

# NITROGEN LOADS MODELLING UNDER THE INFLUENCE OF LAND USE ON A CATCHMENT SCALE



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## Introduction

Most of the water quality models need land use data to run.

Land use maps resulting from remote-sensed image interpretation are often subject to **positional** or **categorical uncertainties** (Eckhardt and al, 2003). These uncertainties can have important consequences on the model results.

First we analyse the sensitivity of the POL model results to land use data, on the example of the Pallas river (France). Then we study the effect of categorical uncertainties, as evaluated by the confusion matrix (Crosetto and al, 2000), on the POL model results.

## Application context

### The POL model

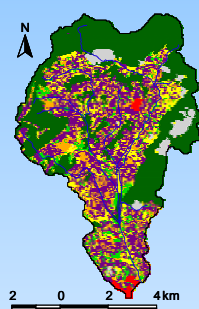
is a semi-distributed model developed to reproduce the nitrogen loads produced at the outlet of a catchment during a flood event (Payraudeau, 2002). Land use data are input in the POL model to characterize the *initial nitrogen storage* in the catchment.

### The land use data

are issued from the results of a 1996 SPOT image classification on the Pallas catchment (52 sq. km), that is the *reference land use map*. The associated **confusion matrix** is obtained from a comparison of a set of interpreted land use data with observed field data (Sagot, 1999).

### The model sensitivity analysis

is made on two variables: **nitrogen load** and **event duration**. The calibration of POL model on three flood events observed in the Pallas catchment with the *reference land use map* gives the **reference values** of these two variables.



### Land use map

- Natural area
- Urban area
- Mining
- Vineyard (15 sq. km)
- Orchard (3 sq. km)
- Cereal (2 sq. km)
- Market gardening (7 sq. km)

### Confusion matrix

Class Name	R.S. Interpreted land use data			
	Cereal	Market gardening	Vineyard	Orchard
Cereal	62%	2%	12%	12%
Market gardening	4%	66%	20%	7%
Vineyard	22%	32%	68%	17%
Orchard	12%	0%	0%	64%

Data source: Agence Méditerranéenne de l'Environnement, 1999

	nitrogen load (kg)	event duration (hours)	
event 1	19 oct. 1994	8146	95
event 2	13 mar. 1996	3372	92
event 3	22 apr. 1996	28	13

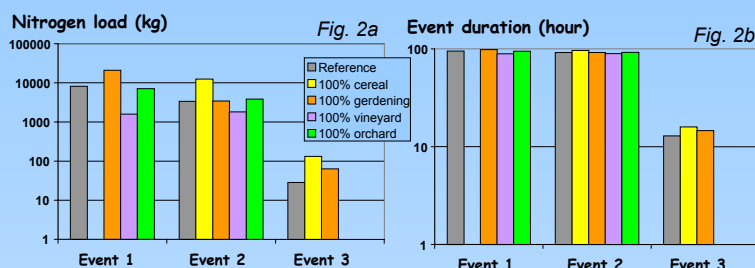
## Analysis and discussion

### First step: Pol model sensitivity to extreme land use change.

#### Assumption

→ Homogeneous land use.

- for **nitrogen load**, the sensitivity is significant, related to the event date, i.e. function of the agricultural practices (Fig. 2a). For example, for the event3 (in April), there is no fertilisation on vineyard and orchard, so the model shows null nitrogen loads for these land uses
- for **event duration**, the sensitivity is lower (Fig. 2b).



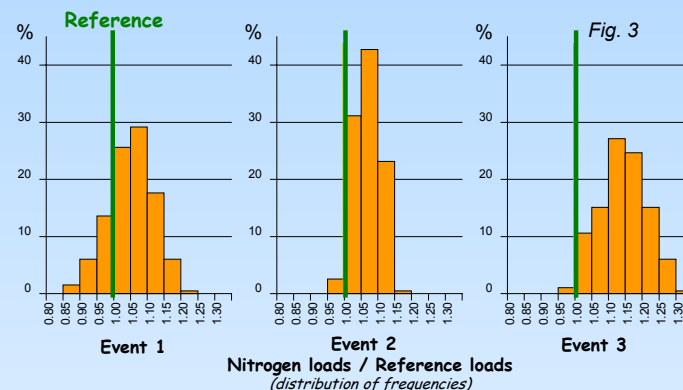
### Second step: Pol model sensitivity to land use categorical uncertainties.

#### Assumptions

→ The confusion matrix is used to quantify **categorical uncertainties**, assuming that they are identical in the whole catchment area.

→ Monte Carlo method is used to generate 200 land use maps, assuming that the confusion matrix is perfectly known.

- for **nitrogen load**, land use uncertainties are propagated by the model, but the sensitivity in the results is less significant than observed in the first step: 88% to 133% of the *reference loads*.
- the distribution of frequencies is related to the event. For example, for the event2 (in March), fertilisation is applied on all crops and the distribution is the narrowest.



## Conclusions

The POL model results are directly related to the initial *nitrogen storage*, that is to say to **land use data** and **agricultural practices**.

**Categorical uncertainties** in land use classification have significant effects on the POL model results.

The effect of **positional uncertainties** is not easy to evaluate in a semi distributed model as POL model.

## References

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