

INTEGRATING LIDAR AND CIR IMAGERY FOR MAPPING TIDAL WETLANDS: AN OBJECT-BASED APPROACH

M.Kelly^a, K. Tuxen^a

^a Department of Environmental Science, Policy & Management, University of California, Berkeley, 137 Mulford Hall, #3114, Berkeley, CA 94720-3114; (mkelly, karin)@nature.berkeley.edu

Tidal and estuarine wetlands are among the most valuable natural resources in our world today. They provide critical habitat for fish, wildlife, and migrating waterfowl populations and offer the plant and algal primary productive basis that is fundamental to complex aquatic-terrestrial food webs. They provide natural flood and erosion control, are natural barriers against saltwater intrusion into freshwater aquifers, and trap pollutants and sediment. However, estuaries are areas that are most inhabited by the world's human population, and have therefore been subjected to massive degradation and land conversion. More than 90% (4.5 million acres) of the wetlands in the San Francisco Bay-Delta Region have been destroyed since European settlement, mostly due to conversion for agriculture. While the San Francisco Bay-Delta is still the largest remaining wetland area in California, the dramatic ecosystem change in the last 150 years has had a devastating impact on the region's natural ecosystem functions.

Wetland restoration efforts are underway in the Bay, and remote sensing is playing a large role in monitoring restored sites. Restoration goals usually include specific objectives for vegetation composition and structure, including a desired level of horizontal cover, biomass, or plant density, in order to restore habitat and ecological processes. Therefore, detail vegetation maps are often needed in order to measure what vegetation exists at a project site. Remote sensing can offer tools to map, measure, and model these characteristics in a non-invasive, cost-effective manner to evaluate wetland restoration success. Technological advancements in spatial and spectral resolution of imagery, as well as the integration of ancillary data like elevation, are improving the mapping of highly detailed vegetation species communities. In particular, the incorporation of terrain or elevation data has proven useful for mapping a variety of ecosystems including wetlands, both at the broad landscape scale, and at a smaller site scale. In wetlands, relative elevation is regarded as the major determinant of sediment supply and inundation regime to tidal wetland areas, and therefore controls what plant species inhabit specific areas, as well as how productive the species are. So it is plausible that incorporating elevation data would help in improving image classification performed solely with spectral statistical properties. However, because most wetland landscapes are relatively flat, for elevation data to be useful, the vertical resolution must be very small to capture the relatively tiny topographic changes that can have such a huge effect on what plant species can exist where. LiDAR (Light Detection and Ranging) is topographic data with the high vertical resolution necessary to capture these terrain features. Incorporation of ancillary data within an image processing framework, especially with very high spatial resolution imagery can be challenging using a pixel-based methods like ISODATA clustering. This paper explores mapping highly heterogeneous wetland vegetation using multispectral imagery and LiDAR data along the lower Napa River in California by utilizing an object-based classification system.