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Tides 2024

Gulf of Trieste



Times of High and Low tides
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The 2024 astronomical tide predictions for the Gulf of Trieste, with updated harmonic constants, were produced by the Alpine-Adriatic Meteorological Society as part of the technical-scientific framework agreement in the fields of climatology, meteorology and oceanography between A-AMS and the Institute of Marine Sciences of the National Research Council (CNR-ISMAR).

Data processing and astronomical tide prediction

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The tide gauge station at Trieste Molo Sartorio

The tide gauge station operated by the Trieste branch of the Institute of Marine Sciences of CNR, is located in a cabin on the NE side of Molo (Pier) Sartorio, which is included in the renewed building of Yacht Club Adriaco since 2004. The geographical coordinates are: 45° 38' 50.0" N latitude, 13° 45' 33.9" E longitude (S. Zerbini, University of Bologna, personal communication, 2002).

It is the oldest station in the Adriatic and the first sea level observations date back to 1859, made by the Imperial Royal Academy of Commerce and Navigation. At present the station is equipped with three float tide gauges, two of which digital and one analogue; one digital and the analogue tide gauges are used as backup instruments. The redundancy of sensors guarantees the continuity of recording even in case of mechanical and/or electrical failures.

The digital tide gauges record the sea level heights every minute, while the analogue tide gauge provides a continuous record on a paper sheet, which is generally replaced every week. On this occasion, a calibration is performed by means of a hydrometer consisting of a flexible metal strip with electrical contact. The operation consists in the direct measurement of the sea level height relative to the tide gauge benchmark (known as "piastrina mareografica"), for a simultaneous comparison with the height recorded by the instruments. The tide gauge benchmark is levelled during geodetic surveys.

The sea level is the height of the sea surface relative to a conventional reference plane, quoted relative to the national geodetic network. At Molo Sartorio this plane is the "Zero Istituto Talassografico (ZIT)", located at 3.993 m below the tide gauge benchmark, that is 2.333 m below the geodetic

benchmark IGM n.39; the pier surface lies 2.778 m above ZIT.

The tide gauge cabin not only hosts the instruments but also a stilling well which opens into the floor, and connects to the open sea through a hole, whose section is 1/400 of the horizontal section of the stilling well. In this way a mechanical filter is obtained, which prevents the registration of the high-frequency oscillations caused by wind waves, while keeping those of longer periods, relevant to tidal applications. Further details on the station and the observations can be found in Raicich (2023).

The tide gauge station at Trieste Molo Sartorio

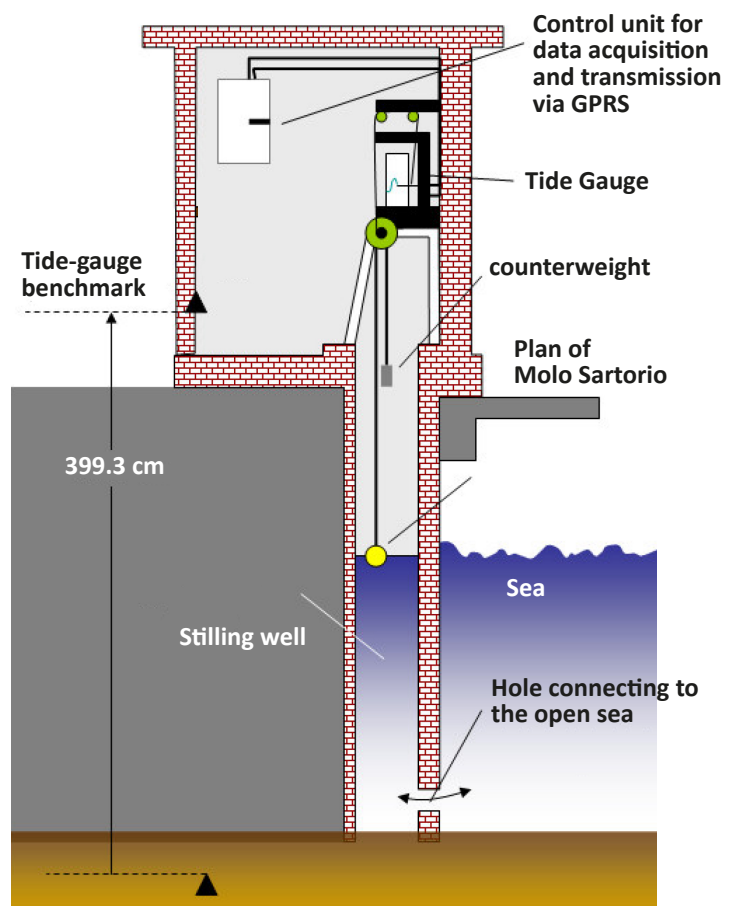


Figure 1

The sea level variability

The sea level variability depends on several factors, the most important being the astronomical tide, the meteorological forcing, the thermohaline properties (temperature and salinity) of the water mass, and the global climatic variations.

If the mean sea level, typically computed over 3 or 6 months, and the astronomical tide are subtracted from the observed sea level, one obtains the “residual sea level” or “meteorological tide”, which essentially accounts for the effect of the meteorological forcing.

Effects of the astronomical tide

The astronomical tide is the product of the gravitational attraction exerted by the Moon and the Sun on the oceanic mass, and it depends on the position of the Earth relative to the two celestial bodies. Because the relative motion of such bodies is known with high precision, the tide evolution caused by their interactions is also predictable with high accuracy, unlike, for instance, the meteorological forecast. On the north Adriatic coast, the tide prevalingly exhibits two highs and two lows per day (semidiurnal type). At the new Moon and full Moon (syzygy) this phenomenon is more marked and the largest tidal ranges occur. At the first and last quarters (quadrature) the tidal range is less marked, often with only one high and one low per day (diurnal type). The tidal forecasts presented here were carried out using the TASK-2000 package (Bell et al., 1999).

Effects of the meteorological forcing

It mainly occurs through the action of wind and atmospheric pressure, whose variations are observed on relatively short time scales, i.e. from less than an hour to many days, following the evolution of the

meteorological situation, up to the seasonal and interannual time scales, due to climatic variations.

The atmospheric pressure acts via the relationship known as the “inverted barometer effect”. When pressure is relatively low in the north Adriatic water is driven from the South, which causes the sea level to rise, and vice versa.

The wind moves the water mass in its directions by surface drag. The prevailing winds on the Adriatic are Bora, which blows across the basin, and Sirocco, along the basin. Sirocco accumulates water towards the northern end of the basin. In the north Adriatic, Bora favours the sea level decrease on the eastern coast and an increase on the western coast. Libeccio favours the sea level increase in the Gulf of Trieste.

The combination of Scirocco and local low atmospheric causes “acqua alta”, namely the remarkable sea level increase observed on the northern coast.

The roles played by the atmospheric pressure and the wind are shown in Figure 2. It displays three curves, the middle one representing the mean sea level for each day of the year, obtained from the daily values of the 1939–2020 period, relative to ZIT; the other two curves are obtained from the middle curve by adding (upper curve) and subtracting (lower curve) the corresponding standard deviation for every day, respectively. The anomalies of the middle curve relative to the annual mean depend on the local effects of the wind and the atmospheric pressure.

It is evident that the sea level is relatively low in the winter months, when high atmospheric pressure and continental winds prevail, and markedly high in November, corresponding to more frequent southerly wind and low atmospheric pressure. The autumn peak is related to the “acqua alta” phenomenon which is mainly observed in October, November and December.

Figure 3 displays the extreme sea level values observed in the 1939-2020 period, for each day of the year. Heights are referred to ZIT.

The black line corresponds the 277.8 cm height and represents the surface of Molo Sartorio, that is, with good approximation, the level beyond which an overflow takes place. The red and blue curves represent the daily highest and lowest heights, respectively. Among the extremes we recall the absolute maximum of 360 cm on 26 November 1969 (82 cm above the surface of Molo Sartorio) e the absolute minimum of 30 cm on 14 February 1934 (248 cm below the surface of Molo Sartorio, not included in the figure).

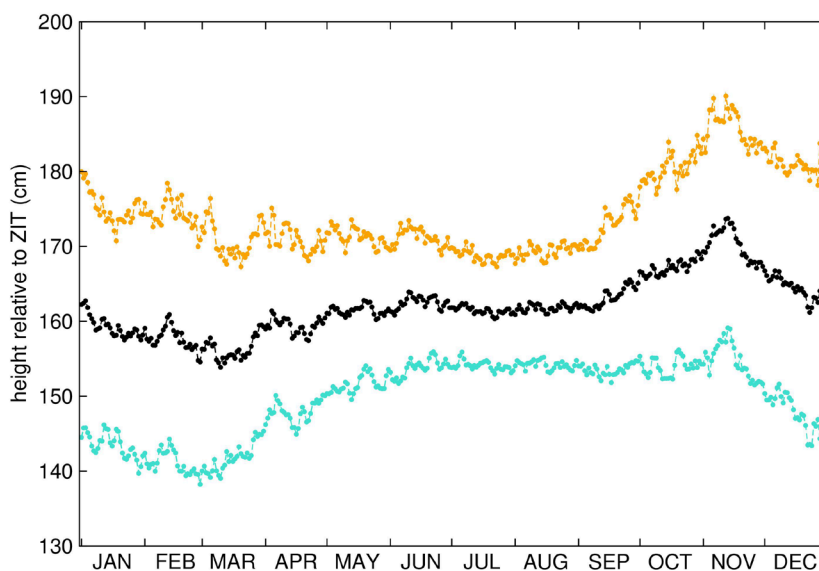


Figure 2

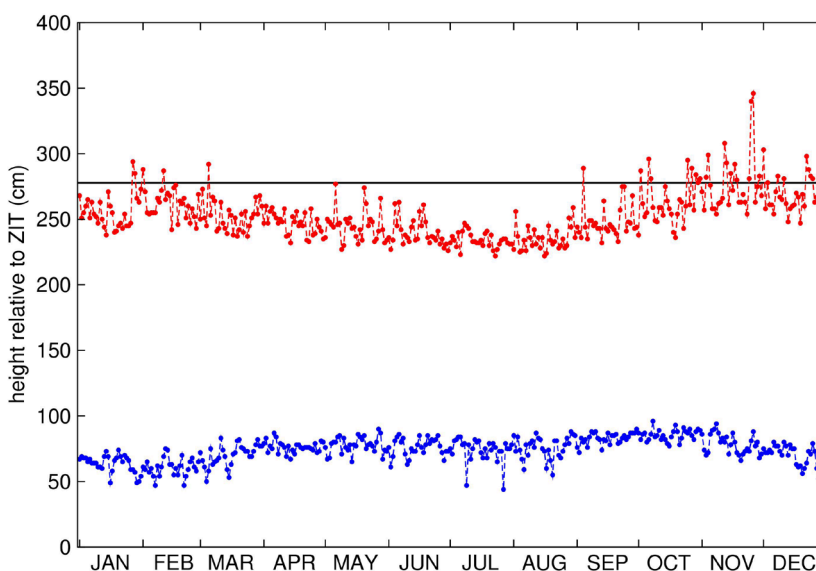


Figure 3

Trieste Molo Sartorio - overflow events; heights relative to Zero Istituto Talassografico

d	m	y	hgt(cm)		d	m	y	hgt(cm)		d	m	y	hgt(cm)
14	10	1875	290	A	11	12	1959	285		25	12	2009	283
23	2	1879	287	A	5	11	1960	278		30	3	2010	284
25	2	1879	320	A	12	11	1961	279		3	12	2010	280
10	12	1882	287	A	4	11	1966	306		24	12	2010	290
12	3	1895	286		3	11	1968	289		27	10	2012	280
15	10	1896	ND	X	18	12	1968	285		11	2	2013	290
27	11	1898	313		26	11	1969	360	S	5	3	2016	294
6	12	1903	ND	X	28	12	1970	278		29	10	2018	287
16	10	1906	282	S	18	11	1975	282		29	10	2018	289
15	11	1910	317		17	2	1979	279		12	11	2019	316
18	11	1910	283		24	9	1979	282		13	11	2019	296
13	11	1913	291		22	12	1979	302		15	11	2019	287
24	10	1926	294	S	25	10	1980	302		15	11	2019	278
10	11	1927	286	S	27	10	1981	291		17	11	2019	298
18	11	1935	289		6	10	1982	304		23	12	2019	293
4	12	1935	278		7	10	1982	281		24	12	2019	280
16	4	1936	291	S	20	5	1984	279		8	12	2020	283
22	3	1937	284		23	9	1984	278		3	11	2021	279
28	11	1947	279		13	11	1985	281		22	11	2022	310
29	11	1947	285		1	2	1986	289		23	11	2022	286
27	1	1948	295	S	24	11	1987	284		27	10	2023	301
28	1	1948	286		2	10	1993	289		28	10	2023	284
4	9	1948	294	S	6	5	1997	284		30	10	2023	282
12	11	1951	302	S	31	10	2004	284		3	11	2023	287
15	12	1952	281		28	5	2007	279		5	11	2023	301
11	12	1954	281	S	1	12	2008	320					
15	11	1959	290		23	12	2009	286					

A = approximate height
 S = estimated height
 X = unknown height

Table 1

In Table 1 we list the “acqua alta” events with overflow. Events caused by waves only, generally due to Libeccio, are excluded from the list.

Effects of the thermohaline properties

Temperature and salinity variations imply changes of the water density that also reflect on the sea level. This is the “steric effect”, consisting of a sea level increase when water temperature increases and a sea level decrease when salinity increases.

These variations can be observed both in the seasonal sea level cycle, which is characterized by relatively low values in winter-spring and high values in autumn, and in the long-term evolution, which depends on decadal and secular climatic variations.

Effects of the global climatic variations

In order to detect their effects on the sea level long time series of observations are required. As mentioned above, the station of Trieste is being operated for over a century and it is, therefore, suitable for studying the centennial sea level evolution.

In the Mediterranean (excluding the Black Sea) there are only four other stations with at least 80 years of observations, namely Genoa (since 1884), Marseille (1885), Venice (1871) and Marina di Ravenna (1873); the last two stations are affected by marked anthropic subsidence (ground lowering).

On the global scale, after the glacial peak about 21000 years ago, on average the sea level has always been rising at variable rates. Between 2000 and 100 years ago the rise rate was less than 2 cm per century. High quality measurements at stations that are considered stable, among which Trieste, Genoa and Marseille, agree on sea level rise rates between 1.5 and 2.0 mm/year in

the 20th century, having taken into account and removed the vertical land movements. During the last 30 years the rise rate is estimated to be greater than 3 mm/year.

Figure 4 displays the time series of the annual mean sea level at Trieste since 1875 together with linear trends over various periods. Note the variability, and, therefore, the low reliability, of trends when the analysed period is short. The time period since 1993 is also covered by satellite altimetry.

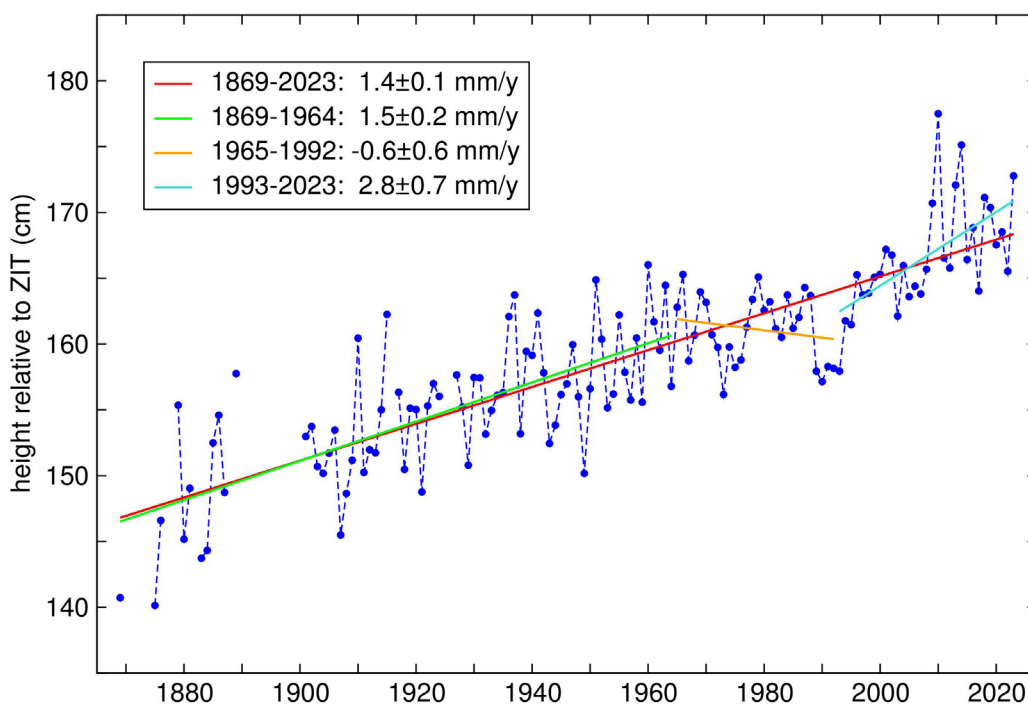


Figure 4

Figure 5 shows the time series of the overflow events at Trieste since 1875 (upper panel) and that of the annual number of such events (lower panel).

According to the most recent projections by the IPCC for the 21st century, compared to the 1995-2014 period, in 2050 the mean sea level at Trieste would be 15 cm (with an uncertainty interval of 0-33 cm) higher in the most favourable scenario and 21 cm (8-37 cm) higher in the most unfavourable one; in 2100 the predicted increase is 31 cm (3-69 cm) in the most favourable scenario e 66 cm (35 e 120 cm) in the most unfavourable one (<https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool>).

However, the future scenarios simulations allow to hypothesize that the frequency and intensity of extreme “acqua alta” events in the north Adriatic should not increase compare to the present, due to a simultaneous decrease of the frequency and intensity of the meteorological events that trigger them. In spite of this, at least by the end of the 21st century, the coastal flood risk is predicted to increase because of the prevailing role played by the mean sea level rise.

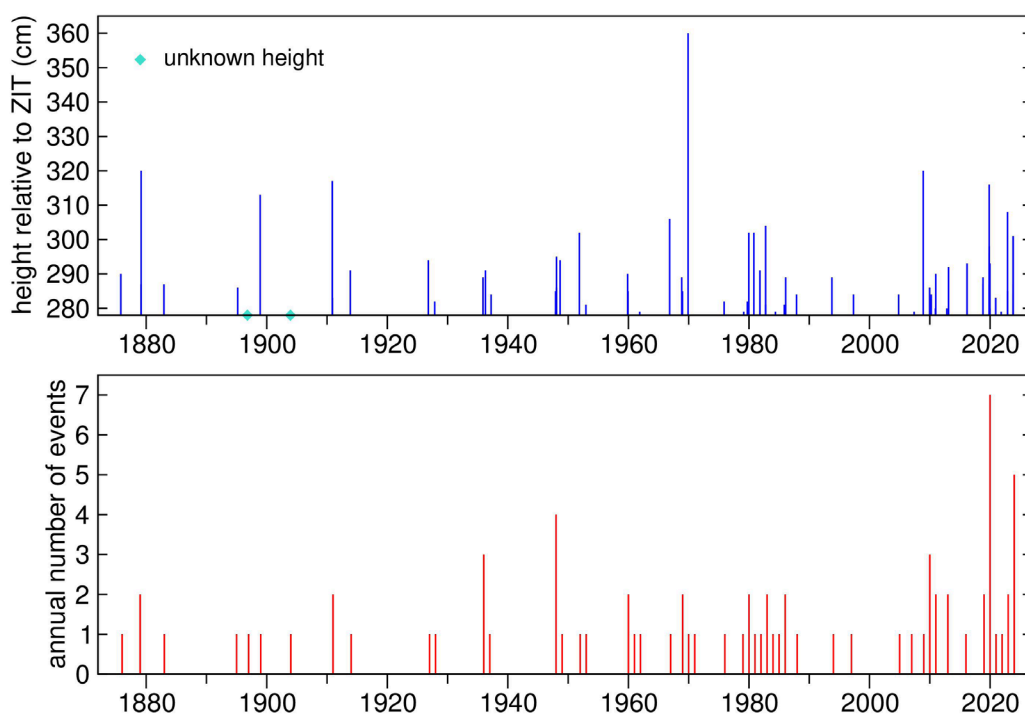


Figure 5

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- Raichich, F. (2023): "The sea level time series of Trieste, Molo Sartorio, Italy (1869–2021)", Earth System Science Data, 15, 1746-1763 (<https://doi.org/10.5194/essd-15-1749-2023>).

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The wording M.S.L. (mean sea level) that the user finds in the following pages, and to which the tide forecasts refer, is not a constant height, nor is its trend over time exactly predictable. This is in accordance with what has already been described on page 5 about the observed level, which is given by the sum of the astronomical contribution, whose values are reported in the following pages, and a variable component depending on the weather conditions.

High and low tides for the Port of Trieste

January		2024							
d	time	cm	time	cm	time	cm	time	cm	
1	6.08	-4	11.20	24	18.24	-41			
2	1.27	27	7.05	-2	11.45	14	18.54	-33	
3	2.13	29	8.26	-2	12.17	2	19.26	-25	
4	3.01	30	11.51	-10	14.49	-8	20.17	-16	
5	3.52	33	12.35	-21	18.26	-4	21.43	-8	
6	4.45	35	12.59	-33	19.33	5	23.20	-4	
7	5.37	38	13.29	-43	20.12	14			
8	0.33	-3	6.29	41	13.58	-53	20.47	21	
9	1.34	-5	7.19	45	14.33	-60	21.23	28	
10	2.25	-9	8.08	48	15.10	-66	21.59	33	
11	3.12	-12	8.54	51	15.47	-69	22.37	36	
12	3.58	-15	9.38	51	16.25	-69	23.15	38	
13	4.43	-16	10.18	49	17.00	-67	23.56	39	
14	5.29	-15	10.56	42	17.34	-62			
15	0.32	40	6.18	-14	11.34	31	18.05	-54	
16	1.12	41	7.12	-12	12.12	18	18.33	-44	
17	1.54	40	8.28	-12	13.00	4	19.01	-32	
18	2.39	39	10.27	-17	14.48	-9	19.29	-19	
19	3.35	37	12.07	-28	18.28	-6	20.21	-7	
20	4.43	35	12.59	-39	19.53	6	23.03	2	
21	5.54	34	13.35	-48	20.29	17			
22	0.54	2	6.51	35	14.09	-55	20.58	25	
23	1.59	-2	7.40	36	14.42	-59	21.28	31	
24	2.43	-7	8.21	39	15.13	-62	21.53	35	
25	3.16	-11	8.56	42	15.43	-63	22.20	36	
26	3.45	-15	9.26	44	16.08	-63	22.45	37	
27	4.12	-17	9.54	44	16.34	-61	23.07	37	
28	4.40	-18	10.21	41	16.58	-57	23.32	37	
29	5.11	-18	10.47	36	17.20	-51	23.59	38	
30	5.44	-18	11.13	27	17.40	-44			
31	0.25	38	6.20	-17	11.40	17	17.58	-35	

Solar time; heights, in cm, refer to M.S.L.

High and low tides for the Port of Trieste

February		2024							
d	time	cm	time	cm	time	cm	time	cm	
1	0.53	37	7.05	-16	12.08	6	18.07	-25	
2	1.24	35	8.08	-15	13.00	-5	17.58	-15	
3	2.04	32	10.19	-19					
4	3.09	29	12.20	-29	20.45	8	22.27	8	
5	4.42	28	13.09	-39	20.30	18			
6	0.47	4	6.07	31	13.46	-50	20.48	27	
7	1.50	-4	7.15	38	14.23	-59	21.15	35	
8	2.38	-12	8.09	45	14.59	-66	21.45	41	
9	3.18	-20	8.55	51	15.34	-71	22.16	46	
10	3.58	-26	9.36	52	16.06	-71	22.47	50	
11	4.35	-30	10.14	49	16.35	-67	23.18	52	
12	5.15	-32	10.49	42	17.02	-60	23.46	52	
13	5.53	-31	11.24	30	17.25	-50			
14	0.14	50	6.38	-28	11.59	16	17.44	-38	
15	0.39	46	7.31	-24	12.37	2	17.57	-25	
16	1.05	40	8.59	-21	14.05	-10	17.23	-12	
17	1.38	31	11.33	-26					
18	2.48	21	12.44	-34	20.32	15			
19	0.52	9	5.59	20	13.23	-42	20.26	24	
20	1.51	0	7.07	24	13.55	-49	20.43	31	
21	2.21	-8	7.49	30	14.26	-54	21.05	36	
22	2.46	-15	8.22	36	14.52	-58	21.27	39	
23	3.09	-20	8.52	41	15.18	-60	21.48	41	
24	3.32	-25	9.17	44	15.43	-60	22.09	42	
25	3.56	-28	9.44	44	16.04	-58	22.29	44	
26	4.21	-31	10.12	41	16.26	-53	22.49	45	
27	4.48	-33	10.37	36	16.45	-47	23.10	46	
28	5.14	-34	11.04	28	17.03	-38	23.31	45	
29	5.44	-33	11.32	19	17.2	-29	23.5	42	

Solar time; heights, in cm, refer to M.S.L.

High and low tides for the Port of Trieste

March		2024							
d	time	cm	time	cm	time	cm	time	cm	
1	6.16	-31	12.03	10	17.20	-20			
2	0.12	38	6.58	-27	12.46	0	17.04	-10	
3	0.35	31	8.04	-23					
4	1.09	23	11.05	-25	20.26	15			
5	0.11	12	4.09	16	12.40	-35	20.05	24	
6	1.24	0	6.13	23	13.24	-46	20.21	34	
7	1.59	-12	7.18	33	14.02	-56	20.46	42	
8	2.32	-23	8.06	42	14.36	-62	21.12	50	
9	3.07	-34	8.48	48	15.06	-65	21.40	55	
10	3.41	-42	9.27	49	15.36	-63	22.09	59	
11	4.17	-47	10.04	45	16.03	-57	22.33	60	
12	4.51	-49	10.40	37	16.25	-48	22.58	59	
13	5.27	-47	11.14	26	16.48	-37	23.19	54	
14	6.03	-42	11.50	15	17.02	-25	23.39	46	
15	6.45	-35	12.34	3	17.05	-13	23.53	36	
16	7.46	-27	23.56	25					
17	10.19	-23	21.40	16					
18	12.05	-29	19.44	22					
19	1.58	1	6.19	10	12.51	-35	19.52	30	
20	1.57	-8	7.10	18	13.26	-41	20.08	35	
21	2.11	-16	7.40	25	13.54	-47	20.28	39	
22	2.31	-23	8.10	32	14.20	-50	20.47	42	
23	2.51	-29	8.35	37	14.45	-52	21.06	45	
24	3.12	-35	9.04	40	15.09	-51	21.25	47	
25	3.35	-40	9.31	40	15.30	-47	21.46	49	
26	4.00	-45	10.00	38	15.53	-42	22.06	50	
27	4.23	-47	10.29	33	16.12	-35	22.25	50	
28	4.49	-48	10.57	27	16.32	-27	22.46	47	
29	5.14	-46	11.28	21	16.47	-19	23.04	43	
30	5.44	-42	12.02	13	16.55	-10	23.21	36	
31	6.19	-36	13.00	5	16.38	-1	23.36	27	

Solar time; heights, in cm, refer to M.S.L.

High and low tides for the Port of Trieste

April		2024							
d	time	cm	time	cm	time	cm	time	cm	
1	7.18	-29	23.28	17					
2	9.45	-25	19.05	21					
3	1.05	4	4.19	9	11.53	-33	19.15	31	
4	1.17	-9	6.10	18	12.46	-42	19.36	41	
5	1.45	-22	7.08	28	13.24	-49	20.03	49	
6	2.16	-36	7.55	36	13.58	-52	20.30	56	
7	2.48	-47	8.36	40	14.29	-51	20.56	61	
8	3.20	-56	9.15	41	14.59	-46	21.22	63	
9	3.55	-62	9.54	37	15.27	-39	21.49	62	
10	4.27	-63	10.33	31	15.53	-30	22.11	58	
11	5.01	-59	11.12	24	16.17	-20	22.33	51	
12	5.35	-52	11.53	16	16.38	-10	22.50	41	
13	6.13	-43	12.49	9	16.56	0	23.03	30	
14	7.02	-33	22.46	19					
15	8.41	-25	18.32	18					
16	10.48	-25	18.40	26					
17	1.42	-5	5.55	3	11.54	-29	19.01	32	
18	1.35	-13	6.43	11	12.36	-34	19.20	37	
19	1.47	-21	7.16	18	13.07	-37	19.40	41	
20	2.08	-29	7.47	24	13.35	-39	20.00	45	
21	2.27	-37	8.18	28	14.04	-38	20.19	48	
22	2.49	-44	8.49	31	14.29	-36	20.38	50	
23	3.12	-51	9.21	32	14.56	-32	21.01	52	
24	3.37	-55	9.51	32	15.21	-27	21.24	52	
25	4.02	-57	10.22	30	15.48	-22	21.48	50	
26	4.28	-57	10.55	26	16.14	-15	22.12	46	
27	4.57	-54	11.33	21	16.38	-8	22.36	40	
28	5.28	-49	12.22	16	17.05	0	22.59	32	
29	6.10	-42	14.01	12	18.00	8	23.23	23	
30	7.17	-34	17.04	19	22.14	11	23.12	11	

Solar time; heights, in cm, refer to M.S.L.

High and low tides for the Port of Trieste

May		2024							
d	time	cm	time	cm	time	cm	time	cm	
1	9.02	-30	17.46	28					
2	0.23	-2	4.08	5	10.46	-32	18.16	38	
3	0.50	-16	5.49	12	11.48	-36	18.46	47	
4	1.20	-31	6.49	19	12.34	-37	19.14	54	
5	1.53	-45	7.38	25	13.12	-36	19.42	59	
6	2.27	-57	8.24	29	13.48	-32	20.12	62	
7	3.00	-65	9.08	31	14.23	-26	20.39	61	
8	3.35	-70	9.50	30	14.58	-20	21.07	58	
9	4.08	-69	10.32	28	15.32	-13	21.36	53	
10	4.42	-65	11.16	25	16.06	-6	22.02	45	
11	5.17	-57	12.04	21	16.42	0	22.25	36	
12	5.53	-48	13.07	18	17.29	6	22.47	26	
13	6.38	-39	14.43	18	18.57	11	22.58	16	
14	7.37	-32	16.24	22					
15	9.01	-27	17.17	27					
16	1.18	-4	3.48	-3	10.17	-26	17.52	33	
17	1.04	-13	5.53	1	11.17	-26	18.15	38	
18	1.22	-23	6.45	7	12.03	-26	18.38	42	
19	1.42	-33	7.26	13	12.41	-25	19.01	46	
20	2.05	-42	8.04	18	13.16	-23	19.27	49	
21	2.27	-50	8.39	22	13.53	-20	19.54	51	
22	2.52	-57	9.16	26	14.26	-18	20.24	52	
23	3.17	-61	9.49	27	15.01	-15	20.53	51	
24	3.46	-62	10.25	28	15.35	-11	21.27	49	
25	4.17	-62	11.04	26	16.13	-7	21.57	45	
26	4.52	-59	11.51	24	16.53	-3	22.31	39	
27	5.31	-54	12.50	23	17.50	3	23.07	31	
28	6.17	-48	14.12	23	19.15	6	23.48	21	
29	7.14	-43	15.32	28	21.20	4			
30	1.01	10	8.20	-37	16.32	35	23.21	-7	
31	3.20	2	9.26	-33	17.15	43			

Solar time; heights, in cm, refer to M.S.L.

High and low tides for the Port of Trieste

June		2024							
d	time	cm	time	cm	time	cm	time	cm	
1	0.17	-22	5.17	3	10.34	-28	17.51	49	
2	0.58	-36	6.33	8	11.34	-24	18.24	54	
3	1.34	-50	7.31	14	12.27	-19	18.57	56	
4	2.09	-61	8.24	20	13.15	-14	19.32	56	
5	2.45	-68	9.12	25	14.01	-10	20.09	54	
6	3.20	-71	9.57	28	14.47	-7	20.44	51	
7	3.55	-70	10.40	30	15.31	-4	21.20	46	
8	4.30	-66	11.22	30	16.16	-2	21.53	40	
9	5.05	-60	12.03	29	17.01	0	22.23	34	
10	5.39	-54	12.47	27	17.50	2	22.52	27	
11	6.15	-47	13.33	26	18.48	4	23.20	19	
12	6.51	-40	14.27	27	20.10	5	23.46	10	
13	7.34	-34	15.21	29	23.29	-1			
14	0.33	-1	8.24	-27	16.08	33			
15	0.28	-12	4.17	-7	9.27	-20	16.50	37	
16	0.55	-23	6.21	-3	10.35	-15	17.25	40	
17	1.18	-34	7.21	4	11.39	-11	18.01	43	
18	1.43	-44	8.07	11	12.34	-9	18.37	45	
19	2.07	-52	8.45	18	13.22	-7	19.16	47	
20	2.35	-58	9.20	23	14.10	-7	19.57	48	
21	3.06	-63	9.55	27	14.54	-8	20.39	49	
22	3.40	-65	10.33	30	15.40	-8	21.20	49	
23	4.15	-66	11.13	32	16.26	-8	22.01	46	
24	4.53	-65	11.57	33	17.14	-6	22.40	41	
25	5.32	-62	12.43	34	18.09	-5	23.18	33	
26	6.10	-57	13.31	35	19.09	-3			
27	0.01	22	6.49	-49	14.23	38	20.29	-5	
28	0.57	10	7.27	-41	15.12	41	22.17	-12	
29	2.26	-2	8.11	-30	16.03	44	23.46	-25	
30	4.55	-6	9.08	-19	16.50	46			

Solar time; heights, in cm, refer to M.S.L.

High and low tides for the Port of Trieste

July		2024							
d	time	cm	time	cm	time	cm	time	cm	
1	0.40	-38	6.42	1	10.25	-9	17.38	46	
2	1.22	-50	7.51	10	11.56	-3	18.26	46	
3	2.00	-59	8.42	19	13.09	-1	19.14	45	
4	2.36	-65	9.23	27	14.13	-2	19.59	45	
5	3.13	-68	10.01	32	15.03	-4	20.43	44	
6	3.47	-68	10.34	35	15.45	-7	21.20	43	
7	4.18	-66	11.05	35	16.22	-8	21.53	41	
8	4.49	-63	11.36	35	16.57	-9	22.24	38	
9	5.16	-59	12.06	35	17.33	-8	22.51	32	
10	5.42	-53	12.36	35	18.13	-7	23.18	24	
11	6.08	-46	13.08	35	18.59	-6	23.46	14	
12	6.32	-37	13.43	35	20.06	-6			
13	0.20	3	6.57	-28	14.23	35	22.24	-10	
14	1.42	-9	7.17	-17	15.09	35			
15	0.20	-21	16.03	35					
16	0.51	-32	8.07	3	10.33	1	17.03	35	
17	1.20	-41	8.28	12	12.13	2	18.02	37	
18	1.50	-50	8.53	20	13.21	-1	18.58	41	
19	2.23	-58	9.20	27	14.17	-5	19.52	45	
20	2.57	-64	9.53	33	15.03	-10	20.37	49	
21	3.32	-69	10.24	38	15.47	-15	21.22	51	
22	4.07	-71	10.58	41	16.30	-17	22.03	49	
23	4.40	-70	11.34	44	17.10	-18	22.40	44	
24	5.13	-66	12.08	46	17.55	-18	23.16	35	
25	5.41	-59	12.41	47	18.44	-17	23.54	22	
26	6.07	-49	13.16	46	19.43	-17			
27	0.37	8	6.32	-37	13.52	44	21.13	-19	
28	1.47	-6	6.52	-23	14.37	40	23.15	-27	
29	5.55	-9	6.54	-9	15.43	36			
30	0.31	-38	8.22	5	9.15	5	17.12	33	
31	1.17	-47	8.23	17	12.37	6	18.28	33	

Solar time; heights, in cm, refer to M.S.L.

High and low tides for the Port of Trieste

August		2024							
d	time	cm	time	cm	time	cm	time	cm	
1	1.54	-55	8.50	27	13.52	0	19.3	36	
2	2.27	-61	9.16	33	14.37	-7	20.12	39	
3	3.00	-64	9.43	38	15.11	-12	20.50	42	
4	3.29	-66	10.09	40	15.40	-16	21.20	44	
5	3.56	-66	10.33	41	16.10	-19	21.49	44	
6	4.22	-63	10.56	42	16.36	-21	22.14	41	
7	4.45	-59	11.19	42	17.04	-22	22.42	35	
8	5.06	-52	11.42	42	17.37	-21	23.08	27	
9	5.26	-44	12.05	41	18.11	-20	23.35	16	
10	5.41	-34	12.31	40	18.51	-19			
11	0.06	5	5.47	-24	12.59	37	19.46	-18	
12	0.49	-5	5.20	-14	13.31	32	21.38	-19	
13	14.30	27							
14	0.18	-27	9.03	11	10.04	10	16.13	24	
15	0.59	-37	8.27	19	12.47	6	17.52	27	
16	1.34	-47	8.38	27	13.46	-3	18.58	34	
17	2.08	-57	8.59	35	14.26	-12	19.51	42	
18	2.41	-64	9.27	42	15.03	-21	20.36	49	
19	3.14	-70	9.55	48	15.39	-28	21.17	52	
20	3.45	-71	10.25	52	16.16	-33	21.56	50	
21	4.14	-69	10.53	55	16.52	-36	22.31	43	
22	4.41	-62	11.21	56	17.32	-36	23.07	32	
23	5.03	-52	11.47	55	18.12	-33	23.43	19	
24	5.24	-39	12.12	50	19.00	-29			
25	0.23	5	5.37	-26	12.37	43	20.12	-25	
26	1.39	-8	5.14	-12	13.03	33	22.44	-26	
27	13.54	22							
28	0.18	-35	8.19	17	12.54	10	17.41	19	
29	1.05	-43	8.10	27	13.44	-1	18.55	24	
30	1.38	-50	8.26	34	14.12	-10	19.38	31	
31	2.09	-56	8.47	40	14.36	-17	20.11	37	

Solar time; heights, in cm, refer to M.S.L.

High and low tides for the Port of Trieste

September		2024							
d	time	cm	time	cm	time	cm	time	cm	
1	2.36	-60	9.10	43	14.58	-23	20.40	41	
2	3.03	-61	9.32	45	15.22	-28	21.07	44	
3	3.26	-61	9.52	46	15.46	-32	21.34	43	
4	3.48	-58	10.12	47	16.10	-34	22.00	40	
5	4.10	-52	10.33	48	16.37	-36	22.28	35	
6	4.30	-45	10.52	48	17.03	-36	22.55	27	
7	4.47	-36	11.11	46	17.31	-35	23.23	18	
8	4.58	-26	11.31	42	18.00	-32	23.52	9	
9	4.56	-16	11.48	37	18.39	-28			
10	0.35	-1	4.24	-8	12.05	29	19.37	-23	
11	12.16	21	23.07	-23					
12	8.10	17	13.00	11	15.52	13			
13	0.30	-33	7.51	25	13.19	0	17.57	20	
14	1.07	-44	8.04	34	13.45	-12	19.00	31	
15	1.40	-54	8.24	43	14.15	-24	19.46	40	
16	2.12	-61	8.48	51	14.48	-35	20.26	47	
17	2.42	-64	9.15	57	15.22	-44	21.05	48	
18	3.11	-63	9.43	61	15.54	-50	21.44	45	
19	3.38	-57	10.09	63	16.29	-53	22.19	38	
20	4.05	-48	10.33	62	17.05	-52	22.56	28	
21	4.25	-37	10.57	57	17.43	-47	23.36	16	
22	4.43	-25	11.16	49	18.24	-39			
23	0.21	5	4.51	-12	11.34	38	19.24	-30	
24	11.35	26	21.55	-25					
25	8.49	17	23.45	-31					
26	7.23	25	13.39	0	18.04	12			
27	0.33	-38	7.31	33	13.39	-10	18.54	19	
28	1.08	-44	7.50	39	13.57	-19	19.27	27	
29	1.36	-49	8.10	43	14.16	-26	19.55	32	
30	2.02	-52	8.31	47	14.37	-32	20.22	37	

Solar time; heights, in cm, refer to M.S.L.

High and low tides for the Port of Trieste

October		2024							
d	time	cm	time	cm	time	cm	time	cm	
1	2.26	-53	8.49	49	14.59	-38	20.50	39	
2	2.50	-51	9.08	50	15.23	-43	21.19	39	
3	3.13	-47	9.28	51	15.45	-47	21.47	36	
4	3.36	-40	9.47	51	16.10	-49	22.15	32	
5	3.56	-33	10.07	50	16.35	-48	22.45	26	
6	4.14	-25	10.26	47	16.59	-46	23.13	19	
7	4.30	-17	10.46	42	17.26	-41	23.47	12	
8	4.31	-8	11.02	35	18.01	-35			
9	0.41	4	3.58	-1	11.12	27	18.55	-27	
10	10.41	17	21.27	-24					
11	6.57	21	13.03	5	15.50	7	23.37	-31	
12	7.00	31	13.02	-8	17.49	16			
13	0.23	-41	7.16	40	13.28	-21	18.46	26	
14	1.00	-48	7.40	49	13.55	-35	19.29	34	
15	1.33	-51	8.04	57	14.26	-47	20.12	39	
16	2.04	-51	8.32	62	14.59	-57	20.52	40	
17	2.36	-47	8.58	65	15.33	-63	21.33	38	
18	3.04	-40	9.26	65	16.07	-65	22.12	32	
19	3.32	-31	9.51	61	16.41	-62	22.52	25	
20	3.58	-21	10.15	54	17.17	-55	23.36	17	
21	4.24	-11	10.36	44	17.58	-45			
22	0.36	9	4.41	0	10.53	32	18.54	-34	
23	10.45	20	20.40	-27					
24	6.12	19	22.36	-27					
25	6.24	27	13.17	-5	17.35	5	23.38	-32	
26	6.44	34	13.17	-14	18.25	12			
27	0.19	-36	7.06	40	13.35	-22	19.02	18	
28	0.50	-39	7.26	44	13.53	-30	19.33	24	
29	1.20	-40	7.44	47	14.15	-38	20.04	28	
30	1.48	-39	8.03	50	14.37	-45	20.35	31	
31	2.14	-36	8.25	51	15.00	-51	21.06	32	

Solar time; heights, in cm, refer to M.S.L.

High and low tides for the Port of Trieste

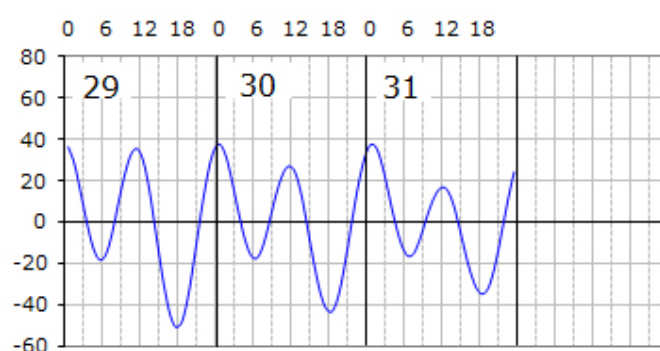
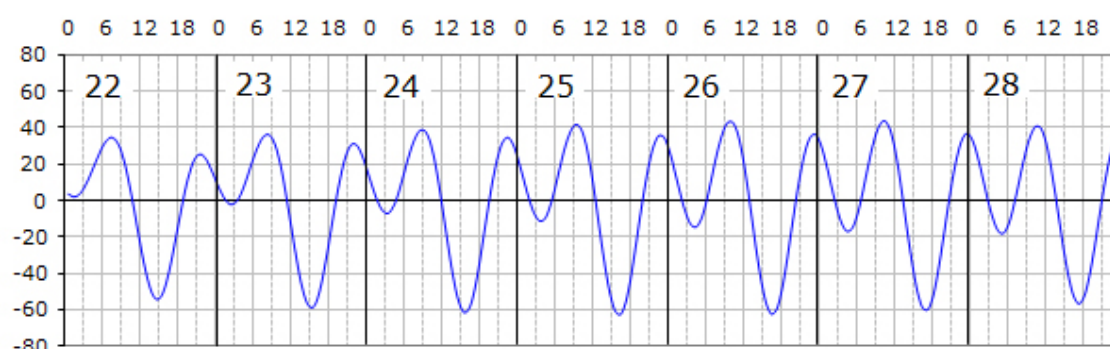
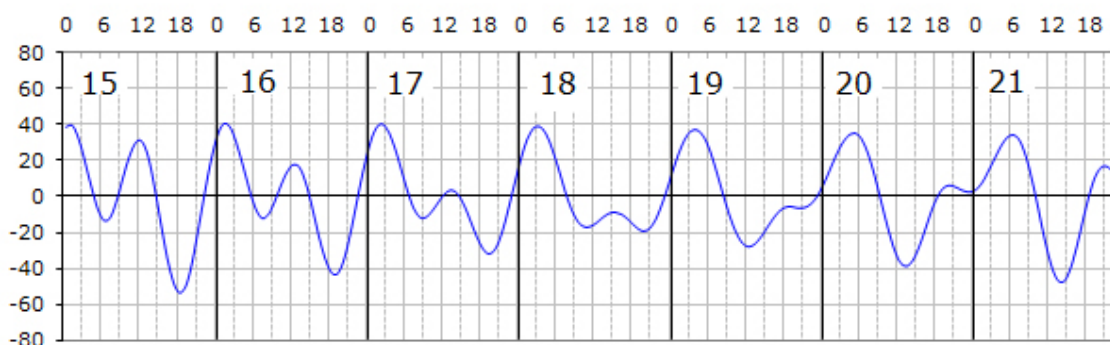
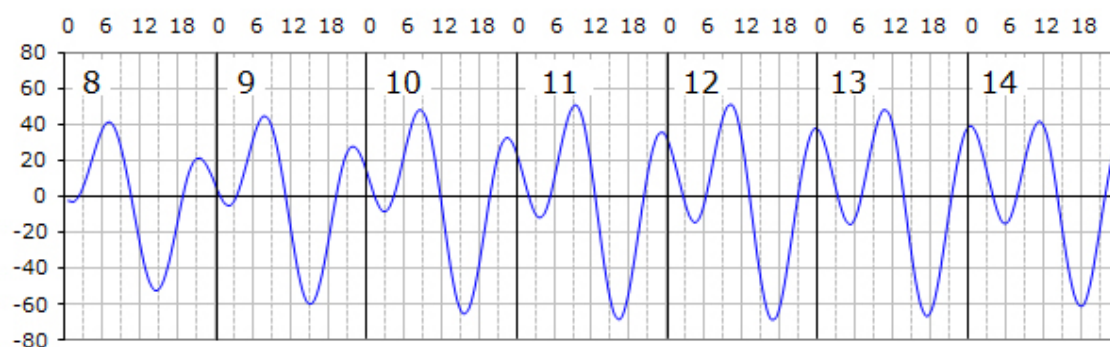
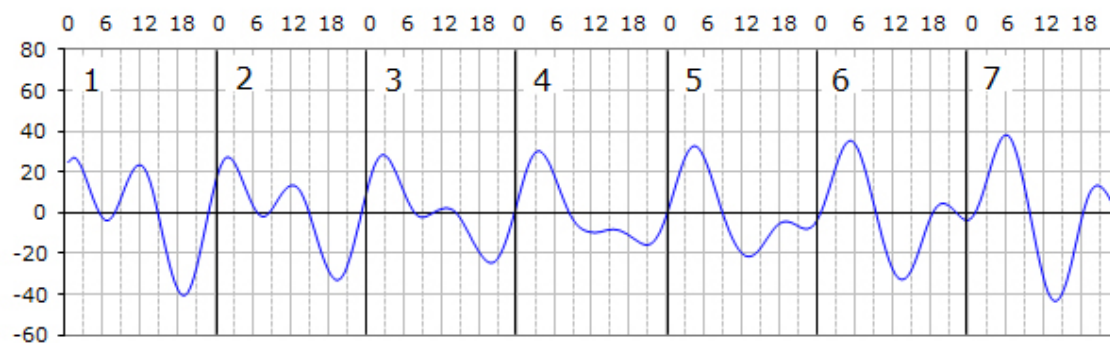
November		2024							
d	time	cm	time	cm	time	cm	time	cm	
1	2.41	-32	8.45	52	15.24	-55	21.36	31	
2	3.06	-27	9.09	51	15.47	-56	22.08	29	
3	3.31	-21	9.33	49	16.12	-55	22.39	25	
4	3.56	-16	9.58	46	16.40	-52	23.14	20	
5	4.20	-10	10.21	40	17.11	-47	23.55	15	
6	4.46	-3	10.47	33	17.51	-40			
7	1.19	10	5.17	5	11.10	25	18.50	-34	
8	4.49	15	8.13	12	11.30	14	20.28	-30	
9	5.31	24	11.58	2	15.10	6	22.12	-31	
10	5.57	34	12.29	-12	17.15	10	23.21	-35	
11	6.24	44	13.01	-27	18.21	17			
12	0.07	-36	6.50	52	13.31	-42	19.13	24	
13	0.48	-36	7.19	58	14.05	-55	20.00	28	
14	1.26	-32	7.49	62	14.38	-65	20.44	31	
15	2.03	-27	8.18	62	15.14	-70	21.28	31	
16	2.39	-21	8.50	60	15.50	-70	22.12	29	
17	3.15	-15	9.21	55	16.26	-66	22.56	26	
18	3.51	-9	9.52	47	17.04	-58	23.45	22	
19	4.29	-3	10.20	38	17.44	-49			
20	0.46	18	5.15	3	10.46	28	18.30	-40	
21	2.13	17	6.35	9	11.06	18	19.32	-33	
22	3.57	20	20.46	-28					
23	5.01	26	13.00	-2	15.10	-2	22.04	-26	
24	5.38	32	12.54	-12	17.38	1	23.05	-26	
25	6.05	37	13.12	-22	18.33	7	23.49	-26	
26	6.29	41	13.33	-32	19.16	12			
27	0.31	-25	6.51	44	13.54	-41	19.55	18	
28	1.07	-23	7.16	47	14.16	-48	20.29	22	
29	1.41	-20	7.42	48	14.40	-54	21.02	26	
30	2.14	-18	8.11	49	15.06	-58	21.35	27	

Solar time; heights, in cm, refer to M.S.L.

High and low tides for the Port of Trieste

December		2024						
d	time	cm	time	cm	time	cm	time	cm
1	2.47	-16	8.42	49	15.33	-59	22.1	27
2	3.21	-14	9.14	48	16.02	-59	22.44	26
3	3.57	-11	9.47	46	16.36	-56	23.25	24
4	4.35	-7	10.21	41	17.14	-53		
5	0.16	22	5.19	-2	10.54	35	17.54	-48
6	1.18	21	6.23	2	11.31	26	18.44	-43
7	2.36	24	7.58	4	12.21	15	19.39	-38
8	3.47	29	10.13	-2	14.07	5	20.45	-32
9	4.39	37	11.45	-15	16.30	1	21.53	-27
10	5.19	43	12.33	-30	18.02	6	22.58	-22
11	5.56	49	13.11	-45	19.06	13	23.59	-17
12	6.33	52	13.48	-57	20.03	20		
13	0.56	-13	7.13	54	14.26	-65	20.51	25
14	1.45	-10	7.52	53	15.03	-70	21.37	29
15	2.34	-9	8.33	51	15.40	-70	22.21	31
16	3.20	-8	9.12	48	16.18	-67	23.00	31
17	4.05	-7	9.50	44	16.53	-61	23.41	30
18	4.49	-6	10.22	38	17.29	-55		
19	0.22	28	5.32	-3	10.53	31	18.02	-48
20	1.03	27	6.21	0	11.19	22	18.35	-41
21	1.52	26	7.25	2	11.45	13	19.10	-34
22	2.43	27	9.24	1	12.08	2	19.53	-26
23	3.38	30	12.19	-9	15.01	-8	20.55	-19
24	4.25	32	12.51	-20	18.20	-4	22.14	-12
25	5.08	35	13.13	-31	19.23	4	23.28	-8
26	5.48	37	13.35	-40	20.05	12		
27	0.30	-6	6.27	40	13.59	-48	20.40	18
28	1.19	-7	7.08	42	14.25	-54	21.11	24
29	2.05	-8	7.48	45	14.55	-58	21.42	27
30	2.45	-10	8.29	47	15.26	-62	22.13	30
31	3.25	-12	9.09	49	16.00	-63		

Solar time; heights, in cm, refer to M.S.L.





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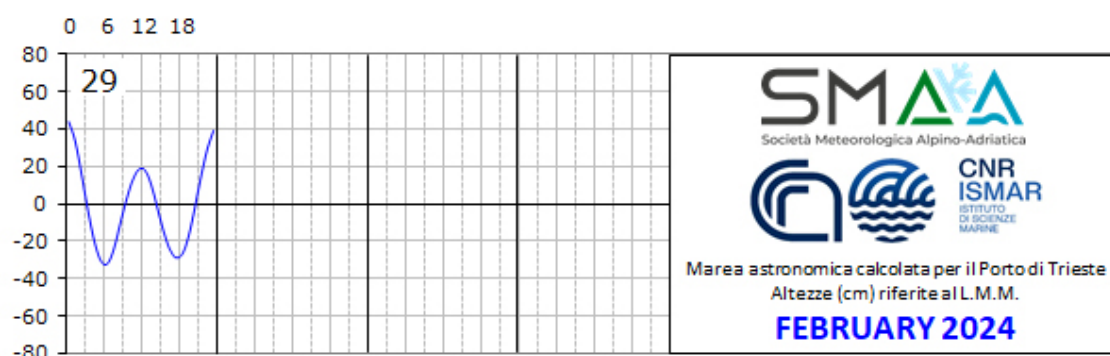
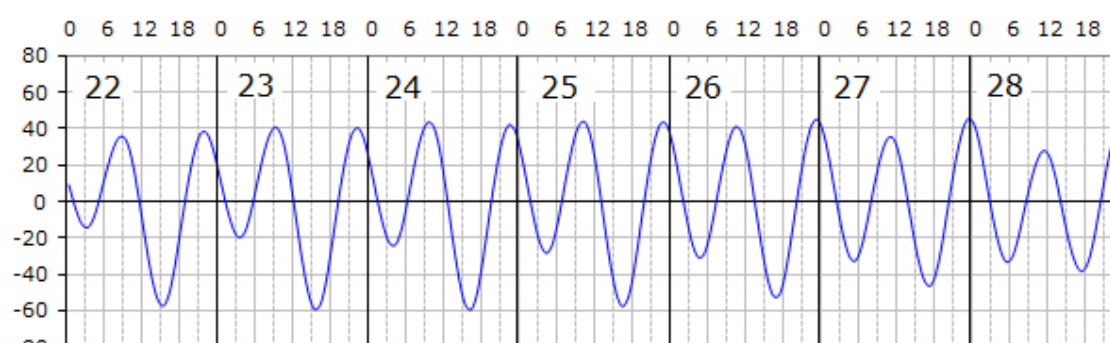
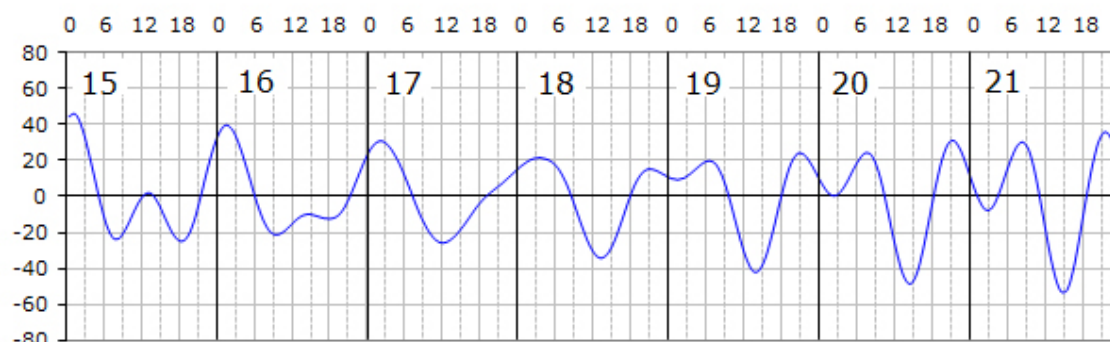
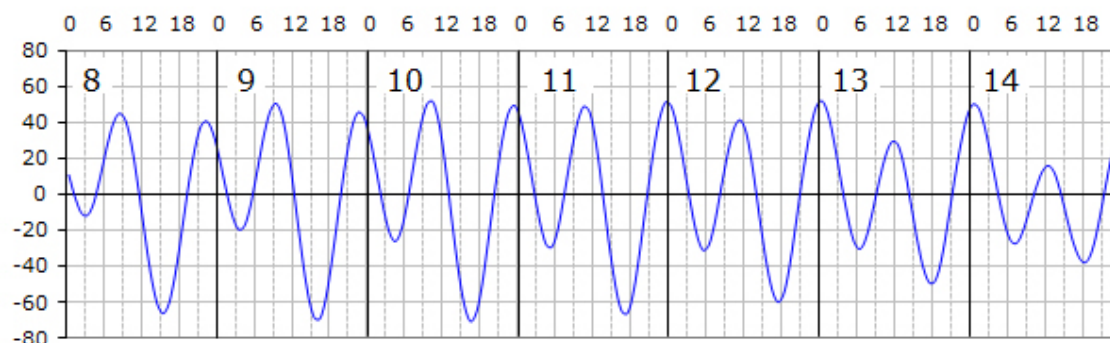
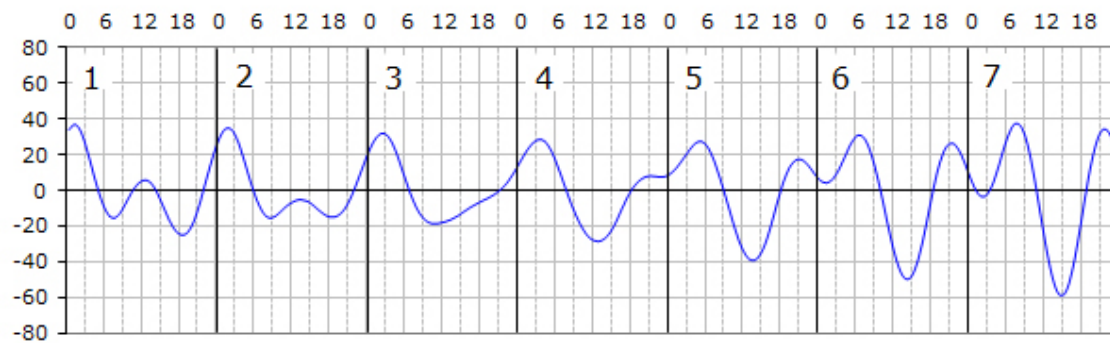
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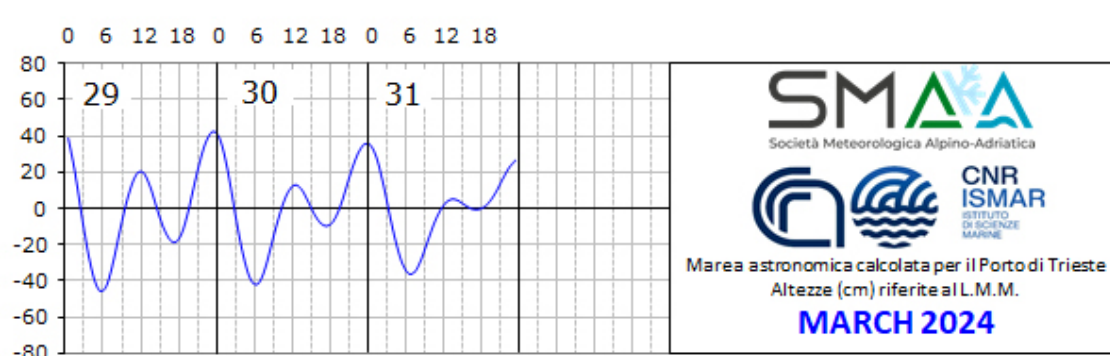
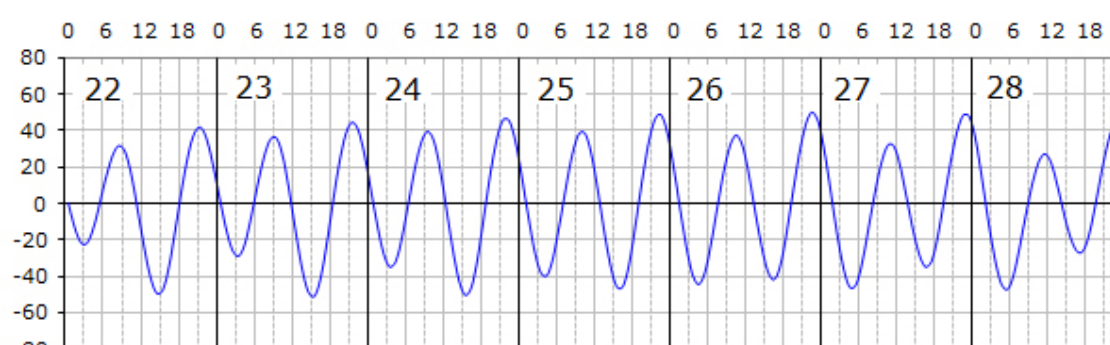
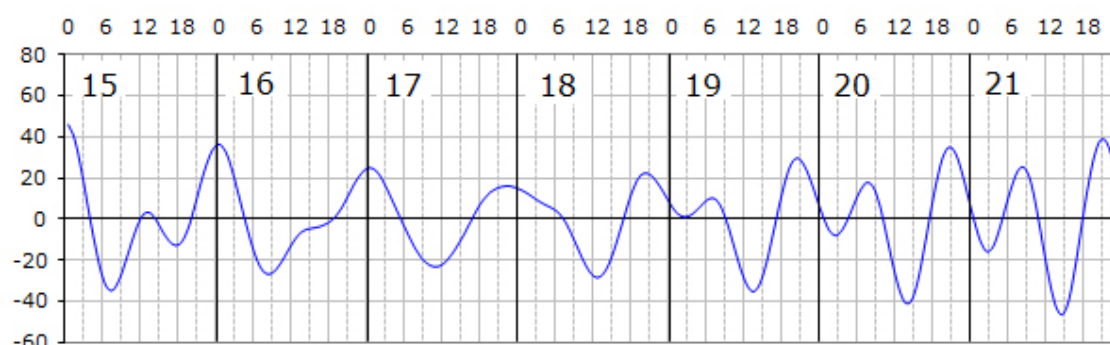
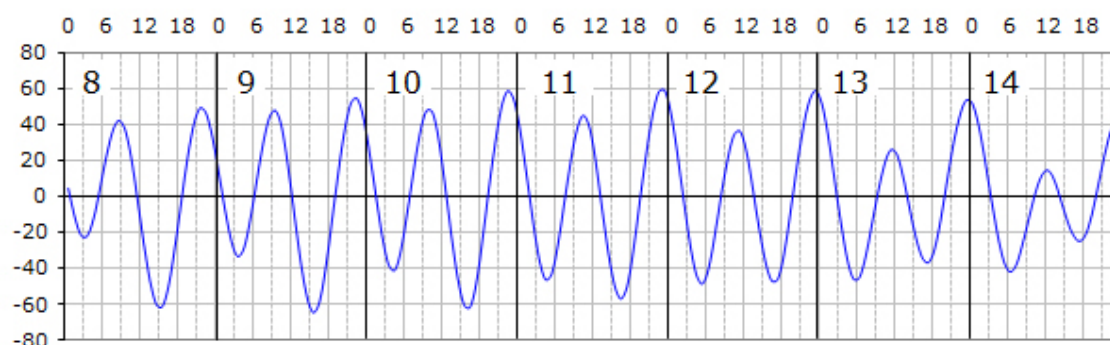
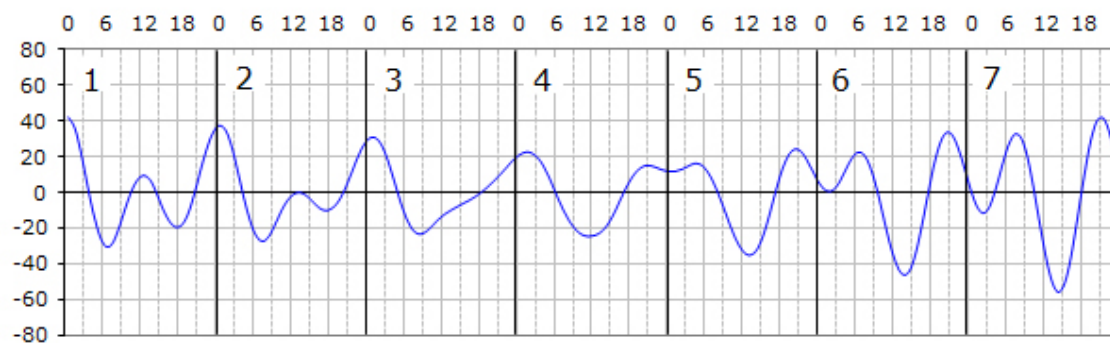
Marea astronomica calcolata per il Porto di Trieste

 Altezze (cm) riferite al L.M.M.

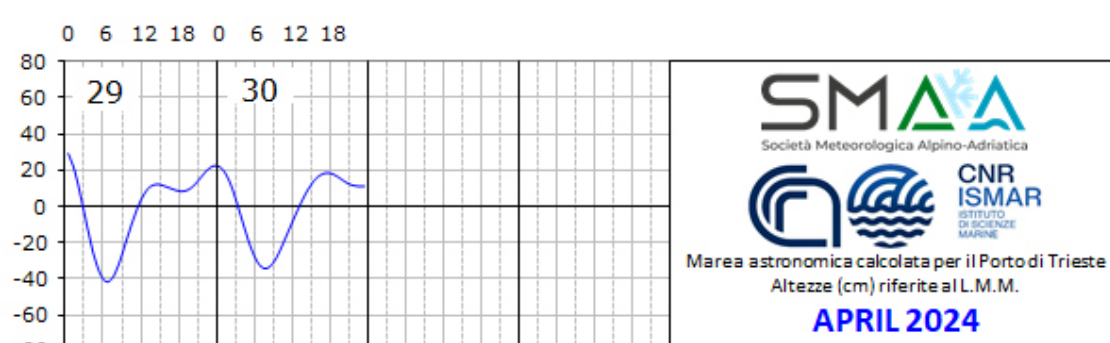
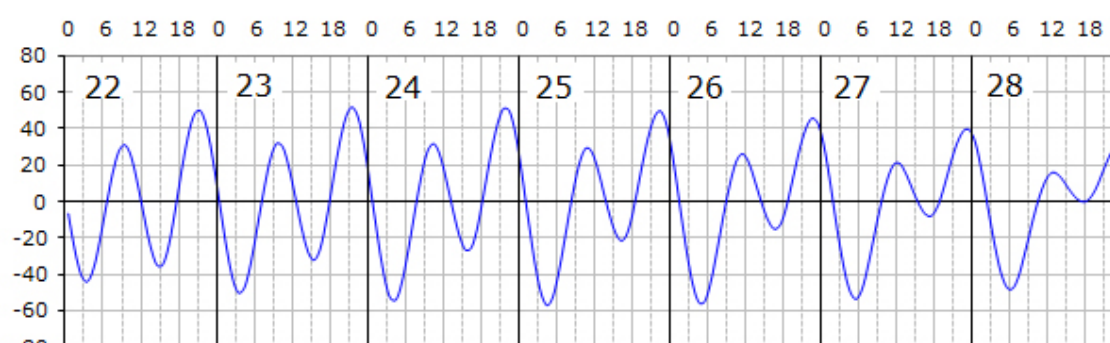
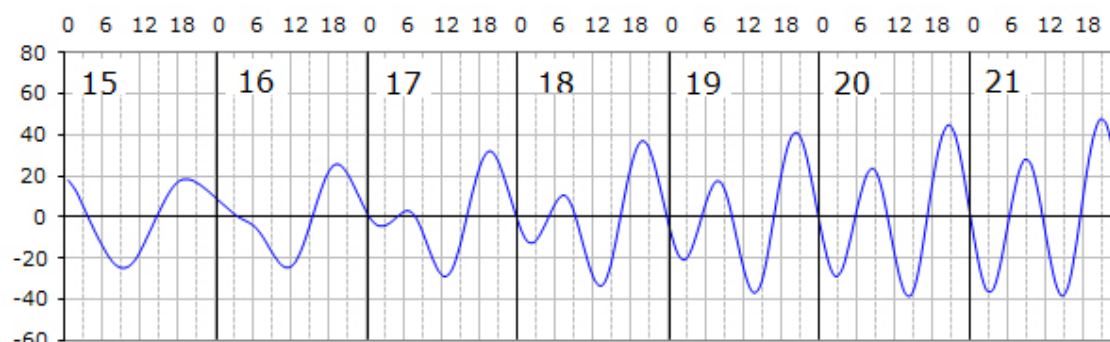
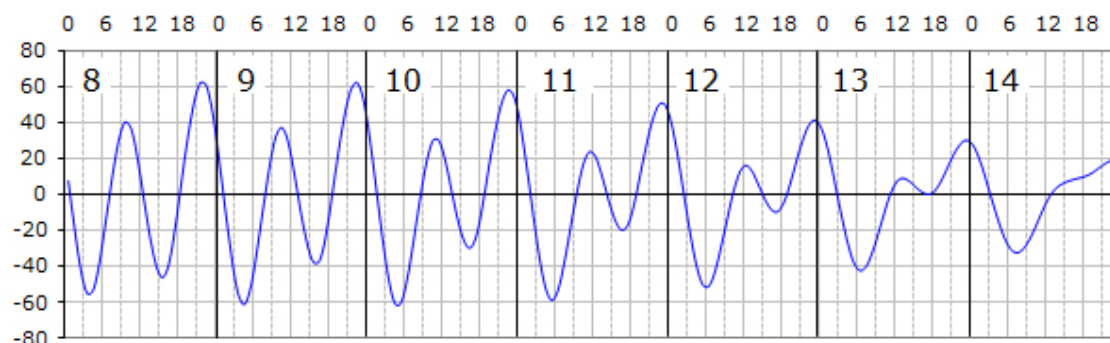
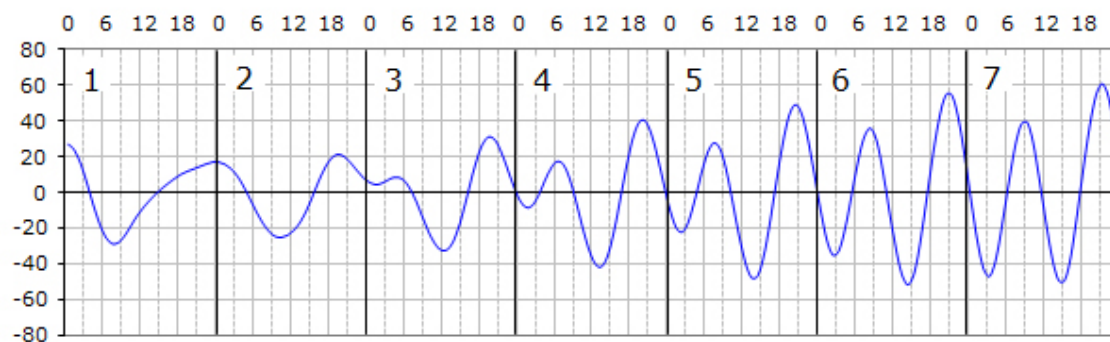
JANUARY 2024



Marea astronomica calcolata per il Portodi Trieste
Altezze (cm) riferite al L.M.M.
FEBRUARY 2024



Marea astronomica calcolata per il Porto di Trieste
Altezze (cm) riferite al L.M.M.
MARCH 2024

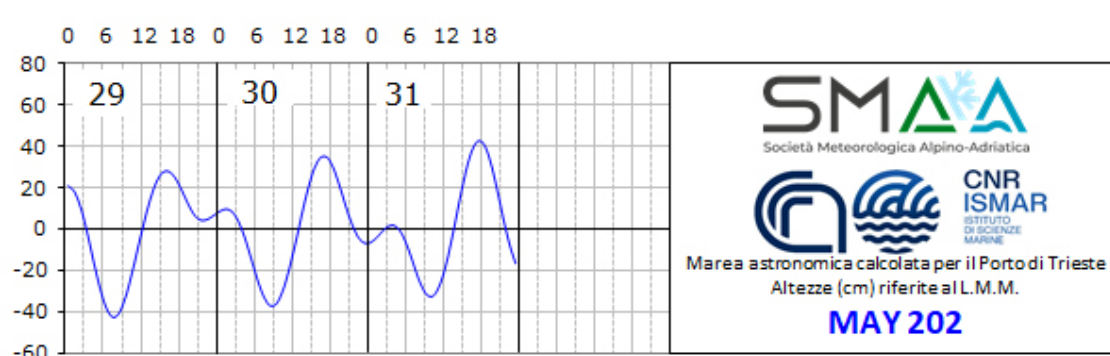
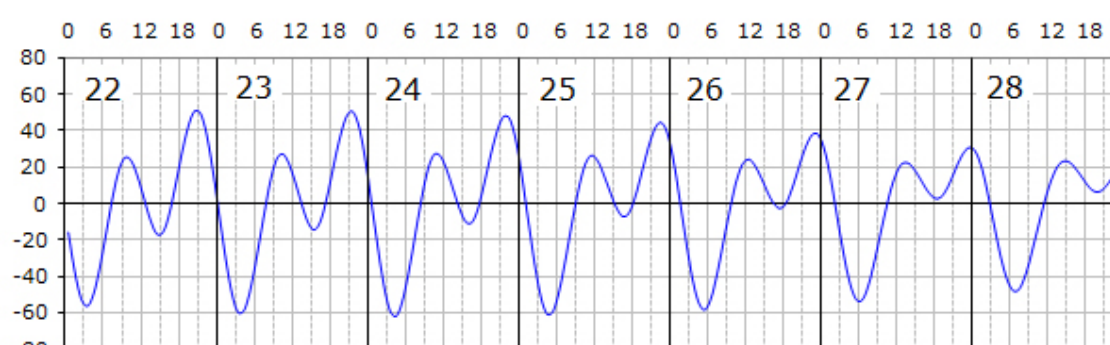
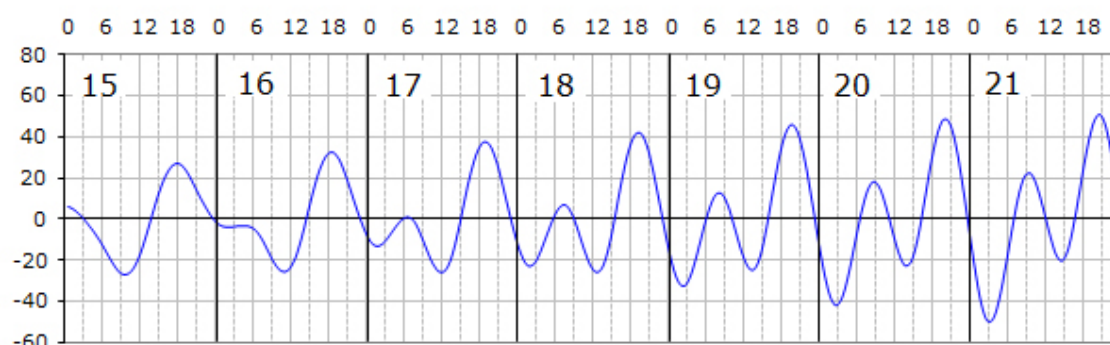
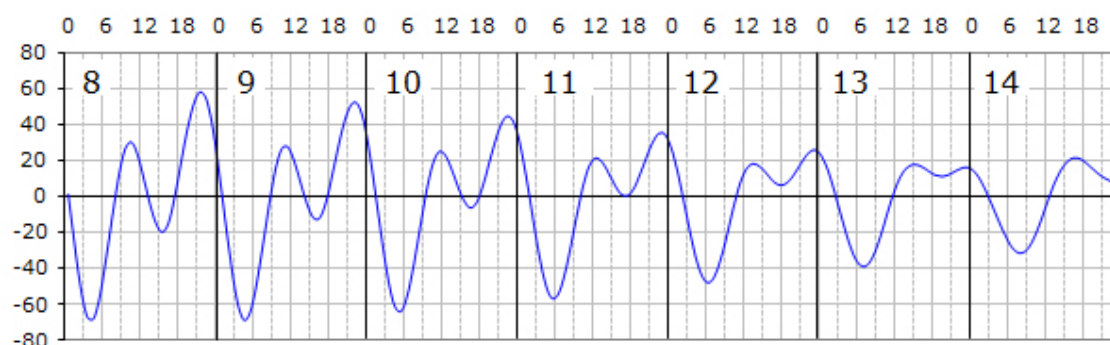
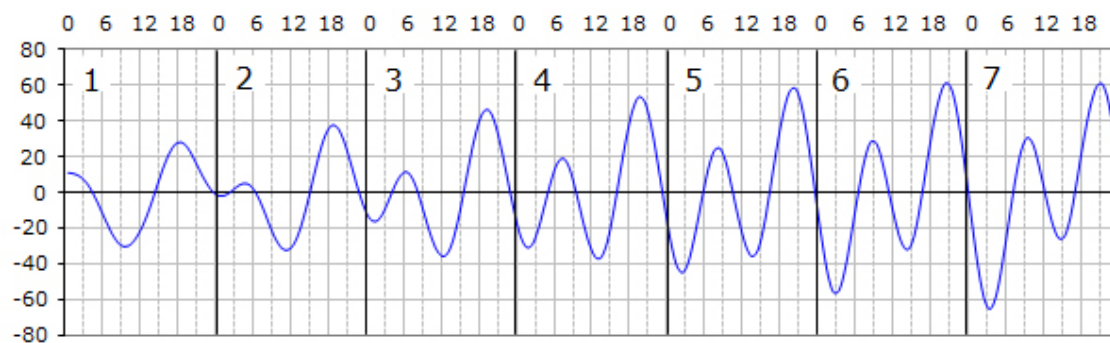


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Marea astronomica calcolata per il Porto di Trieste
Altezze (cm) riferite al L.M.M.

APRIL 2024

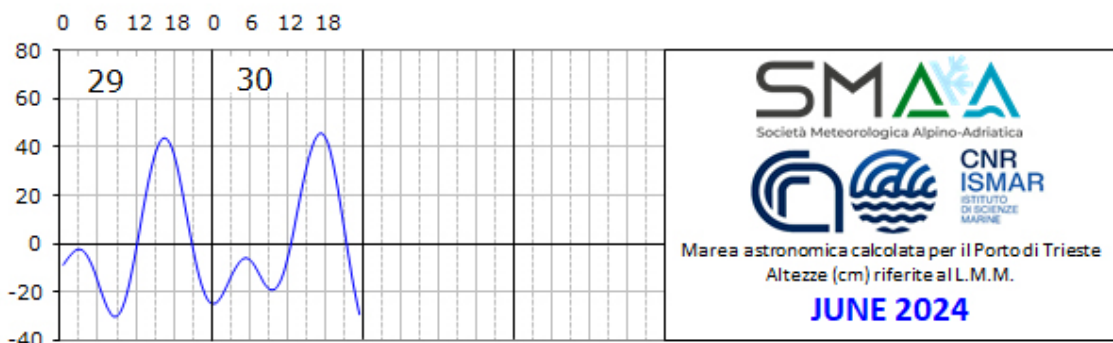
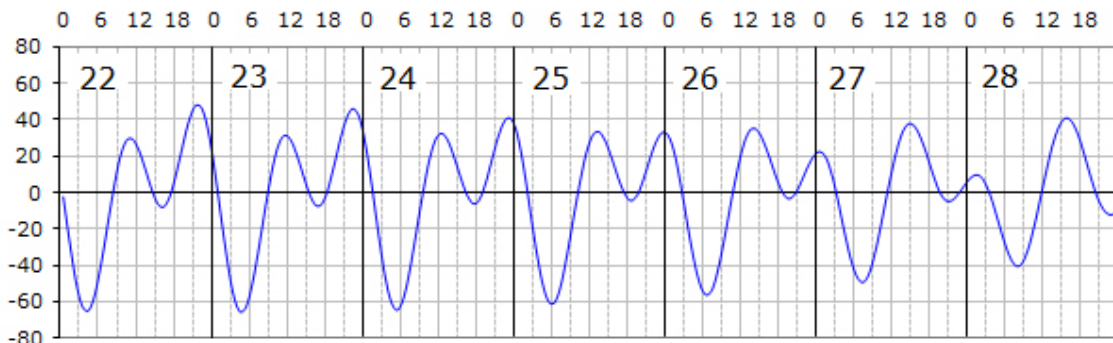
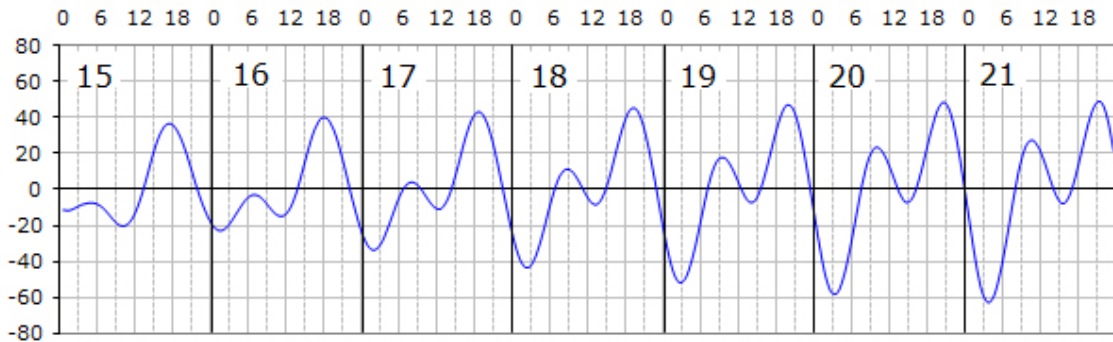
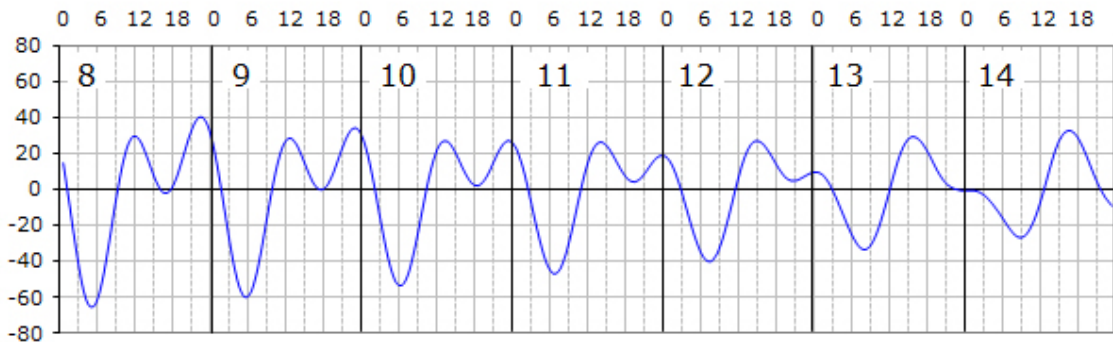
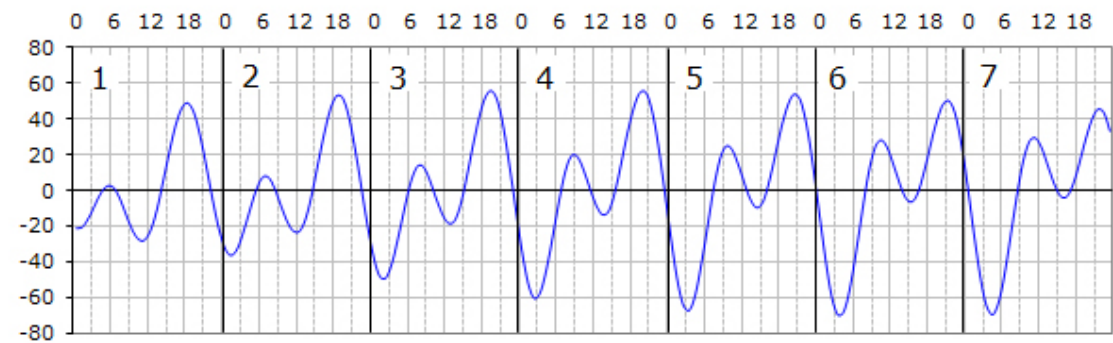


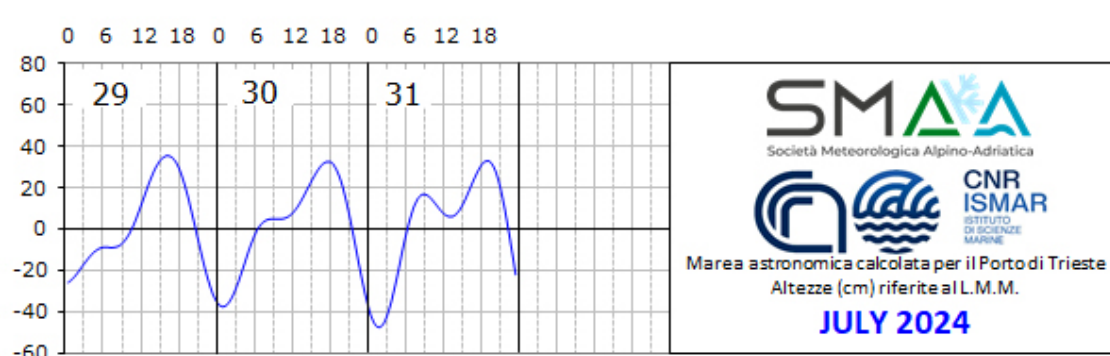
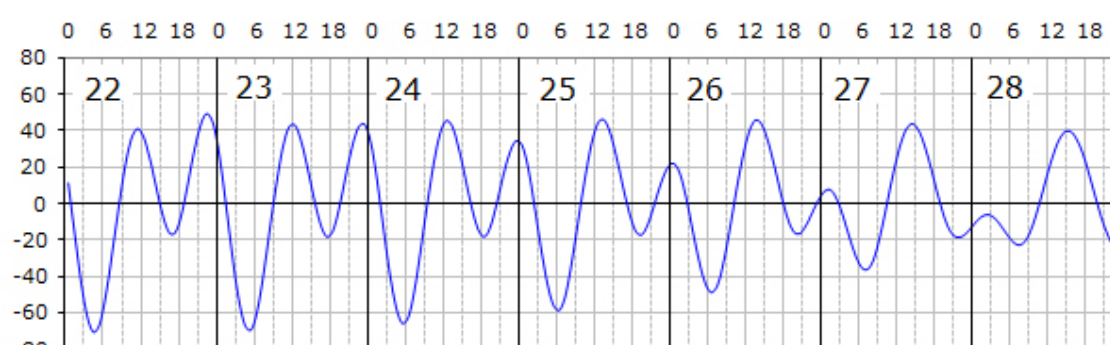
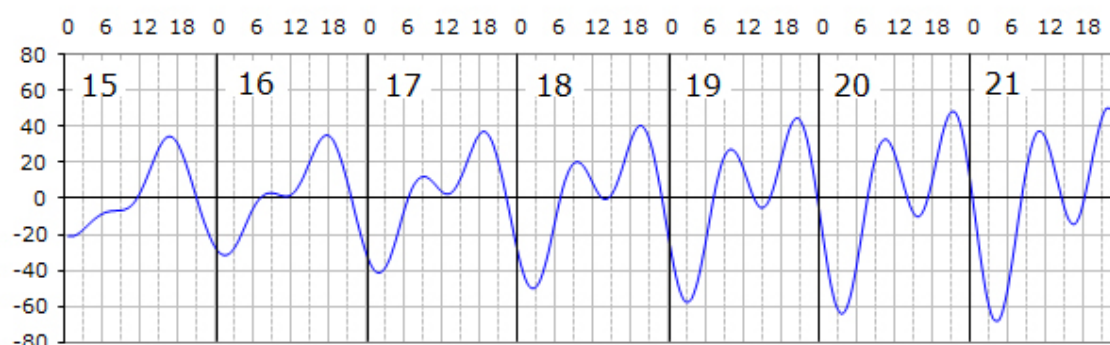
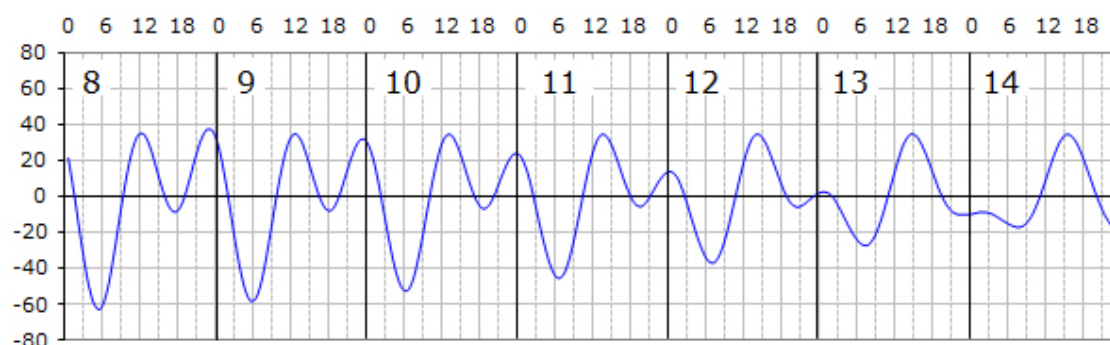
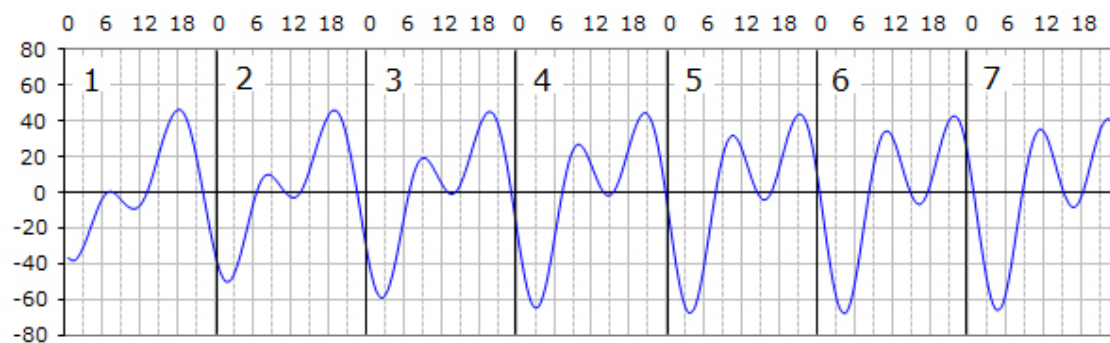
SM Δ **A**
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Marea astronomica calcolata per il Porto di Trieste
Altezze (cm) riferite al L.M.M.

MAY 2022







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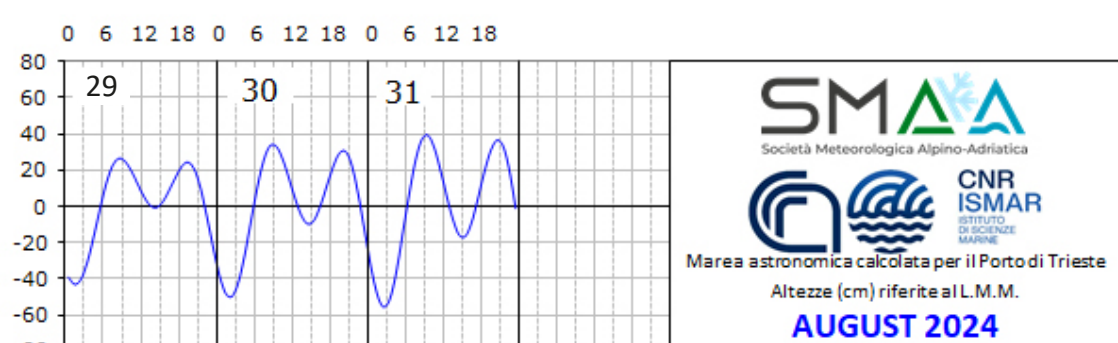
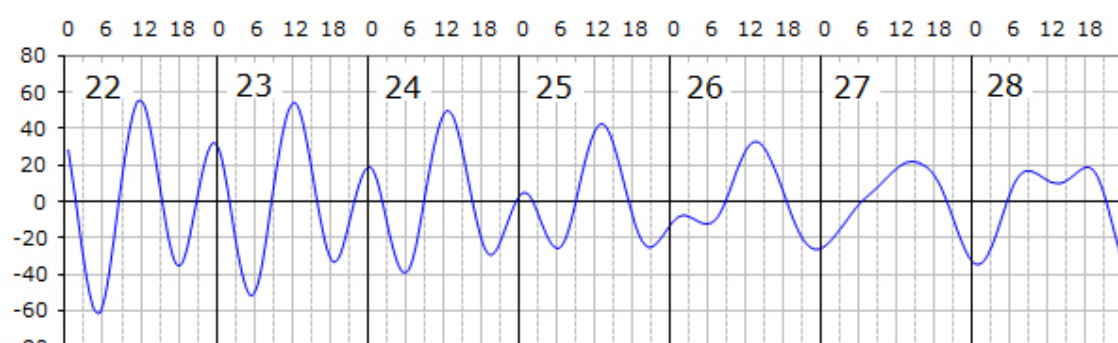
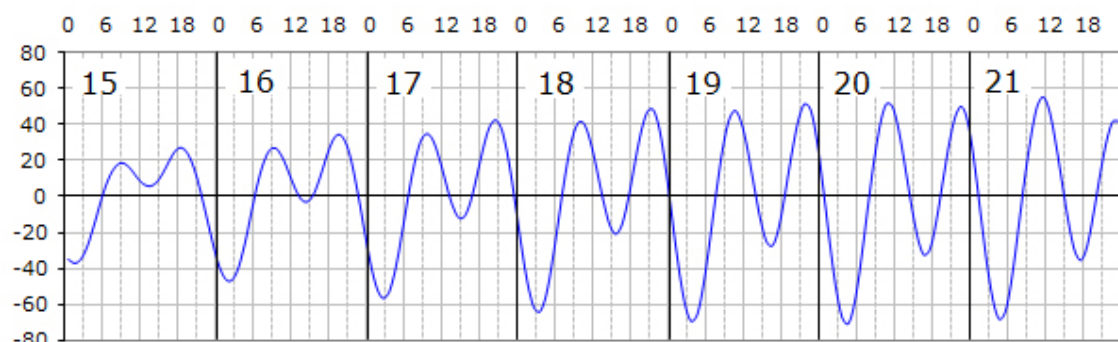
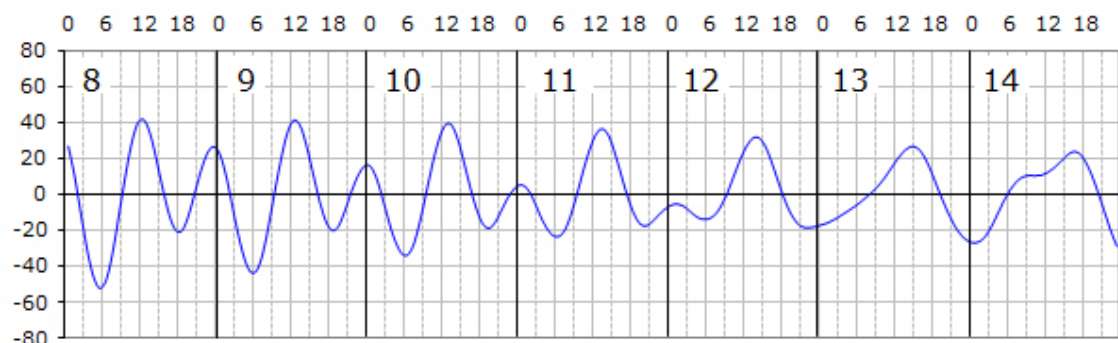
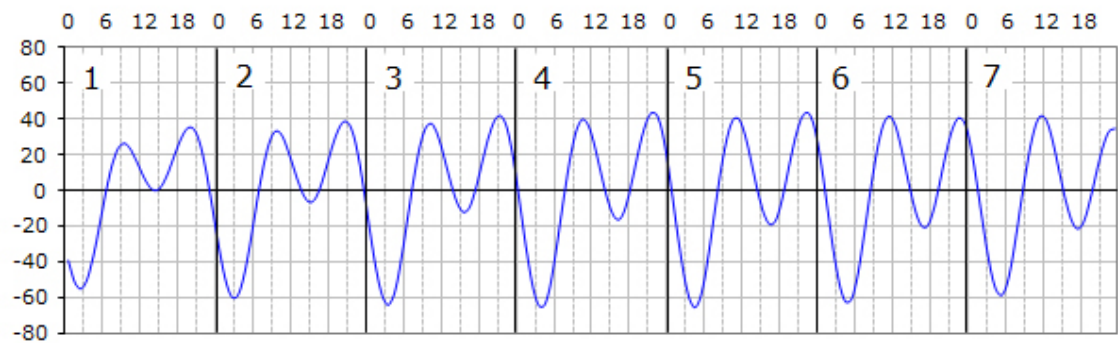
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Marea astronomica calcolata per il Porto di Trieste

Altezze (cm) riferite al L.M.M.

JULY 2024





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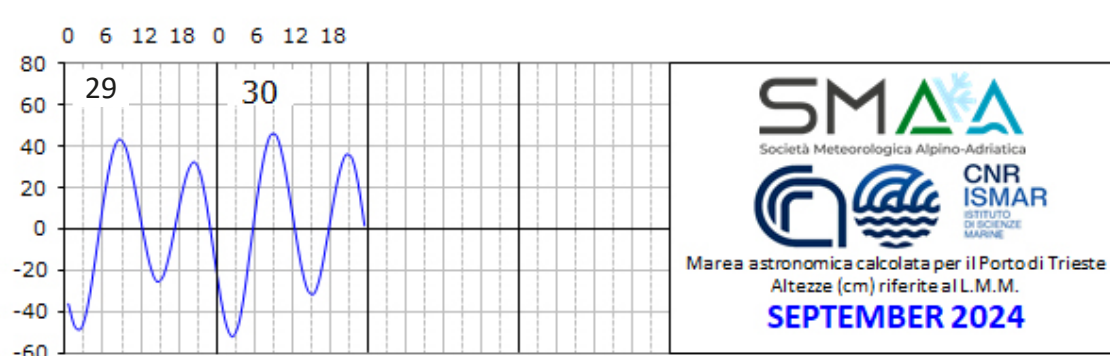
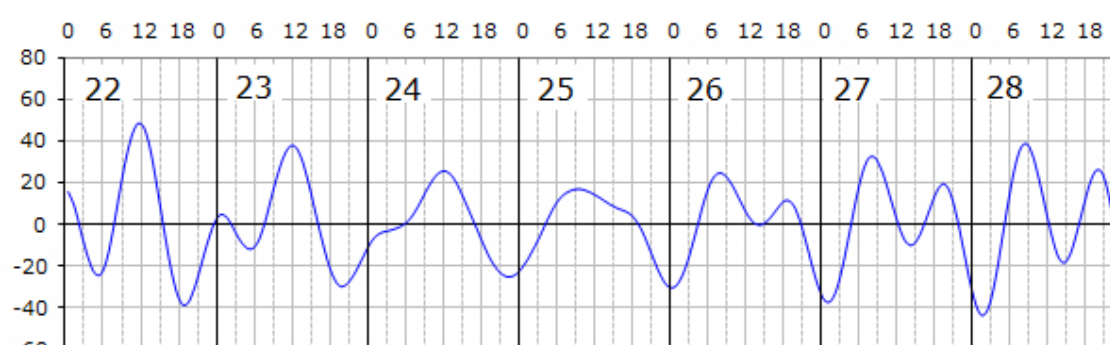
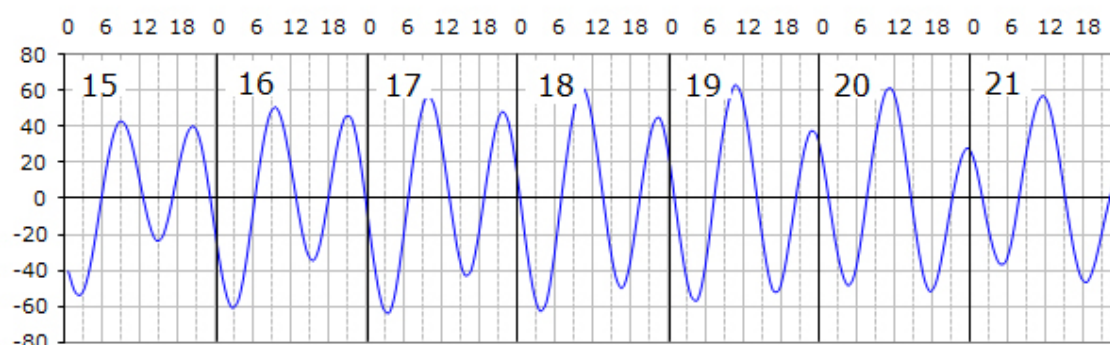
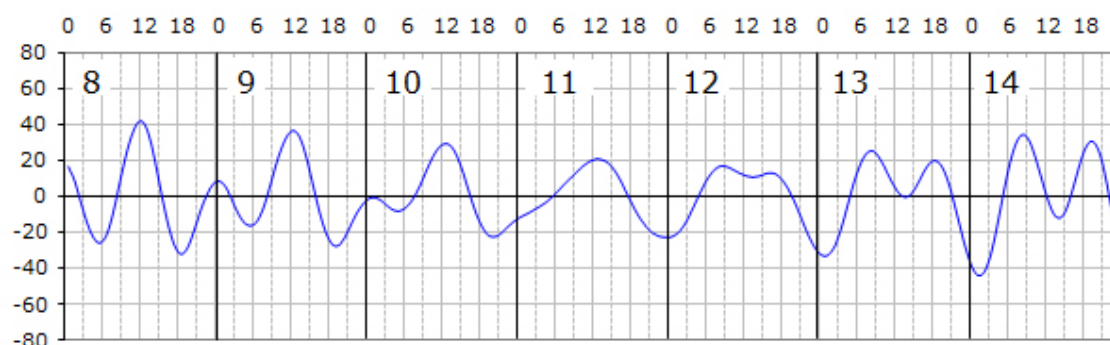
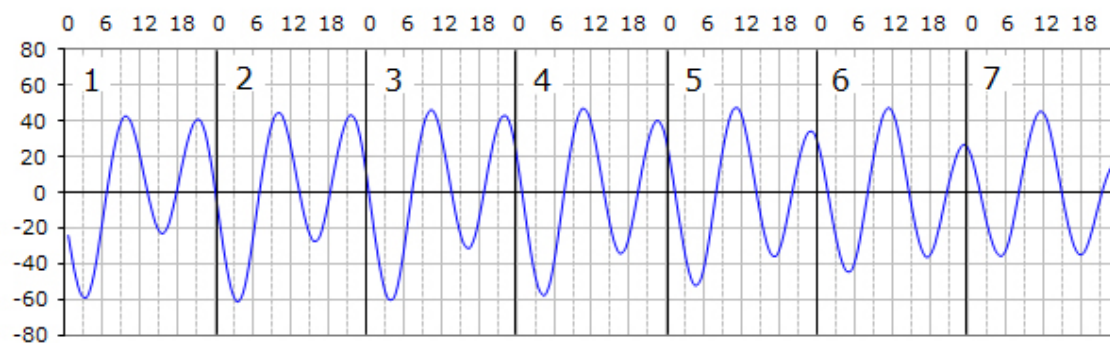
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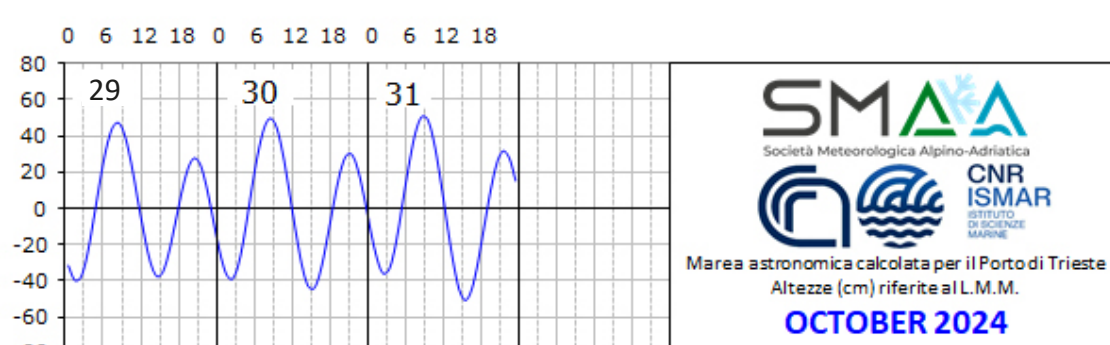
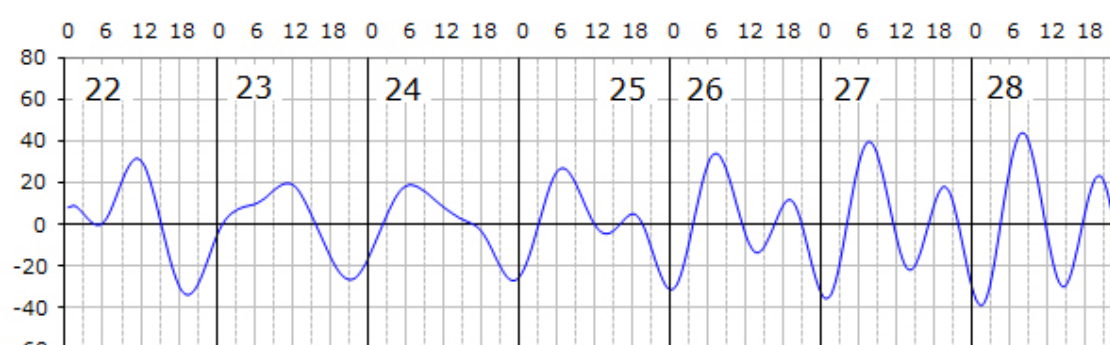
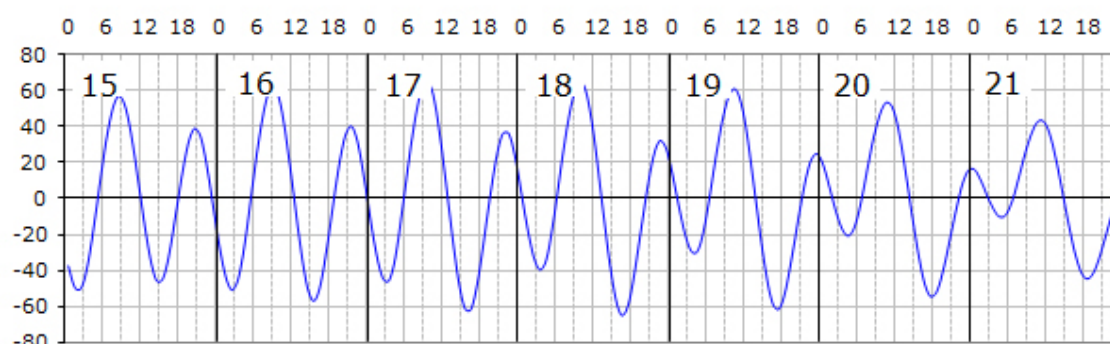
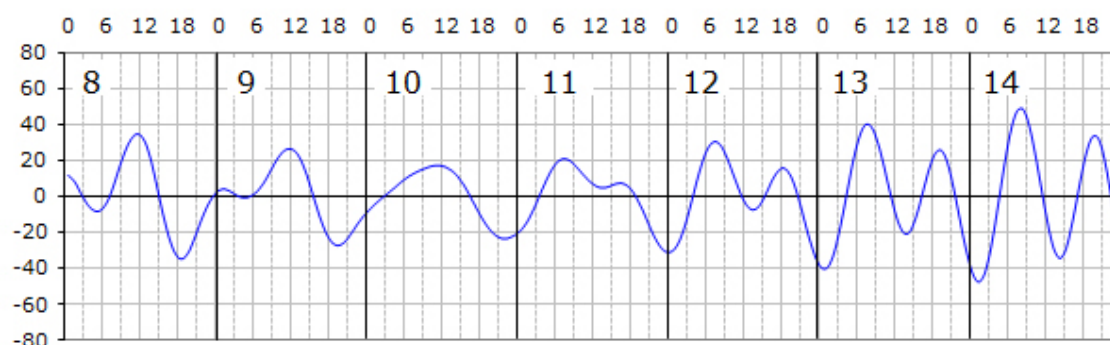
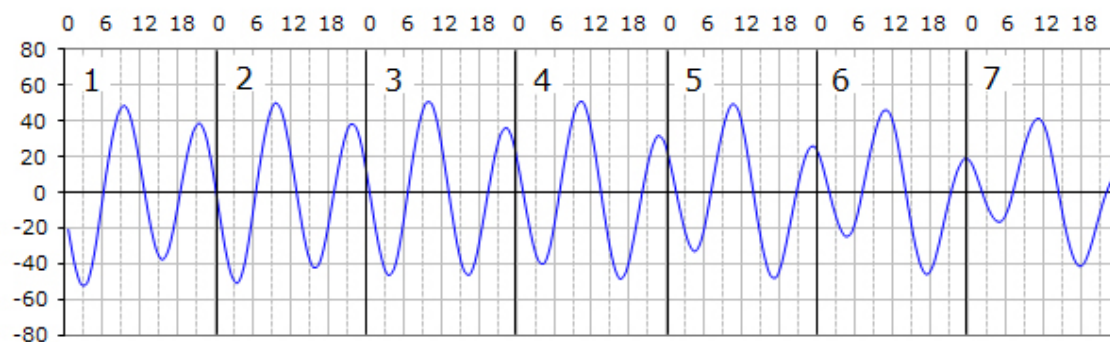
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 Marea astronomica calcolata per il Porto di Trieste

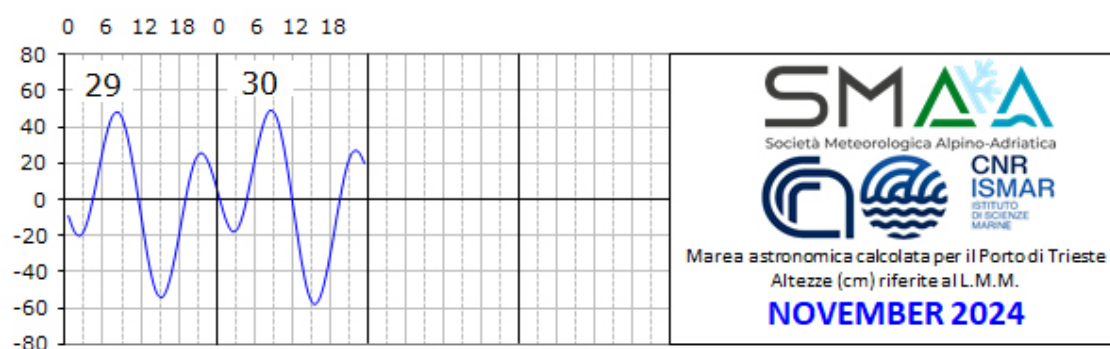
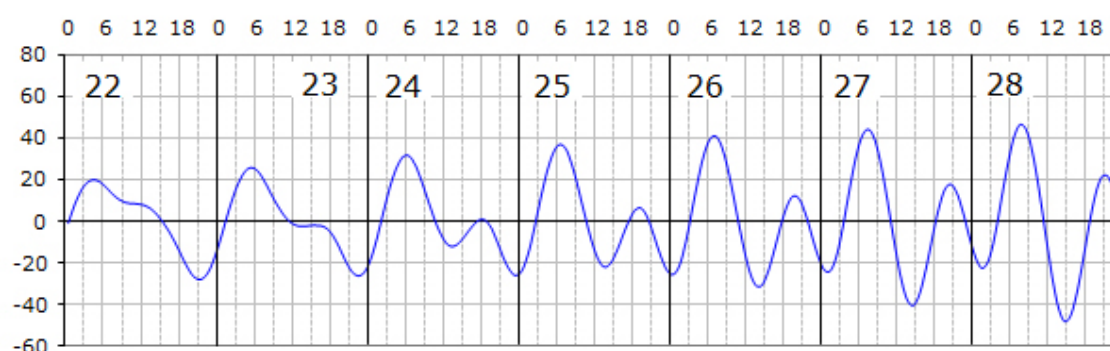
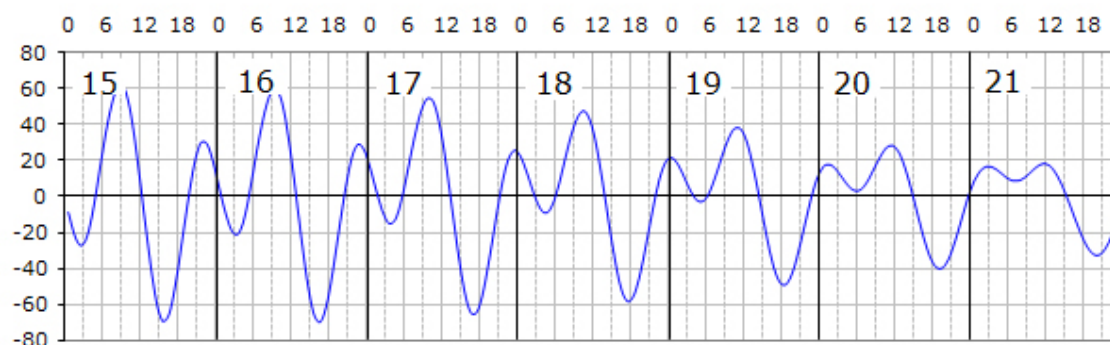
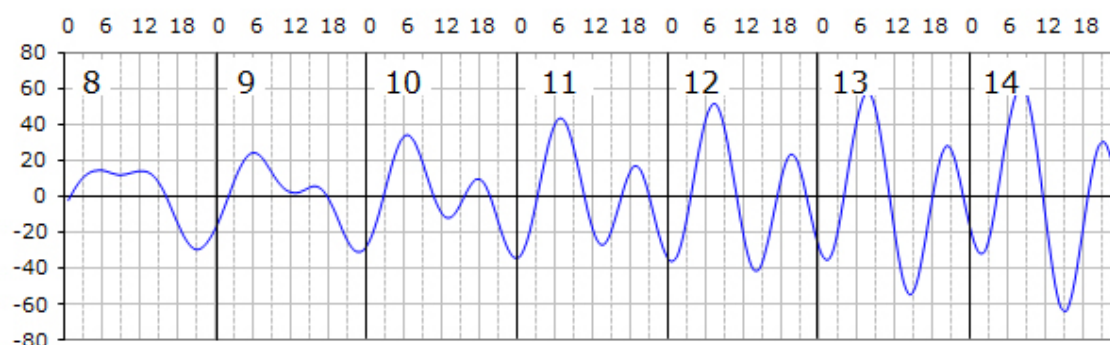
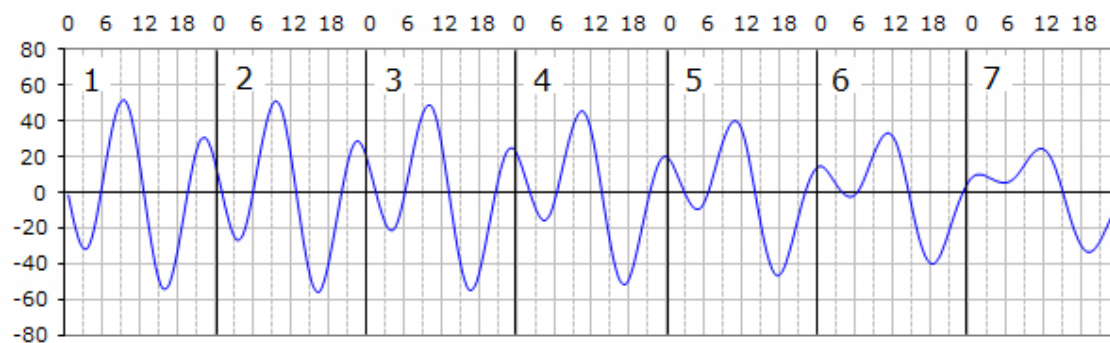
 Altezze (cm) riferite al L.M.M.

AUGUST 2024





Marea astronomica calcolata per il Porto di Trieste
Altezze (cm) riferite al L.M.M.
OCTOBER 2024





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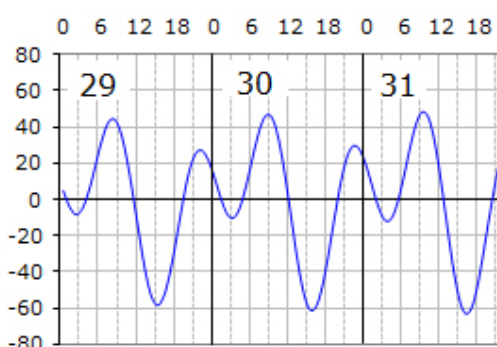
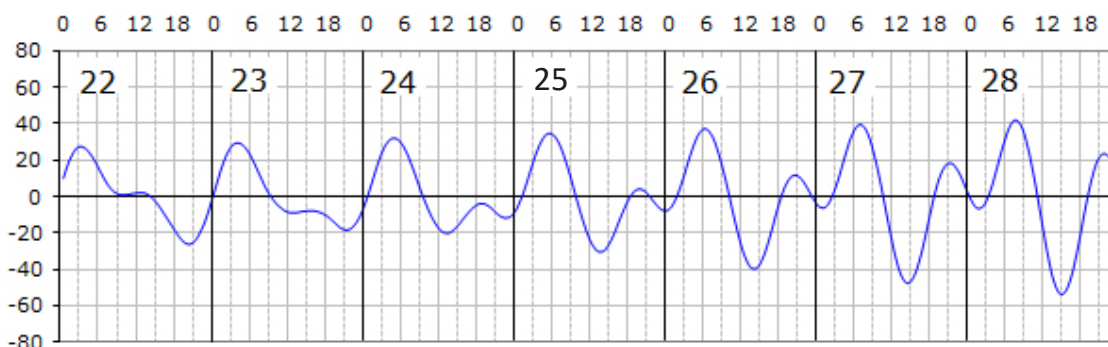
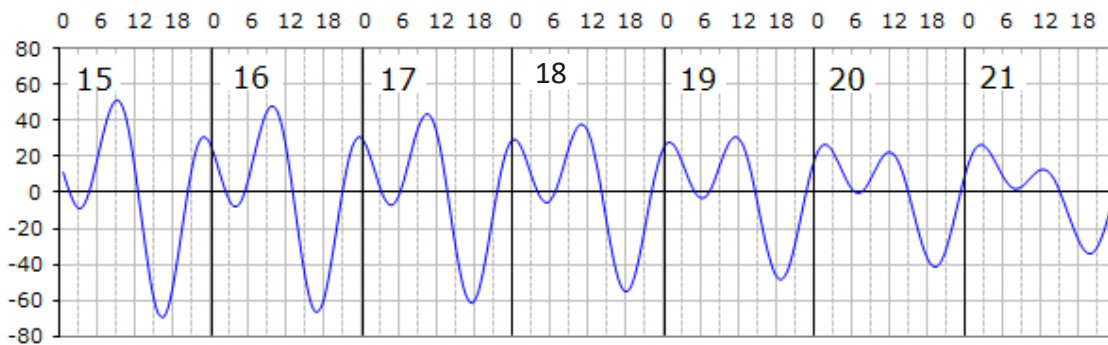
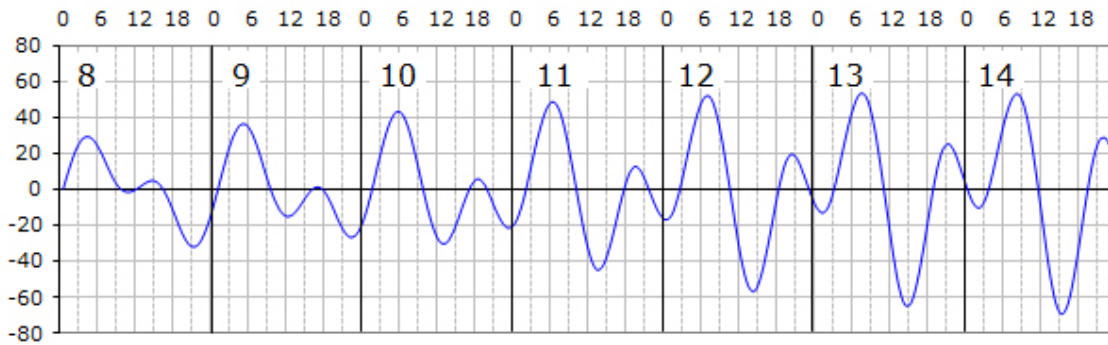
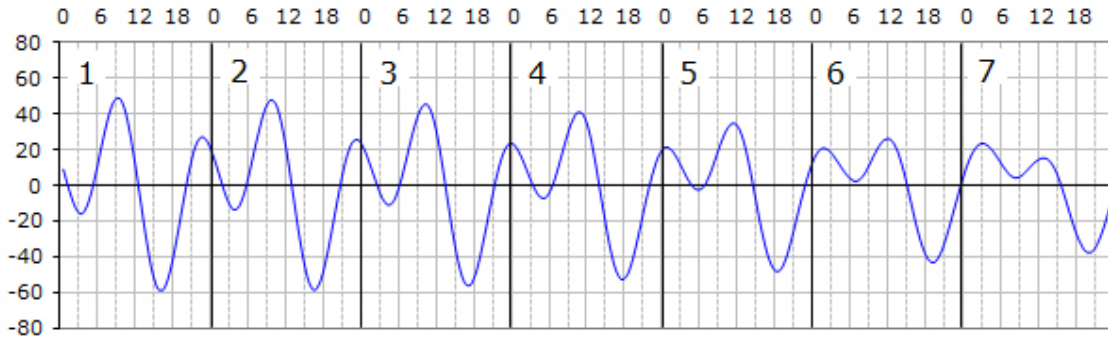
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 Marea astronomica calcolata per il Porto di Trieste

 Altezze (cm) riferite al L.M.M.

NOVEMBER 2024



Marea astronomica calcolata per il Porto di Trieste
Altezze (cm) riferite al L.M.M.
DECEMBER 2024

