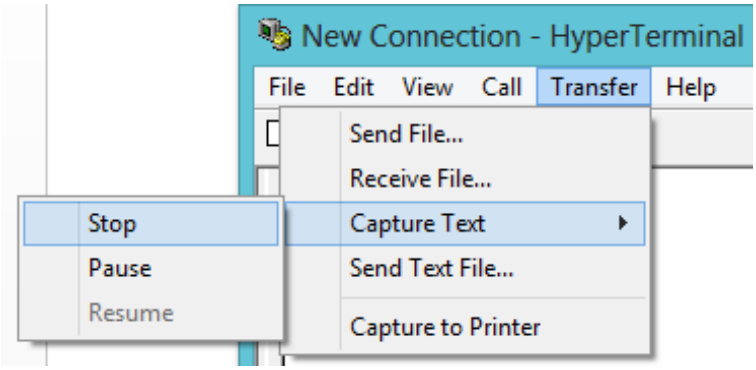
- To stop data recording, select “Transfer”, Capture Text” and “Stop”



ECHO SOUNDER DATA ANALYSIS PROCEDURE

The Echo Sounder Data Collection System (AQFI-1301) was designed to display echogram (Figure 17) and data recorded digital echo signal (50 kHz) into PC screen and hard disc. The Echo Sounder Data Collection System was set up at fixed sampling rate of 0.0512 msec with total 800 sampling echo data of digital value echo-signal recorded into the PC hard disc for each transmitting ping.

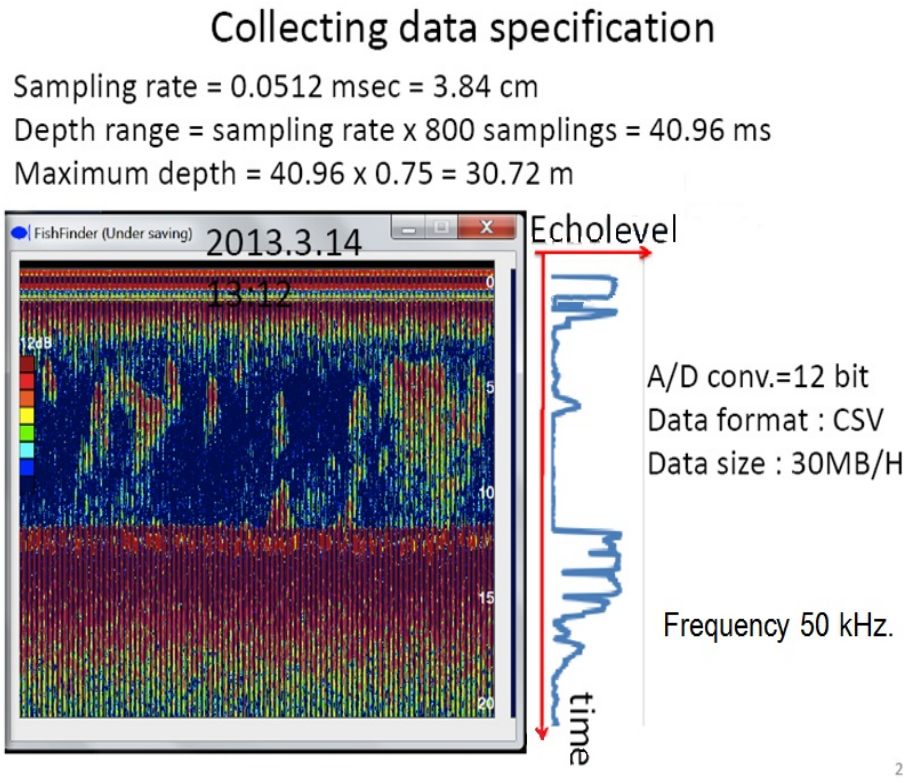


Figure 17. Echogram and A-scope display pattern shown on PC screen.

The echo sounder data can be analyzed using Excel program. This manual shows the procedure of analyzing data with Microsoft Excel.

1) Open echo sounder raw data file using the Excel program, then a table like Figure 18 is displated. Column A indicates the recording date and time. The echo sounder data are set from column B to column ADU (800 data). Since the sampling rate of the system is 0.512 msec (and sampling frequency is 19.53 kHz), the echo data are recorded with 3.84 cm resolution as shown by the following equation:

   Resolution = Sampling Rate × Sound Speed / 2
   = 0.512 (msec) × 1500 (m/sec) / 2 = 3.84 (cm)
   And the maximum depth that the system can measure is:
   Max. depth = Resolution × Amount of Data
   = 3.84 cm × 800= 30.72 m

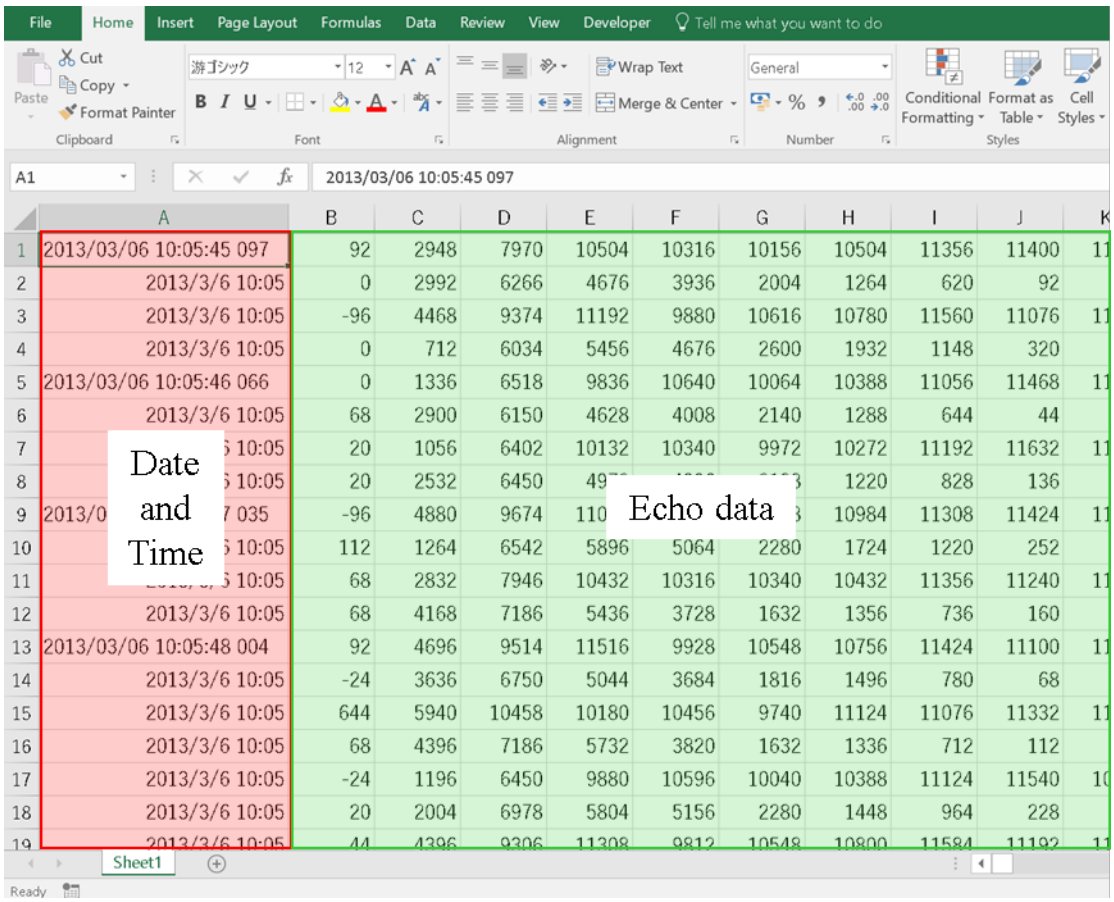


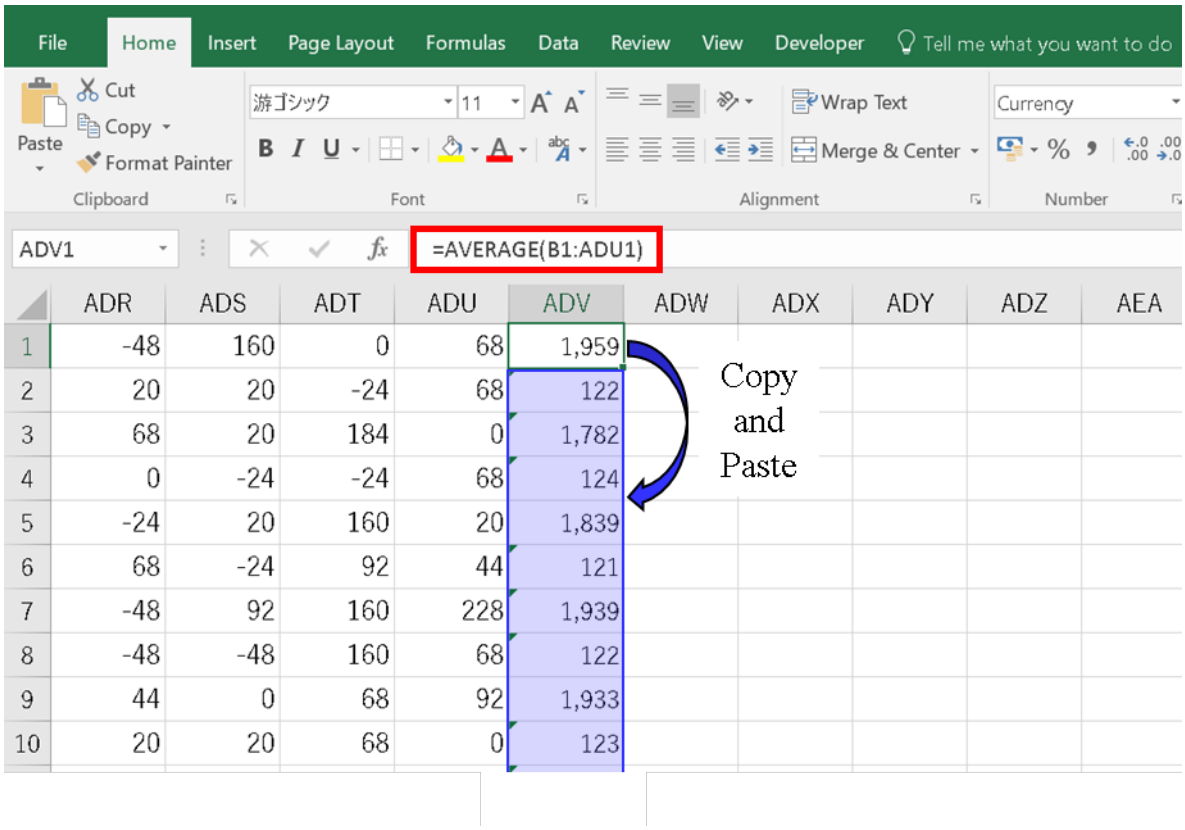
Figure 18. Echo sounder raw data.

The echo sounder FURUNO GP-1670F sends pulses of 50 and 200 kHz alternately. Then, recording echoes are also arranged alternately by 50 and 200 kHz data in the direction of the row. The return echo signal recorded by Echo Sounder Data Collection System (AQFI-1301) on the ".csv" Excel file will also be composed of rows of digital data information of 50 and 200 kHz alternately. However, Echo Sounder Data Collection

System (AQFI-1301) is designed to analyze only 50-kHz data. The following processes show the way to filter the 50-kHz data.

2) Input “=AVERAGE(B1:ADU1)” in cell ADV1 for calculating the average value from cell B1 to ADU1(Figure 19).

3) Copy cell ADV1. Select the whole column ADV and paste the formula (Figure 19). Then the low and high average values are being alternately shown in column ADV.



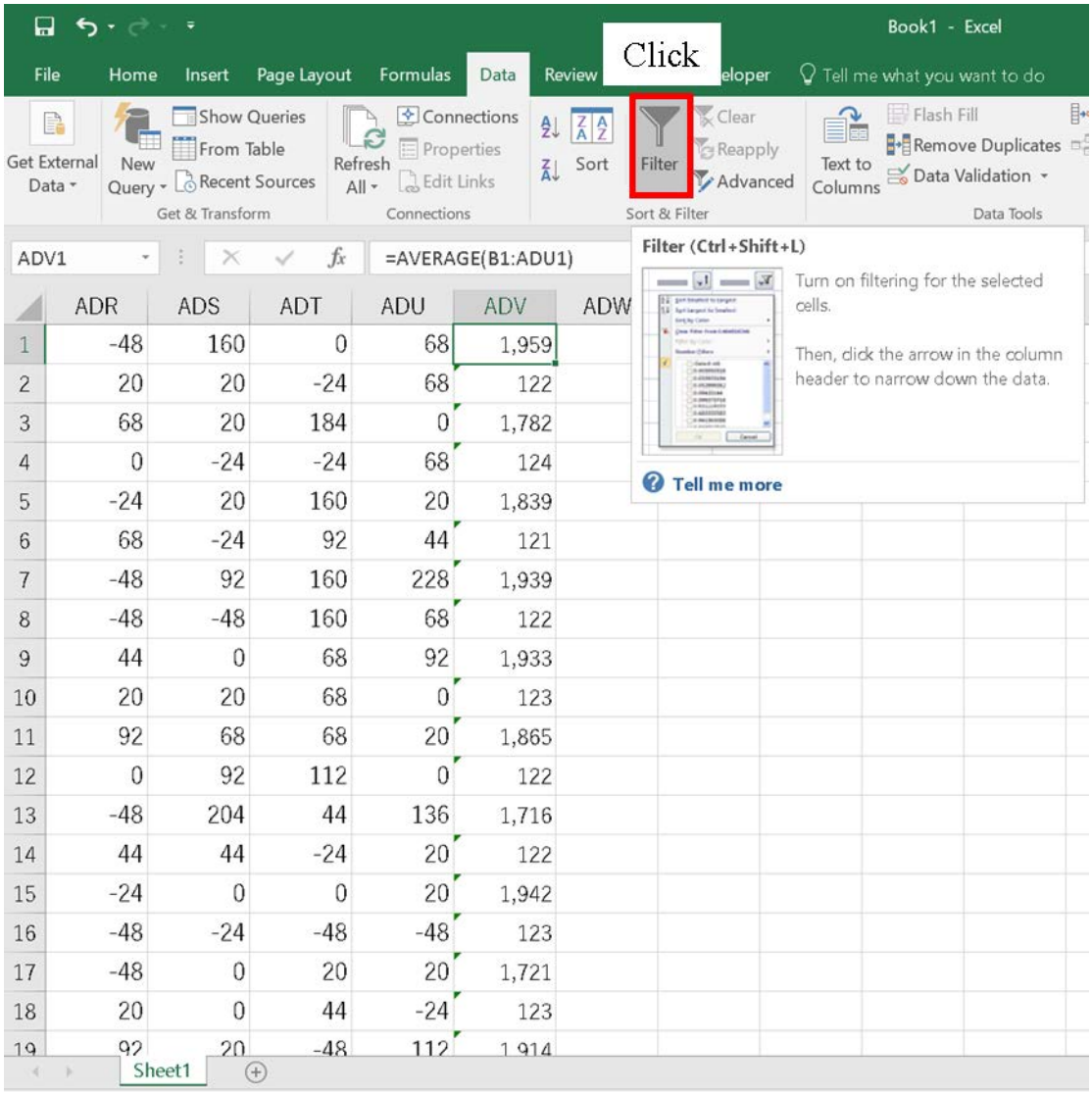
	ADR	ADS	ADT	ADU	ADV	ADW	ADX	ADY	ADZ	AEA
1	-48	160	0	68	1,959					
2	20	20	-24	68	122					
3	68	20	184	0	1,782					
4	0	-24	-24	68	124					
5	-24	20	160	20	1,839					
6	68	-24	92	44	121					
7	-48	92	160	228	1,939					
8	-48	-48	160	68	122					
9	44	0	68	92	1,933					
10	20	20	68	0	123					

Figure 19. Process to average echo data.

The values of 50-kHz data are relatively much higher than those of 200-kHz data. 50 kHz data can be extracted by the “Filter” function.

4) Select cell ADV1 and click “Data” > “Filter” of the upper menu (Figure 20).

5) Click the arrow in column ADV1, and then click “Number Filters”. Select “Greater Than Or Equal To…” (Figure 21), then the Custom Auto Filter box is opened. In the Custom AutoFilter box, type the criteria for filtering your data. For example, type 500 in the upper-right box to show the data higher than 500. Click “OK” to apply the filter (Figure 22).



	ADR	ADS	ADT	ADU	ADV	ADW
1	-48	160	0	68	1,959	
2	20	20	-24	68	122	
3	68	20	184	0	1,782	
4	0	-24	-24	68	124	
5	-24	20	160	20	1,839	
6	68	-24	92	44	121	
7	-48	92	160	228	1,939	
8	-48	-48	160	68	122	
9	44	0	68	92	1,933	
10	20	20	68	0	123	
11	92	68	68	20	1,865	
12	0	92	112	0	122	
13	-48	204	44	136	1,716	
14	44	44	-24	20	122	
15	-24	0	0	20	1,942	
16	-48	-24	-48	-48	123	
17	-48	0	20	20	1,721	
18	20	0	44	-24	123	
19	92	20	-48	112	1,914	

Figure 20. Activation of the “Filter” tool.

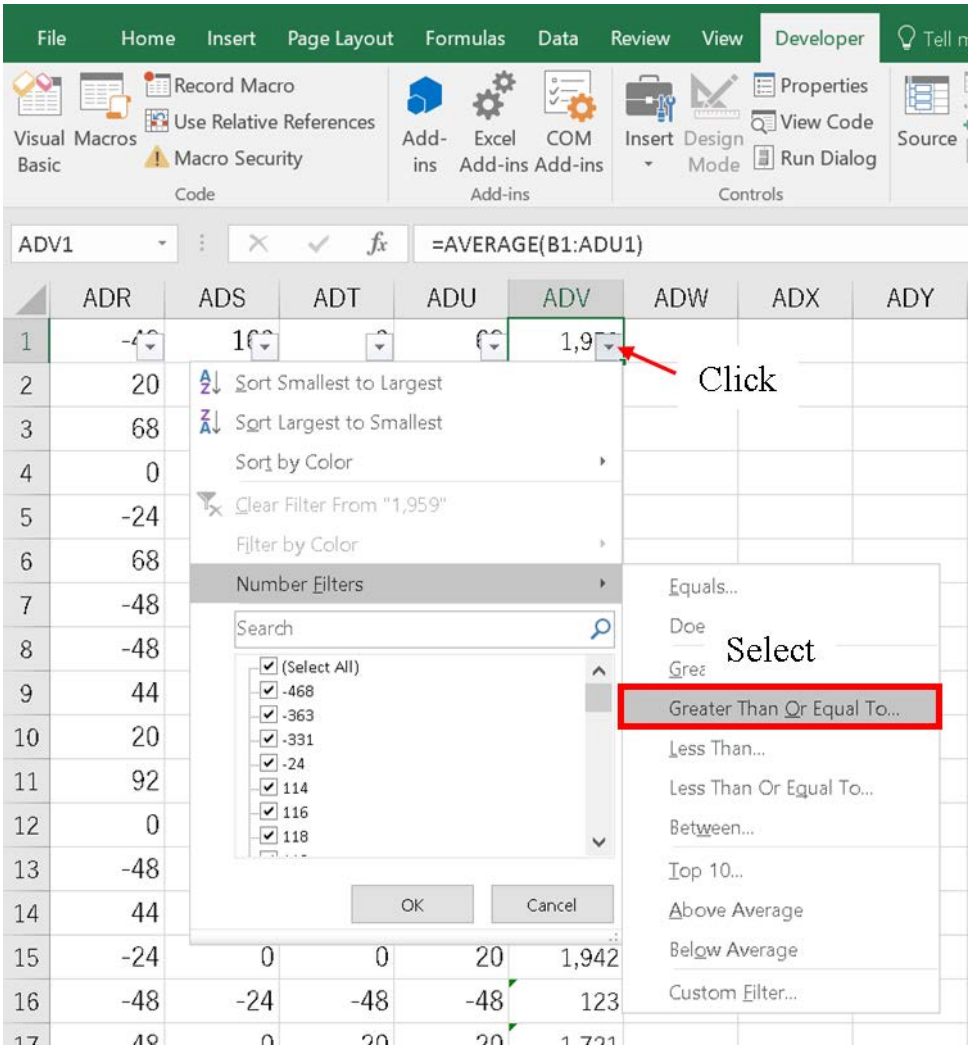


Figure 21. Selecting the way of filtering data.

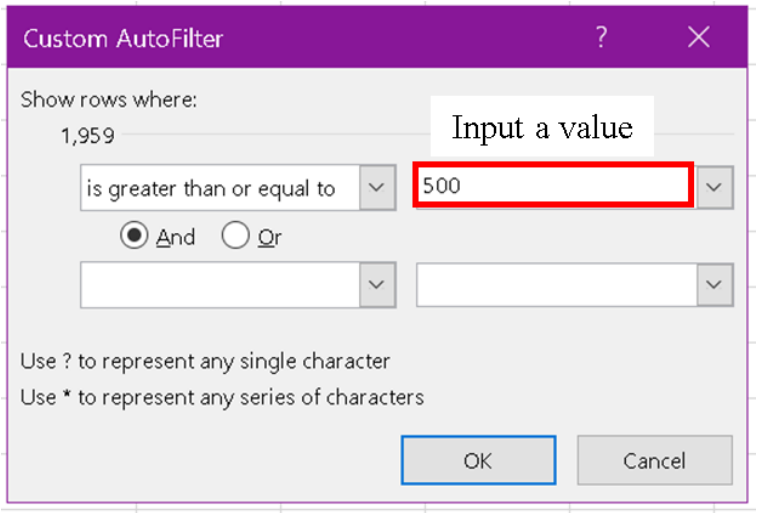


Figure 22. Custom AutoFilter box.

6) Copy the filtered data (column A to ADV) and paste to a new sheet (the sheet is written as "Sheet 2" bellow) (Figure 23).

   The data should be converted to voltage values to evaluate the echo data. The equation for converting is:
   VR = 0.00013 × Raw data value

7) Make an additional new sheet (the sheet is written as "Sheet 3" below). Copy column A of "Sheet 2" and paste to column A of "Sheet 3". Select cell B1 of "Sheet 3" and input "=Sheet2!B1*0.00013" (Figure 24). Sheet 2 should be renamed, then input the name of the "renamed Sheet 2" instead of just Sheet 2 in the equation. Copy cell B1 of "Sheet 3". Select cell B1 to cell ADU *x* (where *x* is the number of rows entered in the 50-kHz data in "Sheet 2"), and then paste.

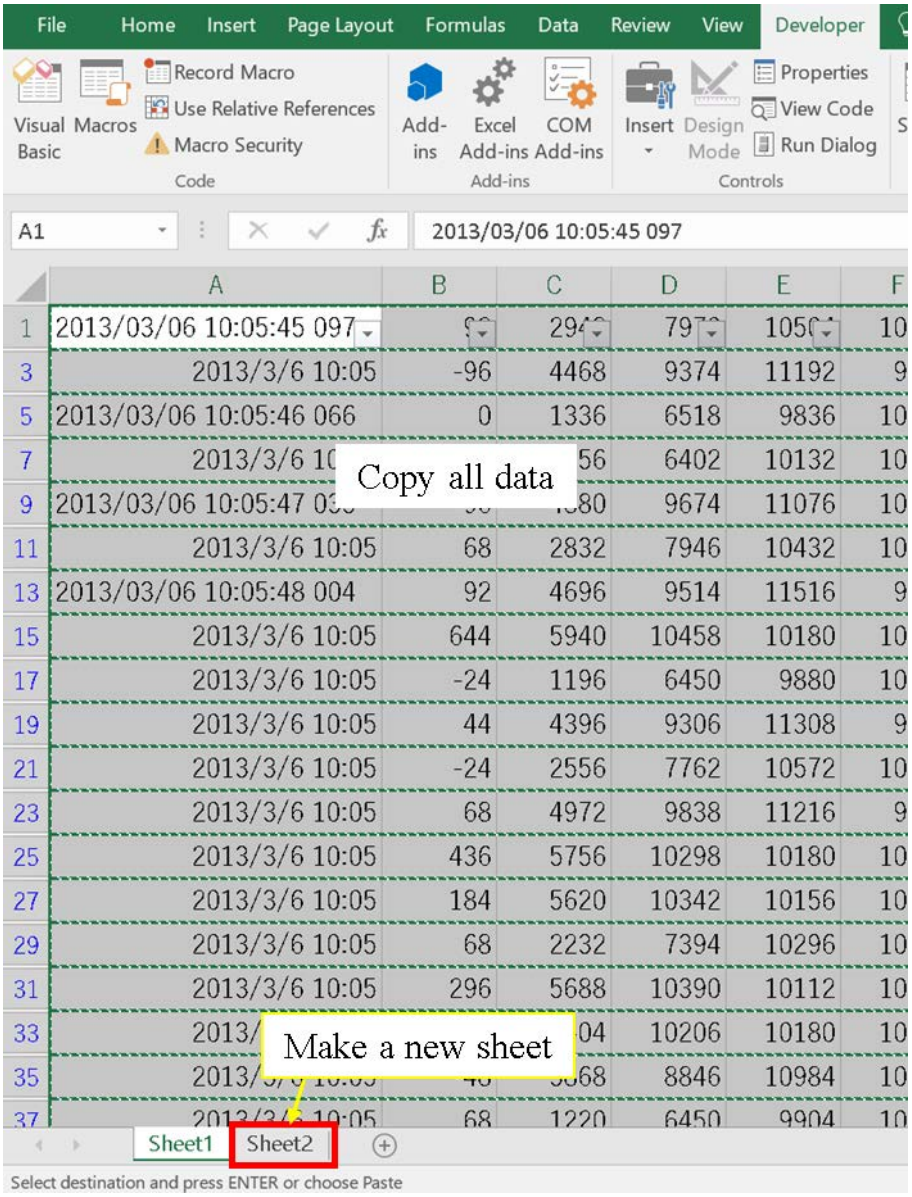


Figure 23. Copying and pasting the filtered data to a new sheet.

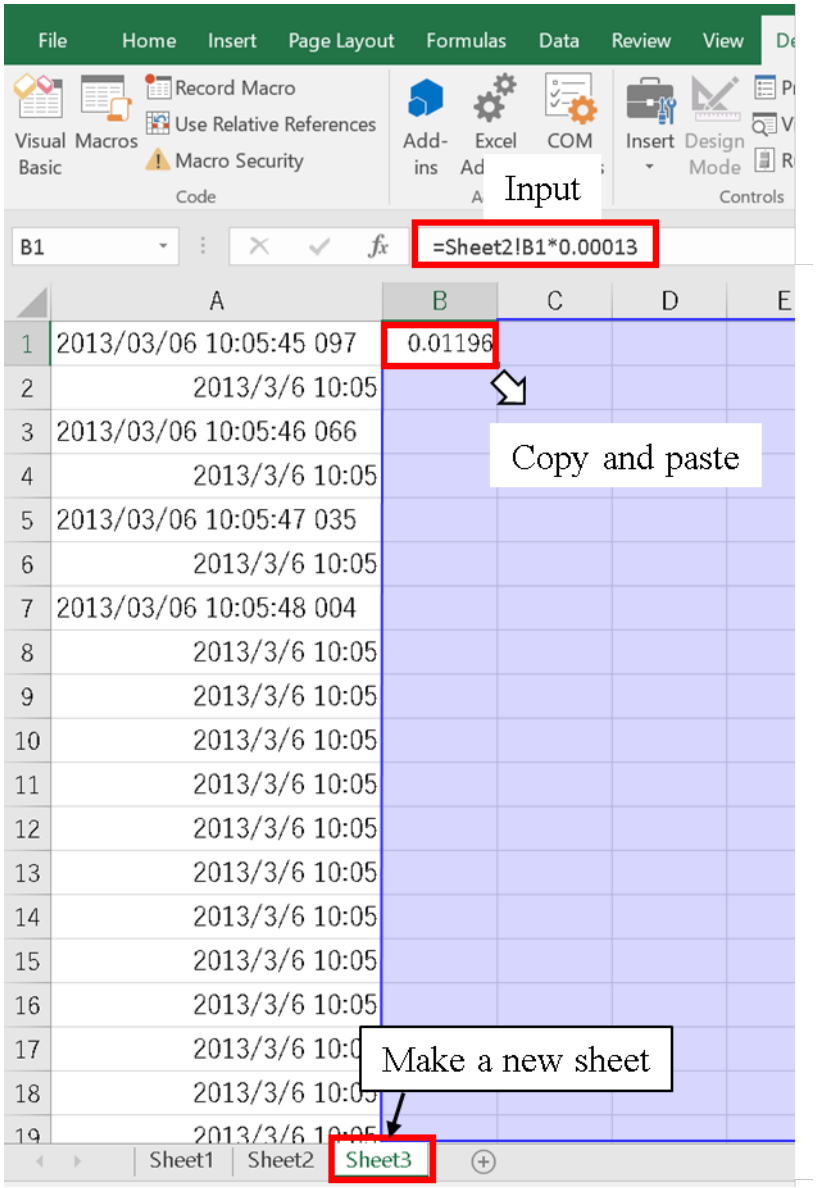


Figure 24 Process of converting raw data into voltage data.

To show the relationship between the voltage data and depth, make a graph as shown in the following processes.

8) Select row 1. Right-click and select “Insert” (Figure 25).

9) Input “Depth” in cell A1 and depth value (meter) in cell B1 to ADU1 (from left cell, 0, 0.0384, 0.0768, …). Insert a “Scatter” graph.

10) Right-click on the graph and select “Select data …”, then the Select Data Source box is opened (Figure 26). Click “Add” in the Select Data Source box. If there is any data series, remove all. And then, Edit Series box is opened. Input Series name, Series x values, and

Series y values. For example, to show the graph of data in row 2, input the data as shown Figure 27, and the graph like in Figure 28 is displayed.

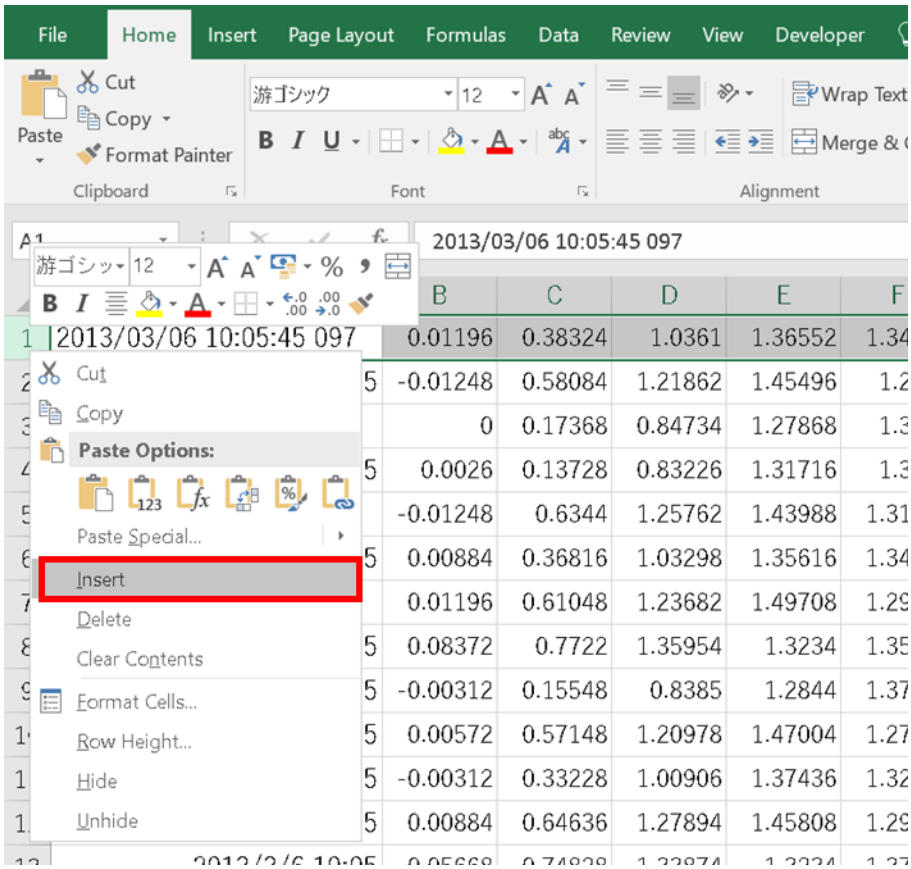


Figure 25. Inserting a new row.

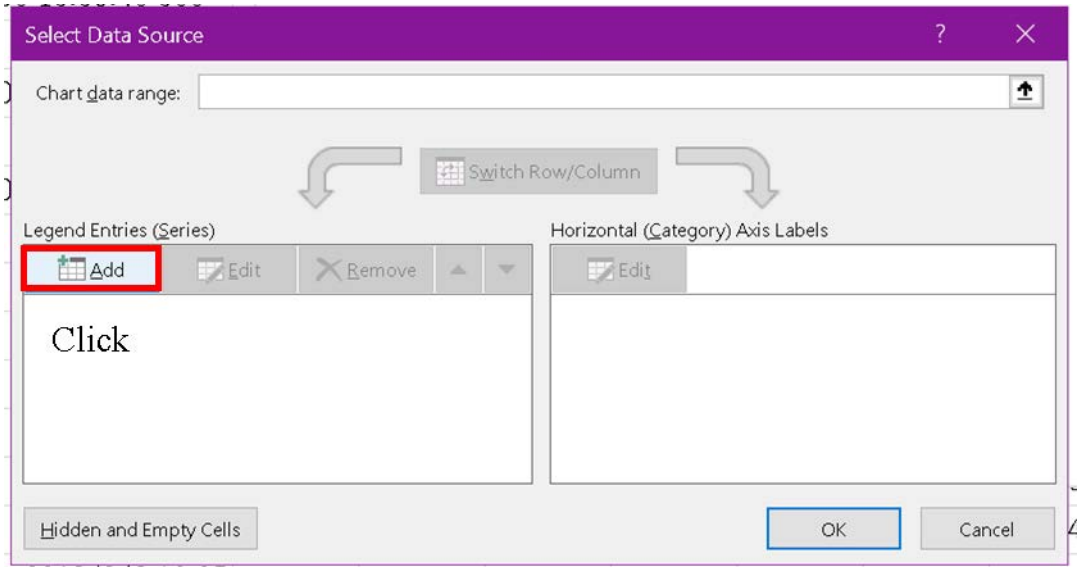


Figure 26. Selecting Data Source.

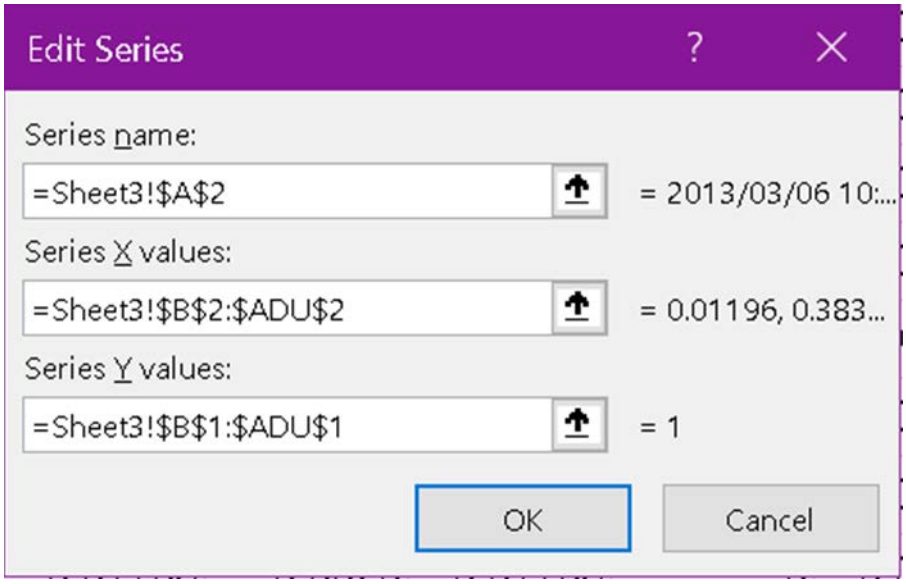
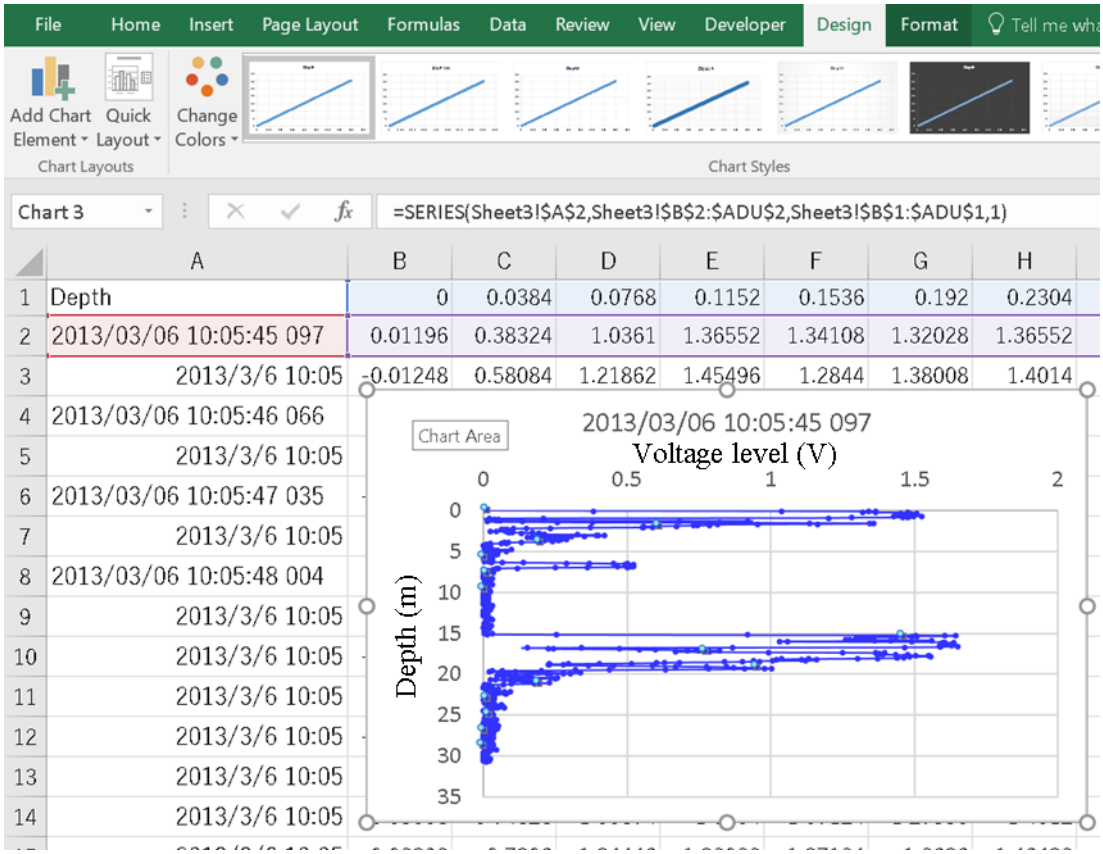


Figure 27. Eample of an input data.



	A	B	C	D	E	F	G	H
1	Depth	0	0.0384	0.0768	0.1152	0.1536	0.192	0.2304
2	2013/03/06 10:05:45 097	0.01196	0.38324	1.0361	1.36552	1.34108	1.32028	1.36552
3	2013/3/6 10:05	-0.01248	0.58084	1.21862	1.45496	1.2844	1.38008	1.4014
4	2013/03/06 10:05:46 066							
5	2013/3/6 10:05							
6	2013/03/06 10:05:47 035							
7	2013/3/6 10:05							
8	2013/03/06 10:05:48 004							
9	2013/3/6 10:05							
10	2013/3/6 10:05							
11	2013/3/6 10:05							
12	2013/3/6 10:05							
13	2013/3/6 10:05							
14	2013/3/6 10:05							

Figure 28. Graph showing the relationship between voltage values and depths.

In order to find out the fish abundance distribution in the survey area, a further echo signal data analyzing process is required as shown in the following:

1) Convert digital data (raw data) into voltage data (in terms of linear and decibels), (Figure 29),
2) Calculate the Time Varied Gain (TVG) compensation of loss echo signal for each layer of water depth (Figure 30),
3) Calculate the average value of echo signal for each transmitting ping, (Figure 31),
4) Calculate the integration value of echo signal of each integration distant, (Figure 32),
5) Plot the echo integration value in the survey transect for fish abundance distribution (Figure 33).

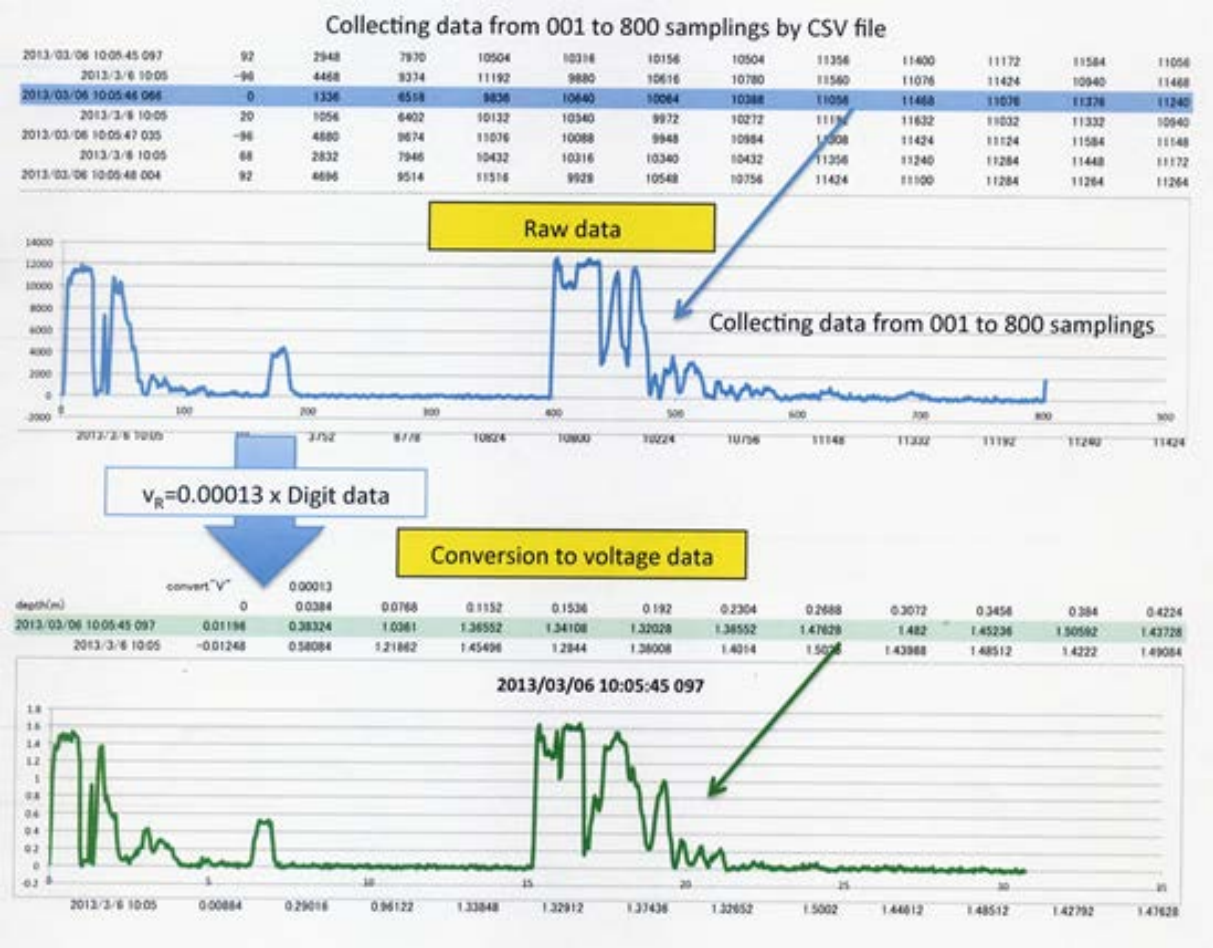


Figure 29. Converting digital data (raw data) in to voltage data.

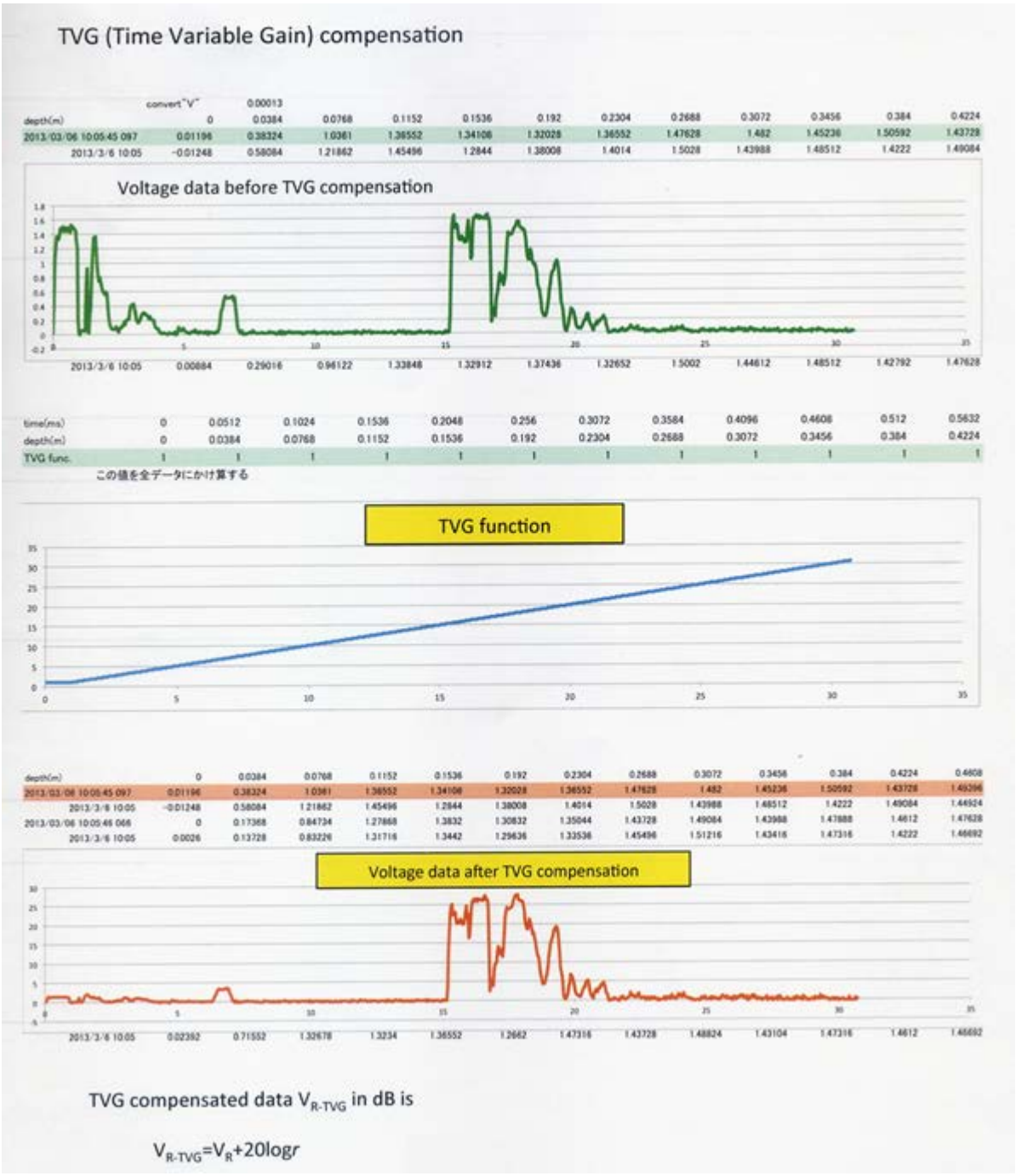


Figure 30. Calculation of Time Varied Gain (TVG) compensation of loss echo signal for each layer of water depth.

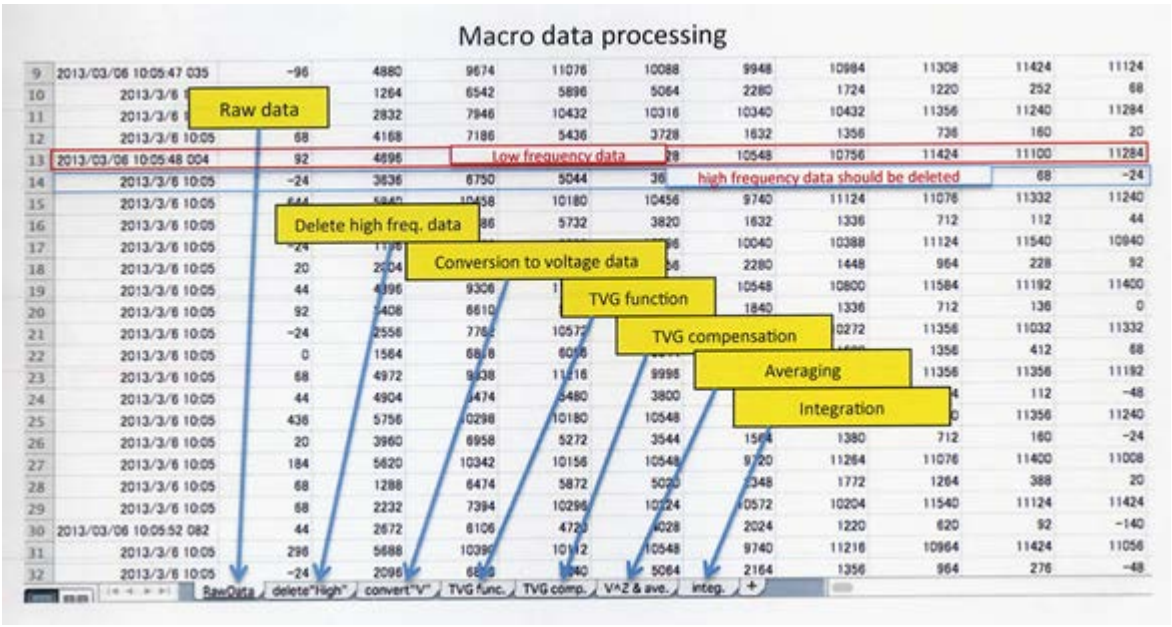


Figure 31. Calculation of average value of echo signal for each transmitting ping.

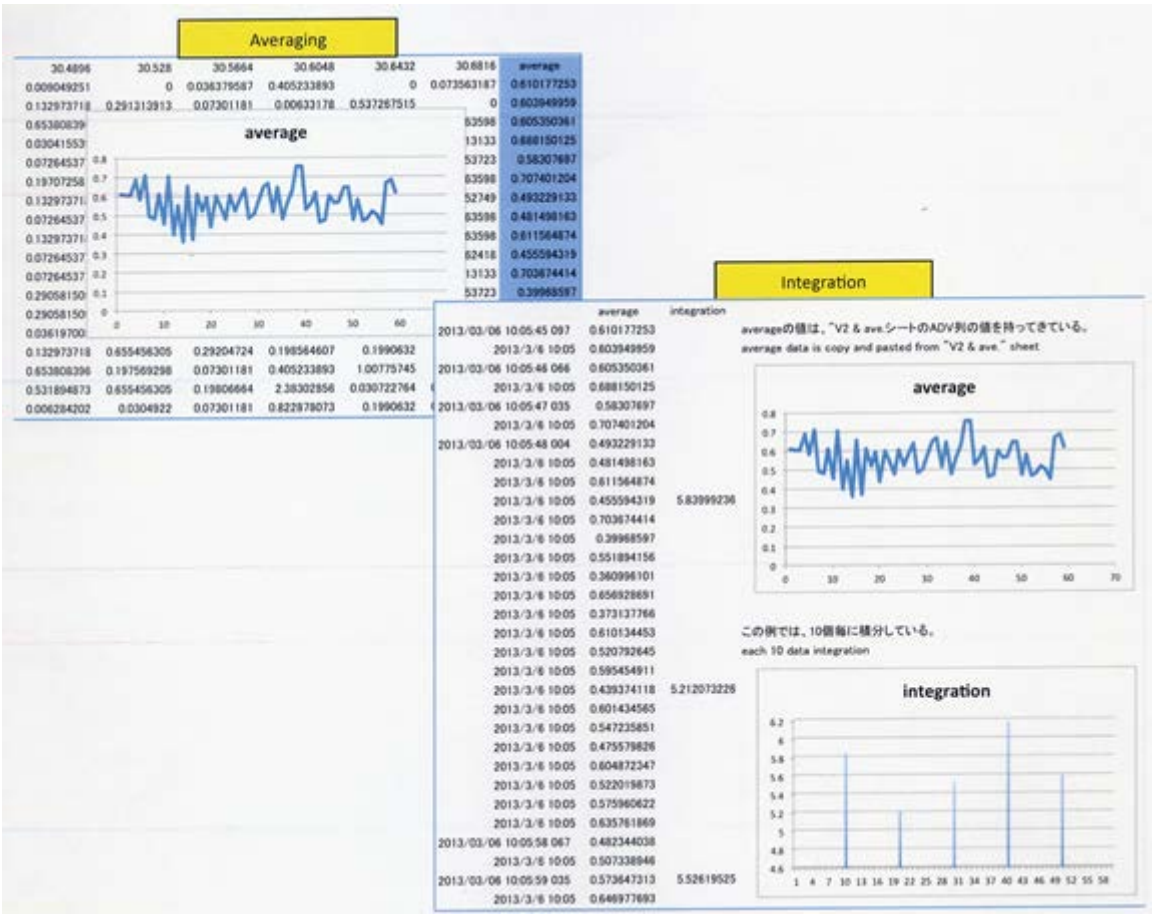


Figure 32. Calculation of integration value of echo signal of each integration distance.

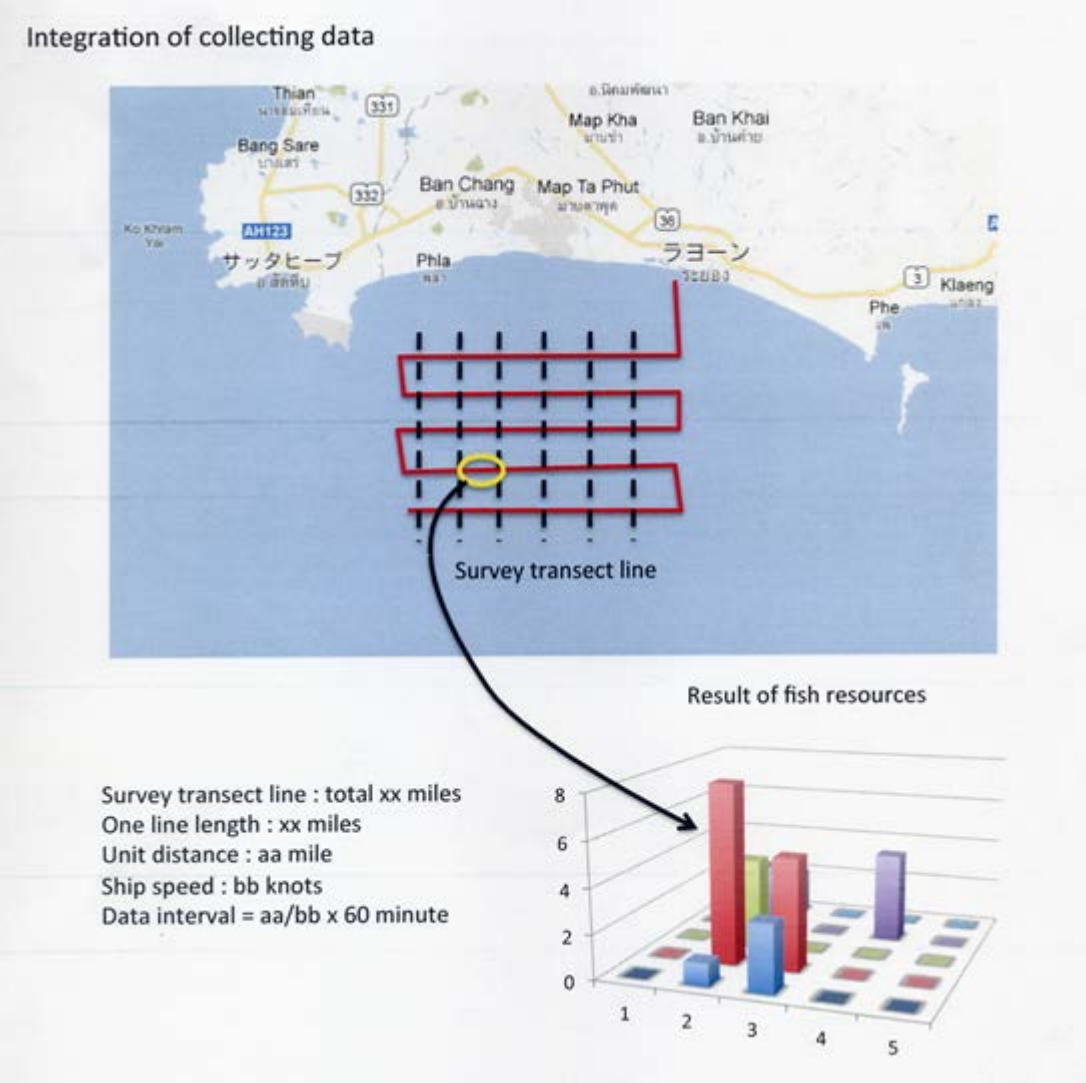


Figure 33. Plot of the echo integration value in the survey transect for fish abundance distribution**.**