STUDENT PARTICIPATION IN LISICOS, THE LONG ISLAND SOUND INTEGRATED COASTAL OCEAN OBSERVING SYSTEM

N. Morata[1]*, E. S. Maung[1], C. A. Loglisci[1], C. V. Manalo[1], D. C. Bennett[1], E. Miller[1], L. Miranda[1], G. McCardell[1], B. A. Costas[1], D. Aurin[1]

[1]Department of Marine Sciences, University of Connecticut, Groton, CT 06340-6048; nathalie.morata@uconn.edu

ABSTRACT

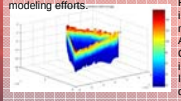
Long Island Sound (LIS) is an urban estuary in the Northeast US with over eight million people living in its watershed. LISICOS was established in 2003 as a component of a regional/national ocean observing system, with the initial goal of developing a capability to observe and understand the LIS ecosystem and predict its response to natural and anthropogenic changes. LISICOS comprises observational, process and modeling studies. The current focus of process studies is on the problem of eutrophication and hypoxia. One function of LISICOS is graduate student training. Currently, theses for two Ph.D students and two master students are directly developed from LISICOS. Six other Ph.D students use LISICOS data as a part of their theses. Along with the principal investigators, students directly participate in cruise design and execution, data analysis and publication. This presentation will give a brief overview of the LISICOS student projects, which cover studies of carbon, nutrients and organic matter fluxes in the water and in the benthic compartments, molecular studies of the phytoplankton and zooplankton communities, ecology of benthic communities, optics and circulation in the Sound. Data from the projects are shared on internet (www.lisiscos.uconn.edu), helping communication within the scientific community, and are also used for educating other students and the public to the eutrophication problems occurring in Long Island Sound.

Diane Bennett, Ph.D

Advisor: Jim O'Donnell

Tracking Currents in Long Island Sound

In order to monitor oxygen levels in any body of water, it is important to be able to model the physical properties of the system. In an attempt to understand the movement of the water by tides, currents and waves and to track water movement through salinity and temperature, I have helped to conduct several intense 48-hour surveys concentrated in Western Long Island Sound to measure these physical properties. Various instruments were used, including an Acrobat towed array, which produced the data displayed in the image below. The results of these surveys give us a much better characterization of both vertical and horizontal structures and movement of water in the Western Sound, helping both our understanding and our modeling efforts.



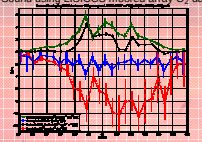
For more detailed information see my poster, Average Circulation Trends in Western Long Island Sound, on display during session OS36D-11

Grant McCardell, Ph.D

Advisor: Jim O'Donnell

The inverse determination of estuarine process rates from time series oxygen data

We expand upon the in situ diel O_2 method by inverse methods and exploit the strong diurnal nature of photosynthetic production to fit a simple mass balance model of dissolved oxygen gains and losses to numerically differentiated time-series of buoy-logged dissolved oxygen data. Below are our results for the Jug Bay estuary in MD, where we successfully quantify primary production, respiration, tidal advection, and atmospheric diffusion. My goal is to extend our inverse diel methodology to a two-layer system and thereby quantify vertical mixing rates within Long Island Sound using LISICOS moored array O_2 data.



Dirk Aurin, Ph.D

Advisor: Heidi Dierssen

Remote sensing retrievals of optical and biogeochemical parameters in an optically complex estuary

Accurately mapping proxies for net primary productivity over large areas with high spatial and temporal resolution requires the use of ocean color imagery from space. In coastal waters where dissolved and detrital materials are optically important constituents of the water column, the standard remote sensing algorithms fail. To validate and tune alternate inversion models and semi-analytical algorithms for remote sensing in LIS, measurements of optical properties and biogeochemical parameters such as spectral absorption and backscatter, chromophoric dissolved material and chlorophyll concentration are being collected at various times of year and locations in LIS concurrently with in situ hyperspectral remote sensing reflectance measurements. Vertical profiles of particle size distribution and biomass are also measured in order to understand the delivery of phytoplankton biomass from the surface to the bottom waters, and the impact on seasonal eutrophication and anoxia.

Cervinia V. Manalo, Ph.D

Advisor: Penny Vlahos

Dissolved Organic Carbon Fluxes in Western Long Island Sound

My research focuses on the chemistry of dissolved organic carbon (DOC) in Western Long Island Sound. To determine spatial and temporal distributions of DOC, water samples were collected at different depths from a 25km² array of sampling stations (5 primary stations and 6 additional stations during intense surveys) within LIS for 3 – 5 consecutive days during March and July 2005 cruises. The main goal of the study is to determine the net carbon flux in LIS. Other aims include determining the major source of OC input in LIS and major sources and sinks of DOC. I also collect samples for nutrient measurements: ammonia (NH_3), nitrate (NO_3^-), nitrite (NO_2^-) and phosphate (PO_4^{3-}). These measurements will be used to assess nutrient distributions and to determine the dissolved organic nitrogen (DON) concentrations. Ratios of OC to ON will be used to infer DOC lability. More details on this component of LISICOS are available in poster session: OS25G-04 Dissolved Organic Carbon Fluxes in Western Long Island Sound by Manalo and Vlahos.

Eric Miller, Ph.D

Advisor: Annelie Skoog

Lignin Analysis as a Measure of Terrestrial Organic Matter in Western Long Island Sound

The study of organic matter in the sediments and overlying water column is vital to better understanding the biogeochemical cycles and their possible links to the hypoxia problem in Western Long Island Sound. Organic matter inputs to the sound are combinations of terrestrial and marine production and exports. One way to differentiate the two sources is through the analysis of lignin compounds. Lignins are biopolymers that are unique to terrestrial plants and can be correlated to terrestrial sources of organic carbon; they can be useful for describing spatial and seasonal changes in a waterbody. To better understand the sinks and sources of terrestrial organic carbon in western Long Island Sound, we are using a new CuO oxidation and HPLC separation method to derive and identify the major components of lignin in the sediments. Identification and quantification of these lignin derivatives may provide a better understanding of the organic matter cycles in this troubled waterbody.

Long Island Sound (LIS) eutrophication

Like many estuaries in densely populated areas, Long Island Sound is eutrophic, and portions of it become hypoxic or even anoxic. The current management plan for LIS assumes a direct link between nutrient reduction and ecosystem restoration. However, our knowledge of LIS nutrient dynamics is insufficient to verify this assumption, does not provide a time-scale for LIS recovery and does not include the effects of non-point sources (about half of the nitrogen loading to the Sound). We know from other studies that large estuaries show system-specific attributes that modulate responses to nutrient enrichment. These are strongly shaped by water circulation, water properties and atmospheric and tidal forcing. Current understanding of the nature and importance of these mechanisms and processes in LIS is minimal. A first step of LISICOS is to build C, N and O budgets in the regions of the Sound that become hypoxic, and to gain a mechanistic understanding of the processes controlling these budgets. The posters presented here contribute different aspects to such undertanding.

LISICOS

The primary objective of LISICOS is to provide accurate nowcasts and forecasts of circulation and the consequent chemical, biological and particulate transport fundamental to issues underlying the management of Long Island Sound.

Specifically, the first year of LISICOS focused on combining the real-time data from UConn's MYSound Project with a numerical model developed under UConn's FRONT Project to predict dissolved oxygen concentrations and the occurrence of hypoxia.

The LISICOS Program is run by a Management Committee which will be consulting with a User Advisory Committee comprised of a number of representatives from a broad cross-section of the user community.

Nathalie Morata, Ph.D

Advisor: Paul Renaud

Sedimentary pigments as biomarkers of eutrophication

The main goal of my Ph.D is to use sedimentary pigments to characterize major ecosystem changes due to eutrophication and global warming.

Eutrophication is characterized by dramatic increases of productivity, high sedimentation rates and anoxia which favour organic matter and pigment preservation. Sedimentary pigments are thus suitable biomarkers to characterize sources and fate of organic matter, and thus to study the eutrophic Long Island Sound ecosystem.

I collect water column and sediment samples. Pigment samples from the water column allow characterizing the actual system by determining the main primary producers. Once fixed, a portion of the production is degraded, another is recycled in the water column and the remainder sinks to the benthos.

The study of sedimentary pigments will then allow determining what pathways followed the organic matter in the water column and in the sediments. Finally sedimentary pigments profiles will help understanding the bioturbation of sediments by benthic organism and the burial rate of organic matter.

Emily, S. Maung, MSc

Advisor: Robert Whitlatch

Benthic processes

The benthos is the focus of my involvement with the LISICOS project. More specifically, I am interested in the fate of the bloom when it reaches the benthos and how that impacts oxygen levels in the western Sound. Along with other benthic team members, I am studying parameters which are useful to monitor this phenomenon. These parameters include potential benthic oxygen demand, benthic biodiversity (see picture below), as well carbon and nitrogen profiles in the sediment. Benthic samples from the five major stations are taken with a multi-corer and analyzed both shipboard and in the lab. Samples are being compared between stations based upon these parameters.

Clymenella (Bamboo worm)

Caroline A. Loglisci, MSc

Advisor: Hans Dam

Zooplankton Fecal pellet mass balance

High zooplankton stocks in eutrophic environments can deliver large quantities of fecal material to the benthos, and provide subtrate for microbial activity in the water column. I am studying zooplankton fecal pellet carbon cycling in LIS. My approach is to measure as many as possible of the rates and stocks required to build mass balances: specifically, production and sedimentation rates and standing stocks of zooplankton and fecal pellets in the water column. The pellet loss term is derived by difference, assuming steady state of pellets in the water column.

Mesozooplankton fecal pellet production: Onboard incubations are carried out both day and night for mixed zooplankton assemblages, and for target species Per capita production and zooplankton stock are used to estimate community pellet production.

Fecal pellet flux downward flux: PARFLUX moored and VERTEX free-floating sediment traps are employed for this purpose.

Fecal pellet distribution throughout the water column: Water is collected at four depths (surface, 5m, 10m, 15m) using a CTD rosette. The samples are filtered through a 30-um mesh and pellet abundance is determined for each depth.

Barbara A. Costas, Ph.D

Advisor: Georges McManus

Using Species-Specific Molecular probes to understand microzooplankton (ciliate) community composition and dynamics

Microzooplankton, specifically oligotrich and choretrich ciliates are an integral part of the ecosystem dynamics of Long Island Sound, playing key roles in the food web as prey, grazers, and nutrient recyclers. Ciliate communities are diverse and dynamic, with rapid changes in abundance and species composition over short temporal and spatial scales. Through the use of species-specific molecular probes we can process a larger number of samples, providing better temporal and spatial sampling than traditional methods.

The molecular approach provides information at the species level, even rare species (<1/L). Initial focus is on the oligotrichs *Laboea strobila* and *Strombidinopsis sp.* and the choreotrich *Favella ehrenbergii*. Results indicate that they have different presence patterns. LISICOS provides an opportunity to sample LIS in conjunction with development of microzooplankton grazing estimates, thus we may better be able to understand what role a particular species has in grazing.

Lilibeth N. Miranda, Ph.D

Advisor: Senjie Lin

Spatial and temporal variability in phytoplankton biomass

The primary objective of this study is to measure the phytoplankton biomass stock in western Long Island Sound. Chlorophyll *a* was extracted from the water samples collected at different depths for 5 stations during March and July 2005 cruises. We also measured the contribution of the different sizes of phytoplankton (<5 µm, 5-20 µm, and >20 µm) to the total biomass. The spatial, vertical and temporal variability of the total and size fractionated chlorophyll will be examined .

Phytoplankton dynamics measured by Real-Time Quantitative PCR.

DNA were extracted from the samples obtained from dilution experiments and the change in the cell concentrations of each species before and after incubation were detected via Real-Time PCR using species-specific molecular primers. The growth rates of specific species were calculated and the grazing impact of microzooplankton on these species was estimated.

ACKNOWLEDGMENTS

LISCOS is funded by NOAA'S COS Program

We are grateful to the captain, officers and crew of the R/V Connecticut for their skillful support during the various cruises. We acknowledge the invaluable help of scientists and technicians.