



Analytical chemistry



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Protecting ecosystem health & environmental chemistry



- Key challenges:
 - Which chemicals, the correct chemicals?
 - In what form, where and how much?
 - How will they behave?
 - Can we predict fate & behaviour?
 - How do we best integrate?

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Keep your eye on....

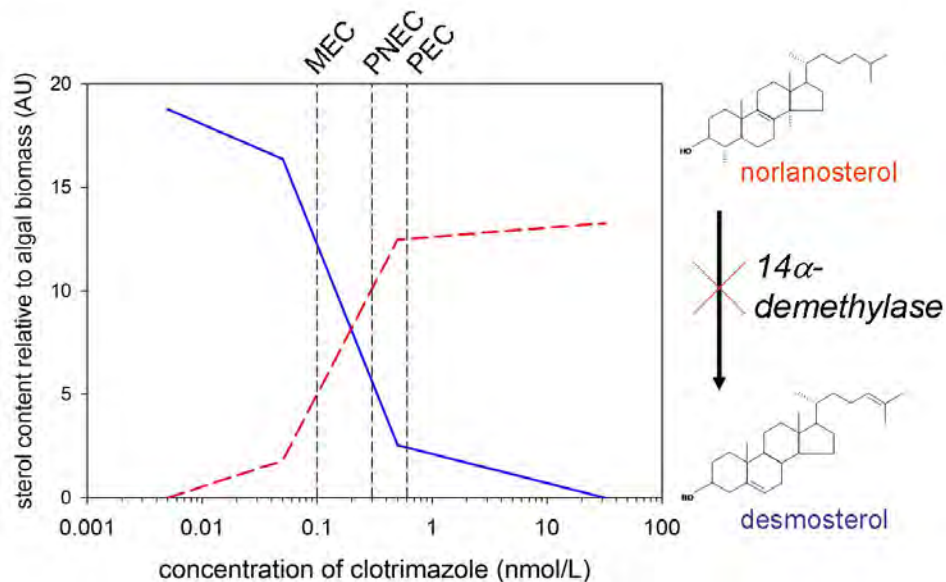


- Narcotics, antifreeze agents, alkanolamines, UV filters, PAC transformation products & natural phytoestrogens.
- Assignment of provisional-PNECs where the EQS is absent. Von der Ohe et al.

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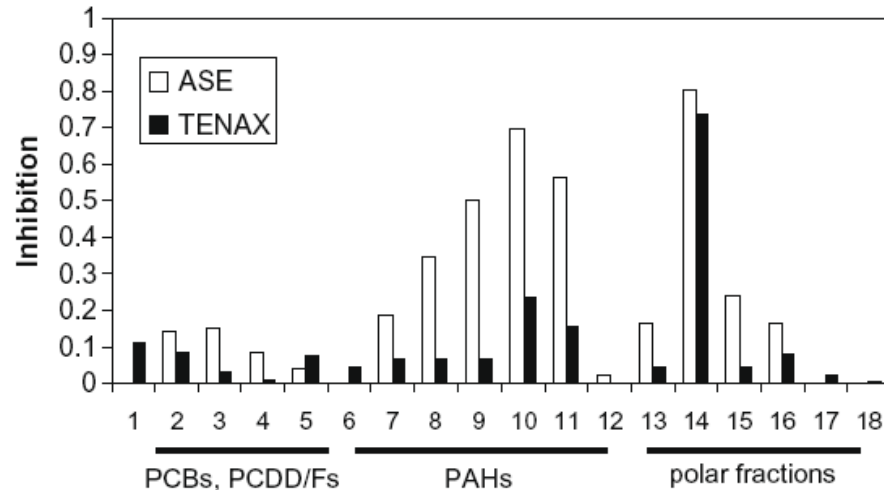
Pharmaceuticals



- Fate of the human antifungals fluconazole and clotrimazole dominated by domestic wastewater. Kahle et al.
- Effects on marine microalgal communities. Porsbring et al.



Partitioning & bioavailability



- (Schwab et al. (2009) Environ. Toxicol. Chem 28:1506-1517)
- Bioavailability & bioavailability based dosing should be considered in biotesting and analysis.
- Polar compounds are a major concern in partitioning processes, effects & long-term fate.



Improved understanding of metal bioavailability

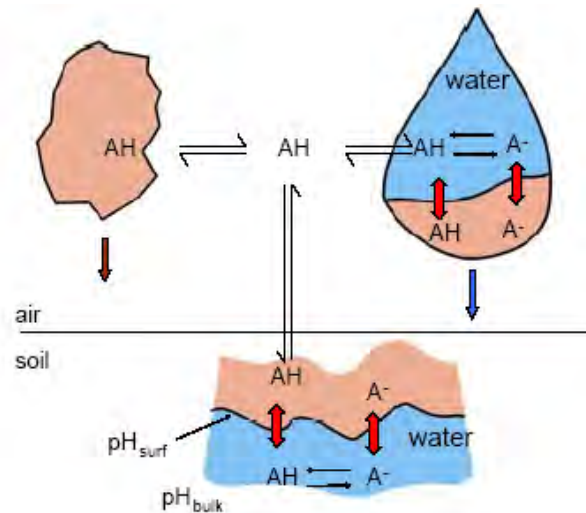


- Evidence for heavy metal uptake by plants from air using advanced spectrometric techniques (extended x-ray absorption fine-structure ; EXAFS). Uzu et al.

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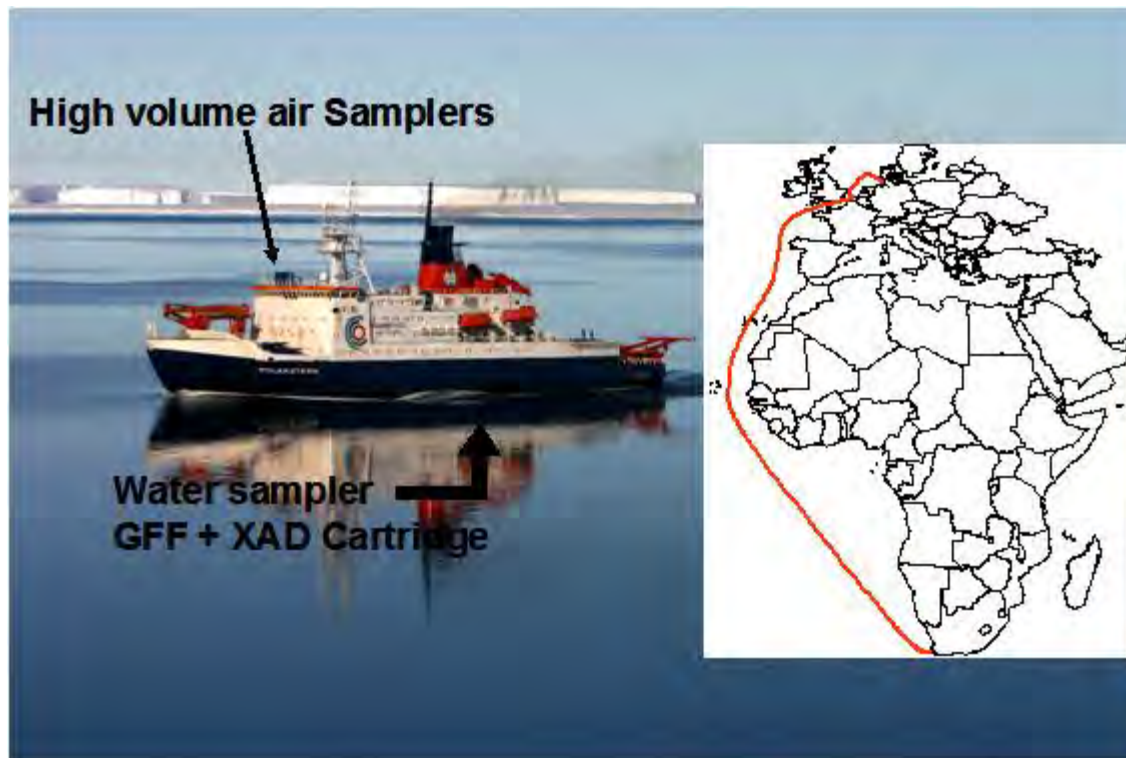
Advancements in fate modelling



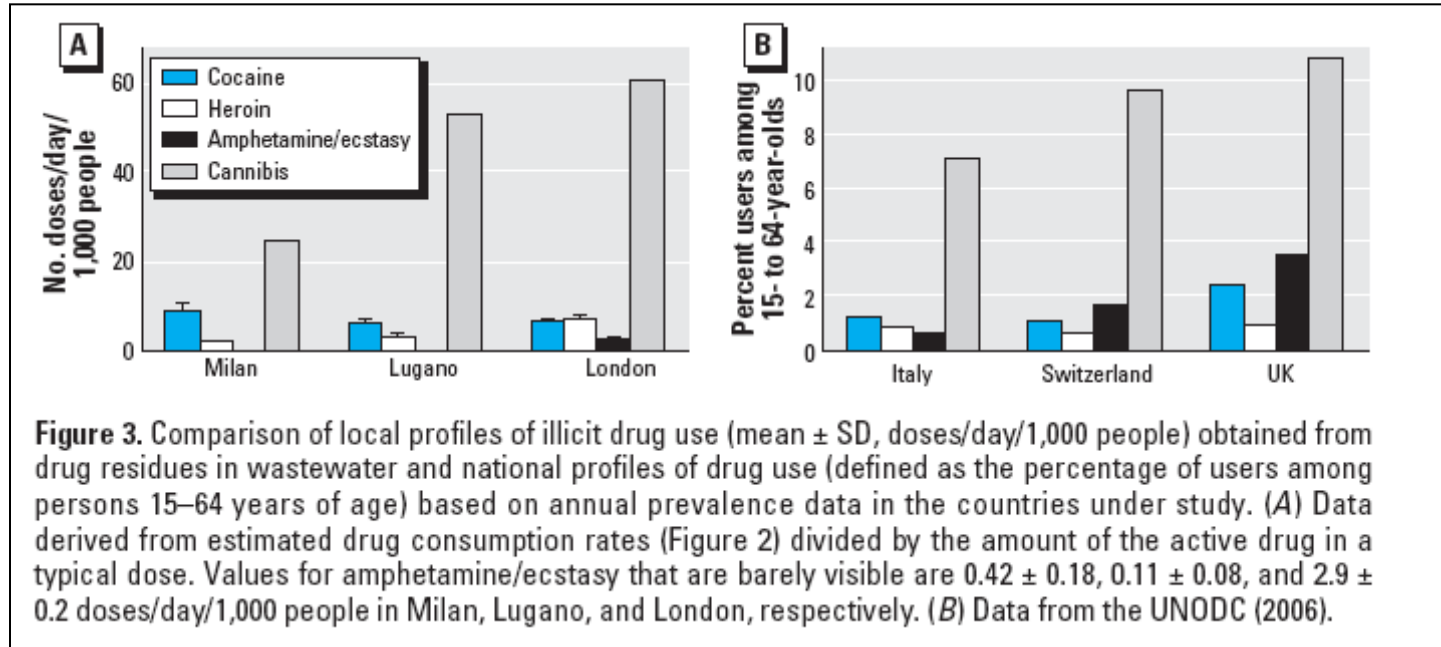
- Multi media models for compounds of emerging concern (e.g. ionizable compounds). Franco & Trapp.
- Proposed improved prediction of bioaccumulation assessment through assessing biotransformation rates. McLachlan et al.



Global



- Evidence of a global scale decrease in background air concentration of dioxins & furans. Nizzetto et al.



- Zuccato E et al., Estimating community drug abuse by wastewater analysis. *Environmental Health Perspectives*, 2008, 116: 1027-1032



Ecotoxicology



Marco Vighi

University of Milano
Bicocca, Italy

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Closing Keynotes on Ecotoxicology



**Protecting ecosystem health:
facing the challenge of a globally
changing environment**

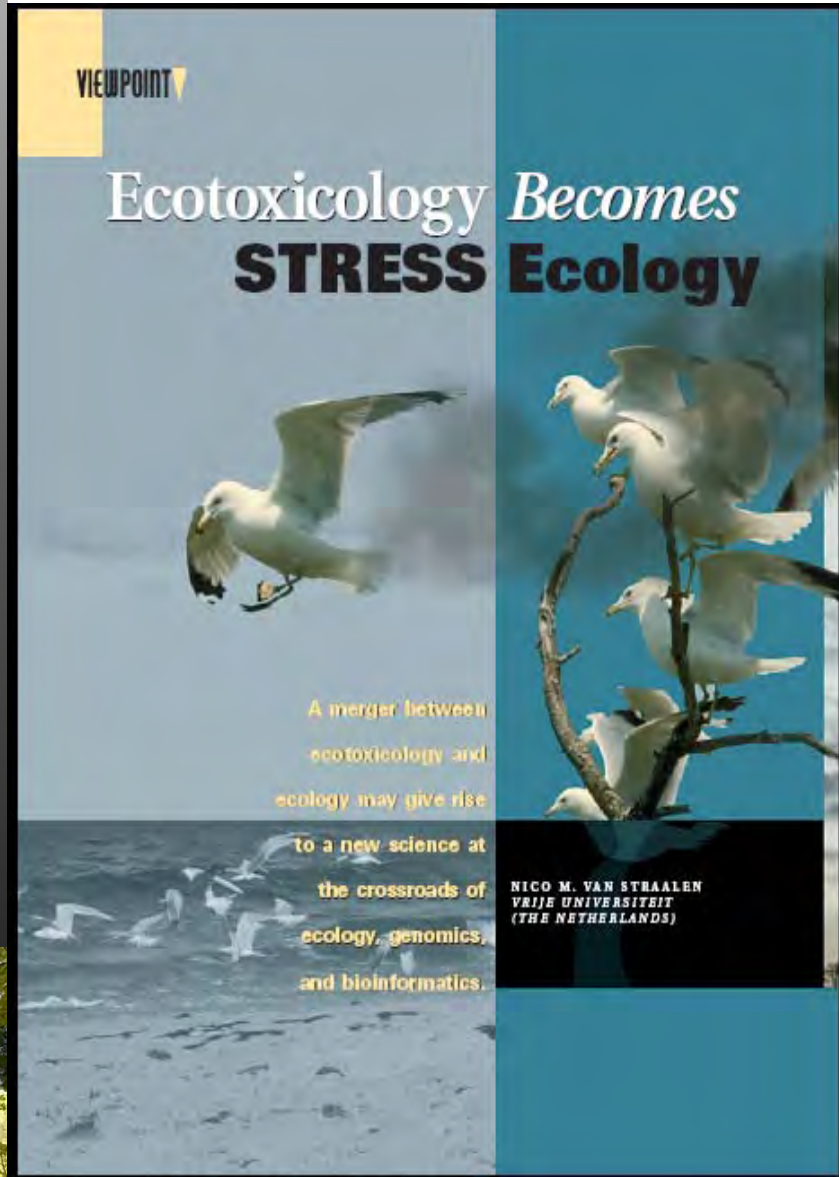
***Is ecotoxicology going in this
direction?***

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A stimulating provocation



Because the major environmental pollutants are coming under the control of regulatory authorities and are declining, the “testing-based” approach of ecotoxicology is not expected to call for major scientific innovation and discovery.

Consequently, ecotoxicology has come to a transition phase and should assume a new role, which is to assimilate with the part of ecology commonly denoted as “stress ecology”.

Nico van Straalen
Environmental Science & Technology,
2003

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Two strictly related concepts



Ecosystem health



Stress ecology

Ecosystem health is the integrated result of a complex interaction between ecosystem properties (biotic and abiotic) and multiple potential stress factors

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A scientific debate



A relevant scientific debate started at the SETAC Meeting in The Hague

The debate continued in Porto and in Warsaw.

“Are ecotoxicological tools suitable for attaining the main objective of ecotoxicology?

Protecting structure and functions of biological communities and ecosystems.”

The question is particularly relevant in light of the van Straalen statements

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Bridging the gap



Ecotoxicological tools

Objective

- Studies on indirect effects
- Higher tier testing (mesocosms, semi-field)
- Multiple stress assessment
- Omics
- Laboratory testing
- Biomarkers

Assessing effects on structure and functions of biological communities

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Ecotoxicology at the Göteborg Meeting



Testing and methodological innovation

ET01 - Animal alternatives in ecotoxicology: experimental approaches

ET02 - Application of OMICS technologies to identifying critical pathways or biomarkers of toxicity that impact risk

ET09 - Histopathology in ecotoxicology

ET12 - New developments in OMICS, including epigenetics

The “testing-based” approach of ecotoxicology has been well represented

Innovative methodological approaches (epigenetics, omics, hystopathology, non-animal testing, etc.) can improve our capability for understanding the ecotoxicological behaviour of dangerous chemicals, for assessing their potential hazard as well as for facing ethical issues.

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However.....

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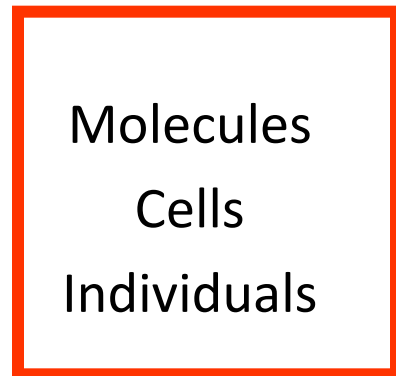


Other important messages have been sent



**Most other sessions highlighted the need for higher
hierarchical level assessment**

Biological Hierarchical Levels



Ecological Hierarchical Levels





Presentations bridging the gap



Effects on dynamic of natural populations

45 presentations

**Effects on structure and functions of communities
(natural or semicontrolled)**

38 presentations

Indirect effects

21 presentations

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This is very promising!

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Conclusions



Ecotoxicology still needs “reductionistic” approaches

The “testing-based” approach of ecotoxicology can still provide essential information required for pragmatic and regulatory purposes, as well as for a better knowledge of complex modes of action.

This is particularly relevant if we consider that for many groups of emerging contaminants (e.g. perfluorinated compounds, nanomaterials, etc.) our ecotoxicological knowledge is still largely incomplete.

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Conclusions



The need for more “ecological realism”

However, reductionistic approaches suffer for a lack of ecological realism.

Protecting ecosystem health requires the understanding of the complex effect of combined multiple stressors, of the complex interactions between natural environmental agents and anthropogenic factors, as well as among the components of ecosystems.

Bridging the gap between reductionistic tools and an holistic ecological view is a difficult challenge.

However, building this bridge has started.

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“Nature is not only more complex than we think. It is more complex than we can think.”

Frank Edwin Egler (1970). *The Way of Science. A Philosophy of Ecology for the Layman*

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Thanks for your attention

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LCA and Sustainability



Annette Köhler

ETH Zürich, Switzerland

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Protecting Ecosystem Health.....



We need more and advanced science...

**Many new advanced developments in
LCA**

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Life Cycle Inventory Session



- Increased sophistication at different levels and for different purposes
- Enhanced use of mathematical models and algorithms
- Increased combination with other methods, e.g. economic input/output modeling

Global multi-regional environmentally extended I/O database (EXIOPOL project)

- Improving present methodological shortcomings of ISO-LCA
- Broadening scope of using life cycle approaches

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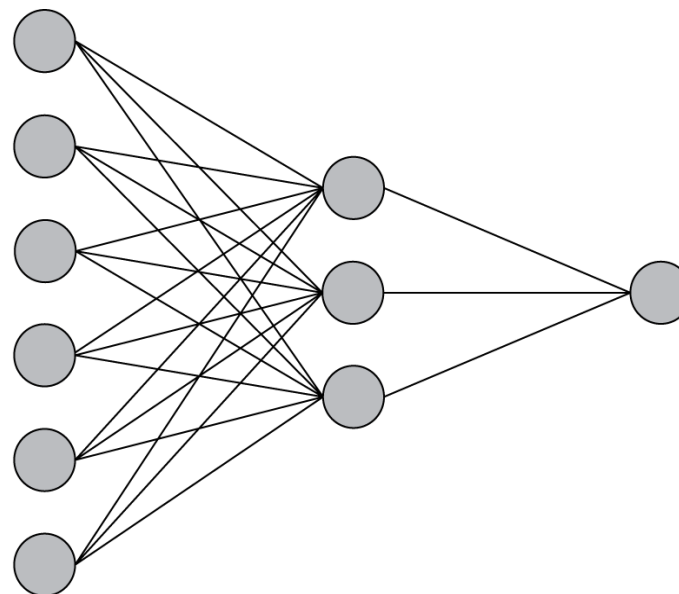
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Neural networks for LCI modeling



- Molecular-structure based approach
- No knowledge of production processes required, only
- Estimation of cradle-to-gate LCI and LCIA parameters



Presentation by G. Wernet et al.:

Advanced neural network models for the prediction of chemical production properties

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Life Cycle Impact Assessment Session



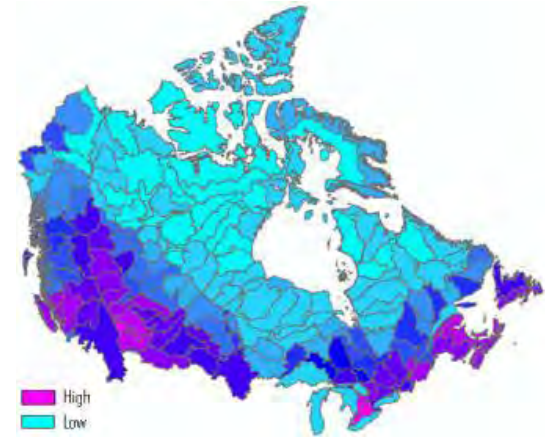
- Special focus on biodiversity damages and water use and scarcity issues
- Methods covering midpoint and endpoint modeling for ecosystem quality and human health impacts
- Broad method portfolio related to water resources as new impact category
 - Weighted virtual water based method....complex models for groundwater extraction
- Closing substantial gaps in LCIA!

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Regionalization Session



•Manneh et al. (Canada)

- Computational limits not crucial
- Increased use of GIS data
- Advanced spatially and temporally resolved multimedia and multi-pathway models with different resolution scales (e.g. eco-zones, sub-watersheds, provinces,...)
 - Resolved models help to
 - (i) reduce uncertainty of characterization factors (CF)
 - (ii) quantify additional uncertainty when using generic CF
 - Managing global life cycles **and** regional ecosystem needs

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**But do we sufficiently
face the challenge of a
globally changing
environment?**

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Needs ?!



- Show how existing science can be used (not wait for perfect solution)
- Approaches needed for implementation and action in practice
 - Policy making
 - Industry

....to protect ecosystem health and make the “world” more sustainable

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Sessions on Life Cycle Management, Environmental Policies, Sustainability Assessment



- Guidelines for social life cycle assessment
 - Expansion of life cycle thinking on social aspects
 - Bringing in the 3rd pillar of sustainability into SETAC
- Links between REACH and LCA
 - New source for environmental product info
- Life Cycle Management
 - Specific, but simple tools needed
 - Integration in conventional engineering tools and existing business processes

➔ From scientific knowledge to decision making

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What else is desirable?to face the challenge



- More cross-fertilization between disciplines
 - Example today:
Session on LCA & RA of nanotechnologies
 - Merged sessions better reflecting environmental pressures and needs for action
 - LCA and ecosystem services
 - Water quality assessment under climate change and water scarcity constraints
- Broadening perspective:
“Are we looking at the right issues?”

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Risk Assessment



Joke van Wensem

Dutch Soil Protection
Technical Committee, The
Netherlands

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activity addition analysis application applied approach aquatic areas
assessment based bioavailability biological biomarkers case cell chemical
compared compounds concentrations conditions contaminants
cycle data de detected determined development different due
ecological ecotoxicological effects environment
environmental evaluation exposed exposure field fish
food germany groups growth health human impact important increased indicate information laboratory lca
levels life management marine measured metals methods model monitoring nanoparticles
natural observed order organic pahs parameters pesticides plant pollutants potential process
products quality range related relevant research response **results risk** river
samples sediment sensitivity significant sites soil species
study substances surface sweden system test toxicity
treatment values water

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Risk assessment sessions



- 14 sessions, and more
 - >110 platform presentations
 - >213 posters
- EQS & sites, aquatic & wetlands, ecosystem services, climate, guidance doc's PPP, biocides, WFD, mechanistic effect models, mixture tox, REACH, metals, sediment, spatio-temporal, standard methods
- Christina Rudén: “All ecotoxicological and chemical research is related to risk assessment”

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Structure



- Assessment of chemicals: REACH, pesticides, pharmaceuticals, nanoparticles, etc.
- Assessment of water & effluent, soil, sediment (groundwater, air)
- Assessment of sites & ecosystems (ERA)

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Chemicals



- REACH
 - methods & strategies to assess the intrinsic properties of chemicals
 - Evaluation of REACH
- New tests, revisions, proposals
 - Evaluation ERA for contaminated soils with TRIAD approach & proposal for standardisation of the process
- Guidelines for plant protection products:
 - First scientific opinion EFSA on GD birds and mammals
 - Include spatial scale besides temporal aspects?
- Pharmaceuticals:
 - Bulk production in India and China
 - Tamiflu & pandemic use conditions
- Nanoparticles
- Biocides
- Radio-active substances

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Water, soil, sediment,



- Water (WDF):
 - Derive a DSS for PS,
 - Catchment area or city
 - Good ecological status
 - Mixtures: application of knowledge, CA works, monitoring data essential, lack of toxicity data for individual substances!
- Soils
 - Community based approach, structural endpoints, soil microbial activities, avoidance/preference, multi-generation, multi-stress
- Sediments
 - Integration multiple factors and stresses is challenging
 - Balance risks and benefits
 - Weighing different lines of evidence

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ERA



- Spatio-temporal aspects
- Trait-based
- Community composition matters
- Models
 - Individual – population
 - Temporal exposure patterns
 - Recovery processes
 - Bioaccumulation
 - Indirect effects
- Time and spatial scale matter!
 - Evaluation of individual activities
 - Effect depends on all activities

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Research driven by legal frameworks



- WFD
- REACH
- RA for Plant Protection Products
- Draft SFD
- Etc...
- Results are looking for legal framework: implementation
- Stakeholder involvement
 - No stakeholder: (often) no action!

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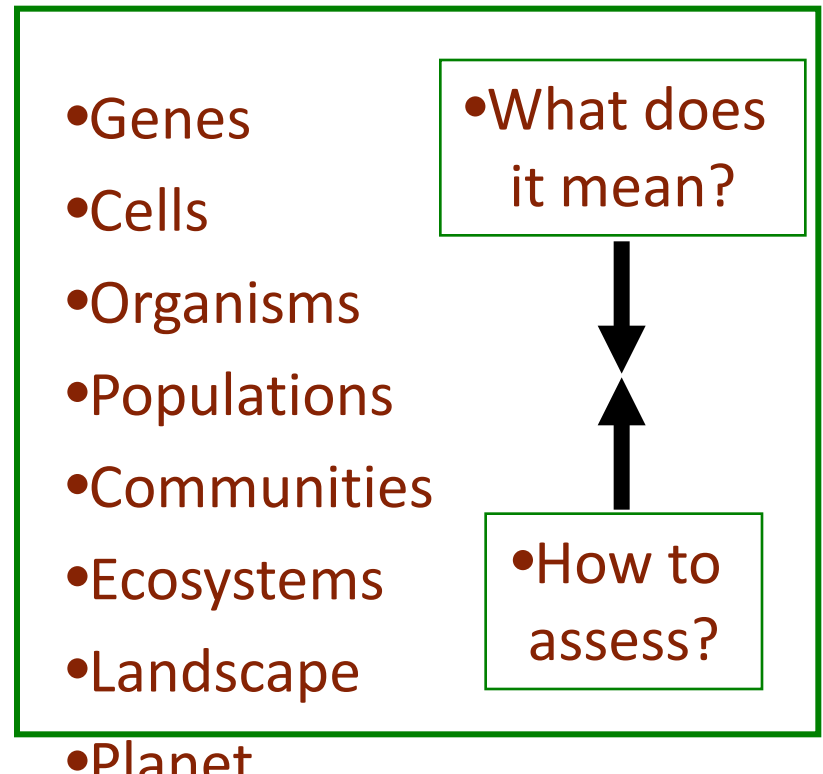
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Societal developments



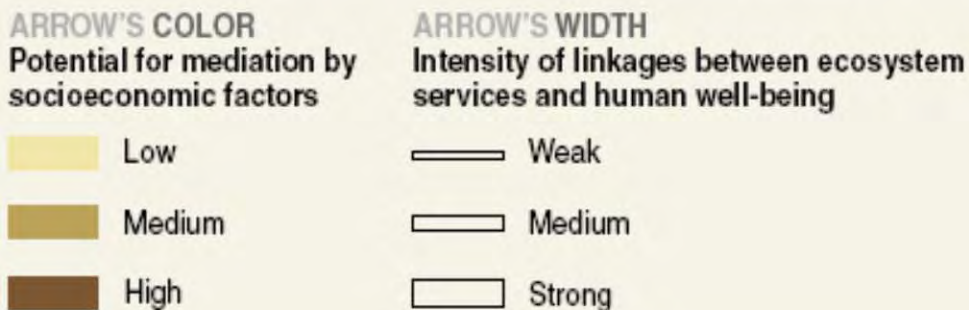
- Biodiversity loss, climate change, food & energy demand, sustainable development
- Draft SFD
 - Services
 - Threats



CONSTITUENTS OF WELL-BEING



Source: Millennium Ecosystem Assessment



New way of looking at our interaction with the environment



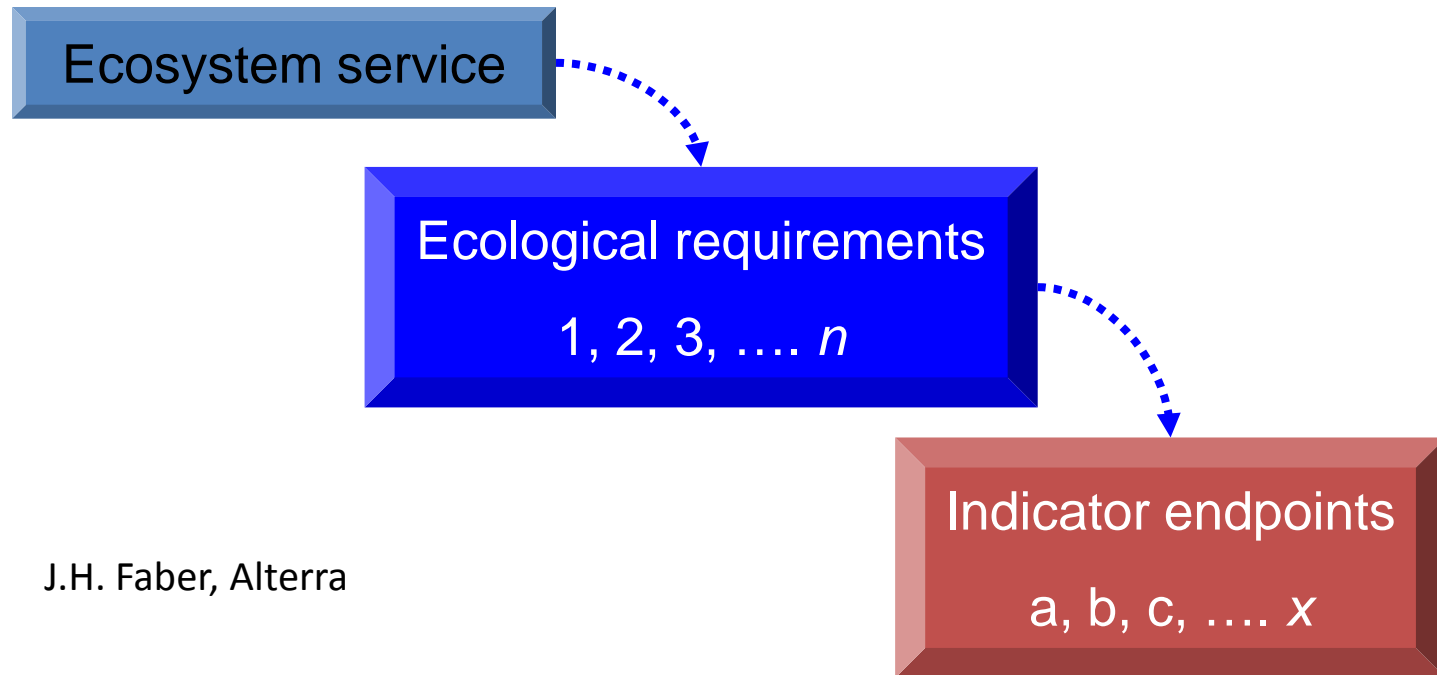
Challenges!



Is it possible to predict effects of chemicals on ecosystems?

It is even more complicated!

From ecosystem service to assessment endpoint



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J.H. Faber, Alterra

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