Use of the Co-occurrence Pesticide Species Tool (CoPST) to Model Seasonal and Temporal Patterns of Pesticide Presence to Guide Water Quality Monitoring Timing and Location

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Problem statement: A decline in pelagic species has been observed in the San Francisco Bay-Delta, triggering questions as to whether contaminants are contributing to the decline. To help address these questions, Waterborne Environmental, Inc. (Waterborne), in conjunction with UC Davis, USEPA, and DWR, developed the CoPST (Co-occurrence of Pesticide and Species Tool), which is a GIS/modeling framework that incorporates 40 high-risk pesticides and aquatic endangered species presence to identify areas and timing of greatest risk.

Approach: This presentation describes the first management application of the tool. In this application, the co-occurrence of endangered species module was not utilized. The question was "when and where monitoring should be focused for specific pesticides, based on historical use application and available monitoring data." Although many monitoring efforts are ongoing in the California Central Valley and Bay-Delta, research has shown that the current temporal and spatial sampling of pesticides may be insufficient to capture the complete profile of water quality. Coordination was necessary with existing monitoring surveys and regulatory programs such as the Central Valley Regional Water Quality Control Board's Irrigated Lands Regulatory Program (ILRP), Surface Water Ambient Monitoring Program (SWAMP), and Delta Regional Monitoring Program (RMP).

Results: The analyses output was a GIS layer using heat map style representation for predicted pesticide edge of field loading indexes, along with layers of actual monitoring results in a monthly time step. The results layer also incorporates a lookup feature by section (640 acres), allowing users to pass their cursor over the indexed sections, showing the individual pesticides that contributed to the modeled index, as well as the corresponding pesticides if present in the actual monitoring data.

Conclusions/Relevance: Next steps include connecting the model output to current permit requirements for irrigated lands, watershed improvement planning efforts, and determining best management practices placement and monitoring priorities.

Keywords: Modeling, pesticides, toxicity, Irrigated lands, species, best management practices, monitoring
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A System of Autonomous Fixed Station Measurements Together with Synoptic Spatial Characterization Provide Insights into Dynamics of Organic Matter, Nutrients and Algal Pigments in the San Francisco Bay-Delta

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Continuous water quality measurements (nutrients, organic matter, turbidity, algal pigments, dissolved oxygen, pH, temperature, conductivity) on autonomous and Lagrangian measurement platforms in the San Francisco Bay-Delta (Delta), have improved our knowledge of important biogeochemical and eco-hydrological processes. The Delta is naturally, hydrodynamically complex and affected by human (wastewater and agricultural discharge, water withdrawals, land surface alterations) and natural perturbations (floodplain and riparian interactions, wind, precipitation, snowmelt), which add complexity across eco-hydrological and water management domains. Timescales of important biogeochemical change occur in the Delta in a matter of minutes to hours, with attendant changes in the ecology of aquatic habitats and human use of the resource. Autonomous water quality measurements collected over fine temporal and spatial scales help to effectively identify important drivers of biogeochemical processes in the Delta. An established network of autonomous, continuous water-quality monitoring stations in the Delta operated by the USGS, Sacramento, CA, currently provides temporally-rich data at fixed locations. The fixed station measurements reveal complex, hydrodynamically driven changes in water quality, useful to describe habitat conditions for pelagic organisms and guide future tidal marsh restoration efforts in the Delta. To complement the fixed-station data monitoring, spatially dense data monitoring using a boat equipped with a GPS-time-stamped high-frequency flow-through monitoring system allow for real-time spatial mapping. Here, we present examples from the fixed-station monitoring network, combined with boat based Lagrangian measurements. We find that real-time mapping in concert with fixed station monitoring is useful for identifying sources and sinks of nutrients and organic material, and identify important biogeochemical drivers relating to pelagic habitat quality, algal productivity, and foodweb dynamics.

Keywords: Water quality, Nitrate, Mapping, Real Time
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The Use of DOC Surrogates to Measure DOC at two Municipal Intakes In the Sacramento – San Joaquin Delta

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The Sacramento – San Joaquin Delta is a major drinking water supply to 2/3 of California. Dissolved Organic Carbon (DOC) is an important constituent in drinking water, as high concentrations of DOC can form Disinfection Byproducts, which are carcinogenic and harmful to human health. Monitoring DOC in the Delta is important, as DOC levels vary both temporally and spatially in the Delta. Unfortunately, DOC is typically collected by discrete grab samples and analyzed in the laboratory. DOC concentrations in the Delta can change hourly, creating the need for in-situ type DOC measurements.

Two studies were conducted by the Department of Water Resources (DWR) and the Solano County Water Agency (SCWA) looking at in-situ type DOC measurements. The first study was a multi-year study by DWR investigating the use of an FDOM sensor at the Banks Pumping Plant, located in the South Delta. The main goal of the study was to investigate and compare the FDOM sensor to DWR's real-time DOC analyzer and discrete grab samples. The second study was conducted by SCWA, at the Barker Slough Pumping Plant, located within the Cache Slough Complex. The main purpose of the SCWA study was to investigate the use of UVA-254 and FDOM as in-situ surrogates for trending of DOC, to support real-time water treatment plant operations.

The results of both studies show that FDOM is a reliable surrogate for DOC in the Delta. Both studies show that FDOM and UVA can track seasonal to tidal changes in DOC concentrations. However, the FDOM sensors are susceptible to fouling, and require weekly cleaning of the optics. Water managers, modelers, and others should consider using FDOM sensors to improve both monitoring and modeling in the Delta. FDOM sensors can also be used to assess large scale wetland restoration impacts in the Delta.

Keywords: Water quality, organic carbon, DOC, FDOM, UVA
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A Hybrid Coagulation-Wetland System Designed to Decrease DOC, Hg, and Nutrient Loads from Subsided Islands in the Sacramento-San Joaquin Delta

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Water discharged from subsided Delta islands affects water quality in the San Francisco Bay-Delta by contributing dissolved organic carbon (DOC), disinfection byproduct precursors (DBPPs), nutrients, and mercury (Hg). These constituents of concern (COC) have been identified as key components affecting drinking-water safety and environmental health. For example, source water DOC concentrations above 3 mg/L have been identified as a trigger point for upgrading drinking water treatment plants. Additionally, a methylmercury (MeHg) TMDL for the Delta is being implemented to reduce Hg impairment in Delta habitats. In 2014, we completed field tests of a treatment system that uses in-situ coagulation followed by passage through wetlands to remove COCs from the water column and sequester them in wetland sediments via natural settling of particulate material. This type of system is commonly referred to as Low Intensity Chemical Dosing (LICD). The field study, located on Twitchell Island in the central Delta, consisted of nine 4,000 ft^2 replicated macrocosms comparing the effectiveness of wetlands alone to wetlands receiving water treated with iron- or aluminum-based coagulants to remove COCs. The coagulant-dosing system was controlled using on-site instrumentation to maintain DOC removal, monitor flow, and track water quality. We found removal of COCs varied seasonally, but the coagulation treatments generally reduced COCs below levels achievable by wetlands alone. Based on results from this study, we can estimate sequestration rates for the different COCs and the size of LICD treatment wetlands required to effectively treat discharges from Delta islands. This project demonstrates the potential usefulness of hybrid coagulation-wetland systems for managing Delta water quality by (1) reducing island drainage water COC precursor loads to the Sacramento Delta and (2) accelerating accretion of soils through the formation of mineral/organic soil blends formed from the capture of floc and the sequestration of organic matter within associated wetlands.

Keywords: Mercury, methylmercury, DOC, low intensity chemical dosing, wetland, water treatment
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Radar Remote Sensing of Subsidence in the Sacramento-San Joaquin Delta

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Nearly a quarter of California's fresh water supply flows through the Sacramento-San Joaquin Delta, an area comprised of tidal marshland and reclaimed land in the form of ~60 islands surrounded by 1700 km of levees. Improved knowledge of region-wide subsidence is needed to maintain the integrity of the Delta levee system and protect the integrity and quality of the state's primary water supply and the overall economic and environmental health of the region.

We focus on measuring spatially and temporally varied levee and island scale subsidence across Sherman Island, located in the western Delta. Long-term subsidence on Sherman Island has resulted in surface elevations that now measure as much as 8 meters below sea level. We use data from NASA's L-band (23.79 cm) Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR), collected at 40-day average interval from July 2009 through the current day. Sherman Island is primarily state-owned, and serves as a test site for various state projects. This island has been imaged in detail by 5 of the 9 UAVSAR swaths acquired over the Delta and is thus an ideal location for our analysis. Ground truth for validating our preliminary results is available from USGS and CA-DWR-installed inclinometers and extensometers and corner reflectors installed and maintained by our group. We will present both our techniques and preliminary results for island-scale subsidence and subsidence along levees in Sherman Island, in the form of maps of levees showing areas exhibiting the most change (moisture, movement, instabilities indicated by localized variance from the surrounding area).

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Keywords: remote sensing, delta, levees, subsidence
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