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Estimating high resolution exposure at landscape-level

On the development of the modular Droplet and Atmospheric Dispersion (DAD) drift model and its application within the SWAT+ framework

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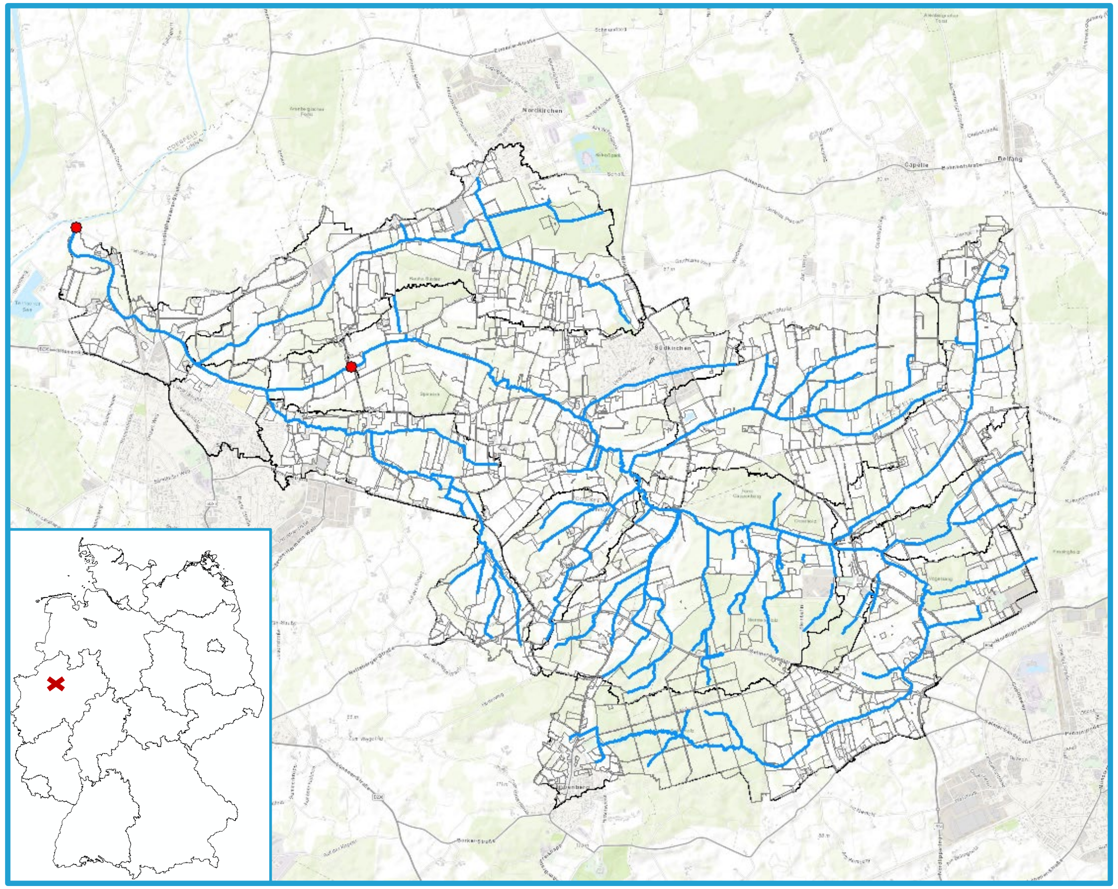
Background

- SWAT+ modelling of the Funne catchment:
  - Agriculturally dominated catchment
  - Assess link between application timing and simulated in-stream concentrations
  - Strong effect of timing between application and rain events
- Process of spray drift not yet implemented in SWAT+
- Examples of simplified drift implementation in SWAT existing



Objectives

- Enable landscape-level spray drift prediction for ground application, taking typical short-term weather conditions into account
- Development of a spray drift model as standalone or module (e.g., SWAT):
  - Landscape-level assessment
  - Exposure assessment in combination with ecotoxicological modelling

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Model Theory

DAD drift assumes flat landscape and no canopy interception

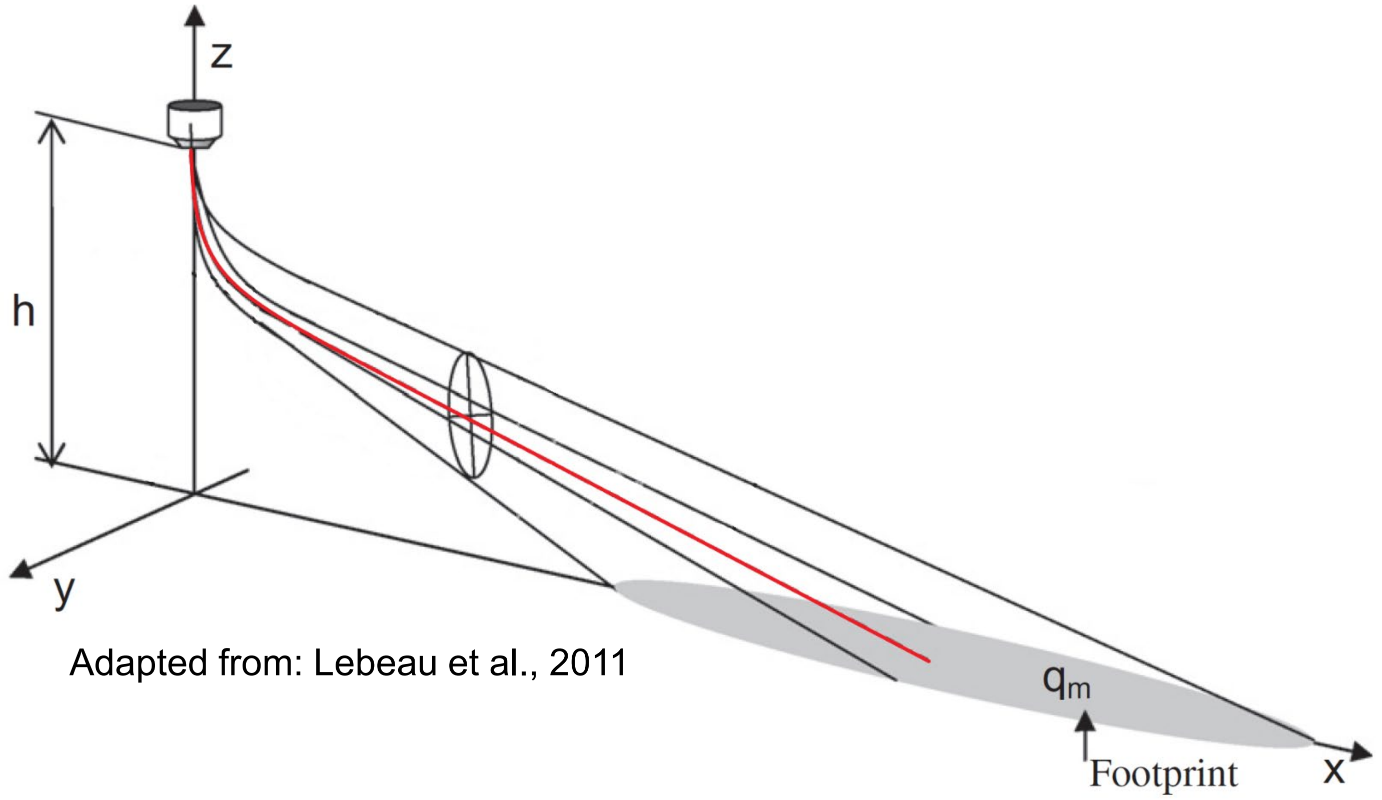
(1) Model inputs

(2) a) Mechanistic Droplet Model
b) Micro-Climate Model

(3) 3D Gaussian Diffusion Model

(4) Prediction of Drift Pattern

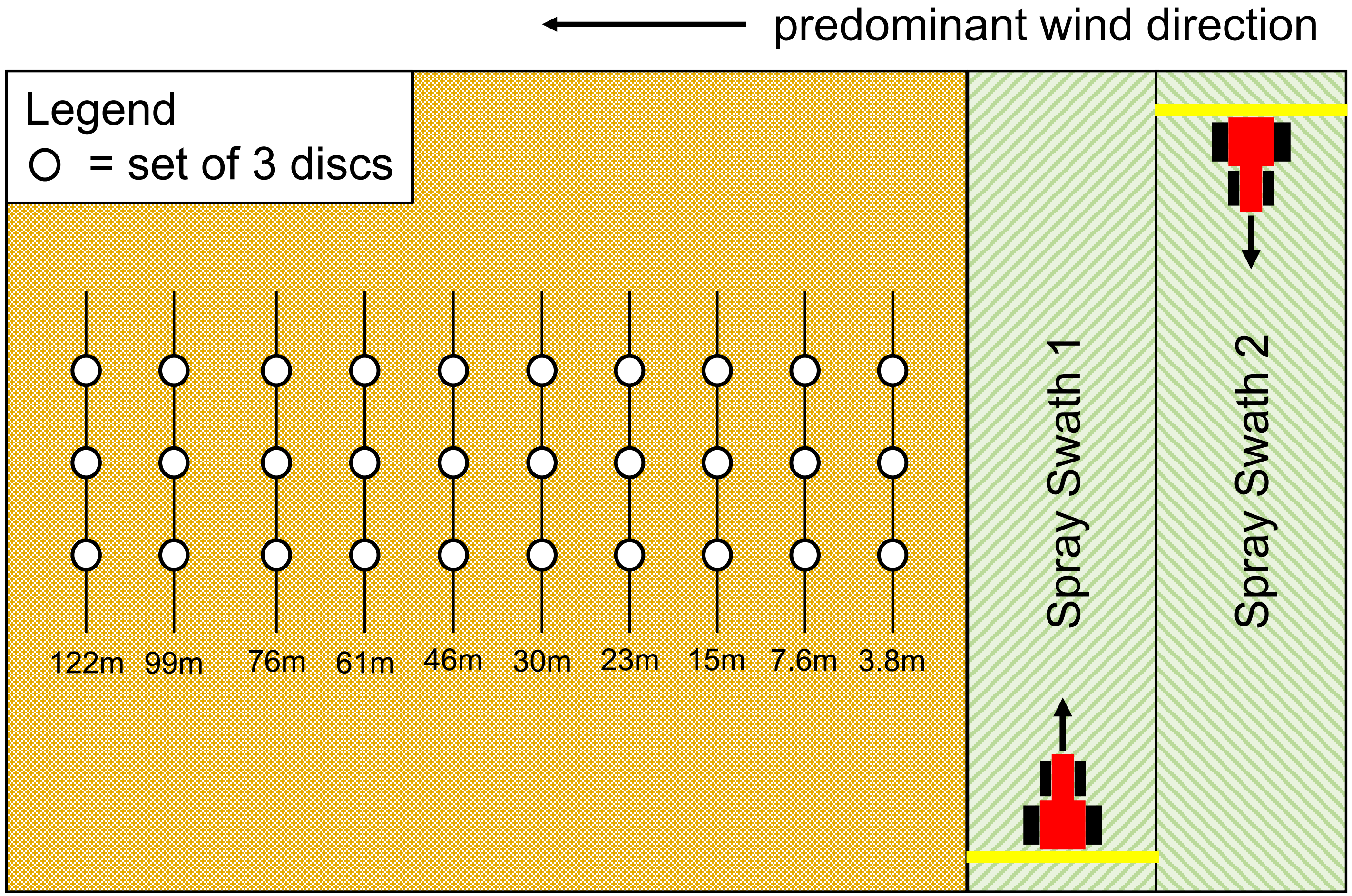
(5) Model Output
- Drift Curve Prediction
- Landscape-level drift prediction



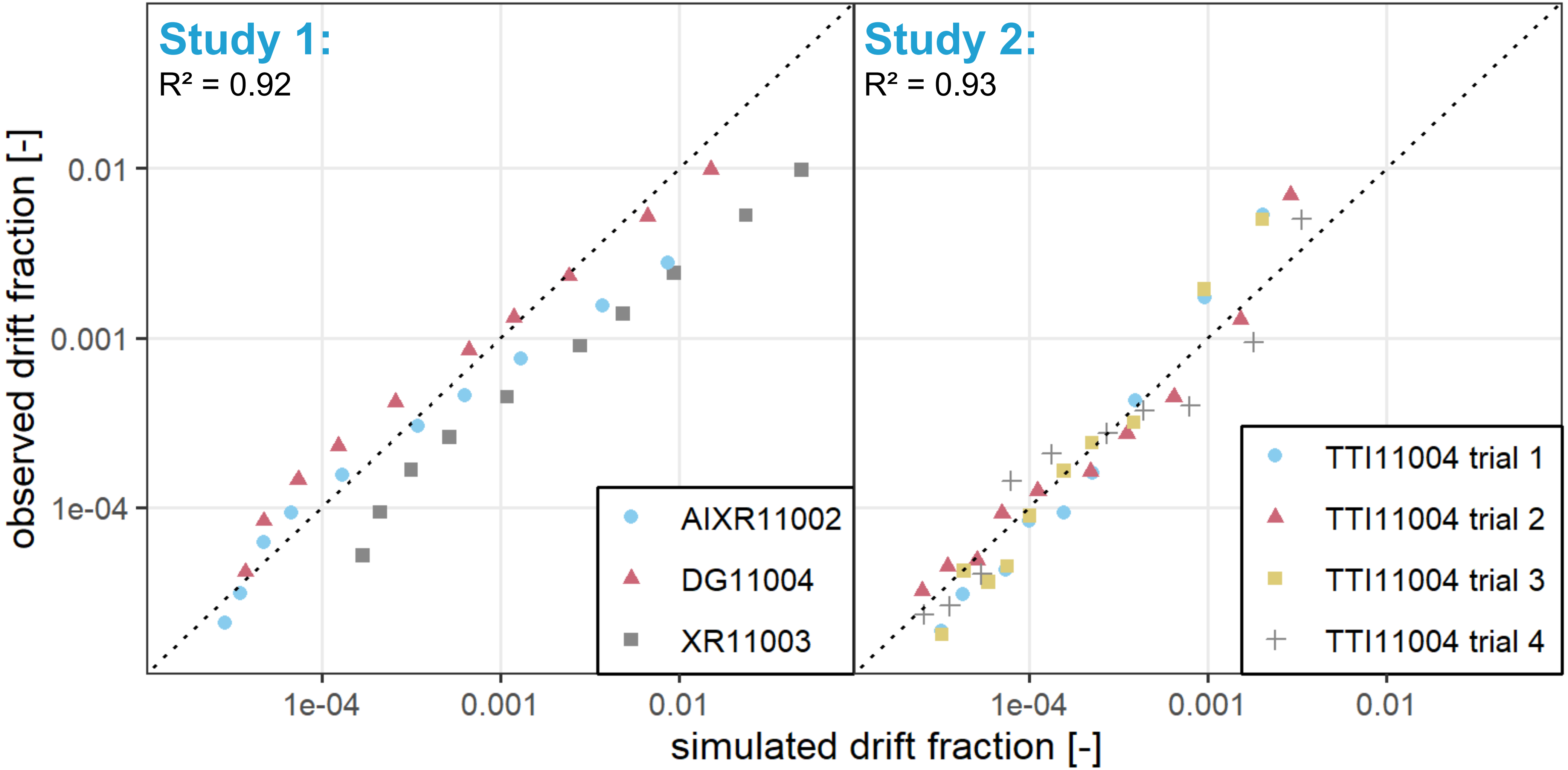
Adapted from: Lebeau et al., 2011

Validation Studies

- Two Studies with similar layout
  - Perine et al., 2021 (Study 1)
  - Brain et al., 2019 (Study 2)
- Ground application on bare soil
- Two parallel application swaths
- Sampling at various distances
- Wide range of drift potentials (nozzles)

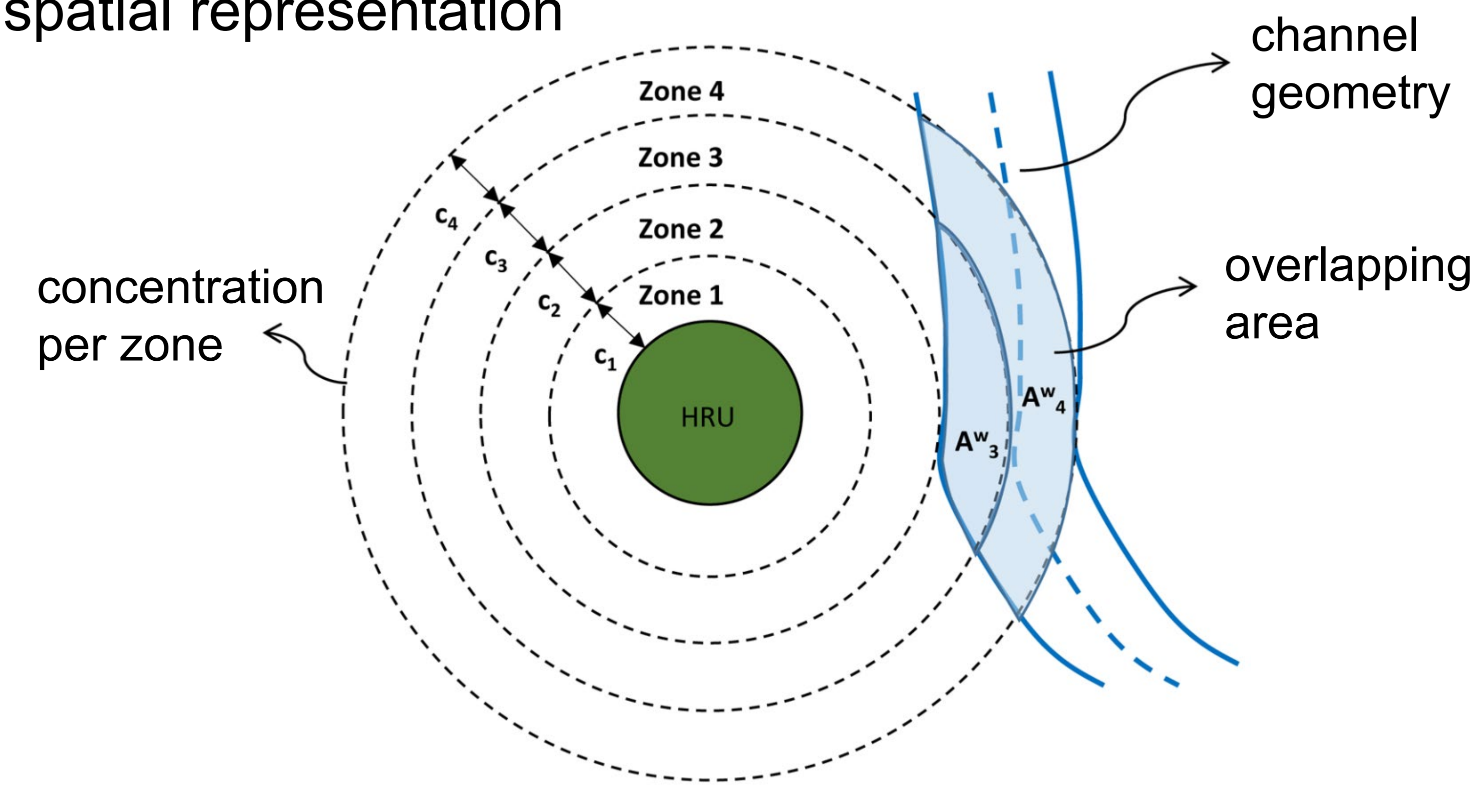


Model Validation



Landscape-Level Drift

- Comparing raster based (1x1m) DAD drift to 3 algorithms based on drift curves with different spatial representation
- Holvoet et al., 2008
  - Square field representation
  - Deposition based on mean deposition
- Winchell et al., 2018
  - Circular field representation
  - Deposition based on buffer zones
- Zhang et al., 2018
  - Circular field representation
  - Deposition based on minimal distance

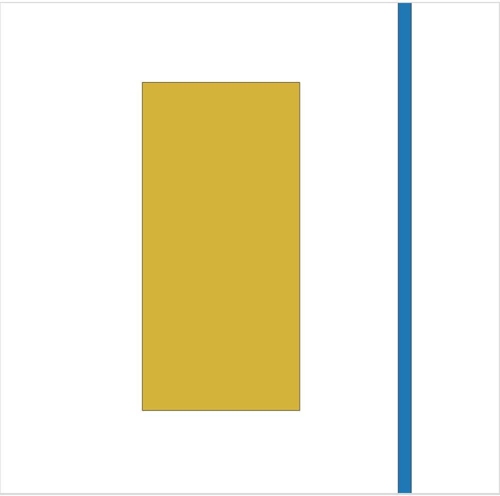


Adapted from: Winchell et al., 2018

Landscape-Level Drift

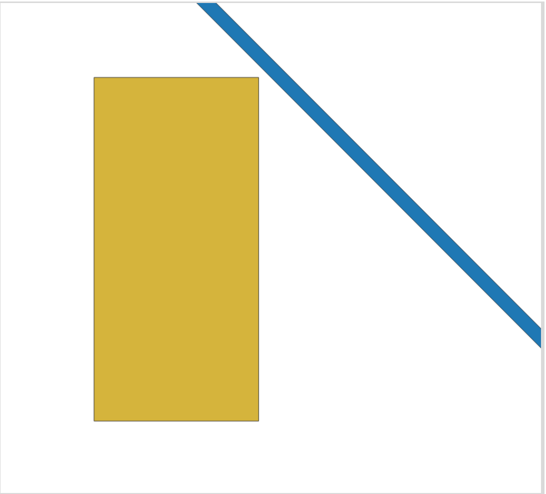
Scenario 1

- Rectangular field
- Straight stream
- Stream parallel to field



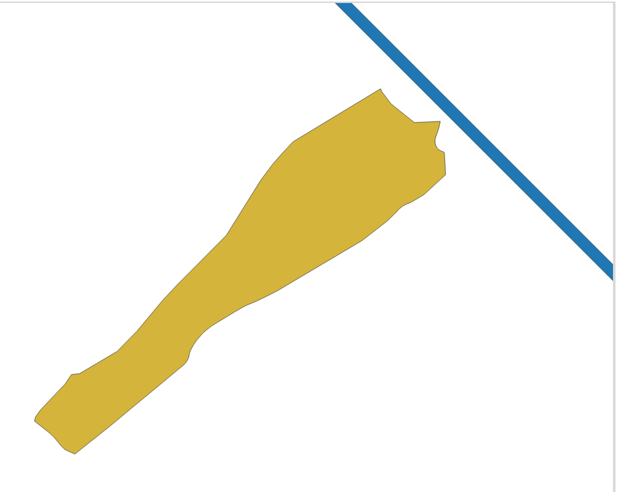
Scenario 2

- Rectangular field
- Straight stream
- Stream at 45° to field



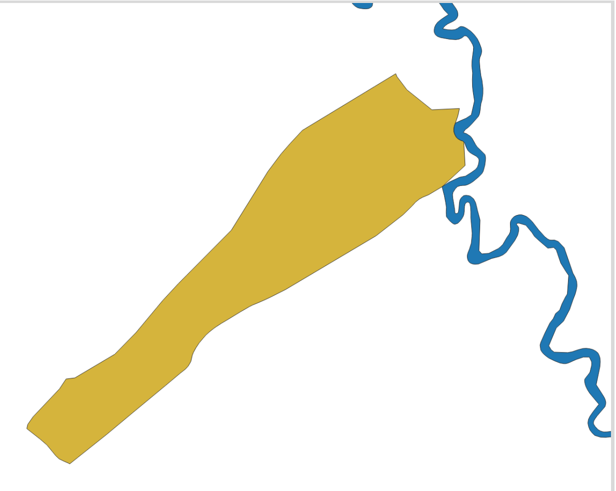
Scenario 3

- Irregularly shaped field
- Straight stream
- Stream at 45°

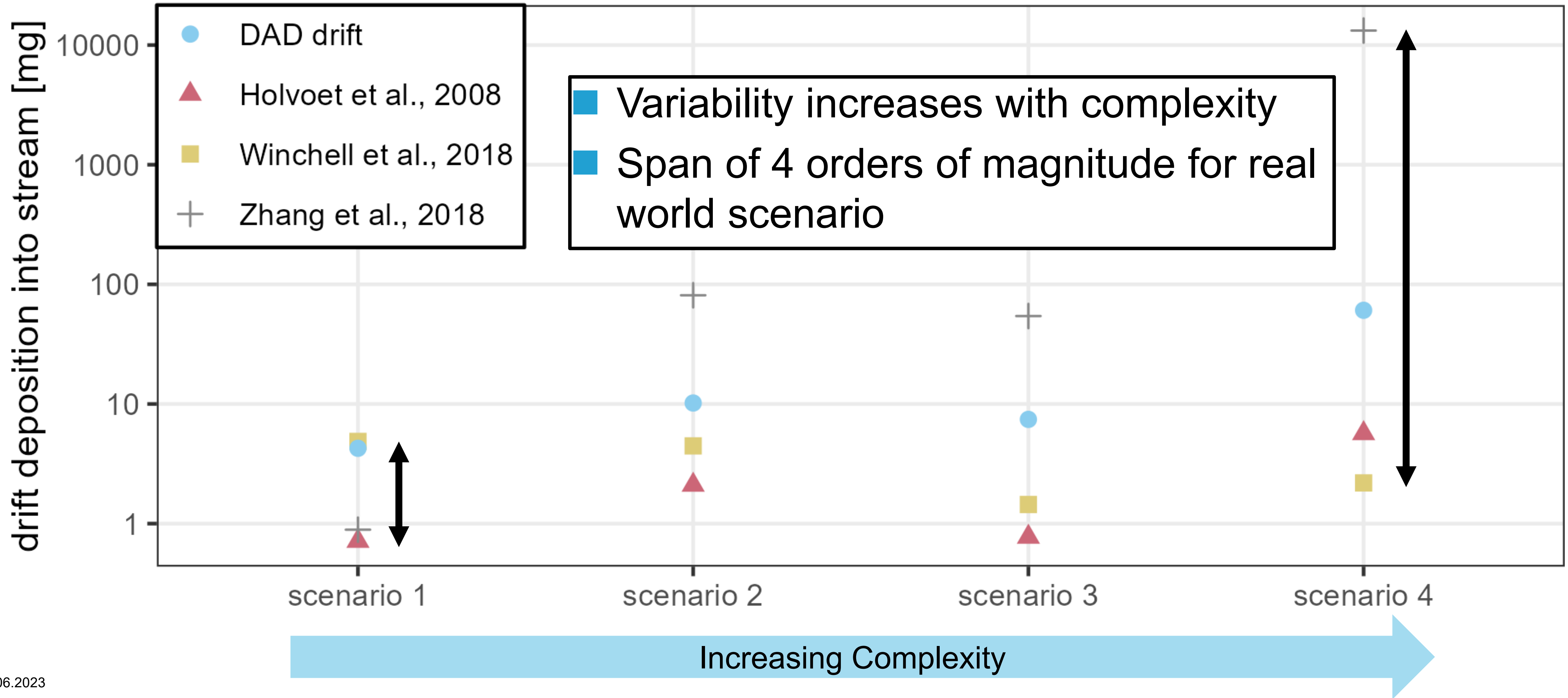


Scenario 4

- Irregularly shaped field
- Meandered stream



Landscape-Level Drift



Conclusion & Outlook

- DAD drift model was successfully implemented and validated
- Drift projecting algorithms has high impact on SWAT modelling results

- Spatial spray drift modelling within the Funne catchment planned:
  - Facilitating a combination of DAD drift and SWAT+
  - To assess primary and secondary aquatic drift entries at the catchment scale
- Linking DAD drift to ecotoxicological modelling is possible

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