PBL Netherlands Environmental Assessment Agency

A SCENARIO FOR EXPOSURE OF WATER ORGANISMS IN THE NETHERLANDS

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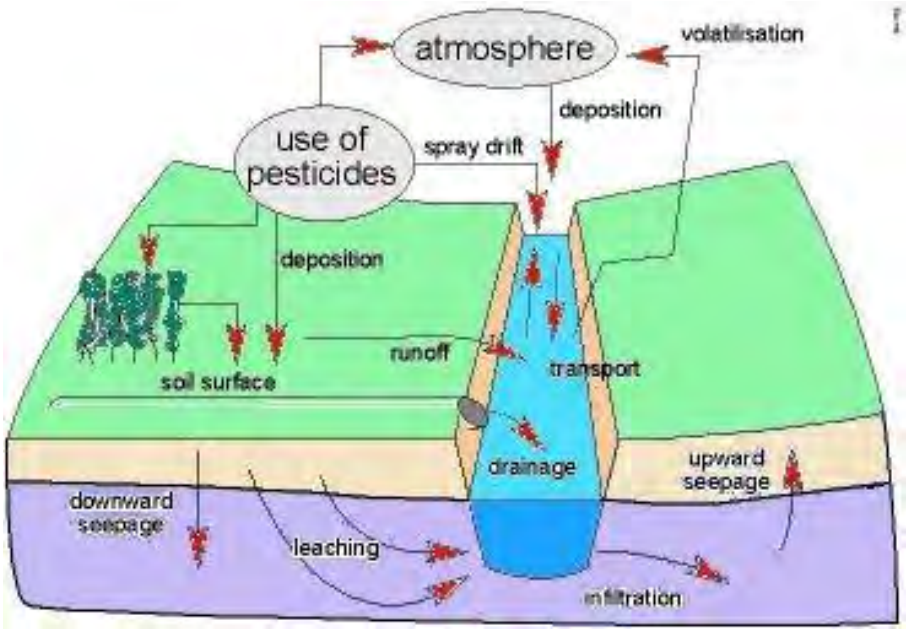
Revision of the Dutch procedure for exposure of water organisms

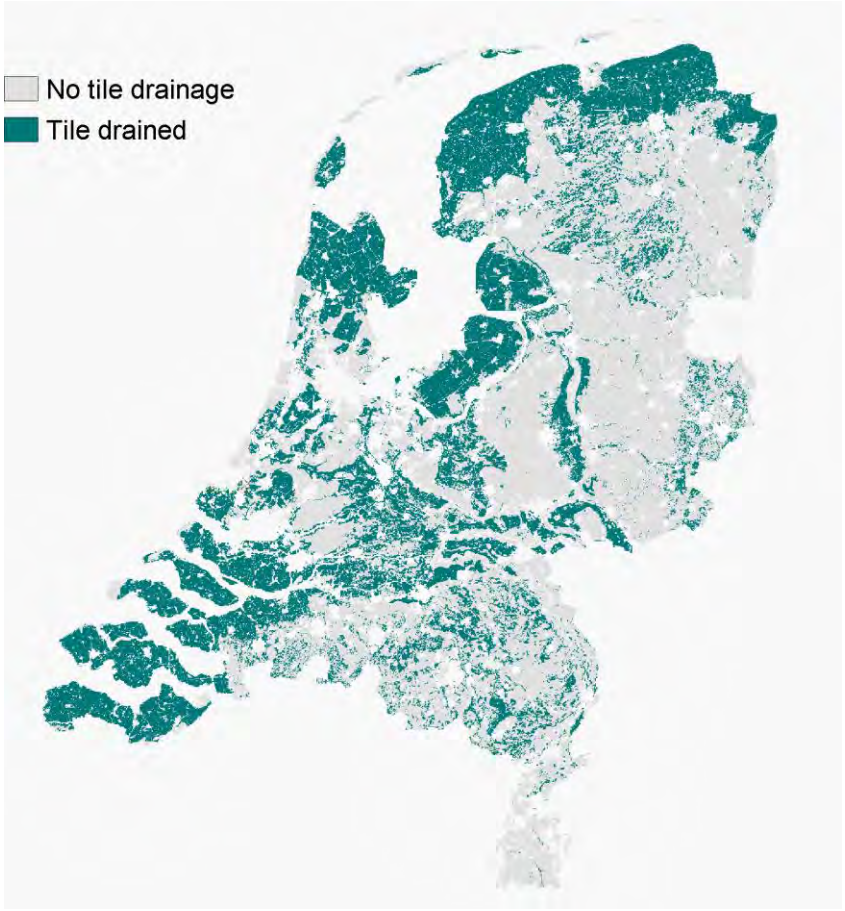
- EU-harmonisation
- Scientific developments
- Water framework directive
- Need for a new Dutch scenario for exposure of water organisms
- Developed by a team consisting of members from six Dutch institutes

Scenario must include all pathways

- Pesticides can enter the surface water by spray drift, drainage, run-off and atmospheric deposition
- Current Dutch procedure considers spray drift only
- Spray drift has been reduced, so the other pathways gain relative importance
- Drainage and atmospheric deposition were added



40% of Netherlands is tile drained



Scenario must apply to the 90th overall percentile

Simulation of the concentration in ditch water using data for the entire population of ditches and weather conditions

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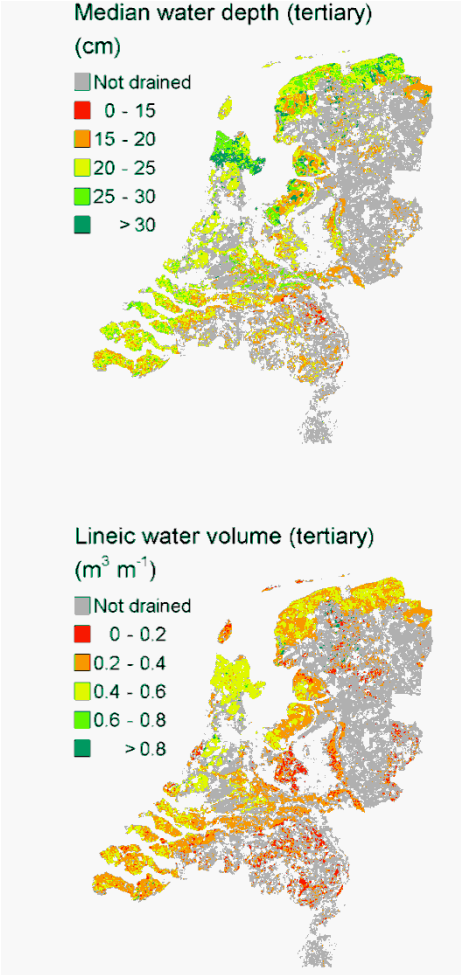
Selection of ditch, soil and weather conditions that correspond to the 90th percentile (the scenario)

↓

Parameterisation of the selected scenario



We have two pathways:

Spray drift

Simulation of the concentration in the ditch using data for the entire population of ditches and weather conditions

↓

Selection of a ditch and weather conditions that correspond to the 90th percentile (the spray drift scenario)

Drainage

Simulation of the concentration in the ditch using data for the entire population of soils and weather conditions

↓

Selection of a soil and weather conditions that correspond to the 90th percentile (the drainpipe scenario)

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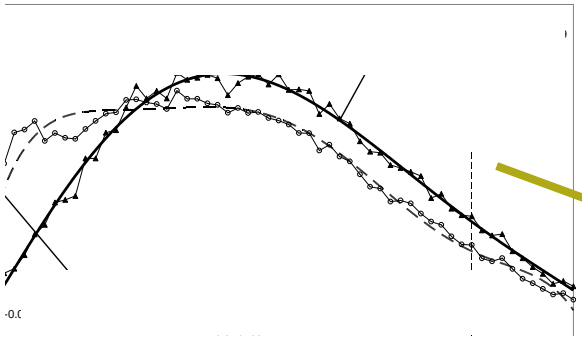
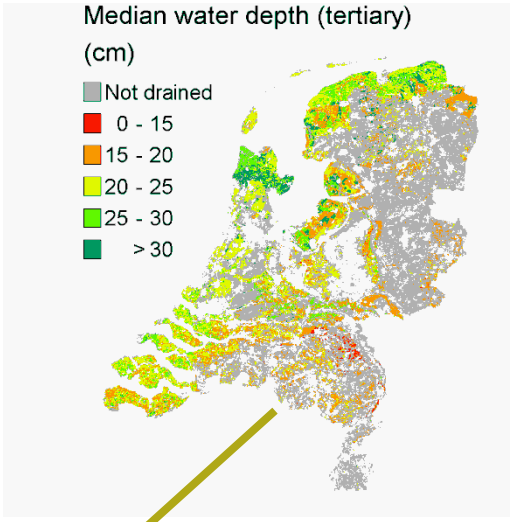
Parameterisation of the selected scenarios

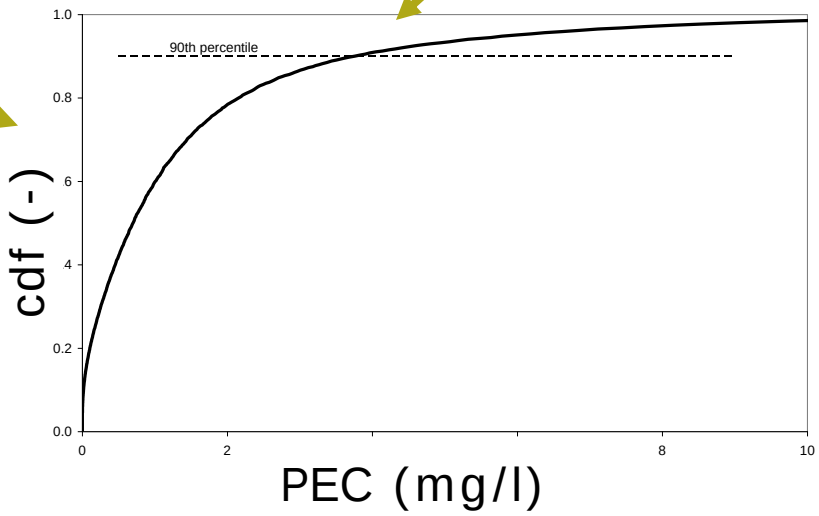
Spray drift simulated with IDEFICS

- Almost 50000 combinations of wind speed, wind angle and water depth and water width



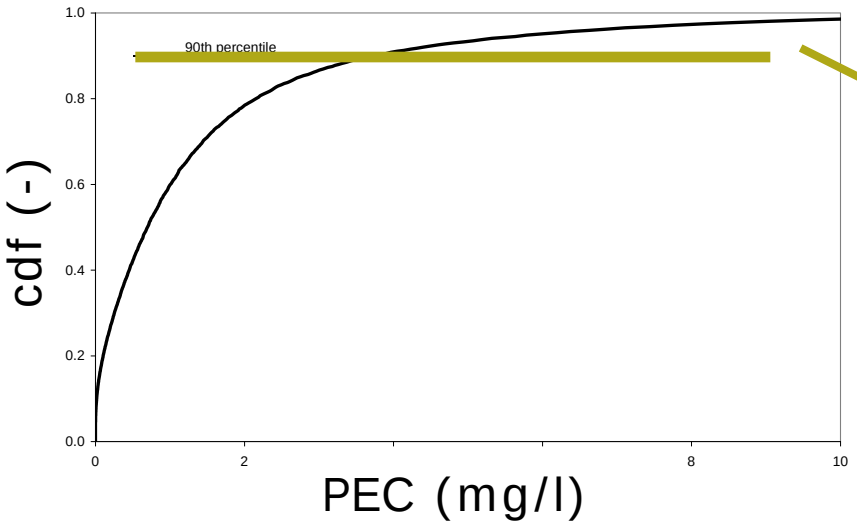
Wind speed

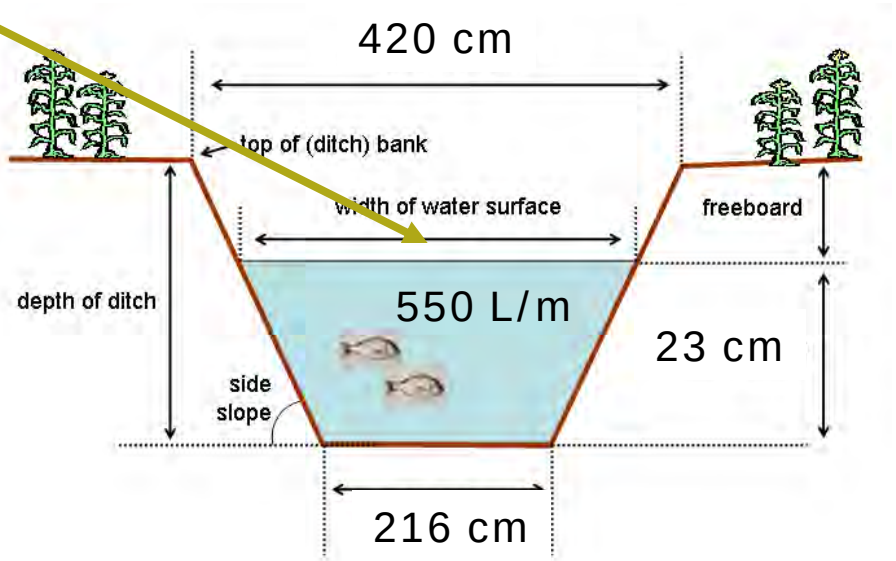




Holterman HJ, van de Zande JC, Porskamp HAJ, Huijsmans JFM, 1997. Modelling spray drift from boom sprayers. Computers and Electronics in Agriculture 19:1-22.

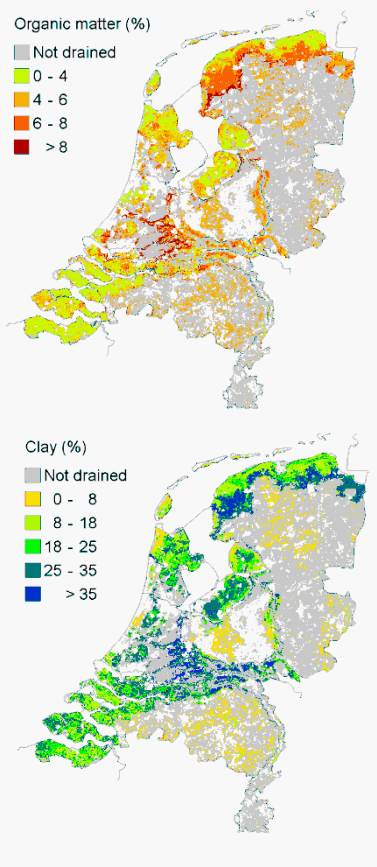
90th percentile ditch selected from frequency distribution



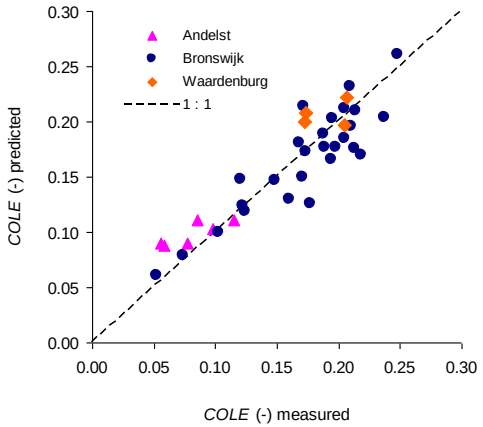


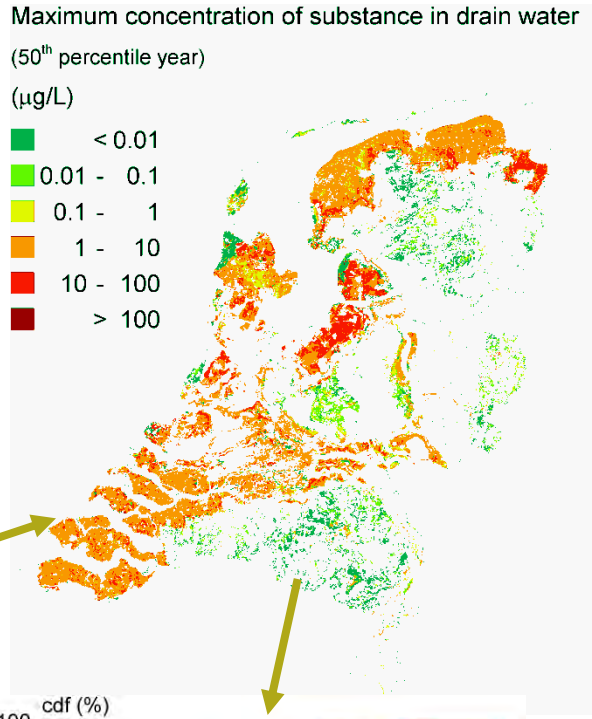
- Realistic ditch – not a rectangular ditch

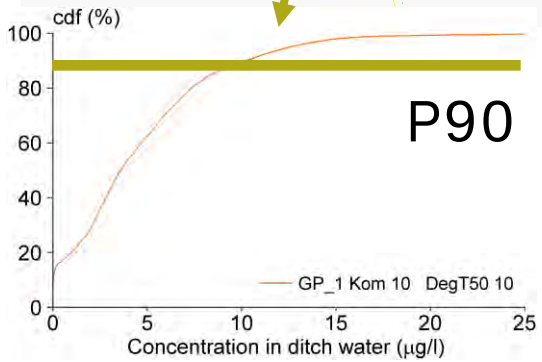
Drainage simulated with a macropore version of GeoPEARL



Pedotransfer rules for macropore parameters derived from several field sites



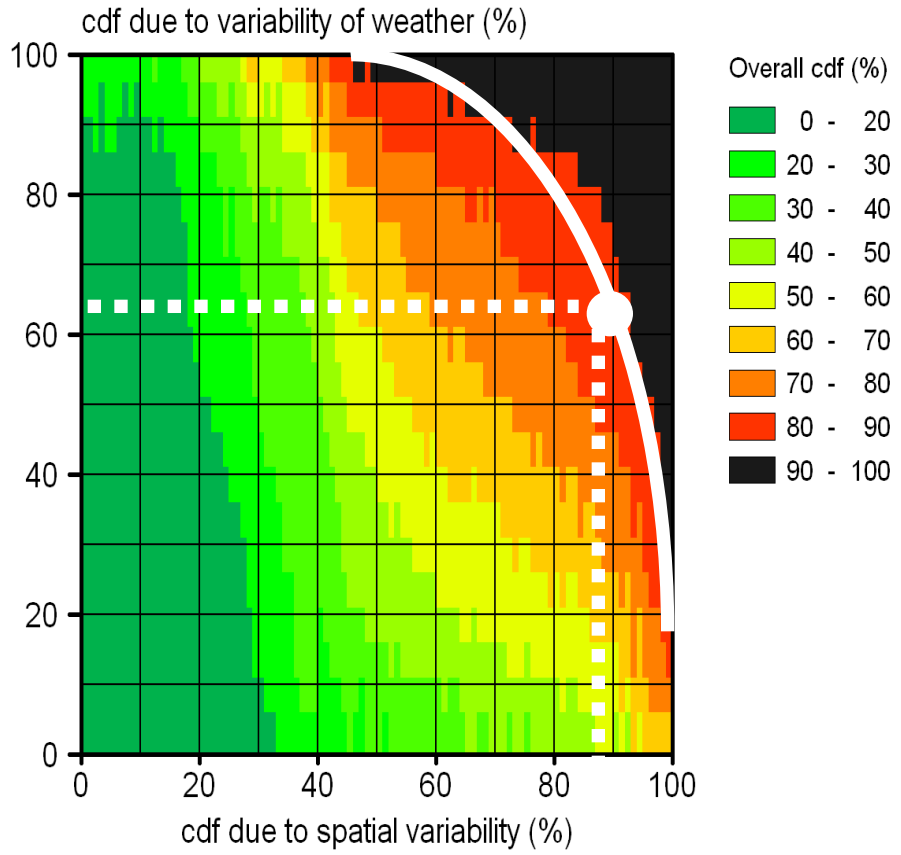




Tiktak A, Boesten JJTI, Hendriks RFA, and van der Linden AMA, 2011. Leaching of plant protection products to field ditches in the Netherlands. RIVM report 607407003

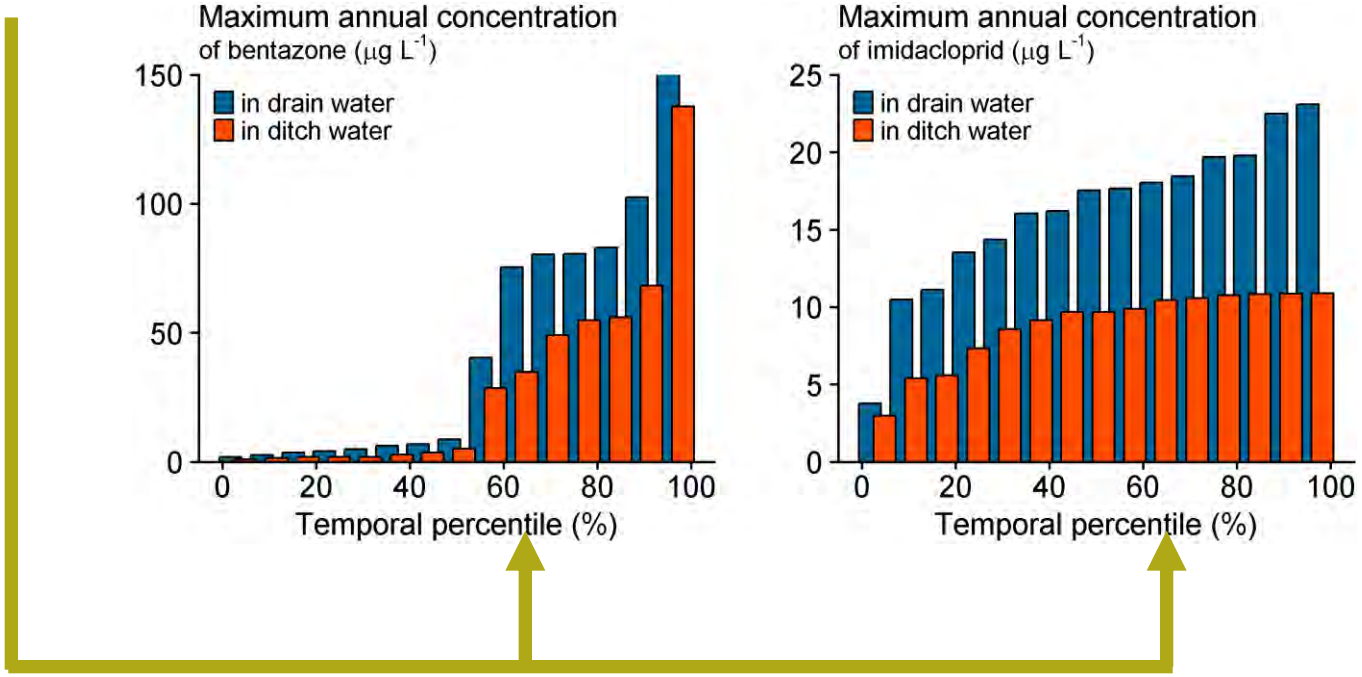
Drainpipe scenario based on Andelst field study

- Real site, lots of experience with this dataset
- We have then fixed the ditch and the soil
- So the only freedom is selecting a weather year
- **63rd temporal percentile which is the 90th spatial percentile**



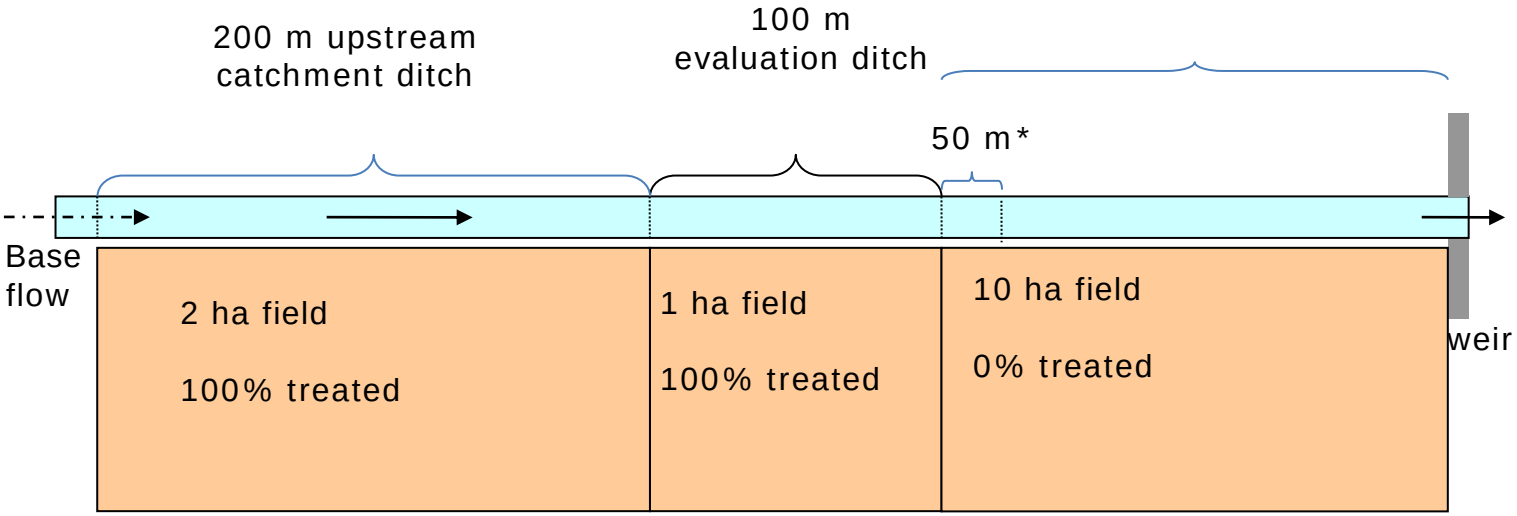
PEARL simulations done for 15-years, so 15 annual peak concentrations simulated

- 63rd percentile corresponds to the 10th year of this 15-years weather series

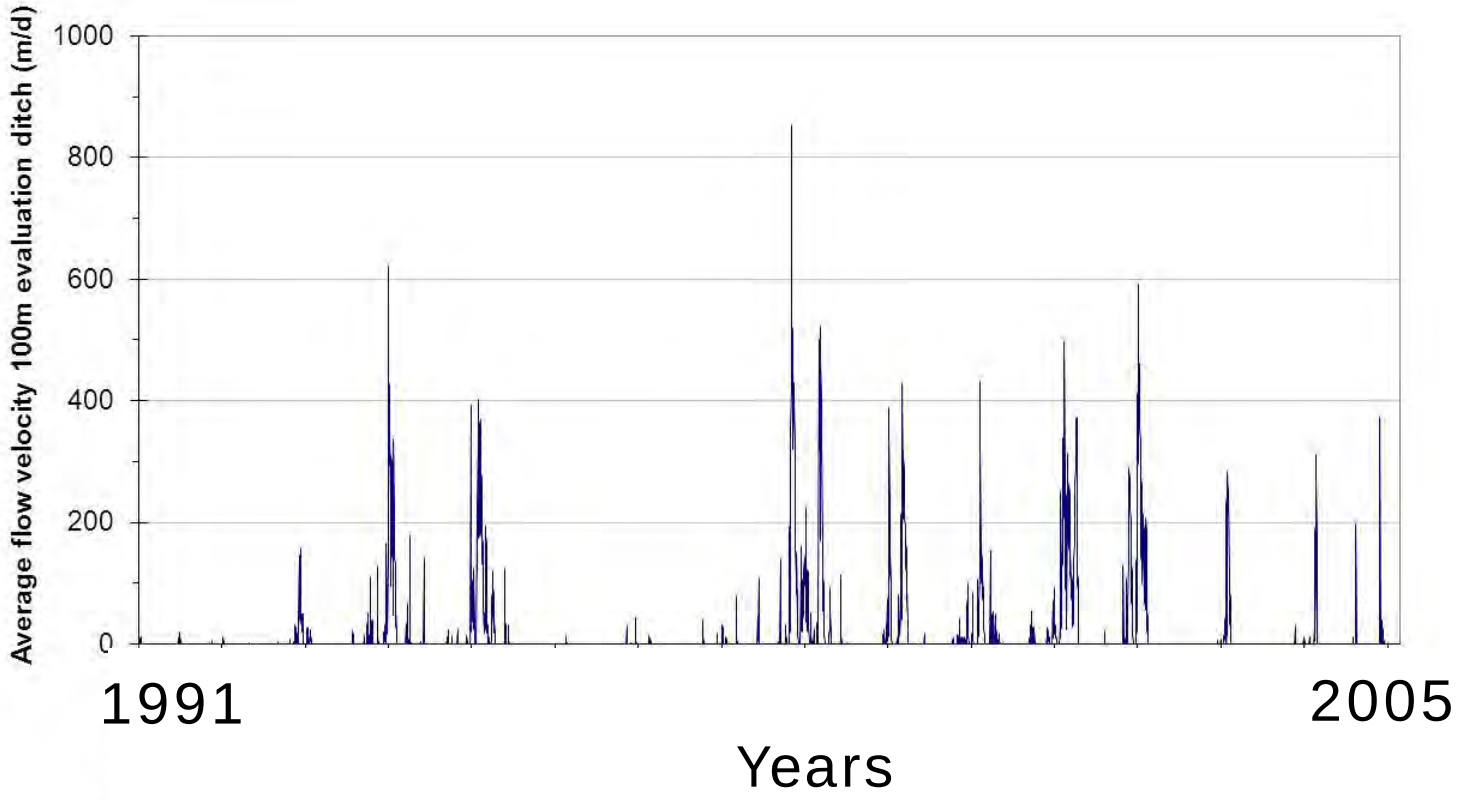


Parameterisation of TOXSWA

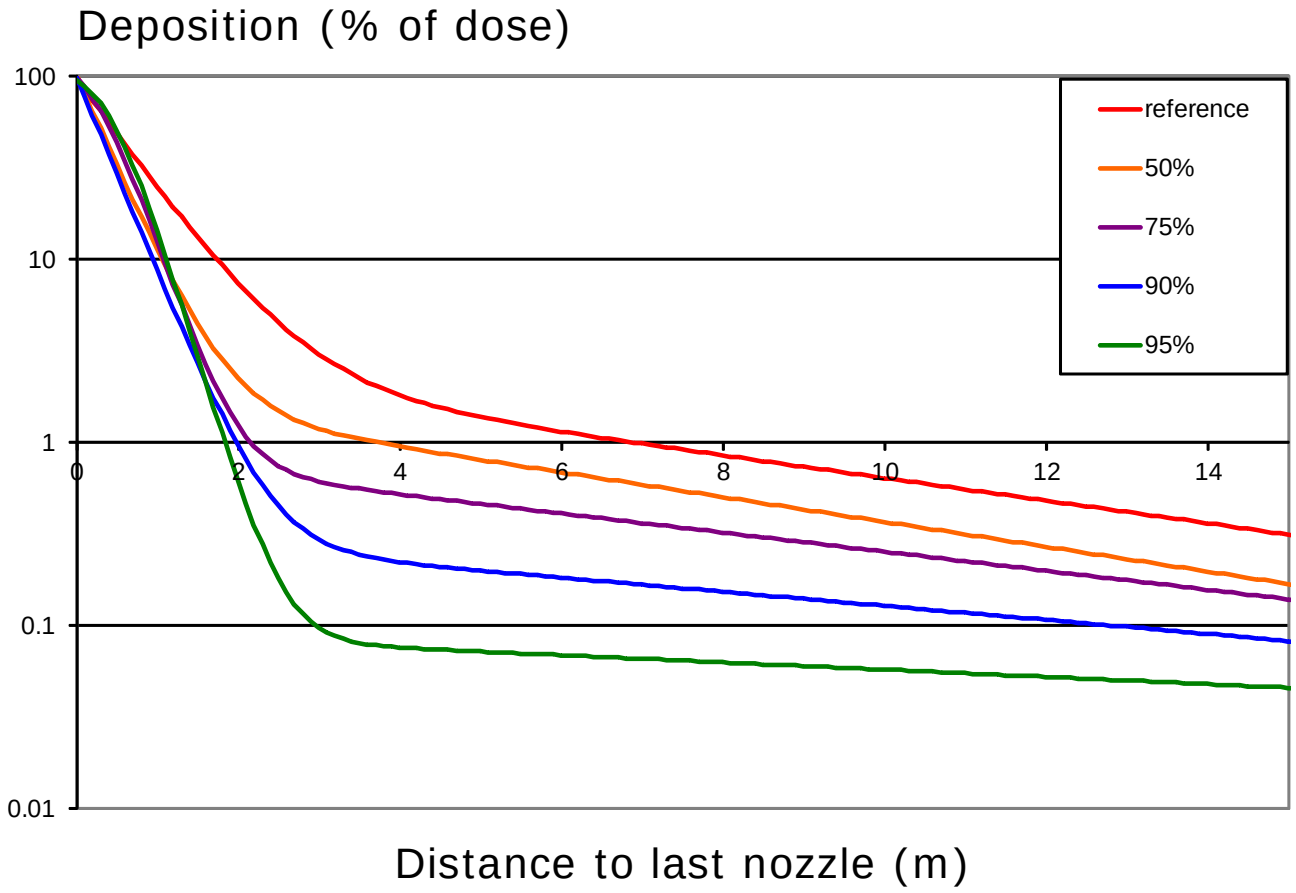
- Upstream catchment 100% treated: Dutch catchments are too small to justify otherwise
- Downstream ditch of 1000 m added: necessary to avoid artefacts of weir
- Baseflow 5 L/day: low value caused by heavy clay soil



Flow velocity low (<1.5 cm/day) most of the time



Spray drift input based on measured drift deposition curves from PRI-database



Van de Zande JC, Holterman HJ, Huijsmans JFM. 2011. Spray drift for the assessment of exposure of aquatic organisms to plant protection products in the Netherlands. WUR-PRI report, 2011, in prep.

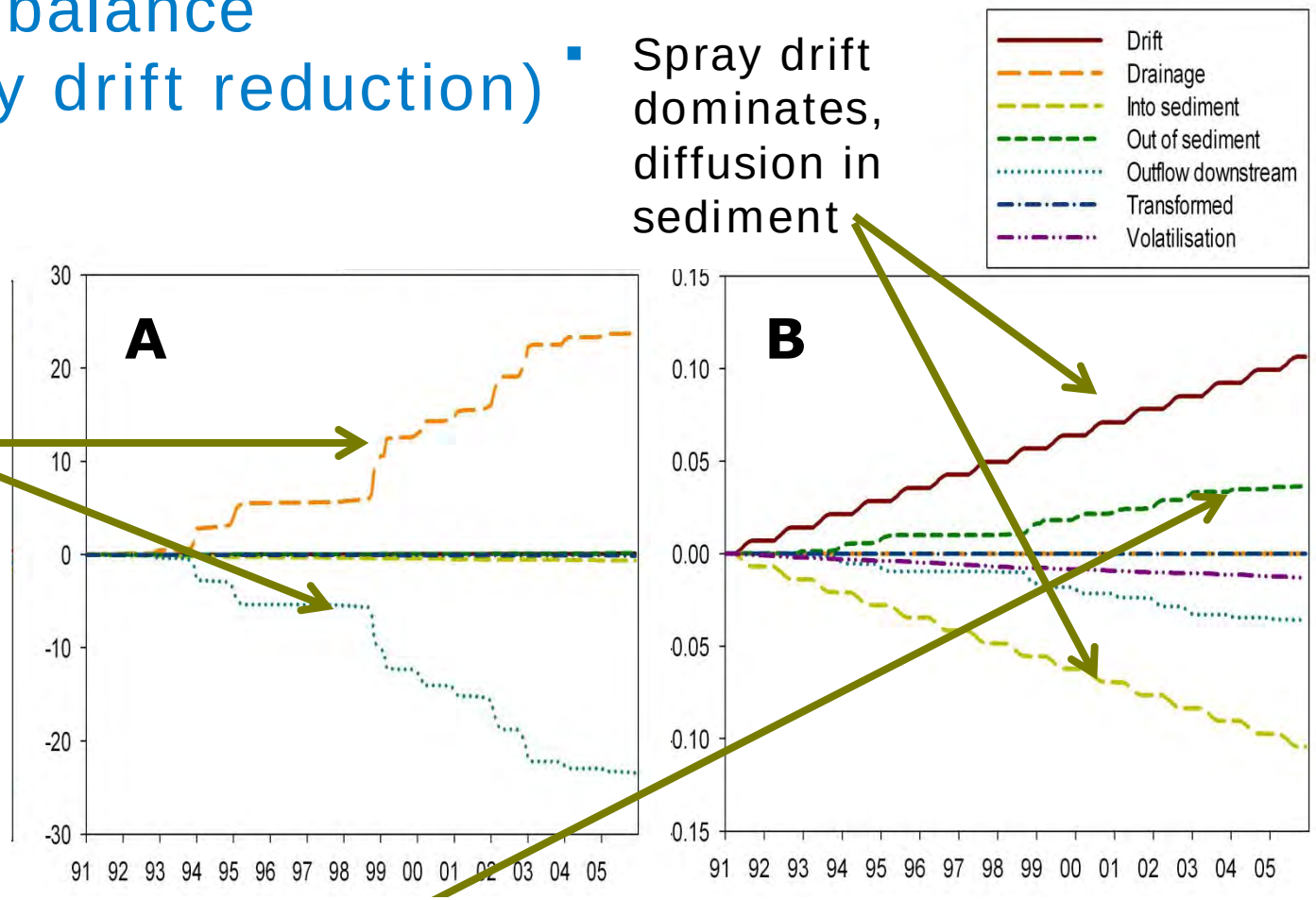
Example calculations for two insecticides

- Insecticide A:
  - 2 applications of 0.07 kg/ha
  - *DegT50* in soil 118 d
  - K_{om} in soil: 130 L/kg
  - DegT50 in water: 1000 d (hydrolysis only)

- Insecticide B:
  - 20 applications of 0.005 kg/ha with intervals of 7 days
  - *DegT50* in soil 50 d
  - K_{om} in soil: 138830 L/kg
  - DegT50 in water: 1000 d (hydrolysis only)

Substance balance (95% spray drift reduction)

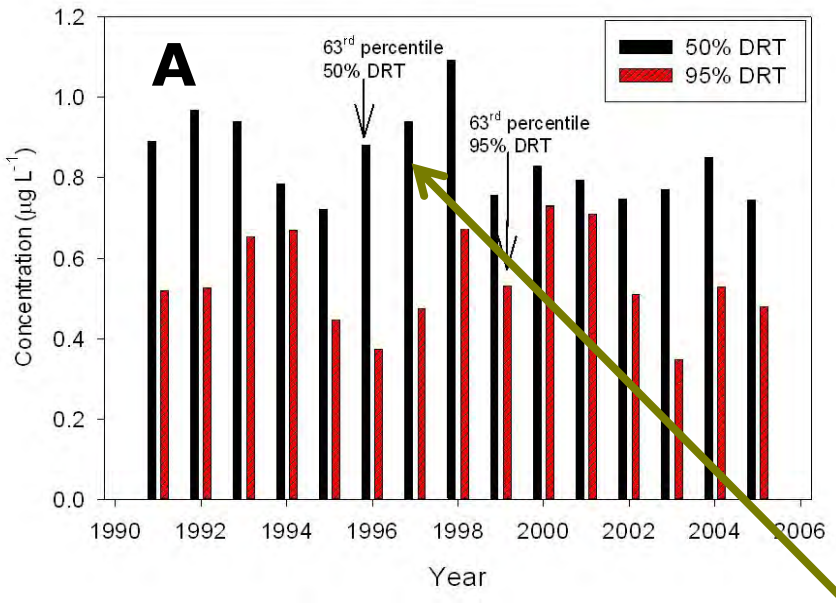
- Spray drift dominates, diffusion in sediment
- Drainage dominates and equals outflow

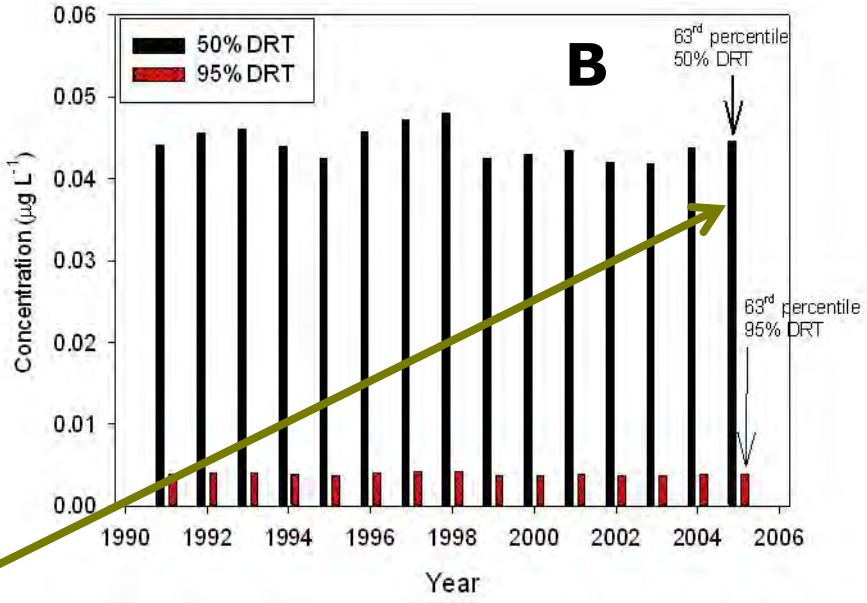


Diffusion from sediment causing slow release to water layer

15 annual peak concentrations

- Peaks variable: effect of drainage
- Peak same for all years: drainage is zero

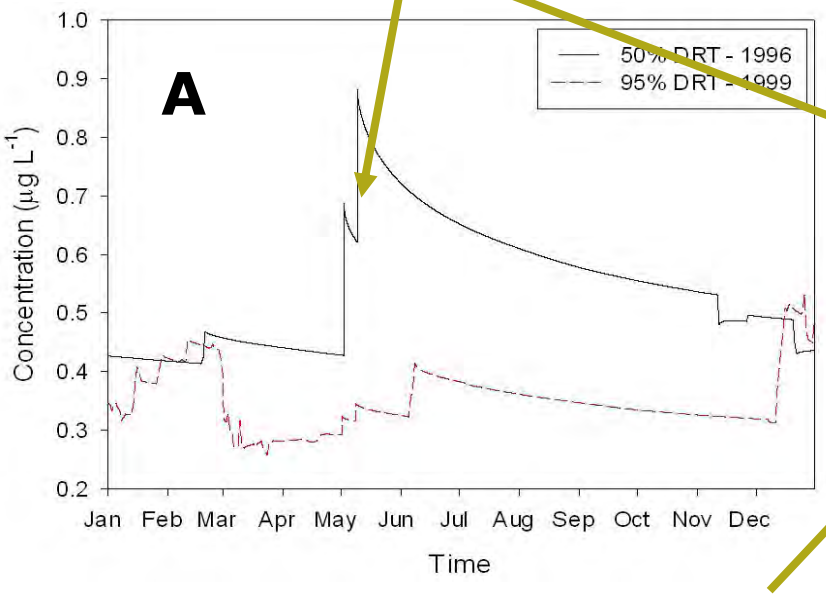


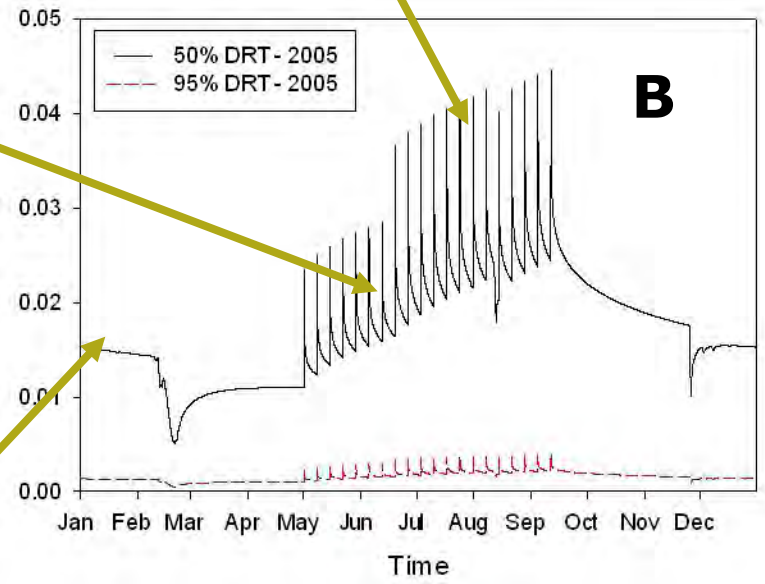


- Different years for 63rd percentile!

Time-course in 63rd percentile year

- PEC increases between peaks because of low flow velocity and long DegT50
- Fast decrease because of sorption





- Concentration does not reach zero: low flow velocity and diffusion from sediment

63rd percentile of maximum annual concentration

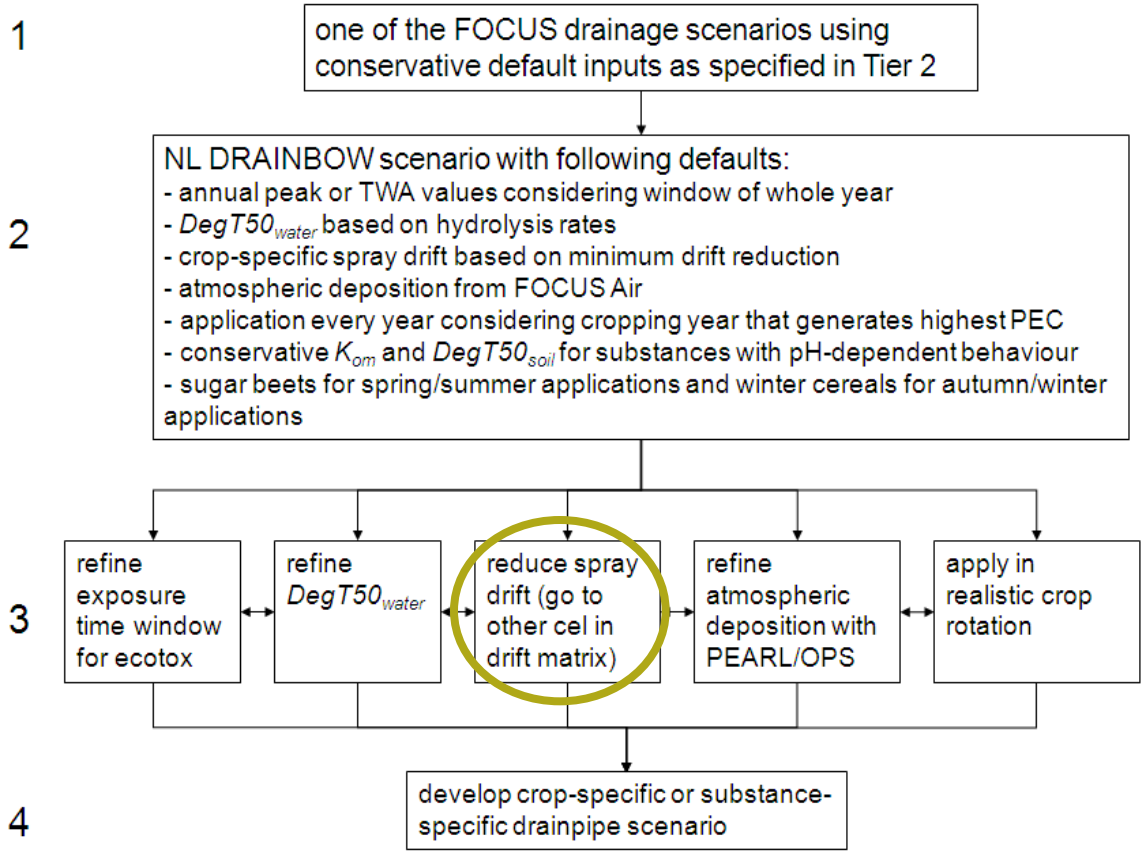
	DRT 50	DRT 95	Drainage only
Insecticide A	0.881	0.532	0.521 (µg/l)
Insecticide B	0.045	0.004	0.001 (µg/l)

DRT = Drift Reducing Technology class (%)

Conclusions from examples

- Low flow velocity in combination with low dissipation rate plays a crucial role in scenario:
  - Accumulation between repeated applications
  - Concentration never reaches zero
- Which pathway dominates depends on DRT and substance properties
  - Strongly sorbing insecticide: spray drift always dominates the peak
  - Moderately sorbing insecticide: drainage dominant at DRT 95%
- As 95% DRT is not yet commonly used in Netherlands, there is still a large potential for spray drift mitigation

What if a substance does not pass in Tier 2?



Mitigation → next slide

Tier-3 mitigation options can be evaluated in a matrix

- ROWS: Drift Reducing Technologies in class 50, 75, 90 and 95%.
- COLUMNS: Crop free buffer zones
- PEC decreases from upper-left to lower right, so evaluation in same direction ("2D-stepped approach")

Technique/ Crop-free buffer zone (m)	0.25	0.50	0.75	1.00	1.25	1.50	1.75	→
Reference							→	
DRT 50		> RAC				↓ →		
DRT 75					↓ →			
DRT 90				↓ →	< RAC			
DRT 95		→	↓					

Thank you