Evaluating Effectiveness of UAS Sensors and Platforms for Multi-purpose Mapping of Marshes and Beaches in the NERRS Sentinel Site Network

A proposal submitted to NOAA UAS Program Office Request for Proposals "Evaluation of Unmanned Aircraft Systems (UAS) Observing Strategies Suitable for Transition into Routine NOAA Applications"

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Outline

- Project Formation
- Project Scope
- Expected Significance
- Technical Project Plan
  - Vegetation mapping evaluation
  - Elevation evaluation
- Project Milestones
- Questions?

Project Formation

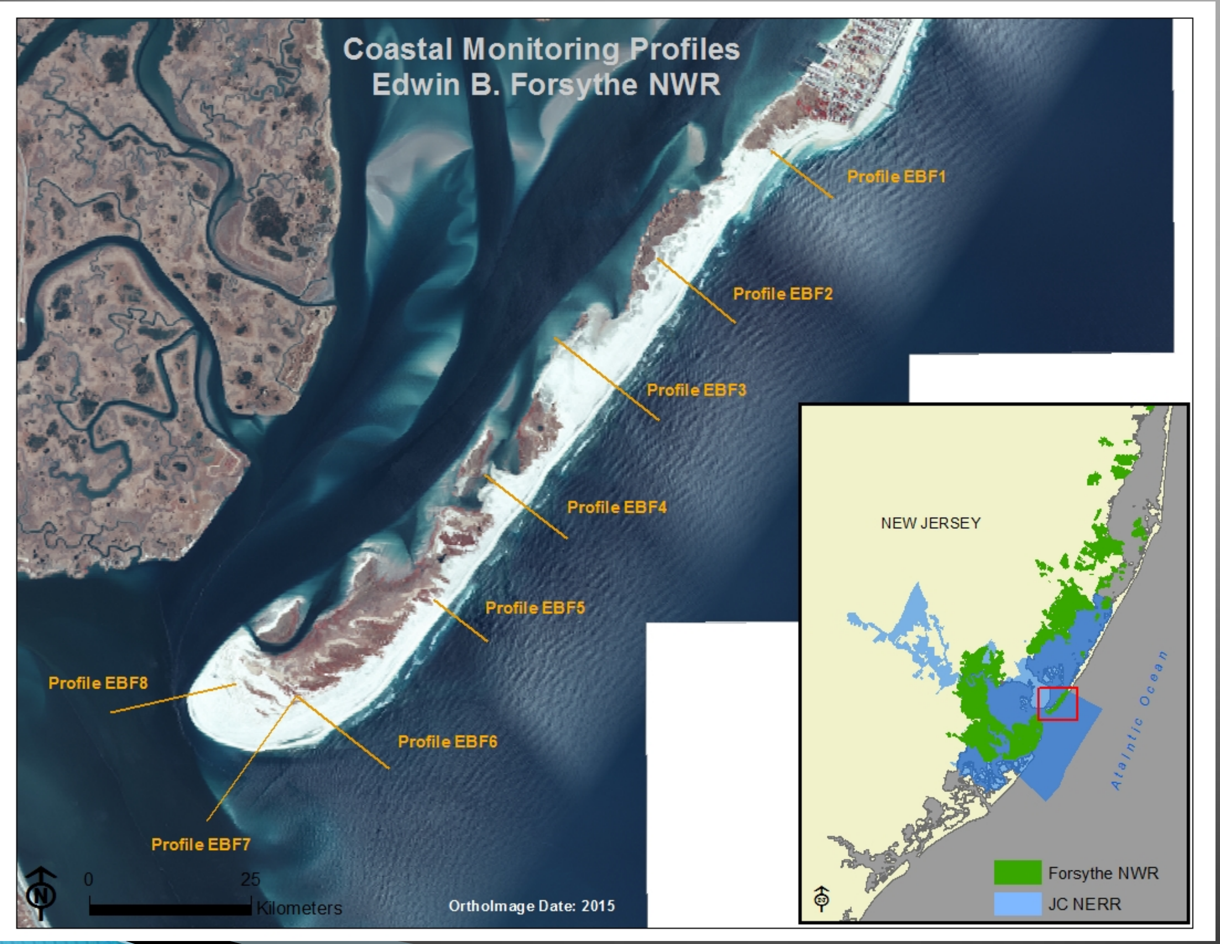
- RFP released January 13, 2016
- OCM solicits input from NERRS and Applied Science staff
- Identify popular research interests (NERRS, OCM)
- Two separate ideas (imagery for veg, elevation for SLR)
- NERRs w/ UAS, Sentinel Site, elevation surveys.
- Proposal due February 24, 2016

General Questions to Address

- Vegetation mapping
  - Need to monitor habitat/veg changes
  - Can UAS imagery provide a better product than manned?
  - If so, at what price?
- Elevation
  - Need bare-earth elevation for SLR impact studies
  - Lidar is an effective mapping tool, but has had trouble in marsh areas.
  - Can the smaller footprint UAS lidar penetrate the marsh grass?

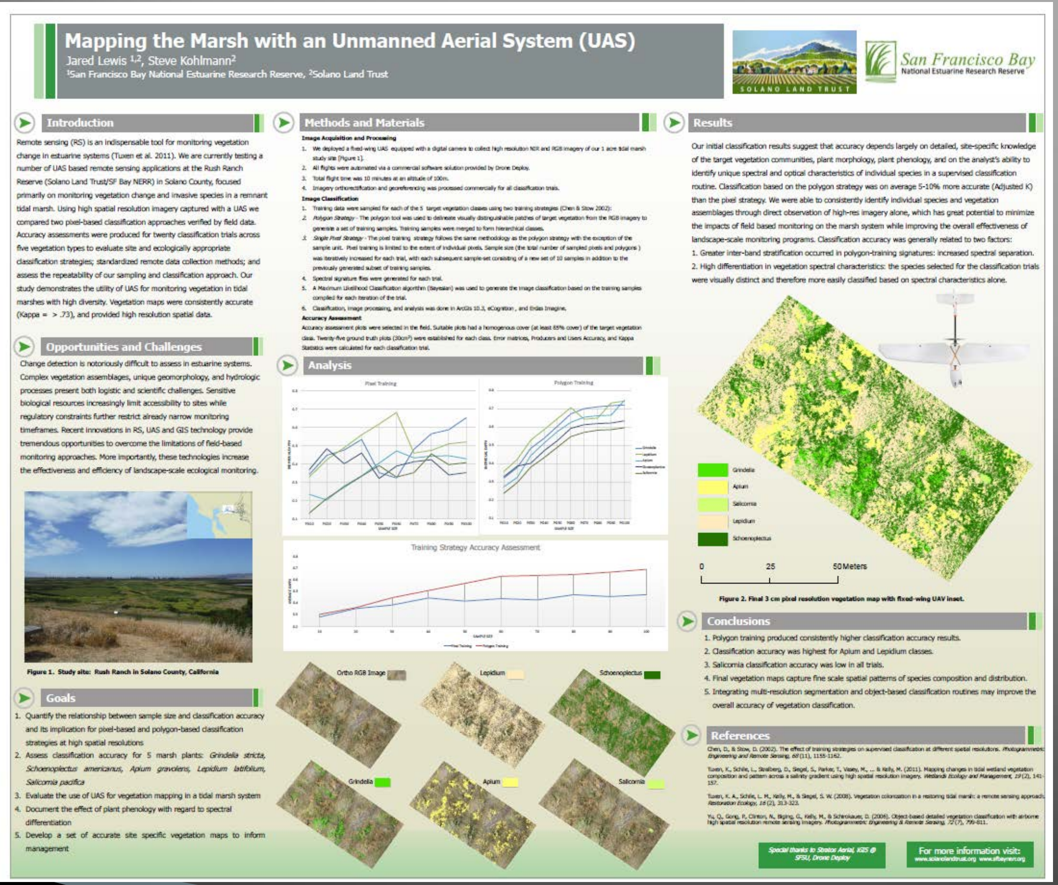
Project Areas

- Jacques Cousteau NERR



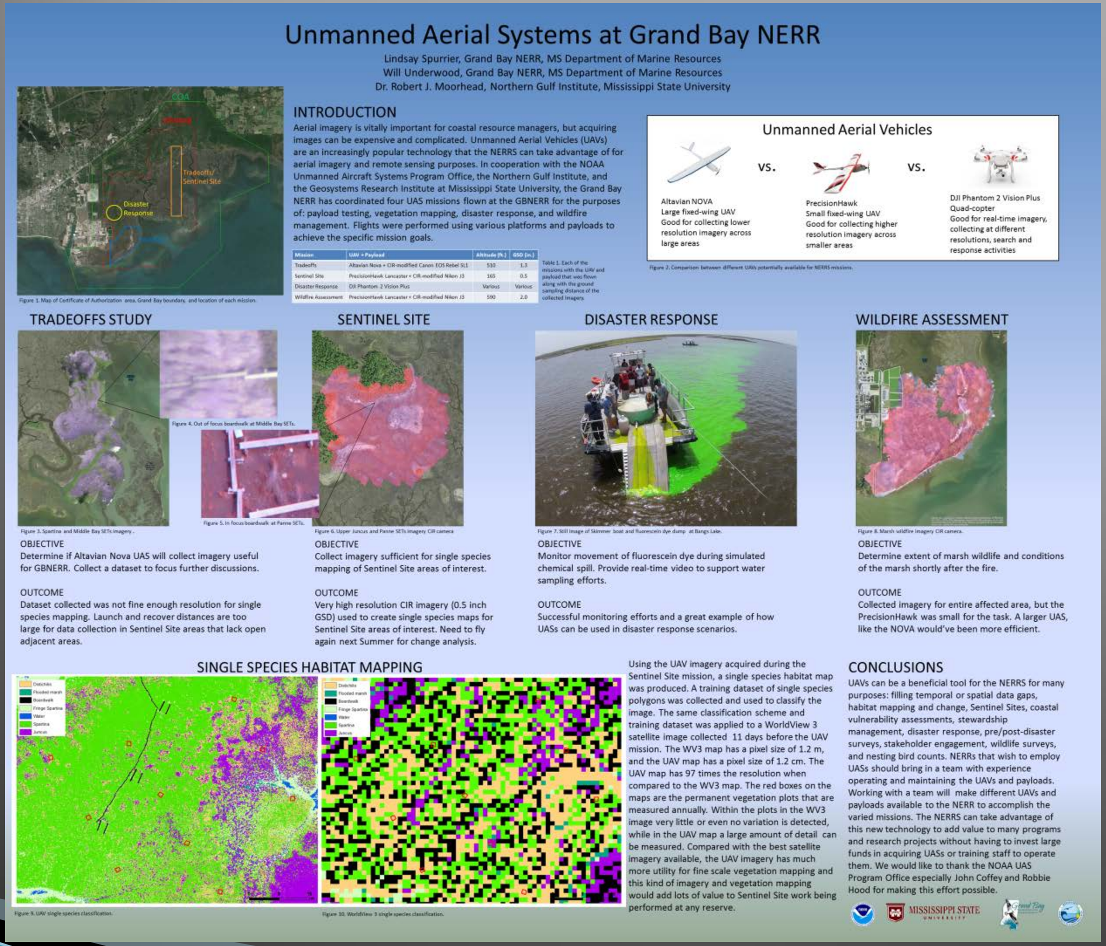
Project Areas

- San Francisco Bay NERR



Project Areas

- Grand Bay NERR



Project Scope

- Acquire multi-spectral imagery and lidar in 3 different ecosystems
- 2 surveys per site to provide multi-season imagery and elevation repeatability
- Specific objectives:
  - Evaluate the horizontal and vertical accuracy of UAS georeferenced imagery and lidar
  - Evaluate UAS lidar to measure ground elevations through marsh vegetation and compare to manned systems lidar
  - Assess the trade-offs between UAS lidar and interpolated RTK transects
  - Compare UAS imagery to manned systems imagery at the supervised classification step of vegetation mapping
  - Evaluate the gains from additional data sources compared to imagery alone for vegetation mapping
  - Evaluate the ability of the private sector to provide UAS-based data using a Brooks Act contract.

Expected Significance

- Improve quality of data used for habitat mapping and assessment to support improved understanding and management
  - NOAA Next-Generation Strategic Plan goal – Healthy oceans/estuaries
- Provide highly detailed rapid assessment with low mobilization costs and minimal environmental impact to understand changes, threats, and dynamics
  - NOS Priorities Roadmap priority – Place-based conservation
- Evaluate ability of UAS derived coastal intelligence to meet NOAA needs
  - NOS Priorities Roadmap priority – Coastal intelligence
- Evaluate commercial UAS capabilities to make more informed operational decisions regarding employment of appropriate technology
  - NERRS operations improvement

Technical Project Plan

- Imagery and lidar surveys contracted through the Coastal Geospatial Services Contract
- Precision Hawk Lancaster platform, 5-band multi-spectral imager, a Velodyne PUCK lidar
- Flights at altitudes of 250 to 300’
- Exact specifications will be determined by the contractor to meet the data requirements

- Products:
    - Multi-spectral (at least 4-band) image 3-cm resolution or better
    - Lidar flown on the same platform to produce elevation data
    - Lidar data will be classified for ground, water, and unclassified and have a non-vegetated vertical accuracy of 7-cm or better
    - A digital elevation model (DEM) from structure from motion (SFM)

Technical Project Plan

- Vegetation Mapping Evaluation
  - Automated supervised classification process
  - Single species identification
  - Evaluate spatial accuracy
  - Evaluate combined imagery and elevation for mapping
- Elevation Evaluation
  - Lidar/SFM error assessment
  - Compare lidar vs SFM
  - JCNERR – evaluate lidar beach volume
  - Business case analysis

Project Milestones

Site implementation/project plans finalized	June 2016
Certificates of Acquisition (COAs) in place; Data acquisition contract in place	July 2016
Flights conducted	November 2016 (first set) May 2017 (second set)
Elevation ground control and vegetation accuracy points acquired	November 2016
Presentation on progress at NERRS Annual Meeting	October 2016
Imagery and lidar positional accuracy evaluated; elevation quantitative and qualitative assessment completed	December 2016
Presentation on progress at NOAA Coastal Geotools	February 2017
Supervised classification of UAS data evaluated against existing maps and similarly processed manned imagery	August 2017
Draft final report presented at NERRS Annual Meeting	October 2017 (est.)
Final report, including component evaluations and overall evaluation of system	December 2017

Contracting Status

- Initial Statement of Work submitted
- Technical proposal and pricing received June 4, 2016
  - Significantly higher costs than initially anticipated
  - Prime/sub relationship. Sub collection and processing is near what was anticipated
  - Prime's costs are mostly in lidar specialist time
- Expect to discuss options June 6, 2016.
  - May do a smaller area of lidar

Questions?