Pesticide distribution in atmospheric fallout: Comparison on regional and national scale studies

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Introduction

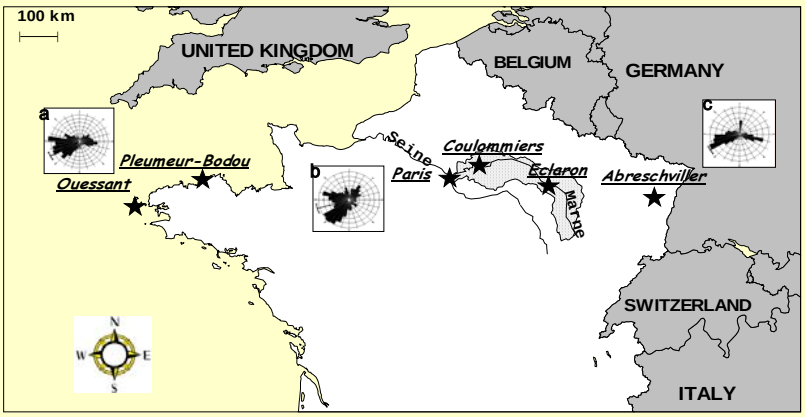
- Atmospheric contamination measured worldwide
- Volatilization processes described by some studies
- Scattering and transport processes in atmosphere not well known

- What are the pesticide origins (local, regional or national) ?
- How to integrate pesticide fallout as catchment inputs ?

Objectives

- To determine the progression of pesticide contamination in the atmosphere
- To extrapolate the fallout at the basin scale
- To define the main characteristics which explain this contamination
- To integrate pesticide fallout into a model at the basin scale

National scale study



Study sites

Remote Sites

- Ouessant : reference site,
- Paris : urban site,
- Abreschviller : Vosges forest.

agricultural Sites

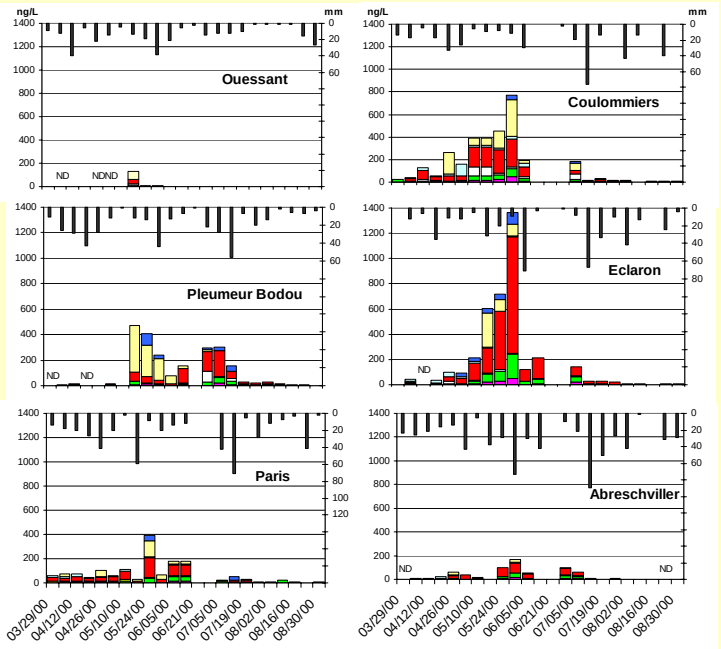
- Pleumeur Bodou : low agriculture,
- Coulommiers : moderate,
- Eclaron : intensive agriculture.

Pesticide analysis

Rainfall contamination :
- total (wet and dry),
- Maximal application period (March to August 2000)
- weekly integrated samples.

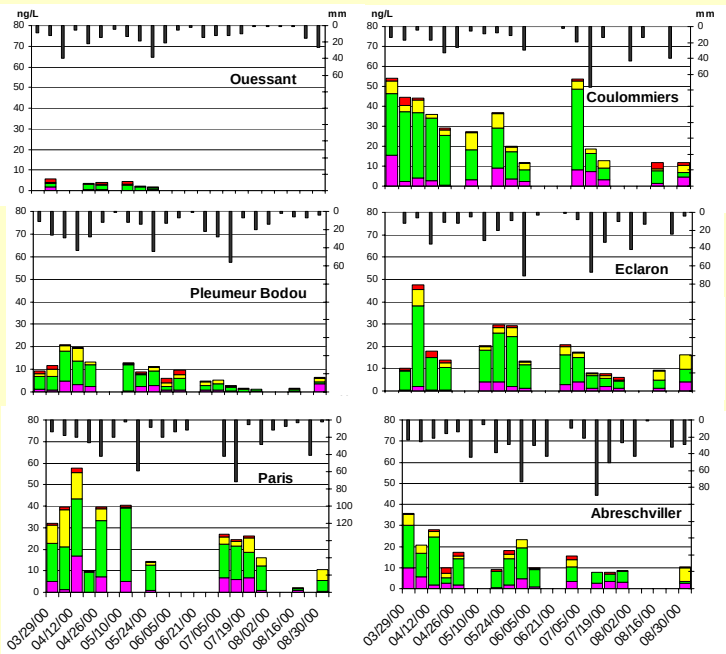
Pesticides:
- Triazines : atrazine, simazine, terbuthylazine, amétryne, prométryne, terbutryne, cyanazine, DEA et DIA.
- Chloroacétanilides : alachlore, métolachlore.
- Organochlorinated pesticides : DDT, pp'DDE, HCB, lindane.

Rainfall contamination : used pesticides



Métolachlor
Alachlor
Terbuthylazine
Atrazine
Simazine
DEA
DIA

Rainfall contamination : banned pesticides



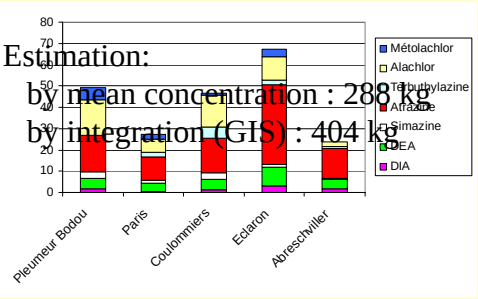
pp'DDE
HCB
gHCH
aHCH

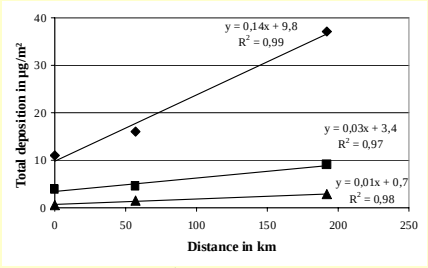
Fallout for the study period

Pesticides in µg/m²	Pleumeur Bodou	Paris	Coulommiers	Eclaron	Abreschviller
Atrazine	16,9	11	16	37,1	14,1
DEA	4,8	3,9	4,5	9	4,4
DIA	1,6	0,6	1,5	2,9	1,6
simazine	3,4	1,2	3,3	1,5	0,4
Terbuthylazine	0,2	2.1	5,3	2,2	1.0
Alachlor	16,5	6.3	15,1	11,2	2,3
Metolachlor	5,8	2,3	0,9	3,3	ND
rainfall in mm	408	474	385	421	668
Total pesticides in µg/m²	49.2	27.6	46.6	67.2	23.8

Load estimation in the Marne basin

Estimation:
by mean concentration : 288 kg
by integration (GIS) : 404 kg





Load of atrazine (◆), DEA (■) and DIA (▲) at Paris (0 km), Coulommiers (57 km) and Eclaron (192 km) and respective regression lines

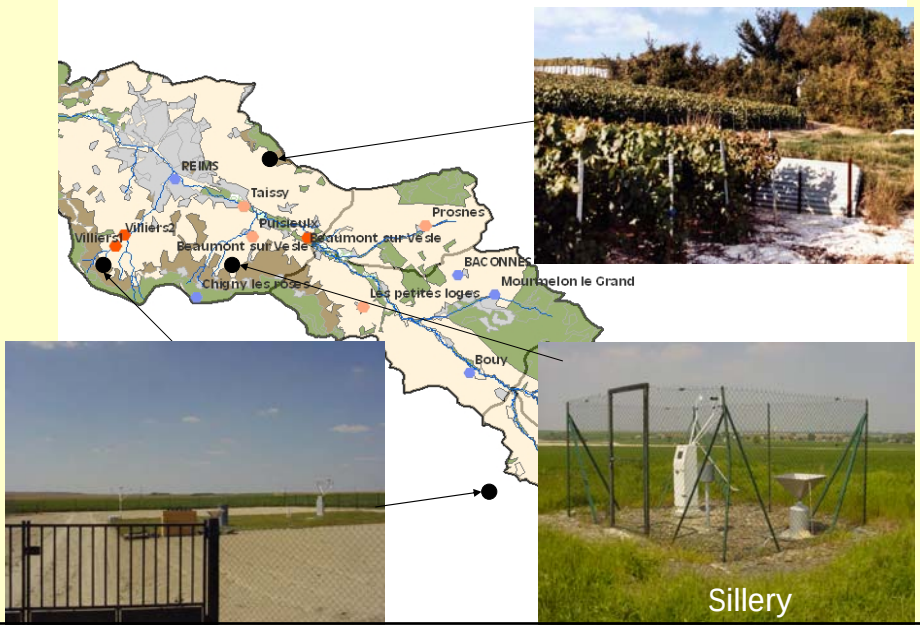
Pesticide properties

	Vapour pressure (mPa)	solubility (mg/l)
simazine	$2.94\ 10^{-3}$	6.2
atrazine	$3.85\ 10^{-2}$	32
DDT	2.10^{-2}	< 1
Terbuthylazine	0.15	8.5
alachlore	2.1	148
Métolachlor	4.2	530
lindan	5.6	7.3

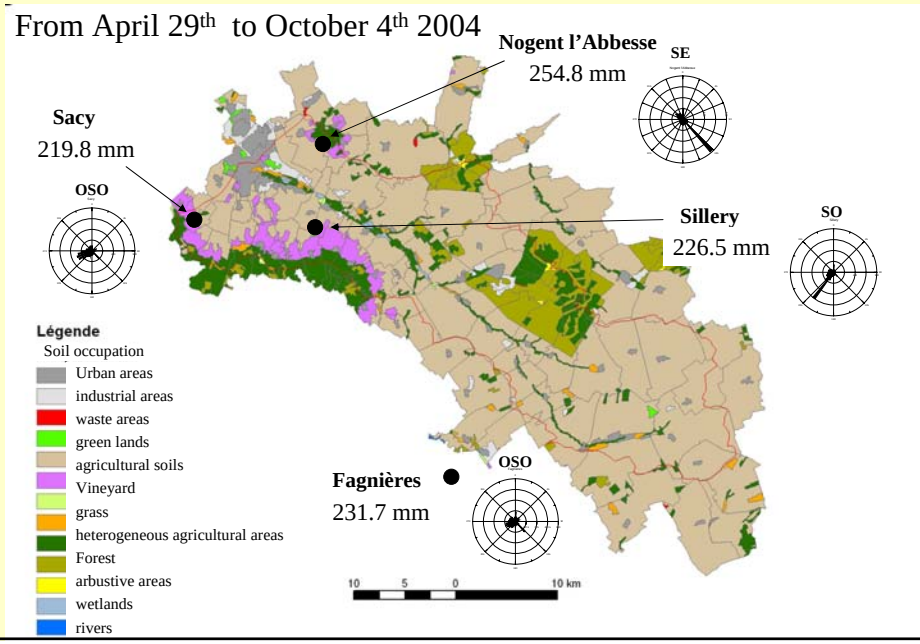
Occurrence of pesticides in atmosphere not only explained by Vp/S
- uses : atrazine
- persistence in soils : lindan

Concentrations in rain observed for pesticides according to vapour pressure (volatilisation) and to solubility (washout)

Regional scale study : the Vesle's basin

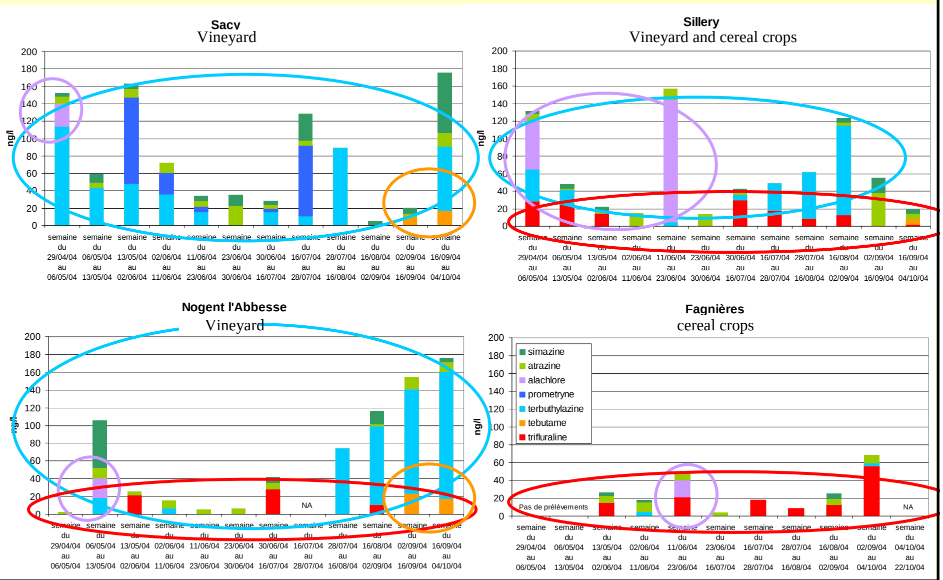


Rainfall measurement



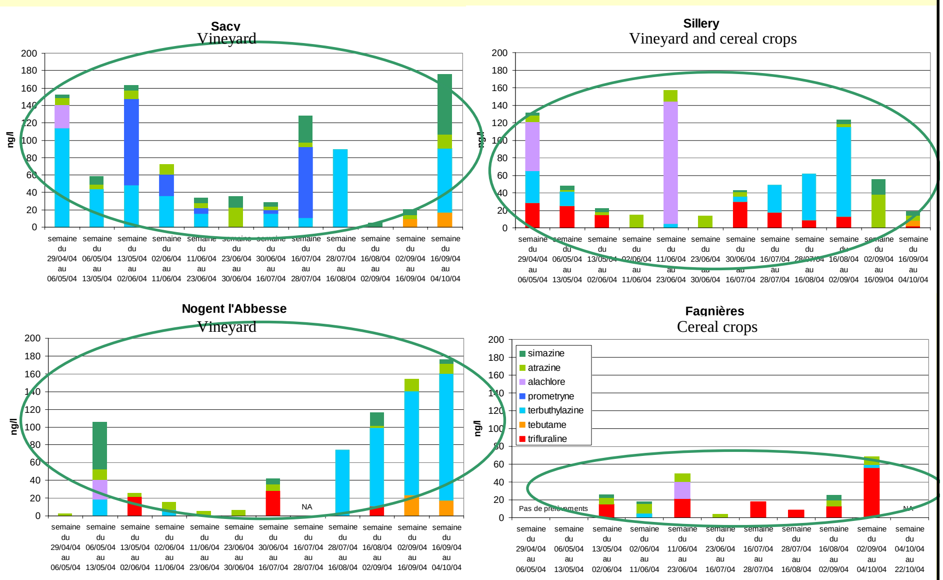
Rainfall contamination from April to October 2004

Tébutam : on rape in September



Rainfall contamination from April to October 2004

Simazine and Atrazine : background noise



Conclusion

- Highest contamination occurred in agriculture areas,
- Contamination has a local impact
- Concentrations occurred for pesticides with high vapour pressure and high solubility,
- Occurrence in rainfall at a national scale only for the most persistant (in soil and in air) and worldwild used pesticides
- This mainly due to post volatilisation rather than long range transport (background noise)

To include pesticide fallout into a model at a basin scale (*Phytodel*):

- Pesticide volatilisation based on Henry ’s law
- pesticide fallout only on treated soils
- Horizontal transport of more persistant pesticides by the way of a second atmospheric layer