firming the springtime component of the seasonal rectification hypothesis (Yager et al., 1995) suggesting that the Arctic is a climate-sensitive sink for atmospheric CO2.

OS21D-71 0830h POSTER

Colloidal Fe accounts for a significant part of dissolved organic Fe-Complexes in the Southern Ocean

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Previous studies have shown that the chemical speciation of dissolved iron (Fe) is dominated, at the thermodynamic equilibrium, by the organic complexation in the oceanic waters (Rue and Bruland, 1995, 1997; Gledhill and van den Berg, 1994; Wu and Luther, 1995 ; Witter and Luther, 1998; Boye et al., 2000; Gledhill et al., 1998; van den Berg, 1995; Witter et al., 2000). In those studies, the organic speciation of iron was determined either in 0.45, 0. 3 or 0.2 microm filtered waters, currently defined as the dissolved pool. But it is not known whether the Fe-binding organic ligands (L) and the organic iron (FeL) are trully dissolved (soluble <200 kDa) or are small organic colloids (>200 kDa - <0.2 microm). This was investigated in this study with, for the first time, concomitant determinations of the organic speciation of Fe in both the soluble and the small colloidal fractions. Distributions at depth (0-1000 m) of the size-fractionated Fe and organic Fe-binding ligand were established in the ambient seawater at 4 stations located in the Atlantic sector of the Southern Ocean during the late austral spring [ANT18-2, RV Polarstern, Nov. 2000]. The physical speciation of iron showed that dissolved Fe (<0.2 microm) occurs predominantly in the smallest size-fraction, with soluble-Fe representing about 62% of dissolved-Fe. However, this fraction tends to decrease with depth to the benefit of colloidal-Fe (colloidal Fe = 15-83% of dissolved Fe below the euphotic layer). The size-fractionation of the dissolved organic ligand was dominated by soluble ligands at all depths, with 84.0% of dissolved-ligand concentration being smallest than 200 kDa. But the small colloidal organic ligand (>200 kDa-<0.2 microm) represented a significant fraction of the dissolved pool (about 4 to 35%), and this fraction tends to increase with depth (13 to 35% of the dissolved-L below 100 m). The organic speciation of dissolved iron as calculated at the thermodynamic equilibrium was dominated by the organic complexation, 99.6% of dissolved-Fe being complexed by the dissolved organic ligand. Separate calculations of the organic complexation of soluble and colloidal Fe also showed that soluble and colloidal Fe occured predominantly in organic complexes with soluble and colloidal organic ligand respectively. The size-fractionation of dissolved-Fe and its organic speciation are discussed in terms of geochemical impact and bioavailability of Fe for the antarctic biomass.

OS21E HC: Hall III Tuesday 0830h

Multidisciplinary Ocean Observations and Observatories III

Presiding: **S Riser,** University of Washington**; J Delaney,** University of Wasington

OS21E-100 0830h POSTER

Freak Waves in the Ocean - We Need Continuous Wave Measurements!

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Freak waves, sometimes also known as rogue waves, are a particular kind of ocean waves that displays a singular, unexpected, and unusually high wave profile with an extraordinarily large and steep trough or crest. The existence of freak waves has become widely known while it invariably poses severe hazard to the navy fleets, merchant marines, offshore structures, and virtually all oceanic ventures. Multitudes of seagoing vessels and mariners have encountered freak waves over the years, many had resulted in disasters. The emerging interest in freak waves and the quest to grasp an understanding of the phenomenon have inspired numerous theoretical conjectures in recent years. But the practical void of actual field observation on freak waves renders even the well-developed theories remain unverified. Furthermore, the present wave measurement systems, which have been in practice for the last 5 decades, are not at all designed to capture freak waves. We wish therefore to propose and petition to all oceanic scientist and engineers to consider undertaking an unprecedented but technologically feasible practice of making continuous and uninterrupted wave measurements. As freak waves can happen anywhere in the ocean and at anytime, the continuous and uninterrupted measurements at a fixed station would certainly be warranted to document the occurrence of freak waves, if present, and thus lead to basic realizations of the underlying driving mechanisms.

OS21E-101 0830h POSTER

Shore-based Mapping of Ocean Surface Currents at Long Range using 5 MHz HF Backscatter

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Increasing use has been made of HF radio-wave techniques to remotely sense ocean surface currents, from the Doppler shift they impose upon backscatter. Radio frequencies of 11-26 MHz have been most commonly used in commercial instruments such as SeaSonde, OSCR, and WERA; these typically allow current mapping to ranges of O(50km).

Recently, we have been operating an array of three SeaSondes designed for lower frequencies, near 4.8 MHz, between Winchester Bay, Oregon (43.7N) and Pt. St. George, California (41.8N). This mode of operation results in greatly extended range, to O(180km). Preliminary comparisons with data from upward-looking ADCPs show a strong correlation at subinertial frequencies; the SeaSonde, measuring the upper 2m, shows somewhat higher energy in the tidal/inertial band than the ADCP data, measured at 9m. Contrary to expectation, these locations have not shown a strong diurnal modulation in range.

Intermittent signal degradation of a type not seen at 11-28 MHz affects a fraction of the data. This degradation appears to be due to scattering from the lower layers of the ionosphere, and results in distinctive distortions of the cross-spectra. Data screening techniques based on these distortions are being tested.

OS21E-102 0830h POSTER

Coupled Physical/Bio-Optical Model Experiments at LEO-15

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A coupled Atmosphere-Ocean-Ecosystem high resolution model is used to study the inherent and apparent optical properties (IOPs and AOPs) associated with recurrent summer upwelling events off of the New Jersey Coast. The physical and bio-optical data gathered by the observational network at the Long-Term Ecosystem Observatory (LEO-15) is used to initialize, update, and validate the coupled system (COAMPS/ROMS/EcoSim). A series of real-time, atmosphere-ocean nowcasting and forecasting experiments were carried during July 2001 as part of the HyCODE adaptive sampling program. The forecasting schedule was tuned to the data sampling strategy which required a three-day forecast twice a week. The overall predictive skill of the atmosphere-ocean system was improved by increasing the horizontal resolution of the atmospheric model (COAMPS) to 5km, when compared to previous year resolution of 40km. The bio-optical simulations using EcoSim were done in hindcast mode.

URL: http://marine.rutgers.edu/cool/hycode2/hycode2.html

OS21E-103 0830h POSTER

Use of time derivative and local velocity in mapping a 2-D field

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A near-continuous measurement from a stationary observation platform allows estimation of the time derivatives. Additional co-measurement of the current velocity can lead to a constraint on the local spatial derivatives, as well. The effects of these derivative estimates on spatial structures of the measured field is investigated in this presentation. Twin experiments are conducted for the evaluation, and methods based on a simple spatial interpolation and a Kalman-filter assimilation are considered. Sensitivity of the derivative estimates to high-frequency variations (e.g., noise) is examined.

OS21E-104 0830h POSTER

Microwave SSTs: Current Achievements and Future Expectations

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The TRMM Microwave Imager (TMI) has produced passive microwave observations at 10.7, 19.4, 21.3, 37.0, and 85.5 GHz since December 1997. Accurate retrievals of sea surface temperature (SST) can be made in all weather conditions except rain. Microwaves penetrate clouds with little attenuation, giving an uninterrupted view of the ocean surface. This is a distinct advantage over infrared measurements of SST, which are obstructed by clouds. Comparisons with ocean buoys show a root mean square difference of about 0.57°C, which is partly due to the satellite-buoy spatial-temporal sampling mismatch and the difference between the ocean skin temperature and bulk temperature. The combination of 1-micron (infrared), 1-mm (microwave) and 1-meter (buoy) SSTs is yielding a better understanding of the ocean skin layer. Microwave SST retrievals are of adequate resolution and accuracy for a high-quality, long-term dataset for climate studies. Future missions (ADEOS-II, AQUA) will include microwave radiometers also capable of SST retrieval. Furthermore, an additional channel at 6.9GHz will increase accuracy, especially at temperatures below 10°C.

URL: http://www.remss.com

OS21E-72 0830h POSTER

ANAIS : Autonomous Nutrients Analyzer In Situ

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The ANAIS instrument is devoted to an autonomous, long-term in situ monitoring of the ocean. We are particularly interested in measuring dissolved nutrients, key players of the oceanic carbon cycle. This led us to develop a chemical analyzer ANAIS, able to measure simultaneously dissolved nitrates, silicates and

phosphates. It is adapted onto the vertical YOYO profiler (LODYC, CNRS, France) within the YOYO 2001 project. YOYO 2001 is an autonomous in situ multidisciplinary ocean observatory which provides mesaurements of fundamental physical ,bio-optical , geochemical and biological variables over the top 1000 m of the water column. ANAIS can be adapted on any Lagrangian profiler. After successful in situ tests in 1998, a YOYO/ANAIS NO3 mooring was deployed over a 2-weeks period in the Mediterranean Sea in October 1999. Conception, methodolgy and results will be presented and discussed.

OS21E-73 0830h POSTER

Physical Oceanographic Constraints for Dispersal of Organisms and Chemical Species at the Endeavour Segment (Juan de Fuca Ridge)

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The Thermal Grid Experiment developed as an interdisciplinary project with the main goal of quantifying the heat flux out of a segment of the Juan de Fuca Ridge between the vent fields of High Rise (HR) and Main Endeavour (MEF) and was realized in a two-year field program in the summers of 2000 and 2001. As a part of this study, data was collected and experiments were designed to characterize the various flow scales that influence not only the transport of heat but also of organisms (larvae) and chemical species. A high resolution CTD survey was conducted at a constant altitude of 20 m which covered the ridge valley and its walls. The currents in the bottom boundary layer (BBL) were measured by MAVS (modular acoustic velocity sensor) and an ADCP (acoustic doppler current profiler) was used to measure the interior flow in the valley up to 300 mab. This velocity data was complimented by a tidal prediction. Detailed along valley tow-yo surveys provided insight into flow structures of a larger scale.

Patterns of larval dispersal will be determined by the variety of scales of motion found in the ridge valley. Upward motion can take the form of shimmering diffuse flow (1 cm/s), vertical flow induced by topography (observed to reach 2 cm/s), and high temperature, point source, convective plumes that penetrate up to 300 meters above the bottom with velocities observed to reach 5 cm/s. Lateral motion is largely, but not solely, tidal and can advect larvae already suspended in the water column into the vicinity of black smokers where they are entrained in the rising plume. Horizontal flows can interact with topography not only to create upward motion, but also to transport plume water back into the BBL. Lateral dispersal of larvae by tidal currents, of the order measured here (5 cm/s) is limited to distances of 350 m. Hence, tidal currents alone would not suffice to transport larvae between major hydrothermal vent fields. However, volumes of plume water with widths of order the Rossby radius of deformation ($\sim$ 1 km) have been observed between the vent fields of MEF and HR. These eddies retain plume water and may be able to transport larvae between vent fields.

OS21E-74 0830h POSTER

Discovering and Surveying Submarine Groundwater Discharges in the Baltic Sea using a new 'Schlieren Optic' System

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Submarine groundwater discharges have recently shown to be an important process in many coastal ecosystems. The discovery of fluid discharges and the characterization of their fluid flow pattern is a frontier of current research. In this study we use a new optical device to detect submarine groundwater discharges and to survey its distribution in the ambient bottom water. The so-called 'schlieren optic' is sensitive to density gradients and thus to heterogeneous water masses since the refraction index of water correlates with its density. The optical system consists of a camera with a time-lapse controller, a light source and two spherical mirrors. Light beams running through heterogeneous water masses will be differently refracted by the escaping fluids. Hence, the flux of groundwater into the denser bottom water can be detected with high resolution. To quantify the fluid flow rate, a funnel was integrated into the optical pathway to focus the released fluids. If the system is deployed above a suspected seep site, the funnel is located directly on the sediment surface. The smaller exhaust port at the top is visible on the video screen. Escaping fluids are channeled through the funnel and their borders are visible as 'schlieren' due to the density gradient between both fluids. Through image processing it is possible to estimate the water discharge rate from the particle velocities.

Numerous groundwater seeps are known in the 'Eckernförde Bay' of the Baltic Sea. Up to now, only very strong fluid discharges that form 'Pockmarks' can be detected by echo sounder systems. However, the new 'schlieren optic' technique is sensitive enough to locate much less active groundwater seeps. The system has been deployed at many stations around known 'Pockmarks'. The discharged fluids were detectable even at a distance of several hundred meters. Furthermore, we discovered new seep locations and localized them by quantifying the fluid discharge.

With this new technique, a much more detailed investigation of submarine groundwater discharges is possible. The 'schlieren optic' system represents a very sensitive instrument to visualize dewatering processes with small density anomalies. The described fluid discharges can now be detected and surveyed with higher resolution in time and space.

OS21E-75 0830h POSTER

Coastal Ocean Research and Monitoring Program at the University of North Carolina at Wilmington

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The Coastal Ocean Research and Monitoring Program (CORMP) is a research program and observing system in the coastal ocean off the Carolinas. The program is funded by NOAA to provide an inter-disciplinary science-based framework that supports sound public policy, wise coastal use, sustainable fisheries and improved coastal ocean ecosystem health.variables of CORMPs monitoring efforts include: physical processes (meteorological and oceanographic), ocean color, water quality (e.g., nutrients, turbidity), irradiation, sediment types, benthic ecology and larval fish distribution. By the end of 2001, the programs observing system will consist of monthly coordinated (multi-disciplinary) surface-based and underwater sampling transects, and a series of long-term moorings in Onslow Bay and Long Bay off North and South Carolina

URL: http://www.uncwil.edu/cmsr/comp

OS21E-76 0830h POSTER

Orbit Design Analysis for Future Altimeter Missions

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Satellite altimetry has proven to be an accurate and vast source of data related to sea level variations. Currently, measurements are being made in 3 distinct groundtracks: TOPEX/Poseidon (T/P) with a 9.9 day repeat period, ERS-2 in a 35-day repeat period, and Geosat with a 17-day repeat period. Jason is being launched to continue observations along the T/P groundtrack until 2005, while Envisat will continue measurements along the ERS-2 groundtrack. After 2005, a Jason-2 mission continuing in the T/P groundtrack is planned. After 2010, there is no planned mission to continue in the T/P groundtrack. However, an altimeter is planned to be placed on a National Polar-orbiting Operational Environmental Satellite System (NPOESS) platform in the 2010 era. Another option being studied is to place an altimeter on an independent platform designated Ocean Observer Mission (OOM). Both concepts are planned as operational missions and will be flown in very different orbits from previous altimeter missions. The goal of this investigation is to examine the effect of the orbit parameters (altitude, inclination, repeat period, groundtrack spacing) on various oceanographic signals such as coastal and deep water ocean tides, Rossby waves, mesoscale variability, and global mean sea level change in order to quantify expected measurement accuracy. The investigation will also present recommended orbital parameters for both the NPOESS and OOM altimeters. In particular, the effects of tidal aliasing on the recovery of tides will be addressed, as will the effect of unmodelled geoid gradients on calibration and the continuation of long time series of global mean sea level change.

OS21E-77 0830h POSTER

An Underwater Winch for Estuarine Research

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The design and performance of a newly developed underwater winch are presented. This estuarine design profiles from the ocean bottom to the sea surface in water up to 20 meters deep. At maximum water depth, the winch can make 1440 profiles with a 3500 watt-hr. alkaline battery. Although simple in design, a unique concept is implemented to give the winch wave following capability. The winch attempts to maintain constant line tension by applying a back torque on the winch drum when the buoy is on the surface. With this capability hockling and entanglement of line is decreased and data telemetry becomes more robust.

This winch is used with a buoyant instrument and communications package to make time-series measurements with continuous vertical resolution. Environmental parameters including salinity, temperature, chlorophyll fluorescence, suspended sediments and dissolved oxygen are going to be measured. Real- time data telemetry will be provided by cell phone transmission.

OS21E-78 0830h POSTER

A Comparison of the Operational and Experimental COAMPS Meteorological Forecasts at LEO During 2001 HYCODE Experiment

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Real-time forecasts with the Operational (FNMOC) and high-resolution Experimental (NRL-MRY) versions of the Navy Coupled Ocean Atmosphere Prediction System (COAMPS) were generated during the July 2001 Hyperspectral Coupled Ocean Dynamics Experiment. The oceanographic experiment centered on the New Jersey coastline at the Rutgers University Long-term Ecological Observatory (LEO) located in Tuckerton, NJ. The ensemble of Navy forecasts and standard NOAA forecasts were used to plan aircraft and shipboard operations, and to drive the Regional Ocean Modeling System (ROMS). The higher spatial and temporal resolution of the Experimental COAMPS showed a substantial improvement in the accuracy of forecast wind speed and direction, temperature, and relative humidity during the eight cycle experiment. Both the Operational and Experimental versions of the COAMPS model showed approximately equal skill in resolving synoptic scale features such as low-pressure areas associated with frontal systems. The high-resolution Experimental COAMPS performed exceptionally well in forecasting the variations and movement of mesoscale phenomena such as the New Jersey coastal sea breeze. The substantial gains of the higher spatial and temporal resolution at the mesoscale level, combined with the negligible losses in the resolution of larger scale atmospheric phenomena, indicates the Experimental COAMPS was a valuable tool for guiding research activities during the HYCODE experiment.

URL: http://marine.rutgers.edu/cool

OS21E-79 0830h POSTER

Validation of an Atmosphere-Ocean Forecast Model at the Longterm Ecosystem Observatory

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Results from the Rutgers Regional Ocean Modeling System (ROMS) were quantitatively compared with an independent cross-shelf mooring array to validate available model ensemble schemes. ROMS was run in real-time during the July, 2001 Coastal Predictive Skill Experiment (CSPE) with surface forcing supplied by a high-resolution regional implementation of the Navy's COAMPS model. Available options for surface mixed layer dynamics in summer 2001 included the K Profile Parameterization (KPP) and the Mellor-Yamada level 2.5 closures. Real-time satellite-derived sea surface temperatures, CODAR-derived surface currents, and subsurface CTD data from the Rutgers University Long-term Ecosystem Observatory were assimilated to generate an ensemble of 3-day ocean forecasts twice per week for adaptive physical/biological sampling by ships, autonomous underwater vehicles, and aircraft. Each forecast cycle was evaluated in real-time using a stationary continuous CTD profiler. Further validation of the quality of the ocean model forecasts and subsequent hindcasts are being assessed through comparisons with a cross-shelf array of ADCPs and thermistors not included in the assimilation data set.

The coastal ocean offshore New Jersey in July is characterized by a strong pycnocline located at a depth of 5-8 m. It responded as a two-layer system to several wind events during the month-long experiment, alternately causing upwelling of cold water or downwelling of warm water at the coast. The strongest wind event of the July 2001 CPSE was the formation of a low-pressure system that moved quickly offshore to the east. The downwelling favorable winds were observed to rapidly force the resulting bottom front through the cross-shelf validation array. Quantitative model metrics for a two-layer system were developed to evaluate model performance using the independent cross-shelf mooring array. The result is an extensive database for the evaluation of different closure schemes, data assimilation methodologies, and boundary conditions. Preliminary comparisons with the real-time ocean forecasts indicate that the KPP closure scheme reproduced the timing of the upwelling and downwelling events with sufficient accuracy to improve adaptive sampling during the experiment.

URL: http://marine.rutgers.edu/cool

OS21E-80 0830h POSTER

Validation of CODAR Wave Measurements: Comparison to Pressure Sensor, ADCP and NOAA Buoys

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Two 25 MHz Coastal Ocean Dynamics Applications Radar (CODAR) systems have been operating since 1998 off the southern New Jersey coast as part of the Rutgers University Long-term Ecosystem Observatory (LEO 15). One system is located in Brant Beach NJ, the other is located about 26 km south in Brigantine. It has been demonstrated that first-order Bragg peaks of the returned signal are used to derive ocean surface currents. Additionally second-order sea echo can be used to derive information about the directional wave spectra. The shallow water environment of the New Jersey shelf requires inclusion of the full dispersion relationship in the CODAR wave spectral calculations.

Directional wave spectra derived from the two CODAR systems were evaluated by comparing to local measurements from an RD Instruments moored ADCP and a ParoScientific pressure sensor located at LEO-15. Additionally, CODAR estimates were compared to remote measurements from two data buoys maintained by the National Data Buoy Center (NDBC) located offshore of Long Island and Delaware Bay. Directional wave spectra are being compared for significant wave height, peak period, frequency spectral shape, and mean direction as a function of frequency. This was done during varying sea states: calm and storm seas, swell and wind seas, as well as mixed seas to evaluate system performance. Preliminary analysis indicates that the CODAR remote sensing estimates of wave parameters track the in situ data through a variety of events.

URL: http://marine.rutgers.edu/cool/

OS21E-81 0830h POSTER

Technology and Science of the MBARI Ocean Observing System

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Through concerted efforts of scientists and engineers at the Monterey Bay Aquarium Research Institute (MBARI), the MBARI Ocean Observing System (MOOS) is being developed and applied to pursue diverse marine science. Scientific challenges arising from the need to better understand ocean biogeochemistry and its relationships to the solid earth cycle and global change processes have broadly guided MOOS development. This presentation will summarize MOOS technology and science, including legacy observing programs and resources, current projects, field experiments that test incremental technology development in multidisciplinary research, and future plans. Top-level system engineering defines MOOS infrastructure and interfaces for power and communications between observing platforms and between the ocean-side and shore-side systems. Across MOOS projects, the underlying principles include incremental development, portability, configurability, adaptability, compatibility, expandability, and leveraging. MOOS projects include 1) low and high-power moorings, 2) vertical profiling system, 3) autonomous underwater vehicle (AUV) development (AUV mechanical, electrical and software advancement; AUV docking with power and data transfer), 4) instrumentation software infrastructure (standardization of power, communications and automated instrument recognition for plug-and-work capability), 5) shore-side data system (platform and instrumentation monitoring; data and metadata management; data presentation) and 6) cabled observatory science through MARS, a Monterey Bay testbed for the NEPTUNE cabled observatory project (http://www.neptune.washington.edu/index.html). MOOS science experiments integrate the most recent technology developments of MOOS to pursue multidisciplinary research in an important area of ocean science. Results from the 2000 MOOS Upper-water-column Science Experiment (MUSE) will be summarized.

URL: http://www.mbari.org/MUSE

OS21E-82 0830h POSTER

Distribution of Bioluminescence Across an Optical Front at LEO-15

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The coupling of bioluminescent and fluorometry measurements is one of the most bio-optically accurate methods for mapping primary and secondary organism distribution patterns in the ocean. During July 2001, bio-optical measurements were taken across a frontal region off the coast of New Jersey at the LEO-15 site on the continental shelf. A High Intake Defined Excitation Bathyphotometer (HIDEX) measuring bioluminescence was vertically profiled in conjunction with a CTD, fluorometer and red transmissometer. Inherent optical properties (IOPs) of surface waters were obtained from flow-through AC-9 data. Inshore, surface waters were turbid and contained high levels of chlorophyll. Offshore, clear surface waters overlaid a prominent deep subsurface chlorophyll maximum (SCM). A horizontal and vertical gradient in measured bioluminescence was observed as we moved offshore. Peak values in the bioluminescent signal occurred in clear offshore waters along the transition zone from turbid into clear waters. The increased bioluminescent signal also corresponded to an increase in the fluorometry signal with depth in clear offshore waters but not in turbid inshore waters. From these preliminary results we will discuss the relationship between in-water physical and optical properties and bioluminescent community distribution as a possible diagnostic tool to bioluminescence prediction.

OS21E-83 0830h POSTER

EOF calculations and data filling from incomplete oceanographic data sets

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A new self-consistent method to infer missing data from oceanographic data series and to extract the relevant empirical orthogonal functions is presented. As a byproduct, the new method allows to detect the number of statistically significant EOFs by a cross-validation procedure, for a complete or incomplete data set as well as the noise level and interpolation error. Since for the proposed filling and analysis method there is no need for a priori informations about the error covariance structure, the method is self-consistent and parameter free. Applications to a synthetic data set and AVHRR data in the Adriatic Sea will serve as an illustration of the method.

OS21E-84 0830h POSTER

Sensitivity of a Navy Regional Ocean Model to Nested High-Resolution Atmospheric Model and Scatterometer Wind Forcing

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The Navys Pacific West Coast (PWC) ocean circulation model is a sigma coordinate, Princeton Ocean Model (POM) configured for the Eastern Pacific Ocean between $30^{c}ircN$ and $49^{c}ircN$. A series of experiments, each one of a 14-day duration, are performed to evaluate the sensitivity of the ocean model to low (NOGAPS) versus high-resolution (COAMPS) wind forcing including scatterometer data insertion into COAMPS using synthetic QuikSCAT observations. Atmospheric model wind stress/wind stress curl and PWC surface and subsurface current/temperature model results are compared and analyzed. In areas where either the atmospheric/ocean models have sufficient resolution, they are expected to produce variability comparable to that observed in field surface/subsurface data taken from moored and drifting buoys, and scientific cruises. Preliminary results are summarized.

OS21E-85 0830h POSTER

An Arctic Environmental Observatory in Bering Strait

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The Arctic Environmental Observatory in Bering Strait is a research effort to improve data collection capabilities at the juncture of the Bering and Chukchi Seas, where nutrient-rich Pacific water flows predominantly into the Arctic Ocean. The observatory currently consists of three distinct tasks. One is the development of a water intake system to sample Bering Strait water on a year-round basis using shore-based instrumentation. A second component is a marine mammal sampling and survey program that takes advantage of the high degree of dependence on subsistence hunting by residents of Little Diomede Island. Finally, a ship-based sampling program is annually sampling water column and benthic parameters at specific long-term stations located from south of St. Lawrence Island and north into the Chukchi Sea. The overall goal remains to improve capabilities to detect and monitor environmental change in the Bering Straits region. The marine mammal sampling program at Diomede and the annual shipboard sampling effort are well underway. Results in 2001 include the first record of a sea ice-associated seal migration within the drifting ice pack. Results of the ship-based benthic sampling are being combined with previous studies of benthic biomass, sediment metabolism and other sediment parameters to continue documenting a decadal pattern of declining trends in biomass and other changes in benthic species composition. The objective of a continuous, year-round water sampling system for Bering Strait waters remains under development. In two successive field seasons, in 2000 and 2001, we have deployed an interim water intake and continuously measured salinity, temperature, chlorophyll a, nitrate, and phosphate over month-long time increments on a demonstration basis. Water has been pumped into a shed under the Diomede Village School using a jet well pump and then through automated instrumentation to measure the aforementioned parameters, at minutes-to-hour frequencies. Discrete daily water samples have also been collected for oxygen-18/oxygen-16 ratios, silicate, nitrate, and phosphate to assure data quality acquisition by the automated nutrient instruments. A radiometer has also been continuously recording UV radiation and PAR on the school roof. Future work includes a geophysical survey during the winter of 2001-2002 that will determine the best orientation and location for drilling an underground/undersea pipeline that can serve as the basis for a more permanent water inlet system that will be less vulnerable to ice and storm damage.

URL: http://arctic.bio.utk.edu

OS21E-86 0830h POSTER

High-Resolution Measurements of Coastal Bioluminescence using Autonomous and Remotely-Operated Vehicles

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In August 2001 we deployed bioluminescence sensors on an autonomous underwater vehicle (AUV) and a remotely operated vehicle (ROV) to examine the small-scale patchiness (tens to hundreds of meters) of coastal bioluminescence. The ROV also conducted horizontal and oblique transects using an intensified video camera to examine the distribution and composition of the bioluminescence community. Predictions of bioluminescence distributions were ground-truthed using plankton samples obtained from discrete depths during the survey. Bioluminescence was well correlated with optical backscatter (OBS) and fluorescence in nearshore environments, but OBS did not correlate well near the bottom, where sediments caused larger signals. Bioluminescent features were repeatably detected when the AUV run passed back through the same water mass. Horizontal patchiness was not readily detected within a 1-km square, although vertical distributions showed clear zones of concentrated bioluminescence. Both vehicles (AUV and ROV) provided detailed information on the distribution and composition of bioluminescent organisms.

URL: http://www.mbari.org/~haddock/muse.html

OS21E-87 0830h POSTER

Analysis of Sound-Speed Measurements from Acoustic Sources Observed at Pioneer Seamount

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In August 2001 a vertical linear array (VLA) of four hydrophones was installed by NOAA-PMEL at Pioneer Seamount, 95 km off the California coast and 930 m below the surface. The four channels, digitized at 100 Hz with 16-bit precision, are available in near real time. We are using this array to monitor four acoustic sources deployed for the navigation of Lagrangian instruments. The data used are absolute arrival times of signals from the 4 sources, measured twice daily. We present a preliminary analysis of 4 months of travel-time variability. We will also show samples of other acoustic phenomena, both anthropogenic and natural, observed at Pioneer Seamount.

URL: http://www.pmel.noaa.gov/vents/acoustics/pioneer.html

OS21E-88 0830h POSTER

Recent work and future plan of Chinese Arctic research expedition

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The China's First Arctic Research Expedition organized by the Chinese Arctic and Antarctic Administration/SOA was implemented in the summer of 1999. The expedition was mainly aimed to understand the role of Arctic in the global change and its impact on the climate in China as well as water mass exchange and interaction between Arctic Ocean and North Pacific Ocean. A comprehensive and multidisciplinary survey of atmosphere-ocean-ice-biology in the Bering Sea and the west Arctic Ocean has been carried out based on the R/V Xuelong, helicopter and sec ice campaign. The field program in the Bering Sea and the Chukchi Sea included cross-section survey of oceanography, marine chemistry and biogeochemistry, marine biological trawling of marine life, surface sampling of marine geology and sedimentary rock core. With the support of helicopter, two sea ice campaigns in the west Arctic ice zone were performed to measure three-dimensional structures of ocean, atmosphere and snow and ice. The preliminary analyses have been made and show in this presentation.

To better understand the role of Arctic in global climate change and to assess the possible impact of changing Arctic environment on ecosystem and human life, China is planning to launch an international Arctic research expedition in 2003. This presentation will also report the preliminary work plan of the expedition.

OS21E-89 0830h POSTER

FleetLink: Autonomous Collection and Telemetry of Real-time Data from Commercial Fishing Vessels for Ocean Observing

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The widespread temporal / spatial distribution of commercial fishing vessels makes them ideal platforms from which to gather basic information on weather, sea-state, oceanographic conditions, commercial harvest data, and fishing conditions for coastal monitoring, modeling, and prediction. FleetLink is a modular, customizable, and integrated shipboard data collection and telemetry system; the systems are linked to a land-based center for collection, management, analysis, and assimilation of data. Participating commercial fishing vessels were equipped with FleetLink sensor systems and collected meteorological and oceanographic data during fishing trips in the Gulf of Maine and over

TUE

Georges Bank in 2001; a survey of the tidal mixing front on the southern flank of Georges Bank was carried out in July, 2001.

We seek to develop strategies for incorporation of environmental and fisheries data into oceanographic research programs, environmental and fisheries resource assessments, coastal modeling and prediction efforts, and marketing strategies for commercial products. We are working toward a goal of 100 or more fully-instrumented fishing vessels which may provide enhanced oceanographic and meteorological data collection capacity for coastal and offshore areas throughout the NW Atlantic. Full implementation of the FleetLink concept will result in a low-cost, high-resolution, synoptic and strategic ocean observing system, based on autonomous collection and telemetry of data from commercial fishing vessels.

URL: http://www.FleetLink.net

OS21E-90 0830h POSTER

Bio-Optical Estimates of Phytoplankton Productivity From an Autonomous In Situ Profiler in the Coastal Waters of the Mid-Atlantic Bight

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As part of the Hyperspectral Coupled Ocean Dynamics Experiment (*HyCODE*), a high resolution vertical 15 day time series of the inherent optical properties (*IOPs*) bioluminescence and physical data were collected with an autonomous optical profiler. Significant variability was observed in the water column optical and physical properties. Using multivariate cluster analysis, water masses were defined based on the inherent optical and physical parameters. The cluster results from the IOPs alone could differentiate both the major water masses and the episodic mixing events as seen in the density profiles. For the distinct water masses, productivity parameters were assigned from photosynthesis-irradiance curves that were measured throughout the experiment. The resulting productivity database was combined with downward light fluxes derived from continuous above water measurements propagated into the water column to calculate phytoplankton productivity. These productivity measurements were compared to productivity estimates of phytoplankton absorption capabilities, derived by deconvoluting the total absorption measured with an AC-9 (*Wetlabs*), derived downward light fluxes, and a constant maximum quantum yield of 0.08. This value of 0.08 was reasonable given the high nutrient concentrations associated with constant mixing and influence of estuarine waters in this near-shore coastal region. Over the 15 day experiment, both volume specific and integrated water column estimates of gross phytoplankton production compared favorably between the physiology-based and optically based model (∼4% difference), indicating phytoplankton production could be derived from measured in situ IOPs in dynamic, nutrient replete, coastal waters.

OS21E-91 0830h POSTER

Assimilation of SST and bottom temperature into a numerical circulation model for Gulf of Maine using a Feature Oriented Regional Modeling System (FORMS)

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During the summer of 2001, we began running an Advanced Fisheries Management Information System (AFMIS) to produce weekly experimental nowcasts and associated medium range (7-10 days) forecasts for the Gulf of Maine regions. We used observations and a feature-oriented model to initialize the circulation model runs. The numerical scheme is focussed on the shallow currents, fronts and sub-basin scale gyres in the Gulf of Maine and Georges Bank system, but encompasses the deep ocean including the Gulf Stream system with its meandering fronts and mesoscale eddies. Along the continental shelf-slope boundary, these two regions are melded across the shelf-slope front. Synthesis of bottom temperature data from Groundfishing fleets by a feature-oriented strategic initialization and updating methodology yields a viable approach for evaluating and applying a numerical modeling system to real-time operational fisheries management system.

Real-time operational (FNMOC) winds, heat-fluxes, evaporation and precipitation fields, and lately data from Buoys and SeaWinds are used for surface forcing of nowcasts and forecasts. Dynamical analyses of selected forecasts determine the sensitivities to different forcing mechanisms and help us evaluate model performances and calibrate regional model parameters for future realistic forecasting. Assimilation of SST improves model skill to predict the location, extent and amplitude of the frontal features. Assimilation of commercial trawler survey bottom temperatures further improves and impacts the three-dimensional evolution in real-time. Selected case studies that illustrate the sensitivity of winds, thermohaline fluxes and assimilation of surface and bottom temperature for July-December 2001 will be discussed.

URL: http://afmis.cmast.umassd.edu

OS21E-92 0830h POSTER

Building a Global Array Regionally: Argo in the Western Pacific

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The global Argo profiling float array is now being implemented, with initial deployments being carried out in regions of highest priority for the 14 float-providing countries. The U.S. and several of its international partners have identified the tropical and western Pacific as a high priority region and have begun float deployments there. A substantial array of temperature/salinity profiling floats is now active, though with only a fraction of the final Argo density of instruments. Beginning from these regional arrays, the Argo domain will expand outward until Argo reaches its target of global sampling - with about 3000 floats by 2005.

Although still sparse in western Pacific coverage, the Argo array provides the first systematically repeating broad-scale measurements of subsurface salinity in that region. During mid-2001, surface layer (0 -100 m) salinity showed anomalously fresh values under the Intertropical Convergence Zone and the Southwest Pacific Convergence Zone, indicating about 0.5 m of anomalous freshwater in these already high-precipitation bands. Anomalously salty surface layers were seen in the wedge separating the convergence zones as well as to the north of the ITCZ and in the far-western Pacific. Salinity anomalies contribute several centimeters to steric sea surface height, so Argo data will provide better interpretation of altimetric sea level signals than is possible from temperature profiles alone. In addition to upper-ocean seasonal temperature, salinity, and steric height anomalies, we will review other early scientific findings and technical challenges from the western Pacific Argo array. Mid-depth trajectories of tropical Argo floats reinforce a finding from WOCE floats that mid-depth velocities throughout the tropics are substantial, with strong zonal polarization.

URL: http://sio-argo.ucsd.edu

OS21E-93 0830h POSTER

Acquisition of High Resolution Bottom Temperature and Fish Distribution Data by Groundfish Trawlers

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During the past year, SMAST researchers and fishermen on 20 commercial fishing vessels of the New Bedford Trawler Survival Fund have been collecting fisheries-related data on the Georges Bank and Great South Channel regions of the Gulf of Maine. As part of their daily operations, crewmembers are recording detailed information about the environment, the fish caught, and their operating practices on log sheets based on National Marine Fisheries Service procedures. These include time- and location-specific data on haul-by-haul fish species and weights, vessel and gear characteristics, and observed weather. Water temperature records are automatically collected using a small temperature data-logger mounted on each set of trawling gear. Through September 2001, data from over 700 fishing days and 4500 hauls on 119 trips have been logged. As this is a small part of the fleet that fishes the region daily, the potential for wide coverage is tremendous.

The bottom temperatures have yielded a unique data set of over 6000 observations on the under-sampled ocean floor. We will present some examples of observed near-bottom features including large temperature gradients across moving tidal fronts, typical warming with increasing depth in the Gulf, and the intrusions of Atlantic Slope Water.

All collected data are archived in the Regional Fisheries Applications Center (RFAC) system at SMAST. These data are assimilated into the Harvard Ocean Prediction System (HOPS) model. We are able to query this multi-source database to examine interrelationships between groundfish and their environment. Comparisons between fish catch data and habitat preferences are being used to study fish abundance and catchability. We anticipate this work will lead to improvements in fisheries management. We will discuss how time- and space-varying observations of multi-species catch per unit effort (CPUE in pounds/minute) data are related to water temperature, bottom depth, and bottom characteristics.

URL: http://rfac.smast.umassd.edu

OS21E-94 0830h POSTER

Combining Altimetric Height with Broadscale Profile Data: A Technique for Estimating Subsurface Variability

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Temporal and spatial variability are vastly undersampled by in situ measurements in the world ocean. Although ship transects can provide synoptic measurements of small scale O(100 km) features in one horizontal dimension, the time-variability and two-dimensional extent of such features is difficult to resolve from historical data. The high temporal and horizontal spatial resolution provided by the TOPEX/Poseidon altimeter offers an attractive solution to the undersampling problem.

A new technique will be presented for combining altimetric height with in situ data to provide improved estimates of upper ocean quantities. By combining TOPEX/Poseidon altimetric data with in situ XBT profile data, an estimate of large-scale, 0/800 m steric height variability can be produced which has substantially smaller errors than estimates from either data set alone. The technique uses profile data to identify parts of the altimetric signal due to temperature variability in the upper 800 meters. The remaining deep baroclinic and barotropic signals can then be excluded from the altimeter data while still maintaining its spatial and temporal resolution. Because steric height is strongly correlated with heat content and subsurface temperature structure, maps of these quantities can be inferred from the steric height estimate. In this way, variability in heat content and subsurface temperature structure can be estimated from the altimeter data. This technique is demonstrated over a region in the south Pacific enclosing the Tasman Sea. Estimates of heat storage and subsurface temperature variability over the past eight years are produced with RMS errors of 5 W/m^2 and 0.5 ^{o}C, respectively. Application of these techniques on a global scale could provide new insight into variability of the general circulation and heat budget in the upper ocean.

OS21E-95 0830h POSTER

Coupling Between Surface and Deep Ocean Processes in Subtropical and Subantarctic waters, SW Pacific Ocean

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NIWA has recently initiated a mooring program to investigate the temporal coupling between surface and deep ocean processes in the SW Pacific Ocean, on timescales of days to years. Two biophysical moorings have been established in 3-kilometer deep subtropical and subantarctic waters, east of New Zealand, since October 2000. The moorings each comprise a near-surface fluorometer, current meter, thermistors and a temperature/conductivity sensor (since March 2001) in the top 200 m with a time-incremental sediment trap and current meter at 1500 m water depth. These moorings have been serviced on a 4-5 monthly basis for the past year, generating a detailed time-series of surface productivity and export production for southern, temperate mid-latitudes.

Initial data from the subtropical site, located in the nominal center of the Wairarapa Eddy, show that substantially higher currents were experienced than expected, resulting in subduction of surface sensors to 600+ meters. Conversely, flows at the subantarctic site were generally <10 cm s-2, resulting in a more stable mooring configuration. Efforts are currently being made to minimize subtropical mooring instability. Preliminary data from subantarctic waters indicate substantially higher levels of surface chlorophyll a (up to 1 mg m-3) than previously recorded from shipboard sampling and satellite remote sensing. The subsurface expression of this early summer chlorophyll maxima in mid-December 2000 in subantarctic surface waters was manifested in a peak POC flux at 1500 m in early January 2001 - about 20 days later. Temporal relationships of the biophysical information generated from the moorings with remotely sensing satellite data (sea-surface temperature, ocean color) and our mechanistic understanding of ecosystem functioning in subtropical and subantarctic waters will enable the single-point data generated by the moorings to be placed in a regional context. This will perhaps allow extrapolation of these observations to encompass the broader extent of the water masses in the SW Pacific Ocean.

OS21E-96 0830h POSTER

Autonomous Ocean and Weather Monitoring System: Modular Sensors for Oceanographic Research on Platforms of Opportunity

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The International SeaKeepers Society has developed an autonomous ocean and weather monitoring system. Systems are currently deployed on private super yachts, and commercial cruise ships, which participate in the NOAA VOS (Volunteer Observing Ship) program. Weather, SST, ships position, and other parameters are reported automatically at regular intervals to the SeaKeepers gateway computer and are available within hour after recording to users such as the National Weather Service.

The system is designed to accommodate a wide variety of oceanographic sensors within the instrumentation module. The standard installation has a single sensor package which measures and logs salinity, temperature, pressure and has options for dissolved oxygen, pH and Eh. Optical sensors for chlorophyll and CDOM fluorescence and turbidity have been miniaturized for this application and are under evaluation. Other sensors for pCO2, total CO2 and trace metals are in development and preliminary testing is underway.

The SeaKeepers system and its member vessels offer unique platforms for oceanographic research which can provide low-cost access to: specific regions of the ocean, simultaneous measurements over a wide area and repeated cruise tracks for time studies on weekly, monthly and yearly time schedules. The Society supports and promotes the development of new sensor technologies and data applications that complement the SeaKeepers Society non-profit missions.

URL: http://www.seakeepers.org

OS21E-97 0830h POSTER

Mapping the Regional Variability of the California Current Acoustically Using a Waveform Inversion Method

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From May 1999 to May 2000, an ocean tomography experiment was carried out to study both the signal fluctuations in a long-range acoustic transmission and the baroclinic variability of the California Current System in the Northeastern Pacific Ocean. Acoustic signals were transmitted once every four days by a low-frequency sound source moored on top of Hoke Seamount, approximately 600 km offshore from the California coast. The signal recorded by a coastal SOSUS receiver at Point Sur, California show stable and identifiable acoustic arrivals through out the year. The extracted time series of travel time representing direct measurements of the path averaged ocean temperature show seasonal variations that are consistent with historical data and theoretical concepts. A full-waveform inversion of the acoustic arrivals further reveals the spatial and temporal variations of the heat contents. In this presentation, we give a physical oceanography interpretation of the tomography inverse results in combination with other oceanographic measurements. [Research supported by NOPP and by ONR.]

OS21E-98 0830h POSTER

Implementation of the Gulf of Maine Ocean Observing System (GoMOOS)

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The Gulf of Maine Ocean Observing System (GoMOOS) has been established as a sustained, real-time observing system that includes a comprehensive array of moored physical and optical sensors, shore based long-range HF radar systems, circulation and wave modeling, satellite observations, and web delivery of data and data products. The first elements of the observing system were installed in July 2001, and the data may be accessed hourly via the web at gomoos.org.

The GoMOOS moored array presently consists of 10 solar-powered, automated buoy systems that telemeter data hourly via cellular phone or GOES satellite transmitters. The buoys are deployed within the major bays and estuaries of the Gulf, along the Continental Shelf from Nova Scotia to the western Gulf, and in the central Jordan Basin. The buoy system measures standard meteorological parameters, as well as fog, and a comprehensive set of surface and subsurface optical and oceanographic parameters. Included in the measurement set are temperature, salinity, and flow velocity at multiple depths, and spectral irradiance, spectral radiance, and chlorophyll fluorescence, and multi-wavelength attenuation and absorption . Data from deep sensors is telemetered up the mooring cable via inductive modem to the buoy data system. The buoy system is designed with a flexible and modular architecture that is capable of handling on the order of 100 subsurface sensors.

The principal technical elements of GoMOOS will be discussed, and the directions of future development of the observing system will be outlined.

URL: http://gomoos.org

OS21E-99 0830h POSTER

In Situ Determination of Oxygen and Nitrogen Concentrations in the Upper Ocean

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Total gas pressure, oxygen, temperature and salinity were measured at 50 meters on a mooring at the Hawaii Ocean Time-series (HOT) station from January through September of 1997 and 1998 using a Gas Tension Device (GTD) and a CTD-oxygen sensor (GTD-CTD-O_2 instrument package). Our goal was to evaluate the precision and accuracy of the in situ total gas and oxygen measurements and to assess their utility for remotely determining net biological oxygen production in the euphotic zone. By calibrating the oxygen sensor approximately every month during periodic visits to the mooring it was possible to remotely measure the time history of the partial pressures of nitrogen and oxygen to within $\pm$ 0.5 % accuracy as assessed by independent determination of nitrogen concentration. Oxygen changed at 50 meters by 2-4 % in a series of episodes with durations of 1 - 3 months, indicating the discontinuous nature of net oxygen production and the probable decoupling of oxygen production and respiration in the euphotic zone. The GTD and O_2 measurements together can be used to distinguish the effects of physical processes and net biological oxygen production on the oxygen concentrations. The largest uncertainty in the coupled O_2 and total gas pressure measurements is the drift of the oxygen sensor, making frequent calibration presently a necessity. With more complete vertical coverage in the upper ocean it should be possible to use this approach to determine depth-integrated net oxygen production in the euphotic zone and upper thermocline respiration.

TUE

OS21F HC: Hall III Tuesday 0830h

Coral Reef Habitats: New Insights From Integrated Coastal Science III

Presiding: **M Field,** University of California, Santa Cruz**; P Jokiel,** University of Hawaii at Manoa

OS21F-105 0830h POSTER

An Approach to Merging Remote Sensing with In Situ Monitoring in Assessing the Status of Coral Reef Ecosystems

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Combined with expert interpretation, aerial photography is an accessible and proven method for coral community mapping, but typically requires labor-intensive film processing and manual georectification of many individual photographs. Satellite or aircraft-based remote sensing has been proposed as a means to create maps that capture regional reef status, but attempts to do so may be confounded by inadequate spatial resolution and the corruption of spectral signals in the water column. Also, the mapping of coral reef communities with remote sensing typically does not fully exploit the expert knowledge possessed by coral reef biologists involved in the field monitoring of coral communities.

The NASA EAARL Digital Camera Mapping System (DCMS) adapts remote sensing to enable close integration with in situ monitoring programs such as CARICOMP or Reef Check. Rather than attempting to automate the creation of contiguous and detailed benthic classification maps over large regions, the NASA DCMS creates low altitude, georectified digital camera mosaics over numerous monitoring sites that serve as waypoints along pre-programmed flight tracks. The NASA DCMS combines three components: 1) a light aircraft equipped with a precise navigation system, a continuously operating downlooking digital camera, and an array of GPS receivers for aircraft location and attitude determination, 2) a dedicated processing program that combines apriori geographical information with aircraft digital photography, flight trajectory, and attitude data sets to create numerous, highly detailed