



# Interpretation of pesticide contamination monitoring data in surface water in France

C. Gauroy

## ► To cite this version:

C. Gauroy. Interpretation of pesticide contamination monitoring data in surface water in France. International Conference on Priority Pollutants in River Basins, May 2011, Karlsruhe, Germany. 9 p. hal-00613590

**HAL Id: hal-00613590**

**<https://hal.science/hal-00613590>**

Submitted on 5 Aug 2011

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

## **Interpretation of pesticide contamination monitoring data in surface water in France**

Christine Gauroy  
Cemagref  
Science, water & land management  
Aquatic environments, ecology and pollution Research unit

3 bis quai Chauveau,  
69336 Lyon Cedex, France  
E-Mail: [christine.gauroy@cemagref.fr](mailto:christine.gauroy@cemagref.fr)



## **1 INTRODUCTION**

The European Water Framework Directive requires a monitoring of pesticide contamination in surface water. In France, 15 million analyses have been collected since 1997. These data are hard to interpret, partly because the surveillance is carried out under multiple monitoring networks. Each network has its own purpose (general knowledge of water quality, control of drinking water standards, or specific knowledge of pesticide contamination) and area of concern, leading to different monitoring strategies in terms of sampling date, location and rate.

A study has been carried out to find suitable methods to assess the current situation and trends of the contamination and to highlight the link between pesticide pressure and water contamination.

## **2 METHODS OF ASSESSING CONTAMINATION**

### **2.1 Geographic grouping**

Analyses from a single sampling site are not often sufficient to assess a trend in contamination. Moreover, samplings date and analyzed pesticides vary from a site to another. To get round these difficulties, we tested a method of interpretation by gathering data on a geographic basis. We assumed that pesticide transfers, and as a consequence temporal patterns of concentration in water courses, are similar within regions that have homogeneous topography, climate, soil type, bedrock and water flow.

We used the hydro-ecoregions (HER), that were defined to implement the European Water Framework Directive, which requires a typology of aquatic ecosystems based on geographical features in order to define reference conditions (Figure 1).

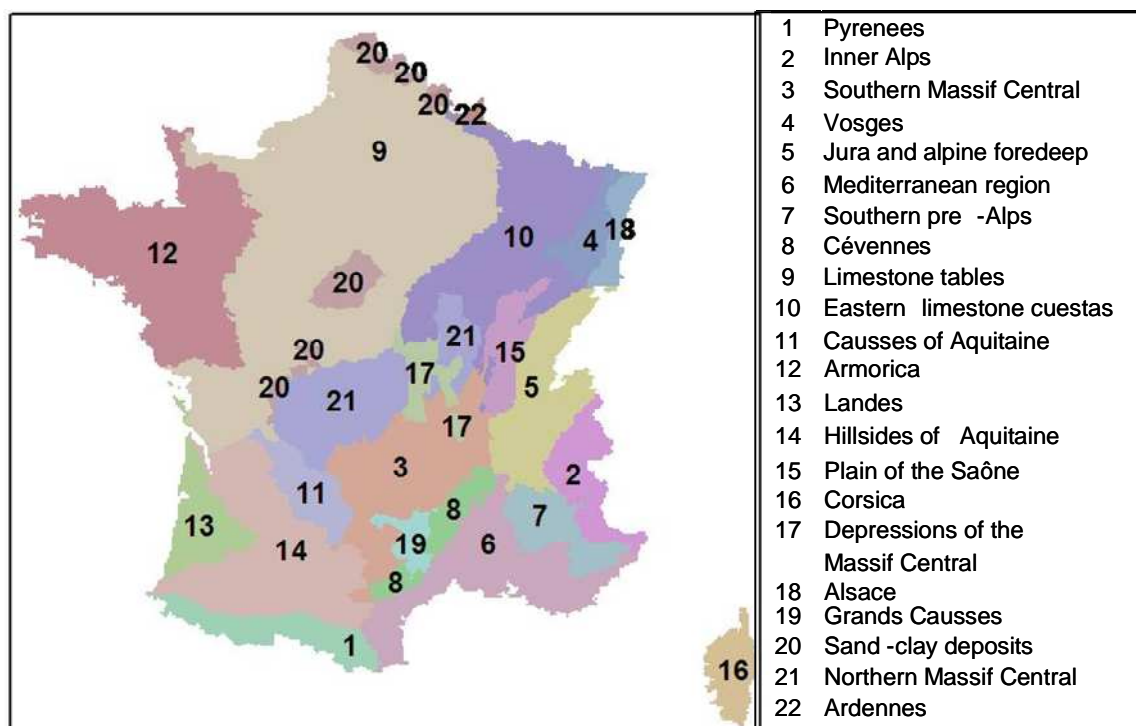


Figure 1: Map of French HER

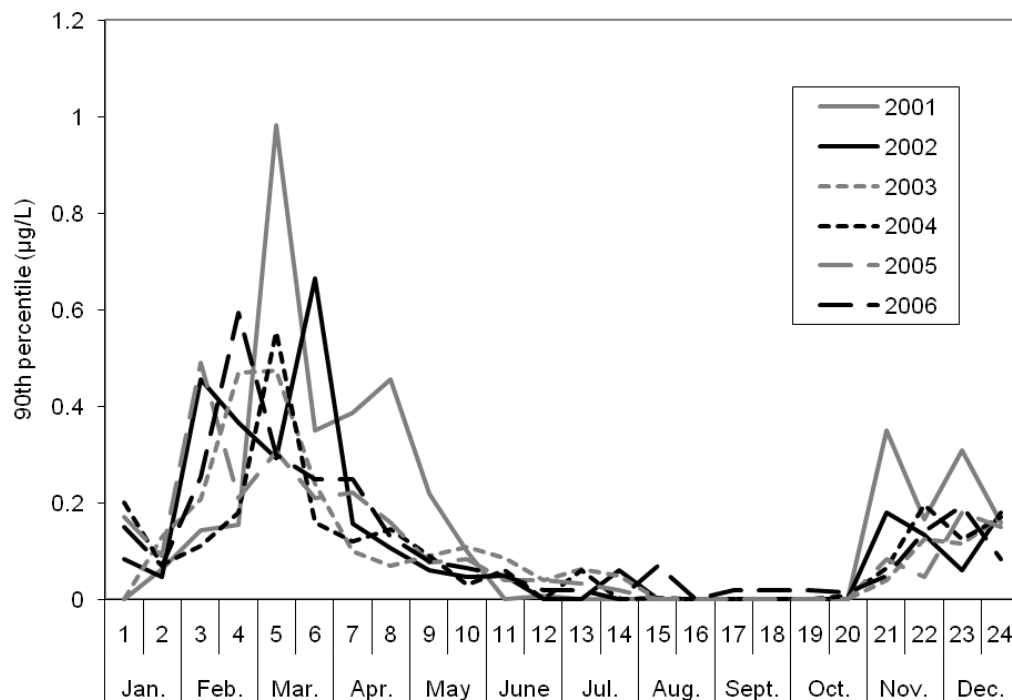
## 2.2 Descriptors

Each analysis is described by its sampling location, date and the substance analysed. The result is either the molecule concentration, the limit of detection (LOD) if the molecule was not detected, or the limit of quantification (LOQ) if traces of the molecule were detected but not quantified. A relevant descriptor is the 90<sup>th</sup> percentile of the results (LOD are replaced by 0 and LOQs by LOQ/2) twice per month (the first 15 days and the rest of the month, thus years can be compared with each other or accumulated) (see Figure 2).

We also used the percentage of concentrations above 0.1 µg/L against all the analyses. These two descriptors are statistically correlated.

## 2.3 Link with application periods, marketing authorisations and land use

Seasonal variations appear to be similar from one year to another. For example, isoproturon, a herbicide mostly used for cereals, shows two periods of contamination per year (Figure 2): the first one at the end of the winter and the second one in autumn. They fit with the application periods of this pesticide: at the vegetation regrowth and at the winter cereals' sowing.



**Figure 2: 90<sup>th</sup> percentile of analysis results per 15 days, for isoproturon, in the armorican HER (12)**

This method also highlights trends between years. For example, Atrazine was detected above all between May and September. Its contamination level decreased steadily until 2003, and sharply between 2003 and 2004. This may be due to the reduction in the applied amounts, as local ban on atrazine use have been implemented since 1997, complete ban on sale at the end of 2002 and complete ban on use at the end of 2003.

A Principal Component Analysis (PCA) was conducted on the percentages of the concentrations above 0.1 µg/L per substance and HER. It showed that substances applied mostly on vineyards, such as norflurazon, procymidone and dimethomorph, are mostly detected in HER 15 (Plain of the Saône), more specifically in the Beaujolais area. Similarly, substances used on beets (metamitron and chloridazon) or potatoes (prosulfocarb) are detected in the north: HER 20 (sand-clay deposits) and 9 (limestone tables). Substances used on corn and/or sunflower (acetochlor, dimethenamid, metolachlor and alachlor) are detected in HER 14 (Hillsides of Aquitaine). Contamination of water, as estimated with this method, is therefore consistent with land use, but there are regions particularly contaminated, as for example the plain of the Saône. Is it because larger amounts of products are applied there or because their environment is more vulnerable?

This way of describing contamination is interesting because it shows patterns which are not always visible at the scale of a stand alone sampling site, and which are consistent with application periods, marketing authorisations and land use. It also highlight regions with comparatively high contamination. We then used pesticide sold

quantities data to pursue the study of the link between pesticide pressure and water contamination.

### **3 LINK BETWEEN PESTICIDE PRESSURE AND WATER CONTAMINATION**

#### **3.1 Database of pesticide sales**

Since 2008, pesticide distributors have had to pay a tax on non-point pollution. Thus sellers must declare the sold quantities of each product for agricultural or non-agricultural uses. At request of the ministry in charge of the environment, Onema (the French national agency for water and aquatic environments) built a tool to access these data for each plant protection product or for each substance.

This leads to a valuable database to assess the quantities of each pesticide applied. However are uncertainties about where the products are used remain. Indeed, some companies have point of sales in much of France, or sell products on the Internet, but declare at their head office the overall quantity sold by the firm.

#### **3.2 Selling periods versus contamination periods**

In 2009, sales were declared from January to June and from July to December. This provides information about selling periods. Figure 3 shows a relation between the ratio of contamination from April to September on contamination from October to March and the ratio between quantities sold from January to June and quantities sold along the year. That is, the substances mostly sold during the first part of year are mostly detected in surface water in the middle of the year, and vice versa.

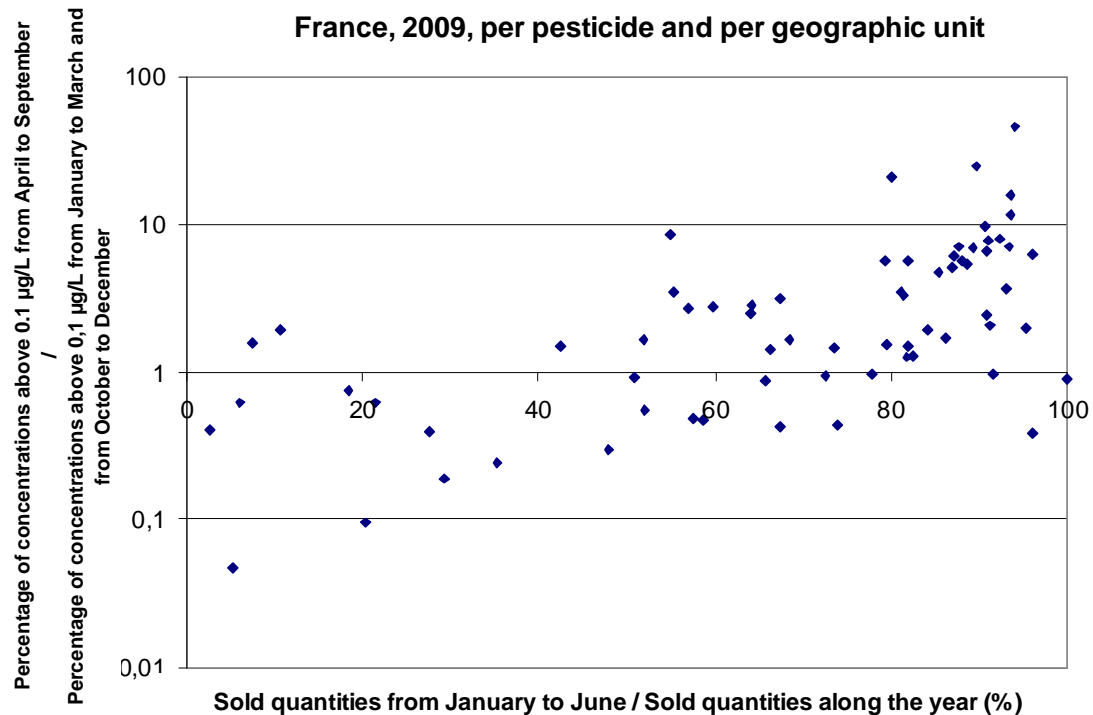


Figure 3: Period of contamination according to period of sales per pesticide and per unit in 2009

### 3.3 Sold quantities versus contamination levels

For this study, we did not group the data within HER but within units based both on HER and land use (31 units). We allocated the quantities sold by a firm to the unit where the city of the firm is located.

First, we studied the relation between sold quantities and contamination levels for some pesticides, for example glyphosate (cf Figure 4). Contamination in a geographic unit is related to the amount of glyphosate sold, but 2 regions have a comparatively high contamination: Paris area and Flanders. This may be due to a higher vulnerability of surface water in these regions (in particular, large surfaces are waterproof in Paris area) or to the uncertainties on the application locations.



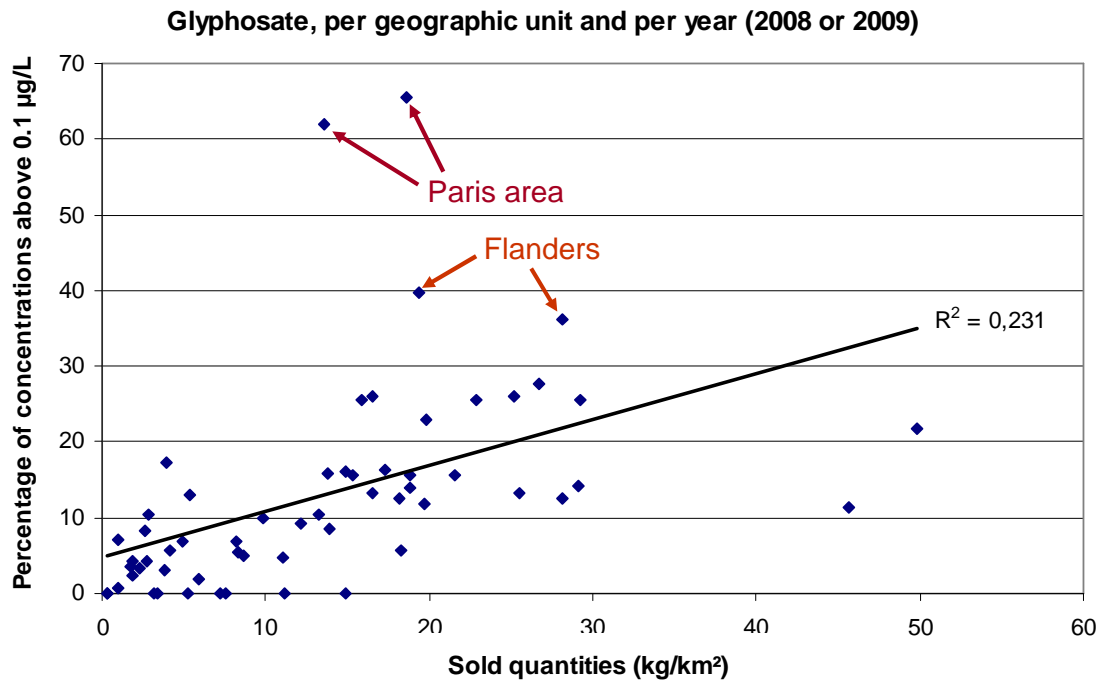


Figure 4: Percentage of concentrations of glyphosate above 0.1 µg/L according to sold quantities, per geographic unit and per year (2008 or 2009)

Then, we studied pesticide transfer for each geographic unit, for example the Cretaceous chalk of Paris Basin. We can see on Figure 5 that, similarly, there is a relation between sold quantities and contamination, but that some substances are comparatively more detected in surface water in this region: aminotriazole, diuron, nicosulfuron and metaldehyde. We can assumed that these substances have a higher transfer ability or are applied in conditions that favour transfers towards surface water.

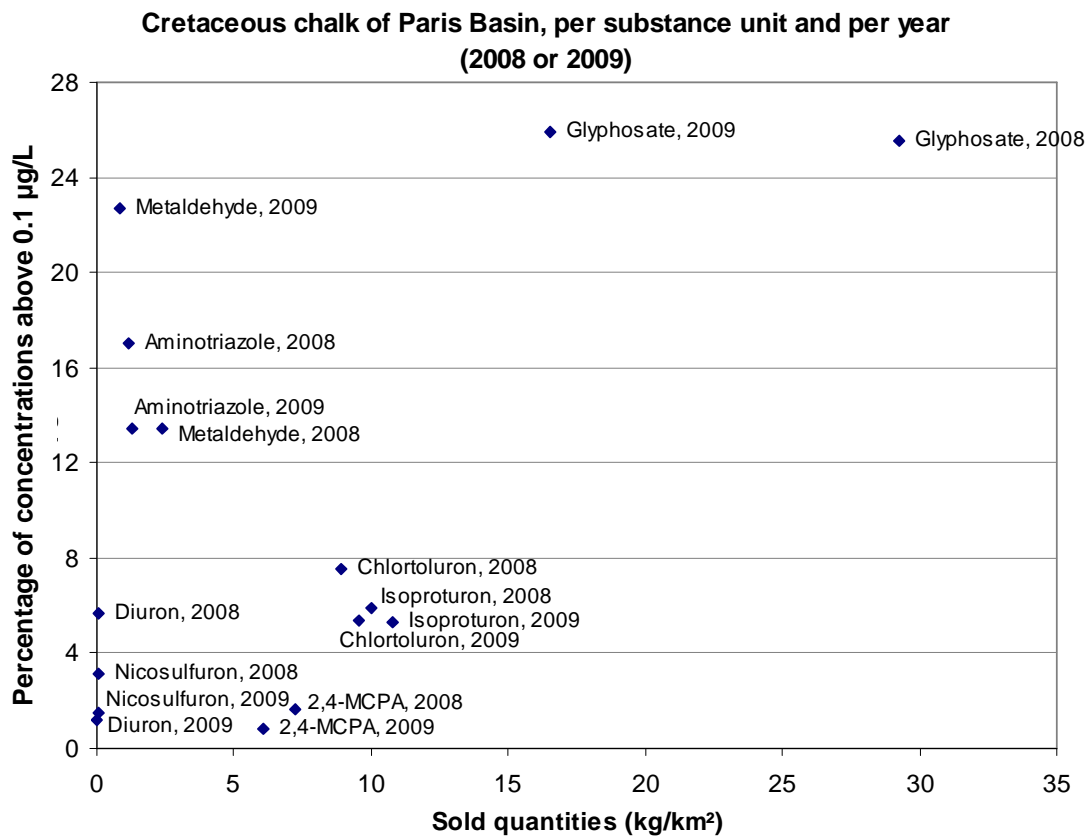


Figure 5

## 4 Conclusion

Methods of interpretation of pesticide contamination monitoring data by grouping data on a geographic basis are interesting to describe contamination and link it to pesticide applications (dates, regions and quantities). Comparison with quantities sold highlights substances and regions with comparatively high contamination, and further studies are necessary to interpret these results.