Modelling the fate of pesticides in a highly dynamic water-sediment system

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Problem statement

Current risk assessment → worst case scenario's
- simple partitioning
- unit world assumptions
- FOCUS surface stream

Is it possible to develop a more realistic model
- taking into account spatio temporal variability
- both indirect and direct pesticide losses
- at catchment scale

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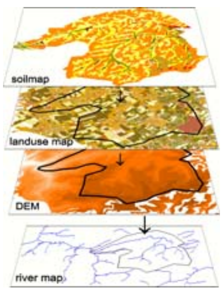
Problem statement

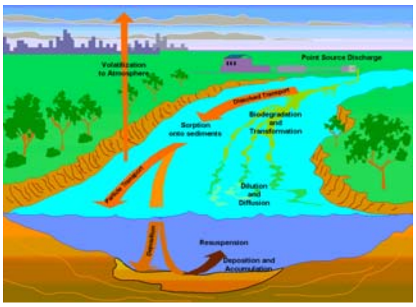
Fluxes towards the river



SWAT-model

Land scape level approach

Processes in the river



RWQM-model

Todays talk …

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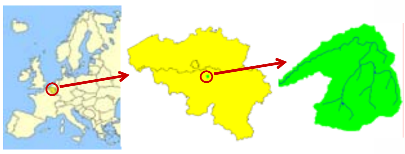
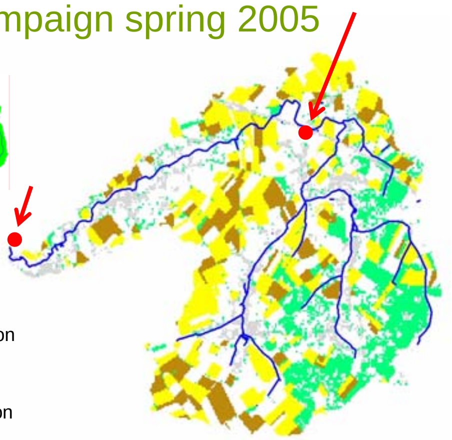
Monitoring campaign

- intensive monitoring campaign spring 2005





	crop	% area	pesticide
(brown)	SGBT	10.34	→ chloridazon
(green)	CORN	15.09	→ atrazine
(blue)	WATR	0.03	
(yellow)	WWHT	21.53	→ isoproturon

Monitoring campaign

- composite samples of water
  - → pesticides in solution
  - → pesticides on suspended solids

Monitoring campaign

- general water quality parameters

Monitoring campaign

- undisturbed sediment samples → sliced

⇓

depth distribution → in pore water

→ on the sediment

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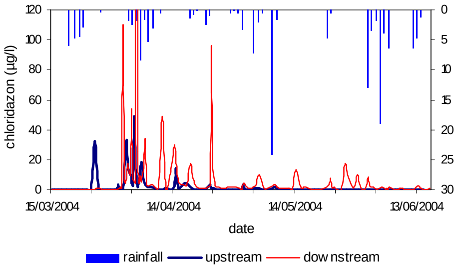
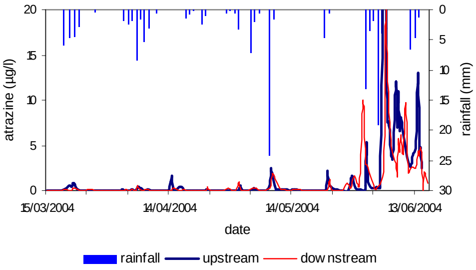
Monitoring campaign

- in the water column

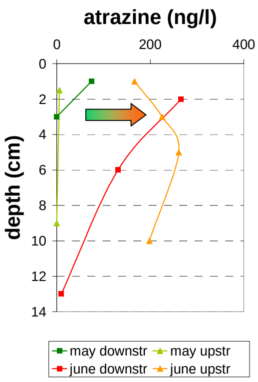




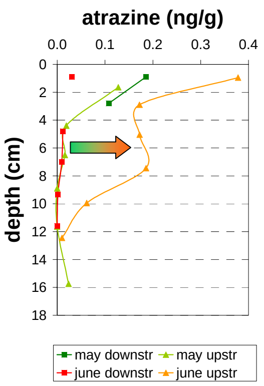
→ highly dynamic system with hourly variations

Monitoring campaign

- in porewater



- on sediment

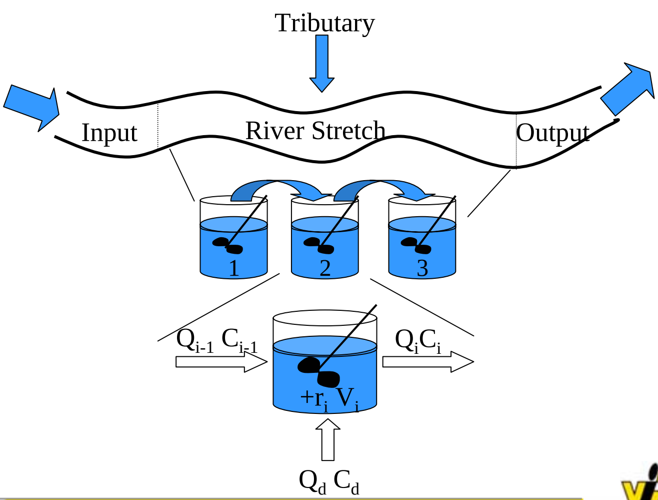


- in agreement with application sheme
- concentrations in pore water <<< water compartment (factor 2)
- irregularities due to stones
- decrease with depth

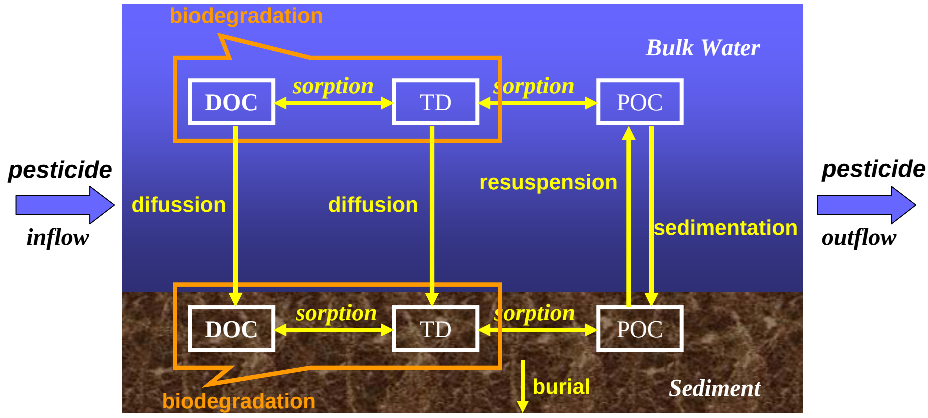
- explanation observations: combined
  - → diffusion
  - → biodegradation
  - → chemical processes
  - → sedimentation – resuspension

dynamic model:
- gain insight in the importance of each of these processes
- realistic predictions

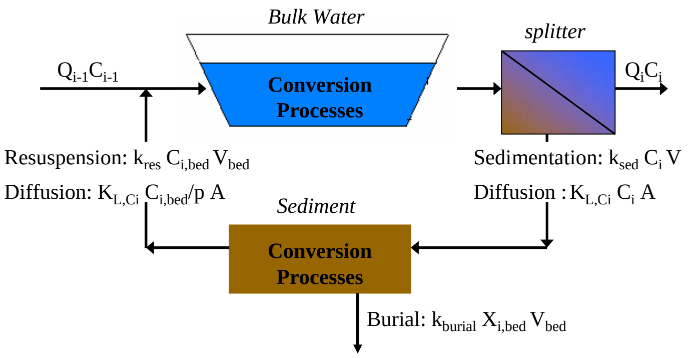
Model development

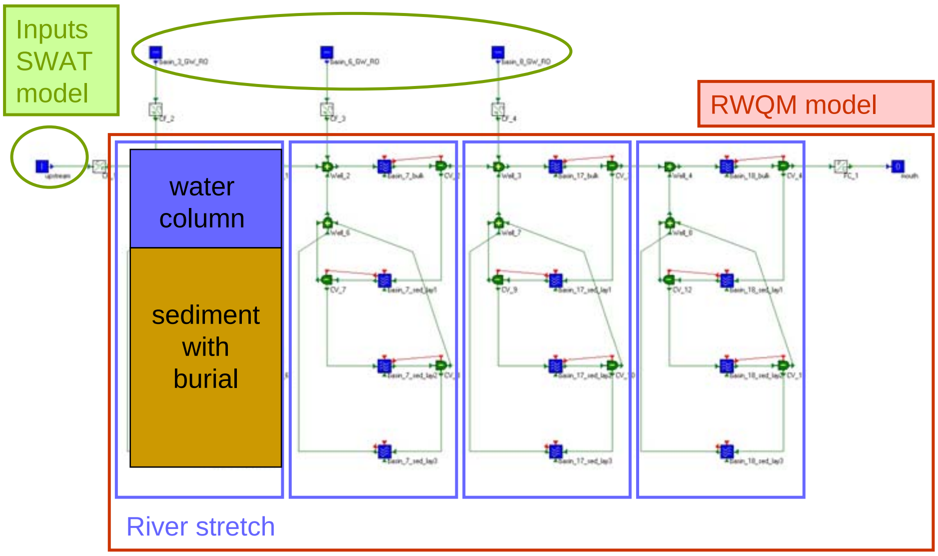


Model development: extension of RWQM



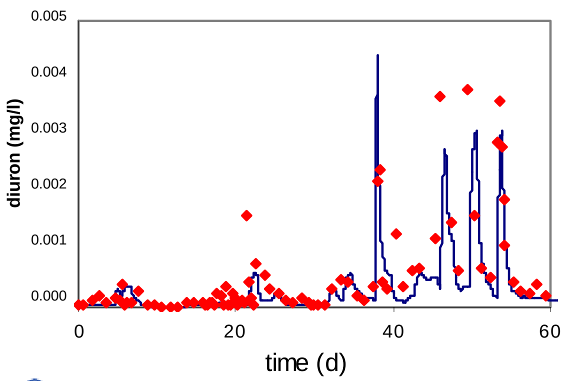
Model development





Results: model validation

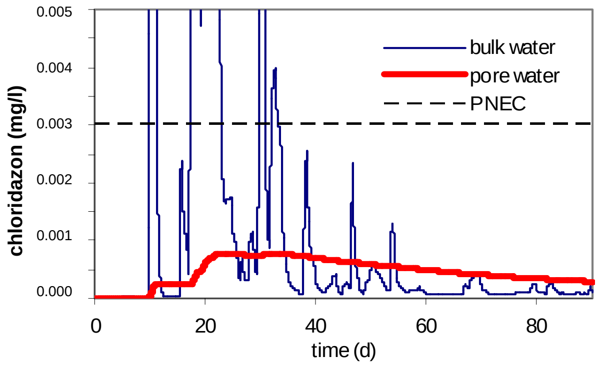
- in the water compartment



- good agreement
- should be validated for other pesticides

Results

- in the pore water



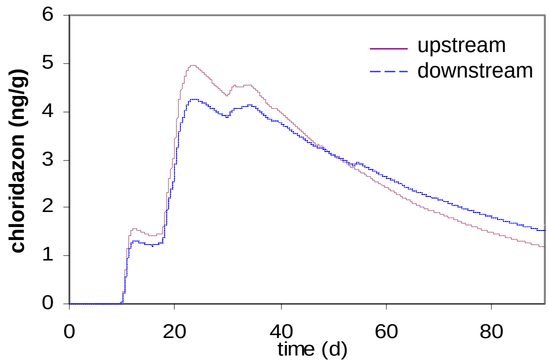
Results

- in the pore water

compartment	pesticide	downstream	
		measured	simulated
Pore water (ng/l)	chloridazon	910	594
	diuron	1540	74
Sediment (ng/g)	chloridazon	1,2	2,5
	diuron	4,9	13,4

Results

- on the sediment



- after the application period: decrease
- upstream sediment is transported towards mouth

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Conclusions

- the water-sediment is a dynamic system
  → dynamic model is necessary for realistic predictions
- extension of the RWQM1-model with pesticide behaviour
- model validation:
  - bulk water: reliable results
  - pore water: underestimated → needs further research
  - on sediment: same order of magnitude
- tool for risk assessment: more realistic pesticide concentrations

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QUESTIONS ?
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