Comparison of a method of interpretation of pesticides public surface water monitoring data and a knowledge-based model of pesticides transfer at national scale

Irstea. Non point pollutions department

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AGENCE FRANÇAISE POUR LA BIODIVERSITÉ
Établissement public du ministère de l'Environnement

anses
alimentation, environnement, travail

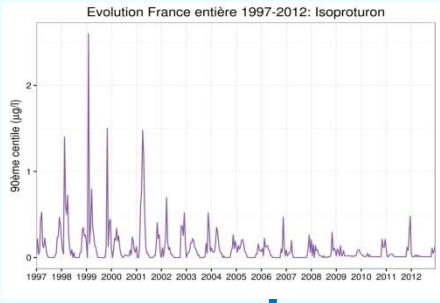
Context

- **WFD reporting:** assessment of the water quality and its evolution
- **Re-registration processes:** need of analysis methods as well
- Development of two methods by **Irstea** for **surface water bodies** monitoring data interpretation and contamination risk assessment

1 – Monitoring data interpretation

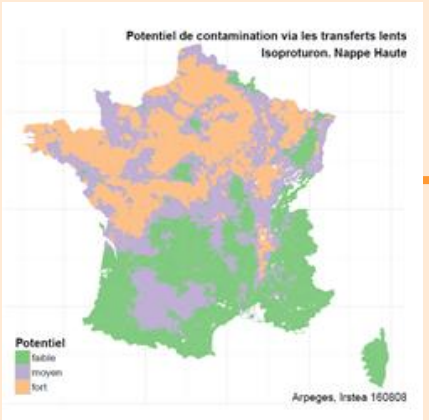
Method and first results presented at Piacenza Symposium in Pesticide Chemistry 2015 (C. Malavaud)

National temporal trends



2 – Surface water contamination risk assessment

Developped since 2012 for the 2013 WFD Directive reporting

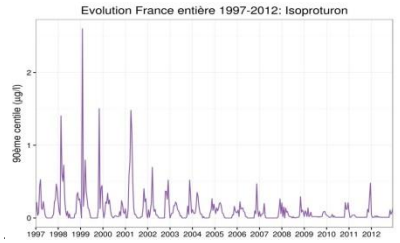


What are the benefits and limits of the two methods, and are they consistent ?

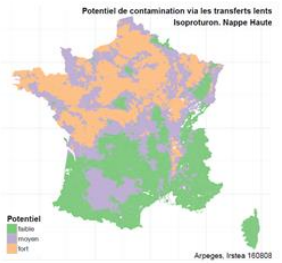
Outlines

Various studied pesticides (environmental behaviours and uses)

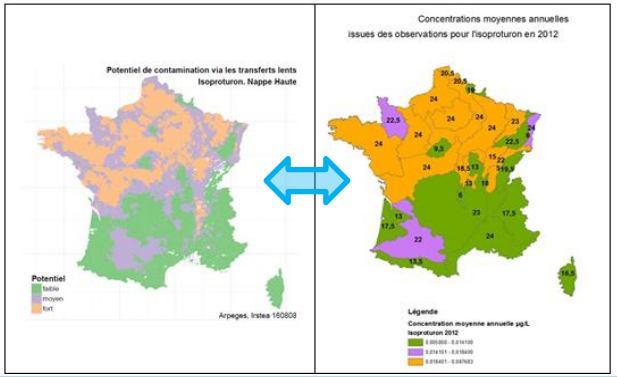
Monitoring data interpretation



Contamination risk assessment



Comparison of the two methods



On-going work and prospects

Eight studied herbicides under re-registration process

Glyphosate, AMPA, 2,4-D, chlorotoluron, S-metolachlore, diflufenican, metazachlore, isoproturon, propyzamide.

Studied periods :

- **1997-2012** for monitoring data interpretation,
- **2008-2012** for the contamination risk assessment.

Case study of **isoproturon** and **chlorotoluron** in the following slides :

Substance	K_{foc} (mL/g)	DT50 (days)	National sold quantities (t)	
			in 2008	in 2012
Isoproturon	122	11.9	1 475	950
Chlorotoluron	183	15	1 235	1 129

Surface water monitoring data interpretation

Monitoring data interpretation method

Hypothesis : temporal and spatial aggregation of monitoring data allows to by-pass their lack of representativeness at the station scale and to approach the contamination dynamics.

⇒ **Temporal aggregation:**

by 15 days

⇒ **Spatial aggregation:**

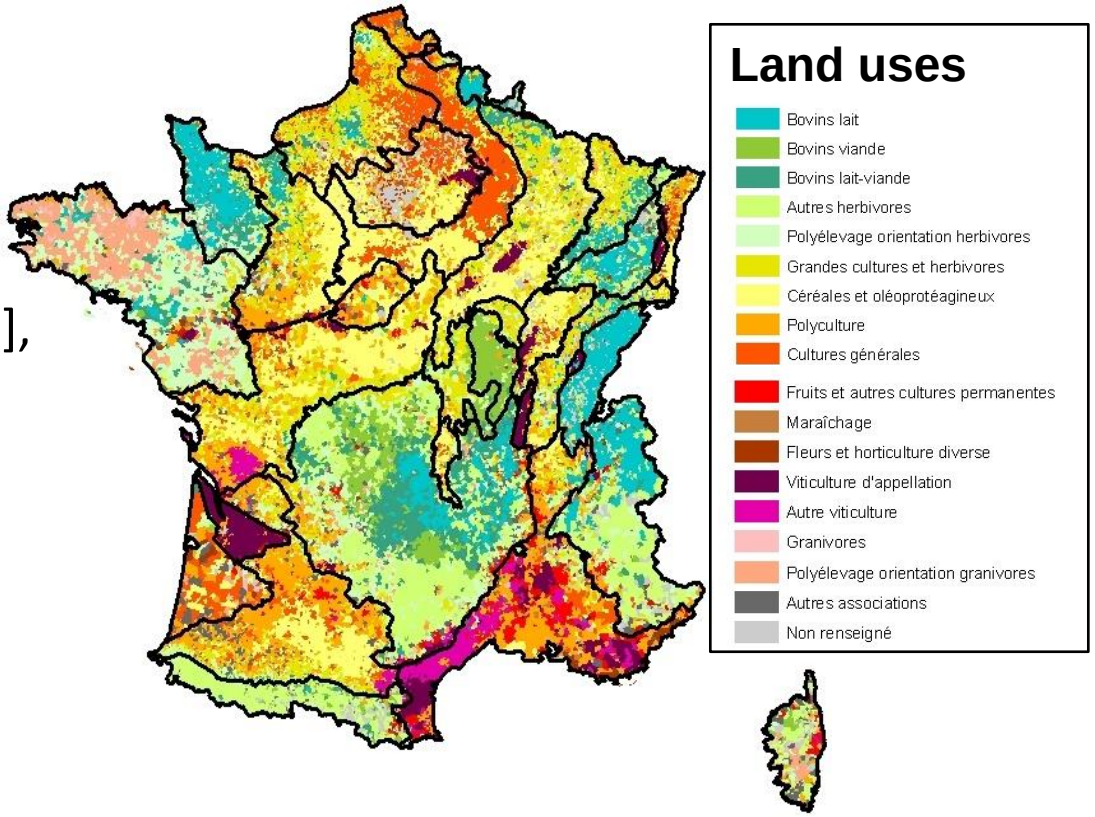
Hydro Eco Regions (HER) [1],

affined by land uses

⇒ **Descriptive value :**

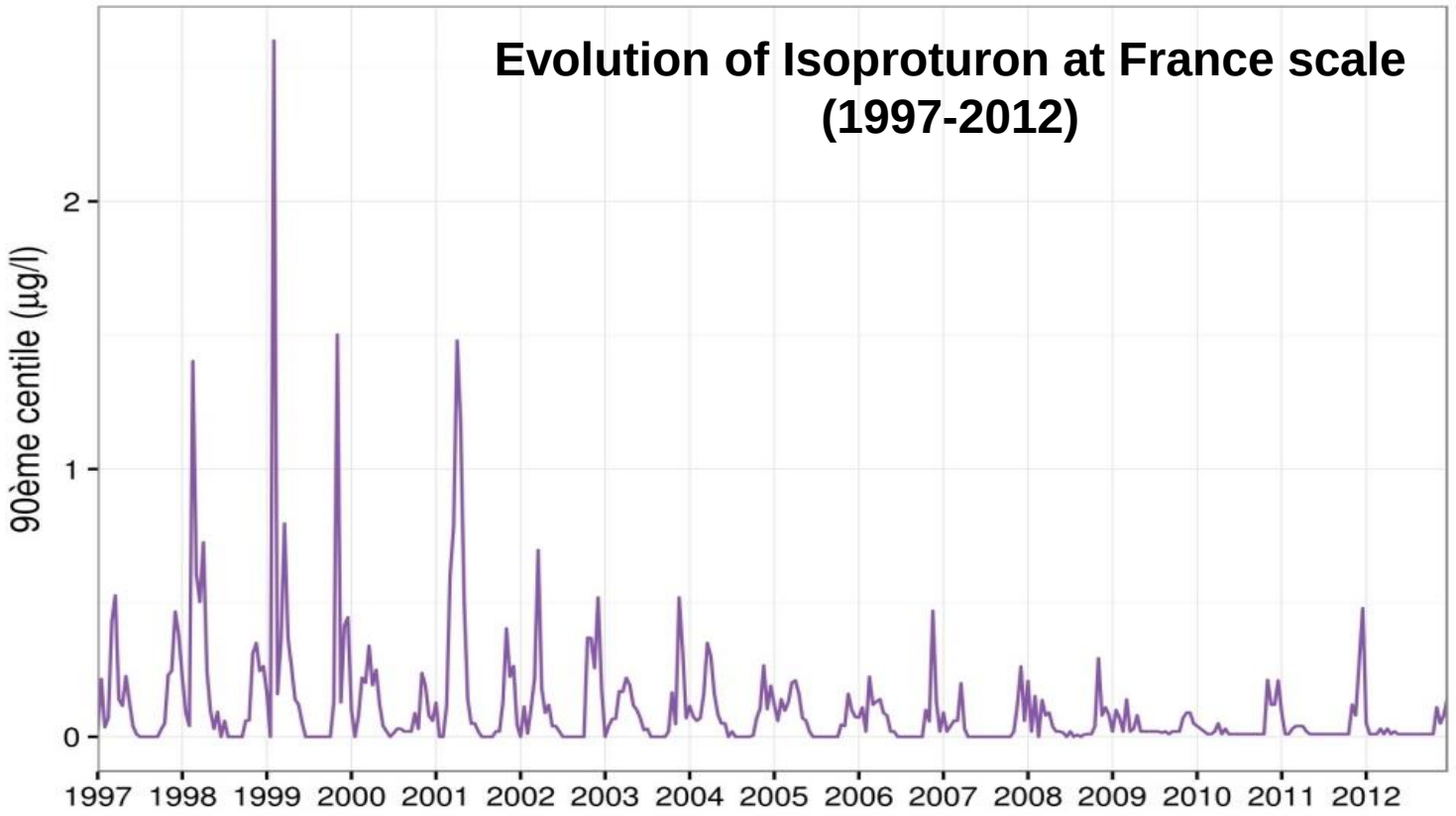
centile 90 of data groups

⇨ envelop curve



[1] Wasson J., et al. Les hydro-écorégions de France métropolitaine, approche régionale de la typologie des eaux courantes et éléments pour la définition des peuplements de référence d'invertébrés. Cemagref (2002).

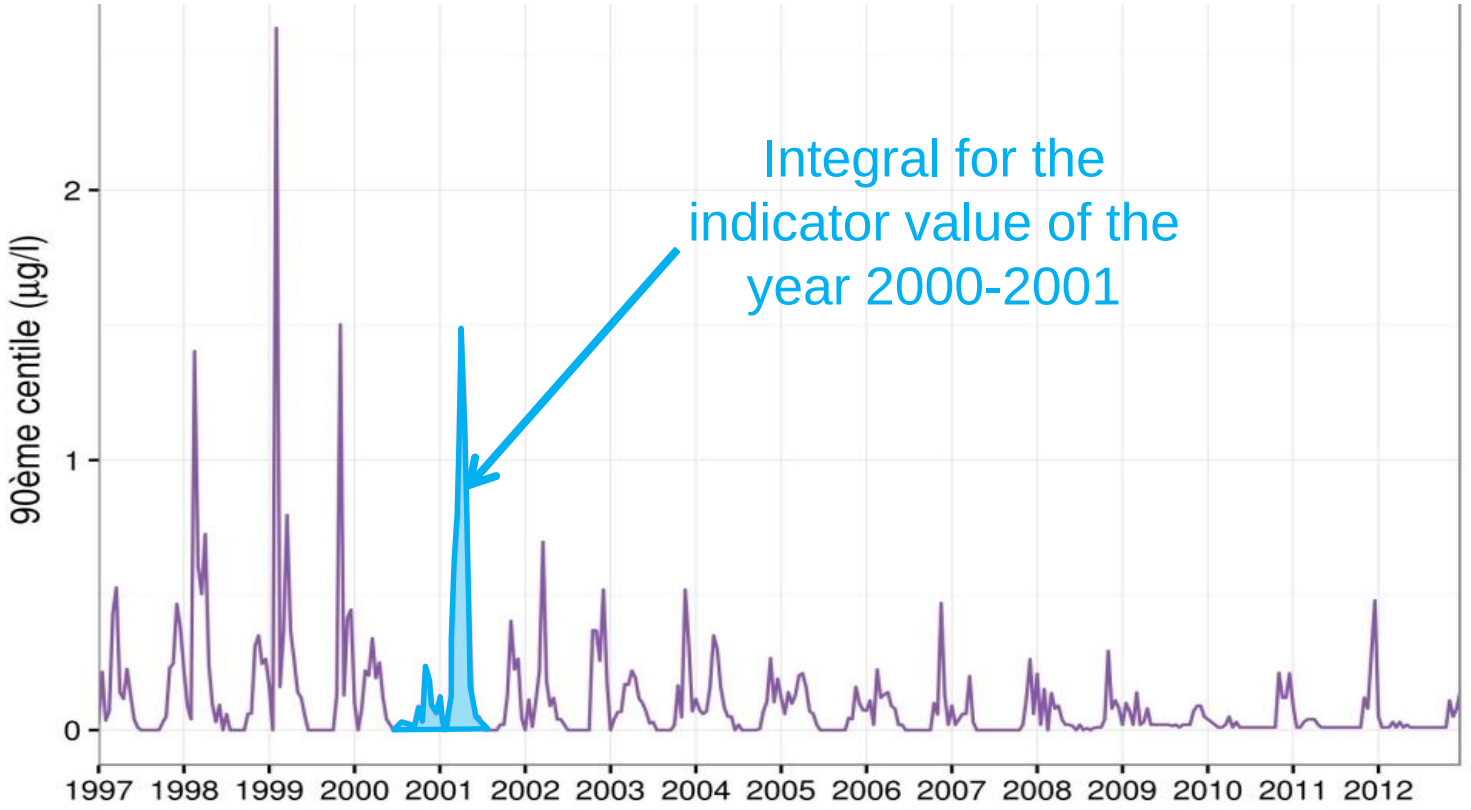
Discrimination of temporal and spatial trends



Useful method also to highlight:

- intra-annual trends at national scale
- some specific intra-annual trends at HER scale, not visible at national scale but consistent with local uses

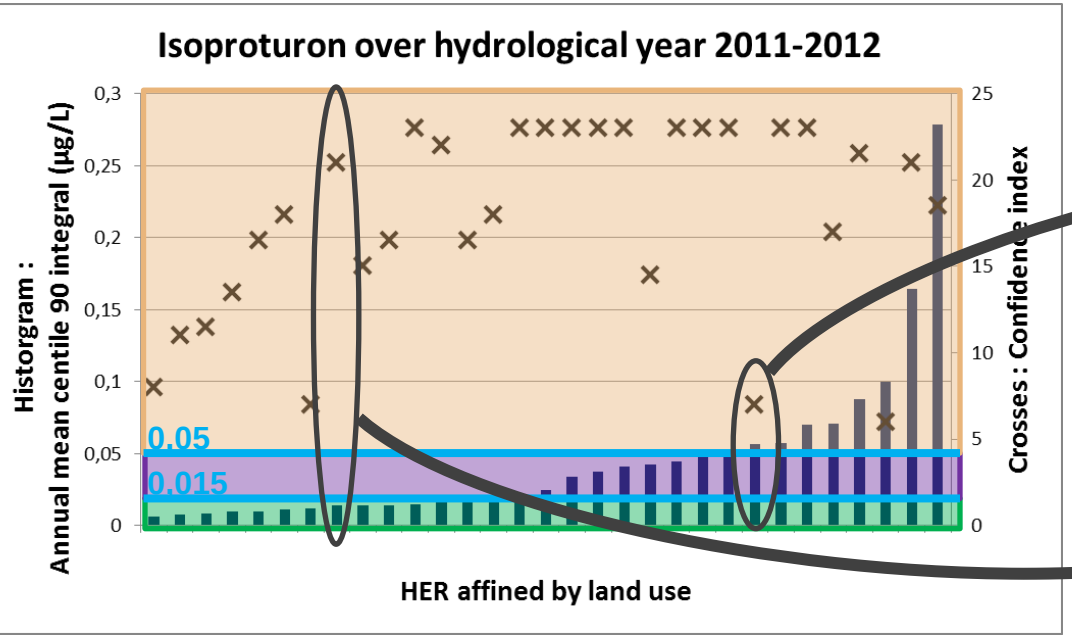
Ranking of spatial and temporal situations

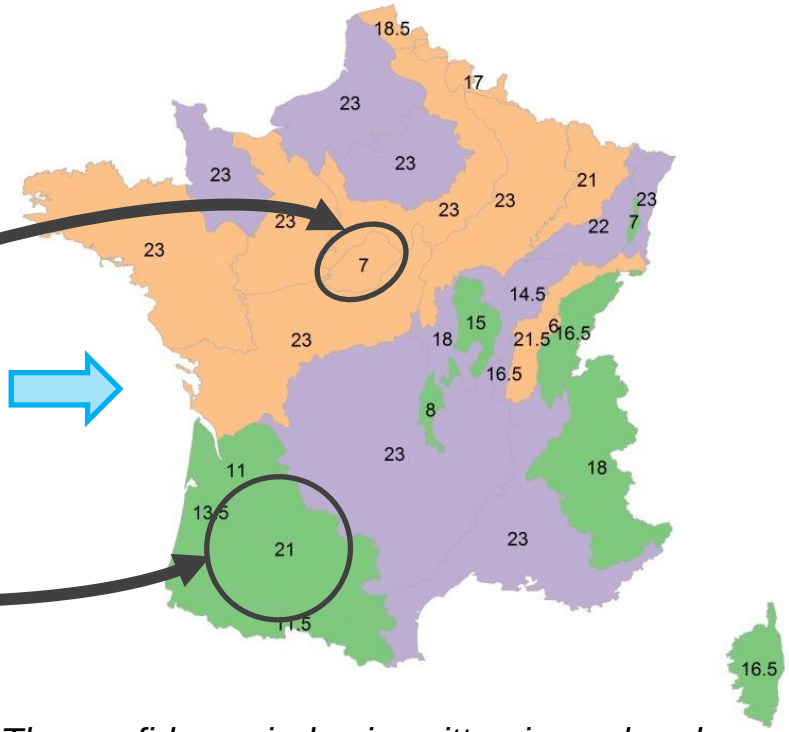


⇒ Envelop curves give trends but they don't provide a global view of each HER potential of contamination

⇒ Proposition of a simple indicator: mean of the envelop curve integral over the year, associated with a confidence index

Ranking of spatial and temporal situations: example of isoproturon





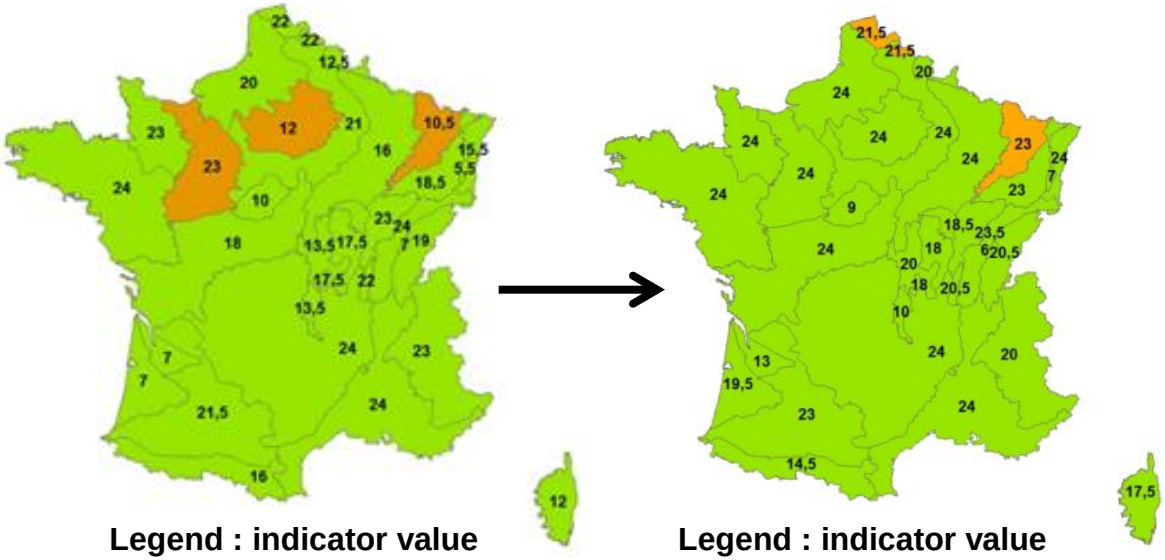
The confidence index is represented by the black crosses. *The confidence index is written in each polygon.*

Annual mean centile 90 integral (µg/L)

- 0,006 – 0,015
- 0,015 – 0,05
- 0,05 – 0,28

Ranking of spatial and temporal situations: example of Isoproturon

2007-2008 → 2011-2012



Legend : indicator value (µg/L)

- 0 – 0,1
- 0,1 – 0,21
- >2

Legend : indicator value (µg/L)

- 0 – 0,1
- 0,1 – 0,25
- >2

Drinkable water (0,1µg/L) and drinkable water treatment (2µg/L) thresholds

2011-2012

Legend : indicator value (µg/L)

- 0 – 4,6
- >4,6

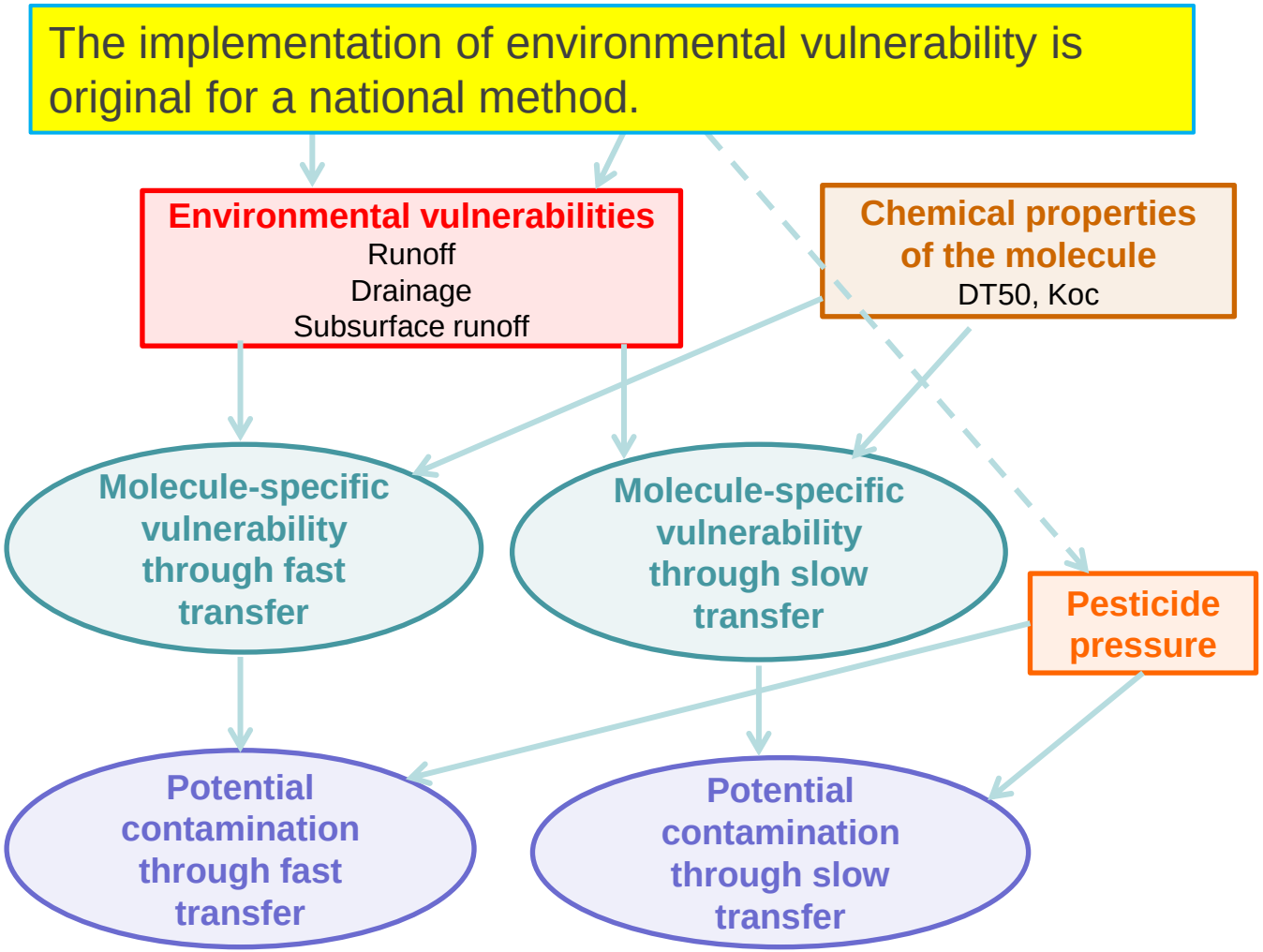
PNEC threshold (4,6 µg/L)

Cartographic representation of the ranking indicator:
Annual mean of centile 90 very low (<0,1µg/L)
for 2,4-D, diflufenicanil, metazachlore, propyzamide

Contamination risk assessment

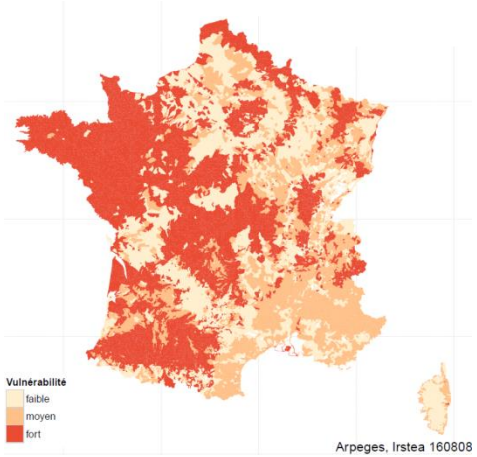
ARPEGES: a knowledge-based model of pesticide transfers to surface water bodies

- ✓ **One active ingredient** at a time
- ✓ **Geographical units:** water bodies catchments
- ✓ **Harmonised** at the national level
- ✓ **18 determinants** of pesticides surface waters contamination
- ✓ **3 classes** for each one (low / medium / high)
- ✓ Aggregation by a **bayesian network**



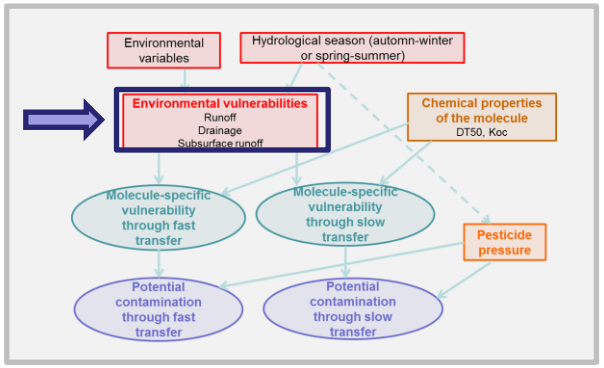
Environmental vulnerabilities: example of run-off

Autumn-winter



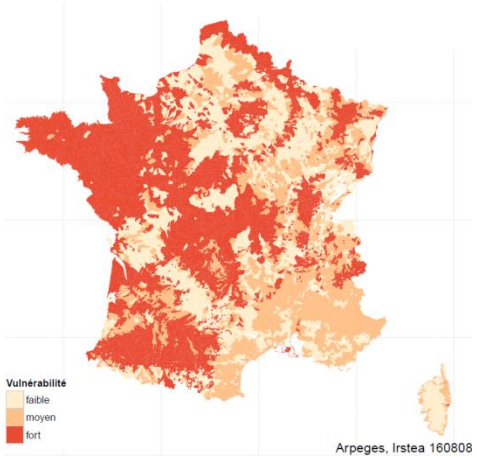
Variables used to calculate vulnerability to run-off:

- ✓ Run-off/Infiltration ratio
- ✓ Water content of soils
- ✓ Hydromorphy
- ✓ Crusting
- ✓ Grass strips
- ✓ Riparian areas

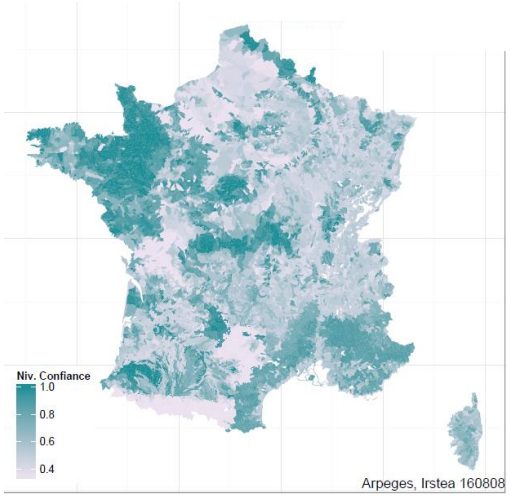


Environmental vulnerabilities: example of run-off

Autumn-winter

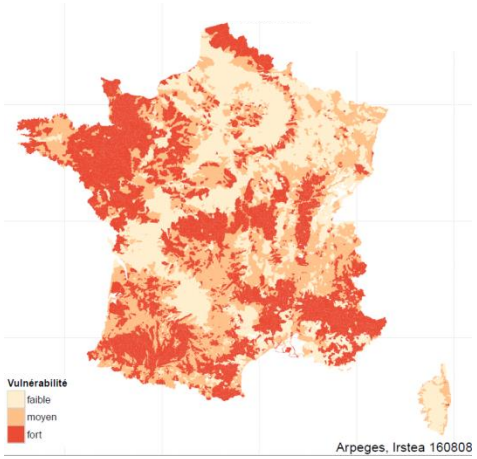


Result of potential contamination



Confidence index of potential contamination

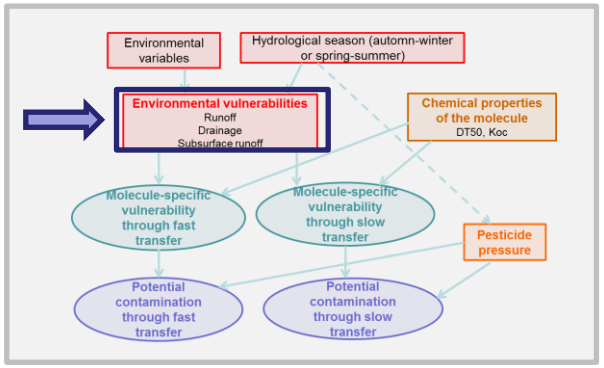
Spring-summer



Bayesian network

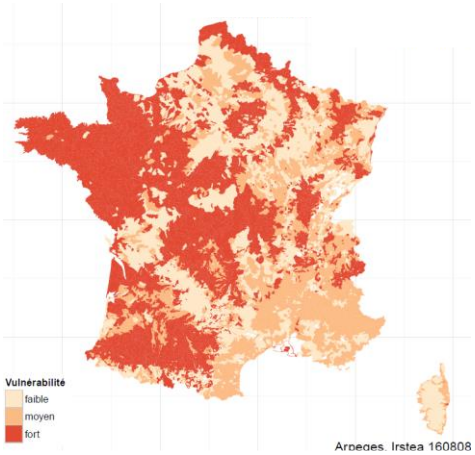
⇩

confidence index based on the probabilities

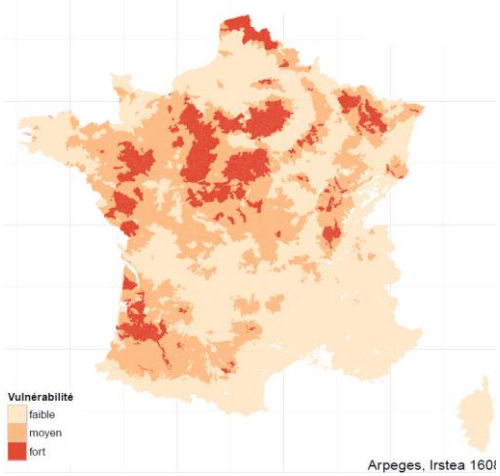


Environmental vulnerabilities

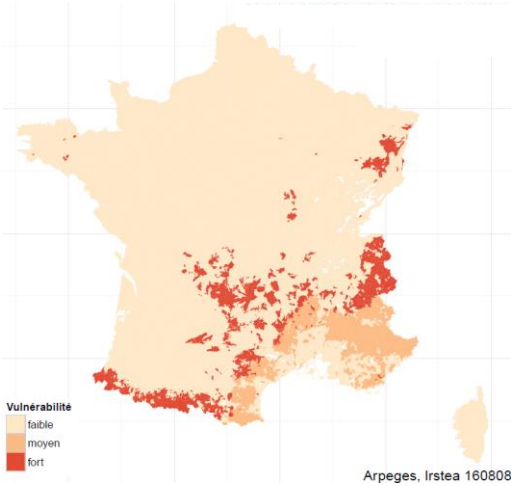
Autumn-winter



Run-off vulnerability

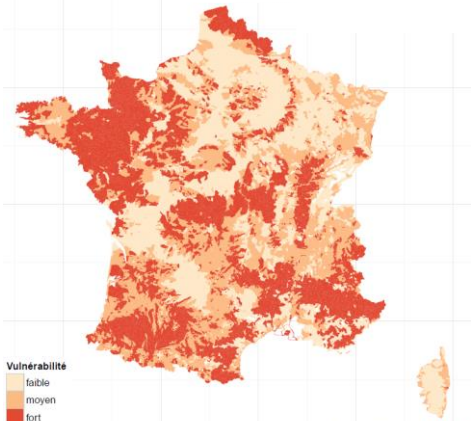


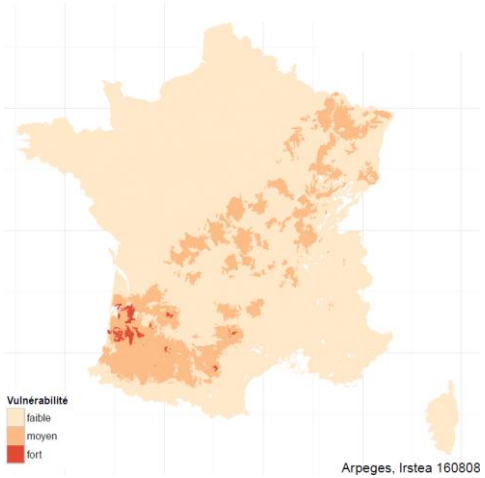
Drainage vulnerability

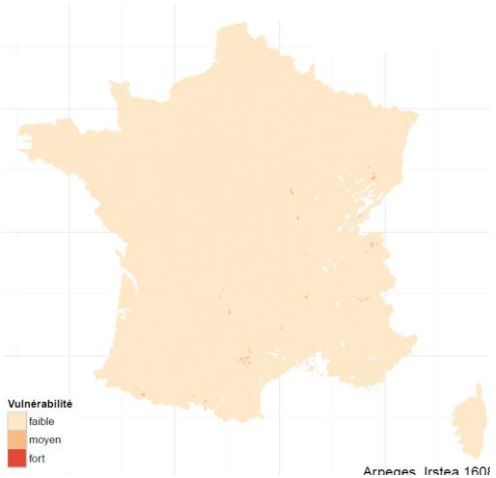


Subsurface vulnerability

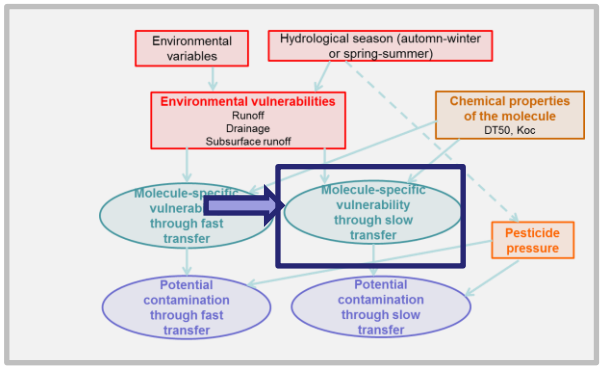
Spring-summer







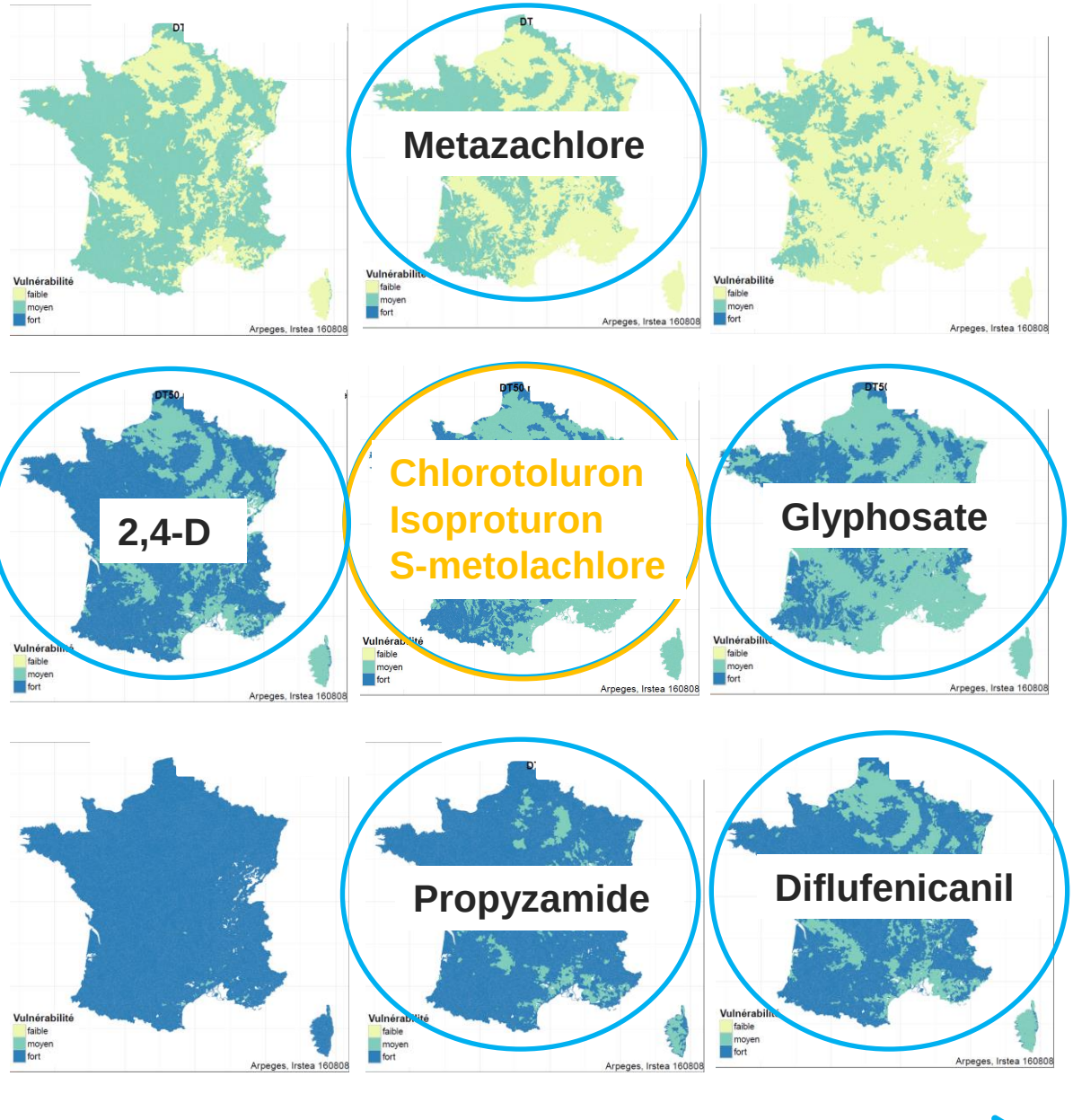
Molecule-specific vulnerability



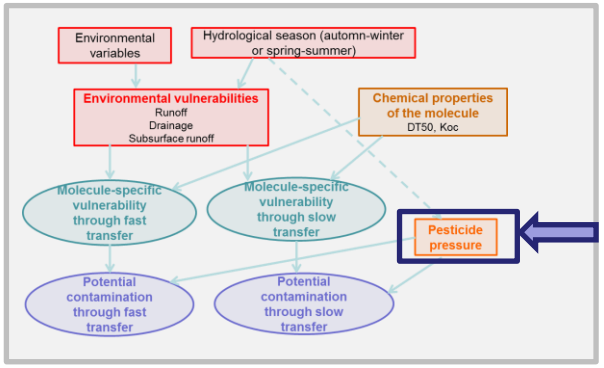
9 combinations of chemical properties

6 combinations covered by the 8 studied herbicides

Example for the vulnerability through slow transfers and autumn-winter



Pesticide pressure

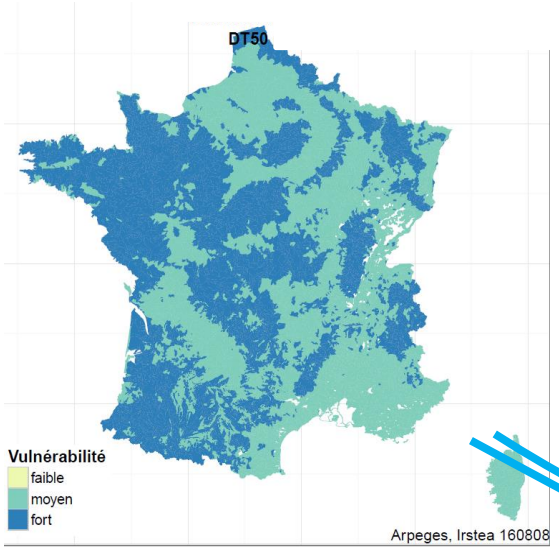


Data : **BNV-D 2012**

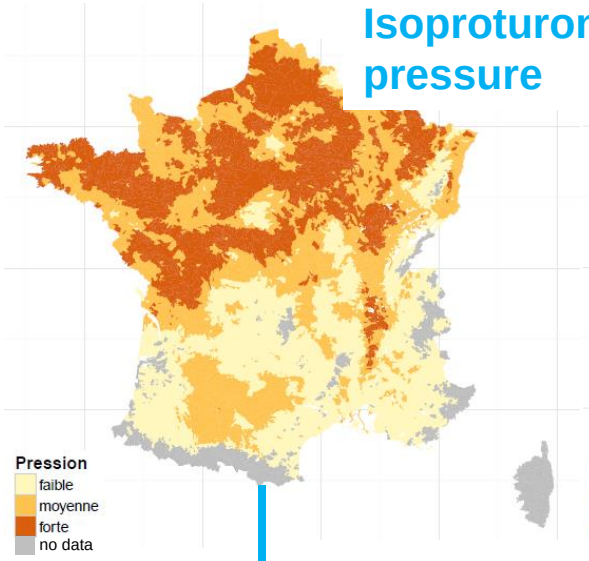
- the most recent and complete French database available at the time
- low resolution of substance sold quantities (HER)
- distribution of the HER quantities between water bodies according to land uses

Potential contamination: example of slow transfers and autumn-winter for Isoproturon and Chlorotoluron

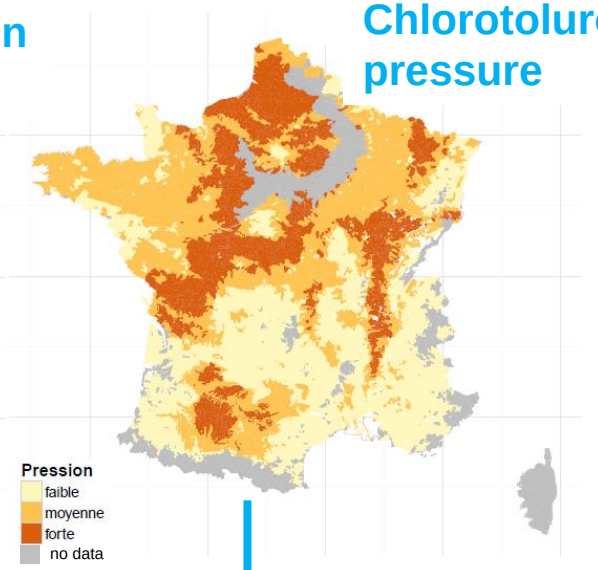
Molecule-specific vulnerability

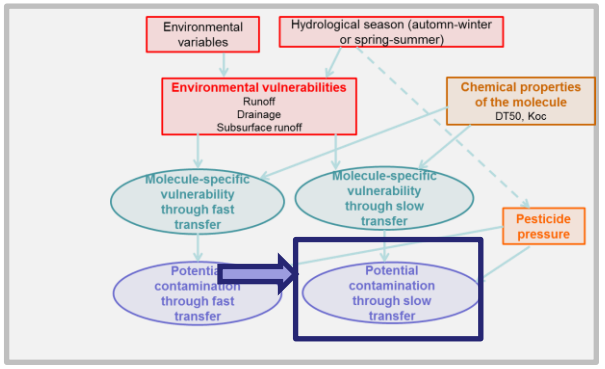


Isoproturon pressure

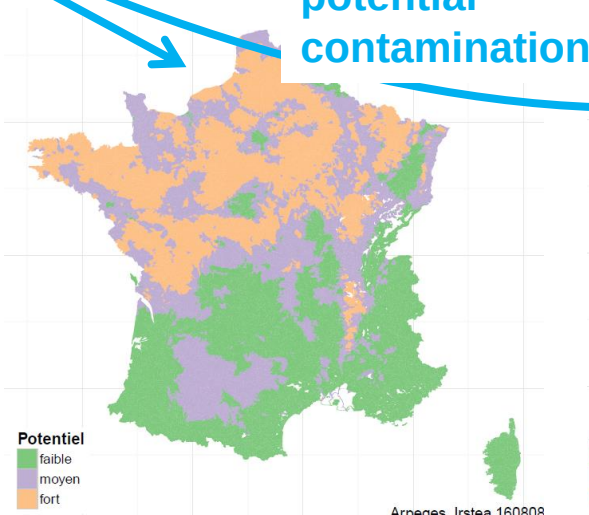


Chlorotoluron pressure

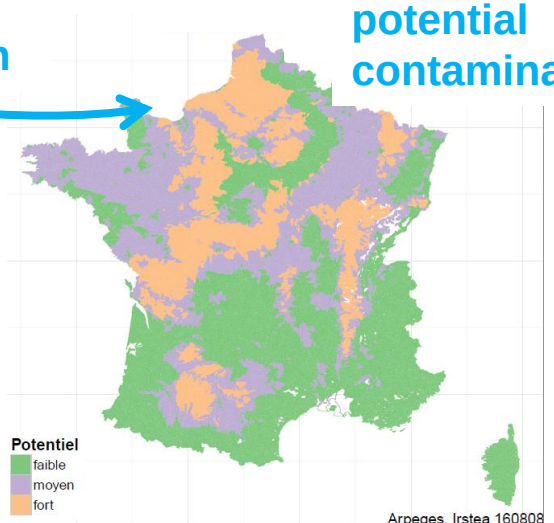




Isoproturon potential contamination

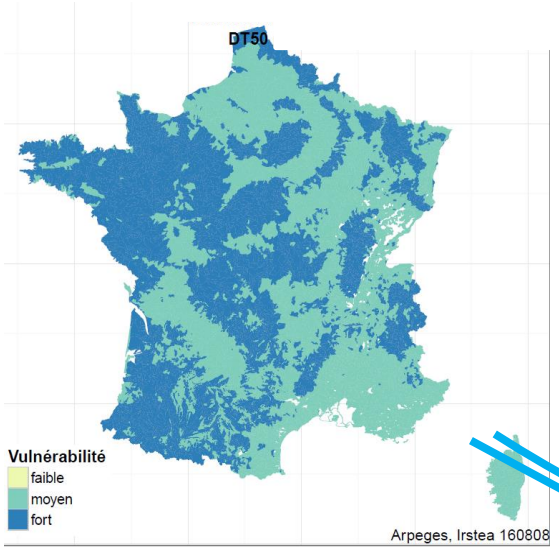


Chlorotoluron potential contamination

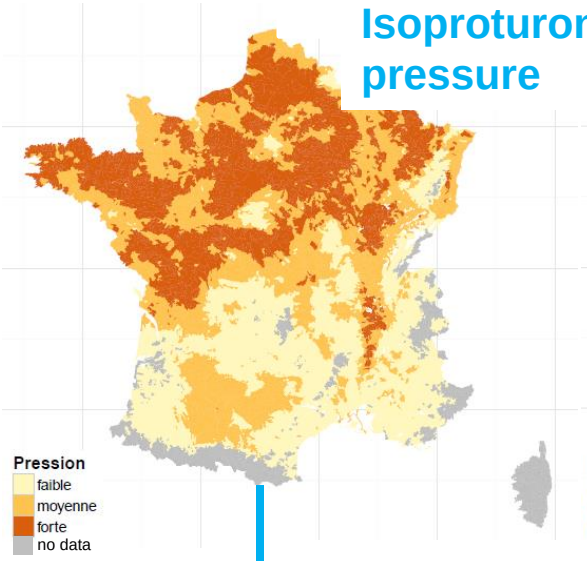


Potential contamination: example of slow transfers and autumn-winter for Isoproturon and Chlorotoluron

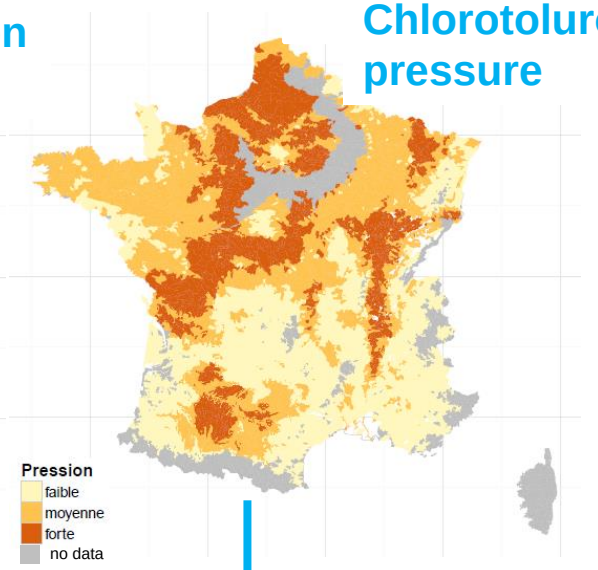
Molecule-specific vulnerability



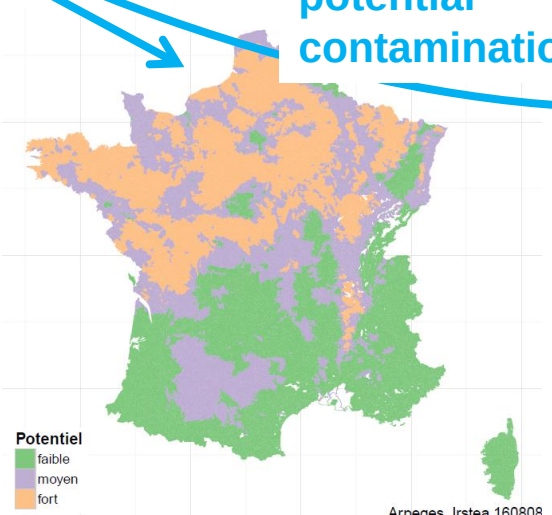
Isoproturon pressure



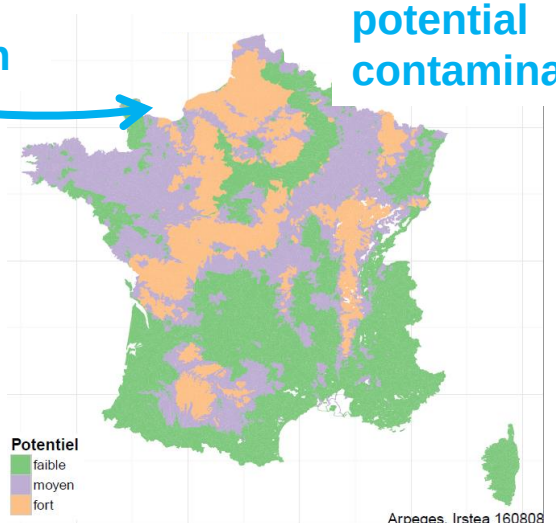
Chlorotoluron pressure



Isoproturon potential contamination



Chlorotoluron potential contamination



- ✓ Cartographic representation of potential contamination for each pesticide
- ✓ Possible to identify the contribution of each transfer determinant

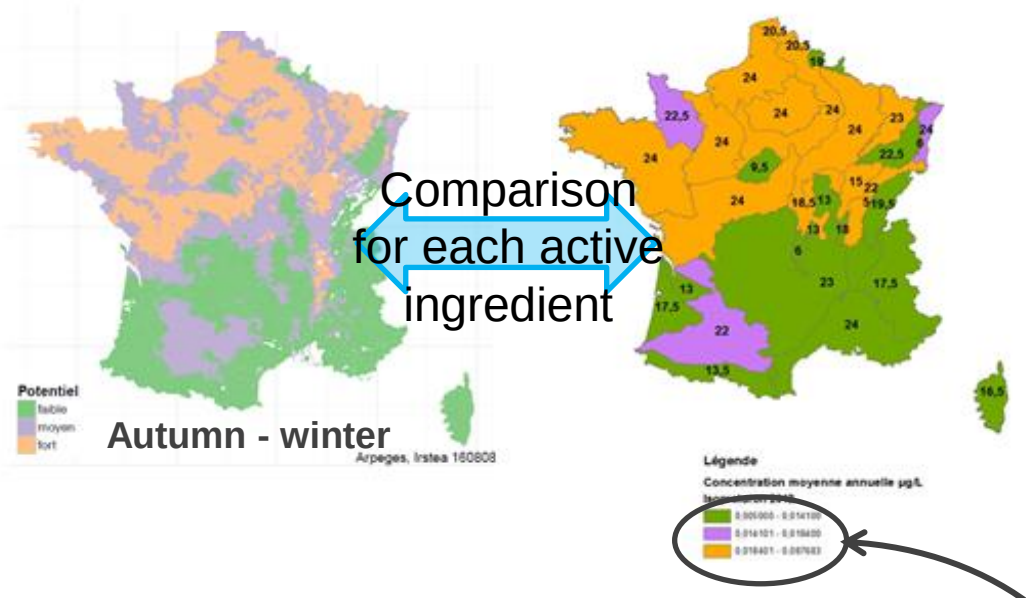
Comparison of the two methods

Comparison rules

Isoproturon

ARPEGES

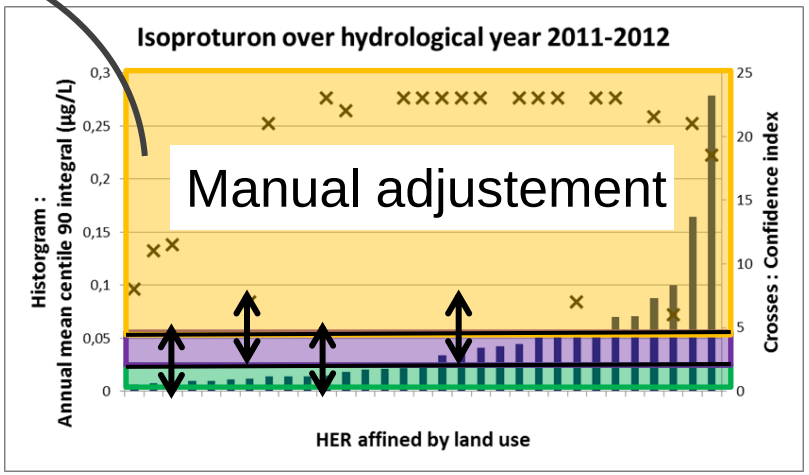
Monitoring data processed



Compared values :

ARPEGES potential contamination through slow transfers and one season

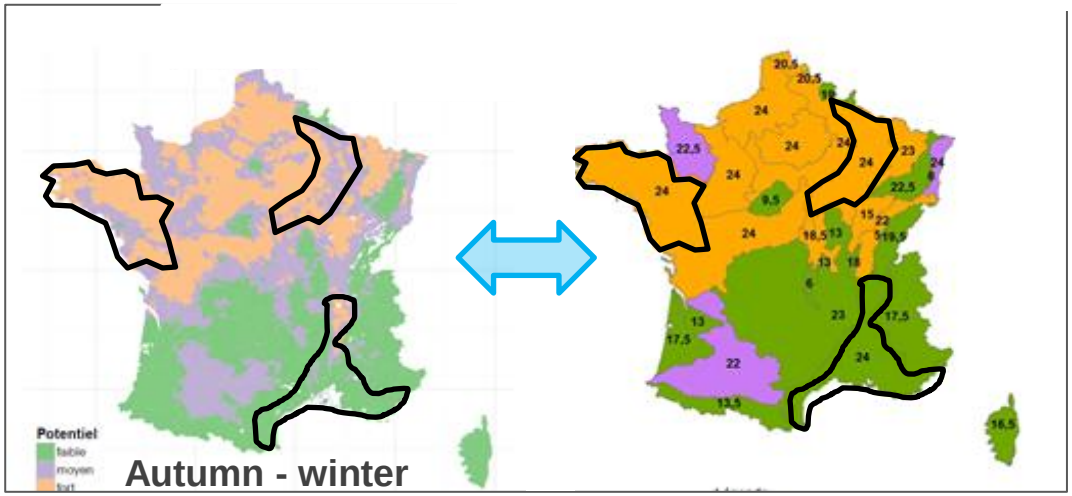
VS monitoring data' centile 90 annual mean integral per HER for the year 2012



Cartographic comparison: examples of Isoproturon and Propyzamide

Isoproturon

ARPEGES Monitoring data processed



Low ↔ 0 – 0,014 µg/L
Medium ↔ 0,014 – 0,018
High ↔ 0,018 – 0,087

- ✓ Orders of magnitude of ARPEGES levels for each pesticide: useful to relativise ARPEGES potential contamination assessment

- ✓ Global consistency of the results between the two methods
- ✓ At a closer look, local differences, due to differences in methods' spatial scales
- ✓ Other explanations :
  - annual weather conditions
  - low confidence index of monitoring data
  - pesticide pressure data resolution

On-going work and prospects: consolidating the comparison of the methods in view of the 2019 WFD reporting

2019 WFD reporting preparation

- Comparison for a wider range of 15 active substances, among which 8 new ones:
  2,4-mcpa, aminotriazole, bentazone, boscalid,
  metaldehyde, nicosulfuron, oxadiazon, pendimethaline

- Monitoring data interpretation method:
  integral calculation on several years to smooth annual weather effect

- ARPEGES input data:
  results production with a more accurate spatialized pesticide pressure data :
  - Before : HER resolution
  - From now on : postcode resolution (year 2015)

  and a new method of spatialization (INRA), taking into account registered rate of spreading according to the types of crops

Other prospects

Those methods can be applied in other European Union countries for re-registration process and WFD reporting as well - as long as there are enough available data:

- Monitoring data
- Environmental variables at national scale
- Pesticide pressure at national scale

Acknowledgments

This work benefits from the technical and financial support of AFB (previously : Onema) and ANSES.

Thank you for your attention

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