

ELINK-2: Linking Exposure and Effect Models Across Scales for Pesticide Risk Assessment: Concepts, Case Studies and Data Gaps for Small-Scale Considerations

V. Roeben¹, L. Garcia², A. Aagaard³, B. Gottesbüren⁴, Y. Chen⁵, J. Koch⁶, A.N. Løvik⁷, M. Meli⁸, T.G. Preuss¹, F. Taubert^{9,10}
¹Bayer AG, Germany · ²BASF Agricultural Solutions GmbH, Germany · ³Danish Environmental Protection Agency (DEPA), Denmark · ⁴Make-Sense Consulting, Germany · ⁵CTGB, The Netherlands · ⁶gaia eco assessment, Germany · ⁷Syngenta Crop Protection, Switzerland · ⁸Adama Agricultural Solutions Ltd, France · ⁹Helmholtz Centre for Environmental Research GmbH - UFZ, Germany · ¹⁰ German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, Germany ·

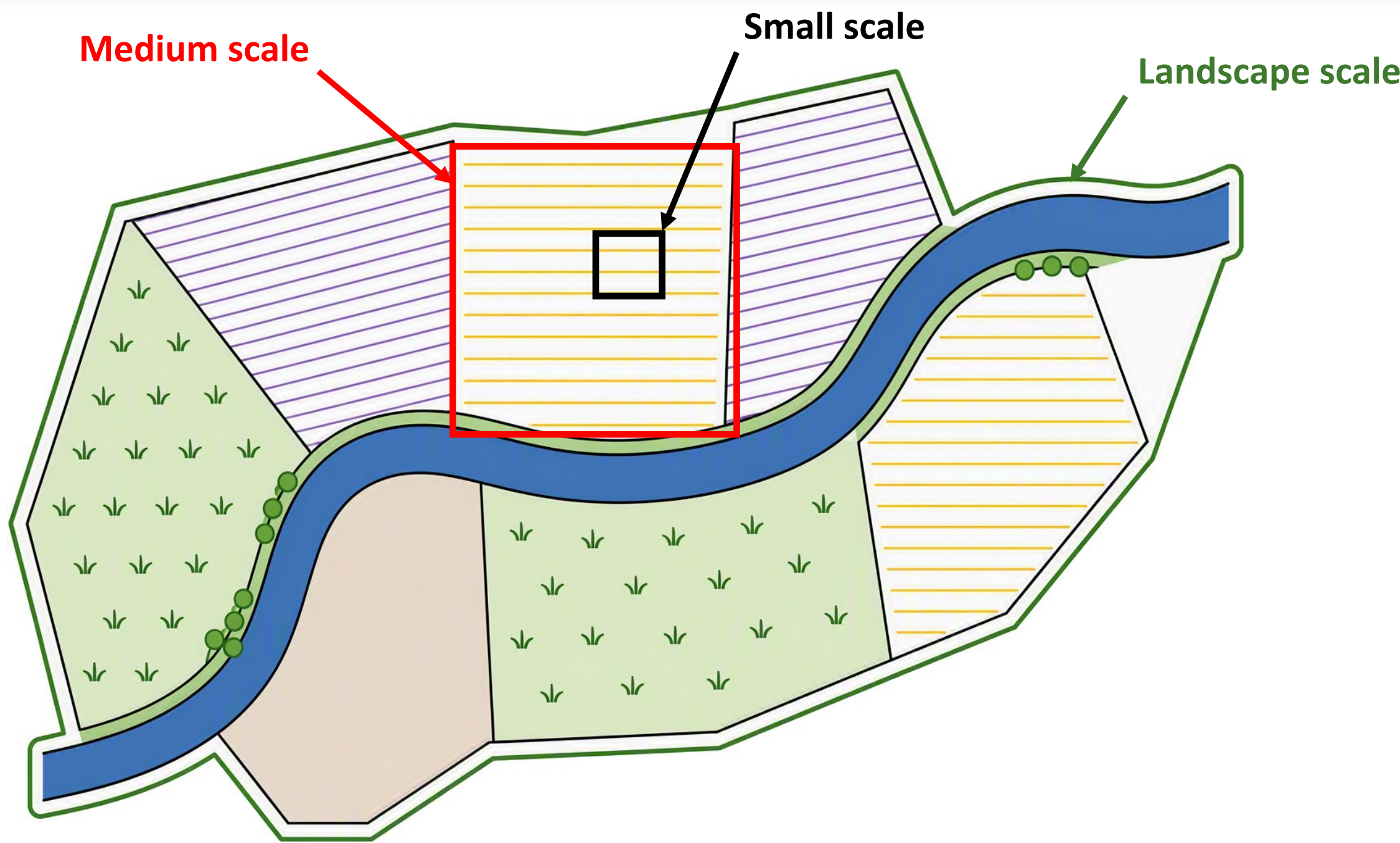


INTRODUCTION

- **Linking spatially and temporally explicit** exposure models with ecological effect models is a **central challenge** for advancing pesticide environmental risk assessment and assessing how the current practices comply with the environmental protection goals.
- The ELINK-2 initiative addresses this challenge by developing and testing **coherent modeling concepts across scales**.

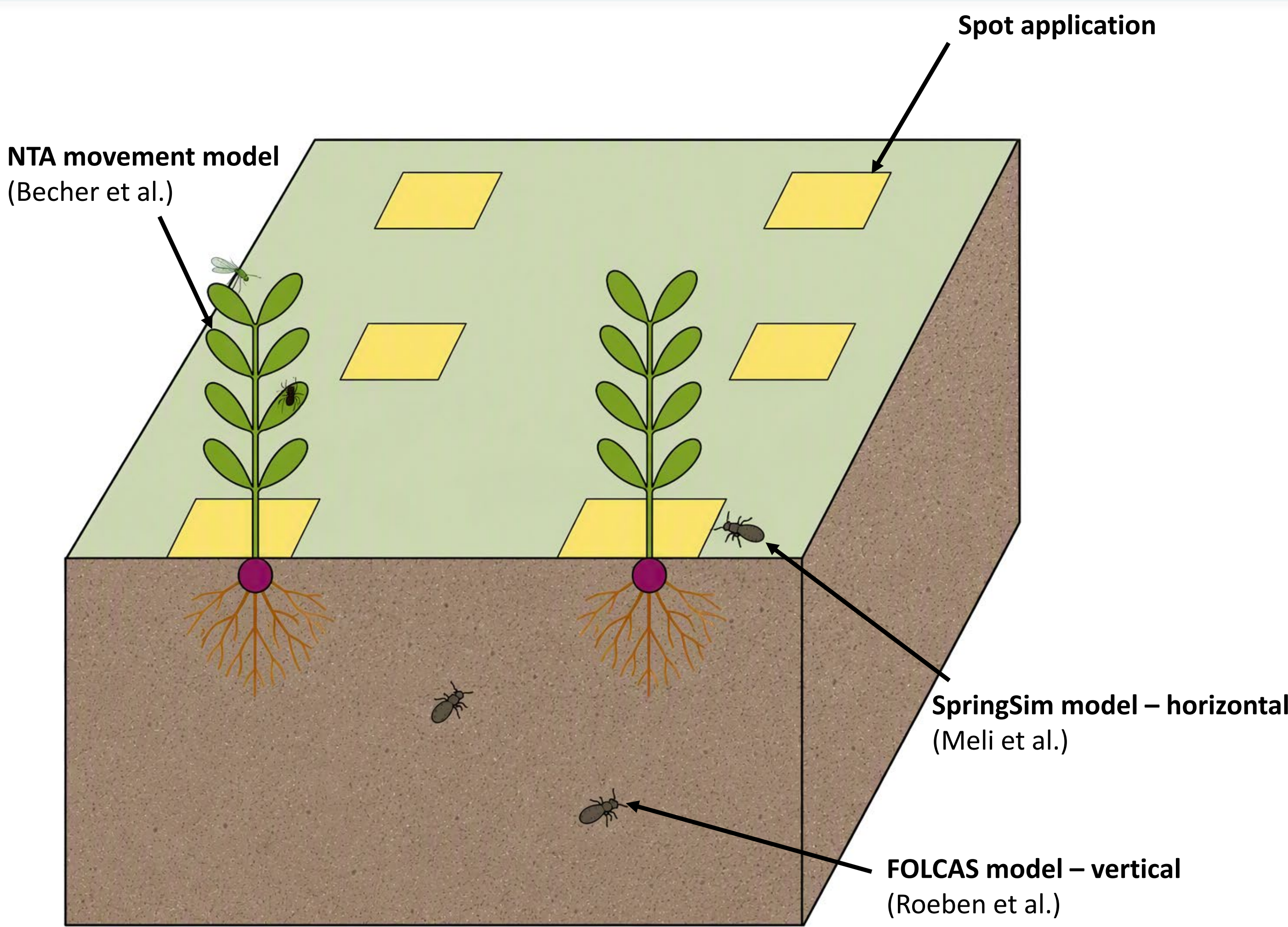
ELINK-2 Small-Scale Working Group (EL-SA)

- EL-SA explores the **implications of organism movement and spatially heterogeneous exposure** at a **sub-field scale** with case studies on **soil organisms** and **non-target arthropods (NTAs)**, highlighting when spatially explicit modeling is required to capture relevant exposure pathways and effects.



Integration of the various scales of interest of the ELINK-2 workgroups

MATERIAL & METHODS



Overview of case studies: Collembola exposure across horizontal and vertical distributions and NTA exposure on a treated plant

CASE STUDIES

Two different organism groups (Collembola and NTAs) with three different models:

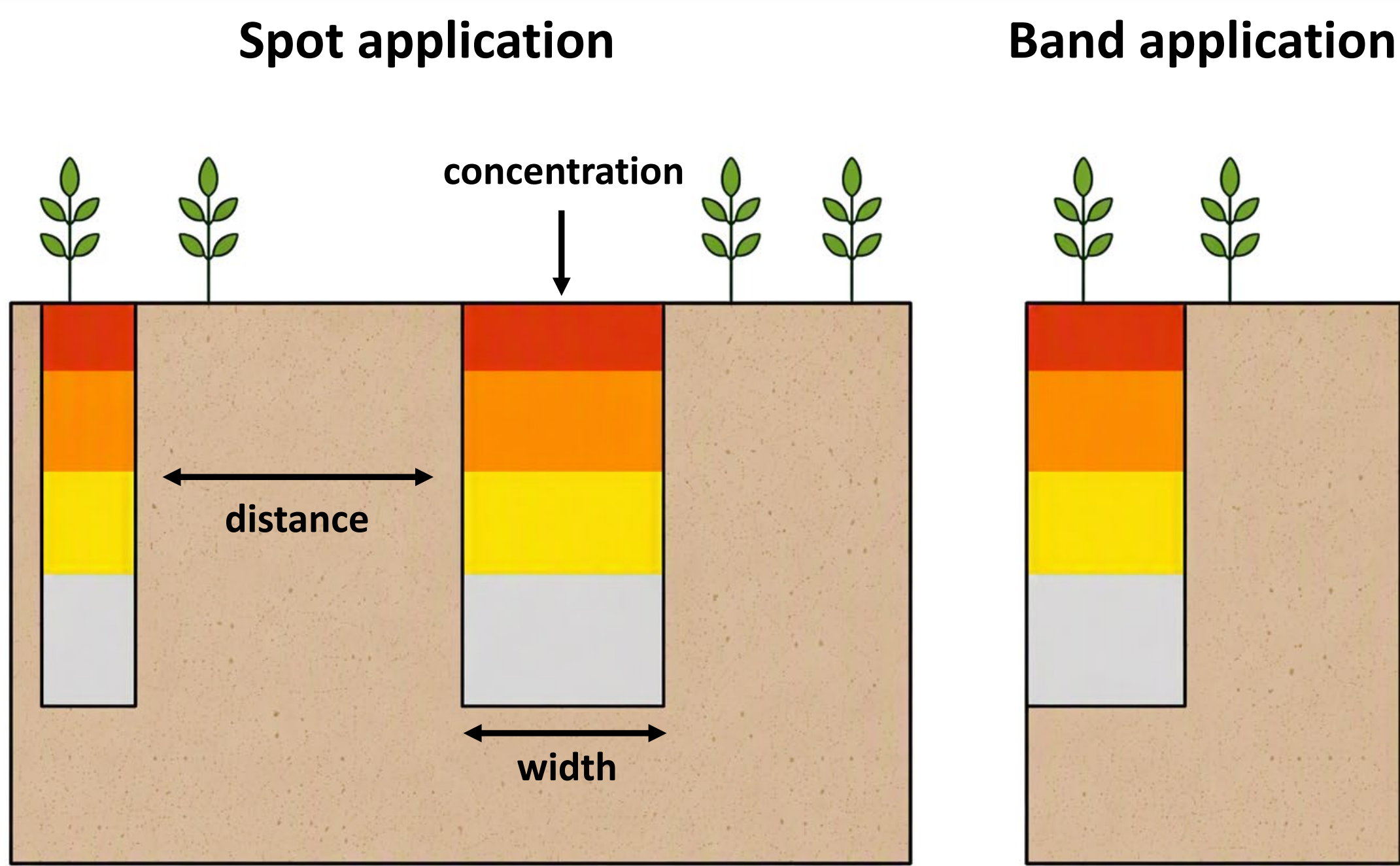
- Collembola model **SpringSim** (Meli et al.) [1] focussing on **horizontal exposure**
- Collembola model **FOLCAS** (Roeben et al.) [2] focussing on **vertical distribution** and exposure of Collembola
- **NTA Movement Model** (Becher et al.) [3] focussing on the movement of NTAs **within a plant**

EXPOSURE SCENARIOS

- To investigate **effects across scales**, all ELINK-2 workgroups consider **the same agricultural water catchment**: the Funne catchment in Germany.
- Exposure and effect models will be parameterized for the composite substance **ELINKmethrin** (from the ELINK and SETAC Modelink workshops).
- **Exposure in soil** for the Collembola case study will be defined for an existing field selected from the Funne catchment. Applications to **oilseed rape** will be simulated to produce the soil concentration profile exposing the organisms.
- Computational Fluid Dynamic (CFD) modeling will be used to establish **the exposure profile in a 3D model** of an applied flowering oilseed rape plant for the NTA case study.
- Considering **precision application**, 3 different scenarios will be investigated: (i) spot application, (ii) band application and (iii) broadcast application.

PERSPECTIVES & CONCLUSIONS

- Small-scale modeling can be used to investigate how **spatial heterogeneity** and **organism movement** influence **exposure-effect relationships**
- Coupling of exposure and effect models at the small scale enables **process-based understanding** that supports interpretation and extrapolation to higher-tier assessments
- **Harmonized case studies** across ELINK-2 can **reveal temporal and spatial mismatches** between exposure profiles and effect model requirements
- **Integration across scales** highlights **methodological limitations and key data gaps**, supporting prioritization of future model development
- The EL-SA work contributes to a **coherent, scale-explicit risk assessment framework**, improving ecological realism while maintaining regulatory relevance



Spatialized exposure profile following application patterns

