Temporal variation in river nutrient concentrations and the impact of storm runoff on Hood Canal nutrient loading

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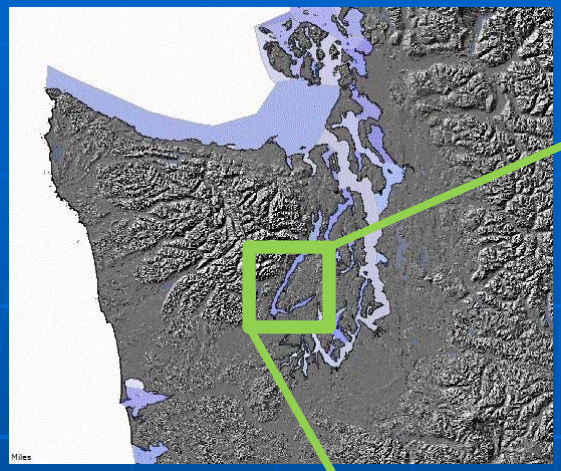
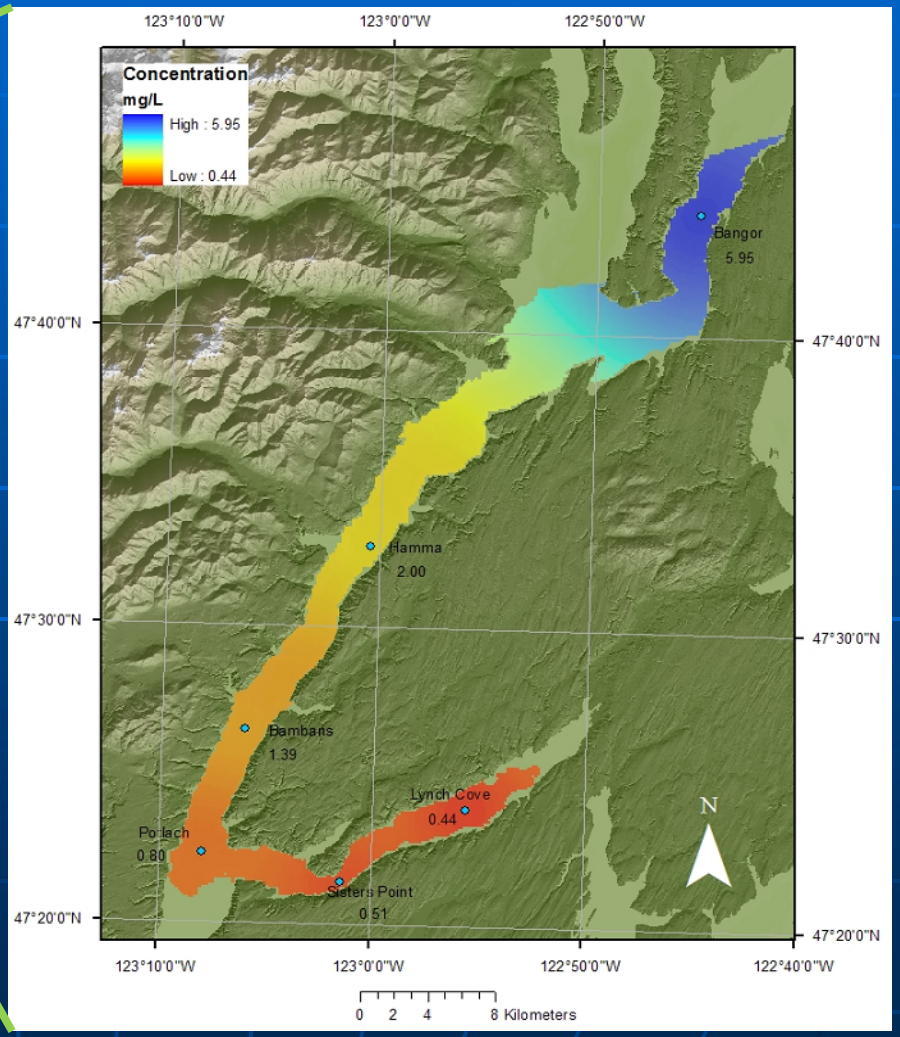
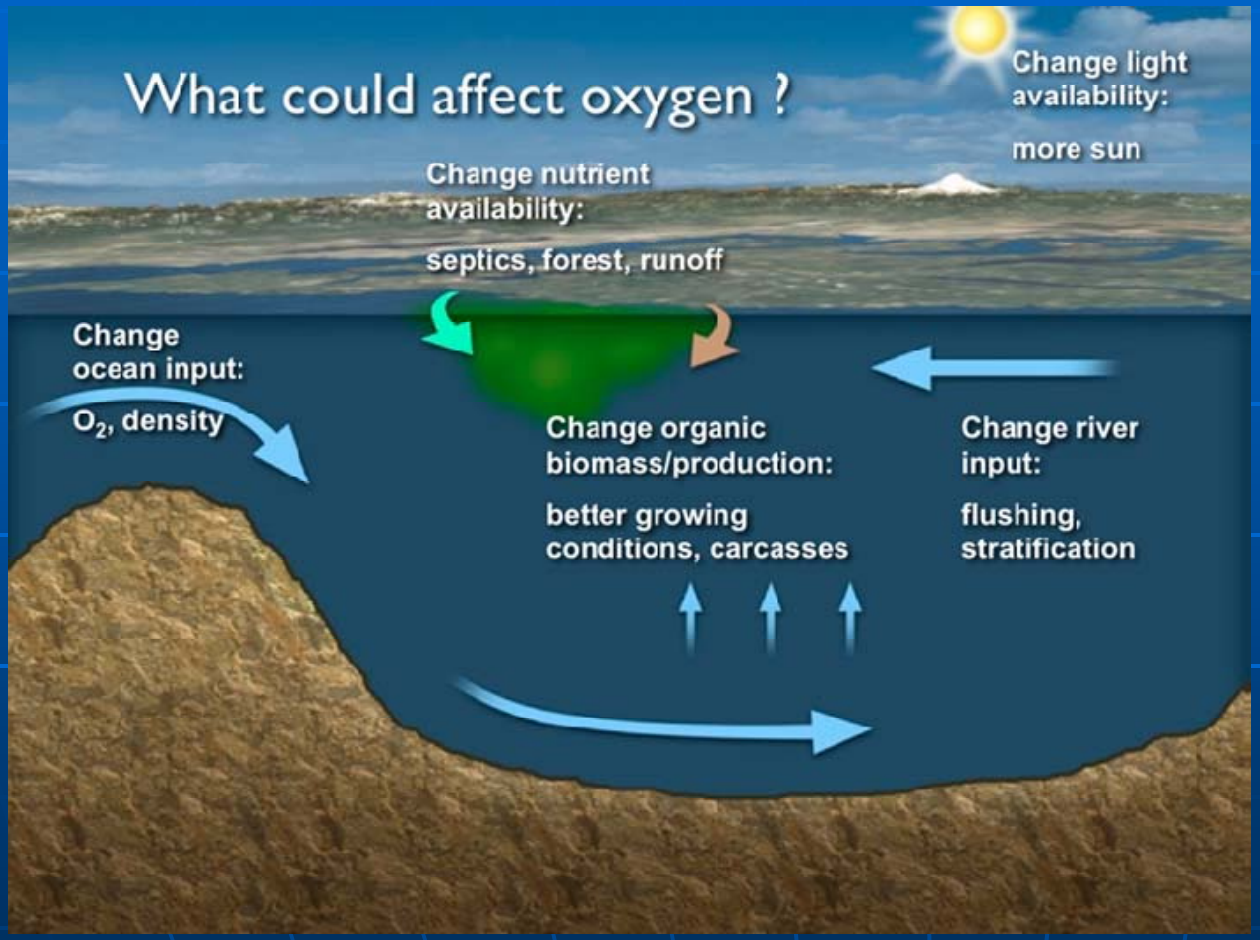
Hood Canal Dissolved O_2 Program





- Increased frequency of low O_2 and fish kill events observed in recent decades

Factors affecting hypoxia

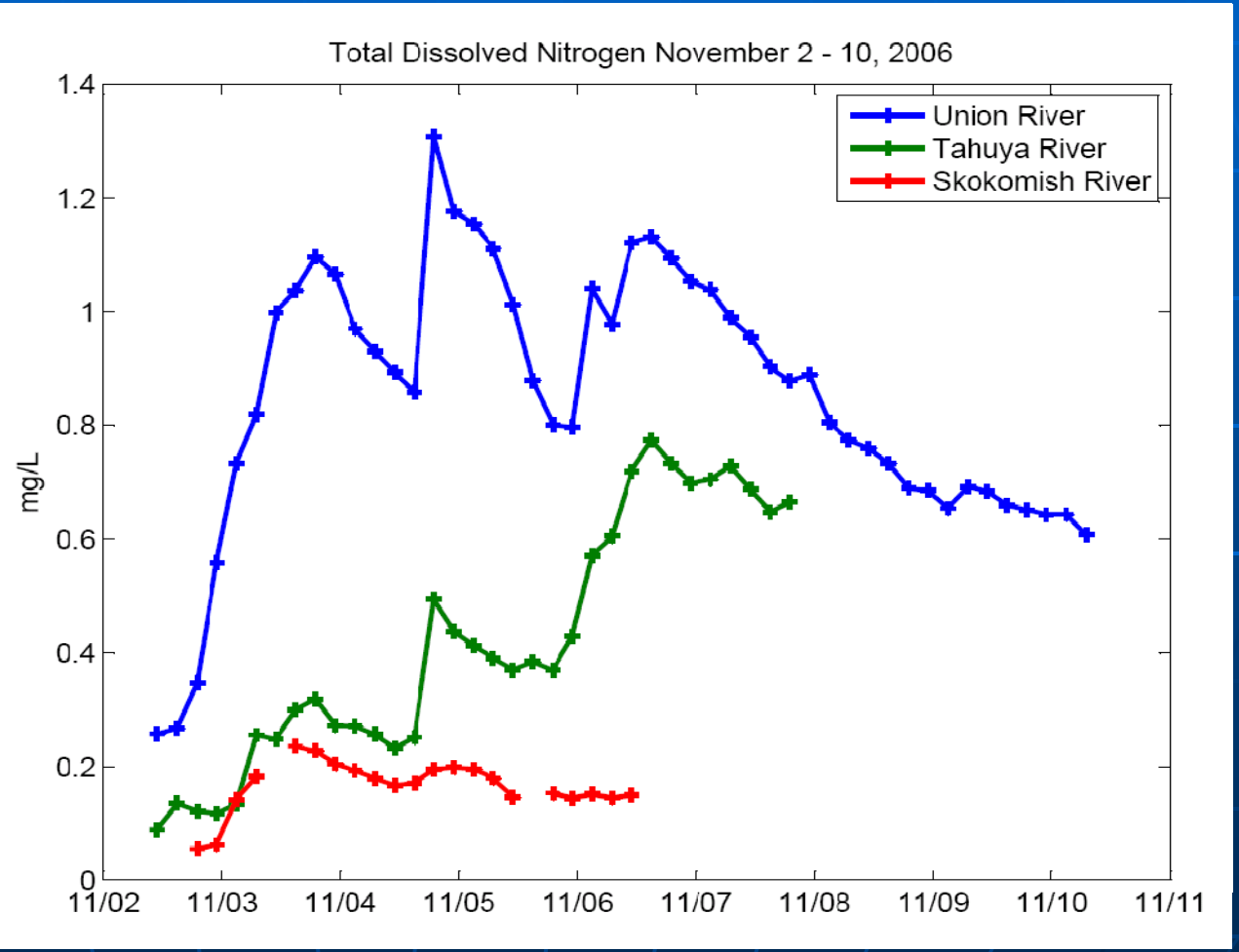


- Focus of this study:

How does terrestrial input of nutrients change over time?

HCDOP Watershed Model

- Chemistry based on monthly samplings of 43 streams
- How do nutrient concentrations vary on shorter timescales?



Peter Steinberg, unpublished data

Storm Sampling Project

Goal:

Determine short term variability in river nutrient concentrations

and

Gain an understanding of the processes behind observed variability

Storm Sampling Project

Measurements:

Total Dissolved Nitrogen

Dissolved Organic Carbon

Dissolved Silica, Phosphorous, And inorganic N concentrations

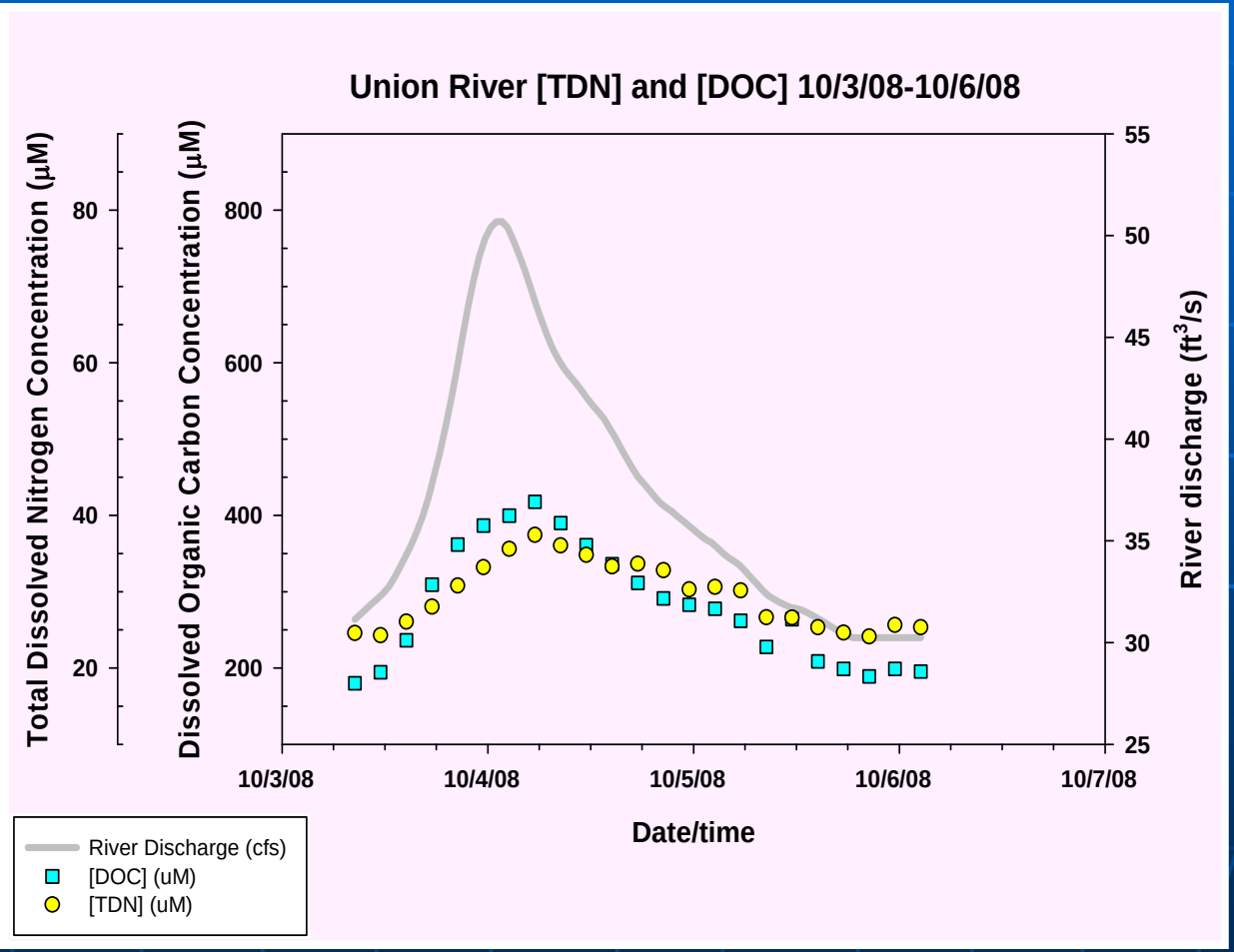
Total Suspended Sediments

Particulate C/N concentrations

Particulate C/N Stable Isotopes

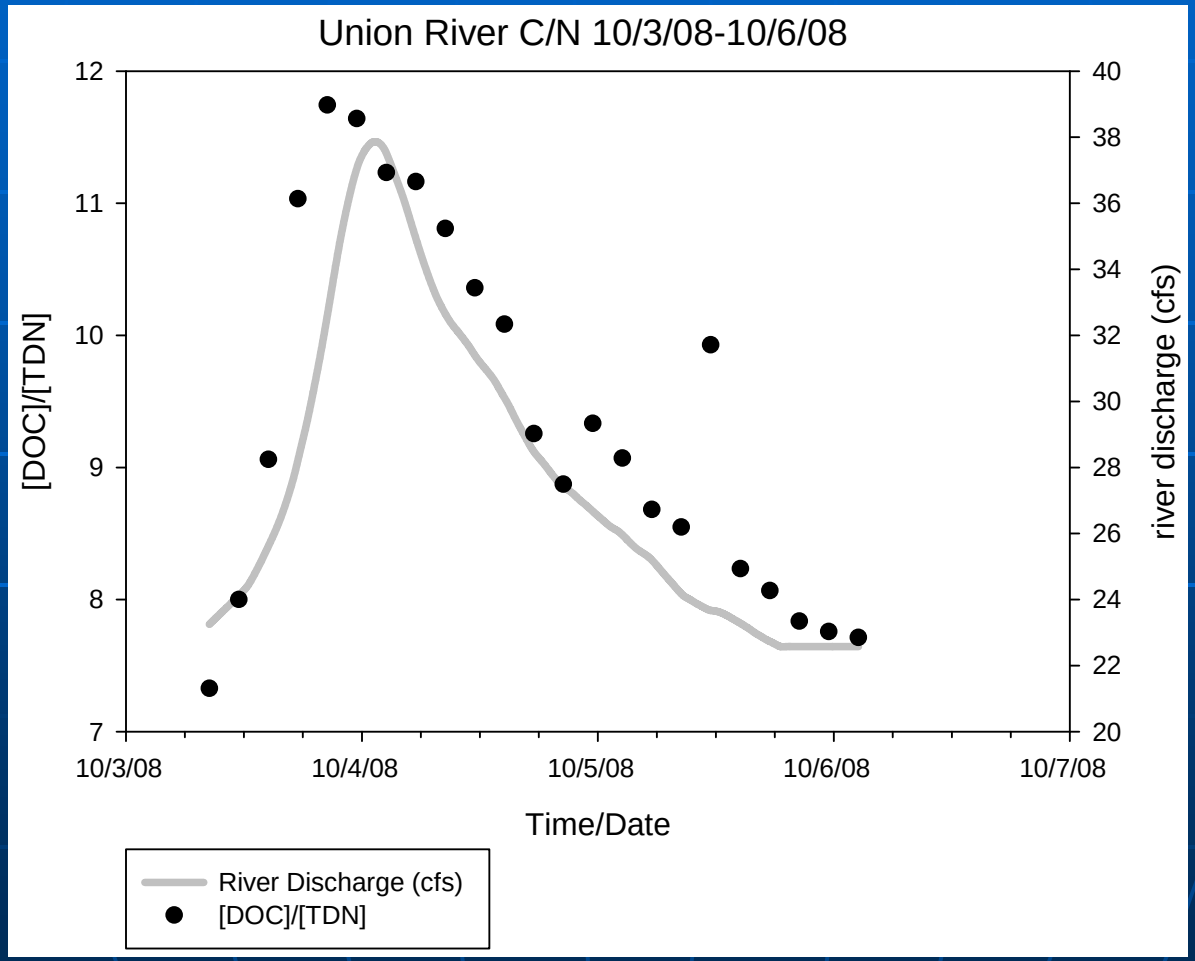
Dissolved Lignin Phenols

Autumn storm sampling results



TDN is ~66-75% NO_3 and 25-33% DON

Autumn storm sampling results



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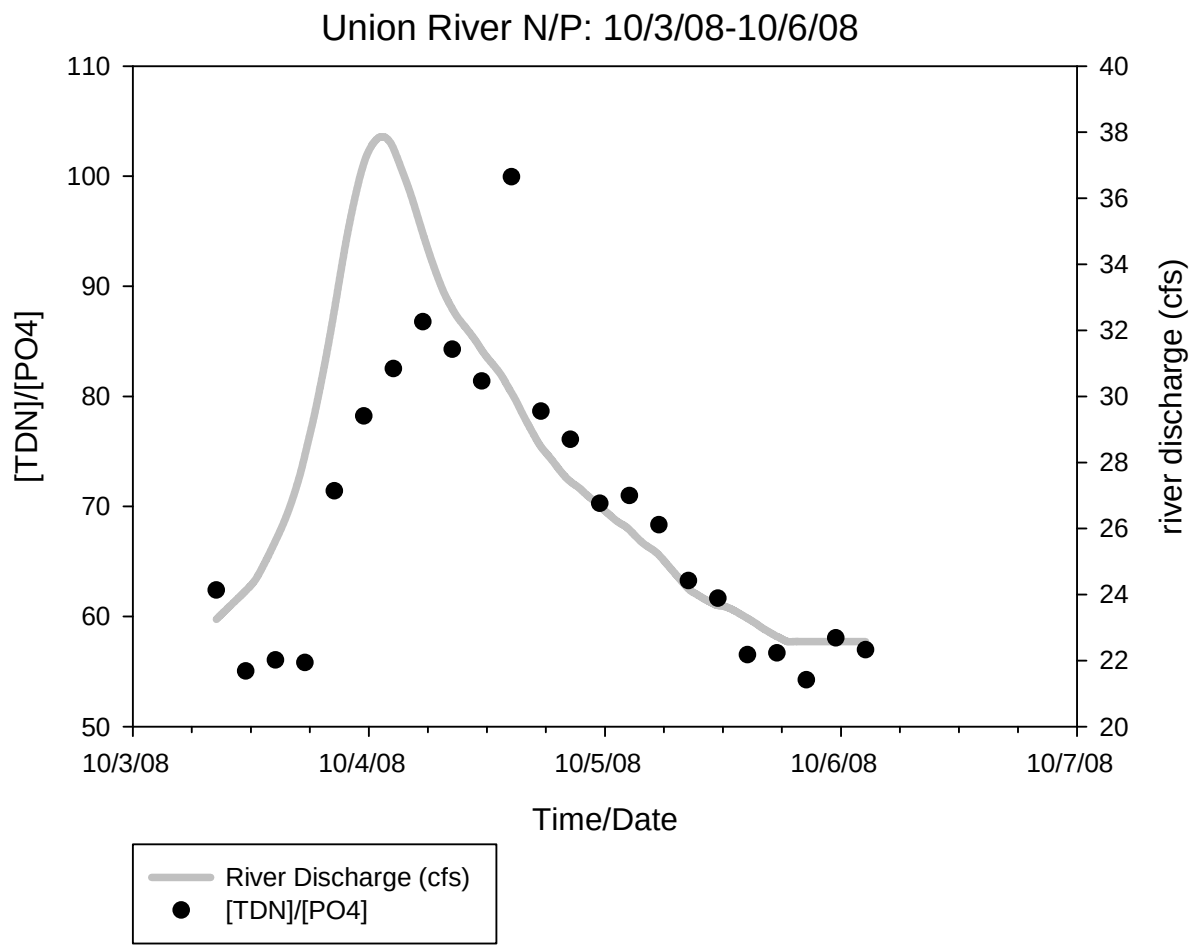
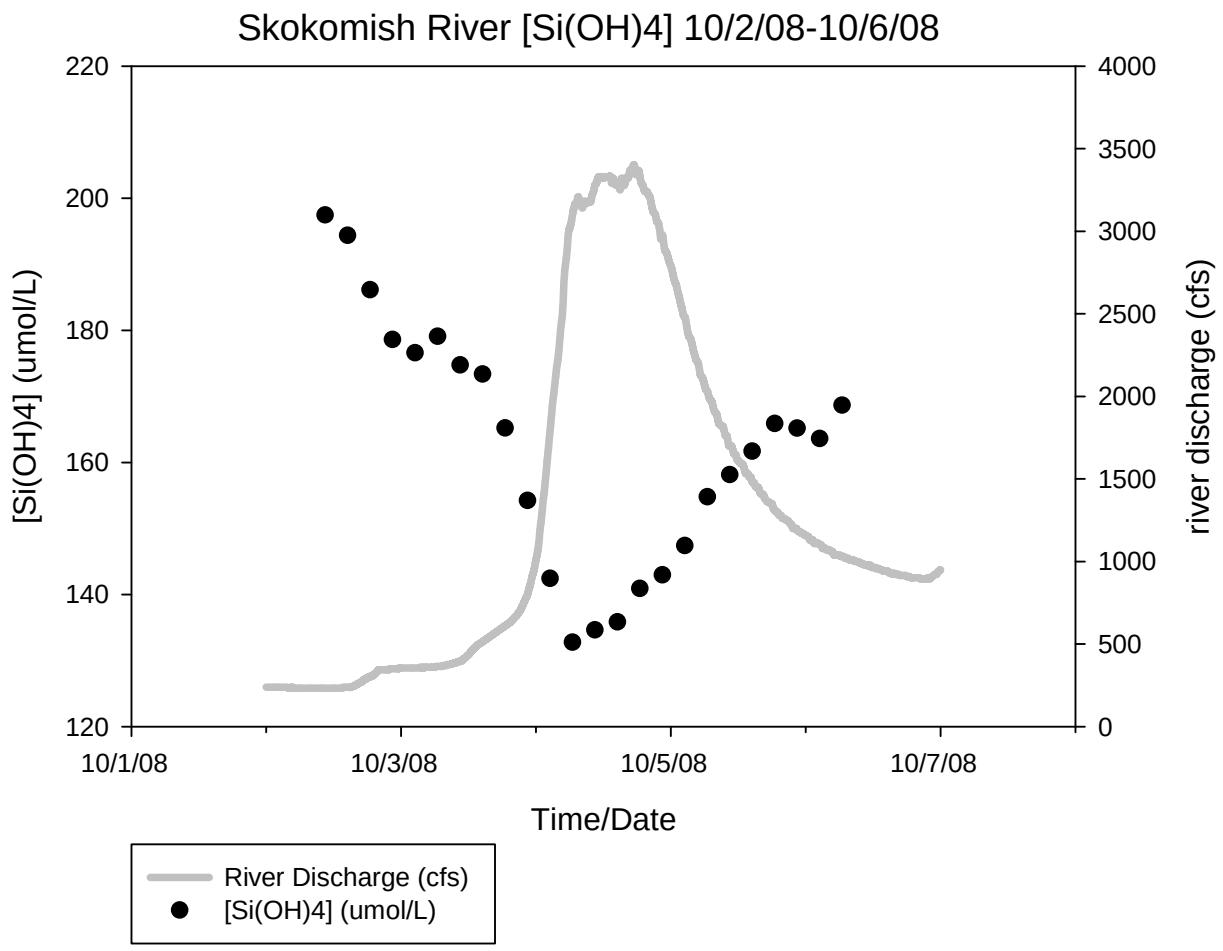
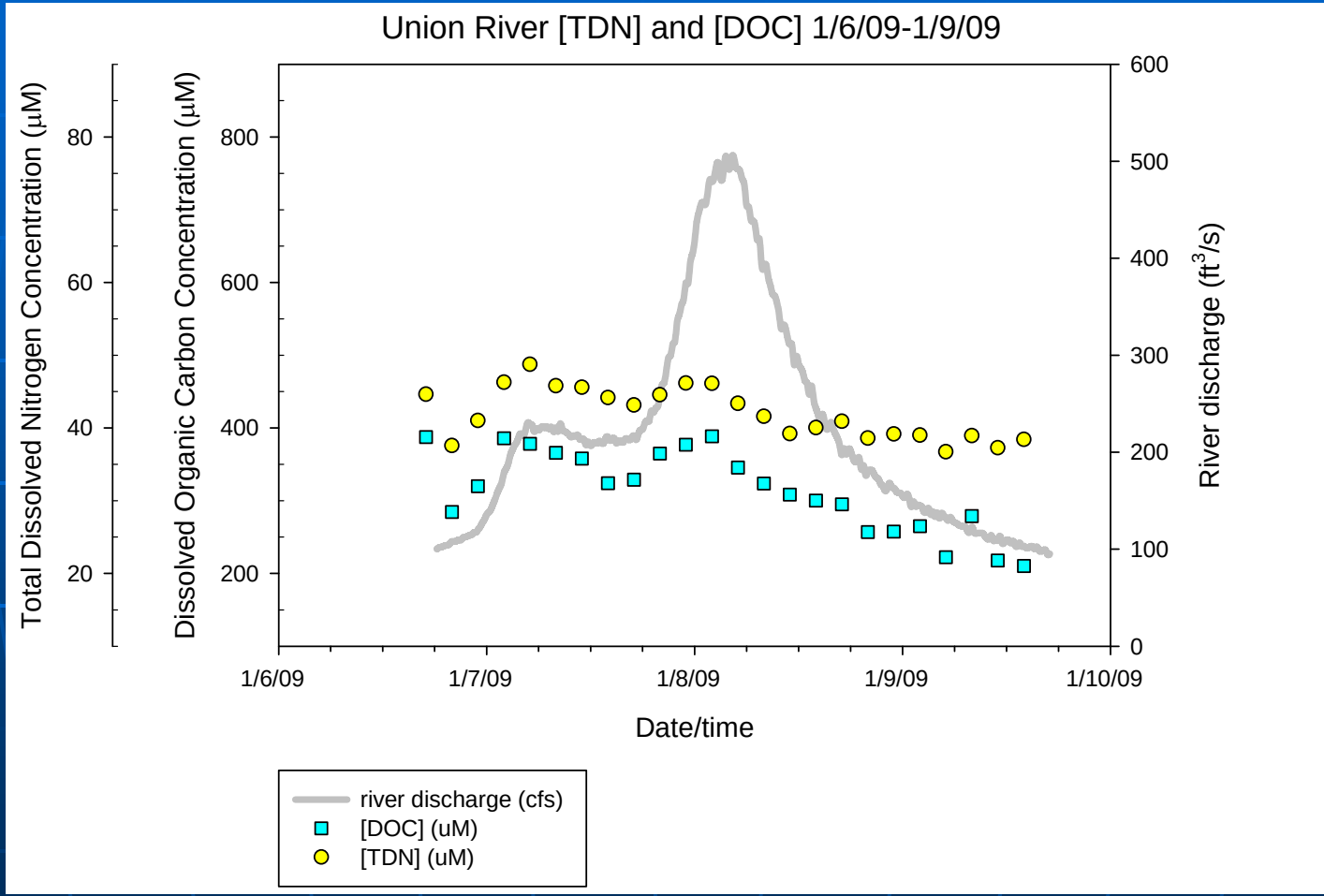


Autumn storm sampling results



Winter storm sampling results

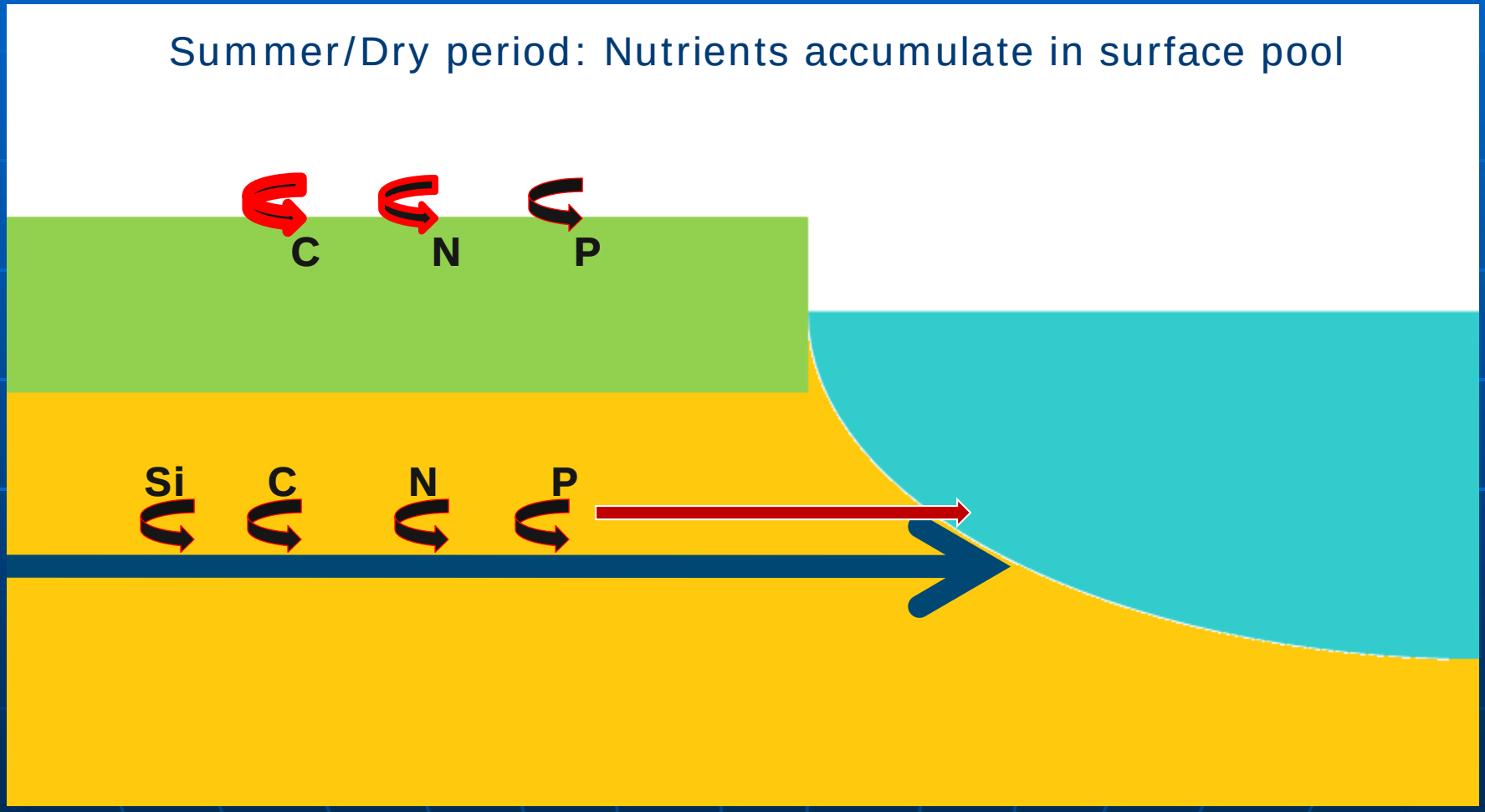


November: 167% increase in discharge=167% increase in [TDN]

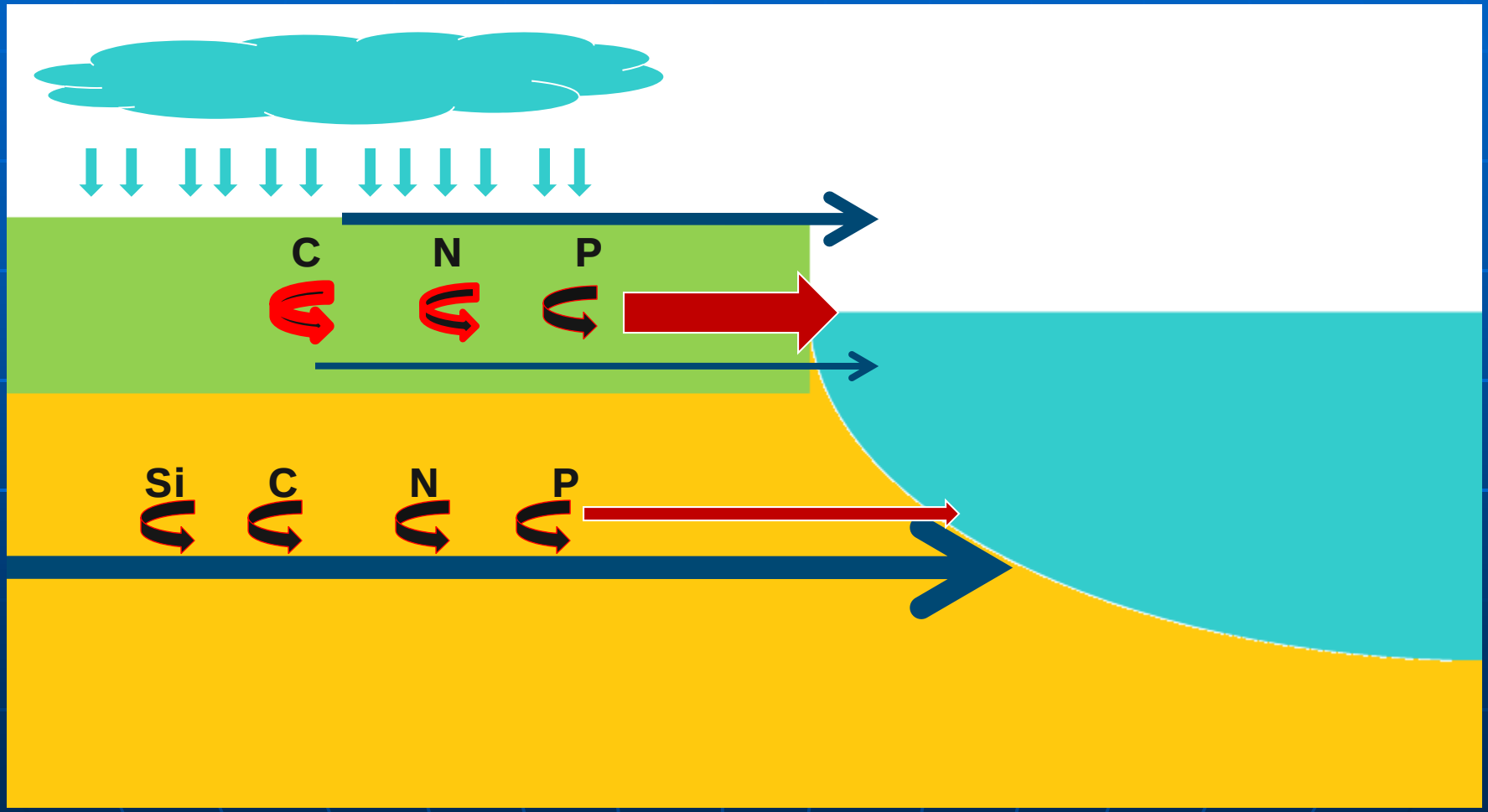
January: 112% increase in discharge=30% increase in [TDN]

By March there is nearly no change in concentrations with river flow

Simple Two Pool Model

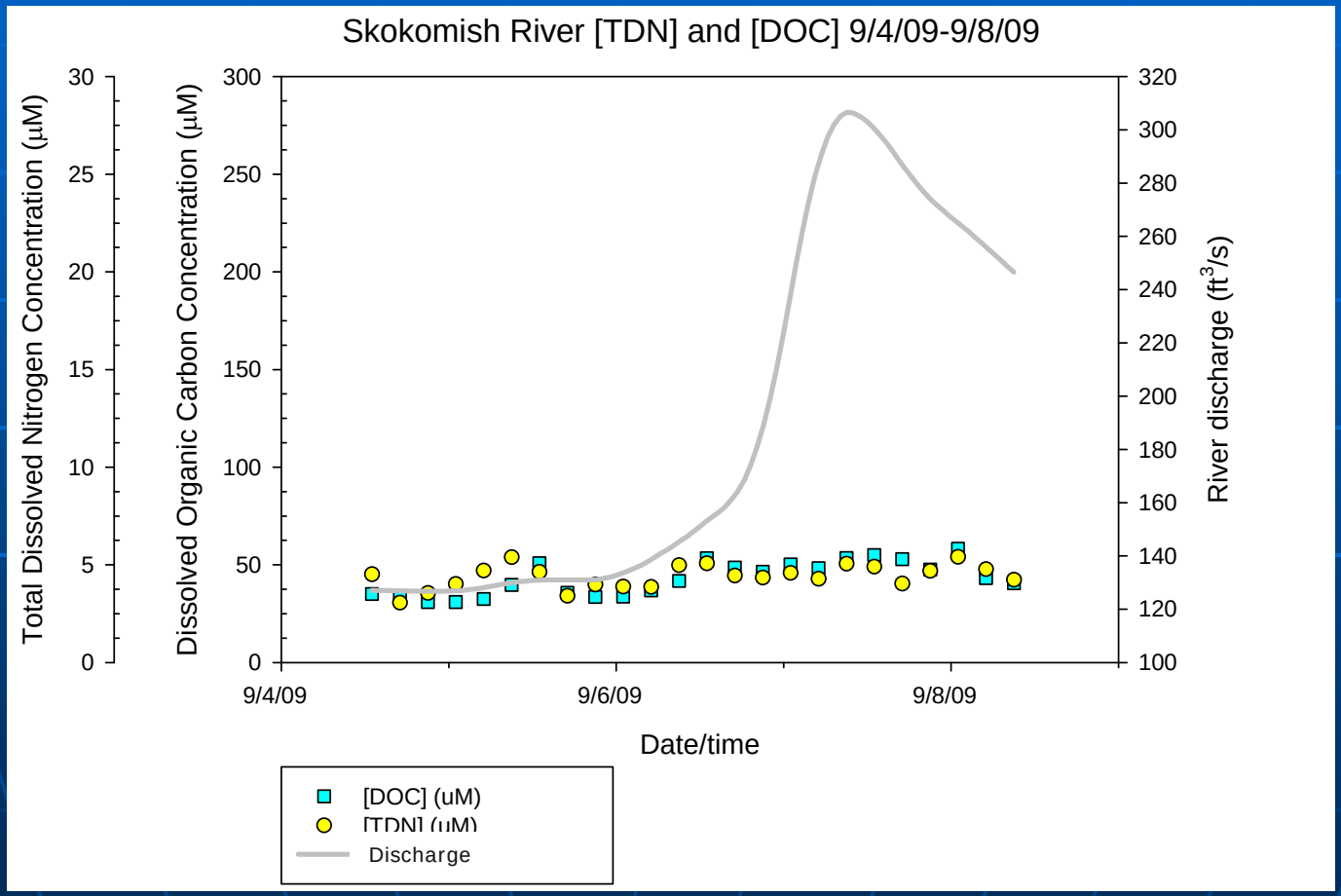


Simple Two Pool Model



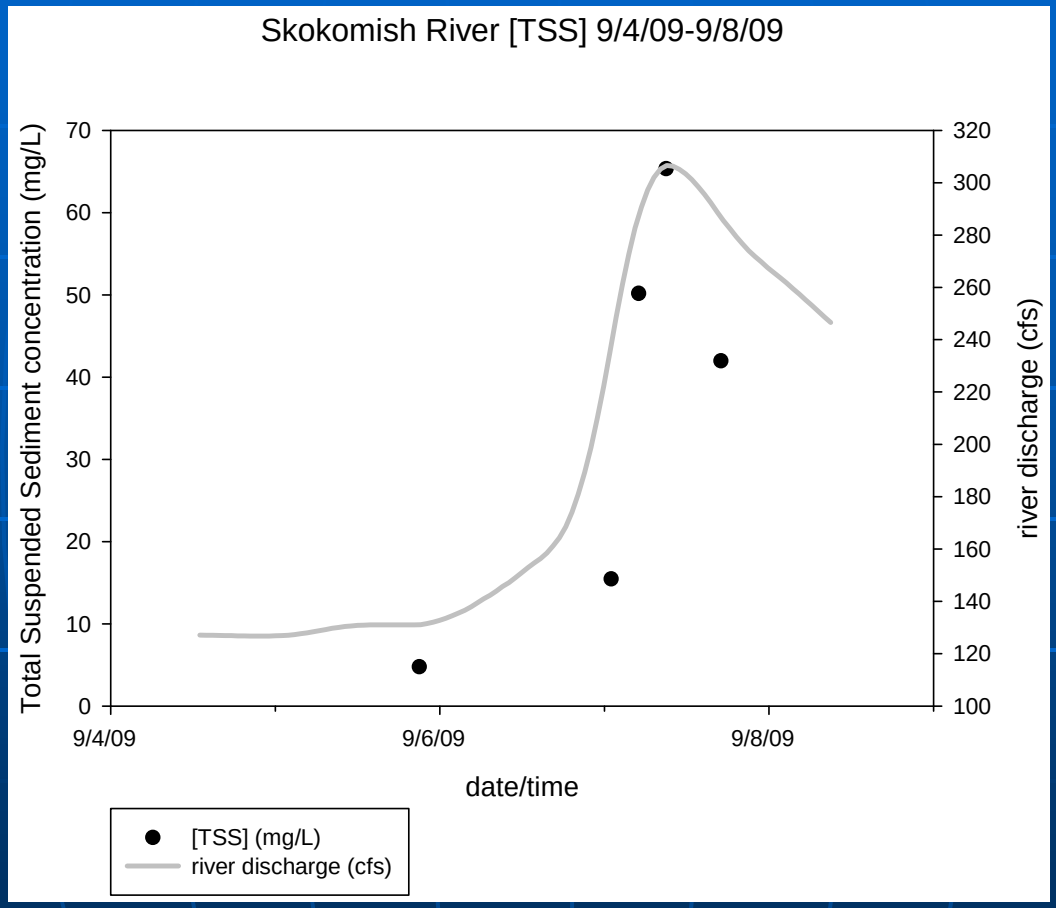
Nutrient flux Water flux Size of arrow reflects magnitude of flux

Autumn storm sampling results



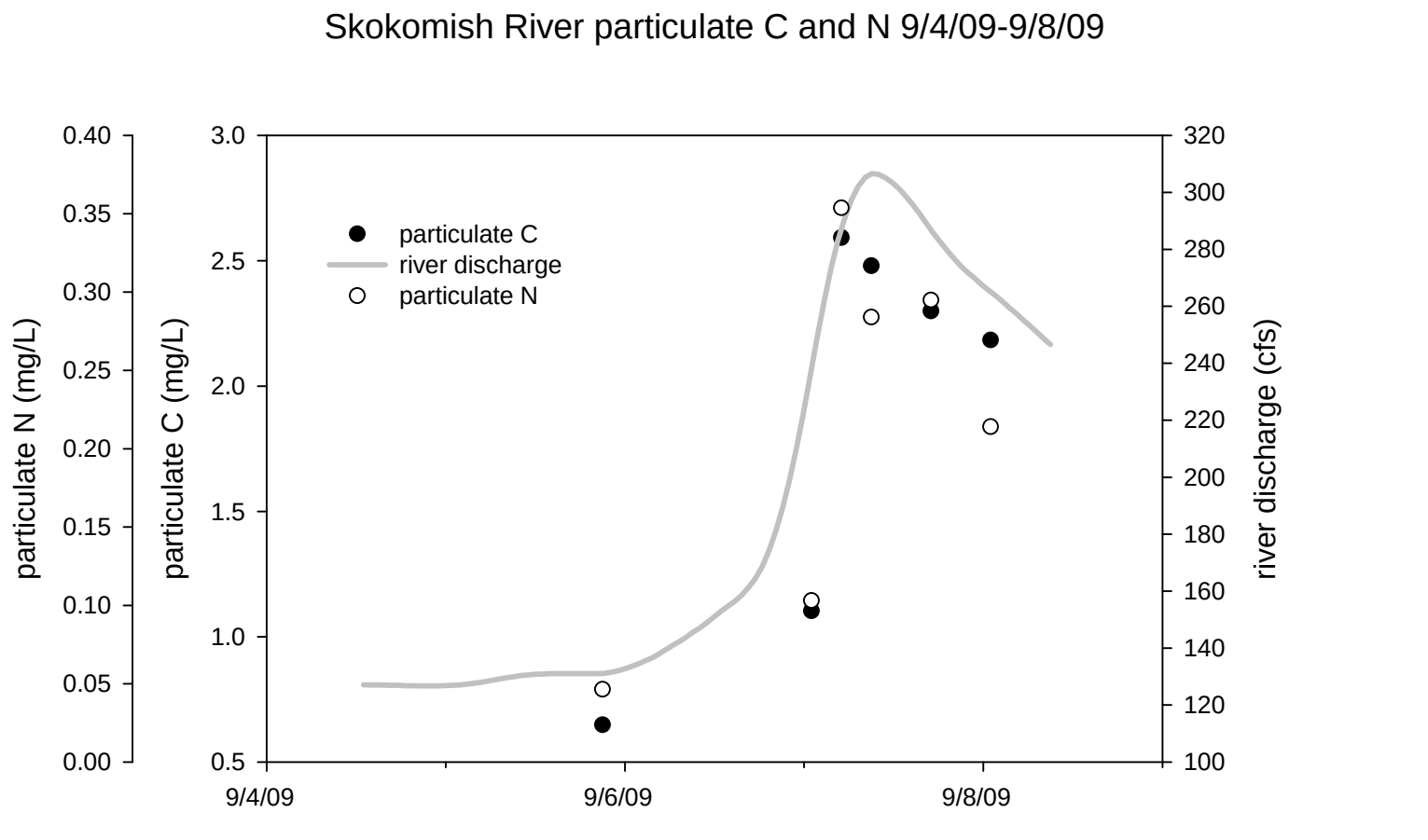
Rainfall not adequate enough to saturate soil and mobilize dissolved nutrients

Autumn storm sampling results



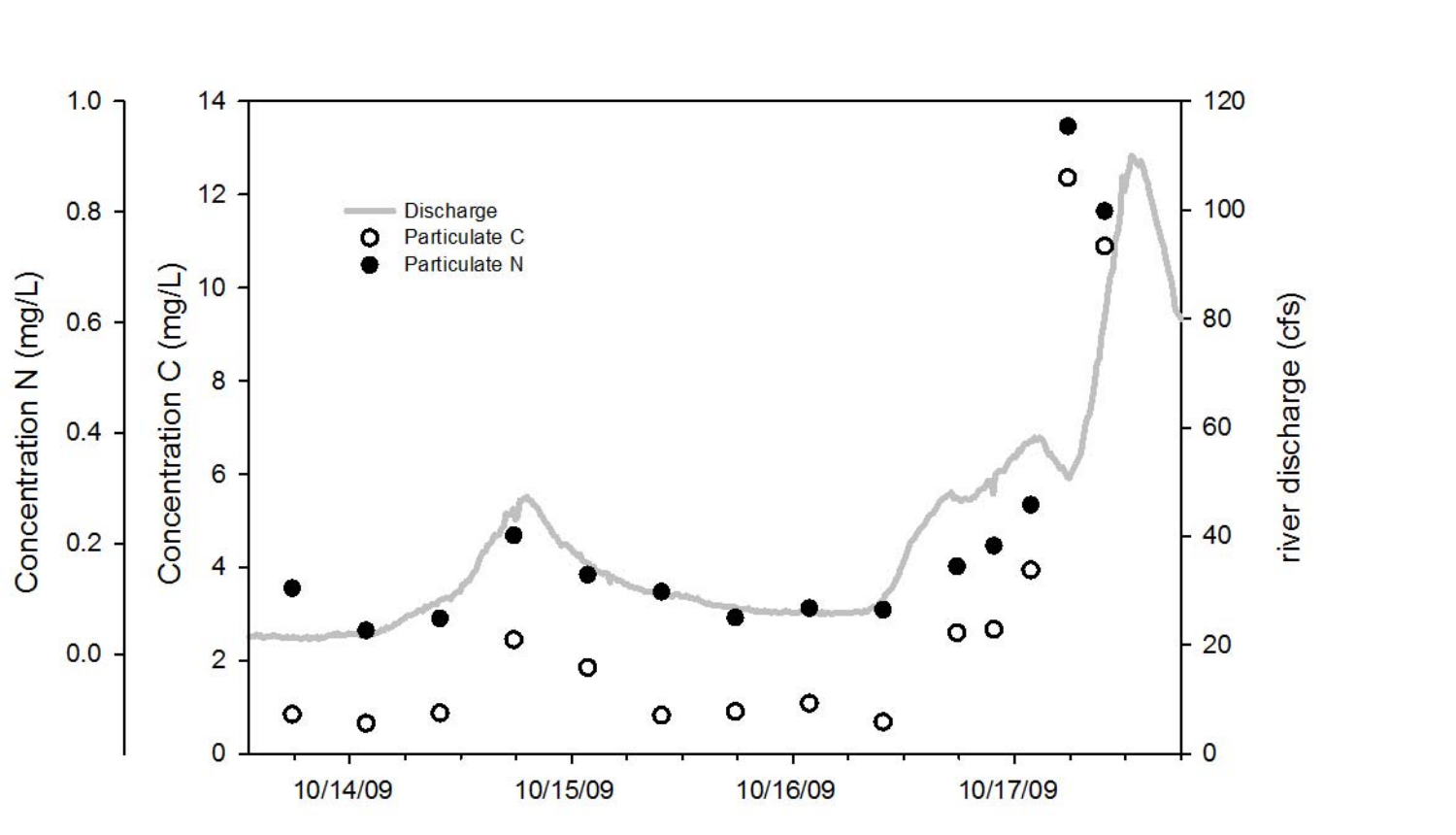
However, surface runoff mobilizes sediments

Autumn storm sampling results



Particulate C and N conc. increase because soils are mobilized, however soil saturation isn't high enough to "flush" dissolved nutrients

Autumn storm sampling results



Like dissolved nutrients, particulates show largest response in early storms, then correlation diminishes

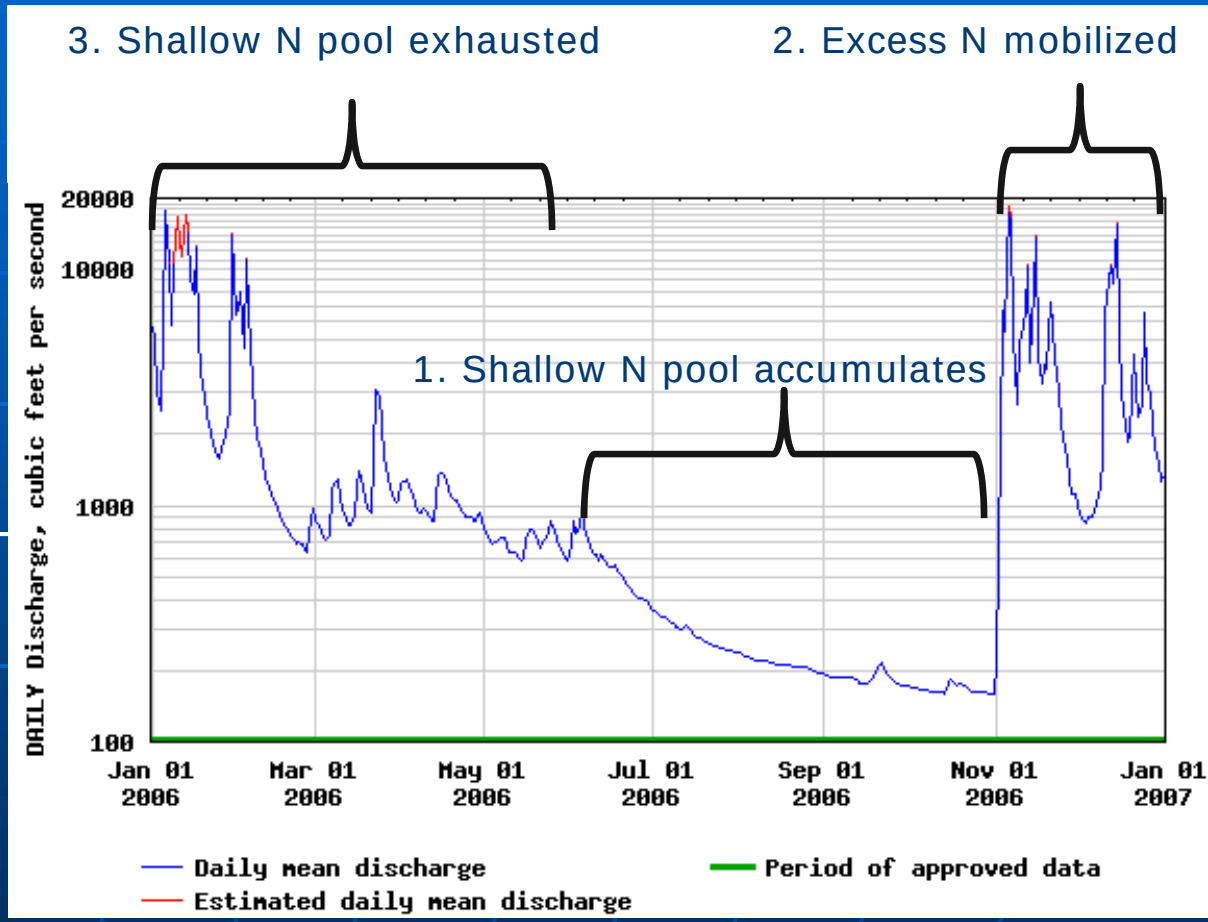
What does this mean for modeled nutrient flux estimates?

Total N flux calculated by

"monthly average" vs.

"discharge-concentration correlation"

- My estimate is ~10% higher for October '07
- My estimate is ~100% higher for November '07



Lignin Phenol Tracer Study

Goal:

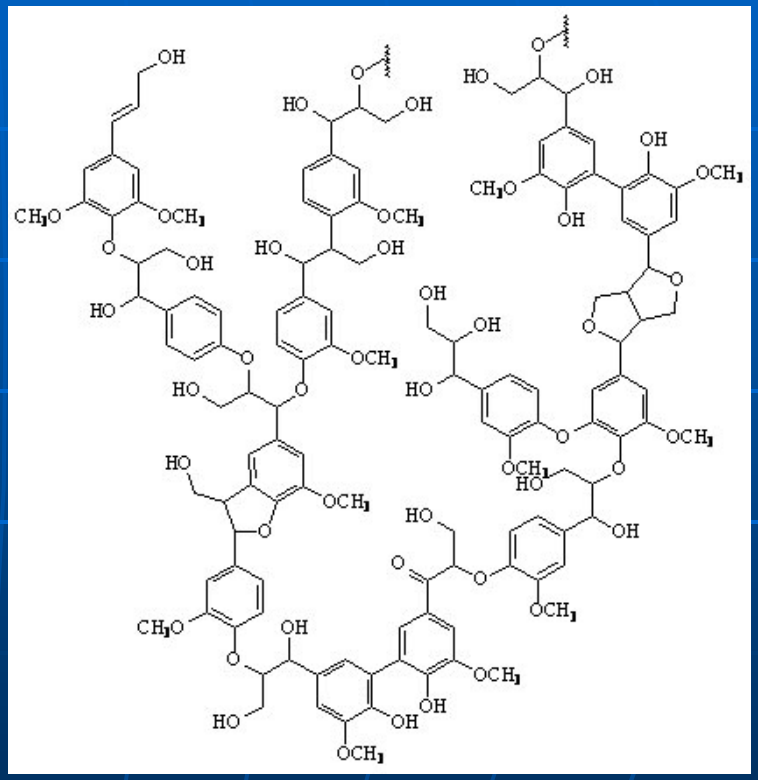
Determine variability in the source of nutrients throughout a storm

and

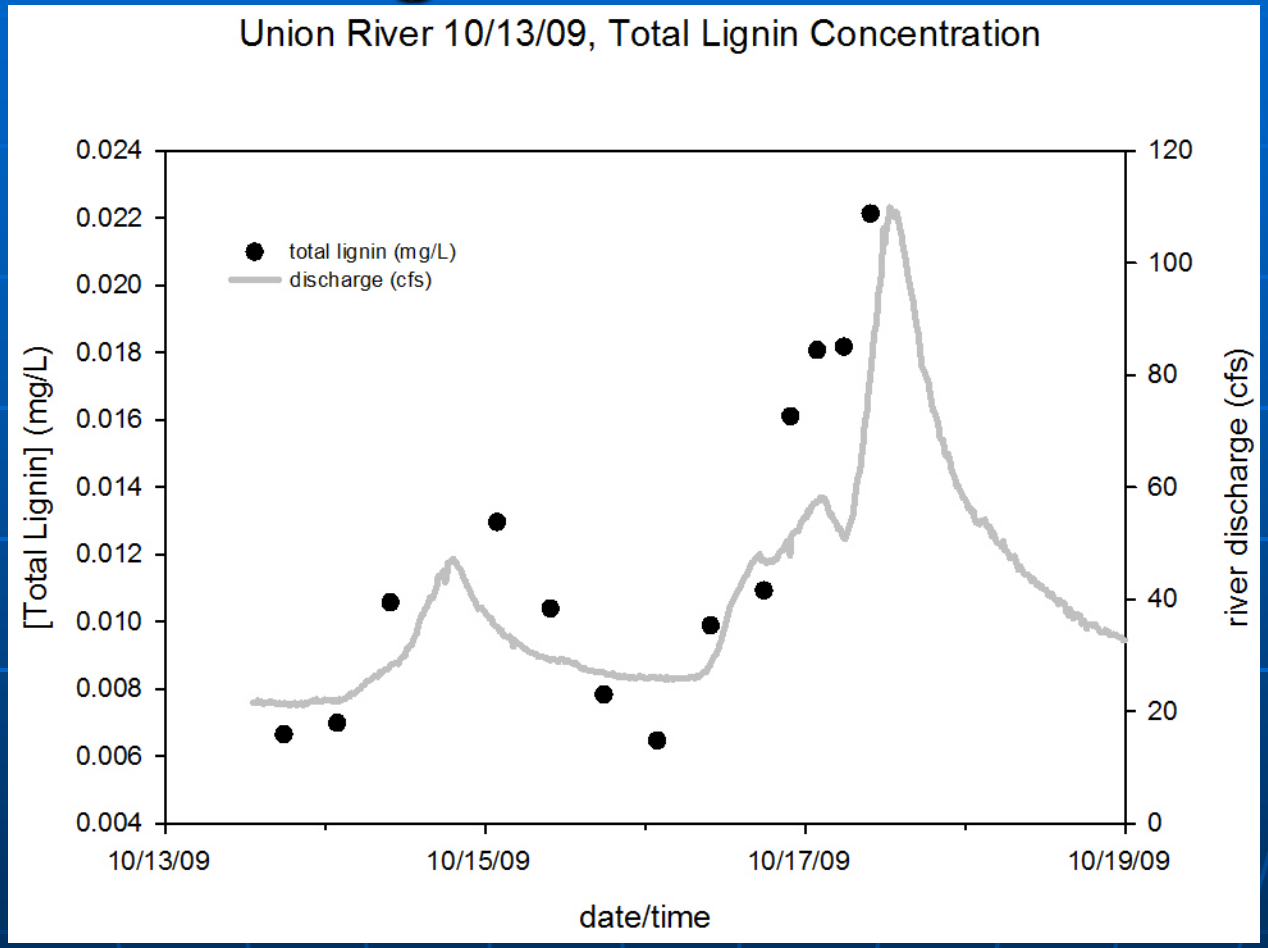
Gain an understanding of the processes behind observed variability, expanding on simple 2 box model

and

Enrich the virtually non-existent dissolved lignin dataset



Lignin results



Correlation between lignin and discharge indicates input of terrestrial OM

Lignin Results

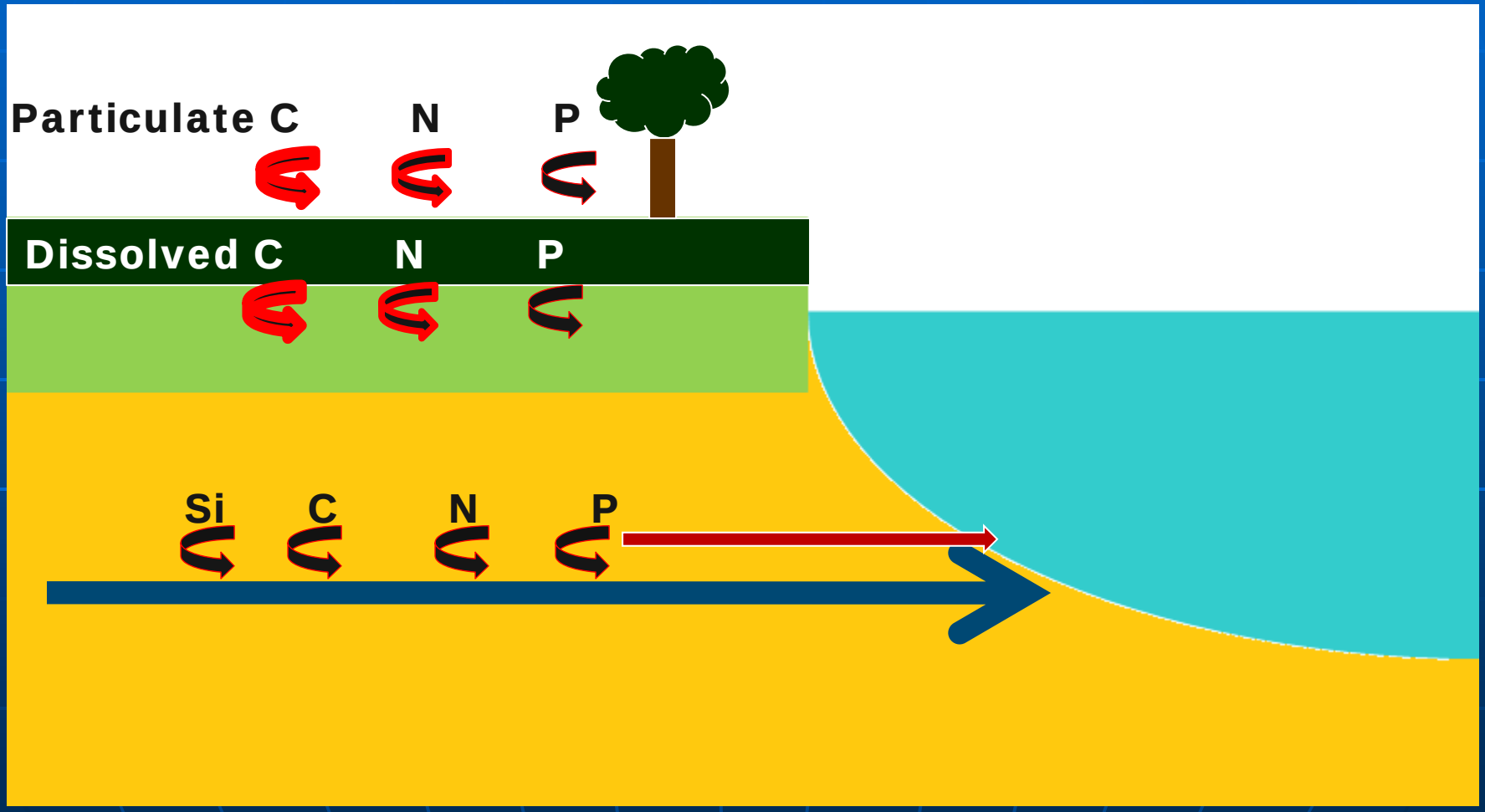
Analysis of ratios of specific phenols revealed:

- During peak runoff, there is a shift toward more degraded material.
- This material is from a more woody/gymnosperm source (conifer tree) than during base flow conditions

This suggests that the “shallow dissolved nutrient pool” is derived from degraded tree material.

Two Pool Model revisited

A nutrient enriched layer of particulates accumulates.
The dissolved pool is derived from the particulate pool



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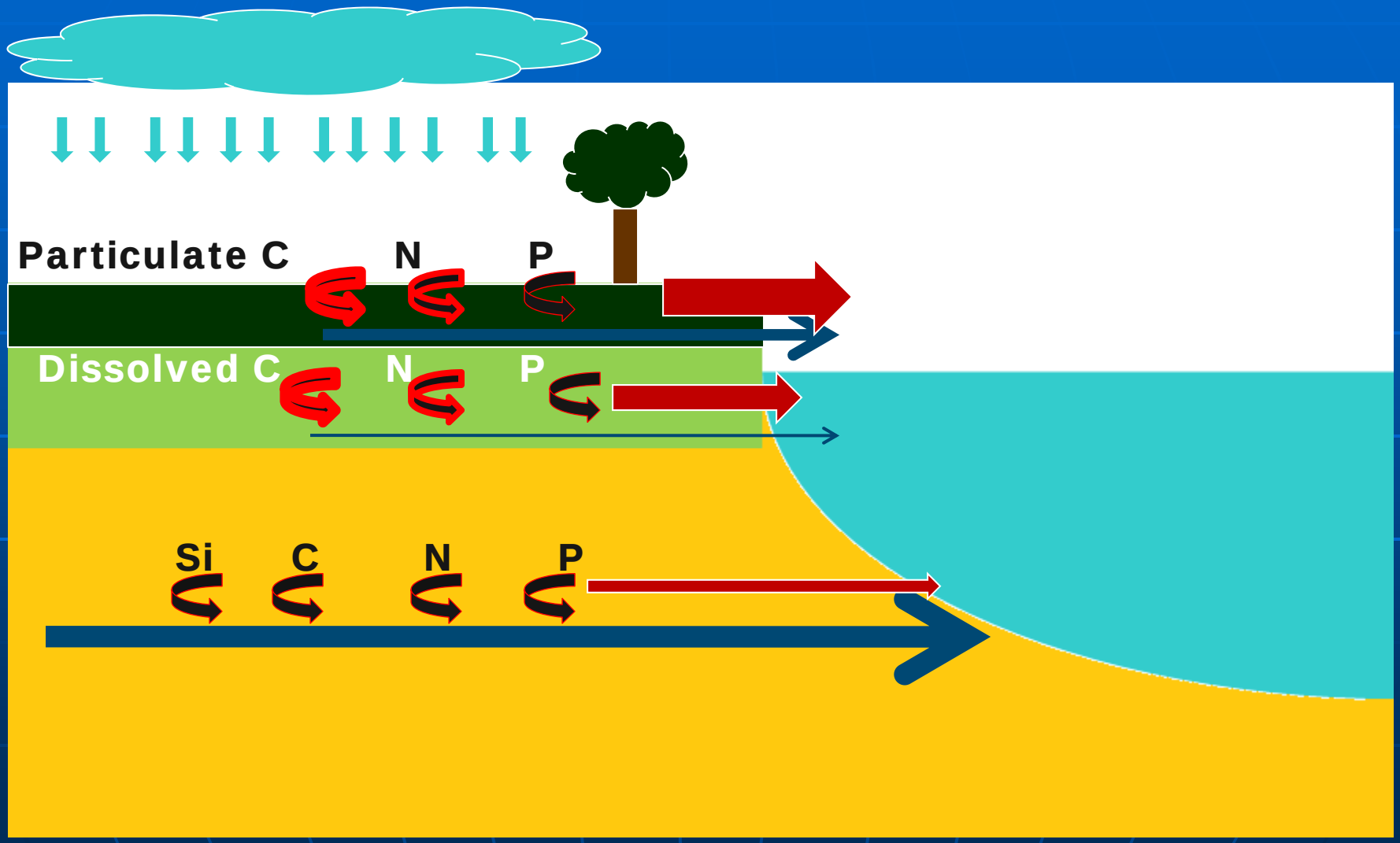
Two Pool Model revisited



Nutrient flux

Water flux

Size of arrow reflects magnitude of flux

Summary

- Gathering monthly samples during “non-average” conditions (i.e. draught/storm) can significantly influence modeled nutrient flux estimations
- Is the magnitude and timing of storm events significant to Hood Canal hypoxia?
- Results from this study can be used to increase accuracy of future modeling efforts as well as help determine the fate of riverine nutrients
- Accurate watershed models can be used to address a diverse set of issues, from water resource management to global biogeochemical cycling

Acknowledgments

-UW School of Oceanography
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