Socio-hydrogeological approach to identify **contaminant fluxes** towards **groundwater-dependent hydrosystems**, case of the Biguglia lagoon (Corsica, France)

E. Crayol, F. Huneau, E. Garel, V. Re, A. Mattei, S. Santoni and V. Pasqualini *

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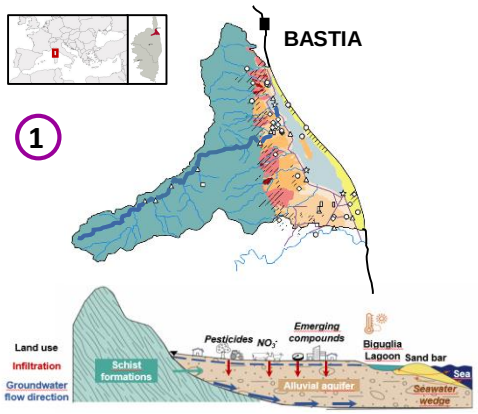
EGU General Assembly 2022

Multidisciplinary approach



Hydrogeological investigations

Socio-hydrogeological approach

3

Overview of the pollutions

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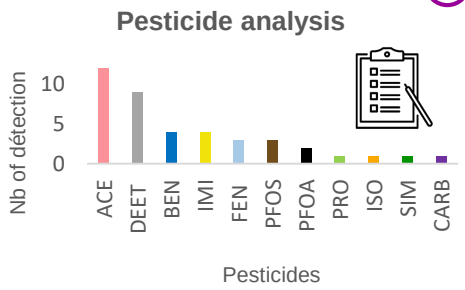


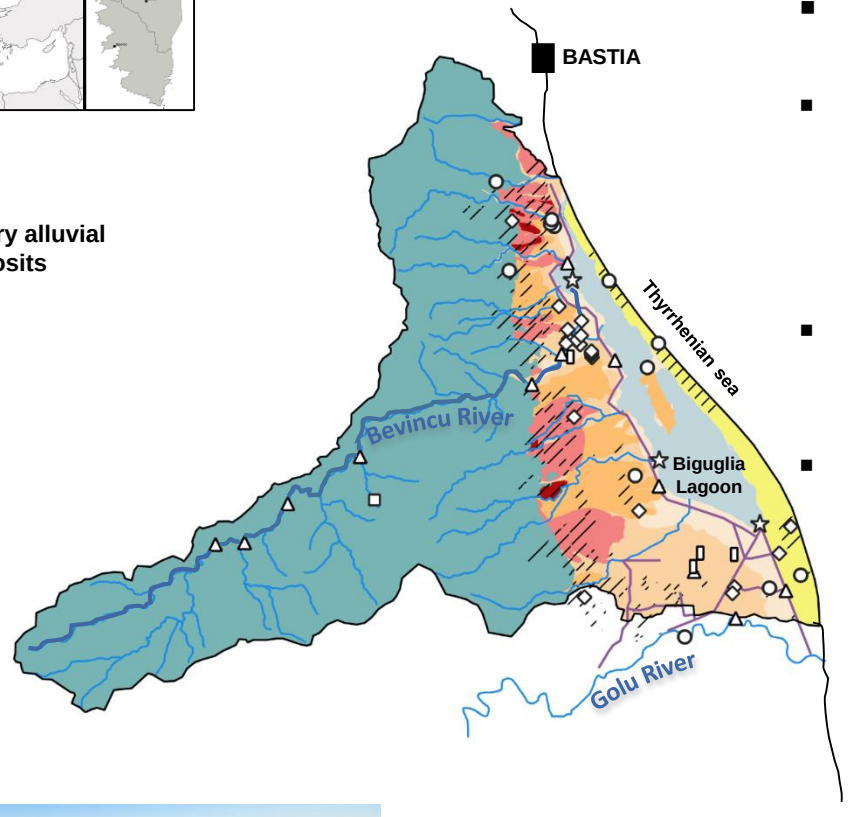
Identification of pollution sources

Key findings

- **Coastal hydrosystems** are usually **groundwater dependent**. They provide good and services from which human societies take advantage. However they are very fragile and vulnerable environments submitted to various anthropogenic pressures. **Groundwaters**, due to their invisible nature, are still **poorly understood**, damaging their management and associated water bodies.
- The use of **classical hydrogeological tools** (physico-chemical parameters, major ions, trace elements, stable isotopes of the water molecule $\delta^{18}O$ / $\delta^{2}H$) combined with complementary tracers like **emerging organic compounds** (EOCs) and **pesticides** are useful to understand the hydrogeological functioning of those hydrosystems.
- Also the **socio-hydrogeological approach**, including social and economic components into hydrogeological investigations, helps to understand the relations between population and groundwater. It allows to identify more precisely the pollution sources and dispersion modalities of pollutant fluxes towards groundwater dependent ecosystems.

OSPP Contest

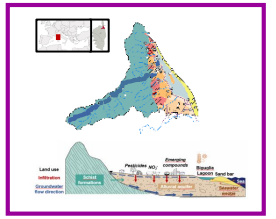
The **Biguglia lagoon watershed** (Corsica, western Mediterranean) **as pilot site**



- **Largest** wetland of the island (14,5 km²) apart of a 182 km² watershed
- Strong **environmental interest :**
  - Natural Reserve
  - Natura 2000 site
  - RAMSAR site
- Located on an alluvial plain which constitutes the main **aquifer** of the region, exploited for **drinking water**
- In a previsous PhD thesis (Erostate, 2020) the hydrosystem **functioning** and the **groundwater dependency** have been demonstrated
- **Agriculture** and increasing **urbanization** since the 1950's are the two main types of land uses on the alluvial plain of the watershed
- Consequently, significant **nitrate contents, emerging compounds (EOCs),** and **pesticides** have been observed ➔ but **their origin** still needs to be specified

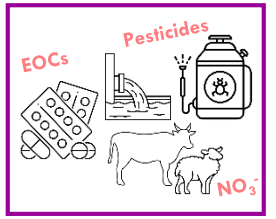
The combination of hydrogeological investigations and a socio-hydrogeological approach allows to identify precise pollution sources on the waterbodies of the watershed

1. Study site

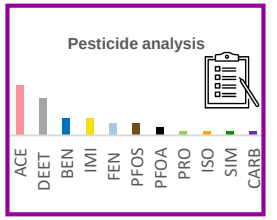


2. Socio-hydrogeological approach

3. Overview of the pollutions



4. Identification of pollution sources



The socio-hydrogeological approach

Socio-hydrogeology : indicator of the relations between the population and groundwater. Including socio-economic dimension in the classical hydrogeological investigations.

Methodology:

- Development of a **semi-structured questionnaire** around **4** axes :

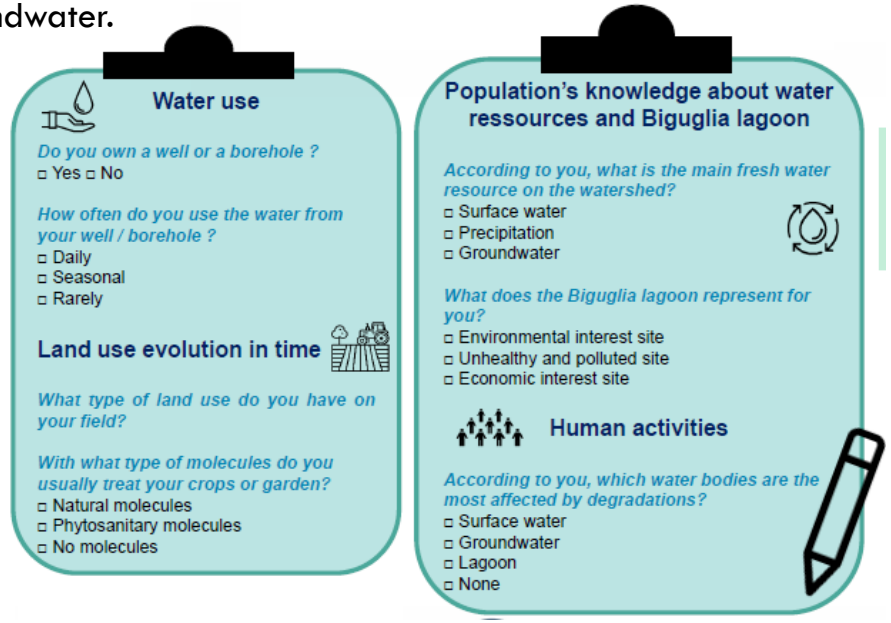
  - Past and present water uses
  - Land uses evolution since 1950
  - Population's perception on groundwater and the lagoon
  - Perception on anthropogenic impacts

  ➔ **25 water users** interviewed and **16 local stakeholders**

- **Field campaign** combining sampling and field survey led in **spring 2021**

- Hydrogeological investigations including **chemical, geochemical** and **isotopic** analysis ($^{2}H/^{18}O$) carried out on **53** sampling points

- **21** sampling points for **pesticide** analysis
  ➔ **11** molecules found among a **screening** of **240** molecules and metabolites



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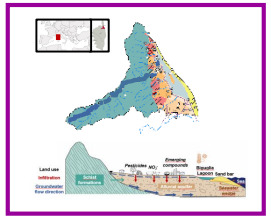

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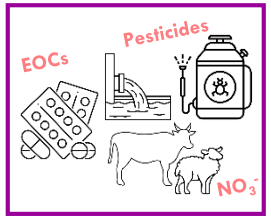

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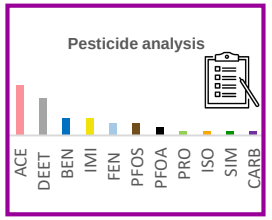


Overview of the differents pollutions identified on the Biguglia Lagoon watershed

Complementary tracers used for the understanding of the hydrogeological functioning

- **Pesticides** : analysis show a double pollution **agricultural and domestic** (molecules from sanitation defects)
  Also molecules **banned since 20 years** (Fenuron, Simazine)

  → Storage capacity
  Pollution legacy

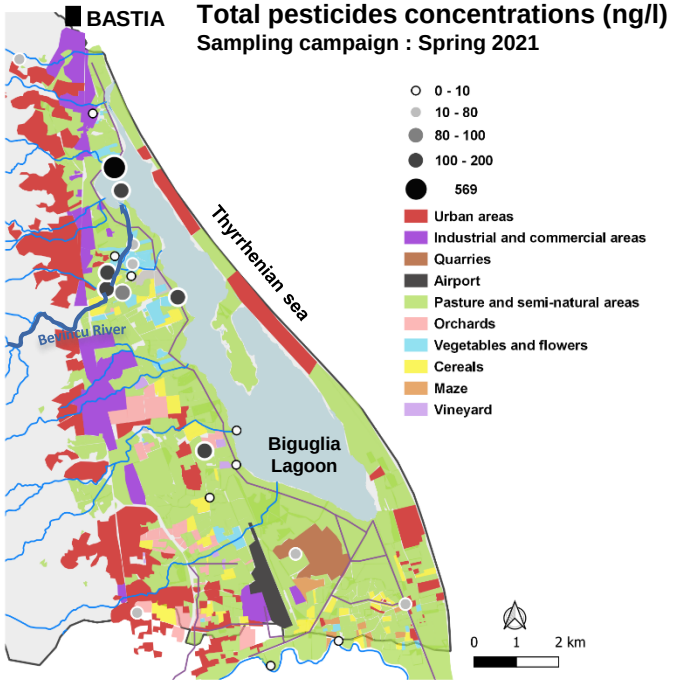
- **EOCs :** Consumed by the population ➔ **anthropogenic origin** mainly from **untreated sewage waters**

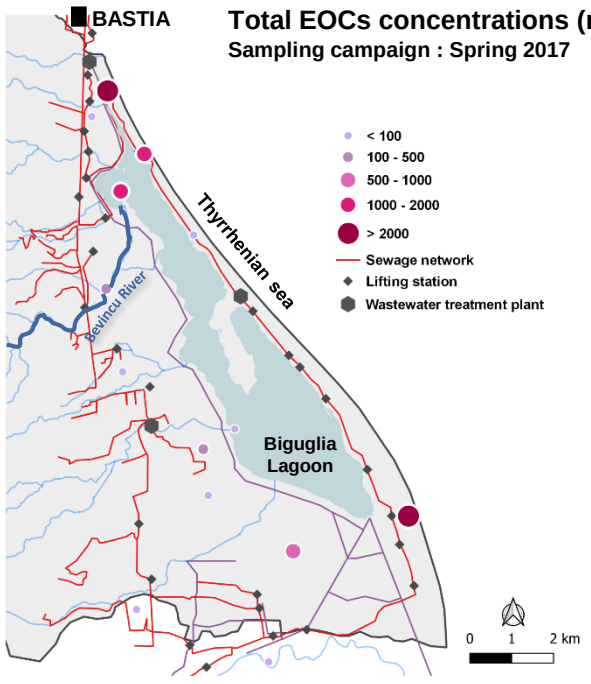
  → Rapid infiltration

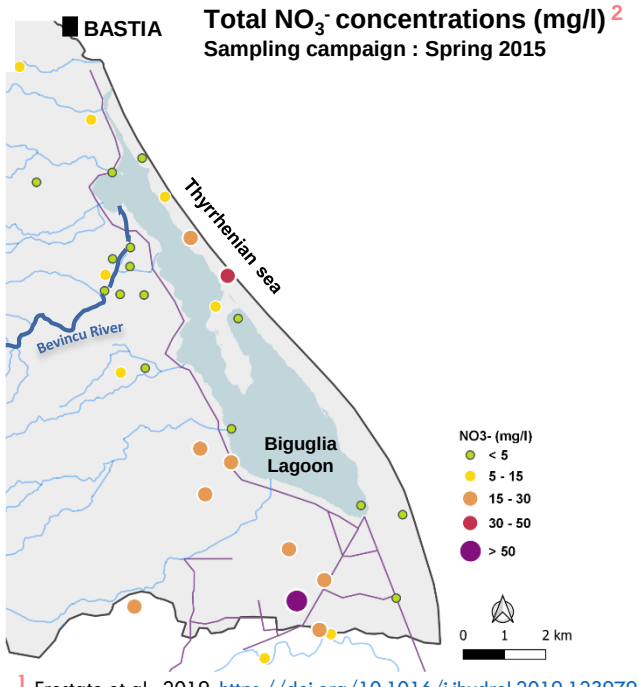
- **NO_3^- :** Contamination with a double origin : **nitrogen from the soil** & **sewage waters**

  → Storage capacity
  Historic pollution legacy

Various anthropogenic pollution sources from past and present uses







[1] Erostate et al., 2019. https://doi.org/10.1016/j.jhydrol.2019.123979

[2] Jaunat et al., 2019. https://doi.org/10.1016/j.scitotenv.2018.12.249

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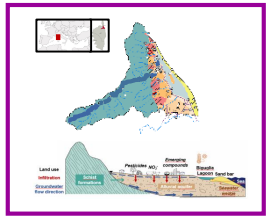

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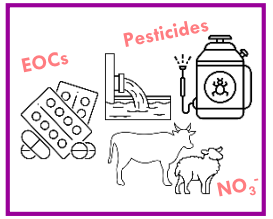

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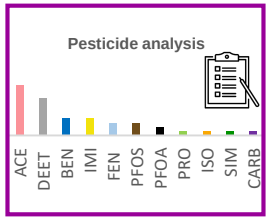


Identification of precise pollution sources

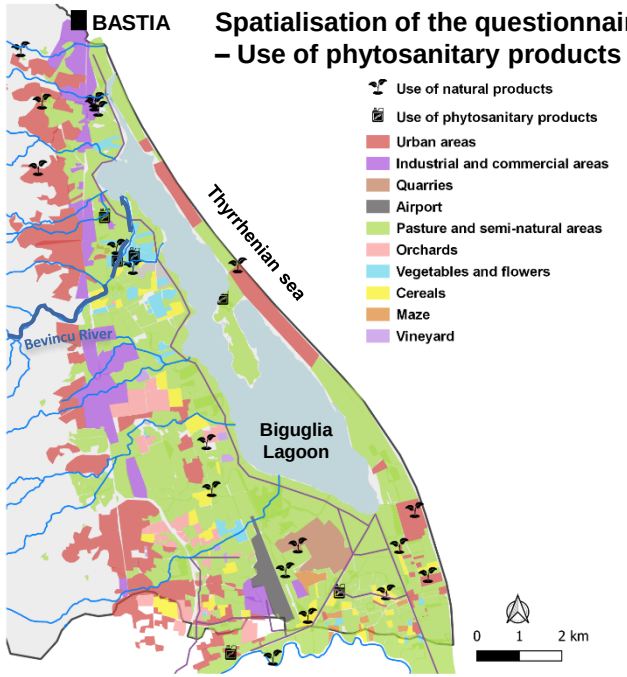
The combination of **hydrogeological investigations** with the **questionnaire** and the **field survey** allows to identify :

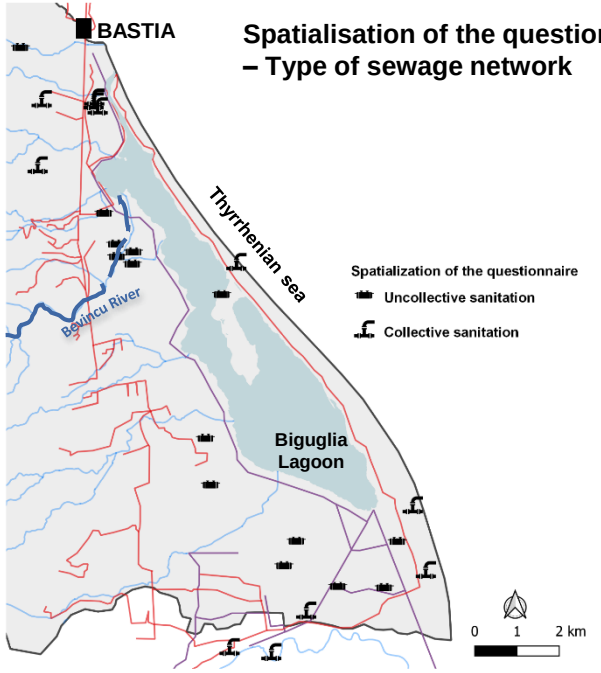
- Agricultural pollution as **very local :** at the **plot scale**

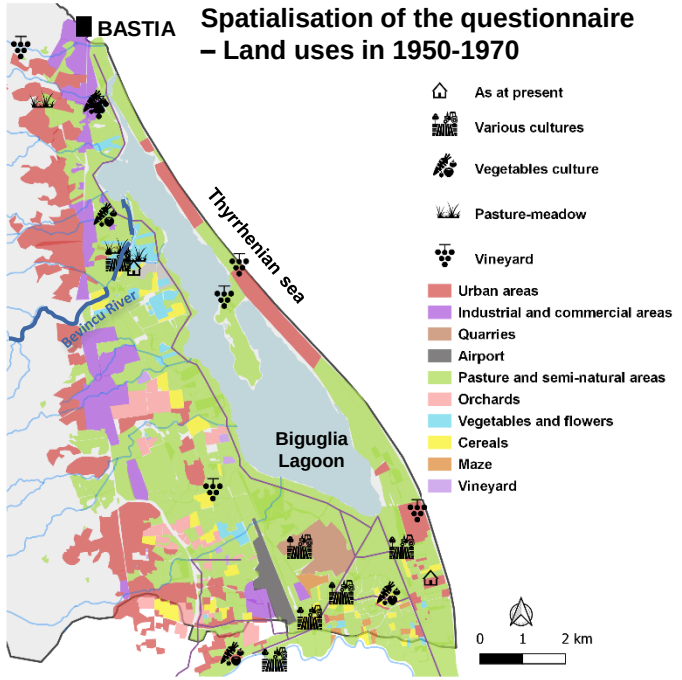
➔ Pesticides identified correspond **to agricultural practices on the plain** identified during the field survey and by the questionnaire

- The sewage network **completed** with the questionnaire highlight that the pollution with **EOCs and NO_3^-** in « recent waters » come from **sanitation defects and septic tanks**

- Land uses in 1950-1970 confirm the **pollution legacy** and the **storage capacity** of groundwater

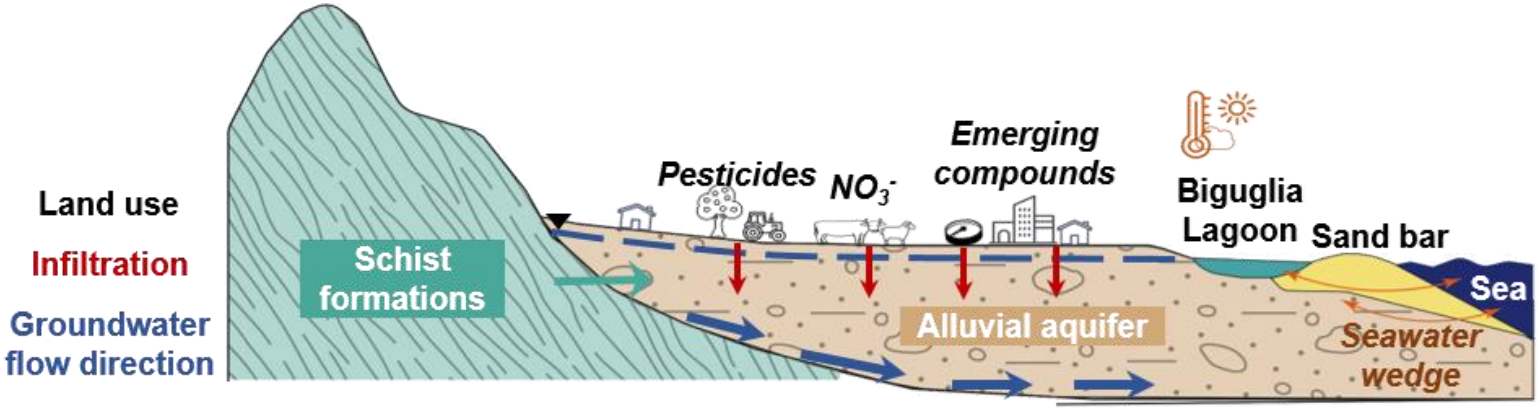


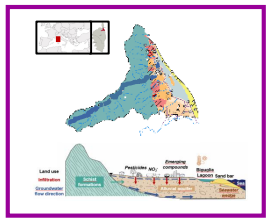


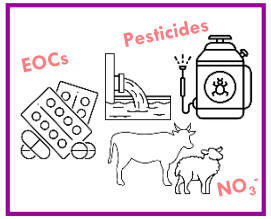


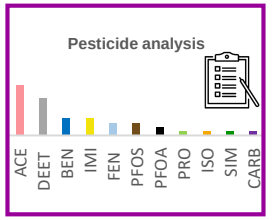
Conclusion

- **Hydrogeological investigations** combined with the **socio-hydrogeological approach** have allowed to identify precise pollution sources in relation to the **water use** and **land use evolution** in time on the watershed
- These specific pollutants are considered as **relevant tracers** of the coastal **Mediterranean anthropization phenomenon**
- The **storage capacity** of groundwater is, most of the time, **underestimated** and not always **taken into account** by resource managers and ecologists
- This new knowledge will help **local stakeholders** to take into account scientific investigations in order to **protect groundwater resources and associated waterbodies**









Main page

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