REGIONAL EXPOSURE ASSESSMENT OF METALS IN THE AQUATIC FRESHWATER ENVIRONMENT – SEDIMENT COMPARTMENT

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Setting the scene

The **update of regional metal concentration levels in the aquatic environment - sediment compartment** is part of Eurometaux's currently ongoing comprehensive **"Metals environmental exposure gathering program" (MEED-program).** This program accounts for both current and anticipated future requirements to comply with the Zero Pollution Ambition and biodiversity objectives. The Green Deal will likely increase the volumes of metals significantly for uses related to digitalisation and decarbonisation while at the same time more stringent legislation and the improvement in emission abatement techniques will mitigate the expected higher emissions. Measured regional metal concentrations are used to derive exposure scenarios under the REACH umbrella. As **environmental release rates of metals are expected to vary over time as new applications are found** and manufactured volumes may change previously collected regional ambient concentration levels that were used (data 2000-2004) may no longer be relevant for the current situations. As sediments are quite often a sink for metals the main aim of the current study was to derive the most recent metal concentrations for this compartment, which subsequently can be used to update the REACH dossiers.
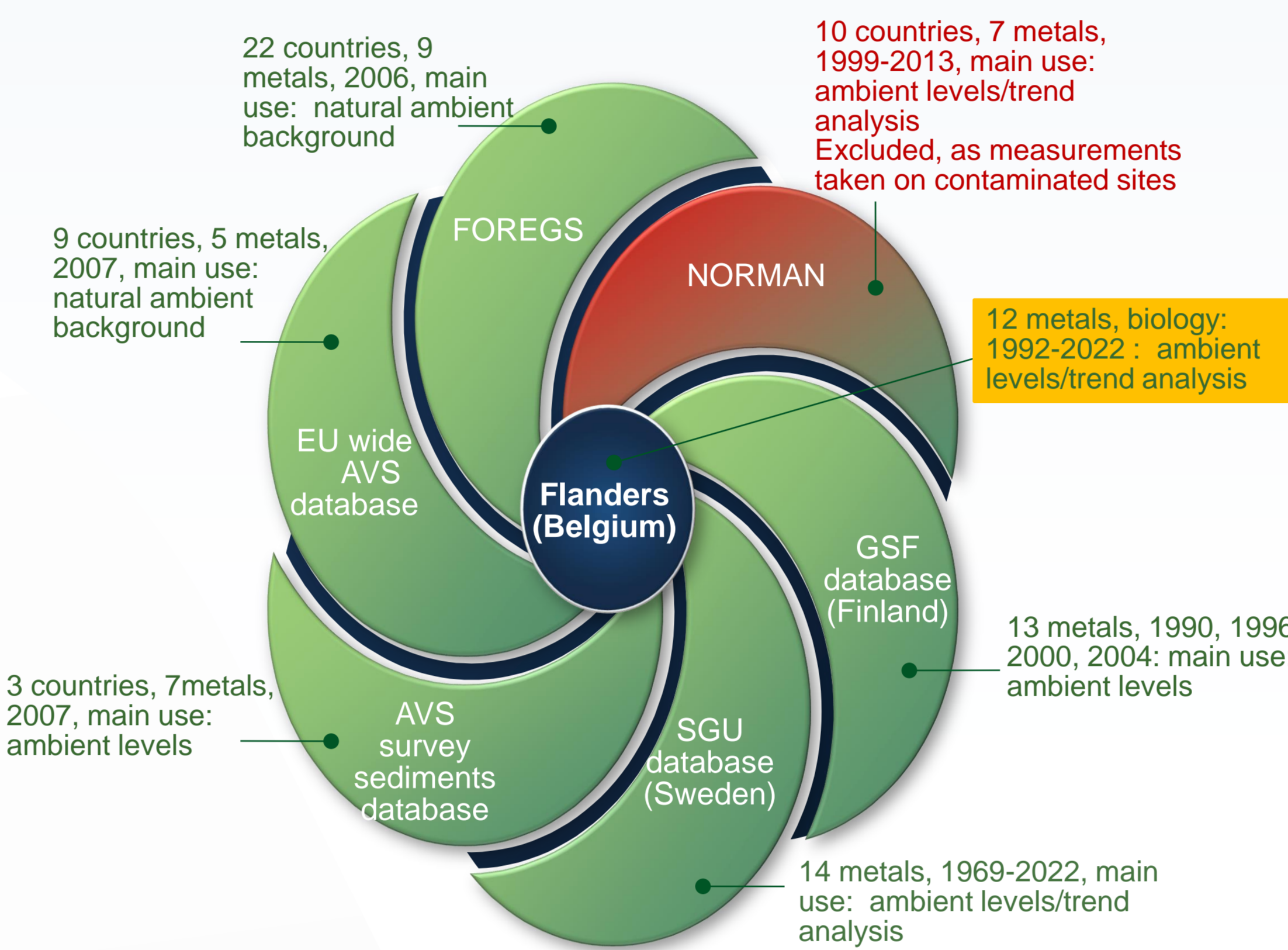
Methodology

Data sources

The challenge – data collection
- **Biased concentrations**: Measurements are often taken at contaminated sites
- **No** centralized European Union (**EU**) database
- Metals in sediment are **not part of most countries' regulatory-based monitoring programs**
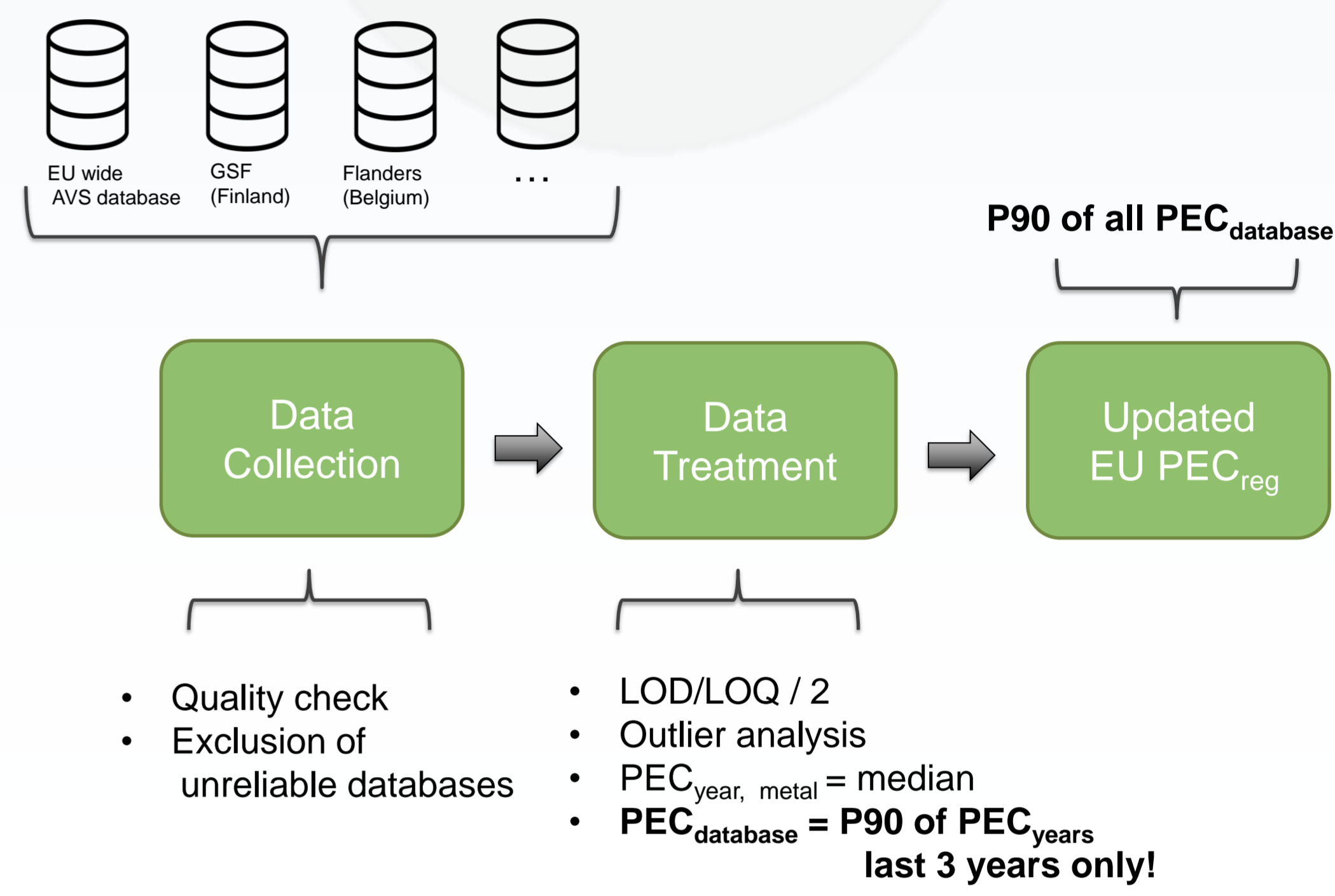
➡ *Tailor-made approach was needed*
Personal communication, national websites, publications

Overview of databases

22 countries, 9 metals, 2006, main use: natural ambient background

9 countries, 5 metals, 2007, main use: natural ambient background

10 countries, 7 metals, 1999-2013, main use: ambient levels/trend analysis Excluded, as measurements taken on contaminated sites

12 metals, biology: 1992-2022: ambient levels/trend analysis

FOREGS — NORMAN — Flanders (Belgium) — GSF database (Finland) — EU wide AVS database — AVS survey sediments database — SGU database (Sweden)

3 countries, 7 metals, 2007, main use: ambient levels

13 metals, 1990, 1996, 2000, 2004: main use: ambient levels

14 metals, 1969-2022, main use: ambient levels/trend analysis

Overview of methodology

EU wide AVS database — GSF (Finland) — Flanders (Belgium) — …

Data Collection → Data Treatment → Updated EU PEC_{reg}

P90 of all $PEC_{database}$

- Quality check
- Exclusion of unreliable databases

- LOD/LOQ / 2
- Outlier analysis
- $PEC_{year,\ metal}$ = median
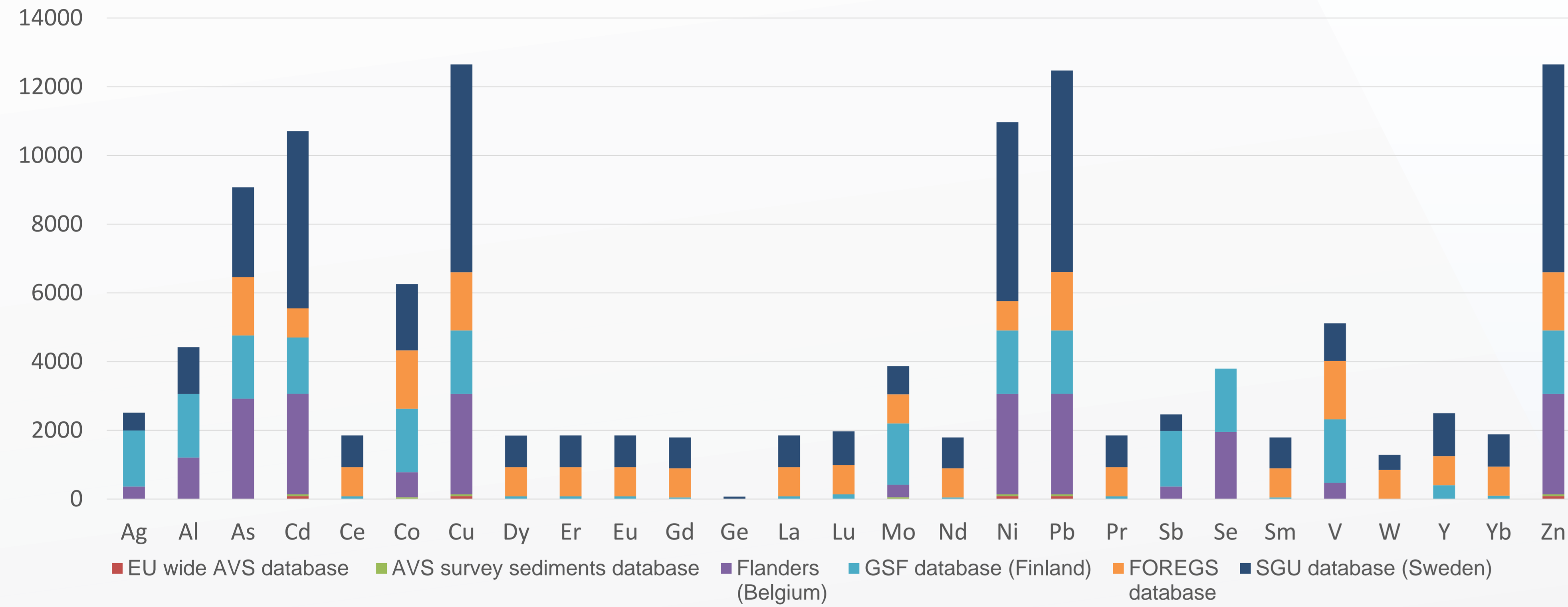- $PEC_{database}$ = P90 of PEC_{years} last 3 years only!

Outlier analysis according to: $\log(X_i) > \log(P75) + K(\log(P75) - \log(P25))$
With X_i = measured concentration and $K = 1,5$ (scaling factor)
Pragmatic approach: removal of outliers > cut-off value is only considered when P75 percentile > relevant reported LOQ/2.

Results

Frequency of metal measurements in the investigated databases
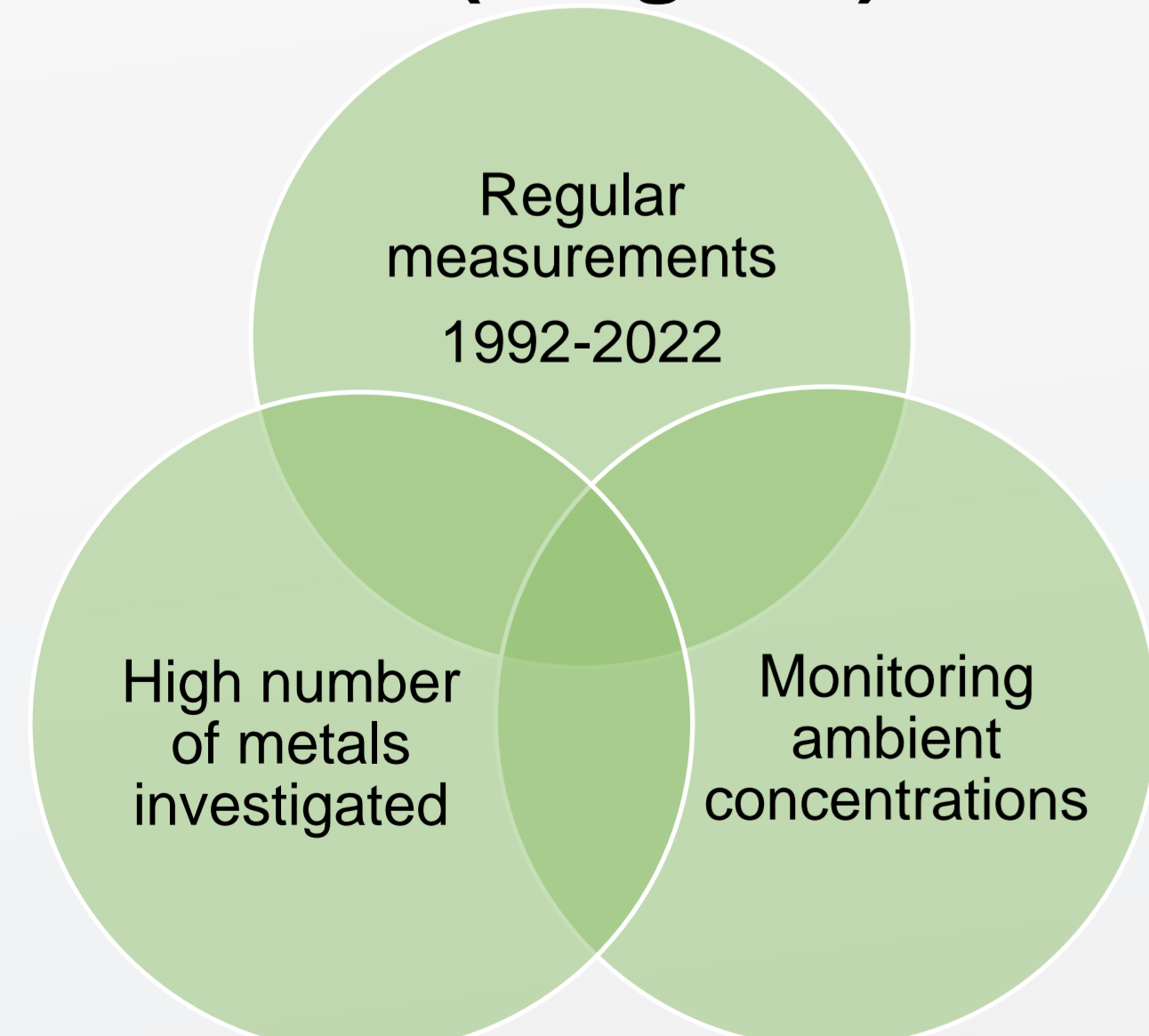As expected, the usual suspects — As, Cd, Cu, Ni, Pb, and Zn — were most often studied.

■ EU wide AVS database ■ AVS survey sediments database ■ Flanders (Belgium) ■ GSF database (Finland) ■ FOREGS database ■ SGU database (Sweden)

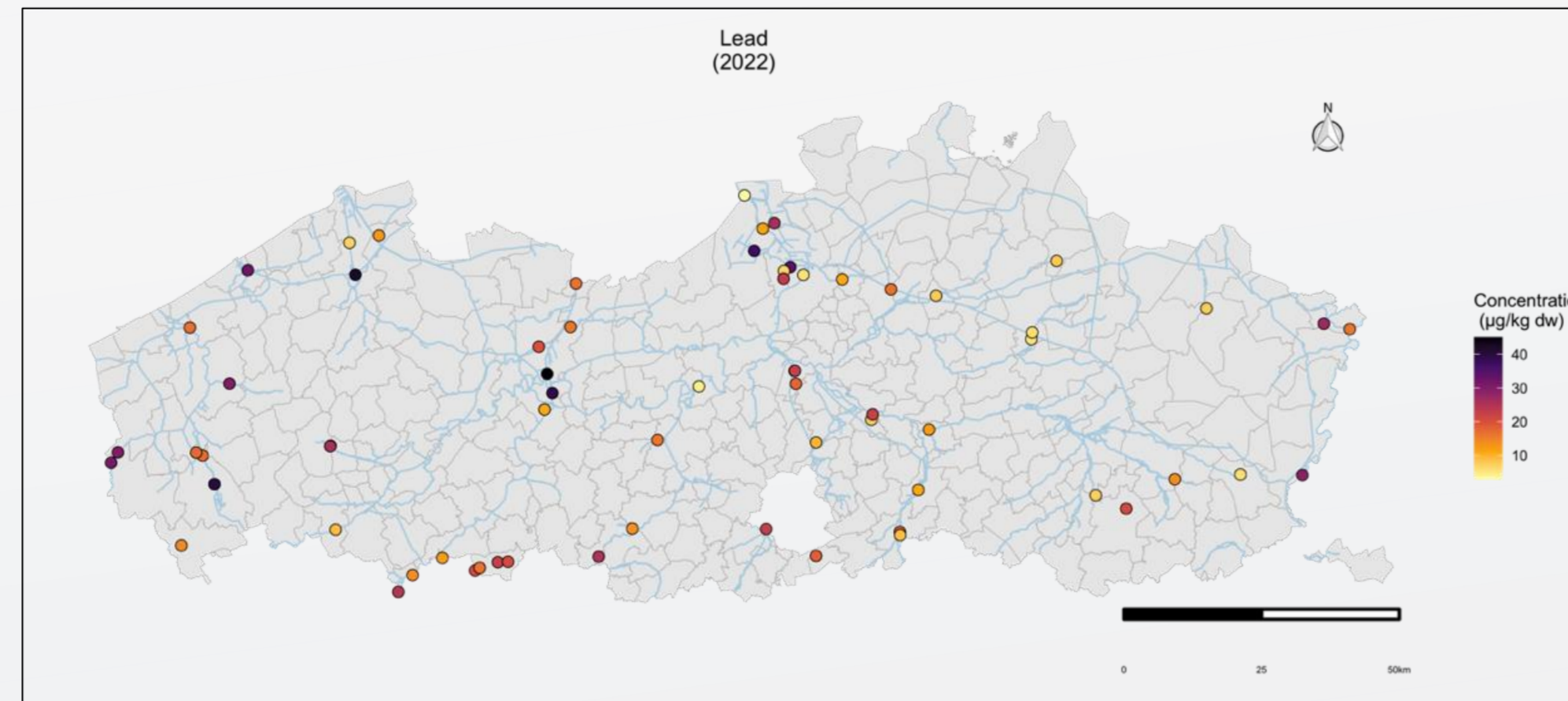| Metal	Range PEC$_{databases}$ mg/kg dw	Derived PEC$_{reg,sed}$ mg/kg dw
Ag	0.1 - 0.7	0.62
Al	10633 - 21285	19510
As	5.8 – 9.7	9.61
Cd	0.1 - 1.5	1.16
Ce	43.6 - 62.21	62.21
Co	5.6 – 34.2	28.04
Cu	0.43 – 50.25	40.20
Dy	3.95 - 4.53	4.53
Er	1.85 - 2.7	2.7
Eu	0.71 - 0.96	0.96
Gd	4.51 - 5.0	5.0
Ge	3.16	3.16
La	26.39 - 30.44.	30.44
Lu	0.41 - 0.49	0.49
Mo	0.5 – 3.4	3.24
Nd	26.32 - 27.11	27.11
Ni	6.4 – 32.9	28.25
Pb	6.0 – 61.6	48.95
Pr	5.89 - 6.87	6.87
Sb	0 .03 – 1.9	1.76
Se	1.0 – 1.8	1.79
Sm	4.84 - 5.27	5.27
V	28.4 – 71.4	65.71
W	1.3 – 9.3	9.3
Y	24.64 - 25.2	25.2
Yb	1.98 - 2.64	2.64
Zn	28.1 – 141.3	129.73

Outcome of the data treatment: Ranges of metal concentrations in the different databases and newly derived PEC$_{reg,sed}$ values

Case study: temporal trend analysis of metal concentrations

Flanders (Belgium)

Regular measurements 1992-2022

High number of metals investigated

Monitoring ambient concentrations

Sediment sampling location in 2022, in Flanders (Belgium)

Lead (2022)

Pb concentrations in sediment in Flanders (Belgium), 1992-2022

- Temporal trend analysis was performed for the metals available in the Flemish (BE) database.
- Example is shown for Pb.
- Sampling locations are presented on the map of Flanders.
- Concentrations were fitted over the years.
- No temporal variability is shown for Pb.
- The same was observed for all other metals: no trends are identified.

Conclusions

- **The span in concentration ranges** found in the different databases **are rather small** for all metals, confirming high level of accuracy.
- **No down/upward temporal changes** of metal concentration levels were noted for the period of 1992-2022 based on the Flemish (Belgian) database.
- **The updated ambient PEC$_{regional}$** will **improve the quality** of the **regional exposure assessment** and **exposure scenarios** in which they are applied.