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

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We have developed a coupled physical-biological model representing plankton and nutrient dynamics of the Strait of Georgia, a fjord-like semi-enclosed coastal sea on the west coast of Canada. The nutrient-phytoplankton-zooplankton-detritus (NPZD)-type biological model is based on nitrogen uptake and remineralization with a coupled silicon cycle and includes both diatom and non-siliceous phytoplankton functional groups. The Strait of Georgia exhibits an estuarine circulation driven by input from the Fraser River as well as many smaller rivers and streams. It has high levels of dissolved silica (can be >50 μM even at the surface). Silicon-replete conditions shape key characteristics of the local ecosystem, which include heavily silicified glass sponge reefs as well as frequent diatom and occasional silicoflagellate blooms. We therefore consider the ability of the model to match observed silicon levels an indicator of the fidelity of its representation of local biogeochemistry. Silicon in the model may be in the form of dissolved silica, living diatoms, or particulate biogenic silica, and model diatom growth may be limited by nitrogen, light, or dissolved silica availability. We will discuss the challenges involved in accurately representing important drivers of the regional silicon cycle. These include accurately capturing the division of primary productivity between diatoms and non-siliceous phytoplankton functional groups, as well as uncertainties in the magnitude of terrestrial inputs and sediment fluxes. We will show how evaluating the model functional groups by comparison with phytoplankton community composition determined by high performance liquid chromatography (HPLC) has informed our interpretation of model results and provided direction for efforts at improving model performance. We will discuss the impact of targeted adjustments to model parameters on the model silicon cycle in light of comparisons to observations.