Nitrogen Transport & Retention within Wetland-Dominated Stream Reaches in New England

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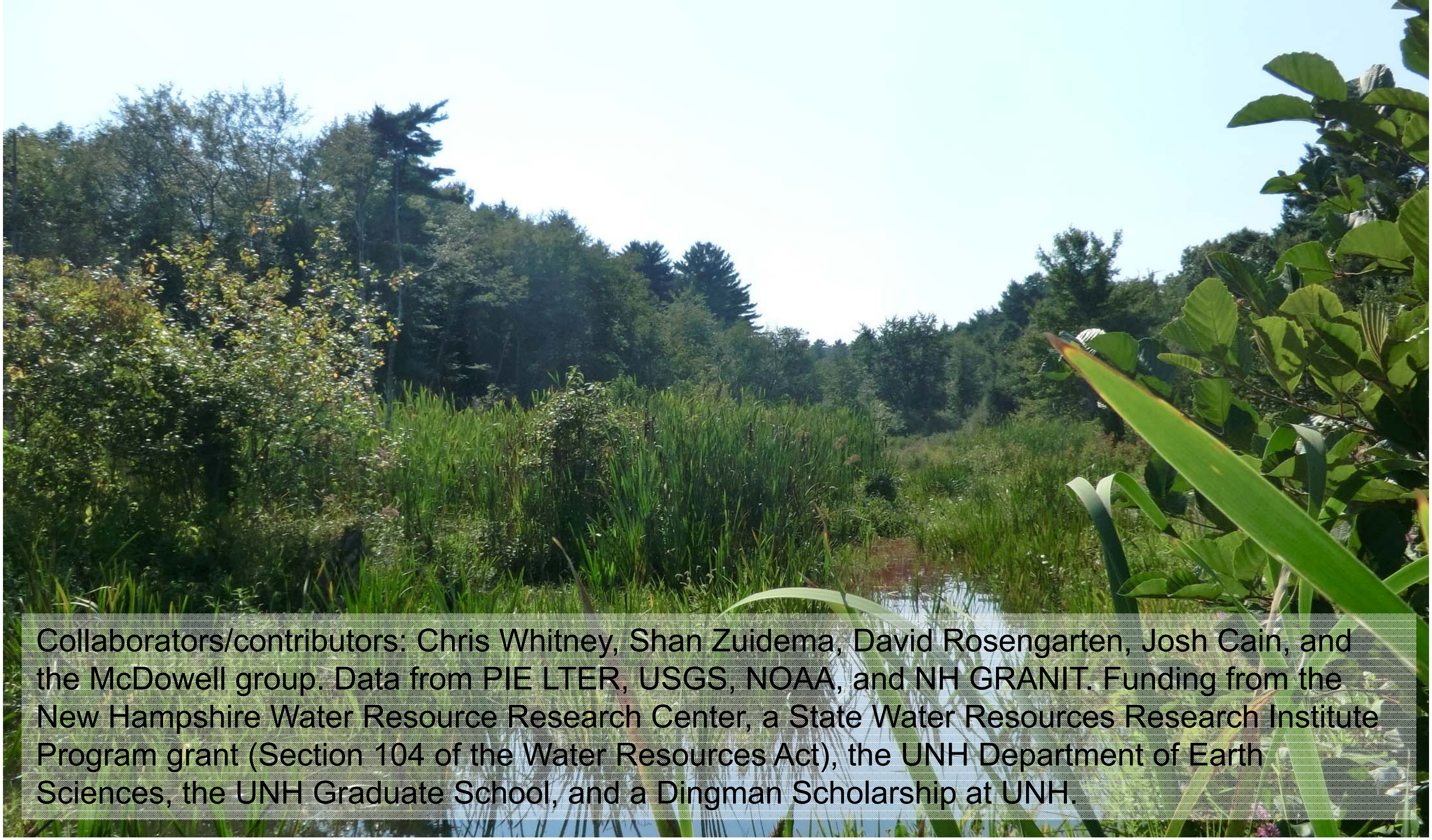
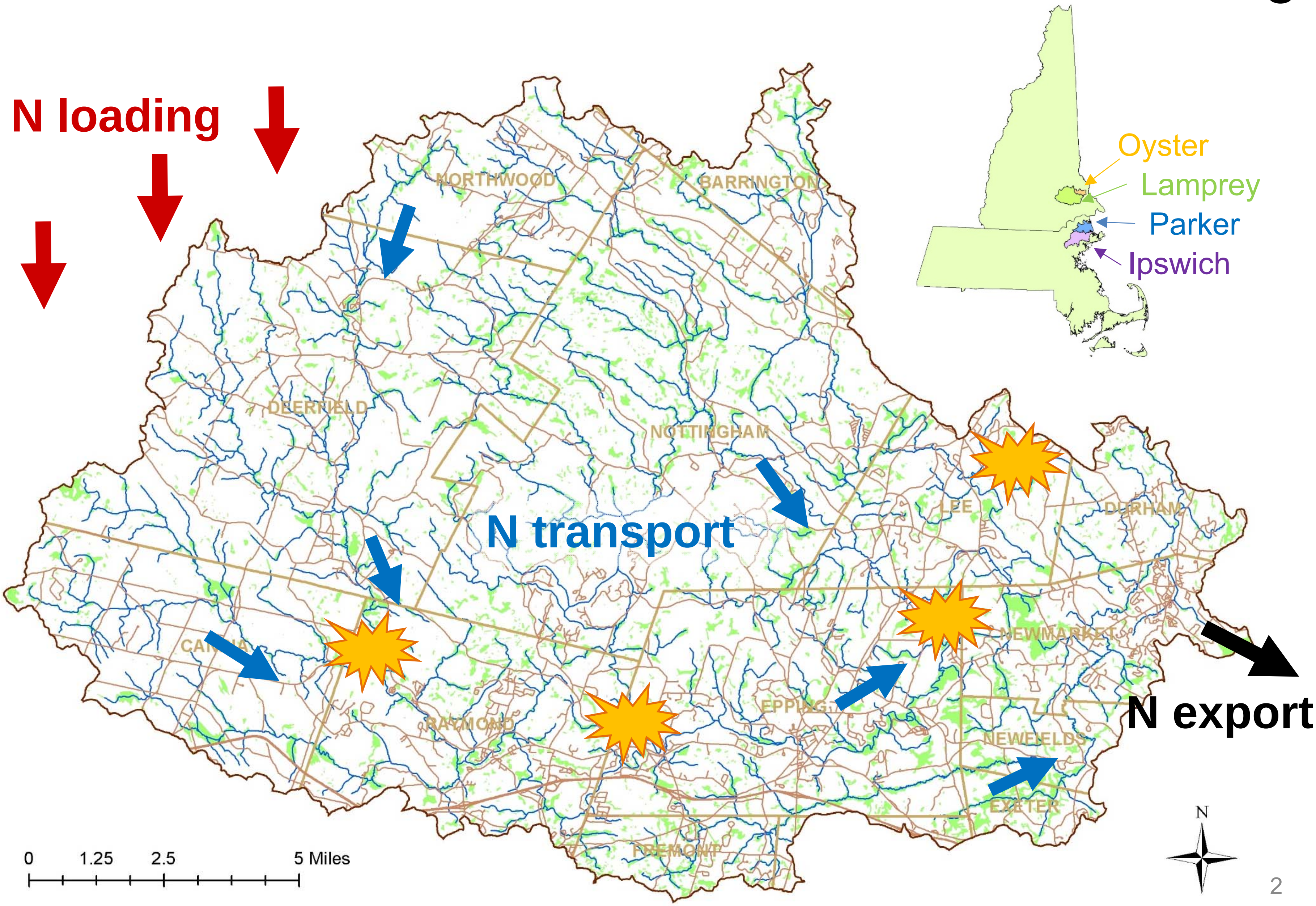
Sophie Wilderotter, USDA ARS

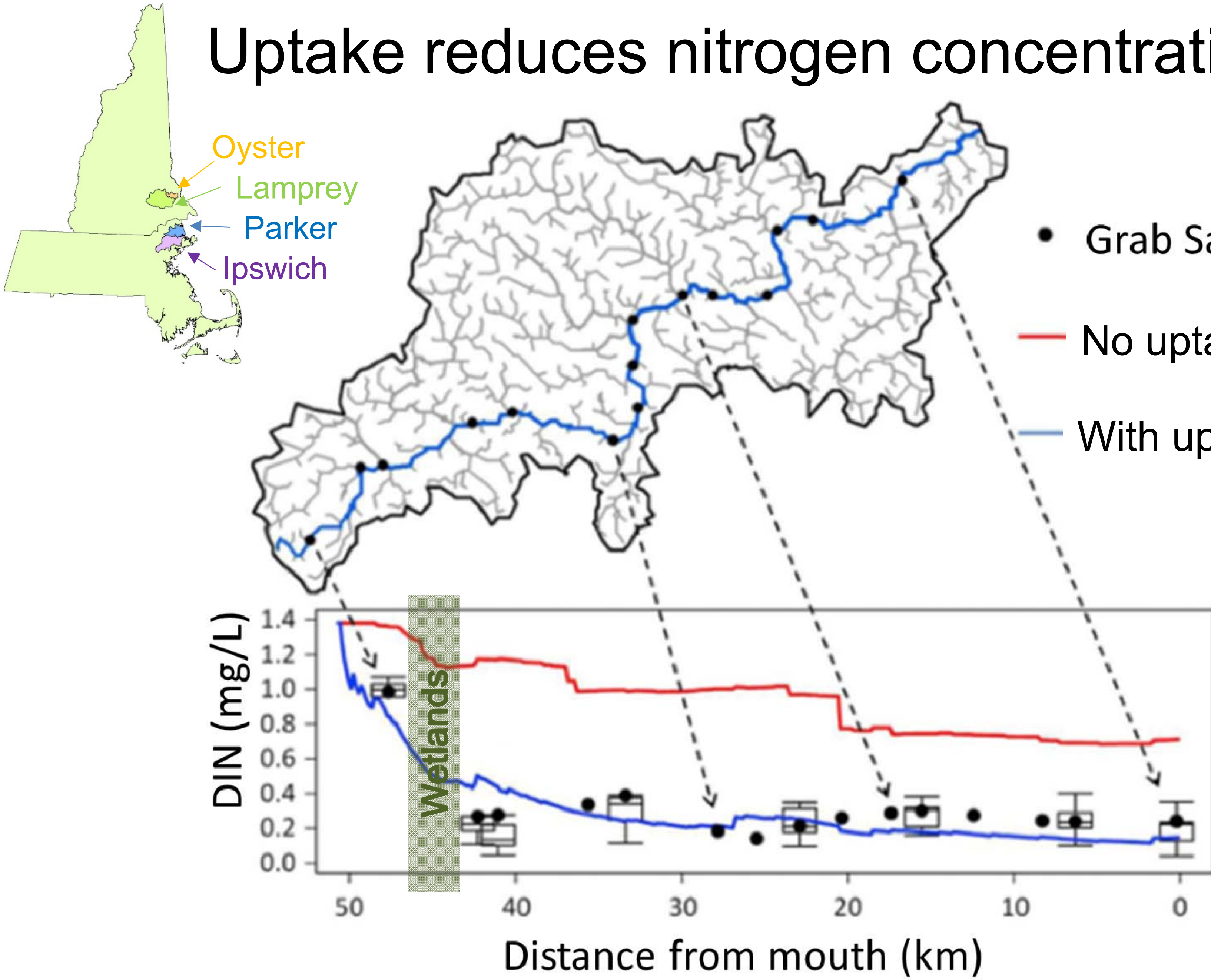


Collaborators/contributors: Chris Whitney, Shan Zuidema, David Rosengarten, Josh Cain, and the McDowell group. Data from PIE LTER, USGS, NOAA, and NH GRANIT. Funding from the New Hampshire Water Resource Research Center, a State Water Resources Research Institute Program grant (Section 104 of the Water Resources Act), the UNH Department of Earth Sciences, the UNH Graduate School, and a Dingman Scholarship at UNH.

River networks retain 80-90% of nitrogen loading

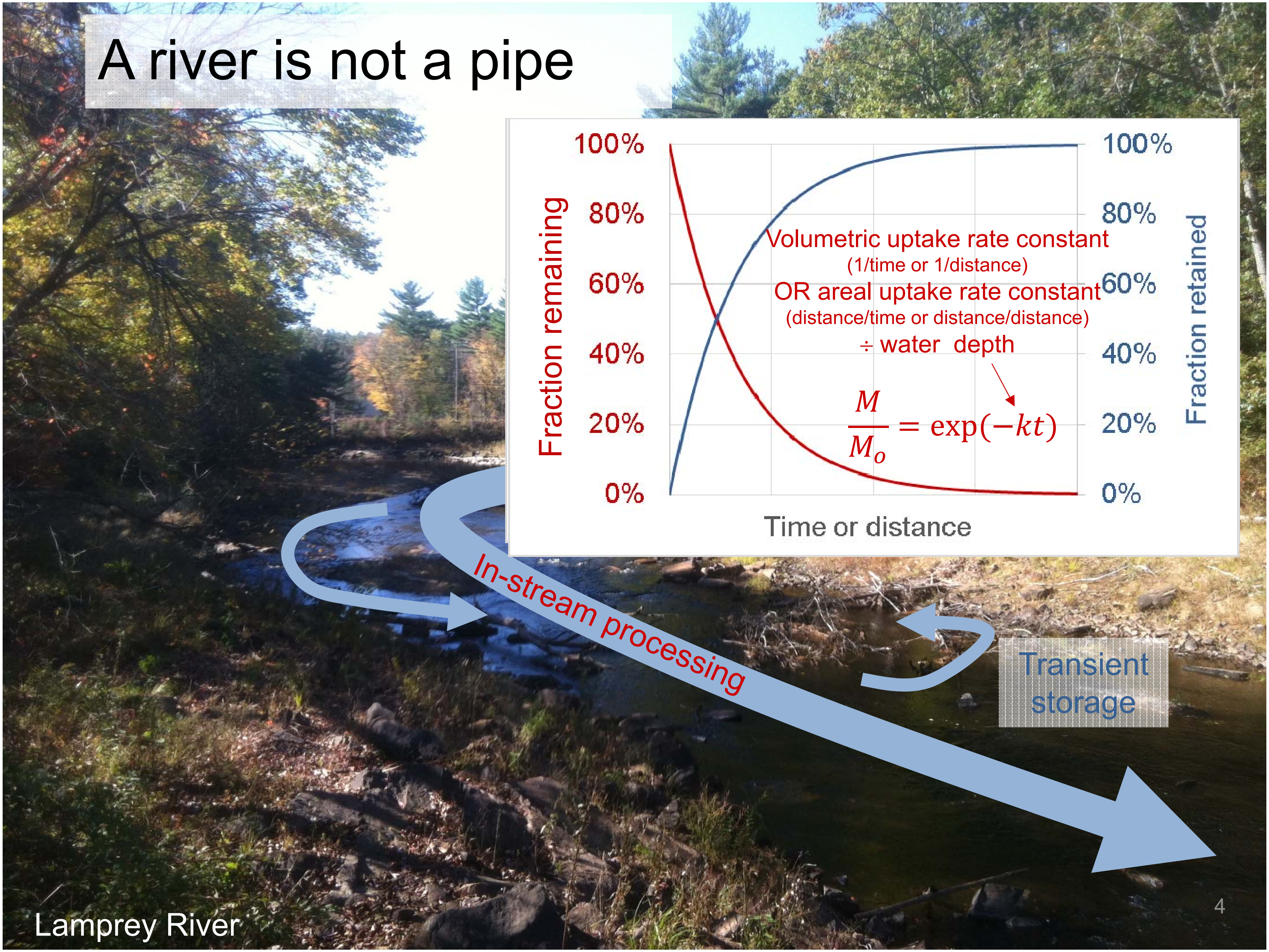


Uptake reduces nitrogen concentration

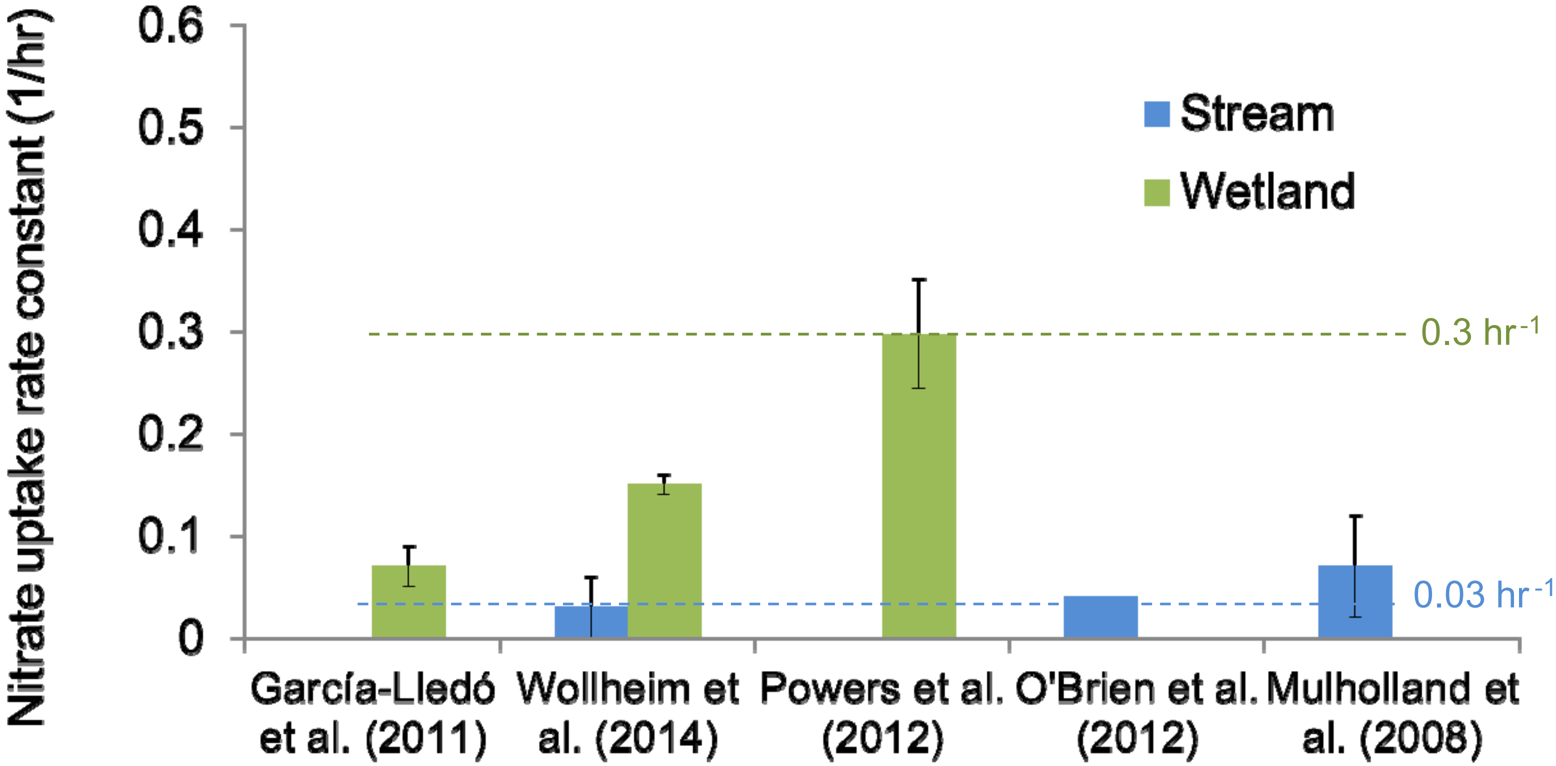


Stewart, R. J., W. M. Wollheim, et al. 2011. Water Resources Research 47(10), DOI: 10.1029/2010WR009896.

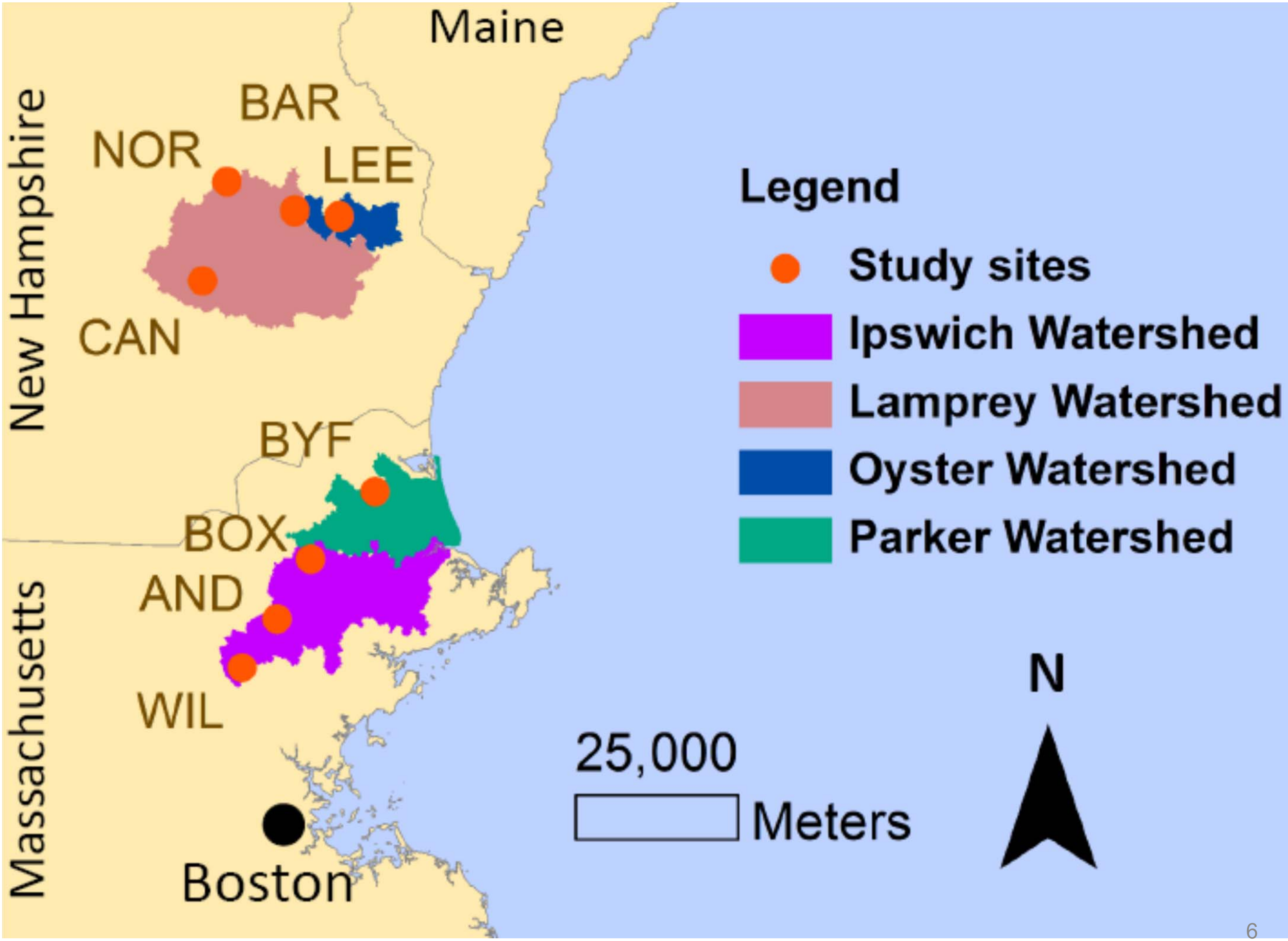
A river is not a pipe

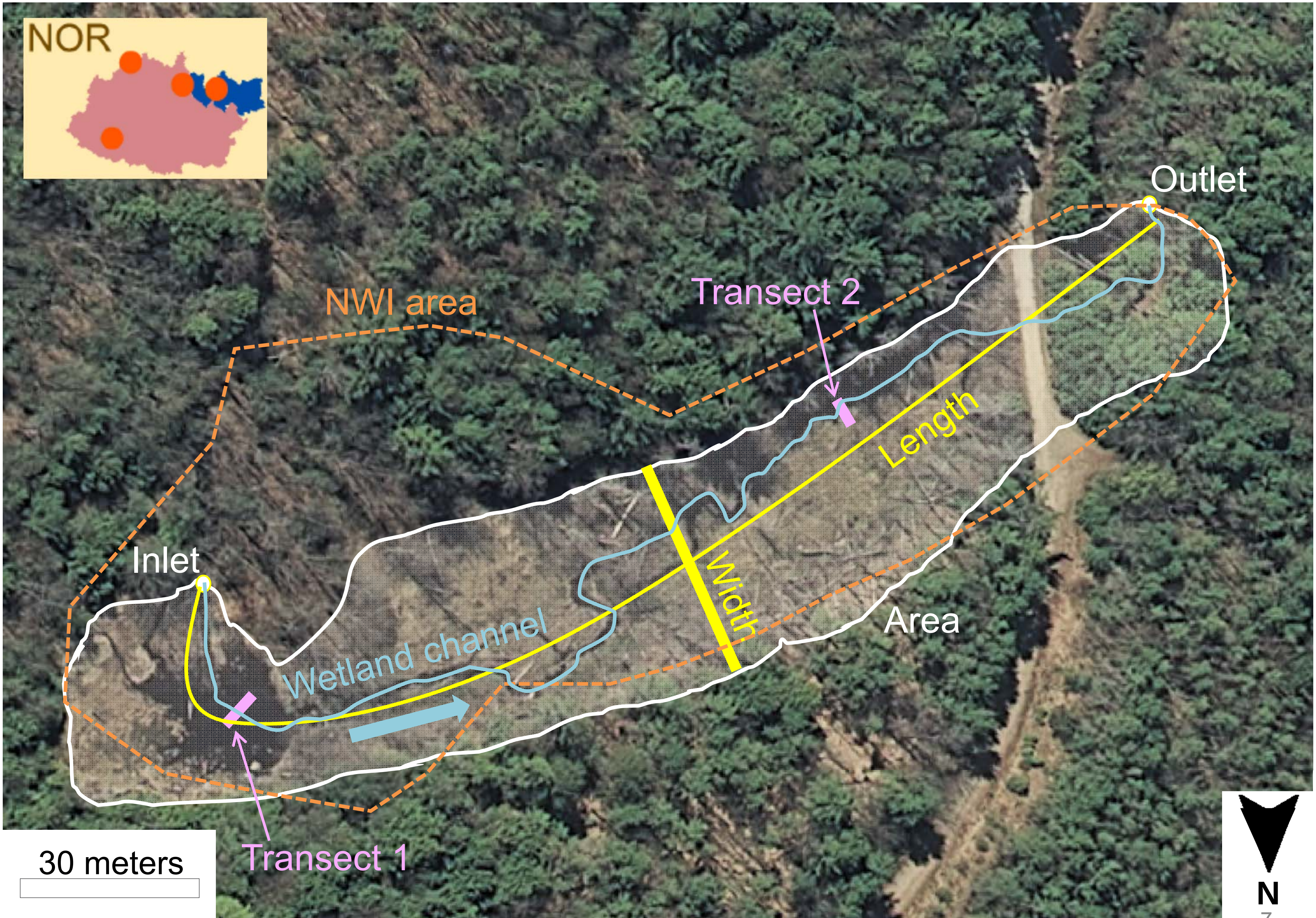


Wetland vegetation increases nitrate retention at patch scale

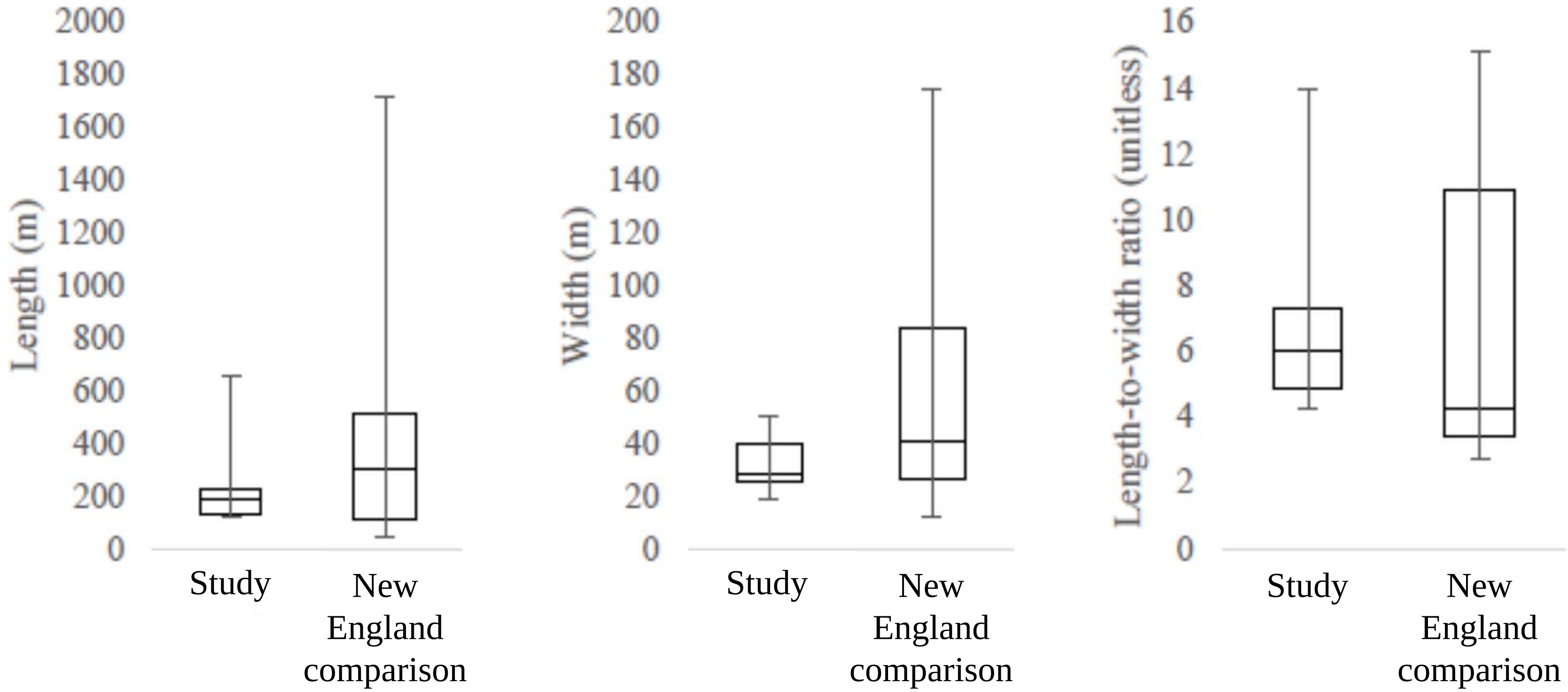


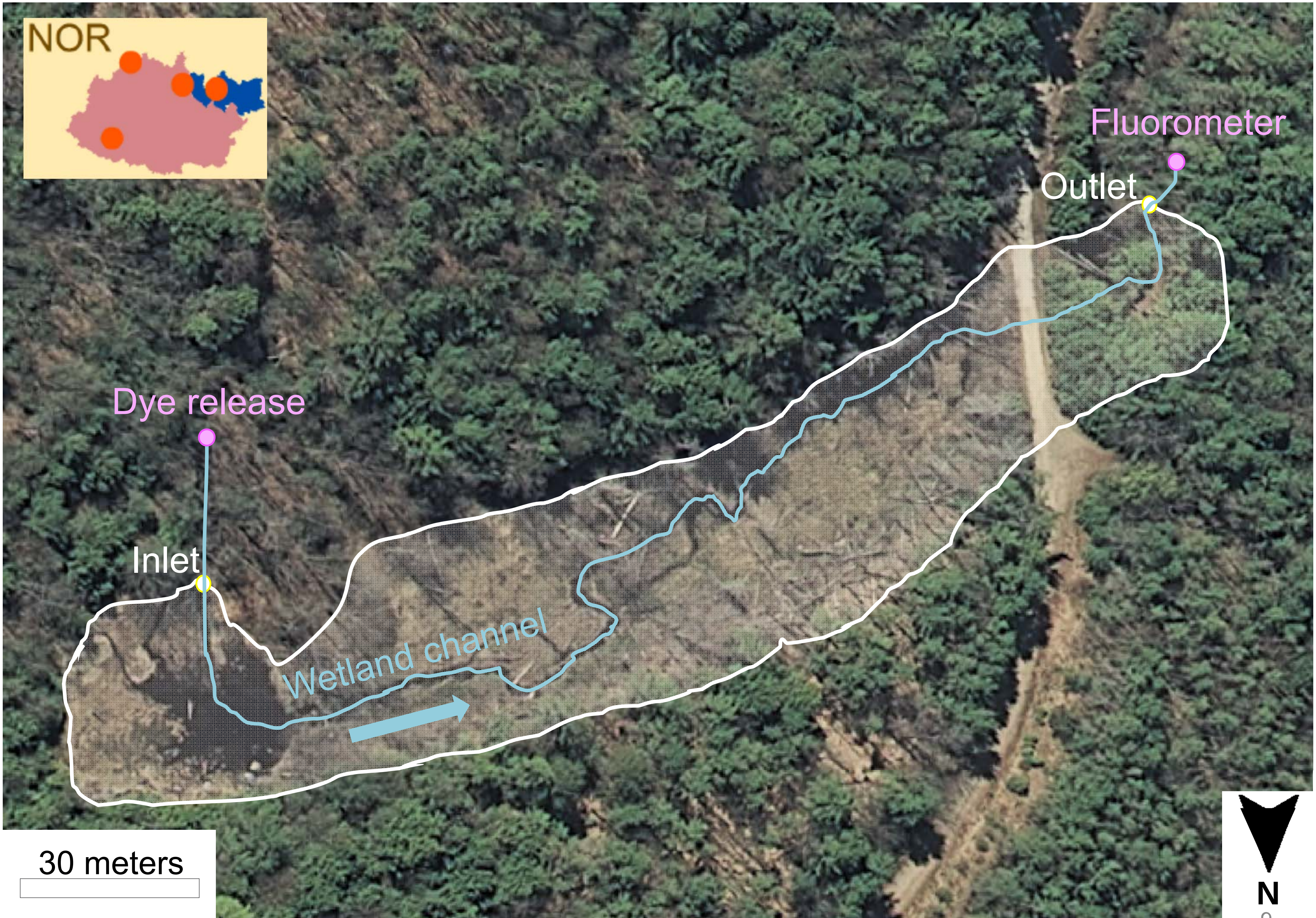
Adapted from Rosengarten, D. W. 2014. UNH MS thesis.

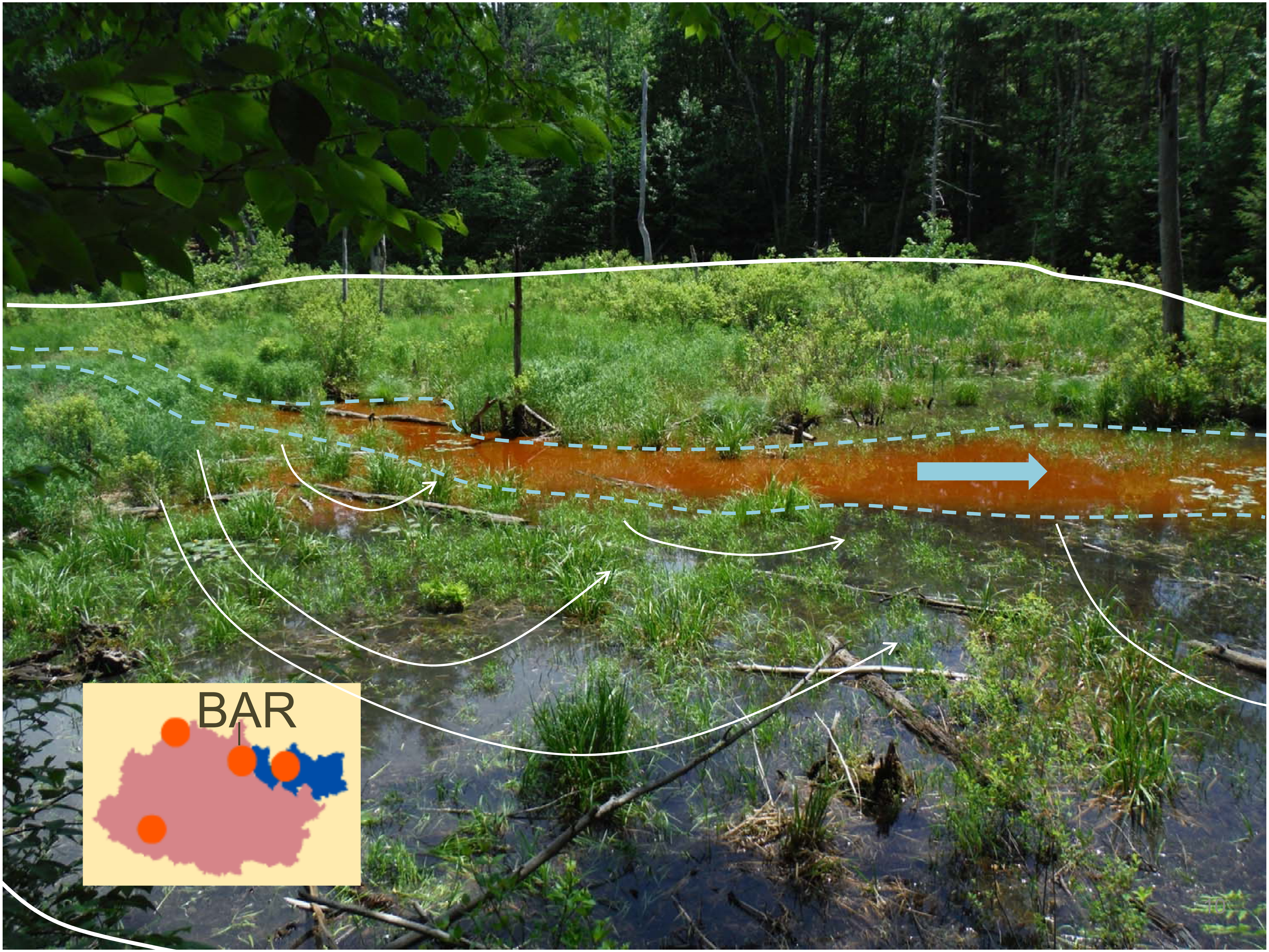

Maine
New Hampshire
BAR
NOR
LEE
CAN
BYF
BOX
AND
WIL
Massachusetts
Boston
Legend
Study sites
Ipswich Watershed
Lamprey Watershed
Oyster Watershed
Parker Watershed
N
25,000
Meters


NOR
Outlet
NWI area
Transect 2
Length
Inlet
Width
Area
Wetland channel
Transect 1
30 meters
N

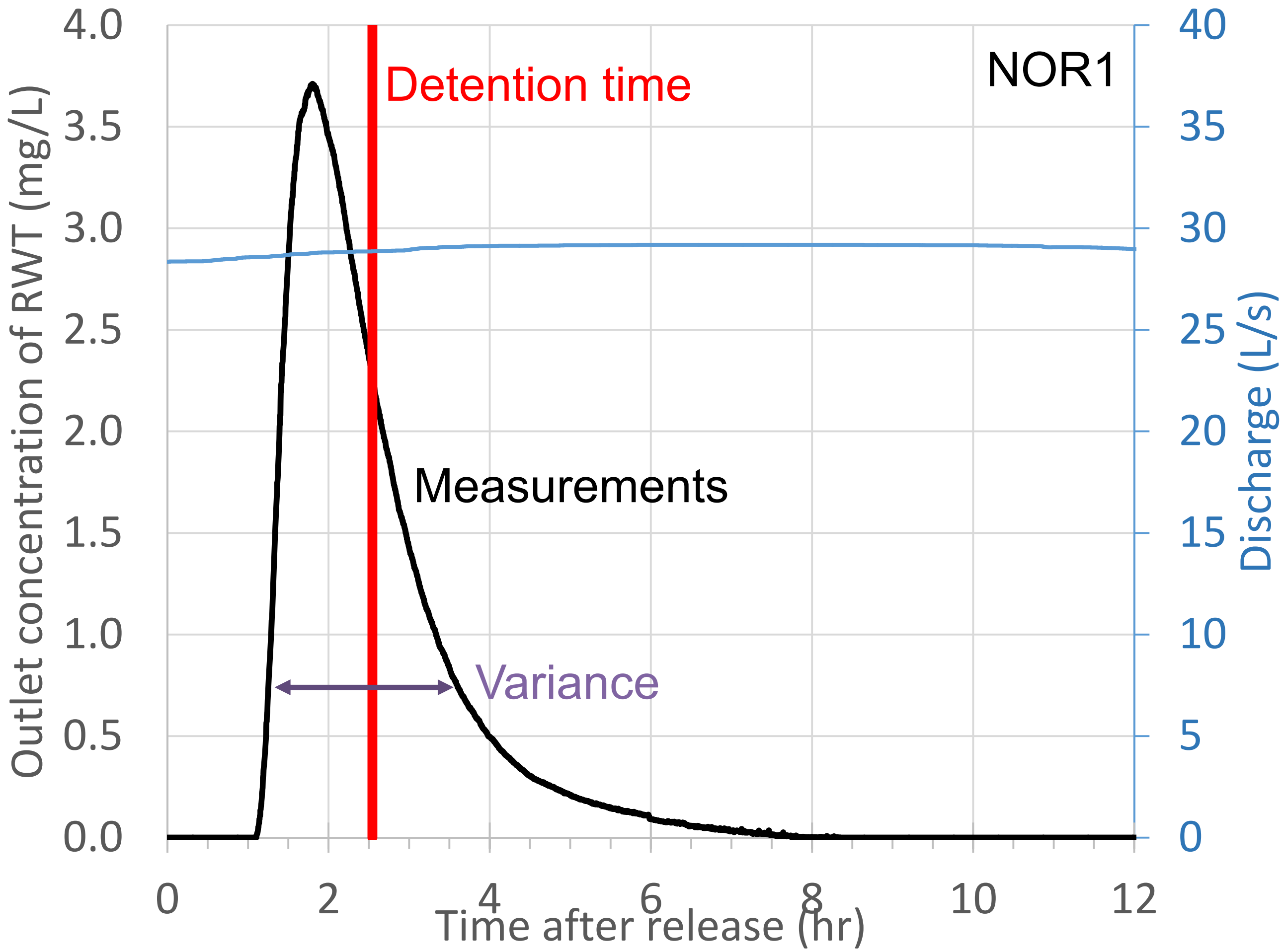
Study wetlands representative of other New England wetlands



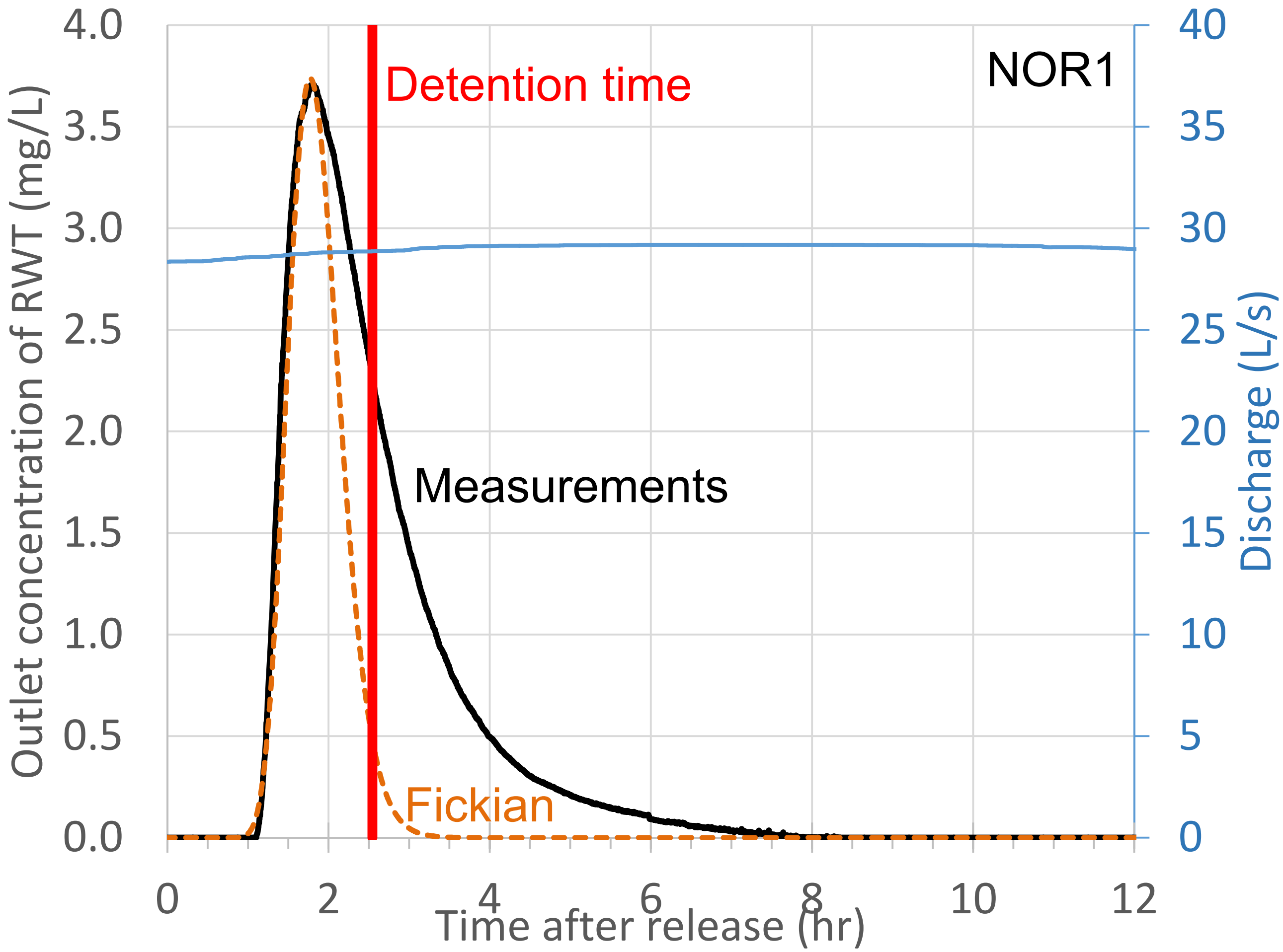

NOR
Fluorometer
Outlet
Dye release
Inlet
Wetland channel
30 meters
N


BAR

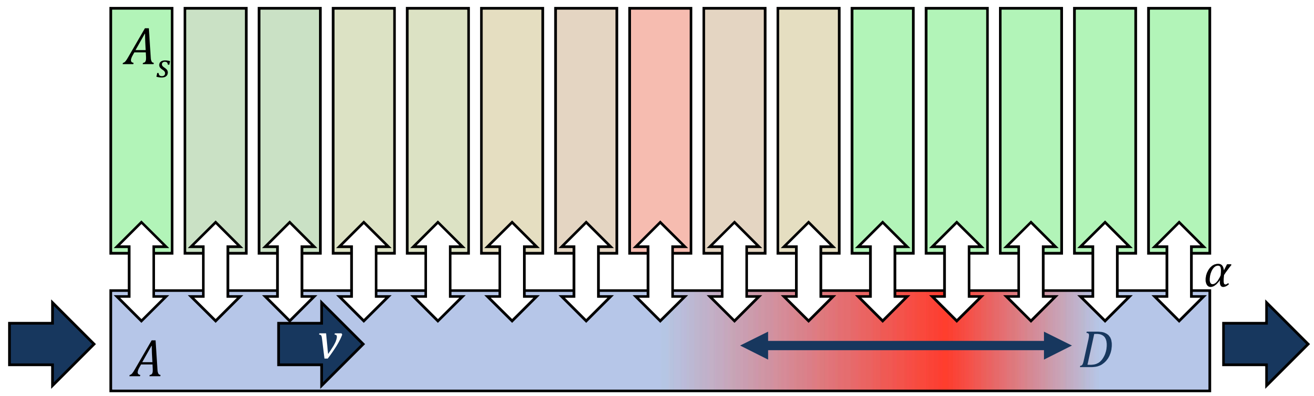
Breakthrough curve following tracer release



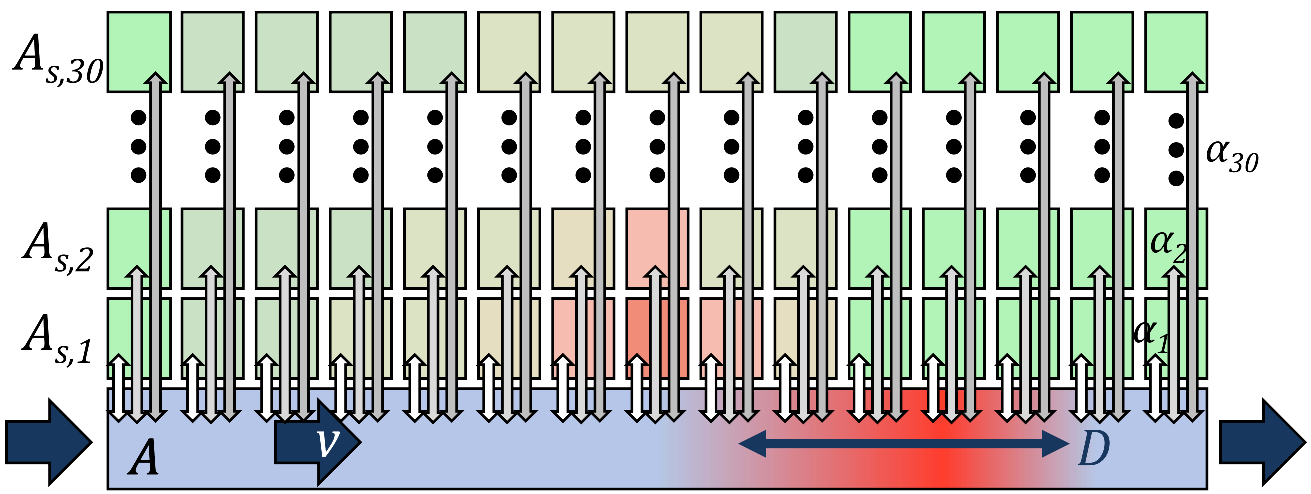
Breakthrough curve following tracer release



Single storage zone representation

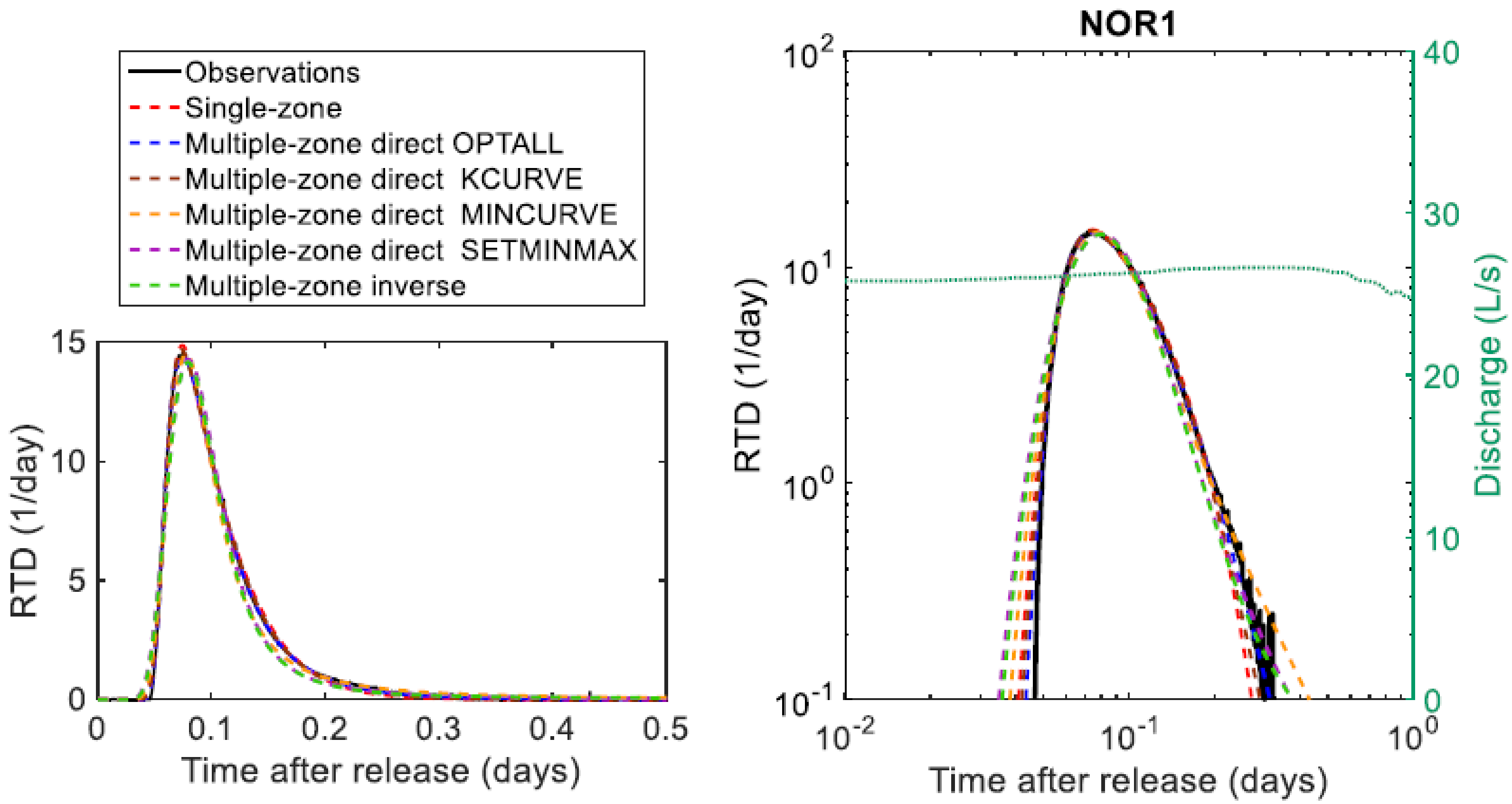


Multiple storage zone representation

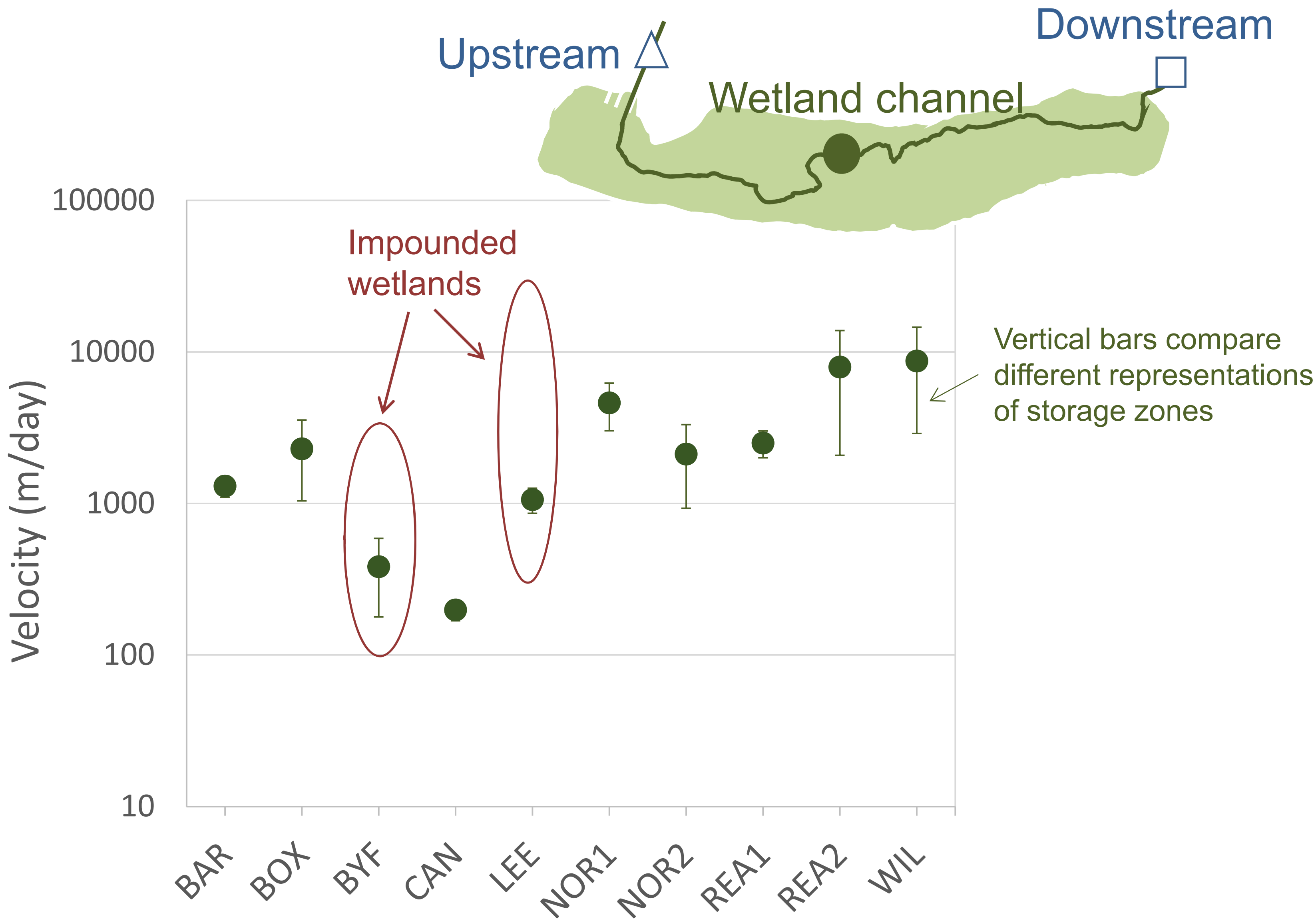


In total, 690 STAMMT-L simulations of 10 breakthrough curves

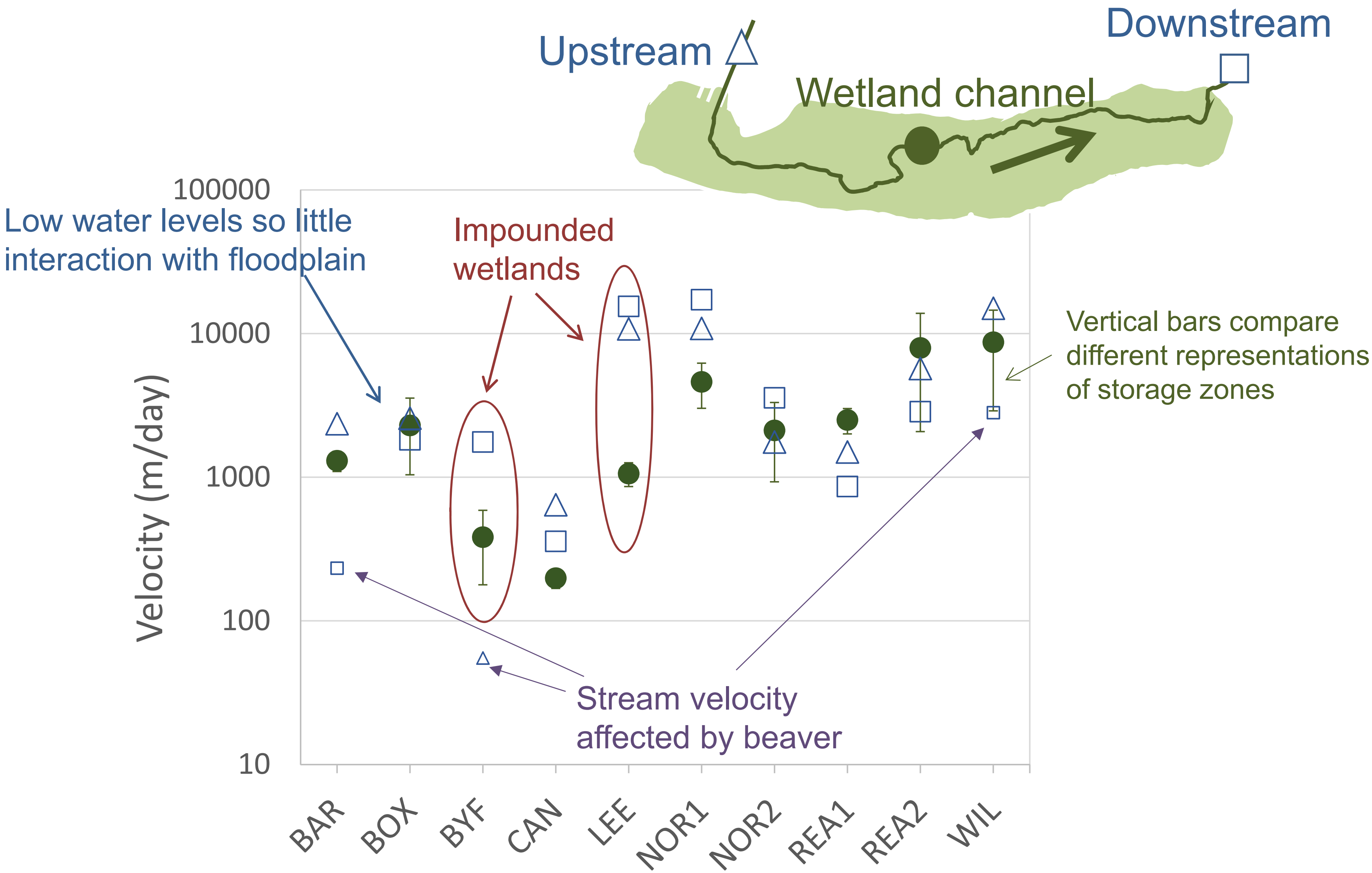
Breakthrough curve



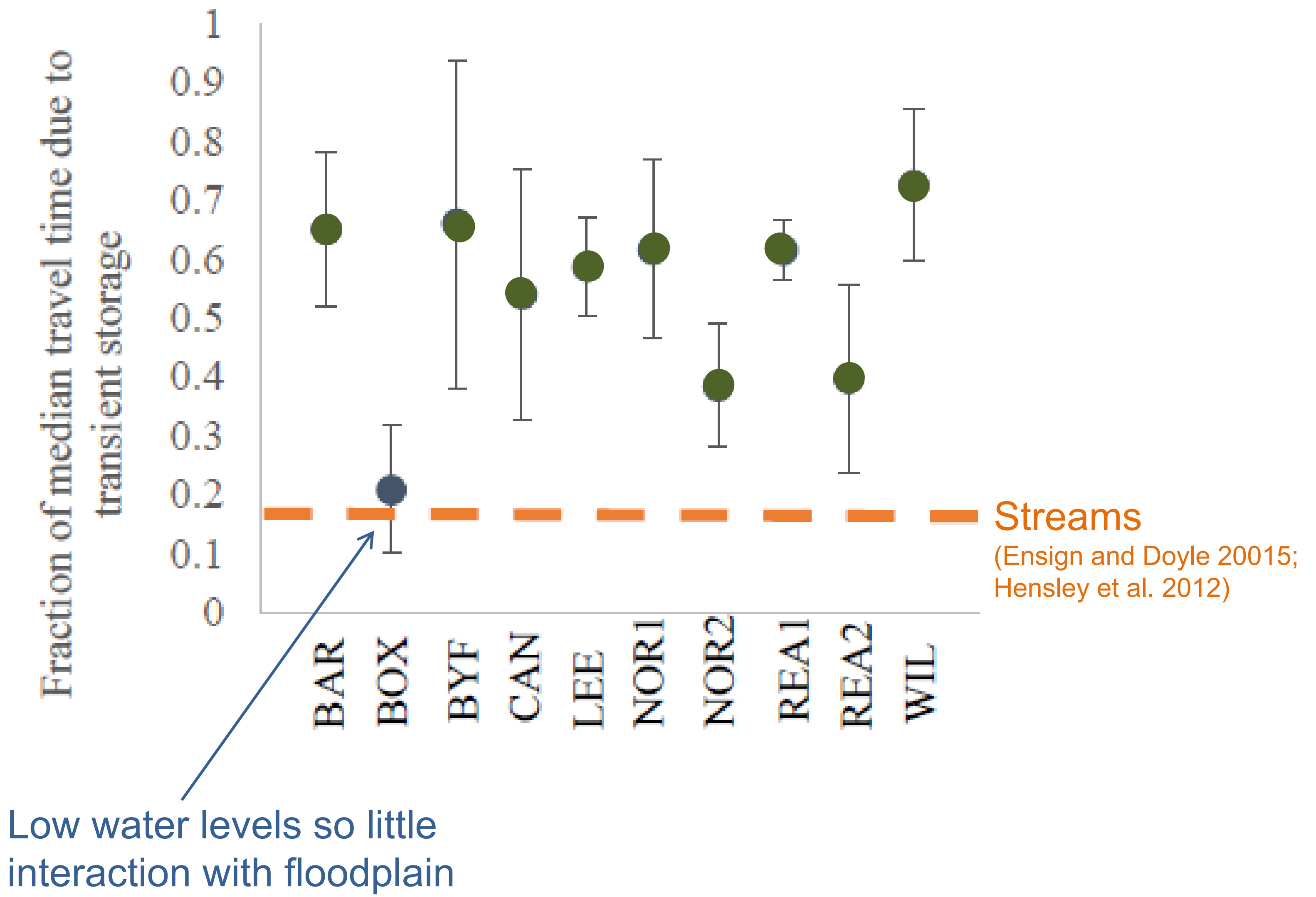
Transport in wetland channels



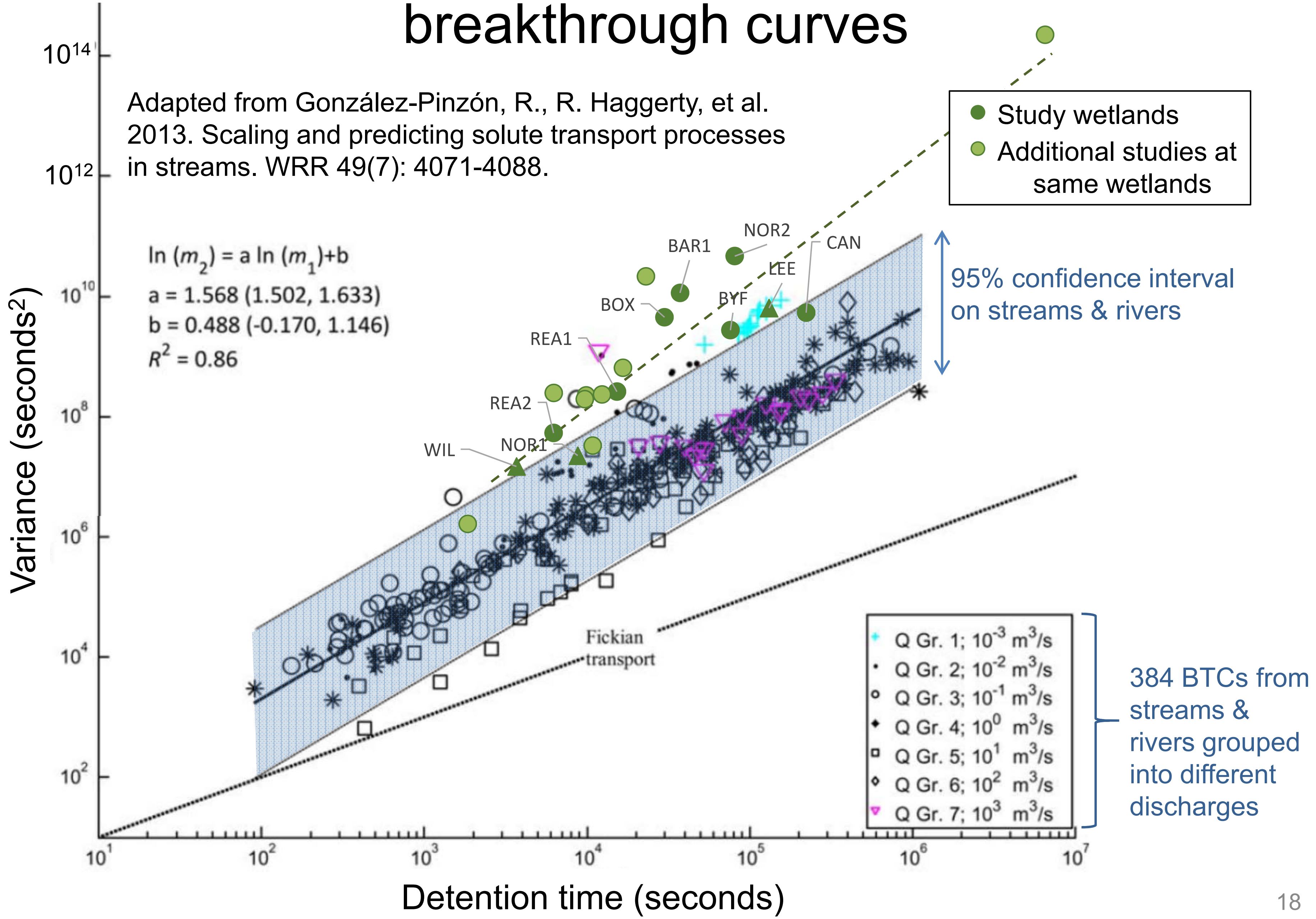
Transport in wetland channels



Surface transient storage important for solute transport in study reaches



Wetland-dominated reaches increase tail of breakthrough curves



Fluvial wetlands delay solute transport

PHYSICAL CHARACTERISTICS

Watershed area
Wetland area
Total width
Wetted width
Length
Length:width ratio
Sinuosity
Channel length
Channel depth
Channel width
Channel XS area
Floodplain depth
Floodplain width
Floodplain XS area
Water surface slope
Stream order

not correlated with

TRANSPORT CHARACTERISTICS

Advective velocity
(v = 10^2–10^4 m/day)

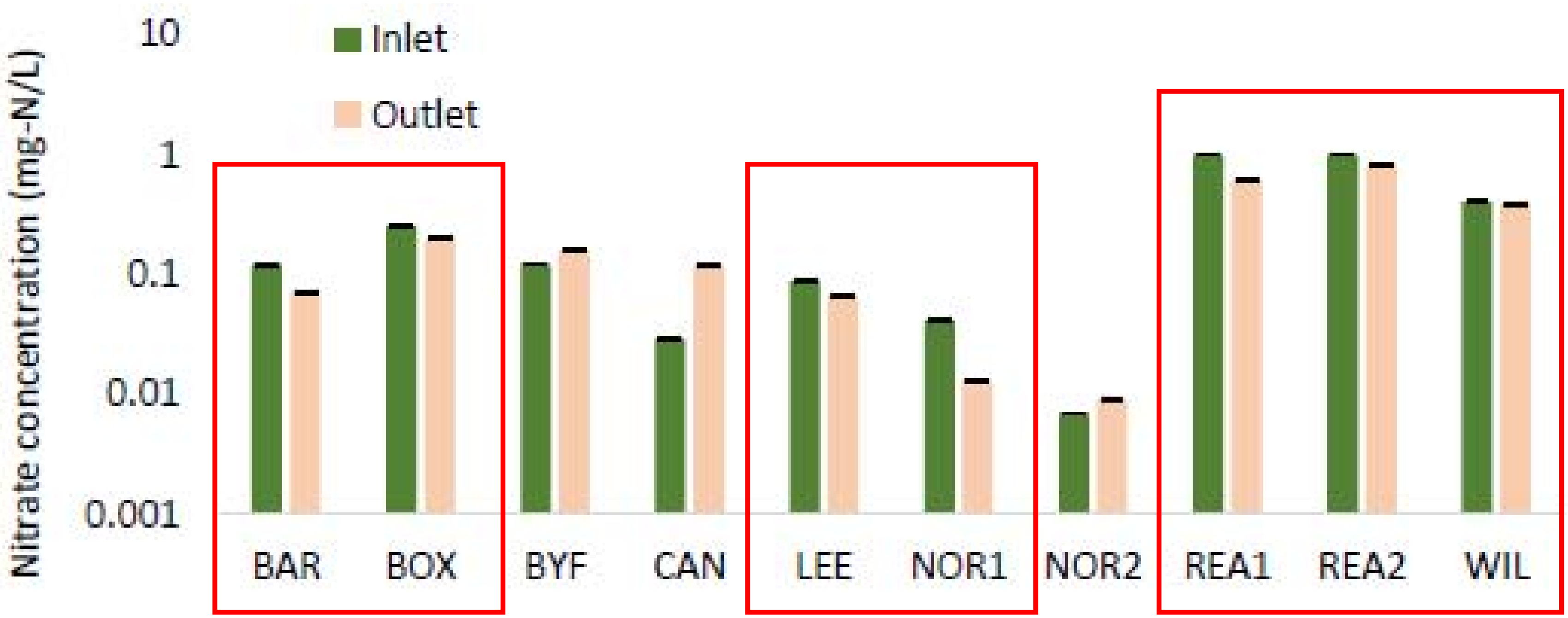
Channel dispersion
(D = 10^2–10^4 m^2/day)

Storage zone total size
(A_s/A = 0.1–1)

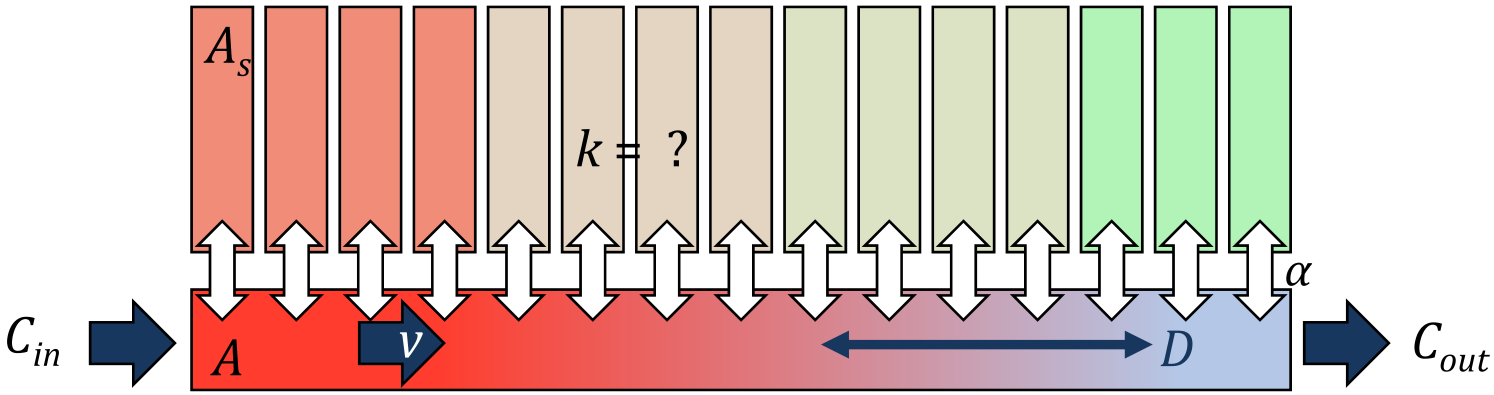
Storage zone size distribution
(power law distribution coefficient 1–3)

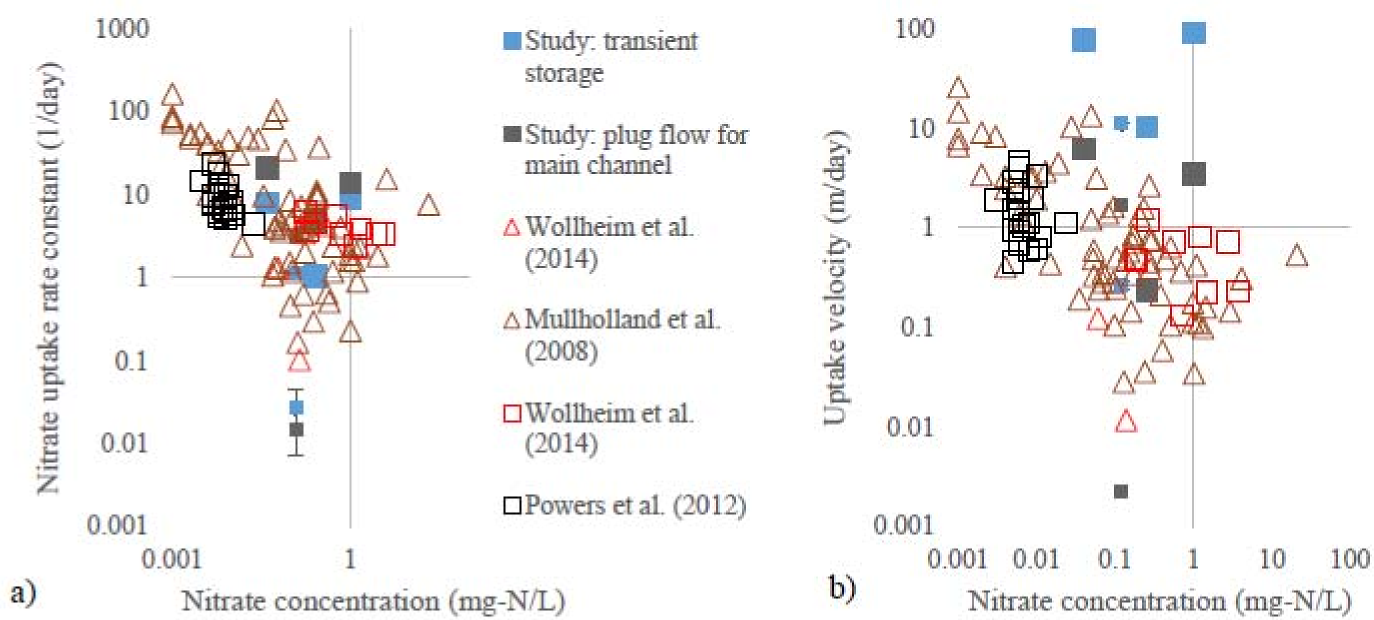
Storage zone connectivity
(α = 10^{-1}–10^2 1/day)

Nitrate concentrations & flux



Storage zone representation of reactive solute





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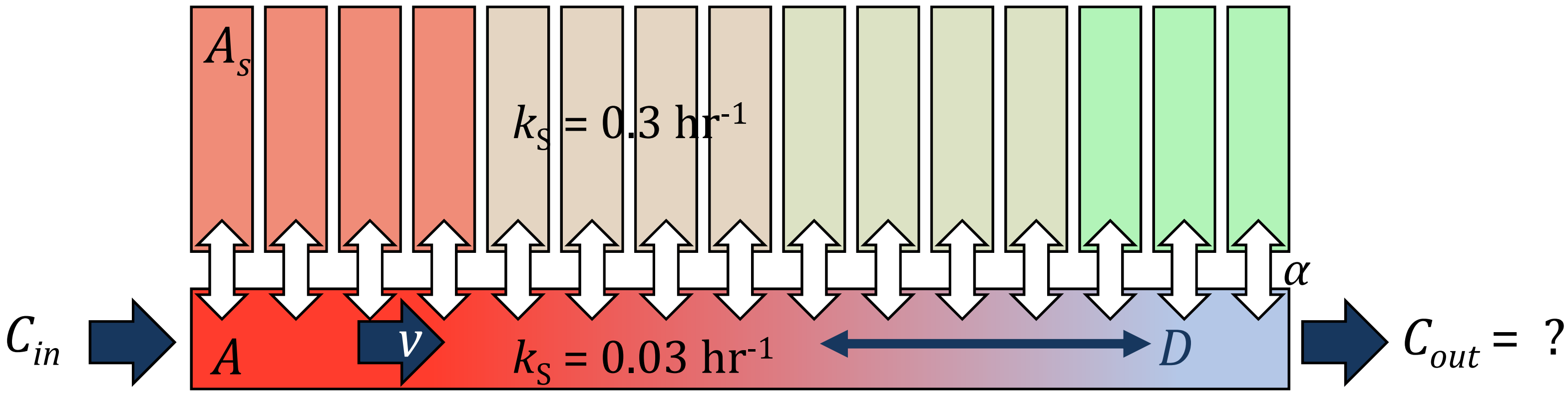

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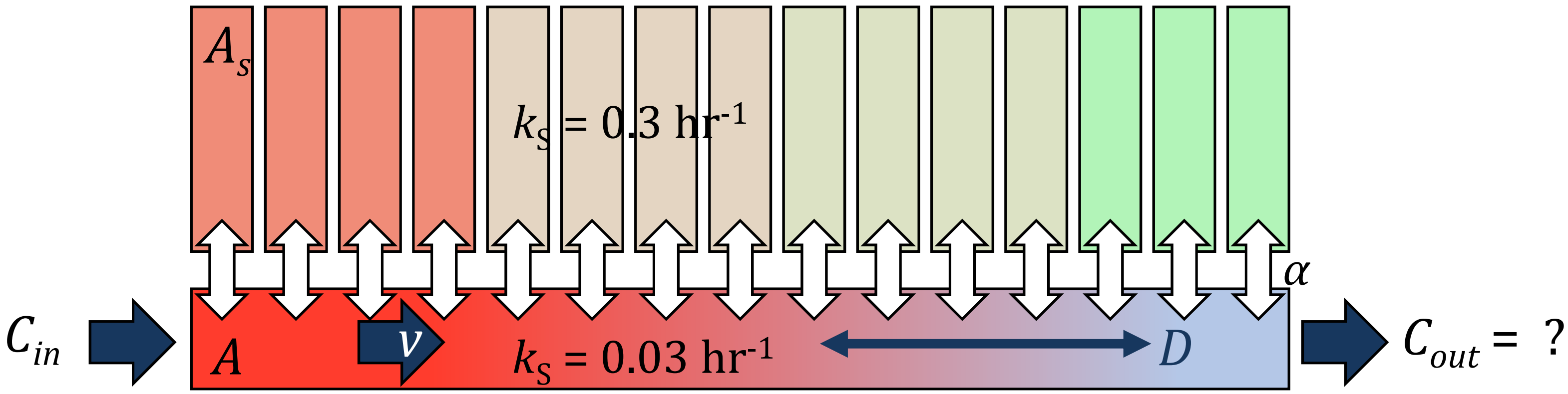

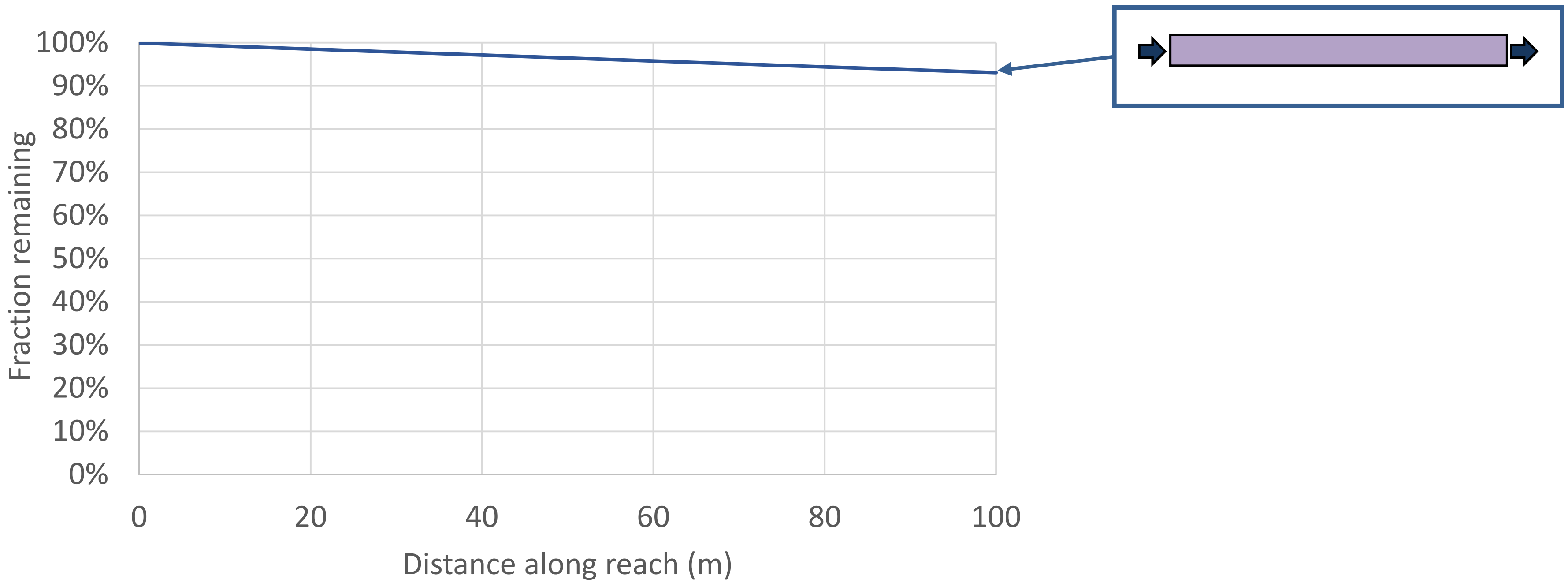

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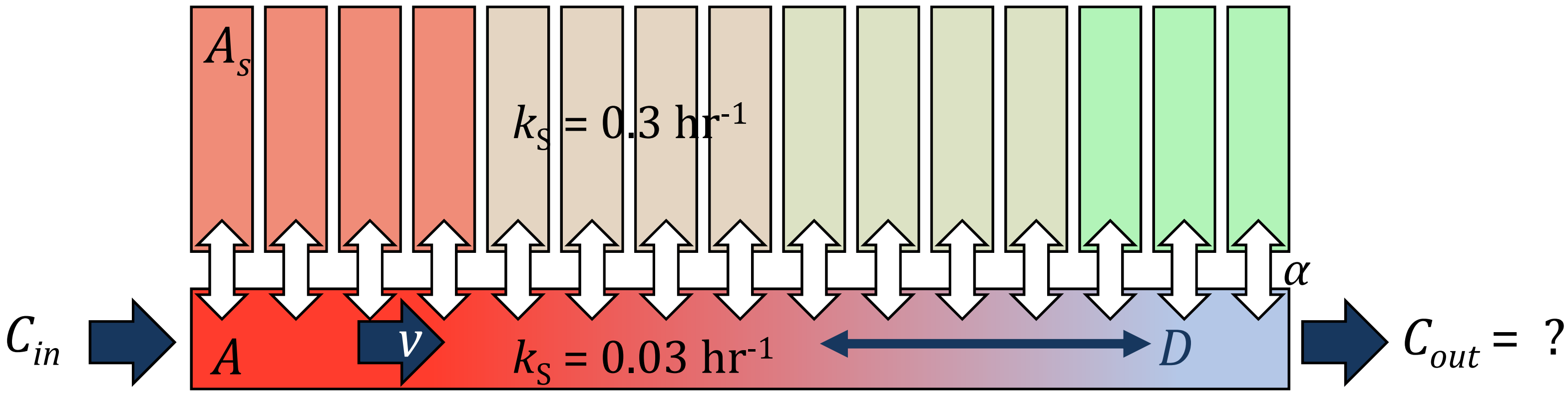

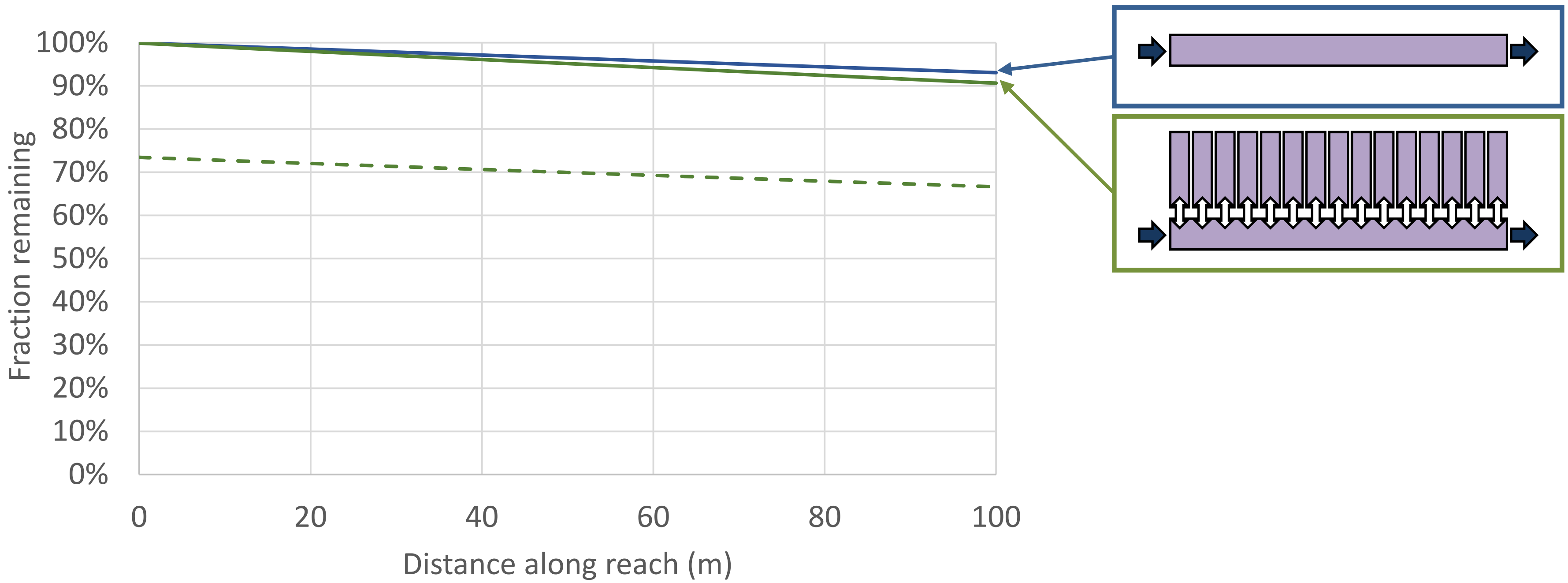

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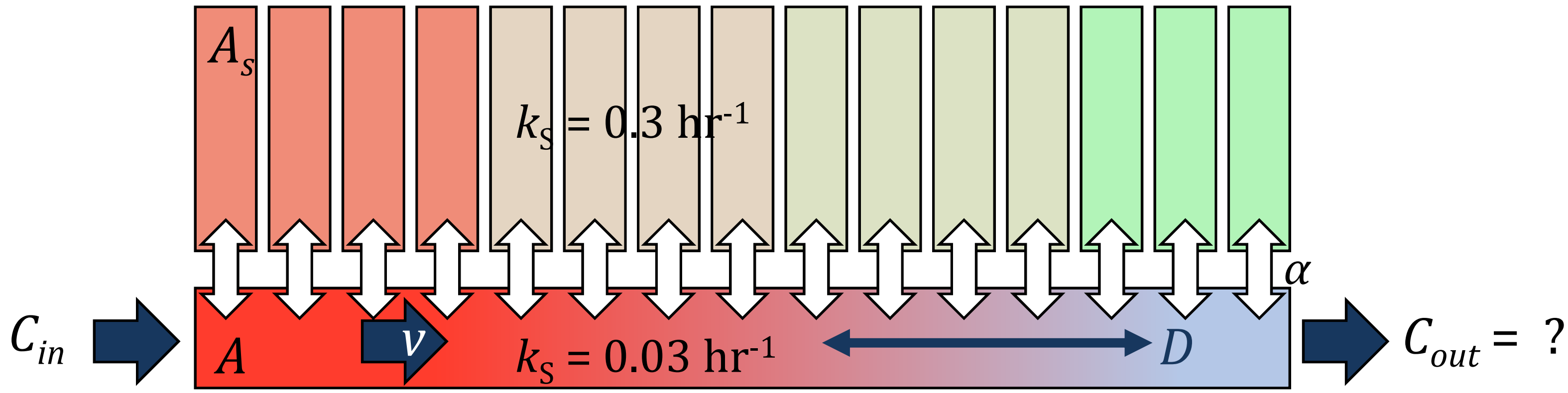
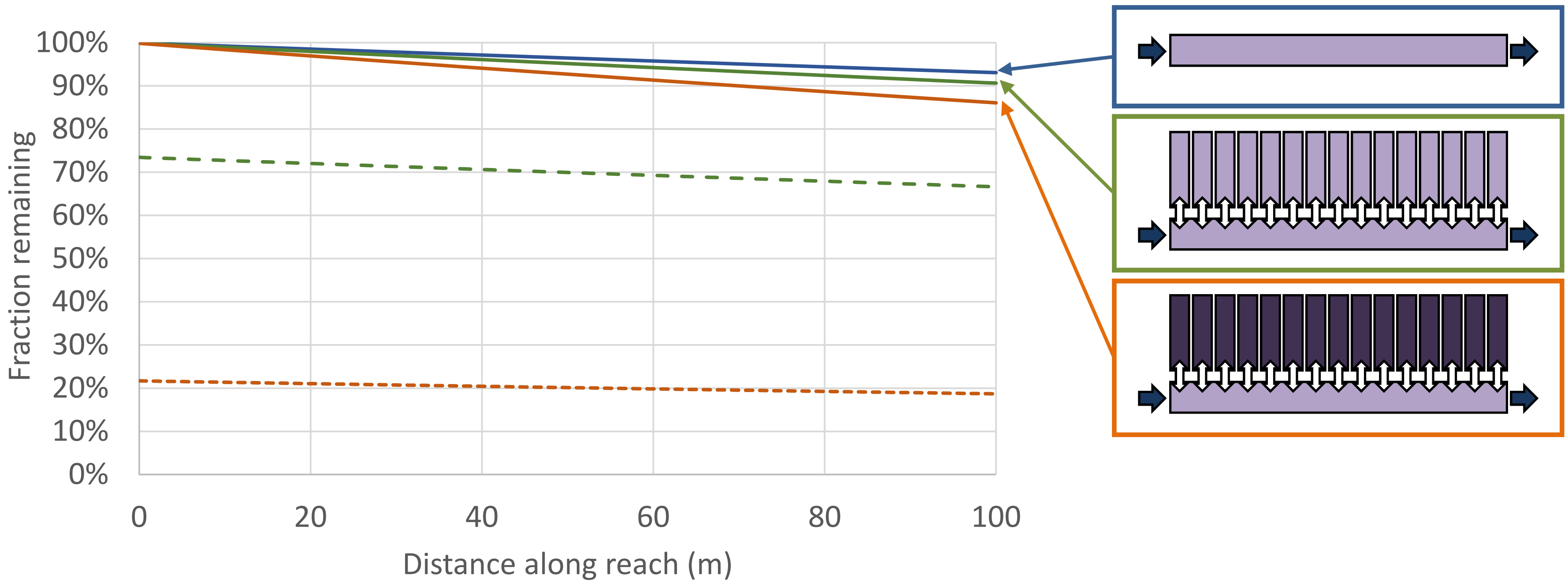
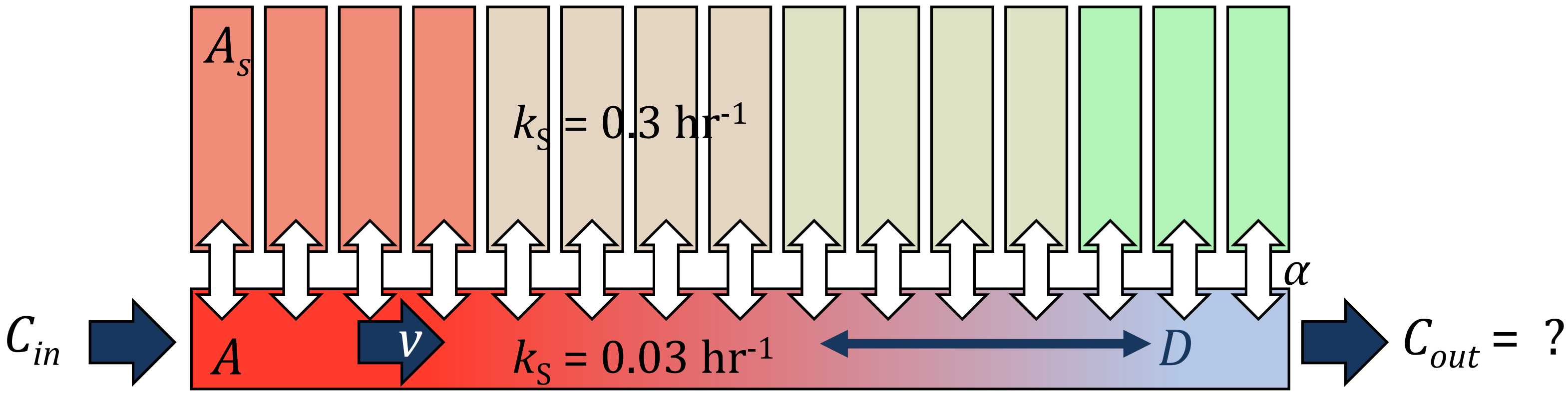
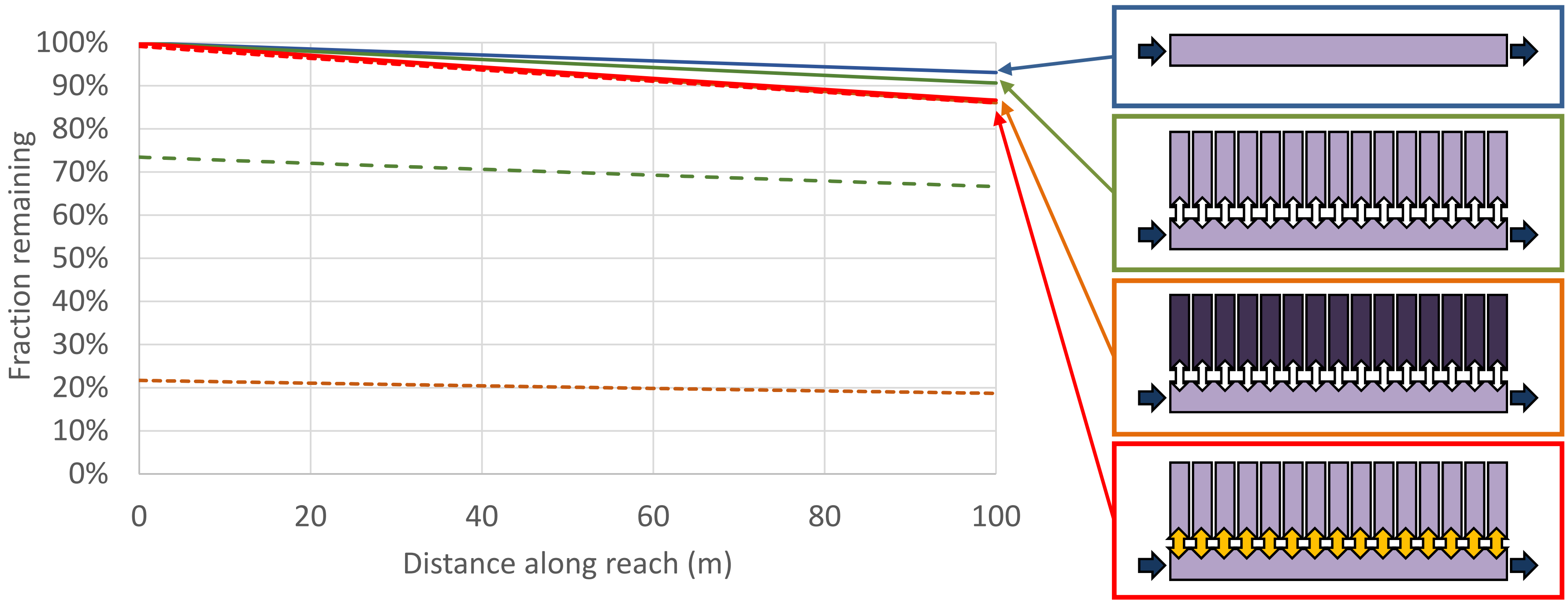


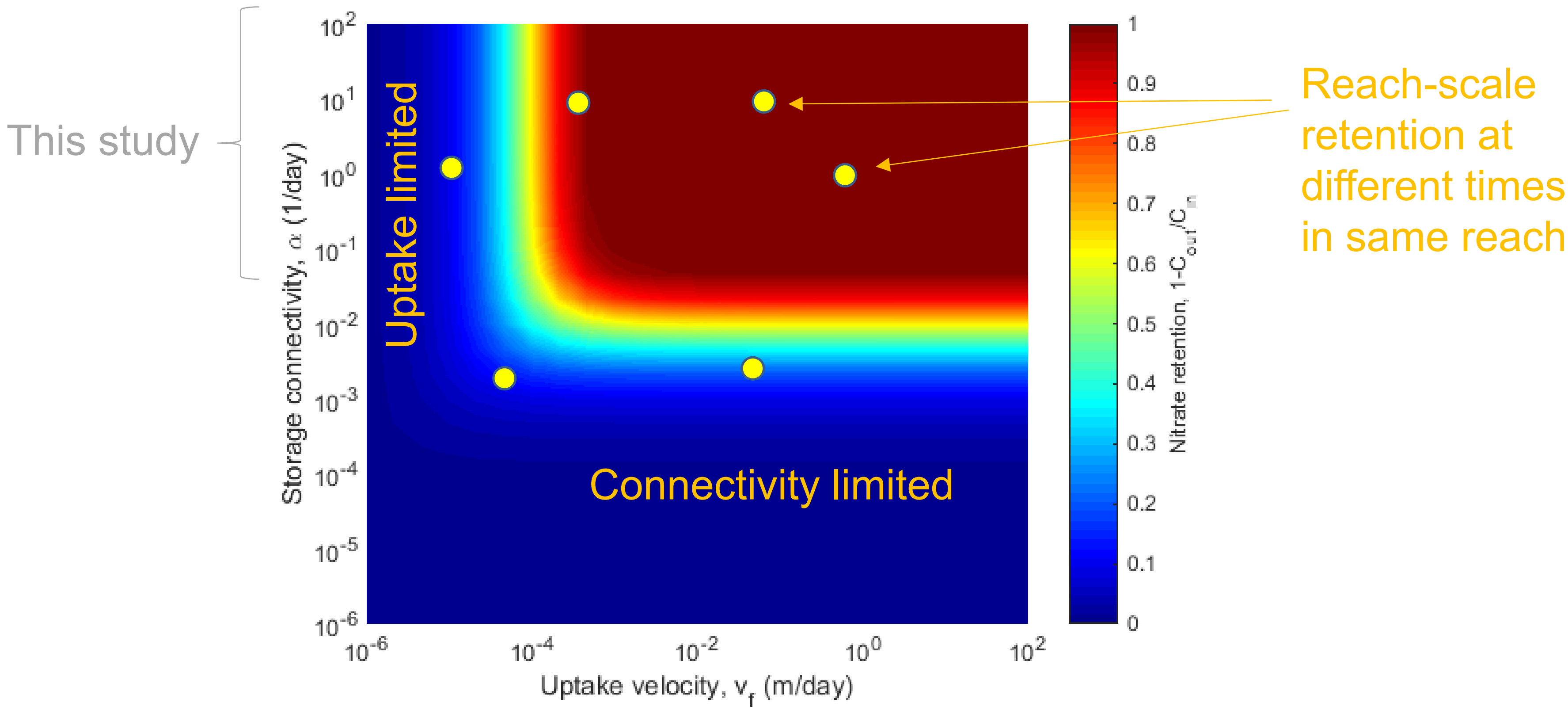


Storage zone representation of reactive solute

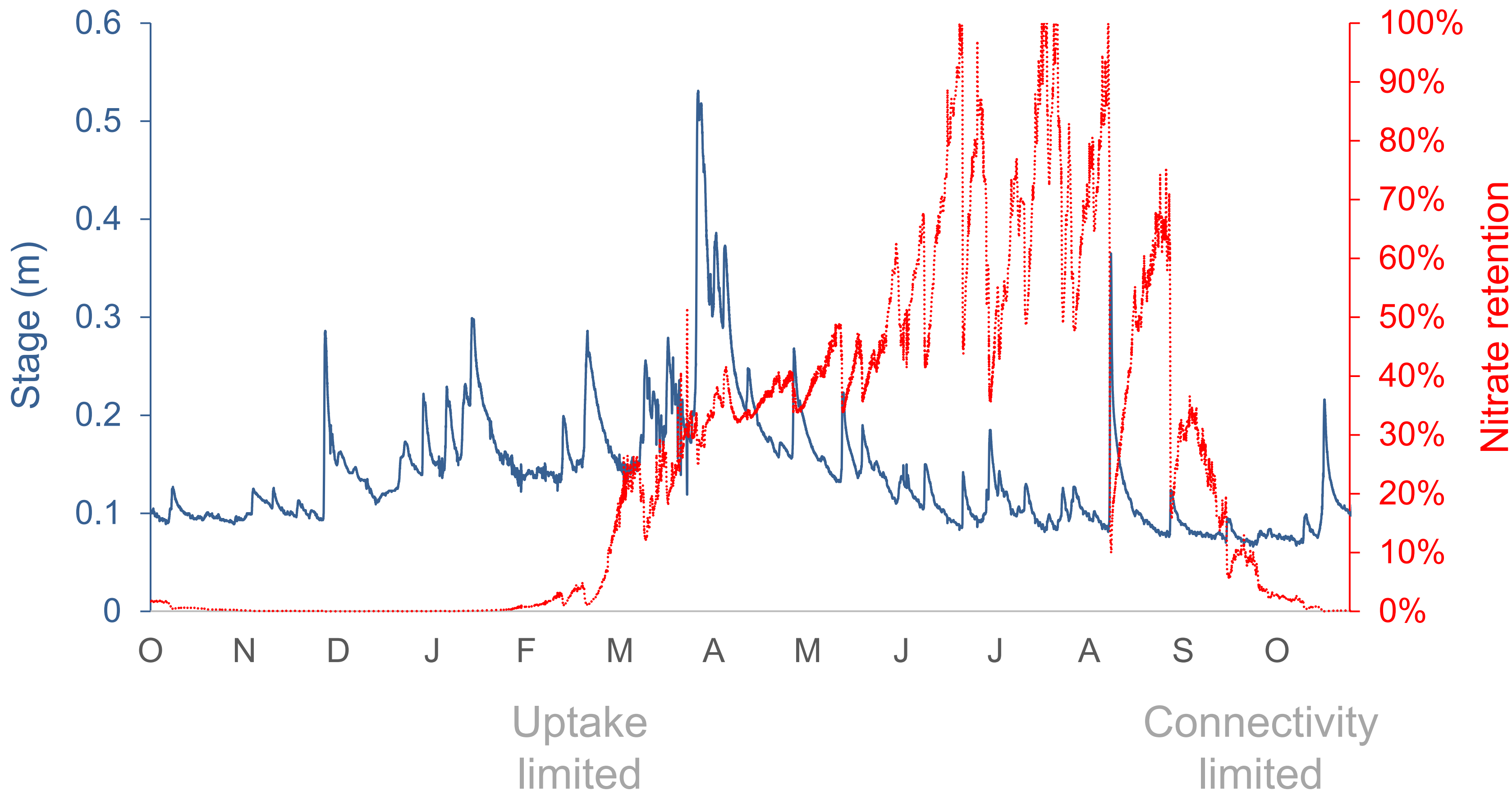




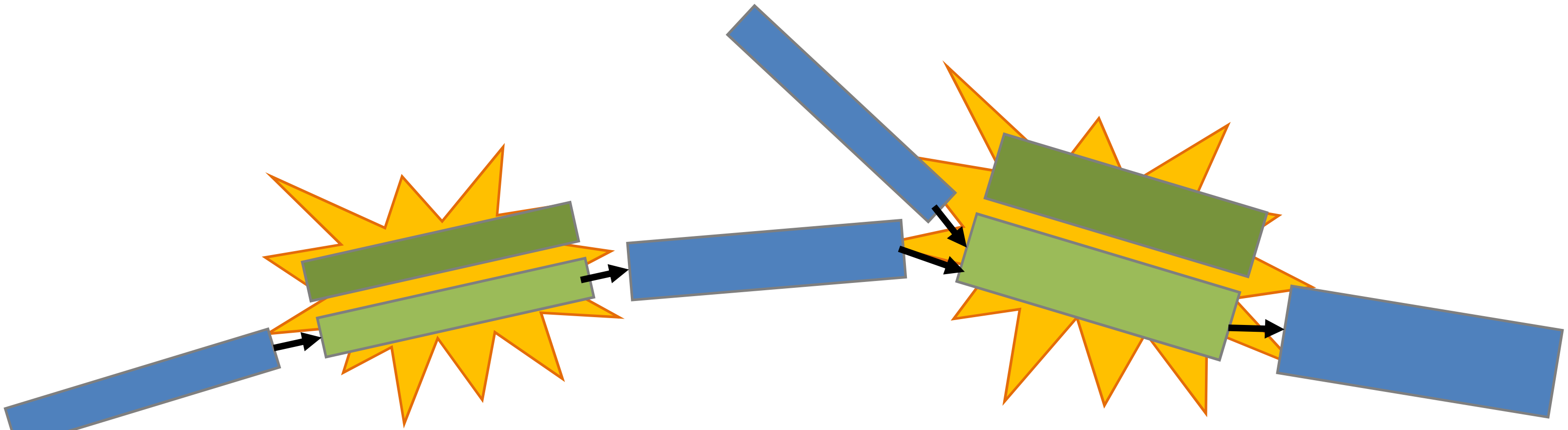
Reach-scale retention depends on patch-scale uptake & connectivity



Seasonality in reach-scale uptake

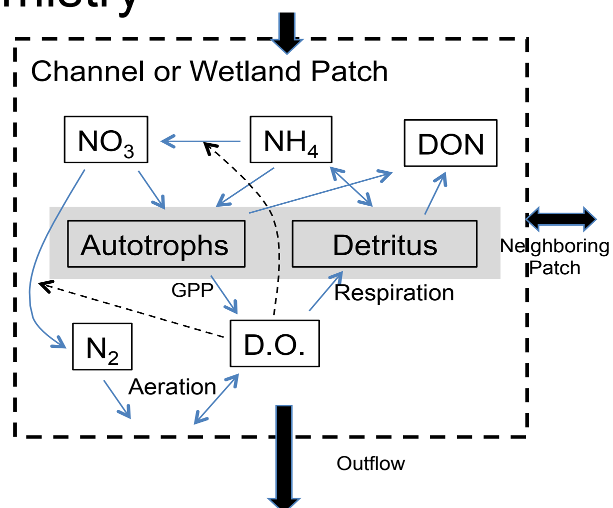


Transport through river networks



Next steps

- Measure patch-scale uptake rates during different connectivity, and compare to reach-scale retention
- Incorporate improved parameterization of wetland-dominated reaches into network models
- Improve characterization of biogeochemistry



- Examine role of impoundments on nutrient transport and retention at reach scale