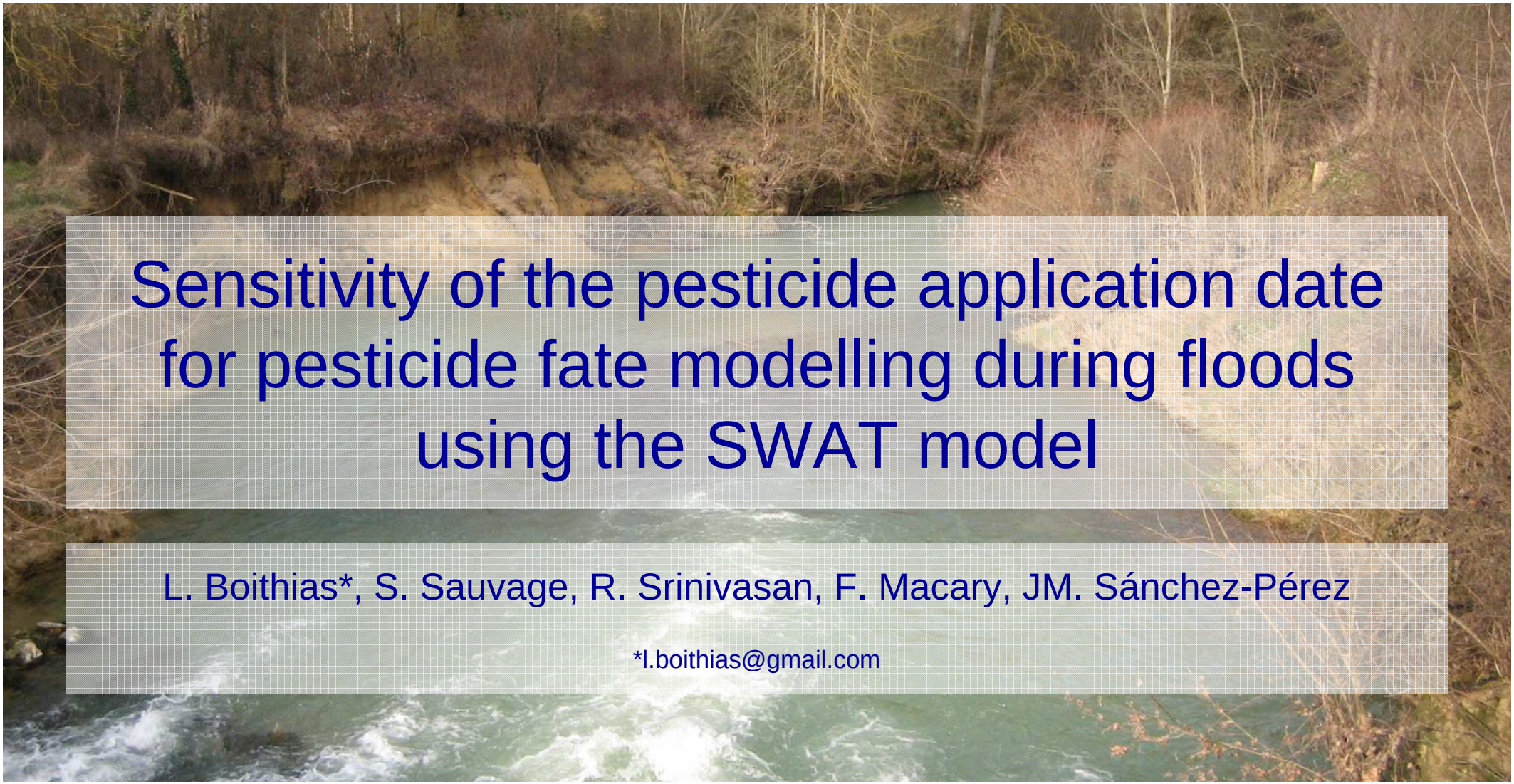


Sensitivity of the pesticide application date for pesticide fate modelling during floods using the SWAT model

L. Boithias*, S. Sauvage, R. Srinivasan, F. Macary, JM. Sánchez-Pérez

*l.boithias@gmail.com

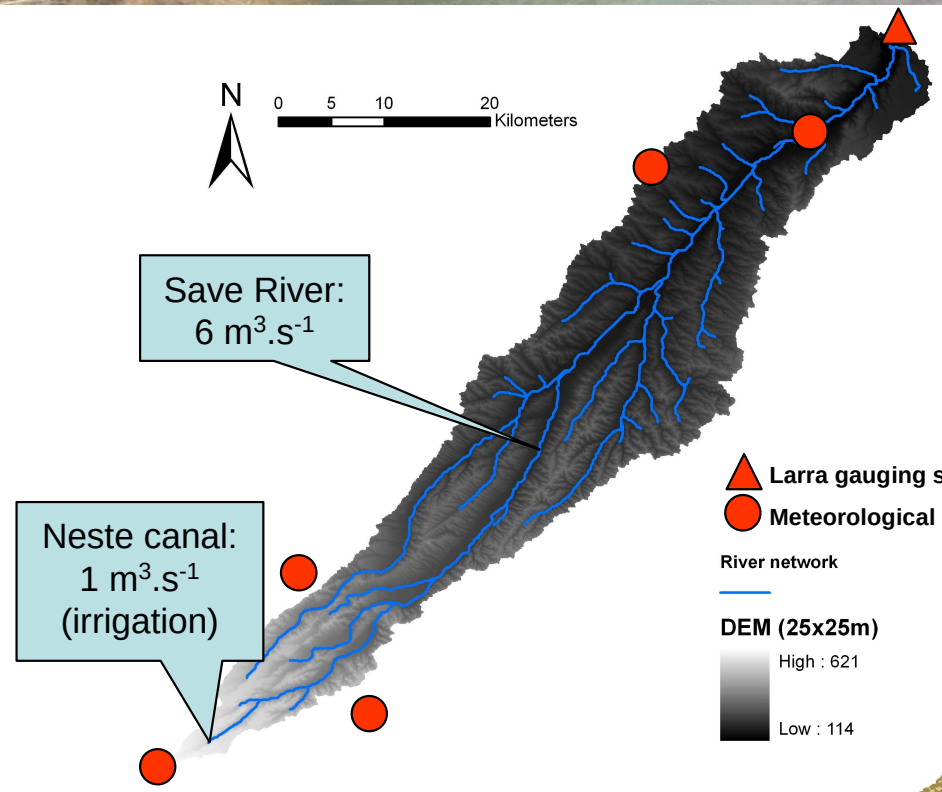
2012 Int. SWAT Conference, Delhi, India

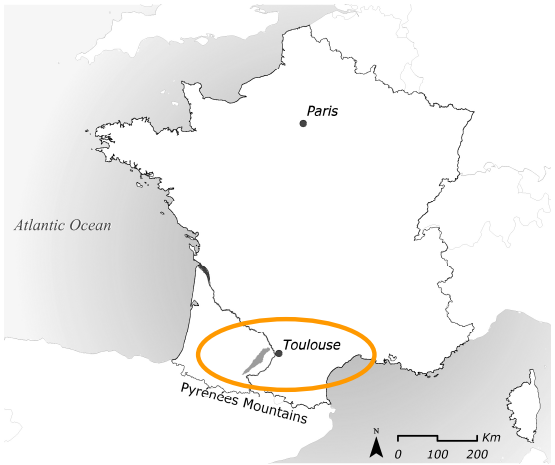
Introduction

- Surface water pesticide contamination is an issue for ecosystems and human consumption
  - EU 1998: 0.1 – 0.5 µg.L-1 for drinking water
- Floods play a major role in pesticides transfers (e.g. Lewan et al., 2009; Taghavi et al., 2011; Boithias et al., 2011)
- Pesticide application : modelling uncertainty issue (e.g. Dubus et al., 2003)
- Holvoet et al. (2005) showed that application date had more impact than application rate for atrazine

→ Which are the factors controlling the transfer of pesticides ?
→ How, and to which extent, can we improve the modelling of pesticide fate?
→ How can we help managers to take decisions regarding pesticide application ?

The Save catchment





Larra gauging station

Meteorological stations

River network

DEM (25x25m)

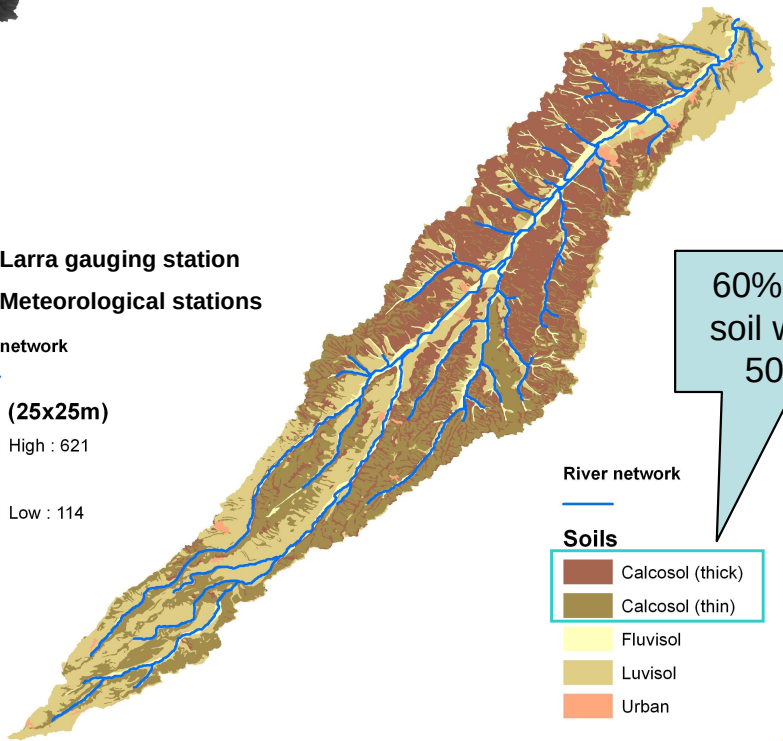
High : 621

Low : 114

Catchment area : 1117km²

Rainfall : 600-800mm

ET : 500-600mm



60% of calcic soil with up to 50% clay

River network

Soils

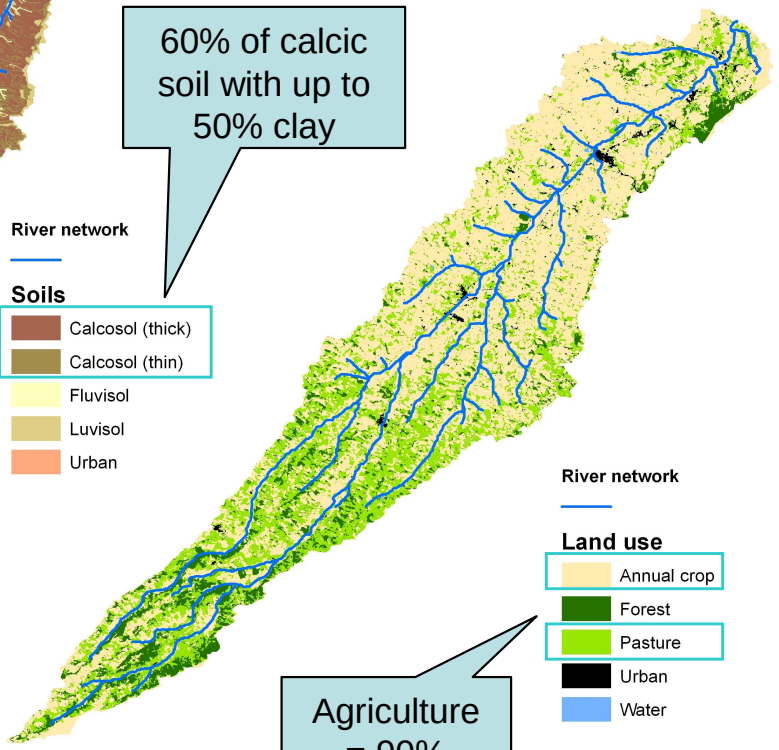
Calcosol (thick)

Calcosol (thin)

Fluvisol

Luvisol

Urban



River network

Land use

Annual crop

Forest

Pasture

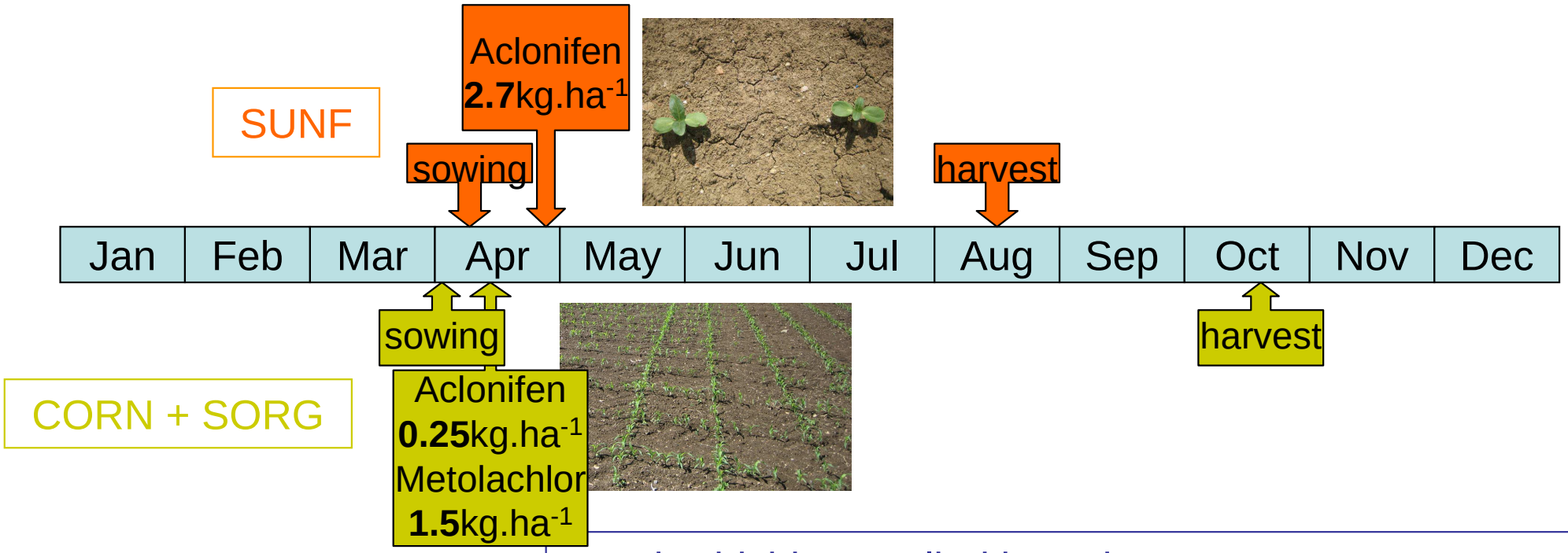
Urban

Water

Agriculture = 90%

Mostly applied pesticides

- 3-year survey : Corn + Sorghum + Sunflower = 23% of catchment area



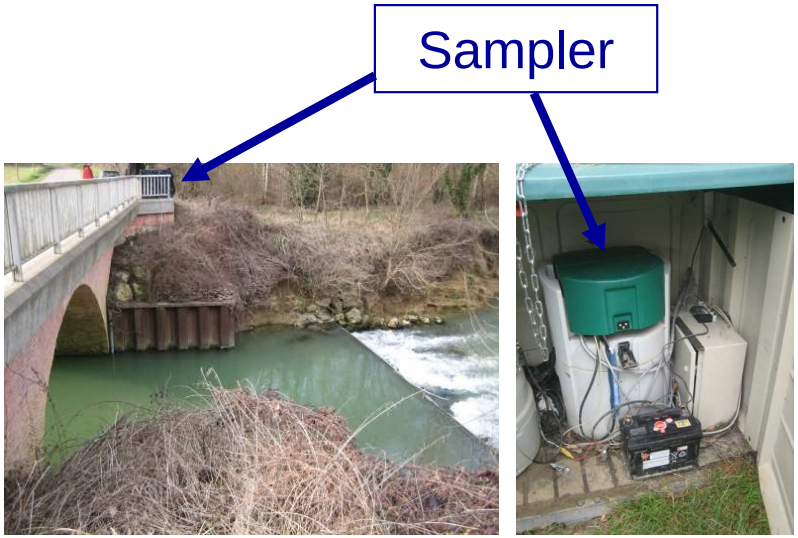
Two herbicides applied in spring :

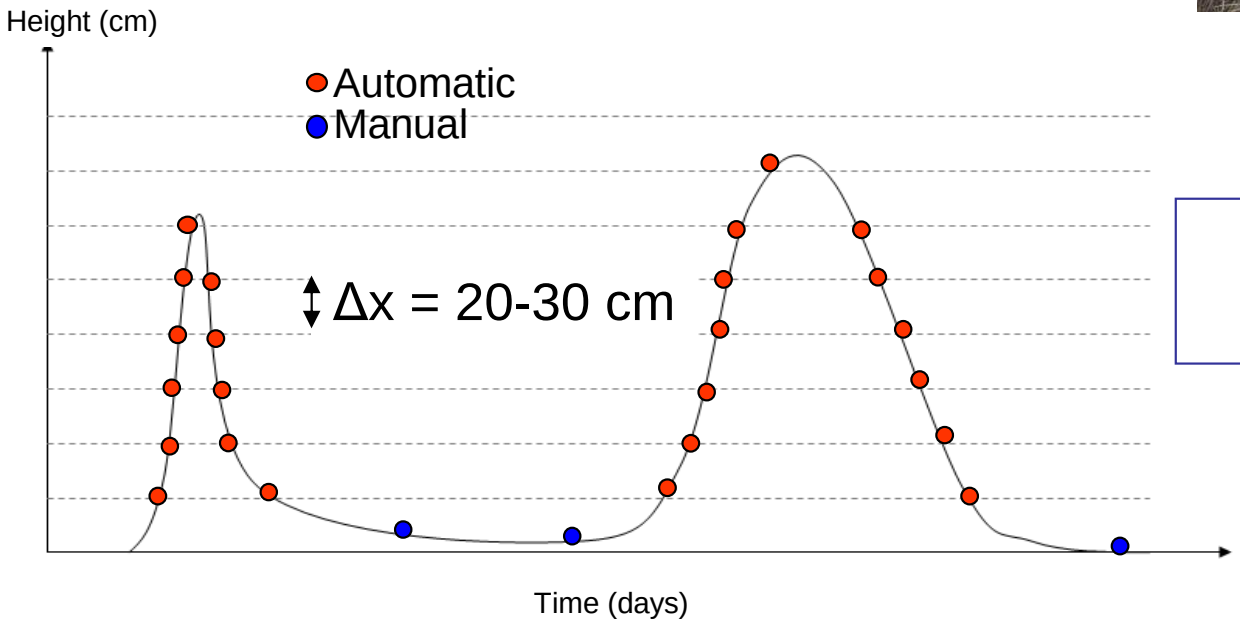
Aclonifen = 56 Tons (S = 1.4 $mg.L^{-1}$, log(kow)=4.37)

Metolachlor = 28 Tons (S = 480 $mg.L^{-1}$, log(kow)=2.9)

Water quality monitoring

- Hourly discharge
- Total suspended matter (TSM)
- Pesticides (diss. and part.)





Sampling period = f(water height)

Aguaflash : 242 samples

Modelling approach

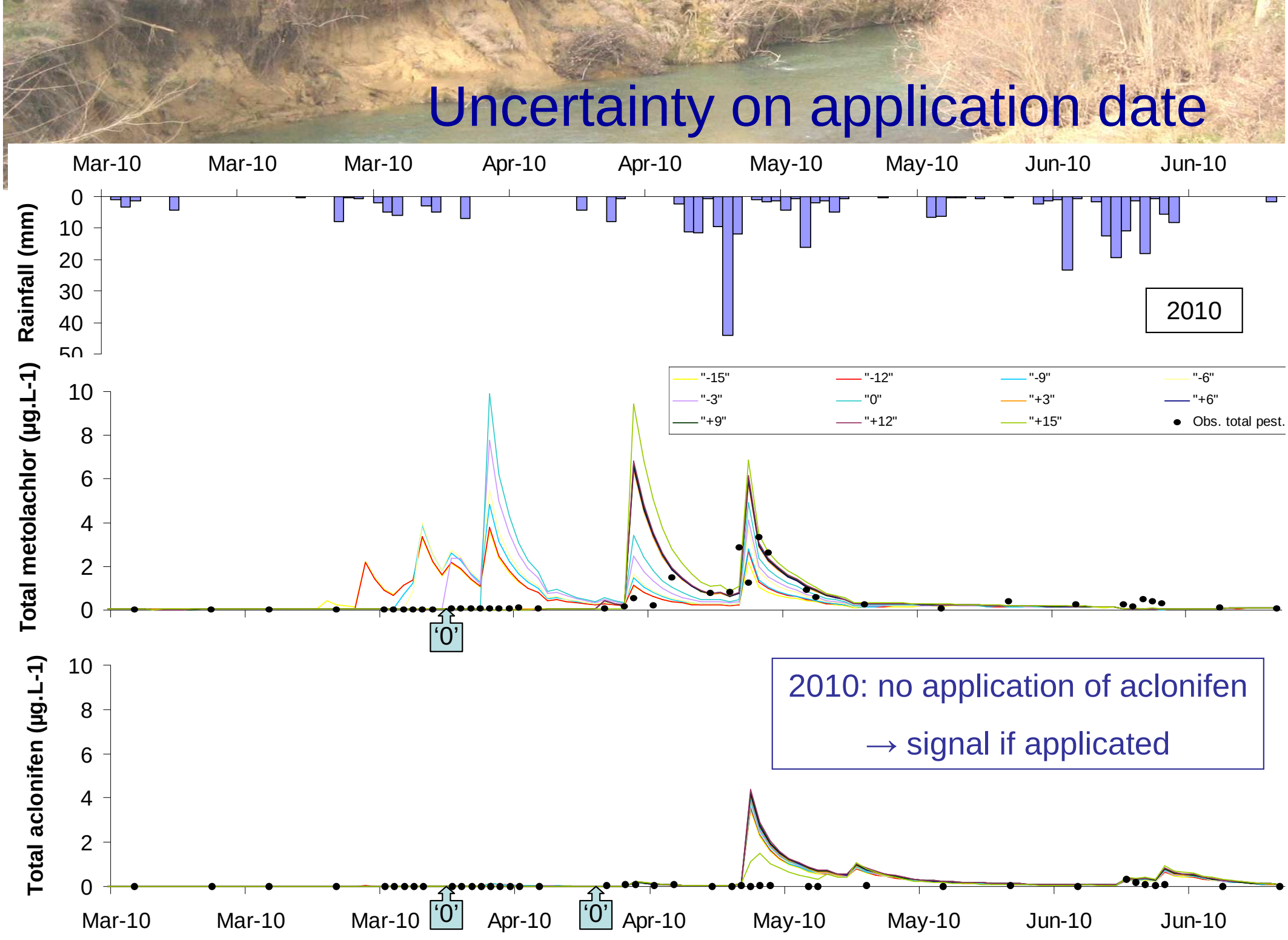
- The SWAT model was calibrated for discharge, nitrate and suspended sediment before calibrating pesticides
- Pesticide parameterisation :

Parameter	Name in SWAT		file	Metolachlor	Aclonifen
SK_{oc}	K_{oc}	$mg.kg^{-1}/mg.L^{-1}$	pest.dat	200	8203
CK_{oc}	CHPST_KOC	$m^3.g^{-1}$	.swq	$2.5x10^{-4}$	$7.2x10^{-3}$
Soil half life	HLIFE_S	days	pest.dat	90	90
Degradation	CHPST/SEDPST_REA	$days^{-1}$	.swq	0.025	0.025

- 10 scenarios of pesticides application date were performed ±15 days
- R^2 and PBIAS were calculated for total pesticide concentrations
- Sensitivity analysis performed on pesticide load at outlet :

$$S_i = \frac{\partial P}{\partial I} \cdot \frac{I}{P(I)}$$

Uncertainty on application date



Improvement of simulation quality

	Metolachlor		Aclonifen	
	R^2	PBIAS (%)	R^2	PBIAS (%)
"-15"	0.01	-91	0.01	-788
"-12"	0.00	-100	0.01	-810
"-9"	0.00	-120	0.01	-831
"-6"	0.00	-137	0.01	-851
"-3"	0.00	-142	0.01	-867
"0"	0.01	-150	0.01	-885
"+3"	0.22	-57	0.01	-893
"+6"	0.22	-60	0.01	-916
"+9"	0.22	-64	0.01	-940
"+12"	0.22	-67	0.01	-978
"+15"	0.19	-104	0.09	-535

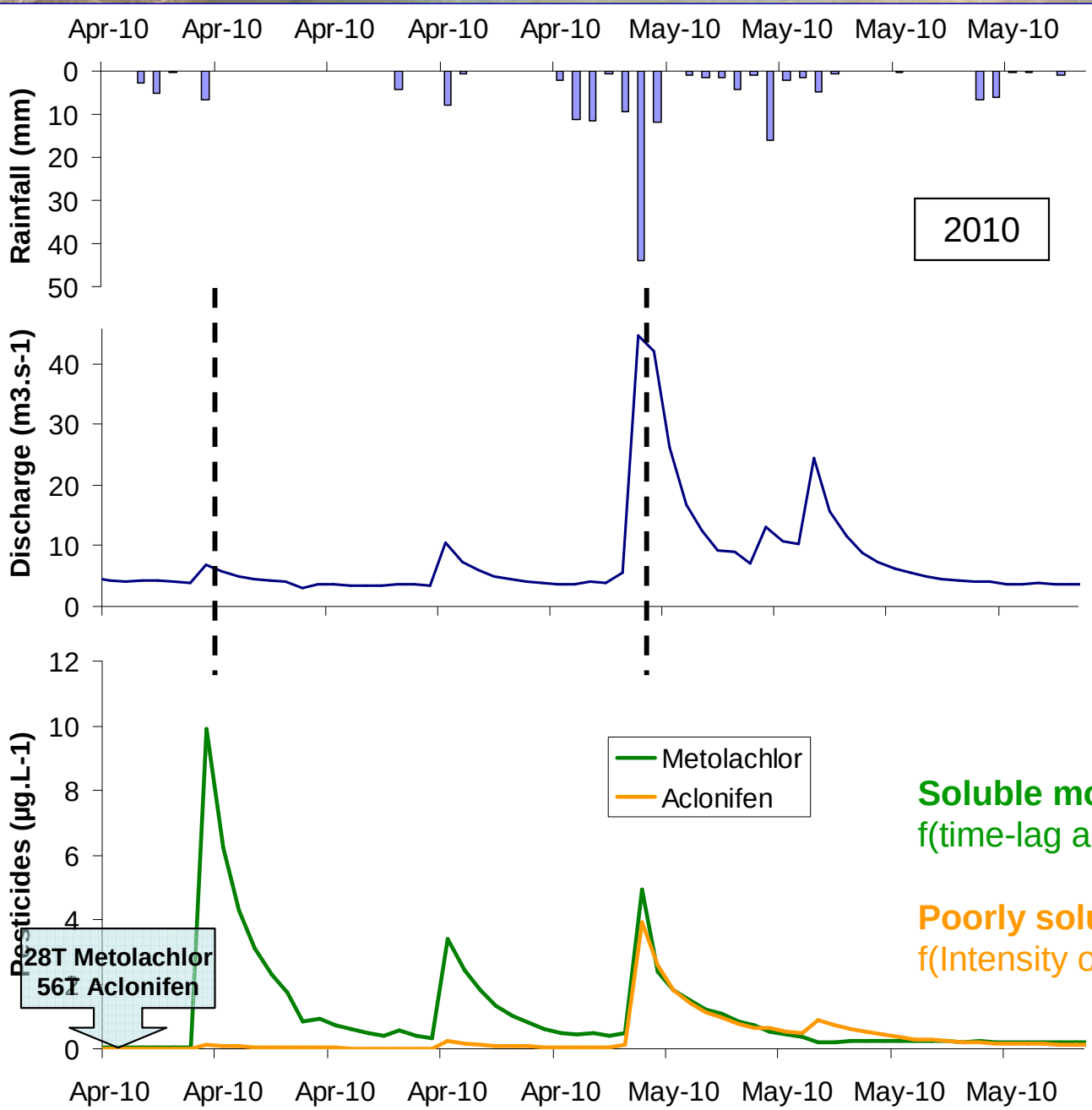
Sensitivity analysis

- Sensitivity analysis depends on the time period considered:

S_i	metolachlor	aclonifen
2008-2010	0.05	-0.76
2010 spring flood period	-0.20	0.06

→ Calibration : keep in mind the simulation period

Application and physico-chemical properties



Controlling factor : application date is of special importance for molecules of low Kow and low S

Soluble molecule
f(time-lag application / precipitations)

Poorly soluble molecule
f(Intensity of precipitation and time-lag)

Conclusions

- Impact of application date for dissolved molecules modelling corroborate previous studies
- Uncertainty from surveys in large catchments: application date model response should be a part of the pesticide calibration process (simulation period, simulated molecule)
- Future work: building input signal based on outlet pesticide concentration signal
- Water quality policies : based on weather forecast, improve management practices to avoid EU Directive limits exceedance

Thanks for your attention !

For further questions :

l.boithias@gmail.com

http://www.aguaflash-sudoe.eu/

Agua flash

INTERREG SUDOE