OBIA (Object Based Image Analysis) in ArcMap for Multibeam and Backscatter Interpretation

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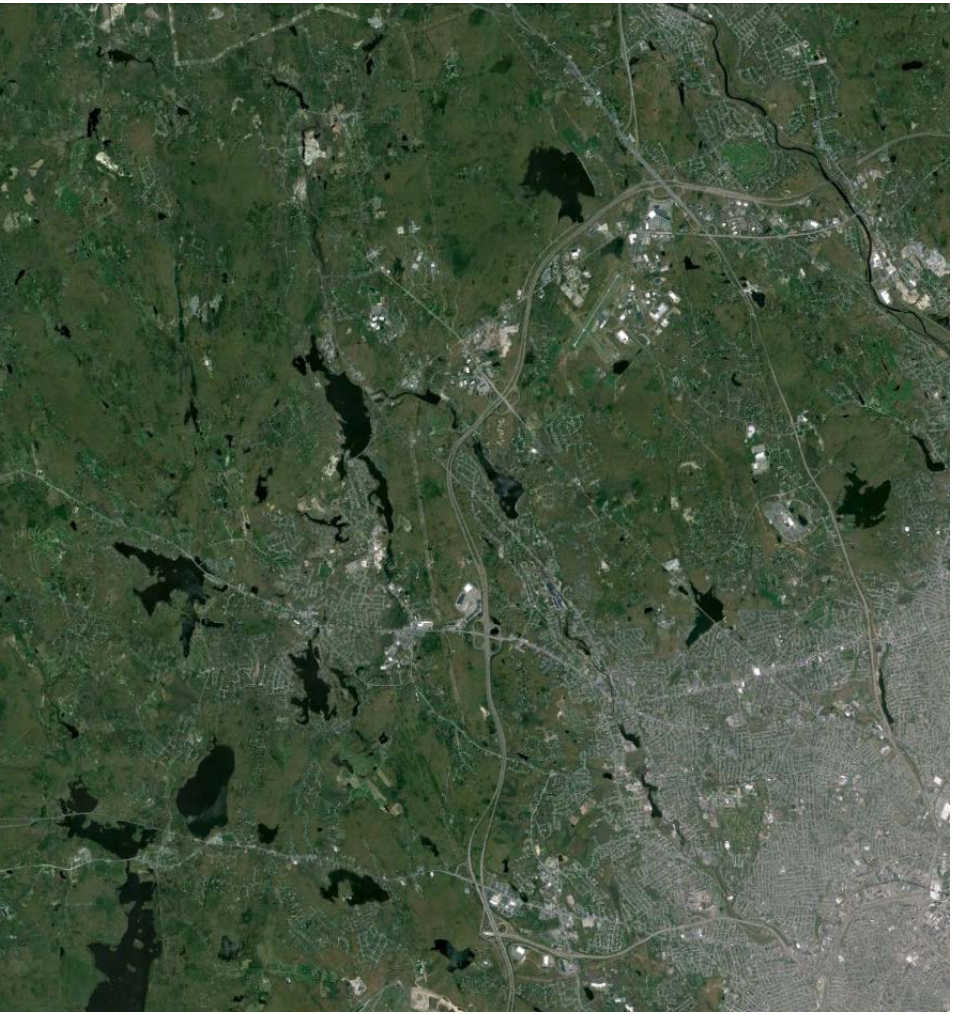
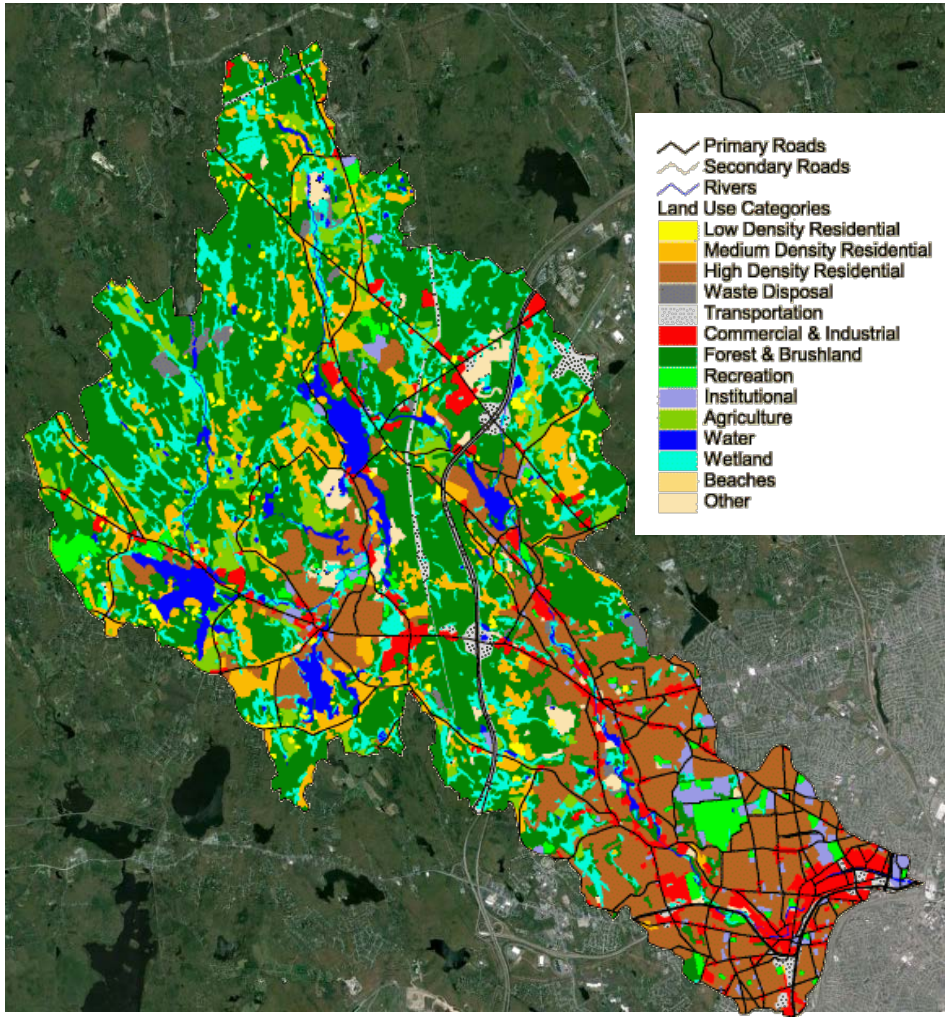
Imagery and Thematic Maps



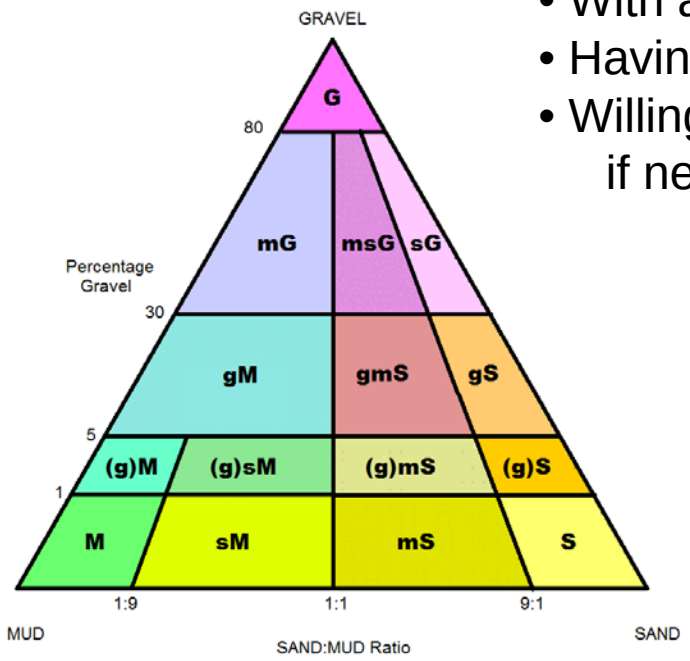


Interpretation by Hand

Probably several data sources (including raster imagery)

Needs a digitiser who is:

- Alert and Awake
- With a steady hand
- Having lots of time available
- Willing to change categorisation if needed



Sediment classification (modified Folk et al.)

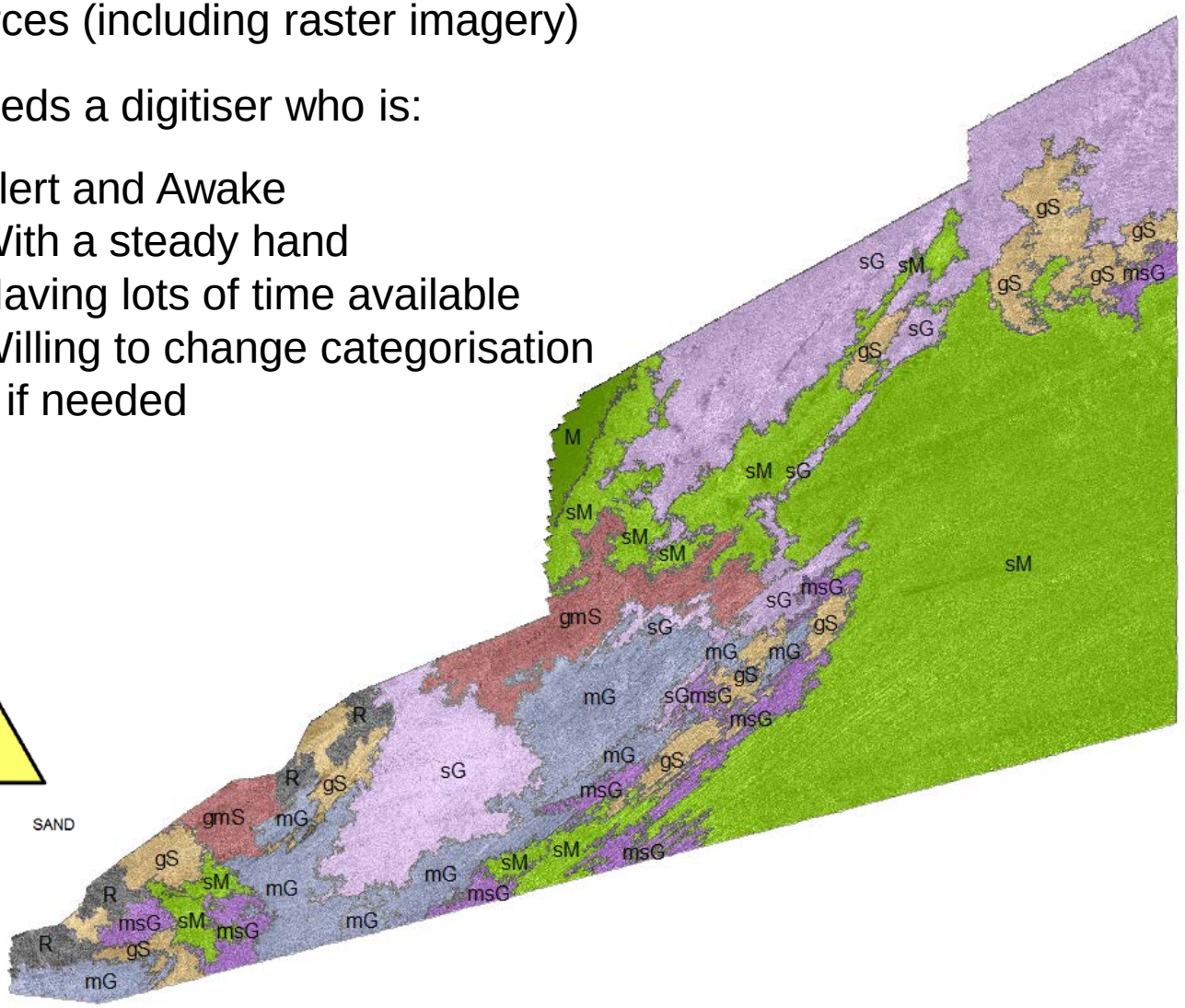


Image Analysis

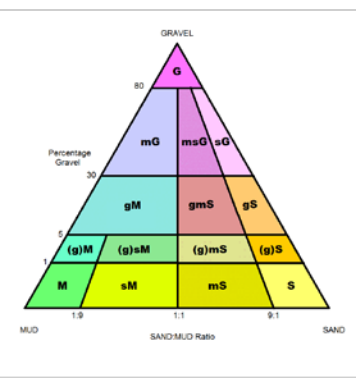
Human Interpretation of Imagery:

- **Human eye** good at picking areas of similar appearance
- Areas often have homogeneous level or texture
- Color imagery can be used to show 3 datasets combined (**RGB**)
- Often considered better than computer interpretation **?**

Disadvantages:

- Digitizing is **slow**
- **Subjective** (i.e. dependent on interpreter's mood, skill, color perception, knowledge…)
- **Non-repeatable** and therefore unmeasured quality
- Difficult with more than 3 layers

Hand Interpretation issues



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NATURAL ENVIRONMENT RESEARCH COUNCIL

Remote Sensing Object Based Image Analysis (RSOBIA)

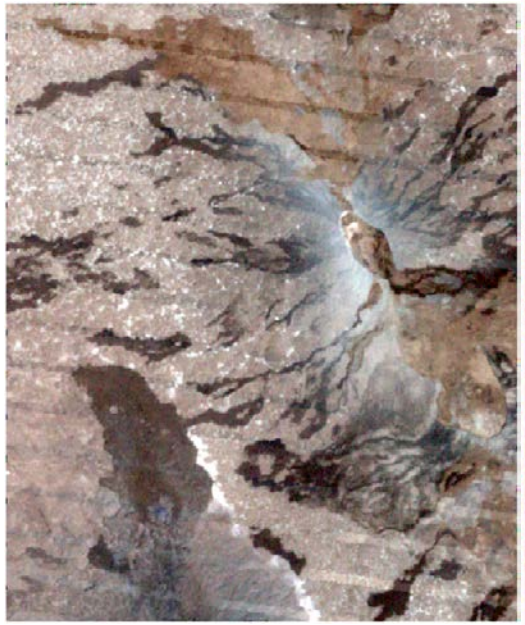
OBIA:

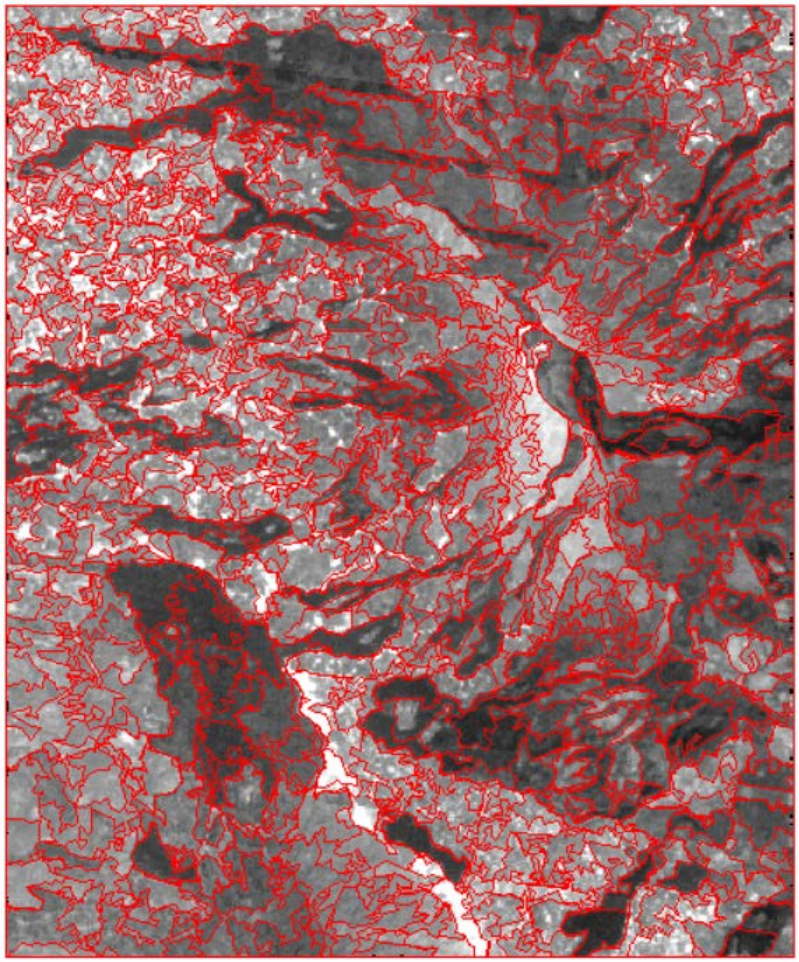
- **Quick** (e.g. 250Mb image < 40secs)
- Divides the data into areas of similar appearance (segments)
- Can use **more than 3** data layers (no limit)
- Scale and level of detail defined by numeric parameters chosen by the user – providing high resolution to a generalization
- **Repeatable**

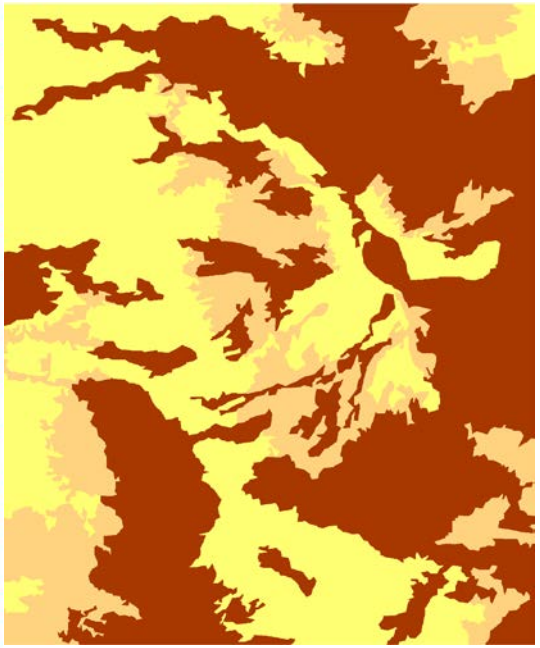
(Dis)advantages?:

- Each segment may have **complex shape**
- Segments may have areas/boundaries identified by previously unseen data
- Maybe confused by systematic imagery artefacts

Example: Landsat Imagery







Segmented result:

"Digitised" in < **10 seconds**

By hand in > **1 hour**
(and a tired intepreter!)

Simple classification:

Coded layer 3 Mean

Each polygon has statistics for every image layer

Works with all types of imagery data

But OBIA software can be expensive **> € 27,000 ($30,000)** per seat

However RSOBIA is written in C++ and Python and is installed easily into **ArcMap 10.x** and therefore made **integral** to workflow. Works from either a toolbar or a toolbox.

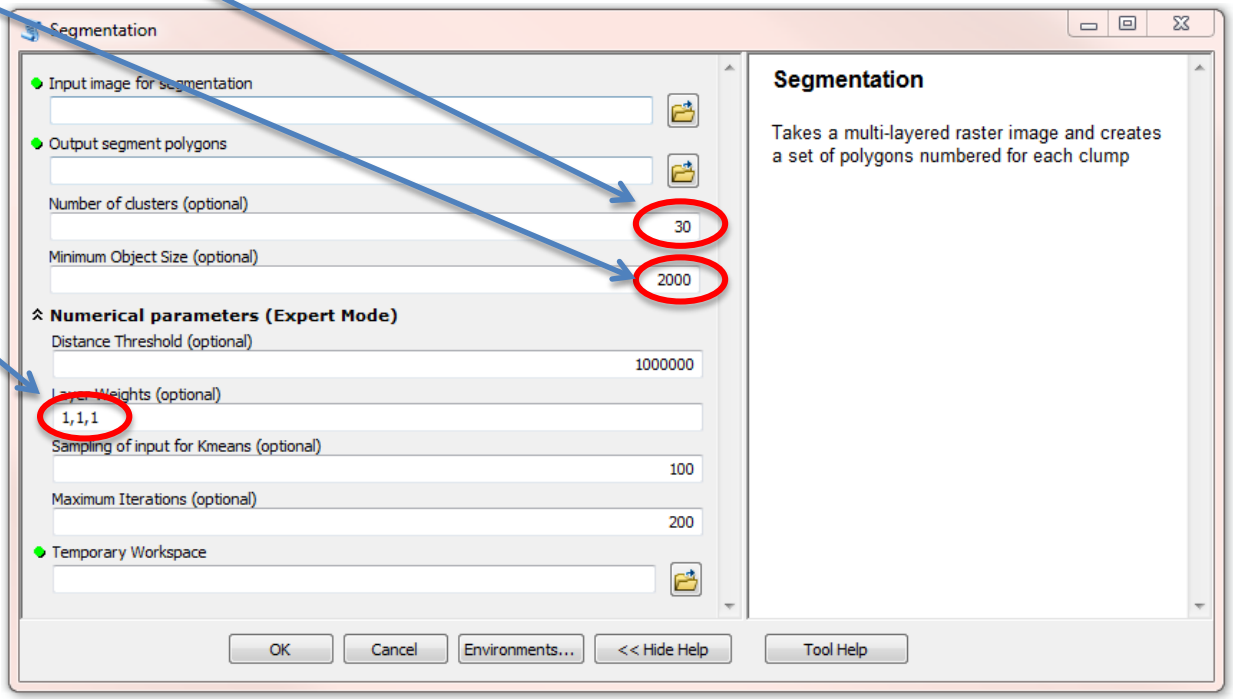
Version 3 to be released soon.

Usage – segmentation parameters

2 main numerical parameters (for layered data):

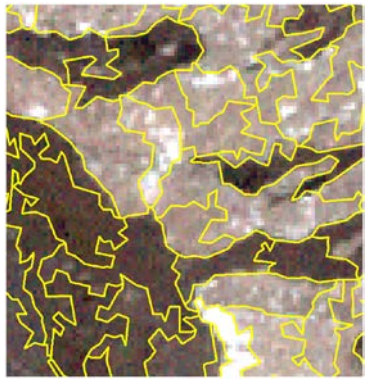
- No. of Clusters – in N-dimensional space
- Min Object Size – Minimum areal extent (in pixels)

Layers can be weighted

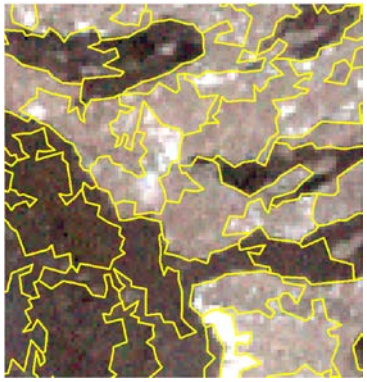


The Minimum and Maximum of each layer is calculated and the data stretched. Differences in layer ranges are therefore ignored.

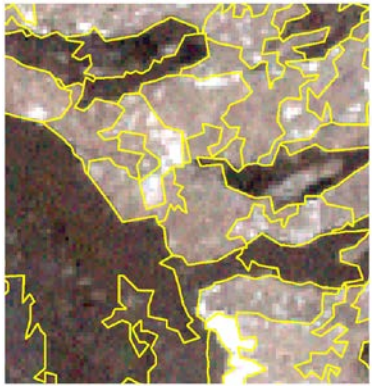
Varying the number of clusters



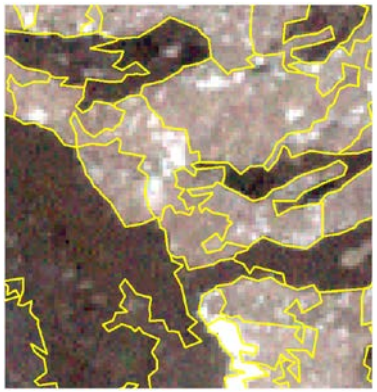
100 clusters



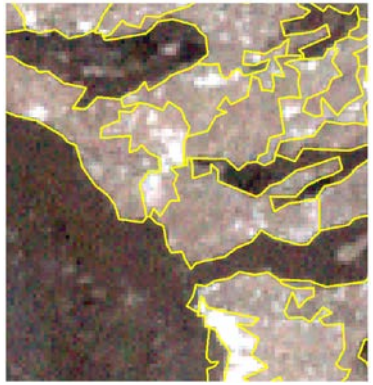
50 clusters



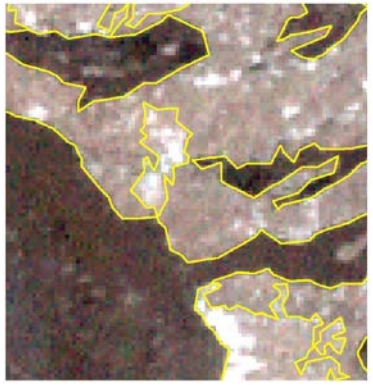
20 clusters



10 clusters



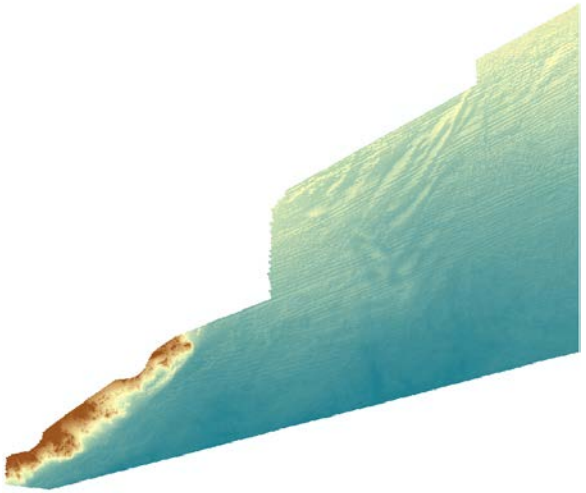
5 clusters



3 clusters

Usage: Marine Datasets

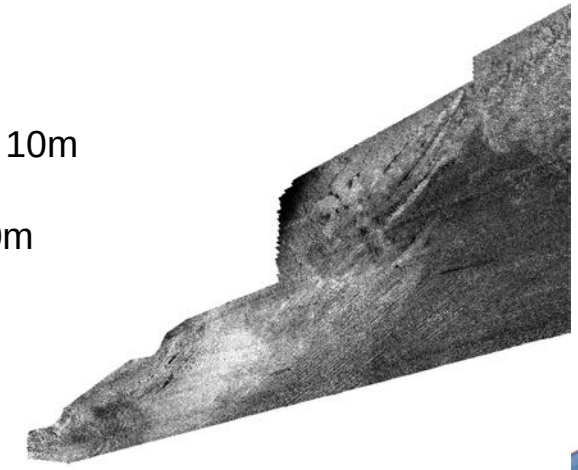
Multibeam Bathymetry Data: Bathymetry and Backscatter



Bathymetry

Shallow 10m

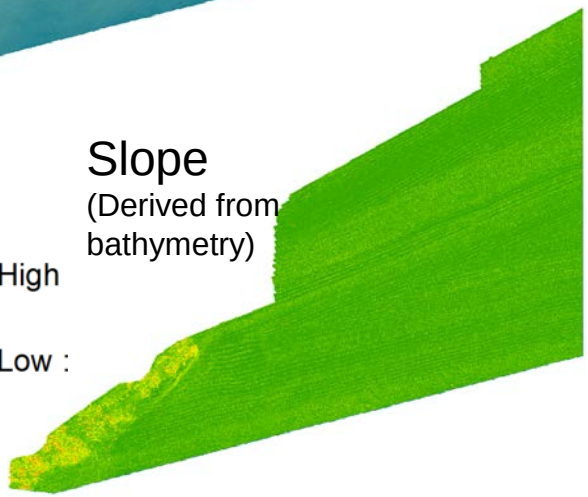
Deep 90m



Backscatter

High

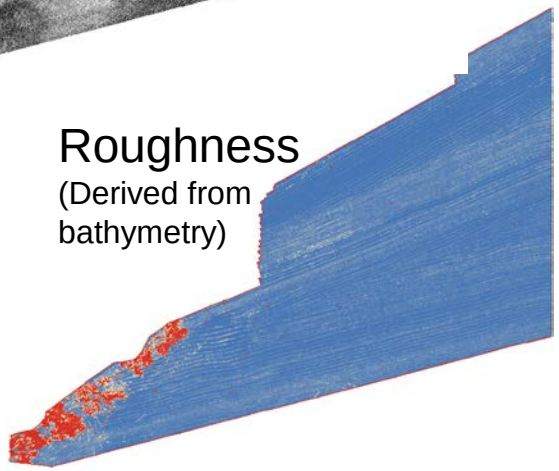
Low



Slope
(Derived from bathymetry)

High

Low :



Roughness
(Derived from bathymetry)

High

Low

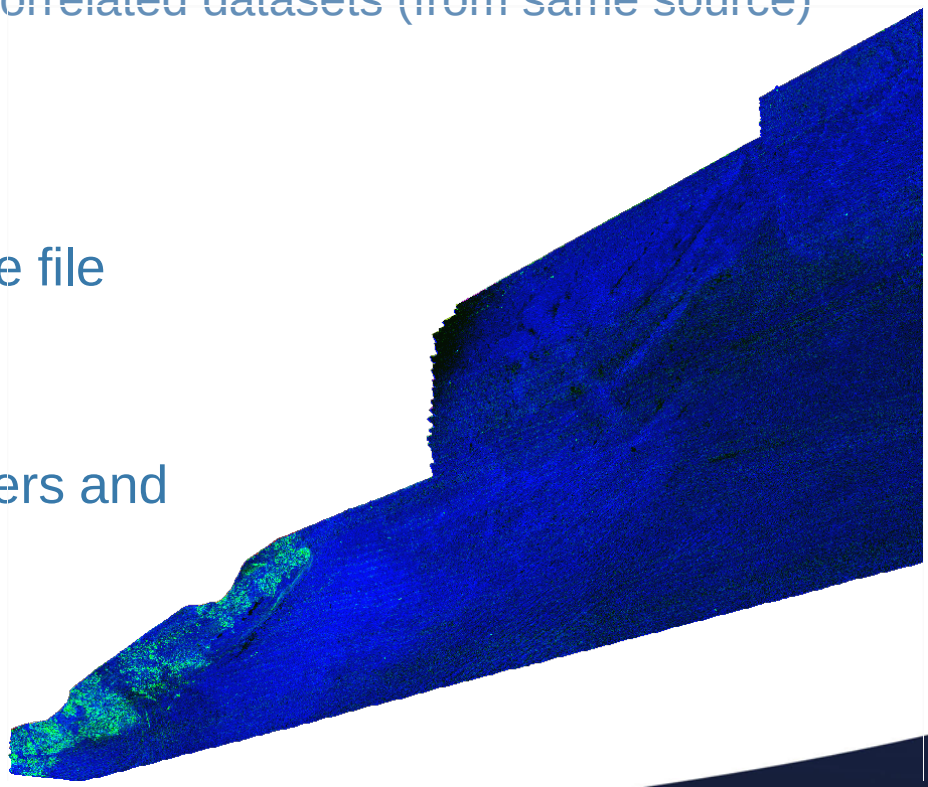
Example data courtesy of MCA

Layering of datasets

3 datasets layered:	Weighting	
1. Slope	1x	Correlated datasets (from same source)
2. Roughness	1x	
3. Backscatter	2x	

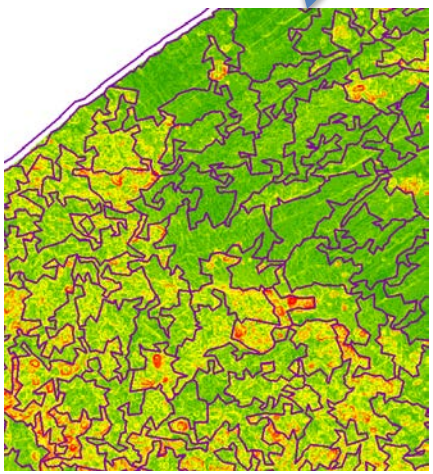
Datasets combined to create a single file (.img)

Segmentation – but how many clusters and minimum area extent?



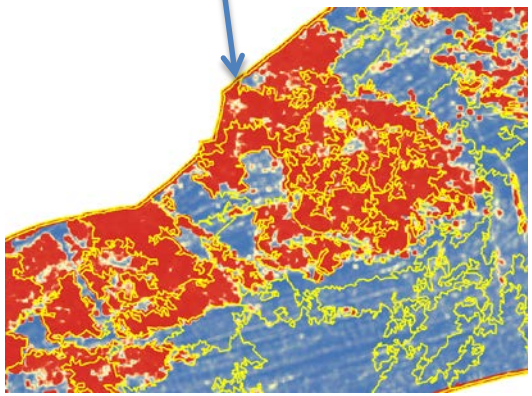
No. of Polygons

Min. Area / No. Clusters	200	2000	10000
50	7437	887	190
25	4312	534	116
10	1541	212	56



Small polygons (lower minimum size and high number of clusters)

Shown on a slope map of bathymetry (green is low slope, red is high slope). Note the high slopes and roughness calculations are closely correlated aiding segmentation

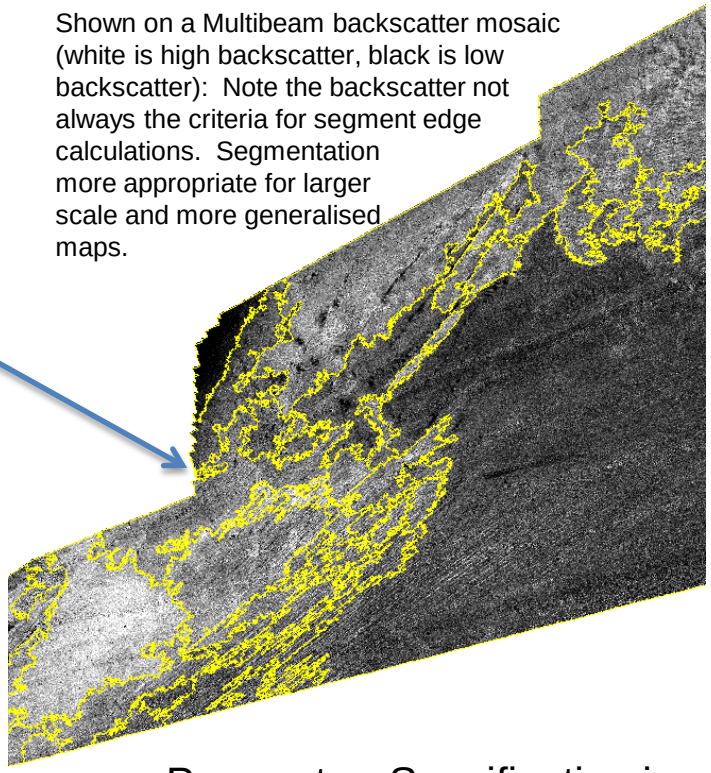


Medium sized polygons (medium minimum size and medium number of clusters)

Shown on a roughness map of bathymetry (red is high roughness, blue is low roughness): Note the high roughness not always the criteria for segment edge calculations. Backscatter and slope may have more effect in places.

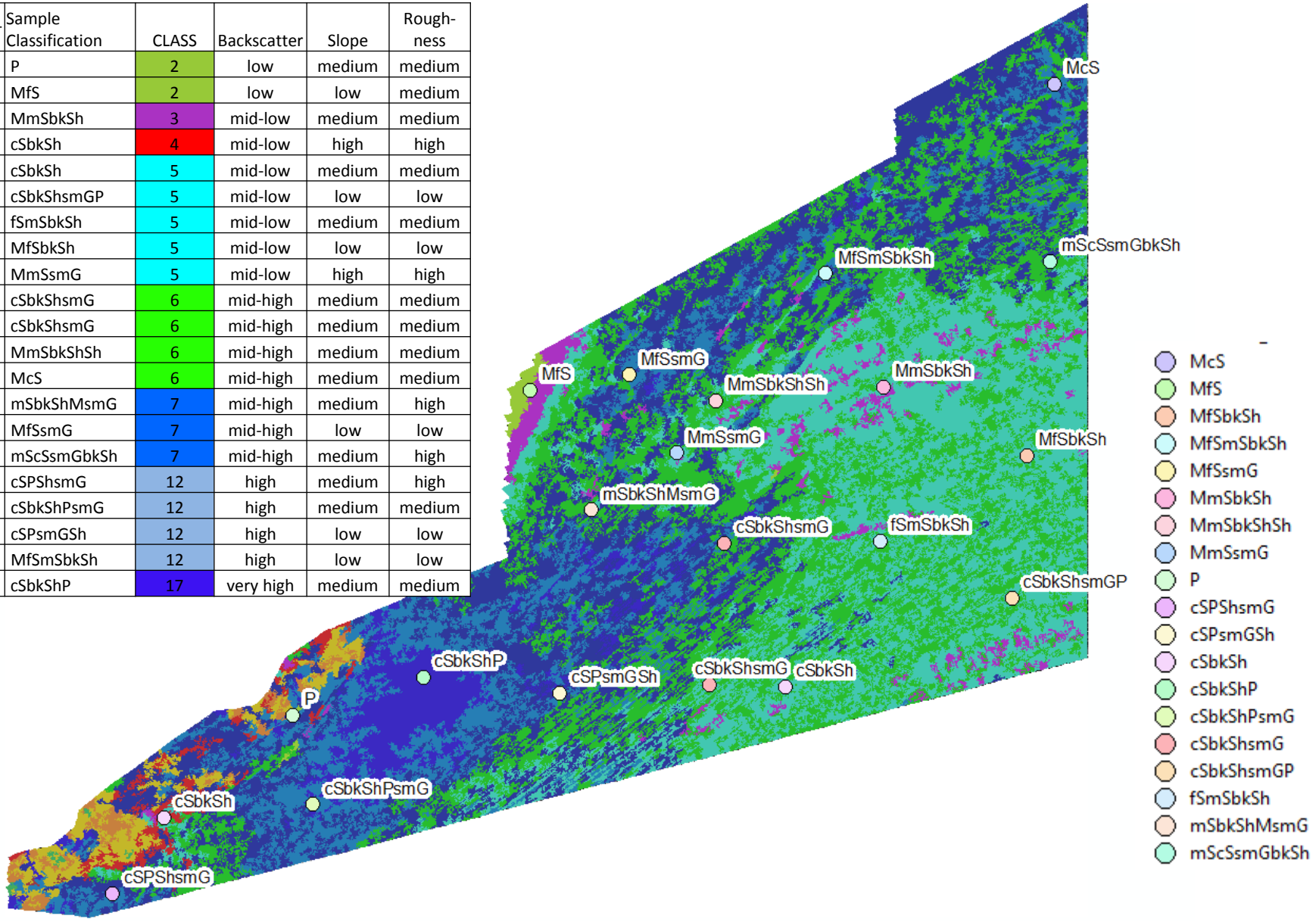
Large sized polygons (large minimum size and lower number of clusters)

Shown on a Multibeam backscatter mosaic (white is high backscatter, black is low backscatter): Note the backscatter not always the criteria for segment edge calculations. Segmentation more appropriate for larger scale and more generalised maps.

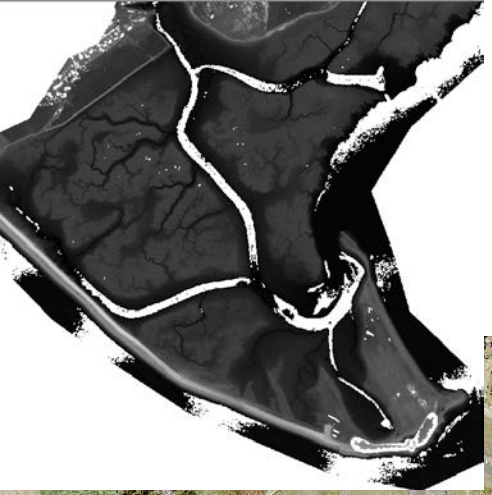


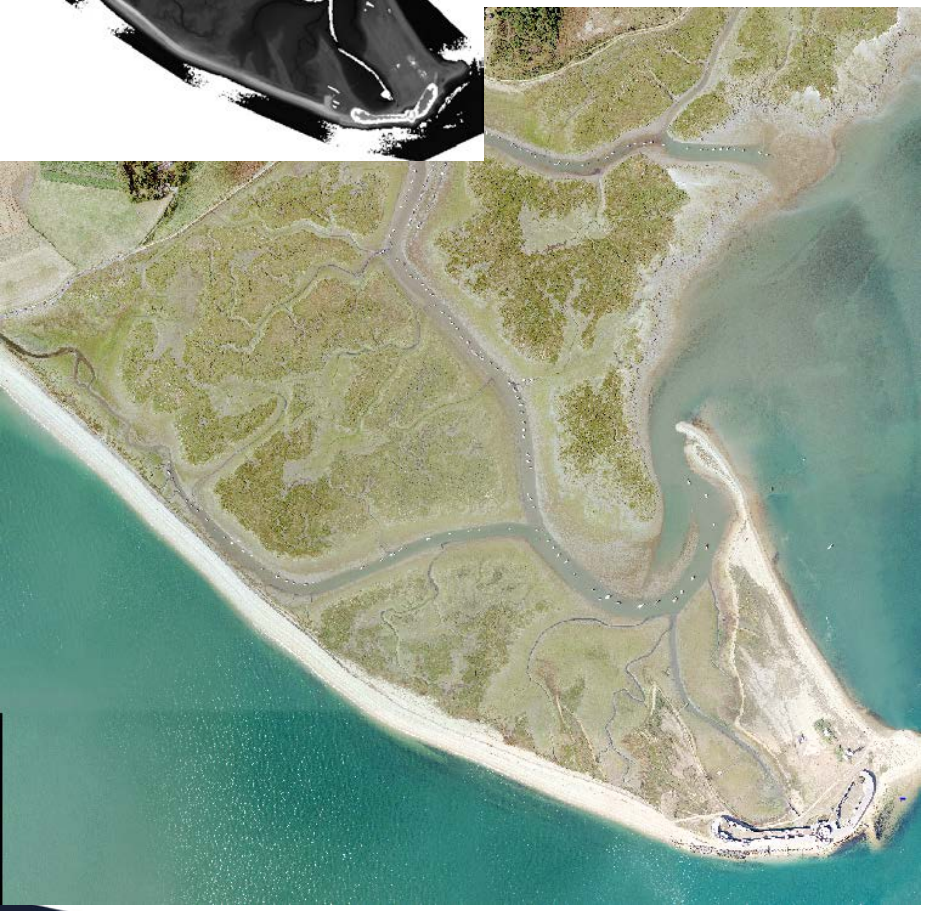
Parameter Specification is dependent on scale of data and level of interpretation required

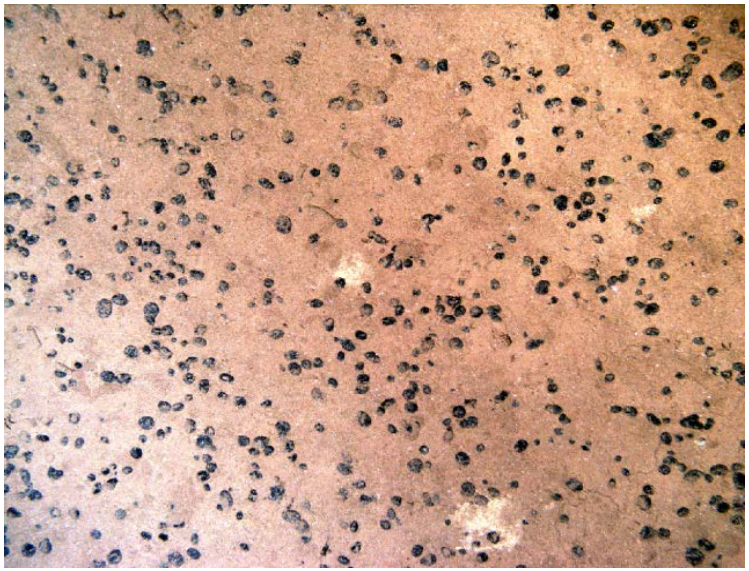
Station_ No	Sample Classification	CLASS	Backscatter	Slope	Rough-ness
6	P	2	low	medium	medium
7	MfS	2	low	low	medium
16	MmSbkSh	3	mid-low	medium	medium
3	cSbkSh	4	mid-low	high	high
19	cSbkSh	5	mid-low	medium	medium
12	cSbkShsmGP	5	mid-low	low	low
11	fSmSbkSh	5	mid-low	medium	medium
13	MfSbkSh	5	mid-low	low	low
1	MmSsmG	5	mid-low	high	high
18	cSbkShsmG	6	mid-high	medium	medium
10	cSbkShsmG	6	mid-high	medium	medium
9	MmSbkShSh	6	mid-high	medium	medium
14	McS	6	mid-high	medium	medium
21	mSbkShMsmG	7	mid-high	medium	high
8	MfSsmG	7	mid-high	low	low
15	mScSsmGbkSh	7	mid-high	medium	high
2	cSPShsmG	12	high	medium	high
4	cSbkShPsmG	12	high	medium	medium
20	cSPsmGSh	12	high	low	low
17	MfSmSbkSh	12	high	low	low
5	cSbkShP	17	very high	medium	medium

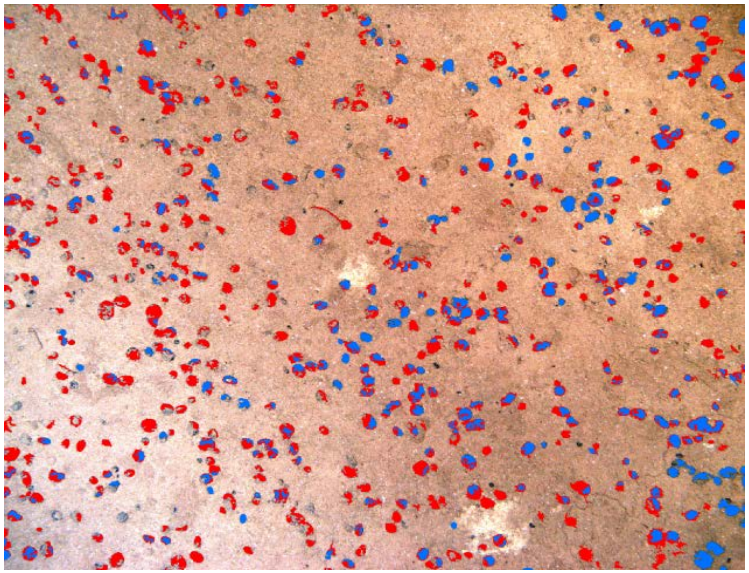


Lidar + Aerial Photos





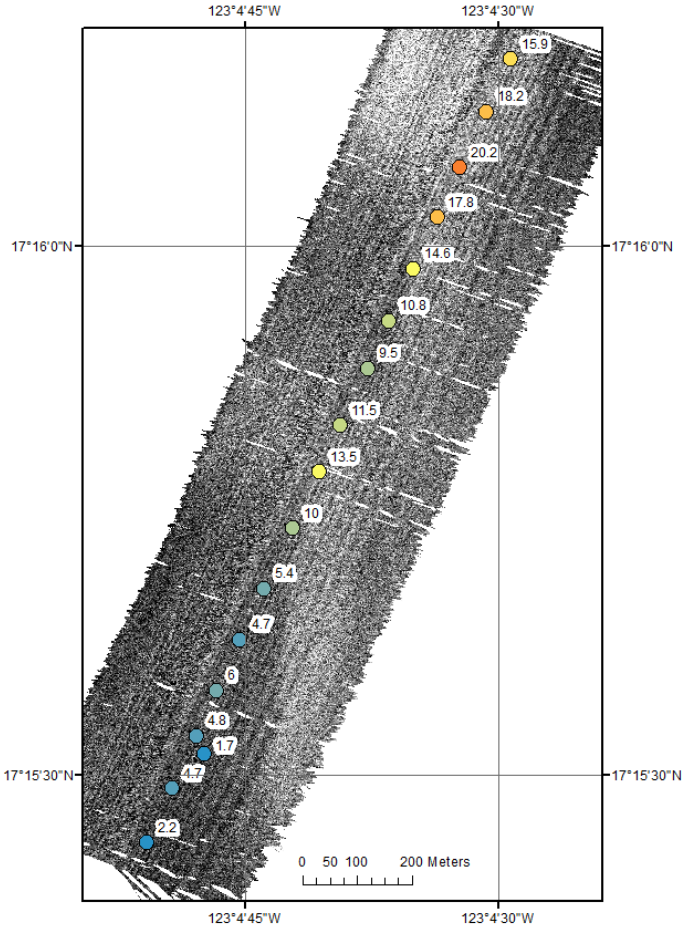


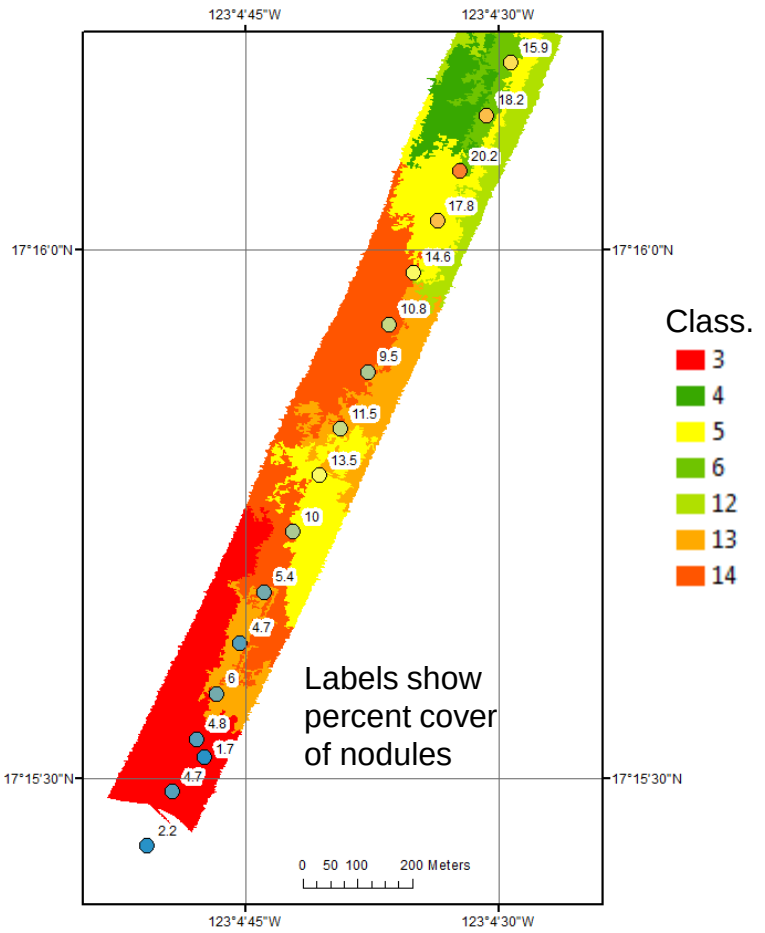


Nodule Identification

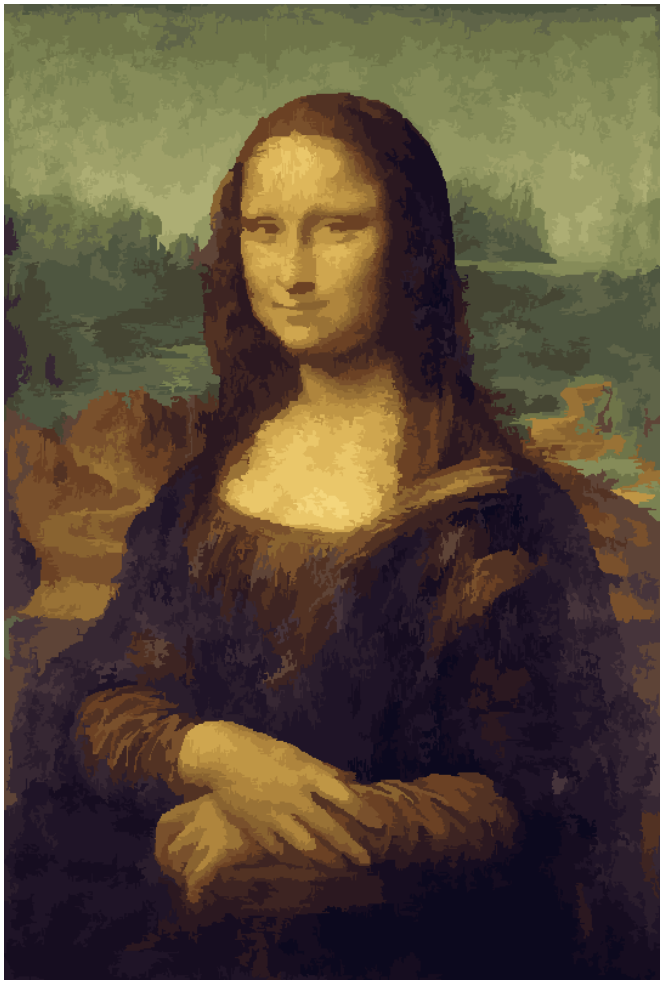
Photo No.	Percent coverage	"Clean" nodules	"Dirty" nodules	Total Identified
1	1.7	163		163
2	2.2	175		175
3	4.7	125	295	420
4	4.8	146	270	416
5	6.0	153	363	516
6	4.7	128	261	389
7	5.4	150	296	446
8	10.0	308	495	803
9	13.5	420	705	1125
10	11.5	395	672	1067
11	9.5	272	560	832
12	10.8	335	571	906
13	14.6	468	847	1315
14	17.8	617	933	1550
15	20.2	571	1134	1705
16	18.2	596	914	1510
17	15.9	493	715	1208
18	8.5	245	390	635

RSOBIA on Multispectral Backscatter





Painting by Numbers



30 clusters (colours?),
minimum polygon size 200 pixels
= 647 polygons

Original (1024*687 pixels)

Installation

Three files to upload: RSOBIA_CPPlib32.exe (about 138Mb)
RSOBIA_10.3.esriaddin (about 350Kb)
(or) RSOBIA_10.2.esriaddin (about 350Kb)
(or) RSOBIA_10.1.esriaddin (about 350Kb)
Read Me.pdf

RSOBIA Library is set to 32bit to match most ARCGIS software installations (even on a 64 bit PC). 64 bit installations are available on request (tlb@noc.ac.uk) but not rigorously tested!

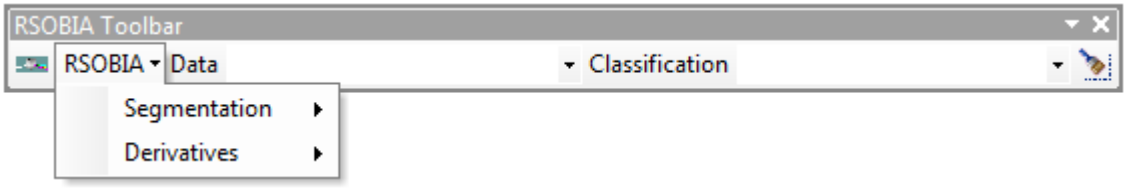
2 stage installation:

1. Run the RSOBIA_CPPlib32.exe and use defaults
2. Double click the RSOBIA.esriaddin

Tested on Windows 7 and 8 (64 bit machines with 32 bit ArcMap 10.3.1, 10.2.2 and ArcMap 10.1)

Toolbar

Toolbar



5 options:

Segmentation – for the creation of multilayered raster data, the actual segmentation process of creating polygons and labelling each polygon with the raster statistics.

Derivatives – for the creation of new raster layers from single band raster data (e.g. Slope, curvature, roughness)

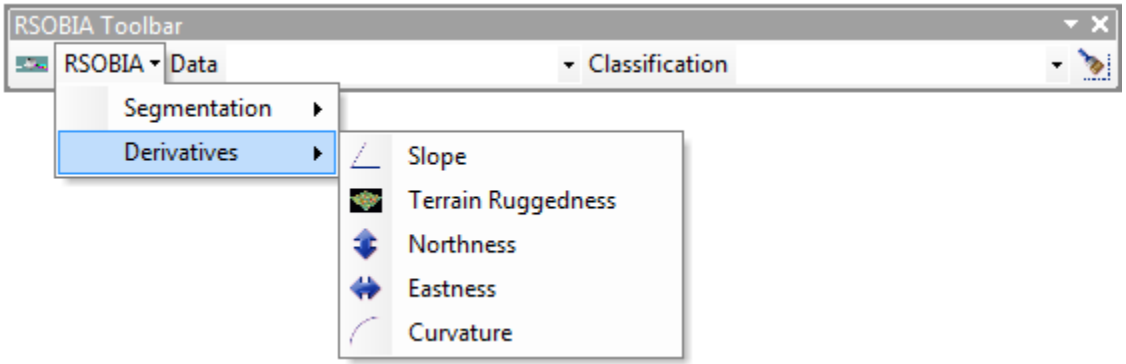
Data (pulldown menu) – To specify the dataset to add a "Class" attribute field

Classification (pulldown menu or type in) – To specify the classification name (e.g. sand) to be added to a segment

<paintbrush icon> - To draw an area on the map that is to be classified with the specified classification.

Toolbar

Toolbar



5 options:

Slope – Calculates the slope (in degrees) for a DTM.

Terrain Ruggedness – Calculates the terrain ruggedness in a 3D model within a small neighbourhood. Measures aspect and slope and combines into a single value. Taken from Benthic Terrain Modeller

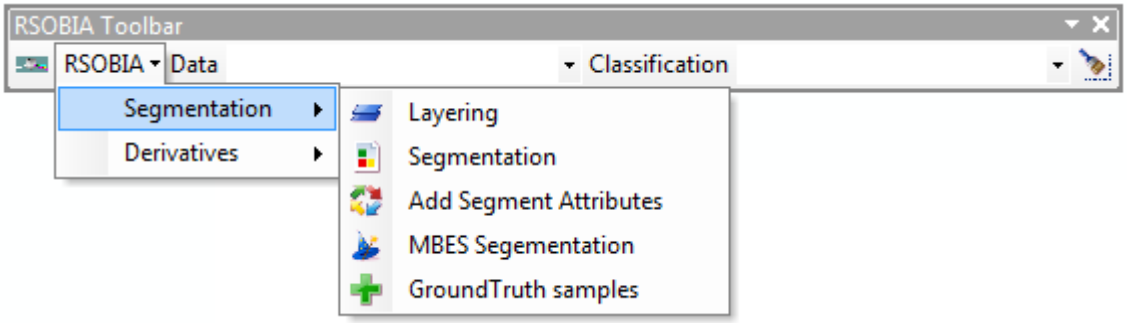
Northness – Calculates the Cosine of the Aspect of a slope

Eastness – Calculates the Sine of the Aspect of a slope

Curvature – Calculates the curvature of a raster surface. Taken from Benthic Terrain Modeller

Toolbar

Toolbar



5 options: Layering – Often data is provided from different sources and for segmentation needs combining into a single raster dataset. No limit on number of layers. Imagery range values need not be similar.

Segmentation – Takes a multi-layered raster dataset and converts into polygons using a region growing and clustering algorithm based on the statistics of the layers.

Add Segment Attributes – Calculates the mean and standard deviation of raster layer within each segment polygon and attaches the data to each polygon's attributes.

MBES Segmentation – A wizard to take the basic bathymetry and backscatter data and use the standard process to create polygons and attributes.

Ground Truth samples – Adds groundtruth sample data attributes to segment attributes.

Future Work

- Integration into core or extension?
- Further robustness (e.g. Non .img files, try....except functionality)
- Streamlining?

- Correlation of Groundtruth with segmentation classes
- Develop Classification clustering – supervised and unsupervised?
- Can new texture analysis be added to layer interpretation?