



Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra

Eidgenössisches Departement für Wirtschaft,  
Bildung und Forschung WBF

**Agroscope**

Eidgenössisches Departement für  
Umwelt, Verkehr, Energie und Kommunikation UVEK

**Bundesamt für Umwelt BAFU**



# The geochemical soil atlas of Switzerland

**Jolanda E. Reusser<sup>1</sup>, Lenny H. E. Winkel<sup>2,3</sup>, Ruben Kretzschmar<sup>2</sup>, Daniel Wächter<sup>1</sup>, Reto G. Meuli<sup>1</sup>**

<sup>1</sup>Swiss Soil Monitoring Network NABO, Agroscope, CH-8046 Zurich

<sup>2</sup>Institute of Biogeochemistry and Pollutant Dynamics, ETH Zurich, CH-8092 Zurich

<sup>3</sup>Department Water Resources and Drinking Water, Eawag, CH-8600 Dübendorf

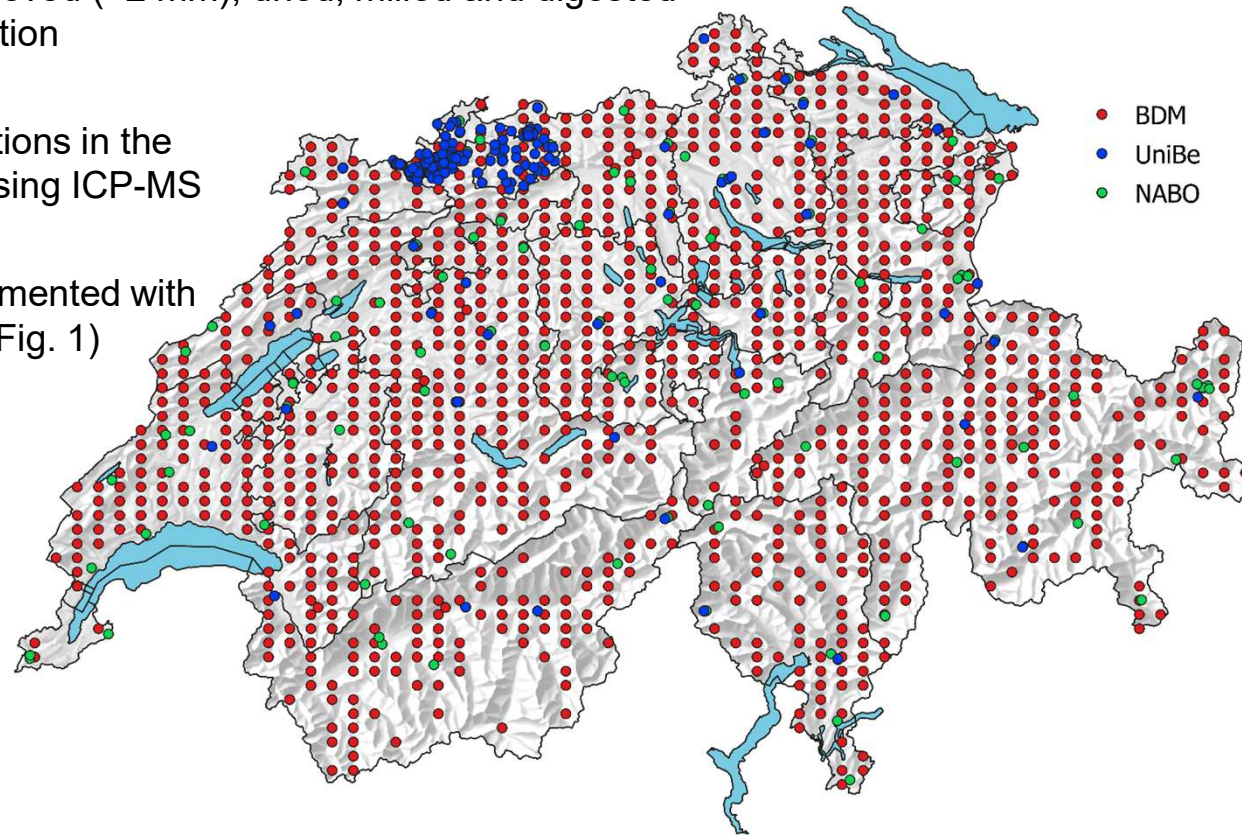
*jolanda.reusser@agroscope.admin.ch*

Assessment of the contents and spatial distribution of 22 elements in Swiss surface soils:

As, B, Ca, Cd, Co, Cr, Cu, Fe, Hg, Mg, Mn,  
Mo, Na, Ni, Pb, S, Sb, Se, Tl, U, V, Zn

# Sampling and Methods

- Between 2011 and 2015, 4'270 samples of the topsoil (0-20 cm) have been collected at 1'153 sampling sites on a regular 6 by 4 km grid within the framework of the Swiss Biodiversity Monitoring program (BDM)
- The soil samples were sieved (<2 mm), dried, milled and digested using an aqua regia solution
- Total element concentrations in the digests were analysed using ICP-MS
- The dataset was complemented with two additional datasets (Fig. 1)
- In total:  
**1'581 sampling sites**



**Fig. 1.** Sampling sites of the geochemical soil atlas. BDM: Biodiversity Monitoring, up to 4 samples per site; UniBe: additional dataset compiled by the group of Dr. Moritz Bigalke (soil sampling 1989-2017), University of Bern; NABO: sampling sites of the Swiss Soil Monitoring Network (soil sampling 2008-2017).

# Results

- The measured elemental concentrations were in range of expected soil contents (Table 1)

- Elevated contents of As, Cr and Ni were detected in more than 25% of soil samples (mostly located in northwestern parts of Switzerland)

Soil value I according to Eikmann & Kloke (1993)\* indicating actual value of natural soil without appreciable anthropological input:

As: 20 mg/kg, Cr: 50 mg/kg, Ni: 40 mg/kg

- In contrast, concentrations of the essential element Se were low, with 75% of the sampling sites being  $\leq 0.5$  mg Se/kg soil

**Table 1.** Elemental concentrations (mg/kg soil) analysed in aqua regia digests of dried, sieved (<2mm) and milled soil samples using ICP-MS. The results include all three datasets. For both the BDM and the NABO dataset, the medians of the sampling points per site have been used for the data analysis.

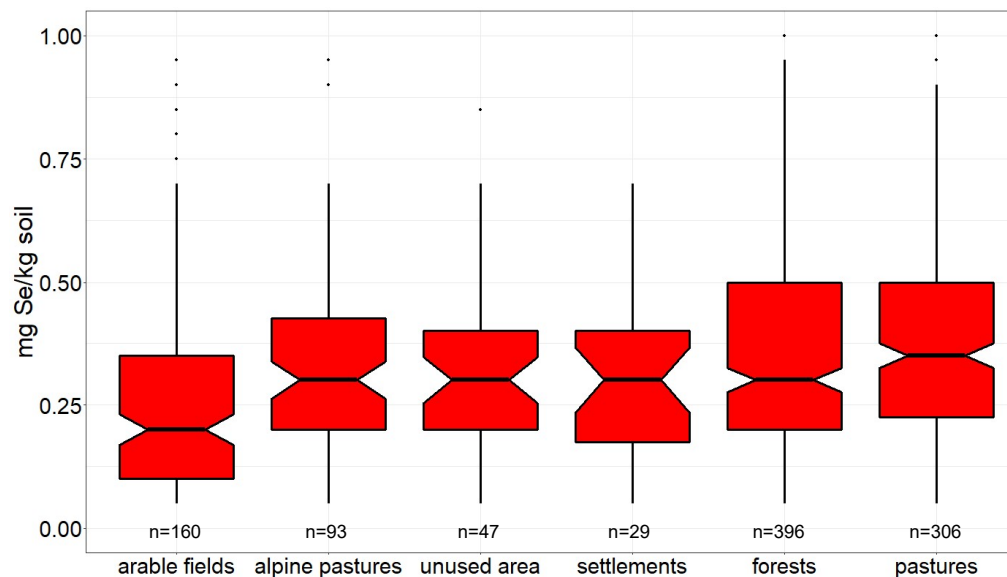
\*Eikmann T., Kloke A., Eikmann S. (1993) Environmental Medical and Toxicological Assessment of Soil Contamination. In: Arendt F., Annokkée G.J., Bosman R., Van Den Brink W.J. (eds) Contaminated Soil'93. Soil & Environment, vol 2. Springer, Dordrecht. [https://doi.org/10.1007/978-94-011-2018-0\\_49](https://doi.org/10.1007/978-94-011-2018-0_49)

mg/kg soil	5%	25%	Median	Mean	75%	95%	CV%
<b>As</b>	3	6	<b>9</b>	29	21	94	326
<b>B</b>	1	3	<b>5</b>	11	10	47	147
<b>Ca</b>	800	2500	<b>5300</b>	24202	26288	110855	164
<b>Cd</b>	0.08	0.17	<b>0.27</b>	0.37	0.44	1.01	99
<b>Co</b>	3	7	<b>9</b>	10	12	17	74
<b>Cr</b>	11	25	<b>35</b>	49	54	100	177
<b>Cu</b>	6	13	<b>20</b>	22	28	43	86
<b>Fe</b>	12453	18300	<b>23000</b>	24254	29000	39000	40
<b>Hg</b>	0.03	0.05	<b>0.06</b>	0.09	0.10	0.18	179
<b>Mg</b>	1700	3300	<b>4400</b>	7392	6600	25963	162
<b>Mn</b>	174	458	<b>700</b>	725	904	1388	55
<b>Mo</b>	0.41	0.50	<b>0.74</b>	1.00	1.10	2.28	102
<b>Na</b>	40	65	<b>90</b>	140	150	400	108
<b>Ni</b>	7	22	<b>30</b>	37	40	63	205
<b>Pb</b>	14	20	<b>26</b>	30	33	53	94
<b>S</b>	100	200	<b>350</b>	408	500	815	71
<b>Sb</b>	0.19	0.31	<b>0.41</b>	0.48	0.50	0.89	98
<b>Se</b>	0.05	0.20	<b>0.35</b>	0.43	0.51	1.10	87
<b>Tl</b>	0.08	0.12	<b>0.17</b>	2.49	0.32	1.43	1431
<b>U</b>	0.30	0.55	<b>0.80</b>	1.01	1.20	2.10	102
<b>V</b>	13	25	<b>37</b>	47	60	110	72
<b>Zn</b>	30	52	<b>70</b>	75	90	134	52

# Results

- Soil Se contents are lowest in arable fields compared to other land use types (Fig. 2)
- On a spatial scale, these potentially Se deficient soils are located in areas most important for agricultural food and fodder production (data not shown)

**Fig. 2.** Concentrations of Se (mg Se/kg soil) measured in aqua regia digests of the BDM soil samples using ICP-MS. The median of the four sampling points per site has been used for the data analysis. The main land use types were assessed in the framework of the Swiss Biodiversity Monitoring program (BDM). The y-axis has been cut at 1.00 mg Se/kg soil for better visibility.



## Outlook

- Multivariate data analysis including additional geodata such as pH, SOC, lithology, etc.
- Mapping the spatial distribution of the elemental concentrations