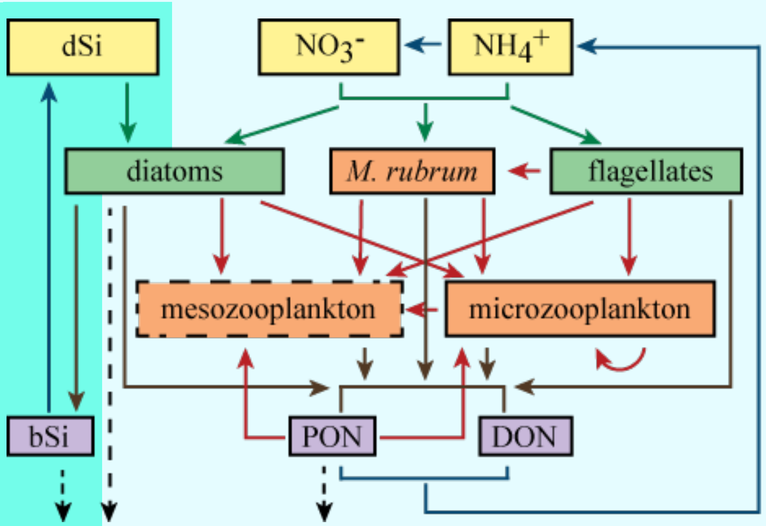
Observations Inform Improvements in Model Silicon Cycling in a Semi-enclosed Coastal Sea

Authors: Elise Olson (presenting), Nina Nemcek, Susan Allen

SMELT/SalishSeaCast



Years analyzed: 2015-2017

In this presentation we describe improvements to silicon cycling in a coupled physical-biological model (SMELT/SalishSeaCast) of a semi-enclosed coastal sea on Canada's west coast (the Salish Sea).

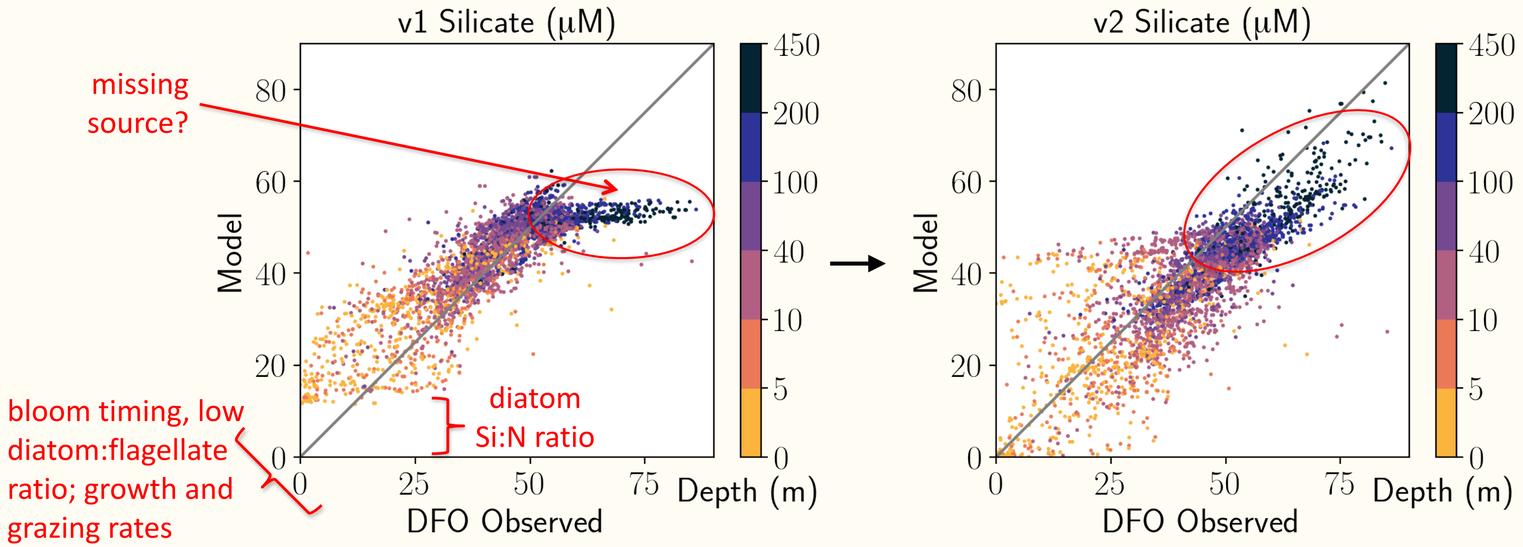
Nina Nemcek provided the pigment-based phytoplankton composition/abundance data we used to evaluate model functional groups, and the work was supervised by Prof. Susan Allen.

The model silicon cycle involves only three components– diatoms, dissolved silica, and a detrital silicon pool. Sources are from rivers and open boundaries, and sinks occur at open boundaries and through a partially reflective bottom boundary condition.

Observations Inform Improvements in Model Silicon Cycling in a Semi-enclosed Coastal Sea

Authors: Elise Olson (presenting), Nina Nemcek, Susan Allen

Despite the relative simplicity of the silicon cycle, agreement between modelled and observed silicate in this setting has been lower than for nitrate, and deep silicate concentrations were less responsive to parameter tuning.
The figures below show modelled versus observed silicate comparisons for successive model versions. Between the first and second versions, surface values were successfully adjusted through tuning of biological rate parameters and stoichiometric ratios, although error was increased due to less accurate spring bloom timing. However, deep silicate concentrations were only partially corrected through reasonable adjustments to sinking and remineralization rates and with the addition of a source in the domain's deep basin.

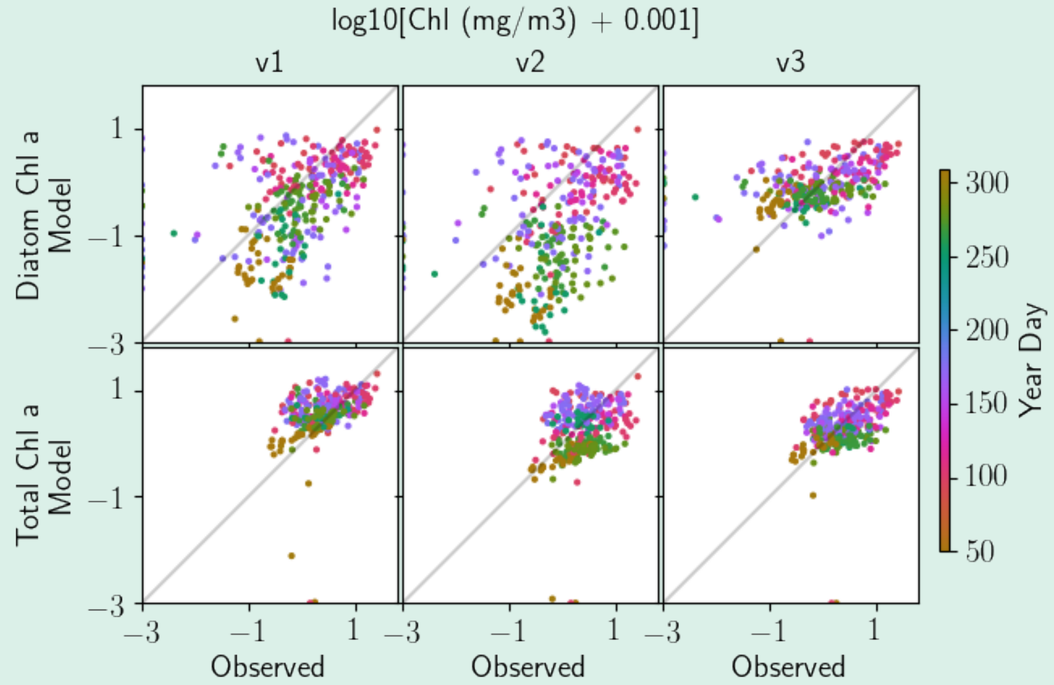


Observations Inform Improvements in Model Silicon Cycling in a Semi-enclosed Coastal Sea

Authors: Elise Olson (presenting), Nina Nemcek, Susan Allen

Between versions 2 and 3, we were able to evaluate the behaviour of specific model functional groups through comparisons to pigment-based phytoplankton group abundance estimates.
This allowed for targeted adjustments to specifically bring the model diatom class into better agreement with observations.

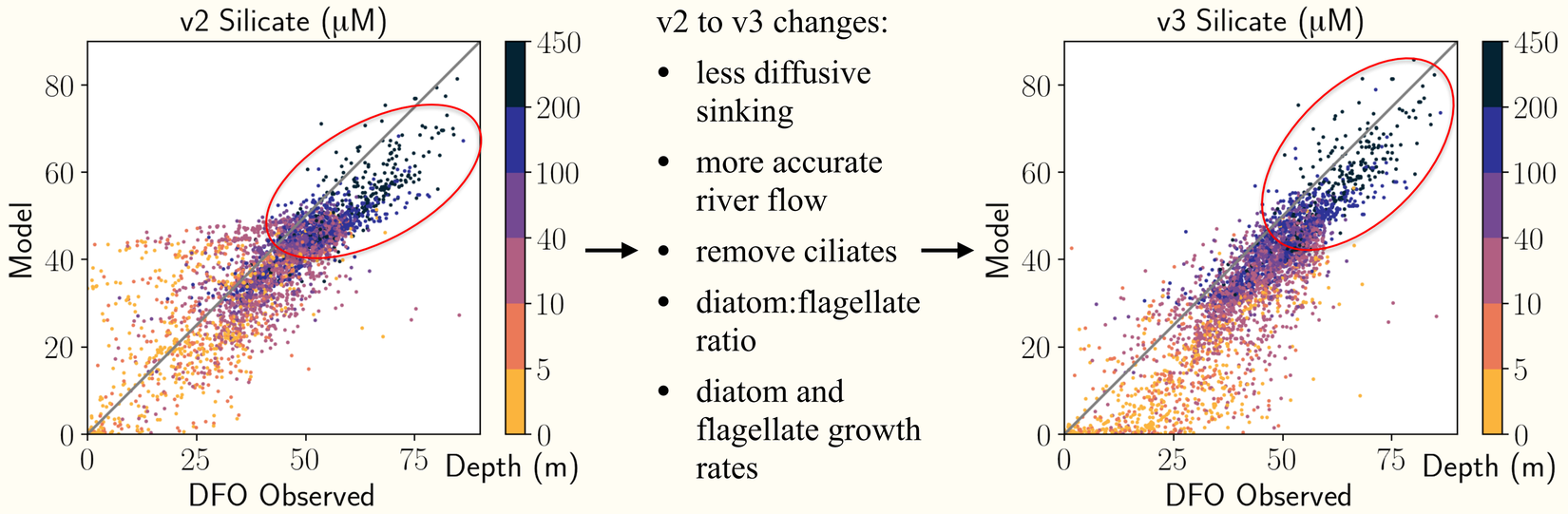
Comparisons with pigment-based phytoplankton group abundance



Observations Inform Improvements in Model Silicon Cycling in a Semi-enclosed Coastal Sea

Authors: Elise Olson (presenting), Nina Nemcek, Susan Allen

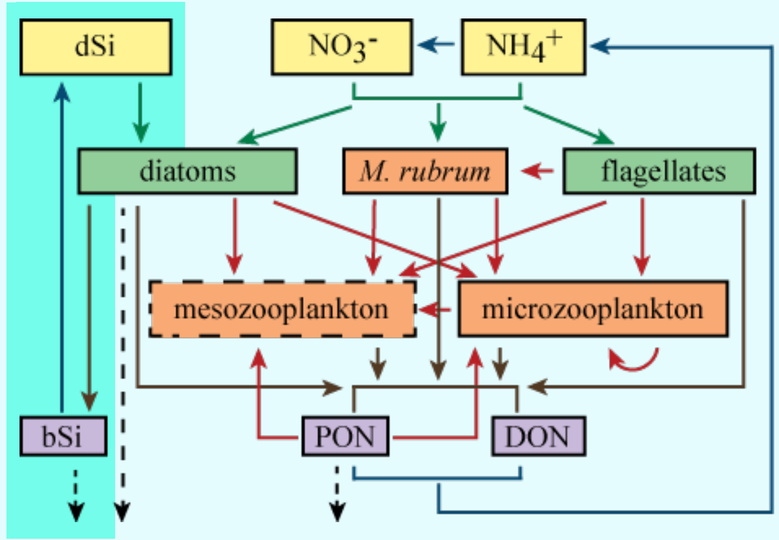
The third model version includes rate adjustments informed by comparison with pigment-based phytoplankton composition measurements, as well as a less diffusive sinking parameterization and more accurate river flow.
It is a preliminary run, and suffers from an over-correction of the ratio of diatoms to non-siliceous phytoplankton.
Nonetheless, it shows improved agreement between modelled and observed silicate concentrations, particularly in the domain's deep basin.
This success demonstrates the power in the use of pigment-based phytoplankton composition data to inform regional biogeochemical modelling efforts.



Observations Inform Improvements in Model Silicon Cycling in a Semi-enclosed Coastal Sea

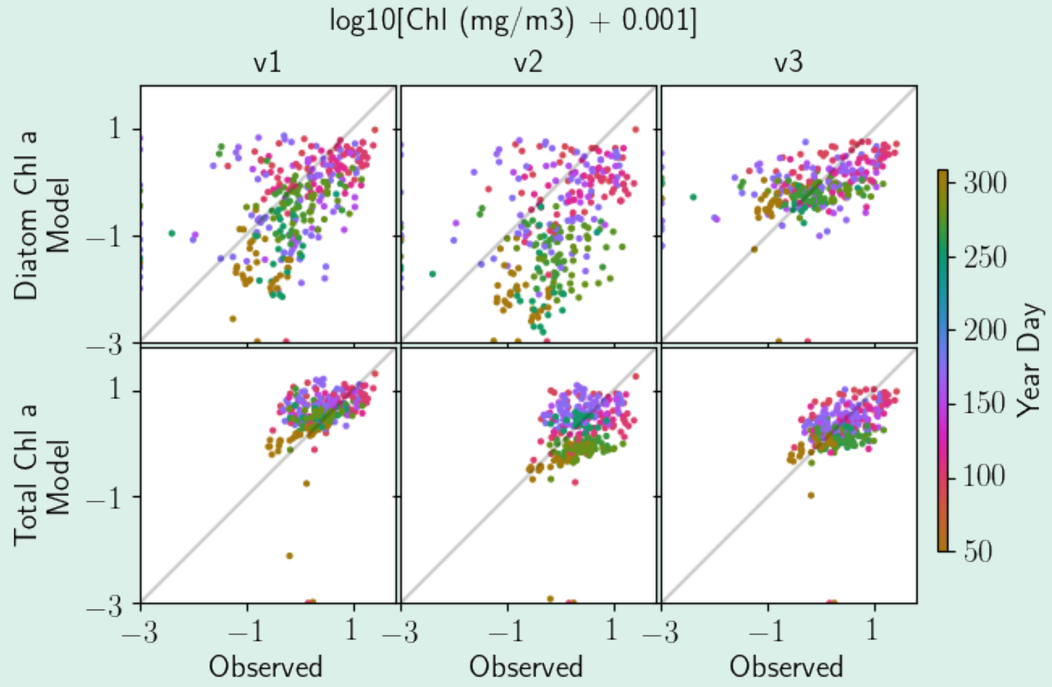
Authors: Elise Olson (presenting), Nina Nemcek, Susan Allen

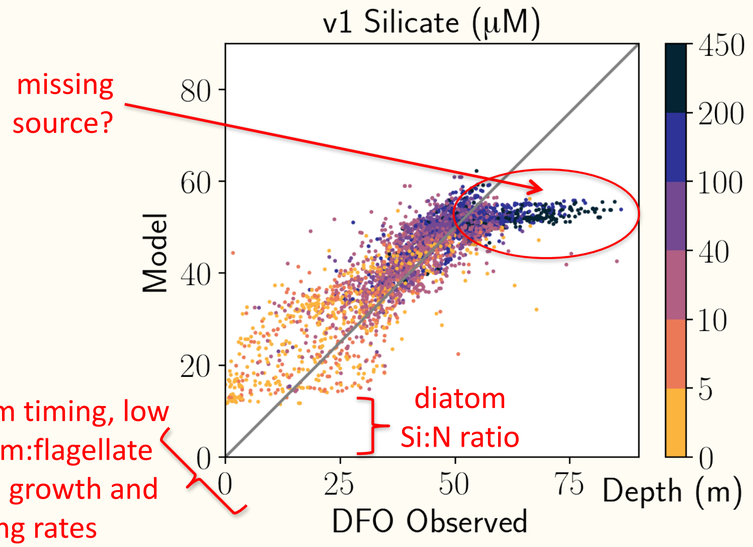
SMELT/SalishSeaCast

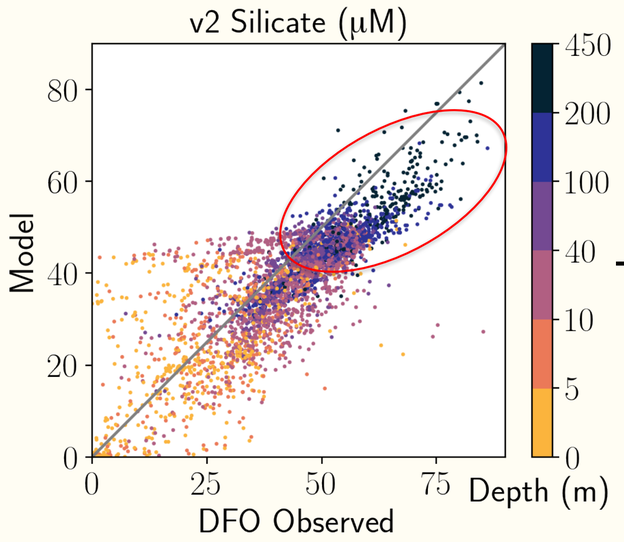


Years analyzed: 2015-2017

Comparisons with pigment-based phytoplankton group abundance

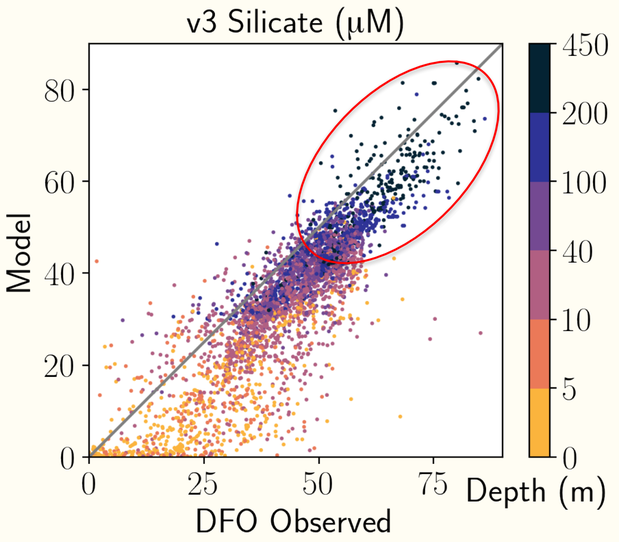






v2 to v3 changes:

- less diffusive sinking
- more accurate river flow
- remove ciliates
- diatom:flagellate ratio
- diatom and flagellate growth rates



Observations Inform Improvements in Model Silicon Cycling in a Semi-enclosed Coastal Sea

Elise Olson, Research Associate, University of British Columbia
Nina Nemcek, Phytoplankton Biologist, Fisheries and Oceans Canada
Susan Allen, Professor, University of British Columbia

Funding/Resources/Data: