OS42C HC: Hall III Thursday 1330h

Biogeoinformatics: Challenges at the Intersection of Biological, Biogeochemical, and Physical Data Over Multiple Scales of Space and Time III

Presiding: **Y p zhang,** Rutgers, the State University of New Jersey**; D G Fautin,** University of Kansas

OS42C-135 1330h POSTER

Real-time Ocean Data Assimilation and Prediction with Global NCOM

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A global implementation of the Navy Coastal Ocean Model (NCOM) has been developed by the Naval Research Laboratory (NRL) at Stennis Space Center. Global NCOM encompasses the open ocean to 5 m depth in a curvilinear global model grid with 1/8 degree grid spacing at 45N, extending from 80 S to a complete arctic cap with grid singularities mapped into Canada and Russia. The model employs 41 vertical sigma-z levels, with sigma in the upper ocean and coastal regions, and z in the deeper ocean. The real-time system uses Navy Operational Global Atmospheric Prediction System (NOGAPS) 3-hourly wind stresses and heat fluxes. Operationally available sea surface temperature (SST) and altimetry (SSH) data are incorporated into NAVOCEANO Modular Ocean Data Assimilation System (MODAS) and Navy Layered Ocean Model (NLOM) analyses and forecasts of SSH and SST. These in turn are combined with the MODAS synthetic database to yield three-dimensional fields of temperature and salinity for assimilation into global NCOM. The model climate is evaluated by comparison with observed transport mean and variability, surface height variability, and large-scale thermal structure. Forecast skill is measured by improvement over persistence in comparisons with unassimilated data. Evaluations of the model climate and forecast skill are presented, globally and in selected areas of interest.

URL: http://www7320.nrlssc.navy.mil/global_nlom

OS42C-136 1330h POSTER

The Navy's Real-time Global Nowcast/Forecast System

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The Naval Research Laboratory (NRL) has developed a first-generation real-time global ocean nowcast/forecast system that runs daily at the Naval Oceanographic Office (NAVOCEANO). The system is built around the operational Modular Ocean Data Assimilation System (MODAS), which is an optimum interpolation analysis system including a climatological data base that has the ability to produce synthetic temperature and salinity profiles from sea surface height (SSH) and sea surface temperature (SST) data. The system's model components are the eddy-resolving 1/16 degree global NRL Layered Ocean Model (NLOM) and a 1/8 degree global version of the NRL Coastal Ocean Model (NCOM). The version of NLOM described here, which is now operational at NAVOCEANO, is wind and thermal forced with assimilation of satellite derived SSH and SST. NCOM is a fully global model that assimilates temperature and salinity profiles from the MODAS analysis and is now running in real-time with delivery to NAVOCEANO planned for 2002.

Nowcast/forecast results from the system will be shown including examples of the ability of the MODAS synthetic profiles to represent the 3-D structure of ocean mesoscale features. NLOM's skill in nowcasting and forecasting SSH and the positions of major ocean fronts and eddies out to 30 days will be discussed. The ability of the NCOM model to provide skillful short-term (5-7 day) forecasts of the upper ocean including SST and mixed-layer depth is also investigated.

URL: http://www7320.nrlssc.navy.mil/global_nlom

OS42C-137 1330h POSTER

Archiving, Publishing and Distributing of Data Sets from Global Change Research Using a Scientific Information System (PANGAEA) and a Data Center (WDC-MARE) that Both are Available Online

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More and more, proper data management has increasingly gained importance in all domains of scientific research. Yet there are no international regulations requiring scientists to store analytical data and related meta-information in any publicly accessible archive. However, some scientific journals and funding agencies encourage Principal Investigators (PIs) or authors to submit raw data or support data sharing.

Anyhow, the necessary database infrastructure was created as early as the 1950s with the invention of the World Data Center system (WDC). These centres are for the international exchange of solar, geophysical and environmental data on a long-term basis, and are established to assist PIs in broad data management and archiving. Among them, the WDC-MARE (http://www.pangaea.de/wdc-mare/) takes responsibility for the distribution of data from Global Change research with special emphasis on paleoclimate, marine and environmental sciences. WDC-MARE uses the scientific information system PANGAEA - the Network for Geological and Environmental Data - as operating platform and data distribution system. PANGAEA comprises a data warehouse, import procedures, web based uniform retrieval applications, GIS functionality (Geographical Information System), and 2-D plots with platform independent functionality. The web clients include a simple search engine 'PangaVista' and a data mining tool 'ART'. The client used for maintenance of information contents is optimized for data management purposes.

URL: http://www.pangaea.de/wdc-mare/

OS42C-138 1330h POSTER

Data, Data Everywhere And Not a Way to Choose

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The proliferation of electronic data sets has been a mixed blessing for researchers and others interested in environmental and biological information. The information potential in the expanding data offerings is often obscured or unrealized by the inability of would-be users to make effective evaluations and comparisons of data sets for the purposes of interest to them. Even within fairly well-defined user communities and applications, data selection can be a tedious and uncertain process. In the projects supported by the joint database of the Land-Ocean Interactions in the Coastal Zone (LOICZ) and the Biogeography of the Hexacorallia projects, the intention is to make useful, relevant data broadly available to non-specialist and multidisciplinary user communities. This requires standard formats for visualization and presentation, a convenient means of reviewing the variables and datasets available, ready access to both local and primary metadata, and importantly, means of visualizing both the numerical and the geographic distributions of the data within a given set. These needs have been addressed by adopting a grid system with appropriate scale and classifications, and by constructing a dynamic front end for a web-served relational database. This design provides rapid access and flexible development. This presentation describes not only the underlying structures, but also some of the tools provided as part of the data selection and download process. These permit the user to select geographic or numerical ranges, filter or transform the data, exclude or modify selected ranges of values, view single-variable distributions as histograms or scatter plots, and construct correlation matrices for multiple variables. For a relatively modest investment of development time, these features greatly increase both the use, and the appropriateness of the use, of the data.

URL: http://www.kgs.ukans.edu/Hexacoral/

OS42C-139 1330h POSTER

Evaluating standards for digital representation of locality information

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Locality data can be used to link environmental and biological data, but digitally representing localities reported in scientific literature is complicated by variation in areal precision and in how they are expressed. I describe three ways to georeference a locality digitally: using a single point to represent a locality; using polygon(s) for exact areal definition of the locality; and identifying bins (grid cells) that correspond to the locality. I evaluate these approaches using the criteria of accuracy, transportability, and cost. An accurate digital representation should describe each locality completely and specifically, quantify its areal precision, and indicate the source of information. Transportable data are easily moved into and compatible with other databases, which provides flexibility, especially for future studies. The cost of time and materials of data input should be minimized. Given a report that a marine animal was collected somewhere in Australia, no single point can adequately represent the possible locations of that site, and areal precision cannot be objectively quantified. Defining a polygon that includes all the area that might be called an Australian marine environment, and excluding all area that would not, is very accurate and allows easy quantification of areal precision, but requires much time and effort. Creating a grid and identifying all the bins that represent an Australian marine environment is more accurate than using a single point, allows quantification of areal precession, and is easier than defining a polygon(s). A grid of latitude and longitude lines is easy to make but the bins are not equal in size, so the precision with which a record can be captured will vary according to latitude. Equal-area grids do exist, but they are difficult to make and compare to existing databases. Supported by NSF grants DEB-9521819 and DEB-9978106 to Daphne G. Fautin (in the program Partnerships to Enhance Expertise in Taxonomy), and OCE-0003970 to DGF and R. W. Buddemeier (in the National Oceanographic Partnership Program).

URL: http://www.kgs.ukans.edu/Hexacoral/Biodata/index.html

OS42C-140 1330h POSTER

Ocean-Scale Biogeography: Predicted Distributions of Anemonefish Sea Anemones

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Only tens to a few hundreds of georeferenced occurrence data are available in electronic form for the sea anemones that host the obligately symbiotic anemonefishes, although these animals occur in tropical waters from the eastern shores of Africa and the Red Sea to French Polynesia and Japan. We investigated whether the environmental characteristics of places where the anemones are known to occur could be used to predict accurately where they are not known to exist but do live. We obtained known localities of the

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anemones and environmental data from the Hexacorallia database, and used the geospatial clustering tool LOICZView to identify the environmental parameters that define suitable habitat for the anemones (all are at www.kgs.ukans.edu/Hexacoral). Initial tests were done using unsupervised clustering of the environmental variables mean depth, mean monthly sea surface temperature (SST), mean salinity, and wave height. Although promising, the results were less generalizable than desired. In refining the clustering, the best results were from mean depth after excluding minimum depths greater than 100 m, minimum monthly SST, minimum monthly salinity, wave height, ocean color, tidal range, and coral reef occurrence. In addition to more selective definition of environmental parameters, known occurrences of anemones were used to train the prediction process. The revised clusters were tested for ability to predict occurrence of anemonefish, which served as indicators of anemone occurrence. Our preliminary results indicate that 1) reef occurrence is a good predictor of anemones and the fishes that live with them, 2) environmental clusters supervised with data on anemone occurrence are equally good predictors of anemonefish occurrence, and 3) we were readily able to identify about one-third of the potential range that has occurrence probabilities substantially better than random chance.

URL: http://www.kgs.ukans.edu/Hexacoral/

OS42C-141 1330h POSTER

Environmental GIS Modeling of Distribution Patterns in *Actinodendron plumosum*, a Sea Anemone With a Large Geographic Range.

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I use locality records to plot the distribution pattern of morphotypes as a way to test the hypothesis that several named species of the sea anemone genus *Actinodendron* actually comprise a single species, *A. plumosum*. GIS tools, prediction algorithms such as LOICZView and GARP, and existing environmental databases can be used not only to predict distribution patterns but also to solve taxonomic problems in marine biota with large geographic range. The known distribution of these sea anemones consists of sparse data points with various grades of precision. The associated environmental parameters can be used to predict the geographic range of each morphotype. I comparatively analyze the predicted distribution patterns to test a species hypothesis. Overlap between distributions of morphotypes supports the hypothesis of synonymy. Geographical separation of morphotypes can be used as evidence that the morphotypes belong to different species.

URL: http://www.kgs.ukans.edu/Hexacoral/

OS42C-142 1330h POSTER

Taxonomic recognition of plankton using optics

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In this contribution of the SCOR working group 118 (New Technologies for Observing Marine Life), we review the state-of-the-art optical methods for obtaining information on phytoplankton species composition and taxonomic distribution in the ocean. Single-cell imaging systems are presented as well as methods for analyzing bulk optical properties to obtain information on the dominant species. We present methods based on both in-situ and laboratory measurements of optical properties, as well as from satellite remote sensing. The application of these methods to the specific condition of red tides (i.e. extreme blooms) is presented as an example. Present limitations and future development are discussed.

OS42D HC: Hall III Thursday 1330h

Coupling of Biogeochemical Processes Between the Upper and Mesopelagic Ocean III

Presiding: **C Robinson,** Plymouth Marine Laboratory**; J Tremblay,** McGill University

OS42D-143 1330h POSTER

Remineralization Ratios in the Indian Ocean Based on WOCE Carbon and Nutrient Analysis

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We have derived subsurface (>500m) remineralization ratios for carbon and nutrients using an optimum multiple parameter (OMP) technique for all available carbon and nutrient data taken during the Indian Ocean WOCE program. The internal consistency of the CO2 data was assured using reference materials and a crossover analysis. For carbon, the anthropogenic CO2 signal was subtracted from the data while the effects of denitrification and calcium carbonate dissolution on all parameters were included in the OMP parameterization. The OMP technique estimates the contribution of up to six different predefined end-members for each sample using a non-negative least squares analysis. The mixing effects are then subtracted from the observations to reveal the changes in nitrate, phosphate, silicate, dissolved inorganic carbon and alkalinity due to remineralization of organic and inorganic carbon. Sensitivity of the estimated remineralization ratios to end-member definitions was determined by iteratively varying the definitions. The spatial patterns of the remineralization ratios, denitrification and calcite dissolution will be discussed and compared to previous studies in the Indian Ocean. The preliminary results show large spatial and depth related variations in the remineralization ratios and seem to be related to the local biogeochemical regimes.

OS42D-144 1330h POSTER

Biogeochemical Patchiness at the Sea Surface

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The surface distributions of many tracers in the ocean are highly correlated in time and space on meso (∼100km) and smaller scales. However, their characteristic scales of variability differ. Some variables like sea surface chlorophyll are very fine-scaled or patchy, while others like sea surface temperature are not. We characterize the patchiness of tracer distributions using a variance-based approach and quantitatively relate sea-surface patchiness to the characteristic response time λ of the tracer to processes that alter its concentration in the upper ocean. Tracers that are more patchy require higher resolution to model and sample; this too can be characterized in terms of λ.

OS42D-145 1330h POSTER

Distribution of Dissolved Enantiomeric Amino Acids in the Oceanic Water Column and Their Bacterial Utilization

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The distribution of selected species of dissolved total enantiomeric amino acids was measured in the water column of the North and (sub)tropical Atlantic, the Eastern Mediterranean, the Southern Ocean and the North Sea. Specifically, we measured the concentration and the ratio of D-/L- amino acids indicative of bacterioplankton cell wall origin (alanine, serine, aspartic acid, glutamic acid) but other enantiomeric amino acid species were measured as well. Also, the bacterioplankton utilization of enantiomeric aspartic acid was determined on selected samples throughout the water column in the North Atlantic and the Southern Ocean.

The ratios of individual dissolved D/L-amino acid species were remarkably constant with depths in all the oceanic provinces. The contribution of total dissolved amino acids to DOC was significantly lower in the eutrophic North Sea than in the open oceanic provinces. Generally, the main components of the D-amino acid pool were the bacterial cell wall-derived aspartic acid, glutamic acid, serine and alanine. The dominant L-enantiomeric amino acids were aspartic acid, serine and alanine as well as glycine and valine. The uptake ratio of D-/L- aspartic acid by bacterioplankton increased with depth from about 0.01 in the surface layers of the North Atlantic to about 1 at 1000 m depth. A similar tendency was observed for the water column of the Southern Ocean. Thus deep-water bacteria are obviously adapted to utilize D-amino acids which are usually considered refractory as efficiently as L-amino acids.

OS42D-146 1330h POSTER

Chemical and Isotopic Characterization of Dissolved and Particulate Organic Compound Classes in the North Pacific and Atlantic Oceans.

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Dissolved organic matter (DOM) in oceanic systems is comprised of identifiable biomolecules such as carbohydrates, proteins and lipids as well as operationally defined and long-lived geomacromolecules (e.g. humic and fulvic substances). However, up to 90% of open ocean DOM is still chemically uncharacterized due to difficulties ranging from the need for large sample sizes to the limitations of currently available analytical techniques. In addition, while $\Delta^{14}C$ analyses of bulk DOM indicate that it is on average long-lived (10^3-10^4 yrs) in open ocean systems, recent studies have shown that the DOM pool also contains a labile fraction that cycles on very short timescales (days to years). We investigated the major compound class compositions of ultrafiltered DOM (UDOM) and the contributions of these organic fractions to the ^{14}C age of bulk DOM. Large volume (1000-3000 L) surface and deep UDOM samples from the North Central Pacific and Sargasso Sea were extracted sequentially for individual organic fractions (as lipids, carbohydrates and proteins) and lipid biomarkers. The $\Delta^{14}C$ and $\delta^{13}C$ signatures of individual organic fractions were also determined.

Lipid biomarkers in UDOM suggest that components of the oceanic DOM pool may be relatively more bioreactive at greater depths compared to surface DOM due the presence of higher percentages of polyunsaturated fatty acids (PUFAs). This contrasts with lipid biomarker results from concurrently measured suspended particulate organic matter (POM_{susp}) which show decreasing percentages of PUFAs with depth. The relative differences in PUFAs between surface and deep samples coincide with decreasing elemental ratios (C:P and N:P) in UDOM and increasing ratios in POM_{susp}. However, all ratios were still much greater than Redfield, indicating that organic P is preferentially remineralized in both pools. Thus, the microbial processing and remineralization of UDOM and POM_{susp} occurs by different biogeochemical pathways and/or over different timescales. Isotopic information on the turnover times and sources of the different aged organic fractions will also be presented.

OS42D-147 1330h POSTER

Particulate Flux from the Upper Ocean to the Mesopelagic Ocean During a Phytoplankton Bloom in the Western North Pacific

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