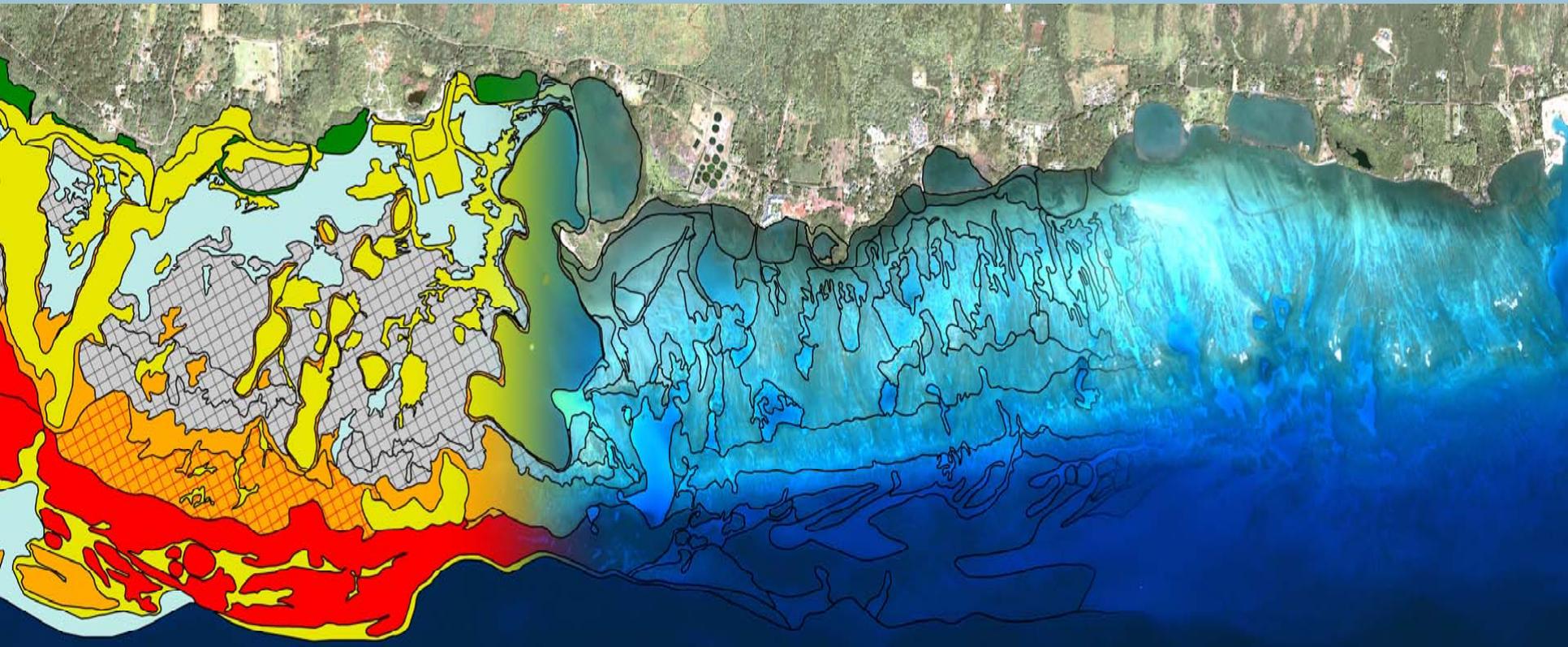


NOAA's Mapping Approach for Tropical Marine Environments



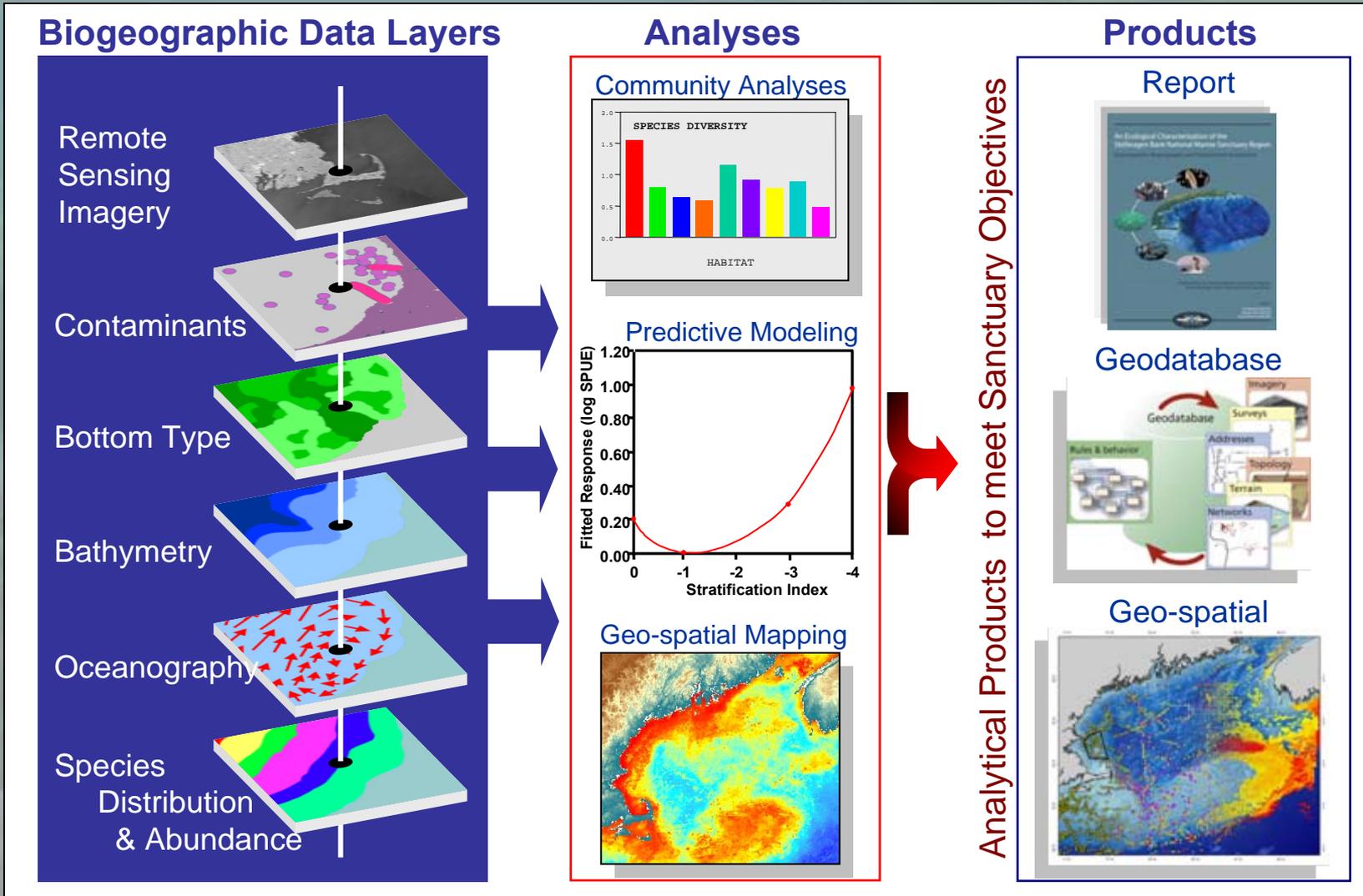
Tim Battista
NOAA/NCCOS/CCMA Biogeography Branch

<http://ccma.nos.noaa.gov/about/biogeography/>



Funding provided by NOAA's Coral Reef Conservation Program

► Marine Biogeography & Predictive Modeling



Status of Shallow Water Coral Reef Ecosystem Maps Using Aircraft, Ship-based & Satellite Platforms

	Area mapped (sq. kms.)*	Percentage of area mapped	Potential coral reef ecosystem <10 fm (sq. kms.)#	Potential coral reef ecosystem <100 fm (sq. kms.)#
Puerto Rico	2,297 (465)	83	2,302	5,506
U.S. Virgin Islands	488 (26)	95	344	2,065
Southern Florida	235 (2,300)	10	30,801	113,092
Hawaii (main islands)	1,306 (230)	85	1,231	6,666
Northwestern Hawaiian Islands	2,360 (333)	55**	1,595	13,771
American Samoa	72 (13)	84	54	464
Guam	105 (7)	94	108	276
Northern Marianas	204 (12)	94	123	476
U.S. Flag Islands (e.g., Palmyra, Navassa)	0	0	256	450
Rep. of Palau%	2,036 (478)	81	2,528	-
Fed. States of Micronesia%	0	-	14,517	-
Rep. of the Marshall Islands%	0	-	13,456	-
Total	9,103 (3,864)	70%	36,814	142,776

*-number in parentheses is unmapped area inside 10 fm depth curve

**-NWHI recalculated based on the extent of the Papahānaumokuākea Marine National Monument

#-Rohmann et al., Coral Reefs 24: 370-383

%-area estimates derived from Landsat imagery

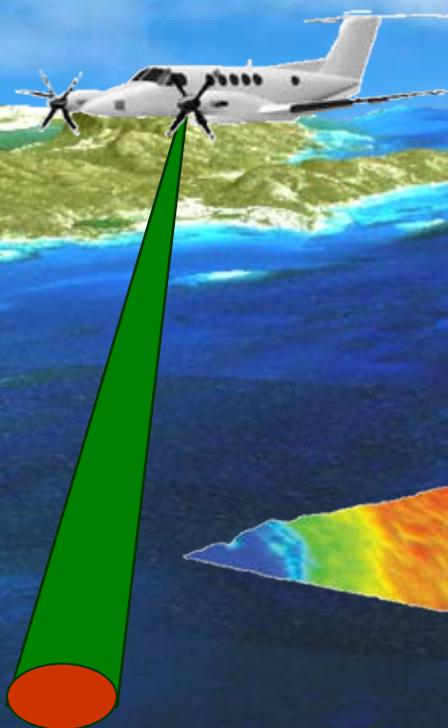
The Suite of Remote Sensing for Habitat Characterization

Optical Imaging

Commercial Satellites
(0 – 30 m)
Multispectral
Pseudo-bathymetry



Bathymetric LiDAR
(0 – 70 m)
Bathymetry
Backscatter

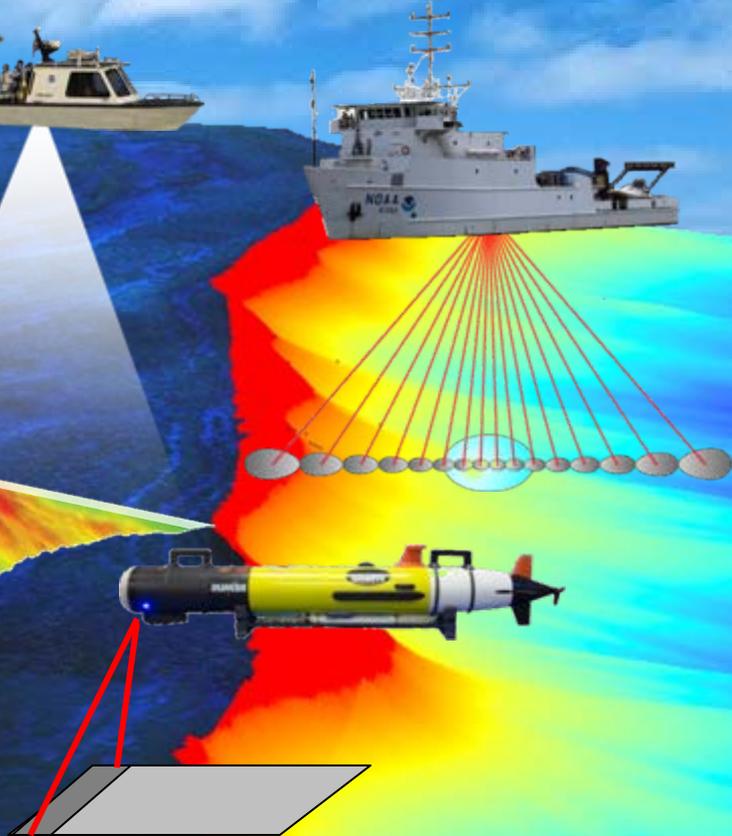


Acoustical Imaging

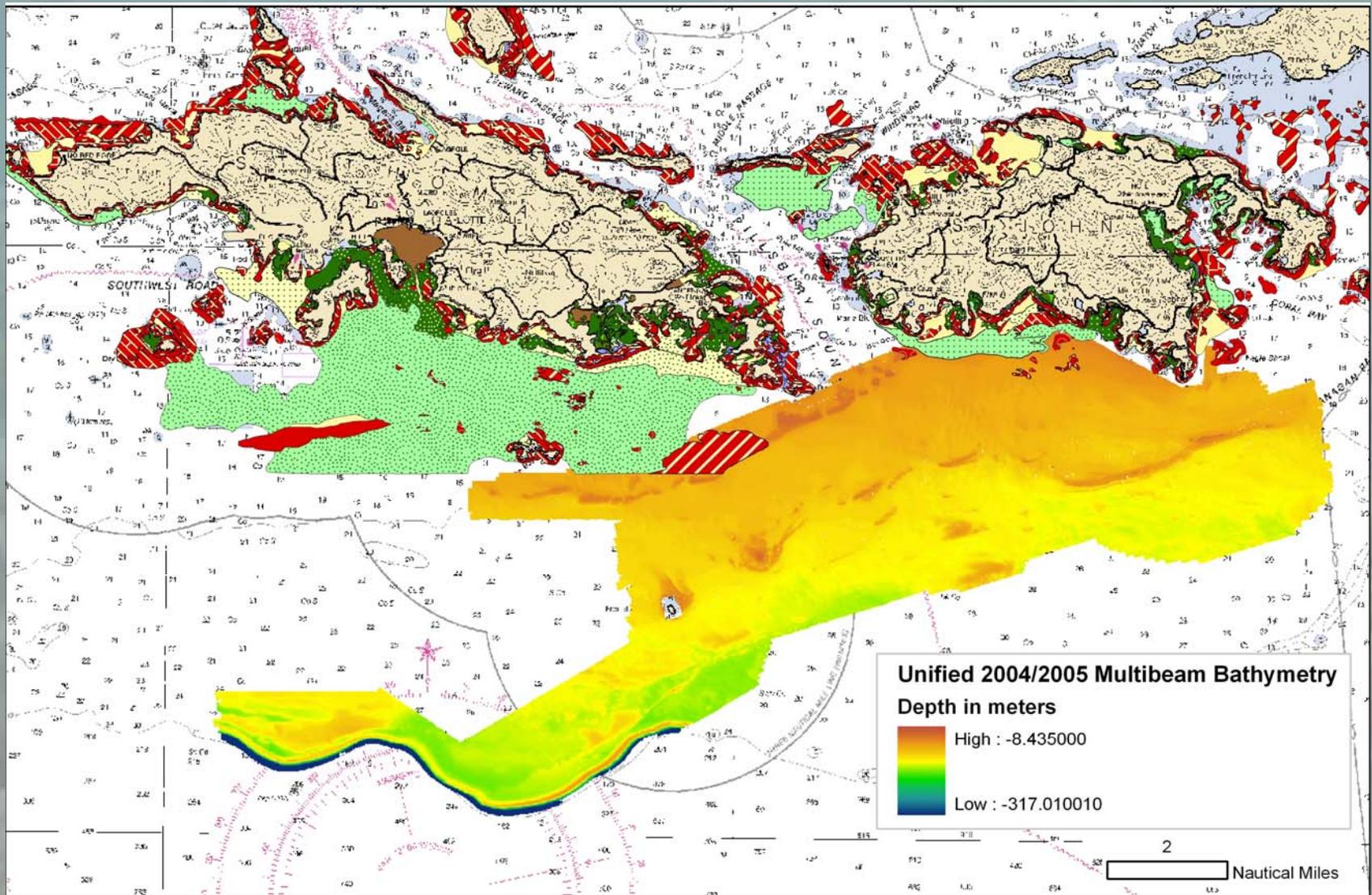
Interferometric Sidescan
(1 – 30 m)
Bathymetry
Backscatter



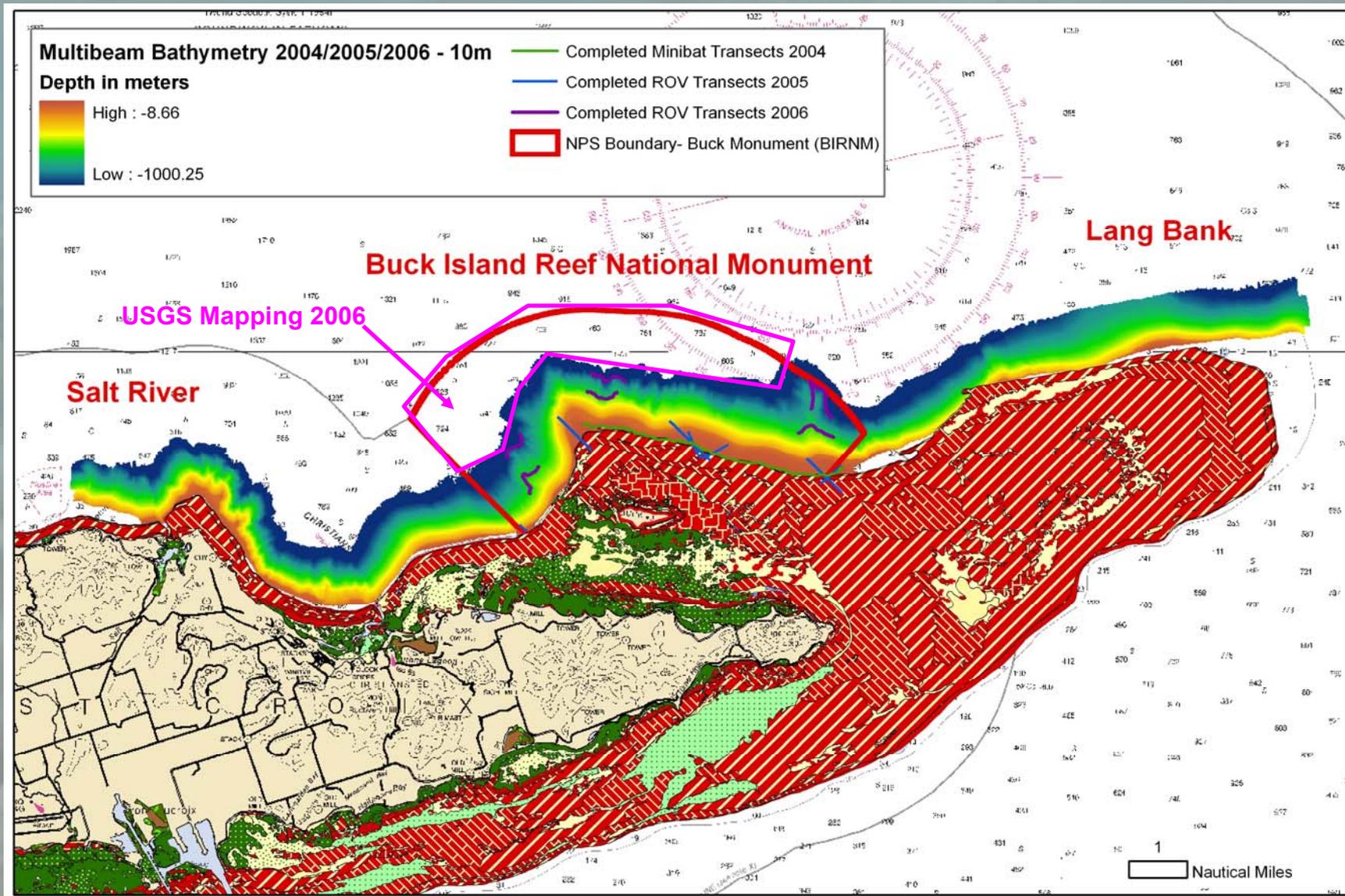
Swath bathymetry
(10 – 1000 m)
Bathymetry
Backscatter



St Thomas and St John Mapping – 0 to 320 meters



St Croix Mapping – 0 to 1,000 meters



Shallow-Water (0-30m) Benthic Habitat Mapping Process

Imagery Acquisition

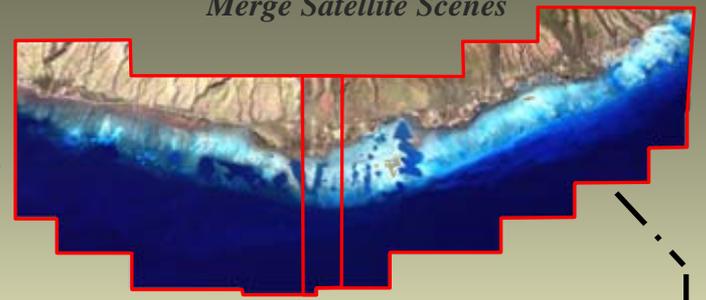
Satellite Data Collect:
11 km swath, 1 m resolution



GPS Positioning:
Collect Ground Control Points

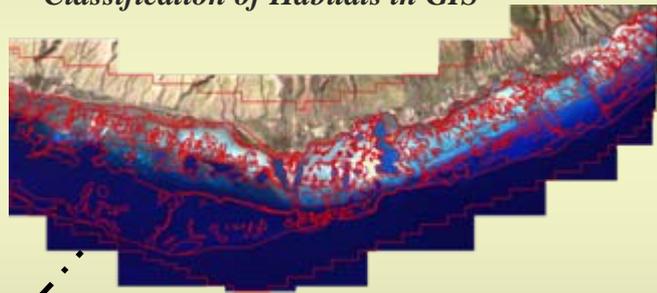


Imagery Mosaic:
Merge Satellite Scenes



Mapping Production

Draft Map Production:
Classification of Habitats in GIS



Ground Truthing:
Coral Team Small Boat Operation



Product Development

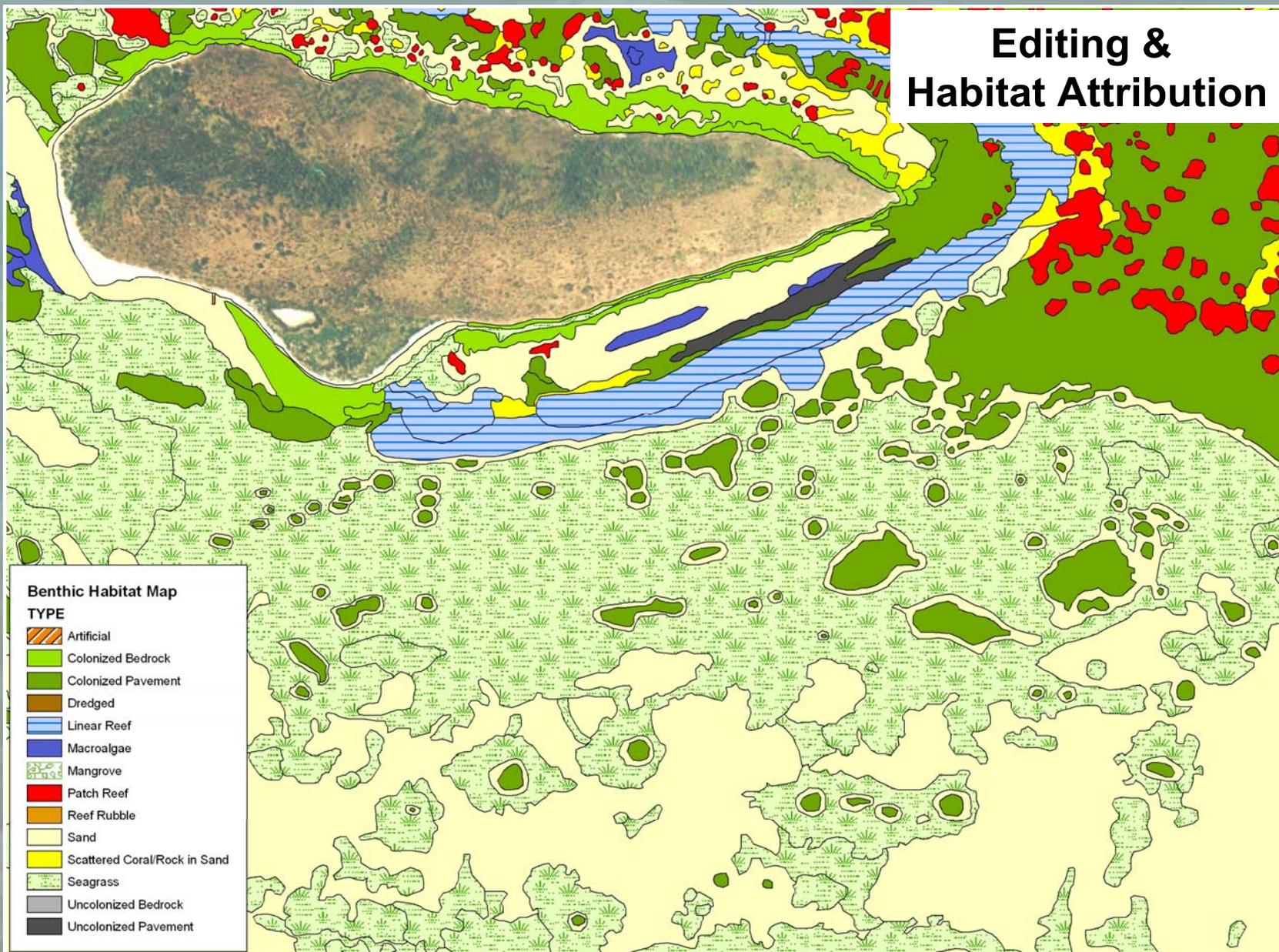
Final Map Review:
Expert Review Workshop



Final Product:
CD-Rom/ website/ atlas



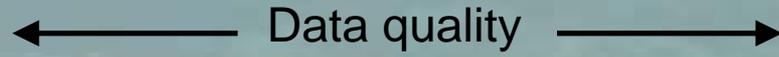
Editing & Habitat Attribution



Semi-automated Seafloor Mapping

*Multivariate Object-segmentation
With rule-based classifiers*

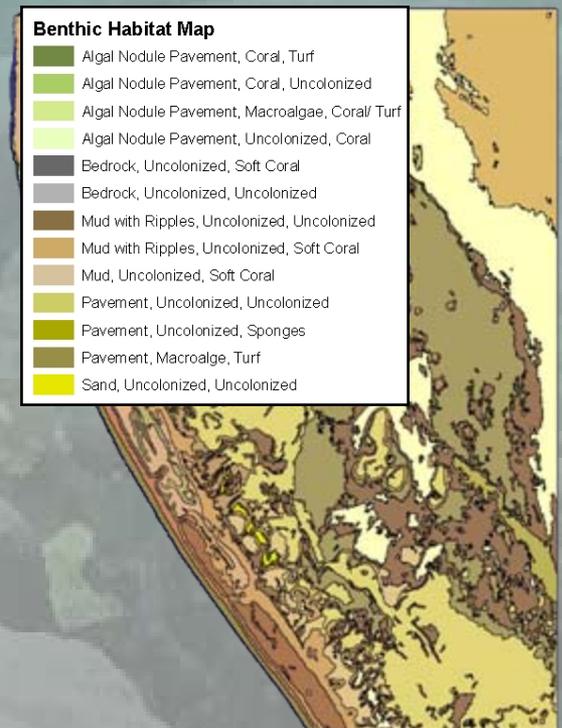
Data with artifacts

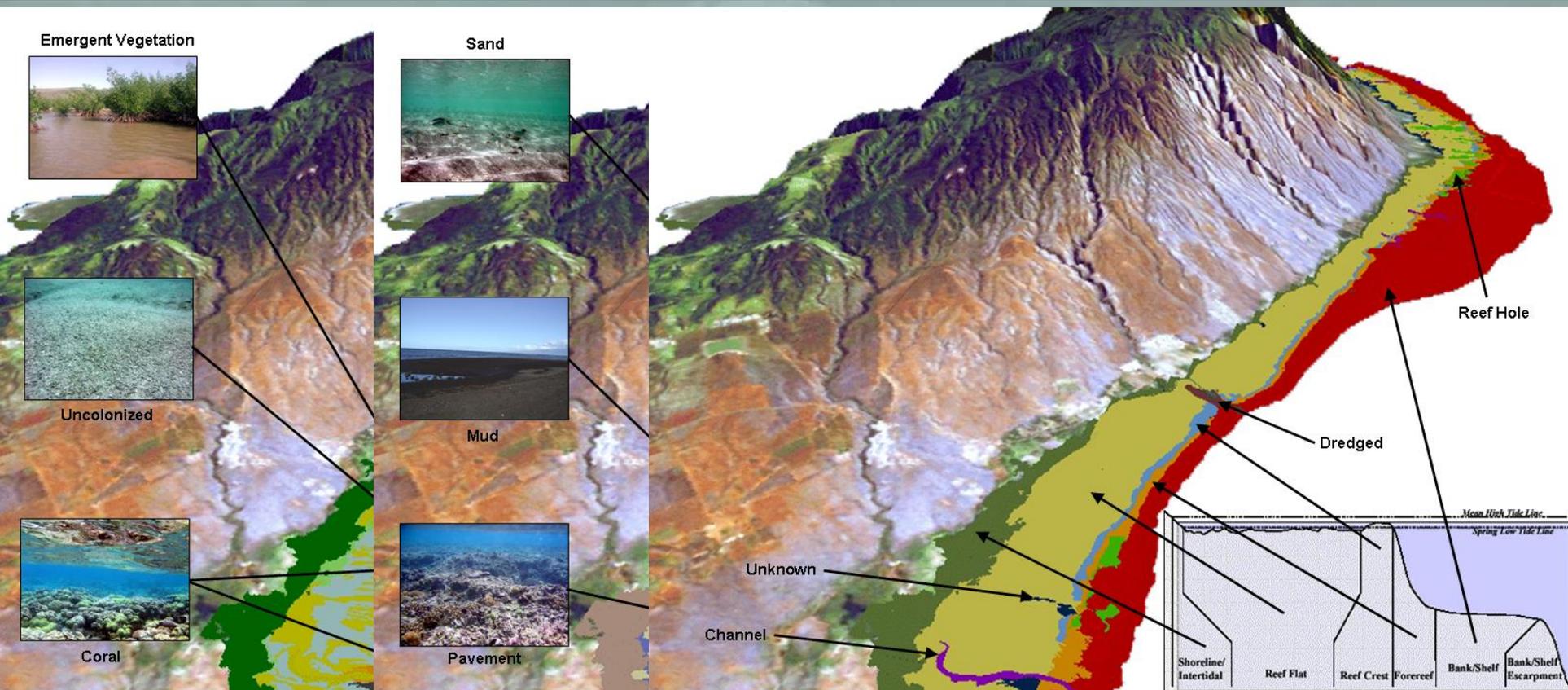


Data quality

Data without artifacts

ENVI Feature Extraction (Fx)





Classification Scheme

- 7 major and 21 detailed biological cover types
- 3 major and 13 major geomorphological structure types
- 13 locational zones

Biological Cover Component

Major Class

Coral

Seagrass

Macroalgae

Coralline Algae

Turf

Emergent Vegetation

Uncolonized

Detailed Class

10%-<50% Cover

50%-<90% Cover

90%-100% Cover

Geomorphologic/Structural Component

Coral Reef and Hard Bottom

Spur and Groove

Individual Patch Reef

Aggregated Patch Reef

Scat Rock/Coral in Unconsol Sed

Aggregate Coral

Pavement

Rock/Boulder

Pavement with Sand Channels

Reef Rubble

Unknown

Unconsolidated Sediment

Sand

Mud

Unknown

Other

Land

Artificial

Unknown

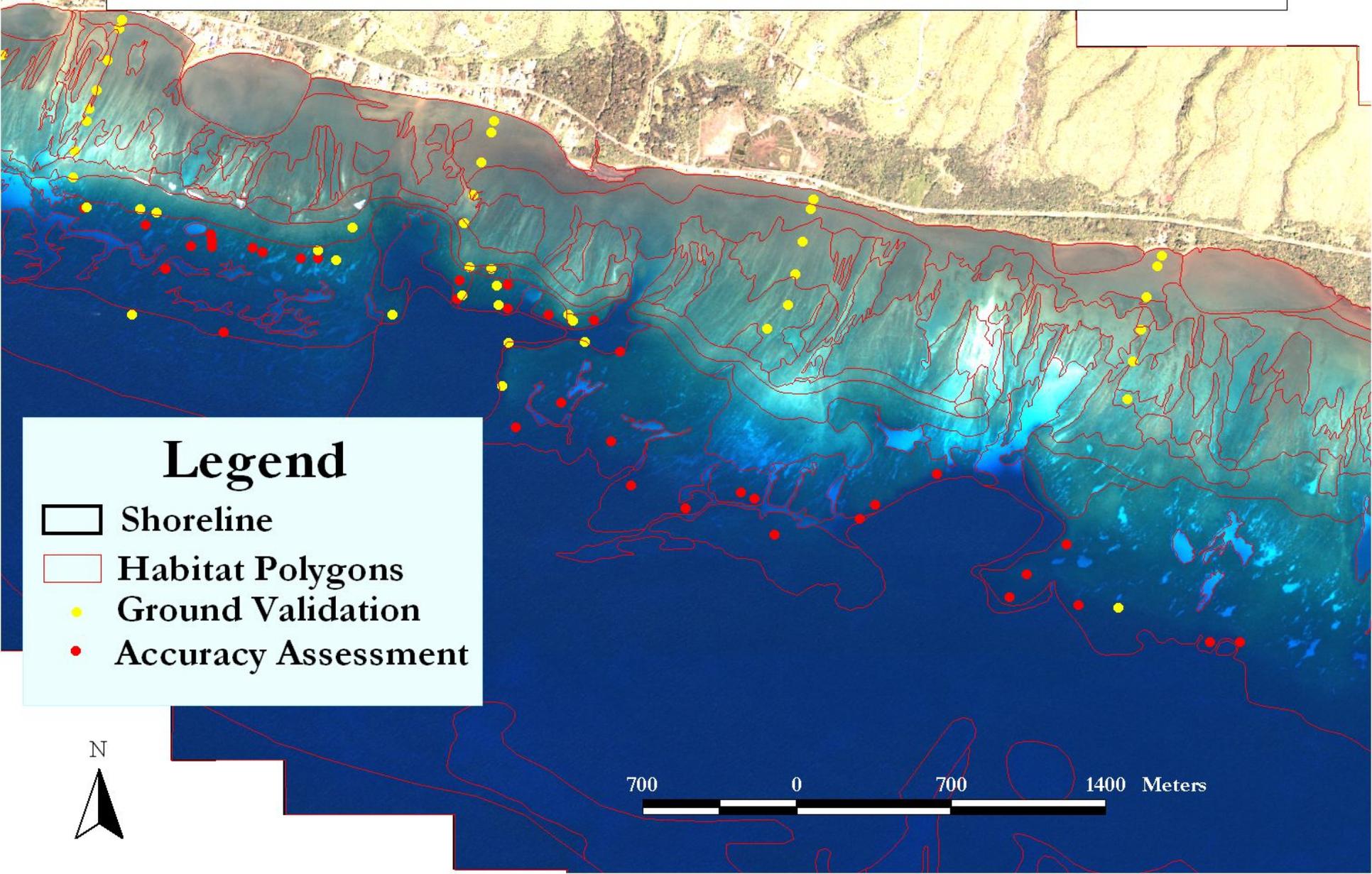
Coral Reef Zone Classification

- Land**
- Vertical Wall**
- Shoreline Intertidal**
- Reef Flat**
- Reef Hole**
- Lagoon**
- Back Reef**
- Reef Crest**
- Fore Reef**
- Bank/Shelf**
- Bank/Shelf Escarpment**
- Channel**
- Dredged**
- Unknown**

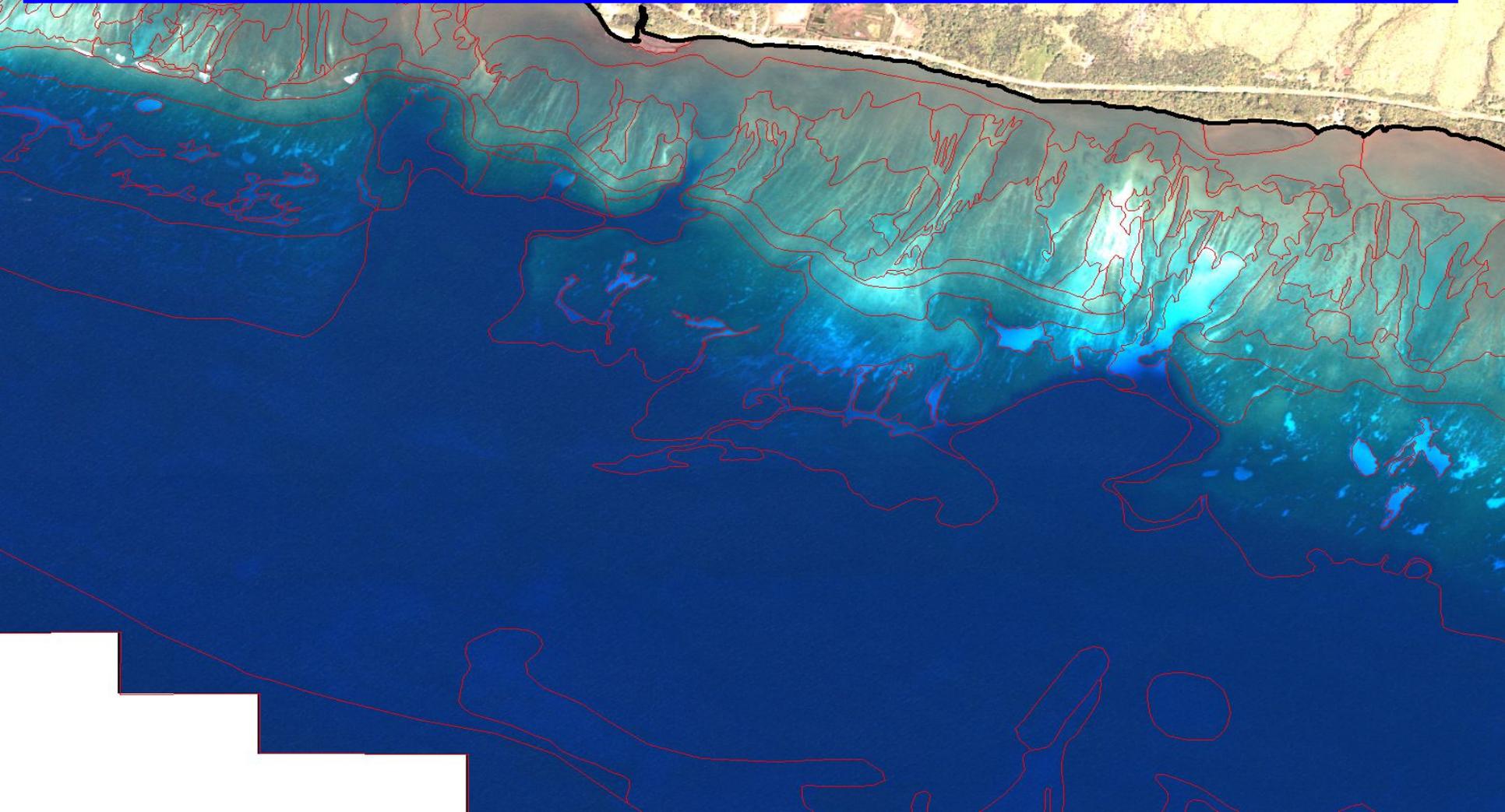
Five step mapping process



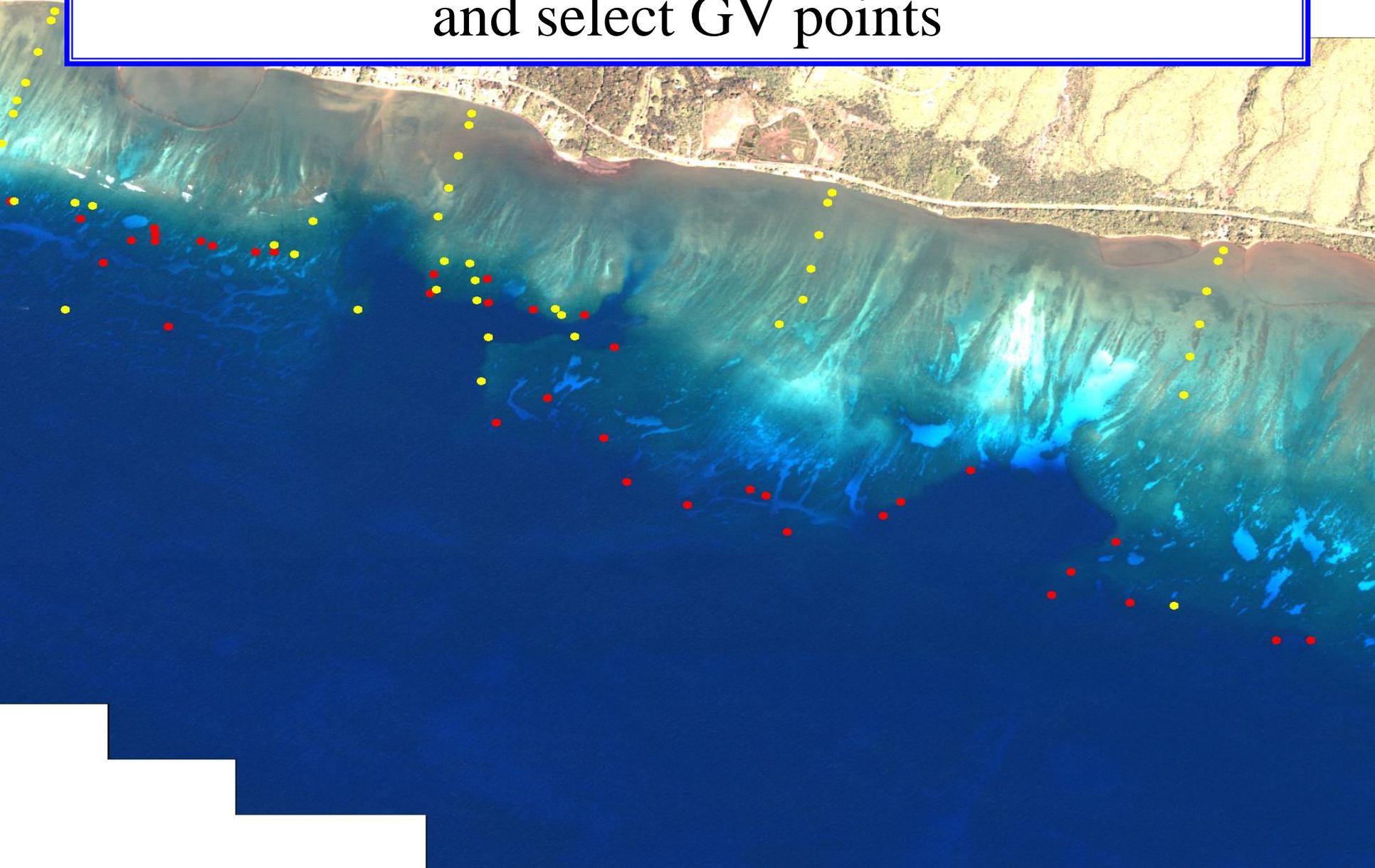
Four Types of Data Generated in this Work



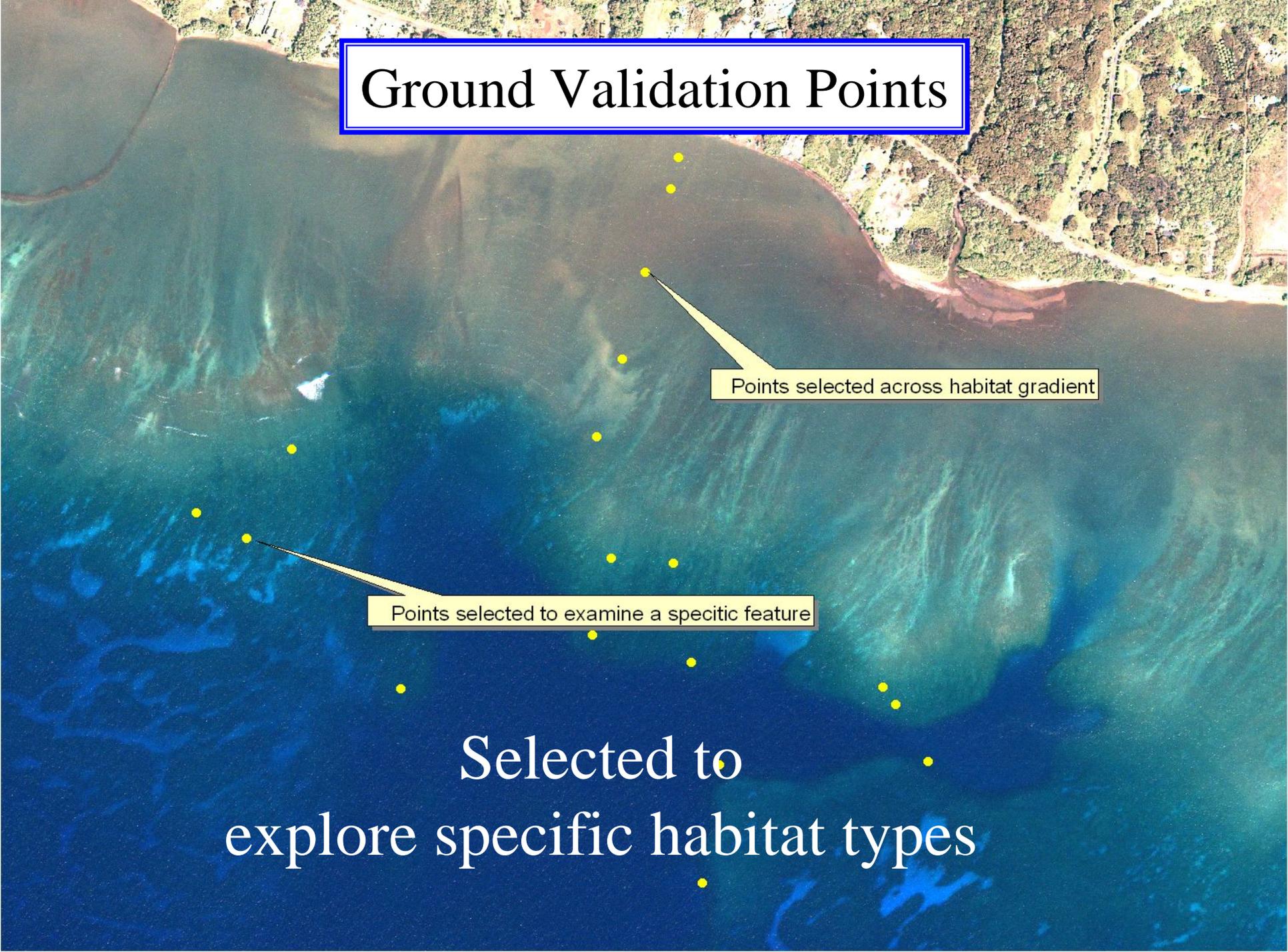
Step 1:
Using the NOAA digitizing extension
delineate as many habitat boundaries as possible



Step 2: Generate stratified AA points
and select GV points



Ground Validation Points



Points selected across habitat gradient

Points selected to examine a specific feature

Selected to
explore specific habitat types

Data Collected at Habitat Assessment Site

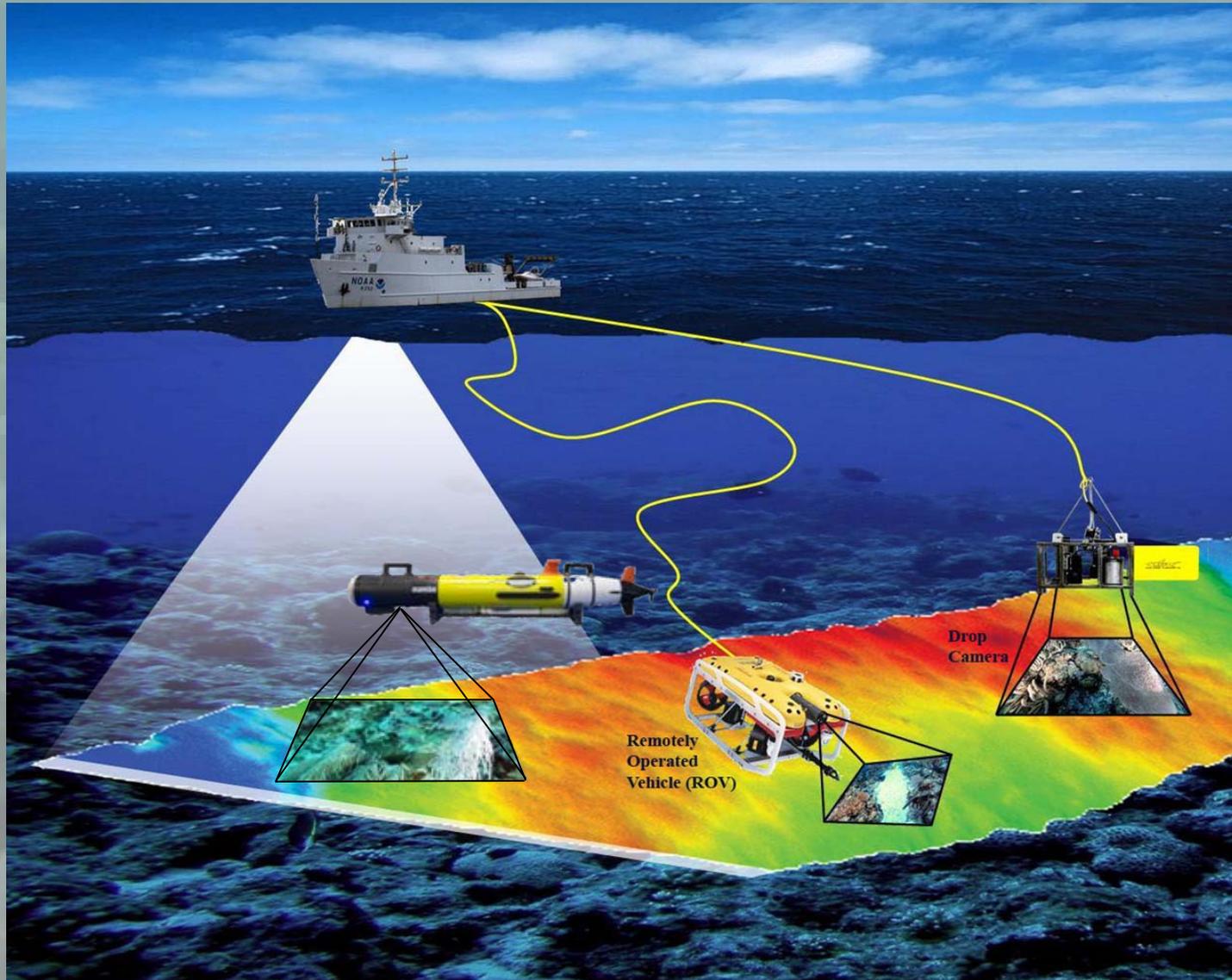
Site Data

Site ID
Study Area
GPS Date
GPS Time
GPS Position
GPS Statistics
Depth
Photo Information
Assessment Method

Habitat Data

Major Structure
Detailed Structure
Major Cover
Detailed Cover
% Cover of Each Class
Zone
Relief
Depth
Comments

Underwater Groundtruthing Imagery

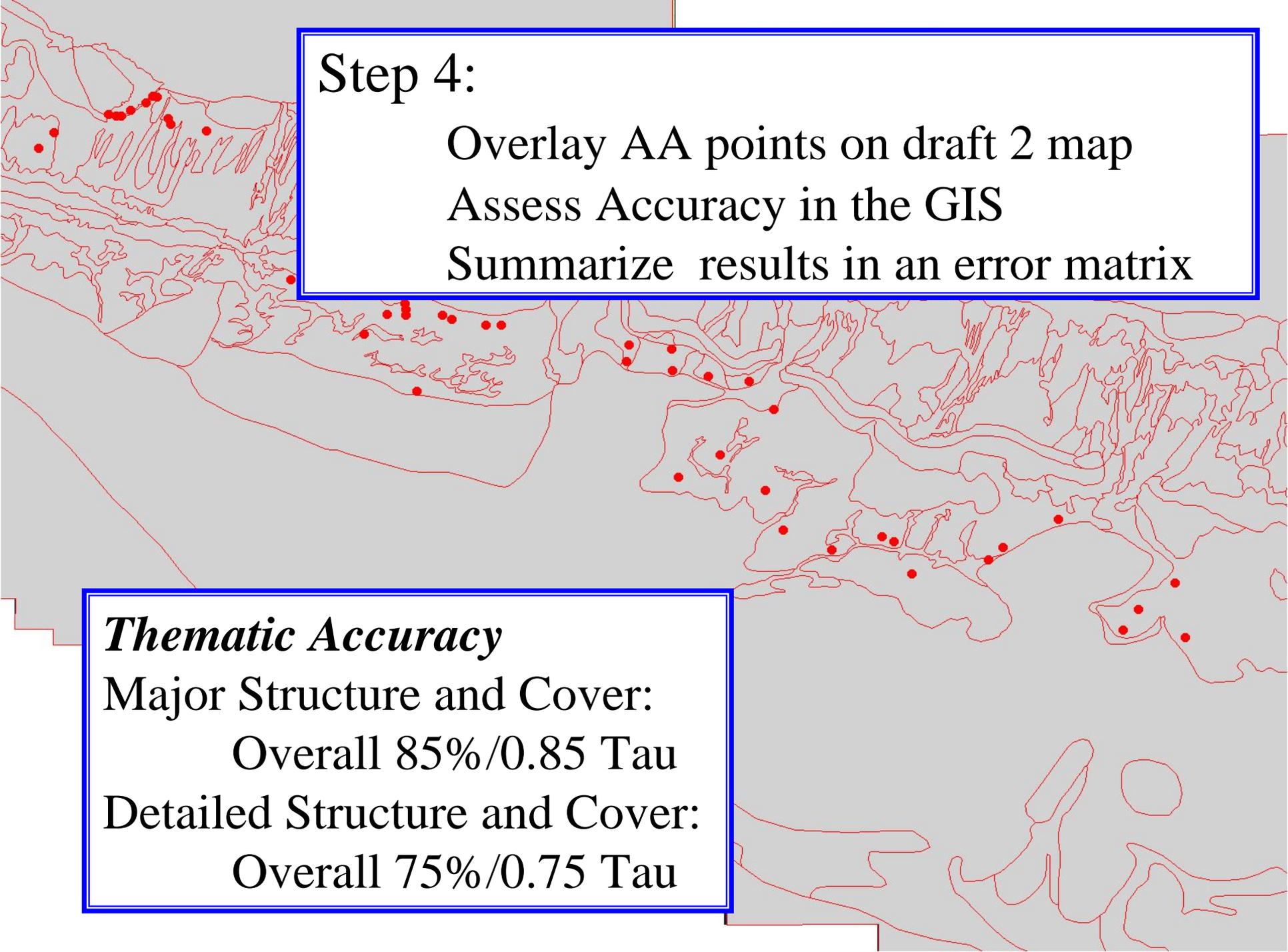


Step 3:

Legend

	Coral 10%-<50%
	Coral 50%-<90%
	Coral 90%-100%
	Seagrass 10%-<50%
	Seagrass 50%-<90%
	Seagrass 90%-100%
	Coralline Algae 10%-<50%
	Coralline Algae 50%-<90%
	Coralline Algae 90%-100%
	Macroalgae 10%-<50%
	Macroalgae 50%-<90%
	Macroalgae 90%-100%
	Turf 10%-<50%
	Turf 50%-<90%
	Turf 90%-100%
	Emergent Vegetation 50%-<90%
	Emergent Vegetation 10%-<50%
	Emergent Vegetation 90%-100%
	Uncolonized 90%-100%
	Unknown
	Unclassified

Produce draft two maps by editing draft one maps based on GV information



Step 4:

Overlay AA points on draft 2 map

Assess Accuracy in the GIS

Summarize results in an error matrix

Thematic Accuracy

Major Structure and Cover:

Overall 85%/0.85 Tau

Detailed Structure and Cover:

Overall 75%/0.75 Tau

**Step 5 and Final Map:
Edit draft two map based on comments
from expert review**



Thematic Accuracy Summary

Area Mapped	Number of AA Areas	Detailed Structure Accuracy (%)	Detailed Cover Accuracy (%)
American Samoa	6	84.0	77.3
Mariana Archipelago	11	92.6	83.5
Hawaii	7	90.0	83.6
Palau	4	88.6	78.1
Total/Average	28	88.8	79.9



Lessons learned from standing-up NOAA's Coral Mapping Program

1. Developing an applied, consensus based classification scheme.
2. Accuracy Assessment – Accept, but verify .
3. Research – Investments towards the future.
4. Scalability – Cater to production.
5. Evaluate existing data for applicability.
6. Output vs Outcome Objectives.

* NPS/NOAA Educational Video Release 2008



For more information, Contact:

Timothy A. Battista
National Oceanic and Atmospheric Administration
1305 East West Highway
Silver Spring, MD USA 20910
301-713-3028 x171

Tim.Battista@noaa.gov

<http://biogeo.nos.noaa.gov>

