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a Multi-stakeholder Network for Emerging Soil Contaminants

Using soil data to map groundwater vulnerability for pesticides

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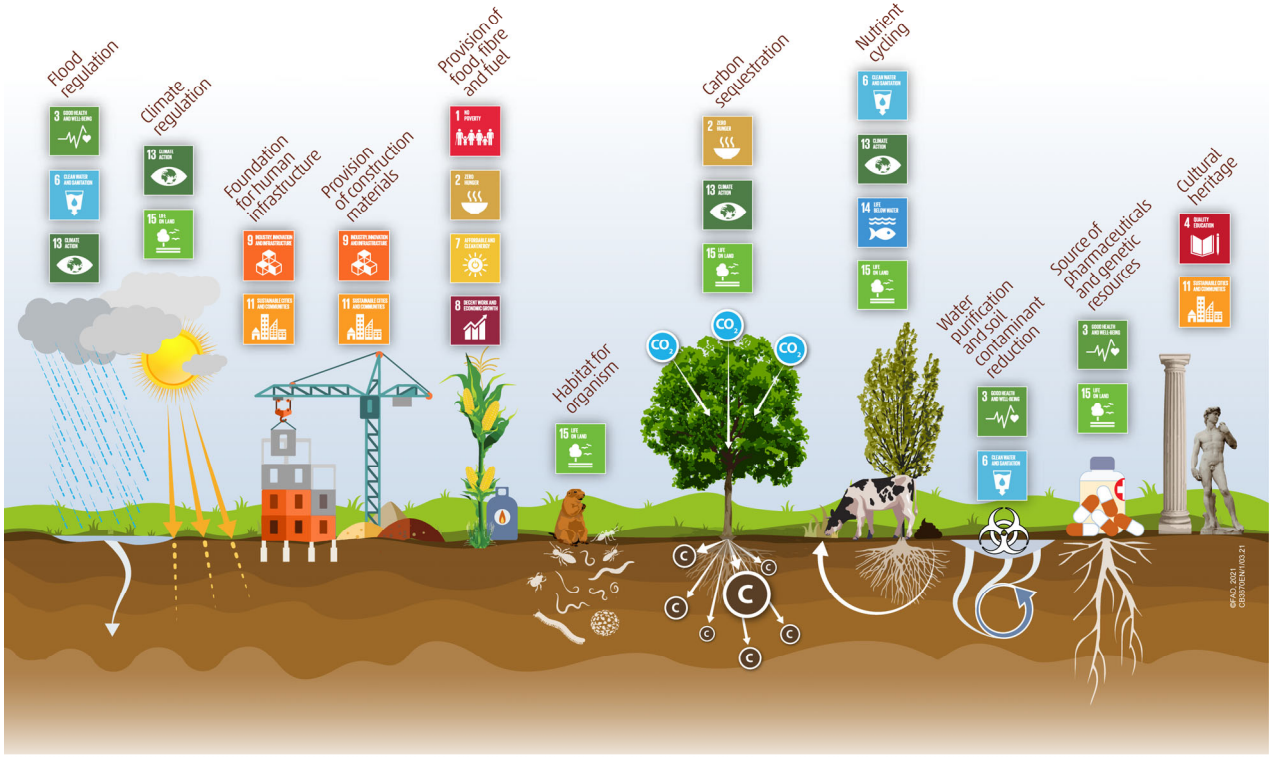
Healthy soils
a prerequisite to achieve the SDGs



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Food and Agriculture Organization of the United Nations

GLOBAL SOIL PARTNERSHIP

SUSTAINABLE DEVELOPMENT GOALS

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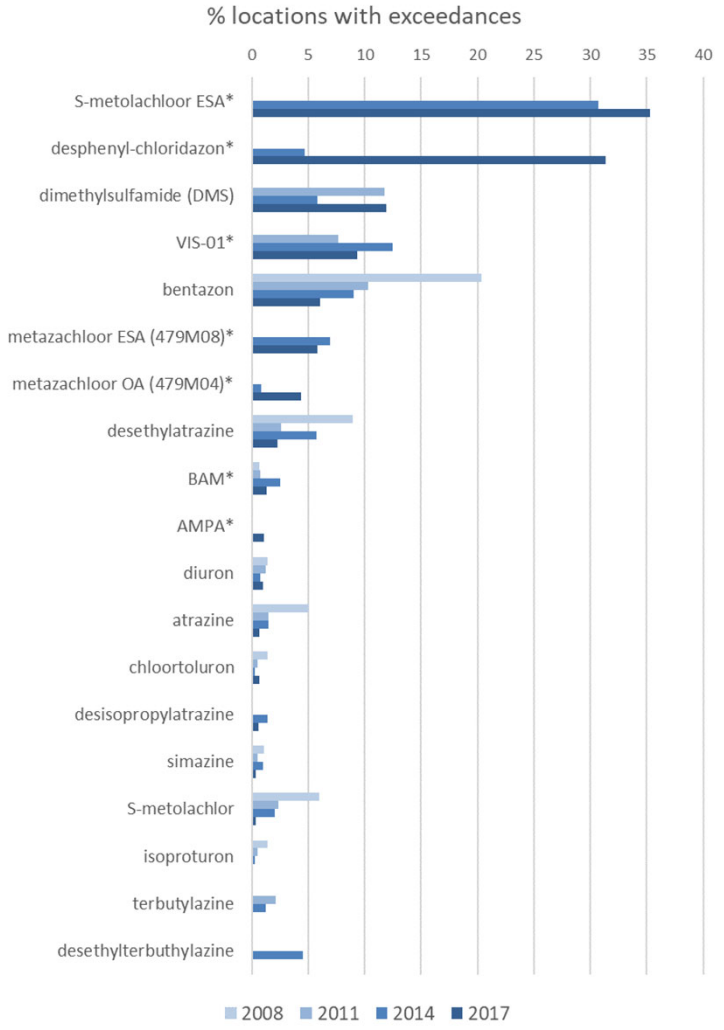
PPPs in groundwater

- Good status not been achieved for 25% groundwater bodies in the EU
- Most common pollutants reported to have caused failure to achieve good status are nitrates, then pesticides (EEA)
- In Flanders, VMM reports frequent detects of PPPs and metabolites in (shallow) groundwater



Source: VMM

Aim

- Develop a tool to calculate groundwater vulnerability maps for PPPs
  - Substance-specific
  - As much as possible process-based
  - Making optimal use of existing Flemish/Belgian datasets and models

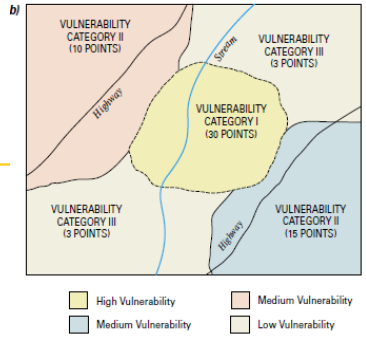
- Use of this tool:

1. support monitoring strategies
2. management of sensitive zones such as drinking water capture zones

Groundwater vulnerability

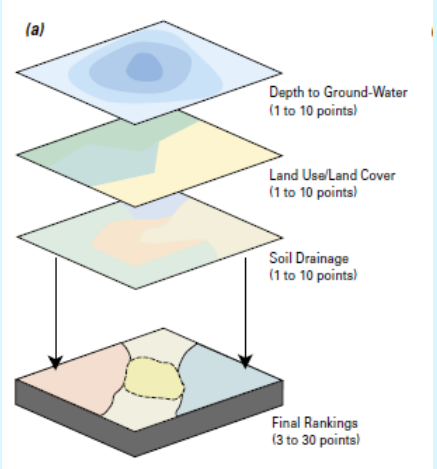
Groundwater vulnerability NRC (1993): "the tendency of or likelihood for contaminants to reach a specific positon in the groundwater system after introduction at some location above the uppermost aquifer"

Factors taken into account in assessing vulnerability	Europe	US-EPA
Subsoil characteristics	Intrinsic vulnerability	Aquifer sensitivity or intrinsic susceptibility
Subsoil characteristics + substance properties	Specific vulnerability	
Subsoil characteristics + substance properties + application	Risk	Aquifer vulnerability



Methodology

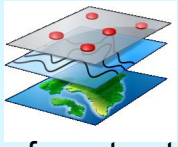
Generic vulnerability maps



Index based method

Tool for substance-specific vulnerability maps

Leaching calculations



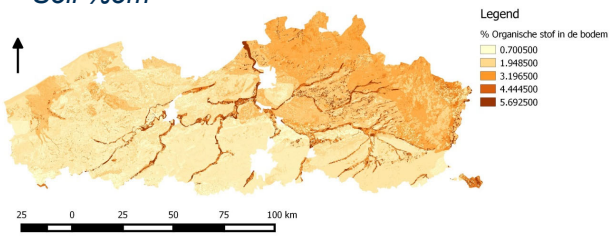
Indices for saturated zone

Hybrid method

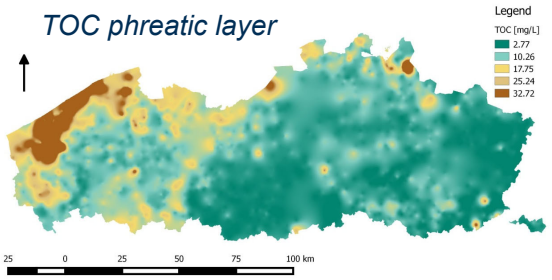
Generic groundwater vulnerability maps

Overlay of maps of relevant factors determining groundwater vulnerability for 4 types of PPP

Soil %om

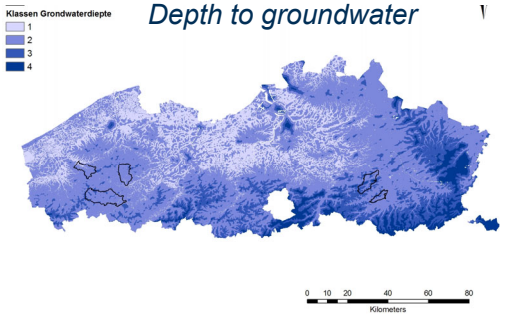


TOC phreatic layer

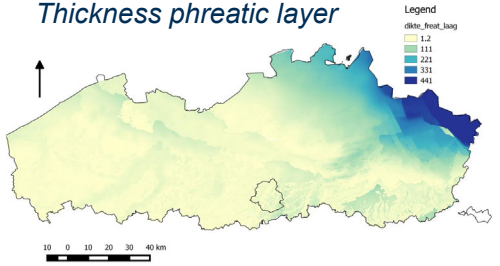


Map	persistent non-mobile	persistent mobile	non persistent non-mobile	non persistent mobile	
Soil organic matter	2	1	2	1	∑=1
Soil clay %	2	1	2	1	
Depth to groundwater	1	1	1	1	
redox phreatic layer	0	0	0.5	0.5	∑=1
TOC phreatic layer	1	0.5	1	0.5	
Thickness phreatic layer	1	1	1	1	
Conductivity phreatic layer	1	1	1	1	

Depth to groundwater



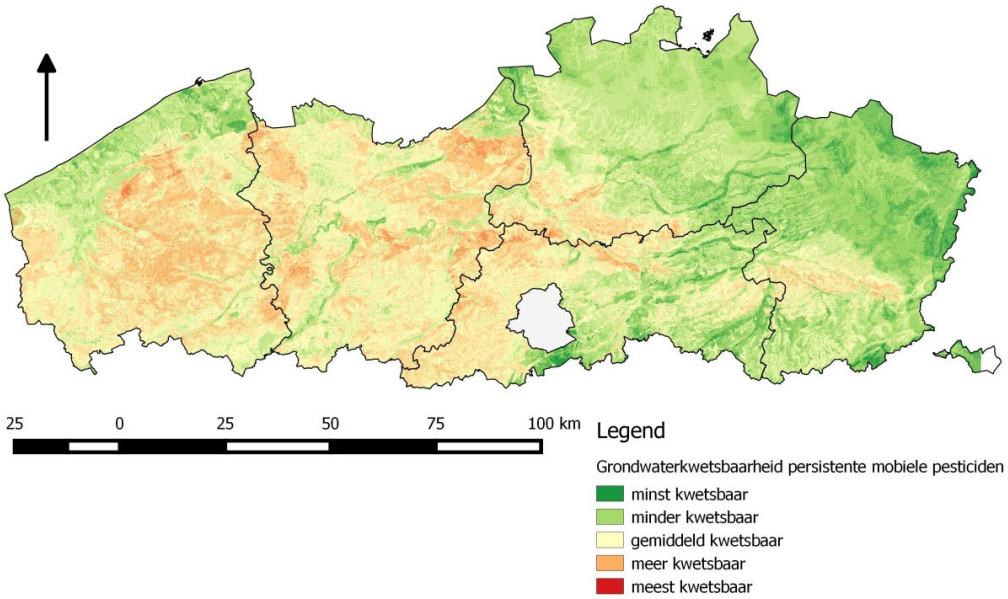
Thickness phreatic layer



Generic groundwater vulnerability map Flanders

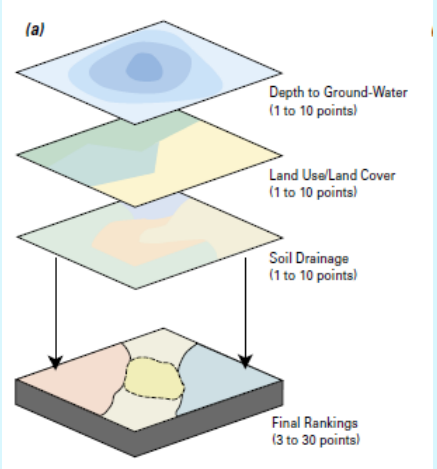
Result is four generic groundwater vulnerability maps for Flanders for different types of PPP

Mobile persistent PPPs



Methodology

Generic vulnerability maps



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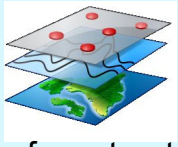


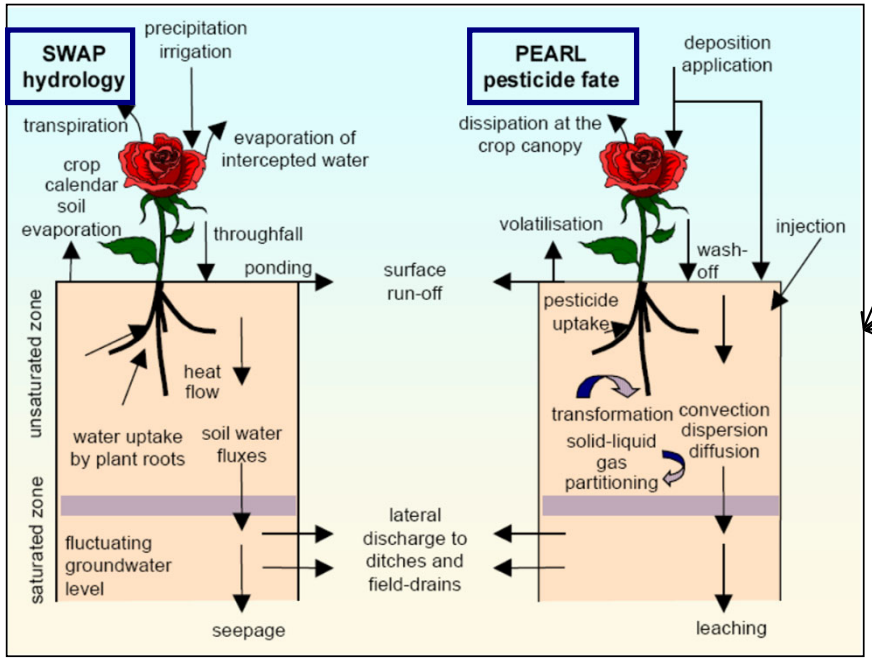
Indices for saturated zone

Hybrid method

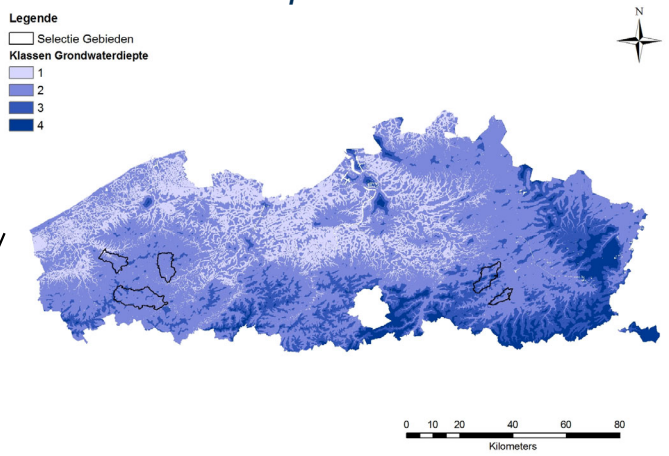
Methodology leaching model

Leaching to groundwater with GeoPEARL

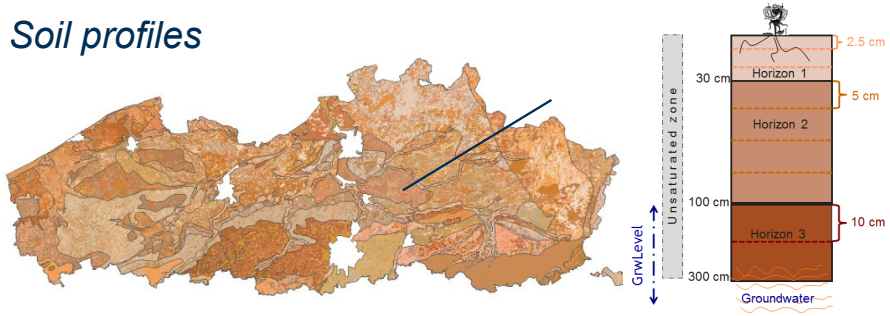
- » Hydrological model SWAP
- » Pesticide fate model PEARL



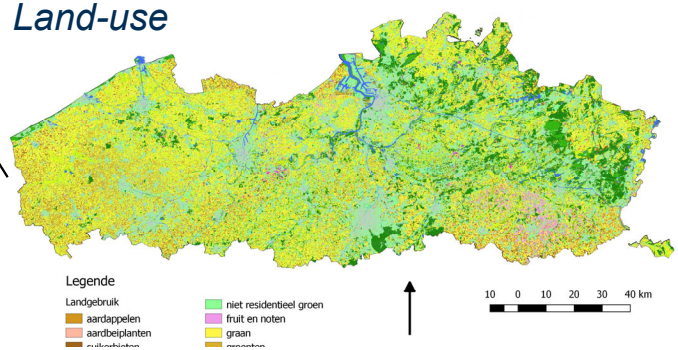
Groundwater depth



Soil profiles



Land-use



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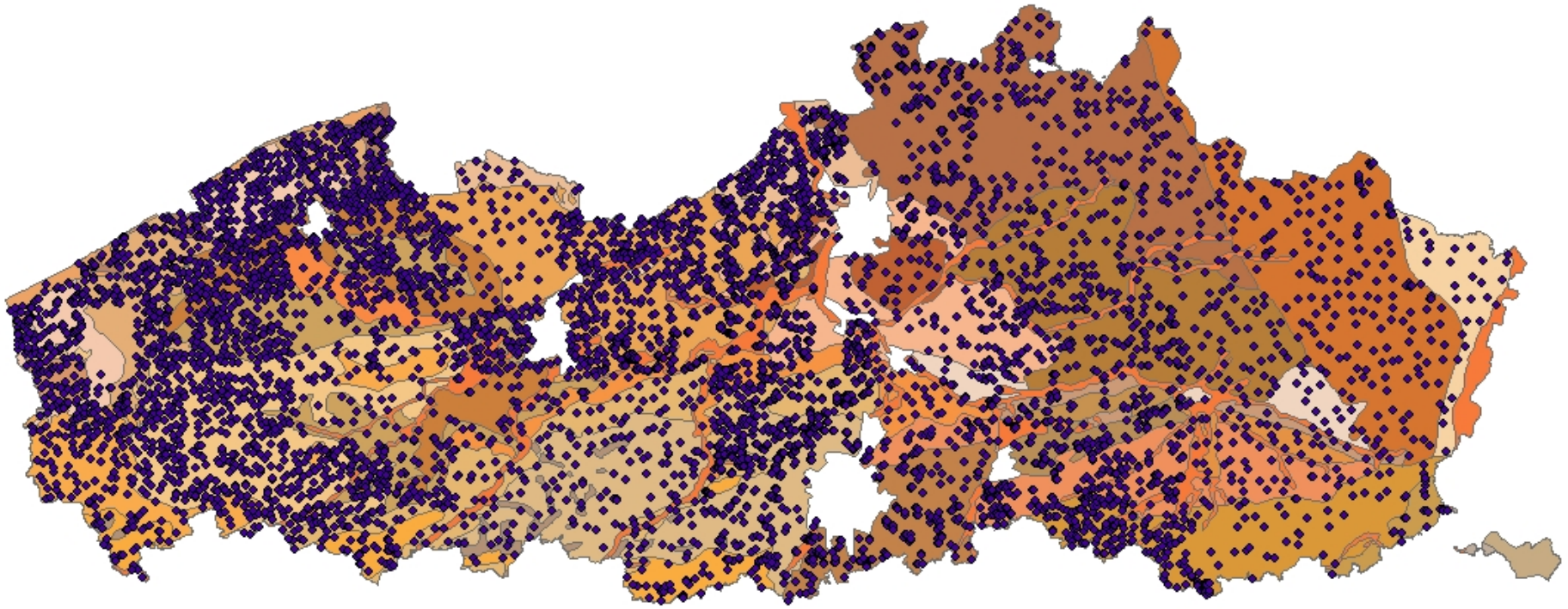
Flanders: wealth of soil data



Belgian soil map + Aardewerk database -> quantitative soil horizon descriptions

6.234 profiles, ~ 34.500 horizon descriptions

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Defining soil scenarios for the leaching model

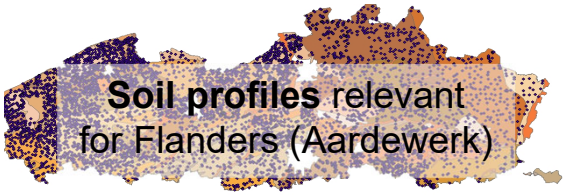
36 soil zones

+

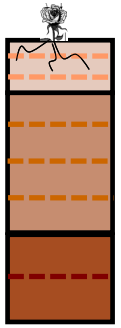
Digital map of
‚basis' soil series

4.405 soil series

+



6.234 profiles, ~ 34.500 horizon descriptions

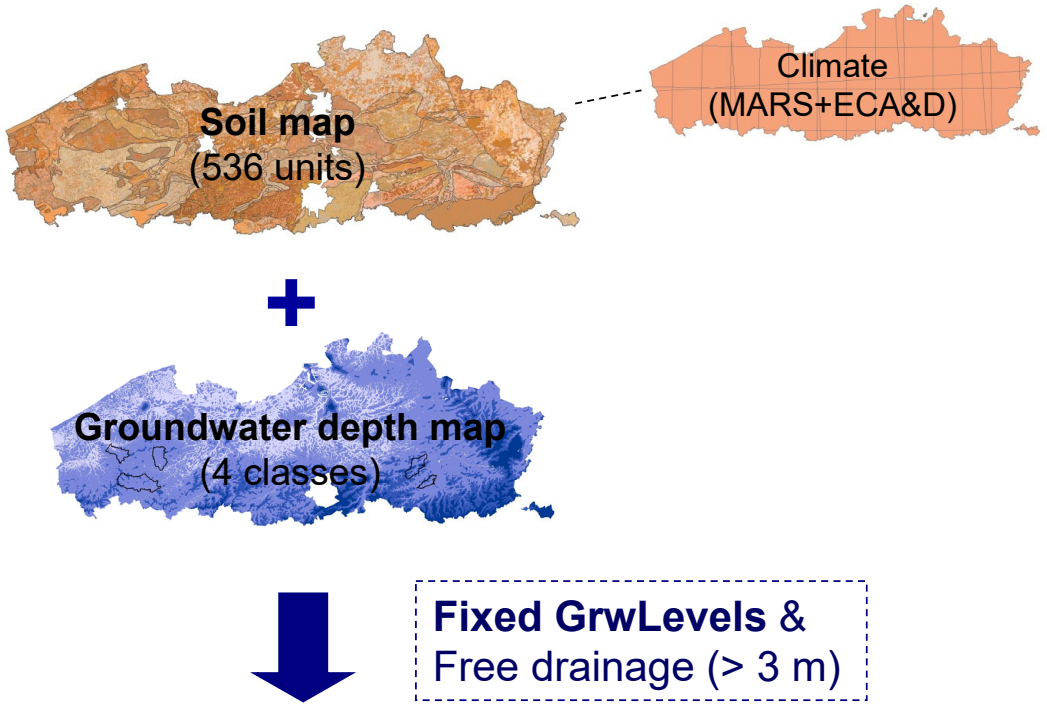


Extraction of properties for dominant soil series, covering **80%** of the area per soil zone

536 soil map units

"Median profile" per soil serie per zone

Unique combinations representing Flanders

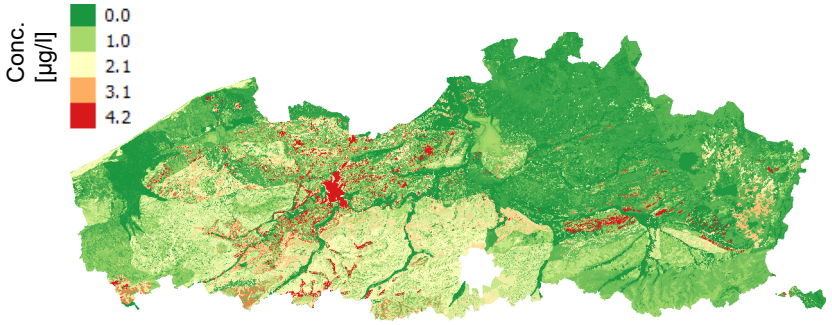


1434 unique combinations

Tool for groundwater vulnerability

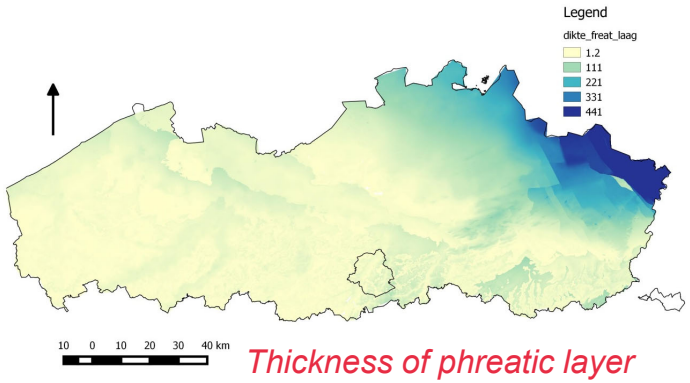
Tool follows a hybrid approach with a combination of process-based calculations for leaching to groundwater and indices for the vulnerability of the saturated zone

GeoPEARL results

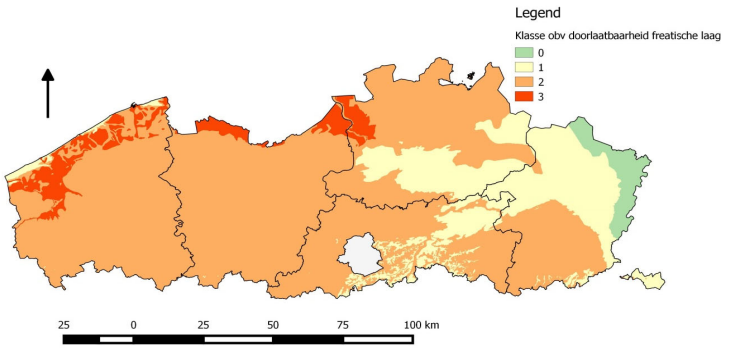


P90-concentrations over 20-yr period

Indices for subsoil vulnerability



Thickness of phreatic layer



Conductivity of phreatic layer

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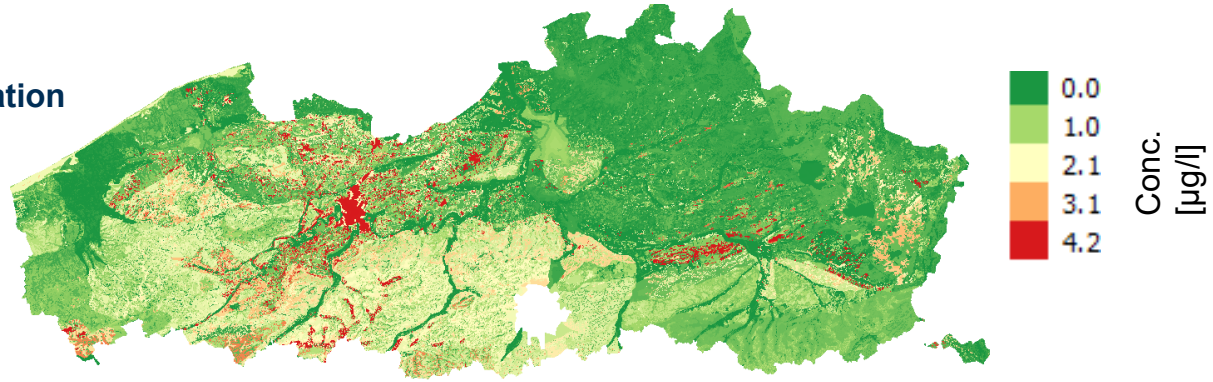
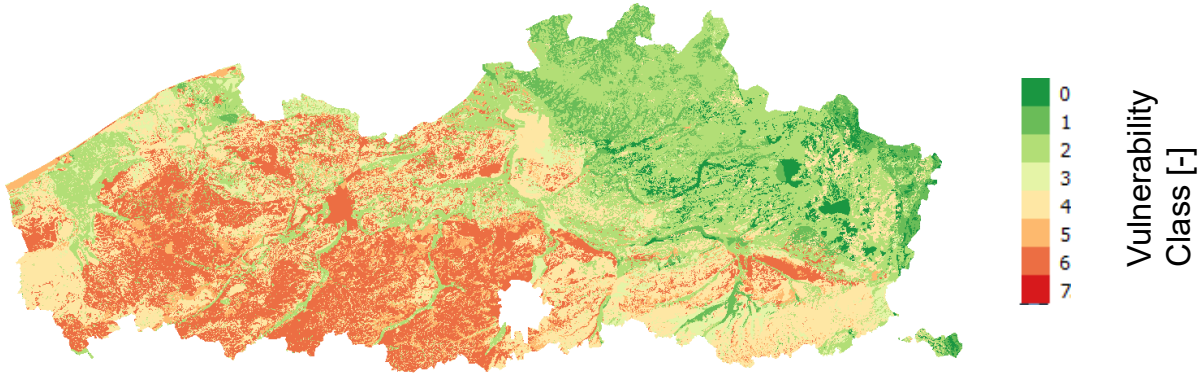
Result

- Example:
  - Vulnerability of phreatic groundwater in Flanders for pesticide x
  - Settings: properties of pesticide x (molmas, Koc, DT50,..) and typical application dose and time, applied on entire Flanders as if maize

P90
Leaching concentration



groundwater-vulnerability class



Conclusions

- Mapping specific vulnerability for PPPs in Flanders/local scale to assist in monitoring strategies
- Maximal use of available soil/subsoil data to assess groundwater vulnerability
- At regional scale, tool follows hybrid approach combining leaching calculations with GeoPEARL with indices of vulnerability for the phreatic zone
- Generic groundwater vulnerability maps for Flanders are constructed for four types of PPPs

Thank you

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