Partitioning and dynamics of pesticides in surface waters

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Objectives

The aim of the study is twofold:

- study the partitioning of pesticides between the different compartments of a water system
- have a look at the dynamics of pesticides in each compartment

Study area: the Nil-catchment

• location
- small basin
  area = 32 km²
  length = 14 km
- well documented
- pesticide data collected

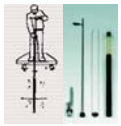
• pesticide application (Beernaerts *et al.*, 2002)

AI	Culture	Application date				
		march	april	may	june	july
atrazine	corn					
isoproturon	winter wheat					
	barley					
chloridazon	beet					
lenacil	beet					
	flax					
diuron	non agriculture					
simazine	non agriculture					
	green peas					

2004 Monitoring campaign

- composite water samples at two locations (upstream and at the mouth): 50 ml taken every 15 min. and mixed over 8 hours: 15 March – 15 June
- analysis of pesticides in suspension and bound on suspended solids: isoproturon, atrazine, lenacil, diuron, chloridazon, simazine

- sediment samples taken twice (17th of May, 29th of June) with multisampler



- taking undisturbed samples
- freezing (CO_2-ice) and slicing
- analysing pore water and sediment of top-layer

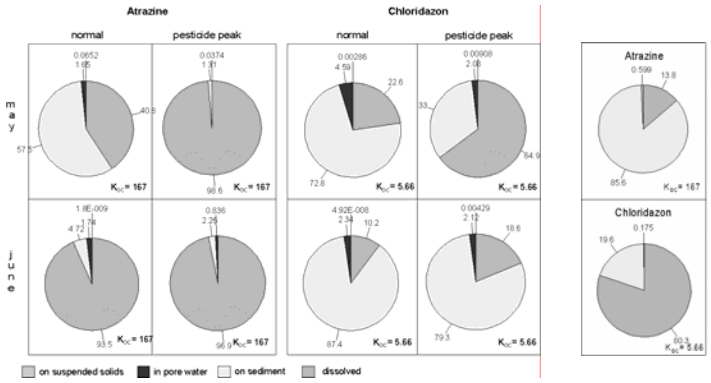
Results and Discussion

• partitioning of pesticides

	Local measurements	Mackay Level I
- water column: thickness	20 cm	20 cm
- sediment: thickness	15 cm	15 cm
dry bulk density	1.5 kg/l	1.5 kg/l
porosity	44%	
OC (g/g)		0.05
- suspended solids OC (g/g)	0.08	0.08

→ comparison of partitioning of pesticides when clear water and when an average pesticide peak passes, both for the months May and June

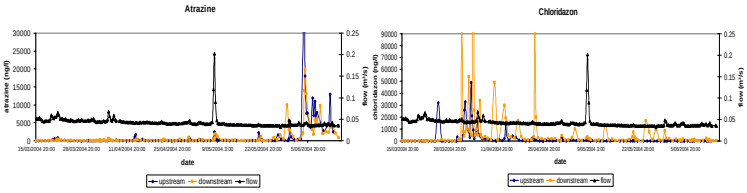
Measurements | Mackay Level I



- partitioning of pesticides cannot only be explained by K_{OC}/ Mackay partitioning
- important as well are: - the history and dates of pesticide applications
  - the limited exchange between the different compartments in the real environment

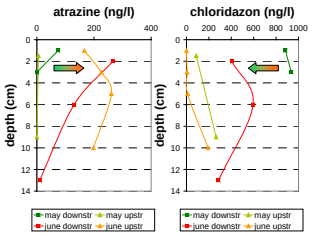
• dynamics in the different compartments

- water compartment



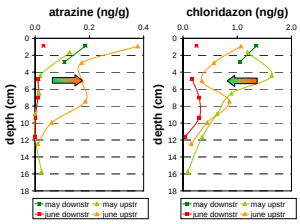
→ dynamic system, with hourly variations

- pore water



→ dynamic system:
- monthly variations: what happens every week/every 2 weeks?
- in agreement with application scheme: atrazine concentration ↑ may → june, chloridazon ↓
- concentrations in pore water <<< in the water compartment (factor 2)
- fast pesticide peaks only have short residence times for interaction with pore water

- on the sediment



→ dynamic system:
- monthly variations
- in agreement with application scheme: atrazine concentration ↑ may → june, chloridazon ↓
- irregularities due to stones
- decrease with depth

Conclusions

- partitioning of pesticides depends on history and a limited exchange between compartments (≠ Mackay partitioning): dynamic modelling → reliable predictions of pesticide partitioning
- the dynamics of the water compartment are determined by point and diffuse sources, the contribution coming from pore water is negligible (but may be of high importance for benthic organisms)

References

Beernaerts S., Debongie P, De Vleeschouwer C. and Pussemier L. 2002. Groenboek Belgaqua-Phytophar 2002, pp. 33-38.

Mackay D. 2001. Multimedia environmental models: the fugacity approach: second edition. Lewis Publishers/CRC Press, New York, Boca Raton, Florida. ISBN 1-56670-542-8. 261 p.

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