conducted to determine if the presence of copper affected fluorescence signals of thiols, showed no measurable effect. Good recovery of tagged-thiols spiked in a NaCl (0.5M) solution is obtained by using the Waters HLB reserved phase resin, while blank levels of glutathione, gamma-glutamylcysteine, and phytochelatin-2, are extremely low. For 100 ml samples spiked with 10 nM thiol standards, the average recovery on the 60mg resin cartridge is 42.7±4.2%, 108.2±5.4%, 112.7±6.5%, and 101.5±7.8% for cysteine (Cys), glutathione (GSH), gamma-glutamylcysteine(γEC), and phytochelatin-2 (PC-2). Using this method, a preliminary study showed a clear dose-response release of GSH from a marine algae species, *Thalassiosira weissflogi*, under different concentration levels of copper additions (from 0 to 500 nM). When inoculated in natural seawater, the release of GSH appears to be inversely related to the concentrations of natural organic matter, reflecting the net effects of both the natural organic matter and ligands released from algae on the bioavailability of copper.

OS21B-30 0830h POSTER

RATS: A Robotic Analyzer for the TCO_2 System in Sea Water from Moorings

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RATS is an instrument designed to make the measurements needed to determine the speciation of the carbonate system in sea water. Determination of the carbonate system is based on the measurement of TCO_2 and pH. It is designed to operate completely independently and to be deployed for prolonged periods, duration being determined by the current limit of ∼1000 sample analyses. RATS can operate at full ocean depth, but testing of components has presently been limited to the pressure equivalent of 900 m. TCO_2 is determined by allowing the CO_2 from an acidified sea water sample to pass through a semi-permeable membrane and react with NaOH. Reaction decreases the NaOH conductivity in proportion to the amount of CO_2 in the sample. pH is measured spectrophotometrically after the methods pioneered by Bob Byrne and co-workers. Provision is made for *in situ* standardization of both TCO_2 and pH at any desired frequency.

Presently the instrument is operating in the lab in its integrated form. TCO_2 analyses carried out over a period of ∼60 days vary about the mean by slightly less than 0.3%. For shorter time intervals (1-2 days) variation is ∼0.2%. The standard deviation of pH measurements carried out over a 70+ day period is <.002 pH units. RATS is scheduled for its first ocean tests in Jan-Feb 2002.

OS21C HC: Hall III Tuesday 0830h

Satellite-Measured Ocean Color Variability in the Ocean III

Presiding: **A Thomas,** University of Maine**; C McClain,** NASA GSFC

OS21C-31 0830h POSTER

Seasonal and Interannual Phytoplankton Variability in the Gulf of Maine

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Four years (1997-2001) of ocean color data from the SeaWiFS mission provide the first synoptic quantification of phytoplankton variability on seasonal and interannual time scales for the Gulf of Maine. The climatological seasonal cycle shows elevated concentrations (>2.0 mg m^{-3}) throughout the year within 30km of the shore and a strong modulation of the amplitude of seasonal cycles over shallow bathymetry in other regions. Deeper basins exhibit a canonical Sverdrup seasonal cycle with a strong spring bloom (> 2.0 mg m^{-3}) in March-April, a fall bloom in October-November and concentrations of ∼1.0 in summer and ∼0.5 in winter (December-February). Strong tidal mixing over shallow bathymetry supports elevated concentrations (> 2.0 mg m^{-3}) throughout the year on Georges Bank and sustained elevated concentrations throughout the summer over Browns Bank. EOF decomposition of the 4 year time series of monthly composites quantifies the strong dominance of the seasonal cycle (93% of the variance) and shows it to be anomalously weak in late 1997 and throughout 1998. The second mode (2.6%) shows a broad seasonal maximum in late summer (Sept-Oct) strongest in coastal regions and over shallow banks, clearly out of phase with three regions of known strong advection/mixing (the Eastern Maine Coastal Current, the southern Scotia Shelf and Nantucket Shoals). Interannual differences in the timing of the spring and fall blooms over much of the domain are consistent with differences in the strength and timing of wind mixing. A 3d coupled biological-physical model captures the dominant seasonal variability and spatial pattern over the interior Gulf.

OS21C-32 0830h POSTER

Quantitative, space-based measurements of ocean suspended calcium carbonate with MODIS and SeaWiFS

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Suspended calcium carbonate (particulate inorganic carbon; PIC) plays a major role in ocean biogeochemistry and little is known about its oceanic distribution. Recently, algorithms have been implemented with MODIS and SEAWiFS for detection of surface PIC concentrations. In this paper, we describe the accuracy of the satellite PIC algorithm, based on simultaneous satellite and ship measurements. We also show the first monthly global composites of oceanic PIC, integrated over the euphotic zone (based on satellite estimates of Kpar). Results show relatively high PIC concentrations in specific portions of the North Atlantic and Black Sea, plus in the Antarctic convergence during austral fall. Values of integrated global euphotic PIC concentrations will be presented.

OS21C-33 0830h POSTER

A multi-year record of bio-optical properties in the Gulf of Maine

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Bio-optical data have been compiled from the Gulf of Maine as part of a ship of opportunity program between 1998 and 2001. Data from surface waters were taken aboard the M/S Scotia Prince passenger ferry that crossed between Yarmouth, Nova Scotia, and Portland, Maine, from May through October of each year. Flexibility in sailing days allowed us unprecedented abilities to sample during clear-sky conditions, when ocean color satellite viewing was optimal. This presentation represents a synthesis of the first three years of measurements, over 3600 sea-truth satellite observations within ±6h of a satellite overpass. One clear result is the connection between hydrography and optics; there was a prevalence of Case II surface water throughout the entire transect for most of the cruises, which was well correlated to salinity. Even far offshore, using standard criteria for defining particulate and dissolved Case II conditions, most of the samples were strongly Case II in character. Also of interest was the significant scattering of the colored dissolved organic matter, which was inversely correlated to salinity in the Eastern Maine Coastal Current. We will present a statistical analysis of volume scattering function shapes relative to coastal volume scattering functions of Petzold. Errors in SeaWiFS normalized water-leaving radiance were highly correlated between wavelengths, with some apparent dependence on the atmospheric models used to derive the radiances. The slopes of the size distribution functions of particulate matter also were compared. There were clear changes in phytoplankton community structure and slope of the particle size distribution, associated with water mass variability.

OS21C-34 0830h POSTER

Physical Forcing of Plumes and Blooms in the Santa Barbara Channel: An Integrated Satellite Approach

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Satellite images of sea surface temperature (SST) and ocean color products are used to assess phytoplankton dynamics and the extent of terrestrial discharge in the Santa Barbara Channel (SBC). Over three and a half years (October 1997 - June 2001) of AVHRR, SeaWiFS, *in situ* measurements, and supporting data are analyzed. Match-up analyses between *in situ* and satellite data show reliable SST retrievals from AVHRR while improvement is needed for retrievals of SeaWiFS products in the region. However, spatial/temporal patterns for all SeaWiFS products are qualitatively consistent on both seasonal and episodic time scales. Monthly climatologies of SST, chlorophyll, and water leaving radiance at 555nm show blooms associated with high water turbidity and runoff in winter, whereas in late spring blooms are associated with upwelling and cool SSTs. Analysis of monthly composites demonstrates that local winds and terrestrial discharge are well correlated with spatial patterns of upwelling and runoff. A set of empirically defined plume and bloom indices is developed based upon field data sets. These show that plumes are found episodically in response to discharge events and affect 20 - 60% of the SBC whereas blooms occur more regularly and cover 50 - 95% of the channel. Further evidence illustrating the spatial effects of upwelling, advection, runoff events, and remote forcing (such as the 1997/1998 El Niño) on blooms and water turbidity will be presented.

OS21C-35 0830h POSTER

Seasonal and inter-annual variability of the particulate backscattering coefficient over the global ocean.

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The global distribution and the annual and inter-annual progression of the particulate backscattering coefficient, bbp, is analyzed from the Sea-viewing Wide Field-of-view Sensor and inverse modeling. The retrieved bbp values are compared with in situ measurements made in various oceanic areas. The seasonal and inter-annual variability of bbp between the years 1998 and 2001 are provided for each major oceanic basins. Moreover, the patterns of the remotely sensed bbp are compared to those of the chlorophyll concentration, Chl, in order to determine whether bbp provides additional biogeochemical information. Because bbp is not sensitive to the dissolved material, it can be used as an index of the particulate load that mostly consists of particulate organic carbon, POC, in open ocean (biogenic CaCO3 particles and terrigenous particles may also contribute episodically to bbp). The interpretation of bbp in terms of POC is discussed.

OS21C-36 0830h POSTER

Removal of Bottom Reflectance Contribution to Remote Sensing Reflectance in Coastal SeaWiFS Imagery

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We determine the contribution of bottom reflectance to the surface ocean color for SeaWiFS imagery. SeaWiFS ocean color algorithms, such as chlorophyll, scattering, and absorption are based on optically deep waters. In clear shallow waters, the bottom reflectance contribution must be removed from the remote sensing reflectance prior to applying the SeaWiFS algorithms. Without removal of the bottom reflectance, the algorithms estimates are too high. We applied a neural network approach to determine bottom contribution. Following atmospheric correction, remote sensing reflectance of six SeaWiFS bands (412, 443, 490, 510, 555, 670 nm) are used in a neural network to separate the contributions from water volume reflectance and the bottom. The network was trained using HYDROLIGHT (3026 samples) solutions over sandy bottoms to define the bottom contribution as the ratio of the optical depth to physical depth. We compared the bottom contribution derived from SeaWiFS Rrs for several scenes and bathymetry along the northern Gulf of Mexico. The neural network shows differences between areas of turbid waters and areas where bottom contribution was significant. We exhibit our attempt to reduce the estimated SeaWiFS algorithm values of chlorophyll and optical properties by attempting to remove the bottom contribution from the Rrs.. We compared results with in situ SPMR and ac9 data collected off of the West Florida Shelf.

OS21C-37 0830h POSTER

Seasonal variability of ocean color and derived phytoplankton properties in the North Atlantic and South Pacific

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Quarterly in situ measurements have been done from the MS Contship London on the shiplane Le Havre-Panama-Noumea, from October 1999, in the frame of the GEP&CO program. They include pigment concentration by spectrofluorometry and HPLC, flow cytometry, cell count, particulate absorption and water absorption after filtration, above water marine reflectance, and aerosol optical thickness. Daily and monthly Level-3 data from SeaWiFS have been acquired from September 1997. First we have validated the SeaWiFS derived geophysical parameters, marine reflectances and surface chlorophyll concentration, using the in-situ measurements. Second, we have analyzed the seasonal and annual variability of the SeaWiFS geophysical parameters and compared it to the variability of in-situ measurements.

URL: http://www.lodyc.jussieu.fr/gepco/

OS21C-38 0830h POSTER

Sensitivity Analysis of MODIS Ocean Net Primary Productivity

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The National Aeronautics and Space Administration (NASA) is modeling ocean net primary production using remote sensing data from the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard the Terra spacecraft, and soon to be aboard the Aqua spacecraft. To that end, two semi-analytic models are applied: the VGPM algorithm (Behrenfeld and Falkowski), which estimates production over the euphotic zone, and a mixed-layer depth production model (Howard and Yoder). Using these models, global maps are created based on satellite derived chlorophyll concentrations, sea surface temperature, radiation available for photosynthesis (PAR), and modeled mixed-layer depth. This study attempts to quantify the response of both models to errors in these inputs. Both models are analyzed to determine their response to variations in their input parameters, including the use of Monte Carlo methods to obtain error response distributions. Also, effects of biases from temporal or spatial aggregation is explored. Spatial and numerical regimes of high sensitivity are quantified and conclusions are drawn about uncertainty in the assessment of regional and temporal variability.

OS21C-39 0830h POSTER

Spring Phytoplankton Blooms in the Southeastern Bering Sea

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Satellite measurements of ocean color (SeaWiFS), winds, sea ice cover (SSM/I), and sea surface temperature (AVHRR) were used to monitor phytoplankton blooms in the southeastern Bering Sea during spring of 1998-2000. Enhanced productivity (chlorophyll biomass) was observed in the cooler waters of the marginal ice-edge zone as the ice edge retreated northward over the Bering Sea Shelf. Typically, the enhanced biomass in surface waters was observed for $>$ 6 days after ice retreat. Shorter bloom life spans may have resulted from strong wind events destabilizing the water column. The areal extent of the ice-edge bloom and its contribution to total production in the region was influenced by the interannual variability of sea ice cover. Evidence was observed of enhanced primary production along the self-break associated with eddies generated from the Bering Slope Current.

OS21C-40 0830h POSTER

Use of SeaWiFS Data to Quantify Carbonate Mass for a Hurricane-Forced Neritic Sediment Transport Event

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On September 21, 1999, the eye of Hurricane Gert approached within 300 km of Bermuda, causing 110-knot winds and extensive beach erosion on the island. On September 22, 1999, data acquired by the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) indicated an apparent plume of sediment originating on the Bermuda Platform generated by this strong wind forcing. SeaWiFS normalized water-leaving radiances were submitted to an analytical algorithm to calculate the suspended matter concentration in this sediment feature. The algorithm is based on minimization of the spectral difference between measured and modeled seawater reflectances. A feature of this algorithm is the capability to vary parameters describing spectral backscatter and absorption when inverting the reflectance model. A computationally fast, linear least-squares technique is used to retrieve bio-optical properties from the reflectance model. The retrieved suspended matter backscattering coefficient is converted to suspended matter concentration using a simple regression: $b_b(550)$[1/m] = 0.015 S [mg/l]. The calculated suspended matter concentrations for each pixel were summed to provide an initial mass transport estimate. The physical characteristics of the Bermuda Platform and the sediment plume, and the assumptions used in this calculation, provide a minimum estimate of the mass of carbonate sediment in the plume. This novel application represents a preliminary step in the use of remote sensing data to quantify this important marine geochemical process.

OS21C-41 0830h POSTER

Using the SeaWiFS data for POC assessment: which data product to use?

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The multiple SeaWiFS data products provide new ways to quantify oceanic conditions through remote sensing. Recent studies have shown a good correlation between the SeaWiFS chlorophyll concentration and POC concentrations in the Antarctic region (Stramski). In this work we performed a comparative analysis of several data products derived from the SeaWiFS data in order to determine which one best estimates POC concentration. POC concentrations were estimated and integrated for the upper 30 m from 361 beam attenuation profiles (660 nm) obtained throughout the South Atlantic. We evaluated chlorophyll concentration, normalized water-leaving radiation at 555nm, diffuse attenuation coefficient at 490nm and integral chlorophyll integrated over the upper optical depth data. Simple water leaving radiation values produce better results than SeaWiFS derived chlorophyll concentrations for estimating POC concentrations.

OS21C-42 0830h POSTER

Algal biomass and sea surface temperature in the Mediterranean Sea : intercomparison of data from various satellite sensors, and implications for primary production estimates.

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The Mediterranean Basin, subject both to climate changes and to increasing anthropogenic inputs, is an appropriate test site for observing the evolution of algal biomass and primary production on a long-term basis. With this aim, it is first necessary to study the consistency of the various sets of satellite data as provided by the Space Agencies, and to compare them to in situ available data. Pixel-by-pixel comparisons of the Level-3 chlorophyll products derived from OCTS (version 4, August 1999), POLDER (reprocessing 2, July 2000) and SeaWiFS (reprocessing 3, May 2000) reveal a reasonably good agreement. Discrepancies, however, appear particularly in oligotrophic areas. Weekly means for POLDER and OCTS (which were operating simultaneously) differ in these areas by 30-70 % on average. OCTS and SeaWiFS weekly means, at one year distance, reveal differences by up to a factor of 2 in the clearest areas, where interannual variations are supposedly weak. Comparisons with measurements at sea, acquired during various cruises, show that all these sensors tend to overestimate chlorophyll concentrations in oligotrophic waters, by a factor up to 5. These observations are consistent with those made by Claustre et al. (submitted), who measured "anomalous" reflectances (with respect to the chlorophyll content) in clear Mediterranean waters, and attributed them to the input into seawater of Saharan dust associated with episodic events. This peculiarity could exist in many areas and subsist over long periods throughout the year. A "regional algorithm" is proposed to reduce this bias.

Month-by-month comparisons of various datasets for sea surface temperature, SST (OCTS SST, Reynolds SST, Levitus climatological profiles) demonstrate that these datasets are in good agreement, except in May-June 1997 where OCTS values were significantly higher than Reynolds values for the same period. The impact of using the various datasets for chlorophyll concentration and seawater temperature in primary production computations is shown. Because they are simultaneous to ocean color data, Reynolds SST data appear to be the most appropriate inputs to such computations, but they have to be combined with climatological vertical profiles of seawater temperature.

OS21C-43 0830h POSTER

Global Chlorophyll Climatologies: Which Data to Use?

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Chlorophyll climatologies derived from historical in situ data, Coastal Zone Color Scanner data (CZCS), and SeaWiFS (Version 2 and 3) data were intercompared to evaluate their strengths and weaknesses in representing chlorophyll distributions in the global ocean. A fourth dataset, produced by blending in situ data with CZCS data was compared to the other three.

Systematic biases were associated with each of these datasets. In situ and CZCS data appeared to underestimate chlorophyll since the blended analysis produced generally elevated values. The SeaWiFS data for the open ocean appears to be valid since its within 10% of the blended climatology for all seasons except winter. In the coastal ocean, SeaWiFS may overestimate chlorophyll with values 30-77% higher than the next closest climatology. Blending of in situ and satellite may produce the best climatology.

OS21C-44 0830h POSTER

Oceanic Habitats Around the Galápagos Islands

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Oceanic habitats around the Galápagos Archipelago are identified from analyses of the temporal and spatial variability of satellite-derived sea-surface temperature (SST, from AVHRR Pathfinder) and ocean color monthly climatologies (from OCTS and SeaWiFS). Harmonic analysis of the climatological time series indicates a best fit with annual and semi-annual constituents. The annual amplitude is the dominant signal in SST, corresponding to the basin-wide seasonal cycle of warming and cooling associated with the north-south migration of the Inter-tropical Convergence Zone. Advection of upwelled water from the Panamá Bight into the northeastern part of the study area is also present in the annual signal. The semi-annual amplitude, most evident in the ocean color signal, is associated with chlorophyll-*a* enhancements at localities where the Equatorial Undercurrent (EUC) upwells. Spatial-variance empirical orthogonal function (EOF) decomposition identifies two main spatial patterns with amplitude time series representing out-of-phase annual cycles. The dominant mode corresponds to the strengthening of the Equatorial Front and the South Equatorial Current during the second part of the year. This mode explains 92.74% of the SST variance and 76.87% of the ocean color variance. The second mode is associated with the topographically induced upwelling of the EUC on the western side of the archipelago, and with advection of upwelled Panamá Bight water on the northeastern side, both reaching their peak during the first part of the year. This mode accounts for 5.56% of the SST variance and 11.47% of the ocean color variance. The SST and ocean color EOF spatial patterns have applications to habitat delineation for oceanic biota.

OS21C-45 0830h POSTER

Time series of calibrated ocean color products from MODIS

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Ocean color products as derived from radiances measured by the Moderate Resolution Imaging Spectroradiometer (MODIS) have undergone exhaustive corrections and calibrations since the instrument was activated aboard the Terra satellite early in the year 2000. These corrections have been developed and applied both at the engineering and algorithm levels. The result is a 4km global time series of ocean color products at exceptional resolution that will be invaluable to the oceanographic community for the quantification of temporal and spatial variability,

We will present both global 4 km and regional 1km time series representative of the current state of the MODIS ocean products. Comparisons both with *in situ* measurements (e.g. MOCE and MOBY) and other remotely sensed ocean color products (SeaWiFS) will show the estimated levels of uncertainties and variability that remain in the MODIS products in order to aid investigators who are beginning to use the MODIS data set for oceanographic research.

OS21C-46 0830h POSTER

On The Biological Signatures In The Tropical Southwestern Atlantic From Seawifs And Czcs Data

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The region to the west of 20W supports a important tuna and billfish fishery exploited by industries based in NE Brazil. To better understand this fishery ecosystem, a study of the variability of upper layer Clorophyll a (CLA) signatures is being made by use of sparse CZCS and 4 years of good SeaWifs data. The CLA content is much smaller than that found east of 20W, but is not at all negligible, especially at some newly found coastal upwelling areas south of 10S. Open ocean variability is dominated by intra-seasonal peaks modulated by the annual cycle with maxima in June-August, with strong interannual variations, between 5S-8S. By use of Topex/Poseidon/ERS altimeter data, we produced a thermocline depth grid based on correlations with data from the PIRATA moorings, and also used wind ERS scatterometer data to calculate relevant forcing functions (e.g., Ekman Pumping). Analysis shows that CLA spectrum is dominated by activity in the intraseasonal band, above the noise level, possibly related to waves in the Central South Equatorial Current, wind-forced at mid basin. Interannual variation is strong, with the largest peak in June-July 2000, and the minimum in 1999. A discussion of the variability in vertical advection of nutrients into the photic layer induced by pulses in Ekman pumping , and the balance against horizontal advection, is presented in a tentative explanation for the amplitudes and phases of the estimated CLA content variability obtained through its surface expression. Fisheries production cycles are also discussed.

OS21C-47 0830h POSTER

Hurricane-Induced Phytoplankton Blooms in the Sargasso Sea

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With wind speeds greater than 33 m s^{-1}, hurricanes can cause sea surface temperature (SST) cooling on the order of -1 to -9°C and mixed-layer deepening by tens of meters in their wakes. This SST cooling is asymmetrical about the storm track with the greatest cooling commonly found to the right of the storm track for the Northern hemisphere. The cause of the SST cooling is known to be mixing and entrainment associated with high wind speeds and near-inertial oscillations in oceanic mixed-layer currents associated with the asymmetric wind field.

Here we examine the impact of hurricanes on the Sargasso Sea. Under normal hurricane-season conditions, the Sargasso Sea is characterized by low wind conditions and large-scale subsidence leading to very low nutrient levels within the euphotic zone and very low chlorophyll concentrations in the mixed layer. We use SeaWiFS observations of surface chlorophyll-a to show that the intense mixing and entrainment of nutrient-rich waters from depth resulting from passing hurricanes can induce significant phytoplankton blooms in their wakes. For example, in 1998, Hurricane Bonnie produced an SST cooling of about 5°C in its wake. Within this wake, the chlorophyll concentration consequently increased by more than 25% above its pre-hurricane 8-day mean values to values as high as 0.2 mg m^{-3}. Thus, hurricanes may provide a potentially important episodic source of nutrients for this oceanic desert ecosystem. Finally, we implement an array of one-dimensional coupled bio-physical models to simulate the surface cooling, mixed-layer deepening, nutrient entrainment and phytoplankton response in an area around Hurricane Bonnie's storm track.

OS21C-48 0830h POSTER

Residual Analysis for Evaluation of Ocean Color Algorithms

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Residual analysis is a standard statistical technique used to better understand the departure of observations from a model and to detect outliers in a sample. It has not, to our knowledge, been employed to evaluate satellite ocean color algorithms. We present results on the use of residual analysis in the evaluation of several existing bio-optical algorithms designed to estimate surface chlorophyll concentration from SeaWiFS data, including the default SeaWiFS Project chlorophyll algorithm (= OC4V4), for waters off the U.S. Northeast and West coasts. Though restricted to regions possessing a sufficient number of coincident in-situ and remotely derived values, we believe that residual analysis provides unique information that will aid in objectively assessing the effectiveness of satellite ocean color algorithms.

OS21C-49 0830h POSTER

Vertical Migration of a Toxic Karena brevis Red-Tide and the Impact on Ocean Color Remote Sensing Reflectance

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Remotely sensed data primarily provides information on the surface layer of the ocean. In the optically deep ocean, however, there can be large vertical variability in particulate and colored dissolved organic matter (CDOM), which significantly affects the absorption, scattering and attenuation properties of the water column. Together, these facts lead to the question of whether information on subsurface structure can be determined by surface satellite data. Blooms of the toxic red-tide dinoflagellate, Karena brevis, are positively phototactic, and their migration will impact ocean color remote sensing reflectance as they swim into an optical depth detectable by the satellite. As part of the EcoHAB and HyCODE programs, we measured the vertical migration of a natural population of K. brevis over a diel cycle making hourly measurements of the inherent optical properties (IOPs). The IOPs provided inputs into the Hydrolight radiative transfer model allowing us to assess the impact of the diel changes in the vertical distribution of K. brevis on remote sensing reflectance (R_{rs}). Initial surface water values of attenuation at 412 nm during predawn hours were approximately 0.64 m^{-1}, but increased ca. 3 fold during the course of the light period to 2.00 m^{-1} by

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mid-afternoon. Surface slicks decreased in the afternoon as cells migrated away from the surface and toward the bottom. The impact was apparent on the magnitude and spectral shape of the IOP's, with late afternoon samples consistent with high phytoplankton absorption. Concentrations of CDOM increased with the migration of the K. brevis population to the surface waters; however the change in the reflectance was dominated by the increase in the phytoplankton absorption (73% decrease in a_{412}/a_{676} and 60% increase in b_{440}/a_{440}). Overall, the net result was that remote sensing reflectance became increasingly green-shifted reflecting the position of the subsurface population. The greening of the surface reflectance, derived from the IOPs, over the diel migration cycle was used to assess the degree with which subsurface features could be distinguished. Secondarily, comparison of the overpass schedule of the international constellation of color satellites with this diel behavior will determine whether the red tide will be detected by the changes in surface reflectance.

OS21C-50 0830h POSTER

Relationship Between Ocean Color and Lidar Penetration in the Gulf of Alaska

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The wide continental shelf in the Gulf of Alaska is a region of high productivity. High chlorophyll concentrations result in water with a greenish appearance. High productivity also results in high concentrations of small particles that scatter and absorb laser light. Those processes limit the depth penetration of oceanographic lidars. We measured the apparent color of the water surface using an airborne three-color imager. From the same aircraft, we measured the depth penetration of the NOAA Fish Lidar. We observed a high correlation between the green index and the inverse of the penetration depth. Water was greener and lidar penetration less in near-shore areas, while the converse was true in offshore areas. SeaWIFS data were used to relate the three-color green index to chlorophyll concentration estimated from ocean color.

OS21C-51 0830h POSTER

Atmospheric Correction and Ocean Color Measurements From the NPOESS/VIIRS Sensor

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The VIIRS instrument is one of several instruments currently being designed for the National Polar Orbiting Environmental Satellite System (NPOESS), as part of a joint effort between the Department of Defense, NASA, and NOAA. Ocean Color is one of the products being developed using the Visible/Infrared Imager/Radiometer Suite (VIIRS) sensor. Measurements of ocean color from space are challenging because about 90% of the radiation reaching a satellite sensor comes from atmospheric scattering and sea-surface reflection. Removal of these effects is crucial to the retrieval of accurate ocean color information. The atmospheric correction procedure takes into account sea-surface reflection along with atmospheric scattering and absorption. The cloud mask design is presented as well as corrections for the effects of whitecaps, ozone, Rayleigh scattering, and the presence of aerosols. The VIIRS Ocean Color product consists of chlorophyll concentrations derived from water-leaving remote sensing reflectances, which are computed by the atmospheric correction algorithm. Retrieval algorithms for chlorophyll concentration has been developed for Case I waters (characterized by having a strong correlation between scattering signature and chlorophyll a concentration, i.e. open ocean) and Case II waters (scattering signature and chlorophyll a concentration are uncorrelated, i.e. coastal waters). The chlorophyll a algorithms developed for each of these water types will be discussed. Algorithm performance is evaluated using both the in situ SeaBAM data sets and simulated remote sensing reflectances. The sensor and algorithms together meet the NPOESS sensor requirements on chlorophyll precision and accuracy thresholds for chlorophyll concentrations typical for open ocean waters. NPOESS is an integrated operational system and this benefits the VIIRS ocean color product. The high spatial resolution of the VIIRS imagers from visible to infrared bands is expected to provide accurate cloud mask and sun-glint mask products. Sea surface wind vectors derived from the NPOESS Conical Scanning Microwave Imager/Sounder will allow for correction of the ocean surface roughness effect. Additionally, the ozone product was derived from the NPOESS Ozone Mapping and Profiling Suite and is expected to produce data which will aid in accurate correction of the atmospheric ozone absorption. Results of NPOESS/ VIIRS algorithm tests are presented. References Gordon H.R., and A. Morel (1983). Remote assessment of ocean color for interpretation of satellite visible imagery. A review. New York: Springer. Carder, K.L., S.K. Hawes, Z. Lee, and F.R. Chen (1997). MODIS: Case 2 chlorophyll a algorithm. MODIS ATBD-19.

OS21C-52 0830h POSTER

Ocean Observer Satellite Study

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In the 2008 to 2018 time period, the National Polar Orbiting Environmental Satellite System (NPOESS) will meet the operational needs of the civilian meteorological, environmental, climatic, and space environmental remote sensing programs, and the Global Military Space and Geophysical Environmental remote sensing programs. This system, however, does not meet all the needs of the user community interested in operational oceanography (particularly in coastal regions) and hazard response. Beginning in the fall of 2000, the Department of Defense (DoD)/Department of Commerce (DOC)/National Aeronautics and Space Administration (NASA) Integrated Program Office initiated the Ocean Observer Study (OOS) which is still ongoing. The purpose of this study is to: 1) determine what additional ocean (particularly coastal ocean) and hazard observations from space are needed in the 2008 to 2023 time period; 2) turn those needs into requirements; 3) examine instrument and satellite options to meet these requirements, and (4) determine the costs for building such an ocean observation satellite. The OOS has produced a draft User Requirement Document. The participants in developing the requirements include scientists, managers, and product users from DoD, DOC, NASA, Federal Emergency Management Agency, Dept. of Transportation, Environmental Protection Agency, Dept. of Interior, and the Dept. of Agriculture, plus many Universities. Also the study has developed and costed 5 architectural scenarios. Sensors included in the study are: wind scatterometers, altimeters, synthetic aperture radars, and high-resolution infrared/visible radiometers. This poster summarizes the Ocean Observer User Requirements and the possible sensor and satellite architectures for meeting those requirements.

OS21C-53 0830h POSTER

New High-Resolution Climatology of Satellite-Derived Declouded Sea Surface Temperature Fields for the East Coast of the U.S.

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A long-term (1985-1998) and high-resolution (∼1.2 km) daily climatology of satellite-derived declouded-Pathfinder Sea Surface Temperature (SST) data have been calculated for the region off the East Coast of U.S. (78°-41°W, 30°-56°N). The declouded-SST fields were obtained from the University of Rhode Island, Graduate School of Oceanography.

The long-term SST climatology was calculated using a temporal harmonic regression technique on a pixel-by-pixel basis, from previously computed, yearly, monthly-means. The harmonic analysis was implemented in a MATLAB environment after using a Distributed Oceanographic Data System (DODS) package to obtain the necessary HDF files. In the future, our daily climatology and yearly monthly means of SST will be available to other researchers via ftp and DODS distributions.

As an example of the uses of this climatology, we present results of a comparison between SST and the distribution of Atlantic mackerel and other fish species. The fish data sets (1981-1987) were obtained from the NOAA/NMFS Northeast Fisheries Science Center, Woods Hole, MA.

OS21C-54 0830h POSTER

Low Salinity Amazon River Plumes in the Tropical Atlantic: Comparison of In-situ Float Data With Sea-WiFS Imagery.

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Forty salinity-profiling floats were deployed in the tropical North Atlantic in 1997 and 1998 as part of the WOCE Atlantic Circulation and Climate Experiment. The salinity capable Autonomous LAgrangian Current Explorer (S-PALACE) floats were the first generation of profiling floats to report salinity as well as temperature. The floats drift at 1000 m depth and rise to the surface every 10 or 14 days to report position and the profiles of temperature and salinity. The deep temperature-salinity relation allows compensation for any salinity sensor drifts, so that confidence in near-surface values is high. The automated data acquisition, processing, distribution and quality control system we developed to deal with the float data will be described.

One of the more striking features of the salinity profiles are occasional low values in the upper few tens of meters with strong contrasts with other nearby float profiles. These low mixed-layer salinities are suggestive of Amazon River water, which is known to be a dominant element in the hydrological cycle of the tropical Atlantic. Accordingly, we examined SeaWiFS imagery for a correlation between low SSS and chlorophyll, and between SSS and colored dissolved organic matter (CDOM), which is a potential indicator of water of riverine origin. Though the degree of overlap of cloud-free imagery and coincident float profiles is limited, we do see a tendency for salinities less than 35 to be associated with high chlorophyll and high CDOM readings. This suggests that SeaWiFS imagery in combination with in-situ float data may help to infer the detailed spatial patterns of low-salinity river plumes in the open ocean.