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DATA QUALITY FOR HYDROGRAPHIC MEASUREMENTS

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ABSTRACT: *The main objective of most hydrographic measurements is to obtain basic data for the compilation of navigation maps with a focus on characteristics that may affect safe navigation. The hydrographic map is the final product of hydrographic exploration. Its accuracy and compliance depend on the quality of the data collected during the measurements.*

KEYWORDS: *Hydrographic measurements, Bathymetric data, hydrographic map*

1. Introduction

Quality is related to "usability". It is related to the extent to which a given group of data or the result of the calculations - the map, meet the needs of the person assessing it. The error is the difference between the measured (actual) and the real data. Error is a major quality problem. In order to allow a complete assessment of the quality of the survey data, it is necessary to record or document certain information together with the survey data. Such information is important in order to be able to use data from different studies, with different requirements. The process of documenting data quality is called "data attribution", and data quality information is called metadata. Metadata must contain at least information on [1, 2, 3]:

- The measurement as a whole, eg date, area, equipment used, name of the monitoring platform;

- Geodetic reference system used, including connections to WGS 84, if local coordinate system is used;
- Calibration procedures and results;
- Speed of sound;
- Achieved accuracy and appropriate levels of confidence.

2. Exhibition

The metadata is preferably in digital form and an integral part of the measurement protocol. If this is not possible, such information should be included in the study documentation. Data quality can be achieved by [1, 2, 3]:

- Automatic (non-interactive) quality control: The coordinates thus obtained (ie positions and depths) must be controlled automatically by a program using appropriate statistical algorithms that are documented, tested and give accurate results.
- Manual (interactive) quality control: The use of 3-D visualization tools is recommended. The interactive processing system must offer different visualization modes, such as depth diagram, single profile, single beam, backscatter images, etc. It should also allow the visualization of survey data in relation to other useful information, such as the coastline, navigation aids, etc. Data editing should be possible in all modes and include an audit.

Reliability diagrams of the hydrographic map

Traditionally, the quality of bathymetric data is a subjective procedure. For a given user, the quality of the presented data is assessed through a reliability diagram of the hydrographic map. This diagram is added to the hydrographic map and shows the study areas, along with some details, such as scale, line spacing, year of study.

The initial concept of the reliability chart is to classify the quality of the survey data and to depict the different classifications of the chart in terms of good, fair or poor quality. The diagram is designed to give the user the opportunity to assess the danger of deviating from the specified direction. If the data are too complex, the reliability diagrams become difficult to present as a mapping activity prone to construction errors, and its use will be neglected by stakeholders [1, 2, 3].

Zones of Confidence (ZOC)

The ZOC concept was developed by the IHO (International Hydrographic Organization) to provide a means of classifying bathymetric data. ZOCs provide a simple and logical ability to show the user the confidence that the national mapping authority places on each individual selection of bathymetric data. The aim is to classify navigation areas by identifying the different levels of confidence that can be placed in the baseline data using a combination of the following criteria [1, 2, 3]:

- Depth and position accuracy;
- Reliability of the demand for the water bottom;
- Compliance with an approved quality plan.

According to this concept, six zones of trust have been developed:

1. ZOC A1 - Location and depth data collected in accordance with the specified procedures and accuracy. Measurements carried out using recognized technology, with a comprehensive survey of the area, in order to ensure that all relevant characteristics are detected and depths are measured. Due to the intensity of data collection and the significant time required to achieve this standard, it can be expected that data with a ZOC A1 rating are likely to show critical channels, retention areas, areas with a minimum keel distance, navigation channels, ports and port approaches [1, 2, 3].

2. ZOC A2 - Location and depth data collected in accordance with the specified procedures and accuracy. Measurement carried out using recognized technology, with a complete survey of the area undertaken to ensure that all relevant characteristics are detected and depths are measured. Although the accuracy of the position and depth is not as high as the ZOC A1, the coverage of the hydrographic bottom is such that the user has a high level of confidence in the quality of the data [1, 2, 3].

3. ZOC B - Location and depth data collected in accordance with the specified procedures and accuracy. However, a complete measurement has not been made in the area and there may be unexplored characteristics that are dangerous for surface navigation. This ZOC shows an average level of confidence in the quality of the data. ZOC B has the same position and depth accuracy required for ZOC A2 and would be applied to modern hydrographic bottom measurements [1, 2, 3].

4. ZOC C - Position and depth accuracy less than that achieved for ZOC B. Depth data may be from sources other than controlled, systematic hydrographic measurement. A complete measurement of the area has not been made and deep anomalies can be expected [1, 2, 3].

5. ZOC D - Location and depth data are of very low quality or cannot be estimated due to lack of additional information. A complete measurement of the area has not been made and large anomalies in depth can be expected [1, 2, 3].

6. ZOC U - The quality of bathymetric data has not yet been evaluated [1, 2, 3].

TABLE 1

Category of data confidence zones

1	2	3		4	5
ZOC	**Position accuracy**	**Depth accuracy**		**Hydrographic bottom cover**	**Measurement characteristics**
A1	± 5 m	= 0.50 + 1% d (d - depth)		A measurement was performed in the whole area. All significant characteristics of the hydrographic bottom had measured depths.	Controlled, systematic measurement with high positioning accuracy and depth achieved with DGNSS.
		Depth (m)	Accuracy (m)		
		10	± 0.6		
		30	± 0.8		
		100	± 1.5		
		1000	± 10.5		
A2	± 20 m	= 1.00 + 2% d		A measurement was performed in the whole area. All significant characteristics of the hydrographic bottom had measured depths.	Controlled, systematic measurement with high positioning accuracy and depth less than ZOC A1, use of modern antenna and sonar or mechanical system.
		Depth (m)	Accuracy (m)		
		10	± 1.2		
		30	± 1.6		
		100	± 3.0		
		1000	± 21.0		
B	± 50 m	= 1.00 + 2% d		A full measurement in the area has not been made. There may be unmeasured characteristics of the hydrographic bottom.	Controlled, systematic measurement, with approximate depth but less positioning accuracy than ZOC A2, using a modern antenna, but without a sonar or mechanical system.
		Depth (m)	Accuracy (m)		
		10	± 1.2		
		30	± 1.6		
		100	± 3.0		
		1000	± 21.0		

<table>
<tr><td>C</td><td>± 500 m</td><td colspan="2">= 2.00 + 5% d</td><td rowspan="2">A full measurement in the area has not been made. Deep anomalies can be expected.</td><td rowspan="2">Measurement with low accuracy or data collected on the basis of depth measurements when passing through the area.</td></tr>
<tr><td></td><td></td><td>Depth
(m)
10
30
100
1000</td><td>Accuracy
(m)
± 2.5
± 3.5
± 7.0
± 52.0</td></tr>
<tr><td>D</td><td>Worse than ZOC C</td><td colspan="2">Worse than ZOC C</td><td></td><td>Poor data quality or data that cannot be evaluated due to lack of information.</td></tr>
<tr><td>U</td><td></td><td colspan="2">Unrated</td><td></td><td></td></tr>
</table>

3. Conclusion

The main purpose of most hydrographic measurements is to obtain basic (characteristic) data needed to compile hydrographic and navigational maps with an emphasis on the characteristics of the water bottom. Other objectives include obtaining the necessary information for related hydrographic navigation products and for coastal zone management, engineering and science.

Data collection depends on various factors. The measurement requirements, the available platform and equipment, as well as the time allotted for a given task, determine the amount of data to be collected. Much of the data can be collected using the latest hydrographic software and tools.

References:

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