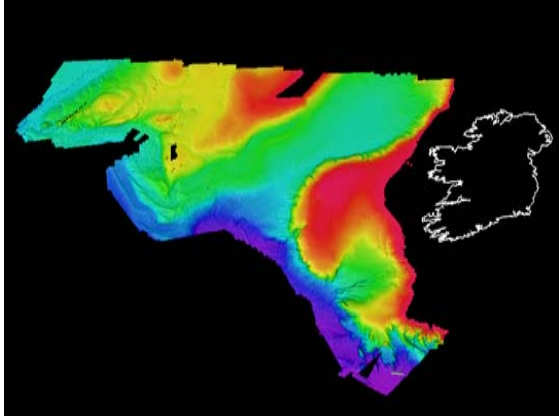
Large-scale deep-water seabed characterisation of the Irish Seabed

Xavier Monteys & Ronan O'Toole (GSI)

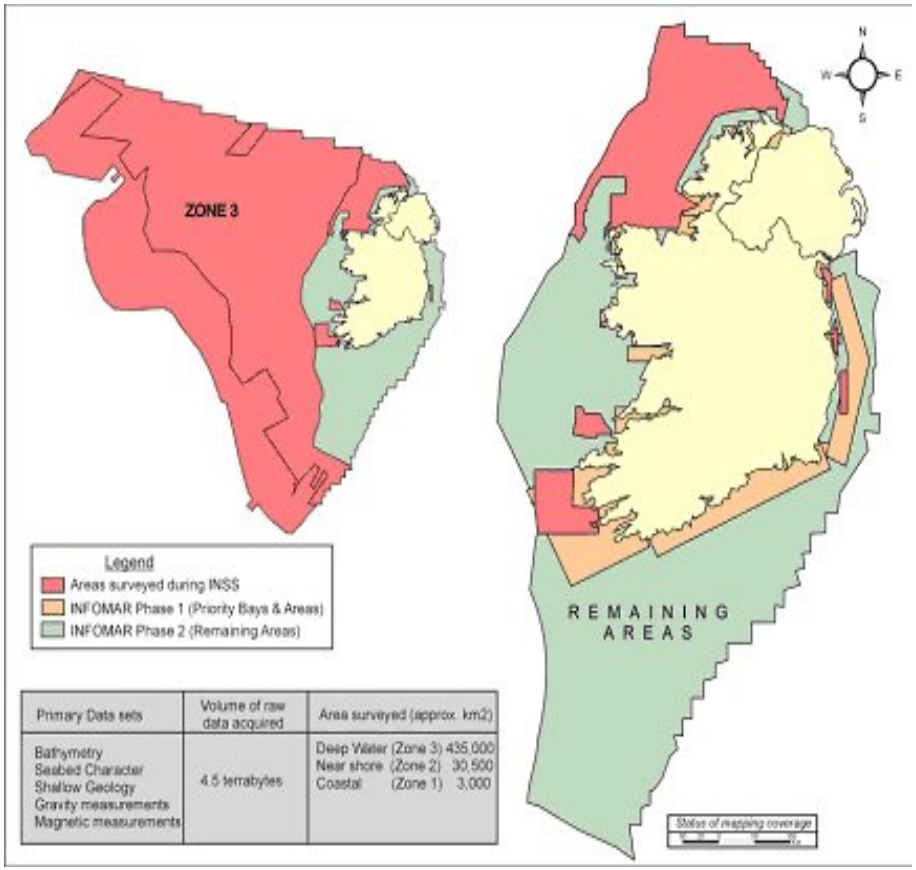
Geohab, Trondheim 2009

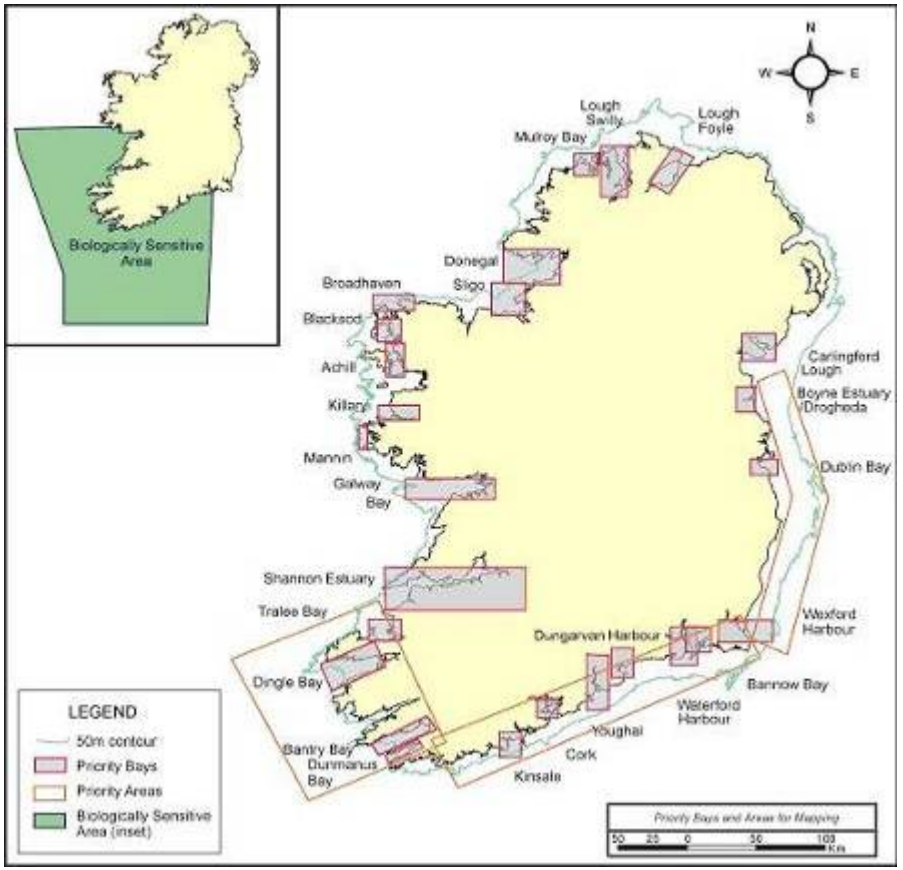
Outline



- *Background*
  - *The backbones: INSS, INFOMAR,…*
  - *Large-scale, deep-water mapping issues*
- *Deep-water physical seabed characterization*
  - *Objectives*
  - *Challenges*
  - *Strategy*
    - *Data: QC, scales, validation,…*
    - *Methodologies*
- *Results*
- *Discussion and Future work*

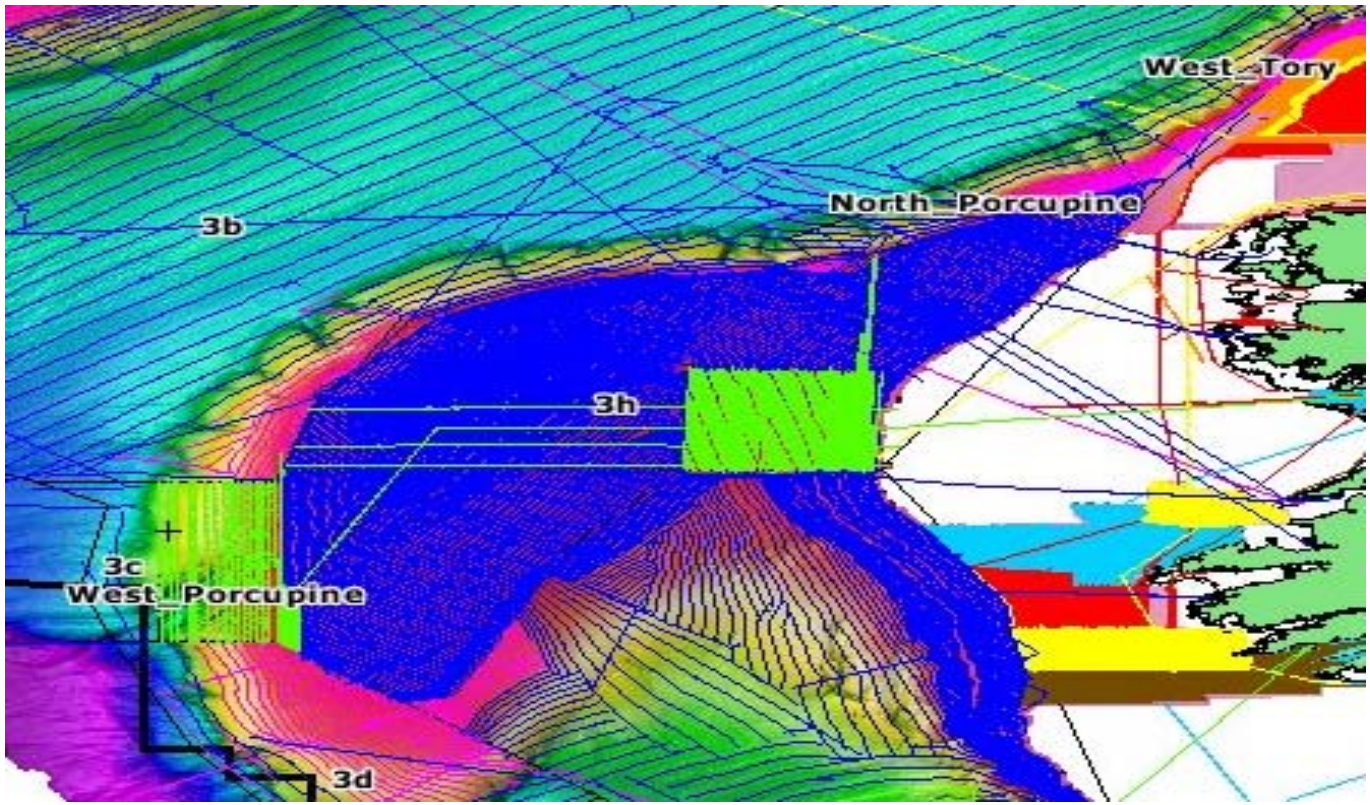
INSS 2000- 2005 & INFOMAR 2006 - 2009





The skeleton

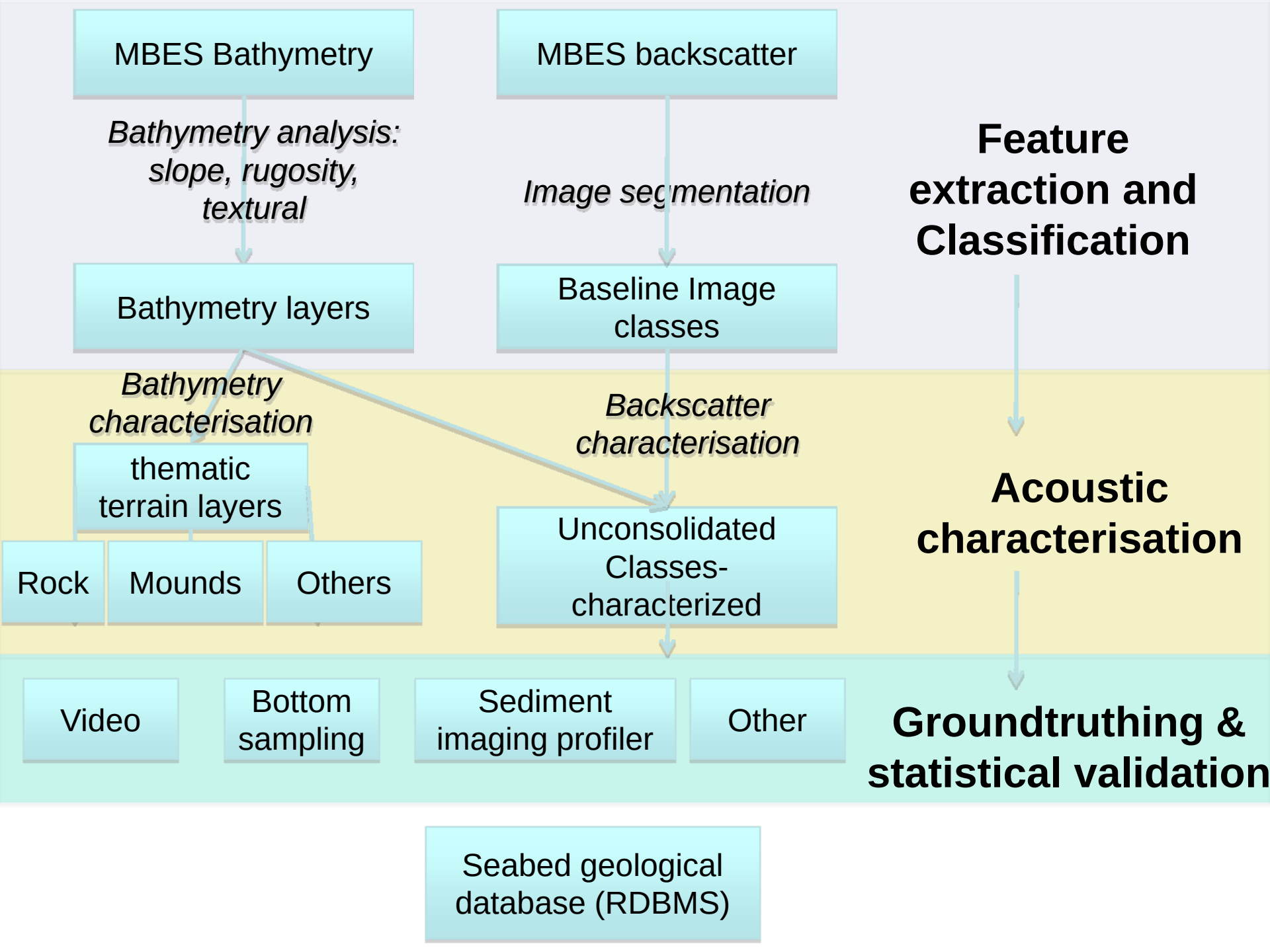
Billions and Billions of Deep Echoes



Goals

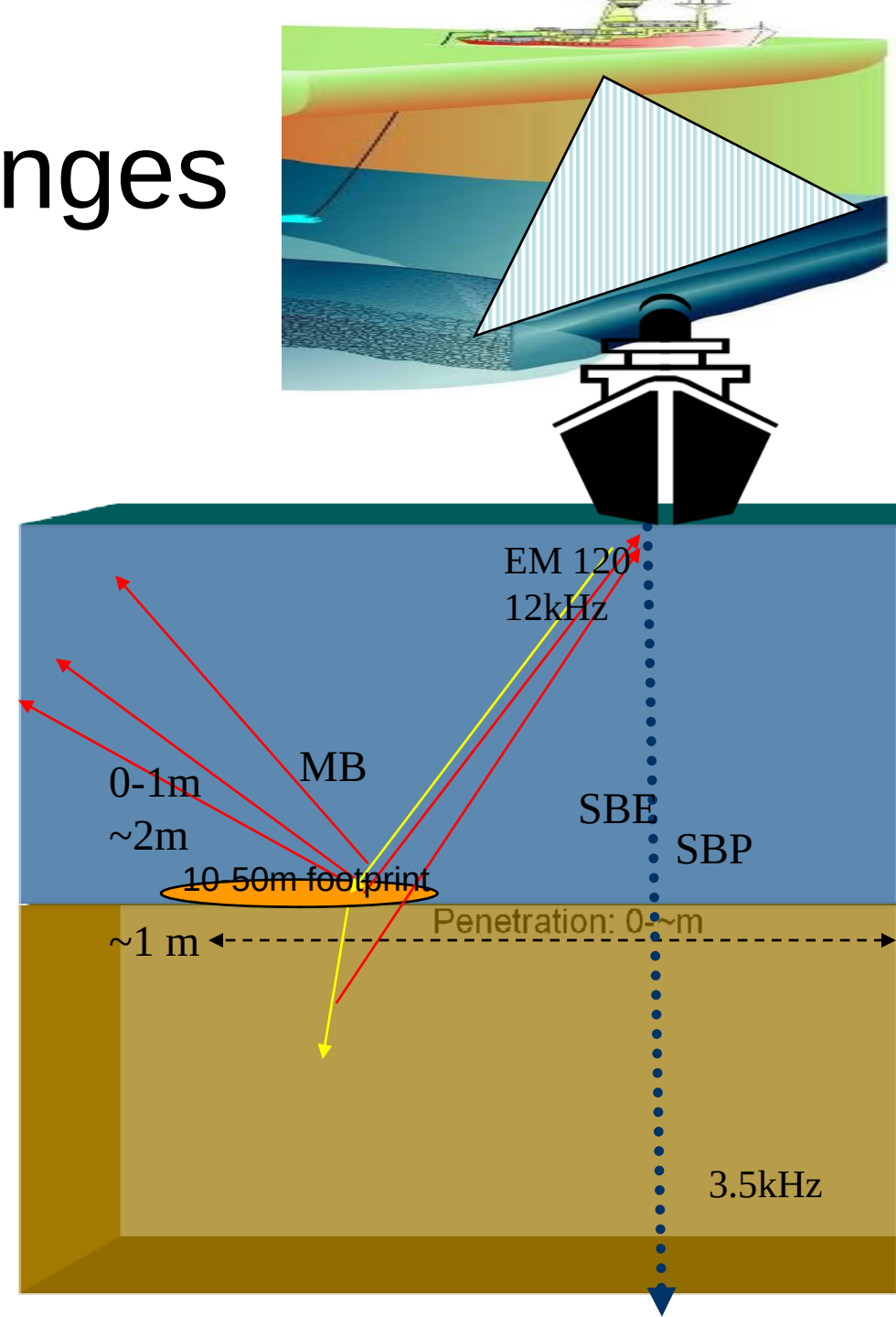
Top objective*: to develop a comprehensive physical environment seabed database for deep waters, primarily based on multibeam data, for multipurpose applications*.

1. To derive and relate seabed sediment classes based on MBES backscatter image classification
2. To derive geomorphological classes and layers by using multibeam bathymetry
3. To validate and groundtruth this classification by using existing seabed samples, video,….


MBES Bathymetry
MBES backscatter
Bathymetry analysis: slope, rugosity, textural
Image segmentation
Feature extraction and Classification
Bathymetry layers
Baseline Image classes
Bathymetry characterisation
Backscatter characterisation
thematic terrain layers
Rock
Mounds
Others
Unconsolidated Classes-characterized
Acoustic characterisation
Video
Bottom sampling
Sediment imaging profiler
Other
Groundtruthing & statistical validation
Seabed geological database (RDBMS)

Our Data challenges

- Pros:
  - Consistency:*1 platform, 1 system, short time*
  - *Survey Planning*
- Cons:
  - *Different years*
  - *3 pulse lengths…*
  - *Depth range (scales)*
  - *Scattering domains*
  - *The weather!*



Supervised image classification

1. Data preparation
   - Cleaning
   - Filtering
2. Processing
   - Feature extraction
     - QC/QA
     - Identifying artefacts
   - Training areas
   - Survey integration
3. GIS management

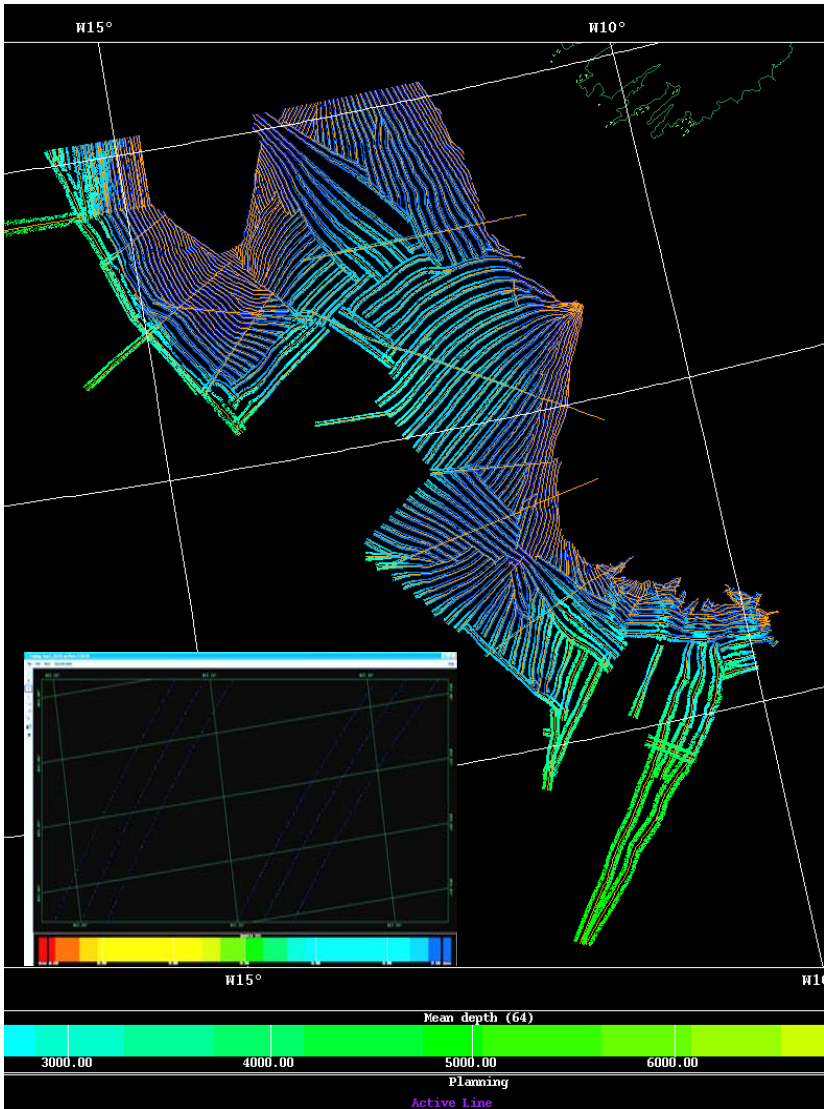
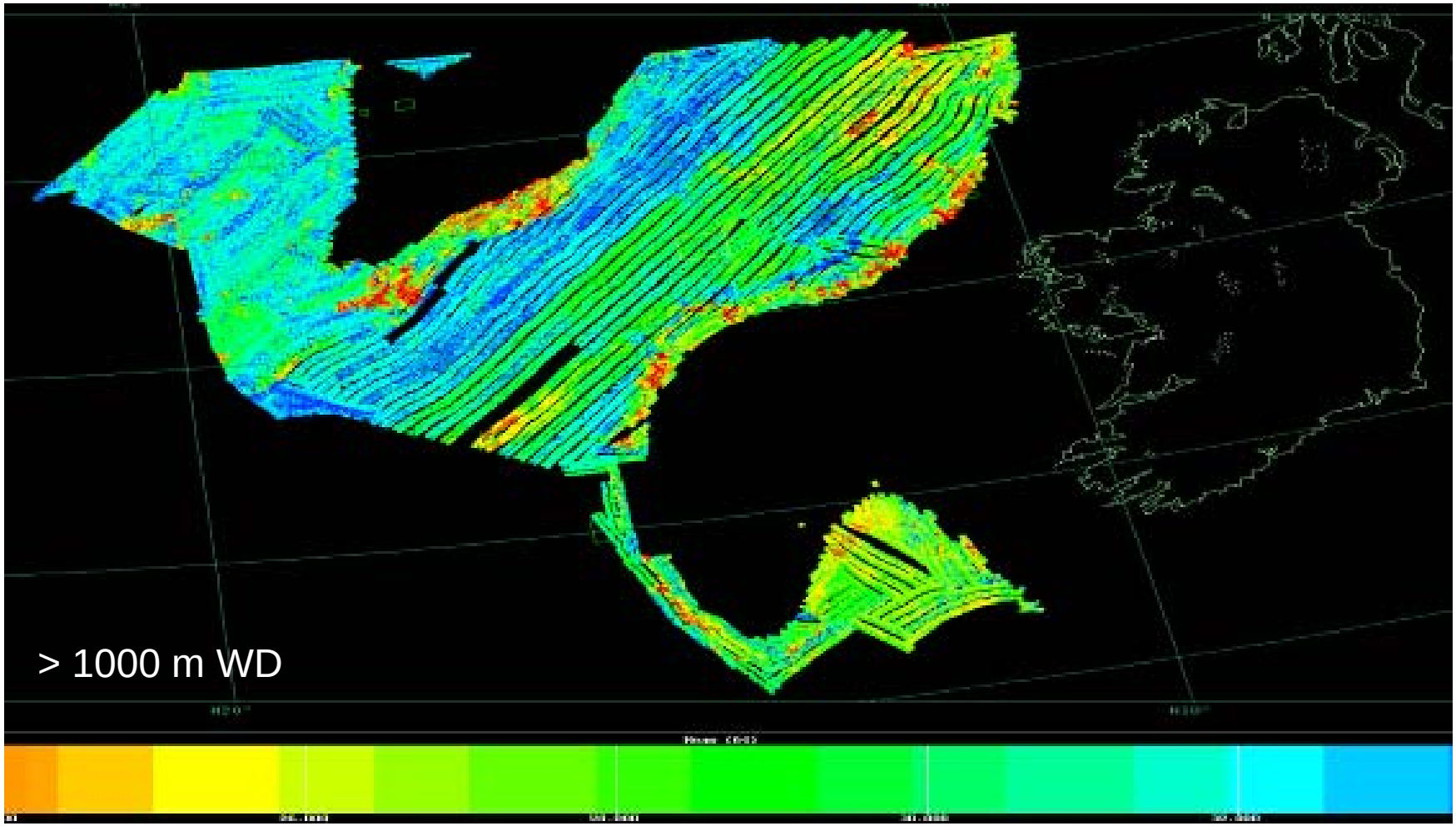
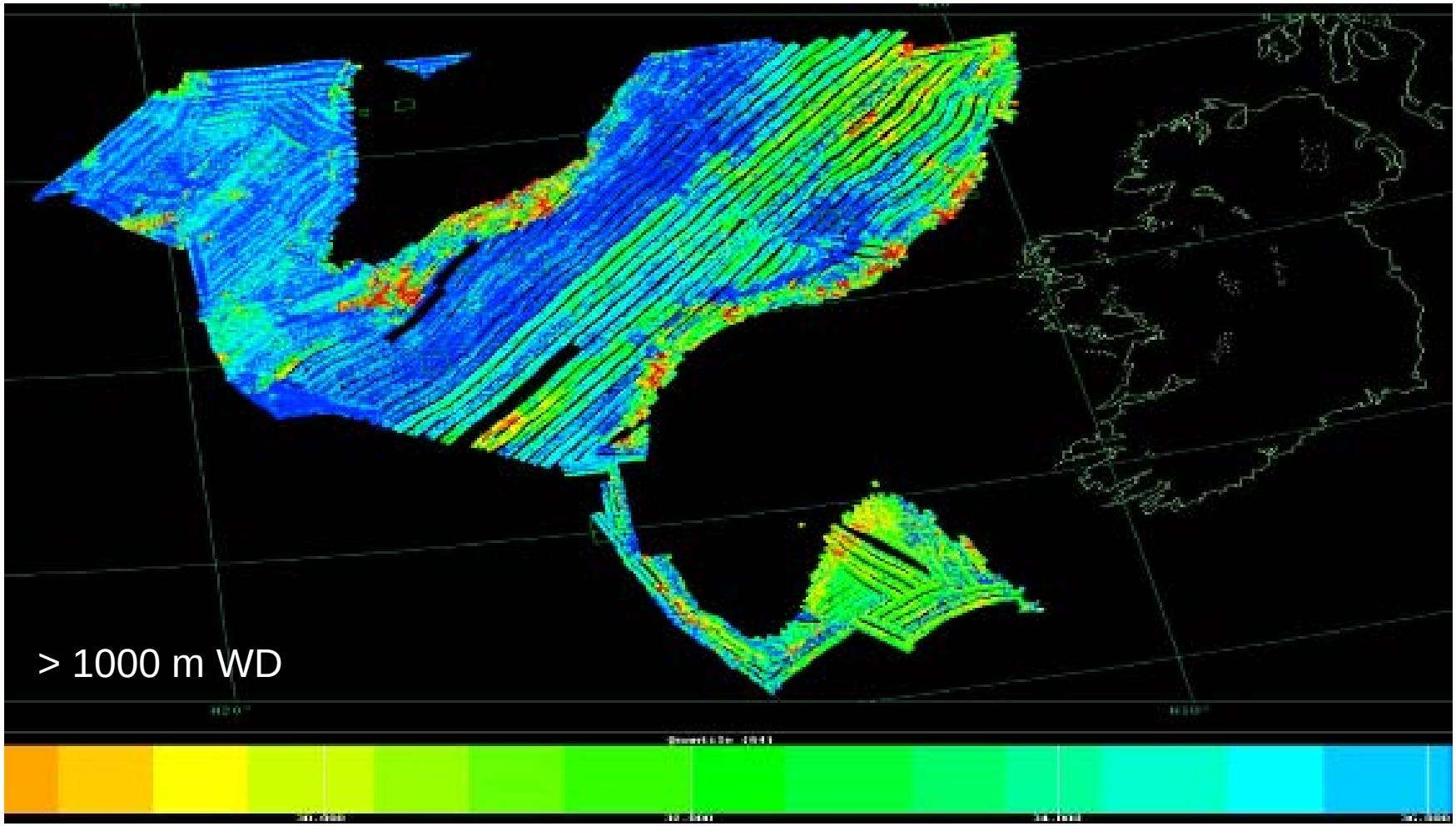


Image Segmentation Features



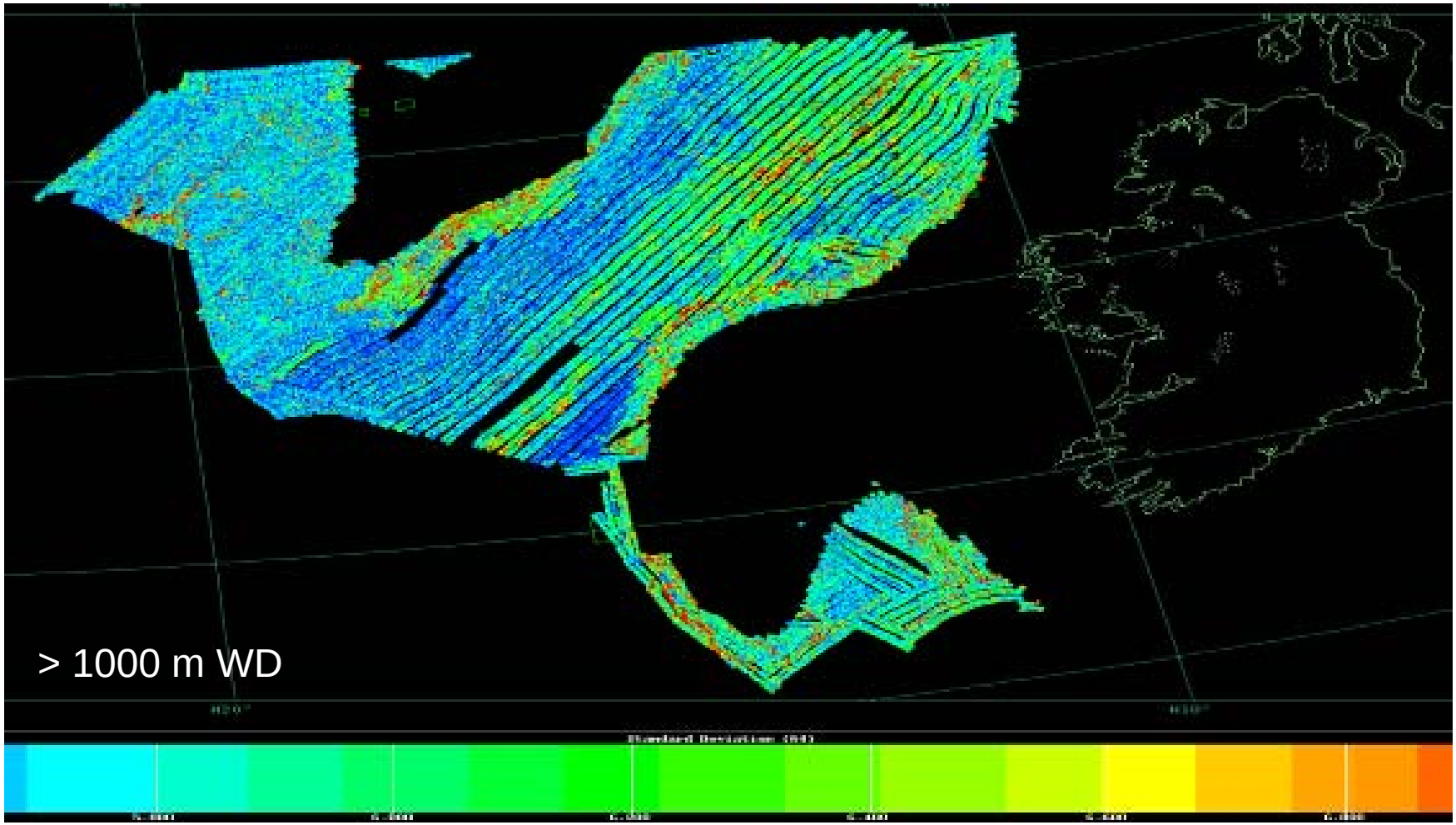
Mean backscatter – tonal feature

Image Segmentation Features



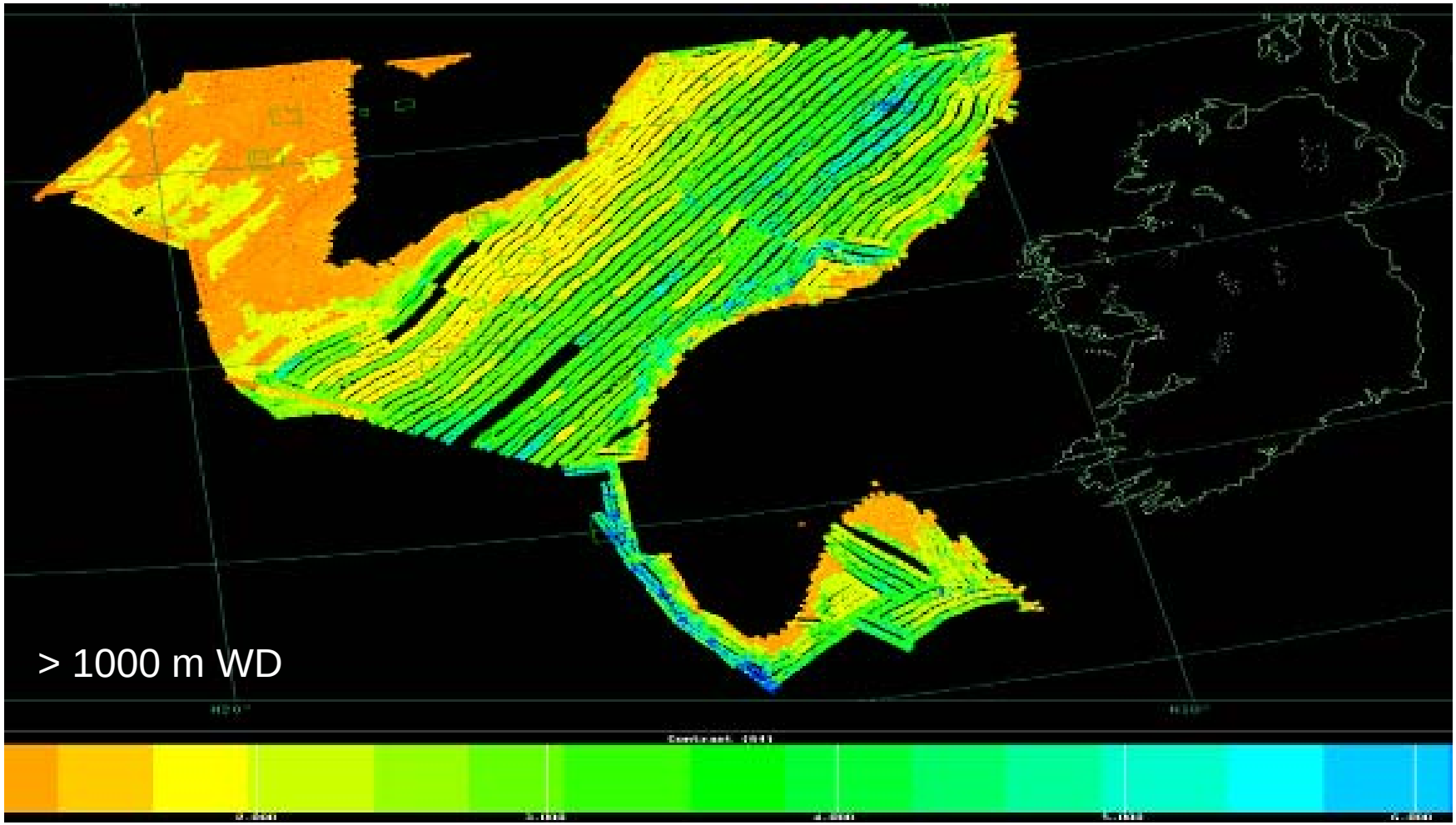
Quantile backscatter - tonal feature

Image Segmentation Features



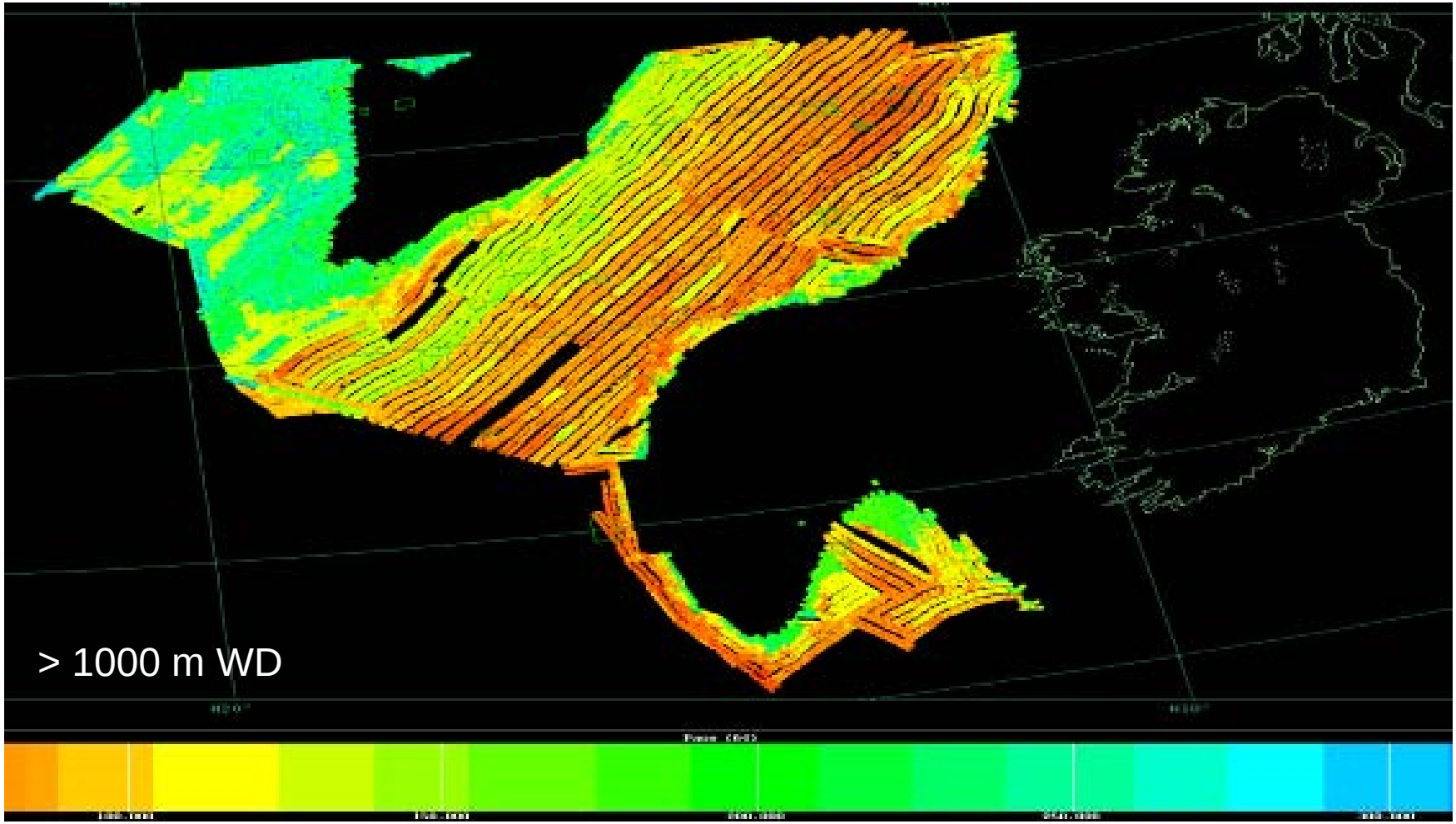
Standard deviation backscatter - variance feature

Image Segmentation Features



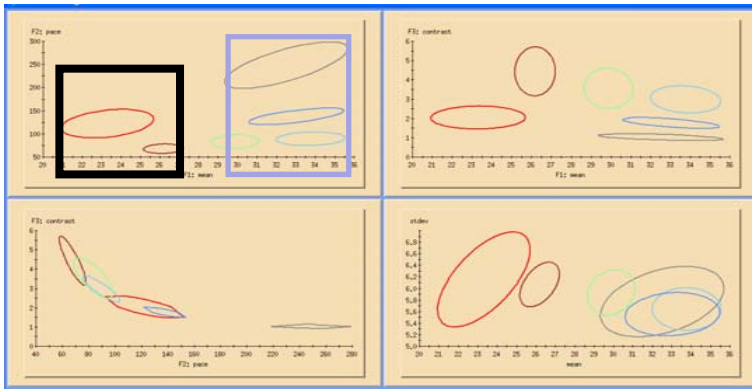
Contrast backscatter – textural feature

Image Segmentation Features

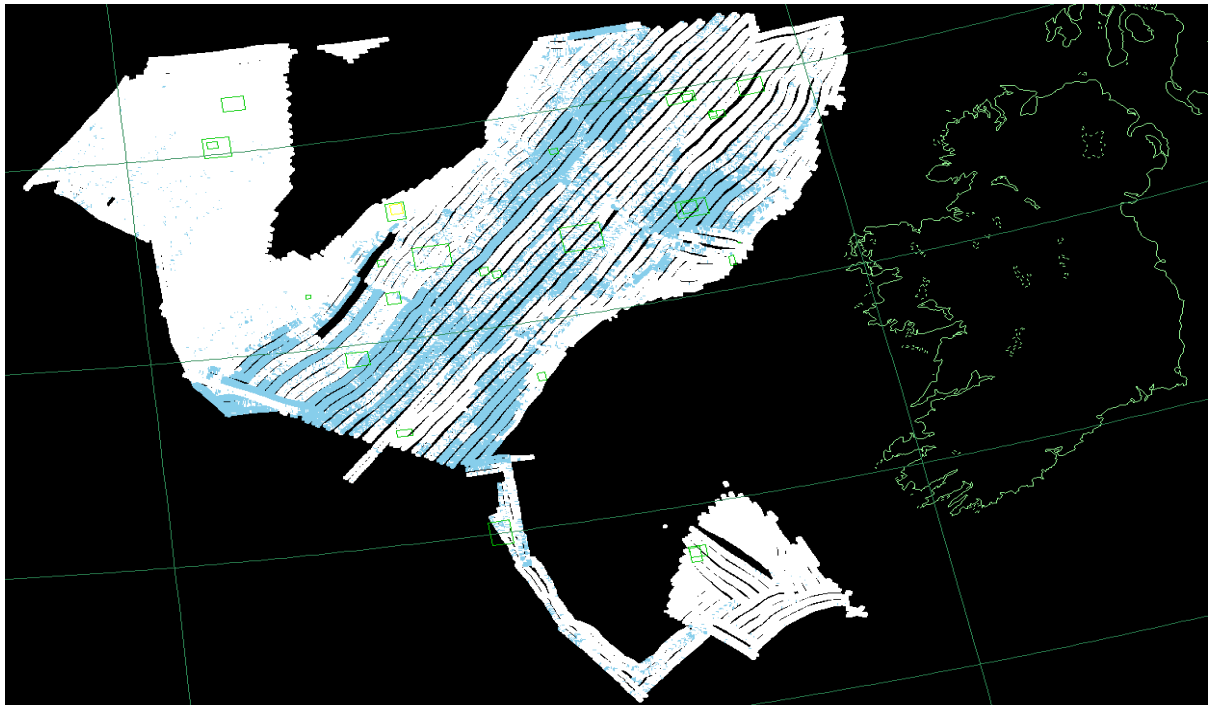


Pace backscatter – textural feature

Image Segmentation Results



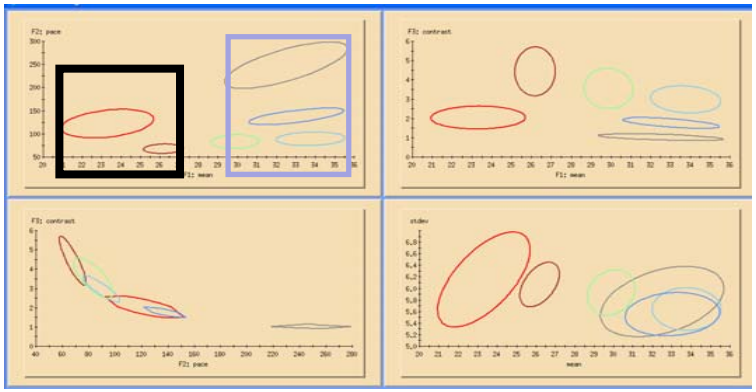
Class 1



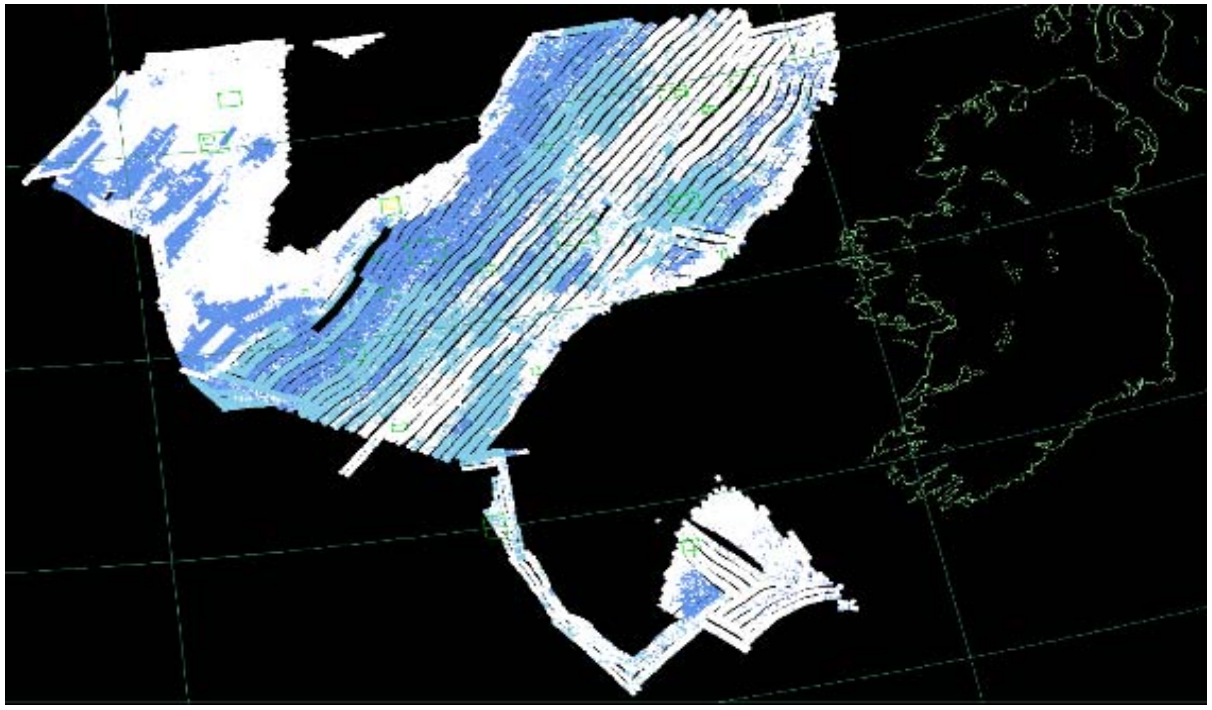
- ***StDev***
- ***Mean***
- ***Pace***

Soft fine sediment 1

Image Segmentation Results



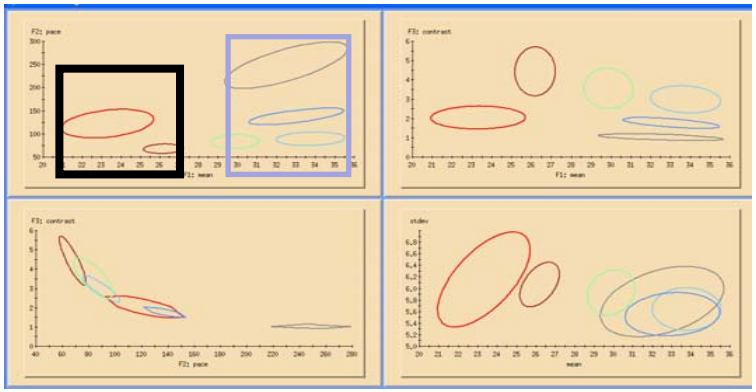
Class 2



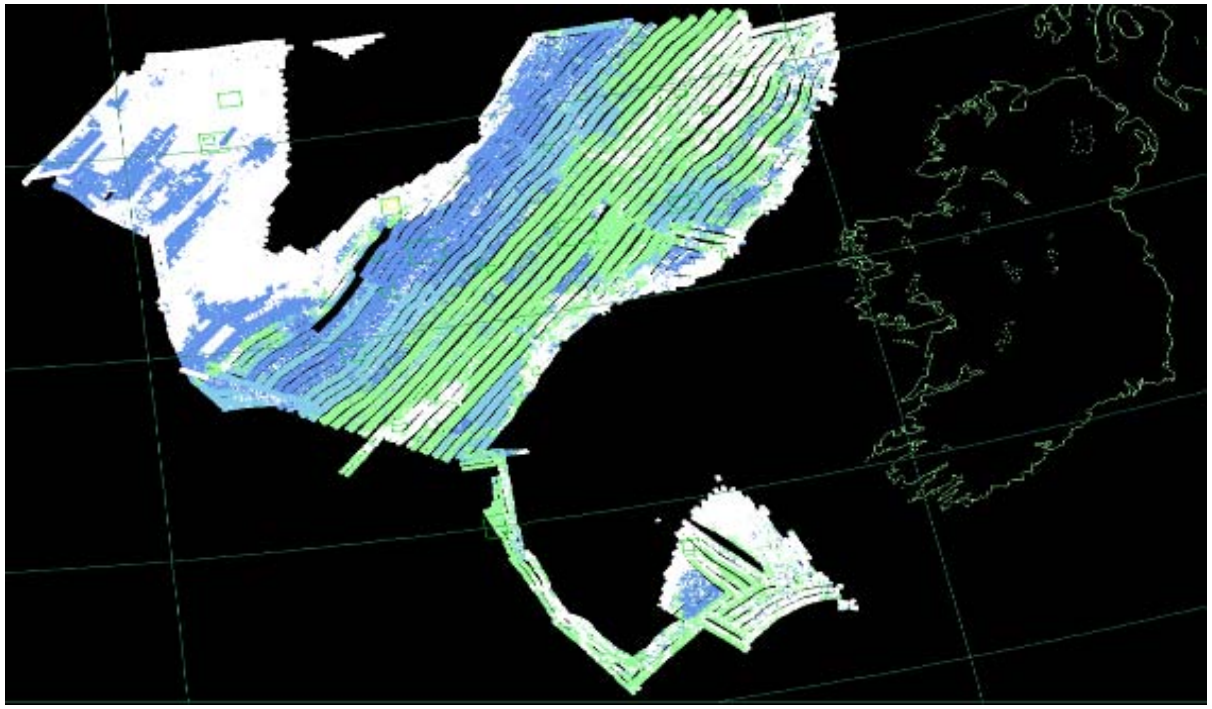
- ***StDev***
- ***Mean***
- ***Pace***

Soft fine sediment 2

Image Segmentation Results



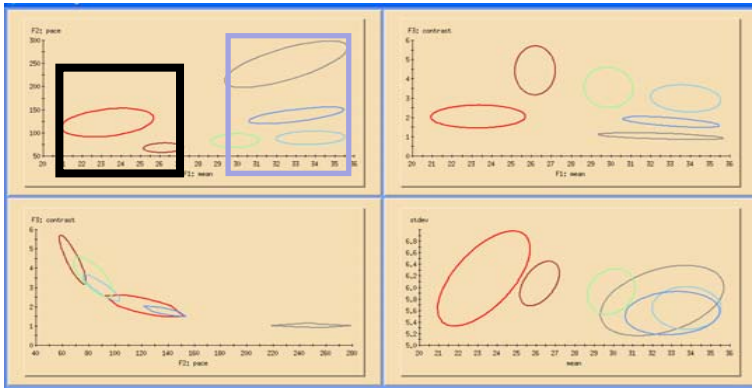
Class 3



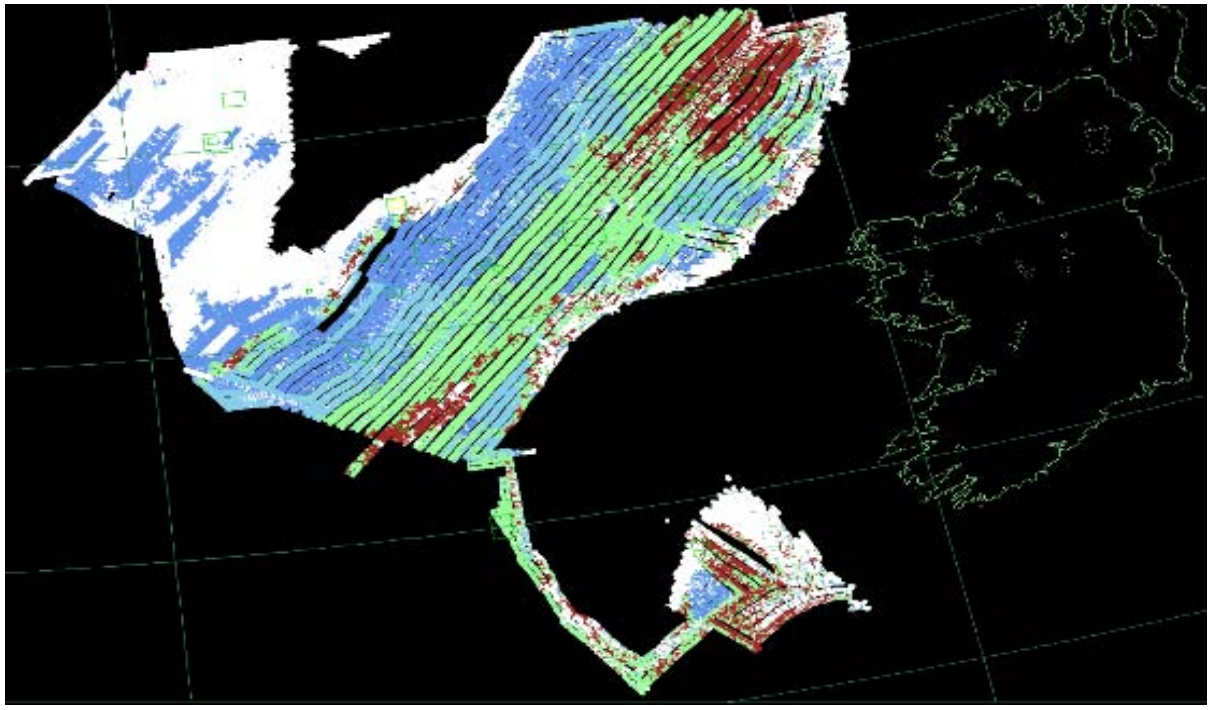
- ***StDev***
- ***Mean***
- ***Pace***

Soft fine sediment 3

Image Segmentation Results



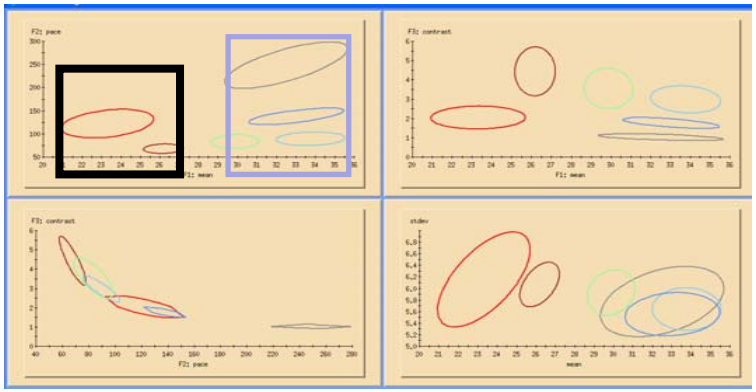
Class 4



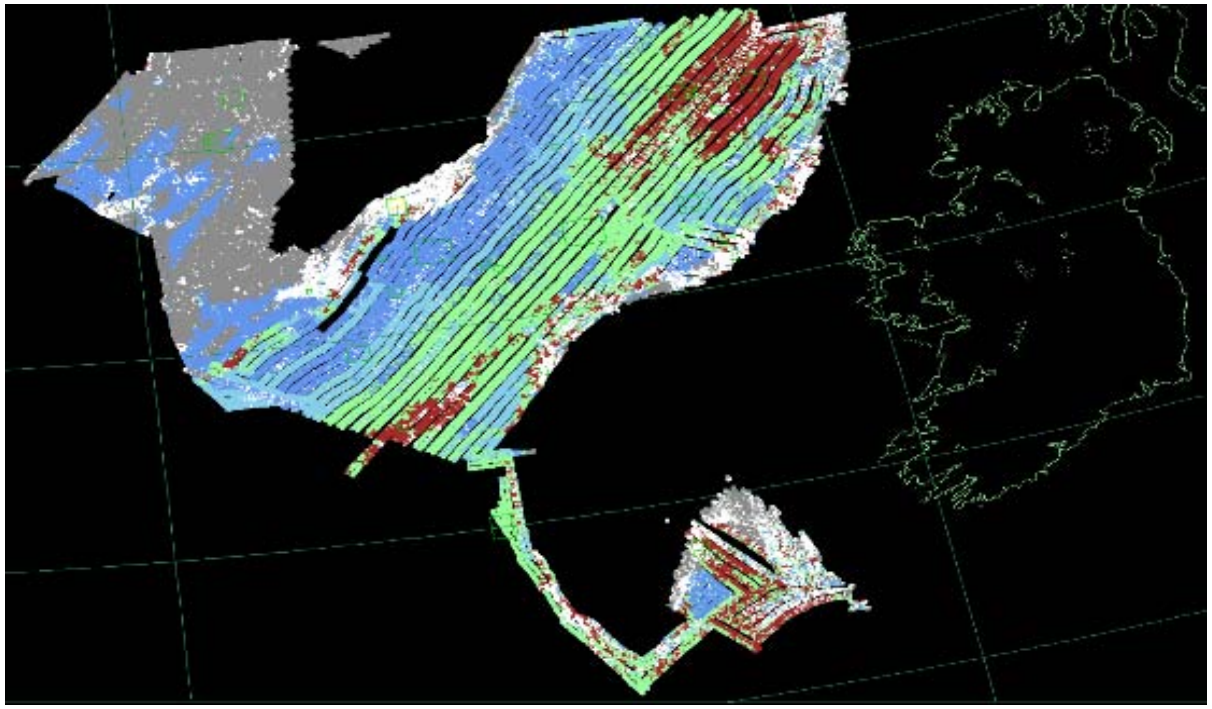
- ***StDev***
- ***Mean***
- ***Pace***

Moderate BS sediment 1

Image Segmentation Results

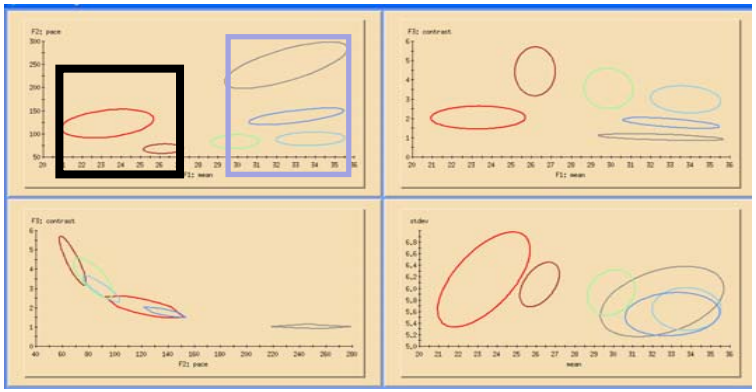


Class 5

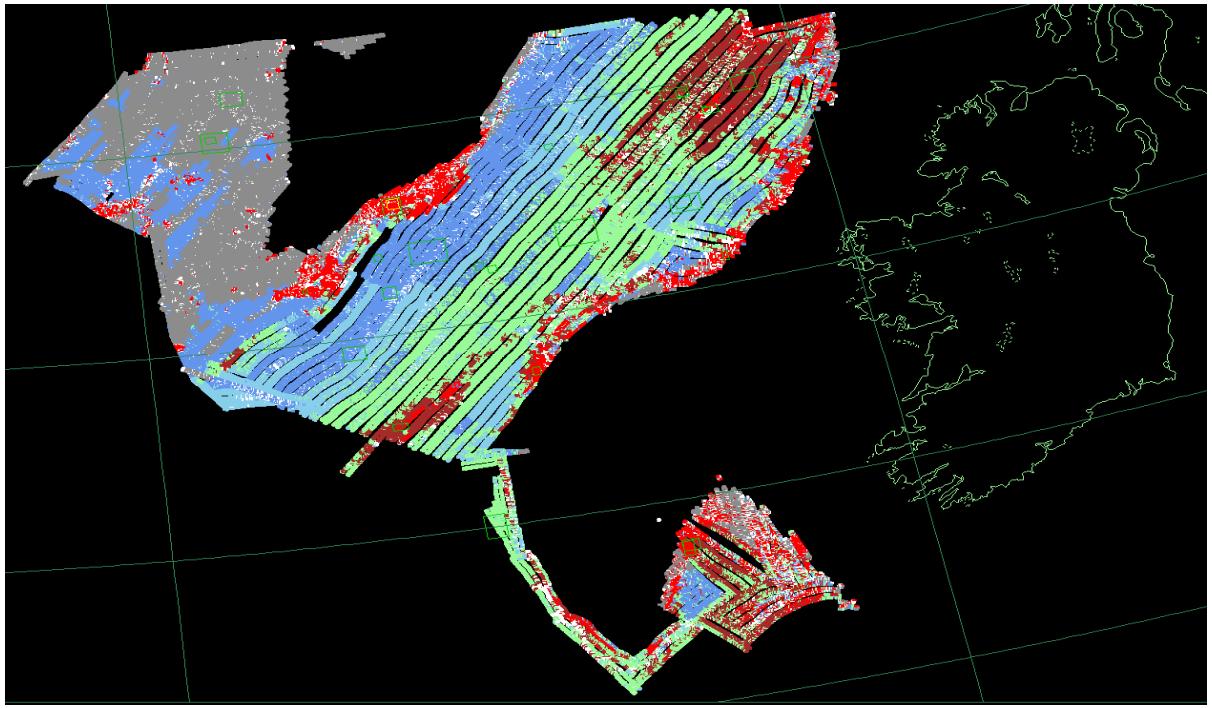


Soft sediment – high textural 5

Image Segmentation Results



Class 6

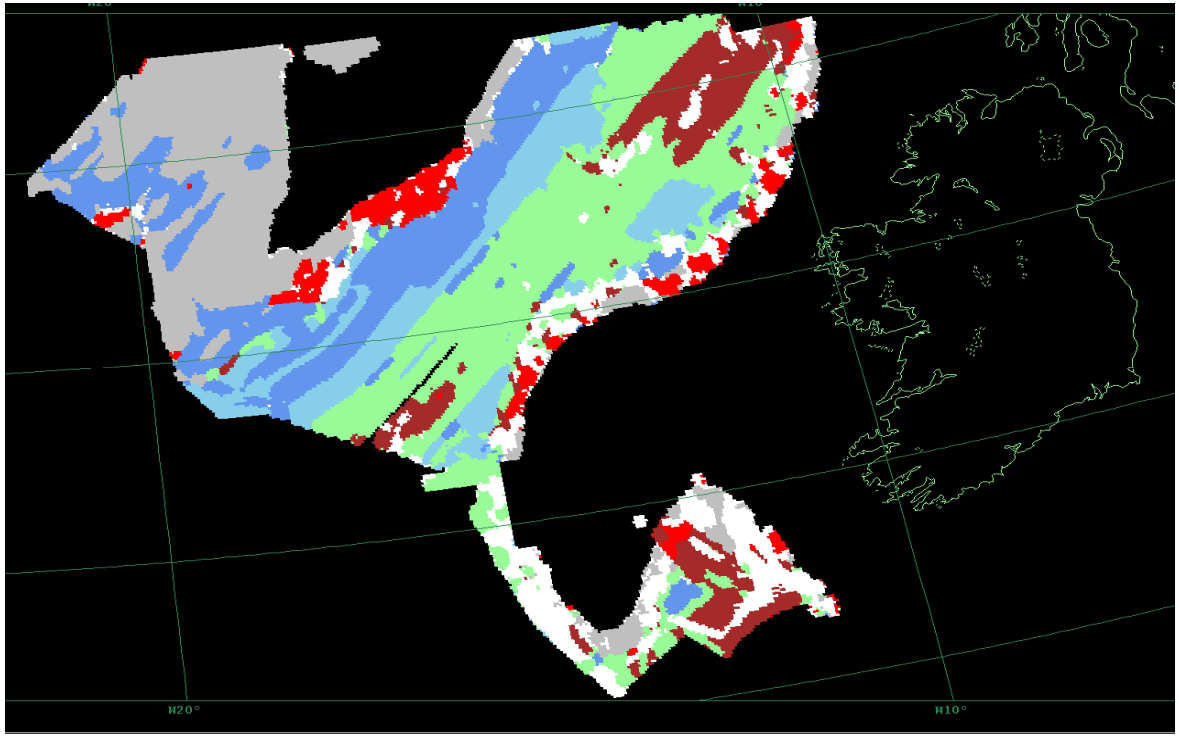


Hard substrate: rock outcrop to slope control,…

Image segmentation

6 Classes

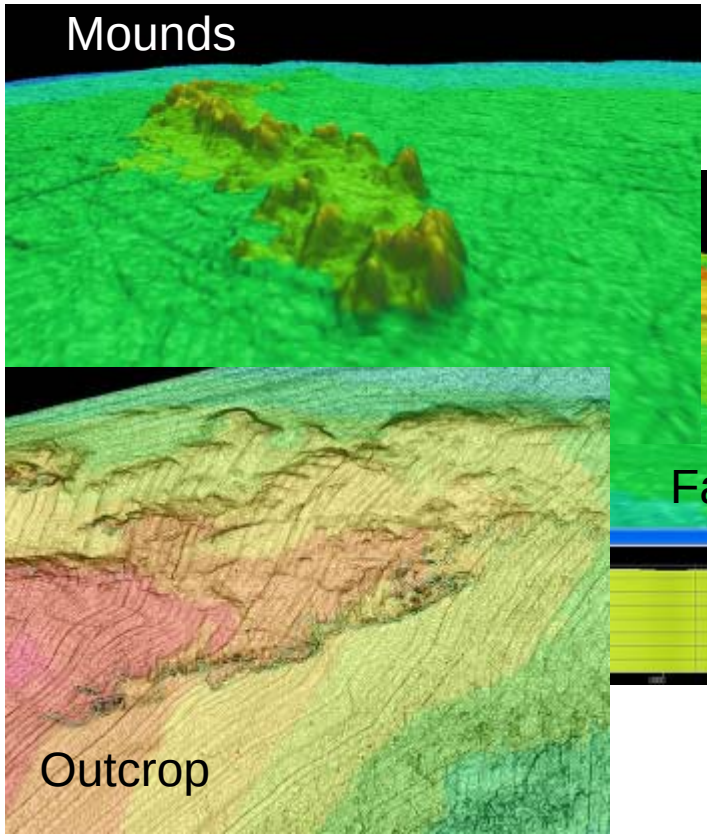
Outliers

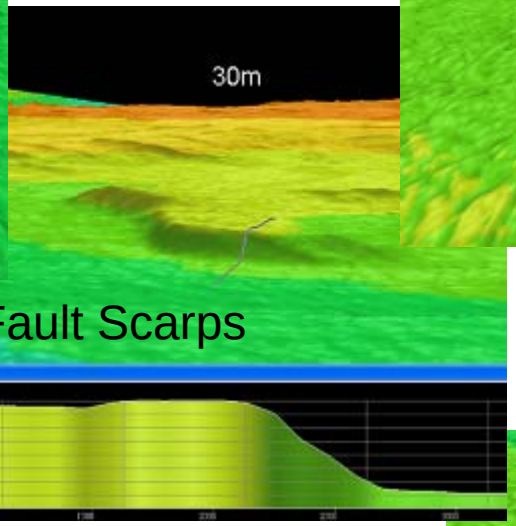


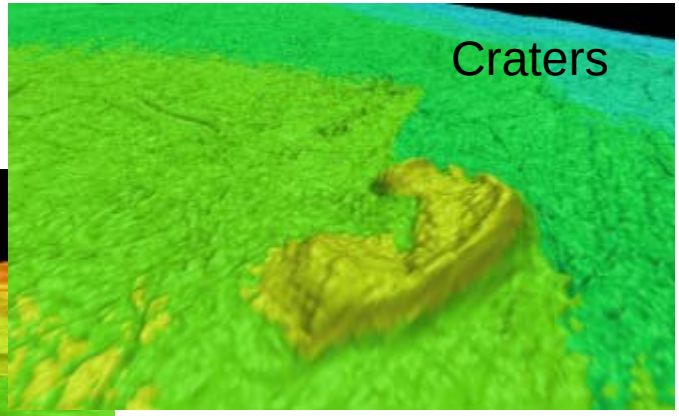
Grid: 1000m x 1000m

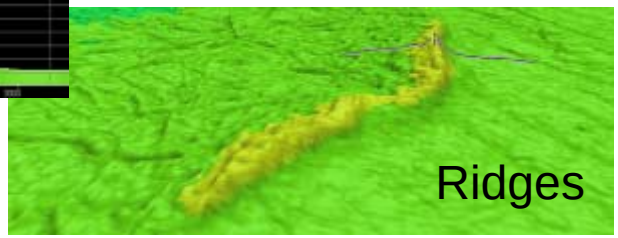
Class	ID	Image features					Bathy		SS	GT	Geology
		M	Q	S	P	C	Slope	B			
A											
B											

Identification of Seabed Bathymetric Features

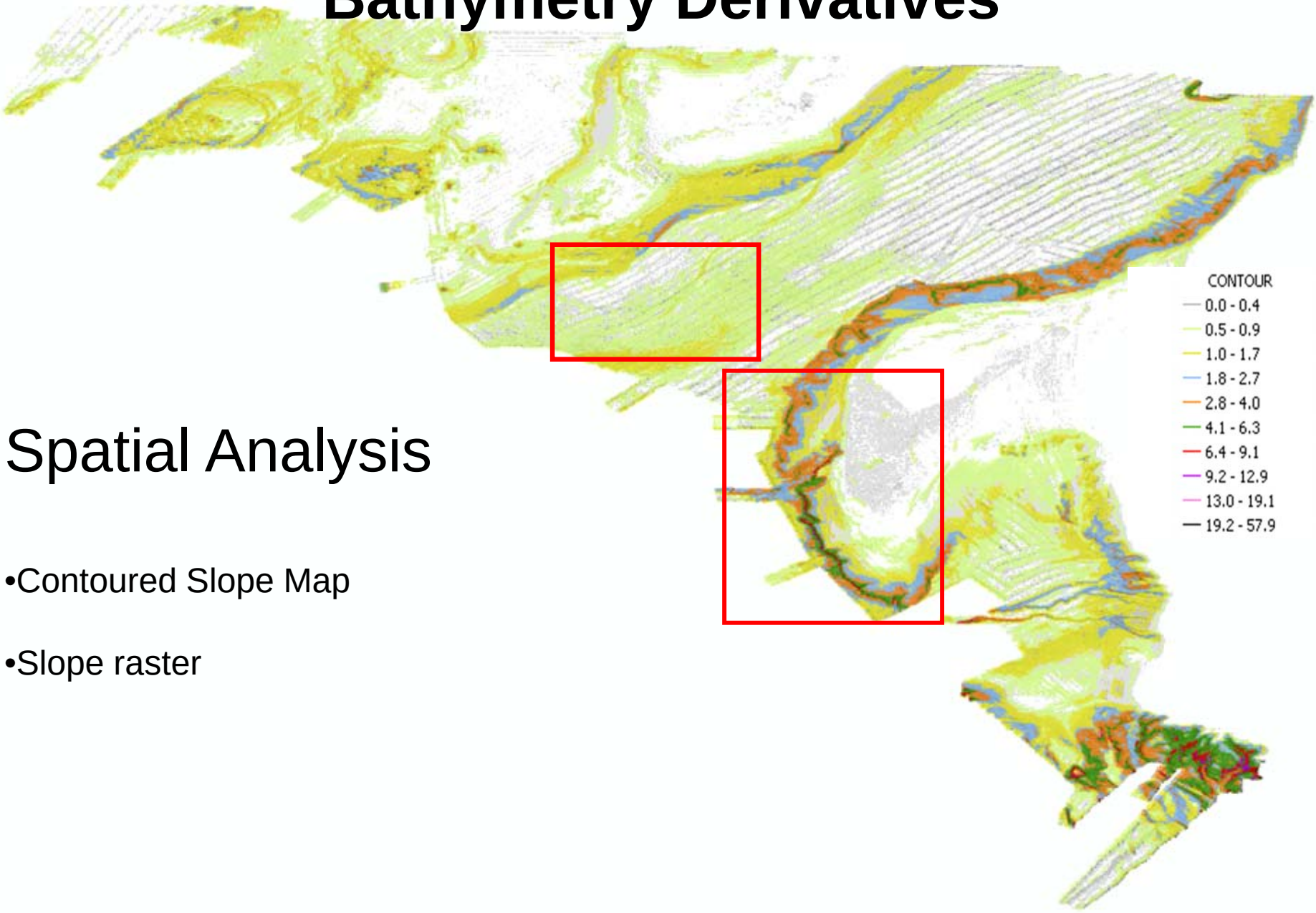






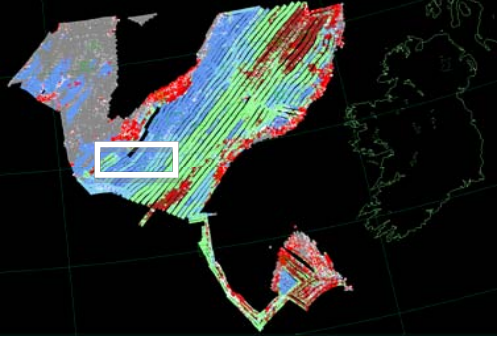


Bathymetry Derivatives

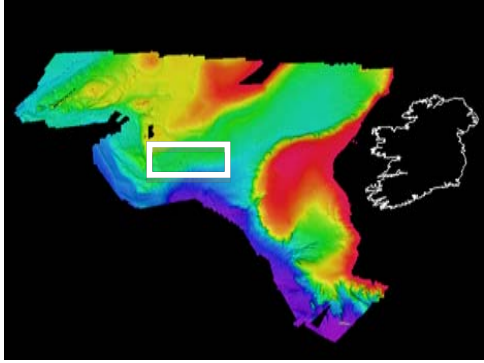


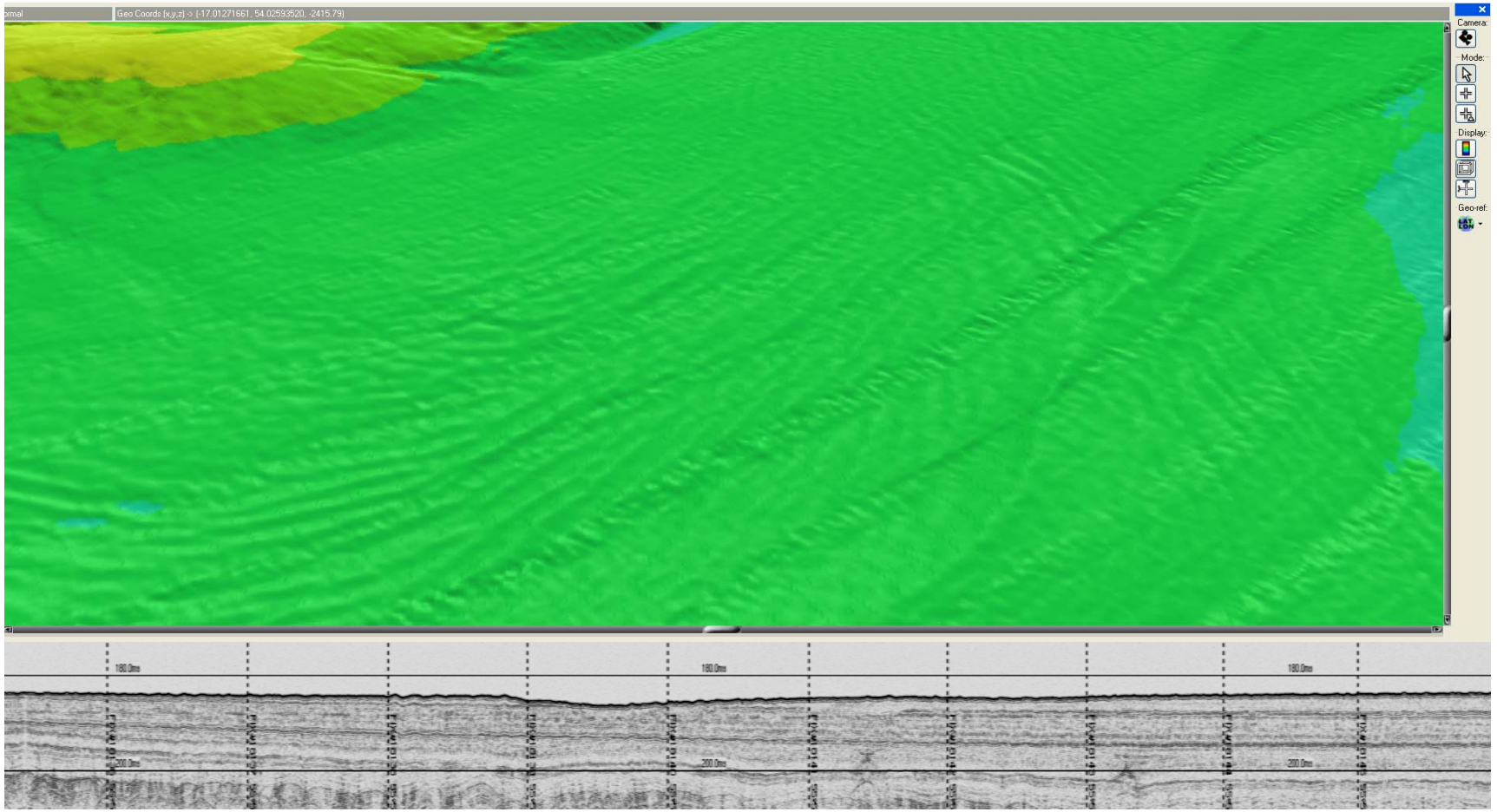
Spatial Analysis

- Contoured Slope Map
- Slope raster



Feni Ridge




Geo Coords (x,y,z) -> (-17.01271661, 54.02593520, -2415.79)
Camera:
Mode:
Display:
Geo-ref:
180.0ms
200.0ms

Discussion

1. Data preparation (e.g. QC & filtering) and processing strategies are key to separate the useful BS from the rest (artefacts,noise,redundant data or inconsistent)
2. Less data coverage and more interpolation to develop a robust baseline classification. Filling the gaps and refining on the characterization stage
3. Image classes show that backscatter data, at these frequencies and footprints,are a consistent and robust tool to discriminate between similar soft grounds, but not a good discriminator for hard seabeds
4. Statitistical analysis: Moderate to high correlation between the 5 variables. Quantile/mean; pace/contrast and stdev. Stdev looks like the more continuous and less affected by system artefacts or sonar geometry factors

Present status and future work

- 1st stage: large-scale BS classification completed.

  2nd stage: characterization-ongoing
- Bathymetry classification
- Geophysical characterization
- Ongoing multidisciplinary groundtruthing (once a year)