

The Coastal Ocean Processes (CoOP) Program

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LONG-TERM GOALS

The CoOP Program implements multi-investigator, interdisciplinary research in the coastal ocean. CoOP encompasses the disciplines of Biological, Chemical, Geological and Physical Oceanography plus Marine Meteorology. The goal of CoOP is to advance quantitative understanding of the processes that dominate the cross-shelf transports, transformations and fates of biologically, chemically and geologically important matter on continental margins.

SCIENTIFIC OBJECTIVES

CoOP's underlying scientific planning assumption is that a series of well designed, interdisciplinary process studies at locations that are characterized by different combinations of fundamental transport processes will provide significant new information to advance our understanding of coastal oceans and be applicable to continental margins around the world. Coupled interdisciplinary process studies and modeling are the core of CoOP research programs.

APPROACH

The CoOP research plan is to conduct process and modeling studies on shelves which differ in the dominant physical processes which influence cross margin transport. CoOP studies thus attempt to isolate key processes that have some global generality and to study these in detail on margins where effects can be isolated with a maximum degree of confidence. Modeling studies are integrated with the process studies and used to synthesize and generalize study results. CoOP initially proposed to study five general categories of cross-shelf transport: wind-driven, tidally-driven, buoyancy-driven and western boundary current-driven transport and transport on seasonally ice-covered shelves.

WORK COMPLETED

Completed Projects:

Inner Shelf Dynamics - The first CoOP study was initiated off Duck, NC in 1992 as a collaborative research effort with funding from ONR, NSF and the Army Corps of Engineers. The basic hypothesis guiding this interdisciplinary research was that planktonic larvae of inner shelf benthic invertebrates exploit the vertical variation of inner-shelf circulation to control their cross-shelf transport. Cross-shelf

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arrays and ship surveys were used to study the physics, sediments and plankton of the inner shelf. A summary and resulting publications are listed at <http://www.skiio.peachnet.edu/coop/duck.html>

Coastal Air-Sea Chemical Fluxes - In 1995, a cooperative program was developed between CoOP and the ONR-sponsored Marine Boundary Layer Research Initiative and the Minerals Management Service (MMS). The focus was air-sea gas exchange; MMS studied surface flux and Langmuir circulation dynamics and ONR focused on exchange of momentum, heat aerosols, and the dynamics of the atmosphere and oceanic boundary layers. New underway mapping systems and moored in situ sensors to measure gases were developed. A summary of the project and a list of resulting publications to date are available at <http://www.skiio.peachnet.edu/coop/airsea.html>

Current Research Projects:

The CoOP Program currently supports over 90 Principal Investigators on four projects underway. A brief overview of the research accomplishments of each program follows.

The Wind Events in Shelf Transport (WEST) project initiated in 2000 is focused off the Northern California coast and examines the relationships among wind-driven transport, nutrient inputs and biological productivity. Following a successful pilot sampling program last year, a full field effort was made this year. Strong upwelling favorable conditions were encountered and successfully sampled. More information about WEST can be found at their website: <http://ccs.ucsd.edu/coop/west>

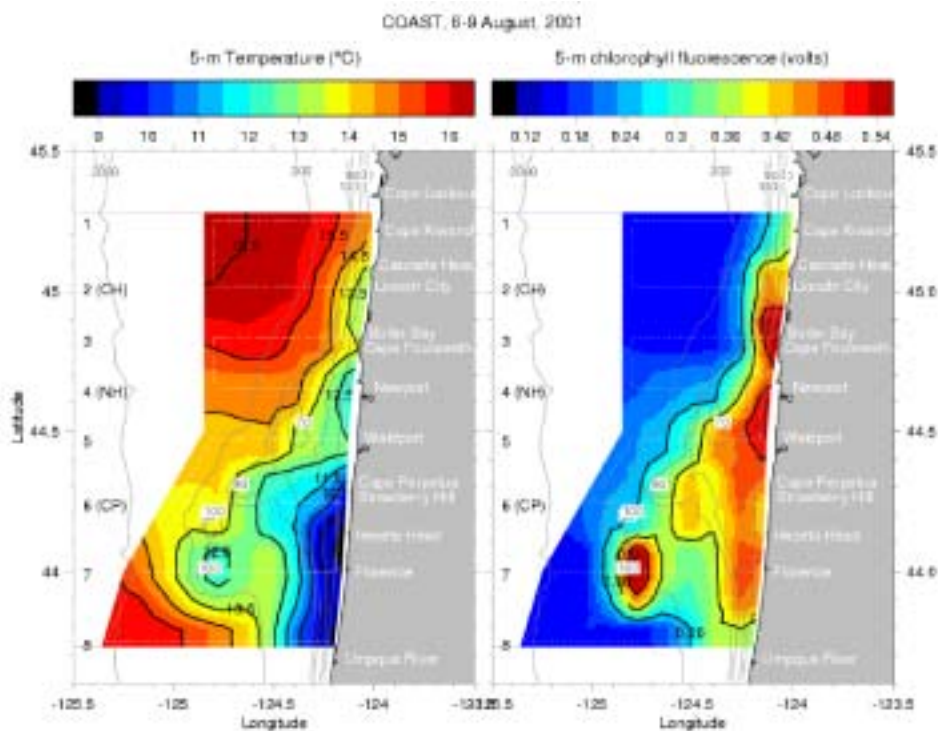


Fig. 1 Surface temperature and chlorophyll fields obtained using the towed undulating vehicle SeaSoar as part of the COAST project. Upwelling favorable winds bring cold, nutrient-rich subsurface water into the surface light zone near the coast. Phytoplankton blooms are associated with the cold upwelled waters. Graphic courtesy Jack Barth, OSU.

Also in 2000, the Coastal Ocean Advances in Shelf Transport (COAST) project began an examination of wind-driven transport processes and coastal biogeochemistry during upwelling and downwelling favorable conditions at two locations off the Oregon coast that differ significantly in bottom topography. The 2001 field effort involved simultaneous measurement efforts involving two ships (R/V Thompson and Wecoma), an aircraft (operated by Dr. John Bane, UNC) and high frequency coastal radar stations. Upwelling and downwelling favorable wind conditions were encountered and numerous specific features such as filaments and fronts were successfully sampled in detail. COAST scientists are exploring the north-to-south asymmetry in upwelling (Fig. 1) and the ecosystem response (Fig. 2). More information about COAST can be obtained at their website: <http://www.oce.orst.edu/po/COAST>

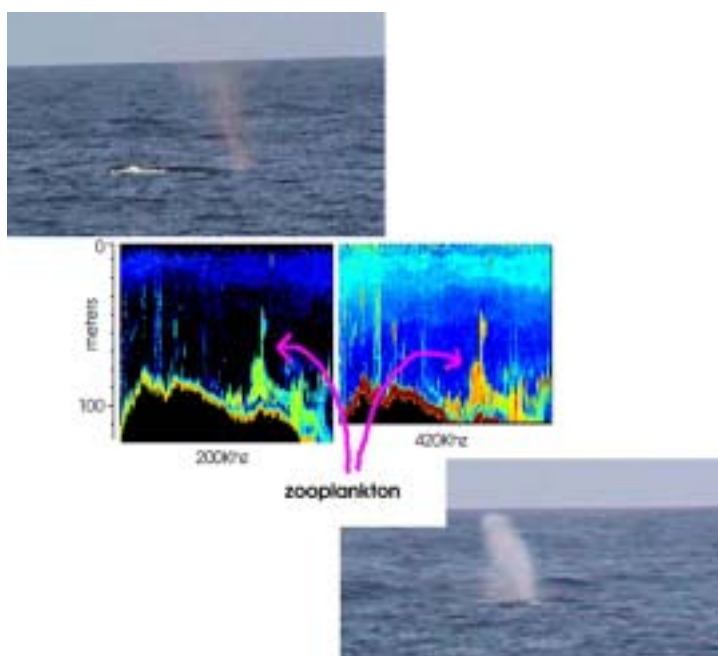


Fig. 2. Heceta Bank buffet. Upper left, lower right: whales spotted over high density zooplankton patches on Heceta Bank, 25 km offshore of Florence OR. Middle: Bioacoustic sonar images in 110-m waters of Heceta Bank show a dense column of zooplankton rising 70 m from the bottom. Photo courtesy Toby Martin, sonar image courtesy Steve Pierce and Jack Barth, all of OSU.

Episodic Events: Great Lakes Experiment (EEGLE). In 1996, CoOP, in collaboration with the NOAA Coastal Ocean Program, began an interdisciplinary process study focused on the role of the annually recurrent southern Lake Michigan plume in transporting material across the margins of Lake Michigan. Mooring arrays, ship surveys, drifter studies and shore-based radar measurements have been used to track the plume, surface currents and the particle field. Three years of field work have addressed the biogeochemical and transport characteristics and consequences of this annual plume. Quantitative interpretation of the results is proceeding through a variety of modeling experiments. Additional information and publications to date are listed at <http://www.glerl.noaa.gov/eeagle>

The Keweenaw Interdisciplinary Transport Experiment in Superior (KITES) also began in 1996 and focused research efforts on the Keweenaw Current which forms a semi-permeable barrier along the southern coast of Lake Superior and inhibits shore and river derived material from crossing the margin system and entering the central basin of the lake. Water movement in this current is the primary means for transport of material from the western to eastern lake basin and is therefore likely to be important in dictating productivity throughout the whole lake. Following three years of field work, synthesis efforts are now underway. Initial presentations will be made at a State of Lake Superior conference to be held in May 2002. Twenty-one manuscripts, primarily from KITES investigators, have already been pledged for this volume. More information on KITES is available at <http://chmac2.chem.mtu.edu/KITES>

The four current CoOP projects will be the focus of a special session at the AGU/ASLO Ocean Sciences meeting in February 2002: OS03 - Transport and Transformation of Biogeochemically Important Materials in Coastal Waters. This 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.

CoOP Office Communications Efforts:

The CoOP Office facilitates communications within and between the research groups and coastal science community by maintaining the CoOP website. This site is updated frequently and provides information and links to each program, plans for future efforts and information about other emerging coastal initiatives. Additionally, periodic newsletters are published (average of two per year) and distributed to nearly 1600 US-based and 180 international marine scientists. Newsletters contain information about CoOP programs and future plans, the development of other coastal efforts and information about funding agencies. The newsletters are also posted on the CoOP web site for widest distribution.

Future Efforts:

The Impacts of Buoyancy-Driven Transport Processes and Substantial Freshwater Inputs on Cross Margin Exchange and Biogeochemistry. In the fall of 1998 CoOP conducted an open workshop to develop a Science Plan for the study of buoyancy-driven transport. The final workshop report was released in February 2000. An Announcement of Opportunity for release by NSF is presently being finalized with intended release by mid-November 2001 and an anticipated submission date of 1 April 2002. An open evening meeting at the AGU/ASLO Ocean Sciences meeting in February 2002 is planned to advertise this program and facilitate the development of interdisciplinary collaborations among potential investigators.

In addition, the CoOP Scientific Steering Committee (SSC) is in the process of developing a workshop which would examine the temporal and spatial scales (event scales) of important cross-shelf biological, chemical, physical, geological and meteorological processes. The central questions to be answered are: what timely and innovative basic research should be performed in the coastal zone and how do recent technological advances facilitate such research goals? This workshop would provide an update of the initial CoOP Report authored by Brink et al. (1992) and would revisit coastal research in the

context of the progress and technological advances made since that report was published. SSC Committee members Jim O'Donnell, Jim Edson, Oscar Schofield and Rick Jahnke have agreed to develop the plans for this workshop.

IMPACT/APPLICATIONS

Through these efforts, coastal research will benefit through greater communications between investigators and stronger interdisciplinary collaborations.

PUBLICATIONS

Jahnke, R. A. (2001) Suggestions for Future CoOP Research Sought, EOS, Transactions, American Geophysical Union, Vol. 82, p. 288.