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Assessment Agency

Spatially distributed modelling

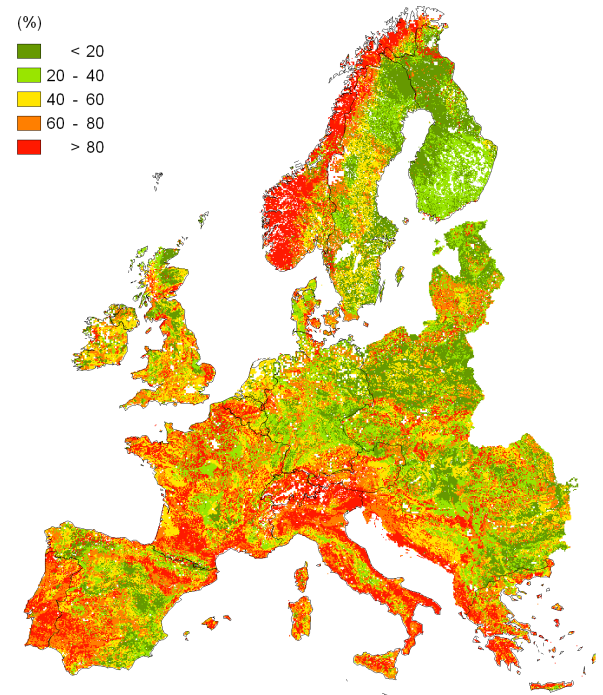
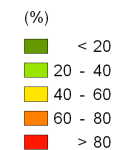
Opportunities and pitfalls

Aaldrik Tiktak

Wye spatial modelling?

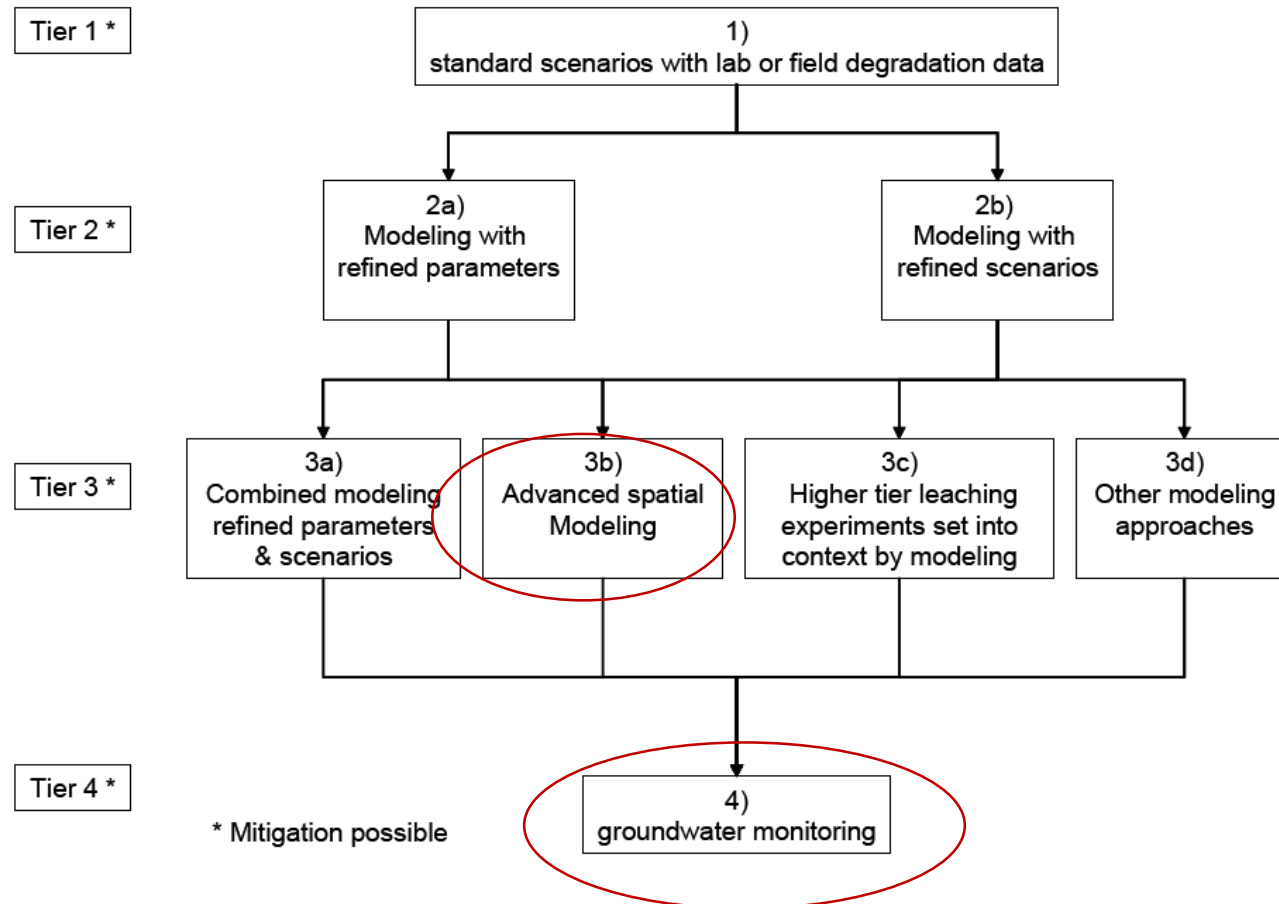
- To set monitoring data and field studies into context
 - Monitoring is a higher tier in FOCUS GW
 - Many discussions in peer-review meetings because the approach has not been harmonized
- To stimulate harmonization within the three European Regulatory Zones
- **Guidance AND tools are needed**

Vulnerability index for substance AT
Autumn application



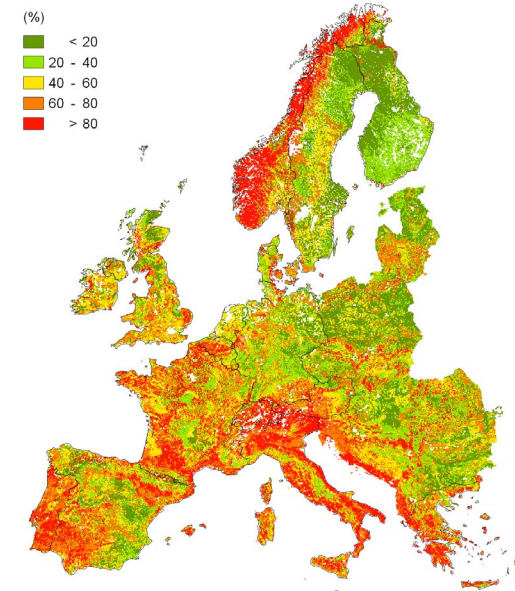
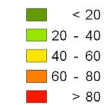
Calculated with MetaPEARL

Both are higher tiers in FOCUS GW



Vulnerability index for substance AT
Autumn application

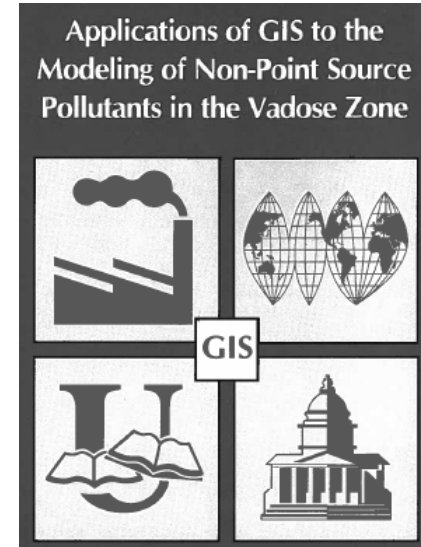
(%)



Calculated with MetaPEARL

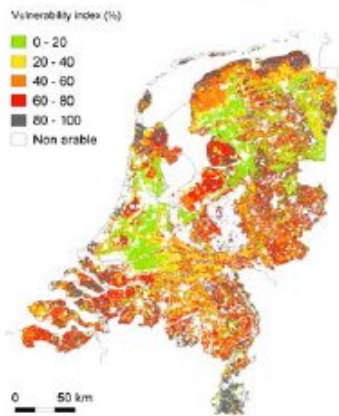
Is this new technology?

- No, this is established technology. Some milestones:
- 1996: First version of spatial leaching model published
- 2004: First spatial leaching model accepted in pesticide authorisation
- 2009: FOCUS adopted spatial models as a tool for scenario selection
- 2010: EFSA developed a systematic approach for scenario selection based on spatial models
- 2012: A spatial leaching model for EU Member States and EU Zones has been developed



Already done for a couple of member states

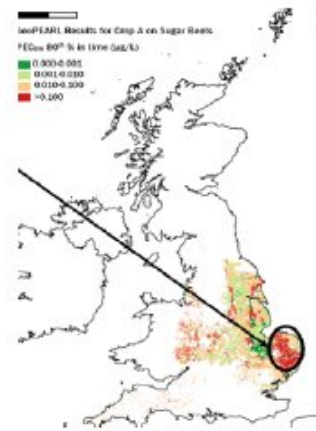
Netherlands (2003)



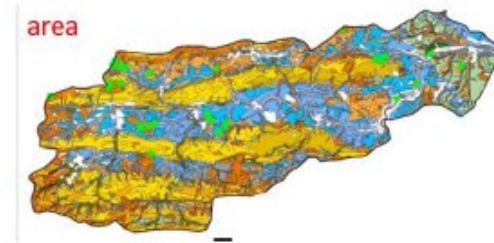
Germany (2009)



UK (2017)

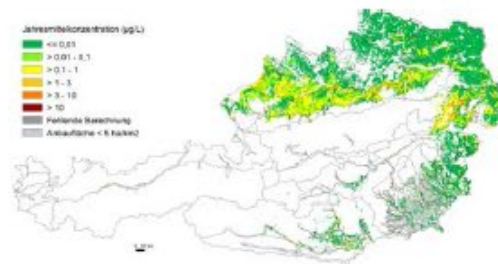


Flanders (2009)

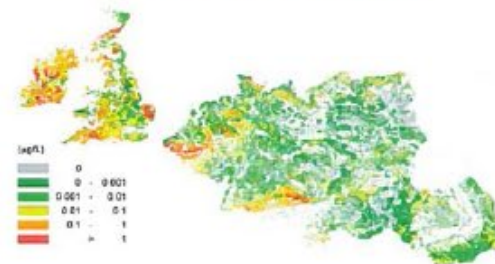


Wallonia (2010)

Austria (2011)

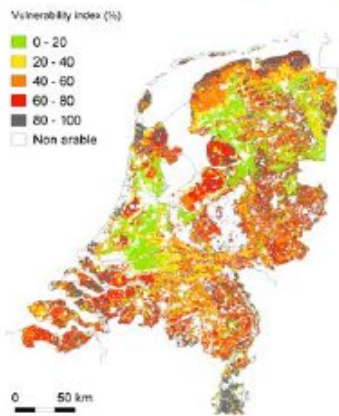


Central Zone (2012)



OK, sorry, one less

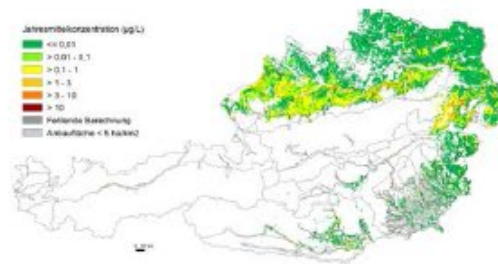
Netherlands (2003)



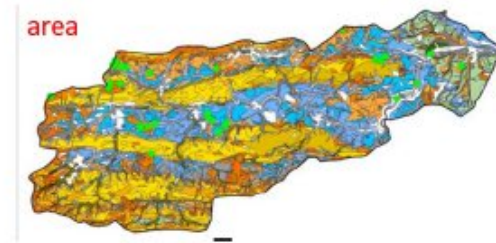
Germany (2009)



Austria (2011)

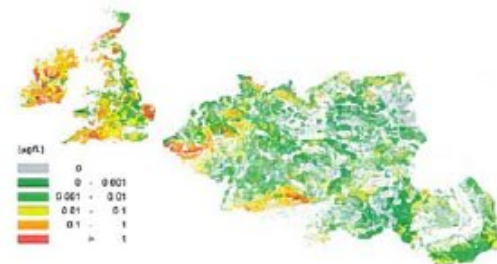


Flanders (2009)



Wallonia (2010)

Central Zone (2012)





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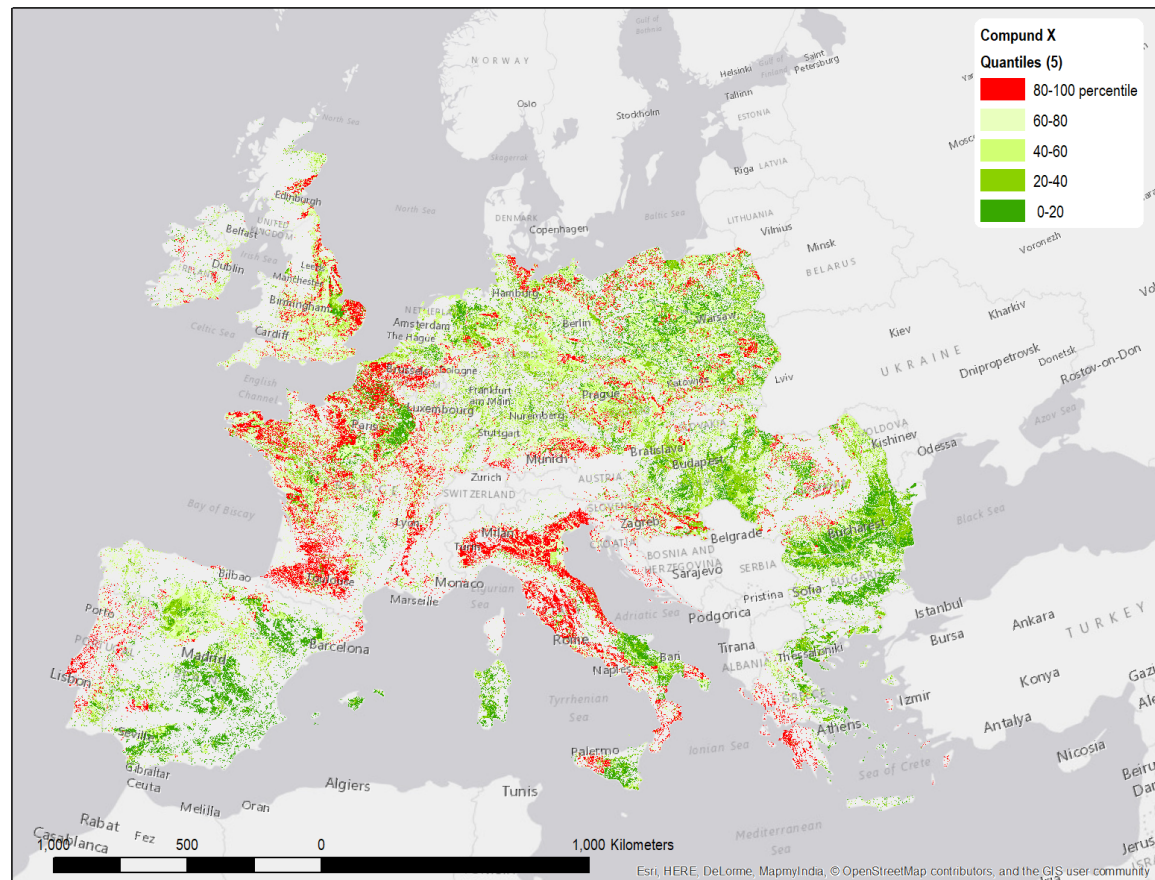


In context setting of monitoring data



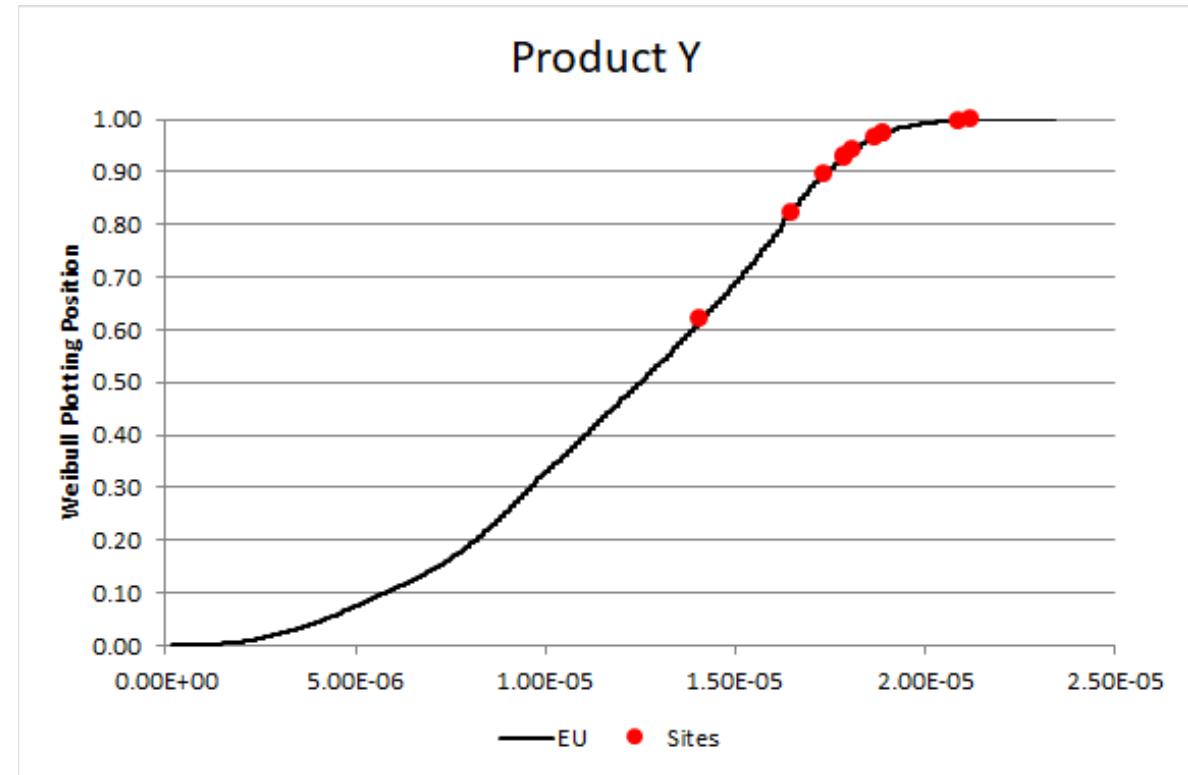
In context setting of monitoring data

- Monitoring is a higher tier in FOCUS Groundwater
- It needs to be known if the monitoring sites represent worst-cases with respect to pesticide leaching
 - SETAC-EMAG report
- A vulnerability assessment is needed



Context setting

- › A frequency distribution can be generated using the leaching map
- › The leaching concentration can be calculated for the monitoring sites
- › The vulnerability can then be compared

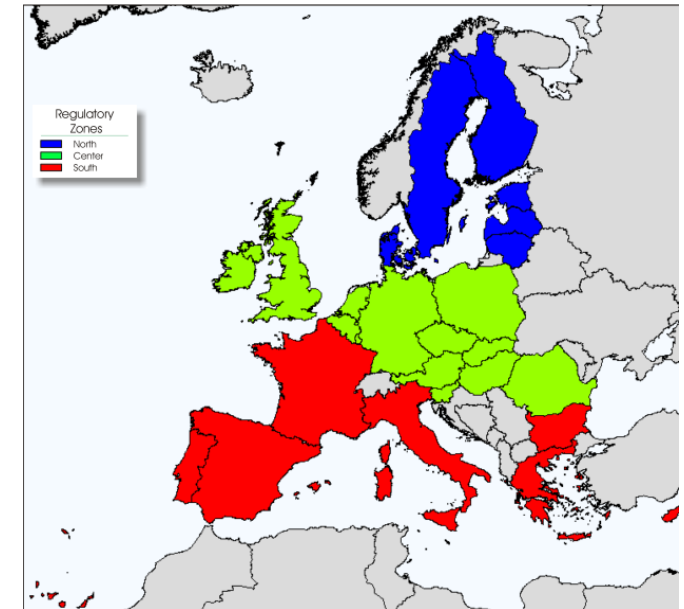
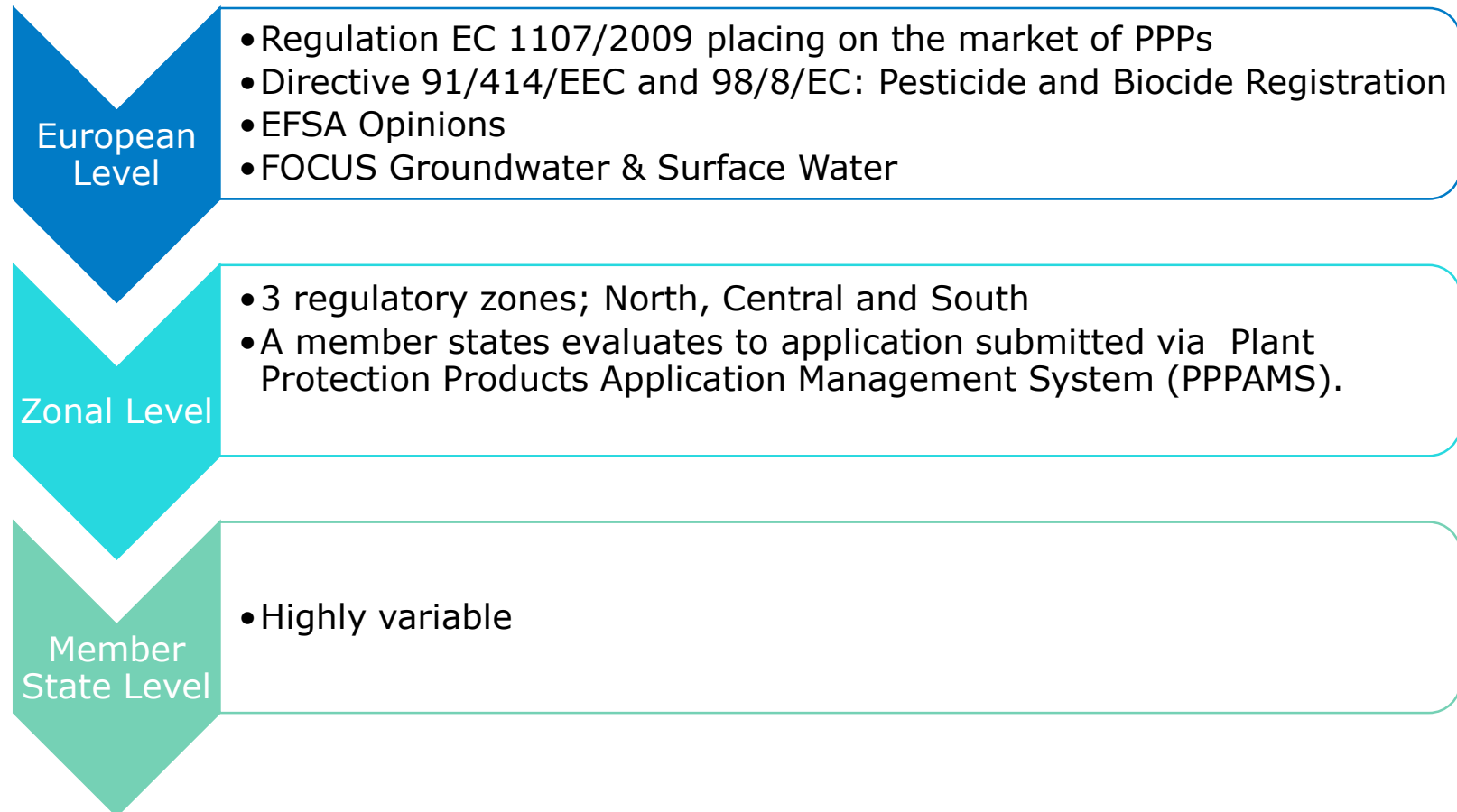




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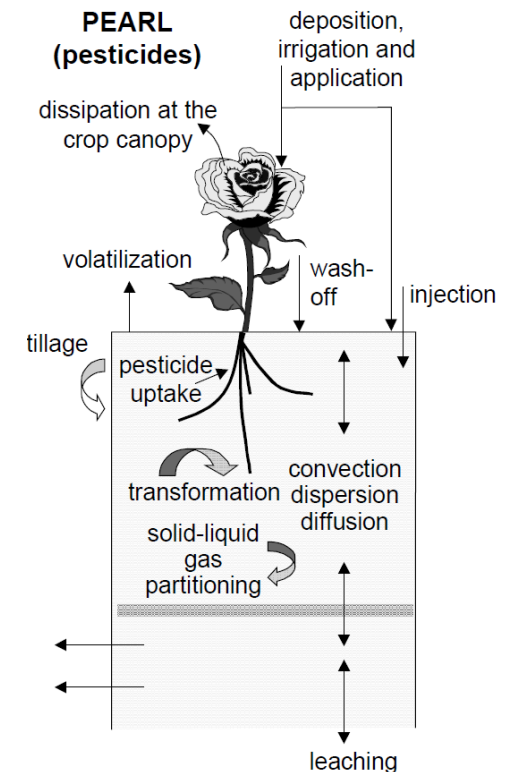
Harmonisation of product authorisation

Regulatory context



Simple or sophisticated models?

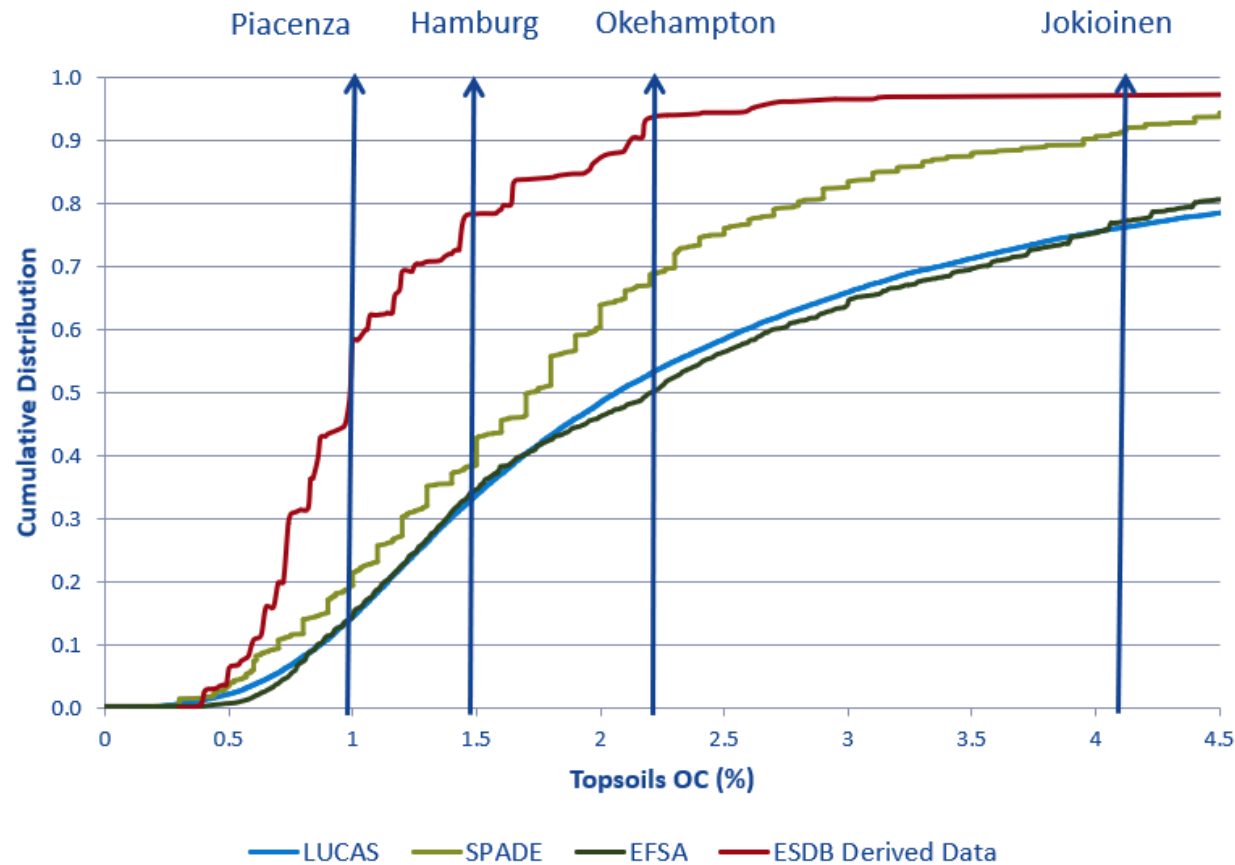
- There are basically two ways to set-up a spatial model:
 - Use a full numerical model (e.g. GeoPEARL)
 - Use a simple (meta)model
- Both approaches have there advantages:
 - Short versus long computation times
 - High spatial resolution versus high process resolution
 - ...



Dilemma's around databases



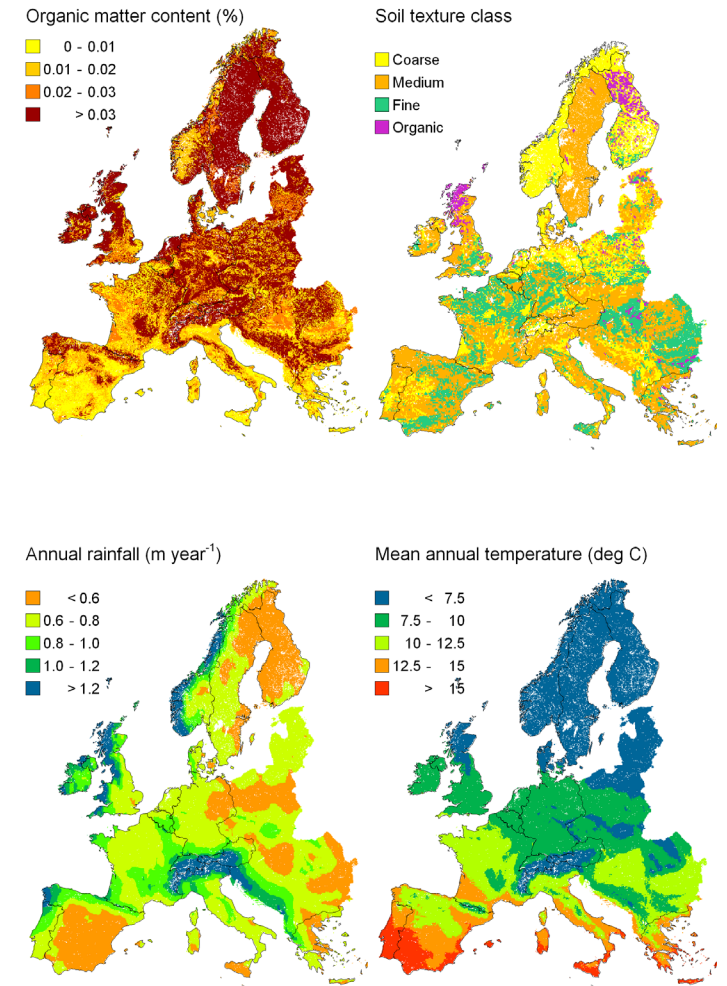
Not a trivial choice!



- > Do the current datasets at the European level justify complex model approaches?

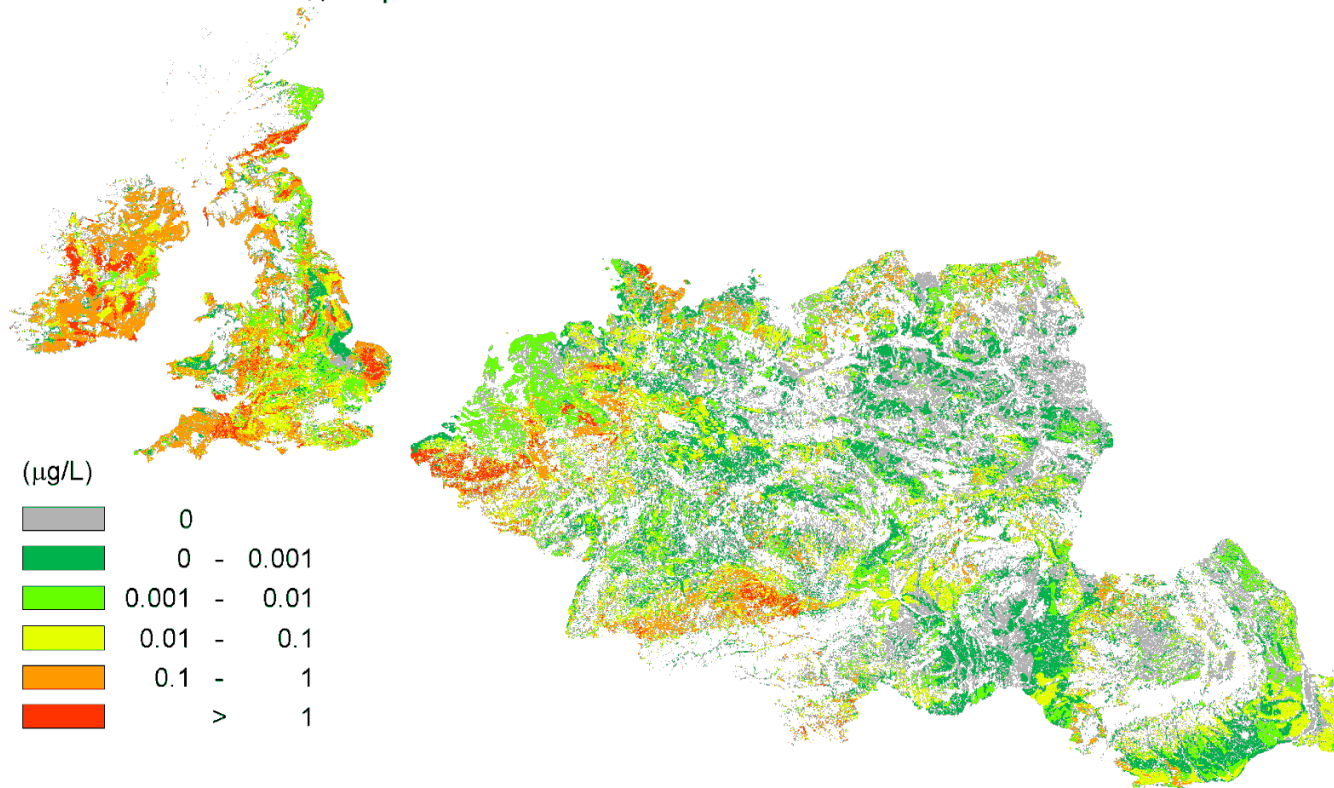
A harmonized tool using a simple model

- A quick assessment with MetaPEARL can be done using harmonized EU-datasets
 - Freely available at the JRC site
 - Developed for the PECs in soil GD
 - Resolution 1x1 km²
 - No need for further processing: all data available in same format



Example: The leaching concentration in the Central Zone

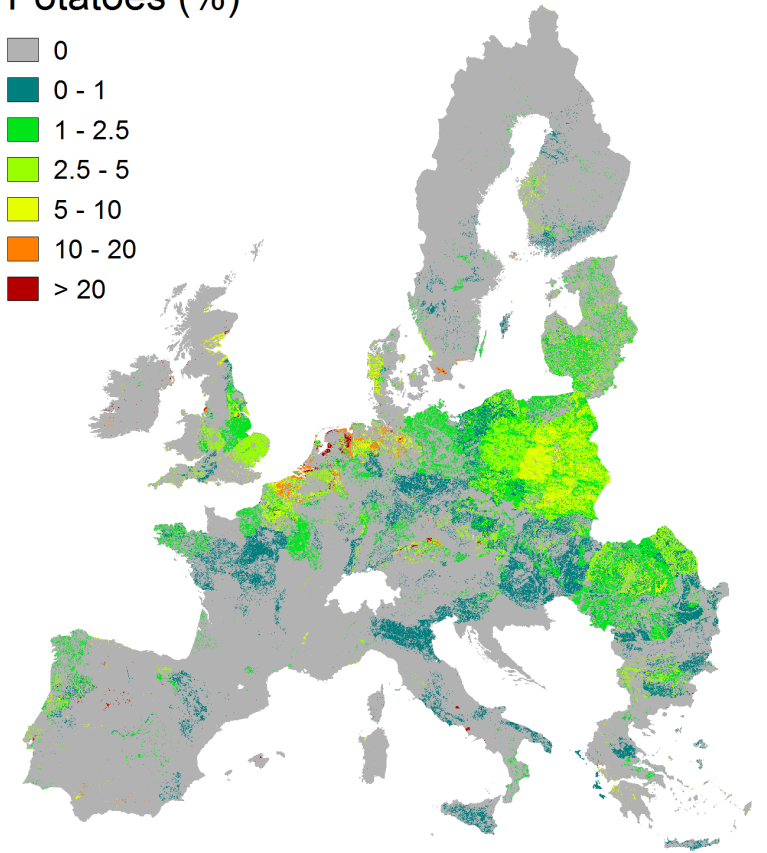
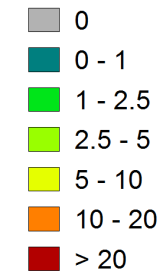
80th percentile of the leaching concentration in groundwater
FOCUS substance D, crop is winter cereals



What could be obtained from such a map?

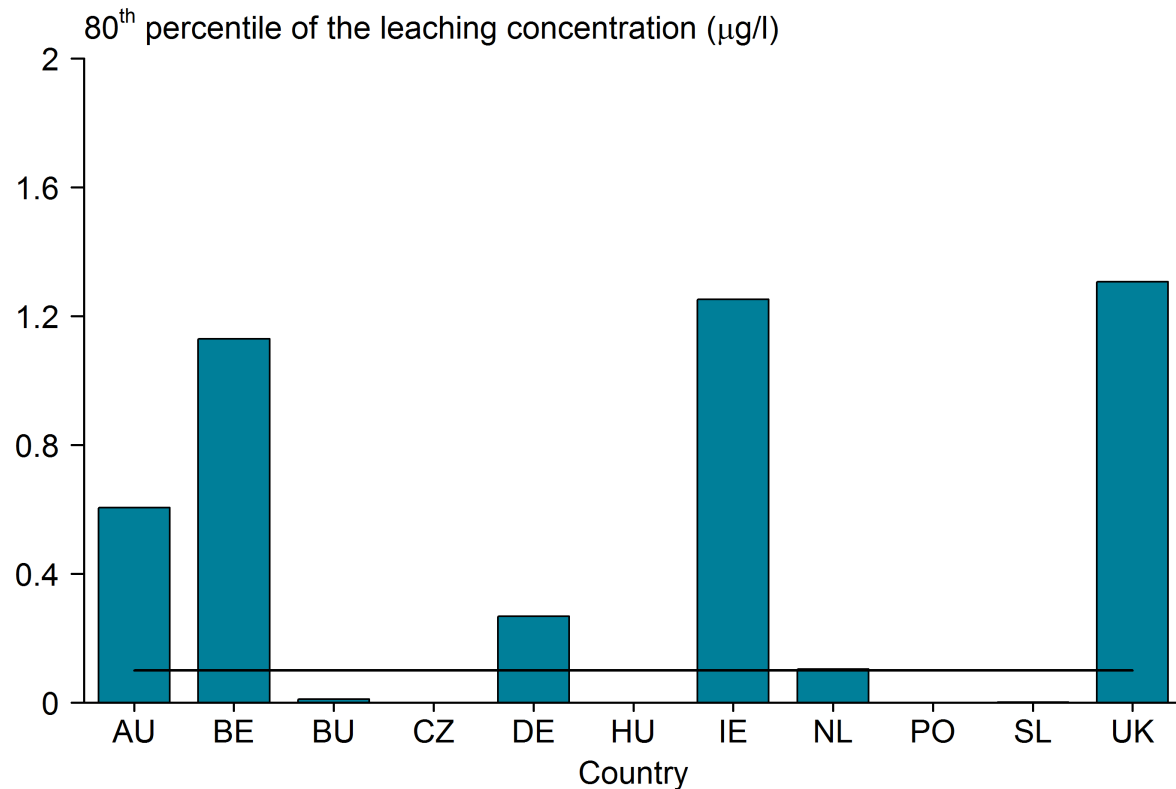
- Percentiles of the leaching concentration in arable land or major crops of
 - the entire regulatory zone
 - individual countries
- Crop distribution for major crops available in EFSA/JRC dataset

Potatoes (%)



Example: leaching concentration in arable land for the 11 countries of the Central Zone

- Harmonized assessment with one single tool





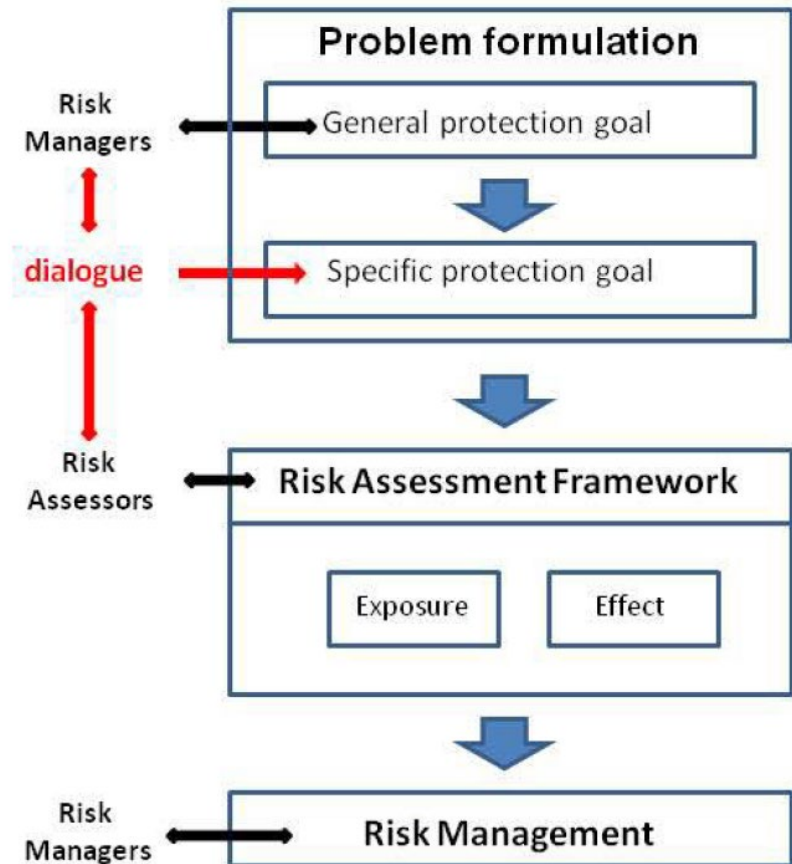
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**Is lack of agreement on protection goals
hindering progress?**

Which steps are to be taken?

1. Problem definition: define protection goals
2. Set-up a risk assessment framework including development of guidance documents
3. Apply framework to individual substances
4. Decision on approval of substances

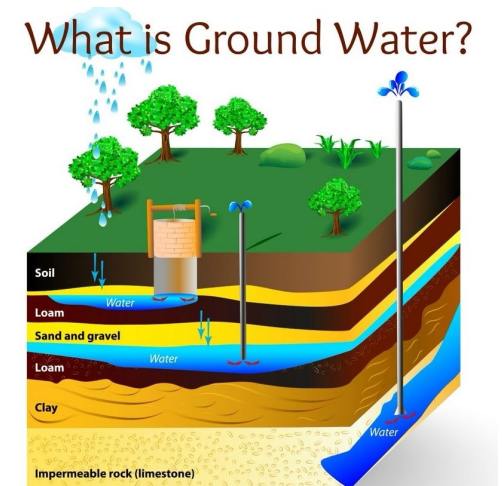


General protection goals are needed

- Protection goals are very generally described in EU-legislation:
General Protection Goals
 - Regulation (EC) No 1107/2009:
“...no harmful effects on human health, directly or through drinking water...”
“...no unacceptable effects on the environment...”
- In the case of groundwater the
Uniform Principles (2011) apply:
 - “...concentration in groundwater shall not exceed 0.1 µg/l...”
 - Too vague for regulatory practice

SPGs for groundwater

- In the case of groundwater, the Uniform Principles do not define groundwater in further detail and concentrations vary in space and time.
- So the following questions need to be answered:
 - **What** to protect
e.g. the uppermost groundwater, groundwater deeper than 1 m, deep groundwater
 - **Where** to protect it
e.g. groundwater below agricultural fields, only in drinking water abstraction areas
 - Over what **time period**
e.g. always, 90-percent of time



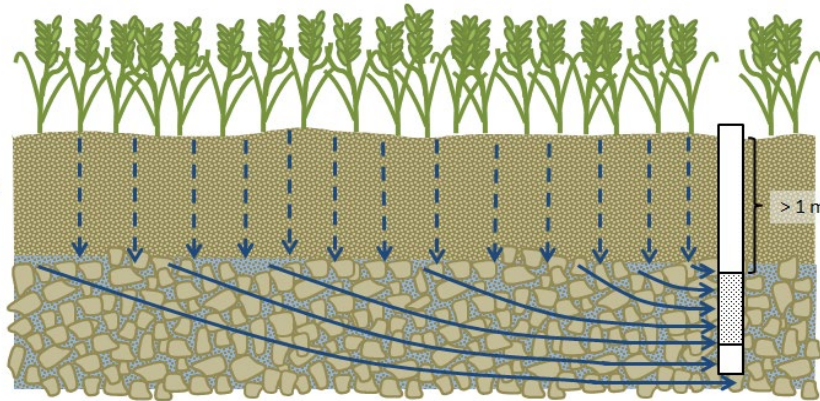
Provide options

- Risk managers don't specify protection goals in scientific language; they think in intentions
 - "... adequate protection of groundwater ..."
 - "... realistic worst-cases ..."
- To make the translation between this scientific language and these intentions, provide risk managers with **options** including examples and **consequences** for product registration



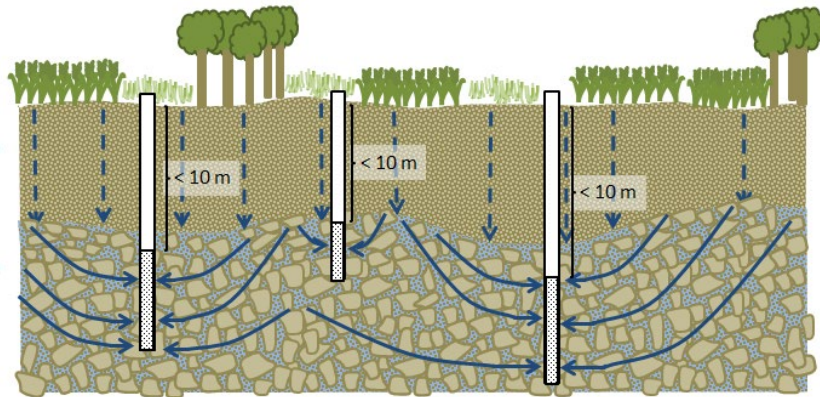
Examples

Most
stringent



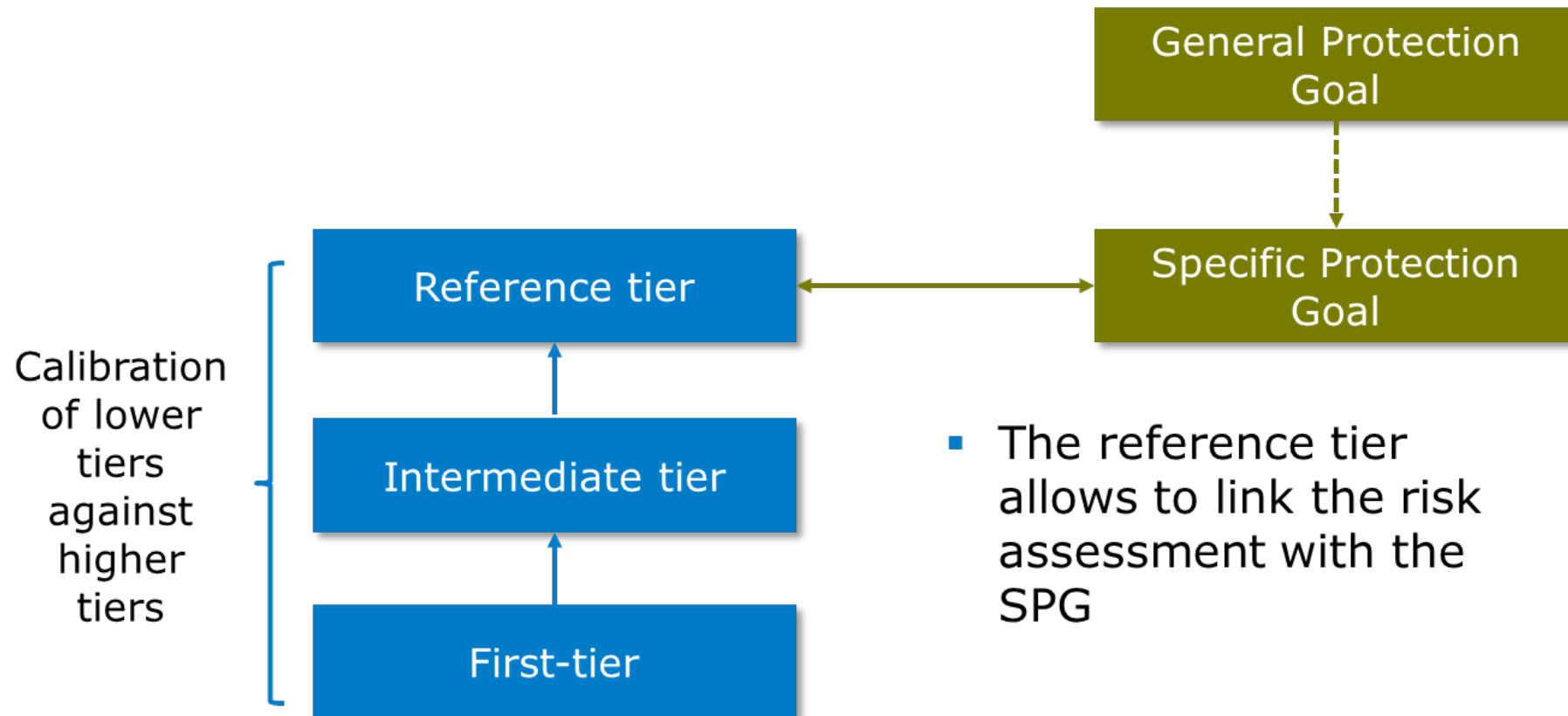
- Shallow groundwater below **each individual** field may never exceed $0.1 \mu\text{g/l}$
- > 90% of herbicides are expected to fail

Least
stringent

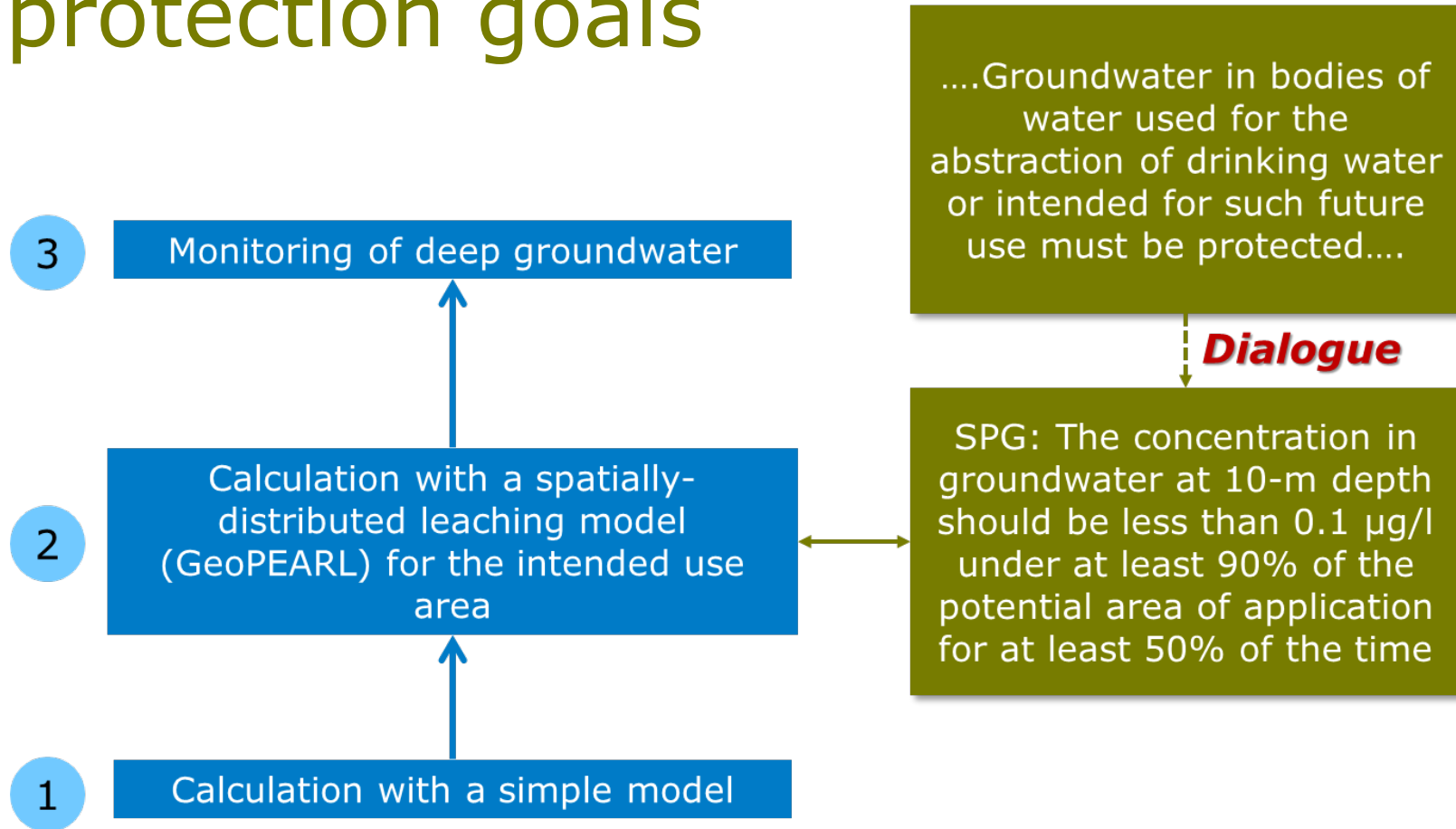


- Concentration in groundwater abstraction wells may not exceed $0.1 \mu\text{g/l}$
- Concentration will be lower because of dilution and degradation
- Possible to register products that degrade in the saturated zone

Results of spatial models provide a link with protection goals

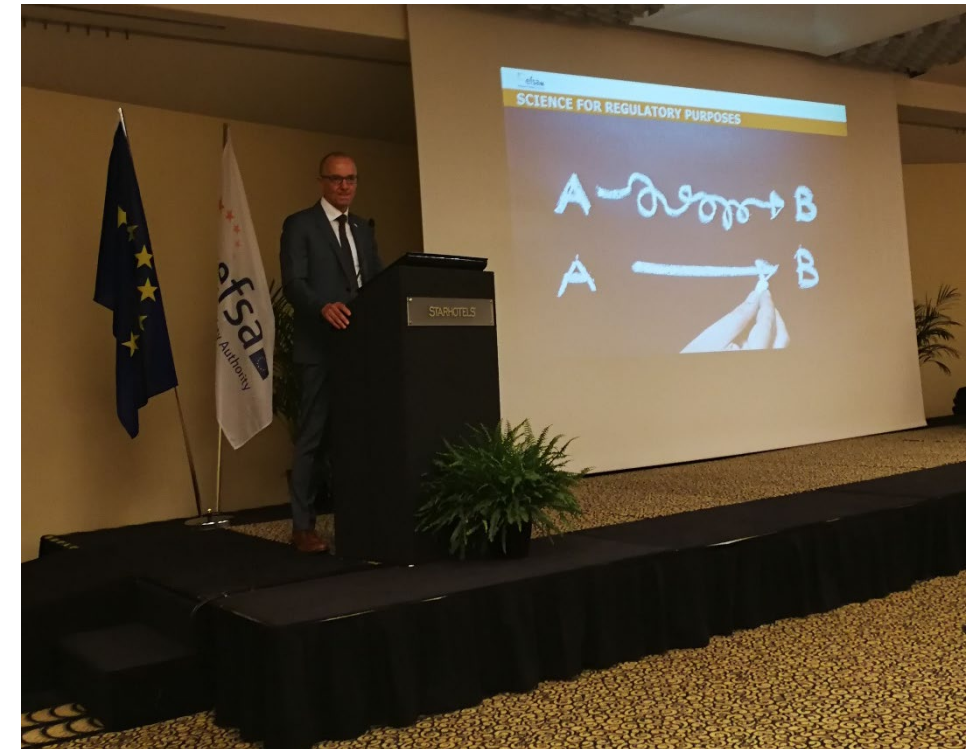


Results of spatial models provide a link with protection goals



Bottleneck: decisions become more political

- › Guidance documents have to be agreed upon in SCoPAFF
- › In contrast to substance approval guidance document have to approved unanimously
- › As long as countries think differently about protection goals, this will be an obstacle





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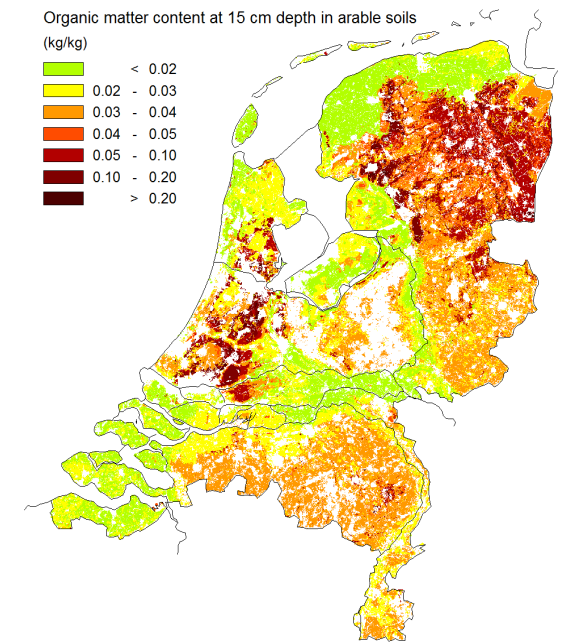
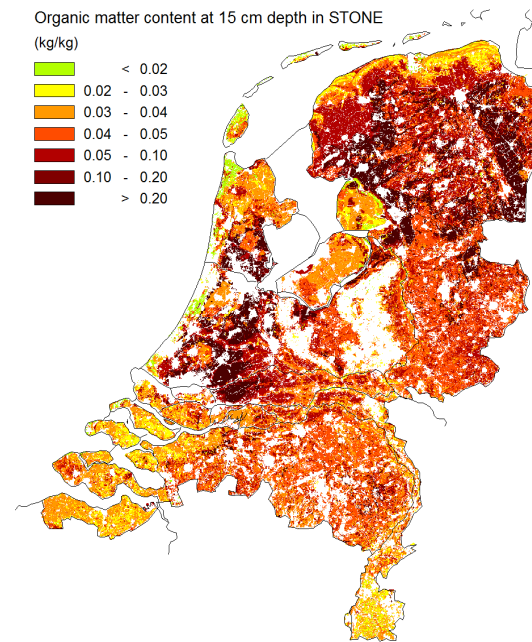
Opportunities and pitfalls

Opportunities

- Spatial models will play an important role in the near future
 - Better link between protection goal and calculated endpoint
 - Lower tier scenarios calibrated to results of spatial models
- Endpoint based on a spatial model more robust
 - Errors at point locations are larger
 - No need to add additional processes that are not part of a simplified model
- Transparent
 - No need to derive ambiguous substance specific scenarios
 - If based on standardised tools and datasets

Digital soil mapping can improve our models

- Digital soil mapping techniques were used to build a new organic matter map for GeoPEARL
- These methods make direct use of all underlying data in soil databases
- They can take account of regional differences within a – generally large – soil mapping unit
- This can be done for the EU as well, using the LUCAS dataset



Pitfalls

- Quality of European datasets
 - Weather (different interpolation methods)
 - Soil (soil profile information)
 - Pedotransfer functions (often not based on European datasets but only for specific countries)
 - More data needed for exposure assessment of aquatic organisms (e.g. slope, surface water density)
- Poor quality of spatial schematisation
 - If not derived in an appropriate way
- Hard to reproduce because of long computation times
 - Most regulators do currently not have access to grid computing systems



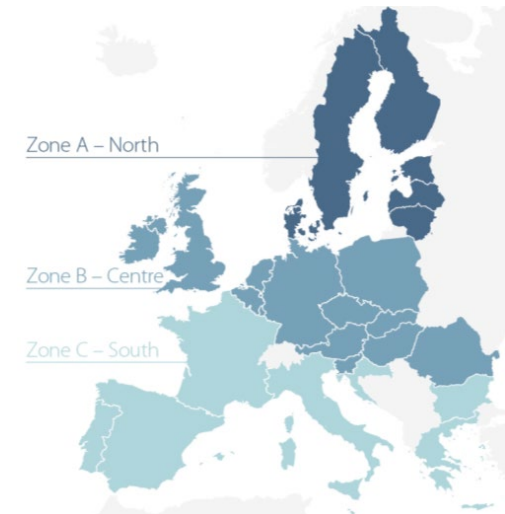
A new generation must take over

- › There are a lot of new developments
 - Big data
 - Digital soil mapping procedures
 - High level programming languages
(which programmer still “speaks” FORTRAN?)
 - Cloud computing
- › There is a need for a younger generation to take over our models
 - But where are they?



Conclusions

- FOCUS Groundwater contains higher-tier approaches for which guidance and/or tools have not been developed
 - This causes a lot of discussions in e.g. peer-review meetings because every company uses his own methods
- The expertise to create harmonized tools is available
 - Integration with current tools such as PERSAM, PELMO and PEARL is possible
- Increase of consistency
 - Tools can be used for both substance approval and product authorization
- A younger generation must take over our models





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Let's start bridging the gap

Thank you

Aaldrik Tiktak