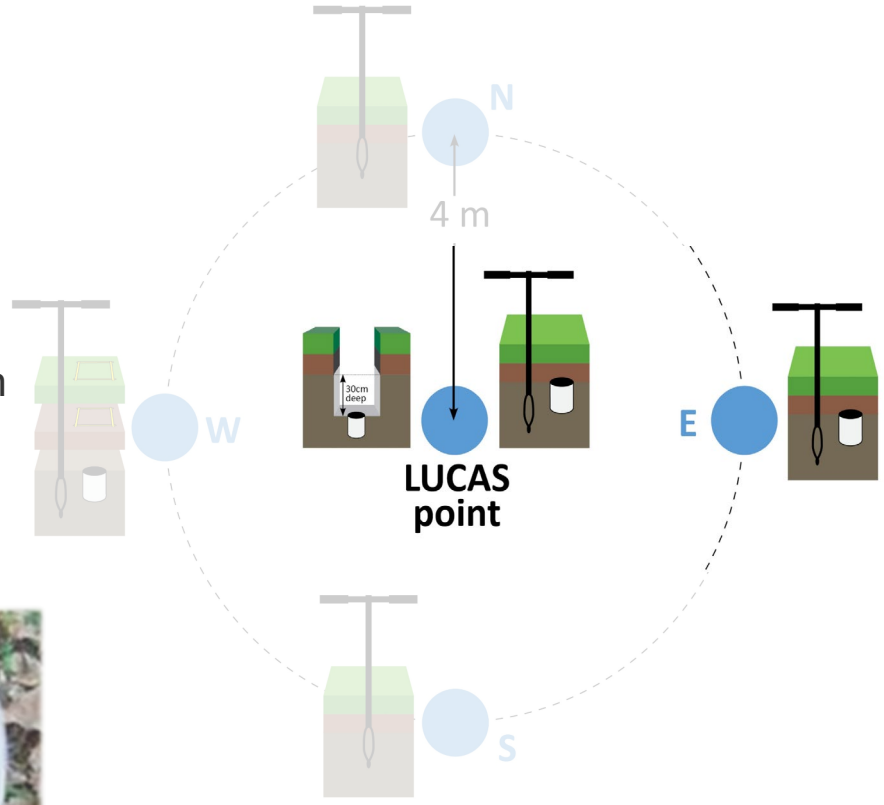


© Photo: Dr. Oliver van Straaten, University of Göttingen

Protocol for woodlands with organic layer 2 – 30 cm **LUCAS** and **EAST** points:

4. Take a **standard soil sample** with the auger 30 cm in the mineral soil

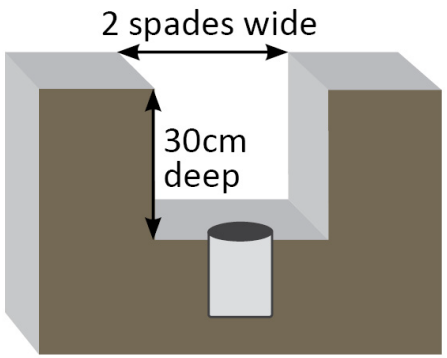
5. Take a **mineral topsoil bulk density sample** next to where the auger has been done

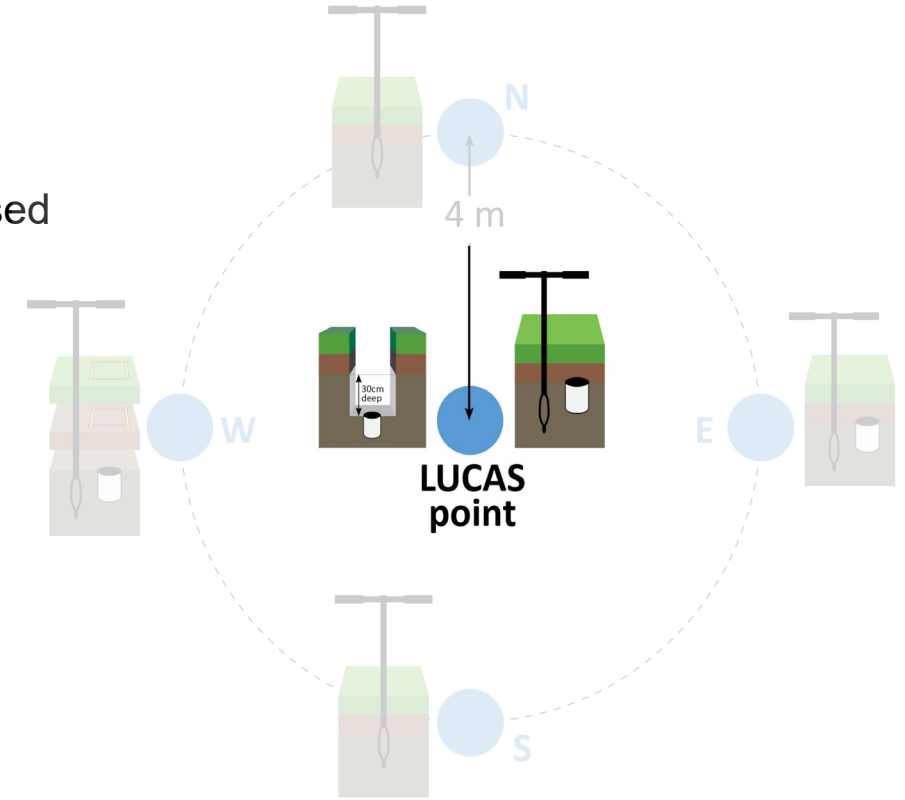


Protocol for woodlands with organic layer 2 – 30 cm **LUCAS** point:

- Dig a 30-cm deep hole into the mineral soil
- Collect **subsoil bulk density sample** using the metallic ring
- The space that was freed from removing the organic and litter layers can be used

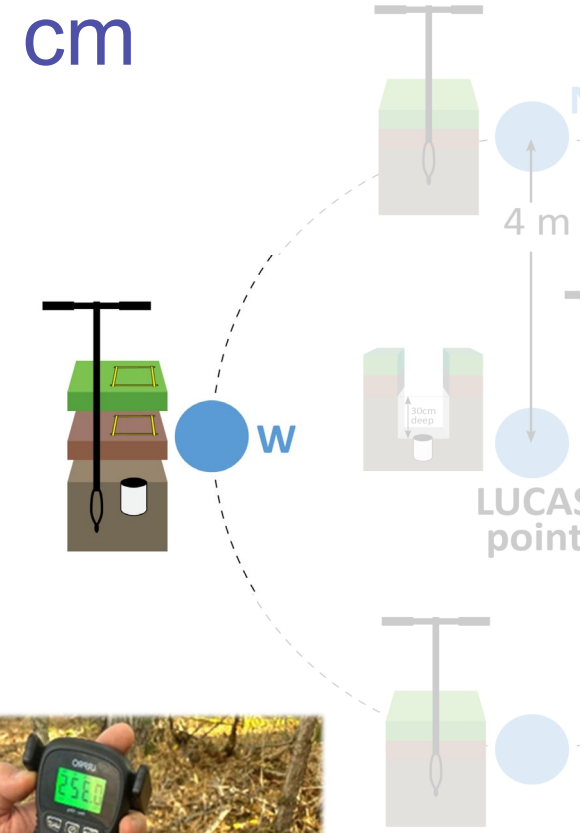
- Assess stone content in the organic and mineral layer





Protocol for woodlands with organic layer 2 – 30 cm **WEST** point:

1. **Collect the litter layer** using the 20 x 20 cm quadrat.
   - Remove all the litter from inside the quadrat
   - Weigh the sample using the fishhook scale (tare the scale first!)
   - Note the depth and the weight of the litter layer



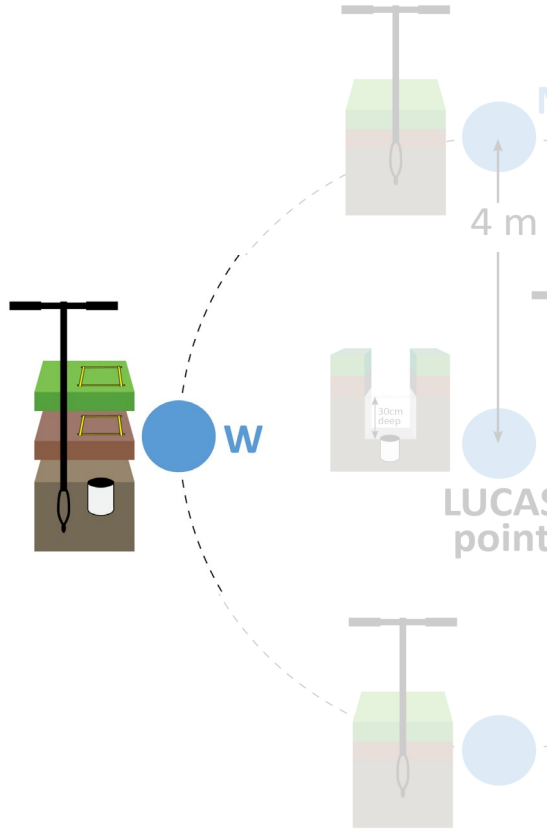
2. Collect the entire organic layer from inside the 20 x 20 cm quadrat
   - Weigh the sample using the fishhook scale (tare the scale first!)
   - Note the depth and the weight of the organic layer

This information is needed to calculate stocks

Protocol for woodlands with organic layer 2 – 30 cm **WEST** point:

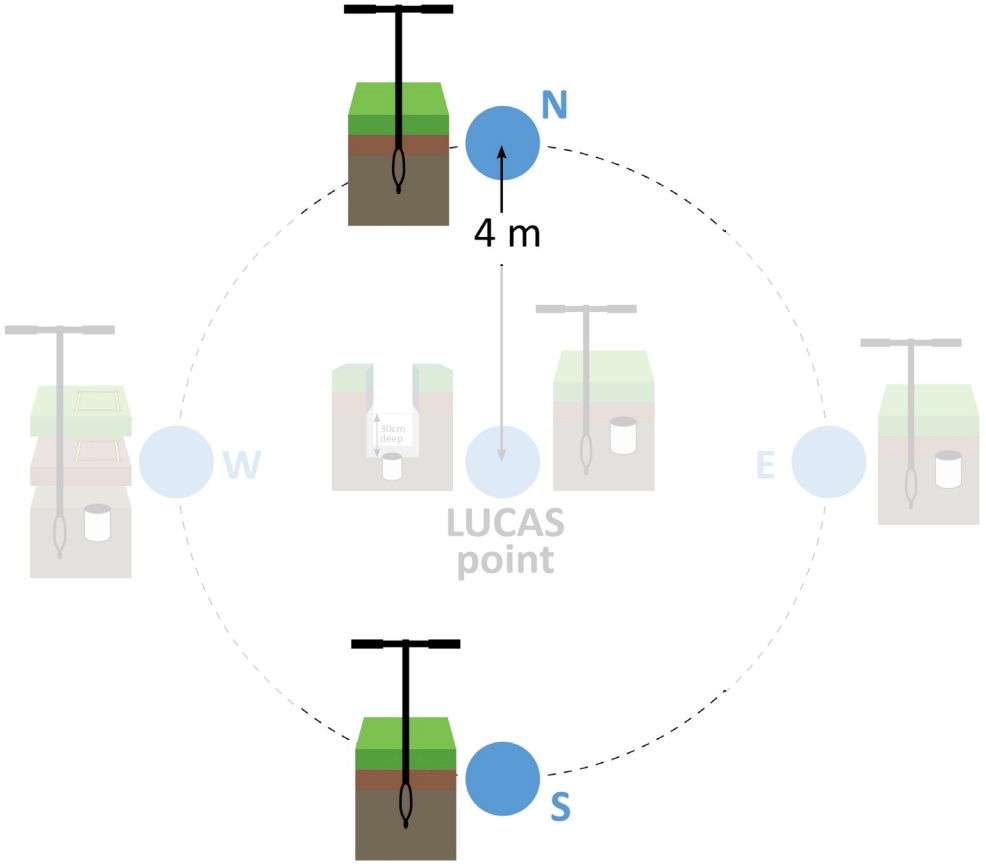
4. Take a **standard soil sample** with the auger 30 cm in the mineral soil inside the quadrat

5. Take a **mineral topsoil bulk density sample** next to the auger has been done

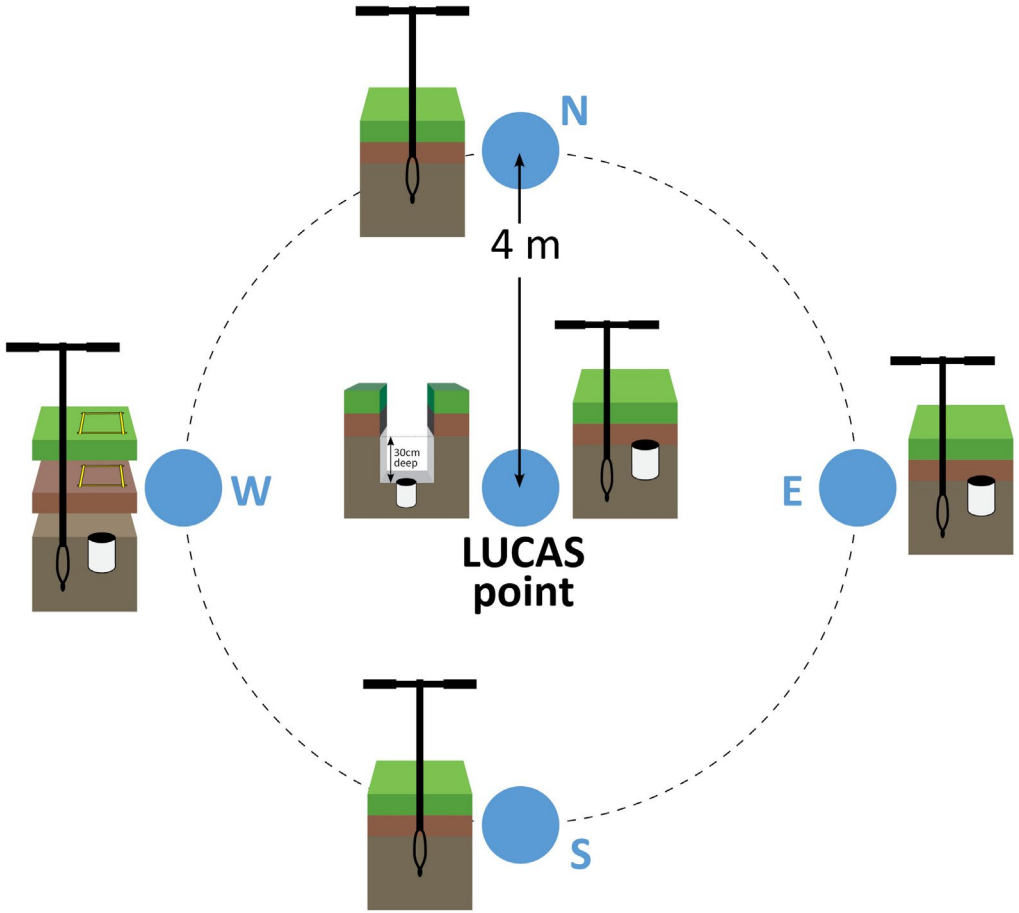


Protocol for woodlands with organic layer 2 – 30 cm **NORTH AND SOUTH** points:

1. Collect a **sample of litter layer** (2 handfuls)
2. Collect a **sample of the organic layer** (2 trowels)
3. Collect a **standard soil sample** with the auger 30 cm in the mineral soil



In summary…



- 1 litter layer sample made of 5 sub-samples (one collected with square noting depth and weight).
Discard if < 1 cm

- 1 organic layer sample made of 5 sub-samples (one collected with square noting depth and weight) if organic layer is between 2 – 30 cm

- Standard soil sample made of 5 sub-samples 0 – 30 cm in mineral layer (auger)

- **3 topsoil bulk density samples** (0 – 10 cm in mineral layer)

- **1 subsoil bulk density sample** (below 30 cm in mineral layer)

Soil biodiversity sampling – 2,000 points

Clean the material with alcohol and wear gloves during sampling

In all land covers except woodlands

- Take 500 g (about 5 heaped trowels) from the standard sample made of 5 sub-samples (0 – 30 cm in mineral layer collected with the auger)

In woodlands

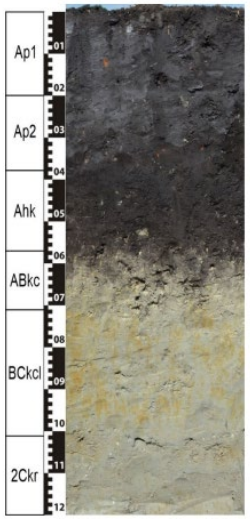
- 300 g (three trowels) of the mineral layer from the standard sample made of 5 sub-samples
- 300 g of the organic layer from the composite sample made of 5 sub-samples
- Keep them in two different bags

Samples need to be kept fresh (e.g., polystyrene box and ice blocks) and sent (in cold conditions) to the JRC for proper storage at -20 °C.

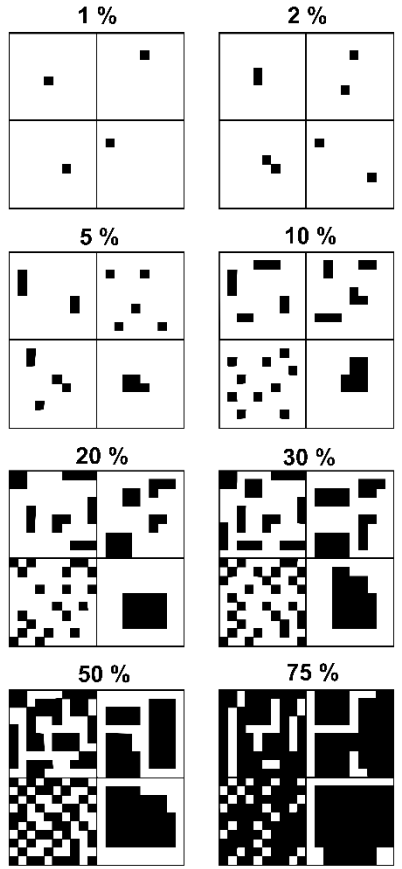
Site description

- Stones at the horizontal surface
- Presence of stones in the organic and mineral layer
- Presence of earthworms while taking a sample
- Presence of anthropogenic artefacts
- Presence of black or very dark surface layer
- Signs of water presence (reddish or greenish colors along cracks or root channels)
- Presence of crop residues

Source: WRB lecture notes Gleysols



Source: WRB lecture notes Chernozems



Source: https://literatur.thuenen.de/digbib_extern/dn064965.pdf

Where to find more information

- Presentation and recordings of this webinar
- Video of the protocol

https://esdac.jrc.ec.europa.eu/euso/TWG_MONITORING

Give your feedback by Friday 12/12

- https://ec.europa.eu/eusurvey/runner/LUCASsoil_feedback

Possible points to discuss

- Subsoil bulk density sample

- Biodiversity samples in woodlands

Thank you

For more details: arwyn.jones@ec.europa.eu