

Monitoring Episodic Nutrient Events from Vessels of Opportunity

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Abstract

The University of South Florida, in collaboration with the Gulf of Mexico Coastal Ocean Observing System (GCOOS), has obtained funding to install continuous ocean monitoring systems aboard petroleum tankers that regularly travel between Houston and Florida ports. The SeaKeeper 1000 systems will monitor temperature, salinity, chlorophyll, turbidity, dissolved oxygen, pH, and nitrate, as well as a standard suite of meteorological parameters along the ships' route. Data will be telemetered to shore via satellite and will be made available on the internet in near-real-time.

Introduction

This project was chosen as a high priority pilot for the Gulf of Mexico Coastal Ocean Observing System (GCOOS) a component of the US Integrated Ocean Observing System. All data collected will become part of the GCOOS/IOOS data stream through our node at USF.

This project will instrument two to three tankers that regularly travel between Houston and Tampa with SeaKeeper 1000 automated oceanography and meteorology monitoring systems as described below. The SeaKeeper system collects oceanographic and meteorological measurements and sends the data to shore via satellite. The system allows routine, continuous observation of water property signatures associated with Gulf of Mexico Loop Current intrusions and eddies, Mississippi River plumes, phytoplankton and harmful algal blooms, and provides data for model and satellite calibration/validation.

Other tanker routes travel from Houston-Galveston to Port Everglades. This project could be expanded in the future to cover this route. There are other regular routes that could be instrumented as well, although they are not as regularly traversed by the same ships.



Seakeeper 1000

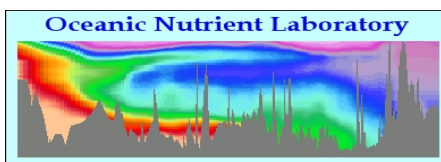
The SeaKeeper 1000 is a complete modular, autonomous, automated surface oceanography and surface meteorology monitoring and telemetering system. The SeaKeeper 1000 converts any vessel into a top performing Volunteer Observing Ship with little or no impact upon the vessel's crew or systems. The basic system includes:

- ❖ a Lloyds approved, through hull, self cleaning seawater gathering and disposal system,
- ❖ a suite of surface oceanographic sensors that measures: sea surface temperature, salinity, pH, dissolved oxygen, REDOX levels (pollution), ocean color (Colored Dissolved Organic Matter), water clarity (turbidity), phytoplankton (chlorophyll) levels,
- ❖ a suite of meteorological sensors for mounting on the mast that measures: wind speed and direction, barometric pressure, relative humidity, air temperature.



The system also includes an INMARSAT C / GPS transceiver, an automated switching system based upon GPS navigation data causes the system to collect data during ocean transects and close down the system when the vessel is entering port or maneuvering slowly, and a computer network link permitting the host vessel to observe the data being collected and transmitted.

The ship is required to supply only AC power at either 120 or 220 Volts and perhaps a monthly cleanout of the flow cell which is automatically flushed with electrically generated Chlorine every 24 hours. The basic system includes a simple suite of physical oceanographic sensors but this is expandable to include up to four additional sensor suites. Available sensor suites include Chlorophyll fluorometers, Nutrient sensors, and even a harmful algal bloom detector sensitive to *Karenia Brevis* the organism responsible for Gulf of Mexico red tides. The USF Oceanic Nutrient Laboratory will integrate the ISUS UV Nitrate Sensor with the SK1000 to monitor nutrient variability along the ship track.



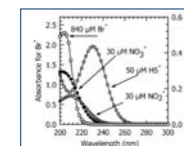
ISUS V2 Nitrate Sensor

Monitoring of sporadic nutrient fluxes with high resolution instrumentation can advance our understanding of complex ecological marine systems, elucidating, for example, cyclic processes affecting riverine nutrient fluxes with markedly different periodicities. The ISUS UV nitrate sensor uses no reagents or complex analytical systems, therefore it is ideal for long-term autonomous deployments. The sensor measures the absorbance of light in the ultraviolet region (215-240 nm) and de-convolutes the absorbance due to nitrate.

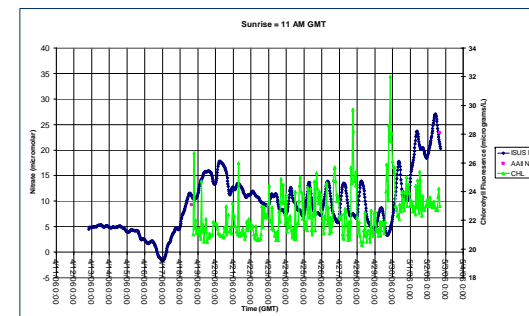
The ISUS sensor was deployed for three weeks on the MARVIN Platform in the Calooshattee River in southern Florida. High resolution data are presented that show variability on daily as well as multiple day cycles. Samples were taken to validate and correct the ISUS signal. High concentrations dissolved organic matter in the river made these discrete measurements necessary, and allowed the signal to be corrected when the de-convolution procedure was inadequate.

UV Detection of Nitrate in Natural Waters
Kenneth S. Johnson*, Luke J. Coletti, 2002. In situ ultraviolet spectrophotometry for high resolution and long-term monitoring of nitrate, bromide and bisulfide in the ocean, Deep Sea Research I 49, 1291-1305.

- ❖ Real-time nitrate concentrations
- ❖ Detection Limit = +/- 2 mM
- ❖ No reagents required
- ❖ Range of concentrations: 0 - 2000 mM
- ❖ DOM yields a positive interference
- ❖ Discrete samples must be analyzed to correct instrument response (22.8 mM offset)



ISUS UV Nitrate Sensor Deployment on the MARVIN Platform, Calooshattee River



- ❖ 50 samples averaged for every data point displayed.
- ❖ Data was corrected for dissolved organic matter absorbance by subtracting the difference between the discrete measurements and the average sensor samples from the same time
- ❖ Chlorophyll tends to increase where nitrate decreases indicating nitrate uptake by phytoplankton

Conclusions

- ❖ Reagent free sensors are preferable for moorings
- ❖ Discrete sampling is necessary to calibrate sensors
- ❖ Variability in nitrate data is seen on multiple day as well as daily time scales