Environment Canada Environnement Canada

Canada

Monitoring algal blooms using the MERIS Maximum Chlorophyll Index

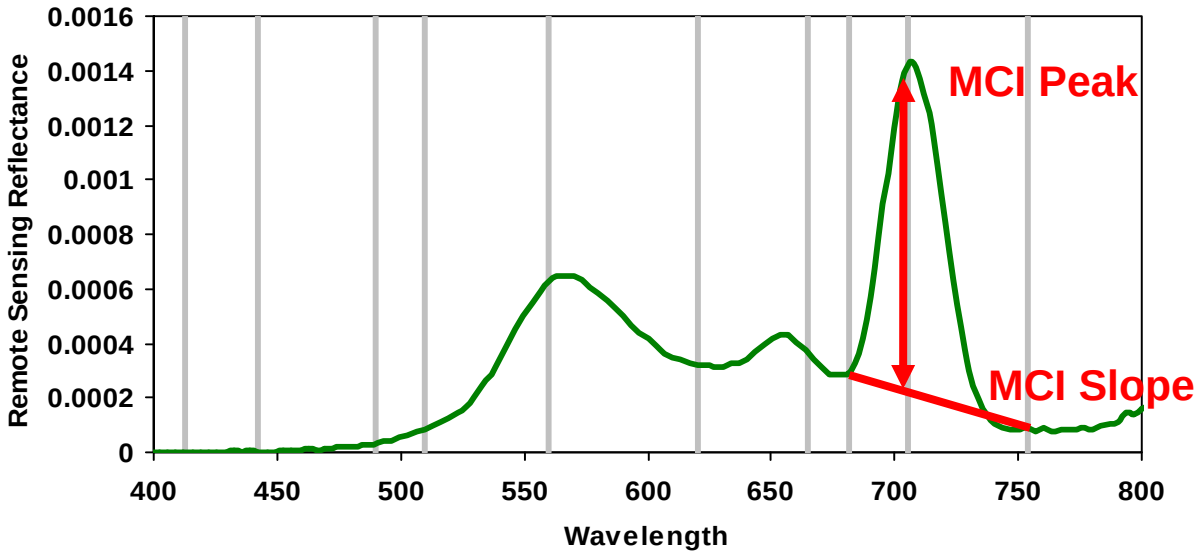
Caren Binding

&

Tracie Greenberg, Bob Bukata, Sue Watson, Shannah Rastin, Jess Gould

Workshop for Remote Sensing of Coastal and Inland Waters
University of Wisconsin-Madison, June 20-22 2012

The MERIS Maximum Chlorophyll Index



$$\text{MERIS MCI} = L_{709} - L_{681} - \left[\frac{(709-681)}{(753-681)}(L_{753} - L_{681})\right]$$

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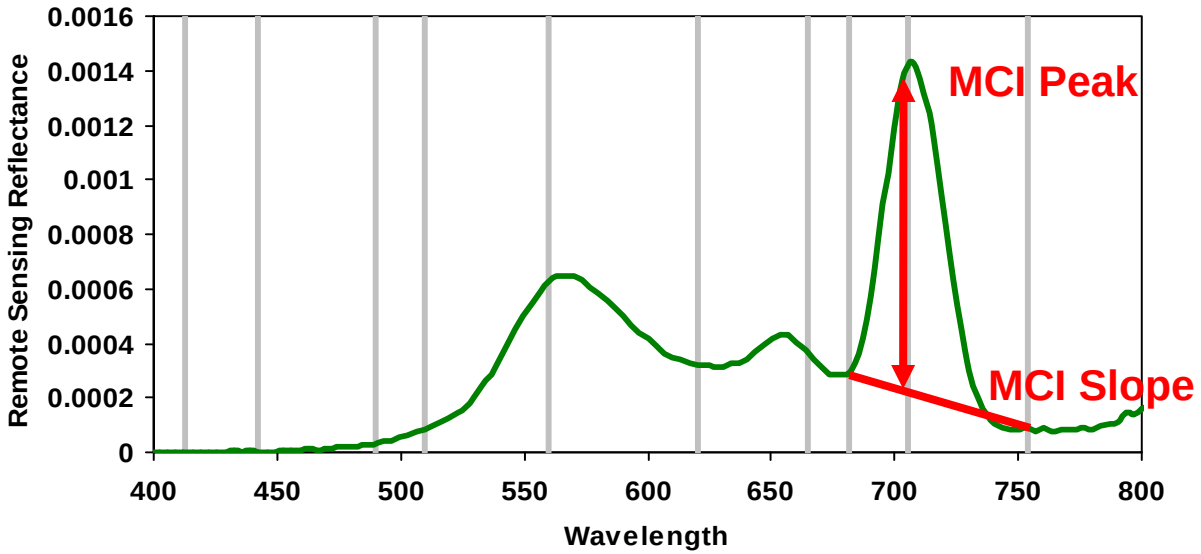

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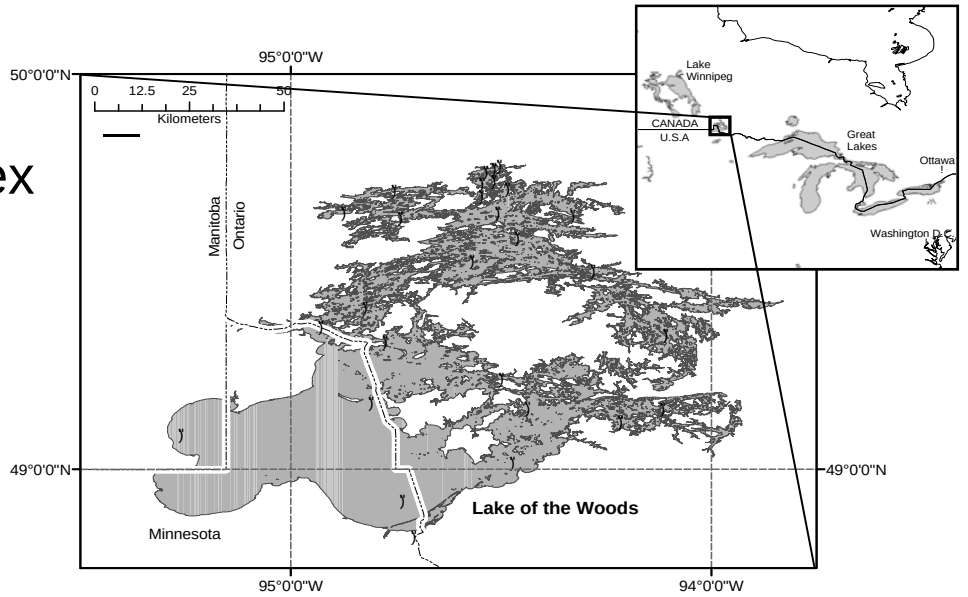
Lake of the Woods

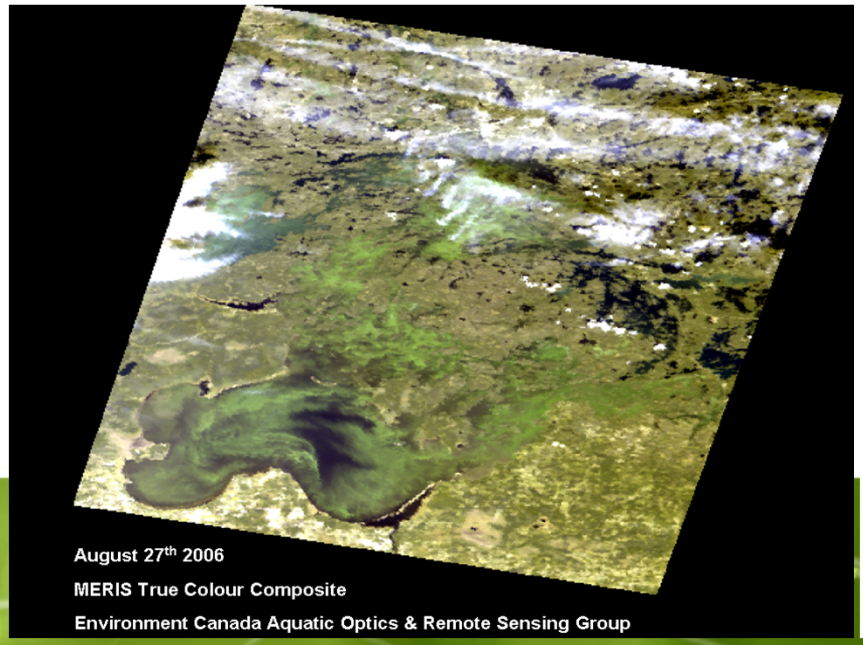
Optically & hydrologically complex

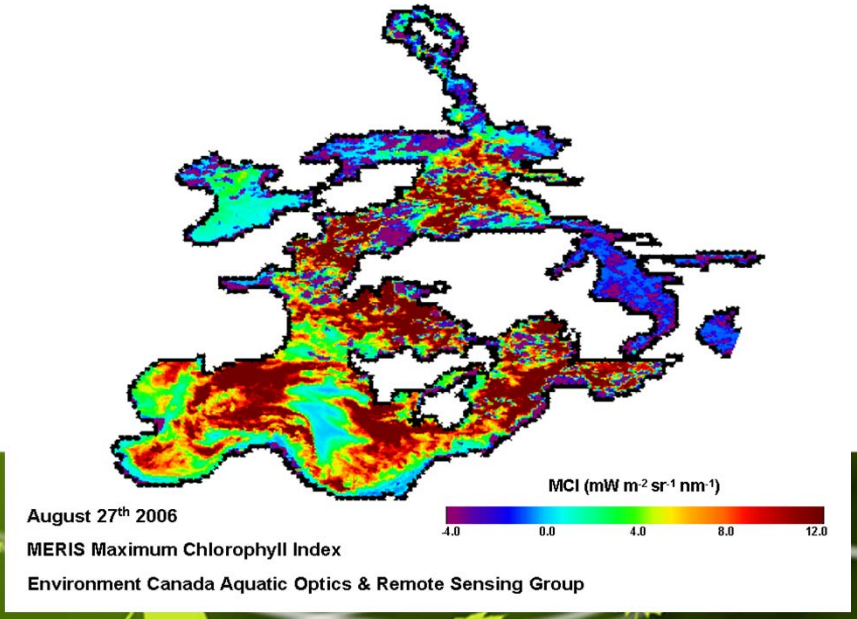
Chlorophyll up to 300 $\mu g\ L^{-1}$

Very high DOC (a_{CDOM} 2-3 m^{-1})

MERIS/MODIS Chl retrievals fail







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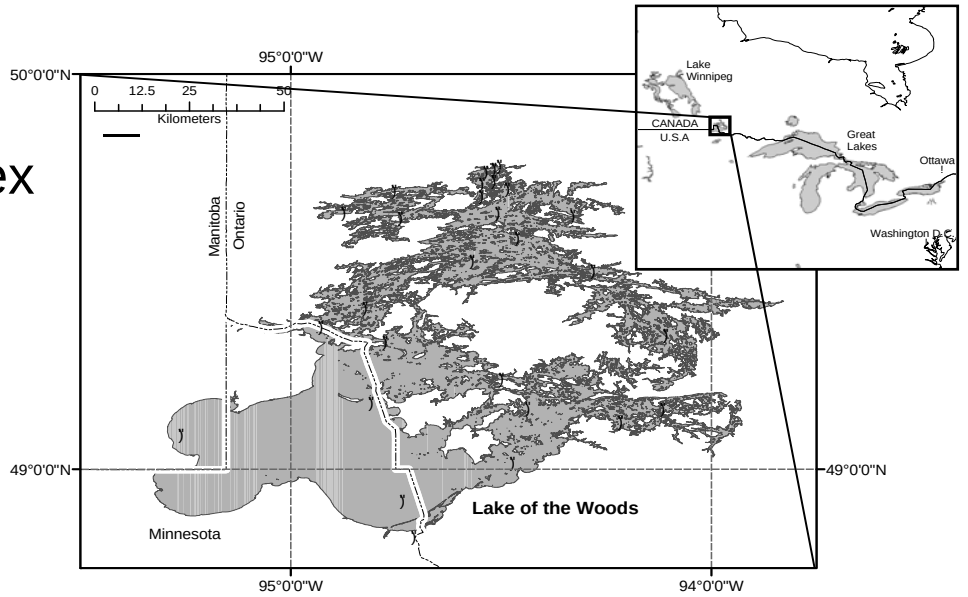
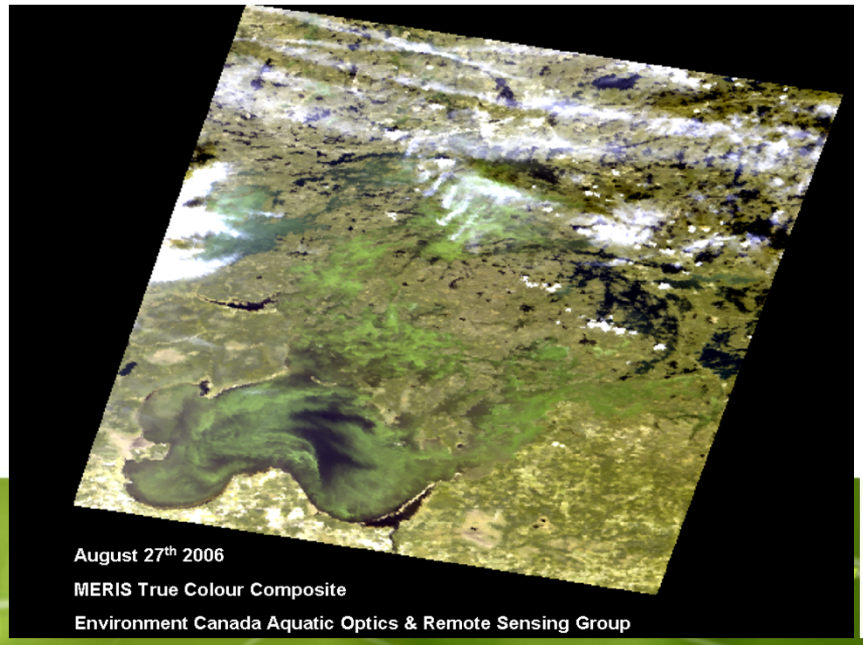
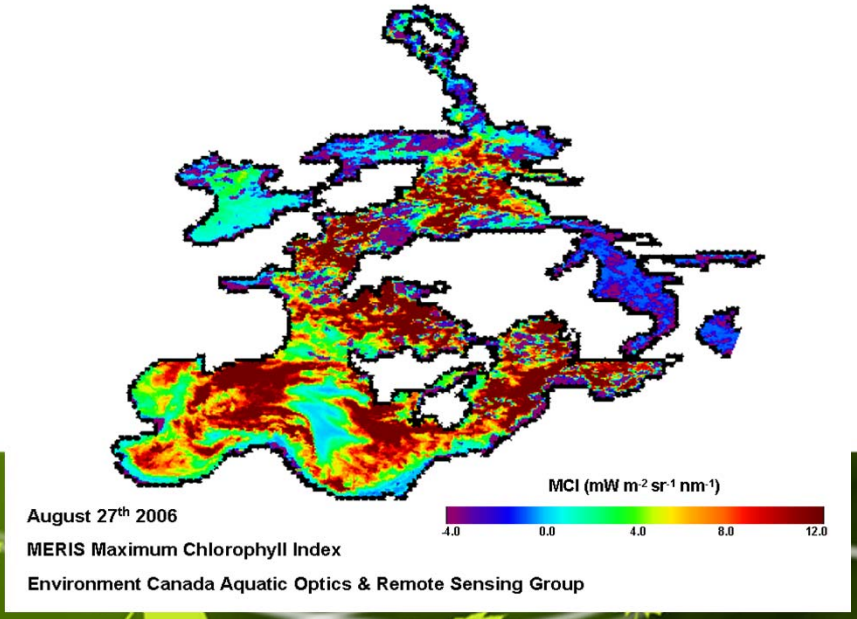






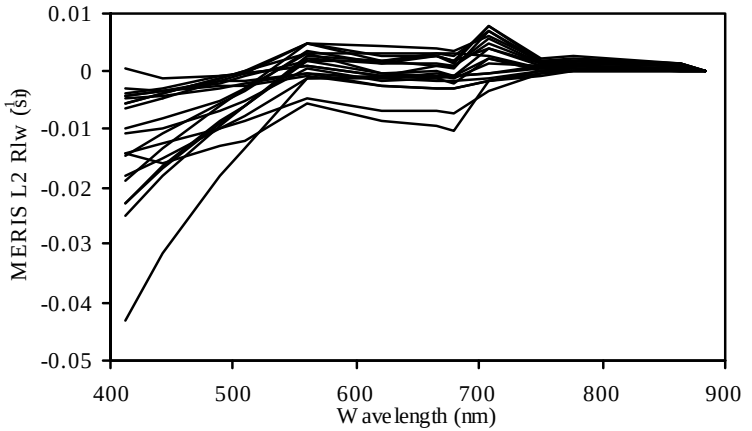
MERIS Rw during intense blooms

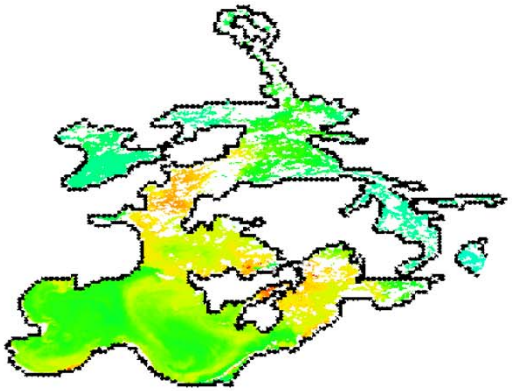
All pixels flagged as turbid

→ Bright Pixel Atmospheric Correction

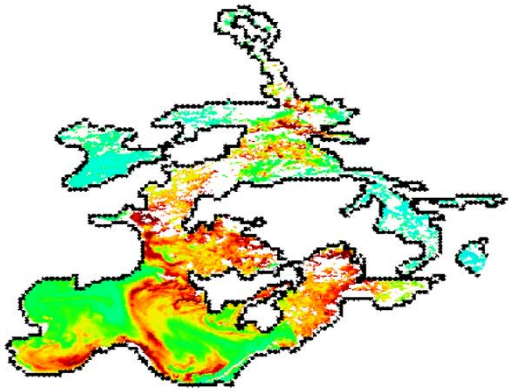
Large over-correction & negative L2 Rw

Non-zero NIR L1 R due to algae rather than mineral, with peak at 708 nm





680 nm



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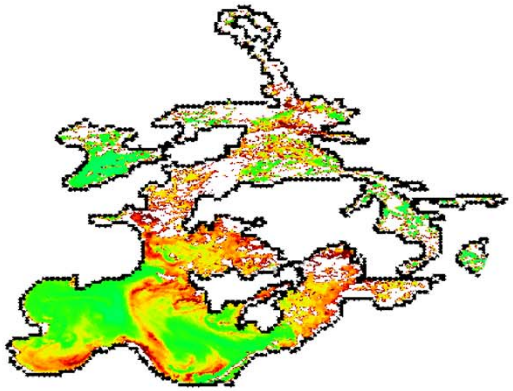

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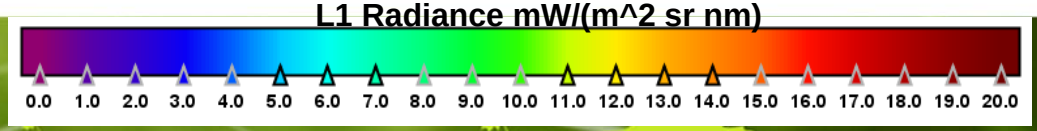

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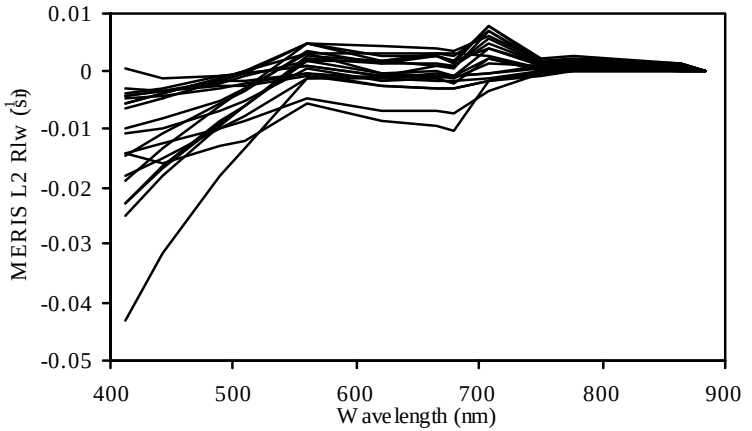

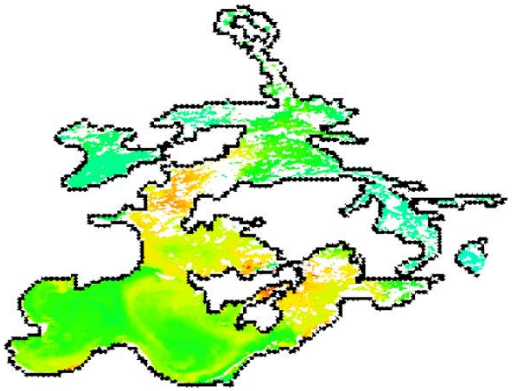

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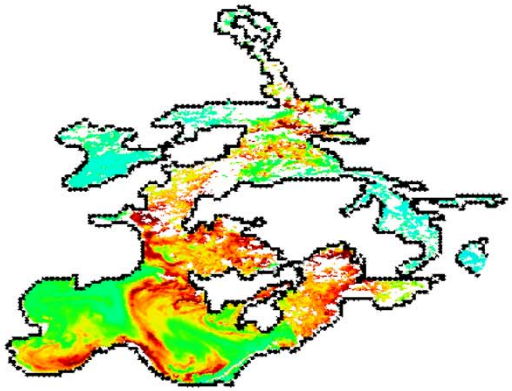

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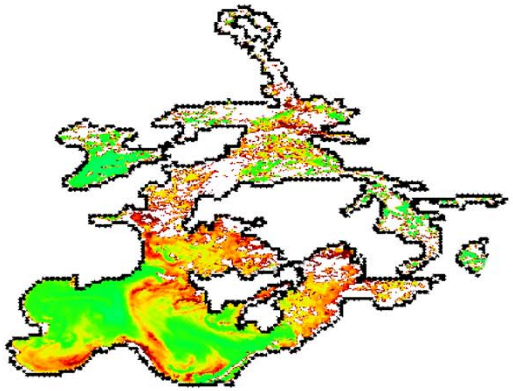

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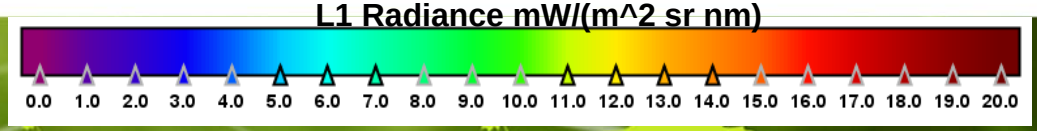
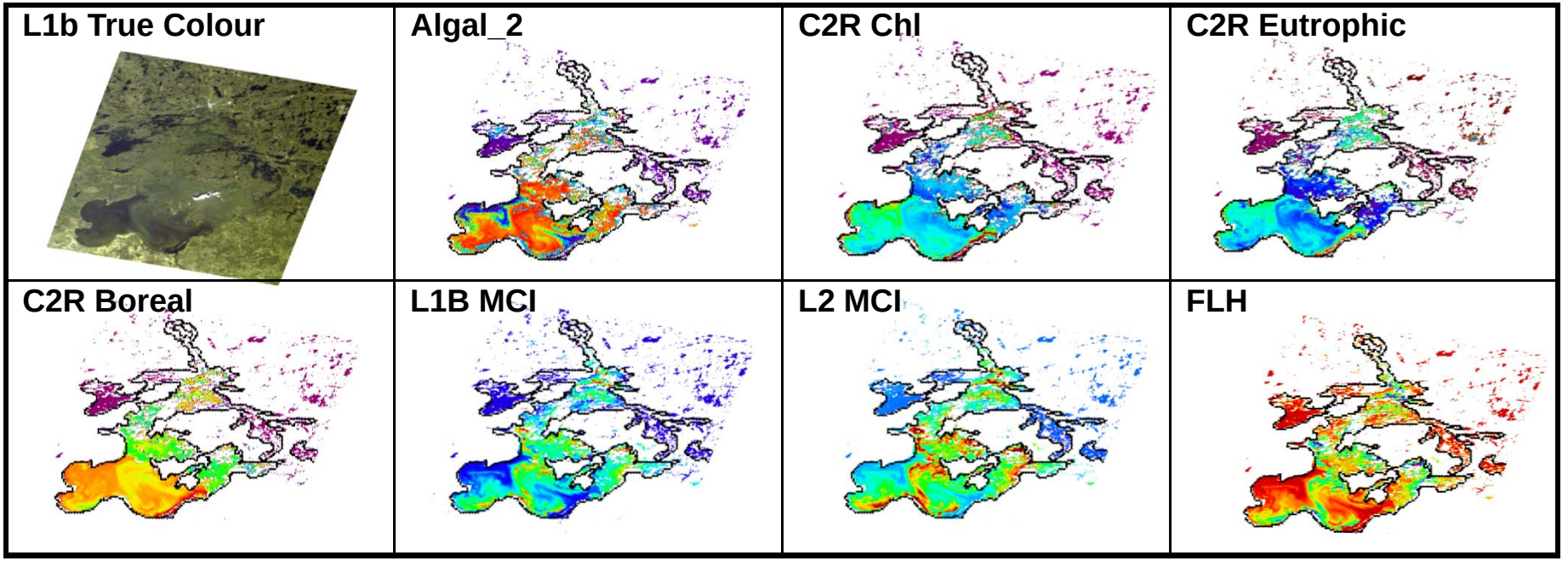


Assessing MERIS Algal Products



	Relationship with Chl_i	R^2	RMSE (%)
L2 Algal_2	$Chl_i = 0.375Chl_M + 7.363$	0.298	100.17
C2R Chl_conc	$Chl_i = 0.664Chl_M + 7.133$	0.159	80.18
C2R w. ICOL Chl_con	$Chl_i = 1.892Chl_M - 4.787$	0.255	77.70
C2R Eutrophic Lake	$Chl_i = -0.129Chl_M + 17.678$	0.188	332.49
C2R Boreal Lake	$Chl_i = 0.444Chl_M + 7.566$	0.207	85.15
L1b MCI	$Chl_i = 6.166MCI_1 + 6.347$	0.739	39.24
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L2 MCI	$Chl_i = 1457MCI_2 + 2.895$	0.720	40.59
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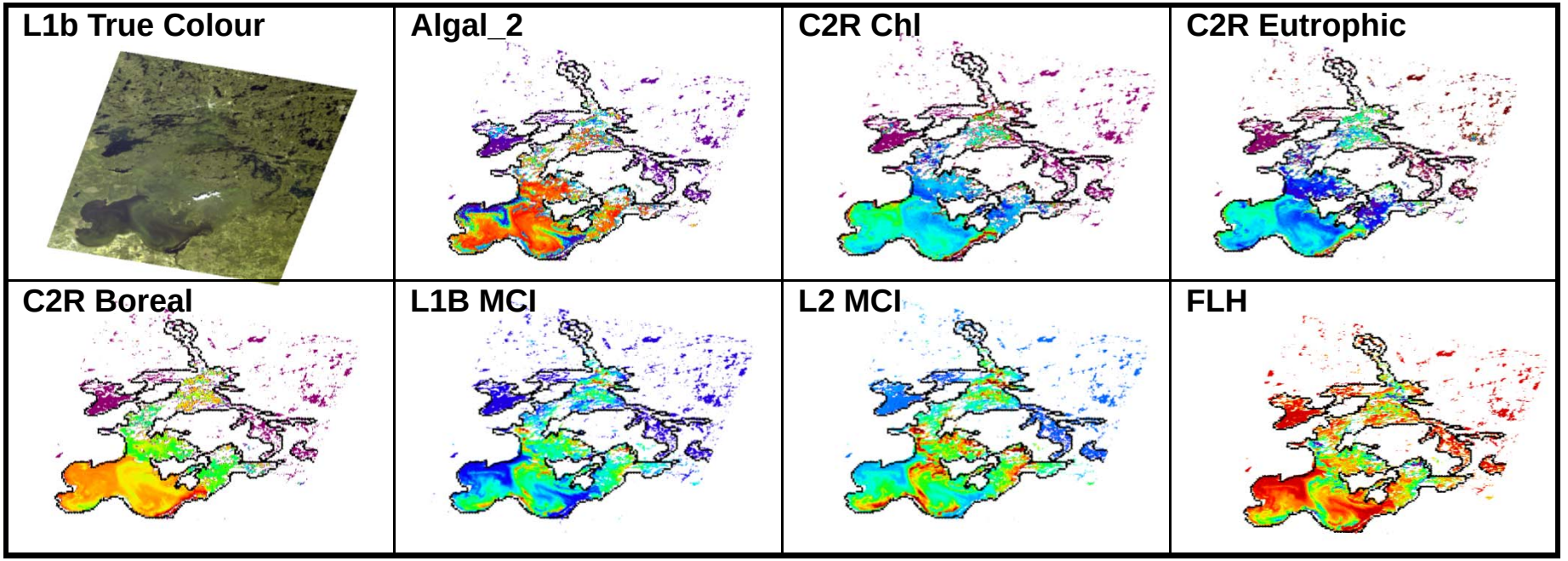

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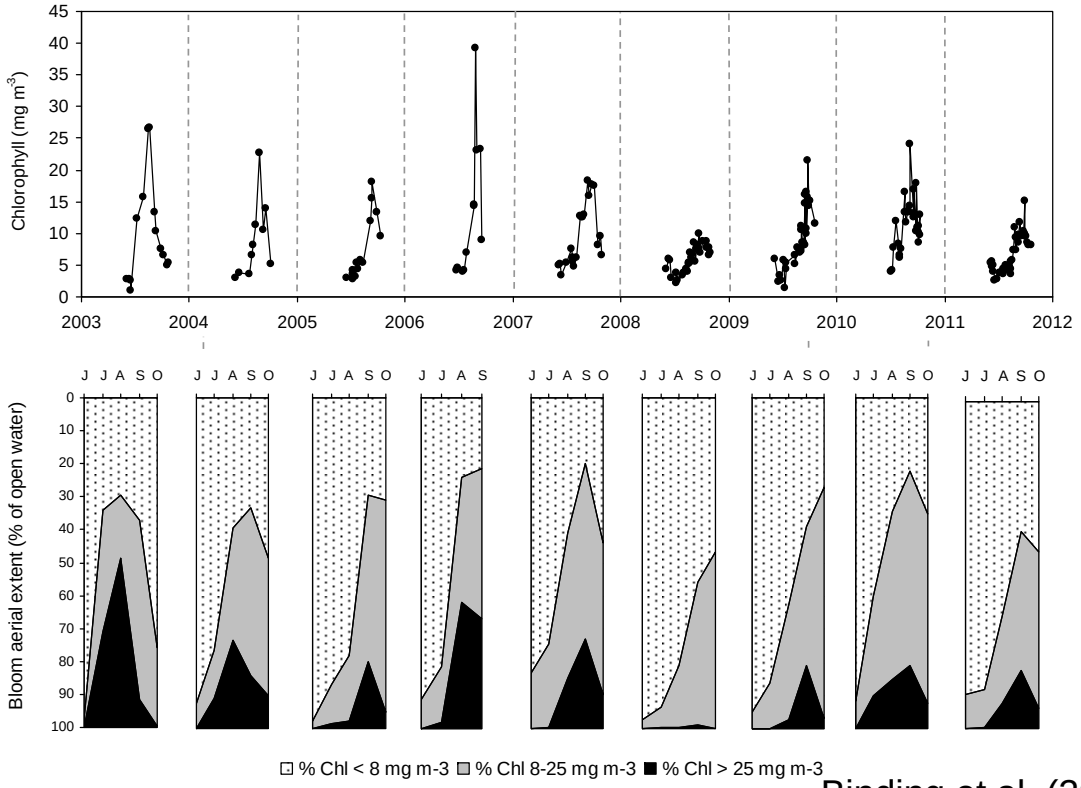
Monitoring lake trophic status, and relating timing, intensity and extent of blooms to climate variables and loadings



Binding et al. (2011) J. Plankton Res.

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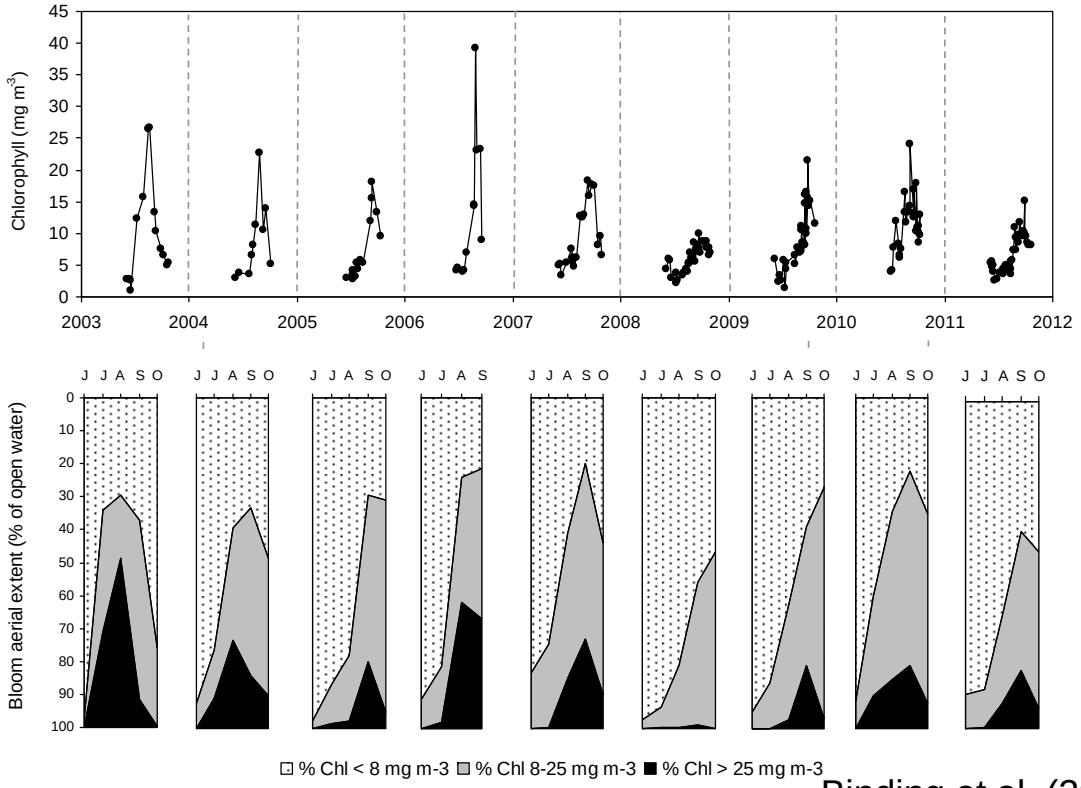

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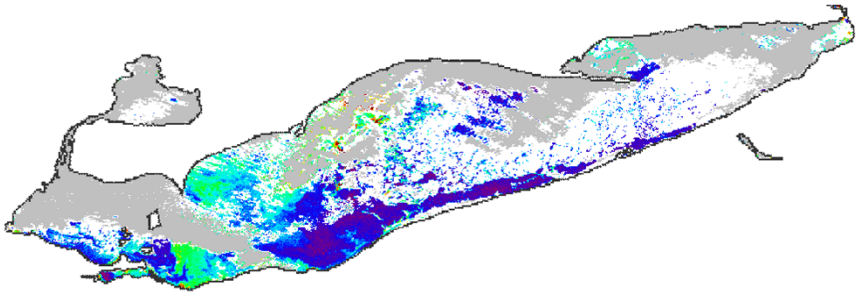
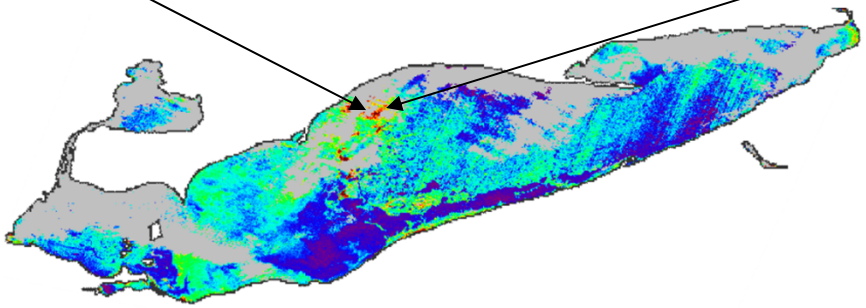
Winter Diatom Blooms on Lake Erie





- Winter blooms of Diatom *Aulacoseira* on Lake Erie with chlorophyll concentrations up to 100 μg L^{-1}
- L1 MCI detects blooms within and surrounding surface ice

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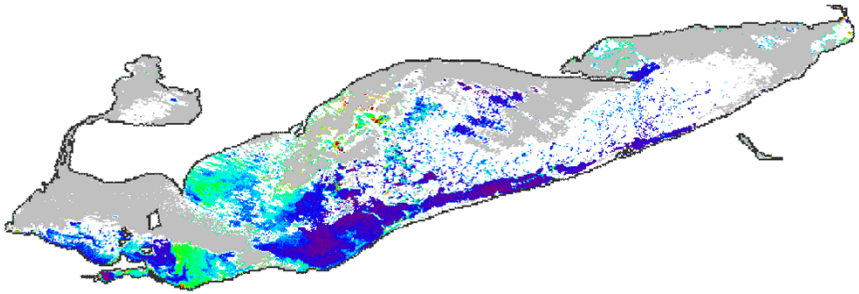

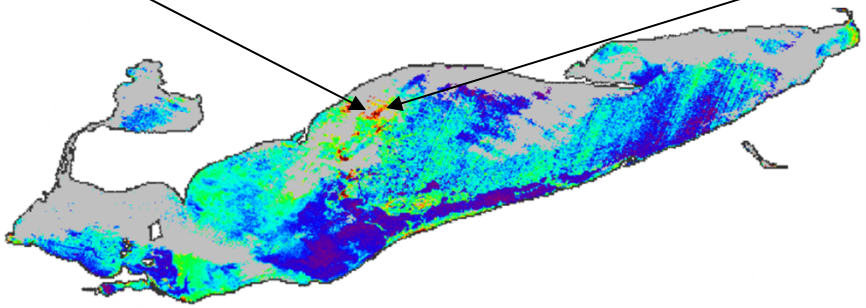

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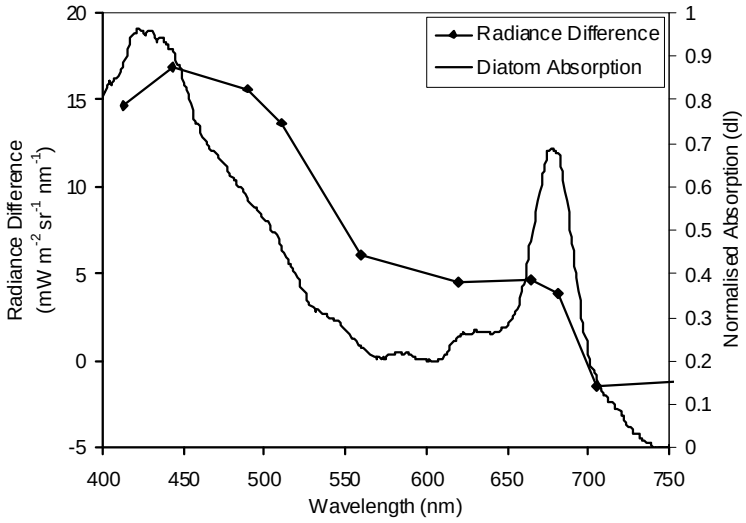
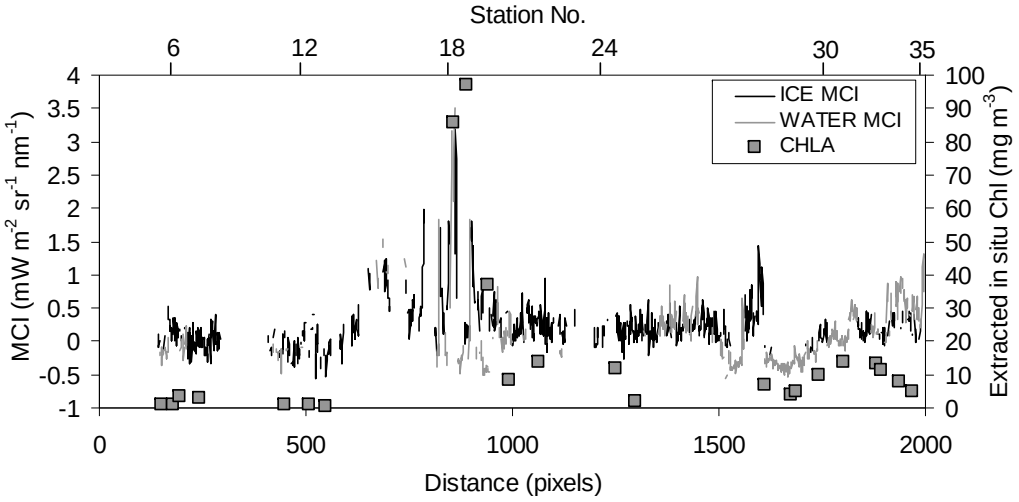


Difference between clean ice and bloom ice signal produces radiance in agreement with absorption spectrum of chlorophyll-a

Location of blooms within ice in agreement with in situ chlorophyll determinations along cruise track



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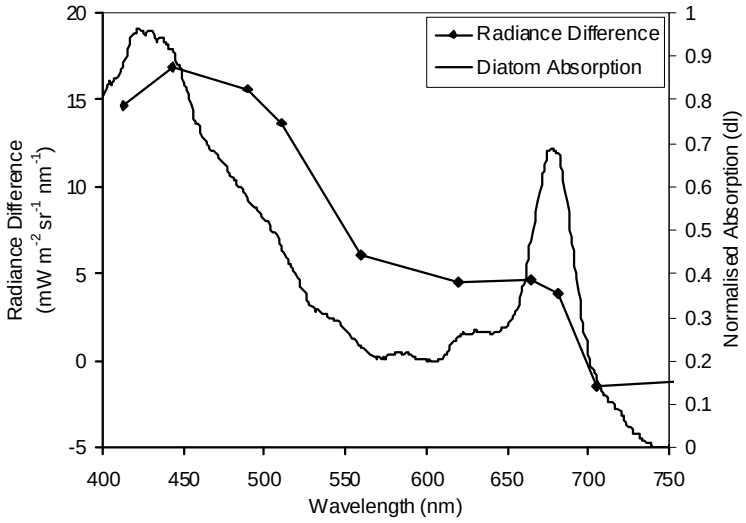

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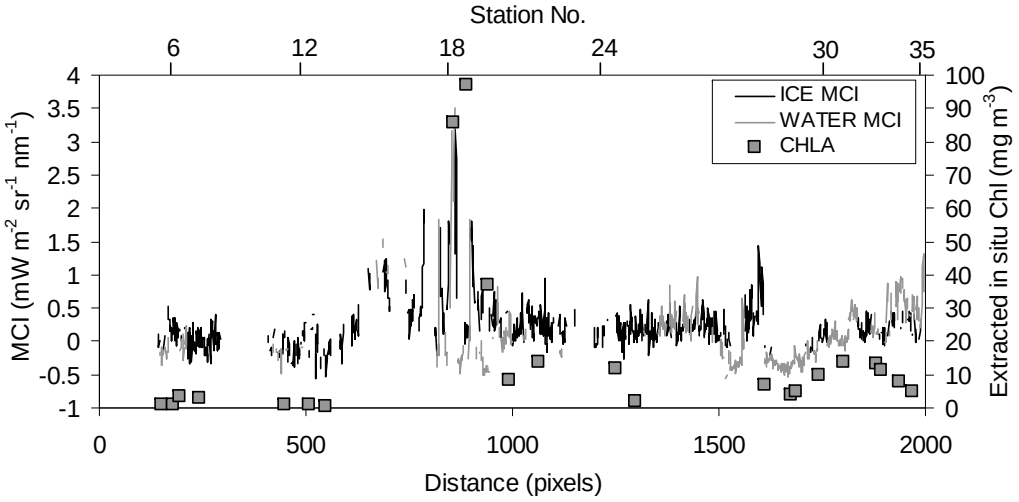
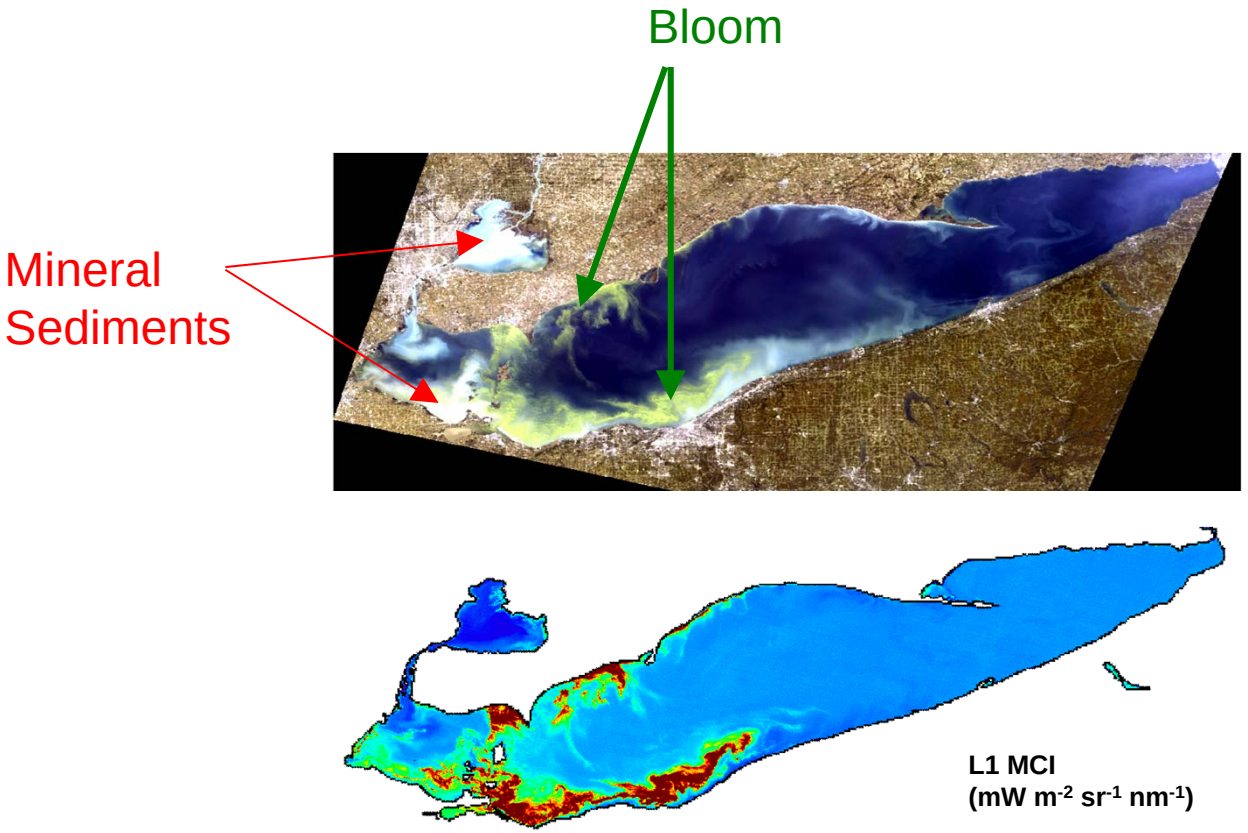
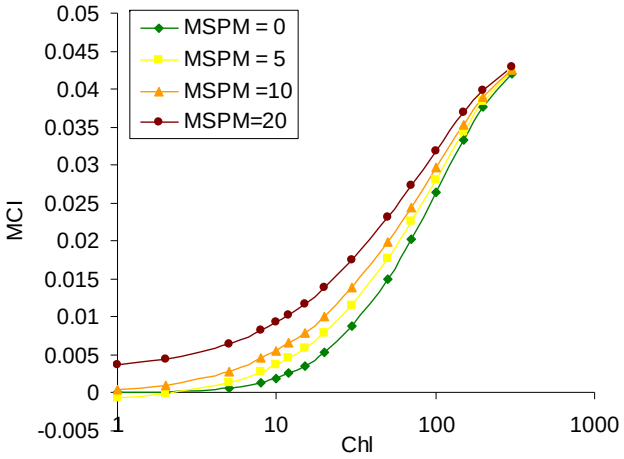


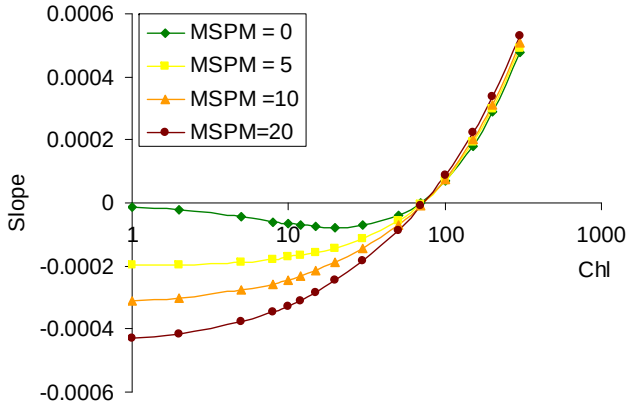
Sensitivity of MCI to Mineral Sediments



First impressions – MCI not overly sensitive to mineral scattering

Modelling Sediment Sensitivity





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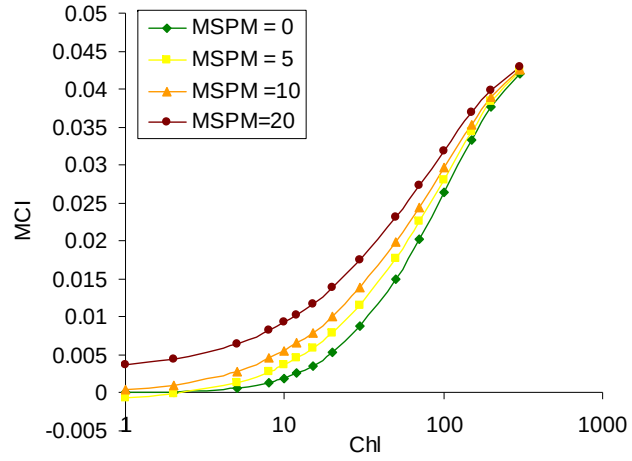
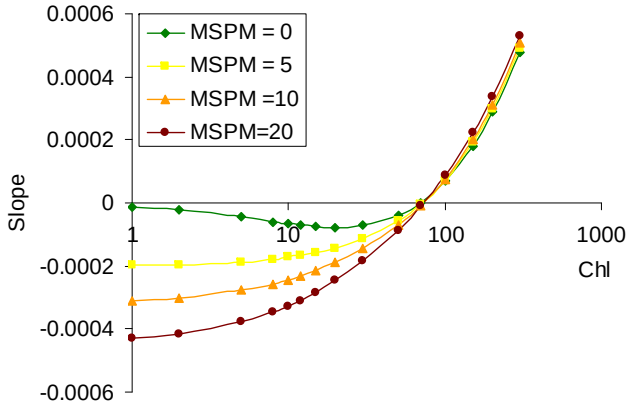
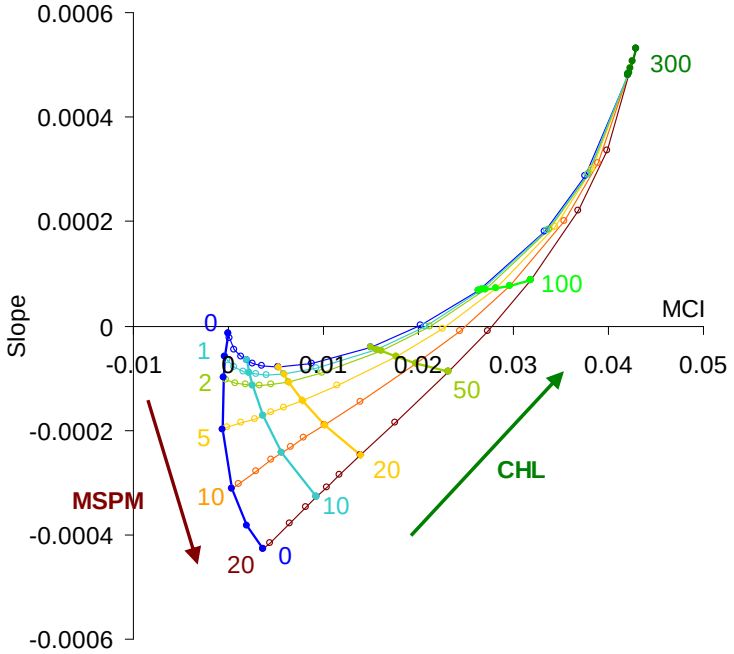




- Hydrolight modelling to determine effects of sediments on MCI properties – peak and slope
- Exploring use of LUT with peak and slope to extract CHL under high MSPM



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