



Comment les eaux souterraines contribuent-elles au fonctionnement des écosystèmes lagunaires ?

Mélanie Erostate - Docteur en hydrogéologie (Université de Corse)

Chargée de mission Nappes profondes (Institution Adour)



4^{ème} plateforme Recherche-Gestion – 30 novembre 2021 à Corte



LABORATOIRE SCIENCES POUR L'ENVIRONNEMENT UMR 6134 SPE



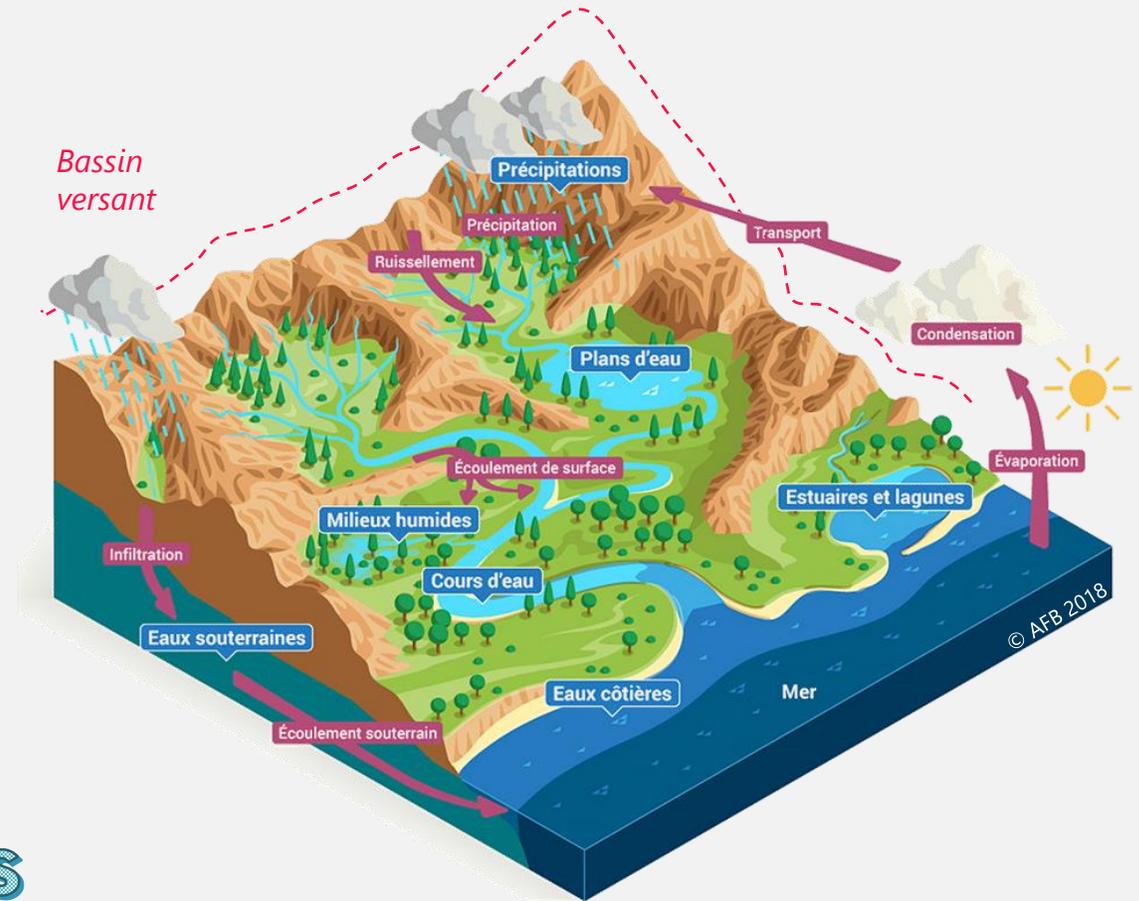
Les eaux souterraines

**La face cachée des
hydrosystèmes**



Hydrosystèmes et dépendance à l'eau souterraine

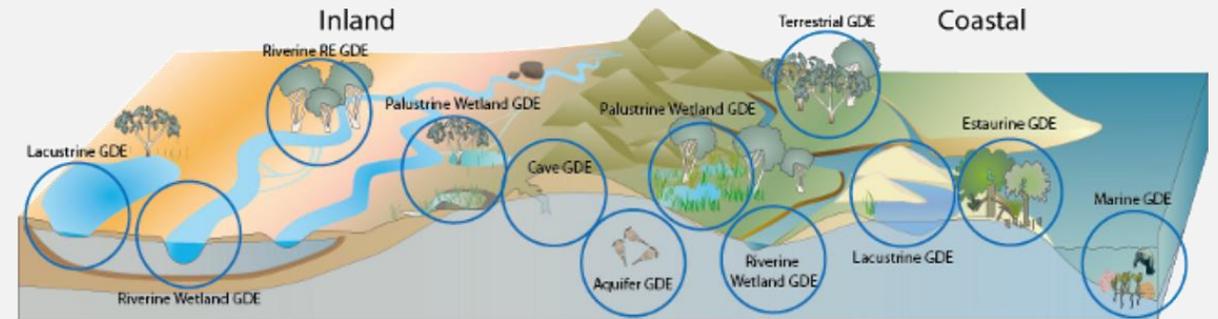
- **Un système complexe**
 - Ensemble indissociable de masses d'eau et d'écosystèmes interconnectés, dans un espace géographique donné
- **Système variable**
 - Evolue dans le temps
 - Modifié par les activités humaines



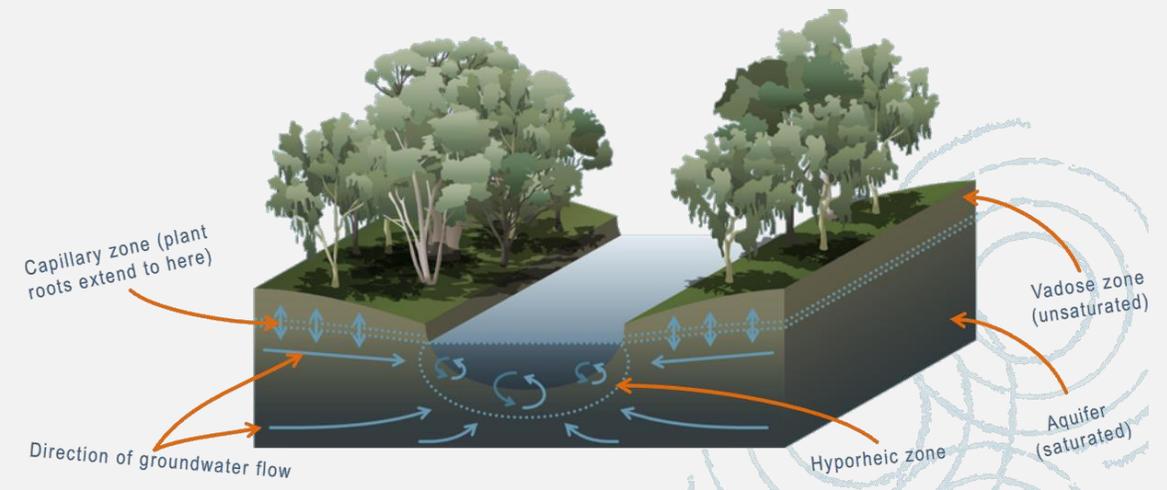
**Écosystèmes tributaires des
eaux souterraines**

Hydrosystèmes et dépendance à l'eau souterraine

- **3 types d'écosystèmes tributaires :**
- Souterrains : écosystèmes aquifères et cavernicoles
- Eau souterraine de subsurface : végétation terrestre
- **Eau souterraine après son écoulement en surface : tous les milieux humides** (riverains, palustres, lacustres, estuariens, marins)



Source : Queensland Government, 2021



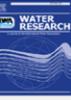
Source : Queensland Government, 2021

Les hydrosystèmes côtiers tributaires



Contents lists available at ScienceDirect

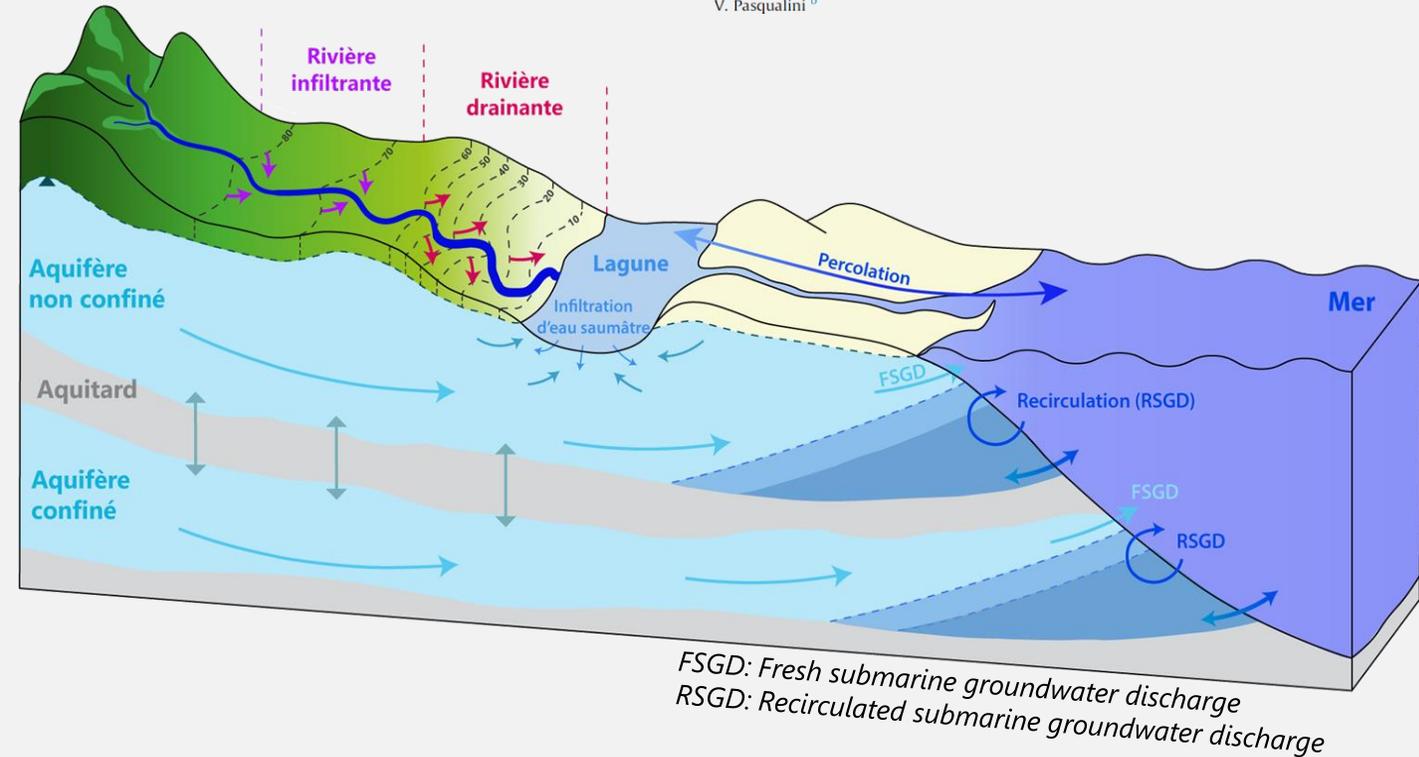
Water Research

journal homepage: www.elsevier.com/locate/watres

Groundwater dependent ecosystems in coastal Mediterranean regions: Characterization, challenges and management for their protection

M. Erostate ^{a, b, *}, F. Huneau ^{a, b}, E. Garel ^{a, b}, S. Ghiotti ^c, Y. Vystavna ^d, M. Garrido ^e, V. Pasqualini ^b

- Bilan hydrique & nutritif
 - **Apports d'eau et de nutriments**
- Assurent la **régularité** des apports & **contrôlent** la physico-chimie
 - **Evolution, pérennité & résilience**
- **Vecteur de contaminations** issues du bassin versant



Rôle majeur des eaux souterraines

Dépendance aux eaux souterraines

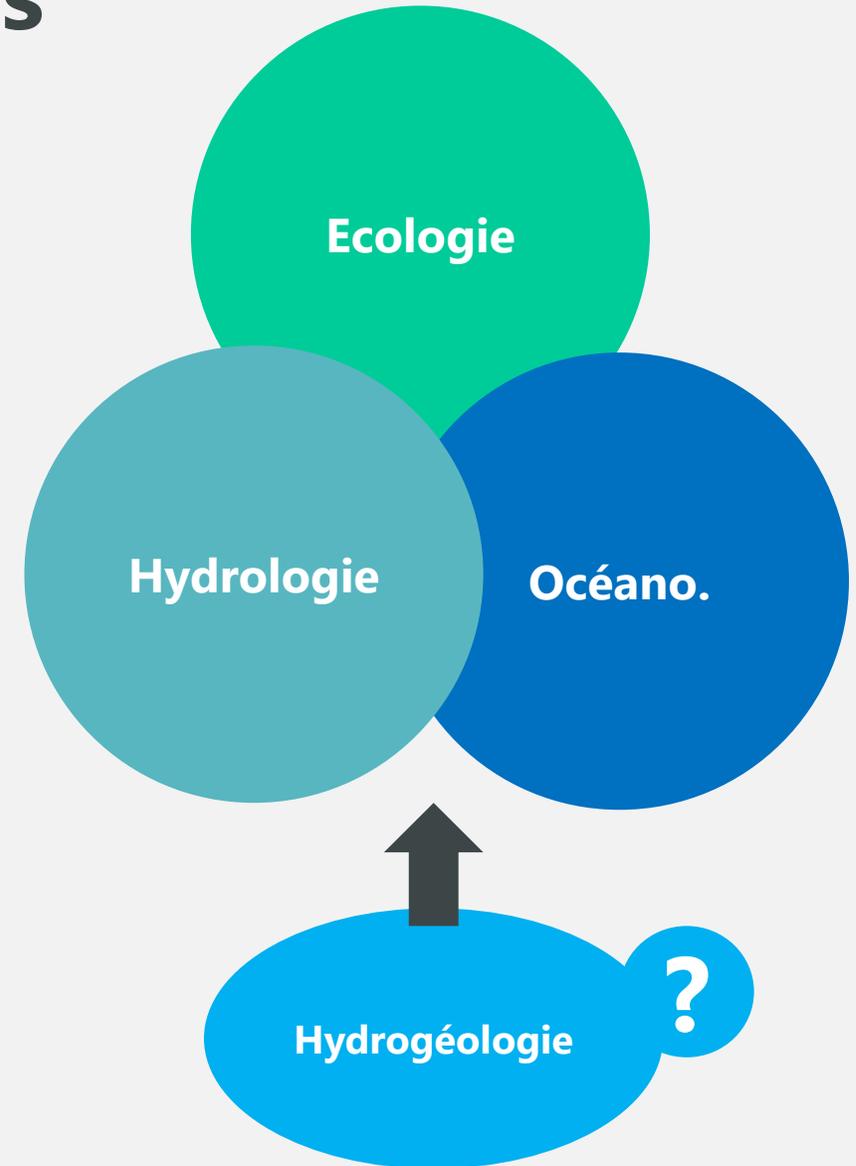
**Le cas particulier
des lagunes côtières**



Spécificités des lagunes côtières

- Importance socio-économique majeure
- **Pressions fortes**
 - Cumul des dégradations
- **Appréhension trop souvent restreinte**
 - En 2D : *on étudie/gère ce que l'on voit*
 - Méconnaissance/oubli de la composante souterraine

Importance de l'approche transdisciplinaire en 3D !

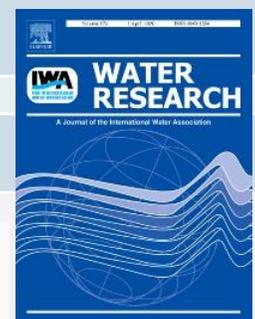




Dépendance des lagunes côtières à travers le monde

Lagoons	Countries	Protection status	Hydrosystem behavior and groundwater dependence	
			<i>Strongly suspected</i>	<i>Demonstrated</i>
Mar menor	Spain, South-East	Ramsar site / Special bird habitat Regional park / Site of Community importance / Specially protected area of Mediterranean importance		Studied and relatively well known
Thau	France, South-Est	Natura 2000 / Special bird habitats / Water Framework Directive site		Studied but lack of data to understand the global behavior
Biguglia	France, Corsica island	Ramsar site / Nature Reserve		Studied and relatively well known
Venice	Italy, North-East	Ramsar site / Natura 2000 / Special bird habitat		Largely studied and relatively well known
Varano	Italy, South-East		Under-documented	
Messolonghi central lagoon	Greece, North-West	Ramsar site / National Park / Important Bird Area / Natura 2000	Under-documented	
Korba	Tunisia, plain of Cap Bon	Important Bird Area / Ramsar site	Under-documented	
Bizerta	Tunisia	Ramsar site / UNESCO-MAB Reserve	Under-documented	
Nador	Marocco, Nord-Est	Ramsar site / Nature Reserve / Site of biological and ecological interest	Groundwater contribution known but under-studied	
Coorong	Australia, South-East	Ramsar site / National Park		Studied and well known
Langebaan	South Africa	National Parks / Ramsar site	Under-documented	
El Yali	Chile	National reserve / Ramsar site	Groundwater contribution known but under-documented	
San Diego	California (U.S.A)	National Wildlife Refuge	Under-documented	
Malibu	California (U.S.A)		Groundwater contribution known but under-documented	

M. EROSTATE, et al., 2020. Groundwater dependent ecosystems in coastal Mediterranean regions: Characterization, challenges and management for their protection. *Water Research* 172, 115461.

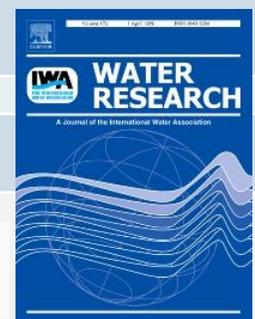




Dépendance des lagunes côtières à travers le monde

Lagoons	Countries	Protection status	Hydrosystem behavior and groundwater dependence	
			<i>Strongly suspected</i>	<i>Demonstrated</i>
Mar menor	Spain, South-East	Ramsar site / Special bird habitat Regional park / Site of Community importance / Specially protected area of Mediterranean importance		Studied and relatively well known
Thau	France, South-Est	Natura 2000 / Special bird habitats / Water Framework Directive site		Studied but lack of data to understand the global behavior
Biguglia	France, Corsica island	Ramsar site / Nature Reserve		Studied and relatively well known
Venice	Italy, North-East	Ramsar site / Natura 2000 / Special bird habitat		Largely studied and relatively well known
Varano	Italy, South-East		Under-documented	
Messolonghi central lagoon	Greece, North-West	Ramsar site / National Park / Important Bird Area / Natura 2000	Under-documented	
Korba	Tunisia, plain of Cap Bon	Important Bird Area / Ramsar site	Under-documented	
Bizerta	Tunisia	Ramsar site / UNESCO-MAB Reserve	Under-documented	
Nador	Marocco, Nord-Est	Ramsar site / Nature Reserve / Site of biological and ecological interest	Groundwater contribution known but under-studied	
Coorong	Australia, South-East	Ramsar site / National Park		Studied and well known
Langebaan	South Africa	National Parks / Ramsar site	Under-documented	
El Yali	Chile	National reserve / Ramsar site	Groundwater contribution known but under-documented	
San Diego	California (U.S.A)	National Wildlife Refuge	Under-documented	
Malibu	California (U.S.A)		Groundwater contribution known but under-documented	

M. EROSTATE, et al., 2020. Groundwater dependent ecosystems in coastal Mediterranean regions: Characterization, challenges and management for their protection. *Water Research* 172, 115461.



La lagune de Biguglia

Apports scientifiques

- Lagune tributaire des eaux souterraines (via les stations de pompage)
- Eaux souterraines :
 - jusqu'à 75% des apports en eau douce à la lagune
 - Capacité de **stockage des nitrates** dans les eaux souterraines → prise en compte des legs polluants, menace pour l'écosystème ?



Améliorer la connaissance/compréhension
Collaboration entre disciplines scientifiques
Laisser une « vraie place » à l'hydrogéologie

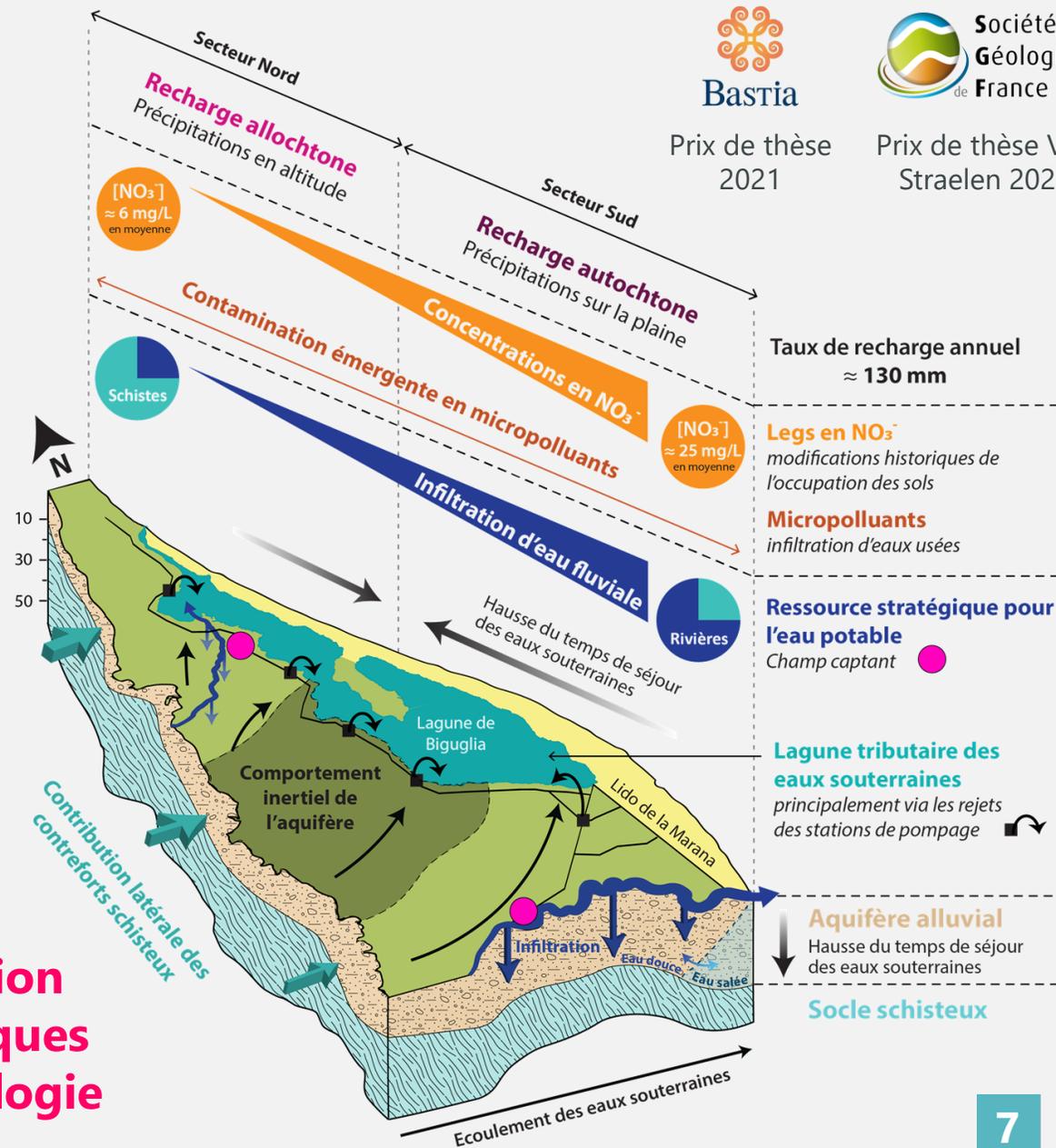


Bastia

Prix de thèse
2021



Prix de thèse Van
Straelen 2021





M. EROSTATE, et al., 2018. Delayed nitrate dispersion within a coastal aquifer provides constraints on land-use evolution and nitrate contamination in the past. *Science of The Total Environment* 644, 928–940.

J. JAUNAT, E. GAREL, F. HUNEAU

J. JAUNAT, et al., 2019. Combinations of geoenvironmental data underline coastal aquifer anthropogenic nitrate legacy through groundwater vulnerability mapping methods, *Science of The Total Environment* 658, 1390-1403.

M. EROSTATE, et al., 2021. The challenge of assessing the proper functioning conditions of coastal lagoons to improve their future management



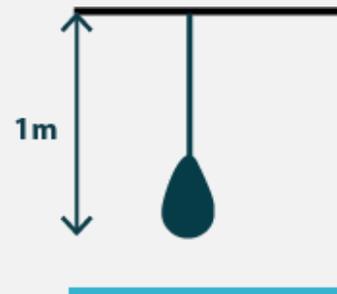
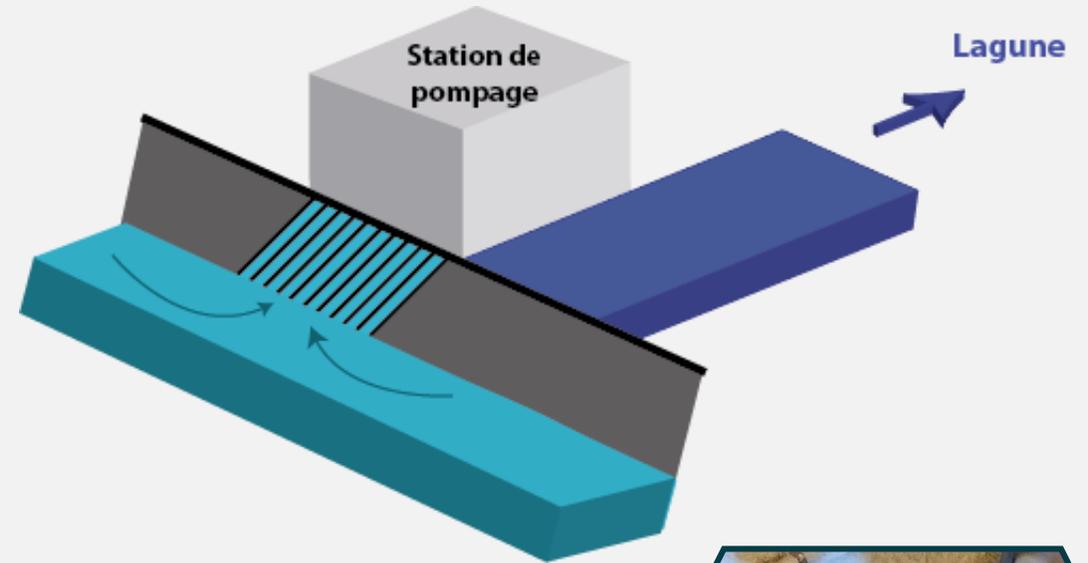
M. EROSTATE, et al., 2019. Coupling isotope hydrology, geochemical tracers and emerging compounds to evaluate mixing processes and groundwater dependence of a highly anthropized coastal hydrosystem. *Journal of Hydrology* 578, 123979.



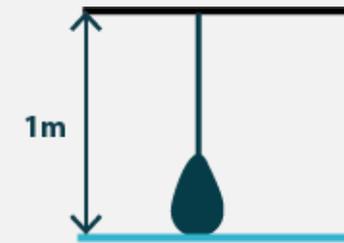
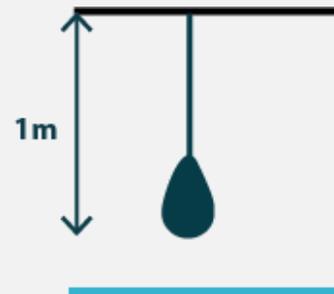
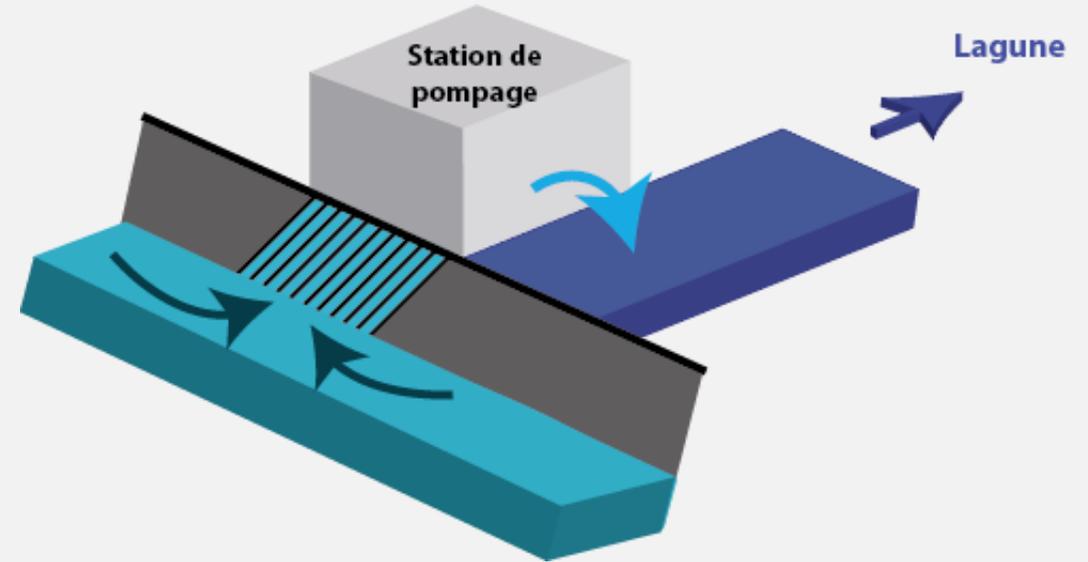
M. EROSTATE, et al., 2020. Groundwater dependent ecosystems in coastal Mediterranean regions: Characterization, challenges and management for their protection. *Water Research* 172, 115461.



La particularité du réseau de drainage artificiel



La particularité du réseau de drainage artificiel



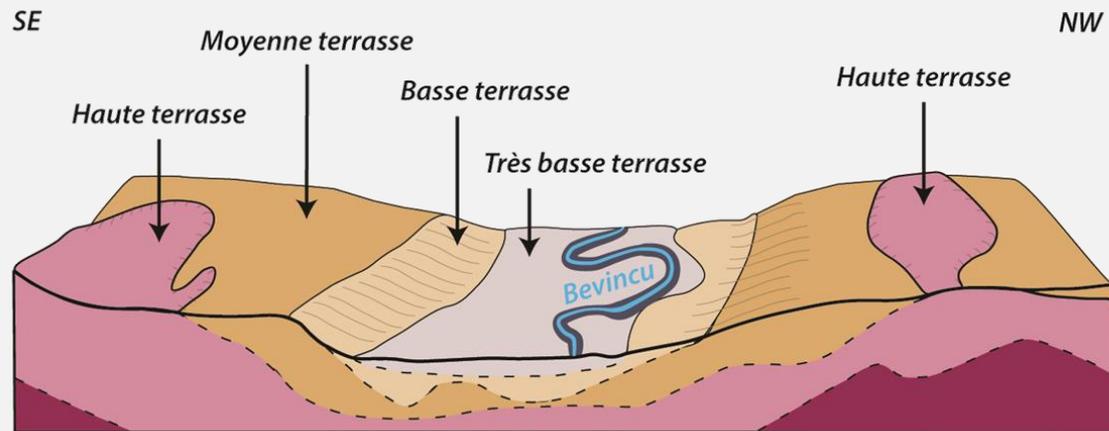


Le bassin versant

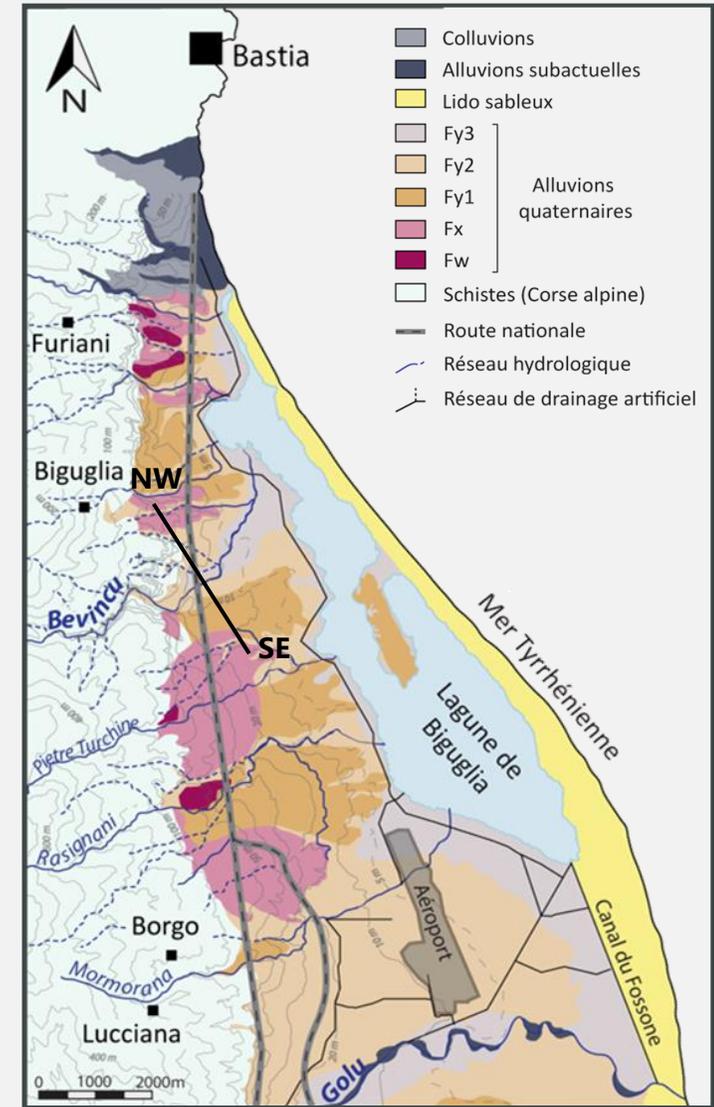
- 182km²
- 2 cours d'eau pérennes
- **Géologie**

→ Schistes lustrés

→ Plaine sédimentaire



- Fz : alluvions subactuelles
- Fy3 : alluvions très récentes
- Fy2 : alluvions récentes
- Fy1 : alluvions assez anciennes
- Fx : alluvions anciennes
- Fw : alluvions très anciennes



- Colluvions
 - Alluvions subactuelles
 - Lido sableux
 - Fy3
 - Fy2
 - Fy1
 - Fx
 - Fw
 - Schistes (Corse alpine)
 - Route nationale
 - Réseau hydrologique
 - Réseau de drainage artificiel
- Alluvions quaternaires