Next Steps
Bayesian network of empirical models

TP Loading

$TP_{BQ}$

Chlorophyll $a_{BQ}$

Daily chlorophyll-$a$ predictions

Loading Uncertainty/Variability

Parametric Uncertainty

Error of the Chlorophyll $a$-TP relationships
Chlorophyll a – TP relationships

**Network of empirical models**

Inability of the TP model to capture the observed peaks

Conventional Regression

Observed daily data
Exceedance frequency of targeted chlorophyll a values

Exceedance Probability

- $> 5 \, \mu g/L$
- $> 7.5 \, \mu g/L$
- $> 10 \, \mu g/L$
Predictive distributions of daily chlorophyll a concentrations

Conventional Regression in 2008

Network of empirical models in 2008
• **The combination of the two structural augmentations is certainly the way forward;**

• **The incorporation of a more realistic hydrodynamic forcing will improve our predictive capacity of the day-to-day variability;**

• **The development of a network of empirical models is a straightforward means to obtain first-order approximations of the system trajectory;**
Synopsis

• The development of a process-based plankton model will offer mechanistic insights into the ecosystem functioning;

• Yet, the improvement of our predictive capacity is NOT guaranteed!

Models are a depiction of our best understanding of ecosystem functioning. They can be as reliable as the knowledge possessed!!
Process-based plankton model
# Process-based plankton model

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a$</td>
<td>Maximum phytoplankton growth rate</td>
<td>day$^{-1}$</td>
</tr>
<tr>
<td>$d$</td>
<td>Zooplankton mortality rate</td>
<td>day$^{-1}$</td>
</tr>
<tr>
<td>$K_P$</td>
<td>Half-saturation constant for $PO_4$ uptake</td>
<td>mg P m$^{-3}$</td>
</tr>
<tr>
<td>$r$</td>
<td>Phytoplankton respiration rate</td>
<td>day$^{-1}$</td>
</tr>
<tr>
<td>$s$</td>
<td>Phytoplankton sinking loss rate</td>
<td>m day$^{-1}$</td>
</tr>
<tr>
<td>$\mu$</td>
<td>Zooplankton grazing half-saturation coefficient</td>
<td>mg P m$^{-3}$</td>
</tr>
<tr>
<td>$\varphi$</td>
<td>Detritus mineralization rate</td>
<td>day$^{-1}$</td>
</tr>
<tr>
<td>$\psi$</td>
<td>Detritus sinking rate</td>
<td>m day$^{-1}$</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>Maximum zooplankton grazing rate</td>
<td>day$^{-1}$</td>
</tr>
<tr>
<td>$K_b$</td>
<td>Background light extinction coefficient</td>
<td>m$^{-1}$</td>
</tr>
<tr>
<td>$K_c$</td>
<td>Light extinction coefficient due to chlorophyll a</td>
<td>L (µg chla m$^{-1}$)</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>Zooplankton assimilation efficiency</td>
<td>-</td>
</tr>
<tr>
<td>$\beta$</td>
<td>Zooplankton excretion fraction to phosphate</td>
<td>-</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>Zooplankton predation excretion fraction to phosphate</td>
<td>-</td>
</tr>
<tr>
<td>$\omega$</td>
<td>Relative zooplankton preference for detritus compared to phytoplankton</td>
<td>-</td>
</tr>
<tr>
<td>$I_s$</td>
<td>Half saturation light intensity</td>
<td>MJ m$^{-2}$ day$^{-1}$</td>
</tr>
</tbody>
</table>
• Chla is a generally poor predictor of toxin concentrations (e.g., microcystin);

• Little relationship exists between water quality at long term monitoring sites and shoreline events

• Samples downstream of WWTP discharge at Trenton, Belleville, Deseronto and Picton ranged up to ~800 μg TP L\(^{-1}\), almost all as particulate P.
One plausible hypothesis is that the episodic nutrient pulses and spills can potentially induce qualitative and quantitative changes in the phytoplankton community. The excessively high nutrient levels in nearshore sites can significantly alter the contemporary growth and species competition patterns, which in turn can be gradually propagated to the offshore sites of the system.
What do we know about the role of the sediments?

Upper segment

- 2.5% (all)
- 97.5% (all)

-modeled mean

Obs

Upper sediment

TP (mg g⁻¹)

What do we know about the role of the sediments?

**Middle segment**
What do we know about the role of the sediments?

**Lower segment**

![Graph showing TP (mg g⁻¹) over time for Lower sediment with 2.5% and 97.5% confidence intervals, modeled mean, and observed data.]