

3rd Tidal and Water Level Working Group Meeting

Jeju Island, South Korea 05 – 07 April 2011

Exchange of Harmonic Constants

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United Kingdom Hydrographic Office



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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:-



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Brazil

35341.030000060719843009198430114		TERMINAL	ALUMAR	024075044218w+030
QMSF	001.0158958		1	-1
101	013.9430356			
1P1	014.9589314			
1K1	015.0410686			
12N2	027.8953549			
1MU2	027.9682084			
1N2	028.4397295			
1NU2	028.5125831			
1M2	028.9841042			
1LAMB2	029.4556253			
1L2	029.5284789			
1T2	029.9589333			
1S2	030.0000000			
1K2	030.0821373			
OMO3	042.9271398	1	1	
1M3	043.4761563			
OMK3	044.0251728	1	1	
OMN4	057.4238337	1	1	
OM4	057.9682084		2	
OMS4	058.9841042		1	1
OSL4	059.5284789		1	1
OMNO5	071.3668693	1	1	1
02MO5	071.9112440	1		2
OMSK5	074.0251728	1	1	1
03MN56	085.3920422		1	3
02MN6	086.4079380		1	2
OM6	086.9523127			3
OMSN6	087.4238337		1	1
02MS6	087.9682084			2
OMKL6	088.5967204		1	1
02SM6	088.9841042			1
02SMK7	104.0251728	1		2
OM8	115.9364169			4
03MS8	116.9523127			3
02M2S8	117.9682084			2

Spain

15	arrecife	GMT 2857 1334
1 ZO	.000000000	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 ZQ1	.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 RH01	.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 ZN2	.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

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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      ||
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                                                fil_00065cyyddda.wlev ||
**                                                                ||
Constituents 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  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

```



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Singapore

UK

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

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

A0: "H" "g"
 Key: S = Suspect F4:f4 0.0464 278.7
 I = Inferred F6:f6 0.0041 186.1

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
chil	0.002	033.3	MSNK4	0.003	028.0	M7	0.002	141.1
pil	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
psil	0.002	315.8	M4	0.255	221.1	3Mnu8	0.005	328.2



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
- **9/1919 (as amended) [formerly A6.1] (Exchange of tidal information), para 1 (a) states: *It is resolved that published tidal information shall be freely exchanged.***
- **10/1919 (as amended) [formerly 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

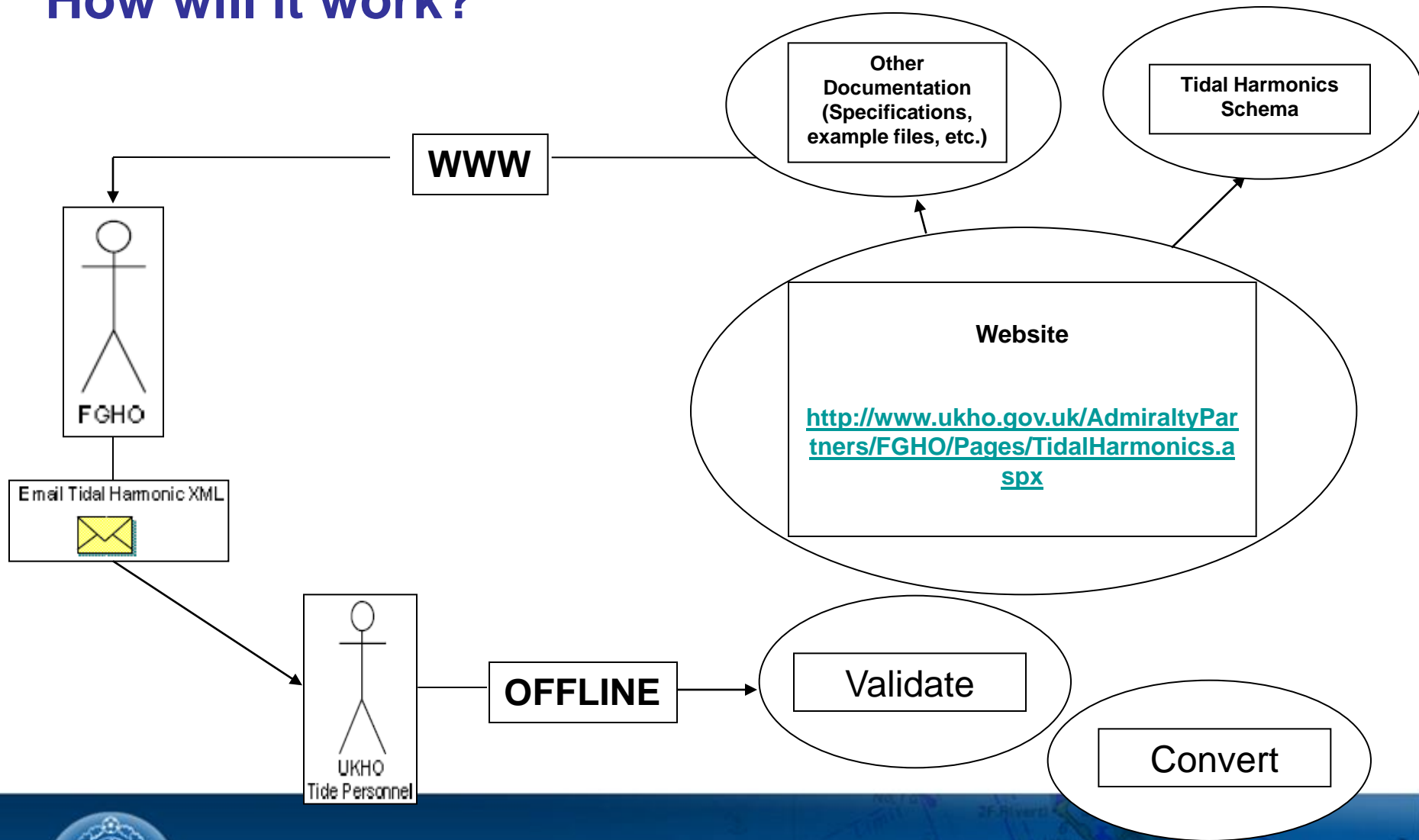


The project

- 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.int/english/committees-wg/hssc/twlwg.html>)
- Application and Computation of Nodal Corrections
- Derivation of Speeds and values of Nodal Corrections from Constituent Names



Web Link

<http://www.ukho.gov.uk/AdmiraltyPartners/FGHO/Pages/TidalHarmonics.aspx>



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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](#)



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Schema Downloads

HC_Schema_V1.xsd

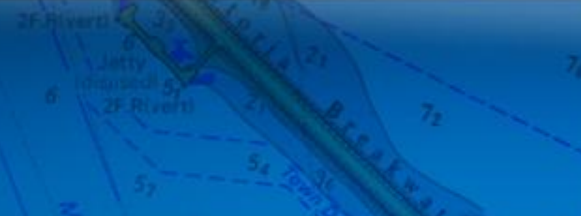
Sample Downloads

- 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



Main UKHO Application

Tidal Harmonics Data Converter

File Edit Help

Port Name: Country: Timezone:

Comments: Latitude: Observation Start: 07 Oct 2008

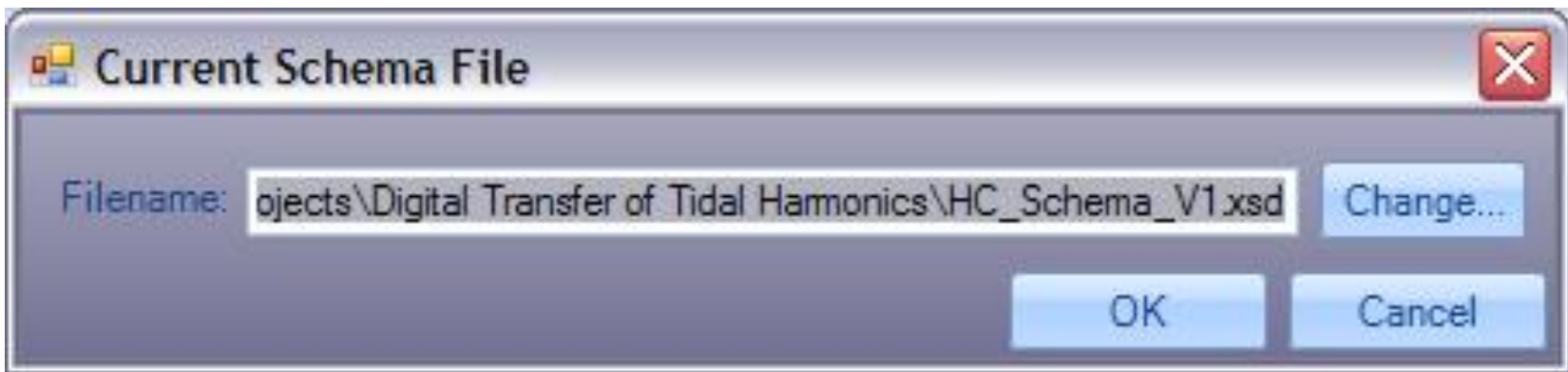
Longitude: Observation End: 07 Oct 2008

Harmonic Constituents

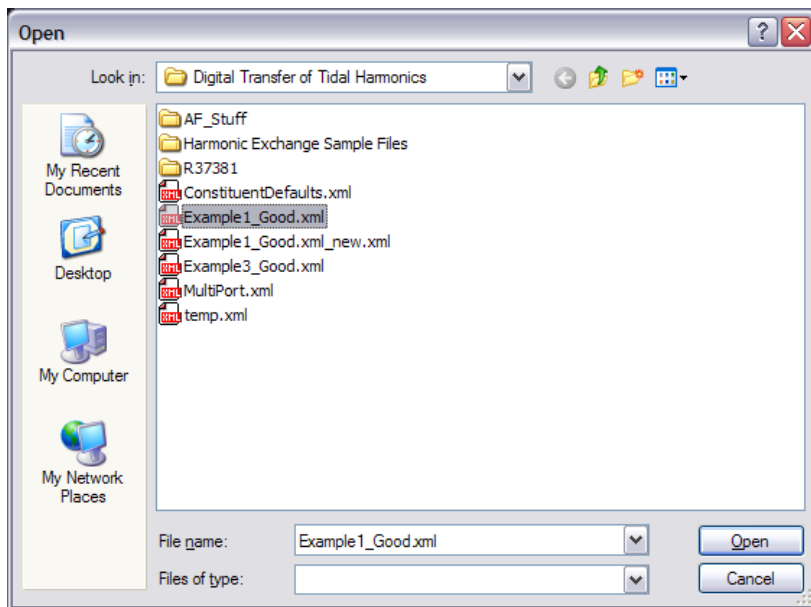
- All
- Long Term
- Diurnal
- Semi-Diurnal
- Third-Diurnal
- Quarter-Diurnal
- Fifth-Diurnal
- Sixth-Diurnal
- Seventh-Diurnal
- Eighth-Diurnal
- Ninth-Diurnal
- Tenth-Diurnal
- Eleventh-Diurnal
- Twelfth-Diurnal
- Fourteenth-Diurnal

Constituent Name	Speed	XDO	Inferred	Phase Lag	Amplitude (m)
------------------	-------	-----	----------	-----------	---------------





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



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Tidal Harmonics Data Converter

File Edit Help

Port Name: 12345 Country: AUS Timezone: -0700

Comments: Latitude: 68-27.00S Observation Start: 03 Aug 2007

Longitude: 77-58.00E Observation End: 04 Aug 2007

Harmonic Constituents

Constituent Name	Speed	XDO	Inferred	Phase Lag	Amplitude (m)
SA			false	53	0.03
SSA			false	290	0.013
MM			false	185.5	0.018
MSF				3	0.007
MF				4	0.03
2Q1				1	0.01
SIGMA1					0.012
Q1			false	355	0.069
RHO1			false	359.2	0.012
O1			false	7	0.285
MP1			false	24.7	0.002
M1			false	8.8	0.011
CHI1			false	14.1	0.003
PI1			false	23.2	0.005

Attention

Empty cells found. Do you wish to fill in blank cells with default values?

Yes No

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



Tidal Harmonics Data Converter

File Edit Help

Port Name: Hanga Piko Country: CL Timezone: 0700

Comments: Test comments - Anything can go in here Latitude: 27-09.00S Observation Start: 11 Sep 2007

Longitude: 109-27.00W Observation End: 12 Sep 2007

Harmonic Constitu...

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°



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Tidal Harmonics Data Converter

File Edit Help

Port Name: Country: Timezone:

Comments: Latitude: Observation Start:

Longitude: Observation End:

Harmonic Constituents:

- All
- Long Term
- Diurnal
- Semi-Diurnal
- Third-Diurnal
- Quarter-Diurnal
- Fifth-Diurnal
- Sixth-Diurnal
- Seventh-Diurnal
- Eighth-Diurnal
- Ninth-Diurnal
- Tenth-Diurnal
- Eleventh-Diurnal
- Twelfth-Diurnal
- Fourteenth-Diurnal

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

Once loaded, the data can be filtered as required



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Web Link

<http://www.ukho.gov.uk/AdmiraltyPartners/FGHO/Pages/TidalHarmonics.aspx>



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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 completed – just need data to feed into it!

