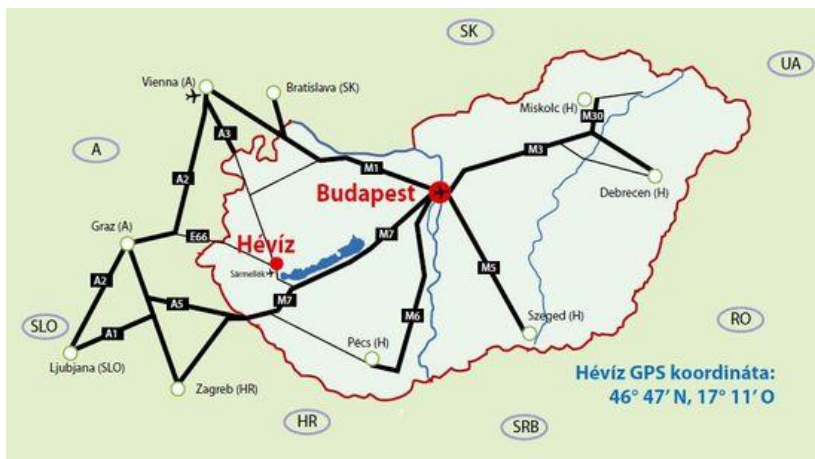

Application of a new, cost effective multibeam
echosounder for
bathymetric survey of Lake Héviz

The survey-site

Lake Hévíz (Lake Héviz) is located in Hévíz, Hungary, near the western end of Lake Balaton Lake.

It is the **largest thermal lake in the world which is available for swimming** (47,500 square metres (511,286 sq ft) in area). The flow of water is very strong and the water in the lake is completely replenished every 72 hours. Its minimum depth is 2 meters, reaching a maximum depth of 38 meters, exactly at the point where the hot thermal water comes out to the surface.

(Source: https://en.wikipedia.org/wiki/Lake_H%C3%A9v%C3%ADz)

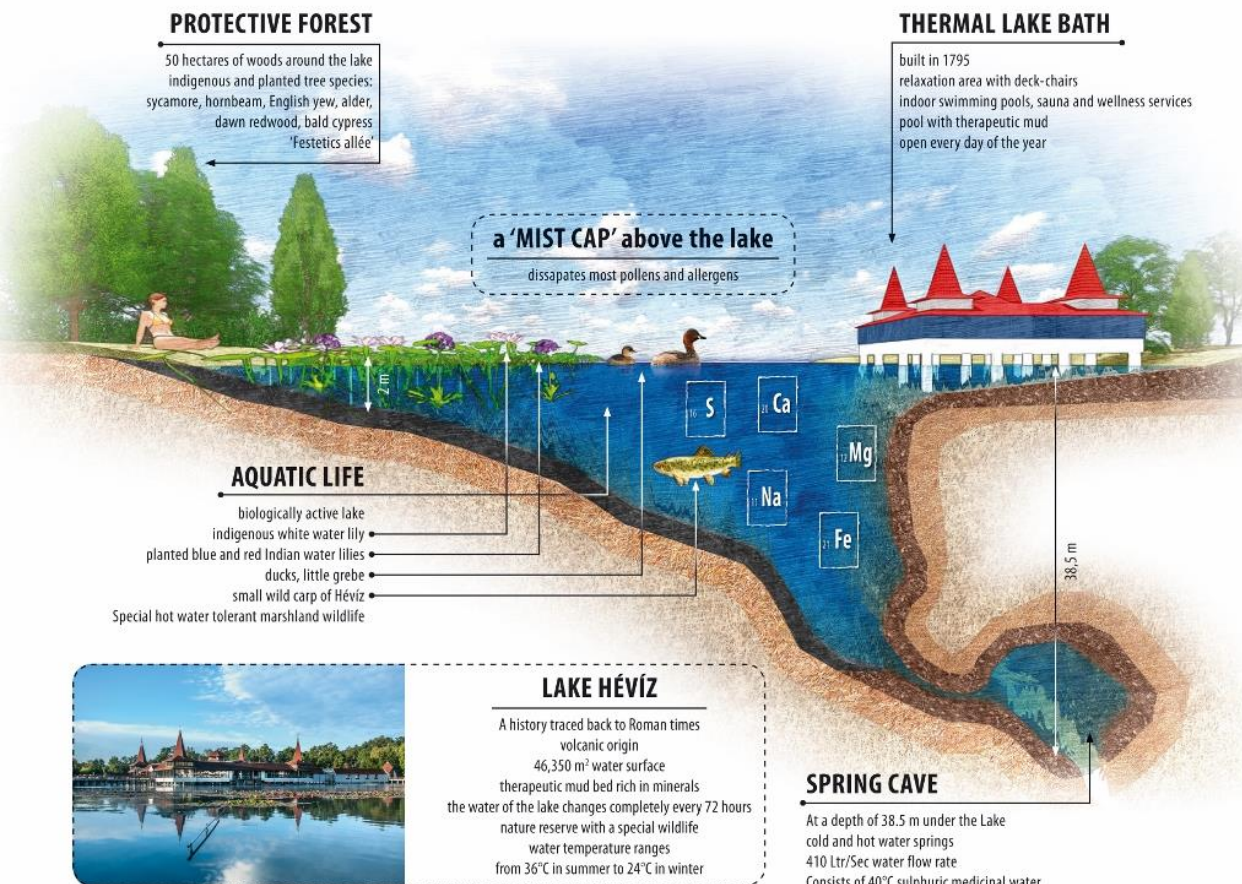


The survey-site

In **1953** the first divers reached the bottom but couldn't enter the inside of the spring crater. In **1972** two divers **discovered** a narrow gap at the bottom of the lake, 60-80 cm high and 2-3 m wide, which turned out to be the entrance to the **spring-cave**.

Finally, in **1975** István Plózer and his team entered this narrow gap where they had to fight against **39,5 °C** heat and a strong current of **30-40 thousand** of liters of water. After this narrow gap they found a cave of 17 meters of diameter. There they found the secret of Hévíz, two springs. On the eastern side they found a colder spring (26,3°C), and on the western, a hot spring (41°C). The amount of the hot water is 9 times bigger than the discharge of the cold spring, so when they mix, the resulting temperature will be 39,5 °C.

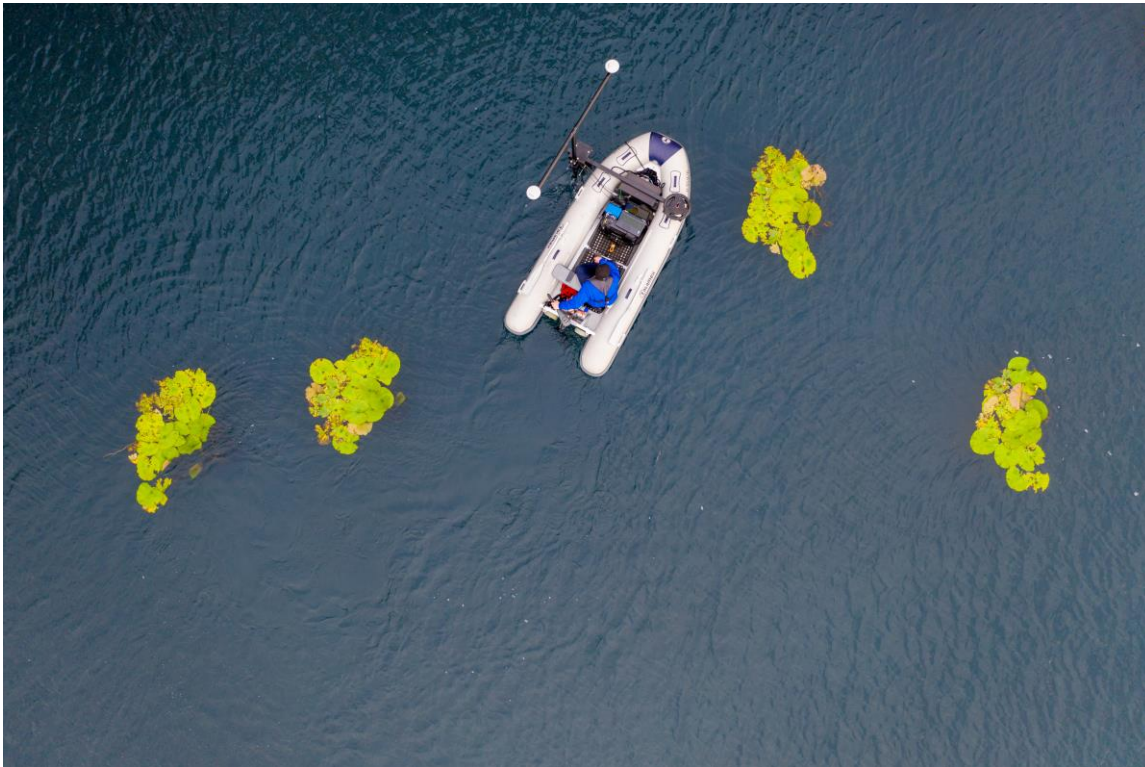
(Source: <https://waterfire.fas.is/Hungary/Heviz.php>)



The survey-site

The fauna and flora (dominated by water lily) are unique in Lake Hévíz due to the temperature and chemical composition of the water, contains **carbonic acid, calcium, magnesium, hydrogen carbonate, reduced sulfuric compounds as well as oxygen** in solution. Several species so far can be found only in this lake.

(Source: https://en.wikipedia.org/wiki/Lake_H%C3%A9v%C3%ADz)



The survey-site

More than **150 years** Lake Hévíz is a well known **balneological site** (later spa), - due the chemical composition and the temperature of the water. Internet is full of old and even older postcards to document this.

1898



1955



1985



1908



Task



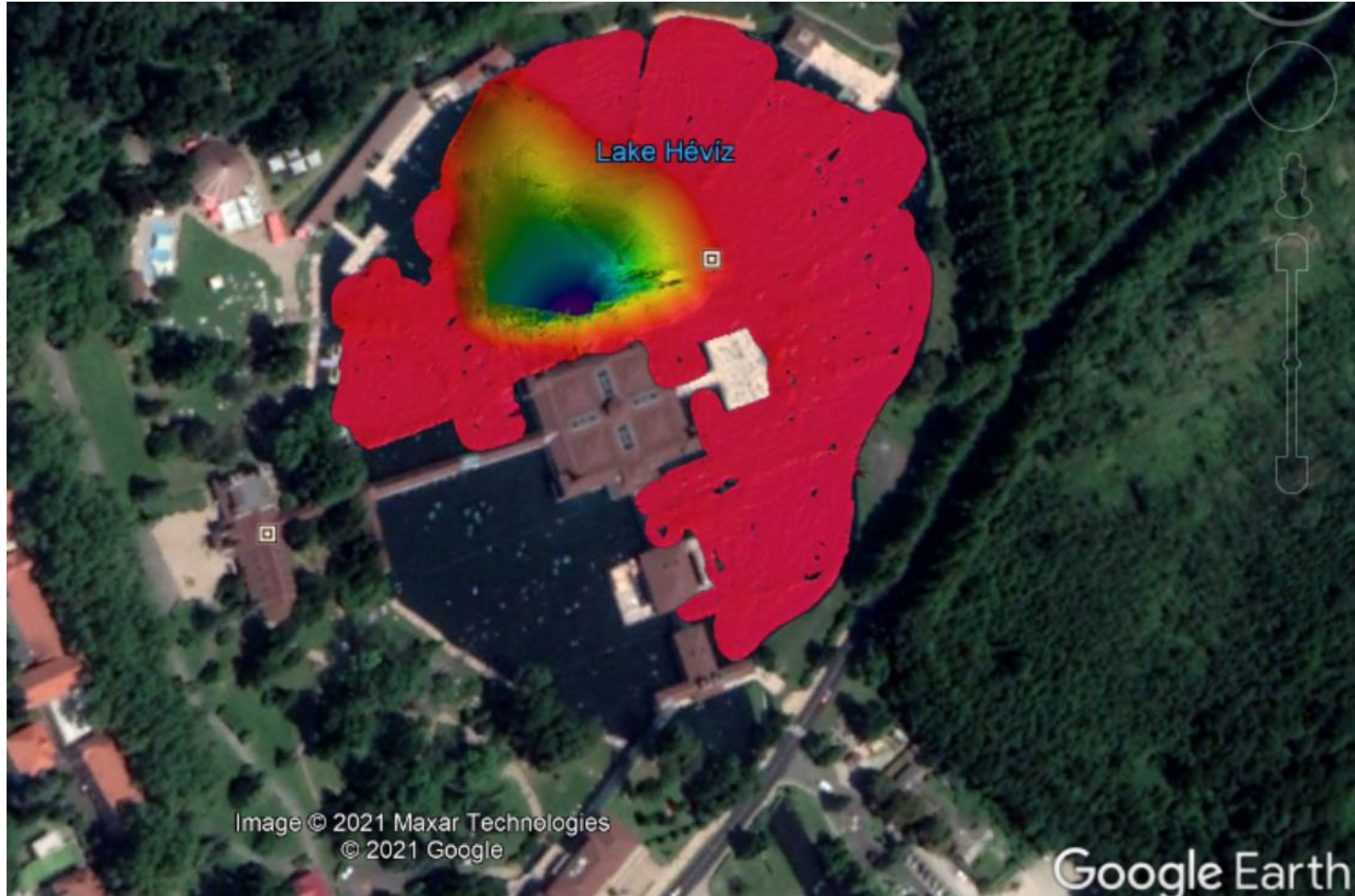
As you can see earlier, Lake Héviz is a very interesting site from hydrological, geological, bathymetrical and balneological point of view. However,

- due the challenges of the lake (depth, temperature, strong water stream from the spring cave),
- the very high number of spa visitors and
- the local restrictions (boat traffic in spa opening times is not allowed),

only limited scuba dives happened, and bathymetric survey was limited for a simple, single beam echosounder (SBES) survey long time ago.

However, a consequence of COVID19 pandemic was the lock down of the Lake Héviz Spa from mid-November 2020. Therefore, local researchers had a chance for detailed underwater research and approached us to help them with a detailed bathymetric survey.

Task



Finally, on 21st February 2021 – on a cold, but sunny day – we surveyed 3/4th of the lake with a multibeam echo sounder (MBES) first time in the history.

The used equipment



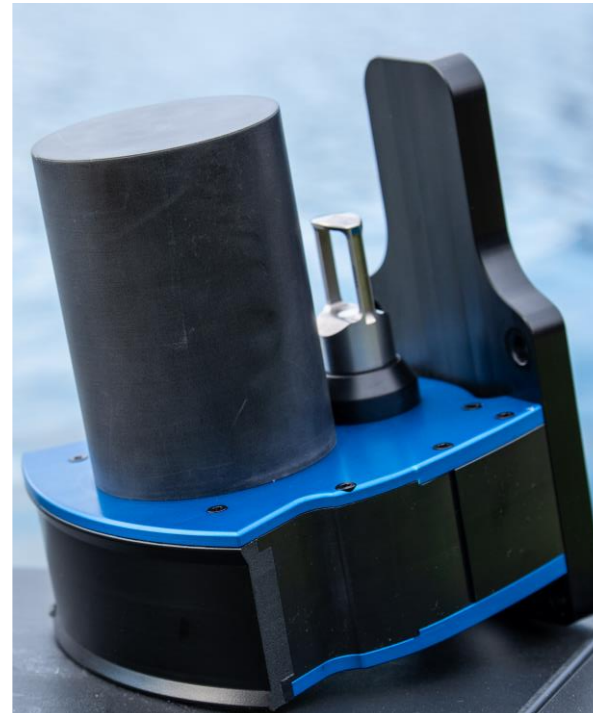
Baywei M5 is a versatile, high-resolution multibeam echo sounder, which is also extremely simple to install and use. The tightly coupled GNSS/INS makes it easy to integrate even on ultra-small vehicles (including USVs) and very quick to mobilize. Its hydrodynamic form factor and its low power consumption make it the perfect choice for small autonomous surface vehicles.

This **cost-effective MBES** was built around market leaders' components using the highest design, integration, and assembling standards. The system includes not only an integrated SVP, but also a simple Data Collection Utility Software.

Baywei M5 specifications



Swath coverage	Up to 130 degrees
Number of RX beams	256
TX beam width along-track	1.45° @550kHz
RX beam width	1° ±0.1 @550kHz
Range 550 kHz	100m @550kHz
Beam distribution	Equi-Distant and Equi-angular beam distribution
Roll stabilisation	Yes
Pressure rating	100m
GNSS/INS	INS in Sonar
Position	HOR: ±(8mm +1ppm X Distance from RTK Station) VER: ±(15mm +1ppm X Distance from RTK Station) (Assumes 1m GNSS Separation)
Heading Accuracy	0.08° (RTK) with 2m Antenna Separation
Pitch/Roll Accuracy	0.03° Independent of Antenna Separation
Heave Accuracy	2cm or 2% (TRUEHEAVE™). 5cm or 5% (Real Time)
Ping Rate	50 Hz
Outputs	Bathymetry, Side Scan
Compatible with	Qinsy, Hypack, EIVA and others



Installation



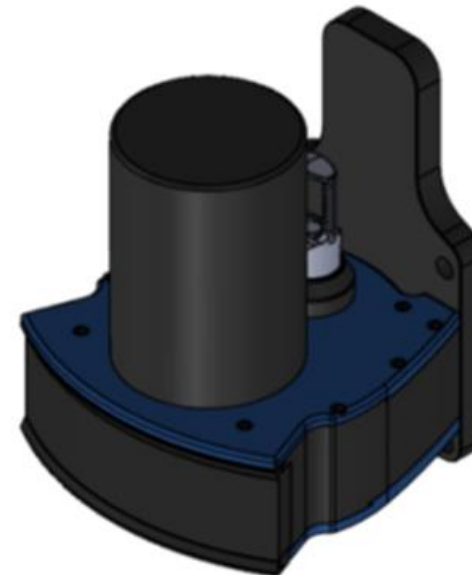
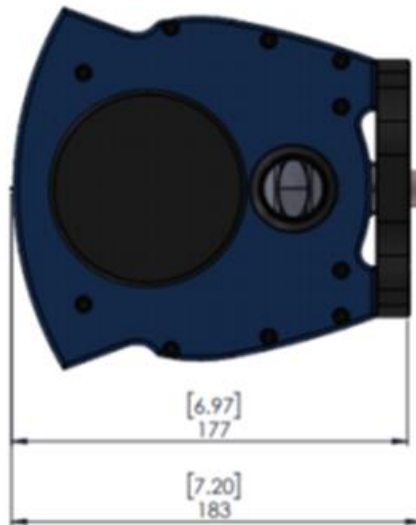
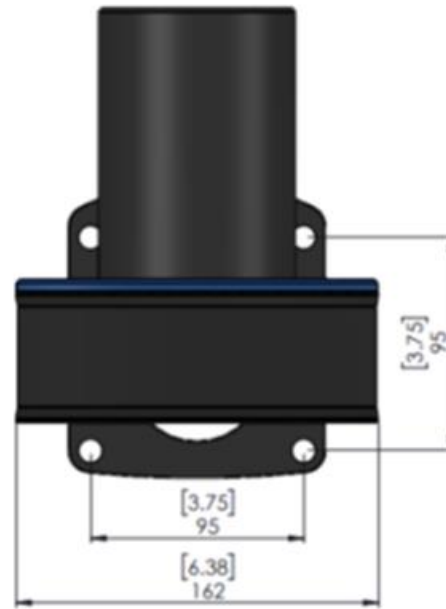
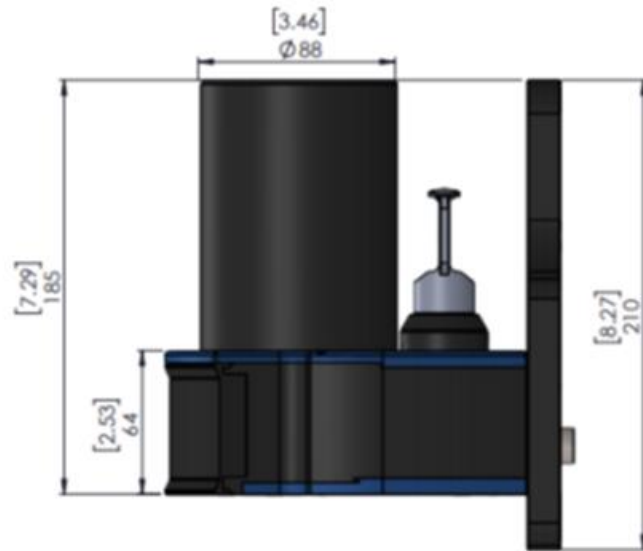
Due local restrictions we used a small electric engine driven 3.5 m (11.5 ft) inflatable boat. The engine used its own battery.

On such a small survey platform Baywei M5 was an ideal solution, - as it is a small and lightweight multibeam echosounder, with the GNSS/INS and the SVP integrated.

For M5 MBES a sinusoidal power inverter generated 230VAC from a 100Ah (12VDC) work battery. The laptop we used operated from its internal battery.

We placed the two GNSS-antenna and the sonar on a T-pole/Console over the side.

Installation



Material		Baywei
-		
Surface finish		Baywei
-		
General tolerance	Weight (g)	Baywei
-		
Baywei M5 & M2 Outline drawing - for public use		

Bathymetric Survey and Data Processing



For high accuracy 3D positioning and heading data we used the “RTK on 4G” correction services of GNSS.HU

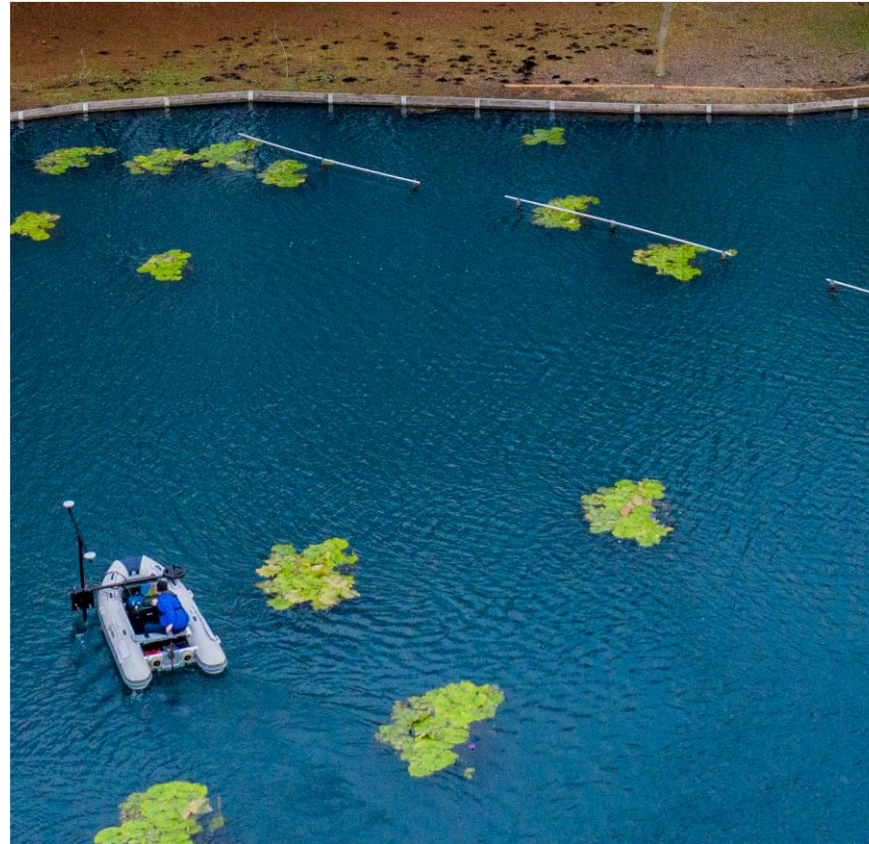
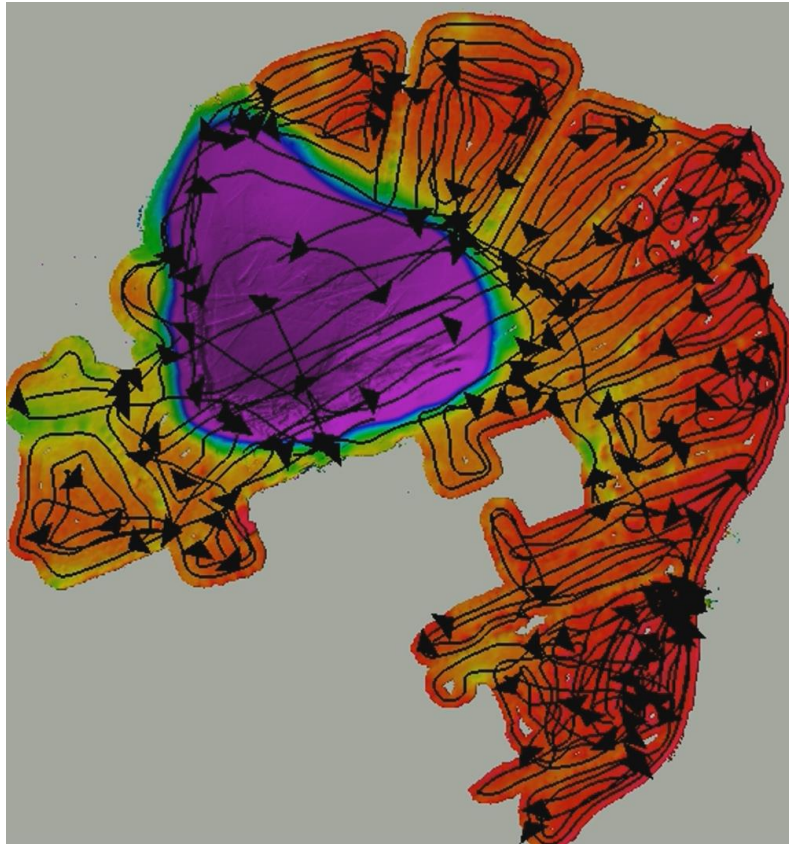
Even in this challenging environment we used only the standard setup parameter set of Baywei Graphical User Interface. Survey was controlled from the Baywei Data Collection Utility Application.

The whole system installation and bathymetric survey took half day.

For post processing we applied Qimera’s QPS



Bathymetric Survey and Data Processing

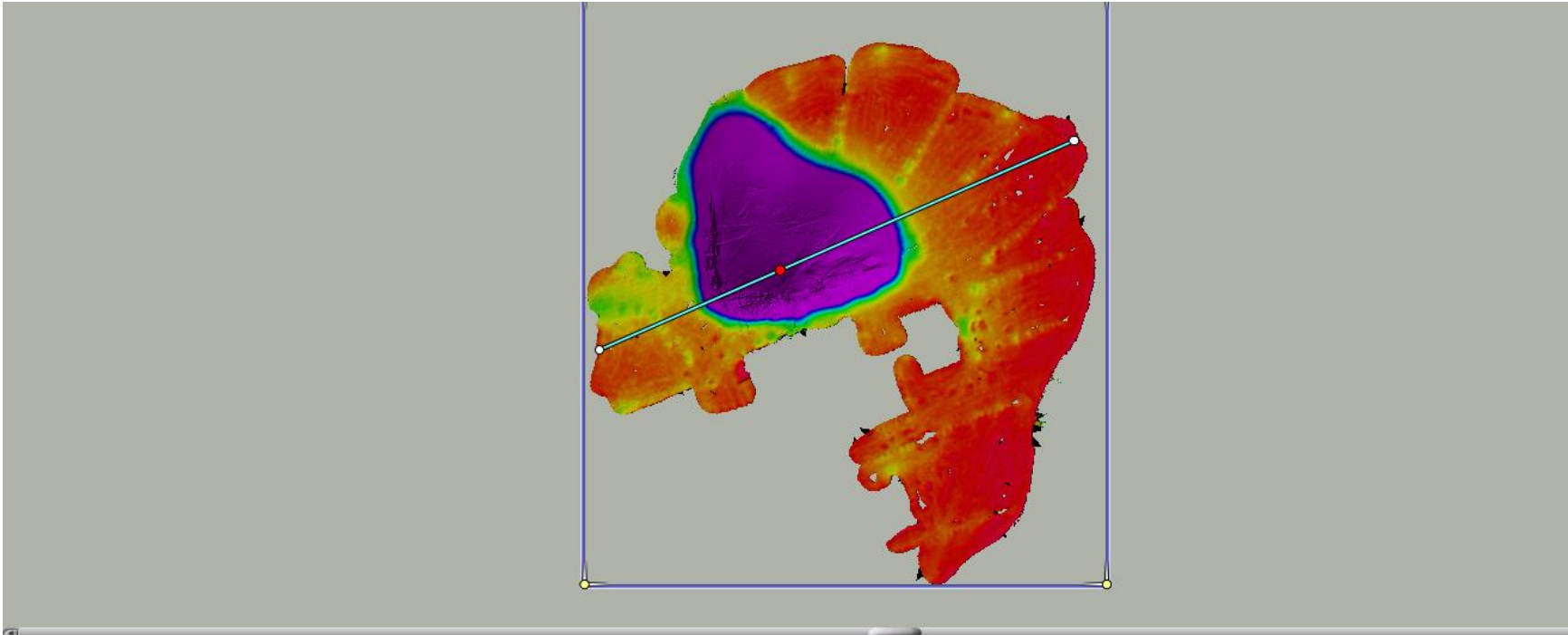


As a good 3/4th of the lake is extremely shallow (0.5 – 2.0 m) we need to place the survey tracks extremely close to each other in those areas.

Anyone running a bathymetric survey with MBES try to run parallel lines. In this project however this was simply impossible!

Due the water lily groups and the long bars (used as handrails by the resting patients), the whole survey was sailed with continuous maneuvering!

Results – Cross section



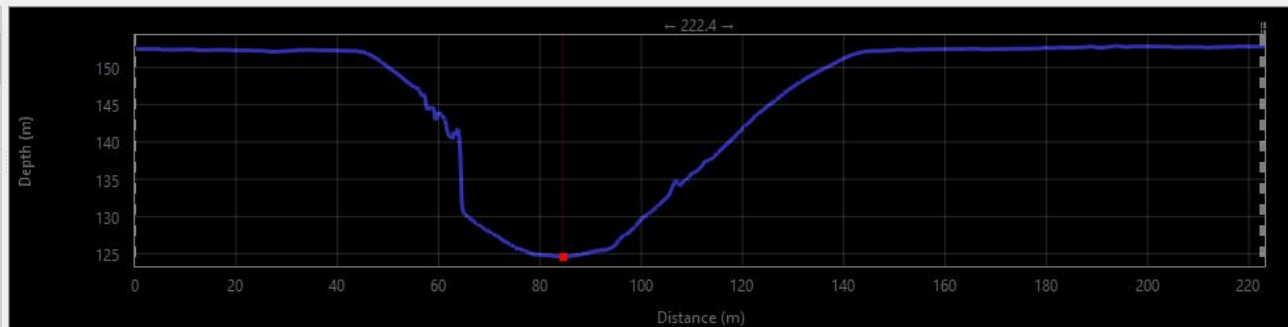
Profile



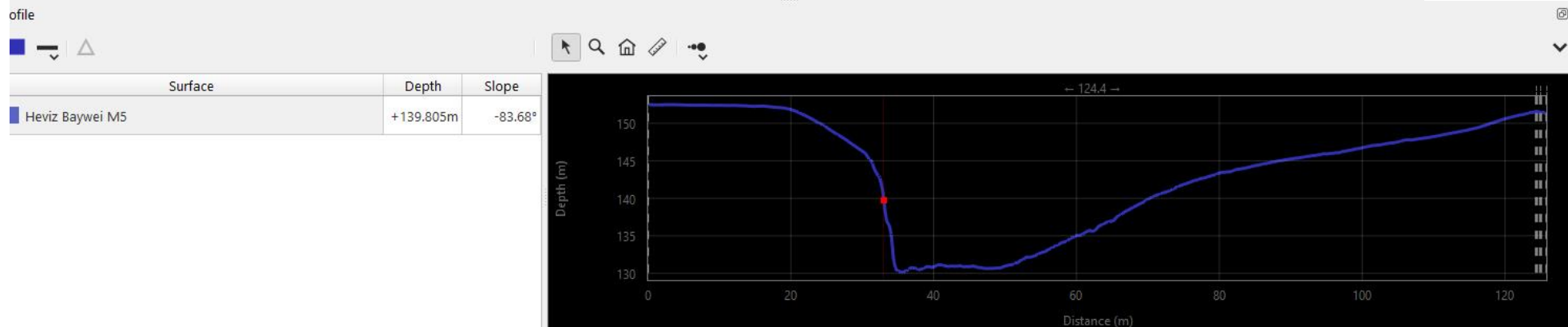
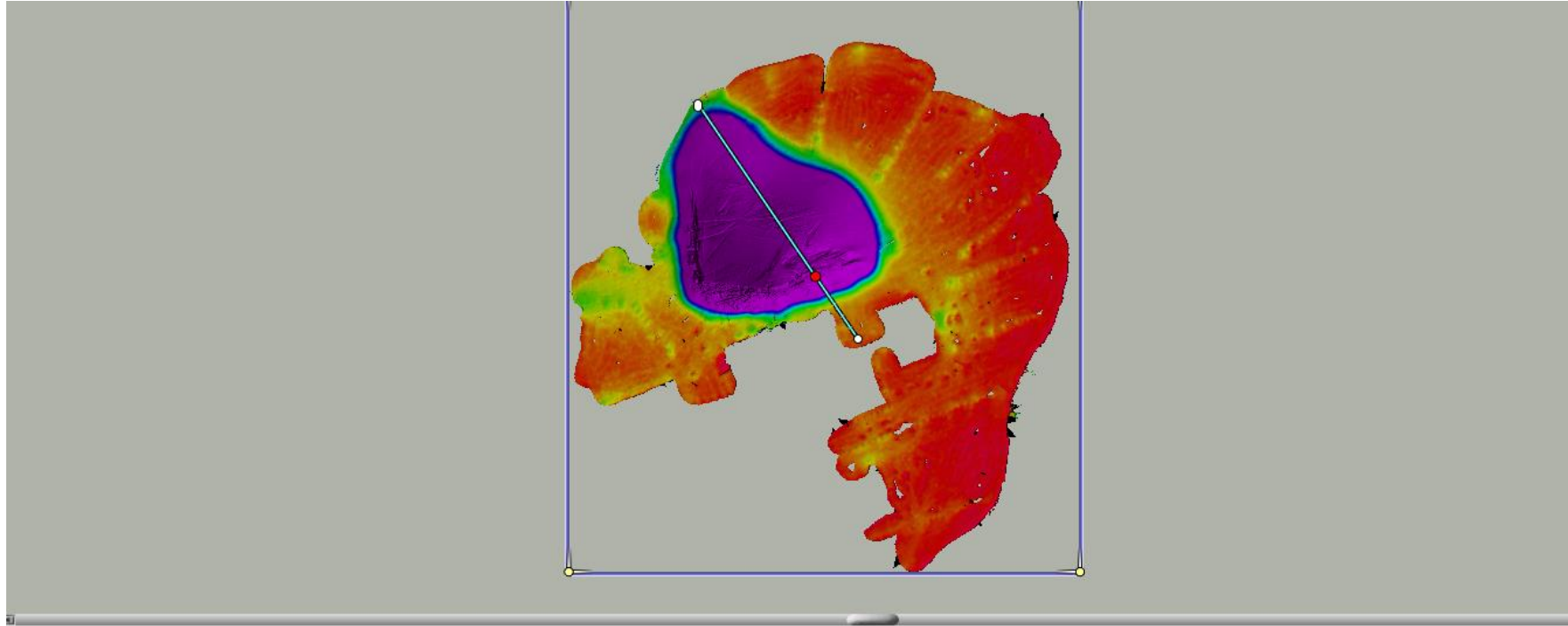
@ 8



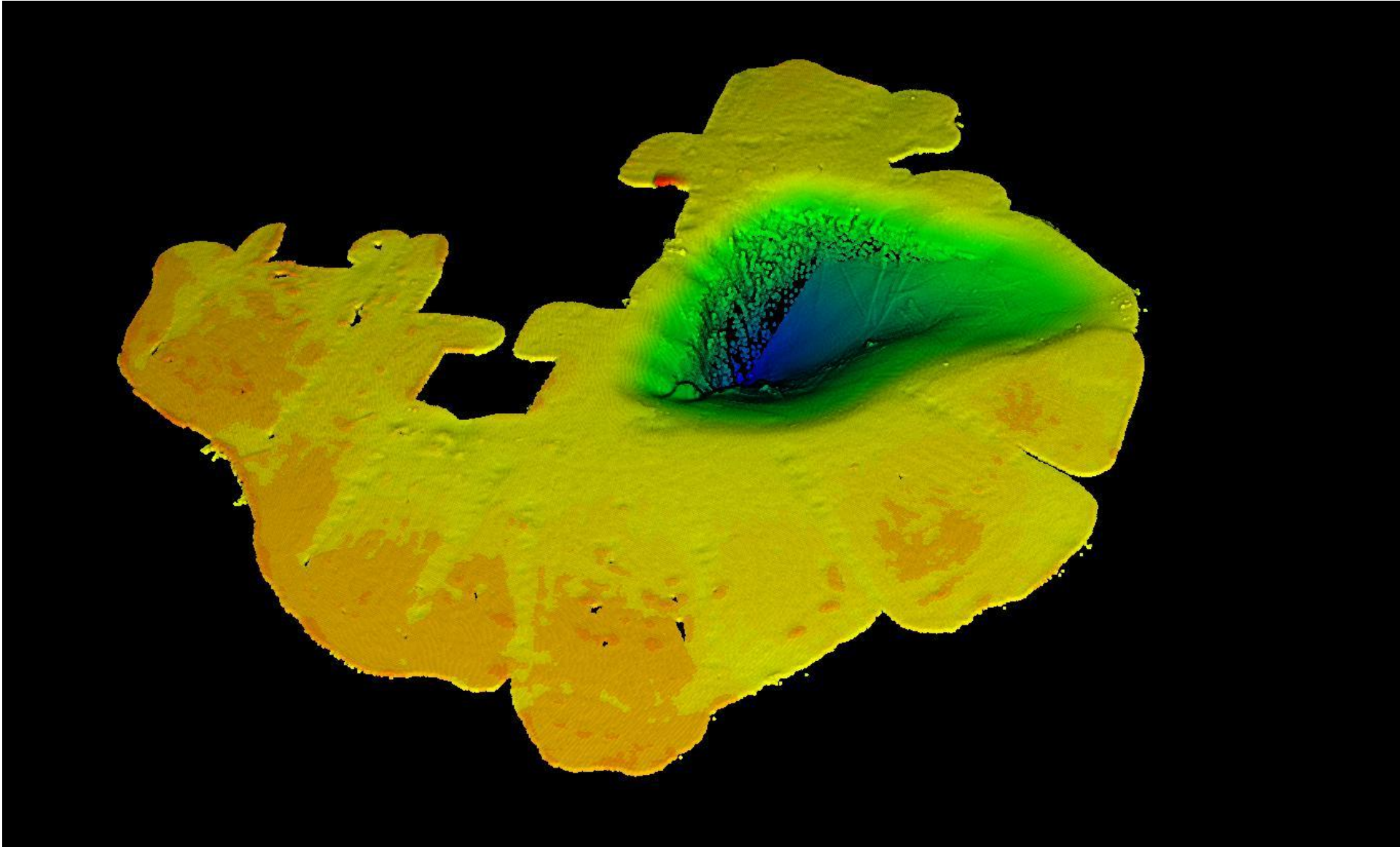
Surface	Depth	Slope
Heviz Baywei M5	+124.609m	+12.19°



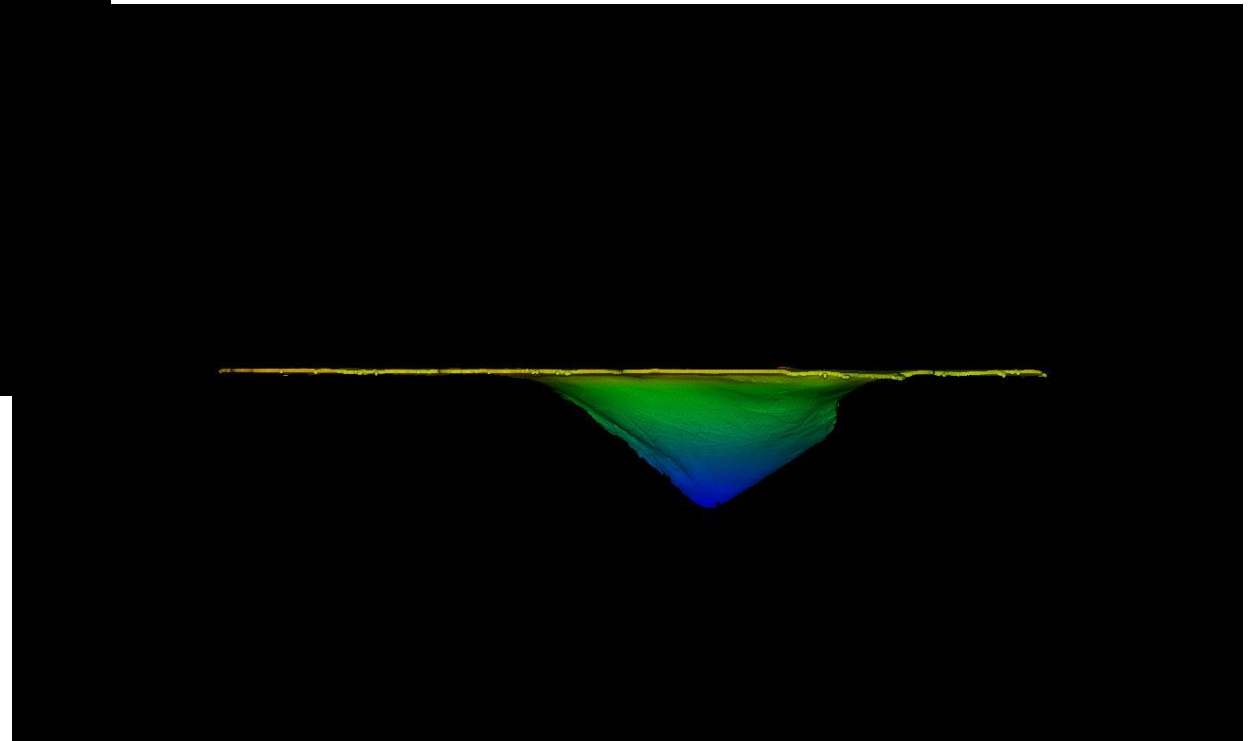
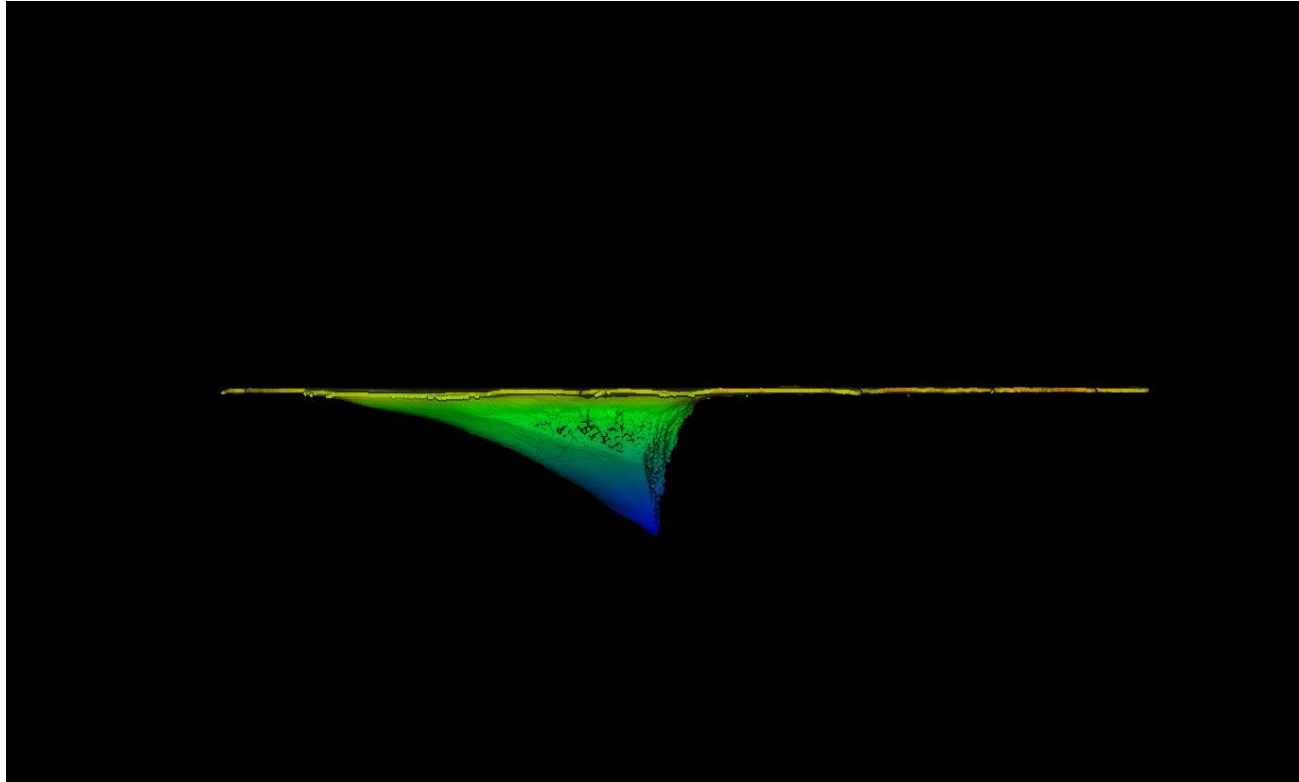
Results – Cross section



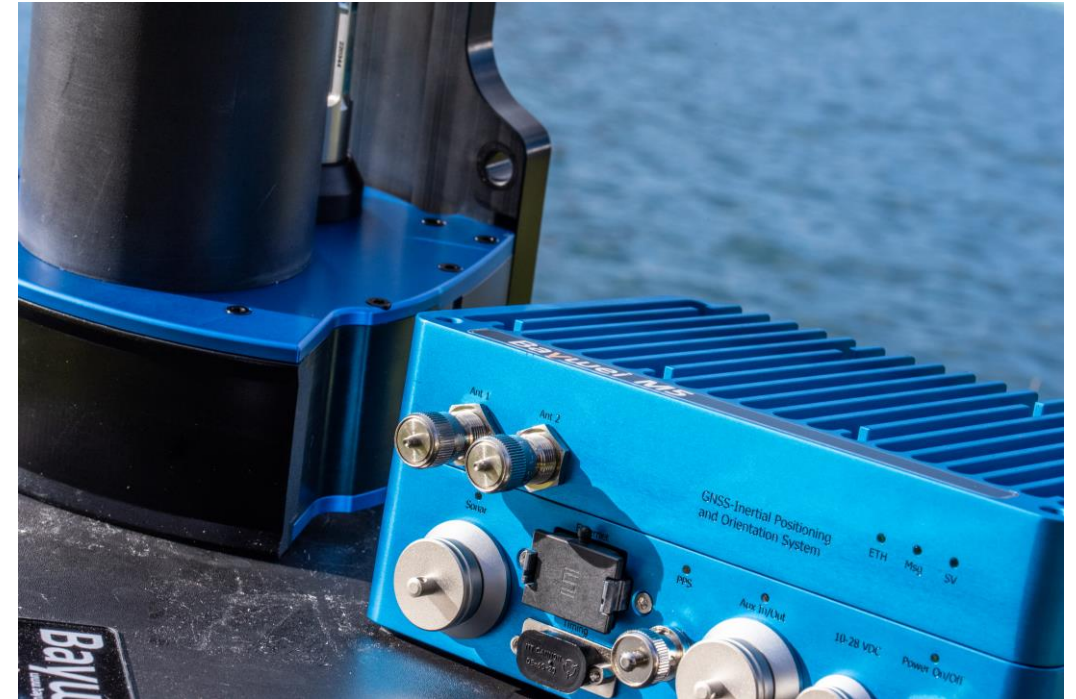
Results – 3D views



Results – 3D views



Questions?
Please contact us!



SALES: sales@bayweisonar.com

SUPPORT: support@bayweisonar.com