

Experiences using spatially distributed models in Austria

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Introduction



Project "GeoPEARL Austria"

Project

- Runtime 2009 – 2012
- Founded by Ministry (Water Management) & AGES

Project team

- AGES
- Federal Office of Water Management
- PBL Netherlands Environmental Assessment Agency (consultancy, Aaldrik Tiktak)

Project report

- <https://www.bmnt.gv.at/wasser/wasserqualitaet/geoppearl.html>
- In German, only

Introduction



Project "GeoPEARL Austria"

☞ **Intention 1 – AGES (Risk assessment/management)**

- Check representativeness of FOCUS scenarios
- Check GeoPEARL as a higher tier (refinement) option

☞ **Intention 2 – Ministry (Water Management)**

- Identification of actives and metabolites posing a risk to groundwater (what, where and when?)

Model parameterization & aggregation

Soil properties & hydrology



↪ **National soil data base**

- ~ 11,000 soil profiles linked to ~ 500,000 polygons
- Profile depths up to 1 m and more
- Measured data on organic matter content, texture, pH

↪ **Additional work needed** to parameterize PEARL

- Many decisions to be made - expert judgment!

Model parameterization & aggregation



Soil properties & hydrology

☞ **Soil hydrological parameters** (Mualem-Van Genuchten)

- Several PTF available - which one is most appropriate?
- Wösten et al. (1999) vs. Rosetta (Schaap et al., 2001)
- Minor impact for humid areas, stronger impact for less humid areas
- Factor on $PEC_{GW} \sim 1.5$

☞ **Evapotranspiration** from bare soil

- Different options in PEARL
- Strong impact for less humid areas
- Factor on $PEC_{GW} \sim 2$

Model parameterization & aggregation



Weather data

- ☞ Data from **national weather stations** (1990 – 2010, n = 55)
- ☞ **High resolution maps (1 x 1 km)** for long-term average temperature, precipitation and evapotranspiration
 - Regional scaling necessary
 - Otherwise transitions in PEC_{GW} clearly visible
- ☞ **MARS-50 data (JRC)**
 - Deviating from national data
 - Strange shifts in data
 - New MARS-25 data have not been checked (not available)

Model parameterization & aggregation



Crop data & irrigation

☞ Crop parameterisation

- FOCUS Kremsmünster without changes
- No green cover crops, no crop rotations

☞ Crop area of interest

- National high resolution crop maps (field scale)
- CAPRI data may strongly deviate (depending on crop)

☞ Irrigation

- National high resolution irrigation map (field scale)
- Regional on/off switch for irrigated crops in GeoPEARL

Model parameterization & aggregation



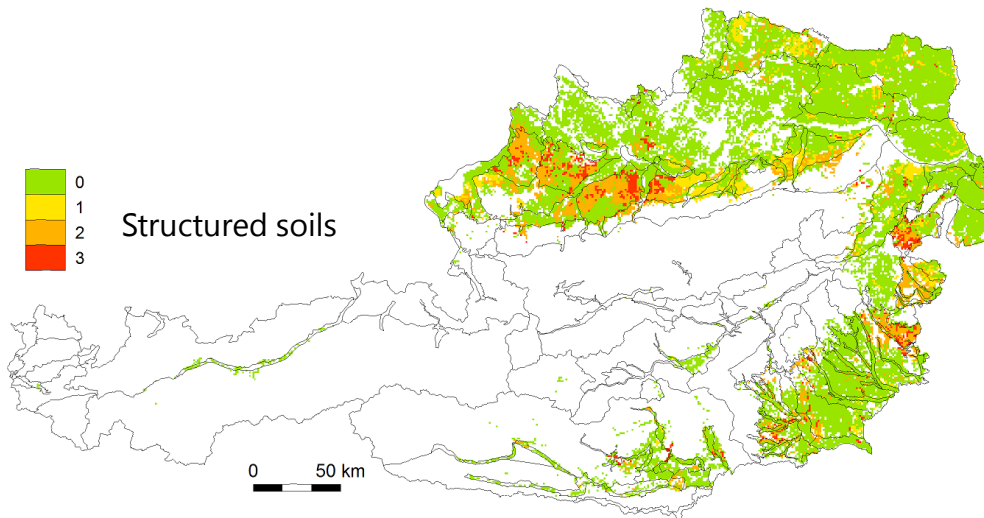
Aggregation

- ↪ Necessary to **reduce computation run time**
- ↪ **Two methods (at least)**
 - Vulnerability rank (implemented in Dutch version)
 - does not work for non-ordinary behaving substances
 - Clustering according to soil and weather properties
 - works in any case
- ↪ 25,000 km² → 6,000 plots → ~ **500 “representative plots” for each crop** (finally used in calculation, extrapolated to total crop area)
- ↪ **Loss in information acceptable**

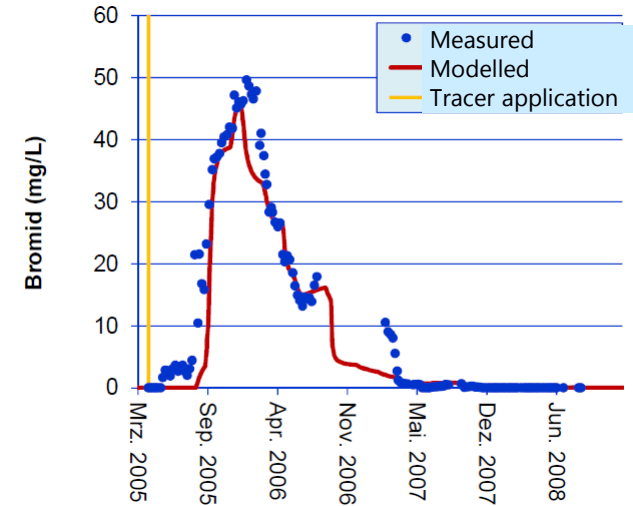
Model validation

GeoPEARL vs. lysimeter

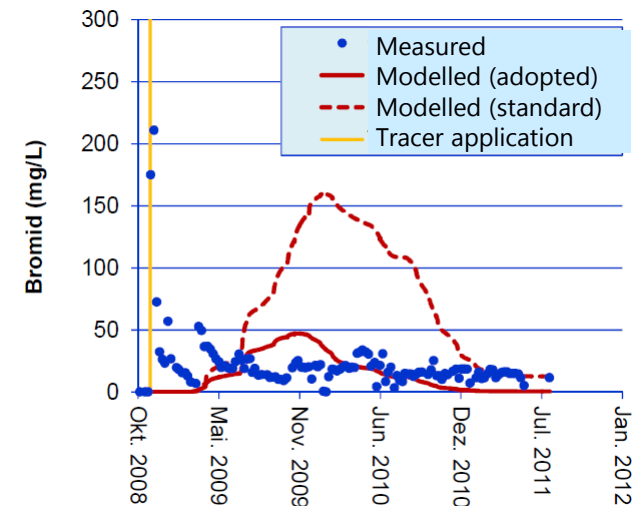
- Overall **water balance OK**
- Water flow** (bromide tracer)
 - Sufficient for non-structured soils
 - Poor in structured soils



Sandy soil



Structured soil



GeoPEARL as a regulatory tool

GeoPEARL vs. FOCUS standard scenarios

Standard runs

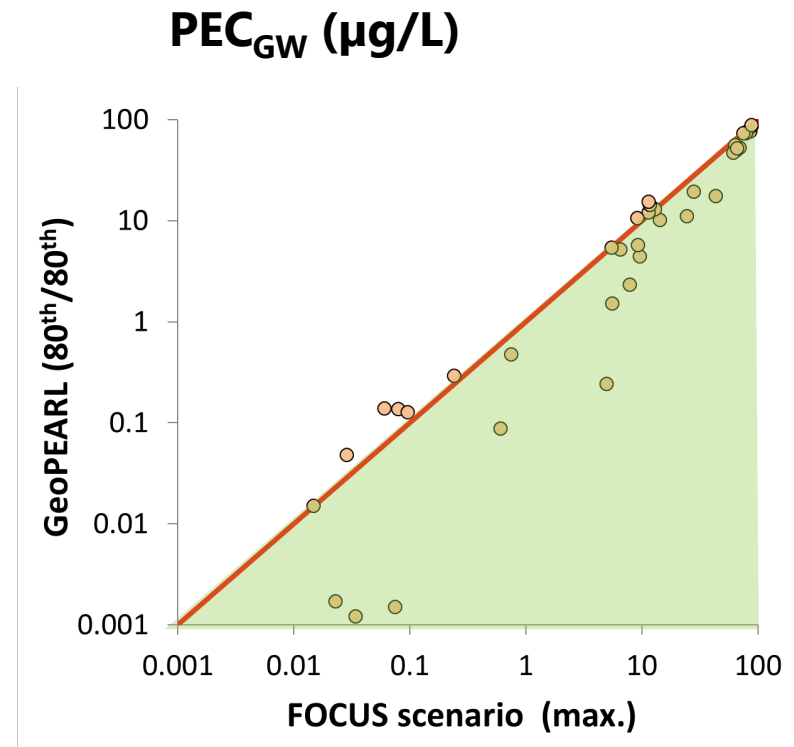
- Dummy substances
- Maize, winter cereals, winter rape, sugar beets, vines

FOCUS standard scenarios

- CH, HA, KR, OK

Major outcome

- Max. PEC_{GW} of FOCUS standard scenarios close to 80th/80th percentile PEC_{GW} in GeoPEARL (or even higher)



GeoPEARL as a regulatory tool



Potential use of GeoPEARL in regulatory world

☞ GeoPEARL as a „higher tier option“?

- Limited use for major crops (same results)
- Refinement option for crops grown in less humid areas (east of Austria) or for substances with properties depending on soil properties

☞ Risk management

- Regional mitigation not foreseen

☞ Finally “**no strong pressure**” to implement GeoPEARL in authorization process

- FOCUS standard scenarios considered sufficient robust

GeoPEARL as a predictive tool



From soil pore water to groundwater

↪ **GeoPEARL overestimation concentrations measured in groundwater monitoring (WFD)**

- No groundwater hydrology implemented
- Untreated area not accounted for
- No information available on regional use (rates)
→ potential use conditions (maximum rate everywhere)
- Very **limited use of GeoPEARL as a predictive tool** for concentrations found in groundwater

↪ **How to account for untreated area within a 1D approach?**

- Regional dilution of PEC_{GW} assuming that groundwater recharge of untreated areas equals groundwater recharge of treated areas

GeoPEARL as a predictive tool



From soil pore water to groundwater

GeoPEARL with dilution factor

- Reduction in 80th/80th percentile PEC_{GW} by a factor of 3 to 15 (depending on crop)
- PEC_{GW} much closer to results from groundwater monitoring (still conservative)

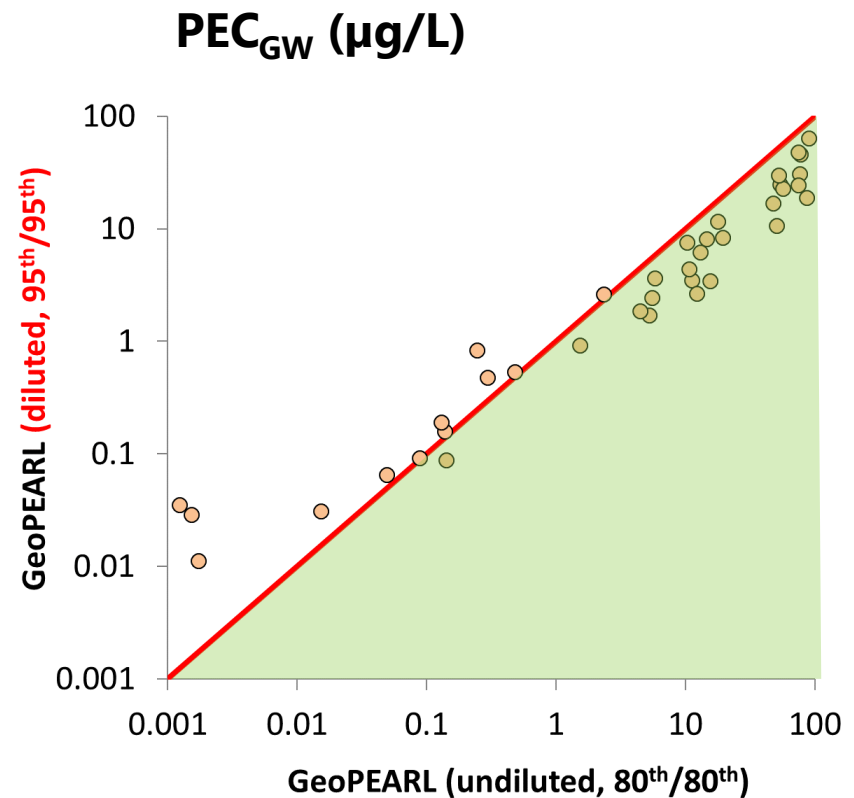
But

- Unspecified “protection goal” in AT: “All groundwater is drinking water”
 - 80th/80th percentile approach not defensible on groundwater level
- Shift in overall percentile necessary

GeoPEARL as a predictive tool

From soil pore water to groundwater

- ↪ **Undiluted 80th/80th**
percentile PEC_{GW} equals
diluted 95th/95th percentile
 PEC_{GW} in many cases



GeoPEARL as a predictive tool



From soil pore water to groundwater

☞ **Is regional dilution a valuable refinement (higher tier) option in the authorization process?**

- Simple regional dilution factor needs validation with more sophisticated models (e.g. 2D/3D models)
- Decrease in PEC_{GW} via dilution counteracts increase in overall percentile necessary at "groundwater level"
- No clear protection goal at "groundwater level" (which overall percentile)

Conclusions



☞ **Data quality**

- National data usually better than EU-wide data
- Accurate data quality important on national/regional level

☞ **Model parameterisation**

- Several expert judgments to be made (with minor/major impact)
- Correct water balance in less humid areas particularly critical

☞ **Model acceptance not necessarily given**

- Data quality may not be not considered adequate
- No preferential flow included (structured soils)
- Regional uncertainties in substance properties not accounted for

➤ **Limited use of GeoPEARL as a higher tier option**

- 80th/80th percentile PEC_{GW} for major crops close to FOCUS standard scenarios (max. of CH, HA, KR & OK)
- Regional mitigation not foreseen in Austria

➤ **Regional refinement (dilution due to untreated area)**

- PEC_{GW} closer to groundwater monitoring results
- Further verification needed (e.g. 2D/3D models)

➤ **Model acceptance outside of the „pesticide regulatory world“ is a difficult task**

- Different „languages“, different „thinking“
- On groundwater level overall 90th percentile approach “not acceptable” (but no clear protection goal given)
- Groundwater monitoring results often considered the benchmark for a “correct leaching model”



AGES

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