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Paper for Consideration by NCWG

Data Quality Indicators for bathymetric data on ECDIS chart display

Submitted by:	Germany
Executive Summary:	Proposal of a new portrayal solution for data quality indicators (M_QUAL/CATZOC) in ECDIS
Related Documents:	HSSC8-05.6B INF6,
Related Projects:	Action Item 25 from HSSC6 (completed)

Introduction / Background

The ENC's Bathymetric Data Quality information is currently encoded by M_QUAL/CATZOC. It has been reported that the mariners are neither familiar with the data quality classification nor with the meaning of the resulting S-52 symbolisation in place (triangle field of stars or Us) for the portrayal of the different CATZOC categories.

Thus, the HSSC assigned two work items:

- to the DQWG to revise the principles of data quality classification resulting in a less complex and more intuitive solution,
- to the ENCWG to search for more intuitive options for their symbolisation.

The DQWG developed a 5 level approach which provides three quality indicators embedded between the two limiting "Oceanic" and "Unassessed" quality indicators. This approach was finally acknowledged by HSSC8 and is now ready for implementation into future S-101 ENC product specification.

The symbolization part however, did not enjoy such progress. Various attempts based on member state input and discussions within the former DIPWG of IHO did not lead to countable results.

Germany initiated a new approach and awarded a research project on investigating and developing portrayal solutions to the said problem to the "Fraunhofer Institute for Computer Graphics Research" (Fraunhofer IGD) in late spring 2016. Considering that the finalization of the research work was imminent, a concluding report (HSSC8-05.6b INF6) was given to HSSC8 in November 2016. HSSC8 tasked the NCWG to consider the report on the visualization of data quality indicators submitted by Germany (HSS8 minutes refer). This paper explains the findings of HSSC8-05.6b INF6 and proposes their acknowledgement as future solution for the highlighted visualization problem.

Analysis/Discussion

Current Status of the Data Quality of bathymetric data portrayal

The current S-57 M_QUAL/CATZOC data model provides information on the data quality of bathymetric data based on a five level approach. Different amount of stars in either a triangle field or a rectangle field specifies the data quality. Additionally, the letter "U" indicating an unassessed area and a "-" indicating an unsurveyed area are provided. In general, the rule applies that the more stars are provided the better the data quality is.

The current S-57 M_QUAL/CATZOC data model doesn't provide information on how the data quality information has been assessed.

Portrayal solutions developed by other stakeholders

Bearing the insufficiency of the current -57 M_QUAL/CATZOC data model in mind, several stakeholders developed ideas on how to portrayal data quality information.

These ideas encompass the introduction of different colour pattern for the safety of navigation based on data quality and ships and environment parameters in a certain area up to the introduction of coloured texture overlays to provide the quality information related to the DQWG data model.

The problems the various ideas encountered were that their colour approach causes potential conflicts with the 3 colour approach for Under Keel Clearance.

New Portrayal Proposals

The Fraunhofer IGD developed a proposal which took following requirements into account:

- It must be possible to visualize the uncertainty of bathymetric data along with all the other information incorporated in ENC. This requires consideration of the properties, limitations and the interplay of data visualization, uncertainty visualization and representation of geo-spatial reference.
- The addition of an uncertainty representation must not lead to visual clutter. This requirement is especially challenging as ENCs already depict a multitude of information.
- The information representation of any kind must be intuitive and unambiguous. This implies a unique visual encoding of uncertainty.
- The information should be represented with high contrast to each other.
- The visual encoding of uncertainty must be adapted according to the three ECDIS modes day, dusk and night.
- Important information should be encoded redundantly.
- There should be as little inaccuracy as possible when processing uncertainty information through the visualization pipeline.
- The visual weighting between data, uncertainty and geo-spatial reference must be considered. For example, in coastal waters which are usually shallow, information concerning uncertainty of the depths plays a more important role than in deep waters.

During the development study various intrinsic and extrinsic solutions have been considered.

Although the intrinsic visualization has some advantages, due to several reasons and due to the risk of visual clutter in particular, the intrinsic approach was considered as not feasible.

The researches evidenced that the extrinsic visualisation promised the most benefits. The Data Quality will be portrayed with textures of different transparency levels. Generally spoken, the better the quality is the higher is the transparency of the texture. As a redundant encoding the size of the texture elements may vary depending on the data quality. The size of the texture elements should be decreased with increasing uncertainty. The main findings can be illustrated and explained by two images in summary:

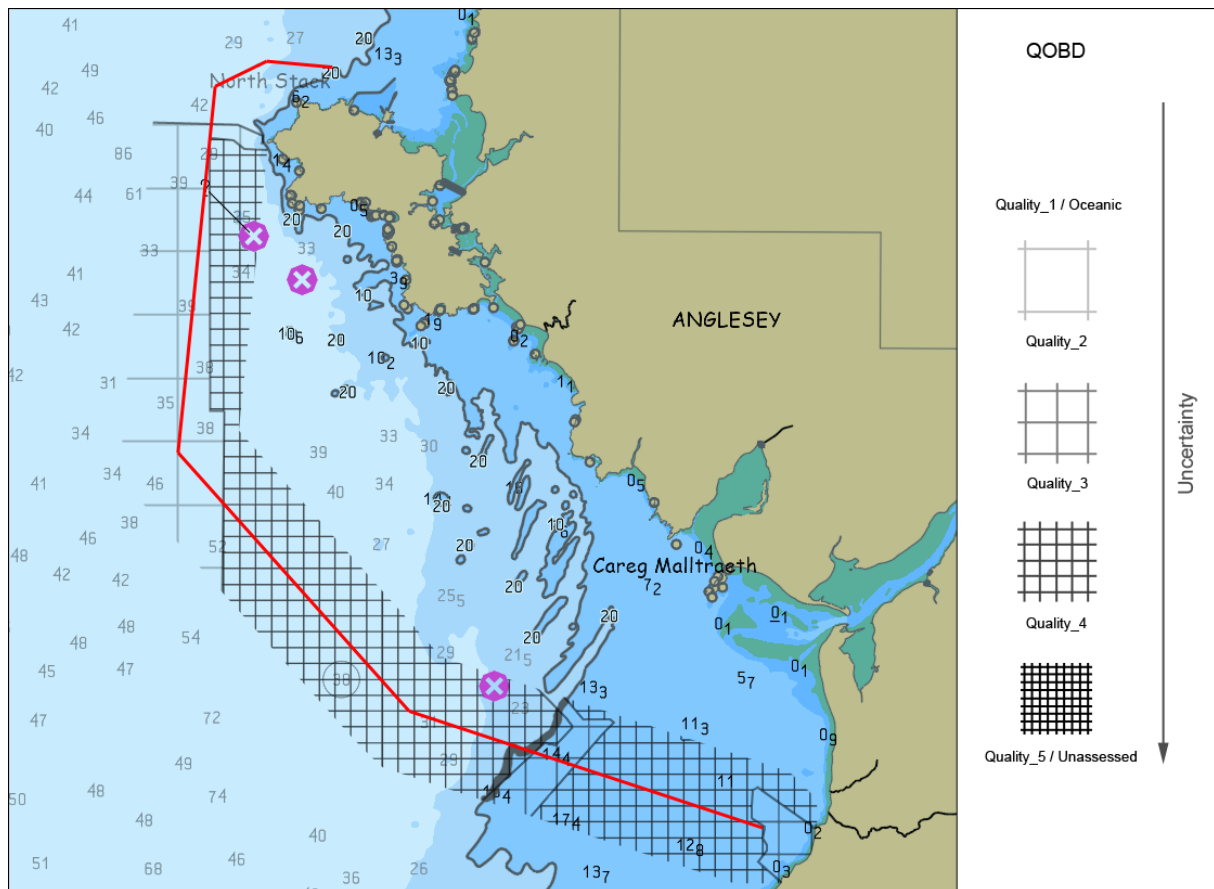


Figure 1: Visualizing QOBD in a route planning scenario and ECDIS mode day via hierarchical texture overlay.

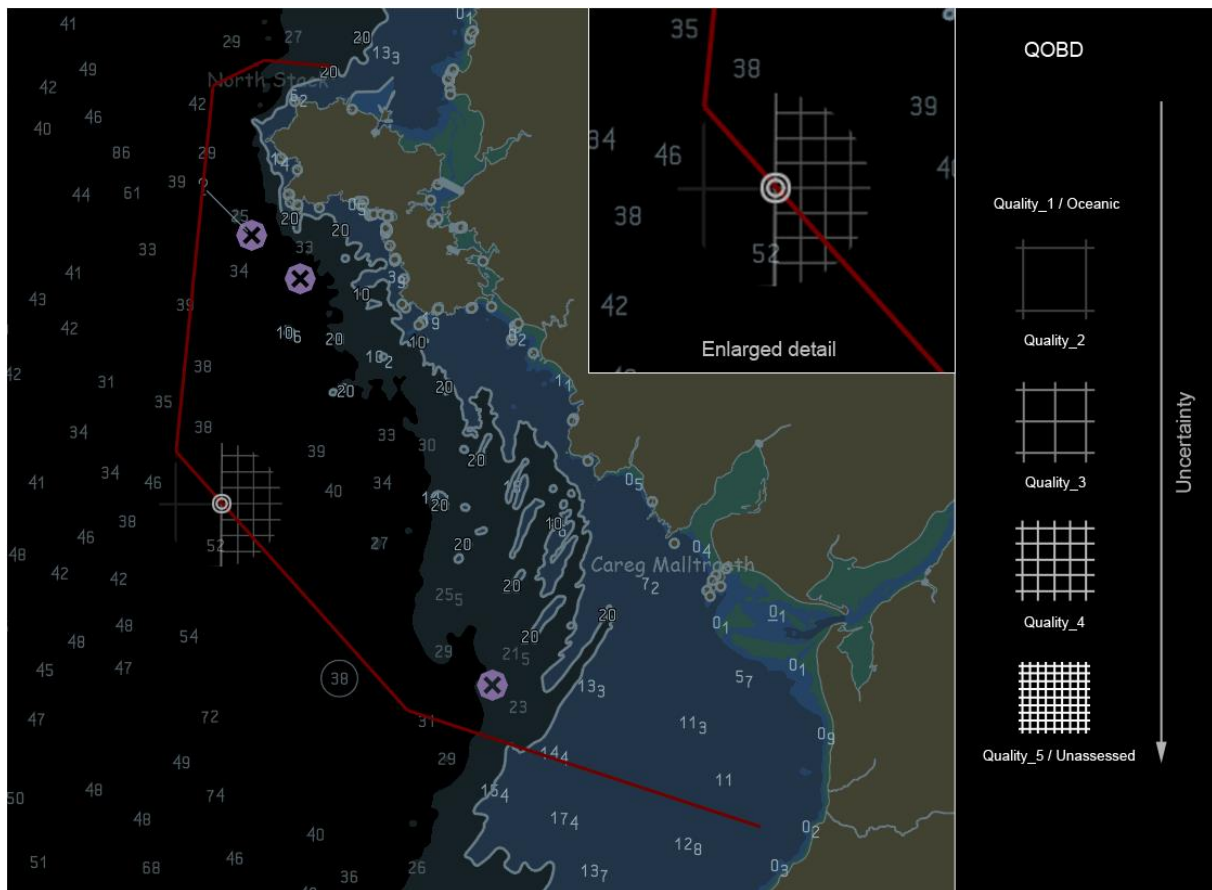


Figure 2: Visualizing QOBD in a monitoring scenario and ECDIS mode dusk via hierarchical texture overlay.

Figure 1 illustrates the basic proposal to use a regular grid structure consisting of squares as hierarchical textual overlay. The square size varies proportional with level of the data quality. The texture becomes less visible with increasing quality of the underlying data.

The data quality texture is presented along a predefined route. The spatial extent depends on ship's parameters such as speed and can be customized. The safety contour is highlighted in bold according to the width of the corridor.

It is part of the concept that data quality information will not be provided for areas which are not in navigational focus. Thus, the clutter of the screen with unnecessary data quality information will be reduced to a minimum.

Figure 2 shows the visualization concept for a pure monitoring scenario. For the case when no route has been created, the data quality information is provided a circle around the own ship. The circle moves according to the ships movement. The determination of the spatial extent bases on the same principle as explained for figure 1. The provision of such a circle could also be provided in mouse over modus for planning purposes.

More illustrating images and extended explanations of the favoured solutions are contained in the Annex of the HSSC8-05.6b INF6 submission. HSSC8-05.6b INF6 itself is a condensed compilation of the full research report which can be made available on request.

Conclusions

The current way of presenting Data Quality information is insufficient. The end user is not familiar with the portrayal solution. Various stakeholders developed ideas on how to portrayal Data Quality information. These ideas were either be insufficient by using reserved colours or by cluttering the ECDIS screen.

The scientific research considered all currently known portrayal solutions. It was worked out that the extrinsic visualisation with a redundant provision of data quality information promises the best advantages.

Recommendations

The result of the research should be considered during the future development of the portrayal solution for data quality for S-101 ENCs. If S-52 for S-57 ENCs would ever experience revision in the future, this proposal should be considered for the applicability to existing ECDIS systems as well.

Action Required of NCWG

The NCWG is invited

- to note this paper,
- to discuss and consider the proposal,
- to continue the development of the portrayal of data quality indicators.