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Tools to Inform Sediment Assessment, Management, and Regulation: Book Update

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6 - 10 October 2025

Talking Points

- **SQGs rest on 40^{+}-year-old science** and reflect conditions that may no longer be environmentally relevant.
- And yet, there is still extensive use of "SQG look-up tables" for monitoring, management, and regulatory purposes.
- Reframing "sediment quality" is needed to support sustainable sediment management in the 21st century.

People

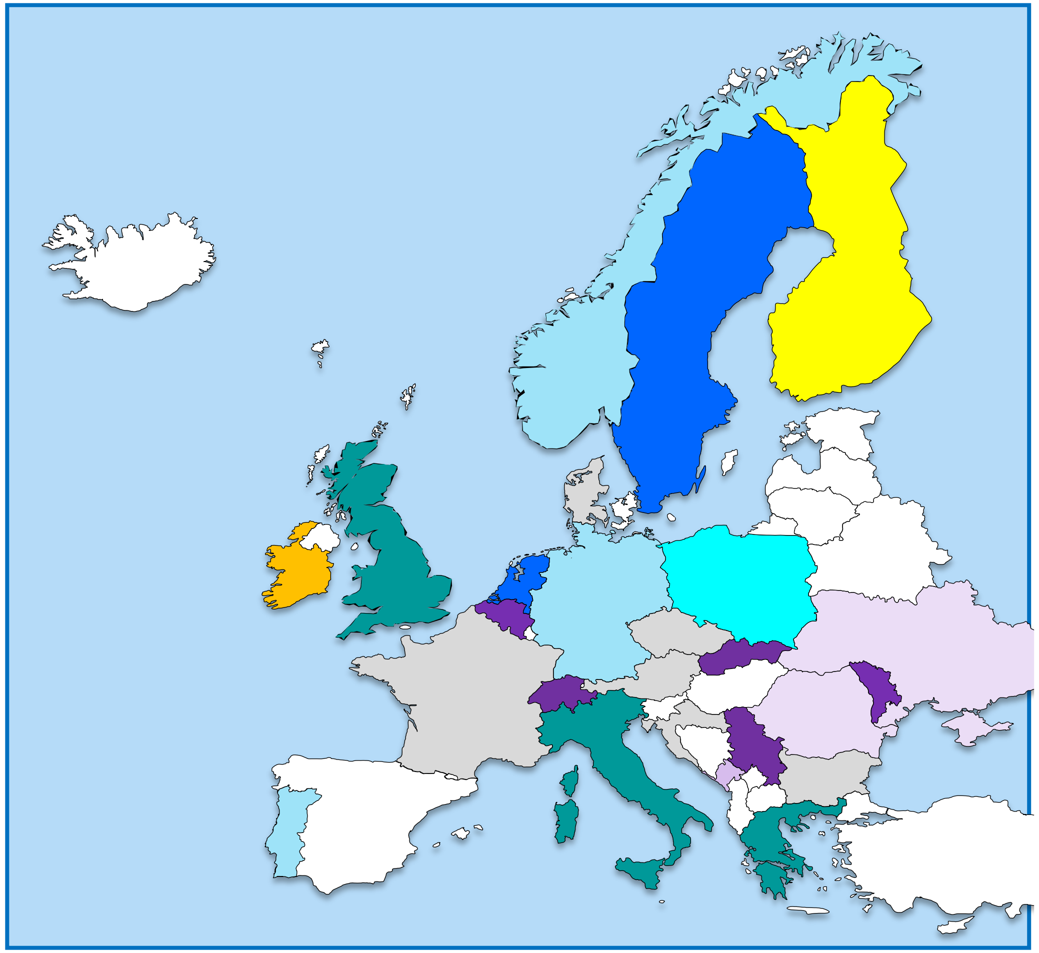
Communities

Business

Ecosystems

Different Approaches to Sediment Quality Assessment In Europe

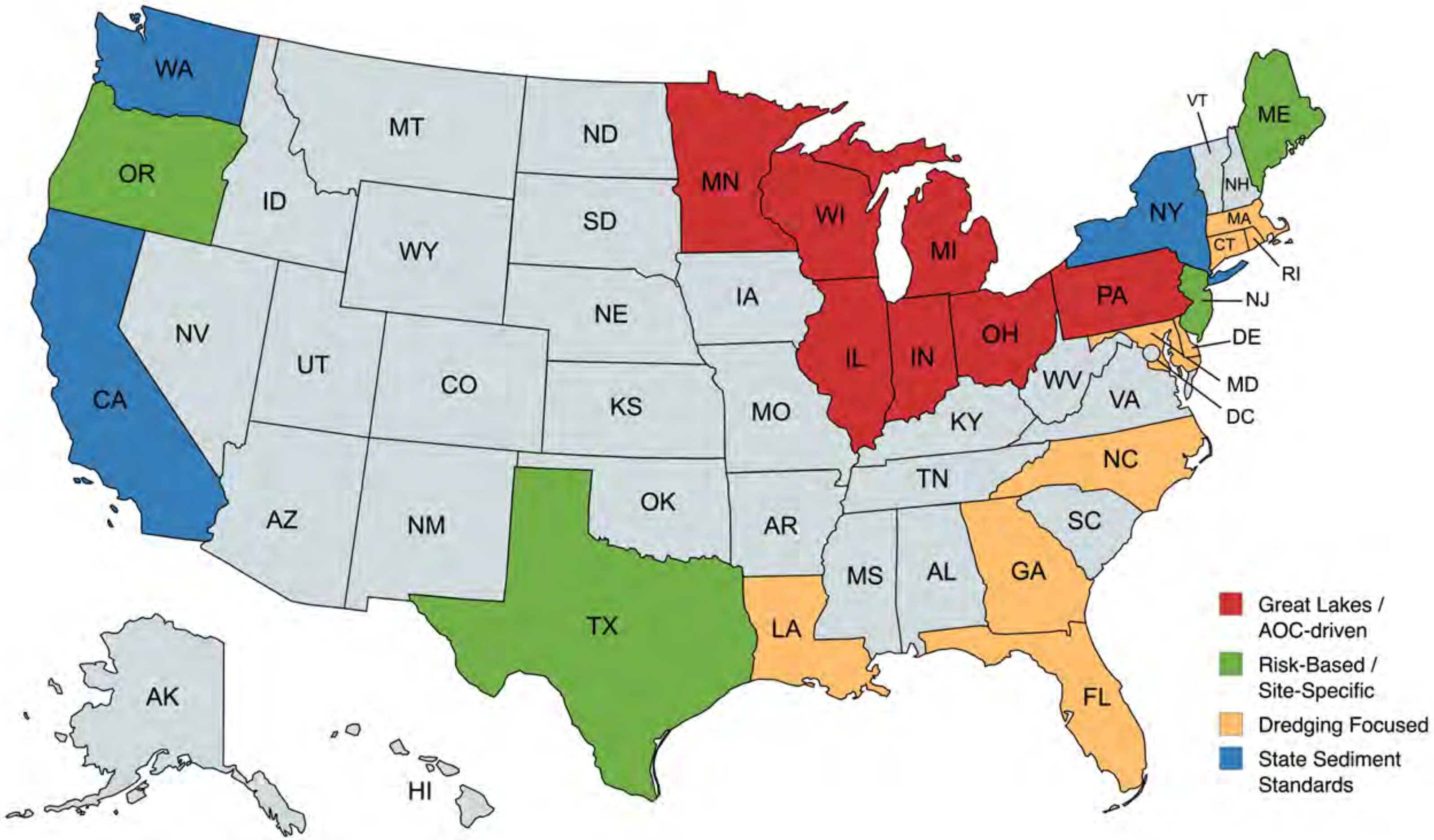
- Standards and guidance – marine and fw
- Standards and guidance – fw
- Standards for monitoring – fw and marine
- Standards for monitoring - marine
- Standards for monitoring – fw
- International approaches
- Sediments evaluated using soil values
- No guidance – soil values available
- No guidance but CRA recommended
- No sediment policy (review-based)
- No info



Different Approaches in the US

Many states use more than one approach depending on context (e.g., contamination vs. dredged):

- **Standards-based** reflects states with formal sediment quality standards/objectives in regulation.
- **Great Lakes/AOC-driven** reflects states where sediment programs are organized around Areas of Concern and RAPs.
- **Dredging-focused** reflects states where sediment assessment activity is routed through dredged-material testing and disposal programs.
- **Risk-based/site-specific** captures states that use case-by-case risk assessment (often tied to human fish consumption).



https://www.mapchart.net/usa.html

Role of SQGs in Sediment Management

Reason for Sediment Assessment	Role for SQGs	Specific Role
Mapping spatial patterns	Primary	Relative patterns of contamination
Measuring temporal trends	Primary	
Remediation / restoration objectives	Primary	In cases of simple contamination… where the costs of investigation outweigh the costs of remediation
	Secondary	As part of an ecorisk assessment, or tiered assessment scheme involving other tools
Determining condition of populations and communities	Secondary	
Estimating ecological risks, including bioaccumulation	Secondary	
Screening suitability of proposed use or development	Secondary	
Assessing impacts of sediment dredging and / or management	Secondary	
Long-term monitoring of system status post-remediation	Secondary	
Estimating human health risks / evaluation of biomagnification	None	Not designed for this purpose
Determining sediment stability / transport	None	Not relevant

Are SQGs Informing Sediment Management Objectives?

Are we looking at sediment differently today?

Are the sediment investigation tools and frameworks fit for purpose?

Are we assessing sediments properly?

The "so what" question about SQGs

Are SQGs even relevant anymore?

What data do we need to manage sediments for the 21st century?

Are new tools helpful for establishing sediment quality?

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Typical Sediment Tools – Purpose and Use

Tool	Purpose	Typical Regulatory Use
Box corer / grab / corer samplers	Collect undisturbed sediment & strata for chemical, bio, and dating analyses	Baseline surveys; contaminated site investigations; dredged material characterization
Side-scan sonar & sub-bottom profiler	Map bathymetry, sediment type, historical layers, buried objects	Identify disposal sites, UXO/obstruction hazards, dredging footprint mapping
ADCP & turbidity sensors	Measure sediment transport & resuspension under waves/currents	Support TMDLs, dredging plume compliance, fate modeling inputs
In-situ passive samplers (DGT, SPMD, PE, PDMS)	Estimate bioavailable contaminants in porewater & water column	Site-specific exposure assessment; comparison to EqP or WQC-derived thresholds
Benthic grabs & eDNA sampling	Characterize benthic community structure & biodiversity	Sediment quality triad; WFD/ELD benthic status assessment
Chemistry Analyses (ICP-MS / GC-MS / LC-MS/MS)	Quantify metals, organics, PFAS, other contaminants	Compare to SQGs (ERL/ERM, TEL/PEL, PEC/TEC); regulatory compliance
Geochronology (210Pb / 137Cs)	Determine sediment deposition & burial rates	Natural recovery evaluation, legacy contamination
Sediment toxicity tests (e.g., Hyalella, Chironomus)	Evaluate adverse biological responses to bulk sediment or porewater	Weight-of-evidence (triad), Tiered testing for dredged material
Bioaccumulation tests	Assess contaminant transfer into food webs	Risk assessment for wildlife/human consumers; evaluate remedy effectiveness
GIS & spatial analysis	Integrate field/lab data into georeferenced maps; Detect temporal and spatial change in sediment condition	Site investigation reports; remedial design & long-term monitoring plans; Long-term compliance & effectiveness monitoring under permits
Fate & transport / food-web models (EFDC, AQUATOX, BASS)	Predict contaminant migration and exposure	Support RI/FS alternatives analysis, remedy performance forecasting
MCDA & cost–benefit tools	Compare remedial options against risk reduction, cost, feasibility	Regulator–stakeholder decision processes for remedy selection

What We Know and Need

What We Know:

- **Aquatic ecosystems differ widely**; more than one sediment assessment tool is needed to evaluate sediment and biotic interactions and to derive ecologically meaningful assessment approaches.

What We [Still] Need:

- **Objective assessment** of various lines of evidence (LOEs) and how they should be integrated to inform sediment management and regulatory decisions.

- **New approaches and improved tools** to account for biodiversity, climate change, emerging contaminants, and chemical mixture interactions.

Assessing and Managing Sediment Quality in the 21st Century

Edited by
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2026
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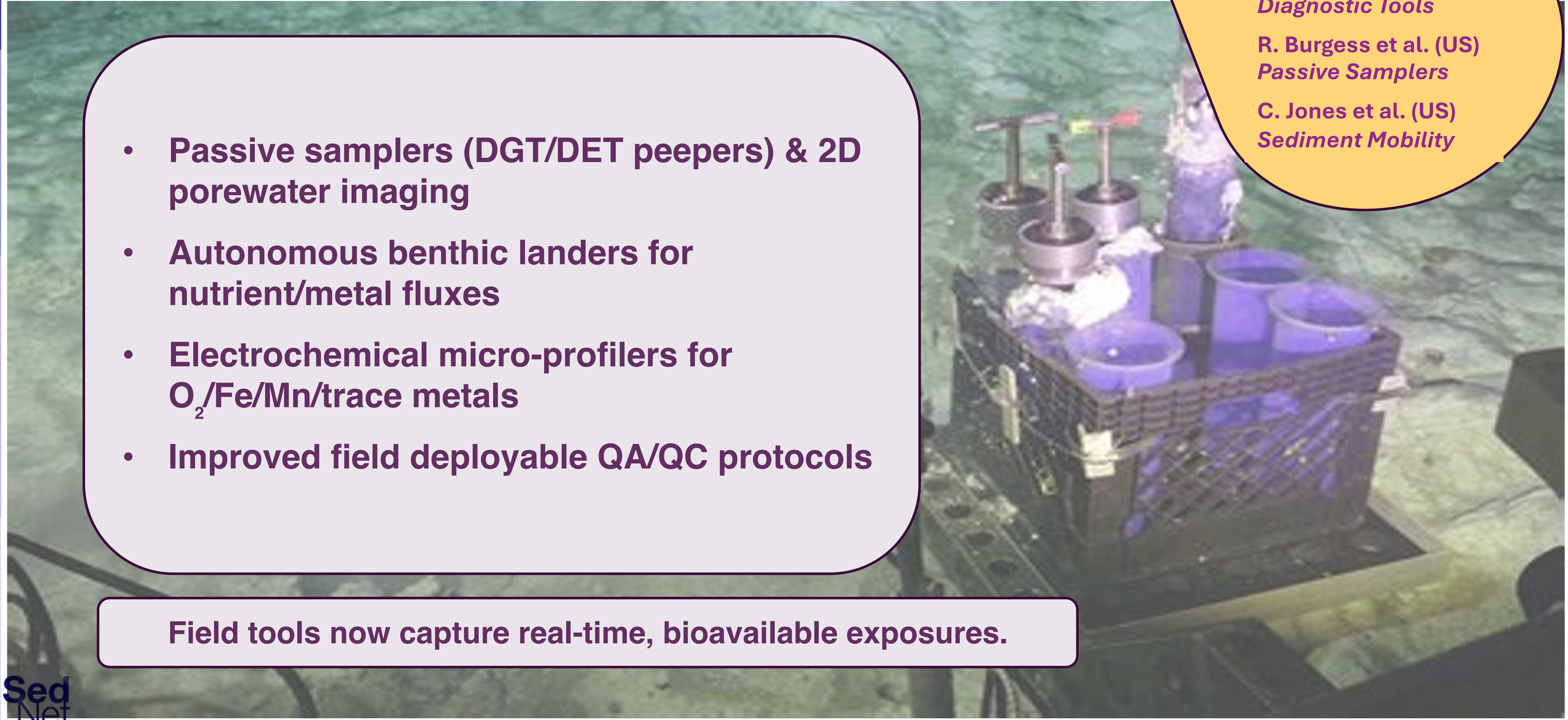
Advances - Field / In-Situ Tools



- Passive samplers (DGT/DET peepers) & 2D porewater imaging
- Autonomous benthic landers for nutrient/metal fluxes
- Electrochemical micro-profilers for O_2/Fe/Mn/trace metals
- Improved field deployable QA/QC protocols

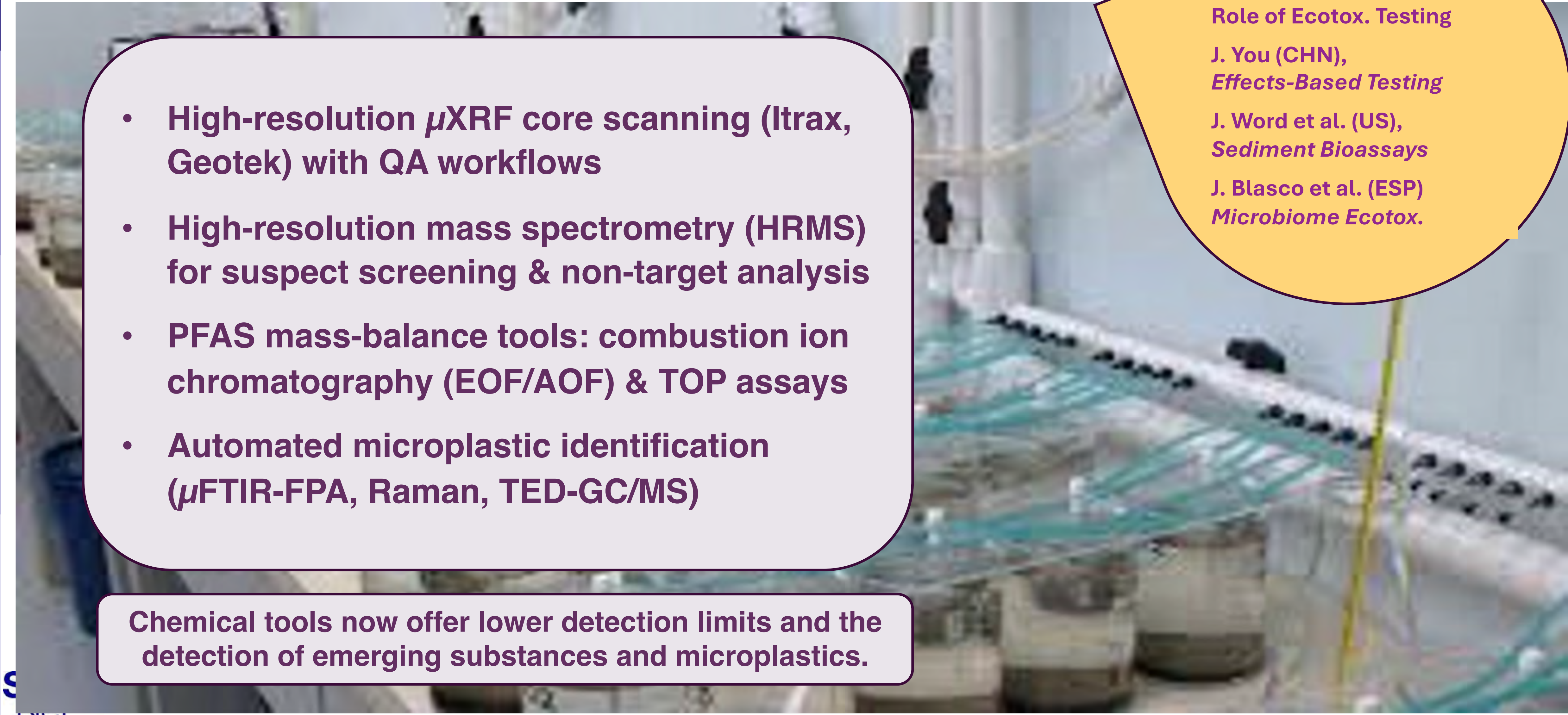
Field tools now capture real-time, bioavailable exposures.

M.L. Baat et al. (NER)
Diagnostic Tools

R. Burgess et al. (US)
Passive Samplers

C. Jones et al. (US)
Sediment Mobility

Advances – Chemical & Toxicity Testing



- **High-resolution µXRF core scanning (Itrax, Geotek) with QA workflows**
- **High-resolution mass spectrometry (HRMS) for suspect screening & non-target analysis**
- **PFAS mass-balance tools: combustion ion chromatography (EOF/AOF) & TOP assays**
- **Automated microplastic identification (µFTIR-FPA, Raman, TED-GC/MS)**

Chemical tools now offer lower detection limits and the detection of emerging substances and microplastics.

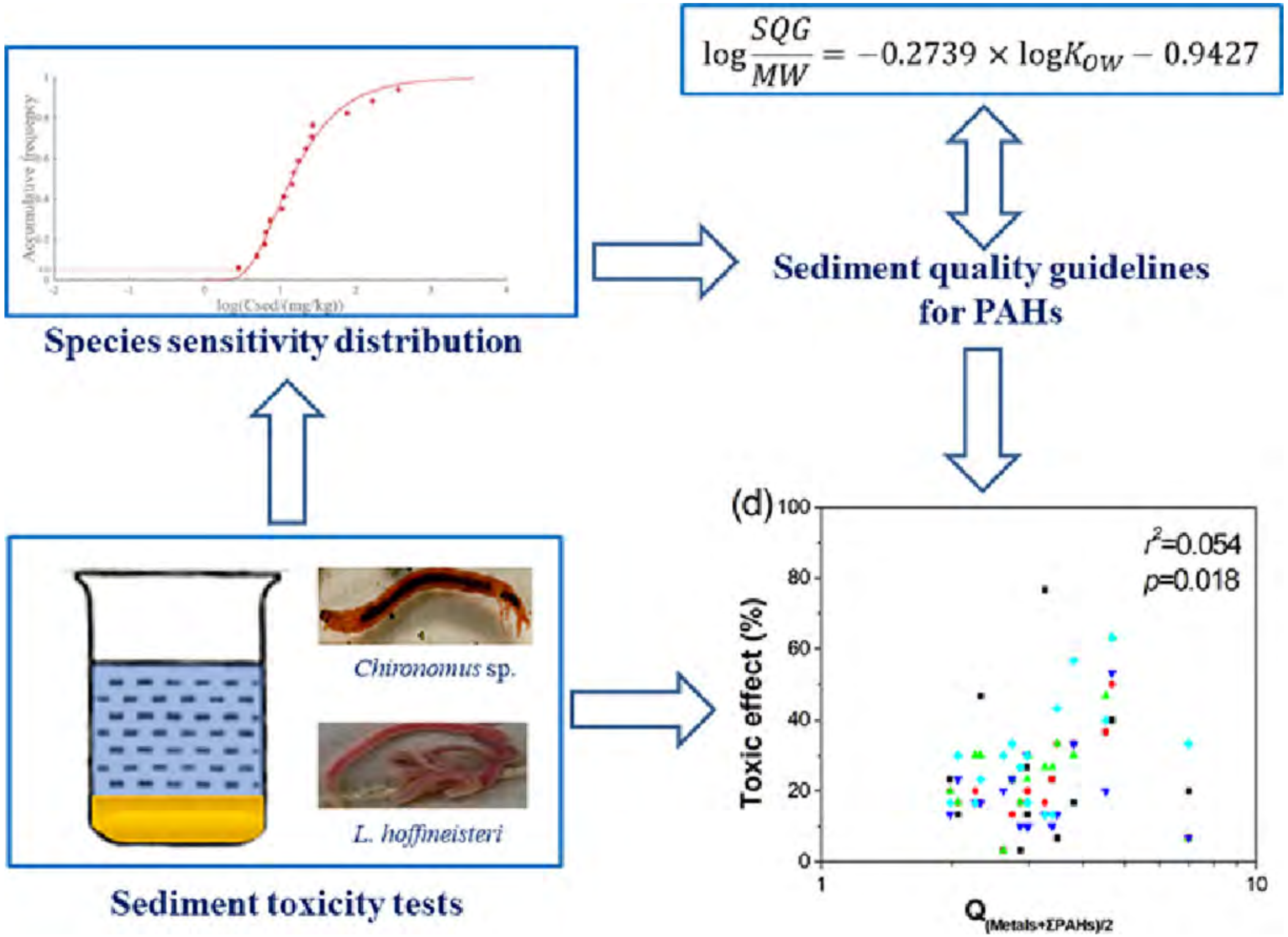
C. Casado et al. (CHE)
Role of Ecotox. Testing

J. You (CHN),
Effects-Based Testing

J. Word et al. (US),
Sediment Bioassays

J. Blasco et al. (ESP)
Microbiome Ecotox.

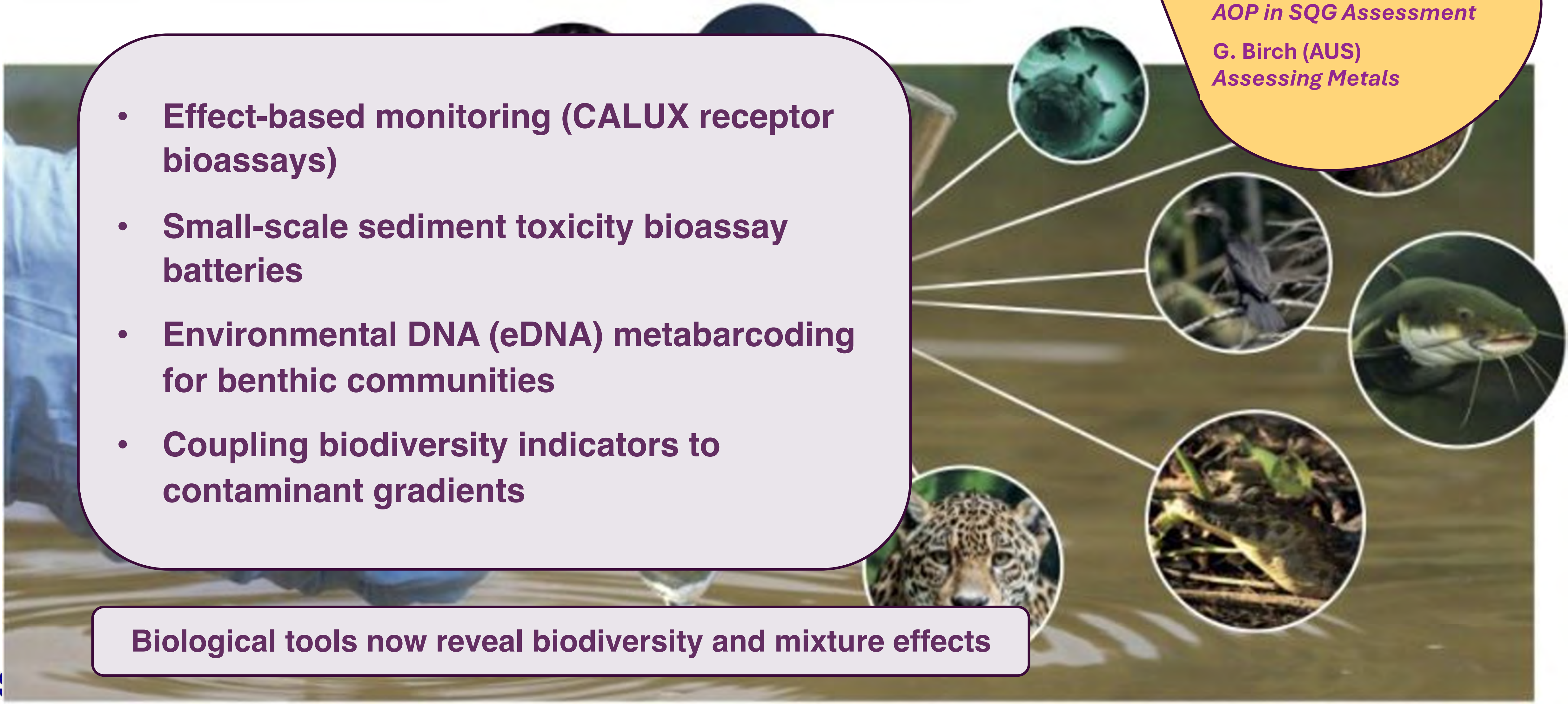
Species Sensitivity Distributions (SSDs)



P. Fuchsman et al. (US)
SSDs and Causality

U. Ghosh (US)
SSDs and Bioavailability

Advances – Biological Tools



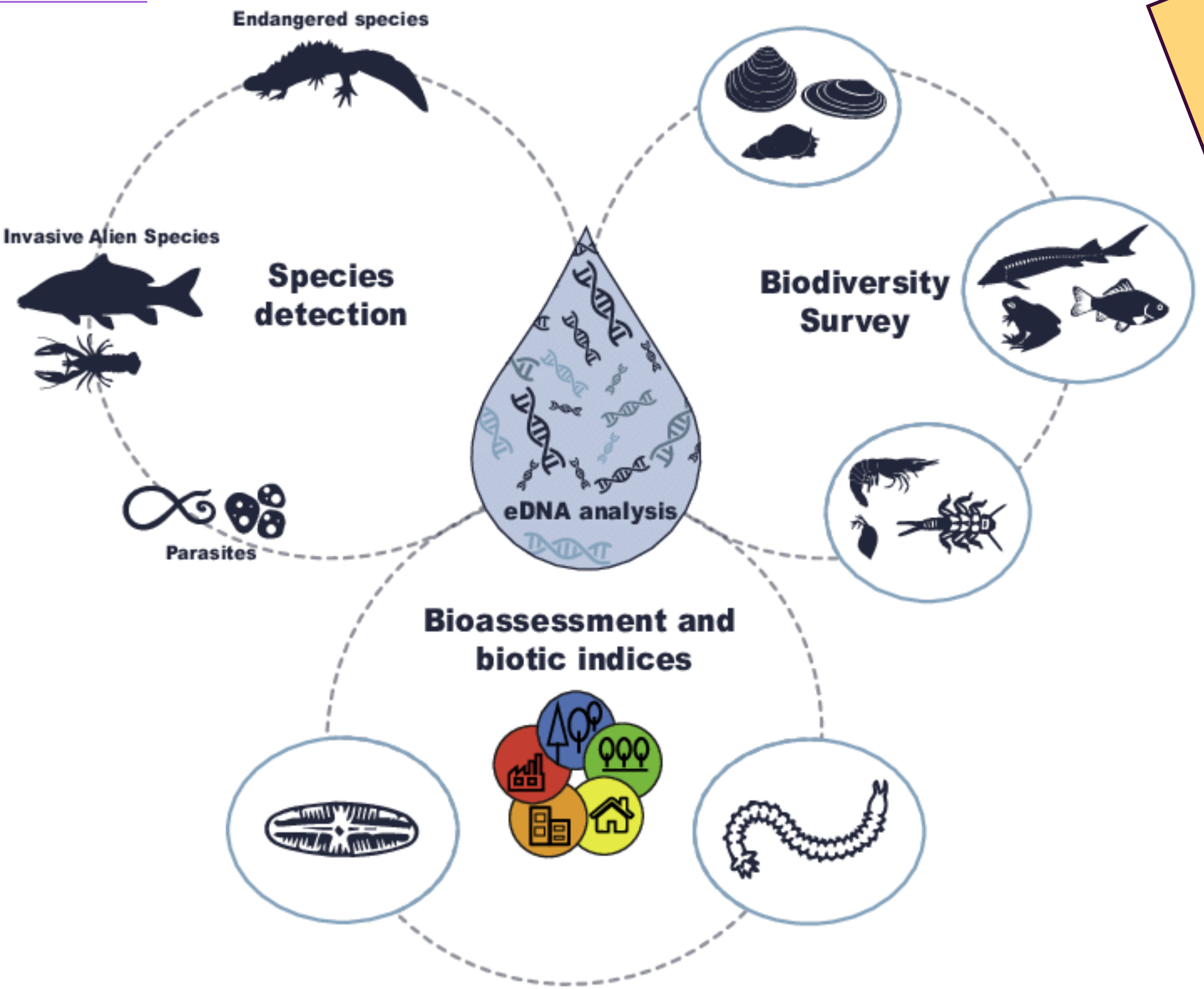
- Effect-based monitoring (CALUX receptor bioassays)
- Small-scale sediment toxicity bioassay batteries
- Environmental DNA (eDNA) metabarcoding for benthic communities
- Coupling biodiversity indicators to contaminant gradients

J. L. Moreira (BRA),
AOP in SQG Assessment

G. Birch (AUS)
Assessing Metals

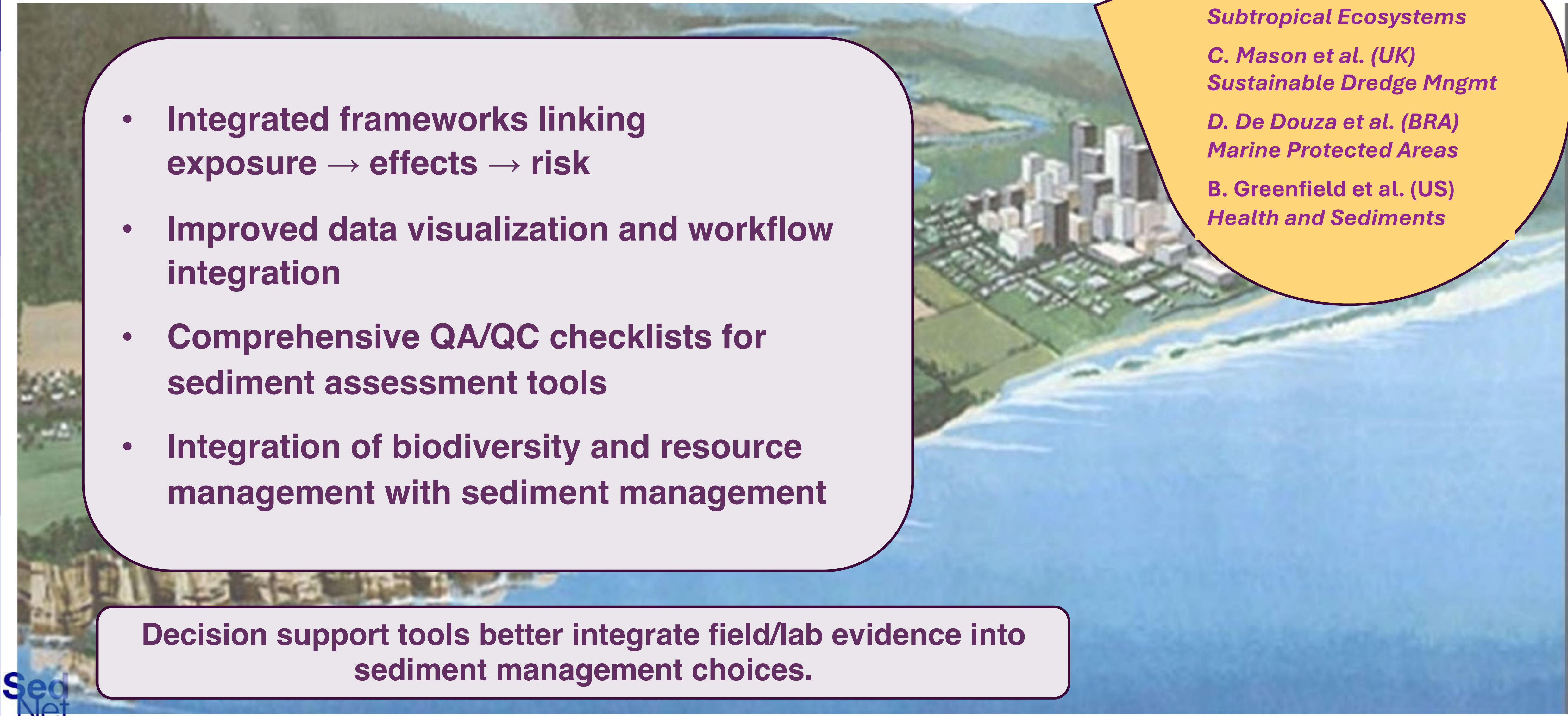
Biological tools now reveal biodiversity and mixture effects

eDNA for Biomonitoring



J. Pawlowski et al. (POL)
eDNA Testing

Advances – Decision Support



- Integrated frameworks linking exposure → effects → risk
- Improved data visualization and workflow integration
- Comprehensive QA/QC checklists for sediment assessment tools
- Integration of biodiversity and resource management with sediment management

W. Malherbe et al. (ZAF)
Subtropical Ecosystems

C. Mason et al. (UK)
Sustainable Dredge Mngmt

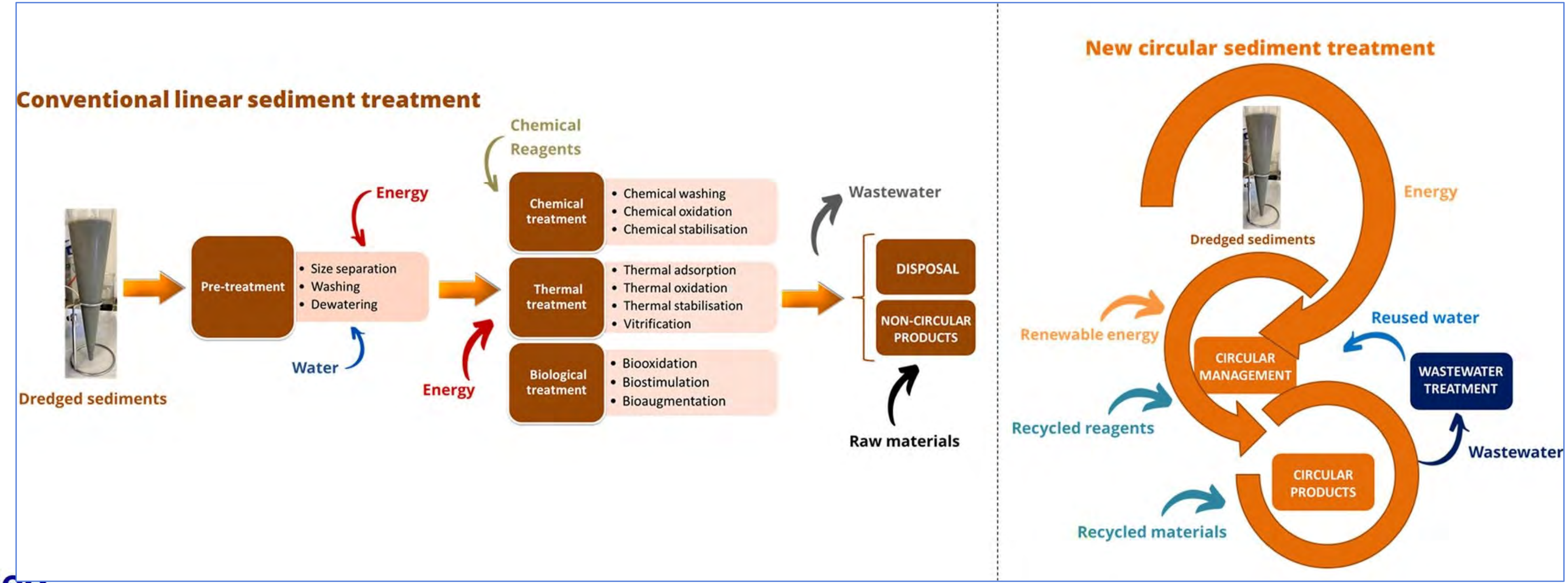
D. De Douza et al. (BRA)
Marine Protected Areas

B. Greenfield et al. (US)
Health and Sediments

Decision support tools better integrate field/lab evidence into sediment management choices.

Sediments in a Circular Economy

Circularity requires that we re-think baseline and background contaminant levels; and the definition of waste



https://www.sciencedirect.com/science/article/abs/pii/S0956053X22002173

Sediment Management in the 21st Century

- **From contaminant cleanups to system-wide sediment stewardship** that supports navigation, habitat, shoreline stability, and climate adaptation.
- **From disposal to beneficial reuse and circularity.**
- **From static standards to adaptive, risk-based decision-making** supported by new monitoring tools.
- **From site-by-site fixes to basin-scale governance and international coordination.**

Thank You!

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Speaker Profiles

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An ecotoxicologist specializing in environmental damage, impact, and risk assessment. His career has focused on investigating environmental contamination, identifying the potential dangers to people and wildlife, and developing solutions that protect the health and safety of affected communities.

Sabine E. Apitz

Director
SEA Environmental Decisions Ltd., UK

An expert in ecosystems-based management and policy applied to catchments and coastal environments. Her career has focused on developing conceptual tools that link what scientists can measure to what they aim to achieve in environmental management, policy, and decision-making. She is editor-in-chief of the peer-reviewed journal - *Integrated Environmental Assessment and Management (IEAM)*.