Central and Northern California Ocean Observing System

CeNCOOS

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San Francisco Bayweb

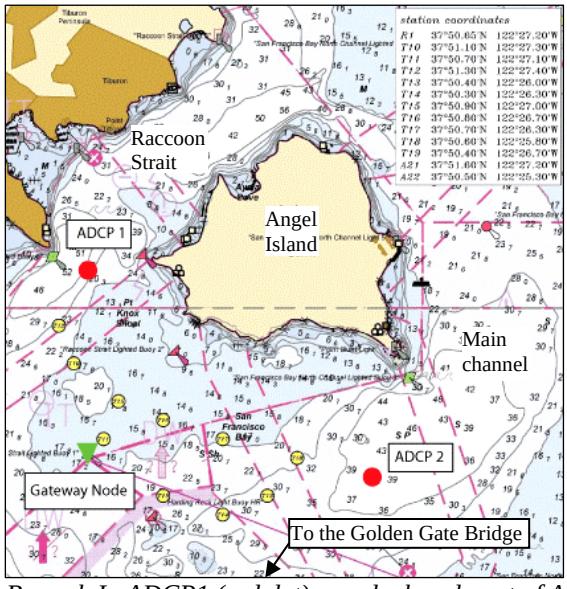
An Ocean Observing Experiment in SF Bay

Bayweb I

Goals: Use Acoustic Doppler Current Profilers (ADCPs) to measure sub-surface currents in the Bay. Establish an undersea and wireless network to send data from the Bay to the internet in real-time.

Methods: Bayweb 1 was conducted in San Francisco Bay from May 1-10, 2009. A new integrated instrument system provided by the Naval Postgraduate School was used to measure currents at different depths (using ADCPs) at two locations. Data on currents were transmitted using several acoustic nodes from the Navy's Seaweb communications system (see map below). A main gateway node was established on a U.S. Coast Guard navigation buoy.

Outcome: Currents were recorded from ADCP2 but ADCP1 and the communications network both failed.



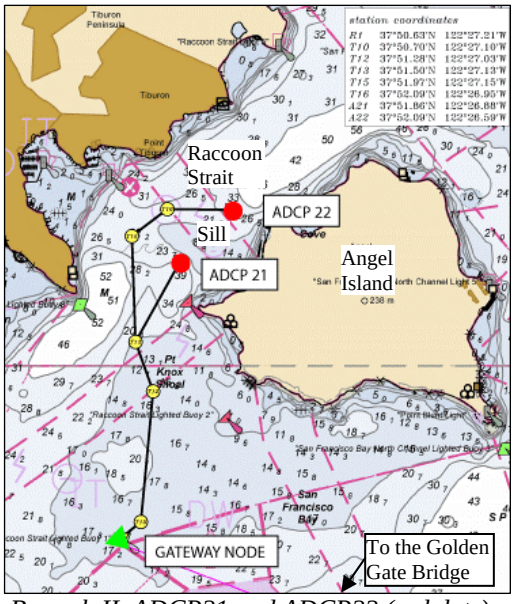
Bayweb I. ADCP1 (red dot) was deployed west of Angel Island and ADCP2 was near the Bay's main shipping channel. The acoustic nodes are shown as yellow circles and the gateway node is a green triangle.

Bayweb II

Goals: Obtain data on currents from Raccoon Strait (where the ADCP failed during Bayweb I) to test the affect of a seafloor feature on currents in SF Bay and try again to transmit data to the internet in real-time.

Methods: Bayweb II took place from July 24-Aug 6, 2009. Two real-time ADCPs were placed in the deeper areas of Raccoon Strait between Angel Island and the Tiburon Peninsula, one on either side of the shallow seafloor sill (see map below). A smaller but similar acoustic array was used to transmit the data.

Outcome: Current measurements were recorded from both ADCPs. The real-time transmission of data was again unsuccessful, due to the very high ambient noise in this area interfering with the acoustic array.



Bayweb II. ADCP21 and ADCP22 (red dots) were deployed to either side of the seafloor sill near Angel Island. The acoustic nodes are shown as yellow circles and the gateway node is a green triangle.

The "Stablemoor" buoy being readied for deployment in the San Francisco Bay. The buoy houses the ADCP, acoustic release and acoustic modem.

USCG navigational buoy used to mount the communications gateway consisting of a hydrophone below, a small computer and wireless internet.

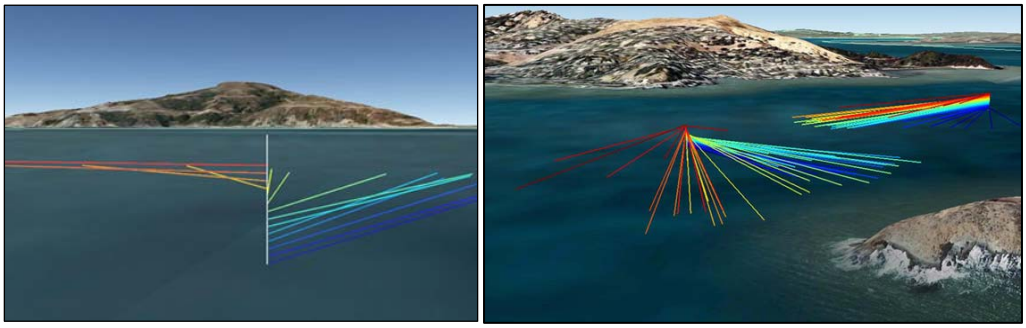
Lessons Learned and New Observations

This is the first time currents have been observed at these locations! The most interesting discovery during Bayweb I was that tidal currents were not uniform throughout the water column. For a few hours in each tidal cycle, the surface and bottom currents in the main channel opposed each other. We hypothesize that this was due to an eddy spinning off Angel Island. The result is important since many kinds of oils and other hazardous spills are heavier than water and sink to the bottom. Surface currents alone would not be sufficient to track and contain such spills.

During Bayweb II, several exciting flow features were observed in Raccoon Strait. Raccoon Strait is one of several key straits that "control" the circulation in the San Francisco Bay. Understanding the basic physics in these straits is central to being able to model and predict the currents on a real-time basis. The new observations during Bayweb II showed us that the currents near the surface were high speed (exceeding 3 knots) while the currents in deeper areas of the Strait around the seafloor sill were near zero. This was especially evident on ebb (outgoing) tides, which had stronger currents than flood (incoming) tides.

More Info:

- Real-time surface currents were used to track the 2007 oil spill in SF Bay
- The currents in SF Bay are some of the swiftest in California, making them important for boat navigation in the Bay.
- Currents in the Bay are also important for juvenile salmon migrating to the ocean.



Google Earth display of current vectors at different depths in the main channel in Bayweb I (left) and Raccoon Strait in Bayweb II (right). Red lines are near-surface and blue lines near-bottom. The tidal current directions often varied with depths, especially at tide changes.

Future uses for results of this project

- To help with the community circulation model being developed for SF Bay
- Improve navigation for shipping and other boat traffic through the Bay
- Aid state and federal agencies in tracking future oil spills in the Bay
- Provide knowledge for migratory fish studies

For more information, please visit our web pages on this subject:

- CeNCOOS Bayweb I
- CeNCOOS Bayweb II

Collaborators:

- Hosted by SFSU's Romberg Tiburon Center
- UC Berkeley
- Bodega Marine Laboratories
- US Coast Guard
- Naval Postgraduate School
- Space and Naval Warfare Systems Command