HYDROGRAPHISCHE NACHRICHTEN

Journal of Applied Hydrography 03/2023 HN 124

Depth measurement per crowdsourcing. Damn it!

DEUTSCHE HYDROGRAPHISCHE GESELLSCHAFT e.V.
DHyG

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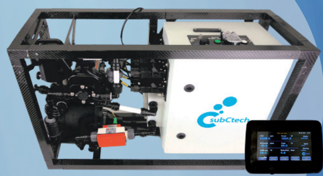
2021 2030 United Nations Decade of Ocean Science for Sustainable Development



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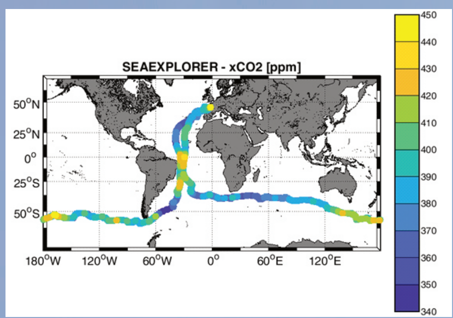
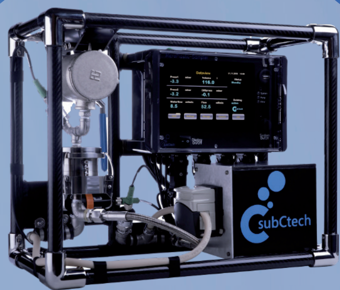


Round the World



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Liebe Leserinnen und Leser,

Freiwillige vor! Gesucht sind Datenspenden zum Wohle aller, genauer gesagt: Tiefendaten aus möglichst allen Gewässern der Welt.

Seit 2009 ruft OpenSeaMap Skipper dazu auf, bathymetrische Daten zu sammeln und auf den OpenSeaMap-Server zu laden. Welche Erfolge die Initiative bis heute verbuchen konnte, erfahren Sie ab Seite 8.

Denselben Ansatz verfolgt seit einigen Jahren auch die IHO. Bis zum Ende des Jahrzehnts, so das ehrgeizige Ziel von Seabed 2030, soll der gesamte Ozeanboden vermessen sein. Mathias Jonas, der Generalsekretär, begründet, warum Crowdsourced Bathymetry für die IHO strategisch bedeutsam ist (Seite 6). Und Jennifer Jencks, die Leiterin der IHO-Arbeitsgruppe für Crowdsourced Bathymetry (CSBWG), berichtet im Wissenschaftsgespräch von den Aktivitäten und verrät, wie sich Leute motivieren lassen, freiwillig Tiefendaten zu sammeln und zu spenden (Seite 22).

Ob die gespendeten Tiefendaten überhaupt brauchbar sind, hat ein Student der HafenCity Universität in seiner Masterarbeit untersucht. Sein Urteil für den von ihm untersuchten Datensatz fällt positiv aus (Seite 14).

Wie ein Hobby-Segler, der selbst regelmäßig Daten spendet, die Sache sieht, lesen Sie auf Seite 20.

Und noch ein Letztes: Den Cartoon für die Titelseite, der den von Crowdsourcern gepiesackten Poseidon zeigt, hat Werner Huth von OpenSeaMap für uns gezeichnet.

Ein Blick zurück: Die letzte Ausgabe dieser Zeitschrift (HN 123) ist zur HYDRO-Konferenz in Monaco erschienen. Während der Veranstaltung wurden druckfrische Exemplare verteilt – siehe das Foto, auf dem zwischen den HN-Redakteuren Patrick Westfeld (links) und Peter Dugge Studentinnen aus Frankreich und den Niederlanden zu sehen sind. Ansinnen des Hefts war es, Gemeinsamkeiten und Unterschiede der Hydrographie in Frankreich und in Deutschland herauszuarbeiten. Ein Bericht über ein Projekt von Studierenden der ENSTA Bretagne, der für die Ausgabe vorgesehen war, hat den Weg in die Redaktion leider nicht gefunden. Den Artikel reichen wir jetzt nach (Seite 28). Außerdem veröffentlichen wir einen Bericht über die HYDRO-Konferenz (Seite 34).

Apropos HYDRO-Konferenz: Nach der HYDRO 23 in Genua steht im November 2024 die Neuauflage in Rostock an. Zuvor jedoch lädt die DHyG gemeinsam mit der Fraunhofer-Gesellschaft zum Hydrographentag in die Hauptstadt. Ich hoffe, wir sehen uns am 20. und 21. Juni 2023 im Fraunhofer-Forum mitten in Berlin.

Lars Schiller

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Crowdsourcing

Die nächsten Schwerpunktthemen

HN 125 (Juni 2023)	**3D-Positionierung auf See**
HN 126 (Oktober 2023)	**BIM und Digital Twins**
HN 127 (Februar 2024)	**Ozeandekade**

 DOI: 10.23784/HN124-01

Warum Crowdsourced Bathymetry für die IHO strategisch bedeutsam ist

Ein Beitrag von MATHIAS JONAS

Crowdsourced Bathymetry (CSB) liefert längst nicht so genaue Tiefendaten wie die professionell betriebene hydrographische Vermessung mit spezieller Ausrüstung. Dennoch möchte die IHO weltweit Seeleute motivieren, aktiv bei der Vermessung der Meere mitzuwirken. Es gibt einige gute Gründe.

Crowdsourced Bathymetry – CSB | Bürgerwissenschaft | Datenspende | Partizipation
crowdsourced bathymetry – CSB | citizen science | data donation | participation

Crowdsourced bathymetry (CSB) does not provide nearly as accurate depth data as professionally operated hydrographic surveys with special equipment. Nevertheless, the IHO would like to motivate seafarers worldwide to actively participate in surveying the oceans. There are some good reasons.

Autor
Dr. Mathias Jonas ist Generalsekretär der IHO.

mathias.jonas@iho.int

Sucht man im Netz nach einer griffigen Übersetzung von *crowdsourcing,* liefert die Suchmaschine unter anderem diese Antwort:

Crowdsourcing setzt sich aus den Begriffen »Outsourcen« und »Crowd« zusammen. Gemeint ist, dass bestimmte Aufgaben und Arbeitsprozesse an die Masse der Internetnutzer, die Crowd, ausgelagert werden.

Das klingt modern und partizipatorisch, aber ist das denn für die Vermessung der Topografie des Meeresgrundes, die üblicherweise von eigens qualifizierten Kräften mit spezieller Ausrüstung ausgeübt wird, überhaupt sinnvoll und technisch möglich? Die Antwort hängt von den Anforderungen und Erwartungen ab, die man an die Genauigkeit und Verlässlichkeit von Tiefenmessungen stellt.

In Seegebieten mit Schiffsverkehr verlangen die IHO-Normen Vermessungsgenauigkeiten von circa ±1 % der Wassertiefe. Diese Anforderungen sind nur von ausgebildeten Fachleuten mit entsprechender Messausrüstung und durch qualifizierte Nachbearbeitung der aufgenommenen Daten unter Berücksichtigung des Wasserstandes erfüllbar. Die von Crowdsourcern erreichbaren Genauigkeiten sind demgegenüber circa mit dem Faktor zehn anzusetzen – und dabei sind die möglichen Abweichungen in der Genauigkeit der gemeldeten horizontalen Position noch nicht berücksichtigt.

Wozu dann die Anstrengungen, weltweit Seeleute zu motivieren, zum Konzept der Crowdsourced Bathymetry (CSB) aktiv beizutragen?

Eine der Antworten ergibt sich aus der schieren Größe der von Wasser bedeckten Fläche des Planeten. Von diesen 70 % sind bisher nur etwa 25 % mit akzeptabler horizontaler und vertikaler Auflösung topografisch vermessen; und für diesen Anteil muss man noch zwischen viel befahrenen Wasserstraßen und weiter abseits liegenden Seegebieten hinsichtlich der Genauigkeit und Häufigkeit der durchgeführten Vermessungen unterscheiden. Richtig ausgewertet, können die »ungenauen« CSB-Daten deshalb vor allem in wenig befahrenen Seegebieten wichtige Anhalte für bisher unerkannte Untiefen, Unterwasserhindernisse und zum Beispiel durch Sedimenttransport ausgelöste Veränderungen ergeben.

Die Datenaufnahme ist durch die zunehmende Ausstattung von kleineren Wasserfahrzeugen mit hinreichend leistungsfähigen Echoloten das geringere Problem. Schwieriger ist die Datenübertragung an die verarbeitenden Stellen und die dortige Prozessierung. Ersteres braucht die Bereitschaft der Datenlieferanten zu zusätzlichem Aufwand, letzteres Verarbeitungskapazitäten aufseiten der Empfänger.

Die Bereitschaft zur bruchlosen Gestaltung dieser Bearbeitungskette »from ping to chart« ist möglich, bedarf aber eines Anreizes. Dafür exemplarisch ist das System der norwegischen Firma Olex, die diese Art der Datensammlung für die Hochseefischerei als Geschäftsmodell betreibt. Von den resultierenden digitalen Topografien weit vor der norwegischen Küste profitieren beide Seiten: sowohl die Fischer als auch Olex, das die erforderliche technische Unterstützung leistet und einen Bezahldienst für diese Daten eingeführt hat.

Einen solchen Anreiz kann das von der IHO betriebene System der für jedermann frei verfügbaren Datensätze leider nicht liefern. Alle Verhandlungen, um die Olex-Daten in das globale topografische Modell – das GEBCO-Grid – zu integrieren, sind bisher gescheitert. Trotz intensiver Bemühungen ist es der IHO bisher nicht gelungen, ein ähnliches Belohnungssystem für die Mitwirkung in CSB zu definieren.

Aber auch ohne einen unmittelbaren Vorteil ist die Mitwirkung im CSB-Modell für einige gesellschaftliche Gruppen attraktiv: In der Schifffahrt gibt es eine jahrhundertealte Tradition des freiwilligen und kostenlosen Informationsaustausches zum Nutzen aller Seeleute – man denke zum Beispiel an Wetterbeobachtungen –, die hier in einer digitalen Variante des Gemeinsinns und des Gemeinnutzens fortgeschrieben wird. In den letzten Jahren ist es darüber hinaus besser gelungen, die Bedeutung der Meeres und damit des Meereswissens für alle globalen Prozesse zu kommunizieren. Die Mitwirkung und Teilhabe an einem positiven Beitrag zur Vermessung der Meere und damit zum Meeresschutz ist für viele Menschen, für Staaten und auch zunehmend für Firmen motivierend.

Bedeutende Datenspenden wurden von den Kontraktoren der International Seabed Authority geleistet, die im staatlichen Auftrag zukünftige mögliche Abbaugebiete in der Tiefsee auf die dort herrschenden Bedingungen hin untersuchen. Einen weiteren wichtigen Beitrag leistet zum Beispiel die weltgrößte Vermessungsfirma Fugro, die die auf Transitfahrten aufgenommenen Messungen für Millionen von Quadratkilometern kostenlos bereitstellt.

Ein anderer wesentlicher Aspekt der CSB-Idee ist die Akquisition von Vermessungsdaten, die in wissenschaftlichen Projekten sozusagen als »Beifang« erzeugt werden. Oft sind jedoch in der projektgetriebenen Finanzierung keine Mittel für die Erstbearbeitung und Übermittlung dieser Datenschätze vorgesehen. Die IHO versucht hier auf allen Ebenen und für alle Regionen, positive Veränderungen herbeizuführen.

Große und sehr brauchbare Datenbestände werden auch bei den nationalen Marinen vermutet. In jüngster Zeit sind zunehmende Investitionen in die Tiefseeaufklärung zur Prävention von Anschlägen auf wichtige Infrastrukturen wie Kabel und Pipelines zu beobachten. Dass diese Vorsorge begründet ist, zeigen die jüngsten Anschläge auf die Nord-Stream-Pipelines in der Ostsee.

Die Datenlage verbessert sich also kontinuierlich; es bleibt jedoch zu fragen, ob und wann viele dieser Daten für eine allgemeine und kostenfreie Nutzung zur Verfügung stehen werden. In der gegenwärtigen geopolitischen Situation erscheint dies für die nahe Zukunft eher zweifelhaft. Diese und andere Hindernisse werden die IHO jedoch nicht davon abhalten, CSB weiter als strategisch wichtiges Element ihrer Aktivitäten voranzubringen.

Durch die Ansprache der verschiedensten Interessengruppen und der positiven Rezeption als Bürgerwissenschaft (Citizen Science) trägt CSB immens zur Sichtbarkeit der Organisation in der Vielstimmigkeit der maritimen Akteure bei. CSB entspricht in seiner partizipatorischen internationalen Ausrichtung zudem der der Arbeit der IHO zugrunde liegenden Überzeugung, dass die abgestimmte internationale Zusammenarbeit zum Nutzen aller die Grundlage für Frieden und Wohlstand ist. //

Hydrographische Nachrichten
HN 124 – März 2023

Journal of Applied Hydrography

Offizielles Organ der Deutschen Hydrographischen Gesellschaft – DHyG

Herausgeber:
Deutsche Hydrographische Gesellschaft e. V.
c/o Innomar Technologie GmbH
Schutower Ringstraße 4
18069 Rostock

ISSN: 1866-9204

Chefredakteur: Lars Schiller
E-Mail: lars.schiller@dhyg.de

Redaktion: Peter Dugge, Dipl.-Ing.
Horst Hecht, Dipl.-Met.
Holger Klindt, Dipl.-Phys.
Friederike Köpke, M.Sc.
Dr. Jens Schneider von Deimling
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 DOI: 10.23784/HN124-02

OpenSeaMap

Crowdsourcing, Open Source und Open Data als Basis für freies Wissen

Ein Beitrag von MARKUS BÄRLOCHER und MARTIN OVER

In drei Abschnitten berichten die Macher von OpenSeaMap über die neue Motivation für Crowdsourcing (Zeitenwende); über die wachsende Zahl der Datenspender, die Flachwassertiefen für OpenSeaMap erfassen, über Erfolge und Rückschläge; und über Details der Prozessierung und Visualisierung von Meerestiefen für OpenSeaMap.

Crowdsourcing | Open Source | Open Data | OpenSeaMap | OpenStreetMap | Datenlogger | Datenspenden
crowdsourcing | open source | open data | OpenSeaMap | OpenStreetMap | data logger | data donation

In three sections, the makers of OpenSeaMap report on the new motivation for crowdsourcing (Zeitenwende); on the growing number of data donors collecting shallow water depths for OpenSeaMap, on successes and setbacks; and on details of the processing and visualisation of ocean depths for OpenSeaMap.

Autoren
Markus Bärlocher, Hochseesegler und Segellehrer, ist Initiator von OpenSeaMap. Er arbeitet als Organisationsentwickler, Supervisor und Paartherapeut.
Dipl.-Geogr. Martin Over ist bei einem IT-Dienstleister im Bereich Web-GIS tätig.

https://bärlocher.de

Zeitenwende

Sicher haben Sie schon mal etwas in Wikipedia nachgeschlagen. Ein riesiger Wissensschatz mit über 60 Millionen Artikeln in über 300 Sprachen. Zusammengetragen von mehr als einer Million Autoren, plus über 90 Millionen Mediendateien von hunderttausenden Fotografen und Grafikern. Schon lange ist Wikipedia nicht mehr nur eine Enzyklopädie. Unter dem Dach der Wikimedia-Foundation hat sich die größte freie Wissensbasis entwickelt und wird auch offline in abgelegene oder politisch abgeschottete Gebiete getragen. Wikipedia ist das größte Crowdsourcing-Werk der Welt und die größte Sammlung freier Daten – und alles Open Data.

Haben Sie auch schon mal in Wikipedia einen Artikel geschrieben? Oder einen Artikel erweitert oder verbessert? Dann sind Sie Teil der Community und der Crowd. Sie haben Ihr Wissen aus Ihrer Quelle – Ihrer Source – geschöpft und mit anderen geteilt. Sofort steht Ihr Wissen allen Menschen zu Verfügung, weltweit. Alle können Ihr Wissen frei nutzen (Open Data). Sie können von Ihnen lernen,

https://commons.wikimedia.org/wiki/File:OpenSeaMap-Wikipedia-Logo.png

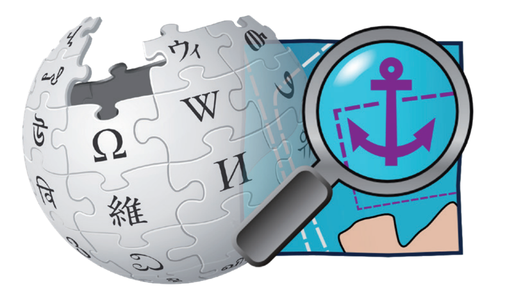

Abb. 1: Wikipedia und OpenSeaMap

Ihr Wissen mit ihren Freunden teilen, es mit eigenen Ideen verknüpfen und ergänzen und erweitern. Wenn sie wollen, können sie es auch in ihrem Alltag nutzen, für ihr Hobby oder ihren Beruf oder für ihre Firma. Und wenn sie wollen, können auch sie ihr Wissen wieder in Wikipedia-Artikel fließen lassen, das dann wiederum auch Ihnen zur Verfügung steht. Dadurch entsteht ein synergetischer Kreislauf zum Wohle aller.

OpenSeaMap ist nicht nur eine freie Seekarte, sondern verbindet die zwei Welten (Abb. 1). Wo auch immer Sie gerade sind oder hin möchten: Klicken Sie sich auf der Karte direkt zum bebilderten Wikipedia-Artikel.

Skipper teilen ihre Revierkenntnisse, Einheimische ihre Ortskenntnisse, Behörden teilen ihre Daten (Open Data), und jeder kann die Daten selber in die große Geodatenbank eintragen. Das Ergebnis steht allen frei und kostenlos zur Verfügung. Geografen teilen ihr Wissen über die Welt, Hydrographen vermessen die Meere für die sprichwörtliche »Handbreit Wasser unter dem Kiel«, Meteorologen analysieren Wetterdaten für den optimalen Kurs. Programmierer, Web-Entwickler, App-Entwickler, Datenbankspezialisten sorgen für die Infrastruktur (Open Source). Journalisten, Redakteure, Grafiker, Webdesigner gestalten die Schnittstelle zur Welt.

Sie alle arbeiten synergetisch zusammen, eine große Community zum Wohle aller. Das ist OpenSeaMap.

Beiden Projekten ist diese Kultur gemeinsam:

Jeder, der etwas weiß, teilt sein Wissen mit den anderen. Und das Ergebnis steht allen frei zur Verfügung. Crowdsourcing und Open Data gehören zusammen.

»Der fundamentale Akt von Freundschaft unter denkenden Wesen besteht darin, einander etwas beizubringen und Wissen gemeinsam zu nutzen. Dies ist nicht nur ein nützlicher Akt, sondern es hilft, die Bande des guten Willens zu verstärken, die die Grundlage der Gesellschaft bildet und diese von der Wildnis unterscheidet. Dieser gute Wille, die Bereitschaft, unserem Nächsten zu helfen, ist genau das, was die Gesellschaft zusammenhält und was sie lebenswert macht. Jede Politik oder jedes Rechtssystem, das diese Art der Kooperation verurteilt oder verbietet, verseucht die wichtigste Ressource der Gesellschaft. Es ist keine materielle Ressource, aber es ist dennoch eine äußerst wichtige Ressource« (Richard Stallman, Abb. 2).

Das alles hat auch eine politische Dimension: Karten beispielsweise sind ein Herrschaftsinstrument. Sie zeigen Gebietsbesitz – und wo es noch was zu erobern gibt. Gute Karten sind existenziell für militärische Strategie und die Taktik. Deshalb sind sie auch heute noch vielerorts geheim. Andererseits können Karten auch verbinden. Menschen, Gruppen, Völker, Kulturen. Entsprechend gut ist es, wenn wir Geodaten teilen, andere teilhaben lassen an unserer Welt und sie einladen, uns zu besuchen und kennenzulernen, damit wir mit und voneinander lernen können.

Das hat Auswirkungen auf unser Zusammenleben und auf unser Miteinander-Wirtschaften. Passende Stichworte sind: Gemeinwirtschaft, Allmende, Genossenschaft, Gemeinschaftswohnen, Kreislaufwirtschaft, Freie Software, Open Science, Open Knowledge, Maschinenring, Tauschbörse,

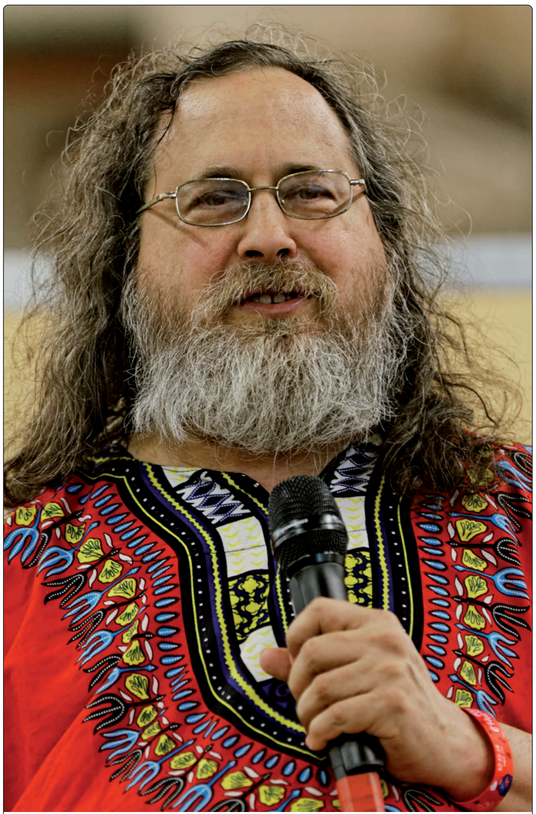

Abb. 2: Richard Stallmann

https://commons.wikimedia.org/wiki/ File: Richard Stallman - Fête de l'Humanité 2014 - 010.jpg

Gemeineigentum (Wasser, Land, Bodenschätze, Energie, Meere), Teilen, Schenken, selbstbestimmtes Lernen und vieles mehr.

Ein guter Kompass sind die 17 Ziele der Nachhaltigkeit. Wenn wir diese für jede Entscheidung zu unserem Maßstab machen, sind wir auf einem guten Kurs in eine lebenswerte Zukunft. //

Flachwassertiefen in OpenSeaMap

Seekarte und Landkarte

OpenSeaMap ist eine Seekarte und gleichzeitig eine Landkarte: sie hört also nicht einfach an der Küstenlinie auf und ist auf der anderen Seite entweder gelb oder blau. Sondern sie verbindet die beiden Welten in synergetischer Weise (HN 91).

Aber eine Seekarte ohne Wassertiefen ist keine richtige Seekarte. Unsere Küstengewässer sind zwar zumindest in den wirtschaftlich gut entwickelten Ländern umfassend vermessen. Aber die wenigsten Länder stellen ihre Daten als Open Data frei und kostenlos zu Verfügung. Und in weniger gut entwickelten Ländern fehlen oft Ausrüstung und Erfahrung. Die Hydrographie beschränkt sich dort auf wenige Gebiete und die Daten sind oftmals veraltet oder auch ungenau. Aber auch bei uns werden finanzielle Ressourcen und Personal knapper und Hydrographen-Nachwuchs ist schwierig zu finden. Deshalb konzentriert man sich bei der Vermessung auf Schifffahrtsstraßen und andere wirtschaftlich genutzte Bereiche wie Windparks, Ölfördergebiete, Unterwasserpipelines und -kabel. Die für die Sportschifffahrt wichtigen Flachwasserzonen bleiben zunehmend außen vor oder werden nur noch sporadisch kontrolliert.

Crowdsourcing

Deshalb hat OpenSeaMap 2011 gleich zu Beginn des Projektes beschlossen, alle Skipper einzuladen, durch Crowdsourcing Wassertiefendaten zusammenzutragen (siehe Abb. 3). Eigentlich wäre das ja ganz einfach: Jedes seegehende Schiff hat ein Echolot und einen GPS-Empfänger an Bord. Die Geräte sind meist den ganzen Tag in Betrieb. Sie werden schon vor dem Ablegen eingeschaltet und erst nach dem Anlegen wieder ausgeschaltet und dazwischen zeichnen sie permanent die Wassertiefe, die Position sowie Datum und Uhrzeit

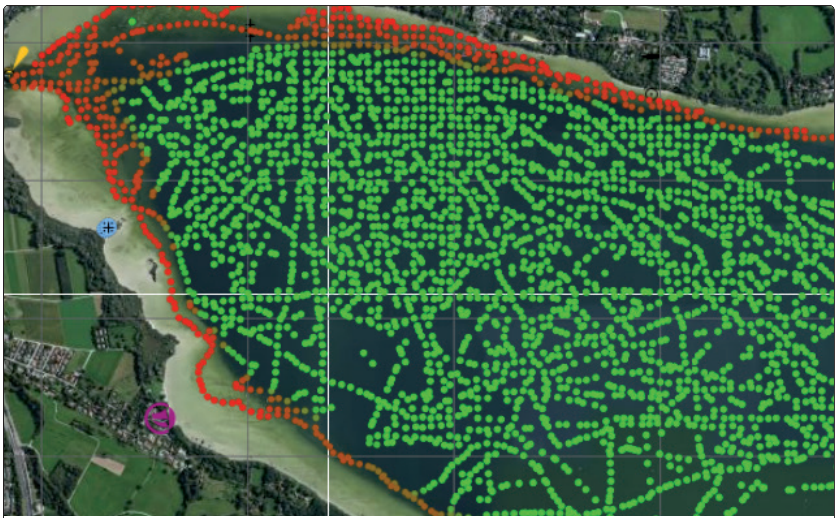

Abb. 3: Gut vermessener See

auf. Wenn man also diese Daten sammelt und auf einen Server hochlädt, könnte man damit Tiefenlinien erzeugen und in die Karte eintragen. Jeder Skipper weiß, dass er die Tiefen mit der Tide beschicken muss, und er hat gelernt, wie das geht. Und er weiß, dass es einen Unterschied macht, ob der Tiefensensor am Bug oder am Heck montiert ist und in welcher Tiefe. Auch weiß er, dass bei viel Seegang die Ergebnisse ungenau werden, ebenso wie bei Krängung oder Seegras oder starker Trübung oder beim Rückwärtsfahren. Und jetzt ist es schon nicht mehr so einfach.

Natürlich gab es Ideen, wie man das angehen und vielleicht lösen könnte. Aber als Hobby-Segler sind wir natürlich keine Hydrographen. Auf der Intergeo haben wir Kontakte geknüpft und Unterstützung gefunden. Volker Böder († 2012) hat uns sehr ermutigt. Wilfried Ellmer und Wolfgang Bosch haben unsere Liste der Erfassungsparameter geprüft und für gut befunden, und Wolfgang hat uns beraten bezüglich Tidenmodellen (siehe HN 95). Da OpenStreetMap nur eine geografisch zweidimensionale Datenbank hat, haben wir eine eigene Tiefendatenbank aufgesetzt und über ein Web-Frontend eine differenzierte Benutzerschnittstelle angeboten. Erfasst werden neben den Benutzerdaten und 18 Parametern über die Messplattform (Schiff, Gerätesensoren, Positionen der Sensoren und Antennen) natürlich die Messdaten plus zusätzlich Daten aus einem Sechs-Achs-Gyrometer, und einem Zeitstempel aus einer internen Uhr, um die aufeinanderfolgenden NMEA-Datensätze einander genau zuordnen zu können.

Datenlogger

2014 haben wir auf der »Boot« in Düsseldorf einen Zwei-Kanal-NMEA-0183-Datenlogger vorgestellt. Er startet automatisch mit einer Boot- und Selbstprüfroutine, und schreibt die NMEA-Daten sequenziell auf eine SD-Karte. Integriert ist ein Lage- und Beschleunigungssensor, um Informationen über Krängung und Seegang zu bekommen. Automatisch wird stündlich eine Datei geschlossen und eine neue Datei angelegt. Auch bei Spannungsunterbrechung wird automatisch die aktuelle Datei sicher geschlossen, damit gespeicherte Daten nicht verloren gehen. Bei Spannungswiederkehr wird automatisch eine neue Datei geöffnet. Entwickelt wurde der Logger von Wilfried Klaas, gebaut wurde er in China, finanziert durch einen Förderer. Seither sind die Datenlogger inklusive Anschlusskabel und Handbuch zum Selbstkostenpreis von 30 Euro im Vertrieb und sammeln fleißig Daten.

Zahlen und Hacker

Inzwischen hat OpenSeaMap etwa 250 Datenspender. Die Anzahl nahm bisher über die Jahre ziemlich regelmäßig zu. Im Jahr 2018 verzeichneten wir einen starken Einbruch bei der Anzahl der Datenspender (Abb. 4). Dieser fällt zeitlich zusammen mit einem Ausfall des Datenservers. Ursache war ein Update des Betriebssystems, das nicht zur Datenbanksoftware passte. Das Ganze war ziemlich kompliziert und wir hatten keinen erfahrenen Server-Administrator. Die Wiederherstellung dauerte mehr als ein halbes Jahr, währenddessen Benutzer sich weder anmelden noch Daten hochladen konnten. Der Einbruch ist auch gut zu sehen in Abb. 5, in der die Anzahl der Tiefenmessungen dargestellt ist.

Leider folgte gleich darauf eine weitere Katas-

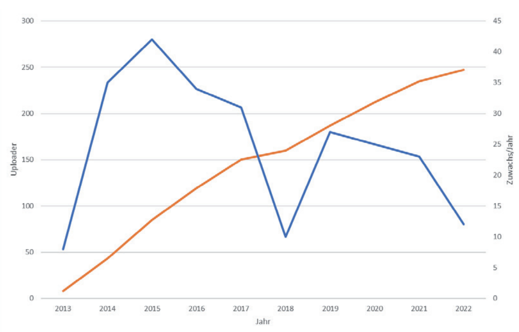

Abb. 4: Entwicklung der Anzahl der Datenspender im Verlauf der Jahre (braun) und Zuwachs pro Jahr (blau)

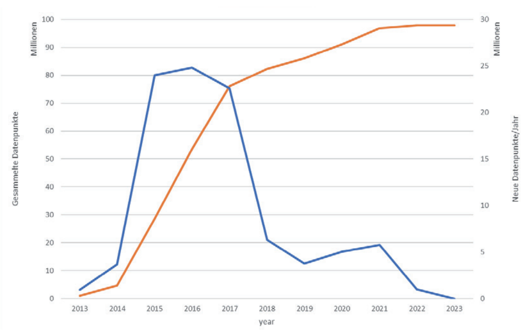

Abb. 5: Entwicklung der Anzahl der Tiefenmessungen im Verlauf der Jahre (braun) und Zuwachs pro Jahr (blau)

trophe: Der Server wurde gehackt. Unser Server-Sponsor erhielt über seine Domain eine Mail, mit einem netten Video, wie er in den Server einsteigt und sich dort »umschaut«. Zum Glück war er ein »White head«, der Schwachstellen aufspürt, um den Admin darauf hinzuweisen. Okay – er forderte schon etwas »Bounty«, aber als wir ihm schrieben, dass wir das alles ehrenamtlich machen in unserer Freizeit und ohne Geld, und uns freundlich bedankten für seinen wertvollen Hinweis, war das dann auch ohne Geld zu regeln. Als Sofortmaßnahme haben wir alle Ports geschlossen, um einen Abfluss von Daten zu verhindern. Aber dadurch konnten sich weder neue Datenspender anmelden, noch konnten Tiefendaten hochgeladen werden. Zum Glück waren die personenbezogenen Daten in einem besonders geschützten Segment der Datenbank abgelegt, da ist nichts passiert. Leider hatte der Admin auch noch die E-Mail-Adressen durch einen Hash-Wert ersetzt (Datenschutz kann man auch übertreiben), was dazu führte, dass wir die Benutzer nicht per Mail erreichen konnten. Trotzdem sind uns viele treu geblieben und liefern – trotz Corona und Krieg – weiter Tiefendaten.

Nun funktioniert alles wieder, und wir freuen uns über neue Datenspender.

Bis Ende 2022 zählten wir knapp 20 Millionen Datenpunkte. Die meisten Daten kommen aus Europa mit Schwerpunkt Ostsee, wenige aus der Karibik (siehe Abb. 6).

Die weitaus meisten Datenspender haben eine ein- bis zweistellige Zahl von Tracks hochgeladen. Nur wenige haben eine vierstellige Zahl von Tracks gespendet (siehe Abb. 7). 190 Spender sind nur einen Monat dabeigeblieben (Zeit zwischen erstem und letztem Hochladen einer Datei), zwei Dutzend sind länger als zwei Jahre dabei (siehe Abb. 8).

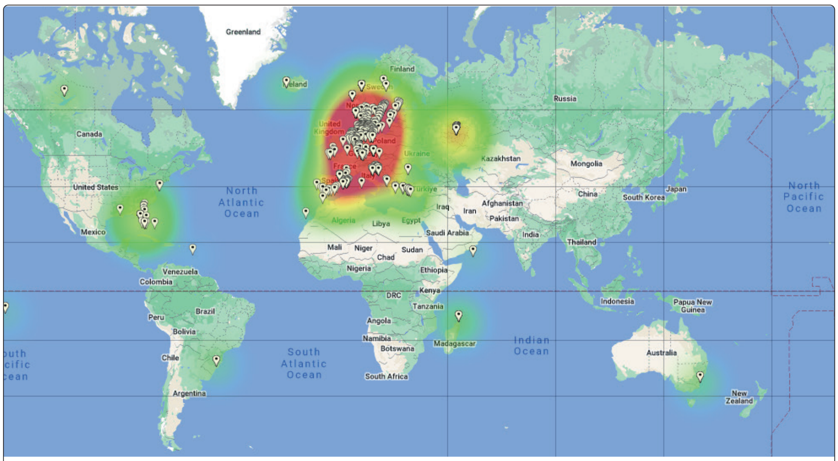

Abb. 6: Verteilung der Datenpunkte weltweit

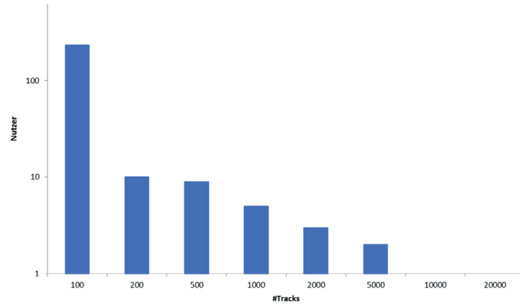

Abb. 7: Anzahl der hochgeladenen Tracks

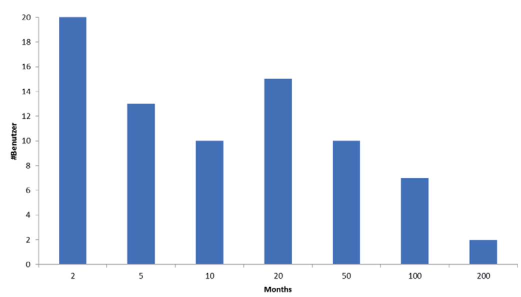

Abb. 8: Anzahl der Monate zwischen erstem und letztem Upload. Die erste Säule (bei 2) ist abgeschnitten und eigentlich 10-mal so hoch. 190 Uploader haben nur ein Mal etwas hochgeladen

Herausforderungen

Aktuell arbeiten wir an einem 2k-Datenlogger. Mit einem Micro-C-Stecker ist er an den Datenbus angeschlossen und überträgt die Daten per WiFi im ganzen Schiff an eine hübsche App. Dort werden die Daten in verschiedenen Ansichten visualisiert und gespeichert und, sobald eine Internetverbindung steht, auf den Server hochgeladen. Datenlogger und App sollen zusammen wie gewohnt für kleines Geld angeboten werden. Die Prototypen sind erfolgreich im Test. Jetzt suchen wir noch einen Produzenten und einen Vertrieb. Wir haben viele Ideen und suchen noch wasserportaffine Entwickler. Bei der Datenanalyse haben wir noch ungelöste Fragen. Da hoffen wir auf Unterstützung von Universitäten und Fachhochschulen (Messtechnik, Statistik, Schnittstellen) und bieten auch Ideen für Masterarbeiten und Projekte. Viel Erfahrung haben wir mit Community-Arbeit aus unterschiedlichen Bereichen und teilen unsere Erkenntnisse gern.

Fazit

1. Die Gefahren lauern nicht nur unter der Wasseroberfläche, sondern manchmal auch im Umgang mit der Technik.

2. Mit Crowdsourcing und Open Data kann man gemeinsam viel erreichen. Und wir freuen uns sehr, dass die IHO sich entschieden hat, nicht nur ebenfalls Crowdsourcing einzuführen, sondern diese Daten ebenfalls als Open Data zur Verfügung zu stellen. Und wir beneiden die IHO ein bisschen um die personellen und finanziellen Ressourcen … //

Meerestiefen in OpenSeaMap

Der Datensatz, auf dem das Meeresprofil in OpenSeaMap basiert, ist das *global ocean and land terrain model* von GEBCO (General Bathymetric Chart of the Oceans). Dieses freie Oberflächenmodell hat eine horizontale Auflösung von 15 Bogensekunden, was ungefähr 460 m am Äquator entspricht.

Trotz dieser recht geringen Auflösung, haben wir uns entschieden, die Daten als Vektordaten aufzubereiten. Dies ermöglicht unseren Nutzer:innen ein besseres Verständnis des Raums.

Abb. 9 zeigt die Meerenge von Gibraltar mit entsprechenden Tiefenlinien. Damit lassen sich nicht nur relative Unterschiede erkennen (wie bei Rasterdaten), sondern auch die absoluten Werte direkt ablesen.

Die Daten sind durch ihre grobe horizontale räumliche Auflösung nicht zur Darstellung bei großen Maßstäben geeignet. Dies birgt natürlich Gefahren, gerade wenn die Daten so aufbereitet werden, dass sich diese optimal in das Kartenbild einfügen. Wir vertrauen hier in diesem Open-Data-Projekt auf die Mündigkeit unserer Nutzer:innen, den in der Legende beigefügten Erfassungsmaßstab (1 : 920.000) richtig zu interpretieren. Da die Tiefen erst ab 25 m dargestellt werden, sind diese zu Navigationszwecken auch nicht relevant.

Die GEBCO-Daten basieren auf unterschiedlichsten Datenquellen. Dies reicht von direkten Messungen (mit Echolot, LiDAR, seismischen Methoden usw.) bis hin zu indirekten Methoden (Gravitation, Interpolation, Seekarten usw.). Bis 2030 soll mit dem Projekt Seabed 2030 der komplette Meeresboden kartiert werden. Seabed 2030 ist eine Kooperation von GEBCO und der Nippon Foundation. Bisher sind nach Einschätzung des Projektes weniger als 20 % des weltweiten Meeresbodens wirklich kartiert. Dementsprechend bildet auch das Meeresprofil in OpenSeaMap nur eine Näherung auf Basis des aktuellen Standes der Möglichkeiten ab.

Datenaufbereitung

Trotz der geringen Auflösung stellte der globale GEBCO-Ausgangsdatensatz mit einer Dateigröße von circa 7,3 Gigabyte eine Herausforderung bei der Prozessierung dar.

Die prozessierten Daten stehen unter einer freien Lizenz auf der Webseite www.opendem.info/download_bathymetry.html zur Verfügung.

Tiefenlinien

Zunächst wurden die Tiefenlinien einzeln mit dem Werkzeug *gdal_contour* der freien Geospatial Data Abstraction Library (GDAL) berechnet. Die Größe des Ausgangsdatensatzes ermöglichte keine komplette Prozessierung in einem Rutsch.

Damit sich die Tiefenlinien nahtlos in das Kartenbild und der darin verwendeten OpenStreetMap (OSM) Karte integrieren, wurden diese mit den OSM-Wasserflächen (osmdata.openstreetmap.de/data/water-polygons.html) verschnitten. Dadurch wurde auch verhindert, dass negative Höhenwerte an Land als Wasserflächen dargestellt werden.

Dazu war es notwendig, den Datensatz in 32 Kacheln zu unterteilen, da ansonsten eine

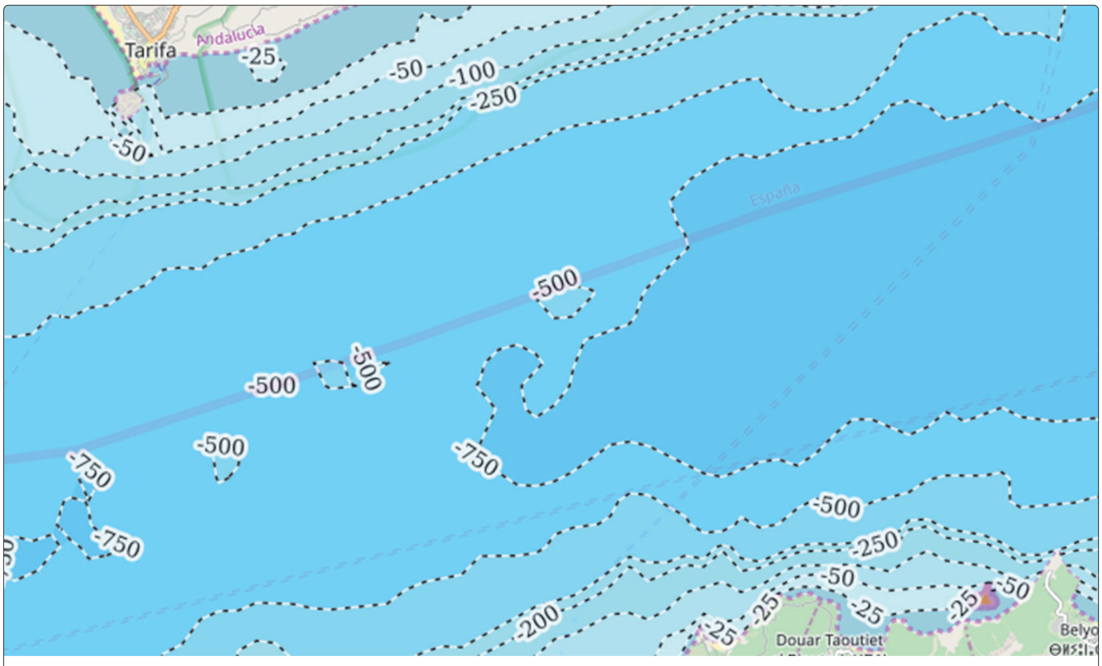

Abb. 9: Meerenge von Gibraltar mit Tiefenlinien. Tiefenangaben in Metern

Prozessierung nicht möglich gewesen wäre. Um die Performanz des Kartendienstes zu optimieren, wurde der Datensatz in 648 Kacheln unterteilt.

Tiefenflächen

Seit Version 2.4.0 kann das Werkzeug *gdal_contour* auch Flächen prozessieren. Dazu war es jedoch notwendig, den Ausgangsdatensatz in 32 Kacheln zu untergliedern. Damit es an den Rändern zu keinem Versatz aufgrund fehlender Daten kommt, wurde ein Überlappungsbereich von einem Grad (WGS 84) verwendet. Anschließend wurden die Kacheln dann auf die entsprechende Größe zugeschnitten. Die weitere Prozessierung entspricht den Tiefenlinien. Allerdings mussten einzelne Kacheln für den Verschnitt mit den OSM-Daten weiter unterteilt werden, damit die Prozessierung erfolgreich durchlief.

Probleme

Leider kommt die Prozessierung der Tiefenlinien und Tiefenflächen nicht immer zu identischen Ergebnissen (siehe Abb. 10). //

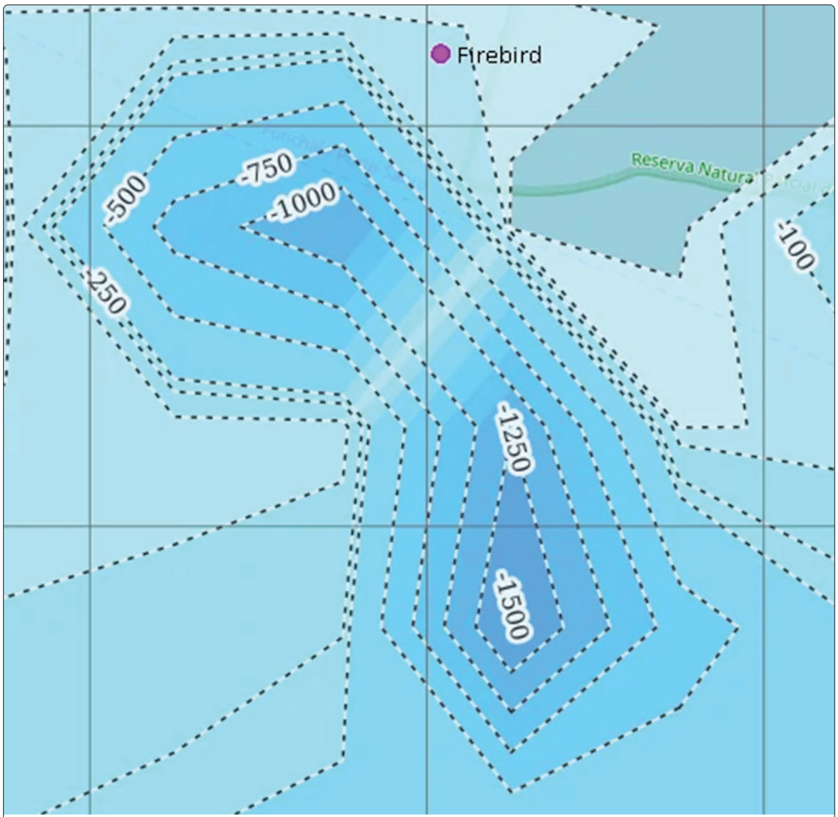

Abb. 10: Unterschiede bei der Prozessierung der Tiefenlinien und Tiefenflächen

Dank

Wir danken – außer den oben schon Genannten – Lars Schiller für die nette Einladung zum Artikel, Pauline Weatherall für die liebevolle Unterstützung seit vielen Jahren, der ganzen IHO-Arbeitsgruppe CSBWG für ihr Engagement für Crowdsourcing und Open Data und Patrick Westfeld, unserem Vertreter in der CSBWG.

Mitarbeit

Mehr über die Aktivitäten von OpenSeaMap erfahren Sie auf openseamap.org und in einem kurzen Video über die Arbeit eines Schweizer Studenten: https://ftp.gwdg.de/pub/oseam-mp4/poseido1.mp4

Wir freuen uns, vielleicht noch mehr nette Hydrograph:innen kennenzulernen.

DOI: 10.23784/HN124-03

Assessing CSB data reliability

Estimating vertical uncertainty of sample CSB data by comparing with reference multibeam data

An article by IDRIS SALAUDEEN

Crowdsourced bathymetry (CSB) is depth information gathered by mariners who voluntarily use standard acquisition sensors on their ships during their routine operations at sea. The data collected from these sources is then made publicly available. However, due to the unregulated and unsupervised nature of the data collection, the reliability of the information obtained from crowdsourced bathymetry is in question. This highlights the importance of assessing the accuracy of the data. The study explores the use of geostatistical methods to evaluate the reliability of the depths obtained from crowdsourced sources by comparing them to trusted bathymetric data. The results indicate that the density of soundings plays a significant role in determining the reliability of the crowdsourced depths, and it is possible to calculate uncertainty estimates even when the error budgets are unknown. However, the reliability of the soundings must be measured against the acceptable limits set by the International Hydrographic Organization (IHO) as outlined in the *S-44* standards for hydrographic surveys.

crowdsourced bathymetry – CSB | Delaware Bay | BAG file | uncertainty | S-44
Crowdsourced Bathymetry – CSB | Delaware Bay | BAG-Datei | Unsicherheit | S-44

Bei der Crowdsourced Bathymetry (CSB) handelt es sich um Tiefeninformationen, welche von Seeleuten gesammelt werden, die während ihres Routinebetriebs auf See freiwillig Standardsensoren auf ihren Schiffen verwenden. Die von diesen Quellen gesammelten Daten werden dann öffentlich zugänglich gemacht. Aufgrund der ungeregelten und unbeaufsichtigten Art der Datenerfassung ist die Zuverlässigkeit der aus der Crowdsourced Bathymetry gewonnenen Informationen jedoch fraglich. Es ist daher wichtig, die Genauigkeit der Daten zu bewerten. Die Studie untersucht den Einsatz geostatistischer Methoden, um die Zuverlässigkeit der aus Crowdsourcing-Quellen gewonnenen Tiefen zu bewerten, indem sie mit zuverlässigen bathymetrischen Daten verglichen werden. Die Ergebnisse deuten darauf hin, dass die Dichte der Tiefenmessungen eine wichtige Rolle bei der Bestimmung der Verlässlichkeit der Crowdsourcing-Tiefen spielt und es möglich ist, Unsicherheitsschätzungen zu berechnen, selbst wenn die Fehlerbudgets unbekannt sind. Die Zuverlässigkeit der Tiefenmessungen muss jedoch an den von der Internationalen Hydrographischen Organisation (IHO) festgelegten akzeptablen Grenzwerten gemessen werden, wie sie im Standard *S-44* für hydrographische Vermessungen beschrieben sind.

Author
Idris Salaudeen is Technical Support Expert at SevenCs in Hamburg.

idris.salaudeen@sevencs.com

1 Introduction

1.1 Background

The oceans make up 70 percent of our planet, and there seems to be a rather large misconception that the earth and the oceans have been fully mapped – especially looking at paper maps and globes of the world which typically show all the continents and oceans. However, this is not the case from a bathymetric standpoint as these maps lack detailed information on the depths of the ocean floors, but rather provide estimated information from satellite observations of the sea surface heights (CCOM 2022).

Crowdsourced bathymetry has the potential to greatly increase the global bathymetric coverage and improve the understanding of the world's oceans. The IHO recognises the potential of crowdsourced bathymetry in augmenting existing bathymetric data and has taken steps to encourage its adoption. The CSBWG was formed to help establish standards for collecting and utilising CSB data, and to work towards overcoming any technical or logistical challenges that may arise during collection efforts. This is in line with the IHO's goal of ensuring that the world's oceans and waterways are properly mapped and charted for safe navigation and effective maritime activities (IHO HSWG 2022).

1.2 The need for crowdsourced bathymetry

Traditional hydrographic surveys are typically expensive, time consuming and logistically challenging and they can only cover a small portion of the world's oceans, leaving vast areas unmapped, especially remote areas.

Crowdsourced bathymetry offers a solution to these challenges by leveraging the power of community involvement and affordable modern technologies such as single-beam echo sounders, GPS systems and data loggers. The concept is simple: anyone with a platform equipped with these technologies can collect bathymetric data and contribute to the mapping of the world's oceans. This data can then be combined with other data sources to create comprehensive bathymetric maps (Jencks et al. 2021).

1.3 CSB error components and data reliability

The reliability of CSB data is typically a subject of concern because the data is often acquired during routine voyage operations using low-cost sounding equipment and data loggers. Added to this underlying concern is the lack of metadata information that is useful to determine the various error sources and estimate the total error propagated on CSB measurements. These include instrument errors, vessel draft errors, speed of sound errors, motion and attitude errors, and tides and water levels errors. All these errors shelter several component errors that constitute the total propagated uncertainty (TPU) upon crowdsourced depth measurement which affects the overall quality and reliability of CSB data (Fig. 1).

1.4 Goal

The goal of this study is to analyse a sample CSB data set and determine its reliability for use in hydrographic applications. This study aims to estimate the uncertainty of the CSB data comparing the collected depth measurements with those obtained from a standard hydrographic multibeam survey. The goal is to determine the reliability of the sample data and draw conclusions on its usage and applications in hydrographic contexts.

2 Data set and area of study

The CSB and MBES data sets analysed in this study were freely obtained from the IHO DCDB website. About 4 GB of data was downloaded in total from the website, as separate compressed folders for each data set (CSB and MBES) in ZIP format.

Both CSB and MBES data sets are from the Delaware Bay area in the east coast of the United States (Fig. 2). The area is a shallow water area with an average depth of around 17 metres. The area also serves as an anchorage area for vessels and leads to the inner areas of the Delaware river, where the vessels can enter the Chesapeake & Delaware Canal (C&D Canal). The canal connects Delaware area to the Chesapeake area of Maryland, United States.

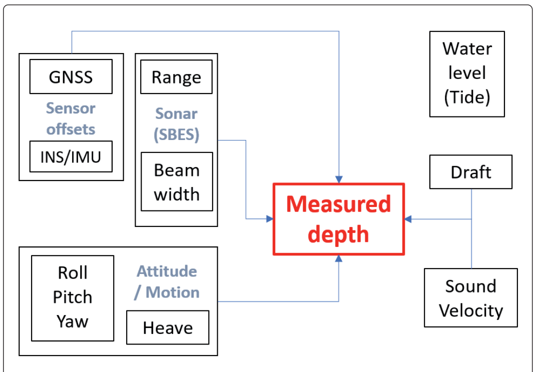

Fig. 1: Illustration of sources of errors propagated on measured depths

2.1 CSB data

The CSB data sets were obtained as lines in GeoJSON and XYZ formats and compressed into a ZIP folder. The collective line data is primarily constituted of over 500,000 individual points that have been acquired with the Rose Point Coastal Explorer software. The software passively logs depth and position data that is being collected by the echo sounder and navigation sensors onboard the acquisition vessel.

2.2 MBES data

The MBES data were obtained as Bathymetric Attributed Grid (BAG) files. The BAG format is a form of bathymetric raster data typically having two bands – the elevation (depth) band, and the uncertainty band. It is noteworthy that BAG files are not necessarily raw files but have already undergone advanced processing with all necessary corrections already applied. In fact, BAG files are finished products of any acquired survey, as they

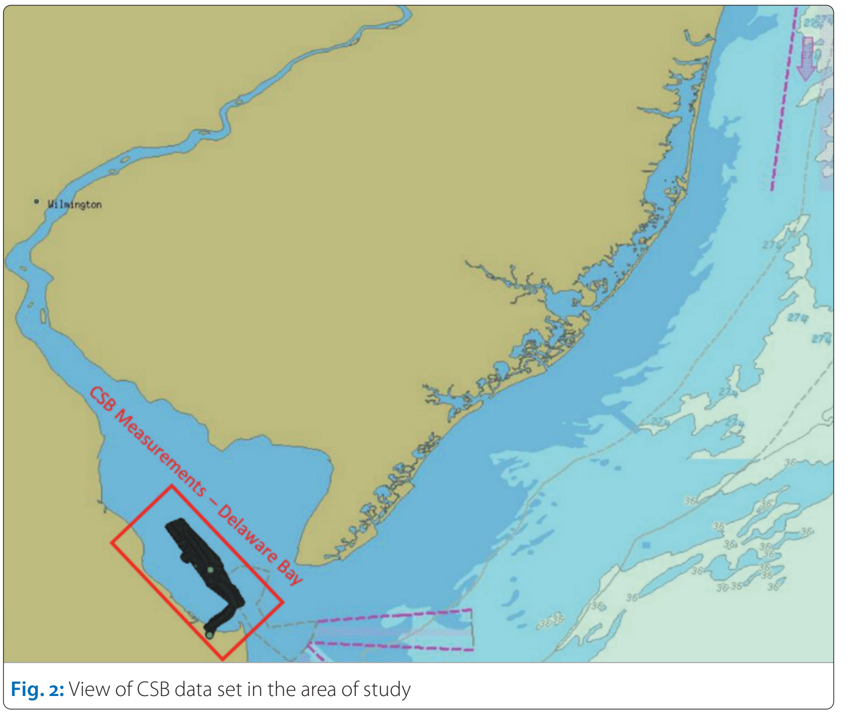

Fig. 2: View of CSB data set in the area of study

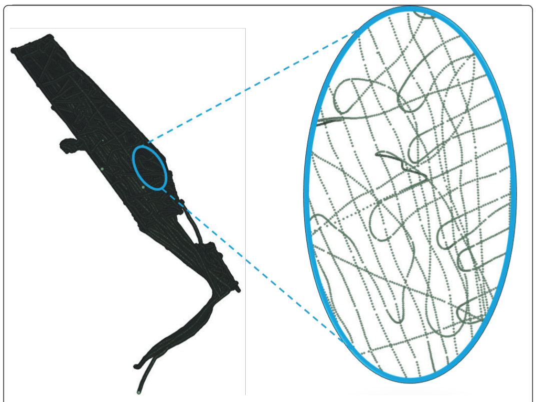

Fig. 3: Graphic of the CSB data sets in Delaware Bay depicting the individual points

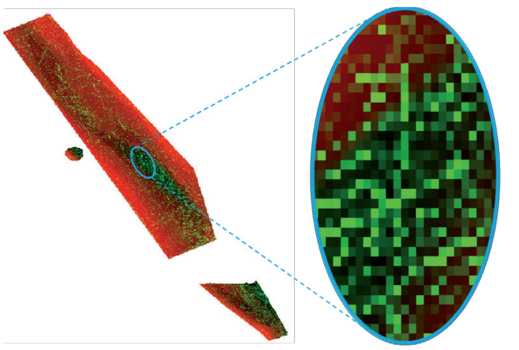

Fig. 4: Graphic of the MBES data sets in Delaware Bay depicting the individual cells (pixels)

would have been fully processed and attached with an uncertainty layer.

The MBES data were acquired by the US National Oceanographic and Atmospheric Administration (NOAA) hydrographic survey vessels equipped with standard sensors for hydrographic data acquisition.

2.3 Metadata

The metadata files for the CSB lines were available as JSON files in the compressed ZIP folders for each CSB data set. Individual CSB lines also contained metadata information embedded into the GeoJSON files. The metadata for the MBES grids were available as separate files that could be downloaded from the Survey Report Page of the data of interest on the NOAA NCEI website. The MBES metadata are primarily available in XML format that was already integrated into the BAG file.

An overview of metadata information provided includes:

- information about the acquisition platform,
- information about the data provider,
- the Coordinate Reference System (CRS) information.

3 Research problem

Estimation of uncertainties in any scientific measurement is to quantify the errors propagated within the measurement and provide a sense of quality of the observed measurements. It also allows for attributing of a certain level of reliability to the observed measurements.

However, the issue with attempting to estimate uncertainties and quantify the errors propagated within physical measurements such as depths is that the true depth value is usually unknown, and it is unlikely that any measurement would precisely equal to the true value.

Since the true depth value is usually unknown and it is unlikely that any measurement would precisely equal to the true value, the IHO has addressed this issue by employing the use of »Uncertainty« and »Confidence Levels« to quantify errors and determine the accuracy of depth measurements (Sanders 2011). This rationale will guide the methods of this study.

4 Methods

This study attempts to estimate the propagated uncertainties in crowdsourced bathymetric data, and since the CSB data were acquired using a single-beam echo sounder, the study adopts the »comparison with multibeam« method of measuring uncertainty. A well-established method for analysing single-beam measurements that is recognised by the International Hydrographic Organization (IHO) and has been acknowledged in IHO Publication *B-11* and IHO Publication *S-44*.

The method involves comparing the single-beam CSB measurements with the available reference data from multibeam echo sounder (MBES) surveys, to assess the reliability of the CSB measurements. The MBES data are obtained from a hydrographic office (NOAA) and are considered to be the standard and authoritative data for comparison. The deviations between the CSB and MBES depths are used to estimate the uncertainty of the measured CSB depths.

Therefore, geostatistical methods were adopted in this study to assess the quality of the CSB data. The method involves calculating the error distribution of the depth values based on Total Vertical Uncertainty (TVU) calculations specified by the IHO *S-44* standards.

The maximum allowable TVU is calculated using this equation:

$$TVU_{max} = \pm\sqrt{a^2 + (b \cdot d)^2}$$

Where:

- a represents that portion of the uncertainty that does not vary with depth,
- b is a coefficient which represents that portion of the uncertainty that varies with depth,
- d is the depth,
- (b · d) represents that portion of the uncertainty that varies with depth.

4.1 Workflow concept

A simple processing workflow that follows the method stated above to determine the reliability of the CSB data was designed. The workflow process overlays the CSB point depths on the MBES gird and compares both measurements in areas where corresponding depth positions.

4.2 Tide correction and datum conversion

Correcting for tides and converting the CSB data to the same vertical reference as the MBES data is an important step in ensuring an accurate comparison of the two data sets. The tidal corrections help to eliminate vertical offsets that exist between the two data set reference systems. This involves converting the CSB data from its original ellipsoidal vertical reference (WGS84) to the same vertical reference as the MBES data, which in this case is the Chart Datum.

The MBES data has already been corrected for tides and referenced to the Mean Lower Low Water (MLLW), which is the Chart Datum used for US charts produced by NOAA. To correct the CSB data, the VDatum software was used. VDatum is a vertical datum transformation tool developed by NOAA and is widely used in hydrographic surveys in the US. It can transform vertical data between different vertical and horizontal datums, using actual tide data and tidal predictions to produce accurate tide and water level corrections to depth data.

By using VDatum, the CSB data was converted to the same vertical reference as the MBES data, allowing for a more accurate comparison between the two data sets.

4.3 Processing

After the corrections were made, the workflow process was implemented using the FME software, which was chosen due to its ability to handle large processing of many depth points. FME is a licensed software and may not be freely accessible. However, QGIS software could also be used as an alternative tool to implement this process, but it may be very slow and may sometimes become unresponsive depending on the size of the data set.

The output from FME was a CSV file containing CSB and MBES depths of corresponding positions, i.e. X, Y and both Z_{CSB} and Z_{MBES}. The CSV file was later imported into other hydrographic processing software like Qimera for further processing as well as QGIS software and Microsoft Excel for statistical analysis and graphical visualisations.

5 Results and discussion

This section includes some graphics for visual comparisons between the processed CSB data and the reference MBES data. It proceeds to outline the results of further statistical analysis and uncertainty estimations carried out on the data sets based on the methodology defined for the study and in line with IHO recommendations.

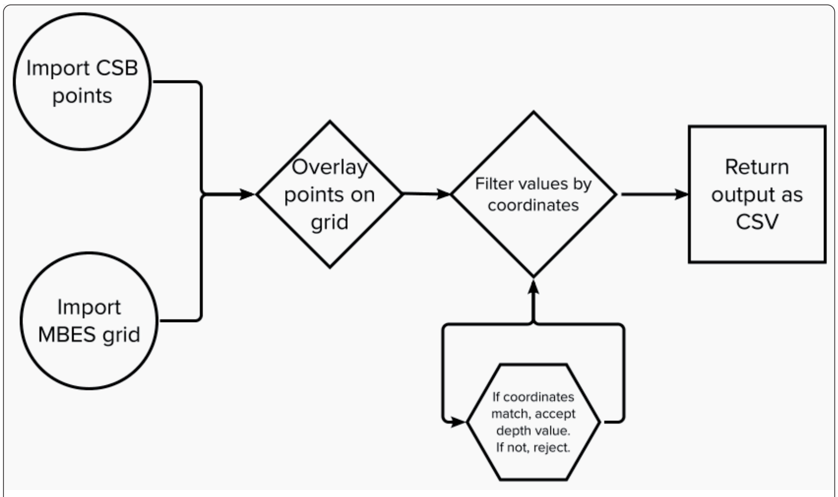

Fig. 5: Simple illustration of the data processing workflow

Firstly, the CSB data was converted from points to a gridded bathymetric surface in Qimera to allow for visual comparison of the CSB and MBES data set and to see how the generated CSB grid will compare visually to the MBES grid.

A cell size of at 30 m was defined for creating the CSB grid surface, which is the same resolution as the reference MBES grid. This is to ensure a balanced visual comparison of both grids and see how well the CSB data represents the seafloor (Fig. 6).

Based on the images provided, it seems that the grid surfaces of the CSB and MBES are quite similar. However, there are still some holes visible on the interpolated CSB grid surface. Further interpolation could be done to cover these holes and eliminate any gaps, but this may increase the risk of interpolation errors. Despite the holes, the CSB surface still looks very similar to the reference MBES surface. If

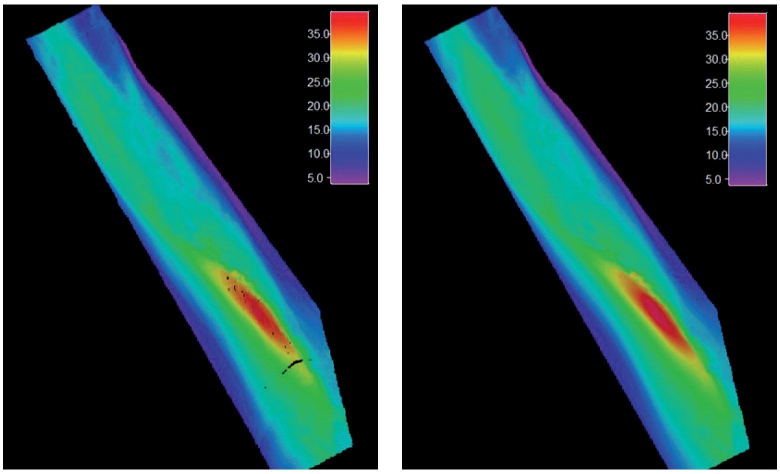

Fig. 6: Images of both CSB (left) and MBES grid surfaces (right) at 30 metre resolution for visual comparison

Details	CSB	MBES
Dimensions	512 rows × 384 columns	512 rows × 512 columns
Cell size	30 m	30 m
X range	478,440.00 to 489,960.00 m	476,335.73 to 491,864.35 m
Y range	4,304,430.00 to 4,319,790.00 m	4,304,002.28 to 4,319,530.90 m
Z range	0.5 to 40 m	3.56 to 39.06 m
Coordinate system	NAD83 / UTM zone 18N 2	NAD83 / UTM zone 18N 2
Mean depth	17.67 m	17.91 m
Standard deviation	5.76 m	5.78 m
Surface area (2D)	50,055,300 m^2	49,889,074.725 m^2
Number of soundings	383566	N/A

Table 1: Statistics summary table for CSB and MBES surfaces in Delaware Bay

the holes are ignored, it is difficult to distinguish between the two surfaces. Moreover, a statistical summary of the surface information for both CSB and MBES grids further proves the similarities between the surfaces and are outlined in Table 1.

To better illustrate the agreement between the surfaces, a cross-section analysis was conducted by selecting an area of interest and plotting the cross-section profiles of both data sets on a graph to display any differences in conformity. This approach provides a clear visualisation of how the cross-section profiles compare between the two data sets (Fig. 7).

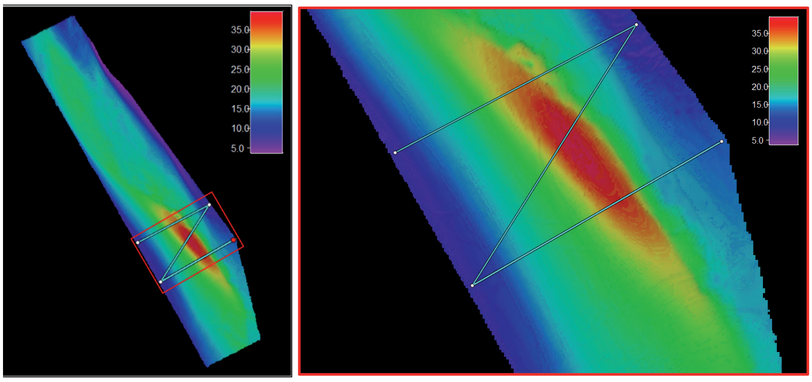

Fig. 7: Cross-section line drawn on CSB and MBES gridded surfaces

The cross-section profiles for the CSB and MBES measurements indicate a high degree of conformity, with very little difference between the two profiles (Fig. 8). The difference profile appears almost flat and straight, with only a few minor variations in the form of zigzags, and the lines depicting the profiles are almost indistinguishable, except for their different colours.

A histogram of the depth soundings was plotted to show the distribution within the CSB and MBES measurements (Fig. 9). The distribution plots are helpful to depict consistency between a measured variable and the true value of the variable.

As revealed by the distribution plots, the CSB measurements display a similar distribution to the MBES measurements, with the majority of the soundings falling within the same range. There is no significant displacement between the two data sets, indicating the absence of systematic bias. The consistency between the two data sets is a result of the sounding density of the CSB data. The CSB measurements can be used as a reliable alternative to map the gaps in the Delaware Bay area. However, it is important to note that this conclusion is based on the specific data set and methodology used in this investigation and may not necessarily hold for other data sets or surveying methods.

The next step is to assess the performance of the CSB measurements against the International Hydrographic Organization (IHO) *S-44* minimum standards for hydrographic surveys. The evaluation is critical to determine the reliability of the uncertainty assessments carried out in this study for the investigated CSB measurements.

An error distribution was then plotted from the depth difference between the CSB and MBES measurements (Fig. 10). The error distribution plots are graphical representations that display the distribution of random errors between the observed variables. In this case, the variables are the CSB measurements and the reference MBES measurements. The plots are useful in quantifying the errors in the investigated observations by using upper and lower error limits that have been calculated at a 95 percent confidence level, as recommended by the IHO.

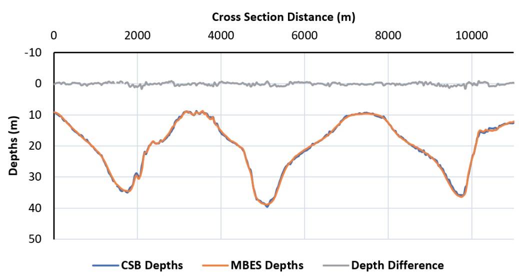

Fig. 8: Cross section showing conformity and the difference between CSB and MBES surface profiles

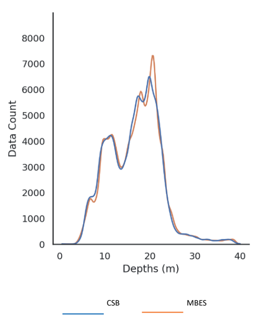

Fig. 9: Soundings distribution graphs of CSB and MBES depths

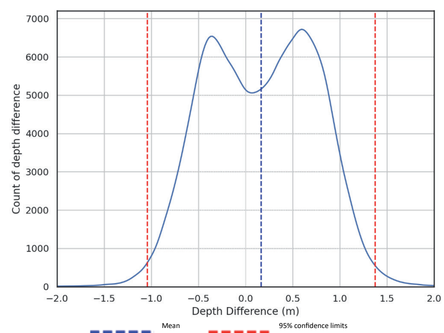

Fig. 10: Error distribution graph of the depth bias between CSB and MBES measurements

The result of the error distribution plot was ascertained further using the Cross Check tool in the Qimera software to generate a Cross Check Report which is presented in Fig. 11.

The Qimera Cross Check tool performs a statistical analysis of beam footprint values referenced to a selected Dynamic or Static Surface (QPS Qimera 2022). In this case, the tool performs a statistical analysis on the CSB point depths referenced to MBES grid surface. The Cross Check report provides values such as standard deviation and mean error necessary to estimate the uncertainty and determine the reliability of the CSB data. It goes further to test the reliability of the CSB data against IHO survey orders and finds that the estimated uncertainty for the CSB data is accepted within the IHO Survey Order 2 limits.

A scatter plot of the CSB soundings against the depth difference was plotted within IHO Survey Order 2 limits to verify if 95 percent of the soundings truly fall within acceptable error limits of IHO Order 2 survey as calculated in Qimera.

The plots show the accepted and rejected depth soundings at 95 % confidence level and further depicts the distribution of the soundings and sounding errors with respect to the IHO *S-44* acceptable limits for Order 2 surveys (Fig. 12). It depicts majority of the accepted soundings falling within the IHO Order 2 limits. Hence, the CSB measurements taken in the Delaware Bay area conform with IHO Order 2 standards and would be accepted as an IHO Order 2 survey.

To calculate the vertical uncertainty, the IHO recommends that uncertainties in depth measurements shall be expressed using confidence levels (IHO 2020). According to the IHO *S-44* publication, »the 95 % confidence level for 1D quantities (e.g. depth) is defined as 1.96 × standard deviation«.

Therefore, the uncertainty estimates for the CSB measurements acquired within this study shall be empirically determined and calculated in accordance with the IHO *S-44* recommendations, using the standard deviation values of the concerned measurements (which is 0.597 m).

This implies that 95 % of the CSB measurements fall within an estimated ±1.2 m depth accuracy.

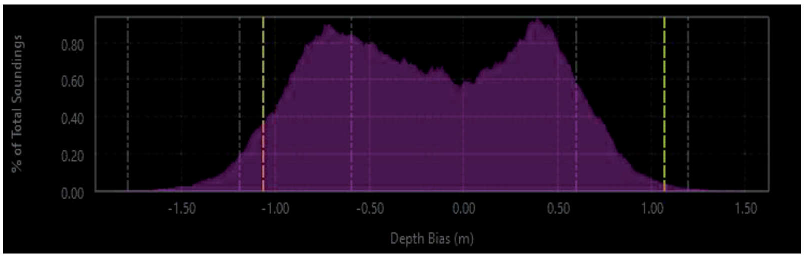

Fig. 11: Histogram plot of the error distribution from the depth bias against IHO limits

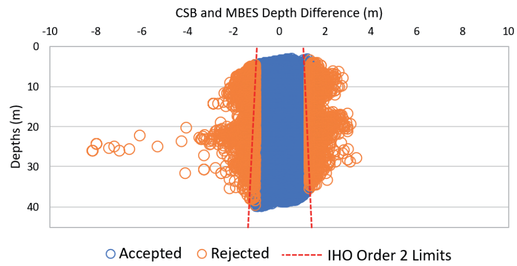

Fig. 12: IHO *S-44* plot – accepted soundings (in blue) fall within IHO Order 2 limits

Summary and conclusion

In this study, statistical methods were adopted to assess the quality of CSB data. The uncertainty was estimated from the computation of error propagated on the depth values based on the Total Vertical Uncertainty (TVU) calculations specified by the IHO in the IHO *S-44* standards.

In conclusion, this study found that uncertainty estimates for crowdsourced bathymetry (CSB) measurements can be determined through statistical computations using a reference measurement such as multibeam surveys. The reliability of CSB measurements can be further established by assessing them against appropriate IHO *S-44* survey order standards. Sounding density was found to have a clear relationship with estimated uncertainties as depicted in the sounding distribution plots. The completeness of a bathymetric data set is a function of sounding density, and the level of measurement completeness achieved for CSB measurements depends on the density of soundings within the survey area of interest. //

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DOI: 10.23784/HN124-04

Crowdsourcing for hydrography

Provision of water depths by pleasure boating

An article by HEINER LAMMERS

Heiner Lammers is member of the yacht club WVH – Wassersport-Verein Hemelingen e. V. in Bremen. He has 25 years of sailing and yachting experience on all European seas and is fond of using up-to-date technology – including crowdsourcing tools! – to further safety and enjoyment with his sport.

crowdsourcing | navigable waters | Wadden Sea
Crowdsourcing | Fahrwasser | Wattenmeer

Heiner Lammers ist Mitglied im WVH – Wassersport-Verein Hemelingen e. V. in Bremen. Er verfügt über 25 Jahre Segel- und Yachterfahrung auf allen europäischen Meeren und setzt gerne modernste Technik ein – auch Crowdsourcing-Tools! –, um Sicherheit und Freude an seinem Sport zu fördern.

Author
Heiner Lammers is Commercial Managing Director at Brunel Service GmbH & Co. KG in Bremen, Germany.

h.lammers@brunel.net

During a chance encounter between private pleasure boating and professional hydrography on a scheduled flight from Bremen to Frankfurt, the following question suddenly came up: With digital applications becoming increasingly networked, the flood of information available appears at first glance to be more than enough for the common man. In specific terms, why would general recreational navigation still need hydrographic specialist knowledge in the future, when the crowd solution using depth sounders and chart plotters with charting functions and GPS means the display of water depths on rivers, lakes and seas can be continually updated?

Admittedly, the water depth measured individually by the water sportsman is to be taken with a pinch of salt due to the presence of ebb and flow, especially in the North Sea (here: the German Wadden Sea) as a result of the tidal range. However, the current state of technology supposedly allows recreational captains a sufficient amount and quality of information to pursue their hobby in a reasonably safe way.

Perhaps a good example in this context is the navigable water passages between the Weser River, the mainland and the East Frisian islands. In this area, the autumn storms alone cause major shifting every year, which leads to changes in the respective passages and the re-setting of the routes every spring. Especially when it comes to the first navigations of the newly set passages in spring, many water sports enthusiasts initially like to »follow behind« and let the boat in front check the existing water depth in a very practical way. But this also means that data is repeatedly made available to the »water sports community« via the depth sounder with GPS device on board and navigation in the Wadden Sea is possible – admittedly in connection with the data material prepared by the professionals.

The number of vehicles on the water alone and the associated constant depth measurement and description of the topography should, with networks becoming much larger, guarantee a level of reliability that might not replace some scientific research, but could be a useful addition, at least.

It might be a thought-provoking argument, but hasn't digitalisation long since offered far-reaching possibilities in this area as well, which, due to the quantity and networking of devices in the field of water sports alone, resulted in such considerable added value in the area of crowdsourcing that their benefits are currently still being unjustly underestimated and therefore not used as much as they could be?

At the latest when the scientific collection of necessary data is not possible due to time constraints, crowdsourcing could also become at least a temporary alternative on the water and provide indications for existing or no longer existing water depths. Moreover, aside from the timesaving factor alone, it is also the cost efficiency of these kinds of methods that make them all the more attractive.

In conclusion, the question posed at the beginning probably cannot be answered, but perhaps even more can be achieved through an even stronger interaction between science and »private measurement of water depths in the field of crowdsourcing« than what professional hydrography already offers us anyway (and thankfully so). //


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DOI: 10.23784/HN124-05

»I would like anyone interested to have the ability to record their depth data«

An interview with JENNIFER HENDERSON JENCKS

Jennifer Jencks is a physical scientist at NOAA's National Centers for Environmental Information in Boulder, Colorado. She is the director of the IHO Data Centre for Digital Bathymetry (DCDB) and she is chair of the IHO Crowdsourced Bathymetry Working Group (CSBWG). In this interview, she talks about the opportunities of crowdsourced bathymetry (CSB), the importance of metadata and how people can be motivated to volunteer to collect depth data.

crowdsourced bathymetry – CSB | citizen science | Seabed 2030 | Trusted Node
Crowdsourced Bathymetry – CSB | Bürgerwissenschaft | Seabed 2030 | Trusted Node

Jennifer Henderson Jencks ist Physikerin bei den National Centers for Environmental Information der NOAA in Boulder, Colorado. Sie ist die Leiterin des IHO Data Centres for Digital Bathymetry (DCDB) und Vorsitzende der IHO-Arbeitsgruppe für Crowdsourced Bathymetry (CSBWG). Im Interview spricht sie über die Chancen von Crowdsourced Bathymetry (CSB), über die Bedeutung von Metadaten und darüber, wie sich Leute motivieren lassen, freiwillig Tiefendaten zu sammeln.

Interviewer

The interview with Jennifer Henderson Jencks was conducted by Lars Schiller and Patrick Westfeld via email in February.

We know more about the topography of Mars and Moon than we do about the topography of our own ocean floor. What do you think are the reasons?

Technology and interest. Mapping the ocean floor is just harder than mapping the surface of Mars or the Moon. Mapping planets using satellite altimetry is pretty effective when water isn't in the way. Unfortunately for us, the ocean is impermeable to the laser altimeter. To get the resolution we want, ocean floor mapping techniques always come back to using acoustic waves and the need for a vehicle that can emit them and then listen to the echo.

But no matter how advanced our sonar systems and ships or other platforms get, coverage will remain limited by the speed and size of the vessel when compared to the largeness of the ocean, the water depth and the ever-changing environmental conditions. Compare that to satellites which can move really fast and cover large distances quickly.

And then, of course, there's interest. Operating professional survey vessels is expensive, but one can certainly argue that satellites and robotic sensors aren't exactly cheap! Yet we, as a society, have always been more supportive of spending billions to map other planets and just haven't exactly gotten onboard (no pun intended) to mapping our own planet for a fraction of the cost.

The aim of Seabed 2030 is to bring together all available bathymetric data to produce the definitive map of the world ocean floor by the end of this decade. Can CSB make a significant contribution to this?

Yes. I believe it can. The fact is, there is no single solution, technology or approach that's going to get Seabed 2030 across the finish line. Volunteer observers operating vessels-of-opportunity in places where surveys are poor, inadequate, non-existent or where hydrographic assets are not readily available absolutely stand to make a significant contribution. If you then consider that SOLAS requirements oblige all commercial vessels to be equipped with systems consisting of at least a single-beam echo sounder and a satellite-based navigation system, then you realise that the world's commercial fleet represent another source of potential depth measurements. Even most non-commercial ships and boats are equipped to measure and record their depth in coastal waters and an ever-increasing number of vessels can also take measurements in deeper water with more affordable and accurate systems than could previously be achieved.

I rarely miss an opportunity when given a microphone to quote Tim Thornton from TeamSurv, »If we got 1 % of all seagoing vessels logging data, and on average they spent half their time at sea, then that's about 5 billion data points a day.«

That's a lot of potential data!

Professional echo sounders, positioning systems and data management infrastructures are needed for hydrographic surveying. What kind of hardware and software solutions do »everyday citizens« need to provide usable data?

Volunteer data from any ship with an echo sounder or fish finder can be used – which many »everyday citizens« likely already have. Then, routinely measured parameters, such as under keel depth and position, can be stored, uploaded and contributed from either an Electronic Chart System participating in the CSB initiative (for example Rose Point's Coastal Explorer or GEC's Aqua Map), or through a variety of data loggers that can be interfaced to the ship's NMEA data bus. Data loggers and systems that are currently being used in the initiative are manufactured by TeamSurv, Orange Force Marine, CIDCO, McGregor, FarSounder and the open source WIBL project. More are on the way too! SeaID's NEMO-30 is currently under development but should be out in the community soon.

Now that we have a record generated, who would we need to contact in order for the data to be used?

I would recommend reaching out either to your hydrographic office or directly to the IHO Data Centre for Digital Bathymetry (bathydata@iho.int). At the DCDB, we accept CSB contributions through a network of what are referred to as »Trusted Nodes«. A Trusted Node is an approved organisation or individual who systematically receives CSB data collected by vessels and is set up to deliver them to the IHO DCDB. We can help identify the best-suited Trusted Node type for you. Or if you're an organisation that is thinking about sponsoring and/or supporting data collection, we'd love to talk to you as well and figure out what it might take to get you going!

What approaches have been developed to ensure the quality of CSB data? Who is responsible for quality control? What is the minimum quality?

The intent of the IHO CSB initiative has always been to encourage the collection of, and access to, more data from different sources and with variable quality. Which is, to say, there is no minimum quality requirement. In fact, raw or »as captured« data (i.e., as close in form to the data presented to the data logger as possible), with a good indication of what the observer's configuration was, are preferable as a contribution to the DCDB. By providing the minimally required information about the time and date a depth measurement was collected, future data users will be able to reprocess the data (e.g., to apply water level corrections), if they so choose.

To allow for an assessment of the quality of the data, it is important to document certain additional information (»metadata«) together with the data, which is why we strongly encourage active data collectors to provide as much extra information as they can (e.g., offsets between GPS and echo sounder, type of corrections applied, if any, etc.). The metadata associated with a data set will provide valuable supporting information relating to how the data collection was performed and will enable appropriate processing, corrections and an informed assessment of the data quality to be made.

Jennifer Henderson Jencks

As a citizen, collecting depth data in international waters is certainly legally unproblematic. How does it behave in territorial waters? What would you like to see from coastal states in this context?

Well, it depends on the coastal state. In 2020, the IHO issued circular letters to all IHO Member States (IHO CL 21/2020) and non IHO member states (via IRCC CL1/2020) requesting they state their position on the sharing of CSB data collected within their waters under national jurisdiction. At the DCDB, we've implemented a geographic filter to take into account these national positions as they are stated and evolve and redistribute the data accordingly. The intent here is to take the onus off the mariner (i.e., of needing to be up to date on national regulations while sailing through various national waters). The simpler we can make things for the individual volunteers, the more data we're likely to get.

»We are telling the story again and again to fresh ears – that some charts still use soundings collected by Captain Cook«

Jennifer Henderson Jencks

To date, it is encouraging to see that 33 coastal states have replied positively to the letters. The letters were written to not only request permission, but also to allow for the capturing of caveats. For example, a state might permit data collected within their EEZ be distributed, but not data from within their territorial sea. Those positions and their associated caveats are available online.

But what we would really like is for *all* coastal states to provide their status. Hopefully a positive one! Because, unfortunately, we have to assume that a lack of reply equates to a negative stance. This is a real shame because that means a *lot* of data has been contributed that can't be used by anyone for any purpose.

How do you get people to contribute to CSB?

So far, there seem to be two primary drivers. The first simply involves outreach. The majority of mariners, no matter their affiliation, aren't even aware this is something they can get involved with. Once the interest from a mariner or a group of mariners is there, we work together to determine the best way to initiate data collection and contribution – meaning, do they use a participating navigational software on their boat, or are they interested in installing a data logger? The second piece involves giving those that have contributed their data something back – preferably a product their own data has been added to. We see time and time again, that getting something useful back in return for their effort, is the greatest incentive for participation. Streamlining that feedback loop is key. And we're working on that.

What is the contribution of the IHO's CSBWG, of which you are chair, to CSB?

The biggest contribution of the IHO's CSBWG, which is composed of international scientific, hydrographic and industry experts, has been the publication of an IHO Guidance Document on Crowdsourced Bathymetry – referred to as *B-12* (iho.int/uploads/user/pubs/bathy/B_12_CSB-Guidance_Document-Edition_3.0.0_Final.pdf). This document describes what constitutes CSB, the installation and use of data loggers, preferred data formats, how to become a Trusted Node and instructions for submitting data to the IHO DCDB. The document also provides information to help data collectors and users better understand quality and accuracy issues with CSB.

There would be no outreach for this initiative without the contributions of such an amazingly diverse working group. In addition to passionate members from national hydrographic offices, there are so many expert contributors from all sectors of industry (hardware and software companies, yachting communities, academia, etc.). The working group has provided a sort of nucleation point for people interested in the process to get together and develop new technologies and projects and to acknowledge issues and try to find solutions to overcome them. These folks not only represent their communities to us, but our work to their communities. They really are an incredible group.

And would we be where we are today without this IHO-led citizen-science initiative?

I can confidently say no. However, my answer oddly is not about data contributions. A citizen-science initiative means we are out there engaging with citizens around the world. We are telling the story again and again to fresh ears – that the global ocean floor is only ~23 % mapped, coastal waters only ~50 % mapped, that some charts still use soundings collected by Captain Cook, etc. Before, these conversations took place mainly among ourselves, at scientific conferences. Now they're taking place in fishing communities in the Canadian Arctic and yacht clubs in Monaco. It's awesome. The more people are educated on the issues, the more they want to be a part of the solution. Remember that most people that work or play on the ocean love their environment and want to know more about it. If we can facilitate this through the citizen-science collection of depth measurements, that's impactful.

Who are the most avid data loggers – the commercial shipping industry, fishery or rather the hobby sailors? Who contributes the most?

I would say the users of Rosepoint Navigation Systems Coastal Explorer software, who provide an easy opt-in to contributing logged data to the DCDB, have contributed the majority of the data holdings. It appears most of their users are hobby sailors, in North American waters. Rose Point was genius in making it super easy to participate, and their customers operate mainly in waters that allow the sharing of data. That said, commercial shipping and especially fisheries vessels go places that hobby sailors don't, and therefore we want to try to encourage as many different sea-going communities to be involved as possible.

What percentage of ocean floor topography do we know thanks to CSB? Which areas are particularly well mapped, where is data still missing?

To see where CSB is making an impact, we need to look at localised data collections. Today, that's really just two regions: North America and along the Great Barrier Reef. The »Crowdsourced bathymetry on the Great Barrier Reef« project, started by Dr. Rob Beaman from James Cook University in 2018, focuses on filling the data gaps along the less-than 40 % mapped GBR. 164,000 line km of CSB data have been added by just eight vessels over the last several years.

As of January 2023, CSB has contributed ~3,000 square nautical miles of new bathymetric data coverage to the U.S. EEZ – or 0.17 % of the total bathymetric data contributions.

Does it happen that you become aware of interesting locations in CSB data such as previously unknown seamounts or other special features under water? Are such areas then specifically surveyed again afterwards?

For those that are actively using these data, yes.

The Canadian Hydrographic Service (CHS) have used CSB data from the DCDB to update several Inside Passage charts along the coastal routes stretching from Seattle, Washington, to Juneau, Alaska. A systematic comparison of charted depths less than 10 m yielded improved charted channel depths, data density and improved chart compilation in areas that were surveyed with traditional single-beam. CSB data has helped prioritise survey areas for following survey seasons and initiated the publication of Notices to Mariners.

In the U.S., NOAA views CSB as a potential valuable tool for chart adequacy assessments to enhance the quality of NOAA's cartographic products, especially in situations of immediate need, such as disaster response. However, NOAA is still in the early stages of determining a sustainable process for handling these data.

The idea behind CSB is to fill the white space on ocean maps and nautical charts. The same idea is pursued by research vessels on their transit. Can you influence their routing in any way to force heterogeneously distributed in-transit bathymetry?

We would like to! Colin Ware's BathyGlobe Gap-Filler tool, which is available online, is intended to support planning for transit and area mapping using GEBCO bathymetry as a background. And GEBCO's Technical Subcommittee on Undersea Mapping have been trying to tackle the issue of pulling in and navigating multiple data layers in addition to GEBCO data (known proprietary data coverage, CSB, transit data, systematic surveys, etc.) to estimate true coverage that a mariner could then use to guide their route planning. We aren't there yet, but we are moving in that direction.

»Most people that work or play on the ocean love their environment and want to know more about it. If we can facilitate this through the citizen-science collection of depth measurements, that's impactful«

Jennifer Henderson Jencks

Survey data from research vessels is certainly much more accurate than data from a cargo or cruise ship. How do you deal with these different accuracies? Is the uncertainty later specified as a metric in the database?

That's correct, CSB is unlikely to ever reach the uncertainty and quality achieved by professionally collected data. But the best available data for an area isn't necessarily the best possible quality data according to standards. As long as the data quality is quantified or qualified, it may very well be the best available data if nothing else exists. And it can certainly be used to fill in between authoritative data or highlight inaccuracies. To allow for a comprehensive assessment of data quality, which we look to the community to do, the richer the metadata the better. As a data centre, our goal is to encourage metadata inclusion and ensure it's available to the public.

As our data volumes and public interest grow, we're hopeful that hydrographic offices and academic institutions will take on these issues, perform analyses, create products, etc. In the meantime, we, as a data centre, are looking for feedback to enhance the way we serve CSB to the public.

Citizen scientists are helping to map ocean's bathymetry. Will the data later be made available to the public, and if so, how?

All types of bathymetric data (multibeam, singlebeam, lidar, CSB) provided to the IHO Data Centre for Digital Bathymetry are made available to the public via our map viewer (ncei.noaa.gov/maps/iho_dcdb/). For CSB data specifically, we redistribute these data in agreement with the information received by the IHO Secretariat from individual coastal states on request.

You work at NOAA and lead the IHO Data Centre for Digital Bathymetry. What are your duties?

Most of my internal day-to-day activities involve working with a wonderful team of data managers trying to improve the various aspects of stewarding bathymetric data. This includes streamlining data ingest and improving data discovery and access. Externally, I spend quite a bit of time collaborating with colleagues around the world who are also motivated to see the number of bathymetric data collectors and contributors increase, not just by encouraging participation, but by reducing the roadblocks that might be in their way.

What do you think about bringing together even more hydrospatial data from a wide variety of sources, with the aim of building a comprehensive hydrospatial information system or even a Digital Twin of the Ocean? What role can hydrography play here?

It's certainly an interesting concept, and one we're hopefully moving closer towards, technologically speaking, every day. Trying to envision the real-time or semi-real-time feed of bathymetric data from a variety of sources needed to make a true Digital Twin seems a bit … daunting. But there are a lot of smart people out there and unimaginable technology becomes imaginable all the time, so who knows what will be possible in the future.

In the meantime, hydrographic information is fundamental to all descriptions of the ocean and while traditional survey methods will likely continue to dominate the collection of bathymetric data, the community dedicated to mapping our global ocean floor understand that it will take a combined effort of all technologies. This includes acknowledging and accepting contributions from volunteers. Vessels journeying across the ocean floor, collecting valuable »passage soundings«, routinely observing and documenting weather and other marine environmental observations, have been taking place for centuries. Remembering that observations from wide variety of sources play a role is critical and should be encouraged.

What would you like to be able to do better?

As far as the CSB initiative goes, it would be the onboarding of mariners who want to participate. Ideally, I would like anyone interested to have the ability to record their depth data. I would then like those data to easily come off the boat and into the DCDB. Basically, the barrier to entry is still too great. Luckily, we have a lot of dedicated people out there that are working on overcoming these obstacles as we speak. We'll get there!

What do you know without being able to prove it?

What a great question! What I know is that people are more likely to want to see a goal be achieved if they're able to participate in the process. »Help us map the ocean floor!« will get us much further than simply stating to the world, »We need a fully mapped ocean floor«. If you get people involved, then they become invested, they'll encourage their peers to join, and suddenly, a truly global effort is underway, working together to reach this extraordinary but achievable goal. //

Hydrographentag in Berlin

am 20. und 21. Juni 2023
im Fraunhofer-Forum

Die Vorbereitungen für den 36. Hydrographentag laufen auf Hochtouren. Mit der Fraunhofer-Gesellschaft und dem »Fraunhofer-Forum« in Berlin-Mitte haben wir einen idealen Gastgeber gefunden. Das Tagungszentrum im Herzen der Hauptstadt ist einfach mit öffentlichen Verkehrsmitteln zu erreichen und bietet mit seiner Lage an der Spree ein einzigartiges Ambiente.
Als Schwerpunkt haben wir das Thema »Autonome Systeme« gewählt, da die Entwicklung in diesem Bereich rasant voranschreitet. Folglich erwarten Sie Vorträge zu autonomen Unterwassersystemen, autonomen Oberflächenfahrzeugen, aber auch zu anderen Themen. Mit von der Partie sind altbekannte Größen wie das DLR, genauso wie das junge Start-up Orthodrone, das mittlerweile seine Drohnen auch mit rotierendem LiDAR ausstattet. Hydrographie zu Land, zu Wasser und aus der Luft also.
Das Vortragsprogramm beginnt wie gewohnt am ersten Tag ab circa 13 Uhr und endet am frühen Nachmittag des zweiten Tages. Noch steht das Vortragsprogramm nicht endgültig fest. Wir rufen hiermit dazu auf, sich aktiv für einen Vortrag zu bewerben (schreiben Sie uns bei Interesse einfach eine E-Mail (dhyg@innomar.com). Das finale Programm werden wir dann zeitnah auf der Website veröffentlichen.
Zum Abschluss des zweiten Tages wird die Mitgliederversammlung stattfinden. Die Veranstaltung wird diese Jahr nicht hybrid abgehalten, wir freuen uns daher auf rege Beteiligung vor Ort.

Weitere Informationen ab Mitte April auf **dhyg.de**

DOI: 10.23784/HN124-06

Study of underwater biodiversity in Lake Guerlédan (France) using acoustic systems

A student project at ENSTA Bretagne

An article by IRÈNE MOPIN

Each year since 2016, students of ENSTA Bretagne specialised in hydrography/oceanography and marine robotics participate to a field project on Lake Guerlédan in Brittany (France). One of the subjects they work on is the study of biodiversity in the lake using acoustic systems. In collaboration with research institutes such as Ifremer and directed by their advisor Irène Mopin, they are using professional echo sounders in order to implement analyses of water column echoes in depths up to 40 m. Each year, results of the previous group are used to improve processing techniques and new specificities are added such as the sonification of data.

hydrography education | practical training | water column | fishery acoustics | sonification
Hydrographieausbildung | praktische Übungen | Wassersäule | Fischakustik | Beschallung

Seit 2016 nehmen jedes Jahr Studierende der ENSTA Bretagne, die auf Hydrographie/Ozeanographie und Meeresrobotik spezialisiert sind, an einem Feldprojekt am Guerlédan-See in der Bretagne (Frankreich) teil. Eines der Themen, an denen sie arbeiten, ist die Untersuchung der Artenvielfalt im See mit Hilfe akustischer Systeme. In Zusammenarbeit mit Forschungsinstituten wie Ifremer und unter der Leitung ihrer Beraterin Irène Mopin setzen sie professionelle Echolote ein, um die Echos aus der Wassersäule in Tiefen bis zu 40 m zu analysieren. Jedes Jahr werden die Ergebnisse der vorherigen Gruppe genutzt, um die Verarbeitungstechniken zu verbessern, und es kommen neue Besonderheiten hinzu, wie zum Beispiel die Beschallung der Daten.

Author
Irène Mopin is a PhD student at ENSTA Bretagne (France) and the university of Bath (UK). She teaches underwater acoustics at ENSTA Bretagne since 2016.

irene.mopin@ensta-bretagne.org

1 Introduction

Each year, almost 50 students of ENSTA Bretagne participate to a field project on Lake Guerlédan in the centre of Brittany (France). They come from two speciality courses of ENSTA Bretagne: hydrography/oceanography and marine robotics. The objective of the project is to apply their technical background on concrete subjects proposed by a team of researchers and engineers from ENSTA Bretagne and external companies or partner research labs. During six months students work in groups of three to five on their subjects. Two weeks in the field are planned in October and February, supplemented by dedicated work-days in between at the lab. Tens of subjects are studied each year, one in particular is discussed in this article: the study of underwater biodiversity of the lake using acoustic systems.

The aim of this subject is to use echo sounders to describe the underwater fauna and flora of the lake. Each year a partnership is made with a research institute (Ifremer, Université de Bretagne Occidentale, IRD France) which gives students the opportunity to discuss any aspect of their subject with expert engineers and researchers specialised in fishery acoustics. This partnership make also available professional fisheries echo sounders and software for the students. At the end of the project, some students have the opportunity to continue their work in some of the partner institute labs, in particular for their internships. In some cases, students can also be hired by the partner institute at the end of their studies.

2 A project in constant change

During the project, students are required to design and prepare the survey (define survey lines, etc.), acquire data in situ and process them using a research methodology and professional software. Acoustic measurements are performed on the lake on the ENSTA Bretagne survey vessel *Panopée* equipped with hydrographic systems (global navigation satellite system, inertial navigation system). An example of survey lines carried out by a group of students and inspired from Simmonds and MacLennan (2008) is given in Fig. 1. Other measurements requiring to stop the vessel (e.g. sound speed profiles) are made at specific locations called stations on the figure.

From one year to another, acoustic systems used were different because of the specificity chosen by the advisor and partners and the availability of the materials. Table 1 shows the different acoustic systems used since 2016 for the project. Each year the Kongsberg EA400 single-beam echo sounder is present. Thanks to the main partner Ifremer, different fishery single-beam echo sounders were available along the years (Simrad EK60 and EK80) which are up-to-date professional echo sounders.

The first years (2016, 2017), the specific objectives were to evaluate the presence of fauna in the lake and its composition. Indeed, the lake was dried up in 2015 in order to repair the dam thus all underwater life decreased severely. It was then re-filled with rain-water during fall and winter 2015. In 2016, 13 tonnes of fish were re-introduced by the fishery federation of the department containing 80 % of roaches, carps, tenches and 20 % of perches, pike-perches, pikes. Measurements with Kongsberg EA400 were therefore made the first years to estimate if fish were still present and where they were located. It also gave the opportunity to demonstrate the ability of this bathymetric echo sounder to provide usable data of the water column.

In addition to acoustic acquisitions, samples of micro-life were taken using a plankton net with a filter of 80 µm. They allow to detect if plankton is present in the lake, as it represents the base of a sustainable underwater life. Also, a fluorometer was used to measure water turbidity and chlorophyll concentration, and water physico-chemical parameters (temperature, sound speed, etc.) were measured with a CTD probe. All these measurements are important to better relate acoustic data to the underwater biodiversity as they give information on the water layers and their compositions.

In the following years, dedicated fishery echo sounders were used to improve the analysis of the water column. Indeed, even if a magnitude calibration of the Kongsberg EA400 was performed based on the method of Foote (1987) and Vagle et al. (1996) on standard sphere, bias on the measurements of fishes acoustic responses (i.e. target strength, TS) still remained because targets cannot be located inside the beam of this echo sounder. This information is provided by Simrad EK60 and EK80 using their split-beam antennae which consequently make the measurements of fishes TS more accurate.

The acoustic response of fish and also of any volume target (e.g. diffusive layers composed of plankton or suspended matter) depends on the frequency of the signal transmitted by the echo sounder. Thus, the use of several frequencies is informative to analyse the underwater biodiversity. That is why different echo sounders at different frequencies were employed each year as mentioned in Table 1. The echo sounder Simrad EK80 was also useful because it can provide wide-band measurements by transmitting frequency modulated (FM) signals. With this single echo sounder, multiple frequency measurements were therefore made in the frequency bands described in Table 1.

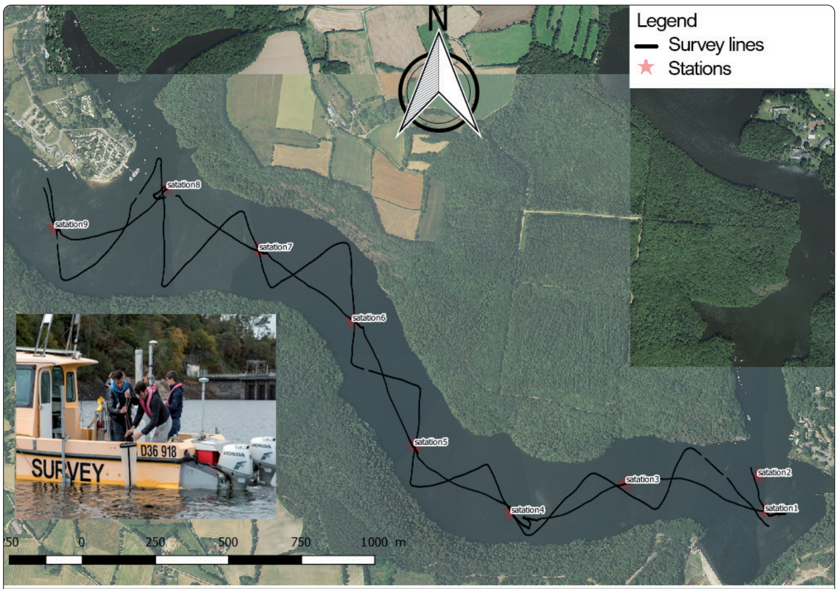

Fig. 1: Aerial picture of Lake Guerlédan in the centre of Brittany, France. Survey lines and stations carried out by the student group of 2016 and 2017. Photo of the students using the plankton net to sample micro-organisms of the water column (illustration from student report 2016–2017)

3 Results along the years

At the end of their project, students are asked to present their results during an oral presentation to a large panel of scientists. They also discuss their results in a report and through a poster. In the fol-

Year	Echo sounders	Frequencies	Other material
2016–2017	Kongsberg EA400	38 kHz, 200 kHz	CTD Plankton net Fluorometer
2017–2018	Kongsberg EA400	38 kHz, 200 kHz	CTD Plankton net Fluorometer
2018–2019	Kongsberg EA400 Simrad EK80	38 kHz, 200 kHz [45 kHz – 90 kHz], [160 kHz – 260 kHz], [260 kHz – 420 kHz]	CTD Plankton net Fluorometer
2019–2020	Kongsberg EA400 Simrad EK80	38 kHz, 200 kHz [45 kHz – 90 kHz], [160 kHz – 260 kHz]	CTD
2021–2022	Kongsberg EA400 Simrad EK80	38 kHz, 200 kHz 120 kHz	CTD

Table 1: Single-beam echo sounders used by students and their frequencies according to the year of the project

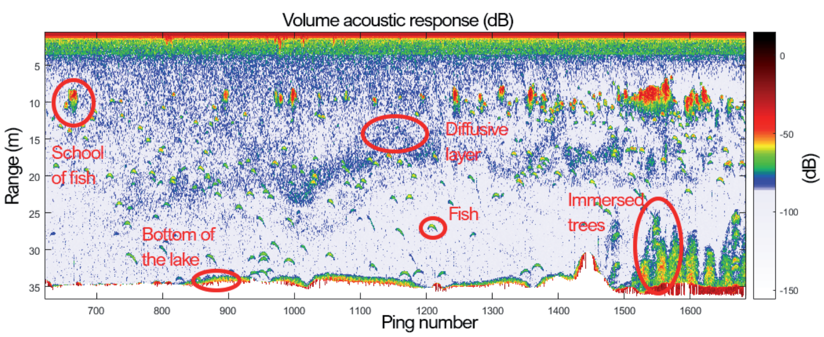

Fig. 2: Echogram of water column data from Kongsberg EA400 at 38 kHz acquired in February 2018 (from student report 2017–2018)

lowing some of their results are presented and illustrated.

3.1 Fishery acoustics

Echo sounder data are at first analysed as images called echograms such as Fig. 2. The vertical axis corresponds to the range, i.e. the distance between the echo sounder and the target (fish, lakebed, etc.). The horizontal axis corresponds to the vessel progression, i.e. the distance travelled by the vessel. Colours describe the acoustic response of the targets in decibels, i.e. the ability of targets to backscatter an incident acoustic energy. Targets in the echogram of Fig. 2 are supposed volumetric thus the response depicted in colour is a volume target strength also noted S_V in decibels (MacLennan et al. 2002).

On the echogram at 38 kHz of Fig. 2 we can observe school of fish, individual fish, diffusive layers that can be composed of plankton or suspended matter, and vegetation on the lake bottom including trees. Indeed, trees and old structures built before the dam was erected are still standing in the bottom of the lake. This immersed vegetation is also seen on Fig. 3 which illustrates the difference of echogram that can be derived from measurements at different frequencies. Targets like fish and trees are less visible at 200 kHz whereas they are perfectly observable at 38 kHz. This effect is due to the difference of transmitted signal length between the two frequencies, the different beam apertures of the echo sounders, and also to the specificities of the acoustic responses of the targets.

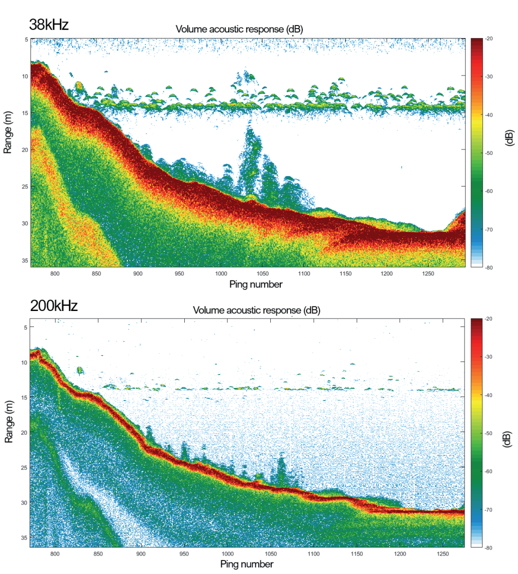

Fig. 3: Echograms of water column data from Kongsberg EA400 at 38 kHz and 200 kHz simultaneously acquired in October 2016. Pulse lengths at 38 kHz and 200 kHz respectively 128 µs and 256 µs. Beam apertures respectively 21° × 13° and 7° × 7° (from student report 2016–2017)

A particular observation was made every year from echograms such as Fig. 2 and Fig. 3: in February fish are found everywhere in the water column whereas in October they are mostly located in a specific layer between 10 and 15 m deep. By measuring the temperature of the water column, the depth limit where the fishes always regroup in fall was observed to be a strong thermocline present in October. Indeed, in October the water mass is highly stratified with an upper layer around 17 °C and a lower layer around 9 °C (see Fig. 4 where an example of representative temperature profiles of October and February is presented). In February, this stratification disappeared and the temperature is homogeneous in the whole water column. In that case, fishes are sparse. The analysis can not be pushed further without any more information, however some useful indications were given using the plankton net and the fluorometer. In October, when the water column is stratified, the concentration in chlorophyll-a is higher in the upper layer than in the lower layer. In addition, the upper layer was observed to contain a higher concentration of plankton than the lower layer, in particular copepods and daphnia. Fig. 5 shows a picture taken by a student during the analysis of plankton net samples.

Because most of the fishes in the lake seem to travel alone, it makes possible to analyse their

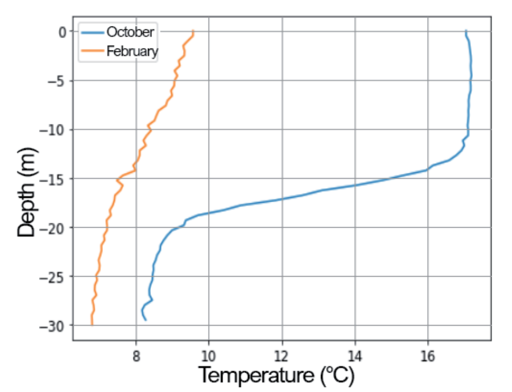

Fig. 4: Temperature profiles measured in October 2019 and February 2020 (from student report 2019–2020)

acoustic responses TS individually. An algorithm to detect the fishes was developed by the students in addition to their calculus of TS using the sonar equation. Resulting fishes responses were then plotted as histogram such as example of Fig. 6 at 120 kHz. On that example we can observe two main modes in the histogram. We can make the assumption that they are related to two different species of fishes. On the echogram on the right of the figure are plotted the fishes which TS being part of one or the other mode to study their location in the water column. A specific behaviour has not been specifically brought to the fore except their aggregation in the thermocline thickness.

Using the echo sounders Simrad EK60 and EK80, it was also possible to track one fish inside the beam of the echo sounder. Once the trajectory of the fish is detected, the incidence angle of the transmitted signal on the fish can be derived. In addition, when using Simrad EK80, the frequency response TS(f) of the fish is also available. Consequently, for a given target detected on echograms, we can derive its acoustic response according to frequency f and incidence angle Θ. An example of track of a target (supposed a fish) is given in Fig. 7 with its frequency response for [45 kHz – 90 kHz]. An example of frequency response TS(f, Θ) is given in Fig. 8 where two echo sounders are used to derived frequencies at [45 kHz – 90 kHz] and [160 kHz – 260 kHz]. On this figure some resonances seem to appear, mostly at high frequencies. This effect could be due to the scattering of the fish bones as observed by Nesse et al. (2009) or other effect of resonance of the target itself.

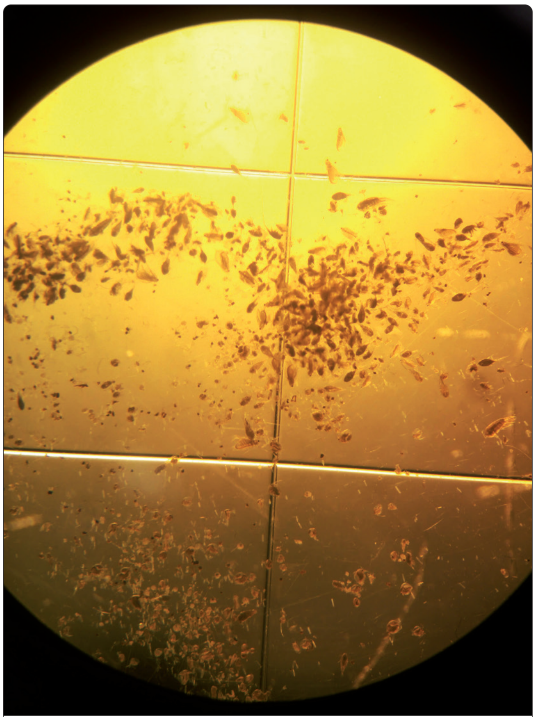

Fig. 5: Picture of a sample taken with the plankton net in Lake Guerlédan (from student report 2018–2019)

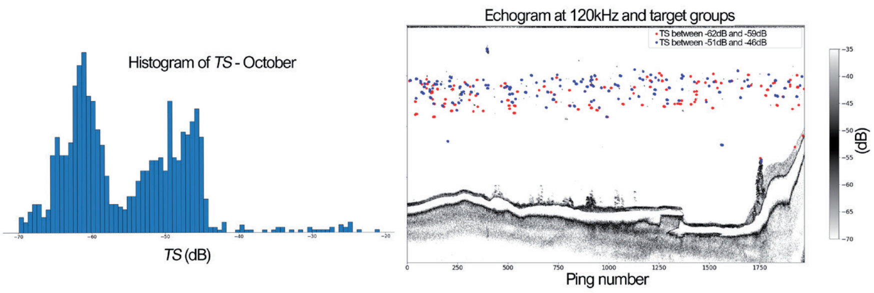

Fig. 6: Histogram of fish acoustic responses TS at 120 kHz and their locations in the echogram in October 2021 (from student report 2021–2022)

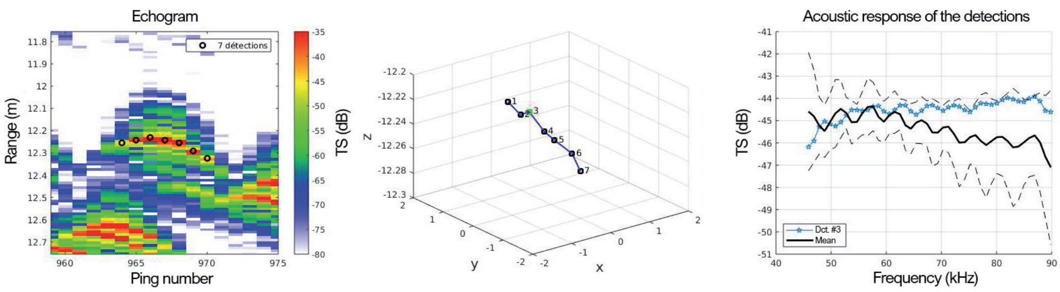

Fig. 7: Tracking of one target (supposed a fish). Left: Detection of the target on the echogram. Centre: Trajectory of the target in the echo sounder beam. Right: Frequency response of the target; blue curve: frequency response of one detection; black curve: mean of target strengths of the different detections of the target; dash curve: standard deviation (from student report 2019–2020)

3.2 Sonification

In 2021, a specific objective of the project was to demonstrate the ability of the human ear to discriminate different underwater targets echoes. Because the echo sounders use ultrasounds for measurements, data had to be transposed into the audible band before performing listening tests (on a panel of 30 persons). This step was fulfilled by re-generating the real acoustic signal based on its envelop provided by the echo sounders, and then translating this signal in the audible band. Three types of targets were studied: individual fishes, school of fishes and the lake bed. Their echoes were all transposed and three tests were performed in order to distinguish between fishes versus lake bed, individual fishes versus school of fishes, and hard lake bed versus soft lake bed. The question asked to the listeners were to classify the sounds from a list of eight in two categories. They had no information on the content. Conclusive results were obtained which are promising for other experiences in classification of ultrasound echoes with human ear.

Besides these scientific objectives, an artistic goal was proposed to the student during the project 2021–2022. The aim was to create a musical piece based on one of their echograms and on the knowledge they learnt in the scientific part of the project. For example, that year they used the fishes detections to generate music notes tuned according to their depth, the fishes TS controlling the magnitude of the notes. At the end of the project, the students creation was performed at two Science & Art festivals in Brest (France): festival RESSAC and Les Art'Pulseurs. It can still be heard on Youtube (youtu.be/s-VfAiiaTn4 with details on the project at youtu.be/GOPh15y5Yiw).

4 Conclusion and feedback

In conclusion, during the several occurrences of the project, students brought into light diverse information on the underwater biodiversity of the Lake Guerlédan. The presence of different species of fishes and plankton was demonstrated. Terrestrial vegetation was also found on the bottom of the lake (shrubs and trees). An interesting result was that between October and February the water mass characteristics change and so is the fauna and flora behaviour. In October the water column is stratified with two layers: a surface layer of higher temperature and containing more plankton concentration than the lower layer. In that period, fishes are found located in the highly marked thermocline which is generally between 10 m and 15 m depth. On the contrary, in February the water mass in homogeneous and fishes are found sparse in the water column. When fishes of the lake were travelling individually their echoes were analysed and their acoustic responses TS studied according to frequency and incident angles.

Echo sounder data were also analysed in order to classify echoes from the different underwater target. The method used was the sonification, i.e., the listening of data with the human ear. Data were therefore transposed in the audible band and submit to a panel of 30 persons to evaluate the ability of human ear to distinguish echoes from fishes, school of fishes and lake bed. In addition, students composed a sound creation based on the echo sounder echograms they acquired. The piece of music was performed at two Science & Art festivals in Brest (France).

The very large majority of students that had chosen the project presented in this article mentioned that they were glad to participate. In addition to their motivation originating from the group work and the practical aspects of the survey, their feedback was excellent and they appreciated to discover new domains of acoustics and underwater acoustics. Years later, satisfying feedback also comes from alumni students that made their internship in fishery acoustics in one of the partner lab such as Dung at Ifremer in 2018:

»The project at Lake Guerlédan was very useful for my internship at Ifremer. I learnt how to calibrate an echo sounder using a standard target. I had also the opportunity to study theory and practice of the sound wave backscattered by the sphere. I appreciated working in group and in autonomy. All of this helped me a lot in my internship which subject was the calibration of a wide-band fishery echo sounder on standard target.«

And also Marie who is now full time employee in the same partner lab:

»The project essentially gave me the opportunity to discover and develop my interest in underwater acoustics, a field in which I am now working full time at Ifremer. More concretely, though the project I learnt a lot about fishery echo sounders: how to install them, to acquire and process data for a concrete scientific purpose. These are tools and knowledge that I still use daily. It was also a privileged way to meet and exchange with scien-

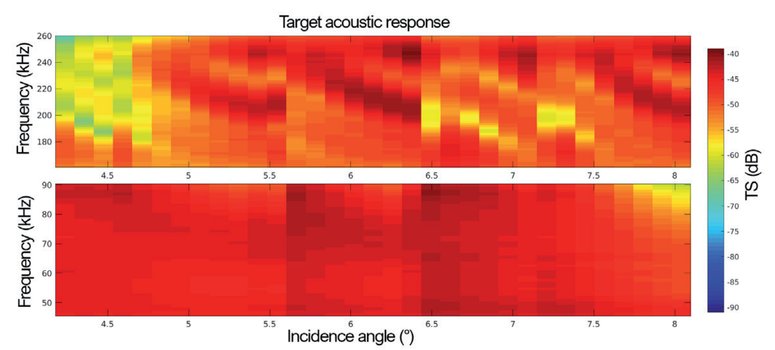

Fig. 8: Frequency response TS(f, Θ) of one target (supposed a fish) according to frequency and incidence angle on the target (from student report 2018–2019)

tists from different institutes, some of whom are now my colleagues.«

5 Acknowledgement

The author would like to thank all the students who participated to the project, and also the partners: Ifremer for their participation and the loan of acoustics systems along the years, Université de Bretagne Occidentale/Image & Son Brest for their help and support with the sound creation, IRD France, festival RESSAC and festival Art-Pulseurs.

All projects at Lake Guerlédan are support by ENSTA Bretagne, EDF, ISblue and Association Francophone d'Hydrographie (AFHy). More information on guerledan.ensta-bretagne.fr. //

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DOI: 10.23784/HN124-07

HYDRO 22 in Monaco

A personal perspective

An article by RUDOLF METZLER

After a two-year forced break due to the Corona pandemic, numerous hydrographers came together at the HYDRO conference in Monaco in December 2022. The event was organised by the francophone hydrographic society AFHy on behalf of the International Federation of Hydrographic Societies (IFHS). Our author, whose professional work revolves around hydrographic applications, attended a HYDRO conference for the first time.

HYDRO 22 | Monaco | Industrial Internet of Things – IIoT
HYDRO 22 | Monaco | Industrielles Internet der Dinge – IIoT

Nach zwei Jahren Zwangspause wegen der Corona-Pandemie kamen im Dezember 2022 zahlreiche Hydrographinnen und Hydrographen bei der HYDRO-Konferenz in Monaco zusammen. Die Veranstaltung wurde im Namen der International Federation of Hydrographic Societies (IFHS) von der frankofonen hydrographischen Gesellschaft (AFHy) organisiert. Unser Autor, dessen berufliche Arbeit sich um hydrographische Anwendungen dreht, nahm zum ersten Mal an einer HYDRO-Konferenz teil.

Author
Rudolf Metzler (M.Sc., Geomatics Engineering) works as a software engineer for navigation at Atlas Elektronik GmbH in Bremen.

rudolf.metzler@atlas-elektronik.com

I never thought I would find myself at a hydrographic conference in Monaco, but here I am. And let me tell you, it's been an adventure. As I arrived, I was surprised to learn that the small principality has a long-standing history in hydrography. Despite its reputation as a luxurious destination for the privileged, I discovered that Monaco is highly invested in ocean science and a sustainable ecosystem.

The conference took place at the picturesque Grimaldi Forum, hosted by the Francophone Hydrographic Society (AFHy), providing a comfortable and welcoming environment for the international and diverse group of attendees. The ice-breaker event held prior to the conference provided a valuable opportunity for attendees to network and establish connections with fellow hydrographic experts. Hence, the conversations covered a wide range of topics, reaching from current and prospective international hydrographic standards over environmental monitoring to military applications, while enjoying the taste of sparkling language enhancers.

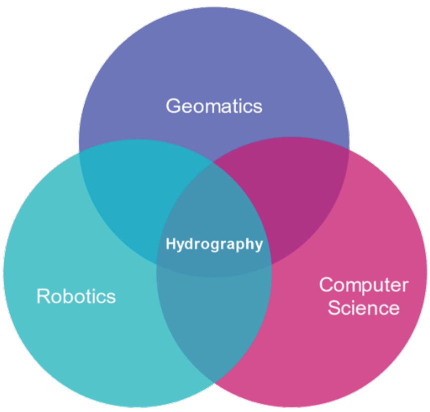


Fig. 1: Venn diagram depicting the domains contributing to latest developments in hydrography

The starting point was an overview of the current developments and challenges in hydrography. Ensuring navigational safety, protecting the ecosystem during ongoing climate change and the importance of securing subsea communication cables are crucial aspects of hydrography that were brought to light during the first sessions. Frankly, I was quite surprised to realise how little I was aware about the aspect of security vulnerability of the latter topic. It connected the dots from the conversations I had the night before and gave me a deeper understanding of the fascinating community and movements driving the field forward.

If you ever find yourself in Monaco after a long day, on a mission to find a cheap place to grab a bite to eat in the evening, don't be surprised if instead of a bistro serving croissants, you stumble upon extravagant sports cars parked unexpectedly in a boutique between a row of small art galleries and real estate offices. Nothing special in a Monégasque way of life, I suppose.

But jokes aside. In addition to the need to adapt education to the demands of the interdisciplinary, high-tech field of hydrography (see Fig. 1), the conference also highlighted the development of cutting-edge technology for autonomous vehicles in the context of Industrial Internet of Things (IIoT), made possible even on the high seas by Starlink. A representative from a USV vendor presented an analogy during the conference, drawing a comparison between their work to that of universities, stating that »our company doesn't focus on researching highly advanced solutions, performing like a Formula 1 racing team, but rather on manufacturing autonomous vessels that meet the specific needs of our clients« pointing out that research is as important as industry in paving the road towards new technologies, with an anecdote about the famous Monte-Carlo racing circuit next to which the conference took place.

New insights into computational methods with mathematical and statistical models for bathymetric surveying were also presented. Satellite-derived bathymetry showed its advancements in on-demand surveying next to hydrospatial sensor analysis, airborne or underwater, to enhance the acquisition of seafloor data. The variety of acquisition methods leads to different kind, quality and size of data. Therefore, automation plays an important role in analysing this data, with Machine Learning providing decision support and processing vast amounts of data, yielding the demand of an efficient representation using techniques like the Discrete Global Grid System (DGGS).

Overall, the conference reinforced the notion that hydrography is undergoing a paradigm shift driven by digital automation and interconnectivity, reminiscent of the early days of the automotive industry where new technology and ways of thinking were not fully understood or embraced. The conference highlighted the domain-agnostic nature of automation, which can make various aspects of hydrographic services more efficient and accessible, such as data processing, quality assessment, decision-making, spatial data representation and emphasised the crucial role that interconnectivity plays in achieving ambitious projects such as Seabed 2030 leveraging the idea of crowdsourcing and frameworks like the European Marine Observation and Data Network (EMODnet). Moreover, it was acknowledged that unfortunately a significant number of women leave the hydrographic domain due to pregnancy and family life, as surveying campaigns on a survey vessel often require long periods of time and are not family friendly. However, with the help of automation and interconnectivity, there is a great chance that it would be possible for them to return and work remotely, thereby increasing diversity and making the field more attractive to others by shaping the field of hydrography into a high-tech direction.

For me personally, HYDRO 22 demonstrated the scale-invariance of applied IIoT, which already works across multiple independent domains, meaning that the same method working for a fraction of a digital system is applicable for an entire fleet of digital systems, i.e. autonomous ships. It is an intriguing moment in time, which should motivate companies to re-evaluate their view on existing technology and perhaps try out new approaches to their niche by taking a leap of faith and a glance at their systems from another point of view.

I would like to use this format to express my gratitude to my colleague Peter Dugge for supporting me throughout my journey and keeping the bar of motivation high, to Bhaswar Goswami (Wayfair GmbH) for teaching me a lot about scalable systems and David Vincentelli (AFHy) for inviting me to the conference. I am already looking forward to the next one in Genoa. //

Jetzt bewerben!

DHyG Student Excellence Award

Mit dem DHyG Student Excellence Award zeichnet die Deutsche Hydrographische Gesellschaft (DHyG) Studierende aus, die sich in einer herausragenden Studienarbeit mit einem beliebigen Thema der Hydrographie auseinandergesetzt haben.

Der DHyG Student Excellence Award ist mit 500 Euro dotiert. Außerdem erhält die Preisträgerin oder der Preisträger freien Eintritt zum Hydrographentag, um dort die Arbeit einem Fachpublikum vorzustellen.

Wer den DHyG Student Excellence Award erhält, wird von der DHyG ins Rennen um den IFHS Student Award geschickt, der auf der Hydro-Konferenz im Herbst verliehen wird und der mit £ 1500 dotiert ist.

Mögliche Preisträgerinnen und Preisträger können in diesem Jahr bis zum 20. April von den Hochschulen vorgeschlagen werden.

Weitere Informationen unter: dhyg.de

DOI: 10.23784/HN124-08

@weltvermesserer

Die Social-Media-Nachwuchskampagne

Ein Beitrag von TANJA DUFEK, MARLENE RYBKA und SONJA RIEGAMER

Um dem allgemeinen Fachkräftemangel entgegenzuwirken und Schüler:innen auf das Tätigkeitsfeld der Geodäsie aufmerksam zu machen, wurde die Social-Media-Kampagne @weltvermesserer von der InteressenGemeinschaft Geodäsie (IGG; Allianz von DVW, VDV, BDVI) ins Leben gerufen. Auch die DHyG ist neben verschiedenen Verbänden, Fördervereinen, Hochschulen und Arbeitsgemeinschaften an dieser Instagram-Kampagne beteiligt. Dieser Beitrag informiert über die Initiative und erläutert, wie Interessierte sich mit Material beteiligen können.

@weltvermesserer | Nachwuchskampagne | Instagram
@weltvermesserer | young talent campaign | Instagram

In order to counteract the general shortage of skilled workers and to draw students' attention to the field of geodesy, the social media campaign @weltvermesserer was launched by the InteressenGemeinschaft Geodäsie (IGG; alliance of DVW, VDV, BDVI). The DHyG is also involved in this Instagram campaign, along with various associations, promotional societies, universities and working groups. This article informs about the initiative and explains how interested parties can participate with material.

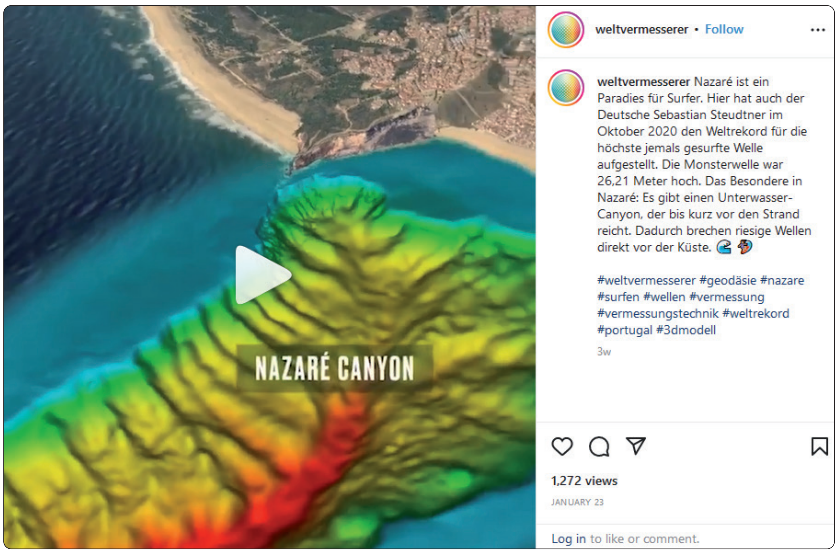
Der Startschuss für die Nachwuchskampagne @weltvermesserer erfolgte Anfang 2020 mit dem Ziel, eine gemeinsame Strategie zu entwickeln, um Schüler:innen im Alter von 14 bis 19 Jahren auf das spannende und vielfältige Berufsfeld der Geodäsie aufmerksam zu machen. Unter der Federführung des BDVI (Bund der Öffentlich bestellten Vermessungsingenieure e. V.) beteiligen sich aktuell 19 Kooperationspartner an der Initiative. Als Plattform wurde Instagram gewählt, da diese bei jungen Leuten sehr beliebt ist und viel und regelmäßig genutzt wird, um sich zu vernetzen, auszutauschen, zu unterhalten und zu informieren. Als Name des Kanals wurde @weltvermesserer gewählt, der Neugier wecken und auf die Relevanz und die Reichweite der Geodäten anspielen soll.

Ziel der Kampagne ist vor allem, die Geodäsie bekannter zu machen, indem durch interessante, lustige und informative Posts Follower generiert werden. Erst durch die Steigerung der Bekanntheit der Geodäsie ist eine Zunahme an Auszubildenden und Studierenden zu erwarten, denn wer die Geodäsie nicht kennt, berücksichtigt sie bei der Berufswahl nicht.

Die Posts sind hauptsächlich visuell (Bild oder kurze Videos) mit prägnanten kurzen Headlines, die schnell erfasst werden können (siehe Beispiele). Die beauftragte Kreativagentur hat neun Kreativkonzepte entwickelt, die die verschiedenen Themen und Ausrichtungen der Posts auf dem Kanal beschreiben. Somit soll die bestmögliche Ansprache erreicht werden. Diese Konzepte schließen zum Beispiel spannende Fakten, Verrücktes, interaktive Quizze, interessante Geschichten aus dem Berufsalltag und Beispiele für begeisternde Technik ein. Auch werden konkrete Personen vorgestellt, die aus dem Berufsalltag berichten oder von ungewöhnlichen Arbeitsorten auf der ganzen Welt erzählen. Insgesamt werden zunächst allgemeinere und leichtere Themen adressiert, um das Interesse zu wecken. Im weiteren Verlauf werden in praxisnahen Beispielen verschiedene Tätigkeitsfelder und Berufe vorgestellt und später auch komplexere und abstraktere Thematiken mit aufgenommen.

Autorinnen
Tanja Dufek ist wissenschaftliche Mitarbeiterin an der HCU in Hamburg.
Marlene Rybka ist Social Media Managerin beim BDVI in Berlin.
Sonja Riegamer arbeitet bei HUisHU. Digitale Kreativagentur in Hannover.

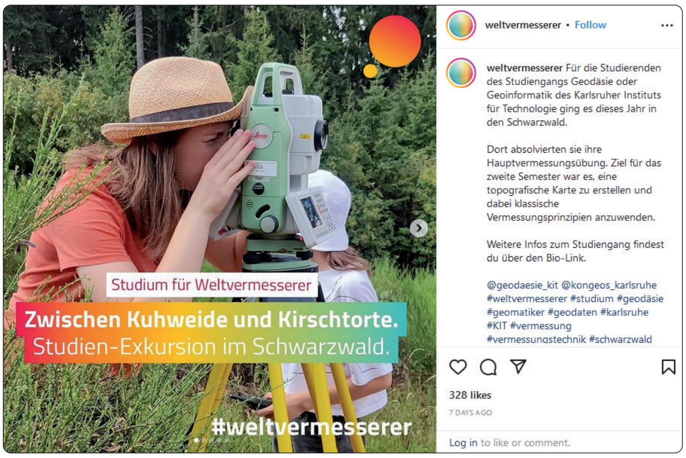
tanja.dufek@hcu-hamburg.de



Die Zielgruppe lässt sich über Hashtags (#) und Verlinkungen (@) erreichen, da diese Reichweite generieren. Instagram-Nutzer können über Hashtags bestimmte Inhalte suchen oder abonnieren. Somit verwendet @weltvermesserer leicht verständliche Hashtags, die von allgemeinem Interesse sind und oft gesucht werden, um Nutzer auf den Kanal aufmerksam zu machen (zum Beispiel #drohne, #studium, #baustelle). Daneben werden aber auch spezifischere Hashtags genutzt, die nicht so oft verwendet werden und somit weniger Konkurrenz bei den angezeigten Suchergebnissen haben, aber auch nur bei bereits spezielleren Suchen verwendet werden (zum Beispiel #geodäsie, #vermessungderwelt, #programmieren).

Aktuell hat der Kanal über 3300 Follower (Stand Februar 2023). Vorrangiges Ziel ist es jedoch nicht, Follower zu generieren, sondern die Zielgruppe soll auf das Informationsangebot auf der Landingpage »Arbeitsplatz Erde« aufmerksam gemacht werden (www.arbeitsplatz-erde.de). Diese wurde entsprechend dem Design des @weltvermesserer-Kanals umgestaltet und bietet ein umfangreiches Informationsangebot zu verschiedenen Themenfeldern der Geodäsie sowie zu Ausbildung und Studium und auch aktuelle Themen. Ursprünglich war die Initiative für drei Jahre ausgelegt. Diese liefen gerade ab, und es wurde beschlossen, die Kampagne um weitere drei Jahre zu verlängern.

Alle Kooperationspartner sind dazu aufgerufen, sich an den Inhalten von @weltvermesserer zu beteiligen und Ideen, Bilder, Videos und Berichte aus dem Berufsalltag beizusteuern. Diese können direkt an die Projektverantwortliche Frau Rybka (socialmedia@bdvi.de) geschickt werden. Darüber hinaus kann jeder Interessierte @weltvermesserer folgen, liken, sharen, kommentieren! //



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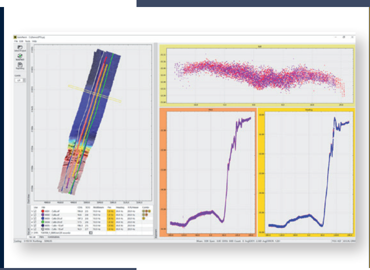

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