GeoAcoustics
A KONGSBERG COMPANY

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Swath Bathymetry 1: GeoSwath Plus
Technology and data examples

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Swath Bathymetry 1: GeoSwath Plus
Technology and data examples

- System overview
- Technology – phase measuring bathymetric sonar
- System specifications
- Data examples

GeoSwath Plus Bathymetric Sonar

Wide Swath Bathymetry and Co-registered Side Scan

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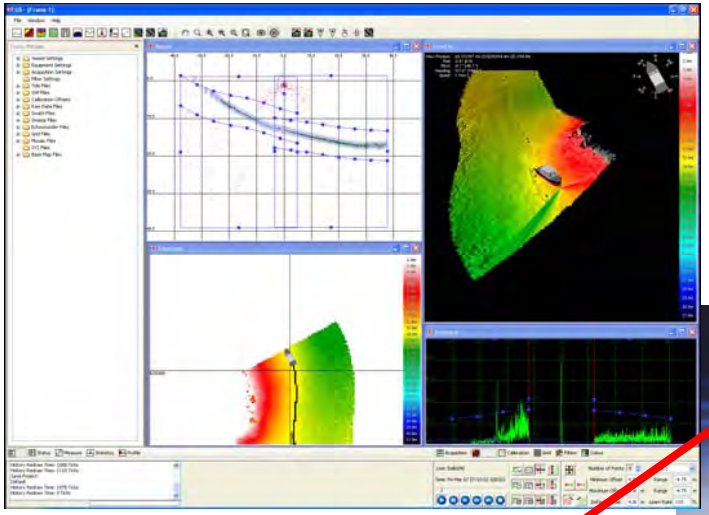

Data Products – Bathymetry and Side Scan

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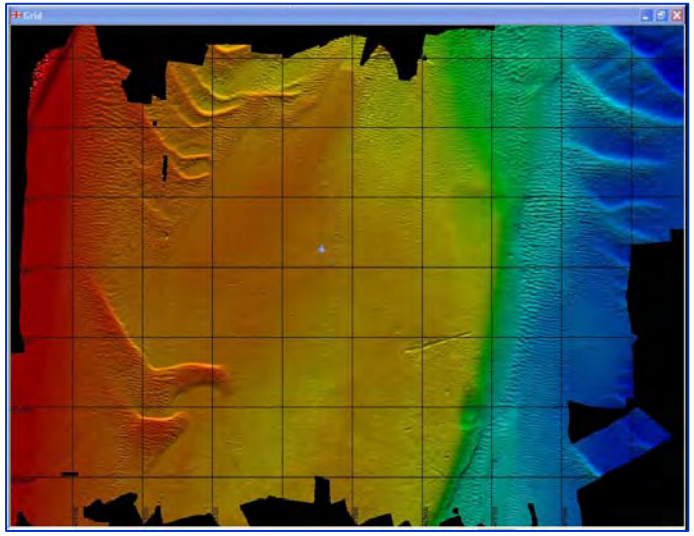

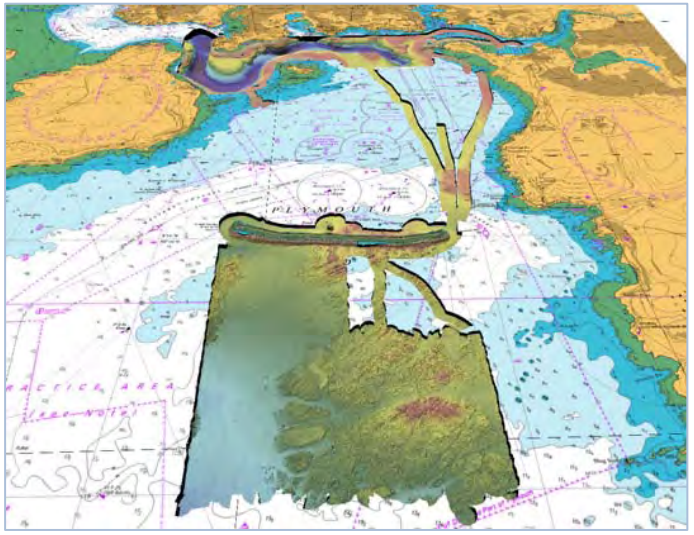

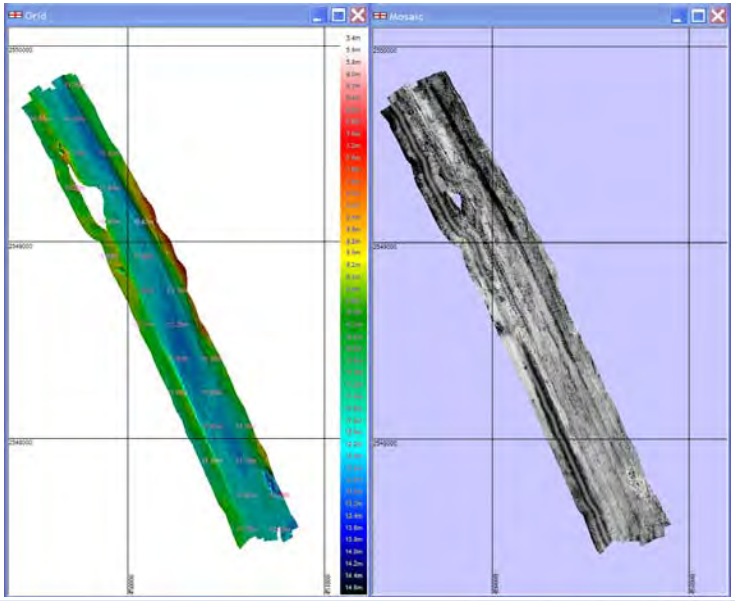

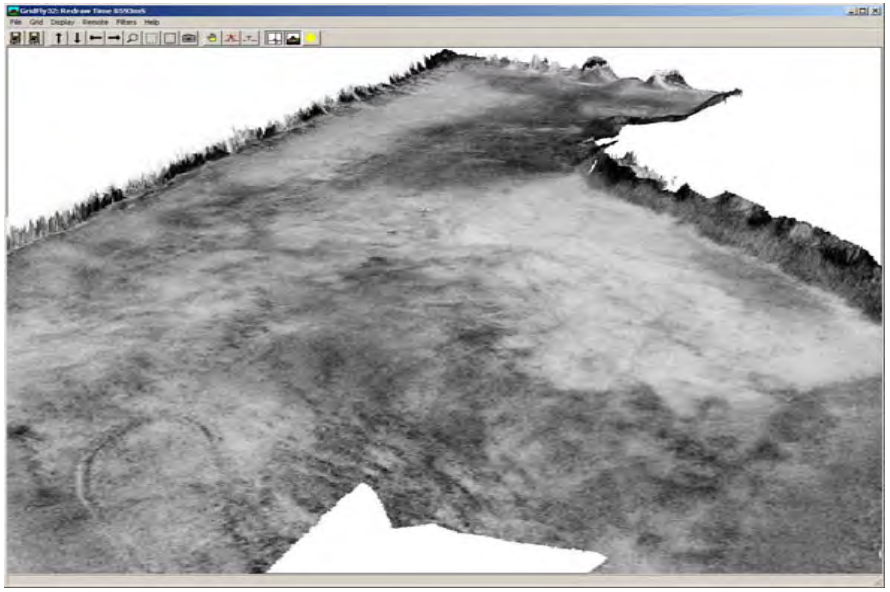

Deployment

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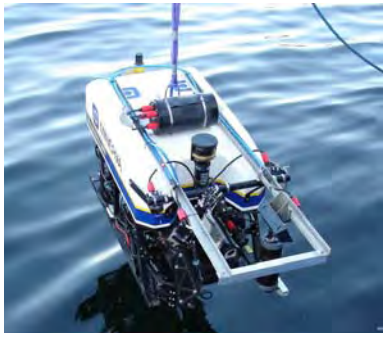

Large and small vessels.

Pole mount, Hull mount,

AUV and ROV mount.

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The technology

Phase measuring bathymetric sonar

Phase Measuring Bathymetric Sonar

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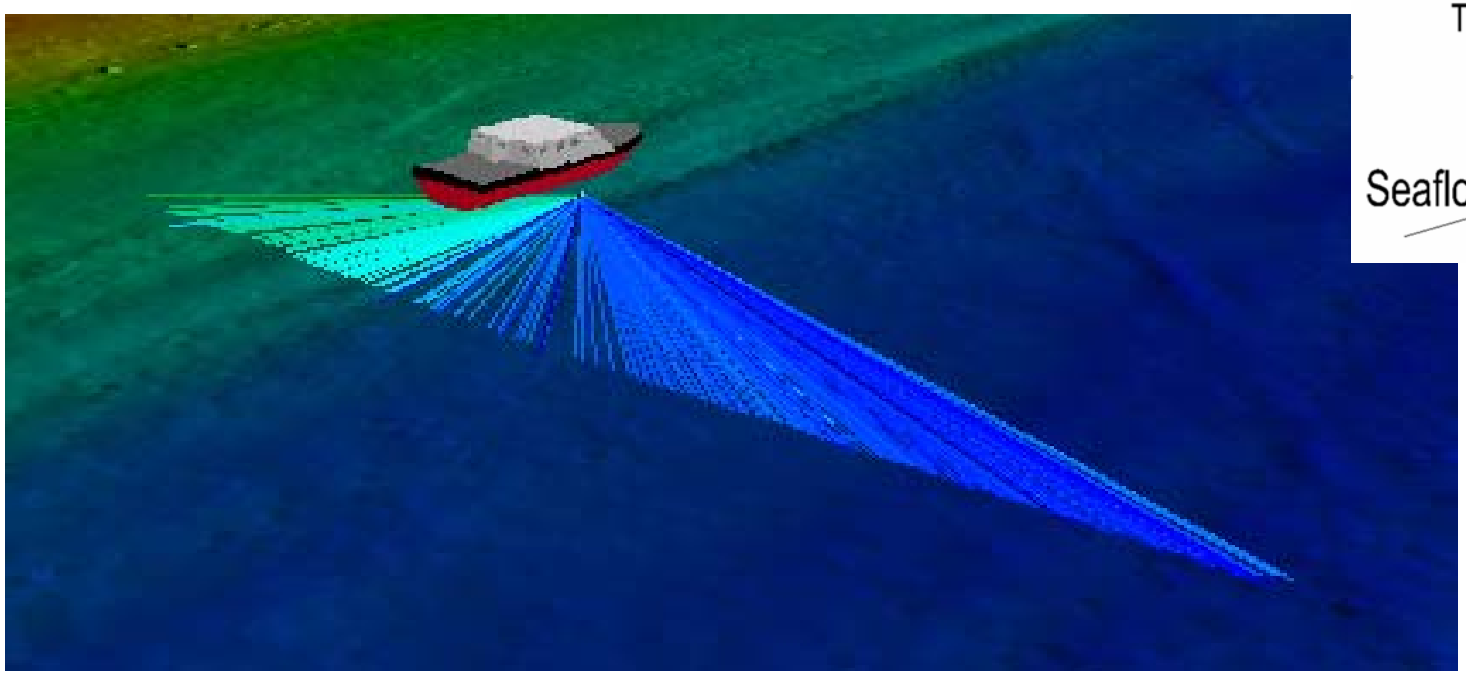
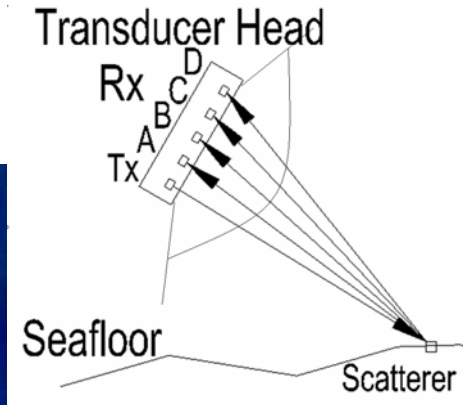
Also called:
Interferometric Multibeam
Bathymetric Side-Scan
Vernier Interferometer
Wide Swath Sonar





Transducer design

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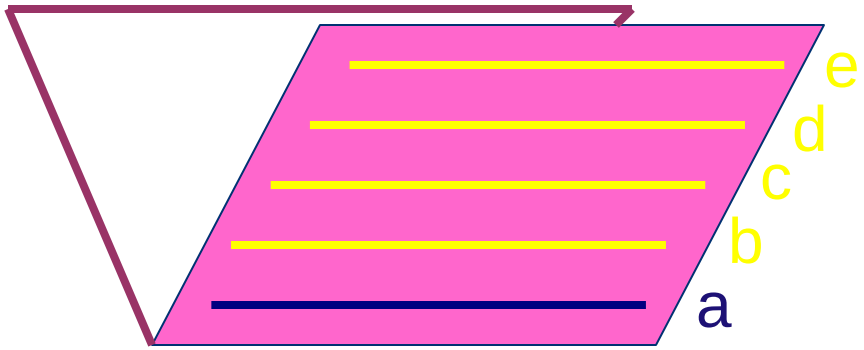
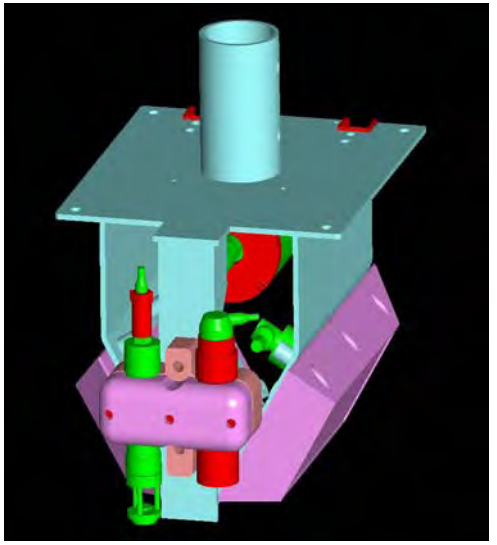
Multi-element receive array measuring phase differences. In the GeoSwath Plus case the primary array consists of two transducers mounted to a “V” plate. Each transducer contains multiple ceramic staves:



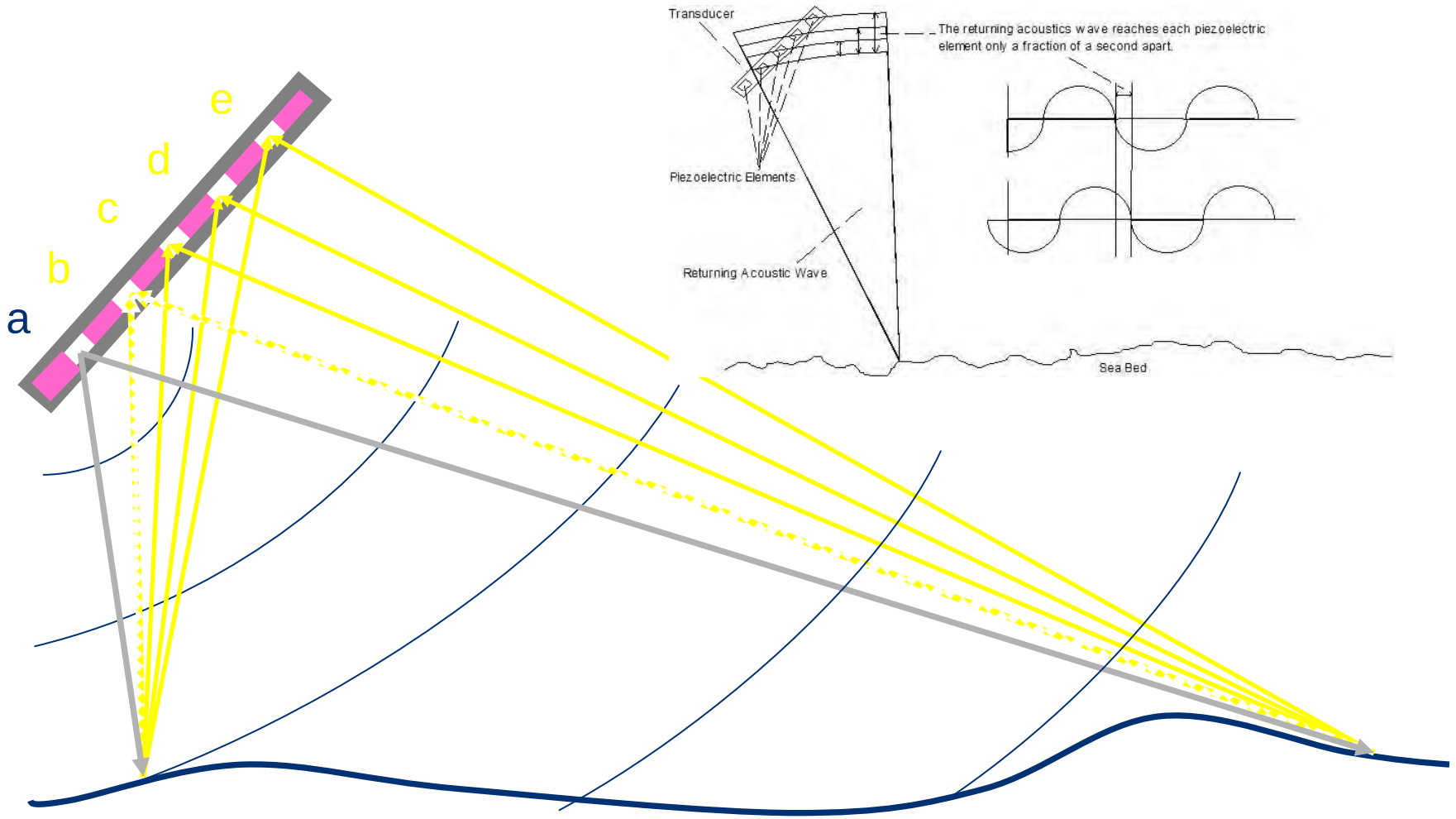


Bottom stave is transmitter, multiple receive elements.

Uses phase differences to measure angle.

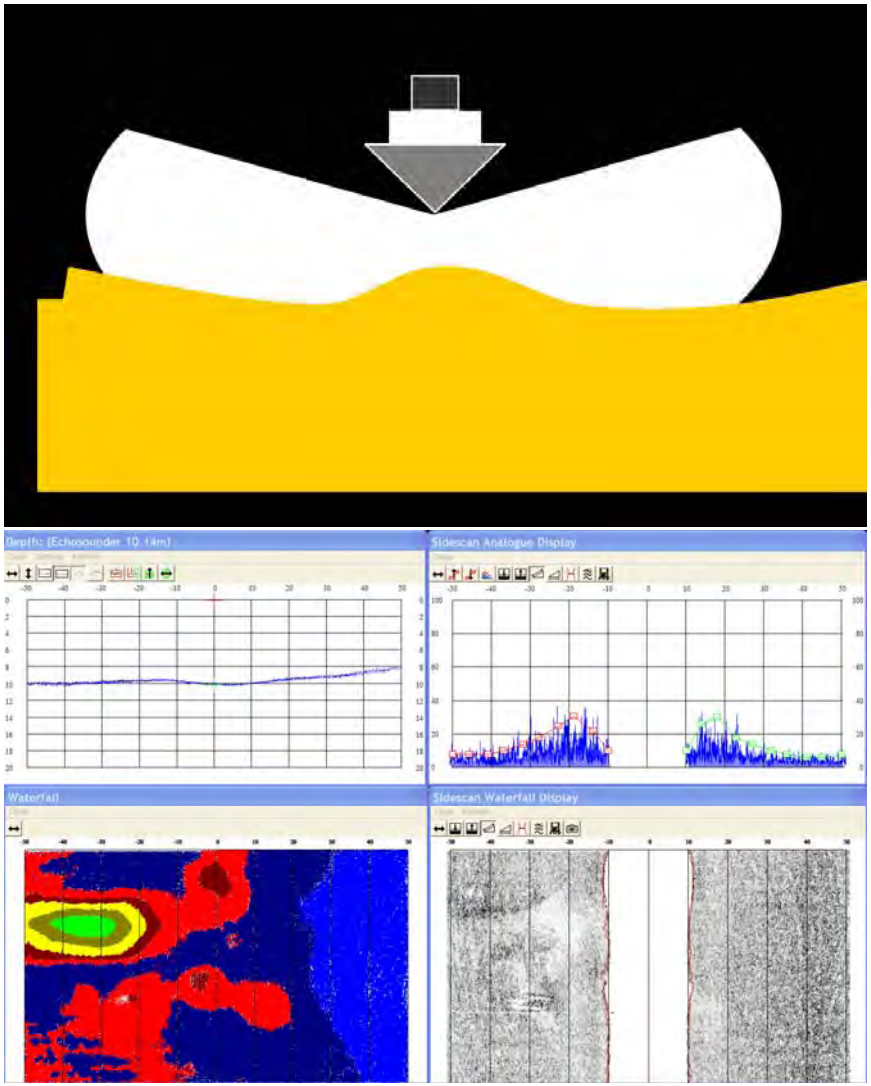
Result: time series of angles (and amplitudes)

Phase Measuring



Transmit geometry

- Sides scan transmit geometry
- Bathymetry and amplitude (side scan) data products



Looking at the Raw Data

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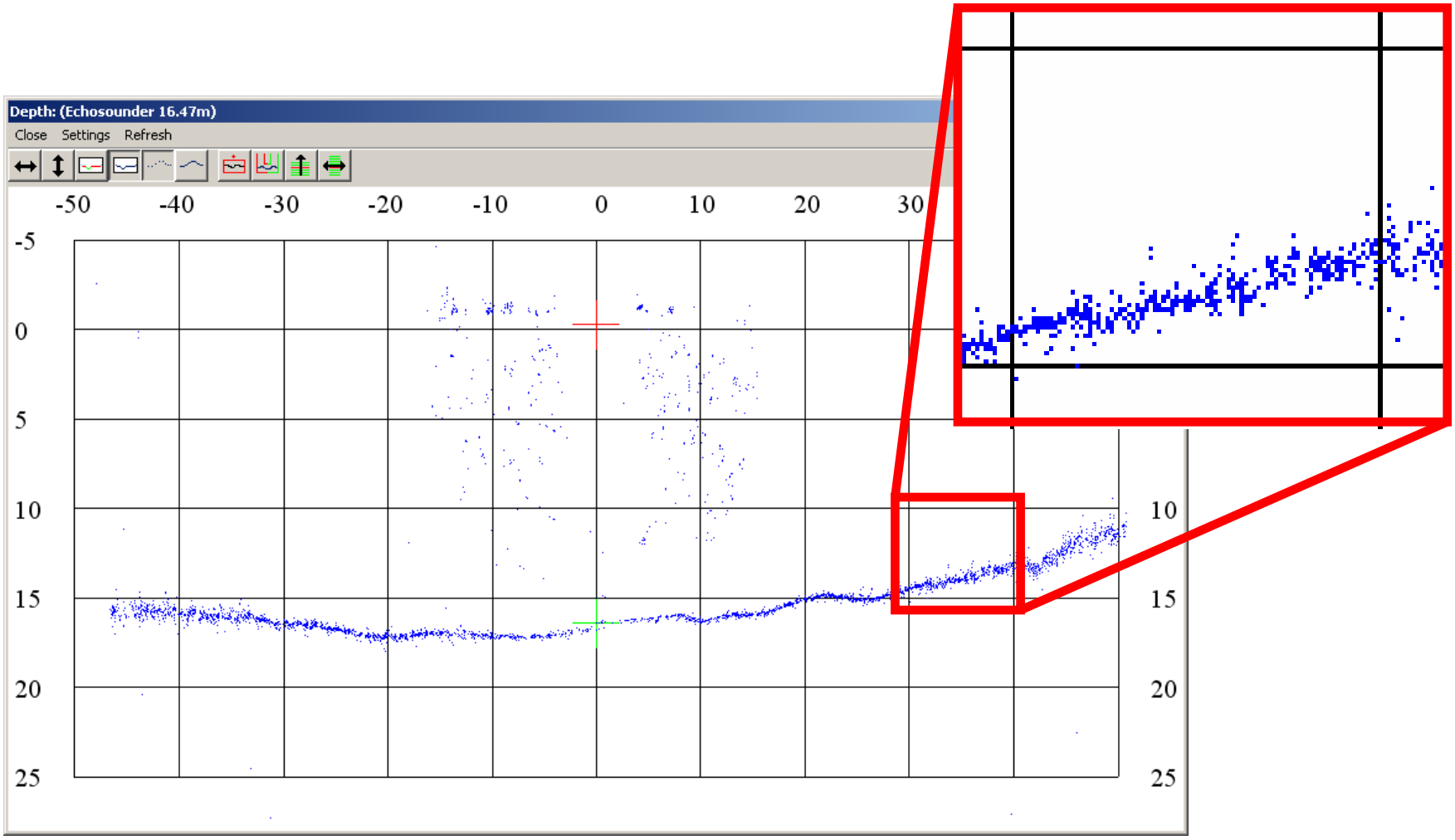
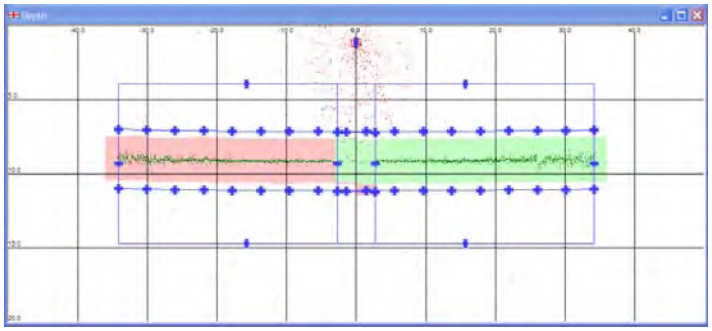
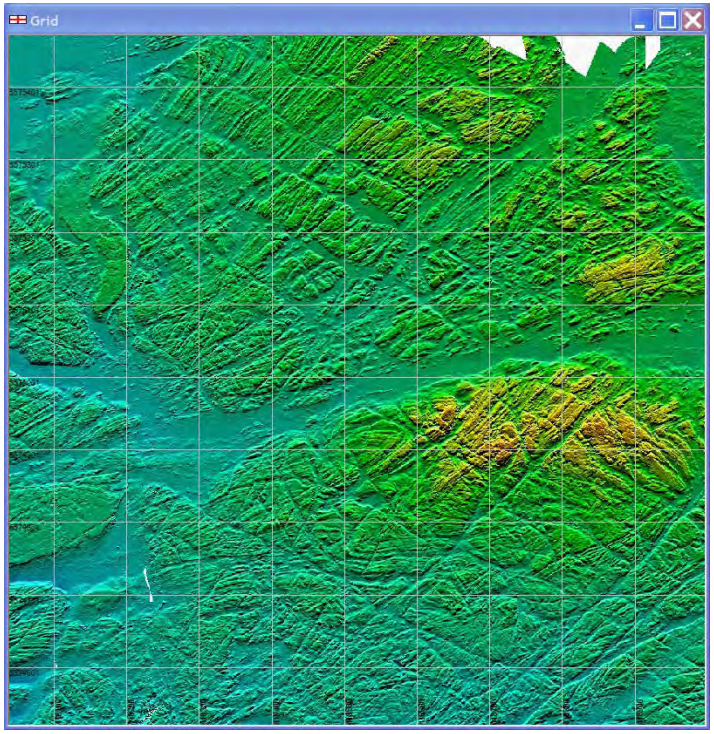


Standard data filtering

- Amplitude filtering
  ▼
- Statistical filtering
  ▼
- Binning





Data filters

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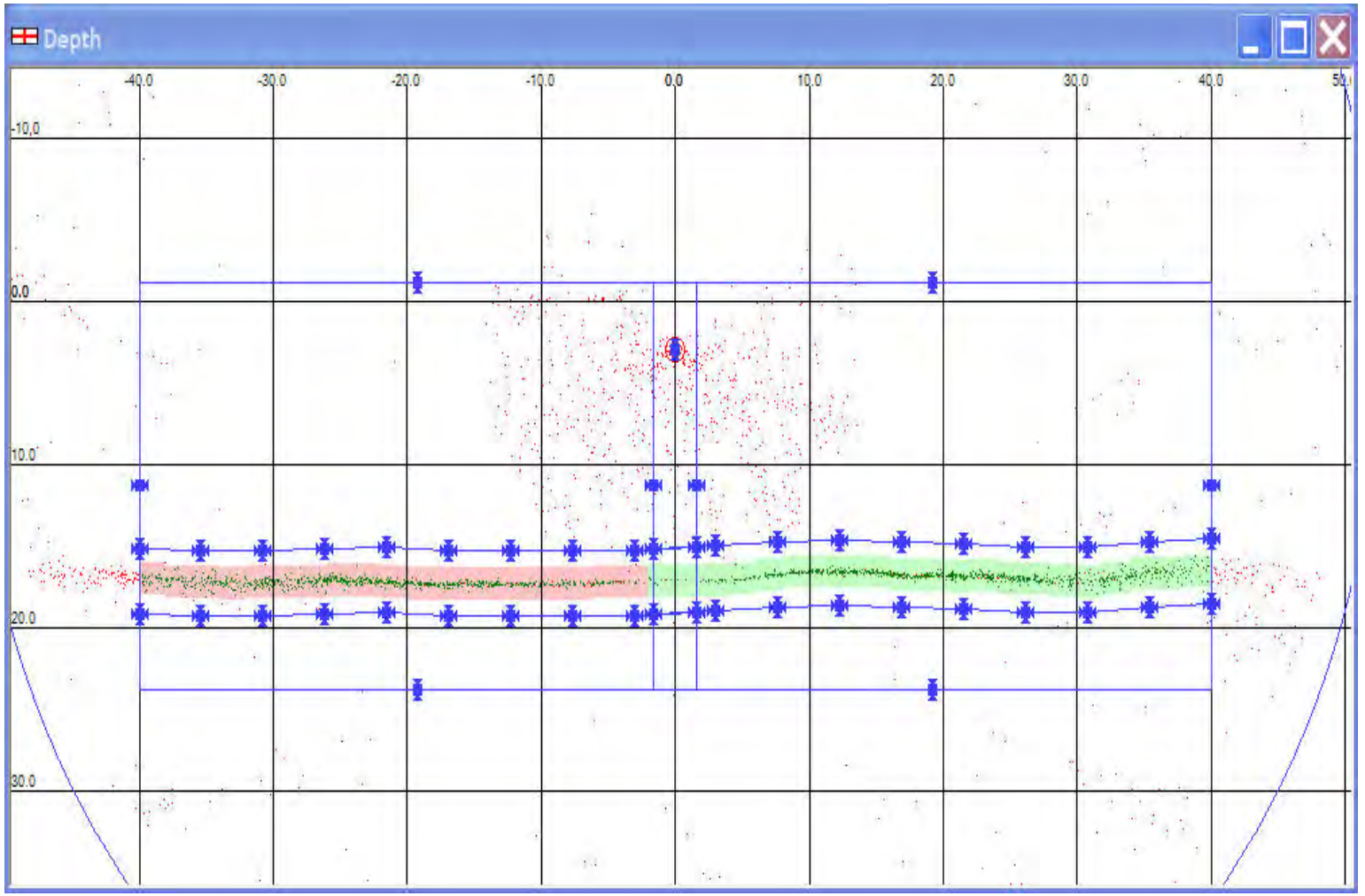

Unprocessed and Processed Data

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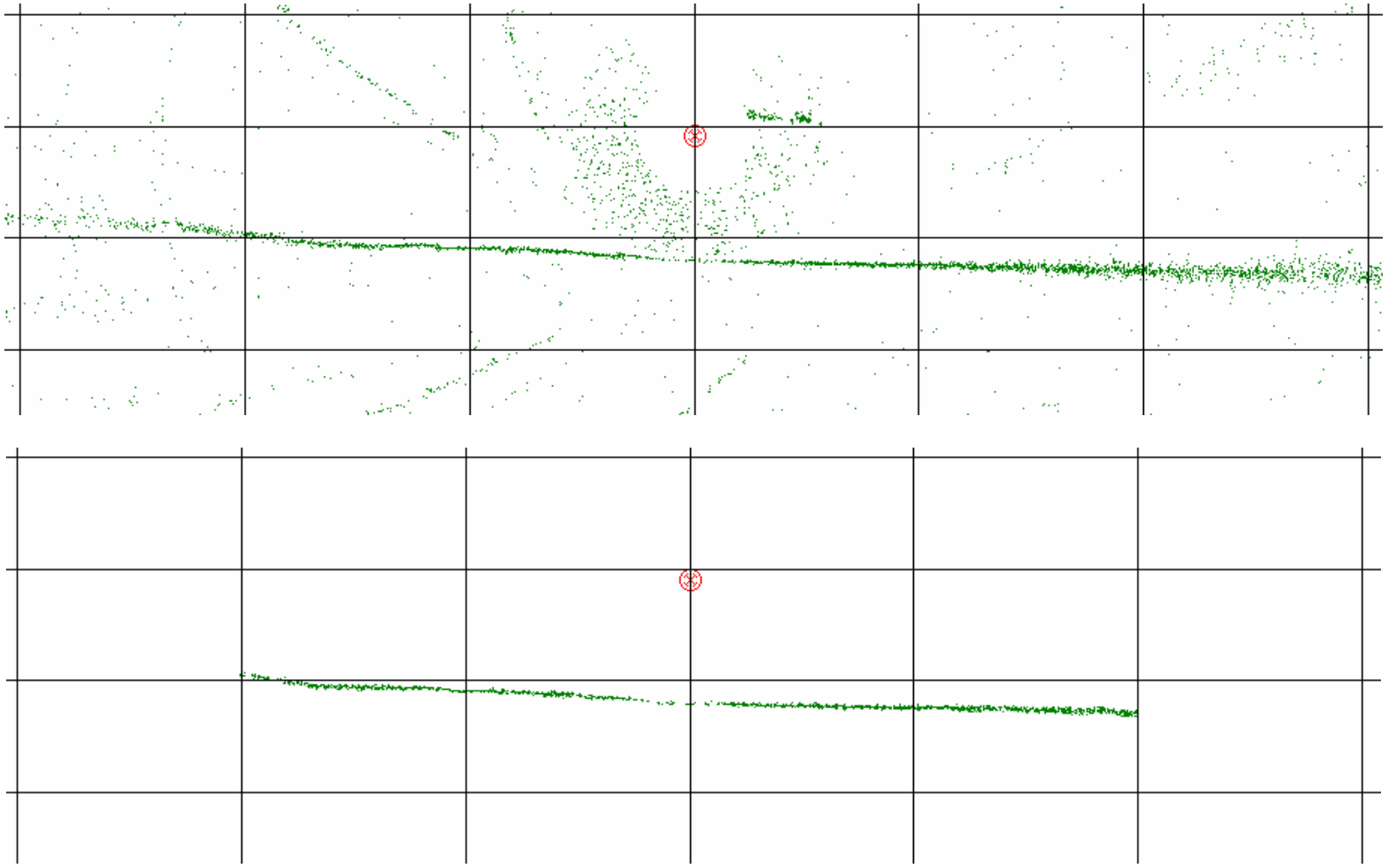

Standard deviation of data

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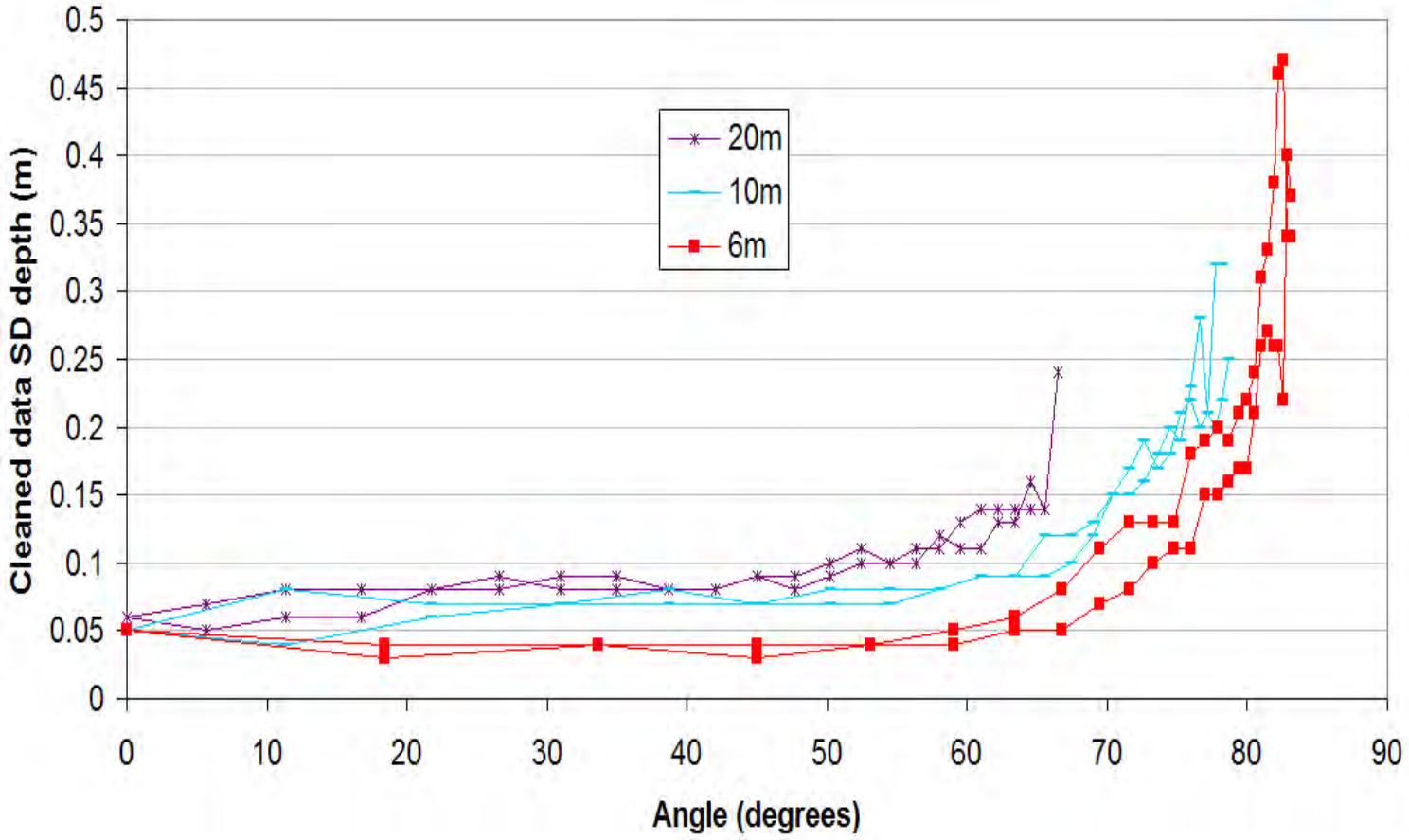
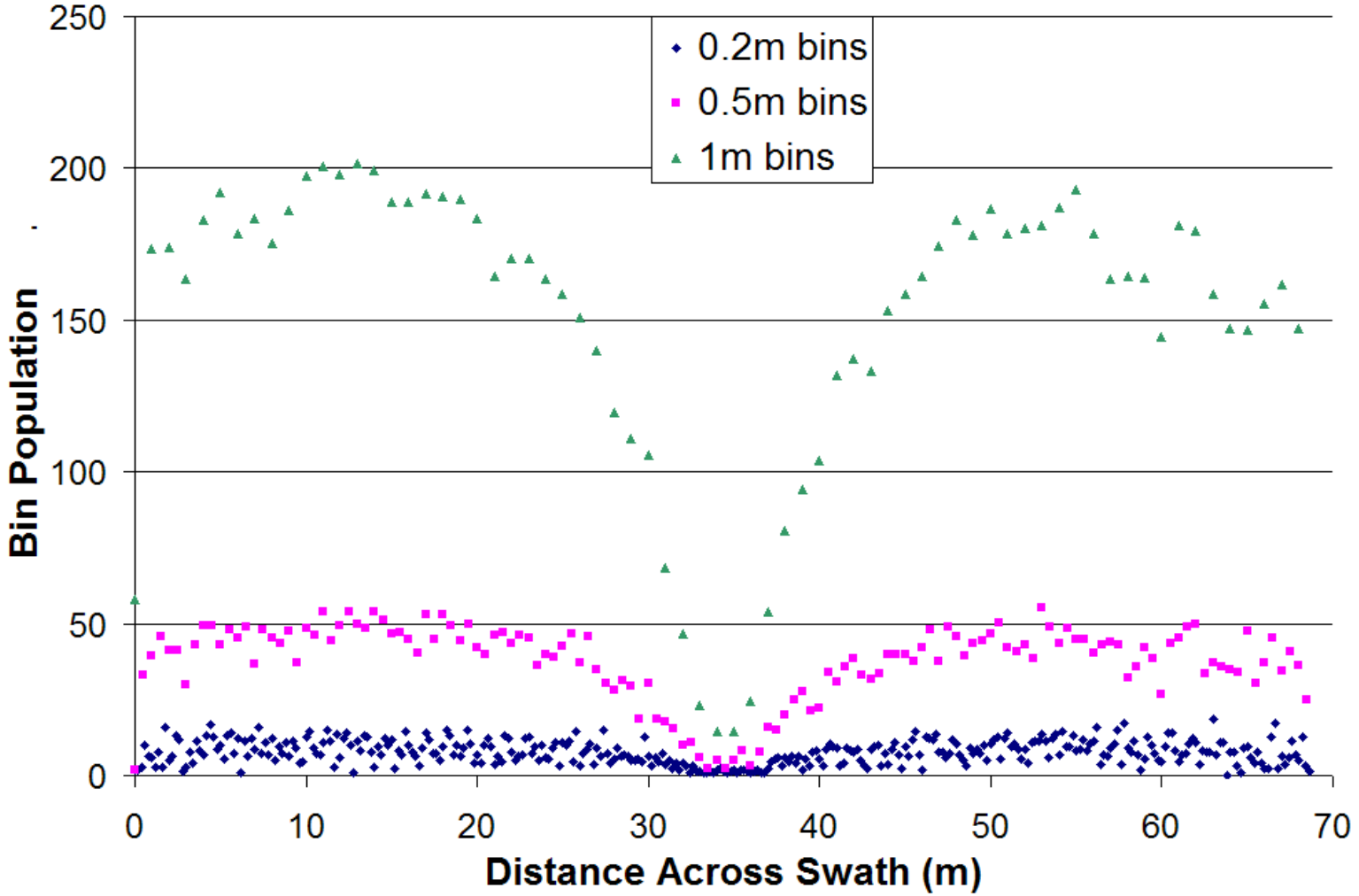
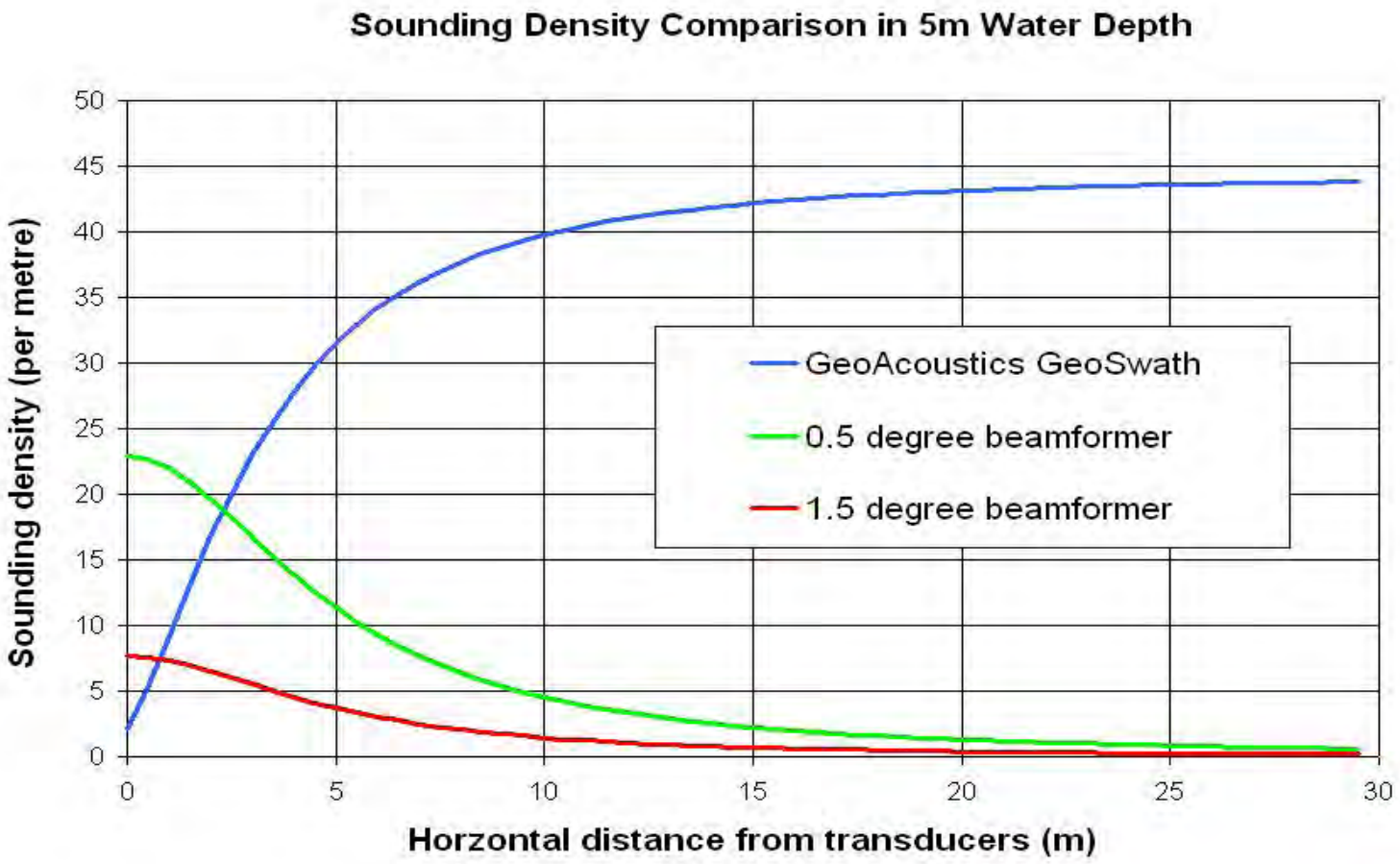


Data density at different resolutions



Sounding Density Comparison



All data view of single swath, 50m per side range setting, 5 Knots vessel speed

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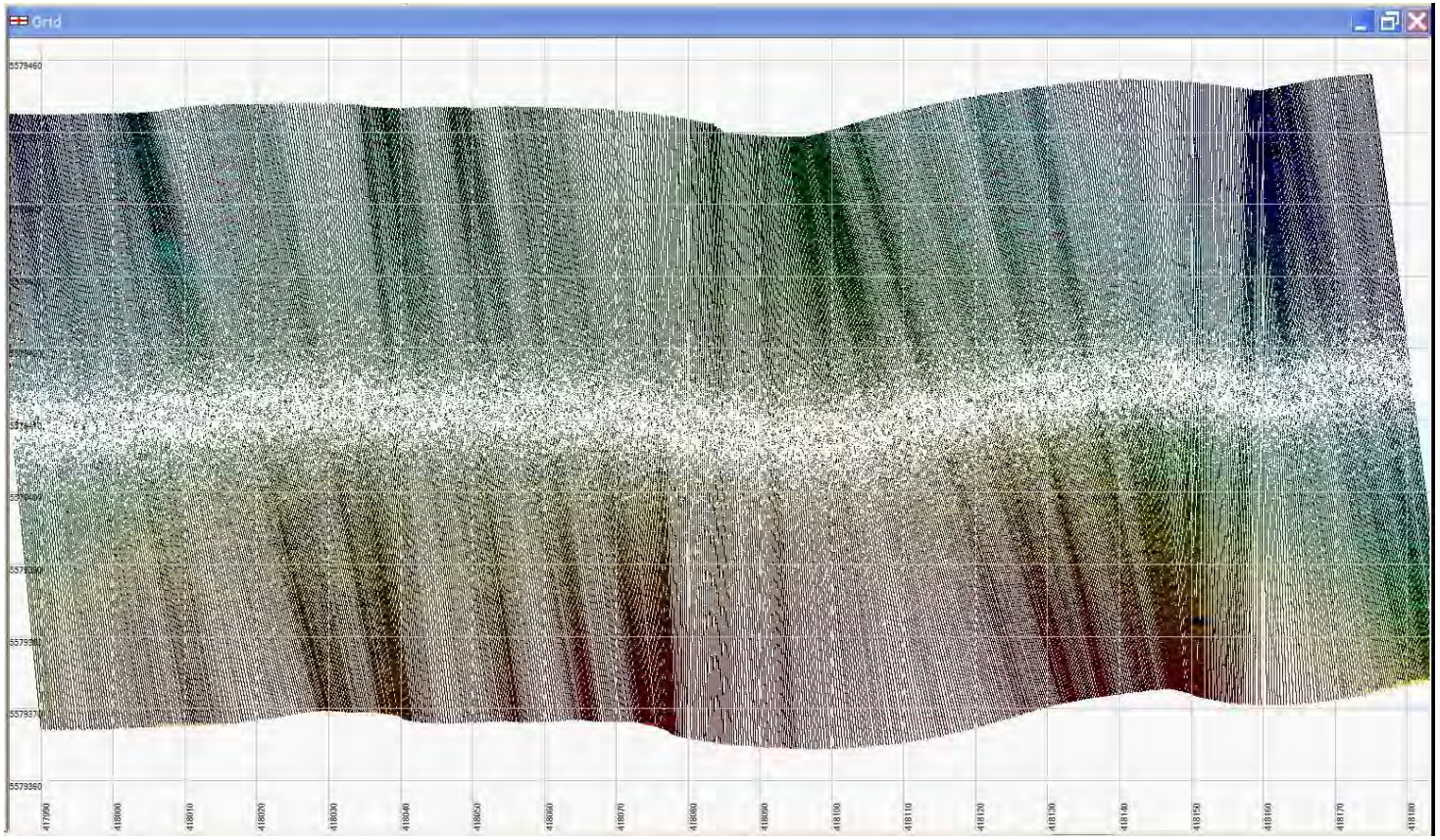
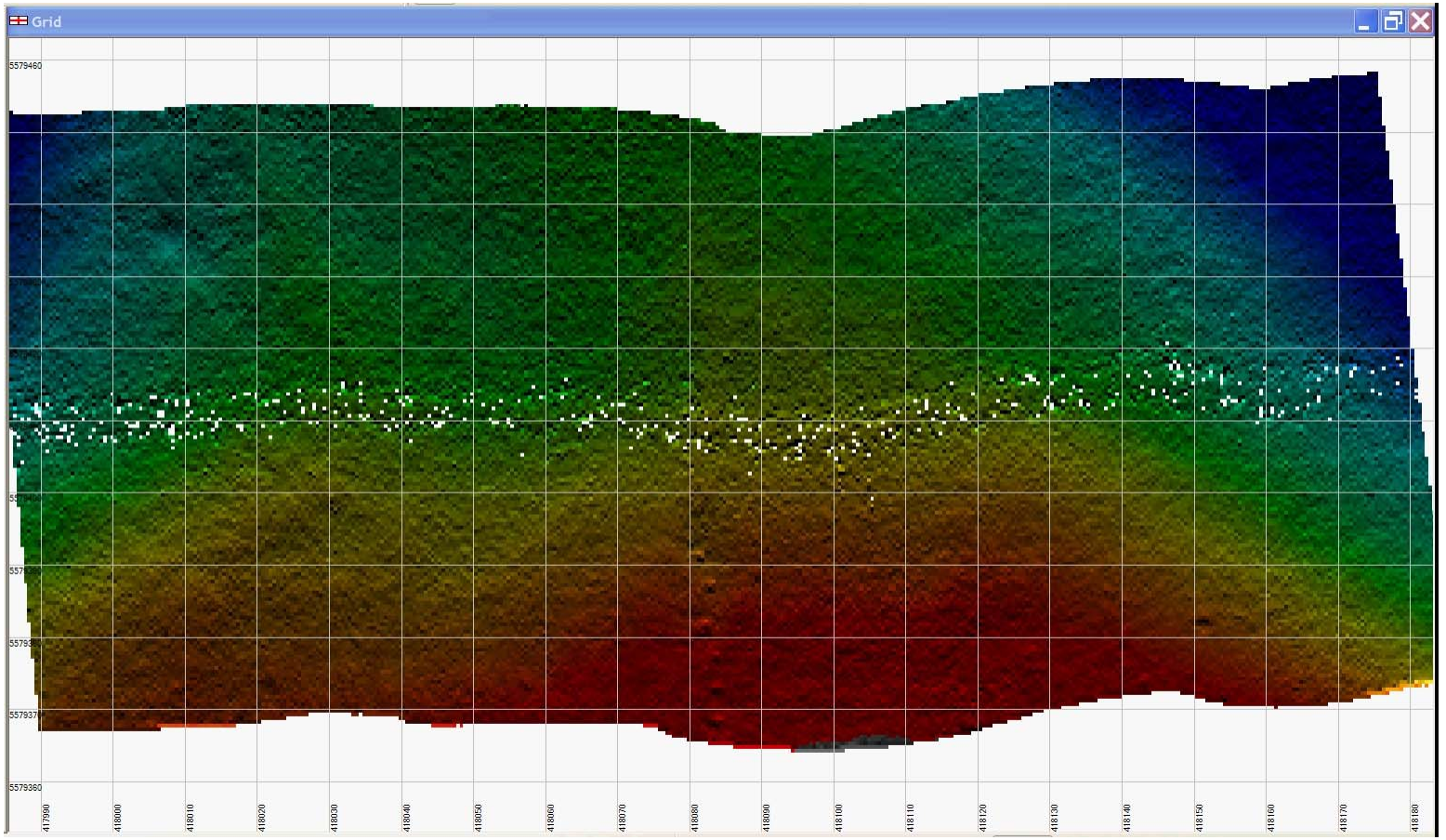
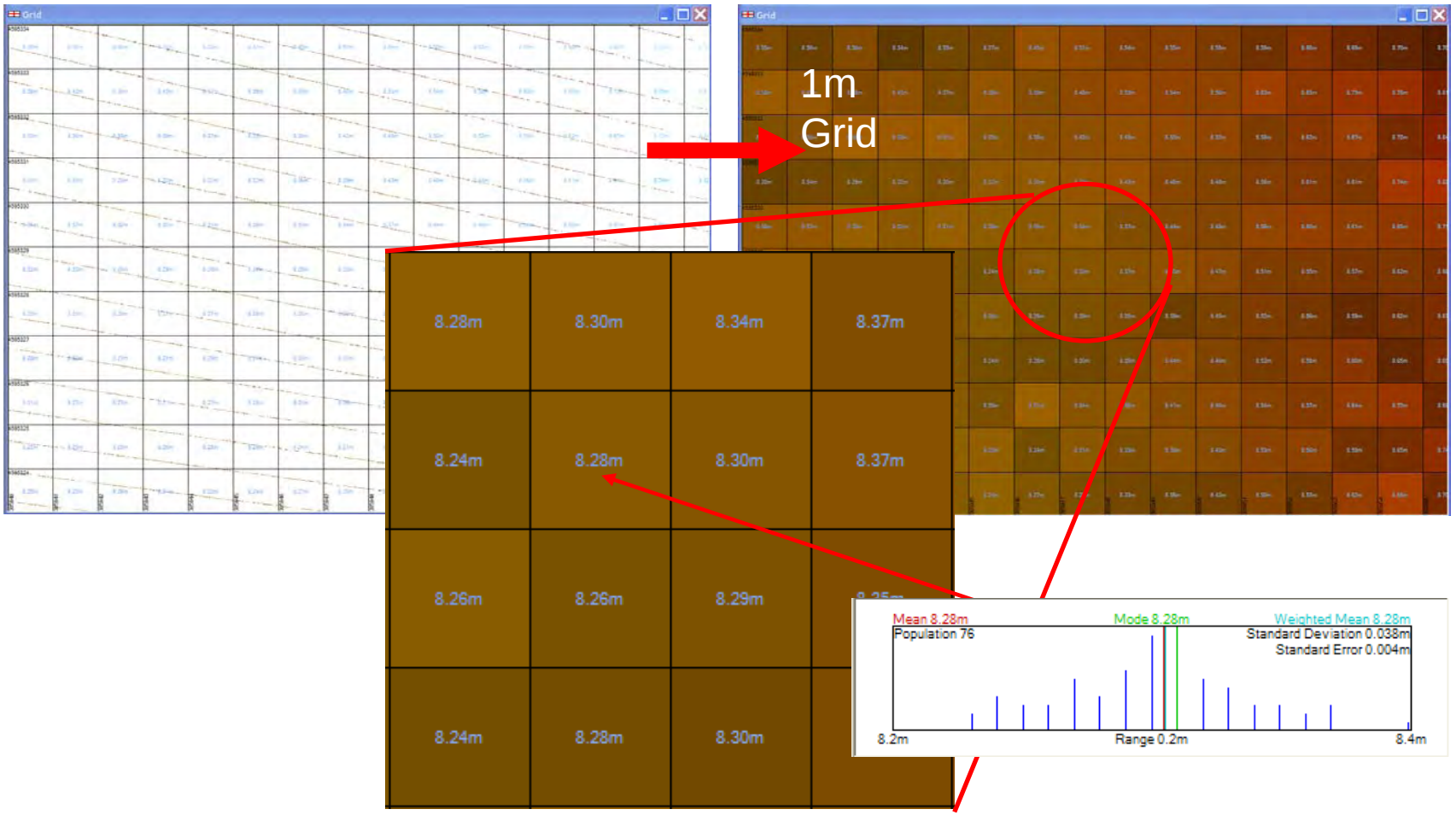


Single swath binned at 50cm without interpolation or smoothing, and sun illuminated



Results: High Data Density Ensures Provable Survey Quality



Bin size ≈ sonar footprint ≈ min. feature size. Data density > (or >>) 10 per bin.

The Technology Benefits

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- Easy to deploy on small vessels of opportunity
  = reduced mobilisation costs

- Very wide swath width in shallow waters
  = increased productivity,
  = easier survey planning
  = survey top of all shoals in survey area

- Compact, robust transducers and electronics
  = able to be deployed on smaller vessels

- Co-registered side-scan with bathymetry
  = '2 surveys in one pass', more applications

  Robust transducers with no active components
  = low cost of purchase and maintenance

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System specifications

Hardware and software options

GeoSwath Plus frequency options

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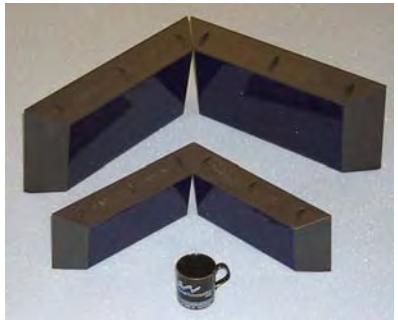
Frequency:	125kHz	250kHz	500kHz
Txd dims:	60x25x8cm	30x15x6cm	15x10x4cm
Max depth:	200m	100m	50m
Usual use:	0m – 200m capability 20m-200m	0m – 100m capability 2m-50m	0m – 50m capability 1m-40m
Found on:	Larger Survey Ship	Small Vessel	AUV/ROV



GeoSwath Plus Performance

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- Bathymetry and true geo-referenced Side Scan
- Coverage up to 12 times depth
- up to 200 m depth performance
- Along track resolution: up to 0.9 degrees
- Across track resolution: up to 0.02 degrees
- 5000+ data points/fan
- Ultra high resolution
- IHO SP 44, Special Order
- Sediment classification
- Turnkey System and interface to Hypack, Quinsy, …
- Windows XP

Ancillary sensors

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- Altimeter
  - Single beam echo sounder,quality control
  - Tritech PA series
- Mini Sound Velocity profiler on transducers mounting
  - Valport MiniSVS

  - GPS Positioning
    - RTK allows use of height instead of tidal information
  - Heading
    - Gyro, GPS, Combined
  - MRU
    - Pitch, roll, heave
  - Tide
    - Gauge or computed
  - Sound Velocity Profiler

Software

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- GeoSwath Plus software
  - Concise proprietary software package included with system
  - GeoTexture – optional package for side scan normalisation and classification
- Hypack
  - United States Army Corps of Engineers
  - Halcrow plc
- QPS QinSy
  - Jan de Nul
  - Reijkwaterstaat
- CARIS
  - United States Army Corps of Engineers
- Fledermaus
  - Netsurvey (Halcrow)

GeoSwath Plus software – set up

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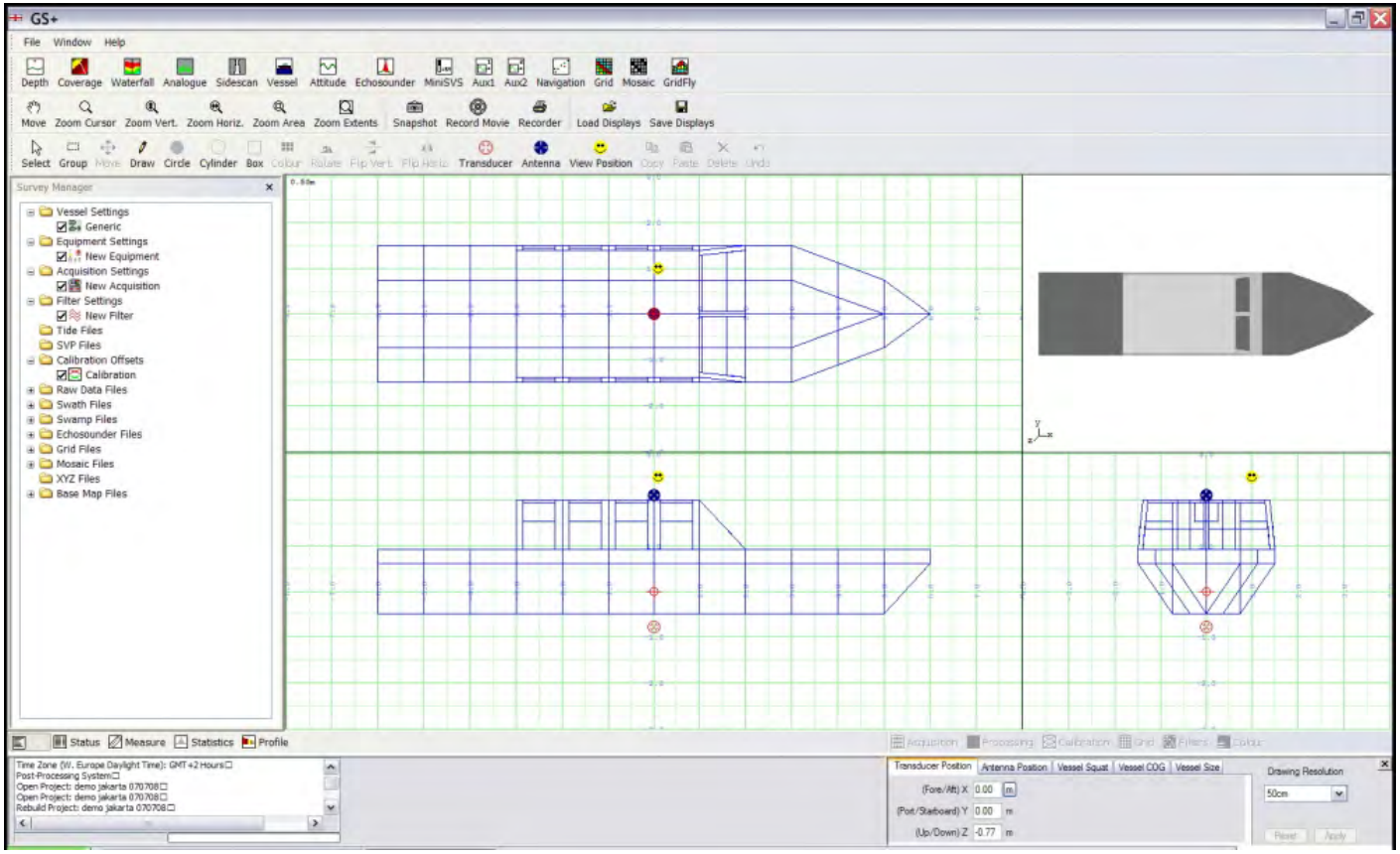

GeoSwath Plus software – acquisition / processing

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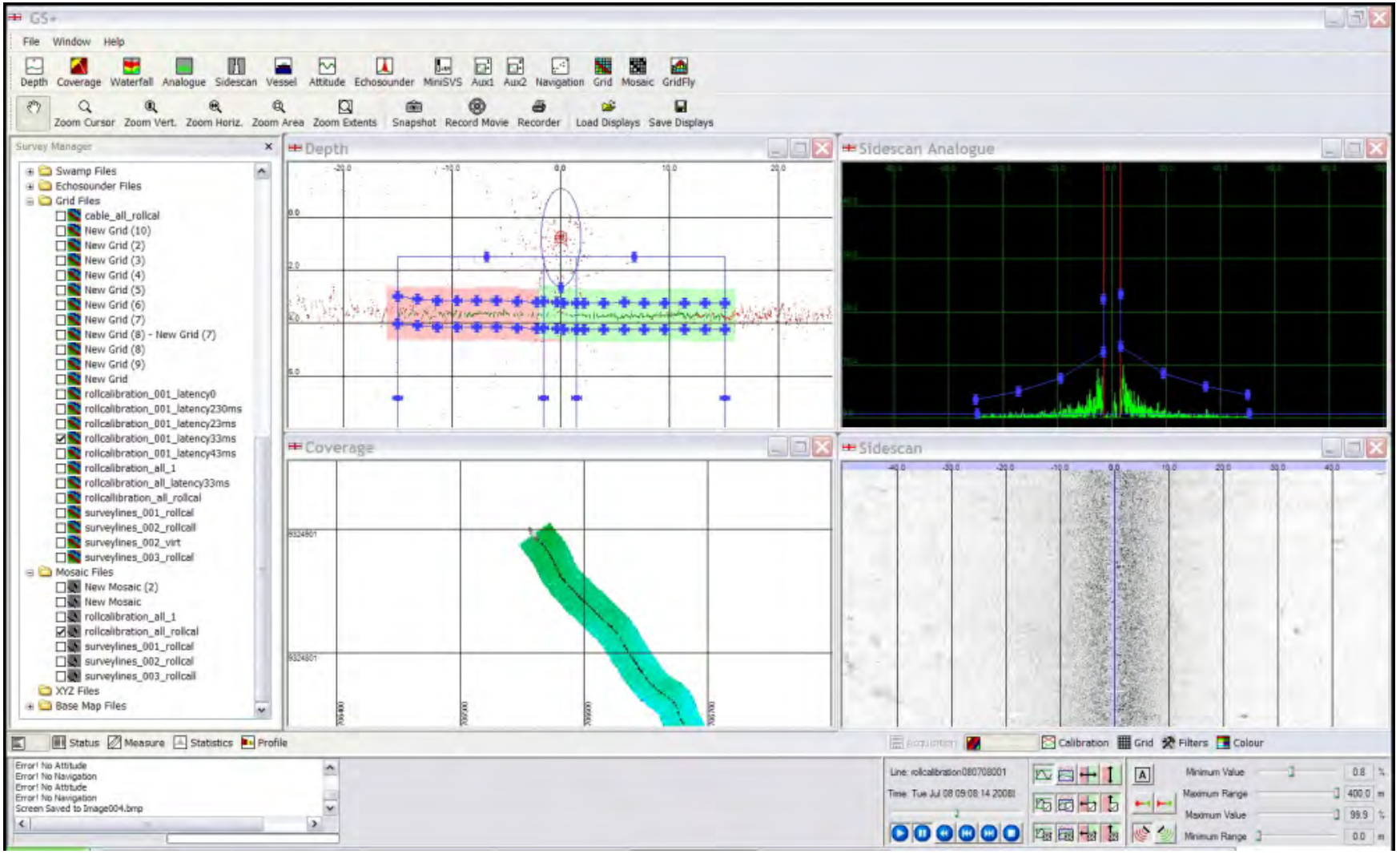

GeoSwath Plus software - calibration

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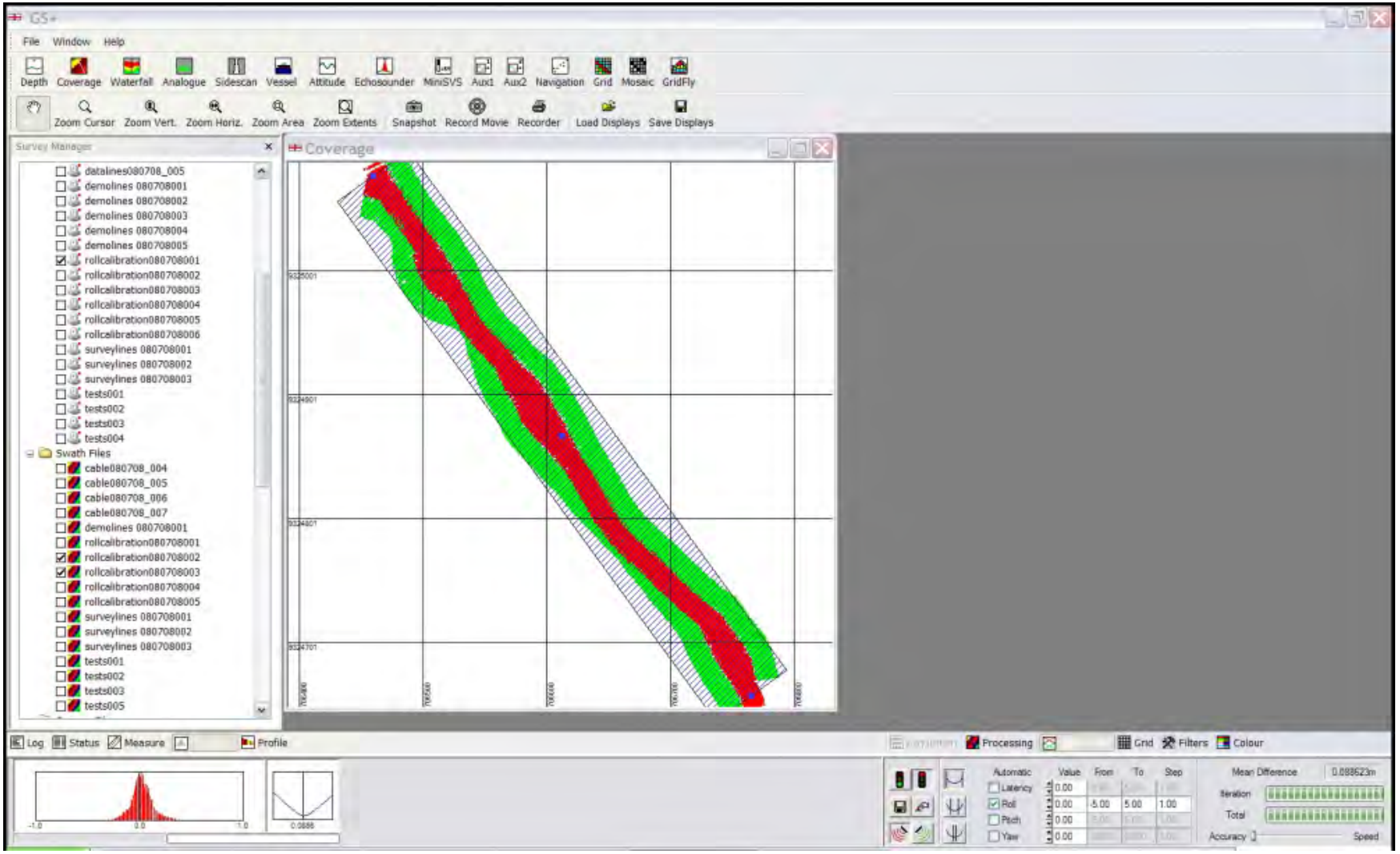

GeoSwath Plus software – gridding / mosaicing

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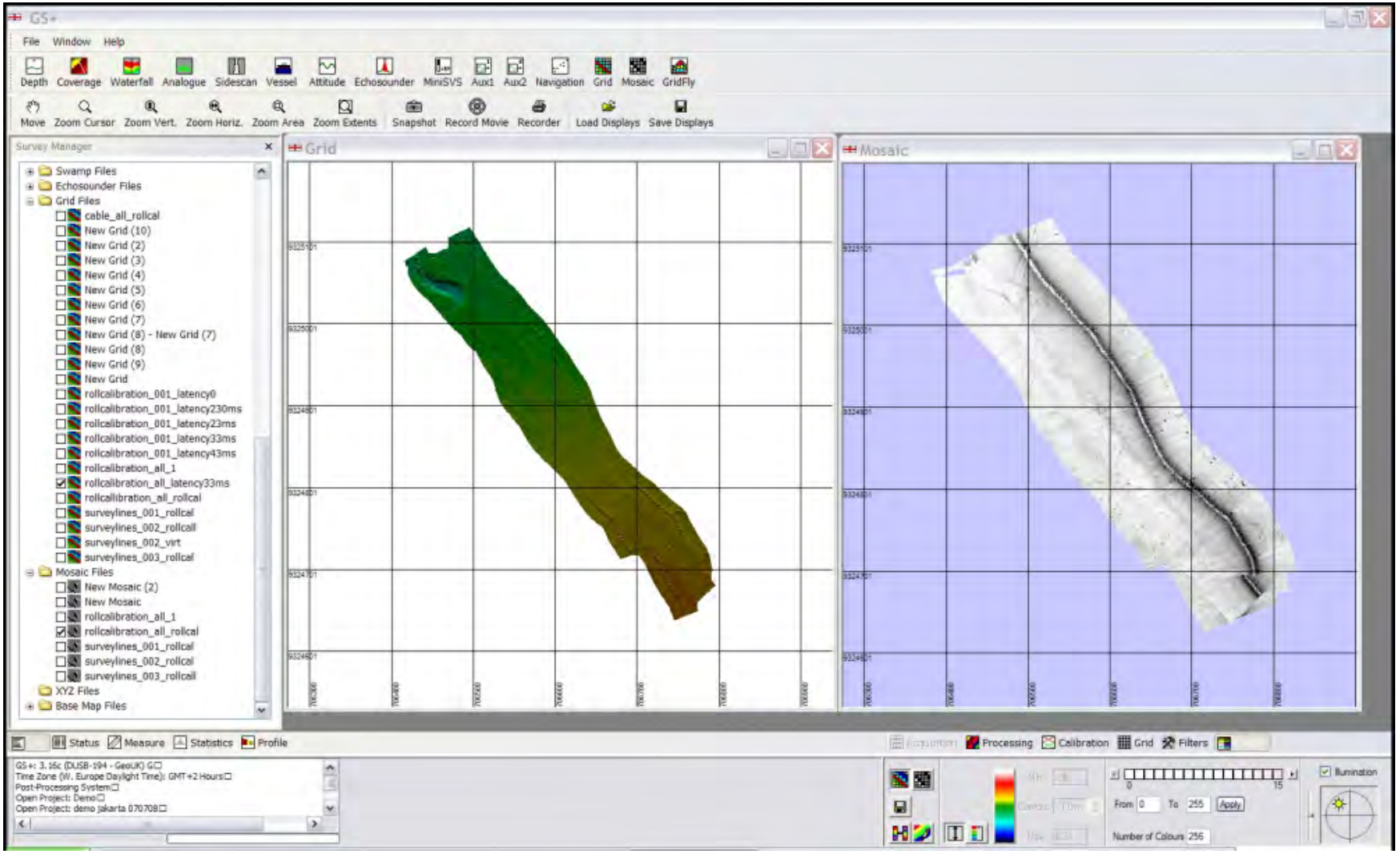

GeoSwath Plus software – 3D visualisation

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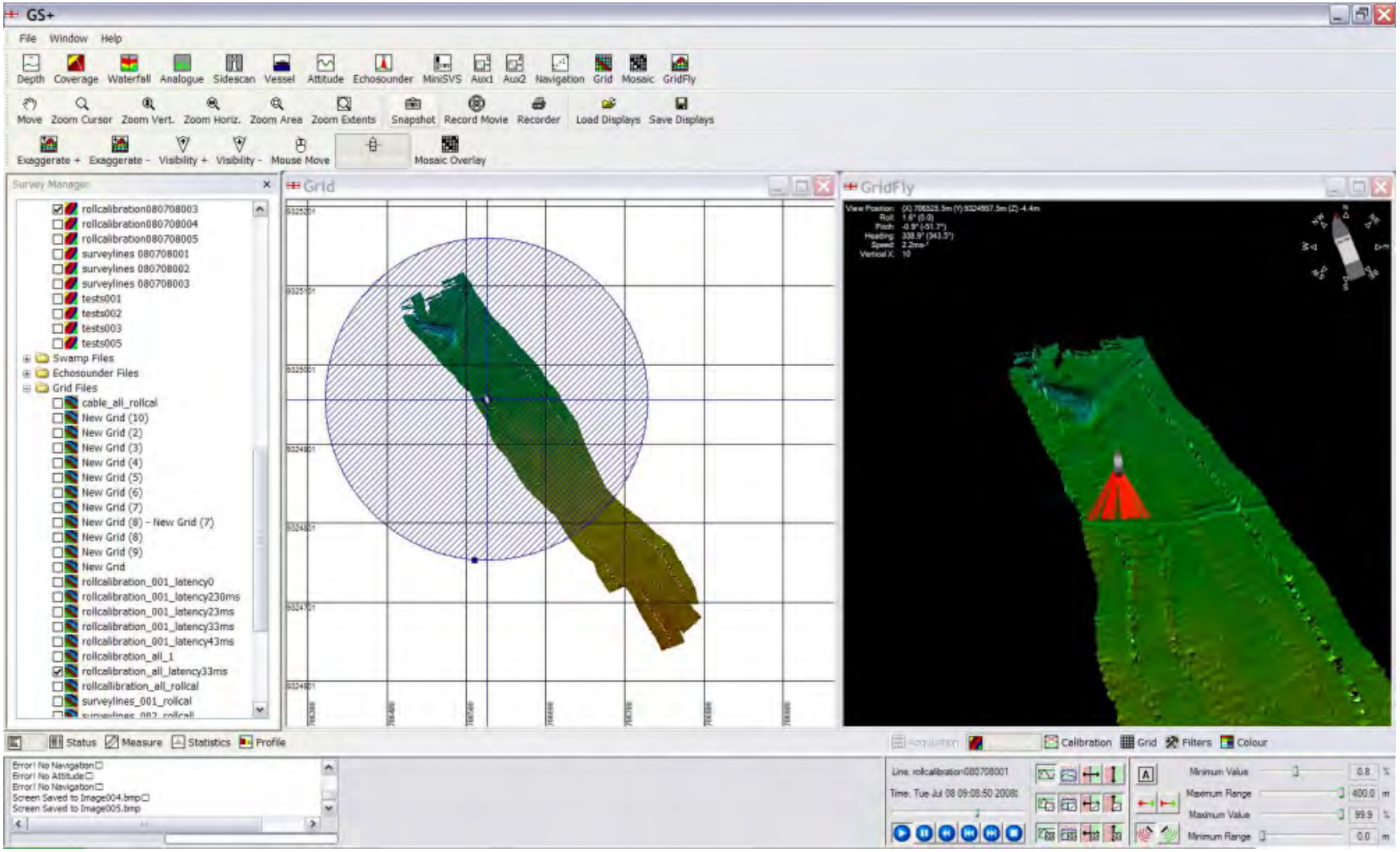

GeoTexture software – Side Scan Normalisation and Classification

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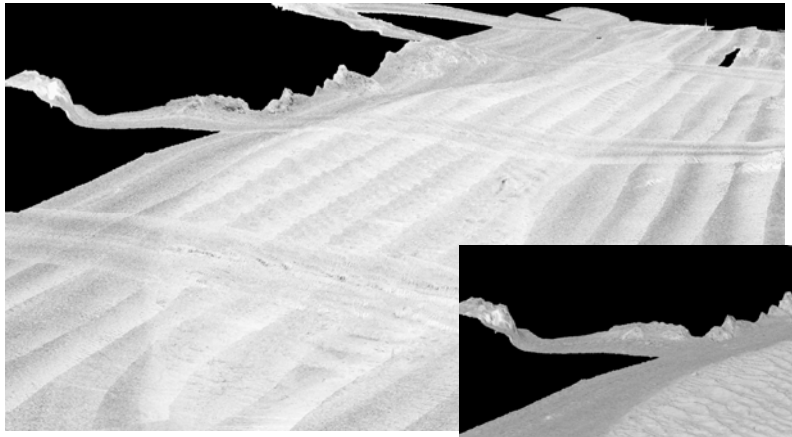
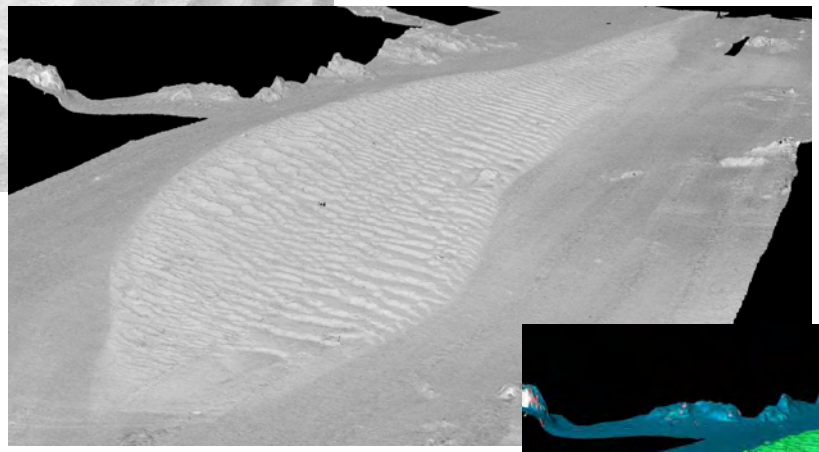
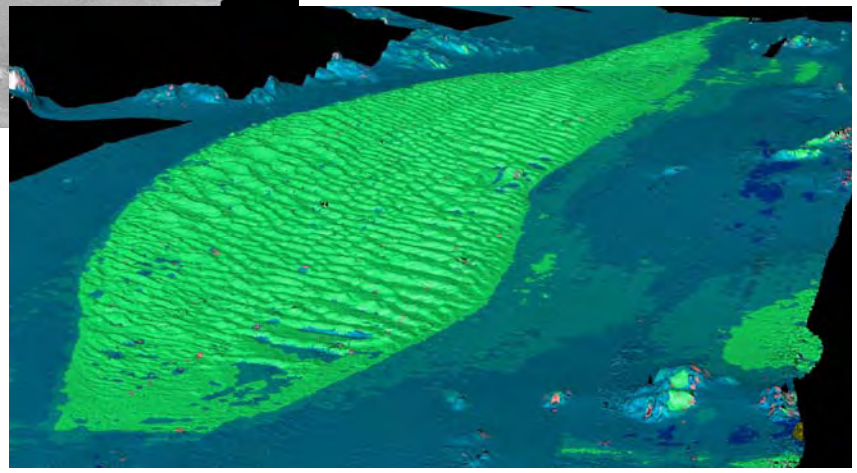


Original

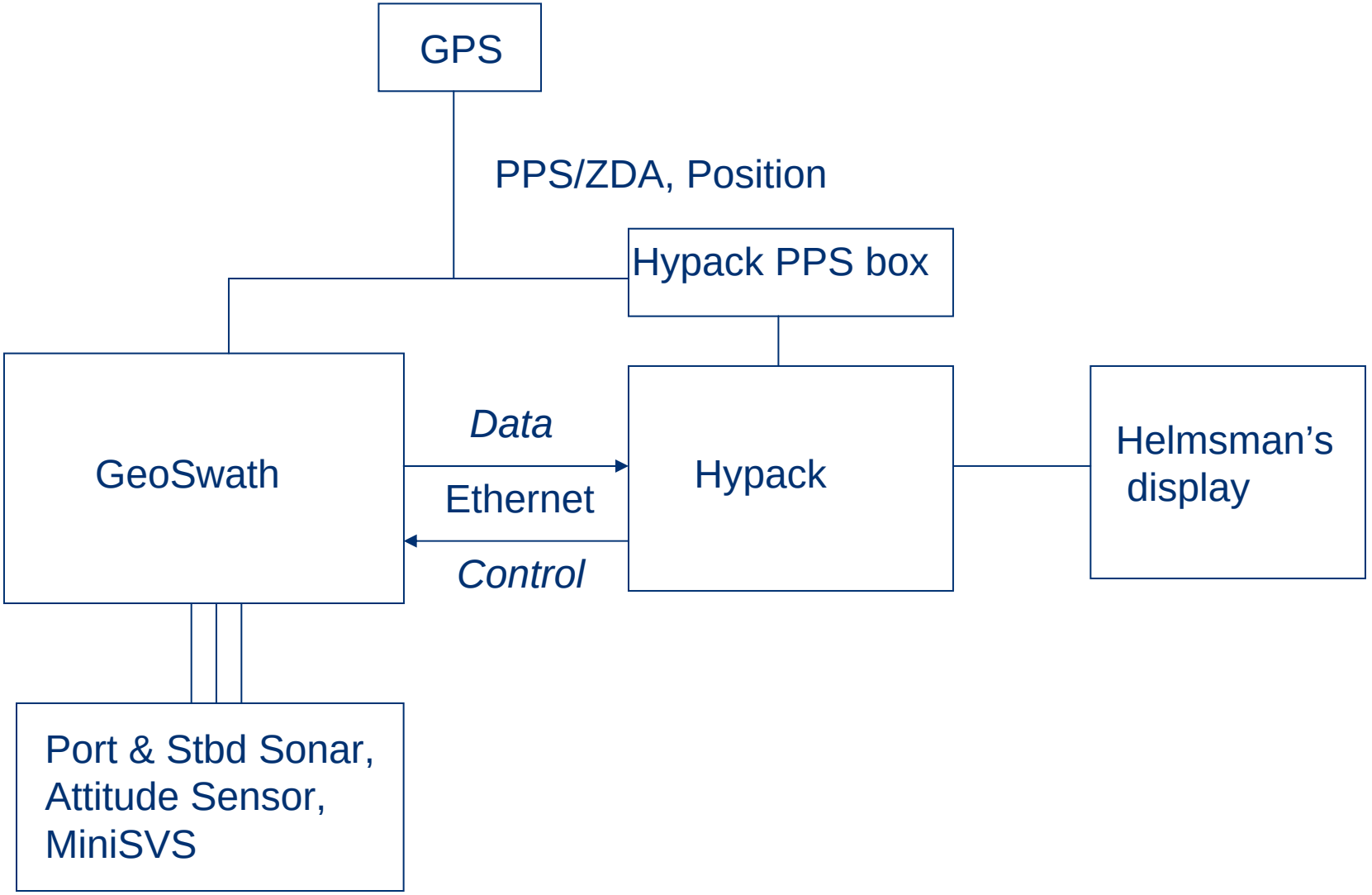


Normalised



Classified

Hypack



Hypack

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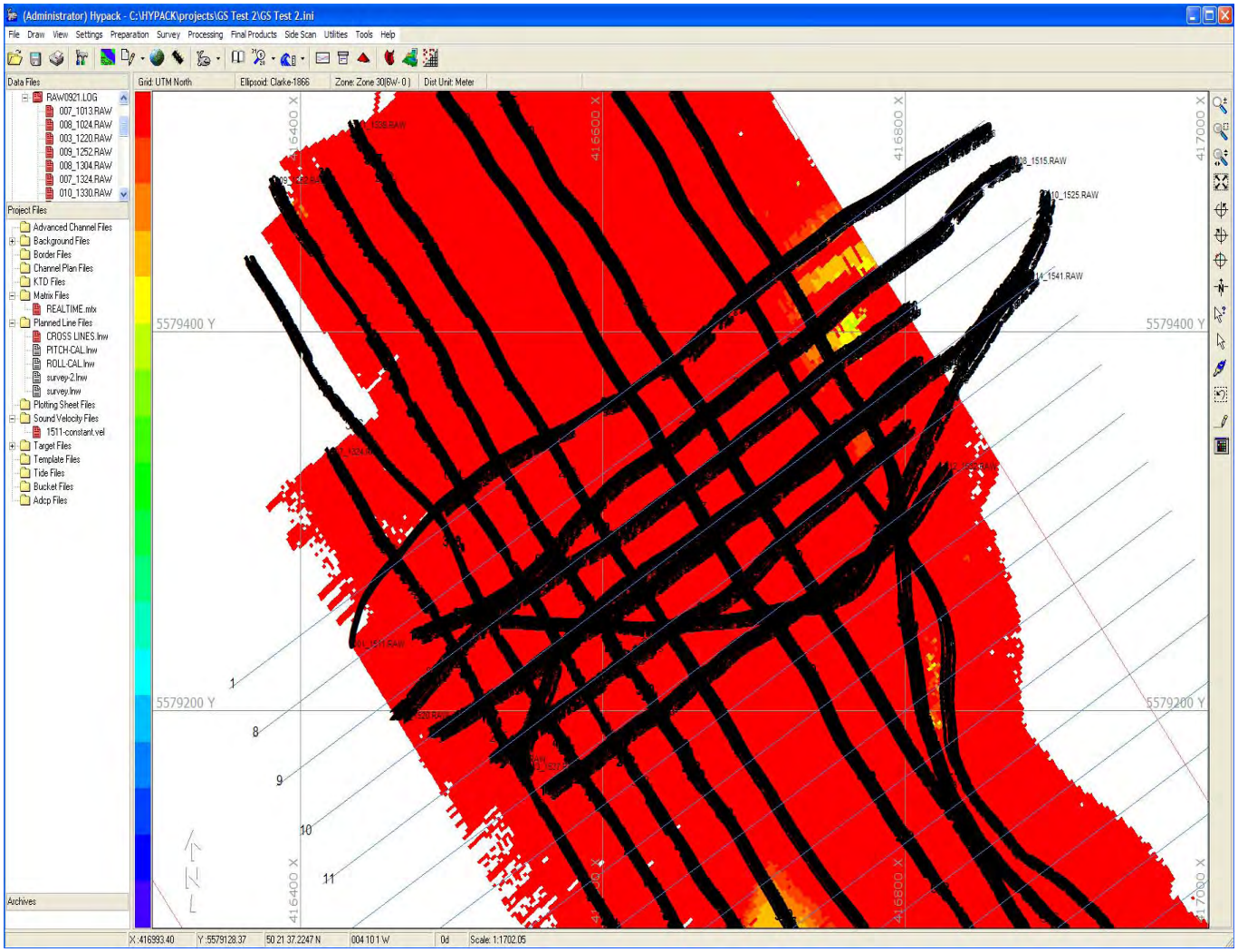
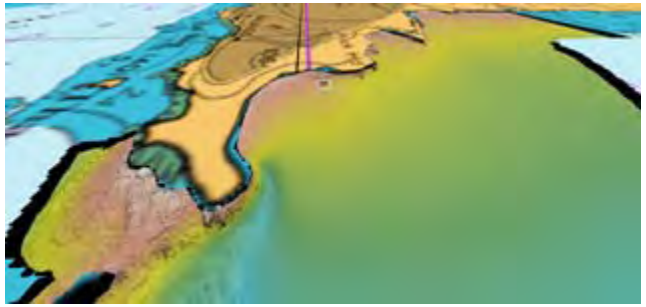
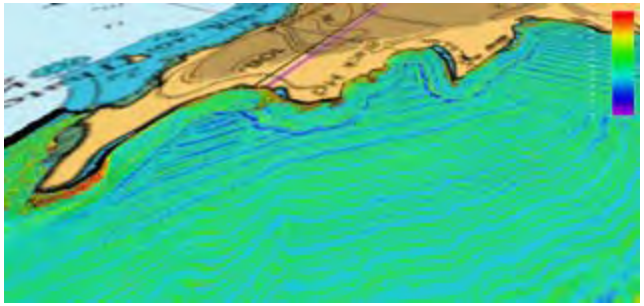


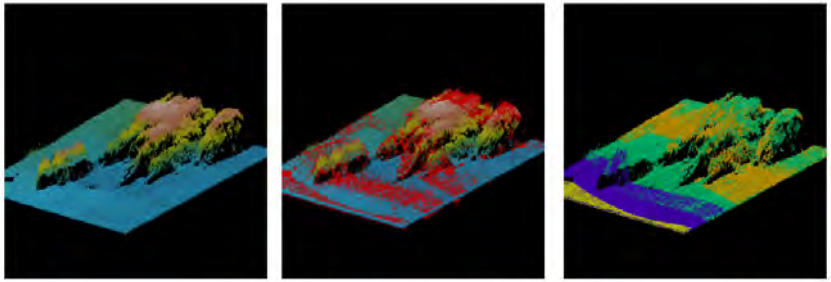
Fledermaus



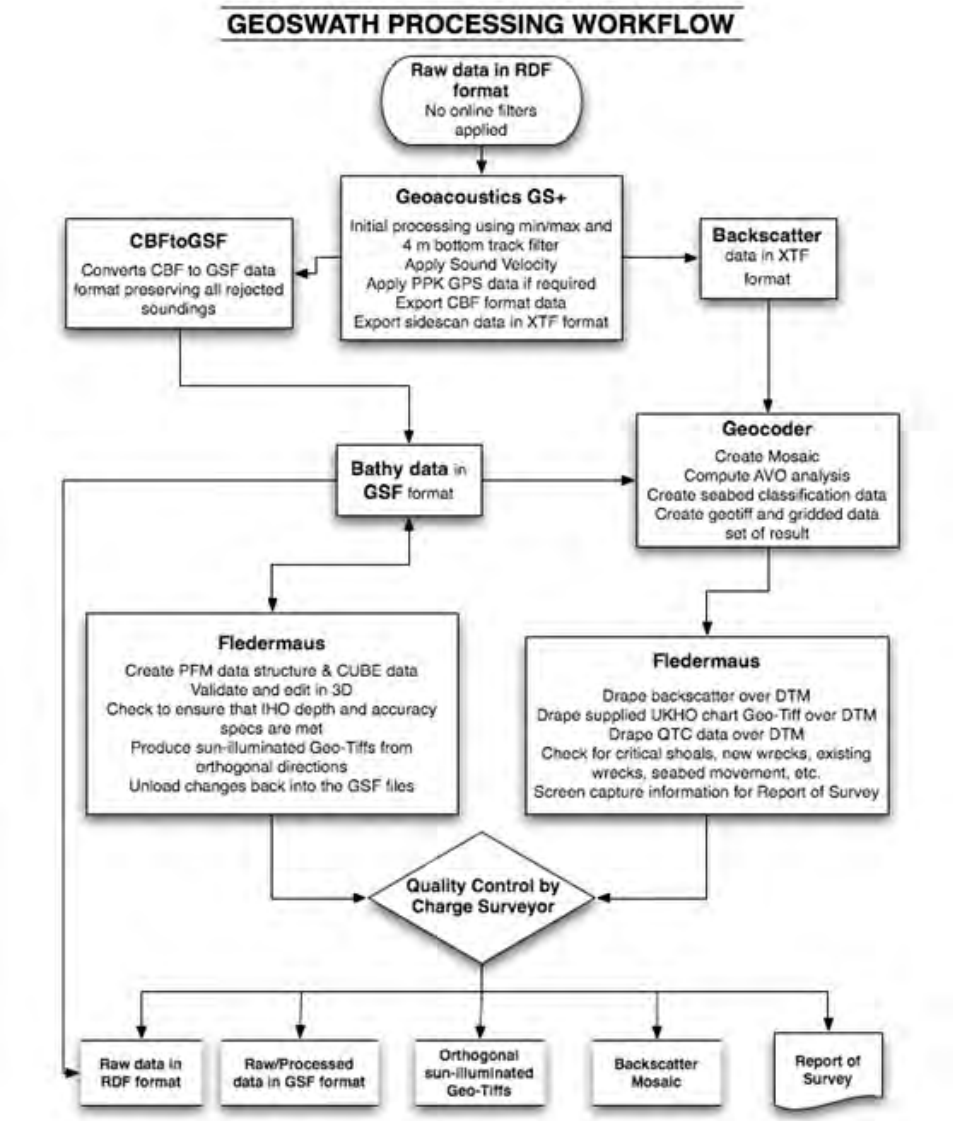
bathymetry



uncertainty



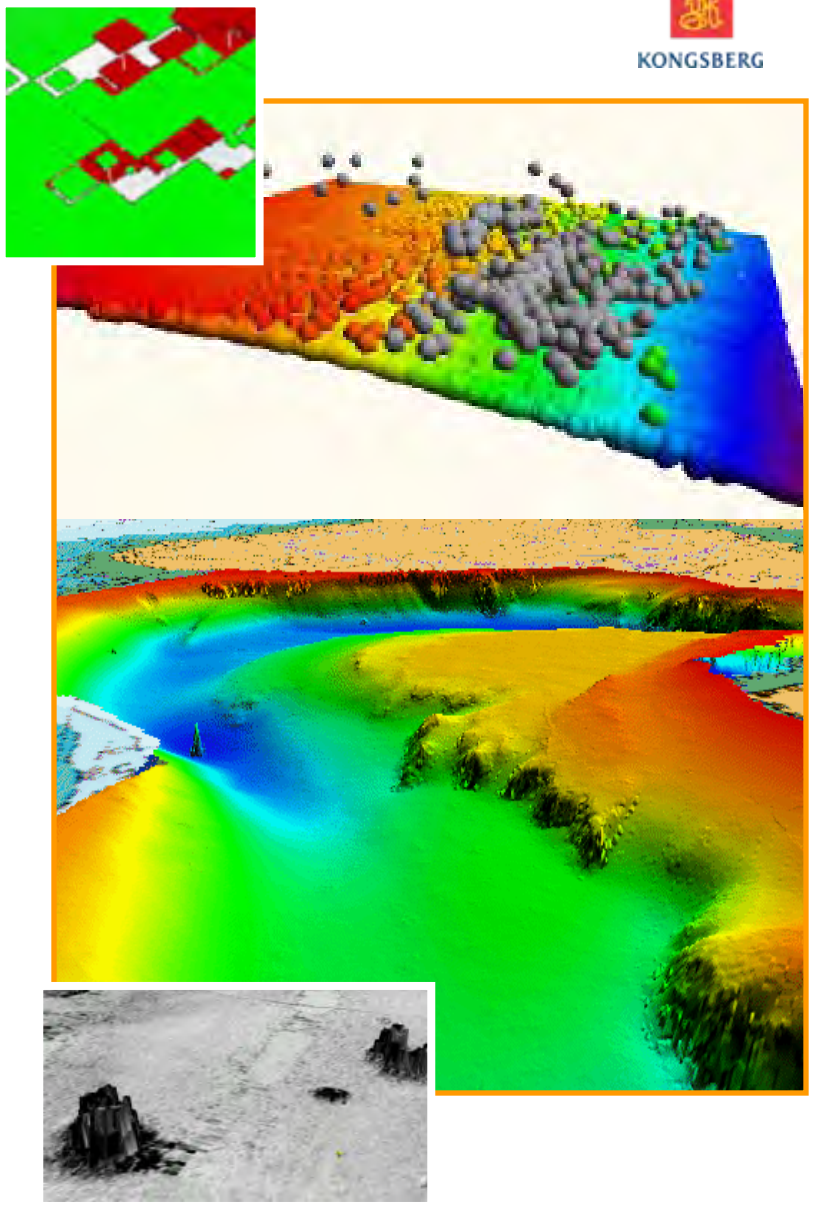
Coloured by Depth | Showing rejected data | Coloured by Line



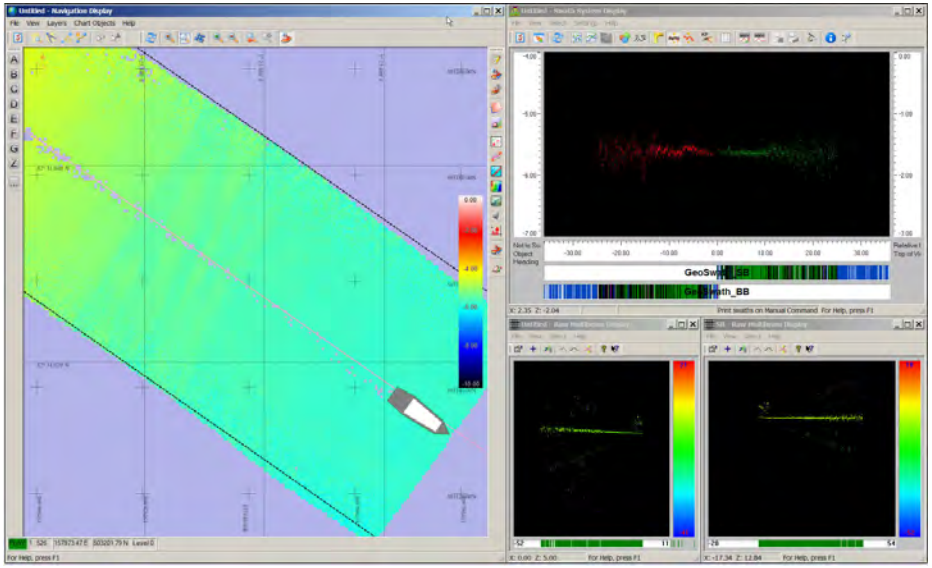
Slide from Duncan Mallace seminar presentation.d

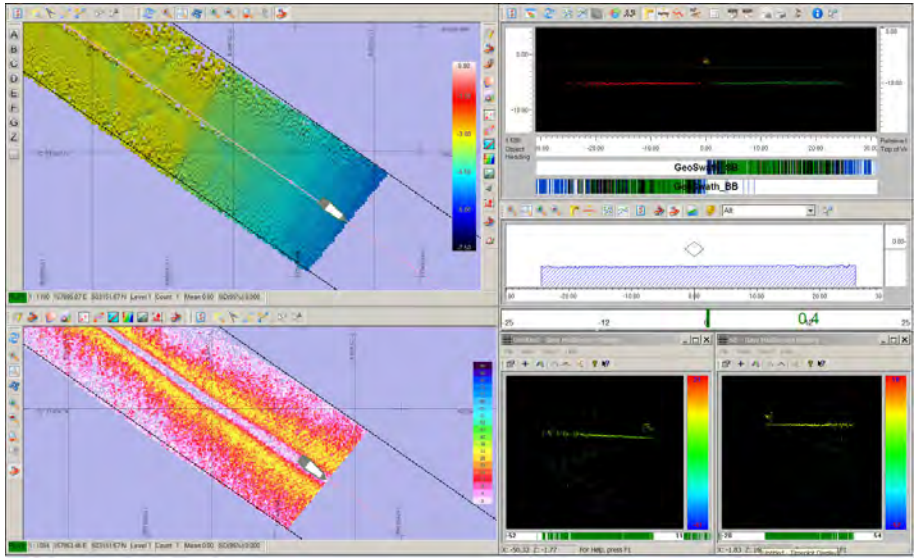
Caris HIPS

- Implement processing and QC tools that reduce acquisition to processing ratios (Rate of Effort)
- Error Modeling and Propagation
- Apply Corrections
  - Tide, Geodetic, Sound speed, Motion
- Surface Creation to Locate Errors
- Data Cleaning
  - CUBE, Statistical, IHO, Area based
- *Designate Soundings
  - Quality Control
    - 3-D Fly Thru, Profiles, IHO QC



QPS - QINSY





CUBE

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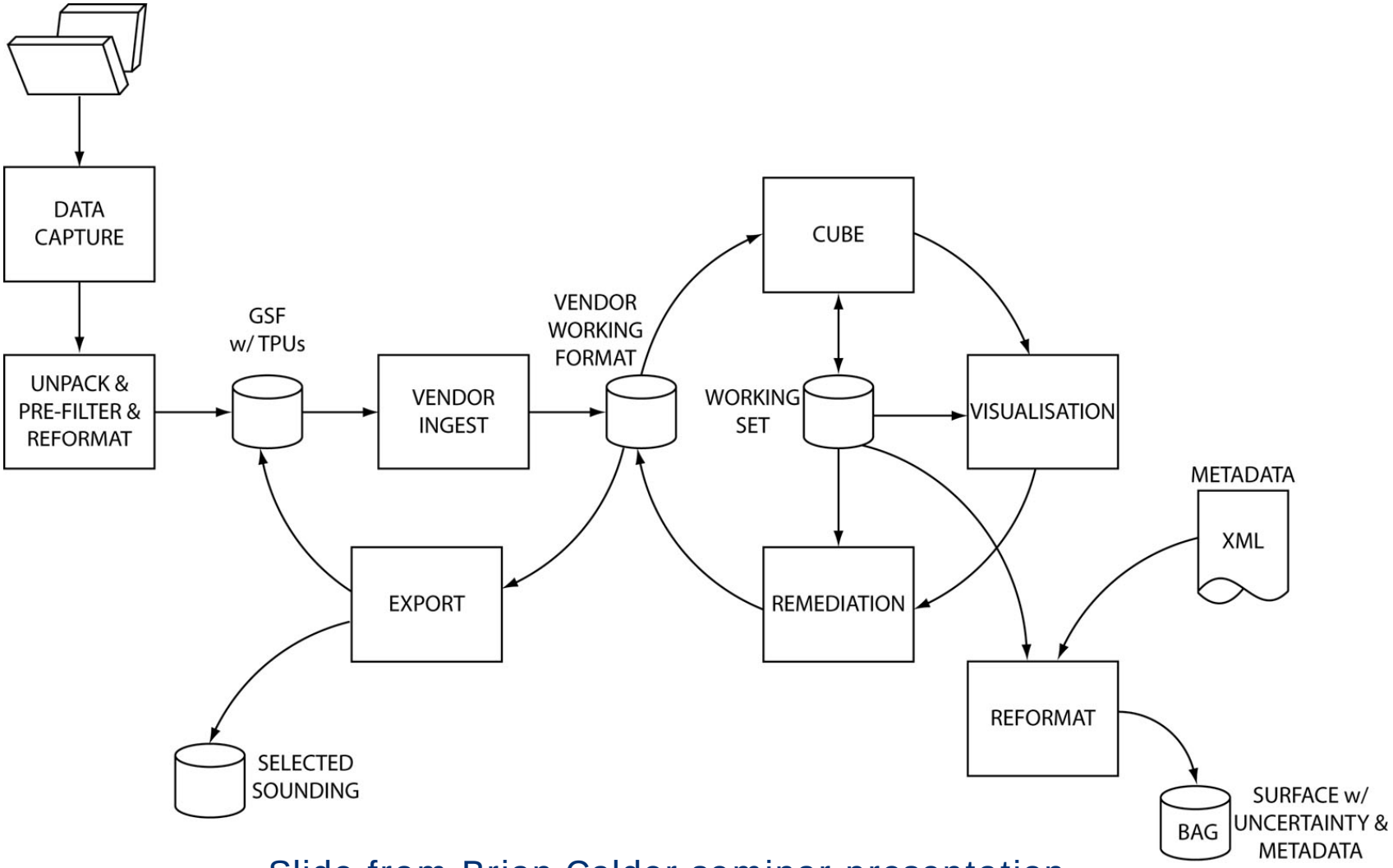

Slide from Brian Calder seminar presentation.

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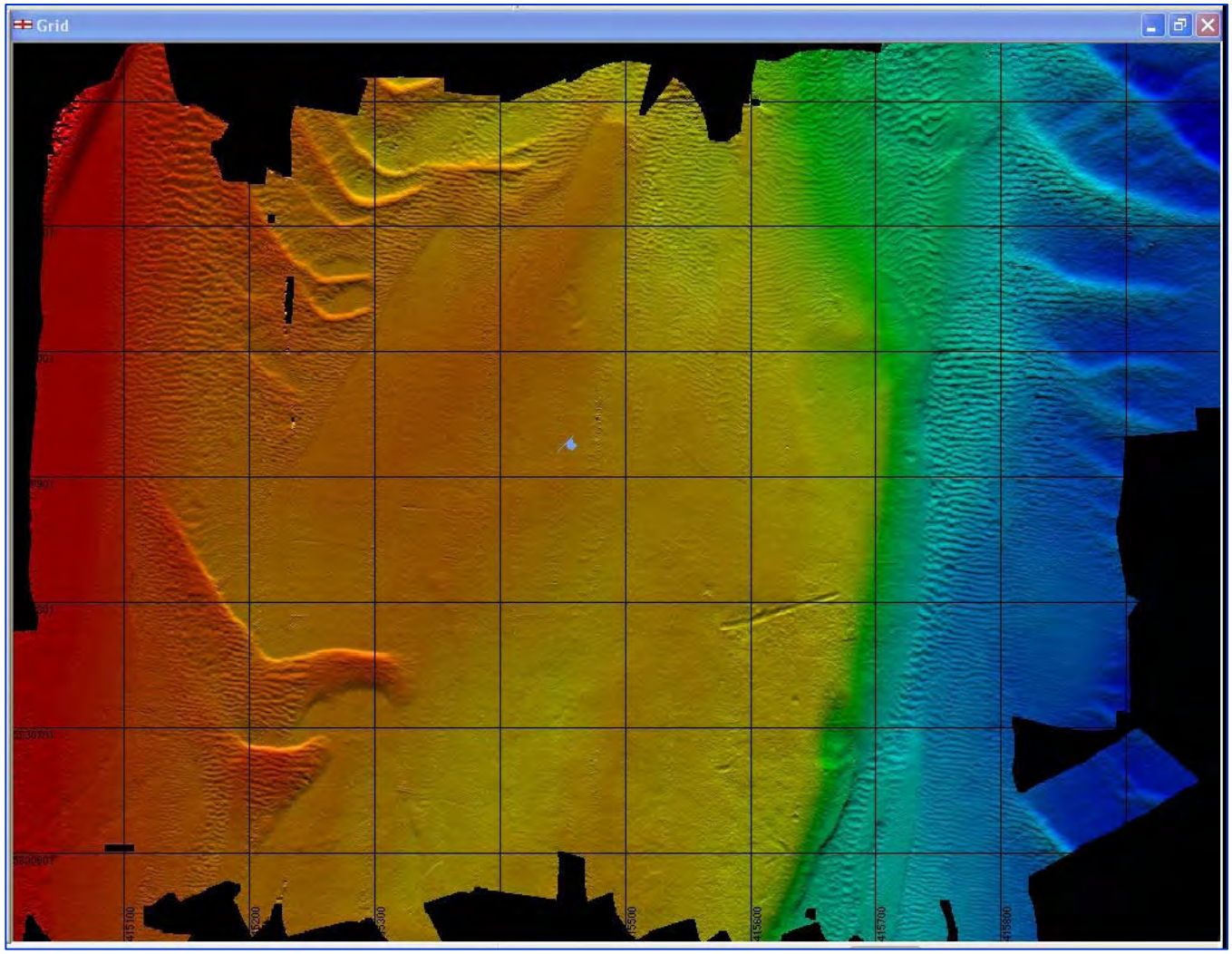
Data examples

Phase measuring bathymetric sonr

Yarmouth Road



Water depth: 7m

Swath width: 70m

Area: 1000x700m

Sand waves: 4 cm

Shallow Survey 05 Common Dataset

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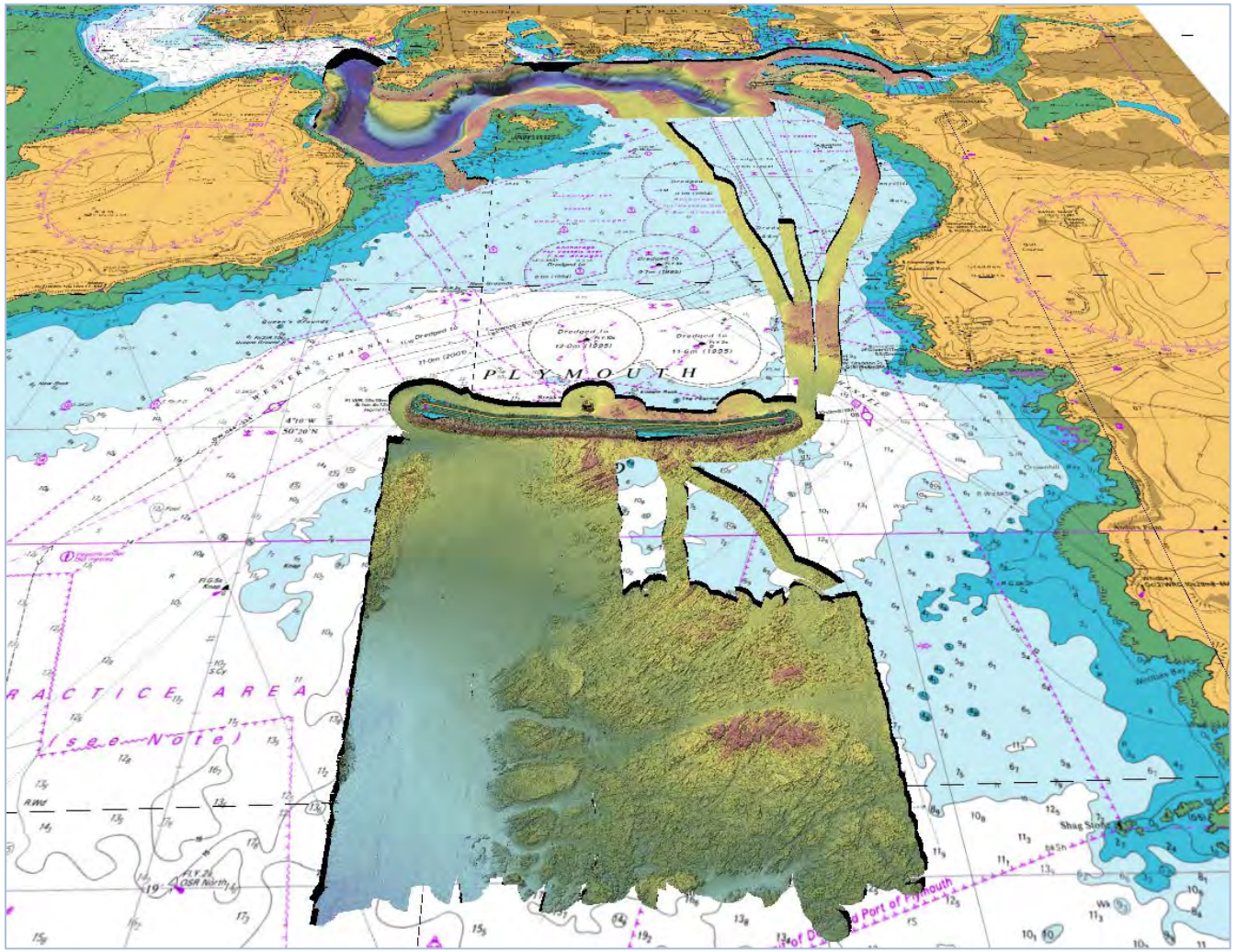

Shallow Survey 05 Common Dataset

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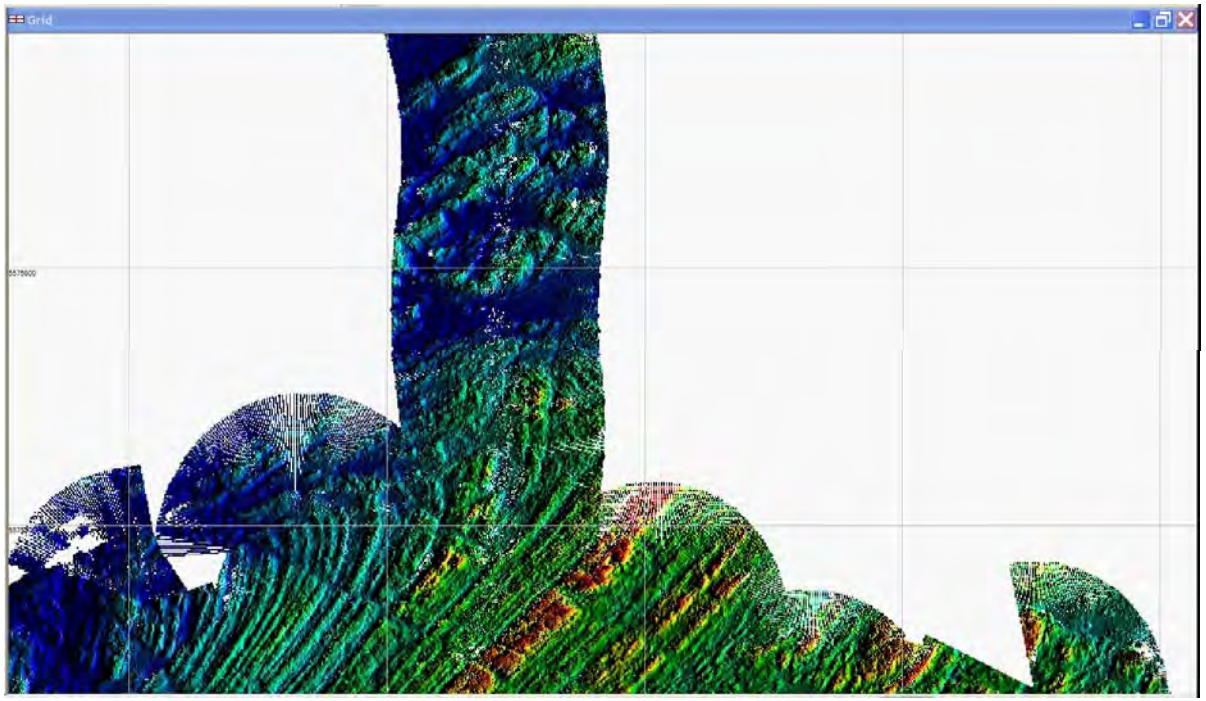
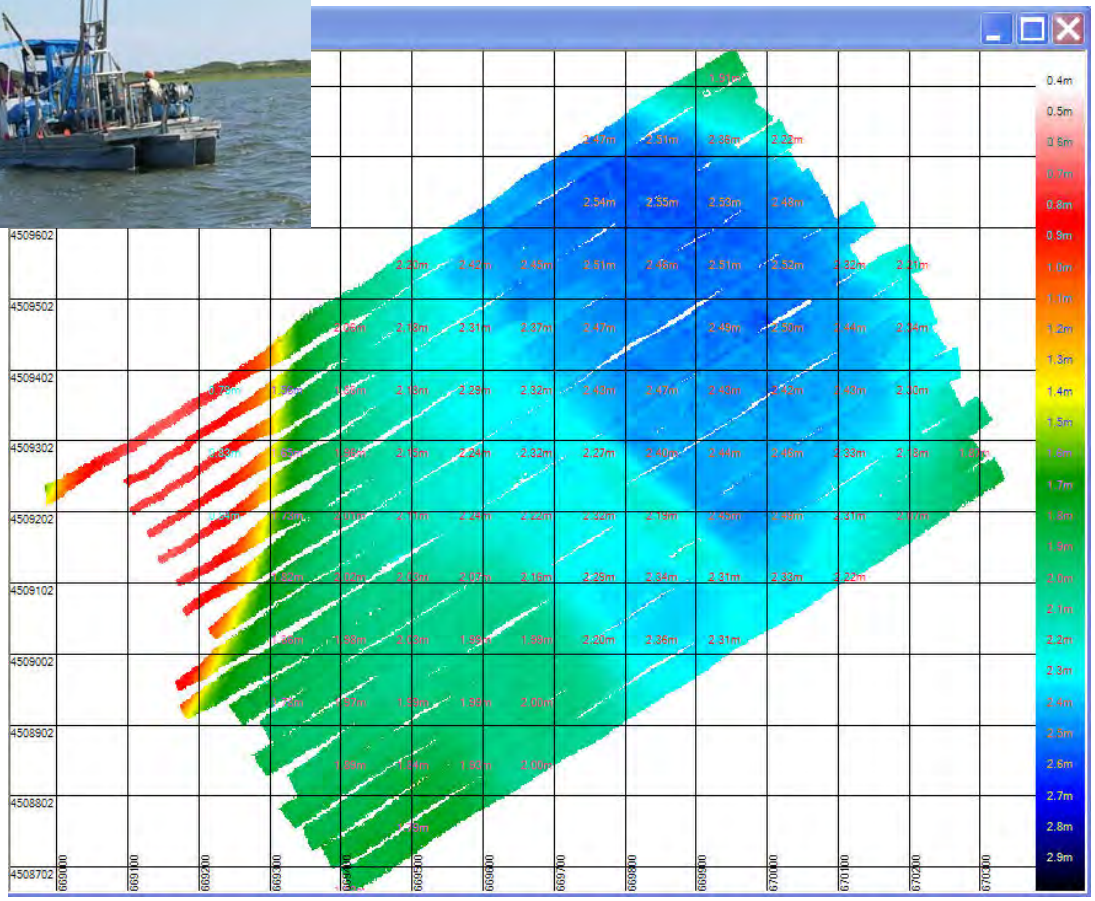
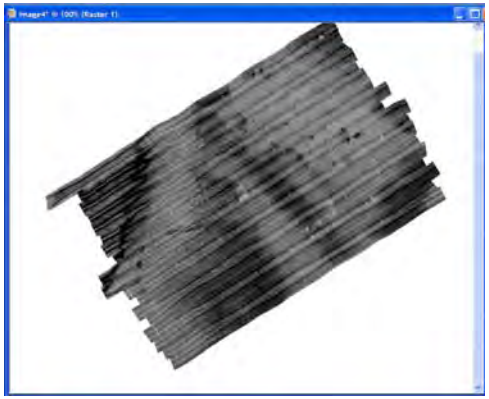
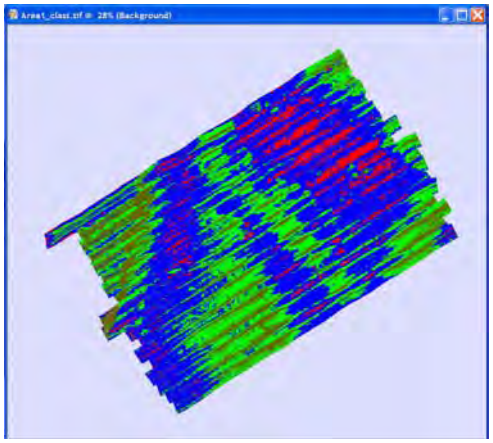
Attitude: Good attitude measurement means consistent survey data - for example POS MV performance in turns (50cm uninterpolated data at 50m slant range)



Constant 40 m line spacing – 2 m water depth







Data courtesy of University of Rhode Islands location between Fire Island and Long Island, NY

Bridge crossing

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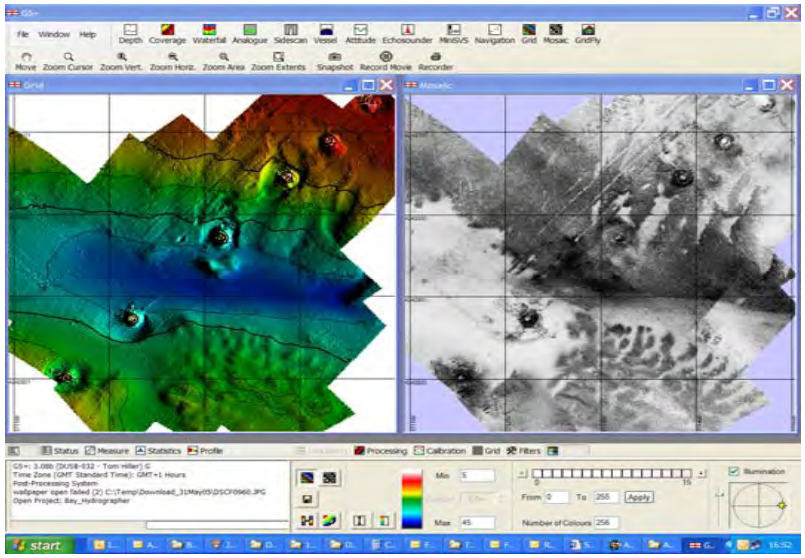

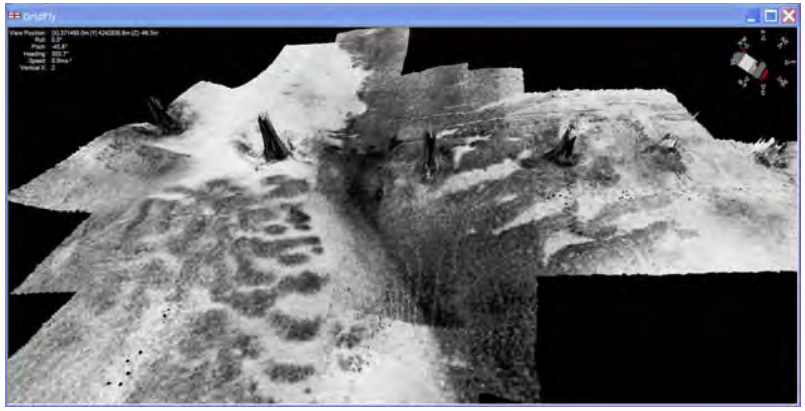

Pipeline inspection

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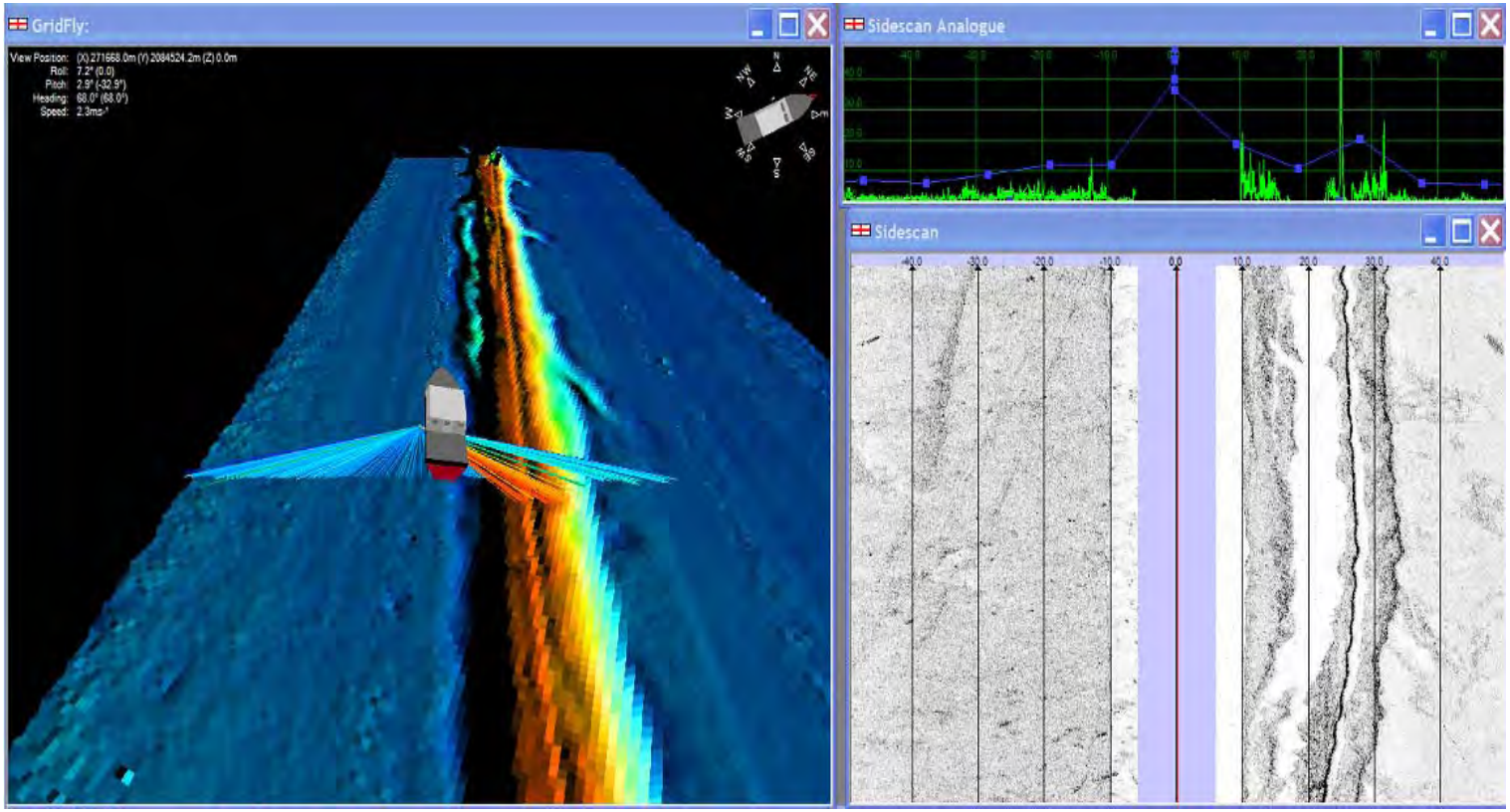

Port survey

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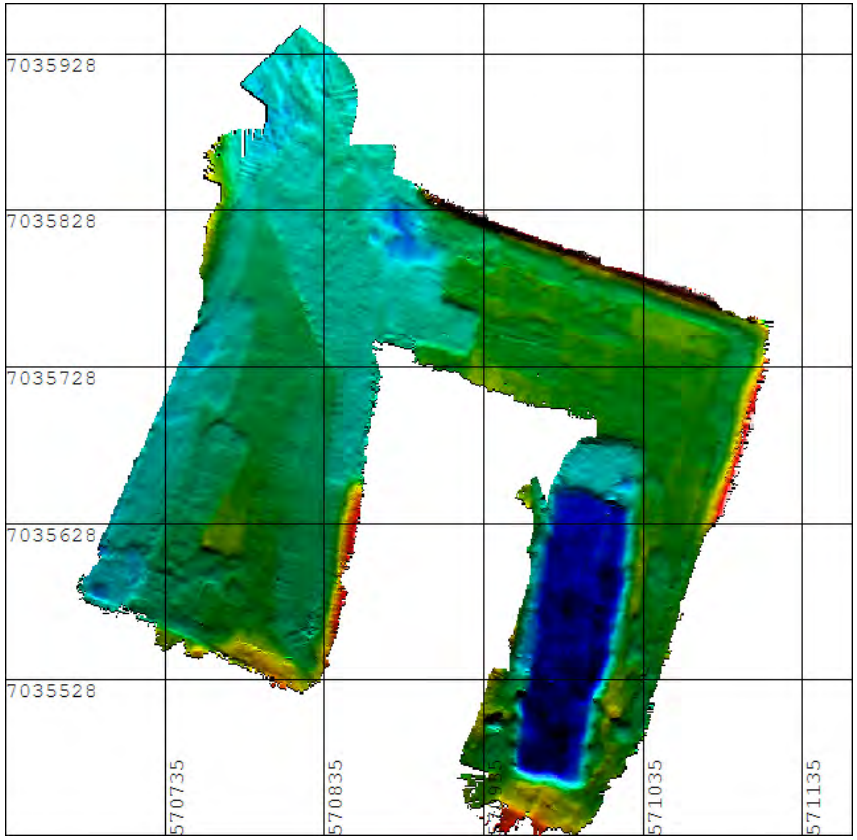
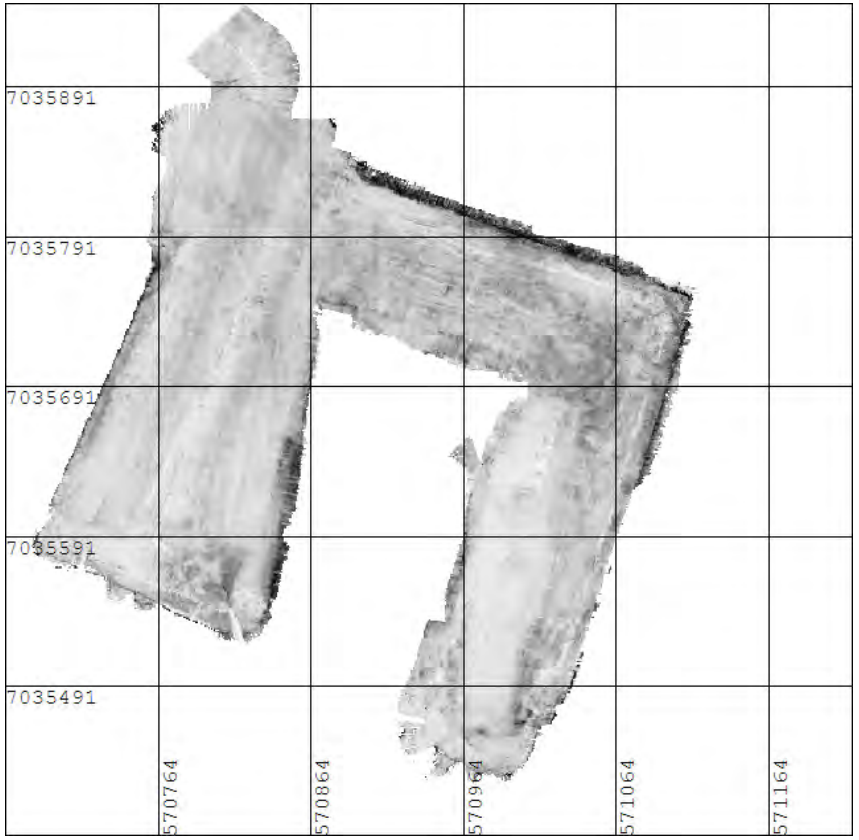
Port of Trondheim, Norway
Maintenance Dredging & Object Detection





Rocky outcrops - bathymetry

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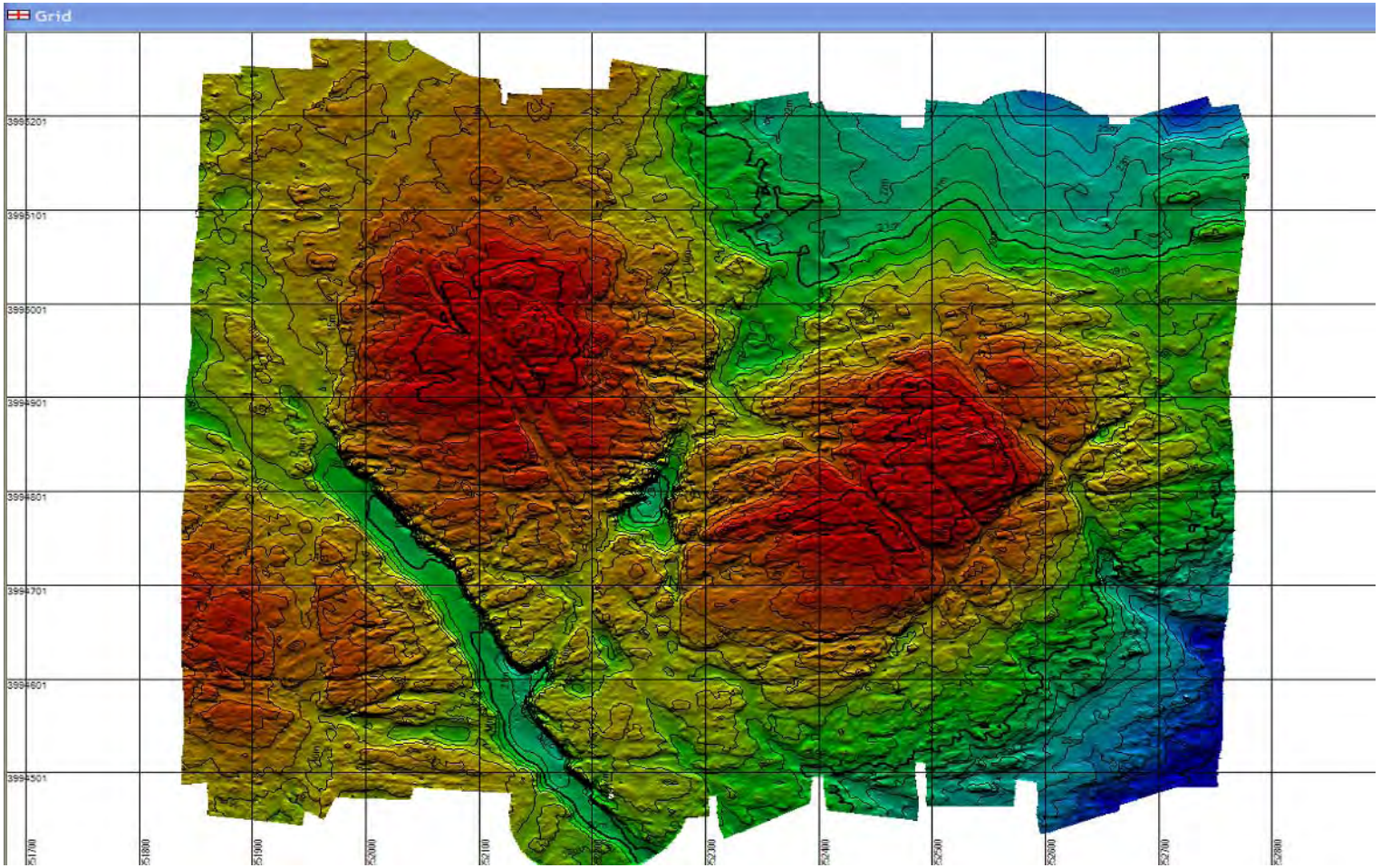

Rocky outcrops – side scan

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500 kHz boat mounted system

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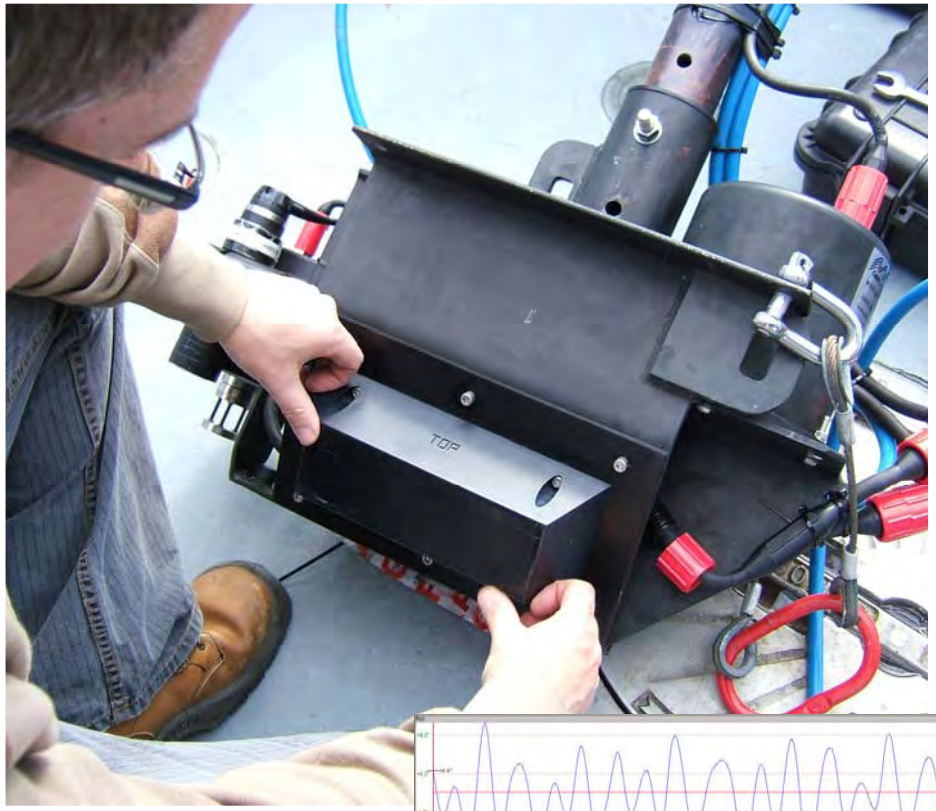

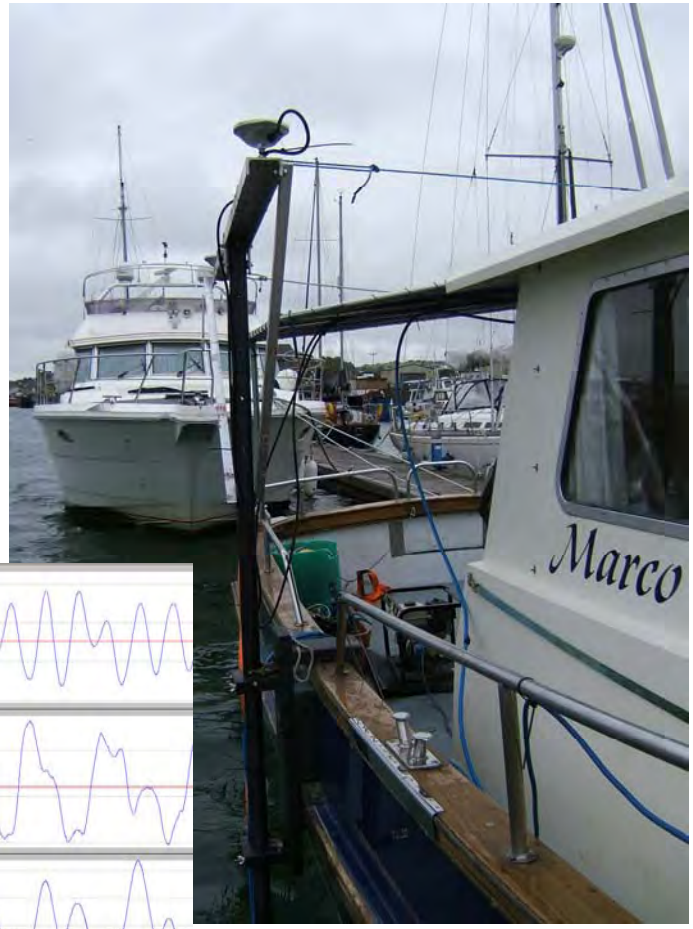

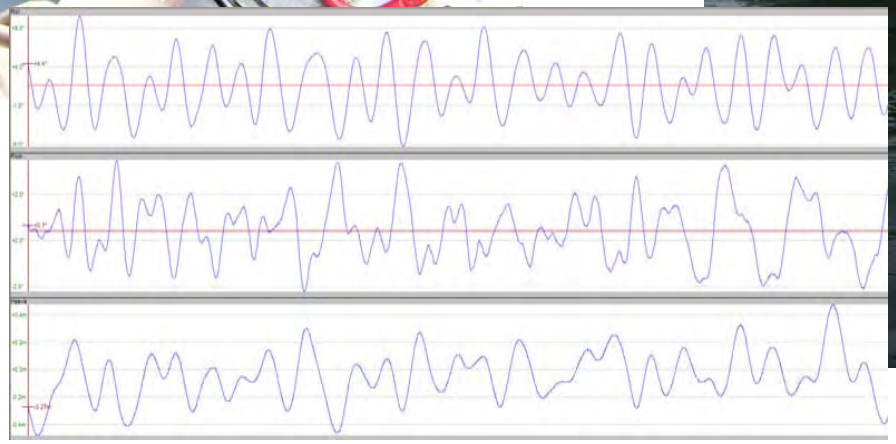

Roll: ~10°

500 kHz boat mounted system

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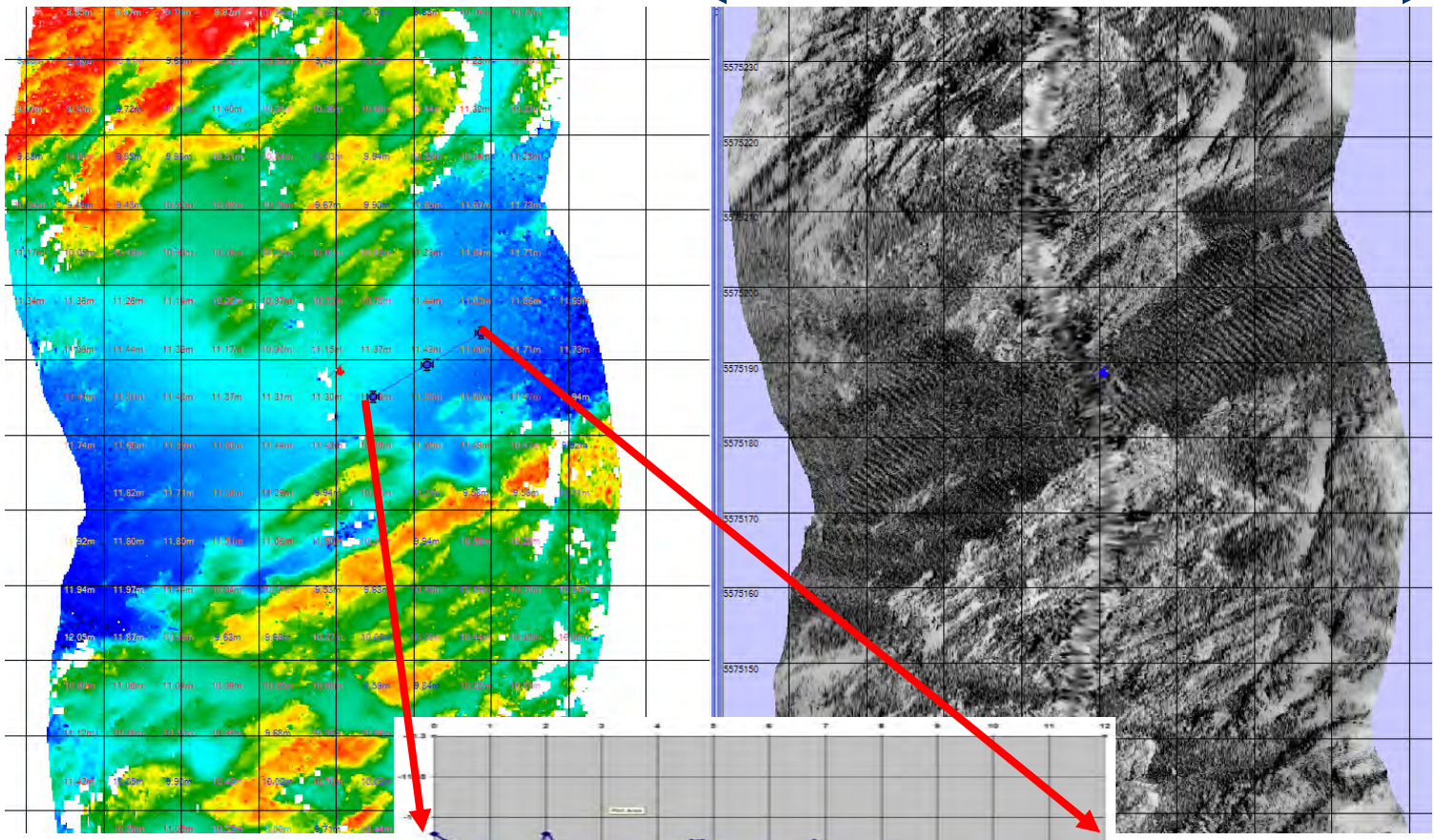
Water depth ~10m under the transducers

80m swath width



Bathymetry
20 cm grid

Side-scan mosaic
10 cm grid

Resolves 5cm high sand waves

500 kHz boat mounted system

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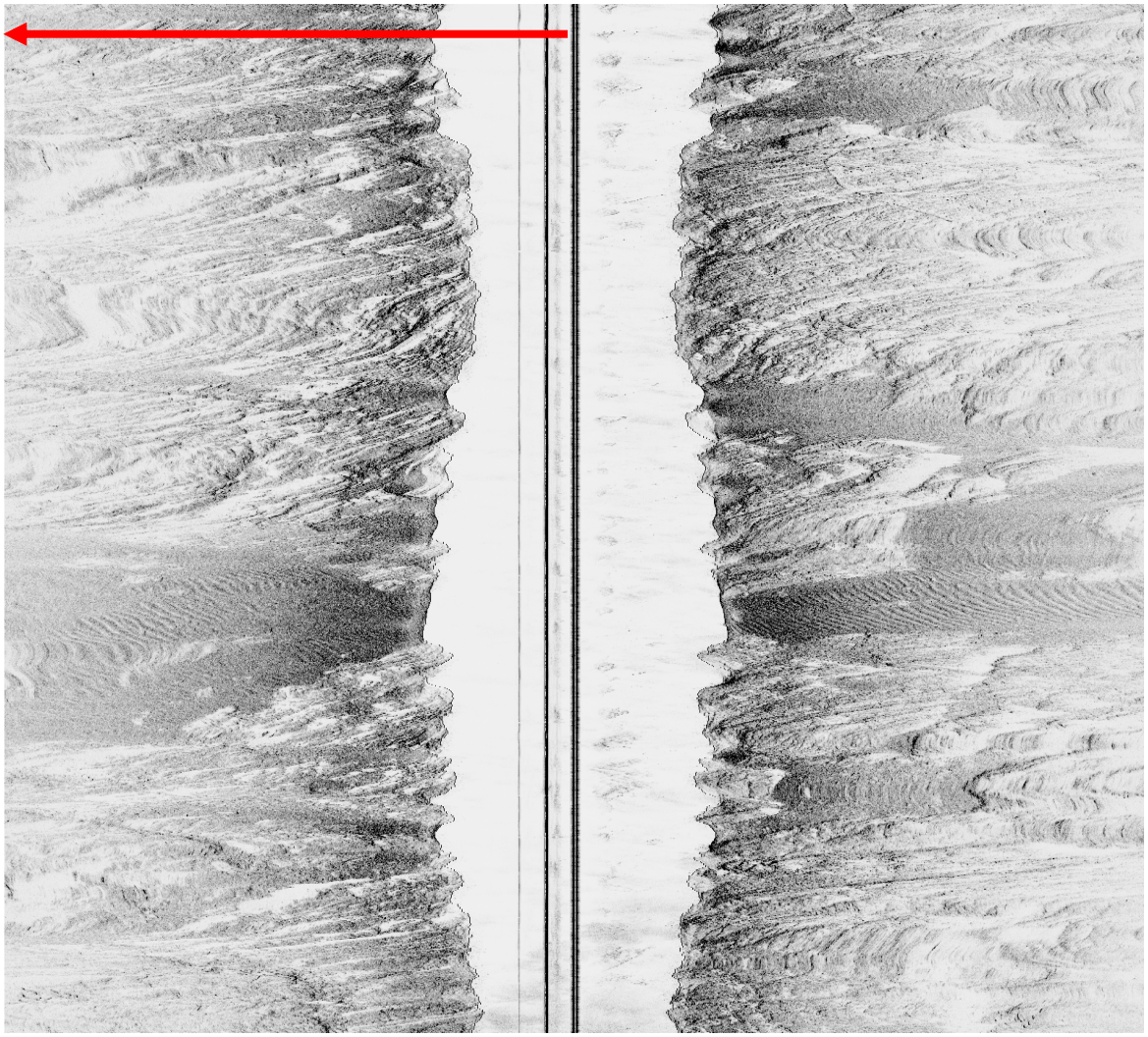
40m range setting



Marine Habitat Mapping

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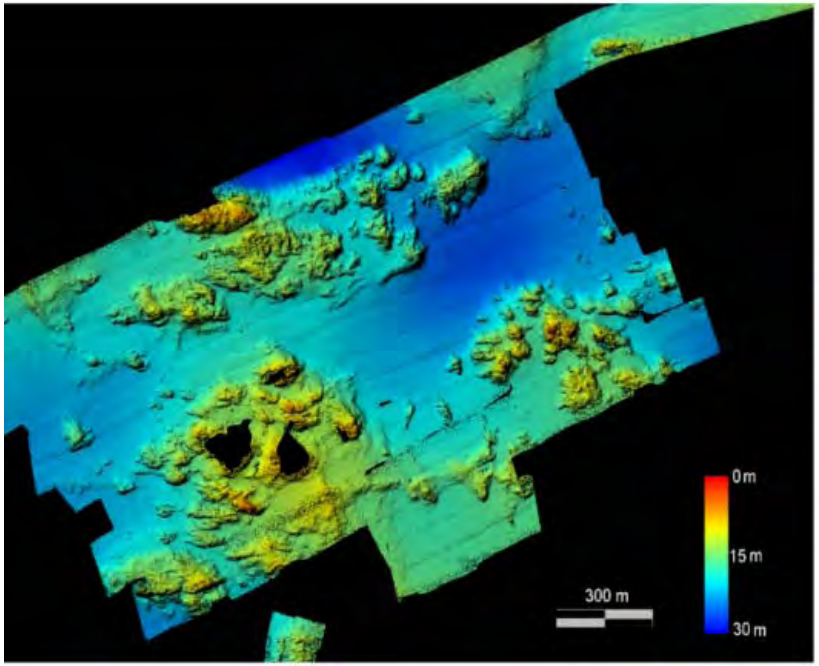

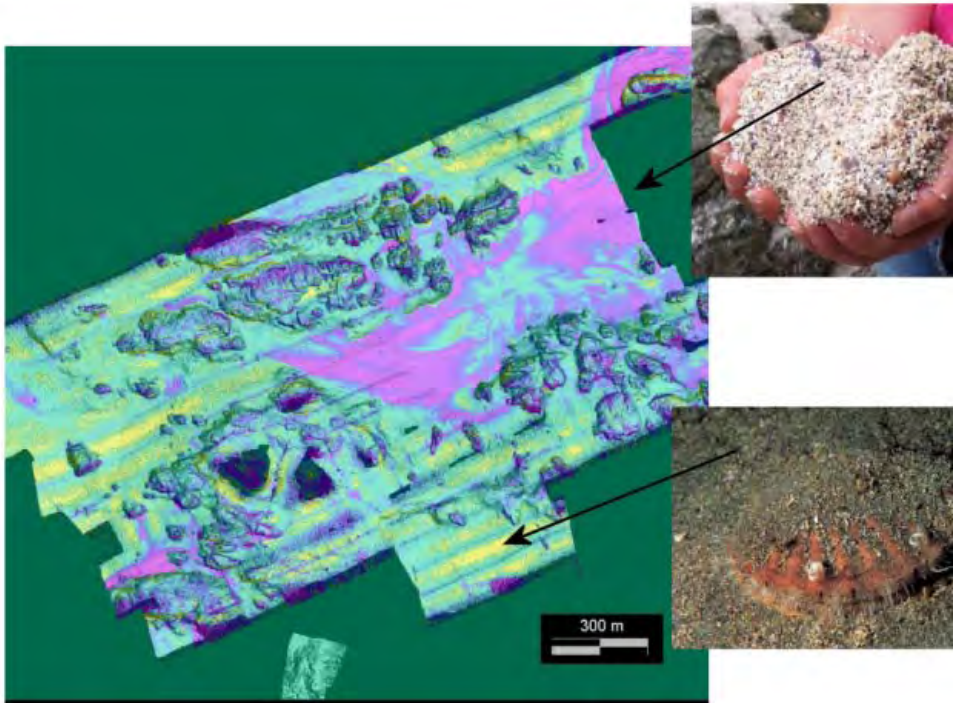

NGU
Norges geologiske undersøkelse

Texture classification

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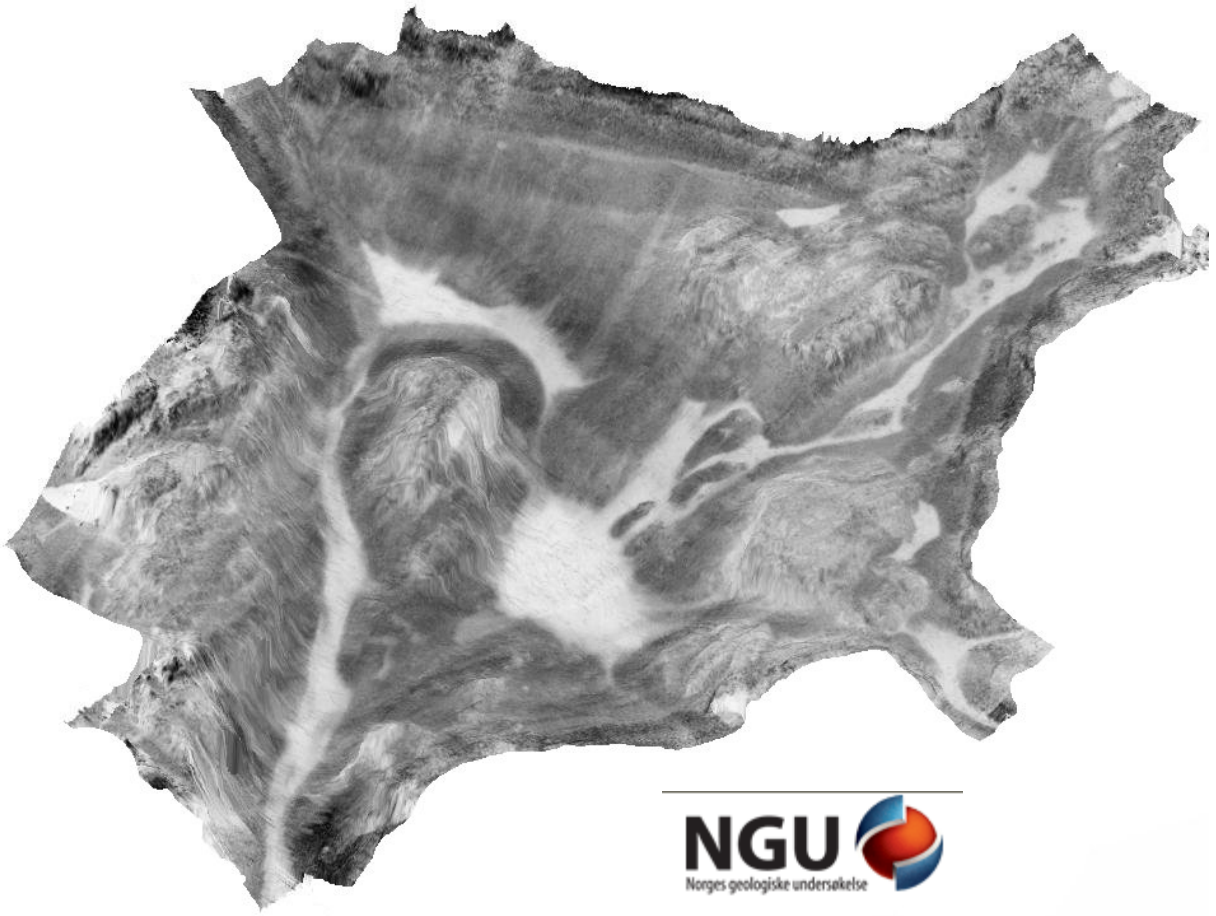

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End moraine in Swiss Lake

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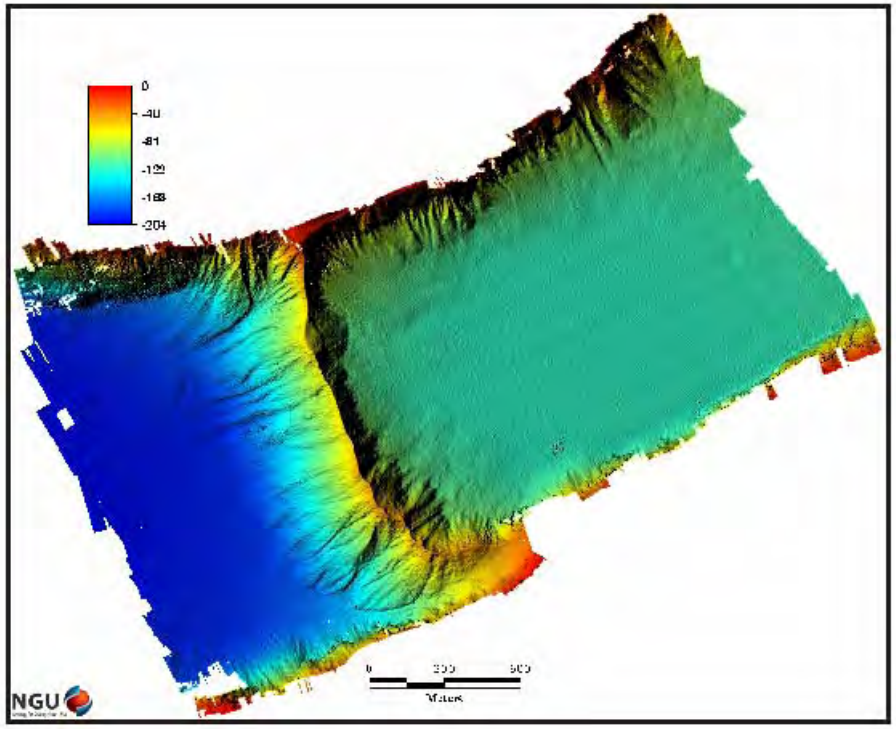

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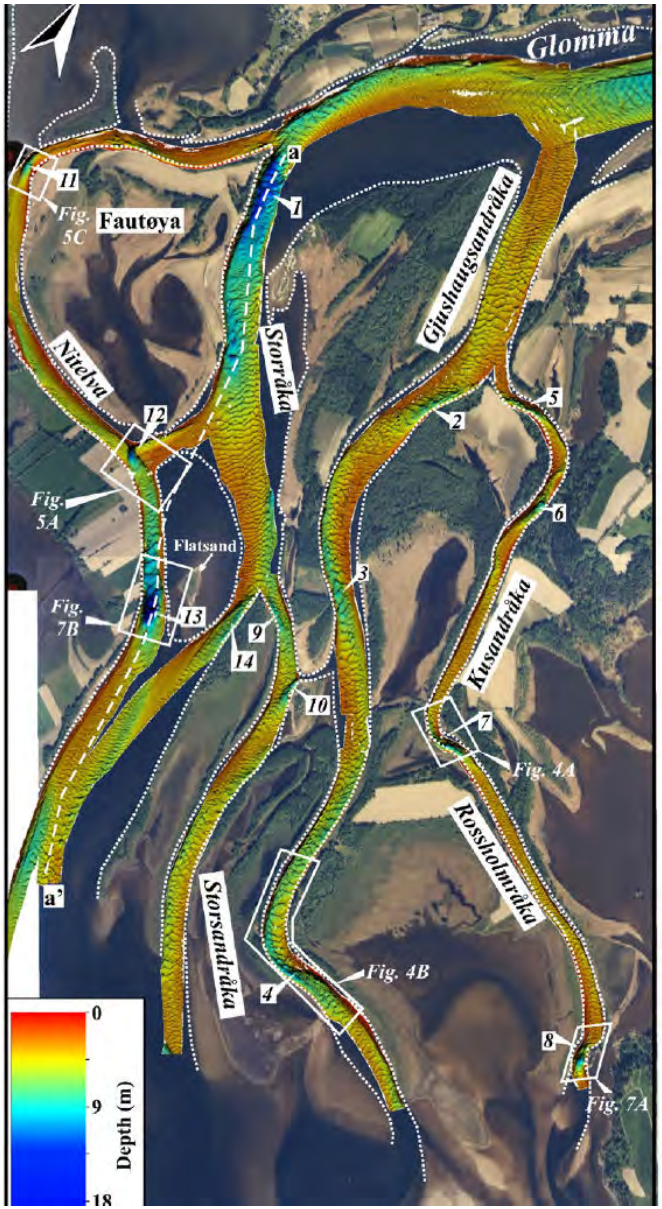
Rivers



Canals and harbours

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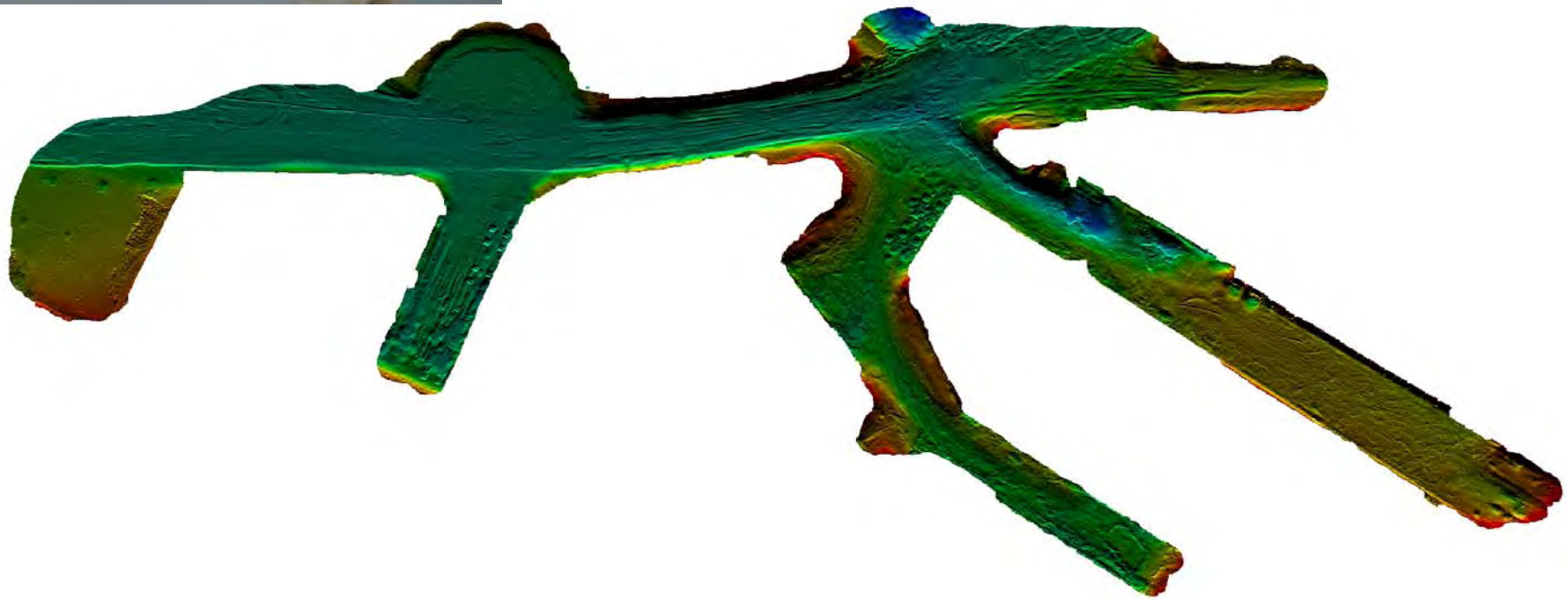

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