GEMAS
Geochemical Mapping of Agricultural and Grazing Land Soils in Europe

GEMAS: Geochemical mapping of agricultural and grazing land soil at the continental scale

Clemens Reimann
and the GEMAS Project Team

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The Geological Surveys of Europe

GEMAS – The Project Team

Geochemical **M**apping of **A**gricultural **S**oil **(GEMAS)**

2007*: *Eurometaux contacts EuroGeoSurveys:

Land-use relatet geochemical data needed at the European scale for REACH *(**R**egistration, **E**valuation, **A**uthorisation and restriction of **CH**emical substances)*

grazing land soil, 0-10 cm

2 sample materials at 1 site/2500 km²

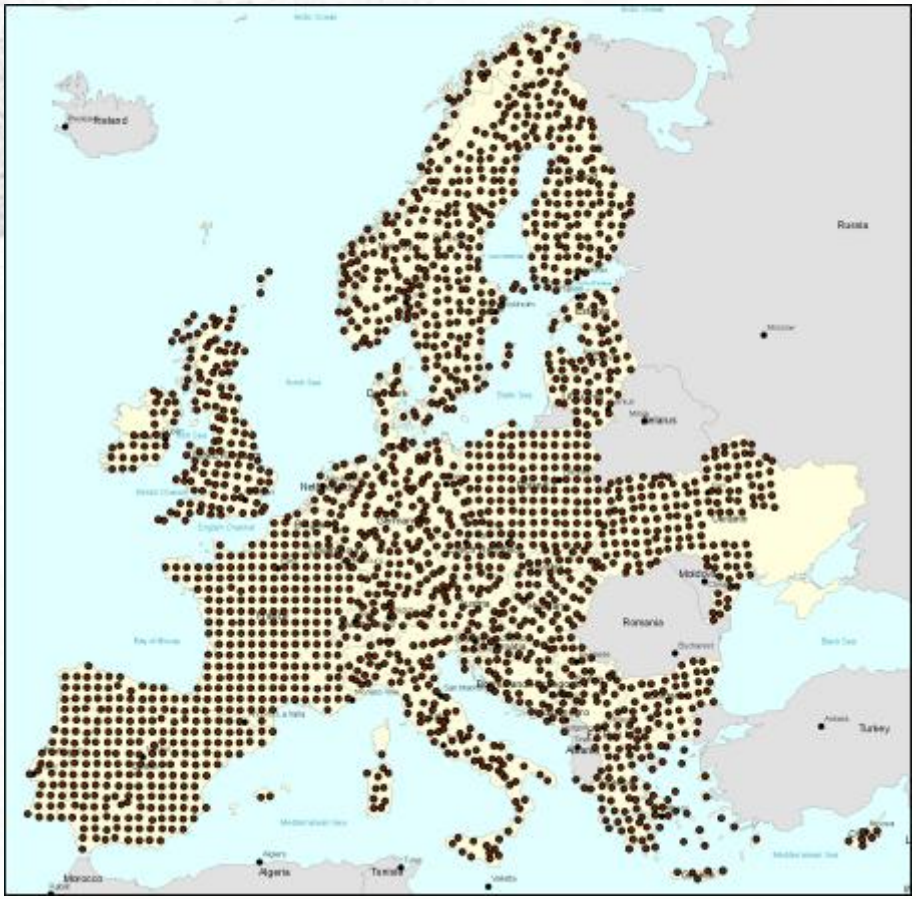
<2 mm fraction

aqua regia extraction

agricultural soil (A_p-horizon), 0-20 cm

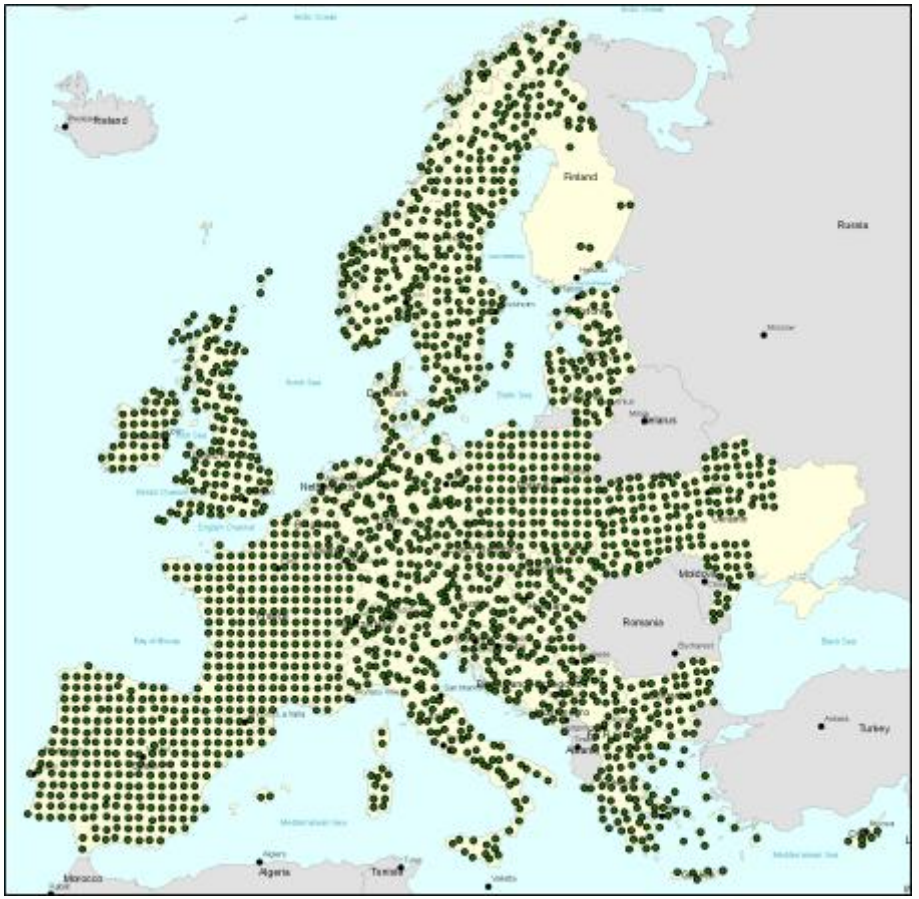
GEMAS - 2008

Agricultural soils (A_p)
0-20 cm



N= 2108

Grazing land soils (Gr)
0-10 cm

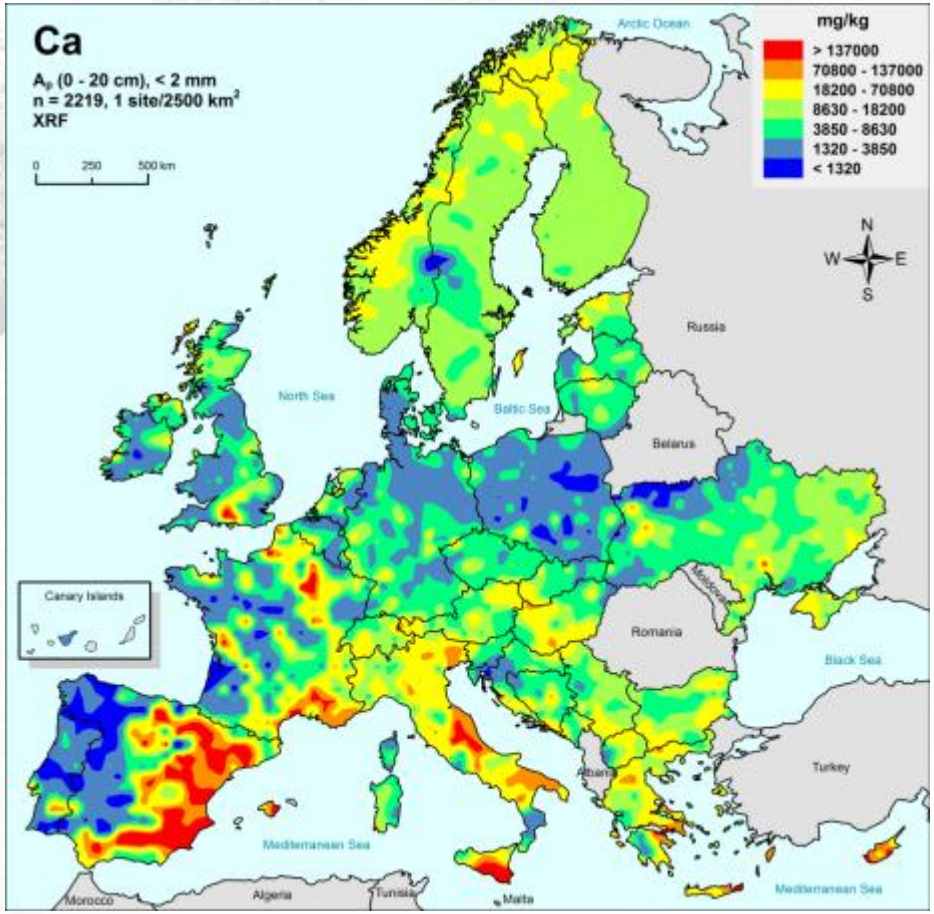


N= 2024

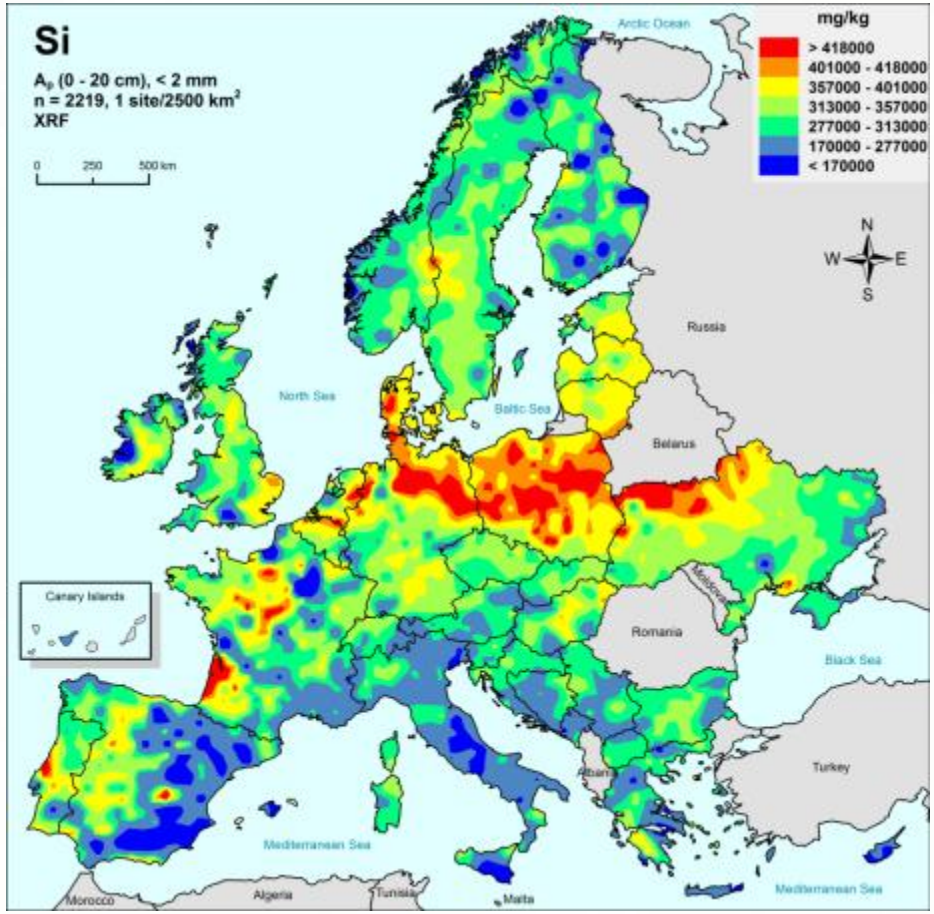
33 countries - 5.6 million km² - 4132 samples in total

GEMAS – total concentration, major elements

(A_p) 0-20 cm



(A_p) 0-20 cm

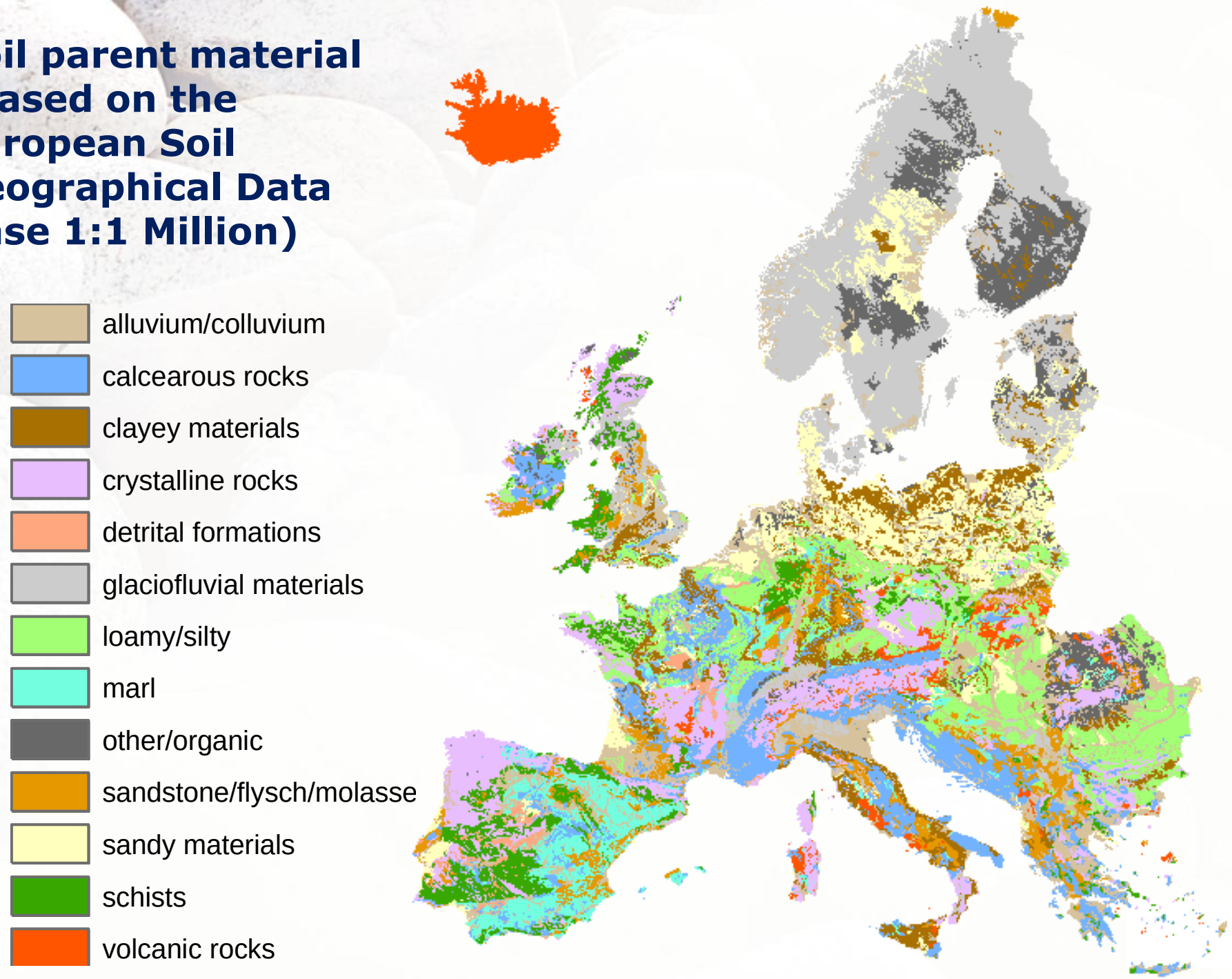


Calcium, XRF: limestones, note Fennoscandia

Silicon, XRF: sandstones, coarse grained, sandy soils

Geology is the driving force behind most of the patterns

Soil parent material (based on the European Soil Geographical Data Base 1:1 Million)



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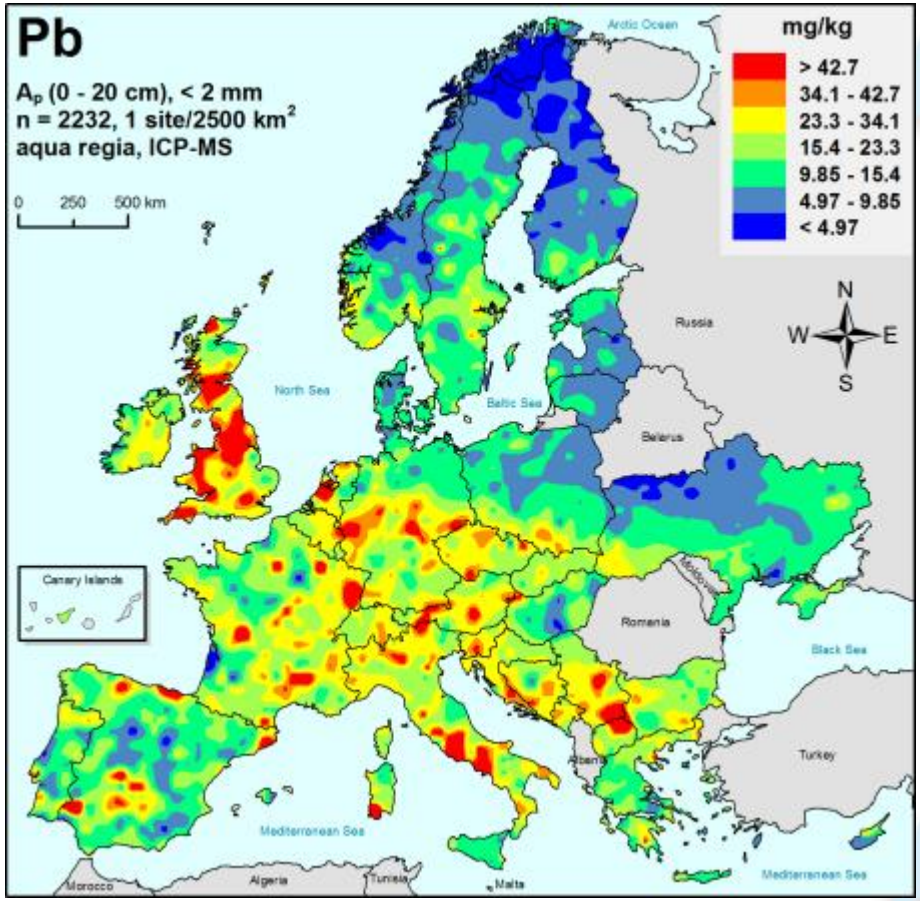
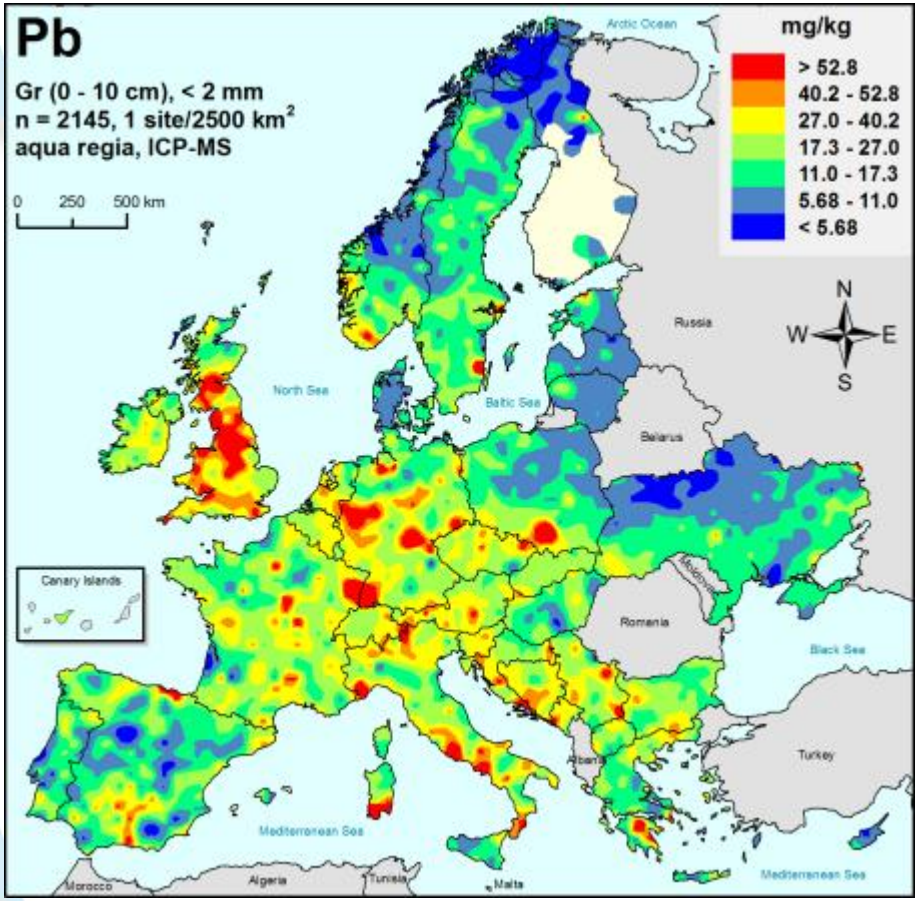
Agricultural soils (A_p) 0-20 cm



Grazing land soils (Gr) 0-10 cm



Lead: Two independent sample materials show comparable patterns. Large difference between N- and S-Europe

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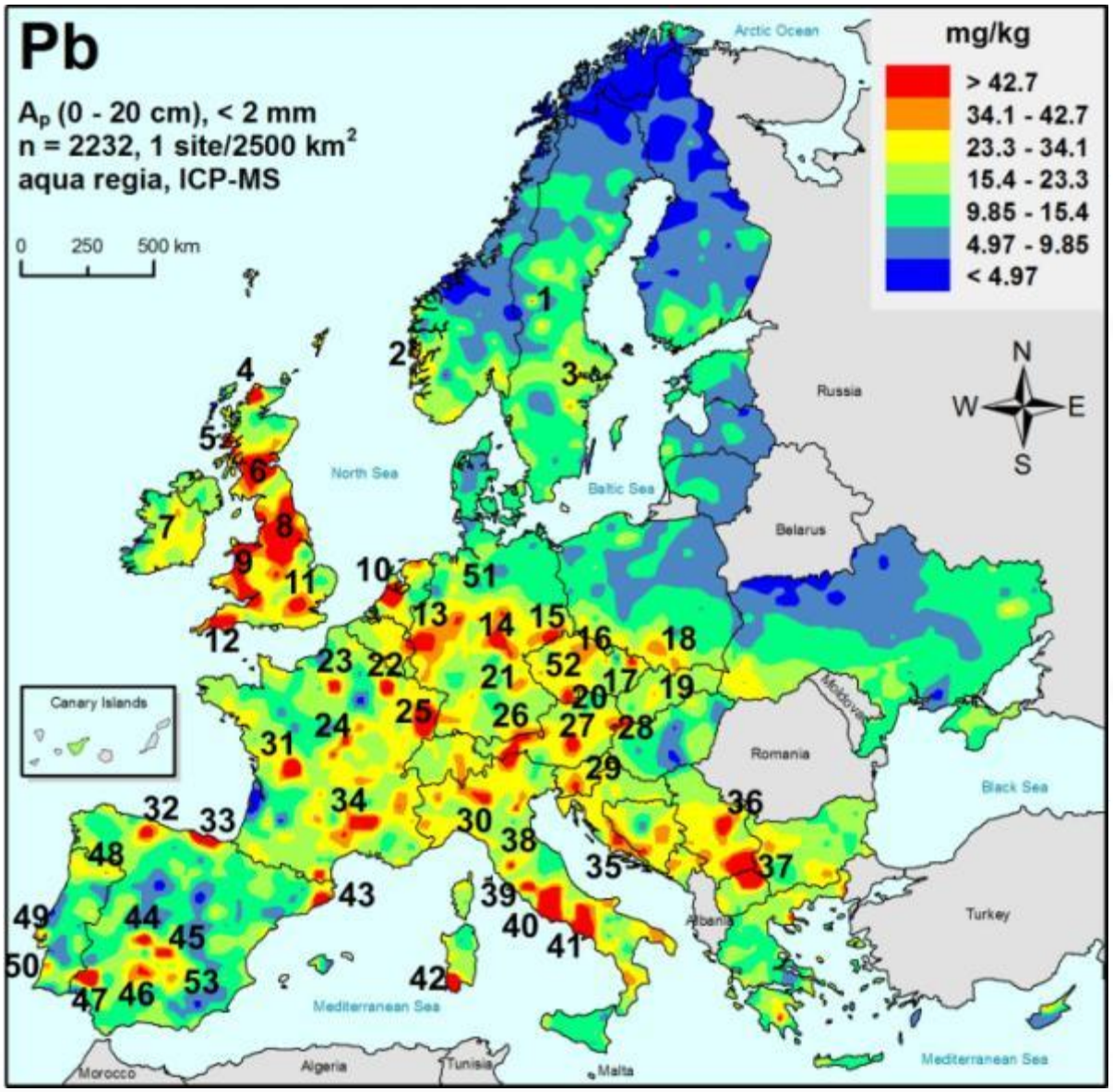
Agricultural soils (A_p) 0-20 cm



Ore deposits: 1, 3, 7, 8, 9, 12, 13, 14, 15, 16, 18, 19, 21, 24, 25, 26, 27, 20, 31, 33, 34, 35, 36, 37, 38, 39, 42, 44, 47, 53

Geology: 5, 20, 28, 29, 40, 41, 43, 46, 48

Cities: 2, 10, 11, 23, 49

Contamination: 6, 17, 32, 50, 51, 52

Unexplained: 4, 22, 45

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(A_p) 0-20 cm

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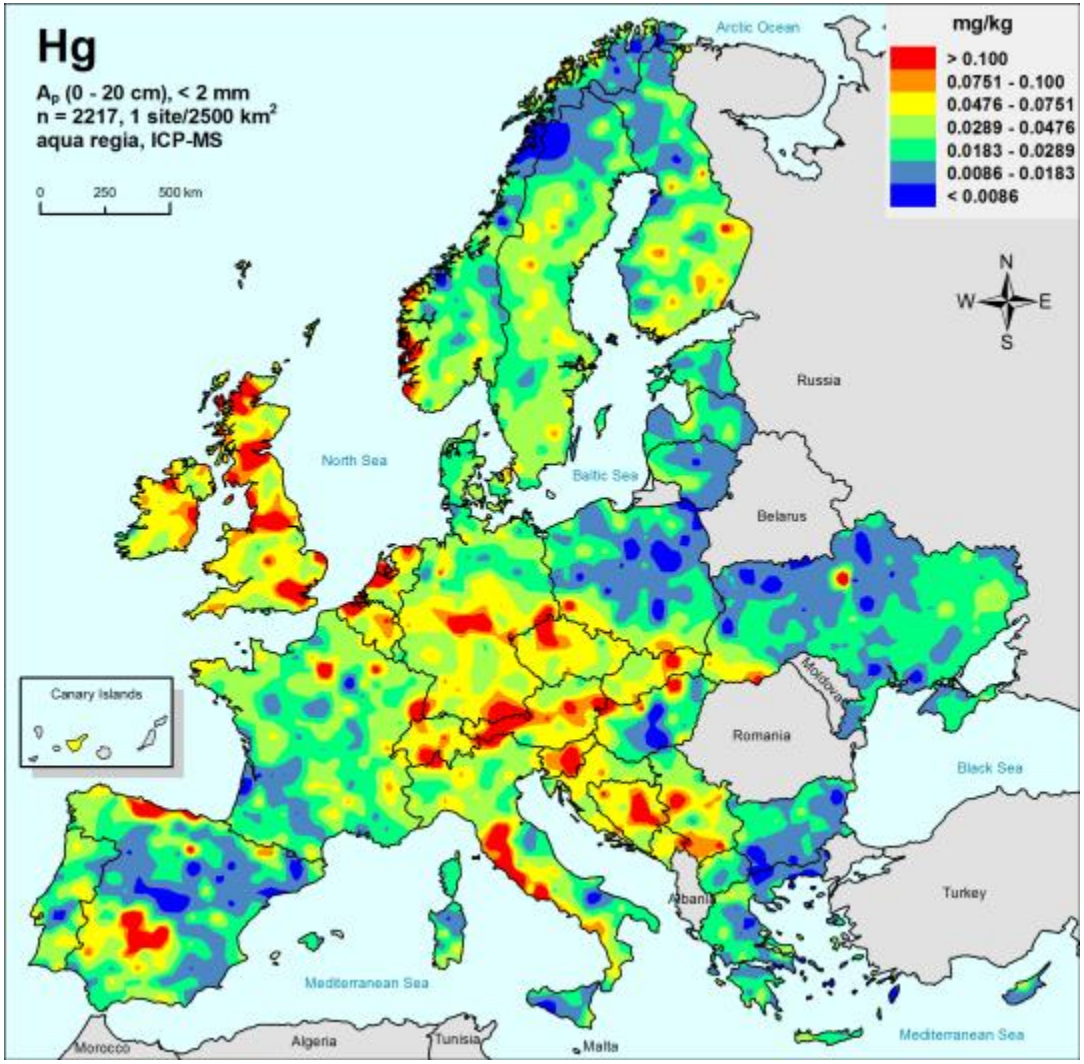
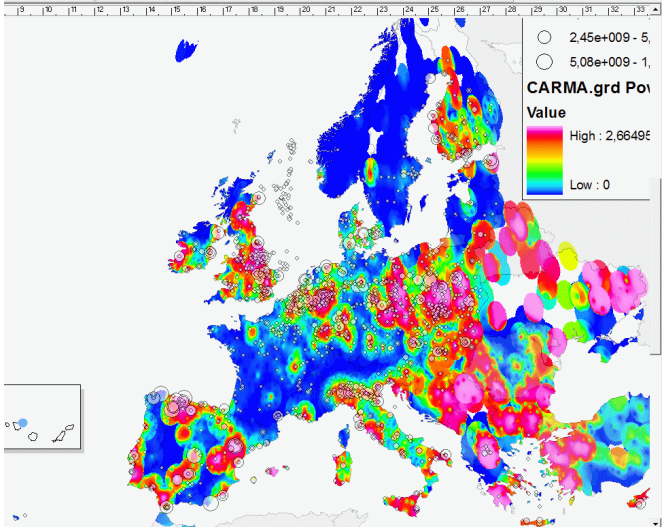
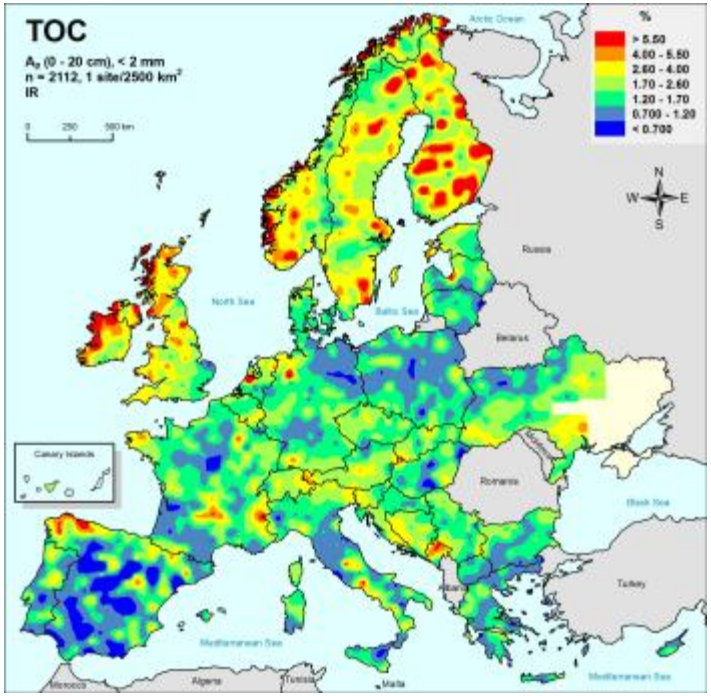


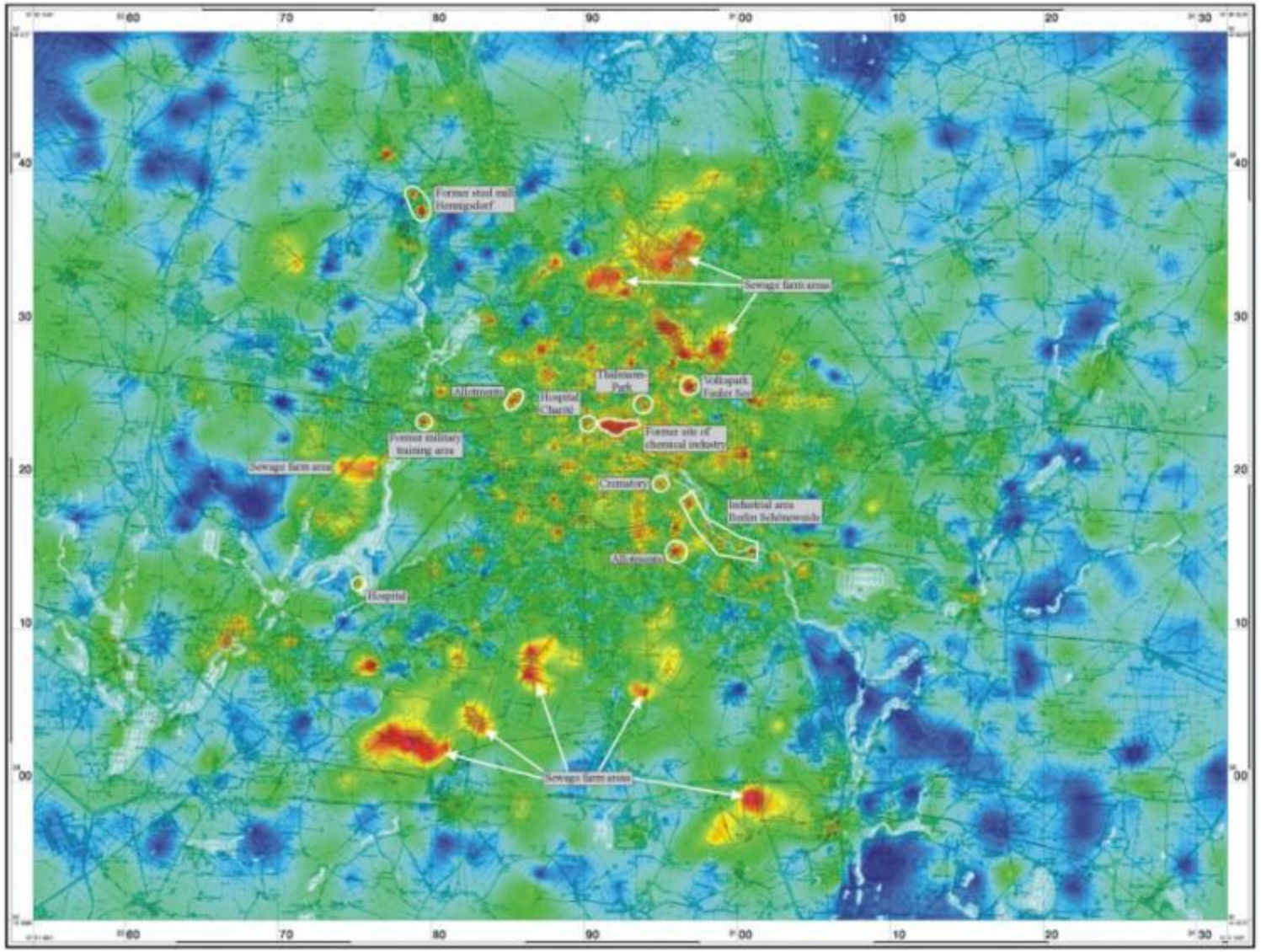




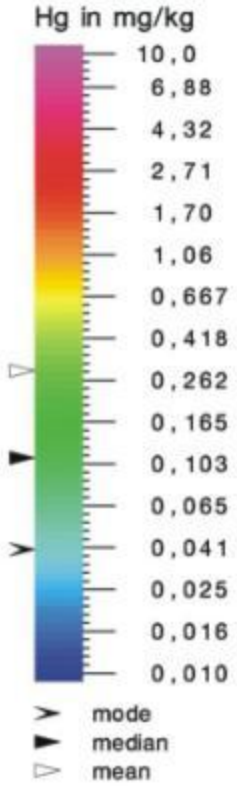
Mercury: natural sources (ore deposits, volcanoes), some cities, border of last glaciation – with regards to metals:

EUROPE´S SOIL IS SURPRISINGLY CLEAN!

GEMAS: local vs. continental scale



78 x 58 km, 3736 samples, ca. 4500 km²

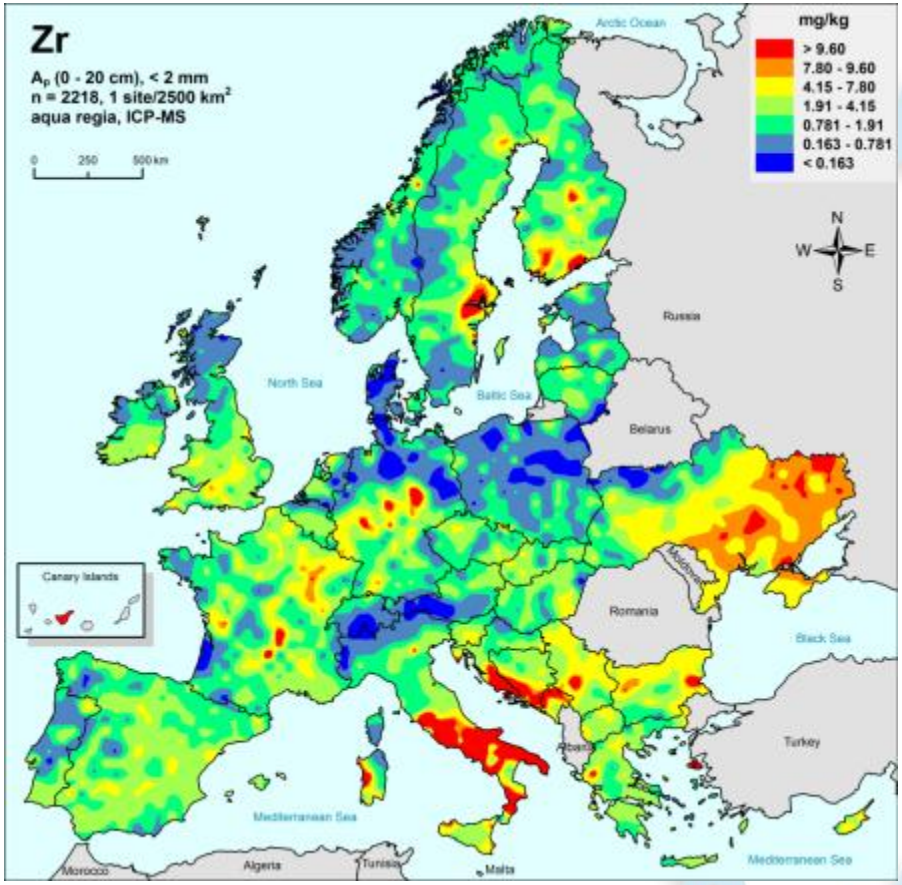


(Birke, M. & Rauch, U., 1997)

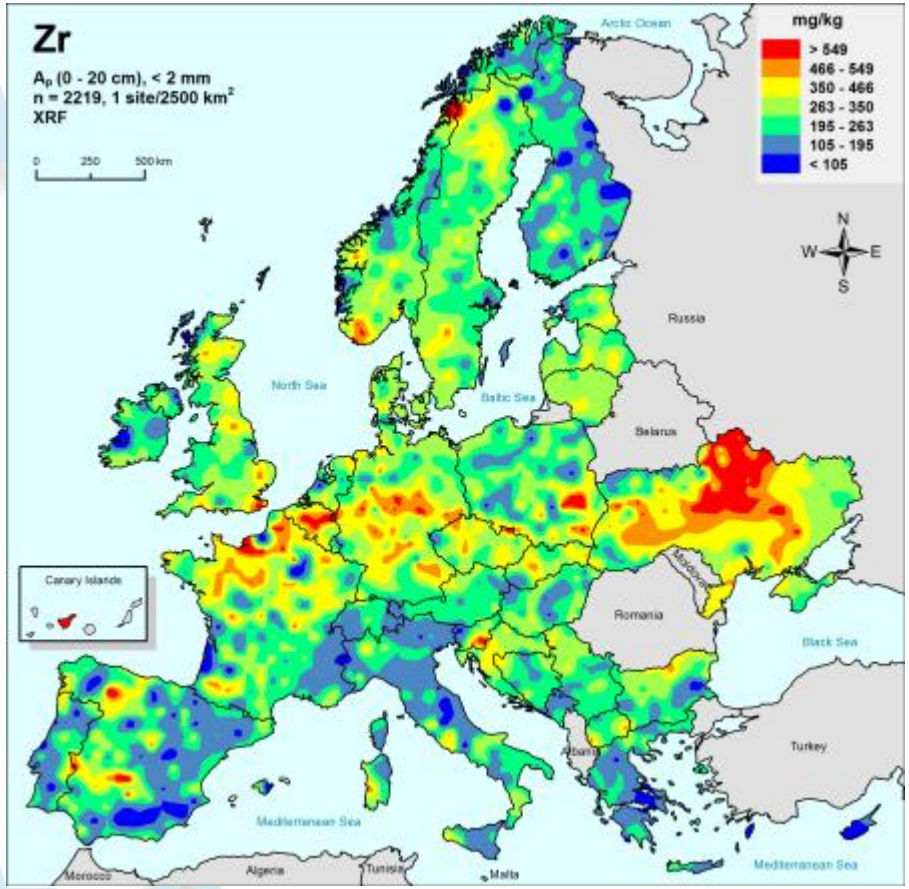
Mercury in topsoil 0-10 cm, Berlin, Germany

GEMAS 2010-2013

A_p 0-20 cm



A_p 0-20 cm



Zr, aqua regia: note the Italian alkaline volcanics

Zr, XRF: the central European loess belt is visible

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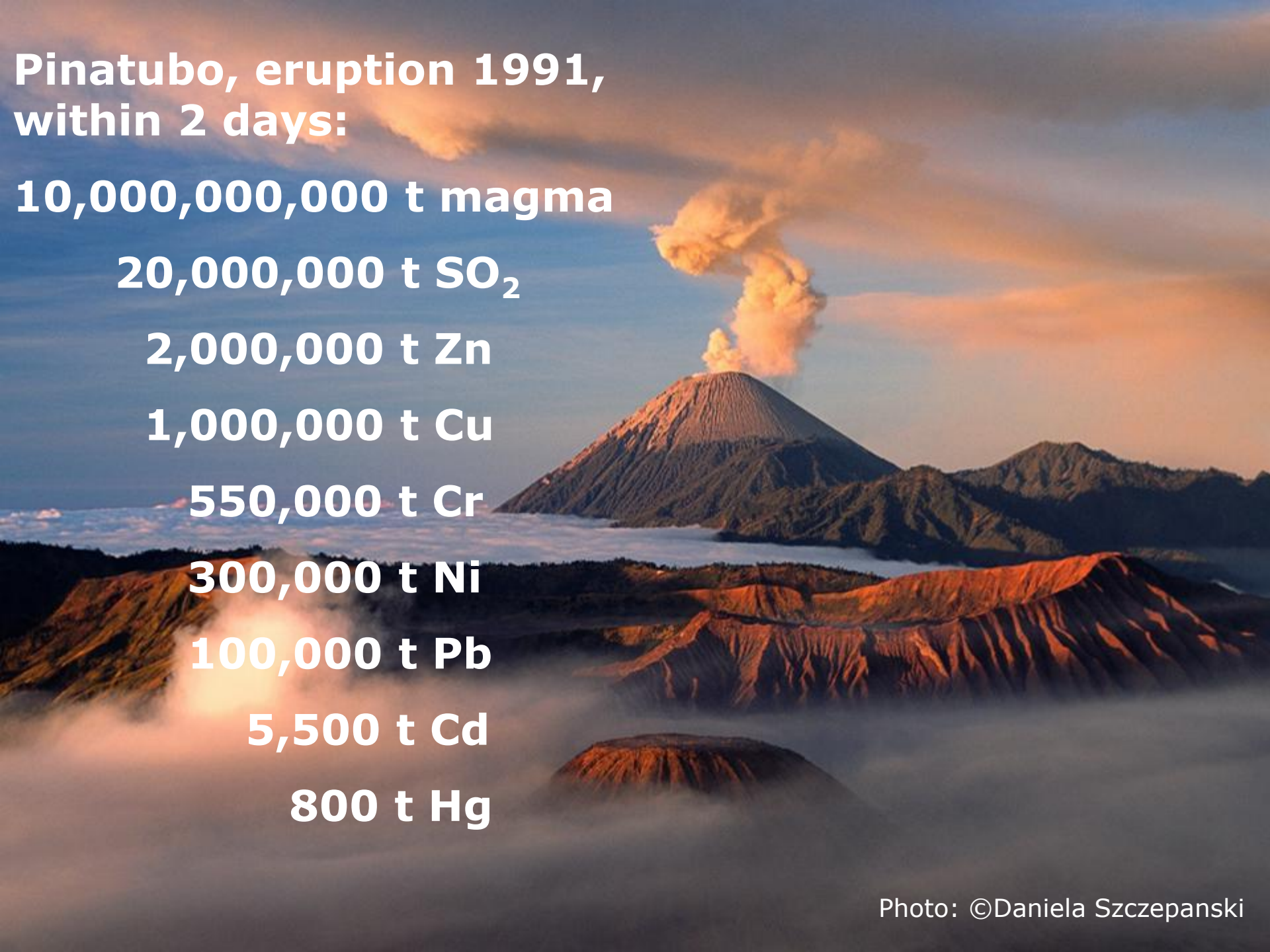
Pinatubo, eruption 1991,
within 2 days:
10,000,000,000 t magma
20,000,000 t SO_2
2,000,000 t Zn
1,000,000 t Cu
550,000 t Cr
300,000 t Ni
100,000 t Pb
5,500 t Cd
800 t Hg
Photo: ©Daniela Szczepanski

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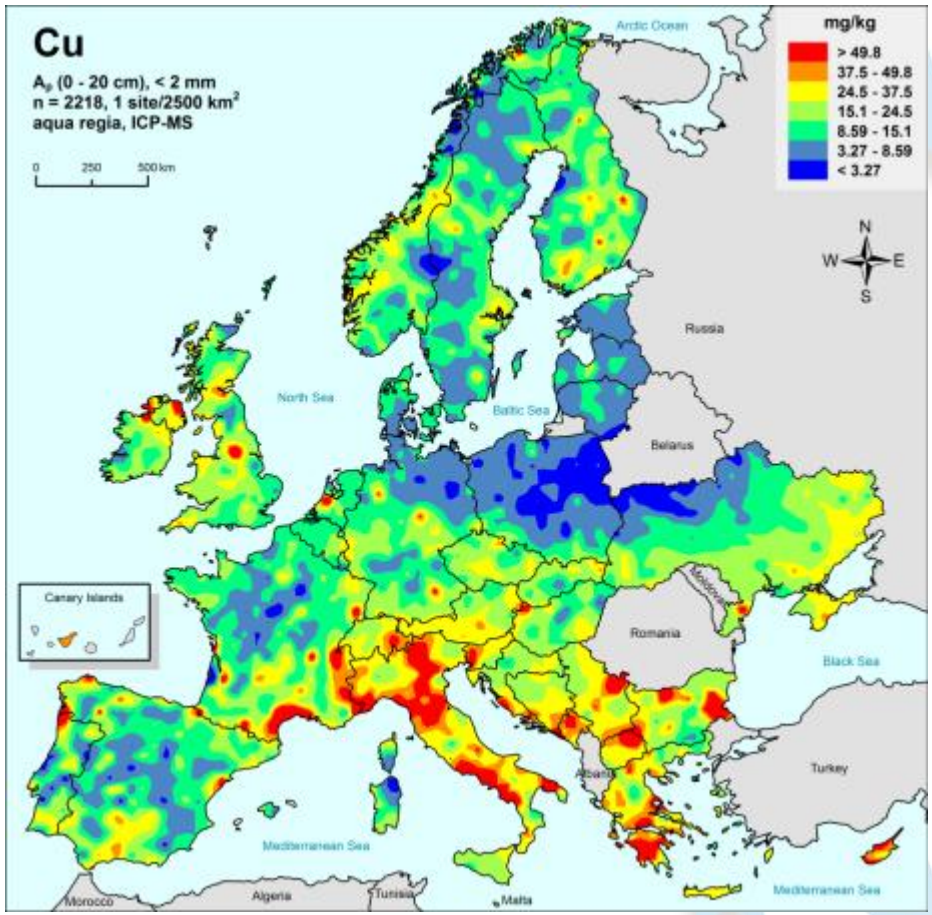
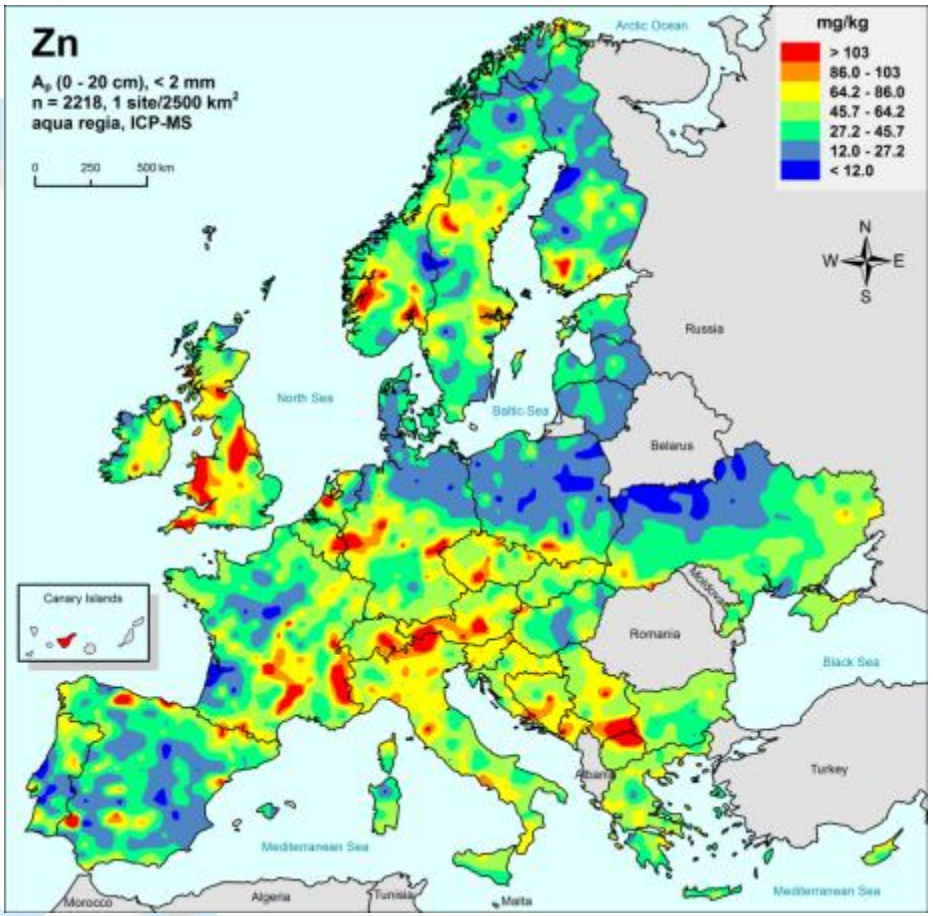
(A_p) 0-20 cm



(A_p) 0-20 cm



Copper, aqua regia: >10% of all values <10 mg/kg

Zinc, aqua regia: 5% of all values <12 mg/kg

Element deficiency needs attention

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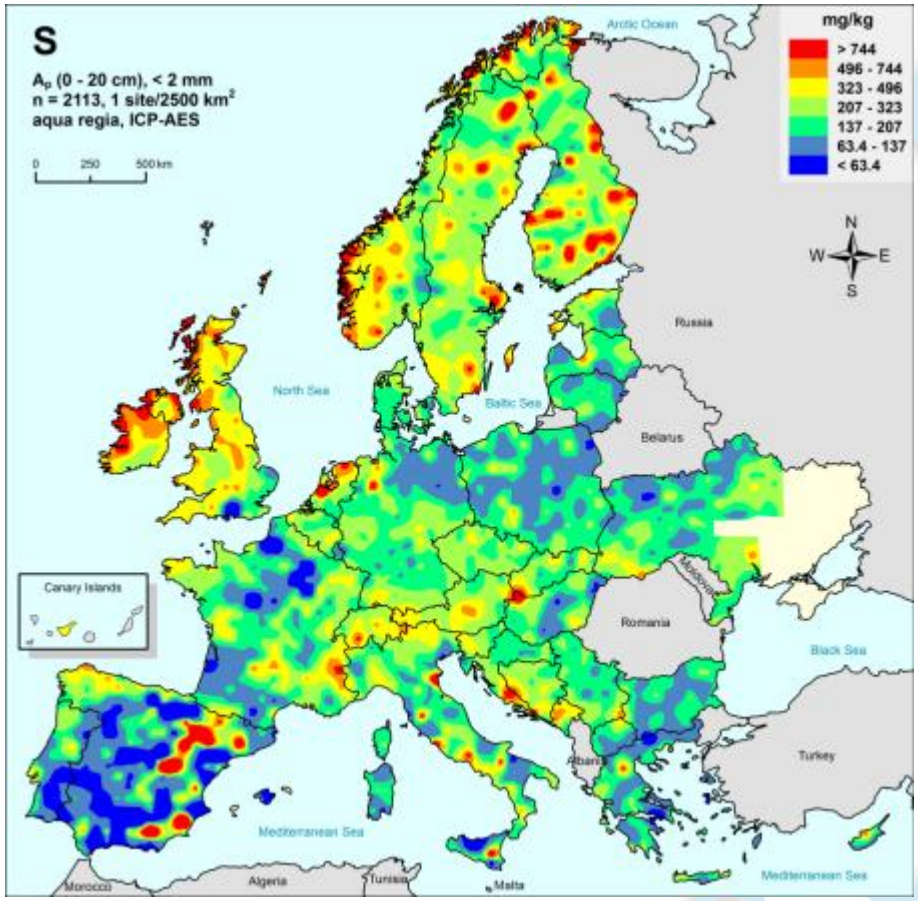
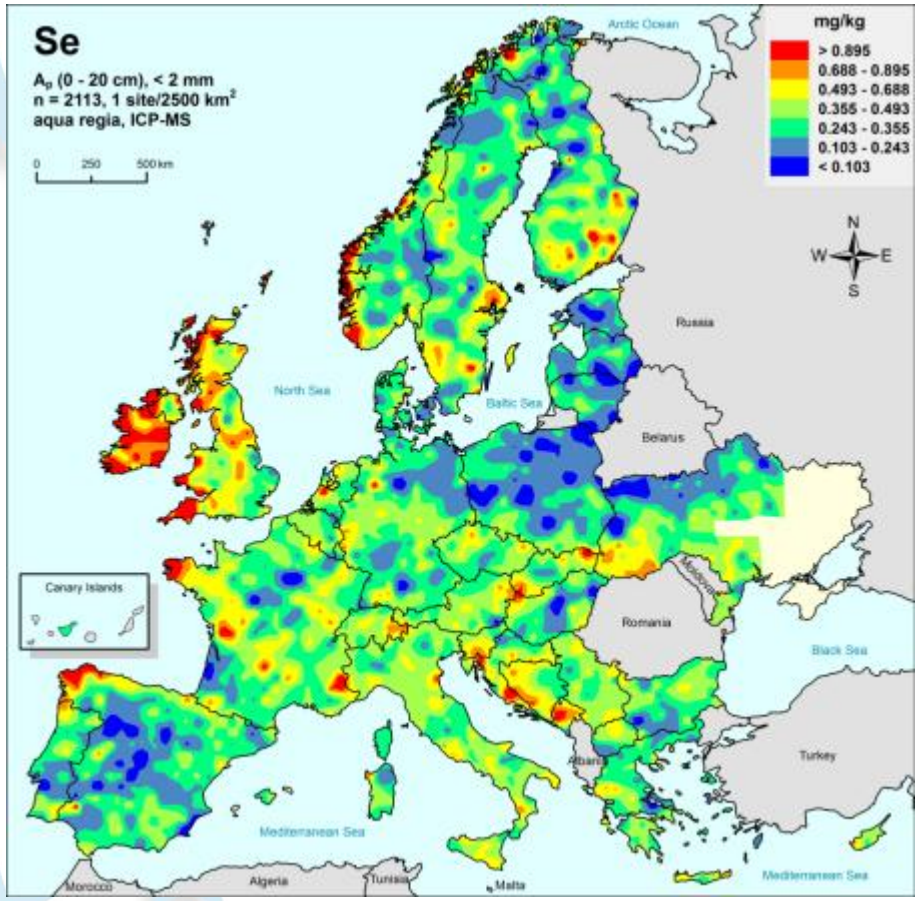
(A_p) 0-20 cm



(A_p) 0-20 cm



Sulphur, aqua regia: coast and organic material in soil

Selenium, aqua regia: strong coastal effect

Climate has an important impact on the observed patterns!

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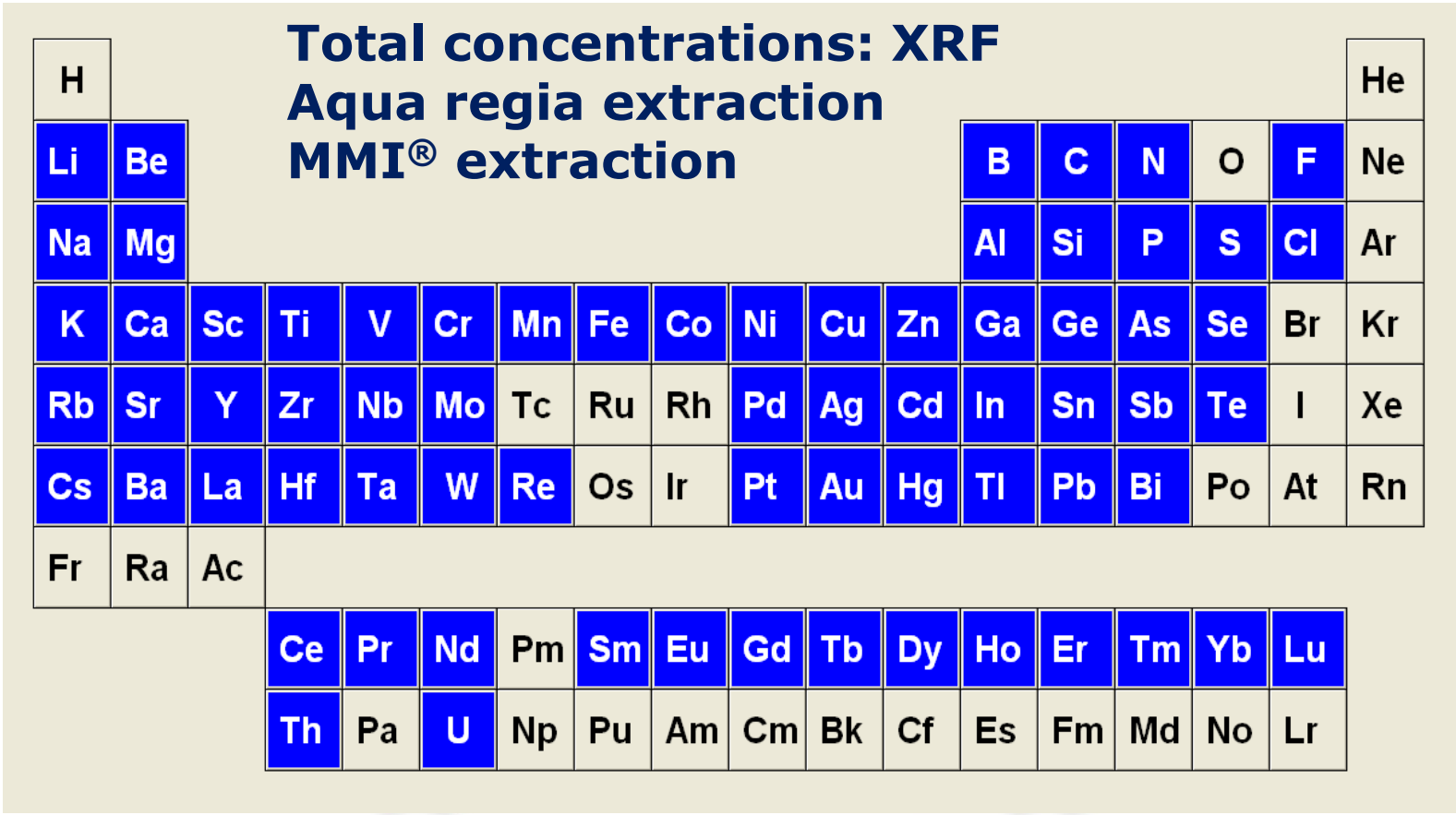
GEMAS – Analytical Program



+ pH_$CaCl_2$, CEC, TOC, LOI, grain size
Pb isotopes, 7N HNO_3 extraction, Ap samples
Sr isotopes, in progress
Magnetic susceptibility, Ap samples
Kd-values, 14 metals
MIR spectra

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- Evidence for diffuse industrial contamination?
- Evidence of other anthropogenic impacts?
- What levels of potentially harmful elements?
- Element deficiencies?
- Differences between the European countries?
- Geology and/or Climate reflected?
- Is European agricultural soil of good chemical quality?

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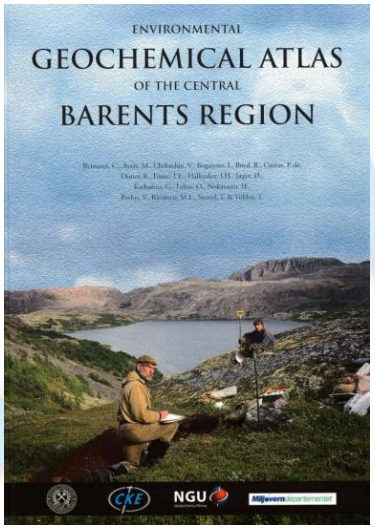
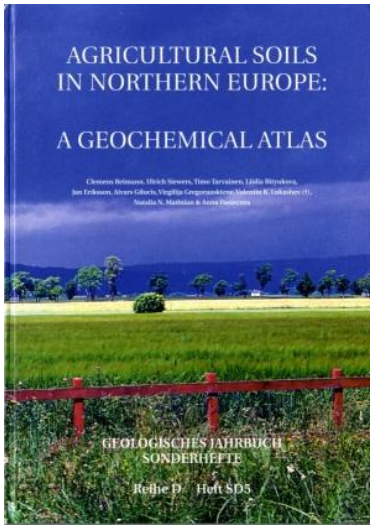
GEMAS history – 1950ies to 2013

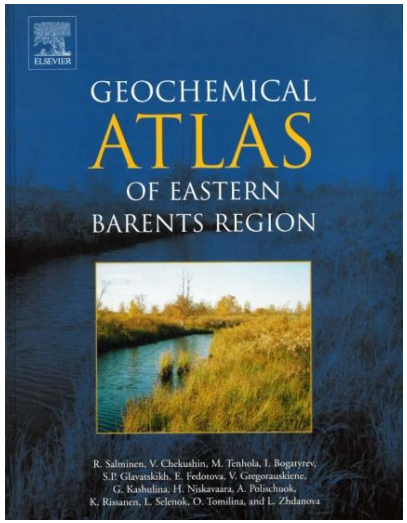
1992



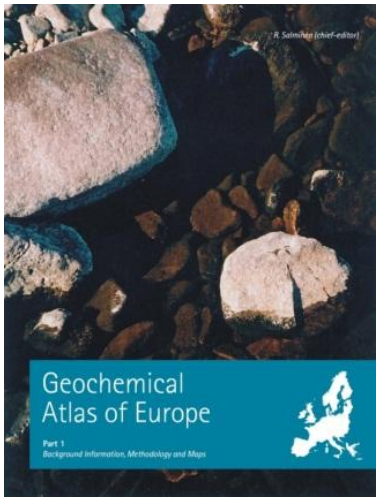
1998



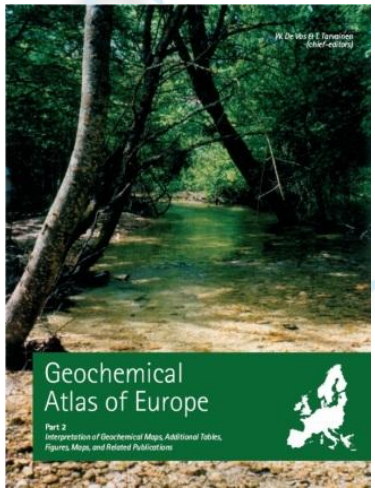
2003



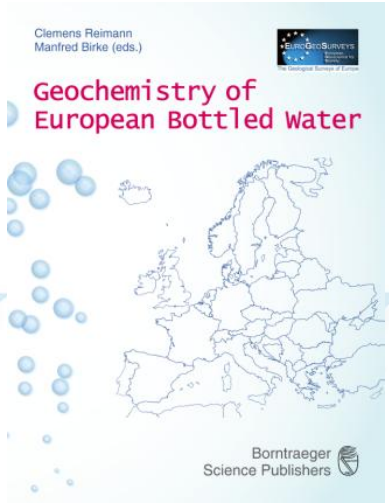
2004



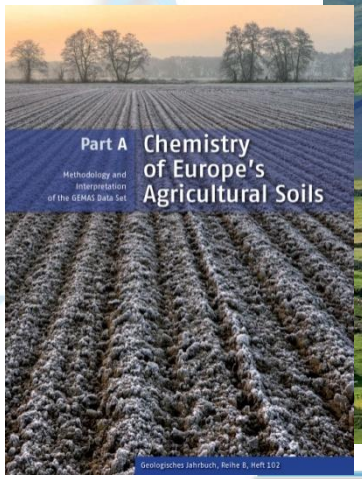
2005

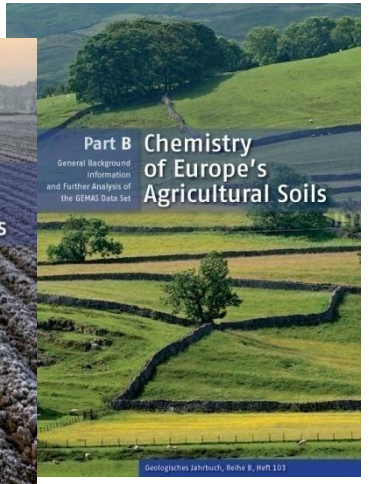


2006



2010





Dec.2013

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For more details join us at the EuroGeoSurveys GEMAS workshop this afternoon

Thank you for your attention!

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