Salt Dynamics in Non-Riparian, Freshwater Wetlands

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We are investigating the salinity dynamics of seasonal wetlands in the San Joaquin River basin, with an emphasis on salinity exchange with wetland soils and how different flooding strategies influence the long-term salinity of the wetlands. A combination of field, laboratory and numerical analysis is being applied to understand the detailed interaction between the soil and water columns and the potential for salinity to be retained in wetland soils.

We are investigating the salinity dynamics of seasonal wetlands in the San Joaquin River basin, with an emphasis on salinity exchange with wetland soils and how different flooding strategies influence the long-term salinity of the wetlands. In the first year of this grant, we have completed the field data collection and laboratory experiments, and have begun some numerical analysis of the relevant processes.

The field data collection consisted of time series of conductivity (EC), temperature and depth at multiple locations in the wetland under study, plus velocity measurements at two locations in a channel that bisects the wetland. These time-series spanned the entire flooded period, and were supplemented by several spatial surveys of EC and temperature collected by towing a conductivity-temperature probe on a floating raft around the wetland. These data have been processed and are now ready for a more complete analysis in the coming year.

The laboratory experiments we have performed focused on how flood-up and draw-down strategies, as well as vegetation types, affect the retention of salts in the soil column. We used four different flood-up and draw-down protocols to span the management strategies typically pursued (Table 1). In each case, the flooding and draining of the soil column was performed on multiple soil columns characterized by a range of vegetation types representative of the actual field site. Between the flood-up and draw-down stages, the water column was replaced with high EC waters to simulate the effects of evaporation in the field. Data recorded in each experiment included detailed time-series of EC and temperature at three elevations in the soil-water column. Just as in the case of the field observations, these measurements are now complete, and the data has been processed and prepared for analysis in the coming year.

Exp	Flood-Up	Draw-Down
1	Fast (2-3 days)	Fast (2-3 days)
2	Fast (2-3 days)	Slow (10-12 days)
3	Slow (10-12 days)	Fast (2-3 days)
4	Slow (10-12 days)	Slow (10-12 days)

Table 1: Laboratory Experiment Summary.

Numerical work currently underway is focused on a vertical model of the soil-water columns being explored in the laboratory. We have developed a one-dimensional advection-diffusion equation that allows a spatially-variable diffusion to be specified. This model is being used to compute time trajectories for salinity in the soil-water columns, which will be compared with the observed time series. In addition to traditional time-series comparisons, we will focus our analysis on defining patterns in the time variability, particularly hysteresis (if it exists) and phasing of constituents relative

to flood-up and draw-down. While these comparisons may seem qualitative in nature, they actually represent a clearer test of our understanding of the underlying processes than a detailed comparison of time variability would. The goal in this analysis is to determine whether the flooding-drying strategy leads to changes in the underlying processes that govern salinity retention in soils and the return of those salts to the water column during flood-up.

Collaborative Efforts

The PI's research group includes two PhD students pursuing research related to the restoration of wetlands on the perimeter of San Francisco Bay. Many of the properties to be restored are currently salt ponds (as in the case of the South Bay Salt Pond Restoration Project, SBSPRP). An open question for many of these activities is what role the exchange of constituents between the soil column and the water column will play in determining the state of the restoration project. In most of these cases, the flooding and drying of the area will be on the tidal timescale, which is considerably faster than the flooding and drying being analyzed in this work, but the concepts may prove to be transferable.

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