

NOAA Coastal Mapping Program and UAS development

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NOAA/NOS/NGS

UASPO Program Review
9 March 2017



Presentation Outline

- Program background and requirements
 - Coastal Mapping Program
- Research priorities
- UAS experience
 - Altair
 - Ebee
- Future direction
 - Structure from Motion (SfM)
 - Sensors

NOAA's Coastal Mapping Program

- Define the National Shoreline and nearshore elevation data
- NOAA nautical charts
- Other important applications:
 - Used in defining the United States' territorial limits
 - Coastal resource management
 - Storm surge and coastal flooding modeling
 - GIS analysis
 - Benthic habitat mapping
- Coastal Intelligence and Resiliency...

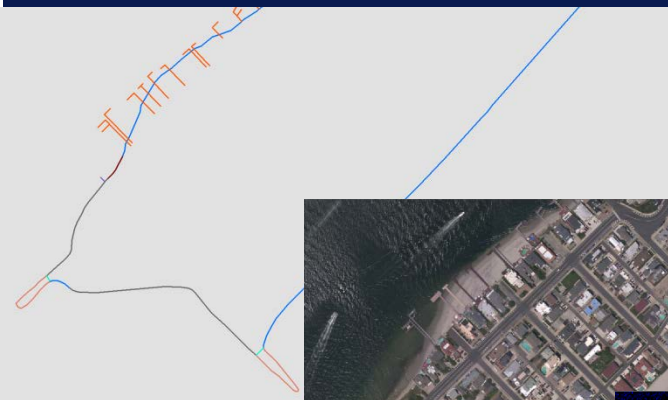


How do we do it?

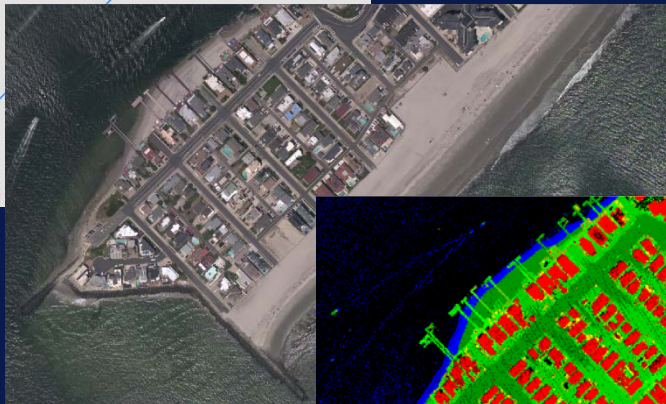
- **King Air 350ER Aircraft**
 - Extended Range: 8 hour endurance
 - 180kt survey & 250kt transit speed
- **DHC-6 Twin Otter**
 - Slow stable, low flying
 - 80-160kt survey speed
- **Trimble DSS580 Dual Cam & DSS500 Dual Oblique Cam**
 - RGB & NIR cameras (NIR in DSS580 only)
 - 35cm GSD at 10,500' flying height
 - In-flight image processing
- **RIEGL LIDARs**
 - Topographic LIDAR (LMS-Q680i)
 - Topobathymetric System (VQ-880G)
- **Satellite Imagery**
- **Private sector contracts**



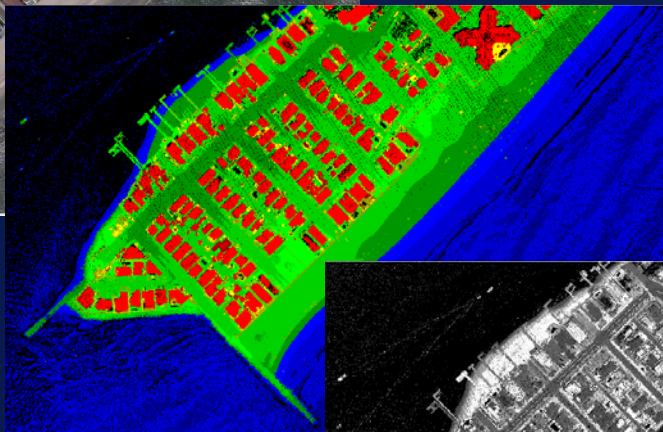
Products NGS delivers and derivatives



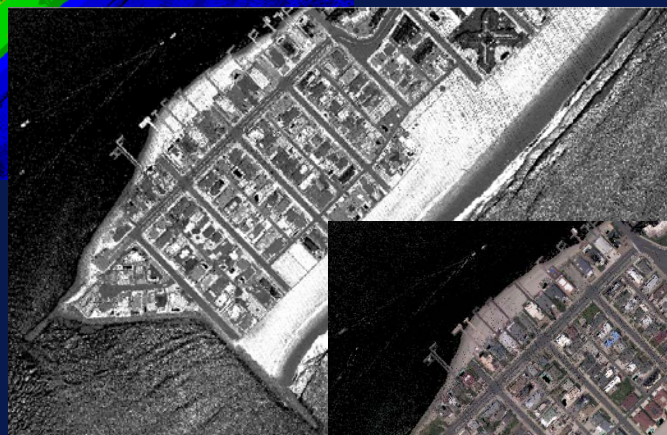
Shoreline



Ortho Mosaic Imagery

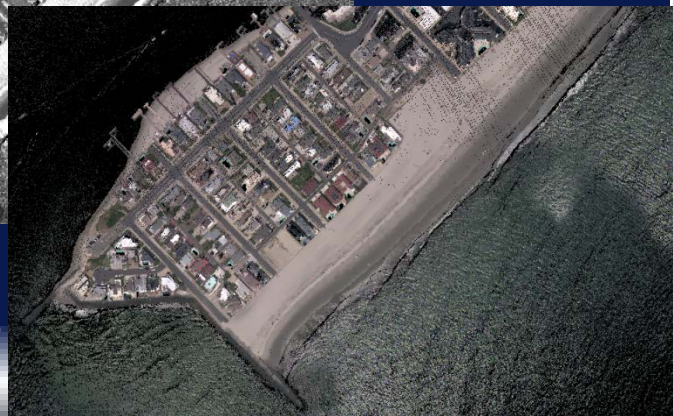


Lidar Point Cloud and DEMs (elevation)



Lidar Point Cloud (intensity)

Map once use many times!



RGB Colorized Lidar Point Cloud

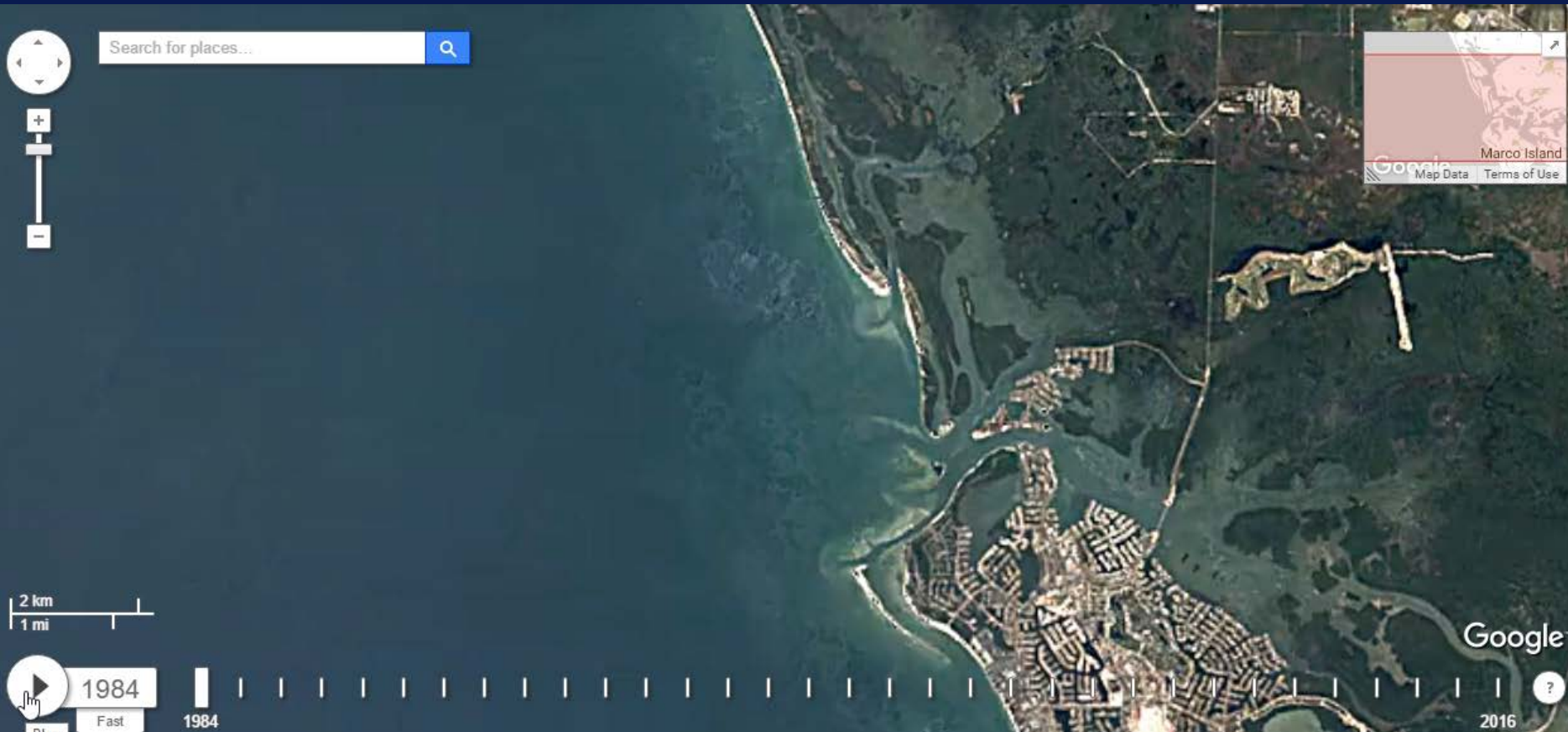
Research Priorities

- Total Propagated Uncertainty (TPU)
 - The development of robust total propagated uncertainty (TPU) models covering the range of NGS and JALBTCX topo-bathy lidar systems will benefit and facilitate operational use of topo-bathy lidar in the lidar community and application to nautical charting by providing a level of uncertainty to improve informative decisions based on the multi-use of the data.
- Imagery derived bathymetry and water clarity estimation
 - Using satellite, aircraft, UAS collected imagery to derive bathymetry as well as building climatology models of water clarity to support operations
- Sensor evaluation
 - Continued evaluation of active and passive sensors to meet mission needs including new approaches to processing.

UAS experience

- Program manager Altair MALE UAS Demonstration
 - Coastal Mapping imagery mission, demonstrated medium endurance capability, flight operations
- Ebee collaboration with USACE
 - Provided remote sensing and positioning/orientation capability
- NOAA UASPO funded Small Unmanned Aircraft System Mapping Project
 - Acquire and operate two small fixed-wing Unmanned Aircraft Systems (UAS) to further the development of UAS operational procedures specifically related to coastal and habitat mapping, living marine resource (LMR) surveys, as well as a range of emergency preparation, response and recovery requirements.

Naples, FL – example of current challenges



And that's just since 1984...



eBee RTK Survey-grade mapping drone
Capture aerial photography to produce
orthomosaics & 3D models with
absolute accuracy of down to 3 cm -
without GCP
<https://www.sensefly.com/drones/ebee-rtk.html>

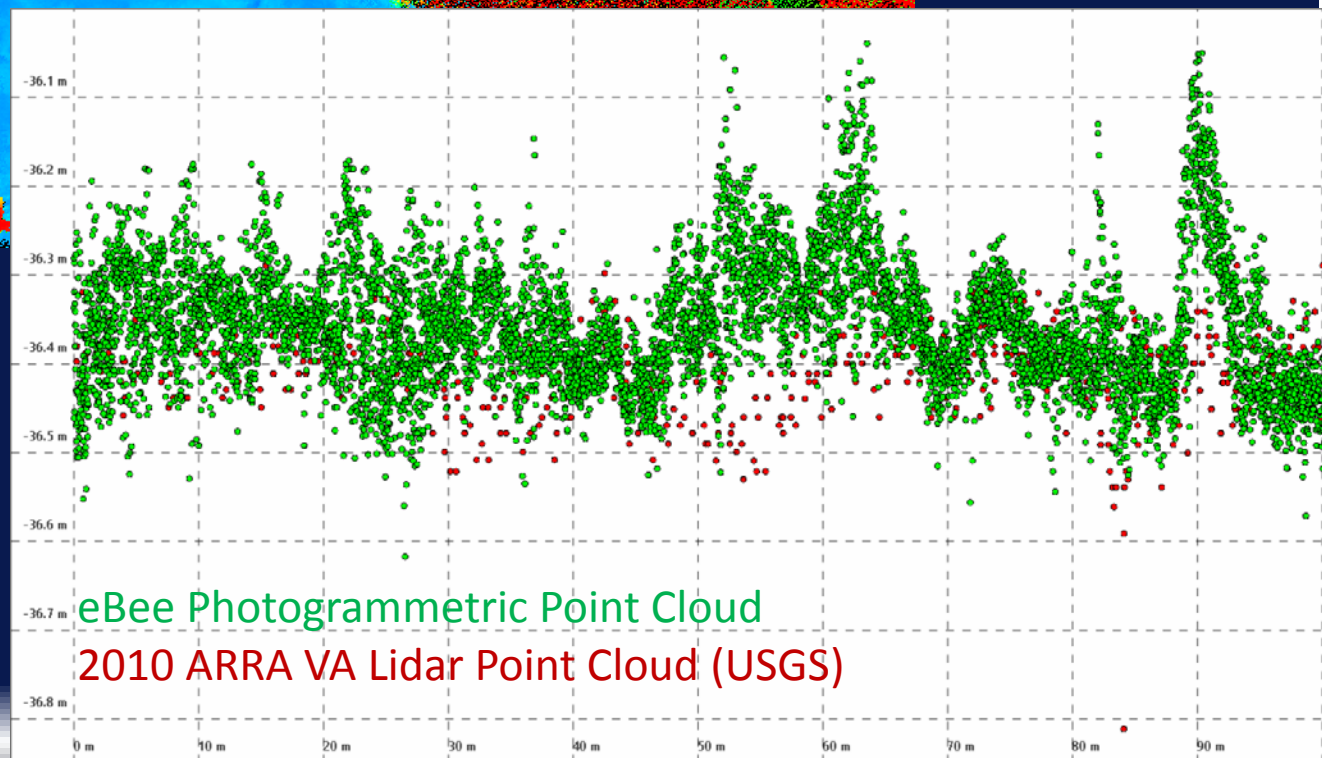
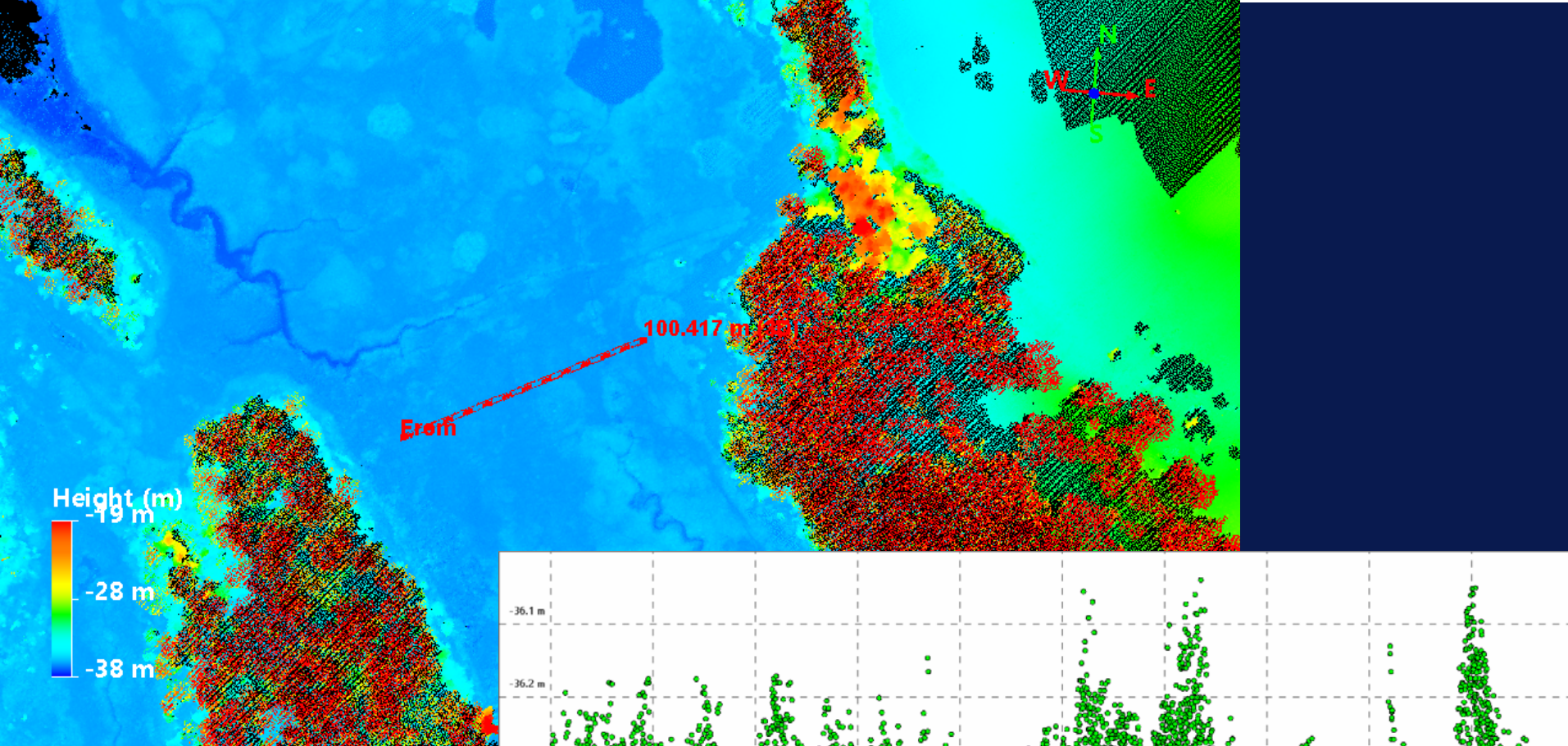


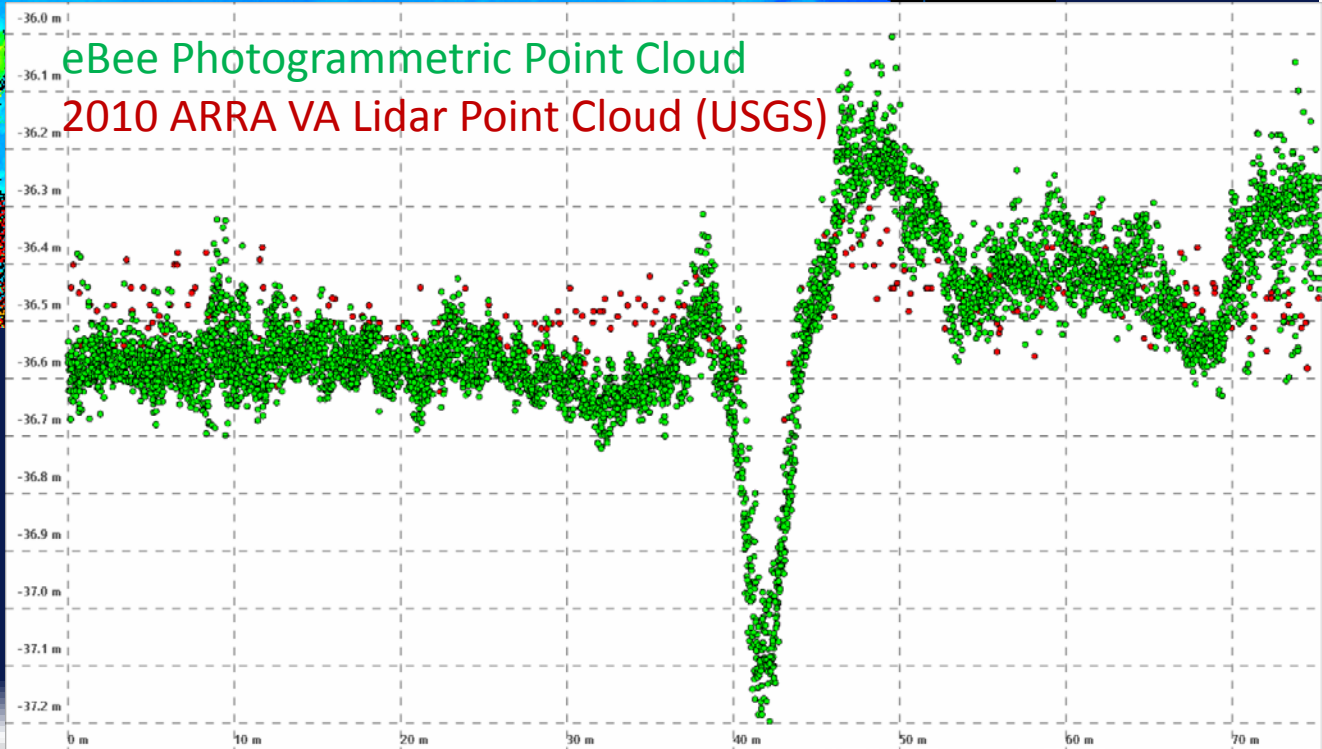
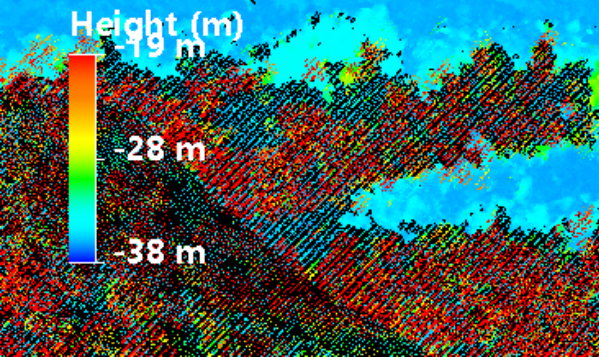
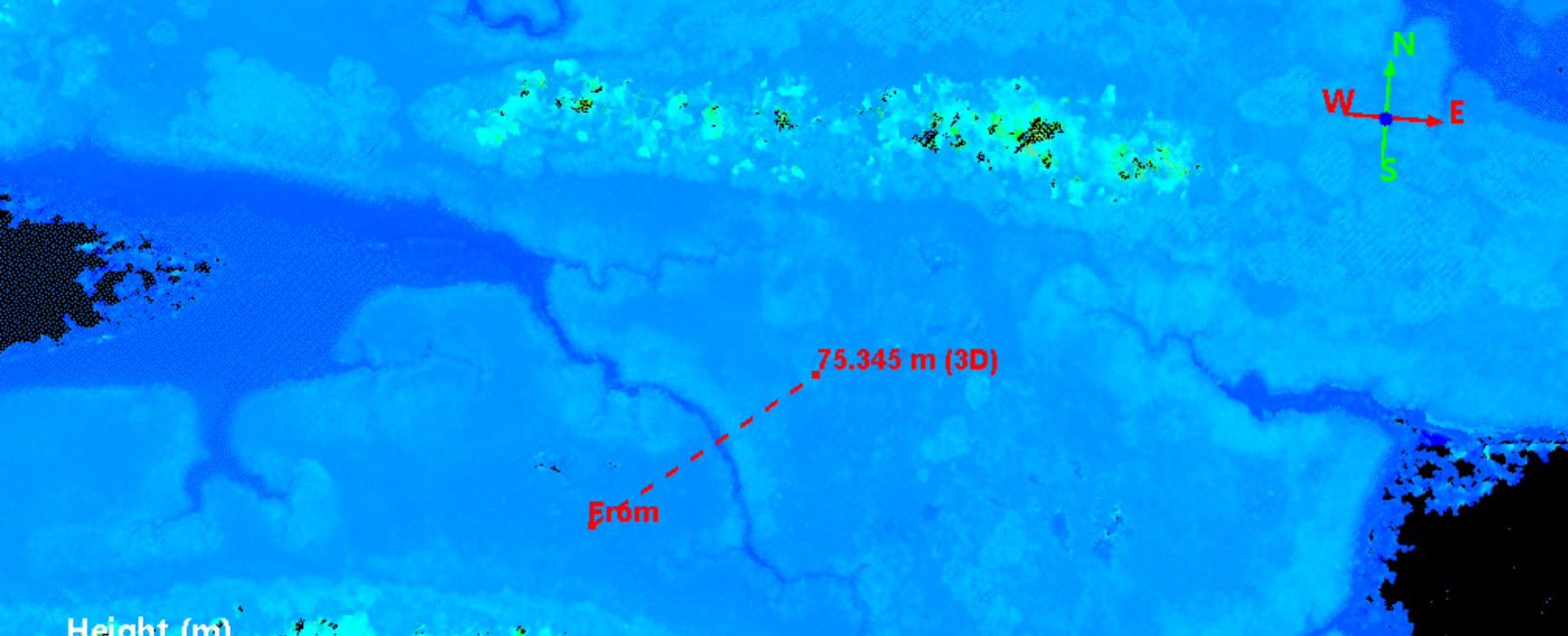


Chesapeake Bay
National Estuarine
Research Reserve
(CBNERR or Reserve)
Catlett Island.
5 cm RGB orthomosaic

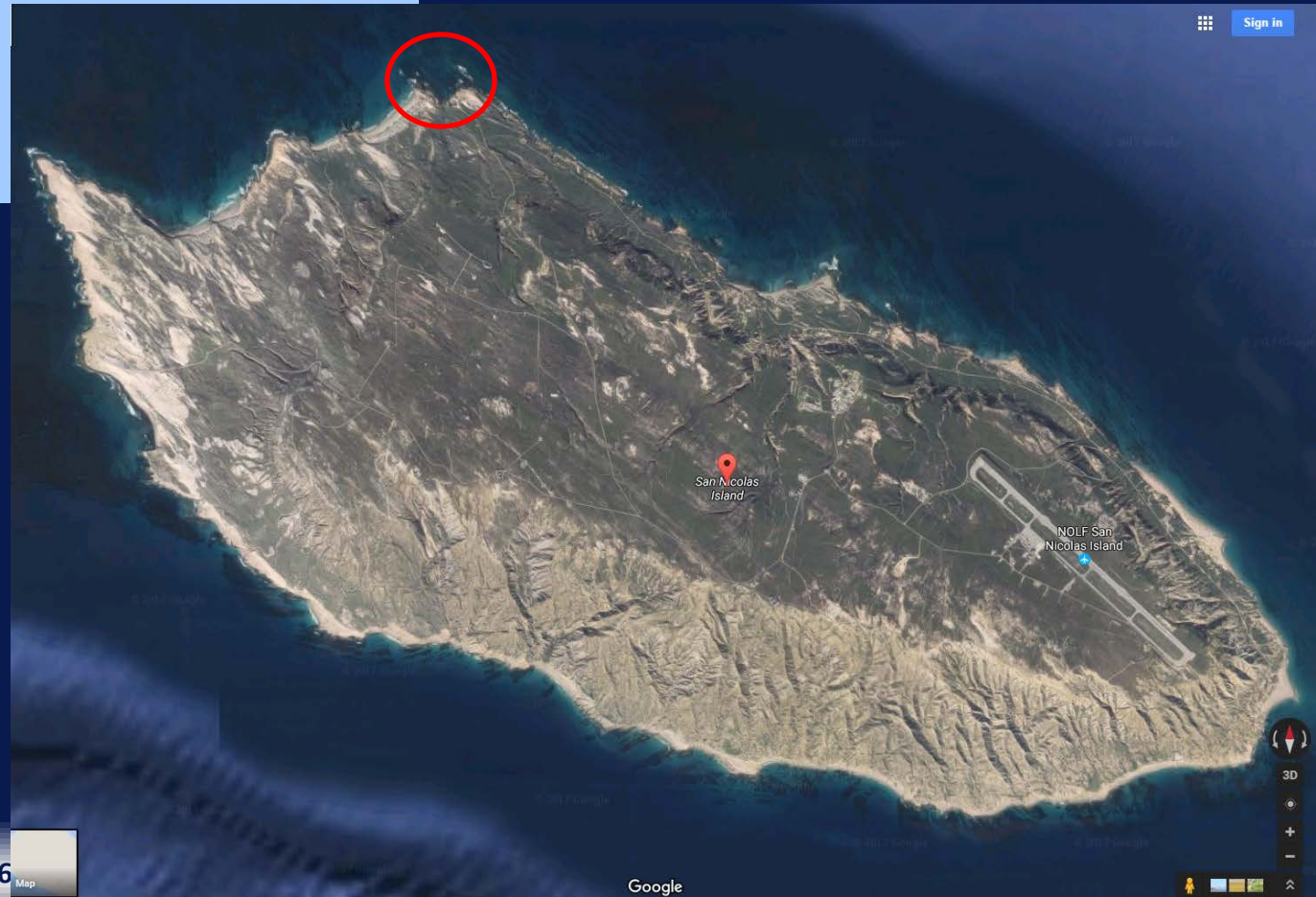
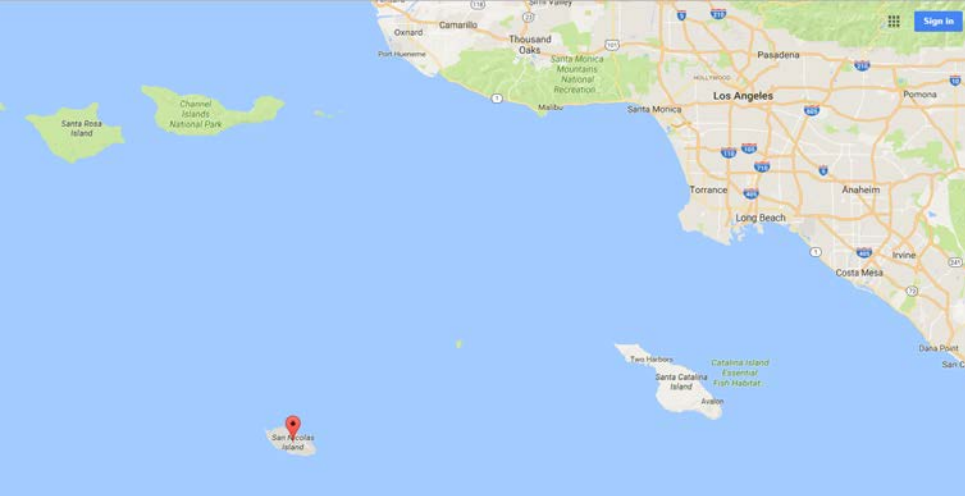


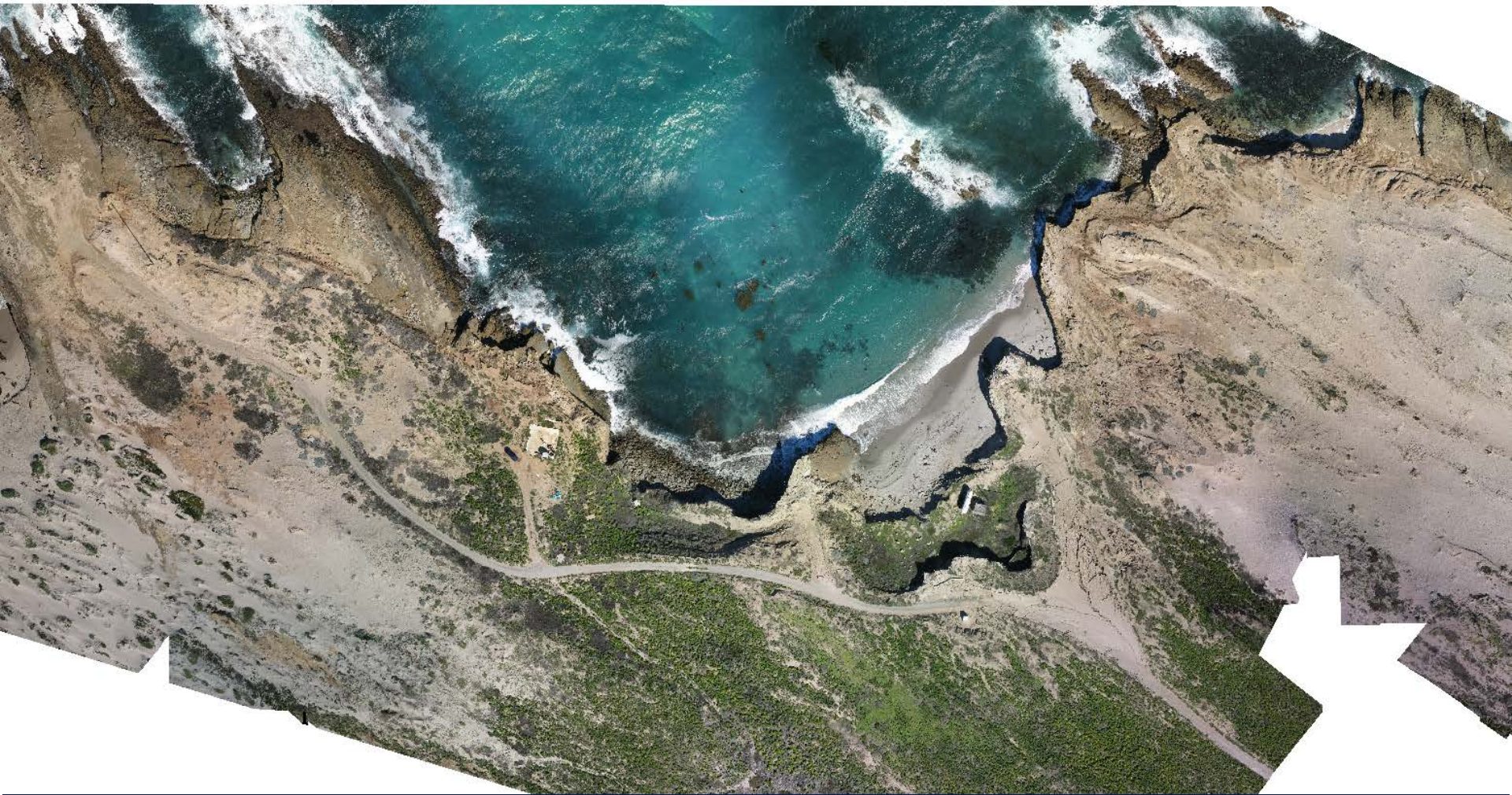
5 cm RGB orthomosaic
+ photogrammetric
DEM



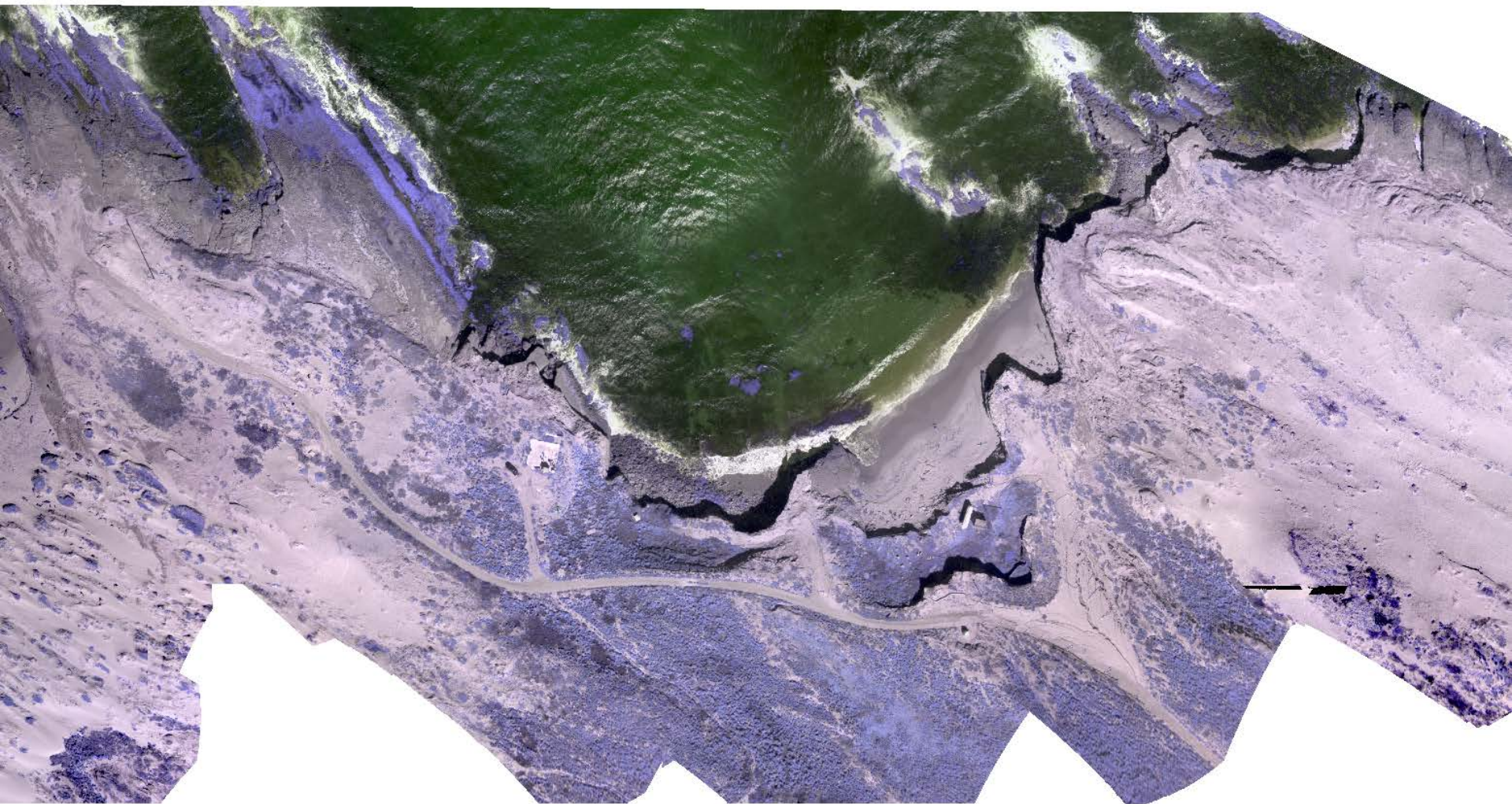


San Nicolas Island - U.S. Navy test and Evaluation site. Joint USN, NOAA, USFWS, and USGS habitat mapping and living marine resources.

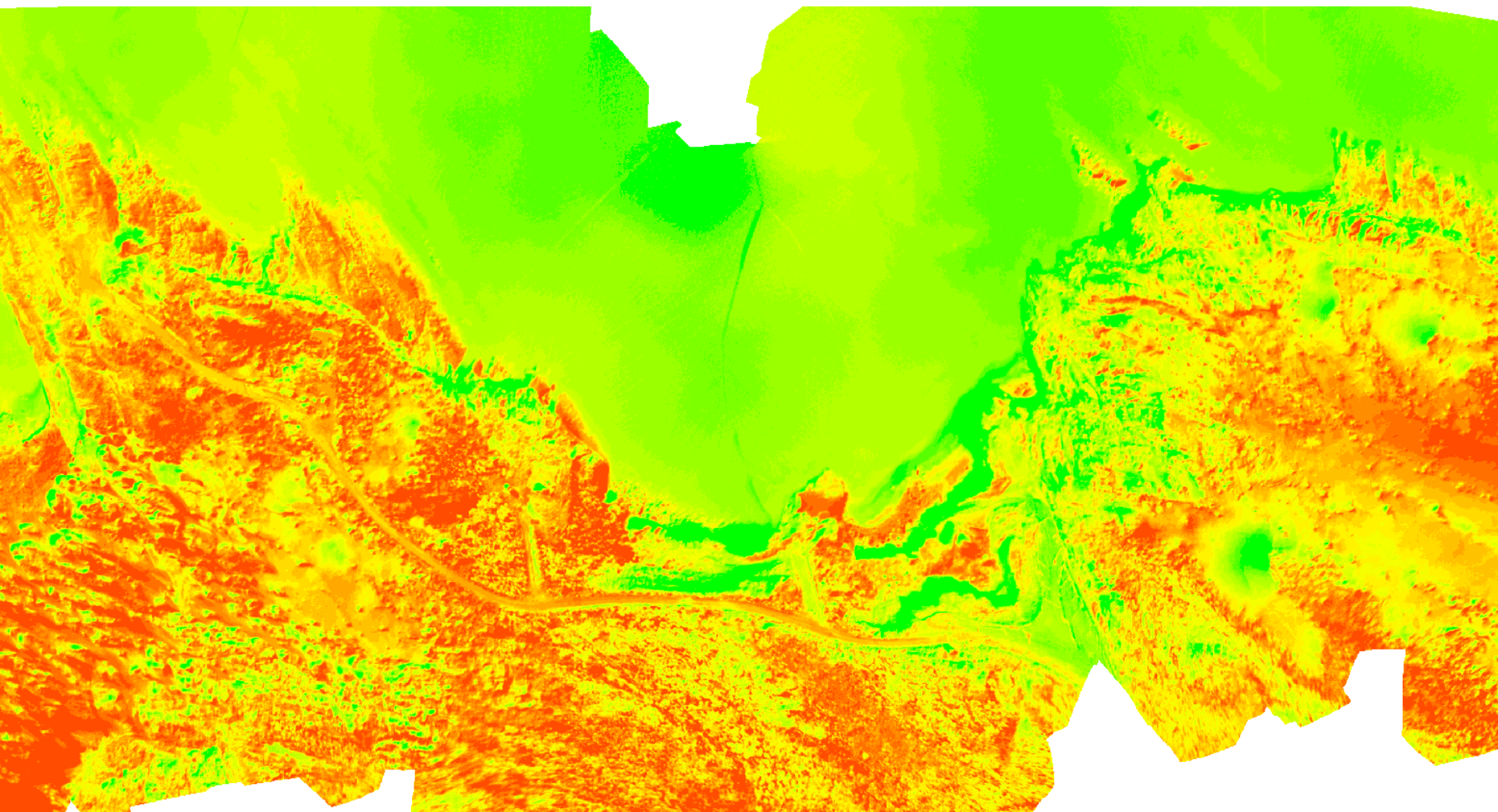




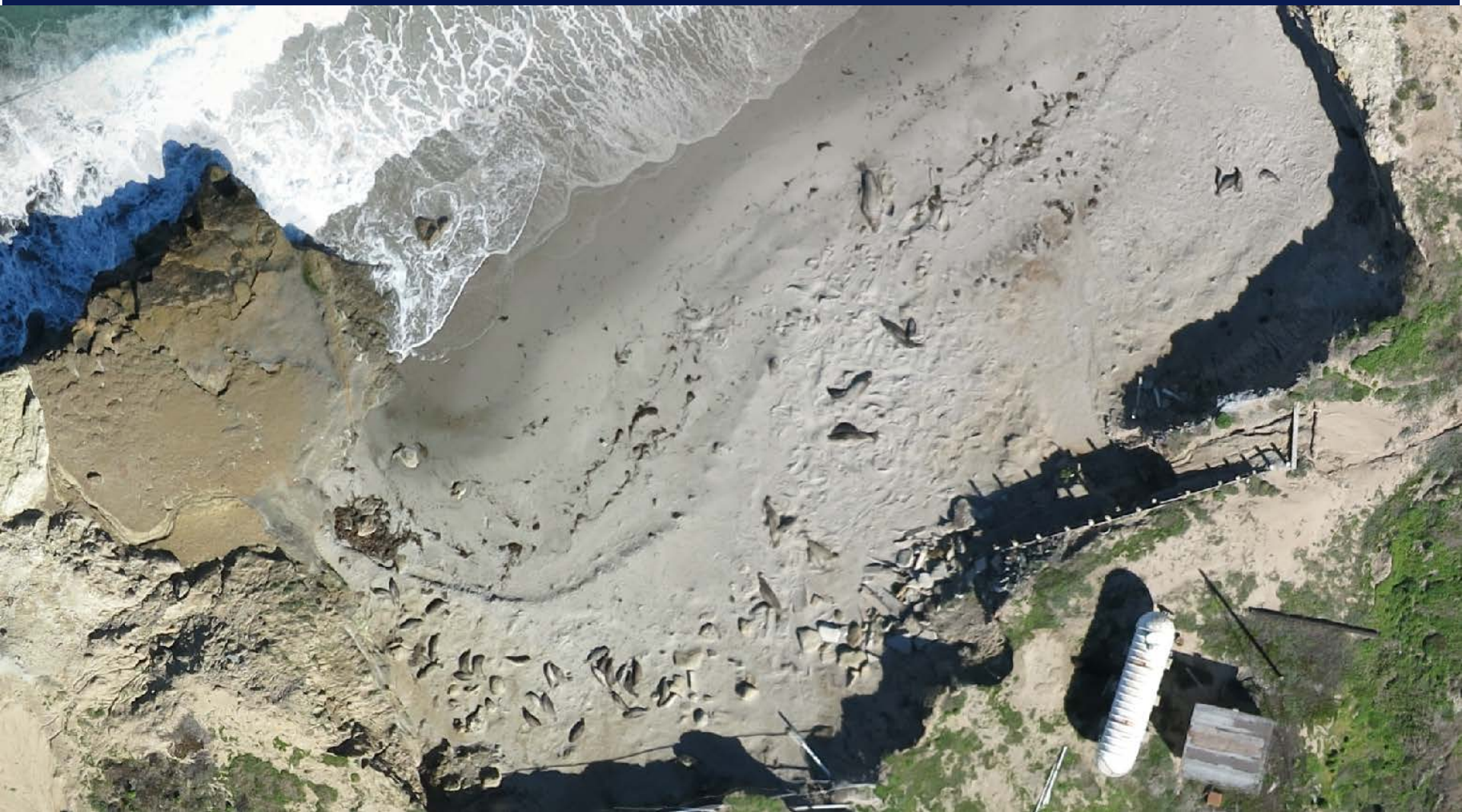
5 cm RGB orthomosaic



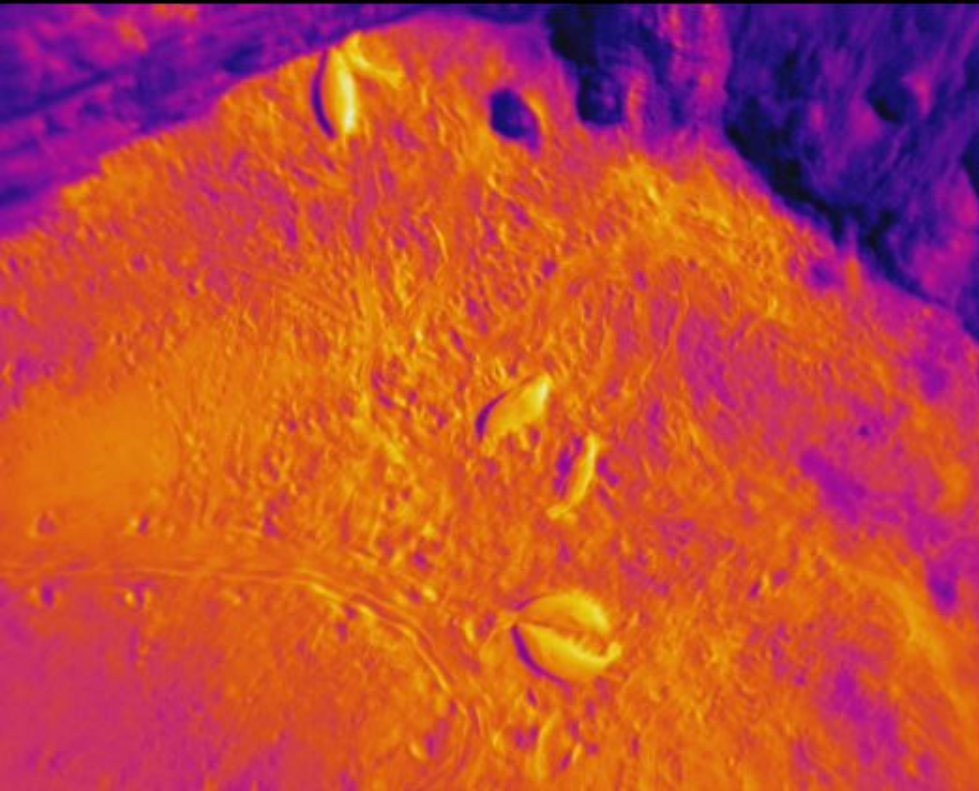
5 cm NIR orthomosaic



Thermal orthomosaic



5 cm RGB orthomosaic



Thermal and RGB orthomosaic

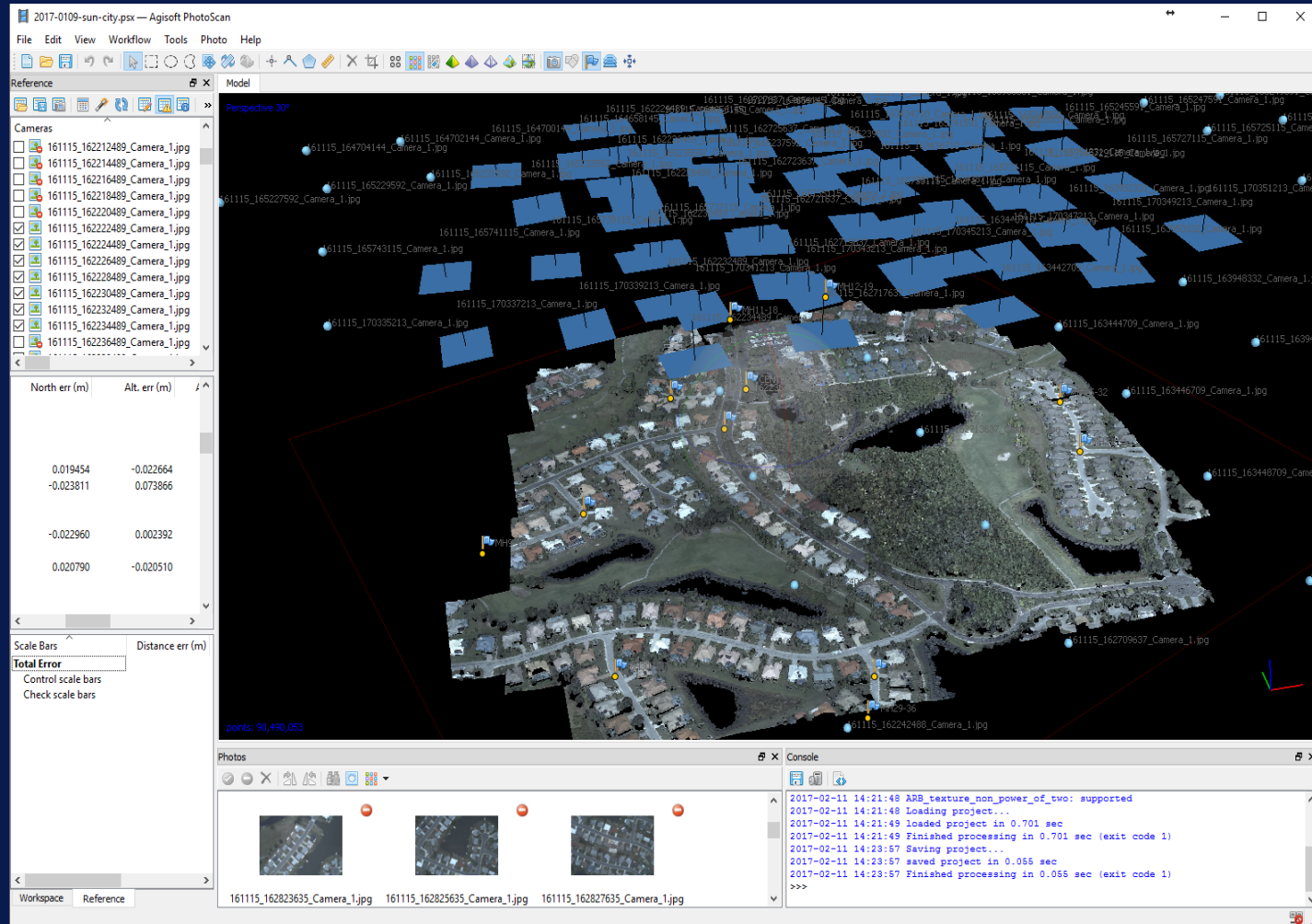
SfM-Agisoft Photoscan

Inputs:

- Photos
- GCPs and / or GPS-IMU

Outputs

- 3D point clouds
- Ortho Photos
- DEMs, Meshes
- Textures
- Camera Calibration



UAS SfM based submerged Topography

- RGB Point cloud image
- Mores Creek, Idaho
- Narrow stream, 0-1.5 meters depth
- Gravel stream bed
- Micro Drone
- Special algorithms to derive calibrated bathymetry



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SfM based UAS Bathymetry

- Rtk Ground Control points and photo targets
- Dark cobble stone stream bed



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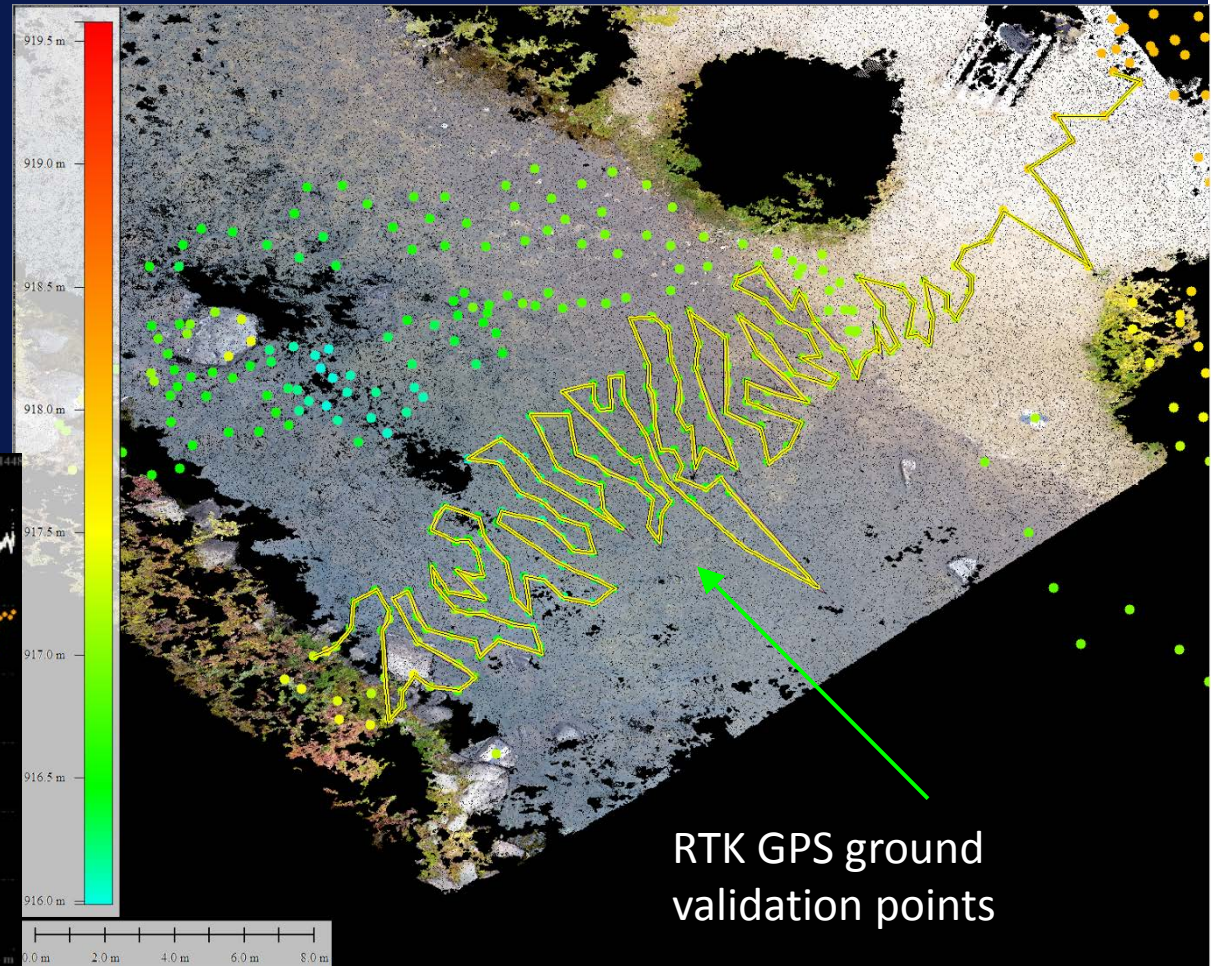
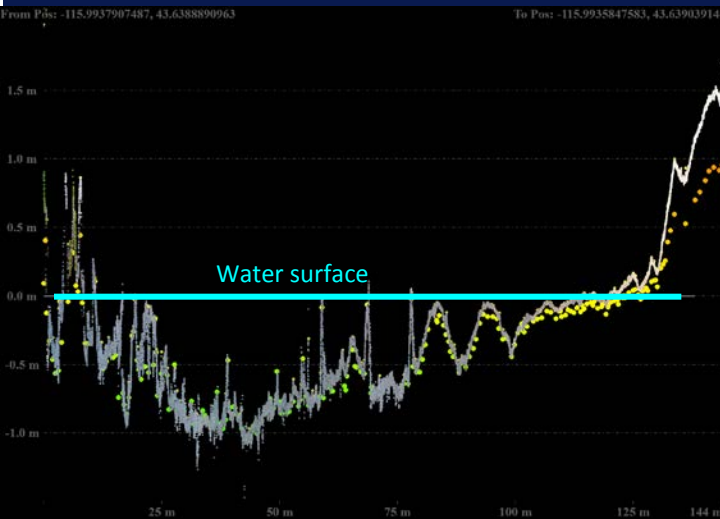
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SfM based UAS Bathymetry



Depth corrected UAS SfM derived submerged topography

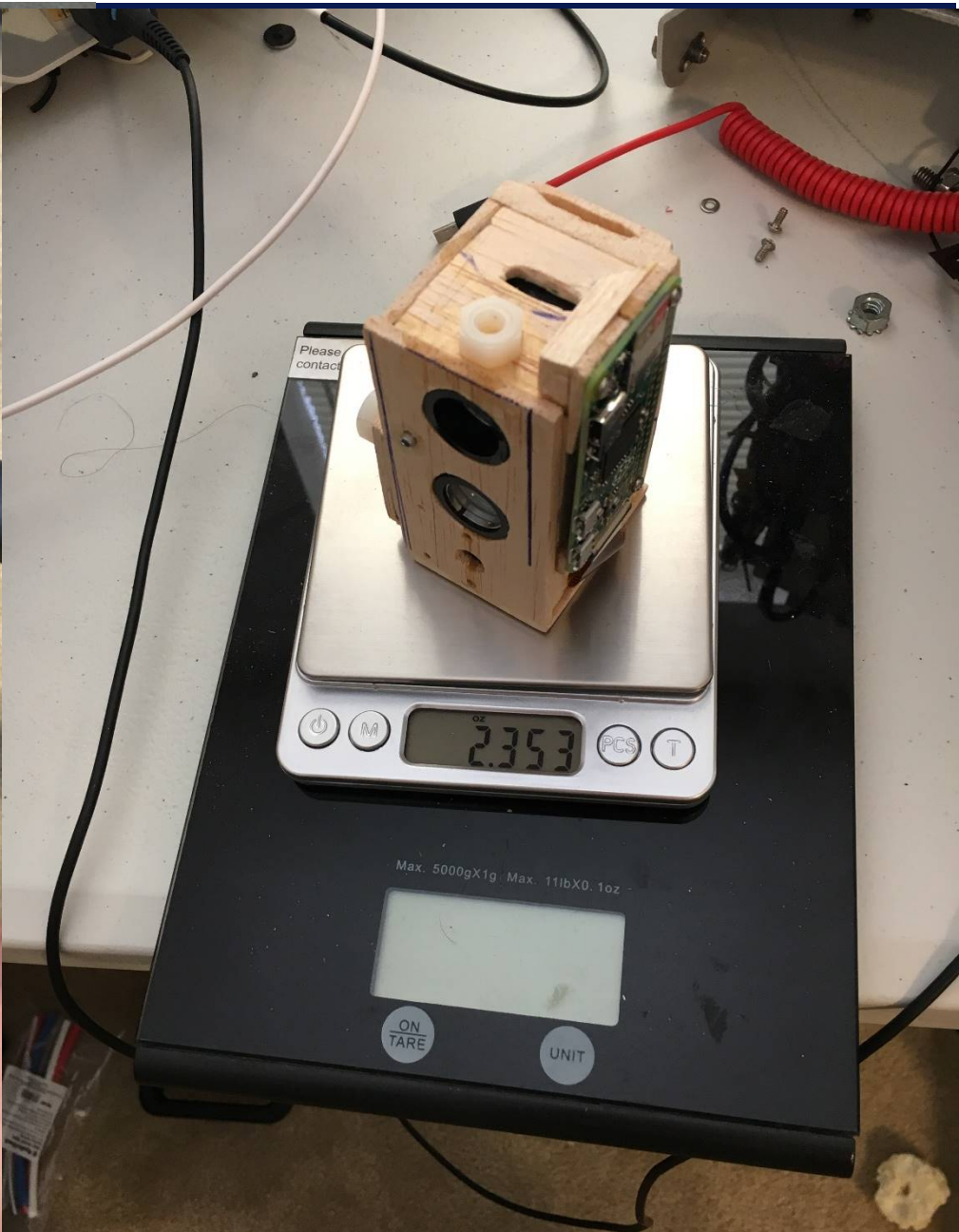


RTK GPS ground validation points

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Used with permission: C.W. Wright

Thank you

- NOAA UASPO
- NOAA OMAO AOC
- NOAA NOS
 - ONMS
 - ORR
- Ebee team: Woolard, Pickett, Wright, Sellars, Sweeney, Sloan, Rogers, Taggart, Mobley
- NMFS, USN, USFWS, USGS, USACE