UCI Samueli School of Engineering | Department of Civil and Environmental Engineering

Presented By:

Stephen Monismith, Ph.D.

Professor & Chair

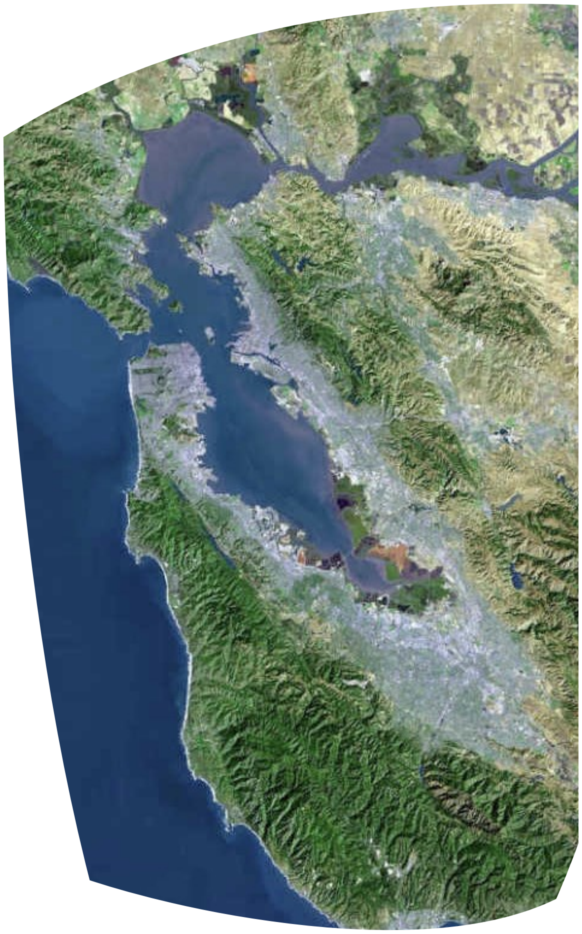
Civil & Environmental Engineering

Stanford University

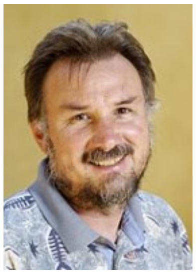
Environmental Engineering *Seminar Series*

Friday, March 4th, 2016
MDEA
1:30PM - 2:30PM

Salinity Intrusion in Northern San Francisco Bay



The problem of predicting how the salinity field in estuaries responds to freshwater inflows is one that draws attention from both physical oceanographers and hydraulic engineers since it has both scientific and practical dimensions. In Northern San Francisco Bay, examination of 20+ years of data spanning the estuary shows that the overall structure of the salt field can be described using a single parameter, X2, the distance in km measured from the Golden Gate Bridge along the channel thalweg to where the salinity on the bottom is 2. Analysis of long-term monitoring of biological data (e.g. fish abundance) shows that much of ecological functioning of the estuary depends on X2 and so regulations have been developed specifying X2 position depending on time of year and hydrologic conditions. Because these regulations can require substantial amounts of water, it is necessary to efficiently predict the behavior of X2 with some accuracy so as to help manage the competing demands for California's limited water supply. In this talk, using several data sets including one that goes back to ca. 1960, I will discuss the observed behavior of X2 and how it responds to flow, Q. In general, the tendency of freshwater flows to carry salt out of the estuary is balanced by the tendency of dispersion to move salt upstream. A surprising aspect of the X2-Q relation in Northern San Francisco Bay is that it is much weaker than would be inferred from classical estuarine circulation theory, behavior that we attribute to the effects of stratification on the turbulent flows that support upstream salt flux. I will present a rigorously derived but simplified model of salinity dynamics that can be used to understand this behavior and that can be used to create a dynamically based (rather than purely empirical) model of unsteady salinity intrusion. Finally, examination of the relevant data also suggests that inability to accurately measure freshwater flows during relatively dry periods may be a bigger limitation on accurate predictions of low-flow behavior than is choice of model structure.



A native son of the Golden West, Stephen Monismith received all his degrees (BS, MS, and PhD) from the department of Civil Engineering at UC Berkeley. Following completion of his thesis, he did a postdoc in Western Australia focusing on the fluid mechanics of stratified flows in lakes. He has been at Stanford University in the Dept of Civil and Environmental Engineering since 1987, and has been the department chair since 2009. He uses field, lab, and computational experiments to look at estuarine and lake physics as well as nearshore flows with waves and stratification, focusing on mixing and transport processes that are central to ecology, biogeochemistry and environmental management. Through his work on estuarine dynamics, he has been active in San Francisco Bay-Delta issues, including helping to develop the scientific underpinnings of freshwater flow regulations. In recent years, much of his efforts (and travel) have focused on the physics of coral reef flows, with field work and modeling carried out on reefs in the Red Sea, and in nearshore waters of Florida, Hawaii, Moorea, Palmyra Atoll, and Palau. He has parallel interests studying the inner shelf flows found near and inside the kelp forests of California. Through his coral reef work, he had the opportunity to serve as the project director for a unique NATO-supported collaboration between Israeli and Jordanian scientists studying the northern Gulf of Aqaba.

Questions? - cee@uci.edu - (949) 824-7548