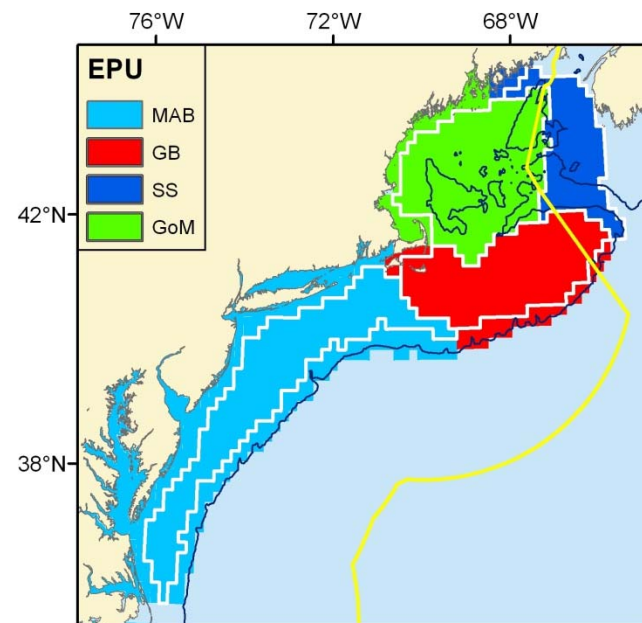
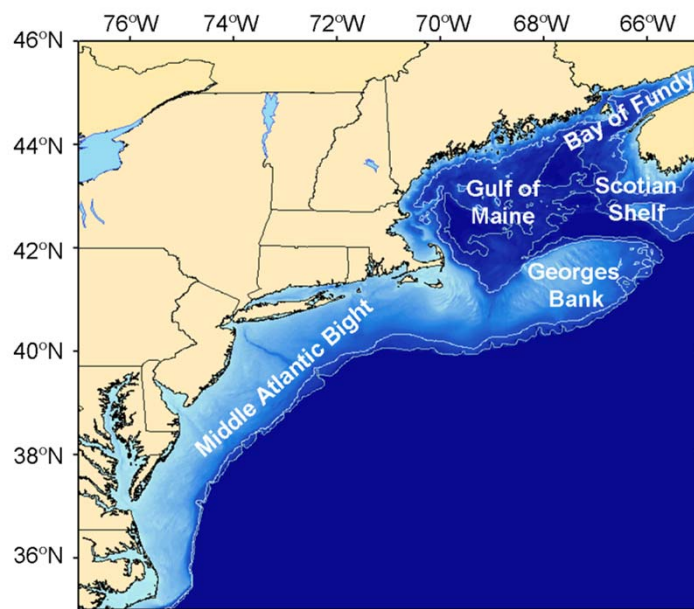


The 2012 Warming Event, Observations and Trends for the Future

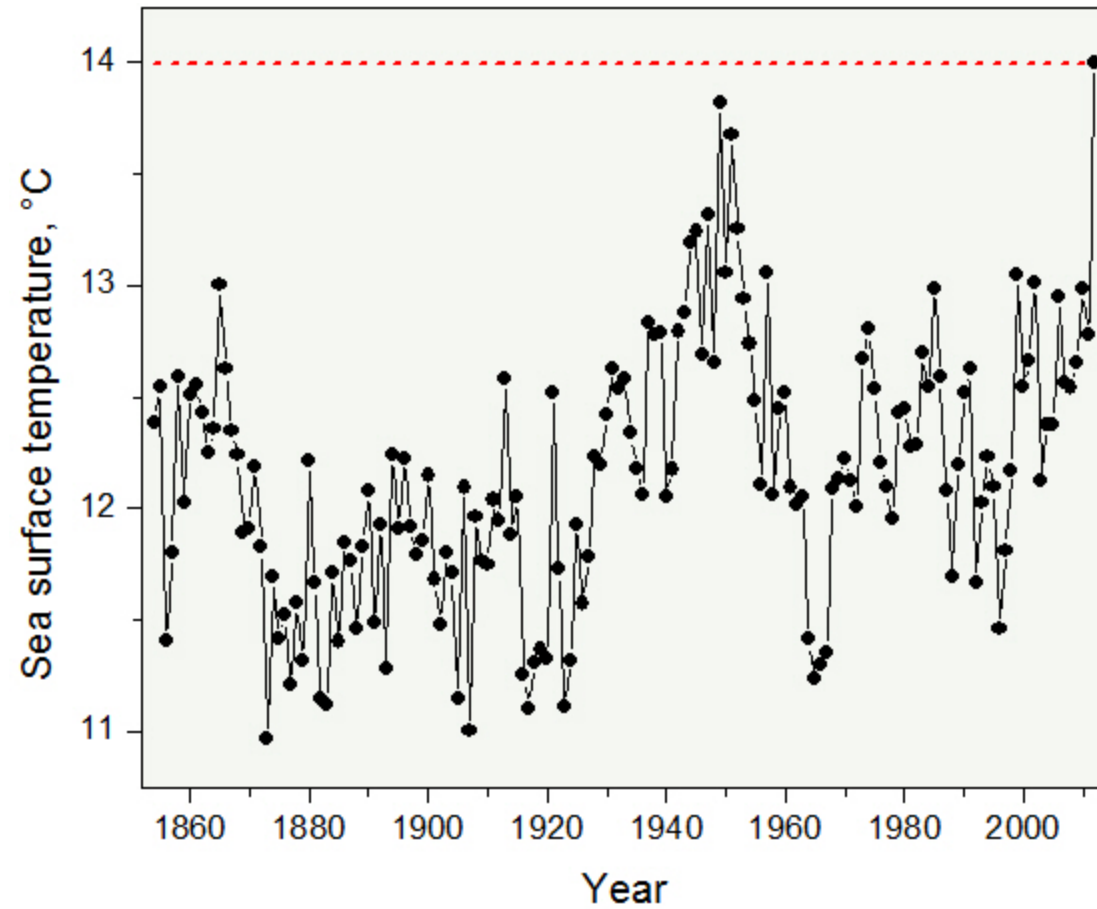


Kevin Friedland
National Marine Fisheries Service
Narragansett Laboratory

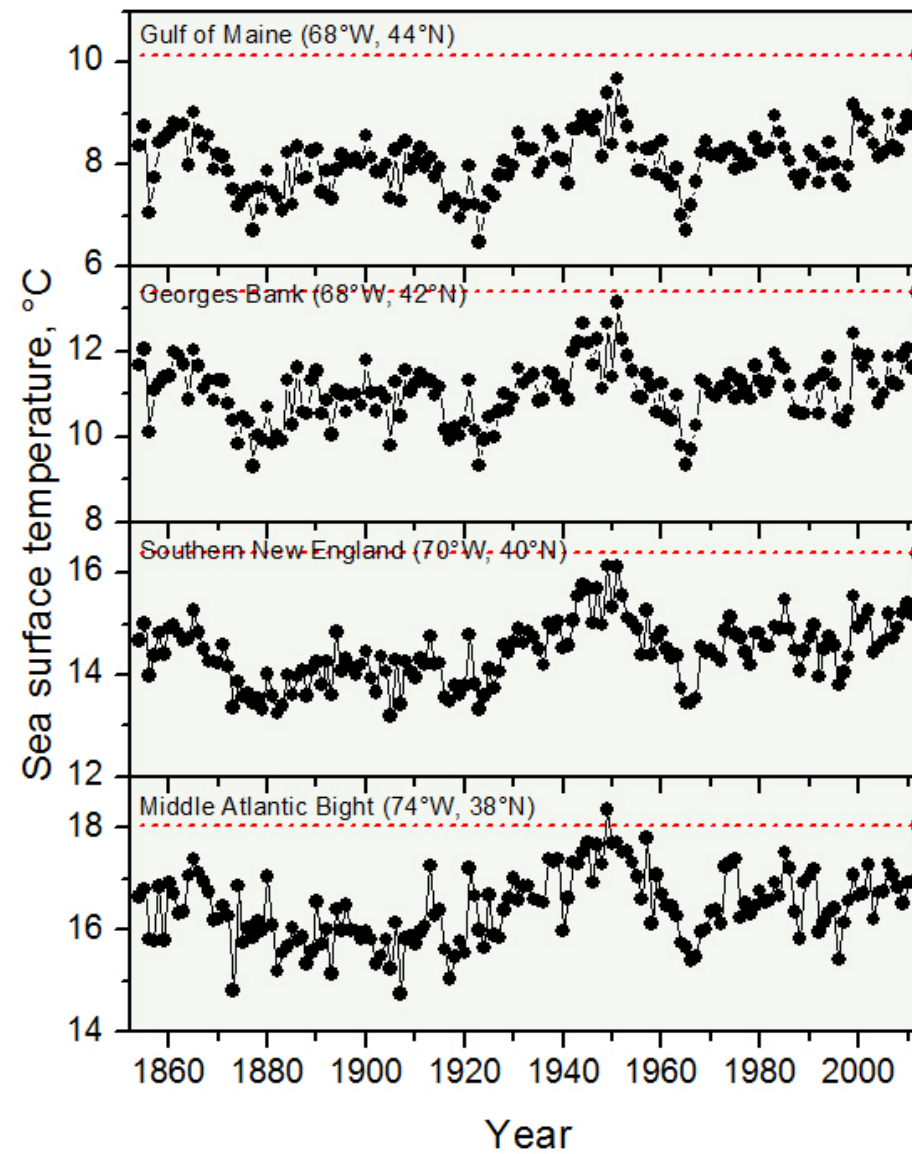
Northeast Shelf Ecosystem



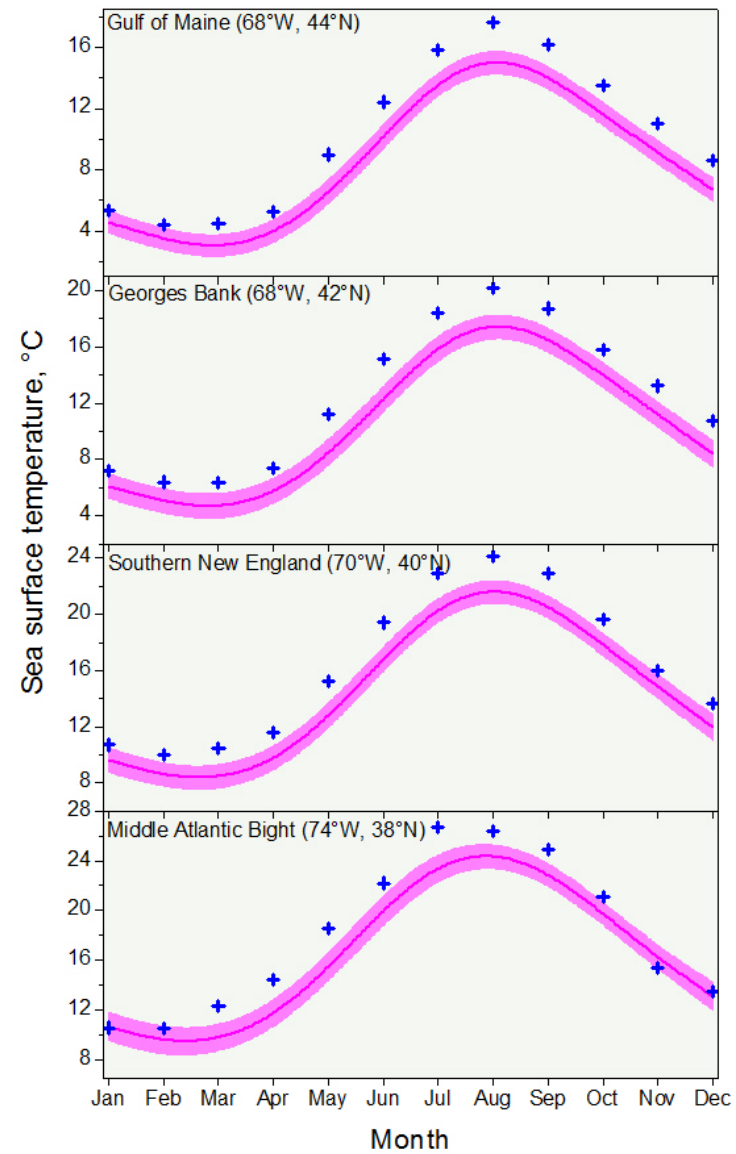
Long-term Sea Surface Temperature-Annual Mean



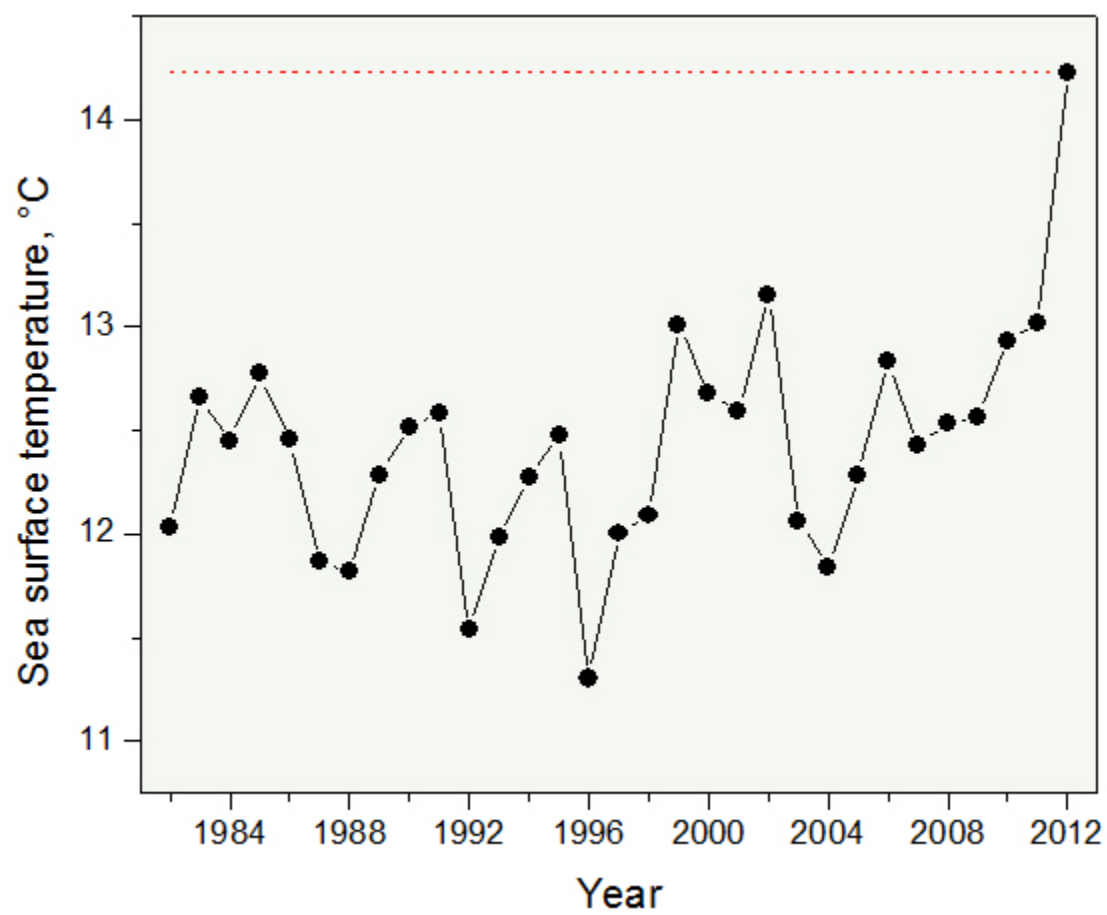
Long-term Sea Surface Temperature-Annual Mean



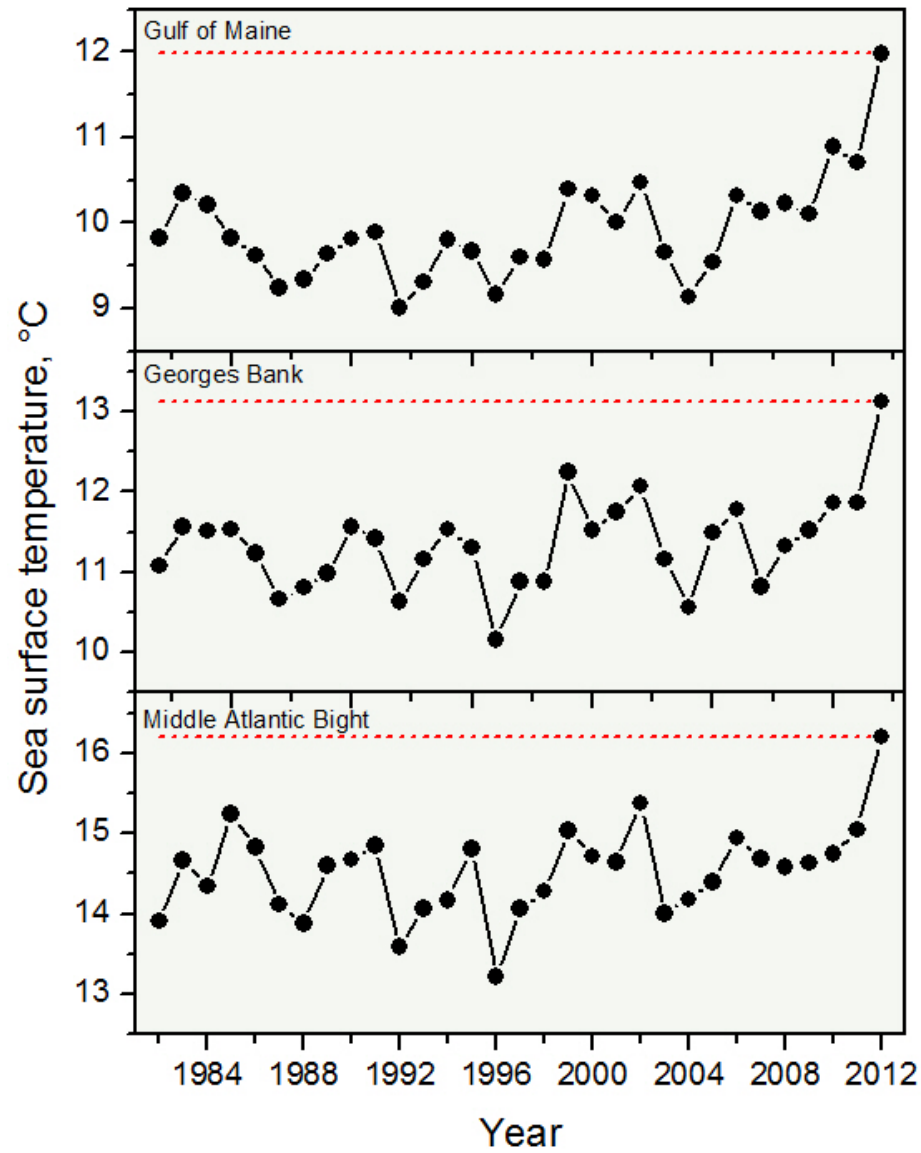
Long-term Sea Surface Temperature-2012 Monthly



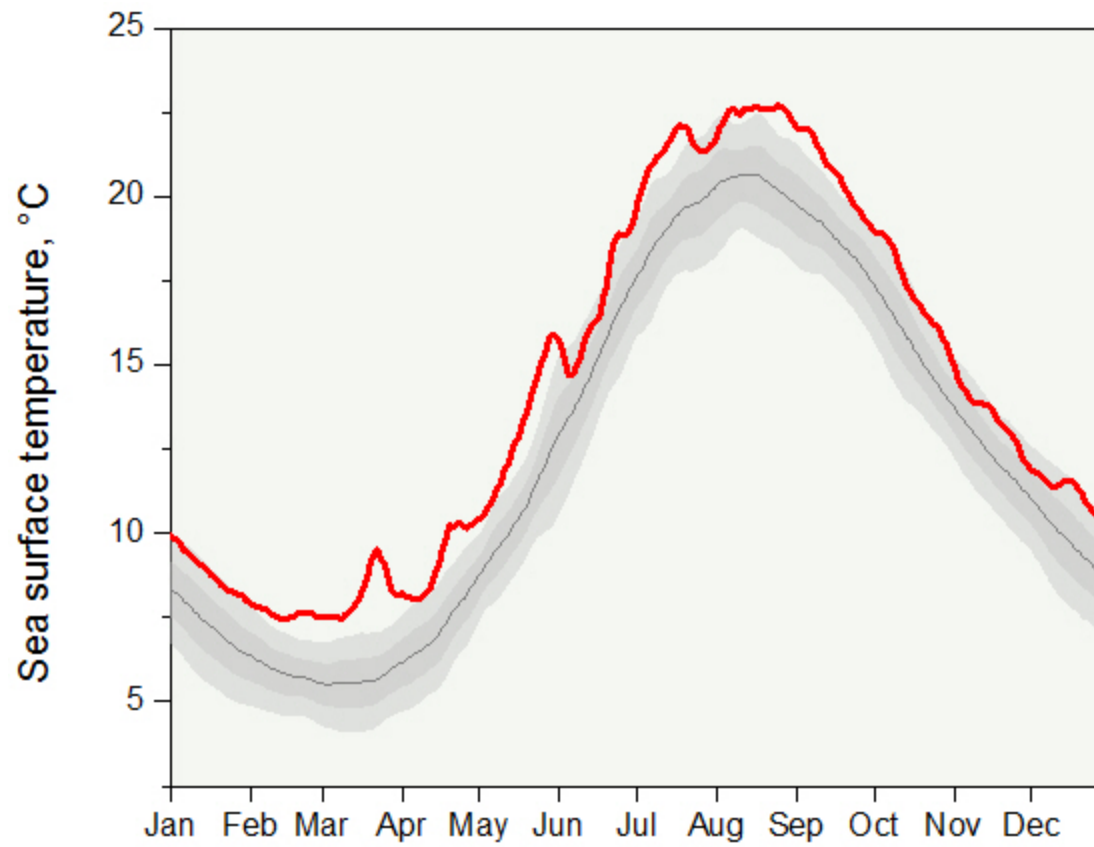
Satellite Sea Surface Temperature-Annual Mean



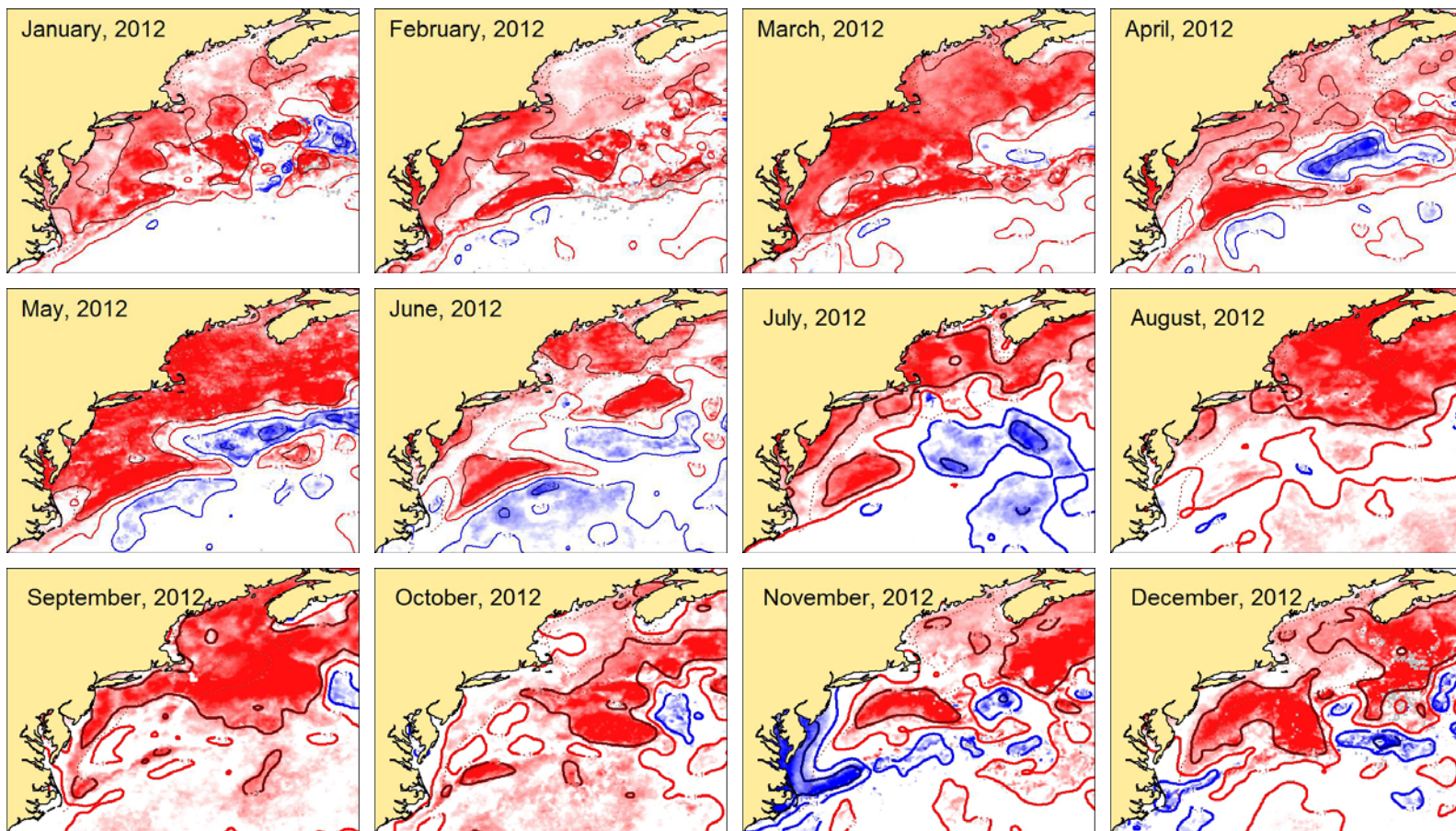
Satellite Sea Surface Temperature-Annual Mean



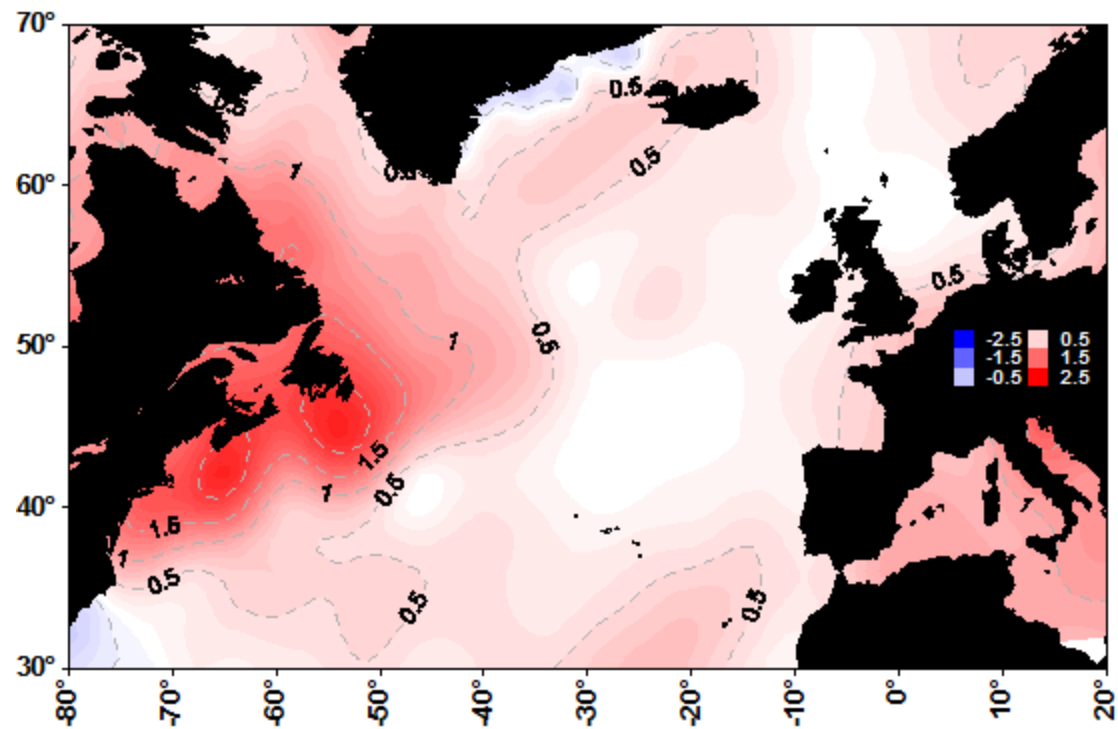
Northeast Shelf Temperature for 2012-Daily Mean



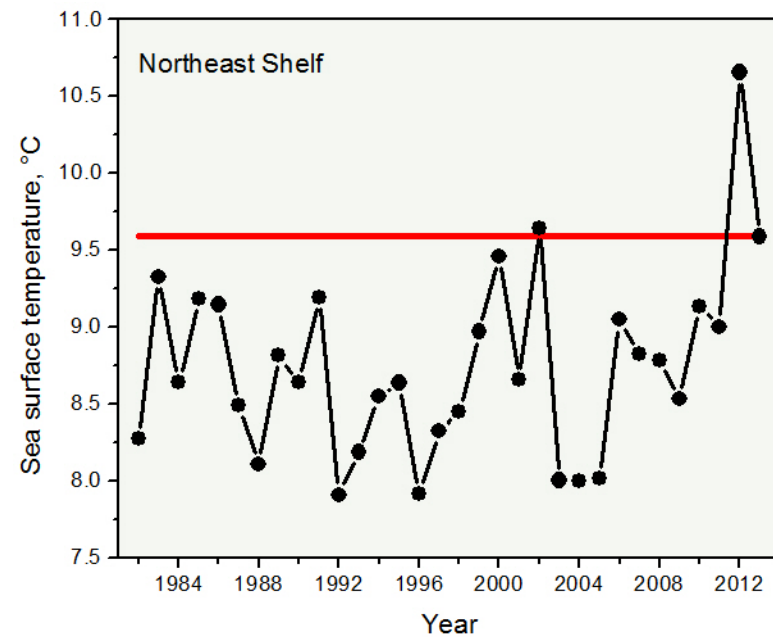
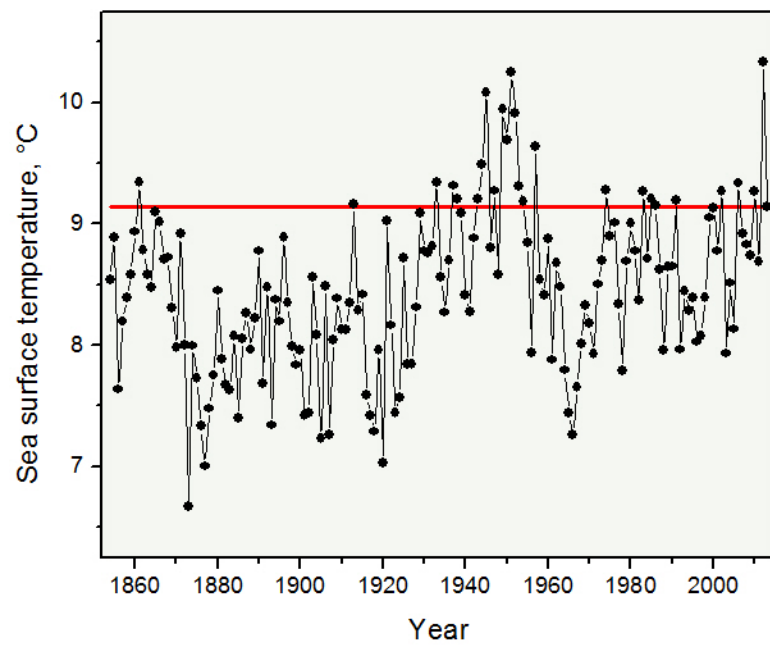
Temperature Anomalies



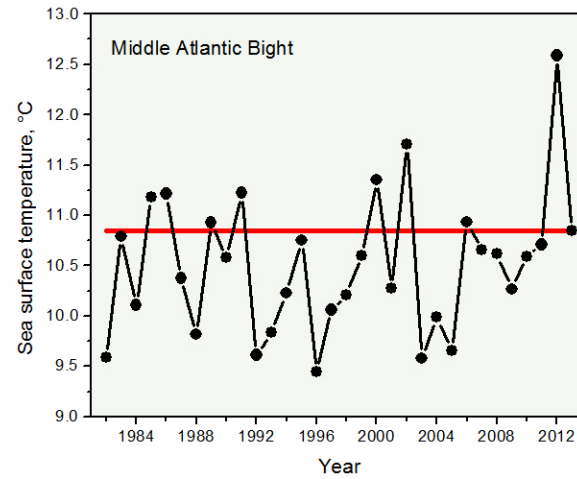
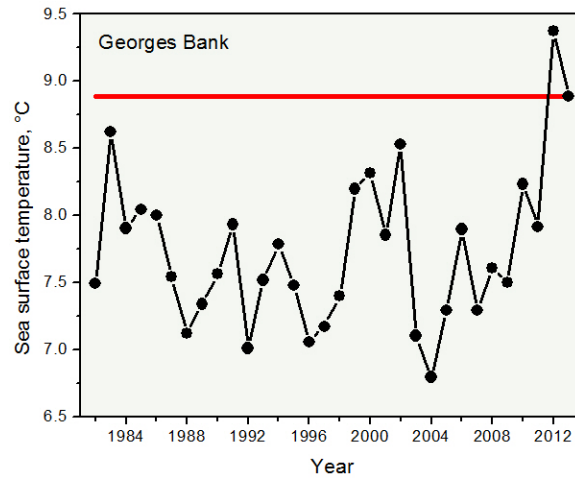
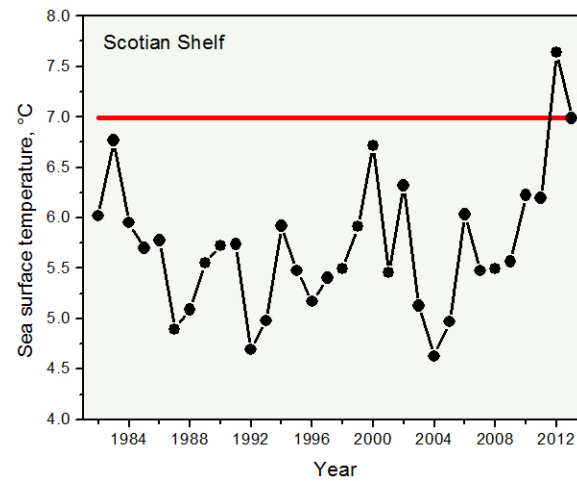
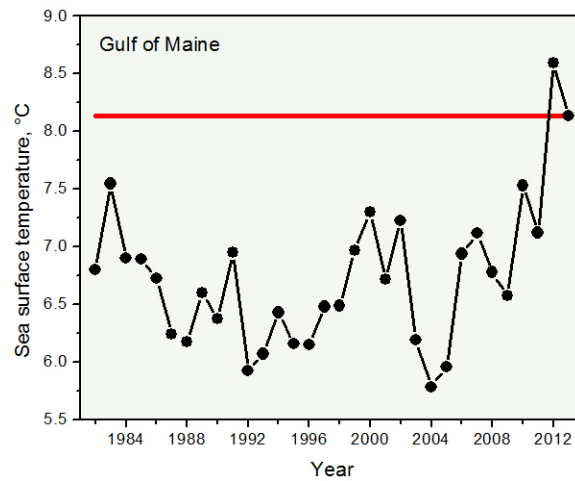
Northeast Shelf 2012 SST in Context to the North Atlantic



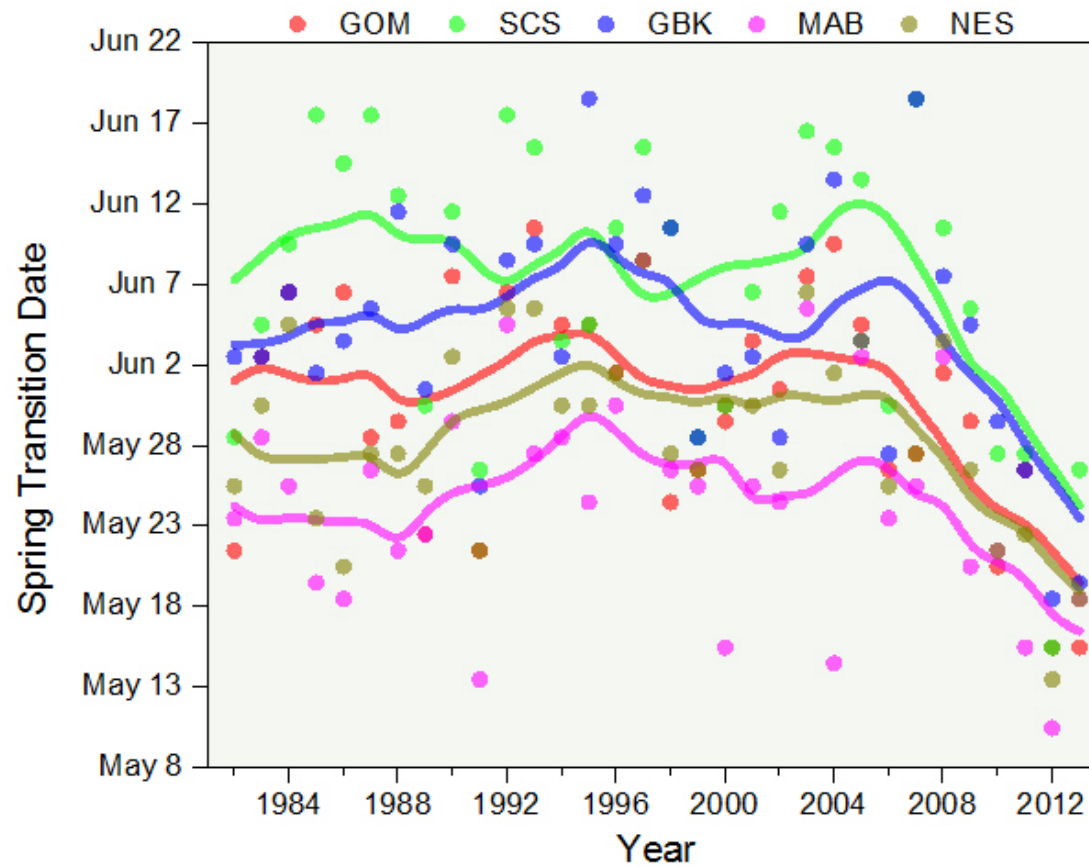
Long-term Sea Surface Temperature-First Half of the Year



Long-term Sea Surface Temperature-First Half of the Year

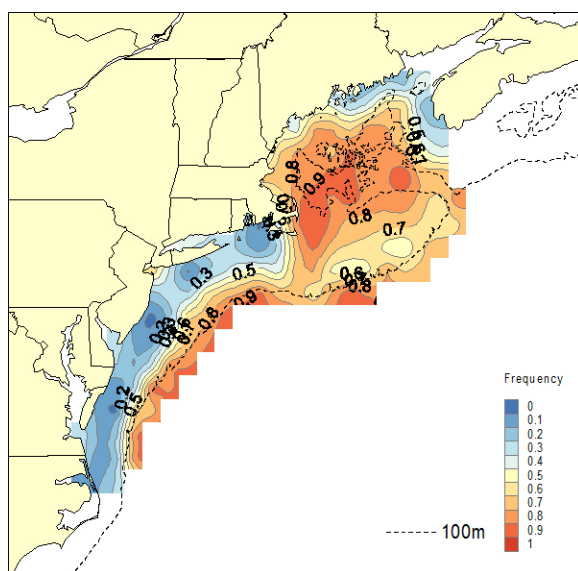


Timing of the Spring Transition

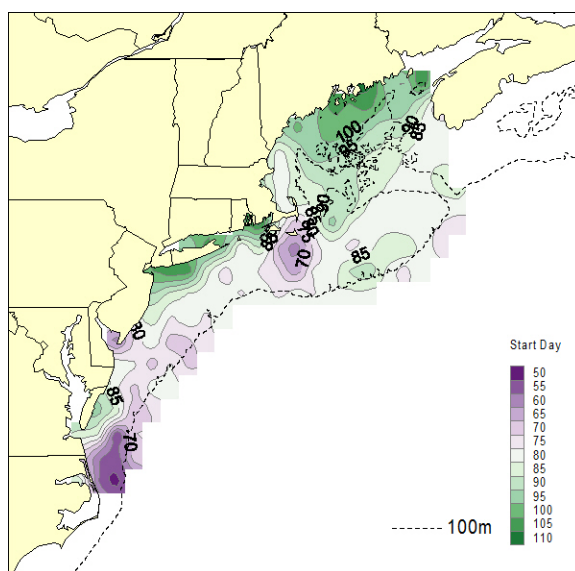


Spring Bloom Dynamics

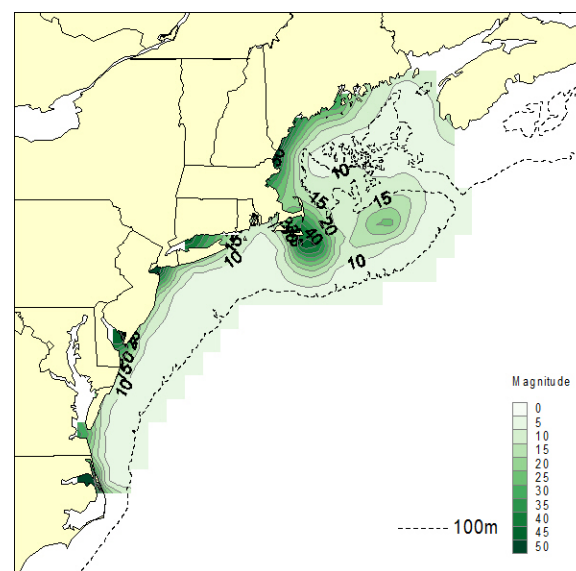
Frequency



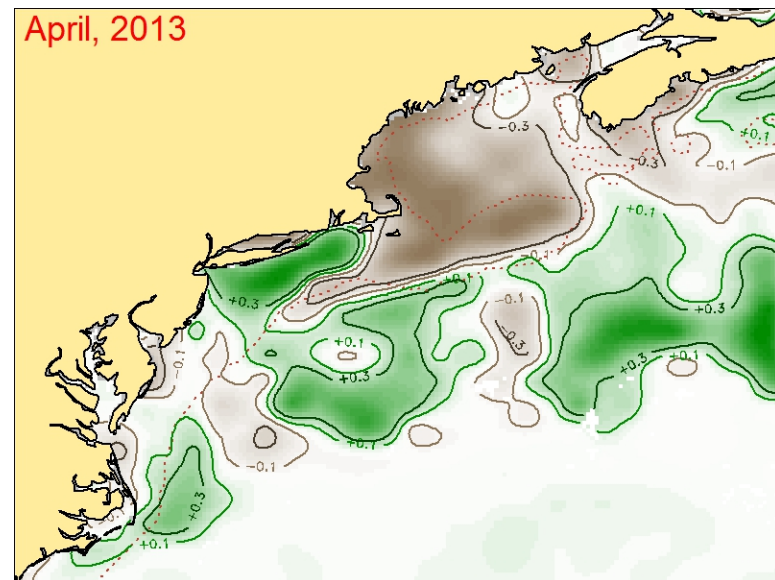
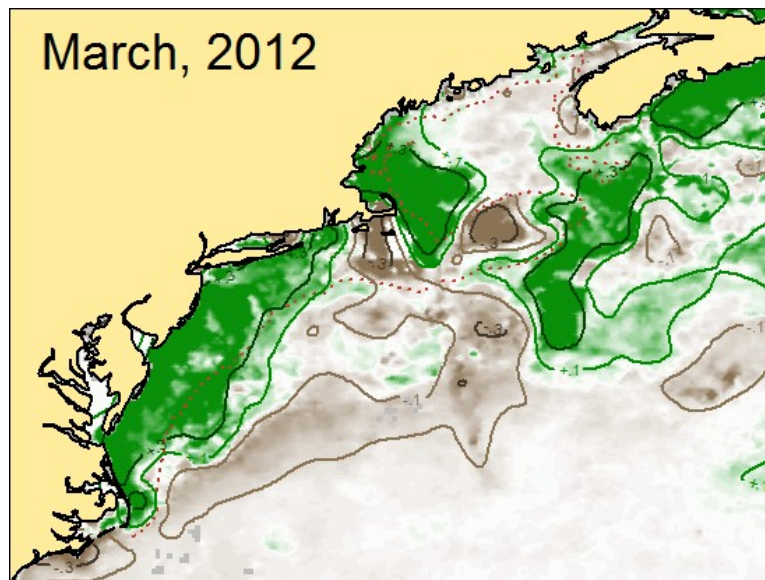
Start Day



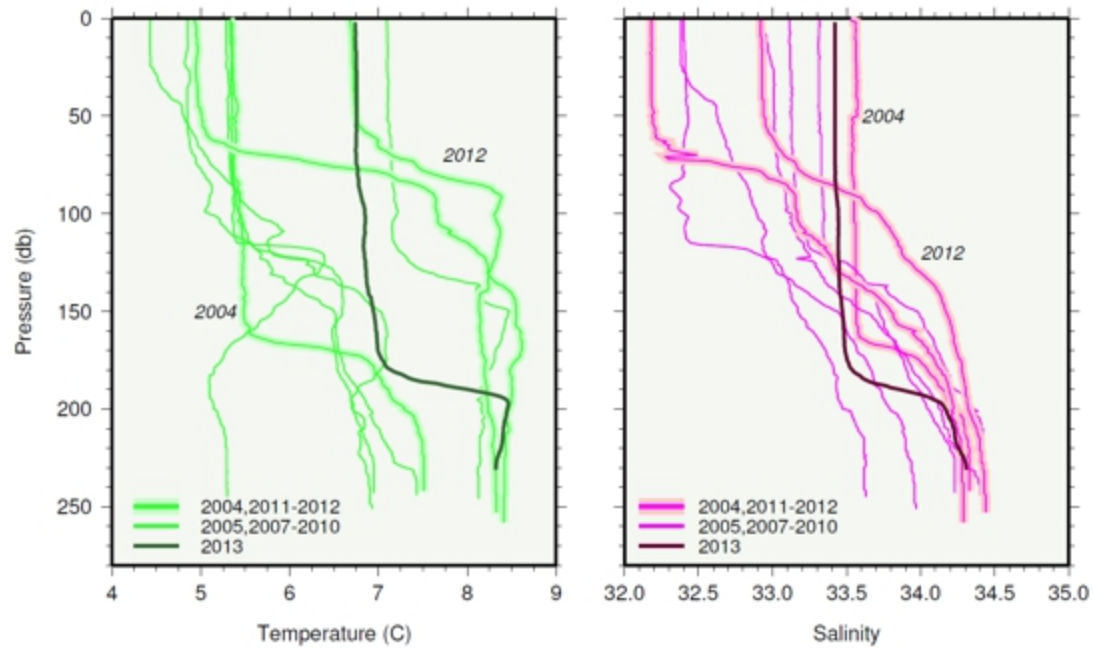
Magnitude



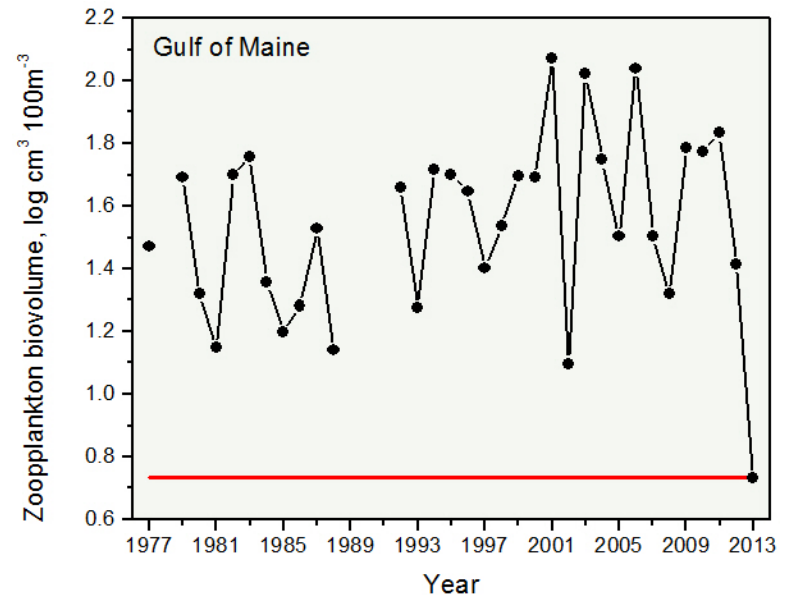
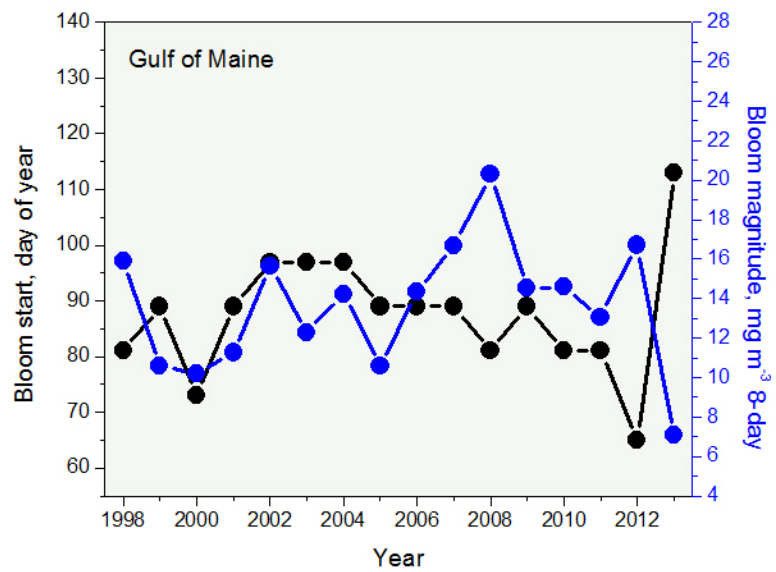
Chlorophyll Anomalies



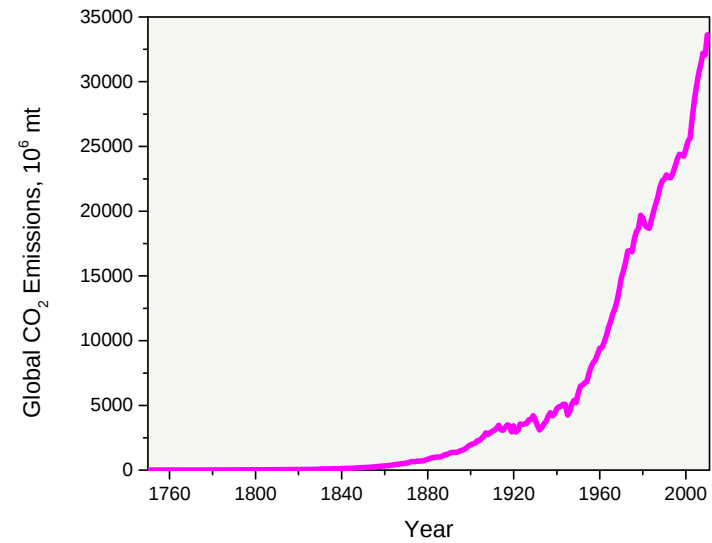
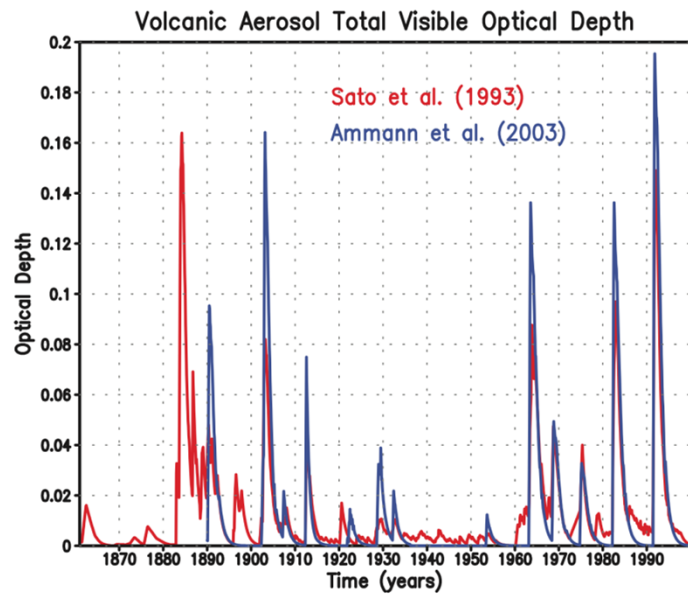
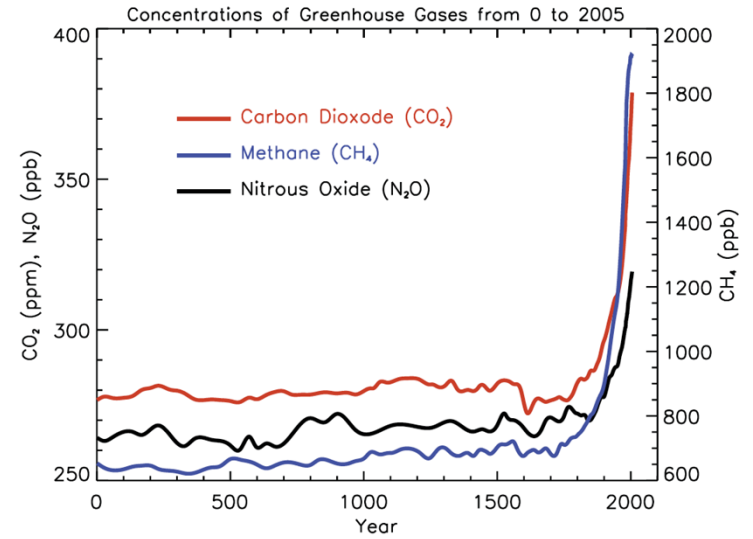
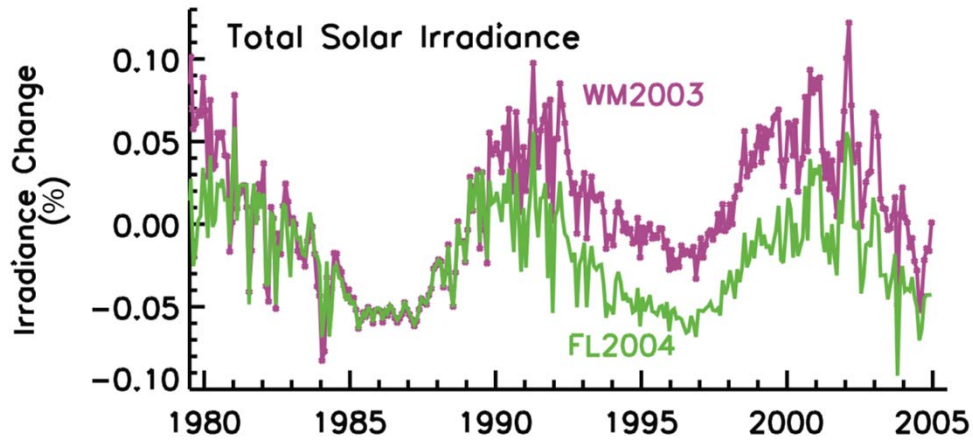
Mixed Layer Depth and the Gulf of Maine Spring Bloom



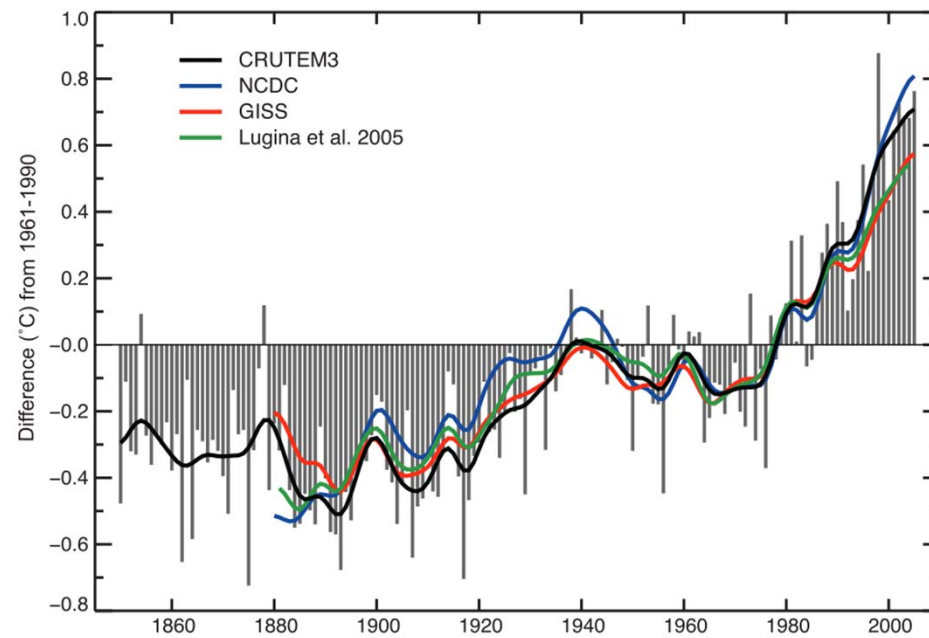
Spring Bloom and Zooplankton Productivity



The Climate System

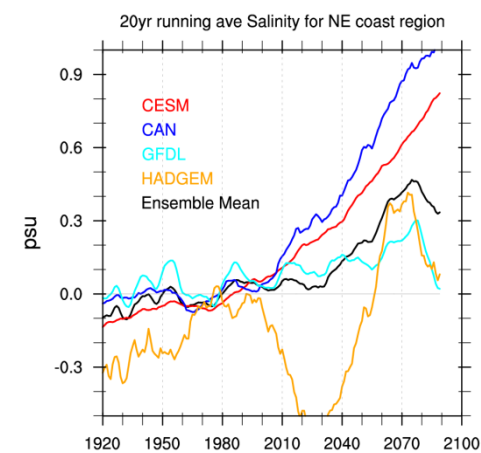
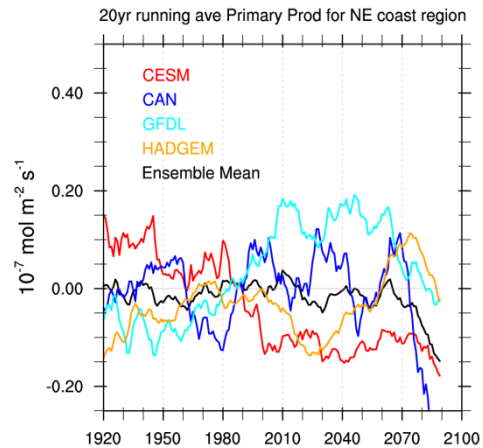
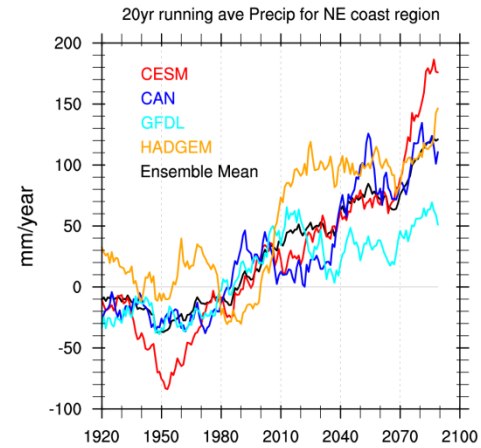
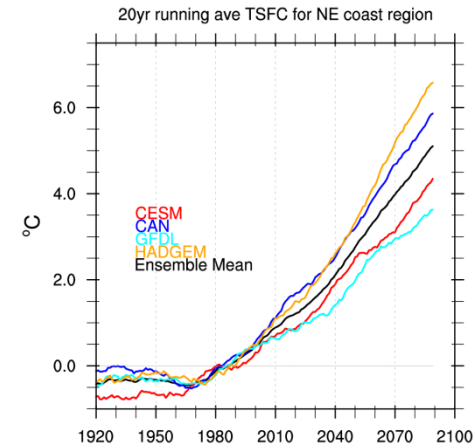


Annual Anomalies of Global Land-surface Air Temperature, 1850 to 2005



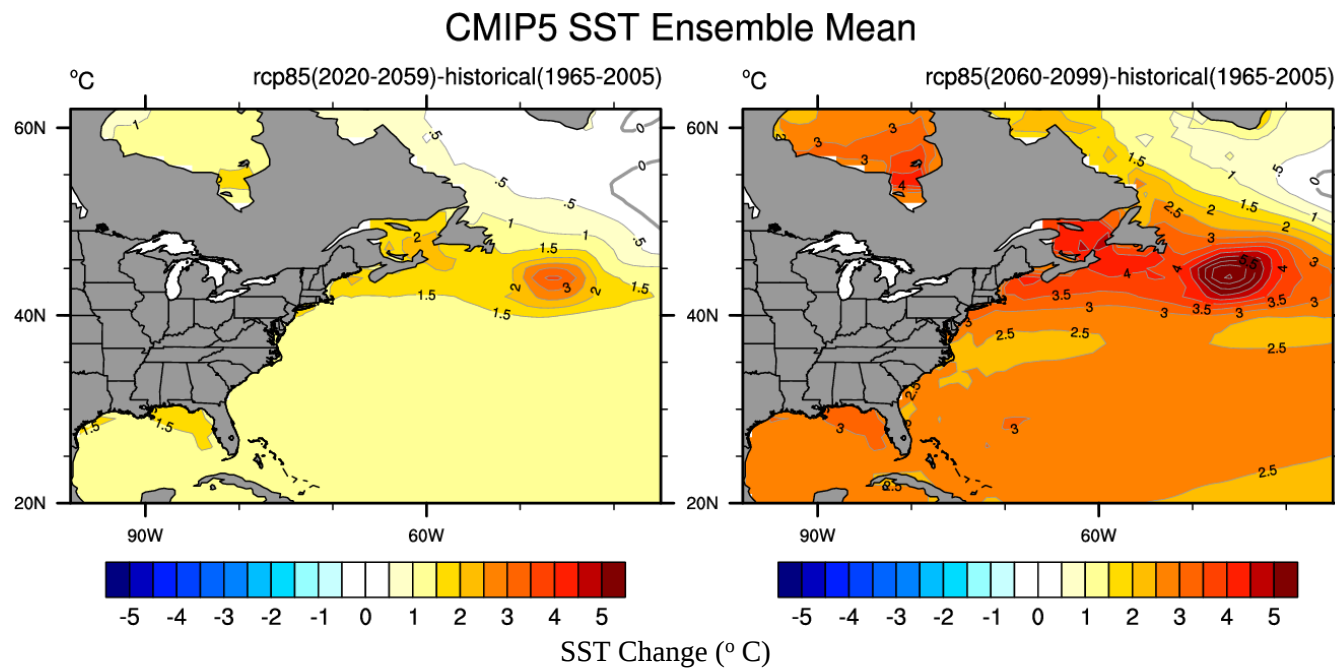
Trenberth et al. (2007)

Projections of Air Temperature, Precipitation, Primary Productivity (phytoplankton production), and Salinity for the U.S. NES LME

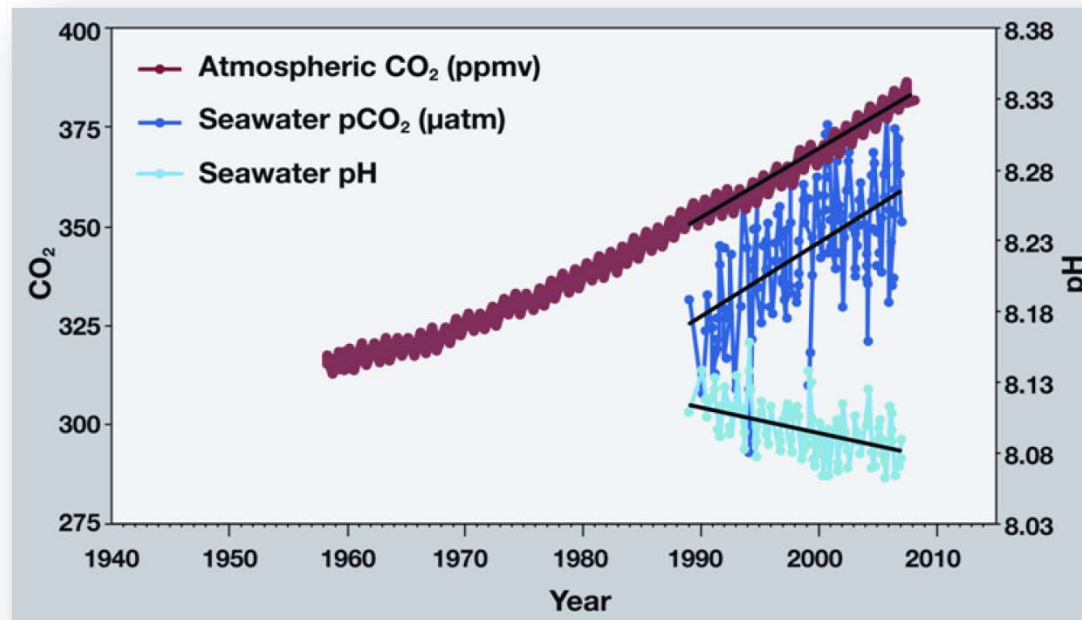


Alexander et al. (unpublished)

Mean Projection of SST for the U.S. NES LME Among Four Earth System Models Using the Highest CO₂ Emission Scenario

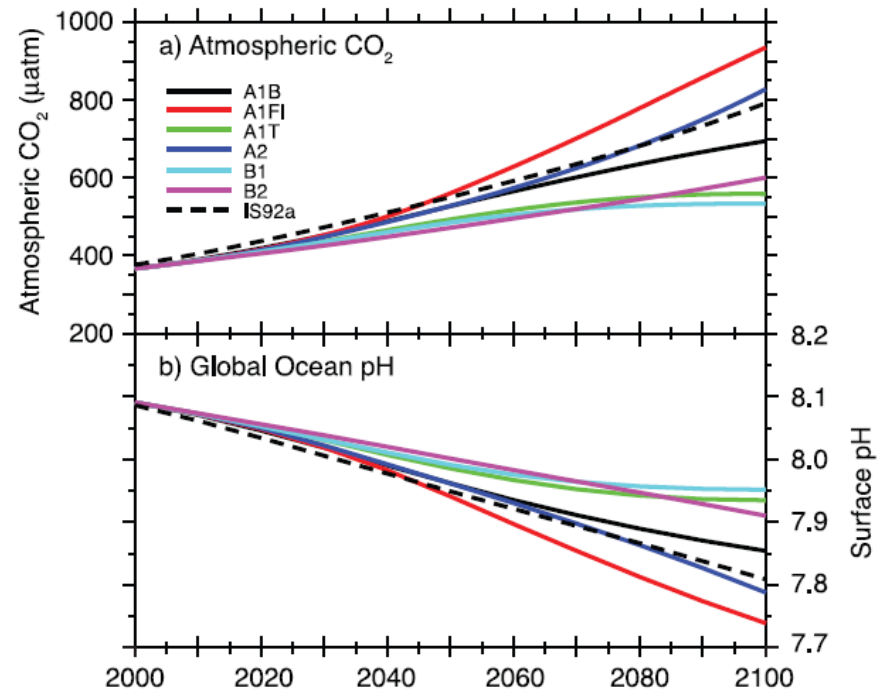


Observed Change in Ocean CO₂ Concentration and pH



Data from Mauna Loa, Hawaii (Feely, 2008)

Projected Change in Ocean CO₂ Concentration and pH



The variability of atmospheric CO₂ is primarily dependent on the rate of fossil fuel emissions while pH variability is dependent on both atmospheric CO₂ and temperature (Meehl et al., 2007).

Acknowledgements, V. Saba, N. Rebuck, P. Fratantoni

