Report of the Programme Co-ordinating Centre

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Outline

1. Key Deliverables
   - Meetings
   - Publications

2. Realization of the 2020 to 2021 workplan

3. Proposed activities for the 2022 to 2023 workplan

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ICP Forests Reporting

Key Deliverables

Task Force Meeting and Scientific Conference

- **FORECOMON 2021** – The 9th Forest Ecosystem Monitoring Conference WSL, Birmensdorf, Switzerland, 7-9 June 2021, hybrid meeting

  - Detailed information to the conference can be found under: https://forecomon2021.thuenen.de/conference/

- **37th Task Force Meeting**, WSL, Birmensdorf, Switzerland, 10-11 June 2021, hybrid meeting
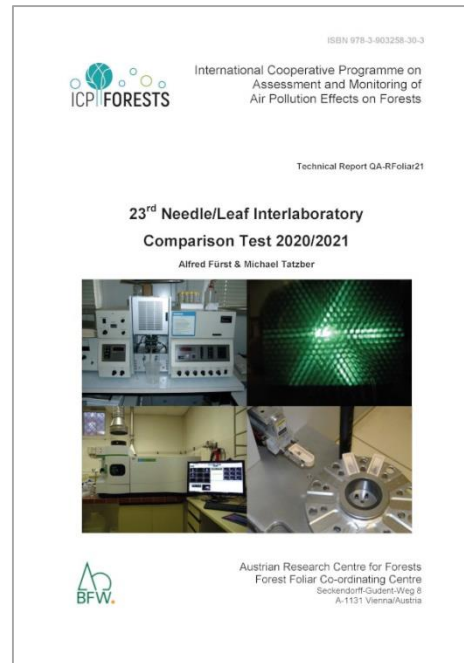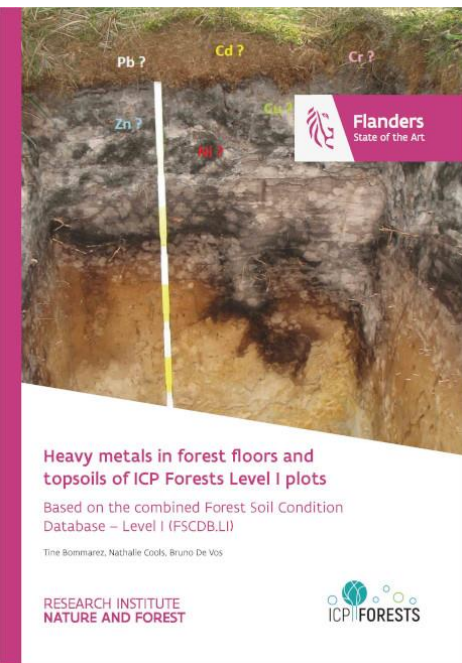
http://icp-forests.net/events

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Latest ICP Forests reports and brochures

All publications are available on the ICP Forests website:

http://icp-forests.net/

ICP Forests Technical Report 2021

- Results from 32 of the 42 participating countries
- List of 81 scientific publications in 2020 for which data and/or the ICP Forests infrastructure were used
- Overview by the chairs of the Expert panel of most significant literature/findings in their respective field
- National reports
- Regular chapters on
  - Atmospheric throughfall deposition in European forests in 2019
  - Tree crown condition in 2020
  - Heavy metals in forest floor and topsoil of ICP Forests Level II plots

Forest Condition in Europe
The 2021 Assessment

ICP Forests Technical Report under the UNECE Convention on Long-range Transboundary Air Pollution (Air Convention)

ICP Forests Briefs

Aims

- **to raise awareness** for forest-related environmental topics

- **to inform stakeholders and enablers** on key findings of the ICP Forests monitoring programme

- **to stimulate the debate** on the effects of air pollution on forest ecosystem functions and services

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ICP Forests Brief No. 5 (in print)

- Long-term tree defoliation trends
  (Nenad Potočić, Volkmar Timmermann, Mladen Ognjenović,
  Till Kirchner, Anne-Katrin Prescher, Kai Schwärzel, Marco Ferretti)

ICP Forests Brief No. 6 (in preparation)

- Status and trends of Heavy Metals in European Forests

  (Bruno de Vos, Nathalie Cools and others)

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ICP Forests
Reporting

Contributions to
the WGE

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2020-2021 Workplan for the implementation of the Convention

Activity description/objective	Expected outcome/deliverables	Status
Ozone flux-response relation-ships by means of DO3SE model and ICP F ozone data and response parameters	Ozone effect on radial tree growth across Europe (2021)	done paper in preparation
N deposition and its effects on forest vegetation	Reports about status and trends of N levels in European forests (2020, 2021)	ongoing
Status and trends of **heavy metals** in forest ecosystems	Seasonal impact of vegetation on atmospheric elemental mercury dry deposition	ongoing **so far two papers published, more to come**
	Maps of heavy metal concentrations across Europe for two different survey periods (2020)	done report published

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Heavy metals in forest floors and topsoils of ICP Forests Level I plots
(funded by the PCC of ICP Forests)
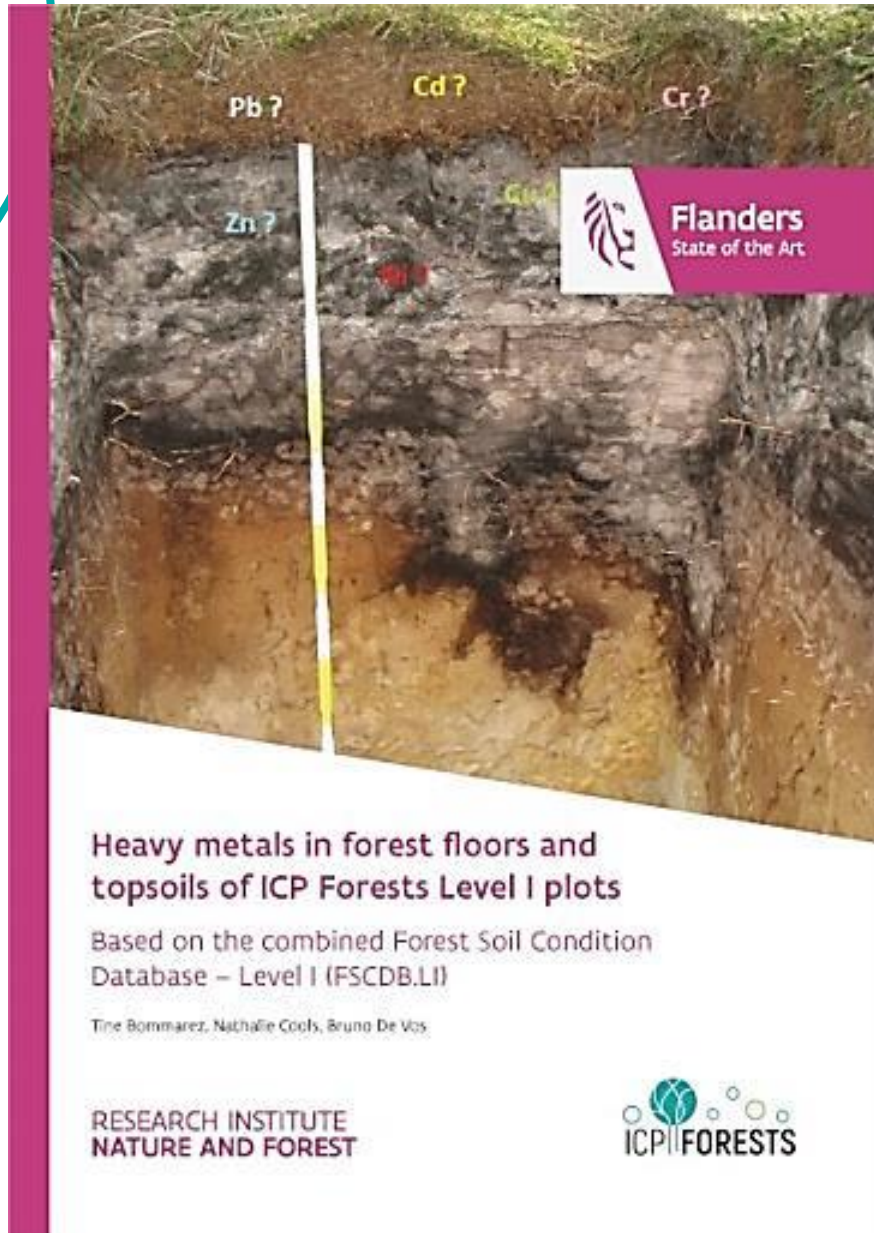
can be downloaded from:

http://icp-forests.net/

Aims of the study

1. Generating maps of **concentration levels of HM** in **forest floors and topsoils** across Europe for the
   - 1st survey period (1985-1999)
   - 2nd survey period (2000-2015)

2. Estimation the **difference in concentration levels** between these surveys

3. Estimation/ documentation of **background concentrations** for all level I plots

4. Development of an **evaluation scheme** at the EU level based on ecotoxicological risk assessment by testing existing national evaluation schemes

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Analysis of heavy metals in soils by ICP Forests

1st survey period (1985-1999):

Measurement of HM concentrations was optional and not mandatory.

- Focus on Cr, Ni, Zn, Cu, Pb and Cd, soil sampling was only mandatory in the organic layer and the upper 10 cm of the mineral soils, bulk density was advised to determine but not mandatory.

2nd survey period (2000-2015):

Measurement became obligatory for some heavy metals; more heavy metals were examined than before.

- Focus not only on organic layer and topsoil but also on subsoil; determination of bulk density and volumetric coarse fragment content became mandatory
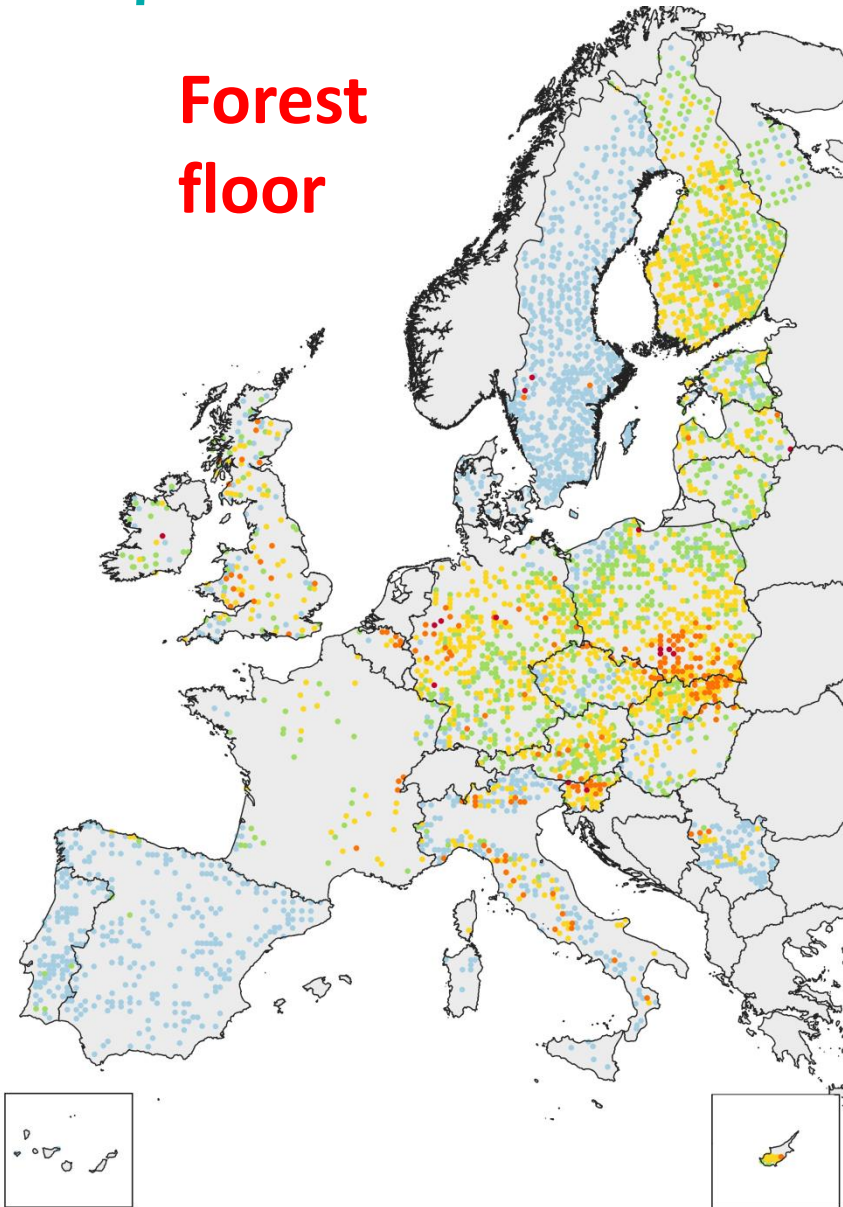
Heavy metal monitoring by ICP Forests
Mandatory (M) and optional (O) heavy metal analyses in ICP Forests' surveys

Survey	Plots	Cd	Zn	Ni	Cr	Cu	Pb	Hg	Co	Mo
Soil	LI & LII	M	M	O	O	M	M	O		
Soil Solution	LII	O	O	O	O	O	O			
Foliage	LII	O	O			O	O			
Litterfall	LII	O	O			O	O			
Deposition	LII	O	O	O		O	O	O	O	O

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Cadmium concentration [mg/kg] – 2nd survey

Forest floor

Mineral topsoil

Cd [mg/kg]

- < 0.2
- 0.2 - 0.4
- 0.4 - 1
- 1 - 3.5
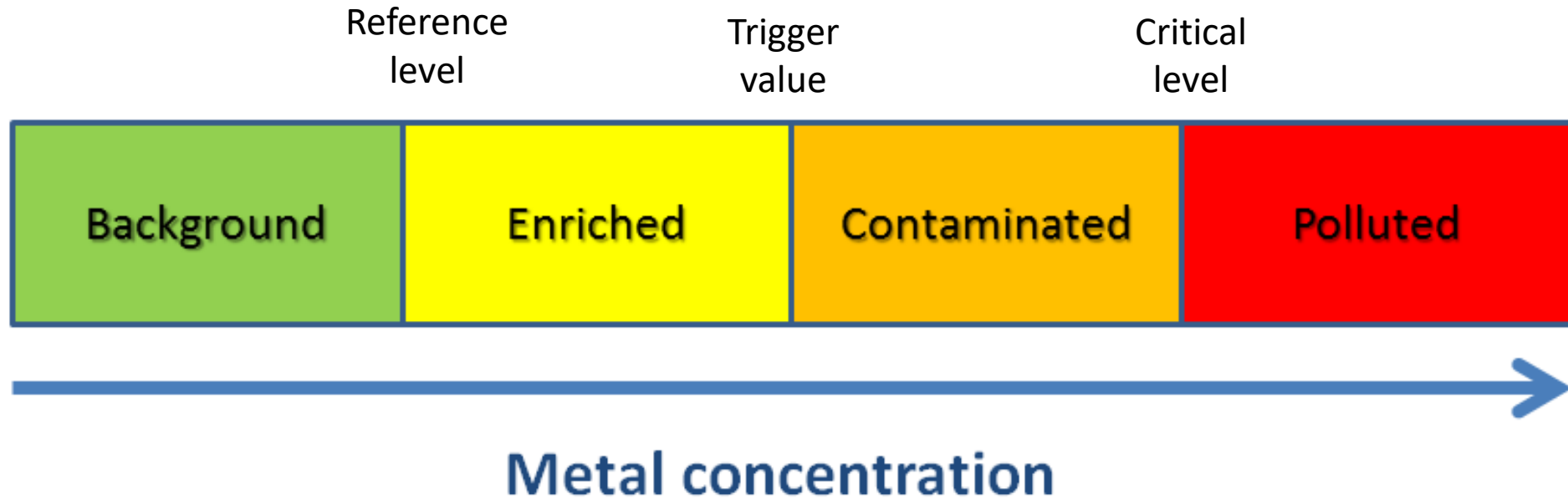- \> 3.5
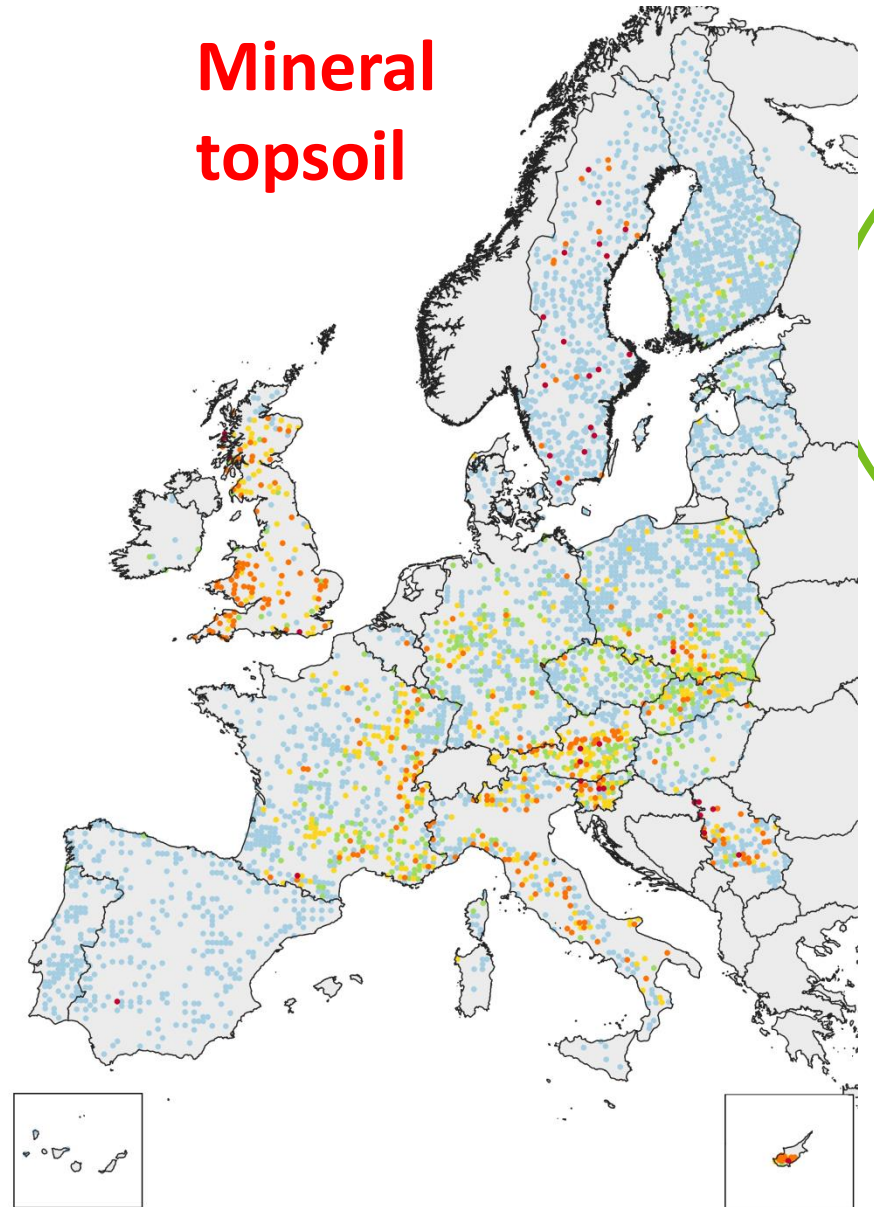
Cadmium stocks [mg/m²] – 2nd survey

Forest floor

Mineral topsoil
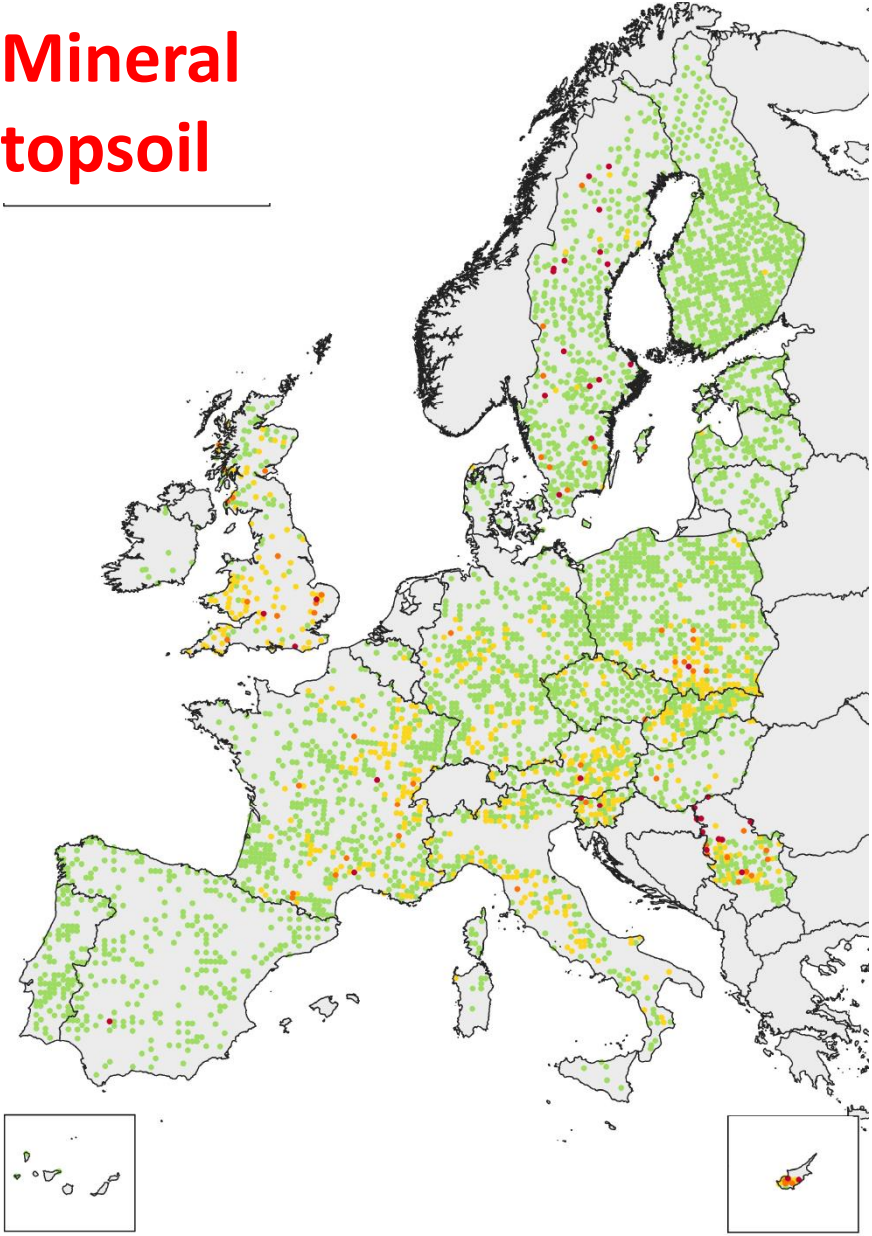
Soil pollution assessment

Reference level   Trigger value   Critical level

Background	Enriched	Contaminated	Polluted

Metal concentration →

Reference level (RL)   = geochemical baseline
= is set to the upper limit of the 95% confidence interval of the sample geometric mean

Trigger value (TV)   = warning level, in between RL and CL (below the TV is a negligible ecotoxicological risk), here derived from literature

Critical level (CL)   = here inferred from ecotoxicological studies/empirical studies on dose-effect concentrations

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# Estimated baseline concentration for forest floors and mineral topsoils
is set to the upper limit of the 95% confidence interval of the sample geometric mean

Biogeographical Region	Cadmium	
	Forest floor mg kg^{-1}	Mineral topsoil (0 to 10 cm) mg kg^{-1}
Alpine	0.43	0.32
Continental	0.38	0.11
Atlantic	0.29	0.21
Pannonnian	0.39	0.19
Mediterranean	0.10	0.10
Boreal	0.25	<< 0.10
European Average	**0.31**	**0.17**

available for Cr, Cu, Hg, Ni, Pb, Zn

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Cadmium stocks [mg/m²] – 2nd survey

S2 - Cadmium stock (mg/m²)
in the forest topsoil (0 - 10 cm)

- < 35   background
- 3.6 - 140   enriched
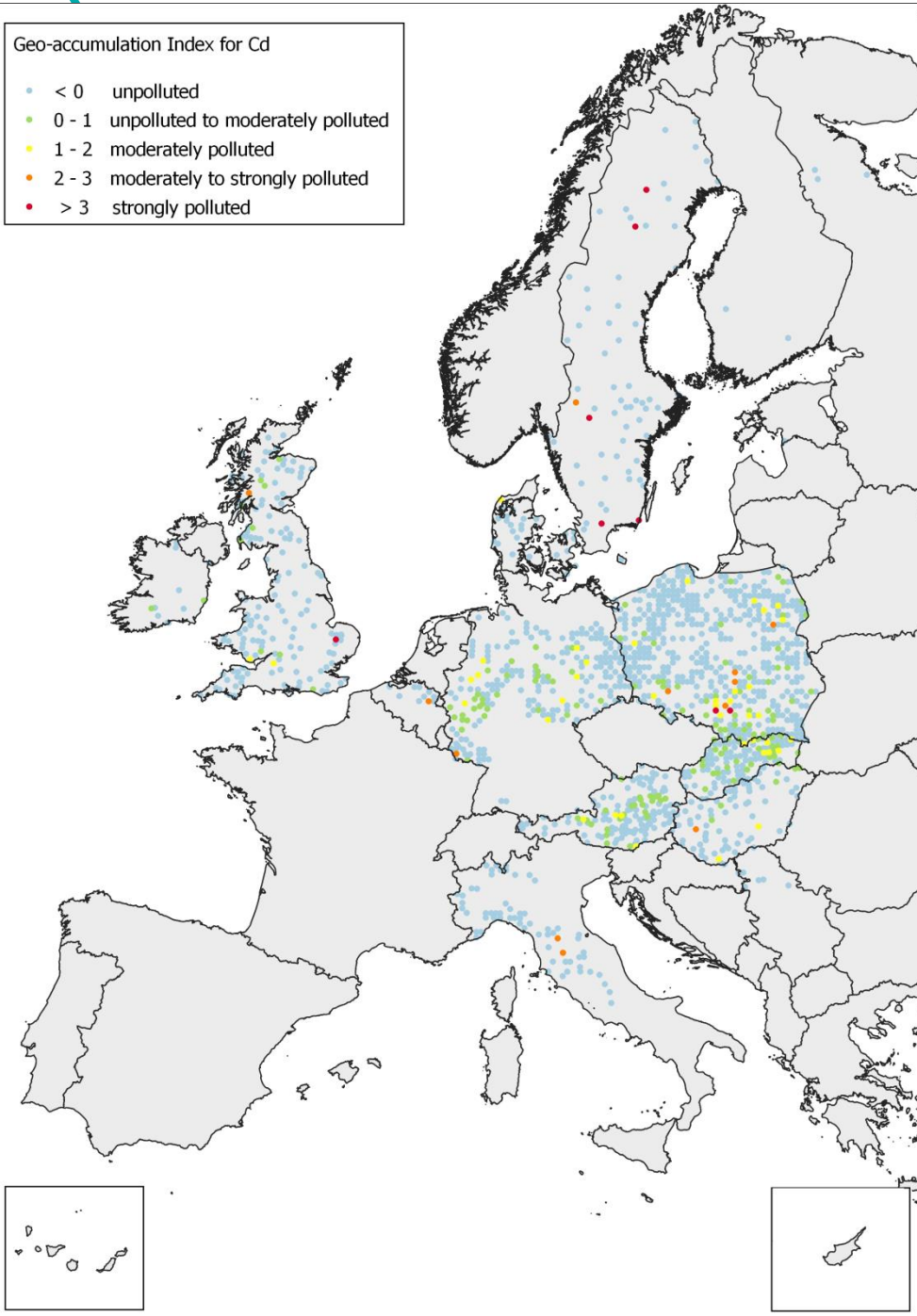- 140 - 250   contaminated
- > 250   critical
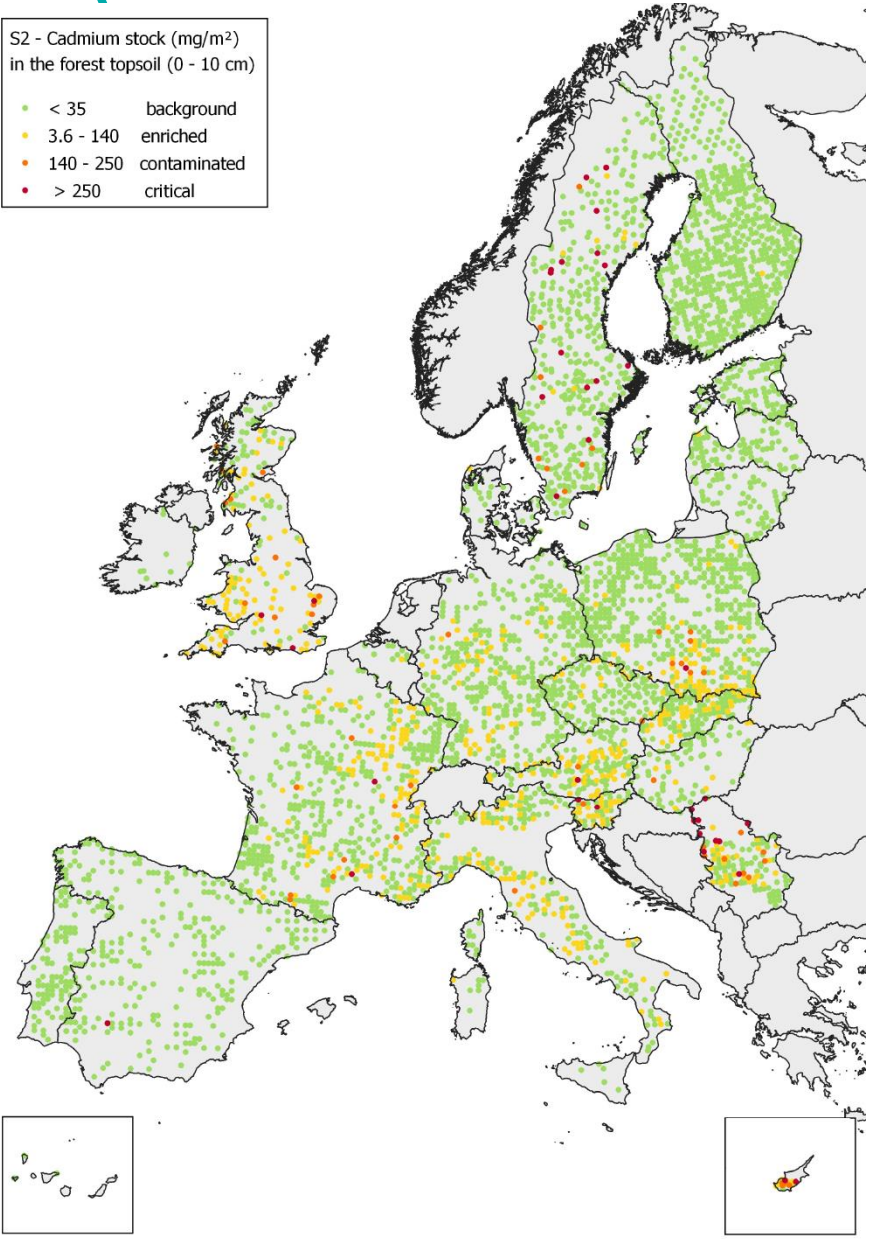
Cd [mg/m²]

- ●   < 35   background
- ●   36 < 140   enriched
- ●   140 - 250   contaminated
- ●   > 250   critical

- Enrichment factor

- Nemorow Pollution Indices

- Geo-accumulation Index

$$I_{Geo} = log_2 \left[\frac{\text{heavy metal content in topsoil}}{1.5x\text{heavy metal content in subsoil}} \right]$$

Geo-accumulation Index for Cd

Geo-accumulation Index for Cd

- 🔵 < 0   unpolluted
- 🟢 0 - 1   unpolluted to moderately polluted
- 🟡 1 - 2   moderately polluted
- 🟠 2 - 3   moderately to strongly polluted
- 🔴   > 3   strongly polluted

Summary of key messages of ICP Forests

1. **Heavy metal specific variation patterns** in forest floors and topsoils are found within countries, biogeographical regions and Europe.

2. **Regional hotspots** of elevated HM concentrations
   - **are clearly visible** on maps and
   - **can be linked to local pollution sources** and well-known contaminated areas.

3. Compared to the mineral topsoil, **heavy metals accumulate** significantly more **in the humus layer**.

4. Generally the **HM concentrations** in forest soils have **declined from 1990 onwards,** although rates of change differ by heavy metal and between countries. Undoubtedly a methodological country effect can be seen.

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2022-2023 Workplan (draft)

Activity description/objective	Expected outcome/deliverables
Nitrogen deposition and its effects on forest health, productivity, carbon sequestration, and biodiversity	Report and scientific paper about status and trends of N levels in European forests (2022, 2023)
	Report to the response of European forest ecosystems to decreasing nitrogen deposition
Status and trends of **heavy metals** in forest ecosystems	Scientific paper and ICP Forests Brief to heavy metal concentrations in Level I plots across Europe
Air pollution-related cause-effect relationships in forests in a **changing climate**	Impact of climate on foliar nutrition in European tree species (scientific paper)
Ambient ozone levels and effects on forest health, productivity, carbon sequestration, and biodiversity	Report on the effect of air pollution on forest health and productivity

Thank you for listening.