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Modeling Water and Sediment Quality in Two California Bays

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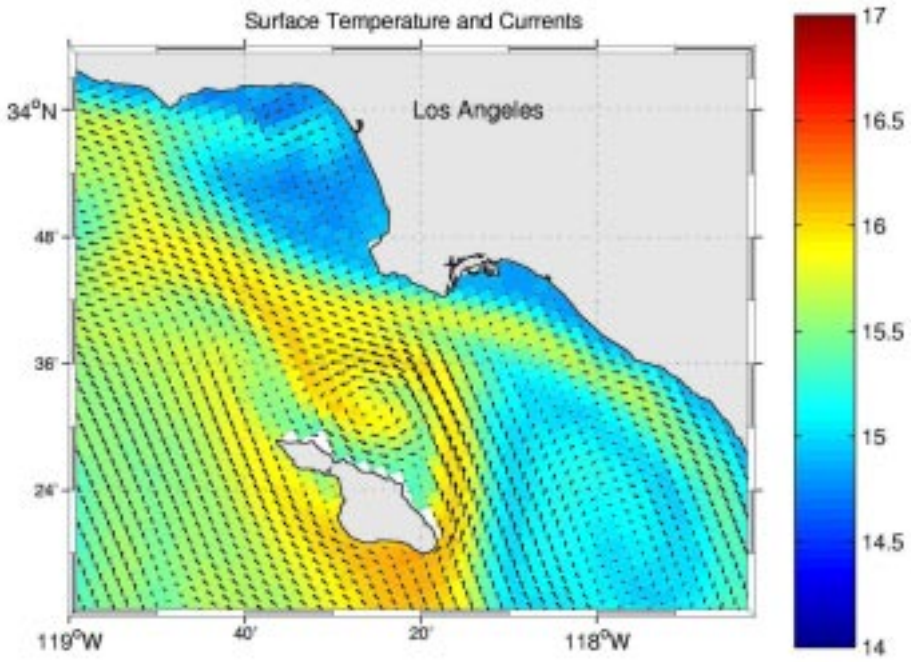
Background

Highly urbanized bays, especially shallow, protected ones are extremely prone to water pollution. Not only do these waterways receive pollutants from sewage, storm drains, rivers and industrial discharges, but the pollutants are slow to disperse—and slow to be diluted with water from the open ocean.

While polluted coastal bays have often been studied observationally, less effort has focused on developing computer models that simulate the processes that disperse, deposit and re-suspend pollution and contaminants on the seabed. Such models would not only help interpret observational data but would also benefit resource managers charged with upholding state and federal clean water laws.



Horizontal water velocities in the Southern California Bight at 50-meters depth (the maximum vector length is 0.23 m/s) estimated using a three-level grid configuration. Velocities are plotted on a contour map of wintertime sea surface temperatures (see color bar, in degrees Celsius). Credit: Marchesiello P., J.C. McWilliams, J. Oram and K. Stolzenbach. 2002. Equilibrium circulation in the Southern California Bight, in preparation.

The Project

In this project, Drs. Keith Stolzenbach and James McWilliams, both of the University of California at Los Angeles, are developing a 3D computer model that simulates the distribution of temperature, salinity, nitrogen and phytoplankton in coastal bays. The model also simulates the biogeochemical processes involved with the dispersion (suspension, sinking and aggregation) of particulate matter.

The model that they will be developing is a modified version of an Ocean Modeling System developed in an earlier California Sea Grant project. Whereas the first model simulated oceanic processes along the entire West Coast (from Alaska to Baja California) and resolved features on a scale of 10 kilometers, the new Regional Ocean Modeling System is being programmed to resolve oceanic processes on a 1-kilometer scale. What further distinguishes the new model is its ability to simultaneously resolve large-scale and fine-scale oceanic processes and to consistently simulate the interactions between the two scales. All this is being done by "embedding" the regional, 1-kilometer calculations within the more global calculations on the 10-kilometer grid.

The strength of such a calculation is that it takes into account how large-scale processes—winds and variations in the California Current—"force" less noticeable, smaller currents that may, for instance, sweep raw sewage onto a favorite beach. Typically, computer models that resolve oceanic processes on a scale fine enough to study coastal bays and beach processes ignore the contribution of large-scale processes.

One major goal of the project is to produce a series of simulations that represent common oceanographic phenomena for two case-studies—the Santa Monica and Monterey bays. These scenarios include understanding:

- the circulation patterns that disperse runoff after a heavy winter rainstorm;
- the dispersion and fate of heavy

metals; and,
• the origin and evolution of toxic plankton blooms.

Applications

The scientists plan to incorporate data on sewage discharges into the model to track the predicted paths of contaminants along the coast. Another scenario the scientists hope to model is the dispersal of fish larvae by ocean currents and winds.

To validate the model's accuracy, the scientists will compare model simulations with observational data collected at sea and by satellites.

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