Newsletter of

Coastal Ocean Processes

Ocean Sciences 2002: CoOP-related sessions and events

Special Session OS03 - Transport and Transformation of Biogeochemically Important Materials in Coastal Waters: A special CoOP-related session proposed for AGU/ASLO Ocean Sciences 2002 was received so enthusiastically that the abstracts submitted will include two full days of oral presentations (48) plus 29 posters in a separate session. The Special Session will address the fluxes and transformations of materials in coastal waters and how these processes determine the character of coastal waters. This session will also include papers that put these processes in context, discussing the ecological structure and function of coastal waters, the capacity of coastal waters to assimilate anthropogenic inputs, the ability of coastal waters to sustain fisheries, and the influence of coastal waters on regional climate. The special session was developed through a collaboration of all four active CoOP projects: KITES and EEGLE in the Great Lakes and WEST and COAST off the coasts of California and Oregon.

The poster session is in the Hawaii Convention Center (HC) Hall III. All four oral sessions are in HC 316C. Conveners and session numbers are listed below. For more information, contact conveners: Brian Eadie of EEGLE (eadie@glerl.noaa.gov), Sarah Green of KITES (sgreen@mtu.edu), John Largier of WEST(jlargier@ucsd.edu) and Jack Barth of COAST (barth@oce.orst.edu). Updates for all four projects are included in this newsletter. Website URLs for all four projects are given on page 2.

session	*conveners*
OS22D (posters)	Brian Eadie
OS31R	Brian Eadie and Sarah Green
OS32S	Brian Eadie and Sarah Green
OS41O	John Largier and Jack Barth
OS42R	John Largier and Jack Barth

Open meeting for discussion of Buoyancy-Driven Transport initiative: Tuesday, 12 February 2002, 6-9 p.m.: The open meeting will address the buoyancy-driven transport research initiative goals and plans and provide an opportunity to develop collaborative groups for interdisciplinary research proposals in response to the pending AO. Interested parties should be prepared to give a 1-2 minute verbal synopsis with one overhead of your research interests. Check CoOP's website for updates.

Buoyancy-Driven Transport AO

The next CoOP Project will focus on biogeochemical and cross-margin transport processes over continental shelves with substantial freshwater inputs. Check CoOP's website (http://www.skio.peachnet.edu/coop) or NSF's Ocean Sciences website (http://www.geo.nsf.gov/oce) for the pending Announcement of Opportunity.

Table of Contents

Coastal ocean processes and observatories: Developing a new vision for coastal research

Richard Jahnke[1] and Larry Atkinson[2]
[1]Skidaway Institute of Oceanography and [2]Ocean.US

The coastal ocean is increasingly the focus of national strategic research efforts. Issues concerning global climate change, natural hazards, resource management and protection, public health, safe marine operations and national security are concentrated within our coastal zone. Advances within these broad areas require an improved understanding of the basic principles and processes that govern and control coastal systems.

At CoOP's inception, a series of workshops developed a list of interdisciplinary, process-oriented studies prioritized by the importance of the cross-margin process and the technological ability to study the process as a dominant feature in a given environment. The list created in 1990 was limited by the research tools available to study basic processes. The CoOP Program has subsequently provided the framework for detailed, process-oriented multi-disciplinary research projects in the coastal ocean. Over the last 9 years, CoOP has conducted studies of air-sea gas exchange, near-shore larval transport, and margins impacted by event exchange processes (KITES & EEGLE), wind-driven processes (COAST and WEST) and, in the near future, fresh water inputs and buoyancy transport processes.

In parallel to these research efforts, coastal observatories and observing systems are now being considered and planned, in some cases tested and in a few cases actually being established. Coastal observatories can be viewed as a new way to look at the ocean: a way to look in more detail in both space and time. Remote and in situ instruments combined with telecommunications and modeling, data management and visualization give us new opportunities. What is underway is the equivalent to astronomers planning and building a new telescope or cosmologists developing a new neutrino detector. The envisioned systems also will make possible sophisticated targeted sampling schemes, greatly enhancing the potential effectiveness of traditional measurement techniques.

The National Science Foundation has proposed, but has not yet received, funding for an Ocean Observatories Initiative (OOI) as part of its major research infrastructure program. The OOI includes coastal ocean observatories along with two other deep-sea systems. This initiative and others such as the National Ocean Partnership Program clearly suggest that the coastal ocean community should continue to develop a vision for coastal observatories.

The CoOP Program, in conjunction with Ocean.US, has proposed a workshop in 2002 in order to evaluate the basic coastal oceanographic research goals in light of the new technological advances and tools which have become available since the first list of research priorities was established a decade ago.The rapid development of observatories provides an obvious technological benefit for process-oriented coastal oceanography.

The 3 day workshop will include an assessment and prioritization of coastal research issues, a review of existing observatory systems, development of a list of critical hypotheses/questions/processes, consideration of the necessary attributes of coastal ocean observatories, and recommendations for the optimum way to implement coastal ocean observatories. The workshop report will be submitted to NSF and other groups that could benefit from our deliberations. The workshop will tentatively be held in May 2002. Information about the meeting will be available on the CoOP website at http://www.skio.peachnet.edu/coop. Organizers of the workshop are Larry Atkinson (l.atkinson@ocean.us.net) and Richard Jahnke (rick@skio.peachnet.edu).

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CoOP Project Websites

Episodic Events - Great Lakes Experiment - EEGLE: http://www.glerl.noaa.gov/eegle/

Keweenaw Interdisciplinary Transport in Superior - KITES: http://kites.chemistry.mtu.edu/KITES/kites.html

Coastal Ocean Advances in Shelf Transport - COAST : http://damp.coas.oregonstate.edu/coast

Wind Events in Shelf Transport - WEST: http://ccs.ucsd.edu/coop/west/

Structure and evolution of the Oregon coastal upwelling system observed by aircraft during COAST 2001

John M. Bane
Department of Marine Sciences, University of North Carolina at Chapel Hill

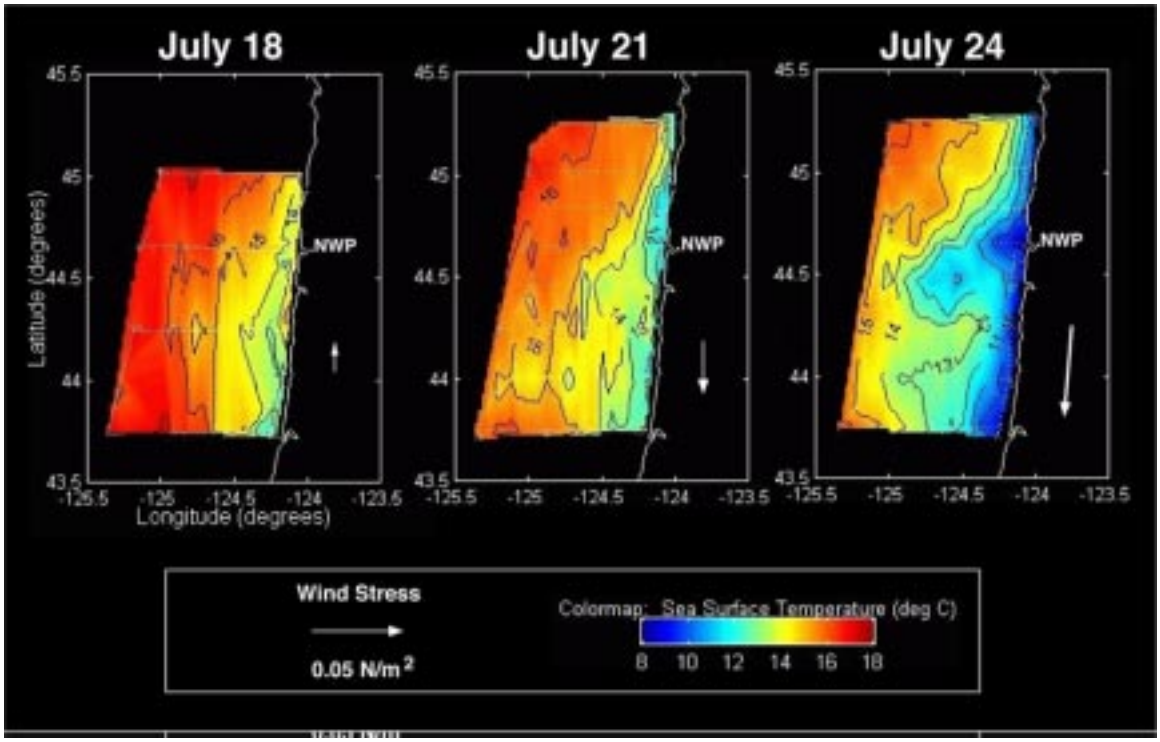
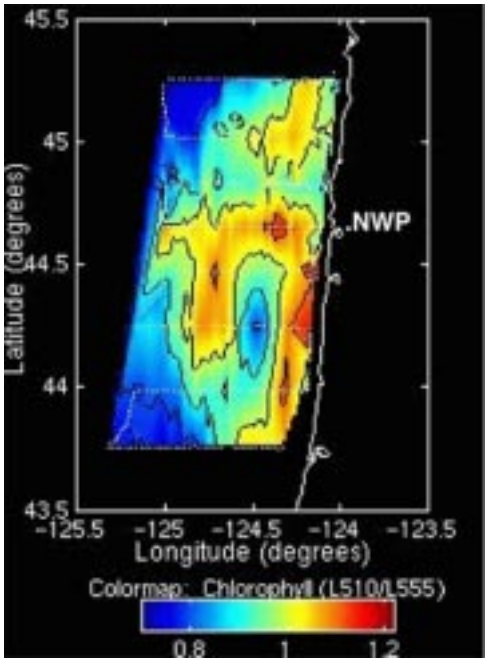


Figure 1. Ocean surface temperature field in the COAST study region as measured by aircraft on three days in July, 2001. The evolution of two upwelling centers is evident. The cool water band extending southwestward from the coast near Newport, Oregon (NWP) on July 24 is upwelled water flowing in a coastal upwelling jet that has separated from the coastline. The arrow in the lower right of each panel shows the buoy-measured wind stress averaged over the three-day period immediately preceding that aircraft flight.

Twenty-seven flights with an instrumented aircraft were made to observe the structure and evolution of the ocean and lower atmosphere over the Oregon continental margin during the COAST summer 2001 field program. Flights, which began in mid-May and continued through August, were scheduled to coordinate with and extend measurements made by the COAST ship and moored instrumentation efforts. The aircraft repeatedly measured sea surface temperature, oceanic subsurface temperature down to 500 m, upper-ocean color, and atmospheric wind, temperature, humidity and pressure.

Atmospheric structure varied throughout the summer on periods ranging from diurnal to several days (the atmospheric synoptic scale), and an atmospheric temperature inversion typically, though not always, developed during episodes of northerly winds. An inversion rarely accompanied southerly winds. The main contributors to the surface wind field in the COAST region were waves in the jet stream, the relative positions of the North Pacific high pressure anticyclone and transient low pressure systems that passed through the Gulf of Alaska towards the northwestern U.S., and the strength of the thermal trough inland over Oregon and northern California. One remnant tropical cyclone and one coastally trapped southerly surge added spice

Figure 2. (below) Upper-ocean chlorophyll content on July 24, as determined by the aircraft's hyperspectral color radiometers. The false-color scale used here shows the relative levels of the upward radiance wavelength ratio 510nm/555nm, which may be taken as an indicator of chlorophyll concentration. Note the high chlorophyll levels in the area of the separated coastal upwelling jet and in the cool nearshore regions. One exception to this is immediately offshore of Newport, where the cool water is likely so recently upwelled that phytoplankton levels have not had sufficient time to develop.



continued on p.4

Oregon upwelling system *cont. from p. 3*

to the variable atmospheric conditions during COAST.

The principal oceanic response to atmospheric forcing was the onset of coastal upwelling during sustained northerly wind events. The short time series of aircraft-measured sea surface temperatures shown in Fig. 1 demonstrates the spin-up of an upwelling event driven by a northerly wind episode in late July. Winds during the three days prior to July 18 were southerly and weak, with speeds measured at the COAST meteorological buoy (45.0° N, 124.1° W) averaging less than 3 m s^{-1}. As a result, the ocean surface temperature field on the 18th was warm except for a small area of cool nearshore water that remained from an earlier upwelling event. Northerly winds with speeds varying between 1 and 8 m s^{-1} occurred between July 18 and 21, and persistent northerlies at speeds exceeding 6 m s^{-1} were measured between July 21 and 24. The development of two upwelling centers in response to these winds is apparent in Fig. 1, one north of Newport (from about 44.5 to 45.1° N) and one extending south from 44.38° N. As the northern upwelling center evolved, its southward-flowing coastal upwelling jet separated from the coastline and continued towards the southwest due to topographic steering by Stonewall and Heceta Banks. The chlorophyll field on July 24, as indicated by aircraft-sensed upper-ocean color data (Fig. 2), generally followed the cool water patterns. Small, nearshore regions of elevated chlorophyll concentrations were also seen and these were related to terrestrial effects such as outflows from coastal rivers.

The persistence of upwelled conditions for a number of days after the demise of northerlies (and on occasion the change to southerlies) was observed in ocean temperature and color fields. The nearshore upwelling band and separated coastal upwelling jet over Heceta Bank were clearly delineated in the oceanic temperature field after such wind changes.

The extensive, high quality data sets gathered from the COAST ships, aircraft and instrument arrays will reveal further details of this complex coastal system as our analyses continue to progress. Further details on the COAST aircraft program may be found at:

http://www.unc.edu/depts/marine/cool/COAST/

Acknowledgments: We are grateful for the support provided for this study by the National Science Foundation through grant number OCE-9907919 to the University of North Carolina at Chapel Hill. I thank Sara Haines and Melanie Meaux for their continuing, superb efforts in data collection, management and analysis. Meredith Sessions was instrumental in the success of this flight program.

COAST update

Jack Barth
Oregon State University

With the recovery of the moored array in late August, the summer 2001Coastal Ocean Advances in Shelf Transport (COAST) field season came to a successful conclusion. We started the season with an instrumented aircraft flight on 16 May, one of 27 flights throughout the summer, during the week of the moored array deployment. The field effort peaked during two intensive observation periods in May-June (early in the upwelling season) and August (late in the upwelling season) when two ships, R/V Wecoma and R/V Thomas G. Thompson; a coastal research vessel, R/V Elakha; and the instrumented aircraft all focused efforts off the Oregon coast. Thousands of profiles measuring physical, biological and chemical properties were collected across the shelf and slope. Near realtime results were communicated between the ships and between ships and shore via cell phones and a shore-based web server.

At the beginning of the second intensive observation period in August, we hosted an Open House with tours of the two large research vessels docked in Newport as they loaded for the COAST cruises. Over 500 people attended and learned about COAST, CoOP and OSU coastal research. The summer field season included nice examples of upwelling (see the article by John Bane on p. 3 of this newsletter), flow-topography interaction and even a preview of our planned 2003 downwelling experiment when a remnant Pacific typhoon transited our study region in August packing 40 knot winds from the south. The COAST modeling efforts, both physical and ecosystem, continue and we're busily processing and analyzing data.

Updates on COAST activities can be found at our web site (http://damp.coas.oregonstate.edu/coast, note the updated COAS address at OSU) and some preliminary results will be presented at the 2002 Ocean Sciences Meeting.

The CoOP newsletter circulates to more than 1650 scientists in the US and 38 other countries on every continent but Antarctica. Sometimes the address and contact information we have for individuals on our mailing list is less than complete. Email addresses would be most welcome, as we hope to develop an email contact list for all interested scientists. Note that the CoOP newsletter is available in pdf format on the CoOP website.

Please help the CoOP Program keep a current mailing list. For changes, additions and deletions, email djahnke@skio.peachnet.edu

KITES update

Sarah Green, Michigan Technological University

The Keweenaw Interdisciplinary Transport Experiment in Superior (KITES) is in its final year. Our focus is therefore on integration, presentation, and publication of results. In August, Michigan Technological University hosted the fourth annual KITES/EEGLE All-Hands workshop in Houghton, Michigan. Intense working groups compared data from Lakes Michigan and Superior and continued efforts to correlate physical and biogeochemical observations. Plans for special journal issues compiling KITES and EEGLE results were discussed and discussions with possible editors are underway. Finally, a dinner cruise on the Keweenaw Star brought participants to the edge of the KITES study site on a beautiful summer evening.

Earlier in the year an intensive retreat-style KITES data workshop was held at the MTU Ford Forestry Center (May 17-19). Excellent progress was made in synthesizing the biogeochemical results, linking data to the modeling efforts, and in merging data on apparent/inherent optical properties and remote sensing.

In June KITES PI Marty Auer organized a full day session on Lake Superior research at the annual meeting of the International Association of Great Lakes Research (Green Bay WI, June, 2001). This session included 13 KITES-related presentations. Continuing the Lake Superior focus, next spring Auer (with M. Munawar and T. Johnson) will host an international symposium entitled "The Lake Superior ecosystem; prelude, processes and perspectives" at Michigan Tech (May 19-21). In conjunction with that symposium a special volume on the "State of the Lake" will be published as part of the Ecovision world monograph series.

KITES and EEGLE are joining with the newer West Coast CoOP projects, WEST and COAST, to organize a special session at the February Ocean Sciences meeting entitled "Transport and transformation of biogeochemically important materials in coastal waters." We expect this session to provoke fruitful comparisons among these varied coastal environments.

WEST initiates main field program

Frances Wilkerson, Romberg Tiburon Center, SFSU

The CoOP-WEST Project initiated their main field program, deploying five moorings in May 2001, off Bodega Head, California. Each mooring has downward looking 300 khZ ADCP in the buoy, temperature loggers sufficient to resolve the surface boundary layer and stratified interior, CTDs with transmissometer and fluorescence at 10 m, and anemometers with air pressure. The central mooring at the 90 m isobath also has a surface nitrate sensor and additional CTD, a hyperspectral radiometer measuring upwelling and downwelling radiance from 350-850 nm, and collects meteorological measurements to estimate the surface heat flux (relative humidity, air temperature, short wave insolation, long wave radiation, and photosynthetically active radiation). CODAR HF radar units established in May at Bodega Marine Laboratory and Point Reyes lighthouse provide hourly maps of surface currents over the central part of the WEST study region (available in real-time at http://ccs.ucsd.edu/coop/west).

The deployment was followed by a month-long intensive survey cruise (May 17-June 15, 2001) aboard the R/V Point Sur. Observations were organized around large and small scale CTD/rosette/net surveys, time series at the mooring locations and underway high resolution surveys using a ScanFish controlled undulating body. Nineteen Argos tracked surface drifters were deployed to estimate the far-field fate of the water upwelled in the study region.

Measurements made included hydrographic, optical, chemical (nutrients, pCO_2) and biological (phytoplankton and zooplankton) parameters. Optical measurements included vertical profiles of attenuation and absorption at nine wavelengths (ac-9), backscatter at six wavelengths (HR-6), light profiles (PRR-600), and discrete measurements of chlorophyll a, b, c, phaeophytin, CDOM, and particulate absorption. Phytoplankton biomass (size-fractionated chlorophyll), abundance, identification and size spectra (using microscopy and flow cytometry) were measured with rates of size-fractionated new and regenerated productivity (using ^{15}N labeled nitrate and ammonium uptake), ^{32}Si-silicate uptake and primary productivity. Zooplankton were sampled with MOCNESS, Bongo and Ring nets, Niskin bottles and an Optical Plankton Counter towed with the ScanFish. Grazing was evaluated using the gut fluorescence approach.

The results of this cruise and the data collected during Year 1 (June1-30, 2000) will be reported at the Ocean Sciences 2002 Meeting in Hawaii where this project has submitted 14 abstracts to the CoOP-related Special Session.

Episodic Events – Great Lakes Experiment (EEGLE)

Michael J. McCormick and Brian J. Eadie
NOAA/GLERL

EEGLE and KITES PIs met at a three day workshop in late August to discuss the themes of over 25 manuscripts being developed for a special issue and to foster interdisciplinary activities. The EEGLE program was designed to quantify the impacts of major late winter-early spring storms on sediment-water exchange, nearshore-offshore transport and subsequent influence on the lakes' productivity. Some of the preliminary conclusions discussed at the workshop include:

1) the magnitude of resuspended sediments is in the range of 1-10MMT, larger than annual external input of fine-grained materials to the southern basin (~1MMT),

2) the resuspended total phosphorus is several times the annual external input, but only about 20% appears to be available for primary production,

3) the reduction of light in the plume counteracts the increased nutrients and results in somewhat reduced productivity,

4) the ecological impacts (e.g. greatly increased heterotrophy) may be localized to the region near the plume, and

5) the events generally include substantial offshore transport.

In last year's CoOP newsletter we described EEGLE's sampling strategy and success. In this report, we focus on the results of Lagrangian current measurements used in conjunction with fixed current meter moorings to help resolve the dominant scales of motion in the coastal circulation of southern Lake Michigan. A pilot drifter program was begun in 1998 followed by more intensive studies in 1999 and 2000. The results of the 1999 experiment are described below.

The drifters were deployed over the first two weeks in April 1999 at five locations. Each deployment episode consisted of one drifter at each of the five sites. This would be repeated in two days, weather permitting, until all of the drifters were deployed. This strategy would enable both large spatial coverage and it would also provide some information on the temporal variability as well. The stations were located along the 20 m depth contour and the buoys were deployed by personnel from the United States Coast Guard operating from stations near Chicago, Illinois; Michigan City, Indiana; and St. Joseph, Michigan. Two of the sites were near Chicago, two were near Michigan City (Michigan City East, MCE; and Michigan City West, MCW), and one just west of St. Joseph (SJ).

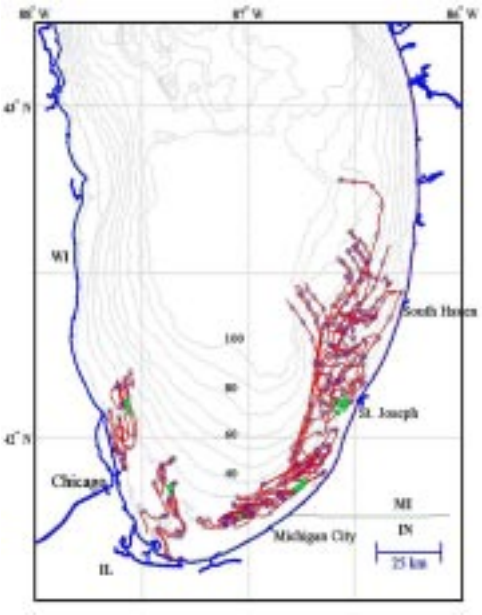


Figure 1. (left) Twenty-two drifter tracks from April 1999 on southern Lake Michigan. The drifters were deployed from 5 different locations over a two week interval. The deployment sites are depicted in green and an open circle is drawn every 24 h on the trajectory path.

Figure 2. (below) Seven of the longest drifter tracks from Figure 1. The solid circles depict the starting locations with the 'x' representing drifters from St. Joseph, squares depict drifters from Michigan City West, and open circles track drifters from Michigan City East. Line markers are displayed every 24 h. A progressive vector diagram, in the down-wind direction, from the midlake meteorological buoy is also shown. The wind speeds are scaled to 1.5% of those measured at the buoy.

Figure 1 shows the study location and a composite of all available trajectories reported from 22 drifters. Numerous reversals are evident in each trajectory due to lack of uniformity in both space and time of the surface winds. Seven of the longest drifter tracks (> 20 days) were examined in detail and their tracks are shown in Fig. 2. Also shown in Fig. 2 is a progressive vector diagram of a particle travelling at 1.5 % of the wind speed as measured from the mid-lake meteorological buoy. Buoy meteorological data were recorded by the NOAA National Data Buoy Center. Although the mid-lake wind data show the winds there to be coming predominantly from the

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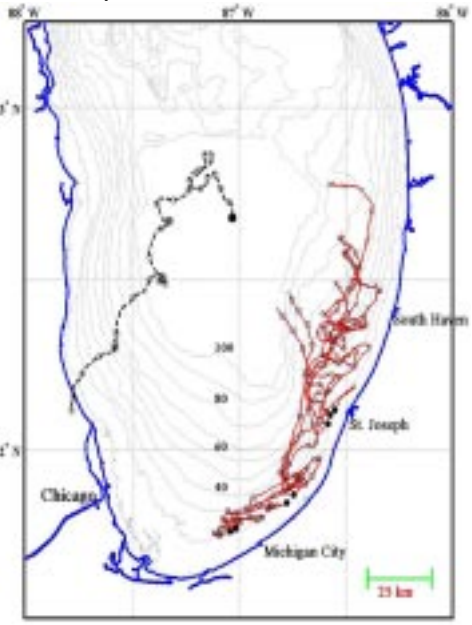

Episodic Events *cont. from p. 6*

northeast, there are coastal data that suggest that significant wind curl can exist on sub basin scales. Therefore, proper correlation between drifter trajectories and wind forcing requires that the wind field be resolved on fine spatial scales which will be addressed in future work. Wind data like that shown in Fig. 2 are included for qualitative purposes only.

Examination of Fig. 2 suggests that the net basin circulation appears to be a single cyclonic gyre. Each of the drifters showed a net positive counter-clockwise longshore velocity with an overall mean longshore velocity of 3.2 cm s^{-1}. Frequent reversals in the flow field are evident from both the drifter tracks and by the large difference between the drifter's scalar speed and velocity averages. Correspondingly, each of the drifters showed a net offshore transport with an overall mean velocity of 1.3 cm s^{-1}. Over a three week time interval the drifters traveled a total excursion distance of approximately 145 km with a net cyclonic transport of 58 km accompanied with a net offshore displacement of 24 km.

EEGLE PIs will next meet at the Ocean Sciences Meeting in February, where many will participate in a special session on cross-shelf transport. Further information can be obtained at the EEGLE website: http://www.glerl.noaa.gov/eegle.

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New OTIC Program Director

Please welcome Dr. Alexandra Isern, our new Program Director for Oceanographic Technology and Interdisciplinary Coordination. Alex received her education at UF (BS, Geology), URI (MSc, Oceanography) and the Swiss Federal Institute of Technology (PhD, Geology), with research on equatorial Pacific carbonate platform development. She provided the following statement as her introduction:

My research over the past few years has centered around investigations on the influence of sea level and environmental change on ancient carbonate platforms and reefs. As part of Ocean Drilling Program Leg 194 for which I was co-chief scientist, I will interpret an extensive, high resolution, seismic data set collected as part of the Leg site survey to investigate the growth, development, and demise of carbonate platforms in a current controlled environment. Seismic data will then be correlated with lithologic and petrophysical data from Leg 194 cores and downhole logs to document the changing nature of sedimentation with variations in current flow.

Although it will be impossible to fill Larry Clark's shoes, I am very much looking forward to my involvement with CoOP with the many exciting activities beginning and underway. The new CoOP Announcement of Opportunity will be released in a few weeks and we can look forward to the synthesis and modeling results from the final year of the EEGLE and KITES programs as well as the ongoing results from WEST and COAST as they start their third year of funding. I hope to meet more of those involved in CoOP at the Ocean Sciences meeting in February 2002.

New Gordon Research Conference on Permeable Sediments 6-11 July 2003

Permeable sediments are increasingly recognized as major factors controlling the biogeochemistry of coastal, estuarine and riverine systems, yet they are fundamentally different from the fine-grained muds upon which most present models of sediment - water column interactions are based. A new Gordon Research Conference has been created to bring together the isolated, individual disciplinary groups that are currently working on permeable sediments and thereby increase the awareness of new developments in the field. The conference will facilitate dialog on pressing problems and effective research strategies, and promote interest in the field of permeable sediments within the larger community of earth, ocean and environmental scientists.

The first conference will take place July 6-11, 2003, at Colby College in Waterville ME. First conference chair is Dr. Richard Jahnke (rick@skio.peachnet.edu) and vice-chair is Dr. Ian Webster, CSIRO (ian.webster@cbr.clw.csiro.au). The conference will develop from the groundwork of two SCOR working groups (WG114 - Transport and Reaction in Permeable Sediments: http://www.scor-wg114.de, and WG112 - Magnitude of Submarine Groundwater Discharge and Its Influence on Coastal Oceanographic Processes: http://www.jhu.edu/~scor/wg112.htm) and a Hanse Wissenschaftskolleg Conference (Subterranean Coastal Environments: Biochemical Processes, Fluxes and Impacts - Dr. Tim Shaw, University of South Carolina: shaw@mail.chem.sc.edu).

For information about this new Gordon Conference, check http://www.skio.peachnet.edu/grc or go to the Gordon Research Conference website at: http://www.grc.uri.edu

CoOP Scientific Steering Committee 2002

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The CoOP Program acknowledges the generous support of the National Science Foundation, the Office of Naval Research, and the National Oceanic and Atmospheric Administration's Coastal Ocean Program.

A sincere thanks for service to coastal science

The CoOP Program would like to express a profound appreciation to Mike Roman, who rotates off the SSC in December 2001. Mike has served on the Steering Committee since January 1990. In 1993, he accepted the job of chairing the SSC, and served in that capacity for six years. During his tenure, both the Great Lakes projects (KITES and EEGLE) and the Wind-Driven projects (WEST and COAST) were initiated. The Buoyancy-Driven Transport Processes workshop was conducted and the result was the development of CoOP's next initiative. When Mike stepped down from the role of chairman in January 2000, he agreed to remain on the SSC for a maximum of two more years. We will miss his insight and perspective.

Appreciation for participation on the SSC is also extended to Barbara Hickey, who also rotated off the SSC in December 2001; to Gail Kineke, Paul Hill and Billy Moore, who rotated off in August 2001, and to Bruce Albrecht and Elise Ralph, who rotated off in December 2000. All contributed generously of their time and expertise to make the CoOP Program better and more useful to the coastal scientific community.

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Coastal Ocean Processes

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