

Investigating optical properties and dissolved organic matter composition in near-shore Lake Superior with emphasis on the spring freshet



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Karl Meingast¹, Evan Kane^{1,2}, Colleen Mouw³

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¹ School of Forest Resources and Environmental Science, Michigan Technological University, Houghton, MI.

² USDA US Forest Service Northern Research Station, Houghton, MI.

³ Department of Geological and Mining Engineering and Sciences, Michigan Technological University, Houghton, MI.



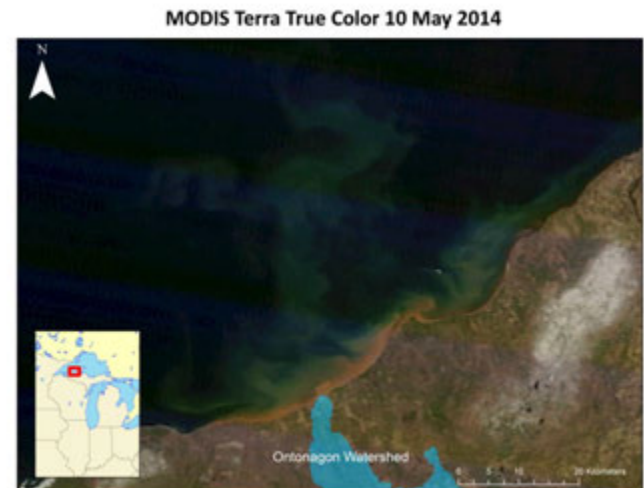
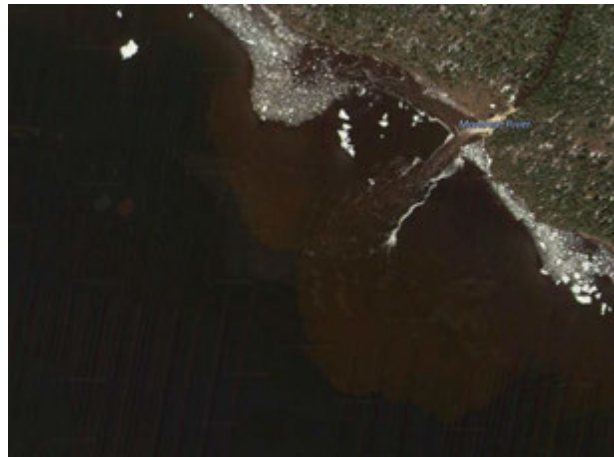
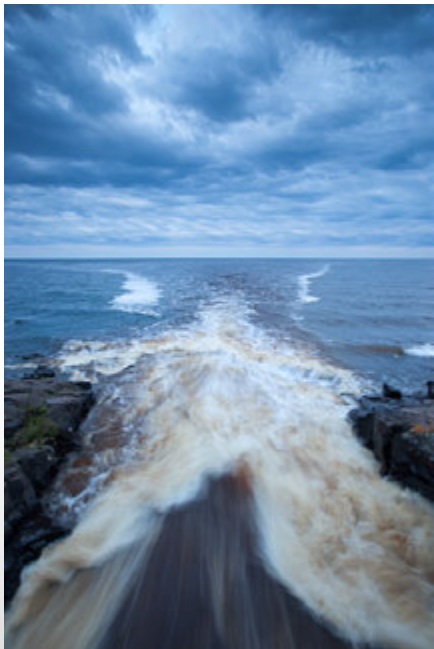
Dissolved organic matter (DOM) in Lake Superior



- Influences productivity
 - Attenuates light
- Contributes to increased respiration in near-shore regions
- Varies in size, shape, and lability
- Runoff flowpaths influence composition of DOM delivered to the lake

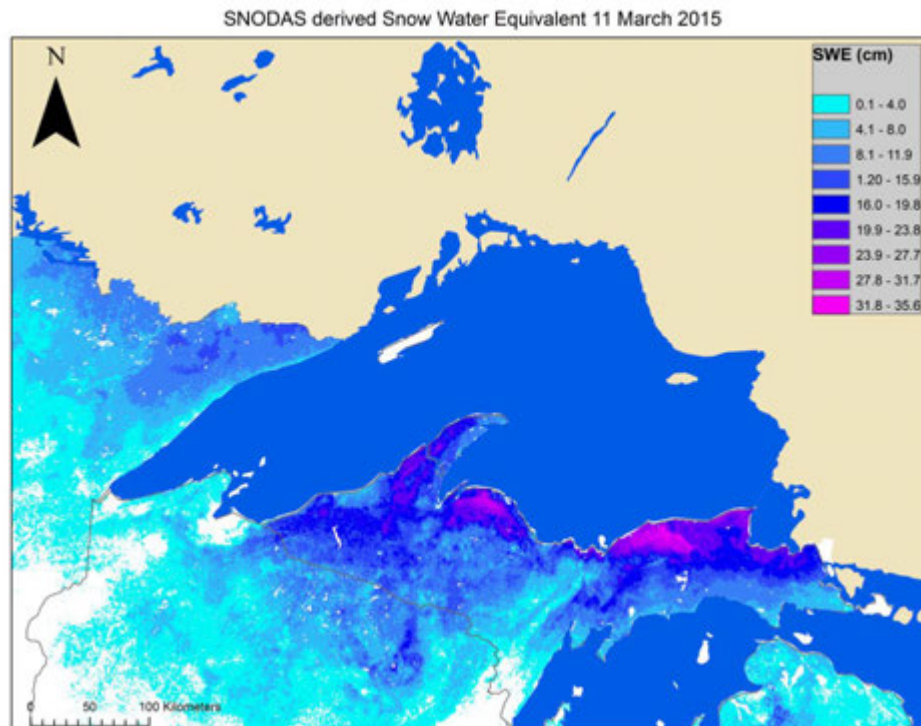
Lake Superior's spring freshet

- Overall annual loadings of DOM to the lake have been approximated (Urban et al. 2005; Bennington et al. 2011).
- **Stottlemeyer and Toczydlowski, 1999**
Observed 2-5 times DOM concentrations and 65 times baseflow loading coincident with peak stream outflow in a small Lake Superior tributary.
- Uncertainty remains as to how the timing and duration of snowmelt contributes to DOM loadings to Lake Superior.
- Large and variable concentrations of suspended sediments (TSS).



Perceived Variability in the Spring Freshet using snow data

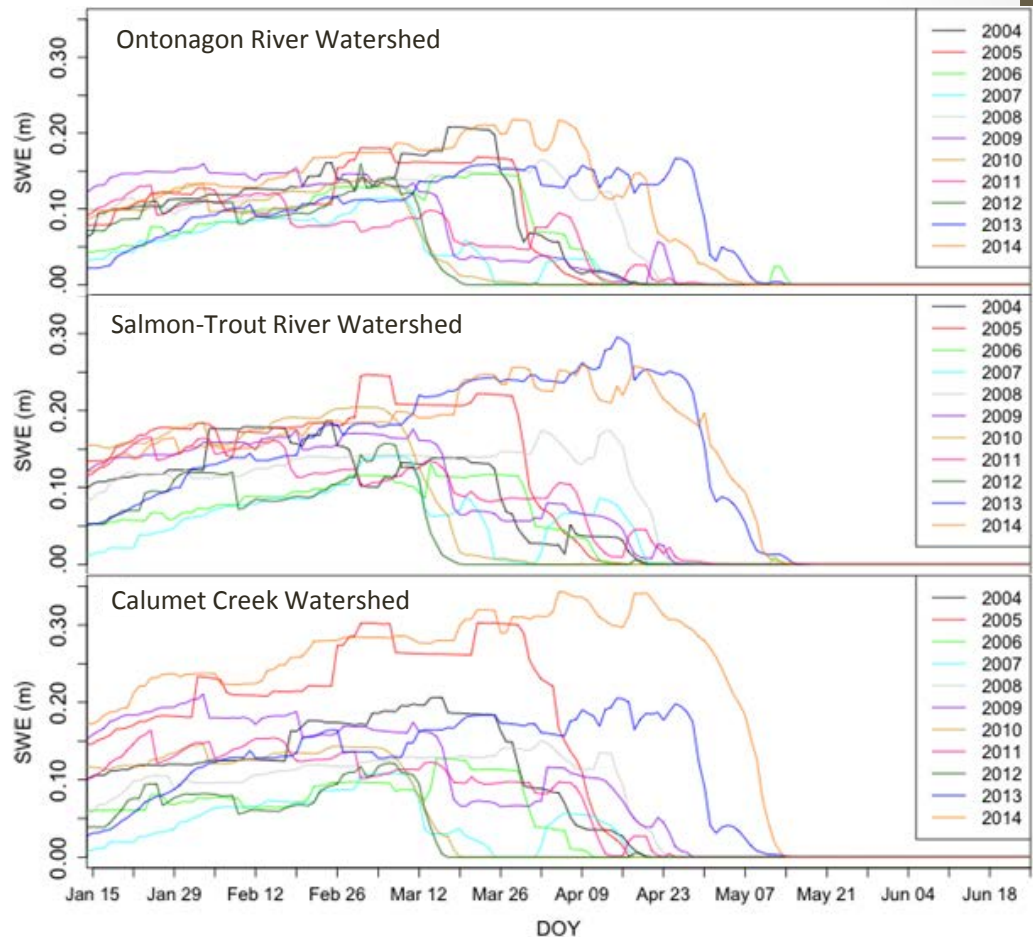
- Snow Data Assimilation System (SNODAS) derived snow water equivalent (SWE) dataset.
 - Daily estimates of SWE at 1 km resolution from 30 Sept 2003 to present (Carroll et al. 2001).
 - Can help extend analysis to previously unmonitored tributaries.



Perceived Variability in the Spring Freshet

Over the past decade, SWE data shows large variability in the timing and duration of the spring freshet across three tributaries on Lake Superior's south shore.

MODIS Terra True Color 10 May 2014



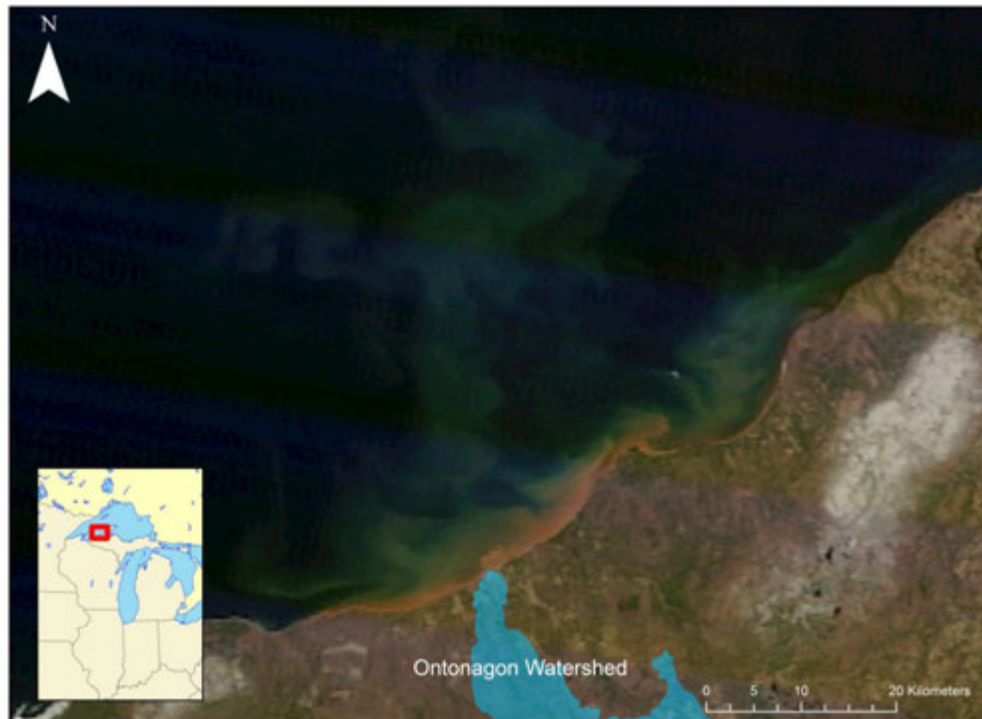
Overarching questions

- Faster snowmelt should mean more flow through shallow flowpaths.
- *Do changes in snowmelt cause variability in DOM flushing to Lake Superior?*
 - Limited data
- Is it possible to leverage remotely sensed imagery to investigate trends in DOM and TSS fluxes to Lake Superior?

Monitor DOC via optical character

- Water color is often used as a proxy to estimate DOM concentrations.
- Suspended solids (TSS) are mixed with DOM making quantification of DOM difficult.
- Understanding optical character of river discharge is especially important for estimating DOM exports in near shore regions.

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Questions regarding the DOM - remote sensing link

- *Can changes in DOM composition from riverine discharge be perceived by changes in remote sensing reflectance?*
 - All “colored water” does not have the same carbon content to color relationship
- *Do relationships between reflectance and DOM/TSS vary across rivers and flow conditions?*
 - *Landcover influence*
 - *Flowpath differences*

Investigating the link between DOM and Remote Sensing Reflectance

Methods

- Relate optical character of river plumes to DOM and TSS concentrations.
 - Measure optical character of multiple river plumes in-situ
 - Measure DOM and TSS in lab
 - Relate in –situ reflectance and DOM quality and quantity across tributaries and flow conditions
 - USGS gauges: Ontonagon, Silver (Baraga county), Coles Creek, Salmon –Trout (Marquette County), Gratiot, Falls.

Further Considerations

- Improved water quality monitoring of near-shore regions in Lake Superior using these findings.
- Other considerations:
 - Land Influence
 - Bottom Influence
 - Ice Cover
 - Cloud cover



References

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Questions and Comments

