# Action plans against diffuse pollution for the protection of drinking water catchment area

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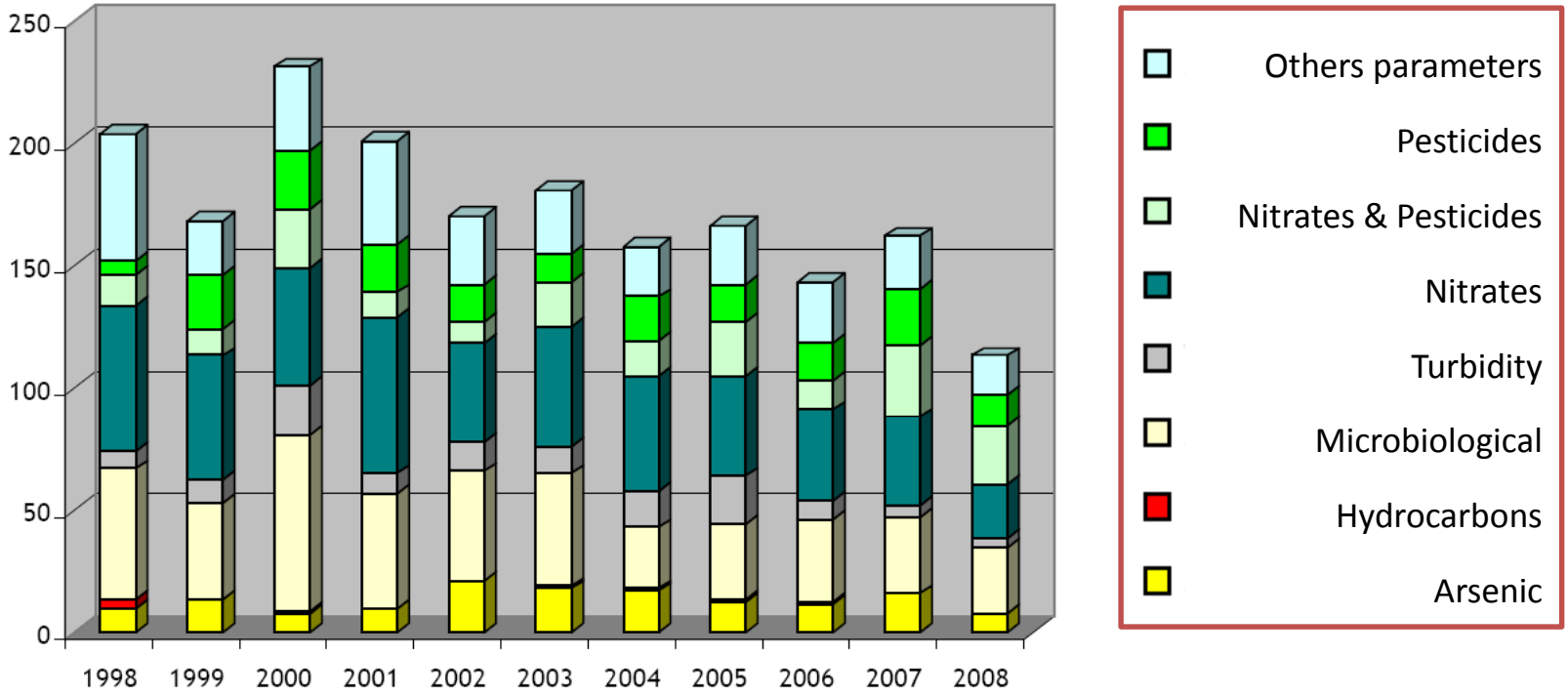
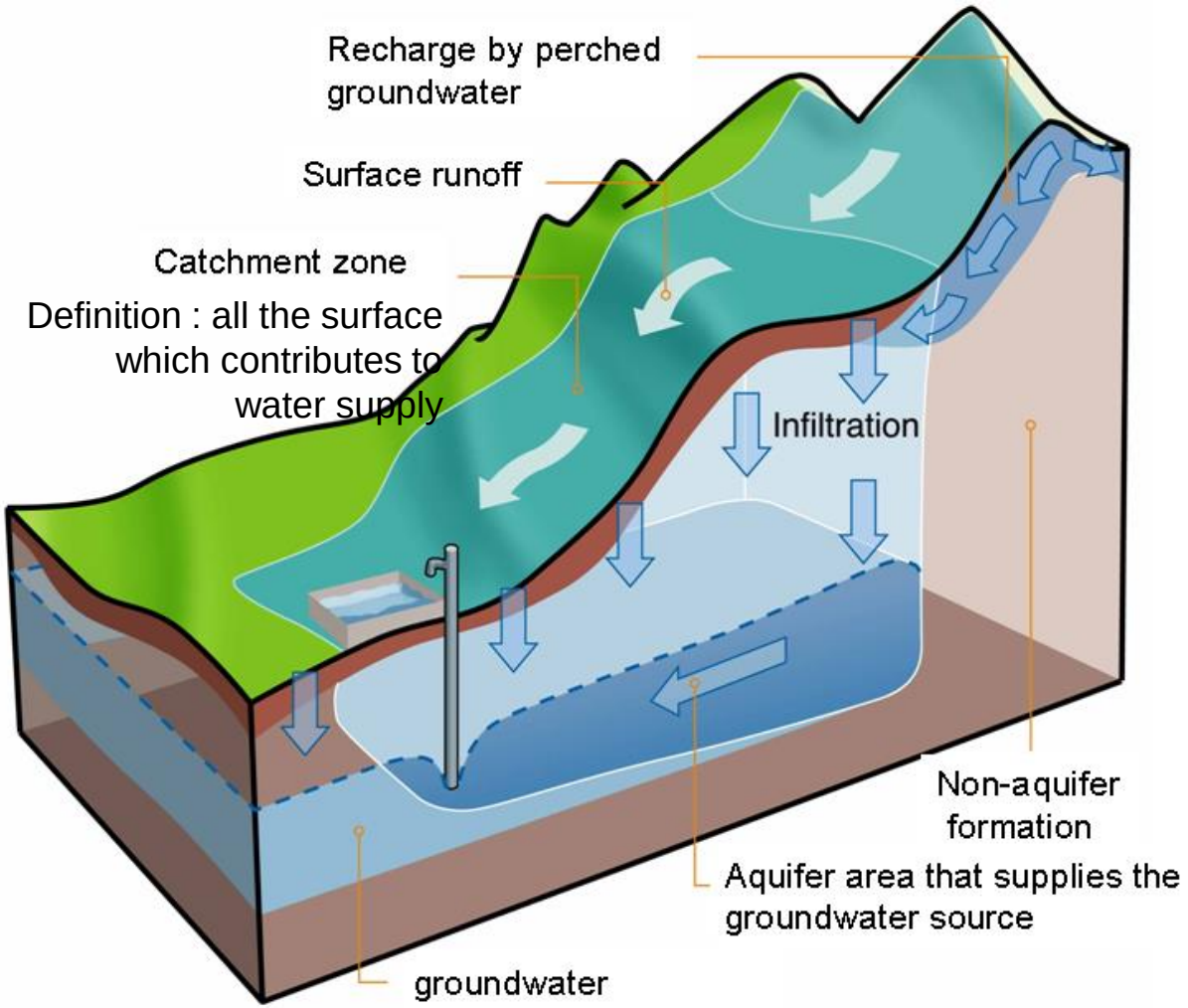
# Abandoned water wells

- About 34000 water wells in France : most of them are groundwater wells
- 5000 water wells abandoned between 1998 and 2008
- Main reason (40 %) : water quality

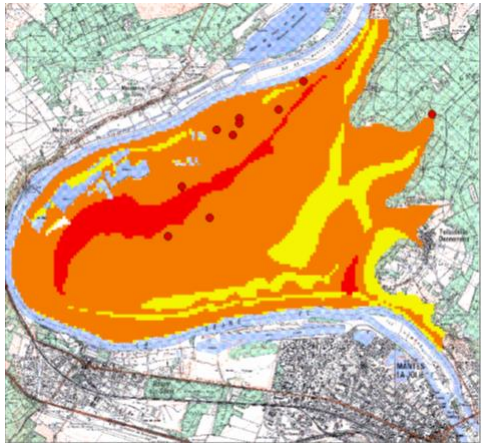



*Source : French Ministry of Health*

# Protection of drinking water catchment area



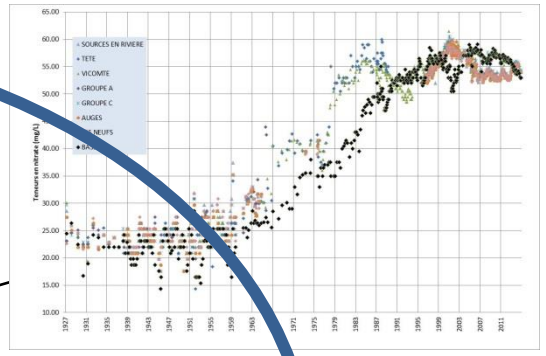

Objective : to protect the most vulnerable parts ot the catchment area

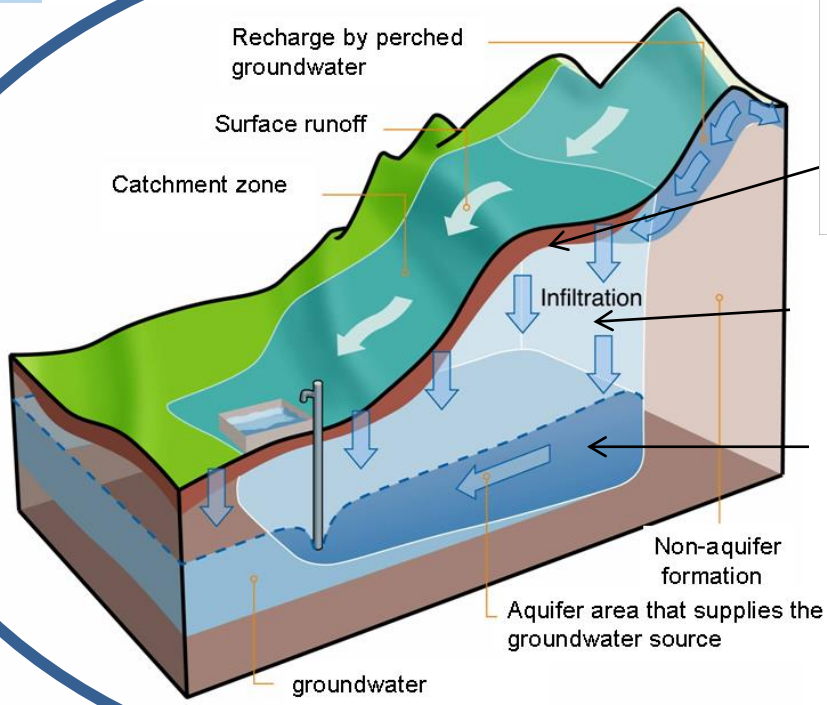


# Complexity of environment ➔ crossover approach

Water quality

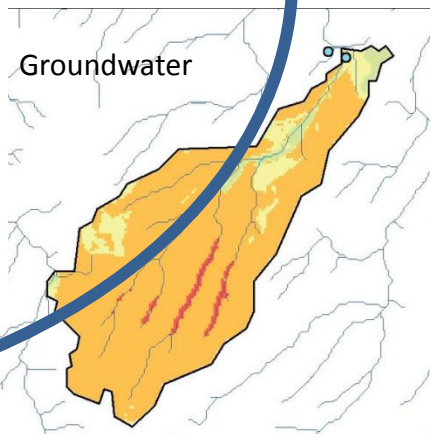
Action plans






(Modeling)

+ economic and sociological data…



Intrinsic vulnerability / mapping of transfers

Characterization of pollution pressure from agriculture practices, urbanization… (nitrates and pesticides)

# Efficacity of mitigation measures for water quality

**Efficient action for water quality**

- **Depend on location (crossover approach pollution pressure/vulnerability and transport pathflow)**
- **Allow**

  **to limit inputs (fertilizers and pesticides) and transfers**

  **to reason the use of inputs**
- **Must be accepted and sustainable**

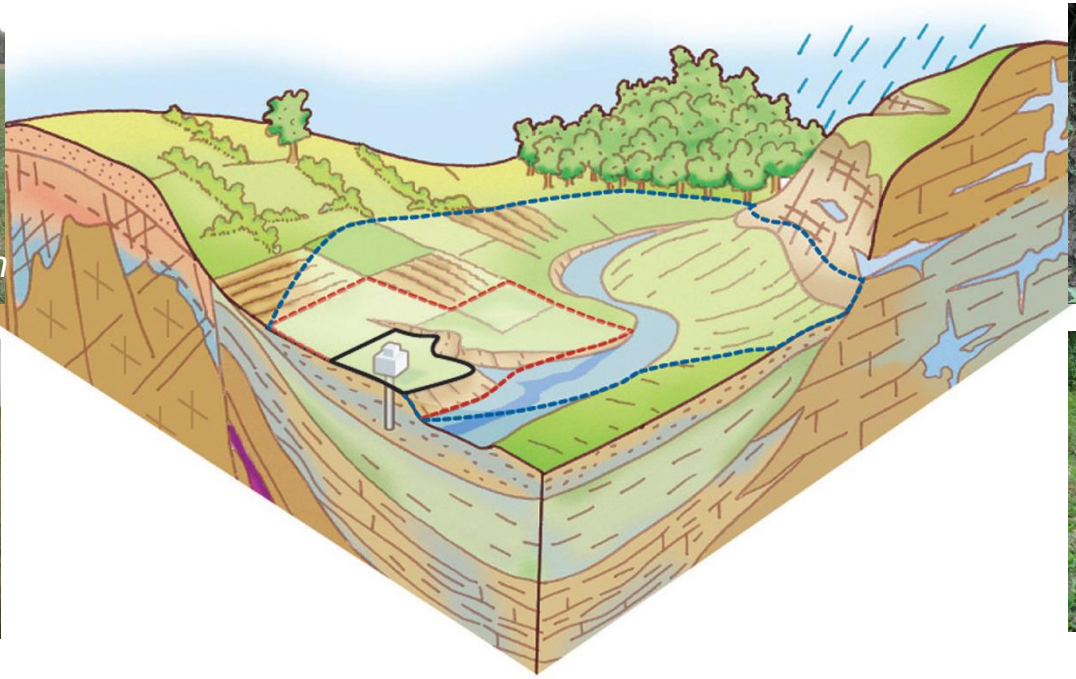
# Actions

- **Regulatory action:** ban sensitive molecules leaching ...
- **Land acquisition and adaptation of agricultural practices**
- **Changes in agricultural practices**
- **Management of land use**
- **Decision support tools**
- **Territorial coordination projects**
- **Actions in non agricultural zones:** improving sanitation, avoid the use of pesticides…

# Characterize flowpaths of contaminants

Mapping of contaminant transferts (global vulnerability according to diffuse infiltration and by transfert types)




# Selecting actions based on contaminant transfert

| Type of transfer | Examples of actions |
|---|---|
| **Infiltration** | Adapting land use according to vulnerability (forest, fallow fields, grass field…)<br>Pesticide reduction (optimization of treatments, reduction of application rates) and adaptation to environmental conditions (period of use, choice of plant protection products)<br>Protection of sinkholes with buffer zones (karstic aquifers)<br>Crop rotation<br>Crop cover<br>Organic farming<br>Energy crops with low inputs (miscanthus…) |
| **Spray drift** | Establishement and management of riparian zones to protect water bodies<br>Buffer strips /Grass strips along waterways |
| **Run off** | Adapting land use according to vulnerability<br>Buffer strips /Grass strips along waterways<br>Management of hedges, soil roughness<br>Agroforestery… |
| **Drainage / sub surface transfer** | Adapting land use according to vulnerability<br>Adaptation of plant protection product<br>Management of artificial wetland for drainage outlet |

# How to access to the performance of action plan towards water quality?

- At the scale of drinking water well: water sampling plan must be adapted to the hydrological and hydrogeological context. Frequencies of sampling, chemical parameters (need to know what pesticides are applied on the fields), periods of sampling are very important to characterise exactly the water quality

- At the scale of catchment area: field measures can be used especialy for large catchment area and long transfer time (sampling of nitrate leaching into the soil, monitoring of other wells, drainage networks, streams…)

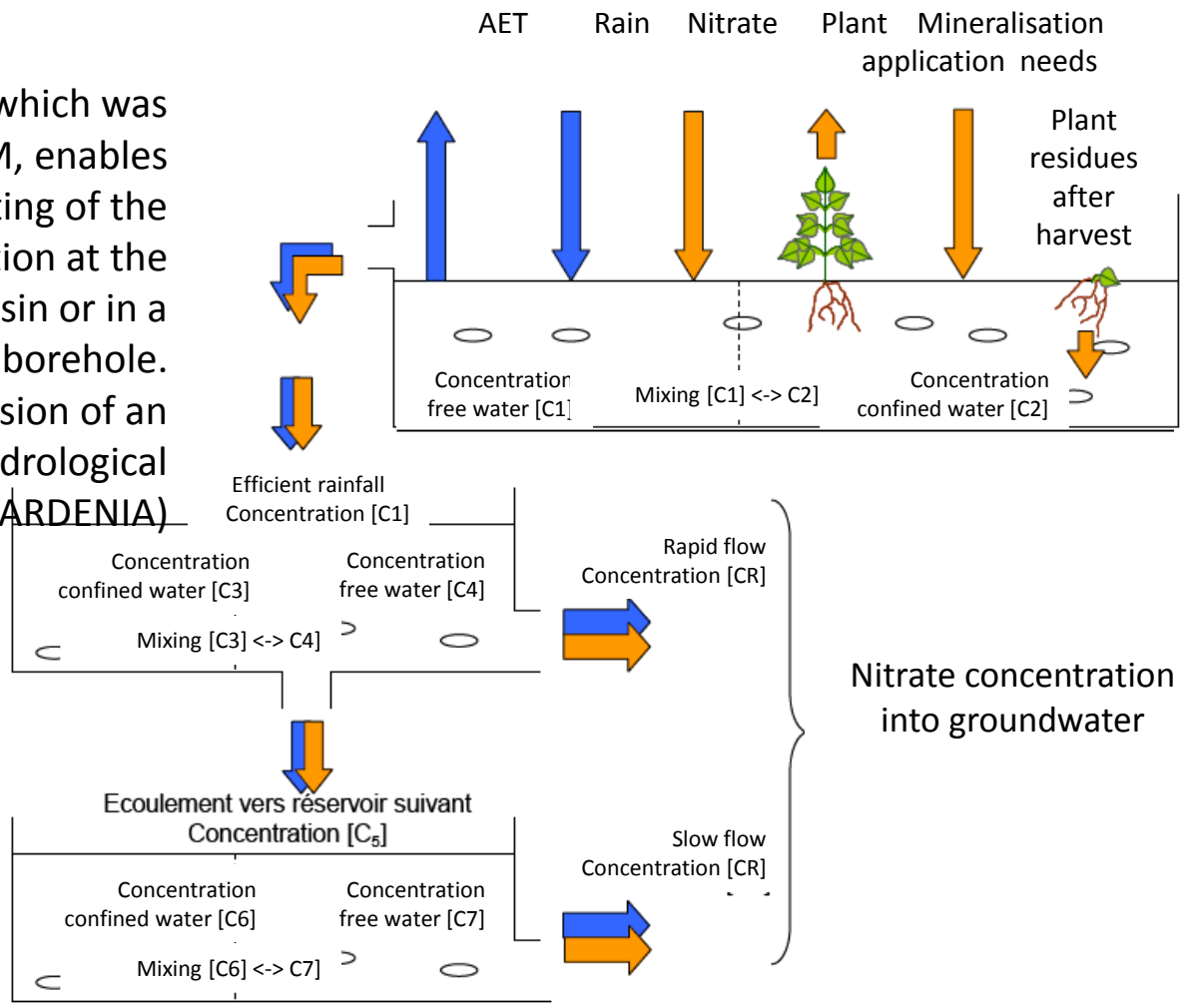
- At the global scale, modeling

# Exemple of the use of a modeling tool

The BICHE model, which was developed by BRGM, enables continuous forecasting of the nitrate content evolution at the outlet of a drainage basin or in a borehole.

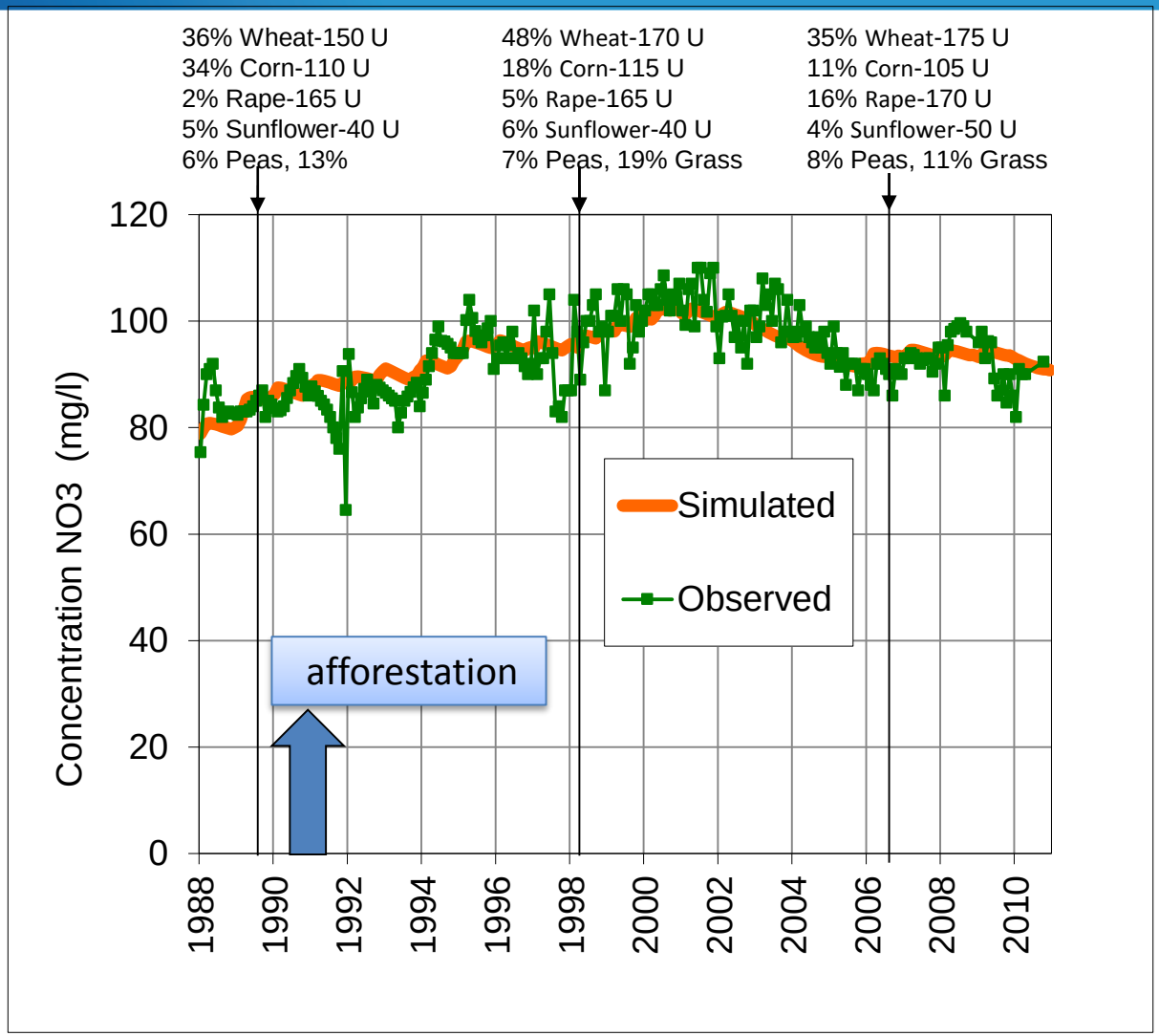
BICHE is an extension of an existing lumped hydrological model (GARDENIA)

The principle of this modelling lies in the analysis of the existing records of precipitations. stream discharge. piezometric level. as well as nitrate contents in a spring or a borehole



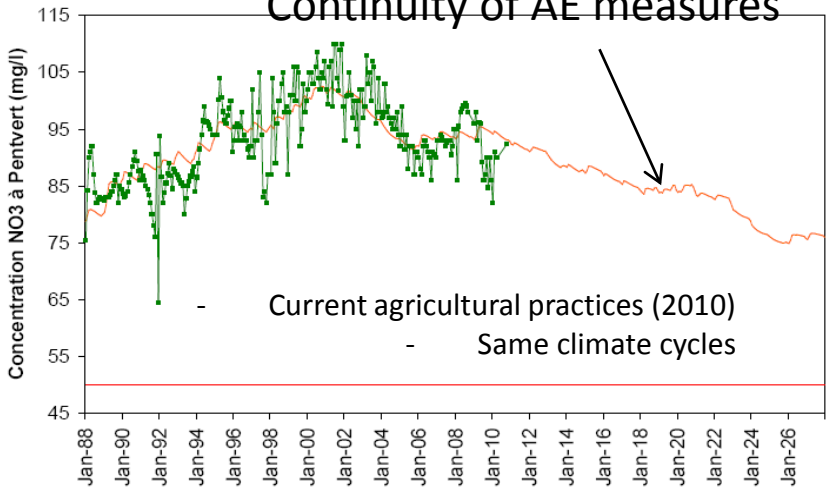
# Modeling calibration

This model, relatively simple, can be used in any hydrogeological context, even karstic, and take into account surface water

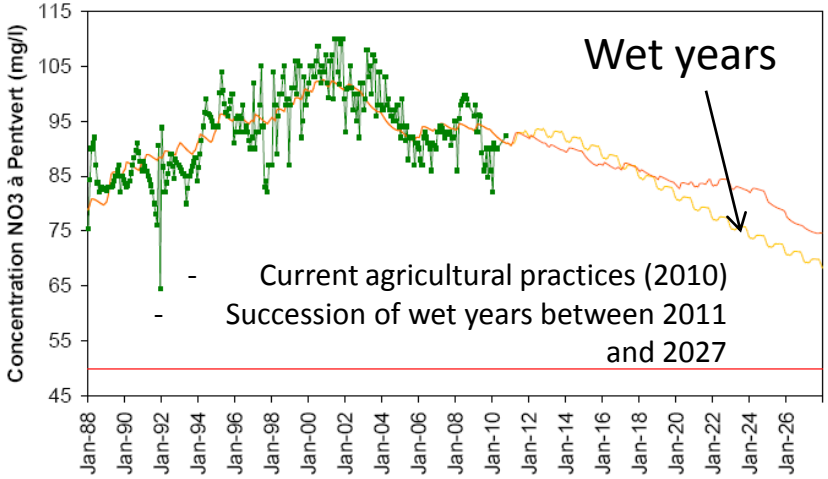


# Study case of Penvert - Scenario testing : 2011-2027

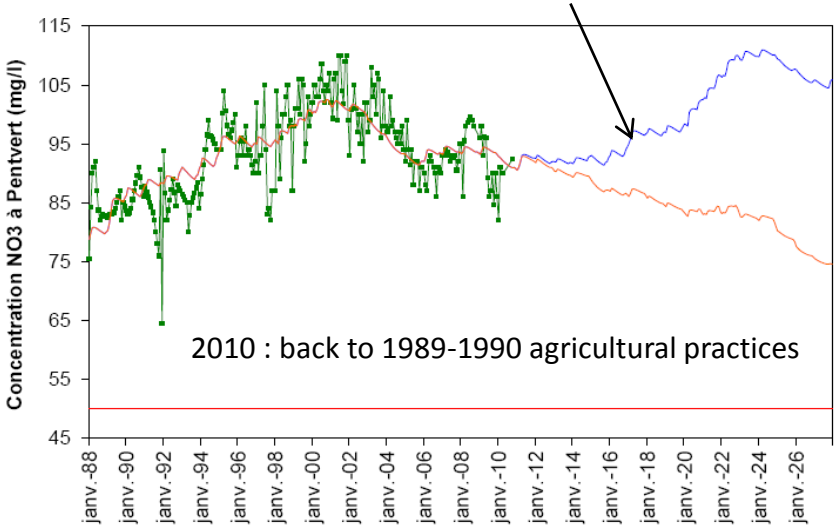
## Continuity of AE measures



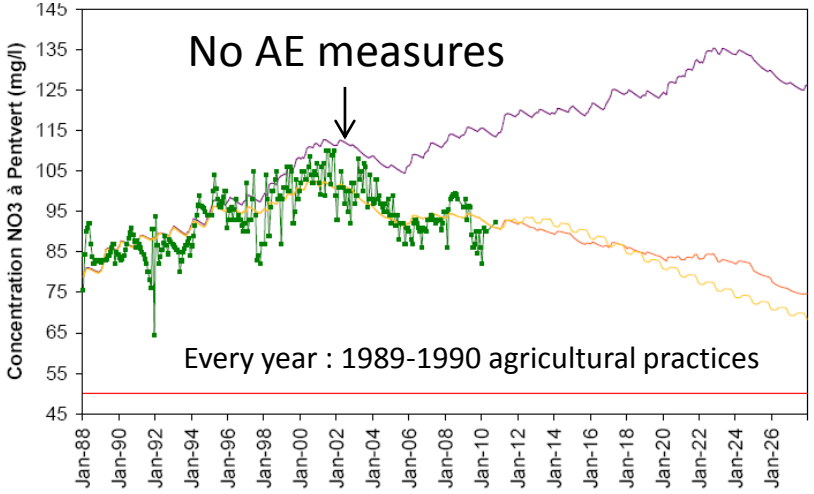

## Wet years




## Abandonment of AE measures

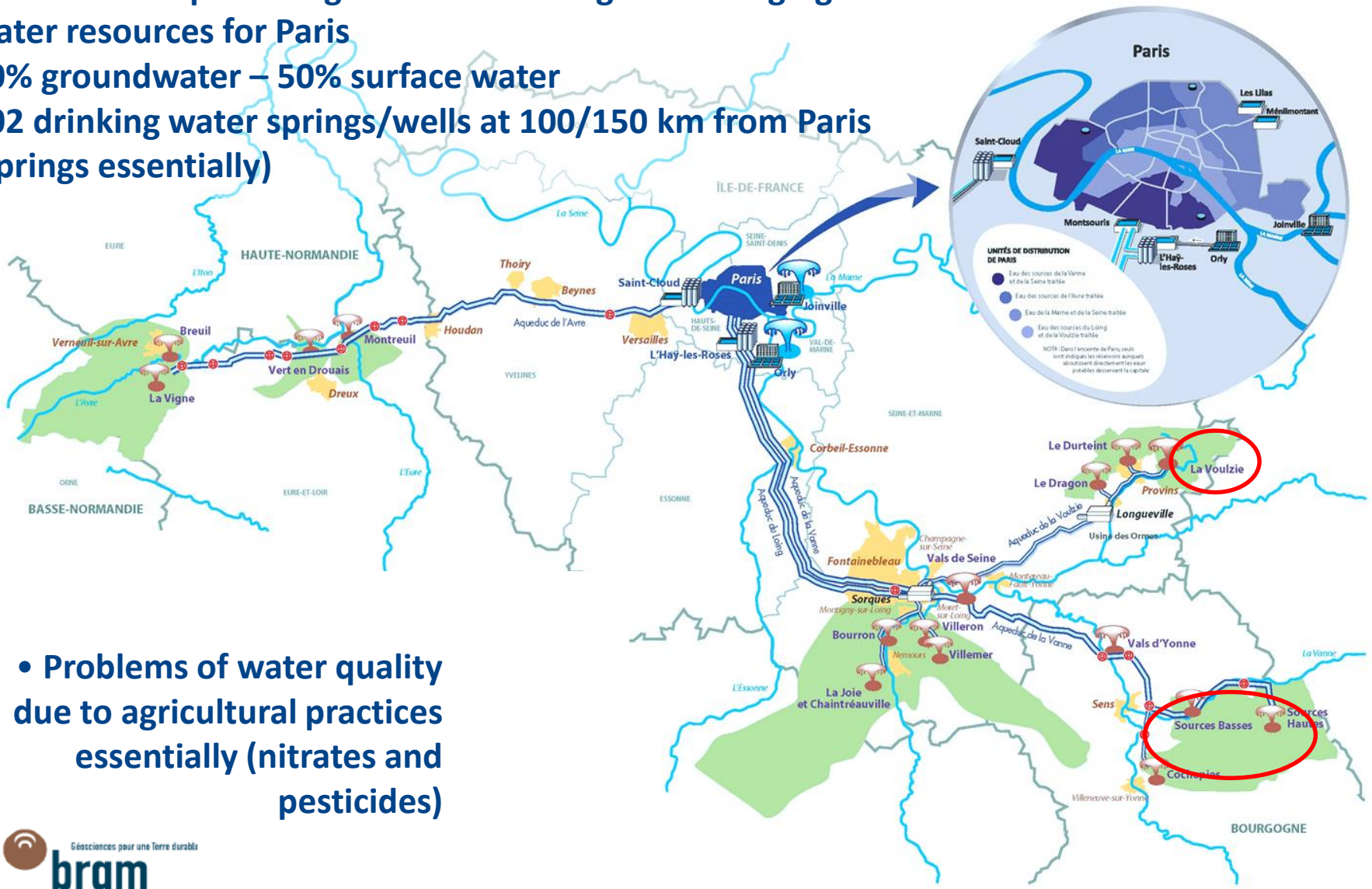



## No AE measures



# Paris – drinking water supply plan

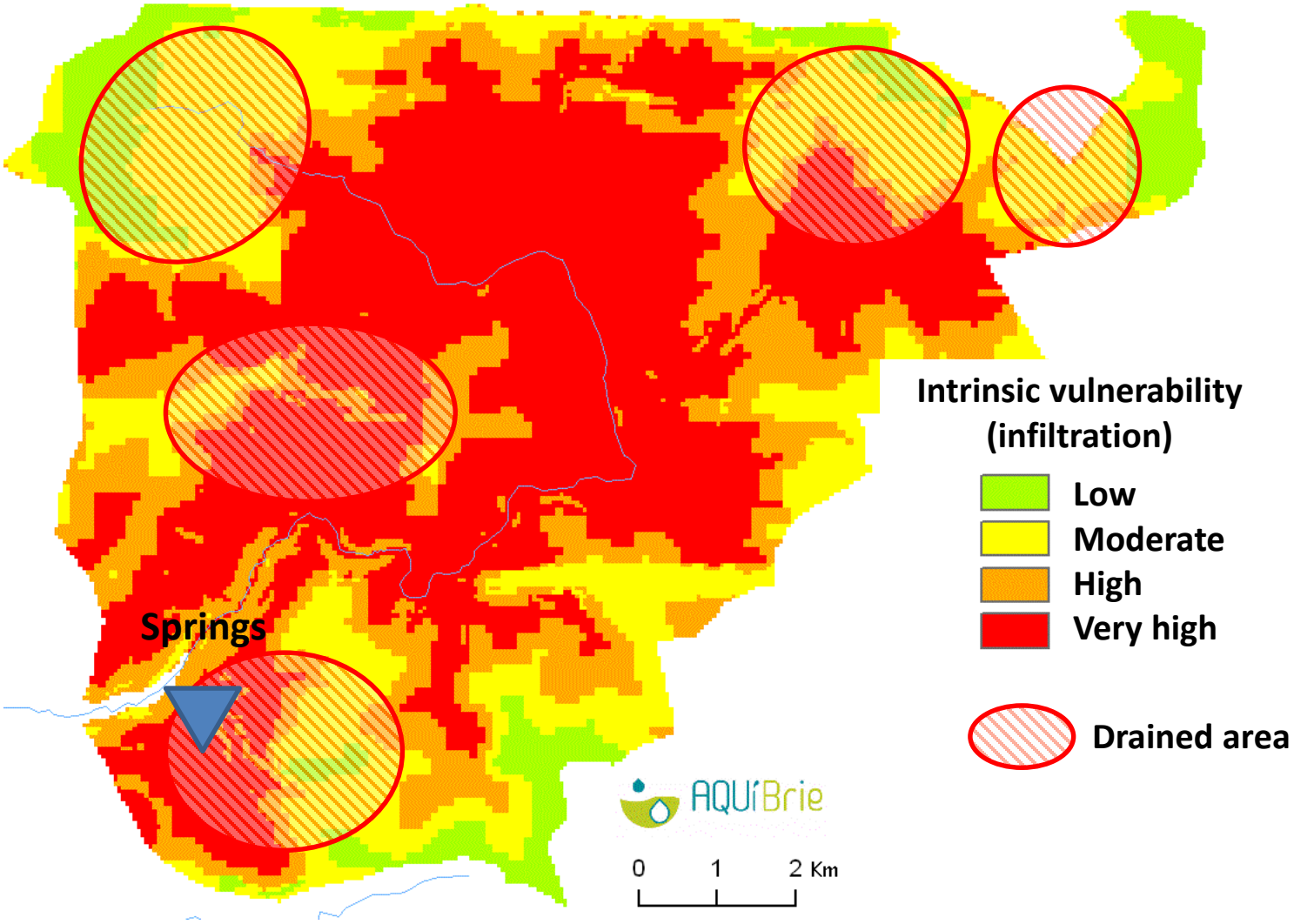
**Eau de Paris – public organisation in charge of managing water resources for Paris**
**50% groundwater – 50% surface water**
**102 drinking water springs/wells at 100/150 km from Paris (springs essentially)**




- **Problems of water quality due to agricultural practices essentially (nitrates and pesticides)**

# Voulzie Drinking water catchment area – vulnerability mapping

- CA: 11500 ha
- 12 springs (60 000 $m^3/d$)
- Major cereal crops
- Nitrates (>50mg/l) and pesticides water quality problems
- Karstic aquifer with localy fast transfers of contaminants (but renewable time is about 20 years old)
- Non perennial streams supplied by run off and drainage



# Voulzie - Action plan and water quality

## Action plan

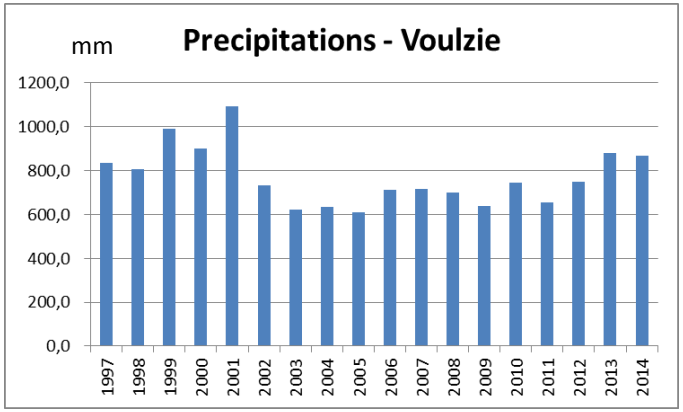
- Work to bypass sinkholes and partial seal streams at the beginning of the 20th century
- Environmental regulation: buffer strips, cover crop…
- Animation work to support the progression of agricultural practices
- Agro environmental measure to reduce the use of pesticides (start in 2007, 40% of territory since 2010 )
- Reflexion about building artificial wetland for drainage outlet (future)

## Water quality

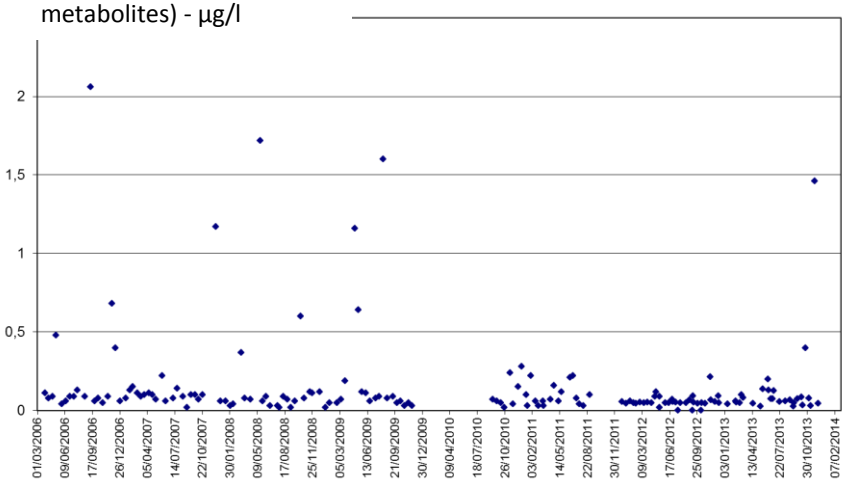
- 400 pesticides (or metabolites) are measured – sampling every two weeks for two springs and every month for other springs.
- Network of suction cups (nitrates)

# Voulzie - Results

Vicomte spring – Flow rate and nitrate concentrations

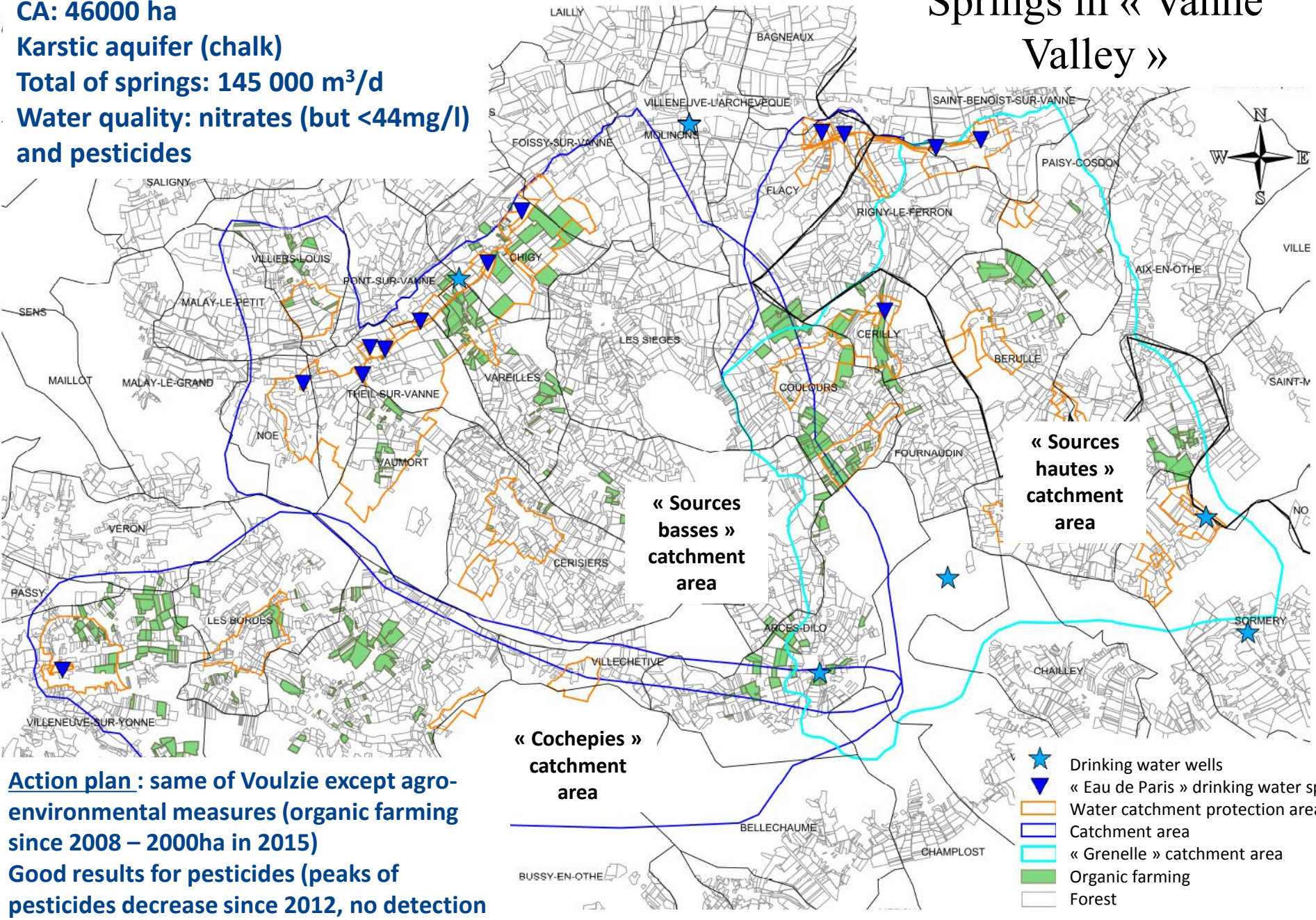

Sum of pesticides concentration (without atrazine and its metabolites) - µg/l




**Stability of nitrate concentration**
**Less detection of peak concentrations of pesticides**

# Springs in « Vanne Valley »

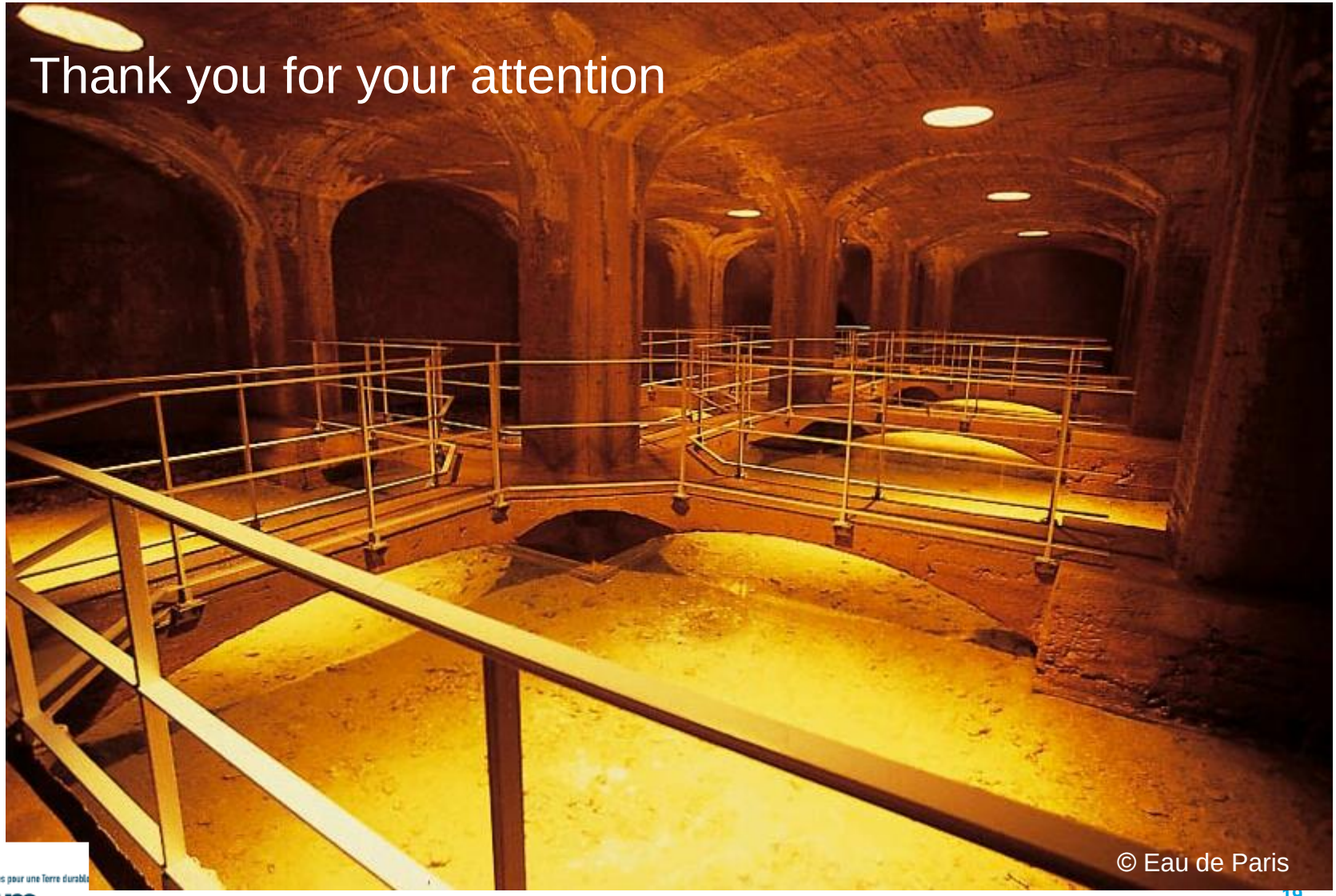
**CA: 46000 ha**
**Karstic aquifer (chalk)**
**Total of springs: 145 000 m³/d**
**Water quality: nitrates (but <44mg/l) and pesticides**




**<u>Action plan</u> : same of Voulzie except agro-environmental measures (organic farming since 2008 – 2000ha in 2015)**
**Good results for pesticides (peaks of pesticides decrease since 2012, no detection > 0.1µg/l in 2014 except atrazine metabolite)**

# Conclusion

- Building action plan need a lot of data (water quality, soil, hydrogeology, agricultural practices, economy…) which are sometimes not available
- Hard to change agricultural practices (depend on technical factors, economy, sociology…)
- Difficulty to know what are the best actions to enhance the water quality for the catchment area. Use of modeling is not all the time possible…
- Agro-environmental measures are not sustainable…


Thank you for your attention
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