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Monitoring the Fluxes of Salinity, Pollution and Phytoplankton into the San Francisco Bay

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Background

Estuaries are transition zones separating freshwater and saltwater ecosystems. They provide both a physical barrier protecting the shoreline from the direct force of storms, and they create unique habitats for fishes and birds.

Estuaries are distinguished by their relatively large swings in salinity. While the tides rhythmically flood estuaries with saltwater, elevating salinity levels, rivers supply freshwater, lowering them. Without tidal flows, estuaries may lose their ability to support marine species, and they may accumulate pollutants. Alternatively, without freshwater, seawater may intrude far upstream, contaminating aquifers and killing wildlife.

A proper balance of tidal flushing and clean freshwater inputs is crucial to maintaining the biological health of estuarine ecosystems. For these reasons, and others, it is important to understand how salinity levels vary with tidal cycles, winds, and ocean currents.

About 80 percent of all freshwater entering the San Francisco Bay comes from the Sacramento River (pictured above). Nearly all this water is released from reservoirs fed by the Sierra Mountains. The reservoirs supply the state with water for agriculture and urban use. Photo: Dale Kolke, California Department of Water Resources.

An aerial view of the Sacramento–San Joaquin Delta. When and how much water is released into the delta is a management decision, based largely on estimates of how river flows will influence salinity levels and how these changes in salinity, in turn, will affect wildlife. Photo: Dale Kolke, California Department of Water Resources.

The Project

The main goal of this project is to study the fluxes of salt, temperature, suspended solids and phytoplankton between the San Francisco Bay and the coastal ocean. To do this, scientists will measure current speeds along a transect across the mouth of the bay, a length of about 5 kilometers. Salinity, temperature, turbidity and phytoplankton abundance will simultaneously be measured along the same transect. Ultimately, scientists would like to identify whether tides, winds, rivers or gradients in water density drive

fluxes of salt, pollution and phytoplankton into the bay.

Method

Salinity, temperature, turbidity and chlorophyll concentrations will be directly measured from water samples collected during six cruises. Measurements will be taken across the mouth of the estuary continuously over a 25-hour period in which time two full tidal cycles can be observed. Ocean currents will be measured with an acoustic current Doppler profiler—an instrument that uses backscattering and frequency shifts of sound waves to estimate current speeds.

Applications

The findings from this project will lead to a better understanding of how physical processes influence biological processes, such as phytoplankton productivity, in the estuary. Beyond the biological implications, which have attracted the attention of scientists from the Romberg Tiburon Center, the Interagency Ecological Program, and the U.S. Geological Survey, the findings from this project will have important implications for determining the net transport of sediment and contaminants between the San Francisco Bay and the ocean. Net transport rates are also of interest to the Port of Oakland and the San Francisco Airport Authority.

In addition, this project gives insights into the effects of water diversions on the Bay–Delta system, underscoring the delicate balance between tidal flows and freshwater inputs.

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