3-2008

Bathypelagic Fish Diversity in the Sargasso Sea, Northwestern Atlantic Ocean

Tracey Sutton
Harbor Branch Oceanographic Institution, Inc, tsutton1@nova.edu

Peter Wiebe
Woods Hole Oceanographic Institution

Ann Bucklin
University of Connecticut

Laurence P. Madin
Woods Hole Oceanographic Institution

rates on EDAB species caused by algal toxicity or unpalatability, which promotes the proliferation of the EDAB species, but also lowers grazer-mediated recycling of nutrients and thereby decreases nutrient availability. Since many EDAB species are well-adapted to nutrient-stressed environments and many exhibit increased toxin production and toxicity under nutrient limitation, positive feedbacks are established which can greatly increase the rate of bloom development and the adverse effects on the ecosystem.

Sunderland, E. M., U.S. Environmental Protection Agency , Boston, MA , USA, sunderland.elsie@epa.gov;
Mason , R. P., Dept. of Marine Sciences, Univ. of Connecticut, Groton, CT, USA, robert.mason@uconn.edu;
Selin, N. E., Dept. of Earth and Planetary Sciences, Harvard University , Cambridge, MA, USA, eckley@fas.harvard.edu;
Strode, S., Dept. of Atmospheric Sciences, Univ. of Washington, Seattle, WA , USA, sstrode@atmos.washington.edu;
Krabbenhoft, D. P., U.S. Geological Survey, Middleton, WI, dpkrabbe@usgs.gov

ESTIMATING RESPONSE TIMES OF OCEANS TO MERCURY EMISSION REDUCTIONS AND IMPLICATIONS FOR EXPOSURE FROM MARINE FISH

We synthesize results from global-scale atmospheric and oceanic cycling models to assess anthropogenic contributions to human mercury exposure from marine fish consumption. Modeling results suggest that anthropogenic mercury enrichment is greatest in the Atlantic Ocean and Mediterranean Sea, and if global emissions remain at present levels, mean concentrations will decrease in these areas. However, our results also indicate concentrations in the North Pacific Ocean may increase. These modeling scenarios agree with data from a 2006 North Pacific cruise, and reveal increases in total mercury concentrations at comparable latitudes to stations sampled in 1987 and 2002. Data from the Mediterranean Sea, on the other hand, indicate decreasing concentrations in recent years. Since almost 40% of human mercury exposure in the U.S. is from tuna harvested primarily from the Pacific Ocean, these data suggest that population wide exposure may not decline concurrently with proposed domestic emissions reductions. This analysis illustrates the complex anticipated response of oceanic fish mercury levels resulting from large-scale mercury emission reductions, and emphasizes the important role scientists have for informing policy makers and resource management agencies.

Sundermeyer, M. A., Univ. Massachusetts Dartmouth, New Bedford, MA, USA, msundermeyer@umassd.edu;
Terray, E. A., Woods Hole Oceanographic Institution, Woods Hole, MA, USA, eterray@whoi.edu;
Ledwell, J. R., Woods Hole Oceanographic Institution, Woods Hole, MA, USA, jledwell@whoi.edu

OBSERVATIONS OF UPPER OCEAN MIXING USING AIRBORNE LIDAR

We present results from dye release experiments conducted off the east coast of Florida in which airborne LIDAR was used to obtain 3-D maps of the dye patch on times scales of minutes to hours, and spatial scales of meters to 1 km horizontally and 0.5-10 m vertically. In particular, we examine the rapid formation of a banded structure in the dye distributions on scales of the mixed layer depth. In situ observations from an acoustic Doppler current profiler (ADCP) combined with conductivity, temperature, and depth measurements (CTD) show a strongly stratified shear layer overlying a weaker, more uniform flow. We investigate the hypothesis that the bands are the result of shear instability in the upper part of the water column (Langmuir circulation can be ruled out based on the observed wind speed, wave height and stratification). As part of our analysis, we estimate vertical diffusivity and horizontal dispersion coefficients from the rates of vertical and horizontal spreading of the dye patch. We further exploit the ability of the LIDAR observations to track individual features in the dye distributions to quantify the scales and extent of small-scale features, intermittency, wavenumber spectra, etc.

Susanto, R. D., Lamont Doherty Earth Observatory of Columbia University, Palisades, USA, dwi@ldeo.columbia.edu;
Gordon, A. L., Lamont Doherty Earth Observatory of Columbia University, Palisades, USA, agordon@ldeo.columbia.edu;
Ffield, A., Earth & Space Research, Upper Grandview, USA, ffield@esr.org;
Pranowo, W. S., Agency for Marine and Fisheries Research, Jakarta, Indonesia, widodosetiyopranowo@yahoo.com;
Wirasantosa, S., Agency for Marine and Fisheries Research, Jakarta, USA, igi1@dkp.go.id

VELOCITY AND TEMPERATURE VARIABILITY OF THE MAKASSAR STRAIT THROUGHFLOW

The Makassar throughflow was monitored within the Labani 45 km constriction, 3°S, in the 1997/98 Arlindo and 2004/06 INSTANT programs. Both data sets record maximum southward speed within the thermocline, though there is variability caused by tides and intraseasonal events plus low frequency phenomena associated with the monsoon, IOD and ENSO. There is a tendency for reduced throughflow toward the end of the monsoon transition months, with maximum throughflow late in the southeast and northwest monsoons. Northward flow in the surface layer zeros or reverses during the northwest monsoon. North Pacific stratification is apparent, least modified in late 2006 when the thermocline was cooling while the transport was increasing. Whereas the Makassar transport during the Arlindo period was ~8 Sv, during the INSTANT 3-year period it was 9 to 10 Sv. This Makassar transport amounts to ~75% of the Sunda export transport, which may be as high as 13 Sv, suggesting an additional 3 to 4 Sv inflow via Karimata Strait and the eastern ITF path, the latter mainly associated with Lifamatola spillover into the Banda Sea.

Sutherland, D. A., Woods Hole Oceanographic Institution, Woods Hole, USA, dsutherland@whoi.edu;
Pickart, R. S., Woods Hole Oceanographic Institution, Woods Hole, USA, rpickart@whoi.edu;
Jones, E. P., Bedford Institute of Oceanography, Dartmouth, Canada, JonesP@mar.dfo-mpo.gc.ca;
Azetsu-Scott, K., Bedford Institute of Oceanography, Dartmouth, Canada, Azetsu-ScottK@mar.dfo-mpo.gc.ca;
Olafsson, J., University of Iceland, Reykjavik, Iceland

COMPOSITION, TRANSPORT, AND VARIABILITY OF FRESHWATER IN THE BRANCHES OF THE EAST GREENLAND CURRENT

The freshwater composition of the waters off of southeast Greenland are described using a set of high-resolution transects occupied in summer 2004 that included hydrographic, velocity, nutrient, and chemical tracer measurements. The nutrient and tracer data are used to quantify the Pacific Water, sea ice melt, and meteoric water fractions in the upper layers of the East Greenland Current (EGC) and East Greenland Coastal Current (EGCC). The EGC/EGCC current system dominates the shelf circulation in this region, and strongly influences the observed distribution of the three freshwater types. Significant fractions of Pacific Water are found in the subsurface layers of the EGCC, indicating that this inner shelf branch is directly linked to the EGC, and thus, to the Arctic Ocean. Historical transects from the Denmark Strait region are examined to determine interannual variability in the Pacific Water fractions of the EGC and EGCC. The variability is found to correlate significantly with the Arctic Oscillation Index, suggesting a link between the freshwater pathways of the Arctic Ocean and those of the Nordic Seas and subpolar gyre.

Sutor, M. M., Louisiana State University, Baton Rouge, USA, msutor1@lsu.edu;
Fratantoni, D. M., Woods Hole Oceanographic Institution, Woods Hole, USA, dfratantoni@whoi.edu;
Alford, M., Louisiana State Univeristy, Baton Rouge, USA, malfor1@lsu.edu

THE USE OF GLIDER-MOUNTED ACOUSTICS AND IN-SITU IMAGING SYSTEMS TO RESOLVE SPATIAL AND TEMPORAL DISTRIBUTIONS OF ZOOPLANKTON LAYERS IN MONTEREY BAY, CA

In July 2006, continuous water column backscatter data was collected with a glider-mounted Nortek 1 mHz ADCP in Monterey Bay, CA over 10 days. Profiles were conducted with an in-situ optical imaging system and direct samples were collected with a pump to groundtruth the density and composition of the observed scattering features. A consistent layer of backscatter was observed in the upper water column over the 10 days of the glider deployment. There was a distinct diel signal to the pattern of backscatter with increased backscatter in the layer at night and lower backscatter during the day. The layer was observed over the entire length of the glider track (10 km) for the entire 10 days. It was 1-3 m thick and formed and dissipated in less than 1 hour. Data from the in-situ optical system will be presented to illustrate the finescale vertical patterns in zooplankton distributions, community composition, and in-situ orientation. With these data, some inferences can be made about the role that behavior and other biological drivers may play in the formation of zooplankton layers.

SUTTON, R. T., Walker Institute, University of Reading, Reading, United Kingdom, r.sutton@reading.ac.uk;
HODSON, D., Walker Institute, University of Reading, Reading, United Kingdom, d.l.r.hodson@reading.ac.uk;
CASSOU, C., CERFACS, Toulouse, France, Christophe.Cassou@cerfacs.fr;
Keenlyside, N., IFM-GEOMAR, Kiel, Germany, nkeenlyside@ifm-geomar.de;
Zhou, T., Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China, zhoutj@lasg.iap.ac.cn;
Okumura, Y., NCAR, Boulder, USA, yukoo@ucar.edu

IMPACTS ON THE AMERICAS OF MULTIDECADAL VARIABILITY IN ATLANTIC AND INDIAN OCEAN SEA SURFACE TEMPERATURES: A MULTIMODEL COMPARISON

Previous work has shown strong evidence that multidecadal variability in Atlantic Ocean conditions influences the climate of North, South and Central America, affecting patterns of rainfall in particular. However, there is uncertainty as to the strength of these impacts, with notable contrasts between results from different studies. It is unclear to what extent these differences arise from the use of different models, or from differences in experimental design. As part of an EU project, DYNAMITE, we have carried out controled experiments in which 5 different atmospheric GCMs have been forced with the same pattern of multidecadal change in Atlantic SST. While there are similarities in the overall patterns of response, we find considerable differences between the model simulations of climate impacts over the Americas, especially with respect to the magnitude of rainfall anomalies. Further analyses are providing insight into the causes of these differences and evaluation of which responses may be most realistic. Finally, we have carried out a similar set of experiments forced by the observed multidecadal change in Indian Ocean SST, and will report on these results also.

Sutton, T. T., Harbor Branch Oceanographic Institution, Fort Pierce, USA, tsutton@hboi.edu;
Wiebe, P. H., Woods Hole Oceanographic Institution, Woods Hole, USA, pwiebe@whoi.edu;
Bucklin, A., University of Connecticut, Groton, USA, ann.bucklin@uconn.edu;
Madin, L., Woods Hole Oceanographic Institution, Woods Hole, USA, lmadin@whoi.edu

BATHYPELAGIC FISH DIVERSITY IN THE SARGASSO SEA, NORTHWESTERN ATLANTIC OCEAN

Of the various marine habitats, one of the (if not the) most daunting to quantify is the under-sampled bathypelagic zone (> 1000 m depth), which at 60% of the ocean's volume is the largest habitat on Earth. One project addressing this challenge is the Census of

Marine Zooplankton (CMarZ), whose goal is the assessment of biodiversity of animal plankton throughout the world's oceans. The 2006 CMarZ cruise in the Western North Atlantic provided an unprecedented opportunity to sample bathypelagic micronekton using a large midwater trawl (10-m^2 MOCNESS) outfitted with fine (0.335-mm) mesh netting. This netting allowed non-destructive sampling of the fragile fish fauna to 5000 m depth, thus facilitating accurate identification and at-sea DNA extraction and sequencing. A total of 3,965 fish specimens were collected from at least 127 species (84 genera, 42 families), many rarely caught, and four of which may be undescribed. Of note were male anglerfishes from five families, which are poorly known. Tissue was taken from all males to match with females, thus enabling the construction of a key for the most diverse bathypelagic fish group.

Sutyrin, G., URI/GSO, Narragansett, USA, gsutyrin@gso.uri.edu

BALANCED AND UNBALANCED VARIABILITY NEAR TOPOGRAPHY

Various physical mechanisms of topographically enhanced variability are discussed. Given that balanced motions are dynamically controlled by potential vorticity, topographic effects will be most pronounced in mesoscale features with strong potential vorticity anomalies. Analysis of intense vortices evolving near horizontal boundaries and tall seamounts is presented. Resonances between Rossby (vortical) and inertia-gravity modes result in unbalanced ageostrophic instability which is shown to be related to violation of Ripa's sufficient stability conditions.

Suzuki, T., FRCGC, JAMSTEC, Yokohama, Japan, tsuzuki@jamstec.go.jp

UNDERSTANDING PROJECTIONS OF SEA LEVEL RISE IN A MODEL FOR INTERDISCIPLINARY RESEARCH ON CLIMATE VERSION 3.2(MIROC3.2)

Sea level changes resulting from CO2-induced climate changes have been investigated in a series of idealized experiments with medium-resolution version of MIROC3.2. Changes in wind stress have important role of the several pronounced local features, while heat flux changes affect sea level rise in the Atlantic Ocean and fresh water flux affects sea level rise in the Indian Ocean. The changes in a wind stress and surface fluxes and the following sea level changes are also shown in the high-resolution version of MIROC3.2 with more detailed features. These local features are related to density changes mainly contributed from redistribution of ocean heat content. This work was supported by KAKENHI 18740305.

Swan, B. K., UC Santa Barbara, Marine Science Program & Department of Earth Science, Santa Barbara, USA, bkswan@umail.ucsb.edu;
Reifel, K. M., University of Southern California, Marine Environmental Biology, Los Angeles, USA, kreifel@usc.edu;
Tiffany, M. A., San Diego State University, Department of Biology, San Diego, USA, mtiffany@sunstroke.sdsu.edu;
Valentine, D. L., UC Santa Barbara, Department of Earth Science & Marine Science Institute, Santa Barbara, USA, valentine@geol.ucsb.edu

FROM BACTERIA TO BIRDS: THE IMPACT OF SULFIDE IRRUPTIONS ON MICROBIAL COMMUNITY STRUCTURE IN A HYPERSALINE LAKE

Numerous water quality problems plague California's largest lake, the Salton Sea. One of these is the presence of high concentrations of hydrogen sulfide (H_2S) in the lake. The development of large phytoplankton blooms and high summertime water temperatures lead to anoxia and H_2S formation. Frequent windstorms mix H_2S-rich bottom waters into surface waters, causing mass mortality of plankton, macroinvertebrates, and fish. Although similar phenomena have been documented in other lakes and marine ecosystems, no determination of how such events affect microbial community structure have been made. A mixing event was captured in the Salton Sea in September 2005 by sampling along a transect passing through an H_2S-rich plume. Physical and chemical water column properties were measured at 12 transect and two reference stations. Community fingerprinting (T-RFLP) was used to determine composition and structure of archaeal and bacterial communities. Archaeal community structure was strongly influenced by H_2S concentration, whereas the bacterial community exhibited only minor changes. Aside from the immediate effects of mixing events on the biota, the resulting changes in microbial communities may also lead to biogeochemical changes.

Swan, C. M., University of California, Santa Barbara, USA, swan@icess.ucsb.edu;
Siegel, D. A., University of California, Santa Barbara, USA, davey@icess.ucsb.edu;
Nelson, N. B., University of California, Santa Barbara, USA, norm@icess.ucsb.edu;
Kostadinov, T. S., University of California, Santa Barbara, USA, tiho@icess.ucsb.edu

PHOTOCHEMICAL CYCLING OF CHROMOPHORIC DISSOLVED ORGANIC MATTER (CDOM) IN THE OPEN SEA: COMPARISON OF PHOTOLYTIC QUANTUM YIELD AMONG THE MAJOR OCEAN BASINS

Solar photolysis of chromophoric dissolved organic matter (CDOM) drives the global open-ocean surface CDOM distribution seen from satellite. This process also leaves an imprint on CDOM absorption (in terms of magnitude and spectral shape) in regions of the ocean interior characterized by relatively frequent ventilation (e.g., subtropical mode waters of the North Atlantic and Pacific). Here we present preliminary experimental determinations of apparent quantum yield (AQY) for CDOM photolysis on open-ocean samples from ranging hydrographic provinces within the Pacific, Atlantic and Southern oceans (collected as part of both the CO2/CLIVAR Repeat Hydrography Survey and Bermuda Atlantic Time-series Study). CDOM photolysis rate is measured from a laboratory-simulated solar irradiation time course and used to solve for parameters describing AQY. Geographic variation in AQYs will be assessed within the context of the oceanic vertical distributions of CDOM and related hydrographic data. We investigate whether variation in AQY can be ascribed to regional biogeochemistry (specifically biological production characteristics) or the geochemical character of source water masses, each of which may influence the chemical composition thus photochemical potential of CDOM.

Swanson, M., University of Hawaii, Honolulu, USA, mswanson@hawaii.edu;
Pawlak, G., University of Hawaii, Honolulu, USA, pawlak@hawaii.edu;
De Carlo, E. H., University of Hawaii, Honolulu, USA, edecarlo@soest.hawaii.edu

SOURCES AND FORCES: WHAT DRIVES VARIABILITY IN SUSPENDED SOLID CONCENTRATIONS AT THE KILO NALU OBSERVATORY

Concern for Hawaiian coastal water quality, especially on Oahu's economically vital south shore, has risen significantly in the past decade. In order to predict variability in water quality, it is necessary to understand the relative importance of the various forcing mechanisms and how their combined effects influence the area. The Kilo Nalu Observatory, located on the south shore of Oahu, is ideal for studying water quality variations and their underlying physical forcing mechanisms. Using ADCP acoustic intensity as a relative measure of suspended solid concentration, quantitative analysis of the variance attributed to the major forcing mechanisms (swells, currents, solar irradiance, and tidal cycles) has been carried out. Regression analyses identify the significance of wave forcing in driving low frequency variability, while spectral analyses reveal diurnal and tidal influences in the acoustic intensity time series. Spatial variability in acoustic intensity in the Kilo Nalu area is assessed using AUV surveys.

Swaters, G. E., University of Alberta, Edmonton, Canada, gordon.swaters@ualberta.ca

STABILITY CHARACTERISTICS OF ABYSSAL OVERFLOWS

Abyssal overflows can progress through a sequence of instability mechanisms. Here, we describe the superinertial frictionally-induced destabilization of supercritical overflows as well as the baroclinic instability of grounded abyssal overflows with isopycnal incroppings.

Swift, J. H., UCSD Scripps Institution of Oceanography, La Jolla, CA, USA, jswift@ucsd.edu;
Osborne, J., OceanAtlas Software and NOAA/PMEL/JISAO, Vashon, WA, USA, tooz@oceanatlas.com;
Diggs, S. C., UCSD Scripps Institution of Oceanography, La Jolla, CA, sdiggs@ucsd.edu;
Talley, L. D., UCSD Scripps Institution of Oceanography, La Jolla, CA, USA, ltalley@ucsd.edu

VISUALIZING OCEAN INTERIOR CHANGES FROM THE CLIVAR/CO2 REPEAT HYDROGRAPHY PROGRAM USING JAVA OCEANATLAS

Most CLIVAR/CO2 Repeat Hydrography Program transects are repeats of WOCE Hydrographic Program (WHP) sections. This facilitates inter-expedition comparisons using off-the-shelf software. The ocean profile data exploration application Java OceanAtlas (JOA) includes an explicit

Sydeman, W. J., Farallon Institute for Advanced Ecosystem Research, Petaluma, USA, wsydeman@faralloninstitute.org;
Bradley, R. W., PRBO Conservation Science, Petaluma, USA, rbradley@prbo.org;
Buffa, J., USFWS, Newark, USA, joelle_buffa@fws.gov;
Largier, J. L., Bodega Marine Laboratory, Bodega Bay, USA, jlargier@ucdavis.edu;
Ralston, S., NOAA-NMFS, Santa Cruz, USA, steve.ralston@noaa.gov;
Suryan, R., Oregon State University, Newport, USA, rsuryan@osu.edu

CLIMATE CHANGE, UPWELLING, AND ECOSYSTEM DYNAMICS IN THE GULF OF THE FARALLONES

In eastern boundary current systems, coastal upwelling is predicted to intensify as a result of increasing temperature gradients between land and sea. Along the U.S. west coast, atmospheric-oceanographic coupling in the past decade has been extremely variable, resulting in dramatic, unpredictable responses of the California Current large marine ecosystem. While global warming is predicted to cause increased upwelling in neritic environments, the potential effects on offshore regions is less clear. Herein, we investigate biological change in neritic to offshore zones to test the hypothesis that global warming is differentially affecting these habitats. To test this hypothesis, we examine primary, secondary, and tertiary productivity by depth zone for the wide Gulf of the Farallones continental shelf ecosystem off central-northern California. We find trends in primary, secondary and tertiary productivity which are consistent with our hypothesis of differential ecosystem changes in the Gulf of the Farallones depending on distance from the coast, and relate these to changes in coastal upwelling and offshore wind curl.

Symonds, E. M., University of South Florida, Saint Petersburg, USA, esymonds@marine.usf.edu;
Rosario, K., University of South Florida, Saint Petersburg, USA, krosario@marine.usf.edu;
Breitbart, M., University of South Florida, Saint Petersburg, USA, mya@marine.usf.edu

VIRUSES FOUND IN SEWAGE AND THEIR POTENTIAL TO INDICATE FECAL POLLUTION IN COASTAL WATERS

The presence of pathogenic viruses in coastal environments is potentially an important tool in evaluating water quality and human health risks. Millions of viruses are excreted in fecal matter and bacterial indicators do not correlate with the presence of pathogenic viruses. Enteroviruses have been used to identify fecal pollution in the environment; however, other viruses transmitted via the fecal-oral route could indicate fecal pollution.