

# Are my Data Sufficient? On the Development of Quality Metrics

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## Thanks for the support to the questionnaire and supply of data

Based on the delivered data several key challenges were identified:

- Structure and management of data
- Quality assessment
- Interpretation and analysis

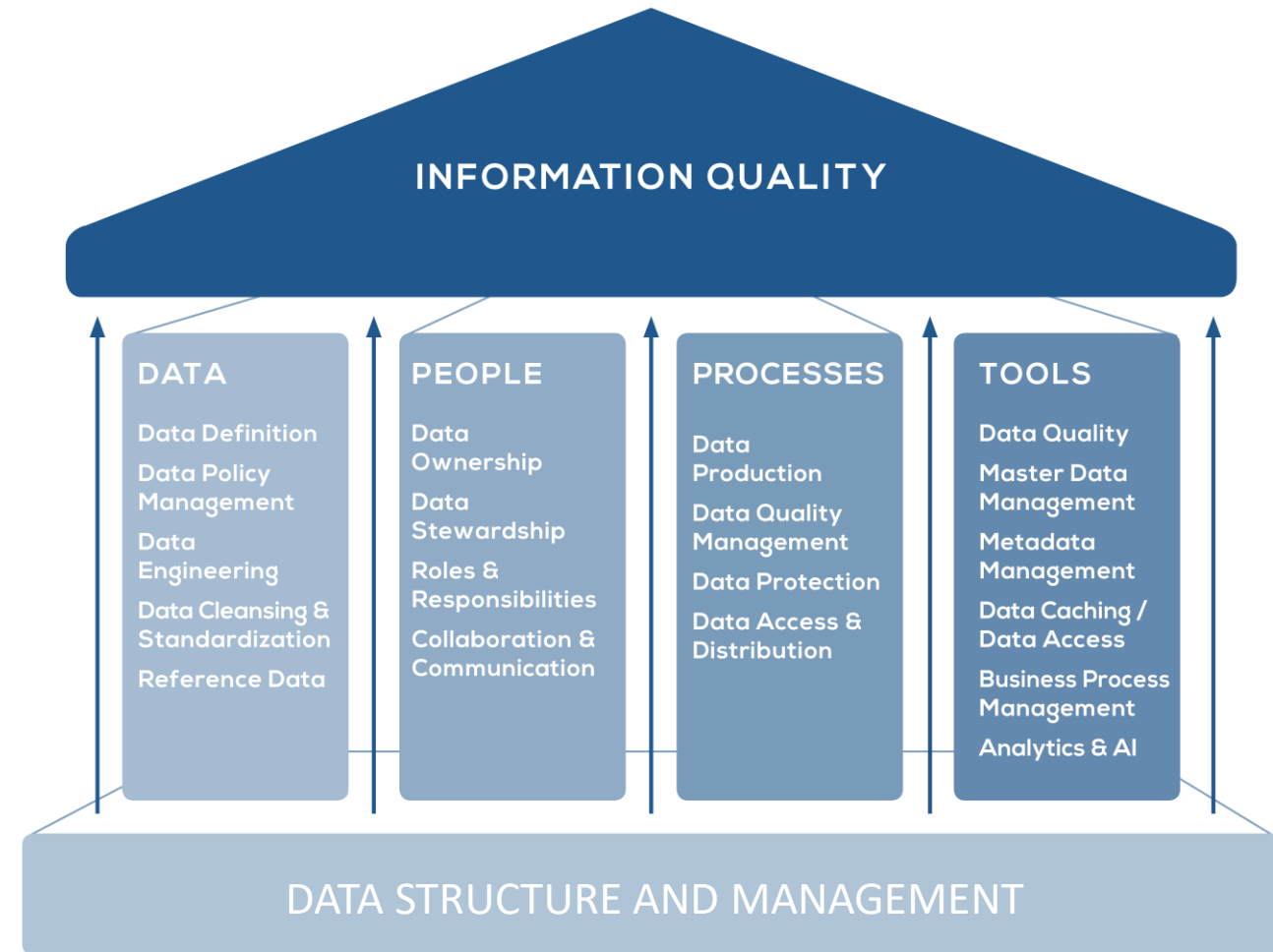


## Data structure and management

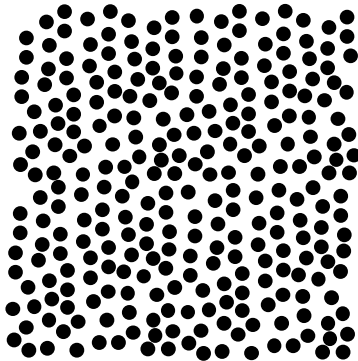
- solid foundation enables all further steps
- several necessities to reach high a level of information quality

## Why data quality metrics?

- Option 1: planning based on „standards“
- Option 2: review of measured datasets

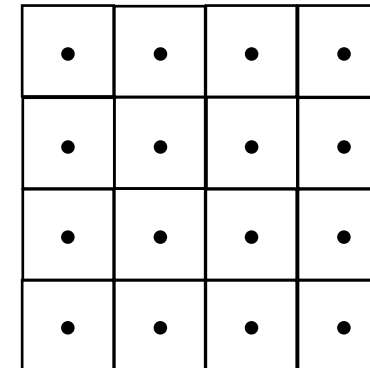


**Point cloud**  
**(raw or processed data)**



- entire dataset
- full information
- large data sizes
- **required to compute data quality parameter**

**Raster**  
**(grid or image data)**



- reduced data
- information loss (e.g. color values in images)
- reduced data sizes

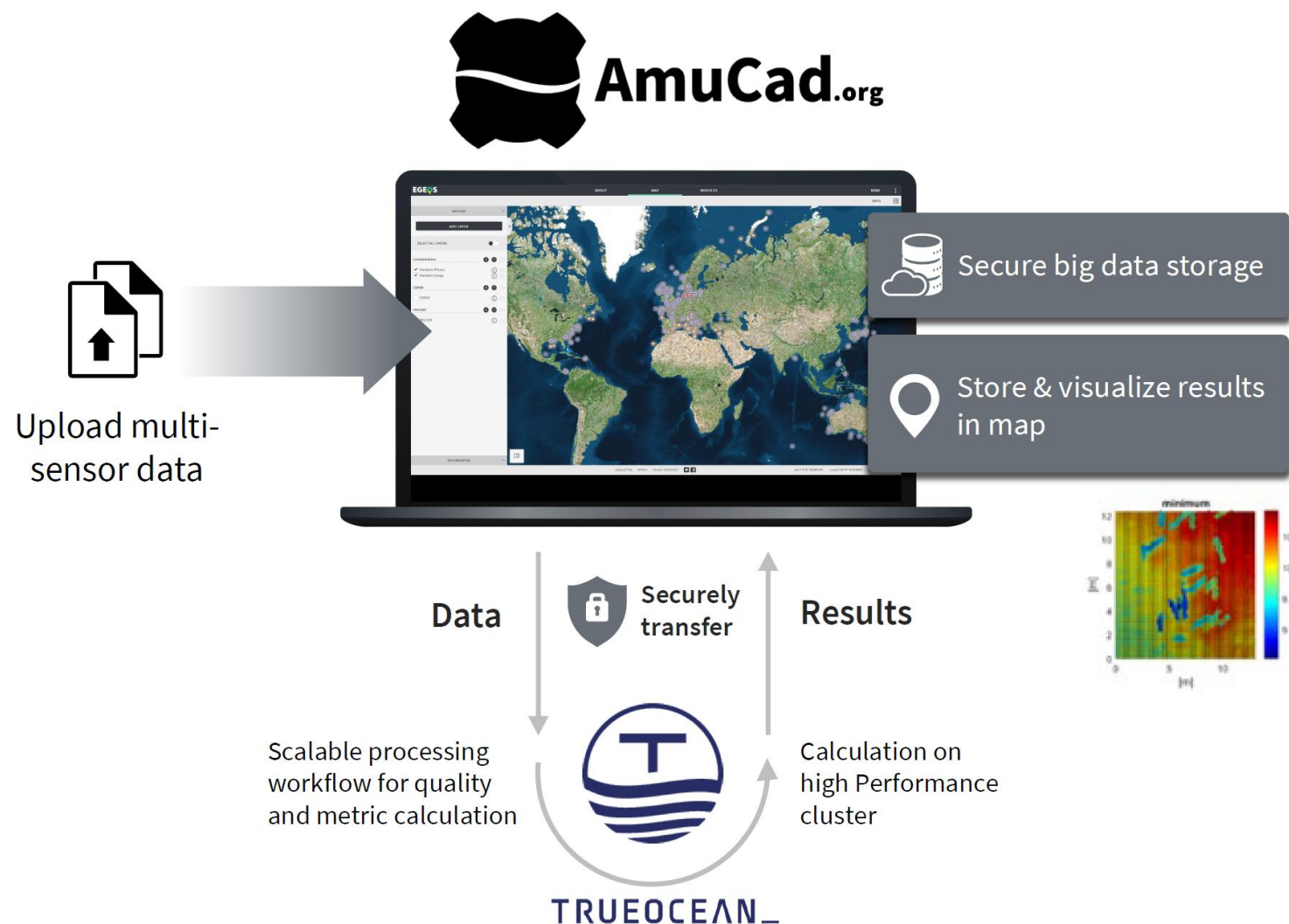
## Software-as-a-Service-Platforms

The software developed in the BASTA project will be integrated into the Ammunition Cadastre Sea platform (AmuCad.org). For the underlying large-scale data processing the technologies of TrueOcean will be used to enable:

- Data management and storage
- Data processing
- Data interpretation
- Data visualization

AmuCad.org under: <https://www.AmuCad.org>

TrueOcean under: <https://www.trueocean.io>



Data Upload

Data Storage

Preprocessing

Target

Quality metrics

Postprocessing

Artificial Intelligence

Visualization

## Challenges

Data and metadata standards

- FAIR principles are suggested

Data upload and management concepts

Big Data

- Storage solutions
- Processing solutions

Heterogeneity

- variety of measurement systems
- multiple file types



<https://www.go-fair.org/>

- **Findable**
- **Accessible**
- **Interoperable**
- **Reusable**

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## Target Definition

- Defining the target object for determination of quality parameters with e.g.:
  - size
  - burial depth
  - magnetic properties

AmuCad

ABOUT MAP DATABASES MENU

Ammunition Types

### EDIT AMMUNITION TYPE

Name of Ammunition Type: Einheitsmine A (EMA)

Origin: german

Category: Sea mines

Sub Group: Moored mines

Purpose:

Origin of Reproduction: ☐ Reproduction available

Gross Weight: kg 68.018 kg

Net Explosive Mass: 149.954 lbs

Height: 296. cm 116.839 inch

Width: cm

Depth: cm

Diameter: 219. cm 86.358 inch

Wall Thickness: cm

Source Type: Select...

Description: The EMA Mine. The EMA was developed during World War I and was the first German mine with a chemical-horn firing system. Accordingly, to differentiate it from the pendulum-type mines then in use, it was designated Elektrische Mine Tyne A. Its production was

Components:

Anchor: Select...

Fuze: Select...

Charge: Select...

Material: Select...

Safety Mechanism: Select...

Pictures Drawings Datasheets

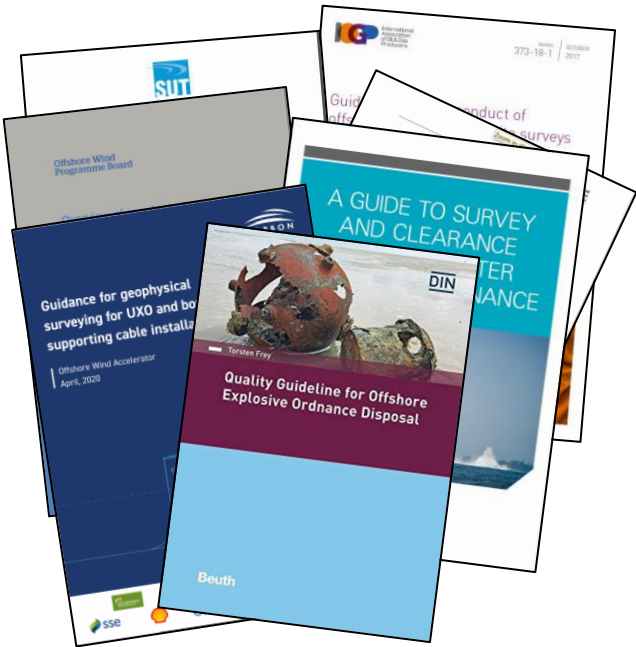
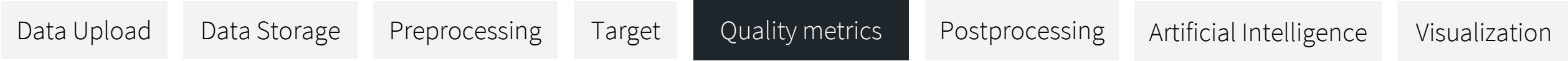
SHOW ALL PICTUREBLOAD

Preview	Name	Description	Source	Security level	Date
	EMA.jpg		1	07.12.2020	

1

CANCEL SAVE

EGEOS NEWSLETTER IMPRINT PRIVACY STATEMENT



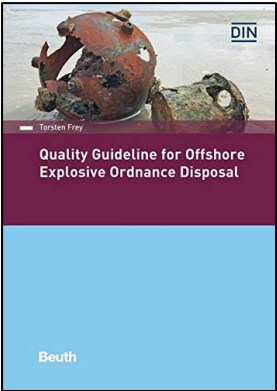
Questionnaire to experts

		Reference Object									
		GP 200 to 500 m (position: GLE)		GP 500 to 1000 m (position: LNA)		GP 1000 to 2000 m (position: LNA)		GP 2000 to 3000 m (position: LNA)		GP 3000 to 4000 m (position: LNA)	
Parameter	Variable	Unit	GP 200 to 500 m (position: GLE)	GP 500 to 1000 m (position: LNA)	GP 1000 to 2000 m (position: LNA)	GP 2000 to 3000 m (position: LNA)	GP 3000 to 4000 m (position: LNA)	GP 4000 to 5000 m (position: LNA)	GP 5000 to 6000 m (position: LNA)	GP 6000 to 7000 m (position: LNA)	GP 7000 to 8000 m (position: LNA)
Current direction	$\theta$	[deg]	0-90	0-90	0-90	0-90	0-90	0-90	0-90	0-90	0-90
True mass	$m$	[kg]	10-5	10-5	10-5	10-5	10-5	10-5	10-5	10-5	10-5
True explosion mass	$m_{exp}$	[kg]	10-5	10-5	10-5	10-5	10-5	10-5	10-5	10-5	10-5
True field amplitude at 100 m	$A$	[dB]	40, 50, 60, 70, 80, 90	70, 80, 90, 100, 110, 120	100, 110, 120, 130, 140, 150	130, 140, 150, 160, 170, 180	160, 170, 180, 190, 200, 210	190, 200, 210, 220, 230, 240	220, 230, 240, 250, 260, 270	250, 260, 270, 280, 290, 300	280, 290, 300, 310, 320, 330
Magnetic moment	$M$	[Am <sup>2</sup> ]	0.0-1.0	1.0-10	10-100	100-1000	1000-10000	10000-100000	100000-1000000	1000000-10000000	10000000-100000000
Explosion depth	$z$	[m]	0-10	10-100	100-1000	1000-10000	10000-100000	100000-1000000	1000000-10000000	10000000-100000000	100000000-1000000000

+

=

Future Workshops



Updated Guideline





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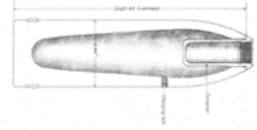
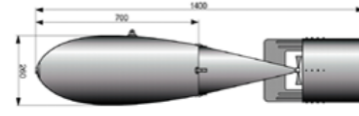
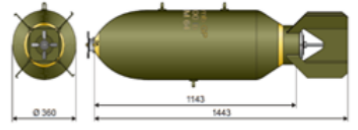

Postprocessing

Artificial Intelligence

Visualization

## Questionnaire - Infos

- Four different types/sizes of munition
  - 155mm shell,
  - GP250,
  - GP500,
  - Bottom Mine MK VI
- 41 parameters were defined for five sensors:
  - Side Scan Sonar (9),
  - Multibeam Echosounder (8),
  - Magnetics (14),
  - Sub-bottom Profiler (10),
  - [Electromagnetics (4)]

Reference Objects	
155mm shell BL Mark VII (nation: GB)	GP 250 lb MK IV (nation: GB)
0.15	0.26
34.9	82
10.5	30
41, 12, 5, 2.5, 2, 1, 0.5	75, 23, 10, 5, 3, 1, 0.5
0.4 -- 2	6 -- 20
1	2
	
Reference Objects	
GP 500 lb M64 (nation: USA)	Bottom mine, Influence, MK VI (nation: GB)
0.36	0.5
158.9	385
68.1	431
300, 91, 40, 20, 12, 5, 2.5	1900, 725, 350, 195, 120, 55, 30
8 -- 80	200 -- 1200
2	3
	

available under: <https://www.basta-munition.eu/software>

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## Questionnaire - Evaluation

- 10 Institutions participated until now
- Responses:
  - 66.8 % with **yes**
  - 17.6 % **too small** values
  - 16.6 % **too large** values
- 12 of 41 parameters with total consensus (answers: **yes**)
- 14 of 41 parameter with no consensus (answers: **yes**, **too small**, **too large**)
- Next steps:** workshops on specified survey methods (spring 2021)
  - people who filled out the questionnaire will be contacted by BASTA, but everyone is welcome

Experience							15				6				4				Geon	
Sensor							Geometrics G882				Geometrics G882				Geometrics G882					
Expert							Yes				Yes				Yes					
Answer based on							Project experience				Calculation				Calculation				Projec	
Data point spacing	$\Delta x$	[m]	$\Delta x \leq d/4$	$\leq 0.04$	$\leq 0.07$	$\leq 0.09$	$\leq 0.13$	Yes	Yes	Yes	Yes	Too small	Too small	Too small	Too small	Too small	Too small	Too small	Yes	Yes
Sensing range	/	[m]	$\leq 4.5$ $\Delta F/B \cdot SN$	$\leq 4.5$	$\leq 6$	$\leq 9$	$\leq 20$	Yes	Yes	Yes	Yes	Too large	Too large	Too large	Too large	Too large	Too large	Too large		
Signal-to-noise ratio	$SN$	[-]	$\geq 3$	$\geq 3$	$\geq 3$	$\geq 3$	$\geq 3$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Height over seafloor	$h_m$	[m]	$h_m \leq h_{f-z}$	3	3	3	3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of sensors (horizontal)	$m_h$	[-]	$\geq 2$	$\geq 2$	$\geq 2$	$\geq 2$	$\geq 2$					Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Too small
Number of sensors (vertical)	$m_v$	[-]	$\geq 2$	$\geq 2$	$\geq 2$	$\geq 2$	$\geq 2$					Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Distance between sensors (horizontal)	$n_h$	[m]	$n_h \leq \frac{\Delta x}{\sqrt{2}}$ $h_{f-z}$	$\leq 4.1$	$\leq 6.6$	$\leq 14.9$	$\leq 38.1$	Too large	Too large	Too large	Too large	Too large	Too large	Too large	Too large	Too large	Too large	Too large	Too large	Too large
Distance between sensors (vertical)	$n_v$	[m]	$\leq 1$	$\leq 2$	$\leq 3$	$\leq 4$	$\leq 5$	Too large	Too large	Too large	Too large	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Line spacing	$n$	[m]	$\leq m_h \cdot n_h$					Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey line length	$L$	[m]	$> 400 \cdot d$					Yes	Yes	Yes	Yes	Too large	Too large	Too large	Too large	Too large	Too large	Too large	Yes	Yes
Horizontal positioning accuracy	$\varepsilon_h$	[m]	$\leq 0.1$					Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vertical positioning accuracy of vessel	$\varepsilon_v$	[m]	$\leq 0.1$					Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Horizontal positioning accuracy	$\delta_h$	[m]	$\leq 1$					Yes	Yes	Yes	Yes	Too large	Too large	Too large	Too large	Yes	Yes	Yes	Yes	Yes
Vertical positioning accuracy of sensor	$\delta_v$	[m]	$\leq 0.2$					Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

available under: <https://www.basta-munition.eu/software>

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Quality metrics

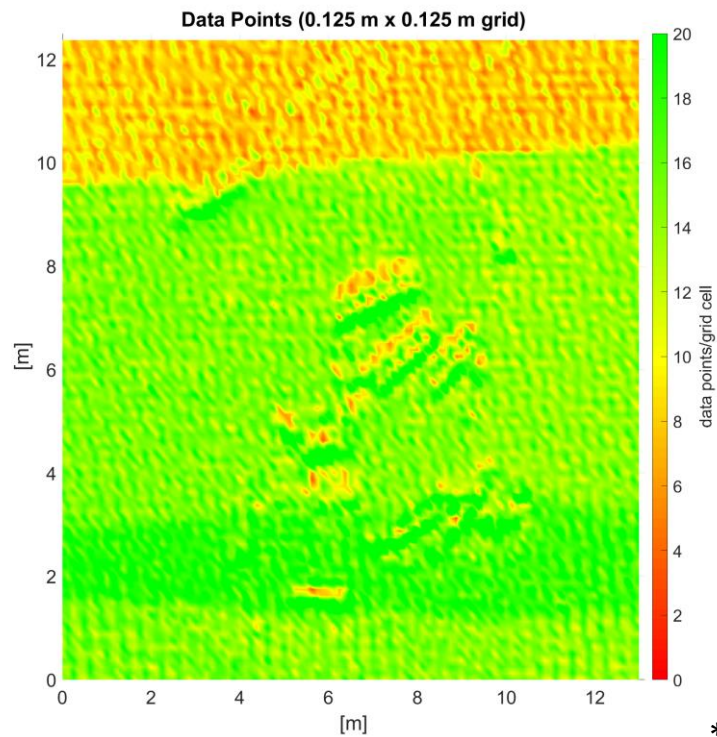
Postprocessing

Artificial Intelligence

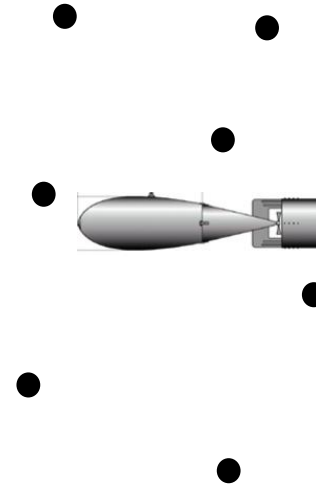
Visualization

## Data Point Spacing

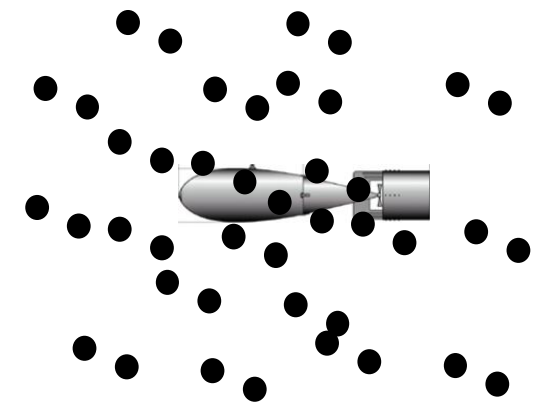
### MBES



### bad



### good



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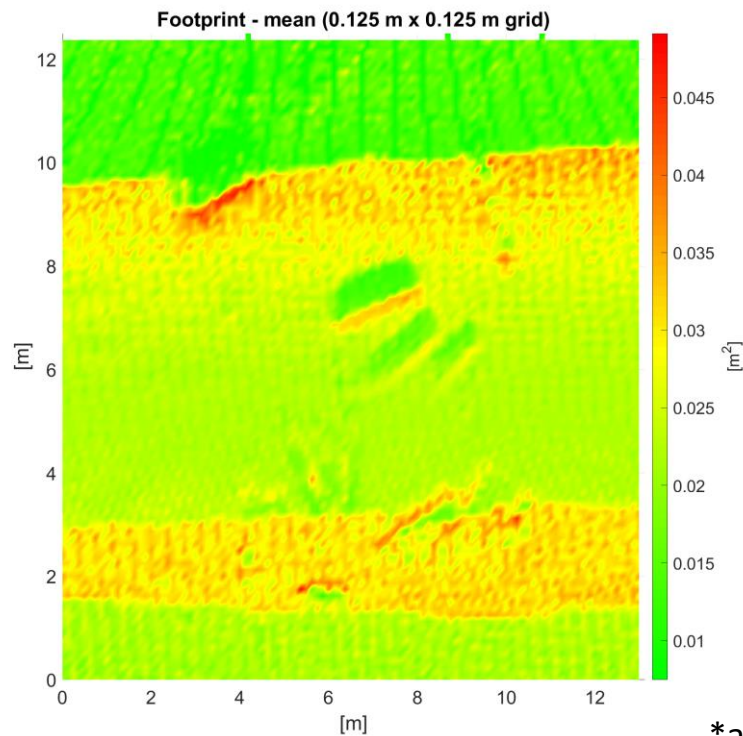
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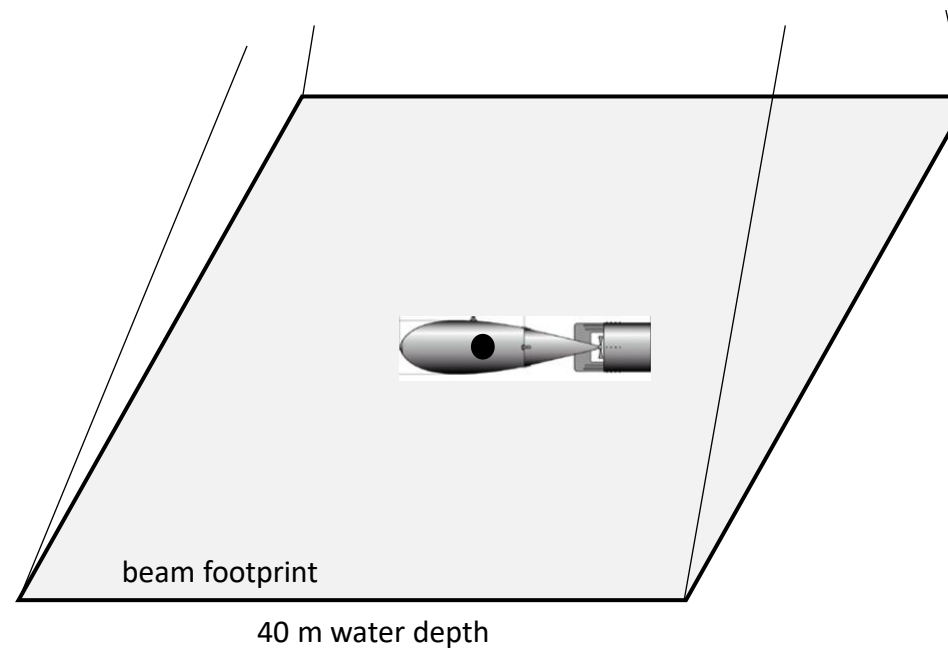
Visualization

## Footprint

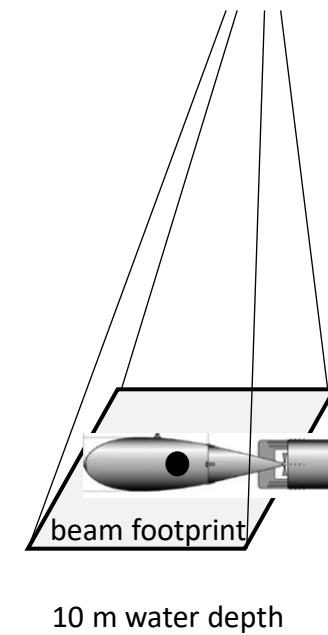
### MBES



### bad



### good



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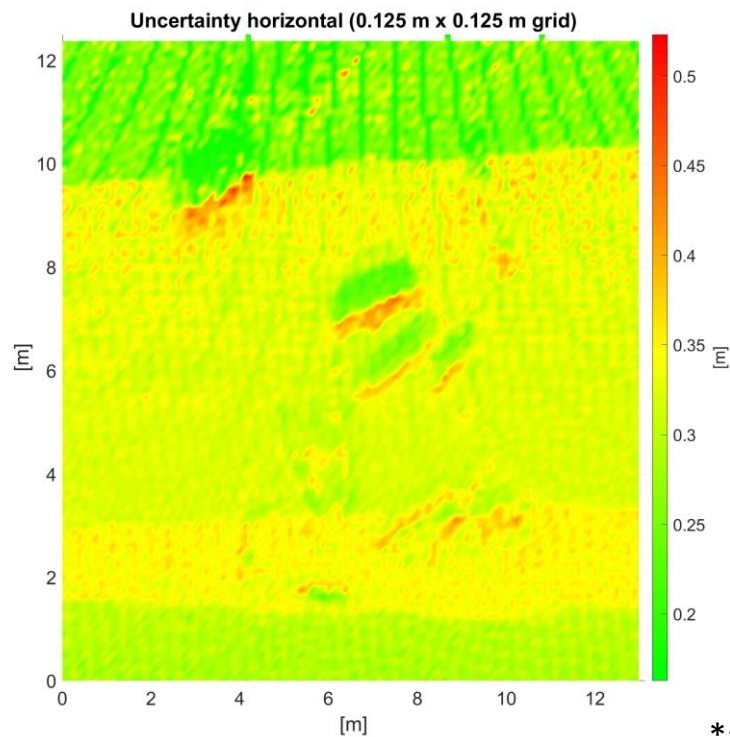
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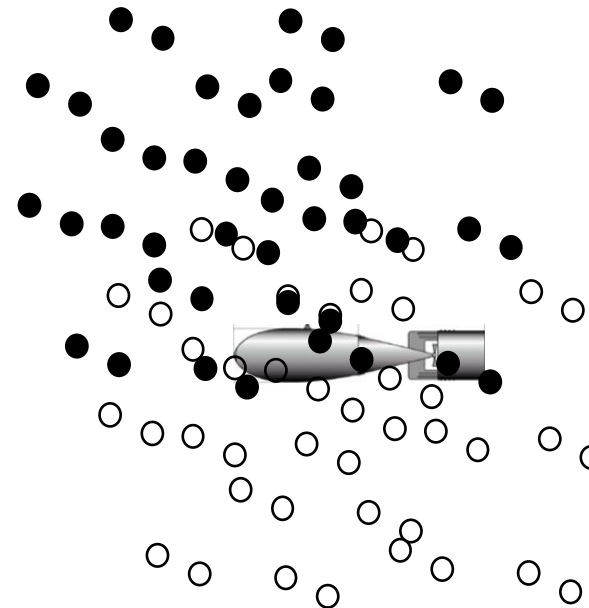
Visualization

## Horizontal Uncertainty

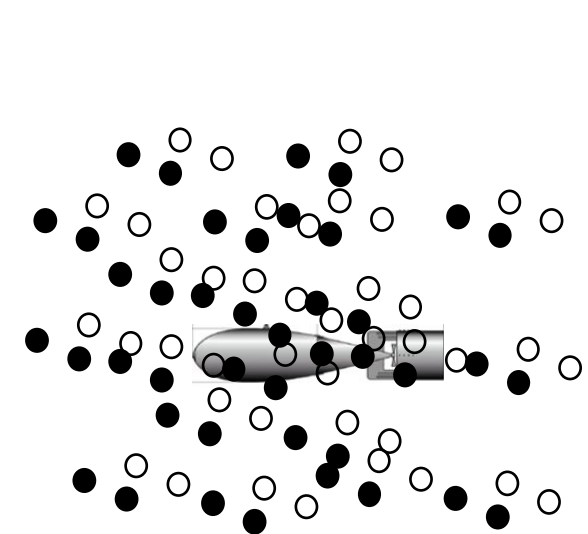
### MBES



### bad



### good



● measured

○ true position



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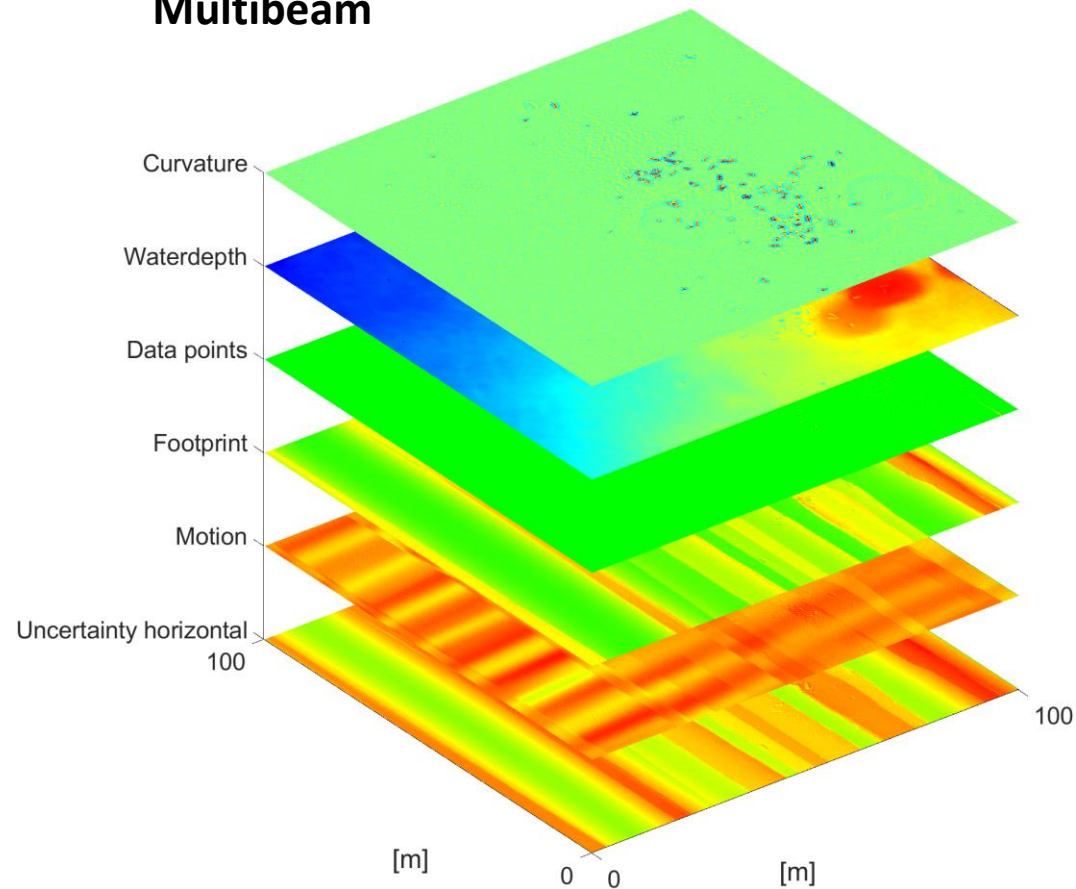
Quality metrics

Postprocessing

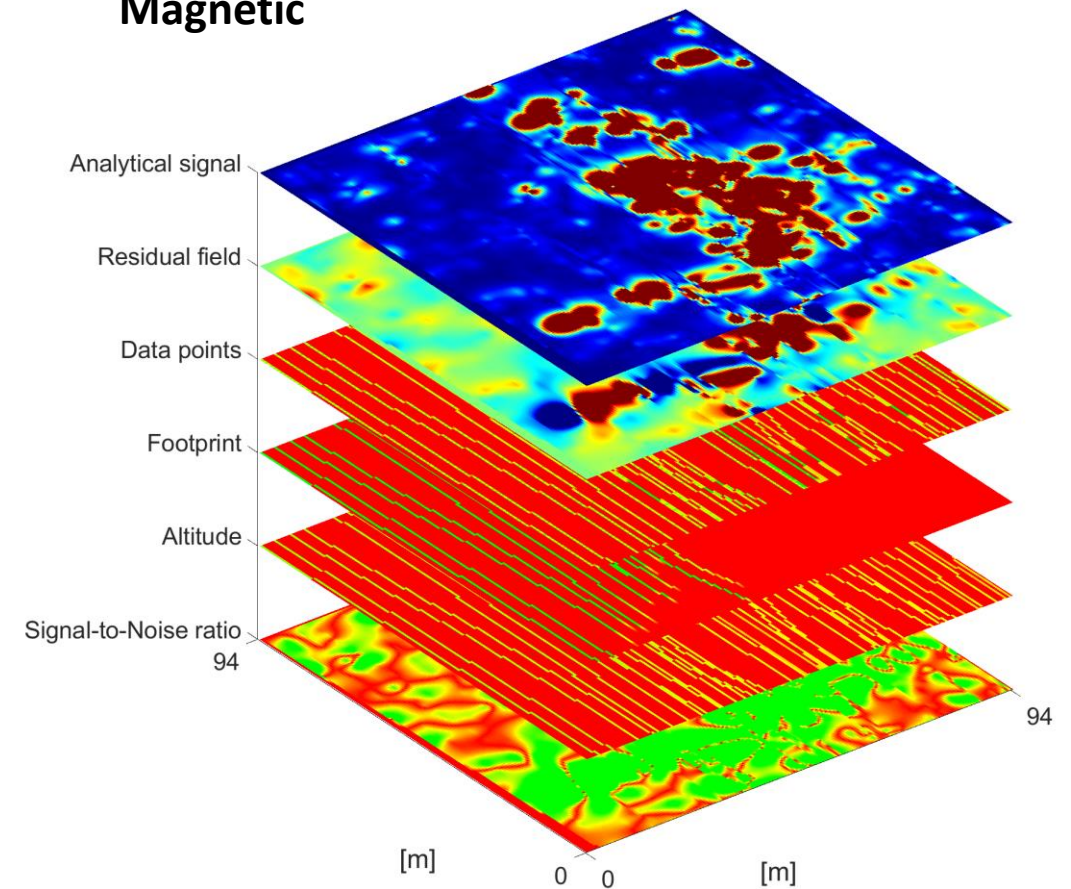
Artificial Intelligence

Visualization

## Multibeam



## Magnetic



\*arbitrary colorscale

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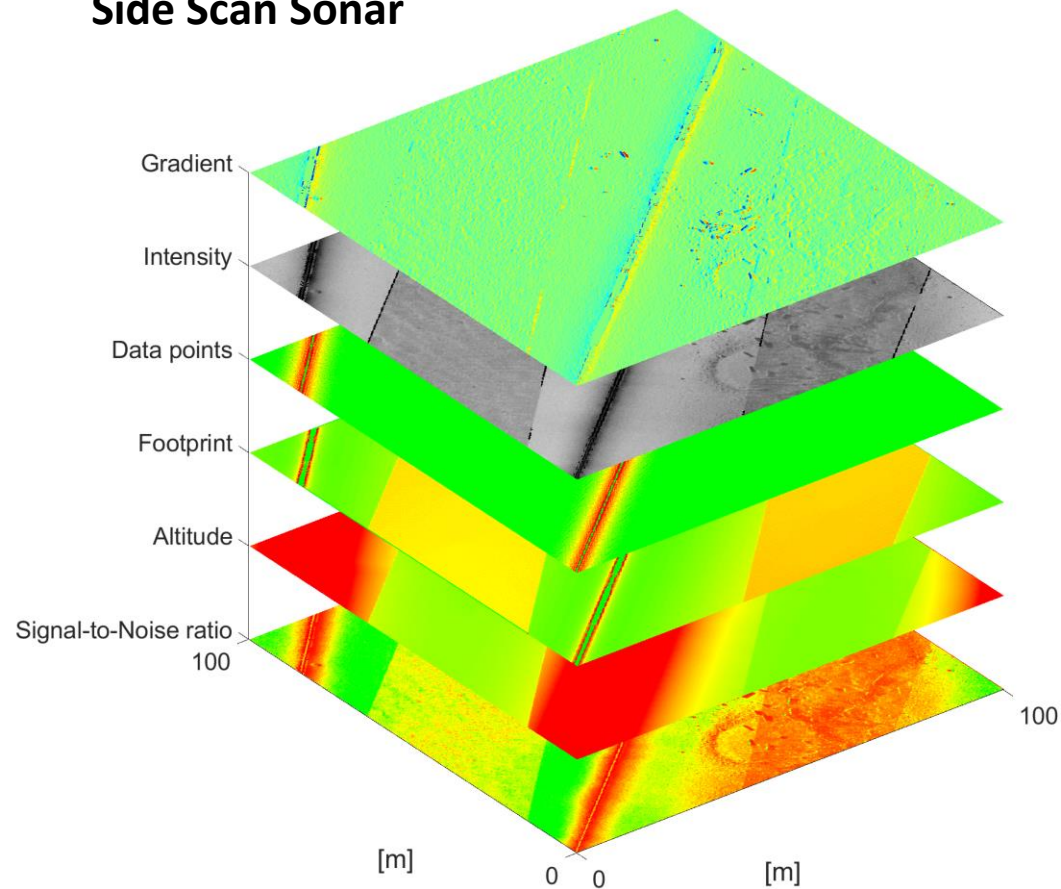
Quality metrics

Postprocessing

Artificial Intelligence

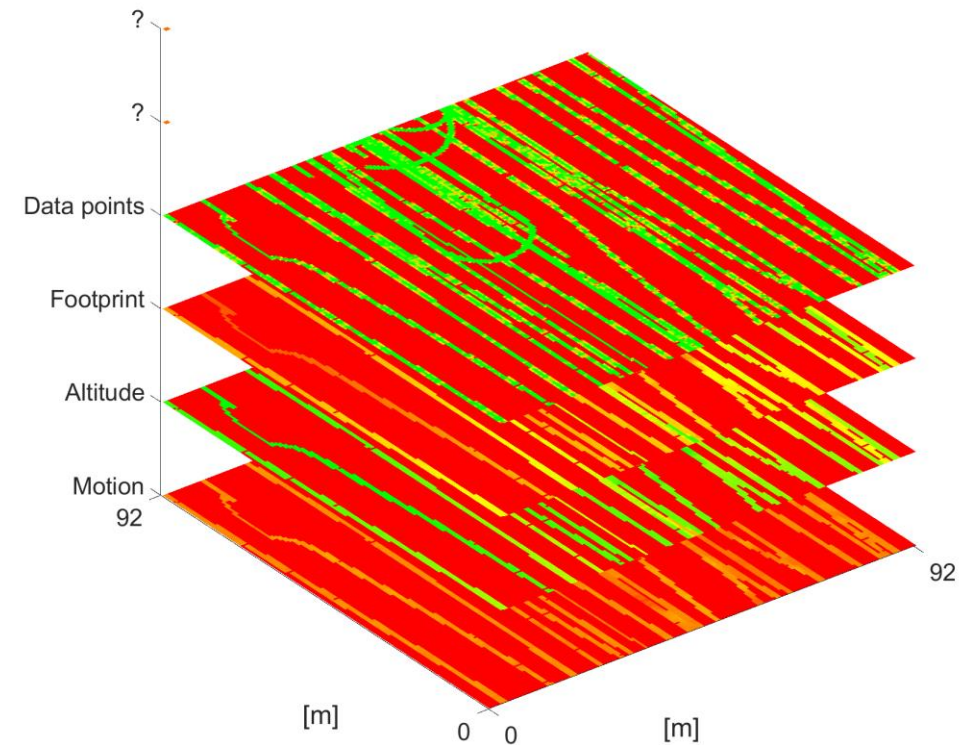
Visualization

## Side Scan Sonar



\*arbitrary colorscale

## Subbottom Profiler



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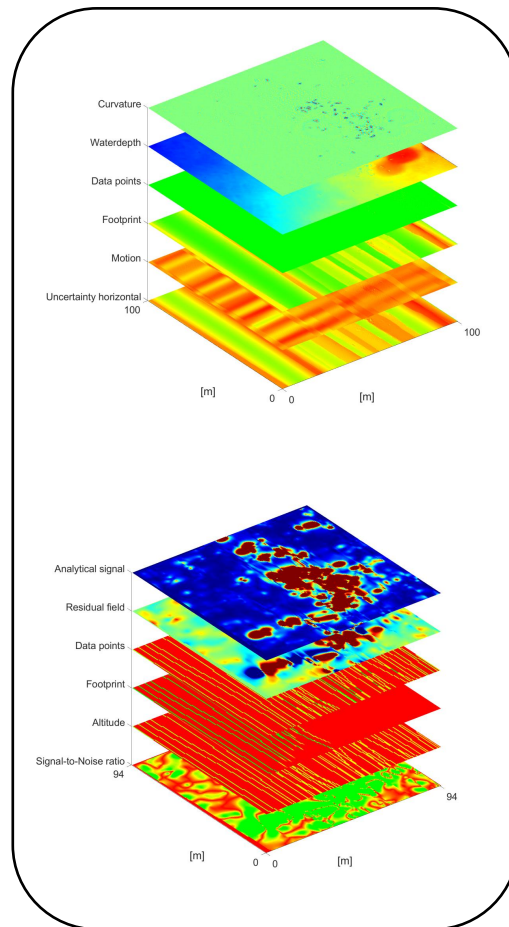
Target

Quality metrics

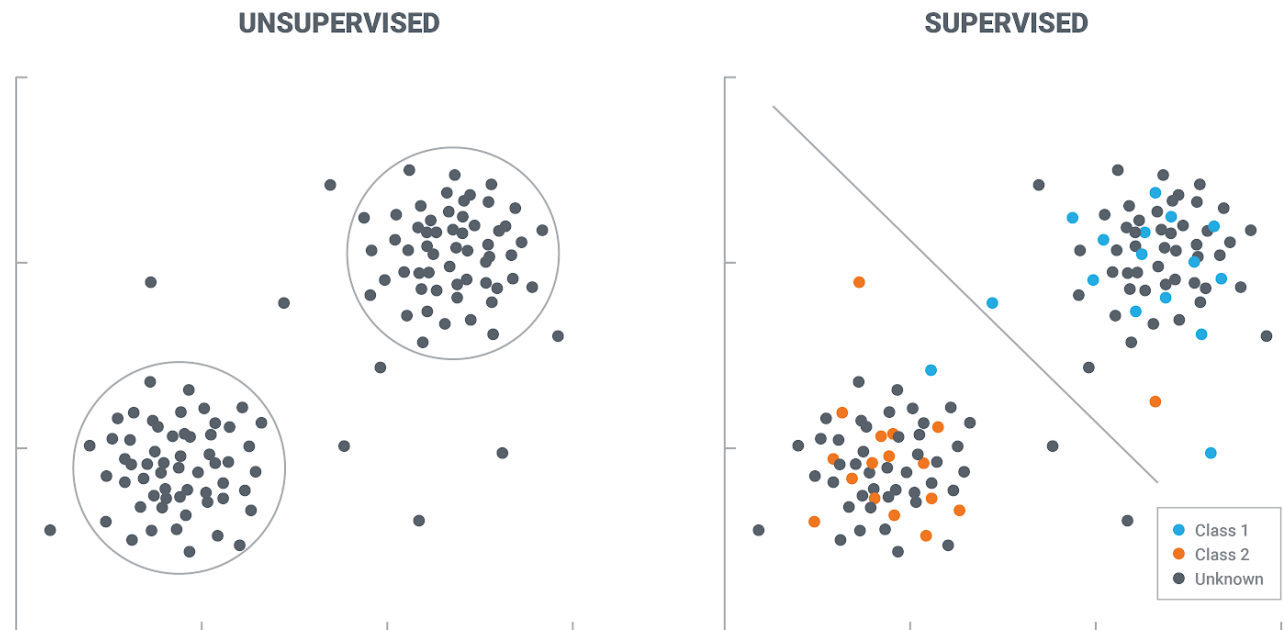
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Verified target list (data labels) of high importance for success



Remember: garbage in, garbage out!



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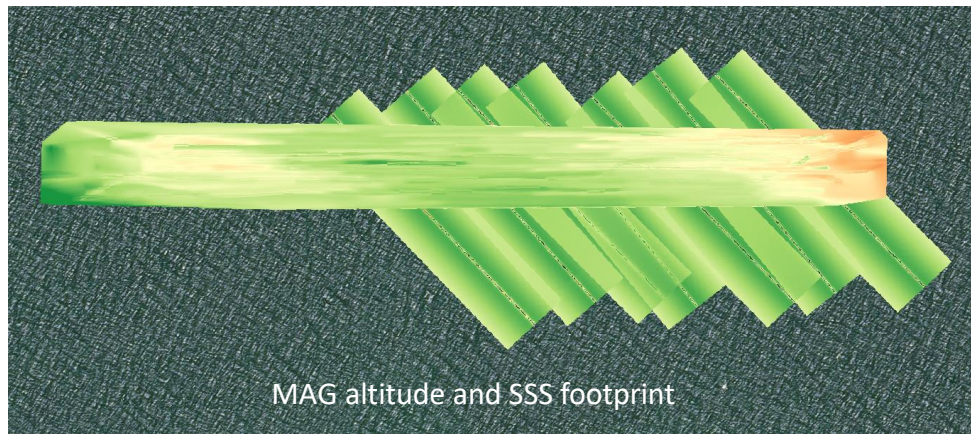
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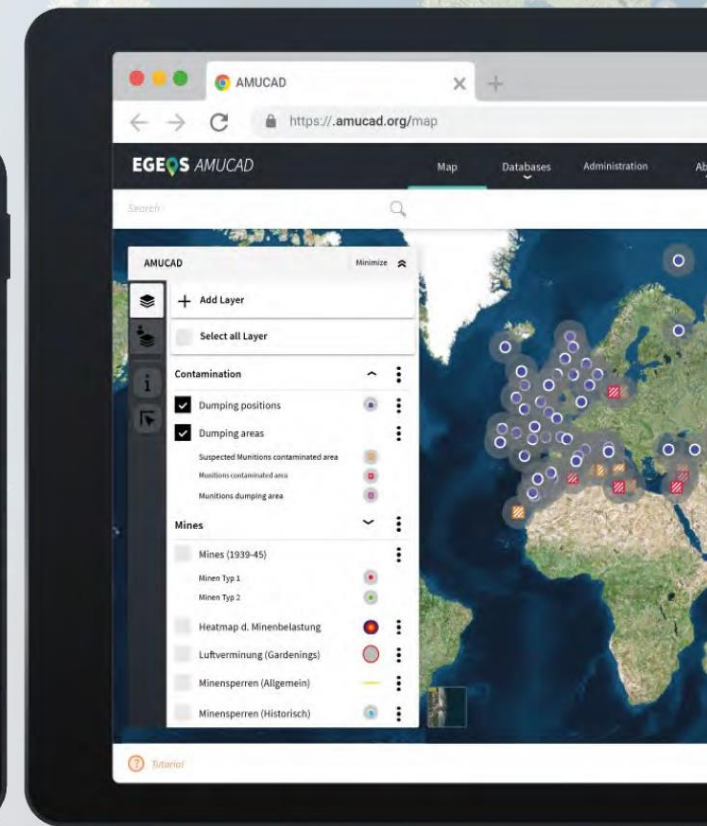
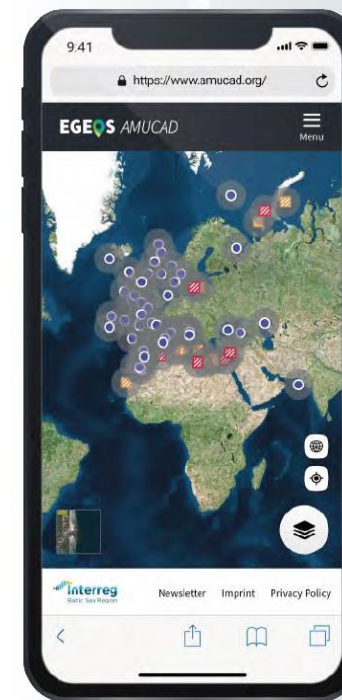
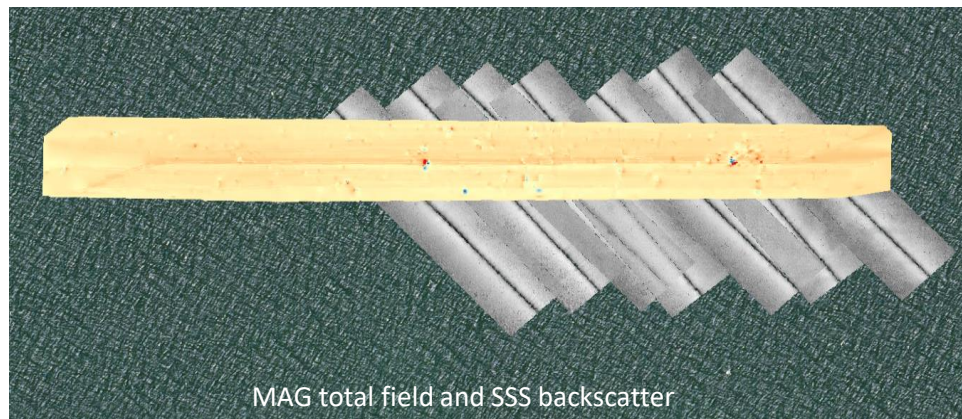
Artificial Intelligence

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## Quality Parameters



## Data



## Next steps (short-term):

- finishing the implementation of Big Data processing pipelines for calculation of quality measures
- starting first real-world tests of quality measures on ongoing and/or finished infrastructure projects

## Next steps (medium-term):

- conception of the User-Interface (workshops)
- development of analytical algorithms/AI
- technical implementation of all functionalities into the AmuCad.org platform

