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Modelling mitigation measures for pesticide pollution control using SWAT

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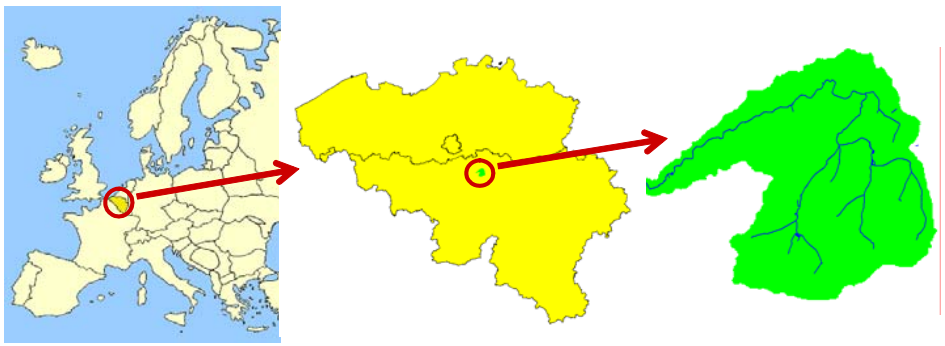
Case study

- location



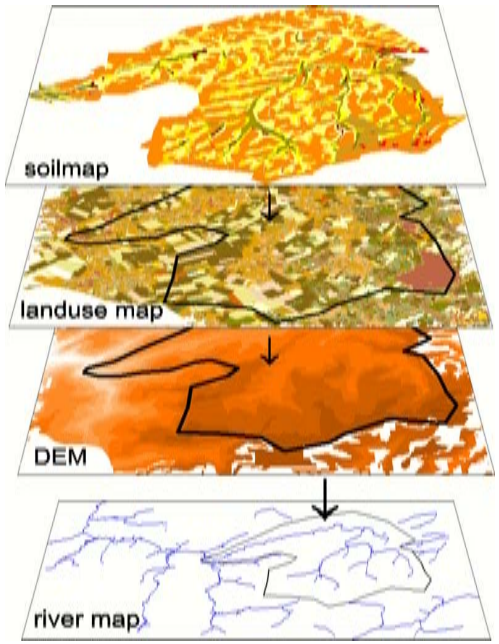
- small basin: 34 km², 16 km long, *t* = 1 day

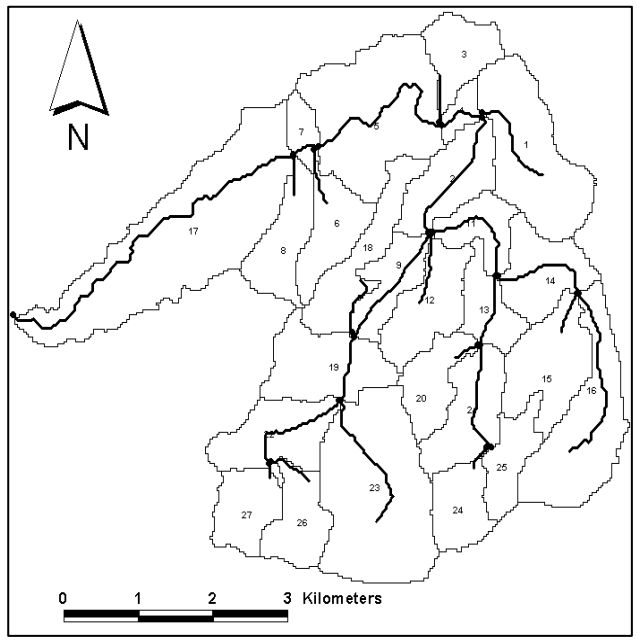
- well documented

- studied in detail for pesticide application: 1998-2002

Modelling pesticide fluxes

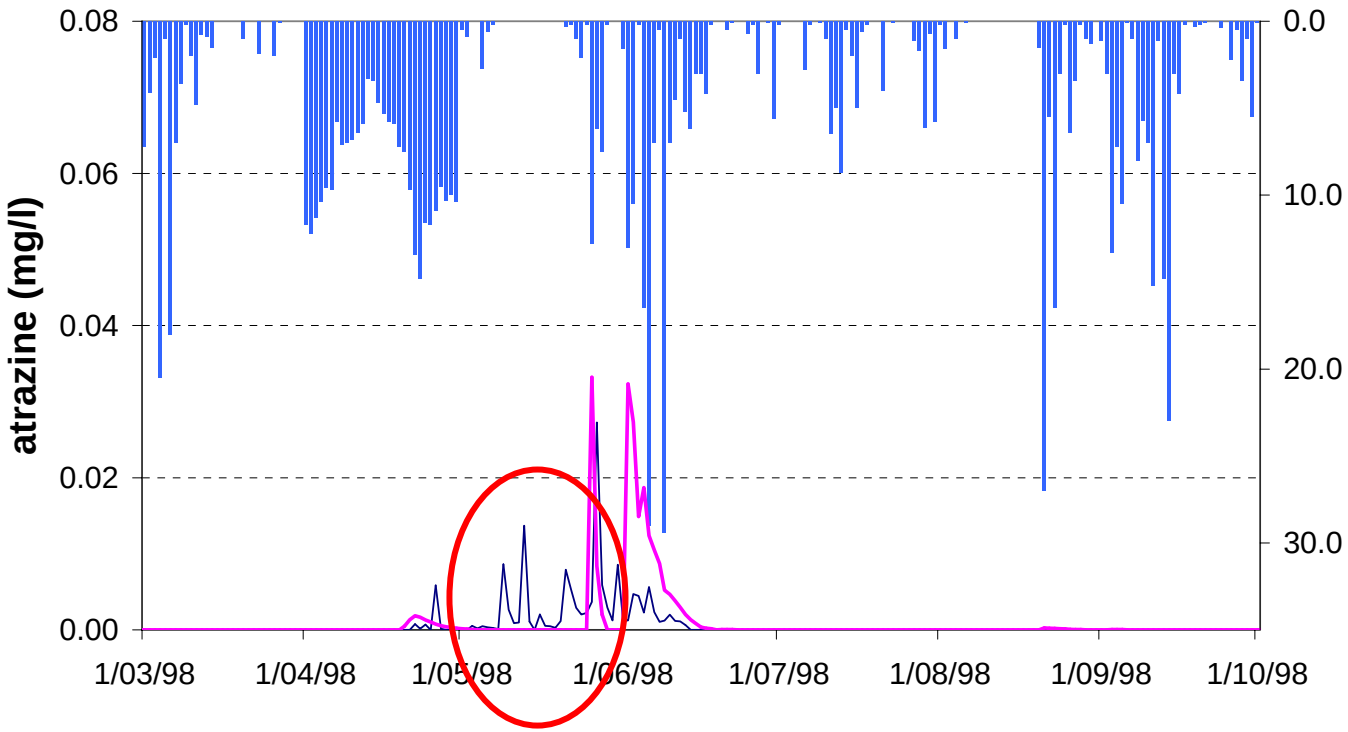
SWAT model





→ modelling hydrology, sediments, nutrients and pesticides

A. Point sources



→ modelling response to rainfall

→ point source losses are lacking

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A. Point sources

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A. Point sources

→ implementing point source pollution

$$point\_loss = ap_{rate} \times (1 - ap_{ef}) \times area_{hru} \times 1e8$$

whith: $ap_{rate:}$ pesticide application rate (kg pst/ha)

ap_{ef} : pesticide application efficiency

$area_{hru}$: area of the HRU (km²)

→ to model reduction: set parameter ap_{ef} to a higher value

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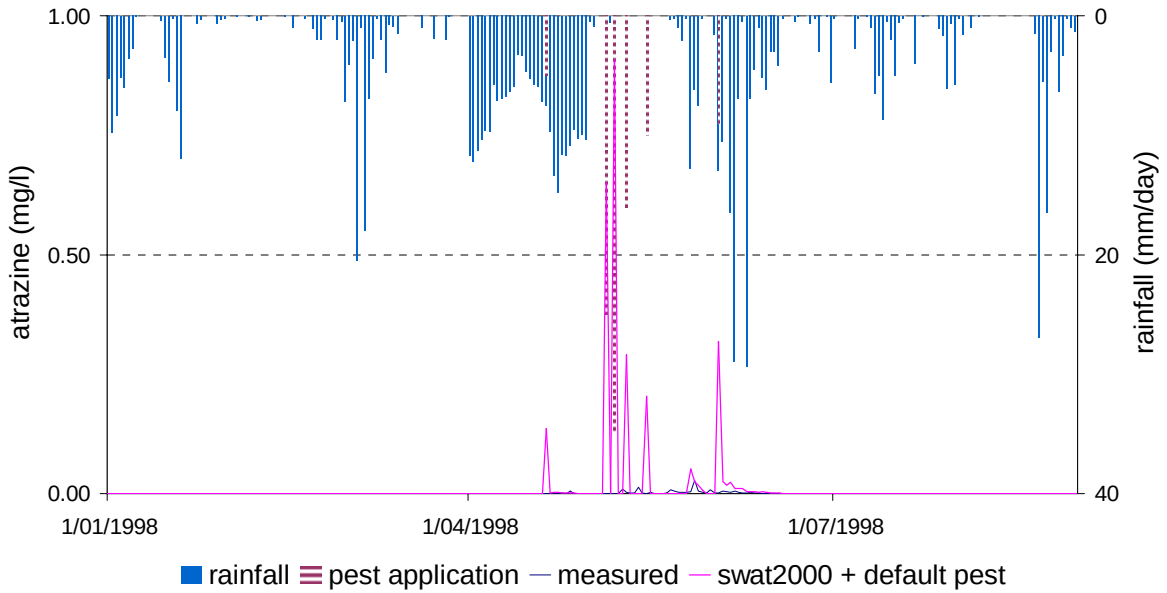
A. Point sources

→ implementing point source losses

$$direct\_loss_{point} = ap_{rate} \times (1 - ap_{ef}) \times area_{hru} \times 1e8$$



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Reduction of point sources with 80% gives a decrease of atrazine of 21%

B. Diffuse pollution: runoff

- **Conservation agriculture:** change ploughing practice in management file of model

- **Vegetated filter strips:** extension of model code (see next slides)

- **Sowing cover crops (e.g. rye), contour farming and strip-cropping:** adapting the model parameters Curve Number (CN2) and/or USLE support practice factor (USLE-P)

cover crop rye

contour farming

strip-cropping

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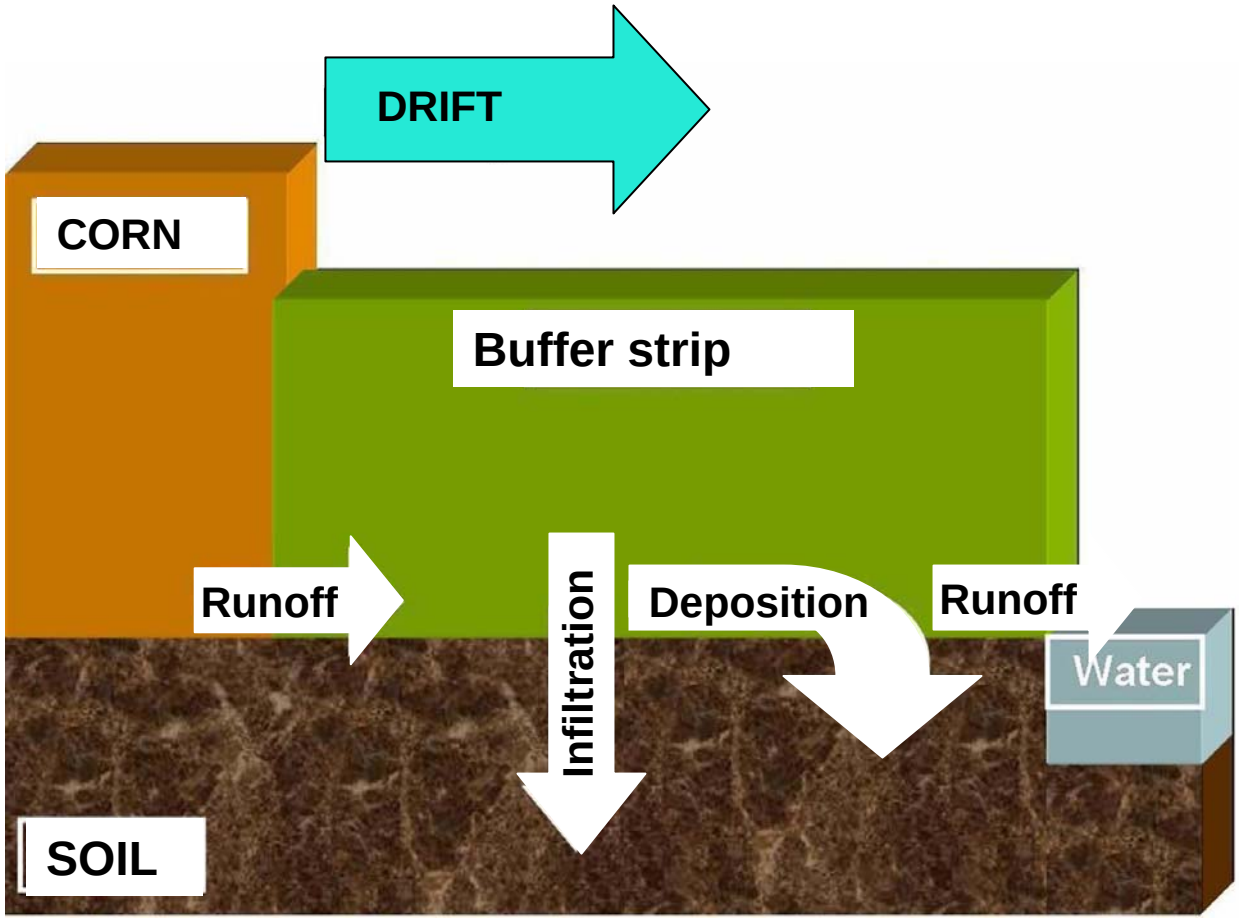
B. Diffuse pollution: buffer strips



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B. Diffuse pollution: buffer strips

Processes buffer strips

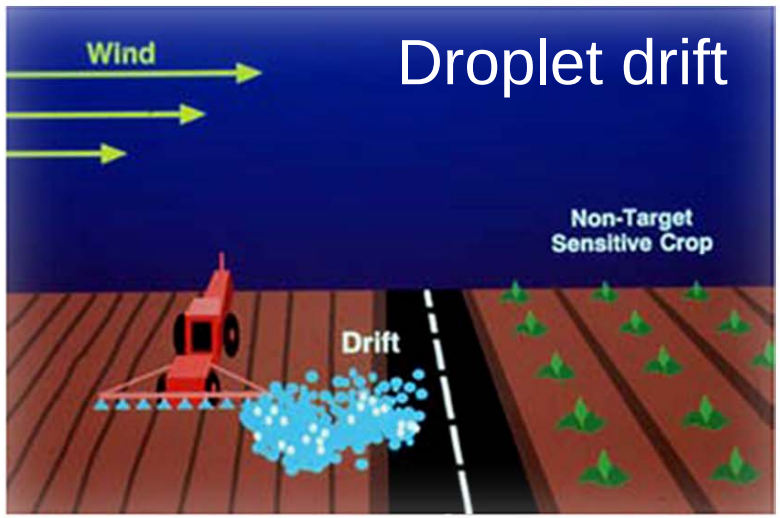
- Deposition (clay/silt/loam) + adsorbed pesticides/phosphorus/nitrogen
  - manning equation + deposition velocity
- Droplet drift
- Infiltration (HRU hyrdrological processes) (water and soluble chemicals)
- Split HRU

B. Diffuse pollution: droplet drift

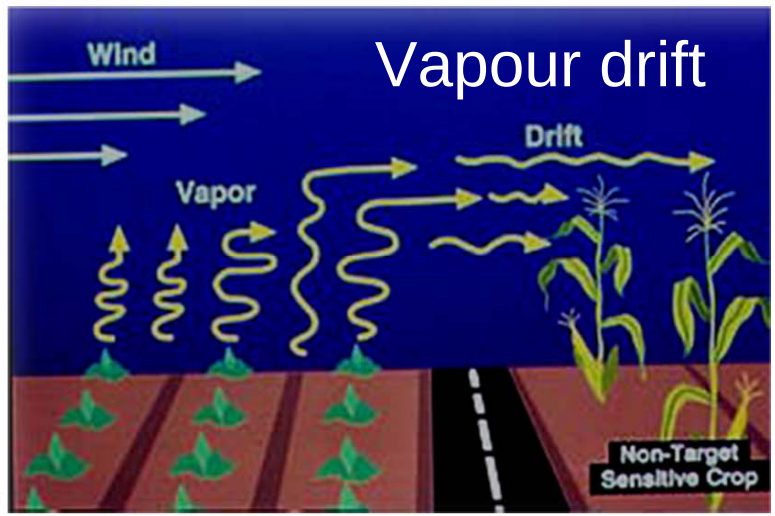
→ implementing an estimator for droplet drift (Ganzelmeier)

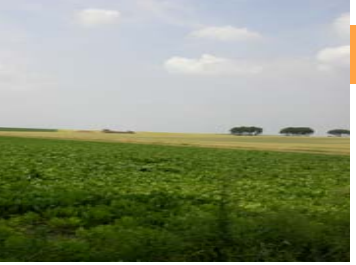
$$\overline{Drift} = \left[A * \int_{z_1}^{z_2} (z^B) dz \right] * \frac{1}{z_2 - z_1}$$

a.



b.





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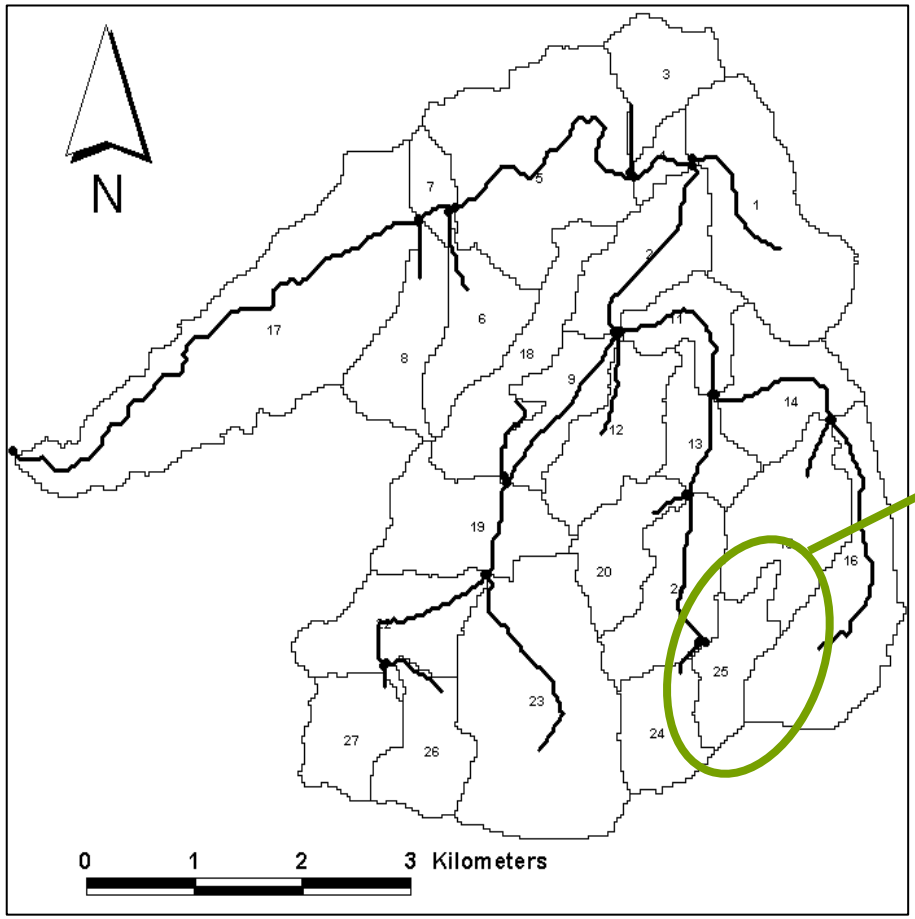
Modelling results: subbasin 25



subbasin 25

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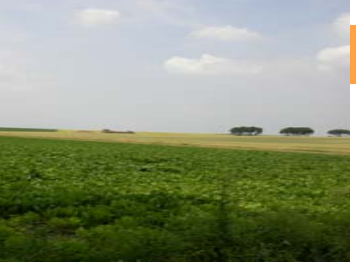

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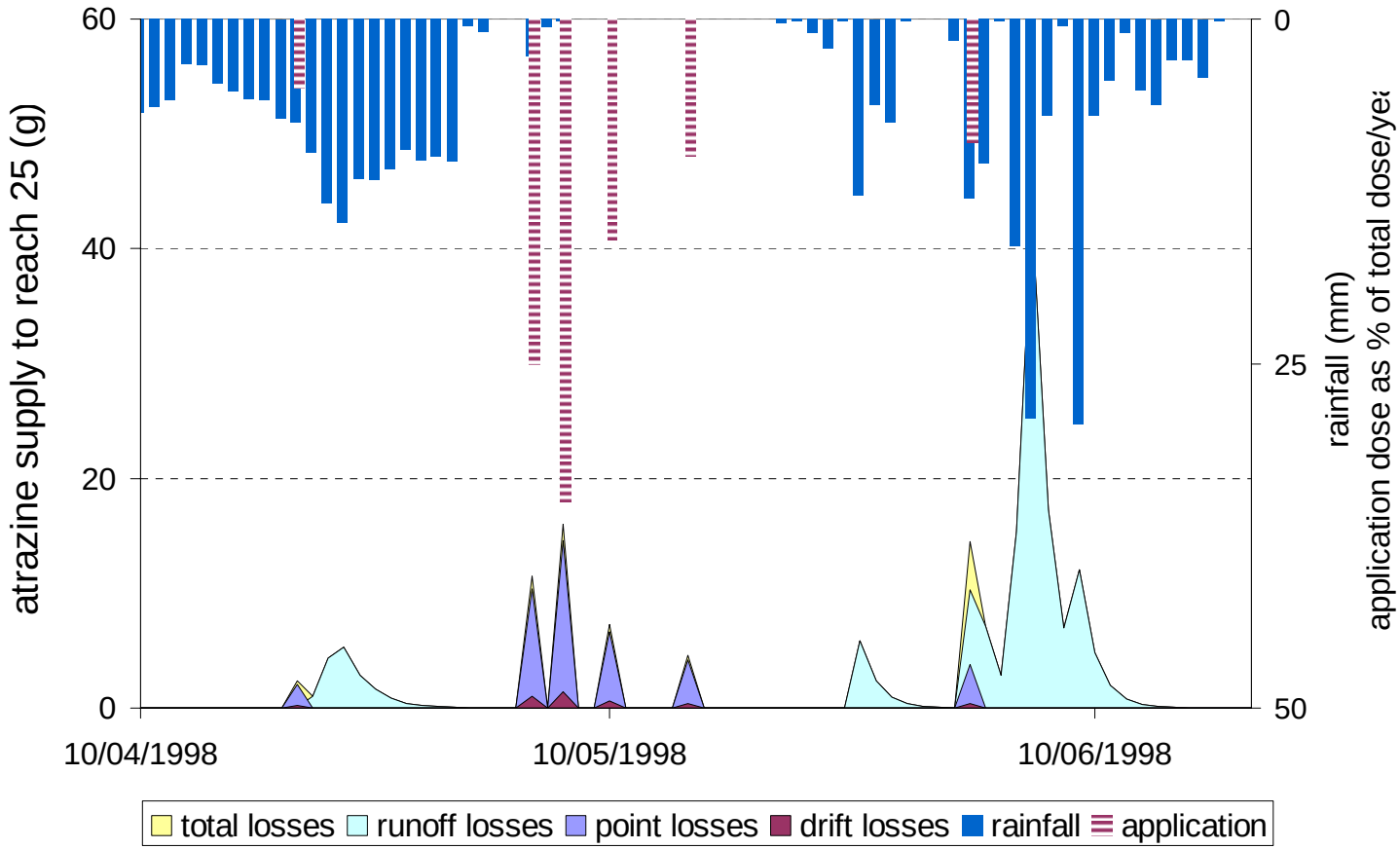
Modelling results: subbasin 25

→ no 'no spray zone'



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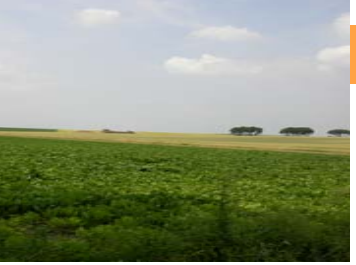

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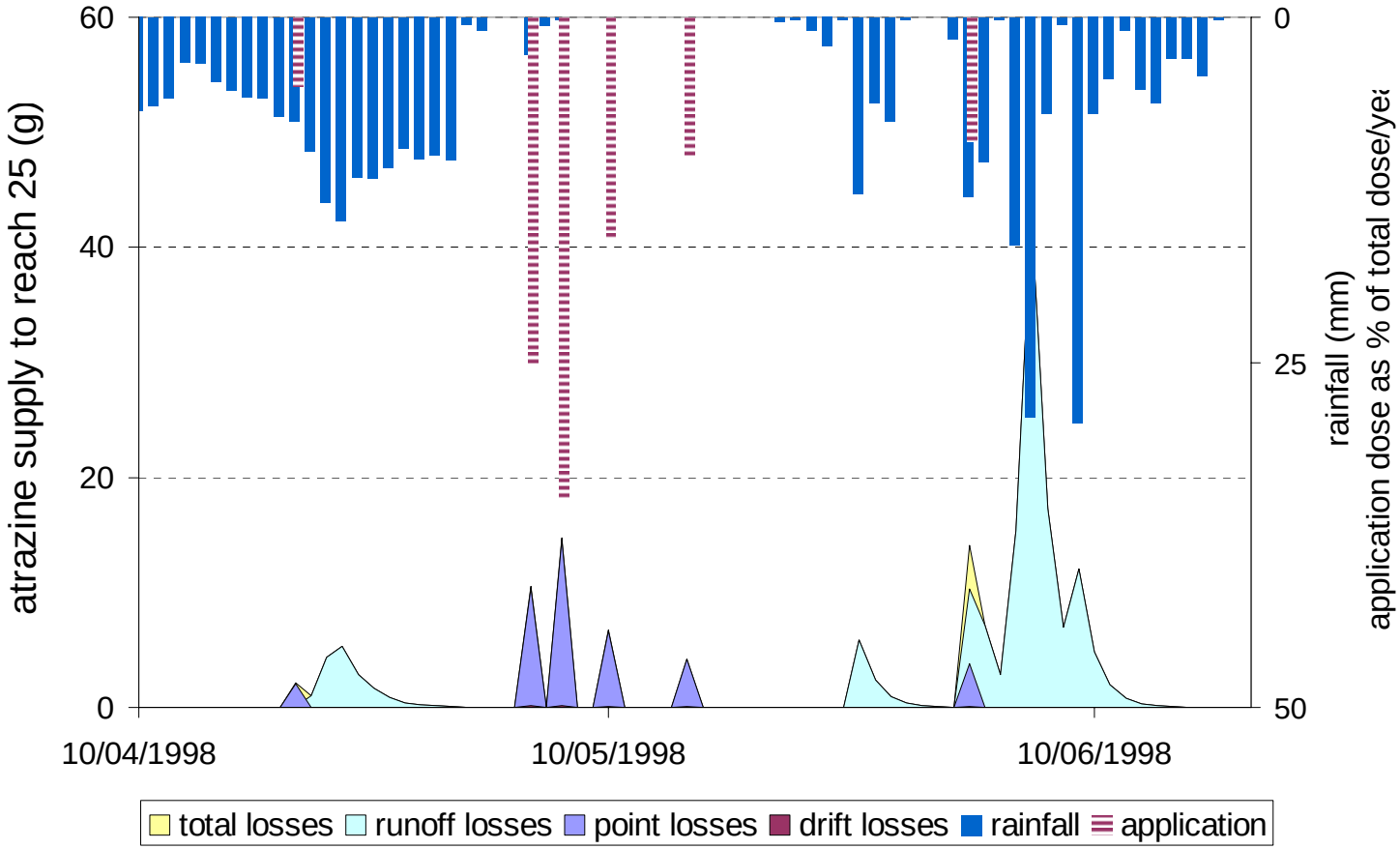
Modelling results: subbasin 25

→ with a 1metre 'no spray zone'



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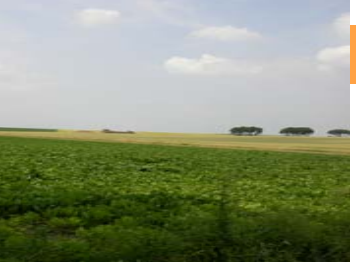

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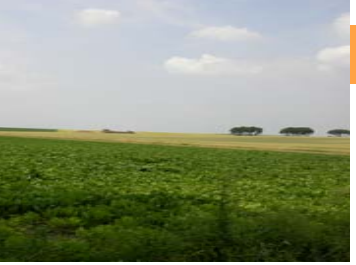
Modelling results: BMPs

BMP		Increase(+)/decrease(-) in atrazine load(%)
Strip cropping		-39.7
Sowing cover crops: rye	Direct seeding	-33.5
	Only seedbed preparation	-33.2
	Chisel plough	-33.0
	Mouldboard plough	-32.2
Contour farming		-27.6
Reduction of point losses with 80%		-21.1
Buffer strip	5 m width	-11.7
Conservation agriculture	Direct seeding	-1.5
	Only seedbed preparation	-1.3
	Chisel plough	-1.0
	Mouldboard plough	1.0

The results are predictions for the year 1998 at the mouth of the river



Conclusions

→drift losses can be ignored, point losses and runoff losses need special attention

→ 22 to 70% of load on year basis: point losses: easy to reduce, but sensitisation of farmers is continuously necessary

→ Diffuse pollution: contour stripping is most effective, but also economically feasible ?

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THANK YOU!

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