Fe and Mn as drivers of phosphorus availability in Missisquoi Bay

Temporal dynamics and stratification patterns in the water column

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Trace Metals and Phosphorus

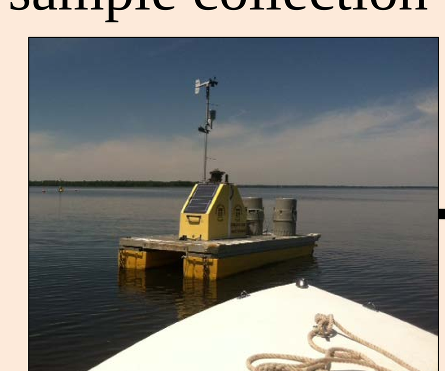
- Soluble reactive phosphorus (SRP) linked to cyanobacterial blooms in Missisquoi Bay[1]
- Iron and manganese (oxy)hydroxides in the water column and in sediment adsorb SRP and control sediment phosphorus releases[2]
- Lake stratification can lead to periods of anoxia and change metals' oxidation states and sorption capacities at or near the sediment-water interfae (SWI)[3]

Objectives

- Describe seasonal patterns in metal redox dynamics by monitoring metal size partitioning using inductively-coupled plasma mass spectrometry (ICP-MS)
  - Colloidal: 0.45µm – 0.02µm
  - Dissolved: < 0.02 µm
- Monitor total dissolved phosphorus (TDP) and soluble reactive phosphoate (<0.45µm)
  - TDP: ICP-MS
  - SRP: molybdenum-blue reactive
- Determine periods of stratification and their effect on sediment metal and phosphorus fluxes

Methods

Peristaltic pump sample collection

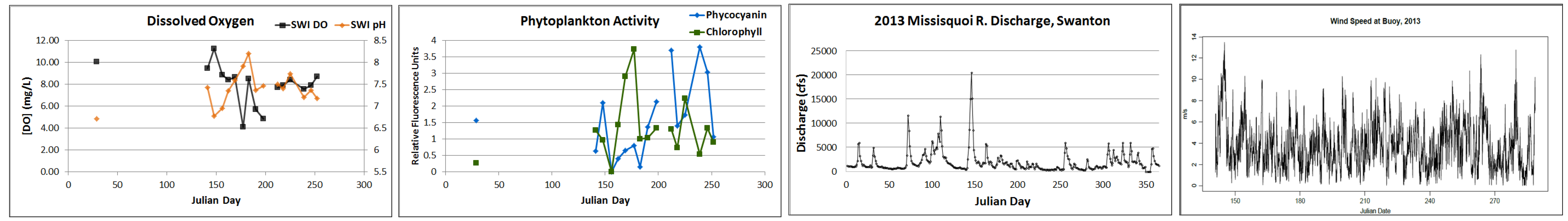


Stacked syringe filters[4]

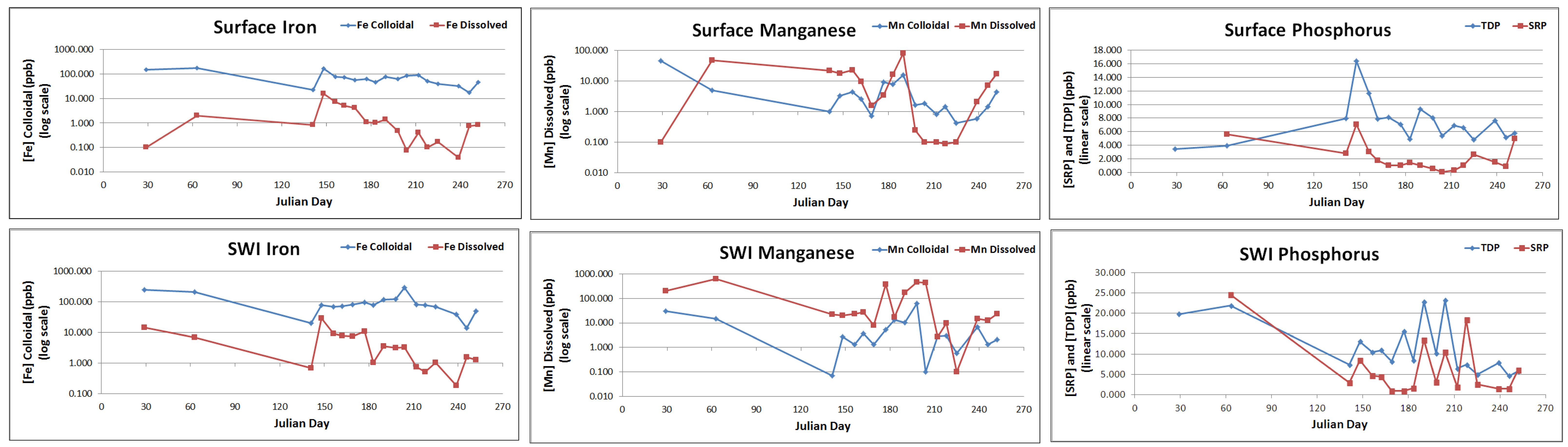
SRP: molybdenum-blue spectrophotometry, 0.45µm filtrate

Metals and TDP (ICP-MS)

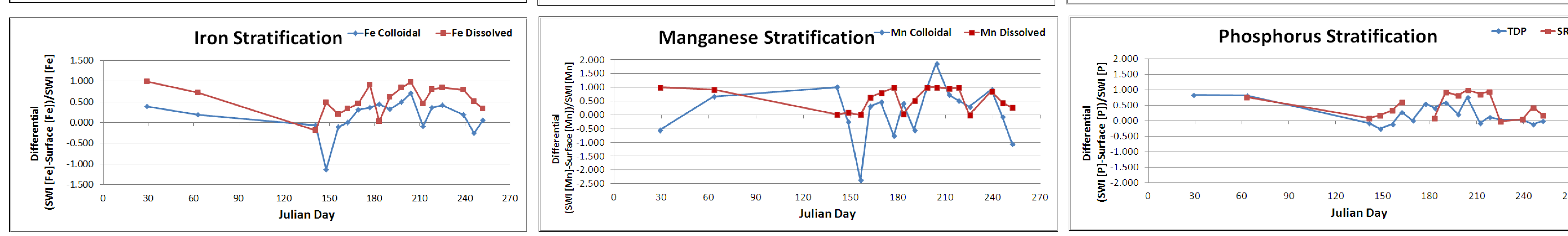
Environmental conditions



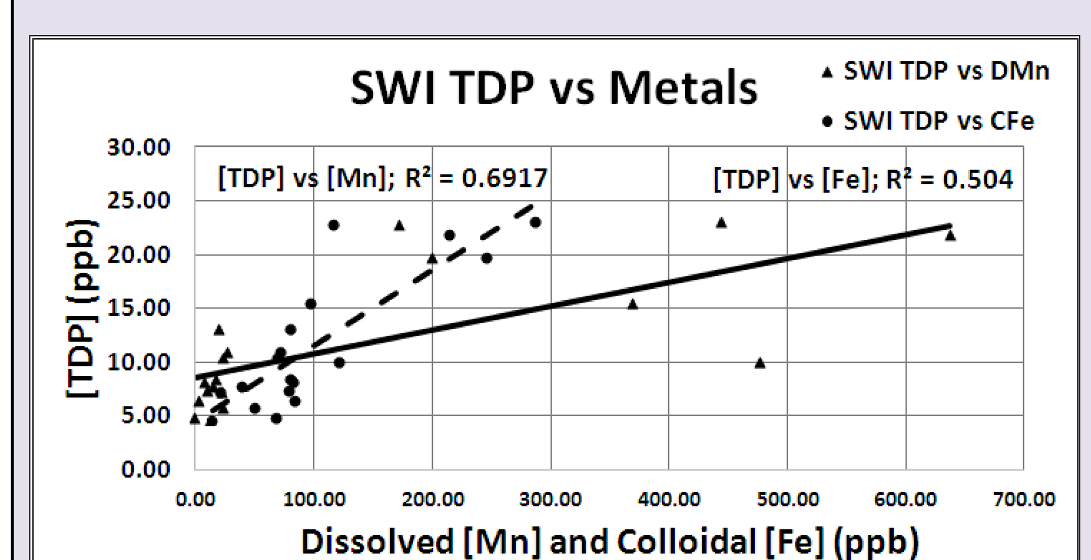
Seasonal trends and metal partitioning

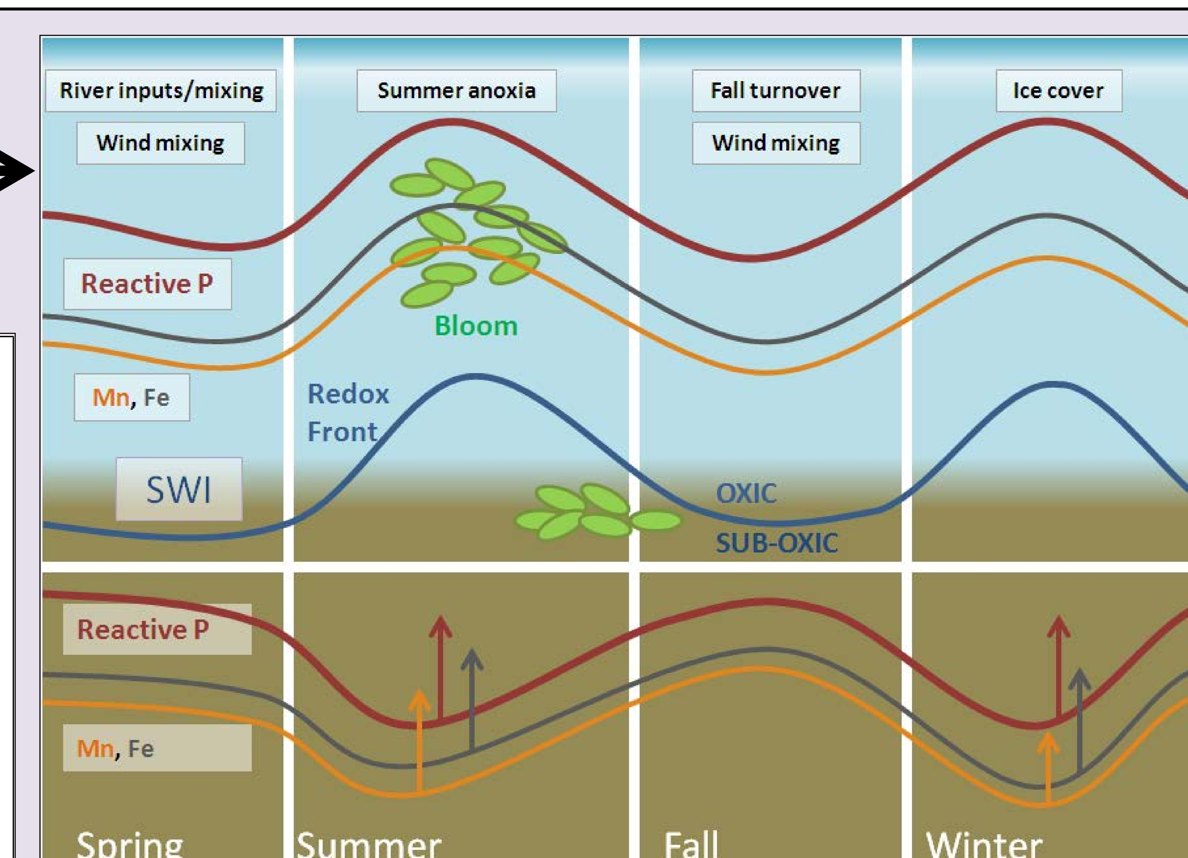


Stratification patterns



Conceptual model of redox-driven nutrient flux from sediment





Conclusions

- Mn is generally dissolved; Fe is generally colloidal
- Fe maintains higher base concentration than Mn, but Mn often peaks much higher than Fe
- [TDP] generally correlated with [Mn] and [Fe]
- Anoxic conditions coincide with stratification both in winter and in late summer, correlating with spikes in water column metals and P
- Mixing from storm events may delay redox-driven sediment nutrient flux

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References

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[2] L. Smith, Watzin, and Druschel. 2011. *Limnology and Oceanography 56*(6): 2251-2264.
[3] Mayer. 1995. Ph.D. dissertation, University of Montana, Bozeman.
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Future Research

- Monitor redox conditions and metals and phosphorus levels at other locations
- High temporal resolution monitoring of SWI redox conditions and fluxes may shed light on mechanisms of P flux driven by reductive dissolution
- Examine direct and indirect relationships between cyanobacteria and metals cycling
- Explore the role of dissolved organic carbon in mediating P sorption capacities