

IOPSIM

(Im)mobilization of organic pollutants by soil constituents in the soil/ground water system– Strategies for innovative management.

1. [BOKU, Vienna, Austria](#)
2. [Deltares \(TNO Built Environment and Geosciences\), Utrecht, NL](#)
3. [IfBk-Leibniz University, Hannover, Germany](#)
4. [Federal Environment Agency GmbH, Vienna, Austria](#)

Changes of climate and soil environment (e.g. land use)

available data (literature study)

Focus of Project

Pathway:

soil-groundwater-system

-mobilization processes
-immobilization processes
(role of soil constituents e.g. SOM in the attenuation)

receptor:

other soil and ground water systems

source:
org. pollutants

End-users
policy
&
management

Role of

(im)mobilization

understanding

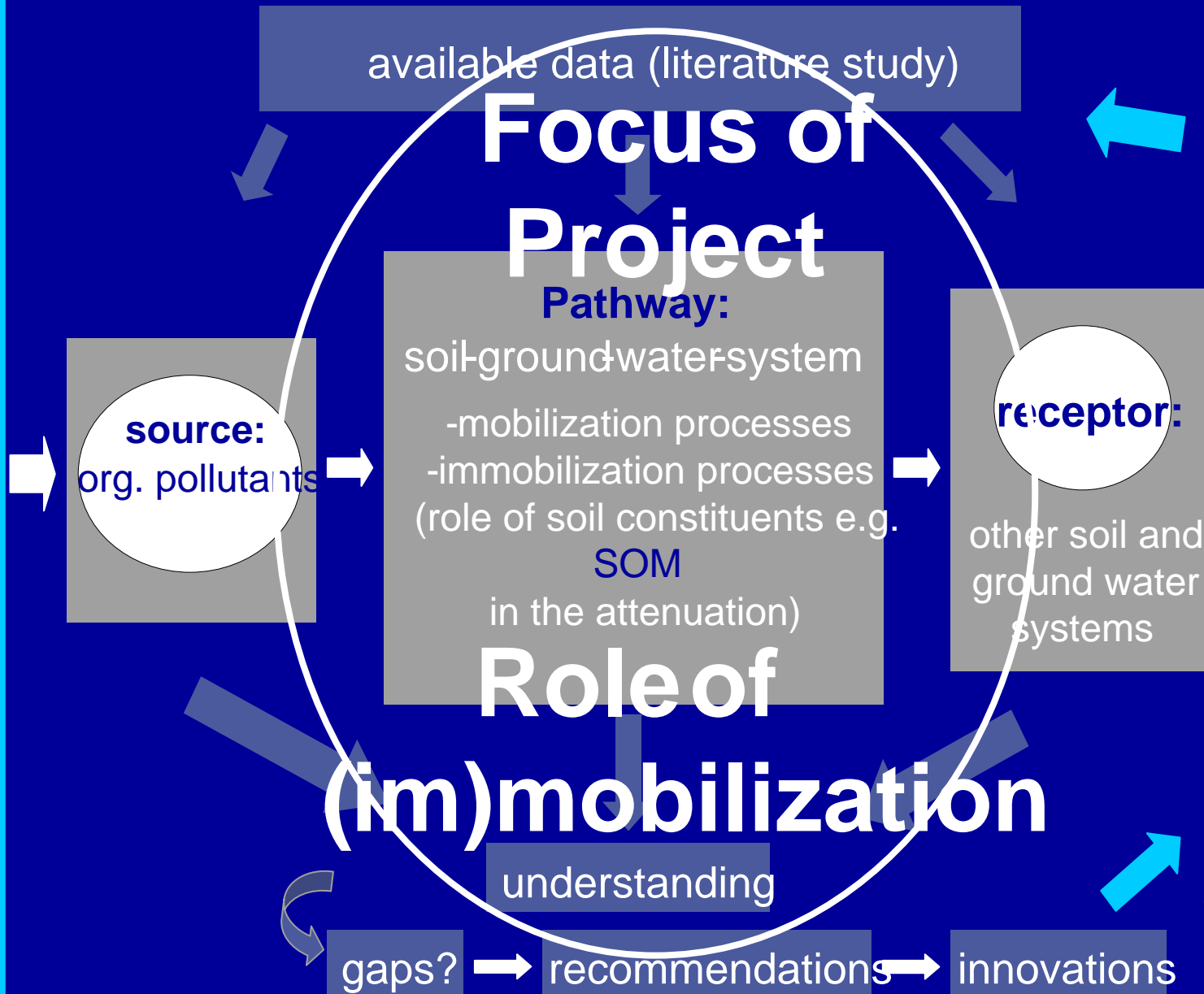
gaps?

recommendations

innovations

societal system

bio-physical system



Special project tasks of the partners:

- IfBk: Literature review on: Main mechanisms, processes and factors governing the fate of organic contaminants in the soil system - Strategies for innovative management
- Deltares - TNO: Literature review on: The role of Soil Organic Matter composition in organic contaminant retention
- BOKU: Literature review on: Biodegradation of organic pollutants with special focus on glyphosate and AMPA
- UBA-A: Literature review on: Emerging Pollutants

Project activities:

- Kick-off meeting, Utrecht, The Netherlands
- First Workshop, Hannover, Germany
- Second Workshop, Vienna, Austria, together with the end-users: ITVA, Germany; UBA-Austria; Lebensministerium, Austria
- Additional activity:
 - Jochen Walsh-Diploma Thesis
 - Student exchange between IfBk and TNO-Deltares

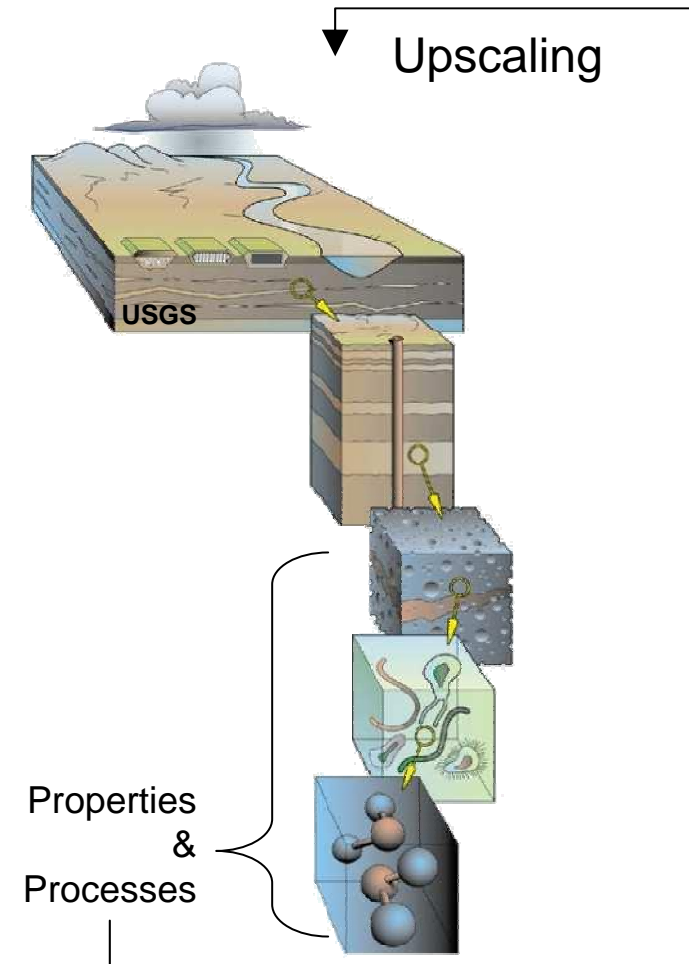
Controls on the fate of organic contaminants

Main properties that influence fate		
Organic Contaminant	Soil and Sediment	Environmental
<ul style="list-style-type: none"> •Charge² •Hydrophobicity (K_{oc}/w) ^{1,2} •Lipophilicity ³ •Molecular weight ^{1,3} •Functional groups ^{1,2,3} 	<ul style="list-style-type: none"> •Clay (%)² •Oxides (% , Fe+Al)² •Organic matter OM (%)^{1,3} •Organic matter (pKa)² •OM composition^{1,3} •Carbonate content (%)^{2,3} •Microbial Mass (%)³ •Soil structure^{1,2,3} 	<ul style="list-style-type: none"> •pH^{2,3} •Eh/redox³ •Temperature³ •EC² •Water Composition²
Processes that determine fate		
Non-ionic Sorption (1)	Ionic Sorption (2)	Degradation (3)

Management Strategies for Organic Pollutants

Range of Management Scales

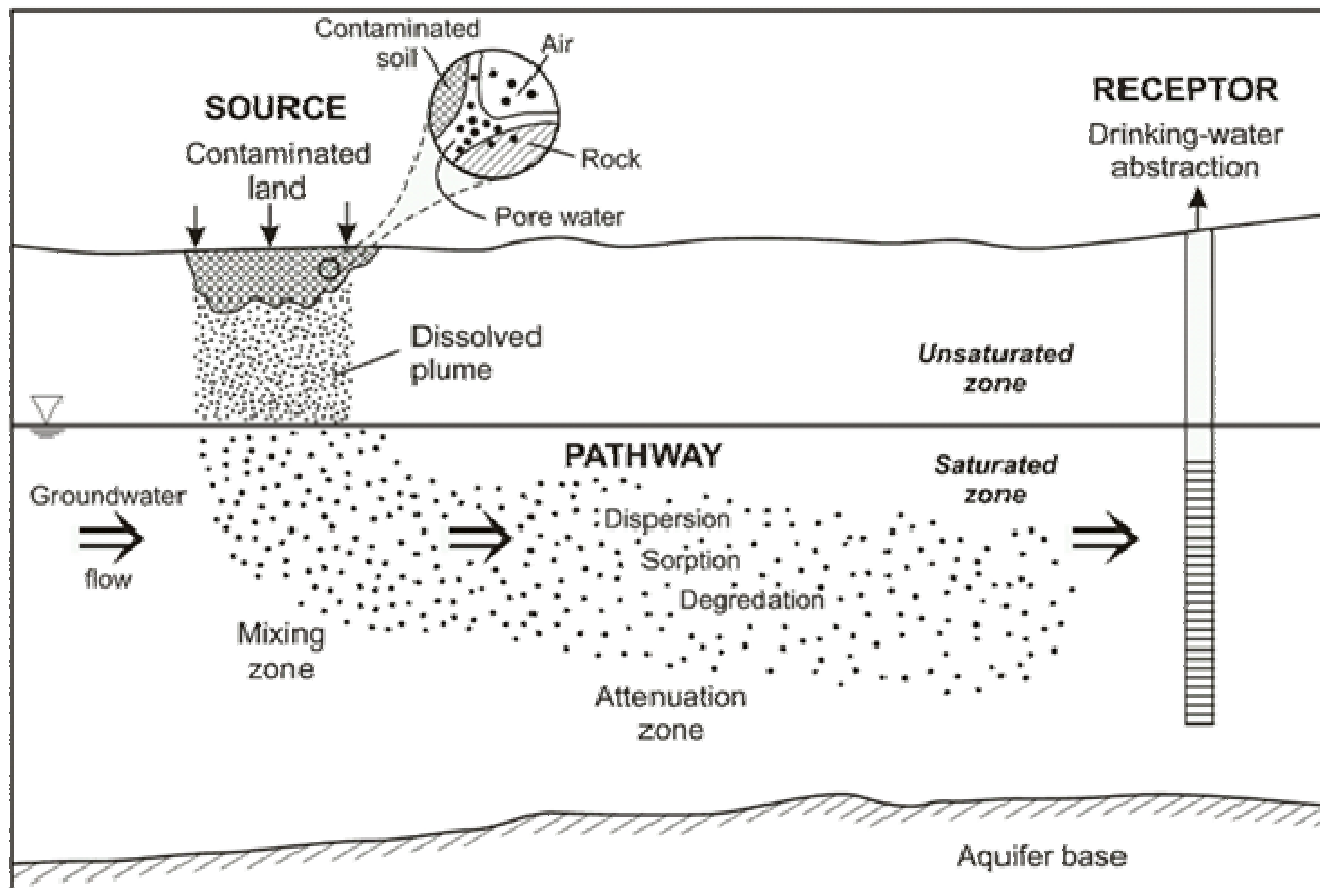
- Surface water protection (regional scale)
 - Vegetated buffer strips
 - Localized water treatment (run-off, drains)
- Agricultural (pesticide) management (sub-regional scale)
 - Application control (timing, modification of soil conditions, tillage operations)
- Contaminated site remediation (local scale)
 - In-situ remediation
 - Risk-based measures



Framework of Effective Management Measures

Types of Measures	
Source Measures	<ul style="list-style-type: none">•Prevention of release (e.g. leak prevention)•Treatment before release (e.g. at sewage treatment, puridrain)•More efficient application•In-situ remediation
Process Measures	<ul style="list-style-type: none">•Improving soil conditions (e.g. stimulate degradation, decrease/increase sorption)•Improve hydrological conditions (Increase/decrease residence times or accessibility)
Receptor Measures	<ul style="list-style-type: none">•Risk-based management•Protect receptor (e.g. vegetated buffer strips)•Localized treatment at receptor

Management Approach: Source→Pathway→Receptor



Framework of Effective Management Measures

Response to Measure	
Fast Result	Slow Result
<ul style="list-style-type: none">•Contaminant Factors<ul style="list-style-type: none">•Degradable•Changes can be made to current application	<ul style="list-style-type: none">•Contaminant Factors<ul style="list-style-type: none">•Less degradable, I.e. strong retardation, accumulation in subsoil•Large amounts of application
<ul style="list-style-type: none">•Soil Factors<ul style="list-style-type: none">•Healthy soil ecosystem	<ul style="list-style-type: none">•Soil Factors<ul style="list-style-type: none">•Disturbed soil ecosystem•Slow hydrological system (long travel times, thickness, hydraulic conductivity)•Poor accesibility (pore size distribution, short-cut flows)

Climate change will affect the following aspects:

1. **Environmental** properties

- Temperature, precipitation
- biogeochemical changes in: higher activity biomass, e.g. organic matter mineralization, affecting DOC concentrations and pH

2. **Soil and Sediment** properties

3. **Transport processes**

- Due to physical changes in: water balances, residence times, water tables, water content, soil cracking

4. **Degradation (biological)** processes will be likely to be affected first and foremost through indirect effects by climate change.

5. **Sorption** processes will be less affected.

Effect of climate change on fate organic contaminants

Effects of Climate Change

Properties that influence fate

Organic Contaminant

Soil and Sediment

Environment

Processes that determine fate

Non-ionic Sorption

Ionic Sorption

Degradation

Realised publications:

- J. Walsch and S. Dultz: Eurosoil 2008 in Vienna – poster „Effects of pH, Ca²⁺- and SO₂—concentration on the surface charge properties of goethite and hematite – Consequences for the adsorption of organic substances“.
- Jochen Walsch: Eurosoil 2008 in Vienna – poster „Effects of pH, Ca²⁺- and SO₂—concentration on the surface charge properties of goethite and hematite – Consequences for the adsorption of organic substances“ (see page 46).
- IOPSIM Poster was presented on the ThinkTank Conference in Amsterdam 2008 and ConSoil conference in Milano 2008.
- The project homepage <http://www.wabo.boku.ac.at/iopsim-snowman.html?&L=1> is already active. The next update will be the final version of the results from the accepted final report.
- IfBk: Manuscript for publication in `Clay Minerals´ with the title: “Effects of pH, Ca- and SO₄-concentrations on surface charge and colloidal stability of goethite and hematite - consequences for the fate of organic pollutants” – submitted in January 2009.

- **Planned publications**

Manuscript for end-users based on the IOPSIM literature research results, for publication in ITVA-Publication – in preparation.



Thank you very much for your attention!