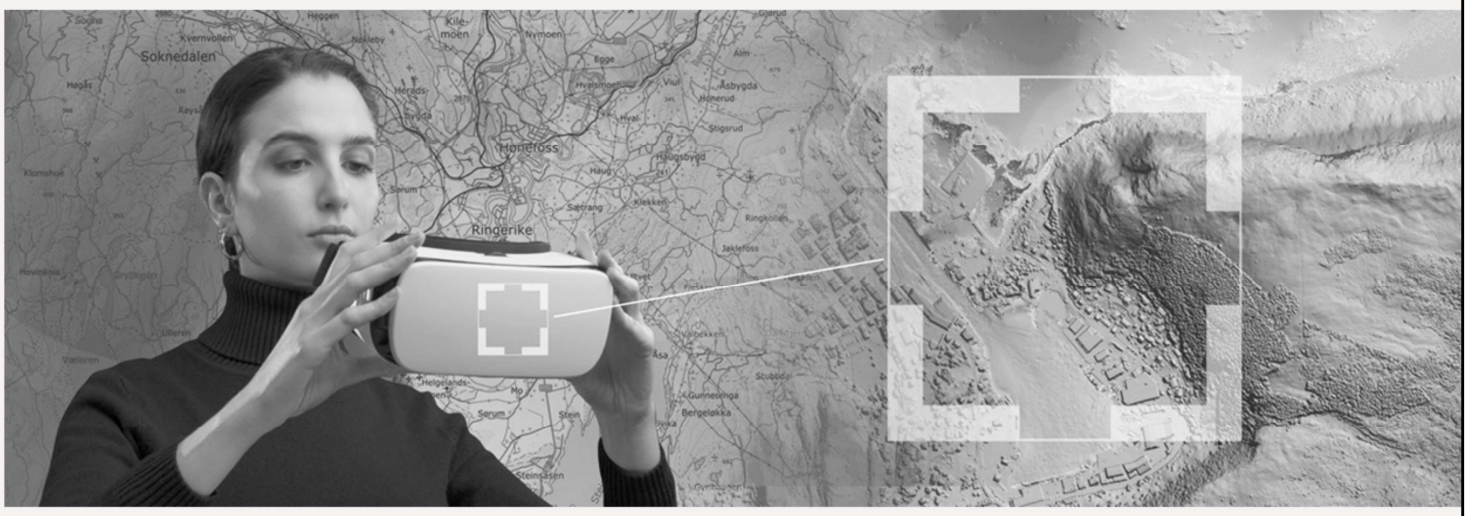
Digitizing the survey specification

Less time spent on manual and visual quality controls



Kartverket

NSHC37 / NHC67
Evert Flier

Horizontal density validation

- Coverage criteria
  - Grid resolution vs. depth
  - Point count requirement
  - Data gap (holiday)
  - Cell approval ratio
  - Boundary check

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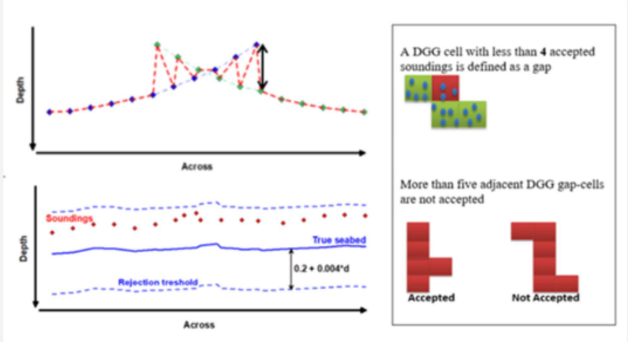


[From Mareano technical specification]

The NHS spend a considerable amount of time and resouces on checking the data for coverage and vertical accuracy. This is espcially true for the Mareano program as a considerable part of the surveying is done by external contractors. It is therefore important to have a common tool for checking the data for compliance with the specification. So far, we have implemented the following quality checks:

For coverage:

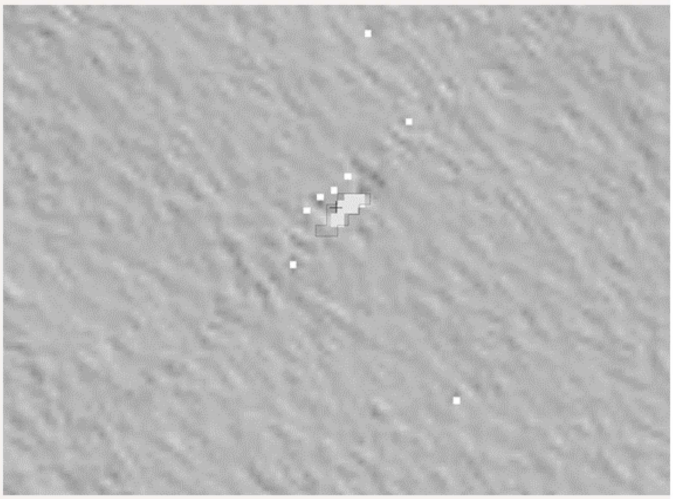
- Resolution. For gridded products, we have implemented a variable resolution grid which is configurable in a straightforward manner
- Point count requirement. For a cell to be classfied as approved there is a minimum point requirement
- Data gap definition. Every specification defines what a data gap is (see illustration). It is also related to what the purpose of the survey is. Coverage is thus different than object detection (NOAA 2022) and Mareano has its

own definition.

- A total percentage of approved cells.
- A boundary check to compare the planned versus the actual area covered.

Results Coverage

Rejected grid cell clusters as raster/vector



HTML report

General information

Dataset name	[redacted]
Date processed by program	4/12/2023
Hydris version used	0.1.119
Pyproj version used	3.6.1
PROJ version used	9.3.0
Total runtime	7 min, 32 sec

Dataset status

0.1% criteria	Accepted		**Units**
Total soundings	734755120	63.543	soundings/average per cell
Soundings outside boundary	128020	0.001	soundings/percent of total
Depth range, MSL depth	145.34833544083224	348.1499938964844	m
Projected datum/zone	ETRS89 / UTM zone 32N	EPSG:25832	
Projected vertical datum	MSL depth	EPSG:5715	
North (min/max)	6382592.0	6426624.0	m
East (min/max)	323584.0	362112.0	m

Cell statistics

Categories of cell coverage	**Cell count:**	**Percent:**
Total number of cells	11563170	100.0
Accepted cells	11563094	99.999
Rejected cells	76	0.001
Cells without soundings	2	0.001
Cells with soundings	11563168	99.999
Rejected cells with soundings	74	97.368

Rejected cell clusters statistics

Cluster size	1	2	3	8
Number of clusters	54	4	2	1
Number of cells	54	8	6	8
Marked as accepted	Yes	Yes	Yes	No

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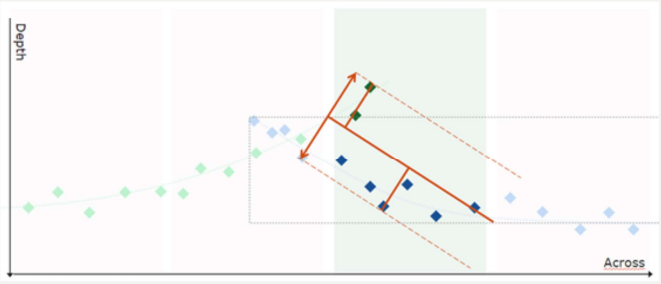
Vertical variation validation

- Vertical accuracy/uncertainty
  - Grid resolution vs. depth
  - Statistical binning
  - Plane fitting
  - Compare to TVU requirement



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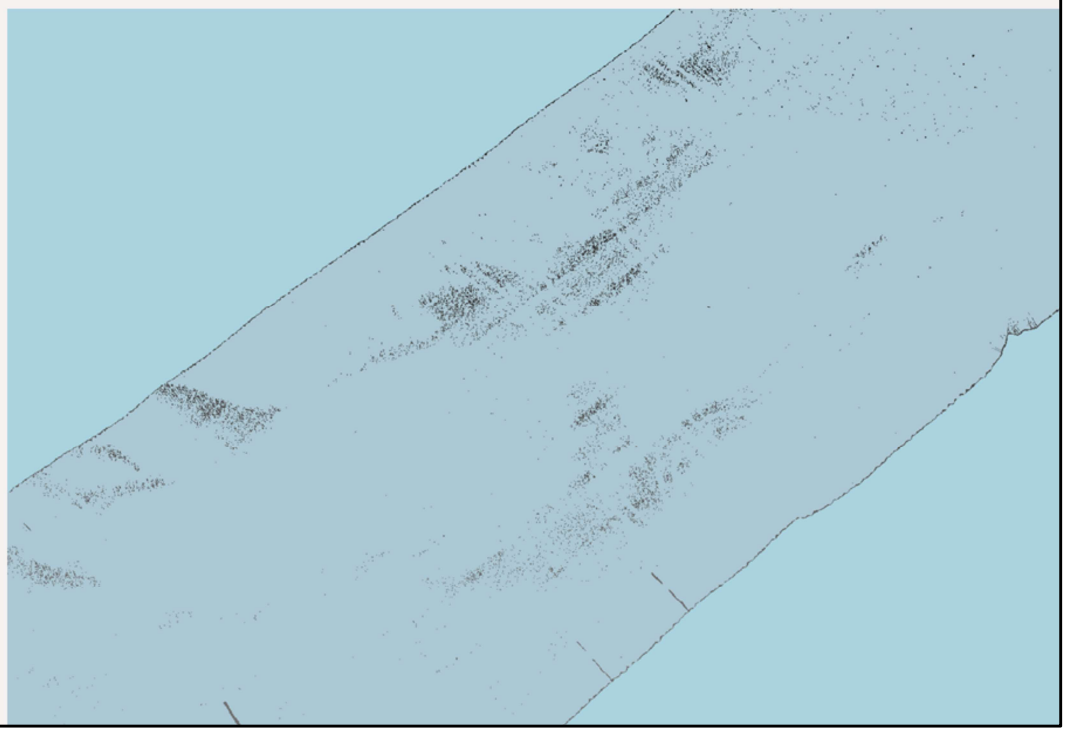
The generalised process for calculating vertical accuracy and compare it to the specification is executed in a few steps:

- Firstly, the same method for creating a variable resolution grid as for horizontal density is used, although with a differently sized grid cell schema.
- We ensure a minimum of 15 points (configurable) for having a statistically sound selection.
- We calculate a plane through the points based on the least-squares solution and find the standard deviation for the points-normal distance.
- This number is compared to the TVU-requirement

Results for vertical uncertainty

(tvu: 0.2m + 0.004*depth)



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The result is presented as a raster with contrasting cells where the vertical accuray is outside of the specification. This is the yes/no map as the black pixels/cells are marked black. It is also possible to show the actual standard deviation for each grid cell, then displayed as a gradient or color map.

Saving time and effort

1. Quality control takes less time, saving more than 90% of the man hours.
2. We can validate for criteria previously unattainable.
3. We can compare effect of (post-) processing, finding what's «good enough».
4. Establishing a reconciled understanding of survey quality.

Run-time characteristics:

On a survey with 1 billion soundings

- Coverage validation runtime: 15 minutes
- Vertical accuracy: 2 hours

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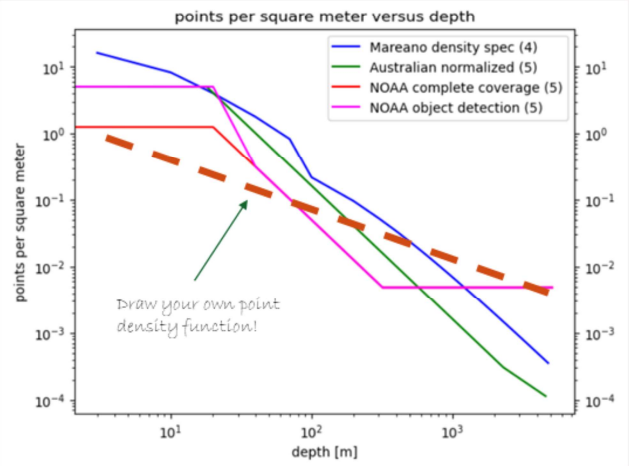
Additional:

The data validation tools developed by NHS will save us a lot of time and effort.

- We can run quality control in hours, not weeks.
- Visual inspection is minimised, only random sampling is necesessary to build confidence in the result.
- «Quality» is backed by actual quantitative properties
- You can run it in the field, in the office, on standard equipment.
- No licenses, everything is built using open source.

Next steps

- Other specifications
  - Open source (2024)
  - Collaboration
  - Revision of technical specification
  - New source: .all/.kmall



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For 2024 and beyond…
Implement additional specifications.
- Introduce a «specification database». It should also be possible to add new, specialized specifications: «draw your own» (se illustration)

First release of the software as open source and start collaborating with others.

As we gain more insight we will have to revise the technical specifications to better fit a machine-readable format.

Currently, we run the validation tool on x,y,z ascii files. We will introduce the validation closer to the source by reading the Kongsberg MBES data format (.all/.kmall)


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