TICON USER MANUAL

Version 1.0, November 2018

1. Introduction

In this document the content and the use of the TIdal COnstants (TICON) data set is illustrated. The TICON data set is a text/ASCII file that contains information on tidal harmonic constants for 40 constituents and for 1145 tide gauge records. The tide gauge records were taken from the second version of the Global Extreme Sea Level Analysis (GESLA) public data set, and are available on a quasi-global scale and for different time periods. The tidal constants were derived from GESLA by a least-square harmonic analysis. TICON is a useful and easy-to-handle data set for tide model validation.

2. Description of the file

The tidal constants for all tide gauge records are provided in a single tab-separated text/ASCII file, named TICON.txt. The data are stored in 13 columns, and contain the following information:

1. Latitude of the tide gauge station in degrees
2. Longitude of the tide gauge station in degrees, with range [0 360]
3. Constituent name
4. Amplitude in cm
5. Phase lag (Greenwich lag) in degrees, with range [0 360]
6. Standard deviation of the amplitude in cm
7. Standard deviation of the phase lag in degrees
8. Percentage of missing observations
9. Total number of observations analyzed
10. Length of the maximum temporal gap found in the time series in days
11. Date of the first observation [day/month/year]
12. Date of the last observation [day/month/year]
13. Code that corresponds to the original source of the record

The code of the source (column 13) has format: gesla.xxxxx, where xxxxx is one of the GESLA data providers (e.g. bodc for British Oceanographic Data Centre). All sources are listed according to nation and data provider at: https://gesla.org/

In table 1 you can find the list of data providers and the corresponding code used in TICON.

An example of the format is shown in Table 2, for the station of Port Angeles, Washington, USA. For each constituent estimate, all the station-related data are repeated, so that data sorting can be done with few lines of code (see section 3).

Data Provider	TICON code
British Oceanographic Data Centre	gesla.bodc
Univ. Hawaii Sea Level Center (UHSLC)	gesla.uhslc
National Oceanic and Atmospheric Administration(NOAA)	gesla.noaa
Réseaux de réfèrences des observations marègraphiques (REFMAR)	gesla.refmar
Japan Meteorological Agency	gesla.jma
National Oceanographic Centre UK	gesla.noc
Idromare	gesla.idromare
European Sea-Level Service (ESEAS)	gesla.eseas
Marine Environmental Data Service (MEDS)	gesla.meds
Instituto Español de Oceanografía	gesla.ieo
Puertos del Estado	gesla.pde
Sveriges meteorologiska och hydrologiska institut (SMHI)	gesla.smhi
Icelandic Coast Guard - Hydrographic Department	gesla.coastguard
Istituto Talassografico di Trieste	gesla.itt
Norwegian Mapping Authority (STATKART)	gesla.statkart
Water, Verkeer en Leefomgeving (RWS WVL) Helpdesk Water	gesla.rws
Finnish Meteorological Institute (FMI)	gesla.fmi
Comune di Venezia	gesla.comune_venezia
Bundesamt fuer Seeschifffahrt und Hydrographie	gesla.bsh
Danish Meteorological Institute (DMI)	gesla.dmi

Table 1: GESLA data providers and corresponding code used in TICON.

3. Data selection from text-file

The use of a single file makes the selection of the data easy and direct.
For Unix users, it is possible to sort the data with **awk/gawk** (https://www.gnu.org/software/gawk/).
For example, we want to validate the estimates of M2 constituent of an external ocean tide model against in-situ data at the Japanese coasts. So we need to define the region of interest (say, 30° to 41° latitude and 126° to 150° longitude) and with awk, we can write in the terminal:

```
awk '$1>=30&&6$1<=41&&$2>=126&&$2<=150&&$3=="M2"{print $2,$1,$4,$5}'
TICON.txt > M2japan.txt
```

Where with the symbols $1, $2, $3,… we indicate column 1,2,3,… of input file TICON.txt, && is the symbol of inclusion and M2japan.txt is the output file, in which only columns 2,1,4,5 of the input file are printed.

For **Matlab** users, we suggest to use a short script like the following:

```
FID = fopen('<path>/TICON.txt');
datacell  = textscan(FID, '%f%f%s%f%f%f%f%d%f%s%s%s');
latitutde = datacell{1};
longitude = datacell{2};
amplitude = datacell{4};
phase     = datacell{5};
fclose(FID);
```

LAT	LON	CONST	AM	PH	ST_AM	ST_PH	%MO	NOBS	MAX	START	END	SOURCE
48.125	236.56	SA	10.612	3.834	0.003	0.001	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	SSA	1.896	220.888	0.001	0.004	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	MM	2.024	197.866	0.001	0.004	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	MSF	0.596	216.913	0.000	0.013	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	MF	1.298	164.147	0.000	0.005	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	MTM	0.460	183.835	0.000	0.017	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	MSQ	0.128	180.8	0.000	0.062	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	2Q1	0.804	231.874	0.000	0.009	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	Q1	6.649	232.57	0.002	0.001	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	O1	38.670	241.412	0.010	0.000	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	M1	2.145	347.22	0.000	0.001	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	P1	20.848	259.529	0.006	0.000	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	S1	2.062	33.524	0.001	0.004	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	K1	66.796	261.405	0.018	0.000	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	J1	3.402	284.364	0.001	0.002	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	OO1	2.499	304.029	0.001	0.002	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	EP2	0.665	200.423	0.000	0.012	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	2N2	1.462	248.399	0.000	0.005	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	MI2	2.754	233.646	0.001	0.003	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	N2	11.756	280.099	0.003	0.001	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	NI2	2.100	287.739	0.001	0.004	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	MA2	1.101	145.594	0.000	0.007	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	M2	51.586	307.293	0.014	0.000	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	MB2	0.823	57.938	0.000	0.010	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	MKS	0.324	169.525	0.000	0.022	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	LM2	0.616	54.276	0.000	0.013	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	L2	1.124	29.774	0.000	0.007	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	T2	0.814	335.278	0.000	0.010	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	S2	14.611	326.503	0.004	0.001	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	R2	0.275	327.092	0.000	0.029	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	K2	2.843	333.255	0.001	0.003	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	M3	0.138	341.12	0.000	0.058	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	S3	0.043	108.247	0.000	0.185	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	N4	0.156	28.526	0.000	0.051	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	MN4	0.711	63.974	0.000	0.011	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	M4	1.463	96.914	0.000	0.005	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	MS4	0.858	112.9	0.000	0.009	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	S4	0.197	114.431	0.000	0.040	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	M6	1.510	198.201	0.000	0.005	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc
48.125	236.56	M8	0.026	153.469	0.000	0.300	28.01	210913	3408.25	01/08/1979	31/12/2012	gesla.uhslc

Table 2. Part of TICON dataset, for tide gauge located in Port Angeles, Washington, USA. EP2, MI2, NI2, and LM2 correspond to constituents ε_2, μ_2, ν_2, and λ_2, respectively.

4. Data validation

The validation exercise followed the methods used in Stammer et al. 2014 to compare modern tide models and tide gauge data in terms of Root Mean Square (RMS) and Root Sum Square (RSS) differences. In this case we compared TICON constants to the Finite Element Solution 2014 (FES2014) global tide model (Carrère et al. 2015). Not all TICON tide gauges were used for this exercise: tide gauges assimilated in FES2014 were discarded, in order to have an independent comparison; in total 923 tide gauges were used. FES2014 was chosen because it is the model with highest performances over complex areas. However, we expected to still see larger differences between FES2014 and TICON close to large rivers (e.g. Amazon River, Bay of Bengal), shelf seas (e.g. North Sea, Argentinian Shelf), and areas with complex bathymetry and/or geometry of the coast (e.g. Indonesian Sea), see figure 1. The plot shows the geographical distribution of the RSS computed for the main tidal constituents (M2, S2, N2, K2, K1, P1, O1, and Q1). For the same locations shown in figure 1, we computed the averaged RMS and RSS differences (table 3). These numbers are relatively small, if compared to the coastal tide gauges in Stammer et al. 2014. This may be due to the fact that here TICON and FES2014 average differences are computed also for tide gauges in open ocean, where stronger agreement between the two is expected. Also, in areas with low tidal amplitudes such as the Baltic Sea and the Mediterranean Sea we expect (and see, from figure 1) smaller RMS differences. These areas are densely populated by tide gauges, and this may overweight the statistics, lowering the RMS differences.

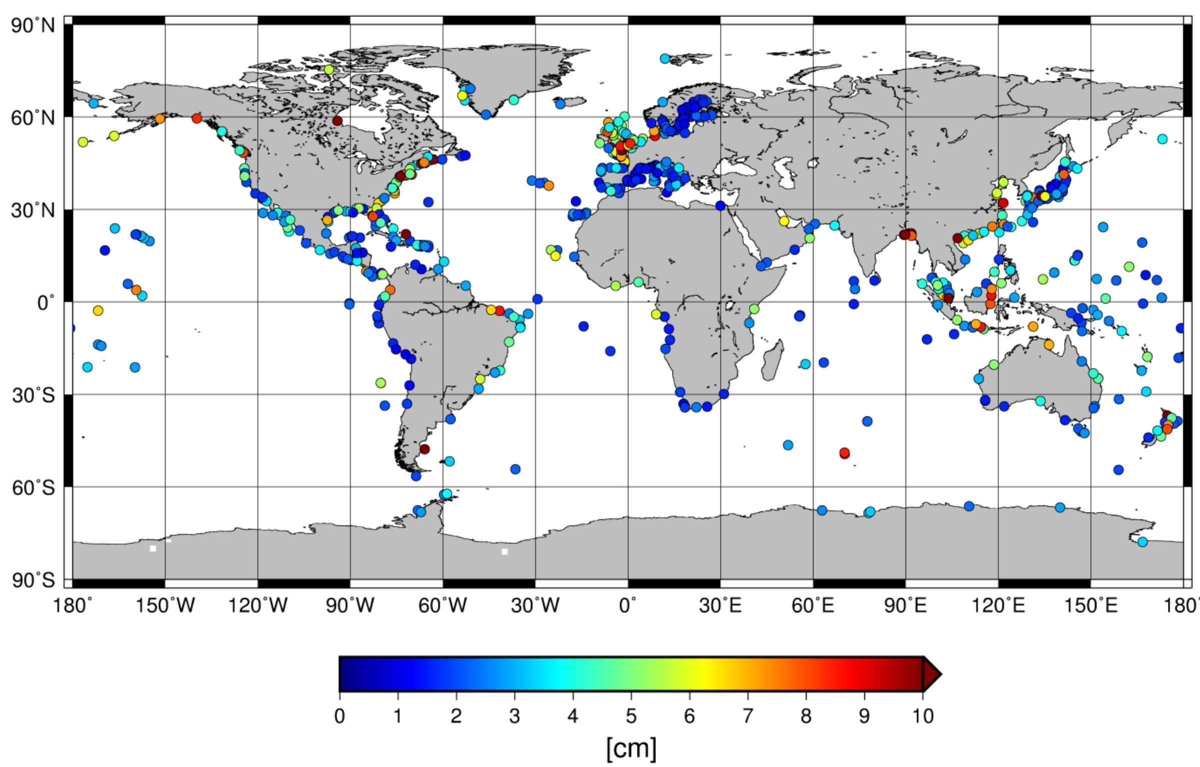
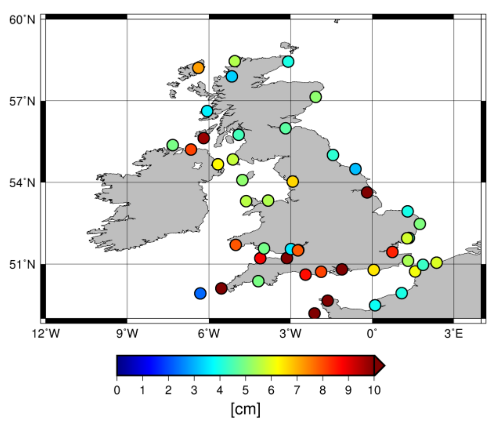


Figure 1. Geographical distribution of RSS differences between TICON and FES2014 for 923 tide gauges

TICON VS FES2014 Results in cm		Signal
RMS M2	2.1915	59.236
RMS N2	1.0377	11.716
RMS S2	1.3334	20.632
RMS K2	0.73272	5.849
RMS K1	0.98474	13.015
RMS O1	0.83692	9.389
RMS P1	0.58937	4.071
RMS Q1	0.42379	1.956
RSS	3.2235	

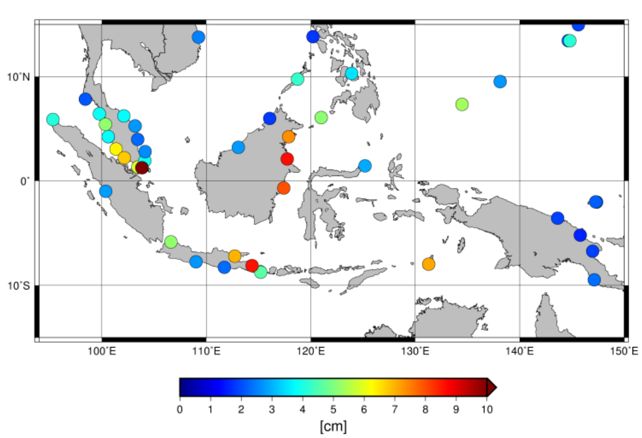
Table 3. RMS and RSS differences between TICON and FES2014 averaged on 923 tide gauges.

Because of the possibility of such overweight, we also performed regional comparisons. Figures 2, 3, 4, and 5 show areas (coasts of North Sea, Indonesian region, Australia, and Eastern USA, respectively) where TICON and FES2014 constants show higher disagreement. The plots are coupled with tables showing the regional average RMS and RSS.



TICON VS FES2014 Results in cm		Signal
RMS M2	11.720	151.759
RMS N2	2.628	28.434
RMS S2	5.374	52.391
RMS K2	1.540	15.055
RMS K1	0.629	6.844
RMS O1	0.557	6.435
RMS P1	0.496	2.289
RMS Q1	0.256	2.161
RSS	13.287	

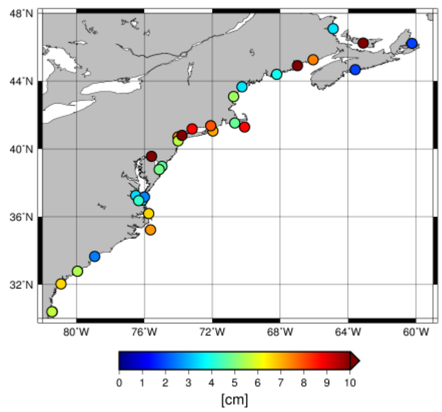
Figure 2. RSS differences between TICON and FES2014 for tide gauges located in the North Sea.
Table 4. RMS and RSS differences between TICON and FES2014 averaged for tide gauges in the North Sea.



TICON VS FES2014 Results in cm		Signal
RMS M2	2.399	37.363
RMS N2	0.639	7.200
RMS S2	1.514	18.559
RMS K2	0.487	5.306
RMS K1	0.992	19.279
RMS O1	1.086	13.851
RMS P1	0.437	6.110
RMS Q1	0.224	2.746
RSS	3.331	

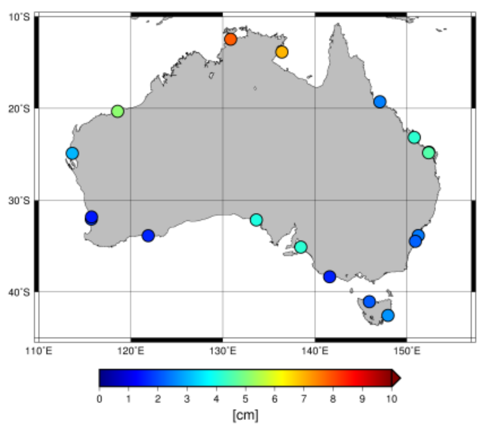
Figure 3. RSS differences between TICON and FES2014 for tide gauges located in the Malay Archipelago.
Table 5. RMS and RSS differences between TICON and FES2014 averaged for tide gauges in the Malay Archipelago.

Smaller disagreement is found in Australia, where the position of TICON tide gauges is often close to locations of tide gauges assimilated in FES2014 (table 7). However, larger differences are found in the northern area, characterized by shallower bathymetry.



TICON VS FES2014 Results in cm		Signal
RMS M2	13.978	69.065
RMS N2	3.486	14.764
RMS S2	2.837	11.604
RMS K2	0.959	3.206
RMS K1	1.349	7.596
RMS O1	1.068	5.862
RMS P1	0.500	2.489
RMS Q1	0.208	1.105
RSS	14.824	

Figure 4. RSS differences between TICON and FES2014 for tide gauges on the Eastern coast of USA.
Table 6. RMS and RSS differences between TICON and FES2014 averaged on the Eastern coast of USA.



TICON VS FES2014 Results in cm		Signal
RMS M2	1.646	60.562
RMS N2	0.440	12.293
RMS S2	0.817	29.876
RMS K2	0.616	8.472
RMS K1	0.936	18.946
RMS O1	0.674	11.545
RMS P1	0.296	5.495
RMS Q1	0.207	2.624
RSS	2.326	

Figure 5. RSS differences between TICON and FES2014 for tide gauges located in Australia.
Table 7. RMS and RSS differences between TICON and FES2014 averaged for tide gauges in Australia.

A comparison was also made between TICON tidal constants computed for two or more "duplicate" records, i.e. records in TICON available at the same location, and coming from different GESLA-2 sources. It can happen that despite the same location, these records may differ in observation period and sampling rate. In table 8 examples for records having these characteristics are shown for constituents M2 and K1. Each tide gauge location is separated with a bold line; the first four examples show results from tide gauges at the same location, but with different observation period, and different provider. In the last example the observation period is the same, but the sampling rate differs.

LAT	LON	CONST	AM [CM]	PH [DEG]	ST_AM [CM]	ST_PH [DEG]	% MD	NOBS	MAX_GAP	START	END	CODE
44.0166	144.2833	M2	17.137	163.21	0.023	0.002	0.000	26280	0.04	31/12/2000	31/12/2003	gesla.bodc
44.0167	144.2833	M2	17.069	163.39	0.002	0.000	2.240	385627	90.71	01/01/1968	31/12/2012	gesla.uhslc
44.0166	144.2833	K1	21.368	55.435	0.026	0.002	0.000	26280	0.04	31/12/2000	31/12/2003	gesla.bodc
44.0167	144.2833	K1	21.352	53.792	0.002	0.000	2.240	385627	90.71	01/01/1968	31/12/2012	gesla.uhslc
41.505	288.673	M2	50.79	2.475	0.004	0.000	4.060	692214	287.46	10/09/1930	31/12/2012	gesla.uhslc
41.505	288.673	M2	50.666	2.784	0.005	0.000	0.000	552253	286.62	01/01/1950	31/03/2015	gesla.noaa
41.505	288.673	K1	6.301	167.88	0.000	0.000	4.060	692214	287.46	10/09/1930	31/12/2012	gesla.uhslc
41.505	288.673	K1	6.318	167.84	0.001	0.000	0.000	552253	286.62	01/01/1950	31/03/2015	gesla.noaa
-0.5283	166.905	M2	53.452	137.98	0.011	0.000	3.830	229975	116.08	07/05/1974	31/12/2001	gesla.bodc
-0.5283	166.905	M2	53.088	138.19	0.012	0.000	4.700	172631	64.58	07/05/1974	04/01/1995	gesla.uhslc
-0.5283	166.905	K1	13.579	61.449	0.003	0.000	3.830	229975	116.08	07/05/1974	31/12/2001	gesla.bodc
-0.5283	166.905	K1	13.559	61.462	0.003	0.000	4.700	172631	64.58	07/05/1974	04/01/1995	gesla.uhslc
50.1024	354.458	M2	170.03	134.64	0.039	0.000	0.000	254232	0.04	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	M2	171.04	133.8	0.007	0.000	11.83	1280675	224.17	22/04/1915	31/12/2014	gesla.bodc
50.1017	354.458	M2	170.56	134.52	0.012	0.000	2.160	820727	224.17	22/04/1915	31/12/2010	gesla.uhslc
50.1024	354.458	K1	6.172	108.36	0.001	0.001	0.000	254232	0.04	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	K1	6.306	109.17	0.000	0.000	11.83	1280675	224.17	22/04/1915	31/12/2014	gesla.bodc
50.1017	354.458	K1	6.222	109.17	0.000	0.000	2.160	820727	224.17	22/04/1915	31/12/2010	gesla.uhslc
69.3166	16.15	M2	66.388	341.43	0.006	0.000	0.070	634242	24.95	09/10/1991	31/12/2003	gesla.bodc
69.3167	16.15	M2	66.269	341.43	0.036	0.000	1.320	105777	25	09/10/1991	31/12/2003	gesla.uhslc
69.3166	16.15	K1	6.518	191.13	0.001	0.000	0.070	634242	24.95	09/10/1991	31/12/2003	gesla.bodc
69.3167	16.15	K1	6.524	191.07	0.004	0.003	1.320	105777	25	09/10/1991	31/12/2003	gesla.uhslc

Table 8. Comparison among duplicates available in TICON.

Finally, we compared TICON with an external dataset, kindly provided by Richard Ray, and used as coastal dataset in Stammer et al. 2014. An example is given in table 9, for the station of Providenya (Russia), where also four “duplicate” records are available. The external dataset can be identified with source code: woce.coastal. woce.coastal contains only information on amplitude and phase lag, therefore we removed the columns of TICON additional information. We kept only the start and the end dates of the timeseries (set as NaN for woce.coastal) because a slight change of phase lag was observed according to the observation period. According to similarities with TICON results, it seems that woce.coastal constants were computed around years 1986-1989 ca. The largest differences in phase lag are found for constituents S3, M6, and MN4.

LAT	LON	CONST	AM [CM]	PH [DEG]	START	END	CODE
64.400	186.800	2Q1	0.230	239.120	NaN	NaN	woce.coastal
64.400	186.800	2Q1	0.183	298.837	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	2Q1	0.322	220.805	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	2Q1	0.182	298.367	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	2Q1	0.323	220.758	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	Q1	0.920	294.010	NaN	NaN	woce.coastal
64.400	186.800	Q1	0.861	282.553	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	Q1	0.929	292.334	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	Q1	0.861	282.491	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	Q1	0.925	292.205	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	O1	5.560	291.300	NaN	NaN	woce.coastal
64.400	186.800	O1	5.690	288.797	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	O1	5.499	291.210	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	O1	5.690	288.786	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	O1	5.500	291.224	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	P1	3.270	314.320	NaN	NaN	woce.coastal
64.400	186.800	P1	3.344	314.158	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	P1	3.282	315.389	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	P1	3.345	314.122	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	P1	3.282	315.373	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	S1	0.780	189.660	NaN	NaN	woce.coastal
64.400	186.800	S1	0.706	183.212	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	S1	0.763	194.697	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	S1	0.706	183.273	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	S1	0.762	194.725	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	K1	10.940	315.060	NaN	NaN	woce.coastal
64.400	186.800	K1	10.796	314.671	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	K1	10.893	315.002	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	K1	10.796	314.677	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	K1	10.894	314.988	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	J1	0.440	343.400	NaN	NaN	woce.coastal
64.400	186.800	J1	0.186	333.684	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	J1	0.419	336.627	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	J1	0.186	333.892	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	J1	0.418	336.680	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	OO1	0.510	349.290	NaN	NaN	woce.coastal
64.400	186.800	OO1	0.460	347.412	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	OO1	0.572	348.526	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	OO1	0.459	347.344	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	OO1	0.571	348.565	01/01/1986	31/12/1989	gesla.uhslc

LAT	LON	CONST	AM [CM]	PH [DEG]	START	END	CODE
64.400	186.800	2N2	1.210	64.970	NaN	NaN	woce.coastal
64.400	186.800	2N2	1.243	68.566	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	2N2	1.209	65.274	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	2N2	1.241	68.674	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	2N2	1.211	65.485	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	N2	8.340	117.450	NaN	NaN	woce.coastal
64.400	186.800	N2	8.166	116.769	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	N2	8.391	118.319	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	N2	8.166	116.761	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	N2	8.390	118.306	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	M2	31.660	170.110	NaN	NaN	woce.coastal
64.400	186.800	M2	31.623	168.626	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	M2	31.712	170.251	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	M2	31.624	168.630	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	M2	31.713	170.242	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	S2	4.020	245.570	NaN	NaN	woce.coastal
64.400	186.800	S2	3.928	241.811	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	S2	4.040	245.349	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	S2	3.926	241.810	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	S2	4.038	245.330	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	K2	1.330	228.590	NaN	NaN	woce.coastal
64.400	186.800	K2	1.320	225.268	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	K2	1.323	228.613	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	K2	1.320	225.371	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	K2	1.325	228.610	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	M3	0.270	352.350	NaN	NaN	woce.coastal
64.400	186.800	M3	0.296	325.552	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	M3	0.311	358.634	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	M3	0.295	325.772	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	M3	0.312	358.458	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	S3	0.050	8.030	NaN	NaN	woce.coastal
64.400	186.800	S3	0.053	339.364	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	S3	0.031	7.462	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	S3	0.055	339.911	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	S3	0.030	3.383	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	MN4	0.250	215.080	NaN	NaN	woce.coastal
64.400	186.800	MN4	0.283	222.948	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	MN4	0.246	219.906	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	MN4	0.283	222.804	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	MN4	0.248	219.222	01/01/1986	31/12/1989	gesla.uhslc

LAT	LON	CONST	AM [CM]	PH [DEG]	START	END	CODE
64.400	186.800	M4	0.650	258.220	NaN	NaN	woce.coastal
64.400	186.800	M4	0.558	260.571	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	M4	0.657	253.622	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	M4	0.558	260.564	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	M4	0.656	253.416	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	MS4	0.220	292.940	NaN	NaN	woce.coastal
64.400	186.800	MS4	0.256	294.968	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	MS4	0.221	294.178	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	MS4	0.255	294.872	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	MS4	0.219	294.557	01/01/1986	31/12/1989	gesla.uhslc
64.400	186.800	M6	0.220	286.210	NaN	NaN	woce.coastal
64.400	186.800	M6	0.186	302.522	31/12/1976	31/12/1985	gesla.bodc
64.400	186.800	M6	0.213	281.266	31/12/1985	31/12/1989	gesla.bodc
64.400	186.800	M6	0.185	302.129	01/01/1977	31/12/1985	gesla.uhslc
64.400	186.800	M6	0.218	281.654	01/01/1986	31/12/1989	gesla.uhslc

Table 9. Comparison between TICON duplicates and coastal dataset from Stammer et al. 2014. Station: Providenya, Russia.

Another comparison was done for the historical tide gauge located in Newlyn (UK). Also in this case similar results are found, and larger differences in the phase lag occur for constituent S3.

LAT	LON	CONST	AM [CM]	PH [DEG]	START	END	CODE
50.102	354.458	2Q1	0.440	245.430	NaN	NaN	woce.coastal
50.102	354.458	2Q1	0.298	246.628	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	2Q1	0.307	245.189	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	2Q1	0.317	249.568	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	Q1	1.610	289.820	NaN	NaN	woce.coastal
50.102	354.458	Q1	1.538	290.416	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	Q1	1.582	290.972	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	Q1	1.546	289.741	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	O1	5.380	341.760	NaN	NaN	woce.coastal
50.102	354.458	O1	5.285	342.830	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	O1	5.258	343.544	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	O1	5.317	342.428	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	P1	2.090	102.070	NaN	NaN	woce.coastal
50.102	354.458	P1	2.127	101.946	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	P1	2.126	100.968	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	P1	2.116	101.675	22/04/1915	31/12/2014	gesla.bodc

LAT	LON	CONST	AM [CM]	PH [DEG]	START	END	CODE
50.102	354.458	S1	0.350	32.690	NaN	NaN	woce.coastal
50.102	354.458	S1	0.300	23.648	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	S1	0.120	0.474	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	S1	0.340	22.811	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	K1	6.340	109.440	NaN	NaN	woce.coastal
50.102	354.458	K1	6.222	109.168	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	K1	6.172	108.359	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	K1	6.306	109.165	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	J1	0.160	175.310	NaN	NaN	woce.coastal
50.102	354.458	J1	0.112	180.772	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	J1	0.120	188.191	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	J1	0.132	179.923	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	OO1	0.170	277.890	NaN	NaN	woce.coastal
50.102	354.458	OO1	0.134	274.671	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	OO1	0.160	262.783	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	OO1	0.133	271.237	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	2N2	4.350	94.440	NaN	NaN	woce.coastal
50.102	354.458	2N2	4.346	95.319	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	2N2	4.394	97.452	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	2N2	4.400	94.268	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	N2	33.070	113.610	NaN	NaN	woce.coastal
50.102	354.458	N2	32.706	114.753	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	N2	32.593	114.846	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	N2	32.928	113.908	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	M2	171.900	133.430	NaN	NaN	woce.coastal
50.102	354.458	M2	170.559	134.515	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	M2	170.029	134.642	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	M2	171.043	133.797	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	S2	57.480	177.820	NaN	NaN	woce.coastal
50.102	354.458	S2	57.117	178.174	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	S2	56.814	177.806	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	S2	57.210	177.805	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	K2	16.490	175.310	NaN	NaN	woce.coastal
50.102	354.458	K2	16.444	176.084	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	K2	16.455	176.018	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	K2	16.428	175.470	22/04/1915	31/12/2014	gesla.bodc

LAT	LON	CONST	AM [CM]	PH [DEG]	START	END	CODE
50.102	354.458	M3	1.090	29.340	NaN	NaN	woce.coastal
50.102	354.458	M3	1.071	29.692	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	M3	1.074	30.484	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	M3	1.072	28.970	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	S3	0.100	193.420	NaN	NaN	woce.coastal
50.102	354.458	S3	0.148	229.487	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	S3	0.258	263.156	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	S3	0.116	219.508	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	MN4	4.210	138.420	NaN	NaN	woce.coastal
50.102	354.458	MN4	4.012	140.432	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	MN4	3.905	140.500	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	MN4	4.104	138.603	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	M4	11.420	166.120	NaN	NaN	woce.coastal
50.102	354.458	M4	10.986	168.257	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	M4	10.725	168.531	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	M4	11.149	166.819	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	MS4	7.470	218.140	NaN	NaN	woce.coastal
50.102	354.458	MS4	7.324	219.545	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	MS4	7.274	219.981	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	MS4	7.339	218.442	22/04/1915	31/12/2014	gesla.bodc
50.102	354.458	M6	0.920	328.320	NaN	NaN	woce.coastal
50.102	354.458	M6	0.777	333.745	22/04/1915	31/12/2010	gesla.uhslc
50.102	354.458	M6	0.767	336.703	01/01/1916	31/12/1944	gesla.bodc
50.103	354.457	M6	0.846	329.409	22/04/1915	31/12/2014	gesla.bodc

Table 10. Comparison between TICON duplicates and coastal dataset from Stammer et al. 2014. Station: Newlyn, United Kingdom.

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