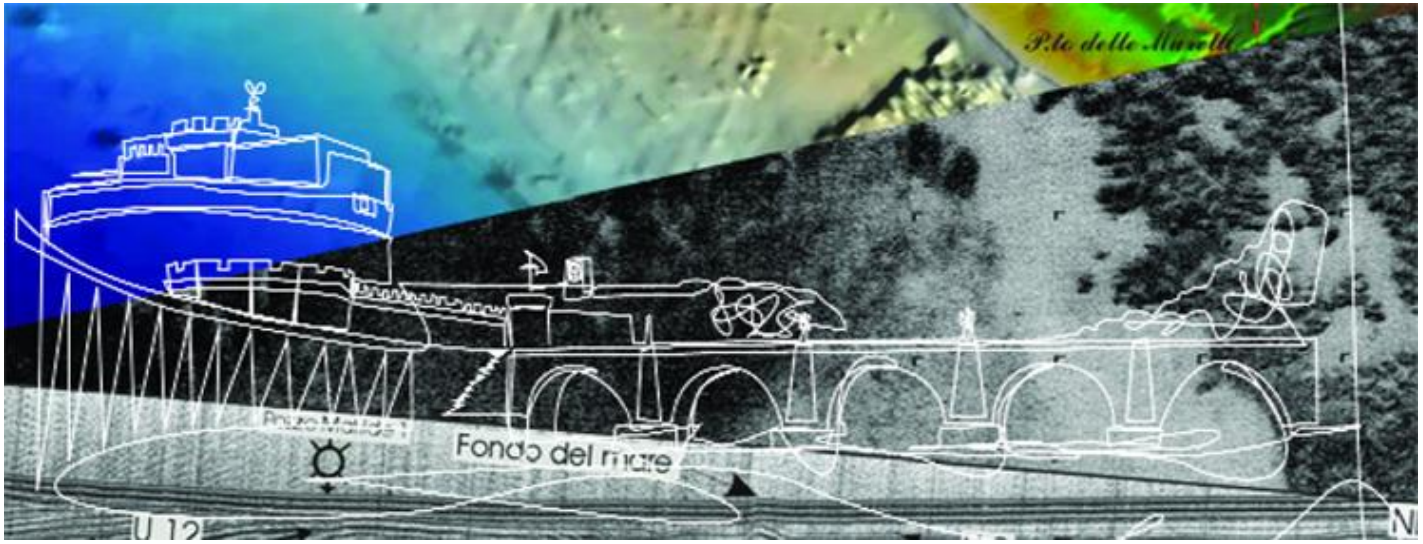
GEOHAB 2013 Workshop -- SUMMARY

Multibeam Backscatter – State of the Technology, Tools, & Techniques

May 2013

Erin Heffron, Fledermaus Product Specialist, QPS

Moe Doucet[1], Craig J. Brown[2], Geoffroy Lamarche[3], Rhys Cooper[4].



1: QPS, 104 Congress St., Suite 304, Portsmouth, NH 03801, USA

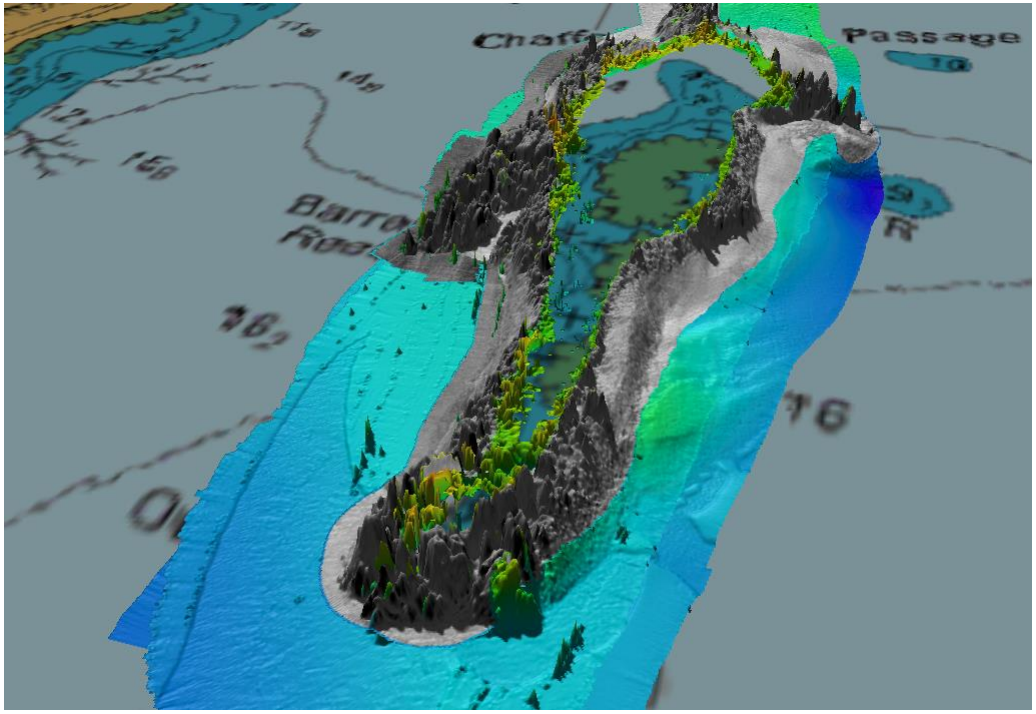
2: McGregor GeoScience Limited, 177 Bluewater Road, Bedford, Nova Scotia, B4B 1H1, Canada

3: NIWA, Private Bag 14-901, Wellington 6241, New Zealand

4: British Geological Survey, Murchison House, West Mains Road, Edinburgh, EH9 3LA, UK

Presentation Summary

- Impetus
- Organizers and proposal
- Review of keynote and sessions
- Moving forward



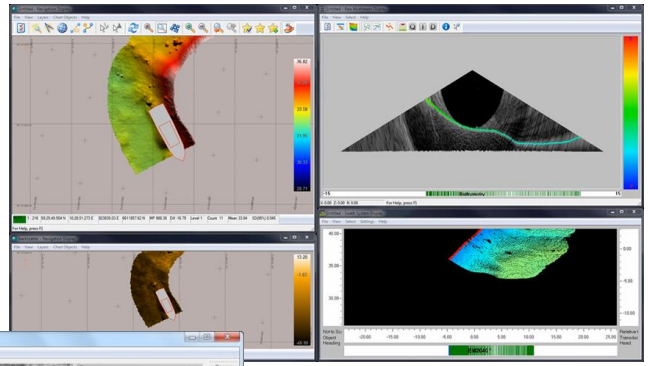
QPS – Hydrographic and Marine Software Solutions

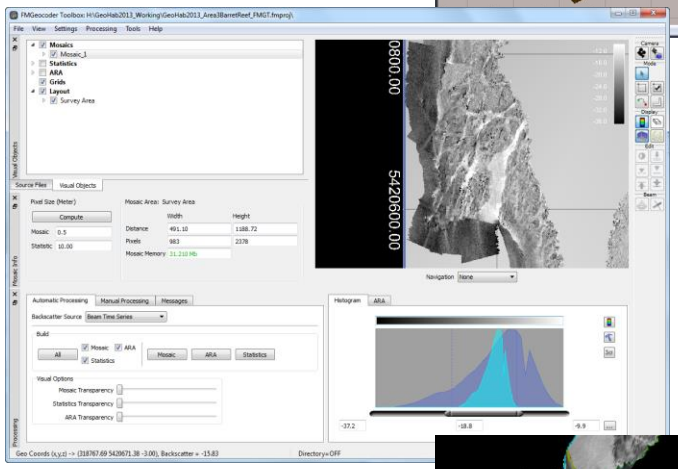
- QINSy: Acquisition and processing software
- Fledermaus: 3D processing, visualization and analysis software
- QASTOR: Piloting and navigation software
- Offices:
  - Zeist, the Netherlands
  - Portsmouth, New Hampshire, USA
  - Fredericton, New Brunswick, Canada
  - Banbury, Oxfordshire, UK

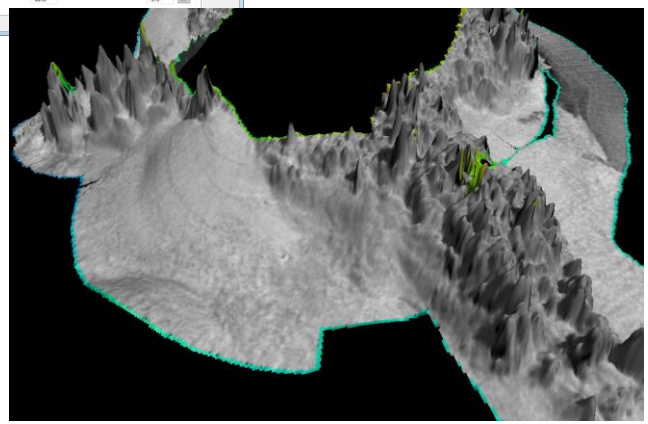
www.qps.nl

QPS – Backscatter

- Backscatter Acquisition -- **QINSy**
- Backscatter Processing and Visualization – **FMGT** module of **Fledermaus**

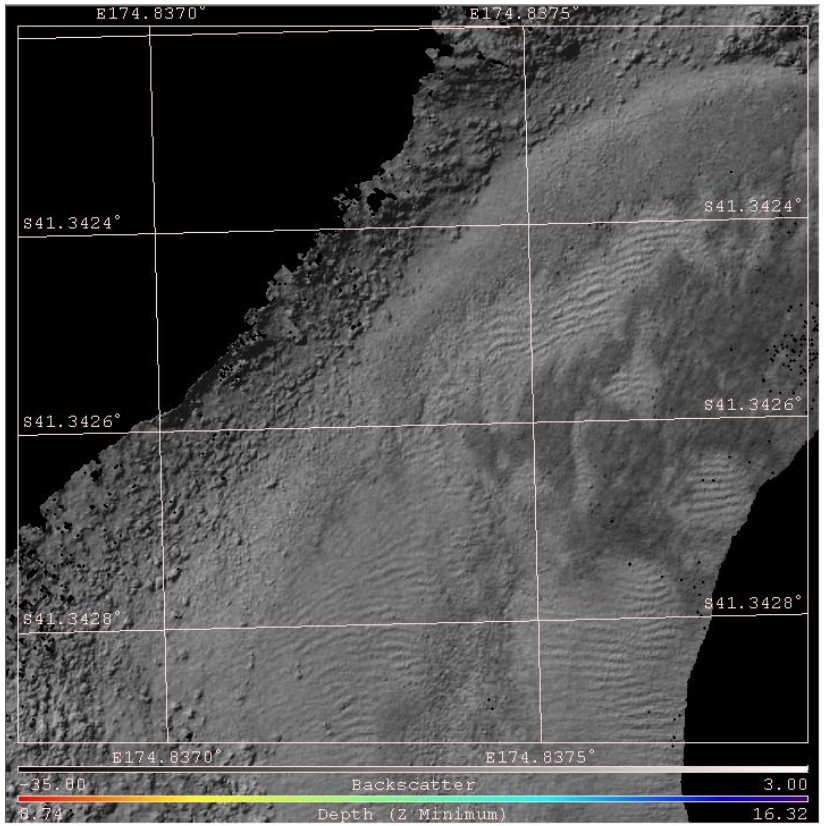






The Impetus

- "Discussion" at GeoHab 2012
- Original title – Why does my backscatter suck?
  - Issues with backscatter we were receiving
  - Sonar? Acquisition? Processing Software? User Error?
  - Do we really understand this data and understand what we are doing with it?
  - Hardware and software manufacturers, users
- Moving towards best practices…to be continued?



Berit Horvei, Kongsberg

NOTE: Images on each slide of this summary are taken from workshop presentations. Name under image refers to the presenter, no necessarily the person who created the image!!

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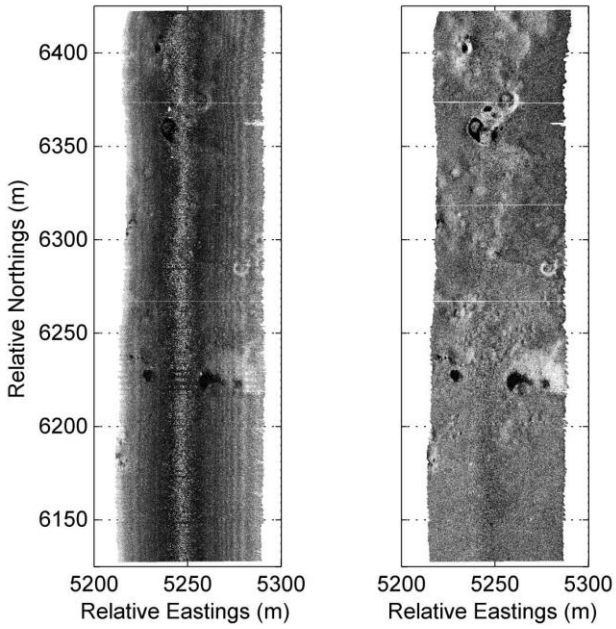
Marine Geological and Biological Habitat Mapping

Workshop Organizers

- Erin Heffron & Moe Doucet, QPS
- Craig Brown, McGregor GeoScience Limited
- Geoffroy Lamarche, National Institute for Water and Atmosphere Research (NIWA)
- Rhys Cooper & Alan Stevenson, British Geological Survey (BGS)



Eric Maillard, Teledyne Reson

QPS

McGregor GeoScience Limited

NIWA

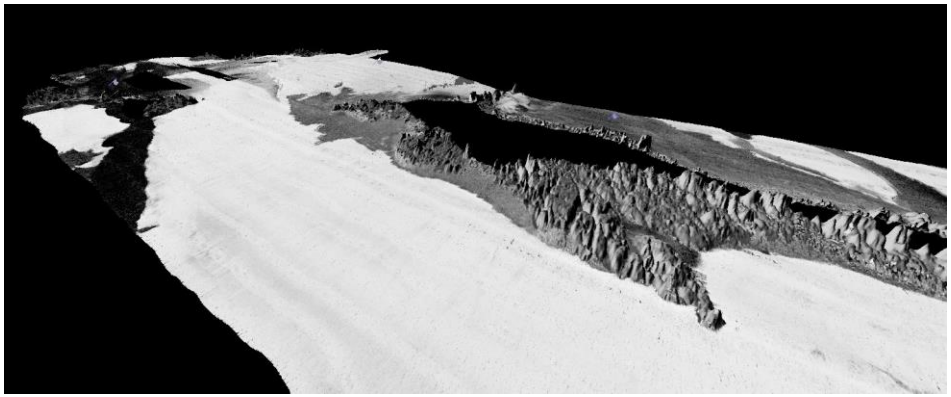
BGS 1835

British Geological Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

Proposed Workshop Summary

- Focus on multibeam sonar backscatter
- Current state of the technology
- Ongoing and future research in this field
- Facilitate discussion regarding processing tools, techniques, uses, and user perspectives



Martin Gutowski,
Kongsberg GeoAcoustics

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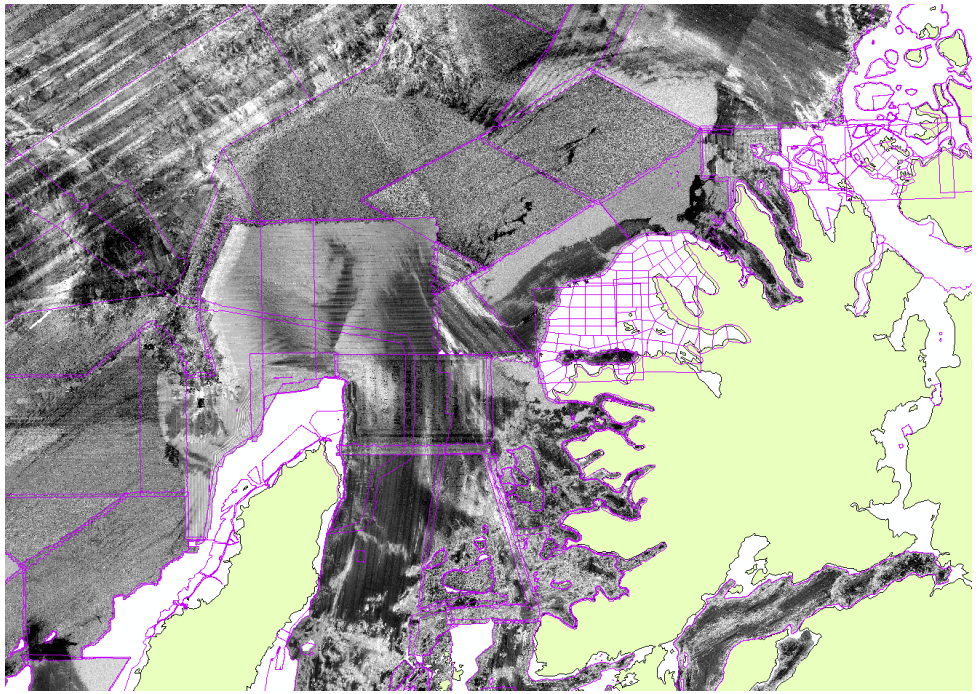
Proposed Workshop Goals

- Provide attendees and contributors with an update on the state of backscatter processing
  - hardware and software issues
  - new research ideas
  - the commercial and non-commercial tools for working with it (e.g., mosaic creation, characterization, classification …)
  - user expectations.
- Provide contributors with a forum to discuss what they are working on
- Provide attendees with a basis for discussion on the current state of multibeam backscatter.



Margaret Dolan, NGU

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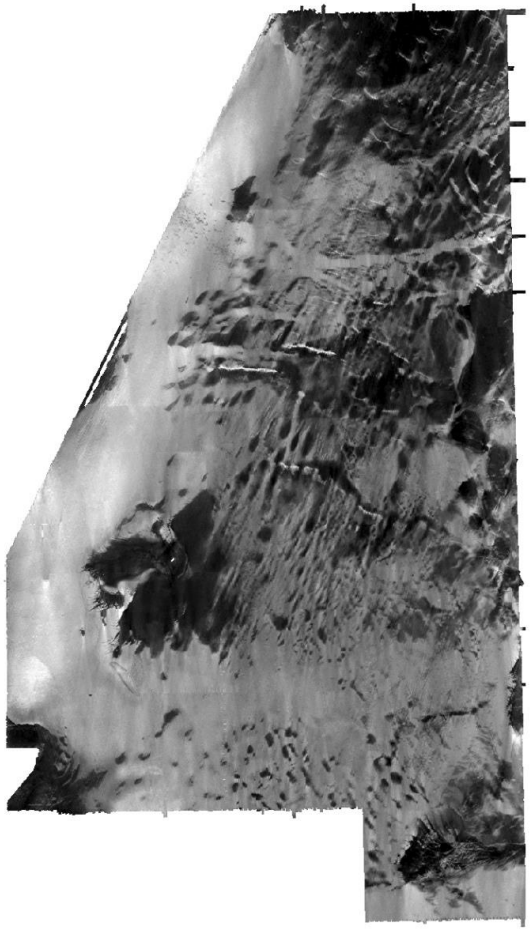
Proposed Workshop Themes

- What is backscatter?
- What do users and data providers want to get from backscatter?
- What can be expected from backscatter?
- What are the potentials and limitations of existing tools?
- User perspectives – issues in acquisition, product creation, down-stream user expectations, etc.
- Backscatter nuts and bolts – real world issues from acquisition to products.



Markus Diesing, Cefas

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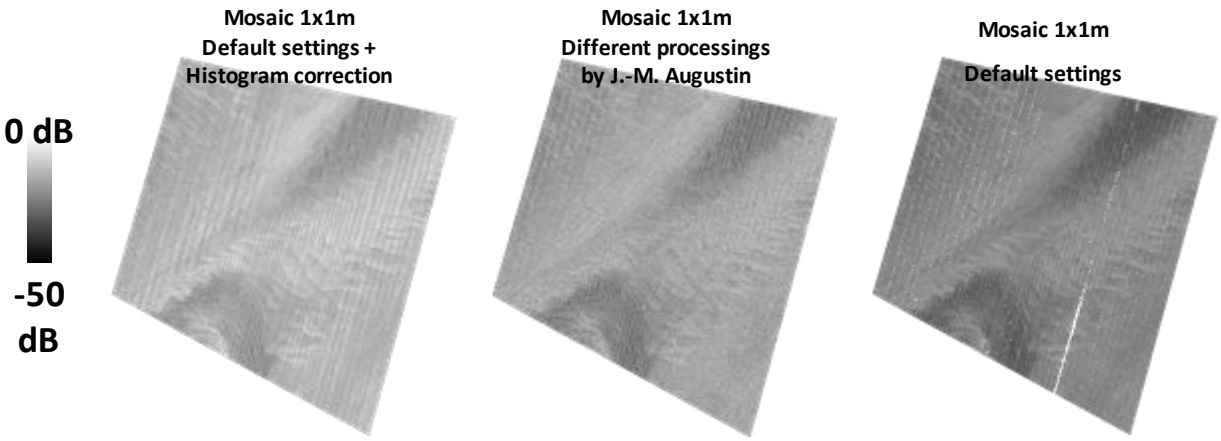
Sessions

- **Keynote:** Xavier Lurton, IFREMER – Backscatter Measurement by Seafloor-mapping Sonars – Basics and Challenges
- **State of Hardware:** Sonar Manufacturer Presentations
- **Recent Backscatter Efforts:** 2012 Workshops
- **Recent Backscatter Efforts:** Challenges and Case Studies
- Processing of **Common Dataset**



Marc Roche, Belgian Federal Public Service Economy

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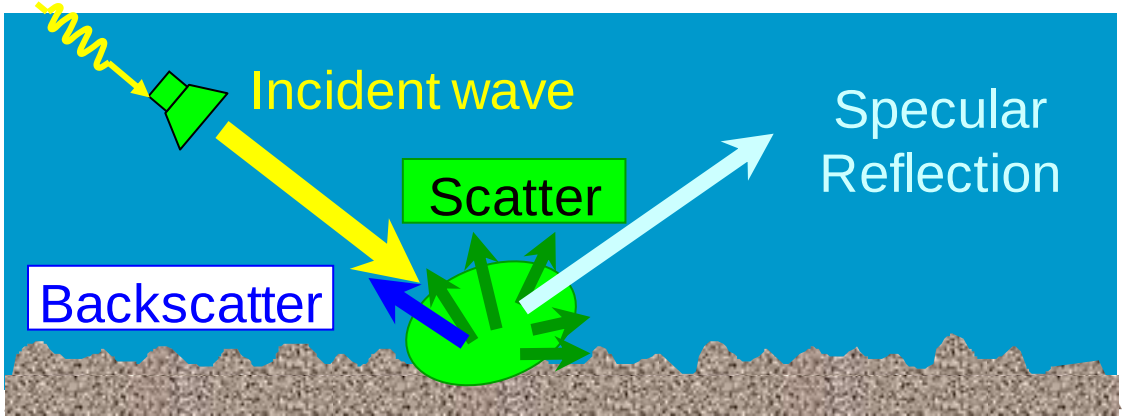
Keynote: Backscatter Measurement by Seafloor-mapping Sonars – Basics and Challenges

Xavier Lurton, IFREMER

- Backscatter in seafloor-mapping
- Physical phenomena and modelling
- Backscatter processing
- A detour by outer Space
- MBES calibration issues
- From backscatter data to seafloor characteristics
- Discussions and prospective



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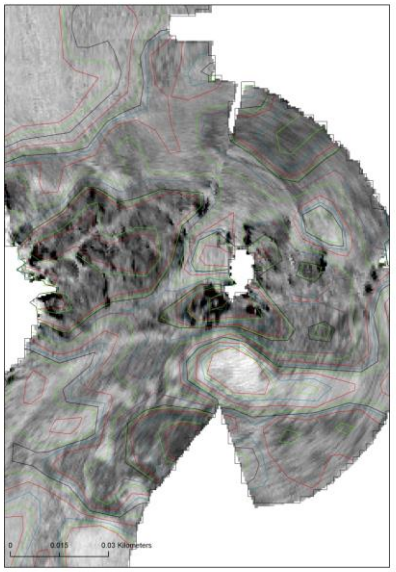
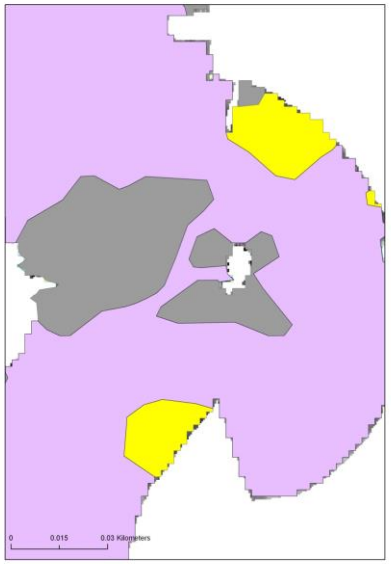
Some pending (and concerning) issues

- **What are exactly the user's expectations?**
- How relevant are our **models of seafloor backscatter**?
  - Which **reality** is **actually accessible** through models & analysis?
  - How do we relate it to user's expectations for habitat mapping?
  - What is the point today of **inverting available models**?
- Are we working at the **appropriate scale**?
  - Varied users, purpose
  - Are people using appropriate tools for appropriate scale
  - Should manufactures be focusing on this so much?
- Can we hope for **reliable absolute calibration** of MBES?
  - Do we need it?
  - How reliable are field data in this respect?
  - How do we proceed? Options? Pros/cons?

Recommendations

- **Specify better the user's requirements**
  - dB-accuracy ; horizontal scale
- Improve strategies in data acquisition
  - Closer lines…
  - Forget the specular and grazing regimes (Radar!)
- Sensibilize users and manufacturers to calibration issues
- Develop SW tools for
  - 3-D Topography compensation
  - System calibration : in factory and in-situ
  - Sensor response compensation
- Build a database of pragmatic backscatter descriptors
  - Seafloor types, frequencies, angles
  - A joint effort of the community?

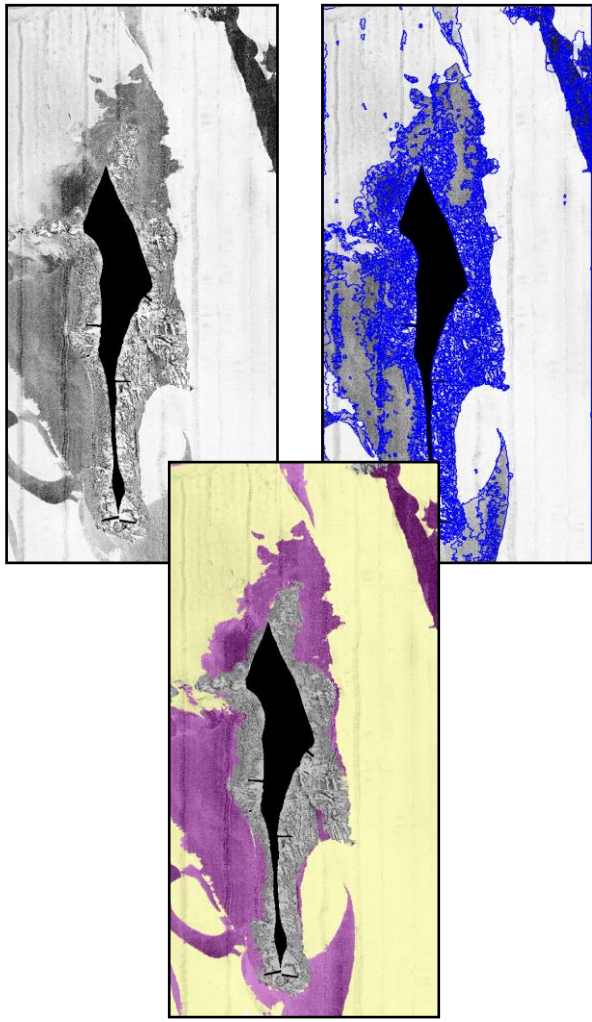




Rhys Cooper & Sophie Green, BGS

Recommendations

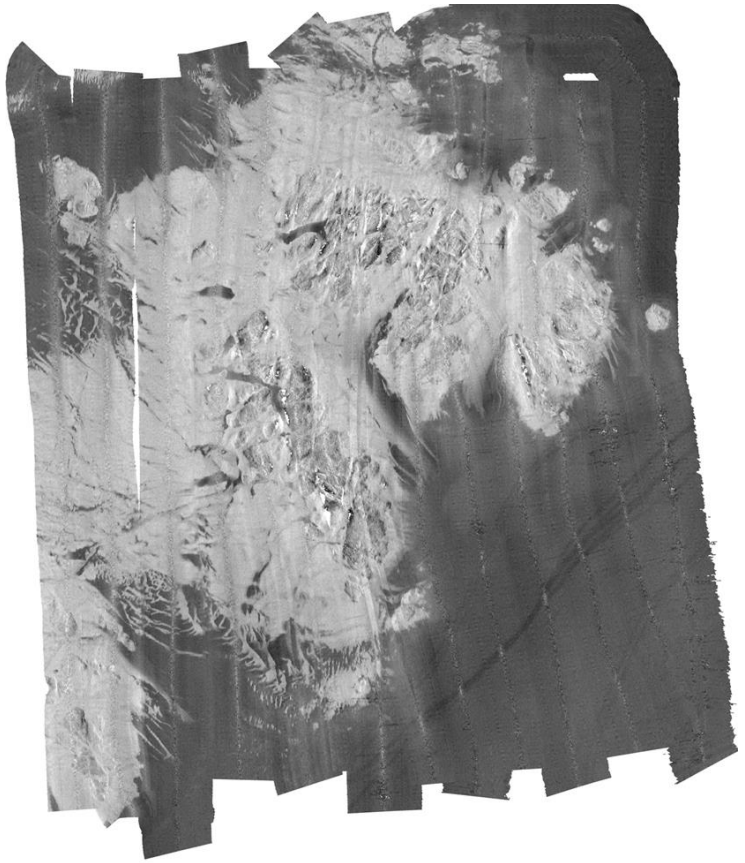
- **Define common standards for data processing and display**
  - Processing flow-charts
  - Equivalent BS @45°?
- Think of new approaches
  - Multi-frequency? Multi-sensors? Multi-angles?
  - Natural reference areas for calibration?
- Design new instruments
  - From existing ones ➔ new modes
  - From the scratch : a sonar scatterometer?
- Investigate the water column effect
  - Surface aeration, interface layer



Markus Diesing, CEFAS

State of the Hardware – Sonar Manufacturers

- Presentations from Teledyne RD Instruments, Teledyne Reson, Kongsberg Maritime, an Kongsberg GeoAcoustics
- Asked to present on:
  - Comparative breakdown of sonar offerings (typical 'versus' chart of capabilities)
  - Given your sonar 'X'
    - Best practice techniques for **configuration** sonar X to perform habitat surveys in areas covered by the Shallow Survey 2012
    - Best practice techniques for **acquisition** using sonar X for habitat purpose
    - Best practice techniques for **processing** (correcting) backscatter data from sonar X
  - Any case studies of sonar X in habitat related work
  - Any habitat related capabilities or coming capabilities (I.e. Calibrated output) this group should know about



Moe Doucet, QPS

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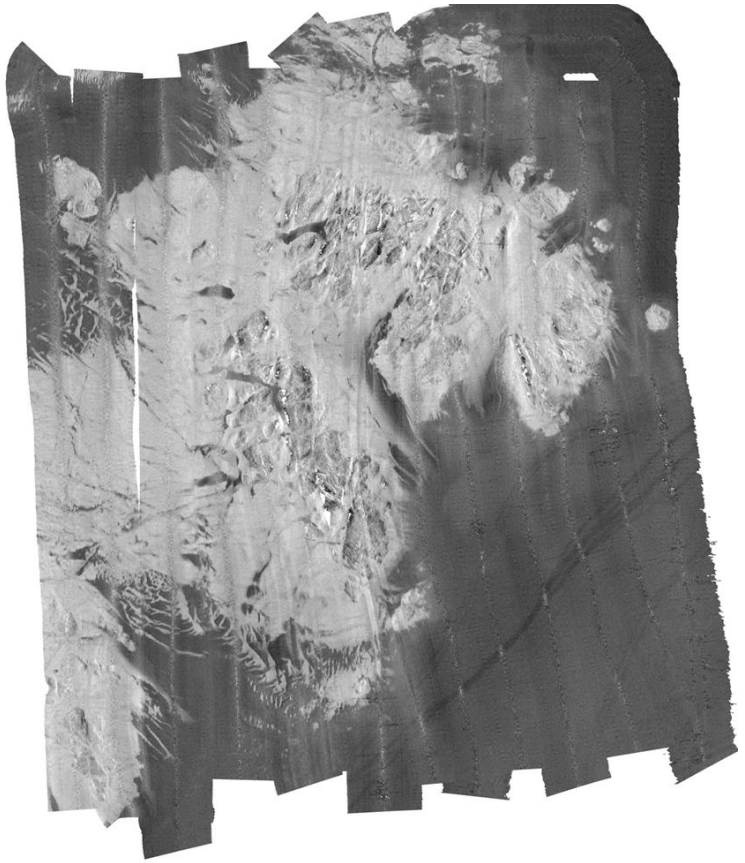
State of the Hardware – Sonar Manufacturers

- Analog to digital conversion in Teledyne
- Recommendations for acquisition best practices/sonar settings for Reson, Kongsberg
- New records for Reson
- Improved calculations for beam refelctivity, Kongsberg



Moe Doucet, QPS

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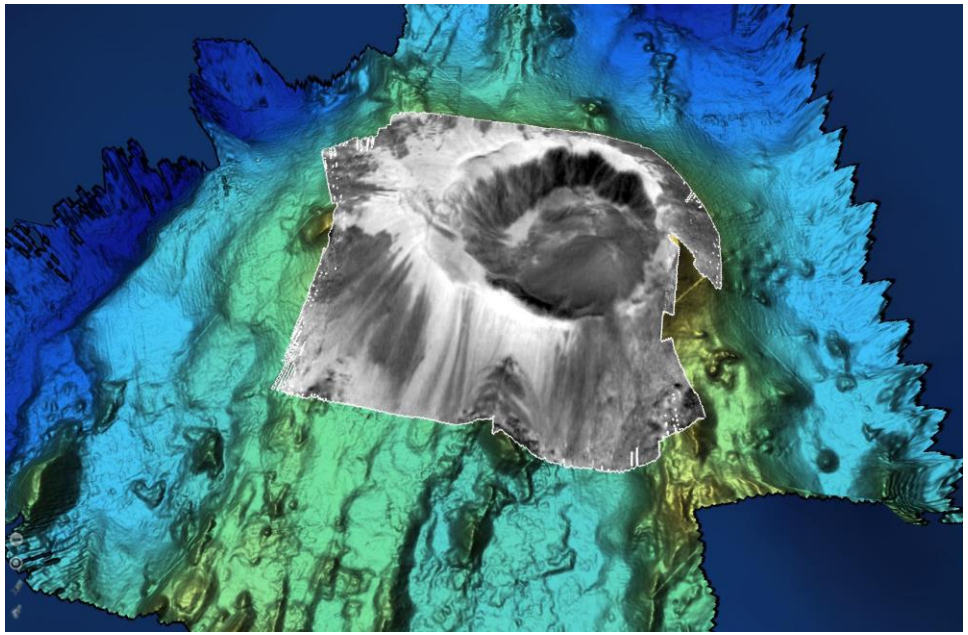
Recent Backscatter Efforts – Recent Workshops

- MAREANO-funded workshop organized by NGU, October 2012; **http://www.mareano.no/en/about_mareano/activities/workshop_trondheim_2012**
- MAREMAP Acoustic Data Interpretation Workshop, organized by BGS and Cefas, October 2012



Geoffroy Lamarche, NIWA

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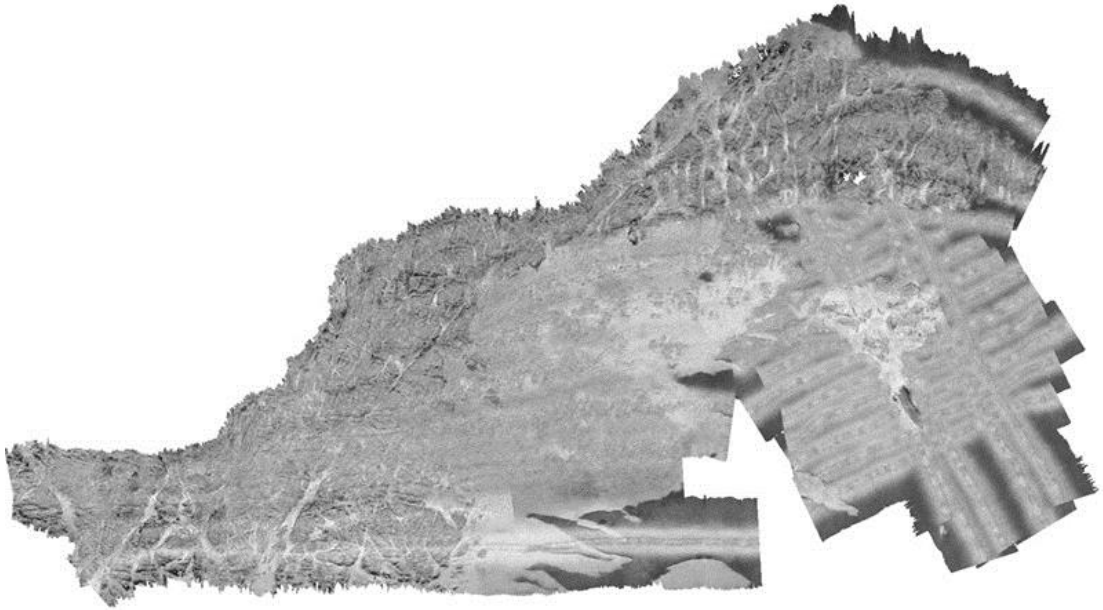
Recent Backscatter Efforts – Challenges & Case Studies

- Processing and managing large volumes of backscatter data from diverse sources (M. Dolan)
- Limitations of using backscatter strength for monitoring (M. Roche)
- Constraining angular response (G. Lamarche, Jean-Marie Augustin)
- Improved acoustic seabed segmentation by combining angular response and spatial information (A. Schimel)



Alex Schimel, Deakin University

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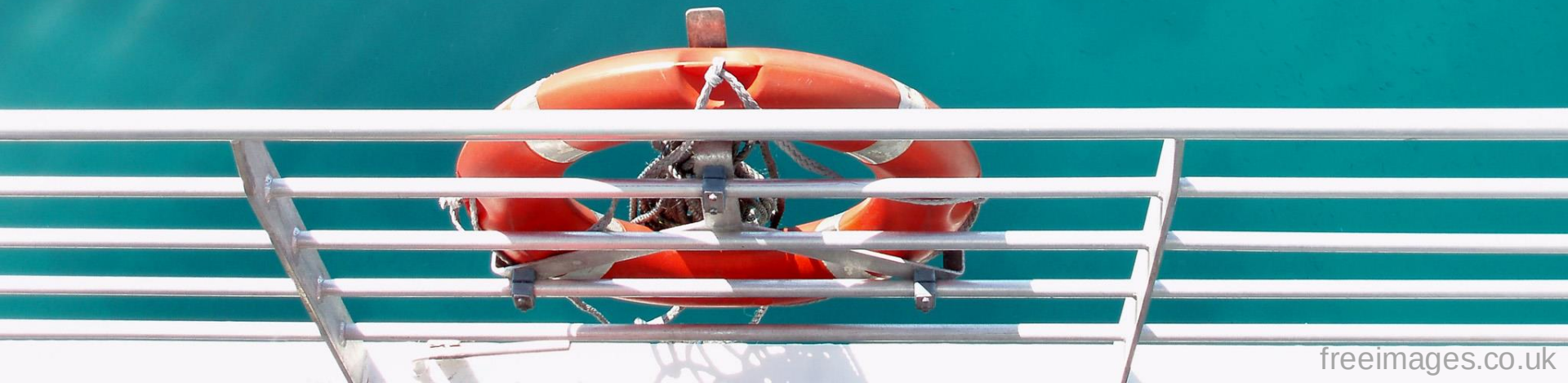
WISH LIST (Margaret Dolan, NGU)

- Common backscatter data **acquisition standards**
- Backscatter vs. Bathymetry optimisation/priority
- Computers/Software for handling large datasets.
- Batch processing/automated workflows
- Easier (quicker) fine tuning of backscatter mosaics
- Direct export from processing software to GIS
- GIS based management of processed mosaics, including levelling to join interpretation/modelling pipeline
- More manpower/time

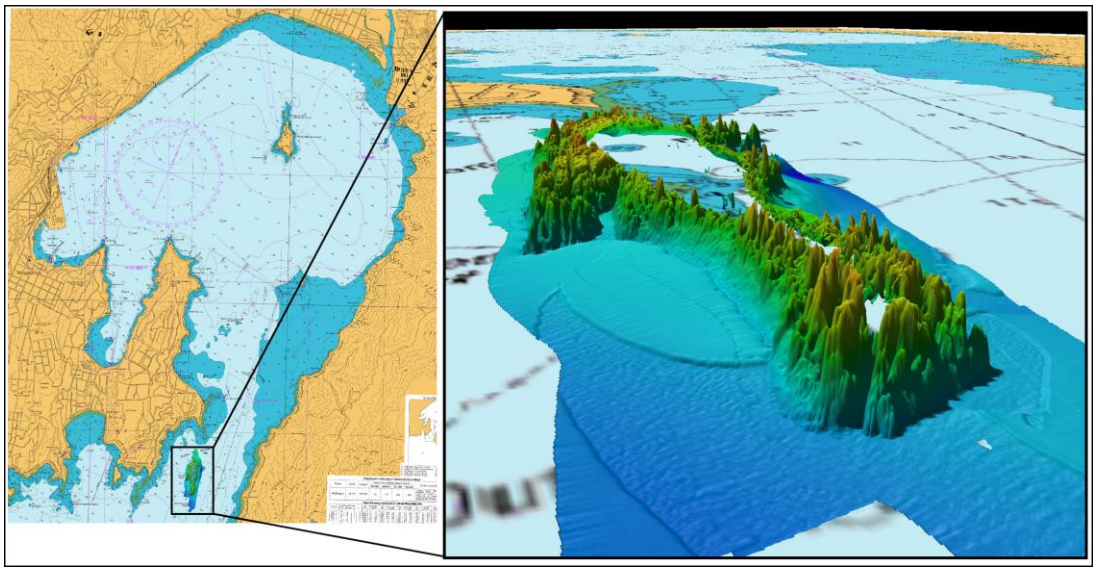


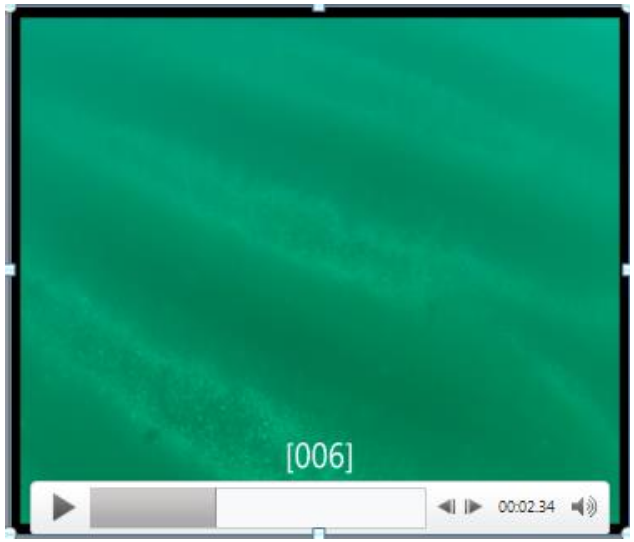
Conclusions (Marc Roche, Economy):

- As for bathymetry, a calibration + quality control **standardized procedure for BS is required asap.**
- Good control on further sources of variation + standard processing procedure are essential.
- Despite good control, the final results remain unclear… What are we measuring?
  - Seabed?
  - Water column (bubbles, turbidity - suspended sediment…)?
  - Antenna state?
- dB values/scale = f(processing software)
  - Restricts dramatically the comparison and exchange of processed BS data between geoscientists.
  - Solution = standardized procedure?

Common Dataset

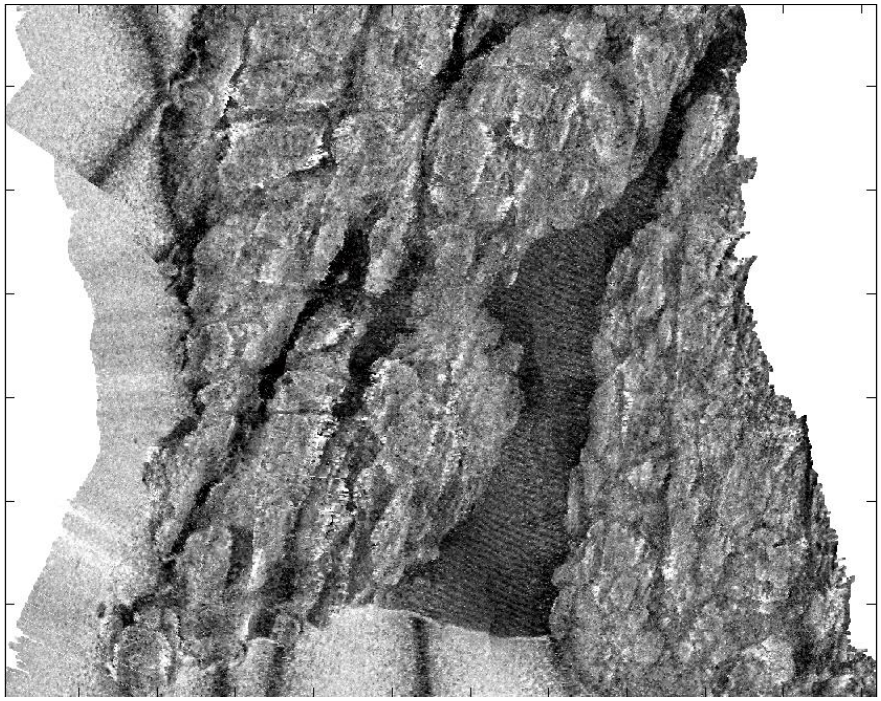
- Multibeam and interferometric bathymetry and backscatter collected in and near Wellington Harbor, New Zealand
- Part of Shallow Survey 2012 dataset
- Ground-truth data collected by Alix Laferriere, Victoria University of Wellington





Common Dataset - Presentations

- Mosaic generation, signal-based characterization generation in FMGT; breaking up the processing and opening up software to plug-ins
- Supervised classification using SonarScope
- Semi-automated classification with ArcGIS, expert interpretation
- Object-based image analysis
- GEOBIA optimization



Arne Pallentin, NIWA

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Moving Forward

- Backscatter still has a **strong interest** from users
  - Demonstrated by 90+ attendants
  - Variety of users, application and scale…
- Manufacturers are now making stronger effort on BS acquisition/preprocessing/delivery/format. Yet the manufacturer still not sure as to **what the users want**.
- **Scale of work** is critical and equipment does not always adequately used. Overkill is just as much as issue as underperformance. Do we need grain size precision for harbour development?

Moving Forward

What Do We Do from here ?

- Calibration of data
  - What methods ? Natural/manmade reference, basin calibration, post survey?
  - Tough one…

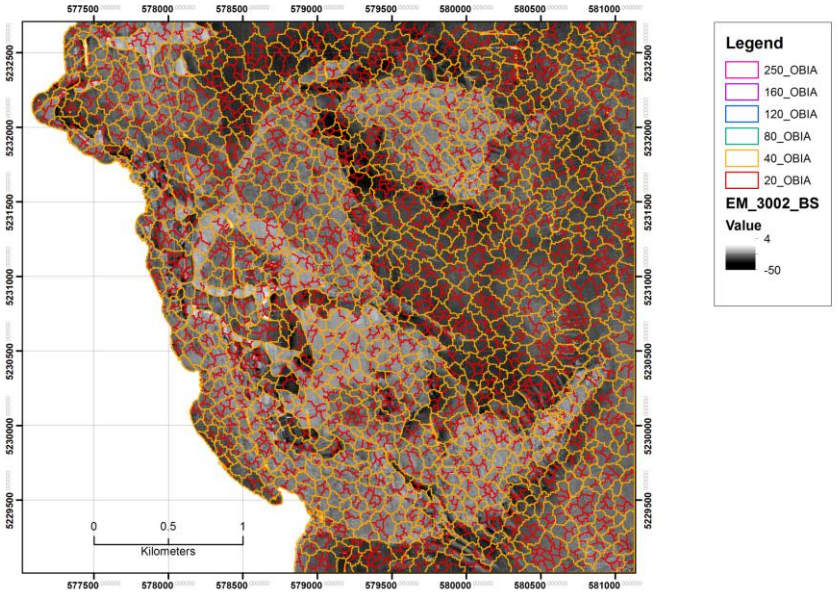
- **Standardisation of acquisition / processing**
  - Need a core group of people representative of users and manufacturers to start working on the issue for next year Geohab to suggest a standardisation of Backscatter acquisition/processing procedure
  - Who is interested to take the lead? Xavier is the 1st name that come to mind of course!
  - What Timeline? Presentation (flowchart/recommendation) at next Geohab?
- **Is it time for another special issue on BS?**
  - Special issue of Marine Geophysical Researches - Backscatter Standardization
  - Pursue further processing of Common Dataset?
  - Timeline: Geohab next year for final paper?

Workshop Materials

- Common Dataset
  - Contact Shallow Survey 2012 committee
  - EH has some data here or can get to you (full dataset needs TB drive)
- Ground Truth Data
  - EH can provide you with download links, requires no-disclosure
- Presentations
  - Working on making them available! Answer by end of GeoHab

Acknowledgements

- GeoHab organizers for accepting our workshop proposal
- Workshop presenters, especially Common Dataset
- Keynote Speaker, Xavier Lurton
- Alix Laferriere, collection of ground-truth data
- Attendees – difficult place to sit inside all day!
- Fellow workshop organizers



Vanessa Lucieer, IMAS

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