OS12E HC: Hall III Monday 1330h

Arctic System Studies I

Presiding: **M Baskaran,** Wayne State University

OS12E-172 1330h POSTER

Shelf-Basin Interaction of Pacific-Origin and Atlantic-Origin Waters on the Shelf-Break of the Chukchi Sea: An Approach Using the NO/PO Ratio.

Shigeto Nishino[1] (+81-468-67-9487; nishinos@jamstec.go.jp); Koji Shimada[1] (+81-468-67-9485; shimadak@jamstec.go.jp); Takashi Kikuchi[1] (+81-468-67-9486; takashik@jamstec.go.jp); Chikashi Kobayashi[1] (+81-468-67-9484; ckoba@jamstec.go.jp); Takatoshi Takizawa[1] (+81-468-67-9450; takizawat@jamstec.go.jp); John P. Christensen[2] (703-292-7425; jchriste@nsf.gov); Patricia A. Wheeler[3] (541-737-0558; pwheeler@oce.orst.edu)

[1]JAMSTEC, 2-15 Natsushima Yokosuka 237-0061 Japan, Yokosuka 237-0061, Japan

[2]Bigelow Laboratory for Ocean Sciences, 180 McKown Point West Boothbay Harbor ME 04575 USA, West Boothbay Harbor, ME 475, United States

[3]College of Oceanic and Atmospheric Sciences Oregon State University, 104 Ocean Admin Bldg Corvallis OR 97331 USA, Corvallis, OR, United States

Modification processes of water masses on the shelf-break of the Chukchi Sea are examined by using the NO/PO ratio. The data used here are collected by the R.V. Mirai in 1999 and 2000 and by the R.V. Alpha Helix in 1996. The World Ocean Database (1998) is also used. The NO/PO ratio is high ($\sim$1) in the Atlantic-origin water and low ($<$0.85) in the Pacific-origin water. Furthermore, the Pacific-origin water has distinct NO/PO ratios within the Chukchi shelf. Therefore, the ratio is a useful tool to understand the water circulation and modification.

First, extension of bottom water of the Barrow Canyon to the Chukchi shelf-break is studied. The Barrow Canyon is one of major pathways of the Pacific-origin water. The bottom water, which is characterized by a vertical minimum of the NO/PO ratio, can be traced to the Chukchi shelf-break just above the upper halocline water (UHW) identified by a vertical nutrient maximum. This indicates that the nutrient maximum layer continuously appears from the bottom of the Barrow Canyon to the UHW in the Canada Basin has different origins between the canyon and the basin. The former water is produced at the bottom of the Barrow Canyon in summer, and the latter water is formed at shelves in winter.

Second, focusing on the difference of the NO/PO ratio between the Pacific-origin and Atlantic-origin waters, mixing of these two waters along the Chukchi shelf-break is investigated. A vertical boundary of the two waters, i.e., a sharp vertical gradient of the NO/PO ratio, appears around 200 m. Taking notice of this boundary, the vertical gradient of the NO/PO ratio is larger in the interior of the Canada Basin than the shelf-break, and the gradient decreases eastward along the shelf-break. That is, the boundary of the Atlantic-origin and Pacific-origin waters becomes obscure toward the east along the shelf-break. This must be the result of vertical mixing of the Atlantic-origin and Pacific-origin waters, the stage of which develops toward the east. The vertical mixing of the two waters, which occurs effectively along the shelf-break, would be due to coastal upwellings of the Atlantic-origin water along the shelf-break.

OS12E-173 1330h POSTER

Circulation of Atlantic and Halocline Waters in the Arctic Ocean

Koji Shimada[1] (81-468-67-9485; shimadak@jamstec.go.jp); Shigeto Nishino[1] (81-468-67-9487; nishinos@jamstec.go.jp); Fiona McLaughlin[2] (250-363-6527; McLaughlinF@pac.dfo-mpo.gc.ca); Eddy C Carmack[2] (250-363-6585; CarmackE@pac.dfp-mpo.gc.ca); Robie Macdonald[2] (macdonaldrob@pac.dfo-mpo.gc.ca); Takatoshi Takizawa[1] (81-468-67-9450; takizawat@jamstec.go.jp)

[1]Japan Marine Science and Technology Center, 2-15 Natsushima, Yokosuka 237-0061, Japan

[2]Institute of Ocean Sciences, 9860 West Saanich Road, Sidney, BC V8L 4B2, Canada

We discuss the circulation and variability of Atlantic (AW) and halocline (HW) waters in the southern Canadian Basin. The appearance of AW warmer than 1 deg.C was first observed near the Mendeleyev Ridge in 1993 from CCGS Henry Larsen and USS Pargo (Carmack et al., 1995; Morison et al., 1998). During the SHEBA experiment in 1997-1998, this warm variety of AW was found on the flanks of Chukchi Plateau. In 2000, aboard the R/V Mirai, warm AW was observed to reach the southern end of the Northwind Ridge. This gGreat Temperature Anomalyh thus traveled from the Mendeleyev Ridge to the Northwind Ridge in about 7 years, yielding an advective speed of about 1cm/s along the flanks of the Chukchi Borderland. However, direct ADCP current measurements from drifting buoys in two periods (1992-1994 and 1997-1998) show flows of about 3cm/s in both periods, and thus do not match the estimate of the advective speed. On the other hand, the flow on the eastern flanks of the Northwind Ridge was southward at 3cm/s in the 1992-94 data, and northward at 1-2cm/s in the 1997-98 data. This reversal in flow along the ridge may thus explain the difference the advective speed and measured flow. We conclude that the circulation pattern of AW is strongly affected by the depth to which the wind driven circulation penetrates within the water column, and this, in turn, is dependent on ice cover. As the result of such interannual variability, the incoming AW may detach at the northeastern tip of the Northwind Ridge and enter the interior Canada Basin, or it may continue southward the to Alaskan Beaufort shelf slope. Thus, two warm spots of AW may form in the Canada Basin; indeed, such warm spots appear in the EWG Arctic Ocean Atlas. The associated spreading of halocline waters (winter shelf water) of Pacific-origin and Eurasian shelf-origin is also revealed in T/S patterns. Here, lower halocline waters are classified into two types according to the salinity (33psu versus 34psu) at which the upper minimum temperature occurs. The former one is originated from the western Arctic shelf the other from eastern Arctic shelf. These two types of the halocline water are identified by the second vertical derivative of salinity or density (i.e., derivative of potential vorticity). On the other hand, the upper halocline water originated from the summer shelf water in the Chukchi Sea is identified by the second vertical derivative of temperature. We discuss the spreading of both the upper (summer) and lower (winter) halocline waters using CTD data in 1990s and EWG Arctic Ocean Atlas.

URL: http://w3.jamstec.go.jp:8338/

OS12E-174 1330h POSTER

Observationally Based Assessment of Polar Amplification of Global Warming

Igor Polyakov[1] (igor@iarc.uaf.edu); Genrikh V Alekseev[2]; Roman V Bekryaev[2]; Uma Bhatt[1] (bhatt@iarc.uaf.edu); Roger L Colony[1] (rcolony@iarc.uaf.edu); Mark A Johnson[3]; Valerii P Karklin[2]; Alexander P Makshtas[1]; David Walsh[1] (dwalsh@iarc.uaf.edu); Alexander V Yulin[2]

[1]International Arctic Research Center & University of Alaska Fairbanks, 930 Koyukuk Drive P.O. Box 75-7335, Fairbanks, AK 99775, United States

[2]Arctic and Antarctic Research Institute, 38 Bering Street, St. Petersburg 199397, Russian Federation

[3]University of Alaska Fairbanks Institute of Marine Science, O'Neill Building University of Alaska Fairbanks, Fairbanks, AK 99775, United States

Arctic variability is dominated by a low-frequency, multidecadal oscillation (LFO). Incomplete sampling of the large-amplitude LFO results in oscillatory arctic surface-air temperature (SAT) trends. Modulated by the LFO, these trends are amplified relative to northern hemisphere trends. Over the 125-year record we identify periods when arctic SAT trends were actually smaller or of opposite sign than northern hemisphere trends. Arctic and northern hemisphere air-temperature trends during the 20th century (when positive LFO phases nearly offset negative LFO phases) are similar, and do not support predicted two-fold polar amplification of global warming. The potential moderating role of arctic sea-ice, which may act to suppress polar amplification,cannot be conclusively identified with existing data. This analysis reinforces the idea that intrinsic variability in the arctic obscures possible long-term changes, and places a strong limitation on our ability to recognize and identify the complex positive and negative feedbacks in the arctic climate system.

OS12E-175 1330h POSTER

Regional Patterns of Oxygen and Nutrients found in the Russian Arctic Seas

Sergey Pivovarov[1] (+8 812 352 0096; pivovarov@actor.ru); Roger Colony[2] (907 474 5115; rcolony@iarc.uaf.edu); E. Kirillova[1]; E. Narkevsky[1]; M. Nitishinsky[1]; A. Novikhin[1]; O. Stepanov[1]

[1]Arctic and Antarctic Res Inst, AARI, 38 Bering Street, St. Petersburg 199397, Russian Federation

[2]IARC/Frontier, University of Alaska Fairbanks, PO Box 757335 PO Box 757335, Fairbanks, AK 99775, United States

The Hydrochemical Atlas of the Arctic Ocean holds many of the oxygen, silicate, nitrate, nitrite, phosphate, pH, and alkalinity measurements taken from the Kara, Laptev, East-Siberian and Chukchi seas during the past fifty years. Summer data, which were obtained from the open waters of the shallow Arctic seas, predominate in the data set. During the ice-covered winter, observations were conducted from airborne expeditions and at the coastal observatories. Additionally, unique data from the Laptev Sea were obtained from the Russian-German TRANSDRIFT expeditions (1993-2000).

This report is focuses on typical spatial distributions of the chemical parameters to demonstrate a beauty and complexity of hydrochemical structure of the water column in the well-stratified arctic seas. The theory of structural zones and concepts of water mass formation are applied and developed to explain mosaic pattern of oxygen, nutrients and other chemical parameters distributions. The influence of ice conditions and river run-off on the regional peculiarities of spatial distributions of the hydrochemical parameters is discussed in detail.

Ice conditions (fast ice, polynya, drift ice, ice margin etc.) influence the chemical properties of surface waters and the vertical distributions of oxygen and nutrients. Ocean processes include enormous river runoff, shelf/basin water mass interactions, the advection of the Atlantic and Pacific Waters in conjunction with the complex and variable circulation pattern, and seasonally variable biological conditions. Ice and ocean processes result in the formation of many hydrochemical anomalies: e.g., oxygen supersaturation near ice margins, extreme of oxygen and silicate concentrations in the intermediate structural zone, and oxygen depletion/high nutrient concentrations in the stagnant water masses.

OS12E-176 1330h POSTER

Temperature Evolution in the Arctic Ocean Atlantic Water: 1995 to 2001

John T Gunn[1] (206-726-0501; gunn@esr.org)

Timothy Boyd[2] (541-737-4035; tboyd@coas.oregonstate.edu)

Robin D Muench[1] (206-726-0501; rmuench@esr.org)

Michael Steele[3] (206-543-6586; mas@apl.washington.edu)

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

[2]Oregon State University College of Oceanic and Atmos. Sci., 104 Ocean Admin Bldg., Corvallis, OR 97331, United States

[3]University of Washington PSC/APL, 1013 NE 40th St., Seattle, WA 98105, United States

Ocean temperature and salinity have been measured annually from 1995 to 2001 along transects across the central Arctic Ocean using submarine-launched expendable CTD probes. Data from these probes have been integrated with data acquired from surface vessels over the same period. These data, which encompass the major transocean ridges and circulation gyres interior to the Arctic Ocean, are used to assess interannual variations across the basin. The overall trend was for continued warming of the Atlantic Water (AW) layer throughout the period. In particular, AW temperatures increased in the Amundsen and Makarov basins and over the Chukchi Rise in the Canadian Basin. This pattern was however somewhat patchy both spatially and from year to year. For example, some early cooling was evident in the upper 200 m of the AW layer overlying the Lomonosov Ridge and extending slightly into the Makarov Basin, however, the Makarov side of the Lomonosov Ridge showed warming in 2001. Persistent warming in the western Amundsen and Makarov basins probably reflected preferential input to these regions of warmer water from the warm, eastward slope current north of Siberia. Other features, more ephemeral, likely show system responses to fluctuations in the regional wind field and, by association, the Arctic Oscillation.

MON

OS12E-177 1330h POSTER

Contributions to the Upper Layers of the Arctic Ocean From the Norwegian Sea

Bert Rudels[1] (358 9 61394428; rudels@fimr.fi)

E. Peter Jones[2] (902 426 3869; jonesp@mar.dfo-mpo.gc.ca)

Ursula Schauer[3] (49 0471-4831817; uschauer@awi-bremerhaven.de)

Patrick Eriksson[1] (eriksson@fimr.fi)

[1]Finnish Institute of Marine Research, P.O. Box 33, FIN-00931 Helsinki, Finland

[2]Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, NS B2Y 4A2, Canada

[3]Alfred Wegener Institute for Polar and Marine Research, Columbusstrasse, 27570 Bremerhaven, Germany

Atlantic water flowing into the Arctic Ocean from the Norwegian Sea is the source for three distinct upper water masses: the Polar Mixed Layer and the halocline in the Amundsen and Makarov Basins, and the lower halocline in the Canada Basin. The inflow from the Norwegian Sea through Fram Strait interacts with sea ice, creating a less saline upper layer that is advected with the boundary current into the Nansen Basin, where it becomes homogenized down to the thermocline. North of the Laptev Sea, less saline shelf water overruns this upper layer. Its contact with the atmosphere is broken, and in the Amundsen and Makarov Basins it becomes a halocline above the Atlantic layer. A part of the Atlantic water entering and flowing through the Barents Sea incorporates runoff from the Siberian rivers. This becomes the low salinity shelf water that enters the interior of the Arctic Ocean at the Laptev Sea, subsequently capping and isolating the Fram Strait derived halocline and forming the Polar Mixed Layer. The main Barents Sea inflow enters the Arctic Ocean as a stratified water column at the St. Anna Trough, with the upper part providing a second halocline source. In the Nansen Basin this Barents Sea branch contribution is as cold as the winter mixed layer of the Fram Strait branch but more saline. In the Amundsen and Makarov Basins it remains at the slope and retains its salinity, but, as a result of stronger vertical mixing and entrainment over the continental slope, it is warmer than the interior Fram Strait derived halocline. Further to the east, beyond the Chukchi Cap, the Barents Sea branch component becomes the main source of water in the lower halocline in the Canada Basin. As it returns to the Eurasian Basin, this lower halocline water contributes to the outflow of Polar Surface Water east of Greenland through Fram Strait as well as to the deep and bottom waters of Baffin Bay after passing west of Greenland through Smith Sound.

OS12E-178 1330h POSTER

Sediment Transport on Arctic Shelves - Evidence From One-Year Monitoring in the Laptev Sea (Siberian Arctic)

Carolyn Wegner[1] (cwegner@geomar.de)

Jens A. Hoelemann[2] (jhoelmann@awi-bremerhaven.de)

Igor Dmitrenko[3]

Sergey Krillov[3]

Heidemarie Kassens[1]

[1]GEOMAR Research Center for Marine Geosciences, Wischofstr. 1-3, Kiel 24148, Germany

[2]Alfred Wegener Institute for Polar and Marine Research, Columbusstr., Bremerhaven 27568, Germany

[3]State Research Center - Arctic and Antarctic Research Institute, 38, Bering St., St. Petersburg 199397, Russian Federation

Shelves cover about 35% of the total surface area of the Arctic Ocean and comprise 25% of the global continental shelf area. They as well as the Siberian rivers are significant sediment sources for the deep Arctic Basin. The Laptev Sea Shelf is one of the largest Siberian shelf seas having several rivers discharge onto the shelf, which transport a substantial load of suspended particulate matter (SPM). The riverine influence is characterized by a strong seasonality due to the fact that most parts of the Laptev Sea shelf is ice-covered for about nine months a year. During and shortly after the spring breakup 60% of the riverine material discharges onto the shelf. The material is either accumulated on the shelf or transported further into the Arctic Ocean. The sediment dynamics and the patterns of deposition and erosion on the Laptev Sea Shelf are described in several models but up to now it has not been possible to quantify them. Especially the processes during the time of ice-coverage are unknown. Therefore the sediment and carbon budget are incomplete.

During the TRANSDRIFT V expedition in 1998 two long-term mooring stations were deployed at key positions in the eastern Laptev Sea to gather broadband ADCP (Acoustic Doppler Current Profiler) and CTD (Conductivity Temperature Depth Meter) data for the period of one year. In addition to current velocity and current direction data the ADCP provides information on the particle concentration within the water column as well. Acoustic backscatter data give relative values for the particle concentration within the water column. Due to additional measurements during the TRANSDRIFT VIII expedition in 2000 it is now possible to quantify and qualify the acoustic backscatter data. Therefore these data have given insight into the formation and dynamics of the benthic nepheloid layer, a near-bottom layer of increased SPM concentration, for the whole course of the year, and its significance for the sediment transport.

Especially during the ice-free months most of the material which is transported onto the shelf by riverine input and coastal erosion is kept in suspension. Due to increased near-bottom current velocities after storm events resuspension takes place. The troughs are then transfer areas. For the months of ice coverage areas beyond the fast ice in the surroundings of the Lena Delta show for a long time after the freeze-up an increased SPM concentration within the water column and especially within the benthic nepheloid layer. Towards the spring breakup most of the material settles, deposition takes place. But generally sediment is transported within the benthic nepheloid layer even during the time of ice-coverage. In areas beyond the polynya near-bottom current velocities after storm events are still high enough to resuspend material from the seafloor but a distinct near-bottom nepheloid layer as in the ice-free period is absent. It develops again due to the large amount of material discharged during and after the spring breakup of the rivers. Sedimentation rates on the inner shelf are probably low due to deposition only during some time of the ice-coverage. In some parts of the troughs even during this time of the year no sedimentation takes place.

OS12E-179 1330h POSTER

Distribution of Dimethylsulfide and Dimethylsulfoniopropionate in the Bering Sea

Naoaki Uzuka[1] (1-907-474-1950; uzuka@iarc.uaf.edu)

Noriyuki Tanaka[1,2] (81-11-706-2370; norit@ees.hokudai.ac.jp)

[1]Frontier Observational Research System for Global Change / International Arctic Research Center, 930 Koyukuk Dr., P. O. Box 757335, Fairbanks, AK 99709-7335, United States

[2]Graduate school of Environmental Earth Science, Hokkaido University, Kita 10 Nishi 5, Kita-ku, Sapporo, Hokkaido 060-0810, Japan

Dimethylsulfide (DMS) is the most abundant biogenic sulfur-bearing compound emitted from the ocean to the atmosphere. DMS is oxidized in the atmosphere and condenses to form aerosols, which affect the solar radiation on the earth. Coccolithophores are known to be an efficient producer of dimethylsulfoniopropionate (DMSP; precursor of DMS) compared to diatoms. The recent appearance of the large-scale coccolithophore blooms during summer in the Bering Sea can effect the sulfur cycle in this region. Observations in the Bering Sea were carried out in October 2000, July 2001, and August 2001. Two (Oct. 2000 and Aug. 2001) of the observing periods coincided with coccolithophore blooms. The concentrations of dissolved DMS, dissolved DMSP (DMSPd) and particulate DMSP (DMSPp) were determined for seawater samples collected at the surface and at 7-9 water depths within the upper 200 m at 6-8 stations in 2001, which were primarily along the fixed transect at 166W. Along the transection, high concentrations of DMS in surface seawater (mean 4.6 and 5.2 nmol/l, range 3.1-5.8 and 1.8-7.0 nmol/l, in Oct. 2000 and Aug. 2001, respectively) were observed at stations where the ocean color looked turquoise green as a result of the coccolithophore bloom. That indicates a considerable amount of DMS is emitted from the coccolithophore bloom area to the atmosphere. Concentration of DMSPp was high in the upper 20 m of the water column. Interestingly, the maximum concentrations of 145 nmol/l along 166W and 165 nmol/l elsewhere were observed in July 2001, when diatoms dominated. This suggests DMSP production by diatoms is also significant in this region. The concentration of DMS was not as high as expected from the DMSPp concentration (in surface water, up to 4% compared to DMSPp volume), even in the coccolithophore bloom area (5.5% in Oct. 2000 and 7.8% in Aug. 2001). The discrepancy suggests that there is biological consumption of DMSPd and DMS. As a result of high DMSPp concentrations, it is possible that the high bacterial activity consumes large quantities of DMSPd and DMS.

OS12E-180 1330h POSTER

^{234}Th:^{238}U disequilibria in the Canada Basin of the Arctic Ocean

Sarah M Trimble[1] (313-577-3259; sarah.trimble@trimbleconsulting.net)

Mark Baskaran[1] (313-577-3262)

Don Porcelli[2] (41-1-632-7713; porcelli@erdw.ethz.ch)

[1]Wayne State University, Department of Geology, Detroit, MI 48202, United States

[2]ETH Zurich, Inst Isotope Geology and Mineral Resources, Zurich CH-8092, Switzerland

The Arctic Ocean encompasses a wide variety of biological regimes, with the lowest (deep Canada Basin) and highest primary productivity (Bering and Chukchi seas) among the world oceans. The disequilibria between ^{234}Th and ^{238}U have been utilized to estimate the export of particulate organic carbon (POC) and nitrogen (PON) from the upper waters. Recently, attempts have been made to estimate the POC and PON export from the Chukchi sea and Beaufort Sea. We extend our study to the deep Canada basin.

We collected two vertical profiles in the deep Canada Basin (75° 13'N, 149° 54'W; 73° 50'N, 152° 55'W), one profile in the slope (73° 15'N, 155° 06'W), and two profiles in the shelf regions (71° 40'N, 154° 46'W; 71° 44'N, 153° 56'W). Concentrations of suspended particulate matter, POC, PON, dissolved and colloidal organic carbon, and a suite of particle-reactive radionuclides were measured. The total ^{234}Th/^{238}U activity ratios in the upper 100 m of the water column ranged from 0.28 to 0.99. The residence time of dissolved ^{234}Th ranged from 9-125 days in the shelf waters to 30-262 days in the deep basin. The particulate ^{234}Th residence time ranged from 2-25 days and 2-64 days in the shelf and deep basin, respectively. The fraction of colloidal ^{234}Th in the deep basin is comparable to the value we reported earlier for this region. The POC export flux for the upper 50 m fall in the range of 14-34 mmol m^{-2} d^{-1} for the shelf waters and 0.4-11.0 mmol m^{-2} d^{-1} in the deep basin. The export flux of PON range from 2-4 mmol m^{-2} d^{-1} in the shelf and 0.07-0.80 mmol m^{-2} d^{-1}. We will summarize all the earlier POC and PON estimates for the Arctic Ocean.

OS12E-181 1330h POSTER

Hydrochemical Indicators of Oceanographic Processes in the Arctic Ocean and Arctic Seas

L.A. Timokhov[1] (ltim@aari.nw.ru)

Roger Colony[2] (rcolony@iarc.uaf.edu)

Ye. G. Nikiforov[1]

Sergey M. Pivovarov[1]

[1]Arctic and Antarctic Research Institute, 38 Bering St., St. Petersburg 199397, Russian Federation

[2]IARC/Frontier, University of Alaska Fairbanks, P O Box 757335, Fairbanks, AK 99775, United States

A new database for the hydrochemistry (silicate, phosphates, dissolved oxygen, nitrate, nitrite, and pH) of the Arctic Ocean allows hydrochemical indicators to be associated with oceanographic processes. The large number of summer data from the shelf and coastal zone allow the roles of ice formation and melting to be seen as a hydrochemistry signal. The data are also suitable for using hydrochemistry as indicators of water mass origin and propagation, including the determination of river runoff influence exerted on hydrochemical regime in the seas. As the hydrochemistry data were collected over several decades, 1950-1995), studies of interannual variability are also possible.

Location of main streams of the deep warm Atlantic waters was for the first time clearly revealed using distribution of silicon and alkalinity. One of these streams propagates from the Fram Strait up to the meridian of the Wrangel Island; the second stream of the "reversible" Atlantic waters separates from the first one to the north off the Laptev Sea and propagates along the Atlantic slope of the Lomonosov Ridge diverging later to the Fram Strait.

The field of mean concentrations of dissolved silicon allowed us to estimate the volume of inflowing Pacific waters of winter origin enriched by nutrients. There are three branches of the Bering Sea current bringing these waters - Alaska, Herald, Long; the Long Branch prevails. As for alkalinity and pH, it becomes possible to distinguish freshening effects from the continental runoff and melt-waters. Seasonal variations of continental waters propagation in the seas and Arctic Basin have been estimated.

OS12E-182 1330h POSTER

Interannual to interdecadal changes of water temperature, sea-level displacement, and sea-ice concentrations in the Bering Sea and associated atmospheric circulation changes

Shoshiro Minobe[1,2] (+81-11-706-2644; minobe@ep.sci.hokudai.ac.jp)

[1]Division of Earth and Planetary Sciences, Graduate School of Science, Hokkaido University, N10 W8, Sapporo 060-0810, Japan

[2]Frontier Research System for Global Change, Kanazawa-ku, Shouwa-machi, Yokohama 3173-25, Japan

The Bering Sea Sea-Surface Temperatures (SSTs), subsurface temperatures, sea-level displacements (SLDs), sea-ice concentration and associated atmospheric circulations are analyzed to identify dominant interannual to interdecadal variations. Seasonally combined EOF analysis of the SSTs in the Bering Sea provides seasonally dependent EOF1, which exhibits smallest amplitudes in winter and largest ones in summer. The corresponding yearly-sampled PC1 is characterized by the warming trend through the record (1925-2001) with the warmest year in 1997, which is followed by rapid cooling until 1999. The warming from1995-1997 and cooling from 1997-1999 are commonly found in heat storage, and also accompanied by SLD raise and fall, respectively. The cooling and SLD fall in the late 1990s might be related with a possible *major* regime shift in 1998/1999, which were suggested by several papers (Minobe 2000, Hare and Mantua 2000, Schwing and Moore 2000). The sea-ice variability corresponding to the SST PC1 is prominent in spring in the eastern Bering Sea with correlations as high as 0.7. The correlations between the SST PC1 and sea-level pressures suggests that the spring atmospheric circulation anomalies play an important role in the variations of ocean and ice in the Bering Sea.

OS12F HC: Hall III Monday 1330h

Algal Blooms, Red Tides, Brown Tides, and Pfiesteria II

OS12F-183 1330h POSTER

Utility of the Algal Photo-pigment Gyroxanthin-diester in Studies Pertaining to the Red Tide Dinoflagellate Karenia brevis (Davis) G. Hansen & Moestrup

Barbara A Berg[1] (941-388-4441; barbib@mote.org)

Bradley A Pederson[1] (941-388-4441; pederson@mote.org)

Gary J Kirkpatrick[1] (941-388-4441; gkirkpat@mote.org)

Chris J Higham[1] (941-388-4441; chigham@mote.org)

David F Millie[2] (941-388-4441; dmillie@mote.org)

[1]Mote Marine Laboratory, 1600 Ken Thompson Pkwy, Sarasota, FL 34236, United States

[2]U.S. Departrment of Agriculture, Agricultural Research Service, New Orleans, LA 70124, United States

Discrimination of the algal photo-pigment gyroxanthin-diester (through High Performance Liquid Chromatography) can be applied to studies of Karenia brevis (Davis) G. Hansen & Moestrup as a biomarker and an indicator of both phytoplankton taxonomy and photophysiology. Few other species of phytoplankton in the eastern Gulf of Mexico contain gyroxanthin-diester therefore this pigment can be used as a biomarker for K. brevis in these waters. Four years of HPLC data, collected in nine independent field studies of the ECOHAB Florida project, were used to demonstrate the utility of gyroxanthin-diester in studies involving K. brevis. A weak linear relationship existed between the abundance of K. brevis and the concentration of gyroxanthin-diester however the presence and relative abundance of K. brevis was obtained from HPLC data. When gyroxanthin-diester was present its ratio to chlorophyll a was found to be constant. A comparison of the ratios of gyroxanthin-diester/chlorophyll a and gyroxanthin-diester/diadinoxanthin also provided information concerning photo-physiological state. Taxonomic composition, including the contribution of K brevis to total community composition, was determined using gyroxanthin-diester and ChemTax.

OS12F-184 1330h POSTER

Seasonal Variations in Ciliate Ingestion Rate and its Relationship to *Synechococcus* Abundance in a Coastal Marine Environment

Jeng Chang[1] (886-2-24622192 ext.5308; jengchang@mail.ntou.edu.tw)

Kung-Ming Chen[1]

[1]Institute of Marine Biology, Taiwan Ocean University, Keelung 202-24, Taiwan

At a sampling location on the northern coast of Taiwan (25° 08.5' N, 121° 47.7' E), the abundance of both *Synechococcus* and aloricate oligotrichous ciliates showed substantial seasonal variations with high values occurred in summer. Using the method of fluorescently labeled prey, *Synechococcus*-sized particles appeared to be the preferred food for ciliates, but particles of other sizes were also ingested. The ingestion rates measured at constant temperature varied seasonally. The highest ingestion rate, 86 *Synechococcus* cells ciliate^{-1} hr^{-1}, was observed in summer when *Synechococcus* abundance reached 5.8×10^4 cells ml^{-1}, and a good correlation could be established between *Synechococcus* abundance and ciliate ingestion rates. When *Synechococcus* abundance was kept constant, a separate set of experiments indicated that the effect of temperature on ingestion rate was small in the range between 20 and 30°C. Our results suggested that the seasonal variation in ciliate ingestion rate was mainly controlled by *Synechococcus* abundance in the water column.

OS12F-185 1330h POSTER

The feeding by the larvae of the mussel Mytilus galloprovincialis on red tide dinoflagellates

Seong Taek Kim[1] (82-63-469-4608; kimst@kunsan.ac.kr)

Hae Jin Jeong (hjjeong@kunsan.ac.kr)

Chang Hoon Lee

Jae Yoon Song

Won Ho Yih

[1]Dept. of Oceanography, Kunsan National University, Myrong Dong san 68, Kunsan 573-701, Korea, Republic of

We investigated grazing rates of the larvae of Mytilus galloprovincialis as a function of the larval age and prey concentration when feeding on the red-tide dinoflagellates Prorocentrum minimum, Cochlodinium polykrikoides, Alexandrium affine, Scrippsiella trochoidea, Prorocentrum micans, and Lingulodinium polyedrum. M. galloprovincialis larvae ingested all prey species used in this study. Ingestion rates of the larvae on unialgal diets of C. polykrikoides, S. trochoidea, and P. micans increased rapidly with increasing larval age up to 17-21 d, but were saturated at older ages, while those for the other prey species continuously increased. Ingestion rates of 25-d old larvae on unialgal diets of the red tide dinoflagellates increased rapidly with increasing prey concentration up to 1,000-3,000 cells ml^{-1} , but were saturated or showed only a slight increase at the higher prey concentrations. Maximum ingestion and clearance rates of 25-d old larvae on these dinoflagellates were 14-69 ng C predator^{-1}d^{-1} and 1.5-11.4 l predator^{-1} h^{-1}, respectively. M. galloprovincialis larvae exhibited higher maximum ingestion and clearance rates than previously reported for the mixotrophic dinoflagellate Fragilidium cf. mexicanum, the heterotrophic dinoflagellates Protoperidinium cf. divergens, P. crassipes, Polykrikos kofoidii, or the small ciliate Tiarina fusus, but lower rates than the large ciliates Strombidinopsis sp. and Favella sp. when grown on the same prey species. Grazing coefficients calculated by combining field data on abundances of Mytilus larvae and co-occurring red tide dinoflagellates with laboratory data on ingestion rates obtained in the present study suggest that M. galloprovincialis larvae usually has a small grazing impact on the populations of red tide dinoflagellates due to the predators low density.

OS12F-186 1330h POSTER

Changes in Seasonal Growth Break Occurrence in Hard Clams, *Mercenaria mercenaria*, Under Brown Tide Conditions Using Stable Oxygen Isotope Analysis

Douglas C Potts[1] (1-631-632-3038; potts@msrc.sunysb.edu)

Robert M Cerrato[1] (Robert.Cerrato@sunysb.edu)

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

Hard clams are a significant economic resource of Great South Bay, New York, but their abundance has dramatically declined in the past two decades. One possible contributing factor to this decline is the appearance of brown tides, monospecific phytoplankton blooms of *Aureococcus anophagefferens*, which have been shown to hinder bivalve feeding under high densities. Since the appearance of brown tides in 1985, shells appear to have more seasonal growth breaks at harvestable size suggesting a greater age and therefore slower growth. The ratio of $\delta\ ^{18}O$ to $\delta\ ^{16}O$ in calcium carbonate is indicative of the temperature and salinity of the surrounding water at the time of deposition. Therefore oxygen isotope analysis of the shell around a growth break can indicate its season of formation. Shells of clams that have either never been exposed to brown tide or experienced blooms of varying duration and density were analyzed using stable isotope mass spectrometry combined with historical water temperature and salinity information to determine the season of creation for multiple growth breaks. Analysis indicated that growth breaks occurred more frequently in clams exposed to brown tides of long duration and high concentration, making the clams appear older at the time of harvest then they actually were. Accurate aging of clams has important implications for population studies and stock management decisions.

OS12F-187 1330h POSTER

Hard Clams (Mercenaria mercenaria) May Play Key Role in Preventing Outbreaks of Brown Tides (Aureococcus anophagefferens) in Long Island Estuaries

David A Caron[1] ((213) 740-0203; dcaron@usc.edu)

Darcy J Lonsdale[2]

Robert M Cerrato[2]

Rebecca A Schaffner[1]

Julie M Rose[1]

[1]Department of Biological Sciences, University of Southern California, 3616 Trousdale Parkway, AHF 301, Los Angeles, CA 90089-0371, United States

[2]Marine Sciences Research Center, State University of New York at Stony Brook, Stony Brook, NY 11794-5000, United States

Harmful algal blooms called brown tides, caused by the pelagophyte Aureococcus anophagefferens, have occurred sporadically in coastal waters of Long Island, New York and elsewhere since 1985. Blooms of this minute (=2-3 m) alga have resulted in significant environmental damage and considerable economic loss. We have been experimentally examining the factors leading to the initiation of these blooms, and factors that might prevent their occurrence. We have conducted experiments in 300 liter mesocosms with natural seawater and under ambient conditions of light and temperature. Experimental setups with and without hard clams (Mercenaria mercenaria) demonstrated dramatic differences in the accumulation of A. anophagefferens biomass. Moderately high abundances of hard clams (densities sufficient to produce filtration rates resulting in the turnover of =25% of the water in the mesocosm per day) prevented any significant buildup in the absolute abundance of A. anophagefferens during 7-10 day experiments. Differences in the absolute abundance of A. anophagefferens in mesocosms with and without hard clams differed by as much as three orders of magnitude after one week. In addition, hard clams prevented a shift in the composition of the phytoplankton assemblage to dominance by the brown tide alga. Our evidence strongly indicates that differences between historical and present abundances of hard clams in L.I. estuaries may be an important factor in explaining the occurrence of brown tides during the past 16 years.

OS12F-188 1330h POSTER

Relationships Between Oceanographic Satellite Data and the Toxic Dinoflagellate, *Alexandrium*, in the Gulf of Maine

Remy Luerssen[1] (207 581 4333; remy.luerssen@maine.edu)

Andrew Thomas[1] (207 581 4335; thomas@maine.edu)

[1]University of Maine, School of Marine Sciences Libby Hall, Orono, ME 04469-5741, United States

Qualitative and quantitative relationships between satellite derived sea-surface temperature (SST), chlorophyll patterns and the distribution of *Alexandrium*, the

MON