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Using remote sensing to monitor past changes and assess future scenarios for the Sacramento-San Joaquin River Delta waterways, California USA

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Historically, deltas have been extensively affected both by natural processes and human intervention. Thus, understanding drivers, predicting impacts and optimizing solutions to delta problems requires a holistic approach spanning many sectors, disciplines and fields of expertise. Deltas are ideal model systems to understand the effects of the interaction between social and ecological domains, as they face unprecedented disturbances and threats to their biological and ecological sustainability. The challenge for deltas is to meet the goals of supporting biodiversity and ecosystem processes while also provisioning fresh water resources for human use. We provide an overview of the last 150 years of the Sacramento-San Joaquin River delta, where we illustrate the parallel process of an increase in disturbances, by particularly zooming in on the current cascading effects of invasive species on geophysical and biological processes. Using remote sensing data coupled with in situ measurements of water quality, turbidity, and species presence we show how the spread and persistence of aquatic invasive species affects sedimentation processes and ecosystem functioning. Our results show that the interactions between the biological and physical conditions in the Delta affect the trajectory of dominance by native and invasive aquatic plant species. Trends in growth and community characteristics associated with predicted impacts of climate change (sea level rise, warmer temperatures, changes in the hydrograph with high winter and low summer outflows) do not provide simple predictions. Individually, the impact of specific environmental changes on the biological components can be predicted, however it is the complex interactions of biological communities with the suite of physical changes that make predictions uncertain. Systematic monitoring is critical to provide the data needed to document and understand change of these delta systems, and to identify successful adaptation strategies.