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Saltmarsh vegetation biomass distribution from drones: a case study

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Coastal salt marshes are unique and complex geomorphological systems, which must accrete to keep pace with sea-level rise. Even though we know the importance of vegetation and organic matter accumulation in the marsh accretion process, we lack an understanding of spatially-distributed saltmarsh dynamics that include feedbacks with vegetation, especially for sites characterized by high species diversity. Remote sensing retrievals of wetland topography, spatial distribution of species, and vegetation biomass and productivity provide an ideal solution, providing observations over the wide range of scales of interest. Here we present the results obtained using LiDAR and hyperspectral data collected via Unmanned Aerial Vehicles (UAVs) on the San Felice saltmarsh (Venice lagoon, Italy). The selected study site hosts at least twelve species of halophytes grouped into five main associations. UAVs data were collected in September 2021, while a simultaneous field survey provided spatially-distributed georeferenced data and samples on the distribution of vegetation associations, above- and below-ground biomass, vegetation height, bulk density and organic carbon content of the soil. Results suggest that, for different plant associations, LiDAR data can be used to retrieve the aboveground biomass and estimate the belowground biomass (through allometric relations), hence providing a spatially-distributed assessment of the vegetation biomass across the marsh. Combining this information with the organic carbon content obtained by soil analyses, we estimate the combined above- and below-ground carbon stock of the salt marsh. The results obtained using hyperspectral data suggest that vegetation indexes defined on appropriate spectral bands correlate with the LiDAR biomass information and ground truth data. Using these results, observations from UAVs and satellites can be combined to bridge data from the plant to the wetland scale and beyond.