National Coastal Mapping Program

Chris Macon

Charlene Sylvester

Heath Harwood

Nick Johnson

15th JALBTCX Workshop

12 June 2014

US Army Corps of Engineers

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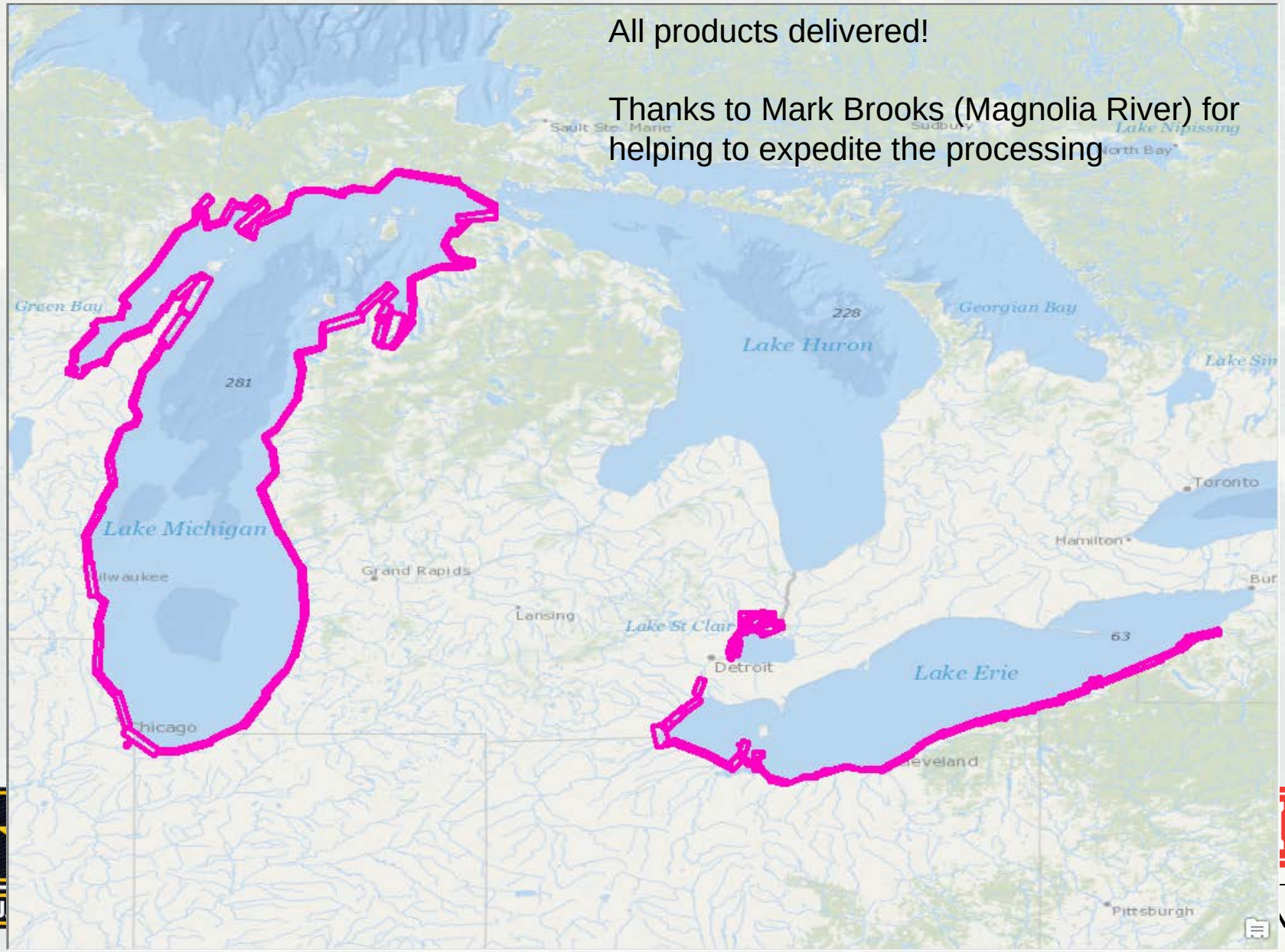
Joint Airborne Lidar Bathymetry Technical Center of Expertise

2012 National Coastal Mapping Program

Actual with Fugro collecting Lake Michigan

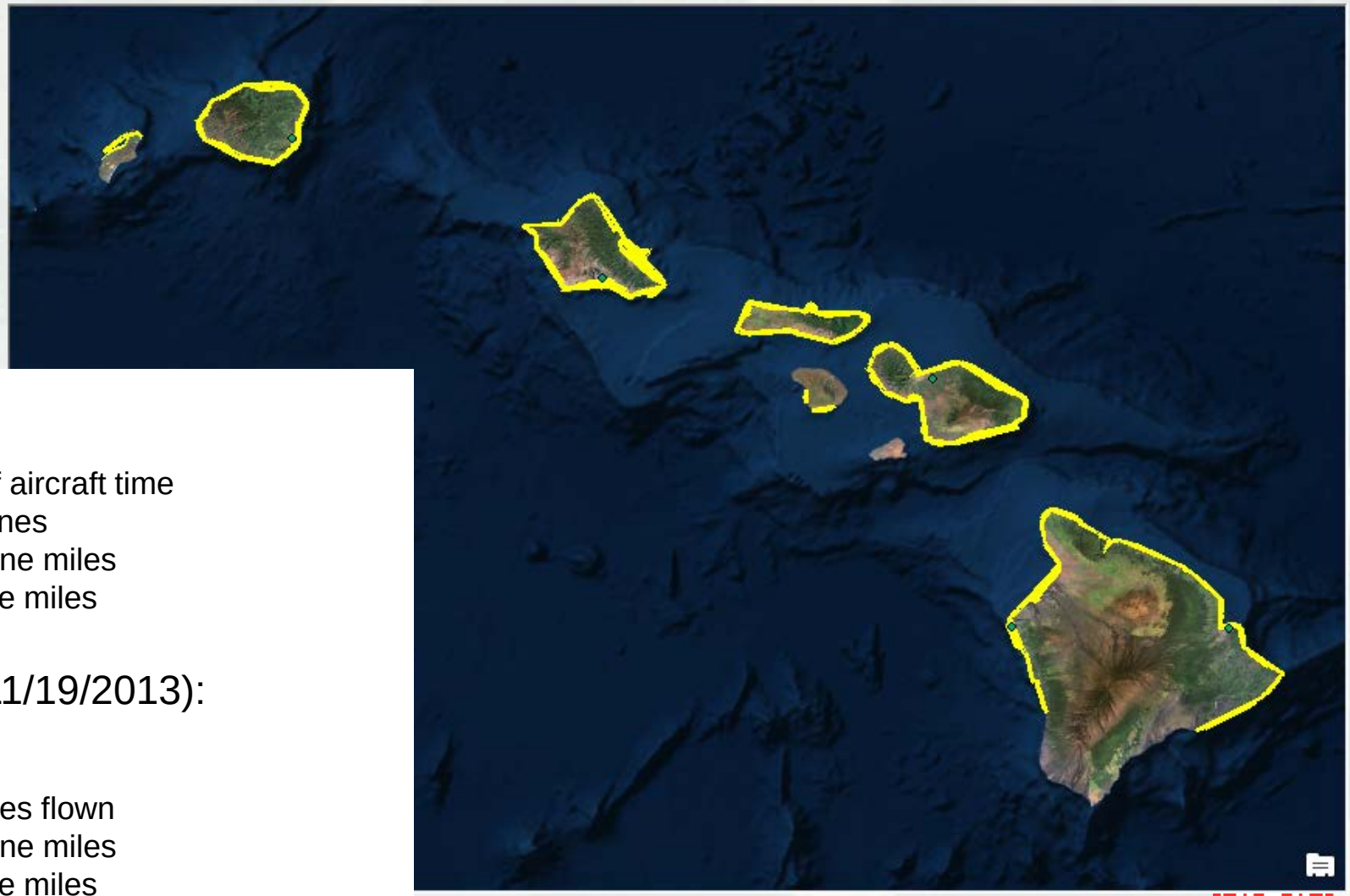


All products delivered!

Thanks to Mark Brooks (Magnolia River) for helping to expedite the processing

2013 NCMP – where we left off

2013 NCMP Hawaii Status



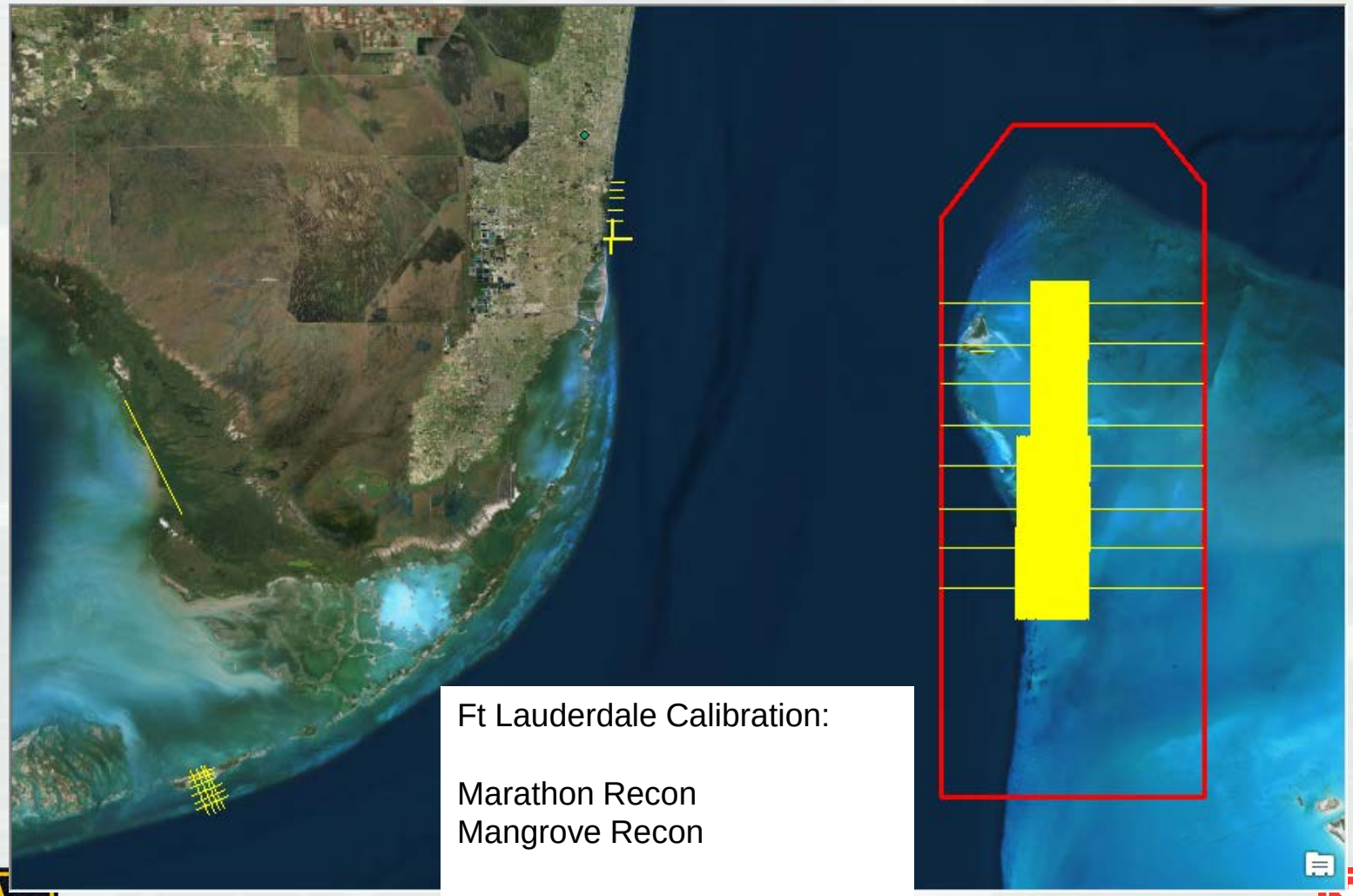
Planned:

90 Days
355 Hours of aircraft time
1143 Flight lines
8740 Flight line miles
147 Shoreline miles

Current (11/19/2013):

80 Days
330 Hours
925 Flight lines flown
7100 Flight line miles
108 Shoreline miles
2.4 Billion Laser shots (~100B returns)
Estimated 10-16 days left

2014 NCMP

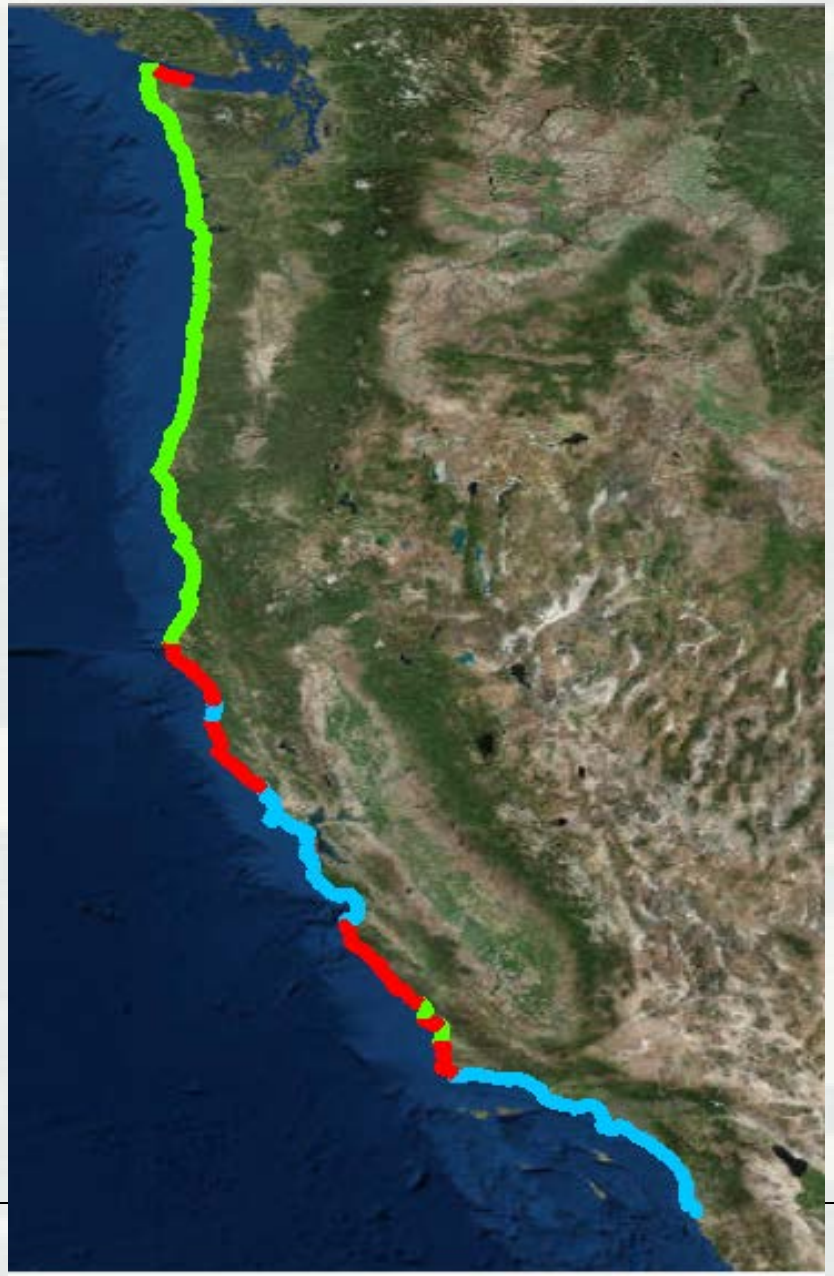


Ft Lauderdale Calibration:

Marathon Recon
Mangrove Recon

Bahamas:
25 Days
55 Hours
273 Flight lines flown

2014 NCMP



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2013-2014 CZMIL Review

Nicholas Johnson

Physical Scientists

JALBTCX Workshop - Mobile, AL

June 11th, 2014

US Army Corps of Engineers

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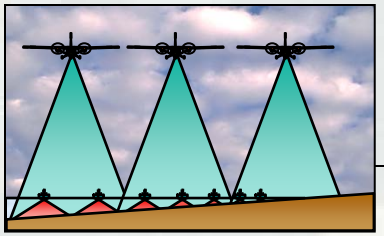
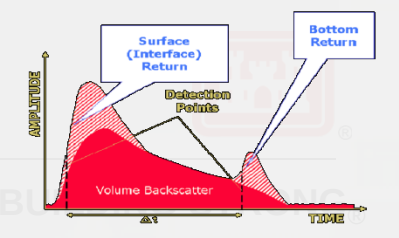
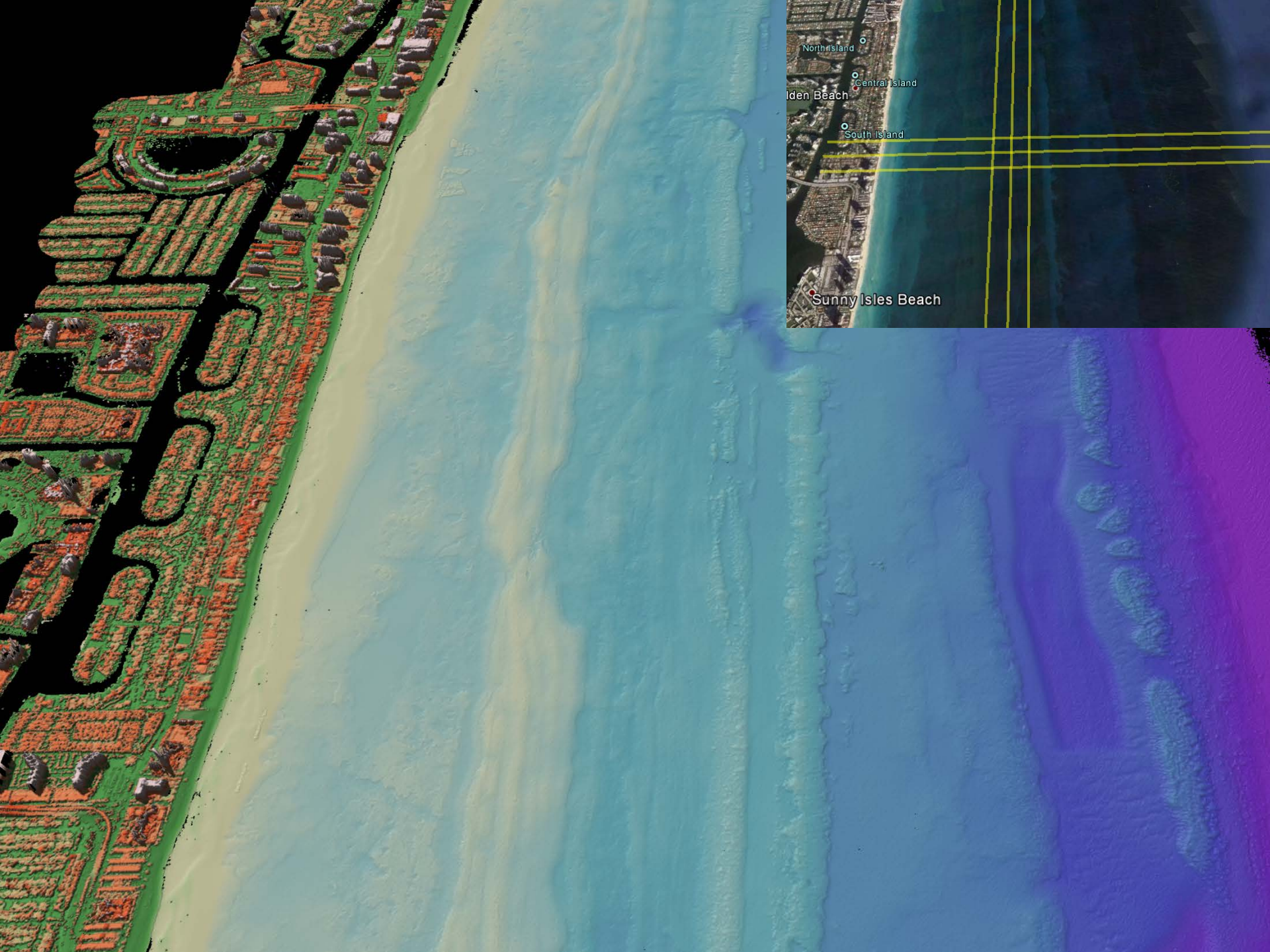
Joint Airborne Lidar Bathymetry Technical Center of Expertise

Outline

- Relative Accuracy and Bathy LUT
- Ops and Calibration Improvements
- HI Shallow and Deep Channel Alignment
- To Do List

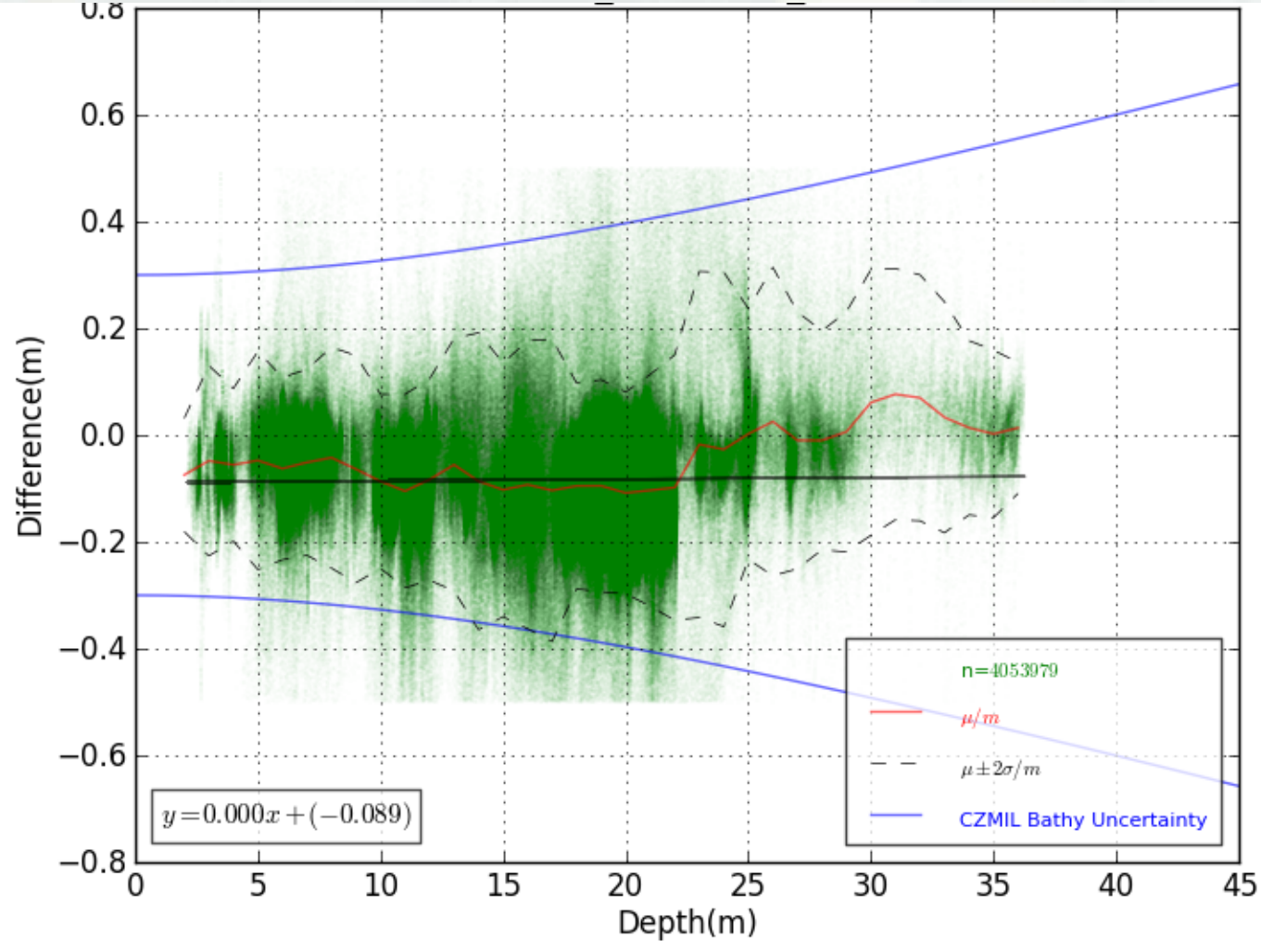





North Island
Central Island
South Island
Sunny Isles Beach

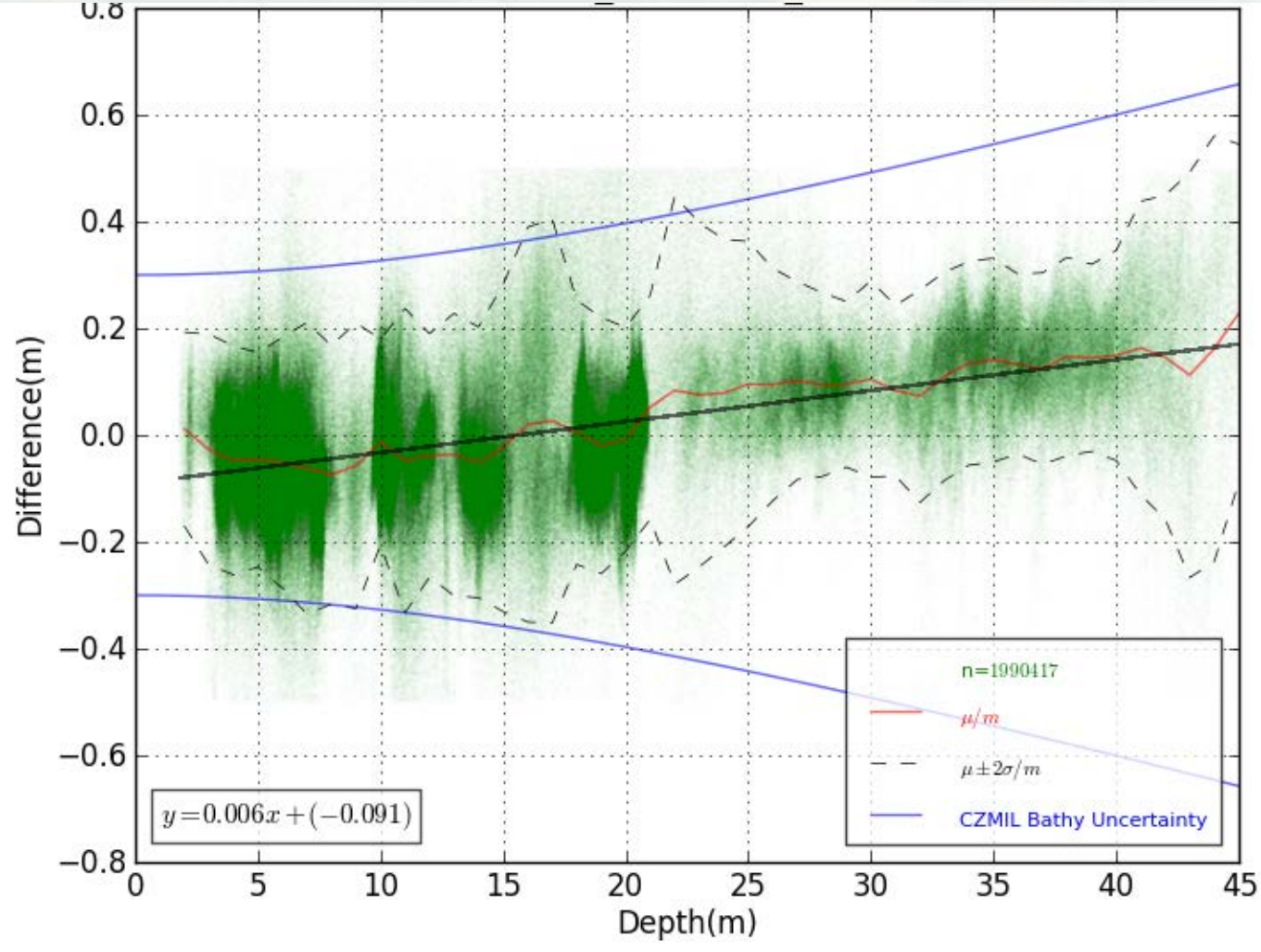
Relative Accuracy and Bathy LUT

2005 SHOALS – MBES source 1



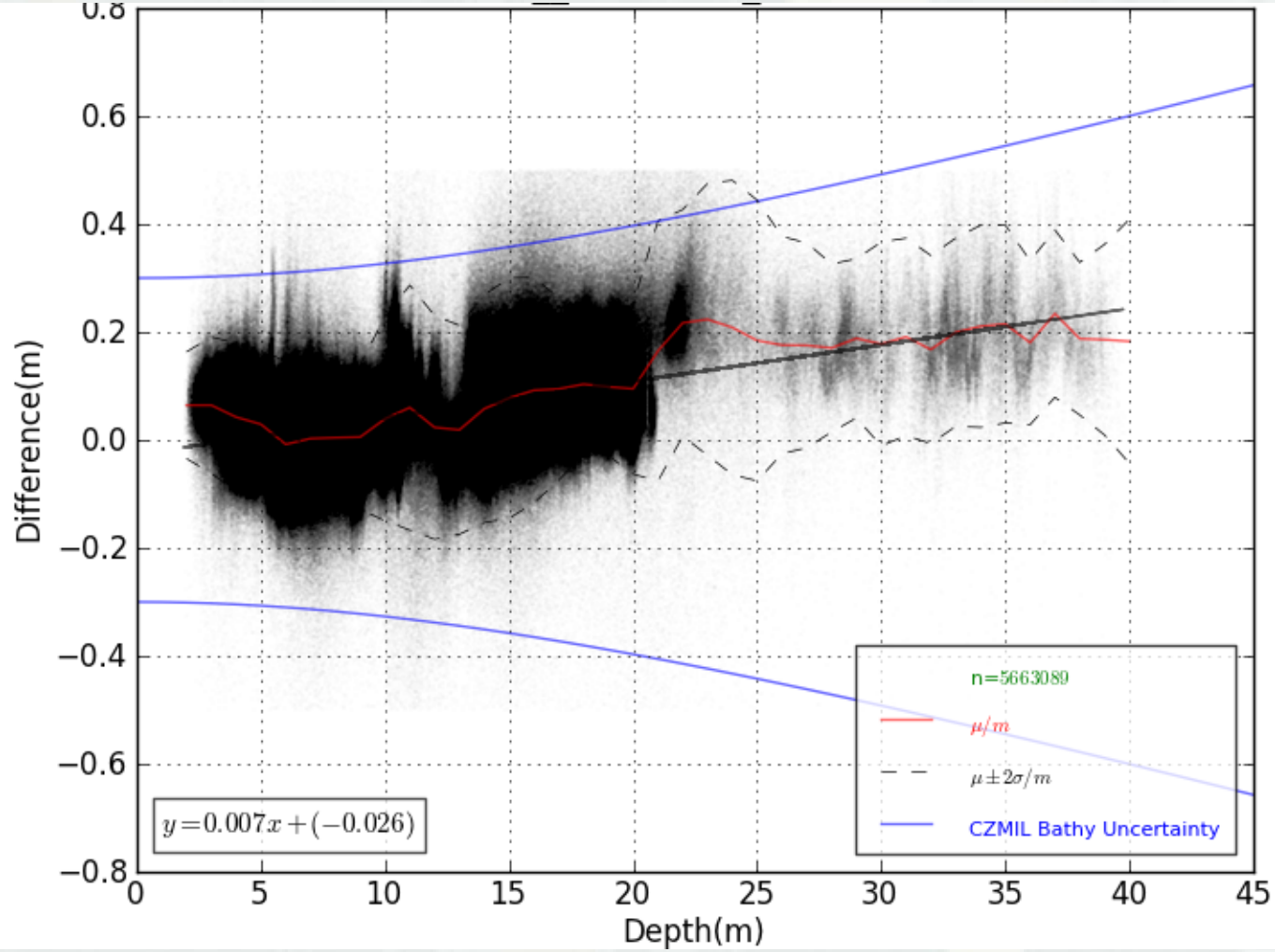
Relative Accuracy and Bathy LUT

2005 SHOALS – MBES source 2

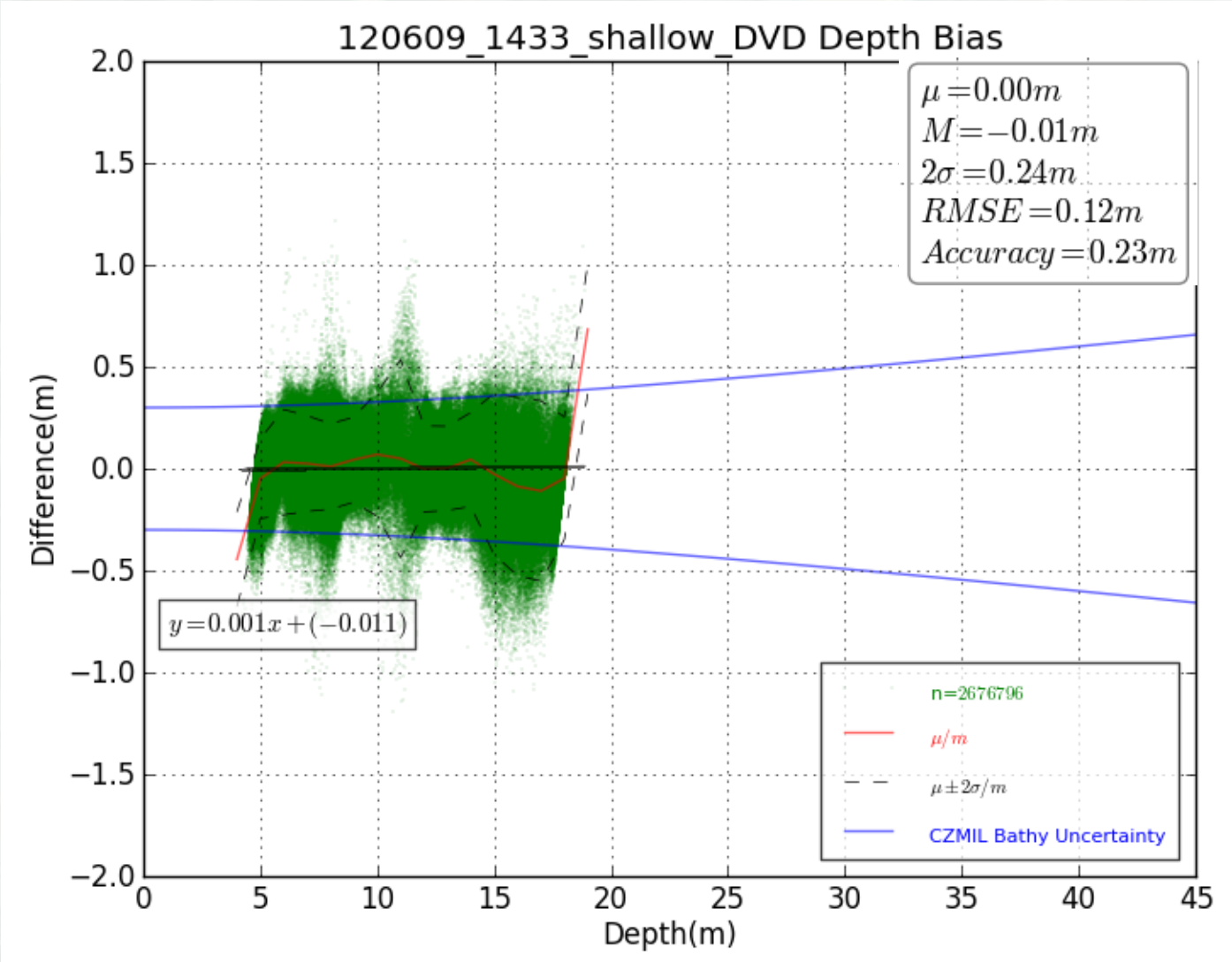


Relative Accuracy and Bathy LUT

MBES 1– MBES 2



Relative Accuracy and Bathy LUT
2005 SHOALS - CZMIL 01



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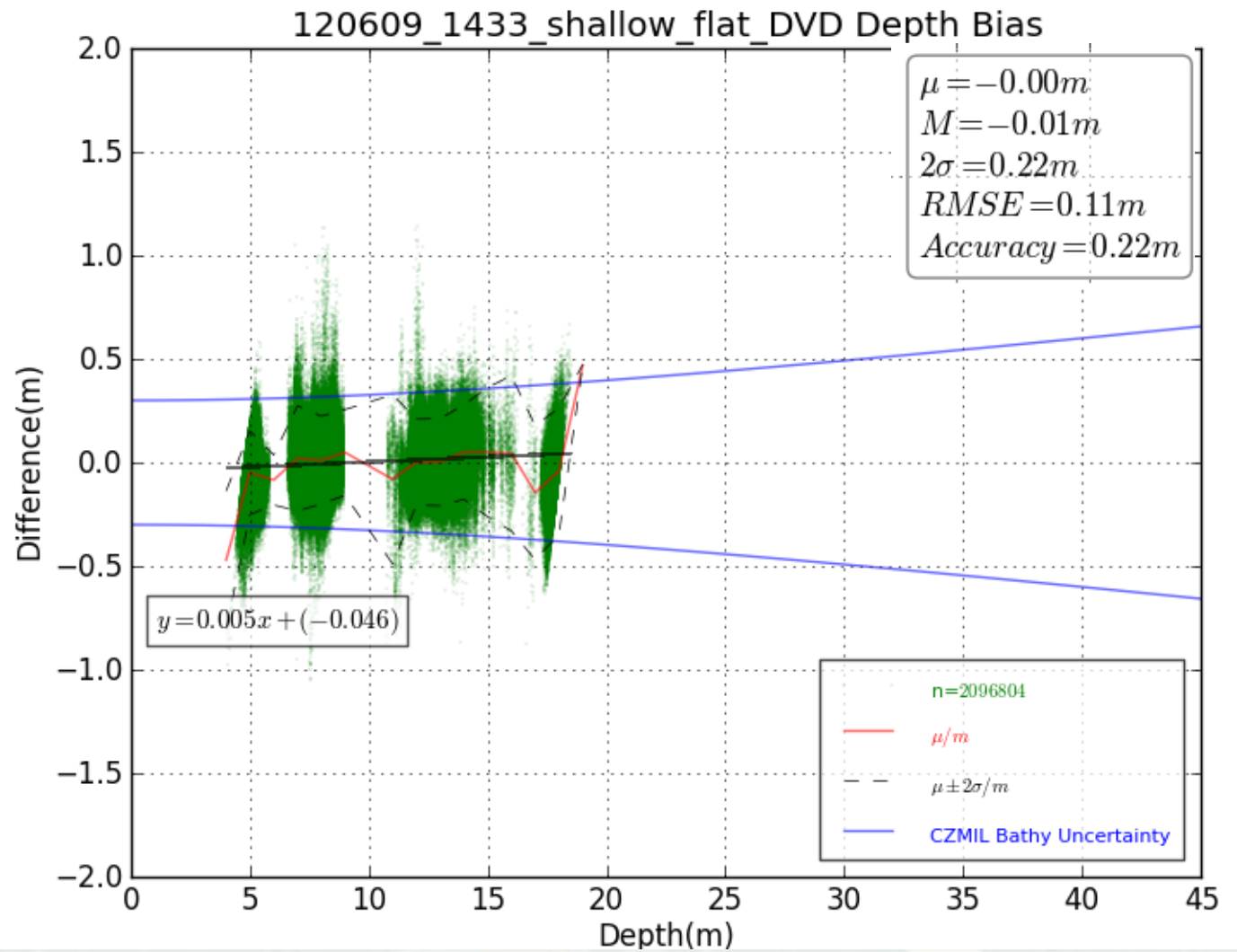
2005 SHOALS - CZMIL 01



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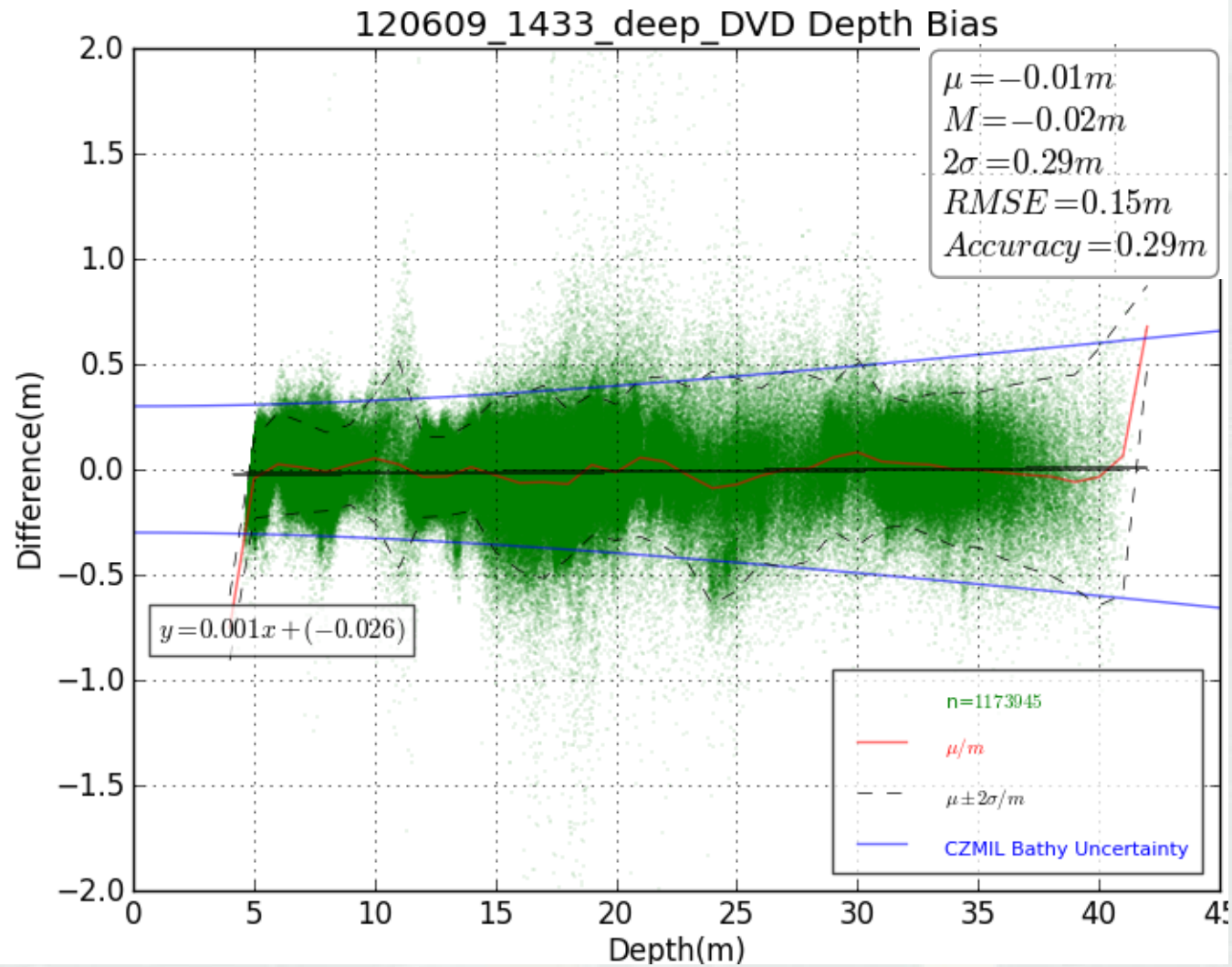
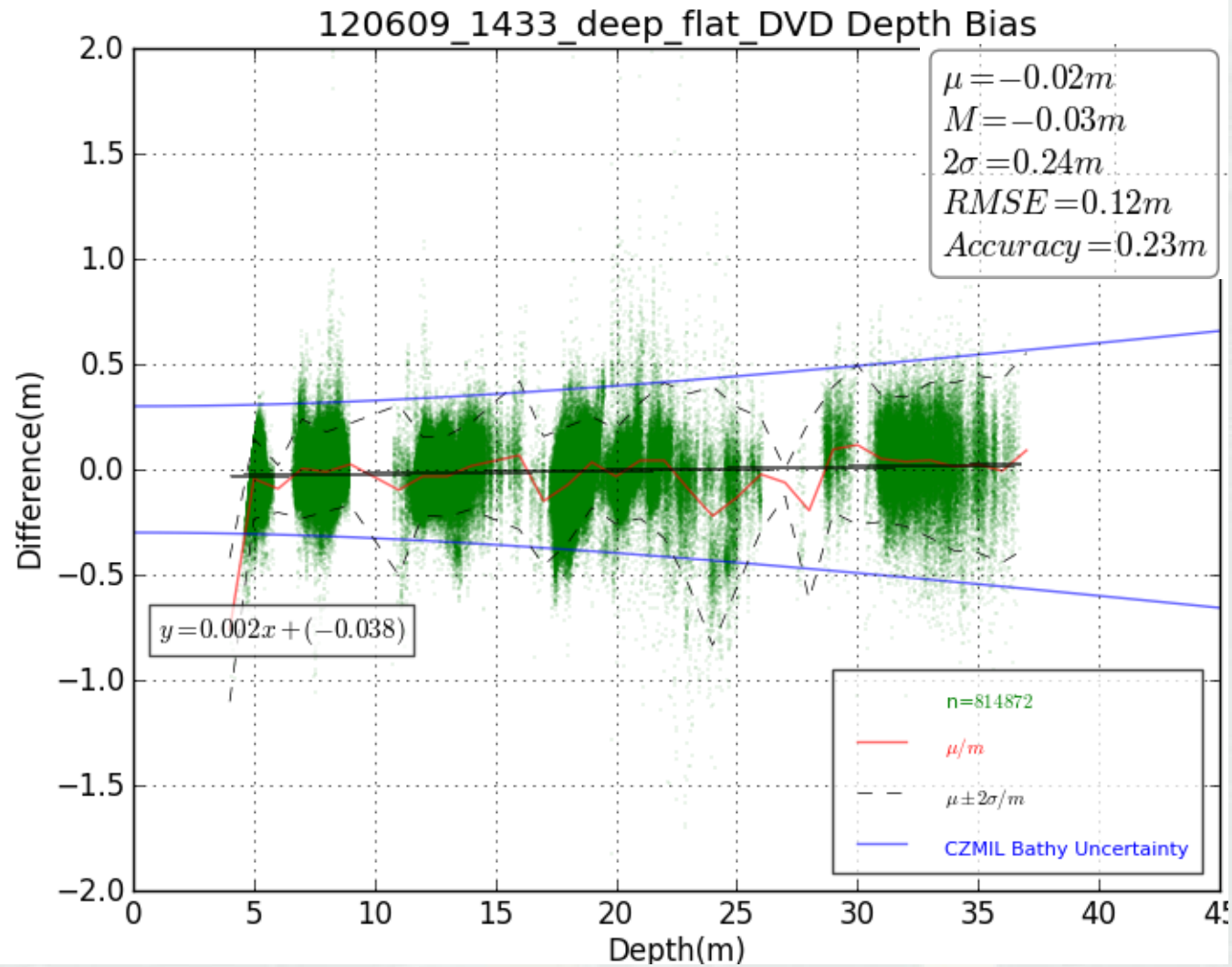
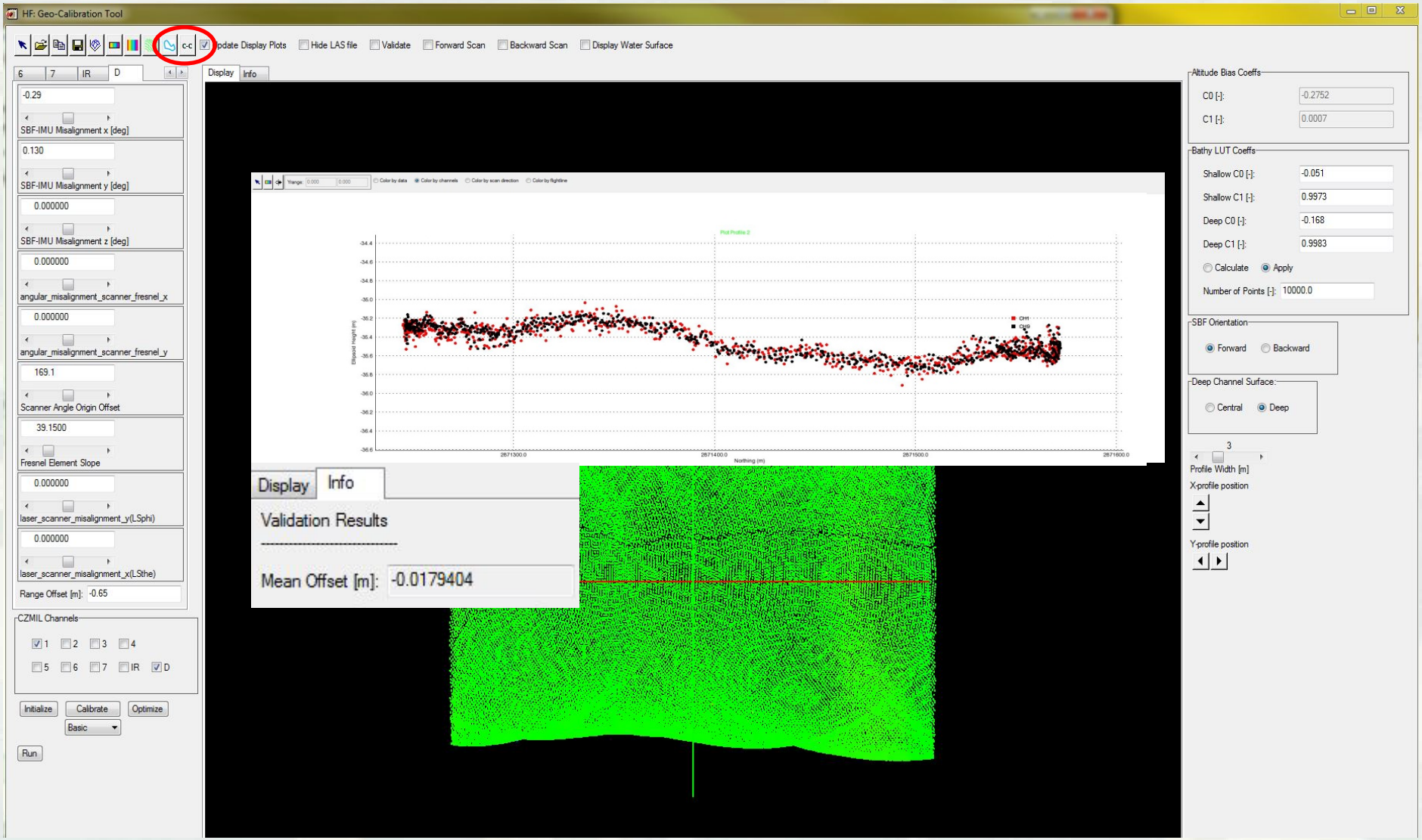
Relative Accuracy and Bathy LUT
2005 SHOALS - CZMIL 01



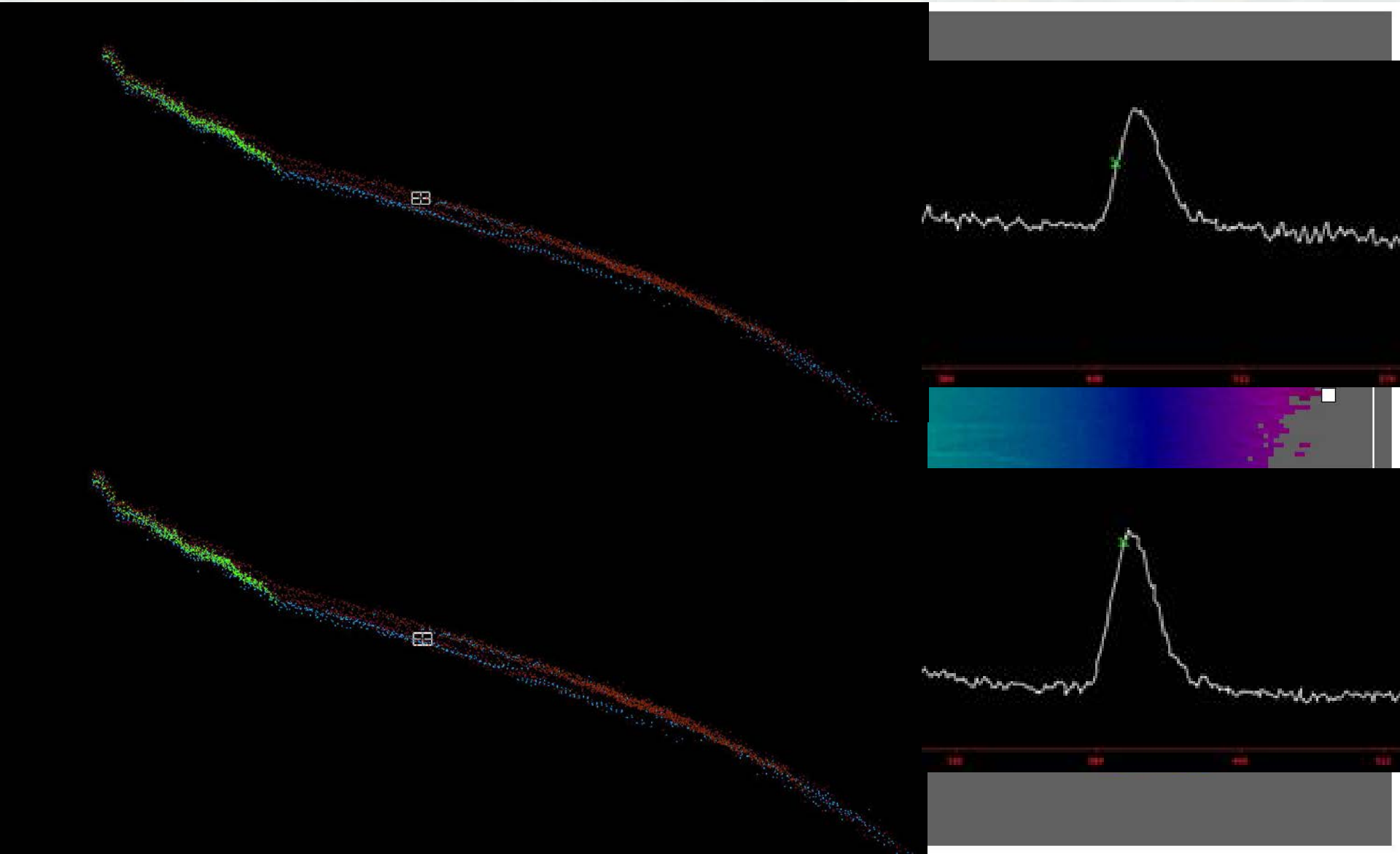
Relative Accuracy and Bathy LUT
2005 SHOALS - CZMIL 01



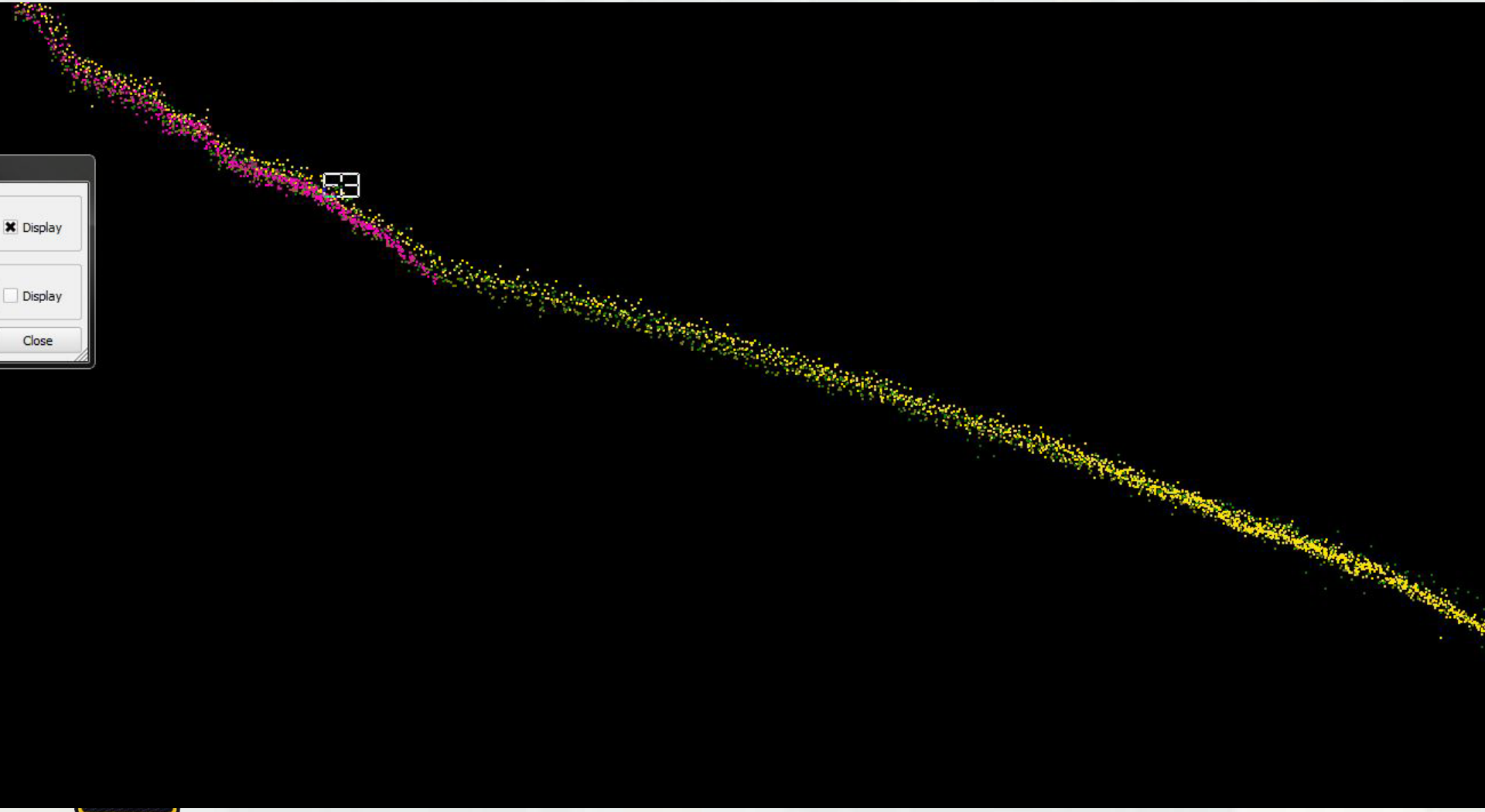
Ops and Calibration Improvements
Deep Surface Calibration



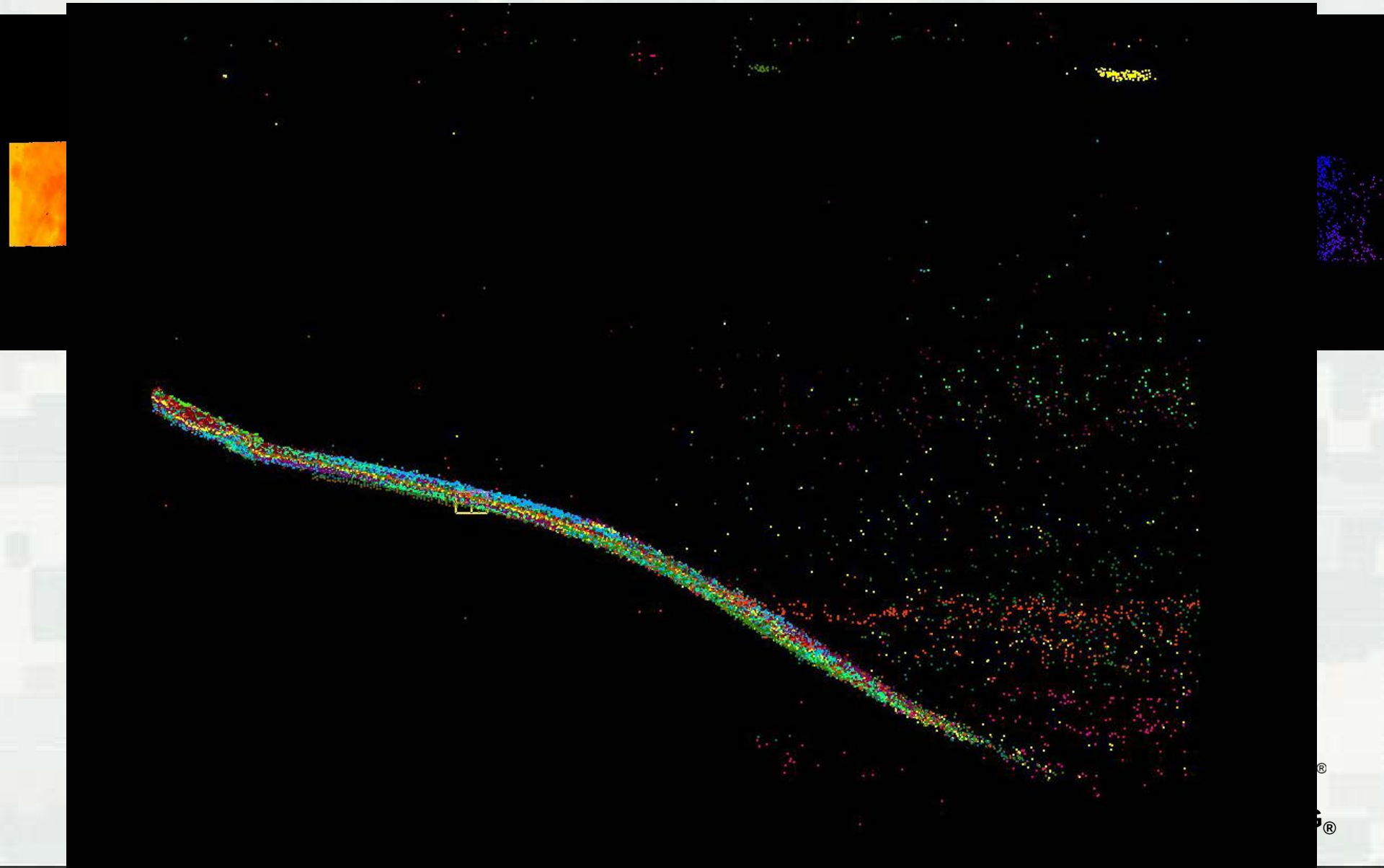
Ops and Calibration Improvements
Range Walk



Ops and Calibration Improvements
Range Walk

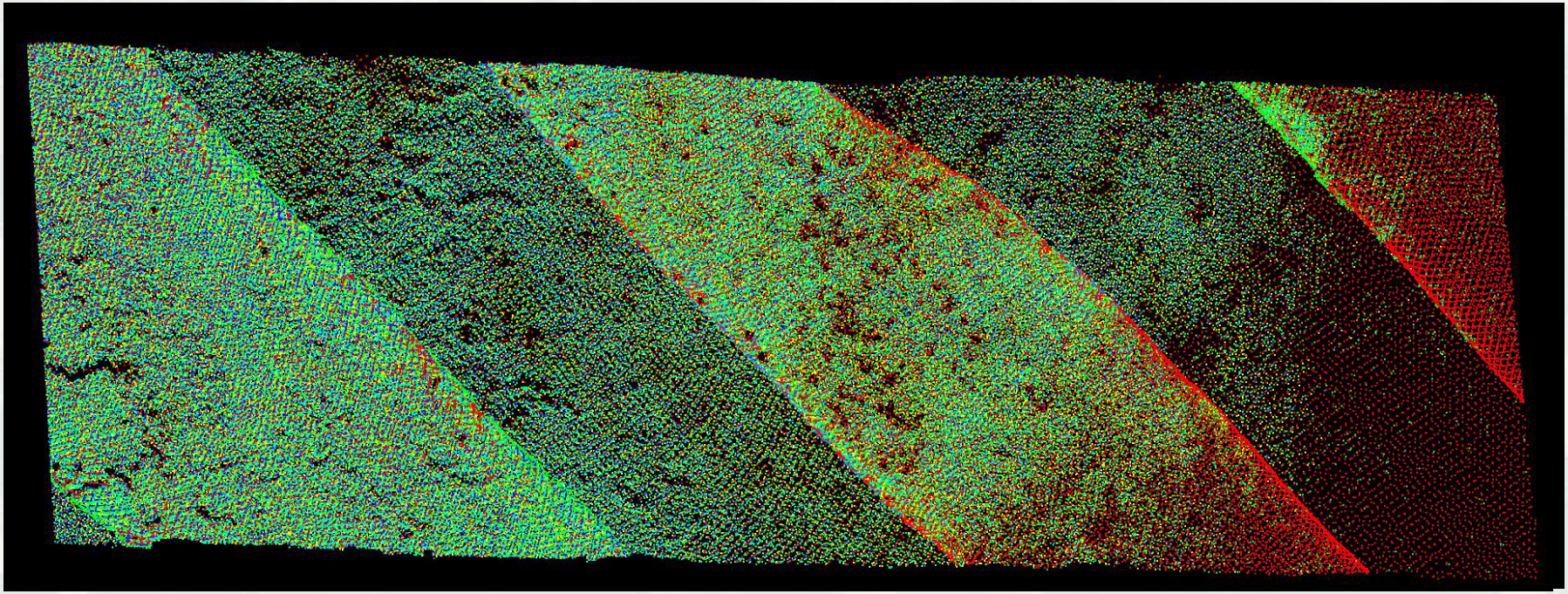


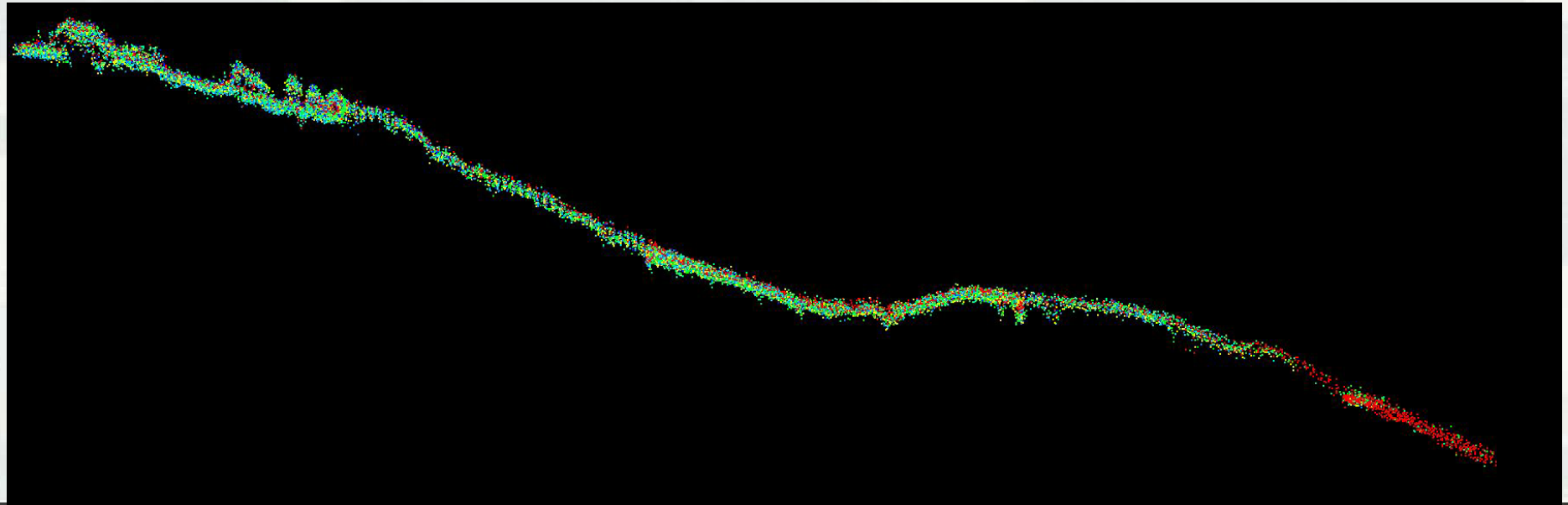
Ops and Calibration Improvements
Probability of Detection/SNR



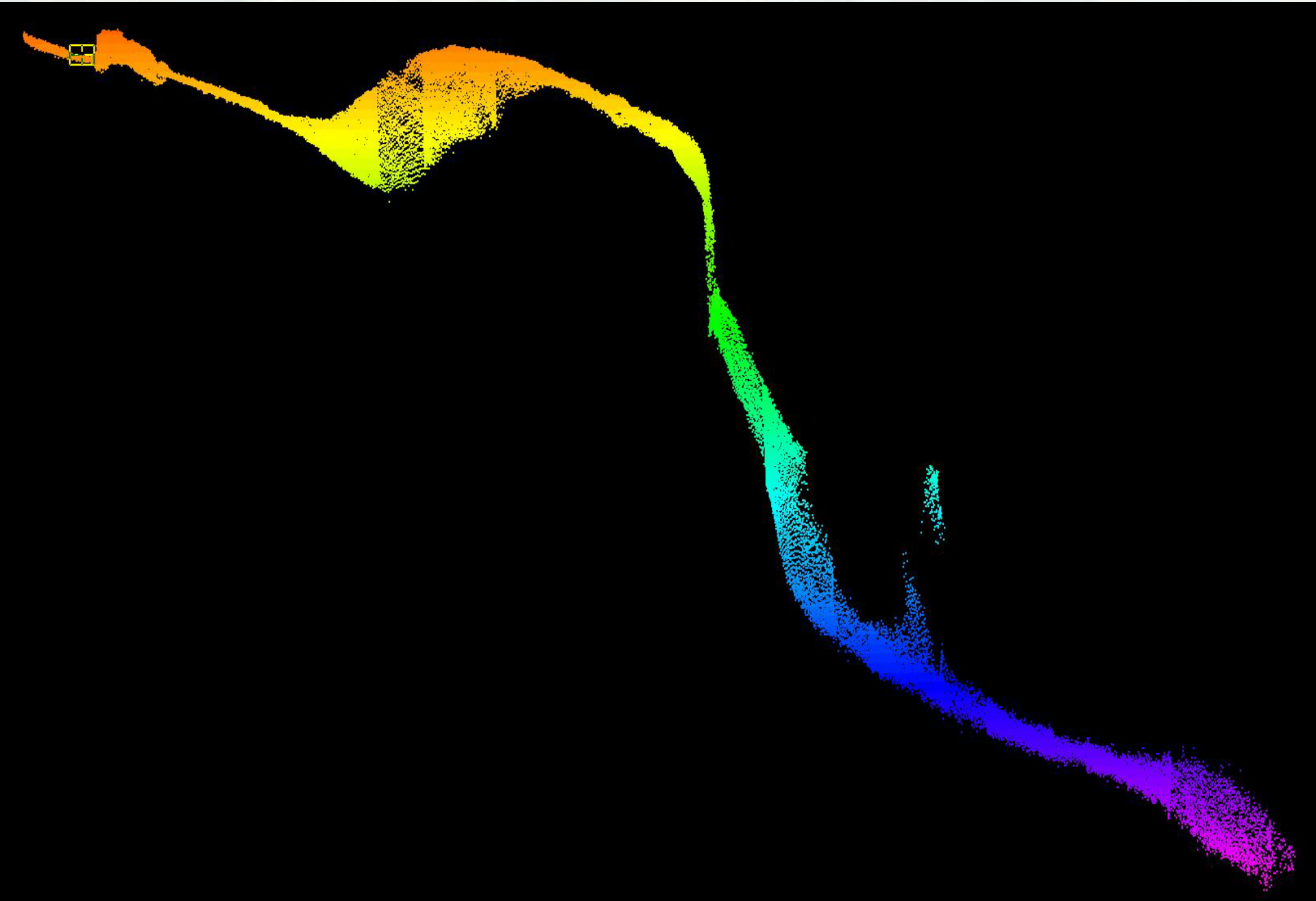
HI Channel Alignment

HI Channel Alignment





HI Channel Alignment



To Do List

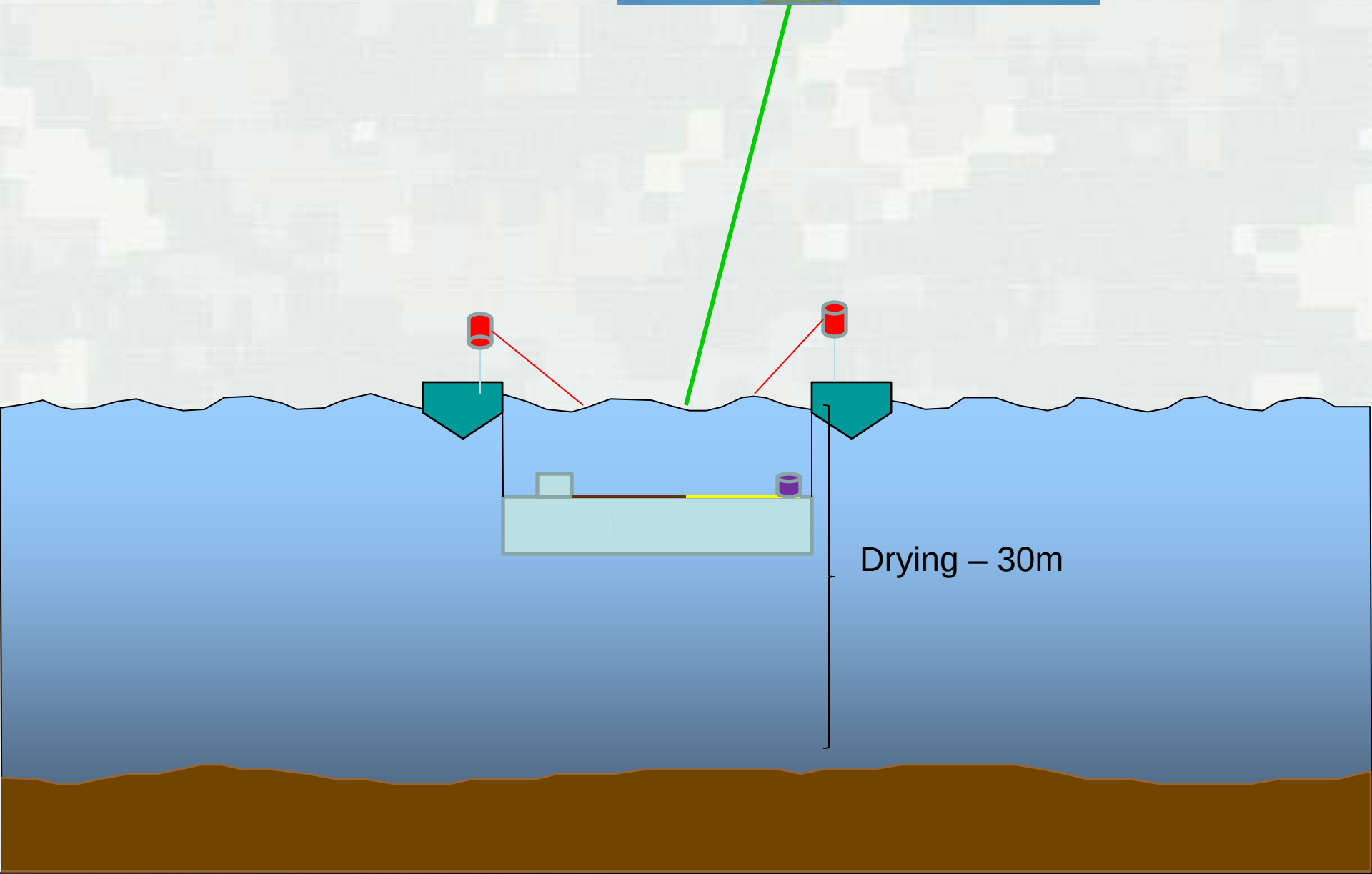
- CZMIL comparison to MBES

- LUT response to different environments (Seattle, Duck, Lake Ontario)

- QA\QC Topo-bathy best practices

- Active participation in partner's push for TPU and additional Data Quality Management tools

BAR CHECK



Imagery? Present!

J. Heath Harwood

Physical Scientist

USACE Mobile District, Spatial Data Branch / Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX)

15th Annual JALBTCX Airborne Coastal Mapping & Charting Technical Workshop

June 12th, 2014

US Army Corps of Engineers
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Joint Airborne Lidar Bathymetry Technical Center of Expertise

Talking Points

- JALBTCX Cameras and Spectrometers
- Challenges: Collection and Processing
- Future Enhancements
- Goals: Metadata and Meeting Accuracy Standards
- Summary

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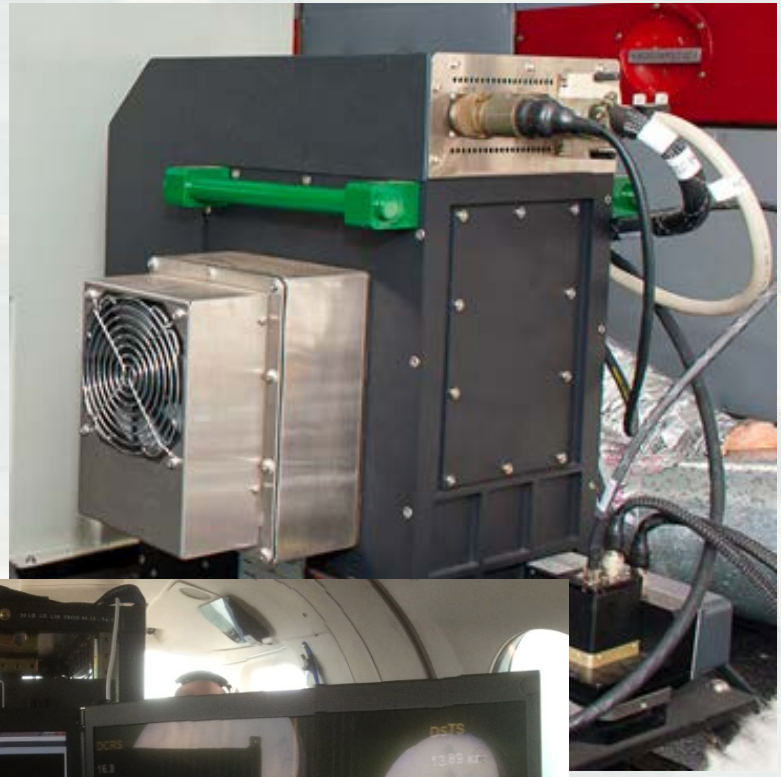
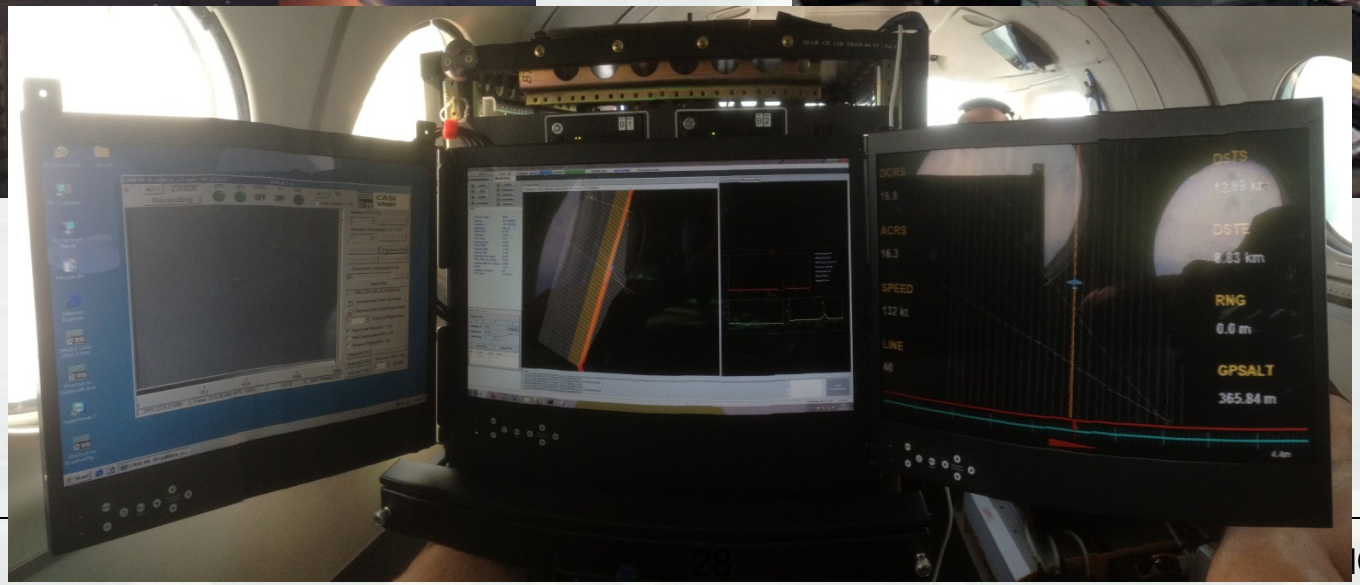
CASI 1500 Spectrometer





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CASI 1500 HSI Collection Parameters Spectral Mode

- Commensurate with Lidar Collection at 400m AGL
- Spectral Mode (360.1 – 1051.7nm), 48 bands
- 0.7m AlongTrack; 0.4m AcrossTrack;
- Integration Time 10ms
- Collection 0.5m GSD; Product 1.0m GSD

- High Altitude 2000m AGL
- Spectral Mode (360.1 – 1051.7nm), 48 bands
- 0.7m AlongTrack;

  1.0m AcrossTrack;
- Integration Time 10ms
- Collection 1.0m GSD; Product 1.0m GSD

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CM-4800S RGB Camera

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CM-4800S RGB Collection Parameters

- Commensurate with Lidar Collection at 400m AGL; High Altitude at 2000m along with HSI collection
- 3 Band R(590-700nm), G(480-610nm), B(400-560nm)
- 4904x3280 Sensor, 7.4µm
- Iteration Time 2s; Integration 1ms
- Collection 0.057m GSD at 400m; Products 0.06m for FNP's, 0.20m for Production Blocks
- Collection 0.287m GSD at 2000m; Products 0.30m for FNP's, 0.30m for Production Blocks

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Challenges?

Challenges: Collection Conditions

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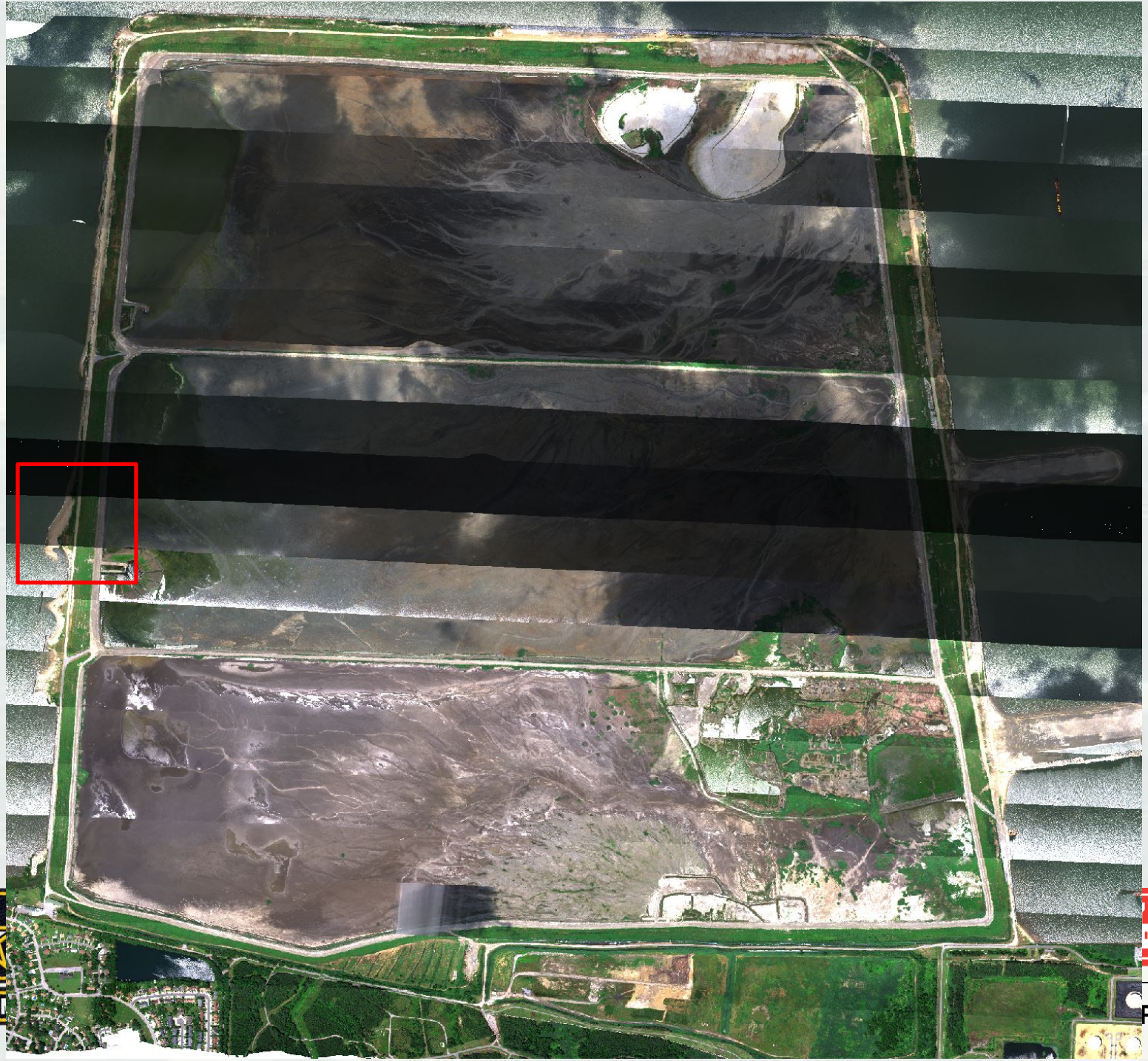

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Challenges: System Reliability

- HSI system is a work horse
- RGB Camera has had timing issues
- Shutters have been known to fail

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Challenges: Processing

- Overlap Pixel Handling for Mosaics
- HSI **algorithms** in Hydrofusion have needed **tweaking** in order to produce the most accurate coastal **reflectance** products
- Camera **timing issues** have occasionally caused unwanted **offsets**; working with manufacture closely to produce **precise timing**
- Better handling of **frame to frame overlap**

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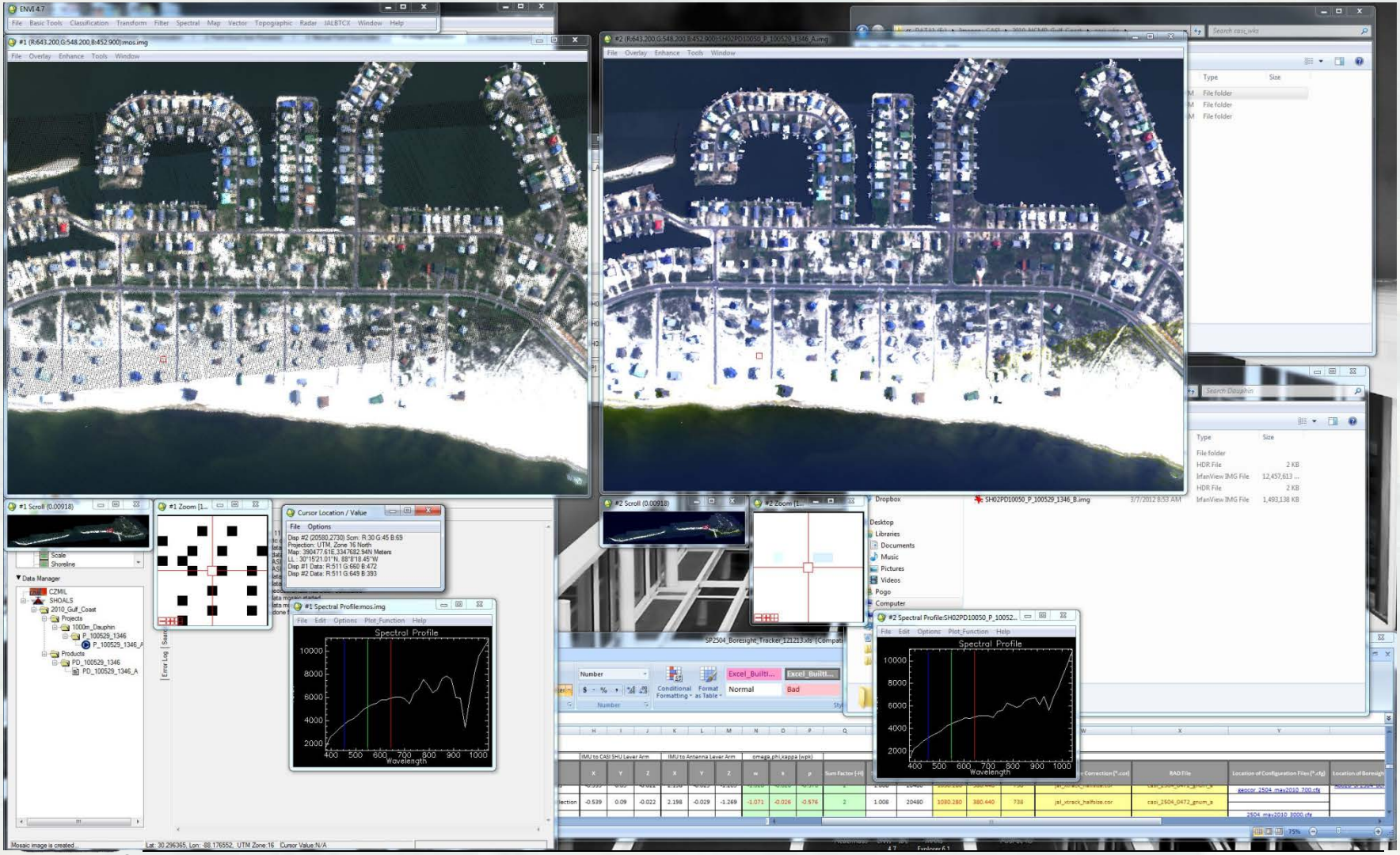
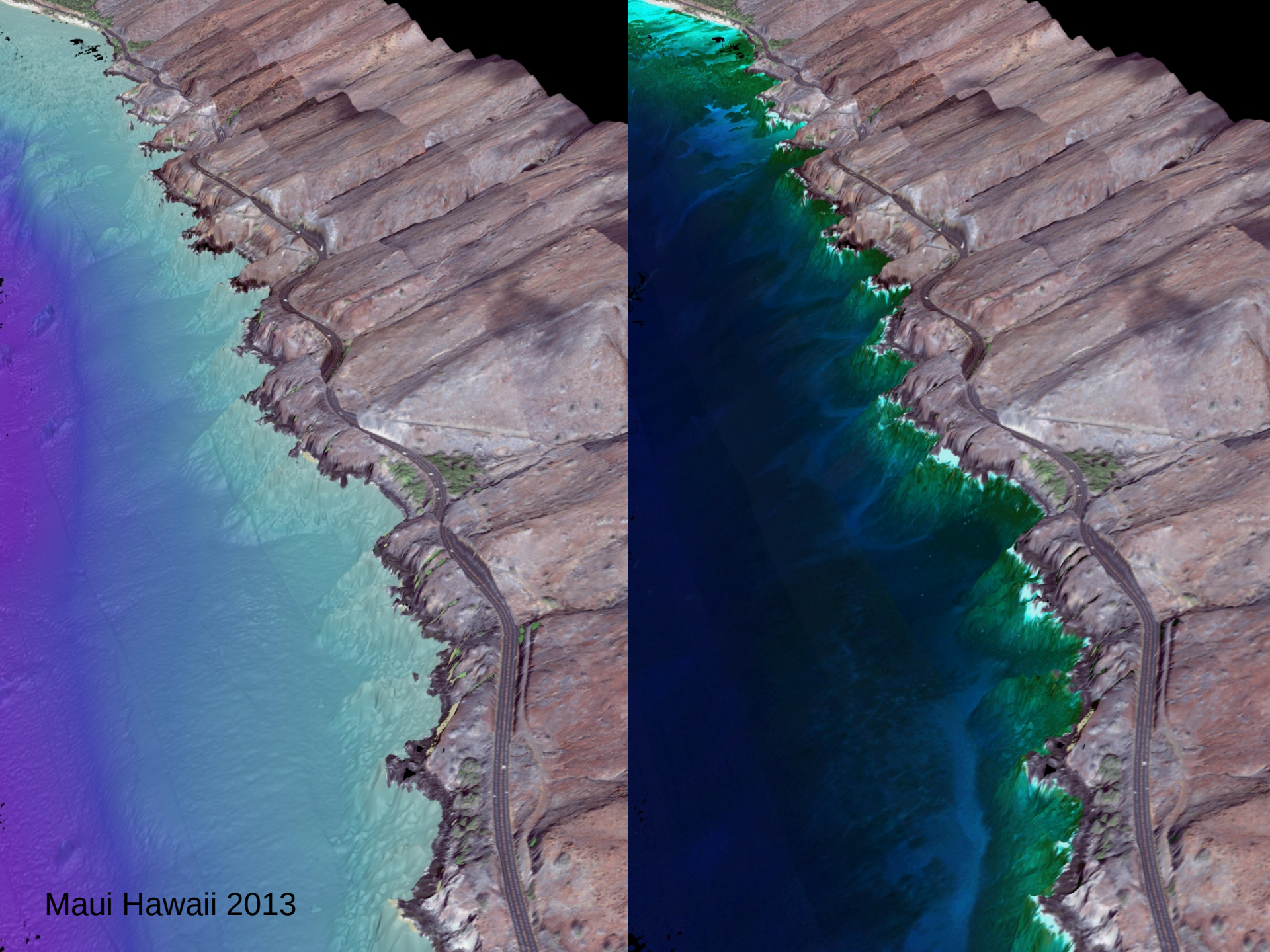
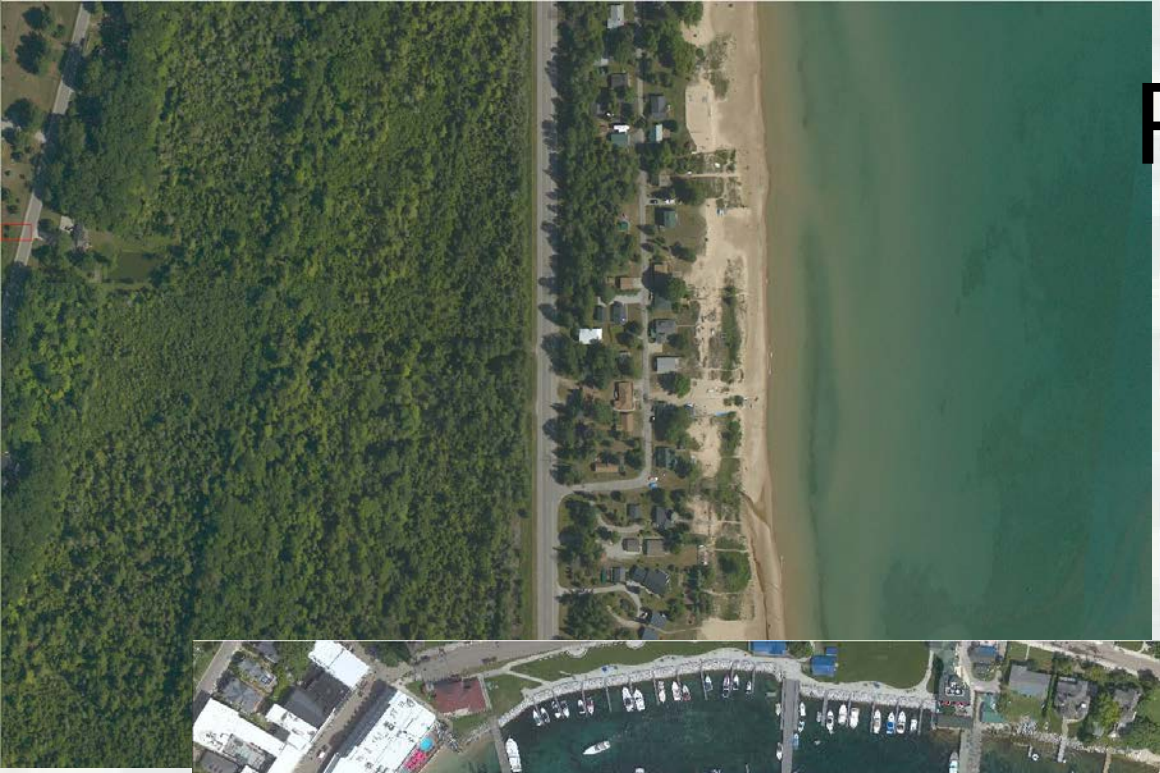
HSI Examples



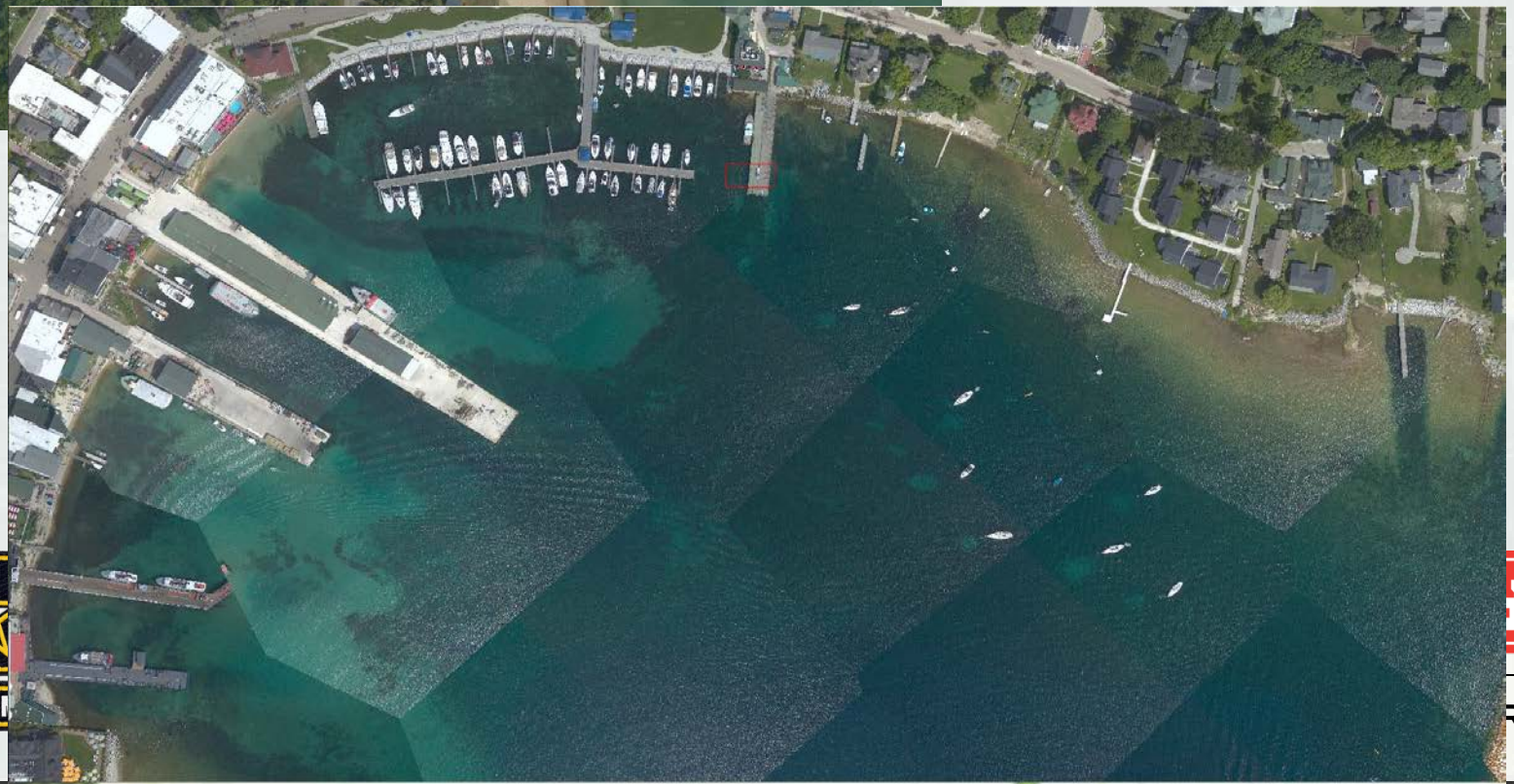

Maui Hawaii 2013

RGB Results



Lake Huron 2013

Mackinac Island 2013



Radial Distortion and Frame to Frame Offsets

Future Enhancements

HSI

- Atmospheric Correction for both land and coastal bathymetry (currently mostly bathymetric corrections that can – in certain conditions - skew land corrections)

RGB

- Manufacturer is testing new camera without shutter; more precise timing
- Development of more accurate automated boresight procedure
- Radial Distortion?

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Future Enhancements

- Developed Multiple Workflows for HSI processing
  - ▶ Hydrofusion > Main Workflow
    - Output Radiance Mosaics (if requested)
    - Output to Reflectance
    - DataFusion products
  - ▶ Hydrofusion > Radiance Files
    - Input for other Atmospheric Correction Algorithms.
      - ▷ FLAASH (Fast Line of Sight Atmospheric Analysis Hypercubes or QUAC (Quick Atmospheric Correction)

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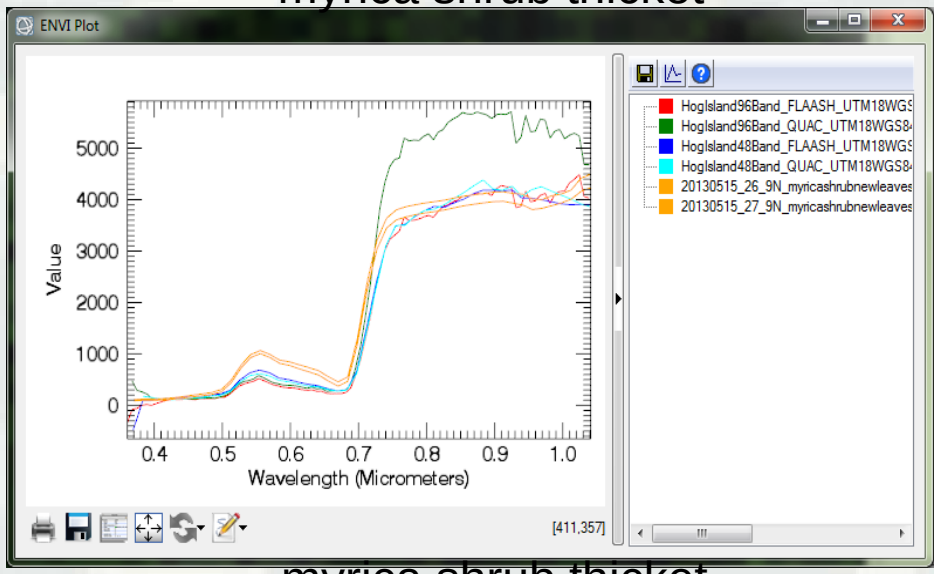
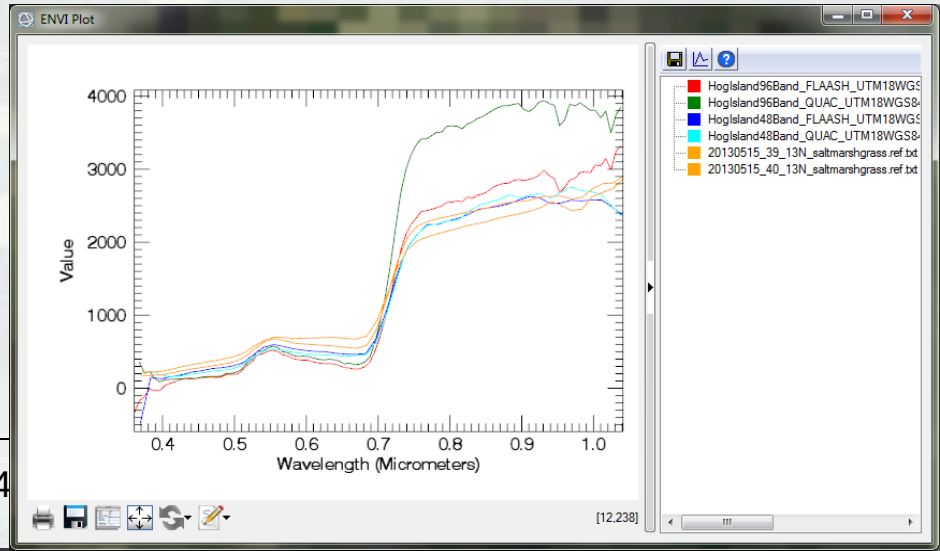
Preliminary Assessment

- Hog Island HSI data
- Land only atmospheric correction
- Used QUAC and FLAASH reflectance output for comparison of ground spectra

myrica shrub thicket



myrica shrub thicket



Goals: Metadata and Accuracy Standards

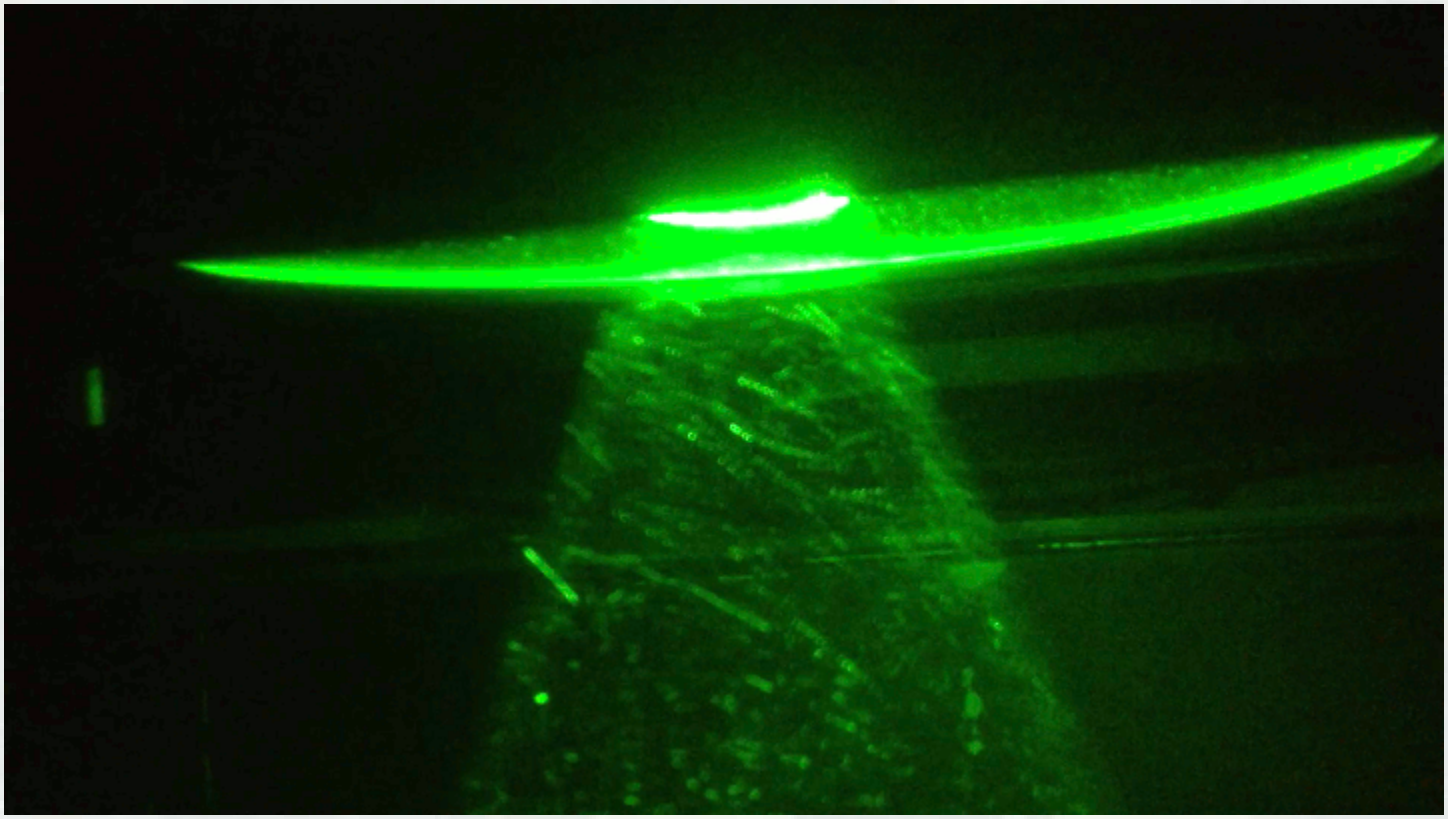
- Accurate more concise metadata and formatted deliverables; for JALBTCX collected data and sub-contractors
- ISO 19115-1 & 19115-2 Compliant
- Calibration –> Collection –> Processing –> Validation Metadata
- Comply with Horizontal and Vertical accuracies*

*ASPRS_Accuracy_Standards_for_Digital_Geospatial_Data_DRAFT_March21_2014_Rev3_V1 And USACE EMs

Summary

- Imagery delivery on special request
- Mass production data when metadata and accuracy compliance is met
- Working towards building end-user delivery system
- Variety of products that best suit the end-users needs

Questions?

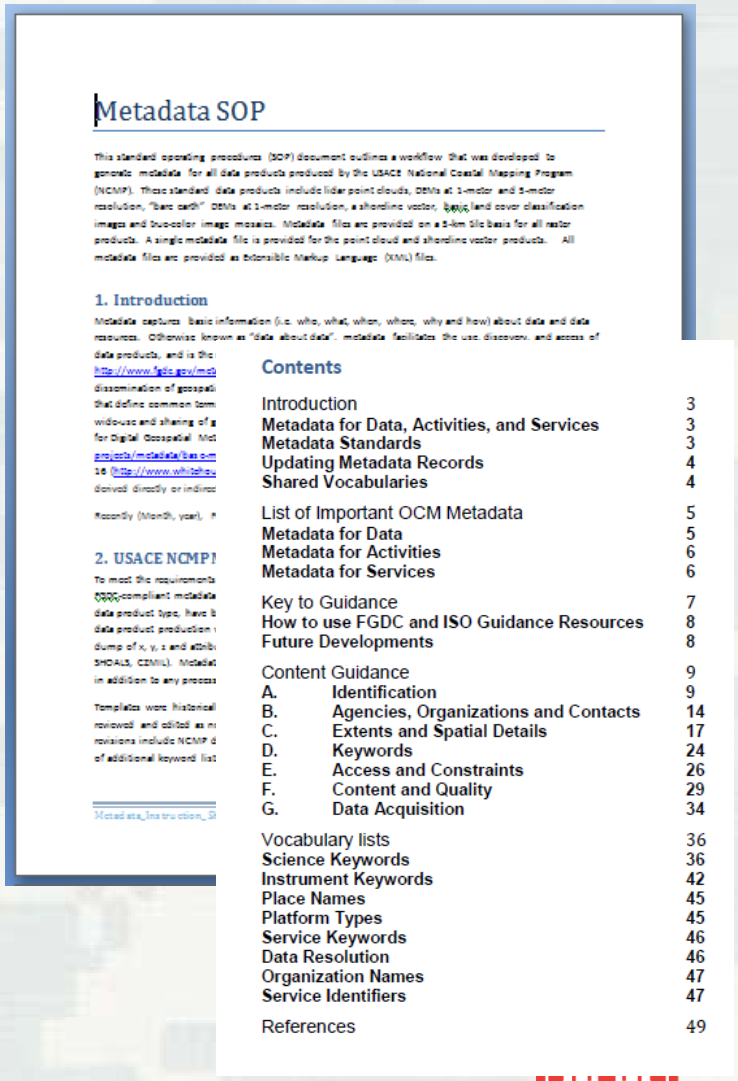


joseph.h.harwood@usace.army.mil
228-252-1109

NCMP ISO Metadata Implementation

USACE NCMP Metadata: Current Status

- Compliant with the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM)
- Utilization of standard keyword lists and IOCM best practices
- Complete documentation of product lineage
- Automation through templates and Python
    - Dissemination/harvest by WAF



Metadata SOP

This standard operating procedures (SOP) document outlines a workflow that was developed to generate metadata for all data products produced by the USACE National Coastal Mapping Program (NCMP). These standard data products include lidar point clouds, DEMs at 1-meter and 5-meter resolution, "bare earth" DEMs at 1-meter resolution, a shoreline vector, land cover classification images and two-color image mosaics. Metadata files are provided on a 5-km tile basis for all raster products. A single metadata file is provided for the point cloud and shoreline vector products. All metadata files are provided as Extensible Markup Language (XML) files.

1. Introduction

Metadata captures basic information (i.e. who, what, when, where, why and how) about data and data resources. Otherwise known as "data about data", metadata facilitates the use, discovery, and access of data products, and is the

2. USACE NCMP

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Updating Metadata Records 4
Shared Vocabularies 4
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Metadata for Data 5
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Metadata for Services 6
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How to use FGDC and ISO Guidance Resources 8
Future Developments 8
Content Guidance 9
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Science Keywords 36
Instrument Keywords 42
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USACE NCMP Metadata: Looking Ahead

- International Standards Organization (ISO) 191**
  - **ISO 19115:2003 Geographic information – Metadata (corrigendum 1):** The base ISO metadata standard for the description of geographic information and services.
  - **ISO 19115 – 2: Geographic information - Metadata - Part 2:** Extensions for imagery and gridded data The base ISO 19115 metadata standard plus extended elements for the description of imagery, gridded data and data collected using instruments, e.g. monitoring stations and measurement devices.

USACE NCMP Metadata: Looking Ahead

- International Standards Organization (ISO) 191**
  - **ISO 19110: Geographic information – Methodology for Feature Cataloging**: An affiliate standard that supports the detailed description of feature types (roads, rivers, classes, rankings, measurements, etc.) in a manner similar to the CSDGM Entity/Attribute Section.
  - **ISO 19119: Geographic information - Services - Amendment 1:** Extensions of the service metadata model. An affiliate standard that supports the detailed description of digital geospatial services including geospatial data portals, web mapping applications, data models and online data processing services.

USACE NCMP Metadata: Looking Ahead

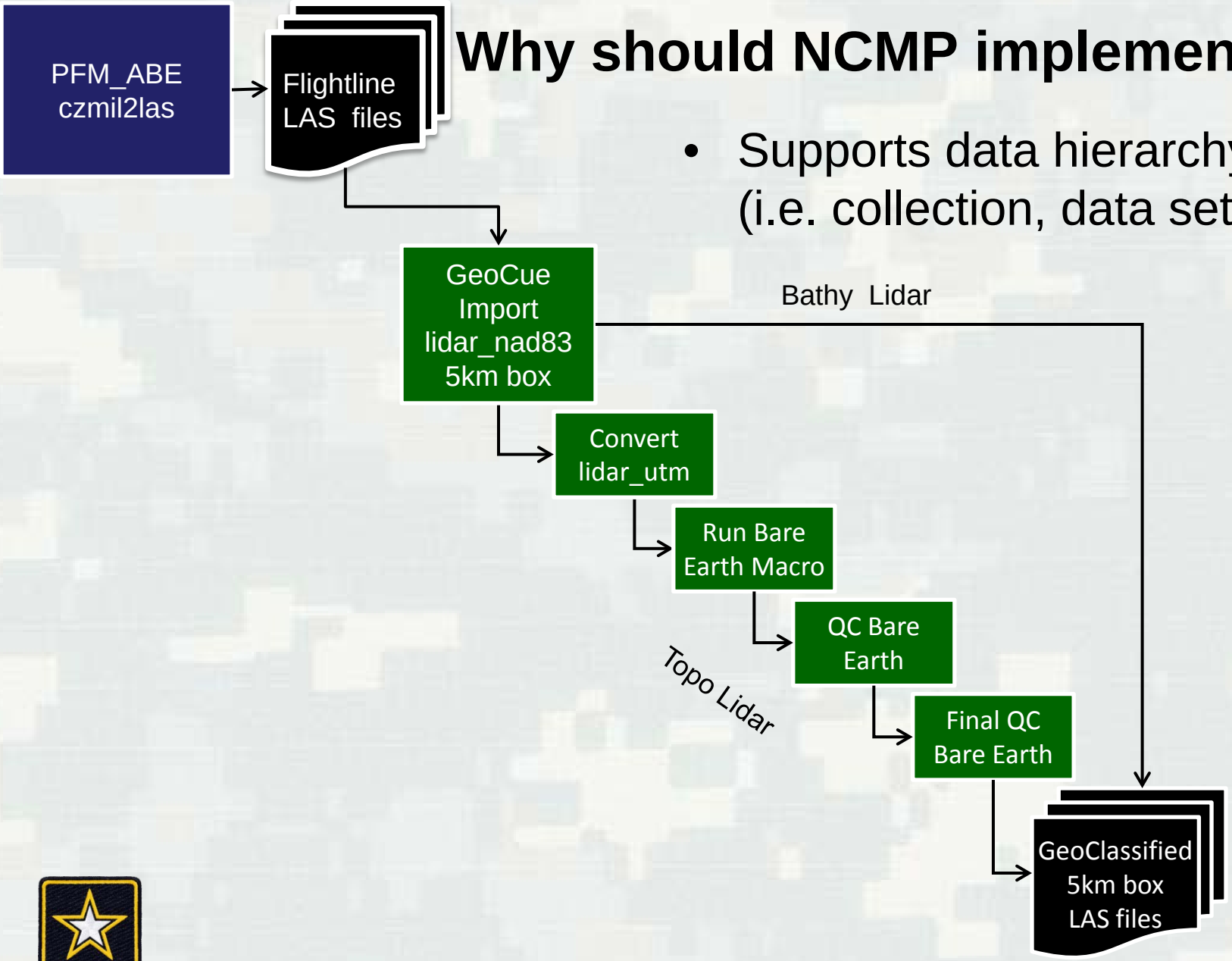
- International Standards Organization (ISO) 191**
  - **ISO 19157: Geographic information - Data Quality:** establishes the principles for describing the quality of geographic data.
  - **ISO 19130-2: Geographic information -- Imagery sensor models for geopositioning -- Part 2: SAR, InSAR, lidar and sonar:** It specifies the sensor models and metadata for geopositioning images remotely sensed by Synthetic Aperture Radar (SAR), Interferometric Synthetic Aperture Radar (InSAR), LIght Detection And Ranging (lidar), and SOund Navigation And Ranging (sonar) sensors.

Why should NCMP implement ISO?

- International scope
- Accommodates new technologies (i.e. services)
- Fewer mandatory elements, increased flexibility
- Improved standardization through the use of code lists, thesauri and vocabularies
  - Global Change Master Directory (GCMD)
  - Geographic Names Information System (GNIS)
  - International Organization for Standardization (ISO) 19115 Topic Categories
  - Coastal and Marine Ecological Classification Standard (CMECS)

Why should NCMP implement ISO?

- Supports data hierarchy (i.e. collection, data set)



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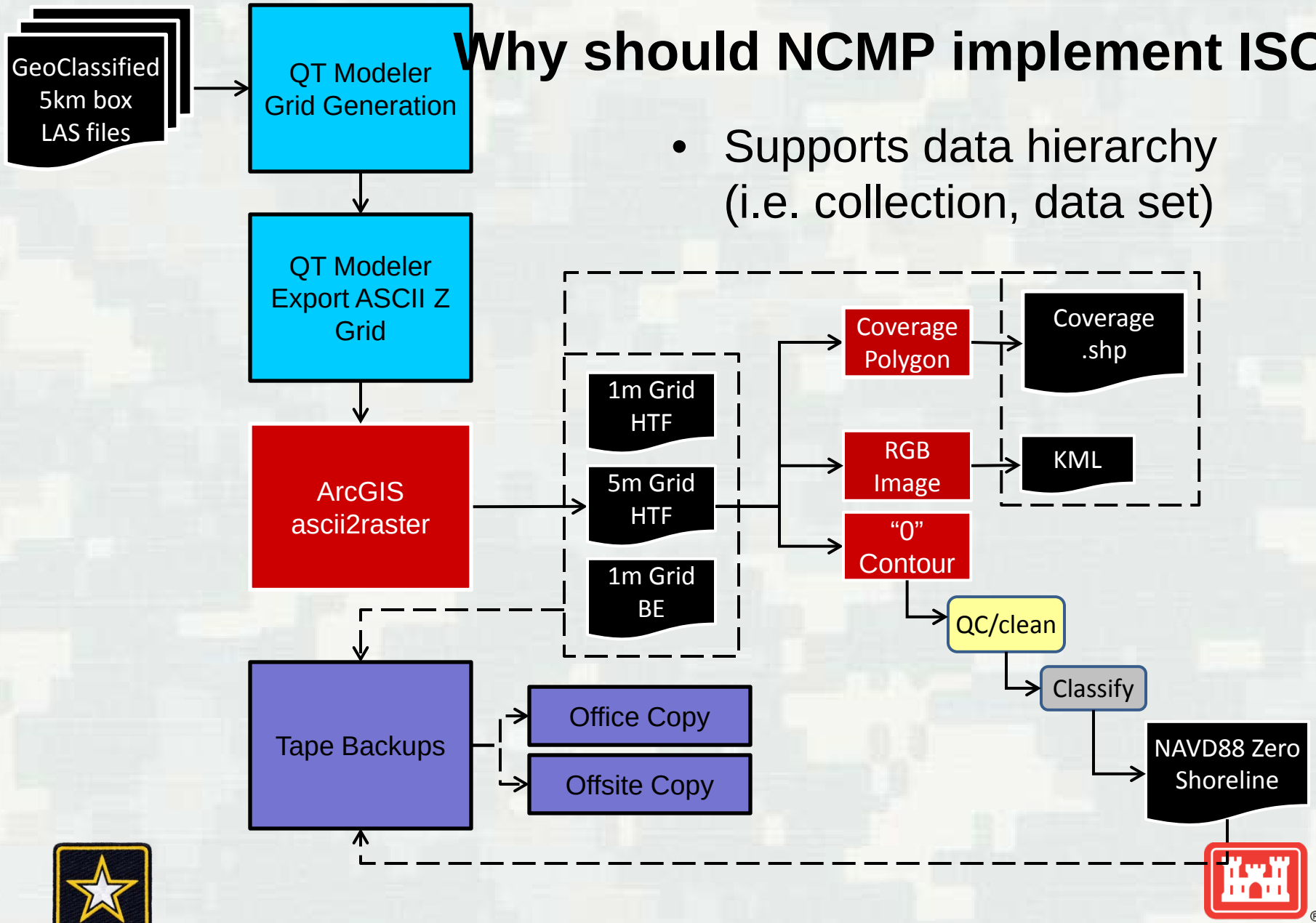

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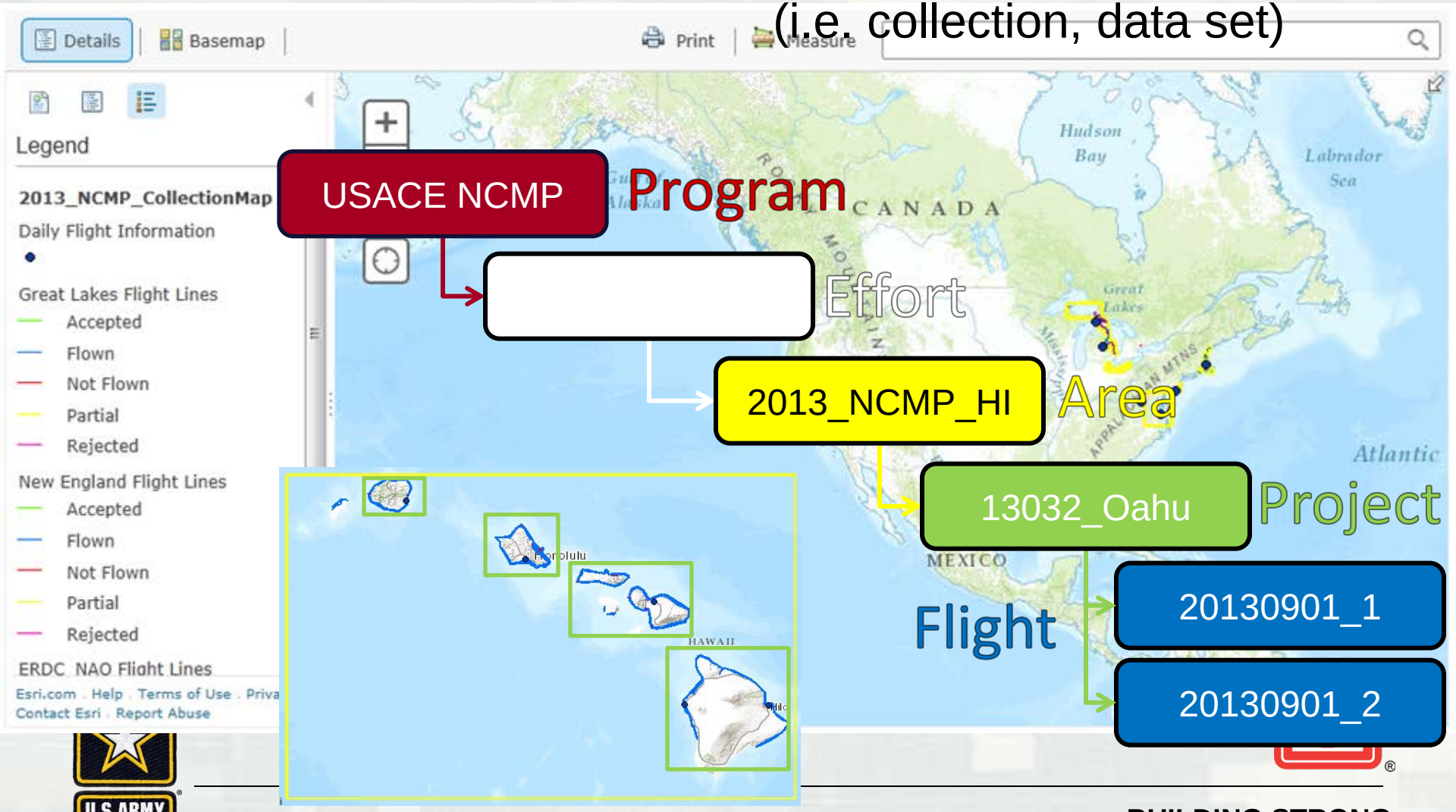

Why should NCMP implement ISO?

- Modular sections and components to document sensors, platforms, responsible parties, process steps, constraints, etc.

	Brief	UUID	Last Updater	Last Updated	Record Sets	Component Type
Show	originator - US Army Corps of Engineers (USACE) Joint Airborne Lidar Bathymetry Technical Center of eXpertise (JALBTCX)	b1e23d69-cf86-45dc-9b48-a0f62c06149d		2014-06-01 01:15:28 MDT	[NOAA/NESDIS/NGDC/MGG/Lidar/]	CI_ResponsibleParty

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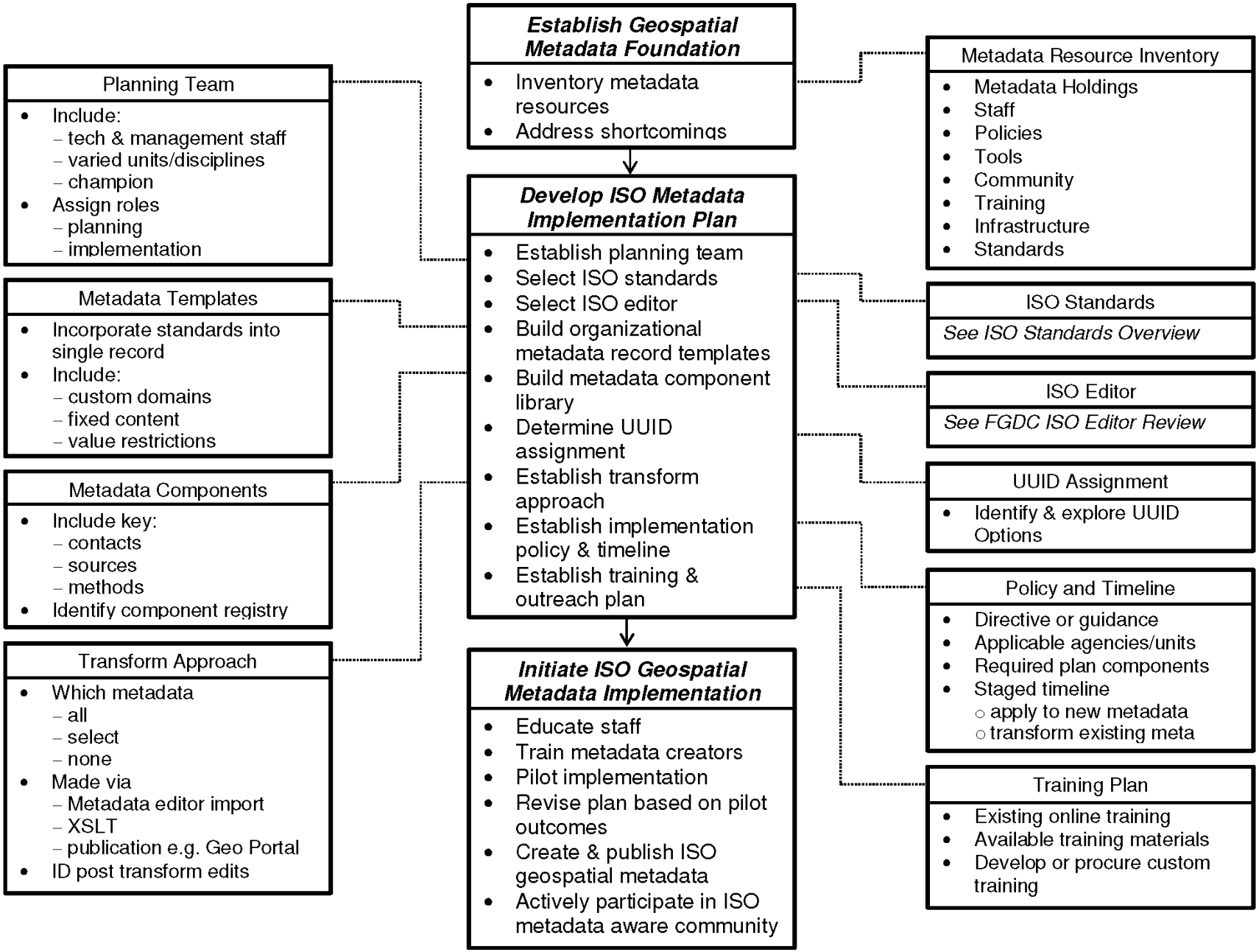
ISO Geospatial Metadata Implementation Model Workflow



ISO Geospatial Metadata Implementation Model Workflow

Planning Team

- Include:
  - tech & management staff
  - varied units/disciplines
  - champion
- Assign roles
  - planning
  - implementation

Metadata Templates

- Incorporate standards into single record
- Include:
  - custom domains
  - fixed content
  - value restrictions

Metadata Components

- Include key:
  - contacts
  - sources
  - methods
- Identify component registry

Transform Approach

- Which metadata
  - all
  - select
  - none
- Made via
  - Metadata editor import
  - XSLT
  - publication e.g. Geo Portal
- ID post transform edits

Originator

Joint Airborne Lidar Bathymetry Technical Center of Expertise

Distributor

NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

Archive

NOAA NATIONAL GEOPHYSICAL DATA CENTER (NGDC)
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Expertise

NOAA NATIONAL COASTAL DATA DEVELOPMENT CENTER
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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Metadata Template Review:

- Update for CZMIL
- Include online linkages to (better) support data dissemination and archive activities
- Standardize access/use constraints across product templates
- Test csdgm2iso transforms


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          <origin>U.S. Army Corps of Engineers (USACE), JALBTCX (Joint Airborne Lidar Bathymetry Technical Center of
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            Program</title>
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        </citeinfo>
      </citation>
```

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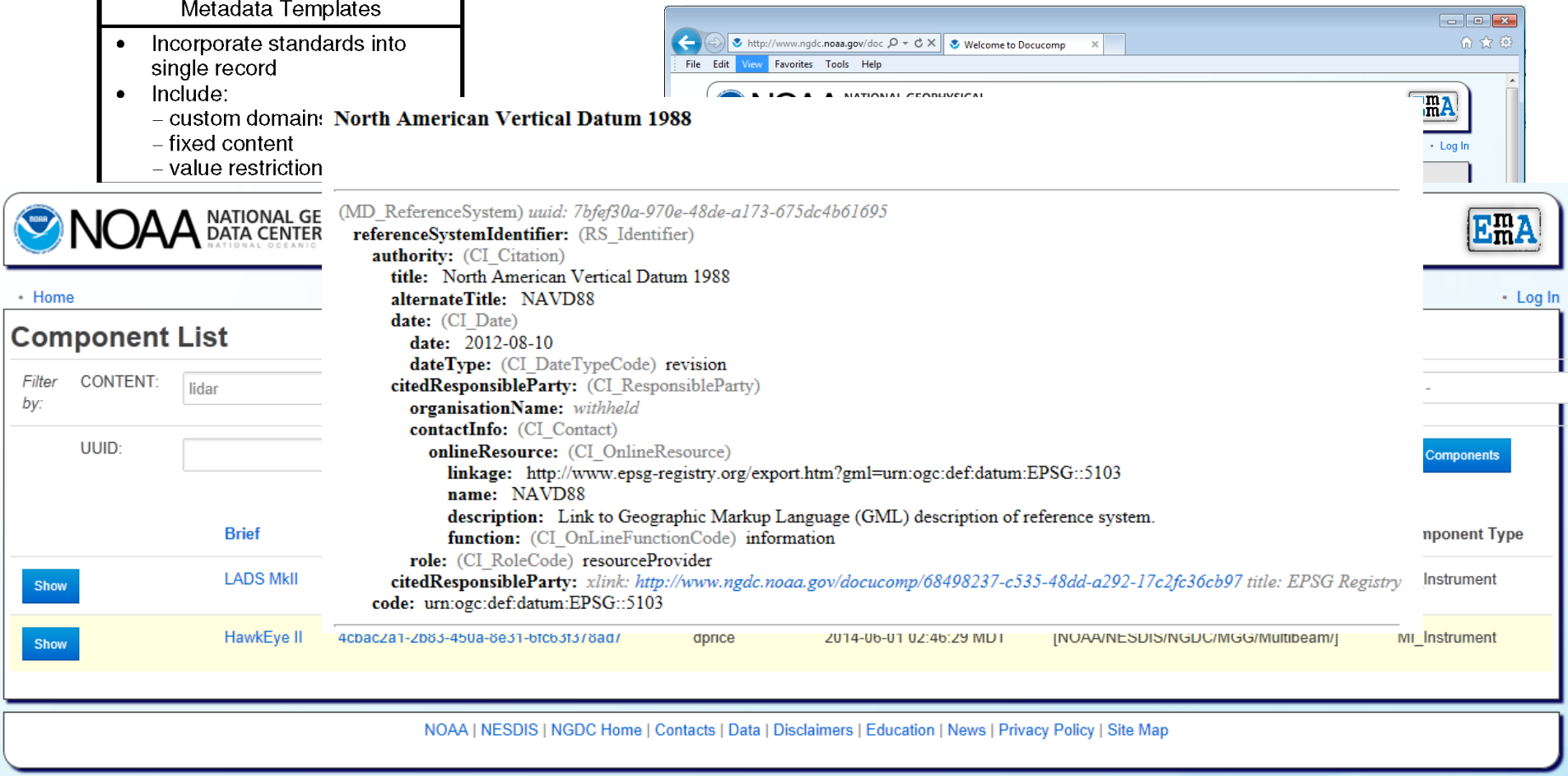
Building Components:

- Analyze existing templates for repeatable elements



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Next Steps:

- Incorporate components
- Software evaluation
  - ArcCatalog
  - Geoportal
  - XmlSpy
  - oXygen
- Training!
- Identify pilot implementation project

Online Training!
http://www.ncddc.noaa.gov/metadata-standards/metadata-training/

Flight Management System (FMS) var log

Make Flight Lines

Flight Line File

txt
shp
kml

Operator Flight Times Log

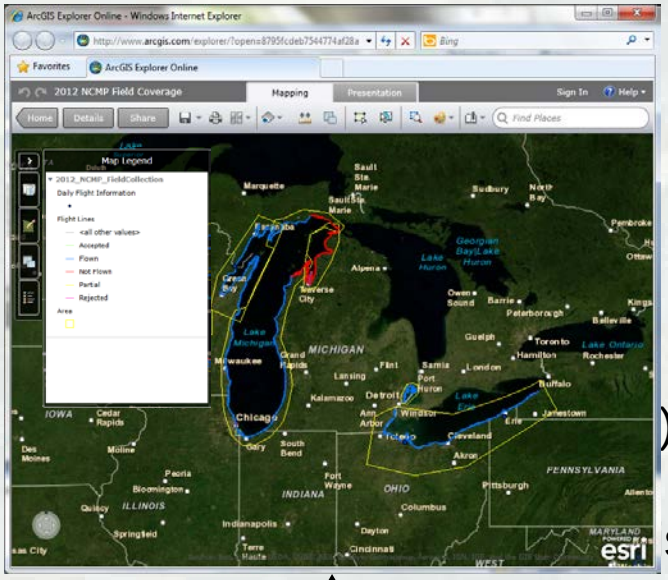
Field Database Insert/Update

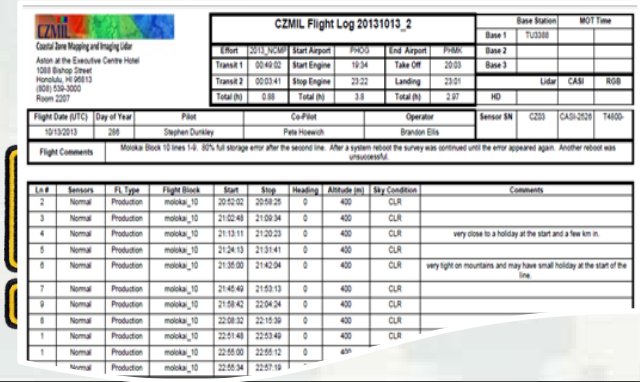
NCMP Field

Synchronize

NCMP Office

Make Flight Log





CZMIL Flight Log 20131013_2

Effort	2013_NCMP	Start Airport	PHOG	End Airport	PHMK
Transit 1	00:49:02	Start Engine	19:34	Take Off	20:03
Transit 2	00:03:41	Stop Engine	23:22	Landing	23:01
Total (h)	0.88	Total (h)	3.8	Total (h)	2.97

Base Station		MOT Time
Base 1	TU3388	
Base 2		
Base 3		

	Lidar	CASI	RGB
HD			

Flight Date (UTC)	Day of Year	Pilot	Co-Pilot	Operator	Sensor SN	C203	CASI-2526	T4600-
10/13/2013	286	Stephen Dunkley	Pete Howech	Brandon Ellis				

Flight Comments: Molokai Block 10 lines 1-9. 80% full storage error after the second line. After a system reboot the survey was continued until the error appeared again. Another reboot was unsuccessful.

Ln #	Sensors	FL Type	Flight Block	Start	Stop	Heading	Altitude (m)	Sky Condition	Comments
2	Normal	Production	molokai_10	20:52:02	20:58:25	0	400	CLR	
3	Normal	Production	molokai_10	21:02:48	21:09:34	0	400	CLR	
4	Normal	Production	molokai_10	21:13:11	21:20:23	0	400	CLR	very close to a holiday at the start and a few km in.
5	Normal	Production	molokai_10	21:24:13	21:31:41	0	400	CLR	
6	Normal	Production	molokai_10	21:35:00	21:42:04	0	400	CLR	very tight on mountains and may have small holiday at the start of the line.
7	Normal	Production	molokai_10	21:45:49	21:53:13	0	400	CLR	
9	Normal	Production	molokai_10	21:58:42	22:04:24	0	400	CLR	
8	Normal	Production	molokai_10	22:08:32	22:15:39	0	400	CLR	
1	Normal	Production	molokai_10	22:51:48	22:53:49	0	400	CLR	
1	Normal	Production	molokai_10	22:55:00	22:55:12	0	400		
	Normal	Production	molokai_10	22:55:34	22:57:19				

Next Steps:

- Development of metadata to support data acquisition

BUILDING STRONG®

Something to chew on …

- A demonstrated ("profile") mechanism exists for tailoring a subset of the full standard to a specific community *Requirement for mandatory "Use Constraints" identified by community*
- *Allows future integration of additional ISO 191xx standards to capture additional metadata identified as important to the community (e.g., 19115-2, 19157)*
- *For example:*

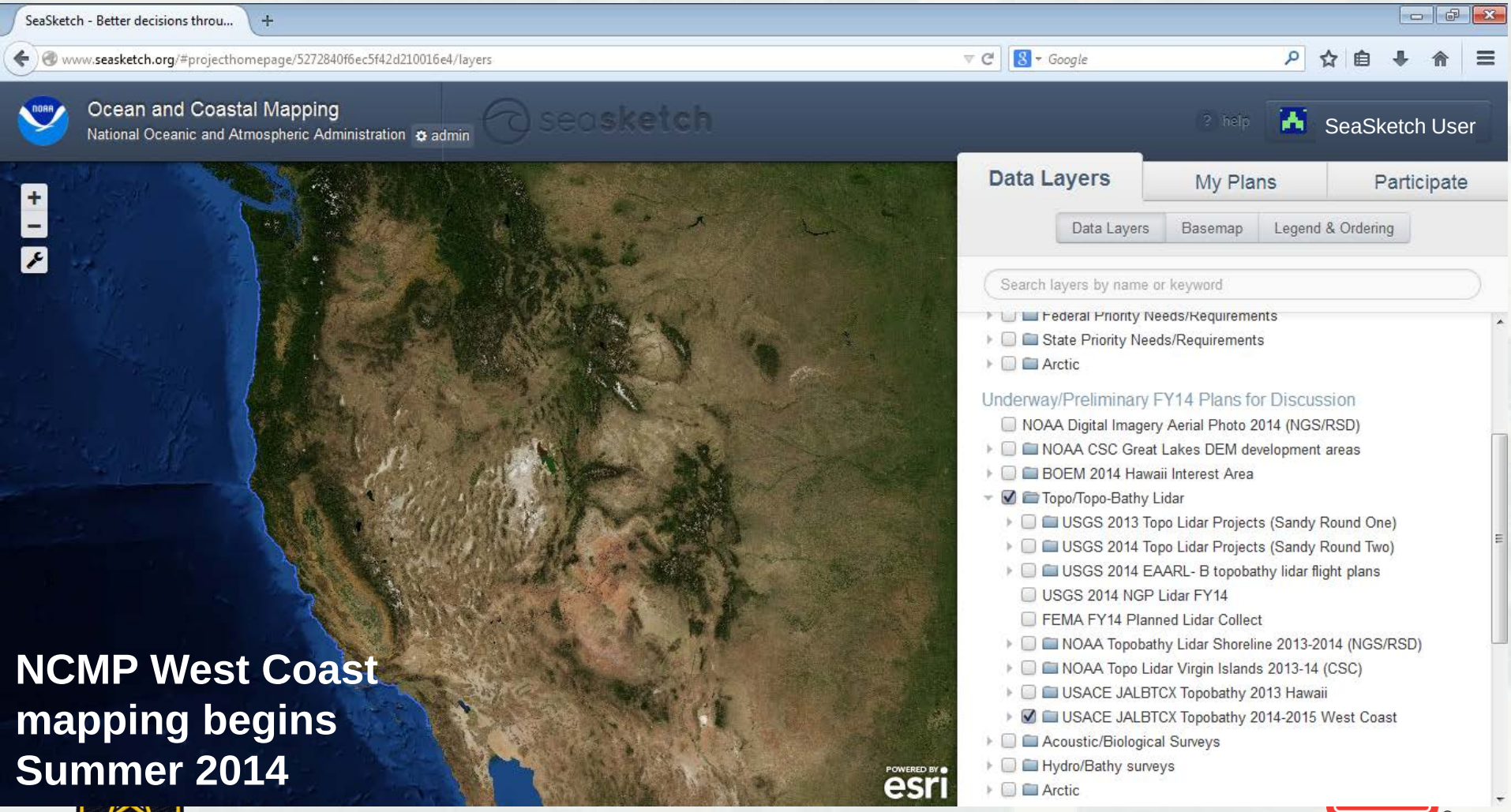
Energy Industry Profile of ISO 19115-1:2014

keep chewing …

- Or utilize existing ISO standards with SensorML or Las 1.4 to document and standardize lidar-specific attributes to support rigorous point cloud analysis, elevation inventorying efforts (i.e. US Interagency Elevation Inventory), search/discovery of available datasets, etc.

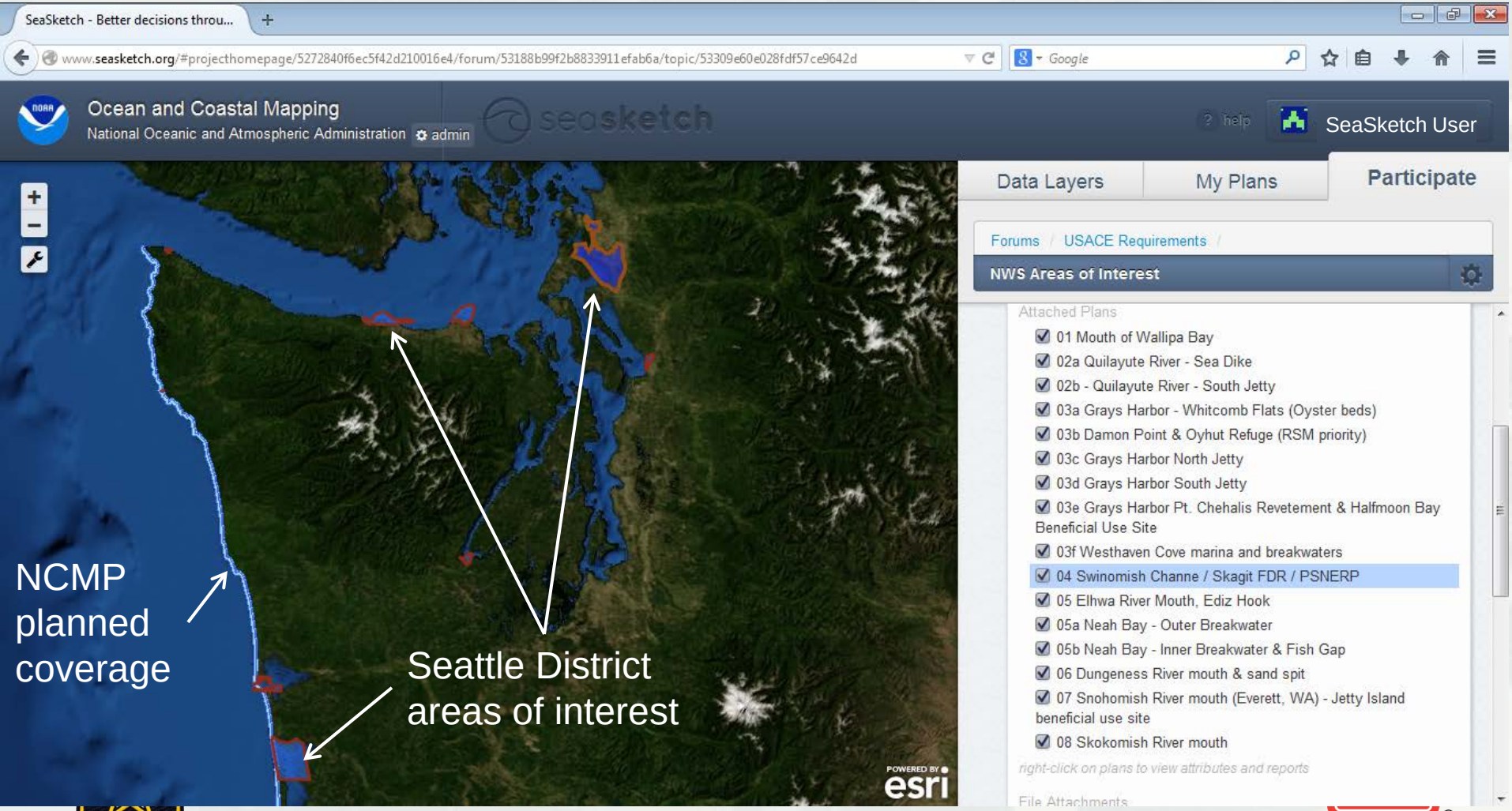
2014 NCMP West Coast Coordination

IOCM SeaSketch

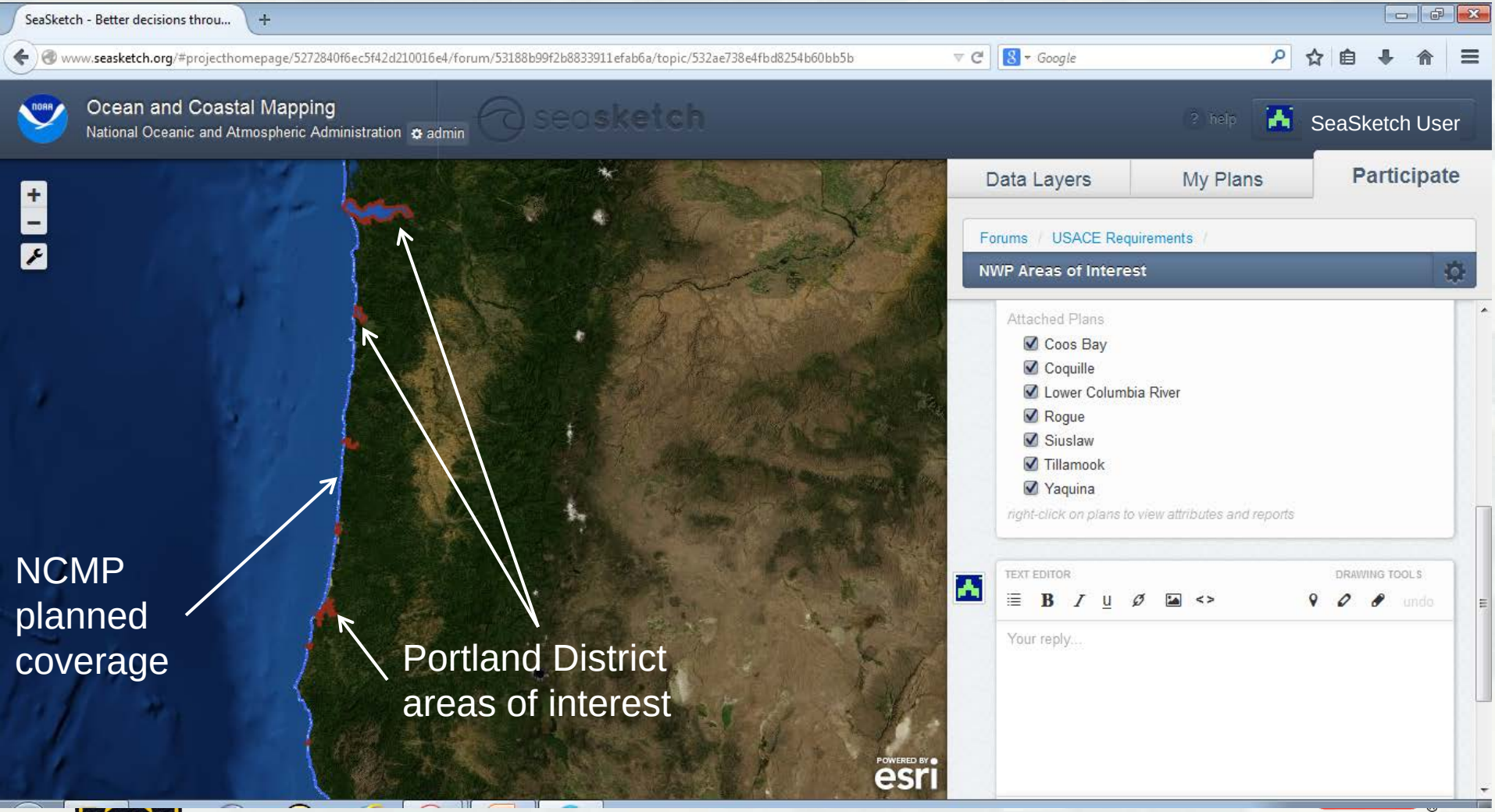


NCMP West Coast mapping begins Summer 2014

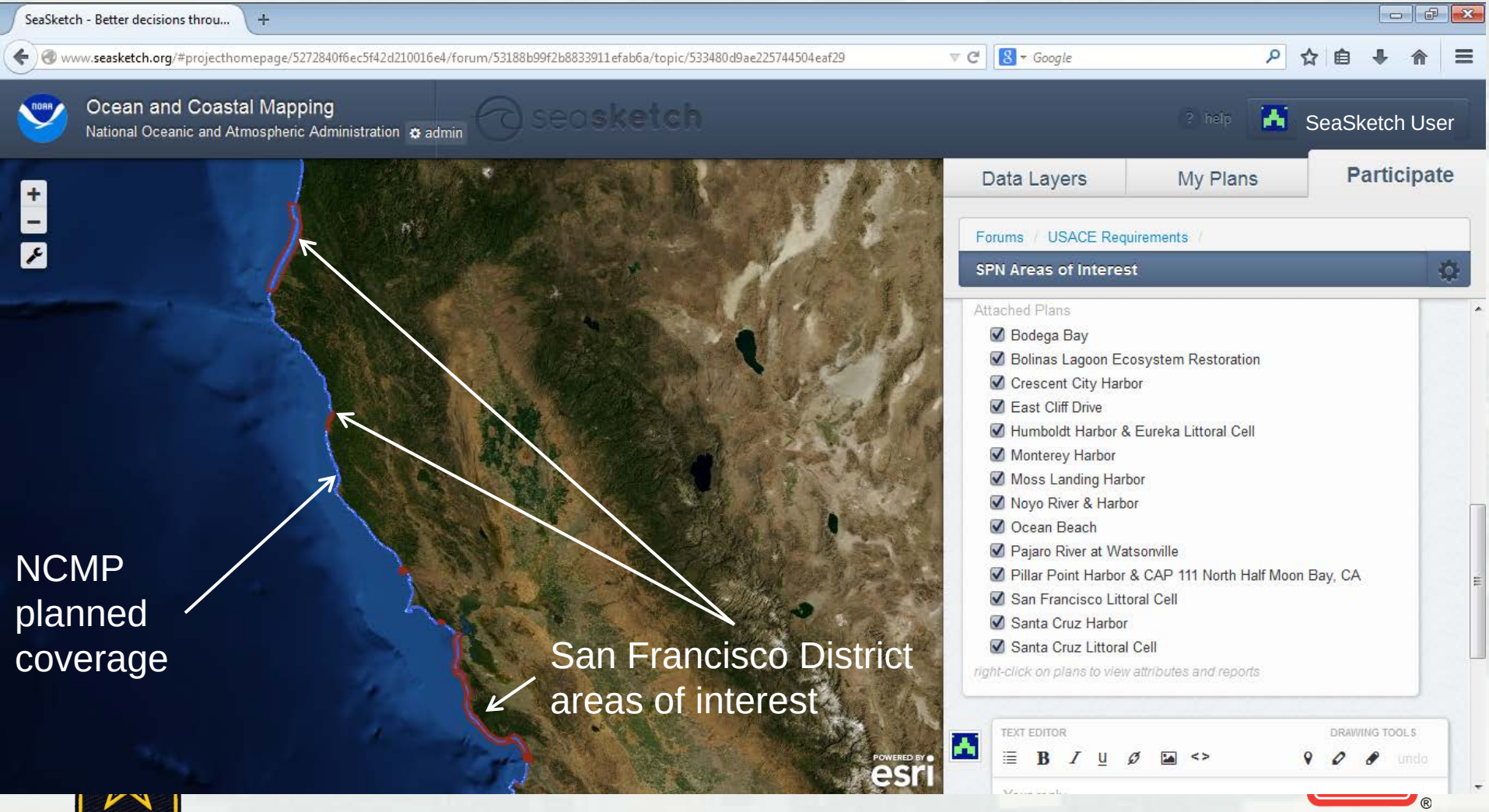
District AOIs: Seattle District (NWS)



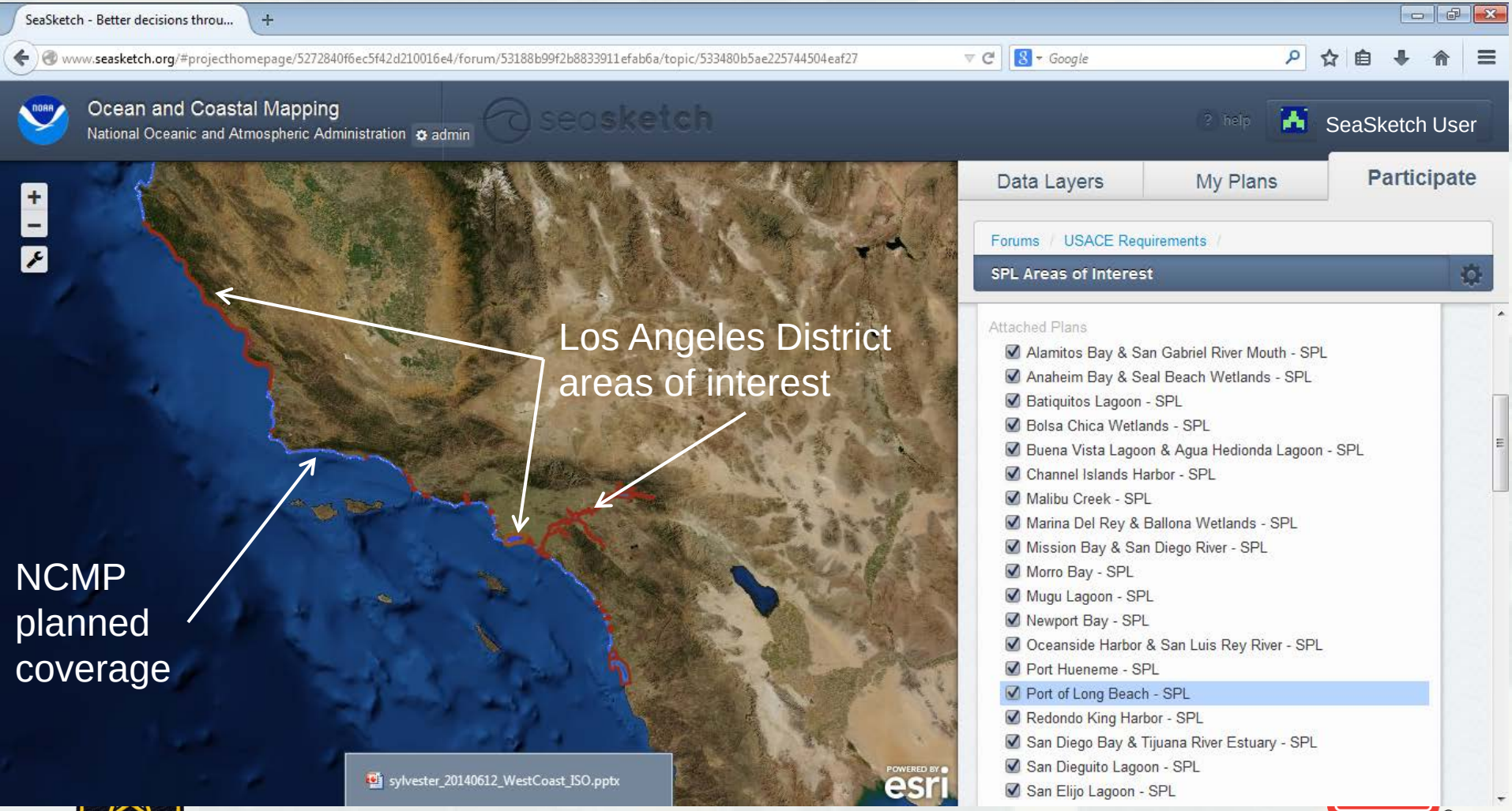
District AOIs: Portland District (NWP)



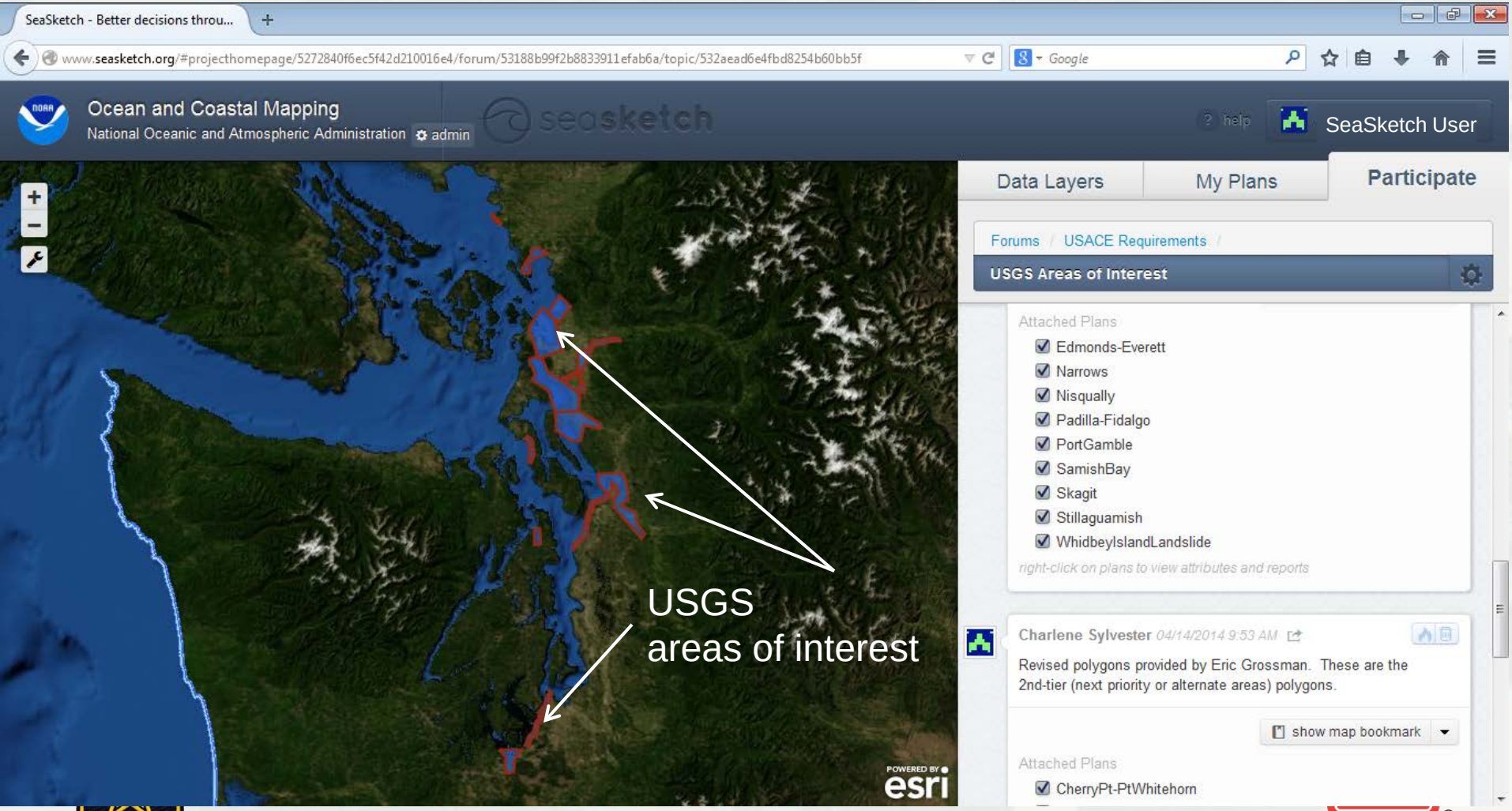
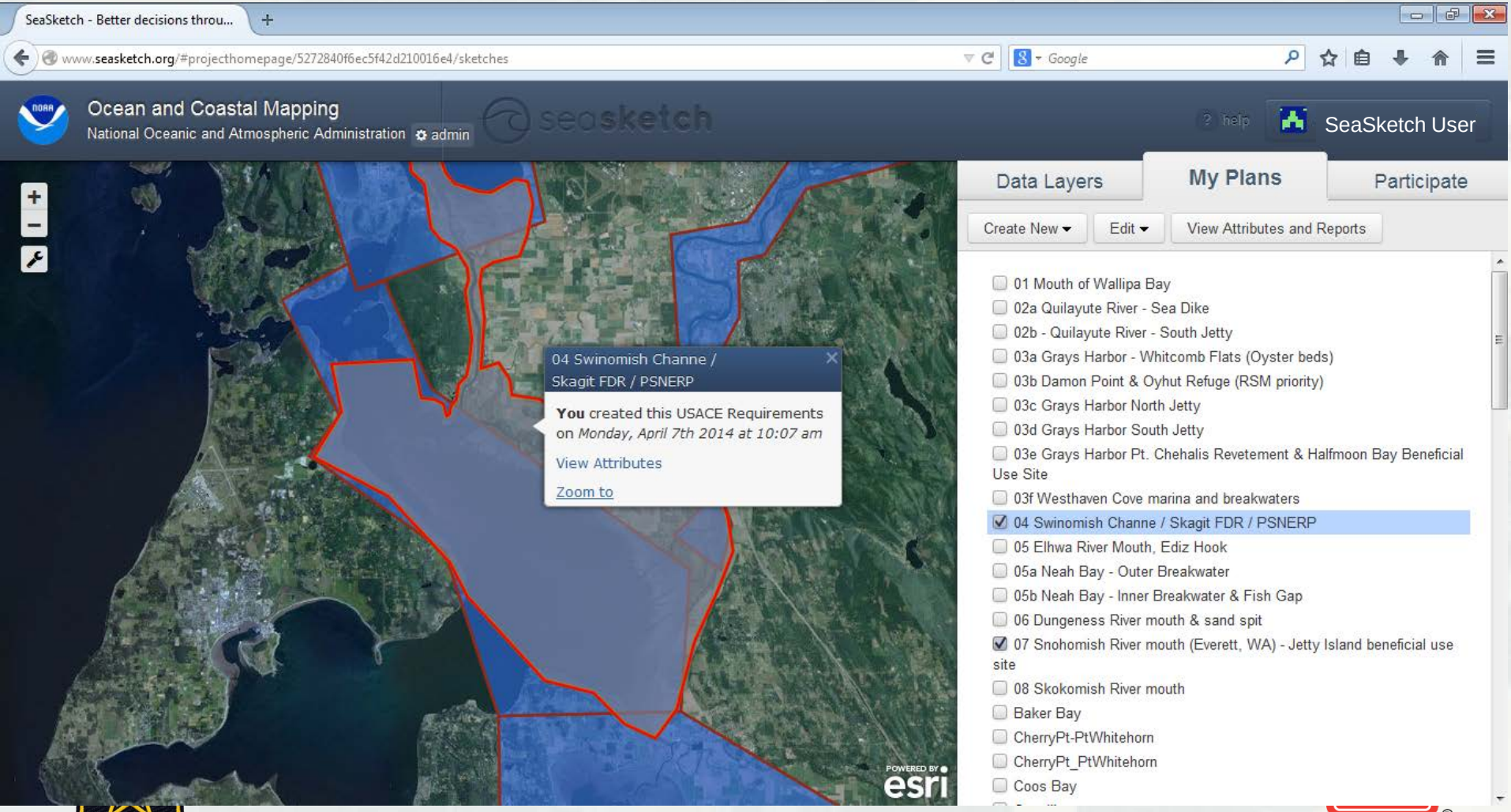
District AOIs: San Francisco District (SPN)



District AOIs: Los Angeles District (SPL)



USGS CMGP AOIs: Puget Sound



USACE/USGS AOI Overlap: Skagit Bay