

Scenario Development for Off-field Soil Exposure and Risk Assessment

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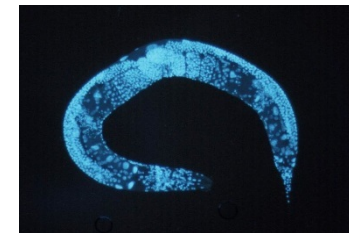
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Introduction

- EFSA published a new opinion on the **risk assessment for soil organisms** (Ockleford et al. 2017*) including **off-field areas**.
- Discussed **Specific Protection Goals** (SPG) for off-field areas:
 - No unacceptable effects on **Biodiversity** and **Ecosystem Services**
 - Negligible effects on **Population/Community**



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Introduction

- How to estimate off-field **exposure** and for **which areas**?
- In absence of appropriate off-field exposure scenarios exposure is proposed as the **sum** of spray drift and surface run-off entry
- *“conservative assumption because it neglects the different dynamic behavior of the processes”* (Ockleford et al. 2017*)
- EFSA acknowledges that more realistic off-field exposure scenarios need to be developed!

*The present work aims to undertake first steps (i) to **develop a model approach** for off-field/off-crop soil exposure due to runoff, erosion, and drift, (ii) to develop **exemplary schematic and real-world scenarios***

What is off-field?

1) Off-field definition: EFSA scheme

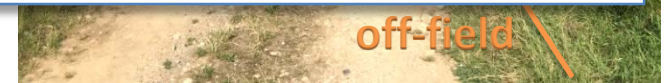
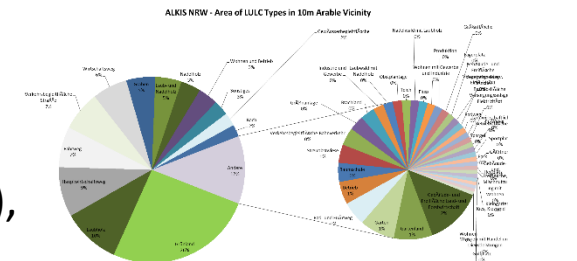
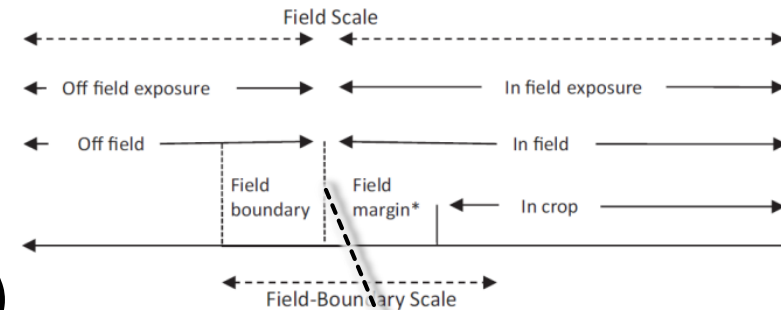
→ Hypothesis: 'Off-field' starts at farmers' property boundary (legal)

2) Off-field characterisation (preliminary)

Preliminary results:

A few off-field types occurring (Ger/NRW)

major off-field types bordering to arable (rounded):
grassland (30%), wood (20%), (rural) road margins (25%),
urban (10%), riparian (10%), others (5%)

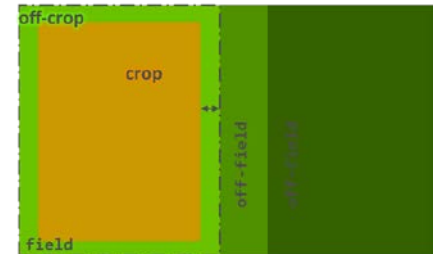


Scenario Development

1) Two landscape scenarios were defined

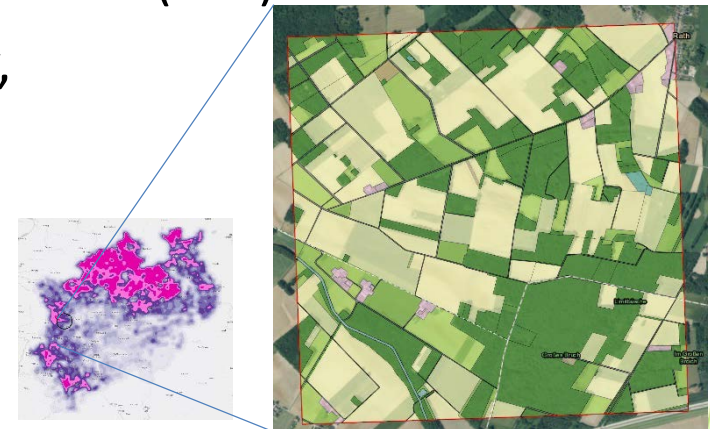
a) Schematic → understanding, testing, simple tier

- in-/off-field, field margin, crop (in-crop buffer)
- runoff / spray-drift towards off-field



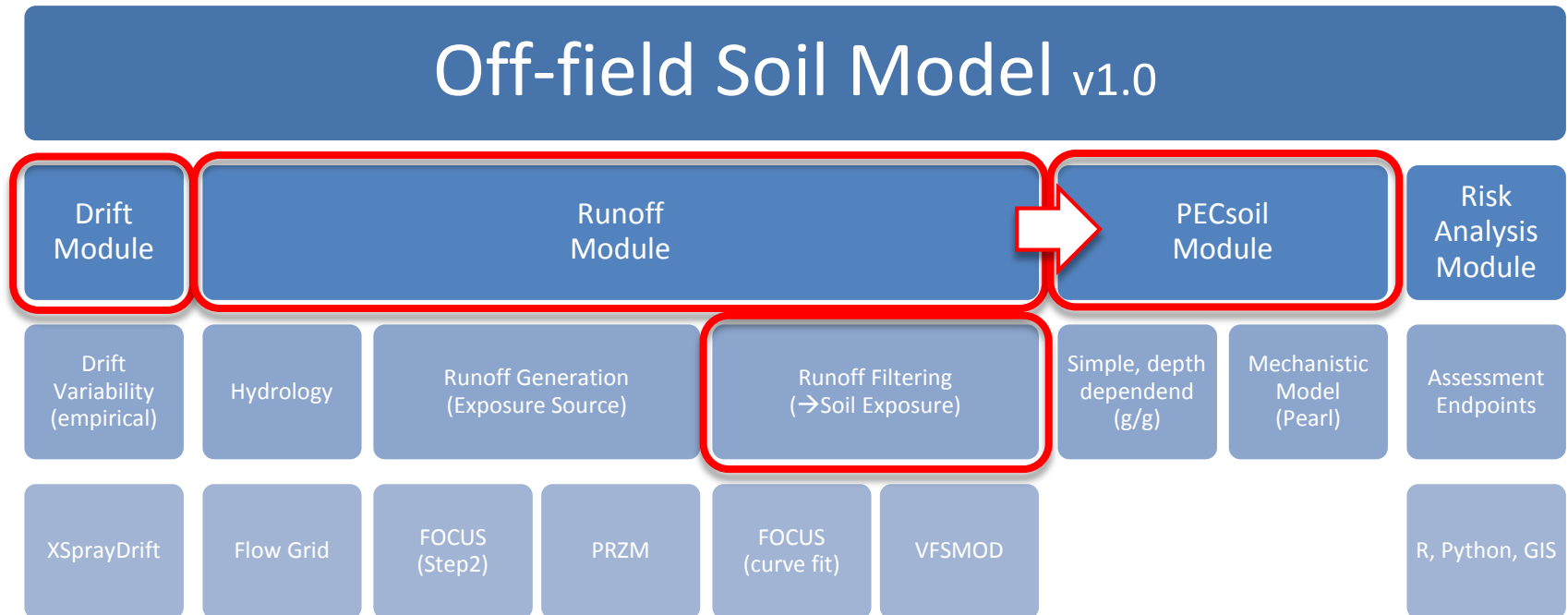
b) Realistic → towards real-world risk characterisation

- identification by large scale risk metric analysis (risk %tile)
- 3 scenarios (2x2 km, 5x5 km) at lower Rhine (Ger)
- arable, off-field, elevation/runoff-flow, weather conditions



Exposure Model Design

Modular, Adaptable Complexity - Key Exposure Modules (ex Farming)

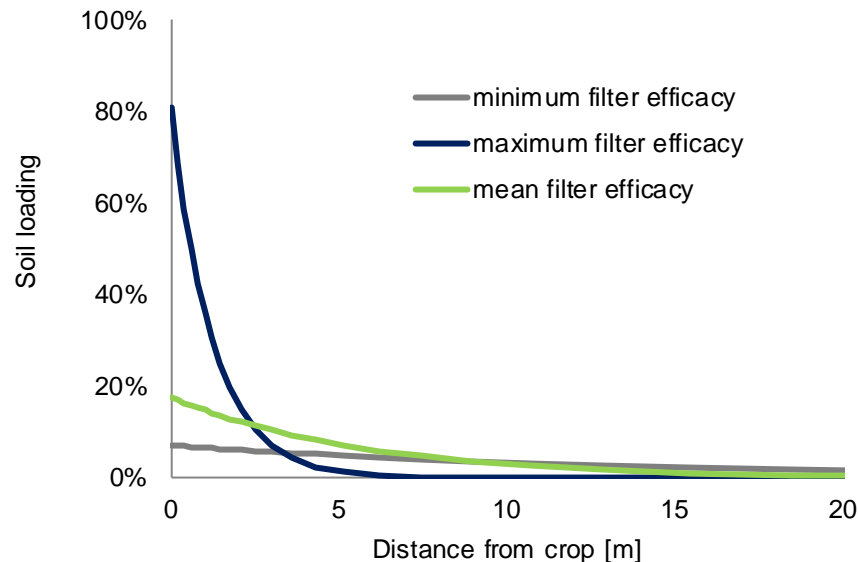


Data: landscape arable/off-field scenario, weather, soil, farming; units, scales

Model is spatiotemporally explicit [m², day] and based on Monte Carlo

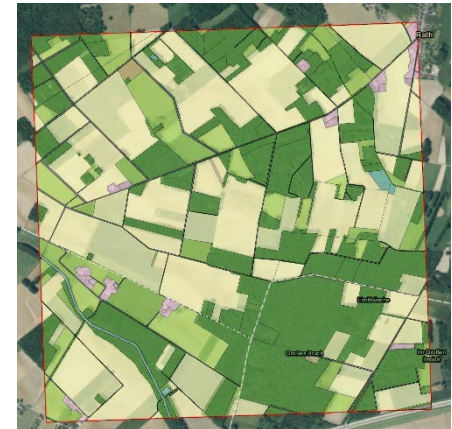
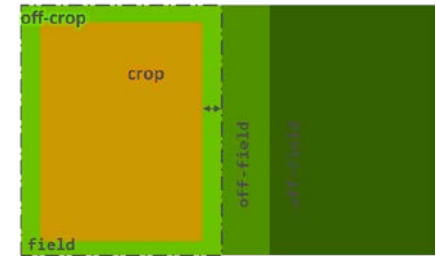
Runoff

- FOCUS (2007; L&M) also provides **minimum, maximum and mean filter** efficacy values for pesticide removal.
- Therefore, it is **necessary to define Assessment Endpoints based on SPGs** before worst-case scenarios can be developed.



Case study - Lindan

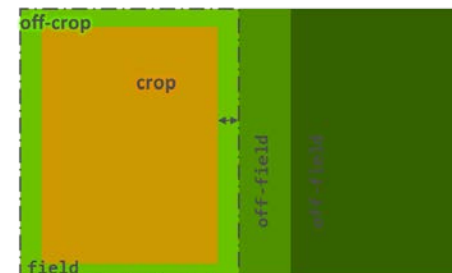
- Simulation of off crop exposure in
 - Schematic landscape (1ha field + 1ha off-crop)
 - Real landscape (2x2km)
- Persistent substance ($DT_{50} = 148$ d)
- 10 years simulation
- Application every year on every field



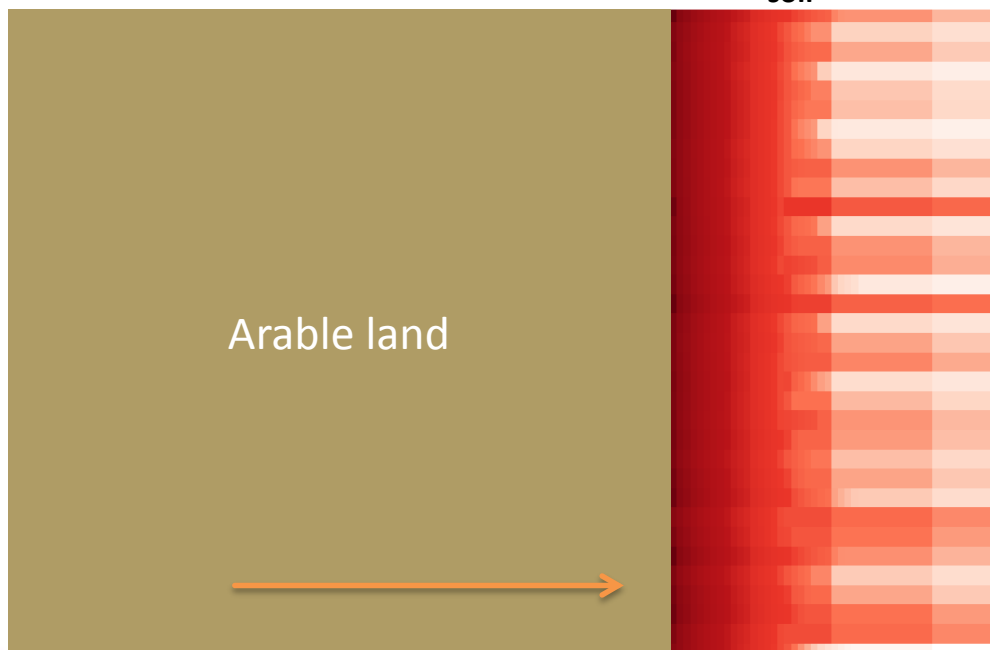
Results

Schematic landscape

- Permanent worst-case runoff-flow direction
- Permanent worst-case wind direction (drift)



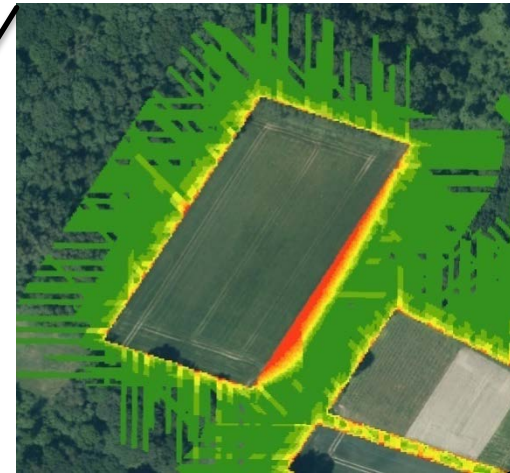
Spatial distribution of maximum PEC_{soil} over time



Results

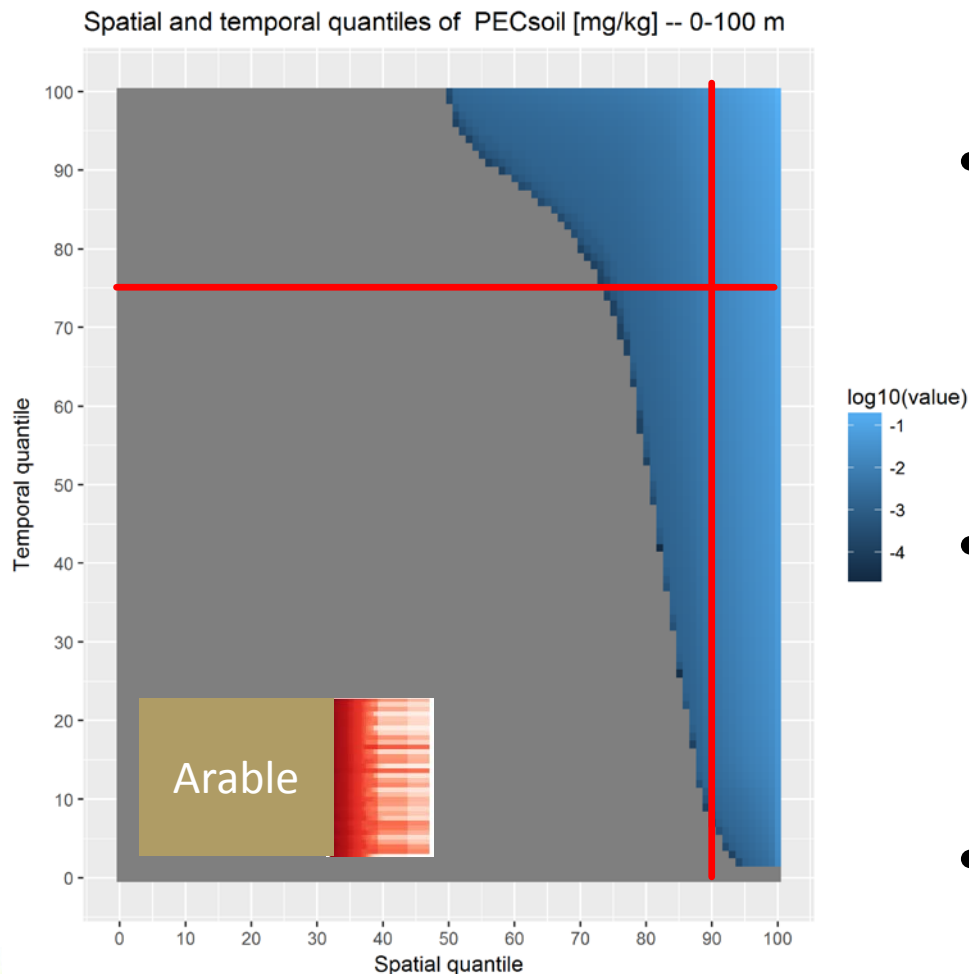
Realistic landscape (Lower Rhine, GER)

- 2x2km landscape
- Real flow direction from Elevation Model
- Random wind direction



**Spatial distribution of
maximum PEC_{soil} over time
(10yrs)**

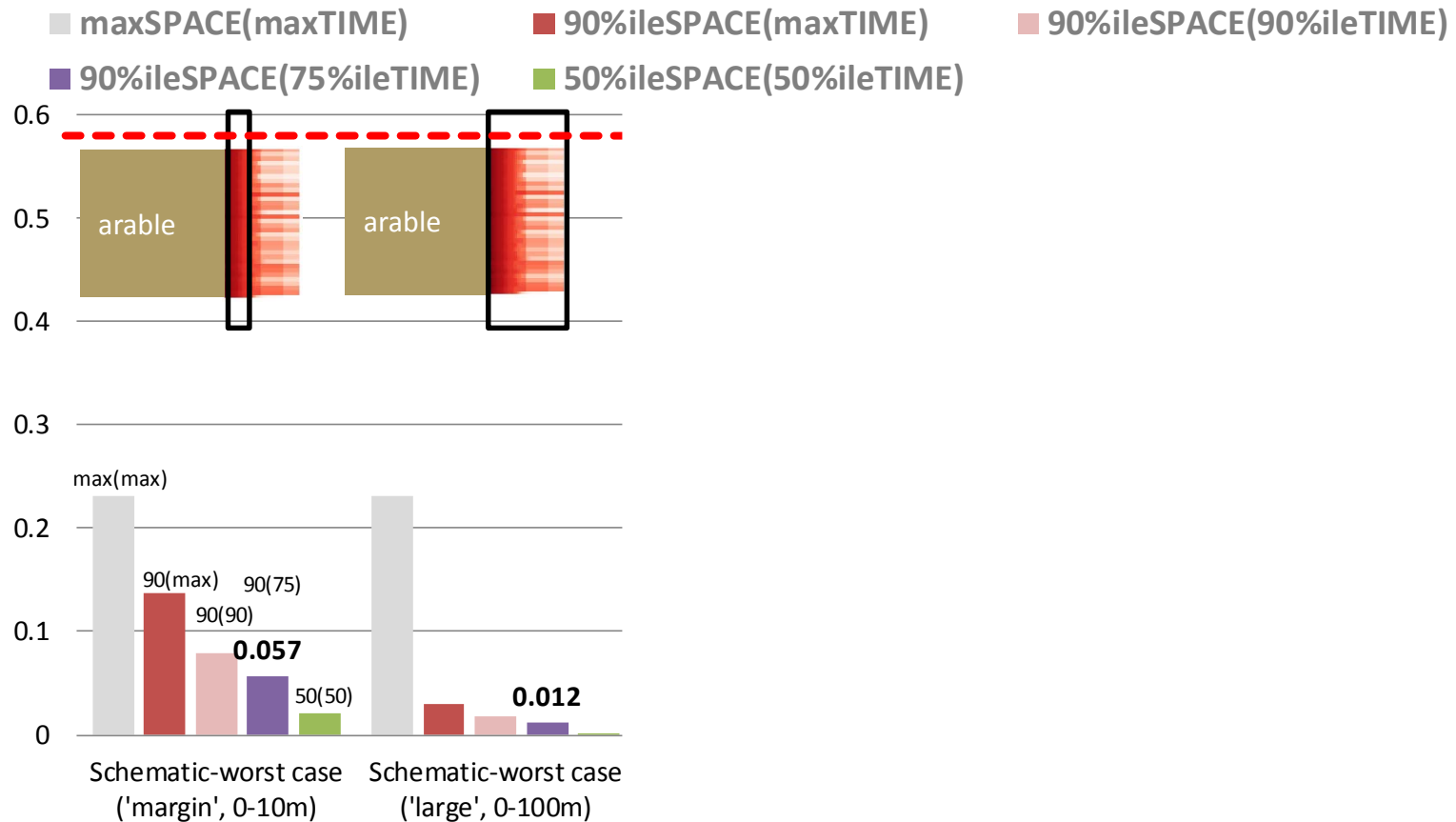
Results



- Exposure (PECsoil) has a **spatial and a temporal dimension**
- **Assessment Endpoints** for off-field to consider these dimensions, as well as further definitions, like the spatial off-field extension (statistical 'population')
- 'Traditional' **Exposure Endpoints** can be derived by using **combinations of temporal and spatial percentiles**
- Explicit exposure ($\text{PECsoil}_{(xy,t)}$) can be directly **linked to effect models**

Results

PECsoil_5cm [mg/kg] Lindan - Selected Spatiotemporal Percentiles



Conclusions

Preliminary observations

- ✓ A **modular off-field soil exposure model** design was developed and an initial implementation accomplished
- ✓ **Simple schematic and real-world scenarios** were build.
The methodology can be applied to other regions or crops.
- ✓ Simulations deliver **spatiotemporal output** that allows to derive **Exposure Assessment Endpoints** matching Specific Protection Goals, or to be **directly linked to effect models**.
- **Limited off-field situation** occurring in real-world cultivation regions; often anthropogenic; about 2/3rd of landscape do not receive runoff flow
- **Limited superposition of exposure** in space and time; conservative spatiotemporal %ile, e.g., **90%tileSPACE(90%ileTIME) << worst-case PECsoil** (FOCUS step2, 90th Rautmann, local)

engineering

case studies

Outlook

- Model **testing & development**, applicability, usability, availability, **version 2.0** (VFSSMOD, mitigation)
- **Uncertainty analysis** (quantitative, according to EFSA 2018 GD; the model design supports any kind of uncertainty analyses, e.g. nested Monte Carlo)
- As proposed in the EFSA Scientific Opinion (2017), a **model approach & scenarios have been developed**,
 - **to support the definition of off-field soil situations**
 - **to support the development of off-field soil Specific Protection Goals (SPGs) and corresponding Assessment Endpoints** (scales, dimensions, ...)
 - **to evaluate consequences of SPGs definitions for pesticide use**, also in view of realistic **mitigation by in-field margins and in-crop buffers**
 - to develop targeted **off-field risk characterisation and communication**

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Risk Assessment

Thank you!