Multibeam Bathymetric and Backscatter Products for Benthic Habitat Mapping

There's No Silver Bullet

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U.S. Coral Reef Task Force Goal

Produce comprehensive digital maps of all shallow (<30m) coral reef ecosystems in the United States and characterize priority moderate-depth reef systems by 2009.

Pacific Moderate Depth Mapping

R/V *AHI*

240 kHz
Reson 8101ER
250 m range
101 beams

NOAA Ship *Hi'ialakai*

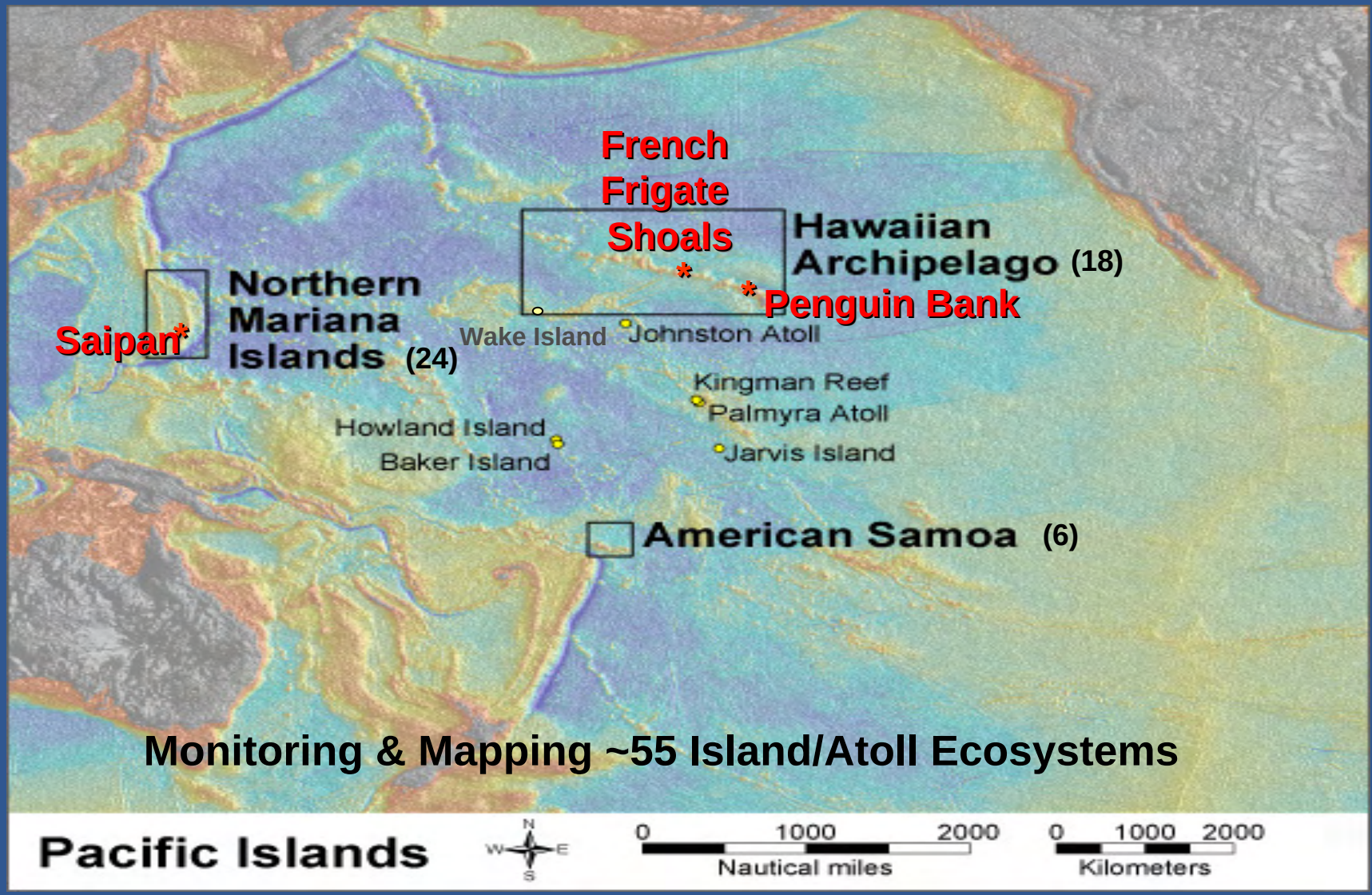
300 kHz
EM3002D
150 m range
250-500 "soundings"

30 kHz
EM300
5000 m range
135 beams

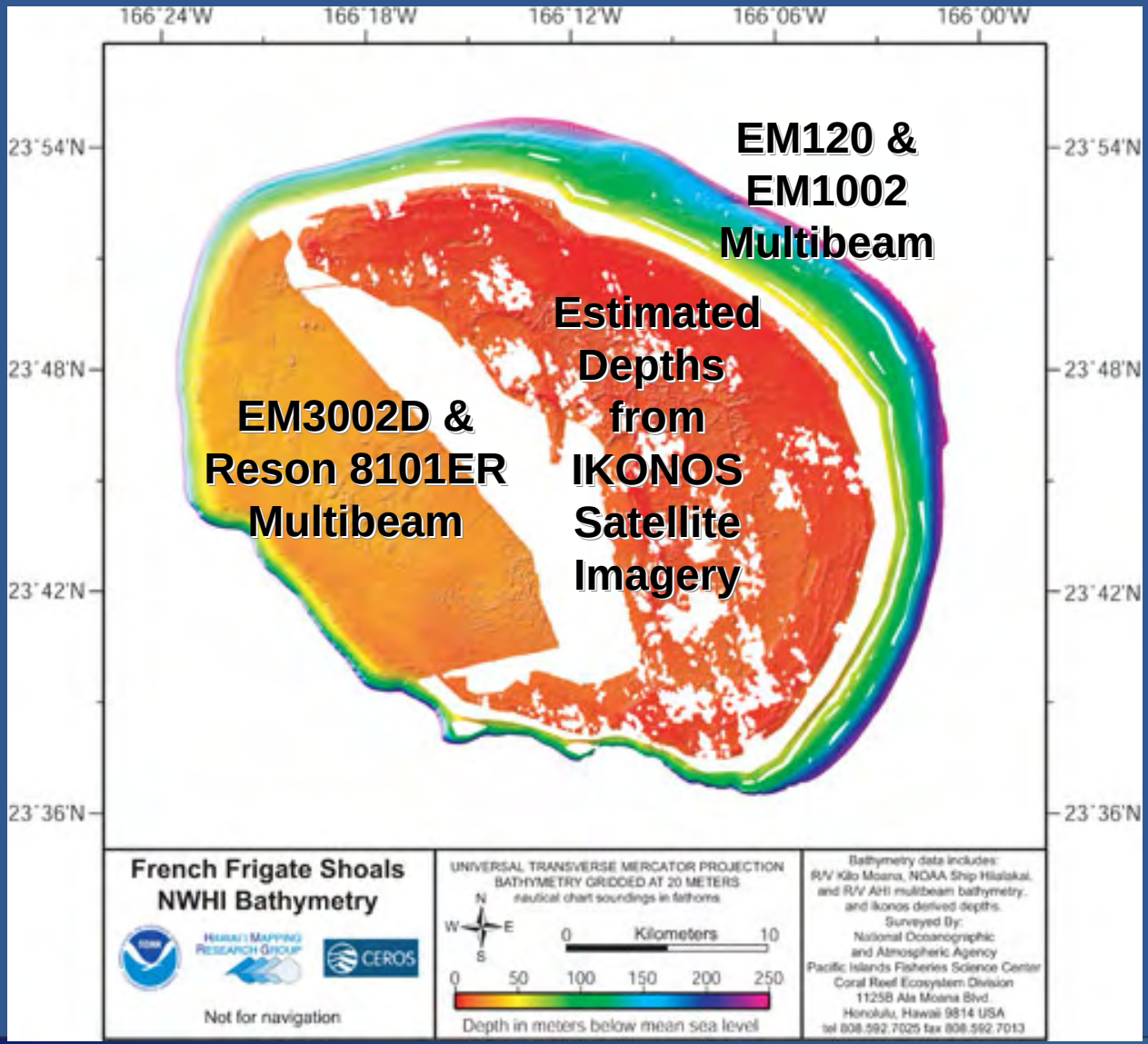
Multibeam Coverage Since 2001

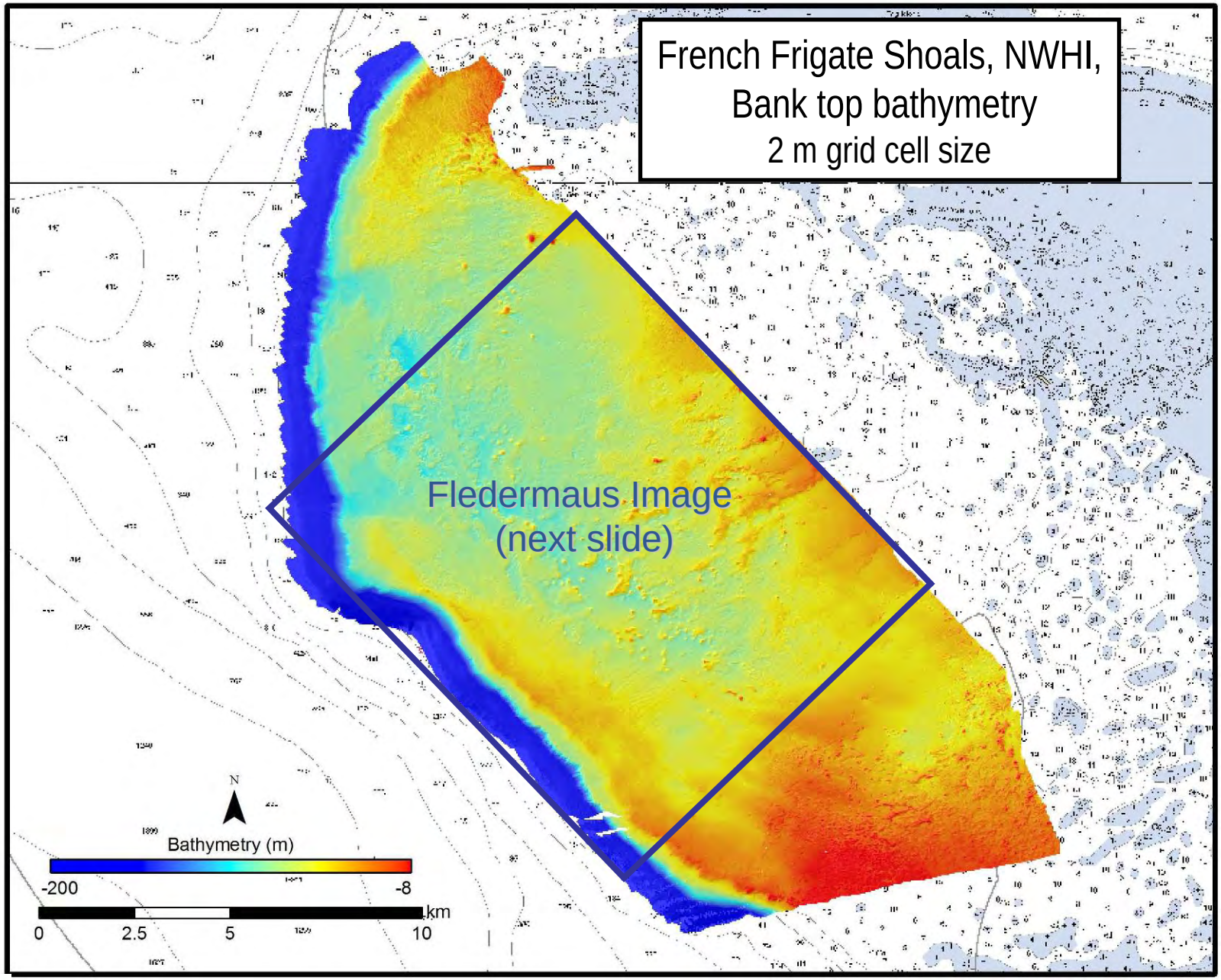
NWHI (2002/KM)	38,367 km^2
NWHI (2003-2006)	2,821 km^2
MHI (2005-2006)	2,505 km^2
CNMI/Guam (2003)	244 km^2
Am. Samoa (2004-2006)	1,385 km^2
PRIAs (2006)	3,793 km^2
Total	**49,115 km^2 (14,319 nm^2)**

U.S. Pacific Islands: Vast and Remote

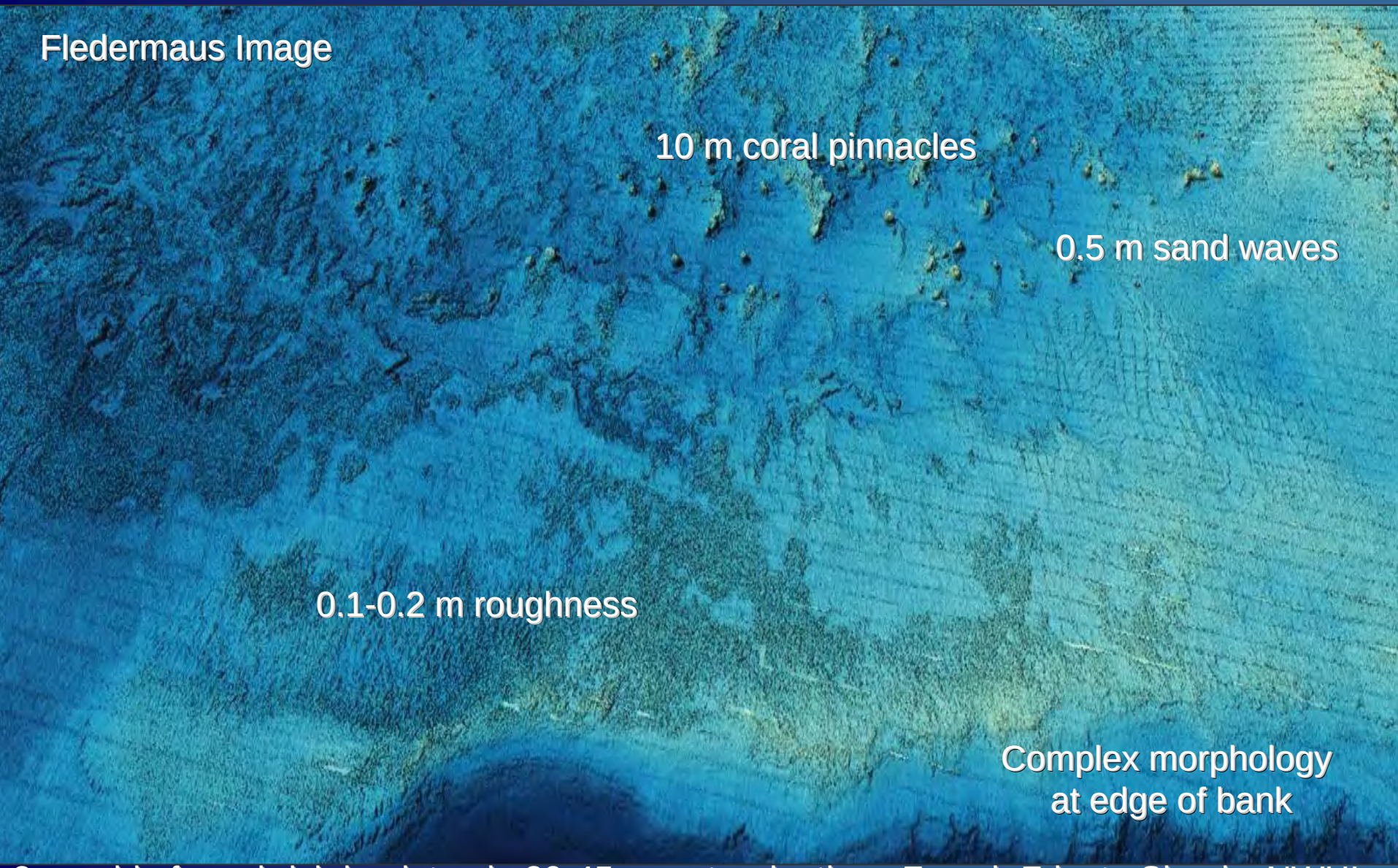


French Frigate Shoals, NWHI



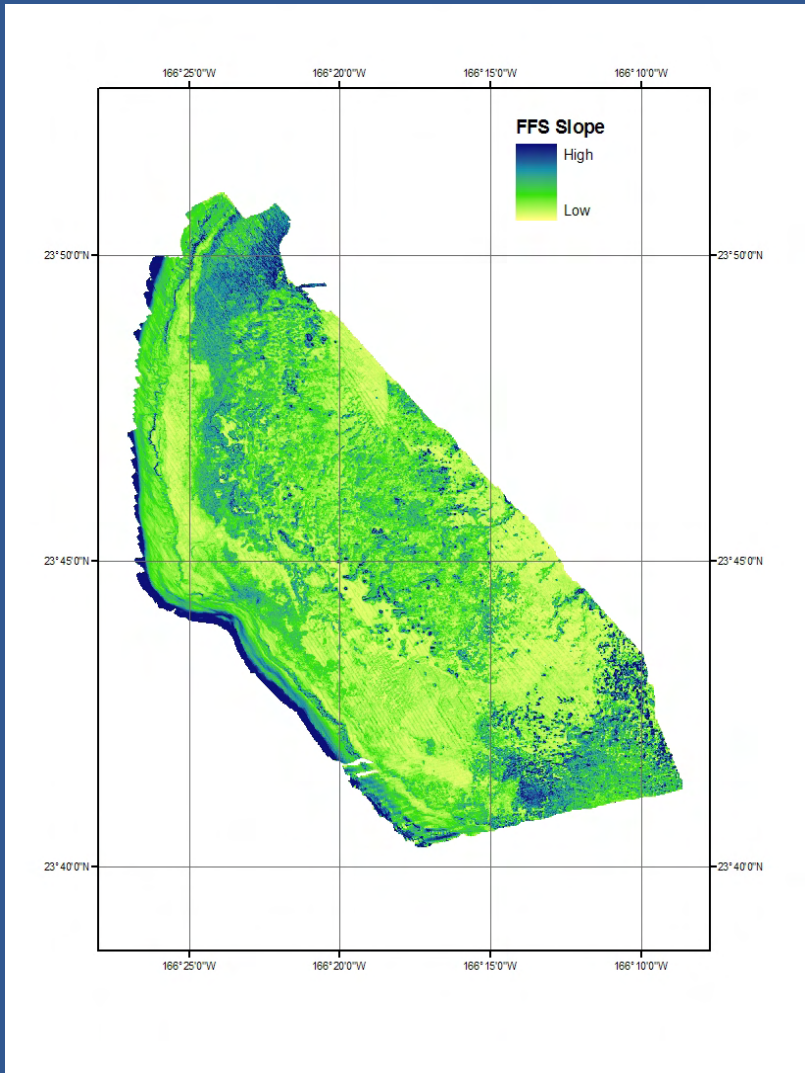

French Frigate Shoals, NWHI,
Bank top bathymetry
2 m grid cell size
Fledermaus Image
(next slide)
N
Bathymetry (m)
-200
-8
0
2.5
5
10
km

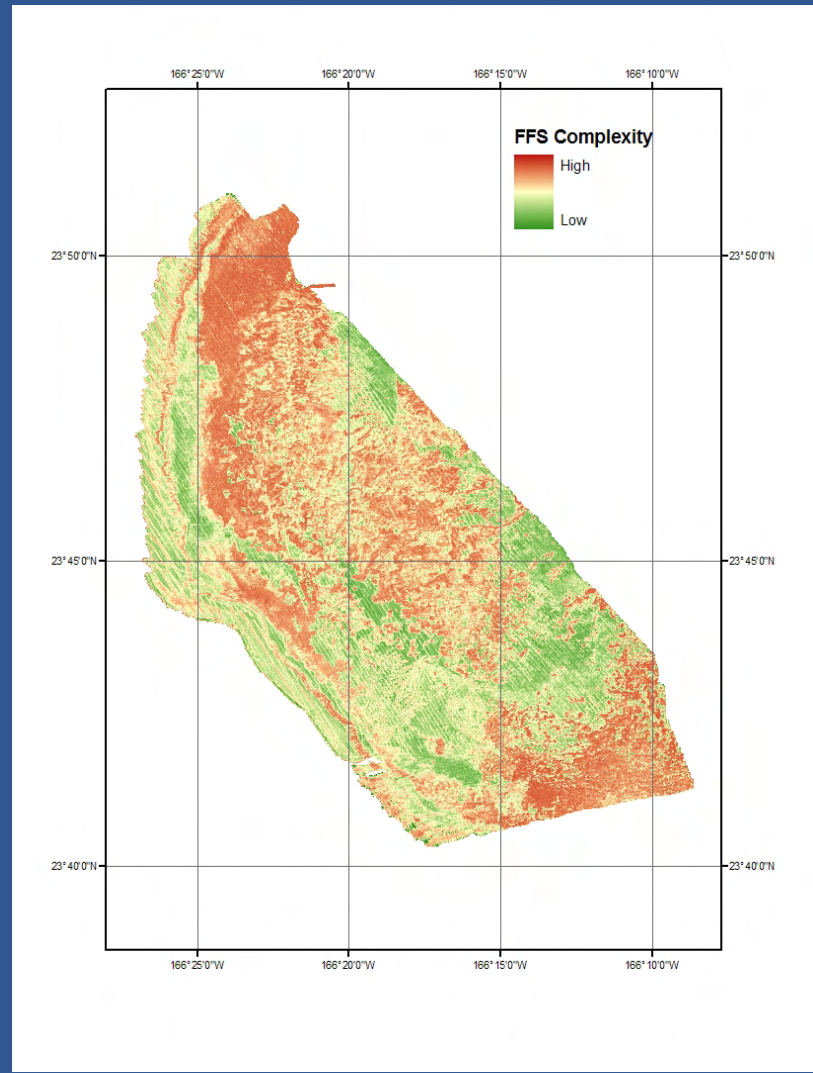
What are we looking for?



2-m grid of coral-rich bank top in 20-45 m water depths – French Frigate Shoals, NWHI

5x Slope & Complexity

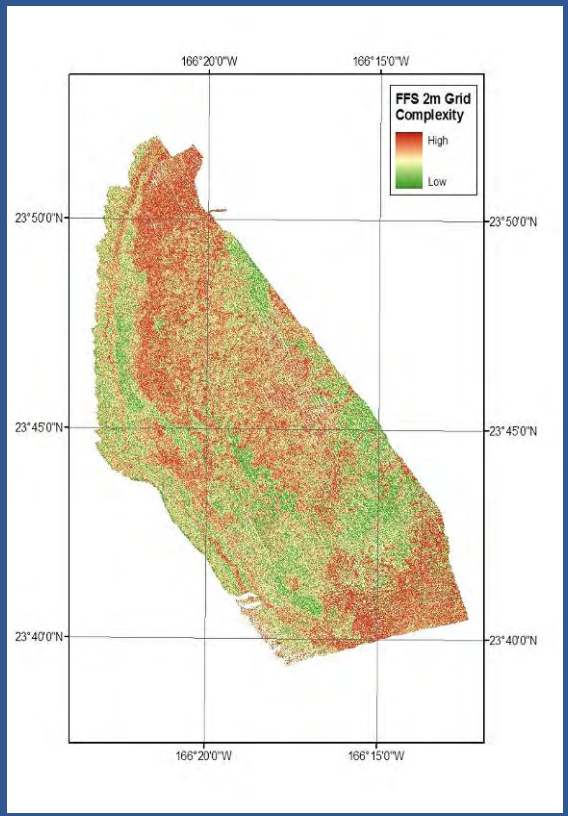


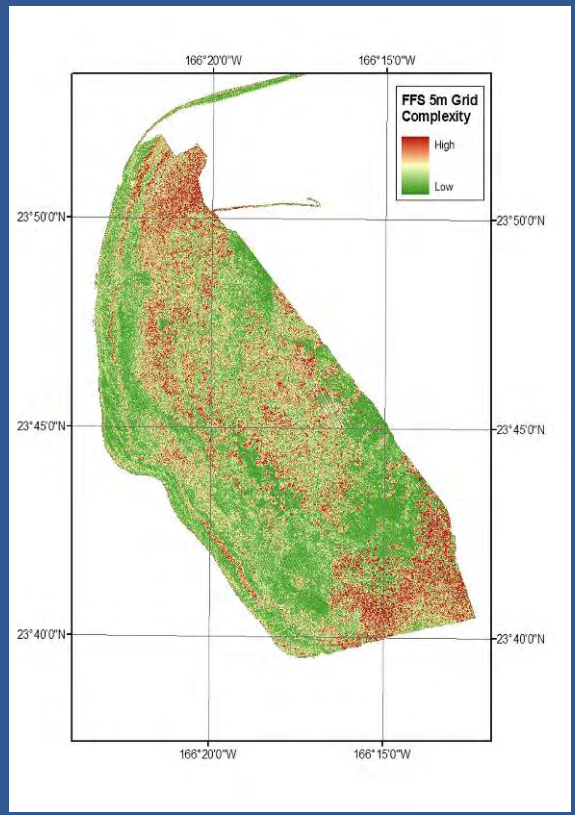


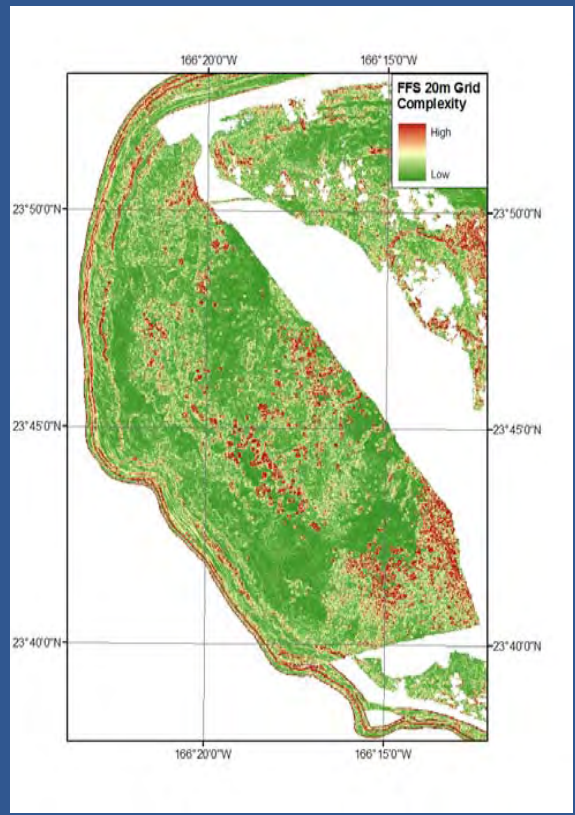
Complexity is derived by taking a slope of a 5x exaggerated slope (2nd derivative).

A GIS Recipe for Determining Benthic Complexity: Jeff Ardron, Marine Geography, 2002.

Grid Size for Products

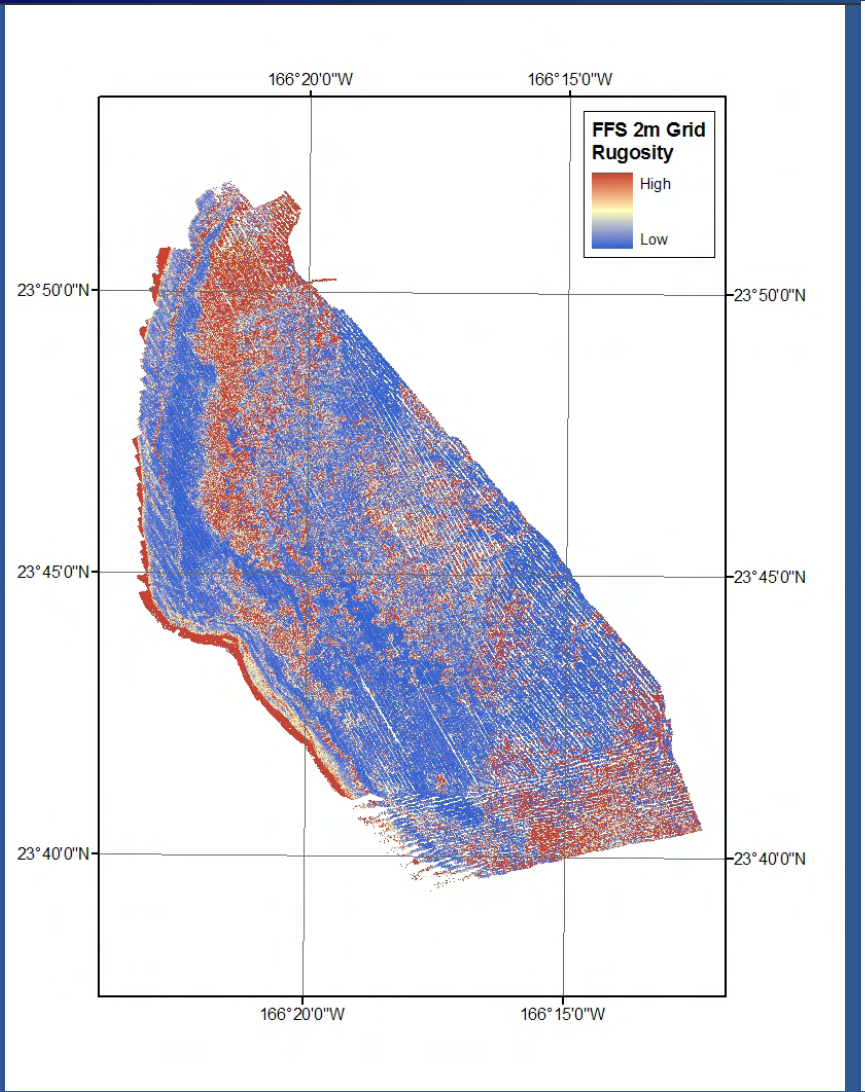


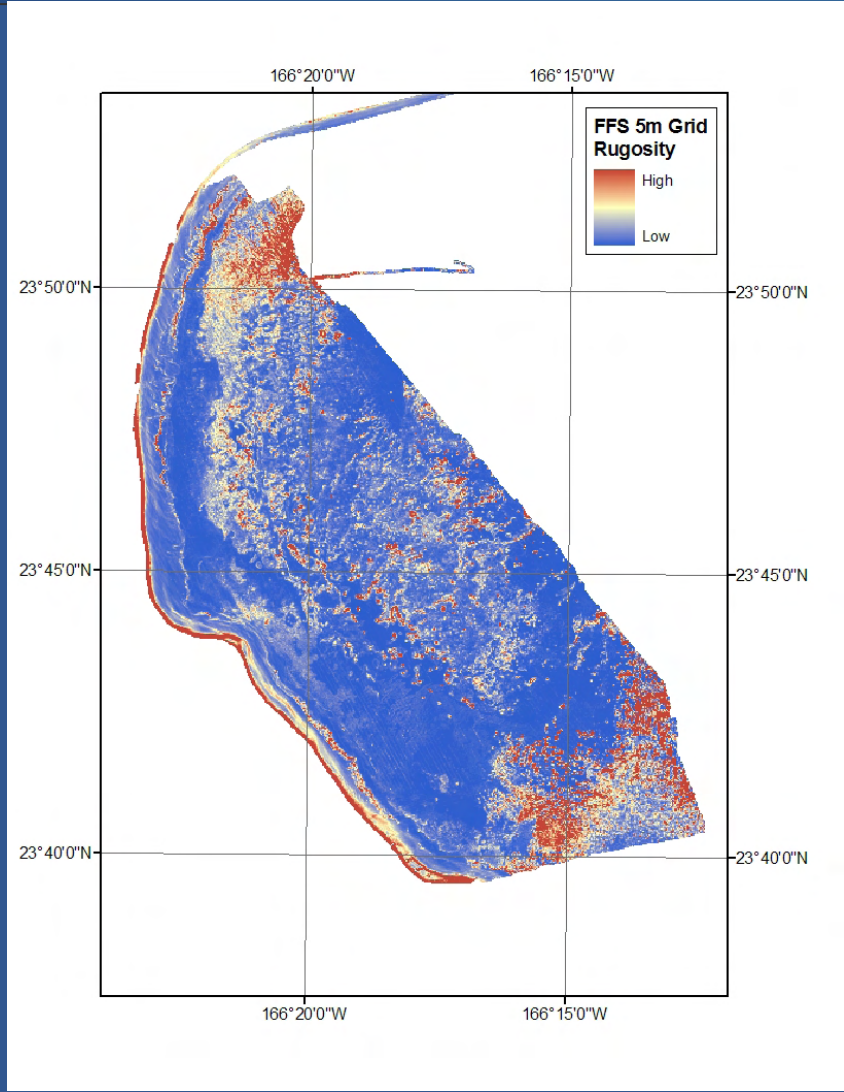




When creating derivative products, what size grid cell should be used?

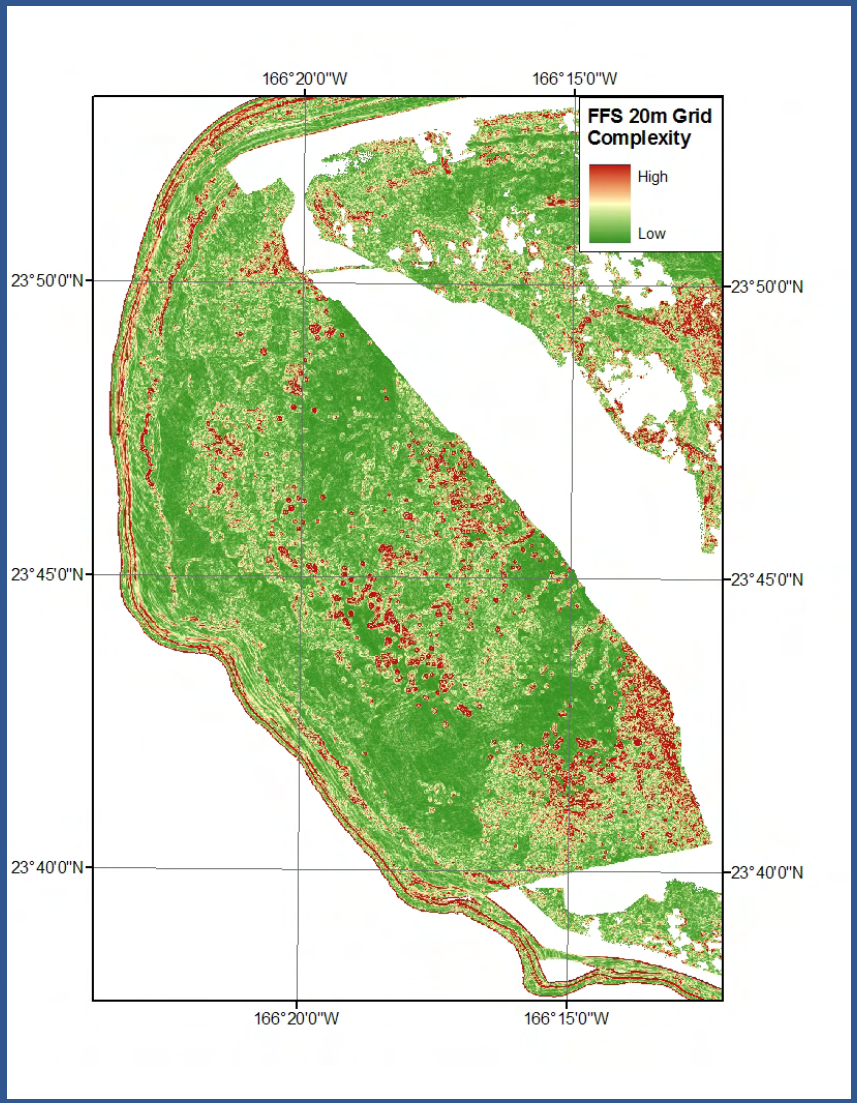
Rugosity

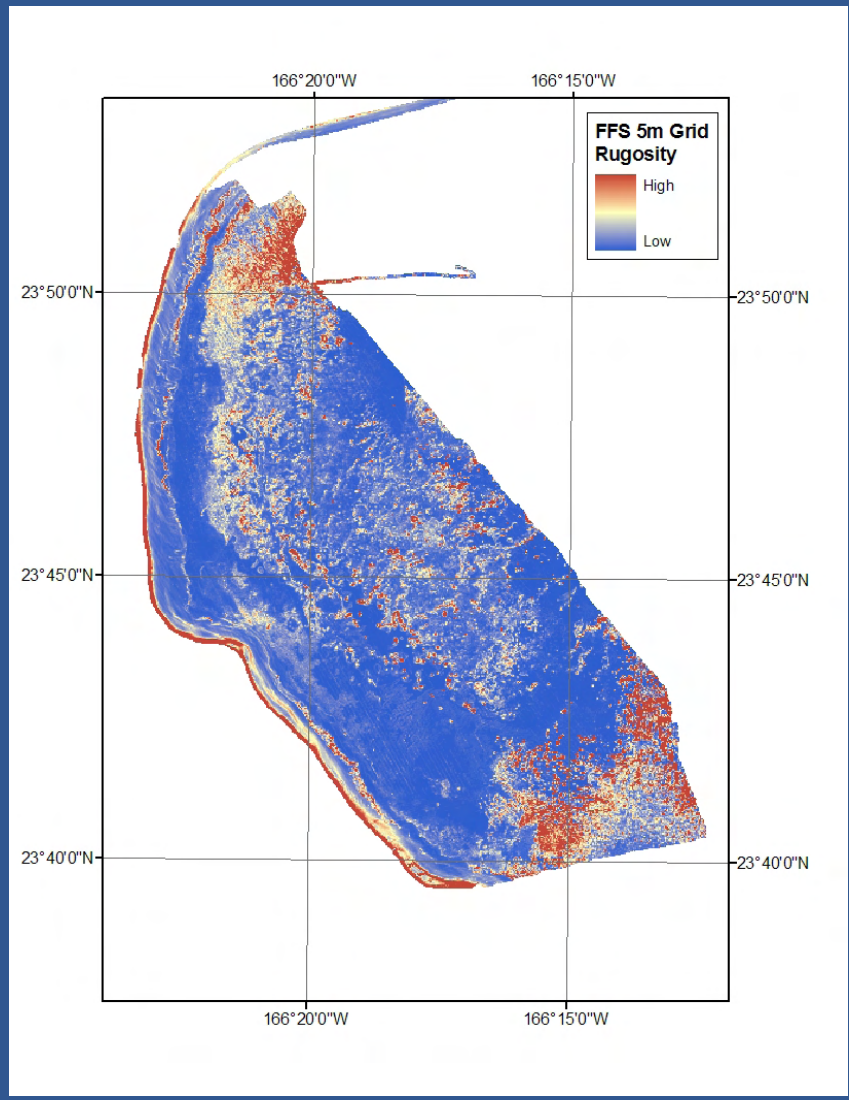




Rugosity was derived using rugosity builder application developed by Jeff Jenness for NOAA's Benthic Terrain Modeler.

Complexity and Rugosity Similar Results



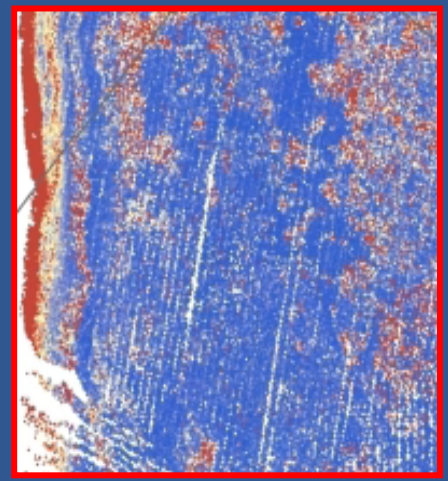


Backscatter from EM3002D (300 kHz) & Reson 8101 (240 kHZ)

At FFS complexity and backscatter are both very informative, but in different ways

Backscatter

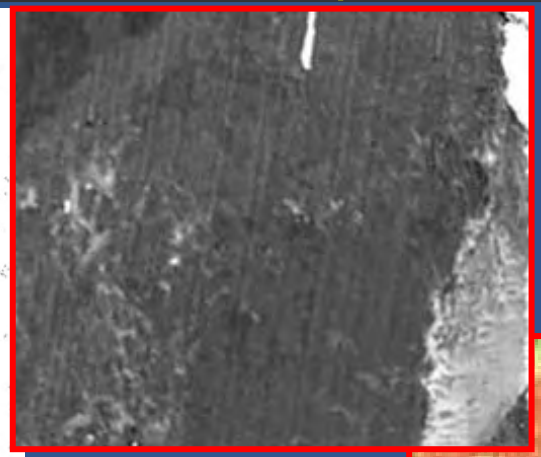
2 m Complexity



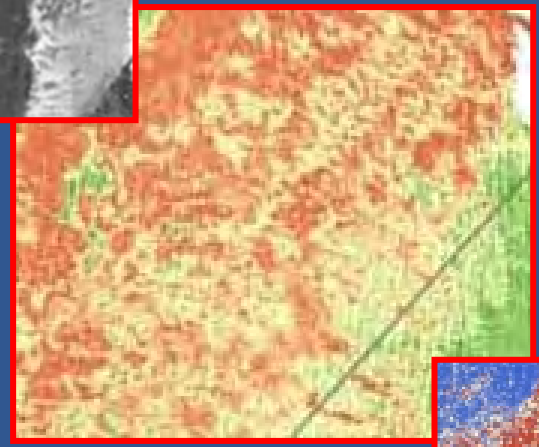
2 m Rugosity

In mixed sediment and hard bottom areas, backscatter variations are more informative.

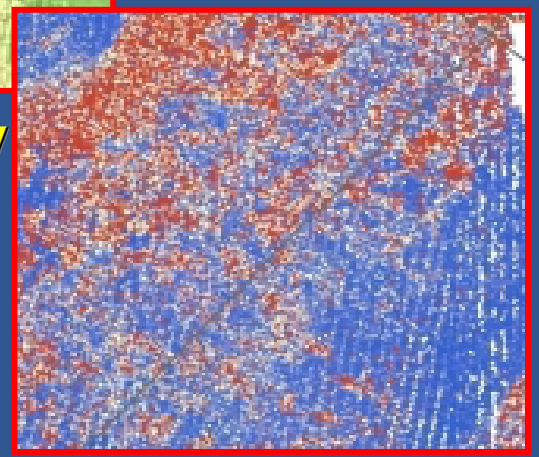
At FFS complexity and backscatter are very informative, but in different ways



Backscatter



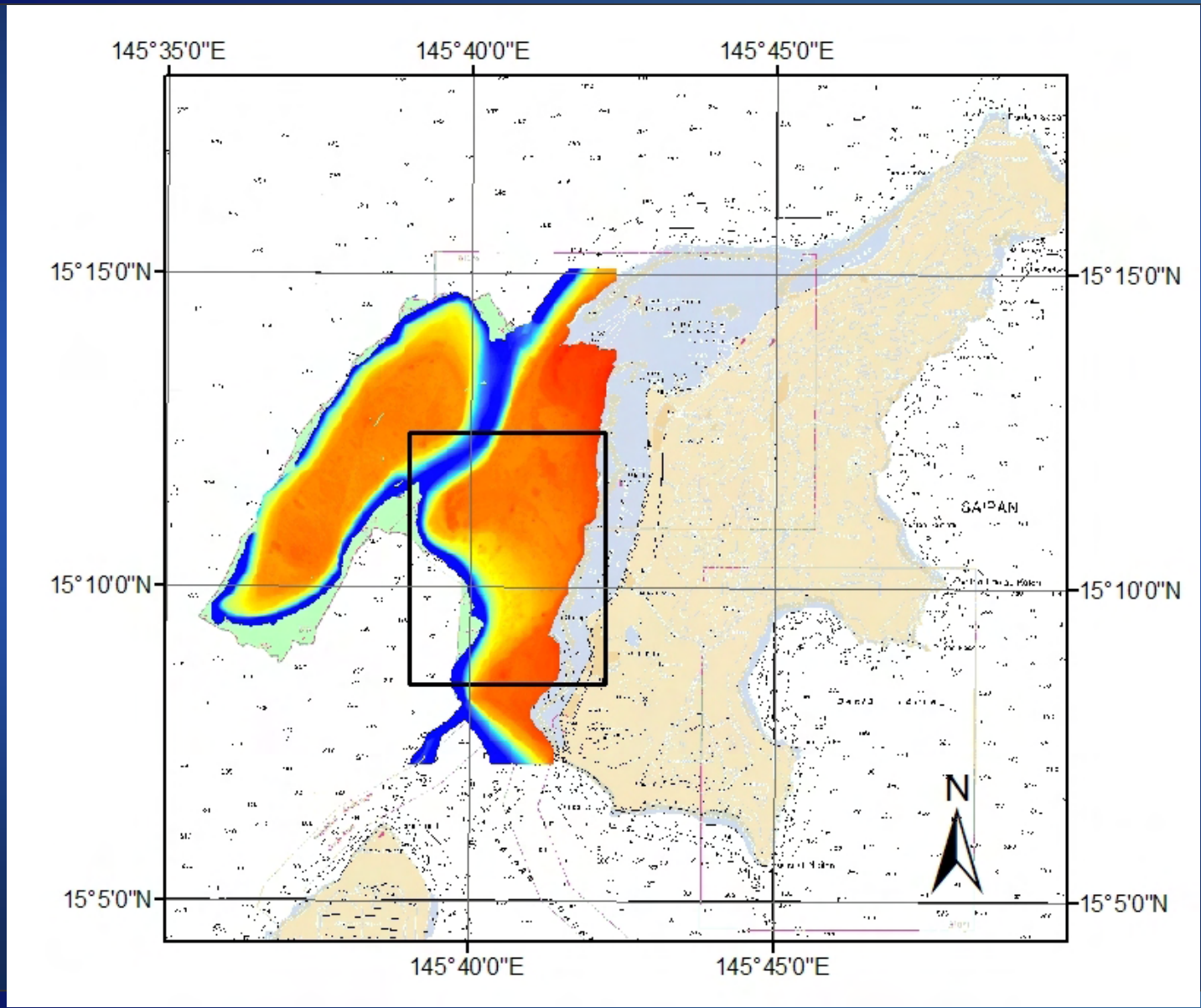
2 m Complexity



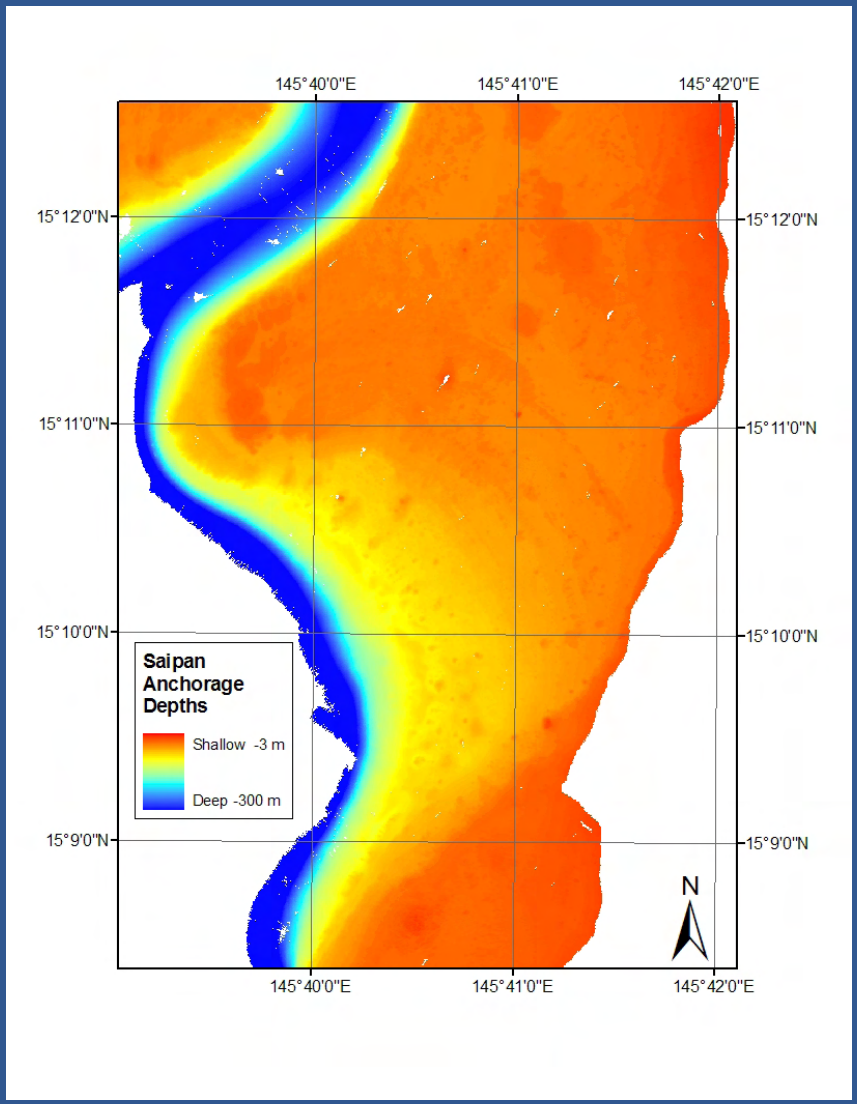
2 m Rugosity

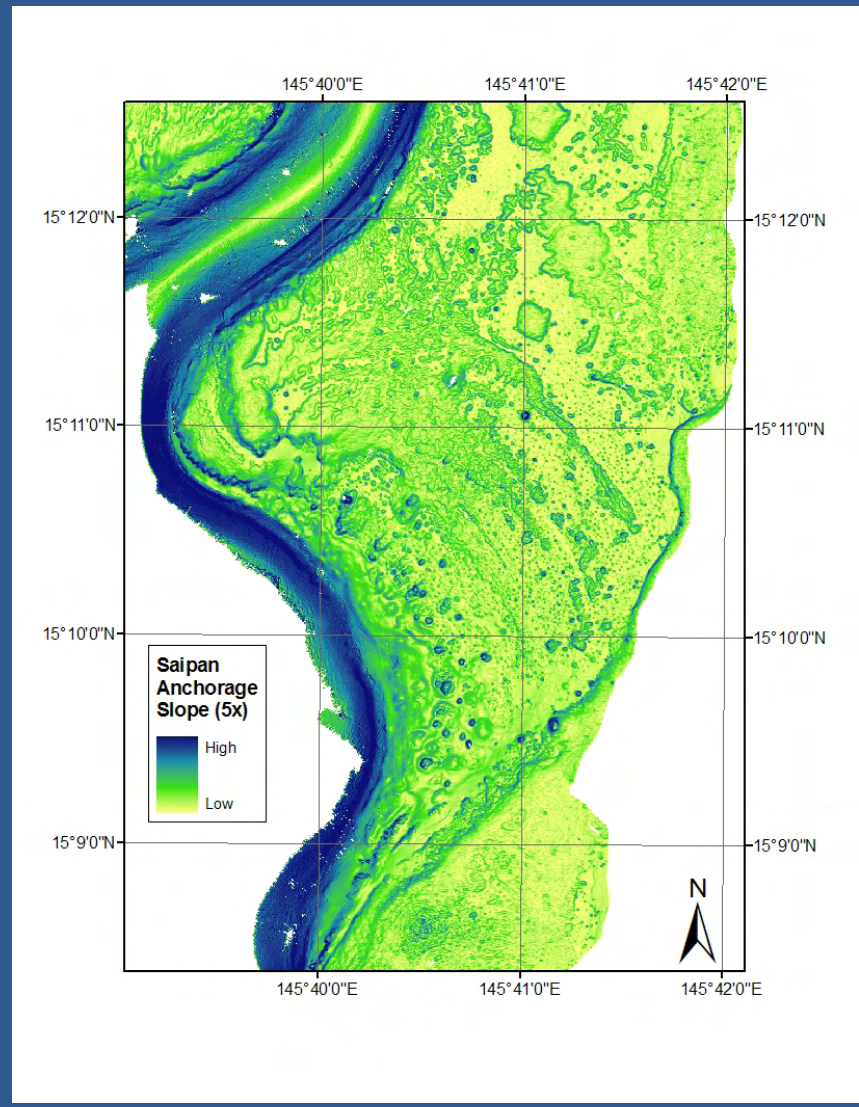
In hard coral and pavement areas, complexity and/or rugosity reveal subtle differences that backscatter does not show.

Saipan Garapan Anchorage, CNMI

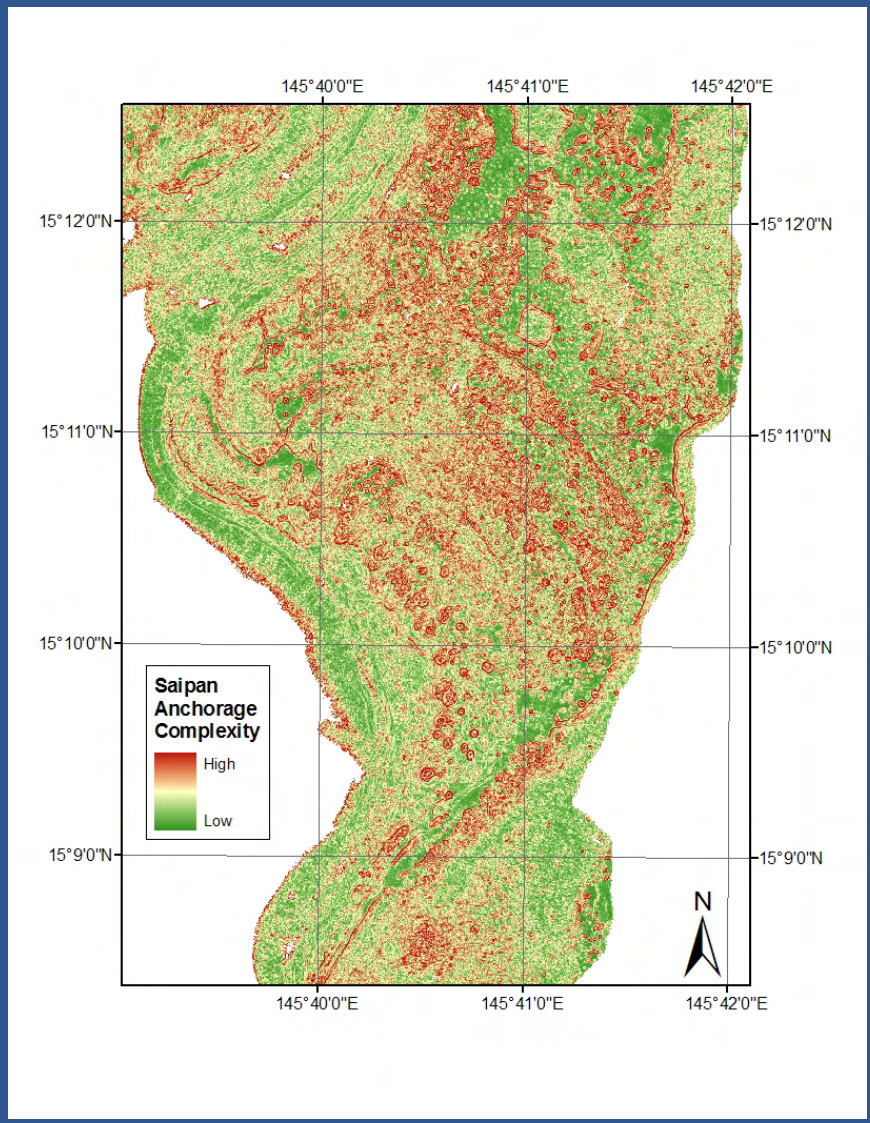


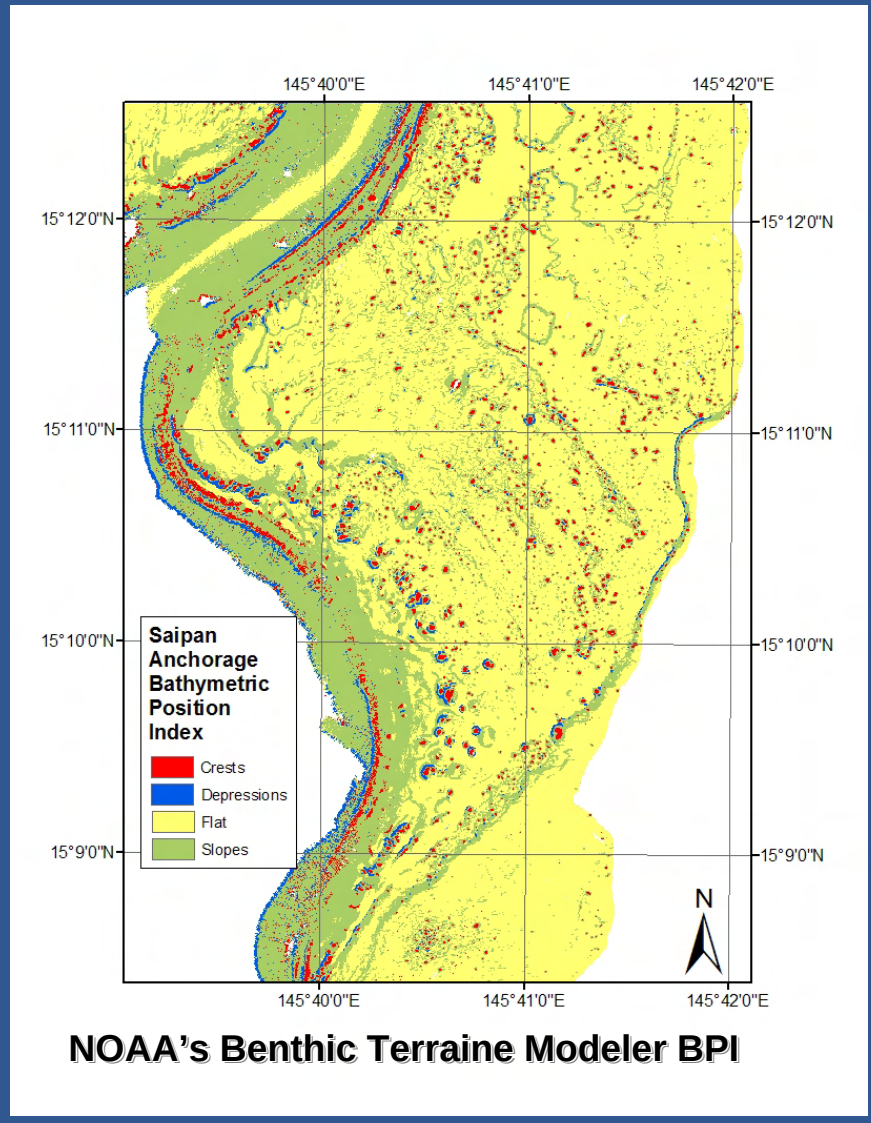
Saipan Depth and 5x Slope





Saipan Complexity and Bathymetric Position Index (Feature Classification)

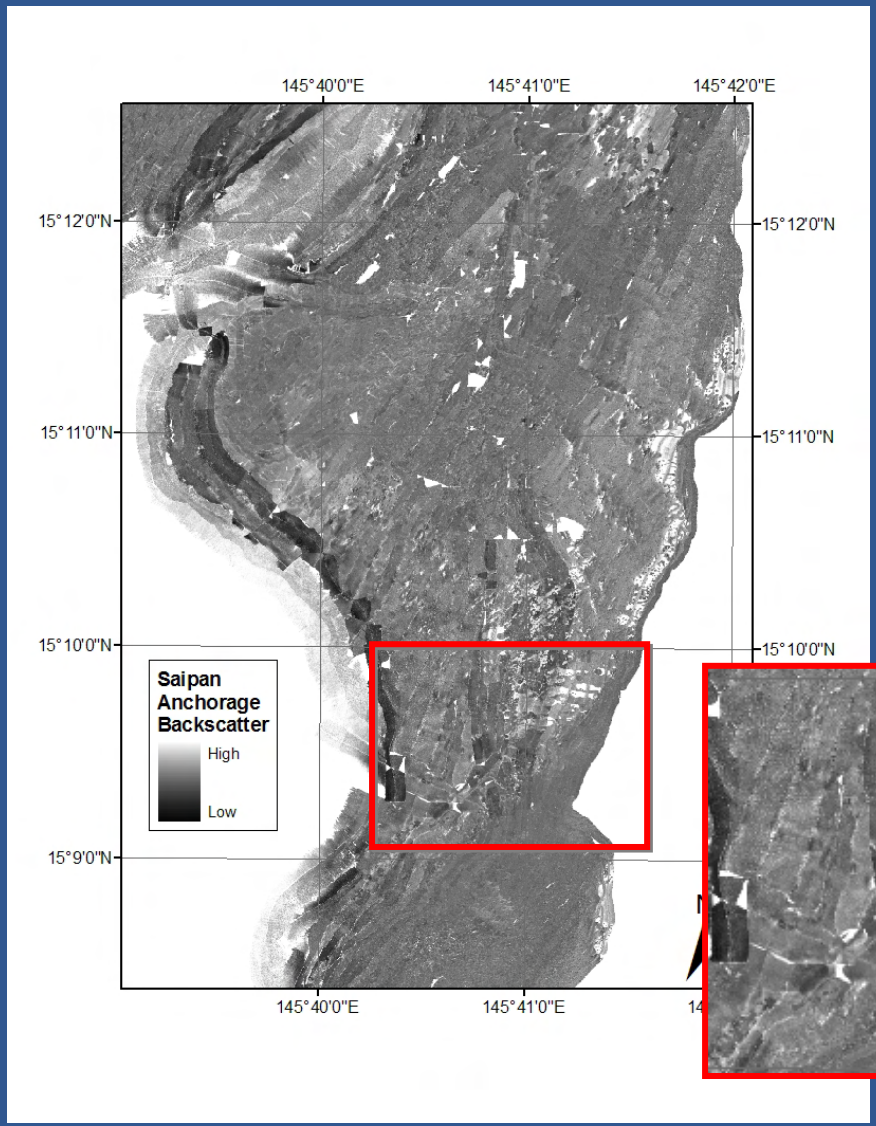




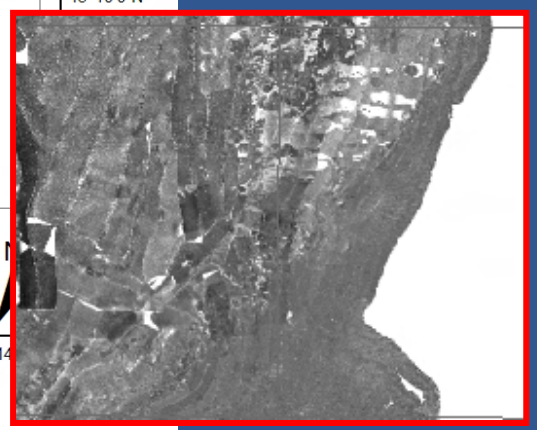
NOAA's Benthic Terraine Modeler BPI

Lundblad et al, 2006, A benthic terrain classification scheme for American Samoa, *Marine Geodesy*, 29(2): 89-111.

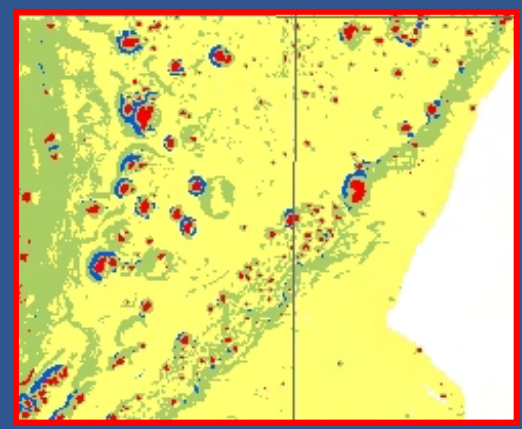
Saipan Backscatter: Lessons Learned



1. Run straight lines.
2. Minimize boat motion – yaw
3. Limit speed to 7 kts.
4. As at FFS, coral rich areas surrounded by hard bottom have similar backscatter signatures that are not easily differentiated.
5. Sandy areas show up well.

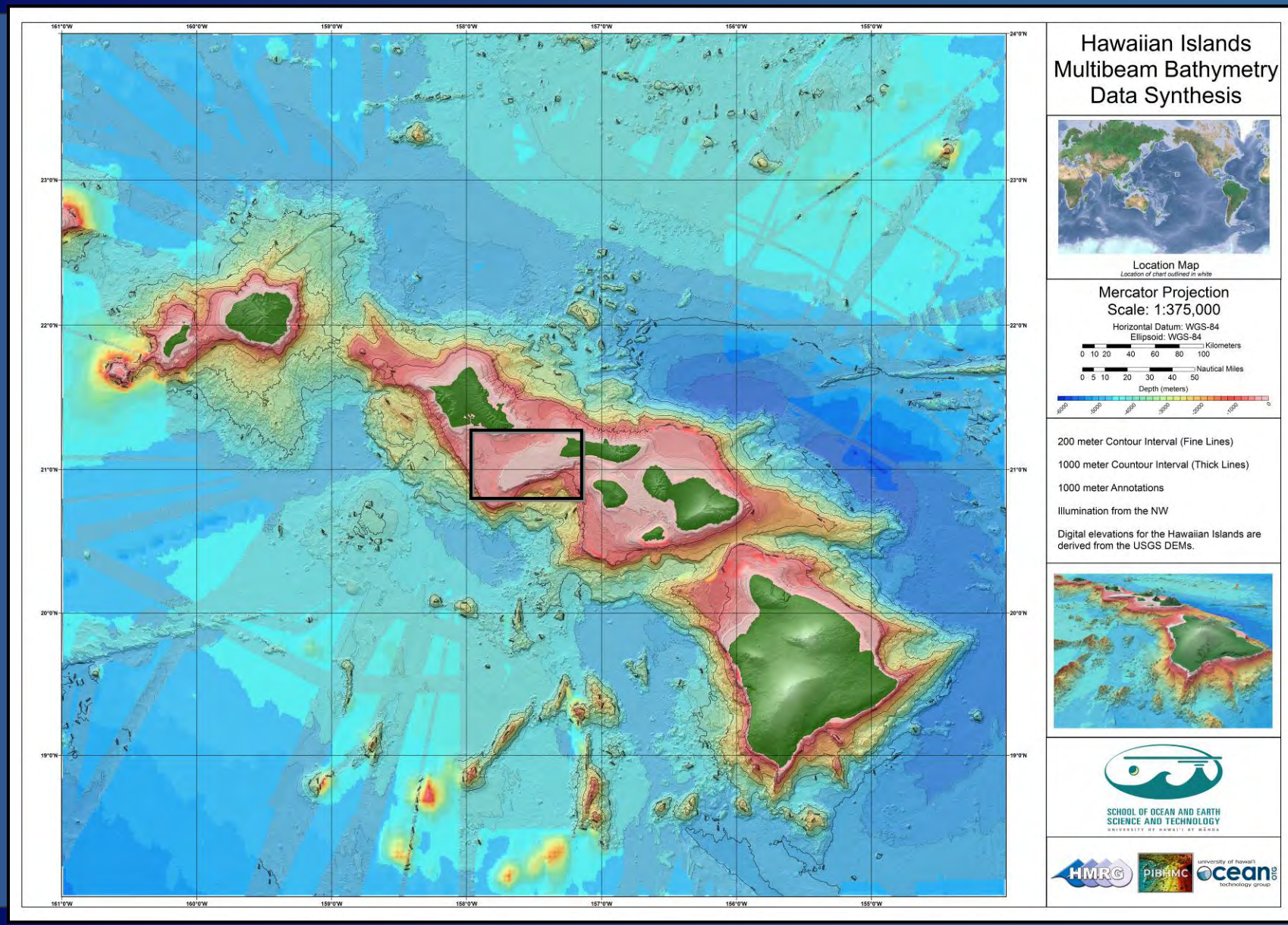


Backscatter

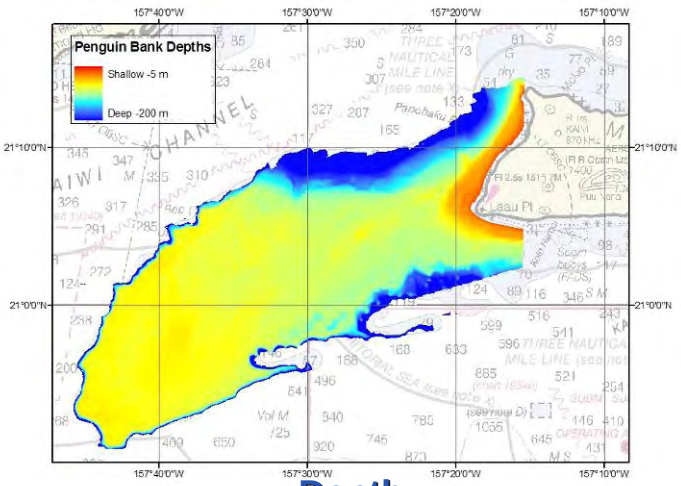


BPI

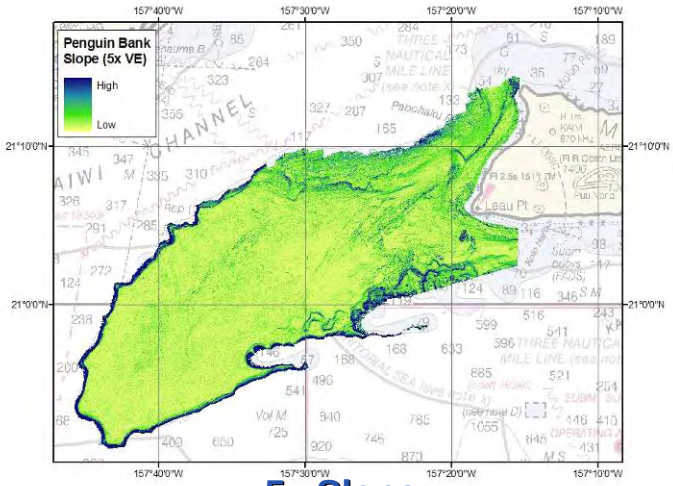
Main Hawaiian Islands



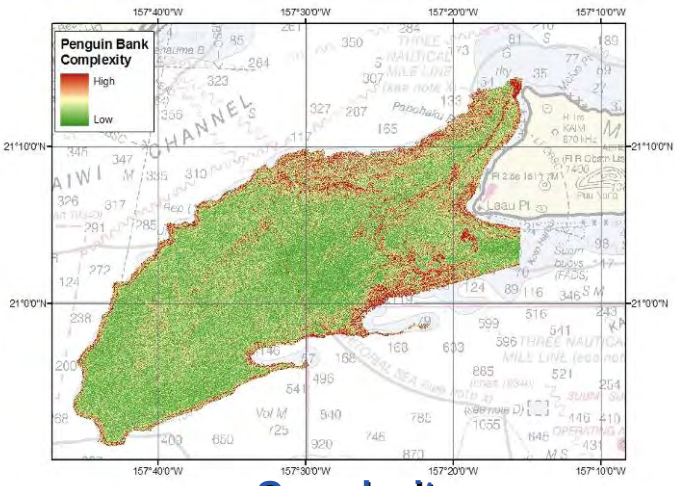
Penguin Bank Bathymetry and Bathymetry Derivatives



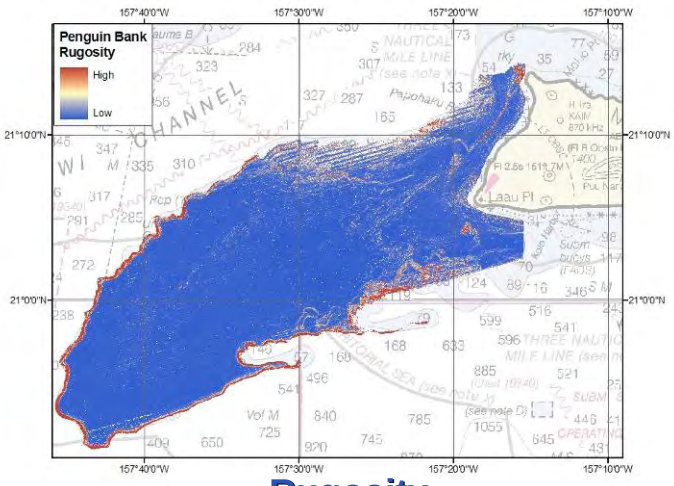
Depth



5x Slope

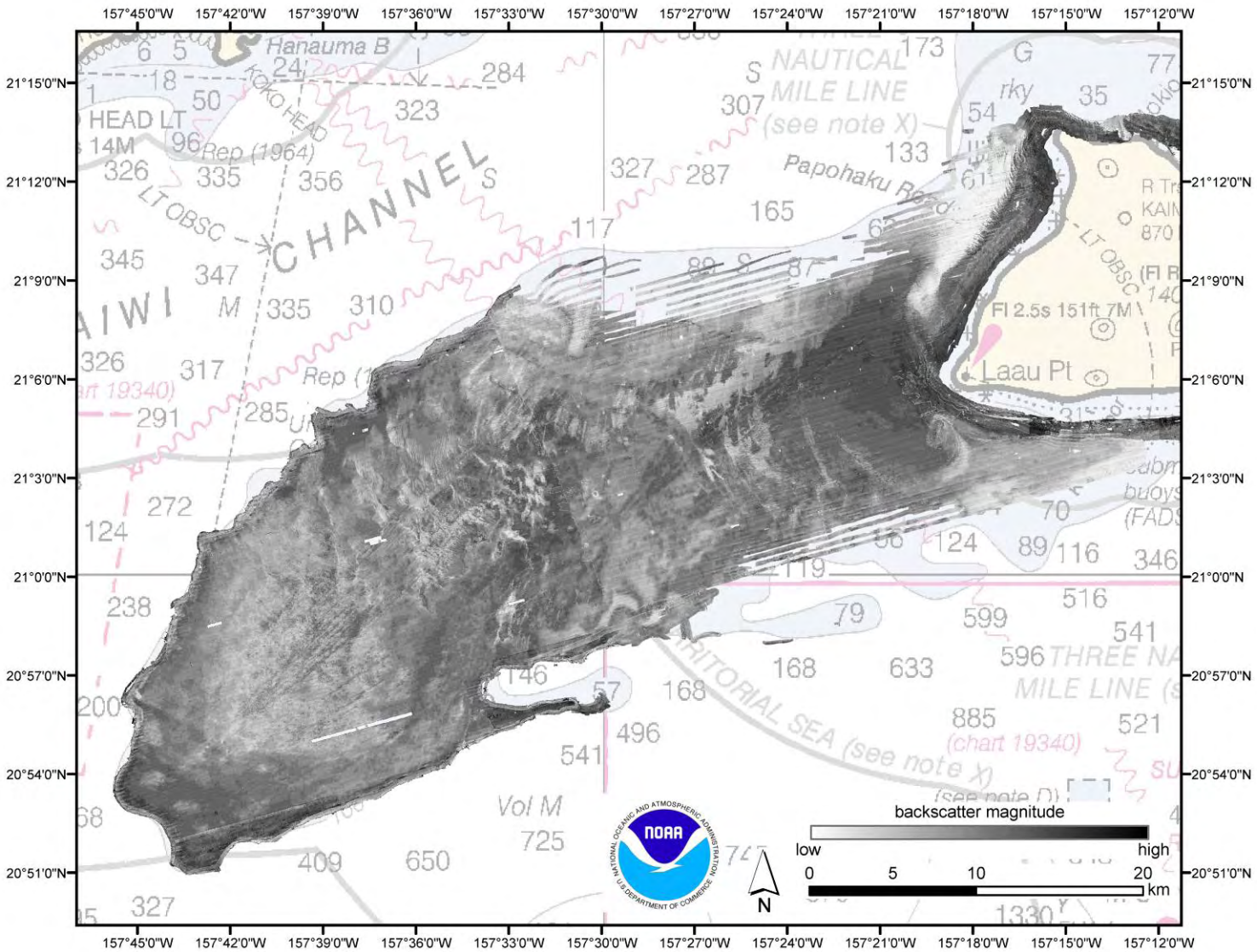


Complexity

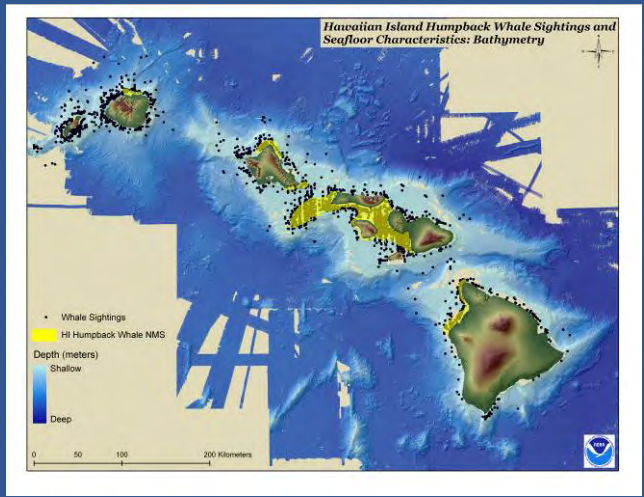


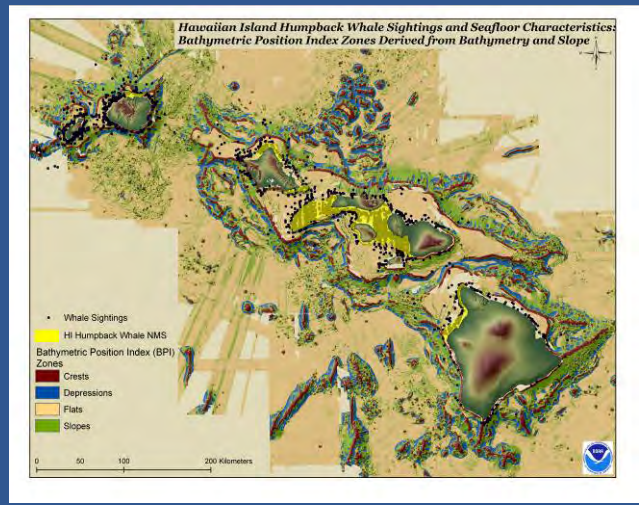
Rugosity

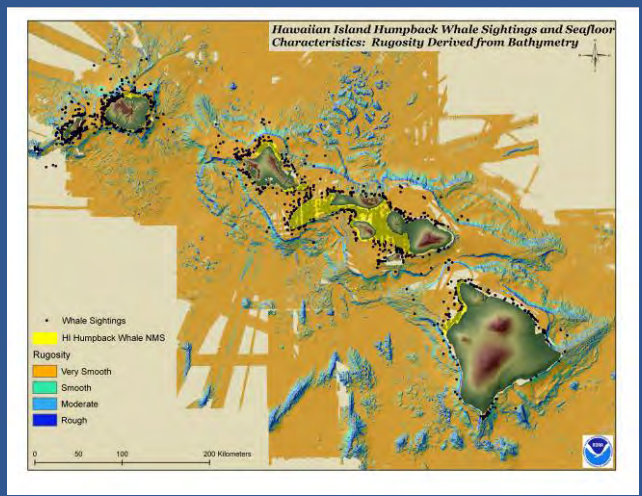
Penguin Bank Backscatter

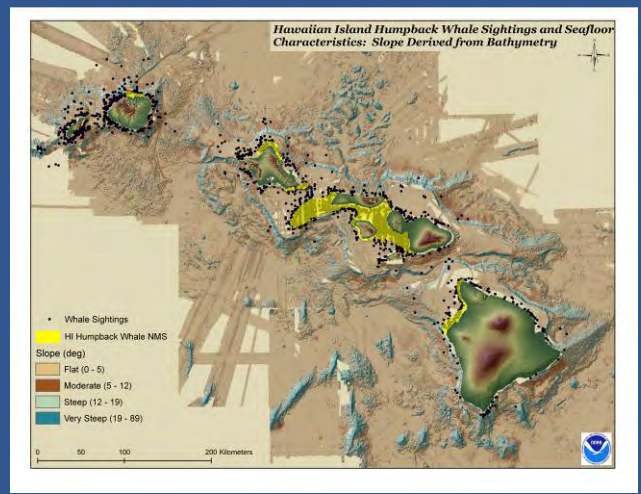


Uses of Derived Products for Ecosystem-Based Management







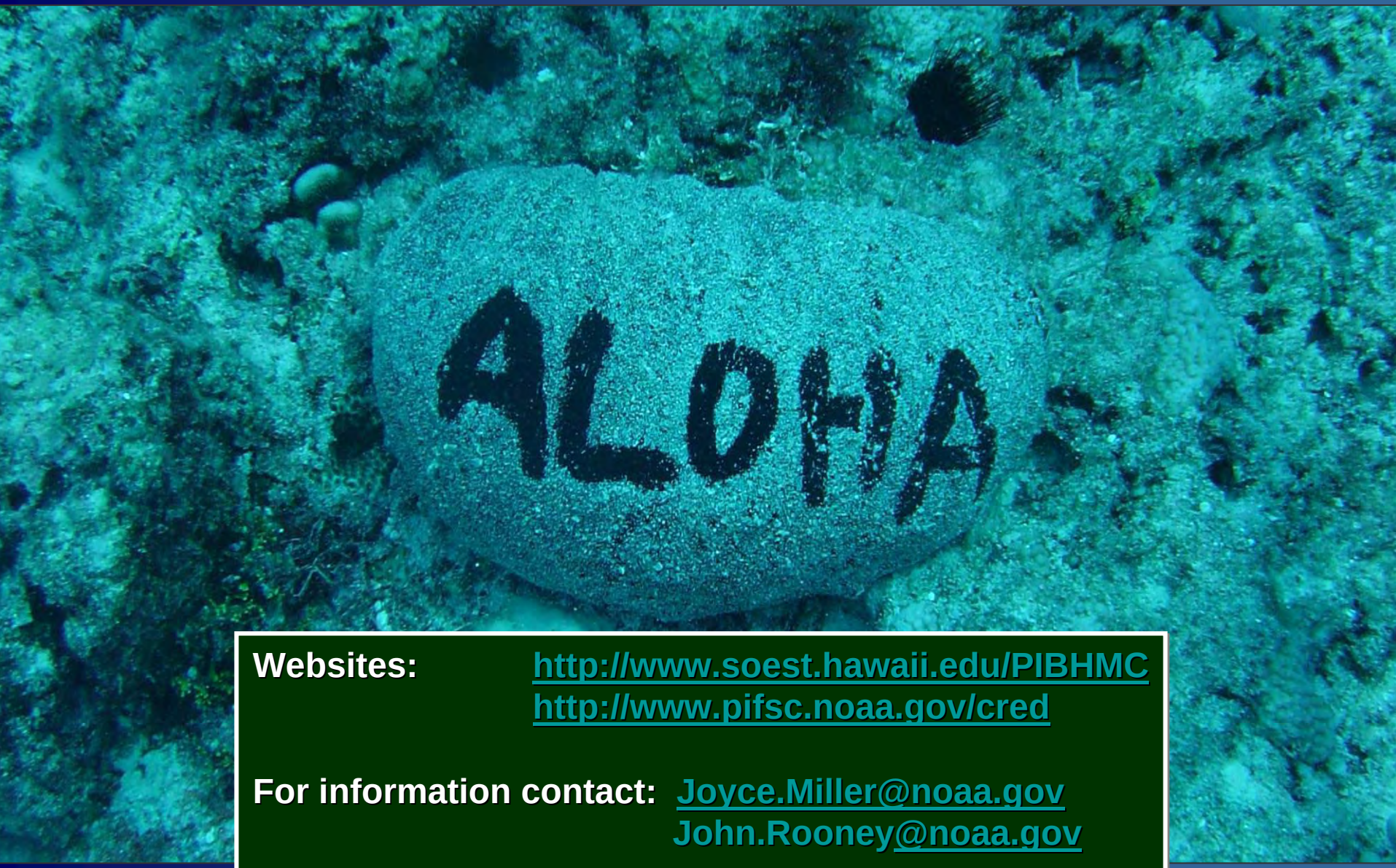


With 22% of habitat still unmapped, there was a 56% correlation of whale sightings with slopes of less than 5% and a 67% correlation with low rugosity.

Techniques Under Investigation

- An Empirical Approach to Mapping the Distribution of Seafloor Geologic and Biologic Characteristics Offshore San Pedro, Southern California, Dartnell et al., Ocean Sciences, Feb. 2006, Honolulu.
- AVO Analysis Of Multibeam Backscatter, An Example From Little Bay, NH And Skjalfandi Ba, Iceland, Fonseca, et al., Ocean Sciences, Feb. 2004, Honolulu.
- Seafloor Texture Analysis of Saipan Anchorage Bathymetry using Local Fourier Histogram (LFH) Texture Features, G. R. Cutter Jr., October 2004

For Information



Websites: http://www.soest.hawaii.edu/PIBHMC
http://www.pifsc.noaa.gov/cred

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