Thursday, March 29, 2018

07 h 00 - 08 h 00  
**Breakfast (provided)**  
Carson Hall - Victoria Convention Centre

08 h 00 - 10 h 00  
**CHC Technical Session: CHARTING, NAVIGATION AND PRODUCT DEVELOPMENT**  
Lecture Hall - Victoria Convention Centre  
Moderator: Michel Breton, Canada Oceans Protection Plan

08 h 10 - 08 h 30  
**QPS Nautical Charting Workflow: Walking a Ping from the Surveyor All the Way to the Pilot**  
Lecture Hall - Victoria Convention Centre  
Matthew Wilson, QPS

The Quality Positioning Services (QPS) Nautical Charting Workflow is the only one in the industry that fully encompasses the journey of a ping from the surveyor to the pilot. There is tremendous advantage in the fully-integrated solution, as it allows for the preservation of data formats throughout the entire workflow, and eliminates errors associated with data conversion and metadata loss. The QPS Nautical Charting Workflow is built on streamlining processes and efficiency: • Actual pings are captured in the integrated navigation software QINSy, built on a philosophy of real-time corrections and quality assurance to ensure high data quality capture. • Acquisition projects open directly in Qimera, a processing software with intuitive, guided workflows, and designed to automate mundane tasks, thus common, human errors are eliminated. • Survey data migrates seamlessly into Fledermaus, a visualization software specializing in 4D geo-spatial analysis, and it promotes above all clear communication and presentation of data. • Soundings and contours are extracted automatically from gridded bathymetry in Qarto, the ENC production software, built for a rapid turnaround—some survey-to-ENC workflows have been measured in hours. • Updated charts go live in Qastor, a precise navigation software for piloting with Under Keel Clearance (UKC) and vessel docking capability, which can be further interfaced
with AIS and meteorological data for real-time updates. Further process efficiency is gained by real-time processing in QINSy, which allows for unprecedented decision-making capabilities for surveyors while they are still in the field. While there are great benefits to the fully-integrated solution, the workflow components are also perfectly modular for the utmost client flexibility. The Port of Rotterdam, an early-adopter of the QPS Nautical Charting Workflow components, is a prime example, and is presented as a case study. The advantages of the solution are shown in terms of timeliness in the ping-to-pilot workflow and rapid product turnaround.

**08 h 30 - 08 h 50**

*eTrac's Evaluation of Qimera: Accomplishing the NOAA Workflow*

Lecture Hall - Victoria Convention Centre

David Neff, eTrac Inc.

eTrac’s 2017 NOAA task orders in the state of Florida cover over 100 miles, from Sarasota to Naples, with area coverage requirements prioritized per NOAA’s hydrographic health model. These include inlets, ferry routes, and over 100 feature investigations, which are particularly important after the passage of Hurricane Irma. eTrac, with their considerable resources and skilled personnel, is well-suited to handle such a project, and at the same time prides itself in their ability to be on the leading edge of new tools and capabilities. QPS Qimera emphasizes above all a clean and streamlined workflow, one that minimizes the error-prone human tasks that traditionally have been required in hydrographic data processing. With eTrac operating three survey vessels daily, each with dual-head multibeam echo sounders, plus with the considerable feature requirements, there is excellent opportunity to evaluate Qimera’s data throughput capabilities, dynamic workflows, and finally, its latest functionality—S-57 feature management. Additionally, eTrac showcases the benefit of QPS QINSy for acquisition—with real-time integration capabilities and seamless project migration to Qimera, there is potential for significant gains in efficiency. Qimera will be evaluated during this project, with particular attention paid to the rapid data processing turnaround that is required by eTrac to ensure quality standards per NOAA specifications. Furthermore, the benefits of Qimera’s processing state management and guided workflows for the eTrac personnel on-scene with varying experience levels will be assessed. Lastly, Qimera’s S-57 capabilities—built with new, innovative methodology, in-spirit with the Qimera philosophy of removing human error from what is traditionally a quite tedious process—will be introduced. Both advantages and lessons learned will be included, and the benefits measurably delivered by Qimera—for eTrac and NOAA alike—will be presented.

**08 h 50 - 09 h 10**

*Benefits and Impacts to Nautical Charting by Adopting a New Reference Frame*

Lecture Hall - Victoria Convention Centre

Neil Weston, NOAA

NOAA’s Office of Coast Survey (OCS) is responsible for maintaining the nautical charts for the nation and most of the publications for the coasts and Great Lakes. Currently there are over 1000 nautical charts in vector and raster format and roughly 95,000 miles of shoreline that OCS is responsible for. Providing accurate metadata and geospatial information on man-made features, depths, rocks, aids and dangers to navigation, and vessel traffic separation schemes, are paramount for the agency and require several strategic approaches for being successful. As NOAA and OCS continue the migration from paper to electronic charts, building seamless databases that distribute accurate navigational products and services requires proper identification of geospatial information and adoption of the most accurate reference frame and datum. In 2022 the National Geodetic Survey, NOAA will be replacing the current North American Datum of 1983 (NAD 83) with a more accurate one that is geocentric and derived using Global Navigation Satellite Systems (GNSS) technology. One significant difference between the two frames is the origin of NAD 83 is offset from the origin of the new frame by approximately 2.2 m. Adoption of the new frame will therefore change the horizontal and vertical components of all NAD 83 positions in the United States and Canada and the magnitude of change to each component is dependent on the geographic location on the Earth. This paper will explore the steps necessary to adopt a new reference frame and datum as well as highlighting the possible impacts that may affect the geospatial foundation of all nautical charts.

**09 h 10 - 09 h 30**

*Dynamic Information in Support of Safe and Efficient Navigation in Canada.*

Lecture Hall - Victoria Convention Centre

Louis Maltais, Canadian Hydrographic Service

Under Canada’s Ocean Protection Plan, Department of Fisheries and Ocean Canada more specifically Canadian Hydrographic Service is fully engaged in delivering operational dynamic information on tides, currents and bathymetry. Increasing safety and efficiency of navigation is the
prime driver but accessible, standardised, modern dynamic information will help the entire marine community. Project deliverables and major milestones will be reviewed. Joining strengths of oceanographers and CHS expertise on standards and services, this presentation will explain what Ocean Protection Plan is putting in place in terms of modern and robust solutions to support the future of navigation in Canada.

09 h 30 - 9 h 50

*Bathymetric Surfaces to Charted Features: Defining a Smooth Path to Safety*

Lecture Hall - Victoria Convention Centre

Karen Cove, Teledyne CARIS

Bathymetric Surfaces to Charted Features: Defining a Smooth Path to Safety
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Efficiently generating smooth contours for navigation from bathymetric surfaces remains a challenge. While the definition of new and innovative products like the S-102 Bathymetric Surface implies that the future may provide new ways to deliver safe, high-quality data to mariners, the current paradigm relies on contours. In addition to the traditional and highly generalized ENC delivery of this information, we also have the opportunity to produce complementary high-resolution overlays in sensitive and high-traffic areas. While these bathymetric data overlays (bENCs) provide an opportunity to provide denser, more accurate, and timely information to the mariner, the problems in constructing smooth contours are compounded by the volume of data to analyze and the number of geometries to construct. In order to meet these requirements there is a need for tools that address the hydrographic constraints of safety, legibility, topology and waterbody morphology. Other drivers are the need to quickly and automatically produce results on high volume datasets and to reduce the time spent by hydrographers on manual validation. Scalability, performance and automation are key drivers for success. Two distinct approaches have been considered and will be presented. Both strategies make use of established research combined with original revisions. The first is based on the idea of using a consistent smoothed surface model. This model can then be used to generate contours that will be smoother, self-consistent, topologically correct, and safe with respect to the original data. The second approach is direct contour smoothing using a method referred to as energy-minimizing snakes. This is paired with resolving conflicts in contour sets and new approaches to curvature gradients to optimize results.

10 h 00 - 10 h 30

*Coffee Break & Exhibits Open*

Carson Hall - Victoria Convention Centre

10 h 30 - 12 h 00

CHC Technical Session: OTHER INNOVATIONS

Lecture Hall - Victoria Convention Centre

Moderator: Whitney Anderson, NGA Marine Safety

10 h 30 - 10 h 50

*A Design for a Trusted Community Bathymetry System*

Lecture Hall - Victoria Convention Centre

Brian Calder, CCOM/JHC University of New Hampshire

Crowd-sourced bathymetry (CSB) has received a significant amount of attention in recent years. Although increasing amounts of data are being collected, attributed, and archived, finding a route to the nautical chart has been problematic. Partially, this is due to a lack of formal means to represent data quality on the chart, but is mostly due to lack of qualifying information for the data. CSB efforts generally suffer from a lack of calibration, leading to time-varying and uncontrolled vertical offsets. Assumptions that these issues can be resolved by having a sufficient number of independent observations (the “wisdom of crowds” argument) are often frustrated by basic physical limitations: the ocean is big, and ships are (relatively) small. Except in limited circumstances, or specific areas, the chances of having any repeated measurements are vanishingly small. As an alternative to the collection of unqualified (CSB) data, we propose a data collection system which, by construction, provides sufficient guarantees of data quality to allow the measurements to be considered for hydrographic use. We call this method Trusted Community Bathymetry (TCB). A TCB system resolves many CSB issues through significantly improved vertical positioning. High-accuracy, high-precision post-processed 3D GNSS solutions allow for the estimation of vertical offsets so that autonomous calibration is possible; ellipsoid-referenced depths obviate the need to apply tidal corrections to the data. Given a known offset, similar techniques can be used to autonomously establish calibration sites. TCB systems can also cross-calibrate CSB data. We demonstrate these ideas using a prototype TCB system developed by SeaID Ltd., which combines a NMEA data logger with a GNSS system. By comparison with survey-grade GNSS and INS systems, we demonstrate how to
establish the vertical offset calibration in a system, and the construction of a calibration site. We also qualify the fundamental performance of the prototype system.

**Radiometric Complications in Multibeam Multispectral Backscatter Data Due to Different Transmission Approaches, Solution and Results**

Lecture Hall - Victoria Convention Centre
Anand Hiroji, Center for Coastal and Ocean Mapping/Joint Hydrographic Center, University of New Hampshire

As an essential prerequisite for utilizing multibeam backscatter data for seafloor classification, proper adjustment to account for the radiation pattern of the transmitter is required. The radiation pattern is a sonar specific property and any method that extract the radiation pattern should not be influenced by the seafloor or ocean conditions. To satisfy this need the Geometric method to extract radiation pattern was previously developed and presented (CHC2016) by the authors. The method was then applied to the multispectral analysis (US Hydro 2017) for the systems (EM710 and EM2040) whose transmit sectors were not compensated for vessel roll. An additional complication, however, exists for those sonars that do have roll stabilized transmit sectors (EM302 and EM122). In this case, the Geometric method can only utilize the grazing angle variations. In this paper, an approach to extract radiation pattern using Geometric method is demonstrated. Practical examples of the different radiation pattern over-print are presented from recent RV Celtic Explorer cruise in South Celtic Sea during which a low-frequency EM302 was simultaneously operating along with high frequency EM2040. The radiation patterns for both EM2040 and EM302 are successfully extracted and then properly corrected from the backscatter data. The corrected backscatter data was then used for multispectral data analysis. The multispectral angular response curves and backscatter mosaics are presented. Collected bottom samples are used to interpret the multispectral backscatter results.

**Quantifying the Impact of Internal Wave Activity on Multibeam Bathymetry**

Lecture Hall - Victoria Convention Centre
John Hughes Clarke, UNH

Imperfect compensation for the refracted ray path has long been recognized as a major source of error for oblique multibeam soundings. Given the discrete nature of sound speed profiling methods, the scale of the refraction-related error can be attributed to a combination of both the vertical shifting of the veloclines as well as their local slope. To quantify the relative scale of these two contributors, a 3D ray trace model output is compared to field results from a broad range of velocline oscillation (internal wave) scales. The example data is from two weeks of multibeam operations in the summertime Celtic Sea. The region is characterized by a very strong thermocline (~20 m/s step) which is routinely perturbed through baroclinic shear resulting from tidal flow over upstanding seabed relief (banks). The net result is a wide spectrum of internal wave activity, with amplitudes ranging from 1-30 m and wavelengths ranging from 100 m to 10 km. As the seafloor morphology is generally so smooth, the signature of refraction related artefacts can clearly be distinguished and measured. The data are corrected using an underway profiling instrument (MVP-200) operated at ~ 30 minute intervals, corresponding to about 7 km spacing. Underway multi-frequency acoustic imaging from both single beams (EK-60, 18, 38, 120 kHz) and multibeams (EM2040 and EM302) are used to define the wavelengths, amplitudes and azimuths of the internal wave activity. The observed scale of undulations are run through the 3D model at various azimuths relative to the survey vessel track. The scale of the vertical depth anomalies are calculated with respect to the perturbation geometry. The impact of the higher density sound speed profiling is assessed.

**Improved Sound Speed Control Through Remotely Detecting Thermocline Undulations**

Lecture Hall - Victoria Convention Centre
Jose Cordero, Center for Coastal and Ocean Mapping / UNH

Internal waves are a common phenomena associated with stratification developed in summer-time shallow tidal seas. They result in very rapid undulations in the main velocline which, if not accounted for, will result in significant refraction errors in multibeam data. Mechanical sound speed profiling, both static and mobile, cannot sample this structure adequately. Thus an alternate means of detecting and accounting for that variability is needed. Within the oceanographic community, it has long been recognized that a distinct volume scattering layer is often associated with major oceanographic boundaries. This reflects a combination of temperature/salinity microstructure or zooplankton around the pycnocline depth. Taking advantage of that, several weeks of multibeam survey on the Irish continental shelf were undertaken during which multispectral acoustic
scattering data from an EK60 echo sounder was acquired together with an MVP profiler deployed every ~½ hour. A directional filter algorithm has been developed to try and extract the location and undulations of the scattering layer(s) from the EK60 echograms. The extracted layer depth was then compared to the velocline found in each of the discrete MVP profiles. Variability in the correlation between the extracted layer and the actual peak velocline is used to assess the accuracy of the method. Where it is deemed successful, the observed sound speed structure can then be shifted on a ping by ping basis to try and emulate the internal wave activity. This way, ray tracing would be possible using a unique profile for every ping. The results of this approach are presented, particularly focusing on periods when the correlation was poorer. This was noted to occur at dawn and dusk due to the diurnal plankton migration. The Celtic Sea is recognized as an area of a relatively strong thermocline, and thus this method may be less useful in more complex stratification conditions.

11 h 50 - 12 h 00
Comparing the Automatic Boresight Calibration against the Patch Test
Lecture Hall - Victoria Convention Centre
Burns Foster, Teledyne CARIS
Comparing the Automatic Boresight Calibration against the Patch Test Eli Leblanc (Geomatics Software Developer, Eli.Leblanc@Teledyne.com)
Burns Foster (Product Manager, Burns.Foster@Teledyne.com)
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Abstract Although it has been used for almost 2 decades, the traditional patch-test to estimate the boresight angles between IMU and sonar has several drawbacks related, among others, to its subjectivity, cost, and the inability to deal with the correlation between roll, pitch and yaw. The motivation behind the new Multibeam-IMU Boresight Automatic Calibration (MIBAC, CIDCO) algorithm was to design a new boresight calibration method that addresses these concerns through a systematic approach to boresight determination. This presentation will introduce a practical integration of the MIBAC tool, and discuss the results and performance in comparison with the traditional patch-test approach.

12 h 00 - 13 h 00
Lunch (provided) and Exhibit Hall
Carson Hall - Victoria Convention Centre

13 h 00 - 14 h 30
CHC Technical Session: SURVEYS, MAPPING AND THE VERTICAL COMPONENT
Lecture Hall - Victoria Convention Centre
Moderator: Rear Adm (Rtd) Gerd Glang

13 h 00 - 13 h 20
Accuracy of the Pacific Region Hydrographic Vertical Separation Surface model using 2016/2017 Field Data
Lecture Hall - Victoria Convention Centre
Neil Dangerfield, Physical Scientist, Canadian Hydrographic Service
A comparison of the bathymetry reduced using the vessel’s satellite-derived vertical position and the Hydrographic Vertical Separation model (HyVSEPs) to traditionally derived water level values indicates the model’s performance to accurately predict separation values. During the 2016/2017 Pacific region field seasons, statistics were generated for multiple sites in a variety of tidal regimes throughout the British Columbia coast. In this study, we investigate the data to evaluate model accuracy and suggest improvements that will adjust the model accuracy in future iterations.

13 h 20 - 13 h 40
Utilization of U.S. Geodetic Service coastal water level gauges in Mississippi to check VDatum tidal datum to NAD83 vertical separations
Lecture Hall - Victoria Convention Centre
Dr. David Wells, President, HydroMetrica Limited
The US National Oceanic and Atmospheric Administration has a Vertical Datum Transformation tool (VDatum) that allows for conversions between tidal, ellipsoid and orthometric vertical datums. One important application is allowing for hydrographic surveying to the ellipsoid and using the VDatum tool to reduce the soundings to Mean Lower Low Water (MLLW). However, in southeastern Louisiana and western Mississippi, VDatum errors have been found by NOAA to be 20-50 cm. These errors cannot be absorbed by the IHO vertical uncertainty budget for special order through order 1b. USGS water level gauges provide an additional source of water level information in the region, which can be utilized to check VDatum results. These gauges report water levels with respect to gauge zero or NGVD88. In order to utilize these gauges for tidal datum to ellipsoid separation, static GNSS surveys have to be conducted for the USGS gauges and tidal datum transfers (using Modified Range Ratio method) from a NOAA tide gauge have to be performed. We report on the results from performing these analyses on a USGS gauge at the mouth...
of the Pearl River in Mississippi, using the NOAA tide gauge at Bay Waveland, Mississippi as the control gauge, and compare the results to those from VDatum.

**Integrating Bathymetric Datasets in the Lower Saint John River to produce a Common Reference Surface**
Lecture Hall - Victoria Convention Centre
Patrick McNeill, UNB
The Ocean Mapping Group has been involved with collecting multibeam bathymetry and oceanography data in the Lower Saint John River and Port of Saint John since the late 1990s. This area is characterized by a complex estuary where the Saint John River meets the large tides from the Bay of Fundy in the Port of Saint John. The bathymetry was collected using multiple vessels in small projects, by different groups, and is referenced to multiple different vertical datums. The goal of the project was to create a seamless bathymetric surface with a common datum and resolution for use in a local high-resolution ocean modelling simulation. To achieve this goal, issues relating the age of the datasets, collection with multiple vessels and sensors, and combining datasets referenced to both river and chart datum had to be overcome. This project involved combining, processing, and cleaning these datasets while reducing them to a common vertical datum to create bathymetric surface products.
These surface products and related oceanography data were then integrated into an online web mapping application for viewing and dissemination.

**MS-PAC: Multibeam System Automatic Parameter Calibration**
Lecture Hall - Victoria Convention Centre
Nicolas Seube, CIDCO
The aim of this paper is to present some recent results from a research project conducted by the CIDCO aiming to design new procedures and associated adjustment methods for automated calibration of MBES parameters. This research is done in collaboration with ENSTA Bretagne (France) and with the support of the SHOM (France). Three classes of methods have been designed: The first one, called MIBAC (MultiBeam IMU Automatic Boresight Calibration) is a fully automated method for calibrating the boresight between an IMU (or an INS) and a MBES. In addition to the calculation of boresight angles, the system provides boresight precision through a statistical analysis of error residuals. The second one, called MILAC (MultiBeam IMU Latency Automatic Calibration) is able to determine the IMU-MBES residual latency from a MBES data set with high accuracy and precision. This method can also detect the presence of time-stamping issues in quasi real-time. The third one, called LAAC (Lever Arm Automatic Calibration) is a tool devoted to the calibration of lever arms between the survey vessel position reference point and the acoustic center of a MBES. Like MILAC, this algorithm is capable of detecting lever-arm variations in quasi real-time. The three classes of methods will be illustrated by numerical results from a series of data sets from CHS, NOAA, SHOM, CIDCO and BSH.

**The Rapid Harbor Search and Rescue by Mapping and Detecting the Seafloor with Acoustic Instruments**
Lecture Hall - Victoria Convention Centre
Yun-ta Teng, CDR, Chief of Underwater Environment Section, Naval Meteorological and Oceanographic Office
February 1st, 2016, one Taiwan Coast Guard patrol vehicle with 2 officers dropped in Taipei Harbor. Taiwan government deployed 5 different groups with hundreds people but spent a week to find the bodies. Even though the searching area just located in the harbor, the weather condition and instruments affected the schedule of search and rescue(SAR). Therefore, Naval Meteorological and Oceanographic Office, R.O.C.(NMOO) started to design a Vessel-Based with a pole mount Tritech Starfish 452F Sidescan(op. freq. 450 kHz), Blueview BV5000(op. freq. 2.25MHz), and VideoRay Scout(ROV) as a Rapidly Estimated SAR mode of shallow water. In a very limited underwater visibility of the harbor, the survey mode provides not only rapidly map in high resolution and wide range images but also detect the detailed 3D shape point clouds. By rapidly surveying a shallow water or harbor area, this combination of vessel-based acoustic instruments makes SAR and mapping more feasible, efficient, and desirable.

**Closing Keynote - FROM JUAN DE FUCA TO THE SALISH SEA: VOYAGING THE WATERWAY OF FORGOTTEN DREAMS PAST AND PRESENT**
Lecture Hall - Victoria Convention Centre
Barry Gough
From the vantage point of any one of the communities, settler or indigenous, that are situated by this fabled waterway, bays and estuaries we can imagine the passage of the millennia and of the centuries, particularly the last five hundred years. These are waters of legend, bounded by islands and continent, and they are seas of international rivalry now defined by international boundaries and safe shipping lanes. Beginning with Juan de Fuca in 1592 a parade of ships form -- one after another -- a bright spectacle of memory, right down to warships transiting Arctic waters. So many great ships have plowed furrows in these waters, forming in a way a microcosm of world maritime history. In late years the Salish Sea had become a new designation, embracing other names and giving a new identity to these waters, one that represents the resilient revival of First Nations and Indian nations on both sides of the border. Barry Gough will tell the larger tale, the inclusive one, that brings together and touches on the diversity of this environment, at the same time commenting on how international rivalries and present-day security problems have made a potentially unitary sea -- the Salish Sea -- a dream rather than a reality. Then again, this is just another chapter in the always incomplete book Voyages in the Waterway of Forgotten Dreams.