

Towards harmonisation of tools for the risk-based assessment of soil quality in Europe

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CONTENTS

- ❑ Introduction
- ❑ Review Soil Quality Standards in EU
- ❑ Elements-of-risk-assessment in EU
- ❑ Conclusions on harmonization

HERACLES

**HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
FOR CONTAMINATED LAND IN EU MEMBER STATES**

**towards the development of European
common references**



**Research framework launched by the
European Commission Joint Research Centre (JRC),
with the contribution/review of many Research Institutes**



EUROPEAN COMMISSION
DG-JOINT RESEARCH CENTRE
Institute for Environment and Sustainability
Soil and Waste Unit

rivm

HERACLES STUDY:

DERIVATION METHODS OF SOIL SCREENING VALUES IN EUROPE

Objectives:

- Review of procedures and Soil Quality Standards
- Evaluation of differences and commonalities
- Further step towards harmonization

CONTRIBUTORS

UBA (AUT),
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NERI, EPA (DNK),
UBA (DEU),
SYKE (FIN),
INERIS (FRA),

INIA (ESP),
ISS (ITA),
Geological Survey (LIT),
RIVM, VROM (NDL),
IETU (POL),
EA (UK),
EPA, KEMAKTA (SWE)

COLLECTION OF INFORMATION

Types of information:

- Questionnaire on Soil Quality Standards and elements-of-risk assessment
- Country profile
- SQSs

Report. **Carlon 2007**, soon to be published

REMARKS

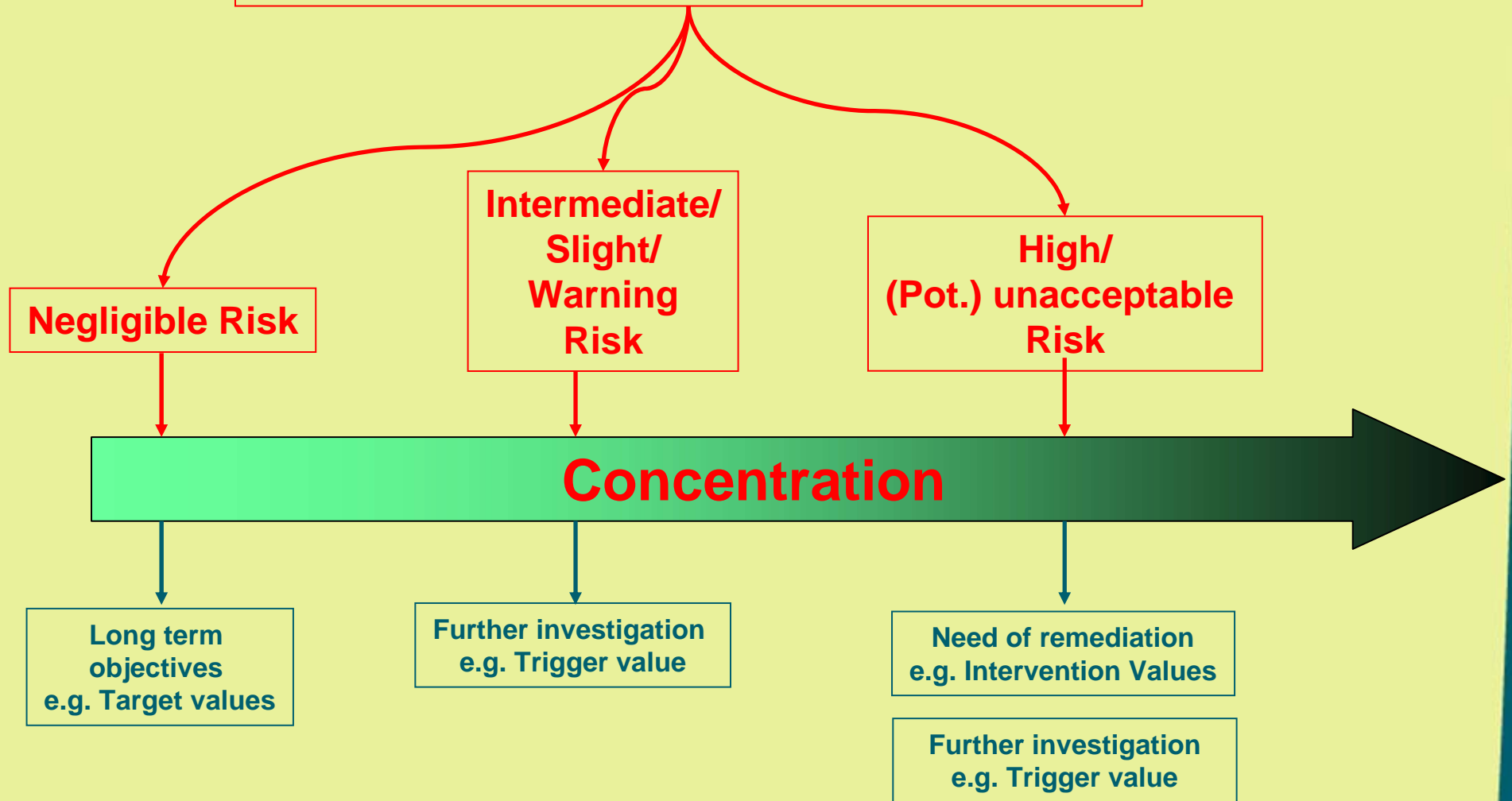
- ❑ Soil Quality Standards (**SQSs**) = Soil Screening Values
- ❑ Many Countries are revising or developing new protocols and/or SQSs
- ❑ Often derivation methods are not published and/or not transparent

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DIFFERENT SQSs

Screening Risk Assessment



REASONS FOR DIFFERENCES IN SQSs

- Discussion possible about classification of SQSs!
- (Minor) differences in the meaning of SQSs
- Different definitions of soil use (industrial!)
- Different procedures!

4 COMPARISONS

- ❑ Negligible risk (4 MSs)
- ❑ Warning risk (9 MSs)
- ❑ Potentially unacceptable risk, *Residential* (13 MSs)
- ❑ Potentially unacceptable risk, *Industrial* (7 MSs)

WHEN DIFFERENTIATION....

... in regard to soil type, pH, OM%, hydraulic conductivity

→ most common in Europe

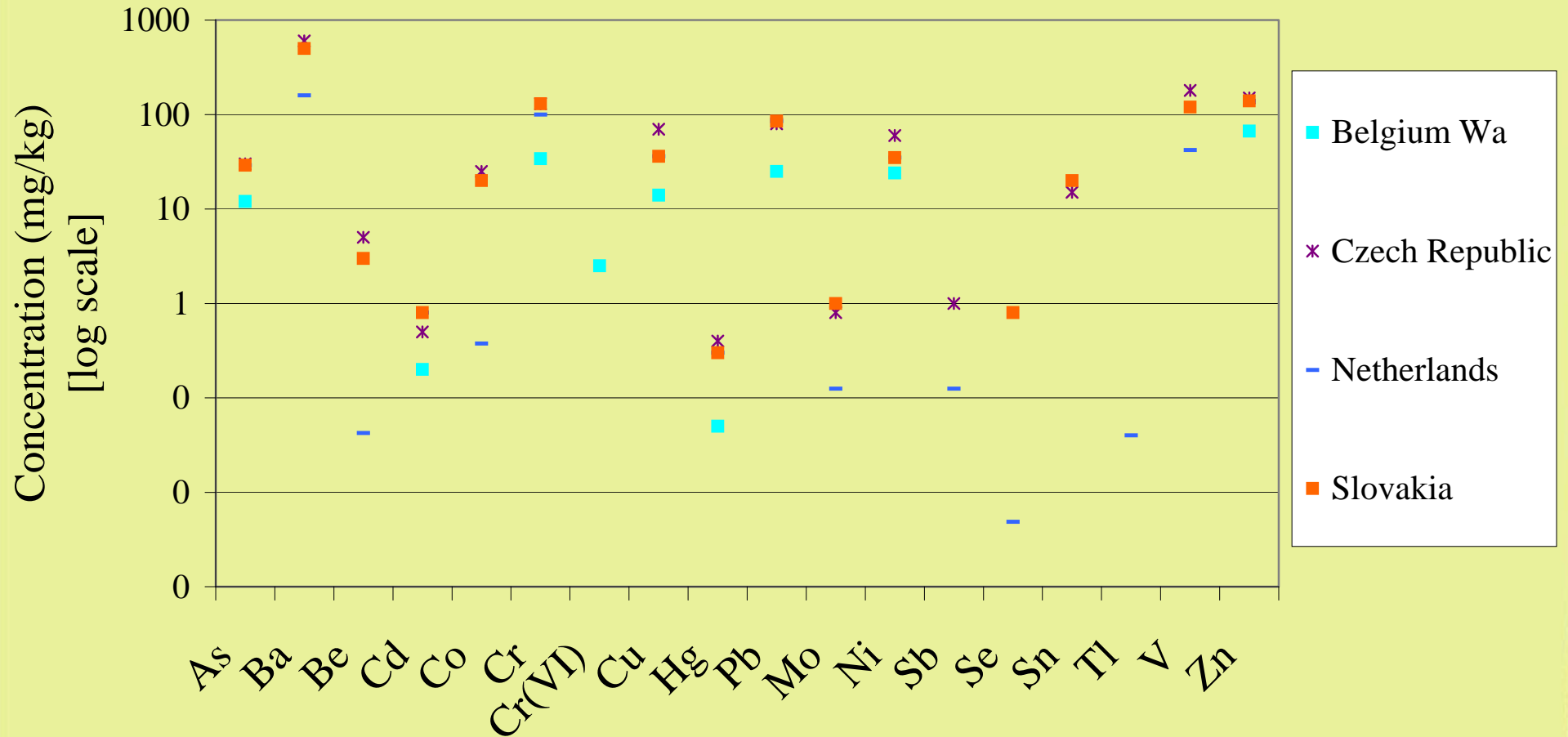
GENERAL OBSERVATIONS

- ❑ Not so many trends in regard to Member States
- ❑ For metals extreme values often (for major metals) differ around 1 OOM
- ❑ For organic contaminants extreme values often differ between 1 and 2 OOM

Note:

- ❑ Depends on number of entries
- ❑ No information on distribution

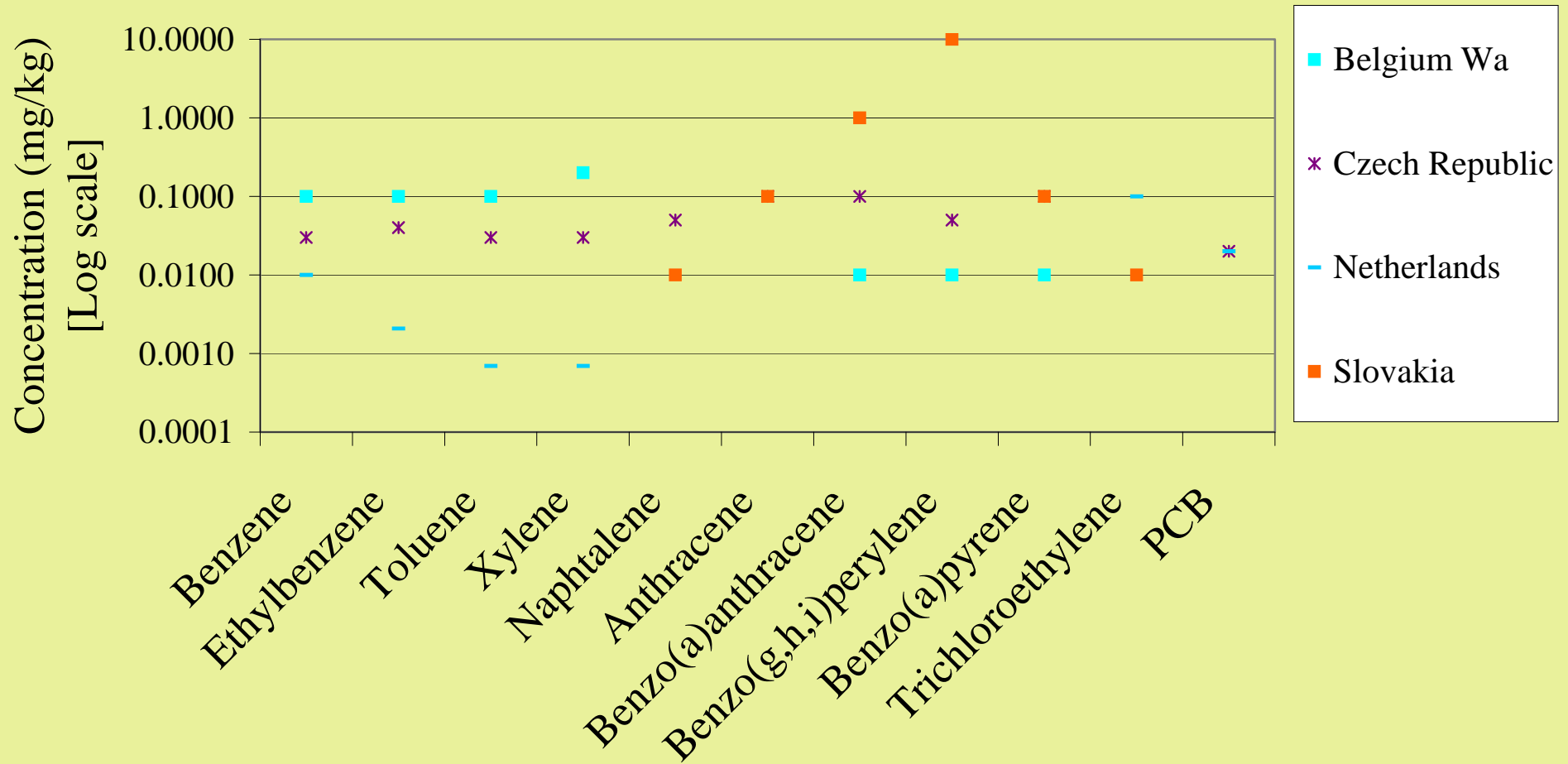
SQSs NEGLIGIBLE RISK, METALS



SQSs NEGLIGIBLE RISK, METALS

- ❑ Extremes often within 1 OOM
- ❑ Substantial variation for Co (66) and Be (125)
- ❑ Role of (natural) background values

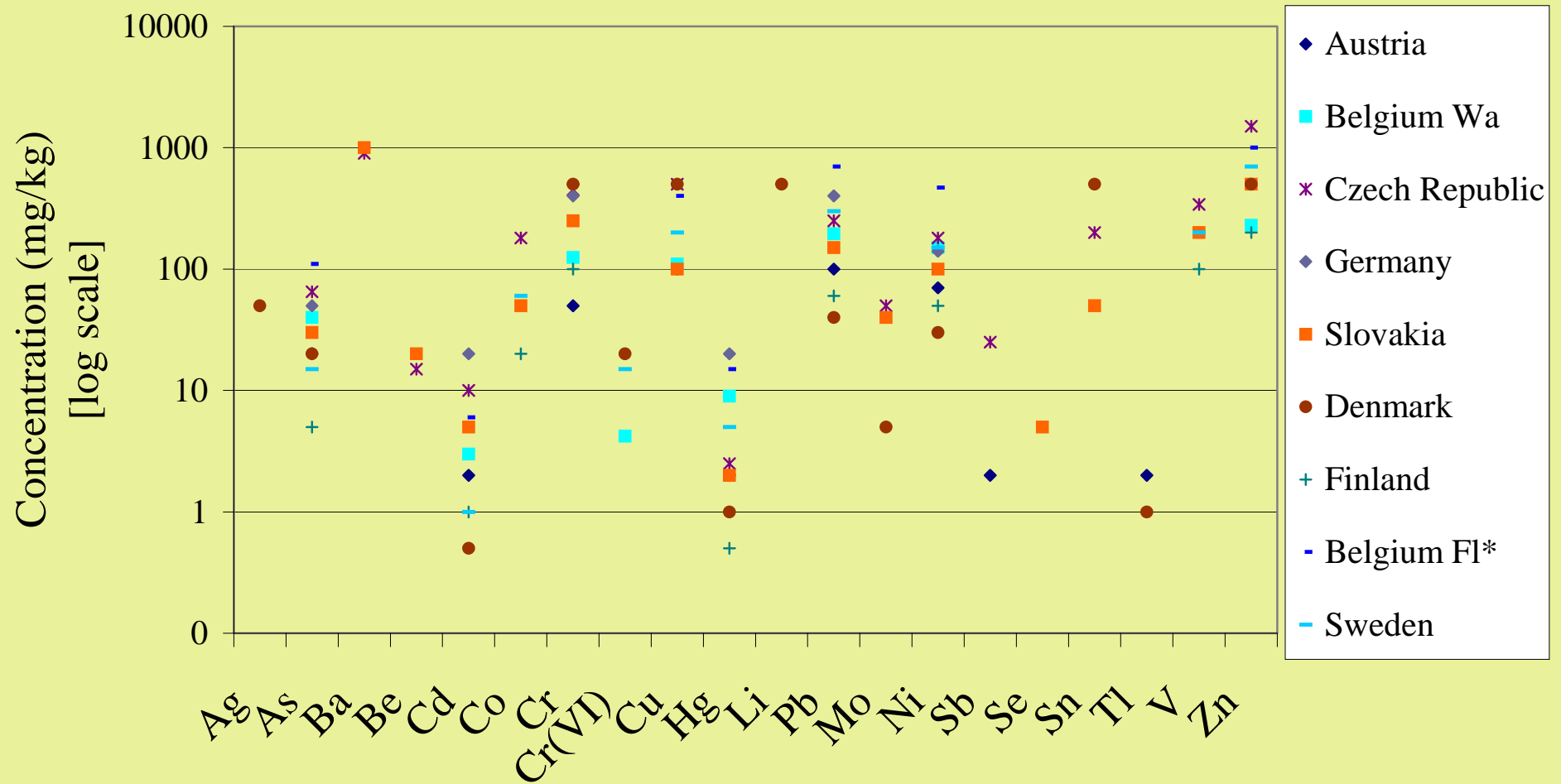
SQSs NEGLIGIBLE RISK, ORG.



SQSs NEGLIGIBLE RISK, ORG.

- ❑ Extremes often within 1 OOM or 2 OOM
- ❑ Substantial variation for xylene (286) and benzo(ghi)perylene (1000)

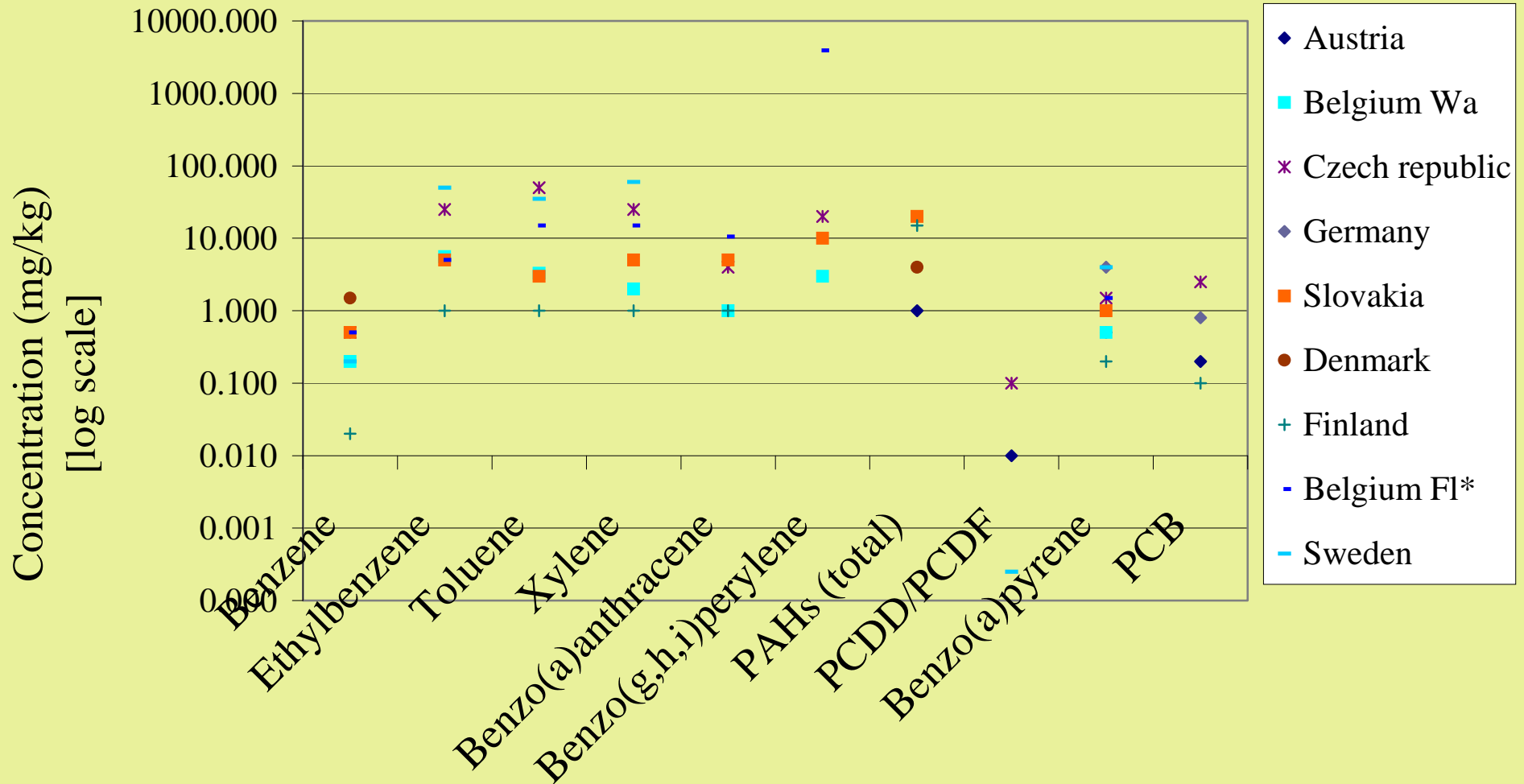
SQSs WARNING RISK, METALS



SQSs WARNING RISK, METALS

- ❑ Extremes often around a factor of 10
- ❑ Substantial variation for As (20), Cd (40), Hg (40)
- ❑ Strongly dependent on terminology

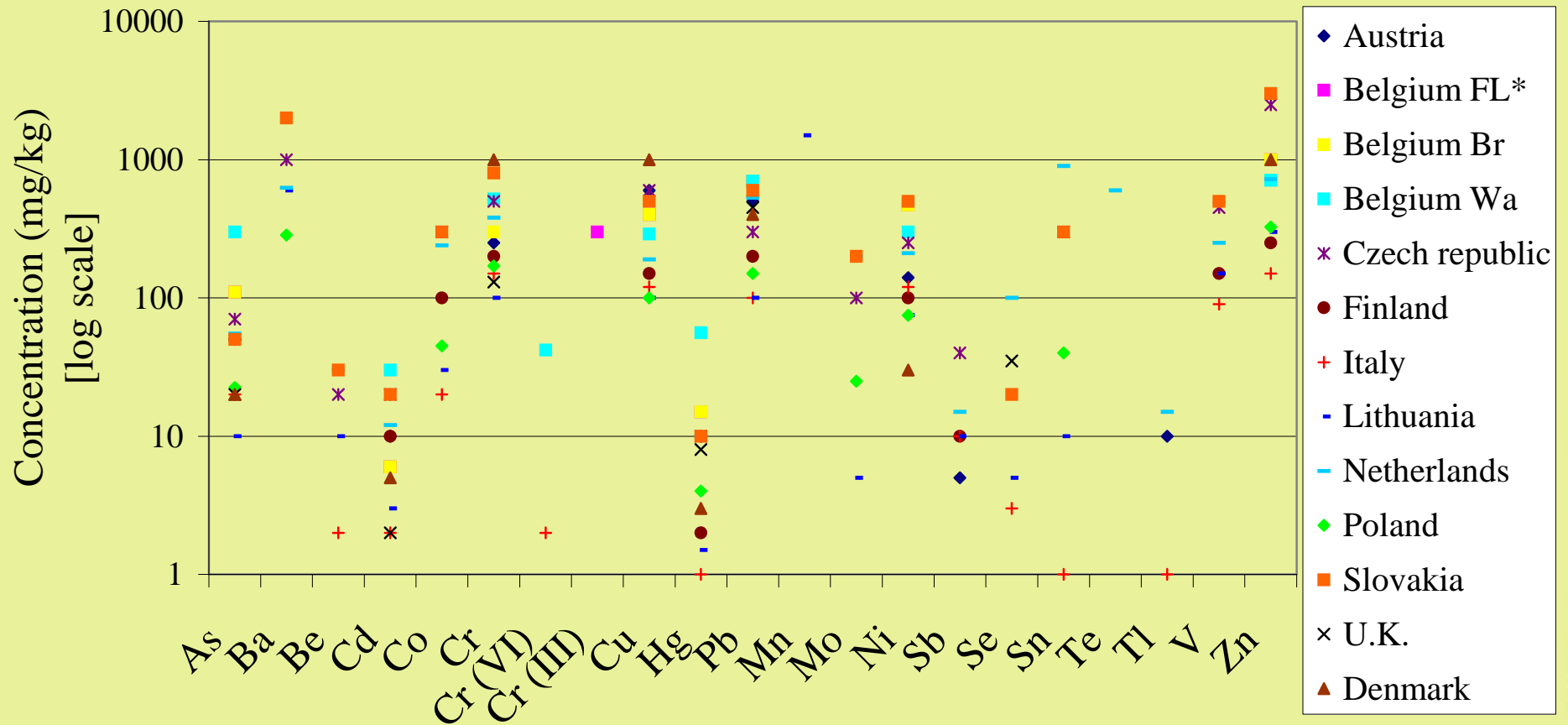
SQSs WARNING RISK, ORG.



SQSs WARNING RISK, ORG.

- ❑ Extremes always within 2 OOM, hardly within 1 OOM
- ❑ Belgium (Walloon region): relatively low
Czech Republic: relatively high

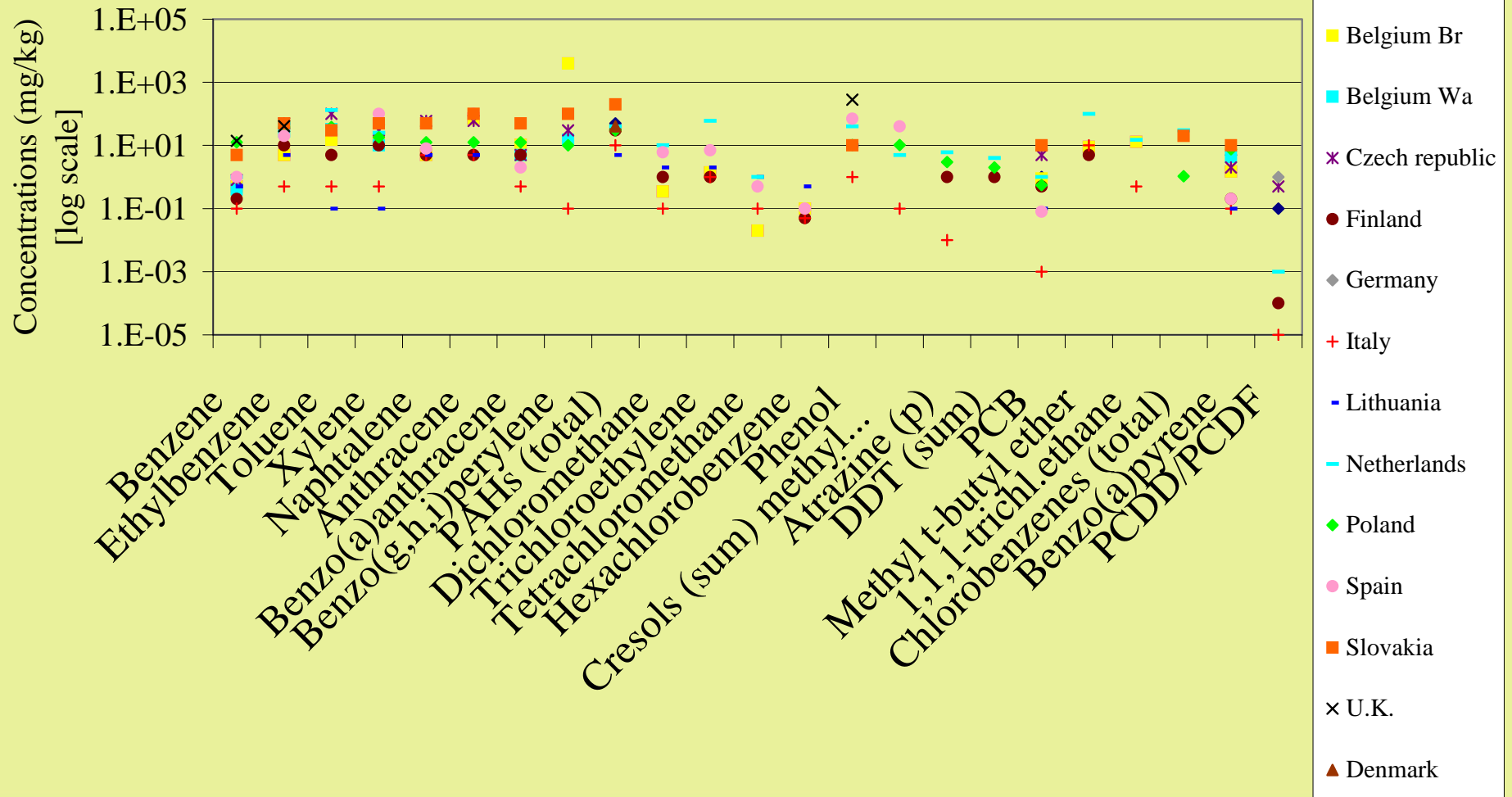
SQSs POT. UNACCEPTABLE RISK, METALS/ Residential



SQSs POT. UNACCEPTABLE RISK, METALS/ Residential

- ❑ Extremes often within a factor of 10 - 50
- ❑ Substantial variation for Hg (56), Se (333), Sn (900)
- ❑ Italy: relatively low

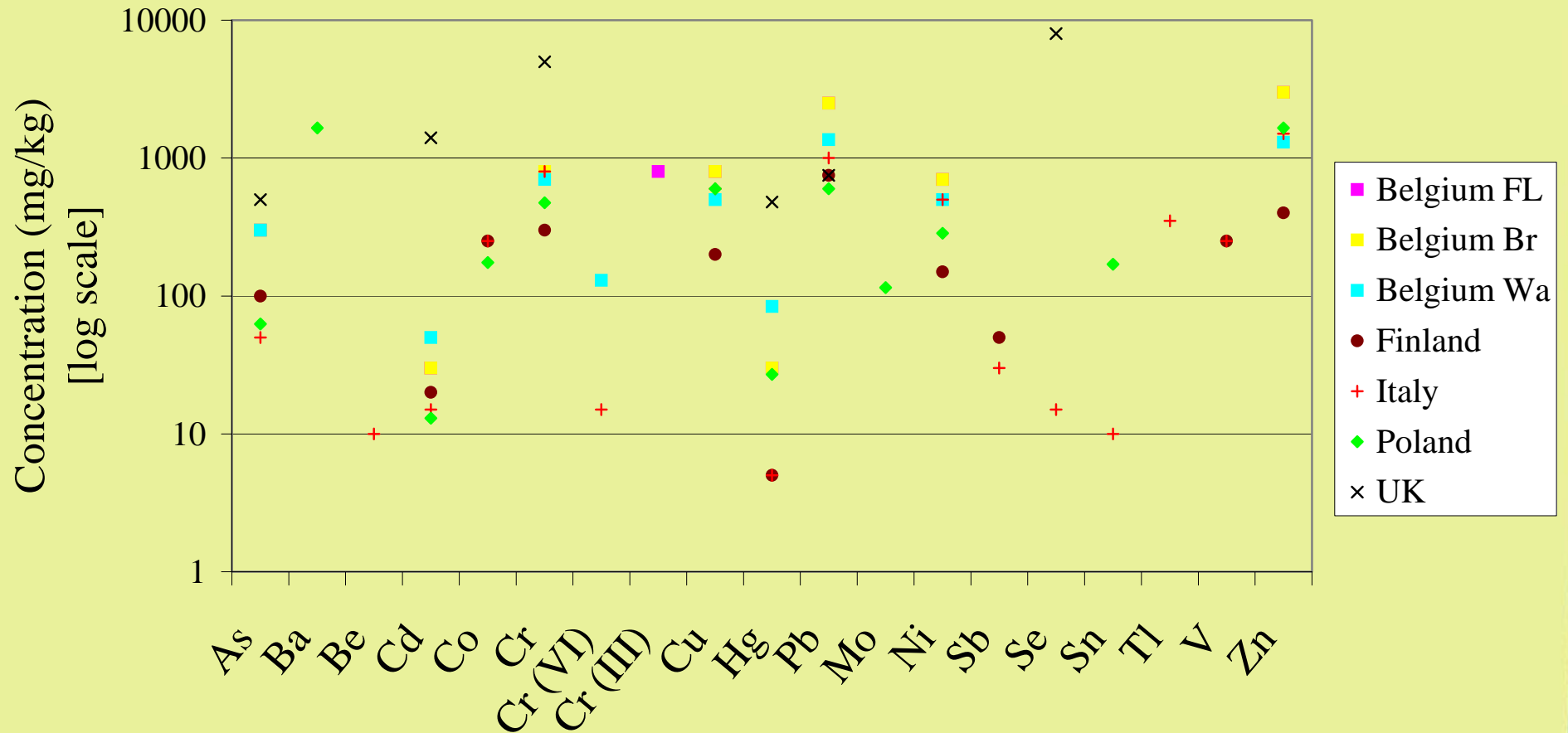
SQSs POT. UNACCEPTABLE RISK, ORG./ Residential



SQSs POT. UNACCEPTABLE RISK, ORG./ Residential

- ❑ Extremes often between 1 and 2 OOM, hardly within 1 OOM
- ❑ Substantial variation for benzo(ghi)perylene (40,000), PCDD/ PCDF (5000)
- ❑ Italy: relatively low
NL and Slovakia: relatively high

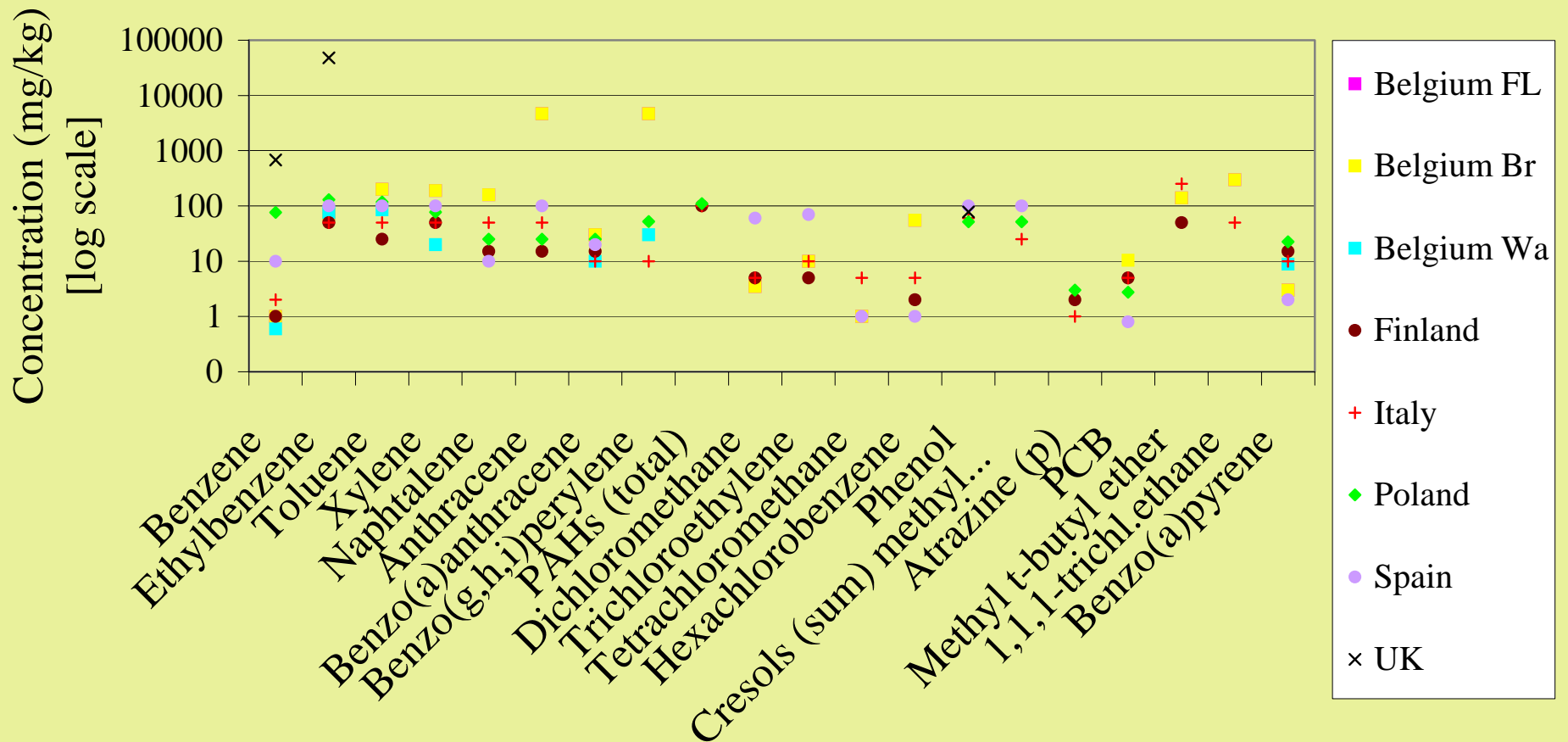
SQSs POT. UNACCEPTABLE RISK, METALS/ Industrial



SQSs POT. UNACCEPTABLE RISK, METALS/ Industrial

- ❑ Extremes often between 1 and 2 OOM, hardly within 1 OOM
- ❑ Substantial variation for Cd (108), Hg (96), Se(533),
- ❑ Italy: relatively low
UK: relatively high

SQSs POT. UNACCEPTABLE RISK, ORG./ Industrial



SQSs POT. UNACCEPTABLE RISK, ORG./ Industrial

- ❑ Extremes often between 2 and 3 OOM, hardly within 1 OOM
- ❑ Substantial variation for benzene, ethylbenzene (960), anthracene (313), benzo(ghi)perylene (469)

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REASONS FOR DIFFERENCES IN ELEMENTS-OF-RISK ASSESSMENT

- Differences in:
 - geography
 - socio-cultural aspects
 - regulatory/ political viewpoints!!!
 - scientific basis!!

GEOGRAPHICAL

- Soil/ aquifer materials
- Depth groundwater table
- Climate

SOCIO-CULTURAL

- Production of vegetables from own garden
- Presence of private groundwater extraction wells
- Fishing for own consumption

REGULATORY/ POLITICAL

- ❑ Protection targets!
- ❑ Protection level human health/
ecological soil quality
- ❑ Availability of documentation

SCIENTIFIC

- ❑ Algorithms and input parameters human exposure models
- ❑ Critical exposure/ Reference dose for non (genotoxic) carcinogens
- ❑ Relation soil concentration – effects on ecological processes
- ❑ Quantifying bioavailability

→

Harmonisation!

EVALUATION IN 3 BLOCKS

1. Regulatory framework and main features
2. Human exposure and human toxicological assessment
3. Ecological risk assessment

RELEVANCE OF DIFFERENCES

- ❑ *Magnitude of differences*
→ extent of heterogeneity among Member States
- ❑ *Sensitivity*
→ the power to lead to numerical differences in SQSs

Based on expert judgement

RELEVANCE OF DIFFERENCES

Magnitude of differences

Score	Differences in elements of risk assessment
0	No differences
1	Exceptions: only 1-2 Members States use an approach that deviates from the majority
2	Circa 25% Members States use an approach that deviates from the majority
3	Circa 50% Members States use an approach that deviates from the majority

Sensitivity

Score	Effect on SQSs
0	No effects on screening values
1	Negligible effect on screening values: affect screening value with no more than a factor of 2
2	Substantial effect on screening values: affect screening value with a factor of 2 to 10
3	Huge effect on screening values: affect screening value with more than a factor of 10

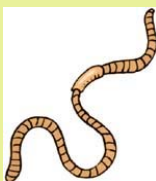
REGULATORY FRAMEWORK & MAIN FEATURES

- ❑ 11 MSs developed national RA models, 4 MSs refer to SQSs from other Countries
- ❑ Most common references:
EC TGD, US-EPA, US-ASTM, NL procedures, Russian federation
- ❑ Methodology published in a few cases and often not accessible

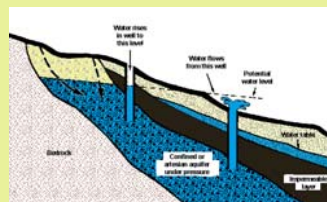
REGULATORY FRAMEWORK & MAIN FEATURES



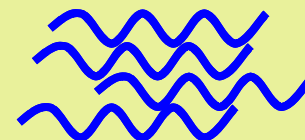
Human health



Terrestrial Ecosystem



Groundwater drinking



Surface Water

	Human health	Terrestrial Ecosystem	Groundwater drinking	Surface Water
Austria	Orange	Green	Light Blue	Dark Blue
Belgium (Flan.)	Orange	Yellow	Light Blue	Light Blue
Belgium (Wall.)	Orange	Green	Light Blue	Light Blue
Czech Rep.	Orange	Yellow	Light Blue	Light Blue
Denmark	Orange	Yellow	Light Blue	Light Blue
Germany	Orange	Green	Light Blue	Light Blue
Finland	Orange	Green	Light Blue	Light Blue
Italy	Orange	White	Light Blue	Light Blue
Lithuania	Orange	White	Light Blue	Light Blue
Netherlands	Orange	Green	White	Light Blue
Poland	Orange	White	Light Blue	White
Spain	Orange	Green	White	Dark Blue
Sweden	Orange	Green	Light Blue	Dark Blue
UK	Orange	Yellow	Light Blue	Light Blue



Eco-SQs derived but not adopted

REGULATORY FRAMEWORK & MAIN FEATURES

- ❑ Integration of human health SQSs and Eco SQSs:
usually the lowest of the two, but in some cases both SQSs are used
- ❑ Economic and Social factors:
usually not included
- ❑ SQSs land use specific, with exception of NL, SLK and DK

SQSs RELATED TO SOIL PROPERTIES?

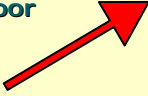
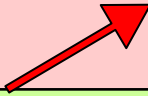

Country	Soil type function	
Austria	No	
Belgium - Flanders	Yes	clay and organic matter
Belgium - Walloon	No	
Czech Rep.	No	
Denmark	No	
Finland	No	
Germany	No	
Italy	No	
Lithuania	No	
Netherlands	Yes	clay and organic matter
Poland	Yes	saturated hydraulic conductivity
Spain	No	
Sweden	No	
United Kingdom	Yes	organic matter and pH

EVALUATION IN 3 BLOCKS

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2. Human exposure and human toxicological assessment
3. Ecological risk assessment



EXPOSURE PATHWAYS

Pathways	Routes of exposure
Soil > Outdoor 	Outdoor: soil ingestion
	Outdoor: dermal exposure to soil
	Outdoor: inhalation of soil vapors
	Outdoor: inhalation of soil derived dust
	Outdoor: inhalation of volatilized irrigation water
Soil > Indoor 	Indoor: dust ingestion
	Indoor: dermal exposure to soil derived dust
	Indoor: inhalation of soil originated vapors
	Indoor: inhalation of volatilized domestic water
Soil > Diet 	Res. diet: uptake of homegrown vegetables
	Res. diet: Ingestion of soil attached to vegetables
	Res. diet: uptake of homegrown fruits
	Res. diet: ingestion of soil attached to fruits
	Res. diet: consumption of meat
	Res. diet: consumption of dairy products
Groundwater	Resident diet: consumption of groundwater
	Indoor: inhalation of groundwater vapors
	Showering
	Irrigation
Surface water	dermal contact surface water (swimming)
	ingestion surface water (swimming)
	ingestion suspended matter (swimming)
	Surface water consumption of fish and shellfish



EXPOSURE TO NON-SOIL RELATED SOURCES

- Food, air and water
- Considered in Flanders, Denmark, Germany, Spain, Sweden and UK
- Reduction of TDI due to non-soil related exposure up to 80% (Germany and UK), 90% (Denmark)



TOXICOLOGICAL DATA SOURCES

WHO-IPCS

US-EPA-IRIS

RIVM reports

national DBs



IARC

ATSDR

RARs from ECB



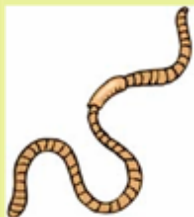
ACCEPTABLE RISK

- ❑ Different TDIs for Threshold toxicological substances
- ❑ 10^{-5} is adopted by the large majority of countries for non-threshold toxicological substances ($10^{-4} - 10^{-6}$)



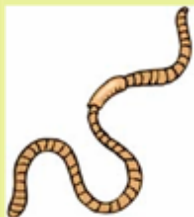
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ECOLOGICAL RISK ASSESSMENT

- ❑ Few technical guidelines already adopted (e.g. DEU, FIN, NLD, SWE)
- ❑ Several under approval (BEL Walloon, CZE, ESP, UK)
or in preparation (BEL Flanders, ITA)



ECOLOGICAL RECEPTORS

	Microbiol. Processes	Soil fauna	Plants	Above soil ecosystem	Aquatic ecosystem
Austria					
Belgium – Waloon					
Belgium – Flanders					
Czeck Rep.					
Germany					
Spain					
Finland					
Netherlands					
Sweden					
United Kingdom					

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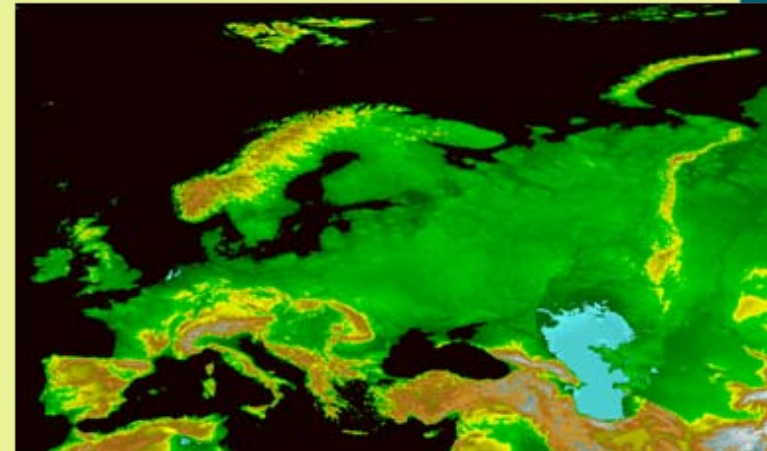
IS HARMONISATION NEEDED?

YES!

- Understanding (differences in) SQSs
- Consensus on technical framework

WHAT HARMONISATION?

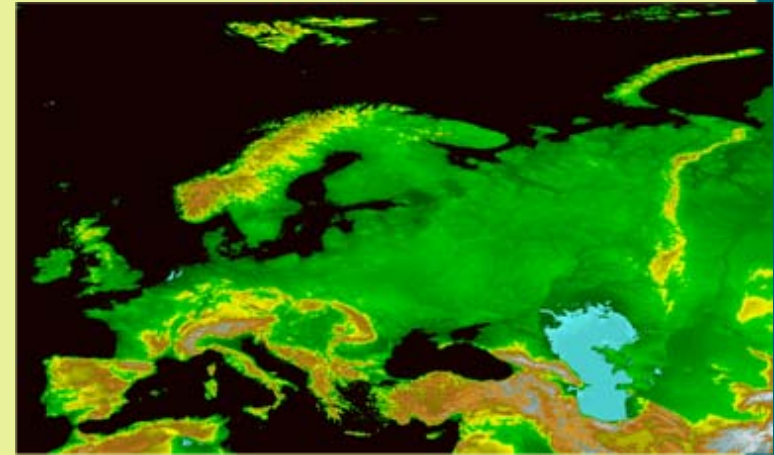
- ❑ One set of SQSs? No!!!
- ❑ The same blueprint? No!
- ❑ → Toolbox, including
 - standardised tools
 - flexible tools



FLEXIBLE TOOLS

Accounting for differences in:

- ❑ Geography
- ❑ Culture/ social aspects
- ❑ **Political decision making**



TOOLS

An instrument to assess information on relevant RA parameters

- equation
- model
- graph
- protocol
- database



TOOLBOX

Combination of relevant tools for a specific application of RA

- report
- manual
- decision support system
- computer program



LET'S DO IT!

HERACLES ...

- is the framework for the collaboration of the European Commission JRC with Institutes and interested Bodies
- is ***open*** to the contribution of all interested Institutes and Bodies

TALKING TAKES TIME....



Review of derivation methods of Soil Contaminant Thresholds in Europe

Claudio Carlon & Marco D'Alessandro, EC Joint Research Centre, Italy, Ispra
Frank Swartjes, RIVM, The Netherlands, Bilthoven

Review

Country reports

DERIVATION METHODS OF SOIL SCREENING VALUES IN EUROPE

A REVIEW OF NATIONAL PROCEDURES TOWARDS
HARMONISATION



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HARMONISATION OPPORTUNITIES

ANNEX 2

COUNTRY REPORTS AND SOIL SCREENING VALUES

ANNEX 3

SOIL SCREENING VALUES



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ICCL audience

THANKS
for
the
ATTENTION !

→ www.RIVM.NL

