Spring Bloom and Associated Lower Trophic Level Food Web Dynamics on Georges Bank: A 1-D Model Study

Ji, R.[1], C. Chen[2], P. J. S. Franks[3], D.W. Townsend[4], E.G. Durbin[5],
R. C. Beardsley[6], R.G. Lough[7], and R.W. Houghton[8]

[1]Department of Biology, Woods Hole Oceanographic Institution, Woods Hole, MA 02543

[2]The School for Marine Science and Technology, University of Massachusetts Dartmouth, New Bedford, MA 02744

[3]Integrative Oceanography Division, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92093-0218

[4]School of Marine Sciences, 5741 Libby Hall, University of Maine, Orono, Maine 04469

[5]Graduate School of Oceanography, University of Rhode Island, South Ferry Rd, Narragansett, RI 02882

[6]Department of Physical Oceanography, Woods Hole Oceanographic Institution, Woods Hole, MA 02543

[7]Northeast Fisheries Science Center, NMFS, NOAA, Woods Hole, MA 02543

[8]Lamont Doherty Earth Observatory of Columbia University, Palisades, NY 10964

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Abstract

A coupled biological-physical model was developed based on the lower trophic level food web dynamics on Georges Bank (GB). The biological model consists of 9 compartments: dissolved inorganic nutrients (nitrate, ammonium and silicate), phytoplankton (large and small size classes), zooplankton (large and small size classes), and detrital organic nitrogen and silicon. This model was tested in a one-dimensional (1-D) domain with the vertical diffusion parameterized by a modified Mellor and Yamada level 2.5 turbulent closure scheme. The model results showed that in the shallow, well-mixed central bank, the timing and duration of spring blooms are closely linked to the light intensity and its downward penetration, while the intensity of blooms is regulated by initial nutrient concentrations and zooplankton grazing pressure. In the deeper southern flank area, under the same conditions of the light intensity/attenuation and initial nutrient concentrations as those in the central bank, the timing of the spring bloom is directly related to the seasonal development of stratification. The 1-D model captured the basic seasonal cycles of the nutrients and phytoplankton in the central bank, but failed to reproduce those patterns in the deep flank area. This study shows that the 1-D model is a useful tool to distinguish the relative importance of local biological and physical forcings from remote forcing.

Key words: Georges Bank, Spring phytoplankton bloom, Food web, Numerical model, Dynamics