Event-scale riverine loading of nitrogen & phosphorus

Impacts of land use and seasonality on N:P export ratios

Dustin Kincaid

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

VT EPSCoR – BREE All Hands Meeting
Tue, June 4, 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

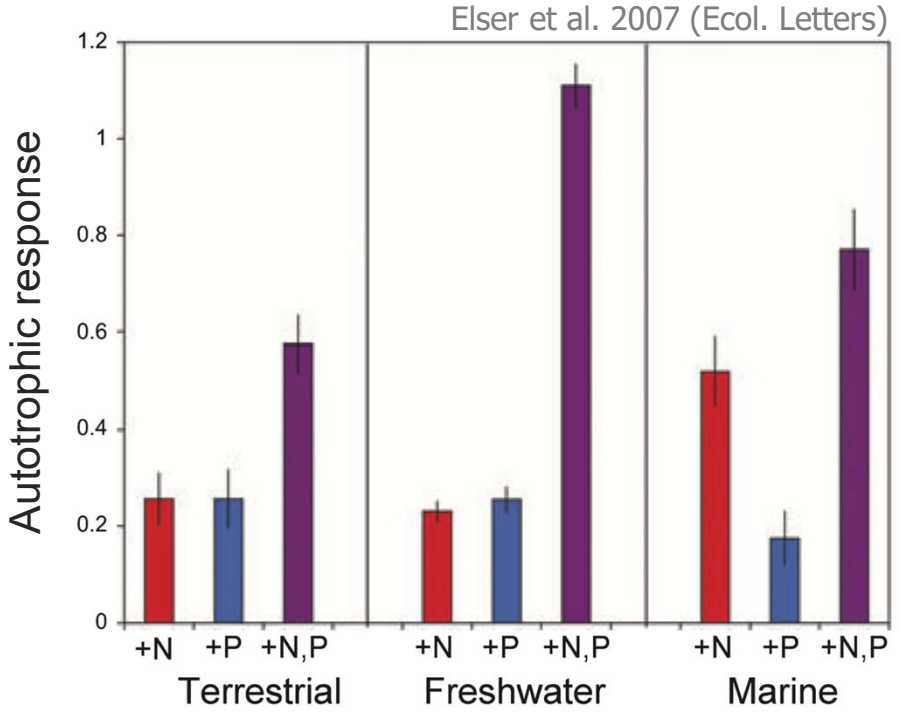
Collaborators & support

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

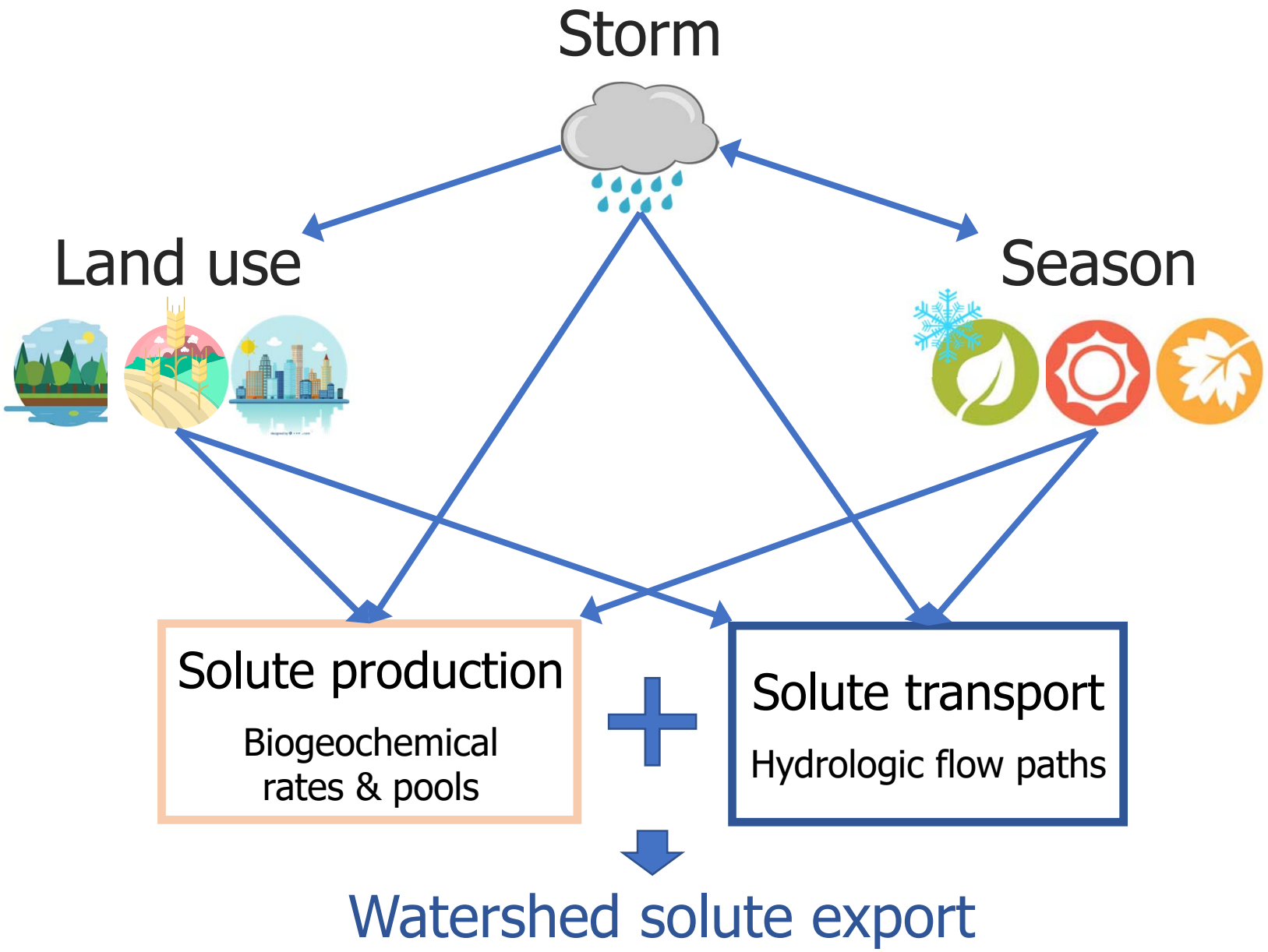


And N:P can influence the likelihood of harmful algal blooms

Tributary inputs are important for lake chemistry

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

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

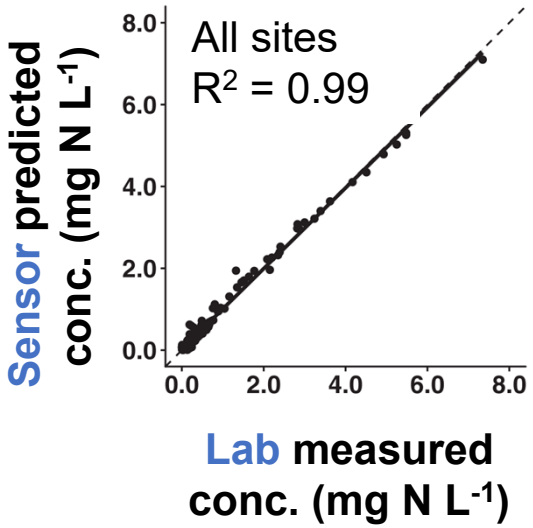


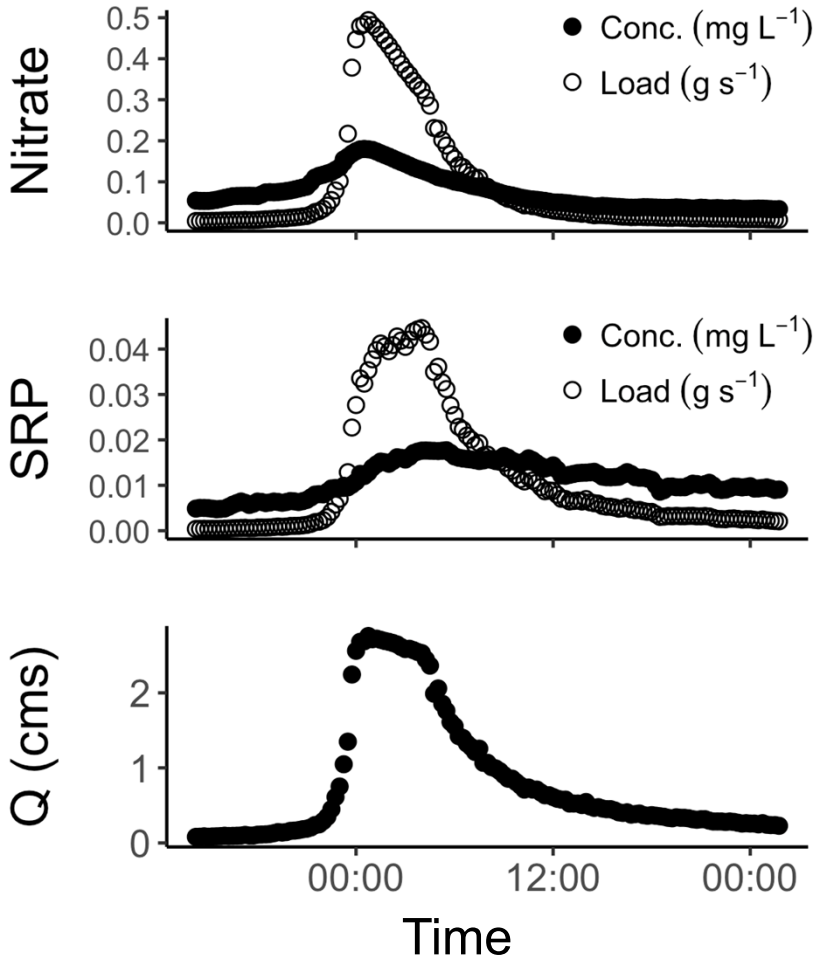
Icon credits: Forest (freevector.com), Ag (vecteezy.com), Urban (reepik.com), Seasons (istockphoto.com), Cloud (Pixabay.co)

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

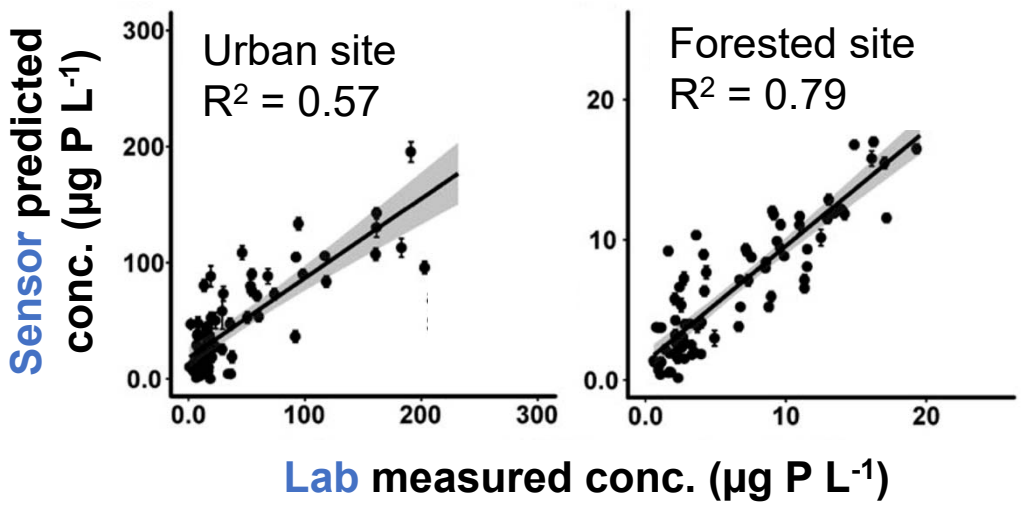
s::can spectro::lyser
UV-vis spectrophotometry

Nitrate



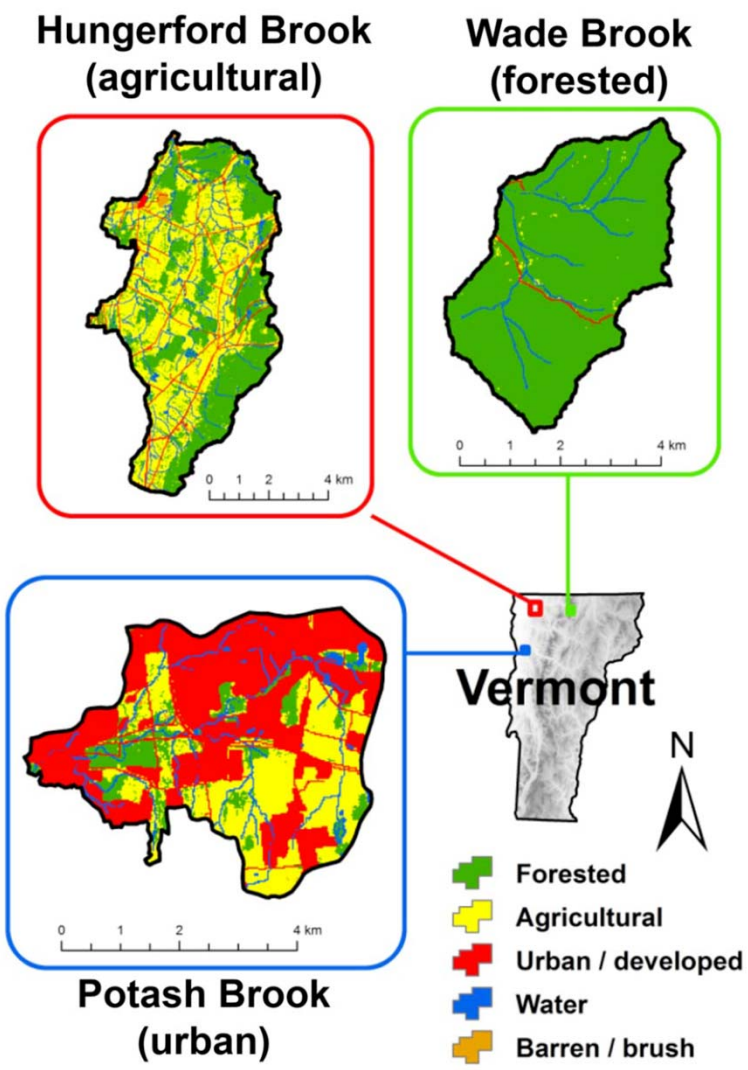


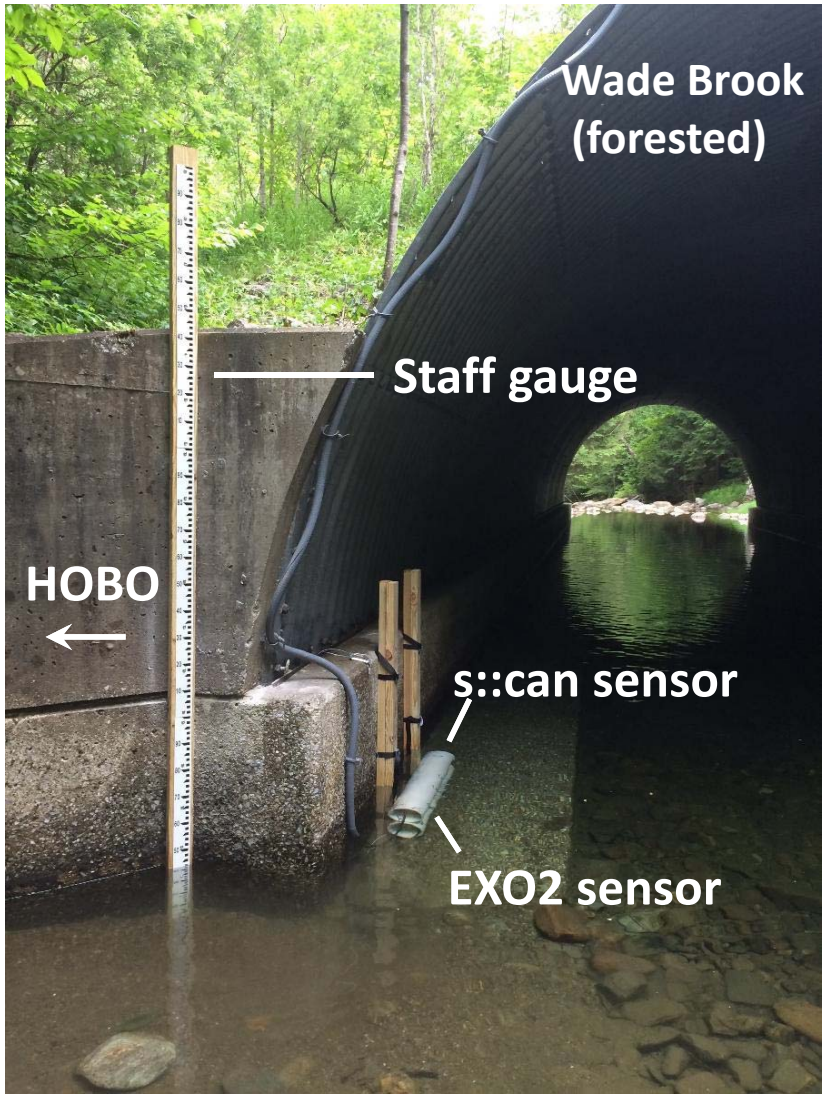
SRP



Vaughan et al. 2017 (WRR);
Vaughan et al. 2018 (L&O: Methods)

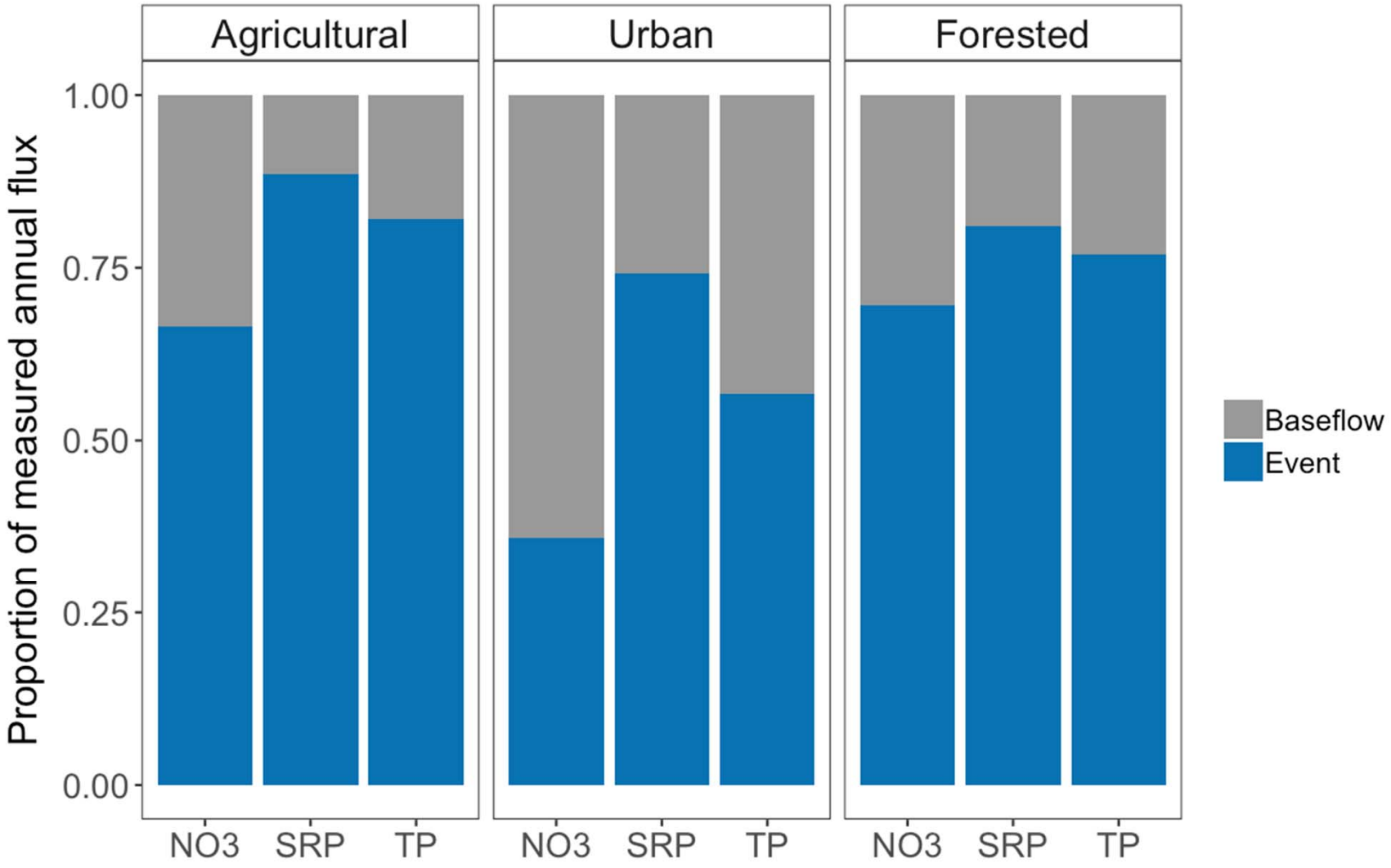
We quantified N & P dynamics for **>350 storm events** across three LULCs from 2014-2018

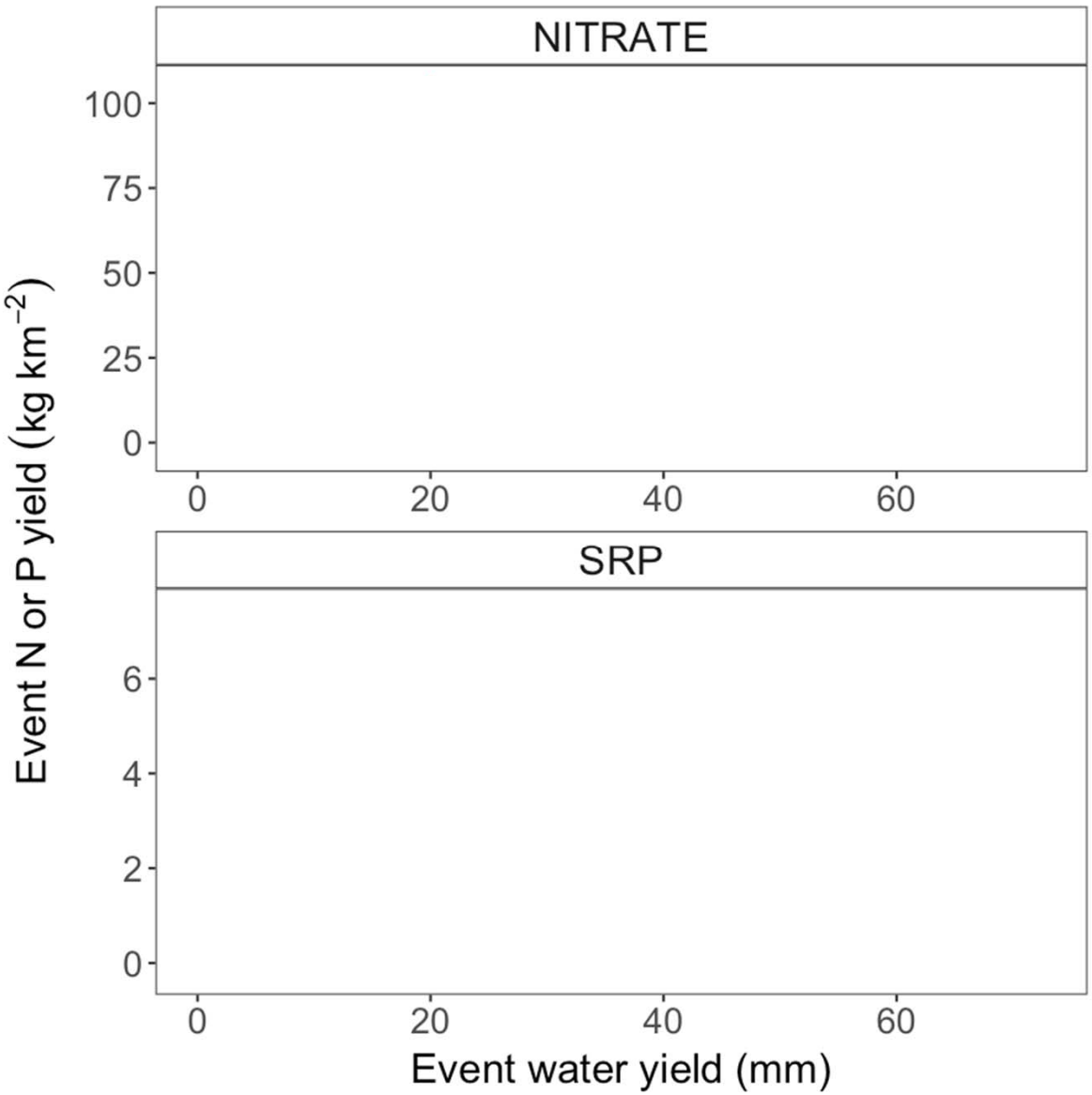




Vaughan et al. 2017 (WRR)

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



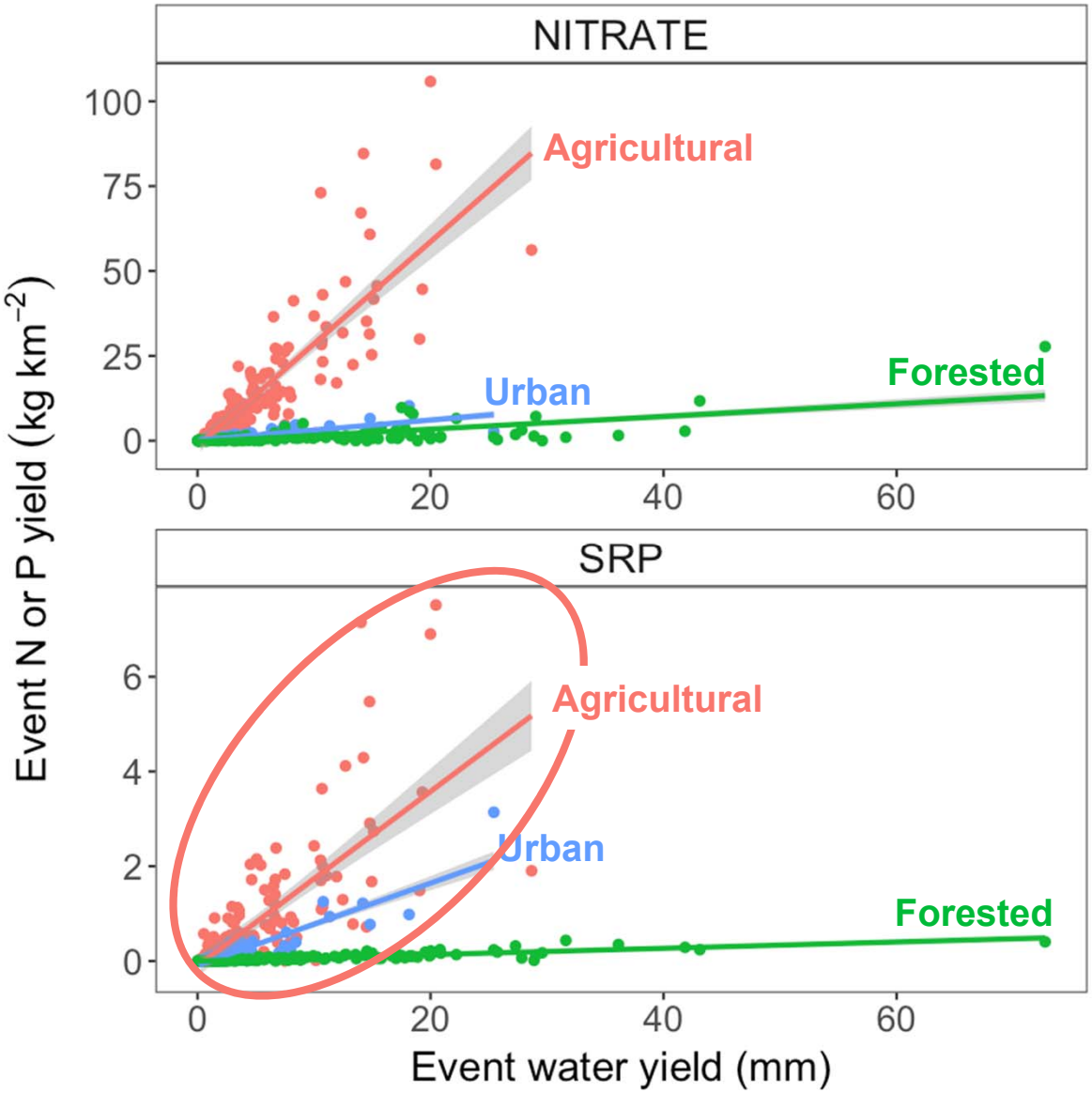

NITRATE
SRP
Event N or P yield (kg km^{-2})
Event water yield (mm)
100
75
50
25
0
6
4
2
0
0
20
40
60

Storm water yield is a good predictor of NO_3^- & SRP event yield

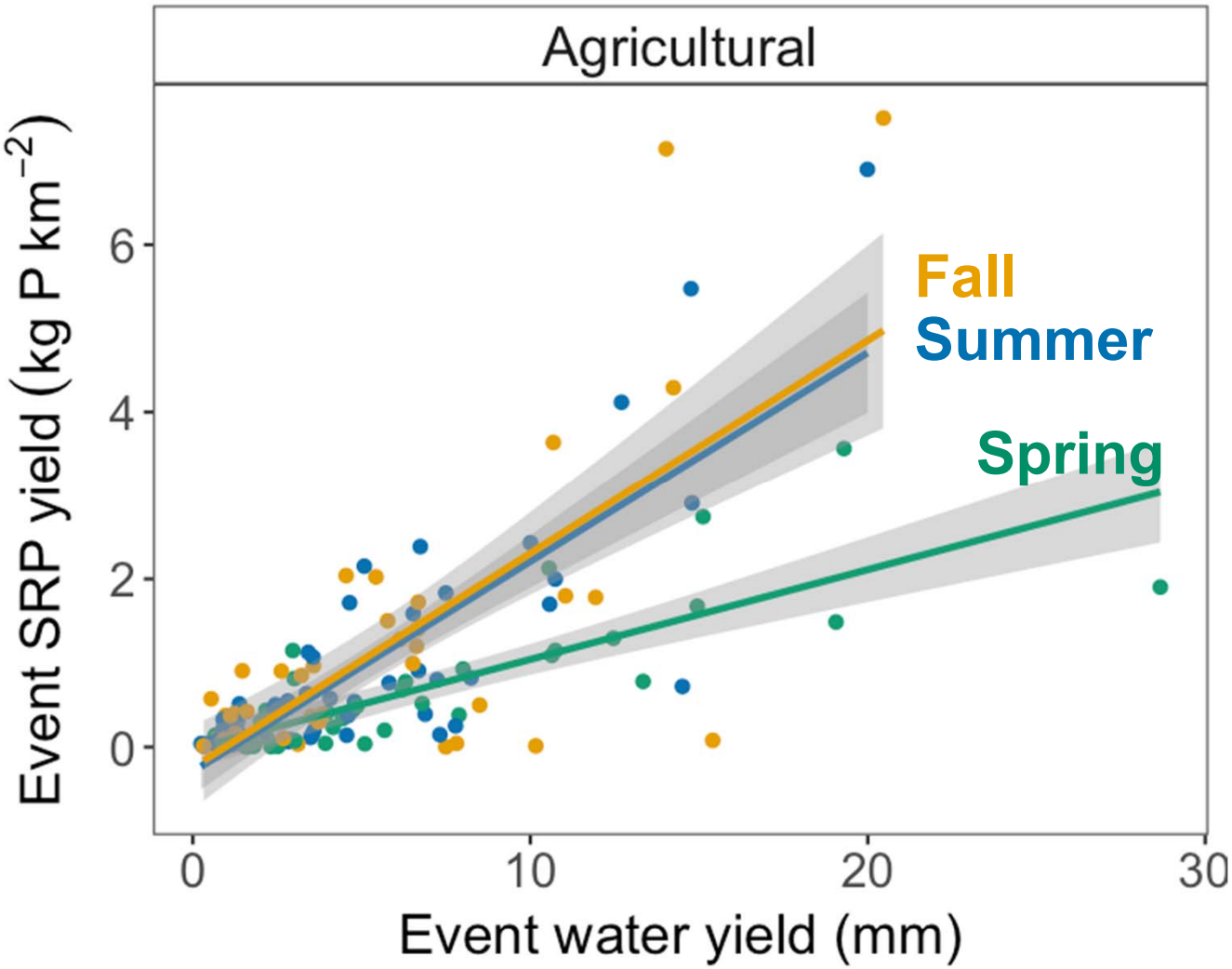
Relationships differ by land use:

AG > URBAN > FOREST

NO_3^- is more responsive to storm water yield than SRP



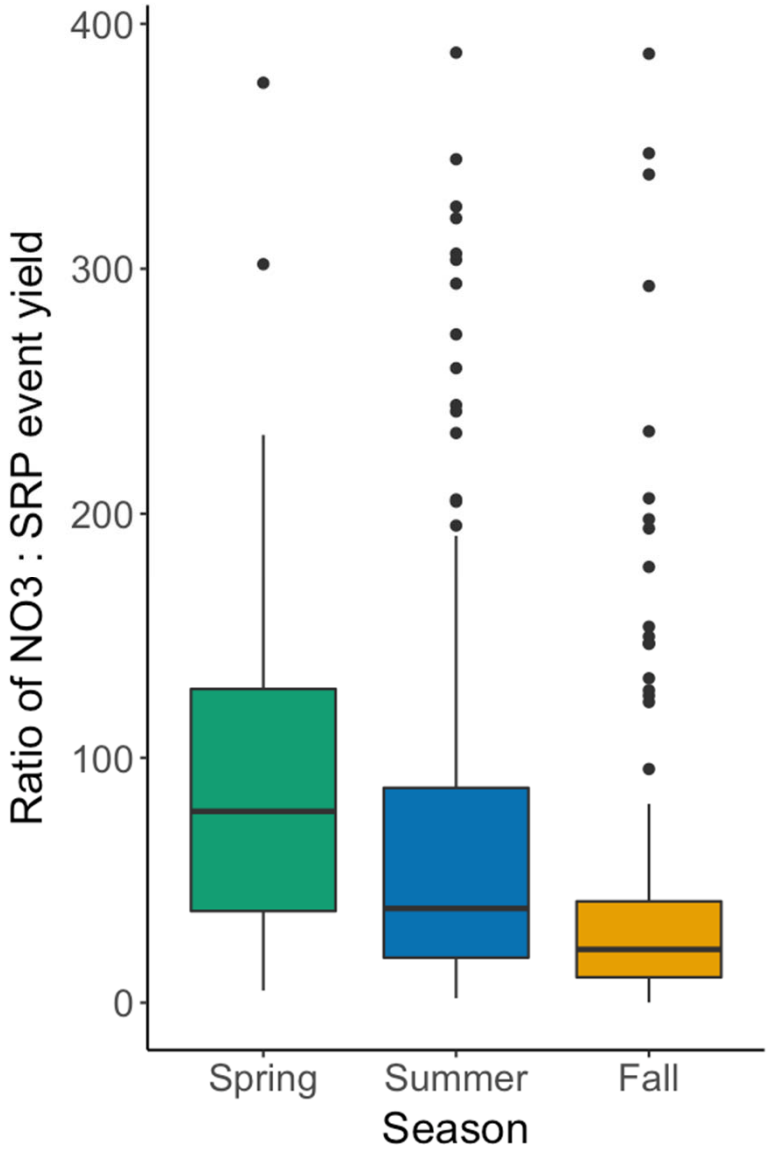
Grouping by season explains more variance in storm N & P yield



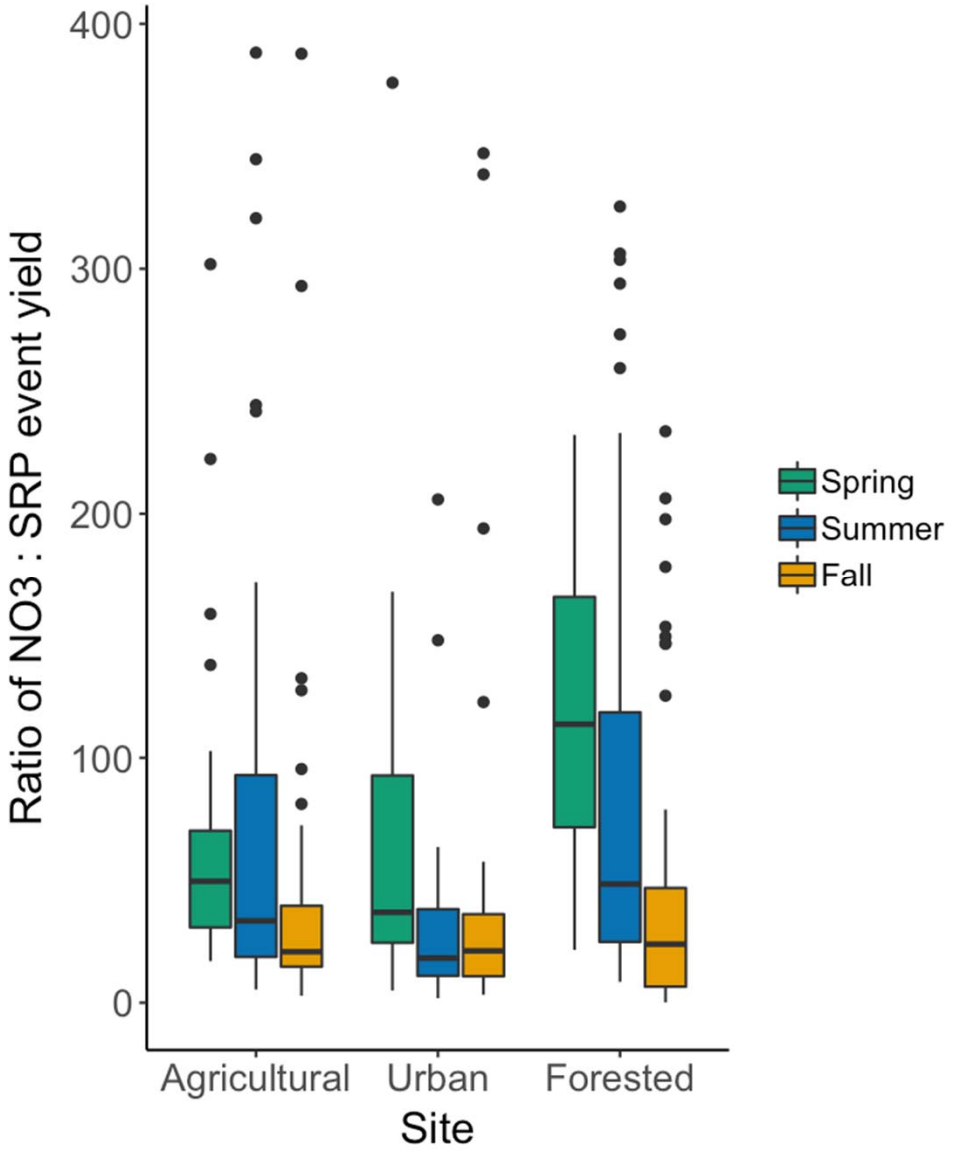
Are there differences in event NO_3^- : SRP export ratios?

$$\text{Event } NO_3^- : \text{SRP export ratio} = \frac{NO_3^- \text{ yield (moles N) per storm event}}{\text{SRP yield (moles P) per storm event}}$$

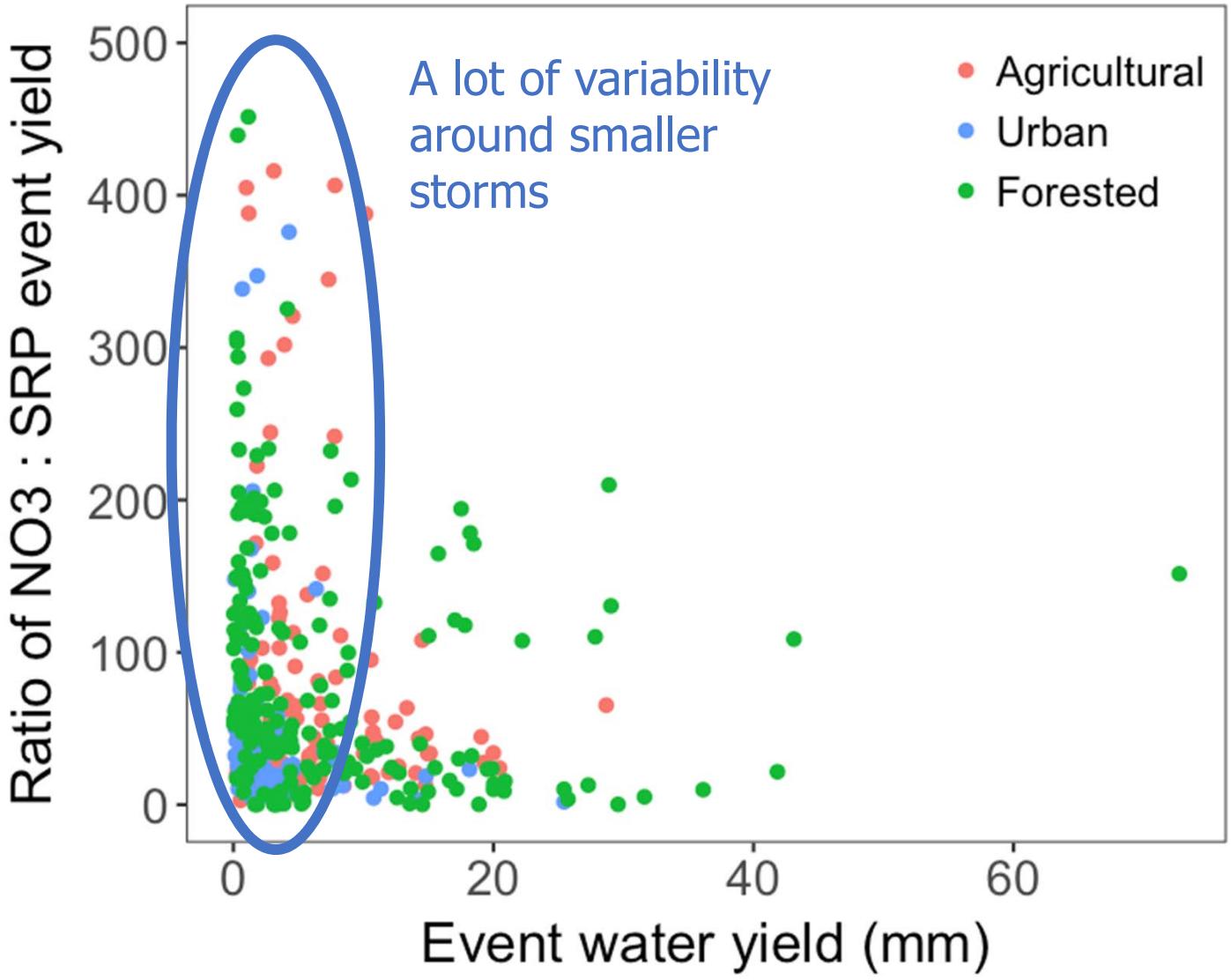
Seasons matter



Land use matters

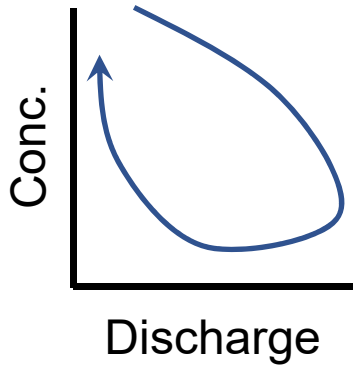


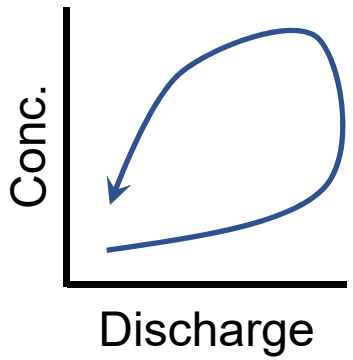
Storm water yield is not the sole determinant of event NO_3^- : SRP export ratios – storm intensity, location, & antecedent conditions?



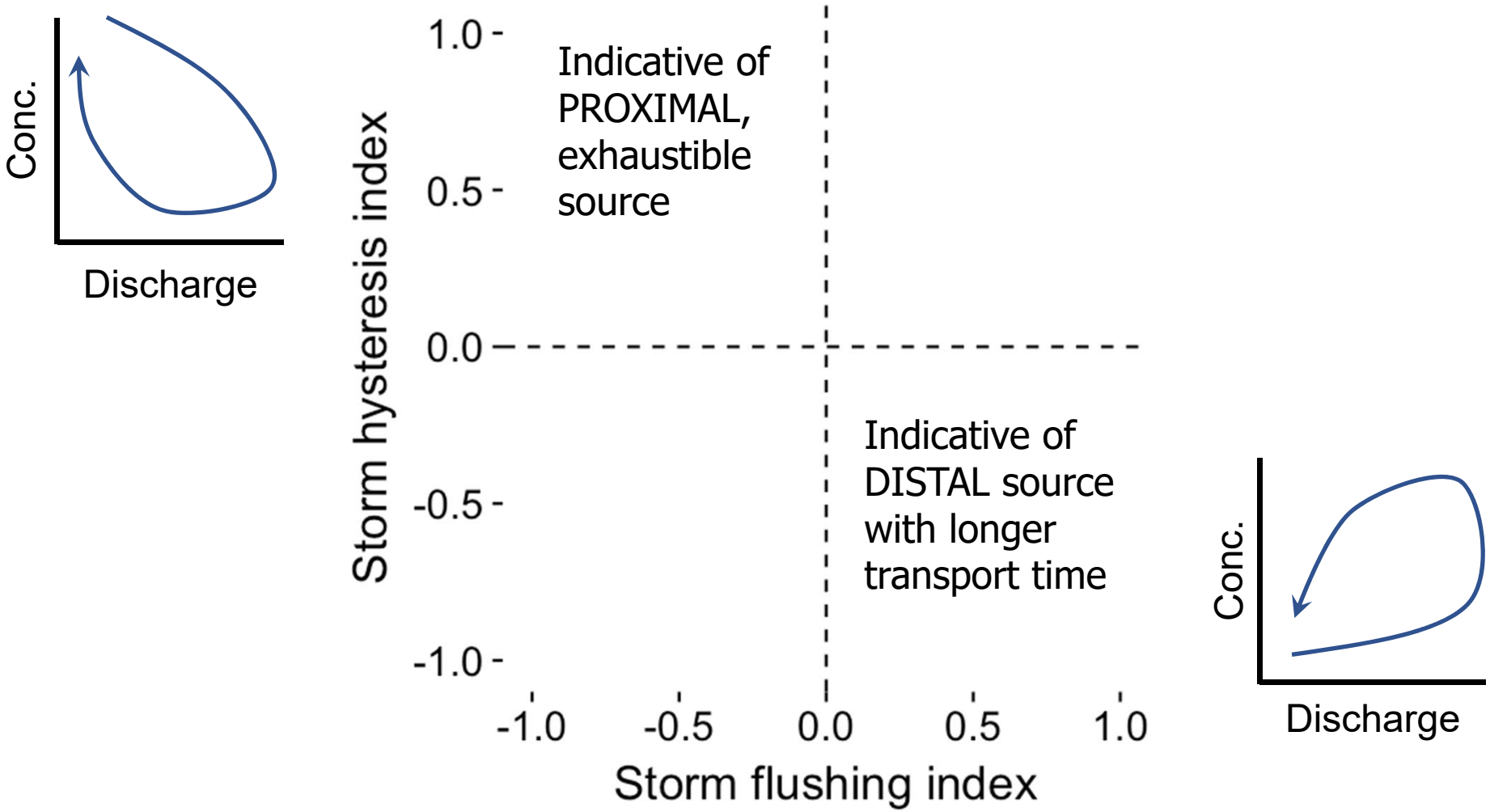
What's leading to all the variability in event NO_3^- : SRP export ratios?

Characterize storm NO_3^- & SRP export behavior



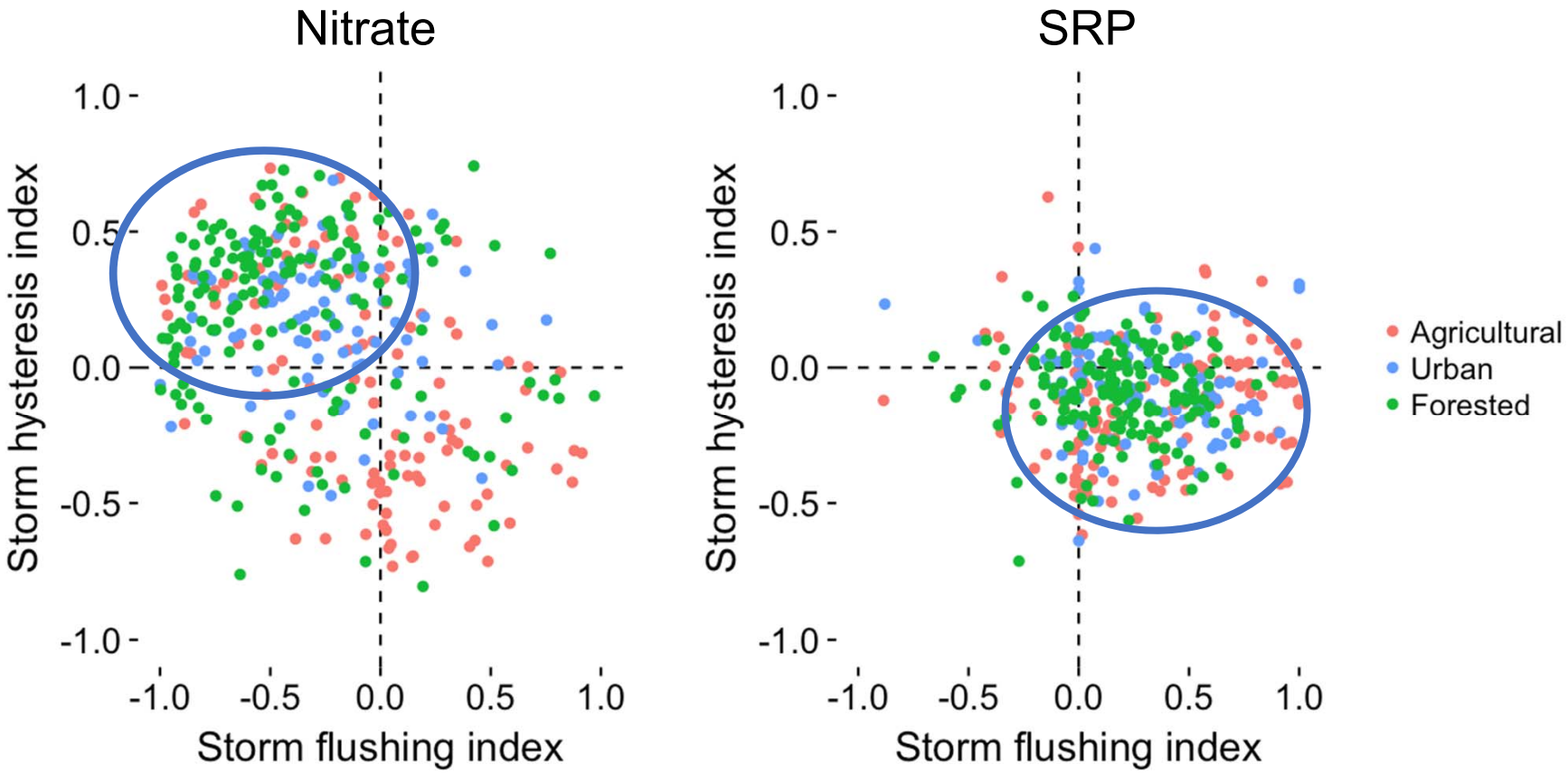


Concentration-discharge relationships can reveal solute export behavior



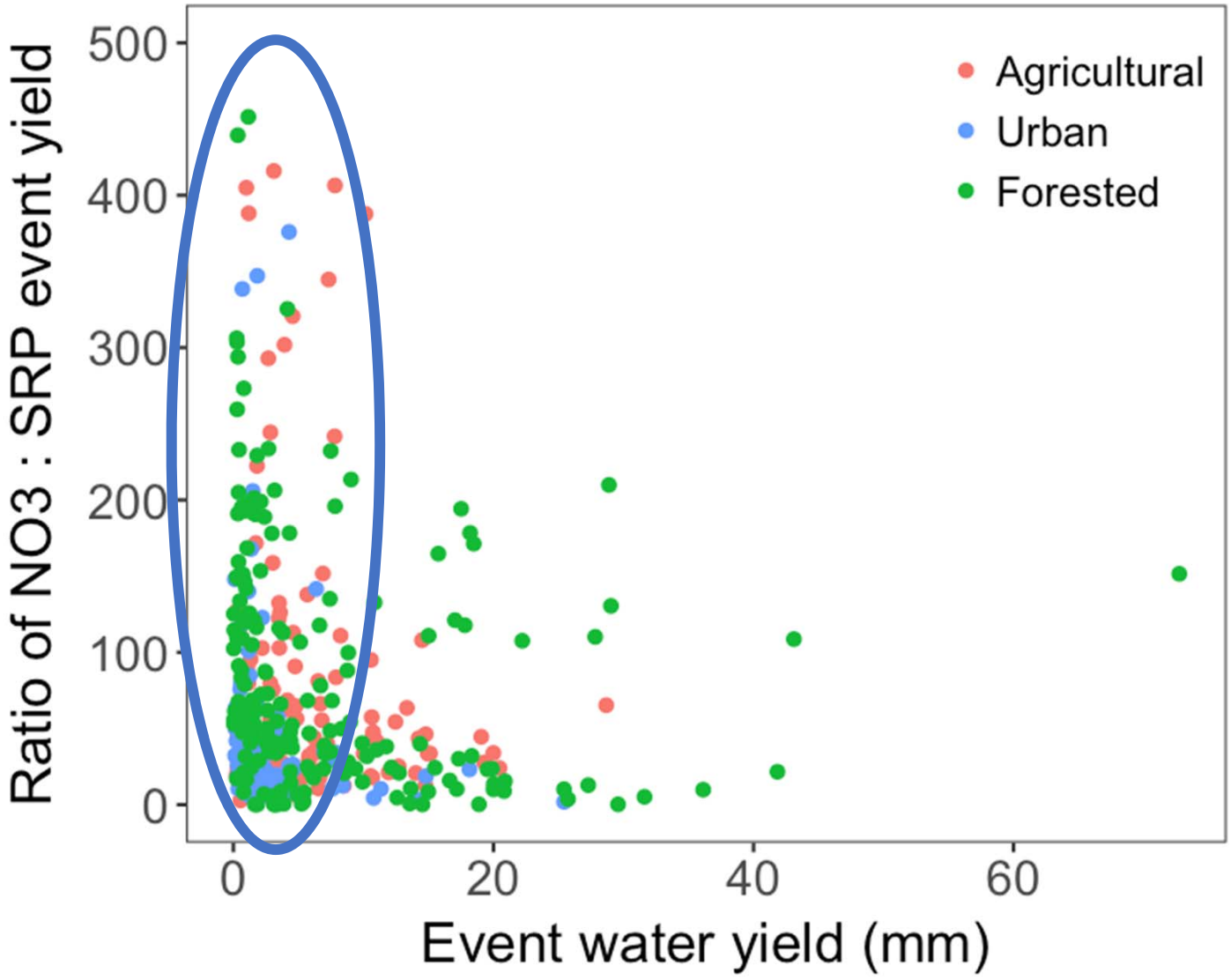
Extremely variable; though NO_3^- often originates from proximal sources or is mobilized earlier in the storm

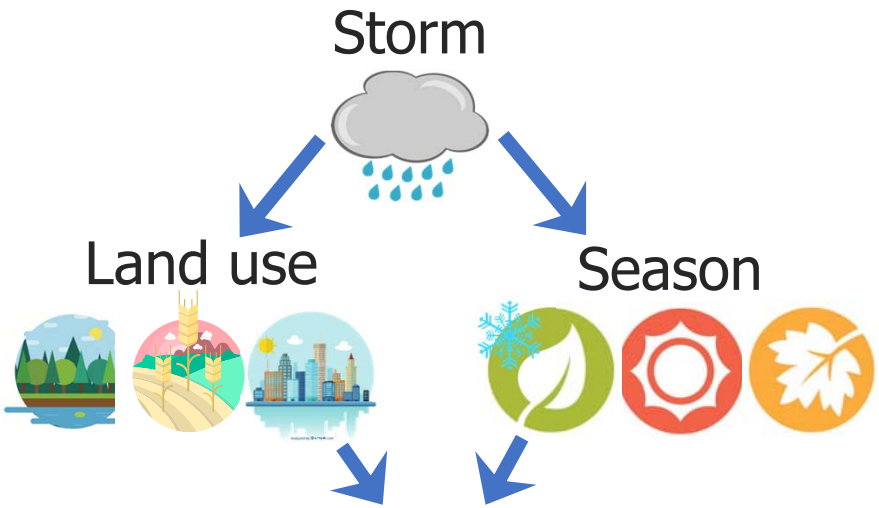
More constrained; most SRP may originate from more distal sources or takes longer to mobilize from soils



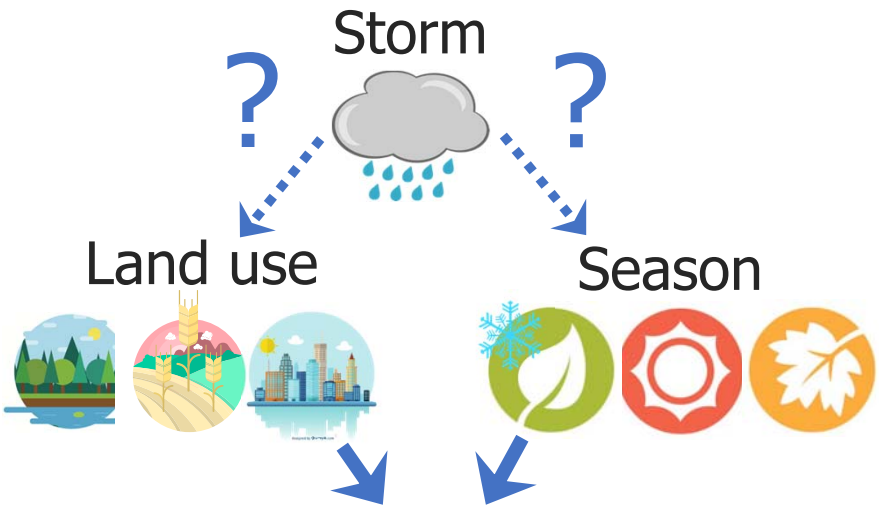
Variability in event NO_3^-:SRP export ratios driven by NO_3^-?
Antecedent conditions important

Variability in event NO_3^- : SRP export ratios driven by variability in nitrate export behavior?



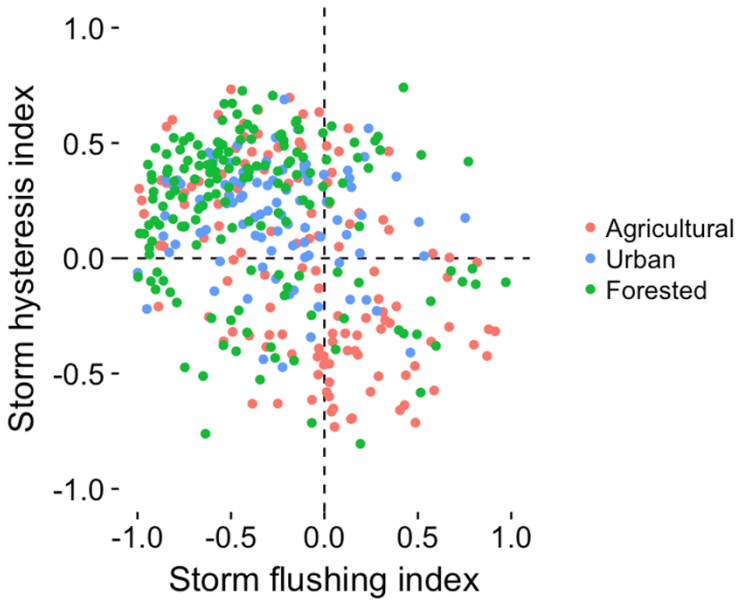


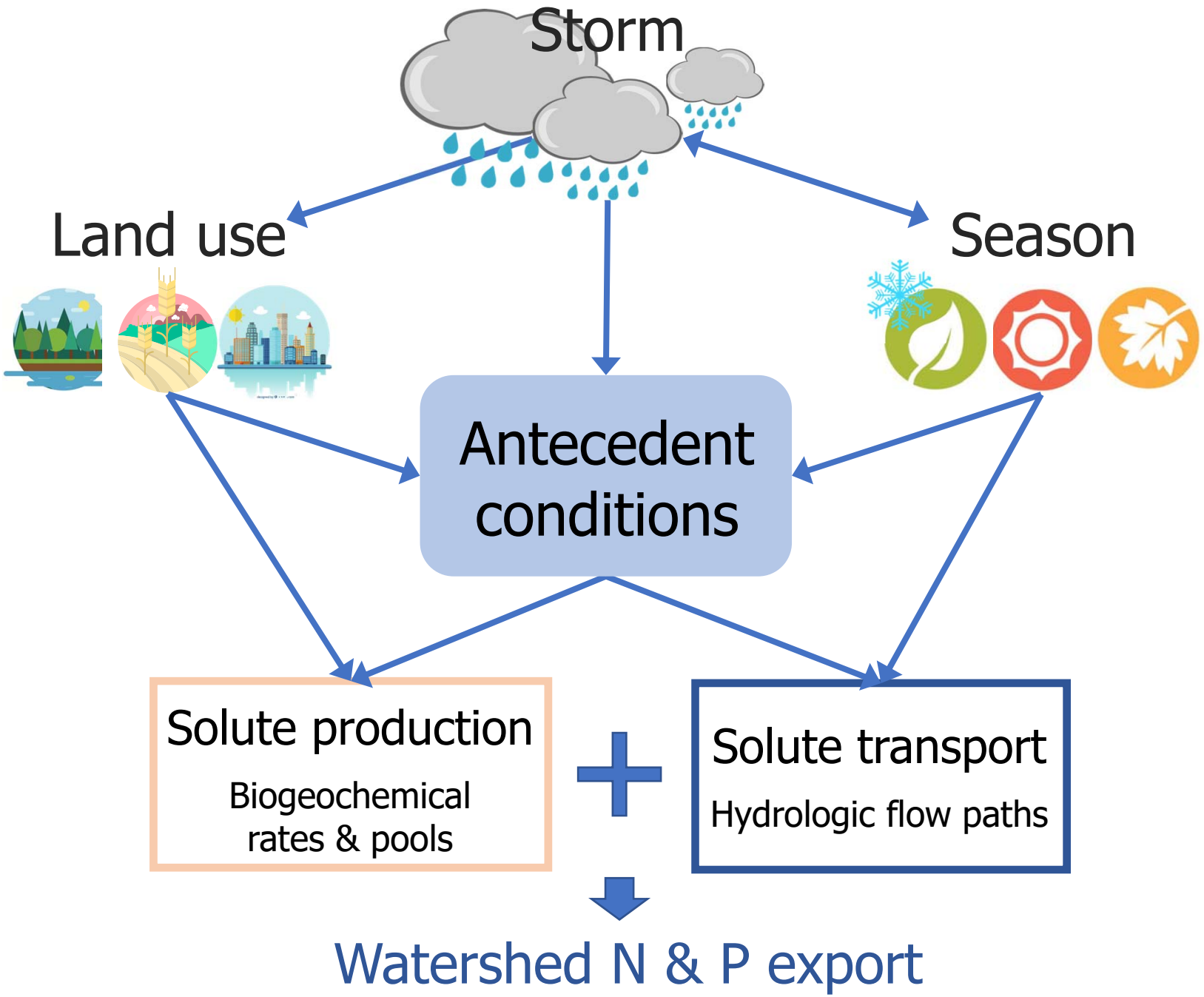
Event-scale riverine NO_3^- & SRP loading



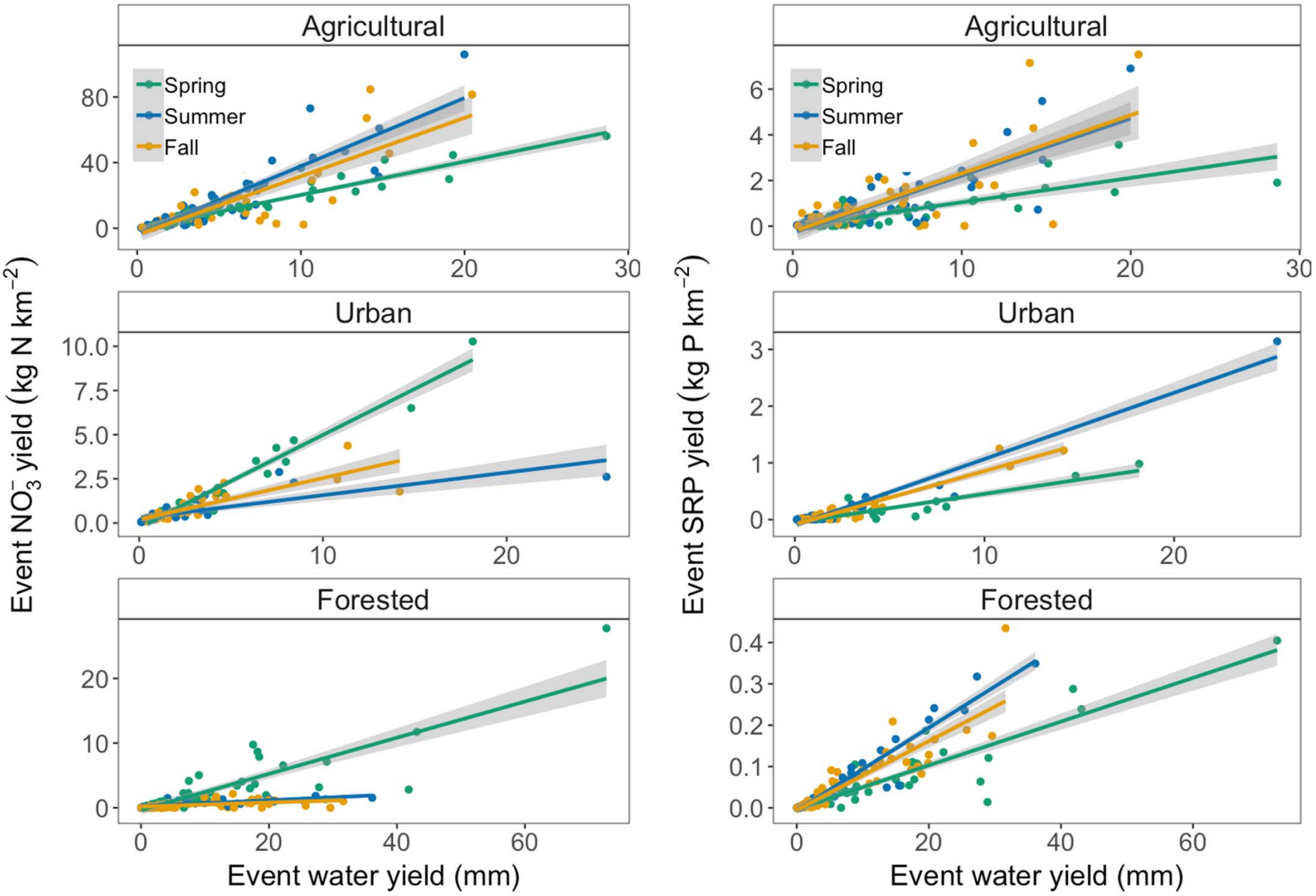
Event NO_3^- : SRP export ratios

Extreme variability in NO_3^- export behavior

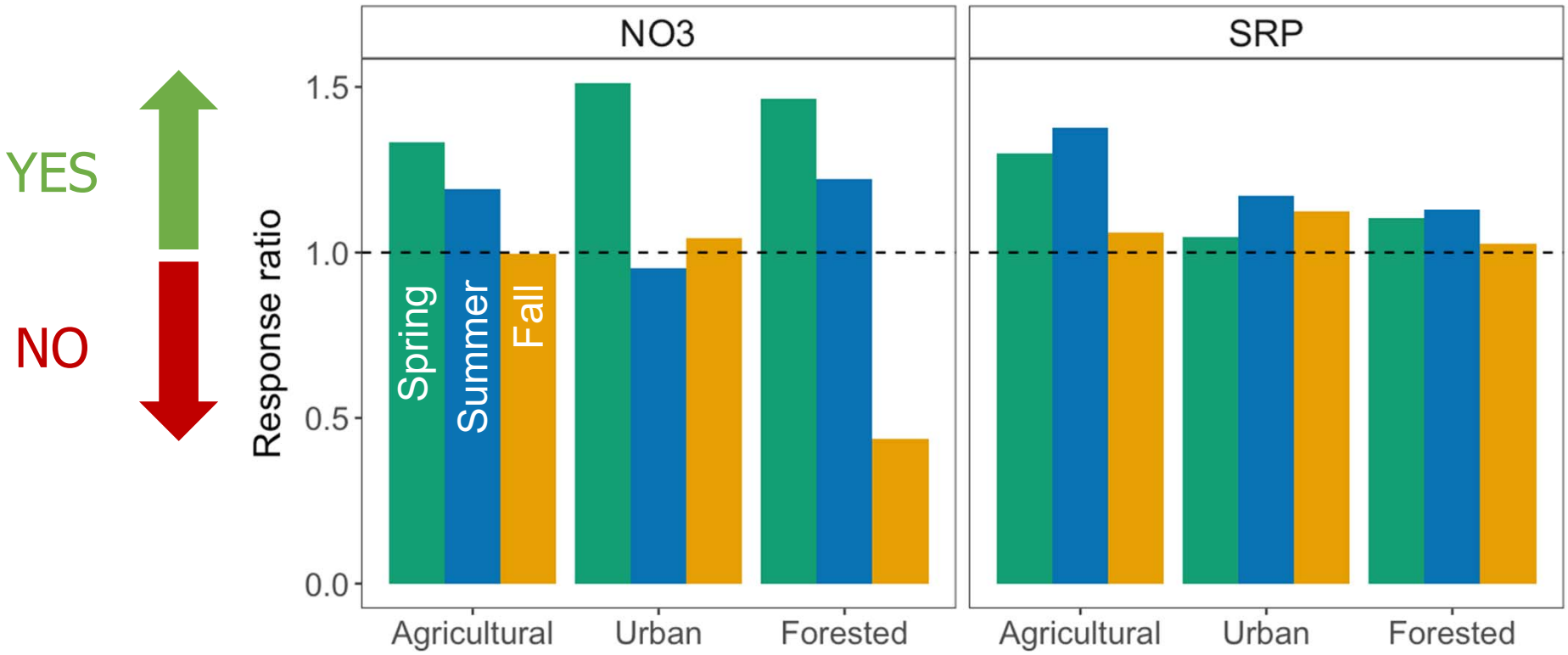




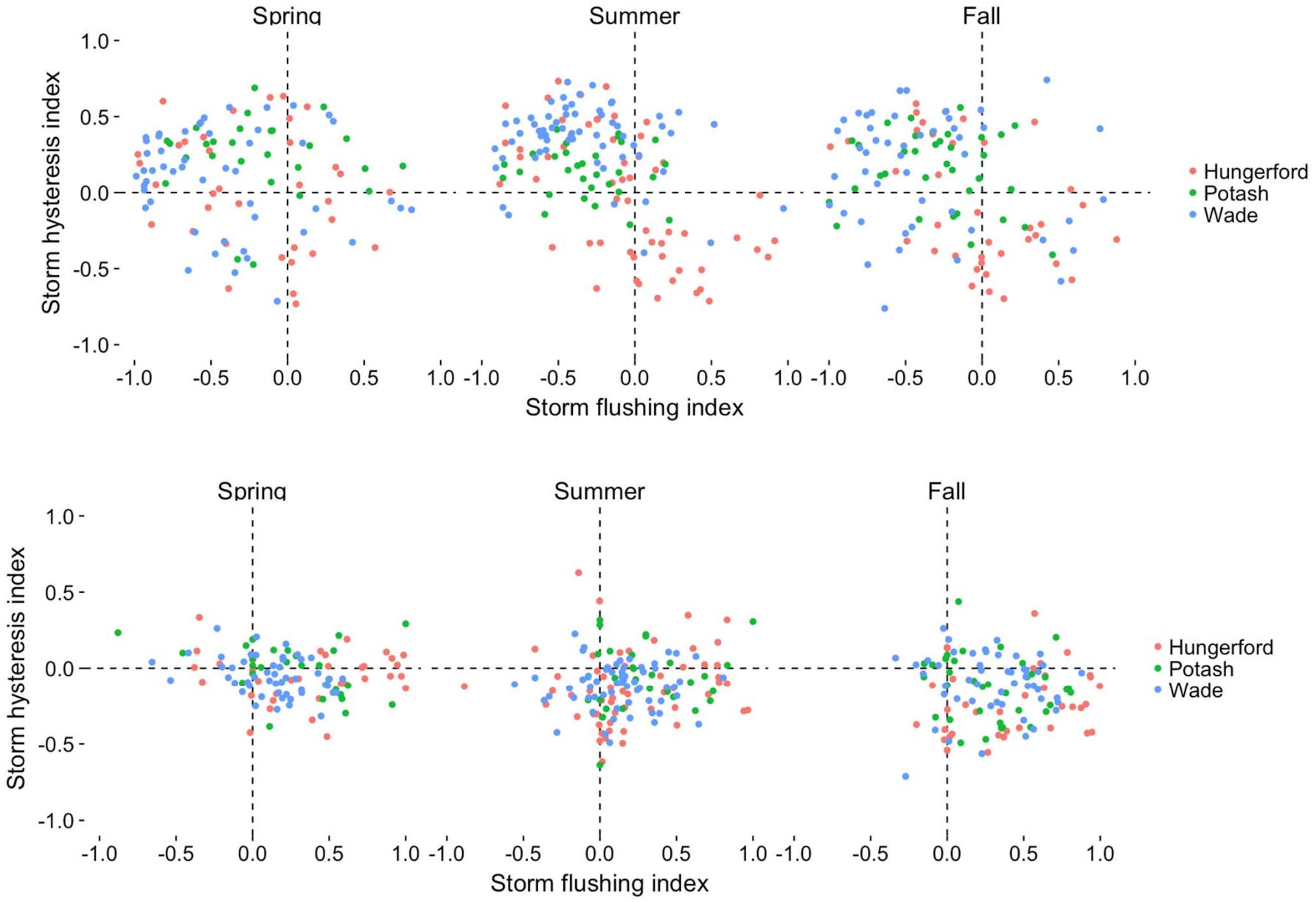
Icon credits: Forest (freevector.com), Ag (vecteezy.com), Urban (reepik.com), Seasons (istockphoto.com), Cloud (Pixabay.co)


Agricultural
Urban
Forested
Spring
Summer
Fall
Event NO_3^- yield (kg N km^{-2})
Event SRP yield (kg P km^{-2})
Event water yield (mm)
Event water yield (mm)

Does grouping by season improve the relationship between event nitrate nitrate & SRP yield and storm water yield?



Seasons don’t provide much more insight



Concentration-discharge relationships can reveal solute export behavior