the simulations for many years to determine the impact of interannual variability of life history and population dynamics of Calanus.

OS42L-10 1605h

Interannual Variations in Environmental Conditions and Calanus spp. Abundance and Transport in the North West Atlantic

Erica J.H. Head (902-426-2317; HeadE@mar.dfo-mpo.gc.ca)

Erica J.H. Head, Dept. Fisheries and Oceans, Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, NS B2Y 4A2, Canada

Calanus finmarchicus is the dominant copepod of the NW Atlantic in spring and early summer, including the Labrador Sea and the Scotian Shelf. Calanus hyperboreus is also present in both areas, although generally more abundant on the eastern than on the western Scotian Shelf, and generally less abundant in the central Labrador Sea than over its shelves and at its margins. In spring 1998, there was cool slope water along and beyond the entire Scotian Shelf shelf-break, whereas in 1999 and 2000, warm slope water abutted the shelf-break in the western regions. In fall, along the shelf-break off Banquereau Bank (eastern Scotian Shelf) concentrations of C. finmarchicus and C. hyperboreus at depth were much higher in 1999 than in 1998 or 2000, probably due to an increased input from the Gulf of St. Lawrence. Beyond the shelf-break off Banquereau Bank, both C. finmarchicus and C. hyperboreus concentrations were higher in 1998 than in the other years. Similarily, off Browns Bank (western Scotian Shelf) both C. finmarchicus and C. hyperboreus were found in relatively large numbers at depth in the fall of 1998, whereas C. finmarchicus numbers were generally lower and very few C. hyperboreus were found in fall of 1999 and 2000. The patterns of abundance and depth distribution suggest that there was an increased influx of Calanus spp. from the northeast (Labrador Sea/Shelf) in 1998, relative to the other years. Another contributing factor in the west, however, might be a difference in circulation patterns on the Scotian Shelf. For example, in spring and early summer of 1998 perhaps most of the Calanus spp. produced on the Scotian Shelf were transported off the shelf to the east of Browns Bank, whereas in 1999 and 2000, perhaps a higher proportion was transported north of Browns Bank to the Gulf of Maine. In 2001, cool slope water was again present at and beyond the Scotian Shelf shelf-break. Sampling in the fall (November) is expected to show Calanus spp. distribution patterns similar to those of 1998.

OS42L-11 1620h

Pathways of Calanus finmarchicus transport between the Labrador Sea and the Slope Sea

Edward G Durbin[1] (4018746850; edurbin@gso.uri.edu)

Mark Prater[1] (mprater@gso.uri.edu)

[1]Graduate School of Oceanography, URI, South Ferry Rd, Narragansett, RI 02882, United States

In the Gulf of Maine-Georges Bank region decadal-scale variability of C. finmarchicus abundance appears to be related to the NAO, with higher abundance during warmer periods when the NAO index is higher, and lower abundance during colder, low NAO periods. We suggest that variations in the flow linking the Slope Sea (from which the GOM populations appear to be derived), to the Labrador Sea, provide a mechanism linking climate forcing to the observed interannual variability of Calanus populations. Links between these two regions are limited by the presence of the Grand Banks and the close proximity of the warm water of the Gulf Stream to the Grand Banks as it "reattaches" to the western boundary and is topographically steered around the Grand Banks. Potential pathways past the Tail of the Grand Banks include the baroclinic Labrador Current (LC) and the upper part (700-2000m) of the barotropic Deep Western Boundary Current (DWBC), which both flow from the Labrador Sea to the Slope Sea, and the Gulf Stream, which flows in the opposite direction. Volume transport in the DWBC is enhanced during high NAO years and is associated with increased production of Labrador Sea Water. In contrast, volume transport in the Labrador Current past the Tail of the Grand Banks is reduced and appears to be episodic. During the fall and winter when Calanus is resting at depth (500-2000m) it will be advected by the DWBC. We suggest that the DWBC provides a significant source of Calanus to the Slope Sea.

OS42L-12 1635h

Modeling Transport, Connectance and Seeding in Georges Bank and Mid Atlantic Bight Sea Scallops.

John A Quinlan[1] (jaq@whoi.edu)

Brian O Blanton[2] (bblanton@email.unc.edu)

Keston W Smith[3] (ksmith@whsun1.wh.whoi.edu)

Michael J Fogarty[3] (mfogarty@whsun1.wh.whoi.edu)

[1]Biology Department (MS-38), Woods Hole Oceanographic Institution, Woods Hole, MA 02543, United States

[2]Department of Marine Sciences, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599-3300, United States

[3]NOAA-Fisheries, Northeast Fisheries Science Center 166 Water Street, Woods Hole, MA 02543, United States

Sea scallops are protected from fishing in a number of areas on Georges Bank and in the Mid Atlantic Bight. The scallop population structure within these areas has changed significantly and recruitment has generally improved. Using hydrodynamic and biological modeling capabilities developed within SABRE and USGLOBEC we will explore the degree of connectance among the closed areas and between closed and fishable areas. Data from the period of 1982 to the present will be used to support this work. This work may have implications for the rational siting of marine protected areas.

URL: http://science.whoi.edu/users/jquinlan/Scallops/index.html

OS42M HC: 315 Thursday 1330h

Equatorial Oceanography IV

Presiding: **M McPhaden,** NOAA/PMEL**; L M Rothstein,** Graduate School of Oceanography, University of Rhode Island

OS42M-01 1330h INVITED

Seasonal Rectification Processes in the Western Equatorial Pacific: The (Subtle) Role of Salinity

Lewis M Rothstein (401 874-6517; lrothstein@gso.uri.edu)

Graduate School of Oceanography, Universiy of Rhode Island 215 South Ferry Road, Narragansett, RI 02882, United States

This talk will address the dynamical and thermodynamical components of the equatorial ocean's response to relatively strong, intraseasonal surface forcing in the presence of the strong density fronts associated with the eastern edge of the tropical Pacific Warm Pool. The application is the seasonal rectification of the zonal migration of the Warm Pool front due to intraseasonal mechanical fluxes. However, buoyancy fluxes (i.e. rainfall) associated with these winds significantly augment the mechanical response and cannot be safely ignored. The tools used to understand this problem are a rather limited observational basis, a hierarchy of numerical simulations, and equatorial theory. A proper application of theory requires augmenting relatively familiar non-linear equatorial wave theory (i.e. non-linear Kelvin waves) with the subtle roles of both the background, large-scale salinity gradient and the salinity gradients that locally evolve due to the rainfall observed to be associated with intraseasonal wind events. This all argues for the important role of intraseasonal variability for understanding seasonal-to-interannual variability.

OS42M-02 1355h

Interannual sea Surface Salinity and Temperature Changes in the Western Pacific Warm Pool during 1992-2000

Thierry C Delcroix[1] (Thierry.Delcroix@noumea.ird.nc)

Michael J. McPhaden[2] (Michael.J.McPhaden@noaa.gov)

[1]IRD, IRD Center, BP A5, Noumea, New Caledonia

[2]NOAA-PMEL, 7600 Sand Point Way NE, Seattle, WA, United States

Sea Surface Salinity (SSS) and Sea Surface Temperature (SST) in the western Pacific warm pool (130E-180; 10N-10S) are analyzed for the period 1992-2000 taking advantage of complementary data from the ship of opportunity program and the TAO-TRITON array of moored buoys. Co-variability of these variables with surface wind stress, surface zonal currents, evaporation, precipitation, and barrier layer thickness is also examined. These fields all go through large oscillations related to the El Nino Southern Oscillation (ENSO) cycle, most notably during the record breaking 1997-98 El Nino and subsequent strong 1998-2000 La Nina. East of about 160E, during El Nino, precipitation minus evaporation increases in the equatorial band, in conjunction with anomalous increases in westerly winds, eastward surface currents, SST, and decreases in SSS. Opposite tendencies are evident during La Nina. Peak to peak 2N-2S averaged variations reached as much as 1.2 m/s for zonal currents and 1.5 psu for SSS. West of about 160E, SST cools during El Nino and warms during La Nina, opposite to what occurs further east. To understand these SST tendencies west of 160E, a proxy indicator for barrier layer formation is developed in terms of changes in the zonal gradient of SSS. Zonal SSS gradients have been shown in modeling studies to be related to barrier layer formation via subduction driven by converging zonal currents in the vicinity of the salinity front at the eastern edge of the warm pool. Correlation between changes in zonal gradient of SSS and changes in SST a few degrees longitude to the west is significantly nonzero, consistent with idea that increased barrier layer thickness is related to warmer SSTs during periods of westward surface flow associated with La Nina, and vice versa during El Nino. Direct evidence of barrier layer thickness variations in support of this hypothesis is also presented.

OS42M-03 1410h

Can the Ocean Salinity Stratification Challenge the Role of Westerly Wind Burst in the Onset of El Nino?

Christophe Maes[1] (33 - 5 61 33 30 07; Christophe.Maes@cnes.fr)

Sophie Belamari[2] (Sophie.Belamari@meteo.fr)

Joel C Picaut[1] (Joel.Picaut@cnes.fr)

[1]Institut de Recherche pour le Developpement, LEGOS, 14 Av. Edouard Belin, Toulouse 31400, France

[2]Meteo-France, 42 Av. Coriolis, Toulouse 31057, France

Reliable forecasts of El Nino-Southern Oscillation (ENSO), the largest observed climate variability, depend crucially on model initial conditions. However, the physical processes implied in the onset phase of ENSO are not fully understood. Westerly Wind Burst (WWB) as an El Nino trigger is the most accepted process but is still subject to debate. In addition to remotely forced equatorial Kelvin waves, WWBs generate a local response over the warm and fresh pool of the western Pacific. The eastward displacement of the eastern edge of the warm pool increases the fetch of the WWB leading to a growing mode of the ocean-atmosphere interactions. Specific salinity stratification of the warm pool known as the barrier layer has been proposed to be important in this growing mode. It maintains surface waters warmer than 28C (threshold for organized atmospheric convection) by reducing the entrainment cooling from below the mixed layer. It also confines the forcing of the WWB in a shallow mixed layer thus increasing the eastward displacement of the eastern edge of the warm pool. The importance of the barrier layer in the onset of El Nino is investigated using an oceanic general circulation model of the tropical Pacific coupled to a global atmospheric general circulation model. The Meteo-France/ARPEGE and the LODYC/OPA coupled model is able to reproduce self-sustained El Nino events together with WWBs. At the onset of three El Nino events of different intensities, the stratification resulting from salinity only is cut off in the vertical mixing parameterization. This cutoff is restricted either to the eastern or the western side of the equatorial band (4N-4S). The impact over the eastern side (SST<28C) is modest. It does not modify the El Nino dynamics with the exception of the amplification of coastal warming. On the opposite, the impact over the western side (SST>28C) deeply modifies the onset of each event. Interactions between the ocean and the atmosphere over the warm pool do not amplify and each El Nino aborts. All perturbed experiments continue to exhibit WWBs and within six months return close to the seasonal cycle. Heat budget in the mixed layer confirms that the combined role of the barrier layer and zonal advection is crucial to amplify ocean-atmosphere interactions over the warm pool. Salinity stratification should be considered in coupled models in order to improve El Nino forecast.

THU

OS42M-04 1425h

Barrier Layer Formation During Westerly Wind Bursts

Meghan F. Cronin[1] (1-206-526-6449; cronin@pmel.noaa.gov)

Michael J. McPhaden[1] (mcphaden@pmel.noaa.gov)

[1]NOAA Pacific Marine Environmental Laboratory, 7600 Sand Point Way, Seattle, WA 98115, United States

Barrier layers between the base of a shallow halocline and the top of a deeper thermocline are a common feature of the western Pacific warm pool. In this presentation, we investigate barrier layer formation and erosion processes associated with westerly wind bursts (WWB). WWBs are typically accompanied by increased rainfall, but strong wind stirring and convective mixing from surface cooling tend to mix the freshwater down to the top of the thermocline. Thus, WWBs tend to erode pre-existing or newly formed barrier layers. However, competing advective processes that act to form barrier layers may counterbalance these one-dimensional tendencies. When WWB occur near a large-scale salinity gradient, the pattern of freshwater flux and ocean current convergences associated with the WWB forcing can sharpen the front. Surface intensified WWB-forced flow can then tilt the salinity front into the vertical, generating salinity stratification above the top of the thermocline to form barrier layers. This advective process appears to have been operative in the formation of some of the thickest and longest-lived barrier layers observed in the western Pacific warm pool.

OS42M-05 1440h

Atmospheric Forcing of Intraseasonal Equatorial Kelvin Waves as a Precursor of ENSO Warm Events

Chidong Zhang (305-361-4042; czhang@rsmas.miami.edu)

RSMAS, University of Miami, 4600 Rickenbacker Causeway MPO, Miami, FL 33149

This study explores whether anomalous sea surface temperature (SST) in the equatorial Pacific during warm events of El Nio - Southern Oscillation (ENSO) are related to anomalous forcing of the equatorial Kelvin waves by the Madden-Julian Oscillation (MJO). Using surface wind data from a global model reanalysis, an index is derived to measure such forcing. The interannual variability in this forcing index is related to interannual anomalies in equatorial SST for the 1980 - 1999 time period. It is shown that during ENSO warm events, stronger forcing in the western Pacific precedes greater SST anomalies in the eastern Pacific by 6 - 12 months. The result suggests that seasonal activities of Kelvin-wave forcing by the MJO in the western Pacific provide a precursory signal to the amplitude of SST anomalies associated with ENSO warm events in the eastern Pacific. Possible mechanisms for this connection between the forcing and ENSO SST and potential applications of this precursory signal to ENSO prediction are discussed.

OS42M-06 1455h

First and Second Baroclinic Kelvin Modes in the Equatorial Pacific at Intraseasonal Timescale

Sophie Cravatte[1] (33 - 5 61 33 29 41; Sophie.Cravatte@cnes.fr)

Joel C Picaut[2] (33 - 5 61 33 29 55; Joel.Picaut@cnes.fr)

Gerard Eldin[2] (33 - 5 61 33 28 72; Gerard.Eldin@cnes.fr)

[1]Universite Paul Sabatier, LEGOS, 14 Av. Edouard Belin, Toulouse 31400, France

[2]Institut de Recherche pour le Developpement, LEGOS, 14 Av. Edouard Belin, Toulouse 31400, France

Intraseasonal equatorial Kelvin waves are of great interest because they are potentially linked to the onset of El Nino. Previous studies have underlined the discrepancy between the frequency of the observed Kelvin waves (70 days) and the intraseasonal atmospheric forcing (30-60 days). TOPEX/Poseidon sea level and time series from the Tropical Atmosphere Ocean (TAO) array of moorings over 1992-1999 are used to investigate the frequencies and characteristics of the Kelvin waves at periods shorter than 180 days. Ocean General Circulation Model (OGCM) simulations forced by different wind stress fields are also analyzed. Spectral analyses show high oceanic energy in two separate bands, at periods centered at 70 days and 120 days. Signals are coherent in both bands all along the equator. In order to separate the two frequency band signals and to examine particular events, we use band-pass filtered time-series around 70 days and around 120 days. Because of its exceptionally strong variability, the period of the onset of the 1997 El Nino is emphasized. Time-longitude diagrams of sea level, dynamic height and 20C isotherm depth filtered in the 70-day band show an eastward propagation at speeds of 2.4-2.9 m/s, characteristic of the first baroclinic Kelvin mode. Phase speeds derived from a gaussian fit to the meridional wave structure along the propagation path are consistent with our previous results. Band-pass filtered model outputs show a vertical structure typical of the first baroclinic mode. These results confirm previous observations of intraseasonal activity at the onset of El Nino. Different properties are found using the same methods for the signal in the 120-day band. Time-longitude diagrams show an eastward propagation at speeds of 1.6-1.9 m/s, characteristic of the second baroclinic Kelvin mode. The meridional extent, as well as the vertical structure are also those expected for a dominant second mode. The presence of these second baroclinic Kelvin modes was previously only suggested, we have now clearly identified their presence and characteristics. Relationships between the zonal wind stress and the oceanic variability show coherence between the wind stress west of the date line and the thermocline variability all along the equator at 120 days. These results suggest that the 120-day period Kelvin waves are remotely forced by the zonal wind at the same period. A simple linear model and the OGCM are finally used to understand why the second baroclinic mode is preferentially forced at 120-day period.

OS42M-07 1530h

Mixed Layer Temperature Balance on Intraseasonal Time Scales in the Equatorial Pacific Ocean

Michael J McPhaden (206-526-6783; mcphaden@pmel.noaa.gov)

NOAA/Pacific Marine Environmental Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115, United States

The purpose of this study is to document the zonal evolution of processes affecting sea surface temperaure (SST) variability on intraseasonal time scales in the equatorial Pacific. We rely primarily on data from the Tropical Atmosphere Ocean (TAO) array of moored buoys, focussing on four sites along the equator with decade-long time series. These sites are located in the western Pacific warm pool (165E), the eastern Pacific equatorial cold tongue (110W, 140W), and the transition zone between these two regions (170W). Results indicate that SST variability on intraseasonal time scales is mainly determined by local surface heat fluxes in the western Pacific (165E), zonal advection in the central Pacific (170W), and vertical advection and entrainment in the eastern Pacific (110W and 140W). Equatorial Kelvin waves mediate intraseasonal SST variations east of the date line, but the details of coupling between Kelvin wave dynamics and mixed layer processes makes for complicated SST phasing along the equator. While thermocline temperatures propagate eastward at Kelvin wave speeds in the central and eastern Pacific, SST can develop in phase over thousands of kilometers, or may even appear to propagate westward. Possible implications of these results for understanding the dynamical connection between intraseasonal and interannual variability are discussed.

OS42M-08 1545h

Seasonal to Interannual Variations of the Surface Currents in the Equatorial Oceans

Fabrice Bonjean[1] (206 726 0501; bonjean@esr.org)

Gary S.E. Lagerloef[1] (206 726 0501; lager@esr.org)

[1]Earth Space Research, 1910 Fairview Ave. E, Suite 102, Seattle, WA 98102, United States

Surface currents are estimated in the three tropical oceans from a data ensemble including mean dynamic height (Levitus), TOPEX/POSEIDON de-meaned sea level height, SSM/I and QuickScat wind, and IGOSS SST. The diagnostic model of the velocity employs direct formulations of velocity contribution related to sea level gradient, surface wind stress and SST gradient. Comparisons to climatological fields based on historical ship drift or on 15m buoy drifter data show consistent close agreement in all equatorial oceans. Annual and semiannual harmonics are investigated. Higher frequency variability accounts for a substantial part of the year-to-year variations of the currents, and salient features of the meso-scale circulation ($\geq$ 1 month) are presented. During the past decade, the interannual variability of the surface circulation was more significant in the Pacific than in Indian and Atlantic in terms of anomaly amplitude and event duration. A description of the most significant circulation events in the equatorial oceans is shown, and their possible connexion with ENSO is addressed.

OS42M-09 1600h

The role of the Kelvin and Rossby waves in the annual cycle of the equatorial Pacific ocean circulation

Dongliang Yuan[1,2] (301-614-5923; dyuan@janus.gsfc.nasa.gov)

Michele M. Rienecker[1] (301-614-5698; rienecke@mohawk.gsfc.nasa.gov)

[1]Code 971, Lab of Hydrospheric Processes, NASA/Goddard Space Flight Center, Greenbelt, MD 20771, United States

[2]GEST, University of Maryland Baltimore County, 1000 Hilltop Circle Southern Campus, Room 3.002, Baltimore, MD 21250, United States

The dynamics of the annual cycle of the equatorial Pacific ocean circulation are investigated in a hindcast study generated by the Poseidon quasi-isopycnal ocean model forced with SSMI/I windstress and heat flux from a atmospheric mixed layer model. The simulated zonal currents reproduce the annual cycle in the TAO mooring measurements. Based on the comparison, the role of the equatorial Kelvin and Rossby waves in the annual cycle dynamics is studied. The Kelvin and Rossby waves are extracted from the hindcast results and their transmission and reflection at the Pacific western and eastern boundaries are investigated and are compared with linear theory. The extracted waves show that the semi-annual oscillation of the thermocline displacement and zonal velocity in the far eastern equatorial Pacific is strongly influenced by the semi-annual oscillation in the western Pacific through the first baroclinic Kelvin waves. The semi-annual Rossby waves reflected from the semi-annual Kelvin waves at the eastern boundary, however, cannot reach the western boundary. Instead, they are overwhelmed by the annual winds in the central-to-eastern equatorial Pacific. The semi-annual oscillation of the western Pacific is a combined effect of the local monsoon and the Rossby wave forcing from the central-to-eastern Pacific.

The comparisons with the linear theory show that the reflection of the first baroclinic waves at the Pacific western and eastern boundaries is in good agreement with the linear theory. In contrast, the reflection of the second and higher baroclinic waves is in significant difference from the linear theory. The difference suggests importance of nonlinear effects in the reflection of the higher baroclinic waves at the boundaries. In particular, the nonlinearity associated with the Equatorial Undercurrent is speculated as the source of the nonlinearity.

OS42M-10 1615h

Seasonal Cycle Response of a Tropical Pacific Ocean General Circulation Model to La Niña Condition Wind Forcing

Renellys C. Perez[1] (541-737-5586; rperez@coas.oregonstate.edu)

Robert N. Miller[1] (541-737-4555; miller@coas.oregonstate.edu)

Dudley B. Chelton[1] (541-737-4017; chelton@coas.oregonstate.edu)

[1]College of Oceanic and Atmospheric Sciences, 104 Ocean Admin Building Oregon State University , Corvallis, OR 97331-5503, United States

Seasonal cycles of the wind over the tropical Pacific have been extracted from several wind products, with the goal of determining the differences in the model response to forcing by these different wind fields. For this study we use the Gent-Cane (1989) general circulation model.

Comparison of results from different wind products allows us to determine the sensitivity of the model's seasonal cycle, with emphasis in the eastern Equatorial Pacific cold tongue region, to the wind forcing seasonal cycle. The wind products considered include FSU pseudostress winds, NCEP reanalysis, and QuikSCAT. The QuikSCAT instrument was launched in July 1999. Our analysis thus covers the 2-year period August 1999 to July 2001, which is well suited to the goals of this study since the wind stress field over the eastern Equatorial Pacific is most heterogeneous during La Niña conditions. We will analyze the response of the GCM upon convergence to the various La Niña condition wind forcing fields.

We expect this series of experiments to allow us to answer the question of whether different wind products give rise to essentially different dynamic balances in a detailed model of the Pacific cold tongue. We pay particular attention to the differences between the QuikSCAT winds and FSU and NCEP products in order to see if results from the remotely sensed product are fundamentally different. Our long term goal is to apply optimized data assimilation techniques to explore the dynamic balances which maintain the cold tongue. We expect the results of this series of experiments to have strong implications for the error models essential

for data assimilation; in particular, we expect these results to be useful for addressing the issue of biases.

OS42M-11 1630h

Understanding Tropical Pacific Rossby Wave Dynamics with Improved Winds

Kathryn A Kelly[1] (206-543-9810; kkelly@apl.washington.edu)

LuAnne Thompson[2] (206-543-9965; luanne@ocean.washington.edu)

[1]Kathryn A. Kelly, Applied Physics Laboratory University of Washington, Seattle, WA 98195-5640, United States

[2]LuAnne Thompson, School of Oceanography University of Washington, Seattle, WA 98195-5351, United States

Near-annual period Rossby waves in the North Pacific are overwhelmed by a zonally coherent response in the latitude band 10–16°N, as observed in sea surface height (SSH) anomalies from the TOPEX/Poseidon altimeter. The apparent lack of wave propagation has also been observed in thermocline anomalies in the same region. Two models, a simple reduced gravity model of wave propagation and an isopycnal model coupled to a mixed layer, are used in analyses of the processes responsible for the coherent annual period signal. Comparisons of model runs with NCEP reanalysis winds and with winds from the QuikSCAT/SeaWinds scatterometer demonstrate that the observed SSH variations reflect the dominant local Ekman pumping response to zonally coherent wind stress that is produced only by the scatterometer fields. Rossby waves do propagate westward, but the magnitude of the free wave is smaller than the locally forced response. The wind stress variations are associated with the annual migration of the Intertropical Convergence Zone. Comparisons with the expected steric response to two surface heat flux products confirm that this is a wind-forced response. The coherent SSH response is accompanied by a coherent SST annual cycle. SST anomalies from the zonal mean propagate westward with the Rossby wave phase speed, which suggests that the Rossby wave is producing a SST signature.

OS42M-12 1645h

The annual cycle of biological productivity in the Equatorial Pacific Ocean

Annette Samuelsen[1] (850 644 4174; samuelse@coaps.fsu.edu)

James J. O'Brien[1] (850 644 4581; obrien@coaps.fsu.edu)

[1]Center for Ocean-Atmospheric Prediction Studies, Florida State University, Tallahassee, FL 32306-2840, United States

A 1 1/2 layer reduced gravity nonlinear ocean model is coupled to a biogeochemical model. The model is integrated from 1961 to 1996 in the tropical Pacific Ocean forced by FSU monthly winds. The annual cycle is calculated from 16 years of model data from the period 1964 to 1980. This period is chosen to avoid years with strong interannual variability. There are two regions that show significant annual variability: the equatorial cold tongue and a region in the central Pacific between 160 W and 120 W near 9 N. The annual cycles in these two regions are calculated and explained in terms of the physical forcing. The east Pacific region shows a semiannual signal, with an increase in biomass in the spring and the fall. There is little production during the winter. This can be explained by a semiannual Kelvin wave, generated in the west Pacific by the movement of the ITCZ. In addition the equatorial upwelling in the region also enhances the production. The region in the central Pacific shows one annual peak in production in late spring, right after the yearly minimum of production. This region is not influenced by planetary waves, but rather by local upwelling caused by the divergence of water just north of the ITCZ.

OS42N HC: 317 A Thursday 1330h

Biogeochemical Processes in Anoxic and Suboxic Environments III

Presiding: **M Scranton,** State University of New York**; J Murray,** University of Washington

OS42N-01 1330h

Evidence of Ventilation Events in the Cariaco Basin

Yrene Margarita Astor[1] ((0295) 239-8051; edimar_biomarina@unete.com.ve)

Frank E. Muller-Karger[2] ((727) 553-1186; carib@carbon.marine.usf.edu)

Mary I. Scranton[3] ((516) 632-8700; mscranton@notes.cc.sunysb.edu)

[1]Fundacion La Salle de Ciencias Naturales, Fundacion La Salle. EDIMAR. Apartado 144, Porlamar 6301, Venezuela

[2]University of South Florida, University of South Florida. Department of Marine Science. 140 7th Ave. South, St. Petersburg, FL 33701, United States

[3]State University of New York, Marine Science Research Center. State University of New York, Stony Brook, NY 11794-5000, United States

The hydrography of the Cariaco Basin was studied using data collected at monthly intervals between November 1995 and May 2000 under the CARIACO(CArbon Retention In A Colored Ocean) Program. Seasonal patterns in hydrography, oxygen and nutrients were observed. Upward migration of isopleths within the upper 150 m was observed between November and May each year, during periods of intensification of the Trade Wind. A seasonal deepening of the isopleths was observed when winds relaxed. A secondary upwelling event was observed every year between July and August, in response to an intensification of the southward component of the Trade Wind. Interannual variations in the seasonal coastal upwelling cycle were driven in part by variations in wind intensity and in part by strong events at time scales of 1-3 months. The latter were associated with intrusions of Caribbean Sea water at depths of 90-140 m that forced waters above them to the surface. Satellite-derived Sea Surface Height (SSH) anomaly maps demonstrated that these events were related to the westward migration of cyclonic and anticyclonic eddies along the continental shelf of the southern Caribbean Sea.

OS42N-02 1345h

Comparison of Controls on the Structure of the Oxic/Anoxic Interface in the Cariaco Basin and the Black Sea

Mary I Scranton[1] (631-632-8735; mscranton@notes.cc.sunysb.edu)

Gordon T Taylor[1]

Yrene Astor[2]

Frank Muller-Karger[3]

[1]Marine Sciences Research Cntr, Stony Brook University, Stony Brook, NY 11794-5000, United States

[2]EDIMAR, Fundacion La Salle de Ciencias Naturales, Isla Margarita, Venezuela

[3]Dept. of Marine Science, University of South Florida, St. Petersburg, FL 33701, United States

In the Black Sea, the depths at which oxygen disappears and at which sulfide appears have shoaled significantly in recent years. In the Cariaco Basin, the depth of the oxic-anoxic interface also has changed dramatically, deepening from about 250 m in 1995 to around 300 m since 1997. In both systems, a suboxic layer has appeared. However, in contrast to the Black Sea, in the Cariaco Basin the depth and structure of the interface does not appear to be strongly controlled by density. This is largely because, in the Cariaco, the density contrast between 250 and 350 m is very small (only about 0.02 units of sigma-t) while the interface in the Black Sea is in a highly stratified portion of the water column. Apparently, in the Cariaco the depth of the interface, and the presence or absence of a suboxic layer, are controlled by multiple characteristics (density, volume, oxygen content) of the intruding water. Since oxidants from intrusions are extremely important in geochemical cycles of carbon and of redox sensitive species in the Cariaco Basin, it is very important to understand these features. We will discuss the properties of the waters near the interface and speculate how intrusions enter and propagate through the Cariaco Basin region.

OS42N-03 1400h

Prodigious Production By Chemoautotrophs In The Cariaco's Suboxic Zone: Fact Or Artifact?

Gordon T Taylor[1] (631.632.8688; gtaylor@notes.cc.sunysb.edu); Maria Iabichella[1]; Mary I. Scranton[1]; Andrei Chistoserdov[1]; Yrene Astor[2]; Frank Muller-Karger[3]

[1]Marine Sciences Research Center, Stony Brook University, Stony Brook, NY 11794-5000, United States

[2]Estacion de Investigaciones Marinas de Margarita, Fundacion la Salle de Ciencias Naturales, Apartado 144, Punta de Piedras, NE, Venezuela

[3]Department of Marine Sciences, University of South Florida, St. Petersburg, FL 33701, United States

Previously, we reported chemoautotrophic DIC assimilation (27-159 mmol C m^{-2} d^{-1}) in sub- to anoxic waters at the CARIACO time series station that were equivalent to between 10 and 333 % of contemporaneous net primary production in the photic zone. Peak rates ($<$ or $=$ 2.5 μM C d^{-1}) were comparable to DIC assimilation reported for the Black Sea's suboxic zone. However, biological production reported for suboxic waters in both anoxic basins far exceeds delivery of energy substrates and oxidants by eddy diffusion.

This imbalance is explored for the Cariaco Basin. Potential artifacts of measurements are evaluated using enrichment experiments and molecular evidence. Required advective fluxes of inorganic substrates (reduced S species and NH_4) and oxidants (O_2, Mn^{4+}, Fe^{3+}) are estimated. Lateral intrusions of oxygenated water along isopycnals are examined as a mechanism to provide oxidant at the interface. Kinetic energy introduced below the interface during advective events also may be important in increasing transport of sulfide-rich water to the suboxic zone.

OS42N-04 1415h

Dynamics of Heterotrophic Nanoflagellates (HNAN) in the Anoxic Cariaco Basin, Venezuela.

Maria de L. Iabichella[1] (1-631-632-9369; miabiche@ic.sunysb.edu)

Gordon T. Taylor[1] (gtaylor@notes.cc.sunysb.edu)

Mary I. Scranton[1] (mscranton@notes.cc.sunysb.edu)

Carly Gomes[2] (gomesbibs@hotmail.com)

[1]Marine Sciences Research Center, SUNY at Stony Brook, Stony Brook, NY 11794-5000, United States

[2]Cornell University, Clara Dickson #5683, Ithaca, NY 14853-2401, United States

Numbers and biomass of HNAN have been determined in the anoxic Cariaco Basin (north of Venezuela) as part of the microbiological component of Project CARIACO, a time series established in Nov-95. HNAN are observed throughout the water column, with numbers on the order of 10^4-10^5 cells/L. Two main peaks in the vertical distribution of flagellates numbers are observed: one in the upper oxic layer and the other in the oxic-anoxic interface, resembling distributions of bacterial numbers and bacterial production.

The HNAN community is made up of small cells, usually less than 12 μm (longest dimension). Cells slightly less than 2 μm generally represent more than 50% of the total. Dividing cells have been observed in deep anoxic waters (930 m) suggesting growth at depth. Significant correlation has been observed between bacteria and flagellates numbers along the water column. Relationships between HNAN and bacterial numbers and production are further explored. Potential for top-down control of bacterial communities by HNAN is evaluated.

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Anaerobic Oxidation of Methane Mediated by Microbial Consortia In Gassy Sediments

Antje Boetius[1,2,3] (+49 421 2028 648; aboetius@awi-bremerhaven.de); Katrin Knittel[3] (kknittel@mpi-bremen.de); Martin Krger[3] (mkrueger@mpi-bremen.de); Thierry Nadalig[4] (tnadalig@ifremer.fr); Katja Nauhaus[3] (knauhaus@mpi-bremen.de); Tina Treude[3] (ttreude@mpi-bremen.de); Bo Barker Jrgensen[3] (bjoergen@mpi-bremen.de)

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