



HD-MAX Assisted ADCP in Measuring the High-sand Content River with **High Accuracy**

“The low-frequency sound wave (24kHz) of the HD-MAX dual-frequency echo sounder has good penetration. In turbid waters with sand content up to 73.1kg/m^3 , the HD-MAX's stable echoes accurately detect the topography of the water bottom, providing stable bottom tracking information for ADCP discharge measurement.”

The challenge: high sand content and high current velocity

Hi-Target's hydrographic equipment has done a challenging job in the Yellow River basin. The middle reaches of the Yellow River flow through the Loess Plateau, and the tributaries bring large amounts of sediment to the Yellow River, making it the most sediment-rich river in the world. Our task was to conduct a hydrological information survey of the flood season for the Huayuankou station - the first station where the Yellow River enters the downstream plain.

Huayuankou hydrological station was established in July 1937 and is the most important water and sand control station of the mainstream of the Yellow River.

The river during the flood season brings a lot of sediment from the upper reaches of the Yellow River. Although the sand content, velocity, and flow rate of the river at the hydrological station are greatly increased, which makes this measurement work more difficult, the hydrological information of high water levels can further enrich the hydrological data of the hydrological station, which

is important for the management of the whole Yellow River basin. Therefore, when the flood season arrives, the hydrological station conducts more intensive flow tests depending on the water conditions.

Solutions: with HD-MAX, HiMAX Sounder and iFlow RP600

An iFlow RP600

In the past, the hydrological station usually used the conventional flow meter method to measure the discharge in high sand content and high current velocity conditions. The technical process has been well developed, but there are still some existing some problems, for example, each measurement takes a long time, the measurement method is complicated. and the requirements for the measured section are strict, etc.

ADCP discharge measurement equipment can be used to survey the discharge easier and quickly. We chose iFlow RP600 ADCP to complete this survey, and another trimaran as the carrier of ADCP. The ADCP was installed on the trimaran while the dual-frequency transducer of the HD-MAX was installed in the front of the trimaran, and the distance between the transducer and the trimaran was reduced as much as possible.



The Conventional Flow Metering Method **FIG1**



FIG2

HD-MAX Dual-frequency Echo Sounder

According to previous measurement experience, when the sand content is $1\sim3\text{kg/m}^3$, the effective measurement profile of ADCP will be reduced to about half of the nominal measurement profile range. Due to the large sand content of the Yellow River, the high-frequency sound wave required for ADCP bathymetry is difficult to propagate in the water, so ADCP cannot measure the bottom tracking information alone under this condition.



FIG3

We knew that the low-frequency acoustic signal at 24kHz has stronger penetration, and the HD-MAX dual-frequency echo sounder has both 200kHz and 24kHz frequencies, so we decided to use the bathymetry data measured by HD-MAX in this measurement to supplement the lost bathymetry data in the ADCP bottom tracking information.

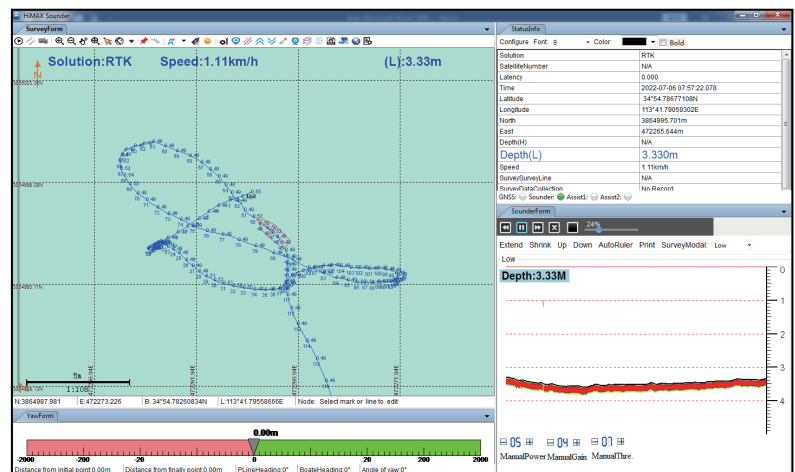
HiMAX Sounder Software

We completed the logging of bathymetry and discharge data on the HD-MAX and ran the HiMAX Sounder software and iFlow discharge measurement software on the HD-MAX simultaneously, in which HiMAX Sounder can output the bathymetry data in real-time. By setting the output serial port and output format, we can input the measured depth data to the iFlow in real-time.

Stable surveying, the real-time output of bathymetric data.

On July 6, 2022, the sand content of the hydrographic station reached a high of 73.1kg/m^3 .

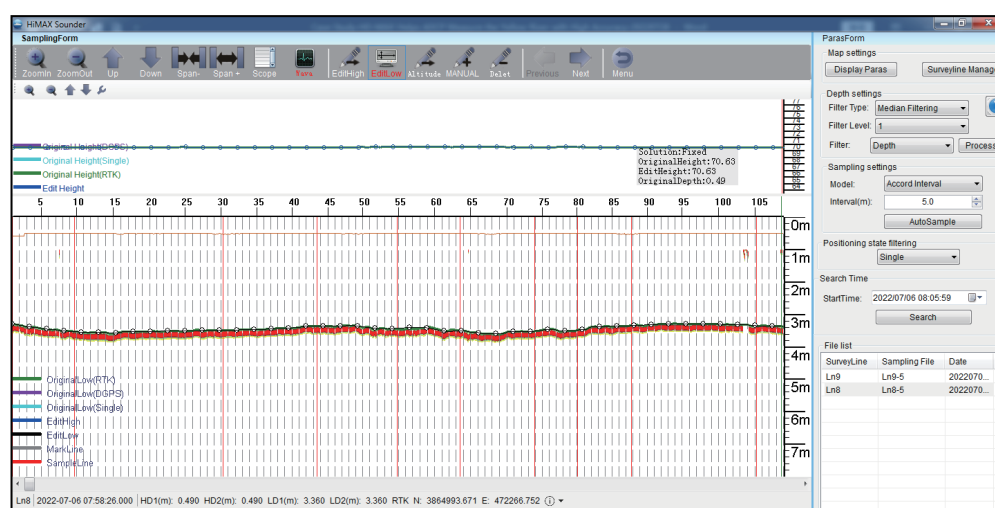
On July 8, 2022, the average current velocity of the section reached $1.3\sim2\text{m/s}$, the sand content decreased to 33.3kg/m^3 , and the maximum water depth of the section reached 5 m.



Sand Content Up to 73.1kg/m^3 FIG4

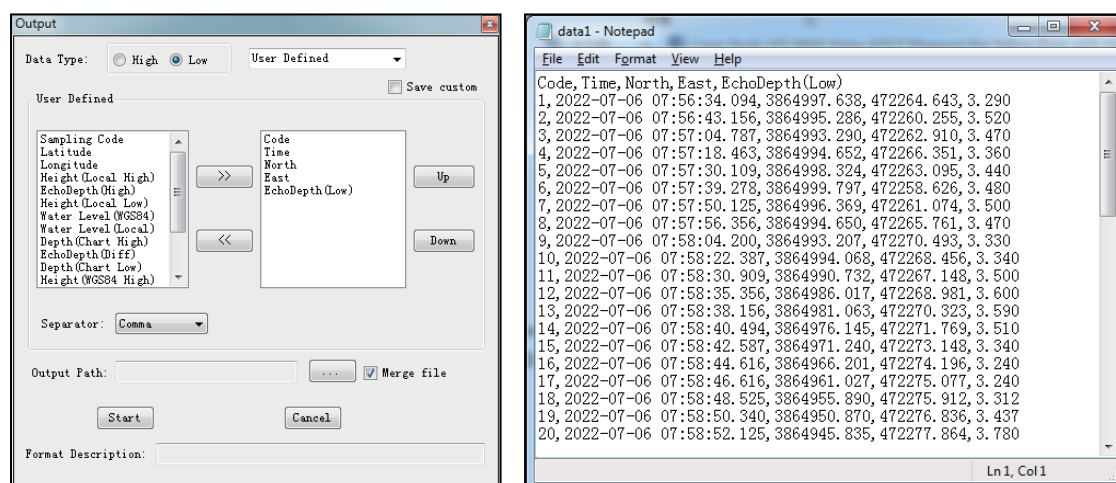
Under such high sand content, the high-frequency sound wave failed and the bottom tracking measurement could not be carried out by ADCP. However, the HD-MAX low-frequency sound wave had a strong penetrating ability, in the case of high sand content up to 73.1kg/m^3 , the low-frequency echo was still very stable.

HiMAX Sounder software also featured the data processing function. Data processing supported not only median filtering, weighted average filtering, and statistical filtering to handle wrong depth points but also sampling by distance, by time, and by depth interval. Users were free to choose acceptable accuracy when processing positioning data, including single solution, DGPS solution and fix solution.



Data processing FIG5

Let's take a look at the data we collected on July 6. HiMAX Sounder can export the data items that users want, and here we exported the coordinates and the echo depth of low frequency.

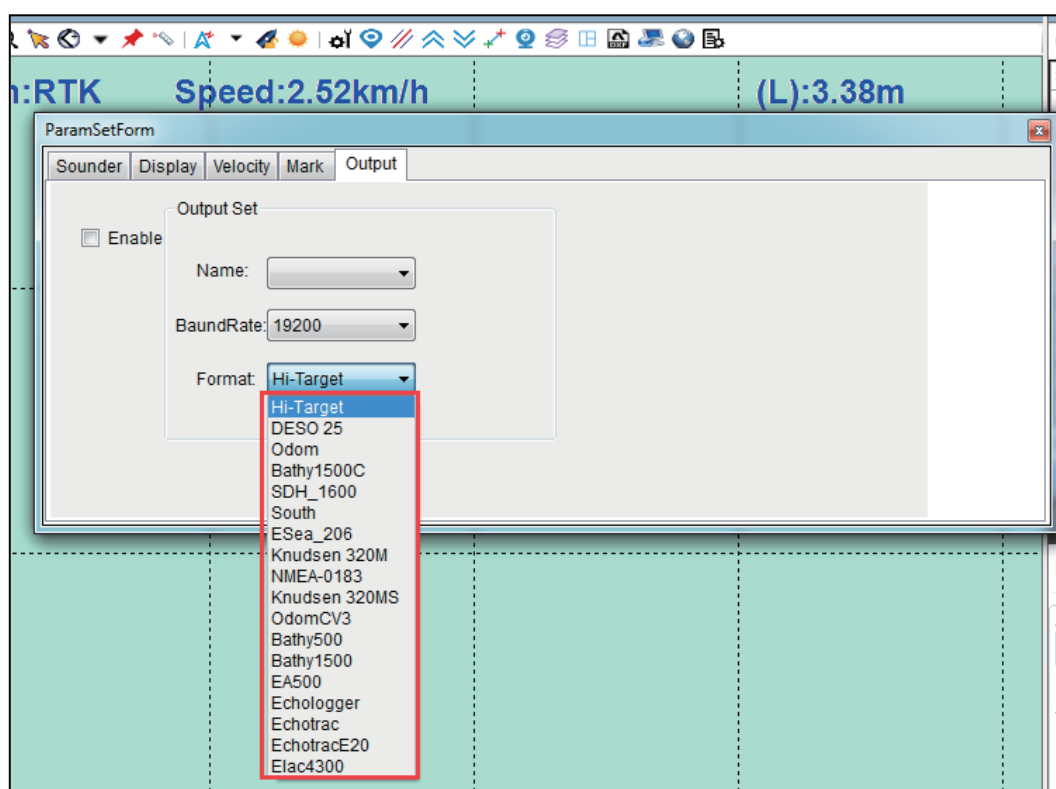


Data Export FIG6

Conclusion

HD-MAX dual-frequency echo sounder measured high accuracy and was suitable for various environments, and performed very well in turbid waters with a sand content of 73.1kg/m³ within 5 m.

Powerful HiMAX Sounder software can output the bathymetry data in real-time, and rich data formats were available, which greatly widened the opportunity for cooperation between HD-MAX and other hydrographic equipment.



Various Output Formats FIG7

Product Overview

HD-MAX dual-frequency echo sounder can be applied widely to sediment measurement for dredging, bathymetry in high sediment content water, and other depth measurement projects in shallow, deep, or much deeper water. The full-featured HiMAX Sounder hydrographic software integrates bathymetry, navigation, and post-processing. Moreover, equipped with a 17" large screen and industrial computer platform, HD-MAX offers a set of reliable solutions for hydrographic offices around the world with a robust dual-frequency transducer and a user-friendly survey pole.

- **Tracking of the Seabed.** Taking advantage of the high energy of low-frequency sound waves and low attenuation in the water, HD-MAX is capable of tracking the seabed.
- **Turbid Water with High Sand Content.** HD-MAX can be easily operated in water with a high sand content of 3~35kg/m³. Low-frequency sound waves allow HD-MAX to penetrate a large amount of sand in the river to obtain the underwater topography.
- **Measurement at High Speed.** HD-MAX supports measurement at high speed with the highest ping rate of 30 Hz. Under the condition of the measurement vessel reaching the full speed of 10.6 knots and the depth of water is 10~40 m, the echoes received by HD-MAX are stable and there are no secondary echoes or spurious echoes.



HD-MAX Dual-frequency Echo Sounder (FIG8)

The iFlow RP series direct-reading Acoustic Doppler Current Profiler (ADCP) is an accurate and easy-to-use current profiling system, which can be deployed on the flexible platform: trimaran, USV, buoys, seafloor mounting, and so on. Providing accurate measurement with a 75m/25m range, the iFlow RP600/1200 can be widely used for monitoring and surveying the discharge of rivers, canals, offshore, and other engineering projects.



iFlow RP600 & 1200 (FIG9)



More information at <https://en.hi-target.com.cn/become-our-partner/>

About Hi-Target

Established in 1999, Hi-Target is the first professional high-precision surveying and mapping instrument brand to be successfully listed in China. Hi-Target provides a wide range of surveying equipment including GNSS Receivers, CORS Stations, Total Station, 3D Laser Scanners, GIS Data Collectors, UAV/UAS, and Hydrographic Products to offer complete solutions for various industries. As the leading brand in the geospatial industry, Hi-Target invests heavily to bring the latest positioning technology and innovation.

For over 20 years, Hi-Target has had approximately 3,300 employees worldwide, with a network of 28 subsidiaries, 28 branches, and more than 200 partners in over 60 countries to service and support our customers.

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