

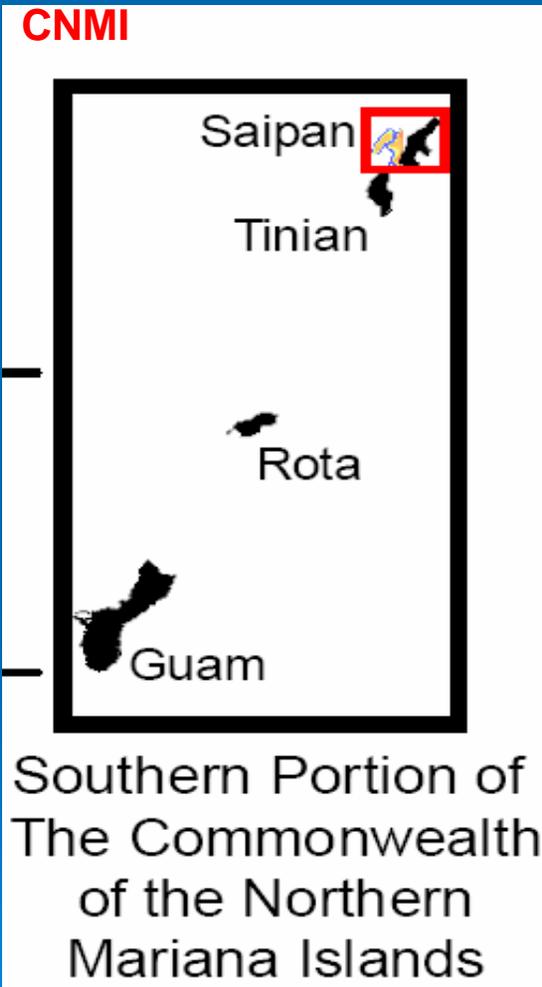
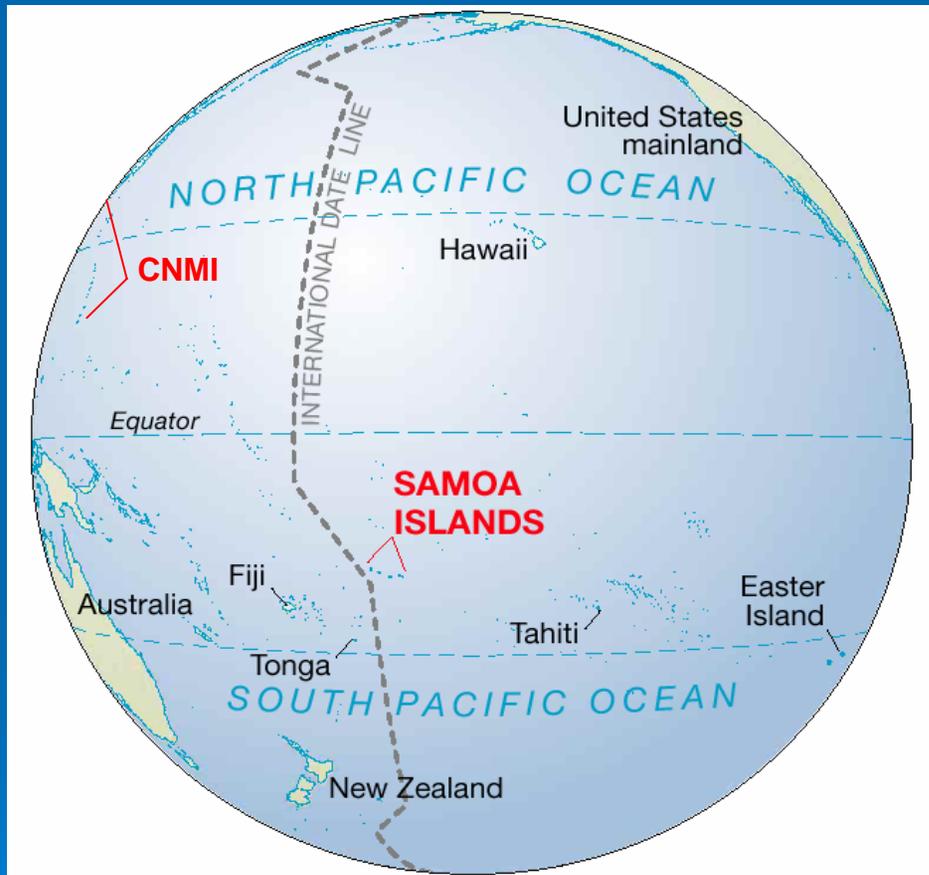
Mapping Pacific Island Coral Reef Ecosystems with Multibeam and Optical Surveys

Introducing the Benthic Terrain Modeler to Automate Terrain Classification

Emily Lundblad, Joyce Miller, John Rooney, Megan Moews, Joe Chojnacki, Jonathan Weiss

*Joint Institute for Marine and Atmospheric Research, University of Hawaii, Contractors to
NOAA Pacific Islands Fisheries Science Center*

The Commonwealth of the Northern Mariana Islands (CNMI)



GOALS

U.S. Navy Environmental Assessment for new anchorage sites

NOAA's Coral Reef Task Force (CRTF) Goal: Map and characterize coral reef ecosystems in the U.S. and flag territories by 2009

NOAA's Coral Reef Ecosystem Division's Goal: To achieve the CRTF goal around the Hawaiian Islands and the U.S. flag territories in the South and West Pacific.



Original Data collected in 2003 - 2004:

- Multibeam Bathymetry
- *Backscatter Imagery**
- *Towed Video Observations**

* Not used in BTM algorithms

Derived Data Sets from Multibeam Bathymetry:

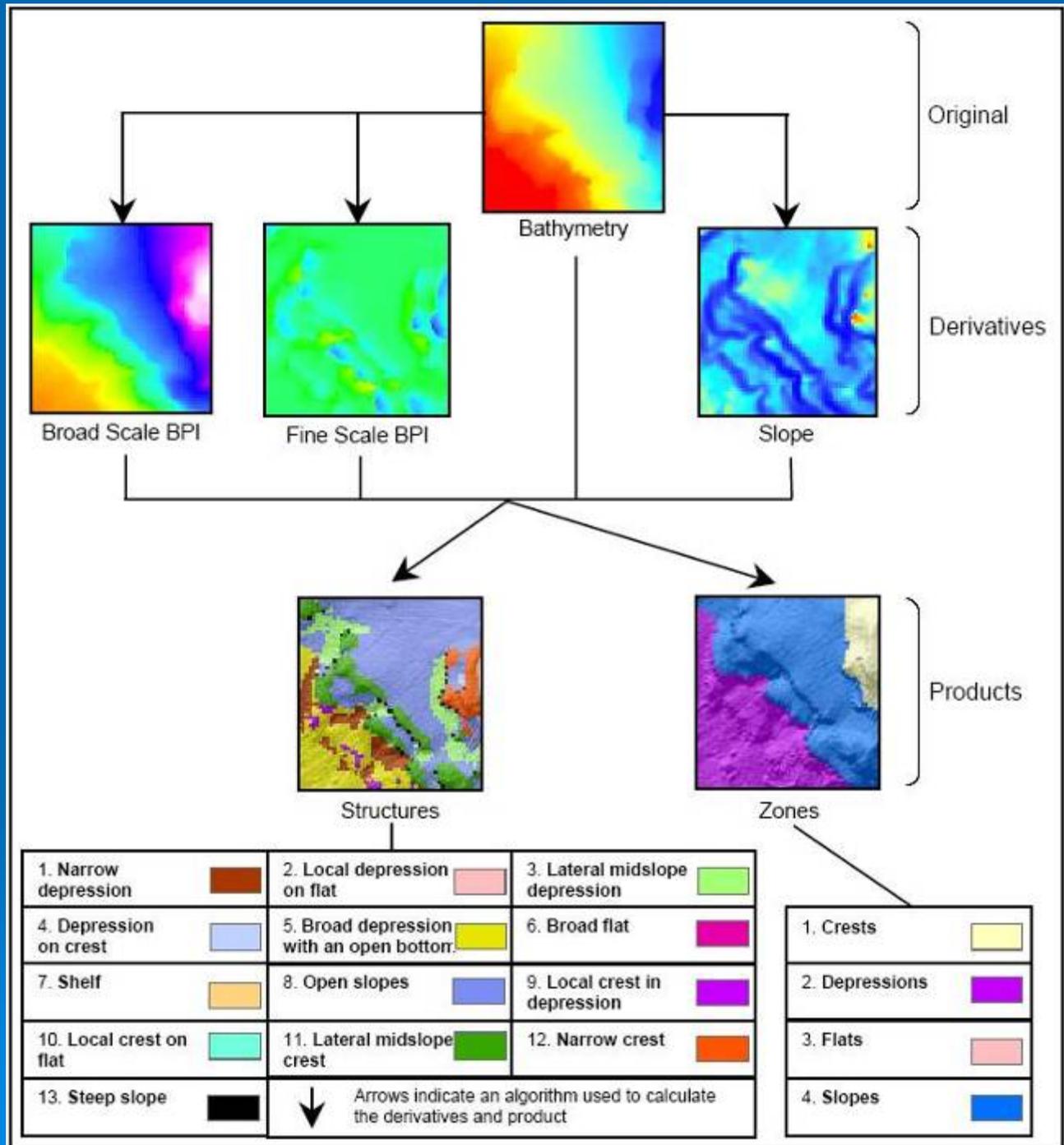
- Fine Scale Bathymetric Position Index (BPI)
- Broad Scale BPI
- Slope

Benthic Terrain Modeler (BTM) Products:

- BPI Zones
- BPI Structures
- Rugosity



BPI Zone and Structure Classification Flowchart



Bathymetric Position Index

$bpi < scalefactor > = \text{int}((bathy - \text{focalmean}(bathy, \text{annulus}, irad, orad)) + .5)$

Algorithm compares each cell's elevation to the mean elevation of the surrounding cells in an annulus or ring.

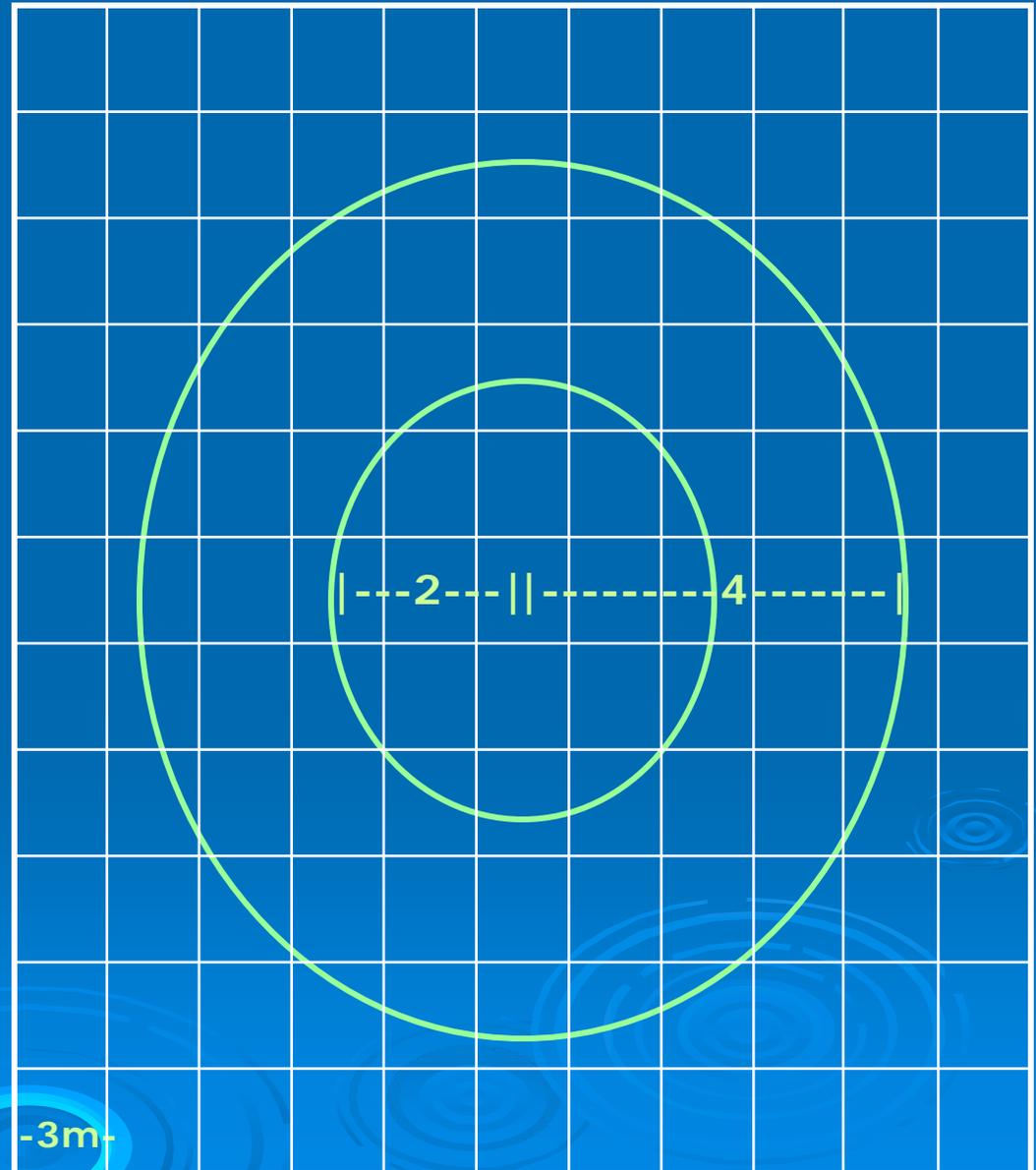
resolution = 3 m

irad = 2

orad = 4

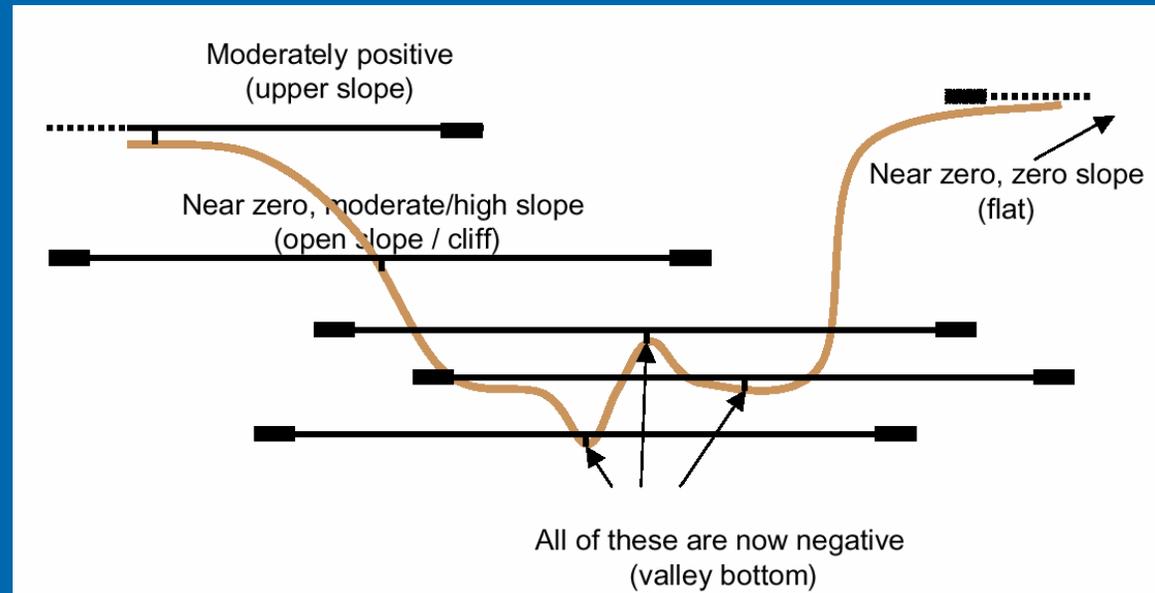
scalefactor =
resolution x orad = 12

- Negative bpi = depression
- Positive bpi = crest
- Zero bpi = constant slope or flat

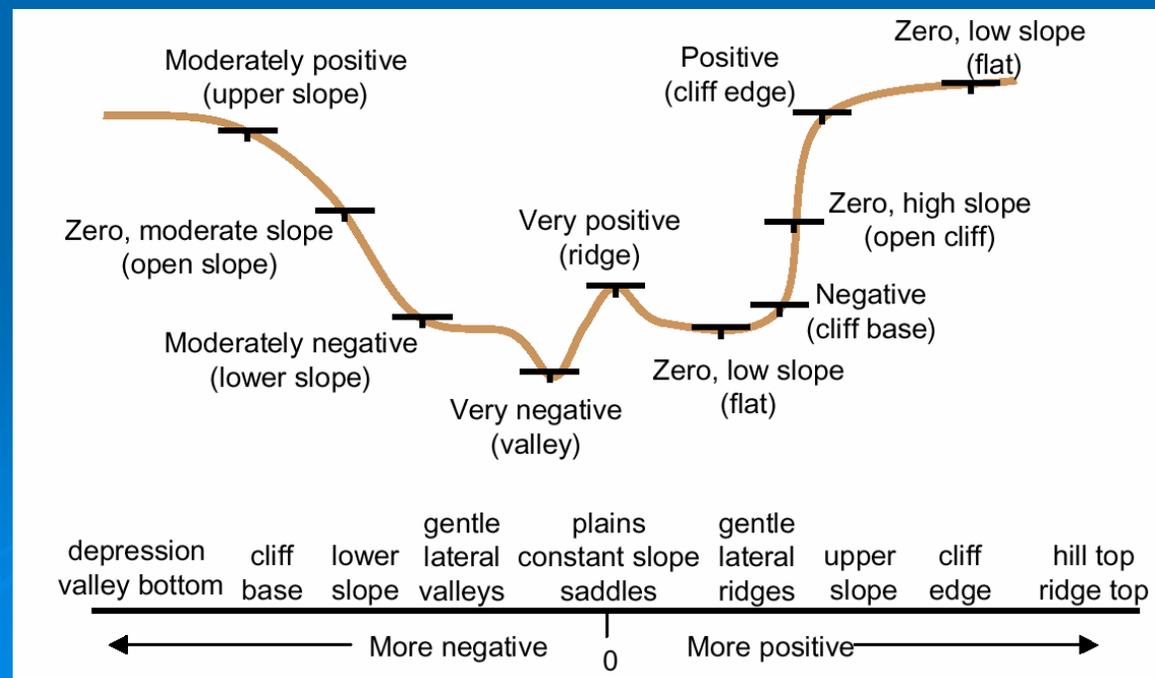


Bathymetric Position Index

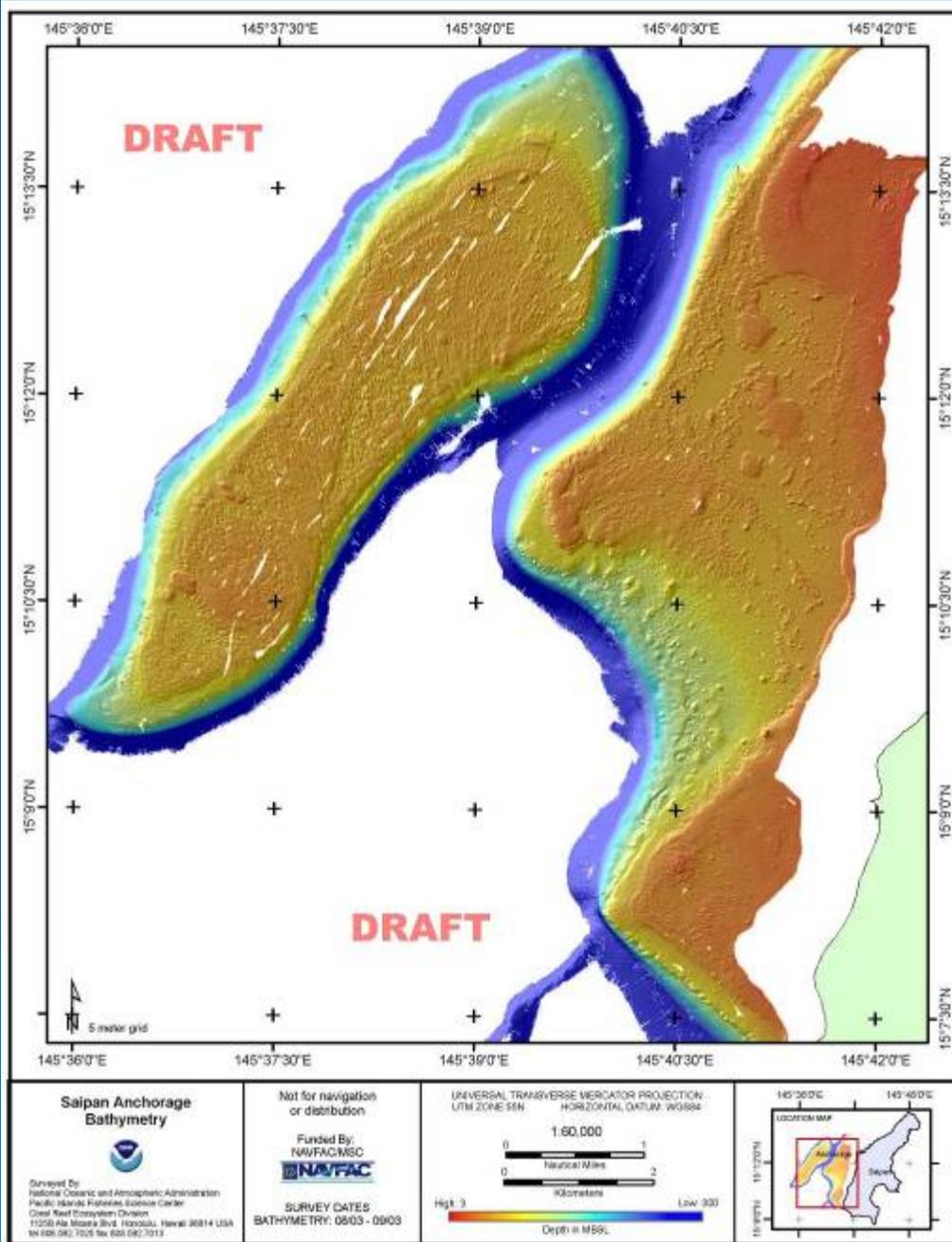
Broad scale



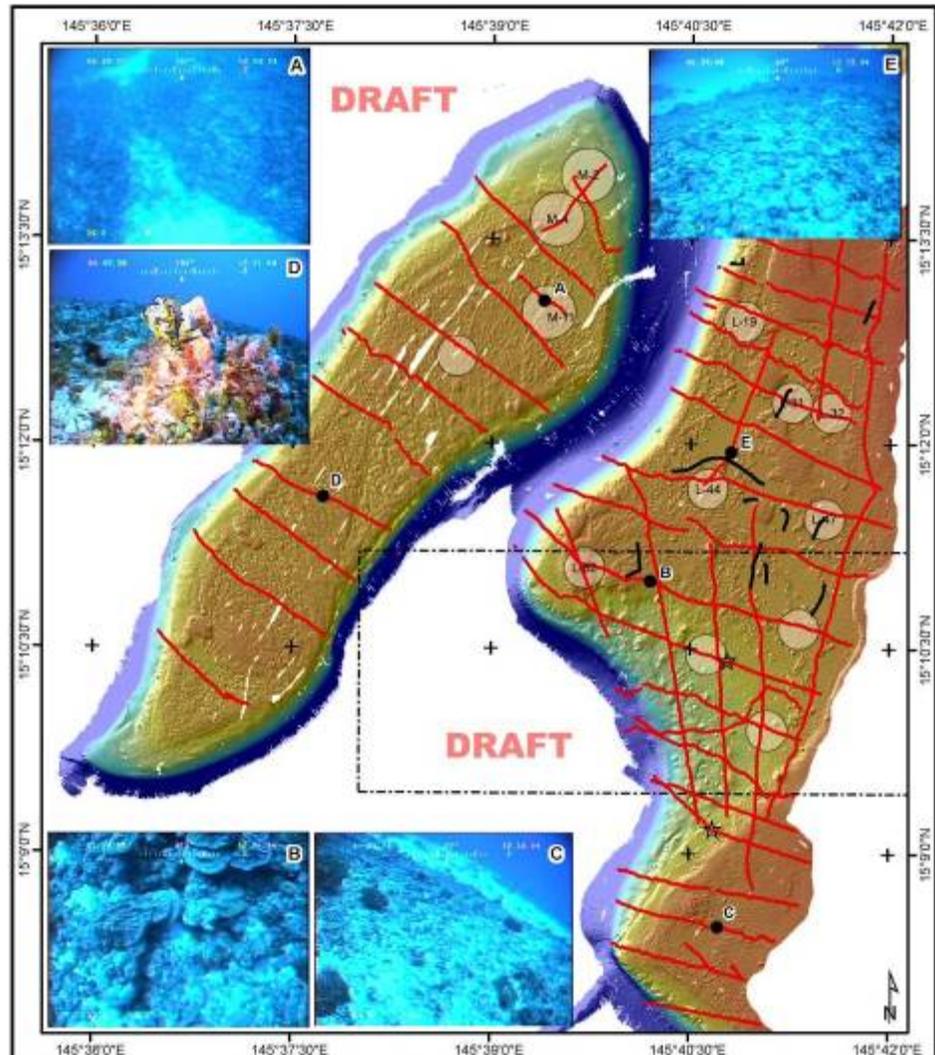
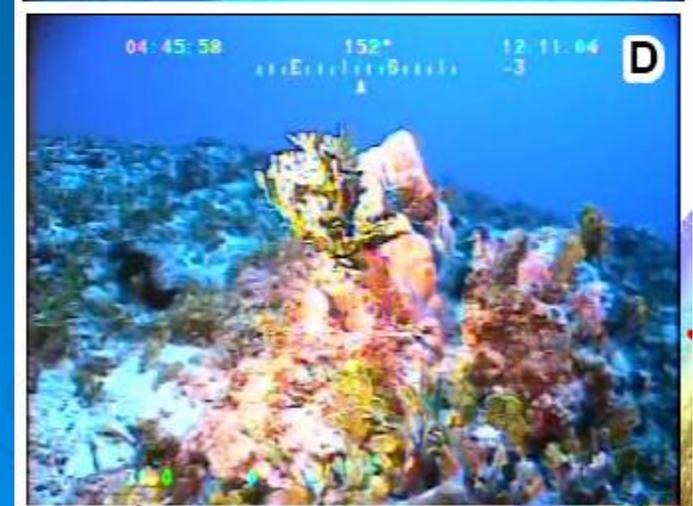
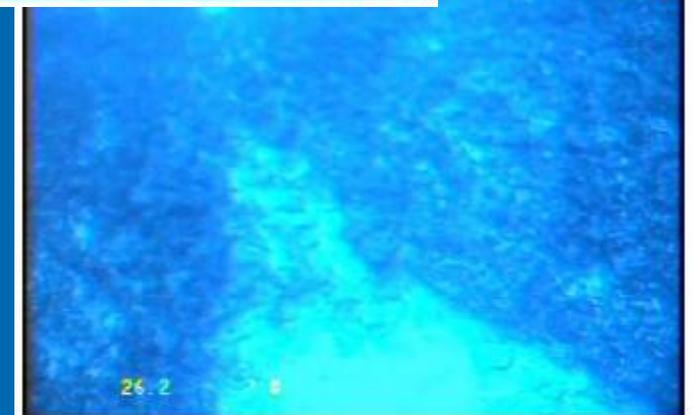
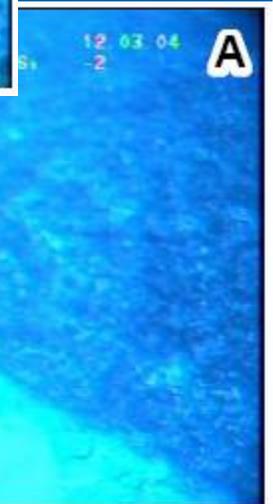
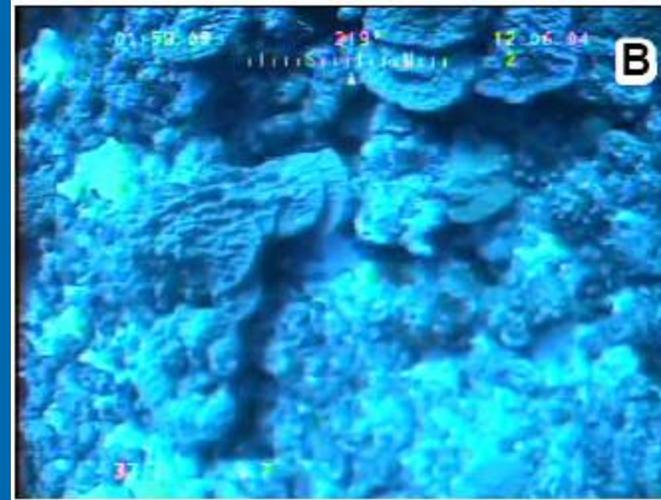
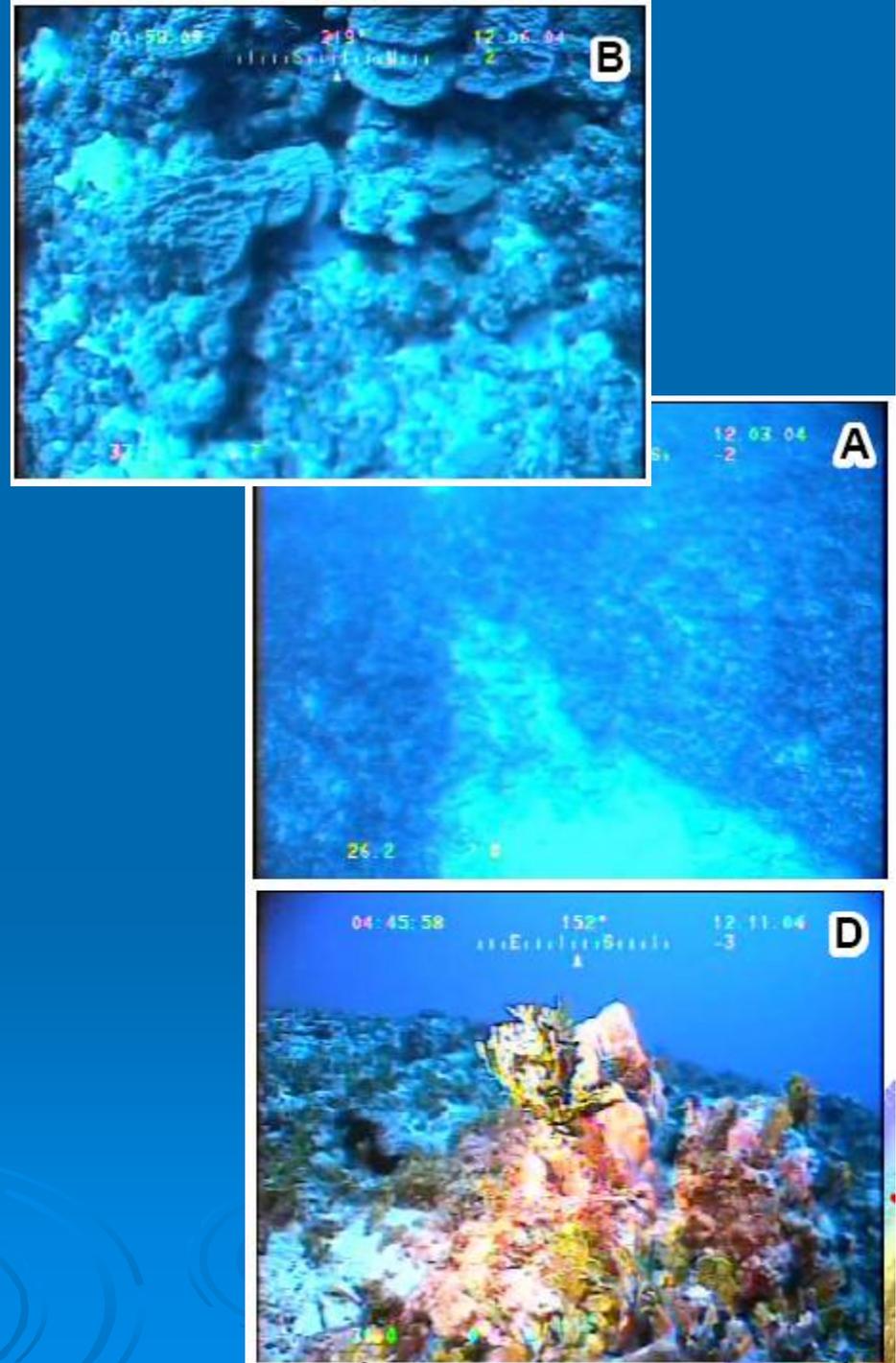
Fine scale



Saipan Anchorage Multibeam Bathymetry



Towed Video surveys in Saipan Anchorage



Saipan Anchorage Towed Video Frame Grabs

● Frame Grab Locations A-E

Not for navigation or distribution

Funded By: NAVFAC MSC

UNIVERSAL TRANSVERSE MERCATOR PROJECTION
UTM ZONE 55N
HORIZONTAL DATUM: WGS84
1:50,000

Scale: 0 to 2 Nautical Miles / 0 to 2 Kilometers

Depth in MSL: High 3 to Low 300

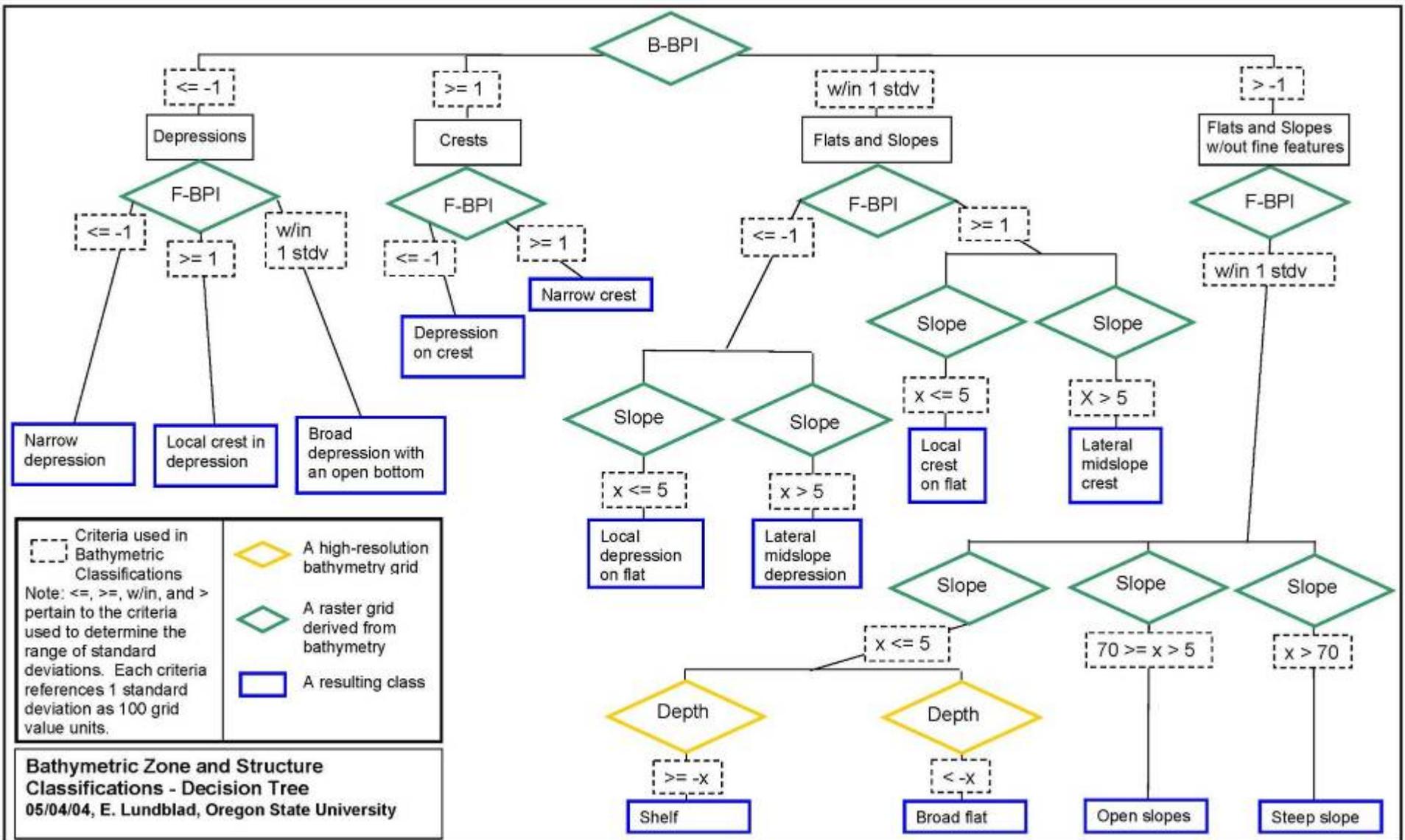
Legend: Known Shipwrecks, Possible Rocking, 2004 Video Tracks, 2002 Video Tracks

Survey By: National Oceanic and Atmospheric Administration, Pacific Islands Fisheries Science Center, Coral Reef Conservation Division, 11200 Ala Moana Blvd., Honolulu, Hawaii 96814 USA, tel 808 962 7025 fax 808 965 5703

SURVEY DATES: BATHYMETRY: 03/03 - 09/03
VIDEO: 08/03 - 09/03, 12/04

LOCATION MAP: 145°30'0"E, 145°40'0"E, 15°00'0"N, 15°10'0"N

Classification Decision Tree

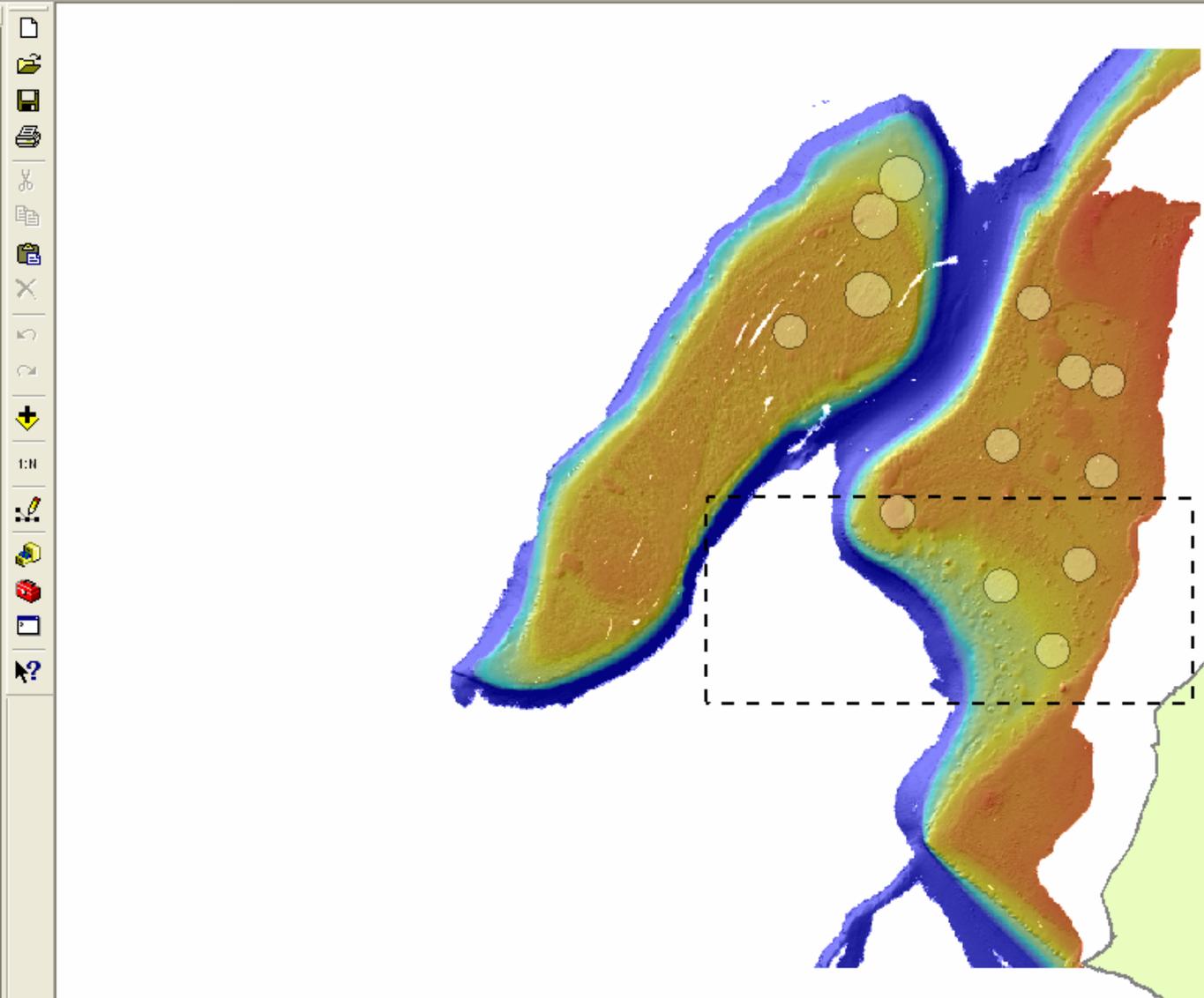


ArcMap Demo: Screen
Grabs below



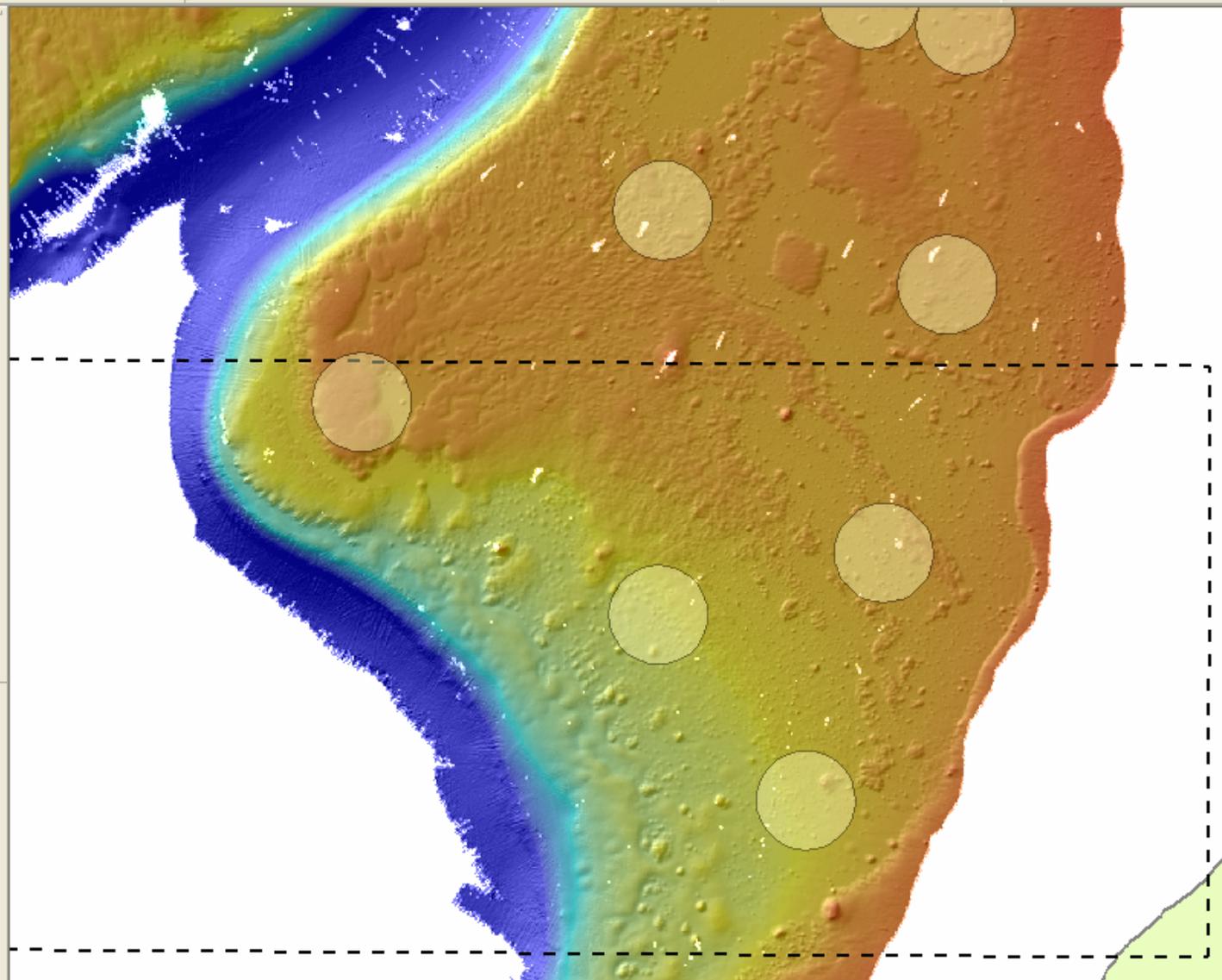
Layers

- Coral, Coral or Coralline, None
- Sai243_rug
- Sand, Rock, Rubble
- ROCK with Rugosity Values
- Classified Tracks
- anchbuffutm2
- box
- sai30x90024
 - All Data Values
 - Narrow Depression
 - Local Depression on Flat
 - Lateral Midslope Depression
 - Broad Flat
 - Shelf
 - Open Slopes
 - Narrow Crest
 - Steep Slope
- sai900zn
 - All Data Values
 - Crests
 - Depressions
 - Flats
 - Slopes
- ahi0304-8-04.00.50m.ss.tif
 - Value
 - High : 255
 - Low : 0
- sai_anc30
 - Value
 - High : 41
 - Low : -30
- sai_anc900



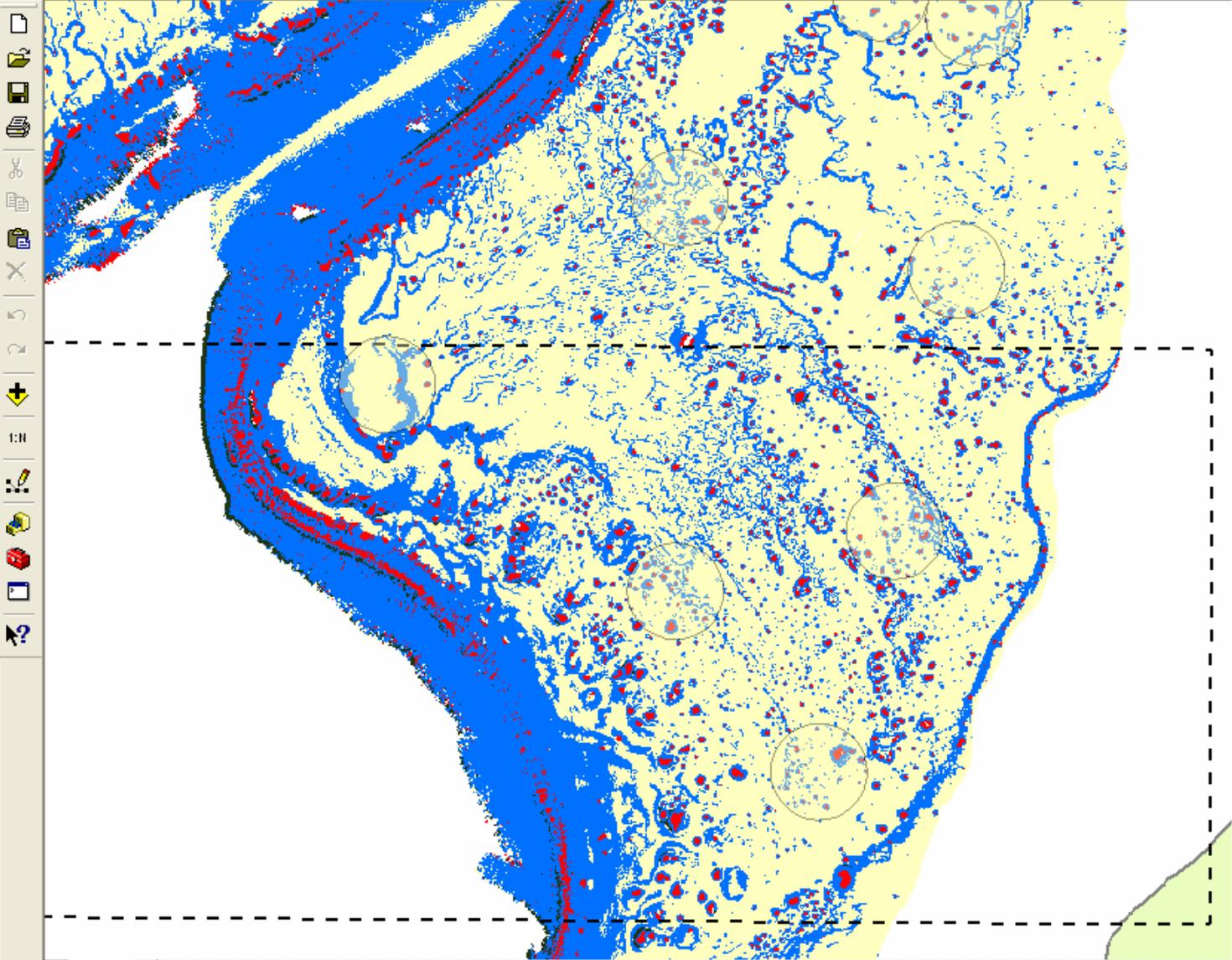
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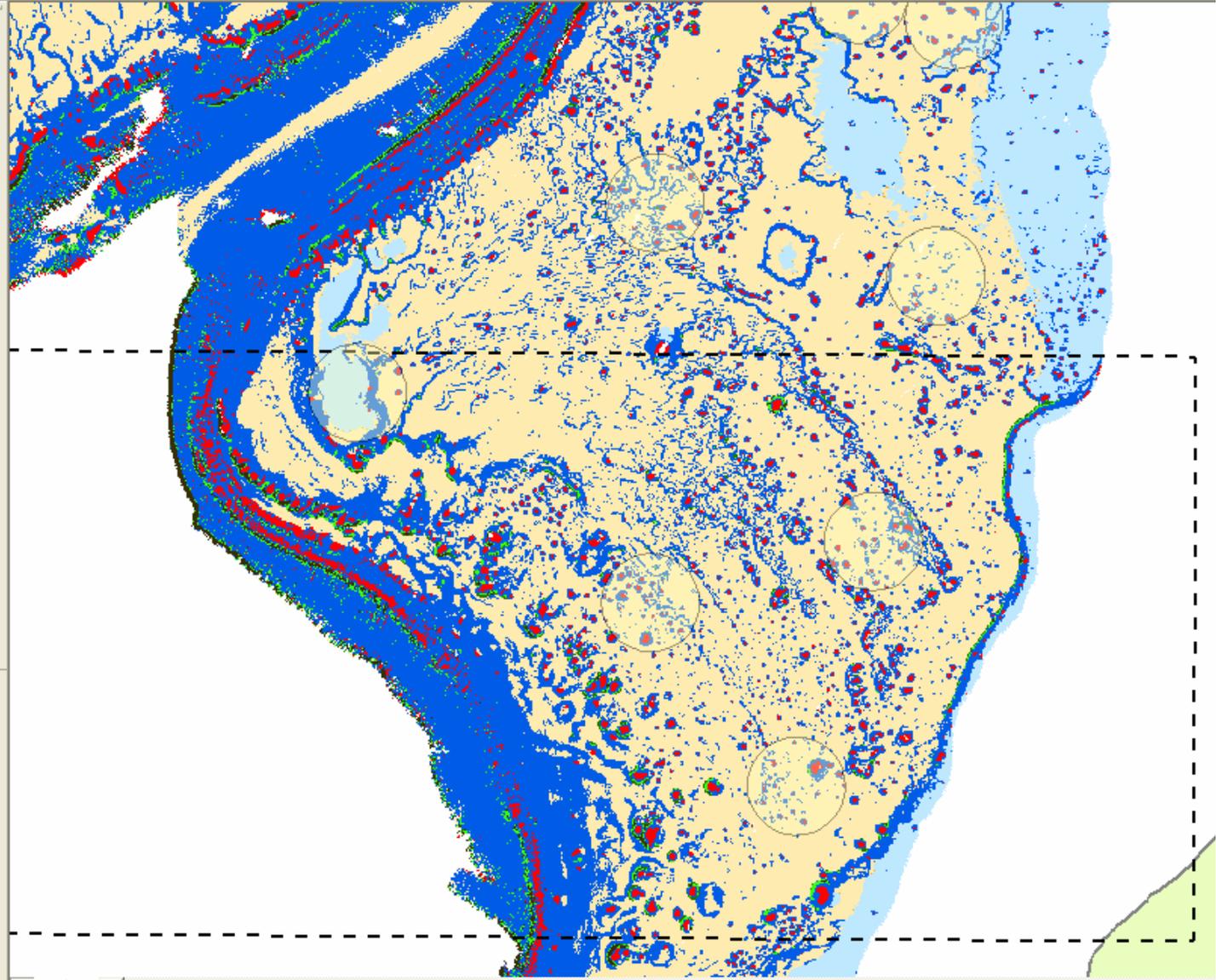
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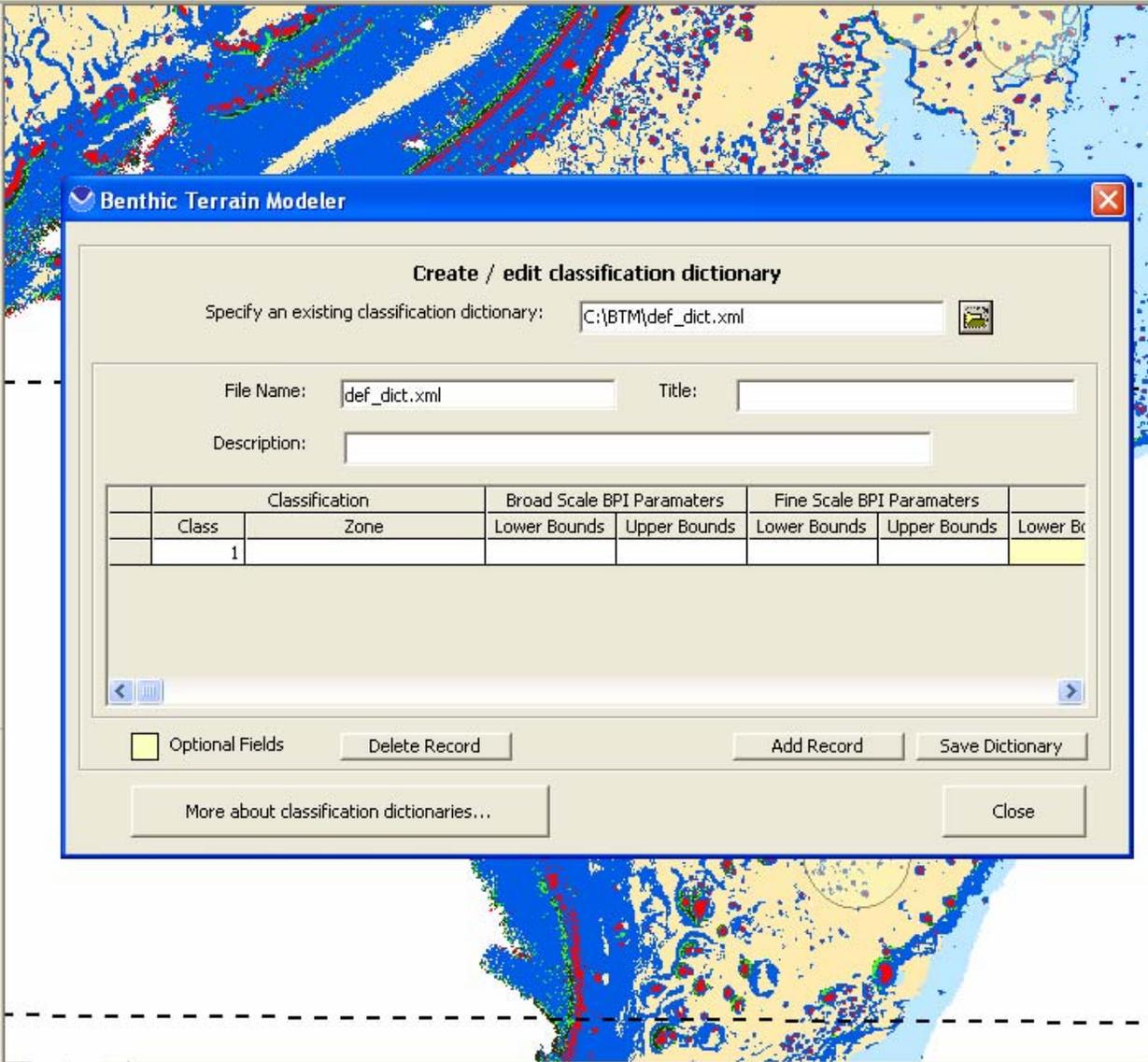


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- Sai243_rug
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Benthic Terrain Modeler

Create / edit classification dictionary

Specify an existing classification dictionary:

File Name: Title:

Description:

Class	Zone	Broad Scale BPI Parameters		Fine Scale BPI Parameters		Lower Bound
		Lower Bounds	Upper Bounds	Lower Bounds	Upper Bounds	
1						

Optional Fields

Layers

- Coral, Coral or Coralline, None
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Benthic Terrain Modeler

Create / edit classification dictionary

Specify an existing classification dictionary:

File Name: Title:

Description:

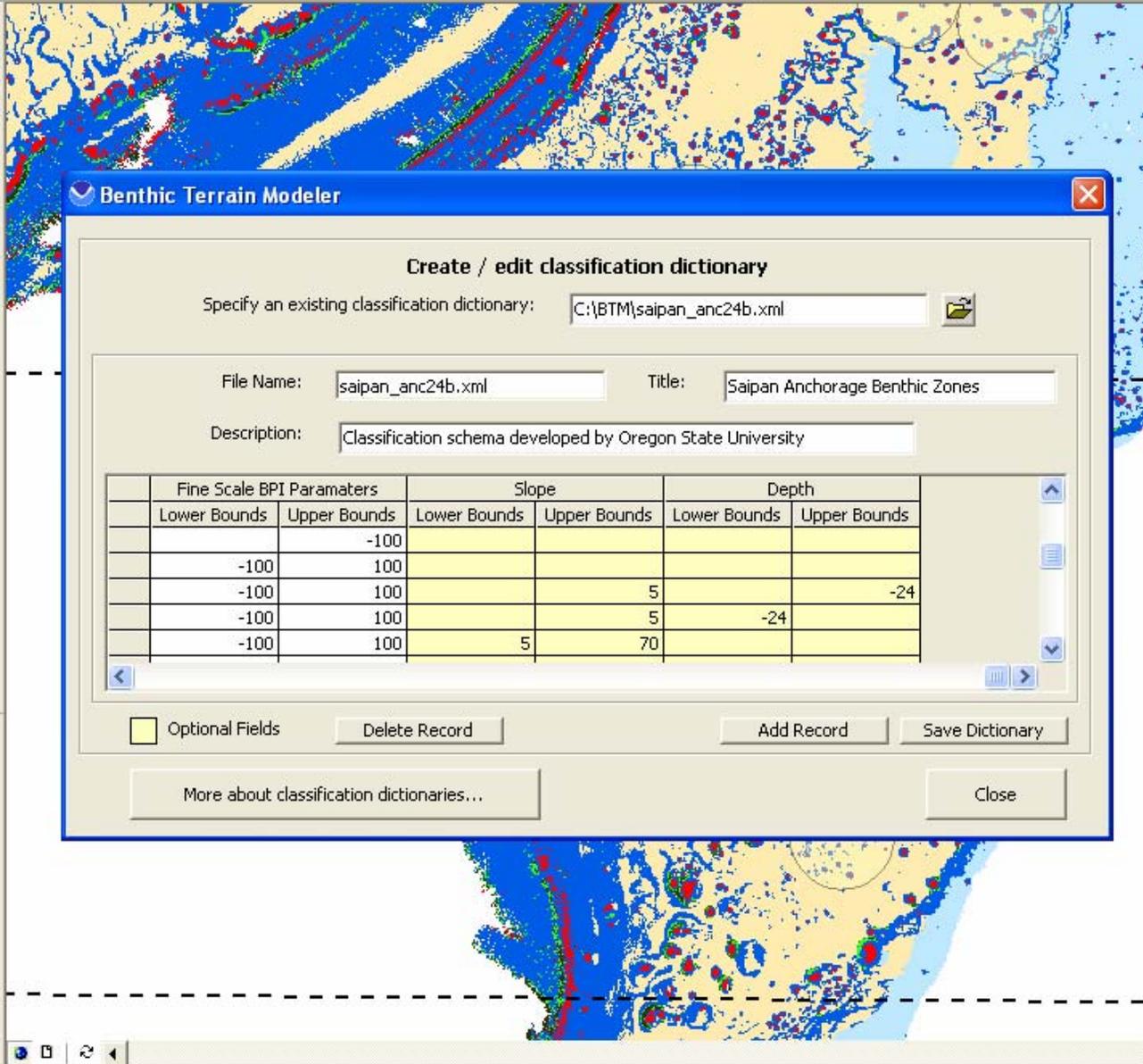
Class	Classification Zone	Broad Scale BPI Parameters		Fine Scale BPI Parameters		Low
		Lower Bounds	Upper Bounds	Lower Bounds	Upper Bounds	
4	Depression on Crest	100				-100
5	Broad Depression with Open t			-100		100
6	Broad Flat	-100		-100		100
7	Shelf	-100		-100		100
8	Open Slopes	-100		-100		100

Optional Fields

Layers

- Coral, Coral or Coralline, None
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Display Source Selection



Benthic Terrain Modeler

Create / edit classification dictionary

Specify an existing classification dictionary:

File Name: Title:

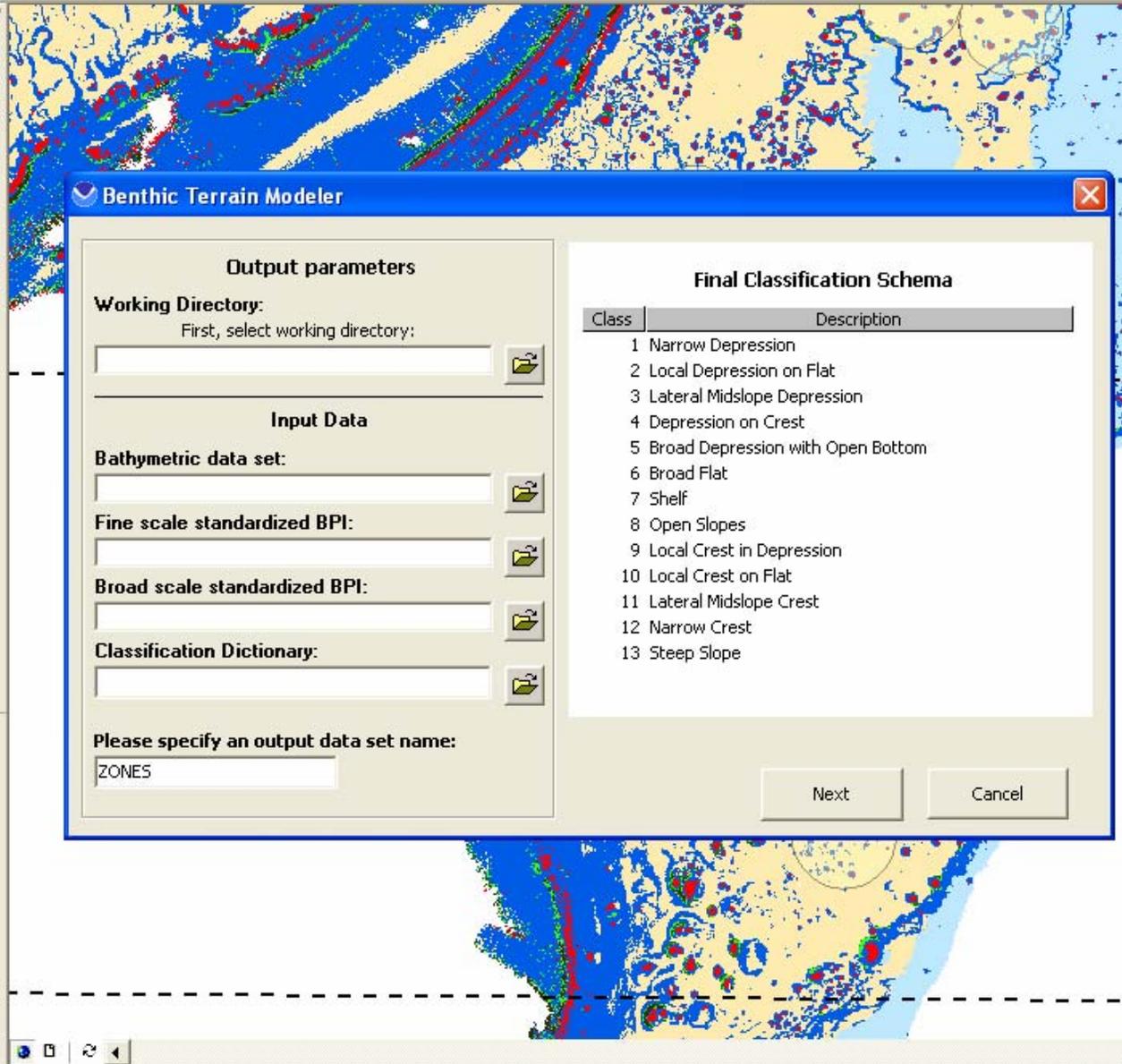
Description:

Fine Scale BPI Paramaters		Slope		Depth	
Lower Bounds	Upper Bounds	Lower Bounds	Upper Bounds	Lower Bounds	Upper Bounds
	-100				
-100	100				
-100	100			5	-24
-100	100			5	-24
-100	100	5	70		

Optional Fields

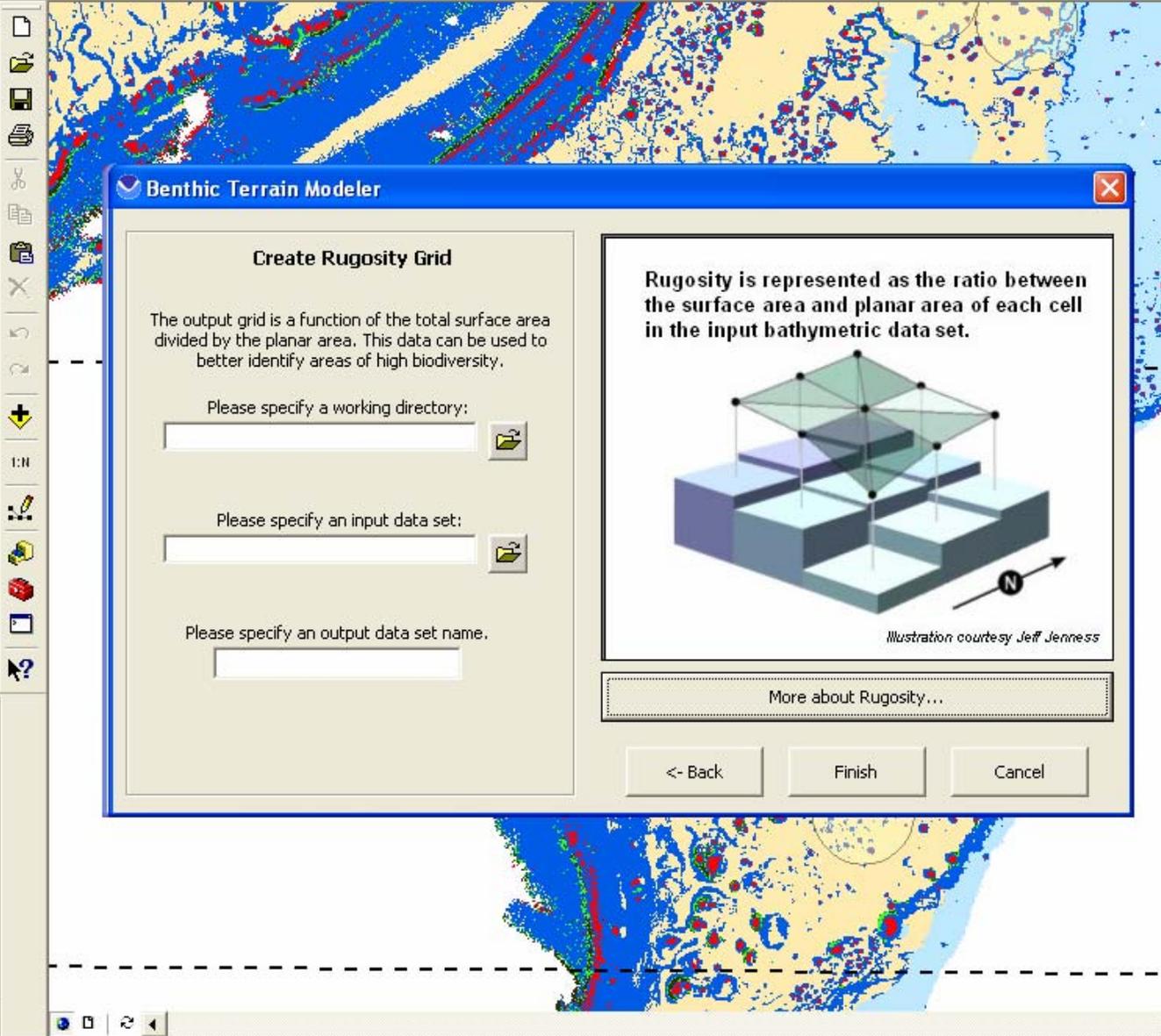
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 - High : 255
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 - Low : -30
- sai_anc900



Benthic Terrain Modeler

Create Rugosity Grid

The output grid is a function of the total surface area divided by the planar area. This data can be used to better identify areas of high biodiversity.

Please specify a working directory:

Please specify an input data set:

Please specify an output data set name:

Rugosity is represented as the ratio between the surface area and planar area of each cell in the input bathymetric data set.

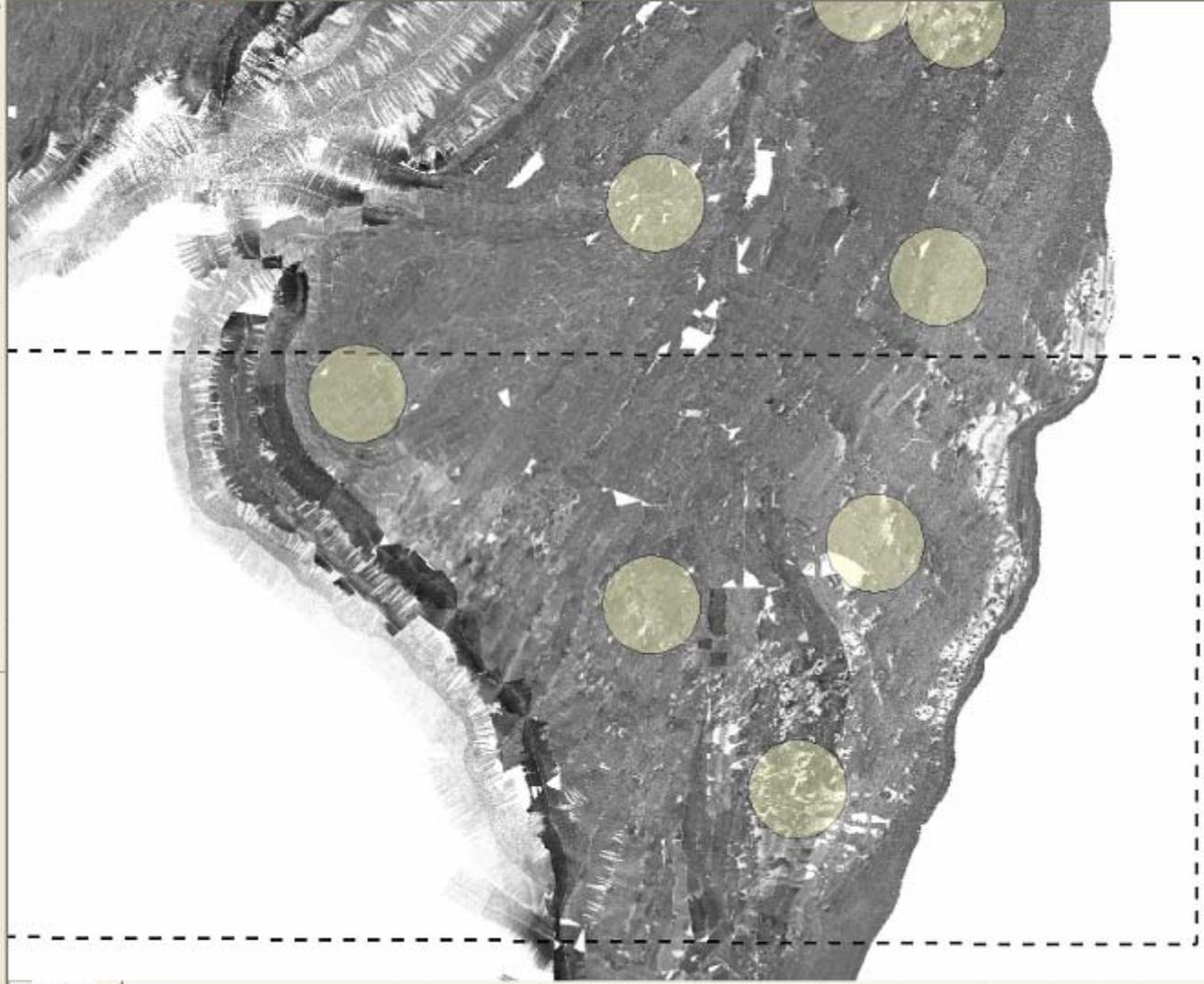
Illustration courtesy Jeff Jenness

More about Rugosity...

<- Back Finish Cancel

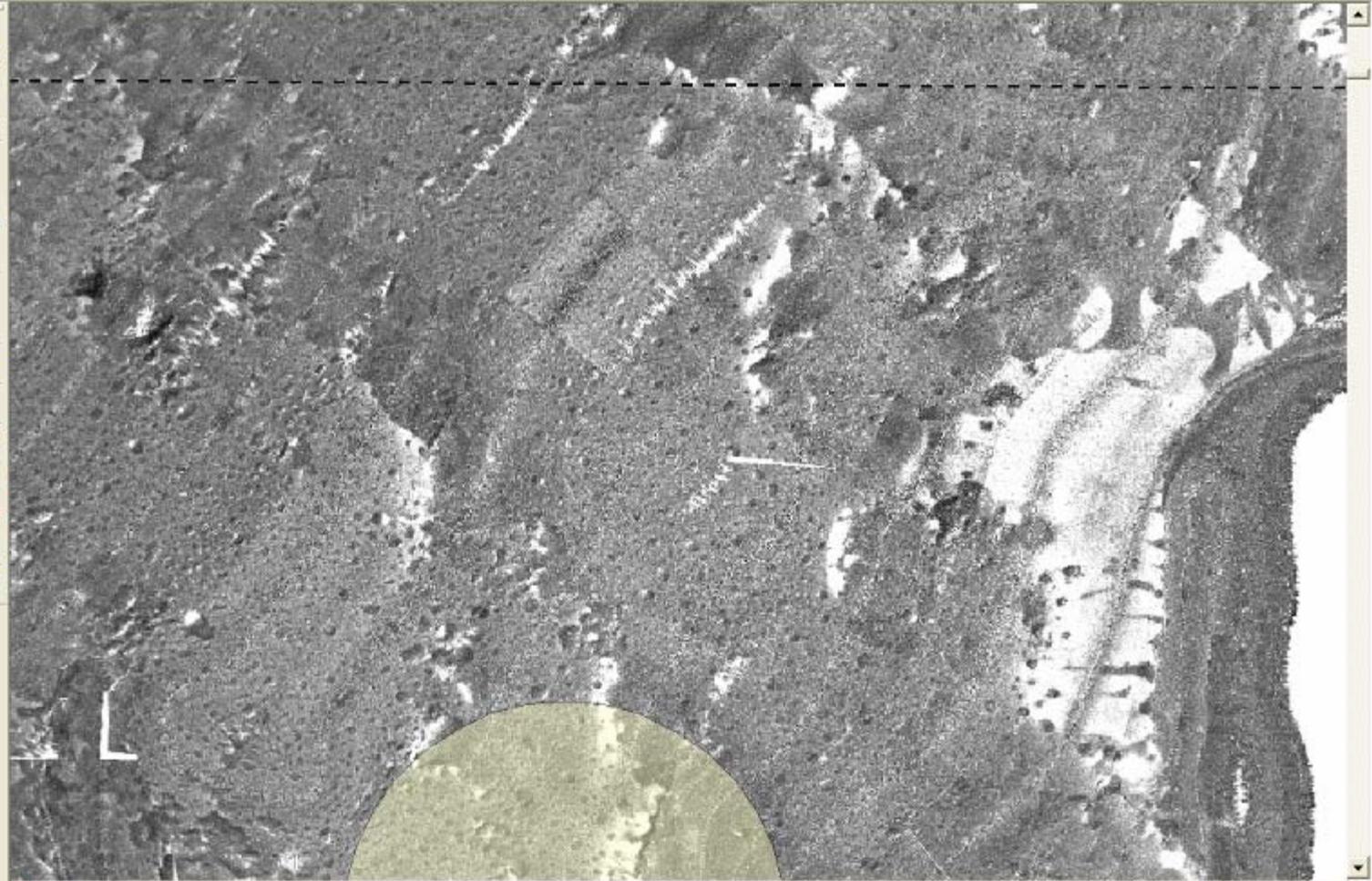
Layers

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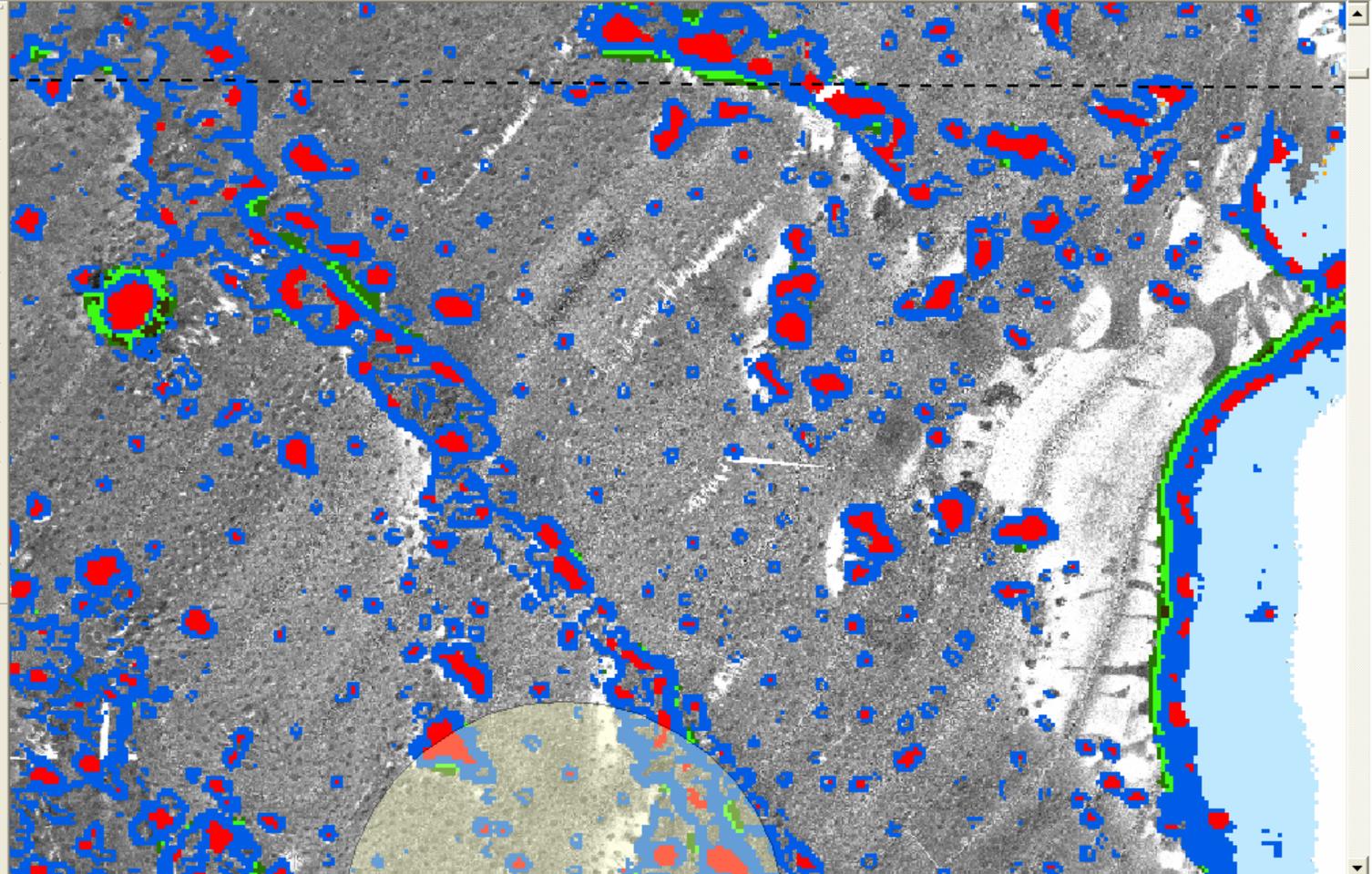
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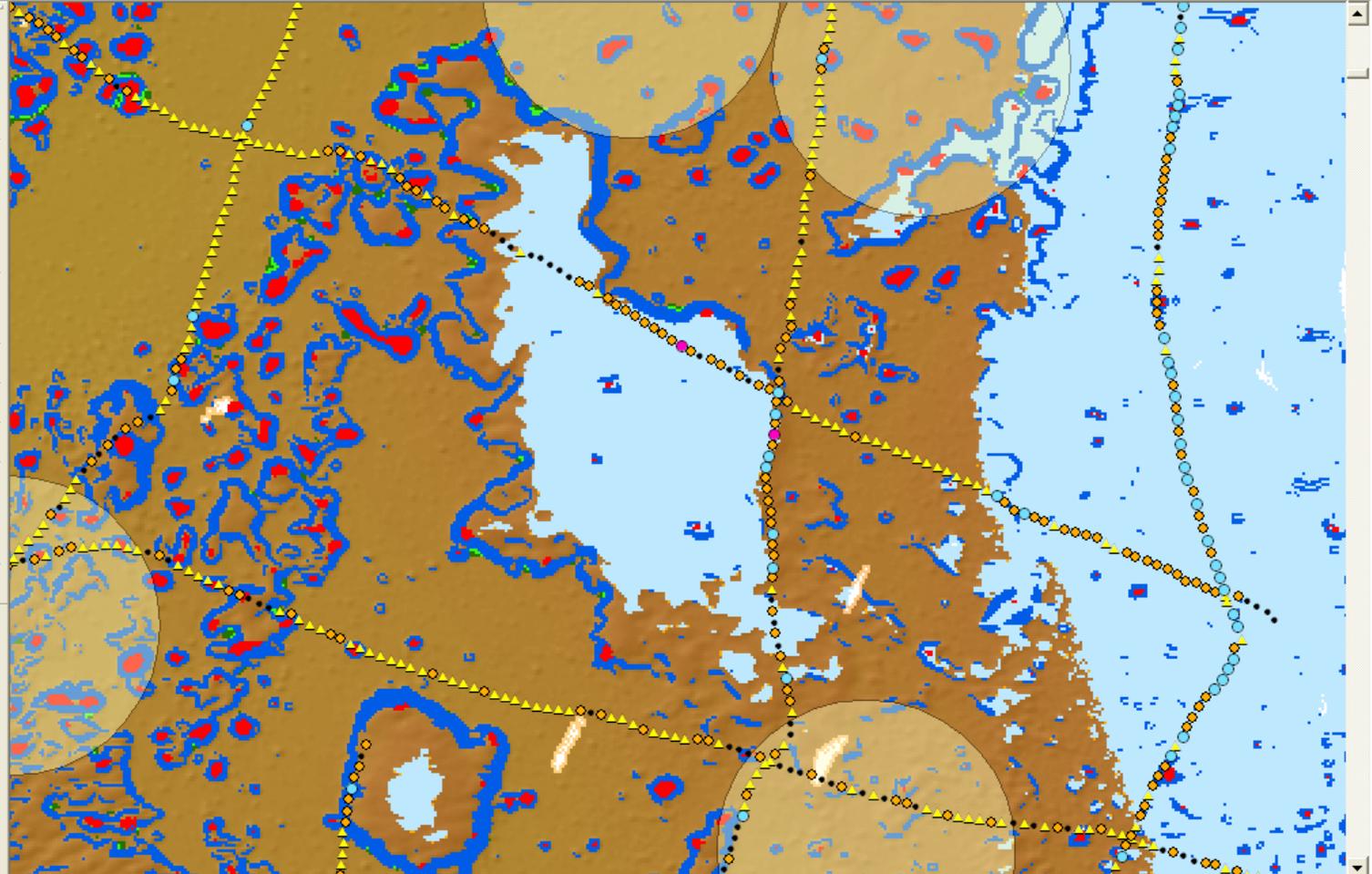
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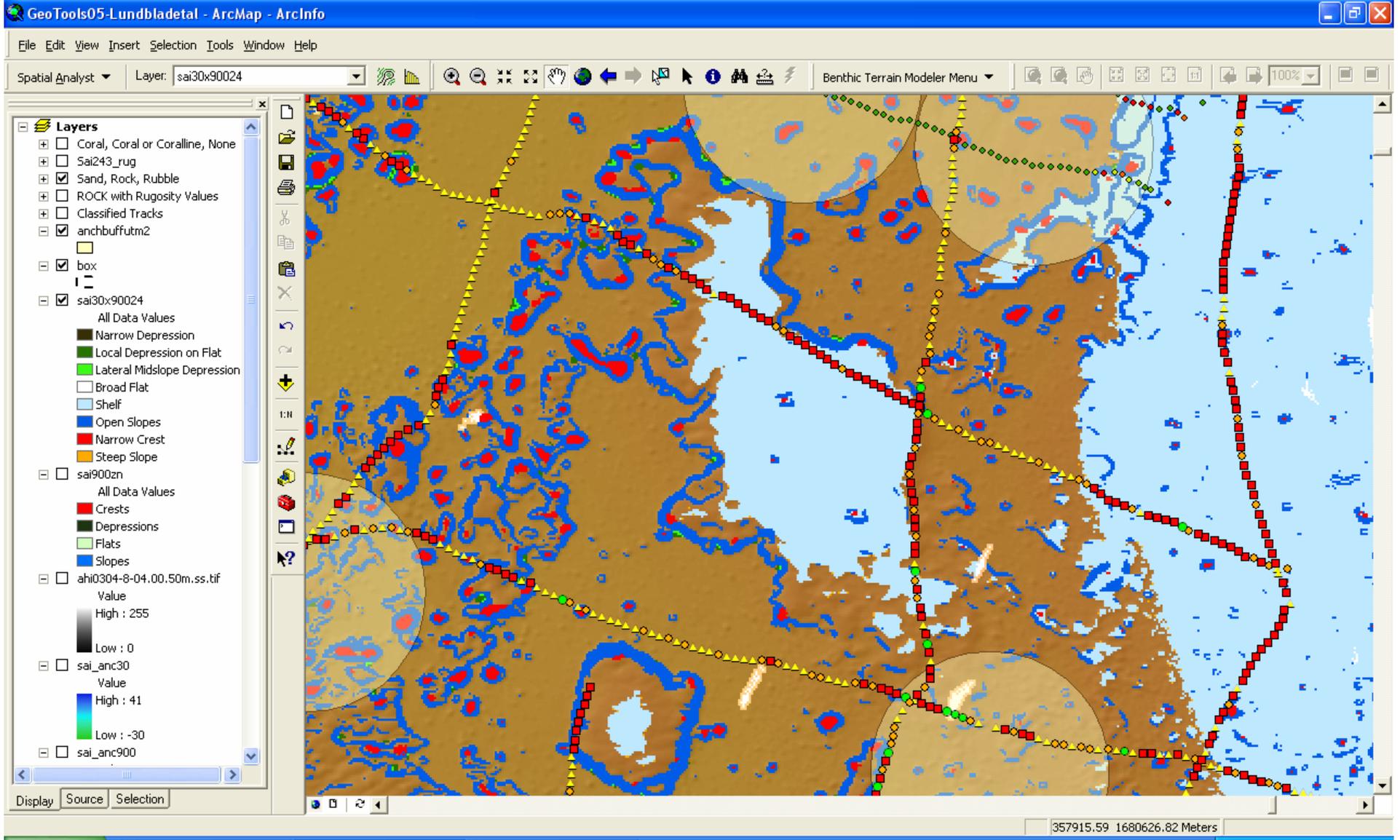
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GeoTools '05 – ArcGIS for Saipan Anchorage Groundtruthing and Bathymetry Position Index Zones

Sand ▲ Rock ■ Rubble ● Mixed ●



Acknowledgements

This research was supported by NOAA Coastal Services Center (CSC) Special Projects for the Pacific Islands Initiative, Grant #NA03NOS4730033 to D. Wright and additional NOAA support to D. Naar.

We acknowledge the logistical and financial support from Marine Sanctuary Director, Nancy Daschbach, as well as the warm hospitality provided by the local villages adjacent to Fagatele Bay and Vatia Bay.

Others that were instrumental in this project are Will White (formerly of Department of Marine and Wildlife Resources), Peter Craig (National Park of American Samoa (NPAS)), Allison Graves (formerly of NPAS), Curt Whitmire (NOAA Northwest Fisheries Science Center), Anita Grunder (Oregon State University), Joshua Murphy and Lori Cary-Kothera (CSC), Jeff Jenness (Jenness Enterprises), and Pat Iampietro (California State University, Monterey Bay), Will Smith (Hawaii Institute of Marine Biology), Deidre Sullivan (Monterey Bay Peninsula Community College), Miles Anderson (Analytical Laboratories of Hawaii).

