OS11T-12 1135h

How Much of the Ocean Primary Production is Grazed by Mesozooplankton?

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A comparative analysis of the importance of mesozooplankton as grazers of the phytoplanktonic primary production (PP) across a wide spectrum of marine ecosystems revealed mesozooplankton ingestion rates to increase non-linearly with increasing PP. The slope of the log-log relationship between ingestion rates and PP was significantly < 1, indicating a decline of relative importance of mesozooplankton grazing with increasing PP. The impact of mesozooplankton on PP (as the percentage PP consumed per day) is moderate in most of the studies (mode 6%, mean 22.6%), and decreases exponentially with increasing productivity. Contrary to the common assumption, the size barrier imposed by dominant picoautotrophs does not always result in a lower grazing pressure in unproductive communities (we consider here those with PP $<$ 250 mg C/m/d). Yet, the amount of phytoplanktonic carbon ingested per unit of mesozooplankton biomass is lower in unproductive communities than in moderate (250 to 1000 mg C/m/d) and highly productive ones ($>$ 1000 mg C/m/d). This observation, together with the generally low values of daily biomass-specific ingestions, suggests that alternative food sources (e.g., protozoans), must represent an important component of mesozooplankton diet in unproductive ecosystems. The relationships obtained in the study yield an estimate of 5.5 Gt phytoplanktonic C consumed per year in the global ocean, which represents 12% of the oceanic PP.

OS11U HC: 318 B Monday 0830h

Algal Blooms, Red Tides, Brown Tides, and Pfiesteria I

Presiding: **J T Turner,** School for Marine Science and Technology, University of Massachusetts Dartmouth**; D G Redalje,** The University of Southern Mississippi

OS11U-01 0830h

Blooms of the Red Tide Dinoflagellate, *Alexandrium* spp. in the Gulf of Maine, Summer 2001.

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Blooms of the toxic dinoflagellate, *Alexandrium* spp., are common in the Gulf of Maine, and often result in the closure of shellfishing in near shore waters because of paralytic shellfish poisoning. We participated in a regional study of the dynamics of *Alexandrium* in the Gulf of Maine as part of the U.S. ECOHAB Program, and have conducted field work in 1998, 2000 and 2001. Our ship-board surveys conducted in 1998 and 2000 indicated: (1) the densest blooms were mostly offshore phenomena; (2) there were two broad but distinct offshore populations, one in the central Gulf of Maine, and another at the mouth of the Bay of Fundy; (3) *Alexandrium* cell densities were correlated with a nondimensional ratio of light and nutrients (Townsend et al., Cont. Shelf Res. 21: 347-369; 2001). The light-nutrient ratio assumes that growth of this large dinoflagellate is best in both high light and high nutrient environments. Pronounced offshore blooms of *Alexandrium* were observed in summer of 1998, during surveys conducted in June, July and August; cell densities were much lower during the late spring surveys conducted in 2000 (April-May and June), suggesting to us that *Alexandrium* follows the spring diatom bloom. We emphasize here results from our survey conducted in July 2001, which was intended to test the light-nutrient ratio hypothesis against other hypotheses that might explain summertime offshore blooms (advection from an upstream source, competitive interactions between dinoflagellates and diatoms). The hydrographic structure of the Gulf of Maine in July 2001 was different from that observed in July 1998. There were fewer wind events (storms) in 2001 resulting in warmer surface water temperatures and a shallower pycnocline than we observed in July of 1998; we argue that this provided optimum growth conditions, as indicated by the light-nutrient ratio, and indeed, offshore cell densities of *Alexandrium* were greater in July 2001 than in July 1998. We include preliminary analyses of the physical connections between the two offshore patches of cells seen in both 1998 and 2001 (in the Bay of Fundy and central Gulf of Maine) by way of advection of cells within the Eastern Maine Coastal Current. In addition to proposing the light-nutrient ratio hypothesis, we also examine the potential role of different ratios of dissolved inorganic nitrogen and silicate in controlling diatom and *Alexandrium* populations. Coastal waters of the Gulf of Maine are rich in silicate from freshwater sources, and hence support high cell densities of diatoms, but not *Alexandrium*. On the other hand, offshore waters have N/Si ratios of 1.3-1.5, and support high cell densities of *Alexandrium*, but (usually) not diatoms.

OS11U-02 0845h

Planktonic *Alexandrium* spp. Hypnozygote Cysts in the Gulf of Maine: A Shallow Water Trap?

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Hypnozygote cysts are a known part of the life cycle of *Alexandrium* spp. Negatively buoyant cysts purportedly fall to the benthos where they undergo mandatory quiescence. If oxygen is present an endogenous clock initiates germination, after which the newly germinated cells divide and swim, or are advected, to the photic zone, establishing the spring vegetative population. Offshore in the Gulf of Maine (GoM), where blooms are well documented, this paradigm is not entirely adequate. Benthic cyst studies have shown wide distribution of cysts, but the largest concentrations are below 100 m and at the downstream end of the Eastern Maine Coastal Current (EMCC) in which *Alexandrium* spp. typically bloom. Additionally, stratification effectively isolates near bottom water in all but shallow areas and the Bay of Fundy (BoF).

To investigate the occurrence of planktonic cysts, water samples were collected during three cruises in the Gulf of Maine in February, April, and June of 2000. 30 L samples were taken from three depths: 2 m below the surface, 5 m above the bottom, and, in all months but June, the top of the bottom nepheloid layer (BNL). Samples were sonified, stained, and examined for cysts using an epifluorescence microscope. Cysts were widely distributed, although not ubiquitous, in bottom and top of BNL samples throughout the GoM, especially over known benthic cyst beds in the BoF and offshore from Penobscot Bay. Highest densities occurred in February (10^3 m^{-3}); June and April had densities of 10-10^2 m^{-3}. Surface samples only contained cysts in February (10^2 m^{-3}). There was no obvious relationship between hydrography and cyst distribution.

Evaluating the role of suspended cysts in bloom initiation necessitates rough growth calculations. With an average speed of 15 km/d, the EMCC transports a given water mass from the mouth of the BoF to Penobscot Bay in roughly 12 days. Assuming a growth rate of 0.3 divisions d^{-1}, a population could double 3-4 times during that passage. To account for cell densities of 300 cells/L as seen in April of 2000 off Penobscot Bay, for example, 20 cells/L, or 20 cysts/L are necessary in the BoF where the EMCC originates. Observed planktonic cyst densities are 10-10^3. This may not mean that planktonic cysts are unimportant, but rather that some physical mechanism exits allowing vegetative cells to accumulate. The presence of the cyclonic gyre at the mouth of the BoF may be one such mechanism, eddies in the EMCC another.

What is the ecological significance of benthic cysts? Benthic cysts appear to establish annually recurring populations of vegetative cells in shallow water where conditions are favorable. In some areas, benthic cysts likely indicate more about where previous blooms terminated than about where new ones might begin. Benthic cysts are, however, implicated in coastal bloom initiation. The global proliferation of *Alexandrium* and other dinoflagellates in recent decades has been explained by transportation of cysts in ship ballast water. Inherent in this explanation is the assumption that natural populations (including the cyst stage) are inadequate for natural transoceanic movement of *Alexandrium* populations (although this possibility has not been eliminated). These ideas, and observations in the GoM, suggest that the ability of benthic cysts to initiate blooms is trapped by water depth and vertical mixing strength. What remains undetermined is the depth to which benthic cysts are viable as a means of vegetative population initiation. A simple experiment to determine how long a newly germinated cell can survive in darkness could constrain this depth.

OS11U-03 0900h

Trophic Accumulation of PSP Toxins in Zooplankton Size Fractions During Alexandrium Blooms in Casco Bay, Gulf of Maine, April-June, 1998

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As part of the ECOHAB Gulf of Maine regional program, paralytic shellfish poisoning (PSP) toxins were measured in various zooplankton size fractions from Casco Bay throughout the April - June, 1998 red tide period. Toxins in the 20-64 micrometer fraction represented toxic Alexandrium cells, whereas toxins in larger size fractions were associated with various microzooplankters (64-100, and 100-200 micrometers) or mesozooplankters (200-500 micrometers and $>$ 500 micrometers). Toxin levels across all zooplankton size fractions generally increased from low levels in April and early May (3-108 nmol STX equiv/g wet wt), to high levels (19-126 nmol STX equiv/g wet wt) in late May, with declining but in some cases still high levels (undetectable - 446, mean = 2.4 nmol STX equiv/g wet wt) in June. Distributions of toxins in size fractions suggest that Alexandrium was grazed by a variety of zooplankters, including microzooplankters such as tintinnids and copepod nauplii, and mesozooplankters such as copepodites, adult copepods and marine cladocerans. Zooplankton represent an intermediate through which PSP toxins can be vectored to upper-trophic-level consumers such as fish, marine mammals and seabirds.

OS11U-04 0915h

A Multiyear Perspective of Pseudo-nitzschia Populations and Toxin Transfer Events in Food Webs of Central California, USA

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Since mid-1999, our group has been tracking the populations of toxic species in the diatom genus Pseudo-nitzschia in Monterey Bay, California. During this time, there have been multiple blooms of P. australis and P. multiseries, with the former being more common. On several occasions during the blooms we found that domoic acid, the neurotoxin produced by these two species, broadly contaminated pelagic food webs, including krill, fish, and even filter-feeding whales. Furthermore, the diatoms coagulated into flocculent aggregates, which settled to the seabed, where they presumably were available to benthic consumers. Here we show the pattern of occurrence of toxic species and domoic acid over the 2 year time interval, and provide several examples of toxin contamination in regional animal populations.

OS11U-05 0930h

Growth Dynamics of Harmful Algal Blooms off the Gulf of Mexico Coast of Florida

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The dynamics of blooms of the red tide forming dinoflagellate *Karenia brevis* was studied during research cruises conducted off Panama City, Florida in October 2000 and off St. Petersburg, Florida in October

2001. Patches of the harmful algal blooms were identified during surveys conducted at the beginning of each cruise. Surface drifters were used to then follow the bloom patches for several consecutive days. Cell densities during each cruise varied from just less than 1 million cells/L to several million cells/L. Water column integrated primary production, measured daily using 24 hour, sunrise-to-sunrise in situ incubations, ranged from 510 to 613 gC/m2/d during the October 2000 cruise. Carbon specific growth rates, measured using the labeled chlorophyll technique, were generally low, on the order of 0.1 to 0.3 per day. Growth rates determined based on the labelling of chlorophyll and of gyroxanthin diester, the characteristic accessory pigment of *K. brevis*, were comparable, indicating that the magnitude of the community growth rate was dominated by the contribution of the dinoflagellates to the community as a whole.

OS11U-06 0945h

Effects of Nutrient and Light Interactions on the Growth and Photosynthesis of the Brown Tide Organism Aureococcus anophagefferens

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The brown tide alga Aureococcus anophagefferens can use various organic nutrients to support growth. It has been suggested that the brown tide may use these apparent heterotrophic capabilities to grow at light levels too low to support photosynthesis. Though the specific causes of brown tide blooms remain unknown, the interaction of light and nutrients may affect growth and photosynthetic efficiency of the organism, thus contributing to bloom formation and longevity. In this study, two approaches were taken to investigate this interaction. The first approach used a photosynthetron to examine growth of A. anophagefferens under controlled conditions with varying nitrogen substrates (nitrate, ammonium, glutamic acid, urea) and a range of light intensities. The light intensity of optimum growth was determined for the different substrates. The second approach involved examination of brown tide growth at two light levels in medium with varying ratios of dissolved organic nitrogen to dissolved inorganic nitrogen (total concentration of 50 micromolar N added to medium, N and P at Redfield ratio). To examine growth rates, nutrient uptake, and photosynthetic pigment usage, measurements of nutrient concentrations, cell numbers, in-vivo fluorescence, Chlorophyll a, and spectral absorbance were taken. Preliminary results of ongoing experiments indicate that inorganic nitrogen promotes growth to a greater degree than equimolar concentrations of organic nitrogen at most light levels.

OS11U-07 1020h

Growth Patterns and C-14 Absorption Efficiencies of Juvenile Hard Clams, *Mercenaria mercenaria*, Raised on Various Diets Containing Brown Tide, *Aureococcus anophagefferens*.

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Brown tide, *Aureococcus anophagefferens*, is toxic to several bivalves, including hard clams, *Mercenaria mercenaria*, when present in high concentrations. We studied the extent to which *A. anophagefferens* influences the carbon absorption efficiency (AE) and growth of juvenile *M. mercenaria* compared to non-toxic phytoplankton. Absorption efficiency was determined using the C-14/Cr-51 dual-tracer method. Clam growth was determined in the lab from the overall change in tissue ash-free dry weight and monitoring individual shell lengths over time.

Results showed that *A. anophagefferens* negatively influenced the AEs of most algae. In one exception, brown tide had no effect when combined with the species that promoted the lowest AE. These results corresponded well with growth patterns. Diets that promoted the highest AEs promoted rapid clam growth, and diets resulting in low AEs caused poor growth. This implies that *A. anophagefferens* can detrimentally affect *M. mercenaria* not only from causing cessation of feeding, but also following ingestion. These data support field observations in which *M. mercenaria* grew well in the presence of species shown that resulted in good AE and growth.

OS11U-08 1035h

Utilization of FITC-Labeled Lectins to Analyze Cell Surface Glycoconjugate Components of *Pfiesteria* Species

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Carbohydrate binding probes were used to study the distribution of their respective epitopes on the cell surface of the two known toxic *Pfiesteria* spp. Ligand binding profiles of 21 FITClabeled lectins were determined for various morphological stages and functional types in *Pfiesteria* spp. The lectin binding characteristics of accessible cell surface glycoconjugates for *Pfiesteria* spp. were determined for cells collected during maximal growth phase. The cells were fixed with 5% v/v formalin and labeled with 50 ug/mL of FITClabeled lectin. An epifluorescent microscope equipped with a triple-band (FITC-DAPITexas Red) filter set allowed for the visualization of fluorescently bound ligands. For all assays, the first 100 cells observed (n=3) were profiled according to the quality of the staining and lectin localization. Previous research has shown that quantitative lectin binding is a useful tool for phytoplankton identification. In seaweeds, lectins or lectinlike molecules have been shown to be involved in gamete recognition and reproductive cell fusion. In ongoing research on *Pfiesteria* spp., we are examining the potential diagnostic value of differences in lectin binding characteristics to differentiate between morphological stages, or among *Pfiesteria* functional types of varying biochemical composition (e.g., toxic versus nontoxic strains).

OS11U-09 1050h

Comparative toxicity of Pfiesteria spp, long term maintenance of toxicity of P. piscicida and evaluation of toxin stability.

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Toxicity of Pfiesteria piscicida (CAAE #2200, Burkholder) in the presence of fish (tilapia) has been maintained in the laboratory for 19 months by serial transfer of toxic cells using a modified maintenance protocol. Toxicity was re-induced when cells removed from fish tanks were cultured on algal prey for 50 days and then reintroduced to tanks containing fish. Toxicity to fish was demonstrated in filtrates (0.2 μm) however it was markedly reduced in comparison to unfiltered water. Filtrates retained toxicity when stored at -20°C for up to six months. Toxicity to fish was retained when filtrates were held at room temperature for 48h, at 70°C for 30 min. or at 88 $-$ 90°C for two hours. P. piscicida (CAAE #2200) killed all fish species tested. Grass shrimp (Paleomonetes pugio), blue crab (Callinectes sapidus) and brine shrimp (Artemia salina) were unaffected by concentrations of toxin that killed tilapia in 4-24 hours. We confirmed toxicity in a strain of P. shumwayae (#10127C) and demonstrated toxicity in a strain of P. piscicida obtained from a culture collection (CCMP #1834). Toxicity in P. piscicida (CCMP#1834) was observed only after extended incubation in the presence of live fish. Toxicity of filtrates from fish-killing cultures and toxin stability of P. shumwayae and P. piscicida (CCMP#1834) toxins were similar to P. piscicida (CAAE #2200). These results confirm previously reported observations on toxicity of P. piscicida and P. shumwayae and of strain to strain variability in toxicity of P. piscicida. We have maintained toxicity in the laboratory longer than previous reports indicated was routinely possible and we have found the toxic activity to be heat stable. In contrast to other studies we did not observe toxicity to crustaceans.

OS11U-10 1105h

Toxicity and Feeding in the Haptophyte *Prymnesium parvum*

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In addition to being highly toxic to other aquatic organisms, the common brackish water haptophyte *Prymnesium parvum* is an active mixotrophic grazer on various planktonic microorganisms. Feeding activity of *P. parvum* preying on other algal species was investigated in batch cultures and in semicontinuous, nutrient-stressed cultures in order to study the importance of phagotrophic feeding for *P. parvum* and the potential significance of nutrient conditions on it's feeding activity. Toxicity of *P. parvum* was measured by determining the survival of target phytoplankton (*Heterocapsa triquetra* and *H. rotundata*) exposed to *P. parvum* cell free filtrate. Results showed that both toxicity of culture filtrate and feeding activity of *P. parvum* were dependent on cell concentration in the *P. parvum* cultures. If lysis of prey cells was induced through osmotic shock immediately before feeding experiments were performed, feeding activity of *P. parvum* increased up to 10-fold. We conclude that lysis and/or immobilization of prey cells was the primary trigger of food uptake in *P. parvum*, whereas nutrient conditions in the culture medium were of minor importance. Since *P. parvum* is a poor swimmer and since it possesses no known mechanisms to capture live, swimming prey, one function of toxin production in the species may be to immobilize and kill prey prior to ingestion.

OS11U-11 1120h

Identifying Regions of Population Growth of the Red Tide Dinoflagellate, *Noctiluca scintillans*, Using Cell Diameter as a Tracer

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Spatial abundance patterns of the red tide dinoflagellate, *Noctiluca scintillans*, were investigated along the south-east coast of Australia to address the hypothesis that population growth of *Noctiluca* is caused by anthropogenic eutrophication. Abundance patterns were correlated with the immediate physical flow field and not the immediate nutrient conditions conducive to growth, highlighting the strong probability of obtaining erroneous trends from the abundance data. *Noctiluca* cells were advected southward with the East Australia Current, which was the dominant transport vector for the cells in this region. Cell size distributions of *Noctiluca* were used to trace the path of advected cells, and more specifically, to identify the region in which population growth was initiated. Small cells (< 525 micron) were considered to be young and capable of population growth, in contrast to red tide cells which are known to be large (> 600 micron) and senescent. Small cells were therefore considered to be located closer to the region in which growth was stimulated and thus closer to the nutrient source. A high proportion of small cells was always found in areas with high phytoplankton biomass. Consequently, this relationship was used to show that population growth of *Noctiluca* may be caused by sewage discharge, although the prevailing hydrological conditions determined the likelihood of such impacts. In most cases, *Noctiluca* was dominant in areas with no sewage discharges into coastal waters. Diffuse estuarine nutrient sources also sustained small *Noctiluca* populations within estuaries, which seeded depleted oceanic stocks. Thus by using a cell size approach, the variance in the spatial abundance patterns of *Noctiluca* in a dynamic hydrological environment was identified and interpreted.

OS11U-12 1135h

An experimental approach to understanding bloom maintenance or decline

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Large chain forming centric diatoms, mostly Thalassiosira spp., are typically the biomass dominants during prolonged blooms in the North Water polynya, the largest recurring region of ice-free water in the Canadian Arctic Ocean. We used an experimental method based on semi-continuous cultures to investigate possible mechanisms responsible for bloom maintenance in this system. Specifically, our objective was to test whether a large-cell bloom could be maintained under an episodic advective regime with losses of all planktonic size-classes on the same scale as nutrient inputs. We compared this scenario to one of a community with nutrient recycling and substantial losses of only larger cells, for example by sedimentation or zooplankton grazing. We followed macro-nutrient utilization, along with production by bacteria, viruses and protists including phytoplankton. Over the 8 days of the experiment the eukaryotic community production in the recycled treatment was able to keep up with the imposed losses, but the community shifted to one dominated by dinoflagellates and ciliates. In the advective treatment, Thalassiosira spp. production continued to increase using the added nutrients and the production exceeded total community losses. There were no differences in net bacterial or viral production between treatments. This implies that advective processes underlie the persistent blooms of Thalassiosira in the North Water polynya, and other large-cell diatoms in similar oceanic environments.

OS12A HC: Hall III Monday 1330h

Recent Advances in Ocean and Freshwater Science Instrumentation

Presiding: **H L Clark,** National Science Foundation**; A Isern,** National Science Foundation

OS12A-100 1330h POSTER

Surface-Following Acousto-Optic Probe for Microbubble and Surface Layer Process Studies

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We have developed a surface-following spar buoy to investigate microbubble populations in relation to air-sea gas exchange processes and ocean colour. Primary bubble sensors are a prototype broadband sonar operating in two frequency bands (300-700 kHz and 1.5-4 MHz) and a special-purpose three-strobe digital camera with sub-micron resolution. Submerged and subaerial hyperspectral measure upwelling and downwelling irradiance. Ancillary sensors monitor water temperature, salinity, gas tension, tilt and axial acceleration of the spar. The onboard data acquisition system combines PC104 and passive-backplane PC technologies, running QNX and Windows-NT respectively. The probe was deployed from RV Endeavor, as part of the Hyperspectral Coastal Ocean Dynamics Experiment (HyCODE) in July-August 2001. Over 3 GBytes of data were collected, in wind speeds up to 20 knots. For HyCODE, the probe was operated from the ship with a 100-m long power/telemetry tether to the ship. Communications between the onboard computers (the central QNX-based node and a Windows-NT thin-client) and the probe-based computers were via Ethernet. Future intended developments of the surface layer microbubble probe include a hardwired moored configuration for longterm observations in the coastal zone, and an autonomous drifter configuration for short-term event-based studies.

OS12A-101 1330h POSTER

A Coastal-Water 10m Range PIV Turbulence and Stress Profiler

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A submersible Particle Image Velocimetry (PIV) system for measuring the velocity distribution and turbulence in the bottom boundary layer and part of the water column in the coastal ocean has been developed and deployed. PIV measures the instantaneous distribution of two velocity components within a sample area. The resulting 2-D vector fields enable us to calculate spatial turbulent spectra and distributions of Reynolds shear stresses (following a procedure described in another presentation - Nimmo Smith et al.), both of which are not contaminated by surface waves. The submersible PIV system has evolved over several years from an original configuration, using one camera with a limited sample area (0.2x0.2m), capable of profiling up to 1m above the sea bed, to a system utilising two higher resolution cameras, and a profiling range of 10m.

The present version of the submersible system comprises two 2Kx2K pixels, 12bits/pixel digital cameras operating simultaneously, each with a sample area of up to 0.5x0.5m. When the two sample areas are aligned horizontally in the same plane, and spaced 1m apart, they enable us to resolve turbulent scales ranging from 8mm (the vector spacing) to 1.5m. The light source of the PIV system is a pair of flashlamp-pumped dye lasers located at the surface, whose beams are transferred to each of the sample areas using two independent optical fibres. Submerged probes are used for expanding the beams into light sheets. In the present configuration we record two exposures within each frame of the digital cameras. To remove directional ambiguity a hardware based 'image shifter' creates a known fixed offset between exposures on the CCD array. Naturally occurring particles are used as tracers. The cameras can capture up to 4 frames/s, requiring a total image acquisition rate of 64Mb/s. The data is stored using ship-board hard disk arrays. Data analysis is based on calculating the auto-correlation function of the intensity distributions in subsections of the image. The calculated velocity distributions are then corrected for optical distortions in the original images. Errors associated with the out-of-plane component of the velocity are minimised by limiting the thickness of the light sheets (to 2.5mm), restricting the sample areas (to about 35cm square), and setting a minimum of the camera to light sheet separation of about 1m.

The components of the PIV system are mounted on a rigid sea bed platform, which enables us to align the sample areas with the direction of the mean current. The profiling range has been extended from very close to the bottom up to 10m above the bed. The elevation is controlled using a rugged, double-acting, telescopic hydraulic cylinder mounted vertically on a heavy tripod base. The instrumentation is mounted on a rigid framework suspended from a turntable at the top of the cylinder. The system also includes a CTD, transmissometer, precision pressure transducer, compass and video camera for monitoring the flow direction. During recent deployments we also installed airfoil turbulence probes and profiled the entire water column using ship-board CTD and ADCP. A 60m umbilical, containing hydraulic, power, fibre-optic, control and data lines, links the submerged instrumentation to the support vessel. The compact size of the platform when fully retracted, 3x2x2.75m, allows it to be deployed from a moderate-sized coastal research vessel.

This system has been deployed in the vicinity of LEO-15 twice during 2001 and once during 2000. Overall 1.2 TB of PIV data were collected. Sample results will be presented. More details are provided in (Nimmo Smith et al.).

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A Unique Approach to Long-Term Turbidity Measurements

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An extensive study to determine the fate of a mixed-sediment dredged material placement mound is underway at the Cape Fear River experiment site, off the North Carolina coast. A critical component includes assessing the mound and ambient turbidity levels, which are important to fish, larvae, and habitat. The approach has been a unique application of the DRL-Sediview method to obtain long-term (months to years) solids concentration data from an array of bed-mounted ADCPs at varying distances from the mound and river mouth. Initial calibration and verification of the technique has involved the LISST-100 and LISST-25 laser concentration and size sensors, an OBS optical concentration sensor, and bottle water samples analyzed by filtration and weighing. The results, including the first attempt to get mean particle diameter from the LISST-25, show a high level of consistency between the methods. This paper will describe the methods and present the multi-sensor results. Data of this kind are to be incorporated into fate and plume models that require suspended particle size as well as concentration.

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HydroScat-4: A New, Four-Wavelength Optical Backscattering Sensor for Both Profiling and Long-Term Mooring Applications

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The HydroScat-4 is the third and newest model in our line of HydroScat backscattering sensors. The HS-4 measures optical backscattering at four wavelengths, which can be chosen from a large set ranging from 420 to 880 nm. Wavelength options also include pairing a shorter-wavelength excitation source with a longer-wavelength emission receiver to measure fluorescence (hence this option is a combined three-wavelength backscattering sensor and fluorometer). Like the HS-6 and HS-2, the HS-4 is calibrated with a robust and well-tested method to provide measurements of the VSF at a nominal angle of 140 degrees which is converted to the backscattering coefficient [Maffione and Dana, 1997, Applied Optics, 36: 6057-6067]. It also retains the unmatched sensitivity (typically 0.0005 m1) and background-light rejection of the HS-6 and HS-2. Like those instruments, the HS-4 includes internal rechargeable batteries, internal data logging, and intelligent real-time interfacing. Moreover, it includes significant advances over current multi-wavelength optical backscattering sensors. For mooring applications the HS-4 incorporates a copper shutter system that prevents fouling of the optical windows. The instruments micro-computer automatically opens the shutter during data sampling, and closes it, covering the windows, during idle times. Considering all these capabilities, it is very compact, measuring only 5 in diameter by 12.6 long. The HydroScat-4 promises to be a uniquely powerful new tool for a wide range of research and ocean monitoring applications.

URL: http://www.hobilabs.com/products/hydroscat4/hydroscat4.html

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A Profiling Optical and Water Return (POWR) Package for In-situ Optical Characterization of Coastal Waters: Results From First Field use During the 2001 HyCODE Experiment at LEO-15

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