

Coastal Ocean Current Monitoring Program

The Value of the COCMP to California

The coastal ocean is of great value to California and we need to ensure that this value is sustained. Information on water movements and transport of water-borne material is the single most important gap in management-related knowledge of the coastal ocean. The Coastal Ocean Current Monitoring Program (COCMP) will deliver pertinent, continuous and real-time information on water movements to management efforts statewide. Products will be developed to meet the specific information needs of agencies addressing coastal water quality issues and other state priorities. The efficacy of information products will be maintained and enhanced through an ongoing dialogue between providers and users of this information.

The need to sustain the value of the coastal ocean

The ocean has been at heart of California society from the earliest times, providing food and moderating the seasons. In recent centuries, the ocean has been the medium for voyages, trade, and settlement. The ocean remains at the heart of Californian culture and commerce, still a source of food, increasingly a gateway to the Pacific Rim, and central to Californian tourism and recreation opportunities. Ocean resources contribute more than seventeen billion dollars to the state's economy (ten billion from spending on coastal tourism), generating 370,000 jobs, according to a 1997 study conducted by the Resources Agency.

Millions of Californians and visitors enjoy the benefits of the ocean – each of us deriving benefit in multiple ways. Increasingly, one beneficial use is compromised by another. Now more than ever, society needs reliable information to make wise decisions that will provide maximum societal benefit while ensuring a sustained production of ecosystem goods and services. Coastal water quality is central to the interactions between uses. It is the primary way in which one use affects another. Our concern for water quality goes beyond the impact of pollution on organisms and even beyond the risks to public health. It extends to a profound concern for the integrity of coastal systems and the lifestyle and value of coastal cities.

Given the numerous and competing demands on the ocean to provide goods and services, we are inadequately informed on how the ocean works and poorly supplied with operational information on the day-to-day conditions in the ocean as well as with data on which to base annual assessments. Our understanding of coastal waters has not kept pace with the economic needs associated with coastal waters.

The foremost information challenge in managing multiple uses of the coastal ocean is to obtain useful data on the incessant movement of coastal waters and the recurring patterns of that movement. Water-borne particles, organisms, and dissolved material move with the water, along paths that are forever changing. This fluidity of the ocean underlies most water quality patterns, as well as patterns of dispersal of the eggs/larvae/juveniles of sea life. Further, it poses a critical challenge to effective rapid response to catastrophes such as vessel and plane accidents, oil spills, and the possible malicious discharge of toxins. Ocean currents also affect shipping speeds and optimal routes, as well as navigation of big and small vessels on approaching or entering harbors and ports. Finally, the fluid nature of the ocean allows energy to propagate, resulting in waves,

Coastal Ocean Current Monitoring Program

surges, and tides that can erode the shoreline in some places and result in sedimentation in others.

We lack an operational monitoring system, however, and seldom is information available when and where it is needed for management decisions. Further, the absence of ongoing information on changing conditions precludes credible characterization of coastal ocean regions. Assessment of the risk of portions of the coast to oil spills, assessment of spatial patterns of public health risk, and assessment of the likelihood that marine protected areas are self-sustaining are three examples of the need for ongoing and spatially extensive monitoring of changing coastal circulation.

A program to provide key information on currents

The Coastal Ocean Current Mapping Program (COCMP) is designed to provide the most critical information relevant to this challenge – information that can benefit those who use or manage the coastal ocean. The COCMP is being developed in response to Propositions 40 and 50, with a mandate to create an infrastructure for the “monitoring and mapping of coastal currents, marine habitats, and marine wildlife, in order to facilitate the protection and enhancement of resources within the coastal zone.” While the COCMP emphasizes coastal water quality, with a focus on providing critical information on the transport of pollutants it will benefit a wide range of state priorities, including improved management of wastewater, stormwater, navigation, civil response, anadromous fish recovery programs, marine protected areas, aquaculture, coastal development, desalination, and marine fisheries.

In parallel with the advances in understanding coastal circulation, there have been major advances in effective and reliable technology for field observations, in the ability to capture and manage these data, and in modeling coastal circulation with computers. We now have the ability to observe the complex and recurring patterns of coastal circulation continuously and over large areas, to make the data available in real time, and to capture variations in a model that can allow for short-term predictions. For example, continuous radar observations of surface flow patterns off Imperial Beach have shown how brief northward flow events may transport fecal bacteria from southern land-based sources, resulting in contamination of popular beaches. Real-time access to these data allows the County Health Officer to include this information in making decisions about when to post a beach and to do so prior to obtaining microbiological lab results a day after the event. Similar observations from the Sonoma helped with the risk assessment of installing an ocean outfall near the mouth of the Russian River.

The COCMP is a system of ongoing, immediate, statewide information on coastal currents directed at addressing several management needs. This operational system is centered on mapping and monitoring transport pathways in the coastal ocean. It is based on available technology, with an emphasis on mapping surface circulation patterns. This priority rests on the recognition that most management issues are affected by processes in surface waters, that effective technology is available to map and monitor surface currents, and that this new program would serve as a focus for integrating existing observation efforts. In parallel with the installation and operation of hardware, there will be a concerted effort in data management and the development of models and other products that most effectively meet management needs.

Coastal Ocean Current Monitoring Program

The COCMP is a coastwide expansion of successful pilot systems that have been developed off Imperial Beach, Point Conception, Monterey Bay, and Bodega Bay with application to the need for improved information on water quality, fisheries, marine protected areas, and coastal ecosystem function.

The ultimate measure of success for the COCMP is the degree to which management efforts become more effective in a wide range of coastal ocean management concerns. Thus, key players in this development are end-users of the information products, including state, federal and local agencies, as well as NGO's and private sector interests. COCMP products will deliver value in one of four ways:

- *Operational* data in support of day-to-day decisions, for example, beach closures, search and rescue, discharge management, oil spill response.
- *Policy* decisions based on aggregated data and assessment of connectivity patterns, including year-to-year changes, for example, evaluation of annual beach water quality scores, assessment of links between thermal discharge and shoreline, assessment of salmon hatchery success, estimates of larval dispersal for proposed marine protected area design.
- *Risk assessment* based on the probability of degraded waters affecting key environments, for example, probability of oil spill from a shipping lane contacting shore, probability of a marine protected area being influenced by increased irrigation runoff.
- *Retrospective analysis of events* – improved understanding of episodic events based on spatially extensive and temporally continuous nature of data, for example, harmful algal bloom event, beach contamination event, or sourcing an oil spill of unknown origin.

While the COCMP is complete in itself, with a well-defined focus on surface current transport patterns, in time it is likely to become a key component of a more comprehensive integrated ocean observing system (IOOS). Planning at the federal level is well advanced and Californian regional efforts are already also supported by federal agencies.

The operational components and key products of the COCMP

Detailed descriptions of the ocean observing systems that comprise COCMP are provided in the proposals submitted to the Conservancy. These two consortia have a common approach, built around the use of high frequency radar to monitor surface currents along much of the coast of California. In addition to long-range units for large-scale mapping (range of 150km), standard units will be used for higher resolution mapping off major metropolitan areas (range of 40-70km), and high-resolution units (range of 10-25km) may be used for detailed mapping of smaller regions within San Francisco Bay. All of these systems are land-based and provide hourly maps of surface current.

While the COCMP relies primarily on high frequency radar observations, the program will also collect data with other technologies, such as sub-surface current meters, GPS drifters, wave buoys, autonomous vehicles, and satellites. A further key operational component is the database and information system that will make data available in real-time, as well as archiving data for later analysis of aggregated data sets. This information system will also serve to integrate existing data streams from satellites and sources with COCMP data and models, including data on tides, sea level, coastal winds, river flow, surface temperature, chlorophyll, winds, and

Coastal Ocean Current Monitoring Program

currents.

An ongoing collaboration between COCMP, other scientists, and end users will apply observation data from the COCMP and other sources to the development of products that will be useful for a wide range of ocean applications. Proposed and potential products include:

- Hourly maps of currents and winds
- Real-time tracking of water-borne material
- Probability estimates of origin, destination, and/or current velocities
- Model-based prediction of distribution, retention and destination of pollutants
- Data and estimates of wave energy, littoral transport, and coastal flooding
- Mean circulation and connectivity patterns
- Indices for specific issues and specific locations related to beach water quality, shore erosion, coastal flooding, wastewater plumes, fisheries, and marine protected areas
- Raw data for input to navigation software (private sector interest)

The water quality benefits of the COCMP

Water quality problems continue to beset the coastal waters of California, in spite of major improvements in wastewater and stormwater management over the last few decades. The COCMP is designed to provide critical missing information that is needed to clarify the links between origin and impact of pollutants, and, in so doing, to help managers reduce sources and mitigate impacts.

COCMP products will support day-to-day decisions as well as policy or engineering responses based on long-term assessment of the risk of water quality impacts. There are two suites of possible management and policy options – actions designed to abate the source (improve water quality), and actions designed to protect the site of potential impact (mitigate impact).

Improving water quality: The COCMP products will be used extensively by organizations involved in policy and management of the following activities:

- Discharge of wastewater, specifically via large publicly owned treatment works (POTW's) such as Orange County Sanitation District (OCSA).
- Discharge of stormwater, which is increasingly subject to state and federal regulations.
- Discharge of cooling water from coastal power plants, e.g., San Onofre nuclear plant
- Anticipated discharge of high-salinity waters from desalination plants
- Discharges, spills, and anti-fouling paints in port, harbor and boating waters
- Oil spills (and other potential spills from bulk carriers)
- Port and harbor dredging and beach nourishment
- Wildlife management as a source of fecal pollution (for example, seals, birds, terrestrial mammals)
- Agricultural practices and the water-borne delivery of nutrients, pesticides, animal wastes and herbicides to coastal waters
- Harmful algal blooms, with associated public health threats

Mitigating the impact of degraded water quality: Management actions can also be directed at mitigating impact, if there is adequate information on the place and time of impact. Information

Coastal Ocean Current Monitoring Program

from the COCMP will allow for rapid-response actions as well as policies that can reduce the impact of known water quality problems. COCMP products will be used by organizations involved in management of the following activities:

- Water-contact recreation, such as swimming, surfing, kayaking and wading. Presently, postings of water quality hazards occur 1-2 days after observation of high levels of fecal indicator bacteria.
- Mariculture harvest. Shellfish farms, such as those in Tomales and Humboldt Bays, are affected by high levels of pathogens (fecal indicator bacteria) and metals.
- Conservation and biodiversity, specifically in the siting of marine protected areas.

Management responses can include public warnings (such as for beach contamination), temporary shutdown of mariculture production, and deployment of booms to deflect oil spills from high-priority areas. Further, the information promised by the COCMP raises the possibility that uses of the coastal ocean could be more effectively zoned and sited to preclude negative interactions among beneficial uses of coastal waters.

Other benefits of the COCMP

In addition to the value of the COCMP in addressing water quality issues, the planned system of observations and information products will also yield substantial value in other state priorities. These collateral benefits are most notable in ecosystem management, marine life protection, fisheries, navigation, port management, search and rescue, oil spill response, and shoreline erosion.

Marine populations – fisheries, marine conservation: Data from the experimental surface radar systems off Bodega Bay and Santa Barbara are already being used in addressing fisheries issues, including key questions about salmon populations and salmon smolt survival, as well as questions about dispersal of sea urchin and crab larvae. The COCMP will make data and relevant information products available for more regions along the coast. Present and future efforts in combining COCMP and fisheries management involve both the California Department of Fish and Game and the National Marine Fisheries Service. Relevance of COCMP products will extend to other important fisheries, such as rockfish populations, as well as to defining essential fish habitat and productivity patterns.

COCMP products will also be used in developing effective marine life protection (conservation) strategies through greater understanding of how currents influence the dispersal of early life stages (eggs, larvae and juveniles). For both fisheries management and conservation management, the continuity of COCMP data in space and time will be valuable in the analysis and understanding of episodic events where altered circulation patterns may explain observed changes in population levels (for example, population die offs during El Niño events) or mortality events (such as sea lion mortality due to alongshore propagation of a toxic algal bloom).

Navigation: Information on surface currents promises a variety of benefits to shipping and boating in California. With the planned real-time availability of hourly maps of surface current, ship captains and boat operators will be able to take currents into account in entering and leaving

Coastal Ocean Current Monitoring Program

harbors as well as in transit. This information can be expected to increase the safety and efficiency of maritime operations.

Rapid response: The operational nature of the COCMP promises to be invaluable in improved and more cost-effective response to catastrophe and unanticipated events. In past ocean catastrophes, search and rescue operations (or response to oil spills) have been severely constrained by a lack of information on surface currents and the likely drift of lifeboats, wreckage or oil slicks. Through providing this information continuously, the COCMP will lead to a much-improved response of emergency teams. For example, a recent analysis concluded that Coast Guard search and rescue operation efficiency doubled when aided by high frequency radar surface current mapping.

Shorelines: In addition to improved estimates of nearshore transport of pollutants, COCMP-derived information on waves will be of great value in reducing risk and loss associated with shore erosion and coastal hazards. In particular, during periods of large waves and high tides, real-time COCMP information will provide improved warnings of potential cliff failures and coastal flooding. Further, COCMP will result in improved assessment of the impact of plumes of fine sediment following beach nourishment activity.

Maximizing user relevance and societal benefit

While the potential value of COCMP observations may be apparent to managers of coastal ocean resources, improved management, policy, and stewardship depends on converting COCMP observation data into reliable and strategic products. Working groups of users and COCMP scientists will shepherd the development and testing of key products and expedite the use of these products in management and policy decisions by state, local and federal agencies. This collaboration of information providers, information interpreters, and information users will be a permanent dimension of the COCMP and ensure an ongoing contribution of the COCMP to sustaining and enhancing the benefits of the coastal ocean for all Californians.

This document was prepared by John Largier (SIO/UCSD), with input from participants in COCMP consortia, Coastal Conservancy staff and consultants, and information users statewide (June 2004).