An Aquatic Biogeochemical Cycling Model Simulation of Puget Sound, WA

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Keywords: modeling, plankton, nutrients, Puget Sound, oxygen

The Aquatic Biogeochemical Cycling (ABC) Model is designed as a modular component for simulating basic nutrient and plankton dynamics within physical circulation models. The model was developed to be a simple flux-based model suitable for Northwest aquatic ecosystems, with the goal of having a common tool applicable to regional planning, scientific inquiry, and education. The model simulates nitrogen and phosphorus inorganic nutrients, oxygen, dissolved and particulate organic compounds, and three types of phytoplankton and zooplankton. The modeled variables are shown as boxes in Figure 1, and the transfer processes are illustrated as arrows in the figure.

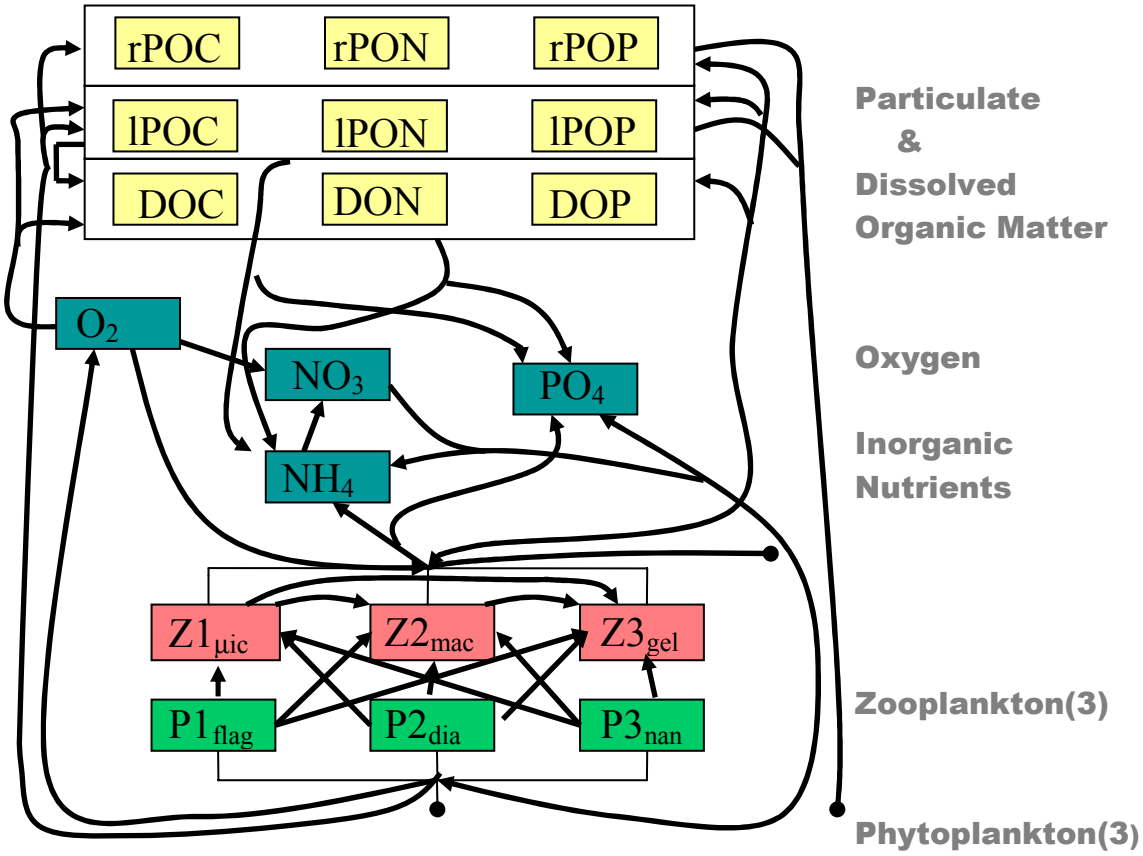

Figure 1: Schematic of variables and transfer processes included in the ABC model

To develop a coupled bio-physical ocean model for Puget Sound, the ABC model was liked to the Princeton Ocean Model (POM). The POM provided the hydrodynamical simulation, while the ABC model simulated the biogeochemical cycling processes. The ABC model is written with a modular interface for C/FORTRAN programs simplifying the process of coupling it to the POM model, or other hydrodynamic models.

The configuration of the POM for Puget Sound is similar to that described by Kawase (2005) and Sarason (2005), but implemented with 1200x1800m horizontal grid and 12 vertical sigma layers. The reduced resolution was selected to improve the computational times of the simulation.

The ABC model uses a web interface and database backend to keep track of coefficients, facilitating the ability to track different simulation conditions. Additional details about the ABC model can be found at the Puget Sound Marine Environment Modeling web site, http://www.psmem.org

The coupled model is presently in the process of being calibrated and compared to existing data obtained in year 2000. It is anticipated that by the end of 2005, this calibration process will be completed, a sediment biogeochemical model will be added to the model, and routine hindcasts will be produced. As model calibration is ongoing, Figure 2 illustrates some general trends shown by the model. Following initialization on January 1, 2000, the model predicts phytoplankton concentrations increase first in shallow and sheltered embayments (panel A), continuing to spread to include areas such as southern Puget Sound (panel B), before spreading through most of Puget Sound (panel C).

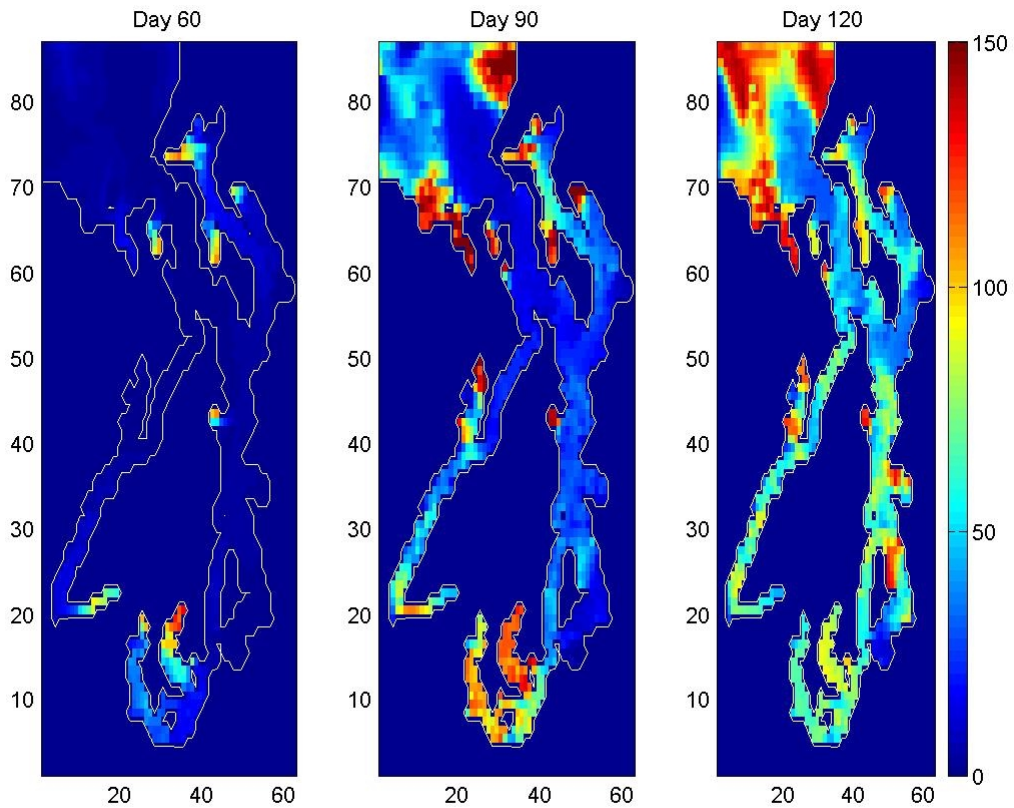

Figure 2. General trends observed in surface phytoplankton concentrations following model initialization, in mmol Carbon per cubic meter. Phytoplankton concentrations increase first in shallow and sheltered embayments (panel A), continuing to spread to include areas such as southern Puget Sound (panel B), before spreading through most of Puget Sound (panel C).