

# Site selection and contextualisation of higher tier leaching studies

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9th EU Modelling Workshop, Copenhagen Oct. 9-11 2018

#### Introduction

- SETAC EMAG GW paper on conducting monitoring studies proposes study designs and approaches to vulnerability assessment and context setting in relation to a range of potential specific protection goals
- What it does not provide are step-by-step "recipes"
- What does a typical process for site selection and context setting look like for a study targeting shallow groundwater with edge-of-field sampling (in porous aquifers)?
- How does it work out in real life?





### Steps in the process

- Problem formulation
- Identification of regions or areas of interest (AOI)
  - **GIS** evaluations
  - Vulnerability mapping
- Site search
  - Desk-based
  - On the ground
- Site selection and characterization
- Field study phase
  - sampling and analysis
  - in-situ capturing of scenario data and related information
- Contextualisation of results





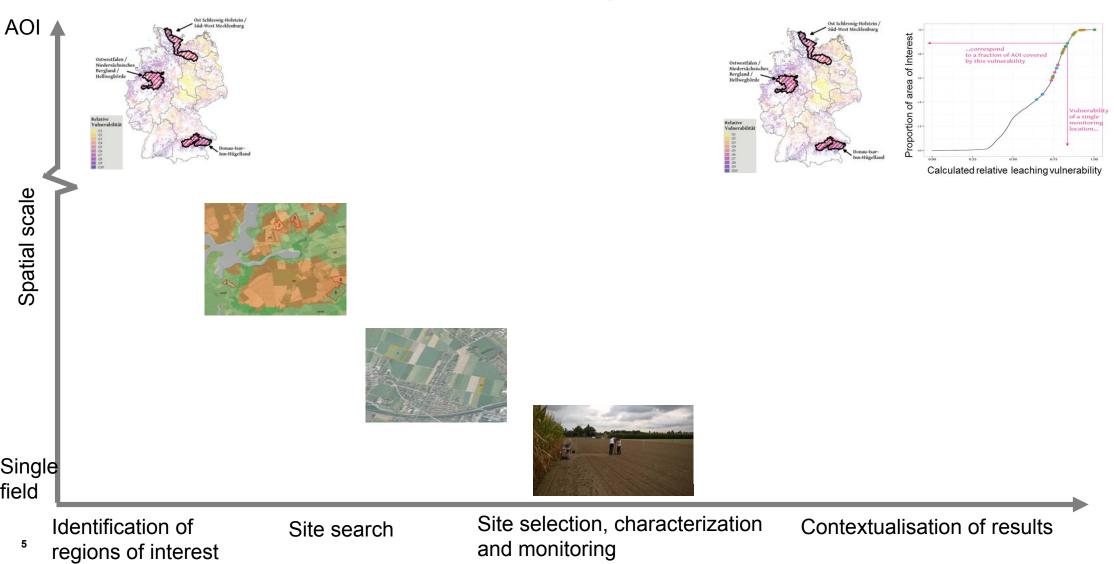
#### **Problem formulation**

- Problem formulation is the first step in environmental risk assessment (ERA) where policy goals, scope, assessment endpoints, and methodology are distilled to an explicitly stated problem and approach for analysis.
- Particularly important when the specific protection goal or regulatory purpose drives the study design
- So at the beginning we should ask the questions
  - What do we want to measure and for what purpose?
  - Where do we want to measure and in what timeframe?
  - At how many sites?
  - What characteristics should the sites have?

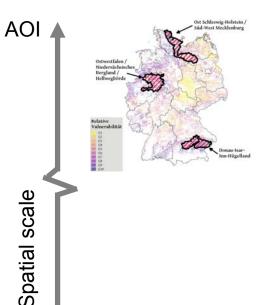




# Spatial scales of selection, monitoring and contextualisation



#### Identification of areas of interest



- GIS analysis and spatial modelling
  - Decision on appropriate geodata (EU/national)
  - ► Intersection of target crop(s), product usage, desired soil characteristics
  - May also include other specific aspects e.g. aquifer type
  - Depth to GW might already be considered at this stage
  - Mapping of pedoclimatic vulnerability with e.g. GeoPEARL
- Decision on target regions for monitoring sites
- In those regions, localities with a high probability of finding suitable characteristics and leaching vulnerability are identified to focus site search
- Open question: do we reach an agreement on modelling tools and datasets for spatial modelling (and some kind of version control)?

Identification of regions of interest

Single field

#### Site search

AOI /

Spatial scale

Single field

Site search first considers more "local" data, knowledge and information

E.g. piezometric maps, topographic maps, soil data, agronomic information

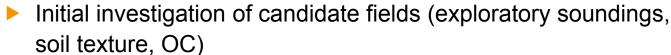
Mixture of desk based and "boots on the ground" work to identify potential fields and farmers



The task is simple...



Find farmers willing to participate, who will be growing a target crop on a suitable field





If everything is ok then go ahead with detailed characterisation, instrumentation and study



Site search

Site selection, characterization and monitoring

## Site search – suitability

- "typical" criteria (assuming cooperative farmer with target crop)
  - Sandy soil, low OC
  - High recharge, porous aquifer
  - Shallow, unconfined groundwater
  - Not a perched water table
  - Flat topography
  - Acceptable hydraulic gradient
  - Not too much GW fluctuation
  - No surface water influences
  - No potential point sources
  - Not drained
- These are often mutually exclusive, or just not representative for the target crop
- Compromises are unavoidable. Do we go for vulnerability, or representative situations?



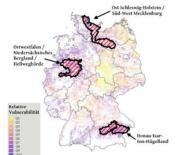


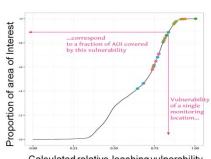


AOI 🛦

Spatial scale

- Or: What do the monitoring data tell us about leaching risk in the area of interest?
- Come back to the vulnerability assessment used to identify the target regions and localities for monitoring
  - → Confirm that the sites vulnerability distribution address the problem formulation
- Different AOI can also be evaluated in this way





Calculated relative leaching vulnerability

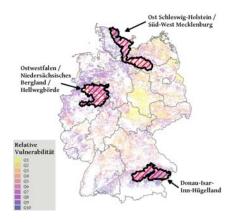
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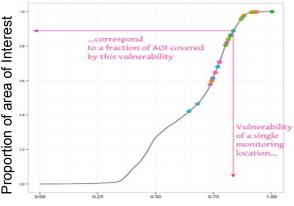
Identification of regions of interest Site search

Site selection, characterization and monitoring

Contextualisation of results

#### **Contextualisation of results**

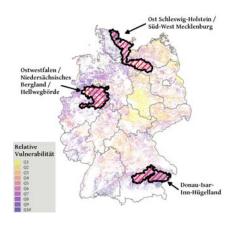


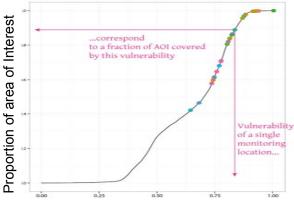


Calculated relative leaching vulnerability

- Statistical distribution (CDF) of leaching vulnerability can be simply derived from the spatial model for the AOI
- Monitoring sites are placed on the curve according to their calculated leaching vulnerability values based on in-situ measurements.
- The proportion of the Area of Interest having lower or higher leaching vulnerability than the monitoring sites can then be derived.
- Aggregated GIS data used in spatial modelling may not coincide with the conditions at a certain field in the grid cell
- Therefore the site-specific data are used to compare the leaching vulnerability of the monitoring sites with the spatial model for the AOI.

#### **Contextualisation of results**





Calculated relative leaching vulnerability

- If the key question defined by the problem formulation is that the monitoring sites
  - a) should be <u>representative</u> for the range of conditions in the AOI, then the sites should be distributed over the vulnerability curve (less vulnerable as well as highly vulnerable situations)
  - b) should meet a predefined protection goal **covering** the whole vulnerability range, then some sites in the high vulnerability area are appropriate and sufficient

#### **Conclusions**

- A proper problem formulation is essential
- Site selection & contextualisation of higher tier leaching studies are two sides of the same coin
  - Partially same methodology (GIS and vulnerability analysis)
  - A-priori vs. a-posteriori analysis
- Compromises in site selection are unavoidable. Do we go for vulnerability, or representative situations?
- If monitoring sites should
  - be <u>representative</u> for the conditions found in the AOI, then their vulnerability should stretch over the whole vulnerability curve representing less vulnerable as well as highly vulnerable situations
  - meet the predefined protection goal and <u>covering</u> the whole vulnerability range, then some sites in the high vulnerability area are appropriate and sufficient







We create chemistry