



# LES CONCENTRATIONS EN SEL DANS LES MASSES D'EAUX LUXEMBOURGEOISES

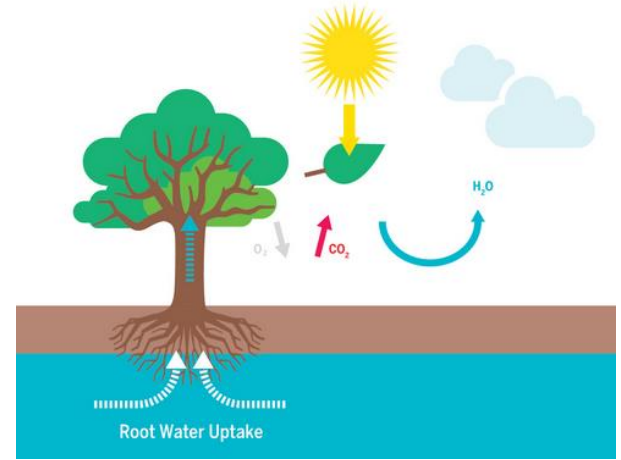
Núria Martínez-Carreras et Laurent Pfister

Luxembourg Institute of Science and Technology (LIST)

22/03/2024

# LE GROUPE CAT AU LIST

Quels sont les facteurs qui contrôlent l'hydrologie des bassins versants, à savoir le transfert, le stockage, le mélange et la libération de l'eau, des solutés et de la matière ?

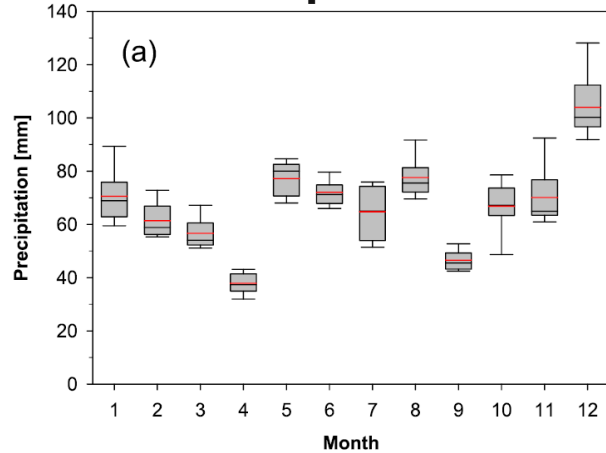


# AGENDA

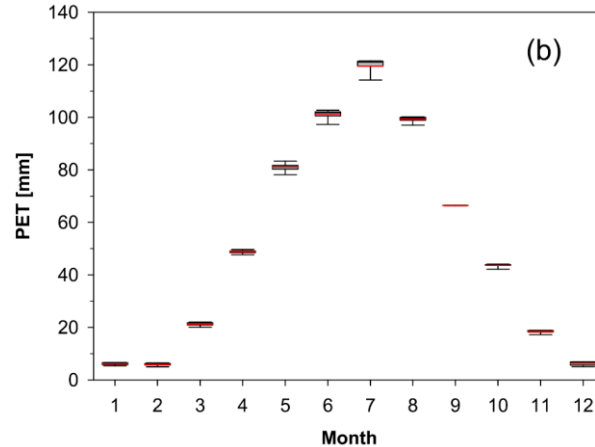
- 01** Le fonctionnement hydrologique du bassin versant de l'Attert
- 02** Les concentrations en sel dans le bassin de l'Attert
- 03** Les concentrations en sel dans l'aquifère du Grès de Luxembourg

# HYDROLOGIE : VALEURS MENSUELLES MOYENNES

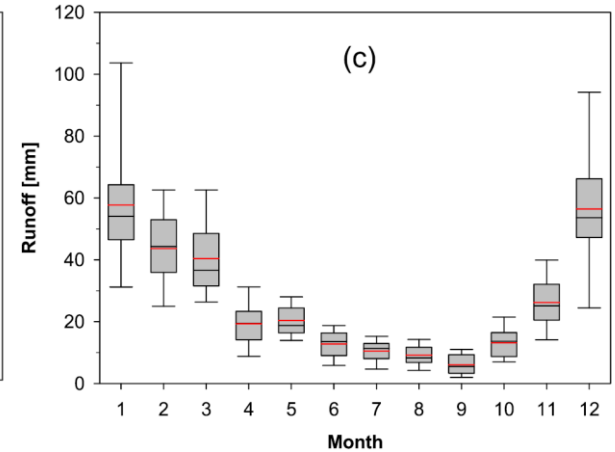
## Précipitations



## Évapotranspiration

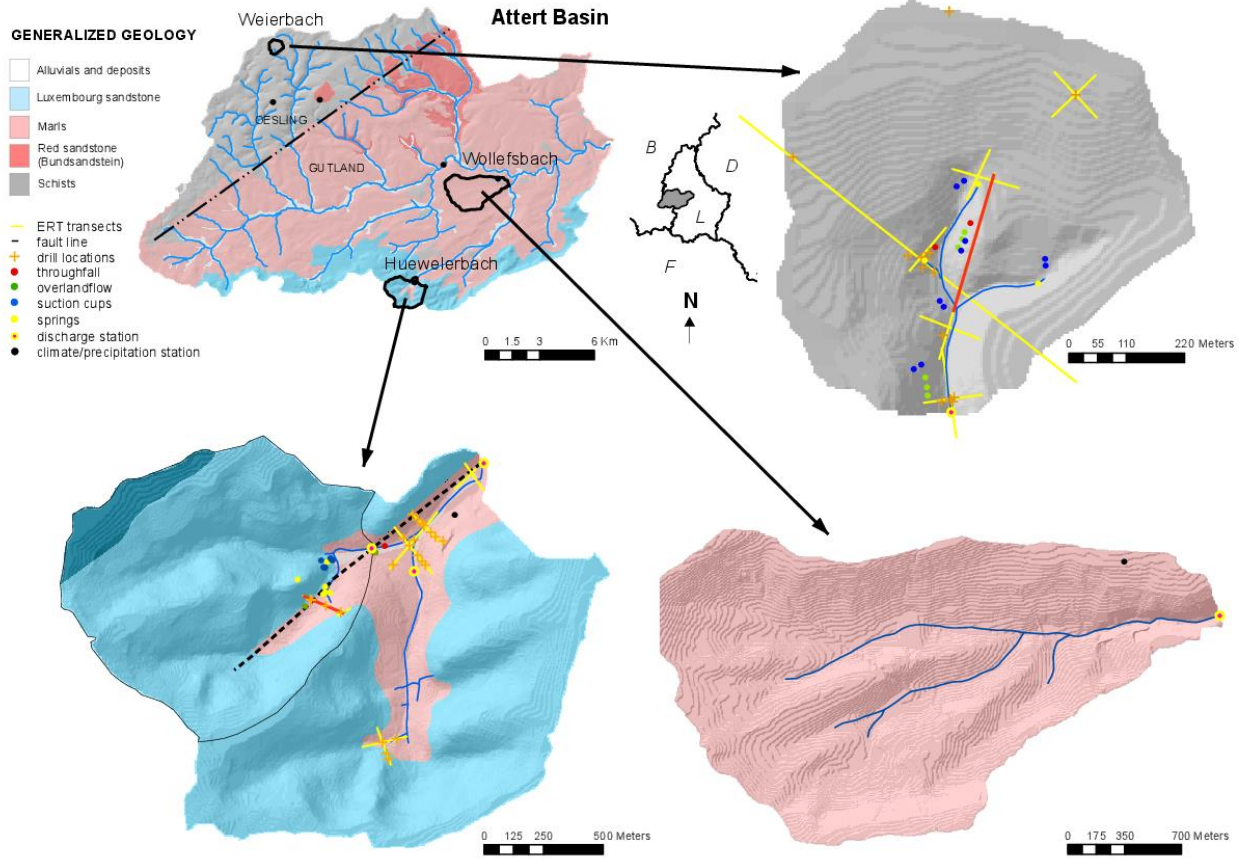


## Écoulement

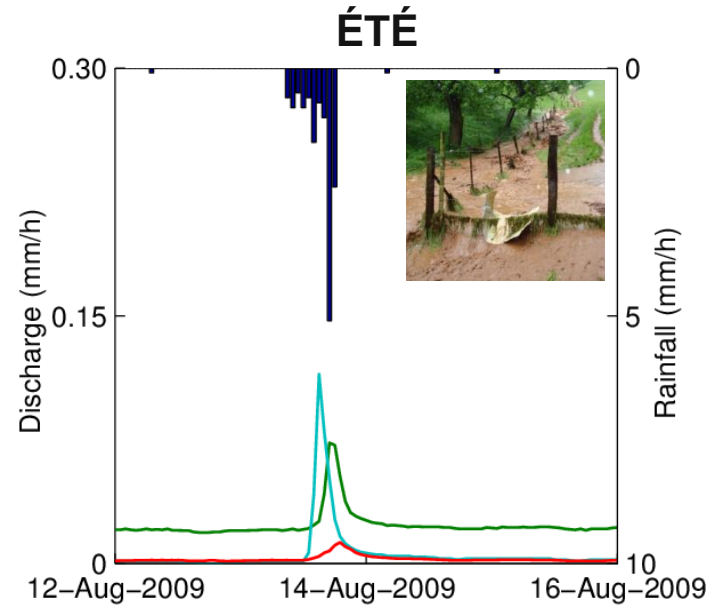
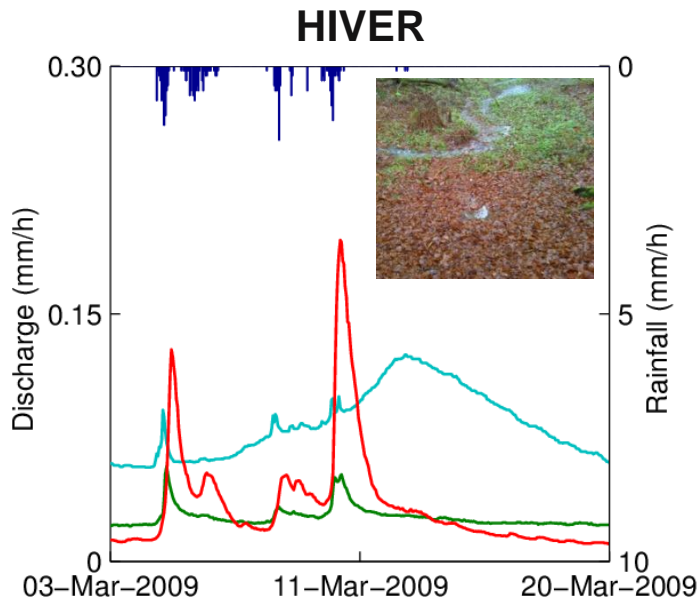
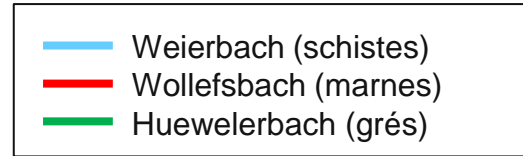


Pfister et al. (2017)





# DIVERSITÉ DES RÉPONSES HYDROLOGIQUES



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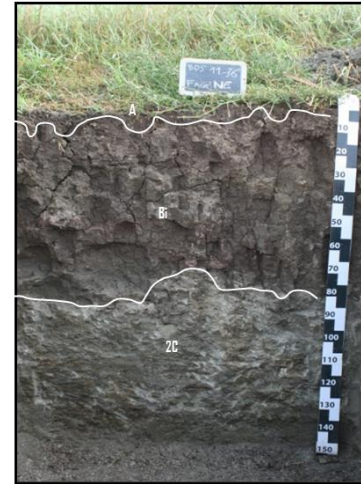
Huewelerbach (grès):  
Albic Podzol



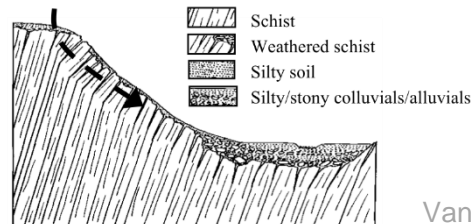
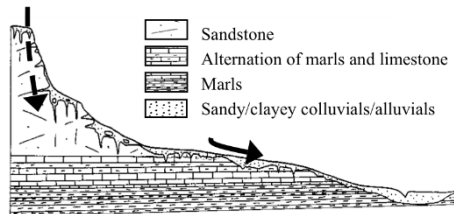
Weierbach (schistes):  
Haplic Cambisol



Wollefsbach (marnes):  
Vertic Cambisol

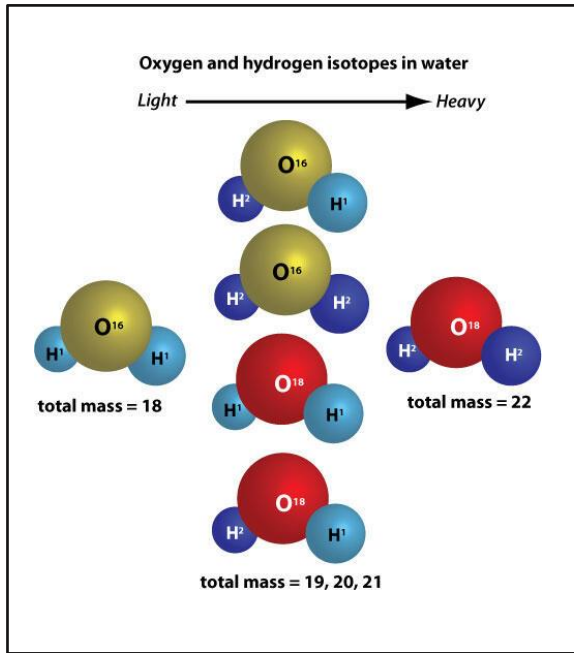


Wrede et al. (2015)

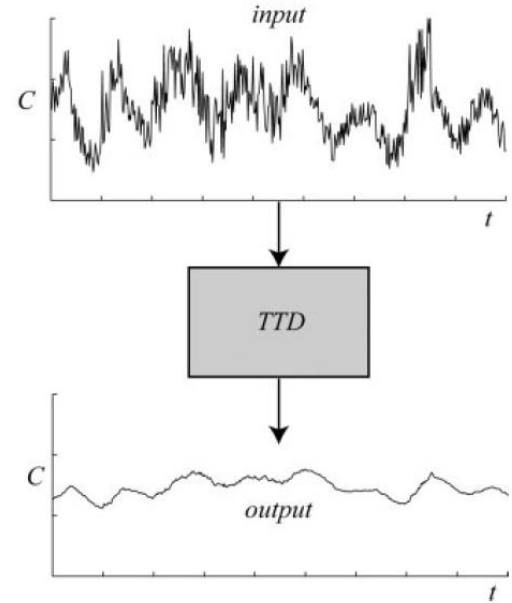
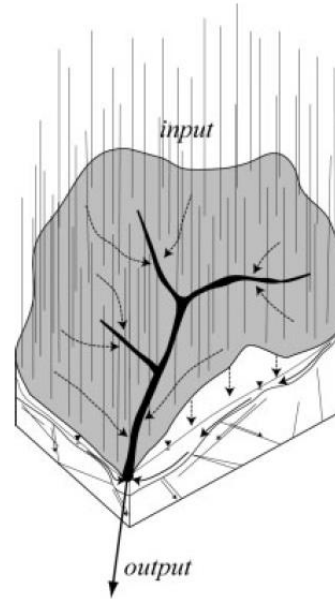


Van den Bos et al. (2001)

# TEMPS DE TRANSIT MOYEN DE L'EAU



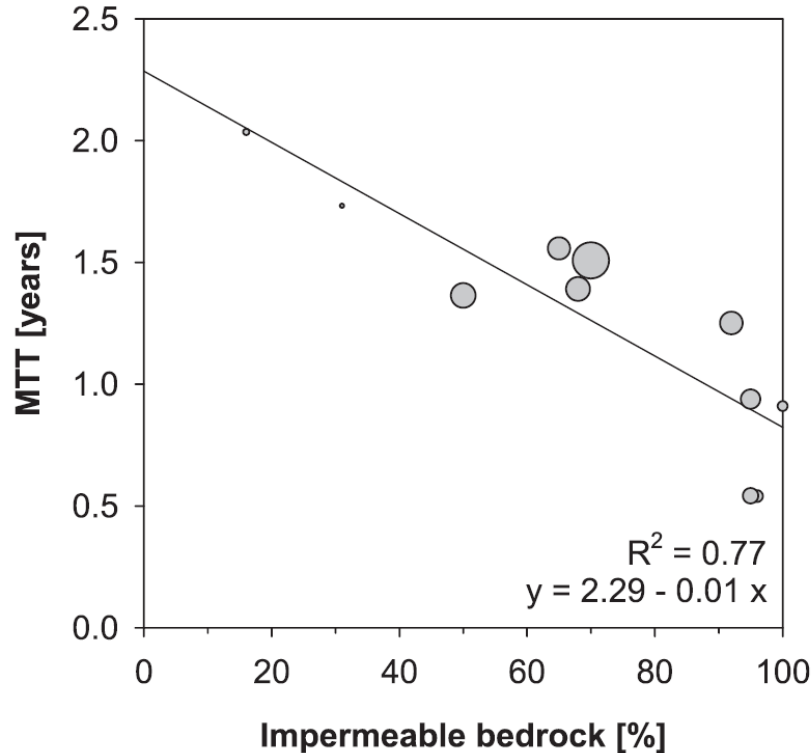
Lesleigh Anderson and Jeremy Havens, USGS (2015)



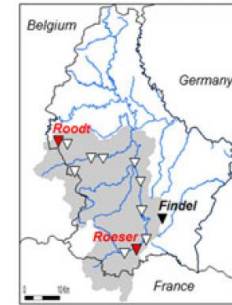
McDonnell et al. (2010)

# TEMPS DE TRANSIT MOYEN DE L'EAU

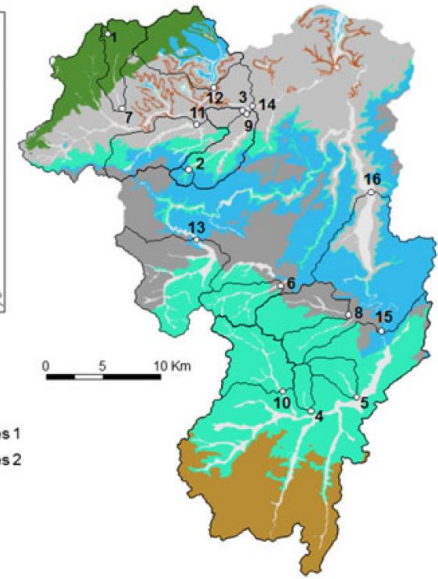
Le temps de transit moyen de l'eau est corrélé avec la géologie



Taille du point proportionnel  
 au logarithme de la taille du  
 bassin versant

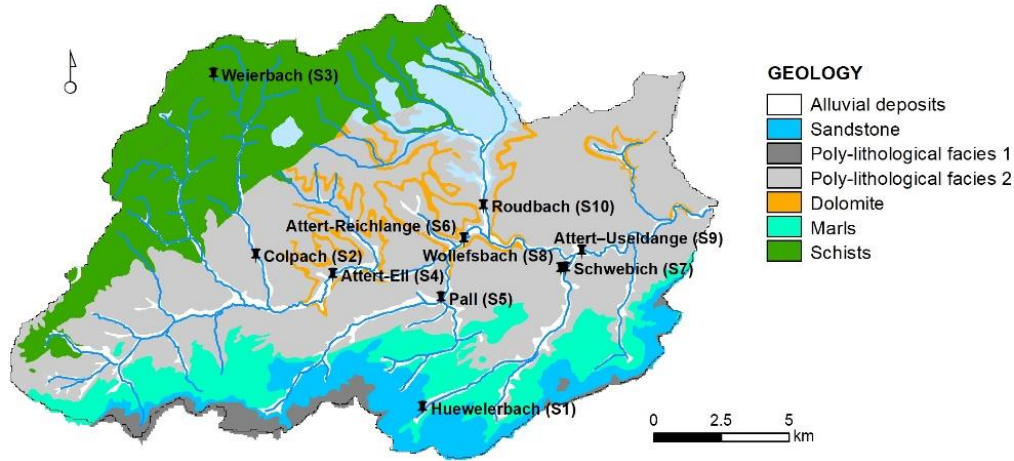


- alluvial deposits
- limestone
- sandstone
- poly-lithological facies 1
- poly-lithological facies 2
- dolomite
- marls
- schists



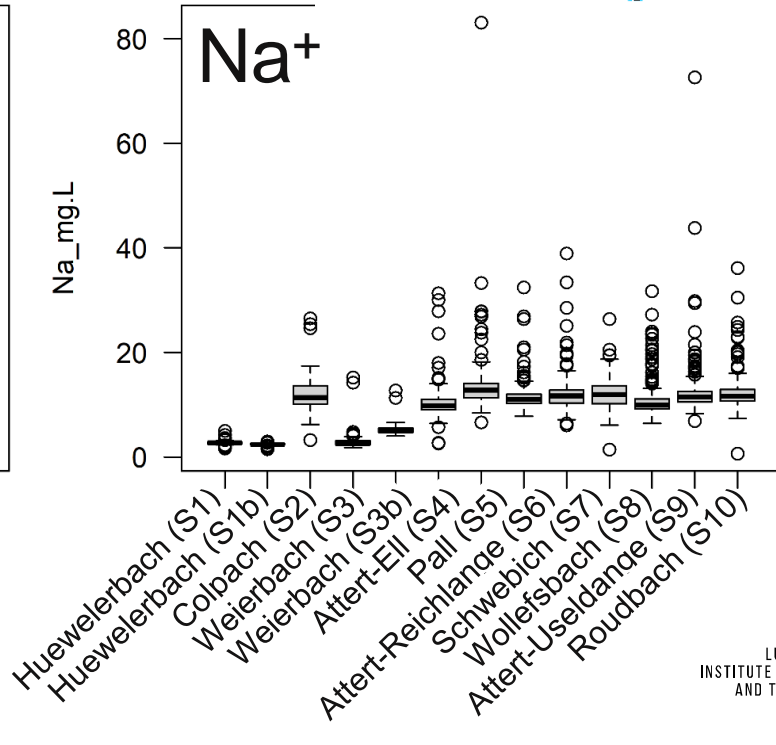
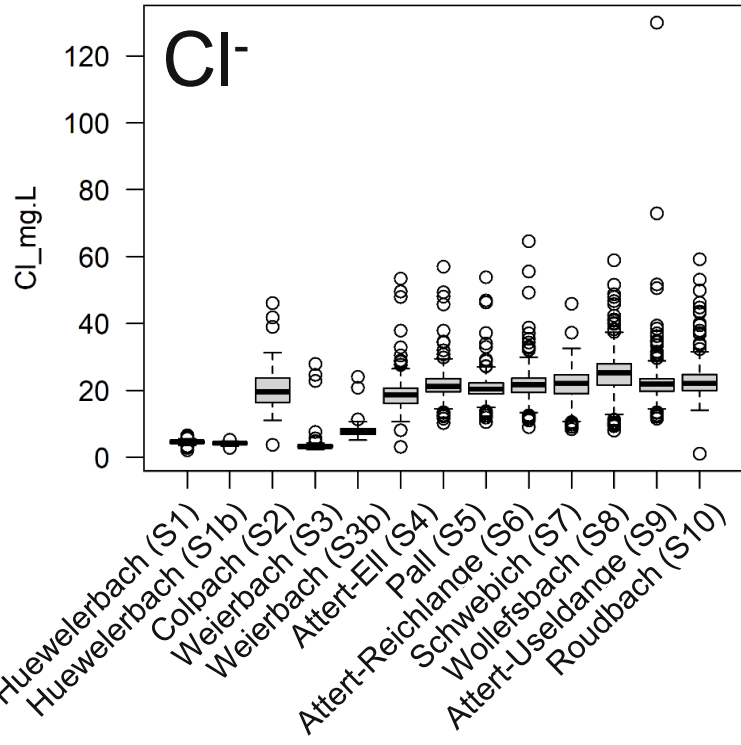
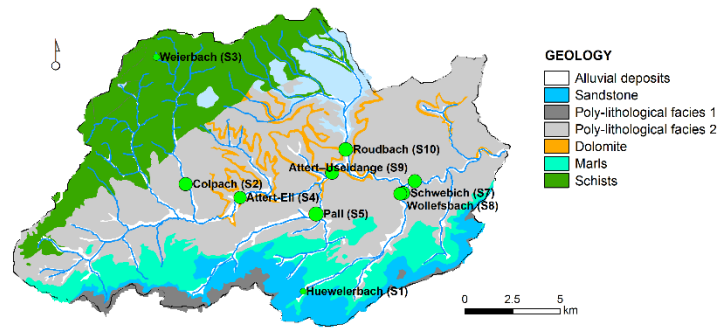
| Catchment name |                      |
|----------------|----------------------|
| 1              | Weierbach*           |
| 2              | Huewelerbach*        |
| 3              | Wollefsbach*         |
| 4              | Mierbech*            |
| 5              | Bibeschbach*         |
| 6              | Mamer                |
| 7              | Colpach*             |
| 8              | Ruisseau de Merl     |
| 9              | Schwebich*           |
| 10             | Mess*                |
| 11             | Pall*                |
| 12             | Roudbach*            |
| 13             | Eisch                |
| 14             | Attert – Useidange*  |
| 15             | Alzette – Hesperange |
| 16             | Alzette – Hunsdorf   |

# ÉCHANTILLONNAGE D'EAU ET ANALYSE EN LABORATOIRE



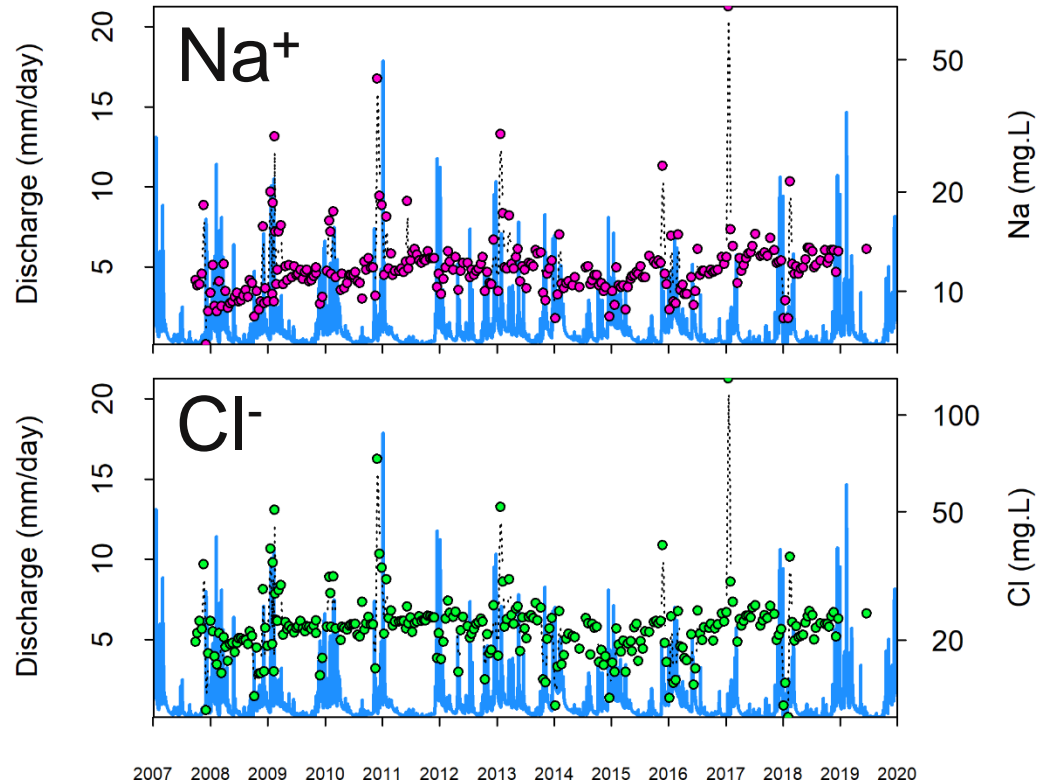
# VARIABILITÉ SPATIALE

2007-2019



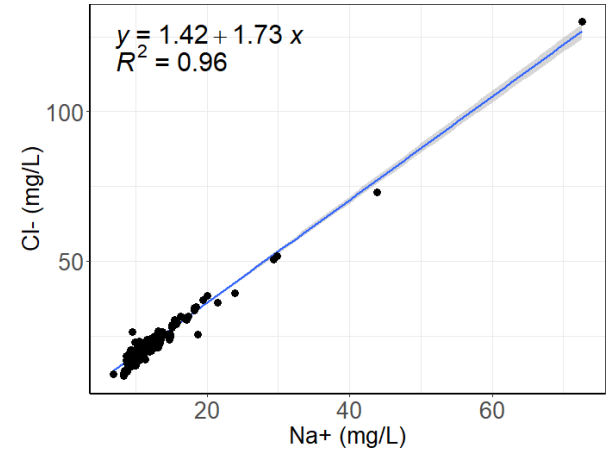
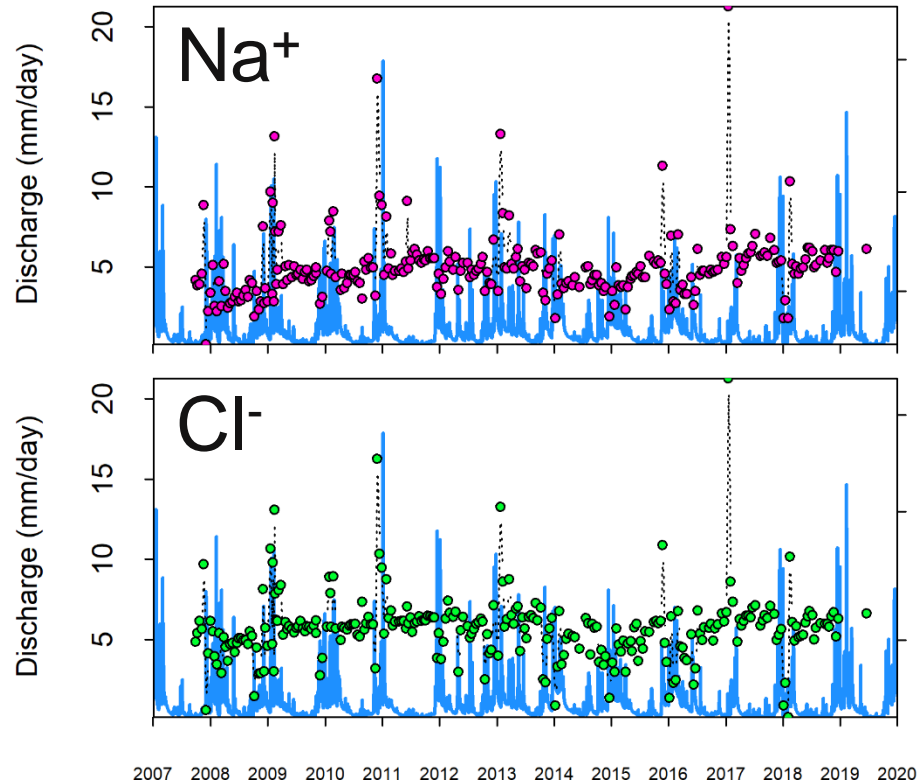
# VARIABILITÉ TEMPORELLE

## Attert à Useldange



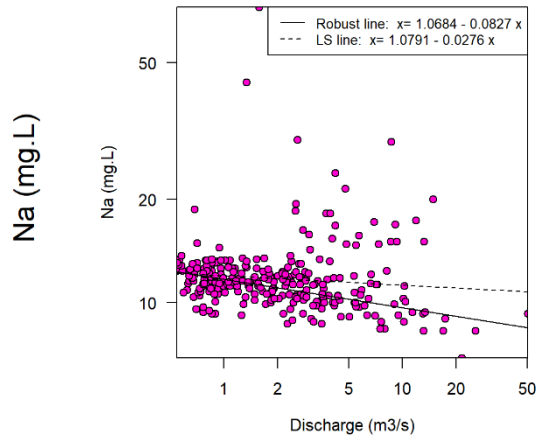
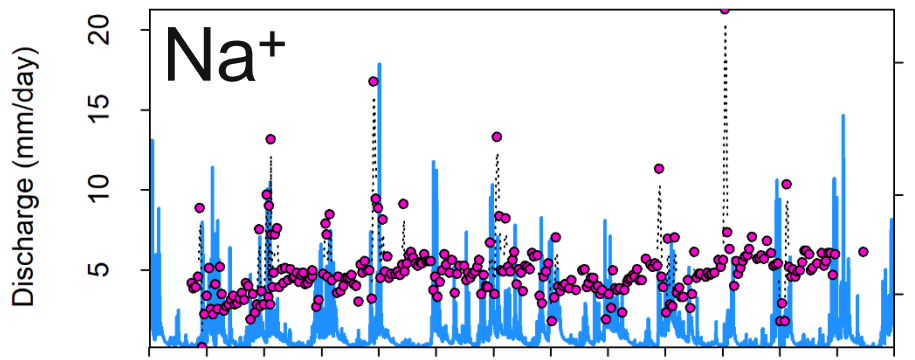
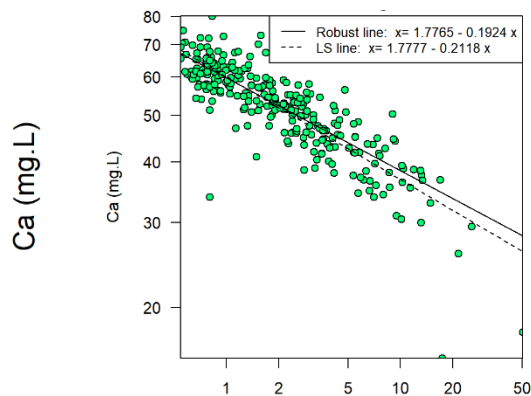
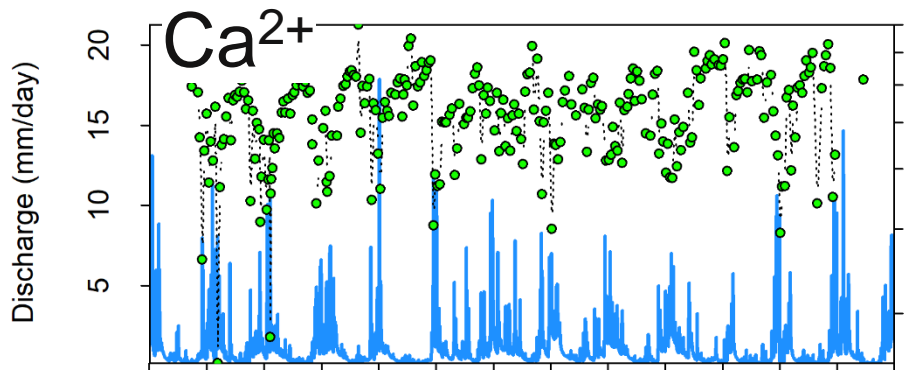
# VARIABILITÉ TEMPORELLE

## Attert à Useldange



# RELATION AVEC LE DEBIT

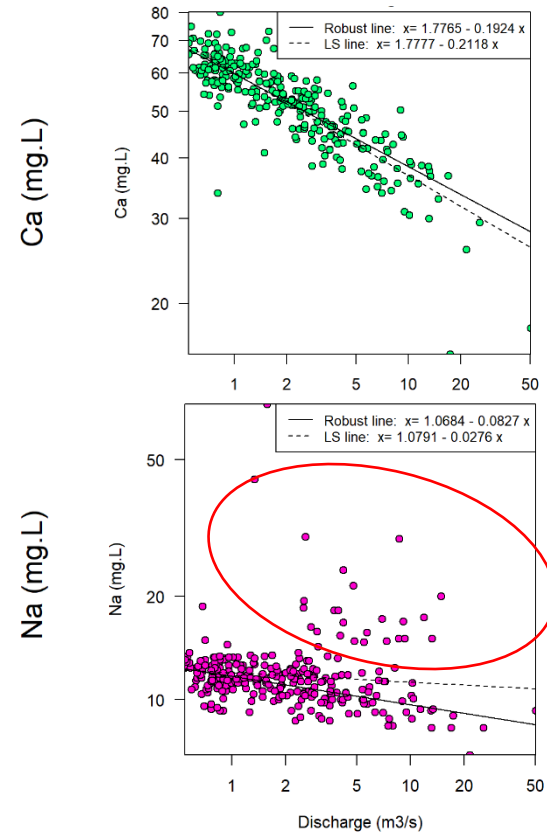
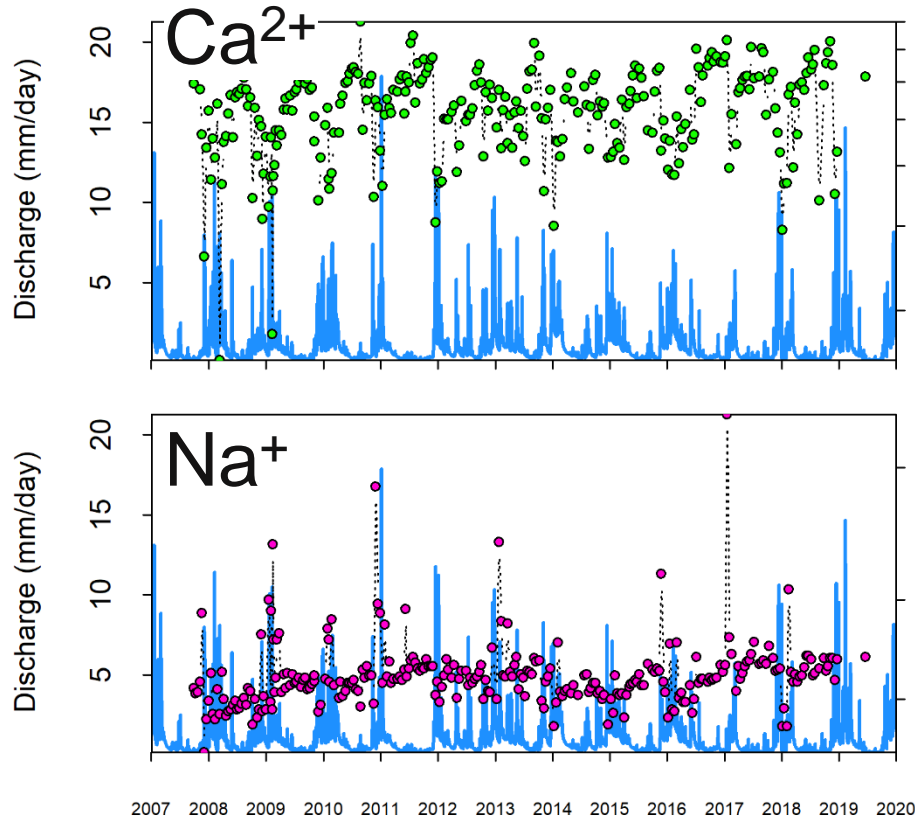
## Attert à Useldange



2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020

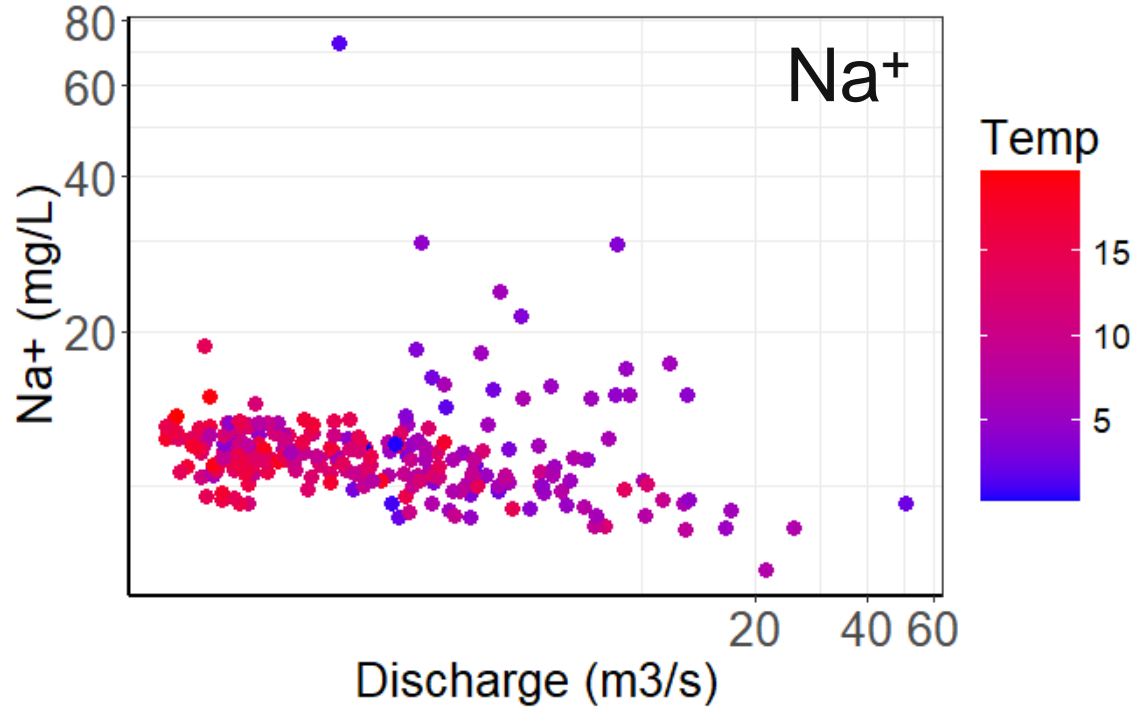
# RELATION AVEC LE DEBIT

## Attert à Useldange



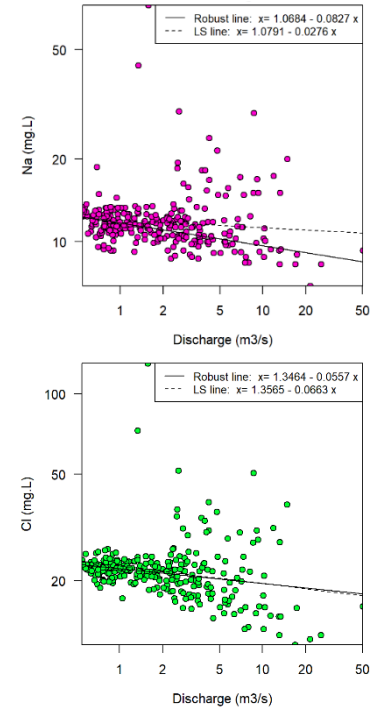
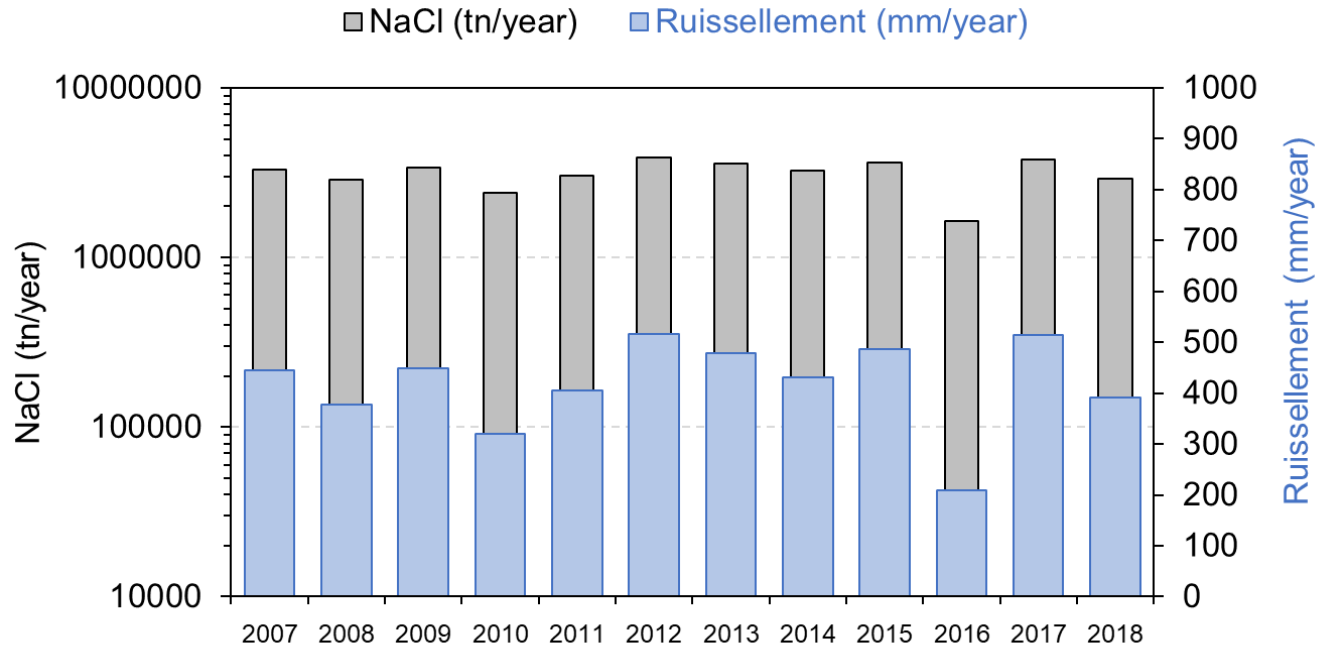
# RELATION AVEC LE DEBIT

## Attert à Useldange

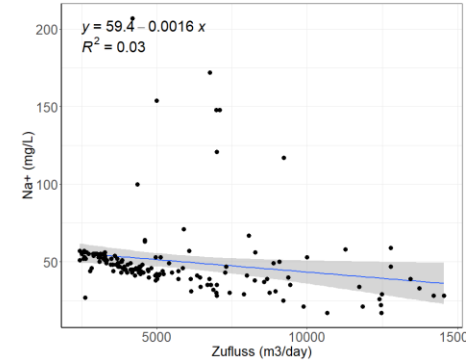
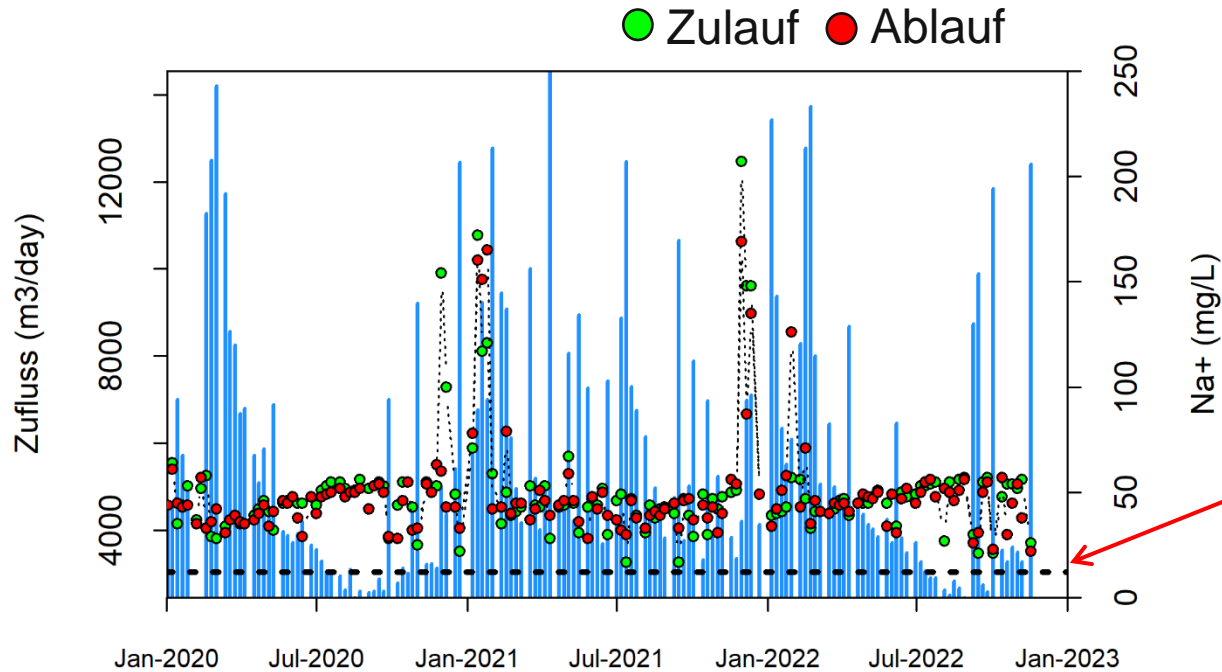


# FLUX DE SEL

## Attert à Useldange



# CONTRÔLE ANALYTIQUE DE LA STATION D'ÉPURATION DE BOEVANGE



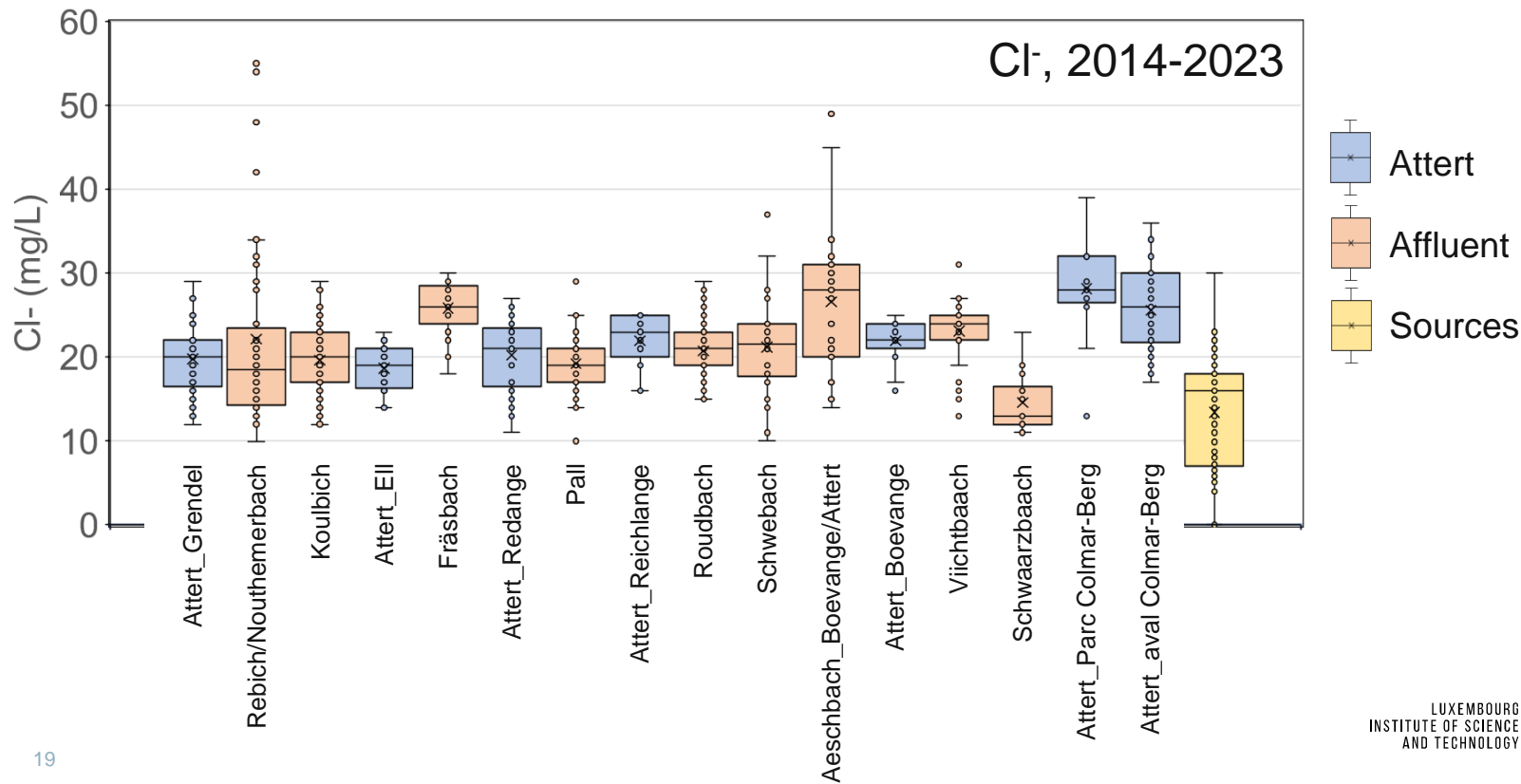
Valeur moyenne  
Attert-Useldange

# CONTRÔLE ANALYTIQUE DE L'ADMINISTRATION DE LA GESTION DE L'EAU



LE GOUVERNEMENT  
DU GRAND-DUCHÉ DE LUXEMBOURG  
Ministère de l'Environnement, du Climat  
et du Développement durable

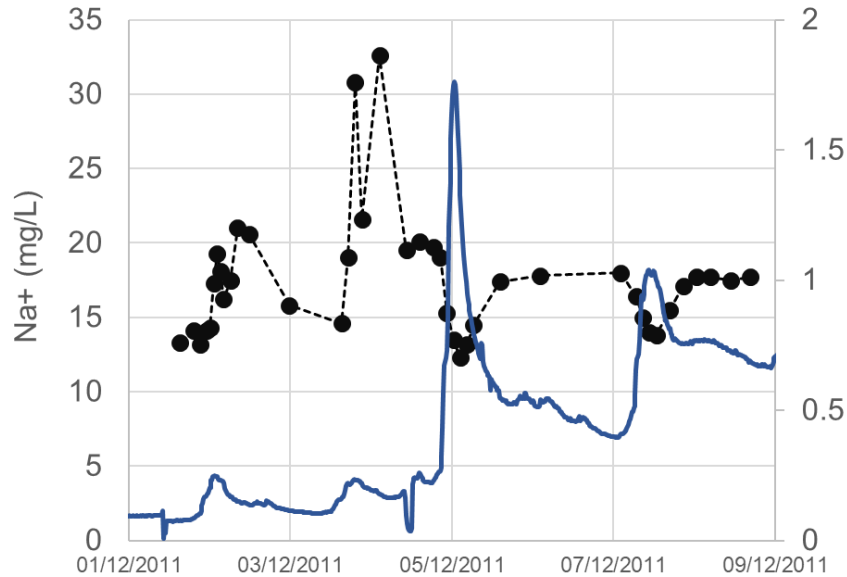
Administration de la gestion de l'eau



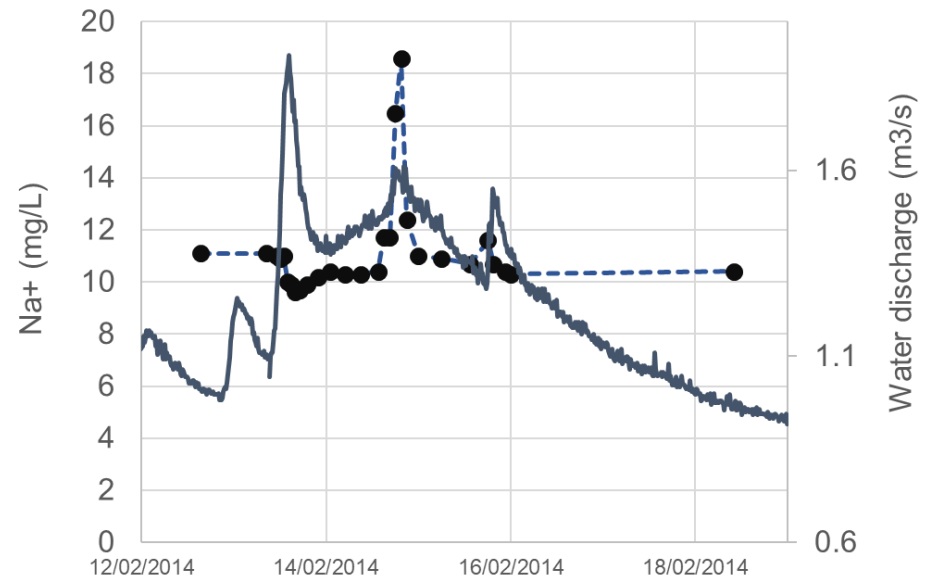
# ÉCHANTILLONAGE EN PÉRIODE DE CRUE

## Roubach

Roubach at Platen



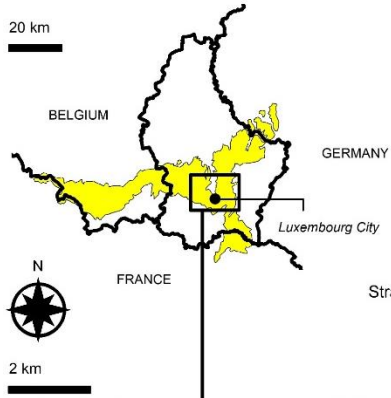
Roubach at Platen



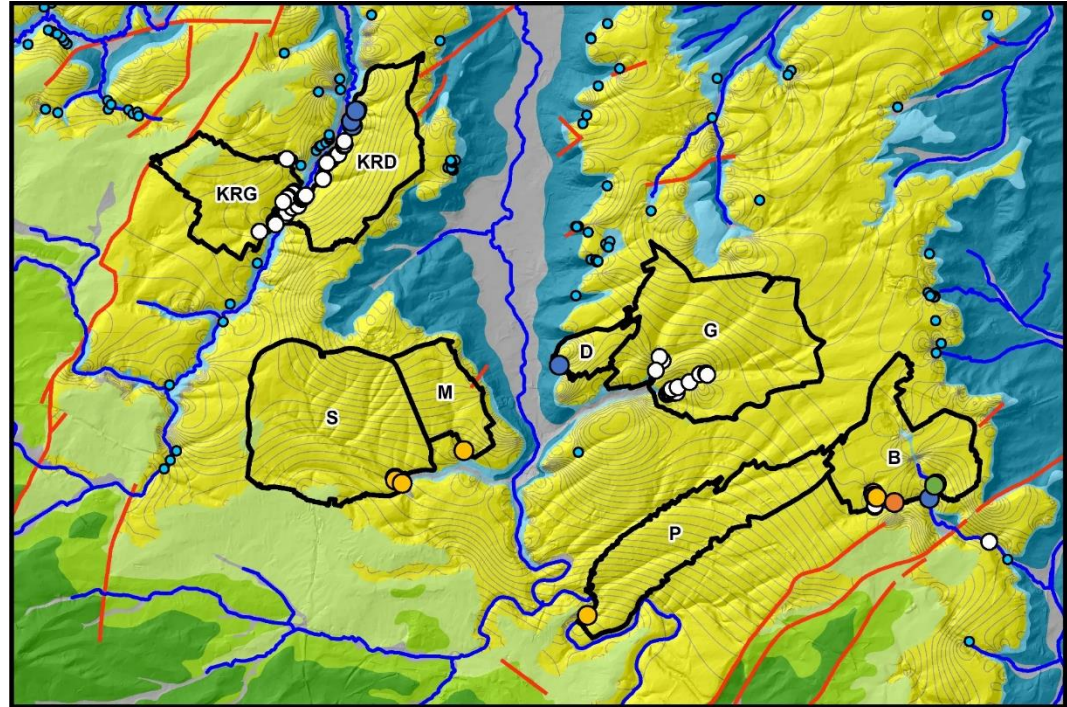
# LES CONCENTRATIONS EN SEL DANS L'AQUIFÈRE DU GRÈS DE LUXEMBOURG



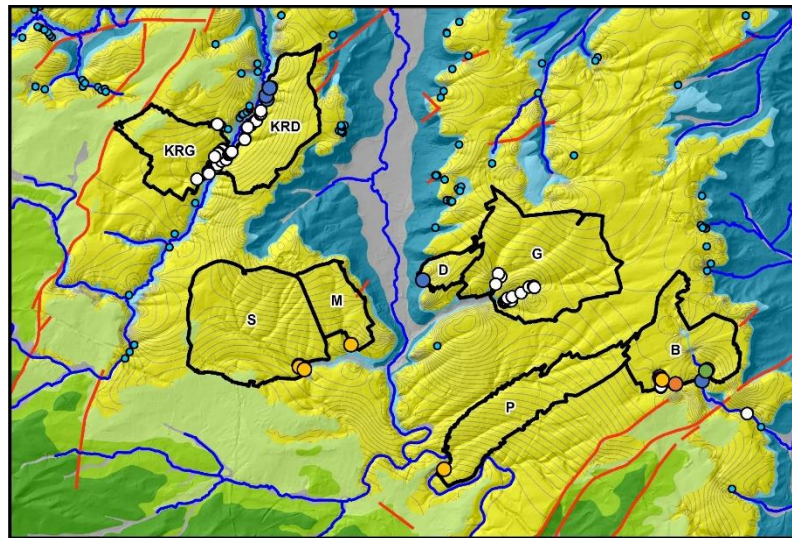
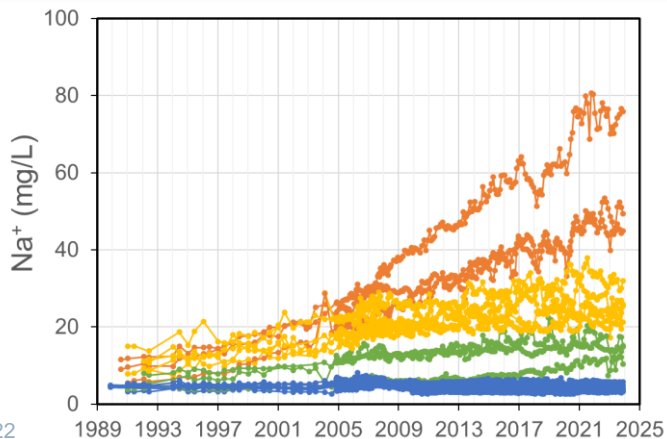
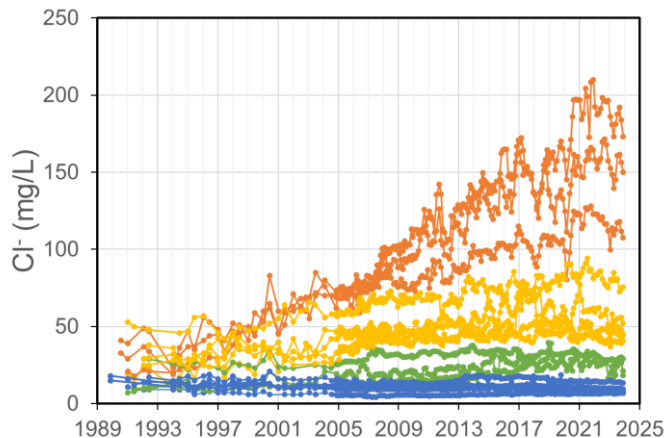
Outcrop area of the Luxembourg Sandstone



- Major rivers ~
- Luxembourg Sandstone springs •
- Springs of Luxembourg City
- no longterm NaCl data ○
- no NaCl increase ●
- small NaCl increase ●
- medium NaCl increase ●
- large NaCl increase ●
- Recharge areas ⓑ
- Faults
- Valley alluvium (Quaternary) █
- Marls and argilite (Keuper) █
- Elvange Marls (Lower Lias - li1) █
- Luxembourg Sandstone (Lower Lias - li2) █
- Strassen Marls and Limestones (Lower Lias - li3) █
- Marls (Lower Lias - li4) █
- Marls and Limestones (Middle Lias) █
- Contour lines of the Luxembourg Sandstone basis elevation (contour intervals = 5.0 m) ~



# LES CONCENTRATIONS EN SEL DANS L'AQUIFÈRE DU GRÈS DE LUXEMBOURG



**DIRECTIVE (EU)  
2020/2184**  
relative à la  
qualité des eaux  
destinées à la  
consommation  
humaine



**Valeurs  
indicatrices**



**Cl<sup>-</sup> ≤ 250 mg/L  
Na<sup>+</sup> ≤ 200 mg/L**

# TAKE HOME MESSAGES

- Dans les bassins versants de l'Attert :
  - Nous observons sporadiquement l'impact du sel de déneigement sur les cours d'eau.
  - Les concentrations moyennes de  $\text{Na}^+$  restent inférieures à 20 mg/L et de  $\text{Cl}^-$  inférieures à 30 mg/L.
  - Environ 3 millions de tonnes de NaCl sont exportées chaque année.
- Les concentrations en sel dans l'aquifère du Grès de Luxembourg augmentent dans certaines sources.



# Villmools Merci !

## Co-financé par le FNR et la VdL