SLHydro USV Software User Manual

Manual Revision

Revision Date	Revision Level	Description
May, 2025	3.0.8	SLHydro USV Software User Manual V3.0.8
Nov., 2024	3.0.7	SLHydro USV Software User Manual V3.0.7
Aug., 2024	3.0.6	SLHydro USV Software User Manual V3.0.6
May, 2024	3.0.4	SLHydro USV Software User Manual V3.0.4
March, 2024	3.0.2	SLHydro USV Software User Manual V3.0.2

Version Description

May 2025

Applicable USVs: HydroBoat 990, HydroBoat 1200, HydroBoat 1500

Applicable versions: SLHydro USV software version 3.0.8, firmware version 1.0.9

Update Points:

1. On the SingleBeam Survey page added water depth indicator, now supports the display of survey line color based on water depth
2. On the Diff Set page added a new PPP switch, now you can turn on/off the PPP function.
3. On the echo settings page added Sound Velocity calculation function, supports calculations by temperature or compare.
4. On the Other Set-Config page added the Distance of Boat option, which shows the distance from the controller to the USV
5. On the Layer management page added display/hide function for survey line and track line layers.
6. In the Manual Mode removed the Hovering feature, now the Hovering switch will only work in auto mode.

Preface

Introduction

Welcome to the SLHydro USV Software User Manual. This introduction describes how to use this product.

Experience Requirement

In order to help you use SatLab series' product better, we suggest you carefully read the instructions. If you are unfamiliar with the products, please refer to http://www.Satlab.com.se/

Tips for Safe Uses

Notice: The contents here are special operations and need your special attention. Please read them carefully.

Warning: The contents here are very important. Wrong operation may damage the machine, lose data, break the system and endanger your safety.

Exclusions

Before using the product, please read these operating instructions carefully: they will help you to use it better. SatLab Surveying Instrument Co., Ltd assumes no responsibility if you fail to operate the product according to the instructions, or operate it wrongly due to misunderstanding the instructions.

SatLab is committed to constantly perfecting product functions and performance, improving service quality and we reserve the right to change these operating instructions without notice.

We have checked the contents of the instructions the software and hardware, without eliminating the possibility of error. The pictures in the operating instructions are for reference only. In case of non-conformity with products, the products shall prevail.

Technology and Service

If you have any technical issues, please call SatLab's technology department for help.

Relevant Information

You can obtain this introduction by:

Logging onto the SatLab official website, downloading the electronic version introduction at "Download center" - "Partners" - "Partner center".

Advice

If you have any comments and suggestions for this product, please email info@Satlab.com.se. Your feedback will help us to improve the product and service.

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Chapter 1

Software Introduction

This chapter contains:

-Software Overview

-Technical Parameters

-Installation and Uninstallation

-Startup Screen

-About

-Exit

1.1 Software Overview

This software is SLHydro USV software. The software is mainly used for underwater topographic surveys. And the software can connect to GNSS positioning data, heading data, single-beam sounder data and Acoustic Doppler Current Profiler (ADCP) data. The main functions of the software include: Project Management, Coordinate System Setting, Coordinate Conversion, Boat Shape Design, Equipment Connection and USV Survey. In order to be applicable to customers, the software pursues more accurate measurement, more humanized operation and more abundant functions to realize diversified measurement work.

1.2 Technical Parameters

Running environment: Boat Controller H16 (android 7.1.2), Boat Controller H20(android 9)

Language environment: Chinese and English.

1.3 Installation and Uninstallation

Installation: Copy the SLHydro USV program (*.apk) to controller, click on the program to start the installation, after a few moments, the program will be installed successfully and the SLHydro USV program icon will appear on your desktop.

SLHydro USV

Uninstall: Long press SLHydro USV desktop icon to move to the top of the screen uninstall position, the screen pop-up window prompts "Do you want to uninstall the software", click OK, you can uninstall the software.

1.4 Startup Screen

Open the software will show software name, software version, skip button.

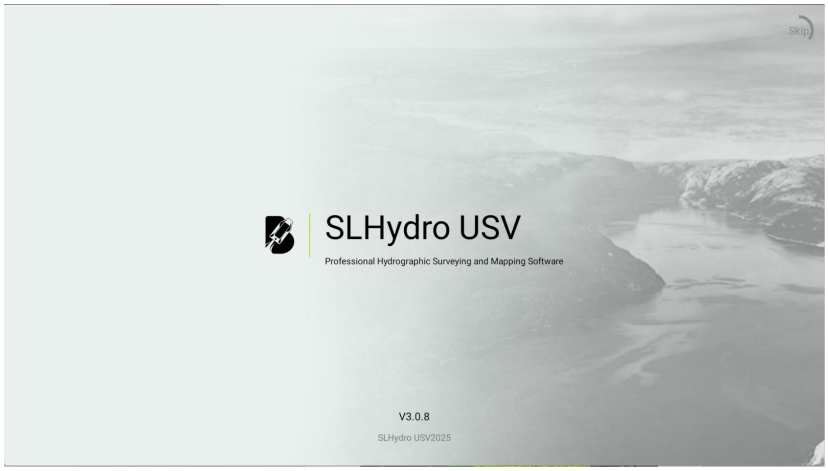


Figure1-1 Start Page

SD Card Tip: If the SD card is not inserted in the controller. After launching the software, a window will pop up prompting that no SD card is inserted. You can also check the "No prompting within 7 days" box when closing the window. Enter the software after closing the tip window. After inserting the SD card, the popup will not be prompted anymore. (Only the H16 controller will show this prompt)

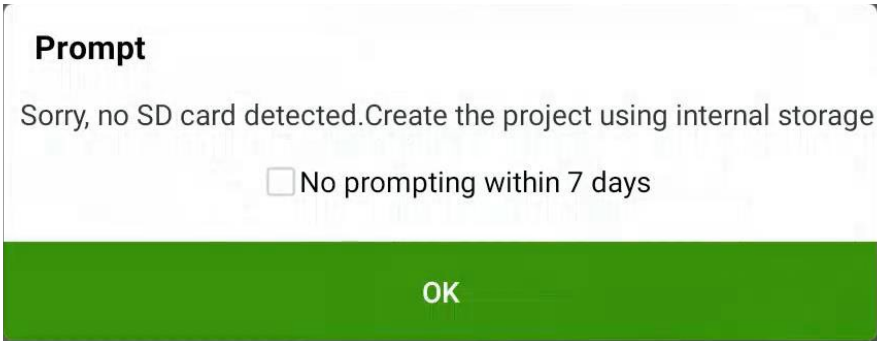


Figure1-2 SD Card Tip

1.5 About

Open the software will show software name, software version, skip button.

Instructions for SLHydro USV software version, update, software protocols and privacy policies

When the controller is connected to the network and there is a new version of software update, the upgrade information will be displayed in a pop-up window.

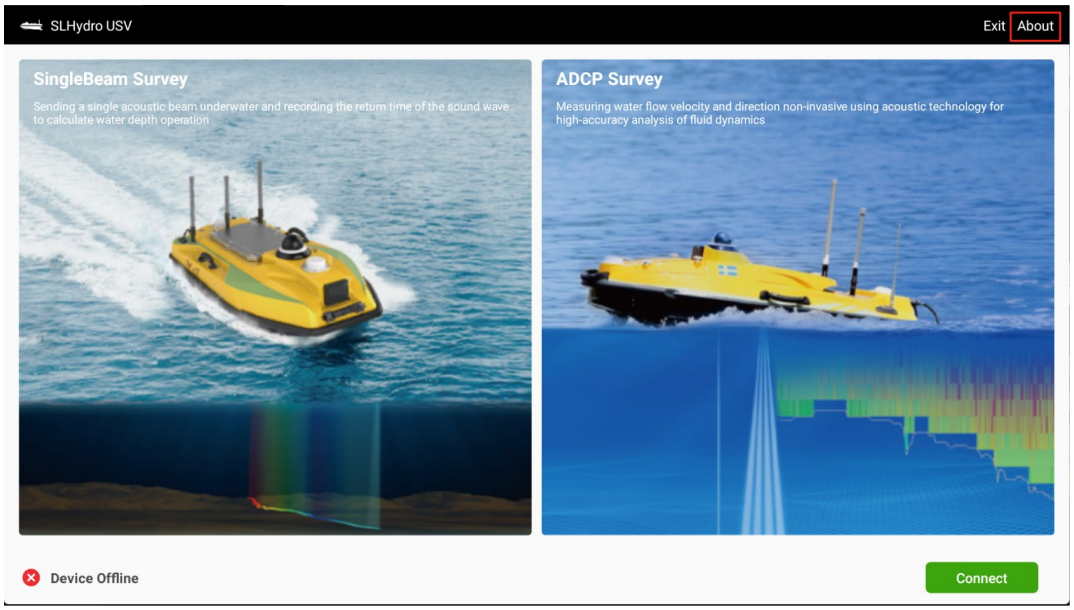


Figure1-3 About

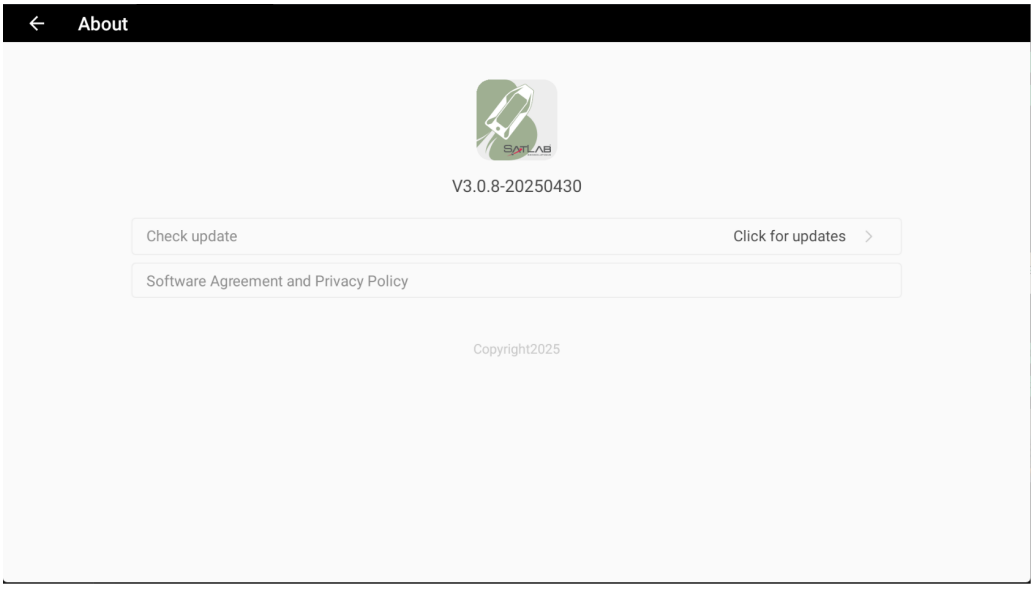


Figure1-4 About

1.6 Exit

Click the [Exit] -> [OK] button to exit the software.

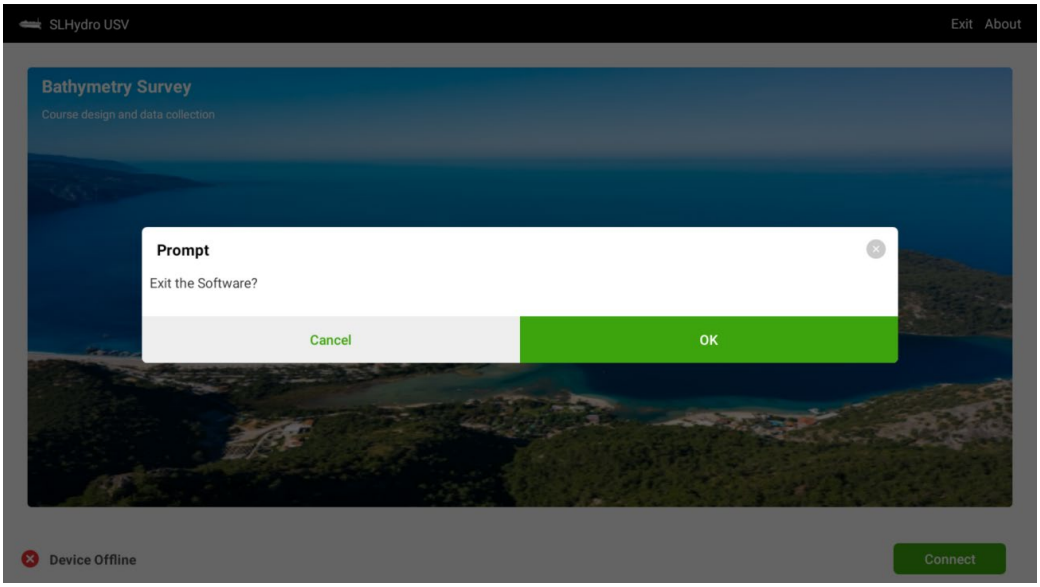


Figure1-5 Exit

Chapter 2

Easy operation procedure

This chapter contains:

-Main Interface

- Simple Operation Procedure

2.1 Main Interface

When you run the software, you will enter the main interface. The main interface includes Bathymetry Survey and Device Connection.

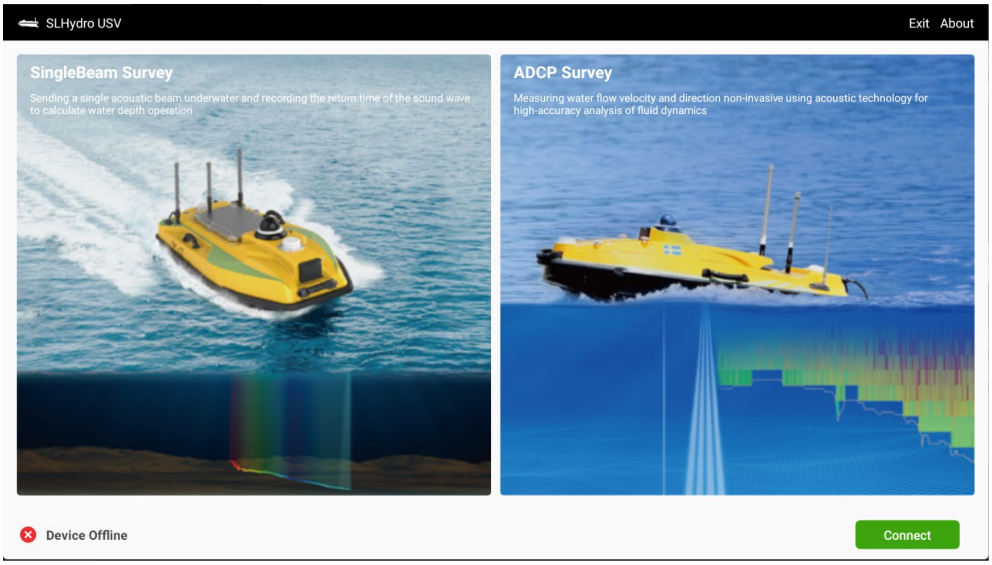


Figure 2-1 Main interface

- *[SingleBeam Survey]* Single-beam bathymetry project creation, track planning, return planning, cruise speed, breakpoint renewal, start sailing, start return, exit the mission, import the bottom, control settings, video settings, differential settings, display information settings, echo data acquisition, echo information settings and other functions.
- *[ADCP Survey]* Expert Mode and AI Mode flow survey, manual flow survey and full-automatic flow survey.
- The bottom bar shows the device connection status, and you can click the *[CONNECT]* to access the device connection interface.
- *[Exit]* button in the upper right corner to exit the software.

2.2 Simple Operation Procedure

2.2.1 Device Connection

Enter the [Device Connection] interface, you can choose to use the *Network Bridge Connection* or *4G Connection* method, the connection interface can see the real-time information received by the device.

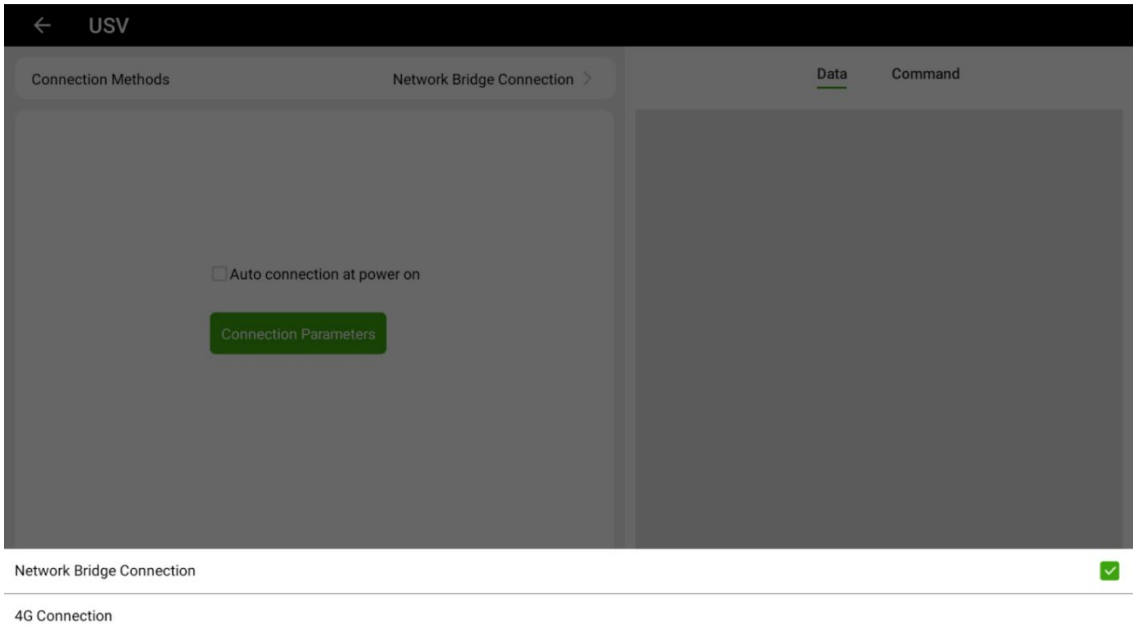


Figure 2-2 Device Connection

2.2.2 Create New Project

Click *[Bathymetry Survey]* → *[New Project]* to enter the project creation interface, enter the Project Name (required), Creator, Comments and other information, select the Project Type and the Coordinate System, then click Complete to complete the new project after confirming that there is no error. (After clicking *Bathymetry Survey*, it will jump to the interface of *Workspace Lib* you can choose to open the created project or create a new project to carry out the survey work.)

Note: H16 controller only supports the creation of Sounder project type.

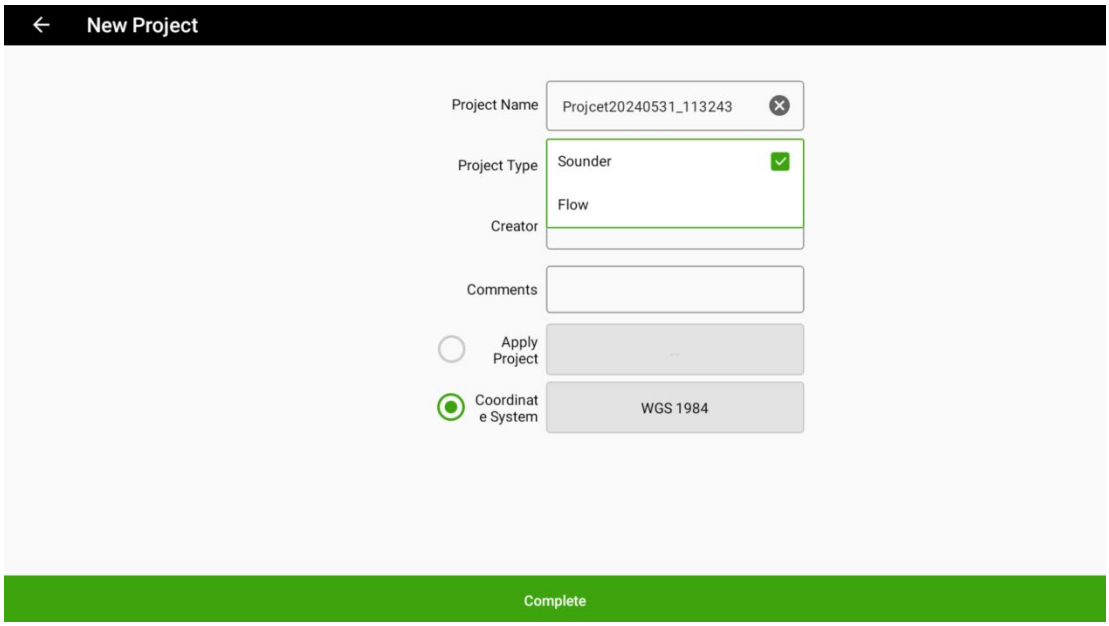


Figure 2-3 New Project

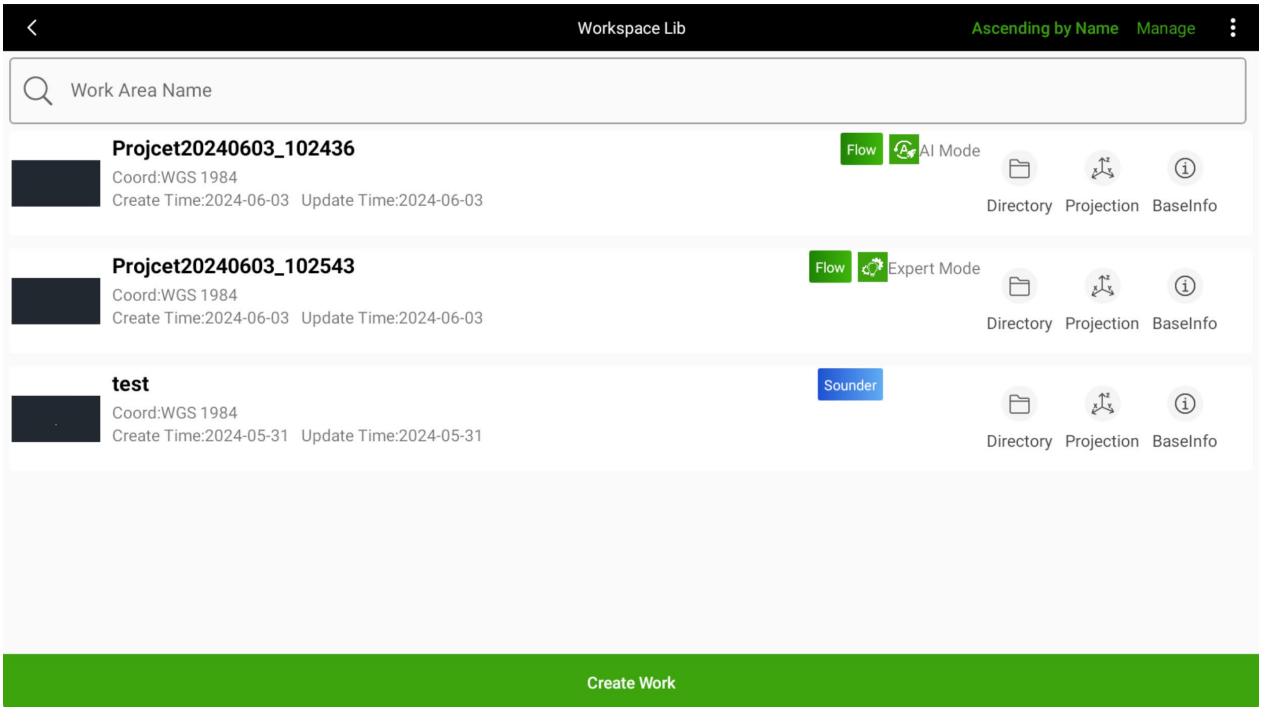


Figure 2-4 Workspace Lib

2.2.3 Setting Coordinate System

When creating a new project, you can choose the required coordinate system (note: the coordinate system file must be placed under the system file path HIBOAT /Coord), or you can define or import the coordinate system in [New Project] - [Coordinate System]. You can set the origin longitude in Coordinate System, and input seven parameters, four parameters, height fitting parameters, point translation parameters and other conversion parameters according to the actual needs.

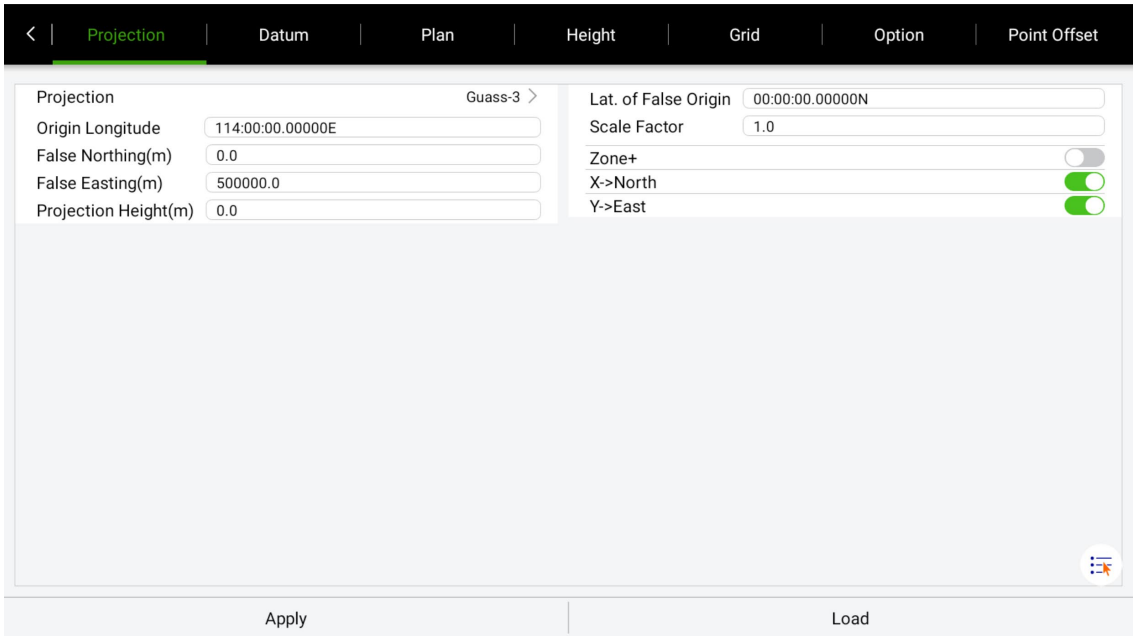


Figure 2-5 Coordinate system

2.2.4 Bathymetry Survey page

Click *[Return]* to set by single point or by line return.

Click *[Mission]* can manually draw the plan line, support General line, Area Line, Vertical Line.
Support read the USV last uploaded track, or read the KML file, DXF file (click to read file).
In automatic mode when the USV in "Auto-p" or "Return", click (H16 controller is toggle) the SW1 or SW4 switch into the "Breakpoint renewal" (including: Stop Mission, The Last Waypoint, The Next Waypoint, Choose another waypoint).
The normal operating procedure is: Set *Return*, Set *Mission*, *Auto-P* (Perform Route Task), *Start Survey*, *End Survey*, *Return*. At the end of the operation, the data can be copy to the computer for data processing and output.
Detailed descriptions are in Chapter 5.

Figure 2-6 Bathymetry Survey Page

Chapter 3

Project Management

This chapter contains:

-Project Information

-Coordinate system

-WiFi Trans File

3.1 Project Information

Click *Bathymetry Survey* enter the *Workspace Lib* page, you can to manage the project. You can create new work, open work, delete work, copy work, etc. In Workspace interface, you can view the current project information: project name, project storage location, coordinate system, creation time, last update time and so on.

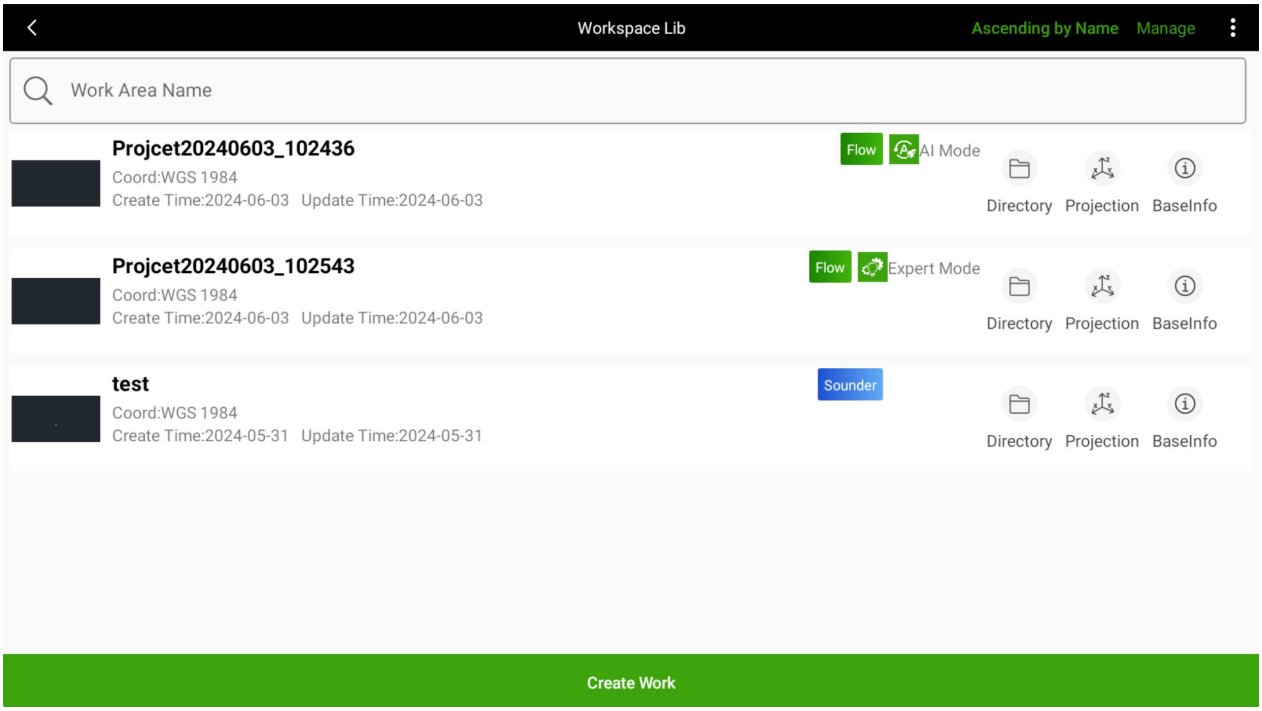


Figure 3-1 Project Infor

Create Work: Click *[Create Work]* button to enter the *New Project* page, input the project name (required), project type, creator, comments and other information, select the required coordinate system (you can choose to apply the existing project directly or select manually, both cannot be selected at the same time, apply the project coordinate system and ship parameters directly when applying the existing project) and project type(H16 controller only supports the creation of Sounder project type.), confirm that there is no error and click *OK* to complete the new project.

Click *Complete* to create a new project, and automatically open the new project as the current project. If there is already a project with the same name in the history project list, it will prompt that the file name already exists and needs to be renamed. Click *History project* item, you can open the selected project.

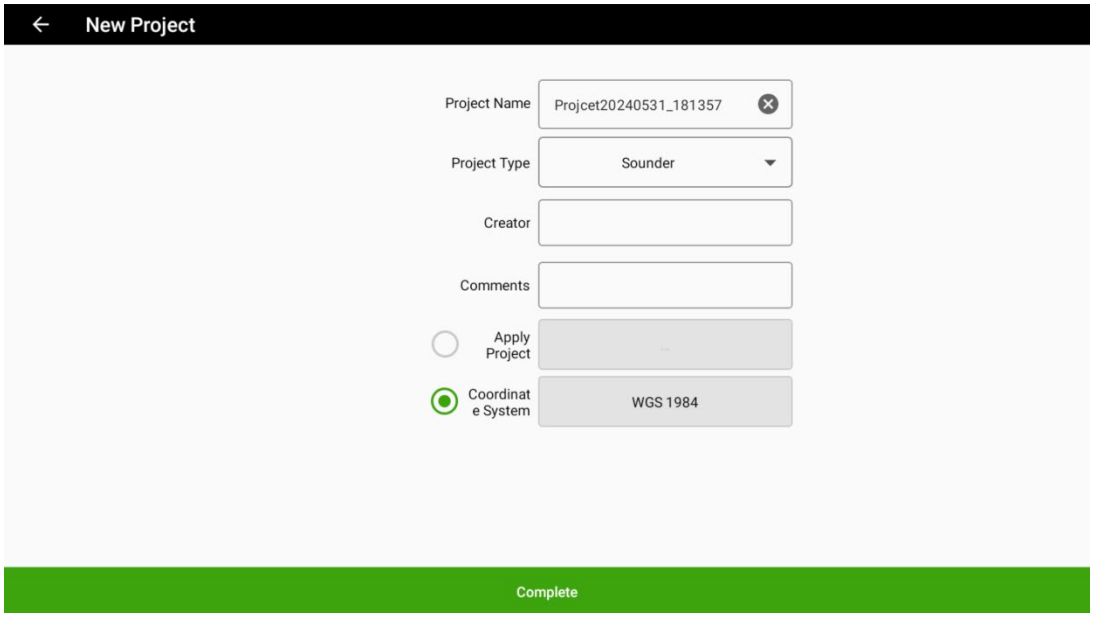


Figure 3-2 New project

Click the *Manage* button in *Workspace Lib* page to delete or copy the created project.

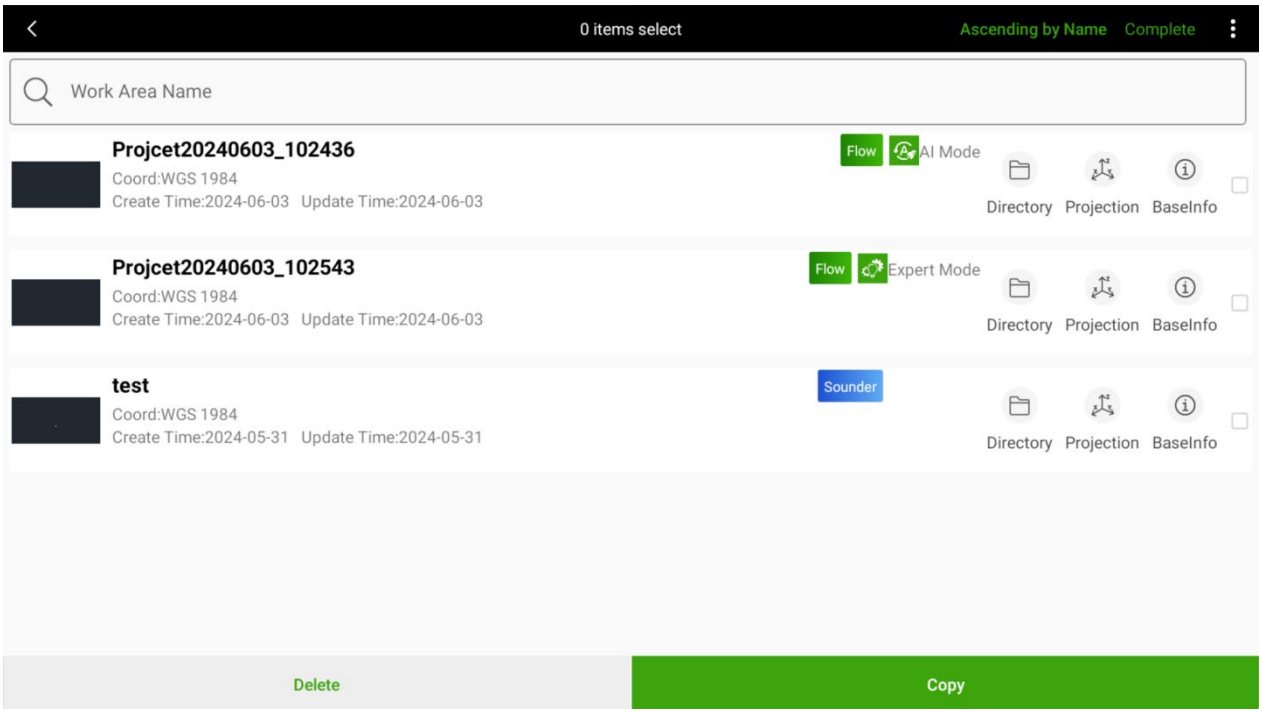


Figure 3-3 Project Manage

Project Copy: Click the upper-right corner *Manage* button to enter the project manage interface, select the project that needs to be copied, click Copy, and then a copy of the selected project will be generated (copying all the contents except the collected data).

Project Delete: Click the *Manage* button in the upper right corner to enter the project manage interface, select the project to be deleted, click *Delete*, and the selected project will be deleted after completion.

Note: The deleted project cannot be recovered, please be careful to delete.

Project Search: You can search for the required project in the search bar at the top of the *Workspace Lib* page.

File Directory： Click the *Directory* icon to open the folder location corresponding to the project and view the file content.

Figure 3-4 File Directory

Basic Information： Click the *BaseInfo* of Sounder project to view *Sounder parameters* configuration, and click the *BaseInfo* of Flow project to view *Flow parameters* configuration.

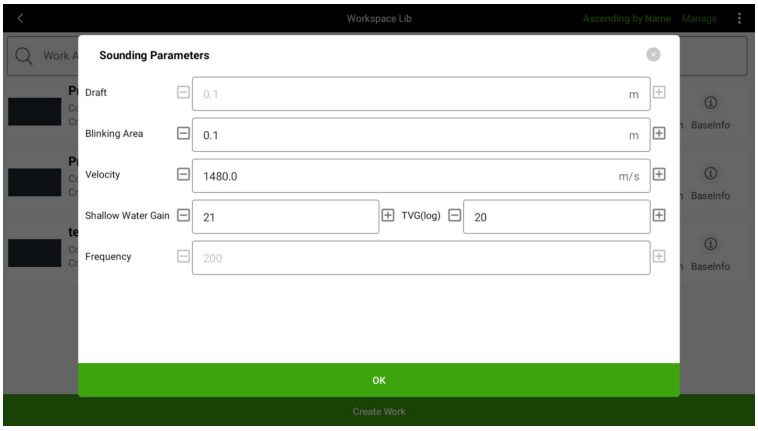


Figure 3-5 Sounder parameters

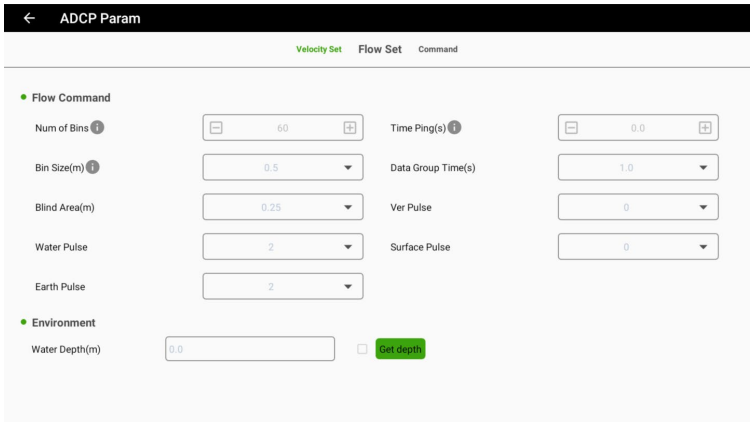


Figure 3-6 File Directory

3.2 Coordinate System

There are 2 ways to enter the *Coordinate System* page.

1. Main interface– Bathymetry Survey- New Project- Coordinate Sys Manage.

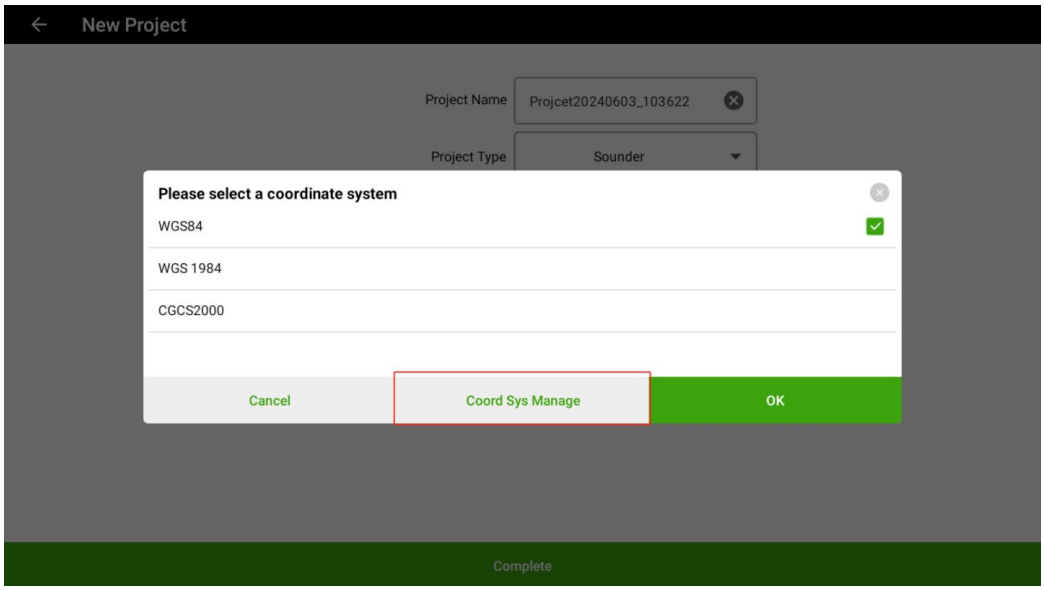


Figure 3-7 Coordinate system

2. Main interface– Bathymetry Survey- Current project - Projection.

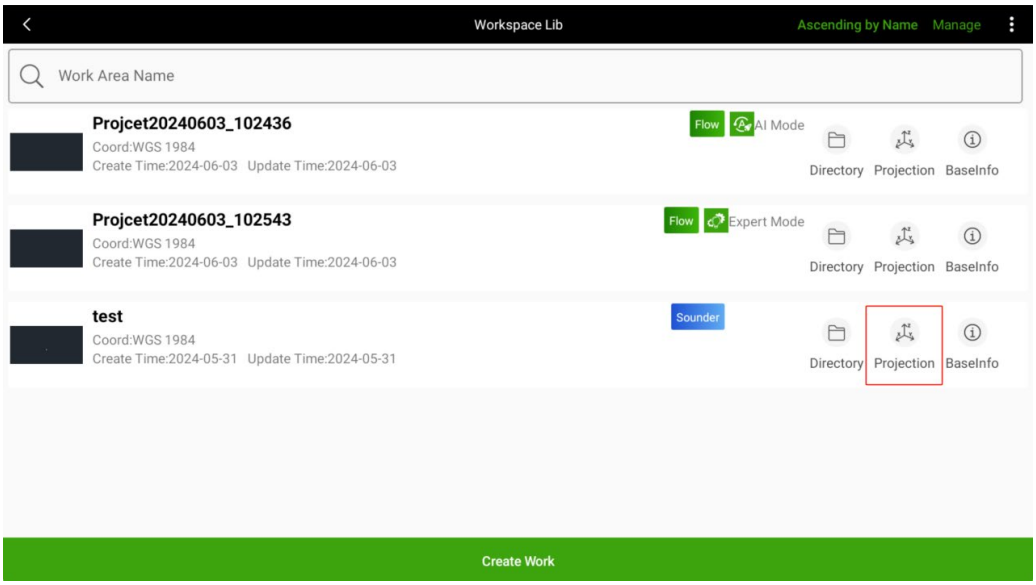


Figure 3-8 Coordinate system

3.2.1 Projection

Built-in common projection methods for each country: including *Gauss*, *Mecator*, *Lambert* and other projection methods (Note: When the projection method is Gauss 3 or Gaussian 6 band, the instrument supports automatic calculation of the origin longitude after connection, while other custom projections are not supported.

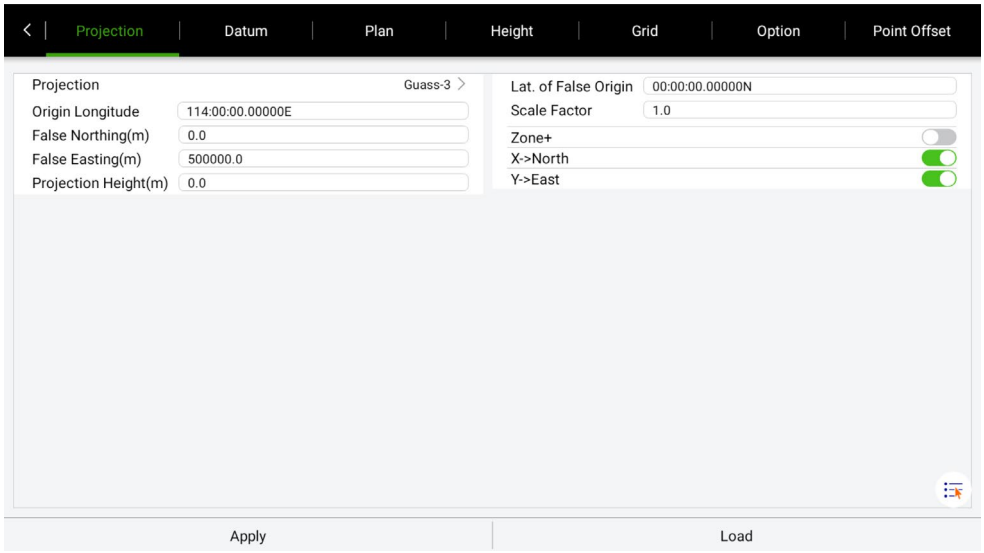


Figure 3-8 Projection

Notice: Coordinate System – Projection – Zone+, set whether to add the band number or not. There is no point data in the software, so this setting item will not have any effect in the project.

3.2.2 Datum surface

The source ellipsoid, local ellipsoid, and reference transformation model can be set under this interface.

Note: The software has built-in ellipsoidal parameters commonly used by countries in all continents of the world.

Source ellipsoid: Is generally WGS-84, where the parameters: a indicates the semimajor axis of ellipsoid; 1/f indicates the inverse of the flattening.

Local ellipsoid: Indicates the ellipsoid used by the current local coordinate system.

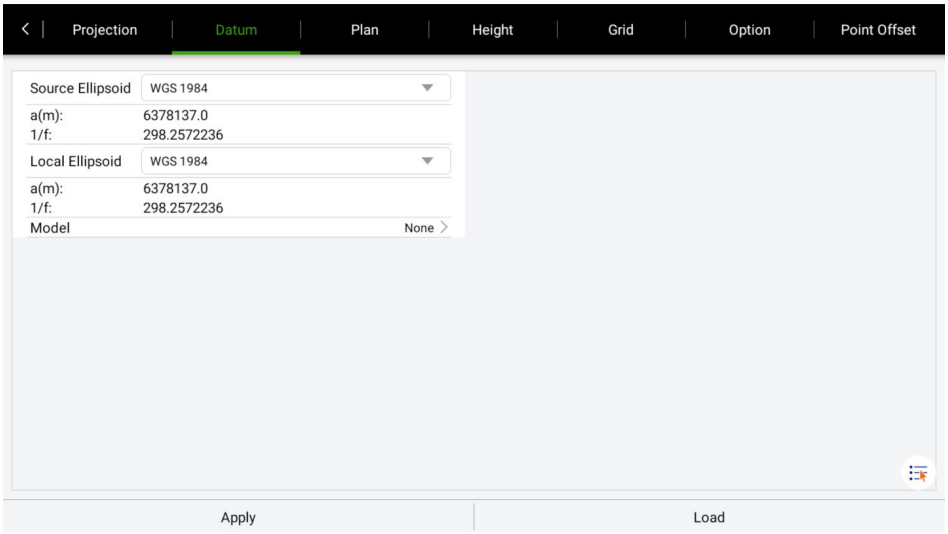


Figure 3-9 Datum surface

Model: The optional conversion parameters are: none, Bursa-Wolf Transformation, Molodensky, One-touch, Polynomial Regression and Ten Params.

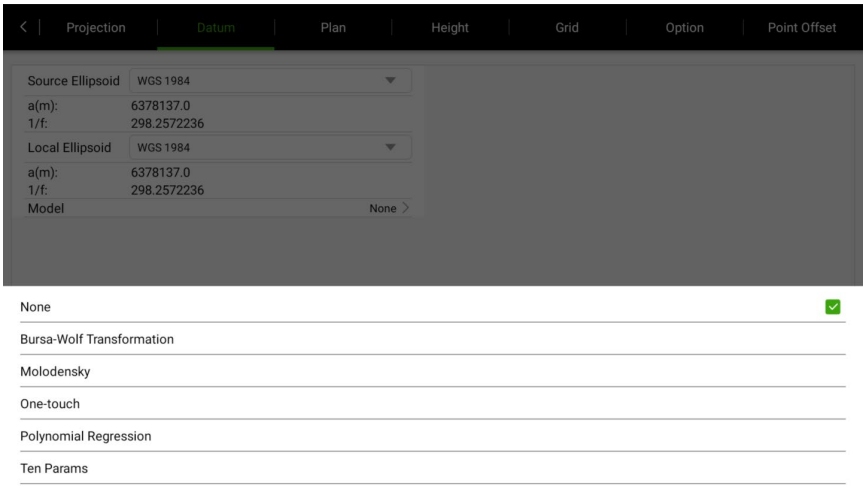


Figure 3-10 datum conversion parameters

- **Bursa-Wolf Transformation**

It is the translation, rotation, and scale parameter between two ellipsoids on a spatial vector. It has a small rotation angle. It is a more rigorous transformation model that requires at least three points to be solved. It is suitable for conversion between different ellipsoidal coordinate systems.

- **Molodensky**

A simplification of Bursa-Wolf Transformation, with only the translation parameter on the space vector. It is a less accurate conversion, which can be solved by one known point. Suitable for conversion from WGS-84 to national coordinate system.

- **Polynomial Regression**

The mapping relationship between two ellipsoids in the direction of each component is expressed by a polynomial.

3.2.3 Plane conversion model

The plane conversion model includes 2D Helmert, TGO, Grid, FreeSurvey and Polynomial Fitting.

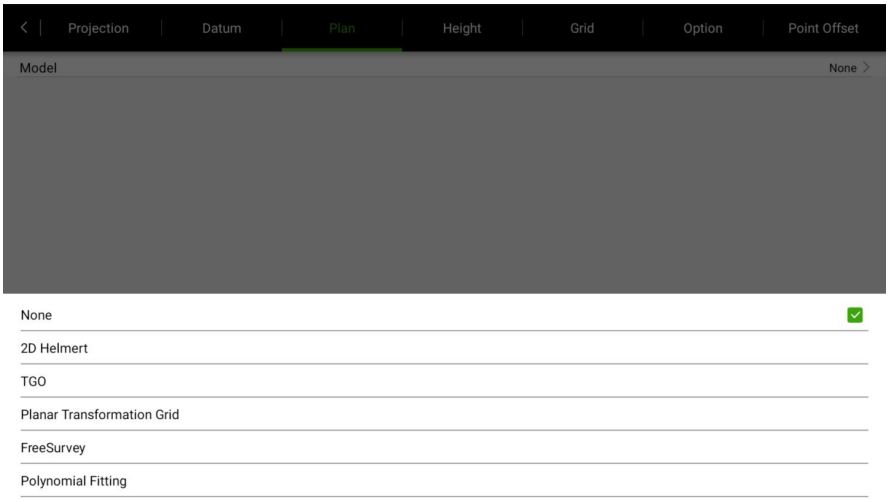


Figure 3-11 Planar transformation model

- **2D Helmert**

The translation, rotation and scaling parameters between two plane coordinate systems are applicable to most common engineering users, and only two arbitrary coordinate systems with known coordinates are required for parameter solution.

- **TGO**

A plane conversion method of TGO software with more origin north and origin east parameters than four parameters.

- **Grid**

You can select an existing grid file to convert WGS-84 coordinates to grid coordinates. Note: The grid file (*.grd) needs to be copied manually to the coord folder under the software working directory *HIBOAT*.

- **FreeSurvey**

A planar conversion method customized by Thales, with more origin north and origin east parameters than the 4 parameters.

- **Polynomial Fitting**

Planar transformation is performed by a polynomial fitting model.

In some projects, when the known points involved in the calculation of plane conversion parameters and elevation fitting parameters are different points, it is necessary to use 2D Helmer and Height Fitting for separate parameter calculation.

The 2D Helmer is a separate part of the planar parameter calculation, and is used in a similar way to the datum plane conversion model calculation.

◇When using 2D Helmer: The scale parameter is generally very close to 1, about 1.0000x or 0.9999x.

◇When using 3 parameters: All three parameters are generally required to be less than 120.

◇When using 7 parameters: All seven parameters are required to be relatively small, preferably not more than 1000.

3.2.4 Height fitting model

Height fitting models include Mathematical Models, TGO, FreeSurvey.

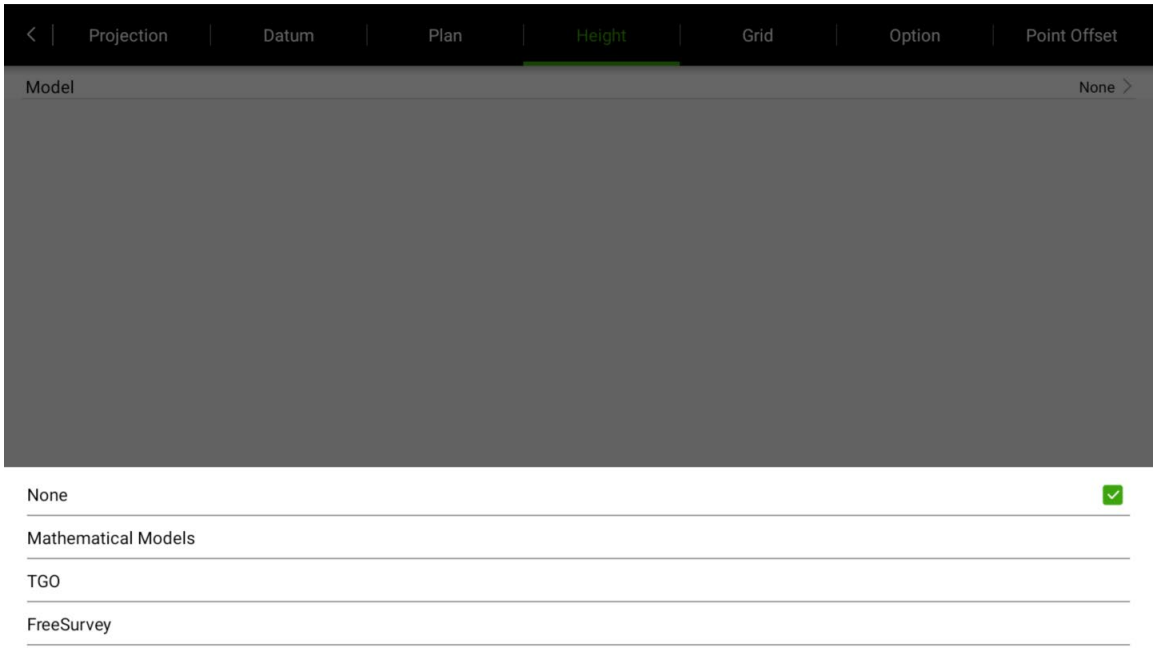


Figure 3-12 Height fitting models

◆ **Mathematical Models**

It includes *Constant Vertical Offset, Planar Fitting, Quadratic Surface and Zonal*. You can input the known parameters directly, or click *Compute* to jump to the *Parameter Calculation* interface to calculate the fitting parameters.

Constant Vertical Offset: translation, at least one starting point.

Planar Fitting: at least three starting points.

Quadratic Surface: at least six starting points.

Zonal: at least three starting points.

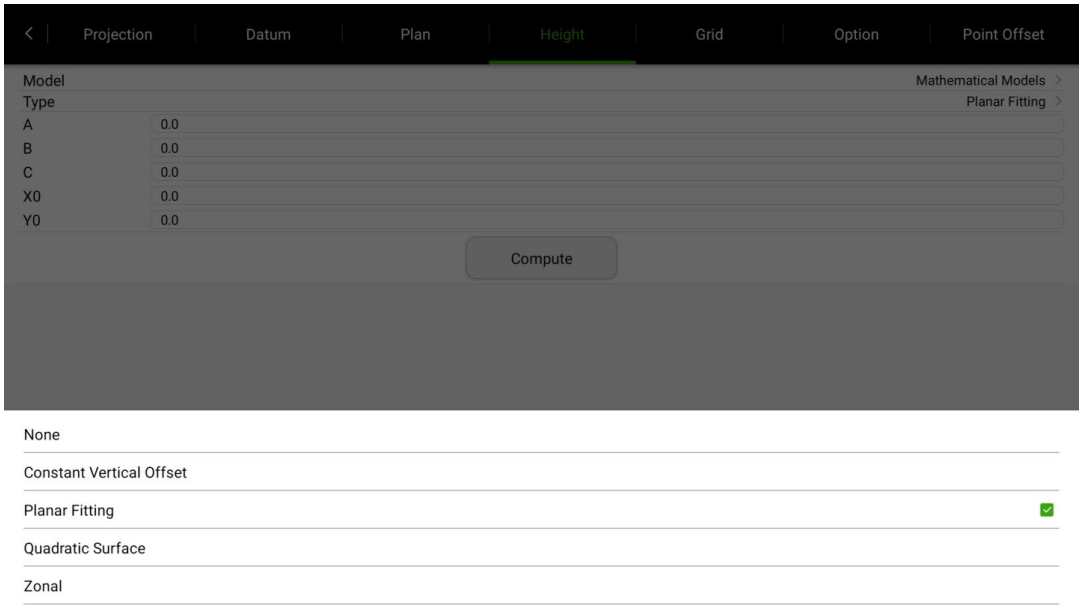


Figure 3-13 Parameter Fitting

If you get the fitting parameters through *Compute*, you need to click *Add* to input the points involved in the calculation of the elevation fitting parameters. After adding all the points, click *Compute* to check the residual data value, the maximum residual value is less than 3 cm.

If the requirements are met, click *Apply* and the calculated parameters will be automatically filled into the elevation fitting page of *Coordinate System*. If the requirements are not met, click *Cancel* to eliminate the points with large errors and then re-solve them.

- **TGO**

The elevation conversion model of Trimble TGO software includes five parameters: constant parity, north slope, east slope, north origin, and east origin.

- **FreeSurvey Elevation Fitting**

Thales elevation conversion model with five parameters: constant, north slope, east slope, latitude of origin, longitude of origin.

Set the height fitting mode description

a. Constant Vertical Offset: It means the elevation measured by the receiver plus a fixed constant as the used elevation, and the constant can be negative.

b. Planar Fitting: It means corresponding to the elevation anomalies at multiple level points to generate a best-fit plane, when this plane is parallel to the horizontal plane, plane fitting is equivalent to fixed difference correction.

c. Quadratic Surface: It means to generate a best-fit paraboloid corresponding to the elevation anomalies at multiple level points. Surface fitting requires high requirements for the starting data, and if the fit is too poor, it may cause the elevation correction values in the working area to be scattered.

d. Zonal: known two level points, virtual out a level point, into three level points and then plane fitting.

e. Grid fitting: that is, *Grid correction* page of the *Height Grid*. Need to choose the grid fitting file, support Trimble (ggf), Hi-Target (zgf), Geoid99 (bin) three formats, compatible with egm-96 model, grid fitting file is often large, reading may take some time, please wait patiently. If *Grid fitting* and other four kinds of elevation fitting method are chosen at the same time, *Grid fitting* will be carried out first, and then other fitting will be carried out.

3.2.5 Grid correction

You can enable the specified type of grids file and call in the corresponding grids file. Note: The grid file (*.grd) needs to be copied manually to the software working directory: *HIBOAT/Coord folder.*

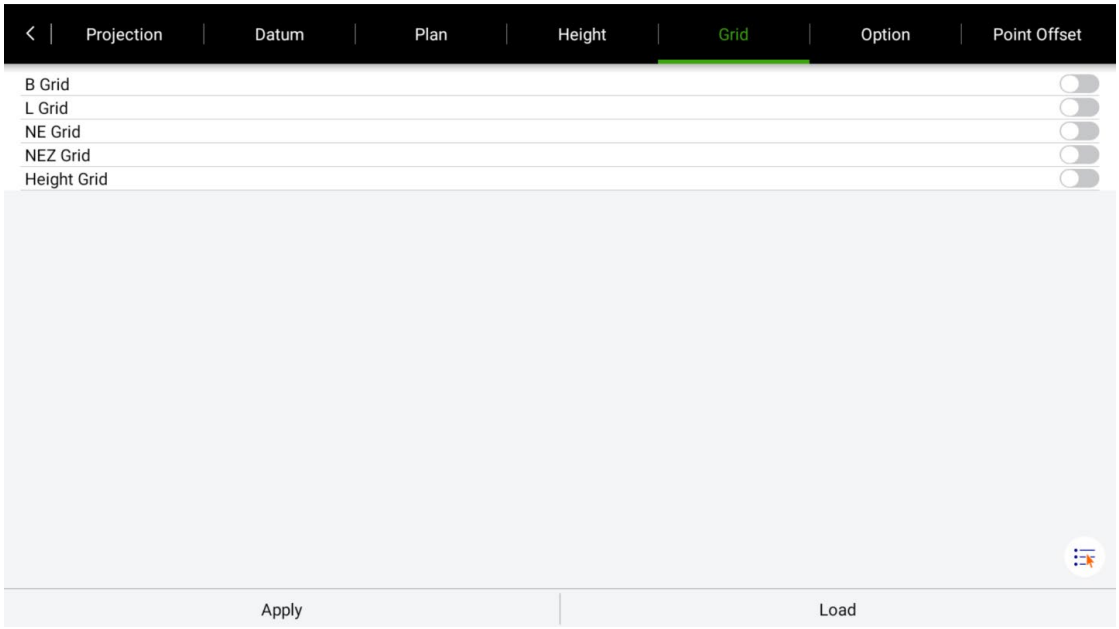


Figure 3-14 Grid Correction

3.2.6 Options

Whether the file is encrypted: the encryption of the file is displayed, the setting cannot be changed here. If the dam parameter file is encrypted, you can check whether the coordinate system date expires.

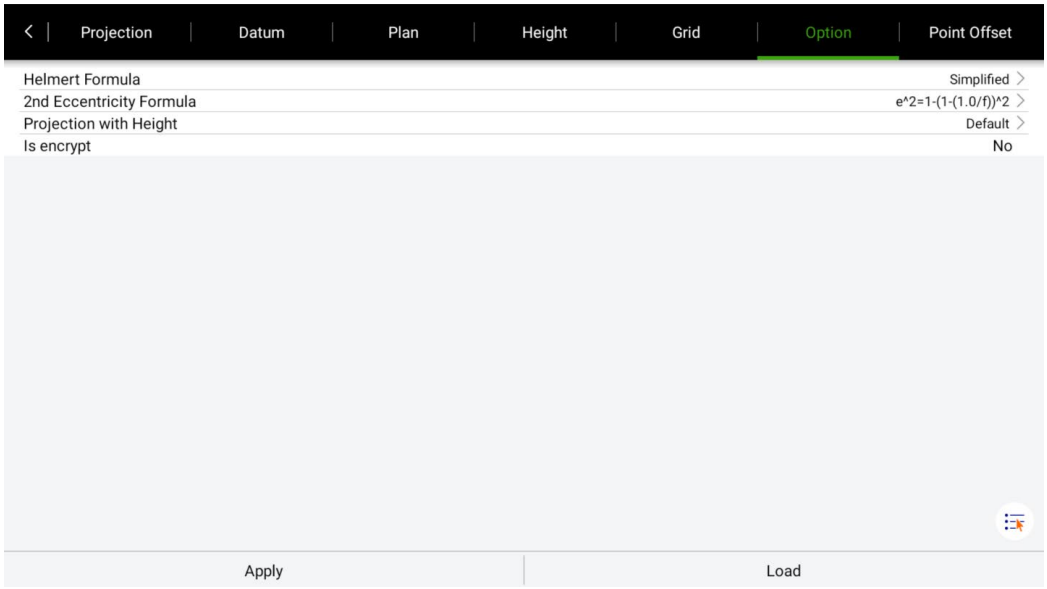


Figure 3-15 Options

After you modify the above values, click *Save* and the software will modify the dam file under the current project with the same name as the project name. If the current reference ellipsoid is transformed then the coordinate values of the coordinate points will change.

3.2.7 Point translation

Point translation is able to translate according to the coordinates of a point in the GNSS acquisition process. Since the correction value of such engineering coordinates is generally large, the conversion between BLH and NEZ cannot be carried out, otherwise a large

deformation will be generated due to the projection error. Therefore, after the point translation parameter is enabled, the saved coordinates point BLH coordinates are still the original BLH values output by GNSS, and NEZ coordinates are the local engineering coordinates are the local project coordinates.

Point: Apply the entered offset parameters to the project

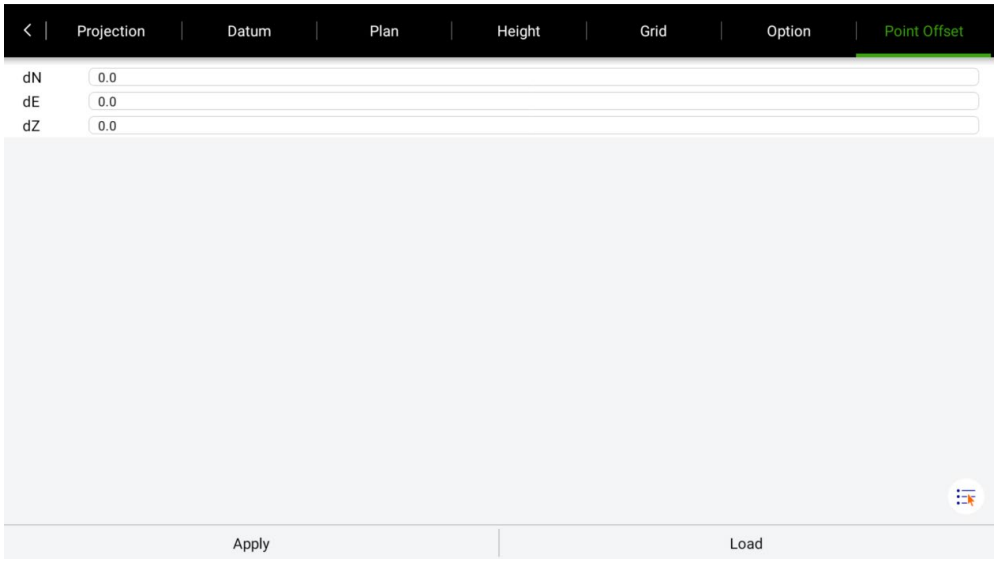


Figure 3-16 Point panning

3.2.8 Parameter calculation

The three functions of datum, plane conversion, and height fitting include many models, some of which can be calculated by the built-in parameter calculation module in the software. It is used to calculate the conversion relation boat between two coordinate systems. The models of parameter calculation include Bursa-Wolf Transformation, Molodensky, 2D Helmert, Height fitting, and One-touch method.

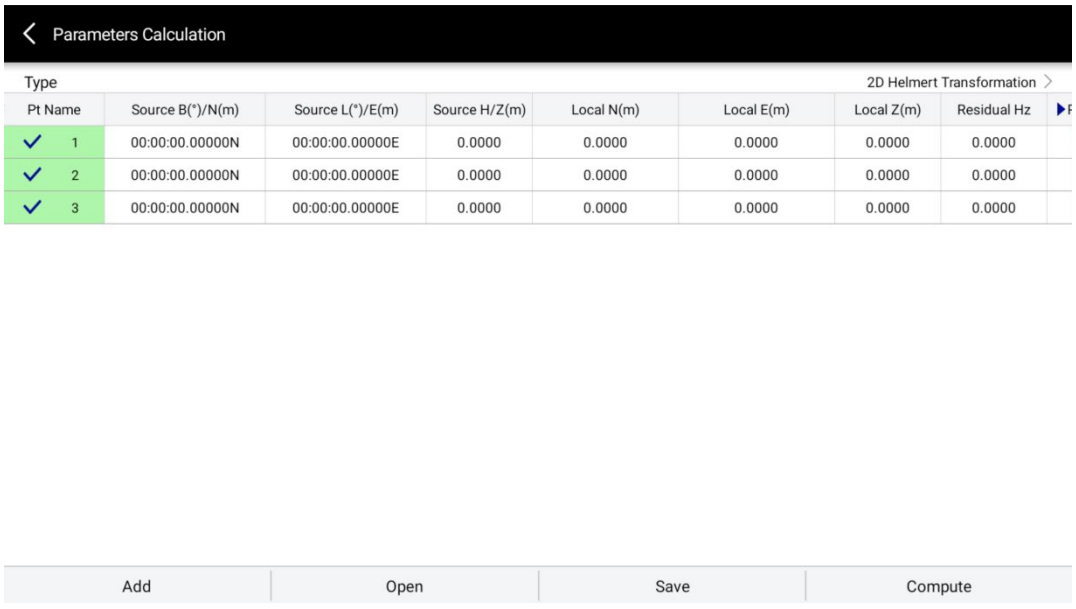


Figure 3-17 Parameter calculation

Add: It is used to add the source and target coordinates of points, the source point coordinates can be manually input or acquired in a real-time acquisition, point library, or map selection (BLH is selected by default), and the target point coordinates can be manually input or acquired from the point library. When calculating the parameters, single point or smoothed points are collected, and data storage is supported (save to coordinate point & coordinate point library). After inputting, click Save, if you need to operate the existing point information, long press to select the line to edit or delete the point information.

In addition, for the point pairs that have been selected, the selected point pairs will not be shown in the list when you enter the list selection screen again after adding them successfully.

Open: It is used to add parameter calculation point pair file (*.txt), Carlson localization parameter file (*.loc), and customization (*.txt) from the file directory.

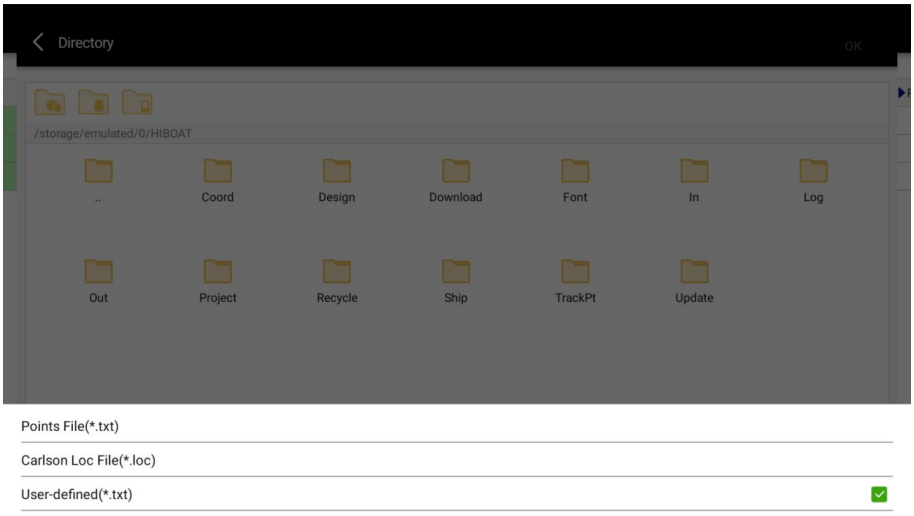


Figure 3-18 Open file type

Save: Save the current point pair coordinate information, support saving *Point File (*.txt)* and *User-defined(*txt)* format.

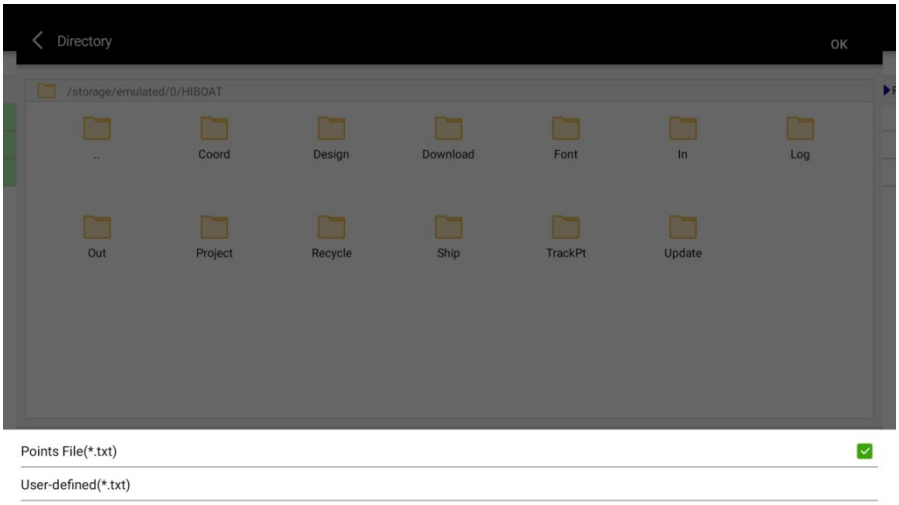


Figure 3-19 Save file type

The *User-defined(*txt)* format allows you to set the angle format of the point pair, export fields, etc.

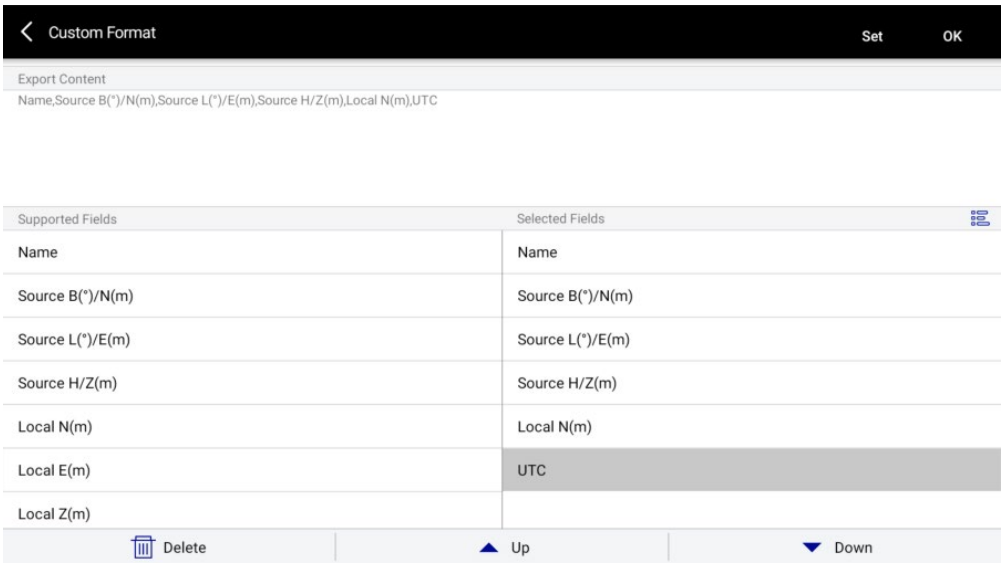


Figure 3-20 Custom Format

Calculation: Calculate the parameters, solve the conversion parameters from source coordinates to target coordinates, click *Calculate*, the software will automatically calculate the parameters and the residual value of each point HRMS, VRMS (HRMS: the plane error of the current point; VRMS: the height error of the current point), the smaller the residual value, the better the accuracy of the point.

Apply: Apply the current calculation result to the corresponding coordinate parameter, and update the coordinate point library when the parameter calculation result is applied to the current project.

Cancel: Cancel the parameter calculation result and return to the parameter calculation interface.

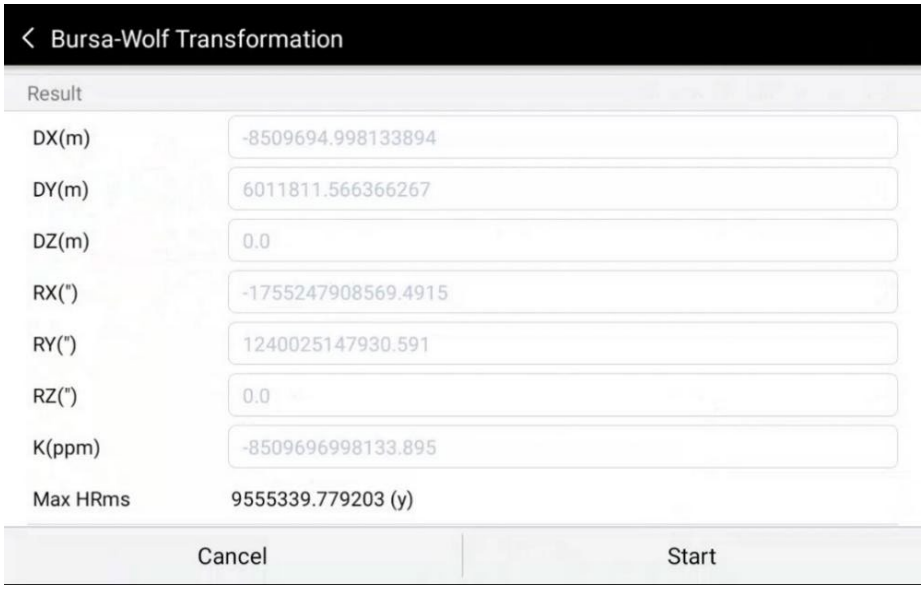


Figure 3-21 Calculation results

Notice:

1. When you enter the parameter calculation from the *Edit* or *Custom* coordinate parameter interface under *Coordinate System - Coordinate System Management*, it is the calculation of the corresponding type of conversion parameter of the current custom or edited coordinate system (i.e. you cannot change the parameter calculation type).
2. From the main interface *Project - Project Information - Coordinate System* into *Parameter Calculation* is the calculation of the current project coordinate conversion parameters, you can independently select the parameter calculation type, the elevation fitting type is initialized to the current project coordinate parameters under the elevation fitting of the parameter fitting the selected type.

3.2.9 Coordinate system management

On the Coordinate System page, you can click to enter the coordinate system management screen. The coordinate system requires the user to place the coordinate files in the system file HIBOAT/Coord path.

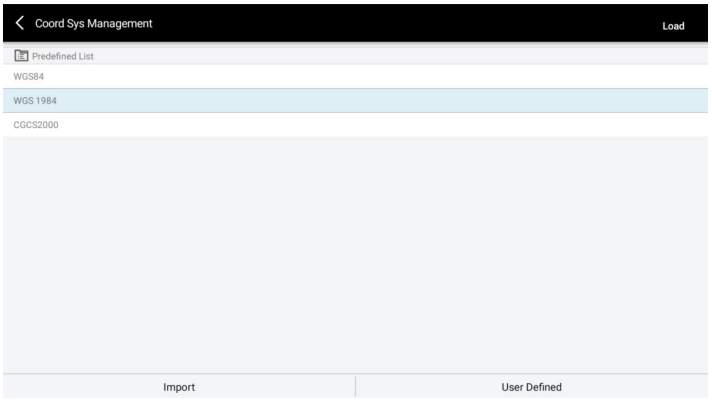


Figure 3-22 Coord Sys management

When there are multiple coordinate systems in the list, you can select the corresponding coordinate system file and click *LOAD* to preview or modify the loaded coordinate system. It is also allowed to add custom coordinate system according to the actual situation of the measurement area.

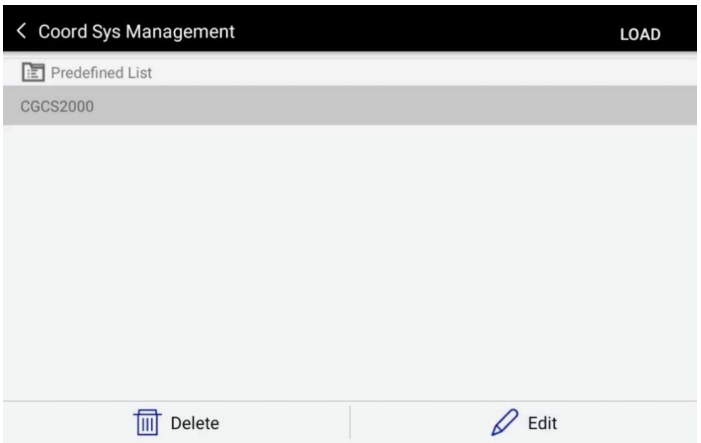


Figure 3-23 Delete/Edit

Delete/Edit: You can delete or edit an item in the system list by long press to select it. Editing the coordinate system parameters in the system list does not affect the coordinate system parameters under the project, unless you click the *LOAD* button after editing and saving the coordinate system.

3.3 WiFi Trans File

In Workspace Lib page, You can click ⋮ – *WIFI Trans File* to use WIFI to transfer files.

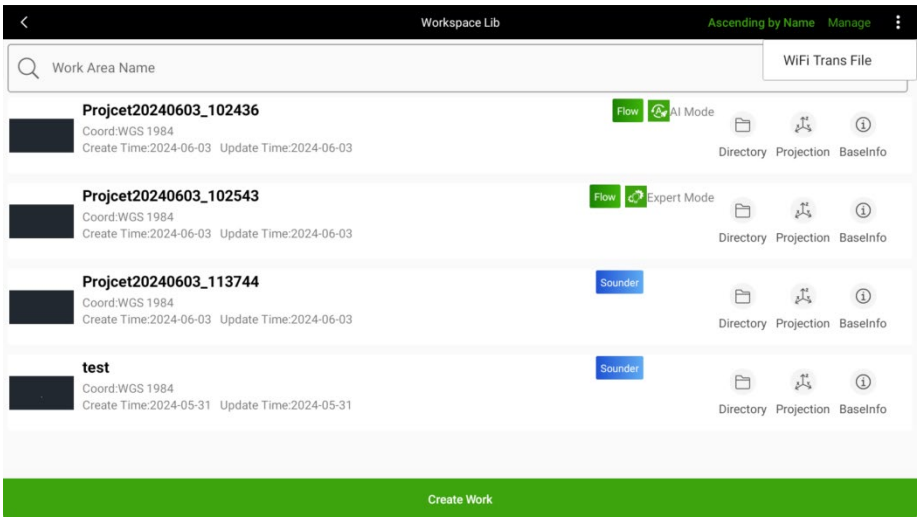


Figure 3-24 WiFi Trans File

By default, the software doesn't tick the box of "Confidentiality-free transfer", users can use the default user name, password and port if needed. Tick the "Secure Transfer" box, no user name and password are needed, users only need to configure the port. When the device is connected to WiFi, the software automatically fills in the IP parameters, and the port number is 8008 by default. after the user configures all the parameters and clicks [Start], the user will be able to download the files transferred by WIFI by typing the corresponding path in the address bar of the computer according to the prompts on the software.

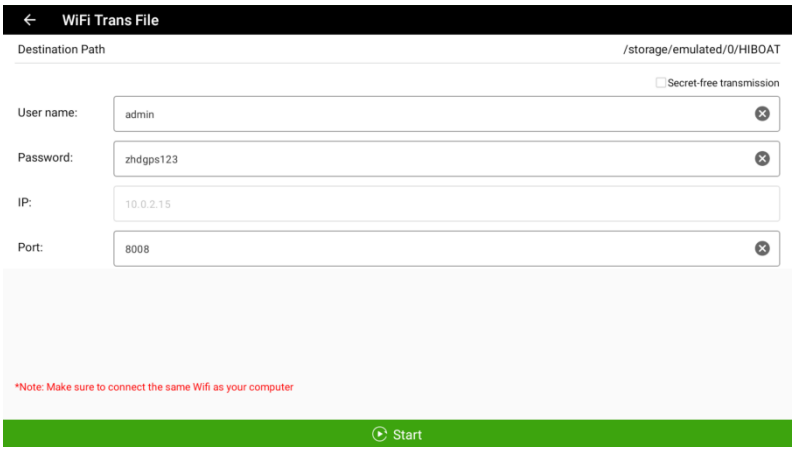


Figure 3-25 WiFi Trans File

Chapter 4

Device Connection

This chapter contains:

-USV Connection

-USV Registration

-Upgrade Firmware

-Restart Boat Control

4.1 USV Connection

We need to connect the data of the various devices on board the USV to the software. SLHydro USV has two ways to connect boat: network bridge connection and 4G connection. All connection parameters have been written to the software. When both the USV and the controller are on, the red light of the USV stays on, select the connection method and click Connect to access data such as echo sounder and GNSS data. Auto-connect at power on: Check this option and the device will automatically connect every time you enter the SLHydro USV.

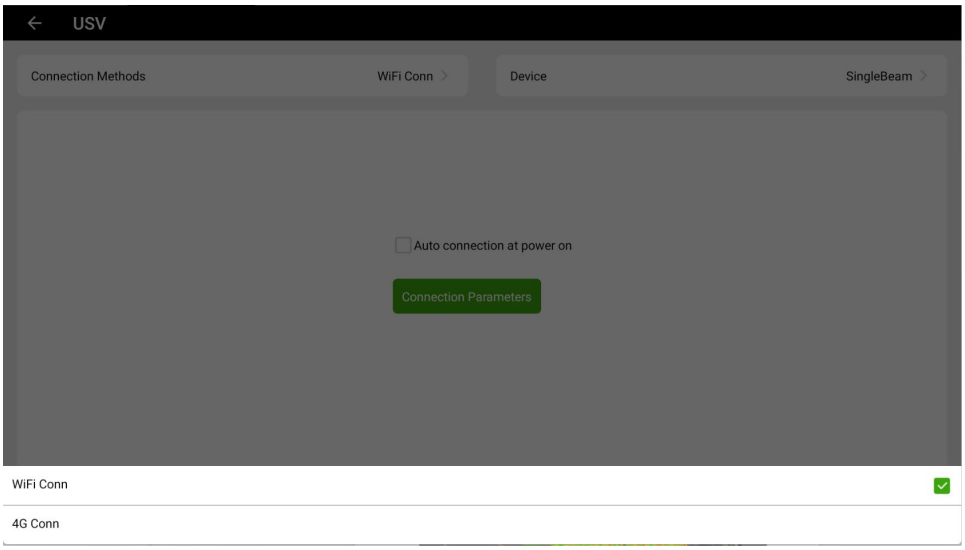


Figure 4-1 Device Connection

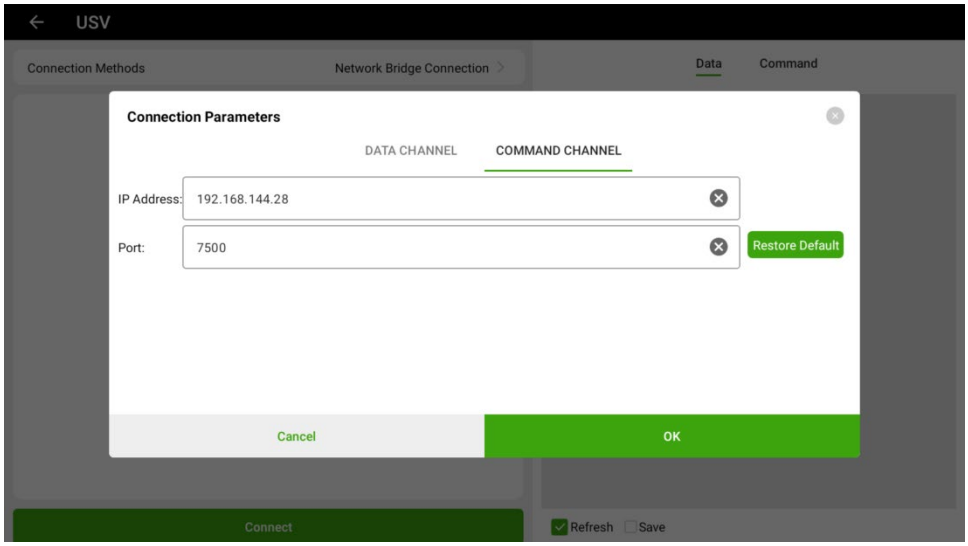


Figure 4-2 Connection parameters

CONNECTED: Click Connect and the software prompts for a successful connection. And you can see the data returned by the device in the right debugging windows, you can choose different ways to view: ASCII, HEX, and Result. After a successful connection, the connection status in the upper right corner of the main screen of the software will be updated and the connection status will be displayed.

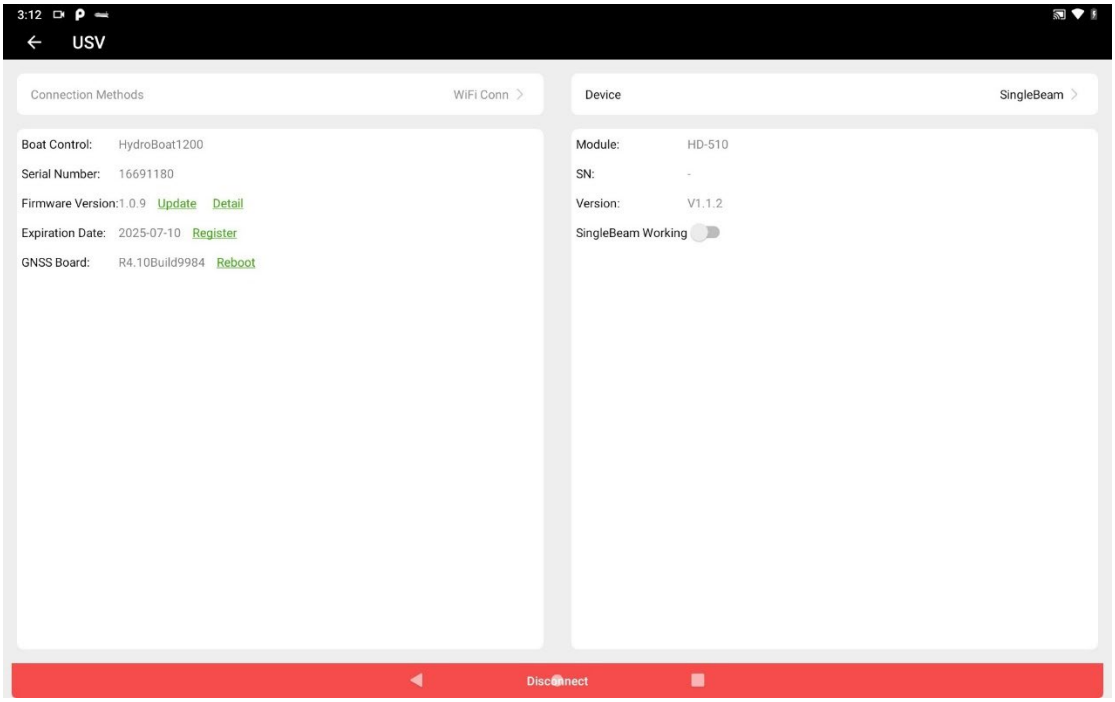


Figure 4-3 Connection result

Figure 4-4 USV connection status

Refresh: If you select *Refresh*, the debug page will output data and display it on the page according to the set frequency. Unchecked page data is not updated, but it can be used normally and does not affect the test.

Save: If you select *Save*, all the output will be saved and overlaid all the time. It can be saved as a *.txt file. (Note: If you save a file with the same name, it will continue to superimpose the new saved content on the original content, and will not overwrite the original content, the software does not carry out the same file name save reminder)

4.2 USV Registration

The registration function is to enter the registration code of the USV after connecting the boat (the registration code is to be obtained from the relevant business personnel of Satlab, the registration code is 24 digits for the 8-digit USV of the S/N number). Not registered or registration date expired, the use of SLHydro USV part of the function is not available, such as the unmanned boat measurement interface in the ship control-related functions.

4.3 Upgrade Firmware

You can upgrade the firmware of the drone ship under WiFi connection. The USV is configured with the latest version of firmware at the factory. If you need to update it, you can directly click *Version Update* on the device connection interface to upgrade. Try not to operate other during the upgrade process, so as not to cause unnecessary errors. After the upgrade is completed, the software will automatically restart the drone boat and

automatically connect. After reboot, the connection interface will be updated to the latest version of the firmware name.

4.4 Restart Boat Control

After connecting the device successfully, you can also restart the ship control module. The USV can be connected automatically after restarting. In order to avoid the problem that the USV is dead or abnormally unable to return normally during the field operation.

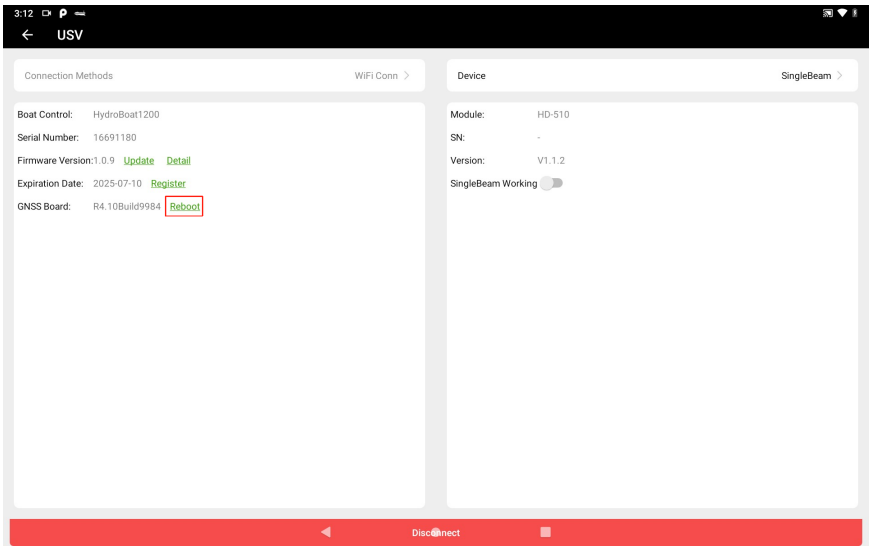


Figure 4-5 Reboot

Chapter 5

USV Measurements

This chapter contains:

-Interface Display

-Common Functions

-Upper Left Information Bar

-USV Setup

-USV Control

-SingleBeam Survey

- ADCP Survey

5.1 Interface Display

Enter the Bathymetry Survey interface, the map will be loaded automatically (the controller is connected to the 5G hotspot).

Figure 5-1 USV measurement

Device Connection: enable work USV Current connection status.

Direction: Heading angle, the angle between USV and due north.

Speed: USV current speed.

Solution Status: The current receiver status.

Battery power: Display the power level of the USV.

Navigation mode: There are two modes, automatic and manual, SW4 is toggled to the top for manual mode and to the middle and bottom for automatic mode.

Mission status: This shows the current mission of the USV, including auto-return, auto-pilot, cruise mode, hovering, and auto-avoiding.

Signal intensity: It displays the number of frames of 4G module signal strength in the USV.

5.2 Common Functions

5.2.1 Display Boat

Click Display Boat icon can display the boat positioning in the middle position, provided that the USV has been connected, if the device is not connected, it will indicate that the device is not yet connected.

5.2.2 Boat position locking

With the boat position locked on, the USV will remain displayed in the middle of the screen no matter how you drag the map.

Boat position lock:

Boat position unlock:

5.2.3 Zoom

Click the *Zoom* button to enlarge the elements of the current map to be displayed in the interface.

5.2.4 Up Mode Switch

Bow Up: The function means to rotate the background map so that the direction pointed by the boat's bow is toward the top of the screen. Bow up can give an intuitive visual experience and is very helpful for ship navigation when taking bathymetric measurements following the plan line.

North up: Click to switch to due north up mode. Make due north toward the top of the screen.

5.3 Upper Left Information Bar

5.3.1 Exception message prompt

The upper left corner of the Bathymetry Survey interface icon can view the exception message of the USV. If there is abnormal information, there will be a red dot to indicate. If there is no abnormality, no red dot will be shown. Click it to see the specific abnormal information. At present, the abnormal information can be returned as follows: 1. device disconnected; 2. EMMC, EEPROM, TF card, temperature abnormal; 3. initialization in progress; 4. distance sensor abnormal; 5. positioning abnormal; 6. device unlocked.

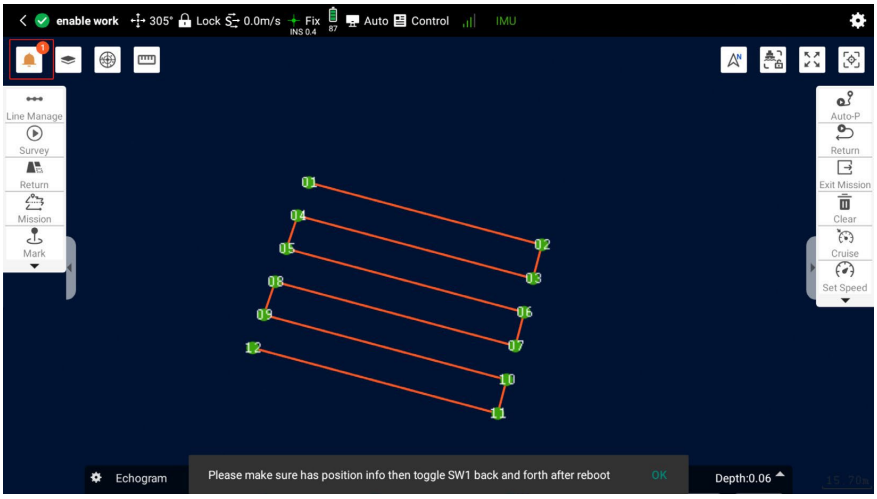


Figure 5-2 Exception message

5.3.2 Layer Management

When you click the Layer icon , the Layer Management interface will pop up.

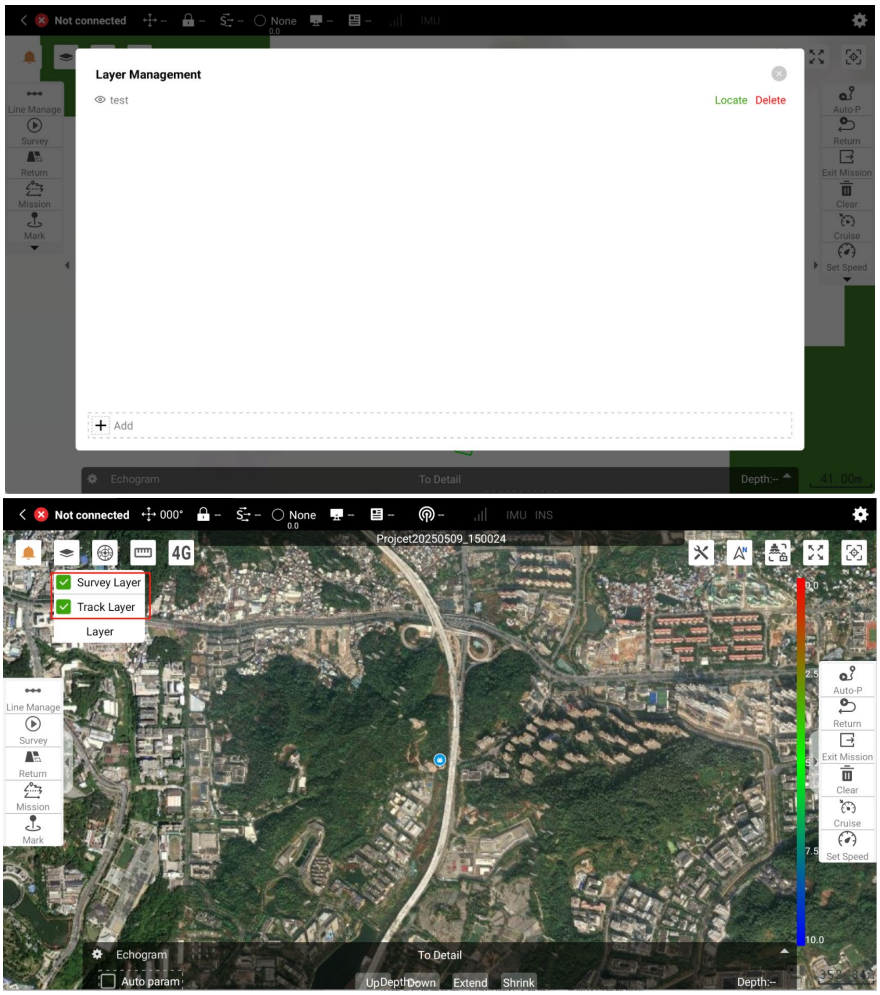


Figure 5-3 Layer Management

Through the layer management, you can add layers to locate, delete, show/hide the added layers. Click the Layer button, uncheck Survey Layer, the interface will hide the Survey line; uncheck Track Layer, the interface will hide the Track line.

Click "add" to enter the data import interface, you can choose the file type *.kml and *.dxf. We choose *.dxf file import for illustration. First of all, you need to copy the *.dxf file to the Controller, select the imported *.dxf file.

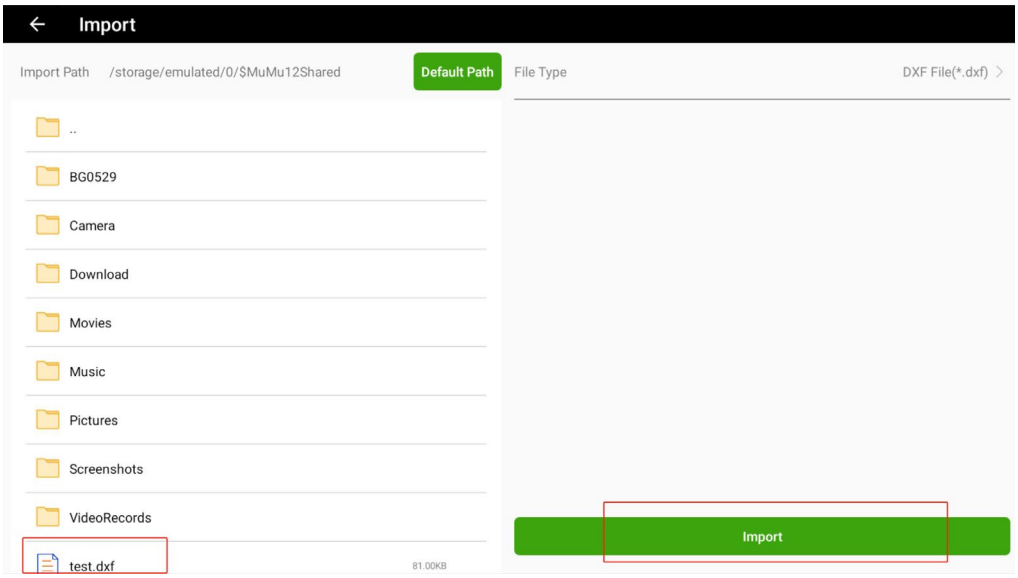


Figure 5-4 Dxf file import

After importing, you can see the *.dxf file drawing on the map, then click on the drawing to turn it into a mission.

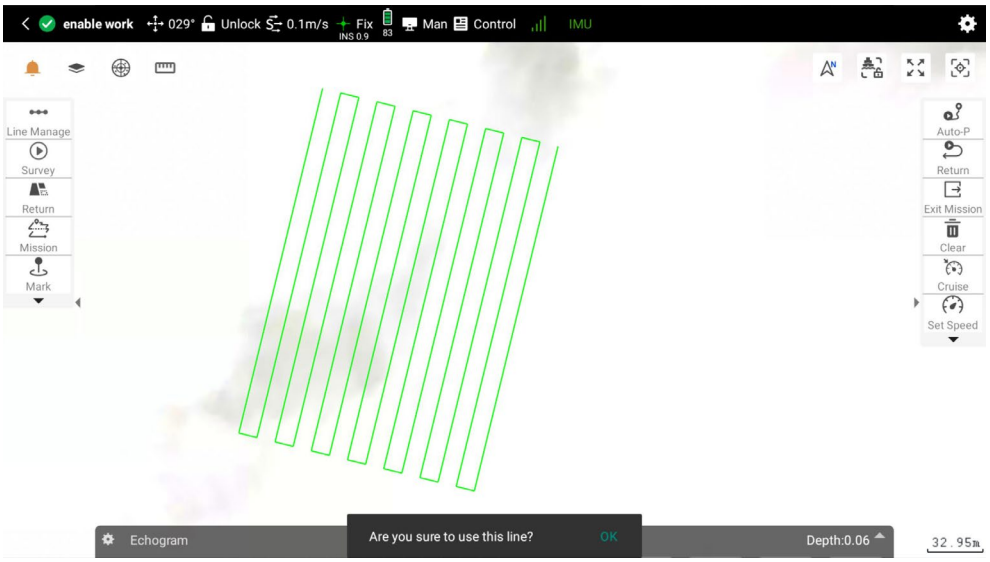


Figure 5-5 Drawing to stake out it

Once you turn it into a mission, you can set the type, angle, intervals, etc. just like manage the mission. (The steps of importing the *.kml files are the same).

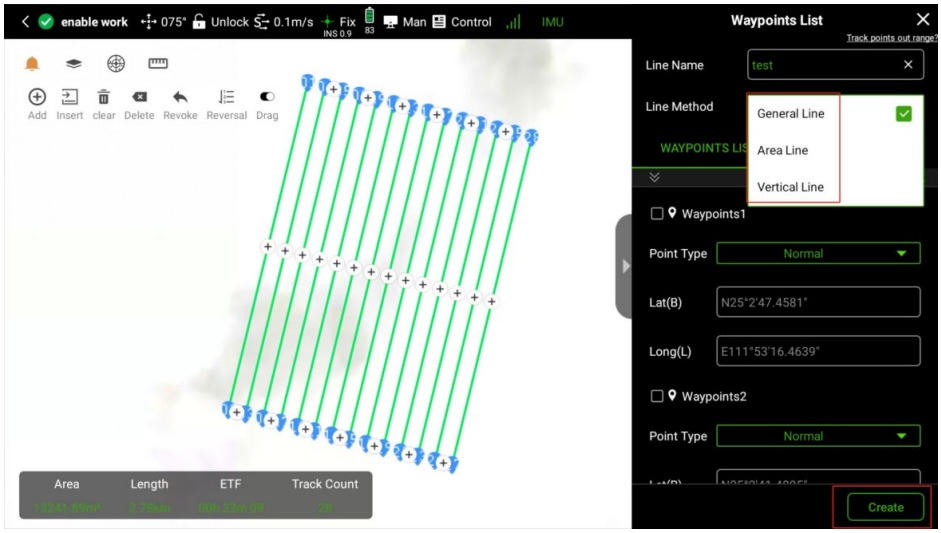


Figure 5-6 Create Line

5.3.3 SAT View

Click on the satellite icon in the upper left corner to view the distribution of the projected positions of the satellites, the national flags of each country represent the satellites of each country, and the corresponding number below each satellite is the number of satellites it is locked to.

GPS: Prn value is G1-G33;

GLONASS: Prn value is R65-R96;

BDS: Prn values of C161-C195;

GALILEO: Prn values of E1-E52;

QZSS: Prn values of J191-J195;

IRNSS: Prn values of L1-L14.

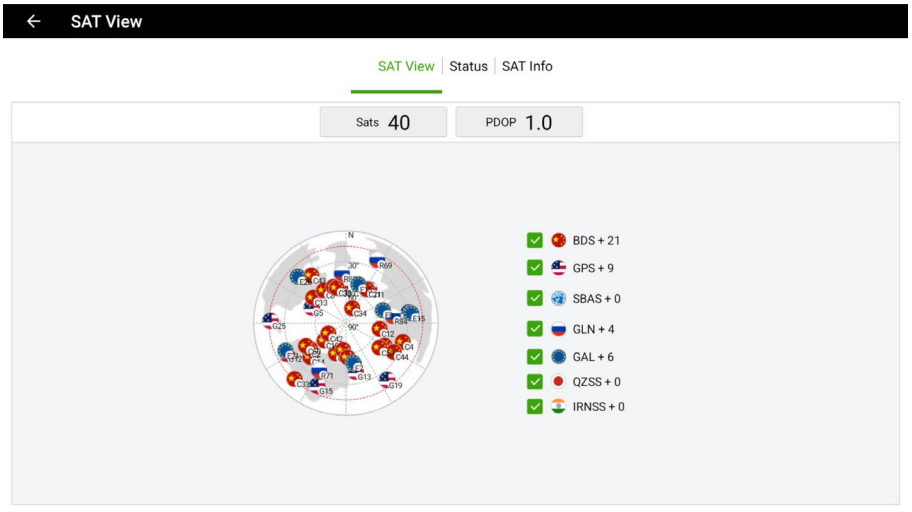


Figure 5-7 SAT View

Colors are assigned according to the satellite's L1 carrier signal-to-noise ratio: red <= 31, 31 < orange <= 41, green > 41.

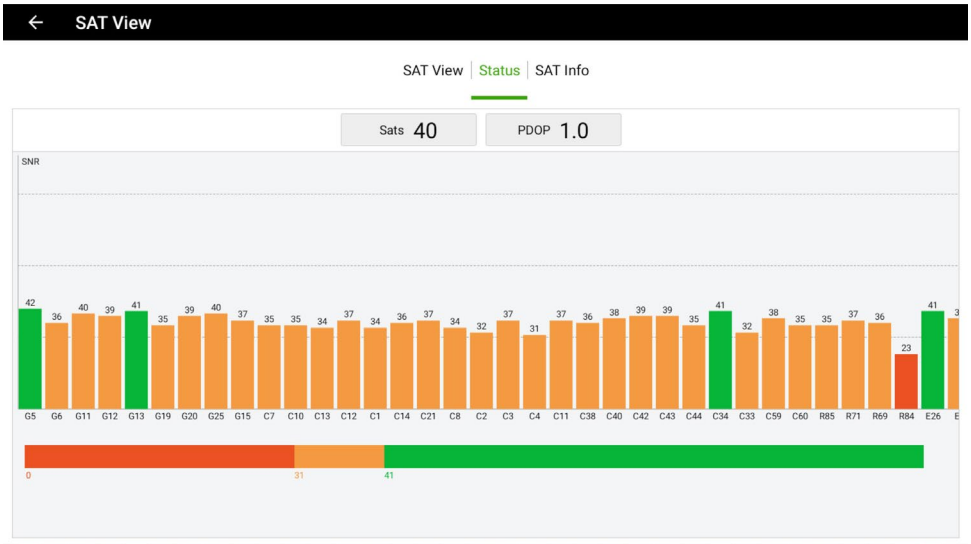
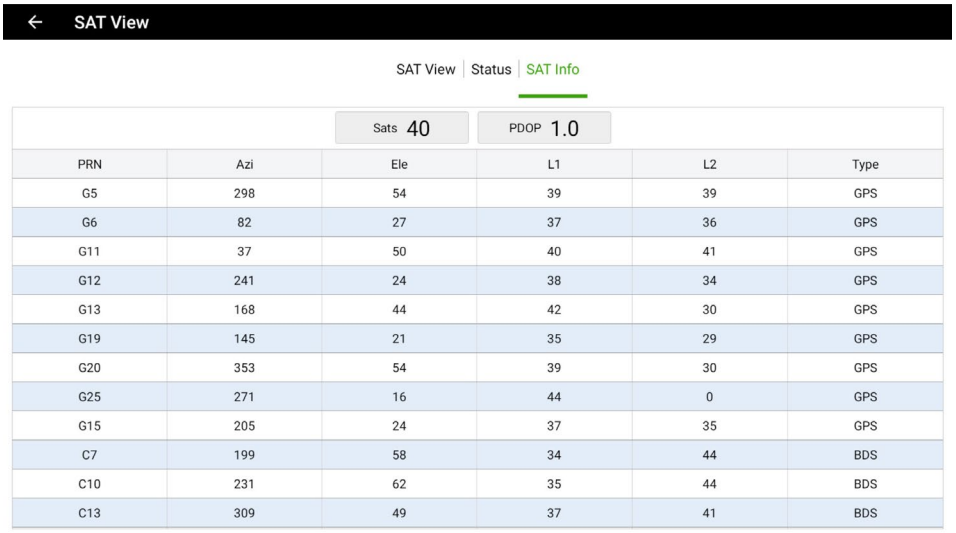


Figure 5-8 Status

Satellite Signal-to-Noise Ratio (SNR) diagram: PRN denotes satellite number, Azi denotes satellite azimuth, Ele denotes satellite altitude angle, L1 denotes L1-band SNR, L2 denotes L2-band SNR, and Type denotes the type of satellite.



PRN	Azi	Ele	L1	L2	Type
G5	298	54	39	39	GPS
G6	82	27	37	36	GPS
G11	37	50	40	41	GPS
G12	241	24	38	34	GPS
G13	168	44	42	30	GPS
G19	145	21	35	29	GPS
G20	353	54	39	30	GPS
G25	271	16	44	0	GPS
G15	205	24	37	35	GPS
C7	199	58	34	44	BDS
C10	231	62	35	44	BDS
C13	309	49	37	41	BDS

Figure 5-9 SAT Info

5.3.4 Ruler

By clicking the Ruler icon , you can tap the screen with your hand to continuously measure angle, distance, and area. You can click the Revoke icon to undo the wrong click. You can exit the measurement by clicking the close button in the upper right corner.

Figure 5-10 Ruler

5.4 USV Setup

USV settings are divided into control settings, video settings, GNSS settings, surveying parameter, and display parameter. In the daily measurement process, the main setting is control setting, which can assist the field test, such as low power return, automatic obstacle avoidance, hover.

5.4.1 Control Settings

In order to ensure the integrity of the ship during the USV field test, low power return, automatic obstacle avoidance and hover can be set on demand.

Low Power Return: When turned on, the USV can automatically return to the return point when the battery level is lower than the set level. You can set the power value range from 20 to 80, drag the progress bar to do so.

Automatic obstacle avoidance: The USV in automatic mode can avoid obstacles according to the set obstacle avoidance distance. After obstacle avoidance, the USV will no longer carry out the navigation task and needs to click again to start navigation, or start to return. The setting range of obstacle avoidance distance is from 5 to 30 meters.

Hover: When the USV has no task at present, the USV can hover at the current position after opening hover. In the process of hovering, the USV will adjust its position according to the current water flow by turning around

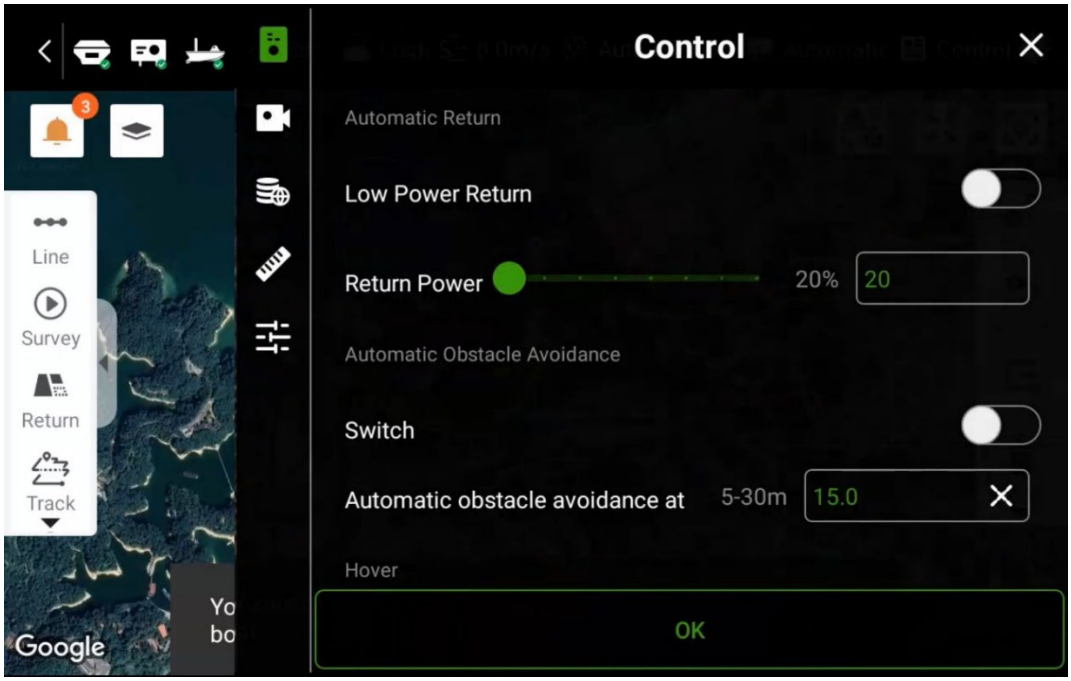


Figure 5-11 Control settings

5.4.2 Video Set

Video settings open the display switch allows users to view the current position of the USV real-time screen, virtual buttons to control the camera direction up, down, left and right. At the same time, you can turn on the sound, in the remote control can receive the sound back from the USV in real time. Exit the *Bathymetry Survey* interface or exit the software video will be automatically closed, the button in the settings still remain open, need to use the camera when you need to set again to open.

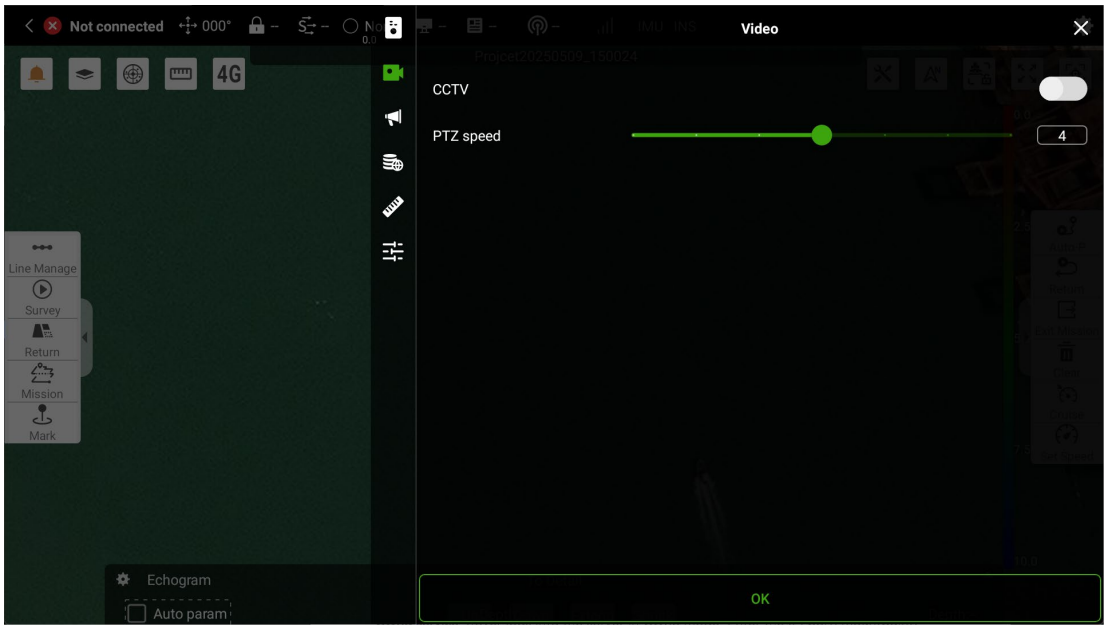


Figure 5-12 Video Settings

5.4.3 Diff Set

CORS service: Rover logs into the server in CORS mode. Enter the IP, port, mountpoint, username, and password to get the differential data. If you choose to use the controller's network to get the differential data, then the controller must be connected to a hotspot; if you don't choose to use the controller's network, you will use the boat's network, which means you need to insert a sim card in the control box of the boat.

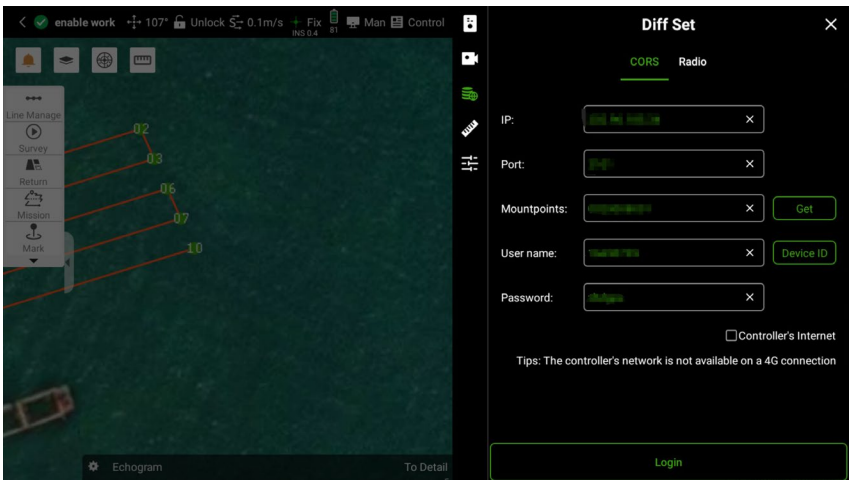
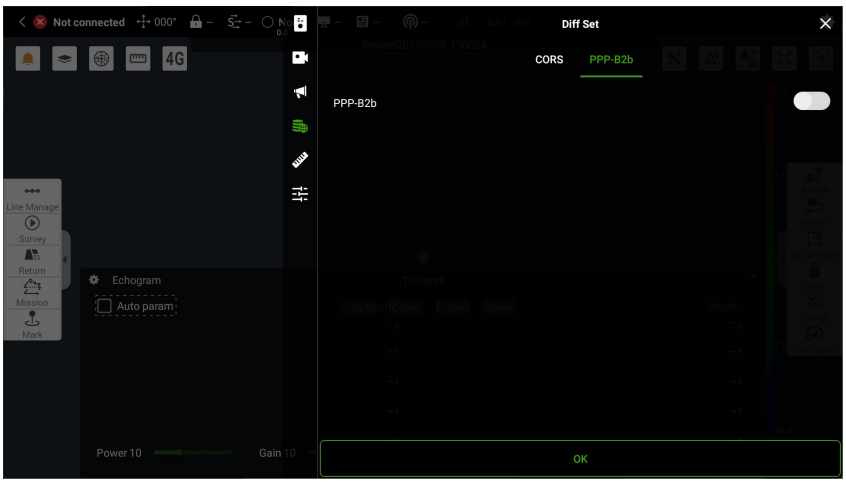


Figure 5-13 Network Differential

Radio setting: To use the "built-in radio" function, you only need to set the data chain as the built-in radio and modify the channel, protocol, and power. The radio protocol and channel must be the same as the base station.

Notice: When using the Controller's network, the Controller must be connected to a nearby WiFi-5G hotspot that can be connected to the network to obtain the mountpoint.

PPP-B2b: When turned on, USV uses PPP for position (first time use needs to wait for position convergence for about 30 minutes or so), switching to other diffs automatically turns off PPP-B2b



5.4.4 SingleBeam Config

Mark mode: If the echo sounder needs to control the marking by measuring software, you need to set the marking mode. The way to control sending marking command is by time interval, by distance. In terms of marking the measurement point display, a bathymetric point will be used to mark.

By time interval: Send marking command to the serial port of the connected echo sounder once every certain time, and the general interval time is set to 1~3 seconds. **By distance**: If the distance traveled by the ship exceeds the set distance interval, a marking command will be sent to the serial port of the connected echo sounder, and the general distance interval is set to 5~10 meters.

Automatic line switch: There are three automatic line change conditions can be selected, which are file size, point count and record time. If the current measurement line reaches the line change condition, the software will automatically change the line record.

Record conditions: There are three recording conditions can be selected, which are auto, float, fix.

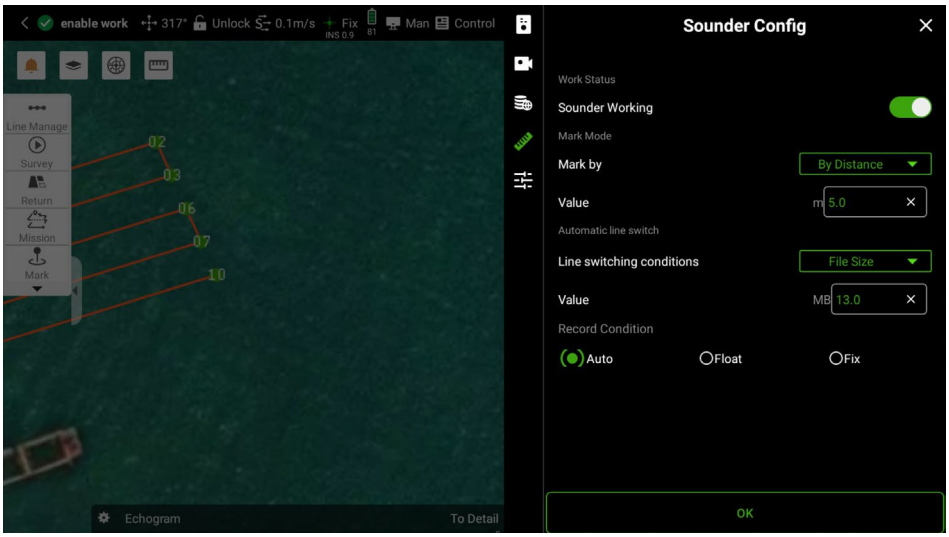


Figure 5-14 Measurement parameters

5.4.5 Other Set

[Time Zone Set]: The default time zone is GMT+08:00.

[Unit Set]: m/s and knots can be switched.

[Debug-Config]: Real-time view of trajectory information, GNSS information, system information, navigation information, equipment information.

[Debug-Device Info]: View the device information, operation information, battery information of the current device.

[Debug-Control Manual]: You can view the instructions for using the remote control buttons.

[Change Map Source]: Click on the [Change Map Source] button, three types of map maps appear at the bottom of the screen: World Sketch, Google Maps, and Custom Maps, and you can manually select the type you need to switch.

[Depth color set]: You can set the adaptive water depth color setting and manual water depth color range.

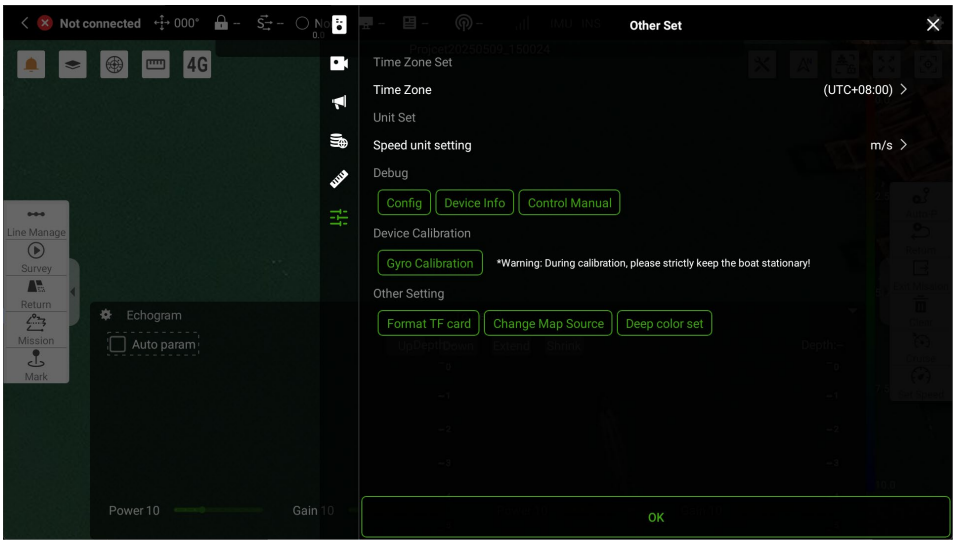


Figure 5-15 Other Set

Map source switching

After successful registration of the USV into the survey interface of the USV click on the icon, at the bottom of the [Other Settings] interface, click on the [Switch Map Source] button, the bottom of the screen appears in the world thumbnail, sky map, customized map three kinds of maps, you can manually select the type of switching you need.

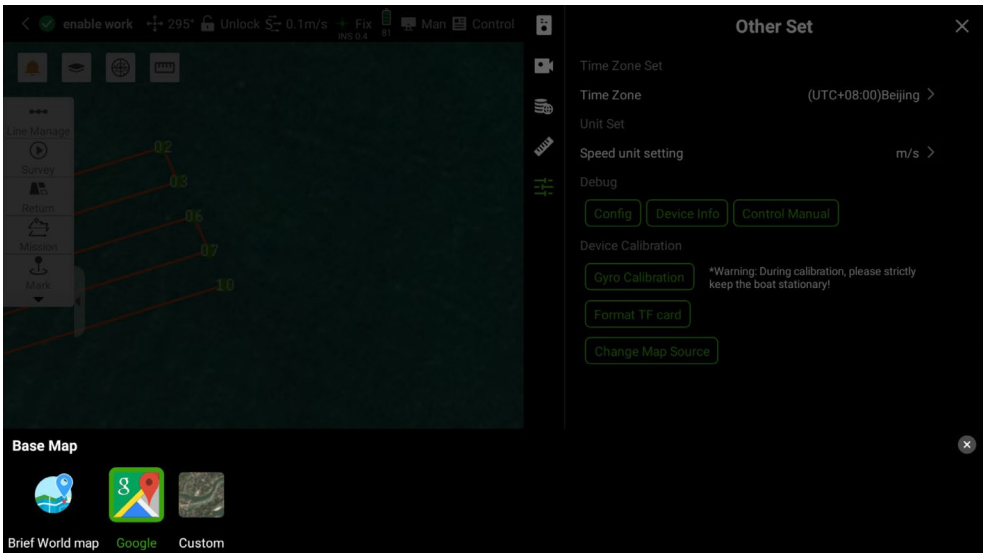


Figure 5-16 Change Map Source

5.5 USV Control

The main functions of the USV control include some functions in the measurement mode, as follows: clear waypoint, exit mission, start return, start navigation, fixed speed cruise, trajectory planning, return planning, and breakpoint renewal.

5.5.1 Breakpoint renewal

When the USV is performing the autonomous return or missions, it can realize the breakpoint renewal function by toggling the SW1 or SW4 back and forth. The function of breakpoint renewal includes *Stop Mission, The Last Waypoint, The Next Waypoint, and Choose another waypoint.*

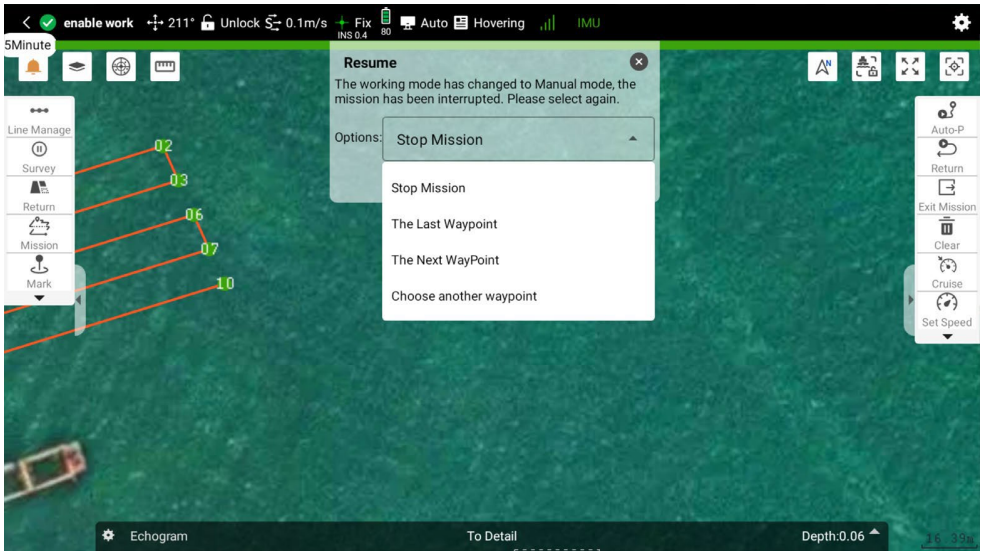


Figure 5-17 Breakpoint

5.5.2 Clear

There is track information or return information on the map, which can be emptied. You can select what needs to be clear. After clear, no mission information is available for the USV, which needs to be re- design or imported.

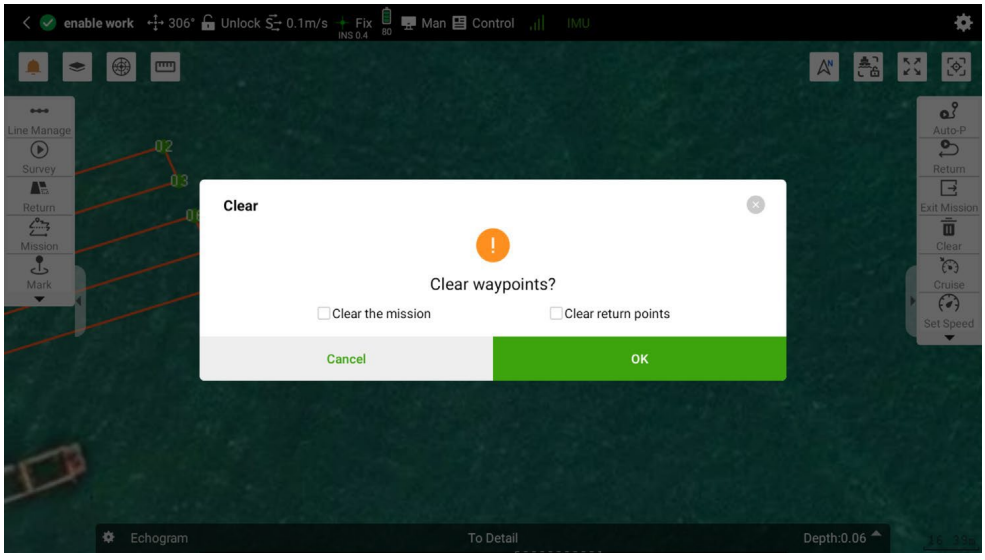


Figure 5-18 Clear waypoints

5.5.3 Exit

When the task exists for the USV operation task, the operation bar is updated to the operation task when you exit the task, and the USV stops the currently executed task.

5.5.4 Return

Click Start Returning, the USV will return from the current position according to the set single point or according to the return route.

5.5.5 Auto-P

Click to start sailing, the USV will carry out the cruising mission according to the currently planned trajectory.

5.5.6 Set Speed

The speed that can be set for fixed speed cruise is 1~6m/s, and the USV cruises in a straight line with the input speed after setting. The trajectory speed can be set when the USV is during return or track task.

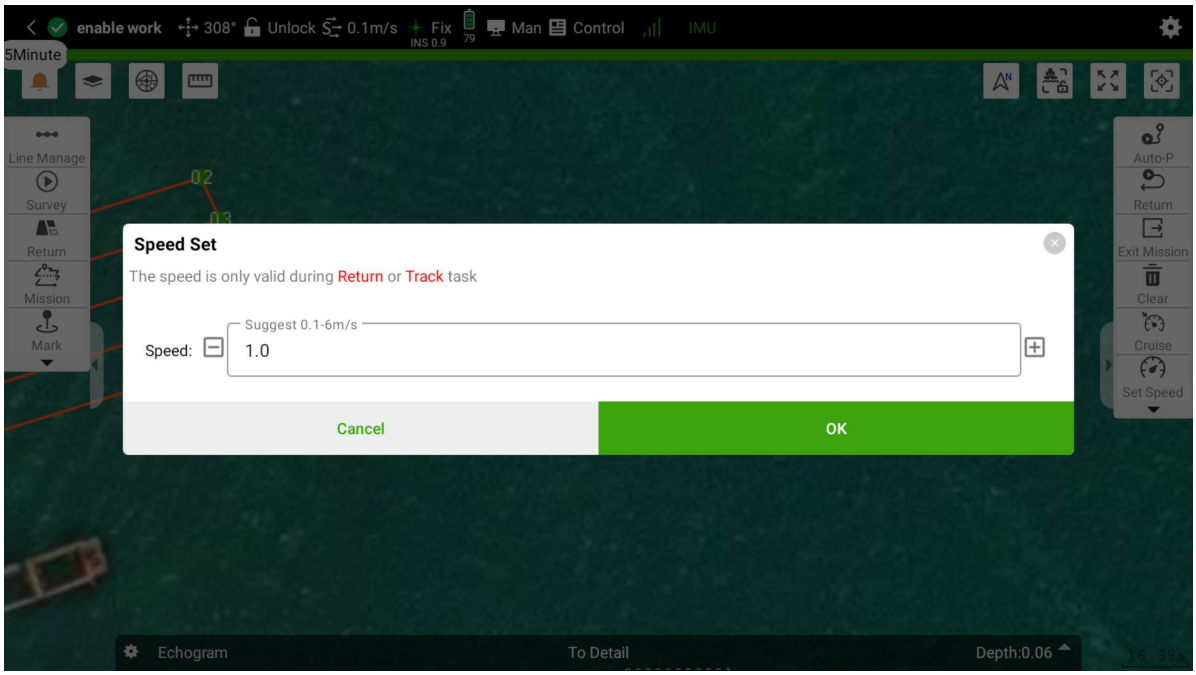


Figure 5-19 Set Speed

5.5.7 Return design

You can plan a single return point and a return route. When a single return point, the USV will drive straight to the return point after completing the automatic cruising task and clicking to start the return task. Return route is to return according to the planned return route and stay at the last point of the return route. Return planning can set the return speed, check the return immediately, and the USV will start the independent return mission after sending the task.

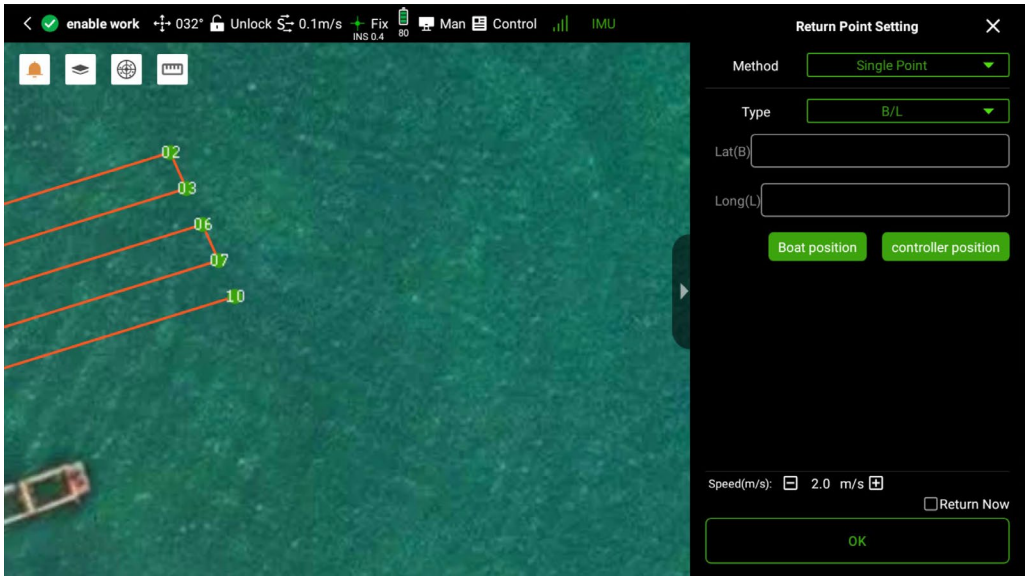


Figure 5-20 Return planning

5.5.8 Mission

There are four ways of Mission planning: *Design, Import, Modify* and *Auto*.

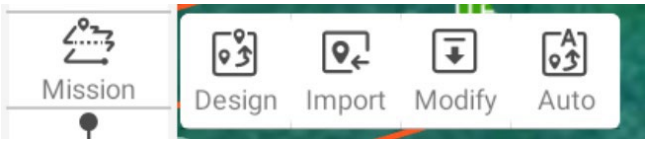


Figure 5-21 Mission

Design: That is, hand-drawn planning on the map, you can plan area line, general line. When planning waypoints, you can check the latitude, longitude, or NE coordinates of the waypoints in the right point list tab, and add, insert, revoke, delete, clear and other modifications to the plotted lines.

a. Revoke: You can click the undo button to undo the last drawn point when drawing error, at least two points must exist in the point list to use this function.

b. Delete: You can select any point on the list of points to delete, at least two points must exist in the list to delete the operation.

c. Add: You can add the next track point to draw the track line when drawing the track points. You can also continue to add track points after they are generated by manually selecting them on the map or by entering the specified coordinate values.

d. Clear: The operation of clearing all point data in the point list is irreversible.

e. Reverse: Sort all points in reverse order.

f. Drag: After switching off, the waypoints cannot be dragged.

g. Create: The waypoints are generated and displayed on the map page.

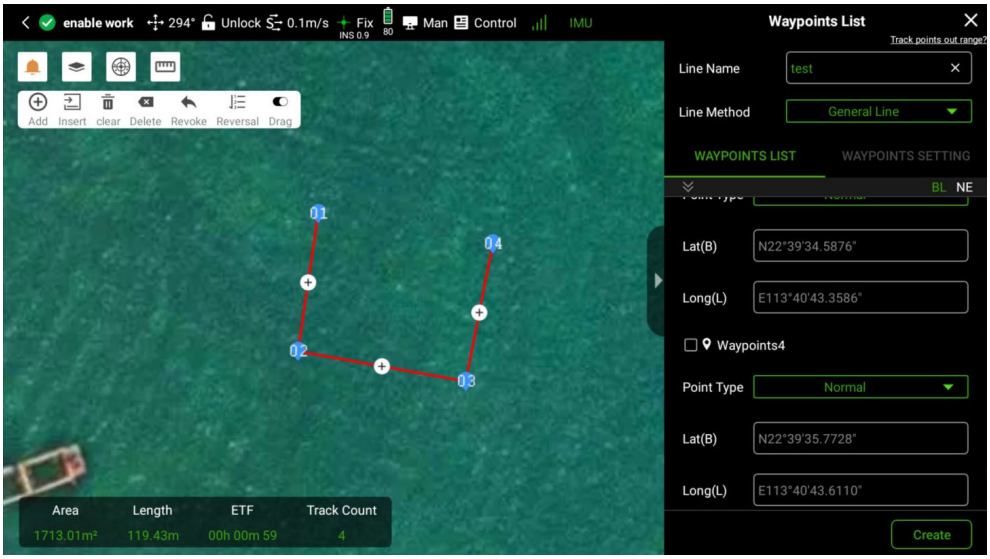


Figure 5-22 Track Design

The area wiring planning can set the track point parameters, such as speed, interval, angle, and start position.

Interval: The generated route generates routes with the same distance according to this pitch (Note: the pitch must be smaller than the actual planned route, otherwise the generated can't generate the waypoint).

Angle: The generated route is oriented with due north. Start position: contains upper left, upper right, lower left, lower right. The initial position of the route is kept consistent according to the setting, independent of the initial position of the planned waypoint.

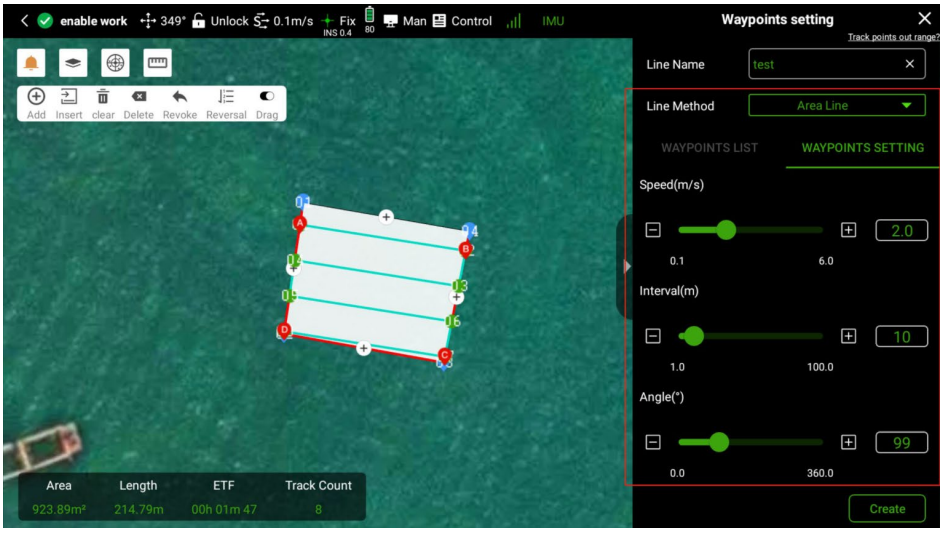


Figure 5-23 Trajectory parameter setting

Load: The unmanned ship already has a route and can plan the read route again. (Note: reading will fail after the USV clears the route, because the USV no longer has a route.)

Import: Import format is *KML waypoints. After importing, you can also edit the line generated by planning waypoints again for common wiring.

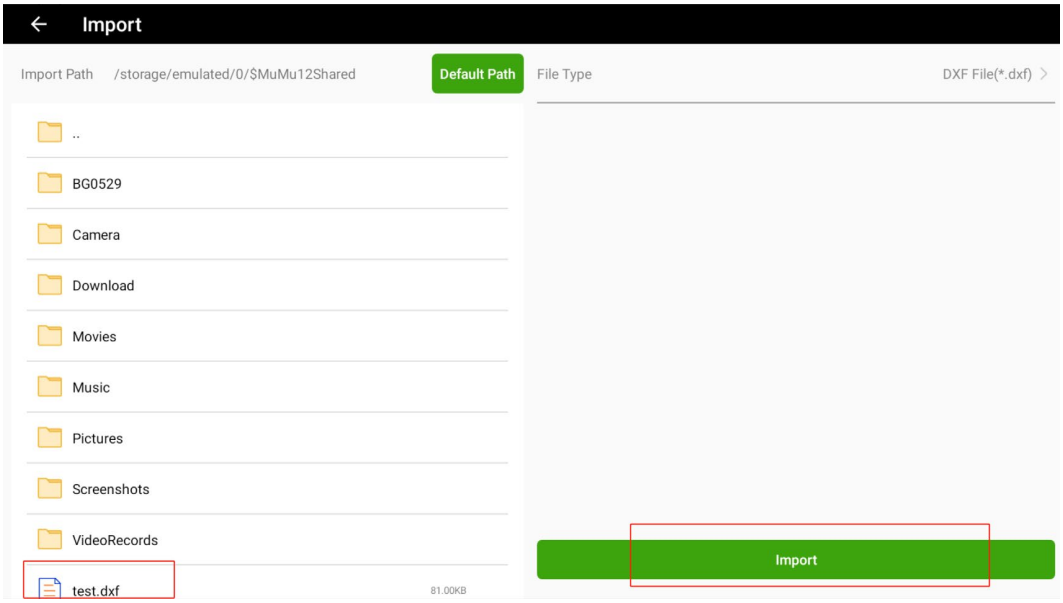


Figure 5-24 Trajectory import

After importing, you can see the drawing of the kml file on the map, and click on the drawing to stake out it.

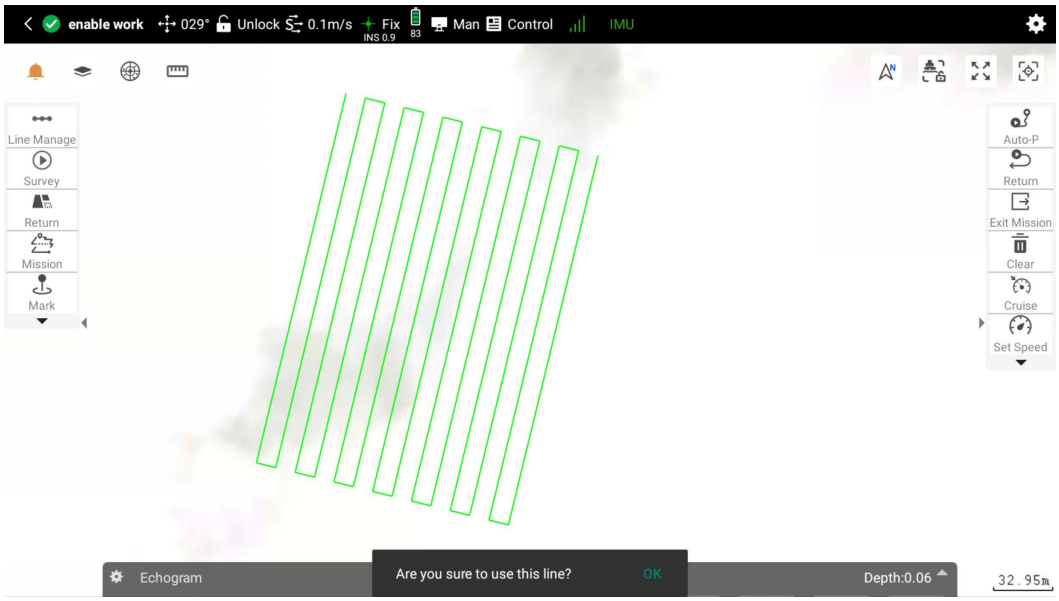


Figure 5-25 Drawing to stake out it

5.6 SingleBeam Survey

5.6.1 Line data acquisition

Click the *Survey* button to enter the capture settings page.

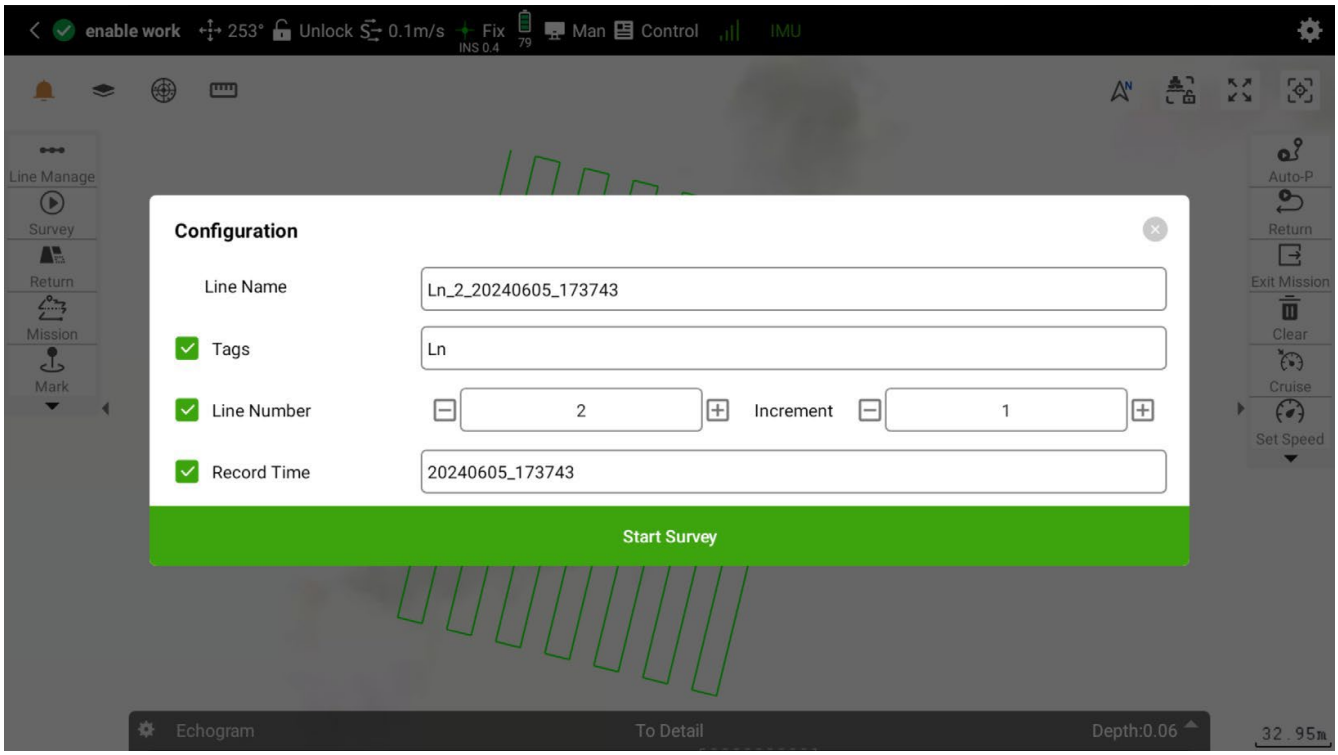


Figure 5-26 Line data measurement configuration

The measurement line file name is named in the following format: Ln_AA _YYYYMMDD_hhmmss

Table 5-1 Measurement line file name

Fields	Format	Description
Marking head	Ln	Measuring line marking
Measuring line number	AA	Corresponding line number of the measurement line, if there is no corresponding measurement line, the field is empty character.
Date	YYYYMMDD	Representing the year, month and date
Time	hhmmss	Representing the hours, minutes and seconds

For example: *Ln_10_20220630_164040* means: June 30, 2022, 16:40:40 for the measurement line No. 10.

After setting the increment, the measurable line will be automatically added to the increment when the line is automatically changed or manually changed, so as to avoid the

occurrence of the same name of the measurable line and the inability to collect the measurable line during the automatic acquisition and reduce the operation steps. After setting the measurement line without error, make sure to open the acquisition, the acquisition button will change to the acquisition state, and the measurement line on the measurement map page will record the track according to the USV's position.

5.6.2 Information Display

At the bottom of the Bathymetry Survey interface, the information setting content is hidden by default. Click the toggle button to display the information on the measurement page. By default, latitude, longitude, north, east, geodetic and elevation are displayed in real time.

Open the message setting page, you can drag the displayed messages, delete the display bar or add the hidden bar content to the display bar, up to 6 messages and at least 2 messages can be displayed.

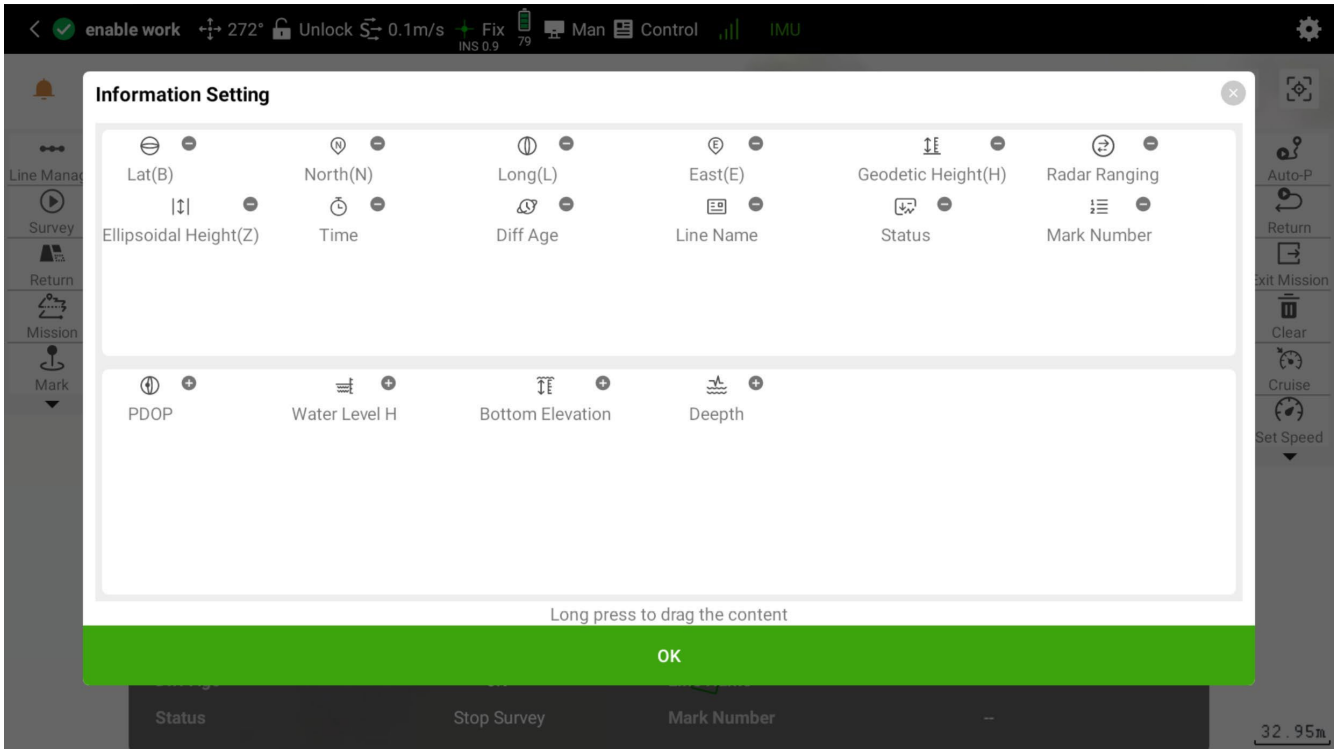


Figure 5-27 Information Setting

5.6.3 Echo information

When switching to the echo information, you can observe whether the current unmanned ship echo data is normal or not. Adjust the echo information display with up, down, extend and shrink. **Up and Down**: adjust the display position of the echo image in the window. After canceling the automatic tracking, the party can adjust the upshift and downshift. **Extend and Shrink**: adjust the position of the echo image in the window.

Figure 5-28 Echo information

Auto param: default on, click to enter the automatic mode, the parameters are automatically adjusted.

Manual param: click on the echo setting to enter the Sounding Parameters configuration page.

Note: Auto Velocity needs the USV to support temperature sensor in order to work properly.

5.7 ADCP Survey

Notice: For ADCP data collection via SLHydro USV software, you need to make sure that the software is version 3.0.7 or higher, the firmware is version 1.0.8 or higher and the controller is an H20.The H16 controller does not support Android collection

5.7.1 Parameter Configuration

Open the SLHydro USV software, choose the ADCP Survey mode, enter the "Project Management" interface and create a new project.

Switch the project type to an ADCP survey project. You can choose to create in either Expert Mode or Intelligent Mode.

Input the project name and select the required coordinate system.

Complete the general configuration and click "Next" to enter the ADCP survey configuration interface.

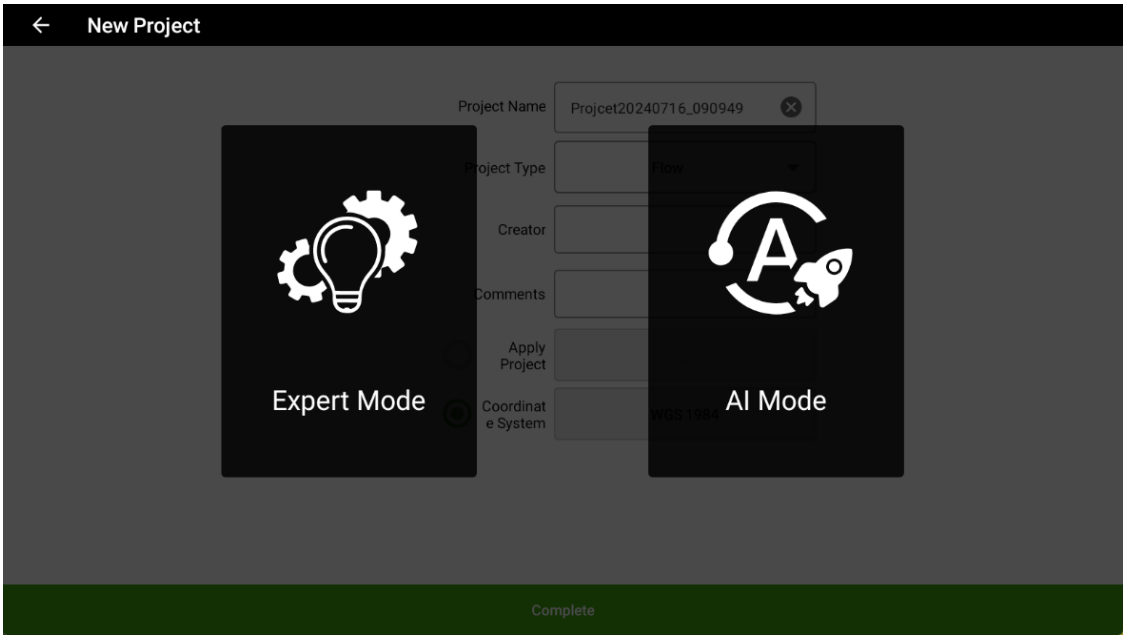


Figure 5-29 ADCP Survey Project Creation

Expert Mode: In the ADCP survey configuration interface, set the following parameters: number of cells, cell thickness, blanking distance, water pulse count, bottom pulse count, ping interval, data group interval, and immersion depth. After completing the parameter configuration, click "Next" to enter the measurement configuration interface.

ADCP Survey Commands:

- Blanking Distance: The vertical depth near the ADCP where effective survey data cannot be provided due to transducer reverberation. Options are 0.12m, 0.25m, 0.5m,

1m, 2m, 4m, and 8m. Typically, the blanking distance is consistent with the cell thickness.

- Cell Thickness: The size of the velocity cells. Smaller sizes provide higher depth resolution and finer layers. Options are 0.12m, 0.25m, 0.5m, 1m, 2m, and 4m.
- Number of Cells: The maximum number of measurement layers, adjustable between 1 and 300. The product of the number of cells and cell thickness, plus the blanking distance, should be greater than the maximum water depth.
- Water Pulse Count: The number of pulses for measuring water.
- Bottom Pulse Count: The number of pulses for measuring the river bottom.
- Ping Interval: The interval time between two pings.
- Data Group Interval: The output time interval between two data groups.
- Vertical Ping Count: The number of pings for vertical distance measurement.
- Surface Ping Count: The number of pulses for measuring surface water.

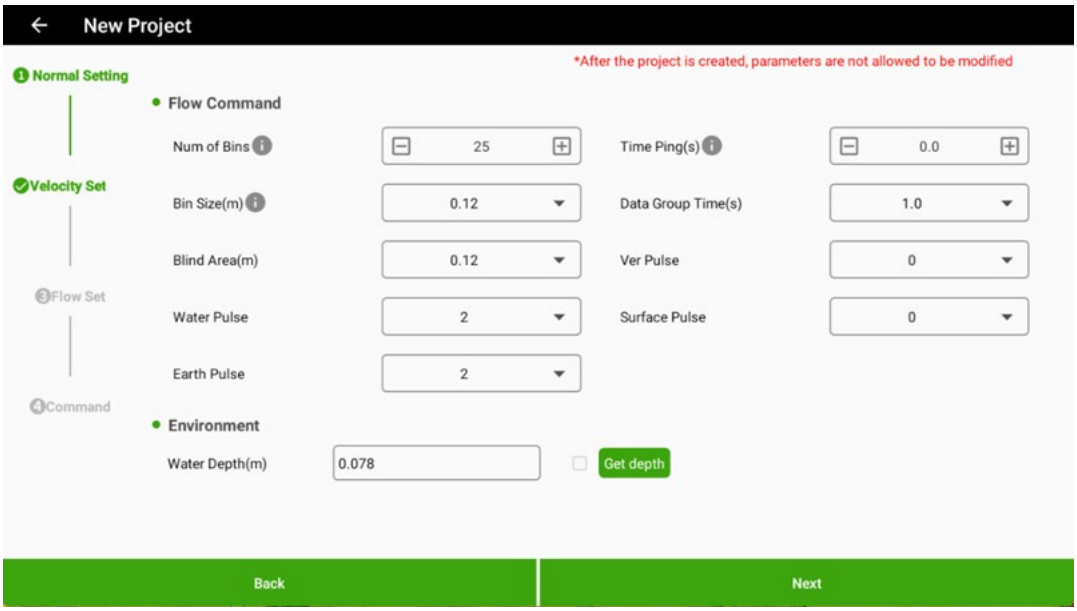


Figure 5-30 ADCP Survey Parameter Configuration

After configuring the parameters, click "Next" to enter the measurement configuration interface.

- **Measurement Configuration**

In the measurement configuration interface, you can configure the following settings as needed:

1) Velocity Reference: When converting the water speed measured by ADCP to absolute speed relative to the earth, the water speed should be subtracted by the reference speed. Options are:

2) Bottom Track: Use the ADCP bottom track speed as the boat speed reference (default option).

3) GPS (GGA): Use the GPS GPGGA data speed as the boat speed reference when good GPS conditions are available.

4) GPS (VTG): Use the GPS GPVTG data speed as the boat speed reference when good GPS conditions are available.

5) No Reference: Set the boat speed to 0 and use the water speed directly as the absolute speed to observe the water speed condition.

- **Compass Offset:** The offset angle between the compass and the heading.
- **Depth Reference:** The method of obtaining depth data. Options are bottom tracking, echo sounder, and vertical beam.

Click "Next" to enter the Command Preview interface.

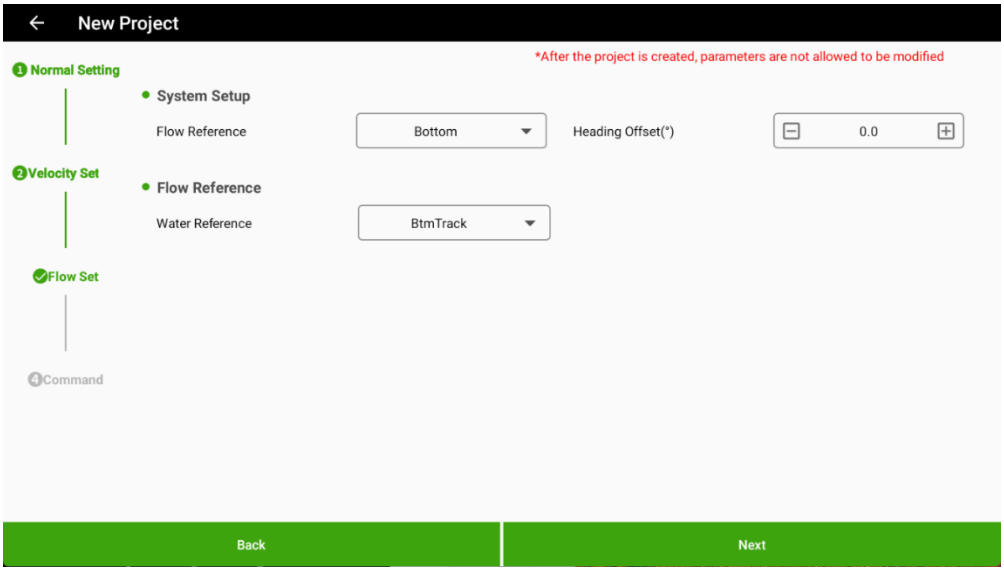


Figure 5-31 Flow Parameter Configuration

In the Command Preview interface, the modified configuration parameters are displayed compared to the default parameters. After selecting "User Custom Input," user commands can be modified. Confirm the settings and click "Finish."

WN: Number of cells

WS: Cell thickness

BP: Bottom pulse count

WF: Blanking distance

WP: Water pulse count

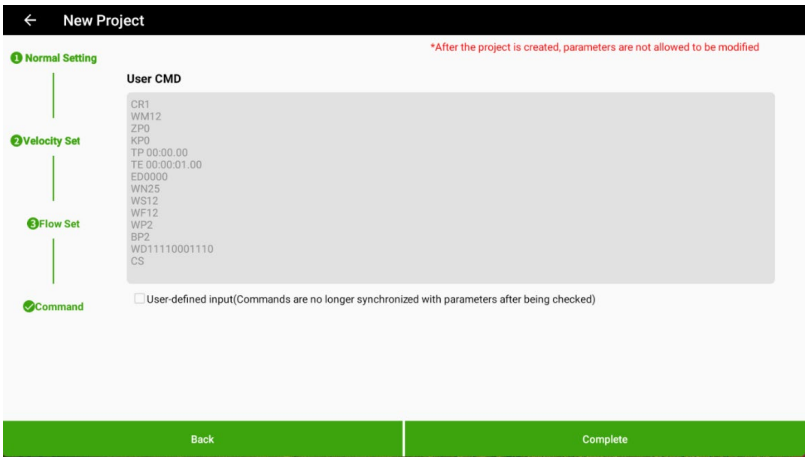


Figure 5-32 Command Preview

Notice: Avoid modifying user commands randomly, as incorrect command formats may result in parameter setting failures. For manual configuration of special commands, please contact the relevant technical personnel to verify before adding manually.

Intelligent Mode Configuration: In Intelligent Mode, simply choose either high flow rate (flow speed greater than 1m/s) or low flow rate (flow speed less than 1m/s).

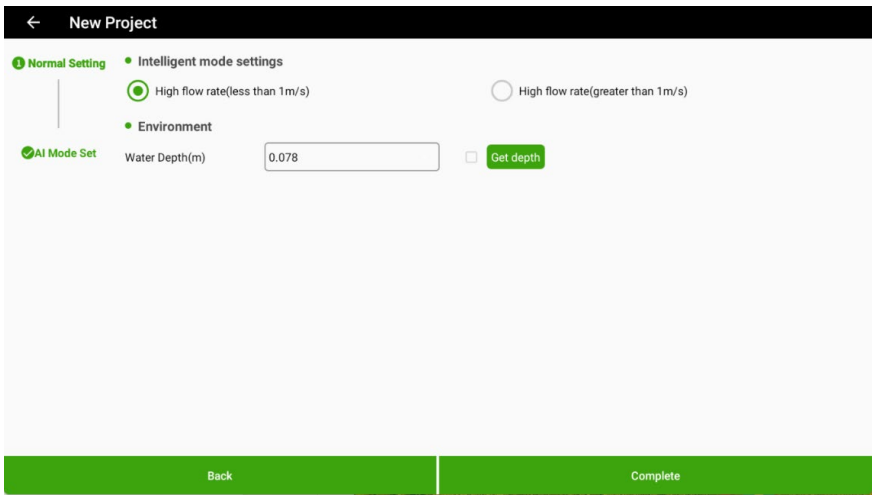


Figure 5-33 Intelligent Mode Parameter Configuration

5.7.2 Data Collection

In the measurement interface, click the "Start ADCP Survey" button. Two buttons, "Start Eject" and "Stop Eject," will appear.

Click "Start Eject" to send user commands, and the button will change to "Start Bank."

Click "Stop Eject" to exit the "Start Eject" and "Stop Eject" interface.

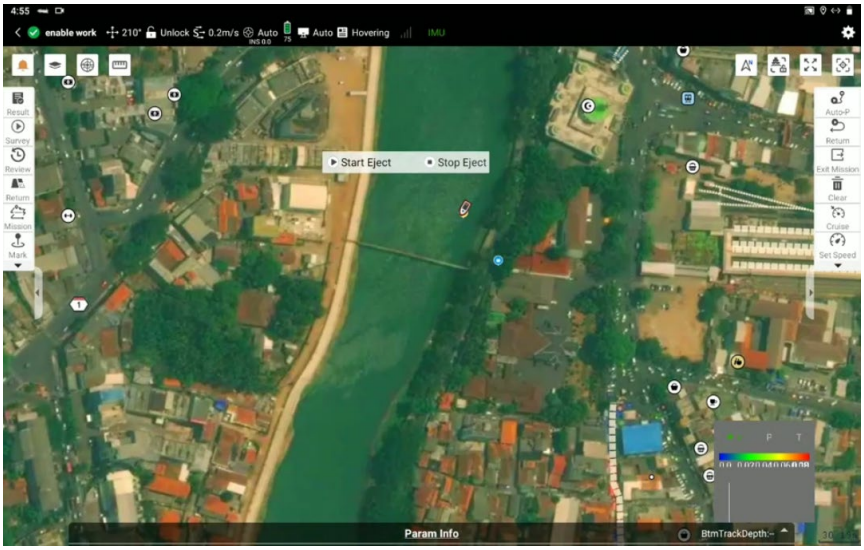


Figure 5-34 Start ADCP Survey

Start Bank: Choose the starting bank based on the flow direction (left bank is to the left of the flow direction, right bank is to the right). Configure bank ping count, bank type, and distance. Click "Confirm" to enter the prompt interface. The button will change from "Start Bank" to "End Bank."

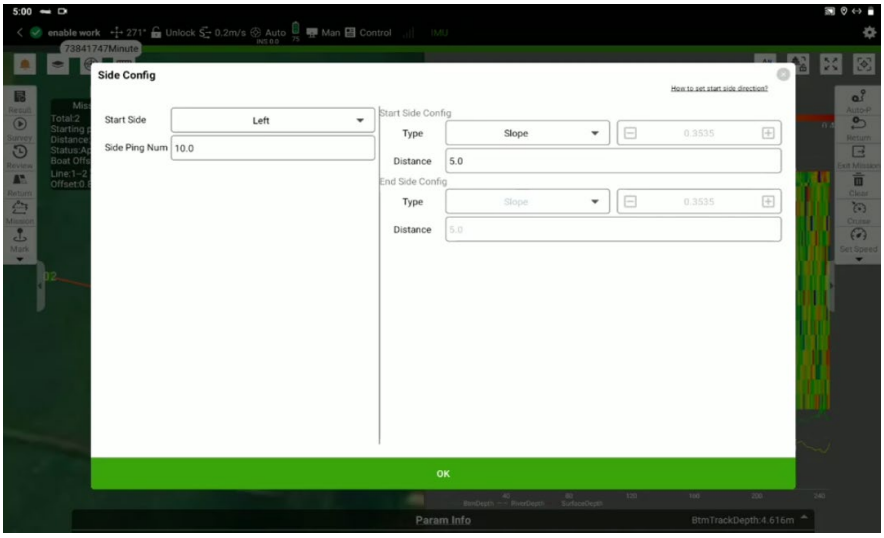


Figure 5-35 Start Bank

The software provides three types: slope bank, steep bank, and custom. The first two types offer fixed parameters that cannot be modified by the user.

Wait for the software to calculate the bank configuration. The number of calculations depends on the configured bank ping count. Once completed, the survey at the starting bank can begin.

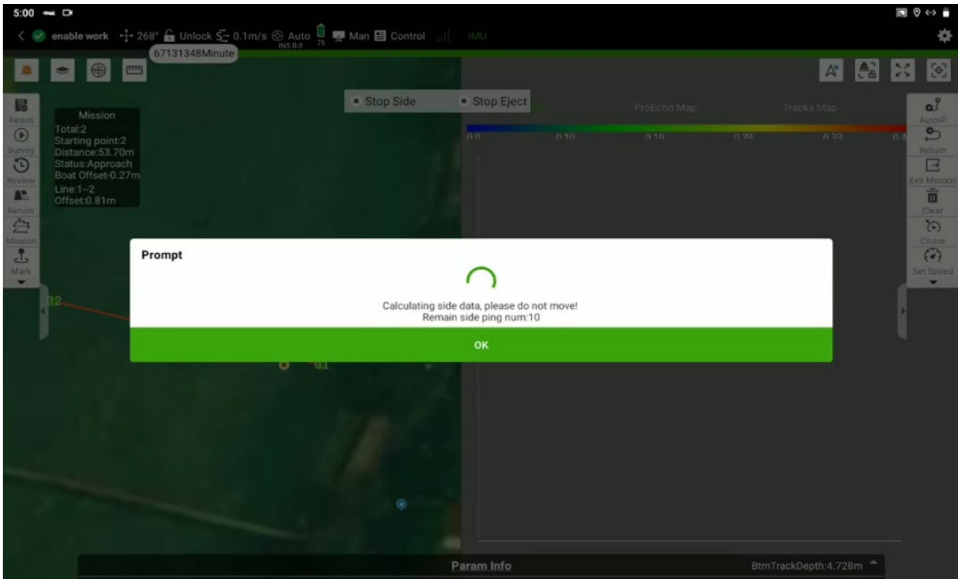


Figure 5-36 Calculate Bank

End Bank: The end bank defaults to the opposite of the starting bank and cannot be changed. The bank ping count, bank type, and bank distance can be adjusted. Click "Confirm" to complete one survey round of ADCP data collection. The End Bank interface is identical to the Start Bank interface, except only the End Bank field can be configured.

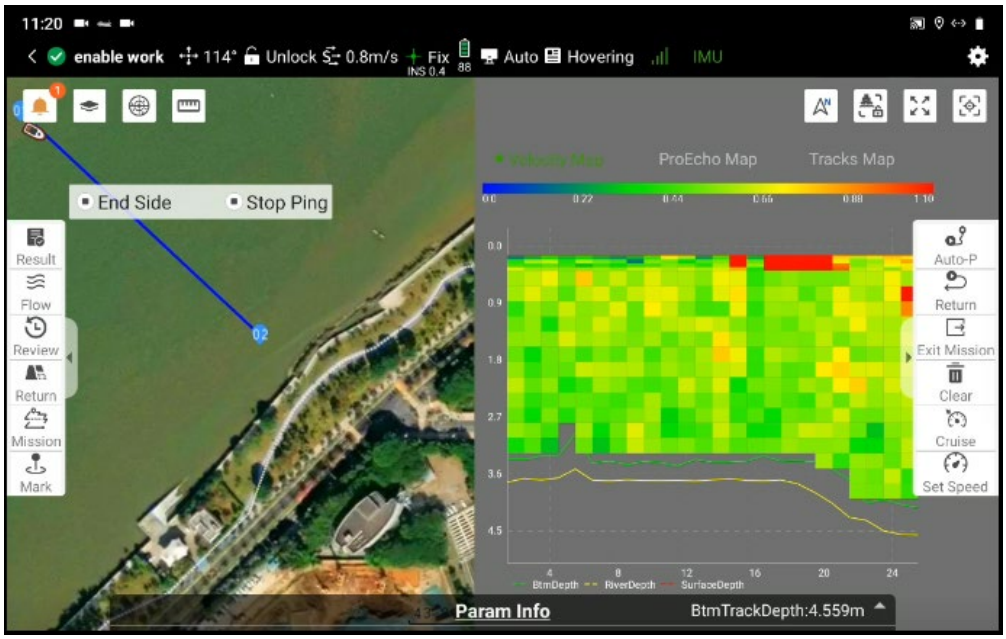


Figure 5-37 End bank

Stop Eject: After completing the survey, click "Stop Eject" to exit the ADCP survey mode.

5.7.3 Survey Information

In the USV survey interface, the survey information is hidden at the bottom of the screen, and the ADCP survey graphical interface is located at the bottom right of the interface. Double-clicking the ADCP survey graphical interface or the map interface will switch the display size of the interface. The software provides three sizes for switching.

Velocity Map: Users can visually view the depth information of the river bottom and the variation trend of the selected parameters through the velocity map.

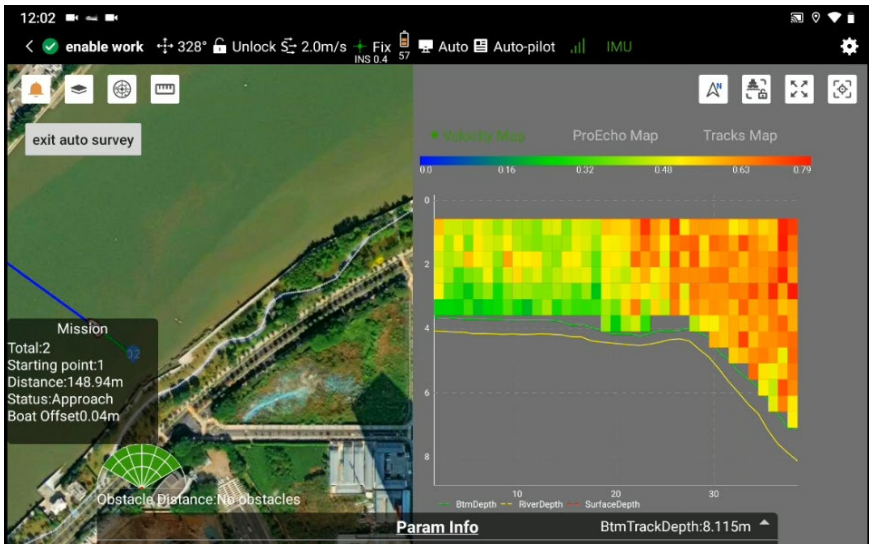


Figure 5-38 Velocity Map

Track Map: On the left side of the navigation map, users can view the navigation track of the survey boat from the start eject to the current eject, and the average flow direction corresponding to each eject. The track map includes bottom track, GGA, VTG, and velocity vector information.

Figure 5-39 Track Map

Profile Echo Intensity: Users can view the relationship curve between the current eject set parameters and depth through the profile map, displaying echo intensity, correlation, and beam velocity information.

Figure 5-40 Profile Echo Intensity

Basic Information: Displays eject set serial number, current time, number of eject sets, elapsed time, number of valid ejects, and number of valid layers.

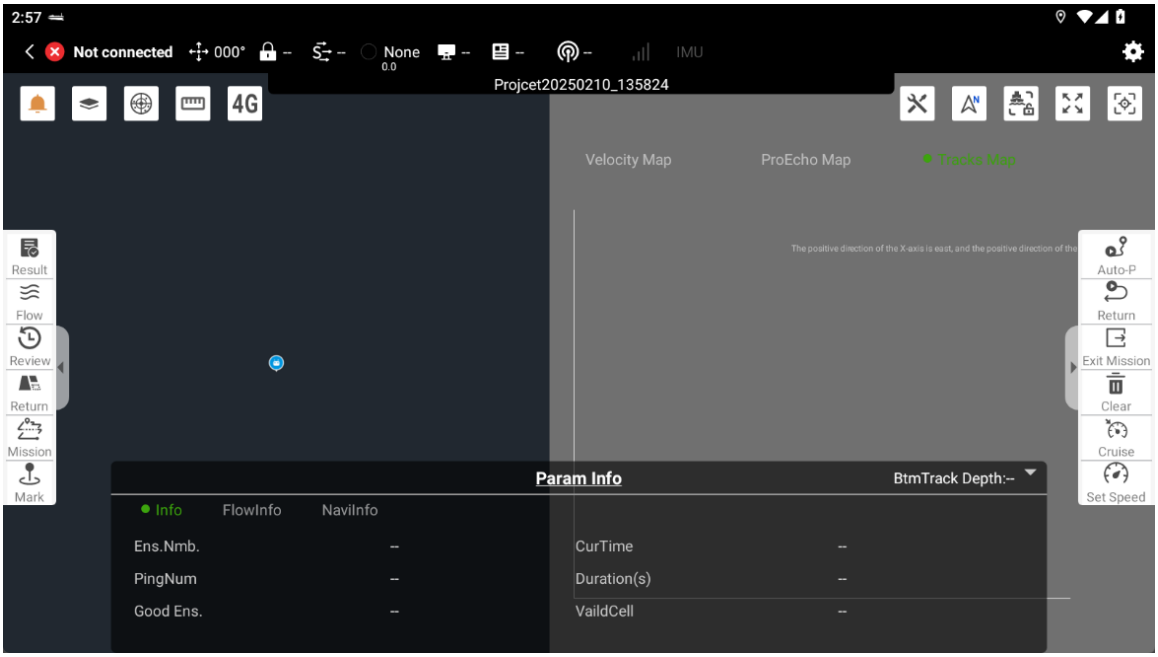


Figure 5-41 Basic Information

Flow Information: Displays total flow, top flow, bottom flow, measured flow, left bank flow, and right bank flow.

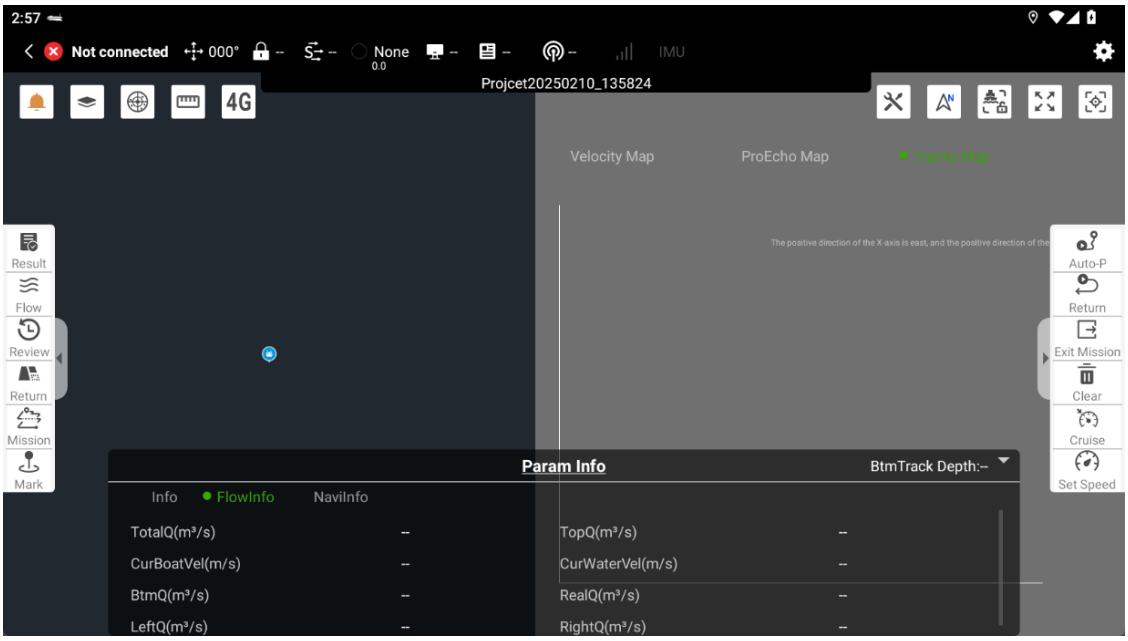


Figure 5-42 Flow Information

Navigation Information: Displays current flow velocity, current flow direction, current boat speed, current heading, track length, straight-line distance, track direction, longitude, latitude, temperature, pitch, and roll.

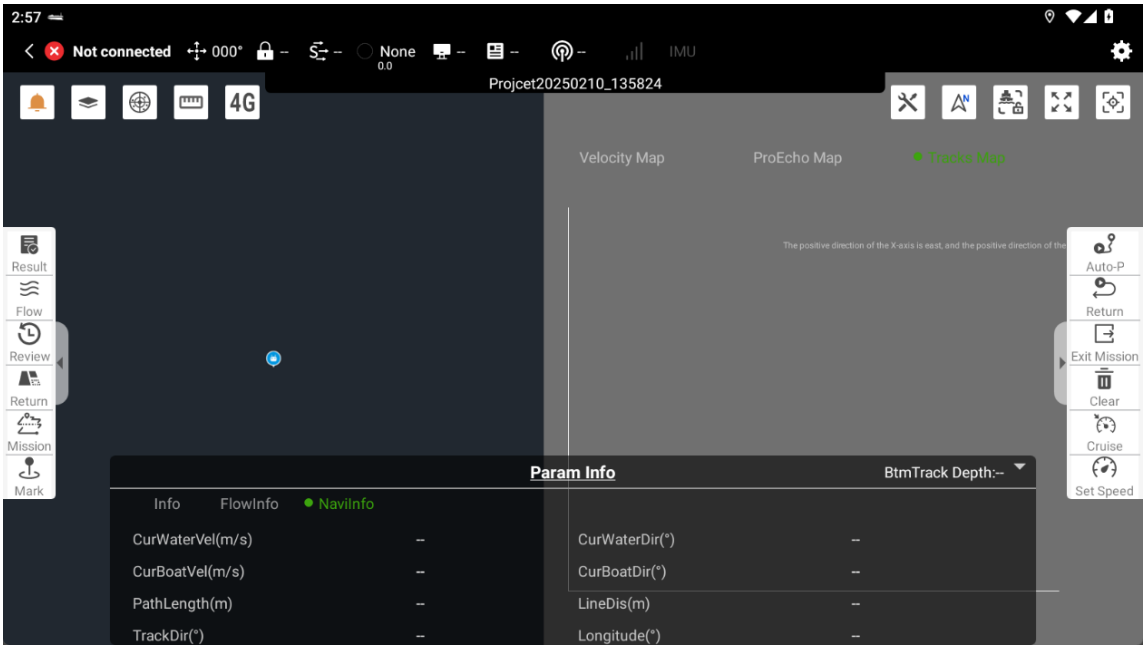


Figure 5-43 Navigation Information

5.7.4 Survey Playback

In the ADCP survey playback interface, you can select ADCP survey data for playback processing. Select the ADCP survey data in the interface and click the "Start Playback" button to replay the current survey data frame by frame. The software provides six

playback operations: "First Frame," "Last Frame," "Forward," "Backward," "Play/Pause," and the "ADCP Survey Progress Bar." The graphics and survey information will change accordingly after performing the respective operations.

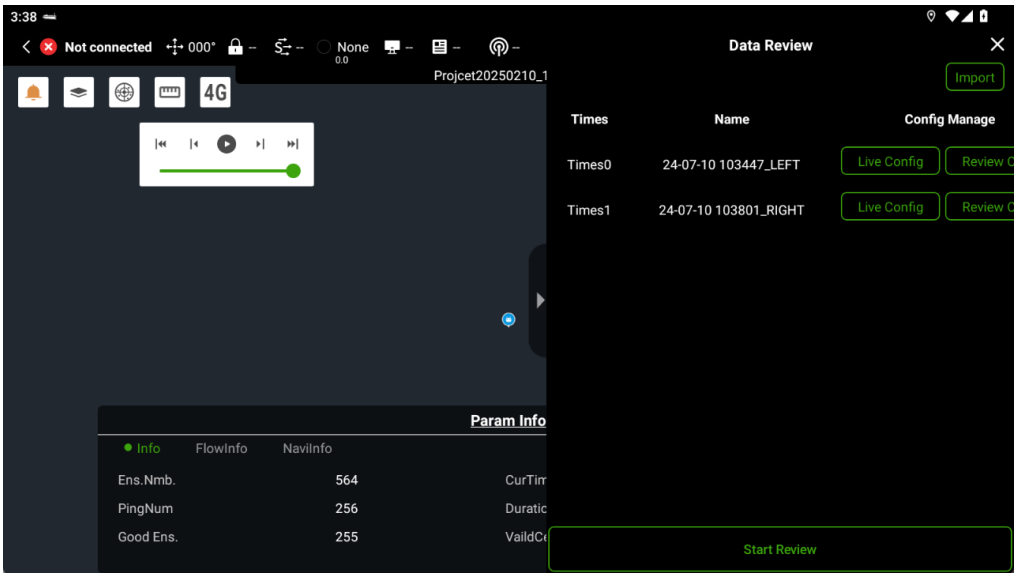


Figure 5-44 Data Playback

For selecting ADCP survey data, you can choose the measured data or manually import ADCP survey data. After opening ADCP survey playback, the "Import" button in the upper right corner allows importing ".PD0" files.

Users can change the playback configuration as needed. The software provides two modes: "**Field Configuration**" and "**Playback Configuration**."

"**Field Configuration**" allows viewing the configuration parameters of the current survey, which cannot be modified.

In "**Playback Configuration**," users can modify the interface's configuration parameters. After clicking "Finish," the software will recalculate the survey based on the configured parameters and update the interface data and survey results.

After setting the playback configuration parameters, you can click "**Restore**" in the upper right corner to reset the parameters.

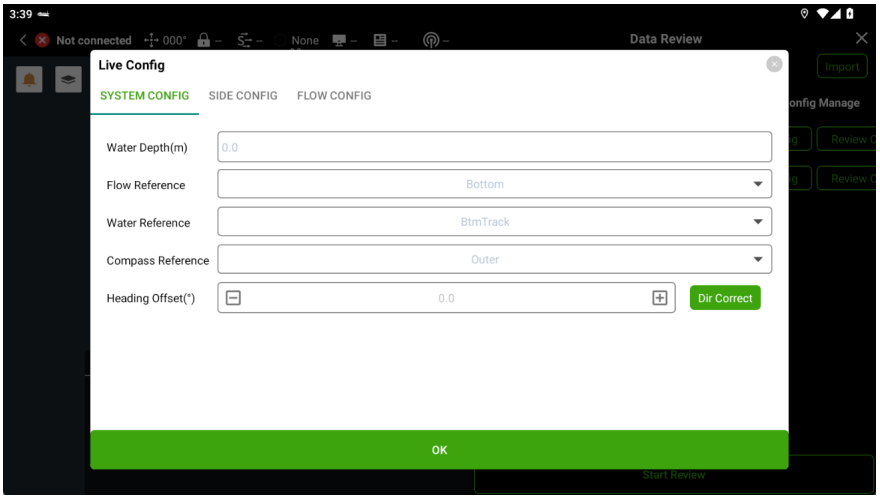


Figure 5-45 Playback Configuration - System Configuration

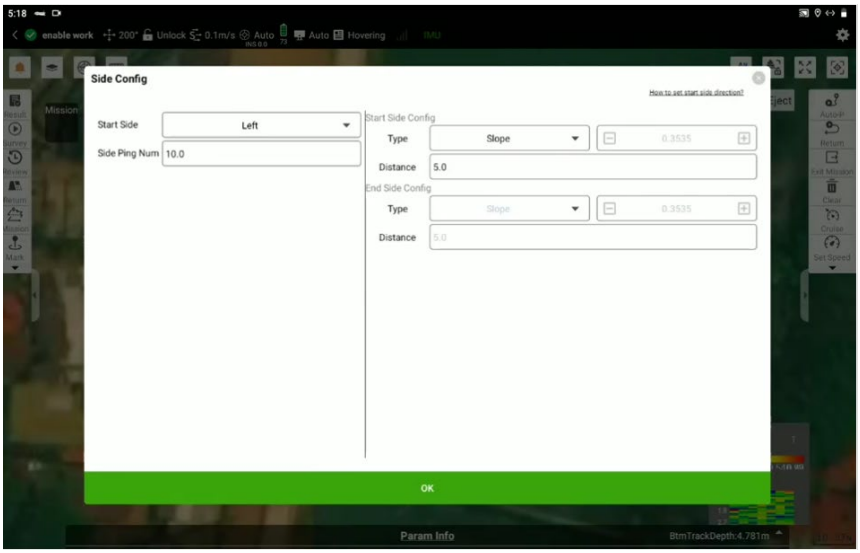


Figure 5-46 Playback Configuration - Side Configuration

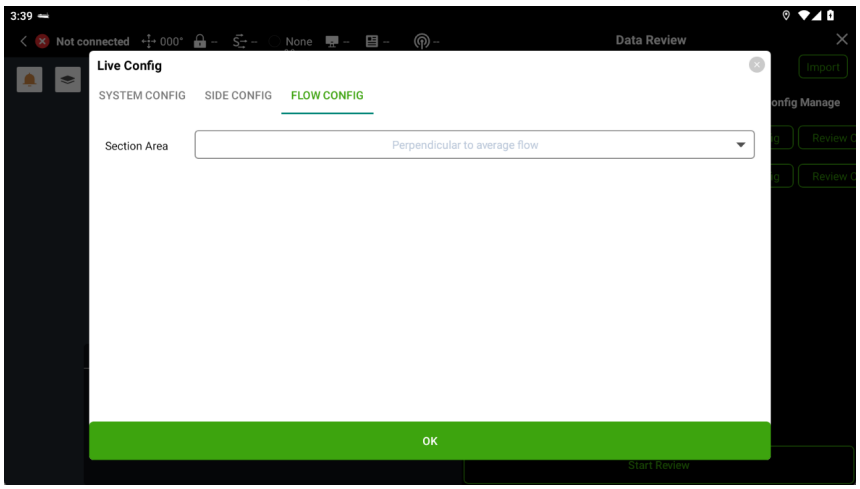


Figure 5-47 Playback Configuration - Flow Configuration

Heading Calibration Table: In the playback configuration, clicking "Heading Calibration Table" allows viewing the bottom track heading values, GGA heading values, VTG heading values, and heading deviation values for each survey.

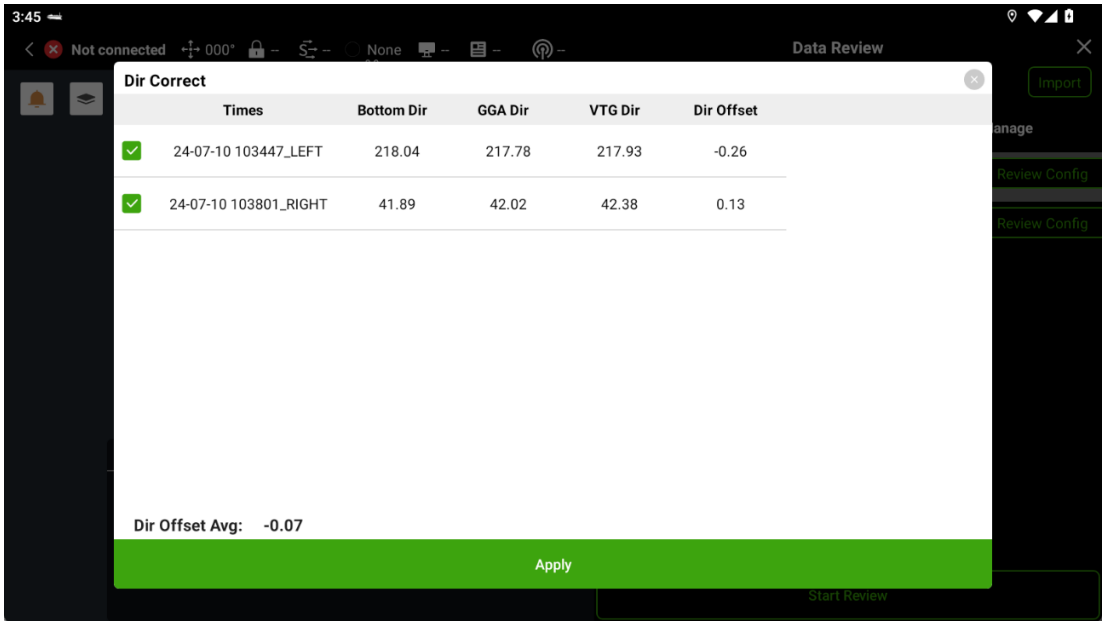


Figure 5-48 Heading Calibration Table

5.7.5 Results

ADCP Survey Results: After completing the ADCP survey, you can view the survey data in "ADCP Survey Results." The data display includes the file name of the measured data, starting bank, number of eject sets, start time, total flow, velocity reference, and other information.

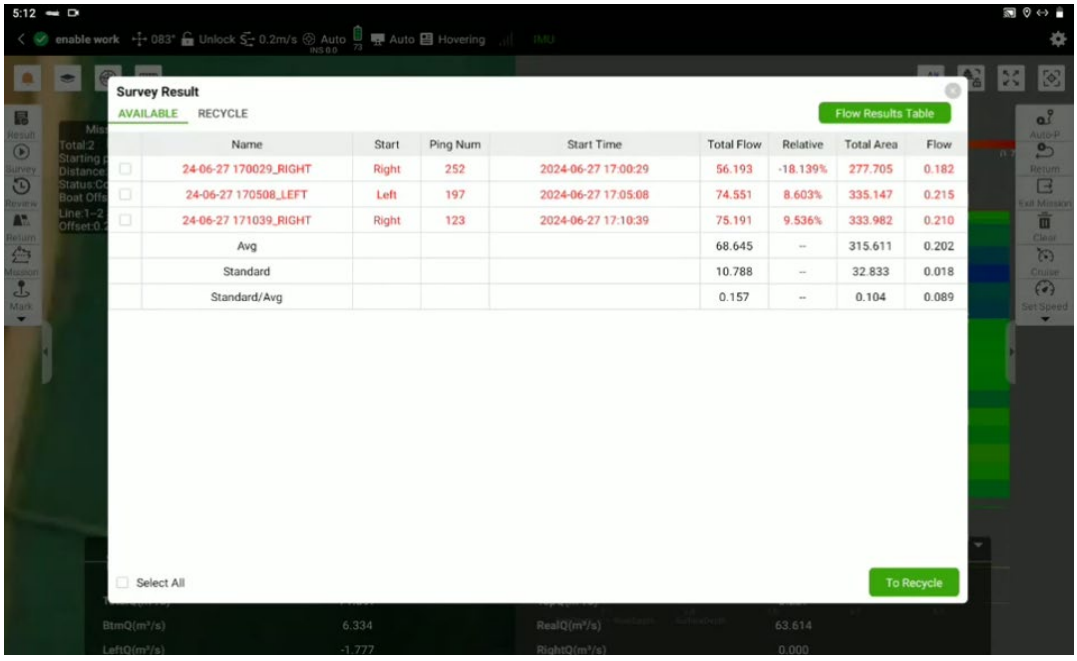


Figure 5-49 ADCP Survey Results

Move to Trash: You can select single or multiple ADCP survey data for deletion. The system files will not disappear after deletion, and the deleted data can be restored from the trash.

Restore: Deleted data can be restored from the trash.

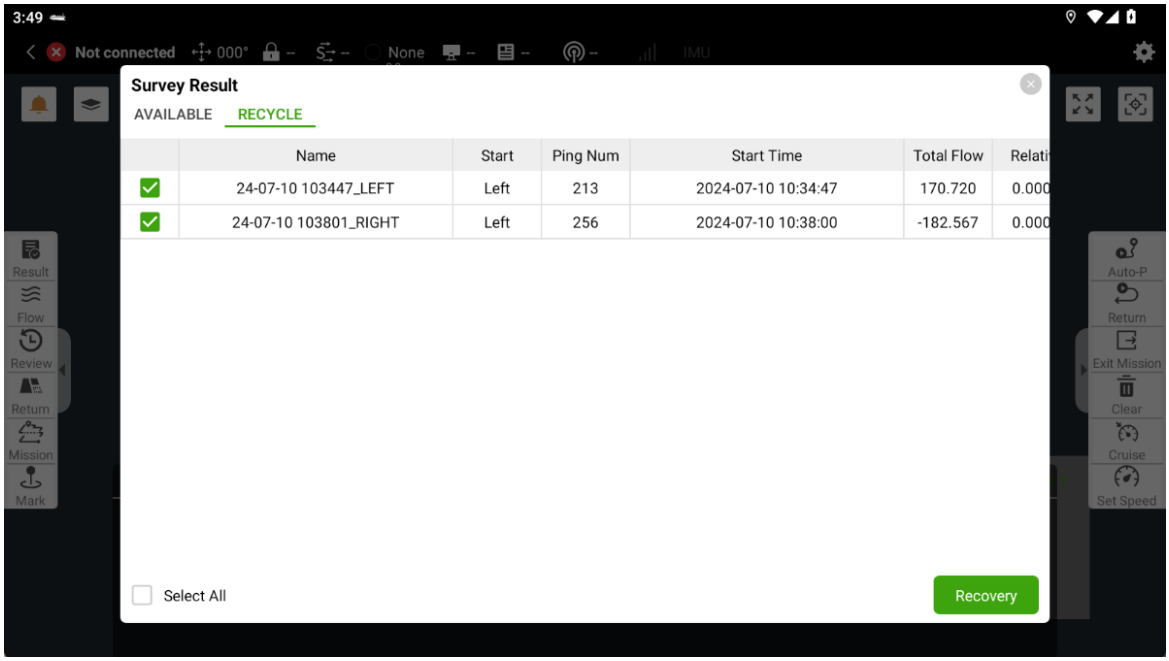


Figure 5-50 Restore

Export Survey Results: After clicking "Flow Results Table," you can fill in the station information, water level information, personnel operations, and remarks. After completing the entries, you can export the results report. The software supports exporting in PDF and EXCEL formats.

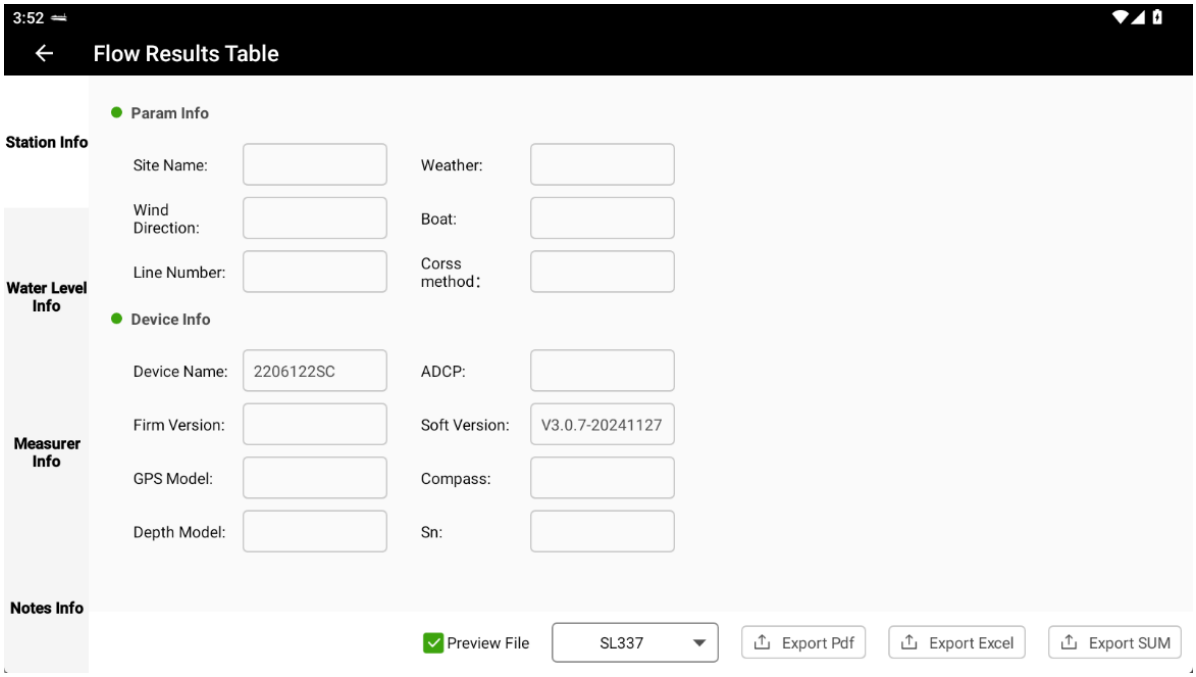


Figure 5-51 Export ADCP Survey Results

Acoustic Doppler Velocimeter Flow Test Record Form

Date: y m d		Weather:		Wind power and direction:	
Measurement times:		Boat:		Computer:	
Start time:		End time:		Aver time:	
ADCP model:		Fire version:		Soft version:	
Gnss model:		Compass:		Echo Sounder:	
Data file path:			Config file path:		
Transducer depth: m		Blanking Distanc:		Depth cell size:	Number of depth cell:
Salinity:		Water tracking ping number:		Bottom tracking ping numbe:	Exponent $\overline{b}$

Measurement Round	Course	Shore distance (m)		Data file name	Half round Q(m^3/s)	Average Q of one round(m^3/s)	Remarks
		L	R				

Measurment Result

Measure Items	Round 1		Round 2		Round 3		Average of rounds
	Forward	Back	Forward	Back	Forward	Back	
Cross-sectional Q (m^3/s)							
Cross-sectioal Area(m^2)							
Average current vel(m/s)							
Max current vel(m/s)							
Average water depth(m)							
Max water depth(m)							
Water surface width(m)							

start water level: m	end water level: m	average water level: m	corresponding water level: m
Remarks:			

Operation record:		On-site review:		Approved:	

Figure 5-52 Export EXCEL

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