Flood Control 2.0: Rebuilding Habitat and Shoreline Resilience Through a New Generation of Flood Control Channel Design and Management

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Flood Control 2.0 is an EPA-funded, multi-partner, four-year project that will advance the science of channel redesign to restore wetland habitat, water quality, and shoreline resilience. This timely project will develop a set of innovative approaches for bringing environmental benefits and cost-savings to flood protection infrastructure along the San Francisco Bay shoreline. The strategy has two complementary approaches that transform costly trapped sediment in local flood control channels into a resource: channel redesign where sufficient adjacent land use flexibility exists, and sediment redistribution for highly constrained channels. Through an interdisciplinary team linking regional science expertise with on-the-ground flood control agencies, the project will advance channel redesign to restore wetland habitat, water quality, and shoreline resilience through demonstration projects at three creek mouths: San Francisquito, lower Novato, and lower Walnut creeks. At a regionwide scale, the project will collect and integrate data on coarse sediment and historical stream characteristics with the results of the local projects.

Keywords: Climate Resiliency, Flood Protection, Habitat Restoration, Multi-Benefit

Poster Topic: Climate Change

A New Geologic Model for Assessing Liquefaction and Related Levee Failure in the Sacramento-San Joaquin Delta

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The Sacramento-San Joaquin Delta is particularly vulnerable to levee failure. A recent investigation commissioned by the Department of Water Resources highlighted how catastrophic multiple levee failures during an earthquake could have major effects not only on life and property in the Delta area, but also on freshwater supplies throughout California. In 2007 a Delta Risk Management Strategy report found that a better understanding of the Delta Quaternary geology is necessary for an accurate risk assessment of earthquake-induced levee failure. The aim of this study is to accurately classify those zones of the Delta at major risk of earthquake-induced flood and levee collapse as a result of seismically-induced liquefaction and ground failure of natural deposits.

Our approach consists of three integrated objectives:
1. Assemble a consistent database;
2. Build a 3D subsurface model and assess spatial distribution of liquefaction potential;
3. Link forms and processes to evaluate the risk of earthquake-induced levee failure.

We have now completed objective 1, obtaining a unified geological map of the Delta region. The map is based primarily on 1:24,000 km scale mapping of the natural and artificial levees and geologic units of the Delta. We have selected the boreholes and the cone penetrating truck data that will permit assessment of the liquefaction-prone subsurface Quaternary sediments. We are focusing on mapping Holocene, shallow sand units.

They key products will be hazard maps (also to be published online) that highlight areas and, importantly, levees, that face higher probability of failure from seismically induced ground deformation. This geological approach to the assessment of levee-failure will enhance risk-assessment in the Delta area, provide information for decision making for a more reliable water supply for California, and improve water quality to protect human health and the environment.

Keywords: Sacramento-San Joaquin Delta, Levee Failure, Liquefaction, Geology, Earthquakes, Flood Control

Poster Topic: Climate Change

Environmental Science Academy Trains Environmental Professionals of the Future

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Global warming, human impacts and dwindling resources challenge planners, politicians and scientists in the Bay Delta region to find sustainable solutions to immediate and long-term problems. How can the environmental professionals of the future be attracted and nurtured in our public schools? The Environmental Science Academy at Oakland High School (ESA), established in 1997, provides a career path in high school for such students. ESA receives funding from the California Department of Education as a Career Partnership Academy (CPA) and adheres to the academy model by providing integrated curriculum, work-based learning, and high academic expectations.

ESA attracts students interested in environmental careers by offering a chance to learn science by doing science at our Lake Merritt Field Station (at the Lake Merritt Boating Center, Oakland Parks and Recreation). ESA students have collected and analyzed basic water quality measures in surface and bottom water at the Lake for 15 years, maintained a database, and produced reports and presentations. Motivational field trips such as white-water rafting, the Catalina Island Marine Institute, and kayaking on Lake Merritt keep students engaged in learning. A team of teachers in core disciplines cooperates to support the students through high school and provide a coherent educational experience focused on STEM disciplines (Science Technology Engineering and Mathematics) and Common Core skills. Our Academy counselor helps students shape post-secondary plans. Community partners in business, non-profit and government sectors advise our teachers and provide internships and job shadowing experiences.

In fifteen years, ESA has succeeded in launching students into careers in geology, hydrology, forestry, fisheries, environmental education, environmental advocacy and outdoor recreation. Students who chose other career paths after high school retain an interest in nature and working toward sustainability. In this poster, we offer statistical summaries and individual stories to document our progress in launching students into environmental careers.

Keywords: STEM, Common Core, Career Partnership Academy, Education, Career Pathway

Poster Topic: Climate Change

Climate Change Effects on Cyanobacteria Blooms (*Microcystis aeruginosa*) in the San Francisco Estuary Delta: Evidence from Experimental Manipulations

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Models of climate change indicate that estuaries will likely contend with both increasing water temperature and increasing salinity (a result of sea level rise). These drivers are hypothesized to promote the occurrence of cyanobacteria blooms globally and shift estuarine algal communities toward cyanobacteria dominance. The San Francisco Estuary Delta (Delta) may already be experiencing just such a shift. Blooms of cyanobacteria in the Delta have been increasing since 1999 and affect water quality, the estuarine food web and potentially human health. Of the cyanobacteria occurring in the Delta, the cyanoHAB *Microcystis aeruginosa* tends to dominate the community during summer. With the goal of understanding how temperature and salinity influence cyanobacteria success in the Delta, a series of small bottle experiments were conducted with increasing temperatures or salinities, using field collected phytoplankton including cyanobacteria-dominant assemblages. Cyanobacteria biomass and chlorophyll-a concentration increased at higher temperatures (23°C versus 18°C), compared to diatoms and chlorophyte biomass. Cyanobacteria endured salinities up to 5ppt where as other phytoplankton declined ~50% at the same salinity. These data linking cyanobacteria to conditions associated with predicted climate change provide insight into potential future habitat expansion and microbial community shifts toward cyanobacterial dominance in the Delta.

Keywords: Climate Change, HAB, Microcystis, Salinity, Temperature

Poster Topic: Climate Change

Keeping Our Heads Above Water: Sea Level Rise Adaptation at the Corte Madera Baylands

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This interdisciplinary project is one of the first efforts in San Francisco Bay to investigate how wave attenuation across mudflats and marshes is sensitive to sea level rise, and to examine how management measures could improve baylands resilience to sea level rise and thereby maintain flood risk reduction benefits. Currently, wave heights are reduced by as much as 80 percent as waves travel across Corte Madera Bay and are further reduced as they travel over the Corte Madera marshes. Field measurements and 1-D and 2-D modeling demonstrated that wave attenuation is more sensitive to water level than to wave height or vegetation species. Since wave attenuation is largely determined by water depth, flood risk reduction benefits depend on baylands being able to keep up with sea level rise. Regional marsh accretion models predict that the Corte Madera marshes will drown and convert to mudflats towards the end of the century, and several lines of geomorphic evidence indicate that the Corte Madera Baylands are sediment-limited. Proactive management measures will therefore be needed to preserve high, wide mudflats and marshes and associated ecosystem services such as flood risk reduction in the face of sea level rise. Seven management measures were considered, and using a geomorphic conceptual model as a decision-support tool, four were selected that could decrease mudflat and marsh edge erosion, increase marsh accretion, and provide space for gradual upland transgression. This project provides proof of concept that mudflats and marshes provide a natural, first line of defense against coastal flooding and demonstrates the kind of information and process that can be used to develop ecosystem-based solutions to protect communities.

Keywords: Wave Attenuation, Sea Level Rise, Baylands Resilience, Conceptual Adaptation Strategy

Poster Topic: Climate Change: Shoreline Adaptations

From Local to Global: Sea Level Rise, Tidal Wetlands, and the San Francisco Bay National Estuarine Research Reserve

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The San Francisco Bay National Estuarine Research Reserve (SF Bay NERR) is taking a lead in developing science aimed at understanding how sea level rise impacts tidal wetlands in the San Francisco Estuary (SF Estuary), testing that science through long-term monitoring and modeling future scenarios, facilitating habitat restoration projects that promote tidal marsh transgression into uplands, and engaging in citizen science activities that build awareness and support for investing in climate change adaptation. The SF Bay NERR encompasses two sites: China Camp State Park and the Solano Land Trust's Rush Ranch. Research at SF Bay NERR sites has demonstrated that under moderate to extreme sea level rise, tidal marshes will likely degrade and convert to mudflats. Marsh retreat across the transition zone to adjacent uplands is essential for the survival of these marsh ecosystems. Tidal wetlands at China Camp and Rush Ranch are becoming sentinel sites (or "early detection" sites) with comprehensive, on-going monitoring, including precise vertical control with water-level monitoring, surface elevation tables, and vegetation monitoring. This will yield insight into current and future marsh responses and provide decision-makers the opportunity to initiate timely adaptation measures. Visitors to these and other sites are being empowered to provide visual evidence of exceptionally high "king" tides on shorelines around the SF Estuary. Lessons learned hint at future effects of sea level rise and are being communicated nationally through the NERR System Sentinel Sites Program and the NOAA Sentinel Sites Cooperative. Extending this effort, the SF Bay NERR is also poised to join a new Smithsonian Institution global coastal observatory program. From local to global, the SF Bay NERR is helping to inform the impacts of future sea level rise on tidal wetlands and coastal communities, while stimulating climate adaptation policies that protect the future of these precious resources.

Keywords: Climate, Adaptation, Sea Level Rise, Tidal Wetland, King Tides

Poster Topic: Climate Change: Shoreline Adaptations

Adapting to Rising Tides (ART): Collaborative Sea Level Rise Adaptation Planning on the San Francisco Bay Shoreline

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Adapting to Rising Tides (ART) is a unique, multi-sector/multi-jurisdiction adaptation planning project aimed at increasing the Bay Area's resilience to sea level rise and storm events. Led by the San Francisco Bay Conservation and Development Commission (BCDC) and the National Oceanic and Atmospheric Administration Coastal Services Center (CSC), the project engaged local, regional, state and federal agencies and organizations in a collaborative effort to consider how best to improve shoreline resilience across six cities, one unincorporated community, a number of special districts, and a portion of a county. The project evaluated existing conditions and stressors, conducted a vulnerability and risk assessment, and developed adaptation responses for natural and built assets in four sectors: community land use, transportation, utilities and shorelines. In addition, the project developed, tested and refined adaptation planning methods and tools, and produced guidance on how best to evaluate, communicate and address complex issues associated with sea level rise and other climate change impacts. The project also investigated the issue of adaptation planning scales, and is currently testing the tools and methods developed at a local (e.g. county) scale at a smaller neighborhood scale. The neighborhood scale planning effort will also help to reveal where relationships between land uses, facilities and services may cause secondary vulnerabilities, and where there are synergies and constraints among adaptation options. Lastly, the ART project placed special attention on integrating social equity, economy, environment, and governance into all steps of the adaptation planning process. These efforts resulted in a framework for carrying these "four frames" through the planning process, and in special issue papers on social equity and governance in adaptation planning.

Keywords: Shoreline Resilience, Vulnerability, Risk, Multi-Sector/Jurisdiction Adaptation Planning, Tools, Scales

Poster Topic: Climate Change: Shoreline Adaptations

Regional Sediment Management (RSM) in San Francisco Bay

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Historically, sediment management has focused on specific components of the sediment system, in reaction to human needs (e.g. safe navigation channels, flood control). Regional Sediment Management (RSM) is an approach to manage sediments within the context of the entire system, including sediment sources, movement, and sinks within the system and exchange with the ocean. By enabling a more holistic, scientific, and proactive management approach, RSM will prescribe a management strategy that addresses the system directly rather than indirectly (and therefore imprecisely), through isolated management of the system components.

In 2011, the San Francisco Bay Conservation and Development Commission (BCDC) initialized the development of an RSM program strategy for the study of Bay sediment processes. Initially, the primary task of RSM must be to improve our understanding of Bay sediment processes for the more appropriate management of Bay sediment as resource that is vital to Bay health and our preparedness for climate change impacts and other system stressors. Secondarily, the RSM strategy will coordinate and focus research efforts that address management goals, harmonize management policies by federal, state, and local agencies affecting sediment processes, and educate managers regarding RSM.

In its first two years, the development process has delivered discrete products that have proven both (1) necessary to further RSM strategy development, and (2) independently valuable to a range of stakeholders. Those products include:

- A searchable and annotated library of literature addressing San Francisco sediment dynamics.
- An analysis of management questions, science needs, and priorities, according to an administered survey.
- Several project component initiatives, including the Flood Control 2.0 Project and an RSM focus on Central Bay.

An overview of these products and others under consideration (e.g. the development of a systemic and coordinated mechanism for sustained support of long-term sediment monitoring) are presented.

Keywords: Regional Sediment Management (RSM), Dredging/Mining, Watershed Management, Habitat Resilience, BCDC

Poster Topic: Climate Change: Sediment

The Dirt on the Delta

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The sediment supply to the Sacramento-San Joaquin Delta has been declining for the past 50 years after a nine-fold increase as a result of hydraulic mining of the Sierra Nevada (Wright and Schoellhamer, 2005; Gilbert, 1917). This decline has significant implications for water supply reliability as much of the levee repair material comes from dredged sediment. Sediment in the Delta creates habitat for all the organisms living within it, in addition to securing California's water supply through levee materials. The reduced sediment supply has led to a reduction in turbidity in the waters which negatively impacts some fish species that require turbidity for various lifecycle processes. Sediment also plays an important role in processes that effect of sea level rise on wetlands and floodplains. Understanding of the state of knowledge on sediment supply and deposition in the Delta is imperative to making informed management and policy decisions now and into the future. I compiled a comprehensive review of sedimentation and identified key uncertainties though an examination and synthesis of federal and state agency documents, as well as academic literature for use by policy and decision makers. Natural sediment supply remains unknown, as do the full effects of modification to the system (i.e. dams and channelization). Therefore, the extent to which the decline may continue remains unclear.

Keywords: Sediment, Policy, Management, Water Supply Reliability, Ecosystem Restoration

Poster Topic: Climate Change: Sediment

Spatial and Temporal Variation of Suspended Sediment Concentrations in a San Francisco Estuary Tidal Marsh: Implications for Tidal Marsh Stability in the Face of Accelerated Sea-Level Rise

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Climate change is expected to result in an accelerated rise in sea level over the next 100 years, and coastal wetlands are among the most likely ecosystems to be negatively affected. Tidal marsh stability is linked to sediment accretion, which is directly affected by suspended sediment. In the San Francisco Estuary, legacy mining has contributed to high rates of suspended sediment for decades. More recently, a reduction in suspended sediment has been observed. The purpose of our research has been to enhance understanding of suspended sediment dynamics in a natural tidal salt marsh located within the Estuary. We measured suspended sediment concentrations over 11 spring tidal cycles at a series of stations at low, mid and high marsh locations within China Camp marsh. Sampling occurred at five locations along each station, including in the tidal channel (0 m) and across the marsh surface at varying distances from the tidal channel (1, 3, 5, and 20 m). Our study also examined external factors (i.e., season, tidal height, wind speed, and precipitation) that may influence suspended sediment concentration values and distribution on the marsh. Suspended sediment concentrations at the low station were significantly higher than other stations (low station average = 910 mg/L; mid station average = 142 mg/L; high station average = 170 mg/L). Our data suggests that suspended sediment concentrations at China Camp tidal marsh may be influenced by position in marsh, season, tidal height, wind speed, and cumulative precipitation over a 24-hour period. Presently, suspended sediment concentrations are sufficient for marsh accretion at current sea-level rise rates at China Camp marsh. Nevertheless, marsh stability in the future is uncertain due to accelerated sea-level rise and declining suspended sediment concentrations in the Estuary.

Keywords: Suspended Sediment Concentrations, Climate Change, Marsh Stability

Poster Topic: Climate Change: Sediment

IRWM Solutions for Addressing the Diverse Impacts of Climate Change on Bay Area Water Supplies

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Bay Area water agencies manage a diverse portfolio of water supplies including groundwater, local surface water, imported water, recycled water, and transferred water. This portfolio varies throughout the region with some areas relying heavily on imported supplies, some on local surface supplies, and others relying on a mix. So while changes in temperature and precipitation associated with climate change could have significant impacts on water supplies, those impacts will vary throughout the region due to differences in these water supply portfolios. This poster will depict the supply portfolios for five sub-regions within the Bay Area Hydrologic Region (as defined in the 2009 California Water Plan) and describe the potential impacts of climate change on the three primary supplies: groundwater, local surface water, and imported water. It will also provide an overview of Integrated Regional Water Management (IRWM), how the IRWM framework can help water managers adapt to a changing climate, and how the Bay Area IRWM Plan is addressing climate change.

Keywords: Climate Change, Water Supply, Integrated Regional Water Management

Poster Topic: Climate Change: Water Supply

Balancing the Sacramento-San Joaquin Delta's Coequal Goals in a Climate of Change

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Climate change poses many challenges to California's water supply infrastructure and threatens ecosystem resilience. Facing a future of less reliable water supplies, it is equally important to consider climate change for short term management decisions as it is to consider it in the long term. Already, the effects of climate change have been observed throughout the state, and model projections show that current trends of warming temperatures and sea level rise will continue into the next century. Understanding and synthesizing existing information on the effects of climate change in the Sacramento-San Joaquin Delta is of particular importance because the Delta is the nexus of the state's water supply delivery systems. Furthermore, policy makers and managers must utilize the best available science to inform policies that support the coequal goals of ensuring a reliable water supply and restoring the Delta ecosystem. In the Sierra Nevada and Klamath Mountains, where the majority of the water supply originates, warmer temperatures are shifting precipitation patterns to greater rainfall and less snowfall, reducing snowpack accumulation, and accelerating the timing of snowmelts. These cumulative effects are likely to result in greater flooding in winter and early spring and diminished water supplies and droughts later in the year. As the climate continues to change, balancing flood protection and water storage will be increasingly difficult. Strategies to ensure a more reliable water supply include improving water use efficiency, increasing surface and groundwater storage, and expanding or building new conveyance facilities. Restoring floodplains will reduce the severity of extreme flood events and will have the added benefit of providing critical floodplain habitat that supports the Delta's ecosystems. Additional strategies to improve the resilience of the Delta's ecosystems include increasing habitat connectivity, creating low-salinity and cold-water refugia, and restoring habitats where there is ample accommodation space for upland migration.

Keywords: Climate Change, Water Supply Reliability, Habitat Restoration, Policy Implications, Management

Poster Topic: Climate Change: Water Supply

The Role of Hydrodynamic Transport in Greenhouse Gas Fluxes from a Restored Delta Marsh

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Twitchell Island, an island in the Sacramento-San Joaquin Delta, stands 5 meters below sea level due to more than a century of peat soil loss. Two 3-hectare wetlands established on Twitchell Island over a decade ago and monitored in recent years by the U.S. Geological Survey have rapidly accumulated organic material, effectively reversing the trend of soil loss. The wetlands have also been shown to be a significant source of methane. As more wetlands are restored to Twitchell Island and other Delta islands, questions remain about the variability of their greenhouse gas fluxes and the factors controlling this variability. One often overlooked factor is the hydrodynamic transport of gases through the water column, which can be influenced by wetland design and maintenance operations. We are evaluating the importance of this factor at one of the restored wetlands on Twitchell Island. We measured dissolved carbon dioxide and methane in the wetland water column on a bi-weekly basis. Dissolved gas concentrations were input to a wetland-tailored model for the hydrodynamic transport of gas to the air-water interface. Modeled air-water gas fluxes were then compared with net gas fluxes measured at the wetland via the technique of eddy covariance. We found that hydrodynamic transport, due primarily to thermal convection as the wetland water column cooled at night, was responsible for approximately one third of net carbon dioxide and methane fluxes at the wetland. This finding has implications for the modeling, prediction and management of greenhouse gas fluxes at the restored wetlands on Twitchell Island and other similar wetlands.

Keywords: Wetlands, Greenhouse Gases, Subsidence, Transport, Mixing

Poster Topic: Climate Change: Greenhouse Gas Flux

Maximizing the Climate Change Mitigation Potential of Carbon Farming: Controls on Methane Fluxes in Wetlands of the Sacramento-San Joaquin Delta

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Restoration of highly productive wetlands on drained peatlands in the Sacramento-San Joaquin Delta (Delta, hereafter) can help mitigate climate change by reversing peat loss and accumulating soil carbon (C). However methane (CH_4) emissions arising from wetland soil decomposition greatly reduces the mitigation potential of these ecosystems. To understand the controls on wetland CH_4 emissions we measured gross CH_4 fluxes in freshly collected soils from restored (2 and 10-years old) and natural Delta wetlands. Sites were selected across a range of environmental conditions. We manipulated redox conditions by incubating soil under an anaerobic headspace and investigated the effects on C emissions over 30 days. Soil respiration rate (CO_2 emission), HCl-extractable iron (Fe), mineral nitrogen (NH_4^+, NO_3^-), pH, dissolved organic C (DOC), and soil C:N ratio were measured as explanatory variables.

Methane emissions ranged from no net flux to 4.1 mg C g^{-1} d^{-1}. Gross CH_4 production was highest at the old restored wetland ($P < 0.05$); NH_4^+ concentrations explained approximately 61% of the variability with a strong positive correlation. Surprisingly, gross CH_4 production was unrelated to measures of C availability despite a wide range in DOC and soil C:N ratios ($P > 0.05$). Methane production was strongly positively correlated with the methanogenic fraction (CH_4:CO_2 production; $R^2 = 0.67$), and weakly correlated with total C (CH_4+CO_2 production; $R^2 = 0.22$) flow. Under extended anoxia, dynamics in CH_4 production varied, but we observed a significant relationship between rates of Fe reduction and the absolute change in CH_4 production ($P < 0.01$) indicating that Fe reduction can competitively exclude CH_4 production in Delta soils. In summation, our results suggest that Delta wetland CH_4 emissions are controlled more by small-scale variability in soil redox state—that may be manipulated by appropriate wetland design and management—and less by landscape-scale edaphic factors.

Keywords: Wetlands Restoration, Carbon, Methane Emissions, Management Subsidence

Poster Topic: Climate Change: Greenhouse Gas Flux

Greenhouse Gas Emissions from Agricultural and Restored Delta Peatlands

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The Sacramento-San Joaquin Delta in California was drained and converted to agriculture over a century ago, and since has experienced high rates of soil subsidence due to peat oxidation. To help reverse subsidence and capture carbon there is growing interest in converting drained agricultural land-use types to flooded conditions. Restored wetlands and rice agriculture are proposed as a flooded land-use type with high CO_2 sequestration potential for this region. However, flooding may increase the emission of methane (CH_4) as well as the loss of water via evaporation. We conducted multiple years of simultaneous eddy covariance measurements at conventional drained agricultural sites (a pasture and a corn field) and flooded land-use types (a rice paddy and two restored wetlands) to assess the impact of drained to flooded land-use change on CO_2, CH_4, and evaporation fluxes.

We found that the drained sites were net greenhouse gas (GHG) sources, releasing between 134-299 g-C m^{-2} yr^{-1} as CO_2 and up to 3.3 g-C m^{-2} yr^{-1} as CH_4. Conversely, flooded land-use types were predominantly net sinks of atmospheric CO_2, resulting in either reduced rate of soil subsidence or completely reversing subsidence due to oxidation. However, the restored wetlands and rice paddy were moderate to larger sources of CH_4, with emissions up 21.3 g-C m^{-2} yr^{-1}. In terms of the full annual GHG budget (assuming that 1 g-CH_4 equals 25 g-CO_2 with respect to the greenhouse effect over a time horizon of 100 years), the flooded land-use types were largely neutral or small GHG sinks. The flooded land-use types evaporated 45-95% more water than the pasture or corn sites. Therefore, from a subsidence perspective, restored wetlands and rice appear to provide a benefit for Delta sustainability. However, flooding also has secondary effects on the GHG budget through increased CH_4 production and higher rates of evaporation.

Keywords: Subsidence, Carbon Flux, Evaporation, Wetlands, Rice, Eddy Covariance

Poster Topic: Climate Change: Greenhouse Gas Flux

Microbial Community Composition and Greenhouse Gas Flux in Wetlands of the Sacramento-San Joaquin River Delta

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Wetlands have the potential to sequester large amounts of atmospheric carbon as the result of especially high plant productivity and low decomposition rates. However, wetlands may also become a net source of carbon to the atmosphere if decomposition rates outpace carbon burial. This delicate carbon balance is influenced by the activity of below-ground microbial communities that return carbon dioxide and methane to the atmosphere. The effects of wetland restoration on the metabolic activity and carbon cycling capacity of microbial communities remain unknown. Using next-generation DNA and RNA sequencing, coupled with greenhouse gas monitoring, we profiled the microbial communities from soil samples on Twitchell Island located in the Sacramento-San Joaquin River Delta. We sampled a restored wetland, a corn field, and a series of rice fields to gauge microbial community composition across inundation regimes. Additionally, we monitored shifts in microbial populations over the course of a seasonal flooding cycle at the rice fields. Our results demonstrate relationships among geochemical gradients, availability of electron acceptors, and microbial community composition. Methanogenic archaeal populations were associated with low oxygen sites, high methane production, and the absence of aerobic respiration genes. Our study provides the first genomic glimpse into microbial populations in restored wetlands of the San Francisco Bay Delta and provides a valuable benchmark for future studies in the region.

Keywords: Wetlands, Microbes, Carbon, Methane, Genomics

Poster Topic: Climate Change: Greenhouse Gas Flux