Comparative Study of Consumptive Water Use in the Sacramento-San Joaquin Delta

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Understanding consumptive water use in the Sacramento-San Joaquin Delta is critical for resource management, water rights administration, and environmental and water quality protection. This study compares evapotranspiration (ET) estimates across the Delta by seven different methods for the 2015 and 2016 water years, along with direct ET measurement at field stations in selected crops. Participating research groups include DWR, USDA-ARS, ITRC Cal Poly-SLO, UC Davis, NASA-ARC, and CSU Monterey Bay. These methods use a variety of input data to estimate ET over multiple land use categories. Common input datasets were shared across methods when possible, and field measurements were made available for calibration and validation. Overall ET results for the Delta are consistent with water balance estimates in the California Water Plan, and all seven methods are within 10% of the mean estimate. Increased fallowing of land caused total ET to decrease from 2015 to 2016, with the majority coming from alfalfa, corn, and pasture crops. Field ET measurements in bare soil, alfalfa, corn, and pasture were lower than many ET estimates, suggesting that localized microclimates and wind patterns in the Delta may reduce consumptive water use compared to estimates based on remote sensing. The study provides additional discussion of methodological differences between methods. This study has important implications for water management in the Delta at multiple scales. Field-level ET estimates may eventually replace water use reporting and can be used to evaluate water transfers or natural vegetation restoration. Regional ET estimates may inform upcoming groundwater regulations and other hydrodynamic and water quality models. Delta-wide estimates will help inform long-term operations and planning. The resulting estimates and measurements of ET within the Delta, along with the knowledge of data uncertainties, can help water managers and stakeholders understand the impacts of land use changes on the estuary's ecosystem and human interests.

Student Award Competition: Yes

Keywords: Evapotranspiration, Modeling, Agriculture, Water, Vegetation, Delta, Policy, Planning, Comparison, ET

Poster Topic Water Management

Incidental Nitrogen Removal in a San Francisco Bay Wastewater Treatment Plant

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San Francisco Bay Area wastewater treatment plants are collectively facing and working to address nutrient pollution challenges in the San Francisco Estuary. Traditional plant upgrades for nutrient removal are millions of dollars in capital investments. Consequently, the City of Palo Alto Regional Water Quality Control Plant (RWQCP) evaluated options for increased nutrient removal by optimization of current treatment works. The RWQCP is a tertiary wastewater treatment plant containing primary sedimentation tanks, trickling filters, nitrifying-activated sludge, and dual-media filters. Current plant treatment works are designed to transform ammonia-nitrogen to nitrate-nitrogen, but not designed to remove nitrogen. A previous study indicated 40 percent of influent nitrogen was incidentally removed through the current treatment works. This study collected influent and effluent samples from pertinent processes throughout the plant to identify where the incidental total nitrogen removal was occurring and through which pathways. Data was used to evaluate where in the current treatment works nitrogen removal optimization efforts should be focused.

Keywords: Nitrogen, removal, treatment, wastewater, nutrients, estuary

Poster Topic Water Management

Investigating the Impacts of Freshwater Flow Pulses in the Yolo Bypass

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Copepods are key members of estuarine food webs, providing a trophic link between phytoplankton and larval and juvenile fish. Copepod growth rate is a useful measure of food limitation and secondary production. In the San Francisco Estuary copepods have been shown to have consistently lower growth rates than maximum laboratory growth rates. However, the Yolo Bypass floodplain of the northern San Francisco Estuary and adjacent waters have been shown to have growth rates that are close to maximum laboratory rates. The objective of this project is to investigate the impacts of freshwater flow pulses passed through the Yolo Bypass on phytoplankton composition and copepod growth. Copepod growth of the Yolo Bypass was determined for summer 2015 and 2016 using the artificial cohort method with image analysis to estimate mass per copepod. Our results indicate that growth rate is high in the Yolo Bypass and that it is weakly correlated to chlorophyll. This research will be helpful in determining whether freshwater flow pulses are an effective way to promote secondary production and thereby to enhance feeding opportunities for endangered planktivorous fishes.

Student Award Competition: Yes

Keywords: Copepod, growth rate, Yolo Bypass, *Pseudodiaptomus forbesi*, management

Poster Topic Water Management

Evapotranspiration from Three Crop Types in the Sacramento-San Joaquin River Delta

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Our research addresses the question, what is the consumptive water use of major crops in the Delta? Evapotranspiration (ETa) measurements were taken at 14 sites in 2016 and 2017 representing three major Delta crops: pasture, alfalfa, and maize (corn). Eddy covariance, eddy covariance with energy budget residual, and surface renewal with energy budget residual were used in this study. All methods converge on lower actual evapotranspiration rates than for using the typical crop coefficient-based estimates and the California Irrigation Management Information System-based reference ETo. Our results agree well with previous measurements in the Sacramento-San Joaquin River Delta for maize and alfalfa and also match the general concept of lower ETa values than predicted if using crop coefficients derived outside the SSJ Delta. The uncertainties between the three methods are analyzed and discussed, but these uncertainties are neither of high enough magnitude, nor exhibit sufficient mean bias, to attribute our lower ETa values' differences from conventional crop coefficients from non-Delta regions. Our research suggests crop coefficients for the Delta may be expected to be lower than non-Delta derived crop coefficients, and apparently the measured crop coefficients may vary depending on year. This information is important to water managers and other stakeholders considering water usage patterns in the Delta.

Keywords: Evapotranspiration, consumptive water use, crop coefficient, eddy-covariance, surface-renewal, micrometeorology

Poster Topic Water Management