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NUMERICAL INVESTIGATION OF CO-OSCILLATING M2-TIDE IN THE MEDITERRANEAN WITH GRID SIZE $1^\circ \times 1^\circ$.

By

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Key Words: Tides, Mediterranean.

ABSTRACT

A two dimensional numerical model of Hansen type has been used to investigate the M2-tides in the Mediterranean Sea. The direct tidal forces as well as the co-oscillating tides with the Atlantic Ocean through Gibraltar Strait were taken into account. The influence of bottom topography, coastal boundaries and friction have been considered. The results showed relatively good agreement with the observations at several localities. Deviations of the computed amplitudes and phases from observations at few localities are mainly due to the large mesh size ($1^\circ \times 1^\circ$) of the grid system used which did not take into account the detailed coastal configuration and depth distribution.

INTRODUCTION

The Mediterranean Sea consists essentially of two basins with an average depth of 1750 m separated by the Sicilian Channel and the Strait of Messinia. It is connected with the Atlantic Ocean through the relatively narrow and shallow Strait of Gibraltar. Since Gibraltar Strait is so restricted, the influence of direct tidal forces, within the Mediterranean particularly in the eastern basin, may be of comparable importance to the external forces. The tides in the Mediterranean are generally comparatively weak, but although considerable tidal ranges are found in the area of Shkirya Minor in Libya (about 200 cm at Gabes and Shkirya). The most important tidal constituent in the Mediterranean is the principal lunar M2 - tide. Over most part of the sea, semidiurnal and mixed tides are observed. Diurnal tides are found only in the central region of the Adriatic Sea and in the western basin (Defant, 1961).

Based on the coastal observations of the tidal elevations. Sterneck (1913-1915) suggested that the tides in the Mediterranean could be represented by two standing waves, one in each basin with a nodal line at its center Nodal lines were also found in the Strait of Messinia and Tunis He added that the rotation of the earth may cause strong transverse oscillations which transform the nodal lines into amphidromies contra solem. The co tidal lines in the Adriatic Sea indicate the formation of a well developed amphidromy which may result from the superposition of longitudinal oscillations with a nodal line at Punta Bianche (43° 47' N Lat. and 14° 20' E Long.) and the transverse oscillations caused by the rotation of the earth (Defant, 1961). In the Aegean Sea, Sterneck suggested the existence of a nodal line somewhat north of Rhodes.

EQUATIONS OF MOTION, NUMERICAL MODEL AND BOUNDARY CONDITIONS

In the present investigation, the model used was based on the following linear vertically integrated hydrodynamical differential equations

$$\frac{\delta u}{\delta t} - fv + ku + g\frac{\delta \zeta}{\delta x} - X = 0 \quad , \qquad (1)$$

$$\frac{\delta v}{\delta t} + fu + kv + g\frac{\delta \zeta}{\delta y} - Y = 0 \quad \ldots \qquad (2)$$

$$\frac{\delta \zeta}{\delta t} + \frac{\delta (Hu)}{\delta x} + \frac{\delta (Hv)}{\delta y} = 0 \quad \ldots\ldots \qquad (3)$$

where:

x,y :cartesian co-ordinates in the east and north direction respectively,

t : time,

ζ : water elevation of the sea surface,

u,v :components of the depth mean current in x & y directions respectively.

H : total depth of water,

f : Coriolis parameter,

k :coefficient of bottom friction in the linear form.

g : acceleration of the earth's gravity.

X,Y : the components of the tide producing force in east and north directions respectively.

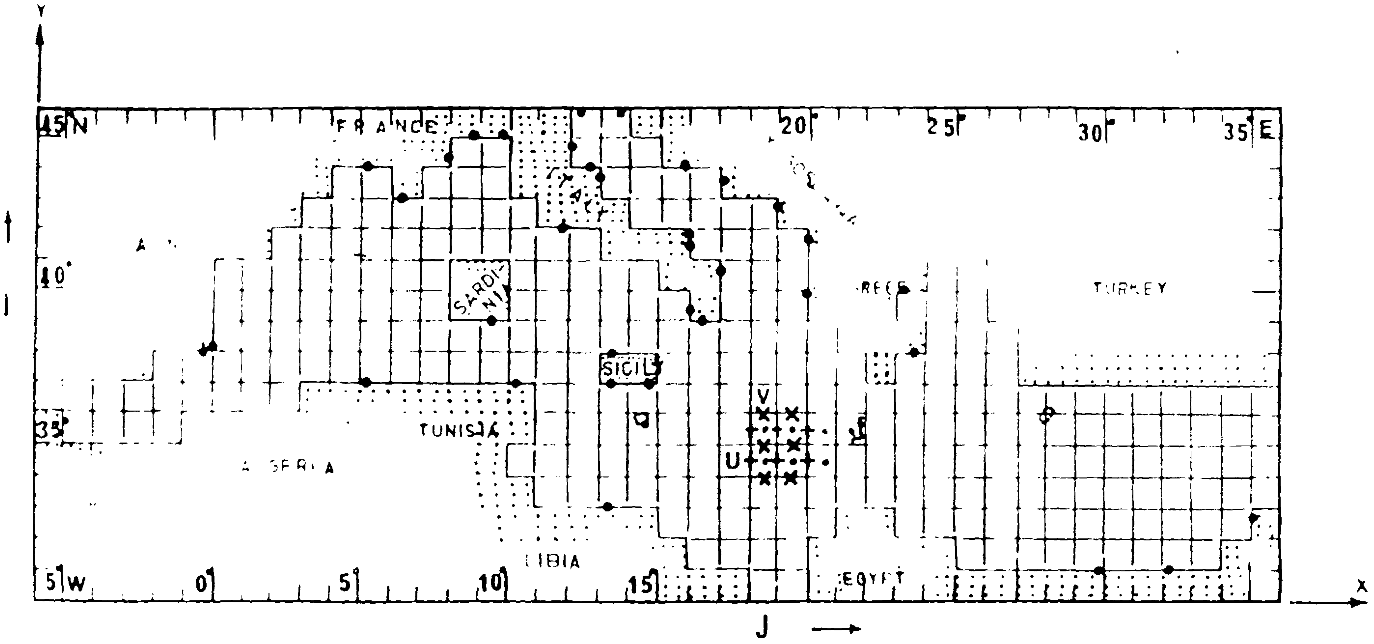

Figure 1: The grid system used in the numerical computation with the positioning of ζ-, u-, and v- points.

A finite-difference scheme, with a forward difference in time and central difference in space, has been applied (Soliman et al., 1991). A grid system with $1^{\circ} \times 1^{\circ}$ mesh size was used (Fig. 1). The potential tidal forces were taken into consideration, while the observed M2-tidal constituent was specified at the Strait of Gibraltar. To investigate the independent M2-tide in the sea, the closed strait boundary condition of zero normal velocity was imposed. As initial conditions, the zero values for the water elevation and the components of current velocity were prescribed. A linear form of bottom friction was employed with a friction coefficient of 10^{6} sec^{1}.

RESULTS AND DISCUSSION

In preceding works the model has been examined to investigate the M2-tide in the Mediterranean Sea as a closed basin (Soliman et al., 1991 and Eid et al., 1993). Actually, the Mediterranean is opened at its western side into the Atlantic Ocean through a very narrow and shallow strait (Gibraltar Strait). Therefore, long waves from the ocean penetrate the Strait of Gibraltar and propagate into the sea basins, such that they may influence the tides of the Mediterranean itself.

Many ideas have been demonstrated about the tides of the Mediterranean. Some investigators assumed the sea as a closed basin and hence its tides is of independent type. Some others denied the possibility of the occurrence of such independent tides. They attempted to explain the phenomena by assuming an Atlantic wave penetrating through the Strait of Gibraltar and propagating in the Mediterranean. In the present study, the direct effect of the tide generating forces as well as the oscillations penetrating into the sea from the Atlantic Ocean have been taken together to represent the driving forces of the tidal motion in the Mediterranean. To examine the influence of the bottom topography, the model has been applied on the sea with a constant depth as well as with real depths. The influence of Sicillian Strait width has also been examined.

1- The sea with constant depth:

Constant depths of 500, 1500 & 2000 m have been suggested to represent the average depths of the sea. Although its mean depth was found as 1750 m approximately, the constant depth of 500 m was proposed to examine the effect of the relatively shallow water areas on the tidal motion. Moreover, the independent M2-tide developed in the sea under the action of the tidal generating forces only has been estimated.

CO-OSCILLATING M2-TIDE.

Fig. 2 presents the co-tidal and co-range lines of the M2-independent tide as obtained in the sea with a constant depth 500 m and friction coefficient 10^{-6} sec^{-1}. Three contra solem amphidromies were found, one to the south of Balearic Islands with establishment of 5h in the Alboran Sea, one around Sicillian Island with establishments of 10h in the western basin and 4h in the Ionian Sea, and the third one as a degenerated contra-solem amphidromy around the Libian coast with establishment of 10h in the eastern basin. Moreover, an additional one as a degenerated contra solem amphidromy was observed in the Adriatic Sea at Ortona in Italy. Amplitudes of more than 5.0 cm were found in the western part of Alboran Sea, northern part of Adriatic, Aegean Sea and along the south-eastern coast of the Levantine Sea. The co-ranges pattern showed some peculiarities, if compared with the patterns obtained by Soliman and Maiyza (1993) to investigate the influence of depth on M2-tide in the sea as assumed to be composed of two connected rectangular basins with a constant depth of 400 m and 500 m respectively. Slight changes from 400 m to 500 m caused quite clear variation in the co-tidal lines with a phase lag of about 3h. The co-tidal pattern obtained in the eastern part of the two connected rectangular basins with constant depth of 400 m was found to be more or less similar to that mentioned in the present pattern (Fig. 2). Meanwhile, quite differences were found between the co-ranges in the western basin. These deviations may be attributed either to the influence of free oscillation in each basin or to co-oscillation with the other basins. Therefore the coastal configuration may influence the tide in the basin.

With great depths (1500m & 200m), the tidal patterns in the sea are nearly similar to that obtained in the case of one rectangular basin with constant depth of 1500 m given by Eid et al. (1993), where only one contra solem amphidromy was observed nearly at the middle of the sea. Generally, the oscillation appears as a standing wave with establishments of 7.5h in the western basin and about 1h in the eastern (Figs. 3&4).

The Mediterranean was then allowed to communicate with the Atlantic Ocean through Gibraltar Strait while the tide generating forces were still acting on the sea. A periodical oscillation corresponds to the Atlantic was maintained at the mouth of the sea according to the following relation:

$$\zeta = A \cos(\sigma t + \phi) \qquad ..... \quad (4)$$

where:

A : is the amplitude of the periodical oscillation at the mouth of the sea (Gibraltar).

ϕ : is the phase of the penetrating wave as the Moon transit the Equator at Greenwich.

Regarding the sea again as a basin with constant depth of 500 m, the results were presented in Fig. 5 where three contra solem amphidromies were detected. Two of them are of degenerated forms. The patterns are more or less similar to that given when the Mediterranean was considered as a closed basin with constant

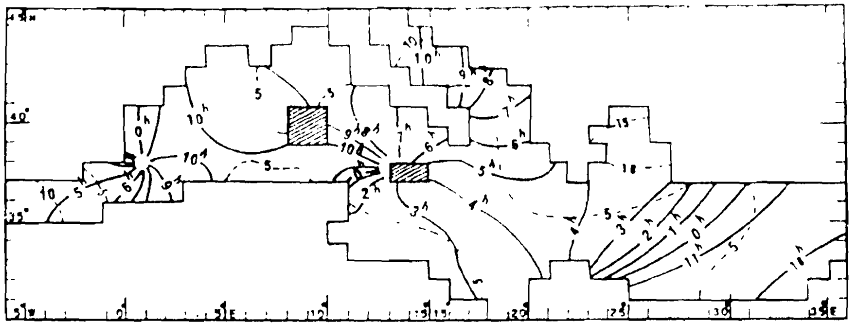

Figure 2: M2-Independent Tide in the Mediterranean Sea with a constant depth of 500m. The co-ranges are in cm, and the co-tidal lines correspond to lunar hours of high tide after lunar-transit at Greenwich.

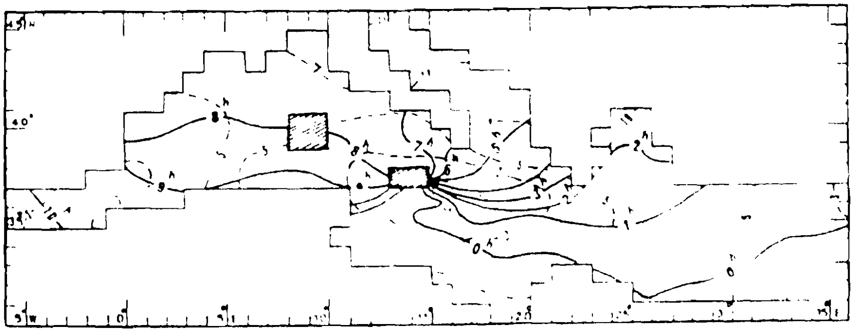

Figure 3: M2-Independent Tide in the Mediterranean Sea with a constant depth of 1500m. The co-ranges are in cm, and the co-tidal lines correspond to lunar hours of high tide after lunar-transit at Greenwich.

CO-OSCILLATING M2-TIDE.

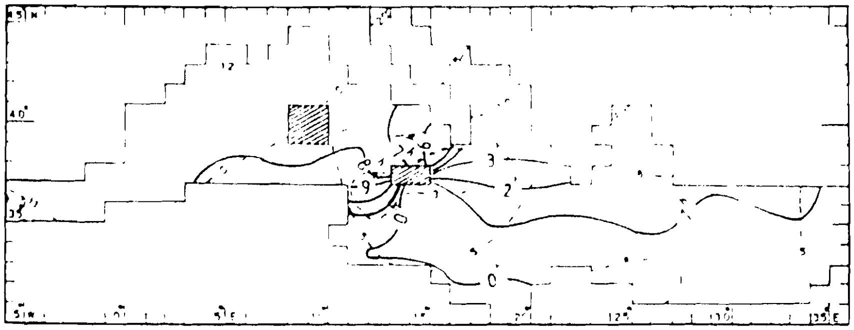

Figure 4: M2-Independent Tide in the Mediterranean Sea with a constant depth of 2000m. The co-ranges are in cm, and the co-tidal lines correspond to lunar hours of high tide after lunar-transit at Greenwich.

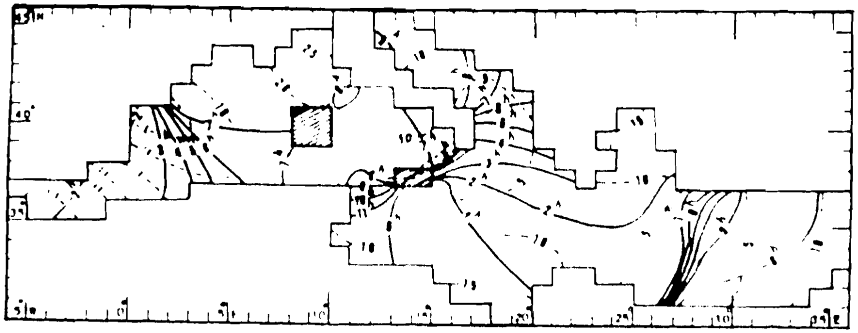

Figure 5: M2-Co-Oscillating Tide in the Mediterranean Sea with a constant depth of 500m. The co-ranges are in cm, and the co-tidal lines correspond to lunar hours of high tide after lunar-transit at Greenwich.

depth of 500m (Fig. 2). Only there is a phase lag of about 2h between the two cases as a result of the penetrating waves from the Atlantic into the western basin which causes the rise of the water level in that basin. On account of the considerable increase of the tidal ranges in the western basin, the eastern basin showed also some increase in its ranges particularly along the boundaries. Hence it is concluded that the tides in the eastern Mediterranean are mainly due to the tidal potential forces. The co-tidal lines are developed and the co-ranges are magnified by the influence of co-oscillation with the Atlantic. It is also concluded that the eastern basin is in co-oscillation with the western basin. Such conclusions contradict Darwin's idea about the tides of the Mediterranean (Defant, 1961), who assumed that the Mediterranean is so completely closed by the Strait of Gibraltar such that only independent tides can develop, so that in each basin only forced oscillations are possible. Meanwhile, it coincides to a great extent with Defant's explanation of the tidal observations (Defant, 1961). He assumed that the western basin has, beside its independent tides, co-oscillating tides not only with the Atlantic Ocean through the Strait of Gibraltar but also with the eastern basin through the Straits of Tunis and Messinia. Hence, it is of great importance to estimate the independent tide in any basin before studying its co-oscillation with the other basins.

With increasing the depth of the sea to 1000, 1500 & 2000 m, the contra solem amphidromy that noticed around Sicilian Island in the previous case did not appear with that depths. A nodal line was detected in each basin when the depth was 1000 m (Fig. 6), while a contra solem amphidromy was found in the eastern basin for the other two depths (Figs. 7 & 8). The co-ranges showed considerable increase particularly for 2000 m. This remarkable increase in amplitude has been explained by Soliman and Maiyza (1993) as a result of approaching from the resonance conditions.

2- The sea with its real depths:

To investigate the M2-co-oscillating tide in the Mediterranean with its real depths, the boundary conditions were imposed at the free opening near Gibraltar as previously mentioned in the case of constant depths. Since the tidal oscillations from the Atlantic Ocean are penetrating Gibraltar Strait into the sea, the width and the depth of the strait may affect the tidal motion in the sea. Three cases were considered by suggesting the depth at the entrance of the sea as 100 m, 200 m and 300 m respectively (Figs. 9-11). Friction coefficient of 10^{6} sec^{1} was assumed. Slight differences could hardly be observed between the three cases except in Ligurian Sea and the area between Balearic Islands and Corsica Island where considerable ranges were observed. This indicates that the variation of depth at the sea entrance affects mostly the amplitudes in the western basin.

The patterns obtained in the eastern part of the Alboran Sea and the region of Balearic Islands with variable depths are different from that produced with constant depth of 500m, but is consonant to that of great constant depths. Actually, these regions are recognized with depths of more than 1000 m and hence the deep water pattern is more convenient In addition, as the eastern basin is

CO-OSCILLATING M2-TIDE.

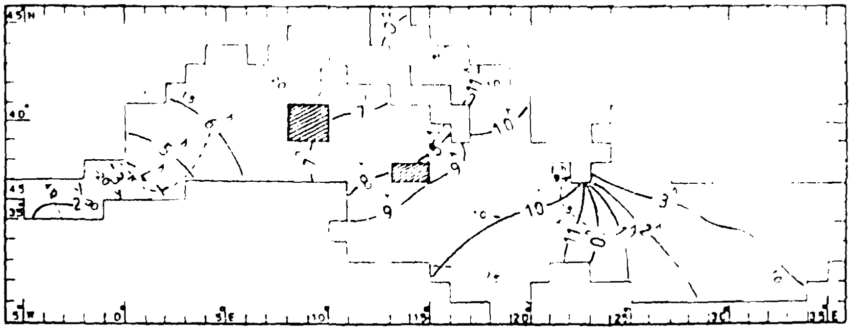

Figure 6: M2-Co-Oscillating Tide in the Mediterranean Sea with a constant depth of 1000m. The co-ranges are in cm, and the co-tidal lines correspond to lunar hous of high tide after lunar-transit at Greenwich.

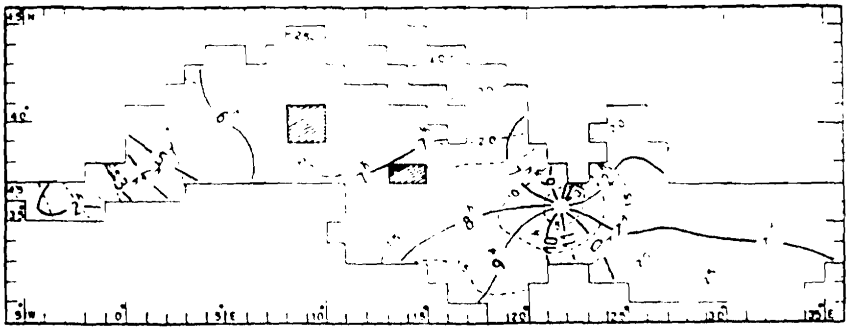

Figure 7: M2-Co-Oscillating Tide in the Mediterranean Sea with a constant depth of 1500m. The co-ranges are in cm, and the co-tidal lines correspond to lunar hours of high tide after lunar-transit at Greewich.

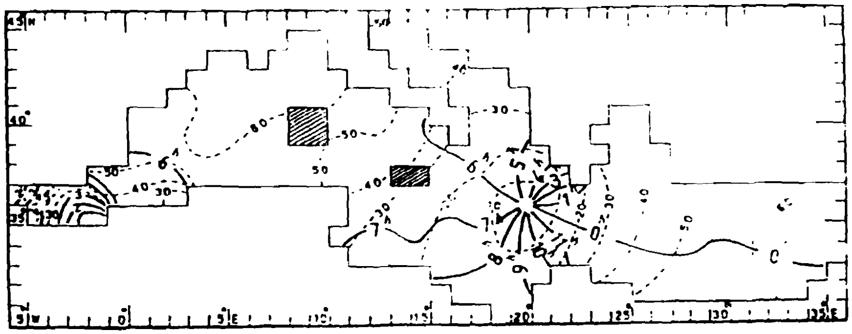

Figure 8: M2-Co-Oscillating Tide in the Mediterranean Sea with a constant depth of 2000m. The co-ranges are in cm, and the co-tidal lines correspond to lunar hours of high tide after lunar-transit at Greewich.

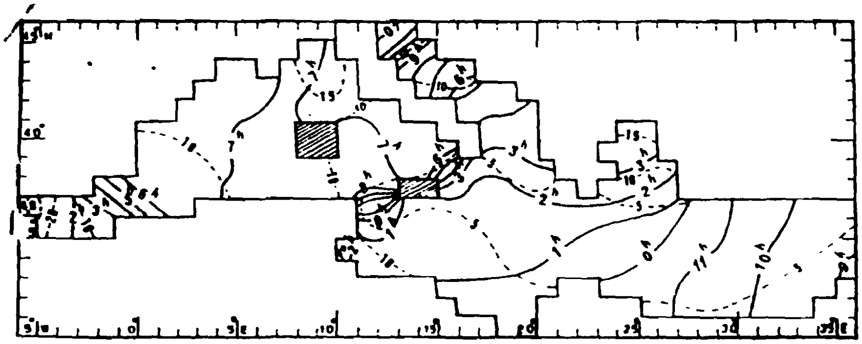

Figure 9: M2-Co-Oscillating Tide in the Mediterranean Sea with its real depths and an entrance depth of 100m at Gibraltar. The co-ranges are in cm, and the co-tidal lines correspond to lunar hours of high tide after lunar-transit at Greenwich.

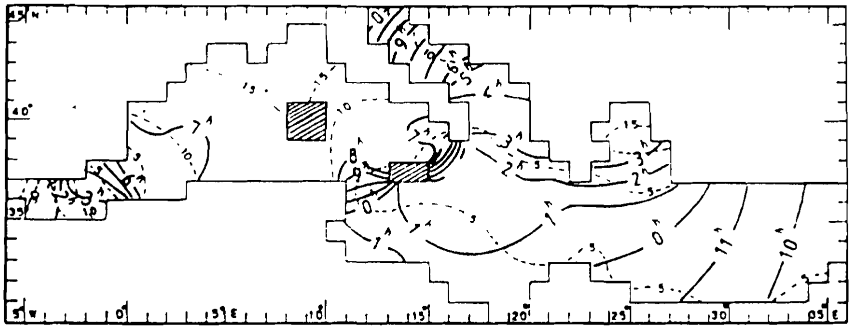

Figure 10: M2-Co-Oscillating Tide in the Mediterranean Sea with its real depths and an entrance depth of 200m at Gibraltar. The co-ranges are in cm, and the co-tidal lines correspond to lunar hours of high tide after lunar-transit at Greenwich.

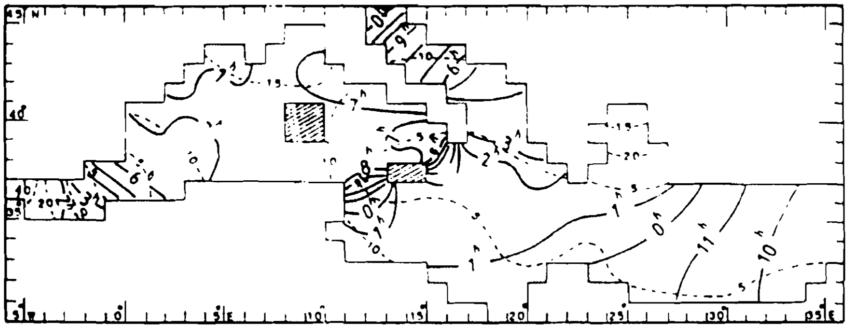

Figure 11: M2-Co-Oscillating Tide in the Mediterranean Sea with its real depths and an entrance depth of 300m at Gibraltar. The co-ranges are in cm, and the co-tidal lines correspond to lunar hours of high tide after lunar-transit at Greenwich.

mostly characterized by its bottom topography, its tidal pattern with real depths is more relevant to that obtained with constant depth of 1000 m. Meanwhile, in the region located between the western and eastern basins, i.e. the area around Sicili Island which occupied by the Straits of Tunis and Messina, the patterns of the real sea are more closer to that obtained with constant depth of 500 m.

Generally, the influence of the shallow coastal area did not appear in the present cases as a result of averaging the depths over each grid whose size was taken as 1° X 1°. The impact of bottom topography on the tidal pattern along the coast may become more recognizable when highly resolution grid sizes are performed. Therefore, it is concluded that the bottom topography has a substantial influence on the tidal patterns.

To examine the influence of friction, the model has been applied again taking the friction coefficient as $5*10^{-6}$ sec^{-1}. The patterns showed only a decrease in the ranges (Fig. 12), i.e. friction reduces only the wave heights and has insignificant influences on the wave patterns. As the width of Tunis Strait was diminished to compose only one grid, relatively high co-range values were observed at some regions in the eastern basin (Fig. 13).

Generally, the results of co-oscillating motions obtained by applying the model on the Mediterranean with its real depths are in good agreement with the observations (Table 1). The model failed in the narrow areas like Adriatic Sea, Alboran Sea and generally in the straits. This problem could be overcome on using grid system with high resolution which is the goal of the next work.

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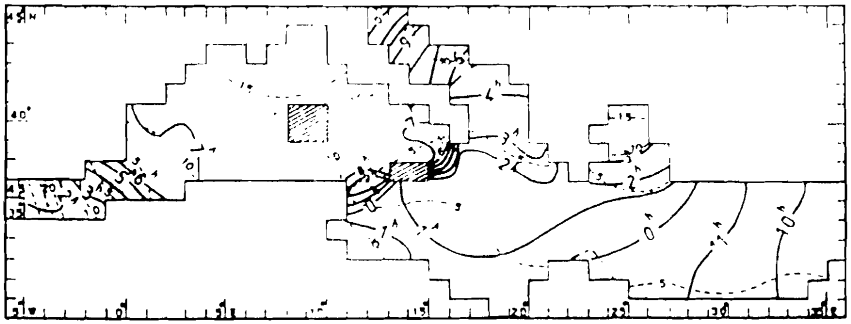

Figure 12: M2-Co-Oscillating tide in the Mediterranean with its real depths and friction coefficient of $5*10^{-6}$ sec^{-1}. The co-ranges are in cm, and the co-tidal lines correspond to lunar hours of high tide after lunar-transit at Greenwich.

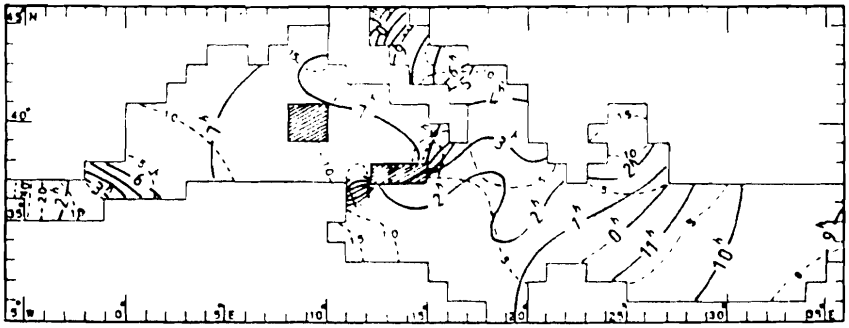

Figure 13: M2-Co-Oscillating tide in the Mediterranean with its real depths and reducing the width of Tunis Strait to only one grid. The co-ranges are in cm, and the co-tidal lines correspond to lunar hours of high tide after lunar-transit at Greenwich.

Table 1: Ampliyudes (cm) and phases (in degrees, of high tide after lunar transit at Greenwich) of observed and computed M2-co-oscillating tide of the Mediterranean with the Atlantic Ocean with mesh size of 1°X1°.

STATION	ABB.	CONSTANT DEPTH r=10⁻⁶						VARIABLE DEPTH r=10⁻⁶									
		500 m		1000 m		1500 m		H = 200 AT. GI		300 m at GI		1° WIDTH at SICILY		3° WIDTH at GREECE		OBSERVED M2-TIDE	
		A(cm)	ϕ °	A(cm)	ϕ °	A(cm)	ϕ °	A(cm)	ϕ °	A(cm)	ϕ °	A(cm)	ϕ °	A(cm)	ϕ °	A(cm)	ϕ °
GIBRALTAR	GI	48.0	046	48.0	046	48.0	046	48.0	046	48.0	046	48.0	046	48.0	046	38.3	036
ALGER	AG	09.7	138	15.1	158	04.8	266	09.7	208	10.2	208	08.5	207	07.2	212	--	--
TUNIS	TU	05.7	297	12.5	247	01.9	299	03.6	320	04.1	311	04.7	054	11.5	122	--	--
SFAX	SF	09.9	356	12.9	275	03.9	001	14.1	058	14.1	054	17.2	092	10.0	103	42.0	106
GABES	BG	11.1	358	13.0	282	04.2	004	14.8	044	14.8	040	16.7	070	11.4	083	51.0	108
TRIPOLI	TL	10.9	002	13.2	284	03.5	351	09.9	034	08.8	031	11.0	058	08.0	077	11.1	085
BANGHAZI	BG	15.0	027	15.6	308	15.4	273	05.7	019	05.8	016	05.1	035	03.6	069	--	--
TUBRUQ	TQ	05.2	055	08.1	023	19.5	004	04.3	351	04.4	352	04.0	333	04.0	311	01.0	343
SALOM	SA	02.6	056	10.0	035	23.7	011	05.4	343	05.5	346	05.6	324	05.0	302	--	--
MERSA MATROH	MM	00.3	230	08.5	052	23.5	016	05.1	332	05.1	336	06.0	311	06.9	291	--	--
ALEXANDRIA	AX	03.9	234	09.2	065	25.9	020	04.6	314	04.5	319	06.1	295	08.3	280	07.2	305
PORT-SAID	PD	8.9	234	09.9	084	27.2	024	05.4	294	05.0	298	08.1	282	12.7	268	11.7	304
BEIROT	BE	11.3	234	11.0	096	27.5	029	05.1	283	04.6	285	08.1	275	11.6	266	13.4	304
SALONIKA	SL	15.4	081	08.0	112	20.8	064	14.9	110	15.1	114	14.8	092	29.8	047	14.6	128
ATHENS	AH	10.3	074	03.7	103	13.7	059	05.3	079	05.2	082	05.9	067	10.2	046	--	--
RHODES	RH	05.6	052	05.9	086	18.3	042	04.5	020	04.5	024	04.7	360	06.5	331	05.9	308
DURRES	DR	05.4	180	08.8	307	27.0	214	07.8	120	07.5	121	09.4	121	17.8	107	09.3	102
DUBRAVNIK	DU	05.9	201	10.2	321	32.5	216	08.9	133	08.6	134	10.4	134	20.1	109	08.7	104

Table 1: cont.

STATION	ABB.	CONSTANT DEPTH r=10-6						VARIABLE DEPTH r=10-6									
		500 m		1000 m		1500 m		H = 200 AT. GI		300 m at GI		1o WIDTH at SICILY		3o WIDTH at GREECE		OBSERVED M2-TIDE	
		A(cm)	ø	A(cm)	ø	A(cm)	ø	A(cm)	ø	A(cm)	ø	A(cm)	ø	A(cm)	ø	A(cm)	ø
SPLIT	SP	08.4	241	13.0	340	40.0	213	12.0	195	11.7	195	13.9	196	--	--	07.6	121
SIBENIK	SI	07.9	261	15.3	344	40.1	218	12.1	208	11.7	208	14.0	210	--	--	06.3	135
ROVINJ	RO	11.4	266	17.2	360	43.5	226	06.8	343	06.6	343	07.8	345	--	--	17.8	263
TRIESTE	TS	11.4	266	17.2	360	43.5	226	06.8	343	06.6	343	07.8	345	--	--	25.9	277
VENEZIA	VE	11.2	268	17.6	002	43.7	226	06.8	010	06.6	010	07.8	011	--	--	22.1	320
RAVENNA	RA	11.0	268	17.7	001	43.7	226	06.3	360	06.1	360	07.2	360	--	--	15.5	303
PESAROP	PS	11.0	270	17.7	001	43.7	226	05.8	348	05.6	348	06.7	349	--	--	12.8	311
ANCONA	AN	10.2	267	16.6	360	41.1	229	10.0	258	09.6	258	11.7	257	--	--	06.0	345
MANFRE DONIA	MF	03.4	254	10.7	342	29.6	227	06.2	126	05.9	126	07.3	128	24.0	110	10.0	113
RBRINDISI	BR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	08.7	102
OTRANTO	OT	04.4	163	08.6	301	24.1	211	06.5	103	06.2	103	07.8	104	13.4	103	06.5	110
TARANTO	TR	02.4	111	06.3	305	21.5	219	05.0	096	04.8	096	06.2	099	11.0	108	06.5	105
GALLICO	GL	01.6	103	06.5	263	16.1	220	03.5	056	03.2	053	04.6	066	05.9	174	05.8	098
REGGIO CALABRIA	RC	07.5	200	09.5	220	20.7	209	06.5	192	06.8	196	06.9	186	08.0	197	06.2	091
PUNTAFARO	PF	07.5	200	09.5	220	20.7	209	06.5	192	06.8	196	06.9	186	08.0	197	05.5	267
NAPOLI	NA	11.6	206	12.6	213	19.9	206	07.3	211	07.8	215	07.3	208	09.1	204	11.1	263
CIVITA VECCHIA	CI	16.6	210	15.1	204	22.0	200	09.8	197	10.2	200	09.5	196	10.0	196	10.3	262
LIVORNO	LI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	08.6	257
LA-SPEZIA	LS	26.0	225	22.4	197	25.1	192	18.3	212	19.0	213	16.9	211	23.7	215	09.4	244
GENOVA	GE	25.8	225	22.5	197	25.0	192	18.0	211	18.8	213	16.7	211	21.0	215	08.6	254

Table 1: cont.

STATION	ABB.	CONSTANT DEPTH r=10-6						VARIABLE DEPTH r=10-6									
		500 m		1000 m		1500 m		H = 200 AT. GI		300 m at GI		1o WIDTH at SICILY		3o WIDTH at GREECE		OBSERVED M2-TIDE	
		A(cm)	ø	A(cm)	ø	A(cm)	ø	A(cm)	ø	A(cm)	ø	A(cm)	ø	A(cm)	ø	A(cm)	ø
IMPERIA	IM	25.7	225	22.5	197	24.9	192	17.8	211	18.5	218	16.4	210	18.6	216	07.3	262
MONACO	MO	23.0	226	21.3	196	24.1	192	15.5	216	16.1	218	14.2	215	14.0	223	--	--
NIECE	NI	23.0	226	21.3	196	24.1	192	15.5	216	16.1	218	14.2	215	14.0	223	--	--
CANNES	CN	23.0	226	21.3	196	24.1	192	15.5	216	16.1	218	14.2	215	14.0	223	--	--
TOULON	TO	17.9	225	19.0	193	22.0	189	15.1	211	15.6	212	13.8	210	13.5	217	--	--
MARSEILLE	MS	16.4	228	19.4	190	21.1	186	15.3	209	15.8	211	13.9	208	16.5	215	--	--
BARCELONA	BA	07.2	230	14.9	183	17.6	178	12.9	210	13.4	211	11.6	208	11.3	219	--	--
VALENCIA	VA	10.1	072	09.6	136	13.0	146	07.6	203	07.9	204	06.4	201	03.9	217	--	--
ALICANTA	AL	26.1	063	17.4	091	--	095	01.8	172	01.8	166	01.3	161	01.7	340	--	--
CABLIARI	CG	10.9	225	14.7	213	20.5	195	13.0	211	13.6	213	12.2	210	10.9	220	07.6	264
PORTO EMPEDDCLE	PE	04.3	005	10.4	263	16.0	226	04.0	037	03.7	030	08.2	062	05.8	103	04.5	107
CAPO PASSERO	CP	--	--	--	--	--	--	--	--	--	--	--	--	--	--	06.3	098
CATANIA	CA	05.2	019	10.2	272	15.6	231	04.8	045	04.6	041	07.4	062	06.0	102	06.4	091
TAORMINA	TA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	06.4	087
CATANIA	GA	01.9	018	09.0	269	14.5	227	02.4	071	02.0	068	03.4	080	05.2	112	03.2	316
MESSINIA	ME	01.9	018	09.0	269	14.5	227	02.4	071	07.1	020	06.8	034	08.0	052	05.3	031
MILLAZZO	MI	07.2	217	11.2	235	19.1	212	05.1	214	21.4	050	21.9	044	21.5	079	11.8	269
PALERMO	PA	09.1	226	12.6	226	18.9	208	07.5	209	20.9	079	21.2	070	21.1	093	10.6	267
MALTA	MA	09.3	011	11.8	285	01.7	001	07.1	031	03.1	071	02.8	079	05.1	069	06.1	095

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