Microbiological Analyzes Contribution To Knowledge Groundwater Transfers

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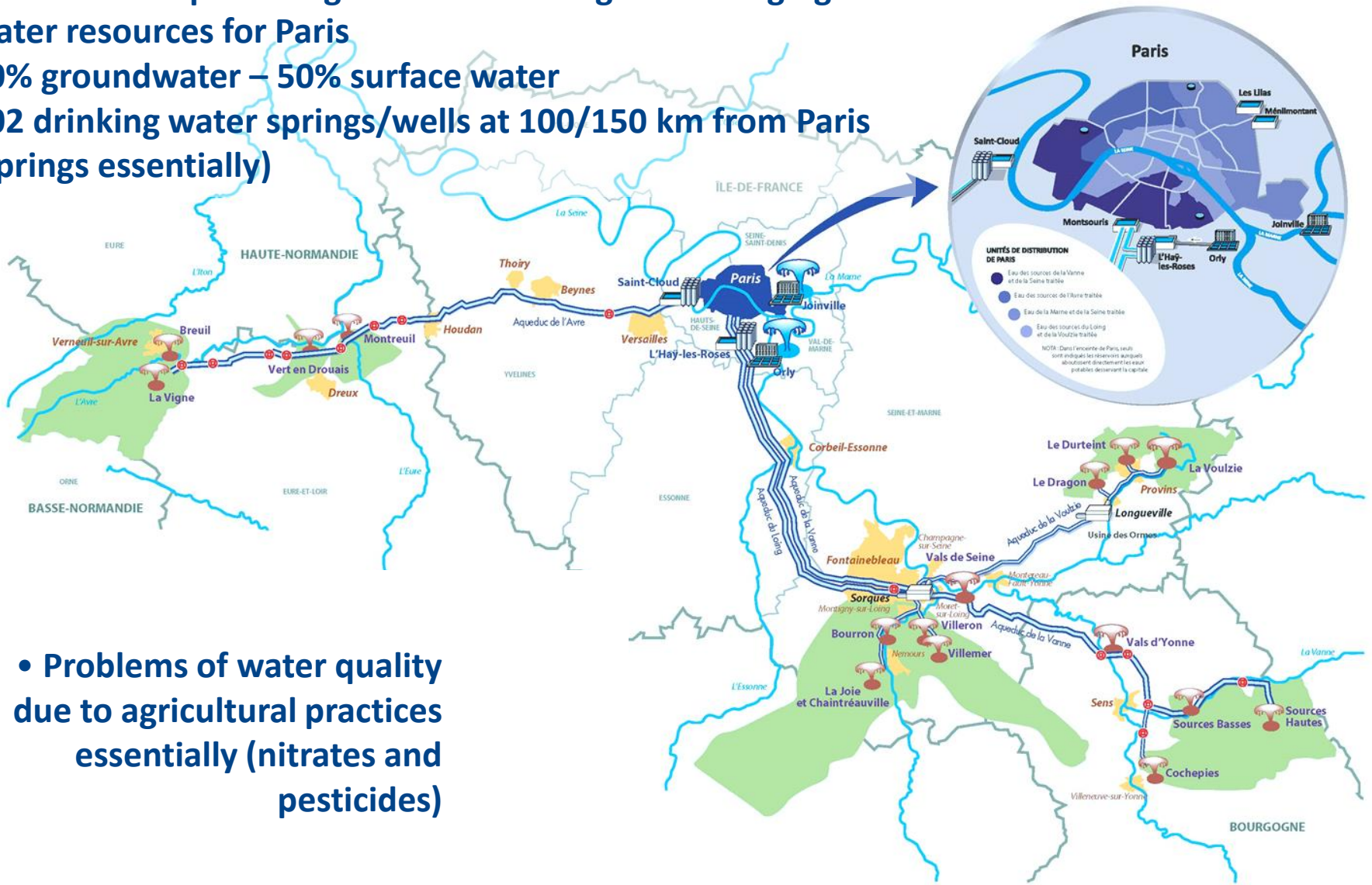
Groundwater Quality 2019, Liege

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)**

Study of viruses: what contribution for hydrogeology?

- For groundwaters used by the city of Paris, the main quality problem concerns nitrates and pesticides

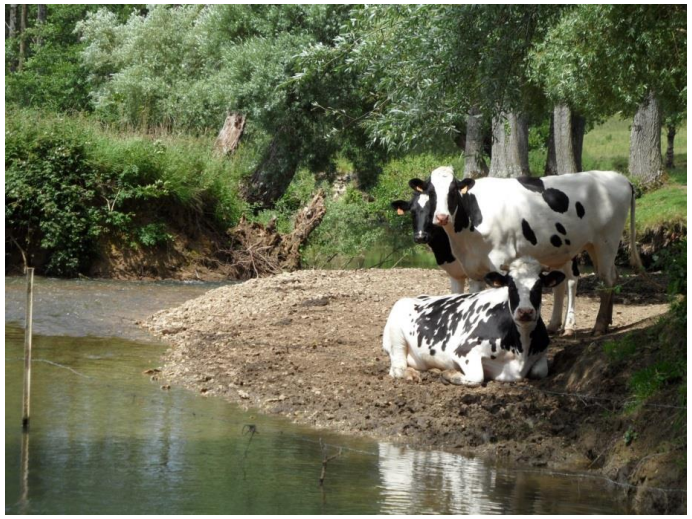
  → dilution + treatment with activated carbon…

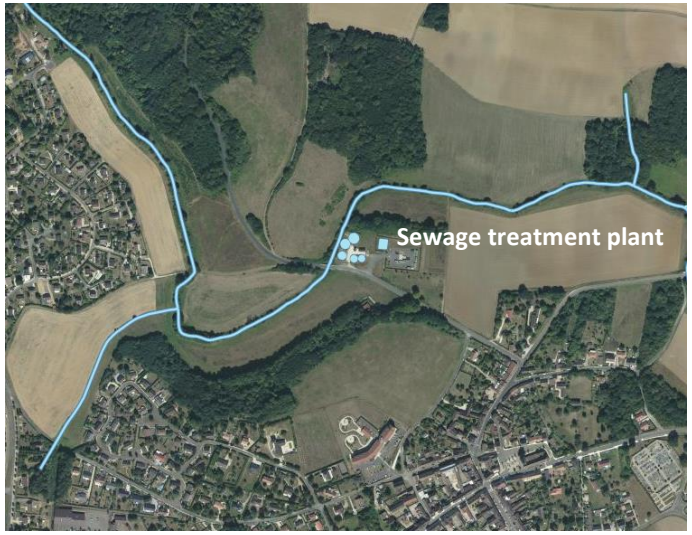
- No problem of quality for microbiological analyses (treatment), but in order to improve knowledge and protection of the water resource, characterization of virus loads and virus types for each water resource is undertaken

  → Possibility to use viruses as tracer of human or animal activity?

Viruses could be interesting tracers…

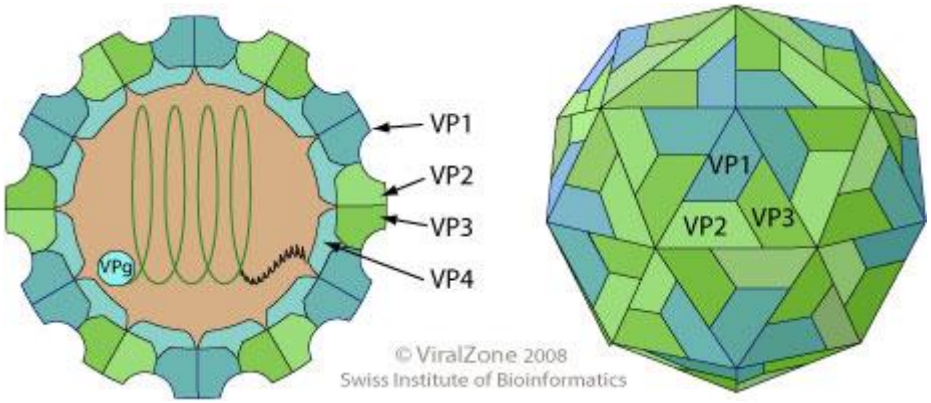
- Viruses can be used :
- To characterize water resource vulnerability
- Tracing urban pollution as defaults of sewage treatment plants or non collective sanitation
- Tracing impact of breeding animals (pollution by direct access to river? Animal load?)…





Viruses and water: recall

- Non-enveloped particles of small size 27 – 80 nm
- RNA or DNA genome
- Protected by structural proteins



- High potential infectious (10 – 1000 particles)
- Resistant in groundwater
- Non correlation with fecal indicator bacteria

Target viruses

- **Targeted search by RTqPCR technology**

- **Mainly specific viruses from human source :**

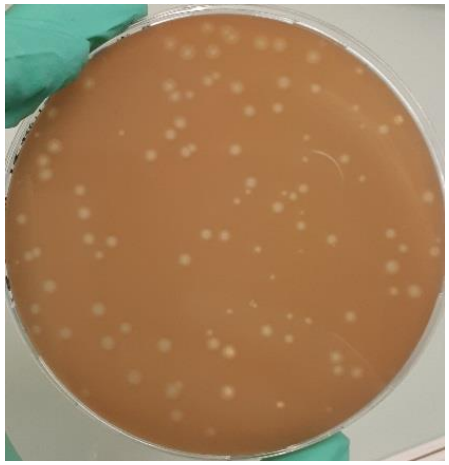
Enterovirus, adenovirus, norovirus 1 and 2, rotavirus, G2 ARN F specific phage, G3 ARN F specific phage

- **Mainly specific viruses from animal source :**

G1 ARN F specific phage, G4 ARN F specific phage

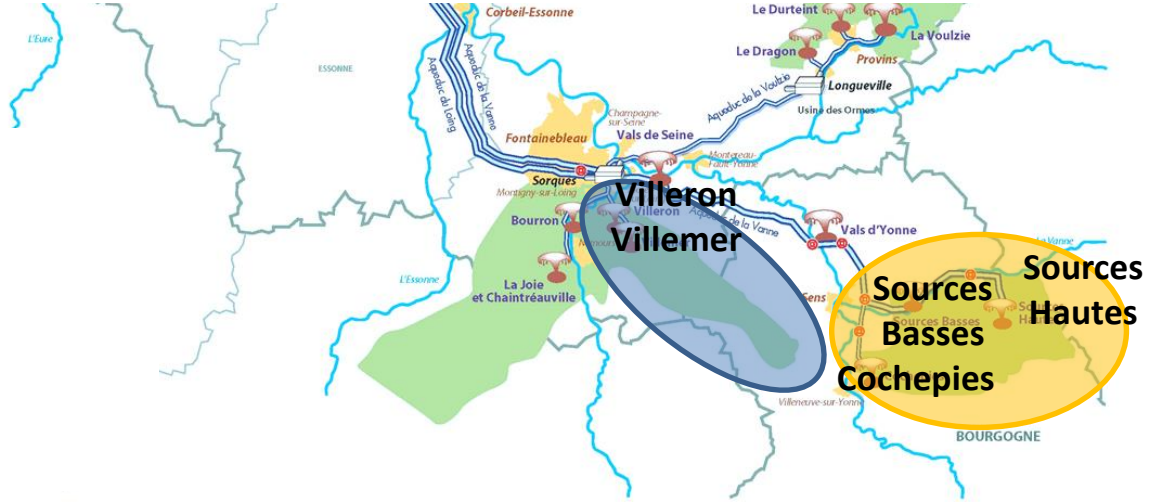
- **Non specific viruses origin : viral indicator by cell culture technology**

Somatic coliphage (non specific animal/human, escherichia coli indicator)



Methodology

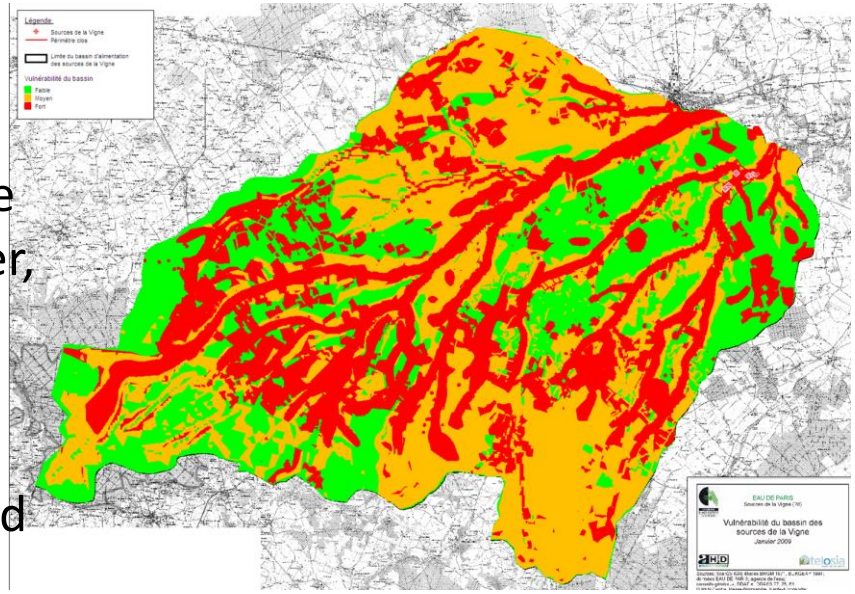
- **1st sampling campaign during summer of 2019** (dry period)
- **2nd sampling campaign will be during winter 2019-2020** (groundwater recharge and contaminant transfer period)
- **1st test in priority on karstic aquifers on 16 springs**



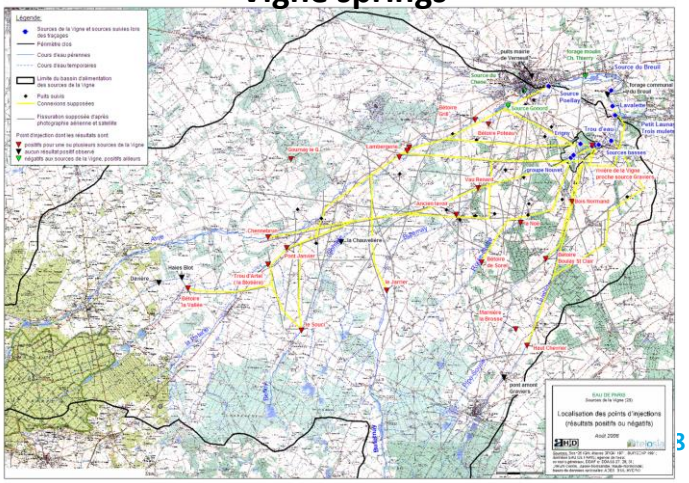
Study areas

- Sampling on 16 springs from karstic aquifers (chalk)
- Strong vulnerability and reactivity for surface transfers (infiltration of rivers to groundwater, sinkholes…). Transfer of contaminants possible in some hours or days to springs
- Water catchment areas essentially concerned by agriculture practices (field crops)
- Occasionally, cattle breeding (but extensive culture) poultry farms, sheep farms (+ horse breeding on water catchment area of Villeron and Villemer)
- Low urban pressure but default of treatment plants for sewage can be observed

Vulnerability of water catchment area of Vigne springs



Tracing experiments of water catchment area of Vigne springs



Water sampling device

Spring (raw water)

↓

Flowmeter

↓

Virus sampler

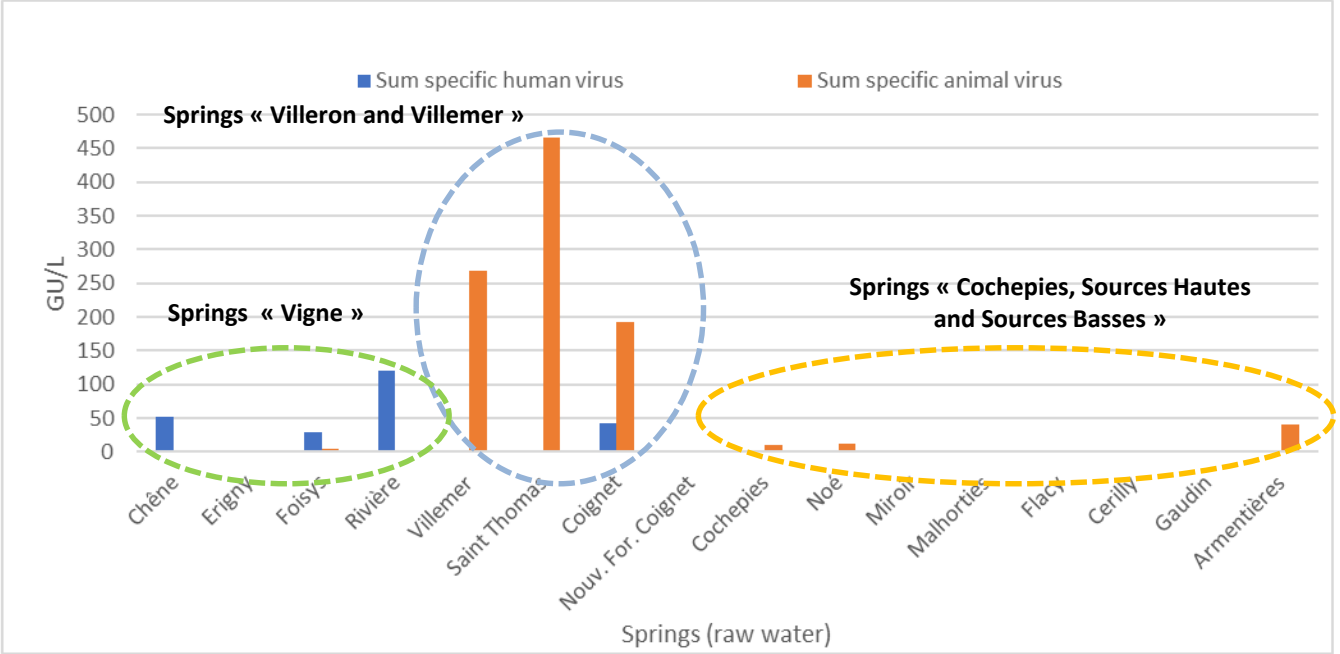
↓

Water meter

↓

Exit

First results



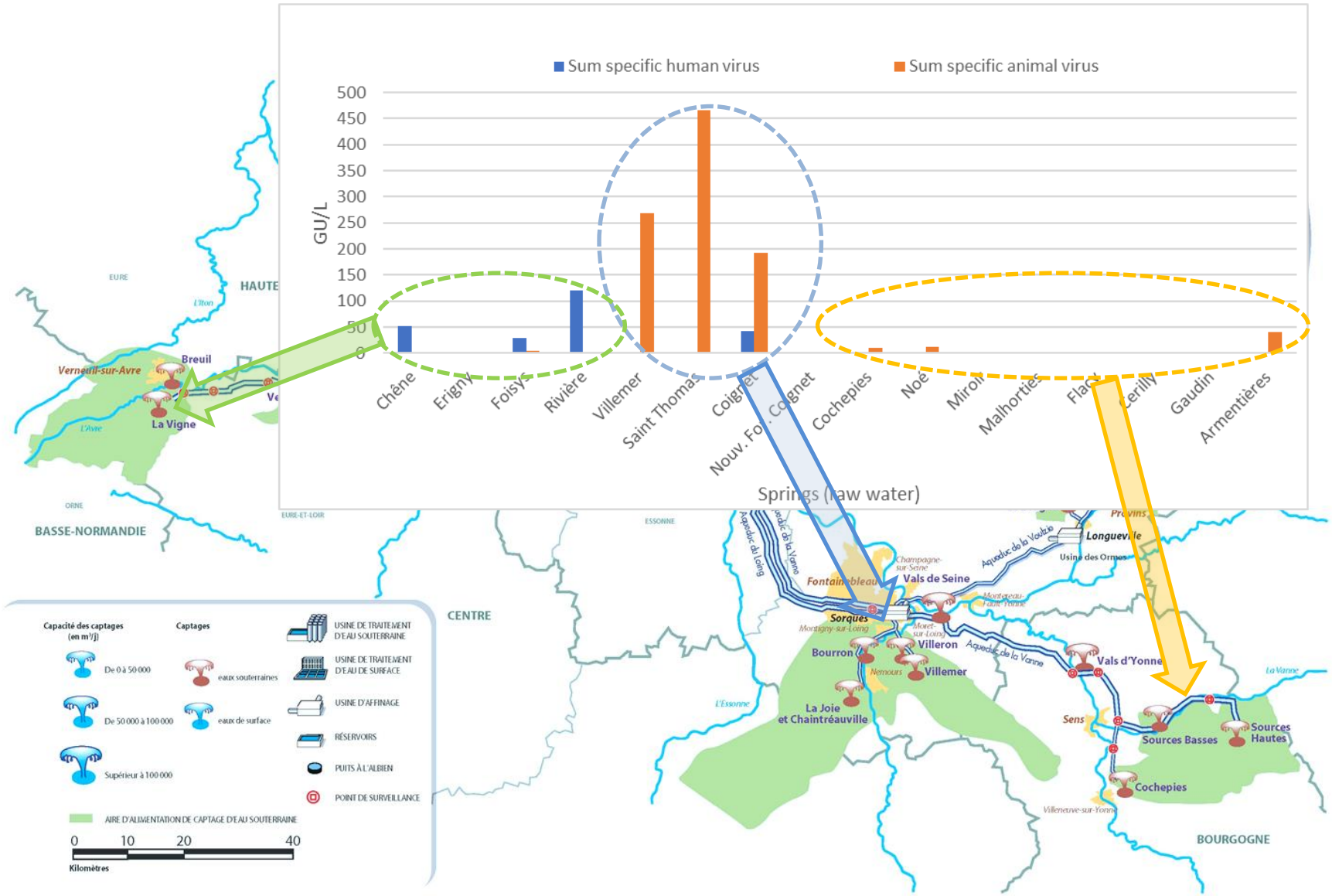
Contamination signal different for each group of springs

Rainfall before sampling:

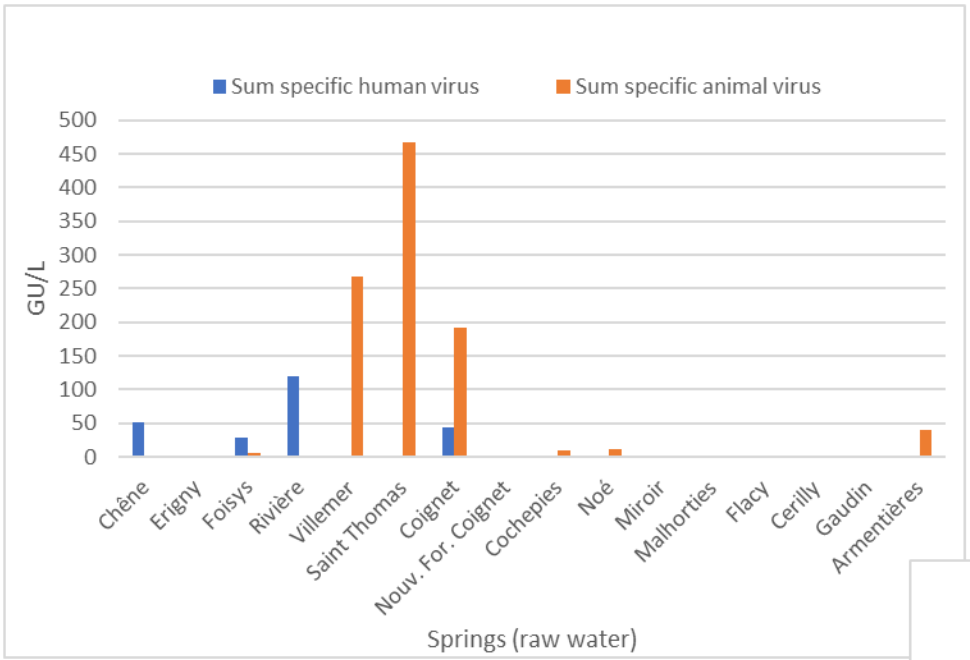
- Springs « Cochepies, Sources Hautes & Basses »: 0 mm on last 3 days, <1 mm on last 10 days
- Springs « Villeron and Villemer »: 13mm on last 3 days, 16 mm on last 10 days (but weak impact on transfer: spring flow rates at about stability)
- Springs « Vigne »: 0 mm on last 3 days, 3mm on last 10 days

→ Dry period, except for Villeron and Villemer springs, but flow rates were about stable during last 3 days before sampling

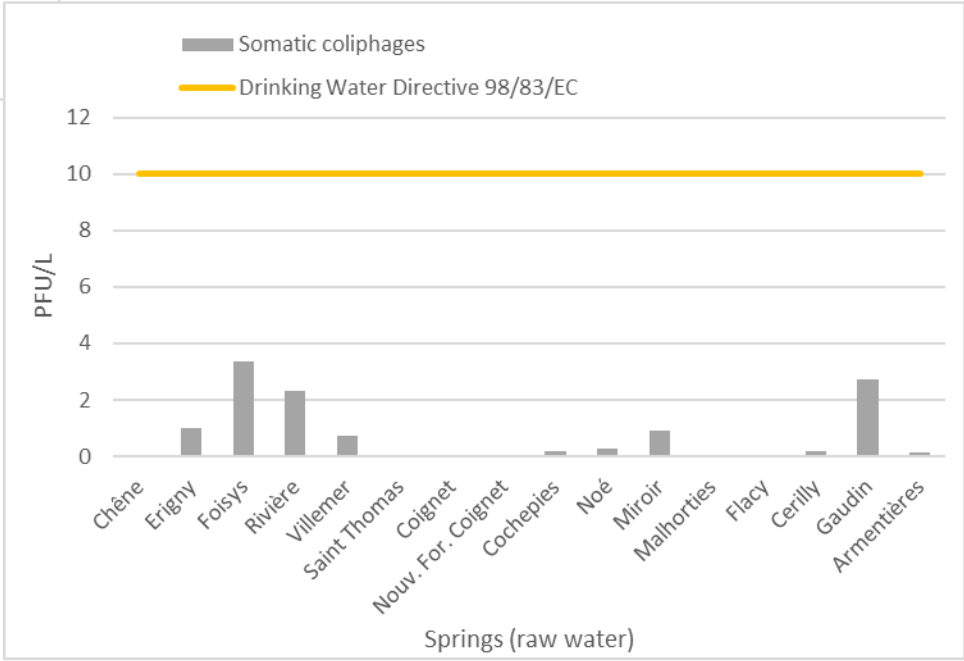
First results



First results



Somatic coliphages not relevant to characterize contamination source or for pollution detection



Somatic coliphages will be used as indicator of treatment efficiency

First conclusions and continuation of study

- Groundwaters used for the city of Paris : good microbiological quality (+ treatment)

… but study of viruses can be very interesting to perform knowledge of water resources:

- Viruses = vulnerability indicators
- Viruses = hydrological tracers for human or animal activities

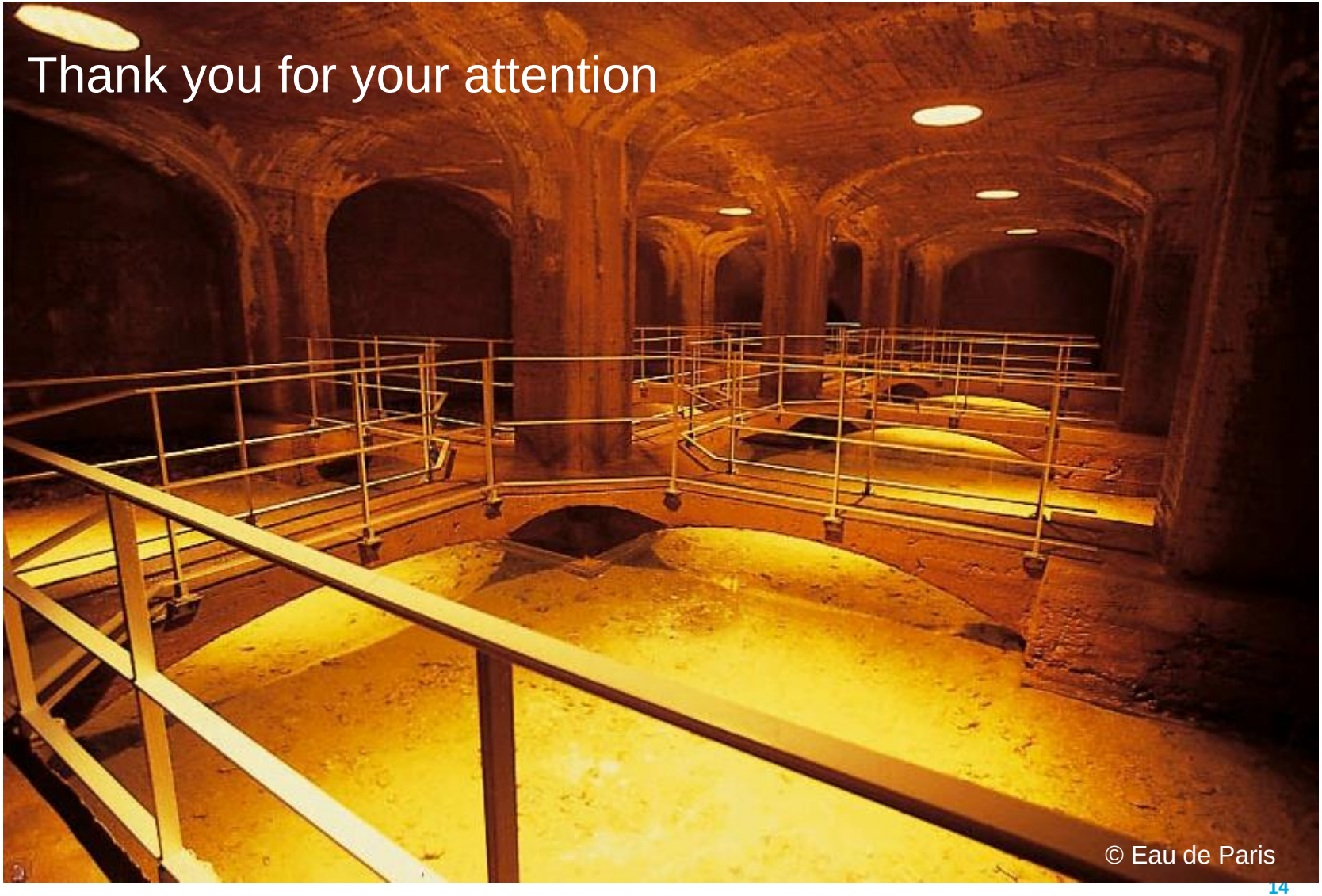
- **Next steps**

- Sampling on other water resources (different hydrogeological contexts) and at different times (what will be signals during winter conditions or after run off periods?)

- Classify water resources according to vulnerability of transfers for viruses

- Cross the results with other specific tracers (medicaments…)…

- When necessary, identify corrective actions to protect water resources


Thank you for your attention
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