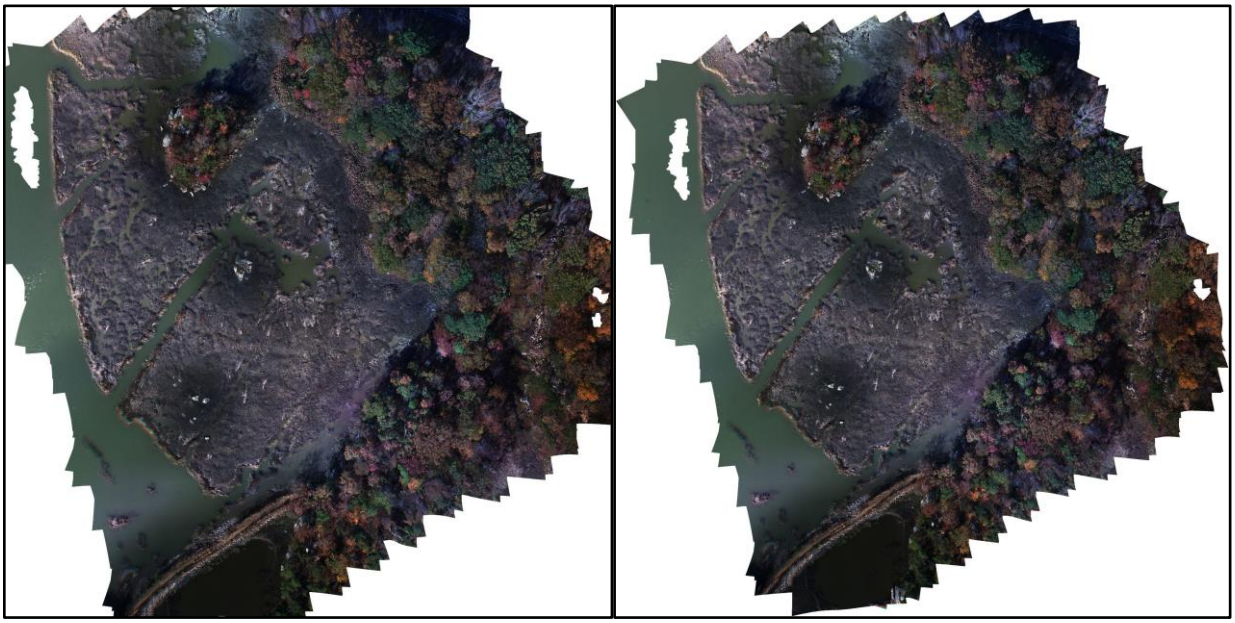
Photogrammetry with Drones and Further Analyses of Richard's Property in Branford, CT

Ali Luchs, Diana Satkauskas, Austin Pruitt, Anamaria Rodriguez
ENV 704
December 20, 2023

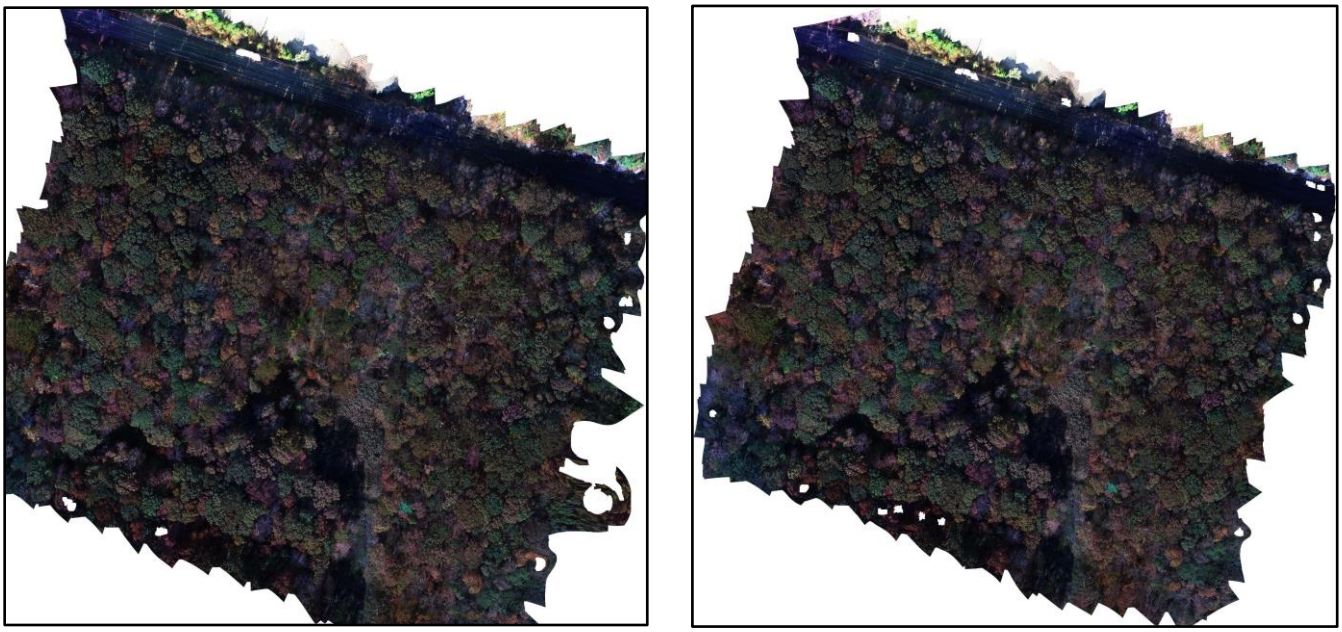
Abstract

The use of unmanned aerial vehicles (UAVs) is increasingly prevalent in forest management and landscape planning. This technology finds widespread application in agriculture, meteorology, natural disasters, wildlife movement, and land management, owing to its capacity and flexibility in acquiring ultra-high spatiotemporal resolution. Satellite-based optical data has limitations when high-resolution data is essential, particularly in ecosystems with low-profile features like marshes or agricultural crops where some species may have a height of less than 3 meters. Optical satellite sensors struggle with depth information in such scenarios. Emerging technologies, such as drone-based data collection, have provided sharper results in these contexts (White et al., 2016; Yang et al., 2017; Valluvan et al., 2023). The high cost and lack of centimeter-based resolution in satellite sensor imagery have been overcome by UAVs, making them practical and cost-effective for landscape-level analysis and site-scale management needs (Wavreck et al., 2023; Banu et al., 2016). The study site, Richard's Property, is a parcel owned by Yale University in Branford, Connecticut. The ecosystem identified by the USGS (2023) is northeastern dry-mesic oak forests, typical in the northern U.S. across extensive areas at low and mid elevations. Our results enabled the creation of detailed representations of the morphological characteristics of the study site. While orthomosaics are commonly used to map geomorphological features, reaching scale morphology metrics (Taddia et al., 2019), further studies could include a Digital Terrain Model (DTM) for objectives involving canopy tree heights and vertical successional growth of vegetation. The point density facilitated the detection of individual trees, aligning with findings by Wallace et al. (2014), suggesting comparable results to LiDAR but at a lower cost.

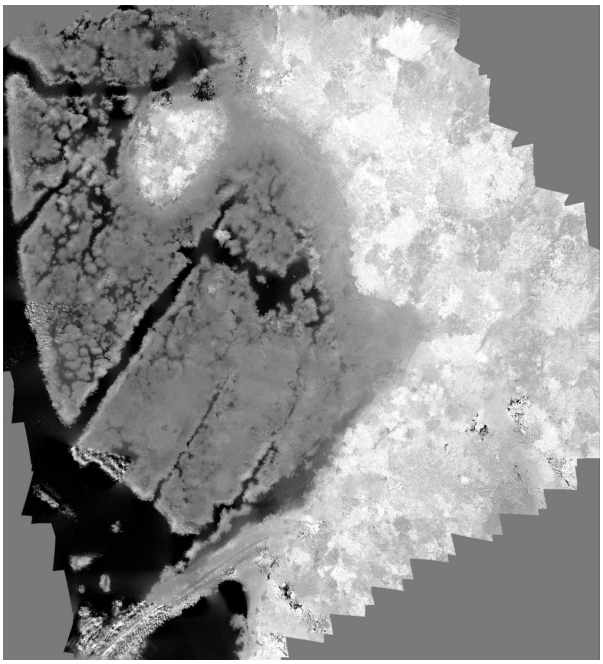
Orthomosaics for Flight 1 without (left) and with XMP data (right).



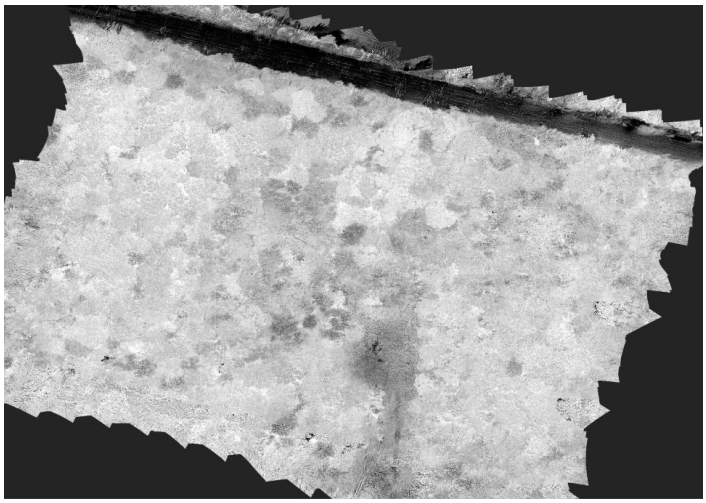
Orthomosaics for Flight 2 marsh area without (left) and with XMP data (right).



Orthomosaics for Flight 2 forest area without (left) and with XMP data (right).

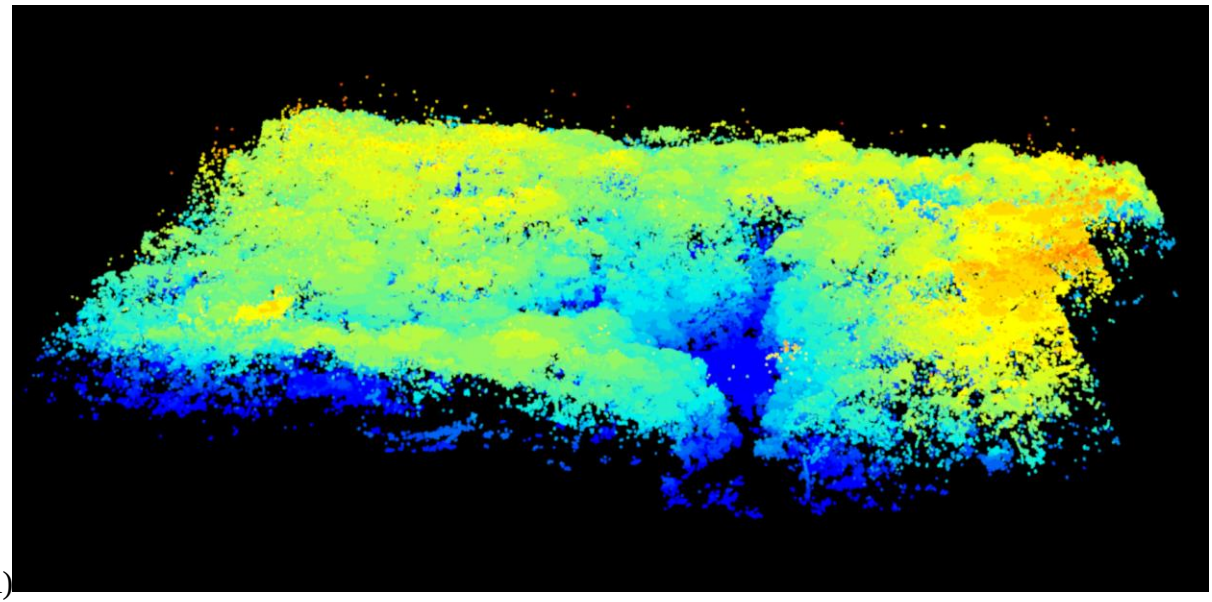


NDVI image of marsh area from Flight 2.

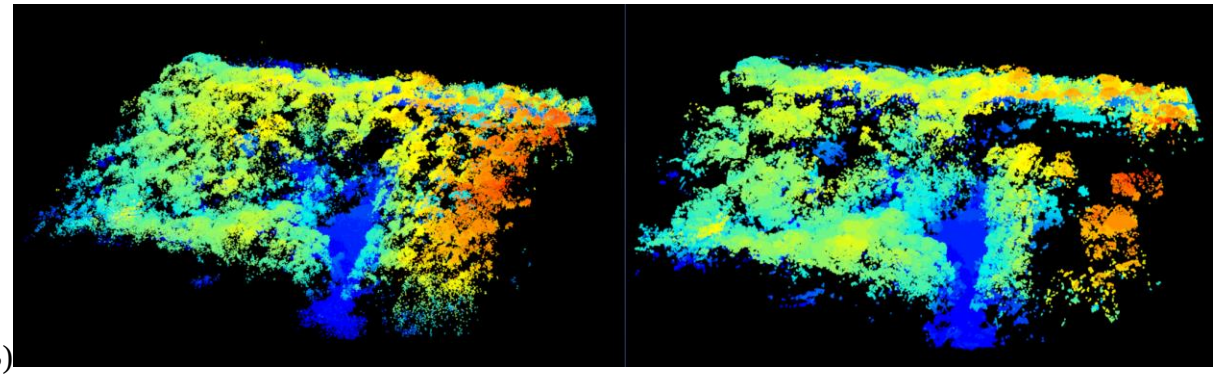


NDVI image of forested area from Flight 2.

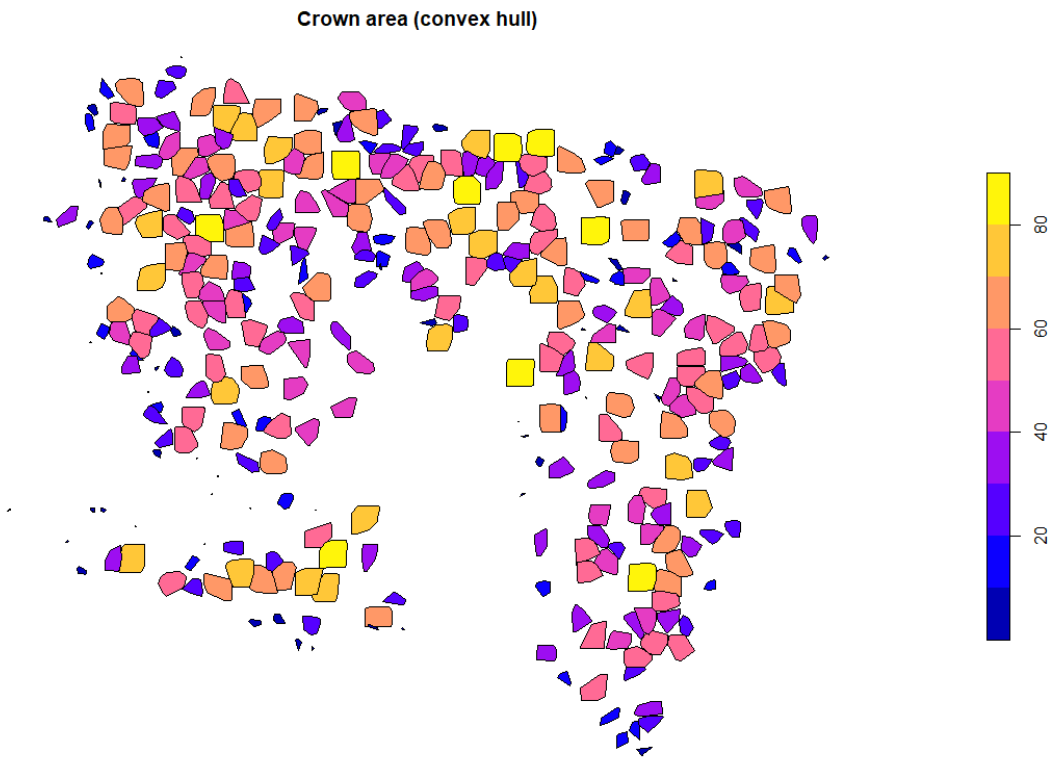
A)



B)



A) An unedited point cloud with abnormal points, and B) A point cloud constructed from tie points (left) and a dense point cloud containing only confidence levels of three and above (right)



Polygonized tree canopies using Dalponte segmented points