Long Term Trends in Water Quality in Buzzards Bay, Massachusetts

Shanna C. Williamson[1], Jennie E. Rheuban[1], Maria T. Kavanaugh[1], David M. Glover[1], Rachel W. Jakuba[2], Scott C. Doney[1]

1.Department of Marine Chemistry and Geochemistry, Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA

2.The Buzzards Bay Coalition, Woods Hole, MA 02543, USA

Introduction

Background

Buzzards Bay is a moderately large estuary bordering the southeastern most section of Massachusetts (Fig. 1). Urbanization of the Buzzards Bay watershed has resulted in increases in anthropogenic nutrients into the system and site specific degradation of water quality. In an effort to monitor the overall health of Buzzards Bay, The Buzzards Bay Coalition developed the "Baywatchers" program. The Baywatchers Program is a citizen science monitoring program that has resulted in a 22 year data set of water quality indicator variables.

Fig. 1. Location of Buzzards Bay estuary (red star).

Motivation

- Anthropogenic nutrient inputs are a concern for the people that rely on Buzzards Bay for commercial and recreational use as well as for the organisms that depend on the health of this system.
- Remediation efforts for anthropogenically induced phytoplankton blooms can be better developed and implemented if we are aware of trends over time.

Hypotheses

- Growing populations, increased urbanization, climate change → Temperature and nutrient loading increasing over time.
- Increases in nutrient loading → Increases in Eutrophic conditions over time.
- Changing Climate in the form of increasing temperature or precipitation → Eutrophic conditions exacerbated by changes in climate.

Methods

Data Collection

- Over 300 Sampling Stations throughout Buzzards Bay
- Baywatchers are given tool kit to collect and process water samples
- Dissolved oxygen, temperature, salinity, water clarity measurements are collected weekly on site from May-Sept.
- Water samples are collected for nutrient analyses 4x during summer

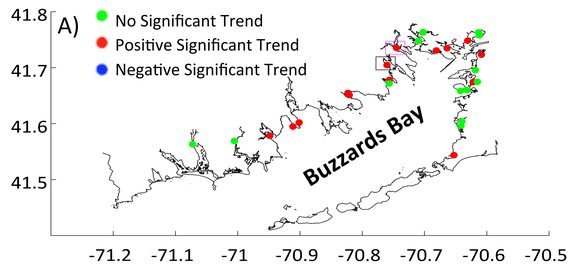
Data Analysis

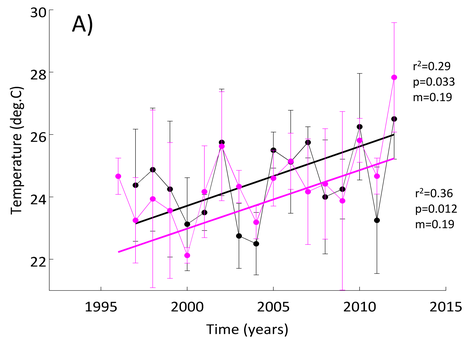
- Examined data from 28 stations
- Applied linear regression analysis to determine trends through time and trends between different variables
- Regarded Temperature, Total Nitrogen, and Chla as proxy variables for climatic and anthropogenic impacts on Buzzards Bay and the bays response

Buzzards Bay 1992-2012 Trends

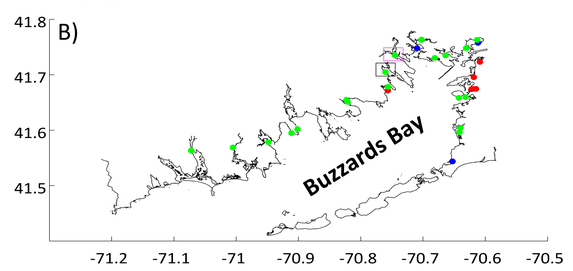
Long term trend analyses help assess the effectiveness of remediation efforts and helps with developing mitigation strategies for eutrophic waters

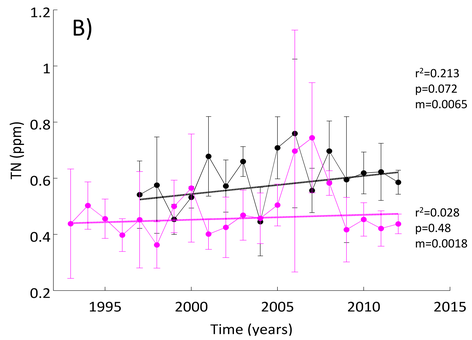
Climatic Impact - Rising or constant temperature





Anthropogenic Impacts - Variable nutrient trends





Buzzards Bay Response - Rising or constant Chla

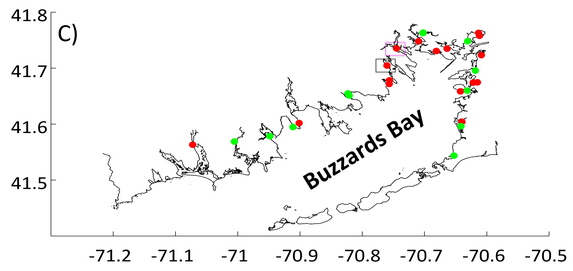


Fig. 2. (A) Temperature, (B) TN, and (C) Chla trends for 28 stations analyzed. Circle color represents the slope significance and direction (Red=significant increasing trend, Blue=significant decreasing trend, Green =no significant trend)

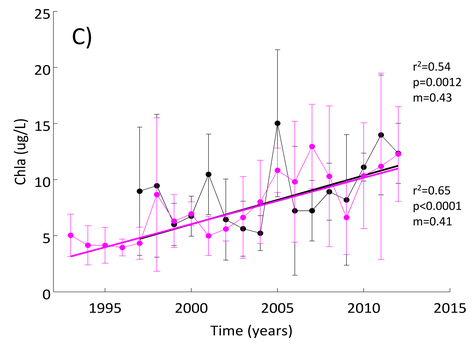


Fig. 3. Time series example of (A) Temperature, (B) TN, and (C) Chla trends for Weweantic River (pink) and Sippican Harbor (black) with Std. bars

Chla in 1993 and 2013

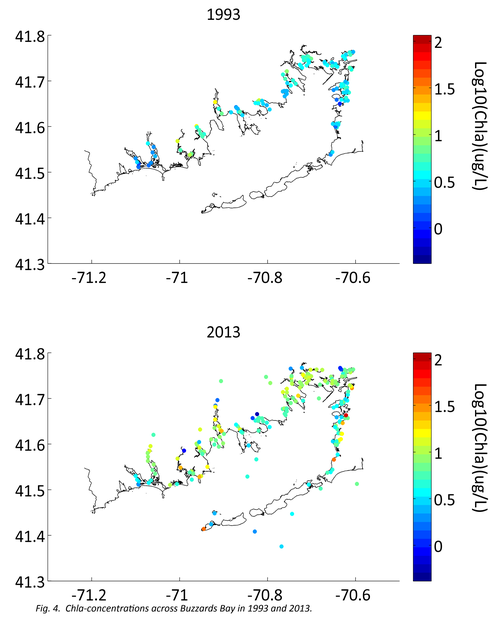


Fig. 4. Chla-concentrations across Buzzards Bay in 1993 and 2013.

Remediation strategies that consider nutrient loading alone may not improve water quality. For instance, Chla, often used as a response indicator, increased despite constant TN

Further Work

Assessment of possible exacerbated changes in nutrient and Chla concentrations as a result of climate change. Development of nitrogen loading model to determine possible shifts in ecosystem response to changes in nitrogen input into Buzzards Bay.

References and Acknowledgments

http://www.savebuzzardsbay.org/

http://www.inlandbays.org/about-the-bays/bay-issues/

Glover, D.M., W.J. Jenkins, and S.C. Doney, 2011: Modeling Methods for Marine Science, Cambridge University Press book website (ISBN-13: 9780521867832

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