



Planbureau voor de Leefomgeving



A Harmonised Framework for Spatially Distributed Leaching Modelling (SDLM) of Pesticides

Aaldrik Tiktak, Amy Ritter, Anton Poot, Bernhard Jene, Dimitrios Skodras, Emilie Farama, Gerard Heuvelink, Gerco Hoogeweg, Gregor Spickermann, Gregory Hughes, Judith Klein, Louise Wipfler, Maarten Braakhekke, Michael Klein, Michael Stemmer, Michelle Morris, Pavan Cornelissen, Robin Sur, Stephan Marahrens, Stefan Reichenberger & Nicoleta Suci

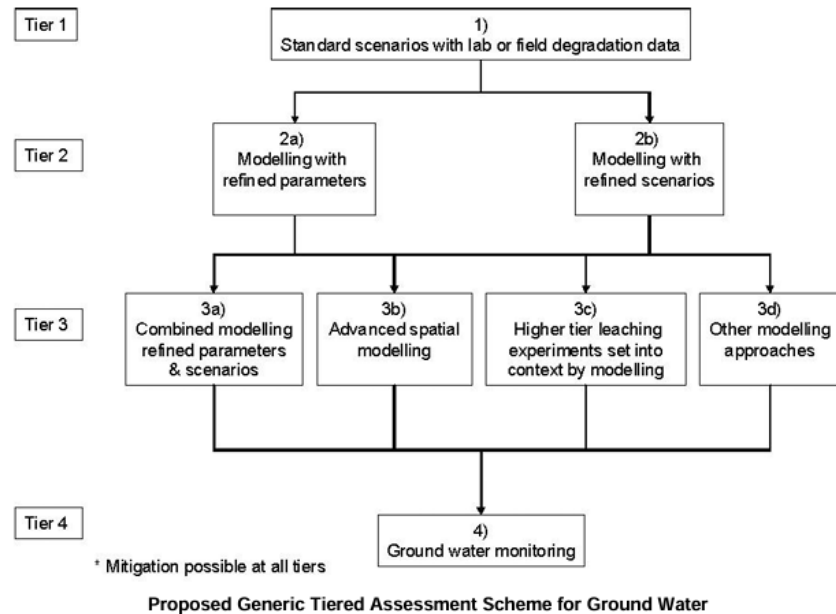
Pesticide Symposium Cremona, 3 September 2026

Overview



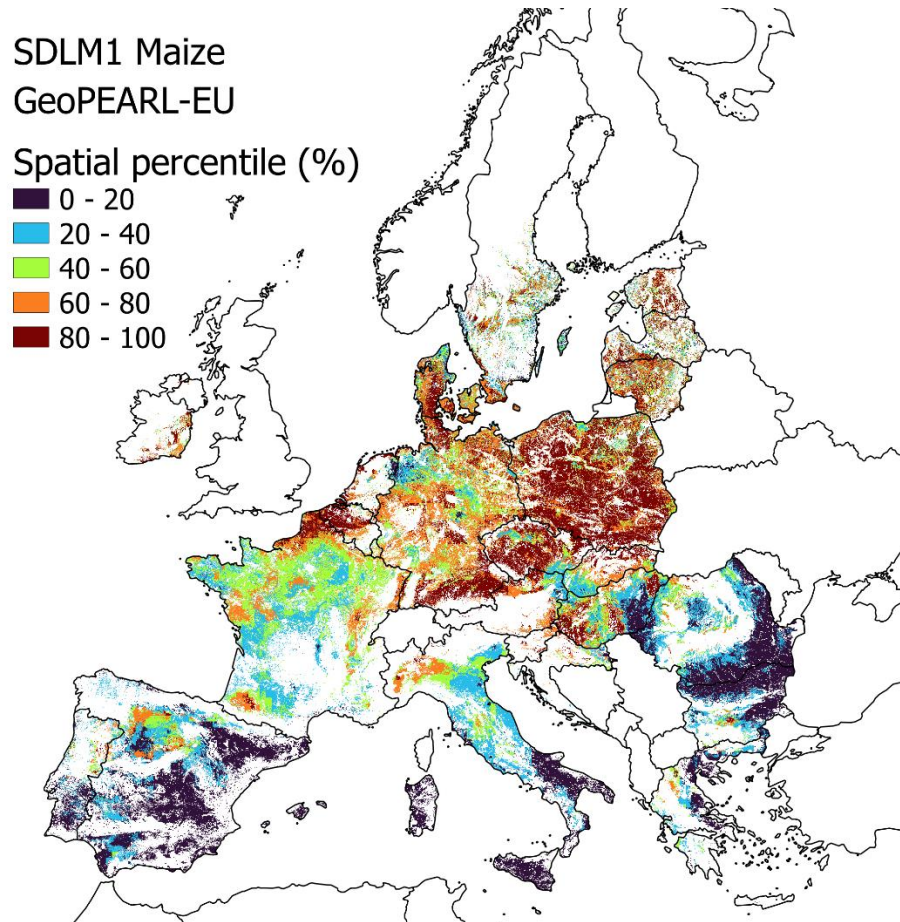
- › Background
- › Set-up of framework
- › Results
- › Perspectives

SDLM plays a role in FOCUS groundwater



- > FOCUS Groundwater report 2014
 - SDLM defined as a higher tier (Tier-3b)
 - No harmonised models available
- > SETAC EMAG-Pest Groundwater 2019
 - Groundwater monitoring at Tier-4
 - SDLM needed for selection of vulnerable sites and to demonstrate that monitoring sites are sufficiently conservative
 - No harmonised guidance available
- > **A SETAC work group was established in 2019 to develop a harmonised SDLM**

Why SDLM?



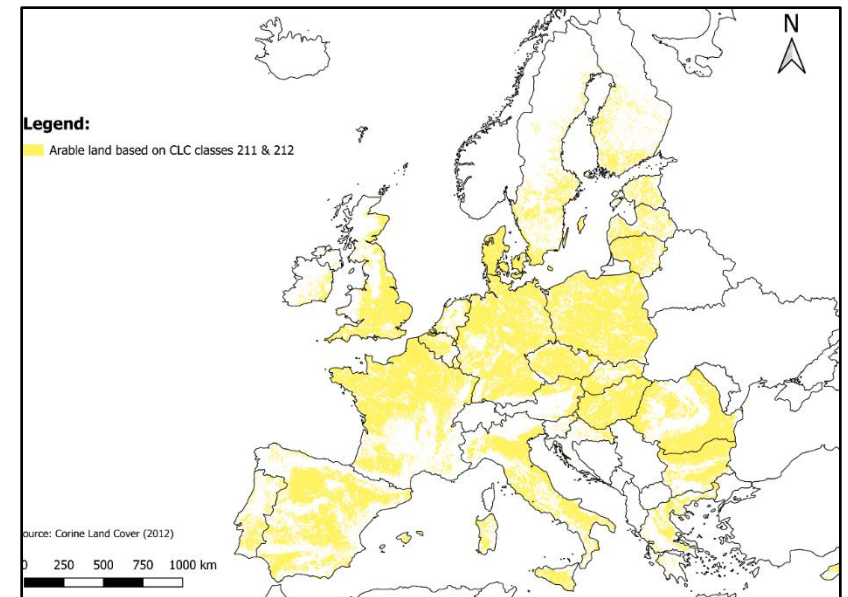
- > Decisions on pesticide authorisation are now based on nine realistic worst-case scenarios
- > With a spatially distributed leaching model, leaching can be simulated in the entire area of use of a pesticide
- > The so-obtained map can be used to:
 - calculate the 90th-percentile of the leaching concentration (Tier-3b)
 - select areas that are vulnerable to pesticide leaching for monitoring (Tier-4)

Aim and products of the SDLM-group

- Develop a **harmonised framework** for conducting spatially distributed leaching modelling at the European and Zonal level
- Products delivered are:
 - An **operational framework** based on two FOCUS leaching models (PEARL and PELMO)
 - The harmonised **datasets** to perform the assessment (open access)
 - Including **documentation**
- Everything will be available for download at **Zenodo**

Models run for 10 000 clusters

- The models cover the **entire arable crop area of the EU-27** (2,5 million km²)
- To save computation time, the models will run for 10 000 unique combinations (**clusters**) of soil, climate and crop
 - A statistical clustering procedure has been used for this purpose
- All data is available at a resolution of 1x1 km²
- The models are based on the **current Tier-1 FOCUS models** and do not include additional processes (e.g., preferential flow)



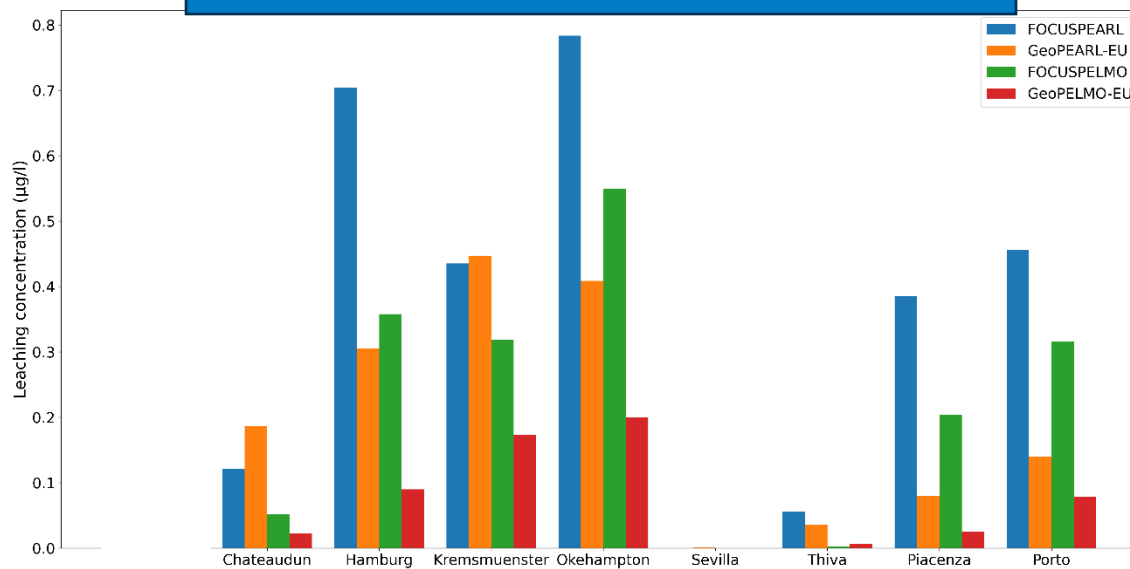
SDLM compared with FOCUS Tier-1

- We show results for **two FOCUS dummy substances**:
 - FOCUS substance A with $K_{om} = 60$ L/kg and $DegT50 = 60$ days
 - FOCUS substance B with $K_{om} = 10$ L/kg and $DegT50 = 20$ days
- **Annual application** of 0.1 kg/ha one day before crop emergence
- **Two crops**: winter wheat and maize
- Results are compared with Tier-1 simulations
 - 80th percentile in time and space; i.e., 90th percentile overall according to FOCUS procedures

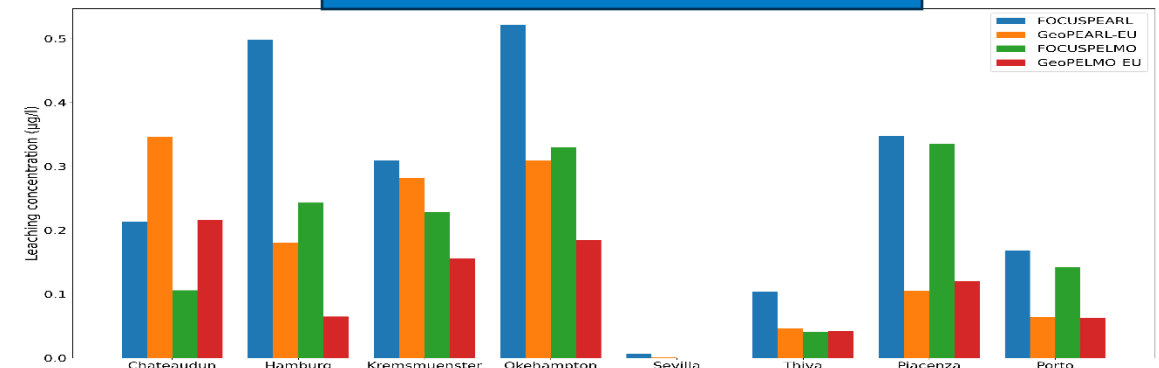


Tier-1 generally higher than SDLM

Substance A in winter cereals



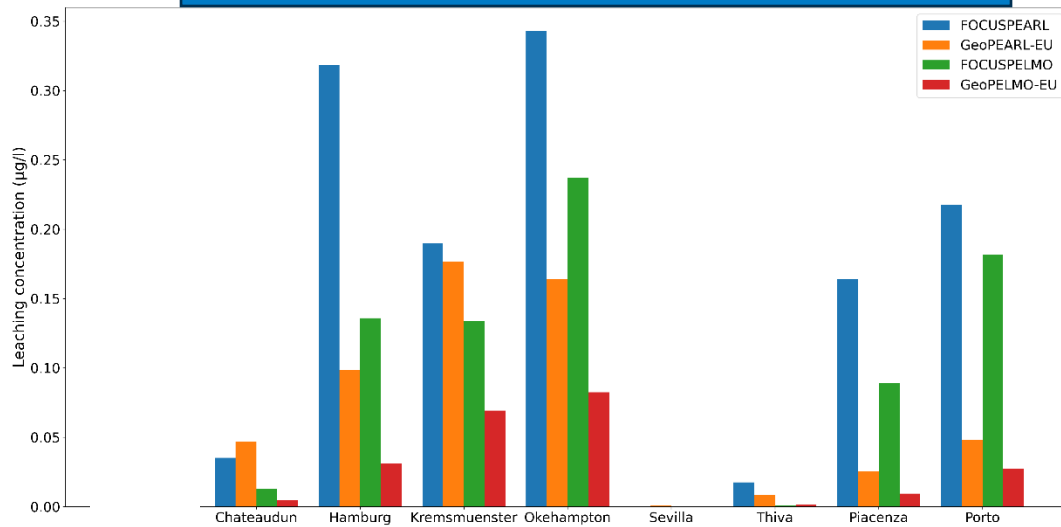
Substance A in maize



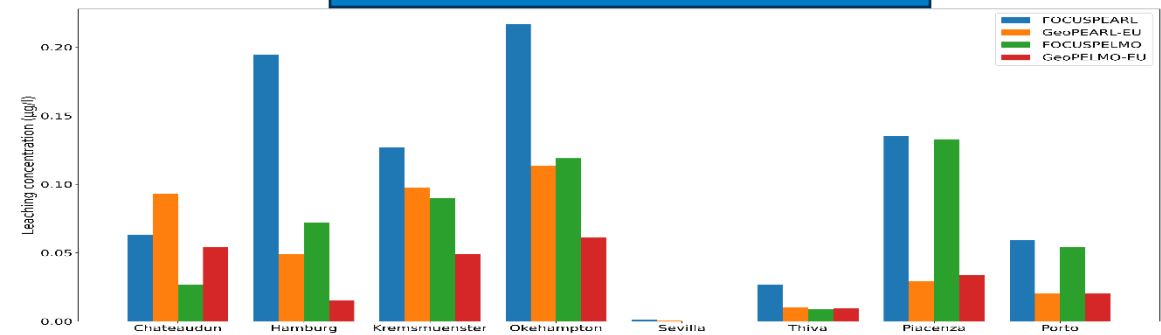
- › Winter cereals generally higher than maize → autumn application
- › Exception: irrigated scenarios (CH, SE, TH, PI & PO)
- › **Tier-1 generally higher than Tier-3b** (except Châteaudun)

Tier-1 generally higher than SDLM

Substance B in winter cereals



Substance B in maize



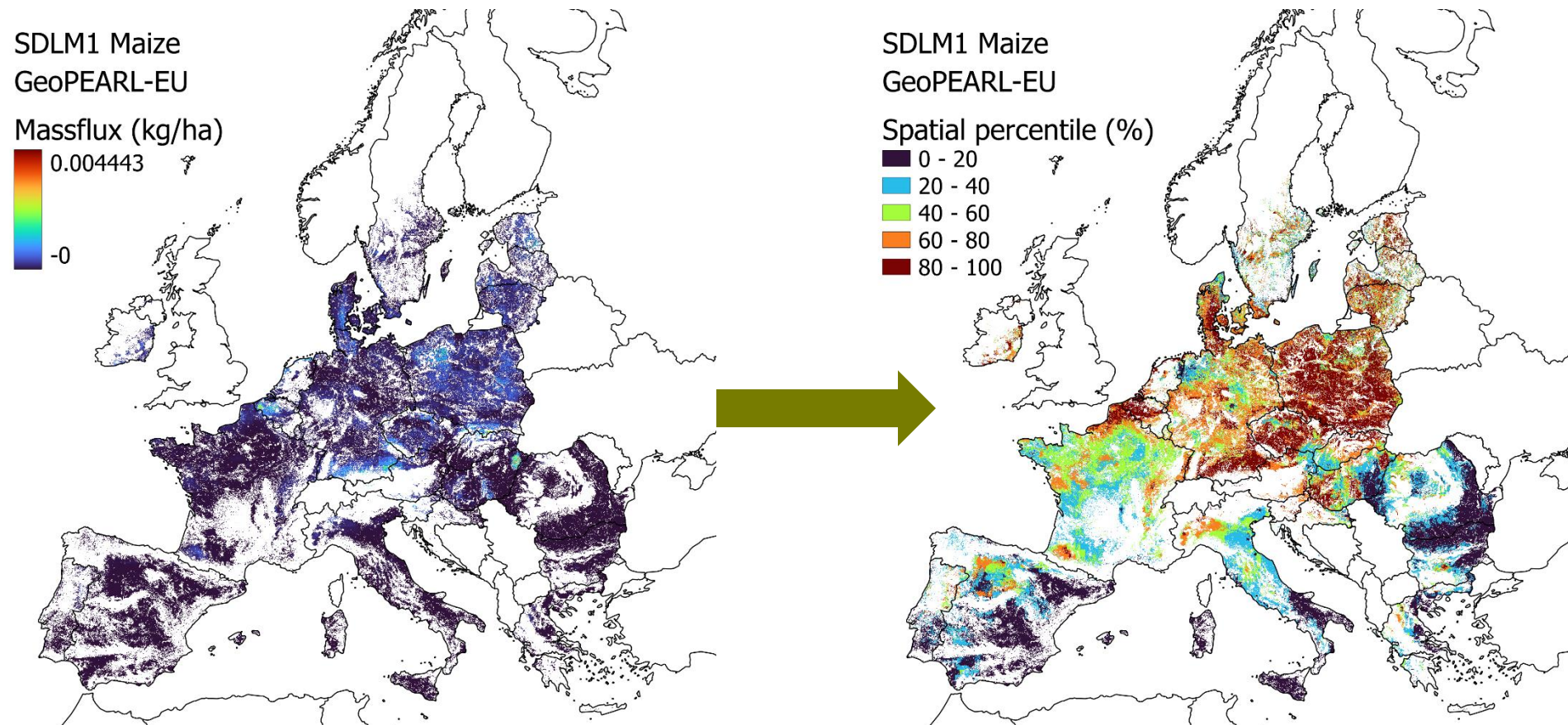
- Conclusions same as for substance A

SDLM supports monitoring studies at Tier-4

- EFSA statement on groundwater monitoring (2023): well-performed monitoring studies can overrule results from lower tiers
- Applicants must demonstrate that monitoring sites represent vulnerable conditions: **vulnerability assessment** required
- SDLM can be used to do this vulnerability assessment

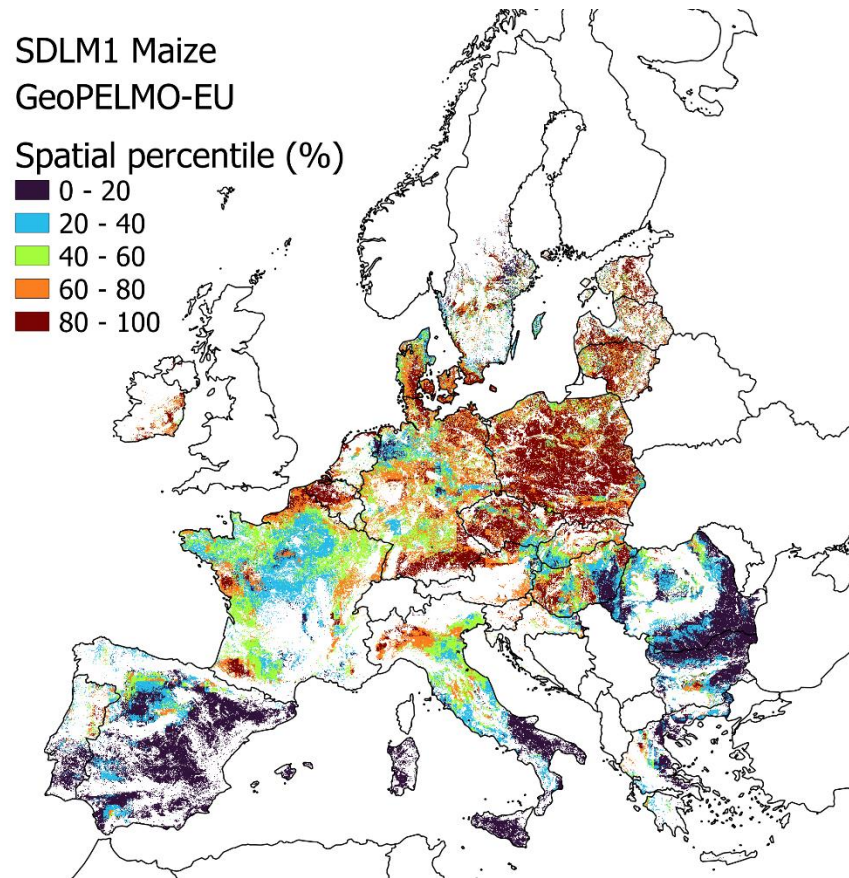
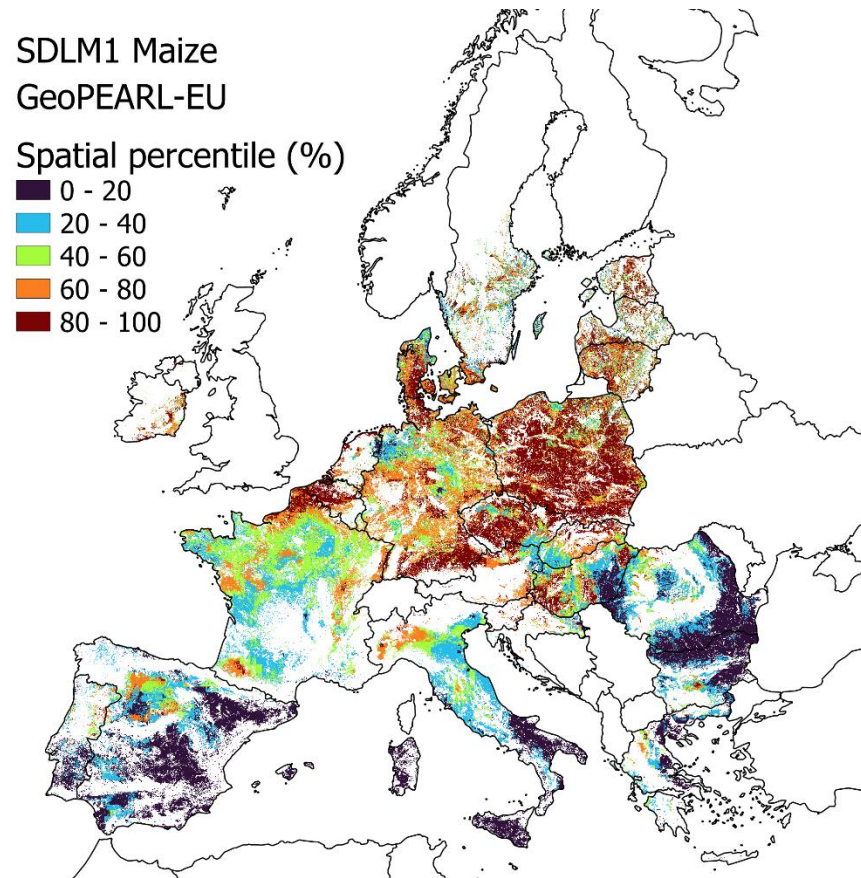
Step 1: create a “vulnerability map”

- Cluster with highest value scores 100%



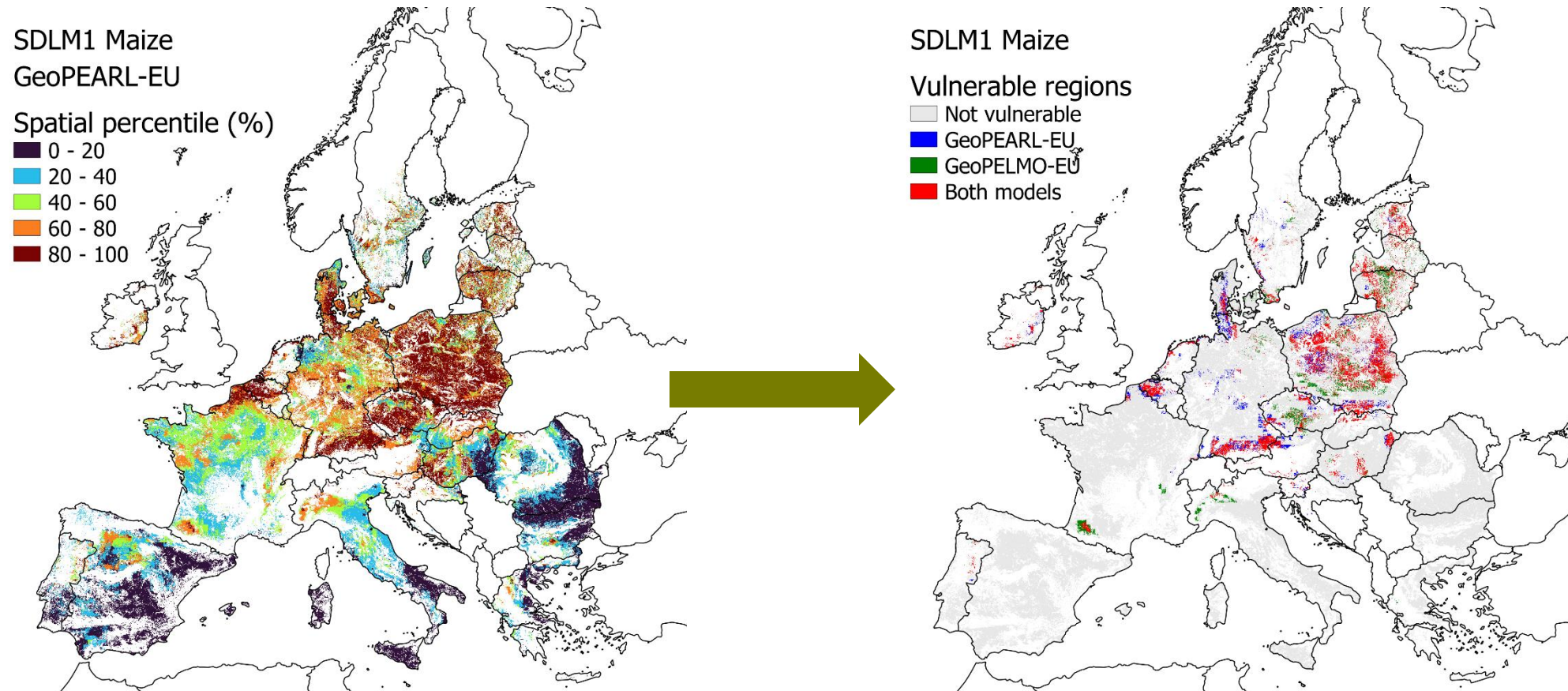
Spatial trend of both models comparable

- › Although there are some differences ...



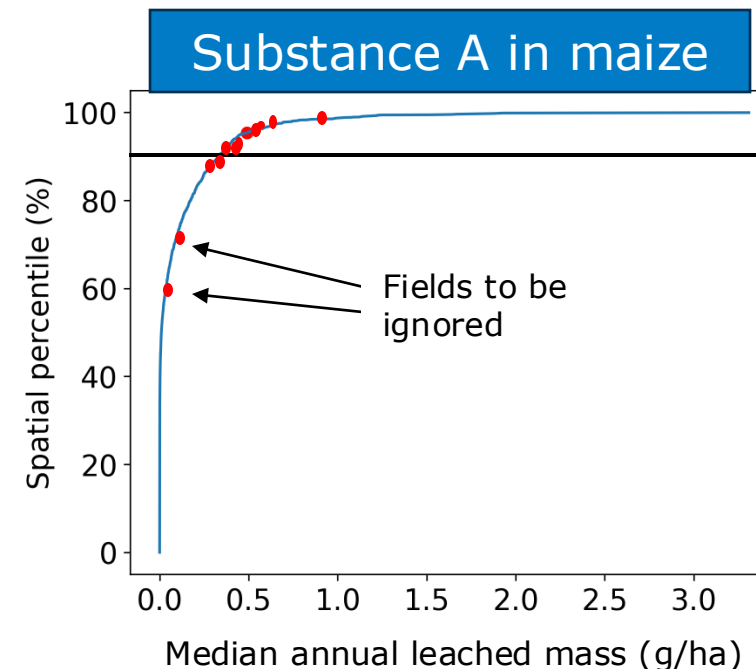
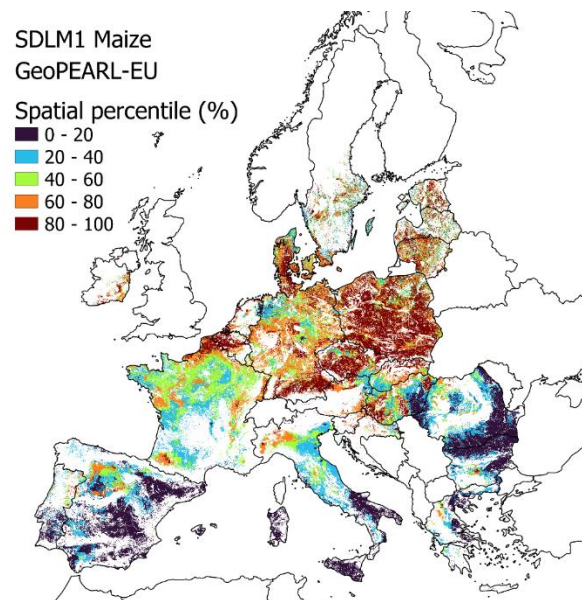
Step 2: select vulnerable regions

- Monitoring sites must be in the areas with significant vulnerability (“significant” to be agreed with responsible risk managers)

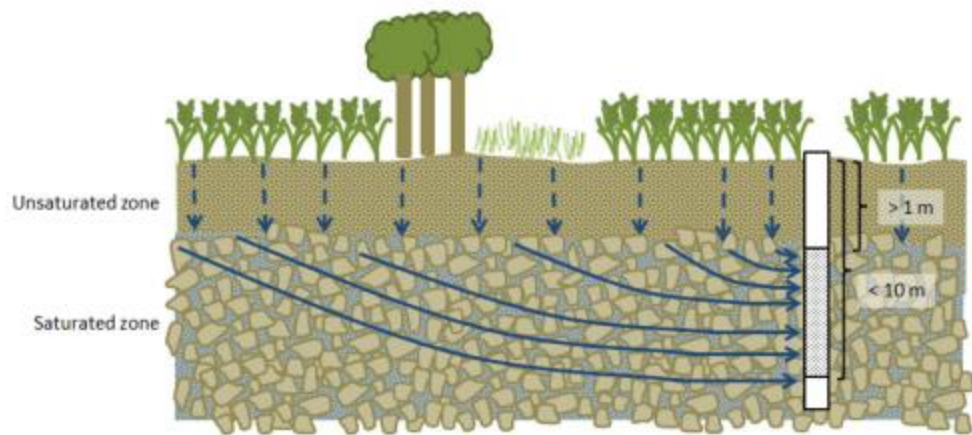


Step 3: show that fields meet the ExAG

- Field characteristic can be different from mapped characteristics
- Applicants must perform **field-specific simulations** to demonstrate that the actual fields meet the exposure assessment goal (ExAG) agreed upon by risk-managers (e.g. FOCUS: the 90th-percentile)



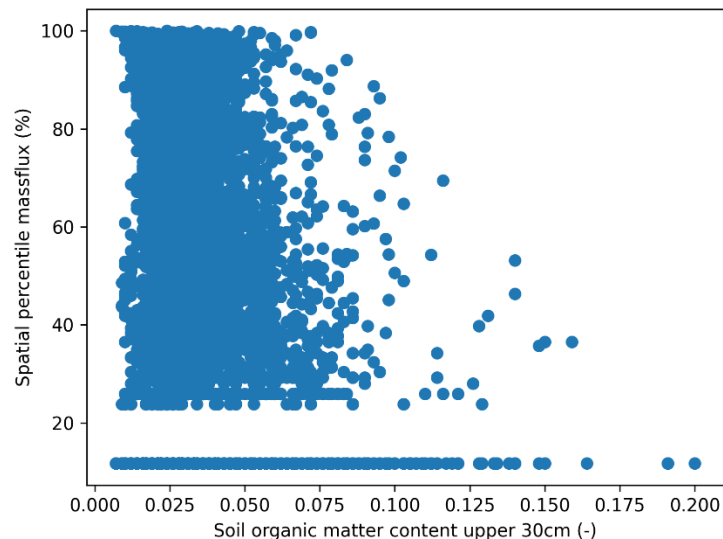
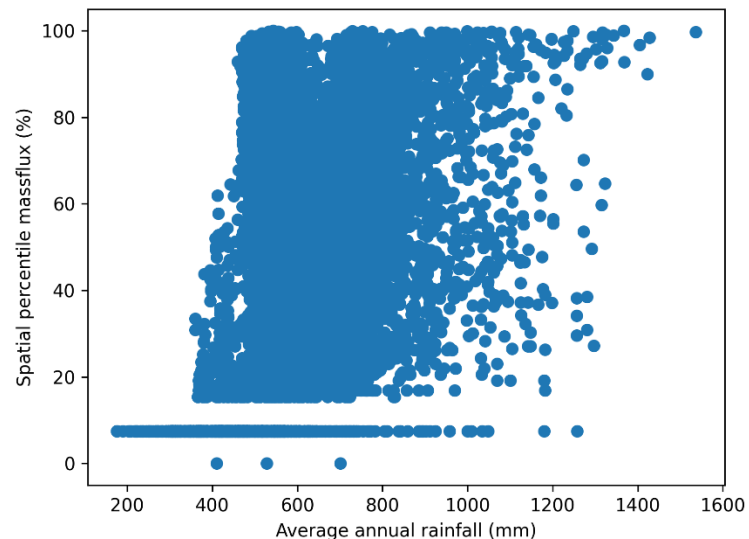
Leaching vulnerability $\neq$ groundwater vulnerability



- > SDLM is only a starting point in GW monitoring
- > Much more work is needed; e.g.,
 - Applicants must prove connectivity between monitoring wells and fields
 - Pesticide use history must be available
 - Please refer to the **EFSA Statement on Groundwater Monitoring Studies (2023)**

Do we really need a model for this?

- There is hardly any correlation between the mass flux leached and spatial parameters such as rainfall and organic matter
- The leaching process behaves highly non-linear, and therefore a model is needed to calculate the vulnerability score



Final remarks

- › **Prototypes** of two spatial models have been developed that show comparable results for both Tier-1, and the leaching vulnerability
- › The models must be **continuously improved** and reviewed; e.g.,
 - Keep data up to date (weather, crop data)
 - Remove artefacts such as the link between irrigation and FOCUS zone
 - Add crucial processes that are not yet in the model (preferential flow, runoff)
 - Evaluate the models using publicly available monitoring data
 - Establish version control, e.g. under the umbrella of FOCUS version control
- › **A standing working group is needed to keep our models fit for the future**



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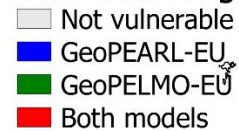
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Irrigation affects the vulnerability score

- Maize is irrigated in five FOCUS scenarios including Châteaudun

SDLM1 Maize

Vulnerable regions



SDLM1 Winter cereals

Vulnerable regions

