1st Tidal and Water Level Working Group Meeting

DHN, Niteroi, Brazil 31/03/09 – 02/04/09

Exchange of Harmonic Constants

Chris Jones

United Kingdom Hydrographic Office

THE UNITED KINGDOM
HYDROGRAPHIC OFFICE

Background

- Harmonic Constant (HC) data is passed freely between Foreign Government Hydrographic Offices (FGHO's) on request…..BUT…..it is frequently in a variety of differing digital formats and layouts.
- Some examples follow:-

Brazil

```
|35341.0300000607198430091984301l4TERMINAL ALUMAR                    02407S044218W+030
0MSF     001.0158958                    1    -1  00011.7200030.38
1O1      013.9430356                        1   00010.9000216.96
1P1      014.9589314                        1   00004.0600252.36
1K1      015.0410686                        1   00012.2600255.23
12N2     027.8953549                        1   00005.5100180.37
1MU2     027.9682084                        1   00010.8500271.59
1N2      028.4397295                        1   00041.7700193.75
1NU2     028.5125831                        1   00007.9400195.54
1M2      028.9841042                        1   00218.7200207.12
1LAMBD2  029.4556253                        1   00001.5300225.07
1L2      029.5284789                        1   00016.4500176.92
1T2      029.9589333                        1   00003.5300244.26
1S2      030.0000000                        1   00059.7600245.81
1K2      030.0821373                        1   00016.2500248.94
0MO3     042.9271398   1                1       00002.3600314.60
1M3      043.4761563                        1   00002.3500307.75
0MK3     044.0251728          1           1       00004.2600016.26
0MN4     057.4238337              1       1       00003.2800225.12
0M4      057.9682084                      2       00009.1900239.81
0MS4     058.9841042                      1     1 00006.1400277.20
0SL4     059.5284789                        1   1 00001.0100234.37
0MNO5    071.3668693   1            1       1   00000.5500317.31
02MO5    071.9112440   1                    2   00000.8800358.08
0MSK5    074.0251728          1           1     1 00000.6200216.63
03MNS6   085.3920422              1       3    -1 00000.8400007.40
02MN6    086.4079380              1       2       00002.5900290.85
0M6      086.9523127                      3       00005.0200311.64
0MSN6    087.4238337              1       1     1 00001.1900350.90
02MS6    087.9682084                      2     1 00004.3900341.33
0MKL6    088.5967204                      1 1     100000.8500241.09
02SM6    088.9841042                      1     2 00001.2400053.40
02SMK7   104.0251728          1           1     2 00000.7500088.61
0M8      115.9364169                      4       00000.5500320.94
03MS8    116.9523127                      3     1 00000.7300000.77
02M2S8   117.9682084                      2     2 00000.5400041.01
```

Spain

```
      15   arrecife             GMT 2857 1334
 1 Z0      .00000000    15  197/1297  1.5540    0.00
 2 SSA     .00022816    15  197/1297  0.0168   85.28
 3 MSM     .00130978    15  197/1297  0.0116  309.35
 4 MM      .00151215    15  197/1297  0.0020  328.92
 5 MSF     .00282193    15  197/1297  0.0109  122.04
 6 MF      .00305009    15  197/1297  0.0129    5.27
 7 ALP1    .03439657    15  197/1297  0.0016  188.98
 8 2Q1     .03570635    15  197/1297  0.0046  200.94
 9 SIG1    .03590872    15  197/1297  0.0034  219.80
10 Q1      .03721850    15  197/1297  0.0184  244.70
11 RHO1    .03742087    15  197/1297  0.0023  250.49
12 O1      .03873065    15  197/1297  0.0509  296.64
13 TAU1    .03895881    15  197/1297  0.0015   33.86
14 BET1    .04004044    15  197/1297  0.0010   61.34
15 NO1     .04026860    15  197/1297  0.0068   33.51
16 CHI1    .04047097    15  197/1297  0.0013  112.74
17 P1      .04155259    15  197/1297  0.0211   27.00
18 K1      .04178075    15  197/1297  0.0696   44.23
19 PHI1    .04200891    15  197/1297  0.0009   60.76
20 THE1    .04309053    15  197/1297  0.0012   96.23
21 J1      .04329290    15  197/1297  0.0012   78.84
22 SO1     .04460268    15  197/1297  0.0012  117.27
23 OO1     .04483084    15  197/1297  0.0027  125.05
24 UPS1    .04634299    15  197/1297  0.0004   73.13
25 OQ2     .07597495    15  197/1297  0.0054  347.65
26 EPS2    .07617731    15  197/1297  0.0076  335.88
27 2N2     .07748710    15  197/1297  0.0262    8.79
28 MU2     .07768947    15  197/1297  0.0333  356.02
29 N2      .07899925    15  197/1297  0.1739   21.11
30 NU2     .07920162    15  197/1297  0.0324   25.54
31 M2      .08051140    15  197/1297  0.8337   36.00
32 MKS2    .08073956    15  197/1297  0.0127   68.62
```

Netherlands

Bath
(N 51 24 E 4 13)
Harmonic constituents computed from hourly levels 1997...2000
(SA and SM from hourly levels 1976...1994)
Mean level = 2.79 meter above chart datum
Resp. name, phase angle (g) in degree (time zone : MET = UT + 1 hour),
amplitude (H) in meter, speed in degrees per hour, and Extended Doodson Number

SA	219.20	.06550	.041069	056555
SM	45.80	.08250	1.015896	073555
Q1	169.87	.03812	13.398661	135655
O1	214.13	.11095	13.943036	145555
M1C	148.71	.00810	14.492052	155555
P1	18.74	.03790	14.958931	163555
S1	8.47	.01076	15.000000	164555
K1	32.92	.07017	15.041069	165555
3MKS2	305.83	.02433	26.870174	217555
3MS2	304.03	.04844	26.952312	219555
OQ2	354.34	.01561	27.341696	225655
MNS2	170.12	.04209	27.423834	227655
2ML2S2	339.94	.03023	27.496687	229455
NLK2	21.11	.05082	27.886070	235555
MU2	187.27	.20563	27.968208	237555
N2	68.82	.34417	28.439730	245655
NU2	54.72	.12188	28.512583	247455
MSK2	263.17	.02979	28.901966	253555
MPS2	152.04	.03604	28.943035	254555
M2	92.03	2.10941	28.984104	255555
MSP2	146.56	.00771	29.025173	256555
MKS2	260.15	.01820	29.066240	257555
LABDA2	104.14	.06988	29.455626	263655
2MN2	286.76	.18402	29.528479	265455
T2	138.40	.03415	29.958933	272556
S2	155.65	.54475	30.000000	273555
K2	156.43	.15648	30.082136	275555
MSN2	.10	.03611	30.544374	283455
2SM2	22.23	.04873	31.015896	291555
SKM2	34.47	.02409	31.098034	293555
NO3	185.98	.01874	42.382767	335655
2MK3	224.94	.04165	42.927139	345555
2MP3	242.64	.00679	43.009277	347555
SO3	311.44	.02151	43.943035	363555
MK3	30.67	.03419	44.025173	365555
SK3	91.24	.01331	45.041069	383555

Germany

506 Cuxhaven Steubenhoef 15 53 52N 008 43E

1	Z0	.00000000	506	1	1/12	1184.0000	.00	515.3334	.00
2	SSA	.00022816	506	1	1/12	1 4.6340	93.79	4.6340	252.59
3	MSM	.00130978	506	1	1/12	1 3.1439	311.62	3.1439	129.43
4	MM	.00151215	506	1	1/12	1 10.7527	243.08	10.7527	148.50
5	MSF	.00282193	506	1	1/12	1 .8476	89.67	.8476	172.91
6	MF	.00305009	506	1	1/12	1 5.7937	344.11	5.7937	226.15
7	ALP1	.03439657	506	1	1/12	1 .3806	140.38	.3859	70.02
8	2Q1	.03570635	506	1	1/12	1 .4287	162.65	.4518	270.38
9	SIG1	.03590872	506	1	1/12	1 .9406	34.37	.9471	227.67
10	Q1	.03721850	506	1	1/12	1 2.3069	210.85	2.3621	222.75
11	RHO1	.03742087	506	1	1/12	1 1.1721	220.42	1.1367	316.36
12	O1	.03873065	506	1	1/12	1 9.5686	264.02	9.5837	180.29
13	TAU1	.03895881	506	1	1/12	1 .6317	217.04	.6707	108.91
14	BET1	.04004043	506	1	1/12	1 1.0199	254.58	1.0219	166.76
15	NO1	.04026859	506	1	1/12	1 1.1642	274.65	1.1208	339.00
16	CHI1	.04047097	506	1	1/12	1 .4777	330.59	.4827	156.24
17	P1	.04155259	506	1	1/12	1 3.1869	55.59	3.1881	66.76
18	K1	.04178075	506	1	1/12	1 7.0270	56.86	7.0419	55.13
19	PHI1	.04200891	506	1	1/12	1 .8369	162.94	.8647	307.35
20	THE1	.04309053	506	1	1/12	1 .5503	239.48	.5328	59.31
21	J1	.04329290	506	1	1/12	1 .3004	212.75	.3245	116.85
22	SO1	.04460268	506	1	1/12	1 .3930	260.35	.3936	343.96
23	OO1	.04483084	506	1	1/12	1 .4093	130.14	.4031	28.56
24	UPS1	.04634299	506	1	1/12	1 .4783	255.08	.4870	64.27
25	OQ2	.07597494	506	1	1/12	1 1.7487	326.48	2.0141	177.79
26	EPS2	.07617731	506	1	1/12	1 3.1475	46.92	3.3648	340.13
27	2N2	.07748710	506	1	1/12	1 4.5215	354.13	5.0346	106.78
28	MU2	.07768947	506	1	1/12	1 13.5897	101.04	13.8726	297.51
29	N2	.07899925	506	1	1/12	1 22.0550	341.58	22.1392	354.79
30	NU2	.07920162	506	1	1/12	1 8.0515	325.00	8.1679	65.81
31	M2	.08051140	506	1	1/12	1136.7370	10.92	137.4238	289.74
32	MKS2	.08073957	506	1	1/12	1 1.8893	133.49	1.8652	228.88
33	LDA2	.08182118	506	1	1/12	1 5.4992	26.27	5.5305	303.38
34	L2	.08202355	506	1	1/12	1 11.5236	36.96	12.1924	27.60
35	S2	.08333334	506	1	1/12	1 34.6370	80.17	34.6344	80.04
36	K2	.08356149	506	1	1/12	1 10.5368	83.92	10.3515	260.37
37	MSN2	.08484548	506	1	1/12	1 2.6139	268.63	2.6369	174.11
38	ETA2	.08507364	506	1	1/12	1 .0862	351.21	.0974	75.50
39	MO3	.11924210	506	1	1/12	1 1.4782	189.39	1.4879	24.48
40	M3	.12076710	506	1	1/12	1 .4448	250.61	.4481	308.95
41	SO3	.12206400	506	1	1/12	1 .8740	287.35	.8753	203.49
42	MK3	.12229210	506	1	1/12	1 .9571	316.81	.9640	233.89

France

Calais

temps en usage: UT +1.0 h
L=50 58N G= 1 51E

longues periodes

onde	nb argument	vitesse (°/h)	amplitude (cm)	situation (°)
NIV MOY	055555	0.00000000	406.58	0.03
SA	056555	0.04106864	8.41	221.82
SSA	057555	0.08213728	2.33	94.68
MSM	063655	0.47152109	0.58	63.24
MM	065455	0.54437469	1.16	218.11
MSF	073555	1.01589578	1.76	186.92
MF	075555	1.09803306	0.91	351.46

diurnes

onde	nb argument	vitesse (°/h)	amplitude (cm)	situation (°)
2Q1	125755	12.85428619	0.68	111.68
SIGMA1	127555	12.92713980	0.22	253.43
Q1	135655	13.39866088	1.67	114.21
RHO1	137455	13.47151449	0.55	136.04
O1	145555	13.94303558	5.52	155.01
MS1	146555	13.98410422	1.42	61.95

Canada

```
WaterLevConstit 00065 SAINT JOHN                                          0/00/00||
!Computed    45 16.00  N  66 04.00  W                          +04   0000:00   ||
        60 0365days 100.0%                                          0000:00 06||
Stephenson,FE                                                                 ||
Reference v2.2 002                                                          0||
                                  0   0                                       ||
01 Const Name [Ref Nam]      0       TW                                       ||
02 Nominal Period hours      1       3W                                       ||
03 Amplitude      metres     2       4W                                       ||
04 Phase Lag[g]      deg     1       2W                                       ||
05 Doodson Numbers           0       TW                                       ||
06 Security                  0       TW                                       ||
Tides & Currents, IOS     Shore                                               ||
00065const.wlev                                      f1__00065cyyddda.wlev    ||
**                                                                            ||
Constitutents from Crawford's analysis at IOS (Jan 2/97)                      ||
Z0 changed from 4.4100 to previous "Bluebook" value of 4.4200 m BdLB 9 Jan 97||
Checked against Crawford's results ok BdLB 9 Jan 1997                         ||
Doodson numbers as defined by Godin's The Analysis of Tides. pp 25-27         ||
                                                                              ||
                                                                              ||
                                                                              ||
                                                                              ||
                                                                              ||
```

Z0	0.000	4.4200	0.00	0	0	0	0	0	0	46
SA	8766.231	0.0240	108.00	0	0	1	0	0	-1	21
SSA	4382.906	0.0510	114.10	0	0	2	0	0	0	5e
MM	661.309	0.0100	205.70	0	1	0	-1	0	0	29
MSF	354.367	0.0080	211.50	0	2	-2	0	0	0	54
MF	327.859	0.0090	242.60	0	2	0	0	0	0	2e
SIG1	27.848	0.0030	124.90	1	-3	2	0	0	0	53
Q1	26.868	0.0190	102.80	1	-2	0	1	0	0	50
RHO1	26.723	0.0050	105.80	1	-2	2	-1	0	0	51

Singapore

Station : Tanah Merah

NO.	DEG/HR	AMPL	PHASELAG	SEQ
		1.6070		
1	.04107	.1452	278.21	1
2	.08214	.0260	137.28	2
3	.54437	.0036	331.88	3
4	1.01590	.0192	69.78	4
5	1.09803	.0185	12.23	5
6	12.85429	.0066	286.49	6
7	12.92714	.0081	259.68	7
8	13.39866	.0607	20.00	8
9	13.47151	.0129	20.49	9
10	13.94304	.2886	54.40	10
11	14.02517	.0082	298.20	11
12	14.49205	.0068	80.63	12
13	14.56955	.0038	120.88	13
14	14.91786	.0074	66.47	14
15	14.95893	.0888	100.84	15
16	15.00000	.0166	225.53	16
17	15.04107	.2818	108.62	17
18	15.08214	.0028	4.23	18
19	15.12321	.0033	12.62	19
20	15.51259	.0030	145.05	20
21	15.58544	.0115	119.87	21
22	16.05696	.0047	6.26	22
23	16.13910	.0093	233.43	23
24	27.34170	.0028	322.83	24
25	27.42383	.0027	93.46	25
26	27.89535	.0216	258.16	26
27	27.96821	.0082	149.51	27
28	28.43973	.1448	296.46	28
29	28.51258	.0305	299.49	29
30	28.90197	.0039	129.13	30
31	28.98410	.7592	321.46	31
32	29.06624	.0075	46.83	32
33	29.45563	.0154	343.64	33
34	29.52848	.0319	342.86	34
35	29.95893	.0160	357.07	35
36	30.00000	.2997	17.44	36
37	30.04107	.0018	8.09	37
38	30.08214	.0921	15.96	38
39	30.54437	.0093	230.62	39
40	30.62651	.0034	207.33	40
41	31.01590	.0163	253.80	41
42	42.92714	.0131	52.67	42

UK

PS1 Tides - Harmonic constants

un by jonescy at 10:59:40 on 17/05/2007

o: 0089 Name: DOVER STANDARD PORT

Time Zone: GMT Position: 51 07 N 001 19 E

Authority: HO 19 YRS 1979-2006 Units: METRES

Z0: +3.758

Shallow Water Corrections

	"H"	"g"
F4:f4	0.0464	278.7
F6:f6	0.0041	186.1

A0:

Key: S = Suspect
I = Inferred

onstituents

Name	"H"	"g"	Name	"H"	"g"	Name	"H"	"g"
Sa	0.065	211.8	2MS3	0.001	265.5	MSN6	0.014	141.7
Ssa	0.023	094.7	2MP3	0.005	141.0	4MN6	0.009	274.8
Mnum	0.005	263.4	M3	0.011	035.3	MNK6	0.001	101.4
Mm	0.007	184.7	MP3	0.003	352.4	2(MS)K6	0.002	303.2
Msf	0.015	220.1	MS3	0.003	341.6	2MT6	0.003	140.5
Mf	0.018	236.1	MK3	0.015	008.9	2MS6	0.060	150.0
Q1	0.023	121.0	2MQ3	0.003	102.2	2MK6	0.017	154.2
rho1	0.006	121.7	SP3	0.003	078.0	2SM6	0.012	217.1
O1	0.057	180.2	S3	0.001	191.3	MSK6	0.007	218.7
MS1	0.001	100.2	SK3	0.007	081.3	S6	0.002	017.7
MP1	0.003	216.7	3MK4	0.008	302.8	2MNO7	0.003	068.6
M1	0.003	192.5	3MS4	0.024	292.1	2NMK7	0.001	045.7
chi1	0.002	033.3	MSNK4	0.003	028.0	M7	0.002	141.1
pi1	0.003	054.3	MN4	0.092	197.2	2MSO7	0.003	167.2
P1	0.021	022.1	Mnu4	0.024	181.2	2(MN)8	0.006	318.2
S1	0.006	239.1	2MSK4	0.009	004.2	5MS8	0.003	095.1
K1	0.049	042.4	MA4	0.007	168.9	3MN8	0.016	343.8
psi1	0.002	315.8	M4	0.255	221.1	3Mnu8	0.005	328.2

THE UNITED KINGDOM
HYDROGRAPHIC OFFICE

Exchange of data is important between FGHO's

- Ensures that the most up-to-date information is used in tidal / navigational products
- The less manual intervention the better – reduces the likelihood of random human error
- In harmony with IHO TR's
- **A6.1 (Exchange of tidal information), para 1 (a) states:** ***It is resolved that published tidal information shall be freely exchanged*****.**
- **A6.2 (Advance supply of tidal predictions) para 3 states*: It is recommended that when tidal constituents or values of harmonic constants are changed from those used for tidal predictions for the previous year, the tidal constituents should also be supplied to the producer nation upon request together with the national tidal predictions.***

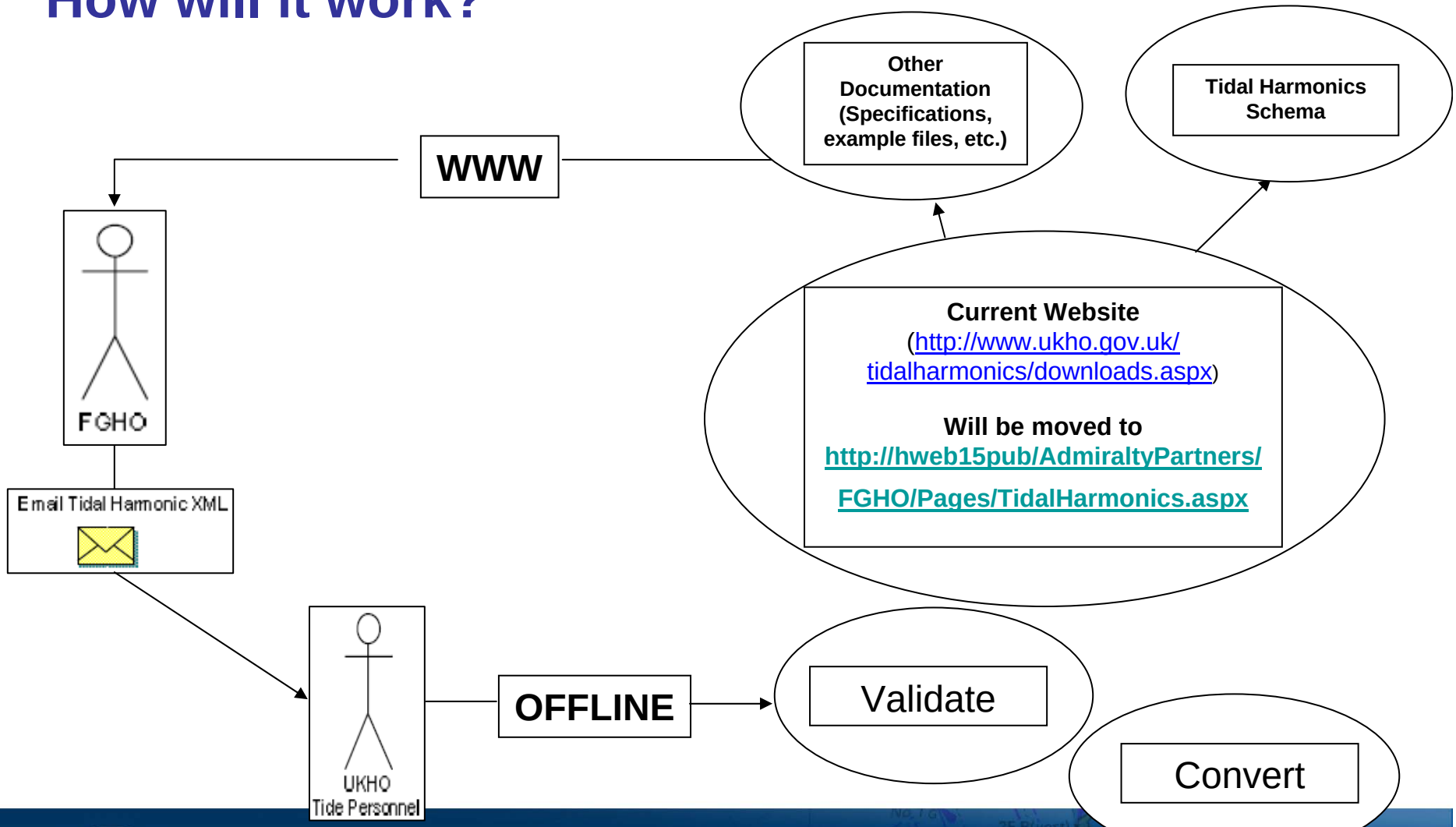
Proposal

- To develop a new way of exchanging HC's between FGHO's
- A convenient way of transferring data - like that of the International Exchange format for predictions (ASCII)
- Website to provide the necessary XML schema and other data to assist respective HO's with their development of a convenient XML format

The project

- IHO Tidal Committee (TC) tasked the IHO Transfer Standard Maintenance and Application Development Working Group (TSMAD) to develop a standard transfer mechanism for harmonic constants
- Draft Product Specification prepared
- Original Aim - to develop a web ***application*** that will output an Extensible Mark-up Language (XML) file for transfer between FGHO's.

How will it work?



Product Specification: Gives details of…..

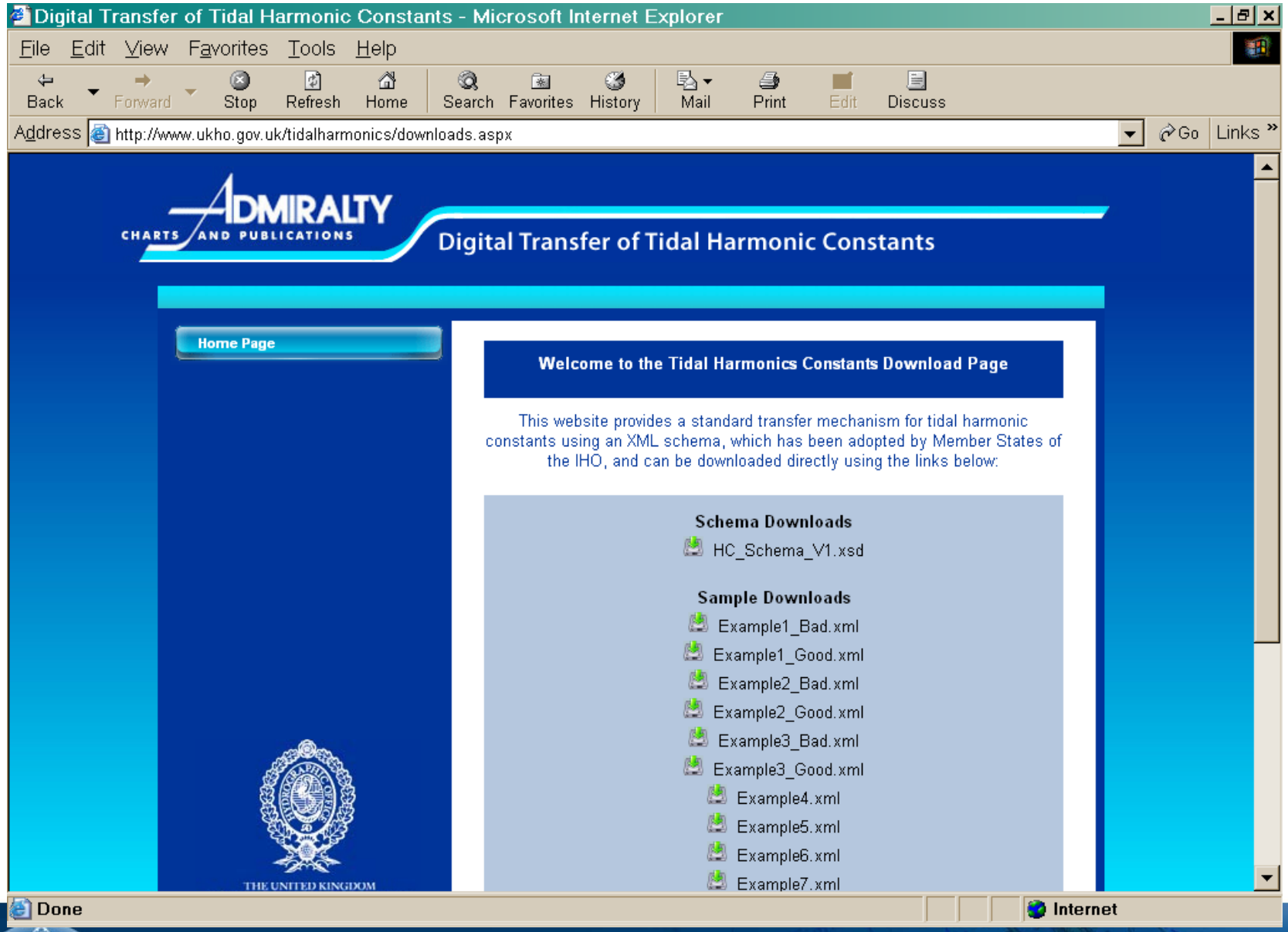
- Header Information and Data Record
- Precision of Phase Angle (g) and Amplitude (H) relative to observation period
- Extended Doodson Number (XDO)
- Computation of the Astronomical Argument and use of the XDO
- General information on the major tidal constituents
- Reproduces the Standard List of Tidal Harmonic Constituents (as published on the IHO website at http://www.iho-ohi.net/english/committees-wg/hssc/twlwg.html)
- Application and Computation of Nodal Corrections
- Derivation of Speeds and values of Nodal Corrections from Constituent Names

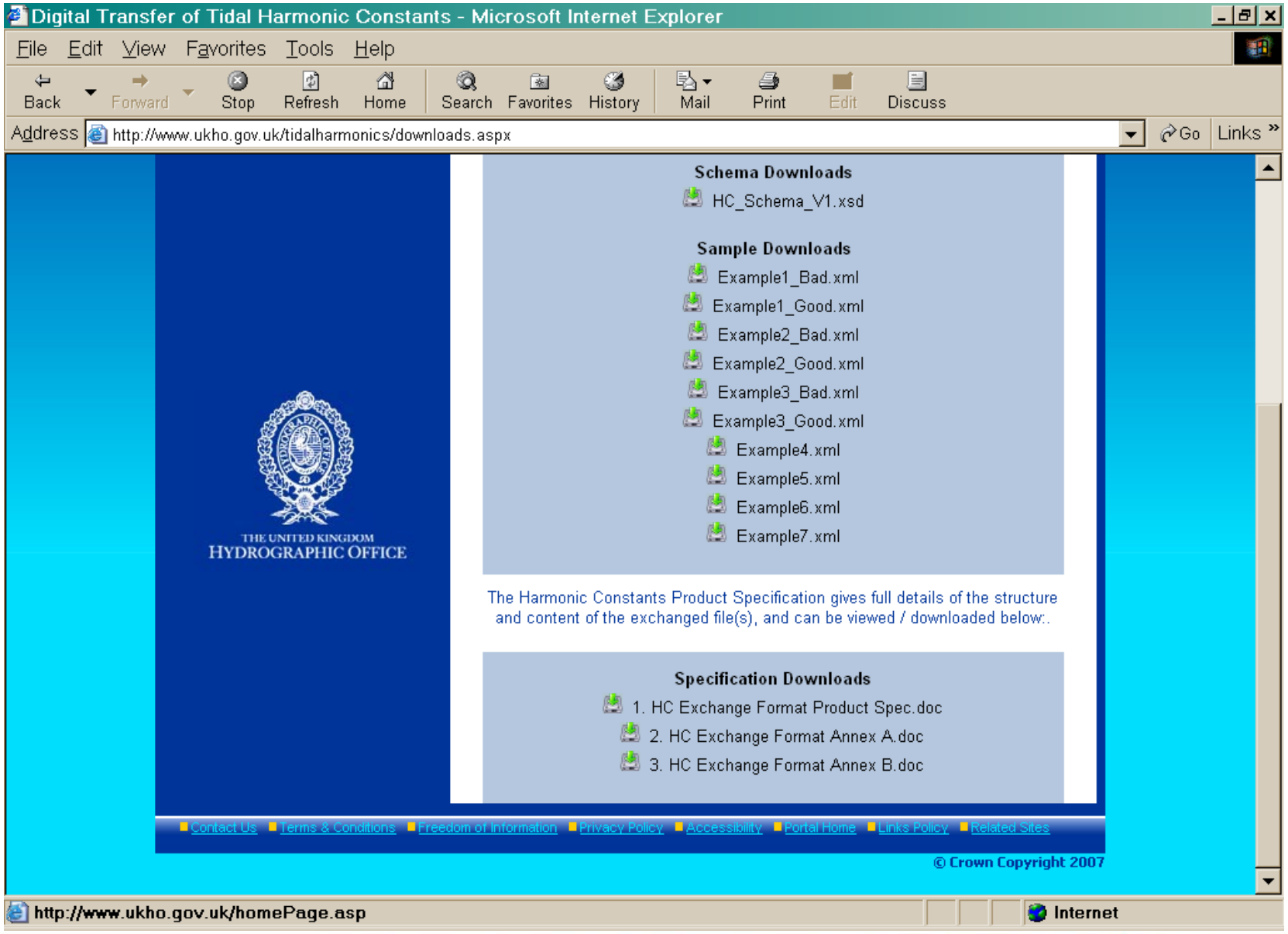
Current Web Link

http://www.ukho.gov.uk/
tidalharmonics/downloads.aspx

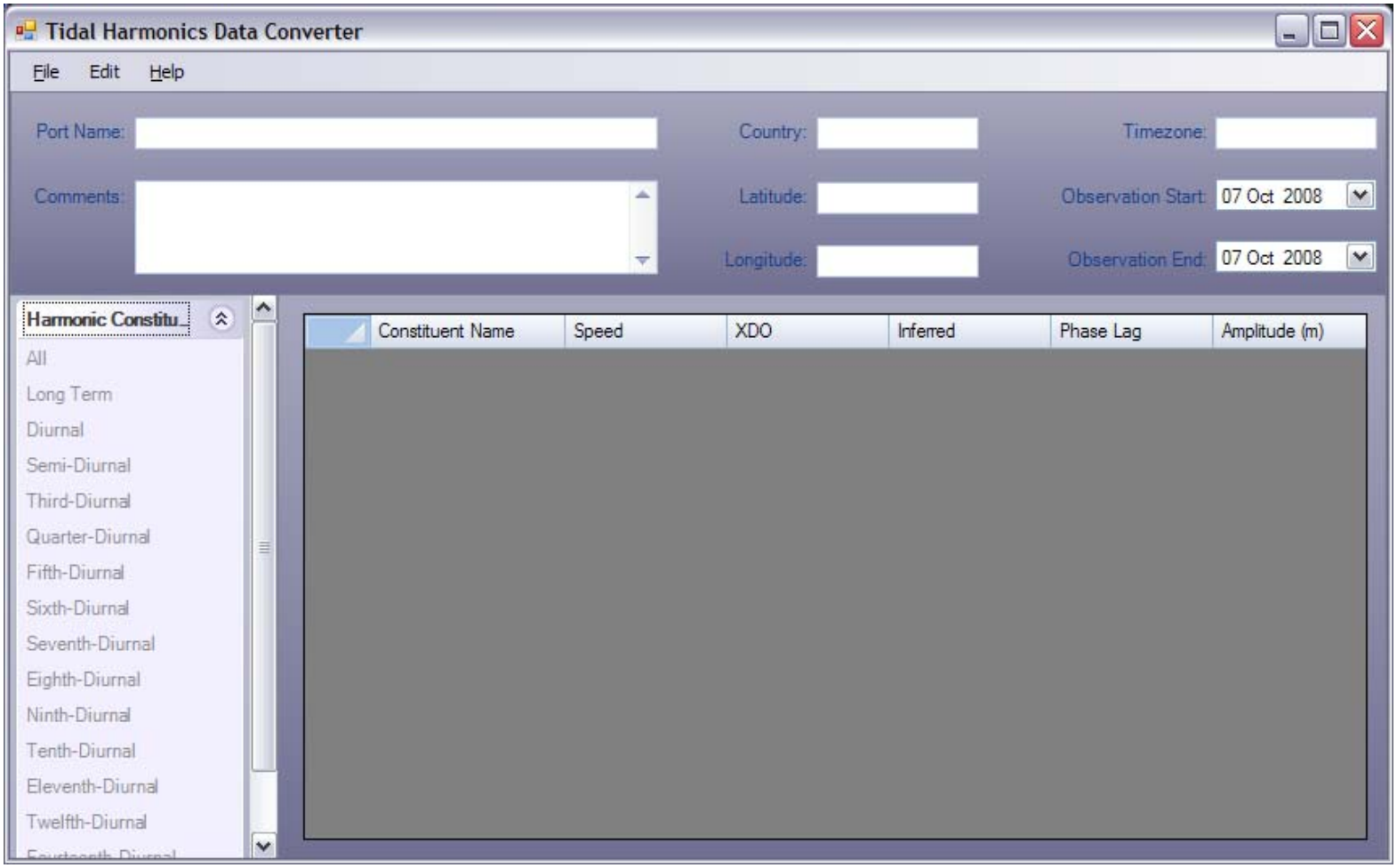
But will become..

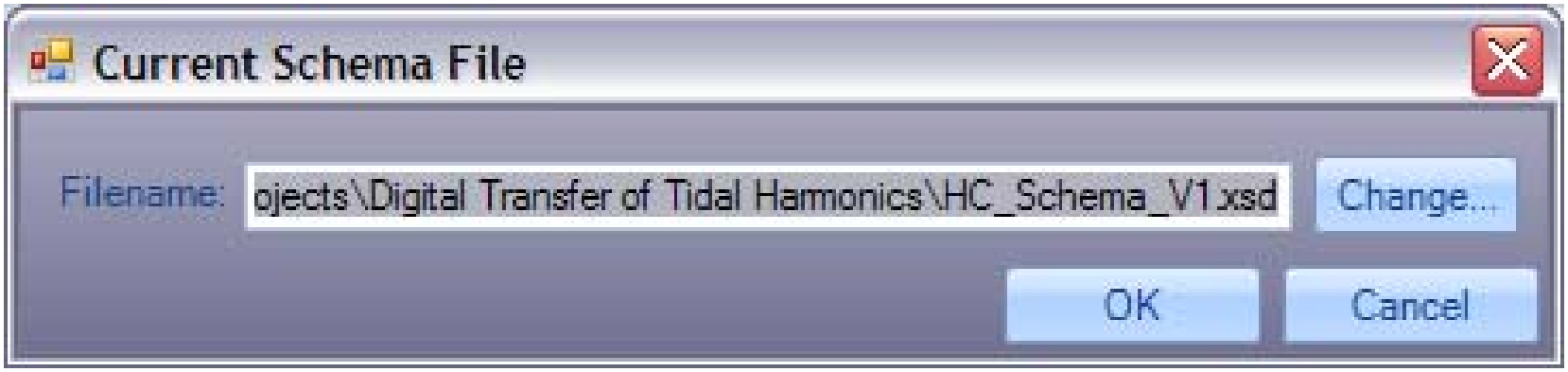
http://hweb15pub/AdmiraltyPartners/FGHO/
PagesTidalHarmonics.aspx


Digital Transfer of Tidal Harmonic Constants - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites History Mail Print Edit Discuss
Address http://www.ukho.gov.uk/tidalharmonics/downloads.aspx
Go Links
ADMIRALTY
CHARTS AND PUBLICATIONS
Digital Transfer of Tidal Harmonic Constants
Home Page
Welcome to the Tidal Harmonics Constants Download Page
This website provides a standard transfer mechanism for tidal harmonic constants using an XML schema, which has been adopted by Member States of the IHO, and can be downloaded directly using the links below:
Schema Downloads
HC_Schema_V1.xsd
Sample Downloads
Example1_Bad.xml
Example1_Good.xml
Example2_Bad.xml
Example2_Good.xml
Example3_Bad.xml
Example3_Good.xml
Example4.xml
Example5.xml
Example6.xml
Example7.xml
THE UNITED KINGDOM
Done
Internet

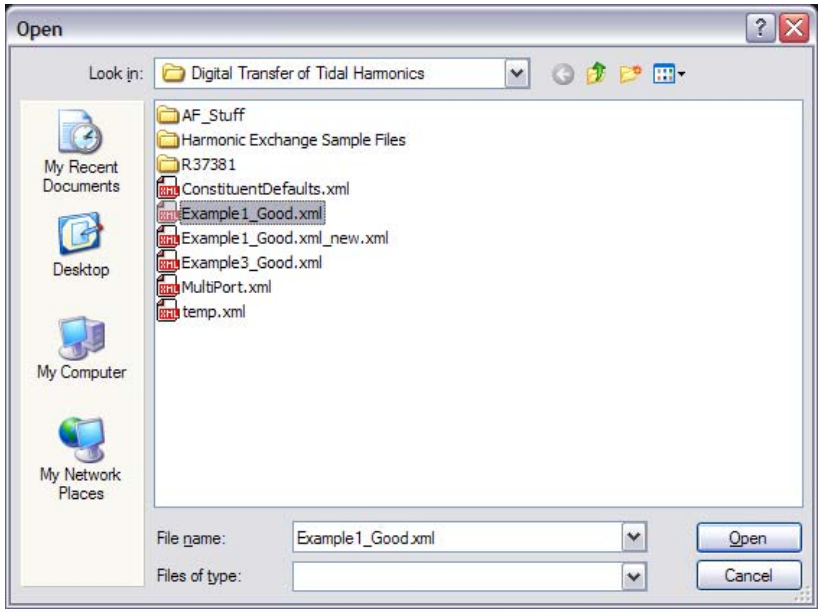

Digital Transfer of Tidal Harmonic Constants - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites History Mail Print Edit Discuss
Address http://www.ukho.gov.uk/tidalharmonics/downloads.aspx
Go Links
THE UNITED KINGDOM
HYDROGRAPHIC OFFICE
Schema Downloads
HC_Schema_V1.xsd
Sample Downloads
Example1_Bad.xml
Example1_Good.xml
Example2_Bad.xml
Example2_Good.xml
Example3_Bad.xml
Example3_Good.xml
Example4.xml
Example5.xml
Example6.xml
Example7.xml
The Harmonic Constants Product Specification gives full details of the structure and content of the exchanged file(s), and can be viewed / downloaded below:.
Specification Downloads
1. HC Exchange Format Product Spec.doc
2. HC Exchange Format Annex A.doc
3. HC Exchange Format Annex B.doc
Contact Us Terms & Conditions Freedom of Information Privacy Policy Accessibility Portal Home Links Policy Related Sites
© Crown Copyright 2007
http://www.ukho.gov.uk/homePage.asp
Internet

Main UKHO Application

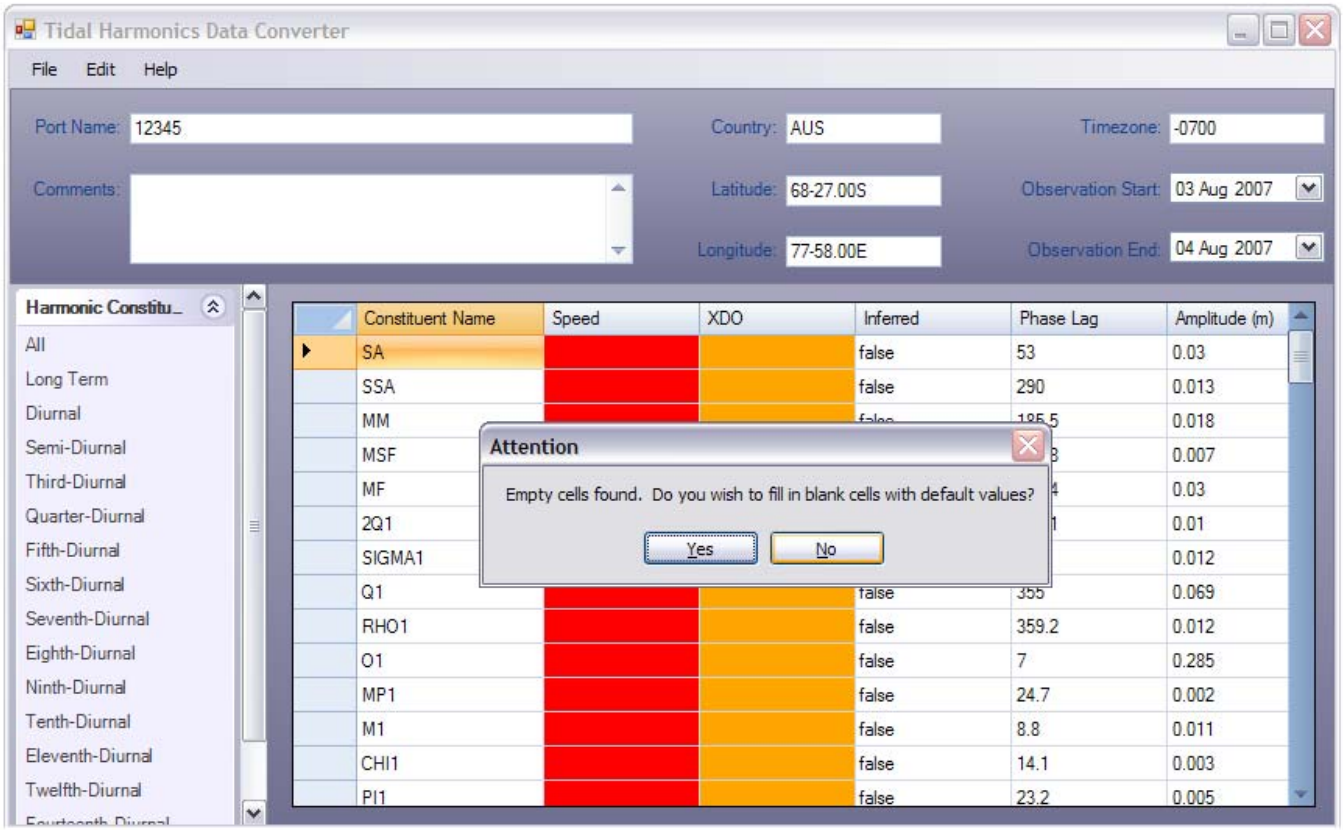




The Edit menu contains the “Set Schema” option which allows you to validate all XML files against a chosen XML schema file

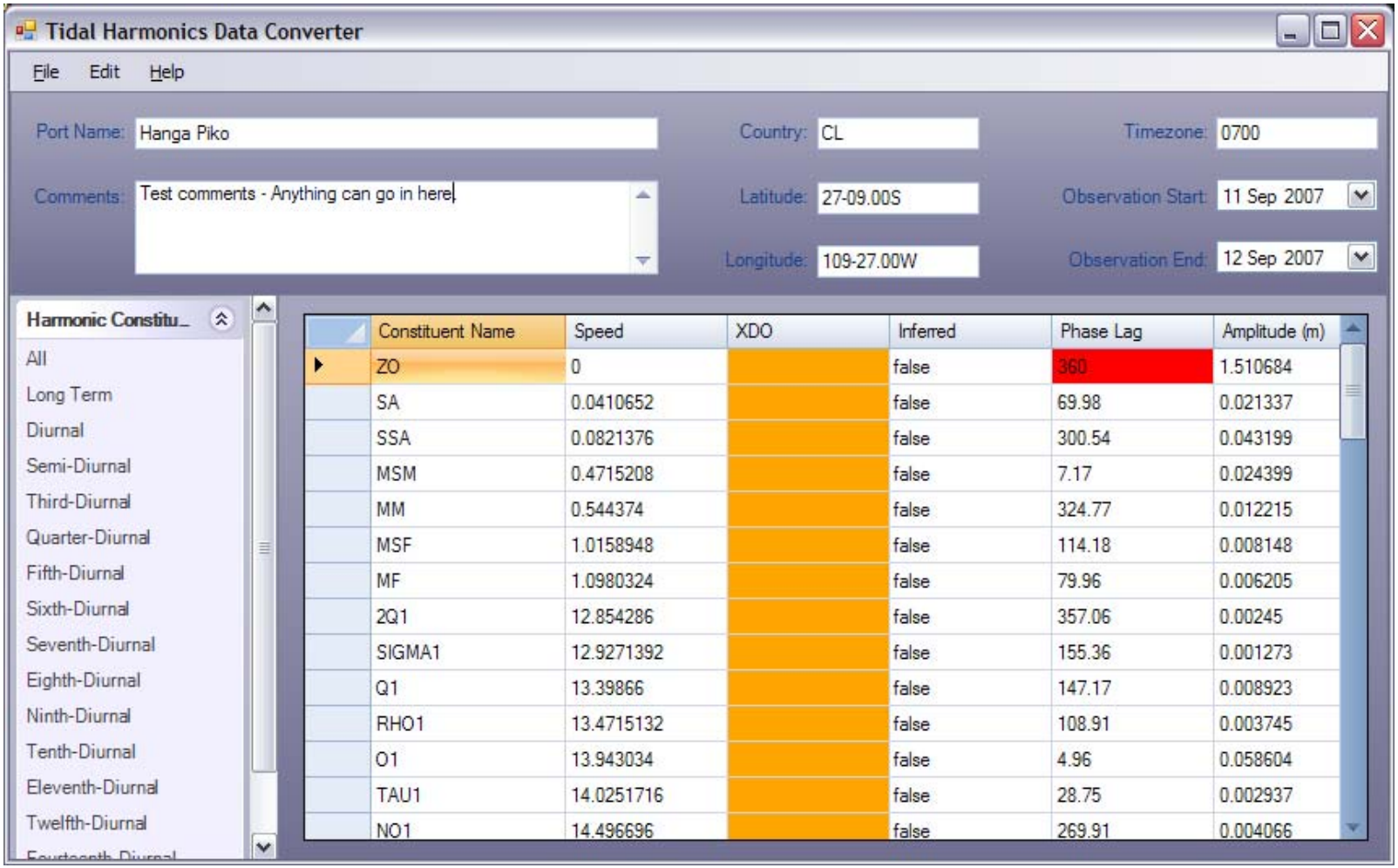


Standard “Open file” dialogue allowing you to select the XML file to load and validate



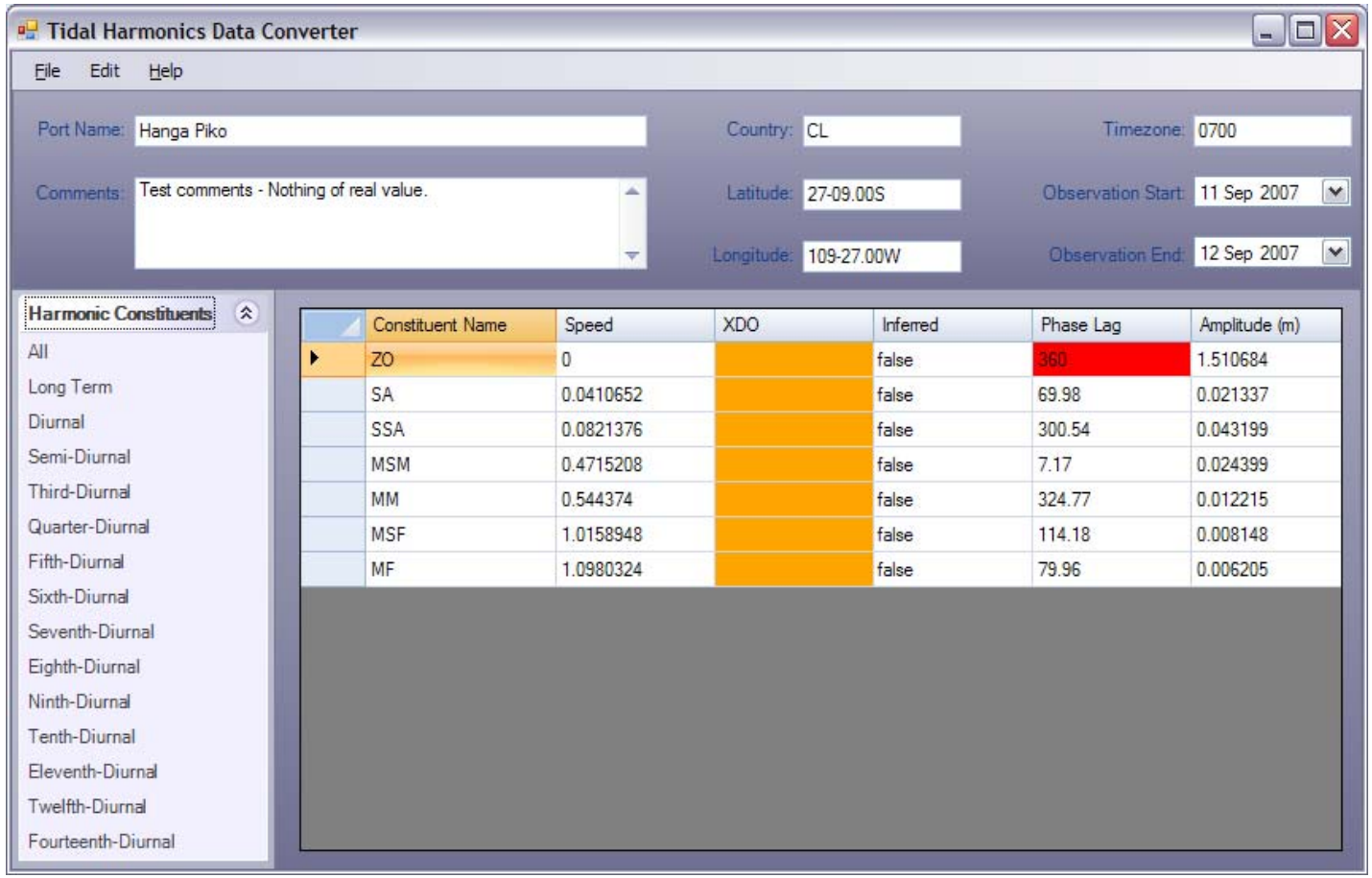
Errors highlighted immediately – mandatory fields in red, non-mandatory in orange

User can choose to populate any mandatory fields with the default values as specified in the XML schema file



Constituent Name	Speed	XDO	Inferred	Phase Lag	Amplitude (m)
ZO	0		false	360	1.510684
SA	0.0410652		false	69.98	0.021337
SSA	0.0821376		false	300.54	0.043199
MSM	0.4715208		false	7.17	0.024399
MM	0.544374		false	324.77	0.012215
MSF	1.0158948		false	114.18	0.008148
MF	1.0980324		false	79.96	0.006205
2Q1	12.854286		false	357.06	0.00245
SIGMA1	12.9271392		false	155.36	0.001273
Q1	13.39866		false	147.17	0.008923
RHO1	13.4715132		false	108.91	0.003745
O1	13.943034		false	4.96	0.058604
TAU1	14.0251716		false	28.75	0.002937
NO1	14.496696		false	269.91	0.004066

Error flagged = 360° phase angle as opposed to 000°



Once loaded, the data can be filtered as required

Project Status

- Schema and other information freely available on the website
- Hydrographic Offices welcome to download the schema but will need to develop their own in-house software to generate / convert them
- UKHO converter not yet completed – UKHO IT staff committed to other areas at present
- Initial version of internal UKHO software available soon

Current Web Link

http://www.ukho.gov.uk/
tidalharmonics/downloads.aspx

But will become..

http://hweb15pub/AdmiraltyPartners/FGHO/
PagesTidalHarmonics.aspx