

Austrian Soil Monitoring

-

current status and perspectives

Hans-Peter Haslmayr

30th anniversary of the Czech Pedological Society, Prague – December 10th 2024

Austrian Soil Monitoring

Background



- ☞ Currently, there is no nationwide monitoring programme in progress
- ☞ Soil protection legislation is the responsibility of the Austrian federal states (not every federal state has its own soil protection law!)
- ☞ First approach in 1990ies – every federal state conducted an individual soil monitoring programme based
- ☞ This was done by applying harmonized methodology (data have been published either as reports or on a common platform - BORIS)

Towards Austrian Soil Monitoring

Background



- ☞ Currently, there is no nationwide monitoring programme in progress
- ☞ Soil protection legislation is the responsibility of the Austrian federal states (not every federal state has its own soil protection law!)
- ☞ First approach in 1990ies – every federal state conducted an individual soil investigation programme based on a harmonized methodology (data have been published as reports and on a common platform - BORIS)

Austrian Soil Monitoring

Soil status inventory

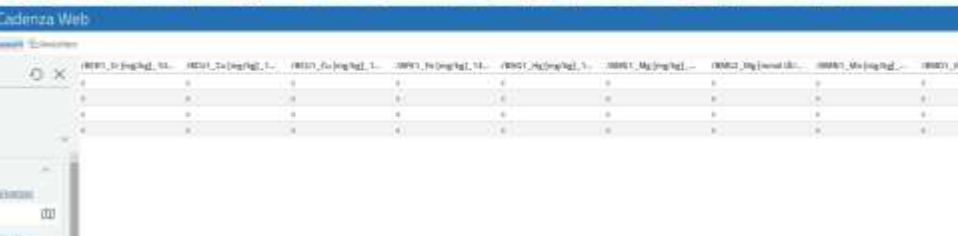
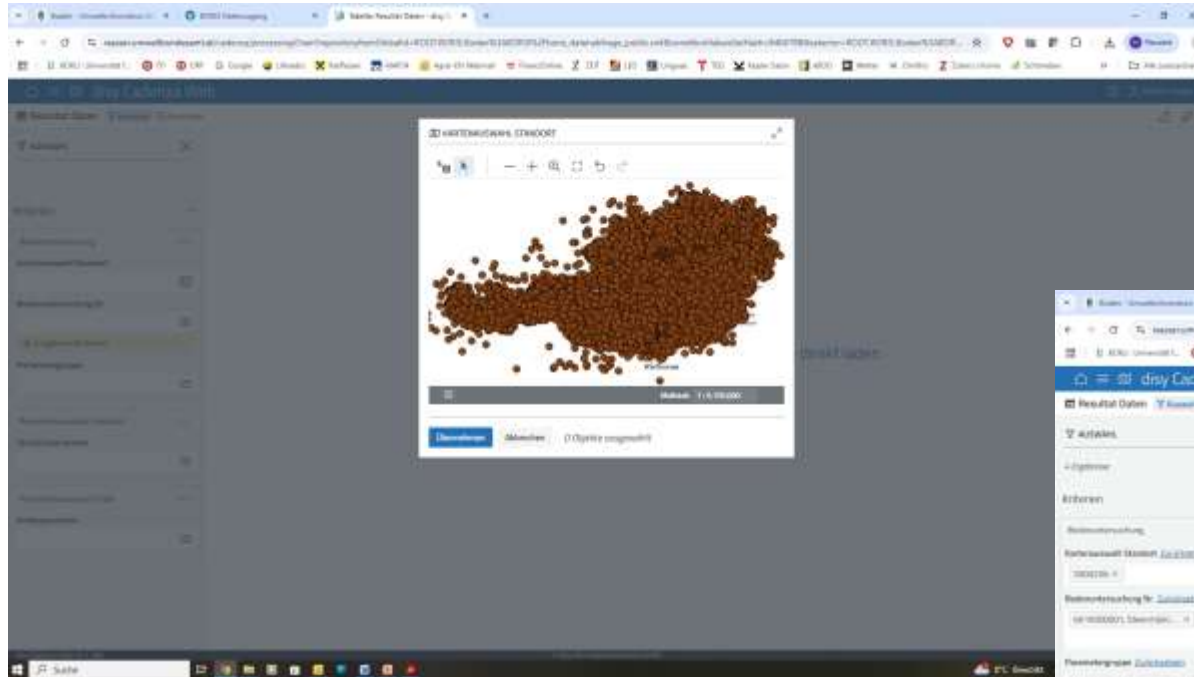


Austrian Soil Monitoring

Soil status inventory



BORIS (Soil information system) <https://www.umweltbundesamt.at/umweltthemen/boden/boris/boris-datenzugang>



The screenshot shows the 'dry Cadenza Web' interface. The main area displays a table of results for a patient named 'Patient'. The table has columns for various parameters and rows for different tests. The left sidebar shows a list of parameters and their values.

Parameter	Value
Parameter 1	Value 1
Parameter 2	Value 2
Parameter 3	Value 3
Parameter 4	Value 4
Parameter 5	Value 5
Parameter 6	Value 6
Parameter 7	Value 7
Parameter 8	Value 8
Parameter 9	Value 9
Parameter 10	Value 10
Parameter 11	Value 11
Parameter 12	Value 12
Parameter 13	Value 13
Parameter 14	Value 14
Parameter 15	Value 15
Parameter 16	Value 16
Parameter 17	Value 17
Parameter 18	Value 18
Parameter 19	Value 19
Parameter 20	Value 20
Parameter 21	Value 21
Parameter 22	Value 22
Parameter 23	Value 23
Parameter 24	Value 24
Parameter 25	Value 25
Parameter 26	Value 26
Parameter 27	Value 27
Parameter 28	Value 28
Parameter 29	Value 29
Parameter 30	Value 30
Parameter 31	Value 31
Parameter 32	Value 32
Parameter 33	Value 33
Parameter 34	Value 34
Parameter 35	Value 35
Parameter 36	Value 36
Parameter 37	Value 37
Parameter 38	Value 38
Parameter 39	Value 39
Parameter 40	Value 40
Parameter 41	Value 41
Parameter 42	Value 42
Parameter 43	Value 43
Parameter 44	Value 44
Parameter 45	Value 45
Parameter 46	Value 46
Parameter 47	Value 47
Parameter 48	Value 48
Parameter 49	Value 49
Parameter 50	Value 50
Parameter 51	Value 51
Parameter 52	Value 52
Parameter 53	Value 53
Parameter 54	Value 54
Parameter 55	Value 55
Parameter 56	Value 56
Parameter 57	Value 57
Parameter 58	Value 58
Parameter 59	Value 59
Parameter 60	Value 60
Parameter 61	Value 61
Parameter 62	Value 62
Parameter 63	Value 63
Parameter 64	Value 64
Parameter 65	Value 65
Parameter 66	Value 66
Parameter 67	Value 67
Parameter 68	Value 68
Parameter 69	Value 69
Parameter 70	Value 70
Parameter 71	Value 71
Parameter 72	Value 72
Parameter 73	Value 73
Parameter 74	Value 74
Parameter 75	Value 75
Parameter 76	Value 76
Parameter 77	Value 77
Parameter 78	Value 78
Parameter 79	Value 79
Parameter 80	Value 80
Parameter 81	Value 81
Parameter 82	Value 82
Parameter 83	Value 83
Parameter 84	Value 84
Parameter 85	Value 85
Parameter 86	Value 86
Parameter 87	Value 87
Parameter 88	Value 88
Parameter 89	Value 89
Parameter 90	Value 90
Parameter 91	Value 91
Parameter 92	Value 92
Parameter 93	Value 93
Parameter 94	Value 94
Parameter 95	Value 95
Parameter 96	Value 96
Parameter 97	Value 97
Parameter 98	Value 98
Parameter 99	Value 99
Parameter 100	Value 100

Austrian Soil Monitoring

Styria

- ☞ Styrian agricultural soil protection law (LGBI. Nr. 66/1987)
- ☞ Since 1996
- ☞ 1.000 sampling sites on agricultural land
- ☞ 10 years measuring interval
- ☞ Parameters: basic soil parameters, nutrients and pollutants



Austrian Soil Monitoring

Upper Austria

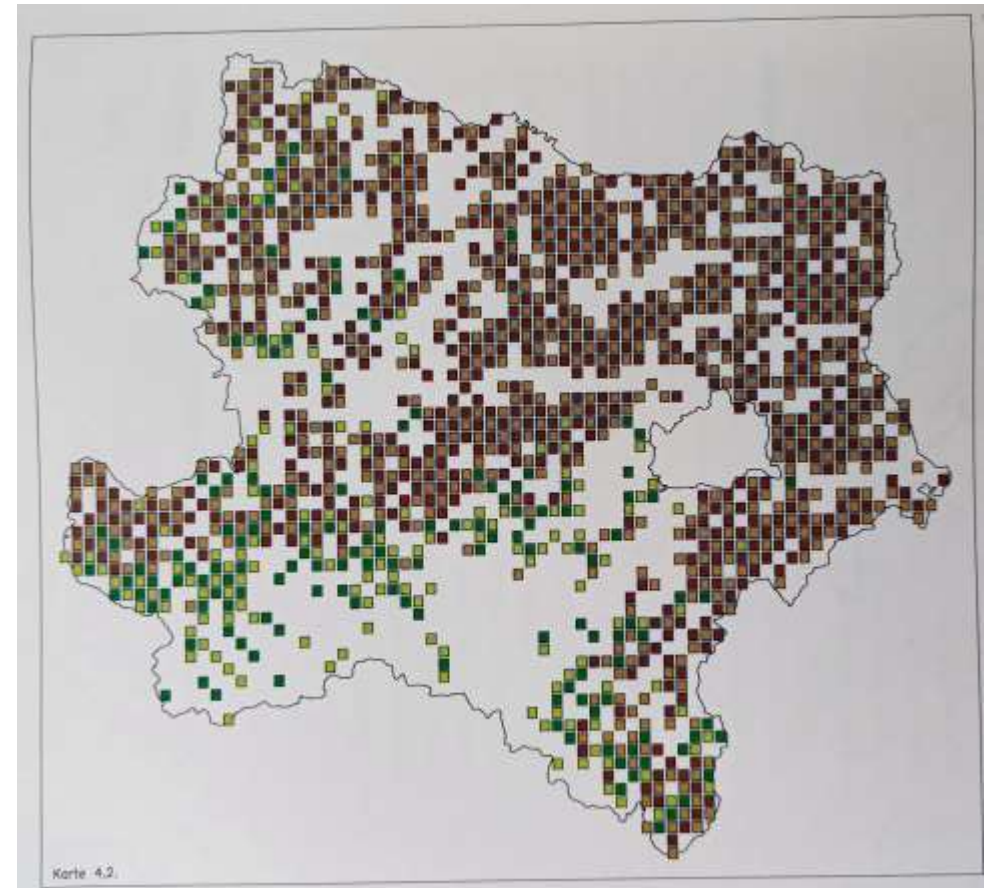
- Upper Austrian soil protection law (LGBL Nr. 63/1997)
- 2 investigation campaigns
1st: 1990-93; 2nd: 2013-22
- 880 sampling sites (439 cropland, 441 grassland)
- Parameters: basic soil parameters, nutrients and pollutants



Austrian Soil Monitoring

Lower Austria

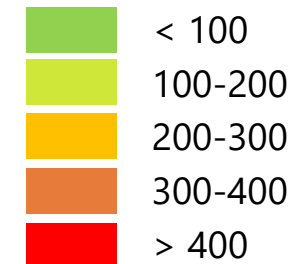
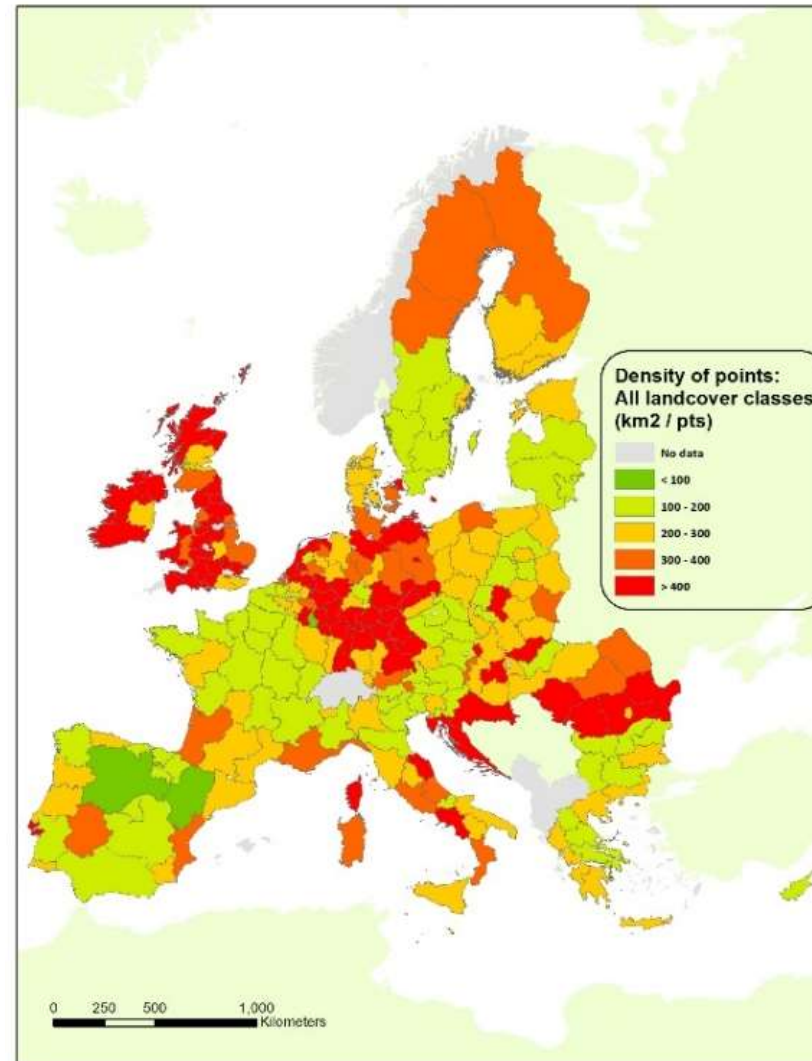
- ☛ Lower Austrian soil protection law (LGBL Nr. 6160-0)
- ☛ 2 investigation campaigns
1st: 1990-92; 2nd: 2020-
- ☛ 1.449 sampling sites (1.151 cropland, 298 grassland)
- ☛ Parameters: basic soil parameters, nutrients and pollutants



LUCAS – Topsoil survey

Land Use/Cover Area frame statistical Survey

Density of points [km²/pts]
in NUTS 2 regions
2018: appr. 19.000 points

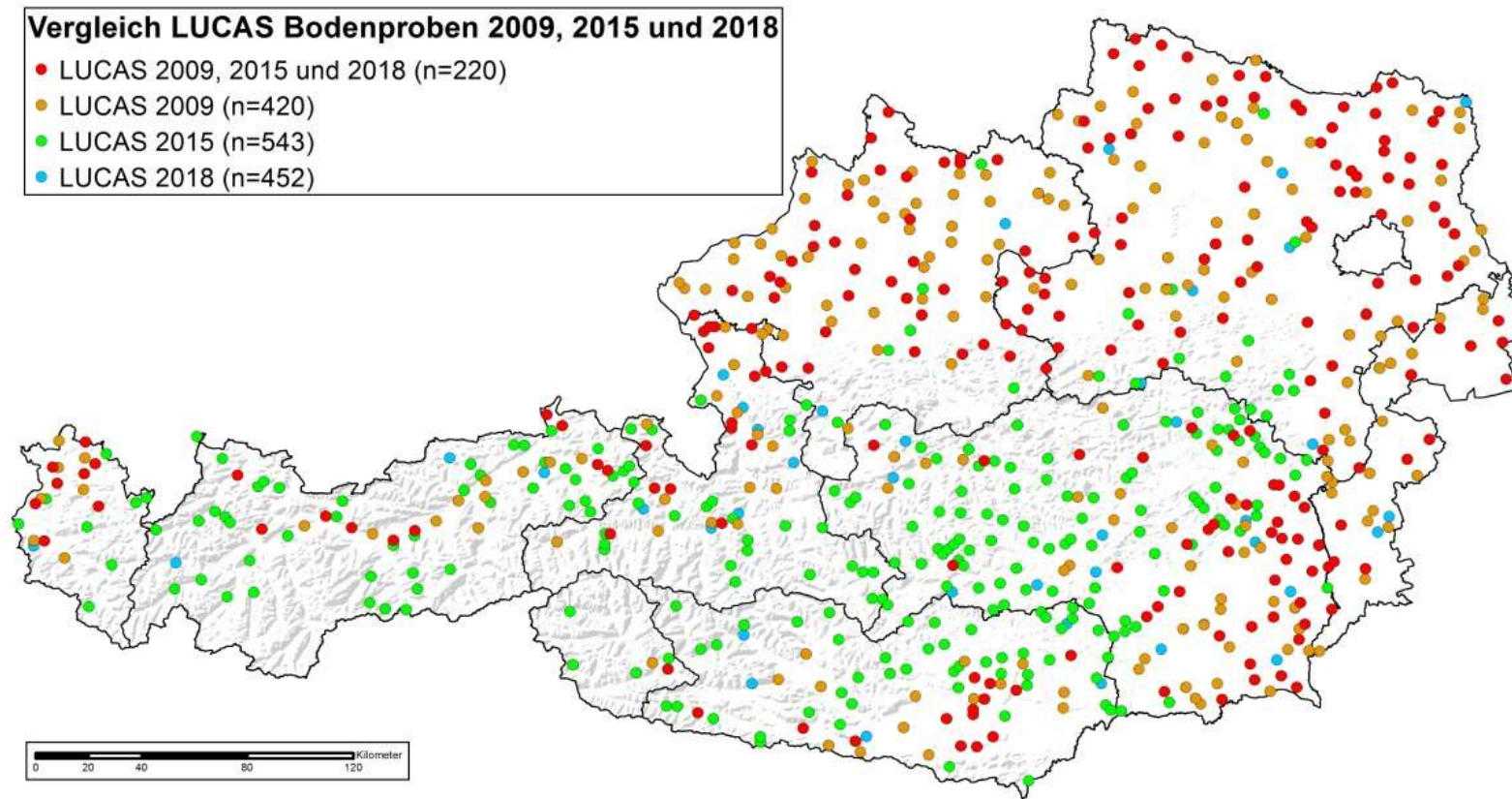


Fernandez-Ugalde et al. (2022): LUCAS 2018 Soil Module. Presentation of dataset and results.

LUCAS – Topsoil survey

Land Use/Cover Area frame statistical Survey

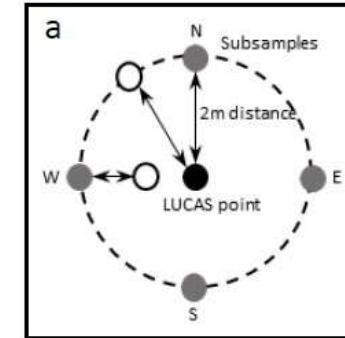
Austrian LUCAS-sites 2009, 2015, 2018



LUCASSA – LUCAS Soil Austria

Project Goals

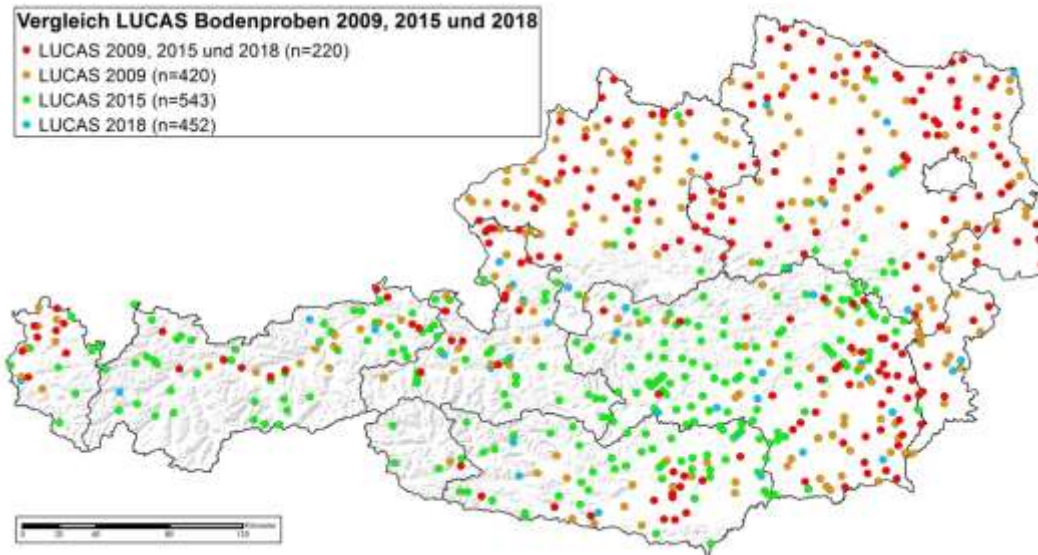
- ☞ Comparability to national methods (double sampling)
- ☞ Heterogeneity within sampling points
 - (1) LUCAS point
 - (2) Circle with 100 m radius
 - (3) 2 x 2 km
- ☞ Representativity
- ☞ Interpretation, applicability



LUCAS evaluation

LUCAS Soil Austria - LUCASSA

Austrian LUCAS sites 2009, 2015, 2018

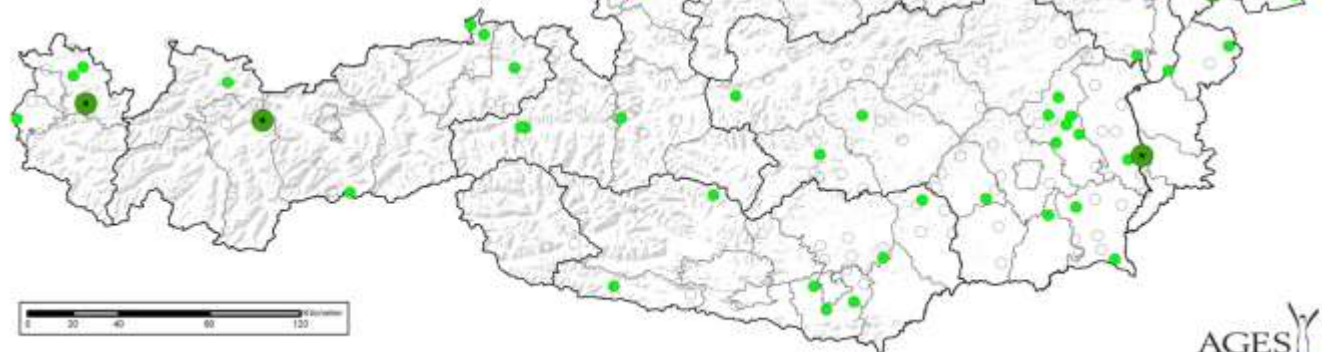


LUCASSA sites 2018

approach 1 + 2
n = 80

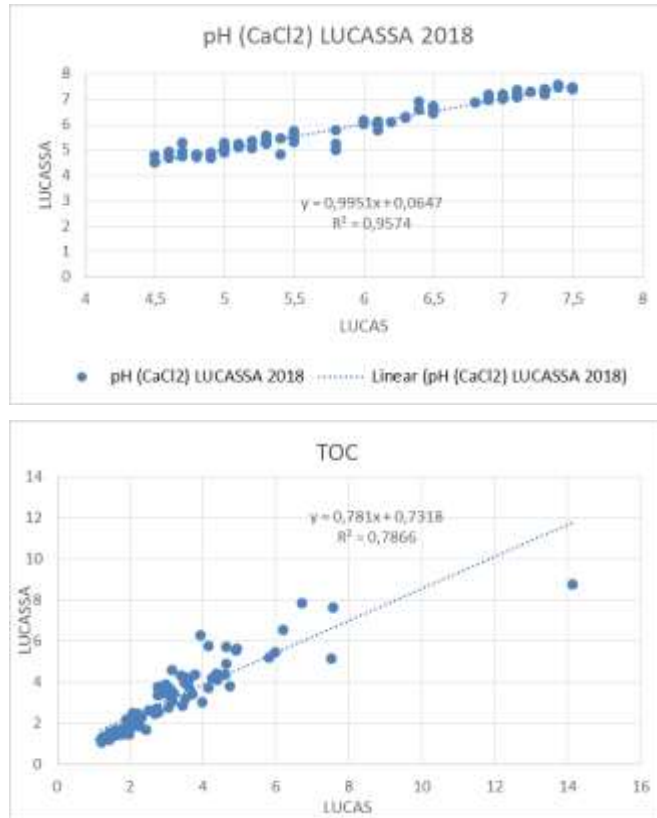


approach 1 + 2 + 3
n = 8

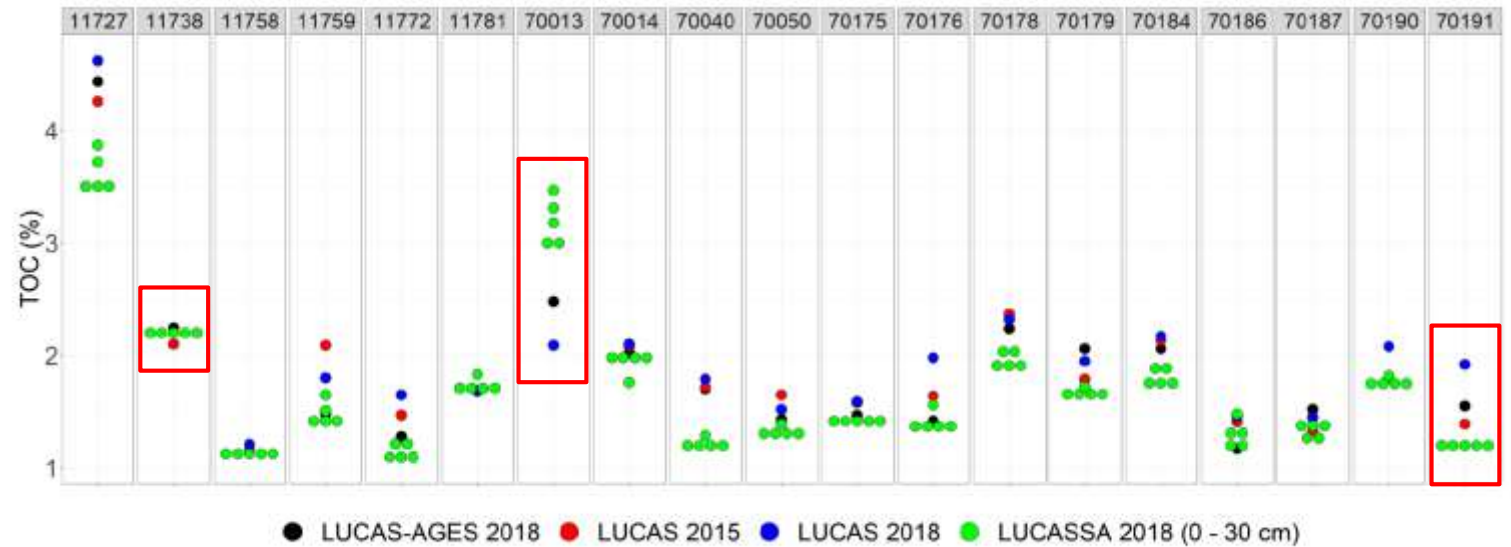


LUCASSA I - results

Correlation, spread



Lower Austrian sites



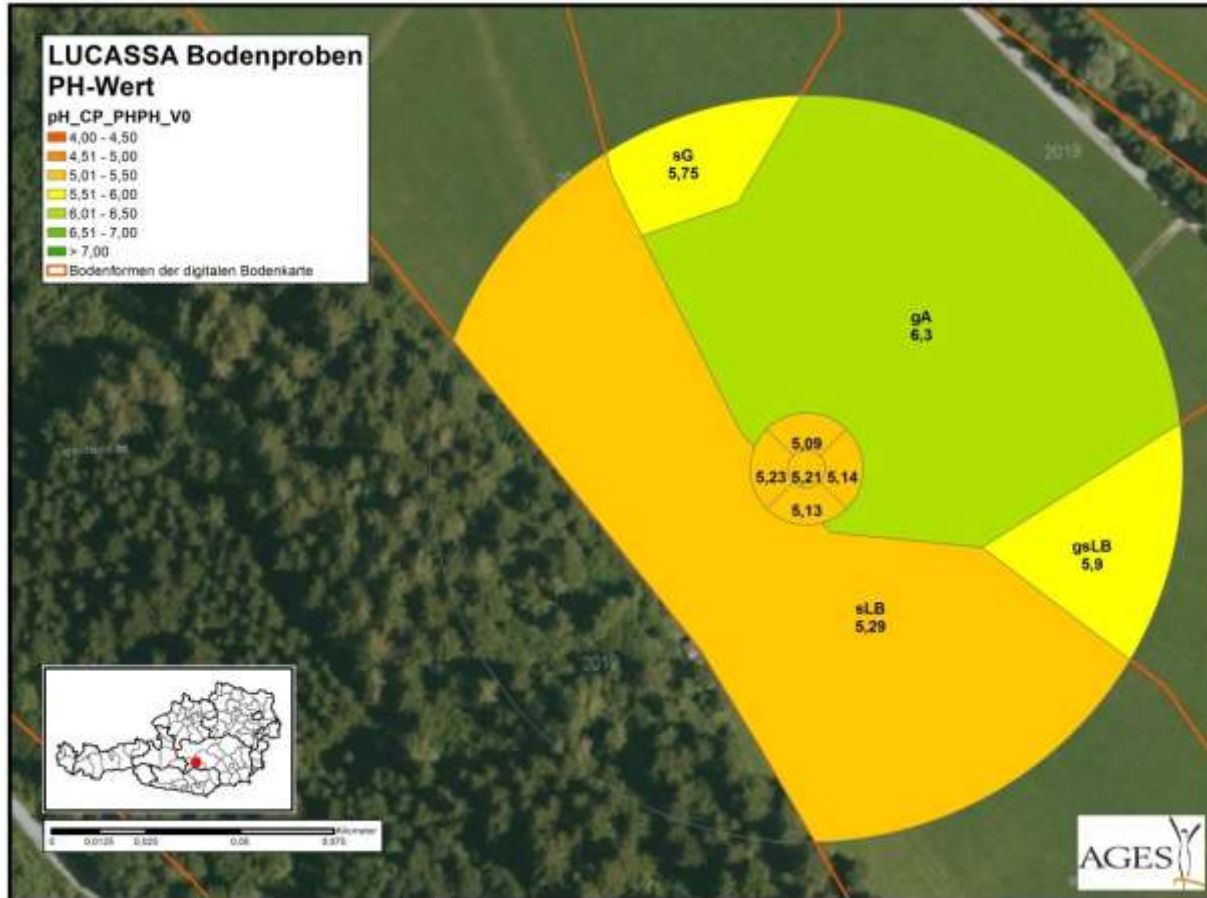
- Parallel analysis: Compliance of results with comparable methodology
- Spread depends on the site

LUCAS point compared to surrounding soil types

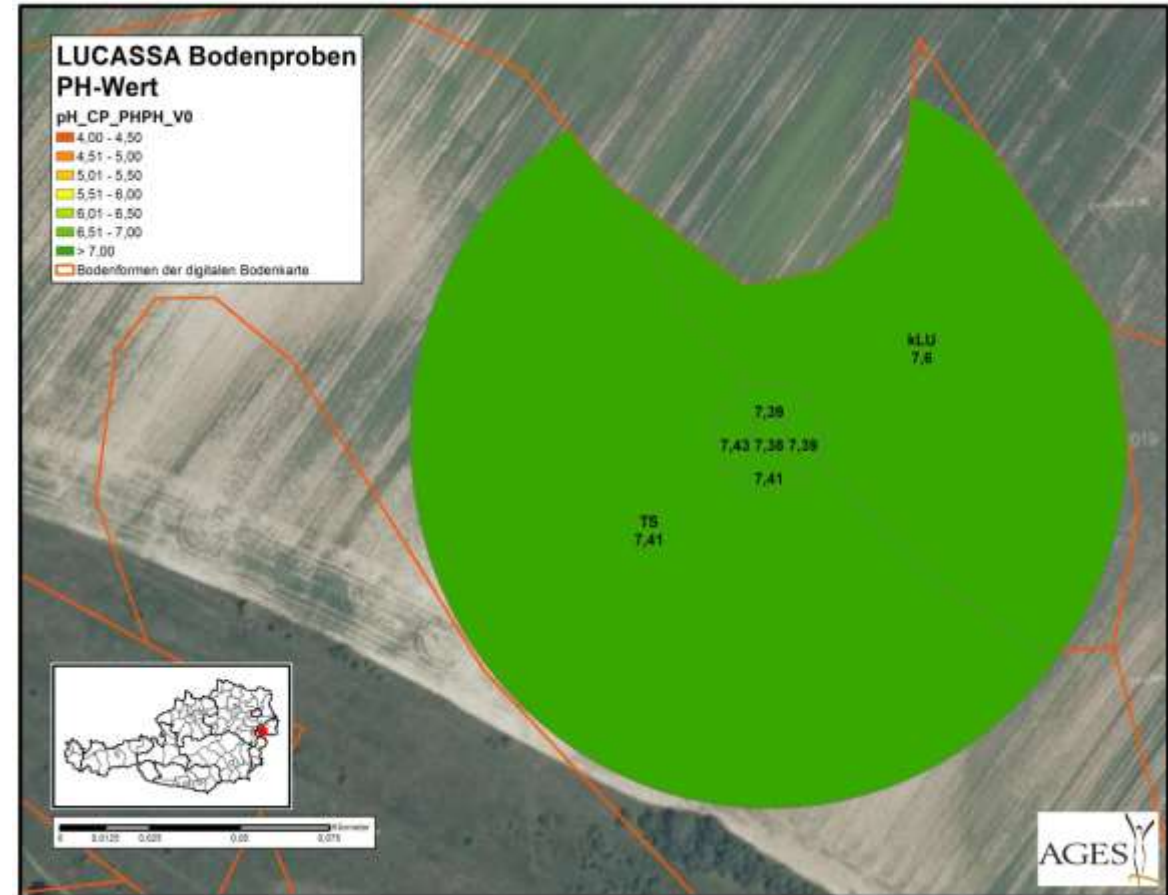
Deviations within an area of 100 m², pH

acidic

calcareous



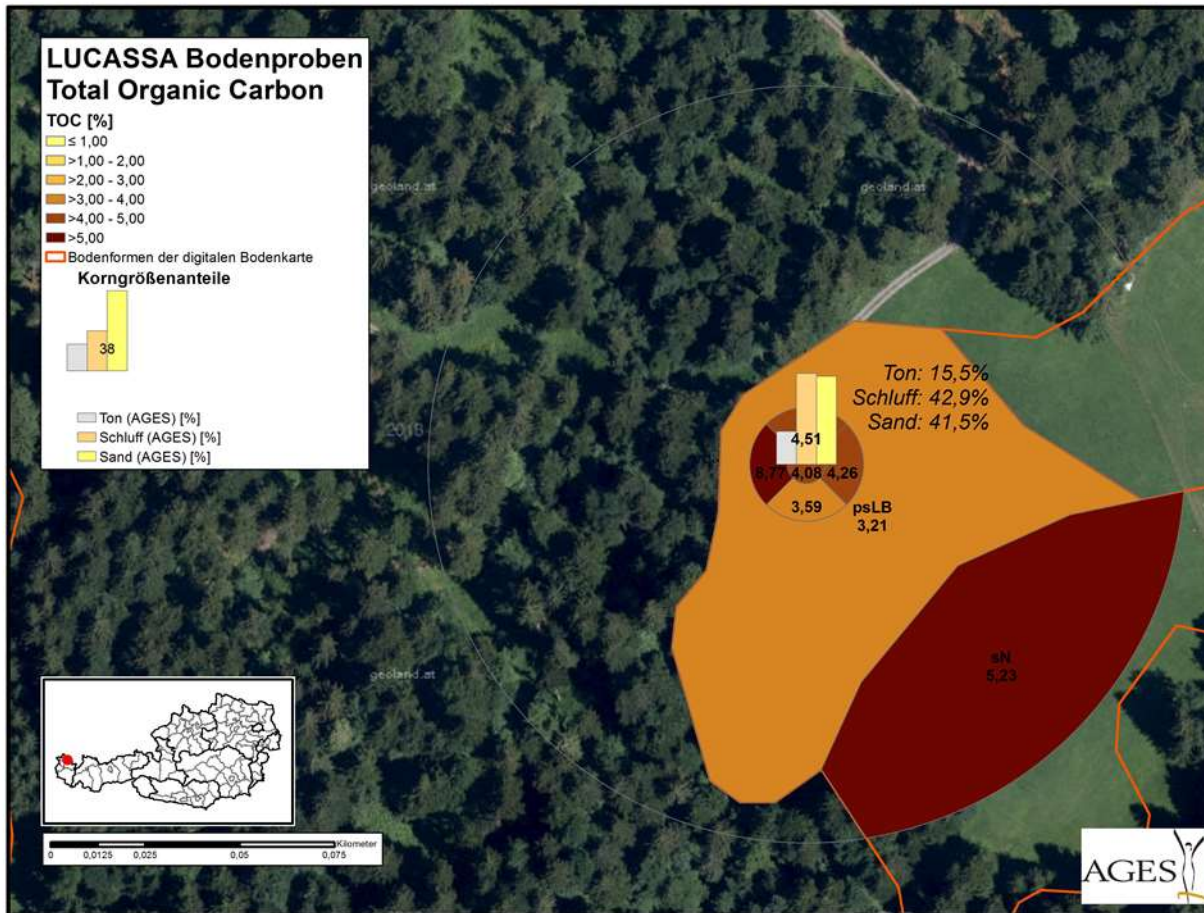
Eutric Fluvic Gleyic Cambisol



Calcaric Phaeozem

LUCAS point compared to surrounding soil types

Deviations within an area of 100 m², TOC



- ↪ Distribution of TOC influenced by adjacent woodland:
- ↪ 3,59 % TOC (south) vs 8,77 % TOC (west)

Hyperdystric Planosol

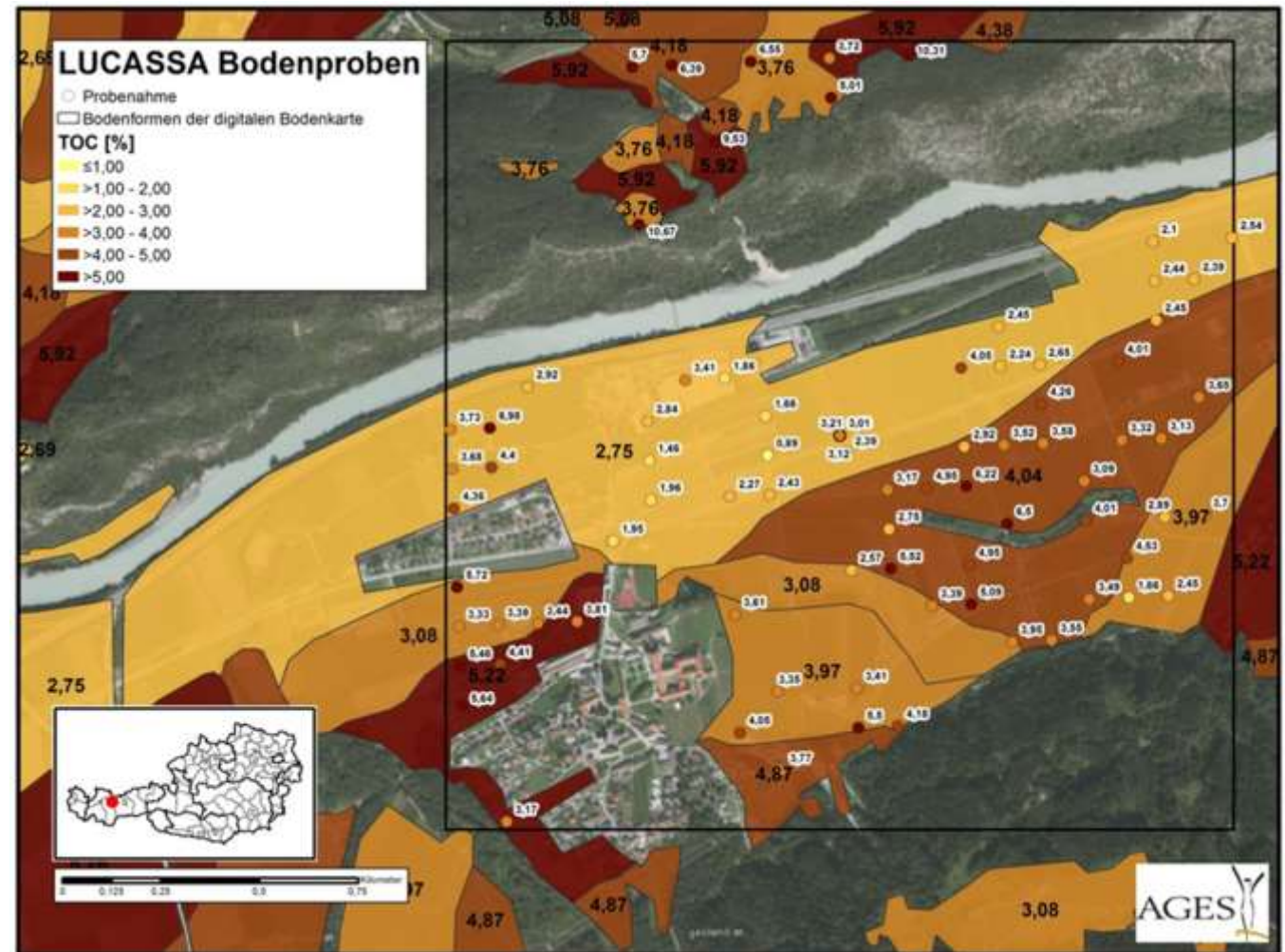
LUCASSA I - results

Spatial representativeness

Range between the lowest and highest measured value

Site	Humus [%]	P _{CAL} [mg.kg ⁻¹]	K _{CAL} [mg.kg ⁻¹]	pH
Upper-A.	11,2	501	2.036	2,58
Styria	8,0	124	218	2,75
Salzburg	18,0	107	592	3,90
Tyrol	16,9	543	502	2,22
Lower-A.I	4,1	244	570	0,35
Lower-A.II	10,5	363	924	0,45
Bgld.	7,4	671	538	2,2
Vbg.	49,1	298	836	3,6

Total organic carbon (TOC) - Tyrol

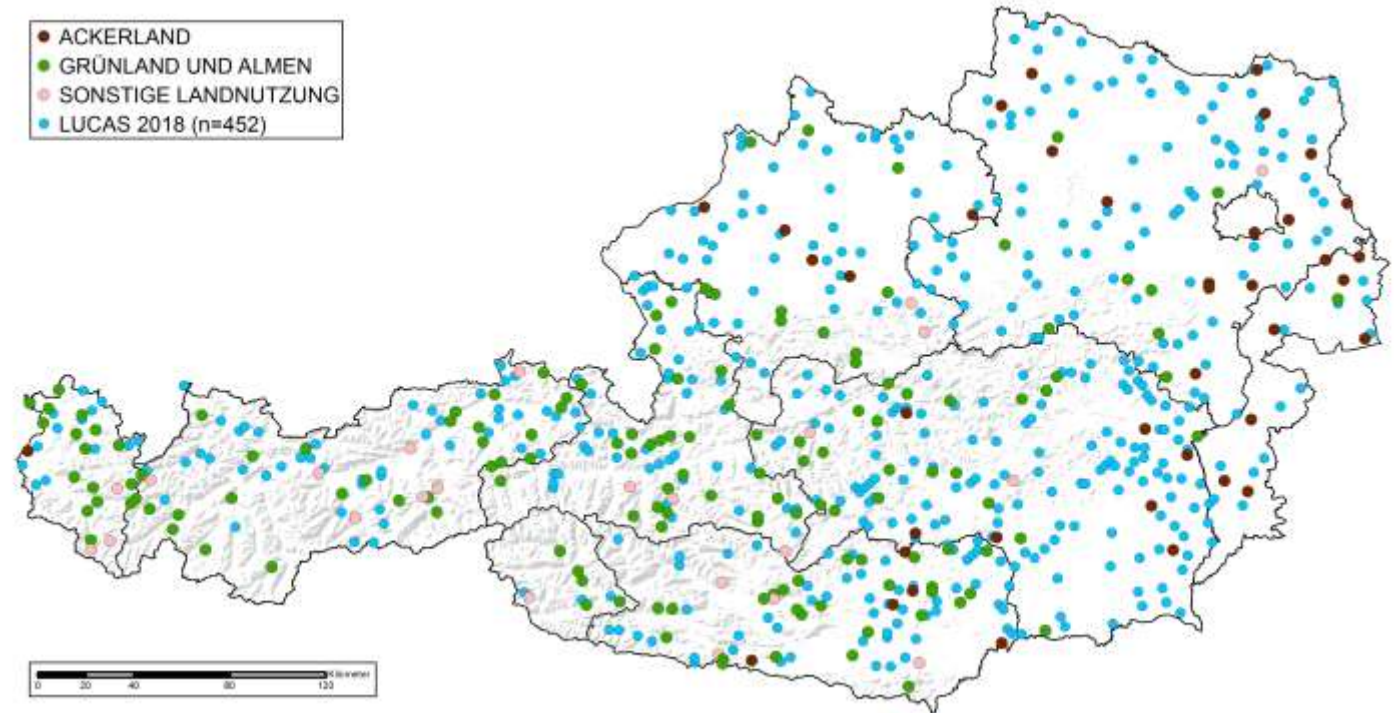


LUCAS expansion

Additional points allocated for 2022/23 sampling campaign

Criteria of priority:

- Representativity: 10 most common mapped soil forms
- Soils sensitive to changes in site conditions (organic or other waterlogged soils)



- Preparing for the EU Soil Monitoring and Resilience Law
- Developing a set of sites with a high degree of representativeness using reference profiles of existing soil maps (Austrian Soil Map and Soil Taxation Survey)

Directive on Soil Monitoring and Resilience (Soil Monitoring Law) – July 5th 2023; Annex II,

Part A: Methodology for determining sampling points:

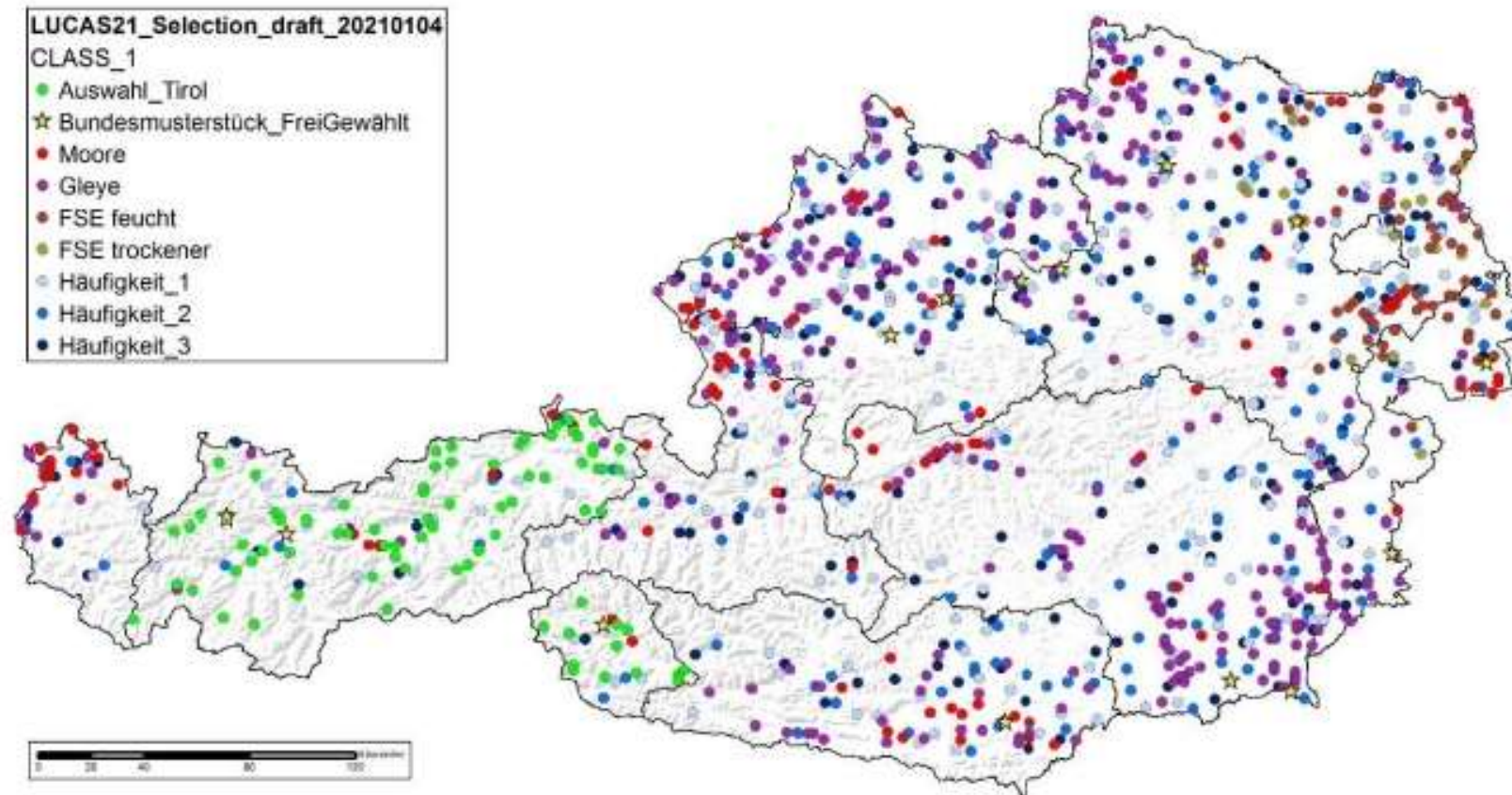
„The sample survey shall be designed from a complete sample frame containing the best available information on the soil properties distribution, including but not limited to information resulting from previous national measurements and measurements under the LUCAS programme.“

- Re-examining these soils and the trajectory of their development
- Describing them according to international standards

LUCASSA II

Land Use/Cover Area frame Survey

Austrian LUCAS-sites 2022/23

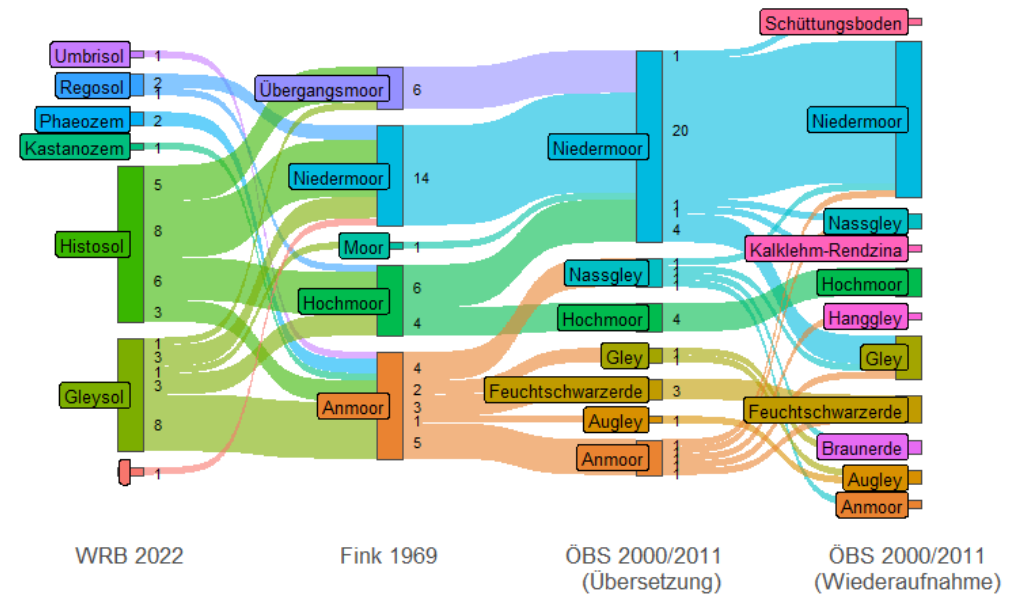


LUCASSA II

Work in progress



Soil types /Reference Soil Groups



Conclusions

- ☞ An Austrian nationwide monitoring programme is missing
- ☞ LUCAS is a **valuable data source** as it offers several parameters in a **time series** and is continuously extended
- ☞ Depending on the individual site, the **data representativeness may differ** to a large extent, especially in countries with **small structured landscapes** and land uses
- ☞ At **some sites**, the measured values may allow **statements** that **apply at least to the soil form in which the LUCAS point is located**. At sites with relatively uniform soil conditions, these can also apply to the adjacent soil types.
- ☞ **Limited representativeness for larger areas**
- ☞ The validity of time series strongly depends on the **precision of the sampling process**

Can LUCAS be part of a national monitoring system?



YES, if

- ☞ there is a sufficient documentation and **quality management** of the **sampling process** and deviations from the grid are recorded
- ☞ the **sampling sites are evaluated** with respect to their soil heterogeneity and representativeness for a certain area
- ☞ A higher **flexibility with respect to the sampling grid** is granted to improve the quality and significance of the data set