GPS DATA ANALYSIS PROCEDURE

Outline of GPS data

The GPS receiver output data or record tracks, the time, accuracy, etc. in NMEA format. NMEA is acronym for the National Marine Electronics Association. There are different types of NMEA messages. Some of those that are applicable to GPS receivers are listed below.

- GPGGA: essential fix data which provides 3D location and accuracy data.
- GPRMC: has its own version of essential GPS pvt (position, velocity, time) data.
- GPDPT: Depth
- GPVTG: Speed over ground and tracking offset.

The GPGGA message has enough information for this Manual's system. To understand the NMEA message structure, examine the $GPGGA message as shown below, this particular message was an output from GPS receiver:

$GPGGA,031959,1235.0071,N,10122.5079,E,1,16,0.7,3.6,M,,,,*0C

031959 is the time stamp: UTC time in hours, minutes and seconds.

1235.0071 is the latitude in the DDMM.MMMM format.

N denotes north latitude.

10122.5079 is the longitude in the DDDMM.MMMM format.

E denotes east longitude.

1 denotes the fixed quality: 1 = independent

2 = Differentially correct coordinate (e.g., WAAS, DGPS)

3 = PPS fix

4 = RTK fix coordinate (centimeter precision)

5 = RTK Float (decimeter precision.

16 denotes number of satellites used in the coordinate.

0.7 denotes the HDOP (horizontal dilution of precision).

3.6 denotes altitude, meters, above mean sea level.

M denotes units of altitude (eg. meters or feet)

(empty field): Height of geoid (mean sea level) above WGS84 ellipsoid

(empty field) time in seconds since last DGPS update

(empty field) DGPS station ID number

*0c is the checksum data, always begins with *

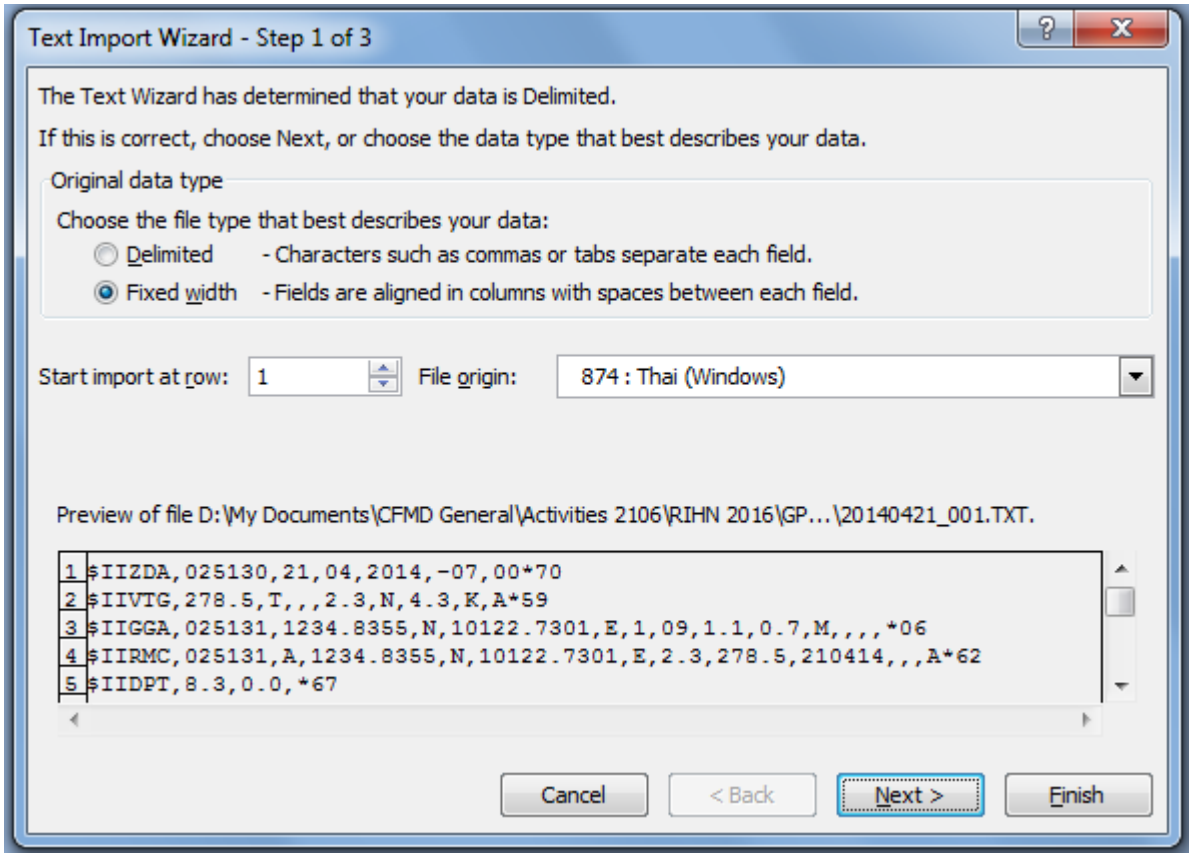
The NMEA of GPS is saved in text format. Here, the resource distribution is mapped with Microsoft Excel.

a. Loading NMEA data with Excel

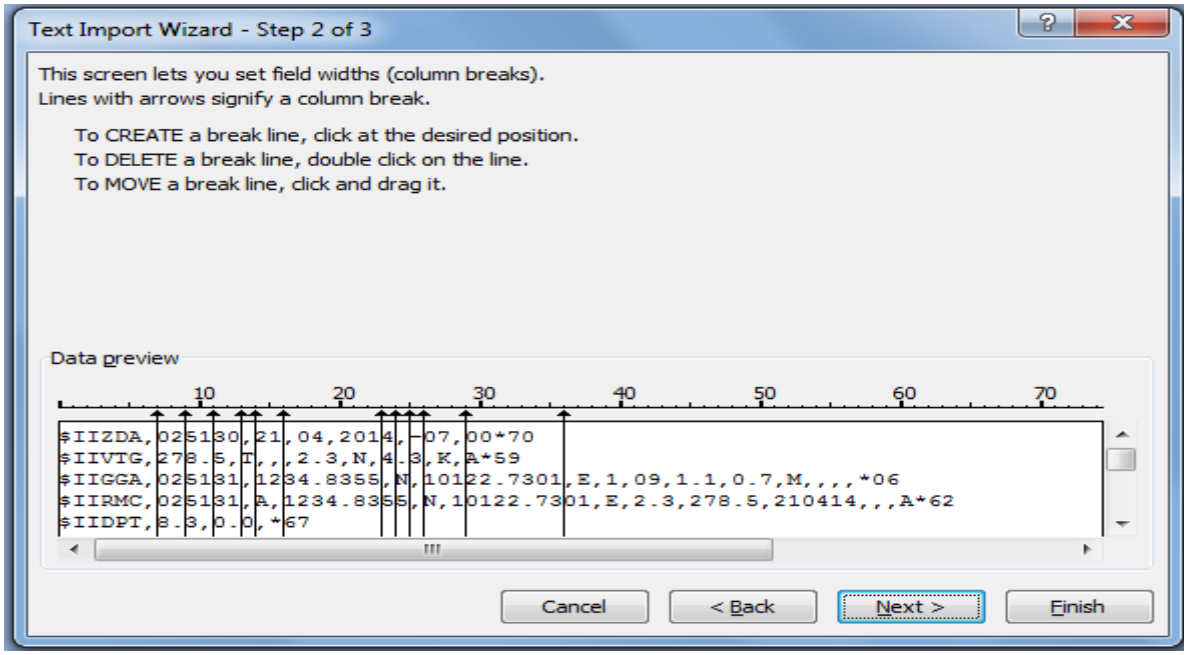
Open text file data by using Excel program

File -> Open --> All Files

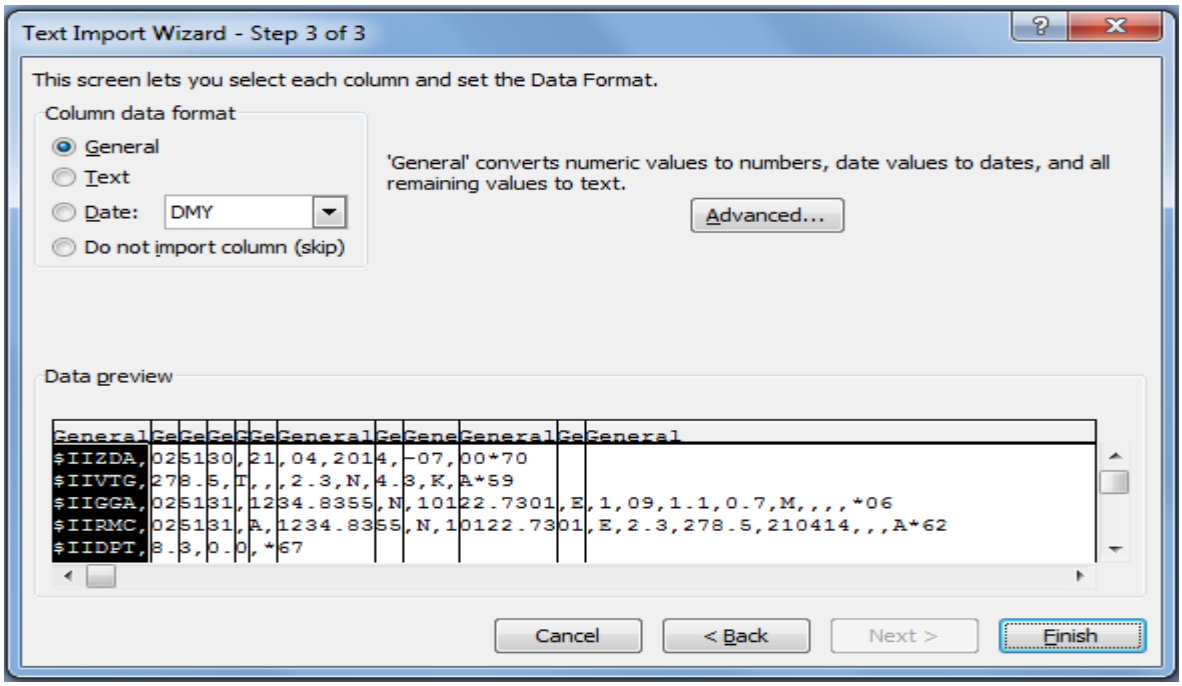
At Text Import Wizard – Step 1 of 3, select “Fix width”, “Next”



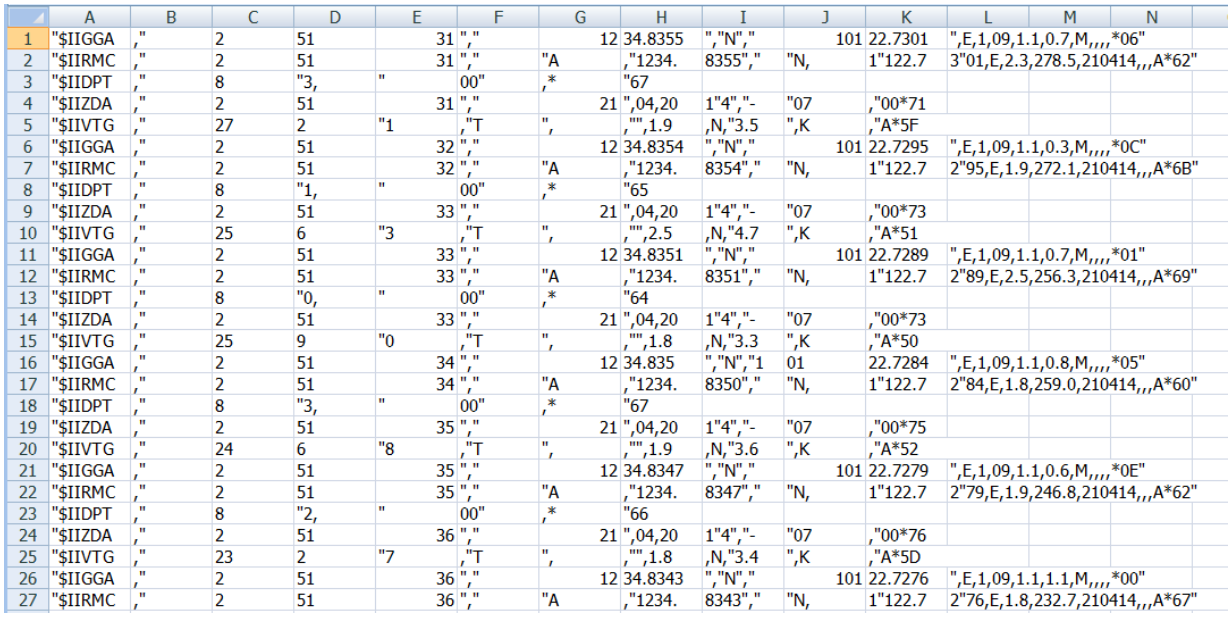
b. At Text Import Wizard – Step 2 of 3, separate cells by hour, minute, second, degree, min., lat., degree, minute, and long., and select “Next”



c. At Text Import Wizard – Step 3 of 3, select “General”, “Finish”

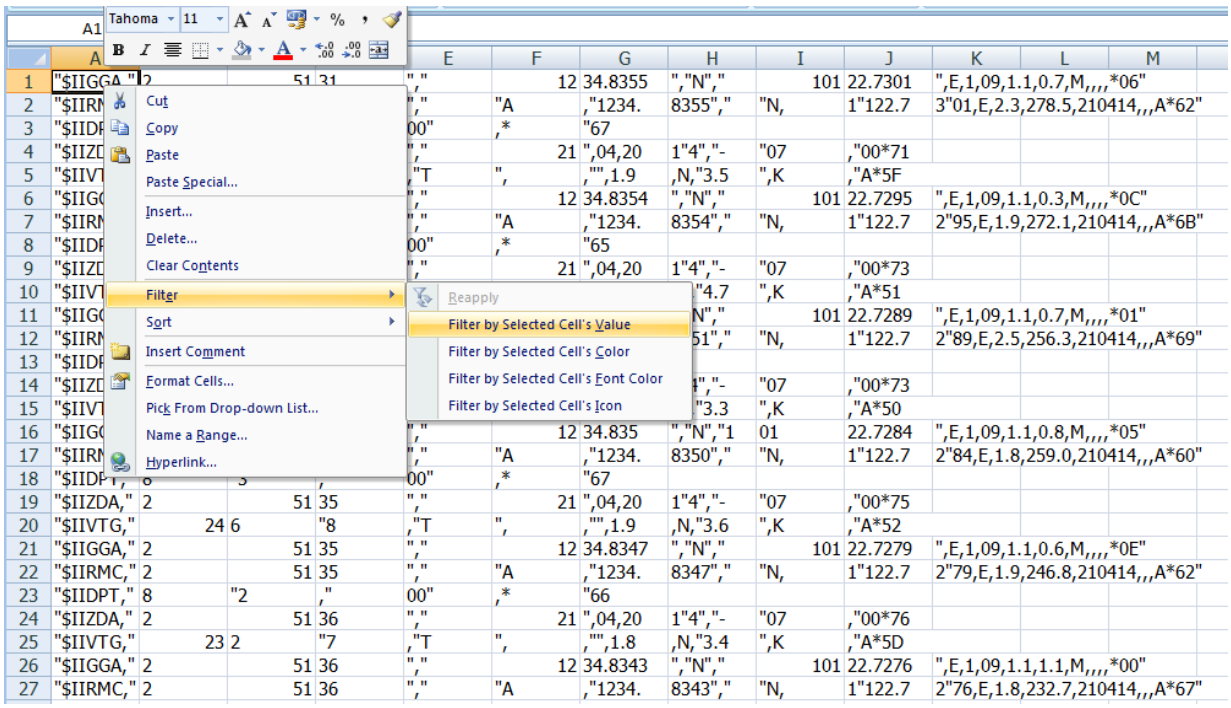


d. The Excel data sheet will be displayed as follows:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	"$IIGGA	,"	2	51	31	","	12	34.8355	","	N,"	101	22.7301	",E,1,09,1.1,0.7,M,,,,*06"	
2	"$IIRMC	,"	2	51	31	","	"A	,"1234.	8355","	"N,	1"122.7	3"01,E,2.3,278.5,210414,,,A*62"		
3	"$IIDPT	,"	8	"3,	"	00"	,*	"67						
4	"$IIZDA	,"	2	51	31	","	21	",04,20	1"4","-	"07	,"00*71			
5	"$IIVTG	,"	27	2	"1	,"T	",	,"",1.9	,N,"3.5	",K	,"A*5F			
6	"$IIGGA	,"	2	51	32	","	12	34.8354	","	N,"	101	22.7295	",E,1,09,1.1,0.3,M,,,,*0C"	
7	"$IIRMC	,"	2	51	32	","	"A	,"1234.	8354","	"N,	1"122.7	2"95,E,1.9,272.1,210414,,,A*6B"		
8	"$IIDPT	,"	8	"1,	"	00"	,*	"65						
9	"$IIZDA	,"	2	51	33	","	21	",04,20	1"4","-	"07	,"00*73			
10	"$IIVTG	,"	25	6	"3	,"T	",	,"",2.5	,N,"4.7	",K	,"A*51			
11	"$IIGGA	,"	2	51	33	","	12	34.8351	","	N,"	101	22.7289	",E,1,09,1.1,0.7,M,,,,*01"	
12	"$IIRMC	,"	2	51	33	","	"A	,"1234.	8351","	"N,	1"122.7	2"89,E,2.5,256.3,210414,,,A*69"		
13	"$IIDPT	,"	8	"0,	"	00"	,*	"64						
14	"$IIZDA	,"	2	51	33	","	21	",04,20	1"4","-	"07	,"00*73			
15	"$IIVTG	,"	25	9	"0	,"T	",	,"",1.8	,N,"3.3	",K	,"A*50			
16	"$IIGGA	,"	2	51	34	","	12	34.835	","N","1	01	22.7284	",E,1,09,1.1,0.8,M,,,,*05"		
17	"$IIRMC	,"	2	51	34	","	"A	,"1234.	8350","	"N,	1"122.7	2"84,E,1.8,259.0,210414,,,A*60"		
18	"$IIDPT	,"	8	"3,	"	00"	,*	"67						
19	"$IIZDA	,"	2	51	35	","	21	",04,20	1"4","-	"07	,"00*75			
20	"$IIVTG	,"	24	6	"8	,"T	",	,"",1.9	,N,"3.6	",K	,"A*52			
21	"$IIGGA	,"	2	51	35	","	12	34.8347	","	N,"	101	22.7279	",E,1,09,1.1,0.6,M,,,,*0E"	
22	"$IIRMC	,"	2	51	35	","	"A	,"1234.	8347","	"N,	1"122.7	2"79,E,1.9,246.8,210414,,,A*62"		
23	"$IIDPT	,"	8	"2,	"	00"	,*	"66						
24	"$IIZDA	,"	2	51	36	","	21	",04,20	1"4","-	"07	,"00*76			
25	"$IIVTG	,"	23	2	"7	,"T	",	,"",1.8	,N,"3.4	",K	,"A*5D			
26	"$IIGGA	,"	2	51	36	","	12	34.8343	","	N,"	101	22.7276	",E,1,09,1.1,1.1,M,,,,*00"	
27	"$IIRMC	,"	2	51	36	","	"A	,"1234.	8343","	"N,	1"122.7	2"76,E,1.8,232.7,210414,,,A*67"		

e. Move cursor into cell which indicates “$IIGGA” where information on time, and position (Latitude and Longitude) are contained, use right bottom mouse click for drop down menu. Select “Filter”, “Filter by Selected Cell’s Value”.



f. Excel data sheet will display only the row of data starting with “$IIGGA”. Column defines C as hour, D as minute, E as second, G as degree of latitude, H as minute of latitude, J as degree of longitude, K as minute of longitude.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	$IIZDA,					,		,04,201	4,-	07,	00*70		
3	$IIGGA,	","	2	51	31	","	12	34.8355	"","N","	101	22.7301	,E,1,09,1.1,0.7,M,,,,*06	
8	$IIGGA,	","	2	51	32	","	12	34.8354	"","N","	101	22.7295	,E,1,09,1.1,0.3,M,,,,*0C	
13	$IIGGA,	","	2	51	33	","	12	34.8351	"","N","	101	22.7289	,E,1,09,1.1,0.7,M,,,,*01	
18	$IIGGA,	","	2	51	34	","	12	34.835	"","N","	101	22.7284	,E,1,09,1.1,0.8,M,,,,*05	
23	$IIGGA,	","	2	51	35	","	12	34.8347	"","N","	101	22.7279	,E,1,09,1.1,0.6,M,,,,*0E	
28	$IIGGA,	","	2	51	36	","	12	34.8343	"","N","	101	22.7276	,E,1,09,1.1,1.1,M,,,,*00	
33	$IIGGA,	","	2	51	37	","	12	34.834	"","N","	101	22.7273	,E,1,09,1.1,1.4,M,,,,*02	
38	$IIGGA,	","	2	51	38	","	12	34.8335	"","N","	101	22.7271	,E,1,09,1.1,1.4,M,,,,*0D	
43	$IIGGA,	","	2	51	39	","	12	34.833	"","N","	101	22.7269	,E,1,09,1.1,1.6,M,,,,*02	
48	$IIGGA,	","	2	51	40	","	12	34.8325	"","N","	101	22.7268	,E,1,09,1.1,1.6,M,,,,*09	
53	$IIGGA,	","	2	51	40	","	12	34.8325	"","N","	101	22.7268	,E,1,09,1.1,1.6,M,,,,*09	
58	$IIGGA,	","	2	51	42	","	12	34.8315	"","N","	101	22.7268	,E,1,09,1.1,1.4,M,,,,*0A	
63	$IIGGA,	","	2	51	43	","	12	34.8309	"","N","	101	22.7268	,E,1,09,1.1,1.7,M,,,,*05	
68	$IIGGA,	","	2	51	44	","	12	34.8304	"","N","	101	22.727	,E,1,09,1.1,1.3,M,,,,*02	
73	$IIGGA,	","	2	51	44	","	12	34.8304	"","N","	101	22.727	,E,1,09,1.1,1.3,M,,,,*02	
78	$IIGGA,	","	2	51	46	","	12	34.8294	"","N","	101	22.7275	,E,1,09,1.1,1.5,M,,,,*0B	
83	$IIGGA,	","	2	51	47	","	12	34.8289	"","N","	101	22.7279	,E,1,09,1.1,1.6,M,,,,*09	
88	$IIGGA,	","	2	51	47	","	12	34.8289	"","N","	101	22.7279	,E,1,09,1.1,1.6,M,,,,*09	
93	$IIGGA,	","	2	51	48	","	12	34.8285	"","N","	101	22.7283	,E,1,09,1.1,1.4,M,,,,*0D	
98	$IIGGA,	","	2	51	49	","	12	34.8281	"","N","	101	22.7287	,E,1,09,1.1,1.7,M,,,,*0F	
103	$IIGGA,	","	2	51	50	","	12	34.8278	"","N","	101	22.7292	,E,1,09,1.1,1.3,M,,,,*01	
108	$IIGGA,	","	2	51	51	","	12	34.8274	"","N","	101	22.7298	,E,1,09,1.1,1.5,M,,,,*00	
113	$IIGGA,	","	2	51	51	","	12	34.8274	"","N","	101	22.7298	,E,1,09,1.1,1.5,M,,,,*00	
118	$IIGGA,	","	2	51	51	","	12	34.8274	"","N","	101	22.7298	,E,1,09,1.1,1.5,M,,,,*00	

Copy all the data to a new work sheet.

g. Delete data in column A, B, F, I and L-N.

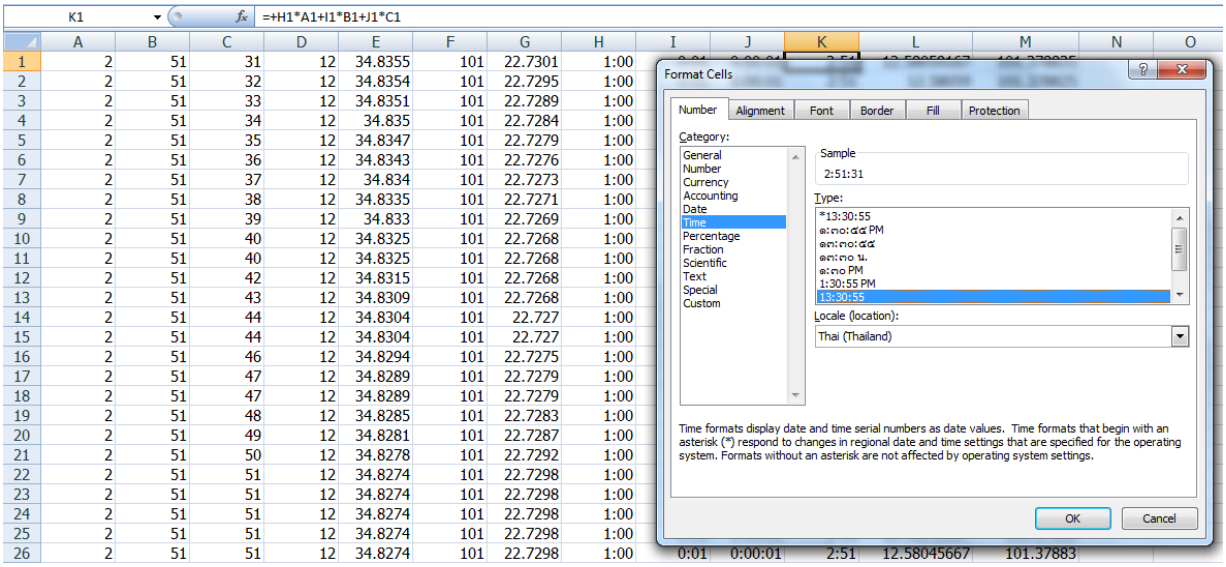
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	"$IIGGA	,"	2	51	31	","	12	34.8355	"","N","	1	22.7301	",E,1,09	1,0.7,M,,,,*06"	
6	"$IIGGA	,"	2	51	32	","	12	34.8354	"","N","	101	22.7295	",E,1,09,1.1,0.3,M,,,,*0C"		
11	"$IIGGA	,"	2	51	33	","	12	34.8351	"","N","	101	22.7289	",E,1,09,1.1,0.7,M,,,,*01"		
16	"$IIGGA	,"	2	51	34	","	12	34.835	"","N","	101	22.7284	",E,1,09,1.1,0.8,M,,,,*05"		
21	"$IIGGA	,"	2	51	35	","	12	34.8347	"","N","	101	22.7279	",E,1,09,1.1,0.6,M,,,,*0E"		
26	"$IIGGA	,"	2	51	36	","	12	34.8343	"","N","	101	22.7276	",E,1,09,1.1,1.1,M,,,,*00"		
31	"$IIGGA	,"	2	51	37	","	12	34.834	"","N","	101	22.7273	",E,1,09,1.1,1.4,M,,,,*02"		
36	"$IIGGA	,"	2	51	38	","	12	34.8335	"","N","	101	22.7271	",E,1,09,1.1,1.4,M,,,,*0D"		
41	"$IIGGA	,"	2	51	39	","	12	34.833	"","N","	101	22.7269	",E,1,09,1.1,1.6,M,,,,*02"		
46	"$IIGGA	,"	2	51	40	","	12	34.8325	"","N","	101	22.7268	",E,1,09,1.1,1.6,M,,,,*09"		
51	"$IIGGA	,"	2	51	40	","	12	34.8325	"","N","	101	22.7268	",E,1,09,1.1,1.6,M,,,,*09"		
56	"$IIGGA	,"	2	51	42	","	12	34.8315	"","N","	101	22.7268	",E,1,09,1.1,1.4,M,,,,*0A"		
61	"$IIGGA	,"	2	51	43	","	12	34.8309	"","N","	101	22.7268	",E,1,09,1.1,1.7,M,,,,*05"		
66	"$IIGGA	,"	2	51	44	","	12	34.8304	"","N","	101	22.727	",E,1,09,1.1,1.3,M,,,,*02"		
71	"$IIGGA	,"	2	51	44	","	12	34.8304	"","N","	101	22.727	",E,1,09,1.1,1.3,M,,,,*02"		
76	"$IIGGA	,"	2	51	46	","	12	34.8294	"","N","	101	22.7275	",E,1,09,1.1,1.5,M,,,,*0B"		
81	"$IIGGA	,"	2	51	47	","	12	34.8289	"","N","	101	22.7279	",E,1,09,1.1,1.6,M,,,,*09"		
86	"$IIGGA	,"	2	51	47	","	12	34.8289	"","N","	101	22.7279	",E,1,09,1.1,1.6,M,,,,*09"		
91	"$IIGGA	,"	2	51	48	","	12	34.8285	"","N","	101	22.7283	",E,1,09,1.1,1.4,M,,,,*0D"		
96	"$IIGGA	,"	2	51	49	","	12	34.8281	"","N","	101	22.7287	",E,1,09,1.1,1.7,M,,,,*0F"		
101	"$IIGGA	,"	2	51	50	","	12	34.8278	"","N","	101	22.7292	",E,1,09,1.1,1.3,M,,,,*01"		
106	"$IIGGA	,"	2	51	51	","	12	34.8274	"","N","	101	22.7298	",E,1,09,1.1,1.5,M,,,,*00"		
111	"$IIGGA	,"	2	51	51	","	12	34.8274	"","N","	101	22.7298	",E,1,09,1.1,1.5,M,,,,*00"		

h. After deleting, calcurate UTC (Coordinated Universal Time) and degree of latitude and longitude, column H as 1:00, I as 0:01, J as 00:00:01, K as =+H1*A1+B1*I1+C1*J1, L as =+D1+E1/60 and M as =+F1+G1/60.

K1 =+H1*A1+B1*I1+C1*J1

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	2	51	31	12	34.8355	101	22.7301	1:00	0:01	0:00:01	2:51	12.58059167	101.378835
2	2	51	32	12	34.8354	101	22.7295	1:00	0:01	0:00:01	2:51	12.58059	101.378825
3	2	51	33	12	34.8351	101	22.7289	1:00	0:01	0:00:01	2:51	12.580585	101.378815
4	2	51	34	12	34.835	101	22.7284	1:00	0:01	0:00:01	2:51	12.58058333	101.3788067
5	2	51	35	12	34.8347	101	22.7279	1:00	0:01	0:00:01	2:51	12.58057833	101.3787983
6	2	51	36	12	34.8343	101	22.7276	1:00	0:01	0:00:01	2:51	12.58057167	101.3787933
7	2	51	37	12	34.834	101	22.7273	1:00	0:01	0:00:01	2:51	12.58056667	101.3787883
8	2	51	38	12	34.8335	101	22.7271	1:00	0:01	0:00:01	2:51	12.58055833	101.378785
9	2	51	39	12	34.833	101	22.7269	1:00	0:01	0:00:01	2:51	12.58055	101.3787817
10	2	51	40	12	34.8325	101	22.7268	1:00	0:01	0:00:01	2:51	12.58054167	101.37878
11	2	51	40	12	34.8325	101	22.7268	1:00	0:01	0:00:01	2:51	12.58054167	101.37878
12	2	51	42	12	34.8315	101	22.7268	1:00	0:01	0:00:01	2:51	12.580525	101.37878
13	2	51	43	12	34.8309	101	22.7268	1:00	0:01	0:00:01	2:51	12.580515	101.37878
14	2	51	44	12	34.8304	101	22.727	1:00	0:01	0:00:01	2:51	12.58050667	101.3787833
15	2	51	44	12	34.8304	101	22.727	1:00	0:01	0:00:01	2:51	12.58050667	101.3787833
16	2	51	46	12	34.8294	101	22.7275	1:00	0:01	0:00:01	2:51	12.58049	101.3787917
17	2	51	47	12	34.8289	101	22.7279	1:00	0:01	0:00:01	2:51	12.58048167	101.3787983
18	2	51	47	12	34.8289	101	22.7279	1:00	0:01	0:00:01	2:51	12.58048167	101.3787983

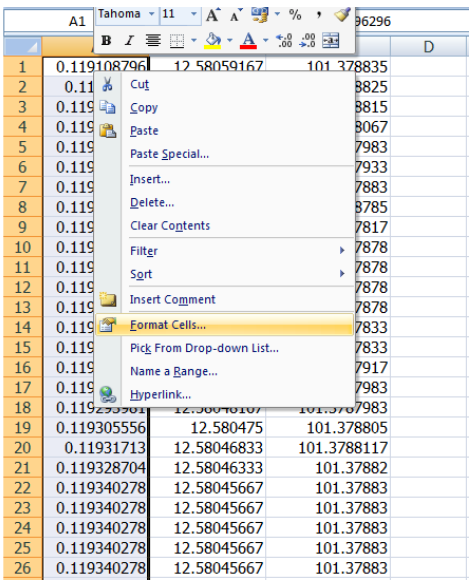
i. Adjust the value of UTC in columm K by selecting, “Format Cells”. “Time”, and “13:30:55”.

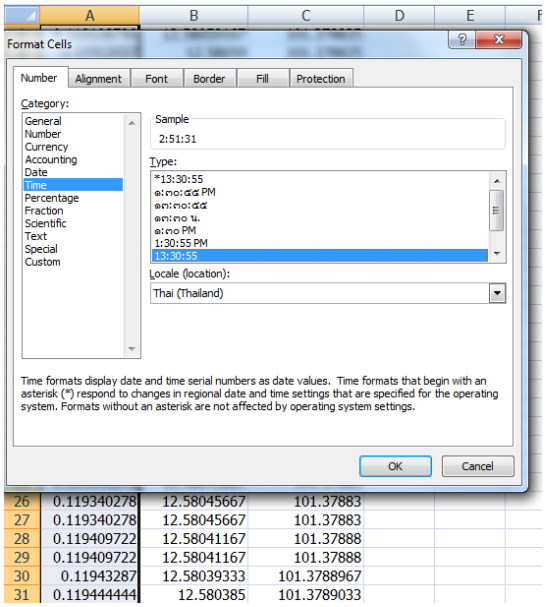


Excel sheet UTC time will show columm K

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	2	51	31	12	34.8355	101	22.7301	1:00	0:01	0:00:01	2:51:31	12.58059167	101.378835
2	2	51	32	12	34.8354	101	22.7295	1:00	0:01	0:00:01	2:51:32	12.58059	101.378825
3	2	51	33	12	34.8351	101	22.7289	1:00	0:01	0:00:01	2:51:33	12.580585	101.378815
4	2	51	34	12	34.835	101	22.7284	1:00	0:01	0:00:01	2:51:34	12.58058333	101.3788067
5	2	51	35	12	34.8347	101	22.7279	1:00	0:01	0:00:01	2:51:35	12.58057833	101.3787983
6	2	51	36	12	34.8343	101	22.7276	1:00	0:01	0:00:01	2:51:36	12.58057167	101.3787933
7	2	51	37	12	34.834	101	22.7273	1:00	0:01	0:00:01	2:51:37	12.58056667	101.3787883
8	2	51	38	12	34.8335	101	22.7271	1:00	0:01	0:00:01	2:51:38	12.58055833	101.378785
9	2	51	39	12	34.833	101	22.7269	1:00	0:01	0:00:01	2:51:39	12.58055	101.3787817
10	2	51	40	12	34.8325	101	22.7268	1:00	0:01	0:00:01	2:51:40	12.58054167	101.37878
11	2	51	40	12	34.8325	101	22.7268	1:00	0:01	0:00:01	2:51:40	12.58054167	101.37878
12	2	51	42	12	34.8315	101	22.7268	1:00	0:01	0:00:01	2:51:42	12.580525	101.37878
13	2	51	43	12	34.8309	101	22.7268	1:00	0:01	0:00:01	2:51:43	12.580515	101.37878
14	2	51	44	12	34.8304	101	22.727	1:00	0:01	0:00:01	2:51:44	12.58050667	101.3787833
15	2	51	44	12	34.8304	101	22.727	1:00	0:01	0:00:01	2:51:44	12.58050667	101.3787833
16	2	51	46	12	34.8294	101	22.7275	1:00	0:01	0:00:01	2:51:46	12.58049	101.3787917
17	2	51	47	12	34.8289	101	22.7279	1:00	0:01	0:00:01	2:51:47	12.58048167	101.3787983
18	2	51	47	12	34.8289	101	22.7279	1:00	0:01	0:00:01	2:51:47	12.58048167	101.3787983
19	2	51	48	12	34.8285	101	22.7283	1:00	0:01	0:00:01	2:51:48	12.580475	101.378805
20	2	51	49	12	34.8281	101	22.7287	1:00	0:01	0:00:01	2:51:49	12.58046833	101.3788117
21	2	51	50	12	34.8278	101	22.7292	1:00	0:01	0:00:01	2:51:50	12.58046333	101.37882
22	2	51	51	12	34.8274	101	22.7298	1:00	0:01	0:00:01	2:51:51	12.58045667	101.37883
23	2	51	51	12	34.8274	101	22.7298	1:00	0:01	0:00:01	2:51:51	12.58045667	101.37883
24	2	51	51	12	34.8274	101	22.7298	1:00	0:01	0:00:01	2:51:51	12.58045667	101.37883
25	2	51	51	12	34.8274	101	22.7298	1:00	0:01	0:00:01	2:51:51	12.58045667	101.37883
26	2	51	51	12	34.8274	101	22.7298	1:00	0:01	0:00:01	2:51:51	12.58045667	101.37883

j. Copy values from column K to M to a new sheet. “Paste”, “Paste Values”. Convert the data of column A to time by “Format Cells”, “Time”, “13:30:55”.

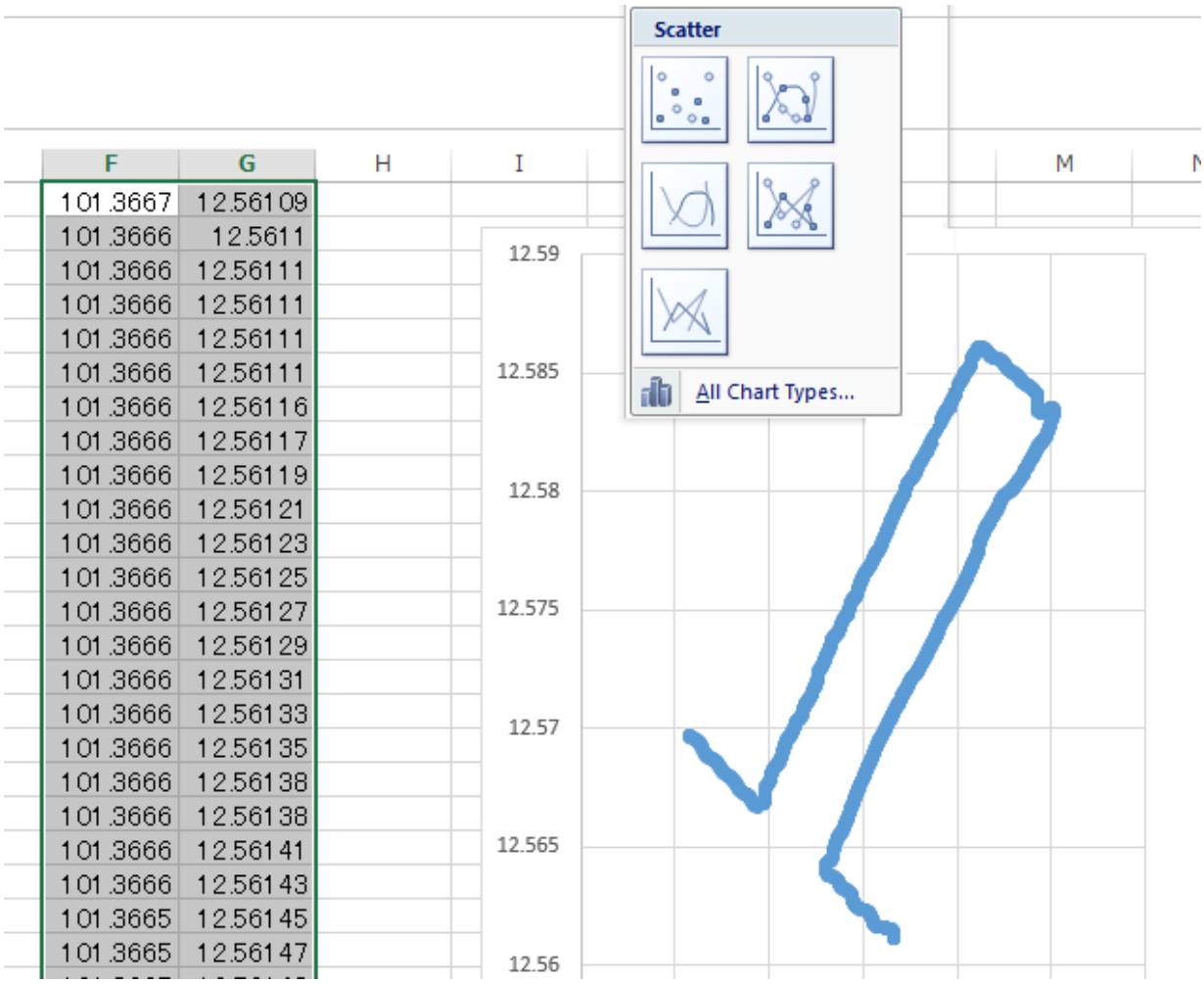




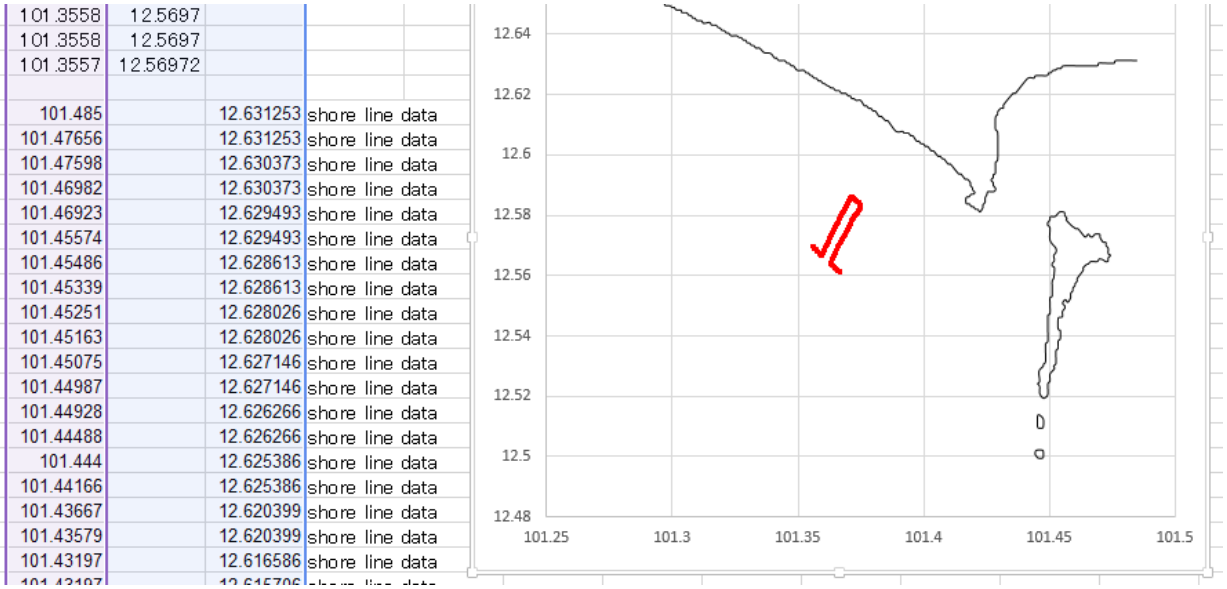
k. The column A is UTC. Normally, local mean time is used in the resarch. So the local time is shown in column E (UTC add Time difference). The columns of latitude and longitude should be reversed, because the latitude is on the y axis and longitude on the x axis.

	A	B	C	D	E	F	G
1	UTC	Latitude	Longitude	Time Diff.	Local Time	Longitude	Latitude
2	2:51:31	12.58059167	101.378835	7:00	=+D2+A2	101.378835	12.58059167
3	2:51:32	12.58059	101.378825	7:00	9:51:32	101.378825	12.58059
4	2:51:33	12.580585	101.378815	7:00	9:51:33	101.378815	12.580585
5	2:51:34	12.58058333	101.3788067	7:00	9:51:34	101.3788067	12.58058333
6	2:51:35	12.58057833	101.3787983	7:00	9:51:35	101.3787983	12.58057833
7	2:51:36	12.58057167	101.3787933	7:00	9:51:36	101.3787933	12.58057167
8	2:51:37	12.58056667	101.3787883	7:00	9:51:37	101.3787883	12.58056667
9	2:51:38	12.58055833	101.378785	7:00	9:51:38	101.378785	12.58055833
10	2:51:39	12.58055	101.3787817	7:00	9:51:39	101.3787817	12.58055
11	2:51:40	12.58054167	101.37878	7:00	9:51:40	101.37878	12.58054167
12	2:51:40	12.58054167	101.37878	7:00	9:51:40	101.37878	12.58054167
13	2:51:42	12.580525	101.37878	7:00	9:51:42	101.37878	12.580525
14	2:51:43	12.580515	101.37878	7:00	9:51:43	101.37878	12.580515
15	2:51:44	12.58050667	101.3787833	7:00	9:51:44	101.3787833	12.58050667
16	2:51:44	12.58050667	101.3787833	7:00	9:51:44	101.3787833	12.58050667
17	2:51:46	12.58049	101.3787917	7:00	9:51:46	101.3787917	12.58049
18	2:51:47	12.58048167	101.3787983	7:00	9:51:47	101.3787983	12.58048167

l. Select Columns F and G, select insert chart, select a scatter plot chart. This procedure can produce a drawing of the track line.

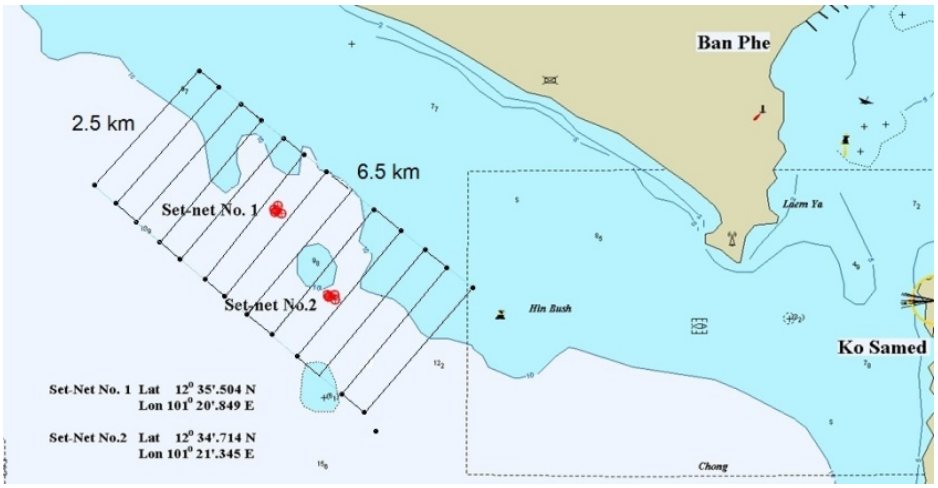


m. Add shore line data and detect with the tracking data. This procedure will produces a rough survey map. After a chart is added, some of the default elements should be modified to create an exquisite eye-catching map.



101.3558	12.5697		
101.3558	12.5697		
101.3557	12.56972		
101.485		12.631253	shore line data
101.47656		12.631253	shore line data
101.47598		12.630373	shore line data
101.46982		12.630373	shore line data
101.46923		12.629493	shore line data
101.45574		12.629493	shore line data
101.45486		12.628613	shore line data
101.45339		12.628613	shore line data
101.45251		12.628026	shore line data
101.45163		12.628026	shore line data
101.45075		12.627146	shore line data
101.44987		12.627146	shore line data
101.44928		12.626266	shore line data
101.44488		12.626266	shore line data
101.444		12.625386	shore line data
101.44166		12.625386	shore line data
101.43667		12.620399	shore line data
101.43579		12.620399	shore line data
101.43197		12.616586	shore line data

Plotting of survey data cruise tract could be displayed to fit with the design survey transect in the study area. This experiment was conducted in the set-net fishing ground of Banphe, Rayong Province, Thailand. The coverage survey area is 2.5 x 6.5 square kilometers with parallel cruise tract of 500 meters apart.



Survey transect coverage in the set-net fishing ground of Banphe, Rayong Province, Thailand.