Overview of the recommendations of the WG-EG-EQS (ISPRA) concerning environmental quality standards for metals in sediment

SedNet, May 2008

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On behalf of the WG-EG-EQS – metals subgroup and
Eurometaux water working group

Content

- Can we set triggers on the need for sediment QC?
- Sediment PNEC setting -MERAG and EU RAs
- Incorporation of bioavailability
- Compliance checking
- Conclusions and future needs

Triggers for setting sediment QC

Principles:

Sediment Metal quality criteria are relevant, in addition to the setting of water quality criteria **IF** the QC set for the water would not protect benthic organisms appropriately. The following aspect are therefore relevant to assess the need for sediment QC

- What is the mode of action – gill binding?
- What is the most relevant toxicity route (water and/or food)?
- Is there evidence of toxicity from dietary exposure beyond what is observed from water exposure
- What integrated toxicity can be expected

Sediment PNEC setting
Weight of evidence approach

2. Equilibrium partitioning

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1. Direct sediment ecotoxicity

⇕

3. Mesocosm
Field data

Derivation of a PNEC sediment
1. Whole sediment toxicity tests-

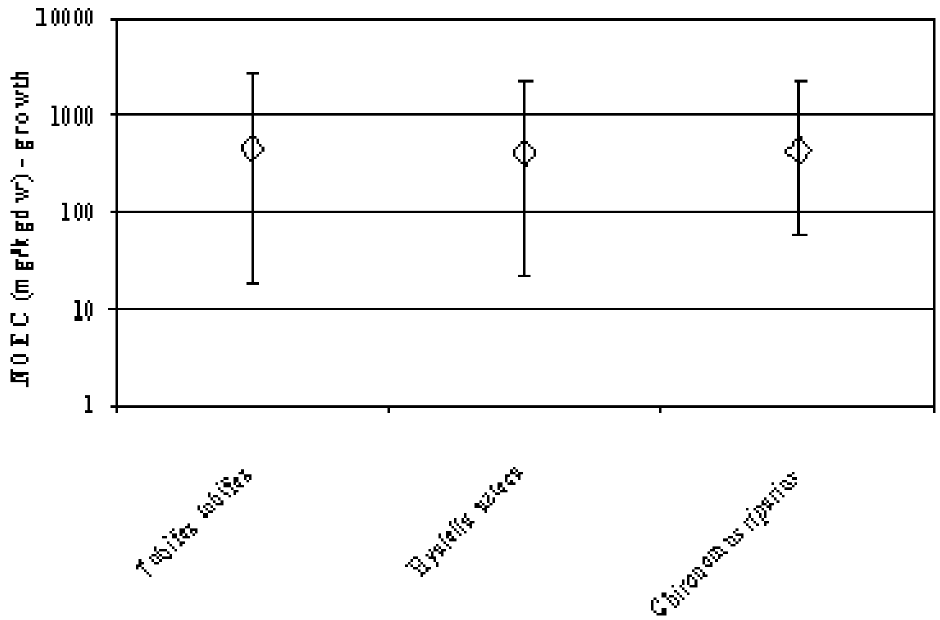
Q1 data set (# NOECs = 95), 6 species

Representativeness

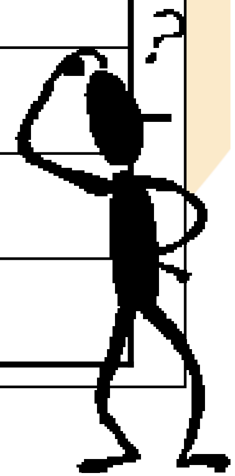
Surface deposit feeders	Sub-surface feeders	Burrowing & surface/ sub-surface feeding
crustaceans	*oligochaetes*	*insects*
Hyallela azteca	***Tubifex tubifex***	***Chironomus riparius***
Gammarus pulex	***Lumbriculus variegatus***	***Hexagenia***



Issues in sediment ecotoxicity : Intra-species variability in NOECs (mg Me/kg dry weight)



Species Cu NOECs	Max/Min ratio growth
T. tubifex	101
H. azteca	70
C. riparius	26

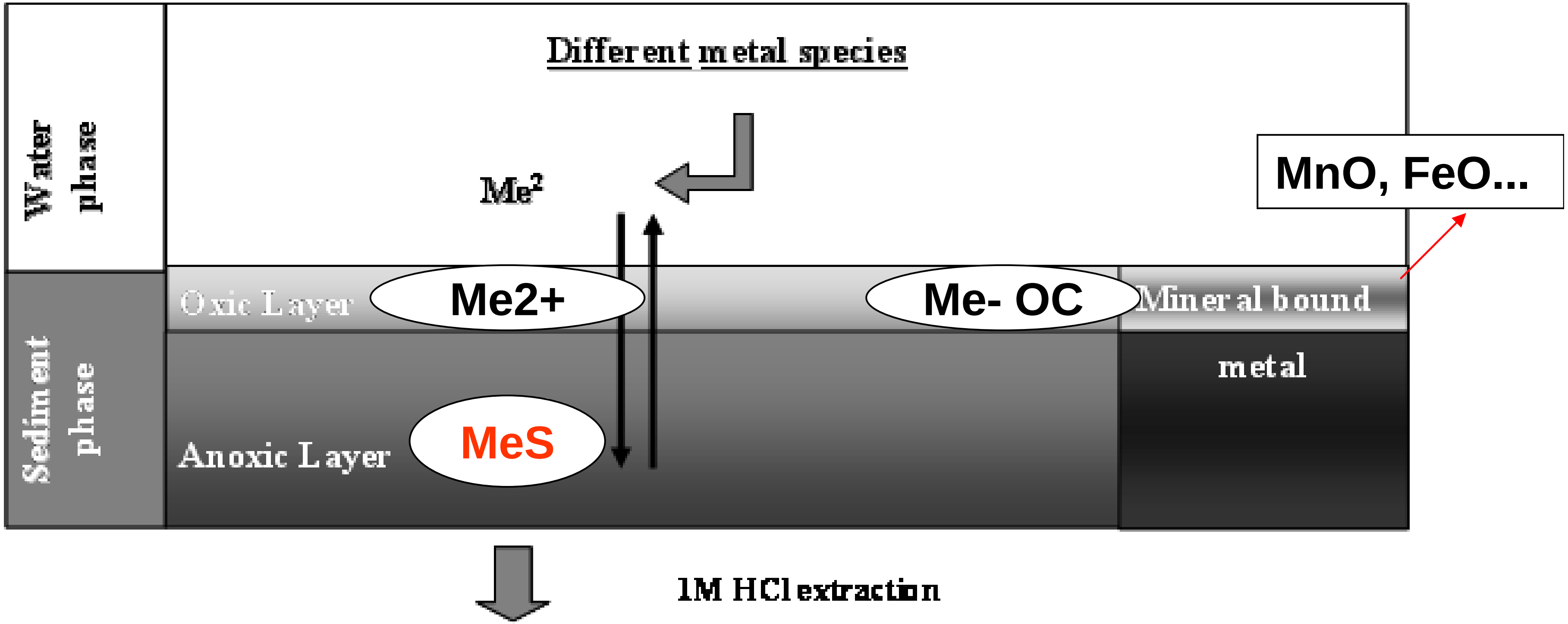


Sediments have large variation in characteristics :eg OC and sulphide content

Ensure appropriate pre-equilibration and evaluate water column metal toxicity

Metal bioavailability

a. Principle of MeS binding

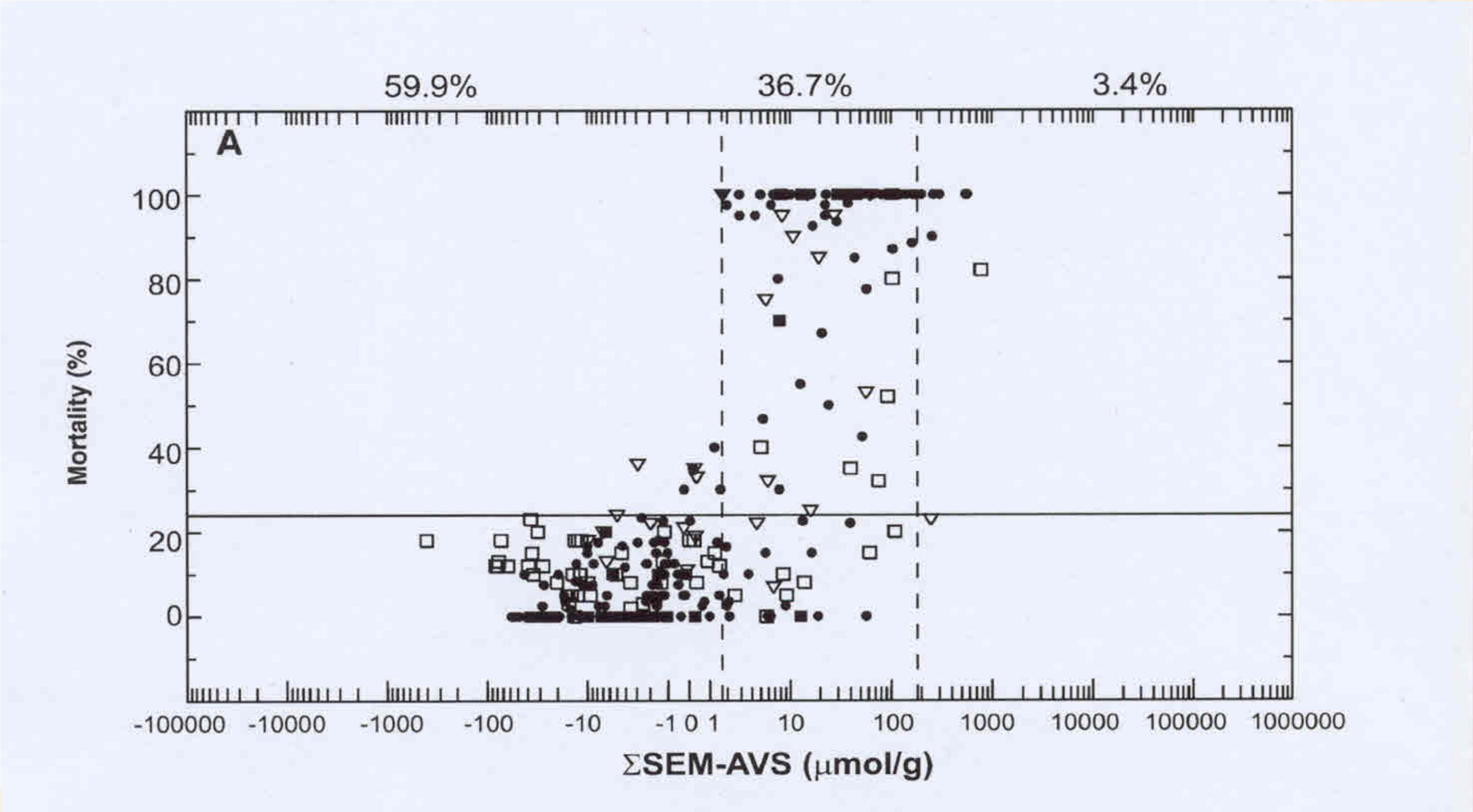


SEM (Simultaneously Extracted Metals) + AVS (Acid Volatile Sulfide)

$$\Sigma SEM = SEM_{Cu} + SEM_{Pb} + SEM_{Cd} + SEM_{Zn} + SEM_{Ni}$$ (AVS affinity Hg>Cu>Pb>Cd>Zn>Ni)

$$\text{Excess } SEM_{Cu} = SEM_{Cu} - (AVS_{total} - SEM_{Hg})$$ → potentially bioavailable

Effectiveness of Me- binding to AVS



Di Toro et al, 2002

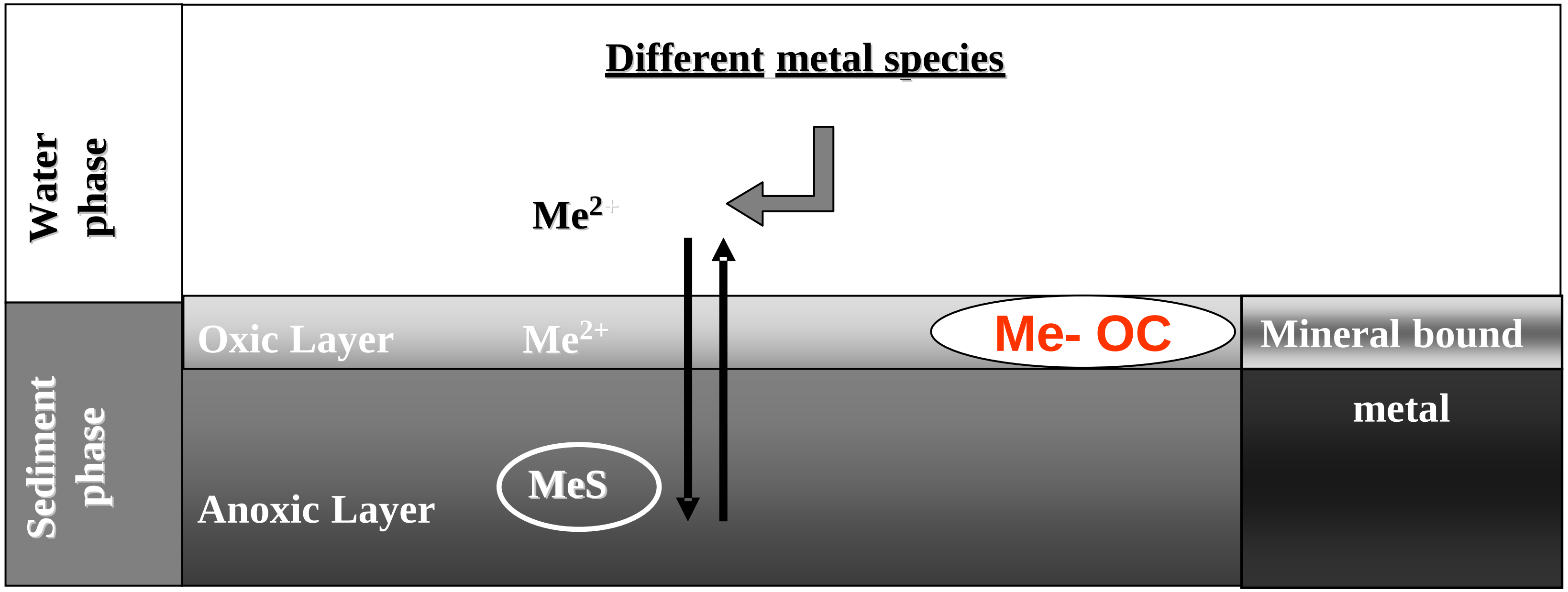
Basic concept

"Me++ bound to sulphides are not available"

= accepted under MERAG & RAs (Zn, Cd, Cu, Ni, Pb)

Metal bioavailability

b. Importance of to OC



Effectiveness of OC binding

Influence OC on ecotoxicity

Variability in EC-50 values, obtained from benthic ecotox tests in different sediments

Species	Total Cu (mg/kg		OC-normalized Cu	
	EC_{50} ratio		EC_{50} ratio	
	mean	range	mean	range
Tubifex	2.4	2.2-2.8	1.7	1.3-2.1
Hyalella	3.3	-	1.1	-
Chironomus	6.2	4.7-7.7	1.7	1.3-2.0
Overall	4	2.2-7.7	1.5	1.1-2.1

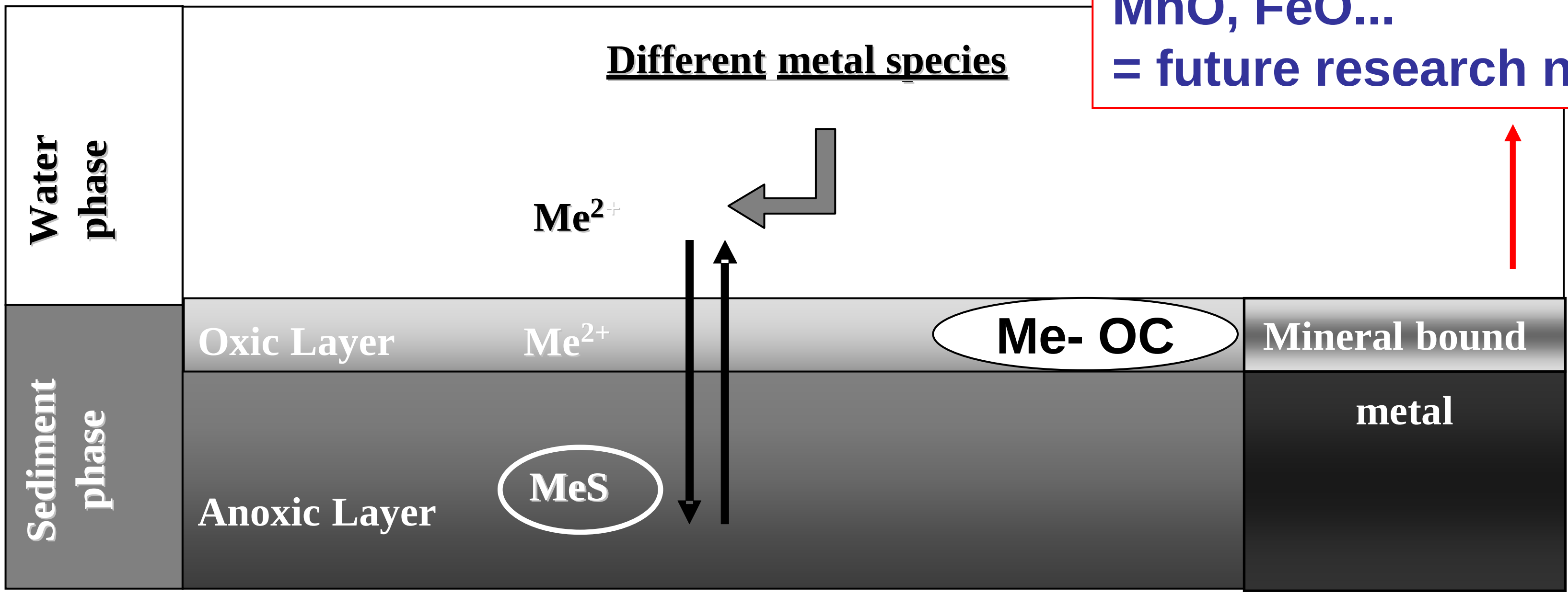
De Schamphelaere et al, 2004

$$NOEC_{OC,\,normalized} = \frac{NOEC_{total}}{fOC}$$

Suggested under MERAG and accepted for the Cu RA

Metal bioavailability
c. Importance of to MnO, FeO..

MnO, FeO...
= future research needs



Derivation of a PNEC sediment
Whole sediment toxicity tests

Bioavailability

NOEC total – mg/kd dry weight

↓

NOEC-AVS corrected - mg/kd dry weight

↓

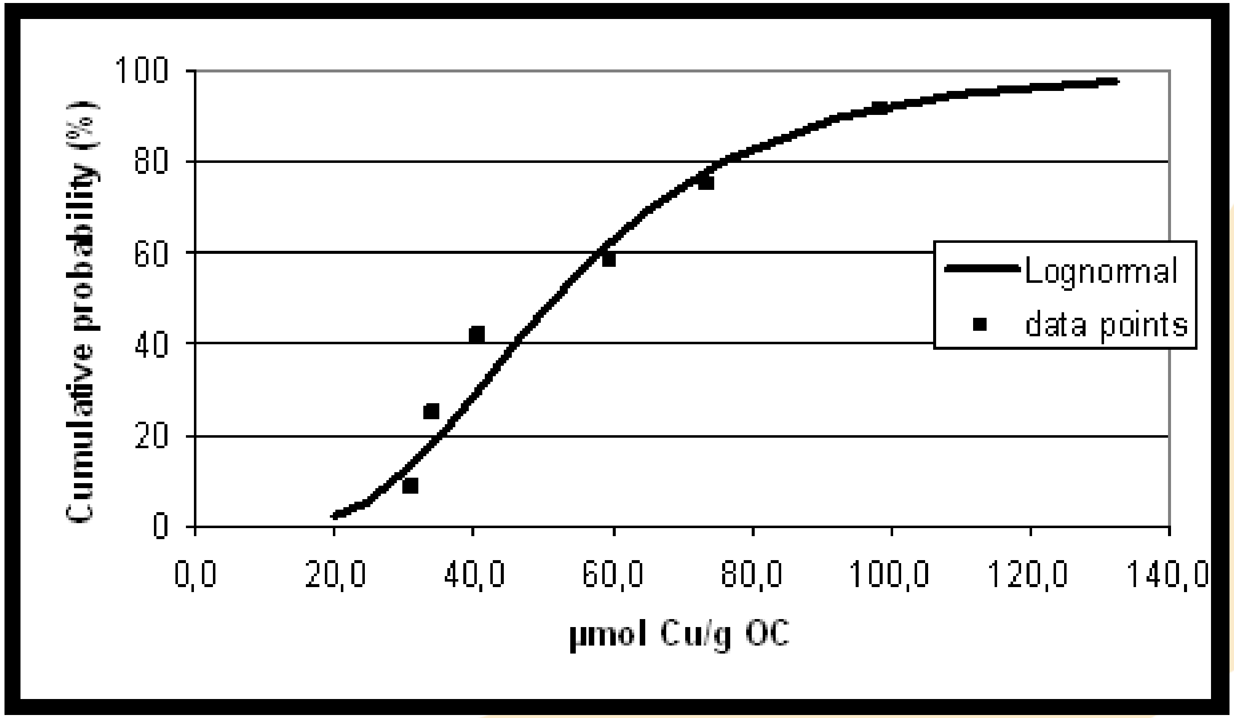
NOEC/OC – mg/kg OC

↓

PNEC – mg/kg OC
Based on lowest NOEC/SSD and AF

EU
Natl
Local

Derivation of a PNEC sediment
Whole sed tests- Data-rich metals



Log normal HC5-50 sed (benthic SSD)
= 1741 (1112-2071) mg Cu/kg OC

Sediment PNEC setting
Weight of evidence approach

Equilibrium partitioning

⇕

Direct sediment ecotoxicity

⇕

Mesocosm
Field data

Derivation of a PNEC sediment
2. Equilibrium partitioning method

Basic Principle

$\Rightarrow$ ***$PNEC_{sed}$ (mg kg-1) = $PNEC_{fw}$ (mg l-1) * Kd (l kg-1)***

PNEC total – mg/kd dry weight

OC SS

PNEC $_{EqP}$/OC – mg/kg OC

$\Rightarrow$ ***$PNEC_{sed}$ (mg kg-1) = $PNEC_{fw}$ (mg l-1) * Kd (l kg-1)***

Kd (l kg-1) : Wham defined

EU
Natl
Local

Derivation of a PNEC sediment
3. Field data and WOE

PNEC - Equilibrium partitioning

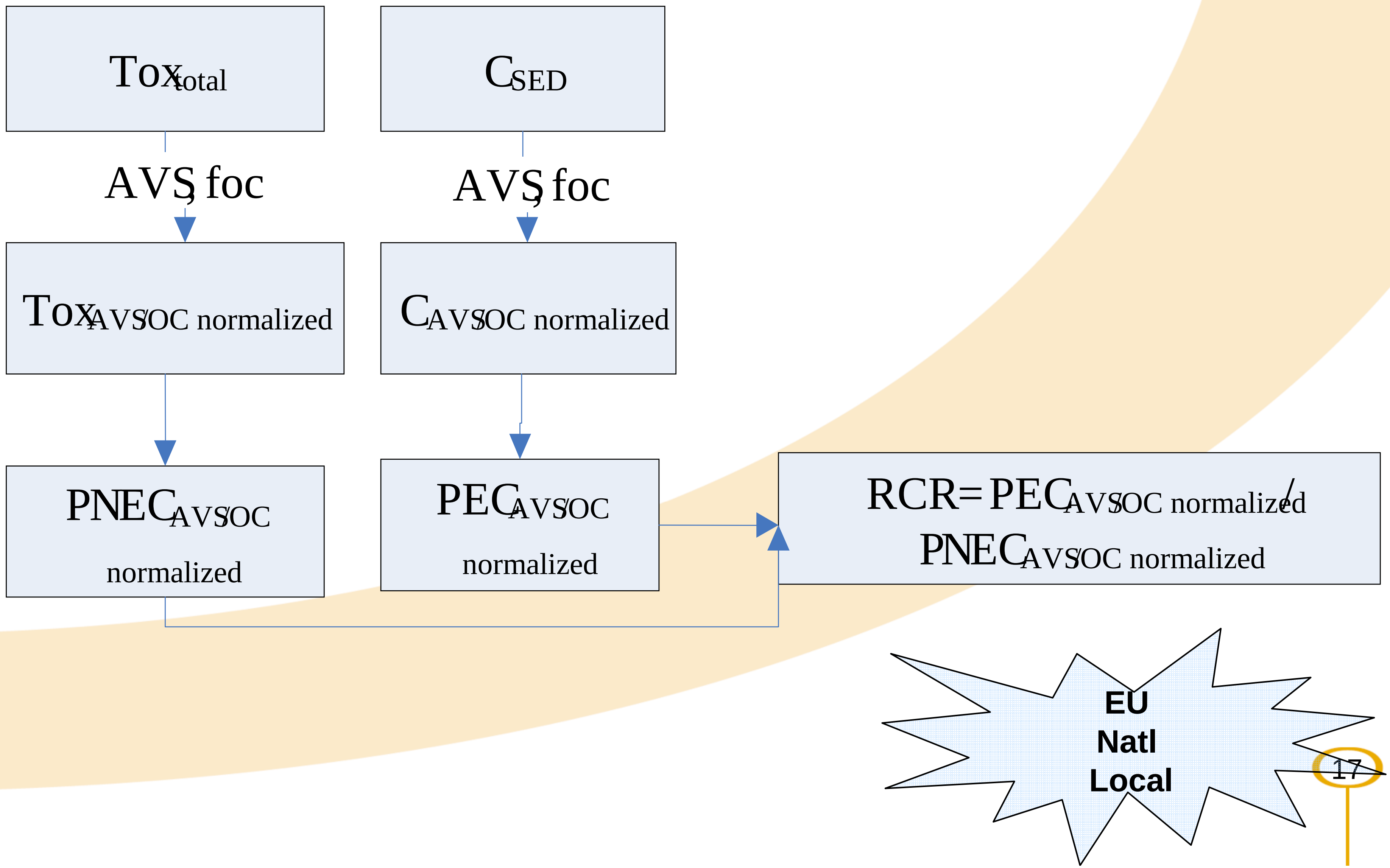
PNEC- Direct sediment ecotoxicity

Background

AF need

Mesocosm studies
Field data

Metal compliance checking



Conclusions and Future needs

Metals SQC may be needed for metals, passing the trigger criteria

Draft proposal metal EQS is based on metal RARs and MERAG and includes

- A weight of evidence approach
- Bioavailabilty corrections- AVS and OC

Further discussion of the proposal by the WG-EF-EQS

Further research on metal binding to FeO, MnO… and its influence on ecotoxicity

Refined monitoring : including measurements of AVS, OC…

Possibility for integrated field assessment