LESSONS ON MONITORING MANGROVES

Remote sensing techniques estimating mangrove coverage in the Baja Peninsula

Astrid Hsu, Eric Lo, John Dorian, Dillion Hicks, Kathy Qi, Matthew T. Costa, and Benigno Guerro Martinez
Contact: ajhsu@ucsd.edu

BACKGROUND

- Over 35% loss of global mangroves since 1970's
- Limited knowledge of the spatio-temporal change of mangrove distribution and ecosystem services
- Current resolution of satellite imagery cannot distinguish among species (res at 6 m/pixel)
- Quantify mangrove species distribution and extent through high resolution imagery via drones (0.03 m/pixel) and machine learning
- Testing sites in Baja California Sur, Mexico

METHODS

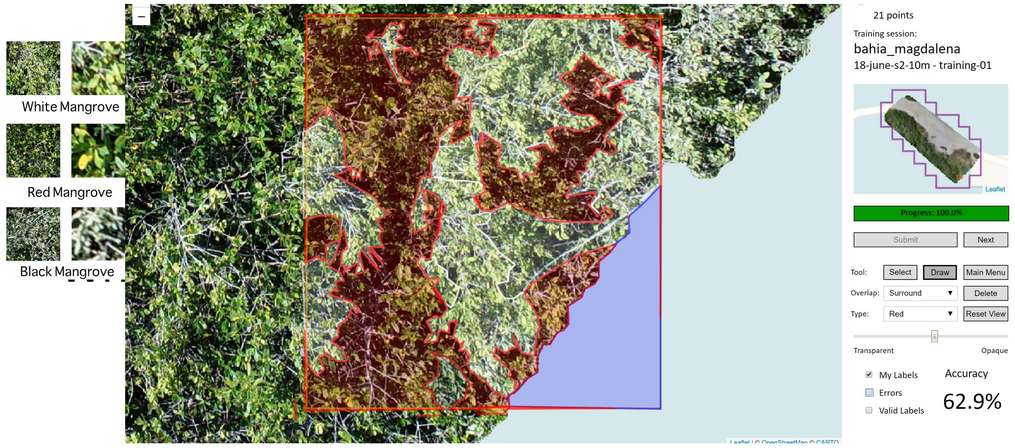
Field Techniques

- Ground truth through conventional mangrove vegetation survey techniques
- Image at 10 m and 120 m using Phantom 4 Pro and Parrot Sequoia multispectral camera
- Compile orthomosaics and digital elevation model (DEM) via PhotoScan

Imagery Analysis

- Manually label mangrove species of drone imagery
- Use sequential classification to first distinguish mangroves from surroundings, then identify among species

Operating the drone on a new mission in La Paz, BCS, Mexico | Photo by Dillion Hicks

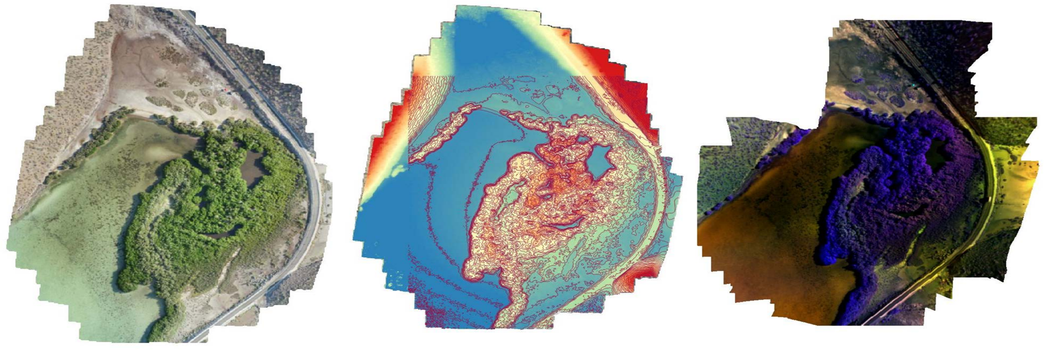


Our labeling platform for manual labeling of 10 m imagery captured from Bahia Magdalena, BCS, MX

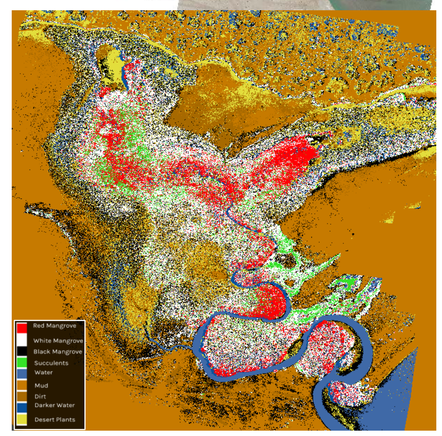
PRELIMINARY RESULTS

- Identified Supported Vector Machines (SVM), Gradient-Boosted Trees (GBT), and Convolutional Neural Networks (CNNs) as algorithms for mangrove species classification of drone imagery
- GBT and SVT algorithms have accuracy near 70%
- Classification Results from CNN-Inception v3:

Mangrove vs Non Mangrove	Species Classification			Final Recall
	Recall		**Precision**	
99%	Red: 98%		Red: 90%	94%
	Black: 83%		Black: 95%	
	White: 93%		White: 82%	



From left to right: RGB, DEM with isoclines, and multispectral orthomosaics of a small mangrove forest in La Paz, BCS, MX



Top: RGB orthomosaic of mangroves in Bahia Magdalena, BCS, MX
Bottom: Results from SVM on mangrove species from the same region

CHALLENGES

- Validating truth data and enough training data
- Bright spotting and vignetting on multispectral imagery; limited usable imagery
- Obtaining accurate GPS measurements among stages and under canopy
- DEM model tilt and warping

NEXT STEPS

- Calculate biomass from drone imagery
- Apply and adapt framework to mangroves of different regions and species
- Use drone imagery and results to validate satellite methodologies of mangrove extent and biomass
- Transfer knowledge to local community