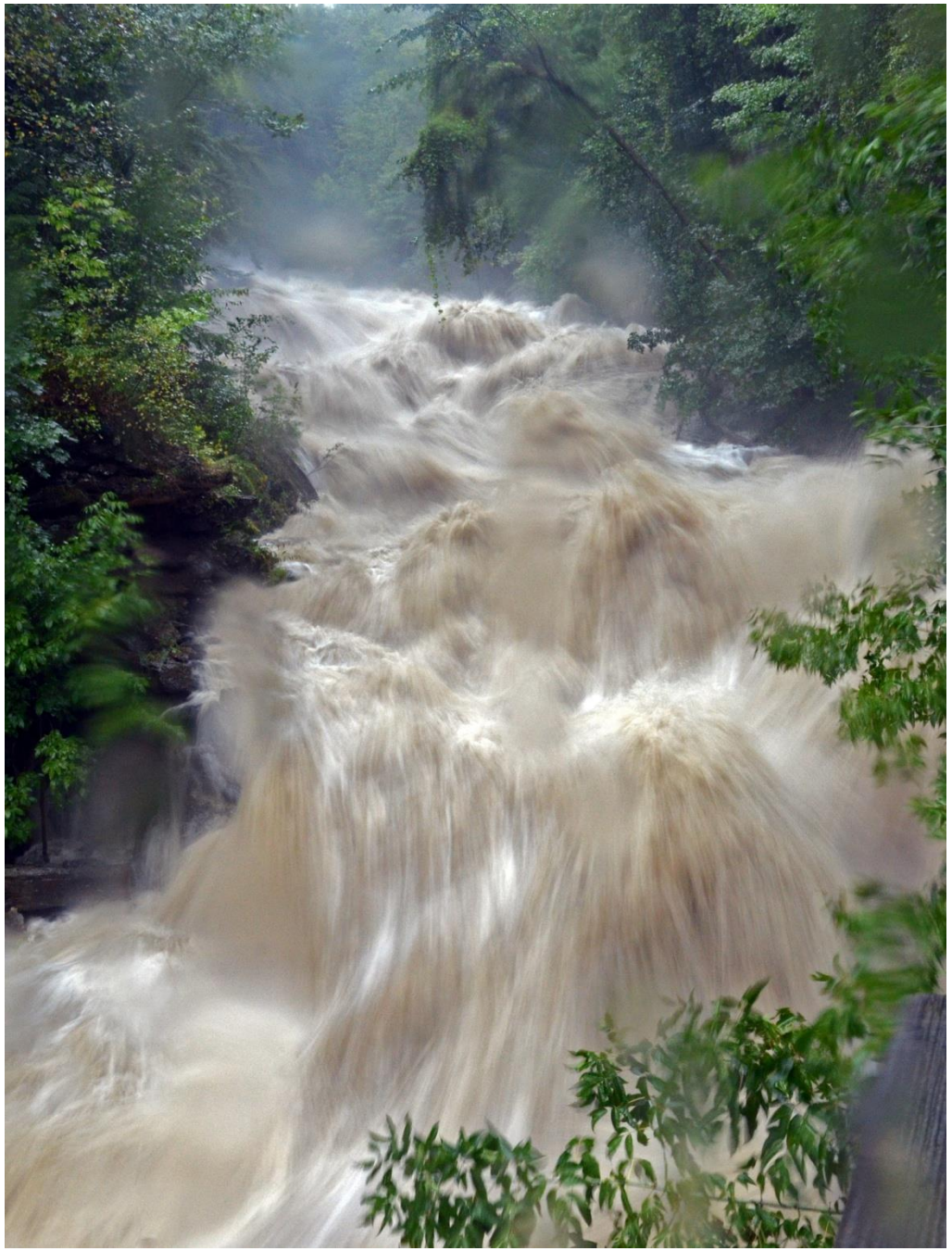
BREE Ecology Team PTAC Update

Dustin Kincaid and Andrew Schroth



BREE
Basin Resilience to Extreme Events
in the Lake Champlain Basin

Focus on Extreme Events and Resilience –

What are the properties and processes critical to maintaining water quality resilience across soil-stream-lake system of the LCB?

Tropical Storm Irene, Aug. 27, 2011
(Gordon Miller)

Ecological Research

BREE
Basin Resilience to Extreme Events
in the Lake Champlain Basin

Resilience to Extreme Events Across Soil-River-Lake Continuum

Cutting edge
sensor network

Ecological Research

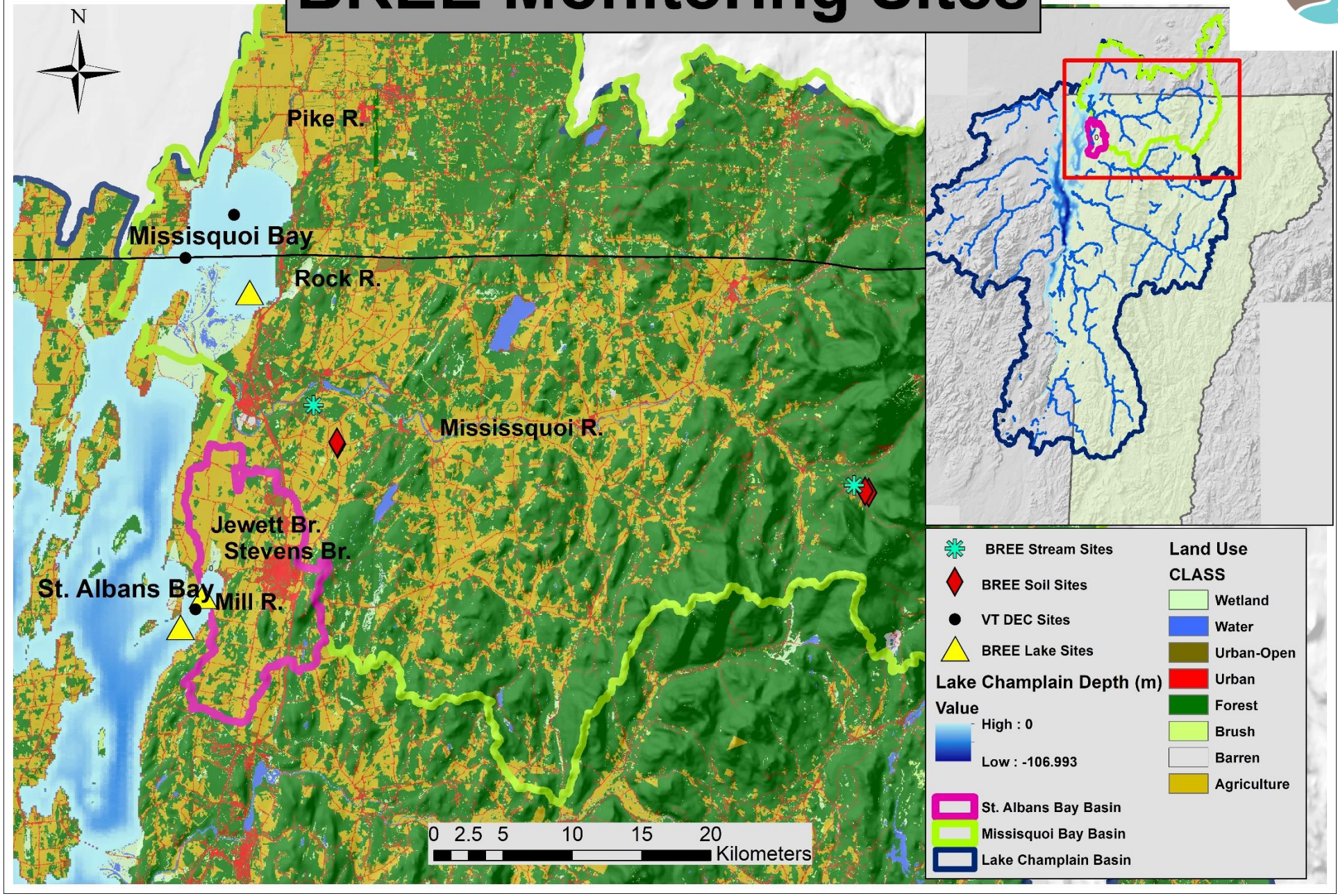
BREE
Basin Resilience to Extreme Events
in the Lake Champlain Basin

Resilience to Extreme Events Across Soil-River-Lake Continuum

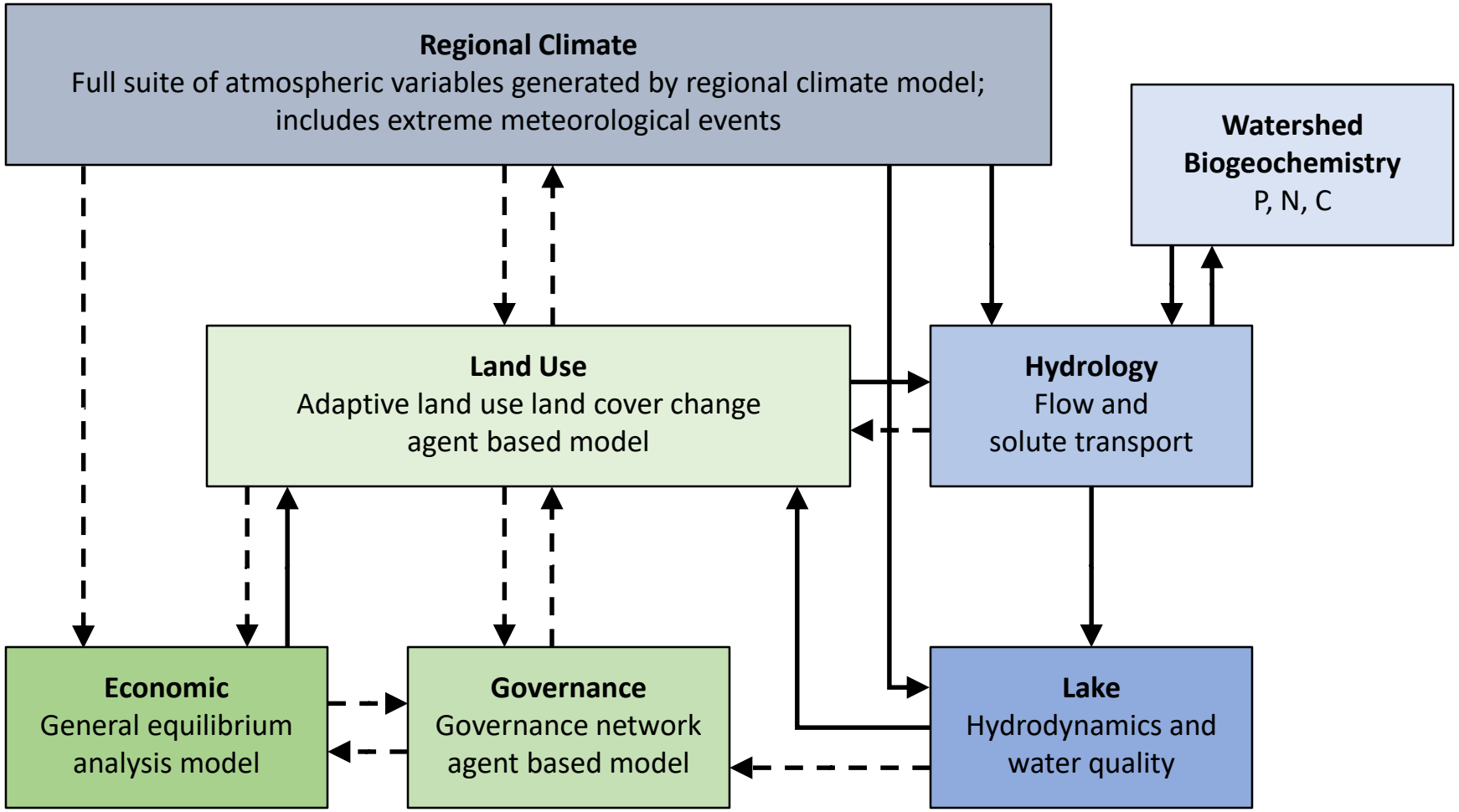
Cutting edge sensor network

BREE Monitoring Sites

BREE
Basin Resilience to Extreme Events
in the Lake Champlain Basin



Major Features of the BREE Integrated Assessment Model



Land use & season influence event-scale nitrate and phosphorus exports & export stoichiometry from headwater catchments

Dustin Kincaid

Erin Seybold, E. Carol Adair, William Bowden, Julia Perdrial, Matthew Vaughan, Andrew Schroth

VT EPSCoR – Fall 2019 – Policy & Technical Advisory Committee Meeting
Thu, December 19, 2019

VERMONT EPSCoR

BREE Basin Resilience to Extreme Events in the Lake Champlain Basin

Acknowledgements

Co-authors

Erin Seybold
E. Carol Adair
Breck Bowden
Julia Perdrial
Matthew Vaughan
Andrew Schroth

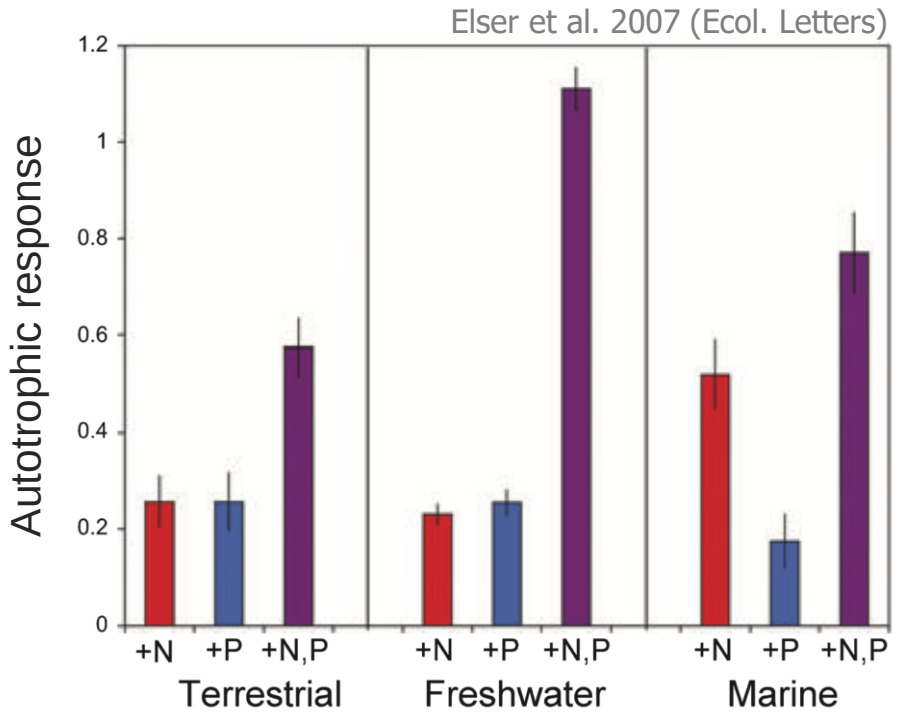
Collaborators & support

Saul Blocher
Scott Hamshaw
James Shanley
Andrew Vermilyea

Funding

VERMONT EPSCoR
BREE Basin Resilience to Extreme Events in the Lake Champlain Basin
The University of Vermont
NSF

The relative availability or stoichiometric ratios of N & P, can affect autotrophic biomass and production

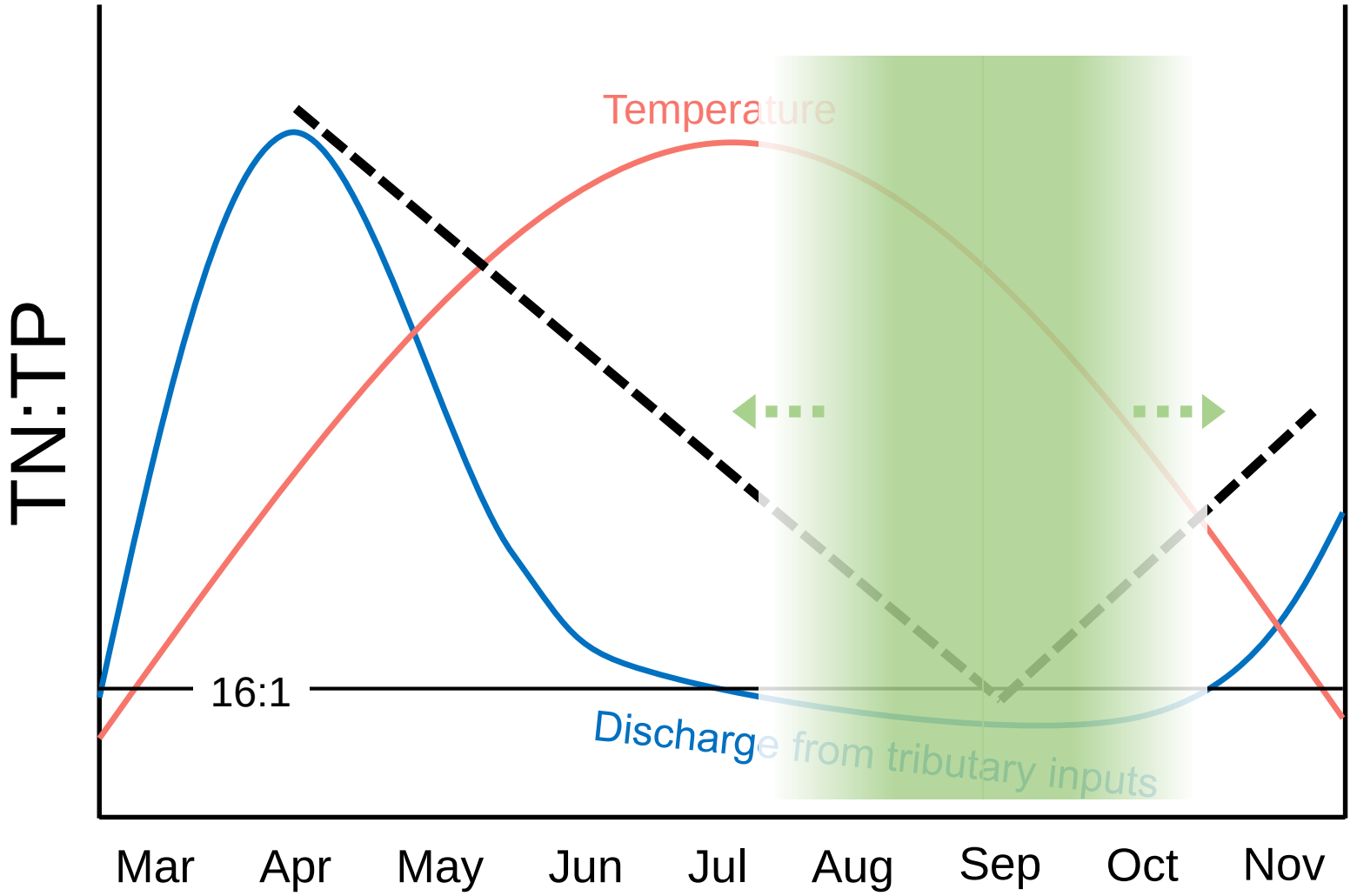


And N:P can influence the likelihood of harmful algal blooms

Tributary inputs are important for lake chemistry

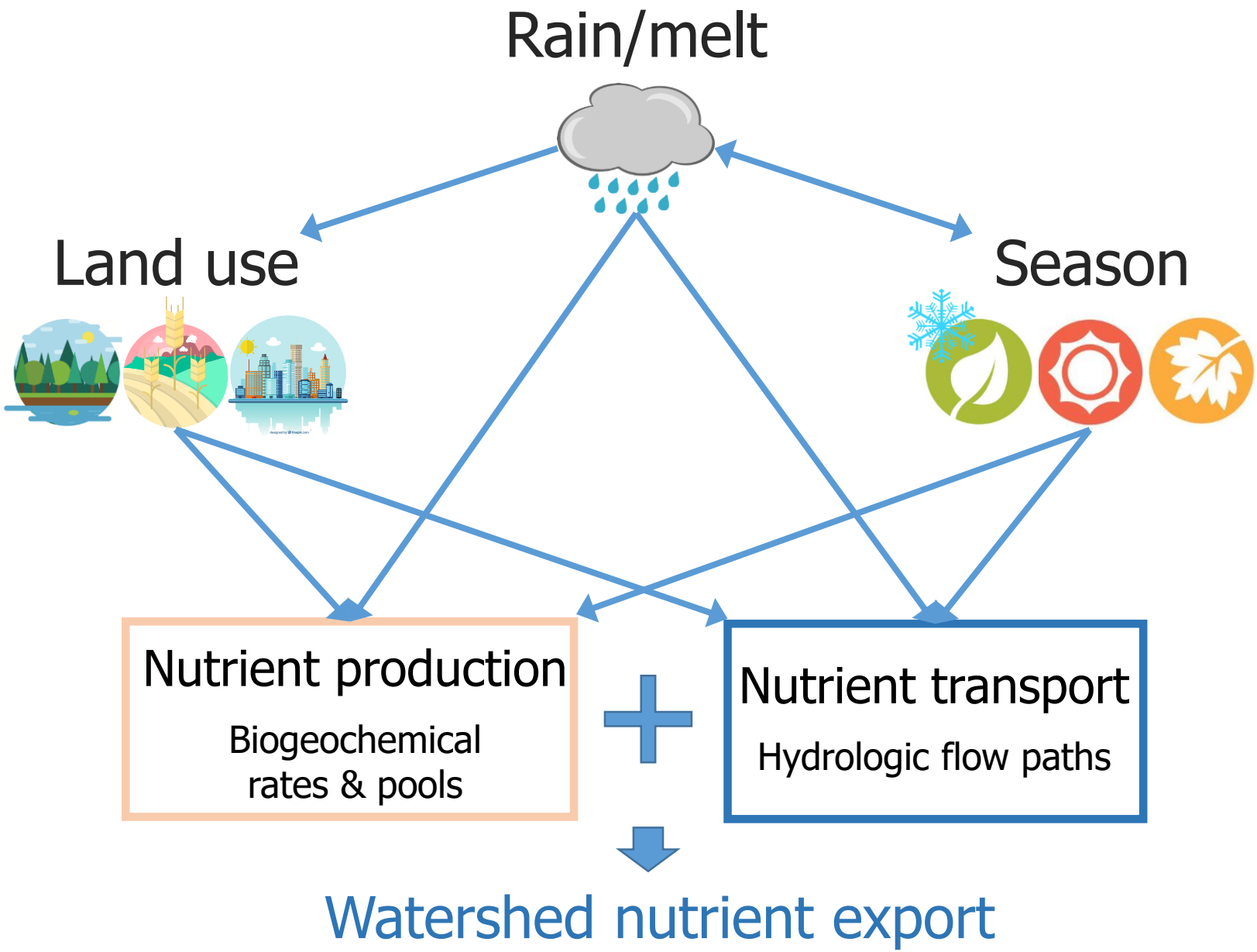
http://lcbp.org/sol18dev/wp-content/uploads/2018/06/tributary-loading.jpg

External controls on lake chemistry in shallow bays



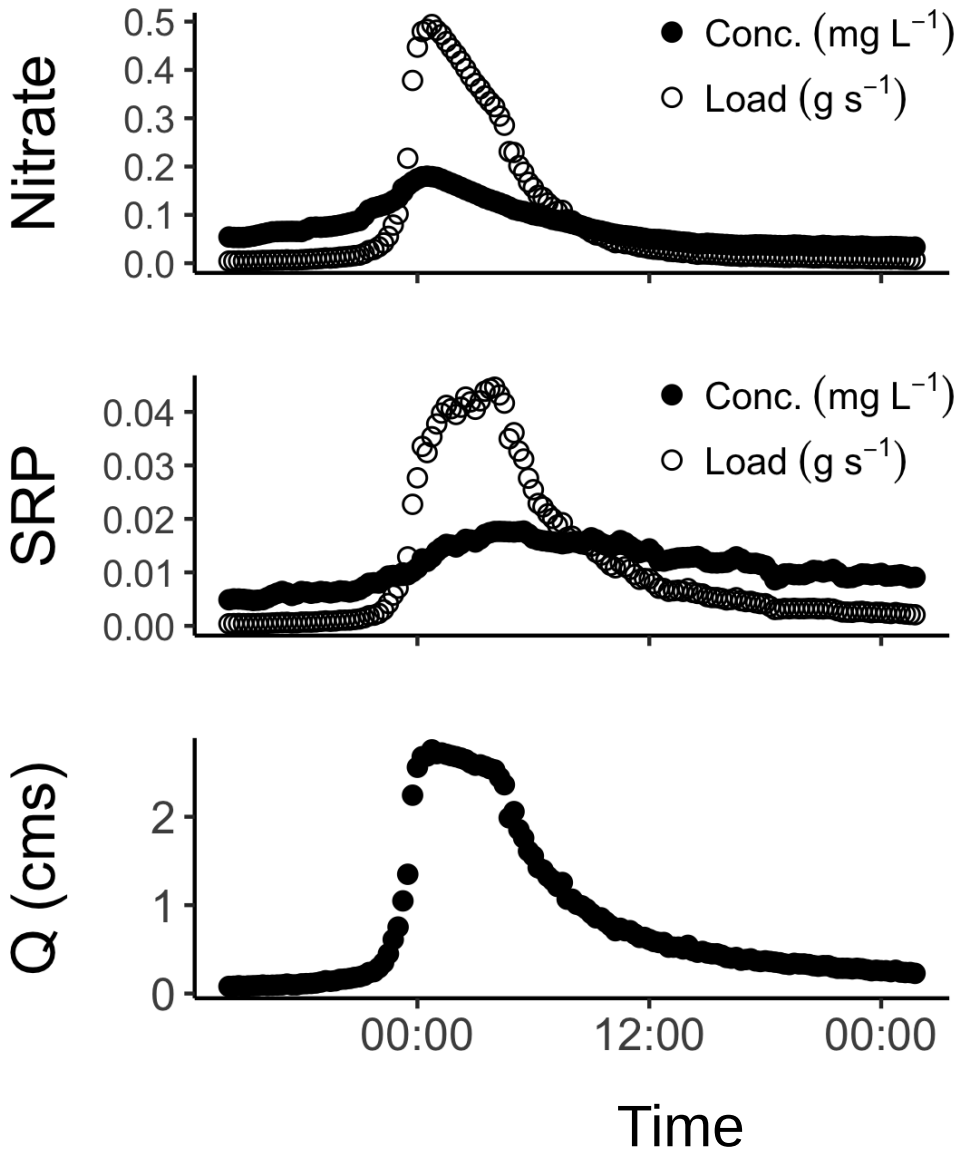
Modified from Isles et al. 2017 BGC

What controls riverine N and P loading patterns on the event-scale?



Icon credits: Forest (freevector.com), Ag (vecteezy.com), Urban (reepik.com), Seasons (istockphoto.com), Cloud (Pixabay.co)

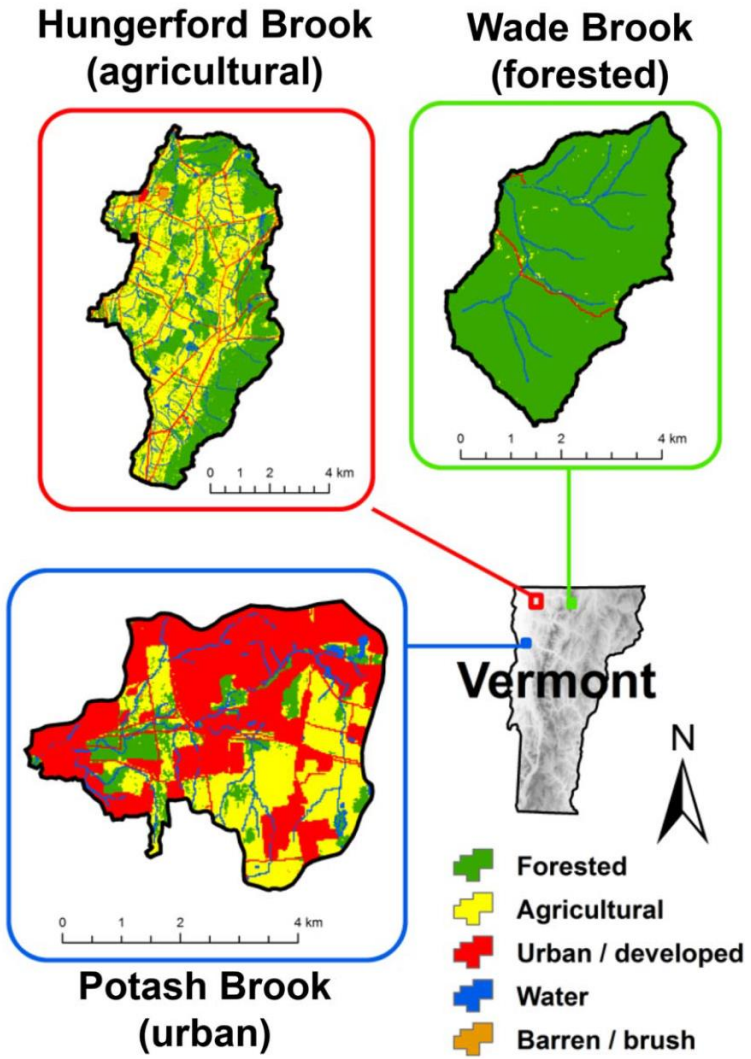
Can now predict N & P concurrently using in situ sensors & algorithms

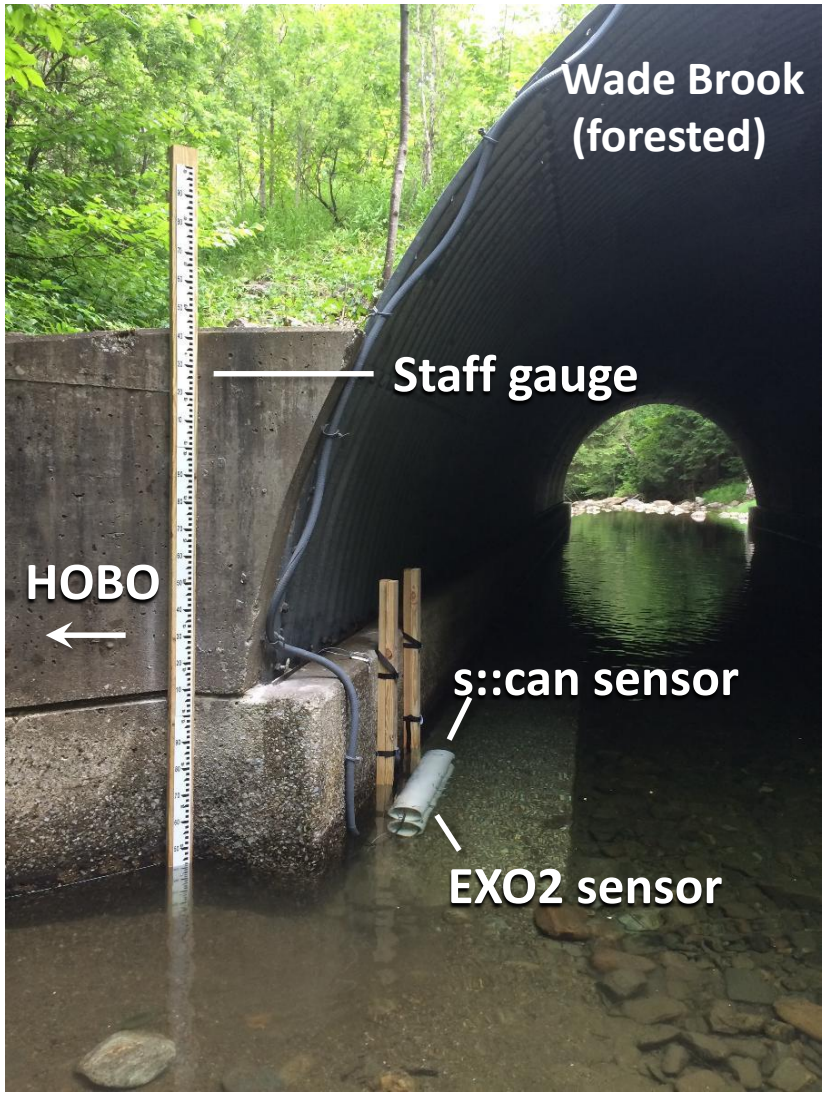


s::can spectro::lyser
UV-vis spectrophotometry

SRP = soluble reactive phosphorus; essentially phosphate

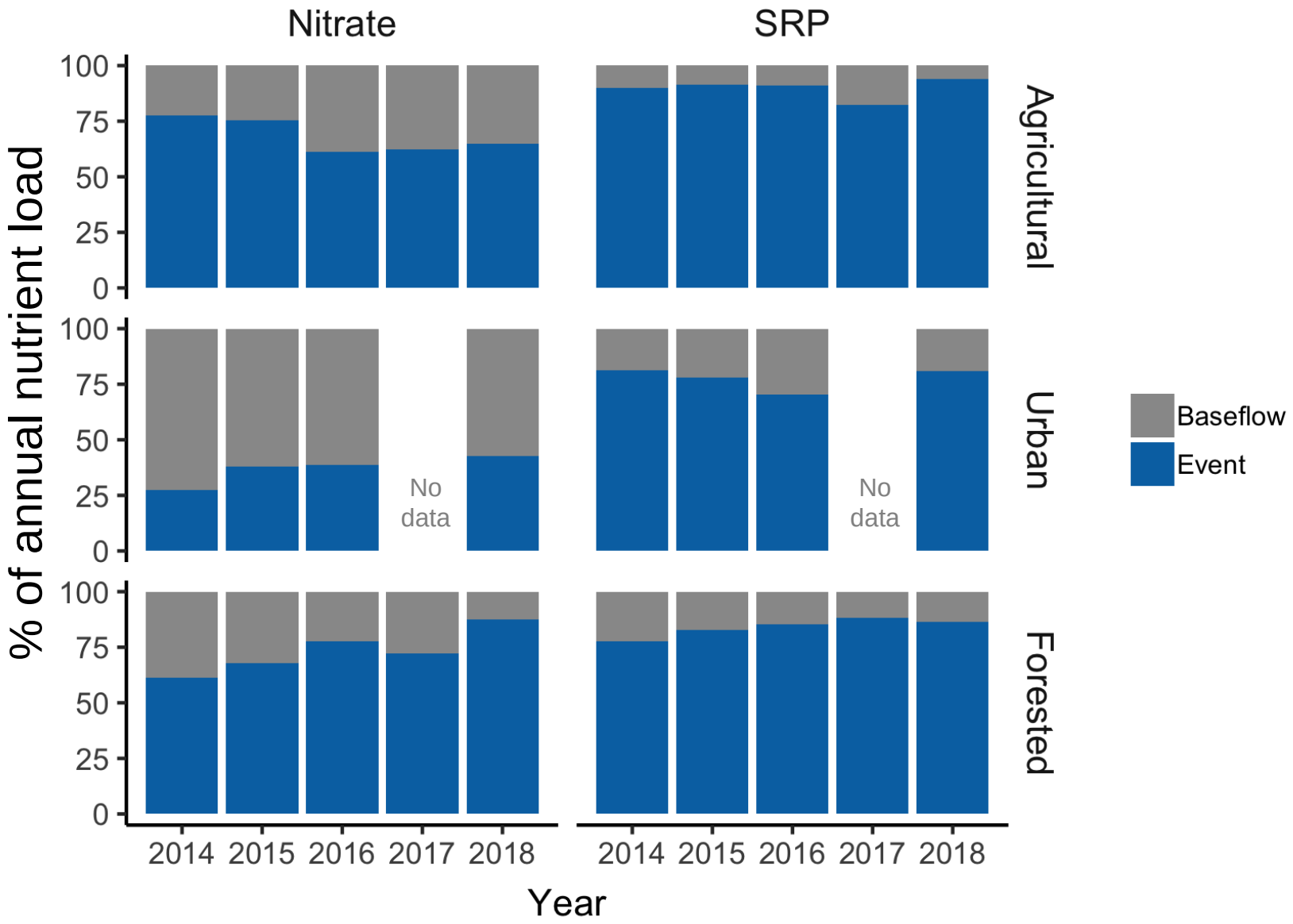
We quantified N & P dynamics for **>400 high flow events** across three LULCs from 2014-2018





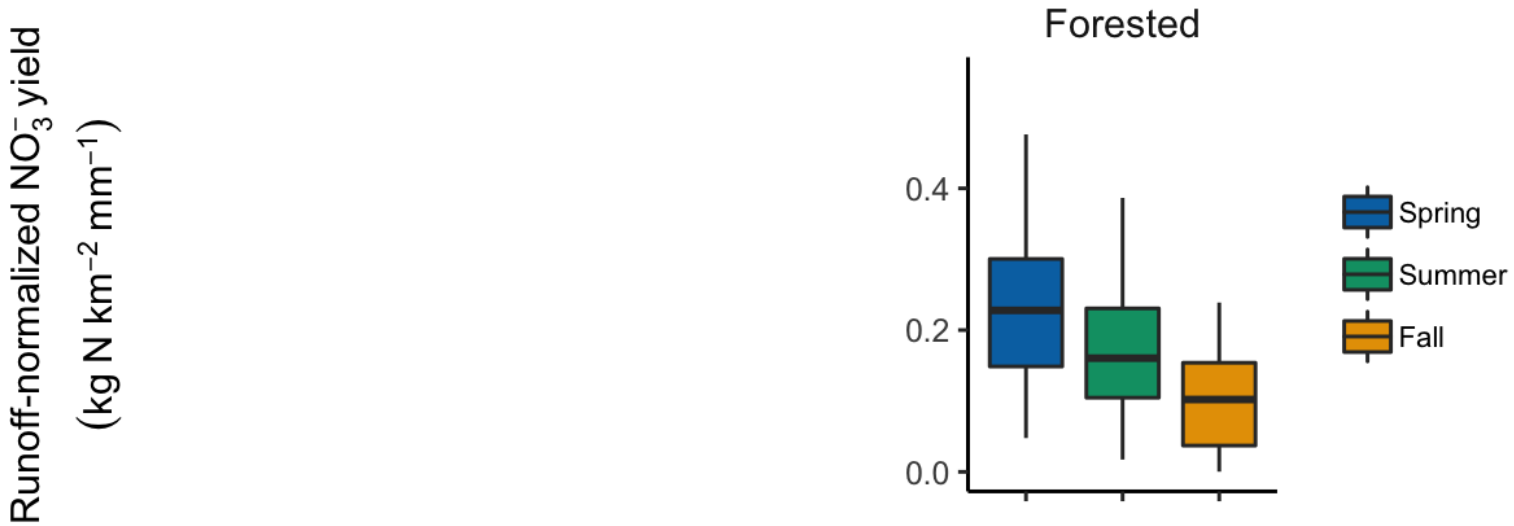
Vaughan et al. 2017 (WRR)

Storms matter for annual loads, though slightly less so for nitrate in the urban site



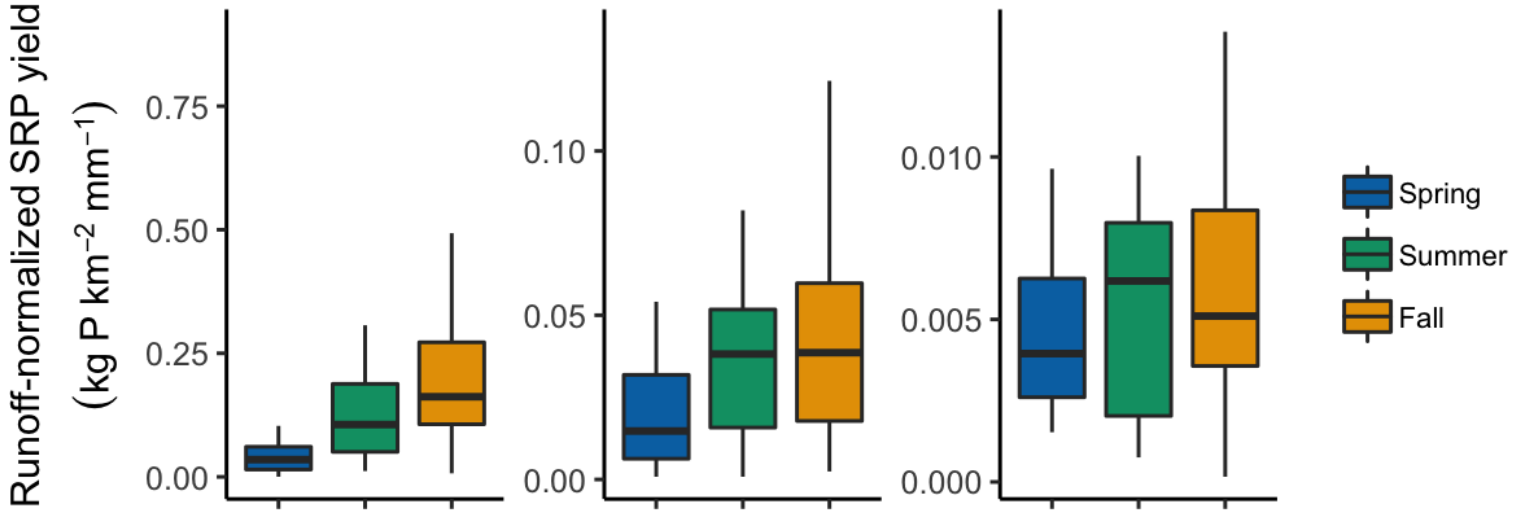
Agriculture increases event NO_3^- yields & masks typical seasonal decline in NO_3^- yields

NO_3^-



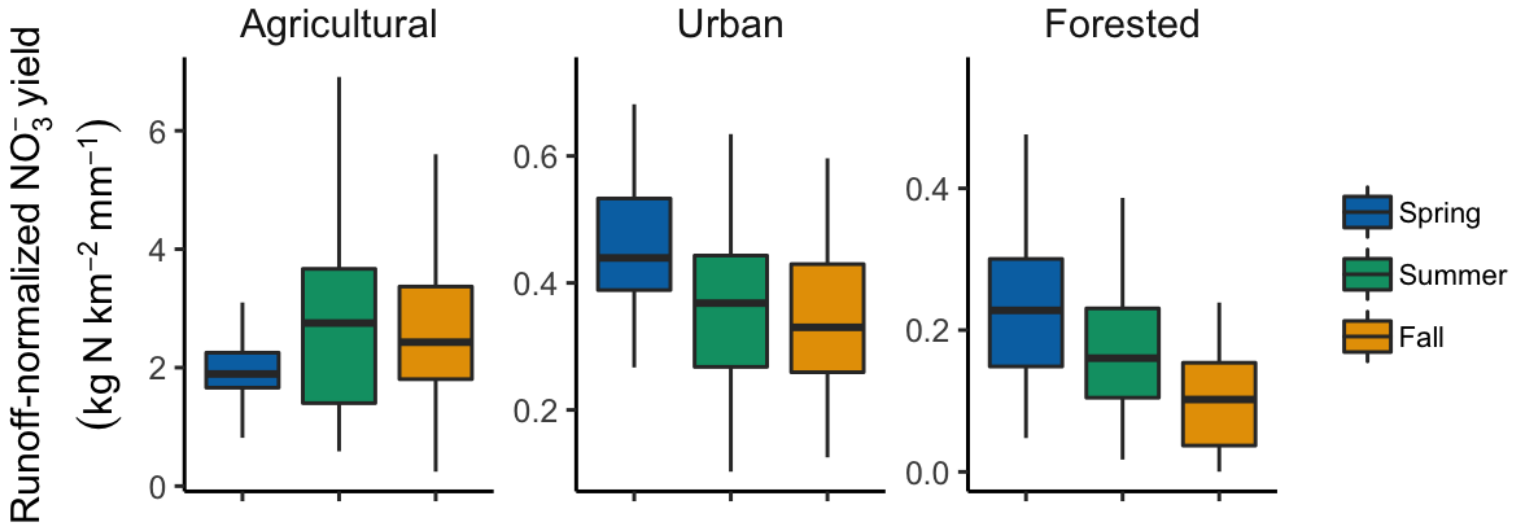
Agriculture & urbanization increase event SRP yields & greatest yields tend to occur in summer and fall

SRP

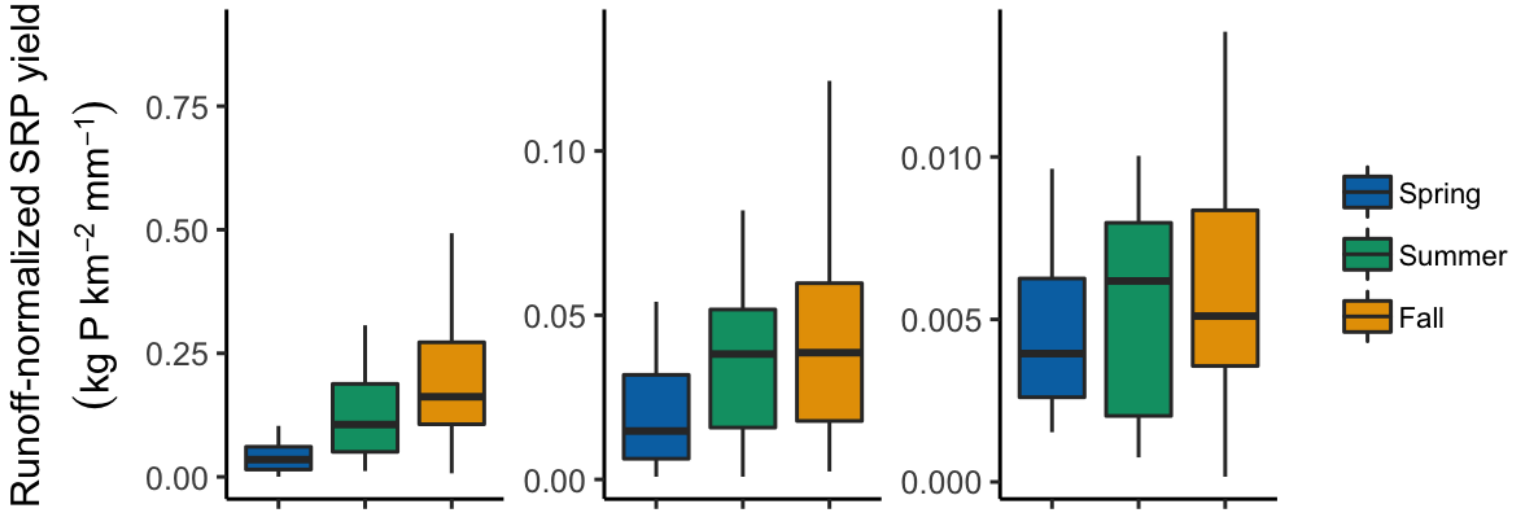


But what about the relative availability or RATIO of NO_3^- to SRP for each event?

NO_3^-



SRP



Export ratios decrease from spring to fall & converge close to N:P ratio of 16:1; BUT convergence is driven by different NO_3^- & SRP dynamics at each site

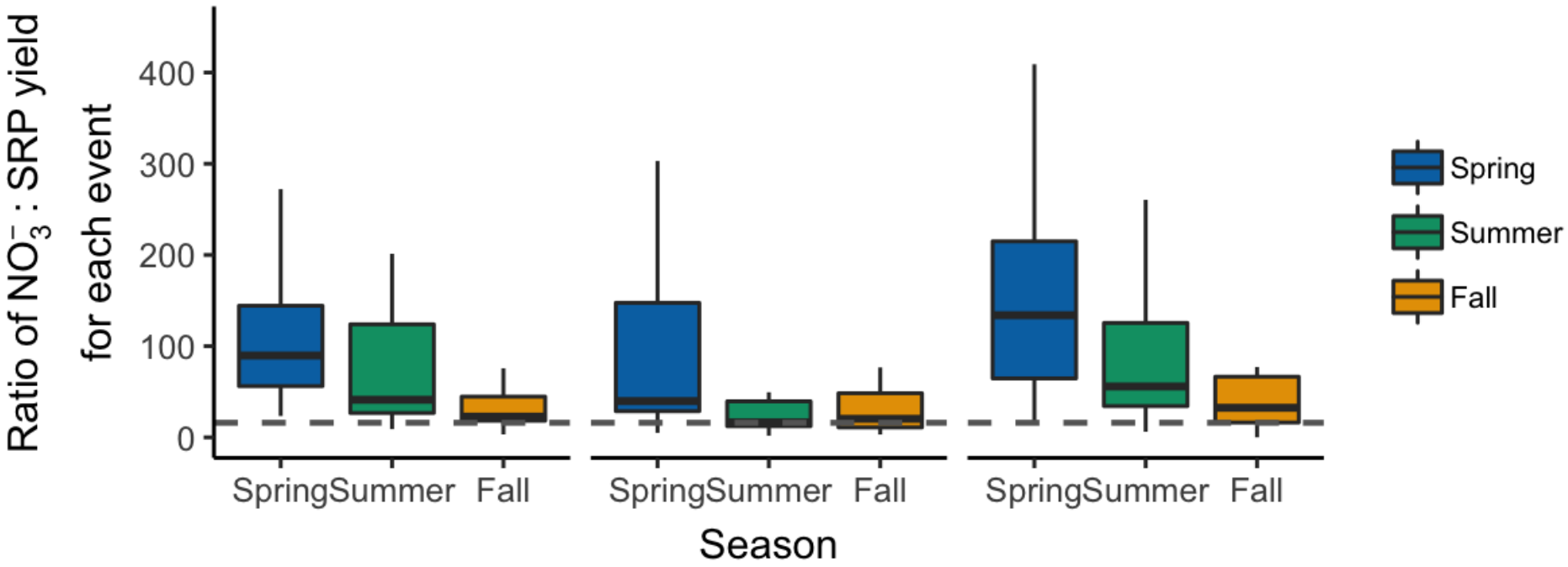
Agricultural

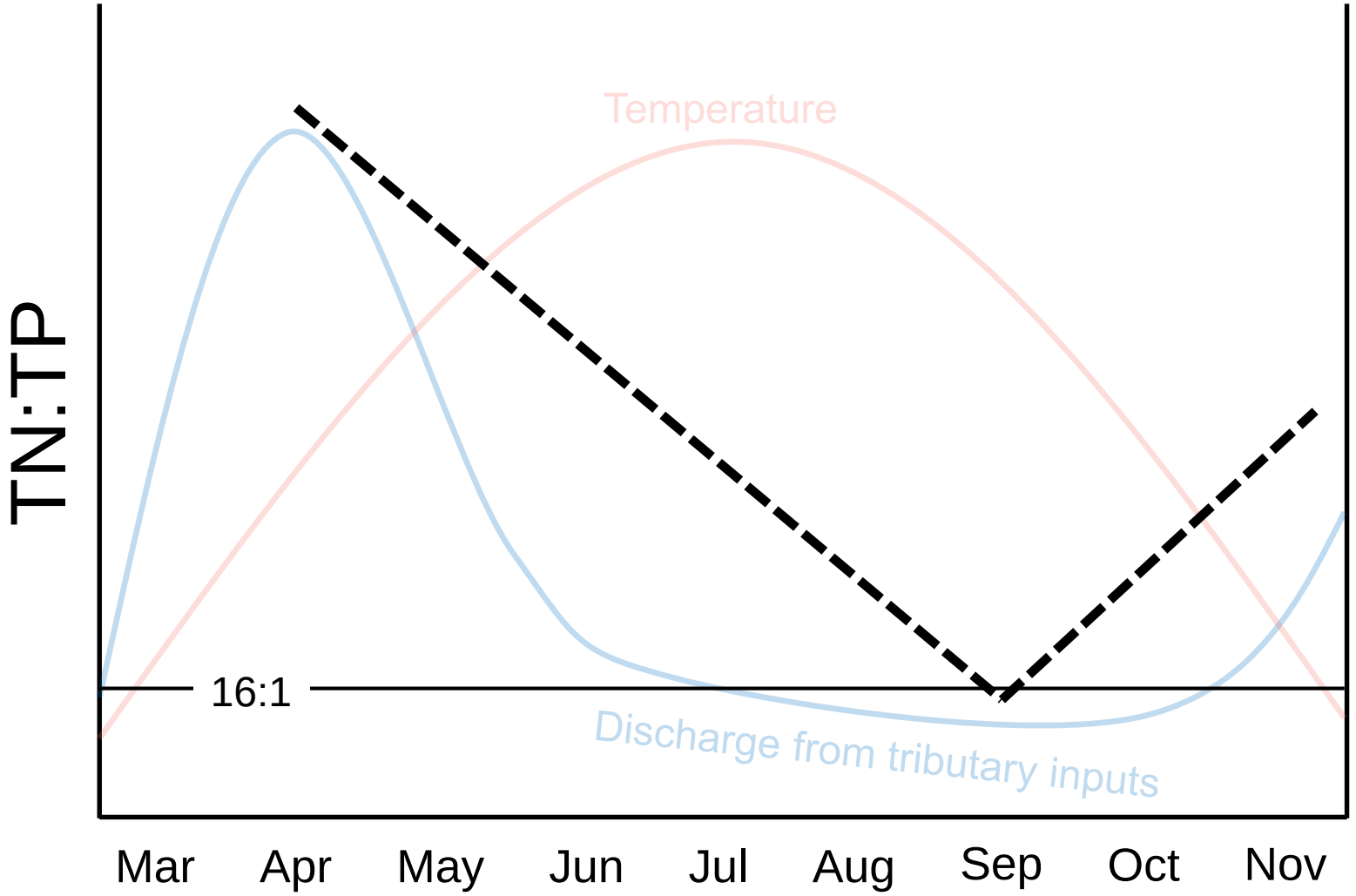
Urban

Forested

NO_3^-

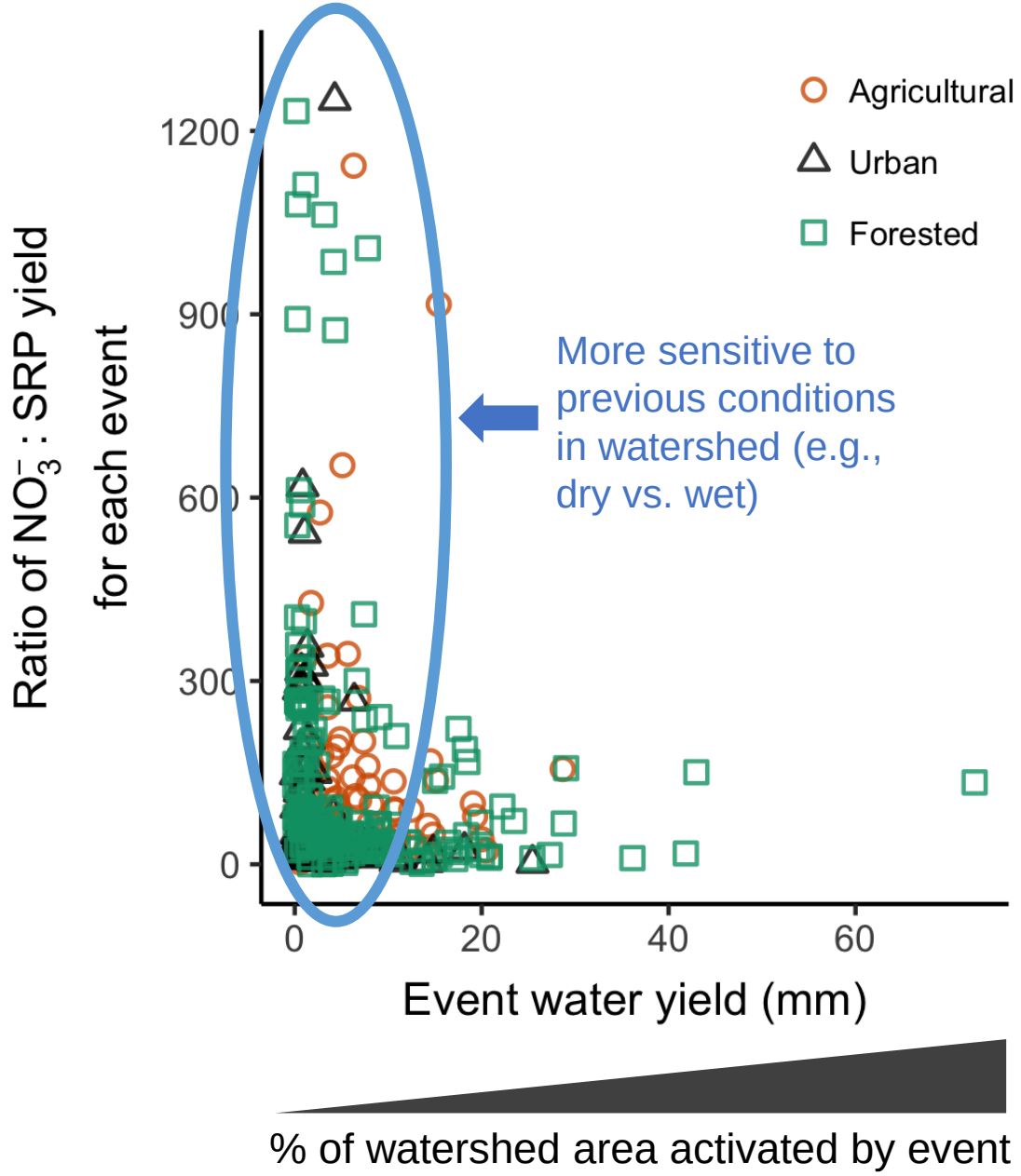
SRP

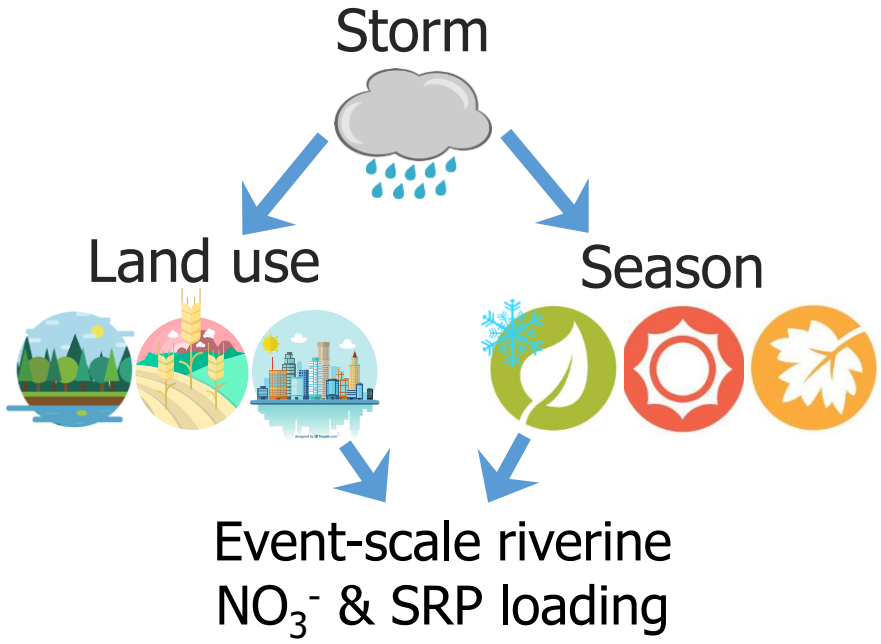


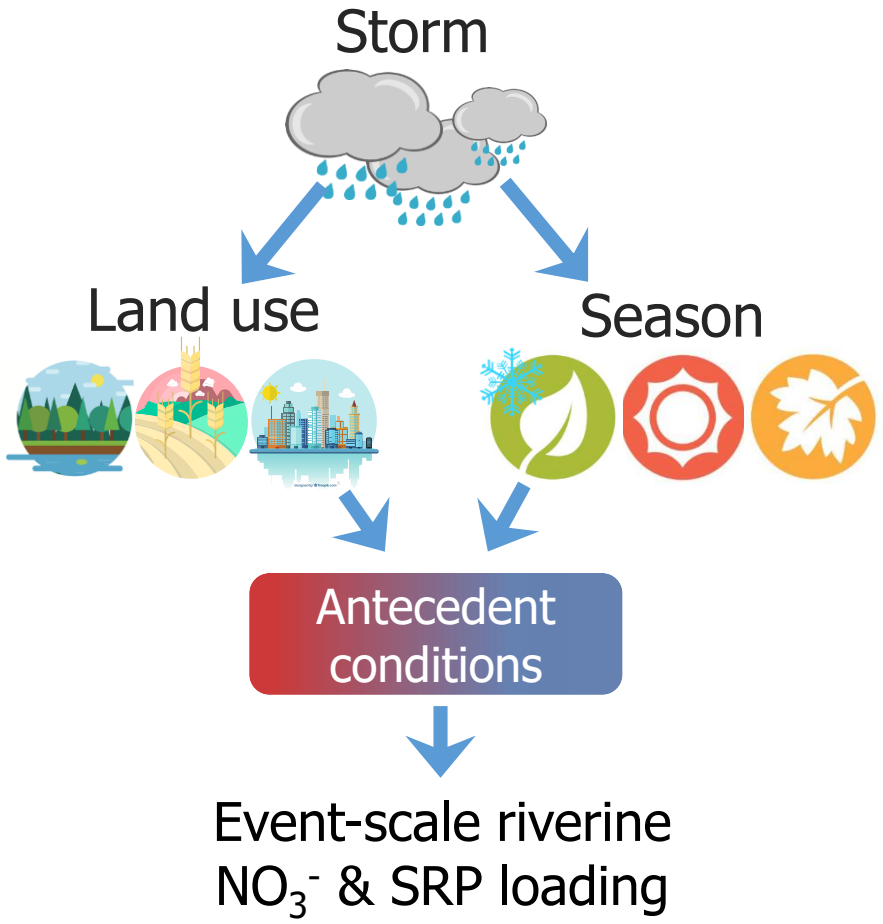


Modified from Isles et al. 2017 BGC

Smallest events had greatest magnitude and variability; large events drive down export ratios

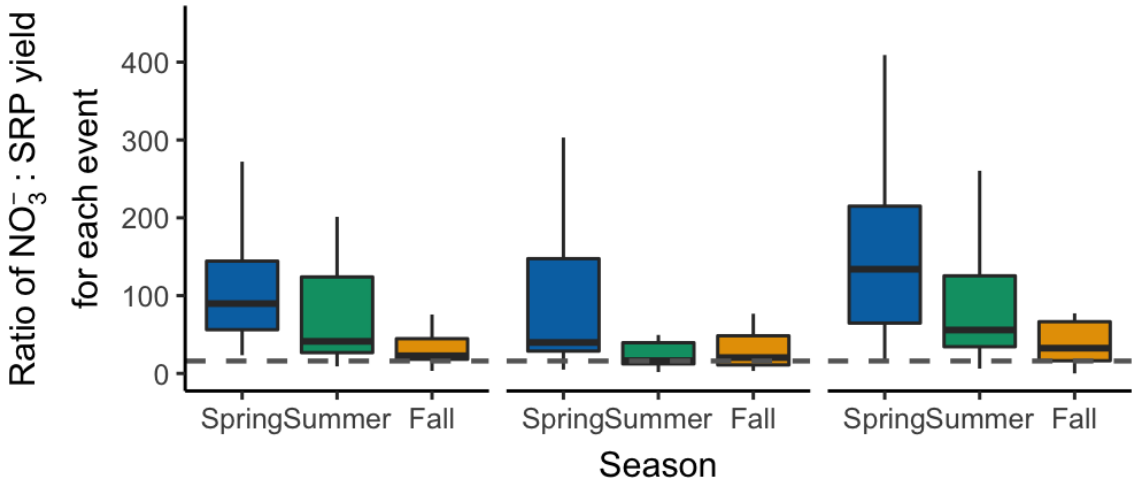



Storm
Land use
Season
Event-scale riverine
NO_3^- & SRP loading

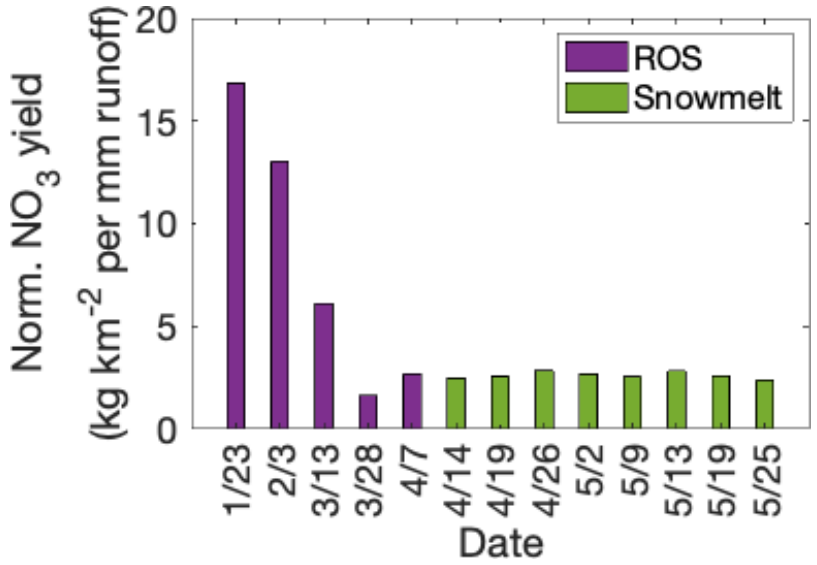

Storm
Land use
Season
Antecedent conditions
Event-scale riverine
NO_3^- & SRP loading

Implications for Lake Champlain

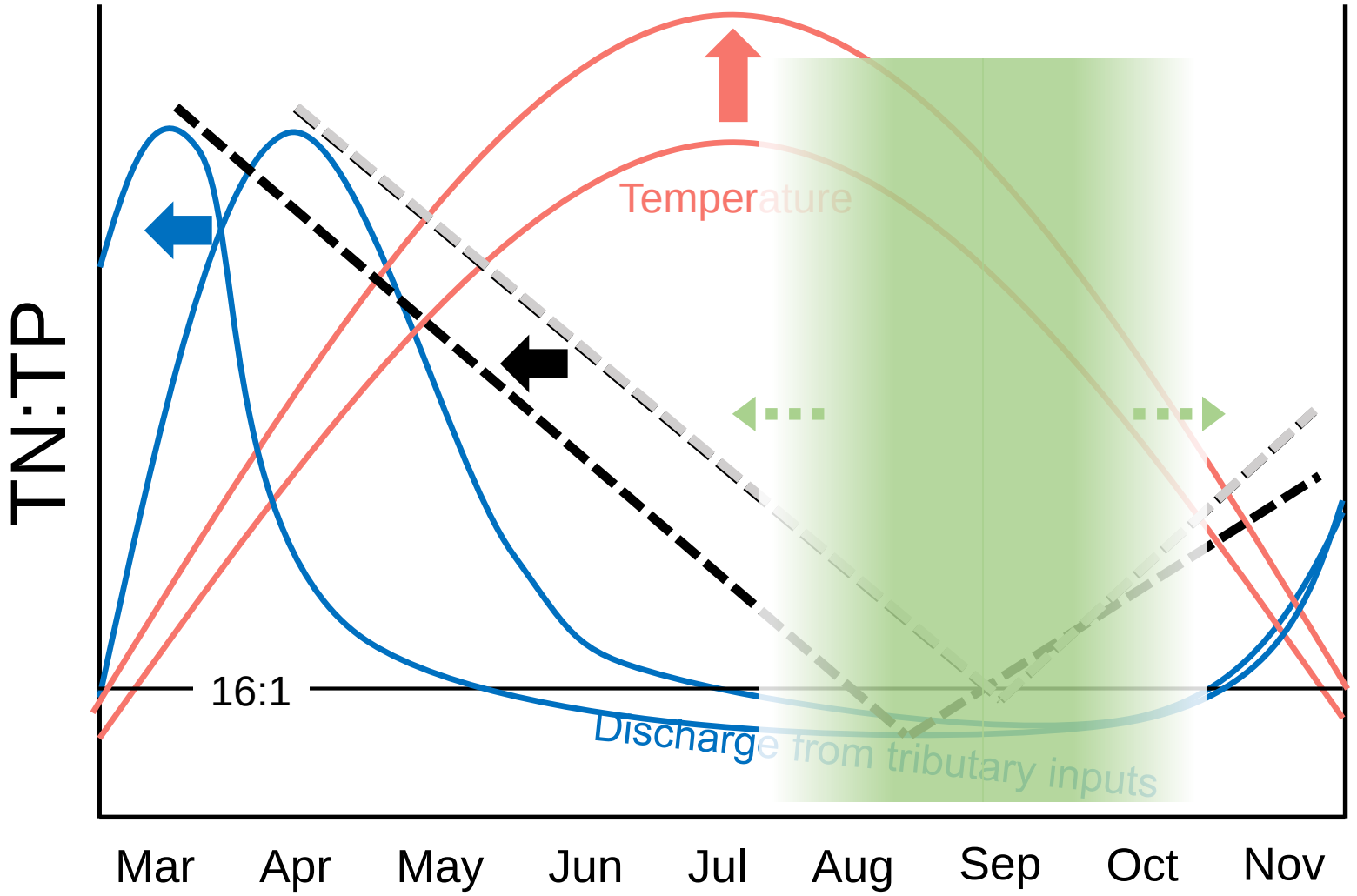
Highest export ratios in spring



Early season rain-on-snow / snowmelt events matter A LOT!



Key collaborator: Dr. Erin Seybold, now at the Kansas Geological Survey



Modified from Isles et al. 2017 BGC

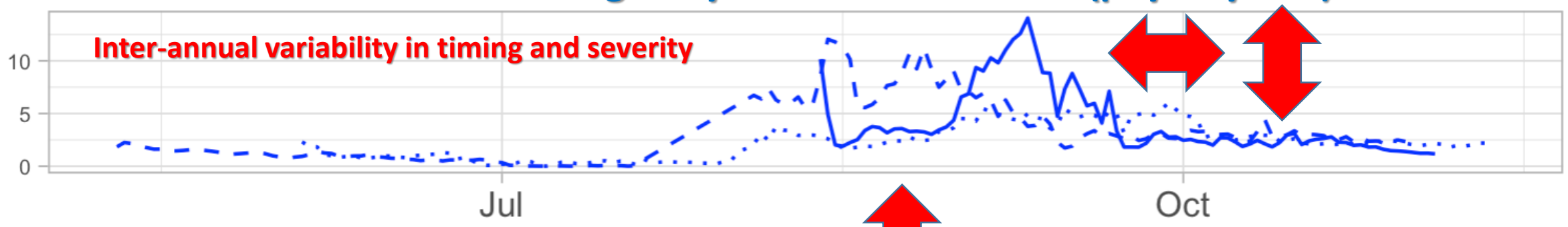
Review of 2017-2019 bloom dynamics - Andrew

St. Albans Bay

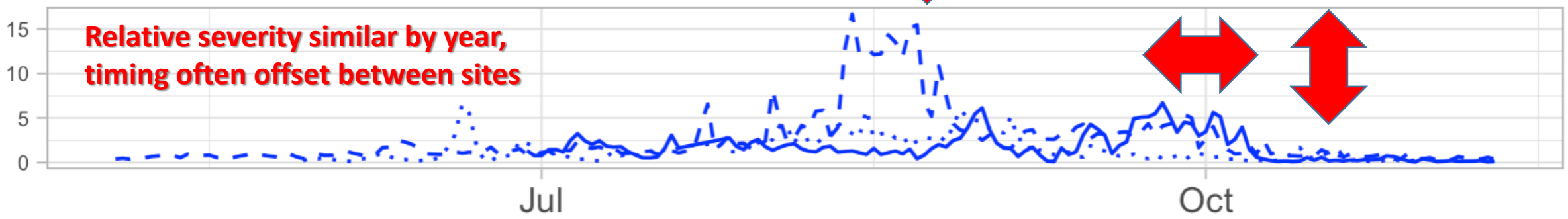
2017
2018
2019

BREE
Basin Resilience to Extreme Events
in the Lake Champlain Basin

Continuous Sensing of Cyanobacteria Blooms (phycocyanin)



Missisquoi Bay



Both were muted in 2019!