



Water Smart Cities: a Modular Modelling Framework for Nature Based Stormwater Management in Urban Areas

6th May 2026 – EGU26 (Vienna)

Christophe Dessers, Stéphane Champailer, Anne-Catherine Renard, Dorentina Sadrijaj, Antoine Dellieu, Vanessa Paulus de Chatelet, Fanny Gritten, Sébastien Erpicum, Michel Piroton, Aurore Degré, Benjamin Dewals, and Pierre Archambeau

Why this software?

Fill a gap between existing products of different complexities

Dimensionnement d'un ouvrage de rétention
Méthode "rationnelle"
version 2019_06_07

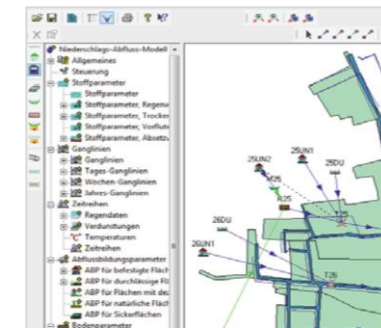
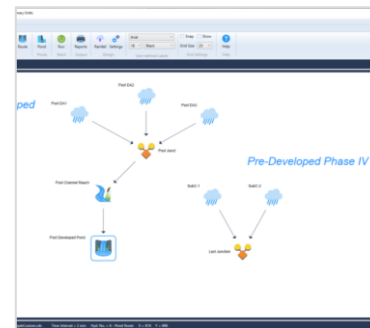
J'ai vérifié que la présente fiche de calcul correspond bien à la dernière version disponible sur le site internet du Service public de Wallonie.

Je déclare avoir lu et compris le guide technique qui accompagne la présente feuille de calcul.

Ville ou Commune : LIÈGE

Surfaces en fonction de l'occupation du sol		coeff. réduc. [1]	surface [m ²]	surface pondér. [m ²]	(notes facultatives)
forêts, bois...		0.20			
prairies, jardins, zones arborées...		0.15			
parcs, jardins, zones arborées...		0.15			
champs cultivés, terres, bruyères...		0.25			
terres vides >50cm, décharges...		0.25			
zones aménageables...		0.4			
terres battues, chemins de terre...		0.5			
pavés à joints écartés, pavés...		0.7			
graves...		0.7			
allées pavées, trottoirs pavés...		0.9			
parkings, terrasses, emplacements...		0.9			
toitures, trottoirs, plans d'eau...		1			
autres (à justifier)					
autres (à justifier)					
autres (à justifier)					
autres (à justifier)					

(coeff. réduc., moyen et surface totale)



Easy-to-use, with reduced learning effort

Oversizing and potential additional cost

Relatively easy-to-use, with limited learning process

Capture key spatial variability and lead to better sizing

Training and expertise required for the use and interpretation

Capture spatial variability, better design and economy

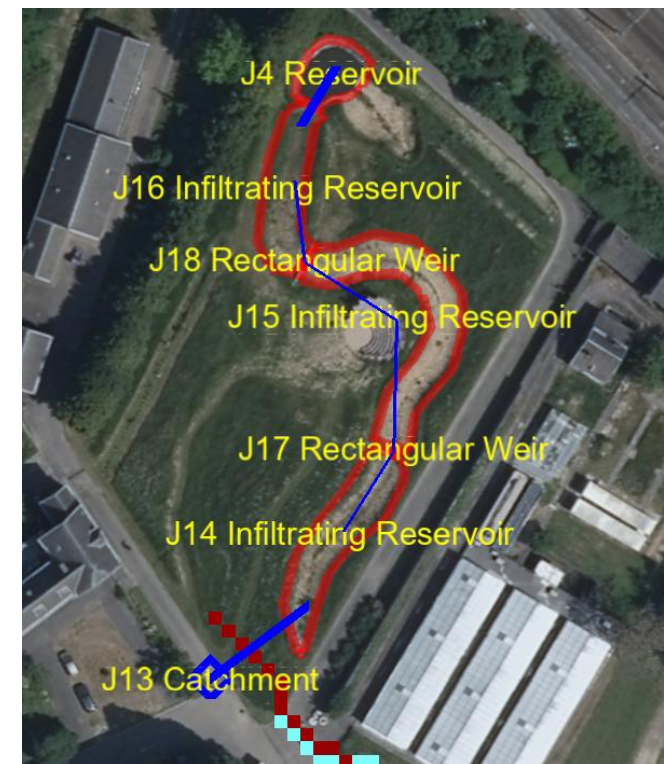
➔ Rapidly assess the performances of NBS and « grey » measures for stormwater management in small urban catchments

GUI interface

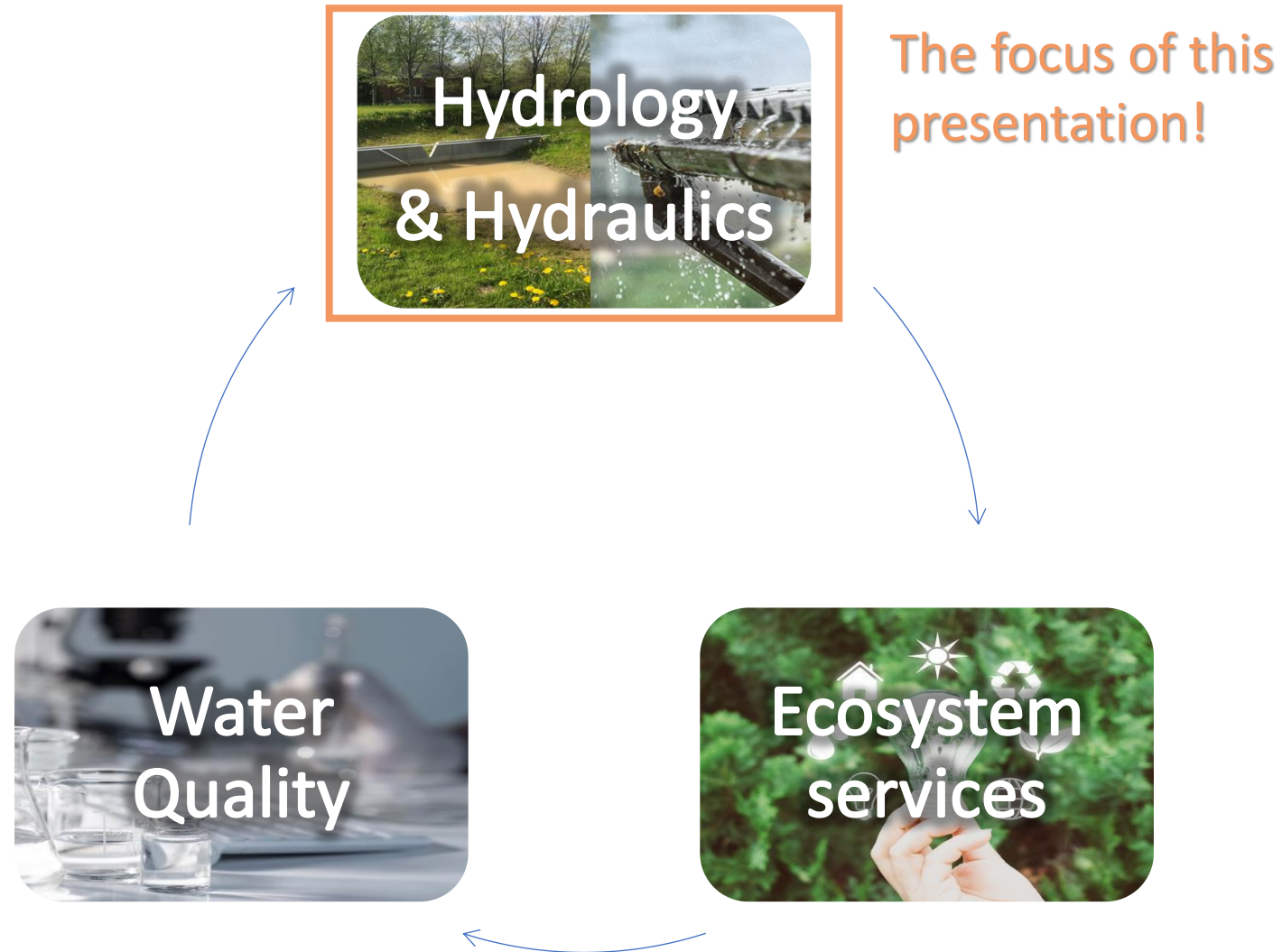
- Synoptic view



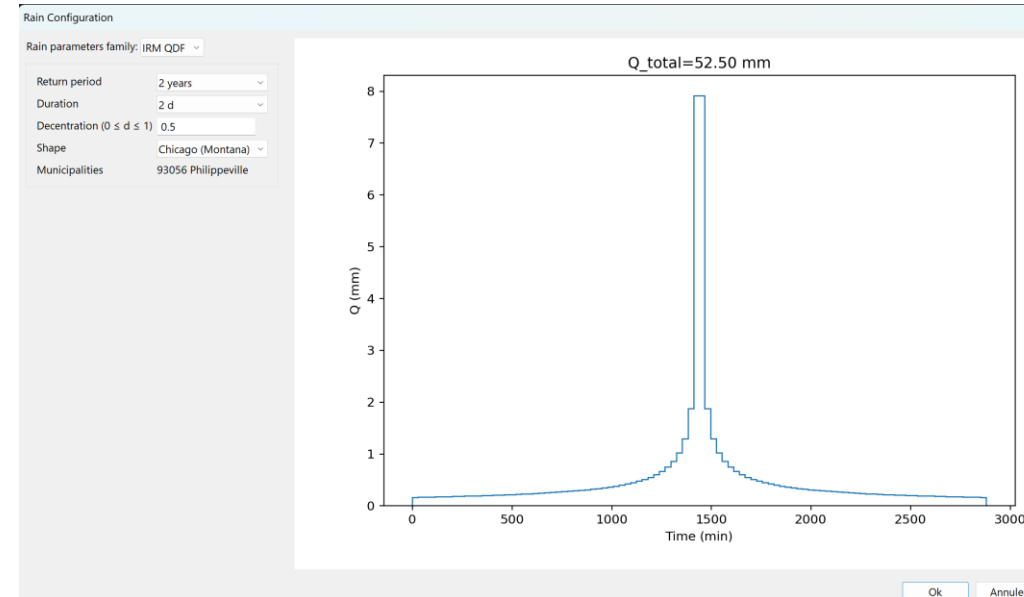
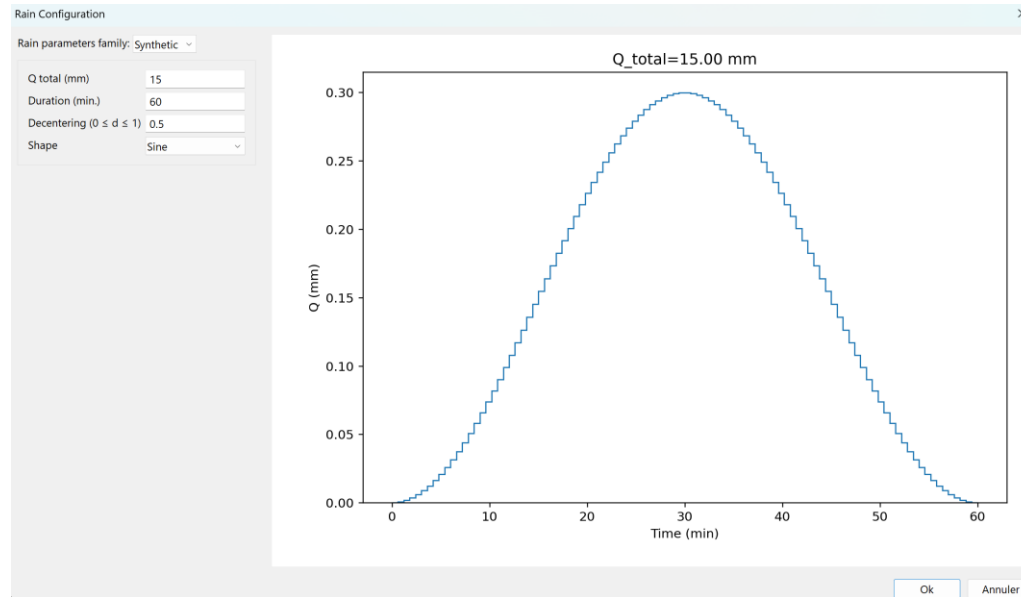
- Map view



Modelling framework



Rainfall generator



Application on the **whole domain of Synthetic/Statistic rainfall**



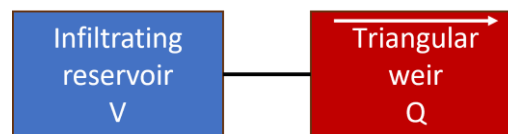
Elementary modules

Storage modules:

- (infiltrating) Reservoir
- Junction / Chamber
- Catchment

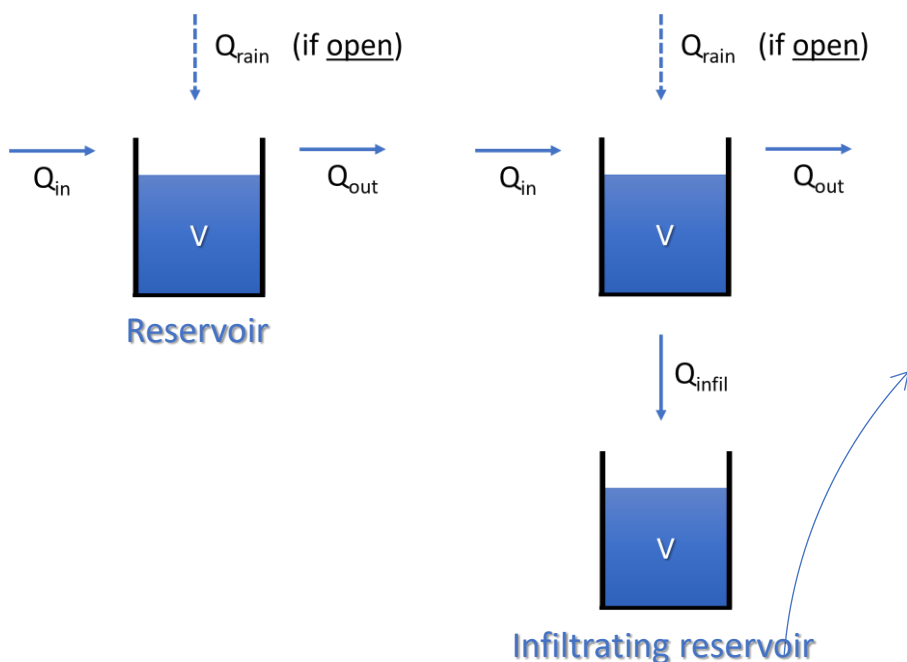


Check-dammed swale



Transfer modules:

- Green Ampt
- Pipe (unsteady Bernoulli)
- Uniform flow
 - Friction laws (Manning, Bazin, etc.)
- Spillway/weir laws
 - Geometries (rectangular, triangular)
- Gutter
- ...



Types of modules



Infiltrating reservoir



Swale



Check-dammed swale



Green roof



Infiltrating parking



Junction / Chamber



Storm drain / Gully



Roof



Pipe



Gutter



Reservoir



Solver characteristics

Implicit numerical scheme

JAX library

- Auto-differentiation
- Just-in-time compilation (JIT)
- Parallel computation in CPU/GPU
- Pure functional paradigm
- Continuously differentiable model equations



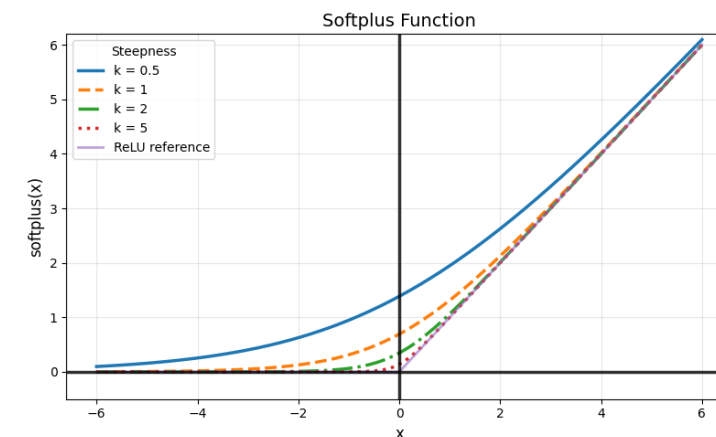
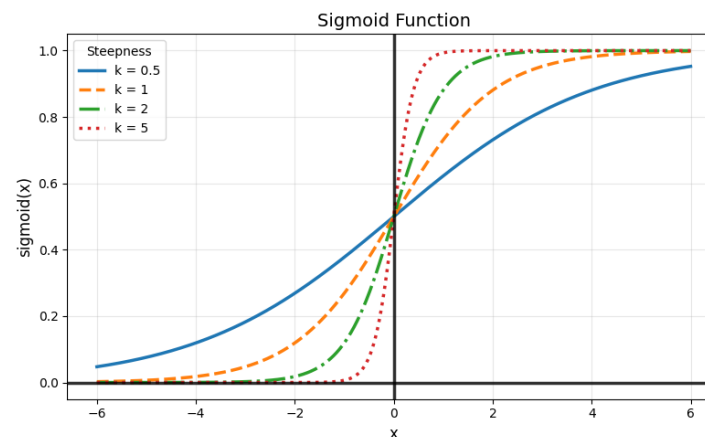
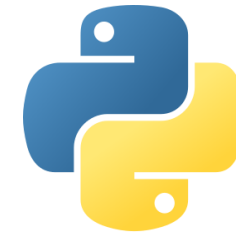
Jacobian/Hessian matrix

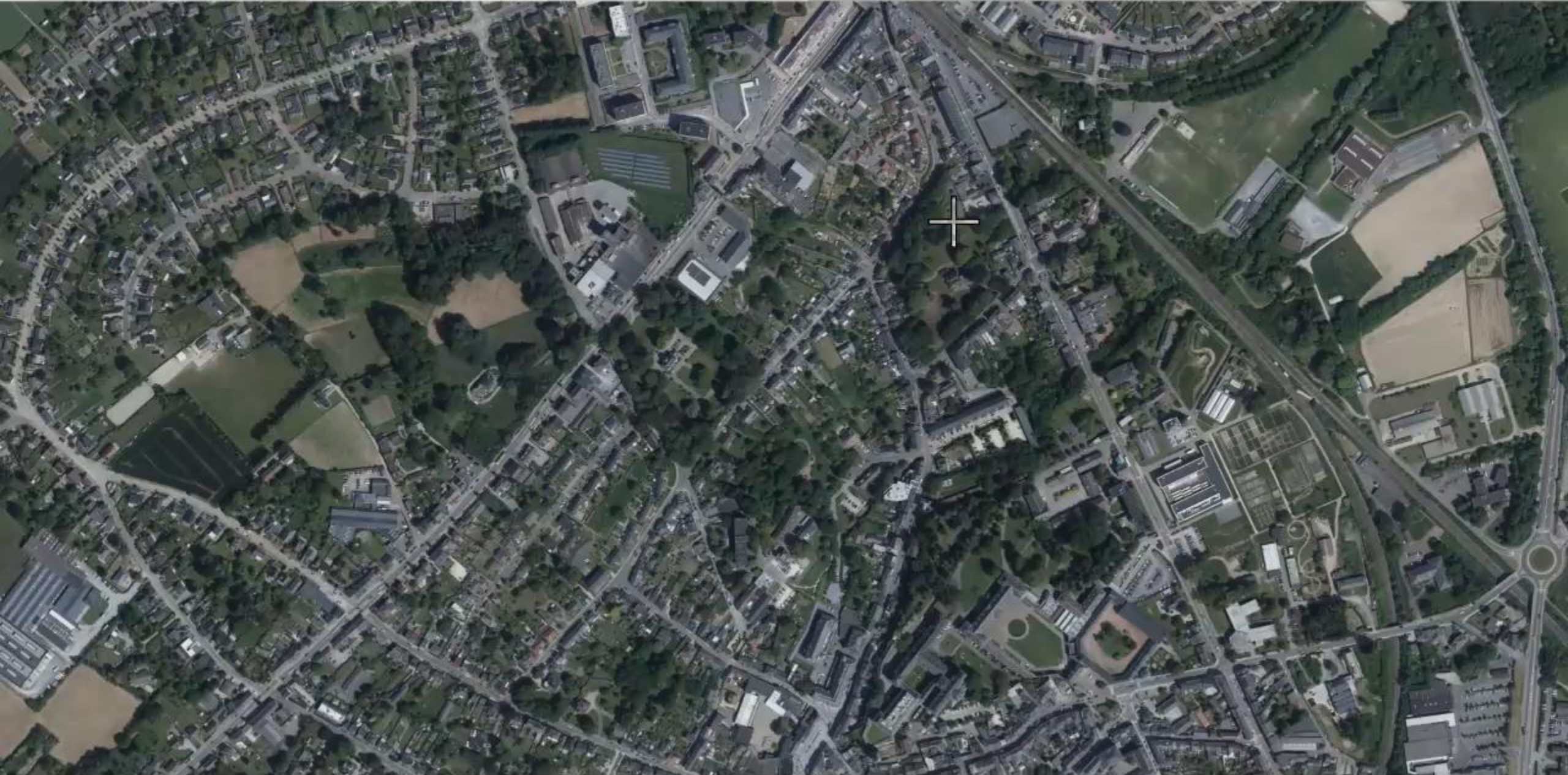


Better performances

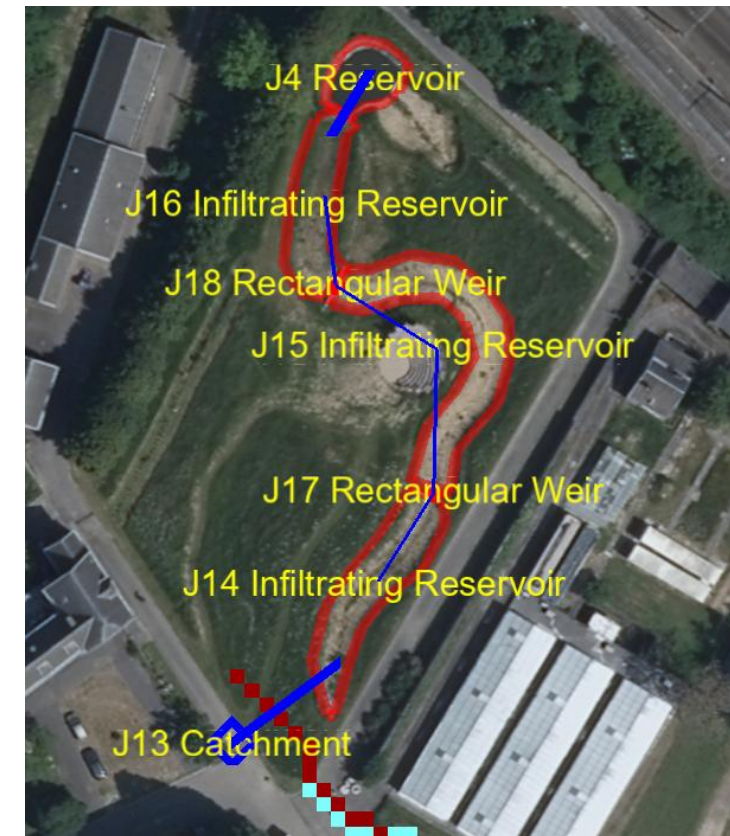
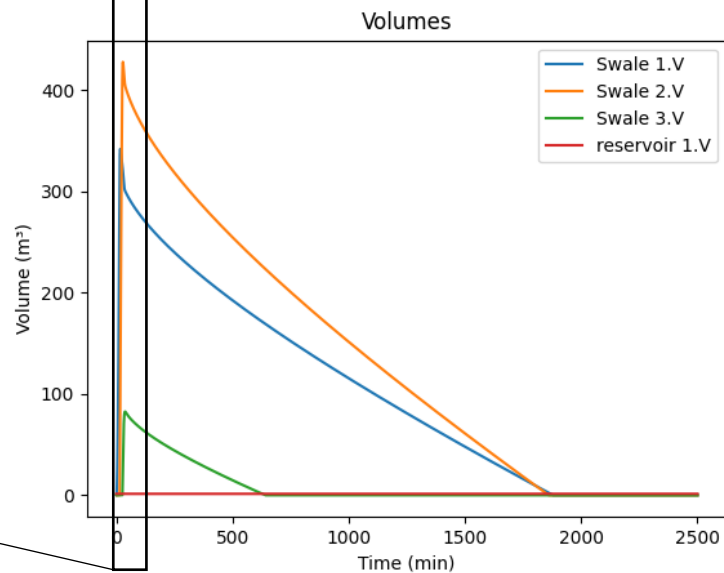
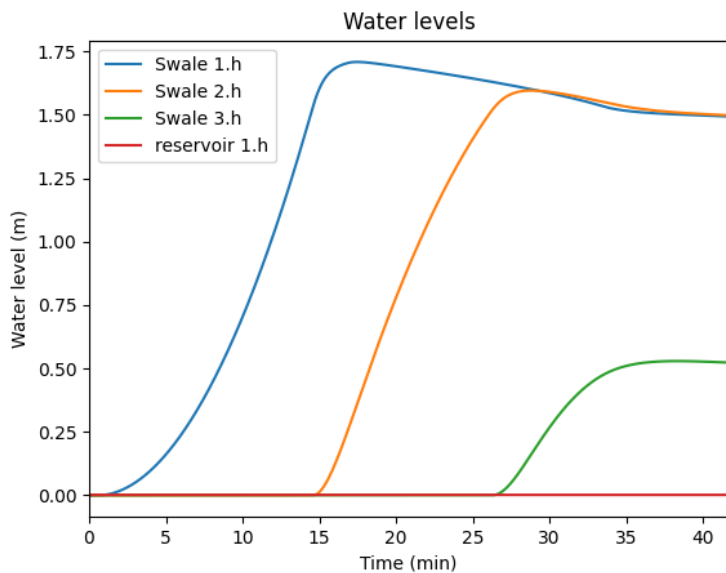
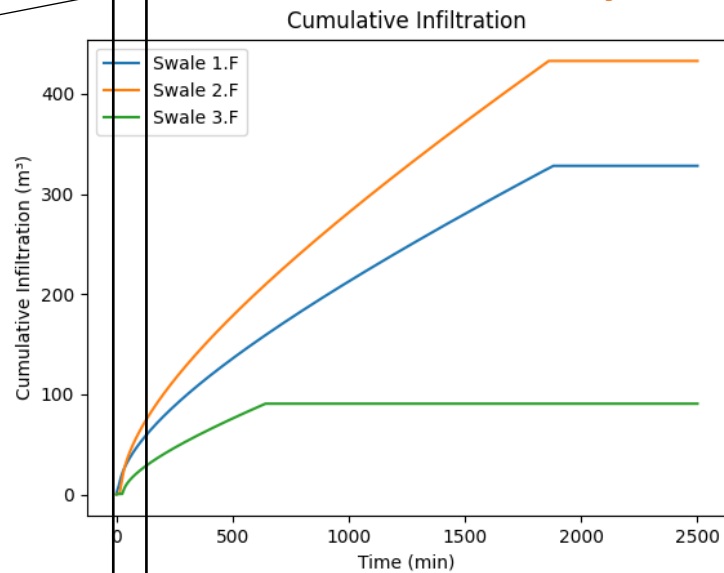
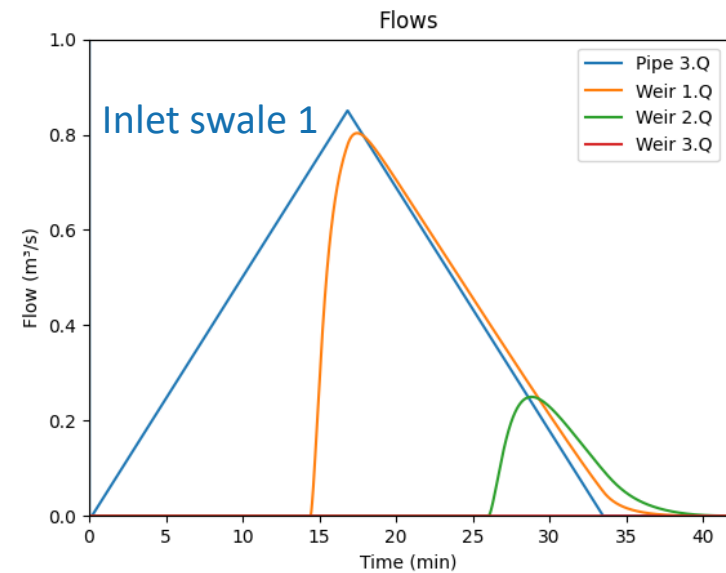


Sigmoid, Softplus
& « safe » functions





Consideration of the different dynamics



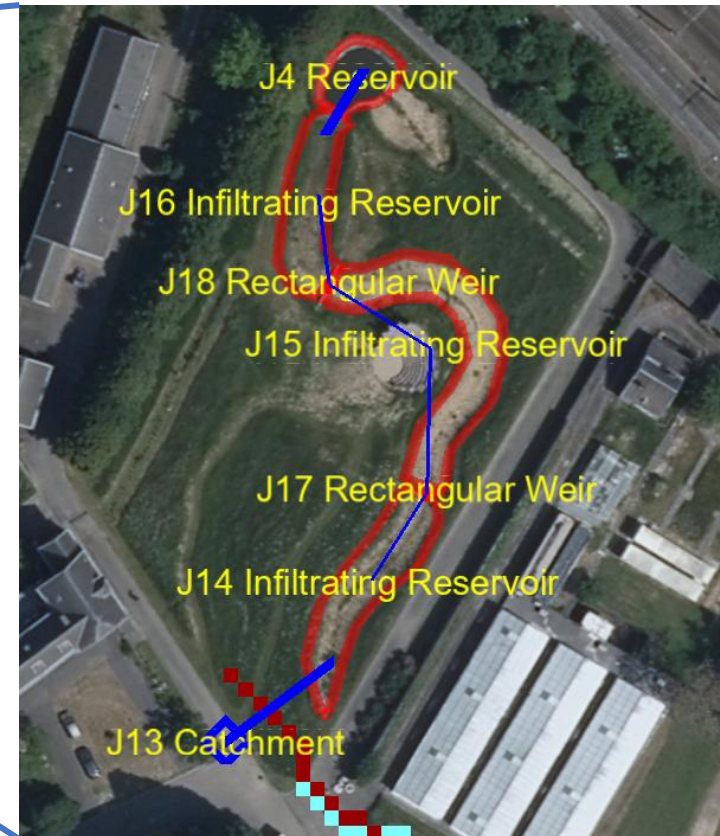
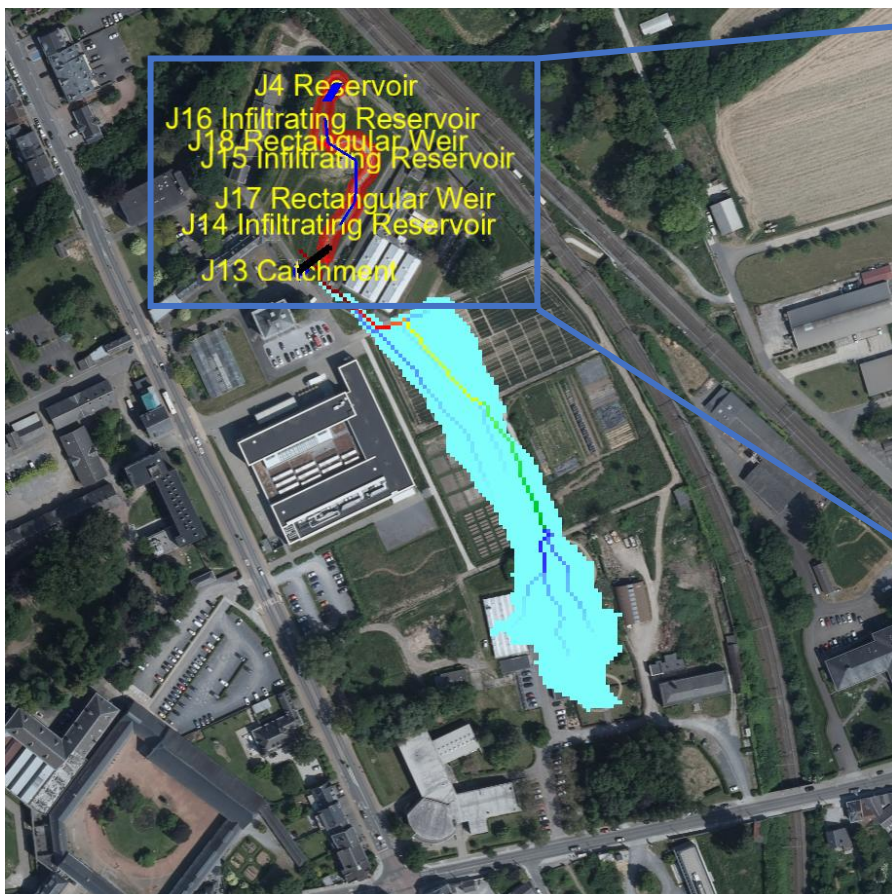
Conclusion

- Software currently in **closed beta** version
- Project finishes at the end of 2026!
- Stay tuned!

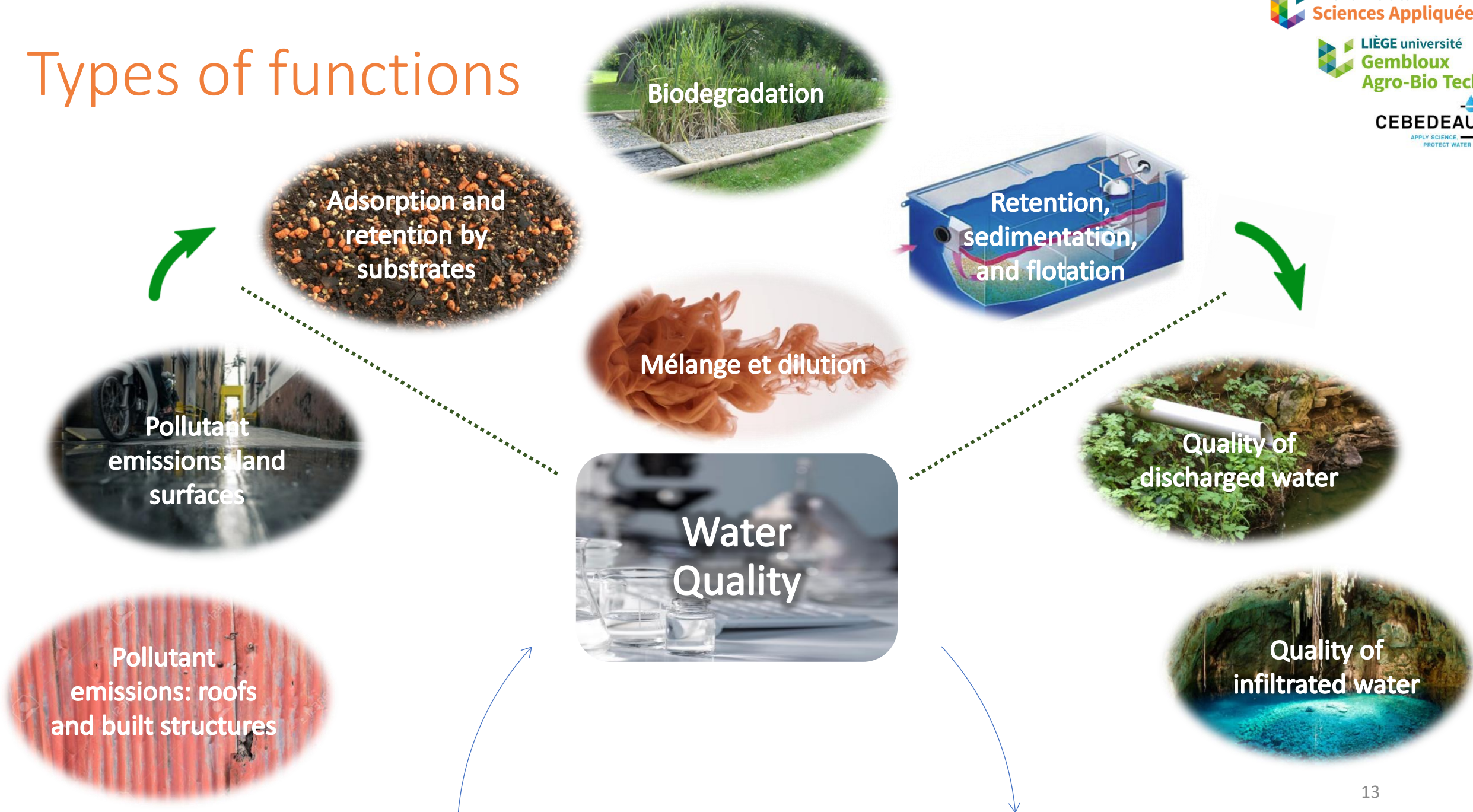
Thank you for your
attention!

Questions?

Example : rain garden



Types of functions



Types of functions



Urban heat islands



Noise pollution



Hedonic value



Fine particulate matter



Pollination

