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Influence of nutrient utilization and remineralization stoichiometry on phytoplankton distribution and carbon export: a modeling study at BATS

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The primary objective of this research is to understand the underlying mechanism of the time-varying flux of carbon in the North Atlantic basin. To address this objective, two different ecosystem modeling approaches are tested at the Bermuda Atlantic Time-Series (BATS) site. The first approach is a multi-component lower trophic level ecosystem model that includes detailed algal physiology as well as nutrient cycles. Autotrophic growth is represented by three algal groups and the cell quota approach with allometric relationships is used to estimate algal growth and nutrient uptake. The second model is a simplistic approach which includes 2 compartments of phytoplankton as phytoplankton biomass and phytoplankton cell numbers. This approach assumes that the number of phytoplankton cells that belong to each size group changes on a log-log scale as a function of environmental factors. These new models are tested and validated for year 1998 using the bimonthly BATS cruise data for model-data comparison.

Preliminary results of the algal group model show that phosphorus and dissolved organic matter (DOM) are necessary compartments to correctly simulate organic elemental cycles at the BATS site. Simulation results also suggest that the recycled nitrogen and phosphorus are important components of the ecosystem dynamics because sustained growth of algal groups depends on remineralized nutrients which accounts for 70% of the annual carbon production. Efforts to couple the two ecosystem models with the MERCATOR North Atlantic (MNATL) 3D physical model of the North Atlantic Ocean are underway.