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Spatial and temporal distributions of surface temperature and chlorophyll in the Gulf of Maine during 1998 using SeaWiFS and AVHRR imagery

Mary Frances Fox *, Dana R. Kester, James A. Yoder

Graduate School of Oceanography, University of Rhode Island, Narragansett, RI 02882, United States

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Abstract

The temporal and spatial distributions of SST and surface chlorophyll in northeastern coastal areas (46.0°N, 74.0°W to 40.0°N, 62.0°W) were examined using a year-long time series of composite SST and chlorophyll images during 1998. Five study areas were identified in these images: Gulf of Maine, Nantucket shoals/Georges Bank, Scotian shelf waters, slope water and coastal waters (depth <100 m) from Cape Cod to Nova Scotia. The mean SST and surface chlorophyll for each region was compared to the mean for the entire area. The coldest water (2.5 °C) was observed on the Scotian shelf in late March (YD 89). Throughout the year, coastal waters were cooler than the mean for the entire area. In the Gulf of Maine during a single day in summer (YD 208) SST ranged from 10 °C south of Nova Scotia to 20 °C in the central Gulf with a variance of over 8 °C. The Maine Coastal Current and its offshore extension were responsible for both these observations. Slope water was consistently warmer than the mean for the entire area. Several warm core Gulf Stream rings were observed in the SST images during 1998. These rings were partially responsible for the warm SST and high variances in slope water. Surface chlorophyll levels were higher than the mean in the Gulf of Maine, Nantucket shoals/Georges Bank and coastal waters; levels were below the mean on the Scotian shelf and in slope water. Using the SST and chlorophyll composite images a transect line along 67.6°W was extracted and surface contour plots for the entire year were made. The SST contour plot showed a strong surface manifestation of the Maine Coastal Current first appearing in late spring (YD 150) and continuing until the end of October (YD 300). High chlorophyll on Georges Bank throughout the year was the dominant feature in the surface contour plot of chlorophyll.

Keywords: Surface temperature; Surface chlorophyll; Ocean color; SeaWiFS; AVHRR; Remote sensing; Gulf of Maine; 46.0°N, 74.0°W to 40.0°N, 62.0°W

1. Introduction

The synoptic view of the surface waters of the world's ocean provided by satellite imagery has revolutionized our understanding of the sea. The advanced

* Corresponding author. Tel.: +1 401 874 6624; fax: +1 401 874 6818.
E-mail address: mfox@gso.uri.edu (M.F. Fox).

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very high resolution radiometer (AVHRR), a broadband, four- or five-channel scanner that senses in the visible, near infrared, and thermal infrared portions of the electromagnetic spectrum, has been used to estimate sea surface temperature (SST) since 1978. The coastal zone color scanner (CZCS) provided estimates of chlorophyll *a* in surface waters of the world's ocean from 1979 to 1986. With the launch of SeaWiFS in 1997, we are again able to couple ocean color imagery with SST. In this manuscript, we use remotely sensed data to study the interdependence of surface chlorophyll distributions and SST in a highly productive area, the Gulf of Maine.

The Gulf of Maine (GOM) is located off the northeast coast of the continental United States. Circulation in the GOM is influenced by strong tidal currents and tidal mixing, particularly within the 100-m isobath (Loder and Greenberg, 1986; Xue et al., 2000; Mavor and Bisagni, 2001); winter inflows of low salinity waters from the Scotian shelf (Mountain and

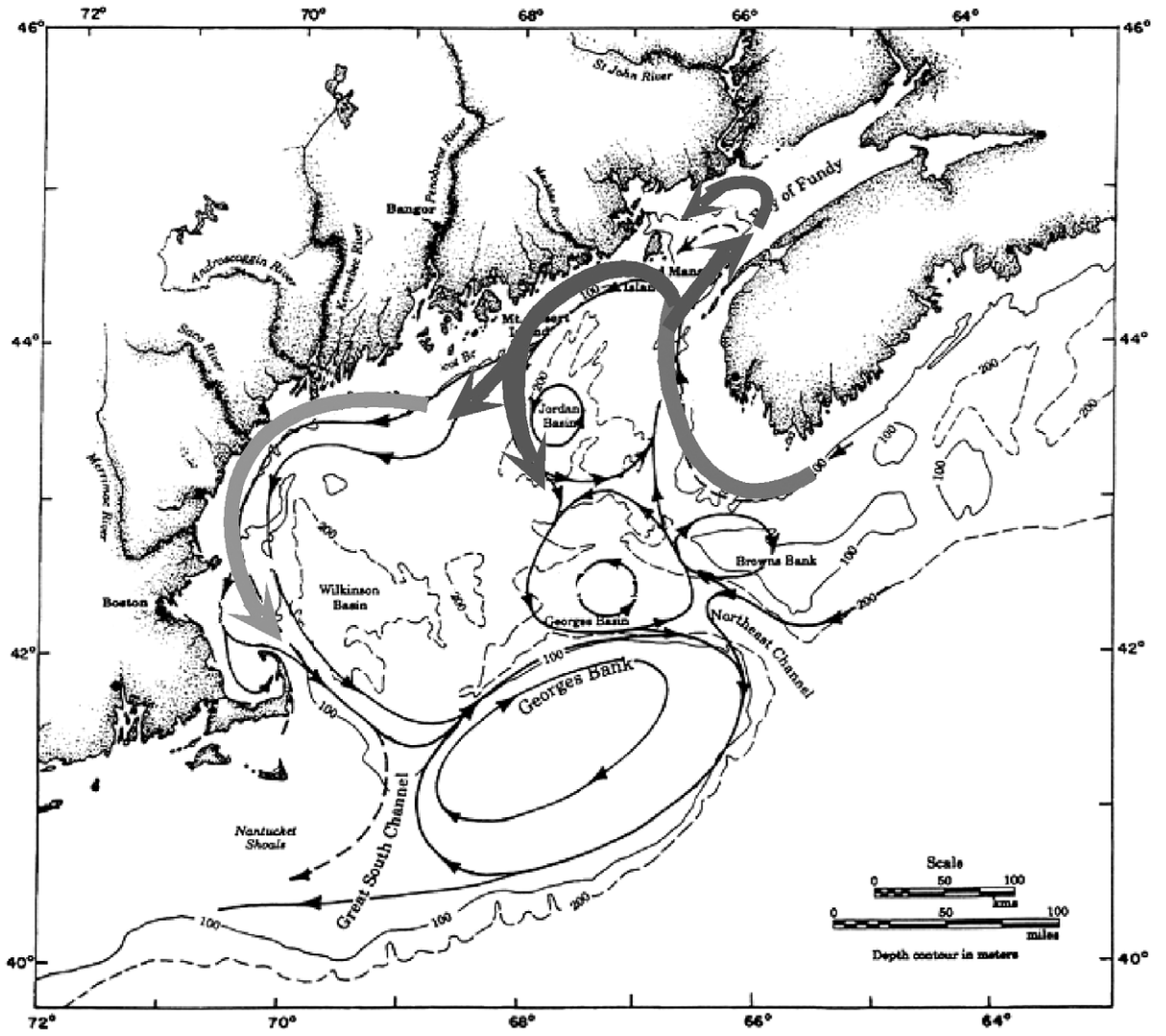

Fig. 1. Schematic of the circulation in the Gulf of Maine based on drifter (drogued at 10 and 40 m) and hydrographic observations in the spring of 1994 (N. R. Pettigrew, unpublished manuscript). The eastern Maine coastal current (EMCC) and western Maine coastal current (WMCC) are shown as shaded arrows (from Townsend et al., 2001).