Temporal Variability in Net Community Productivity on a Coastal Shelf Site as Determined by High-Rate Oxygen and Nitrogen Data

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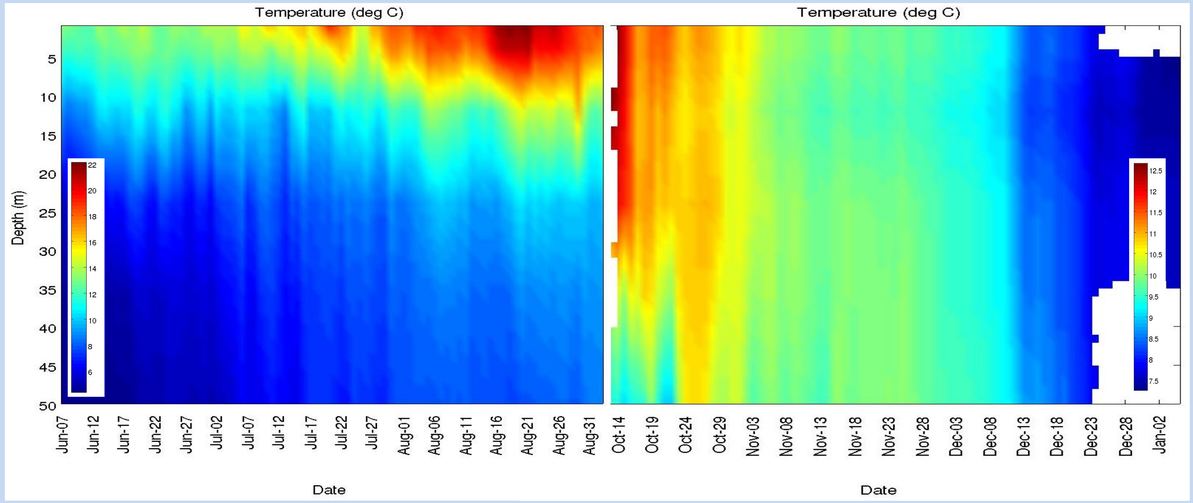
Introduction

-Net Community Production (NCP) is Gross PP minus Community R
- Crucial factor in coastal carbon-cycle studies
- Important in the study of eutrophication and fisheries biology
- Dependent on myriad factors including temperature, solar radiation, dissolved nutrient levels, and community structure

- Several methods exist for estimating NCP in natural waters:
- Light and dark bottles, C14 bottles
- Remote sensing and ocean color
- Ar:O_2 saturation ratios using MIMS (flow through)

- **We estimate timeseries NCP by two methods:**
- **O2 mass balance**
- **N_2:O_2 saturation ratio**



Site and Methods

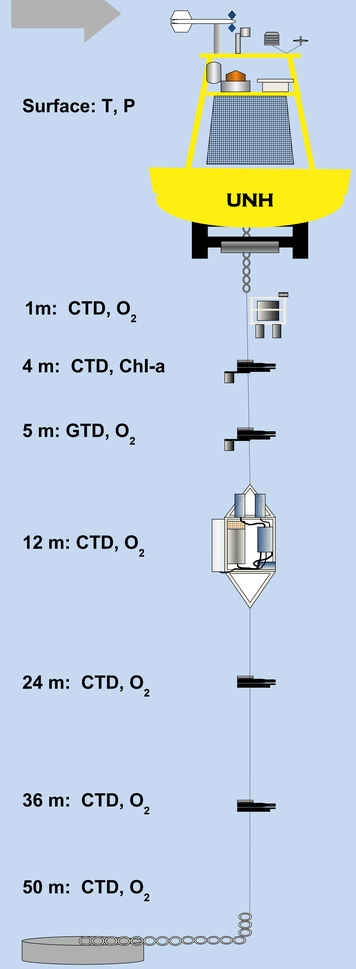
- UNH Coastal Carbon buoy located at 43°N, 70°W
- Approximately 65m depth
- East of Jeffery's Ledge
- Instruments at 1, 4, 5, 12, 24, 36, and 50 meter depth
- Temporal resolution – 10 min
- Two deployments: Spring and Fall 2009

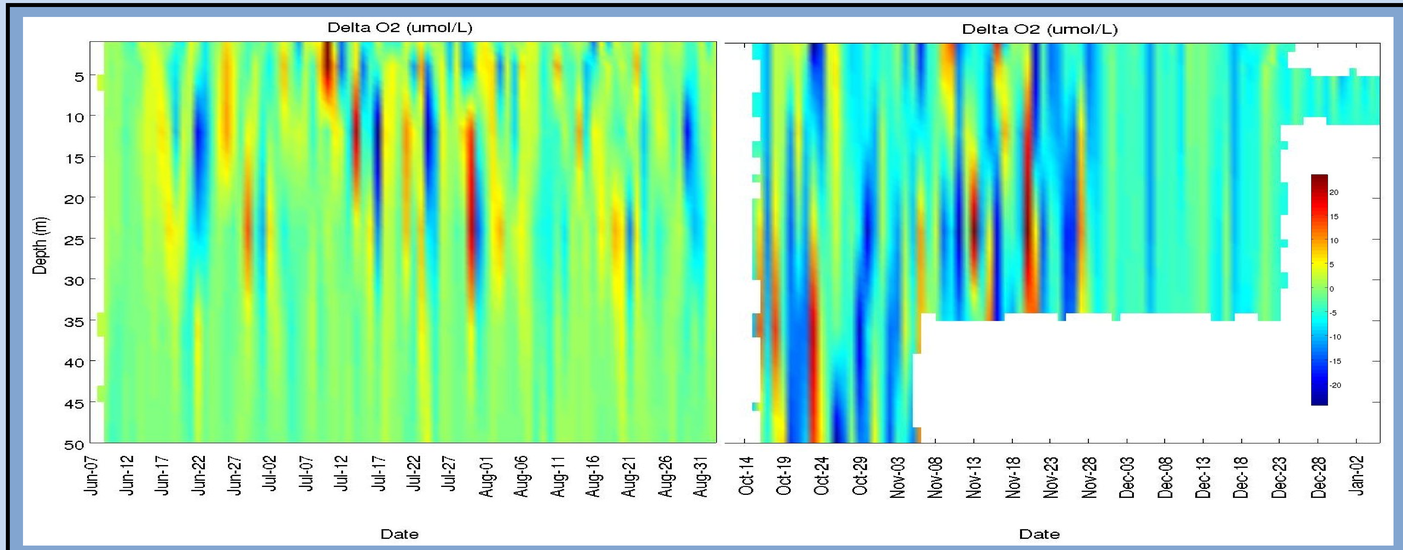
- CTD - Salinity, Pressure, and Temperature

- Optodes for O_2 (Fig. 2)

- Gas Tension Device for N_2 (Fig. 3)
- Measures total dissolved gas pressure
- Total Dissolved Gas - Dissolved O_2 - Dissolved CO_2 = Dissolved N_2

- Wind speed for Air-Sea flux parameterization





Results

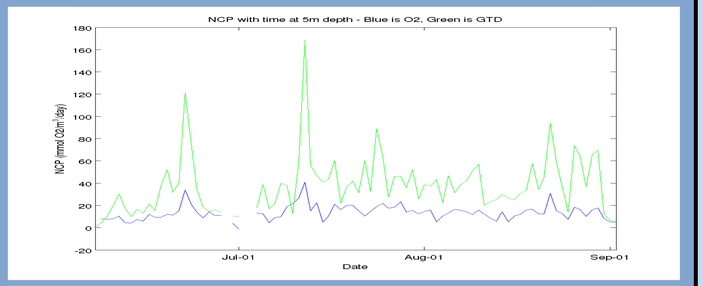
-O_2 saturation spikes in the surface water around July 10
- Expected intense bloom
- Preliminary comparison with sediment trap data
- Dinoflagellate

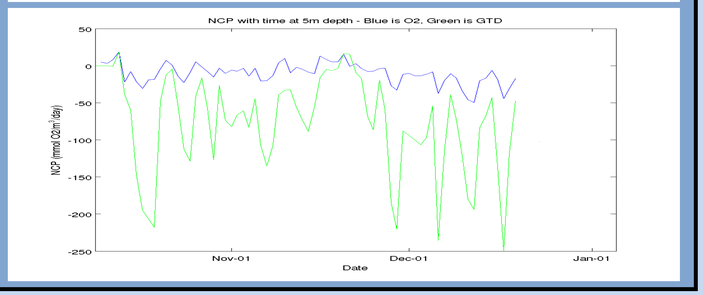
-Mean NCP remains net positive throughout the summer months
-Begins to dip into the negative by the end of August
-Mean NCP remains negative throughout the winter deployment

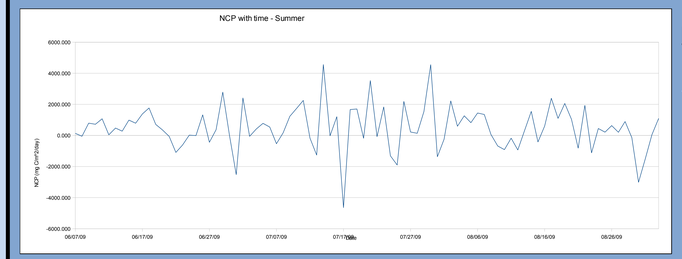
-N_2:O_2 NCP estimates
- Overestimates magnitudes at 5m
- Tracks blooms well in time

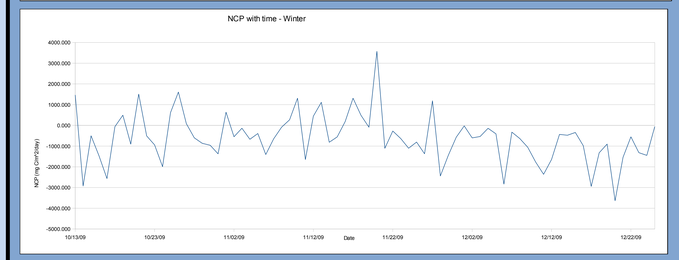
-Future work
- Improve estimates of physical portion of O_2 mass-balance (advection)
- Measure N_2 at multiple depths (multiple GTD's)
- Improve N_2:O_2 estimation method to reflect real differences in physical characteristics

Season	Mean Air-sea mmol O2 m^{-2} d^{-1}	Total Air-sea mmol O2 m^{-2}	Mean NCP mmol O2 m^{-2} d^{-1}	Total NCP mmol O2 m^{-2}
Summer	59.132	5203.6	52.546	4624.02
Winter	-61.029	-4516.13	-65.122	-4819.04









Hypothesis

- Dissolved O_2 is impacted by both physical and biological processes
- Use O_2 mass-balance, estimating physical processes:

$$Z \cdot \frac{d\Delta[O_2]}{dt} = PP - R - F_S - F_Z$$

- Rearranging,

$$NCP = Z \cdot \frac{d\Delta[O_2]}{dt} + F_S + F_Z$$

Z = depth of integration (euphotic zone)
$\frac{d\Delta[O_2]}{dt}$ = Change in O2 departure from saturation with time
PP = O_2 generated by Primary Production
R = O_2 consumed by Community Respiration
F_S = Flux of O_2 outward from ocean surface
F_Z = Vertical eddy flux of O_2

-**If physcial processes alone drive N2 saturation state, it can be used to track those processes:**
- **Use changes in N2 to estimate expected O2 saturation from purely physical forcing**
- **Biological processes account for the deviation of observed O2 from predicted**