

Drowning in backscatter?

The challenges of processing and managing large volumes of backscatter data from diverse sources – experiences from Norway

*and a summary of the MAREANO
International Workshop on Seabed Mapping Methods
and Technology, Trondheim, Norway, October 2012*

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MAIN MULTIBEAM VESSELS OPERATING IN NORWAY



HU Sverdrup (FFI)



Hydrograf (NHS)



Sjøtroll (NHS)



Sjøfalk (NHS)



Nøkken (FFI)



FF Seisma (NGU)



MV Karoline (FOSAE)



Fugro Gauss (FOSAE)



Helmer Hansen (UiT)



GO Sars (IMR)



MV Victor Hensen (FOSAE)



Franklin (MMT)

+ older vessels + other institutes + other contractors + oil company surveys



MAIN MULTIBEAM SYSTEMS USED IN NORWAY SINCE MID 1990s



EM100 (FFI)



EM3000
Hydrograf (NHS)



EM3002
Sjøtroll (NHS)




Seabat 8125
Sjøfalk (NHS)



EM1000
Nøkken (FFI)



EM1002
FF Seisma (NGU)



EM710
MV Karoline (FOSAE)



EM2040
Fugro Gauss (FOSAE)



EM300
Helmer (JIT)



EM302 (IMR)



GeoSwath
MV Victor Hensen (FOSAE)



WASSP
Franklin (MMT)

+ older vessels - other institutes

- Each with different operators/settings



SOFTWARE USED FOR BACKSCATTER PROCESSING SINCE 2006 (NGU)

Kongsberg Neptune/
Poseidon

GeoSwath

WASSP (Olex)

Geological Survey of Canada
Software (Courtney)

FM GeoCoder

+ data processed by
others

+ older vessels + other institutes + other contractors + oil company surveys



data volume/delayed delivery

time/manpower

**cruise/product
delivery deadlines**

backscatter processing challenges

**'best possible'
backscatter mosaic**

**backscatter processing
distinct from acquisition
and bathy processing pipeline**

**'bad data',
software bugs**





EM1002 5-20 GB Raw data typical survey

EM710 30-70GB Raw data typical survey

Data volumes

+ processed data size increased with hi-res



MAREANO over 100 000 km² and growing fast

Areal coverage





EM1002 5-20 GB Raw data typical survey
EM710 30-70GB Raw data typical survey

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MAREANO over 100 000 km² and growing fast

Areal coverage

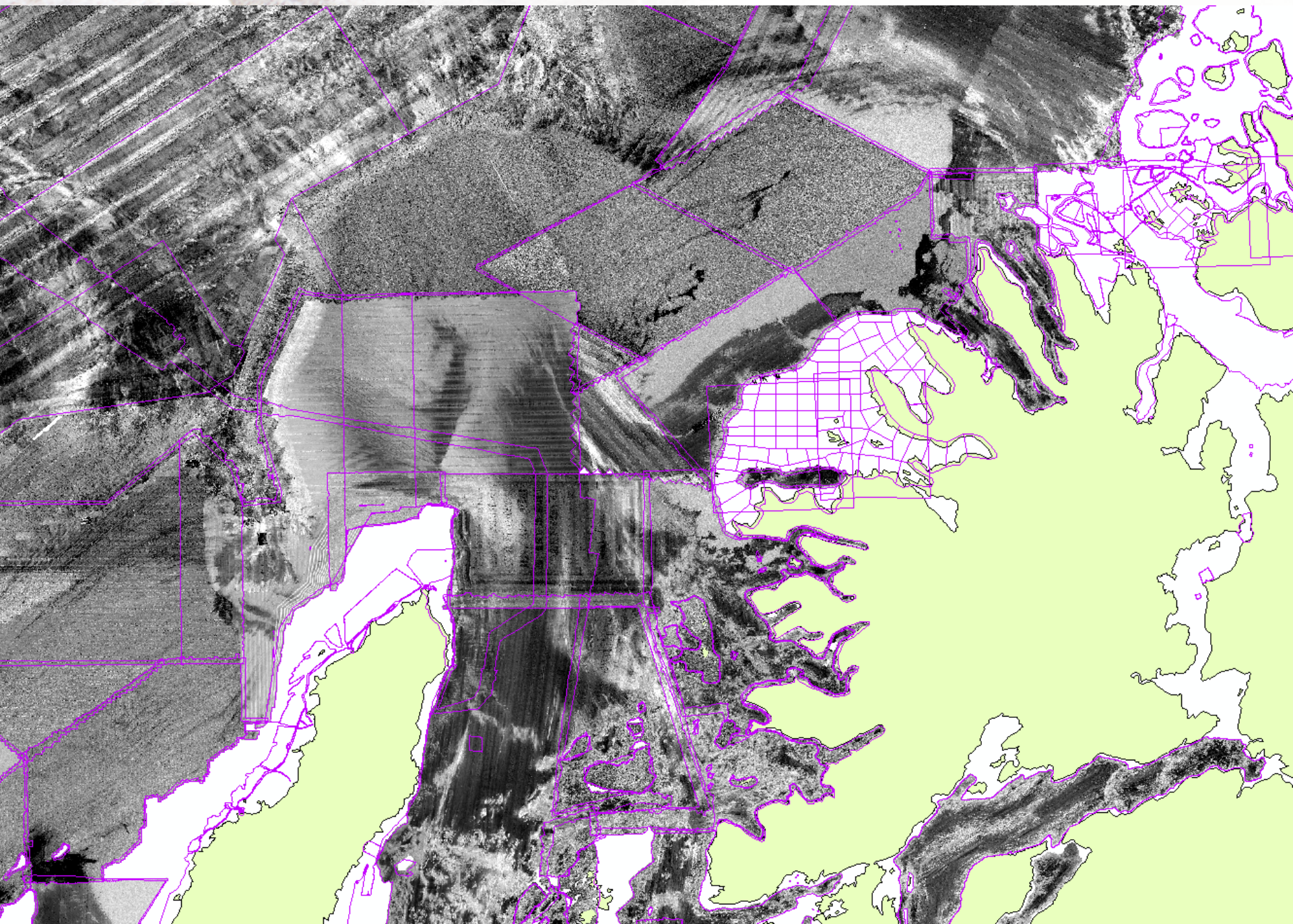


Geological Survey!

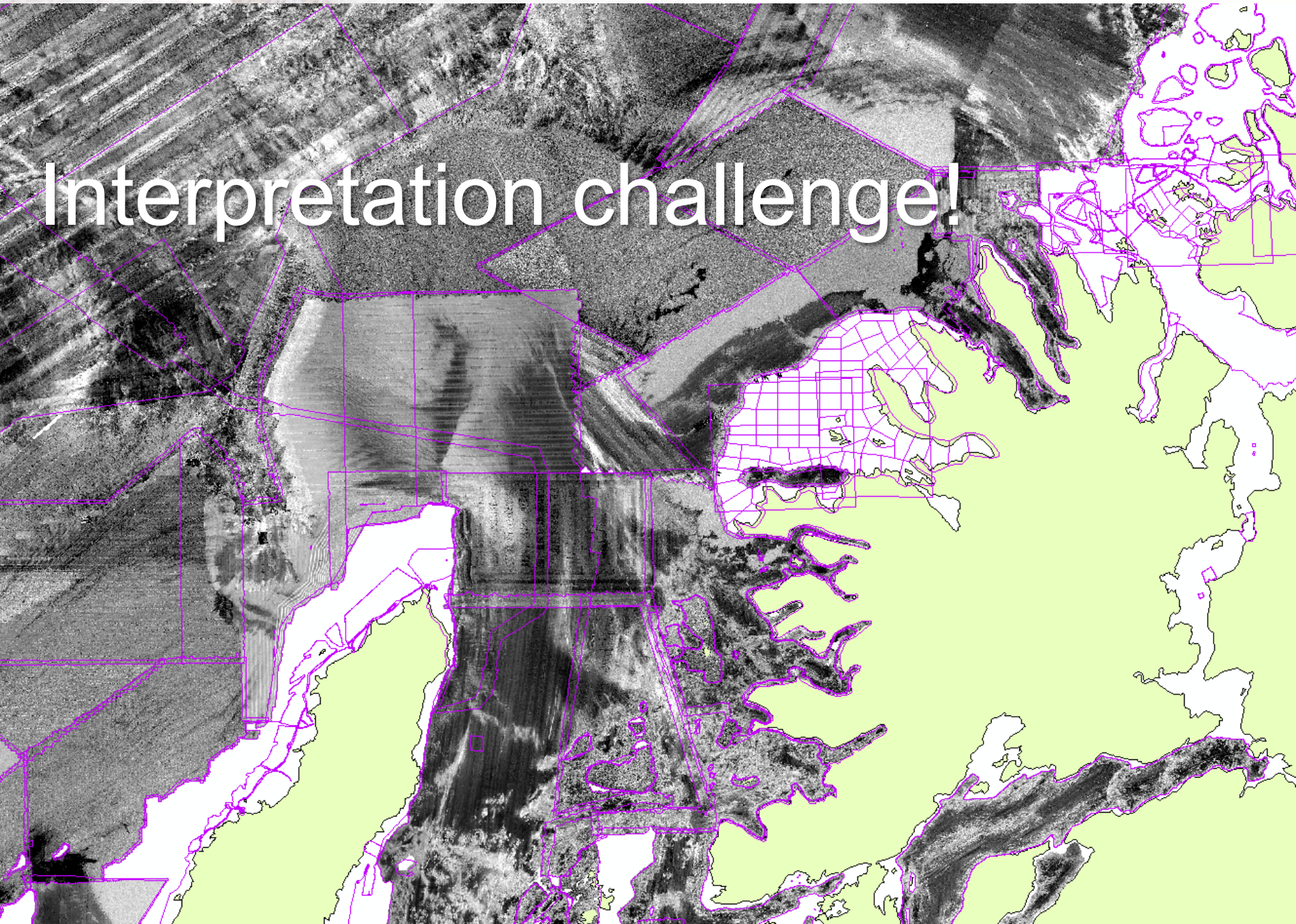
IT/GeoData shock cf. land data

...learn to swim 

BACKSCATTER PATCHWORK



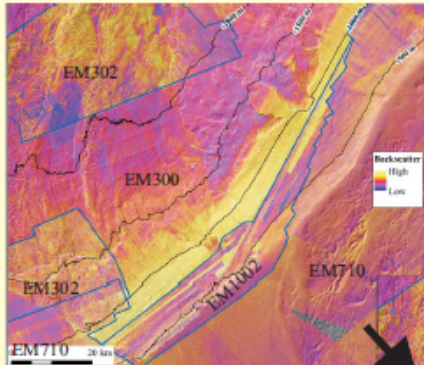
Interpretation challenge!



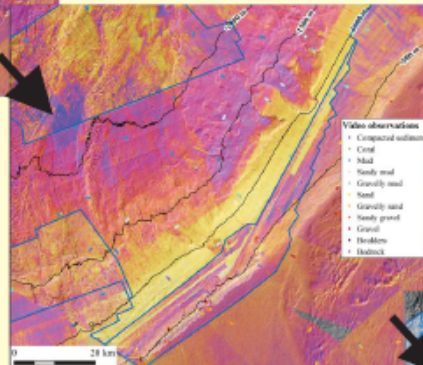
Penetration depth/scattering processes vary

Creating seabed sediment map from the continental shelf to the deep areas

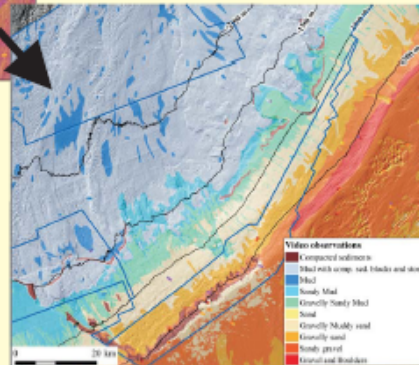
Creating seabed sediment maps based on backscatter data is a challenge as different frequency multibeam systems are used dependant on water depths, creating different acoustic responses for the same bottom types. In our areas, EM710, EM1002, EM300 and EM302 multibeam systems have been used to create geological maps.



Every backscatter mosaics have their own values, even if the same gear is used due to different acquisition and environmental parameters. Moreover, higher differences in values occur between the different multibeam systems. For example, EM300 signal can penetrate up to 8 m mud in certain conditions (Kongsberg communication), which mean at least 1-2 m in normal conditions. EM710/EM1002 have less penetration (less than 50 cm in mud). EM300 system shows a higher variability than EM710 in deep areas, and higher backscatter values than expected. This variability is not observed everywhere at the sea bottom with the video gear.



In fact, some video lines show homogeneous mud with very little coarse sediments due to slide deposits whereas backscatter values are higher than in muddy seabed. This can be explain by the fact that the signal penetrates the 1 or 2 m of mud which covers coarser sediments. The return signal is a mixed signal between the mud coverage and the underlying coarse sediments.



Indeed, in this area the bottom type corresponds to a mixture of catastrophic events (slides, turbidites, debris flows) and hemipelagic mud at depth deeper than -1000 m. In some places, the hemipelagic mud covers entirely slide or debris flow deposits. When the mud cover is thick, the backscatter values are low and the bottom sediment type has been interpreted as mud. When the mud cover is thin or do not exist, the backscatter values are higher. Then the bottom sediment type has been interpreted as a thin layer of mud partly covering compacted sediment blocks, gravel and stones coming from slide deposits and a new class has been created to fit this interpretation: Mud with compacted sediment blocks and stones.

From **Bellec et al.**
Revealing habitats,
surficial geology and
seabed processes of
Norway's continental
slope and deep sea
plain. **GeoHab 2013
poster**



AUTOMATED CLASSIFICATION TECHNIQUES TRIALED BY NGU

SEDIMENT CLASSES!

DATA VOLUME!

Amplitude Versus Angle (AVA)
(Christensen et al.)

Kongsberg Triton

QTC Multiview

FM GeoCoder ARA

CALIBRATION OF RESULTS!

GeoSwath

Geological
Software (Courney)

EM2040

FM GeoCoder

WASSP

GeoS

EM300

WIT

EM300

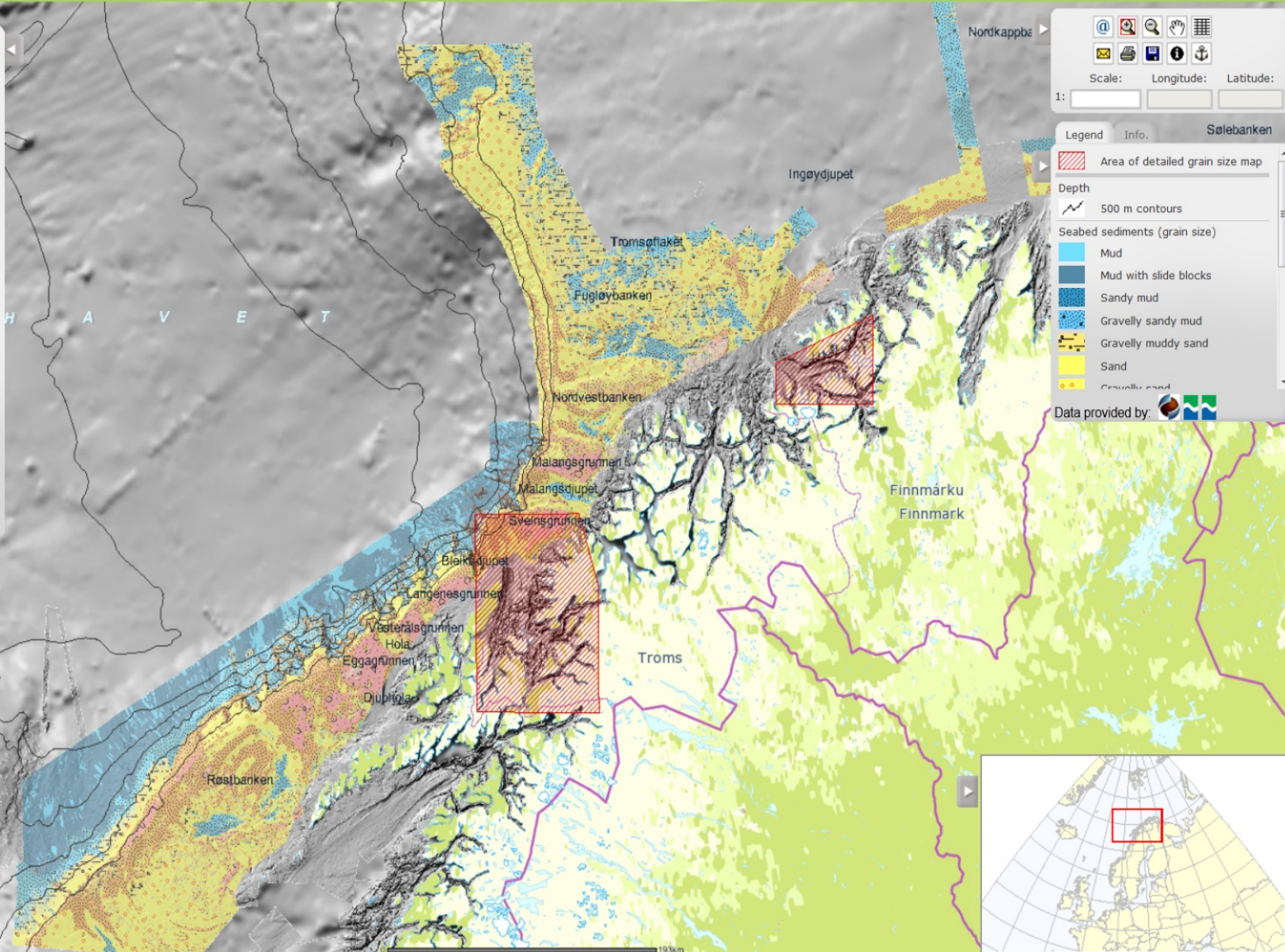
+ older vesse

+ other contractors

+ all company surveys

Sediment grain size by expert interpretation

- Preset Maps Select Themes
- MAREANO and management plans
 - MAREANO images
 - Bathymetry
 - Seabed and Watermasses
 - Landscapes and Land Forms
 - Acoustic Backscatter
 - Sediments (grain size)**
 - Sediments (genesis)
 - Sedimentary environment
 - Ocean currents
 - Sediments from video
 - Biodiversity and Habitats
 - Stocks
 - Environmental chemistry
 - Industrial activity
 - Miscellaneous
- Keep chosen area
- Zoom to Area ---



Scale: Longitude: Latitude:

1: [] [] []

Legend Info Solebanken

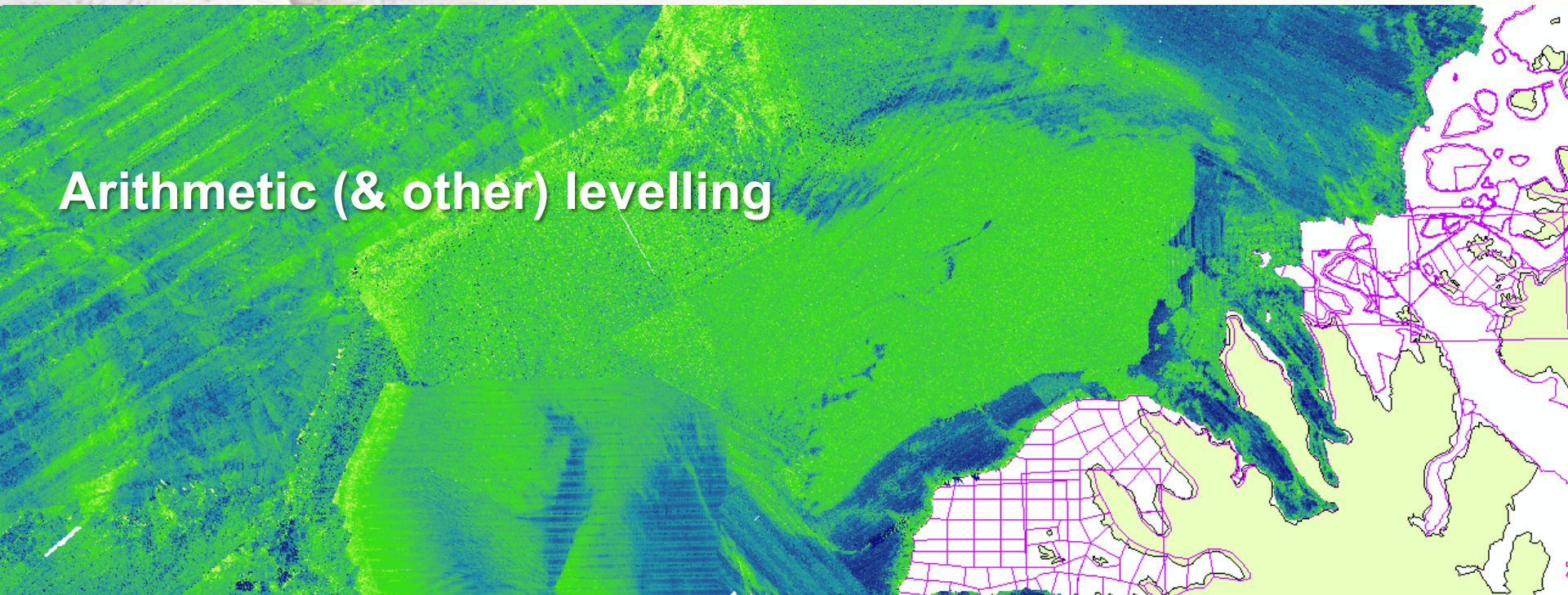
- Area of detailed grain size map
- Depth
 - 500 m contours
- Seabed sediments (grain size)
 - Mud
 - Mud with slide blocks
 - Sandy mud
 - Gravelly sandy mud
 - Gravelly muddy sand
 - Sand
 - Gravelly sand

Data provided by:



BACKSCATTER DATA PRESENTATION CHALLENGE

Arithmetic (& other) levelling



mareano
MAREANO - OVERVIEW

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Ferdige kart Lag ditt eget kart

- MAREANO and management plans
 - MAREANO - overview
 - Mapping - completed/planned
 - MAREANO-stations
 - Oil and gas
 - Specially valuable areas
- MAREANO images
 - Bathymetry
 - Seabed and Watermasses
 - Landscapes and Land Forms
 - Hard and Soft Bottom
 - Sediments (grain size)
 - Sediments (genesis)
 - Sedimentary environment
 - Ocean currents
 - Sediments from video
 - Biodiversity and Habitats
 - Stocks
 - Environmental chemistry
 - Industrial activity
 - Miscellaneous

Behold valgt område

--- Zoom til område ---

Norokkappbanken
Ingøydjupet
Djuprenna
Tromsøflaket
Fugleybanken
Nordvestbanken
Malanggrunnen
Malangsdjupet
Sveinsgrunnen
Blektdjupet
Langenesgrunnen
Våleralsgrunnen
Høla
Egggrunnen
Djupstø
Troms
Finnmärke
Finnmark

Målestokk: Lengde: Bredd
Sel 1: 2631772 6° 30'2" 70° 55'

Tegnforklaring Info

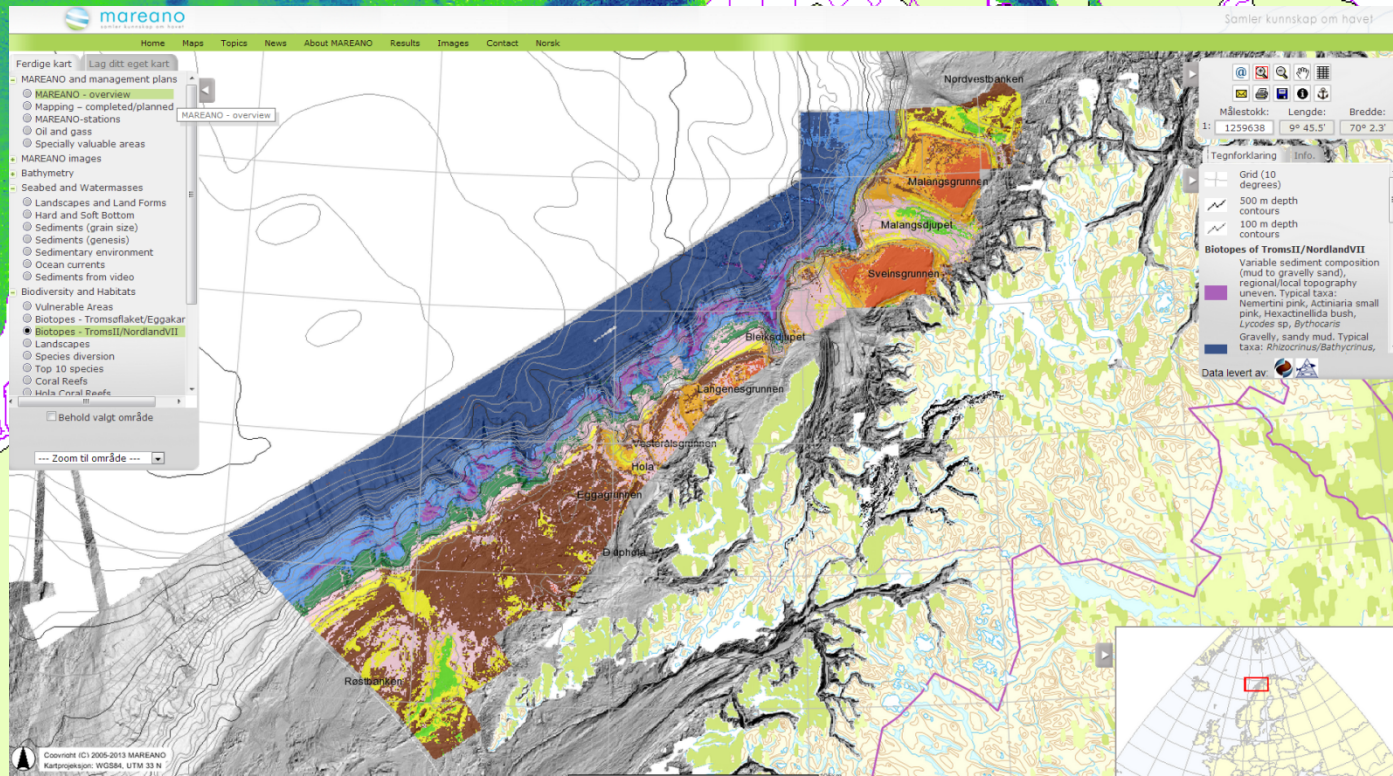
- Grid (10 degrees)
- 500 m depth contours
- 100 m depth contours
- Acoustic backscatter from multibeam echosounder data (indicates hard and soft bottom)
- Harder bottom
- Softer bottom

Data levert av

FURTHER USE OF DATA CHALLENGE – e.g. habitat modelling

Levelling essential

Varying quality/uncertainty in composite backscatter mosaic



DATA MANAGEMENT CHALLENGES

RAW DATA
STORAGE

PROCESSED DATA
FOR NGU

EXTERNAL DATA
DELIVERY



DATA MANAGEMENT CHALLENGES

Confidential data

Different data delivery protocols
from different institutes/contractors

RAW DATA STORAGE

Terrabytes +

Networks



DATA MANAGEMENT CHALLENGES

Access to original and levelled data

PROCESSED DATA FOR NGU

Terrabytes +

Networks

Modelling

Interpretation

Training

ArcGIS
Raster Catalog



ArcGIS
Mosaic Dataset...

ArcGIS for
Maritime: bathymetry?



DATA MANAGEMENT CHALLENGES

ArcGIS

Mosaic Dataset?

Viewing and download solutions

Access to original
and levelled data

EXTERNAL DATA DELIVERY

Terrabytes +

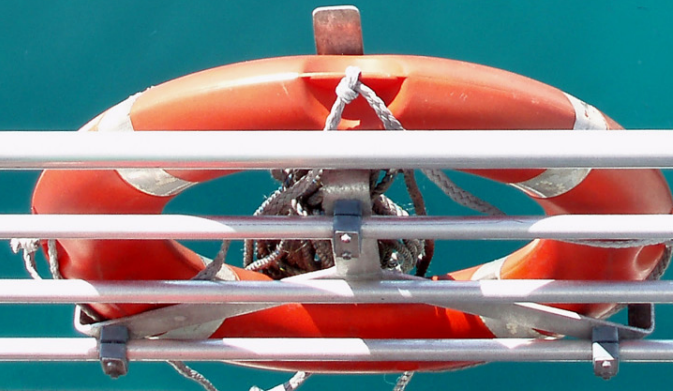
Varying user knowledge

Different user requirements



WISH LIST

- 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



[News 2013](#)

[News 2012](#)

[News 2011](#)

[News 2010](#)

[News 2009](#)

Successful workshop on seabed mapping methods and technologies

State-of-the-art and new developments in methods and technologies for mapping the hydrography, geology and biology of the seabed were the subjects for a workshop on seabed mapping methods and technologies held in Trondheim, Norway 17-18 October.

Published: 11.12.2012

MAREANO funded workshop organized by the Geological Survey of Norway, the Institute of Marine Research and the Norwegian Hydrographic Service.

- Maximising the output from acoustic investigations
- Visual tools for non-destructive sampling
- Benthic biological sampling and data management
- Integration, modeling and dissemination of complex data

Over 20 presentations; 100 participants from 12 countries



Samler kunnskap om havet

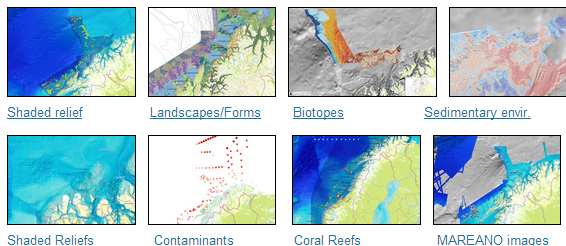
The Sea in Maps and Pictures



MAREANO maps depth and topography, sediment composition, contaminants, biotopes and habitats in Norwegian waters. The results of the surveys are available on this website, visualised through maps. A number of our partners also supply data and maps from their own studies.

- [Photos from the seafloor](#)

Maps:



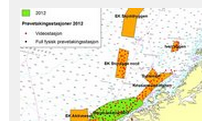
Shaded relief Landscapes/Forms Biotopes Sedimentary envir.
Shaded Reliefs Contaminants Coral Reefs MAREANO images

Lately updated maps:

- Environmental chemistry: [BDE-209](#) [07.03.13]
- Environmental chemistry: [Sum PBDE levels](#) [07.03.13]
- [Biotopes Tromsøfaket and Eggakanten](#) [12.02.13]
- [Coral Reefs](#) [21.01.13]



News



The MAREANO surveys 2013
[03.05.13]



Dancing squid
[12.04.13]

The mid-Norwegian shelf. A fascinating landscape
[20.02.13]

Updated biotope map published for Tromsøfaket-Eggakanten
[12.02.13]


Grant of 2.6 mill Nkr to identify new bristle worms
[07.12.12]

Successful workshop on seabed mapping methods and technologies
[16.11.12]

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About MAREANO

Partners

Activities

Workshop Trondheim
2012

Workshop Trondheim 2012

Published: 28.11.2012

International workshop on seabed mapping methods and technology, Trondheim 17th-18th October 2012

Søk



http://www.mareano.no/en/about_mareano/activities/workshop_trondheim_2012

PDF copies of most presentations available

Session 1 - Maximising the output from acoustic investigations.

Chair: Peter Harris, Hanne Hodnesdal

9:45 [Acoustic data acquisition in MAREANO – an overview.](#)

Hanne Hodnesdal from Norwegian Hydrographic Service, Norway

10:25 [An overview of the use of acoustic data for geology and habitat mapping in MAREANO.](#)

Margaret Dolan, Valerie Bellec, Sigrid Elvenes, Reidulv Bøe, Terje Thorsnes, Shyam Chand, Leif Rise, Monica Winsborrow, NGU, Norway

10:45 [Multiple methods, maps, and management applications: Purpose made seafloor maps in support of ocean management.](#)

Craig Brown, McGregor Geoscience, Canada

11:15 [AUV's equipped with Synthetic Aperture Sonar and other tools – a new tool for detailed seabed mapping.](#)

Terje Thorsnes, Harald Brunstad, Petter Lågstad, Shyam Chand and Aivo Lepland, NGU/Lundin Petroleum/Norwegian Defence Research Institute, Norway

11:35 Maximising Information from Seabed Acoustic Data using New Inversion and Classification Techniques.

Garret Duffy, Klaus Leurer, Maja Fabeta and Colin Brown, National University of Ireland, Ireland

13:00 [Advancing quantitative techniques for the generation of acoustic variables to characterise seabed habitats.](#)

Vanessa Lucieer, University of Tasmania, Australia

13:30 [INFOMAR, meeting the survey challenges in Ireland's inshore.](#)
Sean Cullen and Ronan O'Toole, Geological Survey of Ireland, Ireland

