

Modelling of pesticide transfer on the Vesle catchment (Reims, France)

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Modelling of pesticide transfer on the Vesle catchment (Reims, France)

1. Vesle catchment (Reims)

2. Objectives

3. Experimental studies

4. *Phytodel* Model

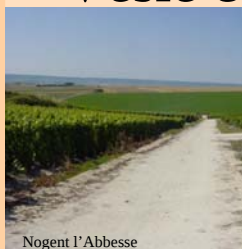
5. Results

- a. Hydrology
- b. Atrazine
- c. Other herbicides

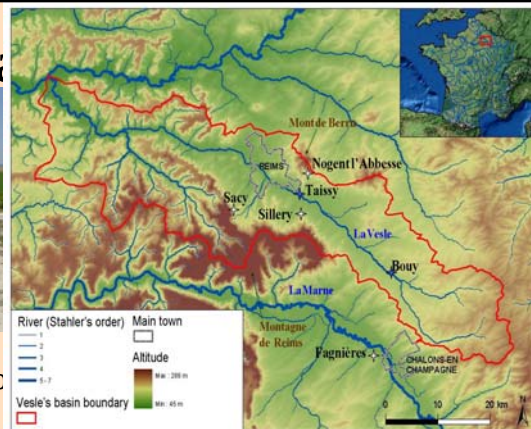
6. Conclusion

7. Perspectives

Vesle c



Nogent l'Abbesse



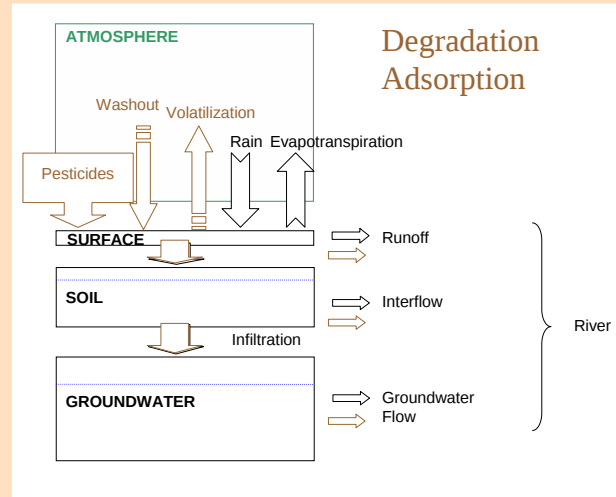
- Situated in N
- 1480km²
- Mainly agricultural activities : « Champagne » vineyard and cereal crops
- Surface and groundwaters usually contaminated by pesticides
- Research program *AQUAL* (fight against the diffuse pollution in rural area on the Vesle catchment)

Modelling of pesticide transfer on the Vesle catchment (Reims, France)	Objectives
1. Vesle catchment (Reims)	
2. Objectives	• Modelling transfer of all pesticides towards surface water in this catchment
3. Experimental studies	
4. <i>Phytodel</i> Model	
5. Results a. Hydrology b. Atrazine c. Other herbicides	• Elaboration of a pesticide database (ASPPRO) according to inquiries
6. Conclusion	
7. Perspectives	• <i>Phytodel</i> based on simplified transfer processes • <i>Phytodel</i> contains an atmospheric layer • Model <i>Phytodel</i> will be coupled to ©<i>Sénèque 3</i> (GIS software based on ©<i>Riverstrahler 4</i> model : biogeochemistry, hydrology).

Modelling of pesticide transfer on the Vesle catchment (Reims, France)	Experimental studies
1. Vesle catchment (Reims)	
2. Objectives	
3. Experimental studies	• Few databases exist in this basin (air contamination, Vesle chemical quality and flow)
4. <i>Phytodel</i> Model	
5. Results a. Hydrology b. Atrazine c. Other molecules	• Since 2004, field studies concerned: – Fallout and air contamination – Runoff on vineyard (laboratory experiments) – Infiltration in lysimeters (cubic box, 2m each side) with non disturbed soil
6. Conclusion	
7. Perspectives	• Pesticide uses have been investigated by enquiries (C. Schott, INRA-SAD Mirecourt) • Chamber of agriculture • Agricultural cooperatives • Agricultural experts

« Phytodel » Model

Vertical processes Horizontal transfer



Simplified processes for pesticide transfer

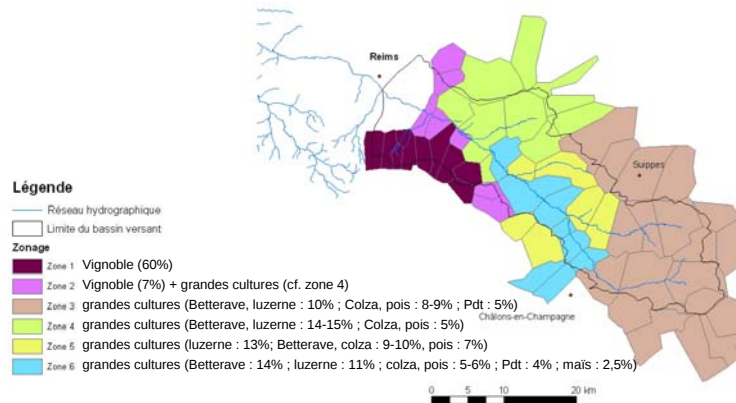
- Adsorption :

Instantaneous equilibrium, $C_S = K_{OC} * f_{oc} * C_L$
- Degradation :
 - Half-life in aerobic soil for the Surface and Soil layer (literature)
 - Half-life in anaerobic soil for Groundwater layer (literature)
 - Half-life in atmosphere (Aopwin of EPI-SUITE from U.S. Environmental Protection Agency)
- Volatilization and Washout:

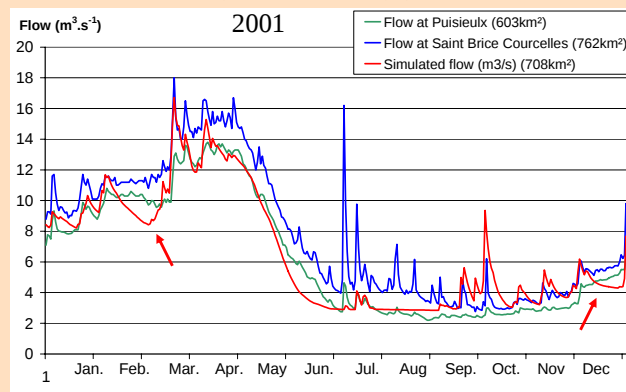
Henry's law constant : $C_L / C_G = R * T / H$

Pesticide Database

- According cultures, the catchment is divided in 6 homogeneous areas
- For each area, we know the percentage of each crop
- For each crop,
 - Pesticides amount used according to treatment proceedings
 - Application period for each use



Hydrology

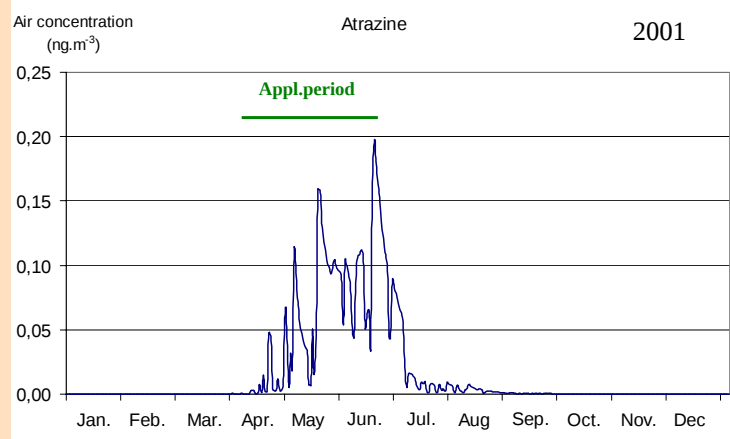
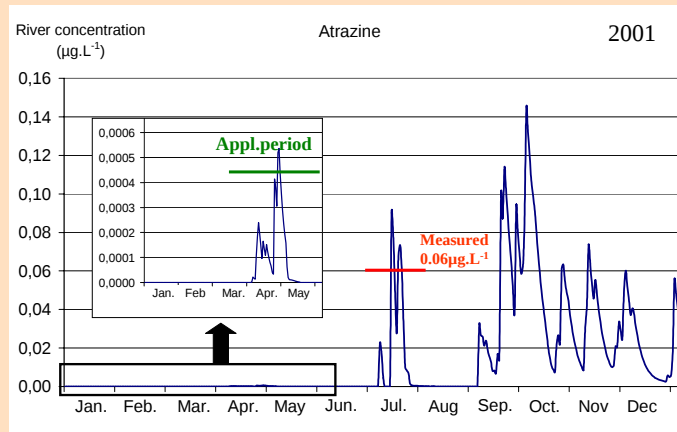


- The hydrology of the Vesle River is complex and depends on:
 - Water exchange with the Marne Canal
 - Groundwater system : karst

Atrazine

• River

Simulated concentrations are in good agreement with observed data (July 2001, atrazine : $0.06\mu\text{g.L}^{-1}$)

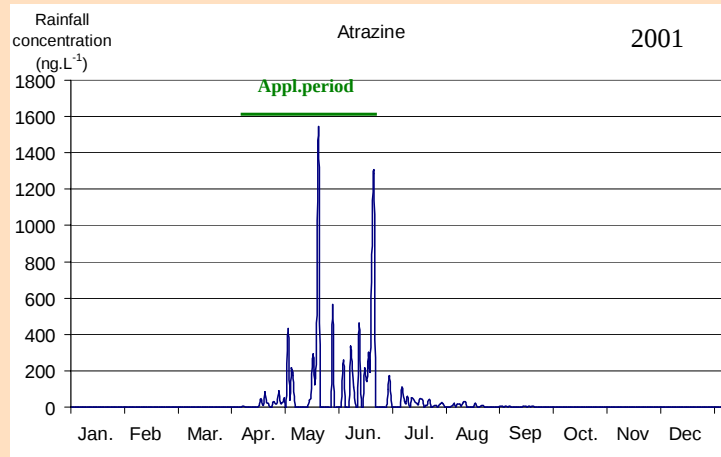


• Atmosphere

- Simulated air concentrations seem good
- Measures in air phase in an agricultural area:
La Ferté sous Jouarre in 1992-1993 : range 0.03 to 2ng.m^{-3} (Chevreuil et al., 1996)

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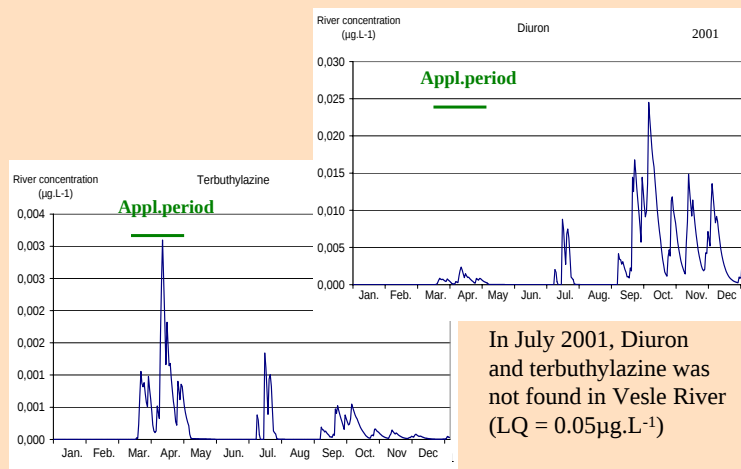
- Atmosphere
 - Simulated rainfall concentrations correspond to concentration measured in close area Eclaron during the week of May 5th, 2000 : atrazine $\sim 1000 \text{ ng.L}^{-1}$ (Blanchoud *et al.*, 2002)

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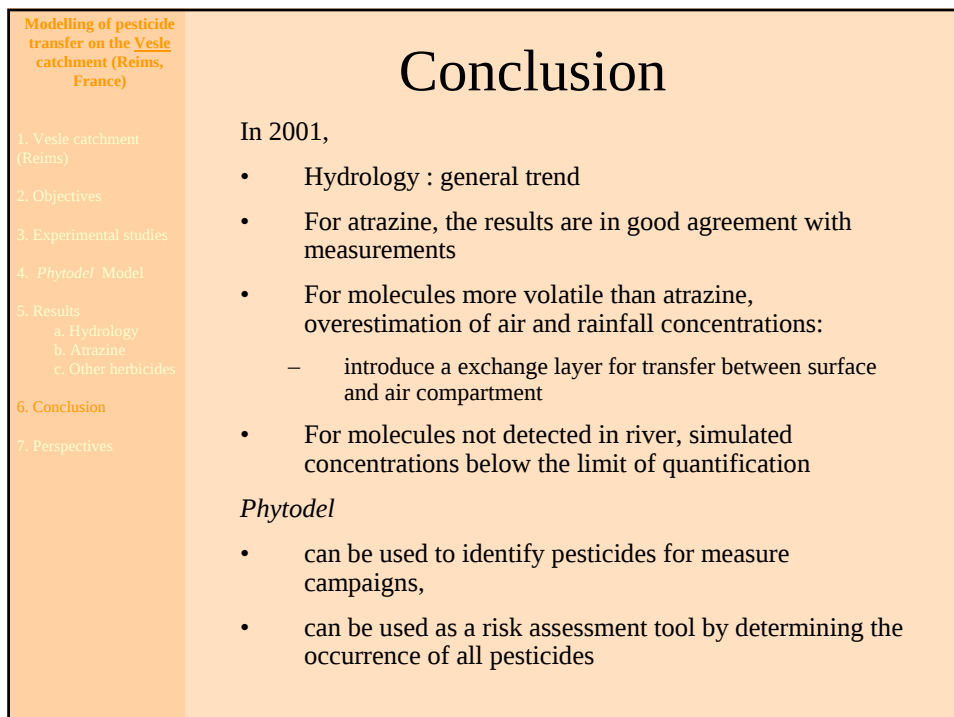
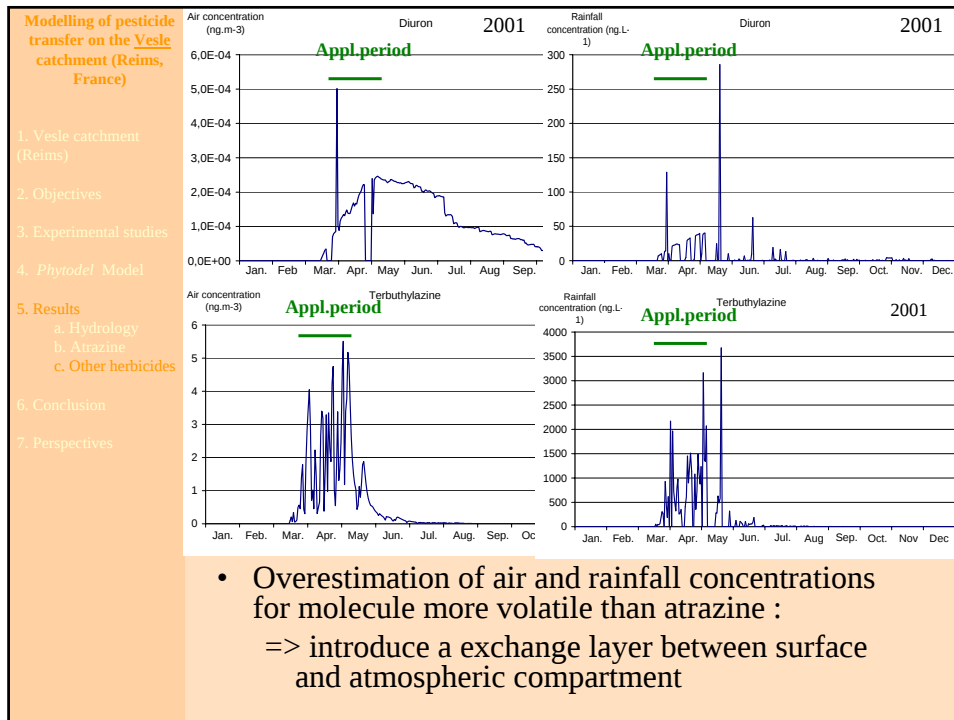
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Other herbicides

- Model was tested with alachlor, diuron, oryzalin, dichlobenil, terbutylazine



In July 2001, Diuron and terbutylazine was not found in Vesle River ($LQ = 0.05 \mu\text{g.L}^{-1}$)



Perspectives

- Short term:
 - Processes
 - Non equilibrium adsorption / desorption
 - Volatilization : exchange layer
 - Spatial distribution
 - Divide the catchment into 16 underbasins
 - Calibration
 - Period from 2002 to 2005
- Long term:
 - Atmosphere :
 - horizontal transport
 - Scale :
 - extension to Marne river, and finally to Seine river system

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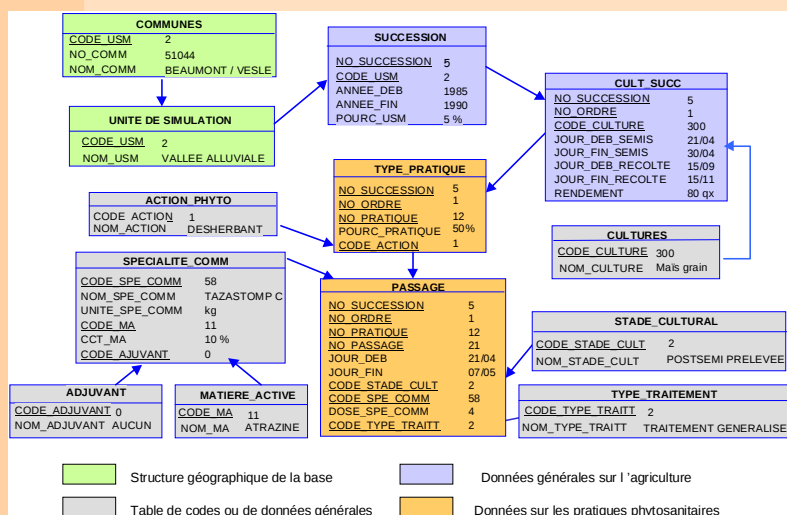
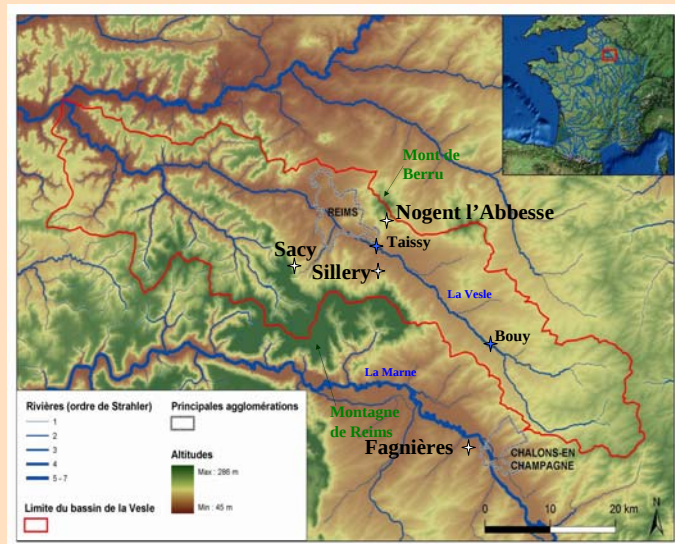
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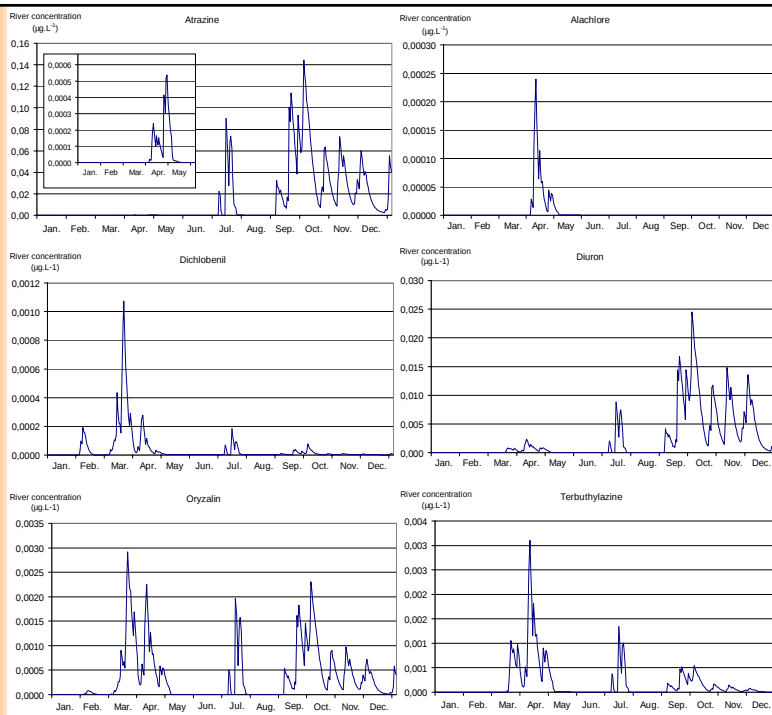
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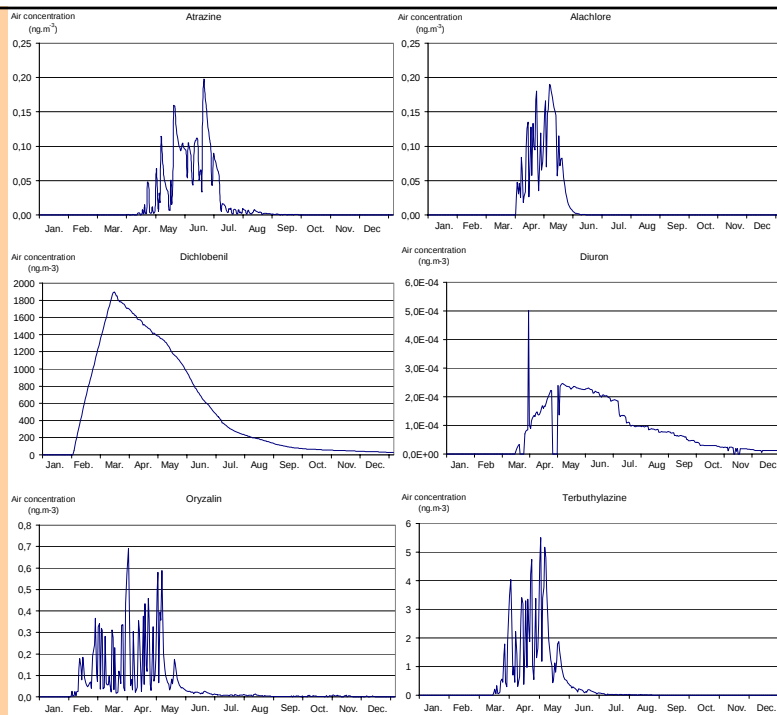




For 2001, river
concentration



For 2001, air
concentration



For 2001,
rainfall
concentration

