DELTA SCIENCE FELLOW 2016

Delta Stewardship Council
Delta Science Program

Sea Grant California

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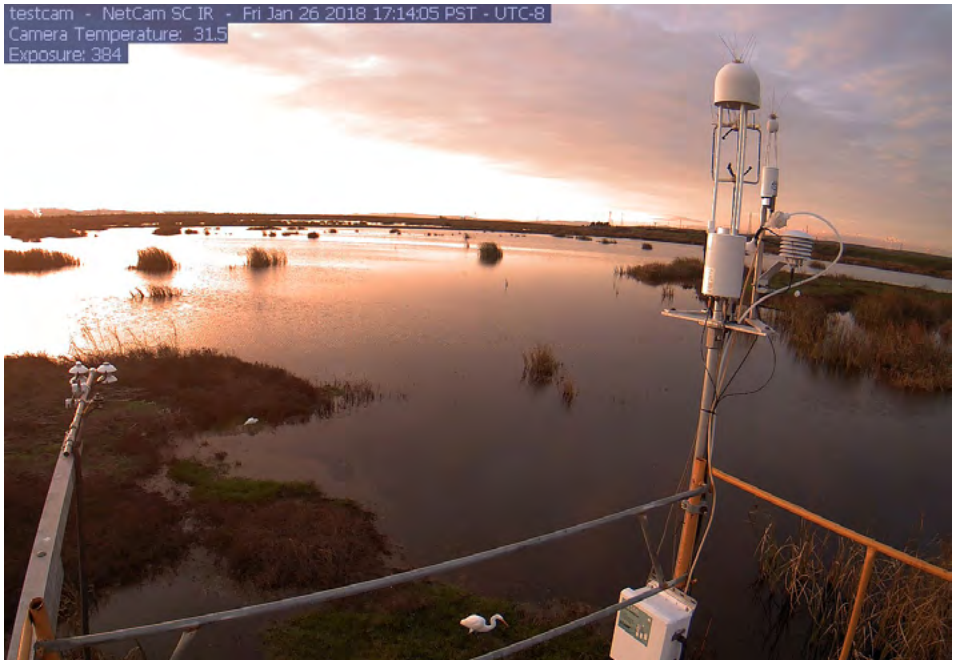
WHY THIS RESEARCH MATTERS

The Sacramento-San Joaquin Delta provides an ideal ecosystem to understand restored peatland ecosystem greenhouse gas fluxes. Marshes are important sinks for carbon, and in the Delta, 7,000 years of organic matter build-up had produced a carbon-rich peat layer up to 15 meters deep. Much of this carbon was removed in the last 150 years through levee building, drainage, and subsidence. Subsided delta peatlands are now being re-flooded to harness multiple environmental benefits. The net climate benefit associated with restoration, however, is highly uncertain, as restoring drained peatlands can also lead to increased emissions of methane, the second-most important greenhouse gas to climate change.

Restoring the Sacramento-San Joaquin Delta peatlands: A complete biogeochemical assessment of climatic impacts



Sherman wetland, newly established on Sherman Island, is located on a subsided area that was previously pasture. Researchers used infrared gas analyzers (white, foreground) which measure instantaneous CO_2 and CH_4 concentrations, and a sonic anemometer (blue, background) which measures three-dimensional wind speed, to determine the net flux of gases into and out of the landscape. *Berkeley Biomet Lab*

PROJECT

The objective of this work is to assess the benefit of restoring wetlands in the Sacramento-San Joaquin Delta for climate mitigation and carbon sequestration. This study analyzed multiple years of turbulent flux and meteorological data across four contrasting wetland restoration sites and multiple agricultural sites in the Sacramento-San Joaquin Delta. Hemes characterized the carbon dioxide, methane, and energy exchange between these ecosystems and the atmosphere to understand how the restored wetlands impact the carbon and greenhouse gas budgets as well as the surface temperature in the Delta.

RESULTS

As a Delta Science Fellow, Hemes helped erect multiple measurement towers throughout the Delta, and analyzed continuous, ecosystem-scale measurements of greenhouse gas and energy exchange across the dominant agricultural and restored wetland land uses. The study found that the Delta's long growing seasons, warm weather, and managed water tables

RESULTS (continued)

result in some of the largest wetland ecosystem methane emissions ever recorded. These large methane emissions cause the wetlands to be neutral to strong sources of greenhouse gases, even while they sequester carbon and build peat soil.

However, the study found that implementing wetland restoration can still achieve substantial emission reductions when the land-use change leads to a net reduction in greenhouse gas flux compared to current practices. In addition to the biogeochemical impact of restoration, some restored wetlands can have the effect of cooling the surface temperature due to the way they exchange heat and water with the atmosphere.

MANAGEMENT APPLICATIONS

With the extensive dataset collected through this project, the researchers have begun to understand that despite significant interannual variability, restored Delta wetlands emit methane at rates that may, in some cases, make them net greenhouse gas sources over policy-relevant timescales. Compared to the emissions and CO_2 loss of subsiding drained peatlands, however, they may provide emissions reductions that could help incentivize wetland restoration in the Delta through nascent carbon markets, like California's Cap and Trade system. In addition to the biogeochemical benefits, restored wetlands can provide a surface cooling, depending on the wetland structure. These insights could help land managers maximize the climate benefit of restored wetlands, incentivizing science-based carbon sequestration in subsided Delta peatlands.

PUBLICATIONS

Hemes, K.S. et al. Aerodynamic and surface properties contribute to cooling in restored wetlands of the Sacramento-San Joaquin Delta, California. *Journal of Geophysical Research: Biogeosciences* (2018). doi: 10.1029/2018JG004494

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