OCS UAS Use and Data Processing
Structure from Motion Shoreline Characterization

LCDR Damian Manda, NOAA
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Office of Coast Survey
National Oceanic and Atmospheric Administration

OCS Goals for sUAS Operations From Vessels

Safer, More Efficient Field Operations

Shoreline Workflow
- Ease of acquisition, automated processing

Shoreline Products
- Chart shoreline features
- Improve cartographic representation

Reconnaissance
- Planning ahead of vessel operations

Ancillary Products
- Point cloud, grids, images/mosaics that can replace first person visual descriptions
- Coast Pilot
- Reconnaissance
- Shallow water bathymetry

Safety
- Remove personnel and property from dangerous situations

UxS Strategy Support

Develop Enabling Technologies

Build and Maintain Operational Expertise

Training Program

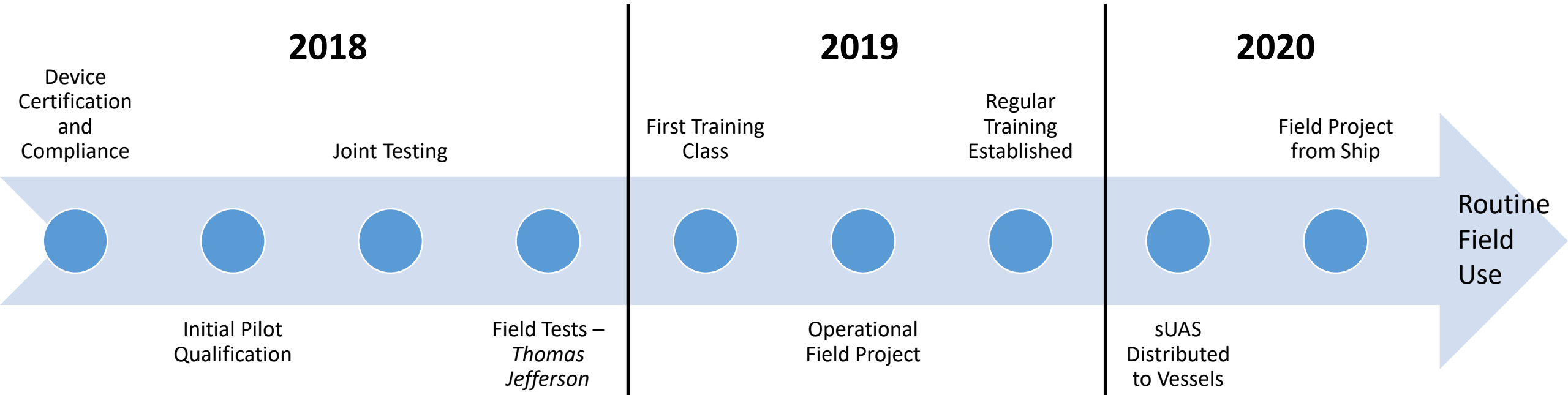**Operational Innovation**
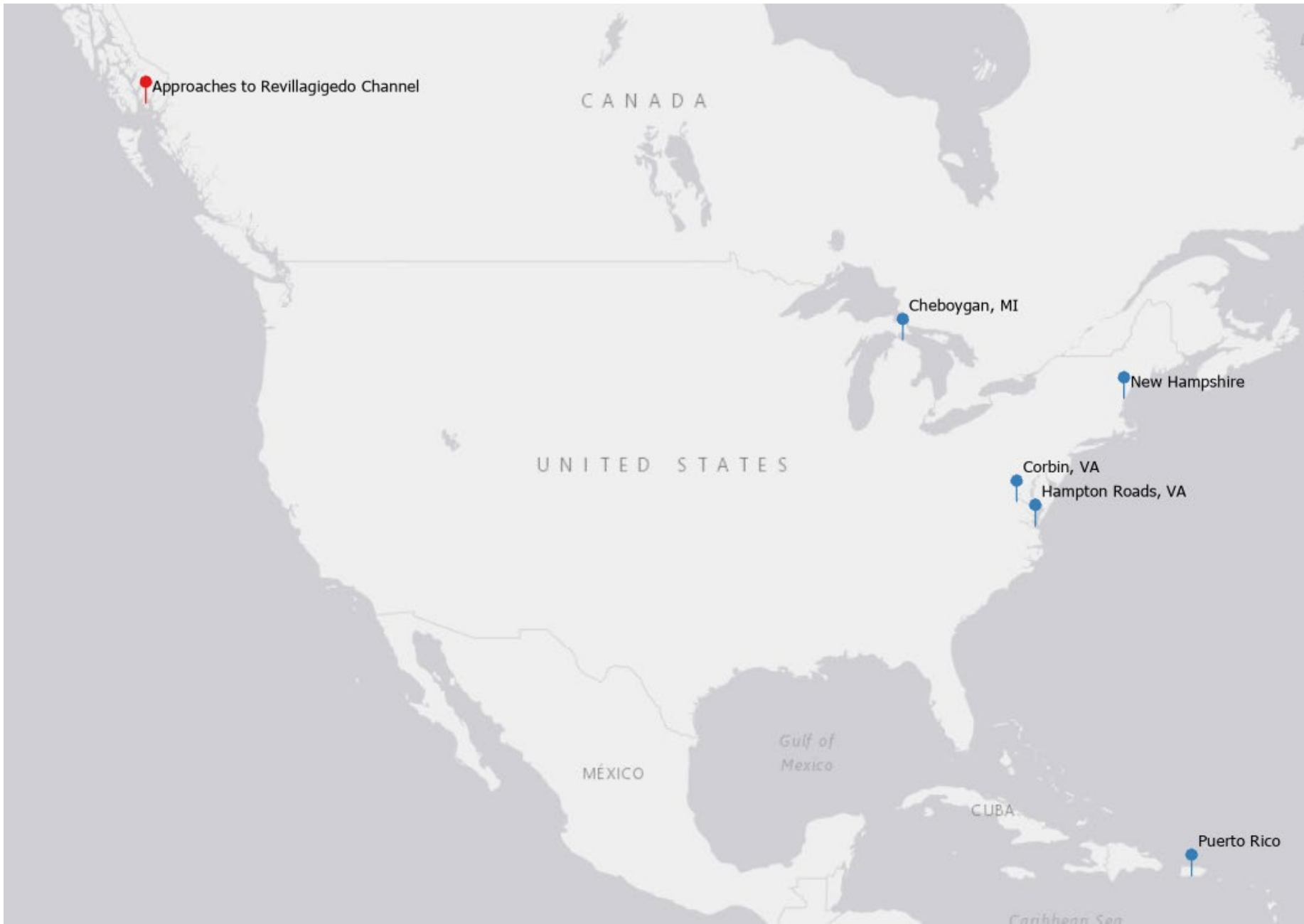
Incorporation of new equipment & methods

Collaboration

Partnership with NOAA NGS RSD & NCCOS, UNH, OSU

Timeline of Development

2018

2019

2020

Device Certification and Compliance

Joint Testing

First Training Class

Regular Training Established

Field Project from Ship

Routine Field Use

Initial Pilot Qualification

Field Tests – *Thomas Jefferson*

Operational Field Project

sUAS Distributed to Vessels

Approaches to Revillagigedo Channel

CANADA

Cheboygan, MI

New Hampshire

UNITED STATES

Corbin, VA
Hampton Roads, VA

MÉXICO

Gulf of Mexico

CUBA

Puerto Rico

Caribbean Sea

Office of Coast Survey
National Oceanic and Atmospheric Administration

2019 Activities – Cheboygan, MI

Use with small boat from NRT-New London in Great Lakes

abandoned lighthouse   water tank   Mackinac Bridge

State Dock

Mackinaw City, Michigan
Image courtesy of NOAA / John Doroba (2019)

N

Products

Orthomosaic

UAS Operations - Cheboygan, Michigan - July 2019

Digital Surface Model
RGB
Red: Band_1
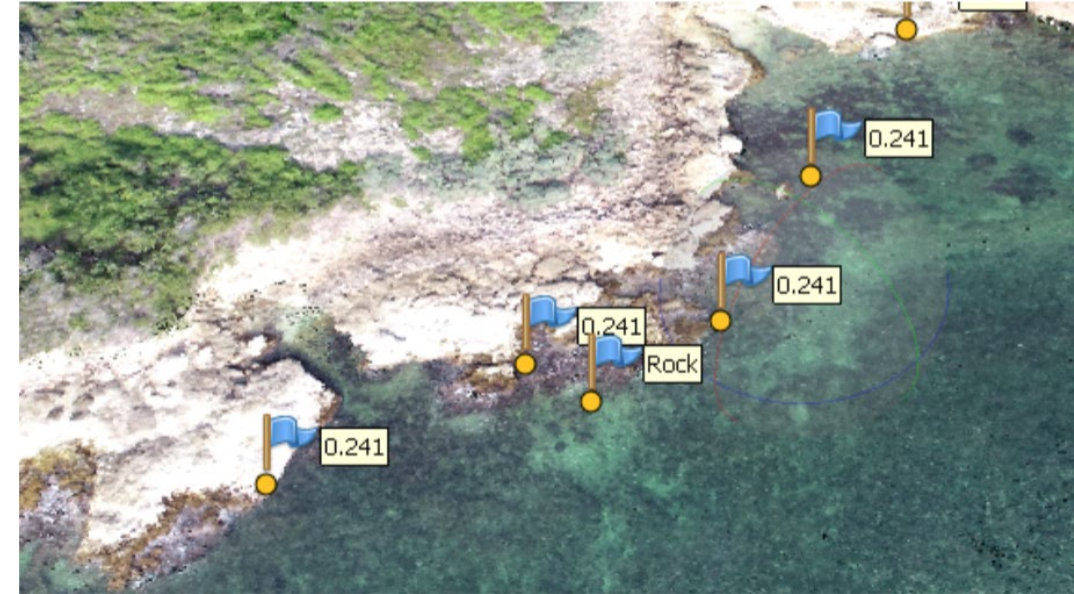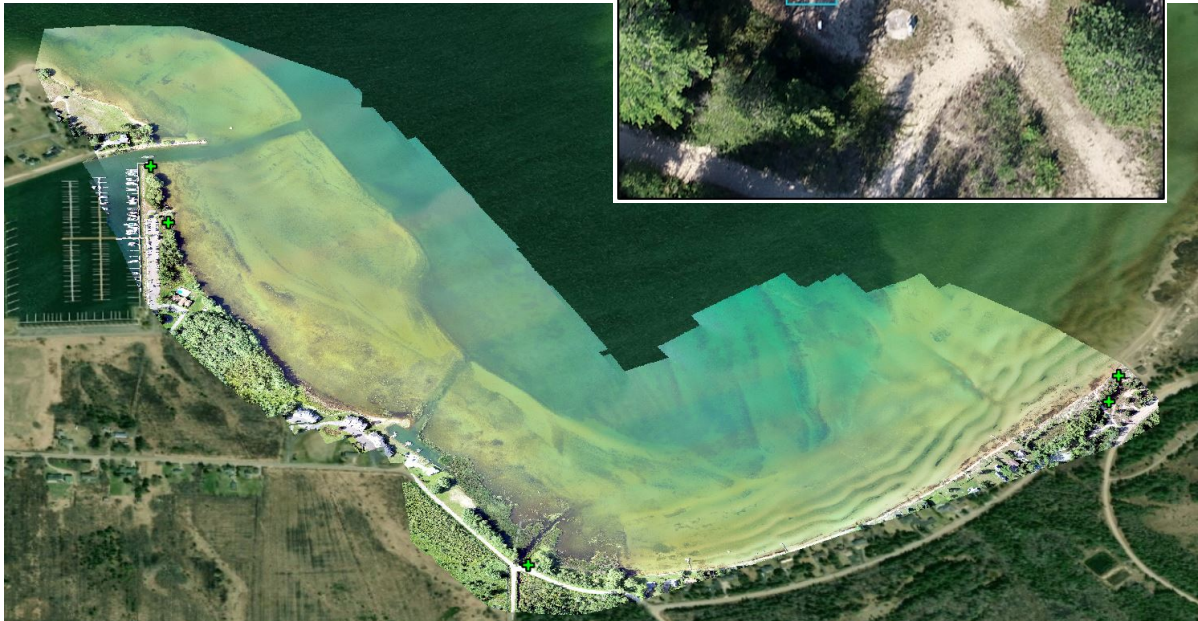Green: Band_2
Blue: Band_3
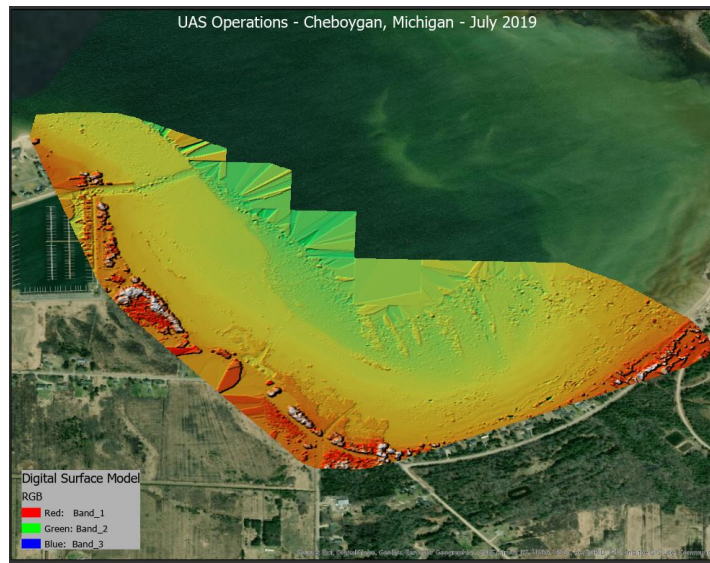
Digital Terrain Model
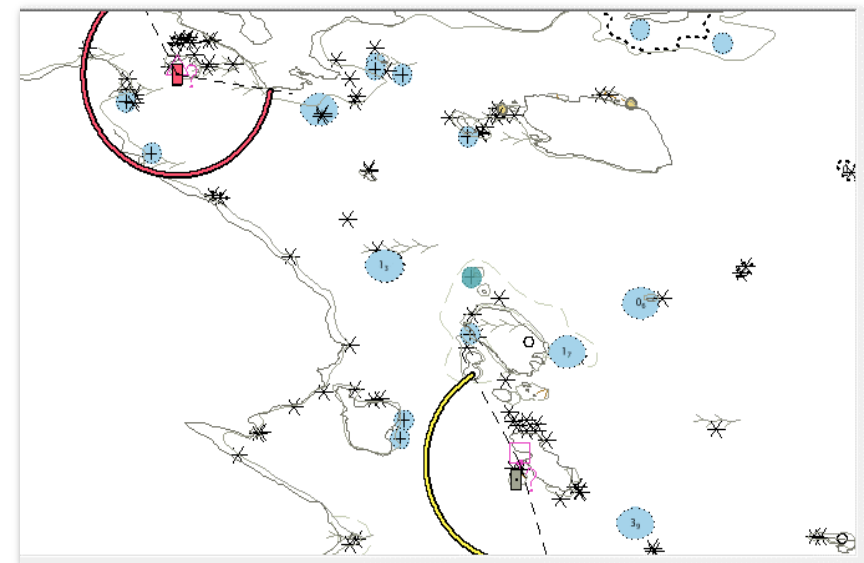
Shoreline Verification

2019 Development – Referencing Methods

Waterline

Ground Control Points

Referencing Investigation – NCCOS

Low Accuracy Trajectories

PPK Trajectories
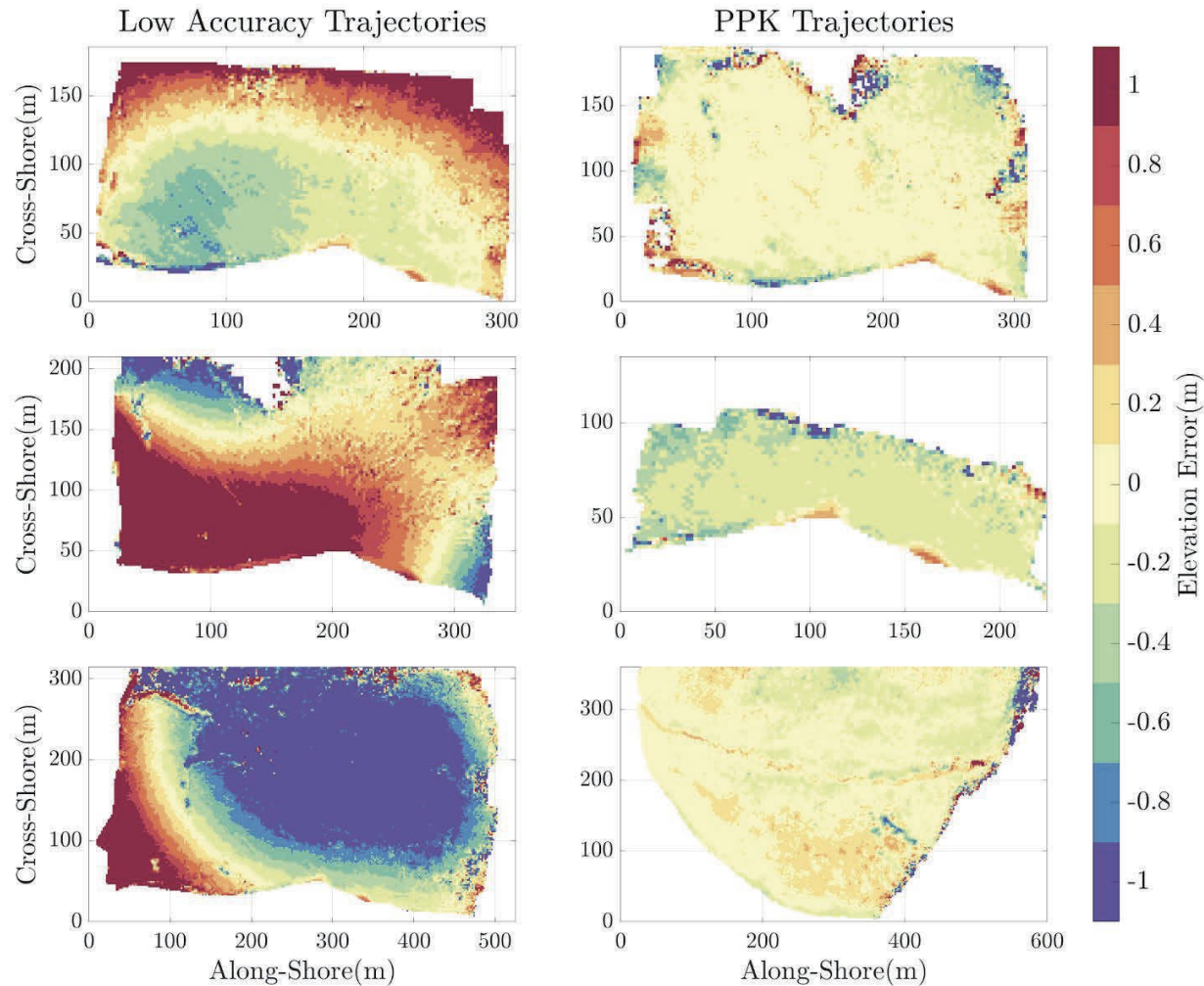
Effect of User Input Uncertainties

10 m camera position

Poor Stochastic Mode

$\mu = -0.37, \sigma = 2.15$

Good Stochastic Mode

$\mu = -0.04, \sigma = 0.39$
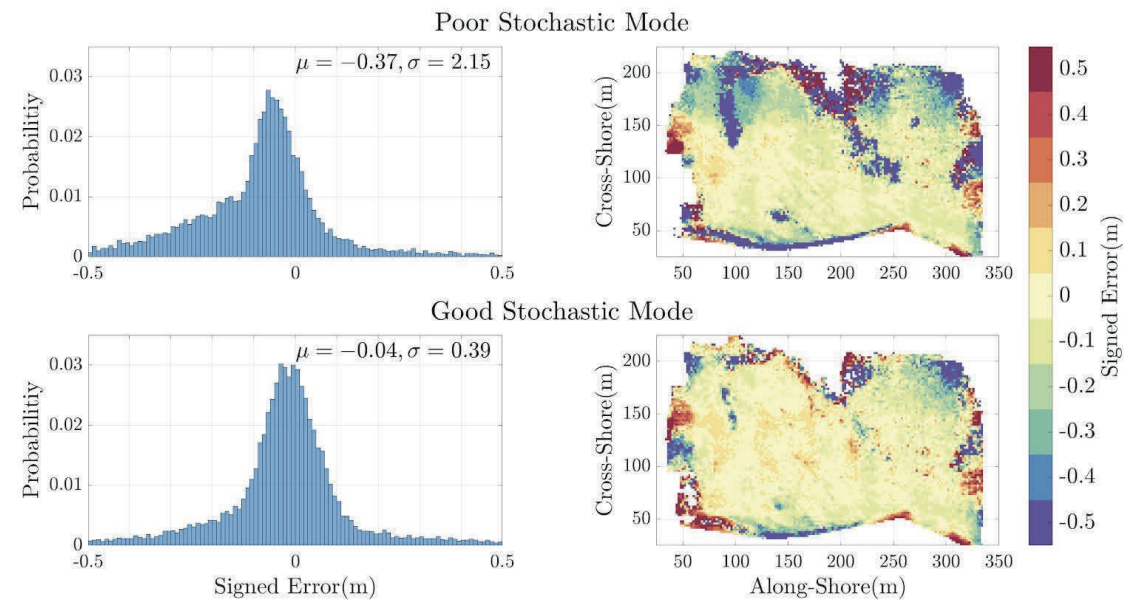
5 cm camera position

Shallow Water Bathymetry

Survey Points

$\mu = 0.113m$
$\sigma = 0.203m$
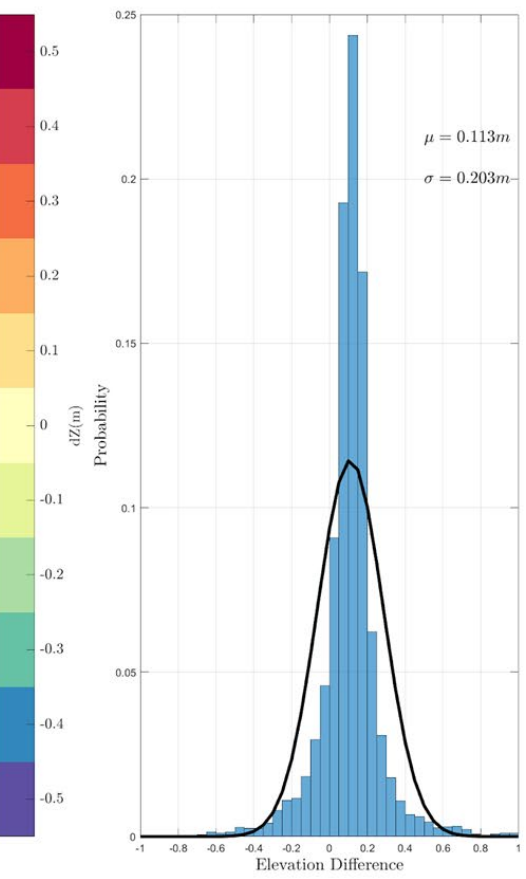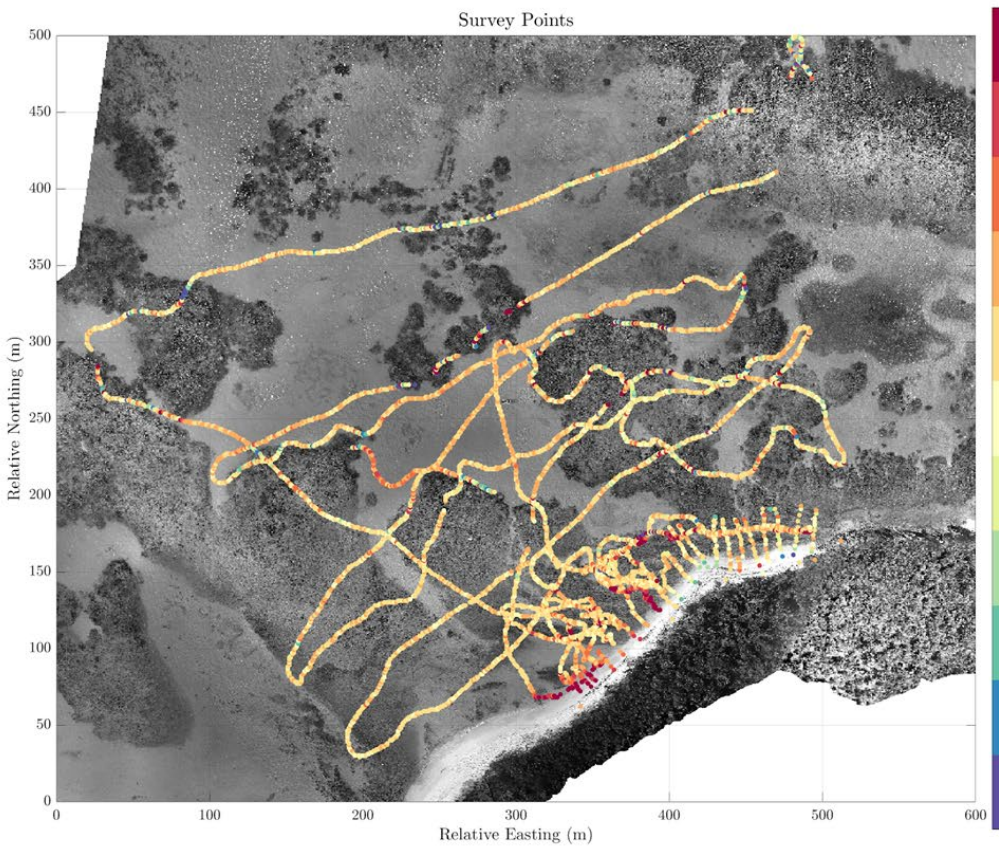
But... Potentially Inconsistent Results
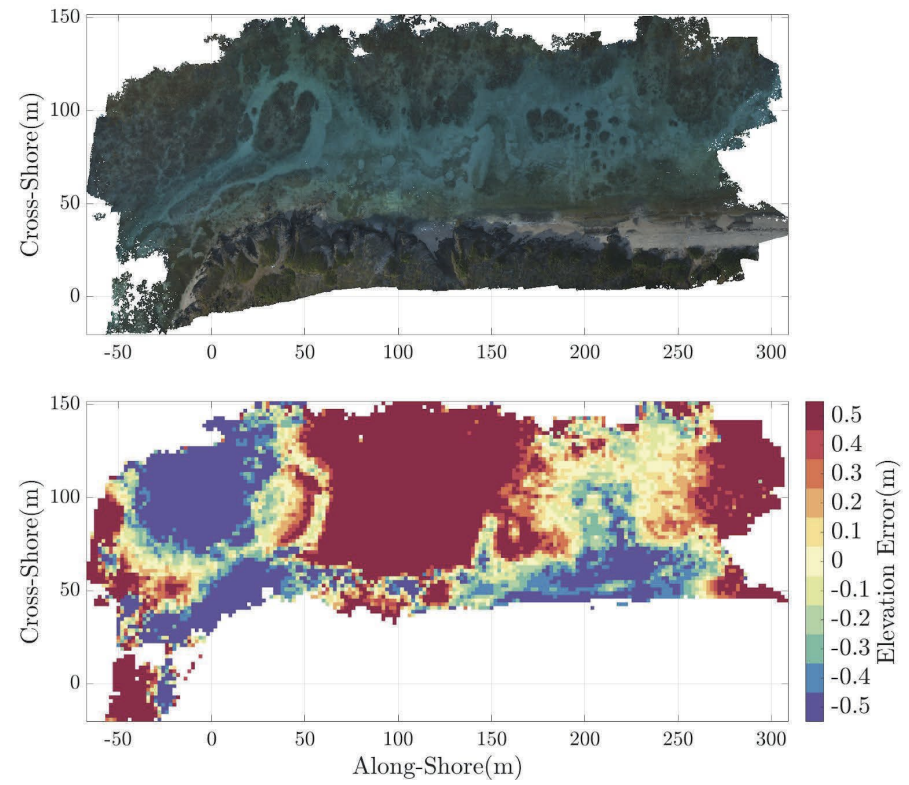
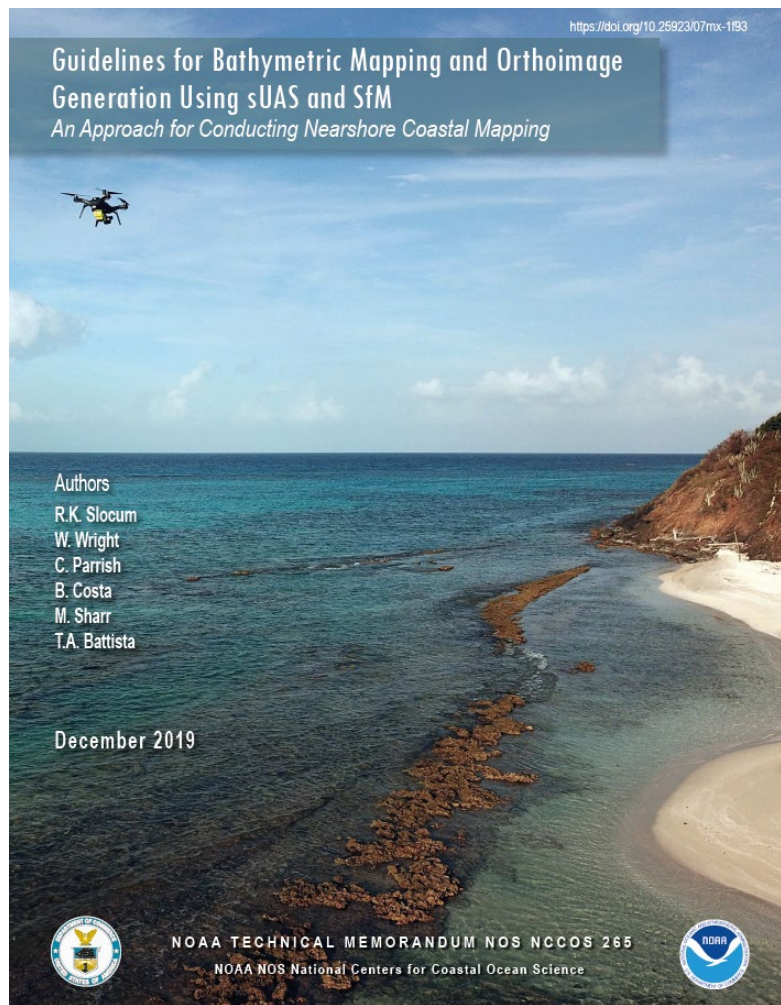Source: NOAA NCCOS/Tim Battista

Training Program

- Collaboration between NGS/RSD and OCS
  - Provides general intro to drone flight and model specific details

- Conducted in Corbin VA, Newport OR, Seattle WA

- 17 Trained

Guidance and Operating Procedures

https://doi.org/10.25923/07mx-1f93

Guidelines for Bathymetric Mapping and Orthoimage Generation Using sUAS and SfM

An Approach for Conducting Nearshore Coastal Mapping

Authors

R.K. Slocum
W. Wright
C. Parrish
B. Costa
M. Sharr
T.A. Battista

December 2019

NOAA TECHNICAL MEMORANDUM NOS NCCOS 265

NOAA NOS National Centers for Coastal Ocean Science

UAS Operation & Workflow Evaluation
Cheboygan, MI
John Doroba, LT jg Matt Sharr, Amber Batts

Executive Summary

- *Front end paperwork is cumbersome and confusing* – We need more experience with process

- *Equipment is inadequate to meet our standard* – Need RTK drones or new method

- *Processing workflow produces deliverable* – We can incorporate UAS data into final features file

- *UAS will impact on PIs, HSSD, and EC* – Work with HSD and others to mitigate problems

- *Pending legislation could affect OCS workflow* – Anticipate and prepare for future hurdles

- *We need to have realistic expectations* – UAS are a potentially valuable tool, not a silver bullet

Background

Drones are tools that are being considered for various survey operations in OCS. One of these operations is collecting shoreline and features for hydrographic operations aboard NOAA hydrographic platforms. Rocks and other nearshore features are dangerous to survey from a boat in shallow water, and UAS are possibly a safer, more efficient solution. In addition to these advantages, OCS is now mandating ERS shoreline acquisition. Therefore, we must find a way to collect data without tide correctors or using manual collection methods, and reduce to MLLW datum.

LT Matt Sharr and PS John Doroba tested UAS functionality in the field in Cheboygan, MI from July 29 until August 2, 2019. OCS, until now, was reliant on NGS and RSD for testing, data collection, processing, and support. We wanted to independently test hydrographic UAS operations and workflows with respect to shoreline and feature acquisition.

Flights were conducted from shore, as well as NRT5. A base station and control points were established for post processing. Data was acquired, processed, correctors applied, and deliverables were created.

Objective

- Primary
  - Operate OCS UAS independently without assistance from other NOAA offices
  - Determine capacity and effectiveness of UAS operations for shoreline & feature acquisition on hydrographic platforms
- Secondary
  - Demonstrate use of drones for Coast Pilot image collection

UAS-SfM Processing
Written by Evan Mazur
Amber Batts, Eric Younkin, John Doroba, and Matthew Sharr

...ssing methods (Drone2Map and Agisoft):

...an overview of that described in the *UAS Data Post-Processing, SfM* ...loped by USGS. The purpose of the describing the steps below is to ...used for this study.
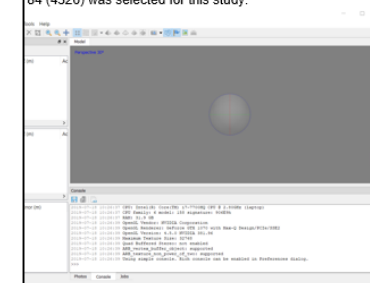
...dd Photos

...tos > Select Photos
...hunk. The project areas used in this study are relatively small and do ...otos in separate chunks, used to minimize processing time.

...for Image Referencing

...using the tabs at the bottom left of the screen in order to access the ...he coordinate system selected matches that used by the acquisition ...84 (4326) was selected for this study.

...photos taken during ascending and descending, photos with poor ...orizon or glares).

Workflow > Align Photos

The preferences shown in the image below were selected.

2020 Planned Activities

- Field Units
  - Training and distribution of systems to field units
  - Shoreline characterization in Alaska
  - Response imagery

- Development
  - High accuracy positioning investigation
  - Testing of alternative sUAS
  - Continued documentation and refinement of processing