The HYDROBALL Project

Crowd Source Bathymetry in Northern Canada

The Hydroball in use in Northern Canada.

by Shelly Leighton

Crowd sourced bathymetry (CSB) is gaining traction on a global scale as a means to supplement hydrographic databases with information collected from vessels of opportunity. These vessels may range from very large cargo ships, medium sized yachts, or the smallest fishing boat. And it is the small skiff used by Northern hunters and fishers that is the focus of one such CSB project – Crowd Source Bathymetry in Northern Canada. What makes this project unique is the main tool – the Hydroball.

The first question one may ask is "What is a Hydroball?" The Hydroball is an all encompassed single beam echosounder, dual frequency GNSS receiver, and inertial measurement unit. It weighs under 13 kilograms and floats gently at the water's surface, despite wave action and turbidity. The system was first developed at the Centre Interdisciplinaire de Développement en Cartographie des Océans (CIDCO) located in Rimouski, Quebec, and designed to collect bathymetric data in turbulent river waters. What makes the Hydroball special for a CSB project is that the system is pre-qualified, meaning there is no vessel installation necessary and the lever arms are known. Since Canada's CSB vision begins with supplementing sparse hydrographic data in the Arctic, the Hydroball CSB project began in Quaqtaq, a small Indigenous community in Nunavik, northern Quebec.

Late September 2017, two researchers from CIDCO brought a Hydroball to the community of Quaqtaq to discuss the technology and the possibility of starting a pilot project there. Quaqtaq is a community of 400 people and is nestled along the eastern shores of Diana Bay. This peninsula protrudes into the Hudson Strait and is an area rich in marine life. Hunting and fishing are mainstays in this community; therefore, engagement was made through the Hunters and Trappers Association (HTA) in order to determine viability of the project with the residents of the town. After a warm reception from the HTA, arrangements were made to discuss the technology with interested locals. Enthusiasm was high during the initial phase and people were eager to assist in the project by providing a vessel and spending some time on the water with the researchers. Unfortunately, by the beginning of October, it was the weather that no longer wanted to participate and the project was put on hold until the spring 2018.

A number of local people were involved in the very first project in Quaqtaq. One local resident was Jimmy-Paul Angatookalook, who captained during one of the training exercises. He is seen with CIDCO researcher Julien Desrochers in Figure 1.

The positive progress that began in Quaqtaq kept motivation high for planning two more pilot projects in other Northern communities. While CIDCO initiated the Hydroball CSB project, thanks to Canada's Ocean Mapping Research and Education Network (COMREN), other educational institutes and researchers were able to contribute greatly to its success in 2018. The Fisheries and Marine Institute (MI), University of New Brunswick (UNB), and York University worked collaboratively with CIDCO to engage communities, process data, and disseminate the final product online. This collaboration also had great support from the Canadian Hydrographic Service, Parks Canada, and other members of COMREN throughout Canada.

Figure 1: Jimmy-Paul Angatookalook (left) and CIDCO researcher Julien Desrochers using the Hydroball in the waters off Quaqtaq.

As the Arctic ice grew thick and polar bears wandered Canada's frozen Arctic shores, researchers and educators from COMREN planned the next two projects to commence in July 2018. While there are many small inlets like Quaqtaq along the Northern coast of Labrador, Quebec, Nunavut, and the Western Arctic, Iqaluit and Gjoa Haven were identified as the next areas to bring the Hydroball. The first step was to identify a local coordinator and individuals who were willing to collect data using their personal boats during the busy summer fishing and hunting seasons. The winter month's planning agenda also included ways to truly engage and motivate residents of the community. A small presentation (in three languages: English, French, and Inuktitut) was created to give context to what the project can do for the community – updated bathymetric information may assist local fishers in finding new fishing areas or habitats for scallops and other shellfish. However, it was also impressed upon the people that their knowledge of the local area is an important aspect to a successful CSB project. Where do they currently fish and hunt? Do they know what the seafloor looks like in that area and has it changed since the time their grandfathers fished there? They were encouraged to take the Hydroball to the areas they hunt and fish and then to areas beyond their beaten path as well. For instance, the Manager of Quaqtaq, Johnny Oovout, was the one to identify areas where people currently travel by boat for hunting and fishing. It is this local knowledge that is imperative if the community is to benefit from hydrographic

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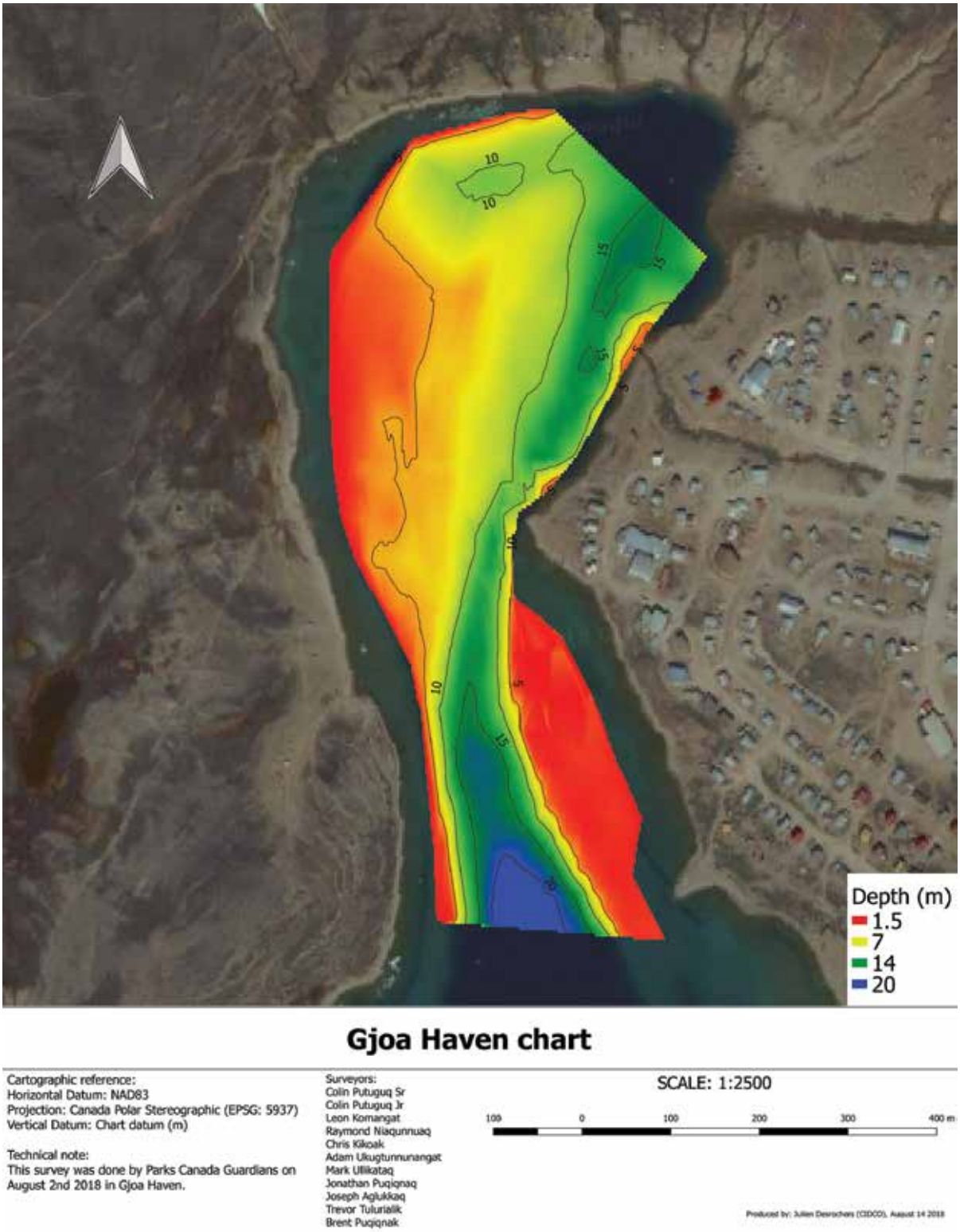
Figure 2: Local residents in Gjoa Haven were interested and engaged in the Hydroball project.

data collection. Mapping an uncharted area may not be useful to a community if they do not travel to the area anyway. The CSB project in the North aims to create meaningful datasets and tie communities to hydrographic processes.

Once areas are identified, the presentation continued to those interested in participating in the project. It included an overview of how the Hydroball works; and how it uses GNSS satellites to position the sounding which will eventually be processed to create a coloured bathymetric model of the seafloor. Suggestions were provided on how to collect the best data: for example, if time permits, it would be helpful to leave the harbour on one track and return using a different track. Any hydrographer will tell you that speed is an important aspect in the bathymetric data collection process. After the trial in Quaqtaq, when the skipper saw a couple ducks on the horizon and decided to make a hurried dash to shoot his supper, a note was added to the presentation regarding keeping survey speeds to 3-4 knots to assist in keeping the Hydroball above water and collecting data.

The first project to kick off in 2018 was in Gjoa Haven – a hamlet on King William Island in Nunavut – towards the end of July where many local residents were interested in getting involved in using the Hydroball (Figure 2). This project was conducted in collaboration with Parks Canada surrounding the training of Park Guardians for a national historic site. Researchers from both CIDCO and MI travelled to the Northern community with the Hydroball in tow. While Park Guardians were being trained to monitor and protect underwater historic sites, they also participated in training with the Hydroball. The Guardians were designated to patrol the area by boat twice a day. Their use of the Hydroball was incorporated into their patrols along with the transit to and from Gjoa Haven.

The first phase of the project was considered successful in Gjoa Haven. Data was collected



Gjoa Haven chart

Cartographic reference:
Horizontal Datum: NAD83
Projection: Canada Polar Stereographic (EPSG: 5937)
Vertical Datum: Chart datum (m)

Technical note:
This survey was done by Parks Canada Guardians on August 2nd 2018 in Gjoa Haven.

Surveyors:
Colin Putuguq Sr
Colin Putuguq Jr
Leon Komangat
Raymond Niaqunnuaq
Chris Kikoak
Adam Ulugtunnunangat
Mark Ullikataq
Jonathan Puqiqnaq
Joseph Aglukkaq
Trevor Tulurialik
Brent Puqiqnak

SCALE: 1:2500

100 0 100 200 300 400 m

Produced by: Julien Desrochers (CIDCO), August 14 2018

Figure 3: A map of the survey area in Gjoa Haven.

and provided to the COMREN network researchers who are looking at ways to process the data to ensure integrity and validate for use by hydrographers and potential navigational safety in the areas. The UNB team along with CIDCO is working on this aspect of the project and has been successful so far in developing processing methodologies and cleaning algorithms for the data collected with the Hydroball. Data downloads and dissemination to the CSB server (York University server) are generally performed by the local coordinator. As Internet access can sometimes be problematic in some remote communities, the local coordinator will ensure the data is sent out once the field work has been completed.

A map of the survey area containing the data collected in Gjoa Haven by the Park Guardians is shown in Figure 3. The Hydroball can collect data in very shallow water, as seen in the map, 1.5 m depth. The maximum working depth for the system is approximately 50 m, so the area covered by the Park Guardians was well within the working limits of the system at 20 m depth. While this map was created to show the results of the survey, York University is working on the creation of an online GIS for the display of the bathymetric data collected so far in the project.

The next phase of 2018 was to bring the project to Iqaluit, the capital city of Nunavut. Alex Flaherty, with Polar Outfitters of Iqaluit, acted as the local coordinator and provided contact with residents who wished to take part in the CSB project. Again, MI and CIDCO researchers conducted an information session and on-water training with the Iqaluit team. The Iqaluit project is also considered a success. Data was collected over a couple of weeks in areas identified locally. Even though it was later in the year (September/October), data was successfully collected.

While completing some on-water training, the outboard motor hit off the bottom, a story most Northern people can tell. This brought home the need for this project to be successful and for the data to be made publicly available.

The project in Northern Canada is, in its essence, a CSB project. To those involved in planning and travelling to the communities, it is equally about successful community engagement. The intention of the COMREN partners, the Canadian Hydrographic Service and other government partners, and the Inuit is to turn this pilot project into a sustainable social enterprise, similar to SmartICE, operating during the open water months. The list of communities willing to participate is growing. ≈

Acknowledgments
This article was written with the help of Kirk Regular from the Marine Institute and Julien Desrochers of Centre Interdisciplinaire de Développement en Cartographie des Océans. They were the boots on the tundra for the CSB in the North during 2018.

Shelly Leighton has spent a number of years working in the offshore oil and gas industry as well as on heavy civil projects in Newfoundland and Labrador. She has worked as an offshore surveyor, data processor, and project manager for construction support projects worldwide. Ms. Leighton graduated from Memorial University with her Masters in Oil and Gas Engineering and a Bachelor of Science and Engineering in Geodesy and Geomatics from the University of New Brunswick. As well as being an instructor with the School of Ocean Technology's Ocean Mapping program at the Fisheries and Marine Institute, she is a Commissioned Canada Lands Surveyor and is involved in a number of initiatives with the Association of Canada Lands Surveyors (ACLS). She has a keen interest in unmanned aerial vehicles for surveying and mapping as an emerging technology and, as a member of the ACLS Offshore Committee, she enjoys being involved in the development of Canada's lands.