Implementation of CARIS Bathy DataBASE at the Canadian Hydrographic Service, Pacific Region

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SUMMARY

Marine chart production requires a significant amount of bathymetric data. Managing these data properly is an ongoing challenge. However, if the data sets are stored within an efficient database instead of a file-based structure, data management and access can be greatly improved. The Pacific Region of the Canadian Hydrographic Service (CHS) has chosen to go that way in 2011. Using the CARIS Bathymetric Database (BDB), 1200 bathymetric data sets have been loaded and are now accessible for hydrographers. The purpose of this paper is to describe the method used in CHS Pacific Region to implement a user-friendly database that holds bathymetry. Some of the topics to be explored include dealing with existing metadata, the choice of attributes, and deciding which data sets need to be loaded.

Key words: Bathymetry, Database, Hydrography, Management

1. INTRODUCTION

In 2011, CHS Pacific decided to update their bathymetric data management system. With the successes of Caris products in data acquisition (Hips and Sips) and in chart production (Hydrographic Product Database), the Bathy Database (BDB) implementation was a natural fit for a seamless workflow in accordance with Caris Ping-to-chart solution.

This paper describes how Caris BDB was implemented at CHS Pacific. It is divided in 2 sections. The first section, Retrospective Review, outlines events, in the last 5 years, that led to BDB implementation. The second part, Implementation, reviews the extraction tool (combine), the choice of attributes and data loading decisions.

Caris Bathy DataBASE is a software suite composed of a client application, database server and database administration tools. The scope of this document is limited to the client application's perspective. The installation of the database server, node manager and Relational DataBase Management System (RDBMS) are not covered.

2. RETROSPECTIVE REVIEW

Without a bathymetric database, data sets were residing in folders on a local network. Legacy data were stored in NTX or ASCII format. In order to compile data sets for chart production or to gather data sets for validation purposes, users had to locate the data set folder and copy the data locally. For the legacy data, NTX files or ASCII files had to be converted to Caris file or point cloud format. A considerable number of steps were necessary to access and gather bathymetric data. Also, the metadata was saved in a separate xml file.

In 2007, CARIS proposed the Bathy Database Server solution with the collaboration of CHS Québec region (Cove and Lavoie, 2007). In the following year, a paper entitled *An Evaluation of CARIS Bathy DataBASE 2.0 as a Bathymetric Data Management Solution for CHS Québec* was presented at the Canadian Hydrographic Conference. This paper was the result of a pilot project where BDB was tested to see if it suited CHS Québec needs. Loading time, data integrity and extraction were the three main topics addressed. Concerns were raised by CHS Québec at that time regarding the format type (point or surface) to be loaded, traceability and vertical datum adjustment.

CHS Pacific ran a number of tests on BDB server 2.3 using one hundred sounding sets. Data integrity was the primary concern. In 2010, with the growing need for a bathymetric database, more testing was done. Contour creation and sounding selection out of combined surfaces were tested to see if CHS Pacific needs were met in terms of traceability.

CARIS released BDB version 3.0 in 2010. Instead of its own back end management system, BDB application was now linked to a RDBMS. The RDBMS uses indexation which optimizes data retrieval operations; it provides data security against unauthorized access and accidents by the implementation of password and specific user views to limit data access; moreover, it allows concurrent access, permitting more than one application to access the data at the same time (Manteigas, 2004). The upgrade to a RDBMS storage environment by Caris made BDB more robust and adaptable to CHS needs. In 2012 Caris released BDB version 3.2.

3. IMPLEMENTATION

The primary use of BDB for CHS Pacific is to store bathymetric data and provide easy access to users when they need to compile data for chart production. Also, most of the validation processes including data comparison, superseding, and data updates can be done from BDB. The maintenance is done by the validation staff. This way, the users can access the best data available when needed. Metadata are provided by CHS metadata database CHSDir. The Figure 1 below shows the primary use of BDB at CHS Pacific.

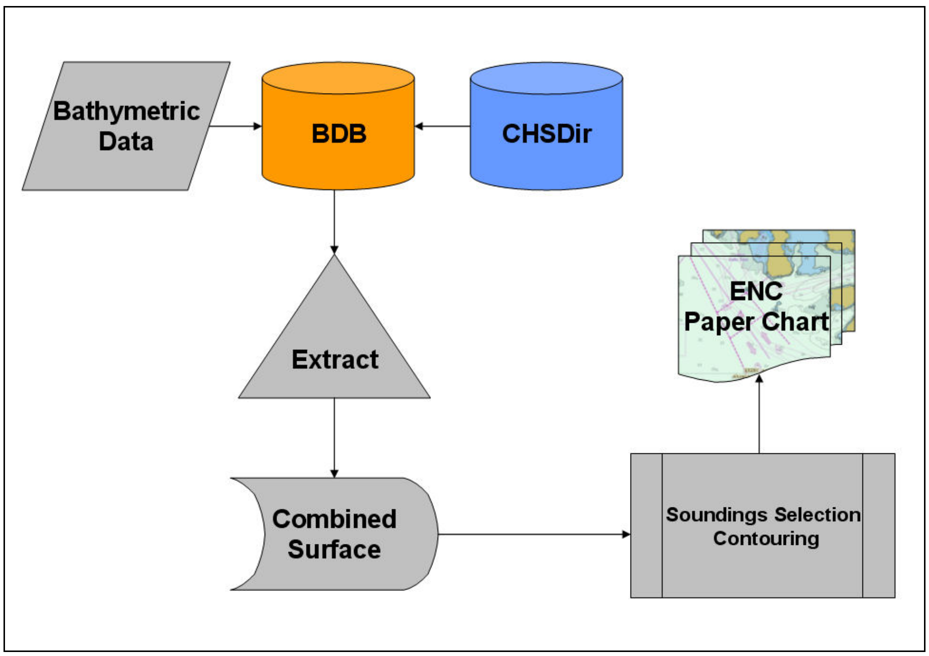

Figure 1 – Primary use of BDB at CHS Pacific

The implementation of BDB was done in 3 steps. However, the steps have a bit of a backward logic. The first step was to understand the combine process and identify the most suitable deconfliction rules. In other words, the extraction process needed to be defined before loading data. The second step was to identify which metadata would be populated into the database. Lastly, it had to be determined which data should be loaded. These 3 steps are detailed in the next sections.

3.1 COMBINED SURFACE

The BDB combine tool is used to merge multiple data sets together to create a surface so that the hydrographer can create hydrographic objects. In the combine surface process, a contributor layer is generated (Figure 2). Each color represents a different source. This contributor layer holds the source document number of the data sets it originally came from. When the sounding selection is performed on the combined surface, the source document number is carried as an attribute to the newly created sounding object. This makes it possible to go back to the original data if required.

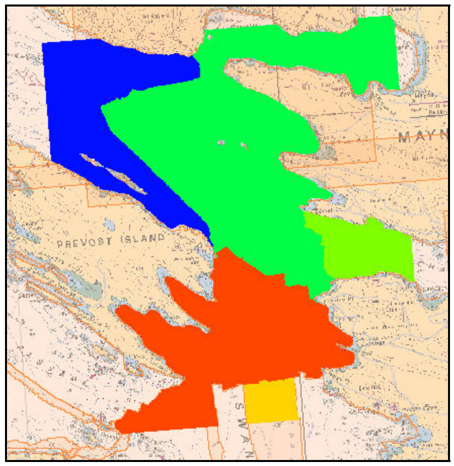

Figure 2 – Contributor layer of a combined surface

In areas where two or more data sets overlaps, deconfliction rules are used to determine which node should participate in the combined surface. Those situations are called “conflicts”. Several tests were necessary to determine which deconfliction rules should be used when combining surfaces. A sounder type attribute was added to the catalogue to use as the primary deconfliction rule, followed by “Newest data” rule and “Shoalest depth” rule. The “Sounder type” rule was added due to a period between 2005 and 2008 where two acquisition systems of different resolution, the Konsberg EM-1002 and the Konsberg EM-3002 were used simultaneously along the BC coast. Surface differences had shown discrepancies in the overlap areas. But after a thorough assessment, it was demonstrated that the discrepancies were isolated and strictly in slopes. On top of shoals, where it really counts, the agreement was within 1 or 2 decimeter, an acceptable difference according to order 1a of International Hydrographic Organization (IHO) S-44 standards.

Figure 3 demonstrates existent discrepancies on the slopes versus agreement on the top of a shoal when comparing both systems. Verification was done thoroughly for all overlapping areas between these two sounders and an acceptable agreement has been obtained on every shoal; therefore, the sounder type rule has been removed and CHS Pacific is currently using "Newest data" and "Shoalest depth" rules to combine surfaces.

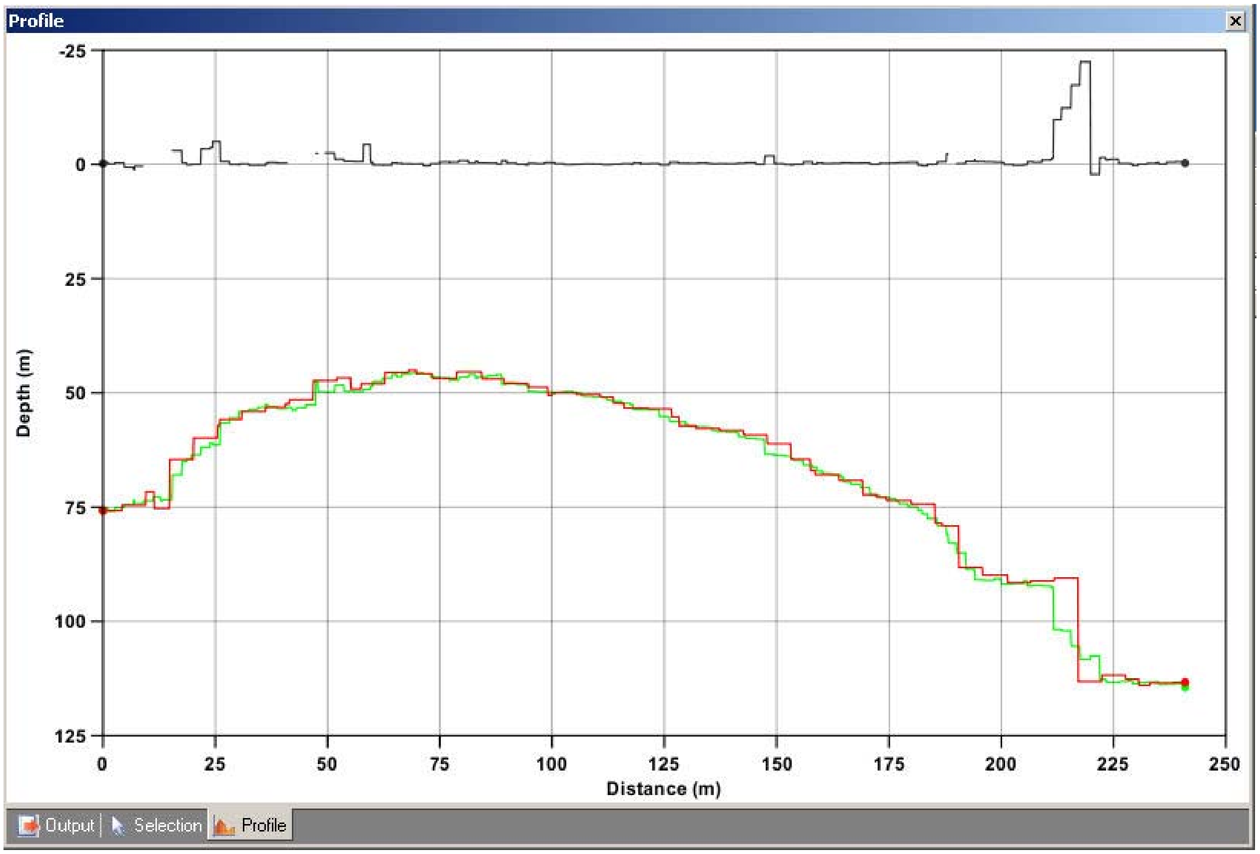

Figure 3 – EM1002 versus EM3002
(Red: EM-1002 surface; Green: EM-3002 surface; Black: Difference between both surfaces)

The "Newest data" rule does a primary selection by choosing the most recent source. The "Shoalest depth" rule does the final selection if there is a tie in the first rule but more importantly, it makes the resampling decisions all over the combine surface. The output resolution is determined by the coarser resolution of all the sources involved in the combine. Figure 4 demonstrates what happens in a resample situation using "Shoalest depth" rule. If we would have only used the "Newest data" in the same situation, a value would have been picked randomly between the nodes that are within a certain radius from the new node.

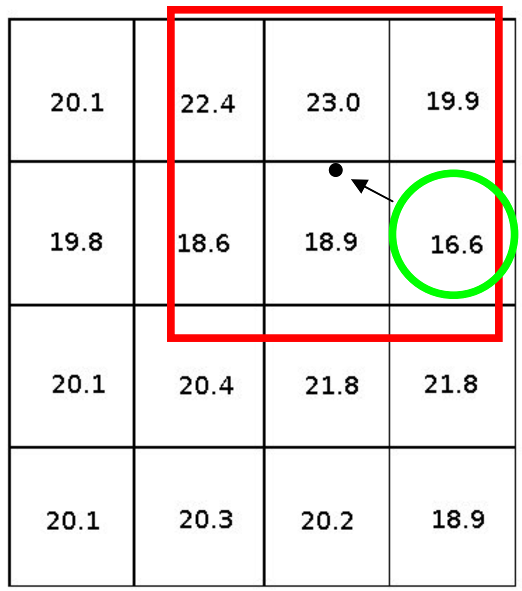

Figure 4 – Resampling with "Shoalest depth"
(red: Resampled pixel size green: Value of the new node)

3.2 METADATA AND ATTRIBUTES

When a data set is loaded into BDB, a SURFAC object is created. It is a bounding polygon shaped to the data extent and it has a list of attributes attached to it. Some metadata (e.g. horizontal datum and vertical datum) from the CSAR file can be read and written directly into the SURFAC object attributes when loading but most of the metadata has to be populated independently, either manually or automatically. At CHS Pacific, CHSDir is the source for these metadata. Table 1 presents the SURFAC's attributes populated at CHS. The S-57 attributes are represented by the higher case font and the CHS custom attributes are represented by the lower case font.

For the usages (right column of Table 1), CATZOC means that those attributes (e.g. TECSOU) will serve in the attribution of CATZOC value. The CATZOC (category of zone of confidence) is an attribute of the S-57 M_QUAL meta-object that refers to the quality of the data. It is now a mandatory object in Electronic Navigational Charts (ENC).

The S-100 usage means those attributes will be used to implement S-100 objects, also related to the quality of the data. The “National” usage means those attributes have been identified through a national process to standardize the list of attributes across CHS regions. Data access usage means those attributes will be used to limit data access to some users or for some usages through filters or views.

Attribute	Description	Main usage
OBJNAM	Object name (Project name)	Information
TECSOU	Technique of sounding	CATZOC
SURTYP	Survey type	National
CATZOC	Category of zone of confidence	M_QUAL
HORDAT	Horizontal datum	Information
VERDAT	Vertical datum	Information
SURSTA	Survey start date	CATZOC
SUREND	Survey end date	Combine
POSACC	Positioning accuracy	S-100
SOUACC	Sounding accuracy	S-100
SCAMIN	The minimum scale at which the object may be used	CATZOC
valsta	Validation Status	Data access
tecpos	Technique of positioning	CATZOC
restrn	Restriction	Data access
organi	Organization	Management
catsur	Category of survey	Filtering
vessel	Survey vessel	National
sndtyp	Sounder type	CATZOC

Table 1 - SURFAC attributes

3.3 LOADING DATA

With the combine process steps defined and the attributes identified, the loading process was ready to begin. A decision was made to load all data regardless of validation status (validated, not validated or superseded). This decision was made because CHS Pacific has a considerable number of data that are pending to be validated. Also, for validation tasks, it's easier to have all the data in the database. For these reasons, all data have been loaded in BDB. Filters on the “valsta” attribute are used to assure that data are utilized for the right purpose. The users in chart production use a filter when they log on to BDB so they only see the validated data. The hydrographer sees it all so he can tell which area hasn't been surveyed.

Another decision was made for those specific situations where sparse data overlap sparse data and where there is no multibeam data. There is quite a bit of those situations along the BC coast, especially in shallow waters where the multibeam can't go or in remote inlets or arms that haven't been multibeamed yet.

When combining data involving that specific situation, all sparse data get captured. The deconfliction rules resolve conflicts where data sets overlap but, chances are, that none of the soundings of the 2 sparse data sets will have the exact same coordinates. When loading a dredge survey for example, the underlying sparse data sets have to be split. The portion of an older sparse data set that is overlapping a newer dredge survey has to be flagged as superseded while the rest remains valid. It is a specific situation that applies to a certain type of data (sparse) and a certain type of survey (dredge) or area where geological processes are very dynamic.

Taking this information into consideration, CHS Pacific has loaded 1200 data sets in BDB. Nine charts currently in production have used the BDB to create combined surfaces. In 2012, migration to BDB 3.2 was accomplished successfully.

3.4 CONCLUSION

The implementation of BDB has been a major upgrade for data management and a useful tool for chart production at CHS Pacific. Bathymetric data and their metadata are now accessible at a glance and simultaneously. The primary use is to provide combined surfaces for chart production but we can easily see BDB being used for other purposes, such as a management tool or a backscatter database.

ACKNOWLEDGMENTS

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BIOGRAPHICAL NOTES

Michel Breton holds a Master in Science, Geography (2011) from UQÀM. He has been involved in field surveys and data validation in the last two years and has been working on the implementation of a bathymetric database. He is the Pacific region delegate for the CHS Bathy Database Working Group.

Gerald Kidson has worked for the CHS for 32 years and is a senior member of the Chart Production team. He has been involved in all aspects of Chart Production from manual methods to present day use of HPD and BDB. He has been actively involved in developing a process to create products from a combined surface for use in CHS Products.

Paul Scott holds a Bachelor of Science in Geography from the University of Victoria. He has worked with CHS for two years and has been actively involved in creating a process that transforms combined surfaces into soundings and contours for chart production.

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