Proposal for Improving the Allocation of CATZOC Values of Crowdsourced Bathymetry Data

Comments from CSBWG

26 March 2024

Geodatastyrelsen

Task

- Collect inputs from CSBWG on DQWG19-05.4A *“Proposal for Improving the Allocation of CATZOC Values of Crowdsourced Bathymetry Data”*:
  - *Member States*
    - *Canadian Hydrographic Service, Canada*
    - *Danish Geodata Agency, Denmark*
    - *NIWA, New Zealand*
    - *NOAA Office of Coast Survey, USA*
  - *Expert Contributors*
    - *Denis Hains, H2i*
    - *Shaul Solomon, DockTech*

DQWG19.05.4A - Table 2

Recommended scheme for assigning CATZOC values to CSB data

Sensor	Position				Data processing (Attitude Correction, Sensor Vertical Offset Correction, Draft Correction, Sound Speed Correction and Tide Correction)			Quality Control				Recommended CATZOC value
	GNSS Receiver		Horizontal Offset Corrected		Full Corrected	Partial Corrected	Uncorrected	Precision Meets Requirements		Accuracy Meets Requirements		
	Yes	No	Yes	No				Yes	No	Yes	No	
Multibeam echo-sounder system + Side-scan sonar system	√		√		√			√		√		A2
Multibeam echo-sounder system + Side-scan sonar system	√		√			√		√		√		B
Multibeam echo-sounder system + Side-scan sonar system	√			√		√		√			√	C
Multibeam echo-sounder system + Side-scan sonar system	√			√			√		√		√	D
Multibeam echo-sounder system + Side-scan sonar system	√			√			√		√		√	U
Multibeam echo-sounder system	√		√		√			√		√		A2
Multibeam echo-sounder system	√		√			√		√		√		B
Multibeam echo-sounder system	√			√		√		√			√	C
Multibeam echo-sounder system	√			√			√		√		√	D
Multibeam echo-sounder system	√			√			√		√		√	U
Single beam echo-sounder + Side scan sonar system	√		√		√			√		√		B
Single beam echo-sounder + Side scan sonar system	√			√		√		√			√	C
Single beam echo-sounder + Side scan sonar system	√			√			√		√		√	D
Single beam echo-sounder	√		√		√			√		√		C
Single beam echo-sounder	√			√			√		√		√	D

Note: In cases where the depth exceeds 200m or the range of echo-sounder, it is recommended to assign CATZOC value 'O' to the CSB data.

Canadian Hydrographic Service, Canada [1/3]

The three categories for **data processing** in table 2 may lead to subjectivity.

- What does ‘partial’ refer to?

Suggestion of **tracking the 5 vertical accuracy data processing steps individually**:

Sensor	Position				Data processing					Quality Control				Recommended CATZOC value
	GNSS Receiver		Horizontal Offset Corrected		Attitude	Vertical Offset	Draft	Sound speed	Tide correction	Precision Meets Requirements		Accuracy Meets Requirements		
	Yes	No	Yes	No						Yes	No	Yes	No	

- Assuming CSB data are often lacking metadata, at the very least we should distinctly record if the data is corrected for tides and if the draft was accounted for, because of the stronger impact on the selection of CATZOC (at least for single beam data).
- The sum of other errors due to attitude, vertical/horizontal offsets, and sound speed errors will potentially have lesser impact and likely be picked up when checking the accuracy with reliable MB data, at QC.

Canadian Hydrographic Service, Canada [2/3]

Sensor	Position				Data processing (Attitude Correction, Sensor Vertical Offset Correction, Draft Correction, Sound Speed Correction and Tide Correction)			Quality Control				Recommended CATZOC value
	GNSS Receiver		Horizontal Offset Corrected		Full Corrected	Partial Corrected	Uncorrected	Precision Meets Requirements		Accuracy Meets Requirements		
	Yes	No	Yes	No				Yes	No	Yes	No	
Single beam echo-sounder + Side scan sonar system	√		√		√			√		√		B (?)

- Does the CATZOC B value for side-scan with single data shown below refer to nadir depths only? If not, that value may need to be reviewed lower.

Canadian Hydrographic Service, Canada [3/3]

Sensor	Position				Data processing (Attitude Correction, Sensor Vertical Offset Correction, Draft Correction, Sound Speed Correction and Tide Correction)			Quality Control				Recommended CATZOC value
	GNSS Receiver		Horizontal Offset Corrected		Full Corrected	Partial Corrected	Uncorrected	Precision Meets Requirements		Accuracy Meets Requirements		
	Yes	No	Yes	No				Yes	No	Yes	No	
Single beam echo-sounder	√		√		√			√		√		BC
Single beam echo-sounder	√			√			√		√		√	D
Single beam echo-sounder		√	√			√						C

- Suggestions
  - Give a **higher CATZOC to fully corrected single beam data** with GNSS antenna.
  - Include single beam data without GNSS receiver, CSB data holdings may have a lot of it.

Danish Geodata Agency, Denmark [1/7]

Table 2 presents a scheme for assigning CATZOC values to CSB data.

- As mentioned in the HSWG presentation to DQWG18, the term '**CATZOC capability**' is more appropriate because the quality of CSB data is only one of the inputs (e.g., cartographic inputs) to assign a CATZOC value.
- Could it be easier to start by writing guidance in **assignment an IHO Order to CSB data** (rather than a CATZOC value)? Or perhaps assessing the CSB data through the S-44 matrix?

Proposed action

Discuss with the HSWG (as the maintainer of IHO S-44) the possible co-development of guidelines for using S-44 (orders or matrix) in assessing the quality of CSB data.

Danish Geodata Agency, Denmark [2/7]

The current definition of CSB from B-12 is *"the collection and sharing of depth measurements from vessels, **using standard navigation instruments**, while engaged in routine maritime operations"*.

- Is the *"Sensor"* column in table 2 compatible with the current CSB definition? For instance, does *"Multibeam echo-sounder system + Side-scan sonar system"* fit the definition of *"standard navigation instruments"*?
- Furthermore, B-12 has a chapter about ***"4. Data Quality Assessment"*** that is currently not mentioned/used in DQWG19.05.4A.

Proposed actions

- Discuss with the CSBWG (as the maintainer of IHO B-12) the current definition of CSB and, eventually, reduce the 'sensor' scope of the scheme currently proposed in DQWG19.05.4A.
- Evaluate the interoperability of the proposed scheme with chapter 4 of B-12.

Danish Geodata Agency, Denmark [3/7]

In the Discussion section of the document, it is stated that *"due to time constraints"*, S-68 edition 1.0.0 *"simply recommended to assign CATZOC value D to all CSB data"*.

- A search was performed in the published S-68, but **no explicit CATZOC capability recommendation for CSB data** was found. Where is the mentioned recommendation *"to assign CATZOC value D to all CSB data"* coming from?

Proposed action

Clarify where a CATZOC capability D is recommended for CSB data in S-68 edition 1.0.0.

Danish Geodata Agency, Denmark [4/7]

The last two rows in the Table 2 of the document address the CATZOC capability assessment in case of singlebeam echosounder (SBES):

Single beam echo-sounder	√		√		√			√		√		C
Single beam echo-sounder	√			√			√		√		√	D

- Based on both rows, it is **only possible to assign CATZOC capabilities D or C to CSB data collected using a SBES**.

Proposed action

Clarify why a CATZOC capability B cannot be assigned to CSB data collected using a SBES.

Danish Geodata Agency, Denmark [5/7]

The *"Data processing"* column in the Table 2 of the document is currently sub-divided into 3 sub-columns: *"Full Corrected"*, *"Partial Corrected"*, *"Uncorrected"*. As mentioned in the same column, the **data processing has many potential steps**: *"Attitude Correction, Sensor Vertical Offset Correction, Draft Correction, Sound Speed Correction and Tide Correction"*.

- Given the large variability on how these steps can be performed, the risk is that, by adopting the current scheme, the CSB data will be always classified as 'partially corrected', defeating the scope of having *"an optimized method for allocating CATZOC values"* for CSB data.

Proposed action

Explore a better identification/assessment of the impact of different data processing steps (and metadata collection) on the quality of the CSB data.

Danish Geodata Agency, Denmark [6/7]

The *"GNSS Receiver"* column in the Table 2 of the document is currently always flagged.

- Is the intent to identify an use case (i.e., no GNSS received) preventing the assignment of a CATZOC capability to CSB data? If it is the case, it should be better clarified together with other factors that would prevent assigning a CATZOC capability.

Proposed action

Clarify the need for the "GNSS Receiver" column (given that it does not have variability) and, eventually, identify situations where a CATZOC capability should not be assigned.

Danish Geodata Agency, Denmark [7/7]

Based on the mentioned considerations, the Danish Geodata Agency:

- Supports the creation of **guidelines on how to assess quality of CSB data for nautical charting**.
- Suggests the **involvement of both the CSBWG and HSWG**, also to keep the **guidelines aligned with B-12 and S-44 publications**.
- Suggests to **focus the guidelines on CSB data collected using SBES**, exploring the impact on quality for various processing steps.

NIWA, New Zealand

From section 2: *"Due to time constraints, it is not possible to delve into the CATZOC assignment of CSB data in S-68 edition 1.0.0. Therefore, it is simply recommended to assign CATZOC value D to all CSB data in S-68."*

- Although a very valid point, the suggestion is **not to phrase it as an absolute truth**.
  - This might not be the reality for all (note that there are many hydrographic authorities which don't even have a single beam echosounder).
  - Suggested rephrasing: *"If due to time constraints, it is not possible to delve into the CATZOC assignment of CSB data in S-68 edition 1.0.0., it is recommended to assign CATZOC value D to all CSB data in S-68."*
- Another suggestion is to move this a bit, so it is **brought up later in the paragraph**.
  - Proper assessment of the data quality should be encouraged, and if and when time/resource constrains don't allow to do this, then the last resource would be to assign CATZOC D.

NOAA Office Of Coast Survey, USA [1/2]

Table 2 provides guidance for situations that are quite rare in the context of CSB, such as **MBES with SSS**, or even **SBES with SSS**.

- The most widely used situation is SBES, or maybe sometimes MBES, so maybe they should be at the top of the table instead of the very bottom?

It almost seems in some areas of the paper and table that there are situations with **MBES CSB done systematically to cover an area of sea floor**.

- Can such situations be really characterized as CSB?

NOAA Office Of Coast Survey, USA [2/2]

There is **no reference to a comparative quality assessment of CSB data** (e.g., by comparing a sample of the data to higher-quality reference bathymetry).

- Relying solely on whether or not transducer offset metadata exists or not is not a good way to discriminate between CATZOC C or D for SBES CSB.
- Transducer offsets in the CSB from the IHO DCDB are often not very reliable. (For example, the *Thomas Jefferson* consistently has a ~1.4m static vertical bias in their CSB data, when compared its tide-corrected data against official bathymetry. Which likely means a wrong transducer draft encoded in their Rose Point software.)
- Comparative statistics is likely more reliable for determining CATZOC than a boolean flag on whether or not a specific metadata exists.

Denis Hains, H2i

- **There must be different CATZOC levels for different quality/uncertainty/ambiguity**, even for low quality/uncertainty/ambiguity.
- Assuming that most horizontal positioning using GNSS is considered modern (even if no differential is used) or 2 types of categories for differential and/or PPP or not be recognized:
  - Singlebeam with high (or low) quality positioning & correction for tides.
  - Singlebeam with high quality positioning and poor correction for tides.
  - Multibeam with high (or low) quality positioning and corrections for sound velocity and for tides.
  - Multibeam with high (or low) Quality positioning and poor corrections for Sound velocity & for tides.
- Single point observation should also be categorized
- **All CSB should NOT be bundled into the same category.**
  - There must be a degree of quality even for poor quality! Unless completely sure that data is corrupted and/or NO quality.
  - Bottom line no data should be rejected. We keep it all even low accuracy/precision.

Shaul Solomon, DockTech [1/4]

“For ease of operation, it can be divided into Full corrected (all corrections have been applied), partial corrected (Only partial corrections have been applied), and uncorrected (no corrections have been applied)“.

- Not sure **what it means for it to be "fully corrected"**. Even something like "tide correction" is never fully precise. Ranges of tolerable uncertainty would theoretically need to be defined per source, and it would also be a challenge trying to validate accuracy.
- From experience, echosounders exhibit forms of noise that cannot always be captured by a-priori uncertainties, such as hardware malfunctions.

Shaul Solomon, DockTech [2/4]

“After correction, the quality of the CSB data can be more accurately evaluated through accuracy and precision evaluation“.

- How is precision/accuracy evaluated?
- It seems that when the proposal defines *"Precision meets requirements"* as being separate from the CATZOC value, an universal threshold is created. Wouldn't it make more sense that the requirements represent the equivalent CATZOC?

Shaul Solomon, DockTech [3/4]

Single beam echo-sounder	√		√		√			√		√		C
Single beam echo-sounder	√			√			√		√		√	D

- This is where **CATZOC somewhat fails CSB Data**:
  - Similar to the S-44, within the grading system there is a combined evaluation of TPU and the extent of the seafloor coverage. **This significantly hurts CSB data**, because as: *"CSB is the collection and sharing of depth measurements from vessels, using standard navigation instruments, while engaged in routine maritime operations."*
  - It is almost **by definition that CSB will not entail a full search**, and by doing so are at best able to get a CATZOC B.
  - **Why single beam echo-sounder is given at best a C** and not a B?

Shaul Solomon, DockTech [4/4]

Summary:

- In general, support of the effort to both
  - Create guidelines for evaluating CSB
  - Encourage/Promote more usage of CSB Data
- Main fear is using CATZOC/S-44, with its focus on Seafloor Coverage, constrains a single-beam echo-sounder reading to C (B?) at best.
  - If we could separate the two categories, and evaluate TPU and Coverage separately, it will allow more space for high quality single beam data.
- Request of clarification for action 4.b "**optimized** method for allocating CATZOC Values of CSB data.“
  - Are there methods that already exist and are we looking for a more optimized/accessible (ex: python library)? If yes, which papers describe such methods?

Summary of CSBWG inputs

- General agreement on the need to provide guidelines for assessing CSB data quality.
  - Is assigning a CATZOC capability the correct approach? Other metrics should also be evaluated.
  - A comparative approach for the quality assessment of CSB data should be also part of the guidelines.
- Table 2 requires relevant modifications.
  - The ‘data processing’ and ‘quality control’ parts should be better defined/expanded to reduce subjectivity.
  - Some of the currently listed sensors are rare and/our outside the definition of CSB. Suggested focus on CSB collected using a singlebeam echosounder.
- Ensure interoperability/alignment of the guidelines with S-44 (HSWG) and B-12 (CSBWG)

Questions?

Geodatastyrelsen

Outcome/Next steps

- DQWG Chair has clarified that:
  - The proposed scheme was an initial proposal.
  - The recommendation of CATZOC D for CSB is not actually present in S-68 1.0.0.
- DQWG Recommendations (6.7.d and 6.7.e) for HSSC16
  - Task DQWG to continue the development of S-68 Ed 1.1.0 with a possible eventual S-68 Ed 2.0.0.
  - Task DQWG to develop a CATZOC allocation scheme for CSB Data by collaborating with CSBWG and HSWG.
    - [Action 19/14] Chair to connect HSWG Chair and CSBWG Chair and discuss the cooperation in the development of CATZOC allocation scheme for CSB Data.