UNIVERSITY OF CALIFORNIA, SAN DIEGO UCSD

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO SANTA BARBARA • SANTA CRUZ

SCRIPPS INSTITUTION OF OCEANOGRAPHY
DEPUTY DIRECTOR FOR RESEARCH, ASSOC. VICE CHANCELLOR–MARINE AFFAIRS
DIRECTOR, UCSD CENTER FOR EARTH OBSERVATIONS & APPLICATIONS
PRESIDENT, AMERICAN GEOPHYSICAL UNION

9500 GILMAN DRIVE
LA JOLLA, CALIFORNIA 92093–0210
TEL: (858) 534–2836
FAX: (858) 453–0167

5 May 2005

Mr. Brian Baird
Assistant Secretary for Ocean and Coastal Policy
California Resources Agency
1416 Ninth Street
Sacramento, CA 95814

Dear Brian:

Thank you for the opportunity to comment on the findings of the California ocean and coastal information, research, and outreach needs workshop. I was a participant in the meeting, but believe that there are several additions that can inform a developing strategy.

National programs for coastal observations are developing relatively slowly and may take 3-5 years to evolve support for a major coastal observatory. It's in California's interest to develop leadership and autonomy in determining the future of its coast as the federal government develops its programs more fully. Scripps believes that California should remain in the lead in coastal basic and applied research as well as operational observations. Developing state funding streams for research and observational infrastructure will assure leadership both within the state and nationally as federal programs grow. If California anticipates some autonomy over the future of its coast, it's important that it take the lead in promoting the importance of its ocean...from environmental, recreational, aesthetic, and economic perspectives.

Understanding the California system—its natural and human-induced hazards, ecosystem health, fisheries, invasive species, climate, pollution and water quality—is crucial to enhancing human health, safety and welfare, reducing disaster losses, and achieving sustainable development. Observations of the coastal system constitute critical input for advancing this understanding. The workshop report enumerates many of these issues quite effectively. However, the integration of the allied observations is dealt with only piecemeal.

The expansion of the coastal observation system must build on and add value to existing coastal observation systems by coordinating their efforts, addressing critical gaps, supporting their interoperability, sharing information, reaching a common understanding of user requirements and improving delivery of information to users. For example, the report touches upon information systems as shown in the following table:

California Spatial Reference Center

IGPP - SIO

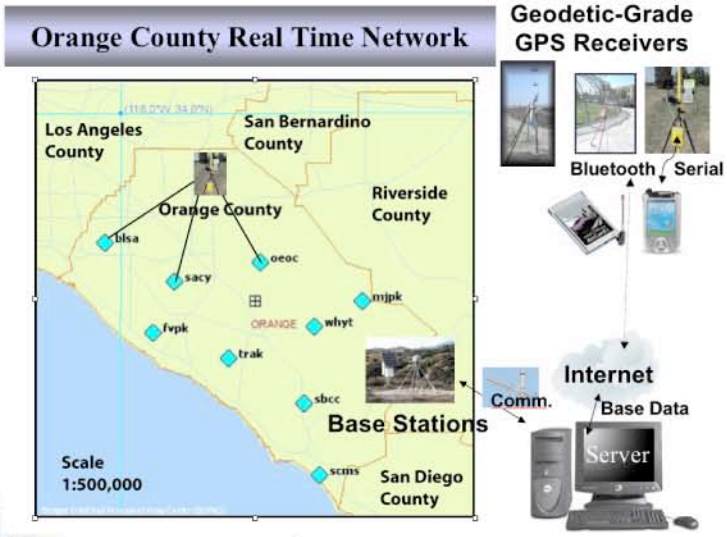
Geodetic services to ensure accurate and consistent spatial referencing of information within California.

CSRC Mandate

Provide the necessary space-based geodetic services to ensure the availability of accurate, consistent, and real-time spatial referencing data in California, including its coastal waters, waterways and islands.

Monitor temporal changes in 3D geodetic coordinates due to tectonic motion, volcanic deformation, land subsidence, and major landslides.

CGPS Technology
Scripps is a leader in the development of real-time continuous GPS technology, such as state-of-art geodetic monuments (left) and data telemetry buffers (below.



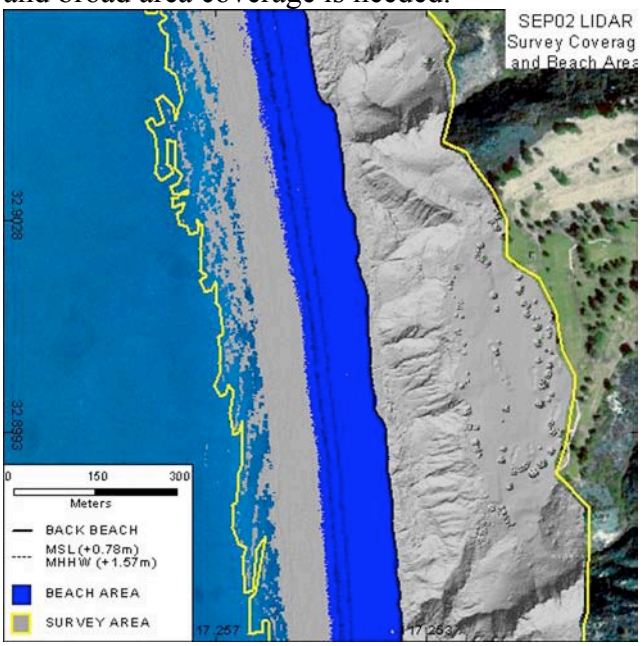
Applications of Real Time GPS Networks

- Disaster preparedness and relief efforts
- Earthquake, volcanic and subsidence research
- Geographic Information Systems (GIS)
- Flood plain management
- Water transportation infrastructure
- Precision Agriculture
- International and offshore boundary mapping
- Aircraft landing systems
- Intelligent Transportation and Telematics
- Fleet Management Systems
- Coastal and Harbor Navigation

The California Spatial Reference Center is located at the Cecil H. and Ida M. Green Institute of Geophysics and Planetary Physics (IGPP), at UCSD's Scripps Institution of Oceanography. In partnership with NOAA's National Geodetic Survey (NGS) and the California Department of Transportation (Caltrans), CSRC has designed a plan to expand and maintain an accurate network of control stations necessary to meet the demands of local and state government and the private sector for a reliable reference frame in California.

CALTM Center for Airborne LIDAR Terrain Mapping
Scripps Institution of Oceanography, UCSD

Scripps Institution of Oceanography (SIO) has undertaken research over the past several years in the application of ALTM to the observation of changes in beach morphology and earthquake faults. The success of this work has led other SIO investigators to consider applying the technology to a wide range of environmental, geological and physical applications where rapid and broad area coverage is needed.



A group of these investigators has been formed to create the CALTM with capabilities to meet present and future airborne mapping needs. The first task is the acquisition of a dedicated light aircraft outfitted with the LIDAR mapping system and digital photography capabilities.

The second task is the training of personnel, creation of data analysis and archiving software, and the quality control procedures necessary to assure the accuracy of data products. The costs of these tasks over a two year startup period are shown in the table.

In addition to the already demonstrated capability for identification of seismic hazards and the broad scale mapping of seasonal variations in beach morphology, CALTM proposes to solicit support for research aimed at establishing capabilities in the following fields:

- Measurement of the spatial and temporal variability of the depth of mountain snow pack.
- Mapping stream channels, stream and lake levels, and other hydrological characteristics.
- Characterization of major landslides.
- Rapid response assessment of fire, storm waves, earthquake or tsunami damage.
- Improved coastal wave impact models.
- Coastal-ocean resources modeling and monitoring.
- Earthquake fault mapping in forested areas.

CALTM Startup Costs ($millions)

	Year 1	Year 2
Equipment	1.77	
Aircraft	0 .39	
Labor & other	0 .55	0.76
TOTAL	**2.71**	**0.76**

Data, Knowledge and Information	
Topic Area	Recommendation
Natural Hazards	…top recommendation was the creation of a communication system to connect the information needs of managers and the expertise of those in academia.
Ecosystem Health	…their top recommendation was the developent of a "Living Obseravtion System" to quantify how critical coastal ecosystems are responding to natural and human drivers
Fisheries Management	Improving single species management by gathering more information on mortality, discards, abundance, life history, and age struction.
Coastal Pollution, water and sediment quality	The group's top recommendation was that a web-based information clearinghouse be created for all seven priority issues.

The forthcoming Ocean Protection Council strategic plan should provide an overall conceptual and organizational framework to build towards integrated coastal and watershed observations to meet user needs. The goal will be to integrate existing and future observation systems, supplementing but not supplanting existing systems' mandates and governance arrangements. The strategic plan should provide the institutional mechanisms for ensuring the necessary level of coordination, strengthening and supplementing existing global observation systems, and reinforcing and supporting them in carrying out their mandates.

The contributing information technology system needed to support integration will range across the processing cycle, from primary observation (data) to information to knowledge. By implementing the strategic plan, they will share observations and products with the system as a whole, and will take the necessary steps to ensure that the shared observations and products are accessible, comparable, and understandable, by supporting common standards and adaptation to users needs.

The strategic plan should seek to encompass the entire California coast and watersheds, and include *in situ*, airborne, and space-based observations. Scripps believes that it is important to base system integration and observation system growth on a modern, distributed, data and computational grid-based system. The nascent California Ocean Current Monitoring Program (COCMP), for example, is employing such a system from northern California to southern California and into Mexico to ensure broad, real-time

access to data collected by the various partners. The complete data set will also be assimilated in regional ocean models to interpolate the data and predict ocean conditions into the future.

Sound management of California's coastal system, in both its natural and human aspects, requires information that is timely, of known quality, long-term, and comprehensive. Ensuring that such information is available to those who need it is a function of governments and institutions at all levels. The current situation with respect to the availability of coastal and watershed observations is not optimal. This situation is particularly true with respect to coordination and data sharing among local and regional governments, organizations and disciplines. There are large spatial and temporal gaps in data coverage. Moreover, there is an eroding observational infrastructure, inadequate long-term data archiving, and no assured continuity for many essential observing systems. Consequently, targeted collective action is needed to bring California's observing systems in line with the requirements for addressing a range of issues of concern to society.

Technically, the goals for an effective information system for California are:

- To address identified common user requirements;
- To acquire observational data;
- To process data into useful products;
- To exchange, disseminate, and archive shared data, metadata, and products; and,
- To monitor performance against the defined requirements and intended benefits.

California is a particularly good position to adopt a modern grid-based information system to federate existing systems and provide a framework for growth. The federally-sponsored Laboratory for Ocean Observatory Knowledge and Information Grid (LOOKING) is one example for data, knowledge, and information integration. Partners in this effort include Southern California Coastal Ocean Observing System (SCCOOS), the aforementioned COCMP, the California Institute for Telecommunications and Information Technology (Calit2), CalPoly, and the Monterey Bay Aquarium Research Institute (MBARI). LOOKING has adopted a information model based on the five goals above that is illustrated in the following figure.

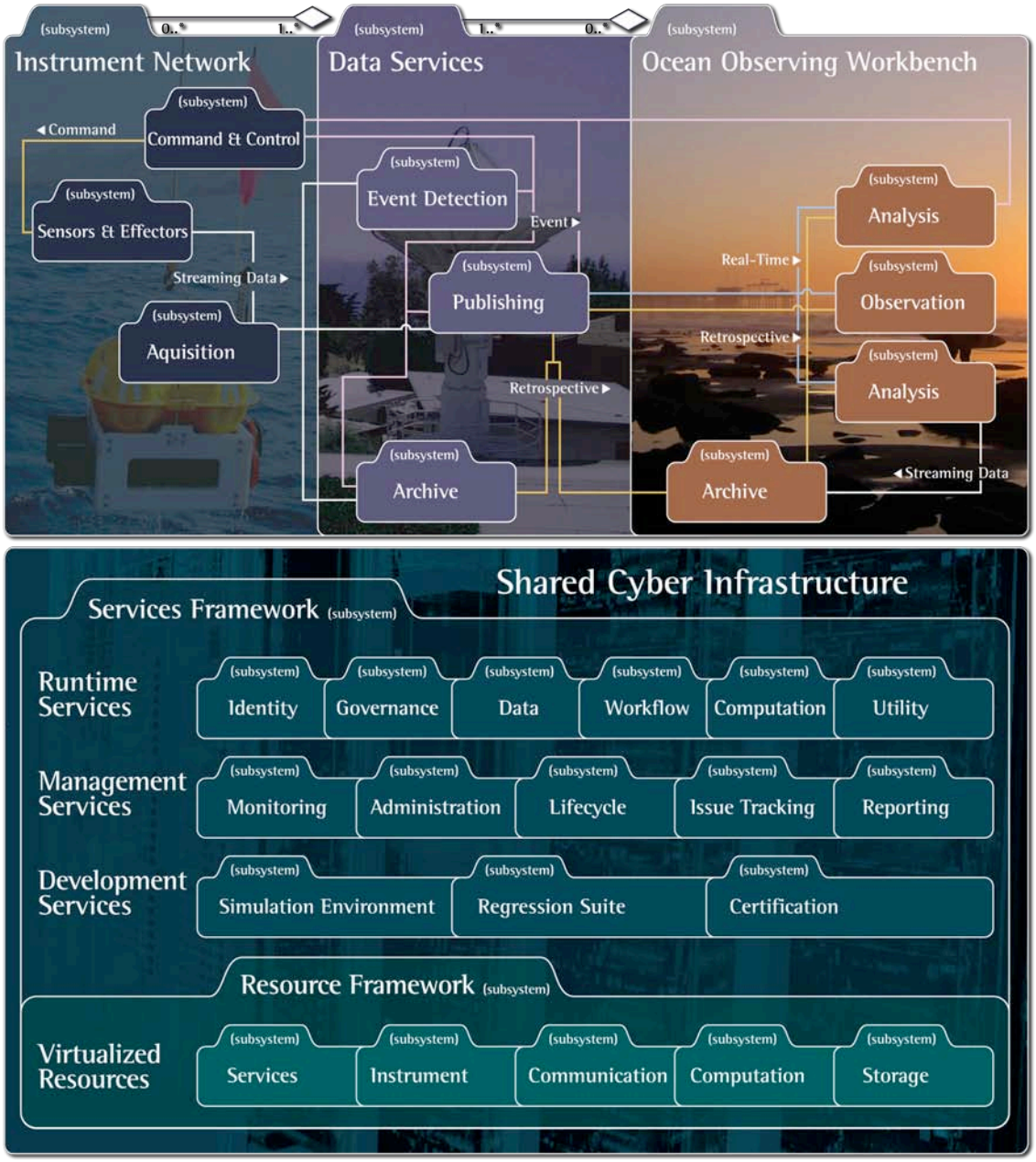


Figure 1: The top figure illustrates the connectivity between a sensor at sea in the left frame to archives and event detection algorithms ashore in the center. The frame to the far right includes standard analysis and modeling tools for transforming data into information and knowledge that can be tailored to be of use to policy makers for coastal observing systems. Most importantly, the sensor, archiving, and analysis systems and centers can be distributed throughout California and not concentrated in any particular facility.

In this implementation of the California ocean observing system, increased sharing of methods for modeling and analysis needed to transform data into useful products will be advocated. In the implementation, harmonization of observations, real- or

near real-time monitoring, integration of information from *in situ,* airborne and space-based observations through data assimilation and models, and early detection of significant and extreme events will be possible. Integration of *in situ,* airborne and space-based observations within the various societal benefit areas cited in the workshop report will be encouraged, as will the establishment of state-wide, efficient, and representative networks of *in situ* observations to support process studies, satellite data validation, and algorithm and model development, as well as the detection, documentation and attribution of change.

We believe that adopting a comprehensive data and information system, based on leading edge information technology developed in California, is essential. We urge the California Ocean Protection Council to include planning and funding for such a system. The investment will leverage federally sponsored work already in place and maintain California in a very competitive position and leadership in the US for supporting nascent systems in other states and the federal government.

I have also attached two single page descriptions of new related tools essential for modern measurements of detailed topography along coastlines, watersheds, slumps, snow pack and earthquake faults in California. The first deals with a high-resolution method for topographic mapping (CALTM – Center for Airborne LIDAR Terrain Mapping) and advocates the acquisition of a dedicated aircraft and modern instrumentation to support regular use of the system in California. The second describes the California Spatial Reference Center (CSRC) and its program for real-time, high speed GPS geolocation. The program has many stations deployed in San Diego, Imperial, and Orange Counties and new installations have begun in Riverside County. The CALTM aircraft depends upon GPS for detailed navigation of the aircraft for accurate surface mapping.

Thanks for the opportunity to provide input to the strategic plan on behalf of Scripps Institution of Oceanography. If questions arise and assistance is needed, please feel free to call on me.

Sincerely,

John A. Orcutt
Deputy Director

Cc: Charlie Kennel
Kathleen Ritzman
Rudy Murillo