National Oceanography Centre

TIDE GAUGE DATA AND PROCESSING

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PASS-SWIO TRAINING 12TH -16TH FEBRUARY 2024

WHAT WILL BE COVERED IN THIS SESSION…..

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- A recap of tidal analysis (which many of you learnt during the C-RISe project)
- A recap of data processing techniques and quality control
- Instructions on how to use the TASK software to complete these tasks on a sample of data from the Toamasina tide gauge

TIDAL ANALYSIS

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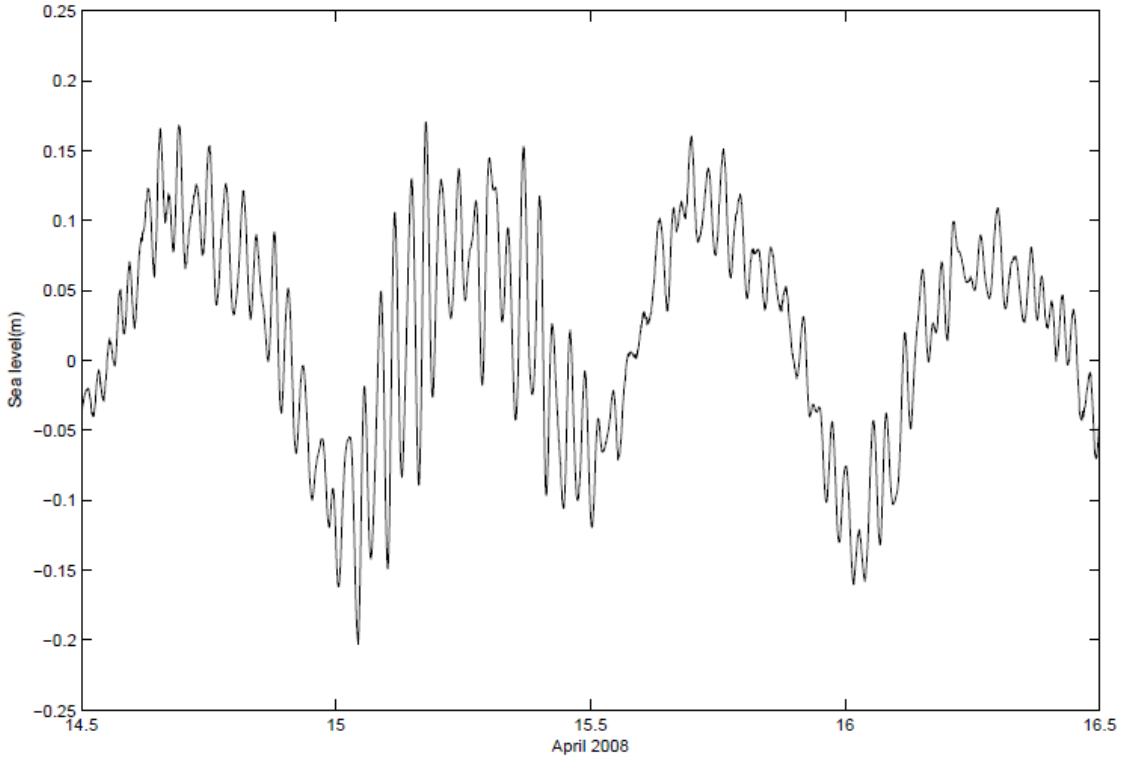
- Some sea level variations are so extreme that they are obviously identifiable in raw tide gauge records:



- However, some variations can be masked by tides. Therefore, tidal and non-tidal components of a sea level record are often separated, making the non-tidal variations much clearer.

HOW DOES A TIDAL ANALYSIS WORK?

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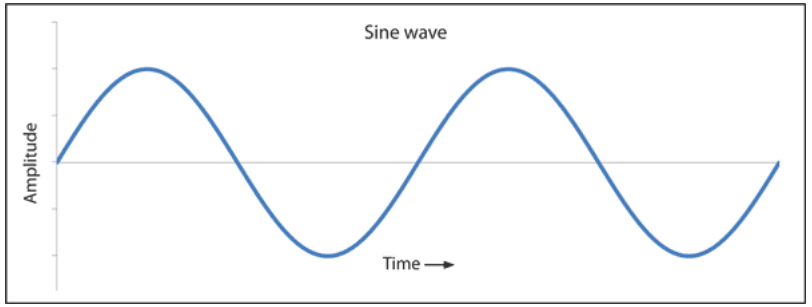
- The tide is parameterised in terms of harmonics with periods specified by the orbits of the Moon and Sun but with unknown amplitudes and phase i.e.



$$Tide = Z_0 + \sum_{j=1}^{N} H_j f_j \cos\left[\sigma_j t - g_j + \left(V_j + u_j\right)\right]$$

- The unknown parameters are Z_0 and the (H_j, g_j).
- The fitting is adjusted so that the sum of the squares of the difference between the observed and computed tidal levels is minimized. The residuals to the fit are considered to be the ‘non-tidal’ terms.

HOW DOES A TIDAL ANALYSIS WORK?

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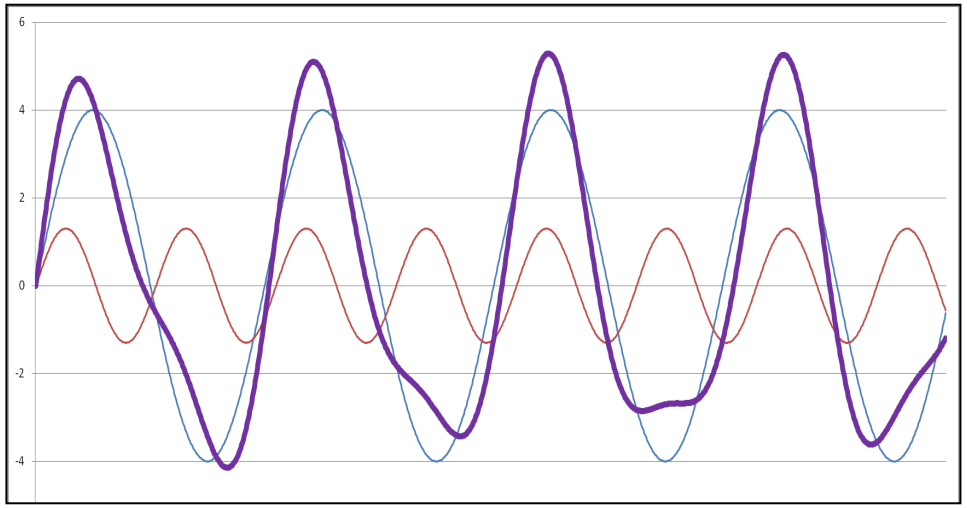
- H_j and g_j are known as harmonic constants and are unique to a location.



- They are summed up to approximate the tide
- The number of harmonic constants used in an analysis depends upon the length of the time series that is being analysed.
- NOC uses a maximum of 114 harmonic constants (for records > 4.5 years)

HARMONIC CONSTITUENTS

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- Names like M_2, S_2, O_1, K_1, Sa, Mf, μ_2, 2(MN)S_6. Most important and most stable constituents are:
  - M_2 : Principal lunar semidiurnal (12 hrs 25 mins)
  - S_2 : Principal solar semidiurnal (12 hrs)
  - O_1 : Principal lunar diurnal (25 hrs 49 mins)
  - K_1 : Principal lunar and solar diurnal (23 hrs 56 mins)
  - Use these 4 constituents as a sanity check.
- Speed (period) is always fixed

TIDAL HARMONIC ANALYSIS AND PREDICTION

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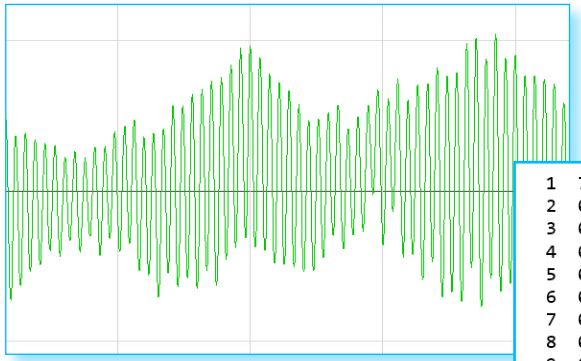
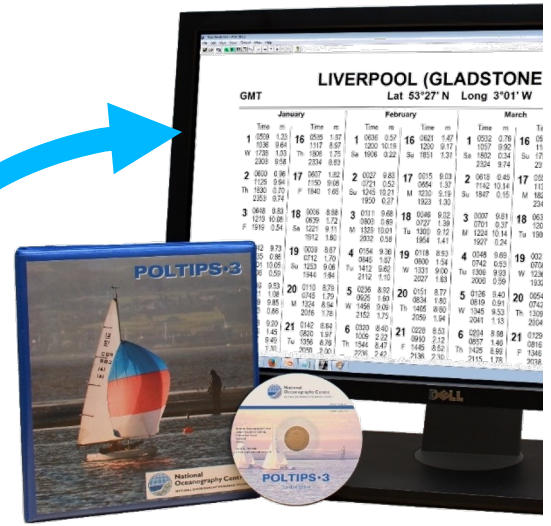


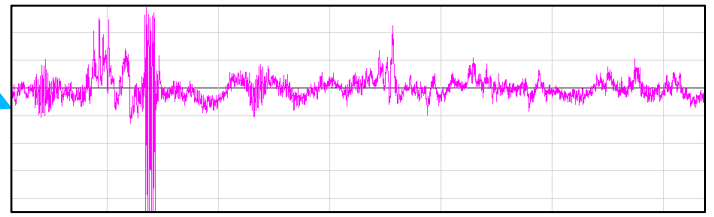
Harmonic Analysis

Harmonic Constants

1	7.09767	0.00	Z0	0.0000000	0
2	0.08368	208.37	SA	0.0410686	1
3	0.01844	108.58	SSA	0.0821373	2
4	0.01783	78.24	MM	0.5443747	3
5	0.10766	53.62	MSF	1.0158958	4
6	0.01924	53.45	MF	1.0980331	5
7	0.00439	294.66	2Q1	12.8542862	6
8	0.00235	125.71	SIG1	12.9271398	7
9	0.02178	318.50	Q1	13.3986609	8
10	0.00654	290.23	RHO1	13.4715145	9
11	0.06914	3.86	O1	13.9430356	10
12	0.00600	242.28	MP1	14.0251729	11
13	0.00415	21.57	M1	14.4920521	12
14	0.00147	73.92	CHI1	14.5695476	13
15	0.00094	98.41	PI1	14.9178647	14
16	0.02520	130.27	P1	14.9589314	15
17	0.01866	82.16	S1	15.0000000	16
18	0.07203	142.18	K1	15.0410686	17
19	0.00504	90.09	PSI1	15.0821353	18
20	0.00188	137.43	PHI1	15.1232059	19
21	0.00312	158.79	TH1	15.5125897	20
22	0.00169	253.41	J1	15.5854433	21
23	0.00527	56.44	SO1	16.0569644	22
24	0.00220	274.70	OO1	16.1391017	23
25	0.04431	64.24	OQ2	27.3416965	24
26	0.11352	240.14	MNS2	27.4238337	25
27	0.09922	172.81	2N2	27.8953548	26
28	0.49330	255.44	MU2	27.9682084	27
29	0.75969	185.90	N2	28.4397295	28
30	0.19517	149.89	NU2	28.5125831	29
31	0.05383	159.12	OP2	28.9019669	30
32	4.25778	199.51	M2	28.9841042	31
33	0.05635	323.91	MKS2	29.0662415	32
34	0.15558	179.46	LAM2	29.4556253	33
35	0.29271	186.72	L2	29.5284789	34
36	0.08379	244.45	T2	29.9589333	35
37	1.50868	259.24	S2	30.0000000	36

Harmonic Prediction





Non-tidal residual

AN EXAMPLE FROM PORT STANLEY NOV-DEC 2004

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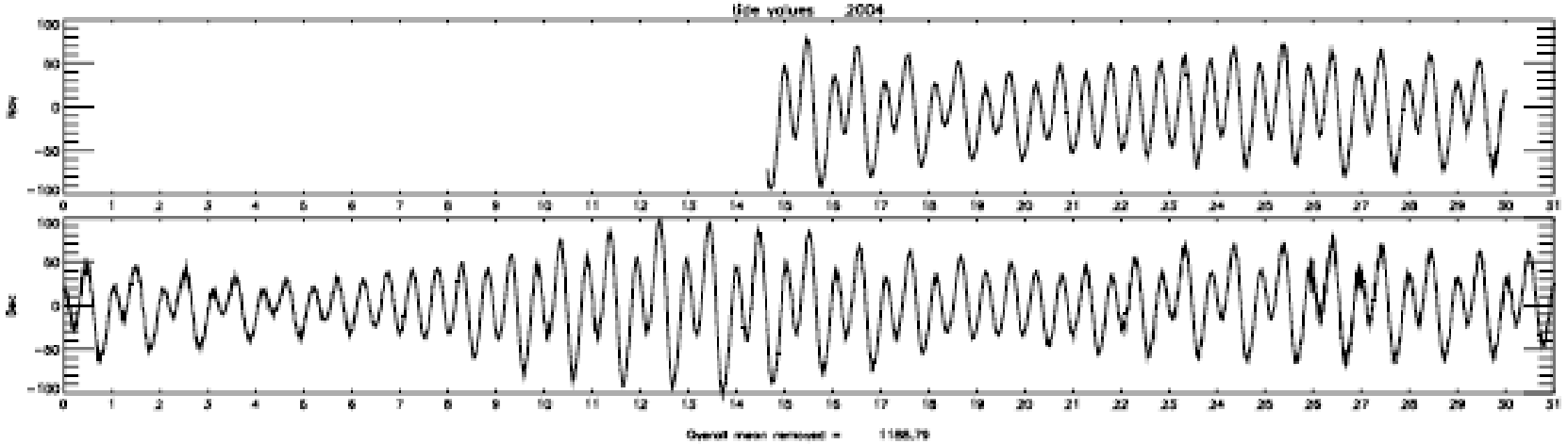
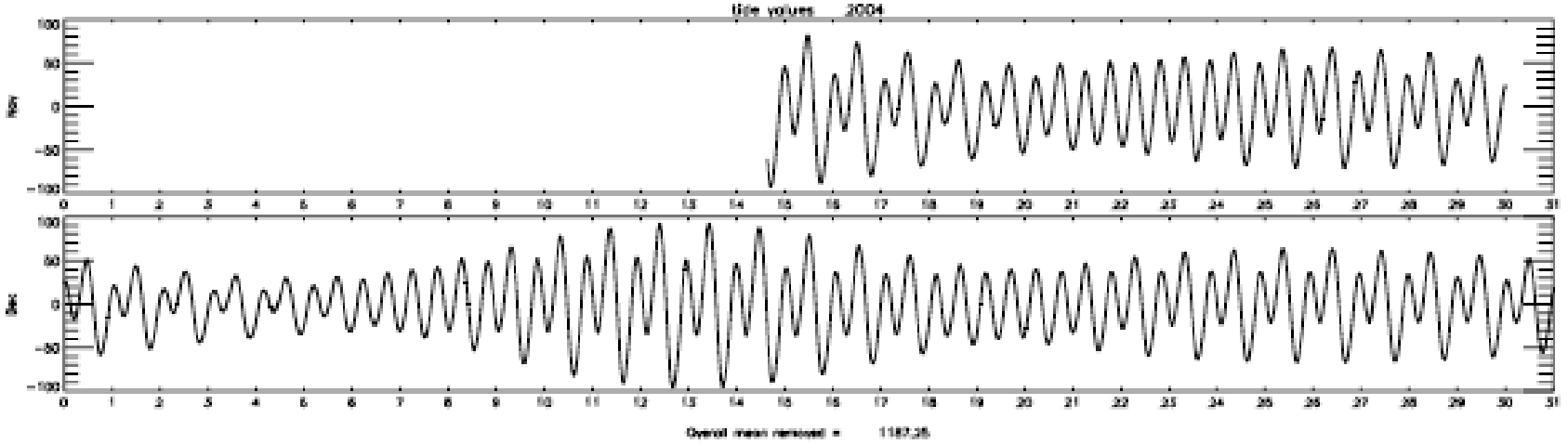
Observation



Prediction



AN EXAMPLE – PORT STANLEY, FALKLAND ISLANDS

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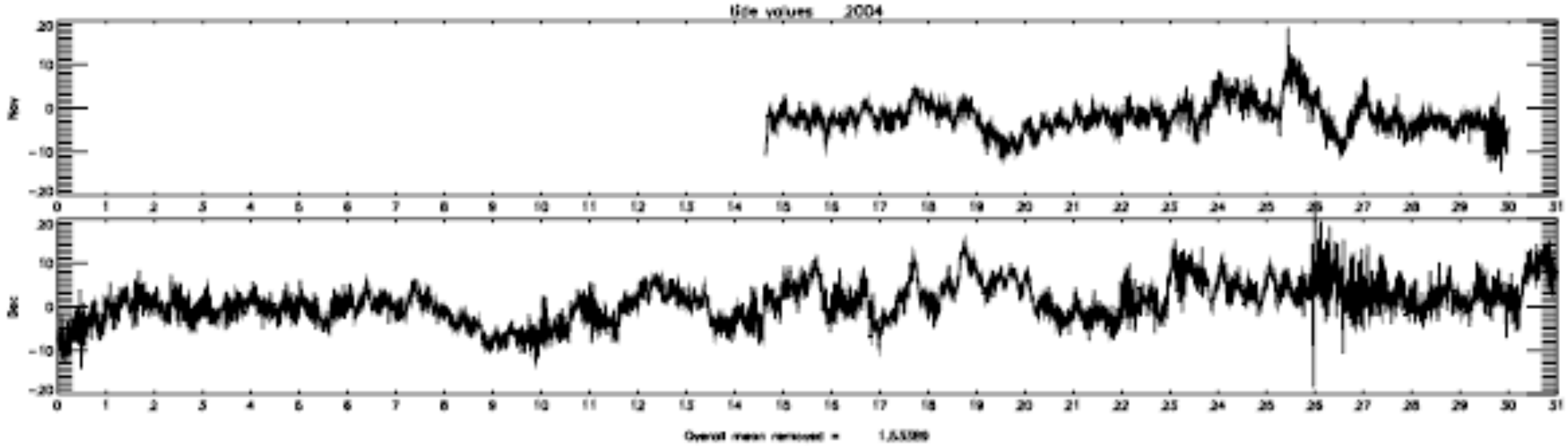

Non-tidal record shows:

1. No big storm surges (Southern Hemisphere summer)
2. A lot of high-frequency noise of a few cm due to harbour seiches
3. On 27 December arrival of the Sumatra tsunami (15 cm or so)

➔ None of this is evident from looking at the total observed record.

USES OF TIDAL ANALYSIS

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1. The separation of the sea level record into tidal and non-tidal components is needed to produce tide tables or tidal predictions

2. The non-tidal signals (seiches, tsunamis) become clearly identified

3. Tidal analysis facilitates quality control, allowing errors in the sea level time series to be identified more easily

PRINCIPLES OF QUALITY CONTROL

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Quality control starts with: Good maintenance
Good record keeping

This helps to identify whether errors are random:

- Malfunctions
- Bad readings

Or systematic:

- Change in practice
- Change in instrumentation
- Change in environment

PRINCIPLES OF QUALITY CONTROL

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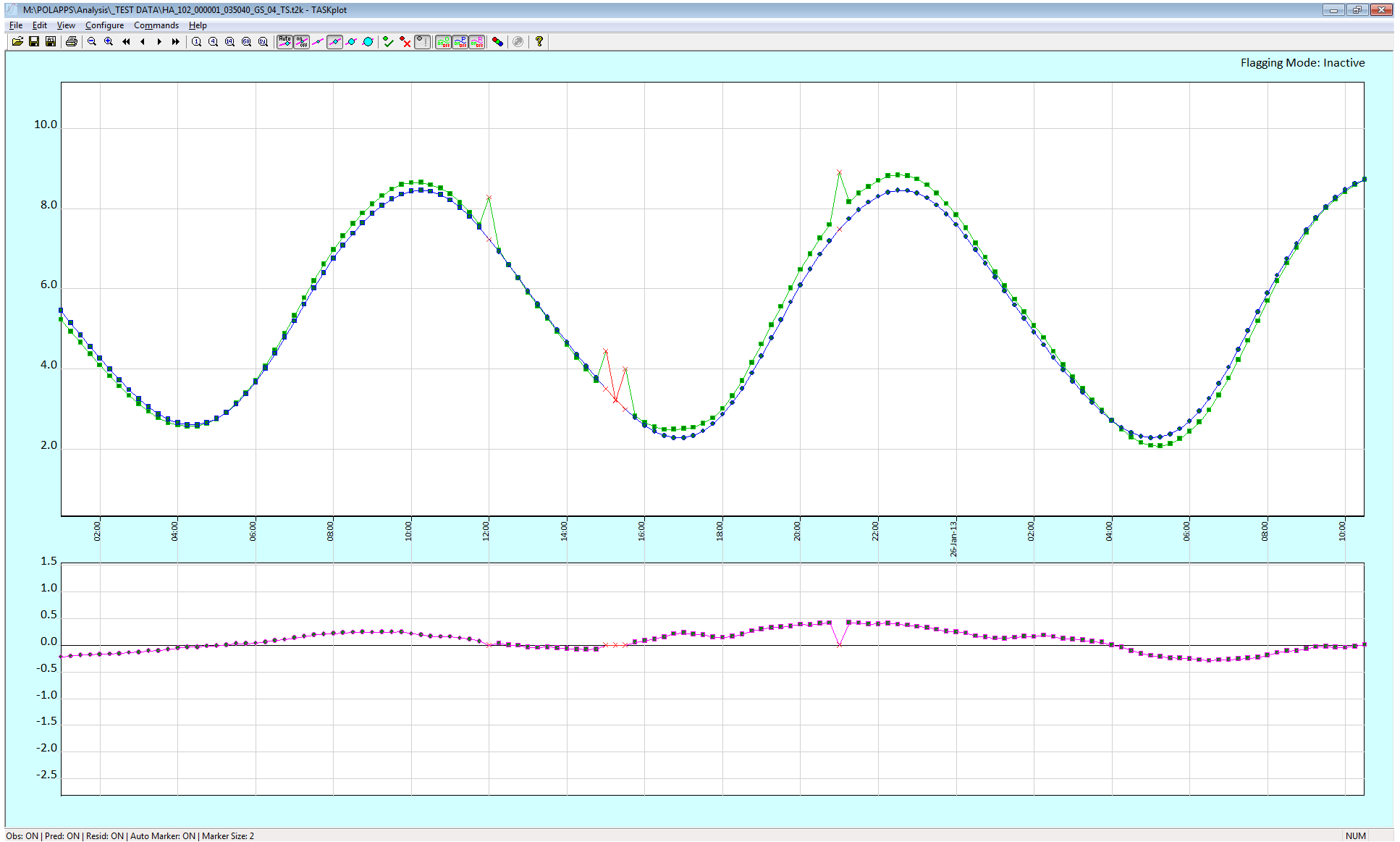
It will be immediately clear (especially with some experience) by looking at the residuals if there is:

- A spike or jump in the data due to instrumental faults
- Missing data
- Reference level changes (also known as datum shifts)
- A timing error
- And many other errors → see the IOC Manuals

These errors can then be fixed in the data set. The final data set is called the Quality Controlled Delayed-Mode data set.

SPIKES


M:\POLAPPS\Analysis_TEST DATA\HA_102_000001_035040_GS_04_TS.t2k - TASKplot
File Edit View Configure Commands Help
Flagging Mode: Inactive
10.0
8.0
6.0
4.0
2.0
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
26-Jan-13
02:00
04:00
06:00
08:00
10:00
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
Obs: ON | Pred: ON | Resid: ON | Auto Marker: ON | Marker Size: 2
NUM

JUMPS

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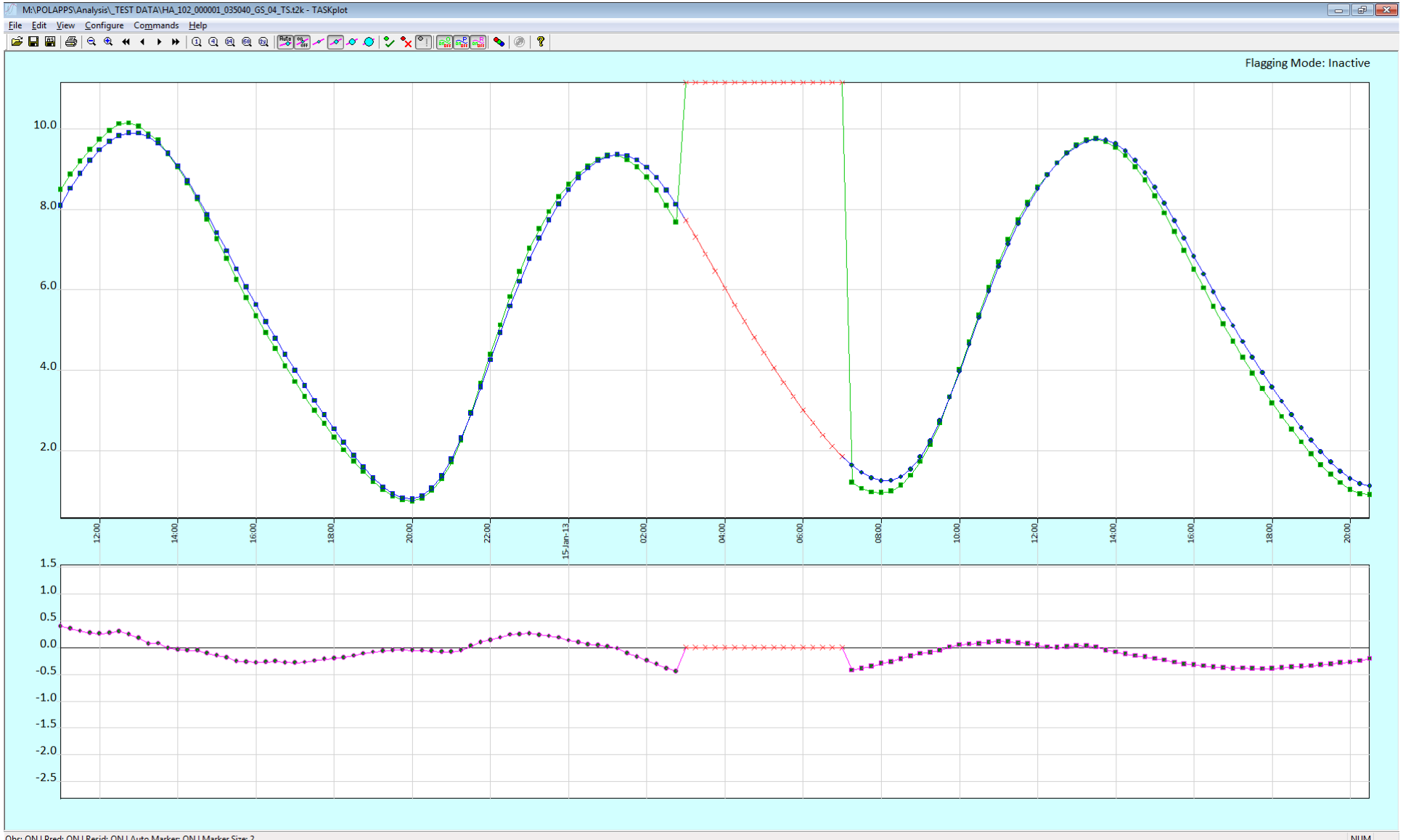

TIMING ERRORS

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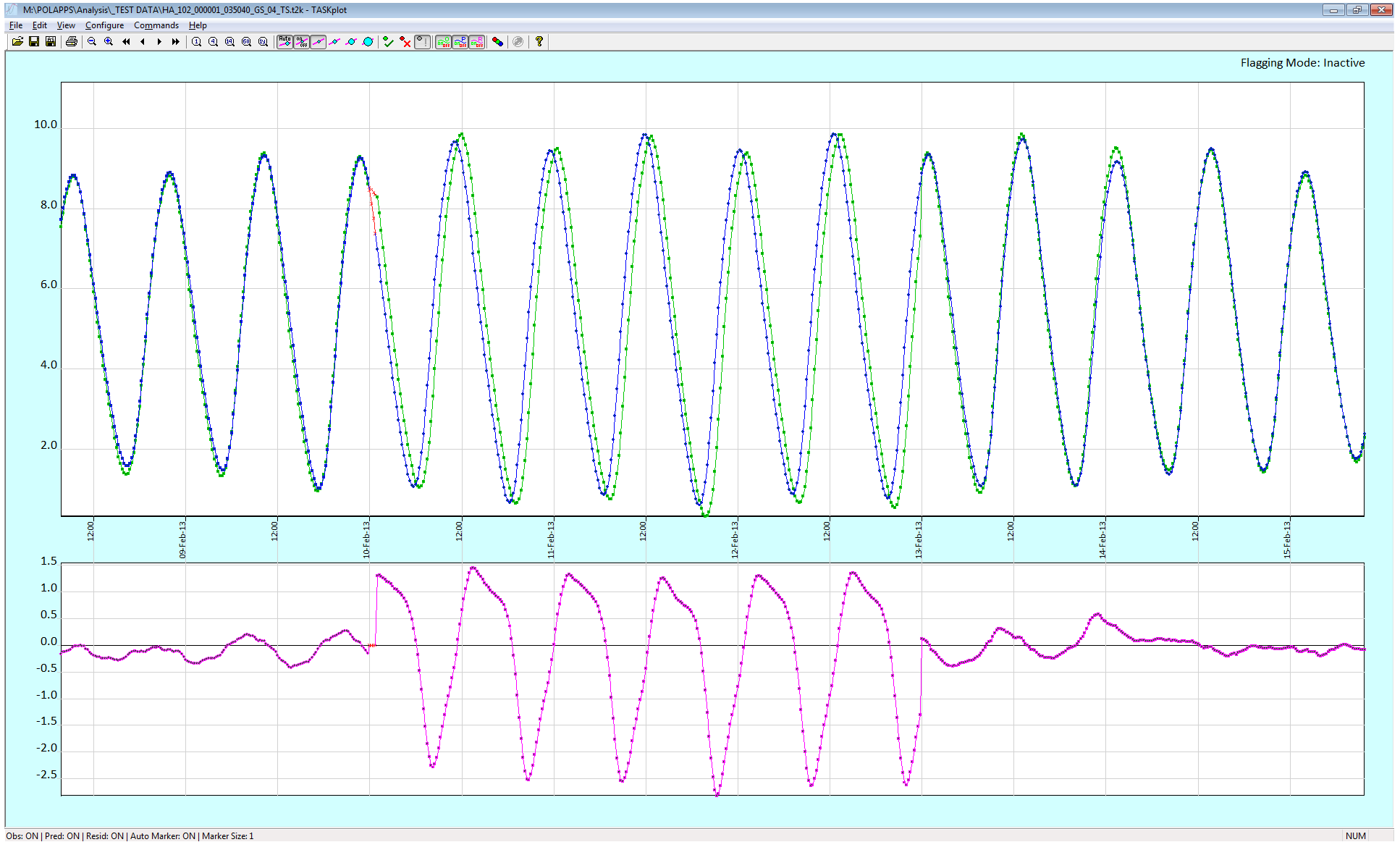

GAPS

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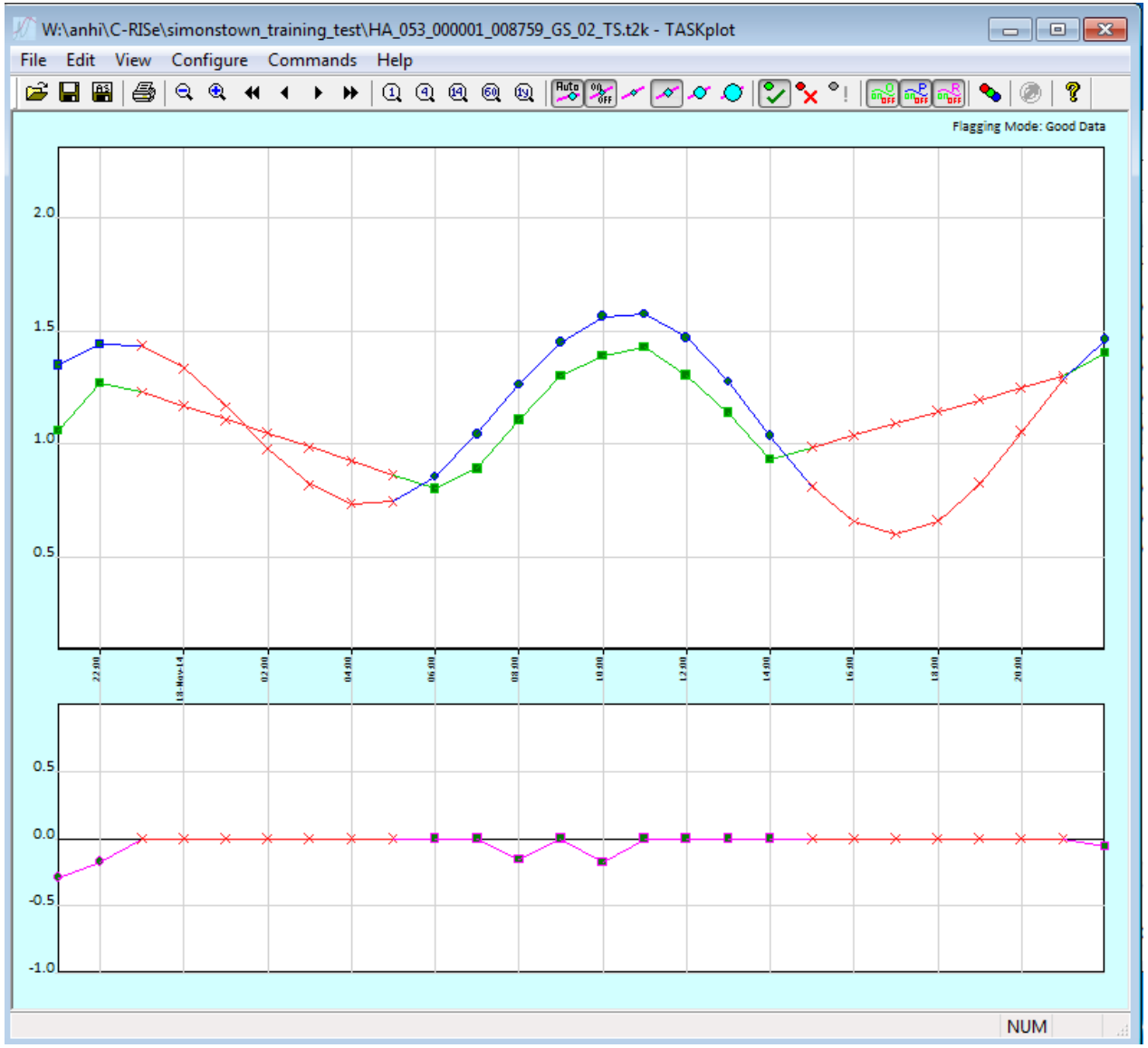

TIDAL ANALYSIS FOR VALIDATION OF SATELLITE ALTIMETRY

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- Ordinarily, the seasonal cycle (described by tidal constituents Sa and Ssa) is removed from the tide gauge data during tidal analysis.
- However, for the validation of satellite altimetry, we must retain the seasonal cycle since altimetry data are detided, but the seasonal cycles are not removed.
- So, for this we use special sets of tidal constituents that exclude Sa and Ssa.
- If you are performing tidal analysis in order to produce tidal predictions e.g. for navigation, port authorities etc, you should include the seasonal cycle.

STEP 1. REFORMAT THE PORTAGAUGE DATA FILE

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Portagauge data are in comma separated value (.csv) files with the following naming convention "MadagascarPG1_log_YYYYMMDD.csv"

- There are 4 datafiles

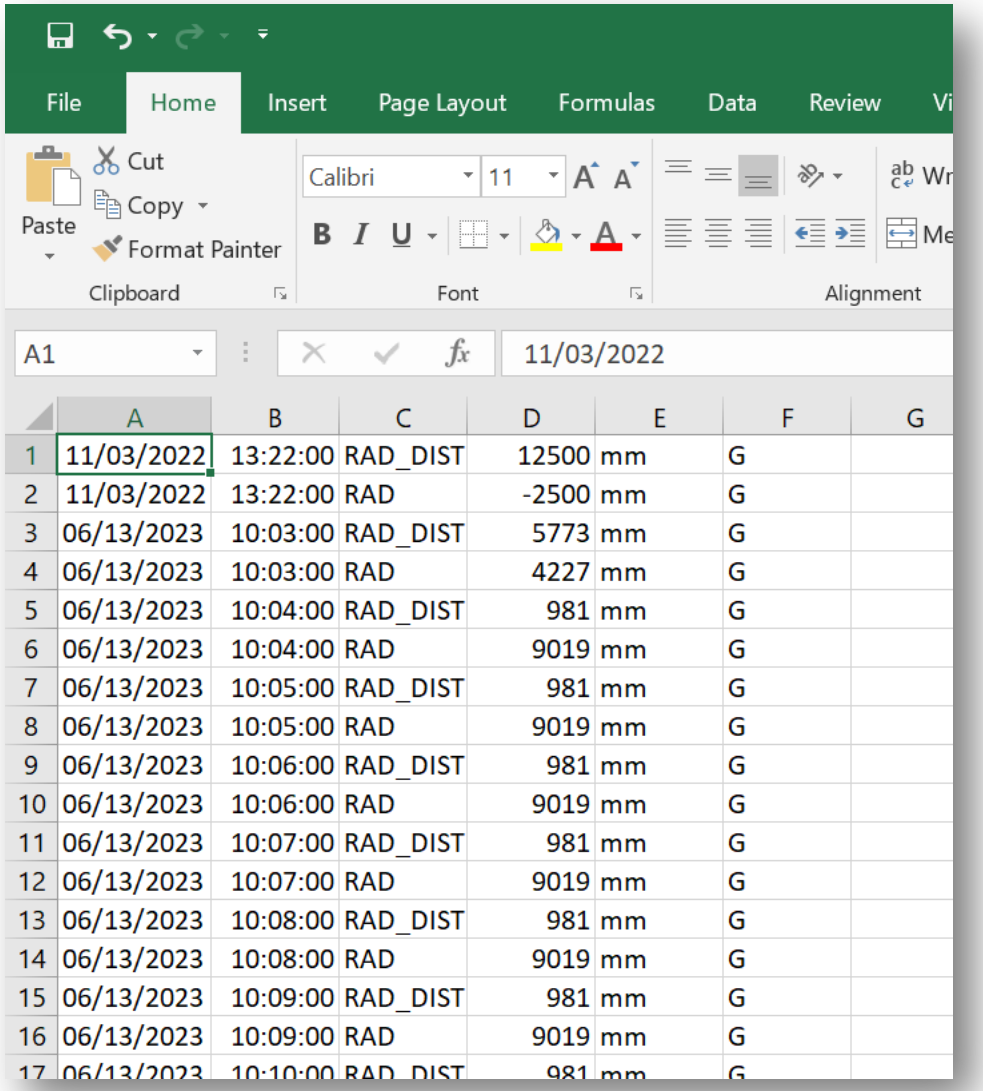
  MadagascarPG1_log_20230821.csv

  MadagascarPG1_log_20230928.csv

  MadagascarPG1_log_20240123.csv

  MadagascarPG1_log_20240131.csv

Using MS Excel (or similar) concatenate these files.



	A	B	C	D	E	F	G
1	11/03/2022	13:22:00	RAD_DIST	12500	mm	G	
2	11/03/2022	13:22:00	RAD	-2500	mm	G	
3	06/13/2023	10:03:00	RAD_DIST	5773	mm	G	
4	06/13/2023	10:03:00	RAD	4227	mm	G	
5	06/13/2023	10:04:00	RAD_DIST	981	mm	G	
6	06/13/2023	10:04:00	RAD	9019	mm	G	
7	06/13/2023	10:05:00	RAD_DIST	981	mm	G	
8	06/13/2023	10:05:00	RAD	9019	mm	G	
9	06/13/2023	10:06:00	RAD_DIST	981	mm	G	
10	06/13/2023	10:06:00	RAD	9019	mm	G	
11	06/13/2023	10:07:00	RAD_DIST	981	mm	G	
12	06/13/2023	10:07:00	RAD	9019	mm	G	
13	06/13/2023	10:08:00	RAD_DIST	981	mm	G	
14	06/13/2023	10:08:00	RAD	9019	mm	G	
15	06/13/2023	10:09:00	RAD_DIST	981	mm	G	
16	06/13/2023	10:09:00	RAD	9019	mm	G	
17	06/13/2023	10:10:00	RAD_DIST	981	mm	G	

STEP 1. REFORMAT THE PORTAGAUGE DATA FILE

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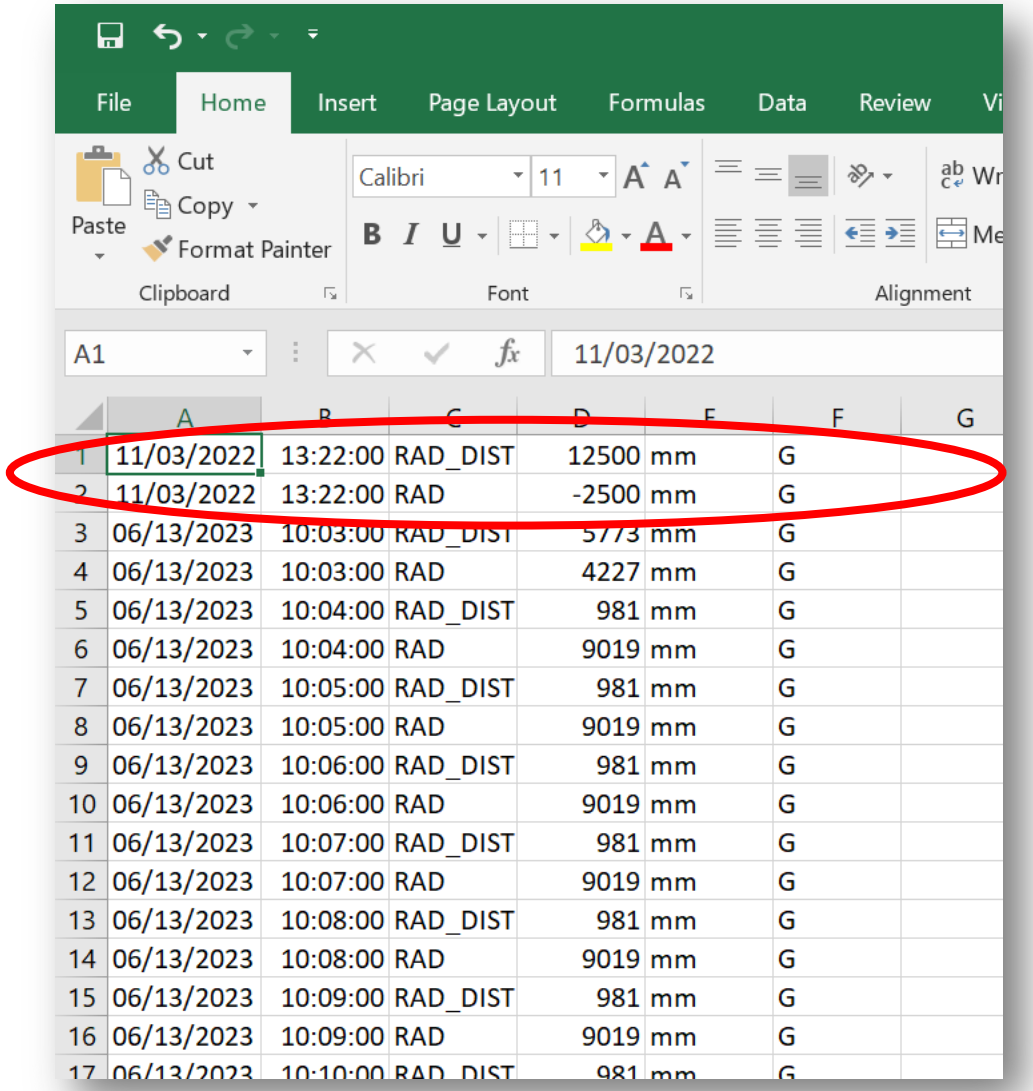
- Delete the first 2 rows of test data
- Save the file as something meaningful e.g.

  PG_Toam_Jun23_Jan24.xlsw



	A	B	C	D	E	F	G
1	11/03/2022	13:22:00	RAD_DIST	12500	mm	G	
2	11/03/2022	13:22:00	RAD	-2500	mm	G	
3	06/13/2023	10:03:00	RAD_DIST	5773	mm	G	
4	06/13/2023	10:03:00	RAD	4227	mm	G	
5	06/13/2023	10:04:00	RAD_DIST	981	mm	G	
6	06/13/2023	10:04:00	RAD	9019	mm	G	
7	06/13/2023	10:05:00	RAD_DIST	981	mm	G	
8	06/13/2023	10:05:00	RAD	9019	mm	G	
9	06/13/2023	10:06:00	RAD_DIST	981	mm	G	
10	06/13/2023	10:06:00	RAD	9019	mm	G	
11	06/13/2023	10:07:00	RAD_DIST	981	mm	G	
12	06/13/2023	10:07:00	RAD	9019	mm	G	
13	06/13/2023	10:08:00	RAD_DIST	981	mm	G	
14	06/13/2023	10:08:00	RAD	9019	mm	G	
15	06/13/2023	10:09:00	RAD_DIST	981	mm	G	
16	06/13/2023	10:09:00	RAD	9019	mm	G	
17	06/13/2023	10:10:00	RAD_DIST	981	mm	G	

REFORMAT THE PORTAGAUGE DATA FILE

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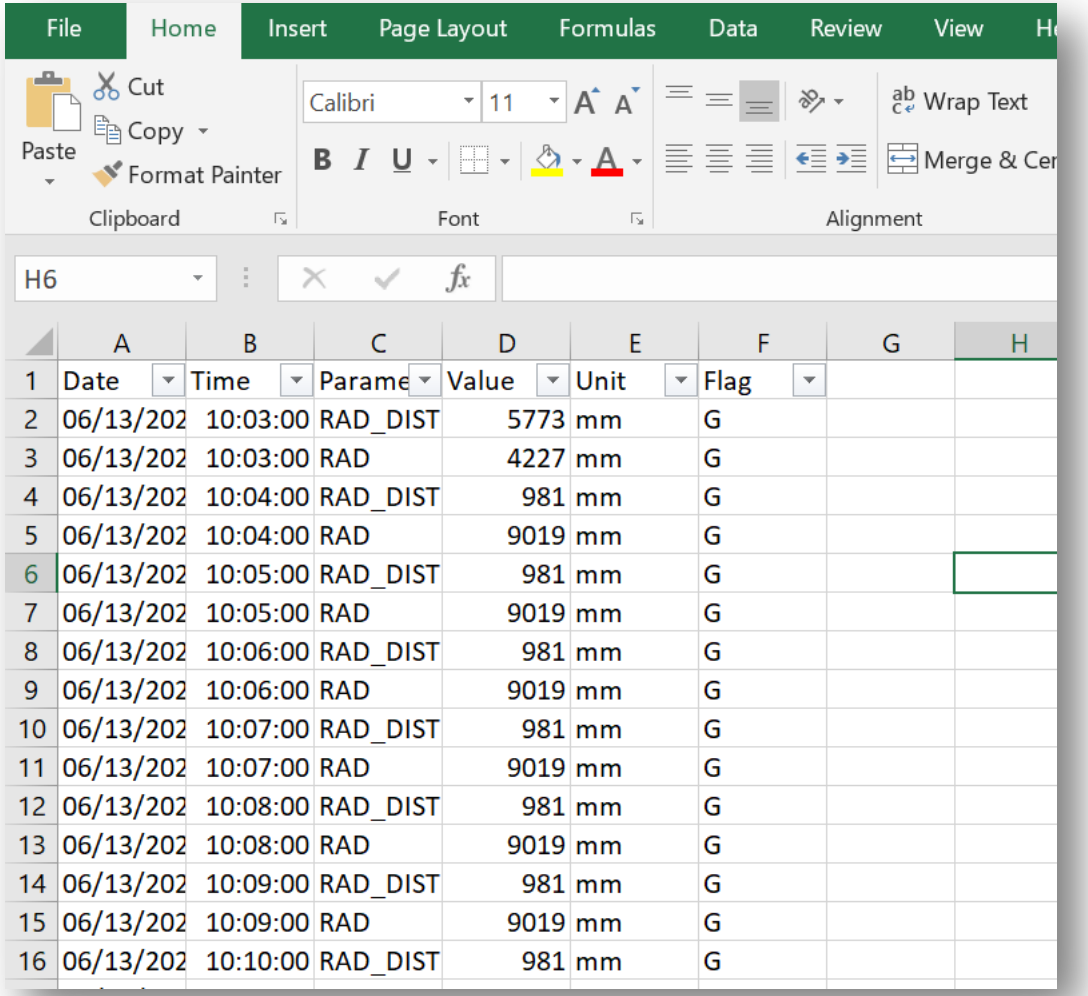
- Using a spreadsheet package such as MS Excel, insert header rows:
- Date, Time, Parameter, Value, Unit, Flag
- Filter the data by parameter “RAD” to obtain sea level heights (or by “BARO” if you are interested in barometer measurements).

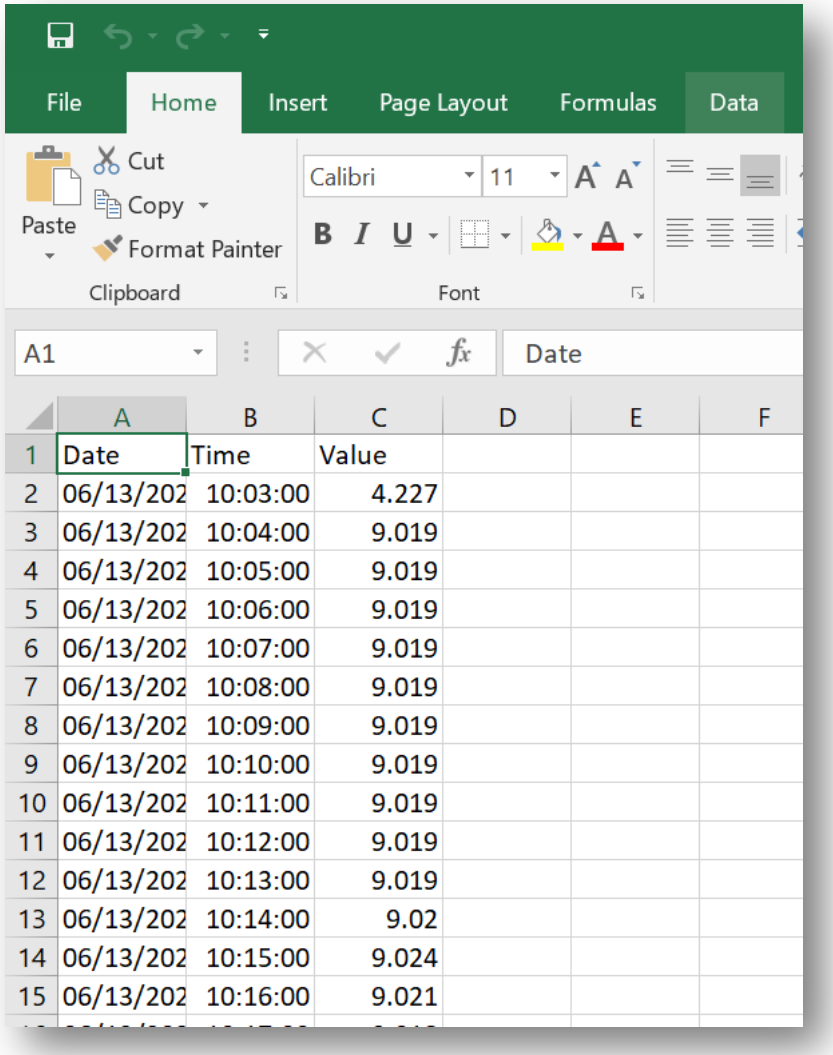


	A	B	C	D	E	F	G	H
1	Date	Time	Parame	Value	Unit	Flag		
2	06/13/202	10:03:00	RAD_DIST	5773	mm	G		
3	06/13/202	10:03:00	RAD	4227	mm	G		
4	06/13/202	10:04:00	RAD_DIST	981	mm	G		
5	06/13/202	10:04:00	RAD	9019	mm	G		
6	06/13/202	10:05:00	RAD_DIST	981	mm	G		
7	06/13/202	10:05:00	RAD	9019	mm	G		
8	06/13/202	10:06:00	RAD_DIST	981	mm	G		
9	06/13/202	10:06:00	RAD	9019	mm	G		
10	06/13/202	10:07:00	RAD_DIST	981	mm	G		
11	06/13/202	10:07:00	RAD	9019	mm	G		
12	06/13/202	10:08:00	RAD_DIST	981	mm	G		
13	06/13/202	10:08:00	RAD	9019	mm	G		
14	06/13/202	10:09:00	RAD_DIST	981	mm	G		
15	06/13/202	10:09:00	RAD	9019	mm	G		
16	06/13/202	10:10:00	RAD_DIST	981	mm	G		

REFORMAT THE PORTAGAUGE DATA FILE

National Oceanography Centre

- Copy and paste these “RAD” data into another spreadsheet and delete the parameter, unit and flag columns.
- Divide the sea level values by 1000
- Save the spreadsheet as a .csv file.



	A	B	C	D	E	F
1	Date	Time	Value			
2	06/13/202	10:03:00	4.227			
3	06/13/202	10:04:00	9.019			
4	06/13/202	10:05:00	9.019			
5	06/13/202	10:06:00	9.019			
6	06/13/202	10:07:00	9.019			
7	06/13/202	10:08:00	9.019			
8	06/13/202	10:09:00	9.019			
9	06/13/202	10:10:00	9.019			
10	06/13/202	10:11:00	9.019			
11	06/13/202	10:12:00	9.019			
12	06/13/202	10:13:00	9.019			
13	06/13/202	10:14:00	9.02			
14	06/13/202	10:15:00	9.024			
15	06/13/202	10:16:00	9.021			

TASK FOR TIDAL ANALYSIS AND POLTIPS FOR TIDAL PREDICTION

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- QuickConvert — Reformats IOC SLMF high frequency data
- TASK – Toolkit — Format conversion, resampling, auto-QC, auto-flagging
- TASK – Analyse — Harmonic analysis module, daily, monthly and annual means
- TASK – Plot — Data viewing, quality control, manual flagging
- POLTIPS — Prediction, statistics, tide table production

TASK

Windows Edition

version 2.0.0

2015 Edition

Tidal Analysis Software Kit

Developed by the Marine Data Products Team at the
UK National Oceanography Centre.

Please read this user guide thoroughly before using the TASK software.

STEP 2. TASK-TOOLKIT

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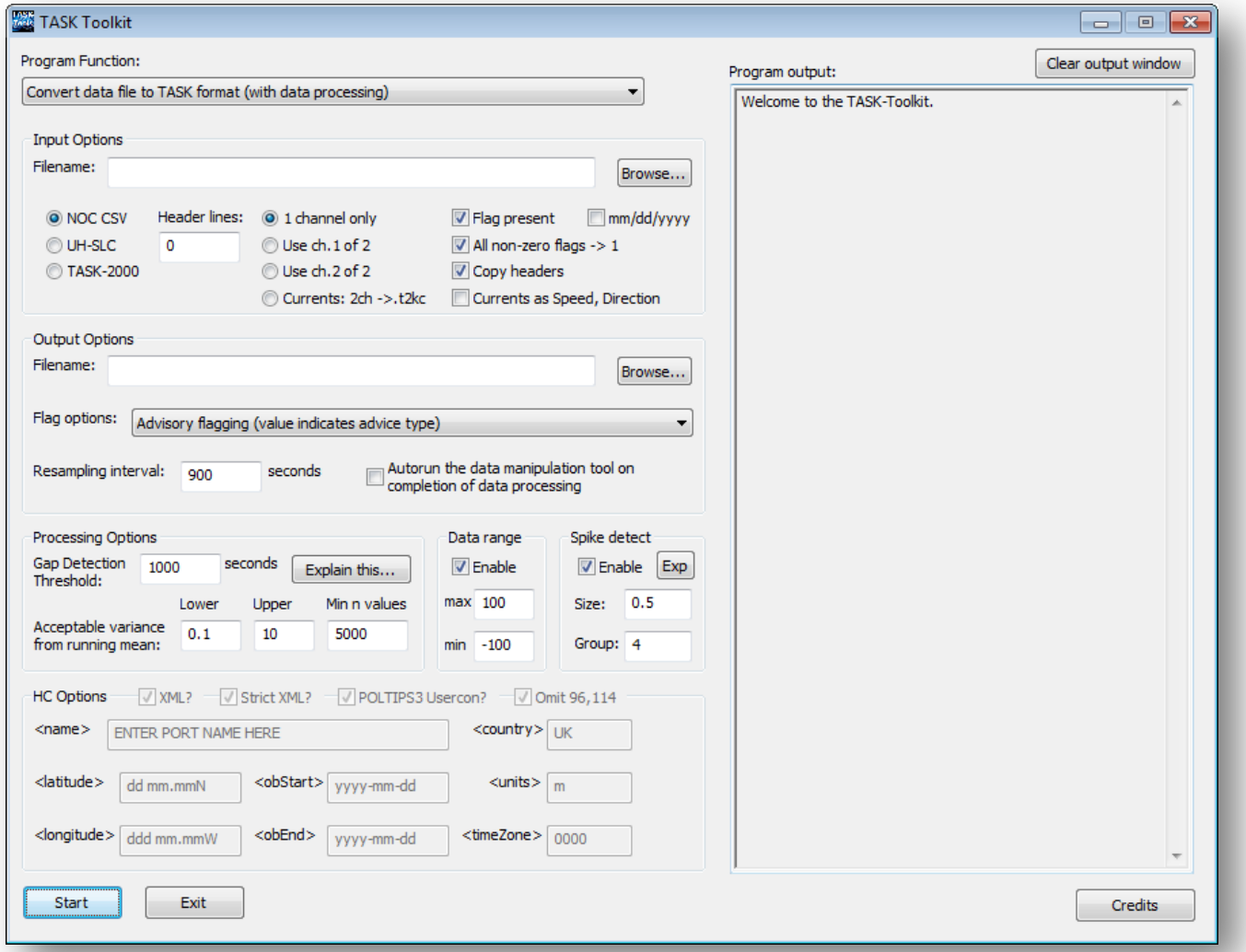
Run the data through TASK-Toolkit which

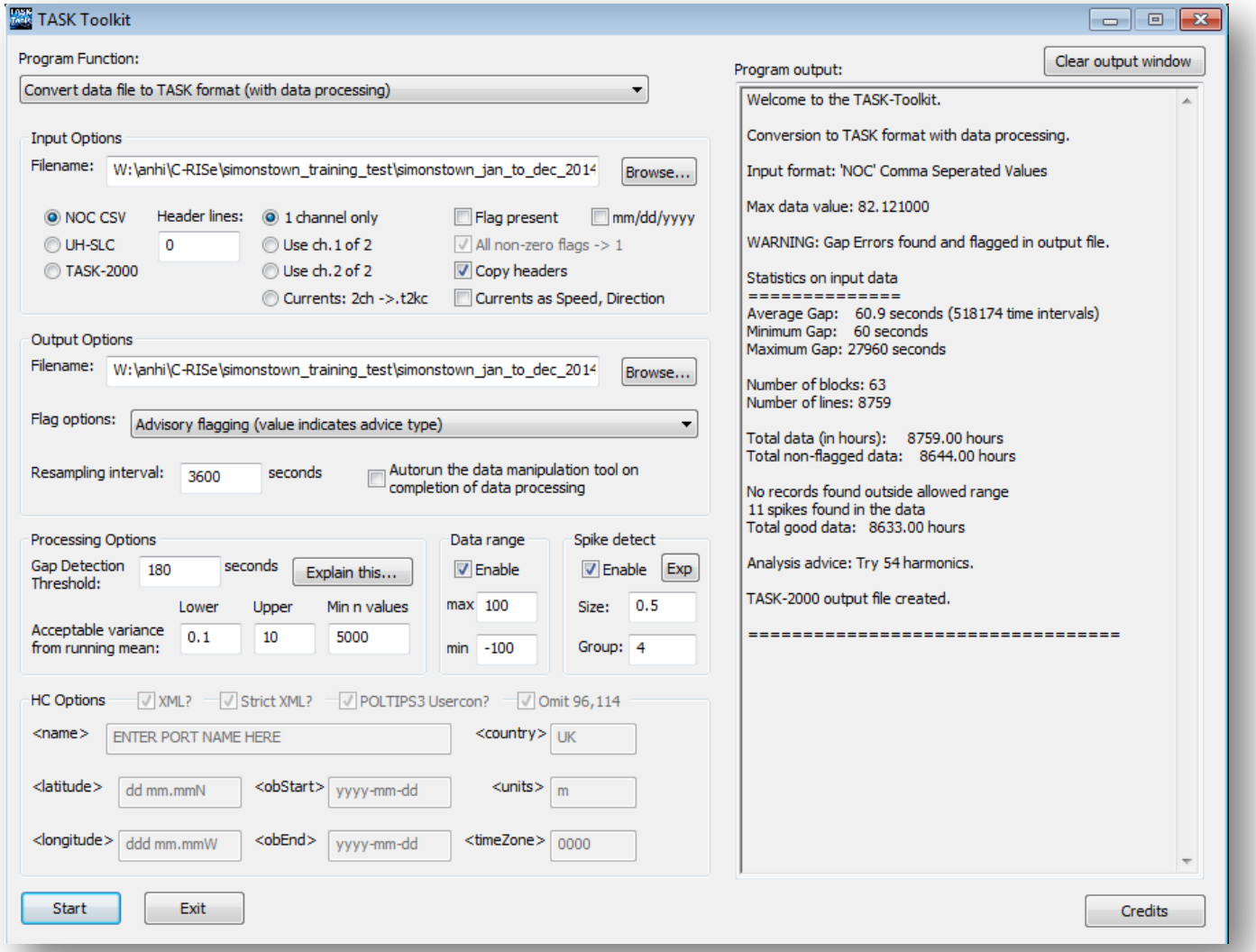
- Converts the data to .t2k format
- Resamples the data
- Checks for gaps
- Checks for spikes
- Automatically flags suspect data
- Advise how many harmonics should be used



STEP 2. TASK-TOOLKIT

- Click the TASK-Toolkit icon to open the tool

- Drag and drop the csv file onto the window
- Uncheck the ‘flag present’ button
- Set flag option to ‘Advisory flagging’
- Set resampling interval to 3600 secs



STEP 3. TASK-TOOLKIT

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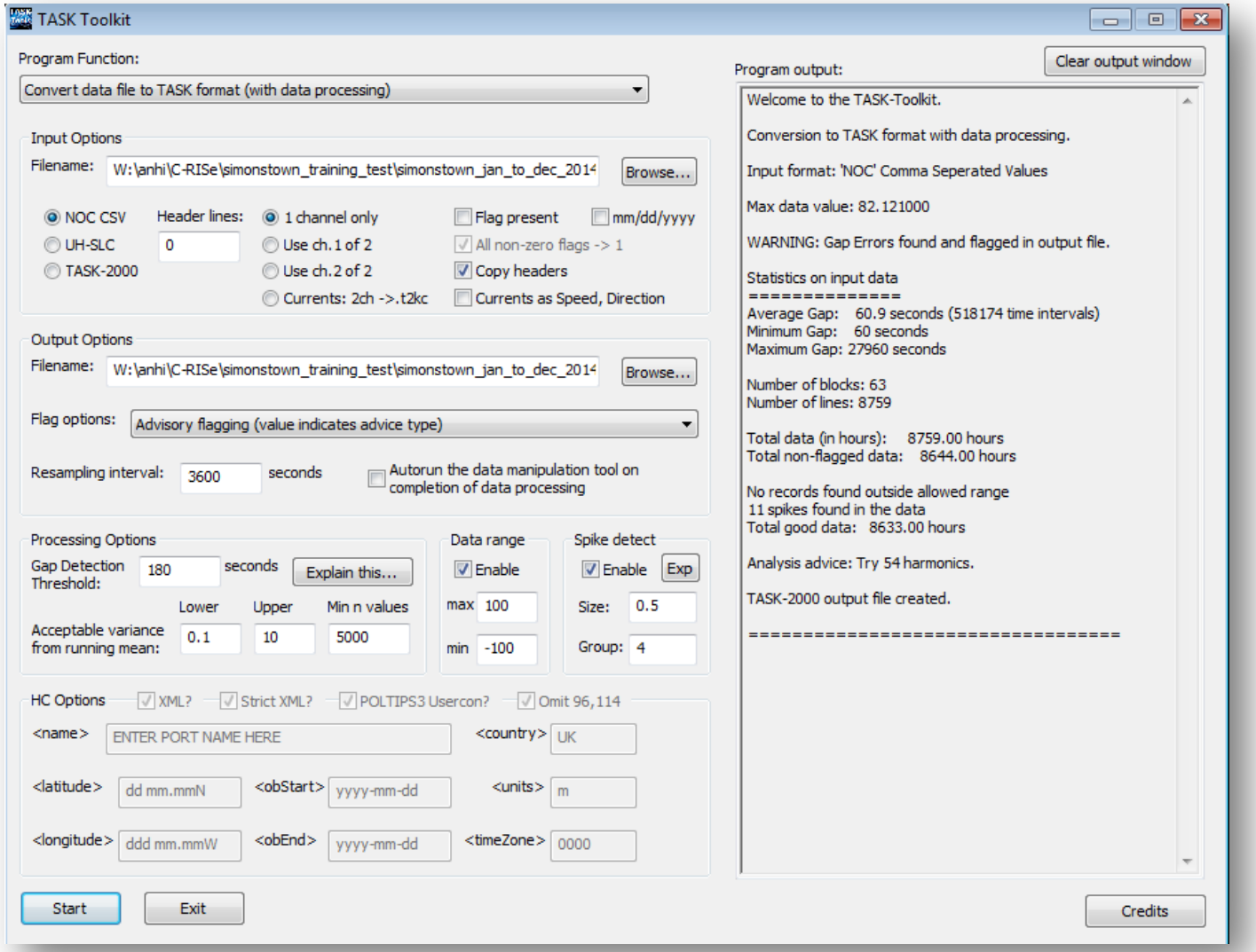
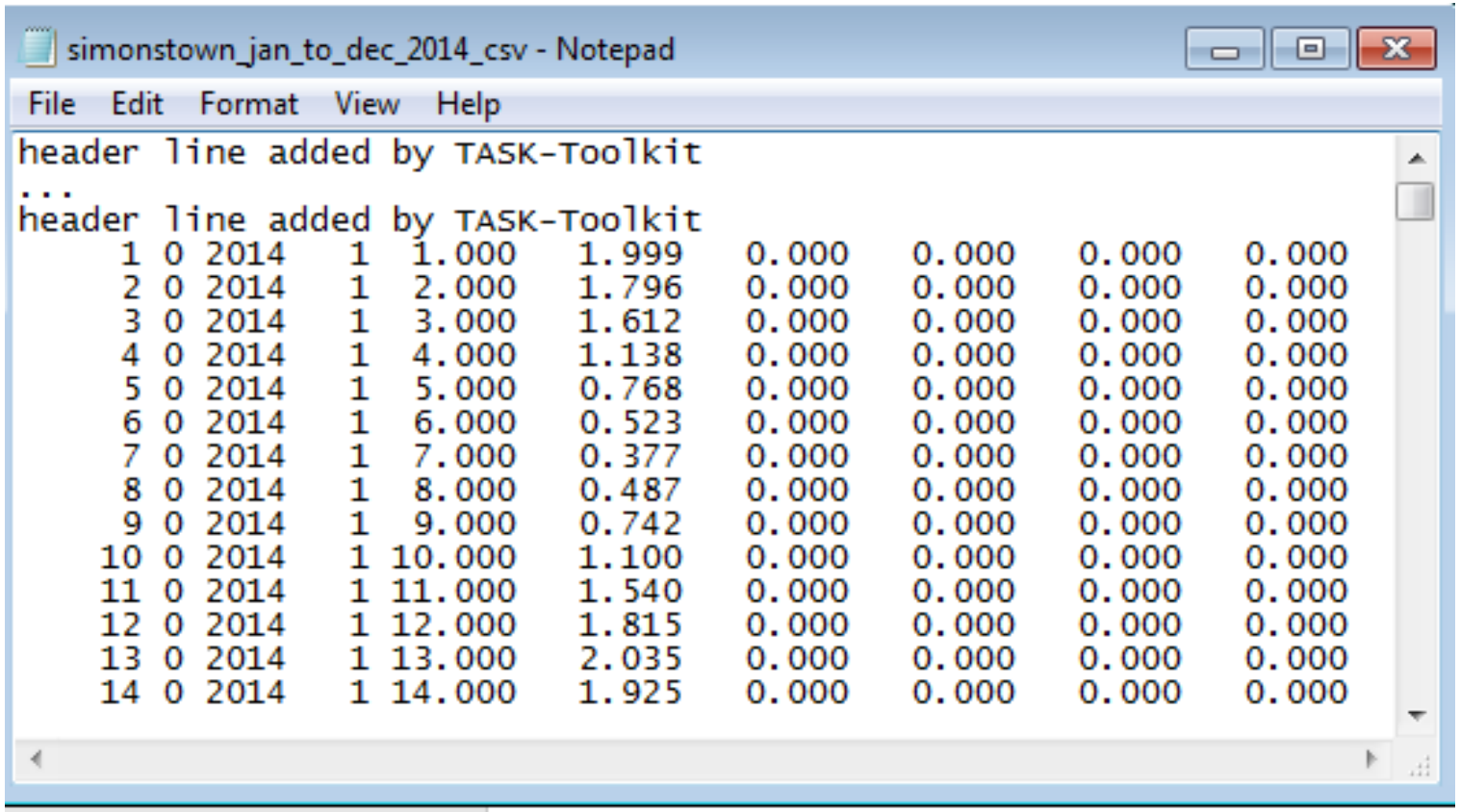
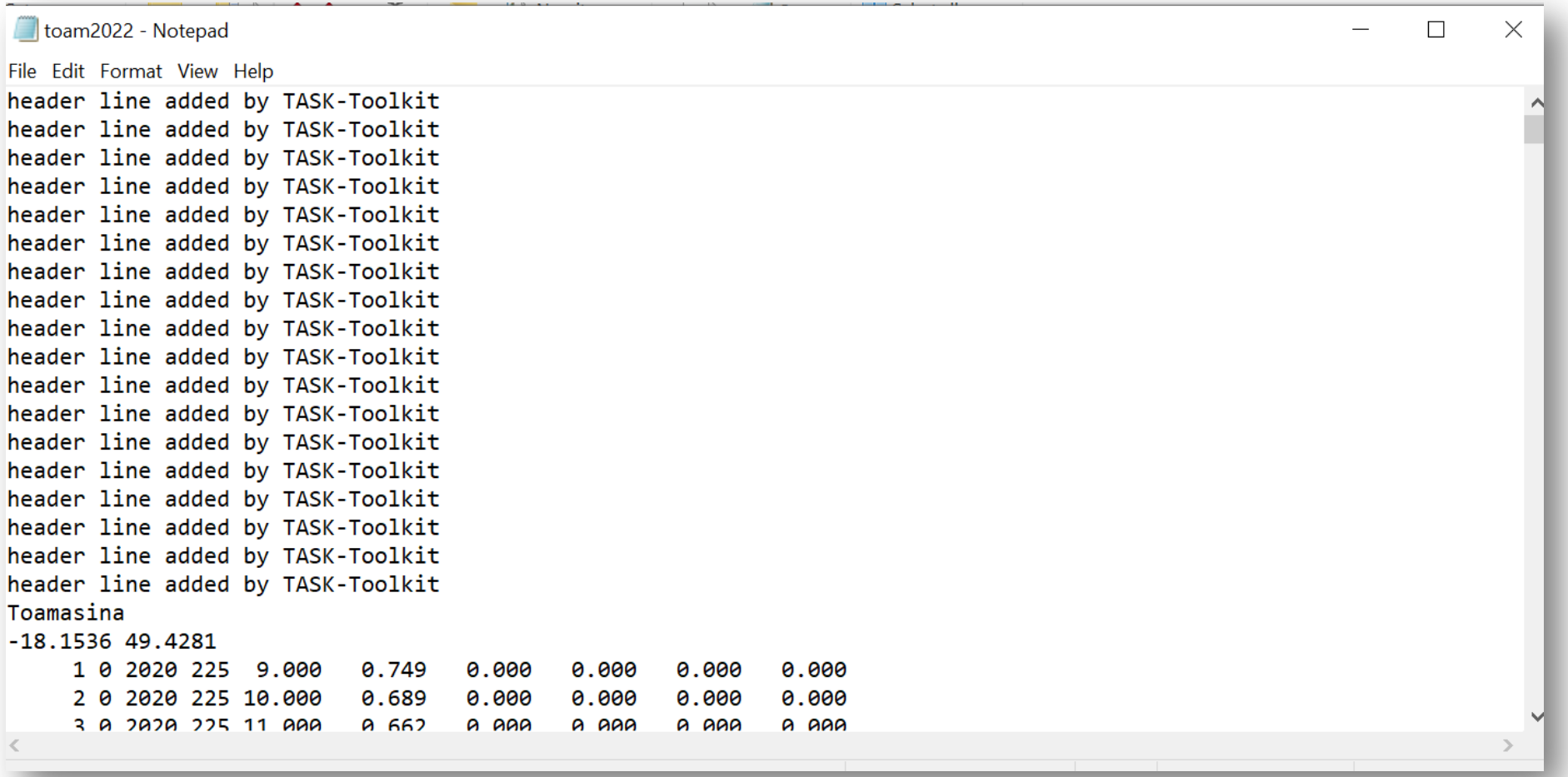
- Set gap detection threshold to 180 secs
- Check the mm/dd/yyyy button
- Set the header lines to “1”
- Data range – use default unless the range of the data is known
- Check the output window for advice on how many harmonics to use.



THE .T2K FILE


simonstown_jan_to_dec_2014_csv - Notepad
File Edit Format View Help
header line added by TASK-Toolkit
...
header line added by TASK-Toolkit
1 0 2014 1 1.000 1.999 0.000 0.000 0.000 0.000
2 0 2014 1 2.000 1.796 0.000 0.000 0.000 0.000
3 0 2014 1 3.000 1.612 0.000 0.000 0.000 0.000
4 0 2014 1 4.000 1.138 0.000 0.000 0.000 0.000
5 0 2014 1 5.000 0.768 0.000 0.000 0.000 0.000
6 0 2014 1 6.000 0.523 0.000 0.000 0.000 0.000
7 0 2014 1 7.000 0.377 0.000 0.000 0.000 0.000
8 0 2014 1 8.000 0.487 0.000 0.000 0.000 0.000
9 0 2014 1 9.000 0.742 0.000 0.000 0.000 0.000
10 0 2014 1 10.000 1.100 0.000 0.000 0.000 0.000
11 0 2014 1 11.000 1.540 0.000 0.000 0.000 0.000
12 0 2014 1 12.000 1.815 0.000 0.000 0.000 0.000
13 0 2014 1 13.000 2.035 0.000 0.000 0.000 0.000
14 0 2014 1 14.000 1.925 0.000 0.000 0.000 0.000
Record number
Year
Time
Additional data channels used later for predictions and residuals
Data flag
Day number
Tide gauge data

THE .T2K FILE

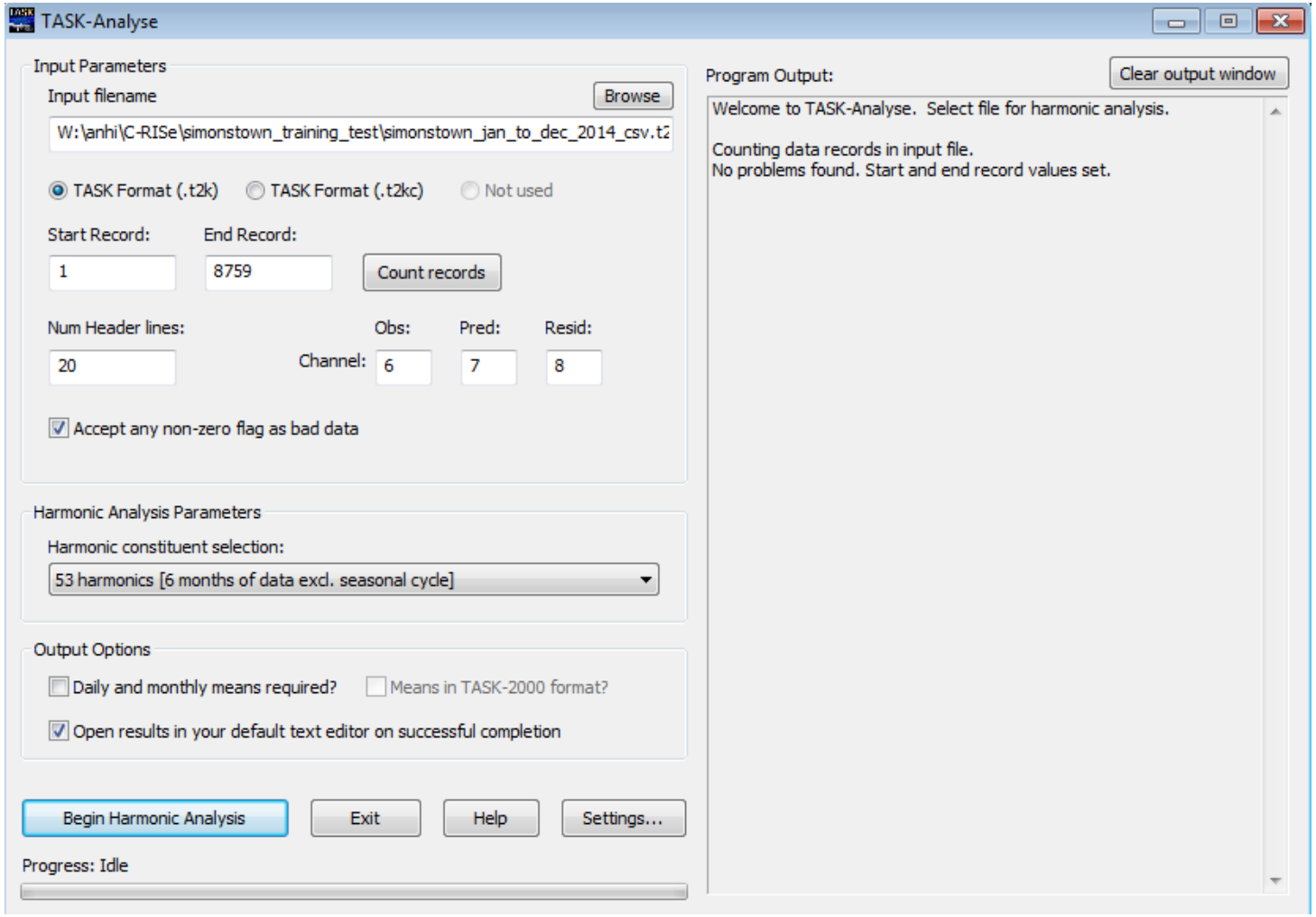


Replace the last two header lines with the location and the latitude and longitude.

Save the file.

STEP 3. TASK-ANALYSE

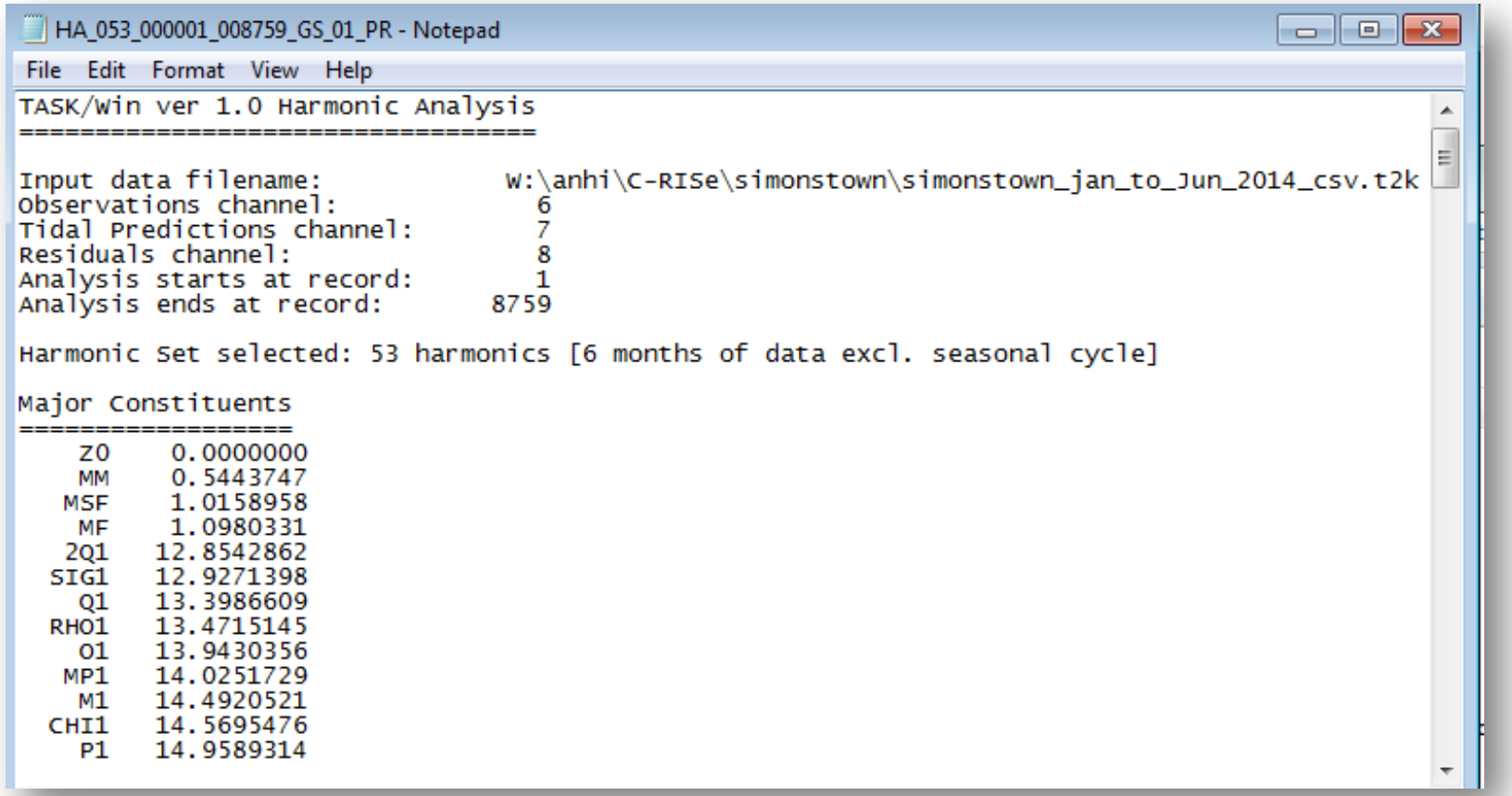
- Double click the TASK-Analyse icon to open.
- Drag and drop the .t2k file onto the window
- Check the ‘Accept any non-zero flag as bad data’ option
- Select the number of harmonic constituents advised by TASK-Toolkit MINUS the seasonal cycle
- Click ‘Begin Harmonic Analysis’



STEP 3. TASK-ANALYSE

National Oceanography Centre

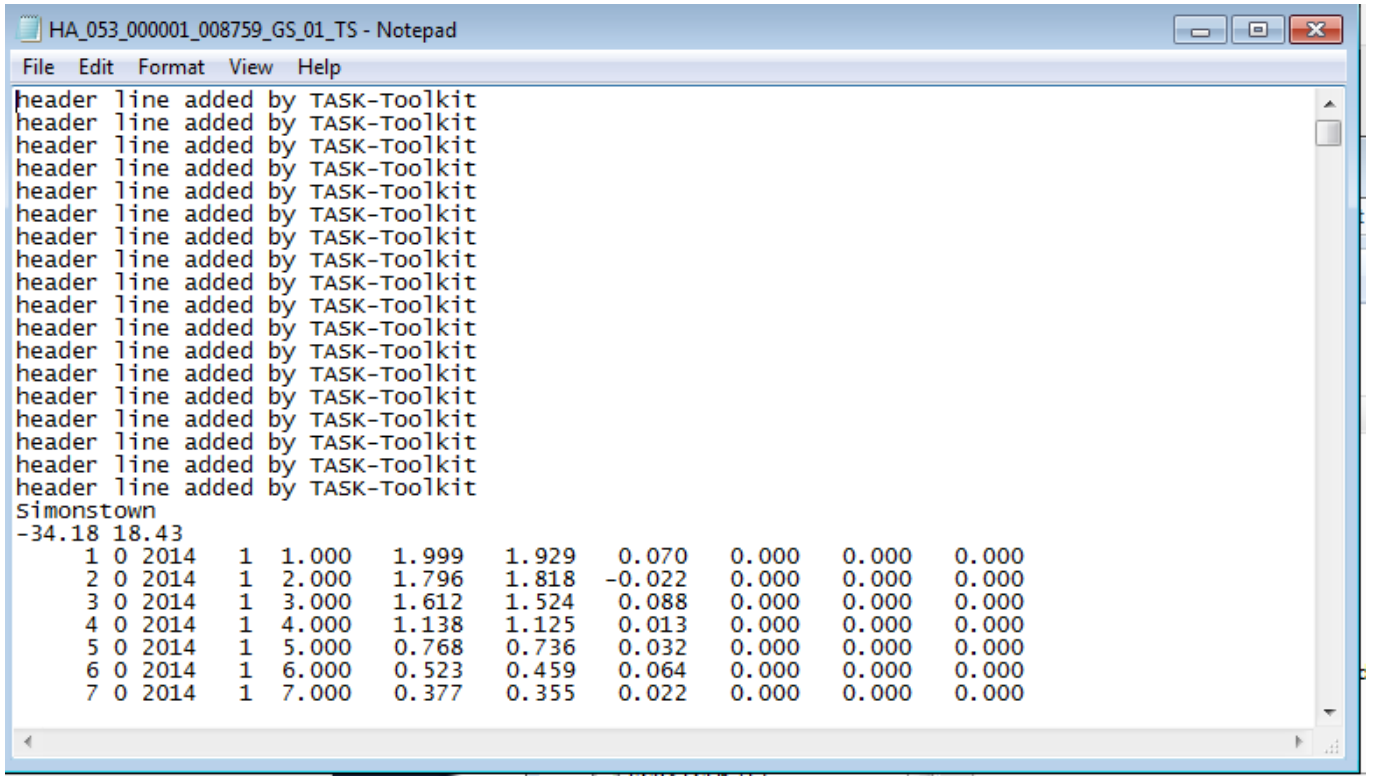
- The analysis creates 2 files:
  - Primary results file which includes the harmonic constants



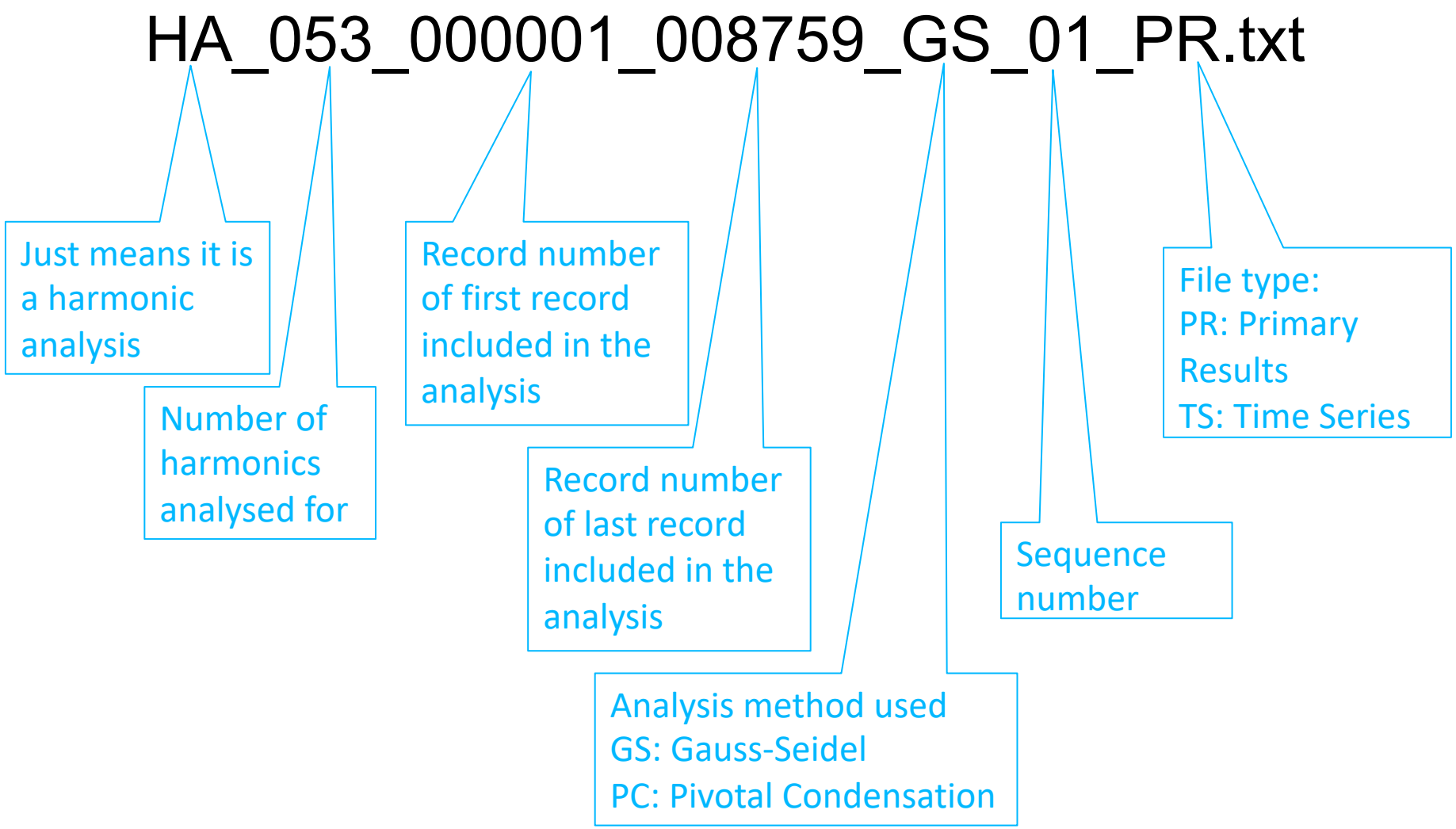
STEP 3. TASK-ANALYSE

National Oceanography Centre

- The analysis creates 2 files:
  - Primary results file which includes the harmonic constants
  - New .t2k.file



PRIMARY RESULTS FILE



PRIMARY RESULTS FILE

Key information:

- Tidal harmonics (amplitude, phase, name, speed etc)
- QC Statistics (residual mean should be very close to zero)
- Max/min residual could show signs of bad data being left in the file
- Raleigh criterion (type of tidal regime)

HA_053_000001_008759_GS_01_PR - Notepad

File Edit Format View Help

```
Quality Control Statistics
==========================

Residual Mean:     0.0000014
Residual S-Dev:    0.0898998
Residual Max:      0.376
Residual Min:     -0.362

Obs Max - Min:     2.223
G(S2) - G(M2):    20.577
Actual largest harmonic amplitude:    0.519   (name:     M2)
O1+K1/M2+S2:       0.101   (semidiurnal)
```

HA_053_000001_008759_GS_01_PR - Notepad

File Edit Format View Help

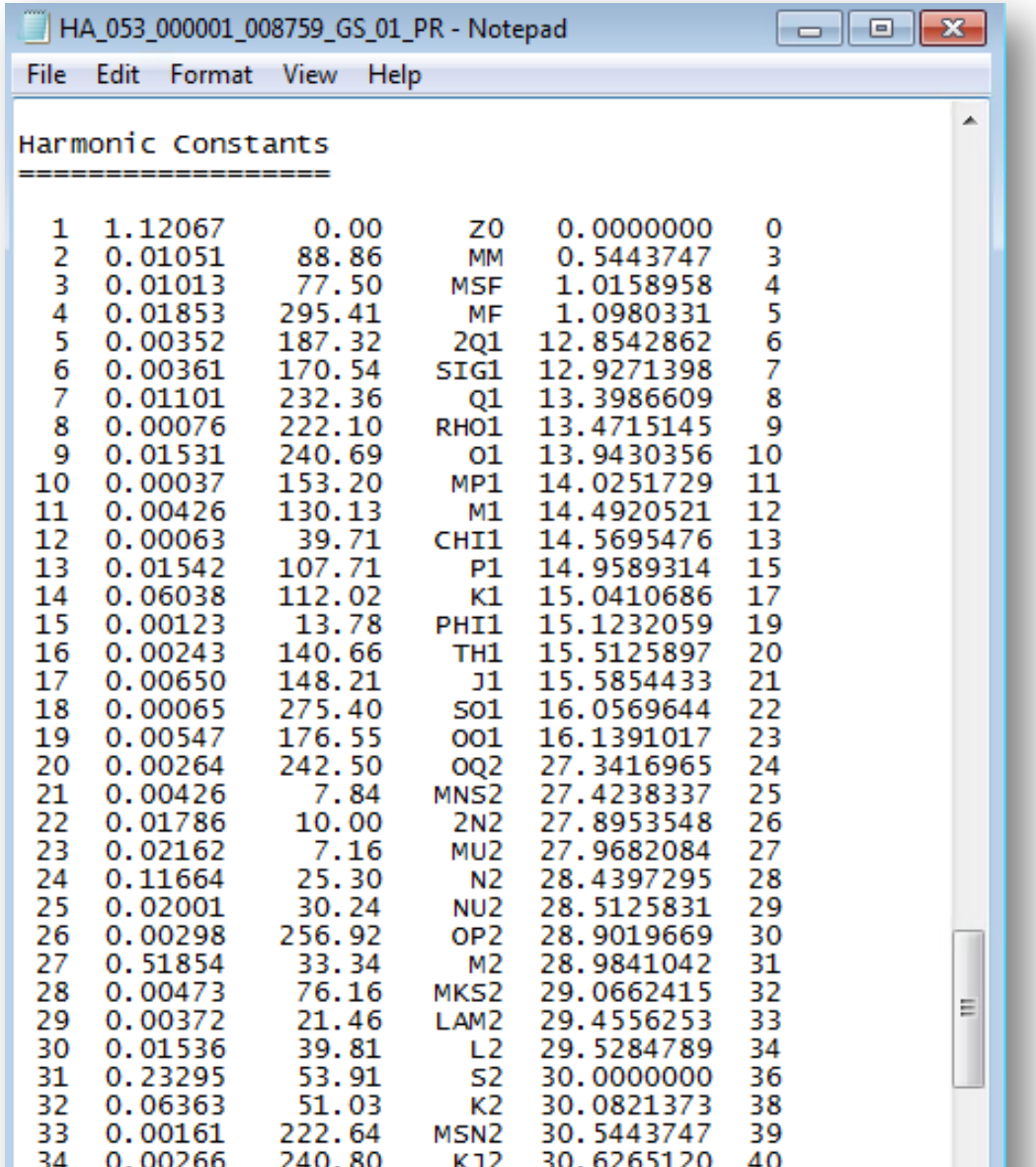
```
Harmonic Constants
==================

  1   1.12067     0.00     Z0    0.0000000    0
  2   0.01051    88.86     MM    0.5443747    3
  3   0.01013    77.50    MSF    1.0158958    4
  4   0.01853   295.41     MF    1.0980331    5
  5   0.00352   187.32    2Q1   12.8542862    6
  6   0.00361   170.54   SIG1   12.9271398    7
  7   0.01101   232.36     Q1   13.3986609    8
  8   0.00076   222.10   RHO1   13.4715145    9
  9   0.01531   240.69     O1   13.9430356   10
 10   0.00037   153.20    MP1   14.0251729   11
 11   0.00426   130.13     M1   14.4920521   12
 12   0.00063    39.71   CHI1   14.5695476   13
 13   0.01542   107.71     P1   14.9589314   15
 14   0.06038   112.02     K1   15.0410686   17
 15   0.00123    13.78   PHI1   15.1232059   19
 16   0.00243   140.66    TH1   15.5125897   20
 17   0.00650   148.21     J1   15.5854433   21
 18   0.00065   275.40    SO1   16.0569644   22
 19   0.00547   176.55    OO1   16.1391017   23
 20   0.00264   242.50    OQ2   27.3416965   24
 21   0.00426     7.84   MNS2   27.4238337   25
 22   0.01786    10.00    2N2   27.8953548   26
 23   0.02162     7.16    MU2   27.9682084   27
 24   0.11664    25.30     N2   28.4397295   28
 25   0.02001    30.24    NU2   28.5125831   29
 26   0.00298   256.92    OP2   28.9019669   30
 27   0.51854    33.34     M2   28.9841042   31
 28   0.00473    76.16   MKS2   29.0662415   32
 29   0.00372    21.46   LAM2   29.4556253   33
 30   0.01536    39.81     L2   29.5284789   34
 31   0.23295    53.91     S2   30.0000000   36
 32   0.06363    51.03     K2   30.0821373   38
```

PRIMARY RESULTS FILE

National Oceanography Centre

Compare the amplitude and phase of the most stable tidal harmonics (O_1, K_1, M_2, S_2) with those from an earlier tidal analysis from the old Toamasina tide gauge. (e.g from your analysis performed in October 2023).

The amplitude and phase should be very similar.



HA_053_000001_008759_GS_01_PR - Notepad

File Edit Format View Help

Harmonic Constants
==========

1	1.12067	0.00	Z0	0.0000000	0
2	0.01051	88.86	MM	0.5443747	3
3	0.01013	77.50	MSF	1.0158958	4
4	0.01853	295.41	MF	1.0980331	5
5	0.00352	187.32	2Q1	12.8542862	6
6	0.00361	170.54	SIG1	12.9271398	7
7	0.01101	232.36	Q1	13.3986609	8
8	0.00076	222.10	RHO1	13.4715145	9
9	0.01531	240.69	O1	13.9430356	10
10	0.00037	153.20	MP1	14.0251729	11
11	0.00426	130.13	M1	14.4920521	12
12	0.00063	39.71	CHI1	14.5695476	13
13	0.01542	107.71	P1	14.9589314	15
14	0.06038	112.02	K1	15.0410686	17
15	0.00123	13.78	PHI1	15.1232059	19
16	0.00243	140.66	TH1	15.5125897	20
17	0.00650	148.21	J1	15.5854433	21
18	0.00065	275.40	SO1	16.0569644	22
19	0.00547	176.55	OO1	16.1391017	23
20	0.00264	242.50	OQ2	27.3416965	24
21	0.00426	7.84	MNS2	27.4238337	25
22	0.01786	10.00	2N2	27.8953548	26
23	0.02162	7.16	MU2	27.9682084	27
24	0.11664	25.30	N2	28.4397295	28
25	0.02001	30.24	NU2	28.5125831	29
26	0.00298	256.92	OP2	28.9019669	30
27	0.51854	33.34	M2	28.9841042	31
28	0.00473	76.16	MKS2	29.0662415	32
29	0.00372	21.46	LAM2	29.4556253	33
30	0.01536	39.81	L2	29.5284789	34
31	0.23295	53.91	S2	30.0000000	36
32	0.06363	51.03	K2	30.0821373	38
33	0.00161	222.64	MSN2	30.5443747	39
34	0.00266	240.80	KJ2	30.6265120	40

TIME SERIES RESULTS FILE

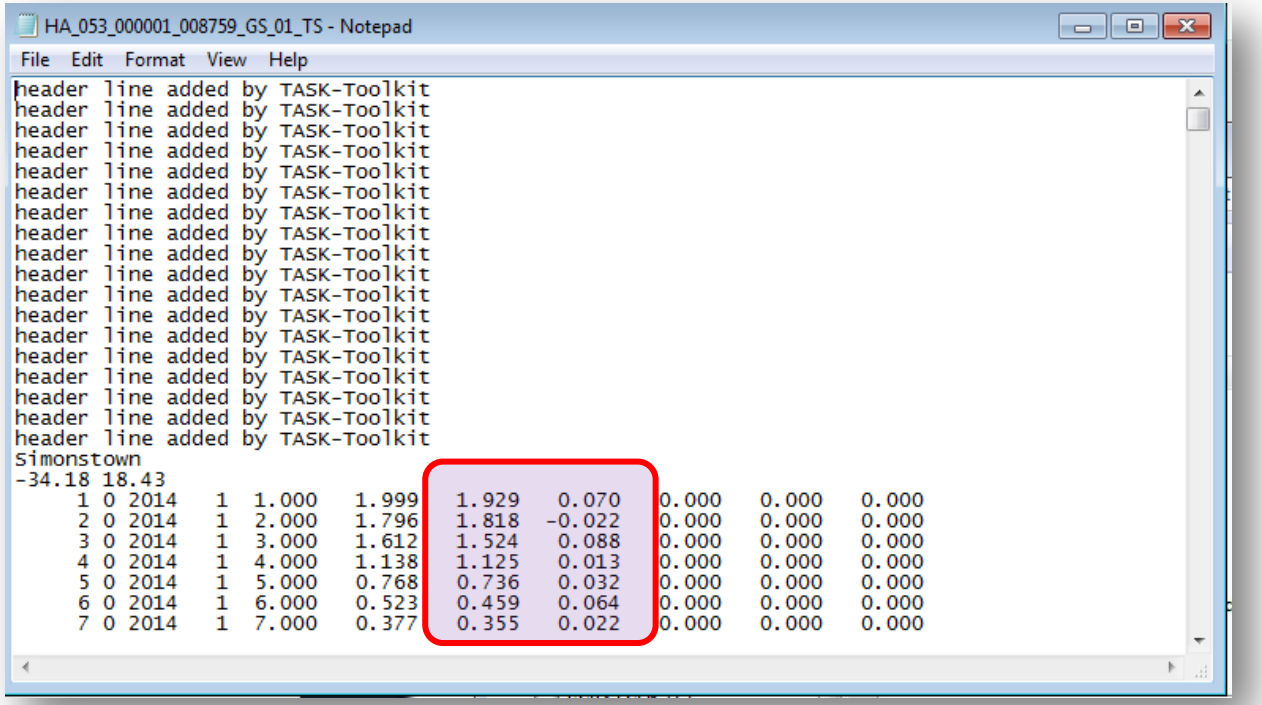
National Oceanography Centre

- Time series file has same name apart from the bit marked:

HA_053_000001_008759_GS_01_PR.txt

HA_053_000001_008759_GS_01_TS.t2k

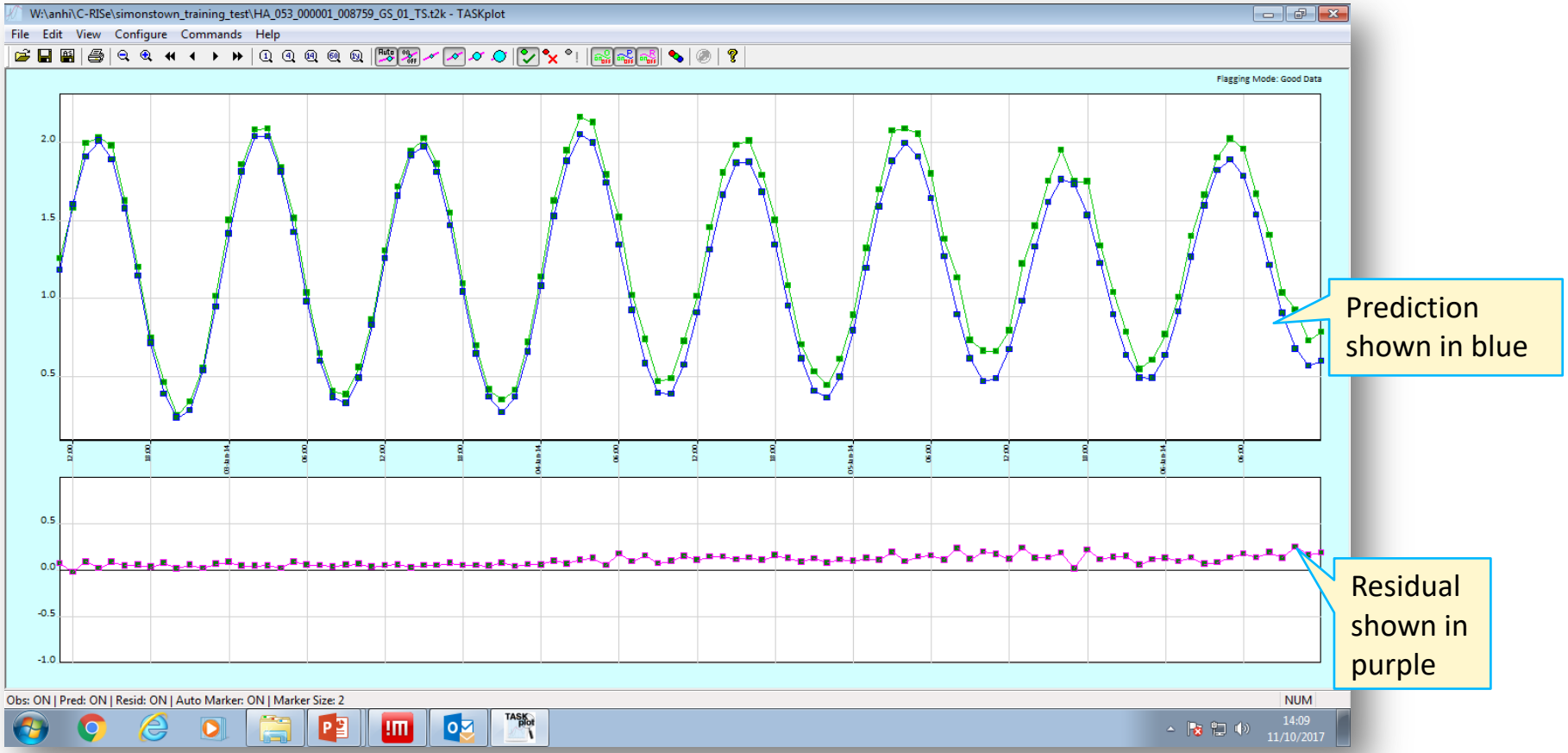
These two columns are no longer set to zero. They contain the predicted level from the newly computed harmonics and the residual (observed minus predicted).



STEP 4. QUALITY CONTROL THE DATA USING TASK-PLOT

National Oceanography Centre

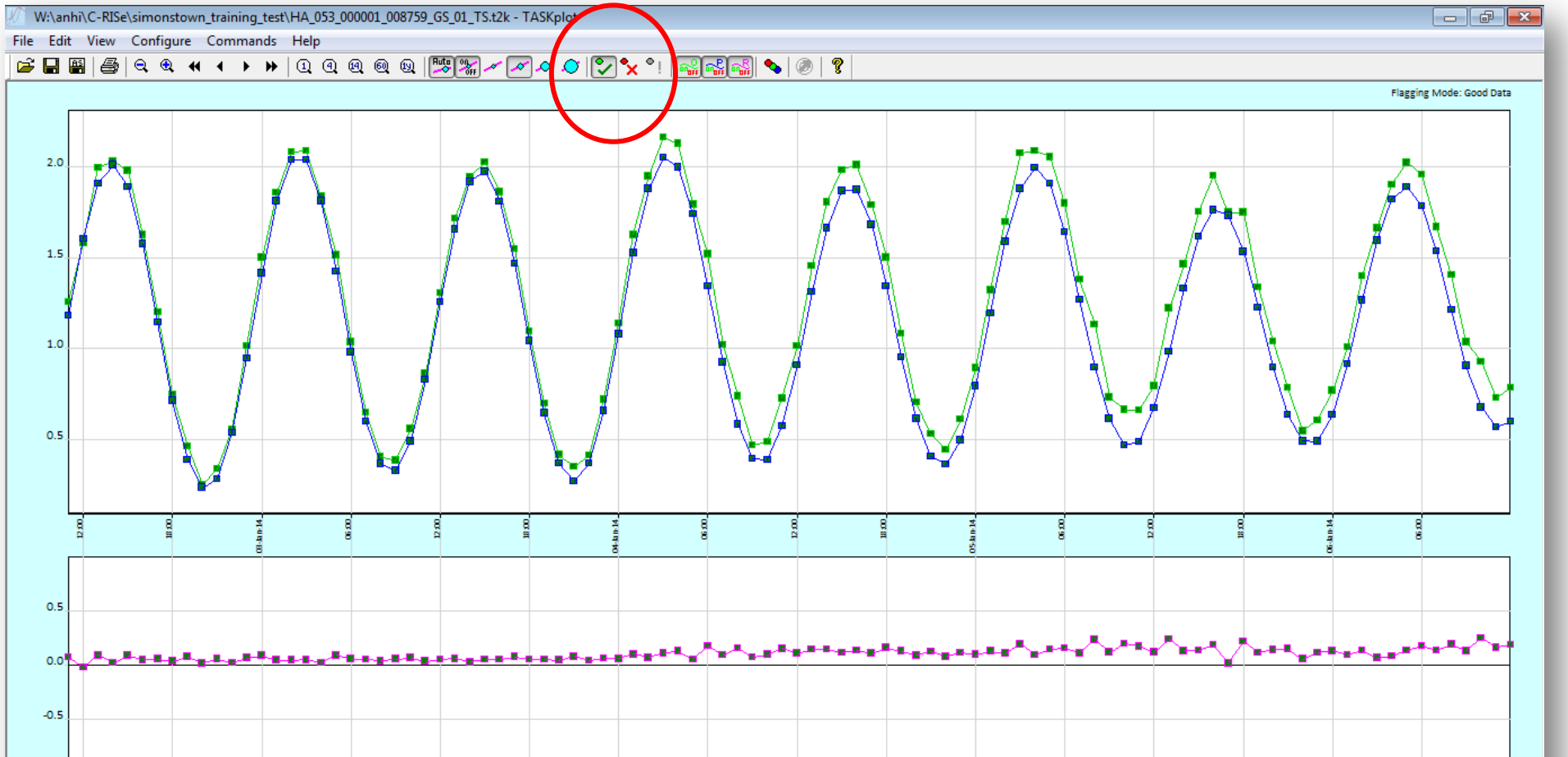
- Click the TASK-Plot icon to open the tool
- Drag and drop the TS.t2k file.



STEP 4. QUALITY CONTROL THE DATA USING TASK-PLOT

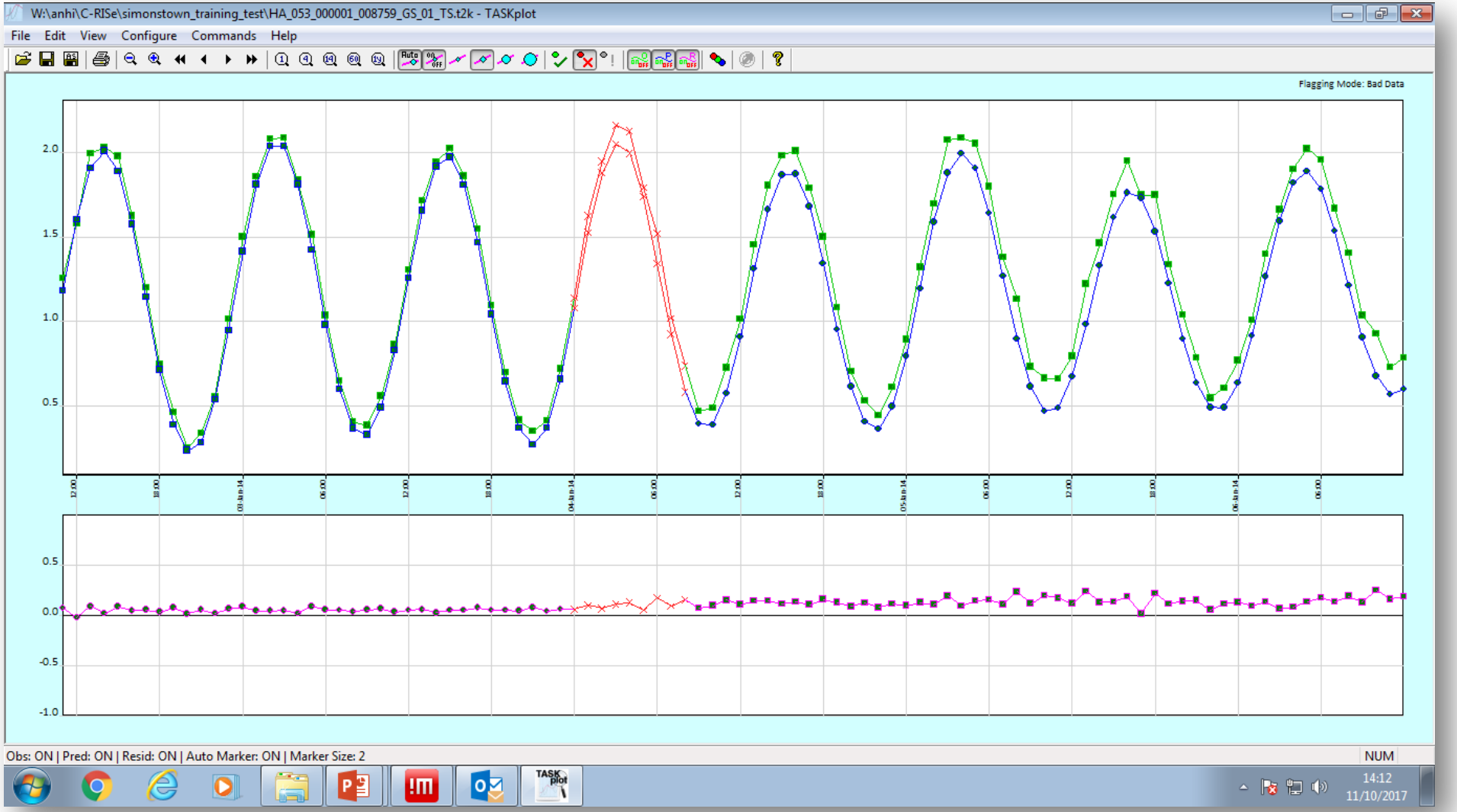
National Oceanography Centre

- Scroll through the data checking for spikes, gaps etc and flag data accordingly. Some data may have been flagged in error automatically, so you should reset it to good data



FLAGGED DATA WILL APPEAR AS RED CROSSES

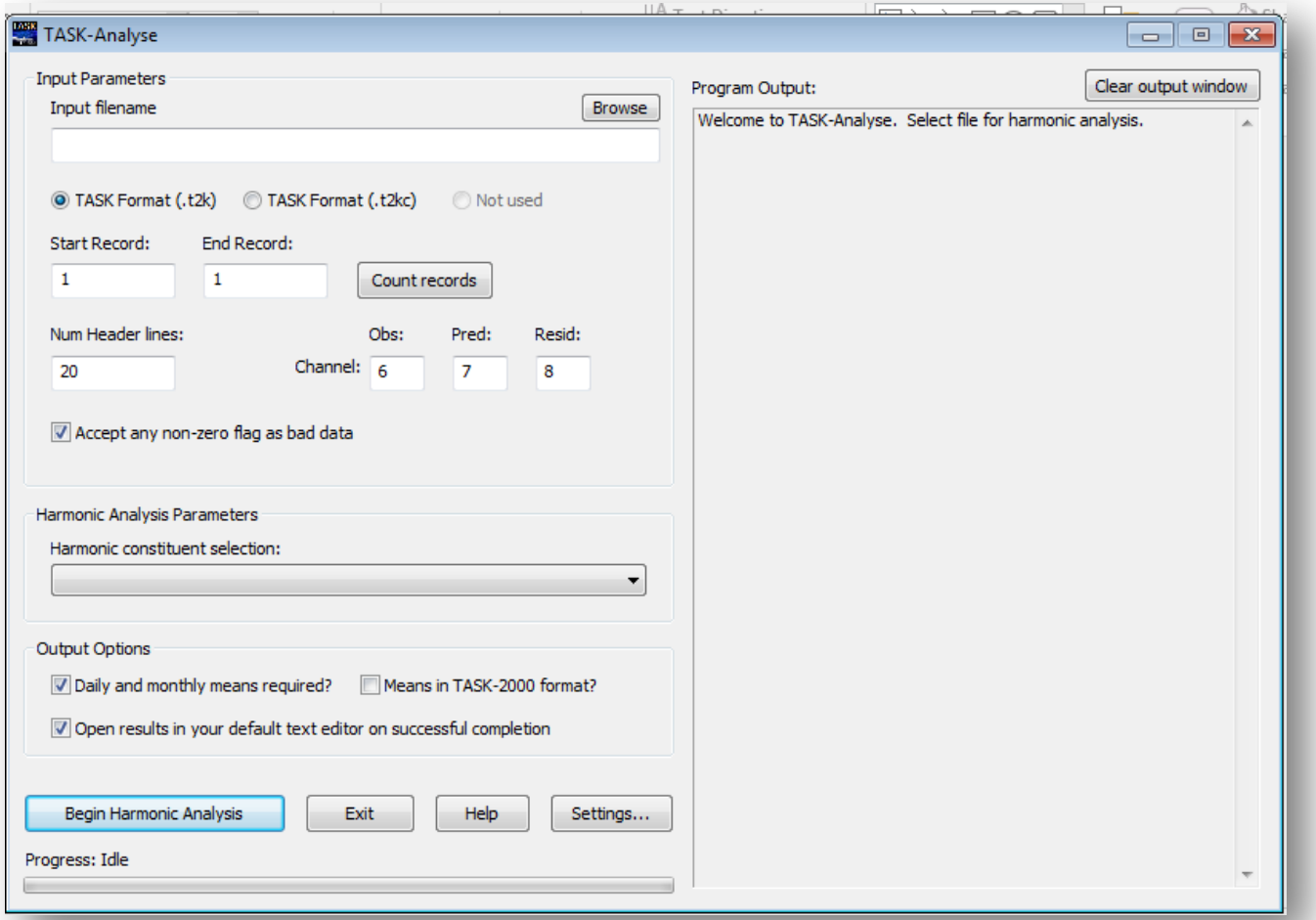
National Oceanography Centre



STEP 5. REANALYSE THE DATA USING TASK-ANALYSE

National Oceanography Centre

- Once you have completed your quality control, save the file (an '_edit' file extension will be added), re-drop it into TASK-Analyse and click the Analyse button
- This time you can check the 'Daily and monthly means required' option if you would like to produce these files



STEP 5. REANALYSE THE DATA USING TASK-ANALYSE

National Oceanography Centre

- NOTE: TASK never overwrites files without asking. Each analysis will automatically create a new filename.

HA_053_000001_008759_GS_02_PR.txt

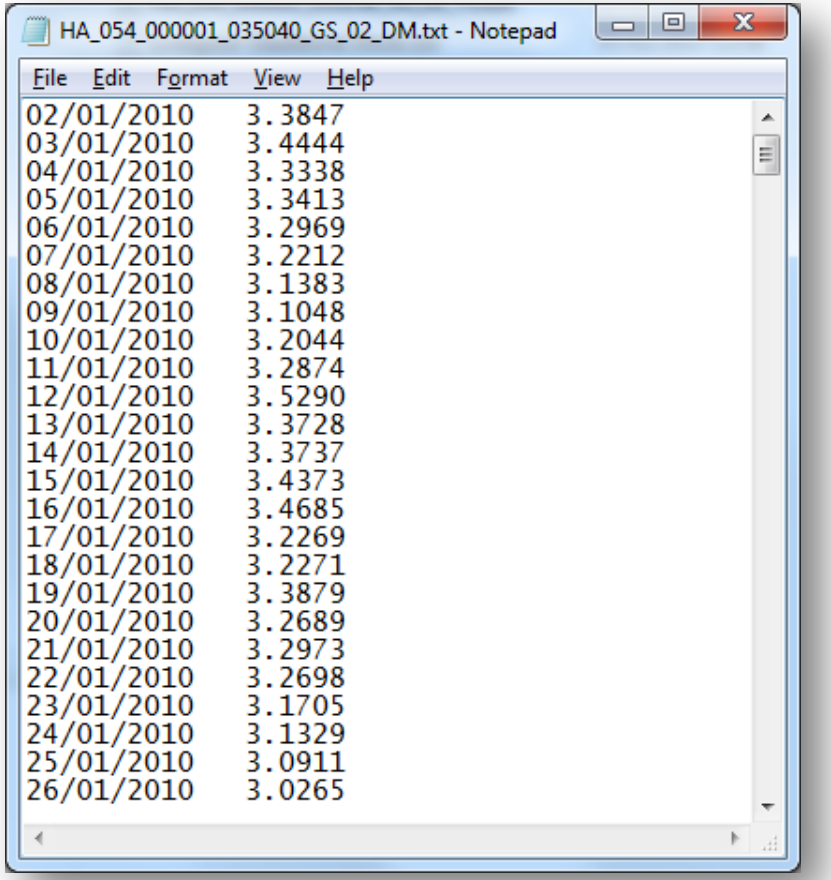
HA_053_000001_008759_GS_02_TS.t2k

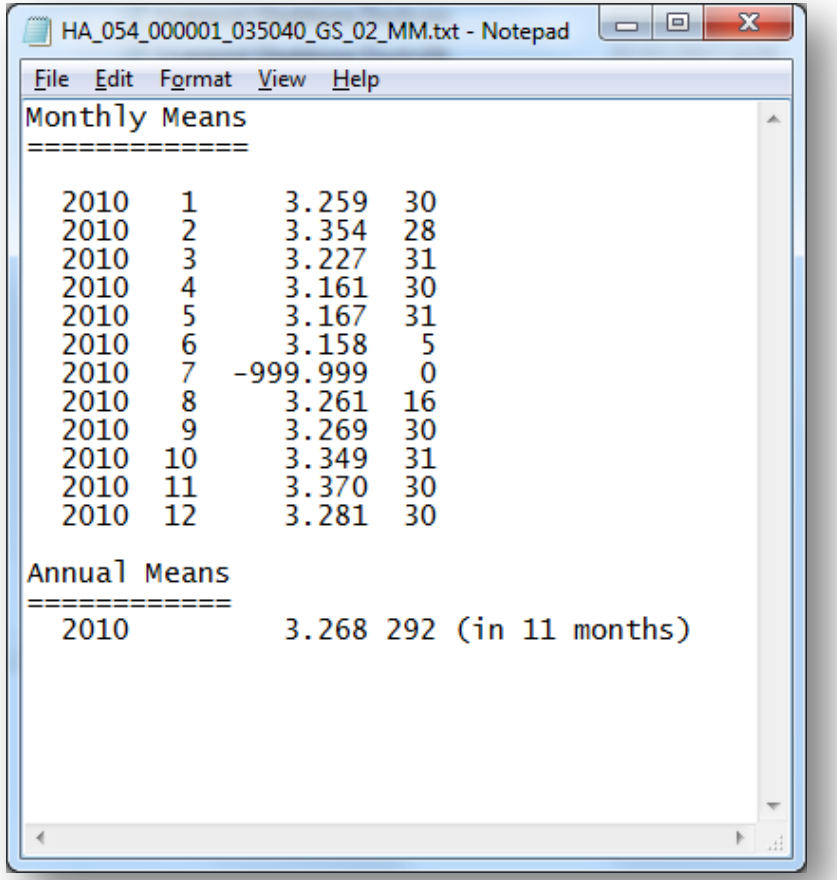
This is your final file to be used for validating the altimetry

DAILY, MONTHLY AND ANNUAL MEANS

National Oceanography Centre

- Generates two additional files (DM and MM)

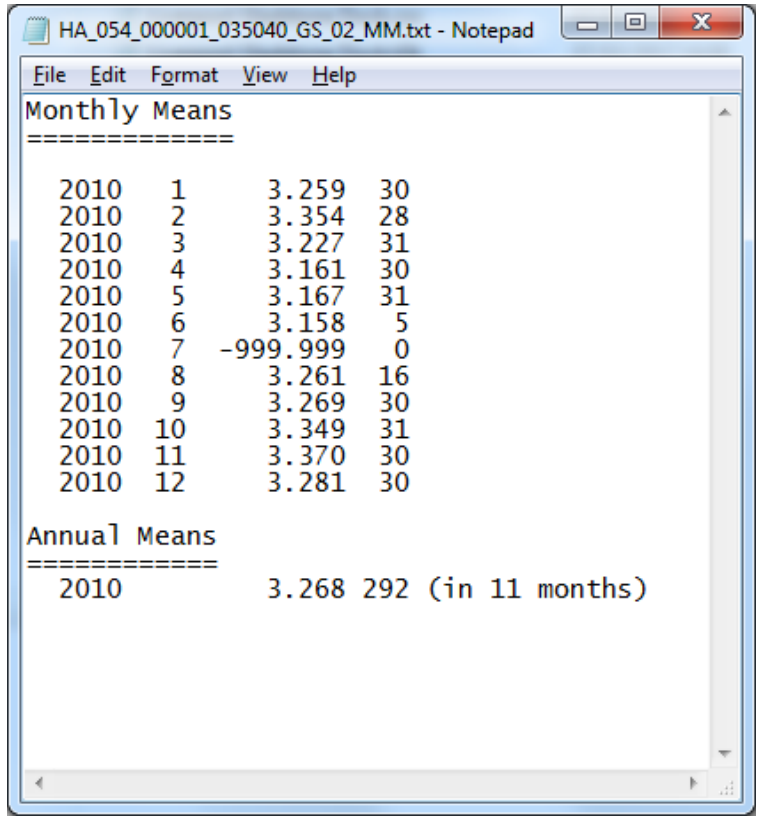




DAILY, MONTHLY AND ANNUAL MEANS

National Oceanography Centre

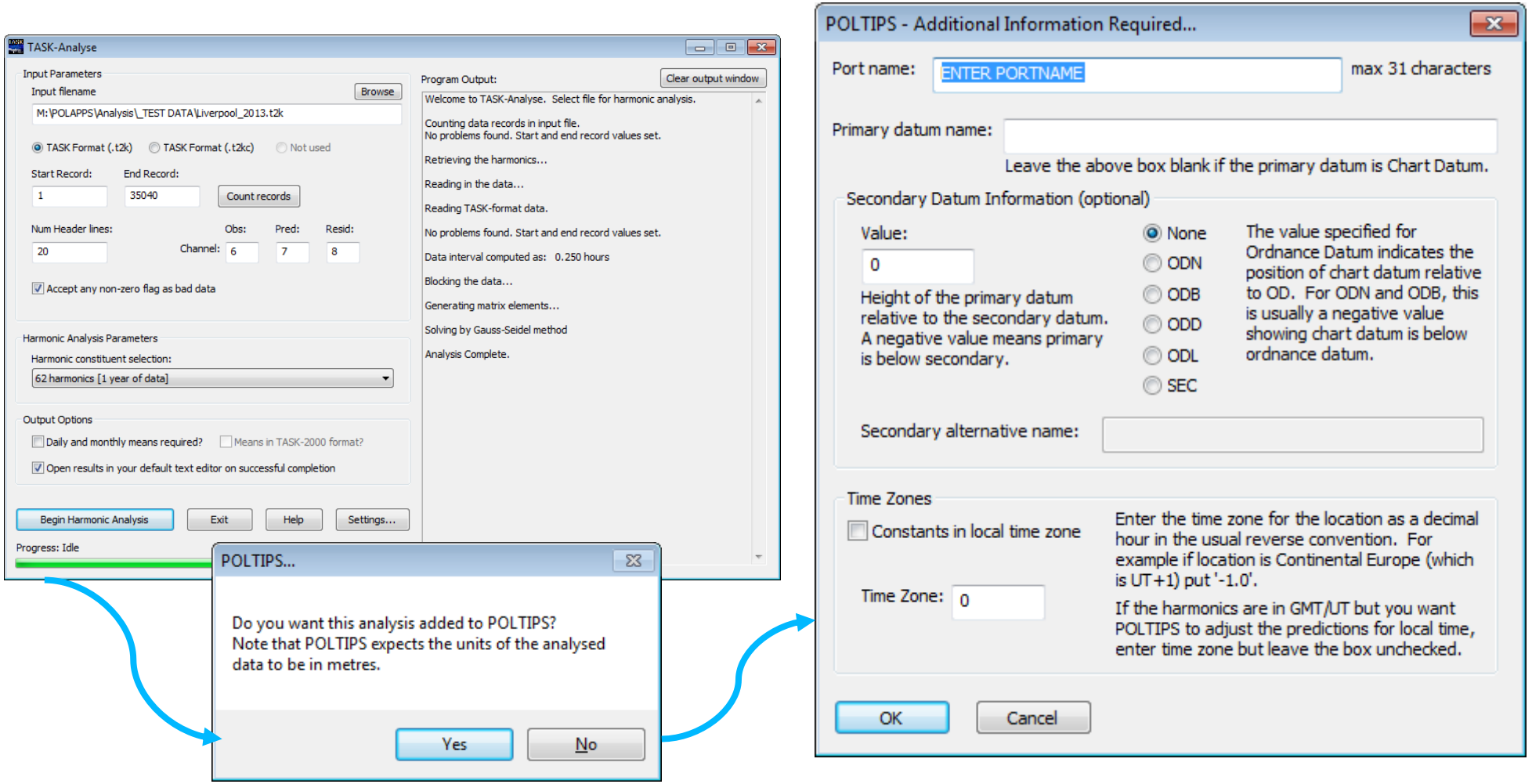
- Are produce used a special tide-reducing filter – the Doodson X0 filter
- Monthly and annual means from this filter can be submitted to the Permanent Service for Mean Sea Level (PSMSL)



FROM TIDAL ANALYSIS TO PREDICTIONS

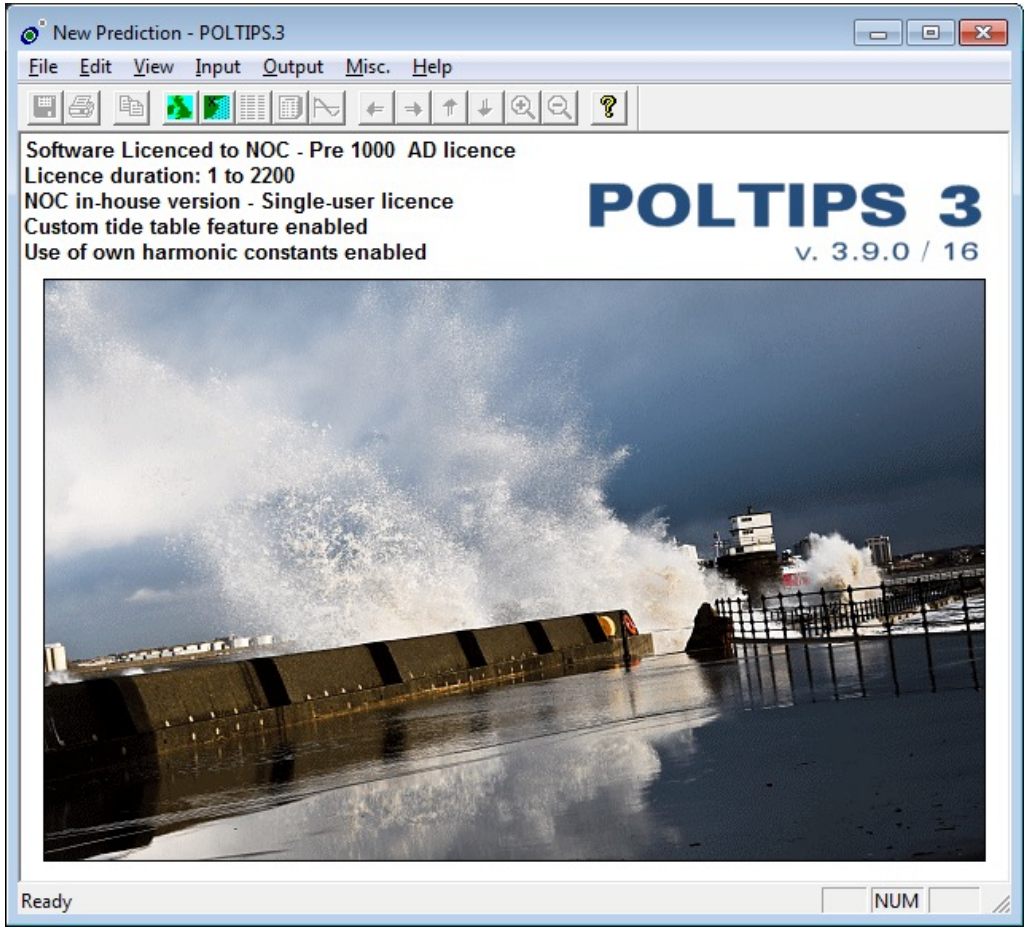
National Oceanography Centre

- On completion of an analysis, you have the option to update the POLTIPS-3 prediction software database



- Set the path to c:\Program Files (x86)\TASK\poltips3

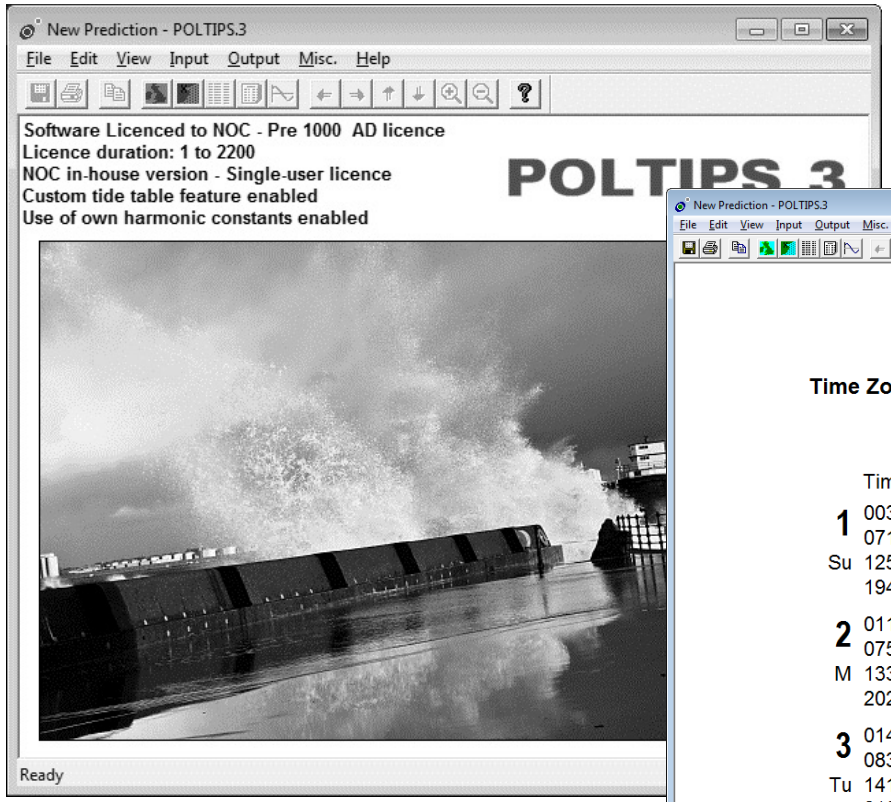
TIDAL PREDICTION



- If you perform an analysis to produce tidal predictions, remember to analyse the seasonal constituents (Sa and Ssa) too!

TIDE TABLES …

National Oceanography Centre



New Prediction - POLTIPS.3

File Edit View Input Output Misc. Help

LIVERPOOL (GLADSTONE DOCK)

Time Zone: UT(GMT) only **Lat 53°27' N Long 3°01' W** **Year : 2017**

January

	Time	m		Time	m
1	0034	8.90	**16**	0124	9.26
	0717	1.76		0810	1.49
Su	1252	9.21	M	1342	9.41
	1944	1.69		2046	1.32
2	0111	8.83	**17**	0203	8.92
	0754	1.89		0848	1.89
M	1330	9.11	Tu	1421	9.05
	2023	1.80		2124	1.79
3	0149	8.70	**18**	0244	8.51
	0833	2.09		0924	2.35
Tu	1410	8.96	W	1503	8.61
	2103	1.97		2203	2.30
4	0233	8.51	**19**	0327	8.09
	0915	2.33		1003	2.82
W	1455	8.76	Th	1548	8.14
	2147	2.17	☾	2245	2.77
5	0322	8.28	**20**	0418	7.68
	1003	2.58		1050	3.24
Th	1548	8.54	F	1644	7.69
☽	2239	2.35		2339	3.15
6	0421	8.06	**21**	0521	7.36
	1103	2.78		1155	3.53

February

	Time	m		Time	m
1	0133	9.10	**16**	0208	8.72
	0821	1.51		0847	2.00
W	1353	9.37	Th	1425	8.73
	2047	1.42		2117	2.10
2	0214	8.91	**17**	0245	8.33
	0859	1.76		0917	2.44
Th	1436	9.15	F	1503	8.26
	2127	1.70		2148	2.59
3	0300	8.63	**18**	0327	7.88
	0942	2.08		0954	2.91
F	1524	8.84	Sa	1549	7.74
	2212	2.04	☾	2228	3.07
4	0352	8.27	**19**	0419	7.42
	1034	2.43		1045	3.35
Sa	1621	8.45	Su	1648	7.24
☽	2309	2.39		2330	3.46
5	0459	7.95	**20**	0528	7.09
	1142	2.71		1201	3.63
Su	1734	8.13	M	1808	6.97
6	0024	2.63	**21**	0056	3.57
	0620	7.82		0651	7.09

March

	Time	m		Time	m
1	0036	9.51	**16**	0103	9.11
	0728	0.89		0747	1.45
W	1254	9.81	Th	1321	9.08
	1953	0.79		2011	1.55
2	0115	9.45	**17**	0135	8.86
	0806	1.01		0815	1.77
Th	1334	9.68	F	1352	8.74
	2030	1.01		2036	1.95
3	0155	9.23	**18**	0209	8.52
	0843	1.30		0843	2.15
F	1417	9.40	Sa	1426	8.32
	2107	1.39		2105	2.40
4	0239	8.87	**19**	0245	8.10
	0924	1.70		0918	2.59
Sa	1504	8.96	Su	1505	7.82
	2150	1.88		2141	2.89
5	0330	8.41	**20**	0330	7.63
	1015	2.18		1002	3.06
Su	1602	8.41	M	1555	7.30
☽	2245	2.41	☾	2231	3.37
6	0436	7.94	**21**	0430	7.19
	1124	2.61		1105	3.44

April

	Time	m		Time	m
1	0136	9.45	**16**	0139	8.64
	0830	1.01		0818	2.00
Sa	1401	9.47	Su	1357	8.32
	2050	1.28		2034	2.29
2	0222	9.04	**17**	0214	8.29
	0913	1.47		0852	2.37
Su	1451	8.95	M	1433	7.91
	2133	1.86		2109	2.74
3	0315	8.52	**18**	0254	7.88
	1006	2.00		0934	2.78
M	1551	8.34	Tu	1518	7.47
☽	2230	2.47		2155	3.18
4	0422	8.01	**19**	0347	7.48
	1117	2.46		1029	3.13
Tu	1706	7.84	W	1621	7.09
	2348	2.90	☾	2300	3.52
5	0545	7.73	**20**	0500	7.22
	1245	2.59		1145	3.27
W	1833	7.69	Th	1745	6.98
6	0119	2.91	**21**	0030	3.51
	0709	7.83		0621	7.30

Ready NUM

TIDE TABLES …

National Oceanography Centre

New Prediction - POLTIPS.3

File Edit View Input Output Misc. Help

Software Licenced to NOC -
Licence duration: 1 to 2200
NOC in-house version - Singl
Custom tide table feature en
Use of own harmonic constar

Ready

New Prediction - POLTIPS.3

File Edit View Input Output Misc. Help

ENGLAND, WEST COAST - LIVERPOOL (GLADSTONE DOCK)

TIME ZONE: UT(GMT) Lat 53°27' N Long 3°01' W UNITS: METRES

JANUARY 2017

			0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
1	Su		8.74	8.81	7.92	6.43	4.91	3.56	2.47	1.80	2.06	3.53	5.75	7.68	8.85	9.20	8.55	7.10	5.46	4.00	2.81	1.94	1.73	2.66	4.66	6.76
2	M		8.19	8.82	8.50	7.32	5.80	4.37	3.16	2.25	1.90	2.56	4.34	6.52	8.14	9.00	8.98	8.01	6.45	4.89	3.56	2.52	1.87	2.01	3.30	5.39
3	Tu		7.25	8.39	8.68	8.06	6.73	5.28	3.98	2.92	2.22	2.19	3.17	5.07	7.04	8.37	8.94	8.63	7.45	5.90	4.46	3.26	2.38	1.97	2.42	3.90
4	W		5.90	7.50	8.38	8.41	7.60	6.26	4.92	3.75	2.85	2.36	2.58	3.72	5.57	7.29	8.40	8.76	8.25	7.00	5.52	4.19	3.12	2.38	2.18	2.82
5	Th	☽	4.33	6.15	7.54	8.22	8.12	7.26	6.00	4.77	3.71	2.92	2.58	2.92	4.07	5.76	7.31	8.29	8.52	7.96	6.74	5.36	4.12	3.13	2.49	2.40
6	F		3.06	4.48	6.13	7.40	8.02	7.91	7.12	5.97	4.81	3.82	3.08	2.78	3.08	4.11	5.67	7.14	8.10	8.35	7.84	6.73	5.42	4.23	3.26	2.62
7	Sa		2.51	3.07	4.35	5.92	7.19	7.87	7.88	7.23	6.16	5.02	4.02	3.23	2.84	3.00	3.88	5.36	6.88	7.92	8.29	7.94	6.93	5.65	4.44	3.41
8	Su		2.70	2.45	2.86	4.04	5.64	7.03	7.86	8.05	7.53	6.49	5.30	4.20	3.29	2.73	2.70	3.46	4.96	6.62	7.84	8.40	8.21	7.27	5.95	4.65
9	M		3.51	2.65	2.24	2.50	3.68	5.42	7.01	8.03	8.39	7.94	6.83	5.52	4.27	3.19	2.47	2.27	2.97	4.59	6.49	7.91	8.65	8.56	7.61	6.19
10	Tu		4.76	3.47	2.48	1.93	2.12	3.39	5.39	7.21	8.37	8.81	8.32	7.08	5.60	4.19	2.97	2.10	1.79	2.51	4.37	6.56	8.14	8.99	8.91	7.84
11	W		6.27	4.71	3.30	2.22	1.58	1.81	3.31	5.62	7.59	8.81	9.22	8.59	7.13	5.50	3.96	2.66	1.70	1.34	2.21	4.41	6.82	8.48	9.33	9.13
12	Th	○	7.87	6.16	4.50	3.03	1.91	1.27	1.66	3.51	6.09	8.07	9.25	9.53	8.65	6.99	5.25	3.67	2.33	1.31	1.00	2.17	4.73	7.21	8.83	9.57
13	F		9.16	7.68	5.88	4.18	2.72	1.61	1.08	1.76	4.00	6.68	8.55	9.59	9.63	8.48	6.67	4.92	3.35	2.02	1.00	0.89	2.46	5.25	7.64	9.11
14	Sa		9.63	8.94	7.28	5.47	3.82	2.43	1.40	1.08	2.17	4.71	7.28	8.94	9.75	9.49	8.08	6.23	4.54	3.06	1.75	0.85	1.08	3.07	5.87	8.02
15	Su		9.24	9.46	8.48	6.74	5.00	3.46	2.20	1.34	1.36	2.87	5.50	7.78	9.16	9.68	9.09	7.51	5.73	4.17	2.79	1.60	0.95	1.63	3.89	6.47
16	M		8.28	9.18	9.05	7.84	6.13	4.52	3.16	2.08	1.50	1.93	3.75	6.22	8.12	9.19	9.36	8.48	6.86	5.22	3.82	2.60	1.62	1.35	2.44	4.73
17	Tu		6.95	8.38	8.91	8.46	7.13	5.54	4.12	2.96	2.15	1.91	2.71	4.62	6.75	8.26	8.99	8.85	7.78	6.23	4.77	3.55	2.54	1.87	1.99	3.33
18	W		5.42	7.22	8.28	8.48	7.80	6.49	5.08	3.86	2.94	2.41	2.50	3.52	5.29	7.02	8.18	8.61	8.23	7.11	5.72	4.46	3.43	2.66	2.30	2.72
19	Th	☾	4.08	5.84	7.26	8.01	7.97	7.21	6.02	4.81	3.80	3.10	2.82	3.12	4.16	5.66	7.03	7.91	8.13	7.63	6.60	5.42	4.34	3.48	2.93	2.79
20	F		3.33	4.55	5.98	7.10	7.64	7.52	6.80	5.80	4.78	3.93	3.39	3.25	3.59	4.50	5.72	6.82	7.52	7.66	7.21	6.34	5.35	4.41	3.68	3.24
21	Sa		3.18	3.68	4.70	5.88	6.84	7.33	7.24	6.66	5.83	4.93	4.17	3.69	3.53	3.79	4.54	5.55	6.50	7.17	7.36	7.03	6.34	5.47	4.59	3.89
22	Su		3.45	3.33	3.73	4.62	5.68	6.63	7.19	7.21	6.77	6.03	5.16	4.37	3.83	3.57	3.71	4.34	5.27	6.24	7.00	7.31	7.12	6.52	5.66	4.75
23	M		3.99	3.43	3.22	3.57	4.44	5.57	6.64	7.31	7.44	7.05	6.26	5.30	4.42	3.73	3.34	3.42	4.05	5.06	6.19	7.09	7.52	7.38	6.73	5.77
24	Tu		4.75	3.86	3.18	2.93	3.35	4.35	5.68	6.91	7.67	7.81	7.32	6.37	5.25	4.22	3.40	2.94	3.07	3.84	5.08	6.42	7.43	7.87	7.64	6.82
25	W		5.68	4.53	3.50	2.76	2.59	3.21	4.51	6.10	7.42	8.16	8.16	7.43	6.23	4.96	3.82	2.92	2.49	2.78	3.86	5.43	6.91	7.92	8.24	7.76
26	Th		6.66	5.36	4.10	3.00	2.30	2.34	3.31	5.00	6.76	8.05	8.63	8.34	7.27	5.85	4.48	3.29	2.39	2.09	2.70	4.21	6.06	7.56	8.43	8.46
27	F		7.61	6.26	4.84	3.53	2.45	1.90	2.28	3.73	5.77	7.54	8.66	8.95	8.25	6.84	5.28	3.88	2.71	1.89	1.85	2.92	4.88	6.85	8.22	8.81
28	Sa	●	8.44	7.21	5.67	4.21	2.93	1.94	1.65	2.51	4.47	6.68	8.30	9.15	9.03	7.90	6.24	4.64	3.27	2.16	1.50	1.84	3.46	5.76	7.64	8.76
29	Su		8.98	8.15	6.63	5.02	3.57	2.36	1.54	1.63	3.04	5.41	7.55	8.91	9.41	8.84	7.34	5.58	4.00	2.70	1.68	1.29	2.13	4.28	6.65	8.30
30	M		9.10	8.88	7.65	5.98	4.38	2.99	1.90	1.34	1.90	3.84	6.36	8.26	9.31	9.41	8.40	6.68	4.93	3.42	2.21	1.36	1.34	2.73	5.19	7.40
31	Tu		8.75	9.18	8.53	7.03	5.34	3.81	2.53	1.62	1.41	2.46	4.76	7.16	8.74	9.46	9.15	7.80	6.01	4.34	2.93	1.85	1.26	1.70	3.54	6.03

Datum of Predictions = Chart Datum : 4.93 metres below Ordnance Datum (Newlyn)
National Oceanography Centre, Joseph Proudman Building, 6 Brownlow Street, Liverpool, UK.

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Ready NUM

Year : 2017

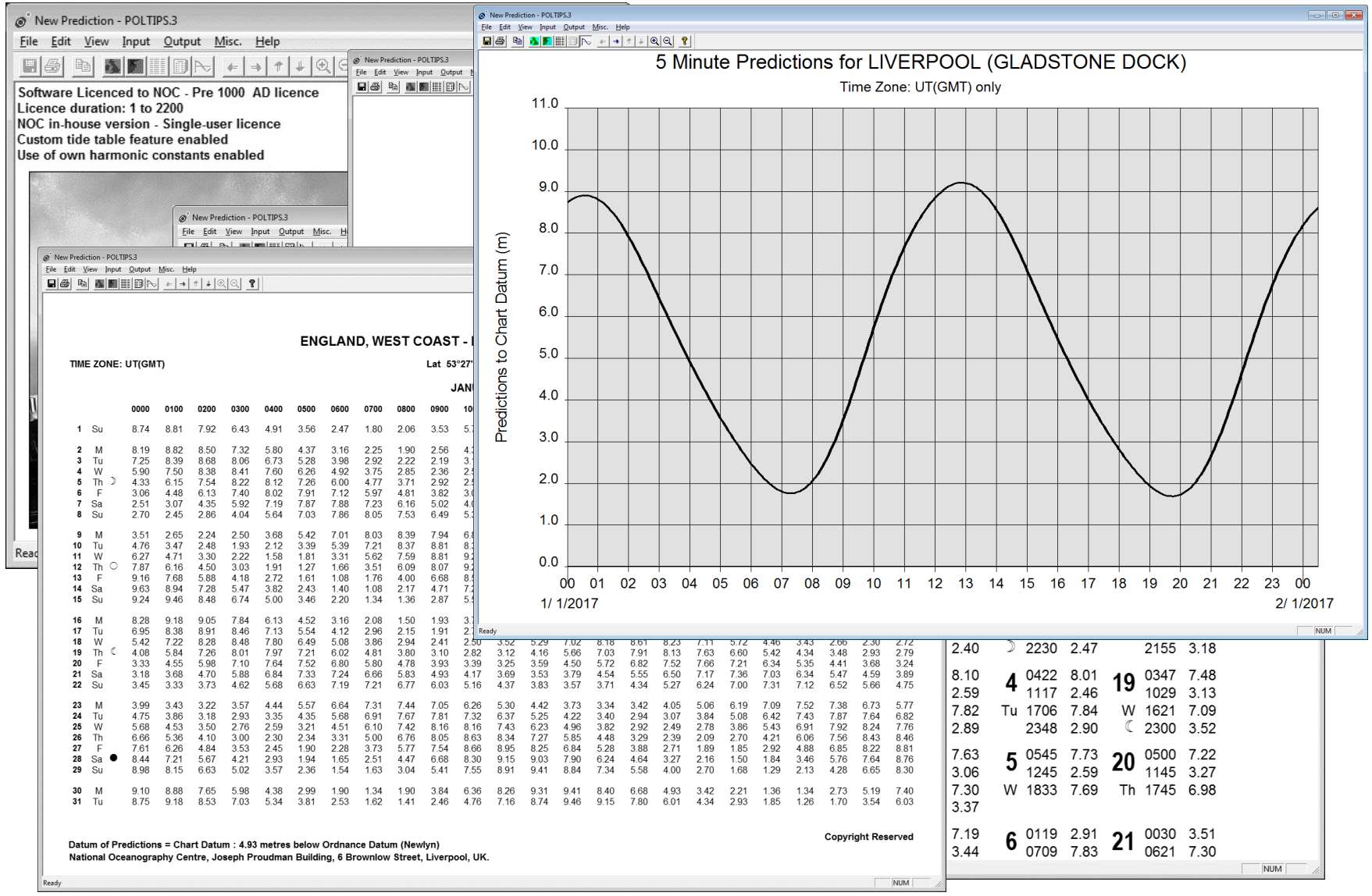
April

	Time	m		Time	m
	ime	m		Time	m
	136	9.45	16	0139	8.64
	830	1.01		0818	2.00
	401	9.47	Su	1357	8.32
	050	1.28		2034	2.29
	222	9.04	17	0214	8.29
	913	1.47		0852	2.37
	451	8.95	M	1433	7.91
	133	1.86		2109	2.74
	315	8.52	18	0254	7.88
	006	2.00		0934	2.78
	551	8.34	Tu	1518	7.47
	230	2.47		2155	3.18
	422	8.01	19	0347	7.48
	117	2.46		1029	3.13
	706	7.84	W	1621	7.09
	348	2.90	☾	2300	3.52

5	0322	8.28	**20**	0418	7.68	**5**	0459	7.95	**20**	0528	7.09	**5**	0330	8.41	**20**	0330	7.63	**5**	0545	7.73	**20**	0500	7.22
	1003	2.58		1050	3.24		1142	2.71		1201	3.63		1015	2.18		1002	3.06		1245	2.59		1145	3.27
Th	1548	8.54	F	1644	7.69	Su	1734	8.13	M	1808	6.97	Su	1602	8.41	M	1555	7.30	W	1833	7.69	Th	1745	6.98
☽	2239	2.35		2339	3.15							☽	2245	2.41	☾	2231	3.37						
6	0421	8.06	**21**	0521	7.36	**6**	0024	2.63	**21**	0056	3.57	**6**	0436	7.94	**21**	0430	7.19	**6**	0119	2.91	**21**	0030	3.51
	1103	2.78		1155	3.53		0620	7.82		0651	7.09		1124	2.61		1105	3.44		0709	7.83		0621	7.30

Ready NUM

TIDE TABLES …


New Prediction - POLTIPS.3
File Edit View Input Output Misc. Help
Software Licenced to NOC - Pre 1000 AD licence
Licence duration: 1 to 2200
NOC in-house version - Single-user licence
Custom tide table feature enabled
Use of own harmonic constants enabled
5 Minute Predictions for LIVERPOOL (GLADSTONE DOCK)
Time Zone: UT(GMT) only
Predictions to Chart Datum (m)
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00
1/ 1/2017
2/ 1/2017
ENGLAND, WEST COAST -
TIME ZONE: UT(GMT)
Lat 53°27'
JAN
0000 0100 0200 0300 0400 0500 0600 0700 0800 0900
1 Su 8.74 8.81 7.92 6.43 4.91 3.56 2.47 1.80 2.06 3.53
2 M 8.19 8.82 8.50 7.32 5.80 4.37 3.16 2.25 1.90 2.56
3 Tu 7.25 8.39 8.68 8.06 6.73 5.28 3.98 2.92 2.22 2.19
4 W 5.90 7.50 8.38 8.41 7.60 6.26 4.92 3.75 2.85 2.36
5 Th ☽ 4.33 6.15 7.54 8.22 8.12 7.26 6.00 4.77 3.71 2.92
6 F 3.06 4.48 6.13 7.40 8.02 7.91 7.12 5.97 4.81 3.82
7 Sa 2.51 3.07 4.35 5.92 7.19 7.87 7.88 7.23 6.16 5.02
8 Su 2.70 2.45 2.86 4.04 5.64 7.03 7.86 8.05 7.53 6.49
9 M 3.51 2.65 2.24 2.50 3.68 5.42 7.01 8.03 8.39 7.94
10 Tu 4.76 3.47 2.48 1.93 2.12 3.39 5.39 7.21 8.37 8.81
11 W 6.27 4.71 3.30 2.22 1.58 1.81 3.31 5.62 7.59 8.81
12 Th ○ 7.87 6.16 4.50 3.03 1.91 1.27 1.66 3.51 6.09 8.07
13 F 9.16 7.68 5.88 4.18 2.72 1.61 1.08 1.76 4.00 6.68
14 Sa 9.63 8.94 7.28 5.47 3.82 2.43 1.40 1.08 2.17 4.71
15 Su 9.24 9.46 8.48 6.74 5.00 3.46 2.20 1.34 1.36 2.87
16 M 8.28 9.18 9.05 7.84 6.13 4.52 3.16 2.08 1.50 1.93
17 Tu 6.95 8.38 8.91 8.46 7.13 5.54 4.12 2.96 2.15 1.91
18 W 5.42 7.22 8.28 8.48 7.80 6.49 5.08 3.86 2.94 2.41
19 Th ☾ 4.08 5.84 7.26 8.01 7.97 7.21 6.02 4.81 3.80 3.10
20 F 3.33 4.55 5.98 7.10 7.64 7.52 6.80 5.80 4.78 3.93
21 Sa 3.18 3.68 4.70 5.88 6.84 7.33 7.24 6.66 5.83 4.93
22 Su 3.45 3.33 3.73 4.62 5.68 6.63 7.19 7.21 6.77 6.03
23 M 3.99 3.43 3.22 3.57 4.44 5.57 6.64 7.31 7.44 7.05
24 Tu 4.75 3.86 3.18 2.93 3.35 4.35 5.68 6.91 7.67 7.81
25 W 5.68 4.53 3.50 2.76 2.59 3.21 4.51 6.10 7.42 8.16
26 Th 6.66 5.36 4.10 3.00 2.30 2.34 3.31 5.00 6.76 8.05
27 F 7.61 6.26 4.84 3.53 2.45 1.90 2.28 3.73 5.77 7.54
28 Sa ● 8.44 7.21 5.67 4.21 2.93 1.94 1.65 2.51 4.47 6.68
29 Su 8.98 8.15 6.63 5.02 3.57 2.36 1.54 1.63 3.04 5.41
30 M 9.10 8.88 7.65 5.98 4.38 2.99 1.90 1.34 1.90 3.84
31 Tu 8.75 9.18 8.53 7.03 5.34 3.81 2.53 1.62 1.41 2.46
Datum of Predictions = Chart Datum : 4.93 metres below Ordnance Datum (Newlyn)
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2.40 ☽ 2230 2.47 2155 3.18
8.10 4 0422 8.01 19 0347 7.48
2.59 1117 2.46 1029 3.13
7.82 Tu 1706 7.84 W 1621 7.09
2.89 2348 2.90 ☾ 2300 3.52
7.63 5 0545 7.73 20 0500 7.22
3.06 1245 2.59 1145 3.27
7.30 W 1833 7.69 Th 1745 6.98
3.37
7.19 6 0119 2.91 21 0030 3.51
3.44 0709 7.83 0621 7.30

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THANK YOU FOR LISTENING

Any questions?

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