Seasonal Patterns in Sediment Deposition across Two San Francisco Bay Estuary Tidal Marshes

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Sediment deposition is an important component of accretion processes that allow tidal marshes to maintain their relative elevation as sea levels rise. Suspended sediment concentration (SSC), elevation, tides, and distance to sediment source interact to determine deposition rates across the marsh. Seasonal variation in SSC, driven primarily by precipitation and wind, has great influence on deposition rates. Seasonal changes brought by drought or climate change may thus indirectly affect tidal marsh sediment deposition, changing wetland vulnerability to sea-level rise. We sought to estimate the influence of seasonality and tidal seasonal cycles on sediment flux by measuring sediment deposition over the course of one year across a tidal marsh surface. In the fall of 2015 we deployed sediment traps along transects perpendicular to large tidal channels and across a range of elevations at two tidal marshes in the San Francisco Bay estuary (salt marsh at Petaluma River and brackish marsh at Rush Ranch), replacing traps at 1-2 month intervals to capture seasonal variation. Similar to previous studies, in our first year of sampling we found sediment deposition was highest close to the tidal channel and decreased as you moved away from the water source. We also found that sediment deposition was highest during periods with more precipitation. We will continue this study through the winter of 2016/17 to see how the results may change in dryer winter conditions. Our results will inform modeling efforts to incorporate seasonality and variation in precipitation and tidal heights into projections of marsh elevation under sea-level rise and future precipitation climate change scenarios. In addition, our results can be used as a guide for future efforts to measure sediment flux by identifying seasonal periods most representative of annual deposition rates.

Keywords: Sediment deposition, tidal marshes, sea-level rise, drought, precipitation, seasonality

Poster Topic: Physical Processes

Seasonal Variations Between Perimeter and Channel Dynamics in South San Francisco Bay

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Lower South San Francisco Bay is interesting from a nutrients perspective because there is a large input of nutrients from rainwater runoff and wastewater treatment plant dumpings. It is curious that South San Francisco Bay has been seemingly resistant to algal blooms in the past when its nutrient levels have been on the higher end when compared to other estuaries. I believe stratification in South SF Bay plays a key role in the onset of algal blooms. Therefore, it is important to characterize the stratification that we see in the bay now in order to move forward in future models which try to predict algal blooms.

South SF Bay is also of the general estuary community's interest because of it's bathymetry and dimensions. South San Francisco Bay consists of a deeper channel down the center, and then shoals off along the perimeter into a wetland ecosystem. Also, the length of the estuary is of similar length to the length of the tidal excursion. Hydrological studies completed on South SF Bay can also give us insight on how estuaries with lengths of similar length to their tidal excursions will behave physically.

I have collected a years worth of salinity and temperature data at site just south of the Dumbarton Narrows. Combined with CIMIS data in nearby locations, I found that the channel water in South SF Bay has an adjustment period of about 14 days when perturbed by an extreme event, such as a storm. The perimeter has an even longer adjustment period due to continual freshwater input from the rainfall runoff. I observed that in the winter, the system is constantly adjusting whereas in the summer, the bay is in a more consistent state.

Keywords: hydrodynamics, lower south bay, stratification, climate change, fieldwork

Poster Topic: Physical Processes

Settling Velocities of Fine Sediments in San Francisco Estuary Margins

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In San Francisco Bay, suspended sediment can transport contaminants and nutrients, limit light availability for primary production, and accumulate in or erode mudflats and tidal wetlands. To predict sediment dynamics and transport, models must include sediment settling velocities. However, fall velocities are still predicted mostly empirically and they are challenging to observe in-situ, thus they remain parameterized in models with high uncertainty.

Previous work in San Francisco Bay found that settling velocities ranged between 0.5 and 10 mm/s. However, this work was conducted along the “backbone” of the bay, and may not apply throughout San Francisco Bay’s extensive shoals, mudflats, and intertidal regions. We measured settling velocities at margin regions around San Francisco Bay to assess the potential for spatial variability.

Preliminary results from a 24 hour field experiment in a channel slough of South San Francisco Bay suggest that sediment in margin regions may be slower settling (0.3-0.4 mm/s) than sediments in the bay center, consistent with results from San Mateo shoals. An improved understanding of sediment characteristics, settling velocities, and spatial variability throughout San Francisco Bay will help us develop more accurate and predictive models of sediment transport. As managers consider marsh restoration projects, dredged material disposal locations, and the possibility of impacts from nutrient loads, understanding sediment transport is key to making informed management decisions.

Keywords: suspended sediment dynamics, settling velocity, flocs

Poster Topic: Physical Processes

Wavy River Bed: The Sacramento River at Georgiana Slough – 2010 to 2016

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Highly detailed multibeam bathymetry has been performed on an annual basis at this intersection since 2010. The junction of the Sacramento River at Georgiana Slough is important for Delta fish migration and fresh water conveyance. Time series bathymetry will allow scientists to properly model the flow dynamics of the river, plan for the installation and maintenance of proposed guidance structures, and to help understand potential biological impacts. As we unveil the detailed channel topography and track changes over time, we are able to reduce model uncertainties and explore how different processes may be interwoven together: Do changes in bathymetry affect the flow split? What does that mean for fish migrating downstream? Understanding sediment movement and depth changes at this and other locations will allow for better decisions when managing the health of the Delta ecosystem.

Keywords: bathymetry, multibeam, sonar, elevation, fish, sediment, Sacramento River, Georgiana Slough

Poster Topic: Physical Processes