RTI Sea Monitor

User Guide

Revision 1

Version 1.0 – Sept. 19, 2019

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1. Introduction

RTI's new ADCP3 products are designed and developed to operate from a frequency range of 38 kHz to 2.4 MHz with single and dual frequency mode of operation. It is important to set up an instrument with the different set of parameters under variable environmental conditions. RTI Sea Monitor software has been developed to simplify the setup configuration for a single, dual and multiple frequency operation of the ADCP3 products.

By utilizing grouping, uniform pinging and burst pinging features provided by ADCP3, RTI Sea Monitor software makes the complicate ADCP setup and deployment procedure a simple standard process for both single frequency ADCPs and dual frequency ADCP systems. The planning of the software will predict the performance of the system based on the setup, the user can choose to use it or to make an adjustment of it. RTI Sea Monitor can also be used to view the live data when it deployed as well as to post-process and display the data collected by RTI ADCP. This manual is designed to help users to get familiar with RTI Sea Monitor system.

System Requirements

RTI Sea Monitor for PC requires the following specifications for the PC:

Windows Vista or newer with .NET framework 4.7

1 GHz processor or faster

1 GB RAM

1 GB hard disk space

1024 x 768 or higher screen resolution

Installation

To install the software on your PC, run the installer "SeaMonitor.X.X.X.X_Installer_DateTime.exe" from the RTI provided CD or memory stick, then follow the installation wizard instructions and keep the default settings. After installed, you should see the "Sea Monitor" software icon on your desktop. Double click the icon to start the Sea Monitor program. You are now ready to use Sea Monitor to plan your development or playback a previous collected measurement data.

Contact Us

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2. Terminology

- **Ping**: a single or multiple sequence of pulse transmission used for echo reception and signal processing.
- **Ping time**: the time taken (in seconds) by the ADCP to complete one Ping. It includes system wake up and initialization time, transmit time, receive time, data processing time and data recording time.
- **Water Profile Time Between Pings (*CWPTBP*)**: the time (in seconds) interval between water profile pings. This is the time interval between the start of a ping and the start of the next ping for each frequency.
- **Subsystem**: one or more sequential pings at one frequency for the potential configuration.
- **Pings per subsystem (*P*)**: the number of pings in each subsystem.
- **Subsystem oPeration Order (*CEPO*)**: the operation order of subsystems. For example, *CEPO ABC* means subsystem *A* pings first, subsystem *B* pings next followed by subsystem *C*.
- **Group (*G*)**: collection of one or more subsystems operating sequentially one after the other. For example, *G{ABC}* is a group of three independent subsystems *A*, *B* and *C*, representing different frequencies.
- **Group Time (*GT*)**: the duration time taken for completing one group.
- **Time Between Groups (*TBG*)**: the time interval (in seconds) between groups. It is also called **Group Interval (*GI*)**.
- **Subsystems per group (*M*)**: the number of subsystems in one group (1 =< *M* <= 12). It will be automatically selected when you chose the instrument.
- **Groups per ensemble (G*N*)**: the number of groups to be averaged in each ensemble. The minimum number of groups in an ensemble should be G*N* >= 1.
- **Ensemble**: the collection of single or multiple groups over a certain time period (usually averaged). The ensemble data is the output of ADCP. It can include measured current profiles, echo intensity profiles, Bottom track velocities, pitch/roll, heading BIT results, and other user selectable data. The ensemble can contain the single ping data over the ensemble interval, or it can contain the averaged data from multiple groups.
- **Ensemble Interval (*CEI*)**: the time interval (in seconds) between data ensembles.

3. Subsystem

ADCP3 system serial number starts with SN07xx, the subsystems used for ADCP3 are listed below:

Code#	Description
0	Reserved
A	Spare
B	1.2 MHz 4 beam 20 deg piston
C	600 kHz 4 beam 20 deg piston
D	300 kHz 4 beam 20 deg piston
E	150 kHz 4 beam 20 deg piston
F	75 kHz 4 beam 20 deg piston
G	Spare
H	Spare
I	1.2 MHz 4 beam 20 deg piston, 45 degree heading offset
J	600 kHz 4 beam 20 deg piston, 45 degree heading offset
K	300 kHz 4 beam 20 deg piston, 45 degree heading offset
L	Spare
M	Spare
N	1.2 MHz 1 beam vertical piston
O	600 kHz 1 beam vertical piston
P	300 kHz 1 beam vertical piston
Q	150 kHz 1 beam vertical piston
R	Spare
S	Spare
T	Spare
U	1.2 MHz 4 beam 20 deg piston, doughnut hole
V	600 kHz 4 beam 20 deg piston, doughnut hole
W	300 kHz 4 beam 20 deg piston, doughnut hole
X	Spare
Y	Spare
Z	Spare
a	Spare
b	1.2 MHz 4 beam 30 deg array
c	600 kHz 4 beam 30 deg array
d	300 kHz 4 beam 30 deg array
e	150 kHz 4 beam 30 deg array
f	75 kHz 4 beam 30 deg array
g	38 kHz 4 beam 30 deg array
h	Spare
i	Spare
j	Spare
k	Spare

l	Spare
m	Spare
n	1.2 MHz 1 beam vertical array
o	600 kHz 1 beam vertical array
p	300 kHz 1 beam vertical array
q	150 kHz 1 beam vertical array
r	75 kHz 1 beam vertical array
s	38 kHz 1 beam vertical array
t	Spare
u	1.2 MHz 4 beam 30 deg array doughnut hole
v	600 kHz 4 beam 30 deg array doughnut hole
w	300 kHz 4 beam 30 deg array doughnut hole
x	150 kHz 4 beam 30 deg array doughnut hole
y	Spare
z	Spare

4. Pinging Scheme

In order to optimize the parameters and maximize the efficiency of dual frequency systems, RTI ADCPs innovatively grouping the different frequency pings together and utilizing the two pinging schemes to operate them: the uniform group pinging and the burst group pinging.

4.1 Grouping

A group is a collection of one or more subsystems operating sequentially one after the other within an ensemble interval. One or more groups in an ensemble will be averaged into a data ensemble and will be outputted by the ADCP (Figure I). For example, *G{ABC}* is a group of three independent subsystems *A*, *B* and *C*, representing different frequencies.

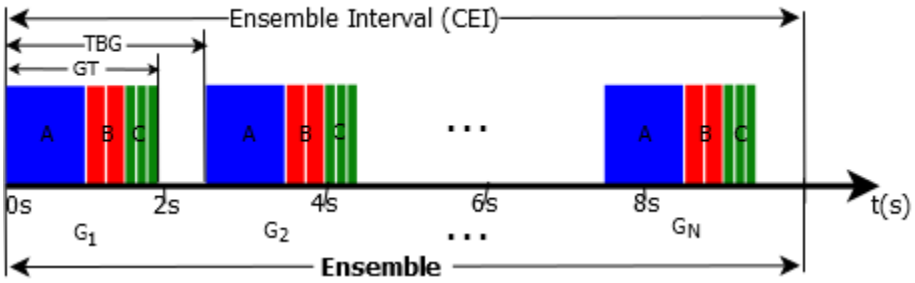


Figure I. Grouping

The group time (*GT*) is the time taken for completing the pings in one group, it is defined as

$$GT \geq \sum_{i=1}^{M} TBP_i * P_i \qquad (Eq.\ 1)$$

in which, TBP_i is the time between pings for subsystem *i*, this is the minimum time required for the ADCP to complete the ping for that particular frequency. P_i is the number of pings in

subsystem *i*. *M* is the number of subsystems in the group. In Figure I, *M* = 3 because there are three subsystems, *A*, *B*, and *C*.

The time between groups (*TBG*) is defined as the ensemble interval (*CEI*) divided by the number of groups (G*N*) in the ensemble, that is

$$TBG = \frac{CEI}{GN} \qquad (Eq.\ 2)$$

The minimum *TBG* is the sum of all subsystem ping times in the group and it equals to the group time *GT*. Thus, is defined as following

$$TBG \geq GT \geq \sum_{i=1}^{M} TBP_i * P_i \qquad (Eq.\ 3)$$

4.2 Uniform Group Pinging

The aim of uniform group pinging is to uniformly place the groups within the ensemble interval. In uniform group pinging, all the groups are evenly distributed in the given ensemble interval. The *TBG* equals to *CEI* divided by the group number G*N*. Please be noticed, the uniform group pinging can have a sleep time after each group if *TBG* is greater than *GT*.

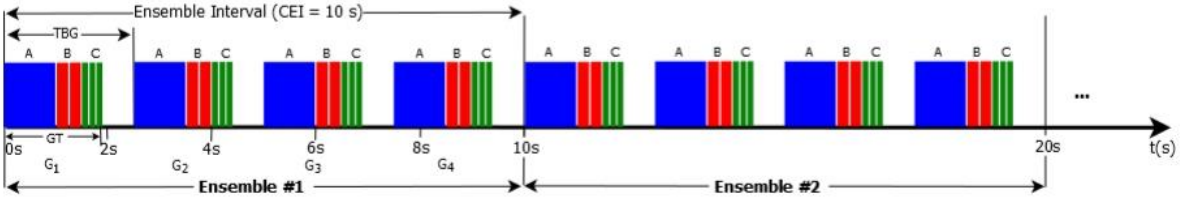


Figure II. Dual frequency uniform group pinging

Figure II is a setup of dual frequency *A* and *B* with vertical beam *C* uniform group pinging deployment. It has four groups in each ensemble and three subsystems, *A*, *B* and *C* in each group. In which, Subsystem *A* has one ping, Subsystem *B* has two pings, and Subsystem *C* has three pings. Figure III are the examples of single frequency uniform group pinging.

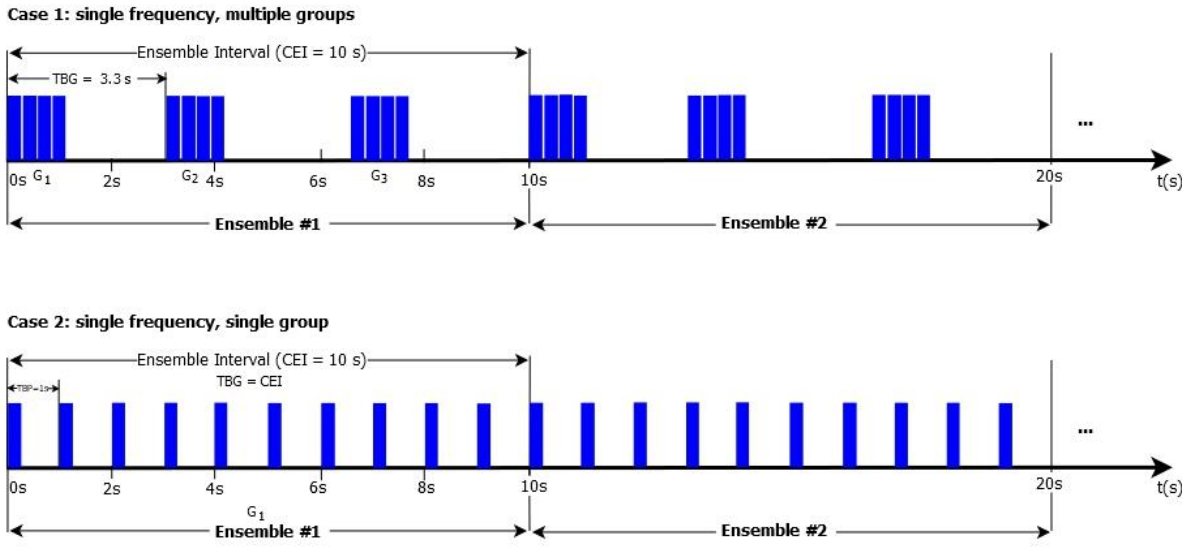


Figure III. Single frequency uniform group pinging

4.3 Burst Group Pinging

In burst group pinging, a sequence of groups will ping immediately one after another in the beginning of each ensemble. After the groups, it will have a sleep time before the next ensemble. In this scheme, *TBG = GT* and it doesn't dependent on the *CEI*, its value depends on the sum of the ping times of the subsystems. Figure III shows an example of burst group pinging of three subsystems (*A*, *B*, and *C*) and two groups in each ensemble.

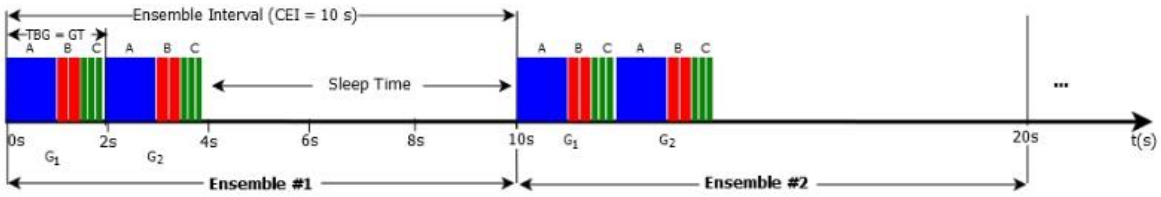


Figure III. Burst group pinging

The example of single frequency burst group pinging is shown in Figure IV. In this example, G*N* = 1, one group per ensemble, and *P* = 10, ten pings per groups.

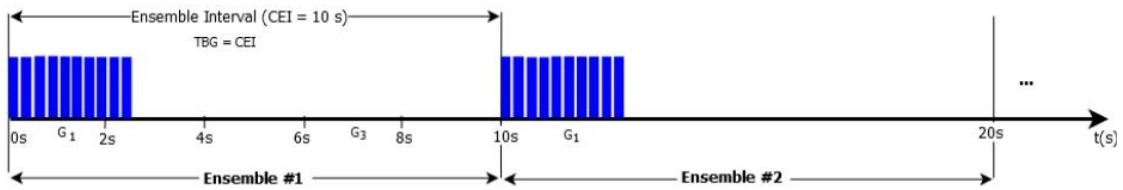


Figure IV. Single frequency burst group pinging

When the user chooses the instrument for the deployment, *M* and *TB*P will be determined. After selected the number of groups in an ensemble and the number of pings per subsystem for

all the subsystems, GT will be determined. The TBG will be determined when the CEI is selected. It either $TBG = \frac{CEI}{GN}$ for uniform group pinging or TBG = GT for burst group pinging. No matter in which pinging scheme, the CEI must be greater or equal to the GT times GN, that is

$$CEI \geq GT * GN \qquad (Eq.\ 4)$$

5. System Overview

RTI Sea Monitor is a highly integrated program that allows the user to do different kind of things like planning a deployment, deploy a system, view live data and playback with the existing data collected from RTI ADCPs. Figure 1 shows the Home page of Sea Monitor program. In the program, Connect is used to connect to ADCP through a serial port, Terminal window is a useful tool to talk directly to ADCP. Plan will guide the user to choose the right instrument and configure it so that it will suit user's deployment requirements. Deploy has detailed steps that will guide the users to a successful deployment. View is a real-time data graphic data display that gives the users a good view of the live data. The Playback post-processing allows the users to trim and process the data collected from RTI ADCPs for their different needs. Download allows the users to download data from ADCP.

Figure 1. RTI Sea Monitor Main Window

You need to connect to an ADCP first in order to use Deploy and Download feature, but you can do planning a deployment and playing back with the existing data without connecting to an ADCP.

6. Connect to ADCP

Click the **Connect**  icon on top of the Sea Monitor main page to open the SerialConnect window (Figure 2). Select the right COM port and baud rate then click "OK" to connect to ADCP. Please make sure the ADCP is connected to your computer through a serial port in order to run the Connect function.

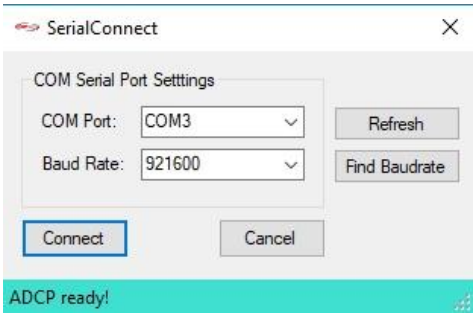


Figure 2. SerialConnect Window

7. Terminal Window

Terminal window is used to talk to ADCP and the external GPS and/or Compass heading devices through serial ports. Click the **Terminal**  icon from the tool bar to open Terminal window (Figure 3).

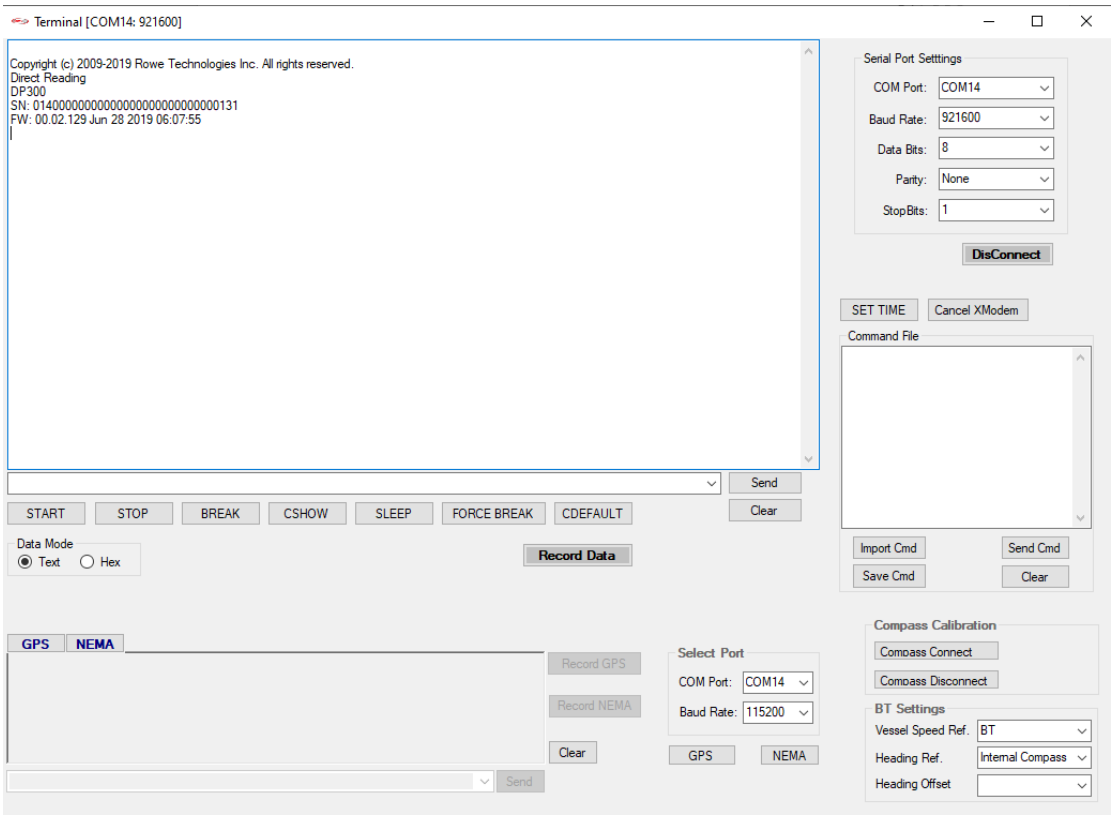


Figure 3 Terminal Window

8. Planning

This is the place to plan a deployment. Click the Plan  icon from tool bar to open Planning window (Figure 4) and start planning. There are three steps to plan a deployment: select instrument, set the environmental parameters, and set up the ADCP configurations. A summary of the selected system and the user configuration along with the predicted performance of the settings will be shown in the right column of Summary. On the left side of the Planning window, there are four buttons to allow the user to check the current ADCP settings if your computer connected to an ADCP, to load an existing deployment configuration file from computer, to save current planning to a file, or send the configuration (commands) directly to ADCP if connected to the right ADCP.

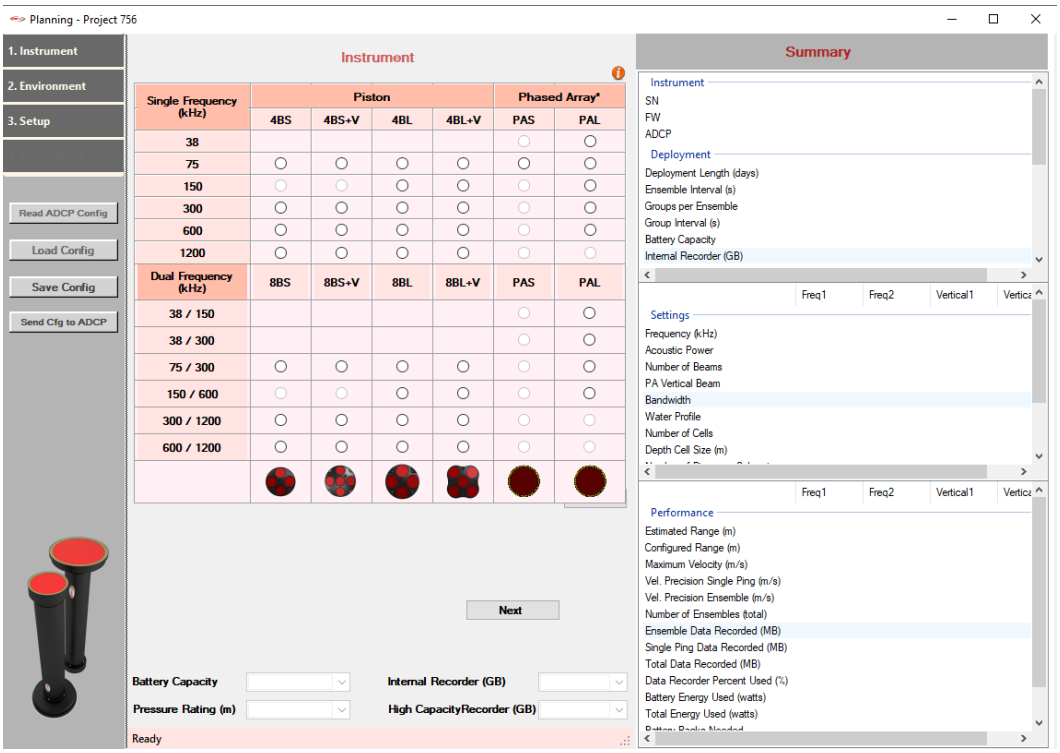


Figure 4. Planning Window - Instrument Page

Note:
You don't need to connect to an ADCP to do planning, Planning can run without an ADCP but you can check the ADCP configurations from Planning if you connected to an ADCP.

8.1 Planning Steps

Step 1. Instrument

The first step of Planning is to choose an appropriate ADCP from the instrument table for the deployment. The instrument table consists of all the RTI ADCP3 products that are designed and developed to operate from a frequency range of 38 kHz to 2.4 MHz with single and dual frequency mode of operation, transducer type can be piston or phased array, size can be large or small. The

information button icon on the right top corner of the table explains the names of the instruments in the table (Figure 5).

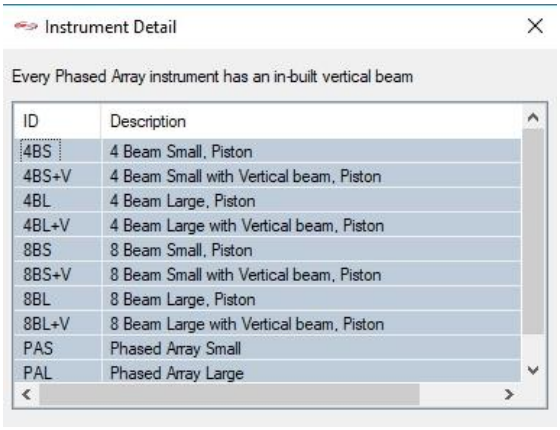


Figure 5. Instrument Description Window

Click any button in the table to choose the instrument, after selecting an ADCP instrument from the table, the ADCP information (subsystems, frequency and transducer type) and the default ADCP settings along with the predicated performance results will be shown in the Summary column on the right side of the window (Figure 6). You can also select other hardware parts that will be used in the deployment such as like battery, pressure rating, internal recorder size, do you need the high capacity recorder or not.

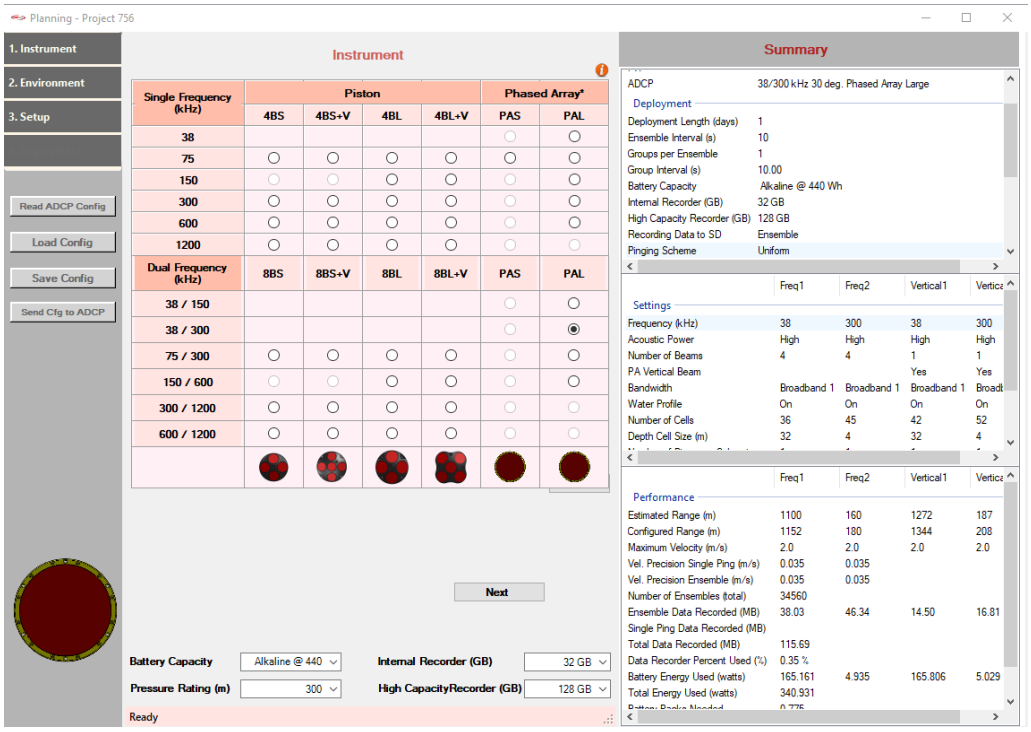


Figure 6. Step 1 – Select Instrument

Please note, any changes of the Planning settings will be reflected in the Summary.

After done with the instrument, click **Next** button on the page or click the **2. Environment** button on the left top corner of the window to go to the Second Step - **Environment** page.

Step 2. Environment

The **Environment** page lets you select the environmental parameters for the deployment.

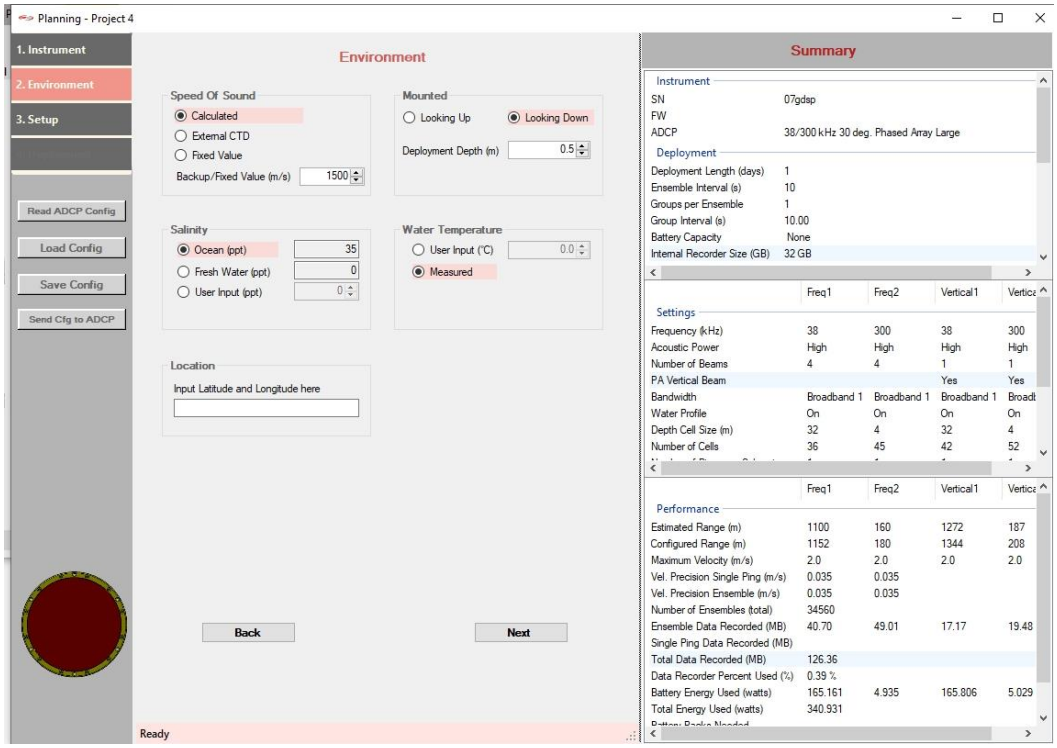


Figure 7. Step 2 - Environment Page

- **Speed Of Sound**: there are three options to set speed of sound:
  - Fixed Value: a fixed value of speed of sound (in meters per second) input by the user.
  - Calculated: will be calculated by the instrument based on the measured temperature and salinity.
  - External CTD: using an external CTD for the value of speed of sound.
  - The Backup / Fixed value is necessary in the situations when none of the three above options is available.
- **Salinity**: the salinity of 0 is for fresh water, 35 for ocean or saltwater, or any other user-input value between 0 and 35 ppt.
- **Mounted**: the mounted orientation (Upward-looking or Downward-looking) of the instrument during the deployment and estimate the distance to the surface. The instrument depth cannot be greater than Pressure rating.
- **Water Temperature**: it can be set by the user or calculated by the instrument.
- **Location**: the latitude and longitude information of where the system will be deployed.

Step 3. Setup

To set up ADCP parameters for the deployment. The performance of the user settings is predicted and shown in the Summary.

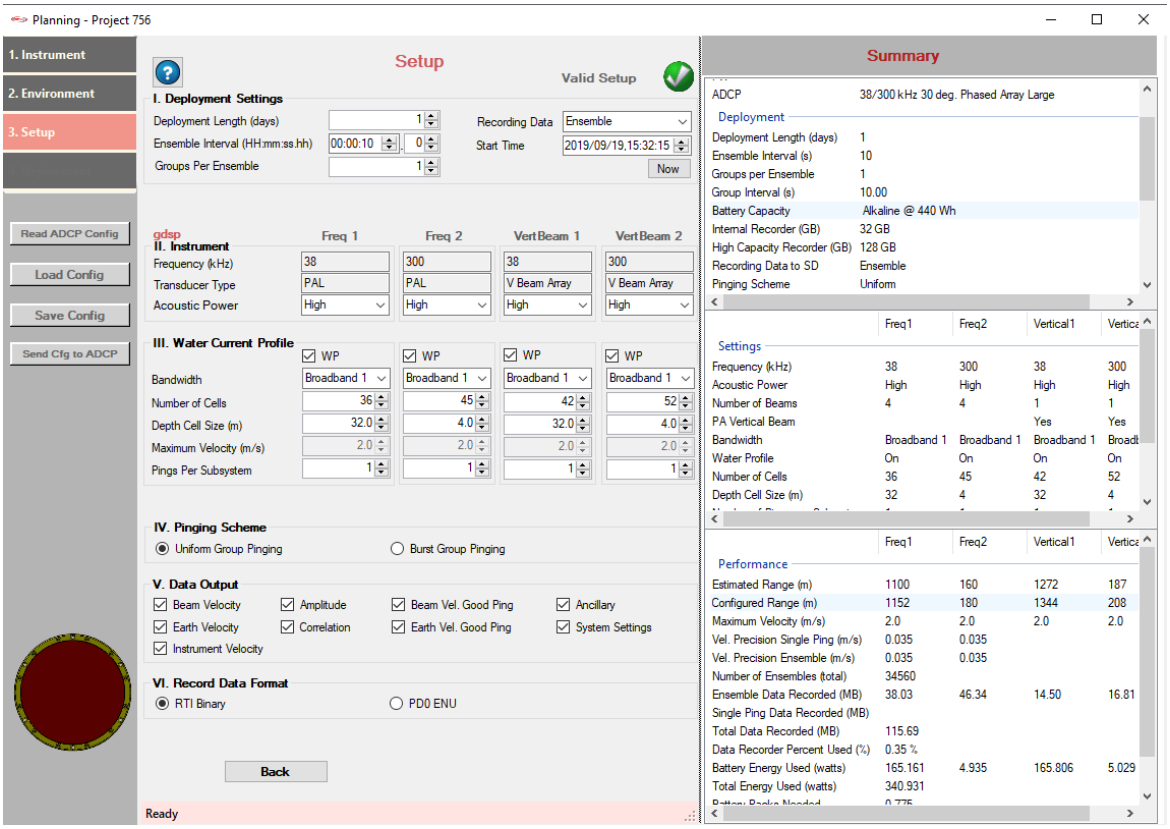


Figure 8. Step 3 - Setup Page

I. Deployment Settings

- **Deployment Length (days)**: the number of days the deployment will last.
- **Ensemble Interval**: the time interval (in seconds) between data ensembles. It's in the format of *HH:mm:ss.ff*.
- **Groups Per Ensemble**: the number of subsystem groups in one ensemble.
- **Recording Data**: to record data in the format of Ensemble, Ensemble + Single Ping No Recording.
- **Start Time**: the first ping time, i.e., the time to start pinging. You can click the **Now** button to use current computer time.

II. Instrument

This will show the instrument information for all the frequencies you selected in instrument table in the first step including frequency (in kHz), transducer type and the default acoustic power (High). The frequency and transducer type for each frequency cannot be changed,

they are only for display purpose. You can change the acoustic power from default "High" to "Low" if needed.

III. Water Current Profile

This is the place to setup parameters for water current profile pings including bandwidth, number of bins, bin size, and number of pings for each subsystem to be averaged in the data ensemble.

- **Water Profile (WP) ON**: to turn ON / OFF water profile ping for each frequency. For each frequency, if WP is checked, it will turn ON water profile ping for that frequency, and all the water profile ping parameters for that frequency will be enabled, otherwise, all the water profile ping parameters for that frequency will be disabled.
- **Bandwidth**: the bandwidth of pinging will be used in the deployment. There are four options of the bandwidth:
    - Broadband 1: 3.125 % of the frequency
    - Broadband 2: 6.25 % of the frequency
    - Broadband 3: 25 % of the frequency
    - Narrowband: 3 % of the frequency
- **Number of Cells**: the number of bin cells.
- **Depth Cell Size (m)**: the vertical size in meters of individual bins in the profile. A larger cell size transmits more energy for a given power level.
- **Maximum Velocity (m/s)**: the maximum current velocity (2.0 m/s for sea monitor by default) can be measured in the profile.
- **Pings Per Subsystem**: number of pings in each subsystem to be averaged together in the ensemble.

IV. Pinging Scheme

To select the pinging scheme that will be used in the water current profile.

- **Uniform Group Pinging**: the ping groups will be evenly distributed in the ensemble interval.
- **Burst Group Pinging**: a sequence of ping groups will ping immediately one after another in the beginning of each ensemble followed by a sleep time before starting the next ensemble.

V. Data Output

To choose what kind of data you want to be included in the data ensemble. In the RTI binary format, these data types will be stored in the specific part of the RTI data ensemble identified by its unique 7 digits ID in the format of E0000XX. Usually you don't need to

change the default setups unless you want to have a smaller size of the data ensemble to save the recorder space.

There are three different categories of the data type:

1) Water current profile data, this includes
    - Beam velocity (E000001)
    - Instrument velocity (E000002)
    - Earth velocity (E000003)
    - Amplitude (E000004)
    - Correlation (E000005)
    - Beam velocity good ping (E000006)
    - Earth velocity good ping (E000007)
2) System settings and ancillary information of ensemble
    - Ancillary (E000009)
    - System setup (E000014)

VI. Record Data Format

To set the output data ensemble to be either in RTI Binary format or in RDI PD0 with earth coordinate format.

8.2 Predicted Performance

The Summary section of Planning reflects the current user settings for a deployment and the predicted performance of the deployment based on the settings. Any changes of the instrument or parameter values in the planning will result in a refresh of the Summary contents. It's recommended that you to keep checking the performance results during planning, to make sure the configuration of the ADCP better serves your goal of deployment.

The following content items are for water current profile pings.

- **Estimated Range (*m*):** the default profiling range for each frequency based on typical setup (bandwidth, acoustic, bin size and bin number).
- **Configured Range (*m*)**: the user configured range for each frequency, equals to bin size times number of bins.
- **Vel. Precision Single Ping (*m/s*)**: velocity standard deviation of single ping
- **Vel. Precision Ensemble (*m/s*)**: velocity standard deviation of ensemble

- **Number of Ensembles (total)**: the total ensemble that will be collected during the deployment
- **Ensemble Data Recorded (*MB*)**: the recorded ensembles in MB on the SD card. This is the space that will be needed to save the recorded ensembles on the ADCP SD card.
- **Single Ping Data Recorded (*MB*)**: the single ping data recorded (MB) on the SD card
- **Total Data Recorded (*MB*)**: the total data recorded (MB) on the SD card including ensemble data and single ping data
- **Battery Energy Used (*watts*)**: the batter energy in watts will be used for the entire deployment if battery is the only power supply.
- **Total Energy Used (*watts*)**: the total energy in watts will be used for fulfilling the length of the deployment. This includes electric energy and acoustic energy that will be used during the deployment.
- **Data Recorder Percent Used (*%*)**: the percentage of space that will be used by the collected data on the SD card
- **Battery Packs Needed**: how many battery packs are needed for the deployment if battery is the only supply.

8.3 Button Functions

There are four button functions the user can use in the planning of the deployment:

- **Read ADCP Config**: if your computer has connected to an ADCP vis serial port, this button can be used to check the ADCP information and the settings of ADCP like bin number, bin size etc. When clicked this button, the software will first try to connect to the ADCP by checking all the available serial port and baud rates. If successfully connected to the ADCP through a serial port, the software will read the ADCP information such as serial number, firmware version, system frequency and transducer type along with the settings of ADCP such as ensemble interval, bin number, bin size etc. and display the results in the Summary column.
- **Load Config**: Load an existing deployment configuration from a file and display the settings in the Setup page and Summary.
- **Save Config**: save the current settings to a file.
- **Send Cfg to ADCP**: if connected to ADCP, after carefully planning and satisfied with the deployment settings, you can send the configuration directly to ADCP by clicking this button. This will send the configuration commands to the ADCP through serial port.

9. Deploy

The procedure of deploying an instrument. Your computer needs to be connected to the ADCP in order to run the Deploy procedure.

First, connect to ADCP through “Connect” by selecting correct serial port and baud rate. After connected, the “Deploy” 

icon will be enabled.

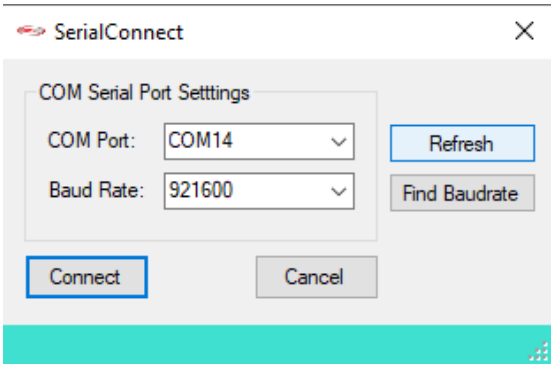


Figure 9. Connect to ADCP

Second, start “Deploy” by clicking the “Deploy” 

icon on the tool bar. The Deploy page will show up as in Figure 10. The information column on the right is the same as the Summary in Planning.

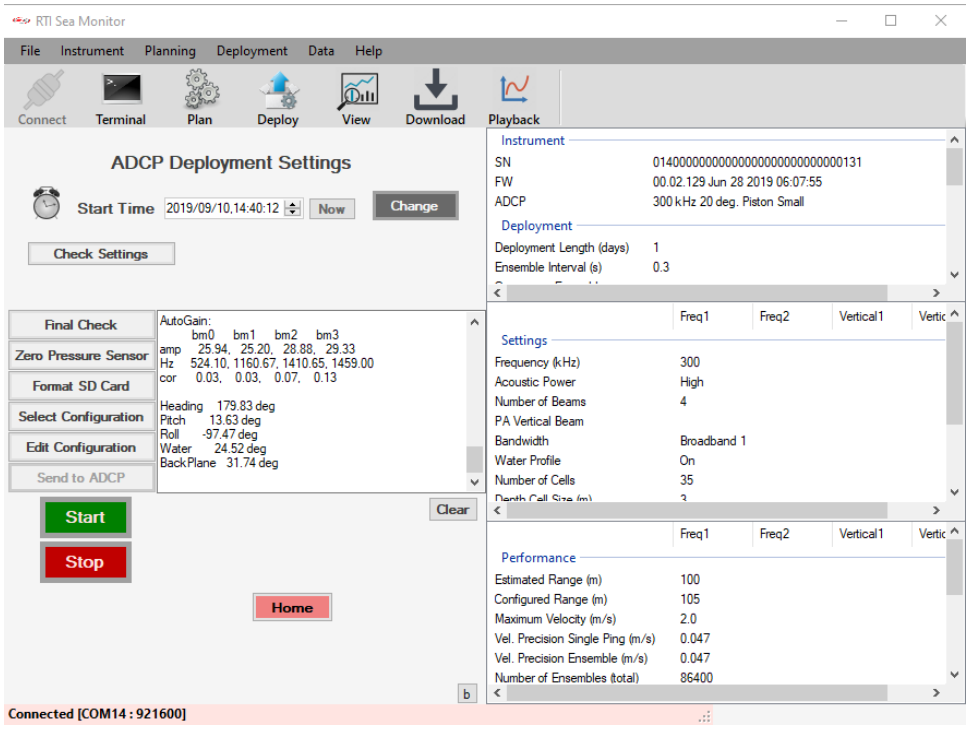
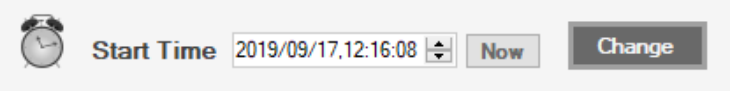


Figure 10. Deploy Page

The first thing Deploy will do is to read the current ADCP settings from ADCP and display it in the right information column. You can also manually check the current ADCP configuration

by clicking the “Check Settings” button on the page. There are several things you can do before deploying the system.

- Set or change the **Start Time** of pinging, i.e. the first ping time. “Now” button will set the time to your local computer time. After you set or changed the start time, click “Change” button will set it on ADCP.



- **Final Check:** do a system check of the system. This will check the installed hardware status such as SD card, pressure sensor, compass etc. Click the button will pop up the System check window as shown in Figure 11.

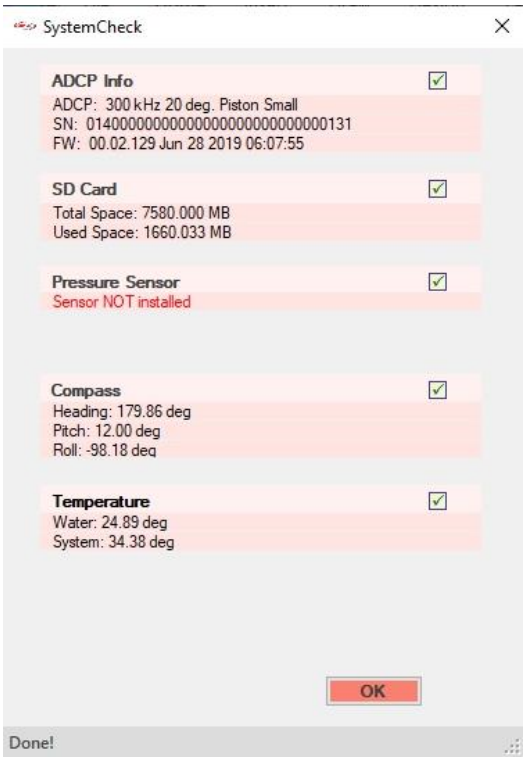
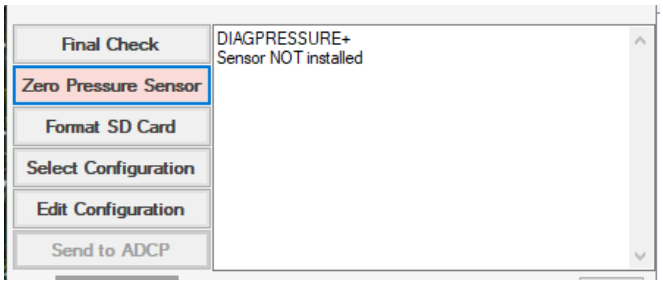
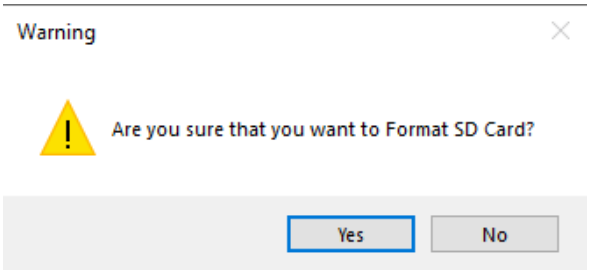


Figure 11. System Check

- **Zero Pressure Sensor:** this will first check if the pressure sensor is installed in the instrument. If installed, it will set the pressure value to ZERO. Otherwise, it will tell the user that “Sensor NOT installed” in the message box.



- **Format SD Card:** this will delete all the data files stored on the SD card of the ADCP to make space for the new deployment. There will be a warning message to ask you if you really want to do this. Make sure you downloaded all the data files from the ADCP to your PC before clicking the "Yes" button to avoid losing your data.



- **Select Configuration:** select a deployment configuration from a configuration file on the computer. After loading the configuration file, the configurations will be show in the information column on the right (Figure 11).

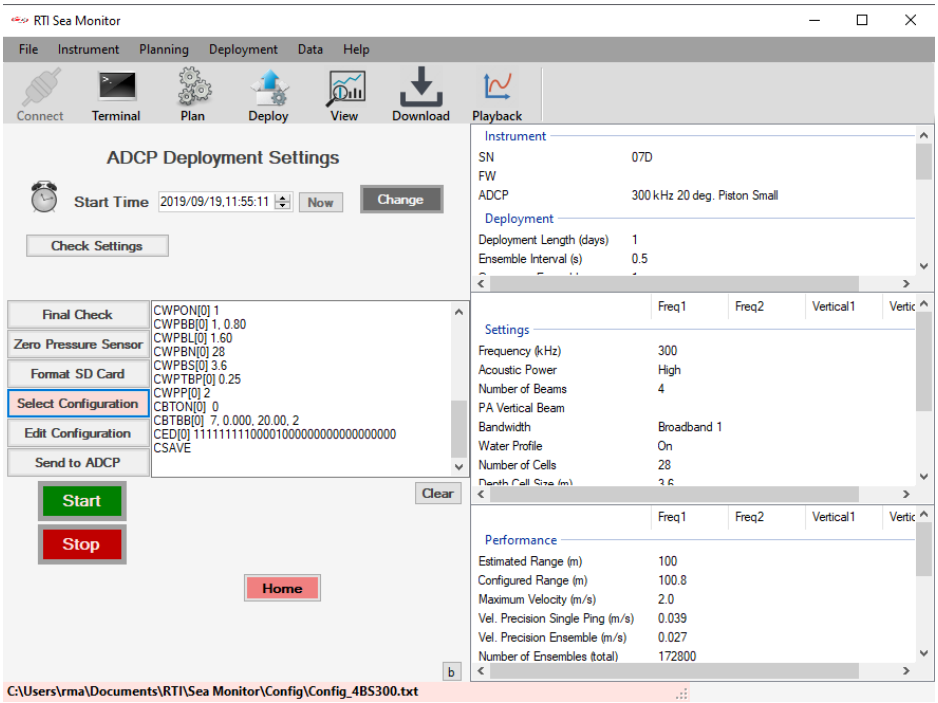


Figure 11. Select Configuration

- **Edit Configuration:** if you want make changes of the configuration, click the "Edit Configuration" button and it will direct you to the **Planning** window (Figure 12) with the selected configuration so that you can make changes in **Planning**. After edition, you can save the edited configuration to the same file or save it to a new file. Then, you need to go back to the Deploy page to load the edited configuration to the deploy page.

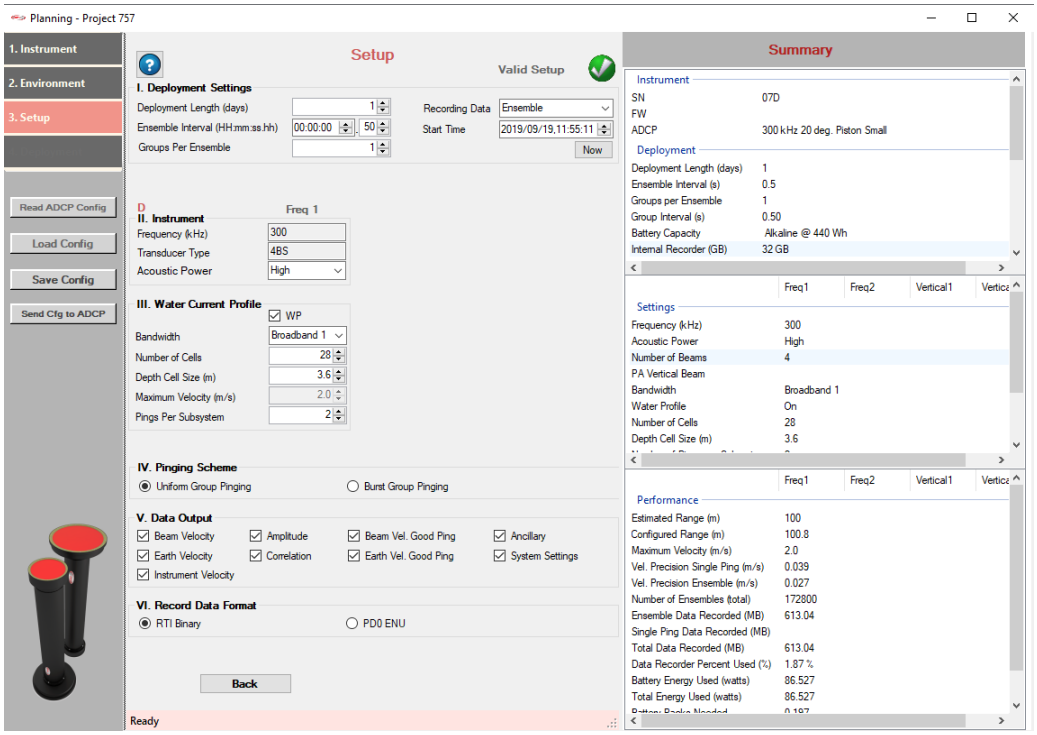


Figure 12. Edit Configuration in Planning window

- **Send to ADCP:** if you are satisfied with the configuration showing on the Deploy page, you can click "Send to ADCP" button to send the configuration / commands to ADCP. The Message Box will tell you if it is successfully sent to ADCP (Figure 13) or an error message if it failed.

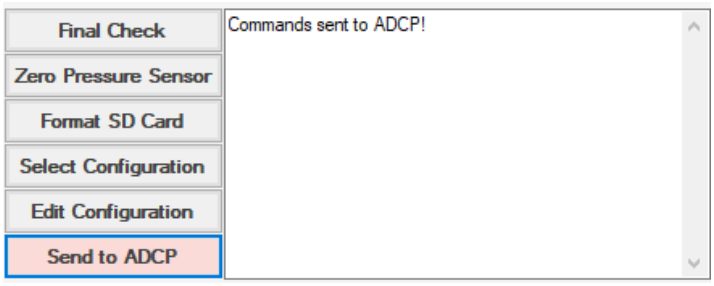


Figure 13. Configuration was sent to ADCP

- **Start:** click the Start button to start pinging / deployment. If the "Start Time" hasn't arrive, the ADCP will in sleep mode and it will show you how many ddd hh:mm:ss left as shown in Figure 14.

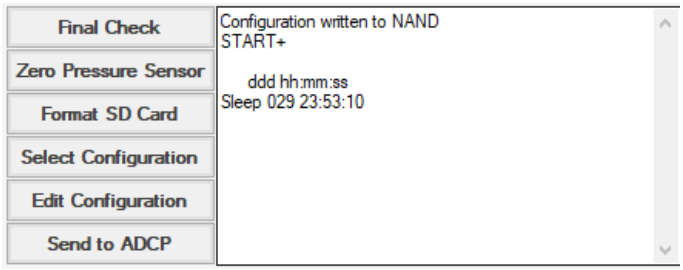


Figure 14. System started but in sleep mode

The ADCP will immediately start pining if the scheduled Start Time is current or in the past, you will see the outputting data in the message window (Figure 15). Now, you can click the "View" icon to open the Display window to see the live data display (Figure 16).

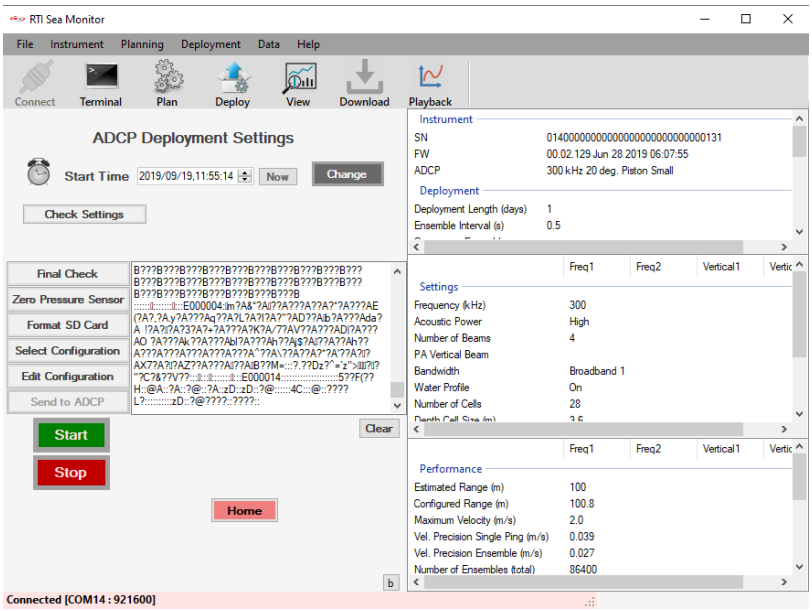


Figure 15. System started pinging

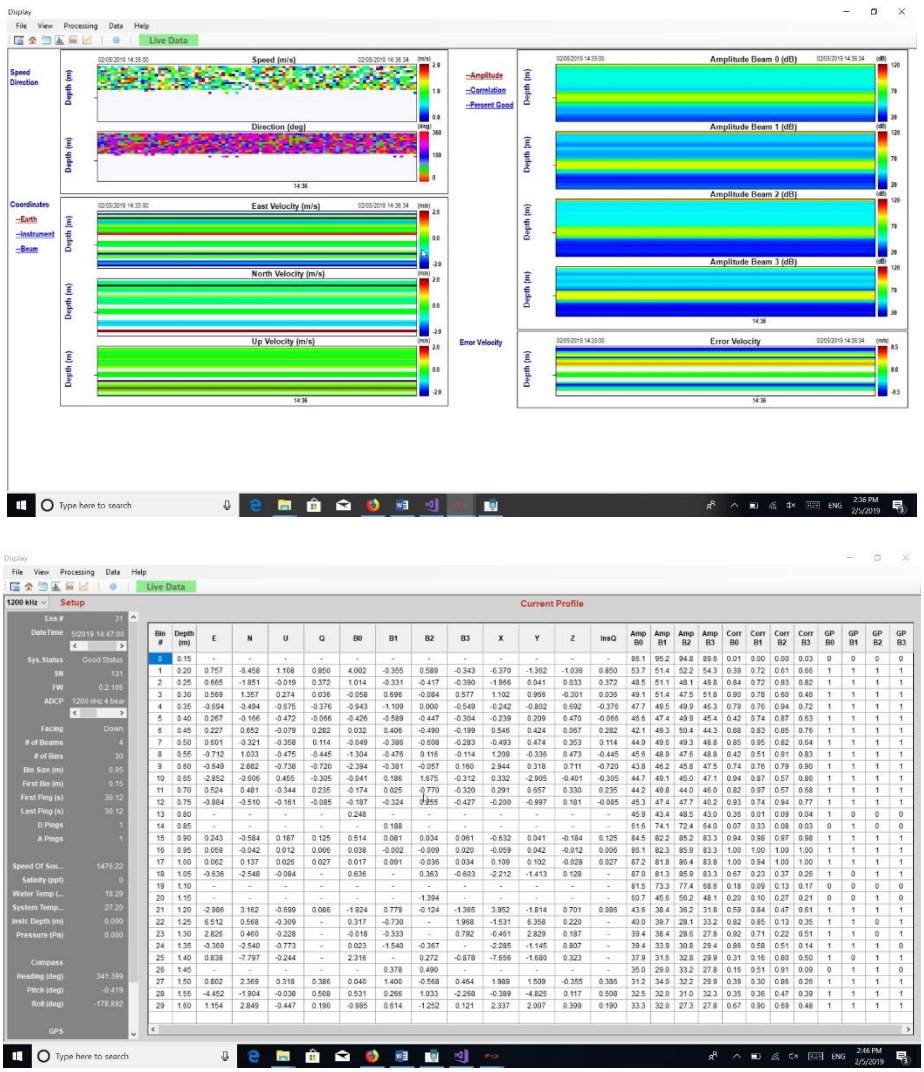


Figure 16. Live data

- **Stop:** to stop ping (Figure 17).

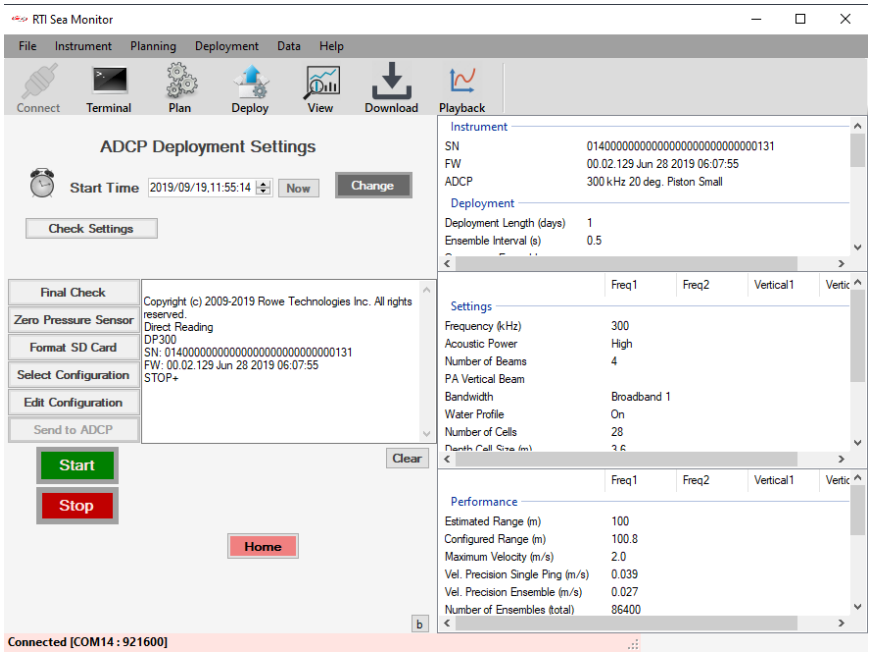


Figure 17. Stop pinging

- **Home:** go back to the program Home page.

10. Download

To download data from ADCP. When you connected to ADCP the 

icon will be enabled, click it will direct you to the **Download** page (Figure 18).

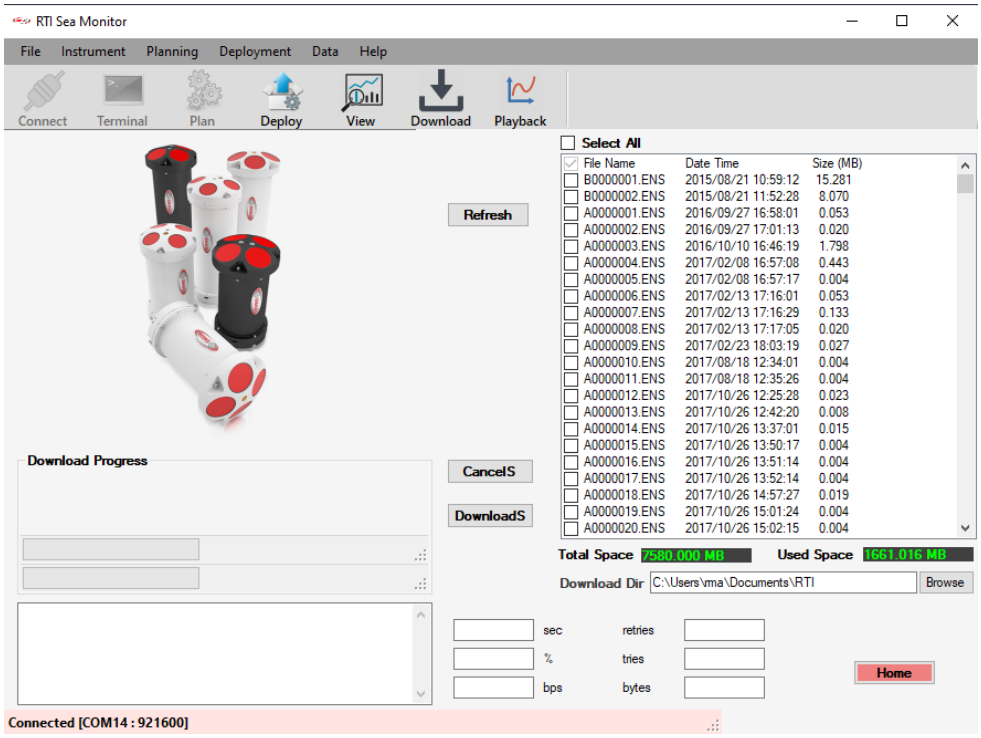


Figure 18. Download page

You can choose the files you want to download by checking the boxes in front of the file name or select all the files to download. The “Download Progress” box will show you the downloading status (Figure 19).

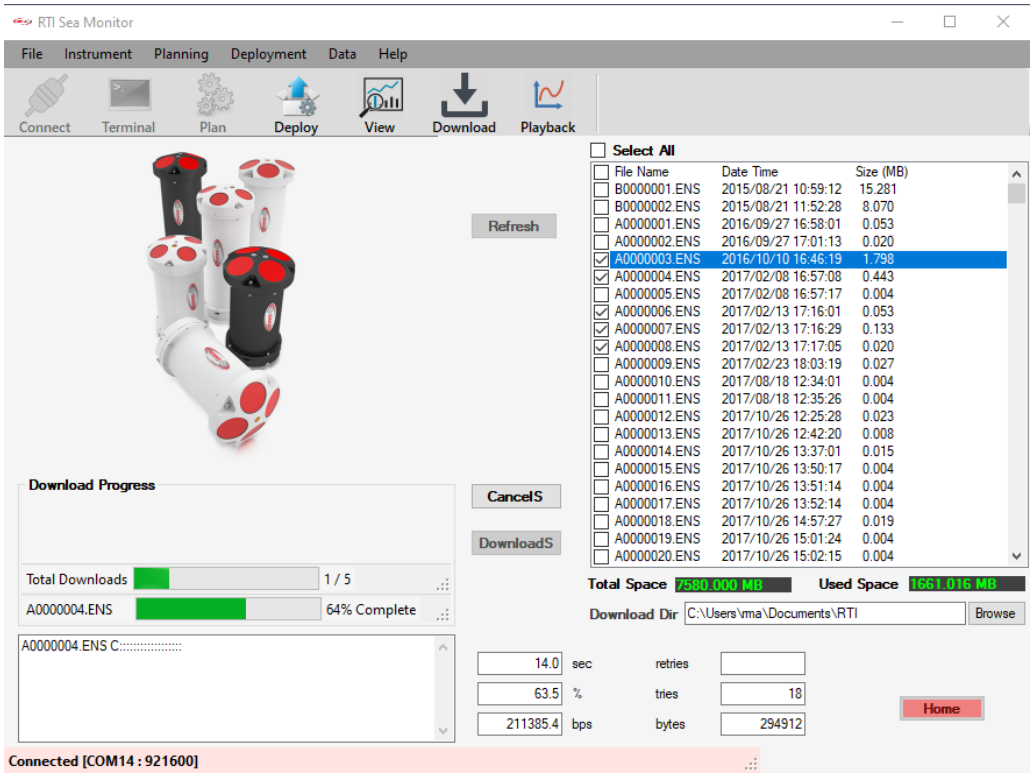


Figure 19. Downloading

11. Playback

Playback is designed for displaying and post-processing the data from a file. The **Display** user interface can be started by clicking the **Playback** 

icon from tool bar or by choosing **Data** > **Playback** from the main menu on the top of the home page. After loading the selected data file, the Display window will show up (Figure 20). You can open more than one **Display** user interfaces for loading different data files to view or compare at the same time.

11.1 Home Page

There are five main parts of the display window (Figure 20): the Tool Bar on the top of the window, the three Buttons on the left side of the window, and the three plotting windows, Contour Window, TimeSeries Window and Vertical Profile Window, in the middle and right.

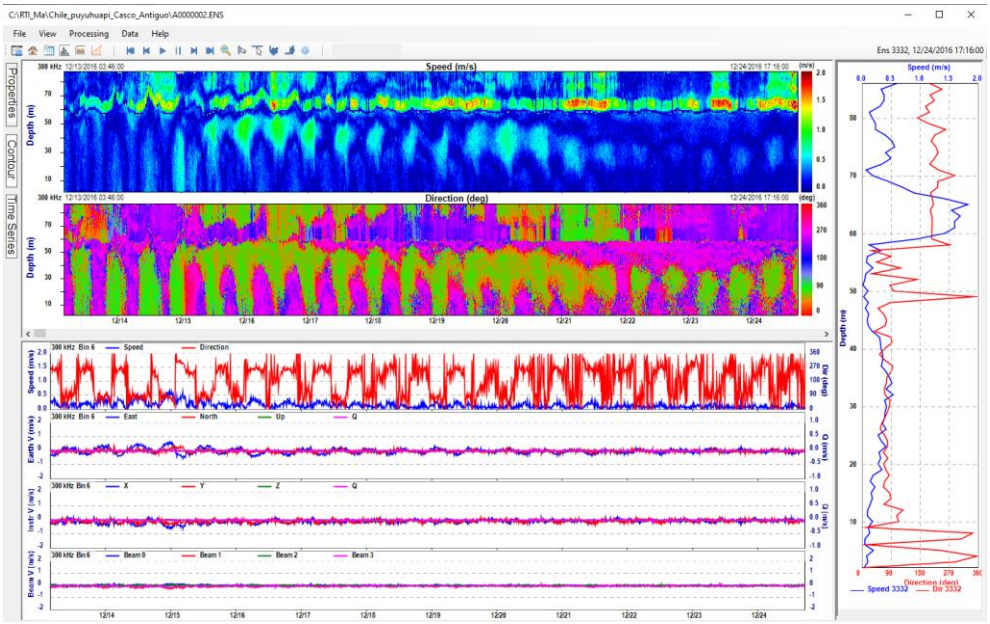


Figure 20. Display user interface

- **Tool Bar**: contains buttons to switch between five pages: **Home** page, **Data** page, **Contour** page, **Timeseries** page and **Vertical profile** page. The **Open file** button allows user to open a different data file.

- **Control Bar**: contains buttons manipulate data includes Play / Pause, step forward / backward, First / Last ensemble; Zoom In / Out, Pick ensemble, Pick timeseries, and change setting parameters.

- **Contour Window**: shows color-filled contour plots of data. The default display in Contour window is Speed and Direction but user can choose whatever data contents he / she wants to view from the extended **Contour** selection buttons on the left side of the **Display** window.

- **TimeSeries Window**: shows the timeseries plots of bin data. User can choose what kind of data and which bin to plot by selecting the items from TimeSeries button menus.

- **ertical Profile Window**: the vertical profile plots of the items showing in the contour window. What will be shown in the vertical profile window depends on what you selected in the contour window.

- **Properties Button**: when click, this button will show the properties of ADCP and the data such as ADCP frequency (s), serial number, firmware version, subsystems, datetime, ensemble number, environmental information and ADCP configurations (Figure 21).

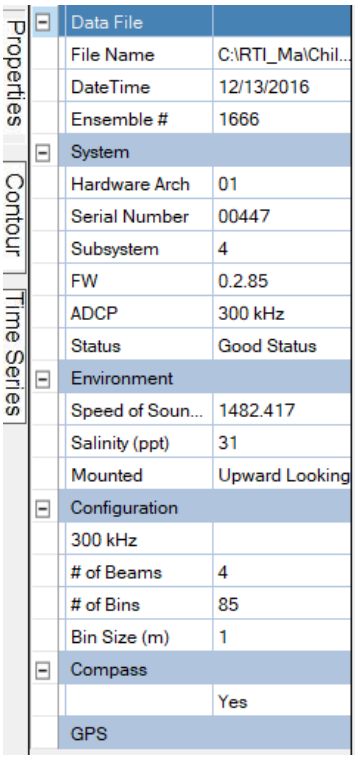


Figure 21. Properties Button

- **Contour Button**: the button items that the user can choose to be shown in the Contour Window (Figure 22). i.e. select what kind of data you want to see in the contour window. Please note, the contents in the vertical profile window will also change if the contour window contents change. The contour items are organized into the following groups:
    - Speed and Direction
    - Coordinates velocity
        - Earth Coord (ENUQ)
        - Instrument Coord (XYZQ)
        - Beam Coord (B0, B1, B2, B3)
    - Amplitude (A0, A1, A2, A3)
    - Correlation (C0, C1, C2, C3)
    - Good Ping (PG0, PG1, PG2, PG3)

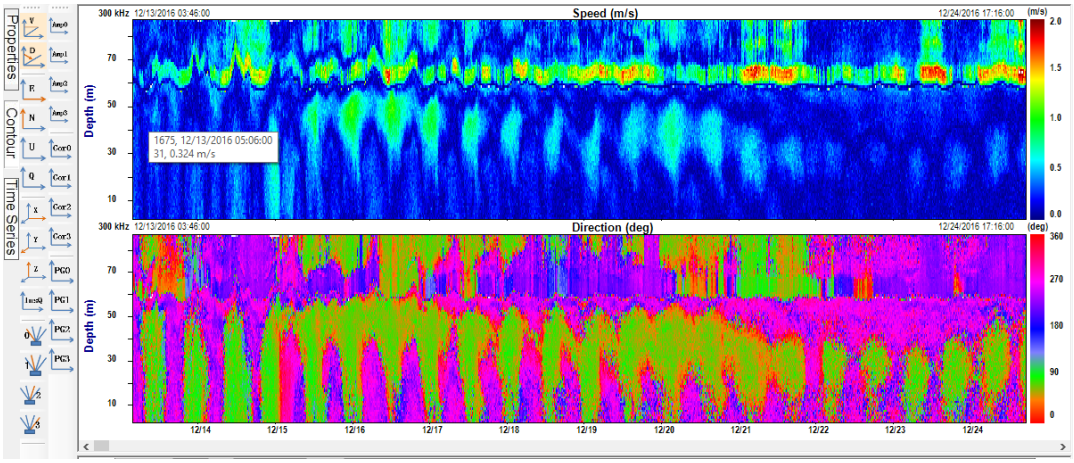


Figure 22. Contour button item and Contour Window

- **TimeSeries Button**: select the button items to be plotted in the TimeSeries Window.
    - Speed / Direction
    - Velocity (Earth/Instr/Beam)
    - Amplitude
    - Correlation
    - Percent Good
    - HRP (heading, pitch, roll)
    - System information such as water temperature and pressure
    - Battery voltage

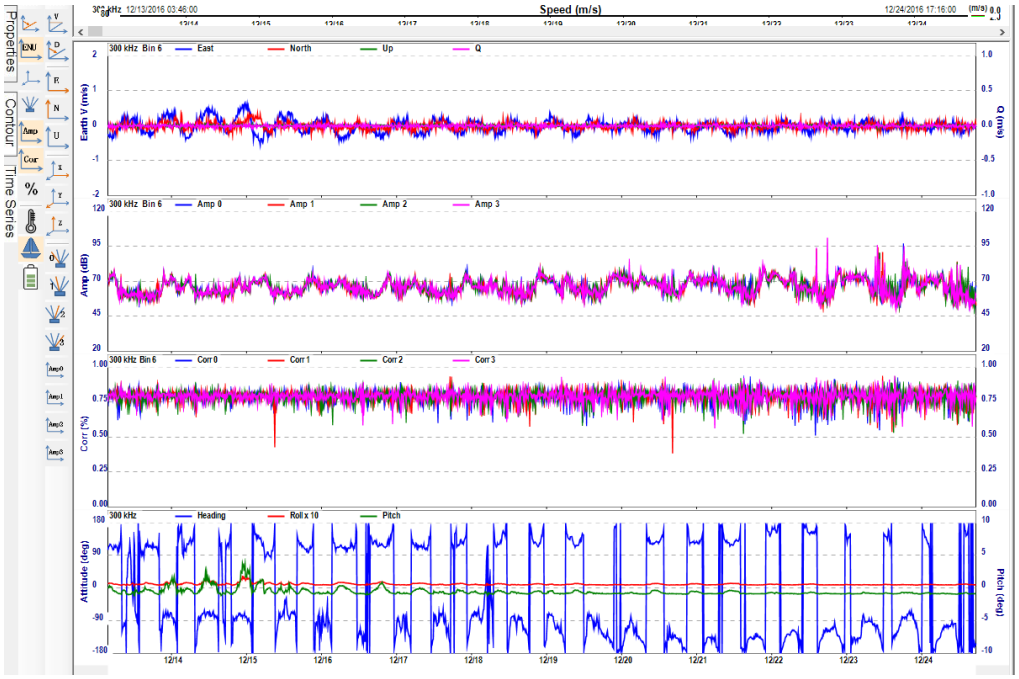
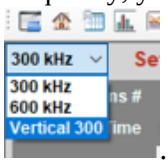


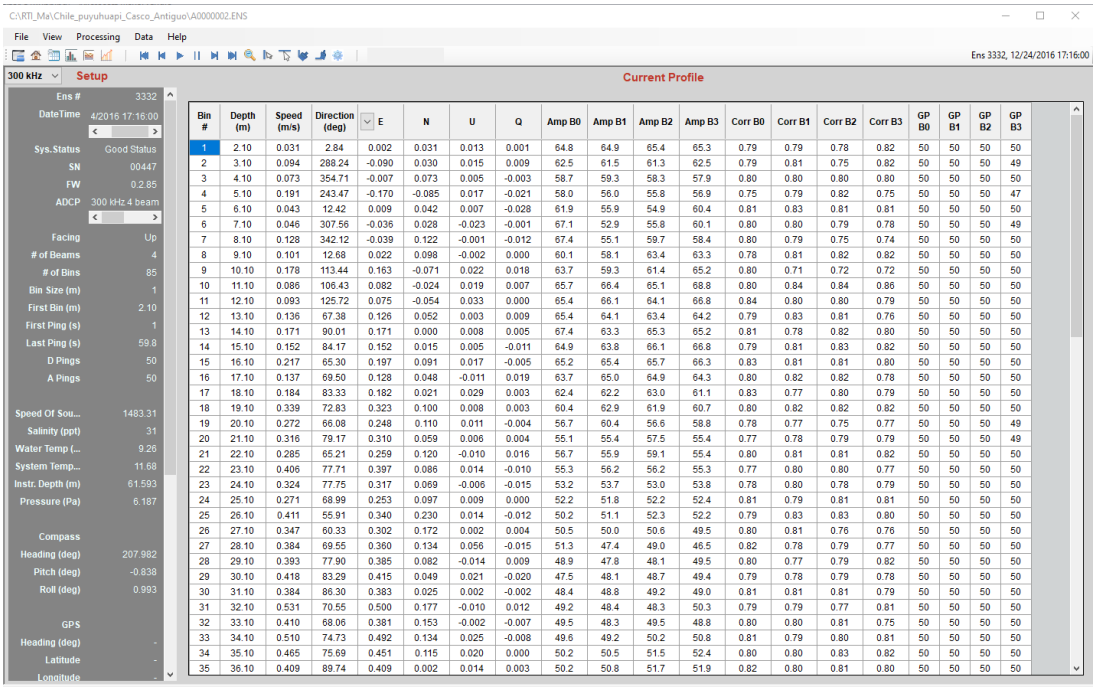
Figure 23. TimeSeries Button items and TimeSeries Window

11.2 Data Page

Data page (Figure 24) shows the data in Tabular includes water current profile data and bottom track data. It also shows the ADCP information and ADCP settings in the left. If is multiple frequency, you can switch between frequencies through the dropdown menu on the left top corner



. You can also switch between three coordinate velocities by clicking on the dropdown button in the Title row of the Current Profile table.



Bin #	Depth (m)	Speed (m/s)	Direction (deg)	E	N	U	Q	Amp B0	Amp B1	Amp B2	Amp B3	Corr B0	Corr B1	Corr B2	Corr B3	GP B0	GP B1	GP B2	GP B3
1	2.10	0.031	2.84	0.002	0.031	0.013	0.001	64.8	64.9	65.4	65.3	0.79	0.79	0.78	0.82	50	50	50	50
2	3.10	0.094	288.24	-0.090	0.030	0.015	0.009	62.5	61.5	61.3	62.5	0.79	0.81	0.75	0.82	50	50	50	49
3	4.10	0.073	354.71	-0.007	0.073	0.005	-0.003	58.7	59.3	58.3	57.9	0.80	0.80	0.80	0.80	50	50	50	50
4	5.10	0.191	243.47	-0.170	-0.085	0.017	-0.021	58.0	56.0	55.8	56.9	0.75	0.79	0.82	0.75	50	50	50	47
5	6.10	0.043	12.42	0.009	0.042	0.007	-0.028	61.9	55.9	54.9	60.4	0.81	0.83	0.81	0.81	50	50	50	50
6	7.10	0.046	307.56	-0.036	0.028	-0.023	-0.001	67.1	52.9	55.8	60.1	0.80	0.80	0.79	0.78	50	50	50	49
7	8.10	0.128	342.12	-0.039	0.122	-0.001	-0.012	67.4	55.1	59.7	58.4	0.80	0.79	0.75	0.74	50	50	50	50
8	9.10	0.101	12.68	0.022	0.098	-0.002	0.000	60.1	58.1	63.4	63.3	0.78	0.81	0.82	0.82	50	50	50	50
9	10.10	0.178	113.44	0.163	-0.071	0.022	0.018	63.7	59.3	61.4	65.2	0.80	0.71	0.72	0.72	50	50	50	50
10	11.10	0.086	106.43	0.082	-0.024	0.019	0.007	65.7	66.4	65.1	68.8	0.80	0.84	0.84	0.86	50	50	50	50
11	12.10	0.093	125.72	0.075	-0.054	0.033	0.000	65.4	66.1	64.1	66.8	0.84	0.80	0.80	0.79	50	50	50	50
12	13.10	0.136	67.38	0.126	0.052	0.003	0.009	65.4	64.1	63.4	64.2	0.79	0.83	0.81	0.76	50	50	50	50
13	14.10	0.171	90.01	0.171	0.000	0.008	0.005	67.4	63.3	65.3	65.2	0.81	0.78	0.82	0.80	50	50	50	50
14	15.10	0.152	84.17	0.152	0.015	0.005	-0.011	64.9	63.8	66.1	66.8	0.79	0.81	0.83	0.82	50	50	50	50
15	16.10	0.217	65.30	0.197	0.091	0.017	-0.005	65.2	65.4	65.7	66.3	0.83	0.81	0.81	0.80	50	50	50	50
16	17.10	0.137	69.50	0.128	0.048	-0.011	0.019	63.7	65.0	64.9	64.3	0.80	0.82	0.82	0.78	50	50	50	50
17	18.10	0.184	83.33	0.182	0.021	0.029	0.003	62.4	62.2	63.0	61.1	0.83	0.77	0.80	0.79	50	50	50	50
18	19.10	0.339	72.83	0.323	0.100	0.008	0.003	60.4	62.9	61.9	60.7	0.80	0.82	0.82	0.82	50	50	50	50
19	20.10	0.272	66.08	0.248	0.110	0.011	-0.004	56.7	60.4	56.6	58.8	0.78	0.77	0.75	0.77	50	50	50	49
20	21.10	0.316	79.17	0.310	0.059	0.006	0.004	55.1	55.4	57.5	55.4	0.77	0.78	0.79	0.79	50	50	50	49
21	22.10	0.285	65.21	0.259	0.120	-0.010	0.016	56.7	55.9	59.1	55.4	0.80	0.81	0.81	0.82	50	50	50	50
22	23.10	0.406	77.71	0.397	0.086	0.014	-0.010	55.3	56.2	56.2	55.3	0.77	0.80	0.80	0.77	50	50	50	50
23	24.10	0.324	77.75	0.317	0.069	-0.006	-0.015	53.2	53.7	53.0	53.8	0.78	0.80	0.78	0.79	50	50	50	50
24	25.10	0.271	68.99	0.253	0.097	0.009	0.000	52.2	51.8	52.2	52.4	0.81	0.79	0.81	0.81	50	50	50	50
25	26.10	0.411	55.91	0.340	0.230	0.014	-0.012	50.2	51.1	52.3	52.2	0.79	0.83	0.83	0.80	50	50	50	50
26	27.10	0.347	60.33	0.302	0.172	0.002	0.004	50.5	50.0	50.6	49.5	0.80	0.81	0.76	0.76	50	50	50	50
27	28.10	0.384	69.55	0.360	0.134	0.056	-0.015	51.3	47.4	49.0	46.5	0.82	0.78	0.79	0.77	50	50	50	50
28	29.10	0.393	77.90	0.385	0.082	-0.014	0.009	48.9	47.8	48.1	49.5	0.80	0.77	0.79	0.82	50	50	50	50
29	30.10	0.418	83.29	0.415	0.049	0.021	-0.020	47.5	48.1	48.7	49.4	0.79	0.78	0.79	0.78	50	50	50	50
30	31.10	0.384	86.30	0.383	0.025	0.002	-0.002	48.4	48.8	49.2	49.0	0.81	0.81	0.81	0.79	50	50	50	50
31	32.10	0.531	70.55	0.500	0.177	-0.010	0.012	49.2	48.4	48.3	50.3	0.79	0.79	0.77	0.81	50	50	50	50
32	33.10	0.410	68.06	0.381	0.153	-0.002	-0.007	49.5	48.3	49.5	48.8	0.80	0.80	0.81	0.75	50	50	50	50
33	34.10	0.510	74.73	0.492	0.134	0.025	-0.008	49.6	49.2	50.2	50.8	0.81	0.79	0.80	0.81	50	50	50	50
34	35.10	0.465	75.69	0.451	0.115	0.020	0.000	50.2	50.5	51.5	52.4	0.80	0.80	0.83	0.82	50	50	50	50
35	36.10	0.409	89.74	0.409	0.002	0.014	0.003	50.2	50.8	51.7	51.9	0.82	0.80	0.81	0.80	50	50	50	50

Figure 24. Data Page

11.3 Contour Page

This is the collection of all the contour plots in the Home Page. When there are multiple frequencies, each frequency has its own tabpage.

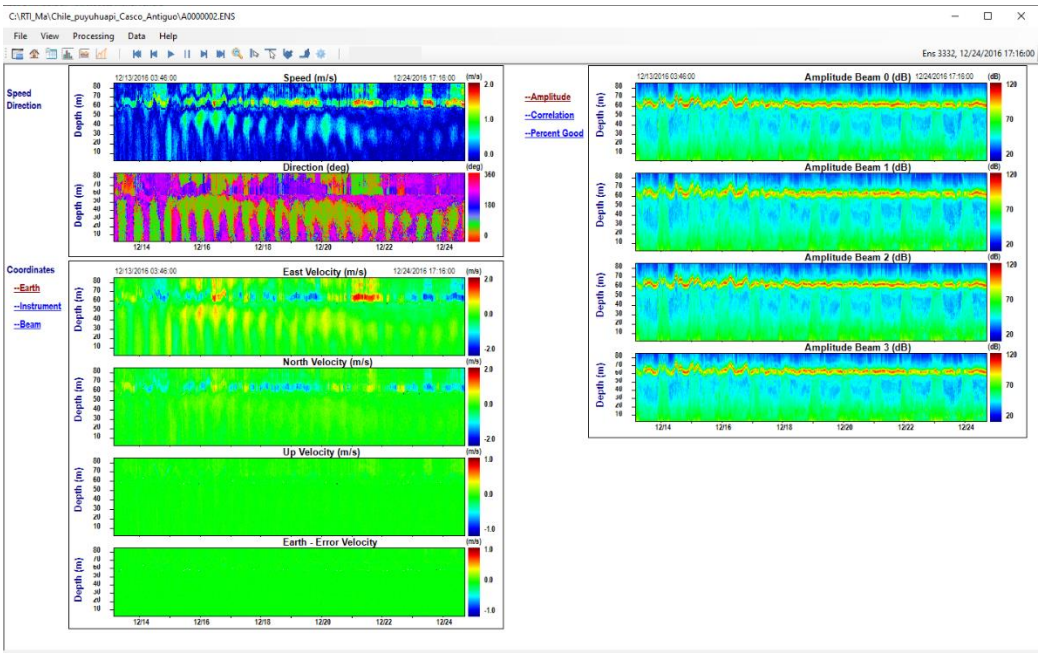


Figure 25. Contour Page

11.4 TimeSeries Page

This is the collection of all the timeseries plots (Figure 26) in the Home Page. When there are multiple frequencies, each frequency except vertical beam has its own tabpage.

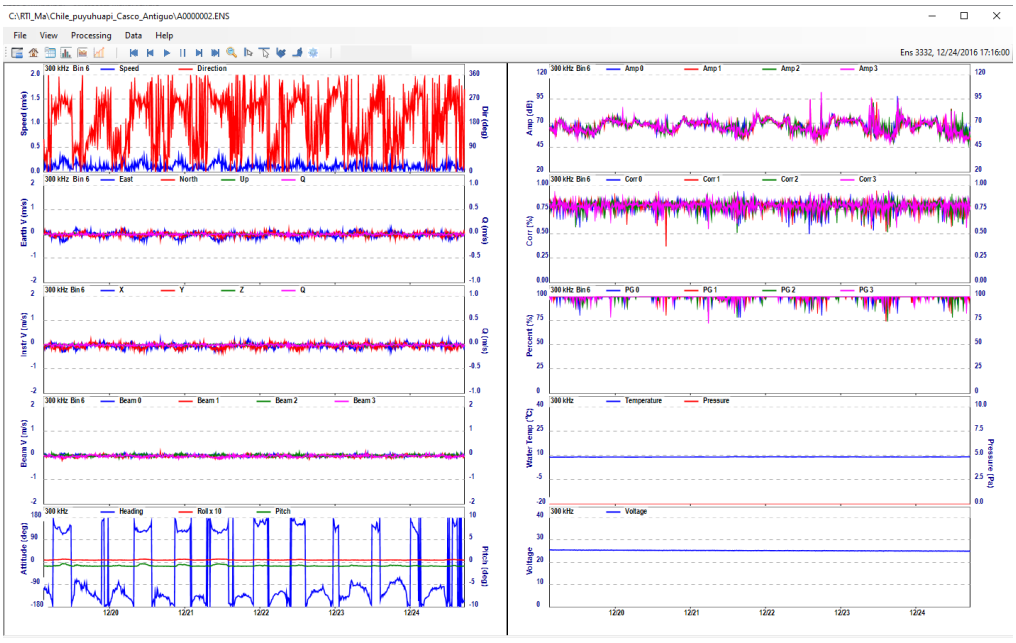


Figure 26. TimeSeries Page

11.5 Vertical Profile Page

The profile plots of Speed / Direction, Velocity (Beam / Instr / Earth), Amplitude, Correlation and Percent Good.

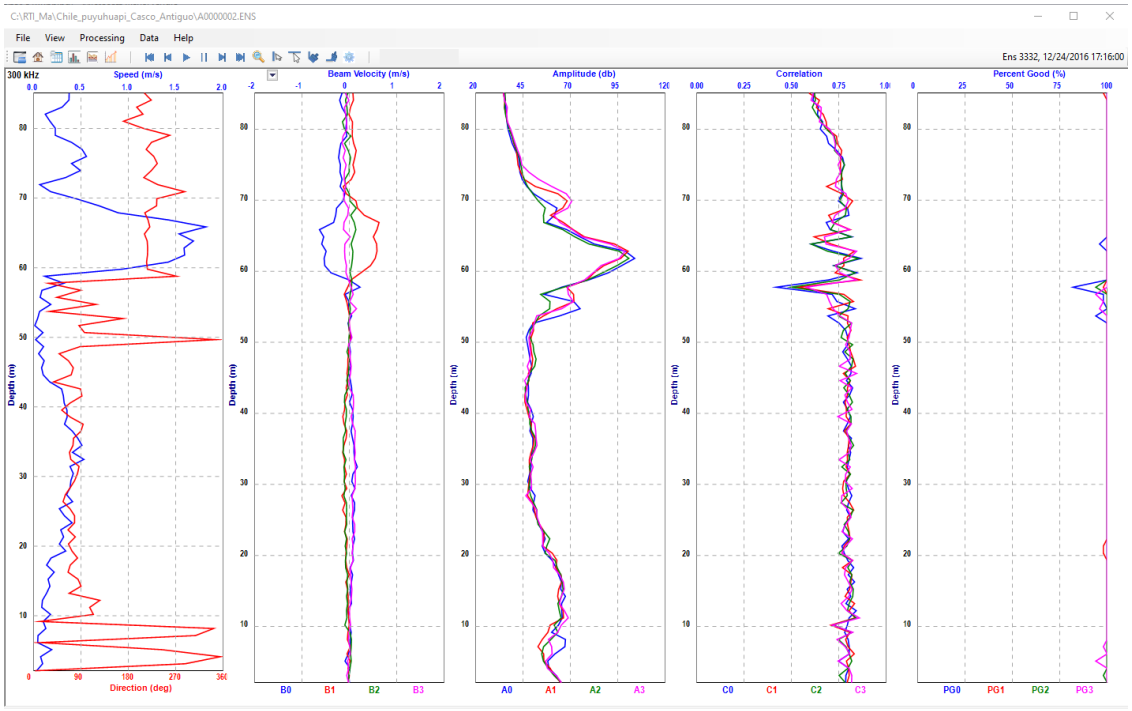


Figure 27. Vertical Profile Page

11.6 Control Bar

The control bar contains buttons  to manipulate data includes Play / Pause, step forward / backward, First / Last ensemble; Zoom In / Out, Pick ensemble, Pick timeseries, and change setting parameters.

- **Play data**  : you can use the buttons to play with the data includes Play / Pause, step forward / backward, First / Last ensemble. Use "Enter" key to fast step forward process, and use "Back" key to fast step backward process.

- **Zoom In / Out**: You can select an area on the contour plot in Home Page to zoom in that area. To do this, put your mouse on the spot on the contour plot, hold the mouse button and drag the mouse. You will see a rectangle on the contour plot. Hold the mouse key and drag the rectangle to select the area you want to zoom in and release the mouse key. The selected area will be zoomed in and shown in the plot window (Figure 28). Click the magnifier icon  to zoom it out.

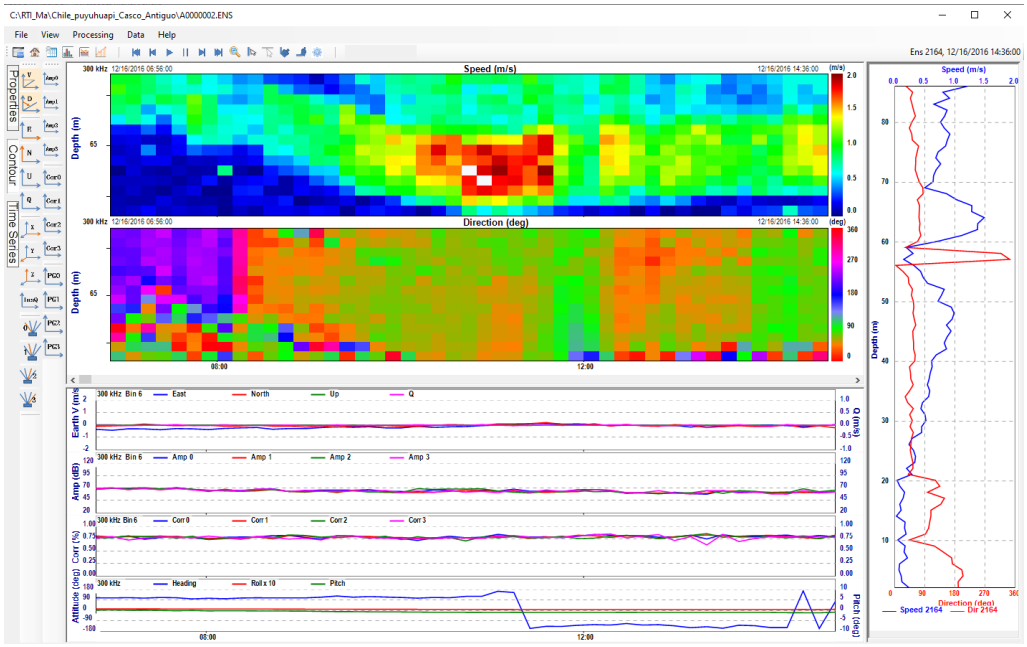


Figure 28. Zoom In

- **Pick Ensemble** : pick ensembles from the contour image in the Home page. The picked ensembles will be shown on the Vertical Profile Window of the Home page. Click the button from the tool bar to enable ensemble picker. You will see a white vertical line on the contour image, move the white line to the ensemble on the contour plot then click. That ensemble will be selected, and the profile file of the ensemble will be shown in the Vertical Profile Window on the right (Figure 29). You can select as many ensembles as you can. Click the button to clear the selected ensembles. Unclick the button to disable ensemble picker.

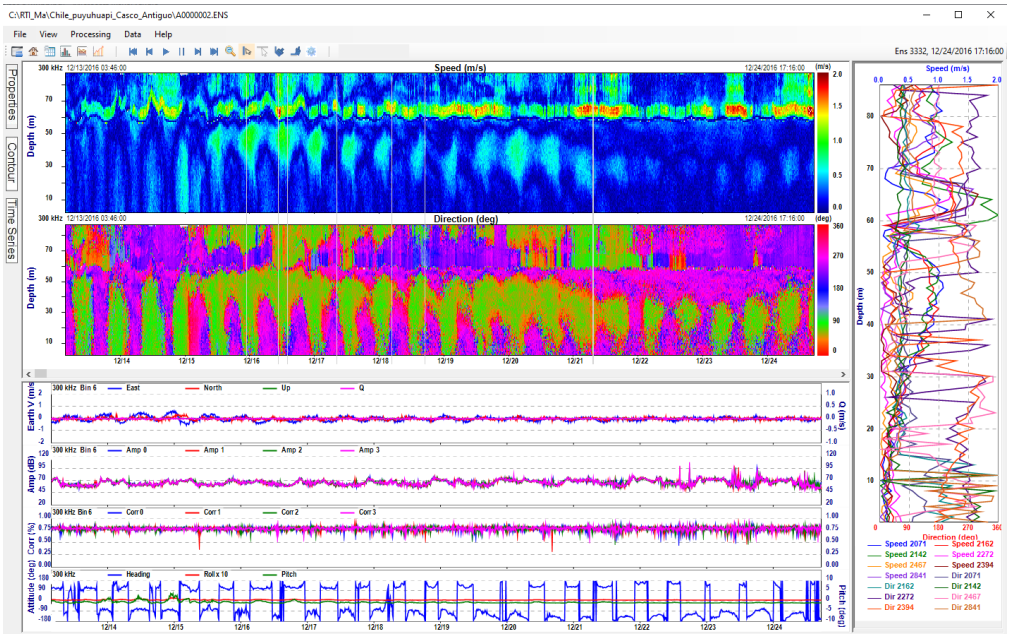


Figure 29. Ensemble Picker

- **Pick TimeSeries** : pick different bins from the contour plot in the Home Page and show timeseries of the picked bins on the TimeSeries plots (Figure 30) in the Home Page. You can only select bins from one contour plot. In doing so,

  First, click button to enable timeseries picker.

  Second, click "Contour" button on the left and select only one item, for example Speed , from the contour item buttons.

  Third, click "TimeSeries" button on the left to unselect all the item buttons from the first column, then select the same item (Speed) on the second column. This way, both the Contour Area and the TimeSeries Area of the home page will only show Speed plots.

  Fourth, now you will see a white horizontal line on the Speed contour plot. click will select that bin data, the selected bin timeseries plot will be shown in the TimeSereis Plotting Area. Move mouse on the contour to different depth to select more bins. Figure 30 shows the result of the selected bin timeseries plots.

  Click button on the tool bar to clear the selected timeseries plots. Unclick button to disable TimeSeries Picker.

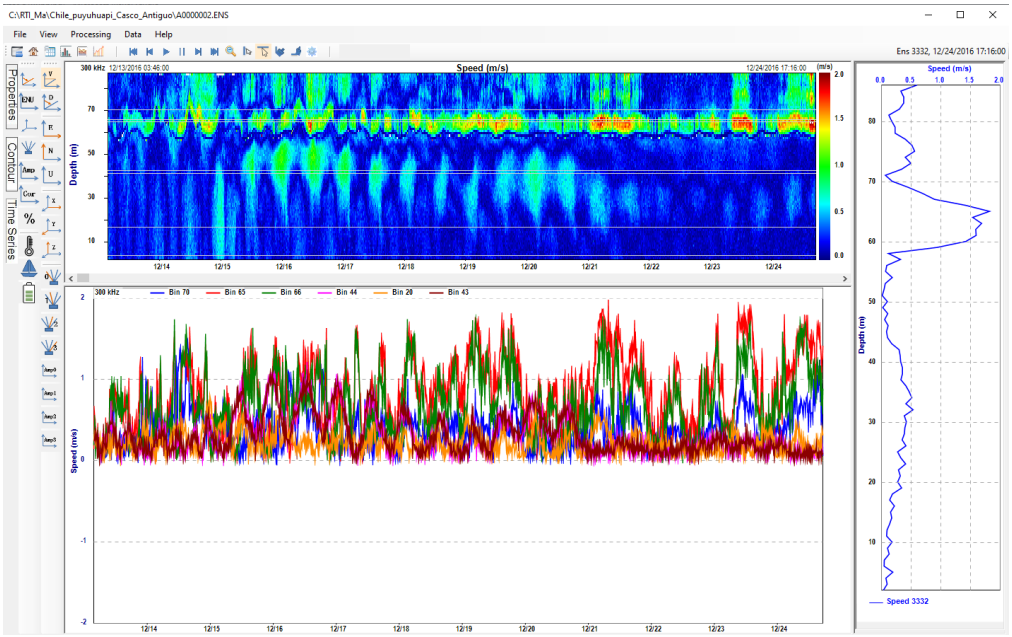


Figure 30. Timeseries Picker

11.7 Display Settings

In addition to just display data, the user can process and trim data to meet their different requirements. This can be done by setting up different parameter values in the **displaySetting** window. Click **Display Settings** icon to open displaySetting window (Figure 31).

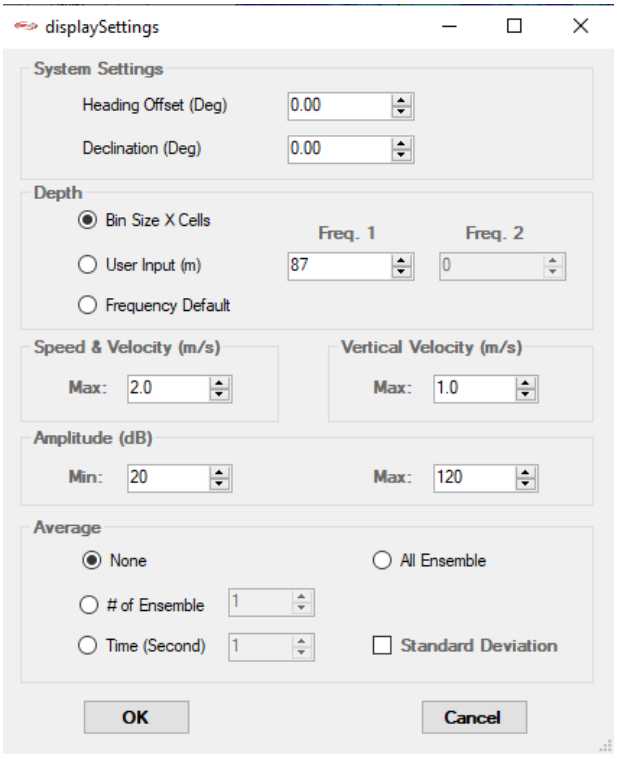


Figure 31. Display Settings

This includes

- **Heading Offset / Heading Declination (deg)**: to input the heading offset and heading declination values (in degrees) to the heading obtained from ADCP data to correct heading.
- **Depth (m)**: to set the maximum depth in meters of the display. This will affect all the contour, timeseries and vertical profile plots.
- **Maximum Speed & Velocity (m/s)**: set the maximum speed and velocity. This will affect all the contour, timeseries and vertical profile plots.
- **Maximum Vertical Velocity (m/s)**: set the maximum error velocity of the timeseries and plots.
- **Max/Min Amplitude (dB)**: set up the maximum and minimum values of amplitude. This will affect all the contour, timeseries and vertical profile plots.
- **Average**: options to average data includes
    - **None**: no averaging
    - **Time in Seconds**: average data based on time intervals. i.e. average data every n second, n is the number of seconds.
    - **# of ensembles**: average data based on ensembles. i.e. average data every n ensemble, n is the number of ensembles.
    - **All ensemble**: average all the data ensemble together. The comparison of vertical profile page of none averaged data and averaged data using All ensemble option are shown in Figure 32 and Figure 33, respectively.

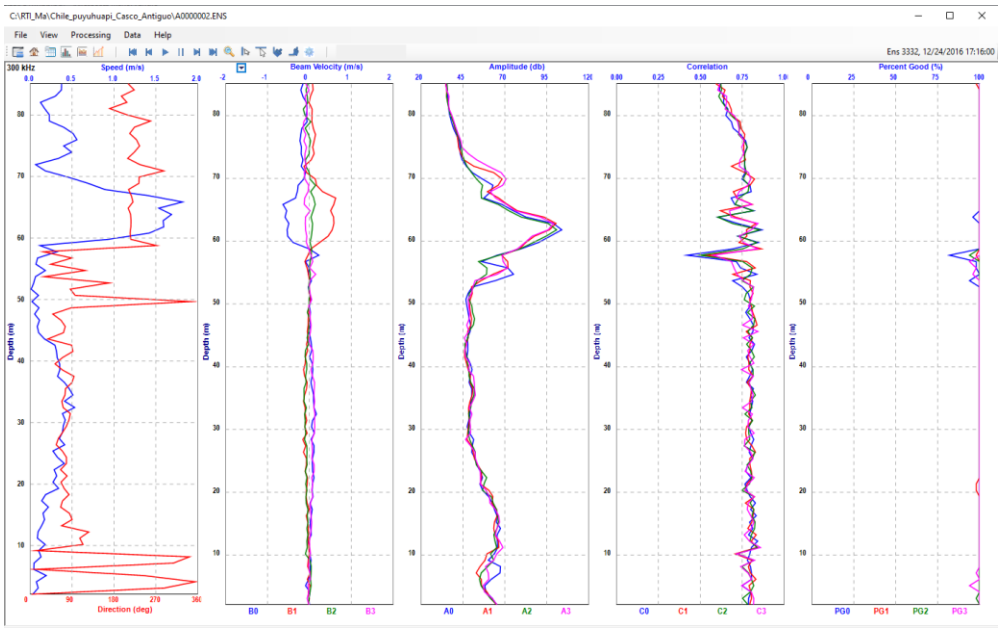


Figure 32. None averaged data

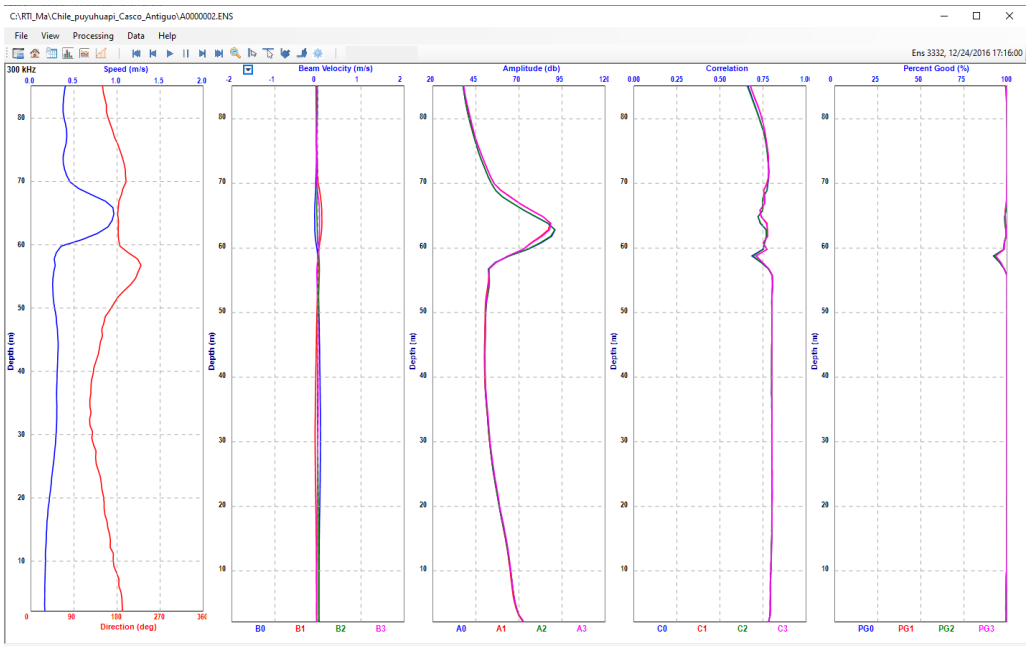


Figure 33. Averaged data using All ensemble option

- **Standard Deviation**: this is show you the standard deviation of the earth velocity on the Vertical Profile Page (Figure 34).

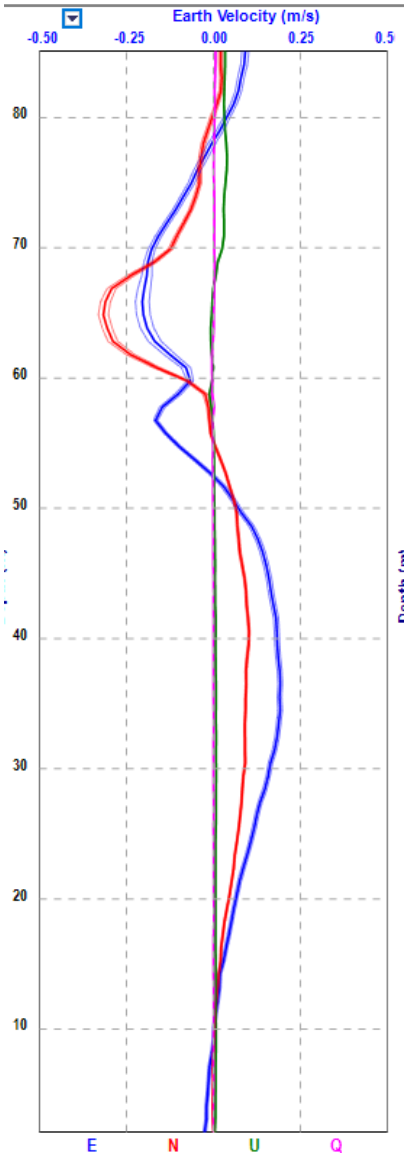


Figure 34. Standard Deviation

11.8 Dual Frequency

The dual frequency data display will be the same as single frequency except there are ways to show the second frequency data such as using tabpages In the following, we use an example of a 300/600 kHz dual frequency system with a 300 kHz vertical beam to show the different pages in the Playback display.

- **Home Page**

  Figure 35 shows the dual frequency Home Page data display. The Contour window shows the two frequencies speed and directions plots, while in both Timeseries window and Vertical profile window, each frequency has its own tab page.

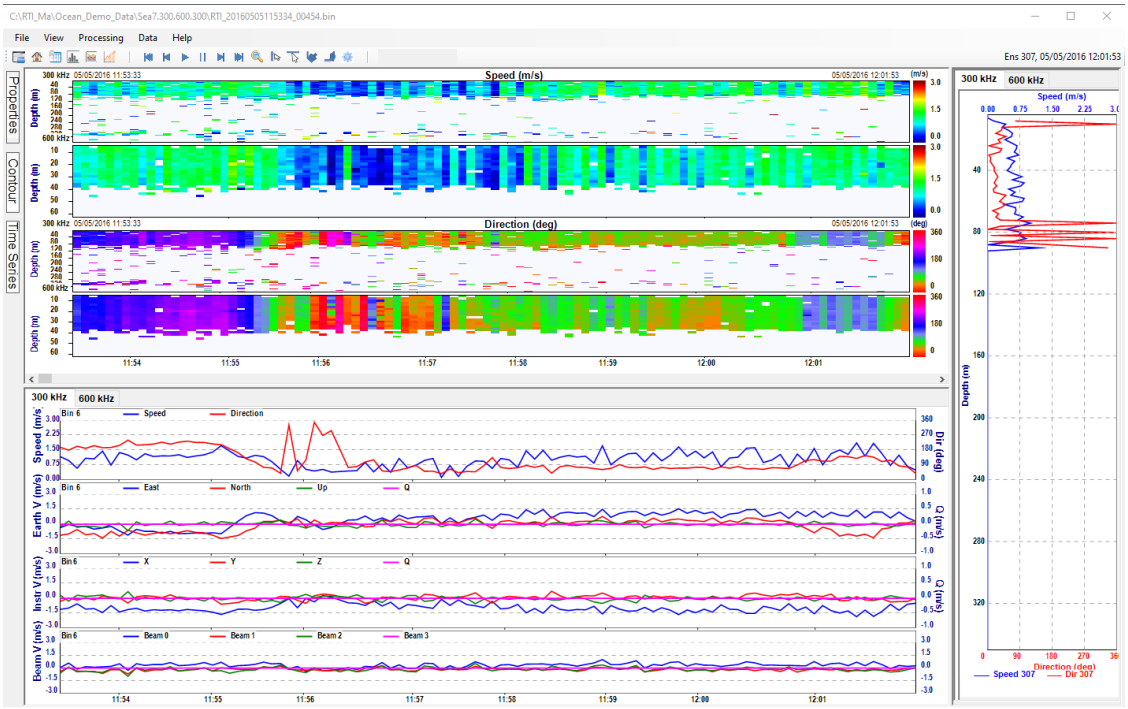
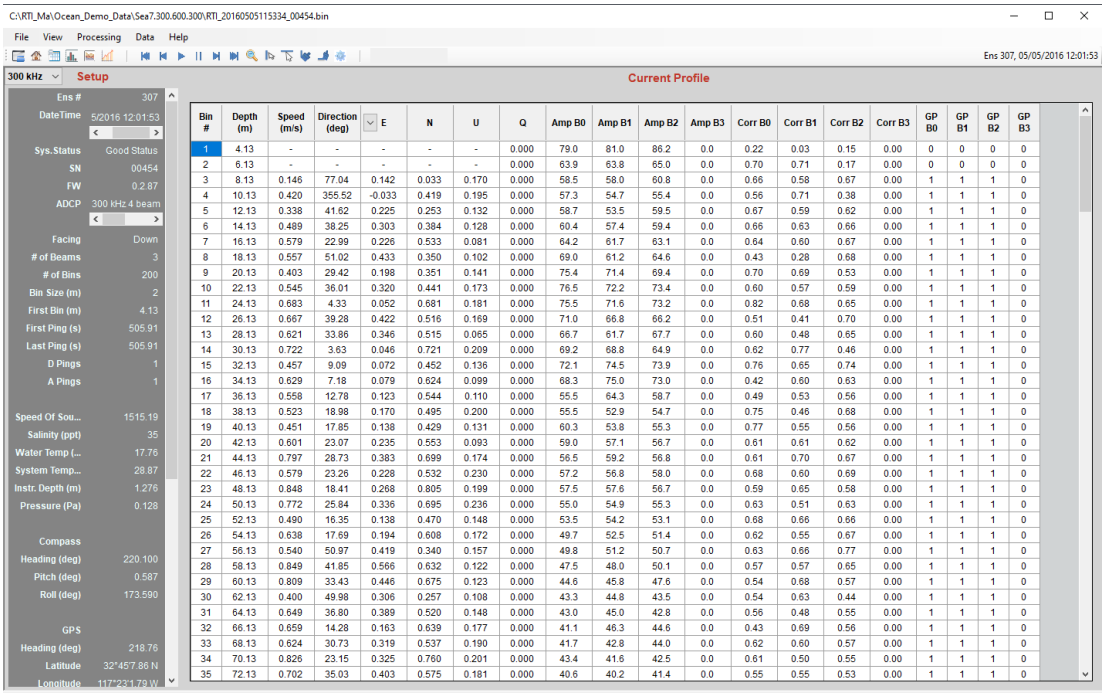


Figure 35. Dual Frequency Home Page

- **Data Page**

In Data Page, you can see each frequency data by selecting each frequency from the dropdown menu on the left top corner of the page.

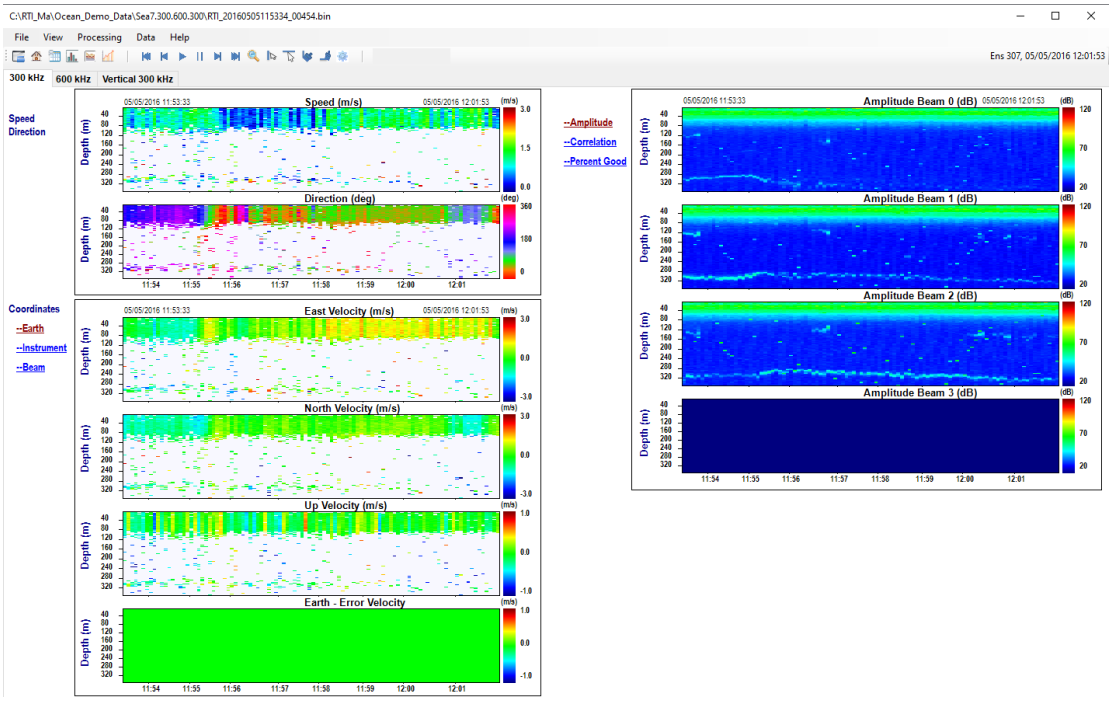


Bin #	Depth (m)	Speed (m/s)	Direction (deg)	E	N	U	Q	Amp B0	Amp B1	Amp B2	Amp B3	Corr B0	Corr B1	Corr B2	Corr B3	GP B0	GP B1	GP B2	GP B3
1	4.13	-	-	-	-	-	0.000	79.0	81.0	86.2	0.0	0.22	0.03	0.15	0.00	0	0	0	0
2	6.13	-	-	-	-	-	0.000	63.9	63.8	65.0	0.0	0.70	0.71	0.17	0.00	0	0	0	0
3	8.13	0.146	77.04	0.142	0.033	0.170	0.000	58.5	58.0	60.8	0.0	0.66	0.58	0.67	0.00	1	1	1	0
4	10.13	0.420	355.52	-0.033	0.419	0.195	0.000	57.3	54.7	55.4	0.0	0.56	0.71	0.38	0.00	1	1	1	0
5	12.13	0.338	41.62	0.225	0.253	0.132	0.000	58.7	53.5	59.5	0.0	0.67	0.59	0.62	0.00	1	1	1	0
6	14.13	0.489	38.25	0.303	0.384	0.128	0.000	60.4	57.4	59.4	0.0	0.66	0.63	0.66	0.00	1	1	1	0
7	16.13	0.579	22.99	0.226	0.533	0.081	0.000	64.2	61.7	63.1	0.0	0.64	0.60	0.67	0.00	1	1	1	0
8	18.13	0.557	51.02	0.433	0.350	0.102	0.000	69.0	61.2	64.6	0.0	0.43	0.28	0.68	0.00	1	1	1	0
9	20.13	0.403	29.42	0.198	0.351	0.141	0.000	75.4	71.4	69.4	0.0	0.70	0.69	0.53	0.00	1	1	1	0
10	22.13	0.545	36.01	0.320	0.441	0.173	0.000	76.5	72.2	73.4	0.0	0.60	0.57	0.59	0.00	1	1	1	0
11	24.13	0.683	4.33	0.052	0.681	0.181	0.000	75.5	71.6	73.2	0.0	0.82	0.68	0.65	0.00	1	1	1	0
12	26.13	0.667	39.28	0.422	0.516	0.169	0.000	71.0	66.8	66.2	0.0	0.51	0.41	0.70	0.00	1	1	1	0
13	28.13	0.621	33.86	0.346	0.515	0.065	0.000	66.7	61.7	67.7	0.0	0.60	0.48	0.65	0.00	1	1	1	0
14	30.13	0.722	3.63	0.046	0.721	0.209	0.000	69.2	68.8	64.9	0.0	0.62	0.77	0.46	0.00	1	1	1	0
15	32.13	0.457	9.09	0.072	0.452	0.136	0.000	72.1	74.5	73.9	0.0	0.76	0.65	0.74	0.00	1	1	1	0
16	34.13	0.629	7.18	0.079	0.624	0.099	0.000	68.3	75.0	73.0	0.0	0.42	0.60	0.63	0.00	1	1	1	0
17	36.13	0.558	12.78	0.123	0.544	0.110	0.000	55.5	64.3	58.7	0.0	0.49	0.53	0.56	0.00	1	1	1	0
18	38.13	0.523	18.98	0.170	0.495	0.200	0.000	55.5	52.9	54.7	0.0	0.75	0.46	0.68	0.00	1	1	1	0
19	40.13	0.451	17.85	0.138	0.429	0.131	0.000	60.3	53.8	55.3	0.0	0.77	0.55	0.56	0.00	1	1	1	0
20	42.13	0.601	23.07	0.235	0.553	0.093	0.000	59.0	57.1	56.7	0.0	0.61	0.61	0.62	0.00	1	1	1	0
21	44.13	0.797	28.73	0.383	0.699	0.174	0.000	56.5	59.2	56.8	0.0	0.61	0.70	0.67	0.00	1	1	1	0
22	46.13	0.579	23.26	0.228	0.532	0.230	0.000	57.2	56.8	58.0	0.0	0.68	0.60	0.69	0.00	1	1	1	0
23	48.13	0.848	18.41	0.268	0.805	0.199	0.000	57.5	57.6	56.7	0.0	0.59	0.65	0.58	0.00	1	1	1	0
24	50.13	0.772	25.84	0.336	0.695	0.236	0.000	55.0	54.9	55.3	0.0	0.63	0.51	0.63	0.00	1	1	1	0
25	52.13	0.490	16.35	0.138	0.470	0.148	0.000	53.5	54.2	53.1	0.0	0.68	0.66	0.66	0.00	1	1	1	0
26	54.13	0.638	17.69	0.194	0.608	0.172	0.000	49.7	52.5	51.4	0.0	0.62	0.55	0.67	0.00	1	1	1	0
27	56.13	0.540	50.97	0.419	0.340	0.157	0.000	49.8	51.2	50.7	0.0	0.63	0.66	0.77	0.00	1	1	1	0
28	58.13	0.849	41.85	0.566	0.632	0.122	0.000	47.5	48.0	50.1	0.0	0.57	0.57	0.65	0.00	1	1	1	0
29	60.13	0.809	33.43	0.446	0.675	0.123	0.000	44.6	45.8	47.6	0.0	0.54	0.68	0.57	0.00	1	1	1	0
30	62.13	0.400	49.98	0.306	0.257	0.108	0.000	43.3	44.8	43.5	0.0	0.54	0.63	0.44	0.00	1	1	1	0
31	64.13	0.649	36.80	0.389	0.520	0.148	0.000	43.0	45.0	42.8	0.0	0.56	0.48	0.55	0.00	1	1	1	0
32	66.13	0.659	14.28	0.163	0.639	0.177	0.000	41.1	46.3	44.6	0.0	0.43	0.69	0.56	0.00	1	1	1	0
33	68.13	0.624	30.73	0.319	0.537	0.190	0.000	41.7	42.8	44.0	0.0	0.62	0.60	0.57	0.00	1	1	1	0
34	70.13	0.826	23.15	0.325	0.760	0.201	0.000	43.4	41.6	42.5	0.0	0.61	0.50	0.55	0.00	1	1	1	0
35	72.13	0.702	35.03	0.403	0.575	0.181	0.000	40.6	40.2	41.4	0.0	0.55	0.55	0.53	0.00	1	1	1	0

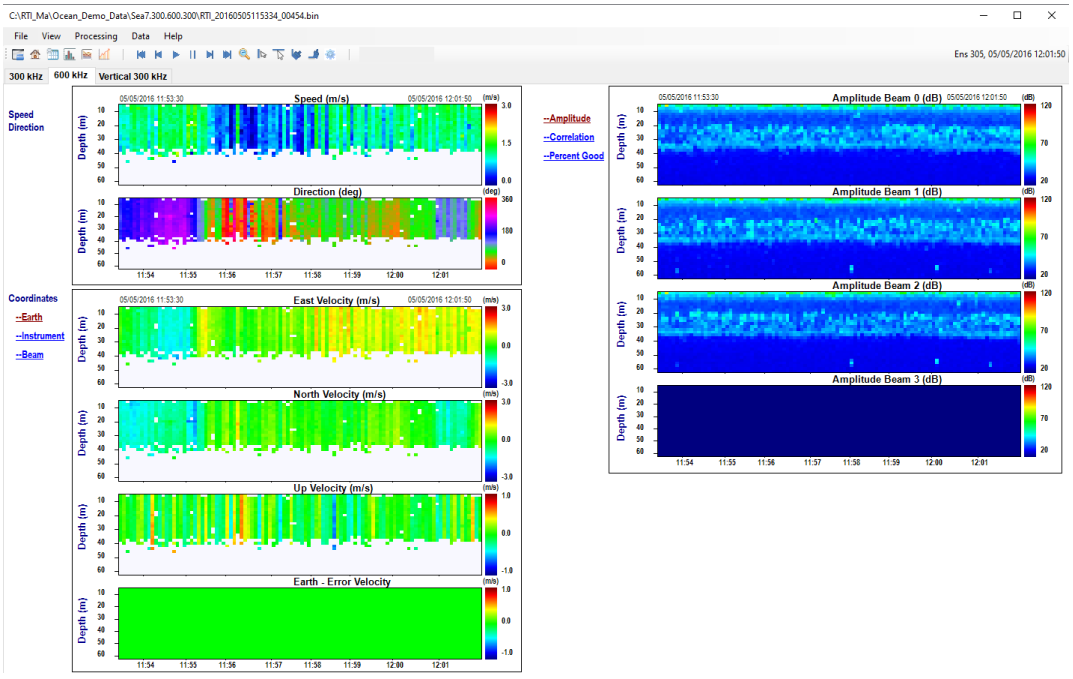
Figure 36. Dual Frequency Data Page

- **Contour Page**

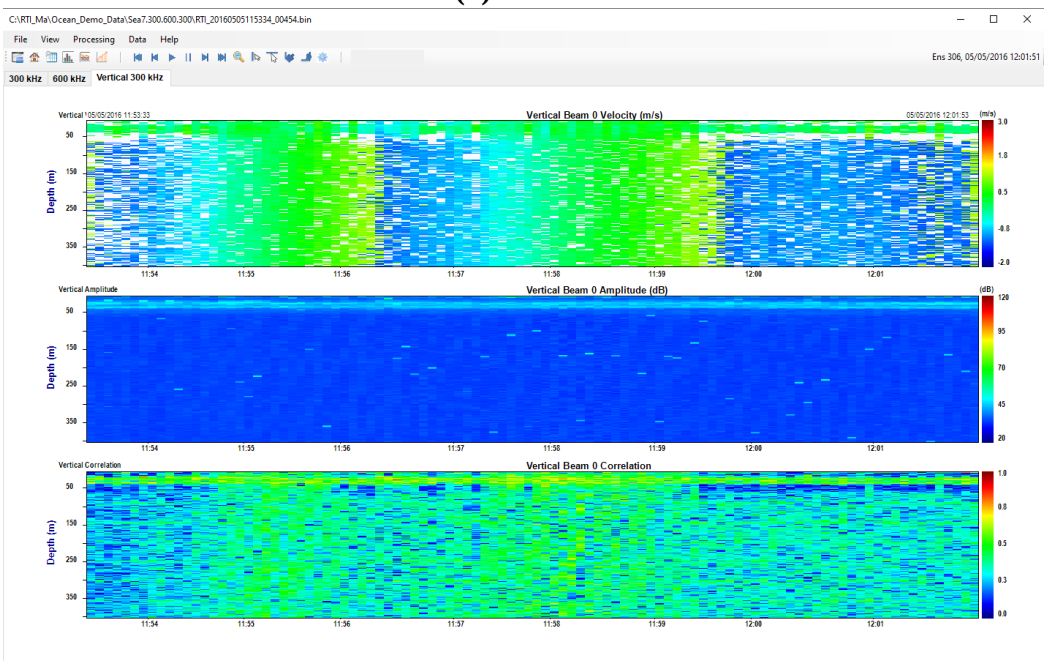
Figure 37 (a), (b) and (c) show each frequency tabpage respectively in the dual frequency Contour Page display. You can choose which frequency data you want to see by selecting the frequency tab page on the left top corner of the page.



(a) 300 kHz



(b) 600 kHz



(c) 300 kHz vertical beam

Figure 37. Dual Frequency Contour Page

- **TimeSeries Page**

Figure 38 shows the dual frequency Timeseries Page display. You can choose which frequency data you want to see by selecting the frequency tab page on the left top corner of the page.

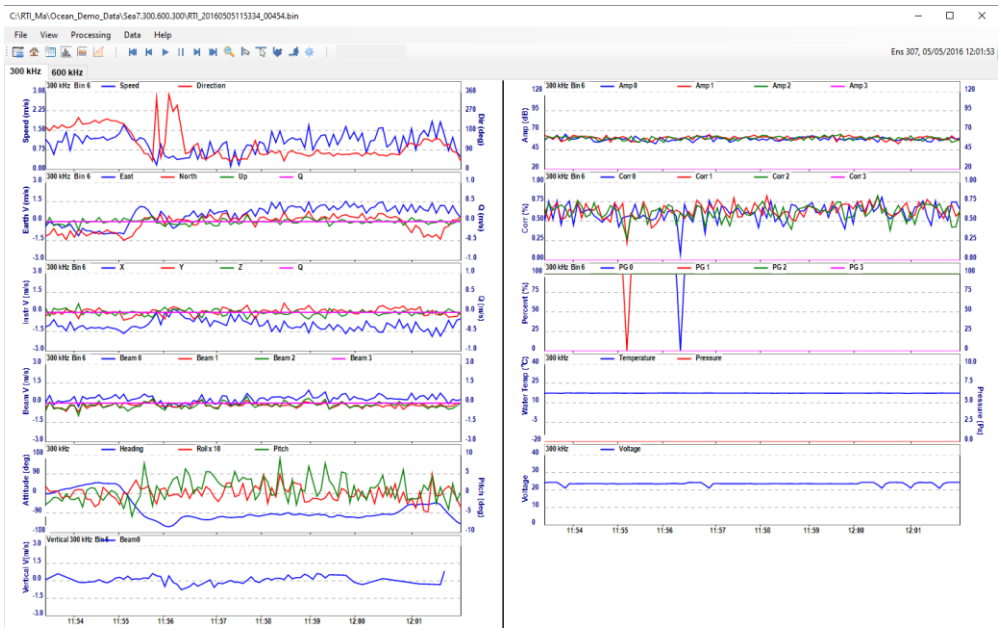
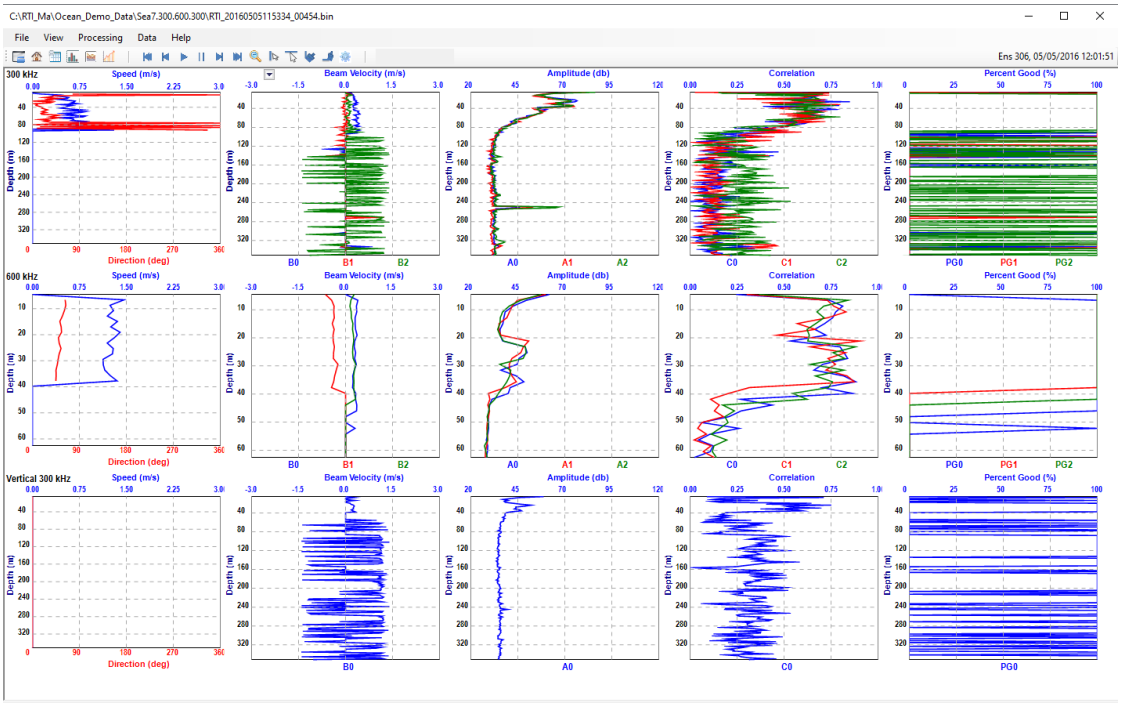


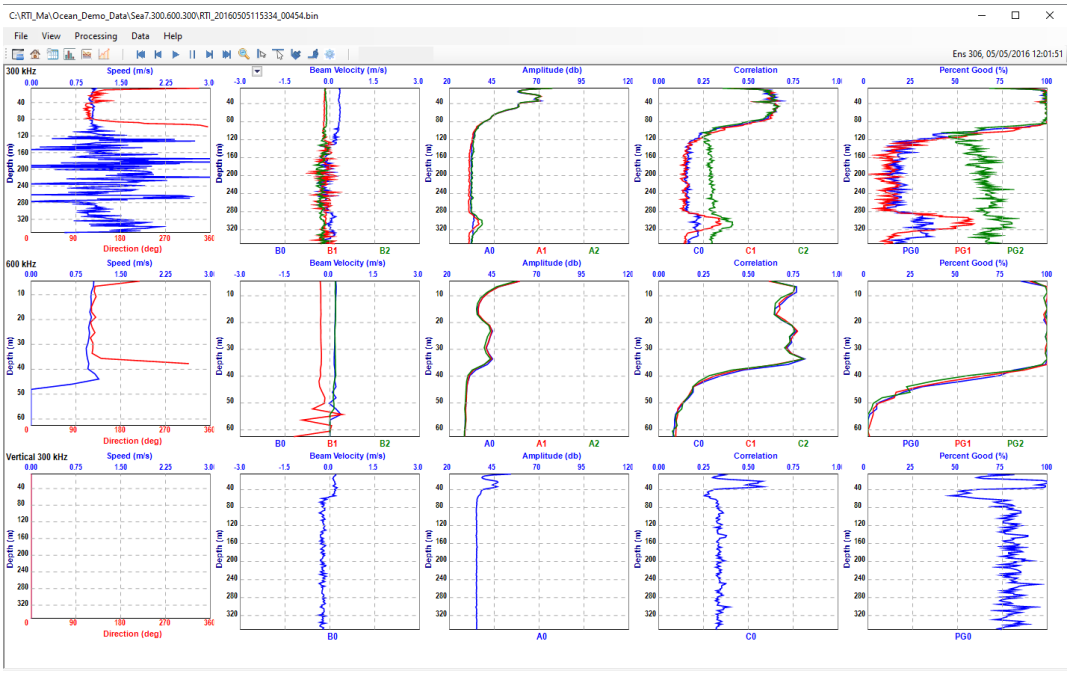
Figure 38 Dual Frequency Timeseties Page

- **Vertical Profile Page**

  Figure 39 shows the dual frequency Vertical Profile Page display when there is no averaging of the data (a) and the data is averaged using “All ensemble” option (b). You can see from the display that you all the (three) frequency profile plots are shown at the same time.



(a) No Average



(b) Average of all the ensembles

Figure 39. Dual Frequency Vertical Profile Page

12. Live Data View

After deployed the system and Started pining, you can open the View page to see the live data received from the ADCP by clicking the 

icon from the tool bar. The real-time data display user interface is the same as the Playback user interface except that play, zoom in/out, ensemble and timeseries picker control buttons are not included in the tool bar.