Nature of Prevailing Wind Waves at the Southern Entrance of Khor ABDULLAH

Ali B. Mahmood , Sadiq S. Abdullah & Ayad A. Al-Mahdi

Marine Physics Department, Marine Science Center, Basrah University.

Abstract:

Wind is one of the major sources for generating water surface gravity waves. Throughout Iraq, overall surface winds come from the northwest at 5-10 knots an average. Three stations A,B and C were selected situated along the southern entrance of Khor ABDULLAH which extended to the distance 20 km.Wave estimation depends on the Sverdrup, Munk (1947) and Bretschneider (1952) method which is possible to be applied for computing the wind-sea significant wave height on a fully developed sea at storm area to the higher waves of greater importance in relation to their effect on ships or coastal structures, while beyond the storm area the swell significant wave height and swell period are computed by using Neumann and Pierson (1966) prediction method, the combined significant wave height is computed by using data of wind speed observed at 10 m over sea surface recorded at Abadan station in the north of Arabian gulf. The results shows that the higher wave height is around 1.7 m in summer season in the range of years 1990-2000,also the higher swell and combined waves are 1.3 m and 2.1 m in summer in the same range of years at the southern entrance of Khor ABDULLAH in accordance with the field data. The manner of increasing of the wind speed and wave height is parallel. The slope of coast at these stations is shallow and mild. The waves breakers occurs on coast are spilling and plunging breakers.

طبيعة امواج الرياح السائدة في المدخل الجنوبي لخور عبد ا

علي باسل محمود, صادق سالم عبد ا ,اياد عبد الجليل المهدي

قسم الفيزياء البحرية,مركز علوم البحار, جامعة البصرة, البصرة- العراق.

الخلاصة

تعتبر الرياح احد المصادر الرئيسية لتوليد امواج الجاذبية الارضية المتكونة على سطوح المياه. فـي عمـوم العراق تهب الرياح من جهة الشمال الغربي وبمعدل سرعة من 5-10 عقدة. تم انتخاب ثلاث محطات وهي AوBوC على طول المدخل الجنوبي لخور عبد ا والتي تمتد مسافة 20 كم. ويعتمد تقدير ارتفاع الامـواج على نظرية التنبؤ للباحثين Sverdrup,Munk (1947) and Bretschneider (1952) والتي من الممكـن تطبيقها لاحتساب الارتفاع المميز لامواج الرياح في بحر متكامل النمو في منطقة العصف ذات الموج العالي وفقا لتاثيرها على السفن والانشاءات الساحلية,في حين,في المنطقة التي تلي منطقة العصف فانه يتم احتسـاب الارتفاع الموجي البارز وفترته بواسطة طريقة التنبؤ للباحثين Neumann and Pierson (1966) ,كما تم

احتساب ارتفاع الموجة المركبة ايضا, من استخدام سرع الرياح المقاسة على ارتفاع 10 متر فوق سطح الماء لجميع حسابات الامواج انفة الذكروالتي سجلت في محطة عبادان شمال الخليج العربي. وقد اظهرت النتائج ان اعلى ارتفاع موجي في منطقة العصف كان 1,7 متر في فصل الصيف خلال السنوات 1990-2000 , واعلى ارتفاع موجي في ما بعد منطقة العصف و الامواج المركبة كان على التوالي 1,3 متر و 2,1 متر في الصيف وفي نفس معدل السنوات في المدخل الجنوبي لخور عبد ا وبالتوافق مع القياسات الحقلية.ان الارتفاع الموجي يزداد بازدياد سرعة الرياح.و انحدار الساحل في المحطات الثلاث هو ضحل وغير حاد.وانواع الامواج التي تتكسر على الساحل هي امواج متدفقة وامواج منحدرة.

Introduction

Sea waves have attracted attention and comment throughout recorded history. Aristotle (322-384 Bc) observed the existence of a relationship between wind and waves, and the nature of this relationship has been the subject of study ever since. The understanding of the mechanism of wave formation and the way that waves travel across the oceans is by no means complete. This is partly because observations of wave characteristics at sea are difficult, and partly because mathematical models of wave behavior are based upon the dynamics of idealized fluids, and ocean waters do not conform precisely with those ideals (open university course team 1989).

The theory of waves generation by the turbulent winds of the atmosphere has had along and rich history beginning with some classic works of Kelvin (1887) and Helmholtz (1888).

In the early 1900's,Jeffreys (1924,1925) works hypothesized that waves created a " sheltering effect" and hence created a positive feedback mechanism for transfer of momentum into the wave field from the wind . Sverdrup & Munk (1947- 1951) presented the first documented relationships among various wave-generation parameters and resulting wave conditions, Bretschneider (1952) revised these relationships based on additional evidence, methods derived from these exemplary pioneer works are still in active use today.

Pierson et al. (1955) recognized that the wave generation process described as a spectral phenomenon ,following a long these lines.

Miles (1957) assumes a logarithmic wind profile and the existence of a wave for the wind to act upon and exponentially wave growth with time.

Phillips (1958) concept involved the resonant interactions of pressure fluctuations with waves propagating at the same speed and liner wave growth with time .

The models of Hasselmann et al. (1985),(WAMDI Group 1988),Hubertz (1992),Cardone (1992) produce very good predictions and hindcasts of wave conditions for a wide range of meteorological situations (US Army Corps of Engineers 2002).

All these models are statistically based .The advanced models attempt to estimate the shape of the wave energy spectrum from wind data rather than wave statistics alone, Finlayson (2004).

Three stations (A,B and C) were selected situated along the southern entrance of Khor ABDULLAH which have the locations E 48^0 27' 14.15" N 29^0 55' 14.85", E48^0 22' 01.04" N 29^0 56' 30.98 " and E 48^0 16' 14.62" N 30^0 00' 02.22", extended to the distance 20 km . The slope of the coast on these stations was obtained from the bathymetric survey of Marine Science Center during the duration May-June 2005.

The aim of this research is to study the nature of prevailing wind waves at the southern entrance of Khor ABDULLAH by compute the wind-sea ,swell and combined significant waves heights, Sverdrup,Munk (1947) and Bretschneider (1952) prediction method is one of the reliable wave method will be used to compute the wind-sea significant wave height , Neumann and Pierson (1966) method to compute the swell significant wave height and its period . Also this research is for knowledge the breaking wave type on the coast of study region.

Description of Study Region

Khor ABDULLAH is considered an important navigational entrance along northwest direction between Shatt Al-Arab Estuary and Bubian island at the Arabian Gulf until Warba island (Fig.(1)), also it has a distinctive geographical site due to its conical shape which is regarded as separating boundaries between Mesopotamia and Bubian island and a connection ring for Khor AL-Zubair and Arabian Gulf, it is surrounded by wide tidal flats.

At the north it is joined to a narrow route called Khor Shaittana .

Khor ABDULLAH ends at the top north in Umm Qaser and Khor Al-Zubair ports, while the southern part is widely open towards Arabian Gulf with width of about 10 km as its southern entrance, also there is a deep channel heading north to Warba island connecting between Khor Al-Saqa and Khor AL-Zubair this channel is called Khor AL-Thaalab where Umm Qaser city lies in (Marine Science Center,2005).

The Nature of Prevailing Winds in IRAQ

At winter (December-March) ,throughout Iraq, overall surface winds come from the northwest at 5-10 knots (1knot= 1800 m) an average peak gusts reached 40-50 knots all over Iraq.

At Spring (April-May),overall surface winds continue to come from northwest at 5-10 knots.

At Summer (June-September),overall northwesterly winds at the surface are stronger and more persistent in summer than in any other season. Average wind speed are 10-15 knots with periods when winds persist above 25 knots for hours or days at a time, peak gusts reached 40-50 knots in most places and 50-60 knots in a few.

At Autumn (October-November),overall surface winds continue to come from the northwest but are lighter than they are in summer, at an average of 5-10 knots. There is also a greater westerly component in more of the country. Peak gusts reached 25-35 knots in most places but sandstorms, dust storms , and dust devils still cause 50-60 knots in a few places.(www.wmo.ch,2006).

Wind Wave Generation Theory

Most waves generated by frictional drag of wind, small friction of wind energy transferred into drift currents but most energy goes into buckling the surfaces. Wind then generates different pressure on windward and leeward sides of buckles causing buckles to grow into waves and then causing waves to move.

Energy transferred into water as waves depends on; wind speed, consistency of wind direction, wind duration, fetch (the maximum length of open water over which constant wind blows),air-sea temperature difference, water depth Gross,M. Grant (1982).The waves continue to grow until speed which corresponds to one-third of the wind speed. On the face of it, the wave grow will continue until wave speed same as wind speed. However, in practice wave growth ceases whilst wave speed is still at some value below wind speed. (open university course team ,1989).

WIND WAVES MODELS OF PREDICTIONS

Wind - Sea Significant Wave Height Prediction:-

The development of prediction methods has been largely empirical and has taken place almost independently of the theoretical and experimental studies just described.
Sverdrup,Munk (1947) and Bretschneider (1952) relationship is a method to predict the wind - sea significant wave height (Hs) for given wind speed (W) ..
The (Hs) gives more weight to the higher waves, which are of greater importance in relation to their effect on ships or coastal structures ,flood barriers, harbor installations, but retains a certain amount of averaging and avoids extreme values, and could be represented as:-

$$Hs = (\lambda/g)*W^2 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where:-

Hs; wind-sea significant wave height is the average height of the one-third highest waves
in unit of meter(m).

λ ; dimensionless coefficient (approximately equal to 0.27). .(US Army Corps of Engineers 2002).

W ; wind speed in unit of (m/sec)

g ; Acceleration due to gravity (9.8 m/sec^2).

This formula provides an easy means to estimate the wave growth for all depths in the storm region (US Army Corps of Engineers, 2002).
The idea of a "fully developed sea" was used to derive this formula, when the wind had been blowing with a steady speed and direction long enough for all wave components to have reached a state of equilibrium in which energy dissipated by the waves at the same rate as the waves receive energy from the wind, under these conditions the significant wave height expected to be a function of the wind speed only (Bowden,1983).

Swell Significant Wave Height Prediction:-

Swell, the waves will travel beyond the storm area , characterized by long wave length and will arrive at a distant coast before shorter waves from the same storm area. The wave height of the swell waves could be related to wind speeds in the corresponding storm area .Several changes take place in the properties of these waves as they travel away from the storm area as follow (Bowden 1983).:-

1- The angular spread of their directions of travel is reduced.
2- The energy density is decreased by geometrical spreading as they move further from
the source.
3- The energy per unit length of wave front would be inversely proportional to the distance

traveled, independently of the wave length.

4- Dissipative processes ,of which wave breaking is probably the most important, although the air resistance and turbulent friction may play some part.

Procedures for making quantitative estimates of the effects of these changes on the swell were included in the prediction method of Pierson, Neumann and James (1955).The following expression for the swell significant wave height (Hsw) in a fully developed sea obtained by Neumann and Pierson (1966) ,where according to the recently studies that the deep water wave growth formula can be used for all depths (US Army Corps of Engineers, 2002), as following :-

$$Hsw = 0.0212 * W^2 \quad \text{...} \ (2)$$

$$Tsw = 0.52 * W \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (3)$$

Where:-

Hsw; swell significant wave height in unit of meter (m).

Tsw; swell period in unit of (sec),which represent the time for a particle on a water to make one complete vibrational cycle.

Combined Wind-Sea and Swell Significant Wave Height:-

These waves come about when wind–Sea (Hs) are superimposed on swell waves (Hsw). The interaction of wind-Sea and swell waves produces larger waves. The resultant combined wave height (Hc) is computed by using the formula which is clarified as the following. (Air Force Weather Agency Doctrine, 1999):-

$$Hc = SQRT\ (H^2s + H^2sw) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \ (4)$$

Where:-

Hc; Combined Wave Height in unit of meter (m)

Coast slope

Coast slope is another major factor in determining the type of coast in the surf zone (the horizontal distance in meter or feet between the outer most breakers and the limit of wave up rush on the coast). Coast slopes can vary from shallow or flat (1:120 or better) to steep or vertical (1:15) (Air Force Weather Agency Doctrine, 1999).

Wind Waves Breaking Upon the Shore

A breaking wind wave is a highly complex system. Even some distance before the wave break, its shape is substantially distorted from a simple sinusoidal wave.

As a wave breaks, the energy it received from the wind is dissipated as following:-

1- Some energy is reflected back out to the sea upon the slope of coast.

2- Most energy is dissipated as heat in the mixing of foaming water, sand and shingle.

3- Some energy is used in fracturing large rock or mineral particles into smaller one, and that may be used to increase the height of the coast form.

The last aspect of the coast depends on the type of waves. Small gentle waves and swell tend to build up coasts, where as storm waves tear them down. (open university course team .1989).

Calculations and Results

By using the data of wind speed observed at 10 m over sea surface recorded at Abadan station in the north of Arabian gulf (Iranian of meteorological organization,1951-2000),as used in previous researches (Al Mahmood 2006 & Yagoob 1993),in the range between the years 1990-2000 as shown in table (1) of the study region (the southern entrance of Khor ABDULLAH as shown in fig. (1)).Hs, Hsw, Tsw and Hc are computing as a function of W from the equations 1,2,3 and 4 respectively which exhibit in tables 2,3,4 and 5, and drawing against W as shown in figures 2,3,4 and 5 alternatively.

Hs ,Hsw with W in fig.(2) and fig.(3) shows that both of them increase in parallel manner with W. This means the energy transferred into water as waves and swell will increase when wind speed increase in same time. That will cause increase in the wave volume and its height. Hc with W in fig.(4) shows that Hc increase in parallel manner with W because Hc comes from the superimposed of Hs and Hsw and each of them increased in parallel manner with W .Then the value of Hc is grater than the value of Hs and Hsw. The relationship between Tsw and W in fig.(5) shows that both of them increase in parallel manner , where the high value of wind speed gives long time to the water particle to make long vibratonal cycle. Because of the higher values of the wind speed in summer season in the range of years (1990-2000) as shown in table (1), the results in tables (2),(3),(4) and (5) shows the higher values also occurs in summer season at the study region where the higher value of Hs is around 1.7 m, also the higher values of Hsw and Hc are 1.3 m and 2.1 m , and these results getting near the field measurements of higher wave height which was recorded at the southern entrance of khor ABDULLAH in the year 2000 and it was equal to 2.33 m (Iraqi Ports Co.) .

For the coast slope to the study region ,with the field geometry measurements to the coast at the three sites A,B and C ,the results will be as following :-

At site **A** : Extension = 1150 m & Depth= 2.8 m , then the coast slope will be shallow or flat.

At site **B** : Extension = 950 m & Depth = 7 m ,then the coast slope will be shallow or flat.

At site **C** : Extension = 600 m & Depth = 7.1 m, then the coast slope will be mild

Then, the wave breakers occurs on the coast from the site A to site B are spilling breakers, while The wave breakers occurs on the coast from the site B to site C are Plunging breakers, in accordance with the results which has been deduced by (Al-Mahmood 2006).

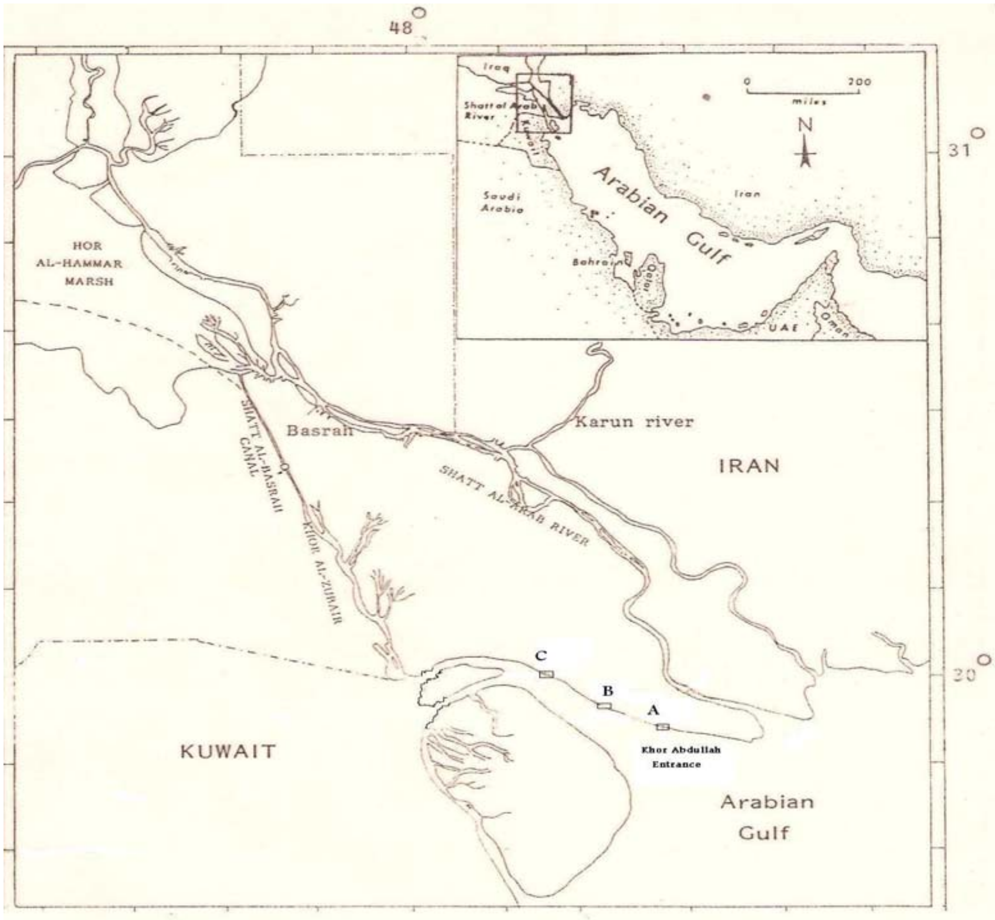

Fig. (1) –Chart of the southern Entrance of Khor ABDULLAH shows the three sites A,B and C at the studying coast

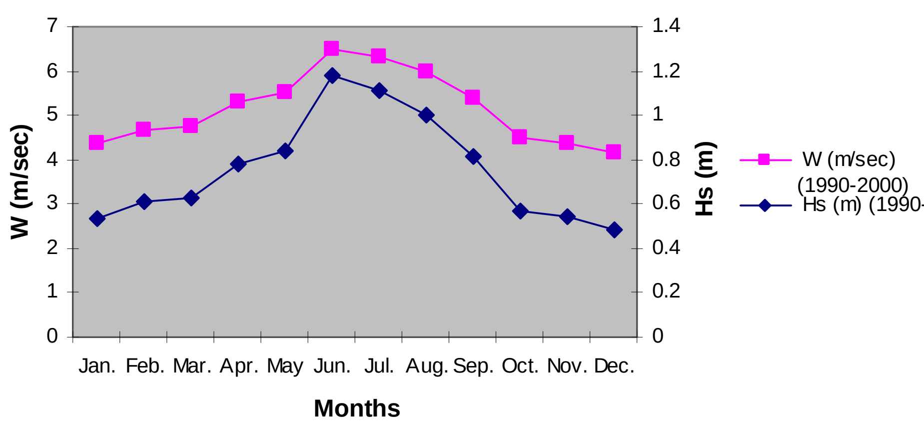

Fig. –(2)- Relationship between Wind Speed (W) and Wind-Sea Significant Wave height (Hs) (1990-2000)

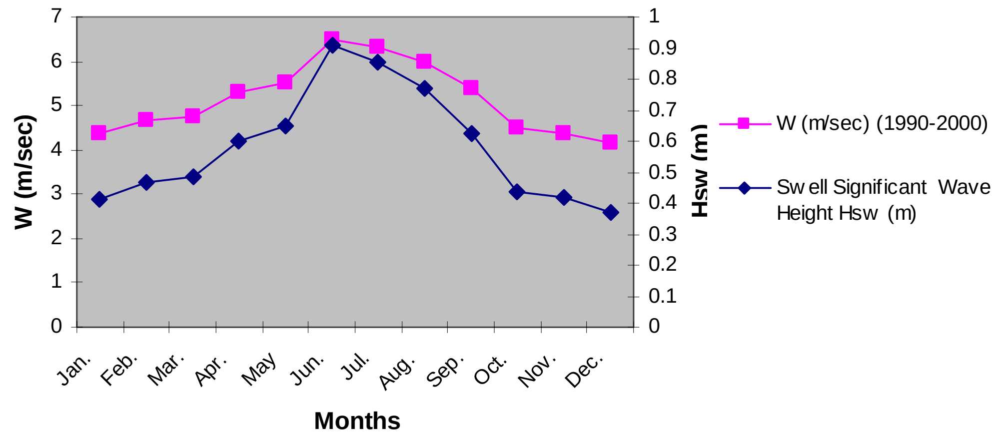

Fig. –(3)- Relationship between Wind Speed(W) and Swell Significant Wave height (Hsw) (1990-2000)

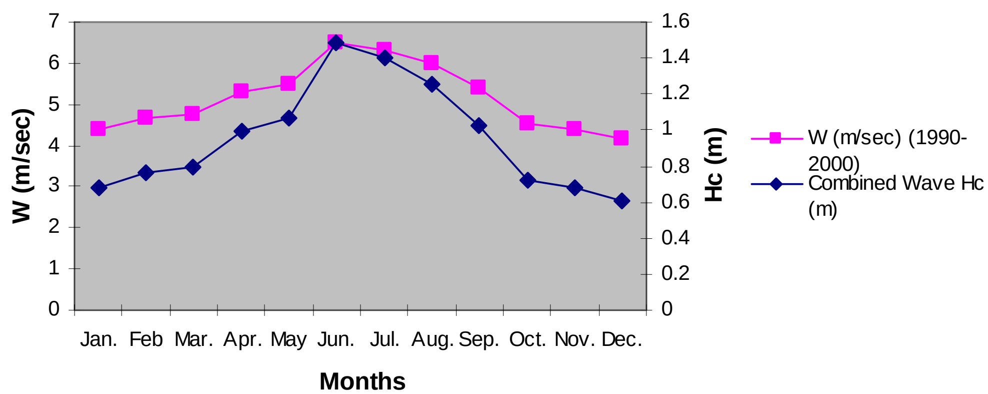

Fig. –(4)- Relationship between Wind Speed(W) and Combined Wave height (Hc) (1990-2000)

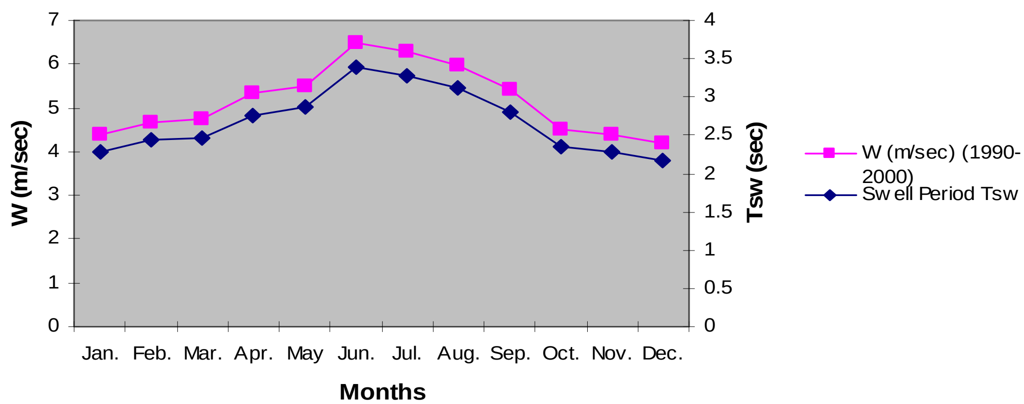

Fig. –(5)- Relationship between Wind Speed (W) and Swell Period (Tsw) (1990-2000)

Table – (1) – Wind speed average (1990-2000)in the study area

Months	W(m/Sec) 1990	W(m/Sec) 1991	W(m/Sec) 1992	W(m/Sec) 1993	W(m/Sec) 1994	W(m/Sec) 1995	W(m/Sec) 1996	W(m/Sec) 1997	W(m/Sec) 1998	W(m/Sec) 1999	W(m/Sec) 2000
Jan.	4.05	3.95	3.80	4.00	4.40	5.35	5.40	4.75	4.30	4.00	4.15
Feb.	4.35	4.30	4.40	6.15	4.80	4.70	4.80	4.35	4.90	4.30	4.35
Mar.	4.60	4.55	4.85	5.70	4.65	5.30	4.85	4.80	4.25	4.55	4.20
Apr.	4.95	5.65	5.40	5.45	5.45	5.85	5.50	5.40	4.60	5.30	5.00
May	5.05	6.90	6.00	5.10	5.85	5.20	5.70	4.80	5.10	5.70	5.10
Jun.	6.95	7.20	7.80	6.85	6.45	5.85	7.00	5.50	6.00	5.95	6.00
Jul.	6.35	7.50	7.95	6.20	6.10	6.60	5.35	6.70	5.40	5.50	5.70
Aug.	6.60	6.55	6.70	6.05	6.50	5.55	5.10	6.55	5.65	5.15	5.50
Sep.	5.50	6.80	5.20	5.45	4.65	4.90	5.80	5.30	4.95	5.90	4.95
Oct.	4.75	3.90	4.50	3.45	4.90	4.45	5.35	4.30	4.55	4.55	4.95
Nov.	4.85	3.25	4.50	4.55	5.70	5.15	4.25	3.65	4.30	4.30	3.65
Dec.	4.20	3.95	4.20	4.40	4.75	3.80	4.20	3.80	4.45	4.45	3.75

Table – (2) – Wind-Sea significant wave height average(1990-2000)in the study area

Months	Hs(m)1990	Hs(m) 1991	Hs(m) 1992	Hs(m) 1993	Hs(m) 1994	Hs(m) 1995	Hs(m) 1996	Hs(m) 1997	Hs(m) 1998	Hs(m) 1999	Hs(m) 2000
Jan.	0.4519	0.4298	0.3978	0.440816	0.5333	0.7885	0.8033	0.6216	0.5094	0.4408	0.4744
Feb.	0.5213	0.5094	0.5333	1.042048	0.6347	0.6086	0.6347	0.5213	0.6615	0.5094	0.5213
Mar.	0.5829	0.5703	0.6480	0.895132	0.5957	0.7739	0.6480	0.6347	0.4976	0.5703	0.4860
Apr.	0.6750	0.8794	0.8033	0.818334	0.8183	0.9428	0.8334	0.8033	0.5829	0.7739	0.6887
May	0.7026	1.3117	0.9918	0.716602	0.9428	0.7449	0.8951	0.6347	0.7166	0.8951	0.7166
Jun.	1.3307	1.4282	1.6762	1.292762	1.1461	0.9428	1.3500	0.8334	0.9918	0.9755	0.9918
Jul.	1.1109	1.5497	1.7412	1.059061	1.0251	1.2001	0.7885	1.2367	0.8033	0.8334	0.8951
Aug.	1.2001	1.1820	1.2367	1.008436	1.1640	0.8486	0.7166	1.1820	0.8794	0.7307	0.8334
Sep.	0.8334	1.2739	0.7449	0.818334	0.5957	0.6615	0.9268	0.7739	0.6750	0.9590	0.6750
Oct.	0.6216	0.4190	0.5579	0.327926	0.6615	0.5455	0.7885	0.5094	0.5703	0.5703	0.6750
Nov.	0.6480	0.2910	0.5579	0.570375	0.8951	0.7307	0.4976	0.3670	0.5094	0.5094	0.3670
Dec.	0.4860	0.4298	0.4860	0.533387	0.6216	0.3978	0.4860	0.3978	0.5455	0.5455	0.3874

Table- (3)- Swell significant wave height average(1990-2000)in the study area

Months	Hsw(m) 1990	Hsw(m) 1991	Hsw(m) 1992	Hsw(m) 1993	Hsw(m) 1994	Hsw(m) 1995	Hsw(m) 1996	Hsw(m) 1997	Hsw(m) 1998	Hsw(m) 1999	Hsw(m) 2000
Jan.	0.3477	0.3308	0.3061	0.3392	0.4104	0.6068	0.6182	0.4783	0.3920	0.3392	0.3651
Feb.	0.4012	0.3920	0.4104	0.8018	0.4884	0.4683	0.4884	0.4012	0.5090	0.3920	0.4012
Mar.	0.4486	0.4389	0.4987	0.6888	0.4584	0.5955	0.4987	0.4884	0.3829	0.4389	0.3740
Apr.	0.5195	0.6768	0.6182	0.6297	0.6297	0.7255	0.6413	0.6182	0.4486	0.5955	0.5300
May	0.5407	1.0093	0.7632	0.5514	0.7255	0.5732	0.6888	0.4884	0.5514	0.6888	0.5514
Jun.	1.0240	1.0990	1.2898	0.9948	0.8820	0.7255	1.0388	0.6413	0.7632	0.7505	0.7632
Jul.	0.8548	1.1925	1.3399	0.8149	0.7889	0.9235	0.6068	0.9517	0.6182	0.6413	0.6888
Aug.	0.9235	0.9095	0.9517	0.7760	0.8957	0.6530	0.5514	0.9095	0.6768	0.5623	0.6413
Sep.	0.6413	0.9803	0.5732	0.6297	0.4584	0.5090	0.7132	0.5955	0.5195	0.7380	0.5195
Oct.	0.4783	0.3225	0.4293	0.2523	0.5090	0.4198	0.6068	0.3920	0.4389	0.4389	0.5195
Nov.	0.4987	0.2239	0.4293	0.4389	0.6888	0.5623	0.3829	0.2824	0.3920	0.3920	0.2824
Dec.	0.3740	0.3308	0.3740	0.4104	0.4783	0.3061	0.3740	0.3061	0.4198	0.4198	0.2981

Table- (4)- Swell period average(1990-2000)in the study area

Months	Tsw (sec) (1990)	Tsw (sec) (1991)	Tsw (sec) (1992)	Tsw (sec) (1993)	Tsw (sec) (1994)	Tsw (sec) (1995)	Tsw (sec) (1996)	Tsw (sec) (1997)	Tsw (sec) (1998)	Tsw (sec) (1999)	Tsw (sec) (2000)
Jan.	2.106	2.054	1.976	2.08	2.288	2.782	2.808	2.47	2.236	2.08	2.158
Feb.	2.262	2.236	2.288	3.198	2.496	2.444	2.496	2.262	2.548	2.236	2.262
Mar.	2.392	2.366	2.522	2.964	2.418	2.756	2.522	2.496	2.21	2.366	2.184
Apr.	2.574	2.938	2.808	2.834	2.834	3.042	2.86	2.808	2.392	2.756	2.6
May	2.626	3.588	3.12	2.652	3.042	2.704	2.964	2.496	2.652	2.964	2.652
Jun.	3.614	3.744	4.056	3.562	3.354	3.042	3.64	2.86	3.12	3.094	3.12
Jul.	3.302	3.9	4.134	3.224	3.172	3.432	2.782	3.484	2.808	2.86	2.964
Aug.	3.432	3.406	3.484	3.146	3.38	2.886	2.652	3.406	2.938	2.678	2.86
Sep.	2.86	3.536	2.704	2.834	2.418	2.548	3.016	2.756	2.574	3.068	2.574
Oct.	2.47	2.028	2.34	1.794	2.548	2.314	2.782	2.236	2.366	2.366	2.574
Nov.	2.522	1.69	2.34	2.366	2.964	2.678	2.21	1.898	2.236	2.236	1.898
Dec.	2.184	2.054	2.184	2.288	2.47	1.976	2.184	1.976	2.314	2.314	1.95

Table- (5)- Combined wave average(1990-2000)in the study area

Months	Hc (m) (1990)	Hc (m) (1991)	Hc (m) (1992)	Hc (m) (1993)	Hc (m) (1994)	Hc (m) (1995)	Hc (m) (1996)	Hc (m) (1997)	Hc (m) (1998)	Hc (m) (1999)	Hc (m) (2000)
Jan.	0.5702	0.5424	0.5020	0.5562	0.6730	0.9950	1.0137	0.7844	0.6428	0.5562	0.5987
Feb.	0.6578	0.6428	0.6730	1.3148	0.8010	0.7679	0.8010	0.6578	0.8347	0.6428	0.6578
Mar.	0.7356	0.7197	0.8177	1.1295	0.7517	0.9765	0.8177	0.8010	0.6279	0.7197	0.6132
Apr.	0.8518	1.1097	1.0137	1.0326	1.0326	1.1897	1.0516	1.0137	0.7356	0.9765	0.8691
May	0.8866	1.6551	1.2515	0.9042	1.1897	0.9400	1.1295	0.8010	0.9042	1.1295	0.9042
Jun.	1.6792	1.8021	2.1150	1.6312	1.4462	1.1897	1.7034	1.0516	1.2515	1.2308	1.2515
Jul.	1.4017	1.9554	2.1971	1.3363	1.2935	1.5143	0.9950	1.5605	1.0137	1.0516	1.1295
Aug.	1.5143	1.4914	1.5605	1.2724	1.4688	1.0708	0.9042	1.4914	1.1097	0.9220	1.0516
Sep.	1.0516	1.6075	0.9400	1.0326	0.7517	0.8347	1.1694	0.9765	0.8518	1.2101	0.8518
Oct.	0.7844	0.5288	0.7040	0.4138	0.8347	0.6884	0.9950	0.6428	0.7197	0.7197	0.8518
Nov.	0.8177	0.3672	0.7040	0.7197	1.1295	0.9220	0.6279	0.4631	0.6428	0.6428	0.4631
Dec.	0.6132	0.5424	0.6132	0.6730	0.7844	0.5020	0.6132	0.5020	0.6884	0.6884	0.4889

Conclusions

1-Sverdrup,Munk 1947 and Bretschneider 1952 prediction method can be used to compute wind-sea significant wave height at the southern entrance of Khor ABDULLAH and gives fairly results comparison with field data because this method can be used in all depths.

2- Neumann and Pierson (1966) prediction method for swell significant wave height can be used at the southern entrance of Khor ABDULLAH which have shallow water characteristic and gives fairly results comparison with field data.

3- The higher wave height is around 1.7 m in summer season in the range of years 1990- 2000,also the higher swell and combined waves are 1.3 m and 2.1 m in summer in the same range of years at the southern entrance of Khor ABDULLAH in accordance with the field data gathered by hydrographic survey department of Iraqi ports company.

4- The value of Hs is greater than Hsw as shown in the results of tables (2) and (3),where the swell significant wave height is gradually diminishes due to the attenuation.

5-The slope of coast at A & B is shallow or flat ,while the slope of coast at C is mild, that result from the prevailing wind waves action which cause high erosion situation concerning at site C more than in the two sites A & B.

6-The prevailing wave breakers types at study region are spilling and Plunging breakers ,that because of the type of coast slope ;are between shallow and mild where the circular orbits of the water particles become flatted and some wave energy will be used in moving sediments to the sea-bed, so more energy will be lost from waves before break then less energy is reflected.

References

Air Force Weather Agency Doctrine, USA, SC 1W01B (B Course) Volume 3, Oceanography, 1999 ,http://www.fas.org/spp/military/docops/afwa/ocean-U2.htm.

Al-Mahmood, Hasan Khalil,2006," The Properties of Iraqi Coast Geographical Study ",P.hd. thesis, college of Art, University of Basrah.

Iraqi Ports Company ,Hydrographic survey department, unpublished data.

Bowden.K.F. 1983."Physical Oceanography of Coastal Waters."Ellis Horwod Ltd.,UK.

Bretschneider, C. 1952. " Revised Wave Forecasting Relationships." Proceedings of the 2nd Coastal Engineering Conference , American Society of Civil Engineers,pp1-5.

Cardone,V.J. 1992."On the Structure of the Marine Surface Wind Field."3rd International Workshop of Wave Hindcasting and Forecasting,montreal,Quebec,May 19-22,pp 54-66.

Climate of Iraq, 2006 (www.wmo.ch).

Finlayson,David . 2004. " Weighted Mean Significant Wave Height Rasters for Hood Canal,WA". Doctoral Dissertation.

Hasselmann,S.,Hasselmann,K.,Allender,J.H.,and Barnett,T.P.1985"Computations and Parameterizations of nonlinear Energy Transfer in a Gravity-Wave Spectrum;Part II Parameterization of Nonliner Transfer for Application in Wave Models,"J.Phys.Oceanogr.,Vol 15,pp 1378-1391.

Helmholtz,H. 1888."Uber Atmospharische Bewwgungen." S. Ber. Preuss. Akad. Wiss. Berlin, Mathem.Physik Kl.

Hubertz,J.M. 1992." User's Guide to the Wave Information Studies(WIS)Wave Model,Version 2.0."WIS Report 27,U.S. Army Engineer Waterways Experiment Station,Vicksburg,MS.

Hugh J.Mclellan 1977."Elements of Physical Oceanography ."Bultter &TannerLTD.,UK.

(I.R.I.M.O.) Iranian Meteorological Organization,Data processing center station of Abadan (IRAQ Beach Weather,Marine,Coast Section 1951-2000).

Jeffereys,H. 1924." On the Formation of Waves by Wind, " Proc. Roy.Soc. Lond.,Vol 107,pp 189-206.

Jeffreys,H. 1925." On the Formation of Waves by Wind. " Proc. Roy.Soc. Lond.,Ser.A.,Vol 110,pp 341-347.

Kelvin,Lord,1887."On the Waves Produced by a Single impulse in Water of Any Depth or in a Dispersive Medium," Mathematical and Physical Papers,Vol IV,London,Cambridge University Press, 1910,pp 303-306.

Marine Science cener,2005." Hydrographic Study for Khor ABDULLAH",.

Miles,J.W. 1957." On the Generation of Surface Waves by Shear Flows." Journal of Fluid Mechanics ,Vol3,pp 185-204.

Neumann,G. and Pierson,W.J. 1966."Principles of Physical Oceanography," Prentice-Hall,Englewood Cliffs, N.J.

Open University Course Team.1989,"Wave,Tides and Shallow-Water Processes," printed by BPCC Wheatons Ltd.,Exeter,UK.

Perkins,E.J. 1976."The Biology of Estuaries and coastal waters." Academic press Inc.(London) LTD.,2nd Printing.

Phillips,O.M. 1958." The Equilibrium Range in the Spectrum of Wind-Generated Waves." journal of Fluid Mechanics,Vol 4,pp 426-434.

Pierson,W.J.,Neuman,G.,and James,R.W. 1955."Observing and Forecasting Ocean waves by Means of Wave Spectra and Statistics ," U.S. Navy hydrographic Office Pub. No. 60.

Pierson,W.J.,Neuman,G.,and James,R.W. 1955." Practical Methods for Observing and Forecasting Ocean waves by Means of Wave Spectra and Statistics ." H.O.Publ.603. U.S. Navy hydrographic Office ,Washington,D.C.

Sverdrup,H. U. and Munk, W. H. 1947."Wind ,Sea,and Swell: Theory of Relations for Forecasting." Pub. No. 601, U.S. Navy Hydrographic Office, Washington, DC.

US Army Corps Engineers 2002." Coastal Engineering Manual".

WAMDI group.1988."The WAM Model-aThird Generation Wave Prediction Model," Journal of Physical Oceanography,Vol 18,1775-1810.

www.wmo.ch,2006

Yagoob, Raad rashad, "Meteorology of Arabian Gulf ", Arabian Gulf scientific studies, University of Basrah, Marine Science Center,1993,p83.