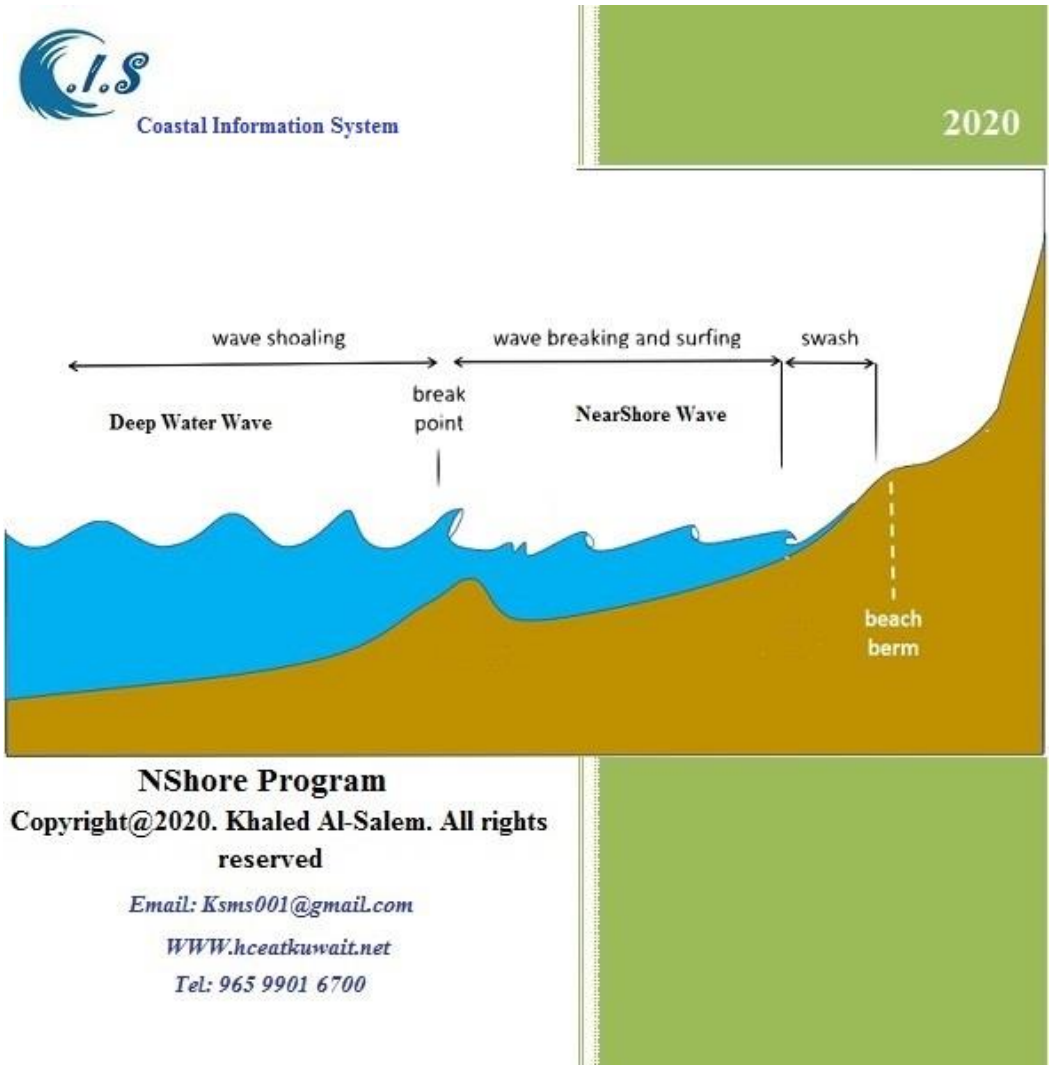
NShore Model

Technical Report



Prediction of NearShore Wave Height Conditions for Irregular Deep Water Waves Height

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ABSTRACT

NShore model presents state-of-the-art NearShore wave height prediction from irregular deep water wave height techniques developed by [Al-Salem K. 2022] based on Goda (1975a, 1975b). Methods for estimating nearshore irregular wave height conditions for the case of continuously shallowing bottom contours, given the bottom slope and offshore wave height characteristics, are presented. The methods are based on the work of Goda (1975a, 1975b) and Goda, Takayama, and Suzuki (1978). NShore model was developed for running in two operation system [PC version and Internet version at website address WWW.hceatkuwait.net].

INTRODUCTION

Waves are often irregular in height, period, and direction with some or most of the waves breaking or near the point of breaking during extreme wave conditions. Procedures for predicting design wave conditions for irregular waves are not discussed in the Shore Protection Manual (SPM) (U.S. Army, Corps of Engineers, Coastal Engineering Research Center, 1977). Much of the information in this report are supplements state-of-the-art irregular wave prediction techniques developed by Goda (1975a, 1975b) and suggested by Goda, Takayama, and Suzuki (1978). Easy-to-use methods for estimating nearshore wave height, angle of approach, and resulting water level setup for irregular waves are presented. The methods are intended for open sections of the coast with continuously shallowing depth contours. Wave setup due to narrow band frequency spectra and surf beat is considered but other forms of wave-wave and wave current interaction and spectral shape factors have been neglected. Design curves and examples of estimating the nearshore significant wave height are also available in Seelig (1979).

The transformation and attenuation of waves propagating from deep water to a beach is a problem of considerable difficulty because of a lack of field data and a poor theoretical understanding of the complex wave deformation process. The methods presented in this report are empirical in nature with the physics of the actual problem only partially understood. The results, based on laboratory and limited field data, are considered promising enough to recommend their application in selected field calculations. The results of calculations should be carefully examined to assure that the basic assumptions of the method have will be violated.

THEORETICAL ANALYSIS

The directional spreading of a wave energy model suggested by Goda, Takayama, and Suzuki (1978) is used to predict the refraction coefficient and refracted wave height for the nearshore point of interest. The height is then used, as input to the surf zone wave height distribution model developed by Goda (1975a, 1975b) to estimate the nearshore wave conditions and setup. The input information necessary for the application of these prediction techniques includes the deep water significant wave height, wave period of peak energy density and dominant wave direction,

the directional spreading of wave energy parameter, S*, beach slope, and water depth at the point of interest.

The confused sea state in deep water may be described as the sum of wave simultaneously moving in various directions. As this wave move toward the coast, the waves with the largest angles between their crest and the bottom contours refract the most, so that nearshore waves appear to be less confused. The reason for the directional spreading of wave energy in refraction Calculations for the case of straight parallel bottom contours are discussed in this section as:

- **Wave Refraction Analysis.**

Refraction calculations are based on the energy-weighted superposition of refraction coefficients obtained from linear theory. If E_i and K_{Ri} are the wave energy and refraction coefficient, respectively, for a wave direction, ***i***, then the composite refraction coefficient for waves from several simultaneous directions is taken as

$$\boldsymbol{K_R} = \sqrt{\frac{\sum_{i=1}^{N} \boldsymbol{E_i K_{Ri}^2}}{\sum_{i-1}^{N} \boldsymbol{E_i}}} \qquad [1]$$

where
N is the number of wave directions

The use of equation [1] in the calculation is to obtain a better estimate of refraction coefficients for irregular waves then would be obtained if a single value of the refraction coefficient obtained from linear theory were used.

Calculation of refraction coefficients and nearshore wave direction angles using the design curves as in Fig 1 requires the dominant deep water parameter conditions as

- wave direction angle, $\boldsymbol{\alpha_0}$,
- Type of deep water wave condition $\mathbf{S_*}$.
- Deep water wave period $\boldsymbol{T_s}$
- Shallow water location depth $\boldsymbol{d}$
- Acceleration due to gravity $\boldsymbol{g}$=9.8 m^2/s

E_i is the density of wave energy in a given direction, i.
Longuet-Higgins, Cartwright, and Smith (1963) suggest the following density function for wave energy:

$$\boldsymbol{E_\theta} = \boldsymbol{K}[\boldsymbol{cos}\frac{\boldsymbol{\theta}}{\boldsymbol{2}}]^{\boldsymbol{2}}\ \boldsymbol{S_*} \qquad [2]$$

where
θ = wave direction angle with respect to the dominant deep water direction, α_0 (Fig. 2; note that α_0 is measured from a line perpendicular to the shoreline)
K = a constant used to define the total wave energy
E_θ = the density of wave energy in a given direction, θ

S_* = a parameter that defines the variation of energy level with wave direction. Smaller values of S_* yield higher amounts of directional spreading of wave energy. Goda, Takayama, and Suzuki recommend the values of S_* in Table 1 for design purposes.

Table 1. Recommended values of S_*.

S_*	**Wave condition**
4	Wind waves
12	Swell (short-to-moderate decay distances)
37	Swell (moderate-to-long decay distances)

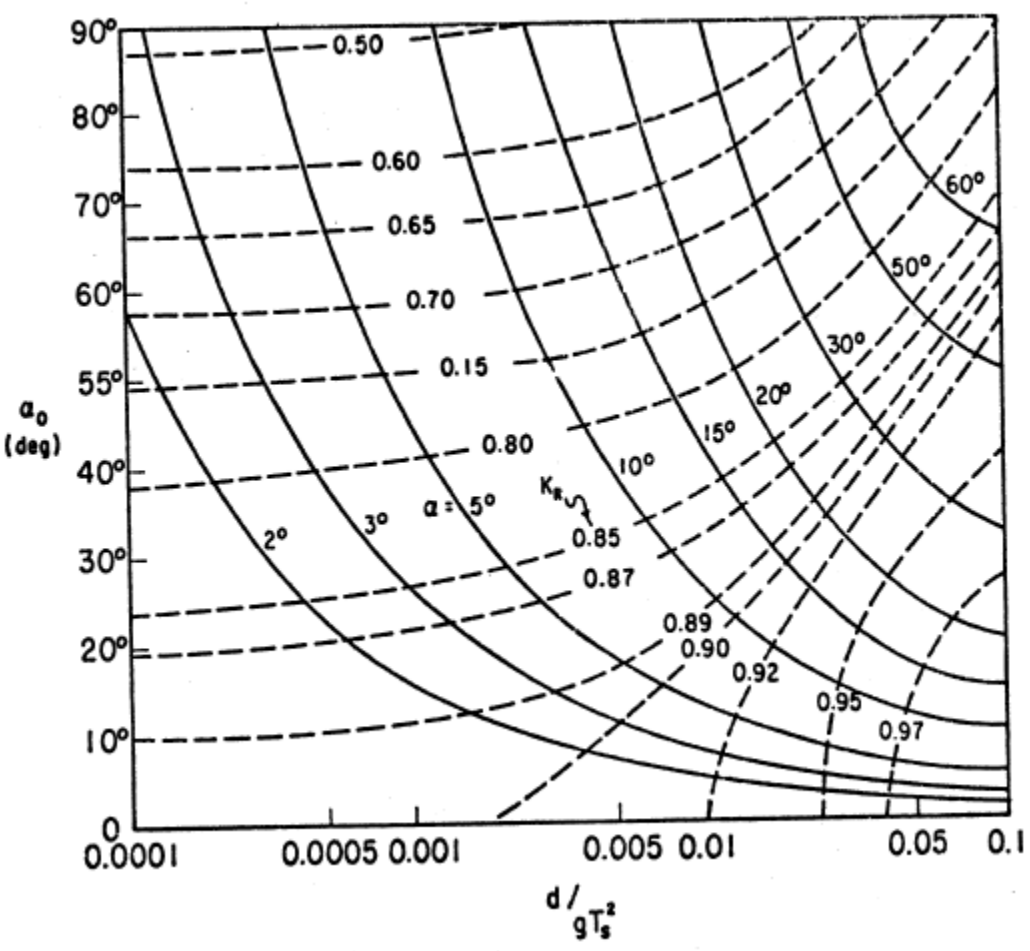

Figure 1. Design Curve for Wave Refraction For S_* = 4

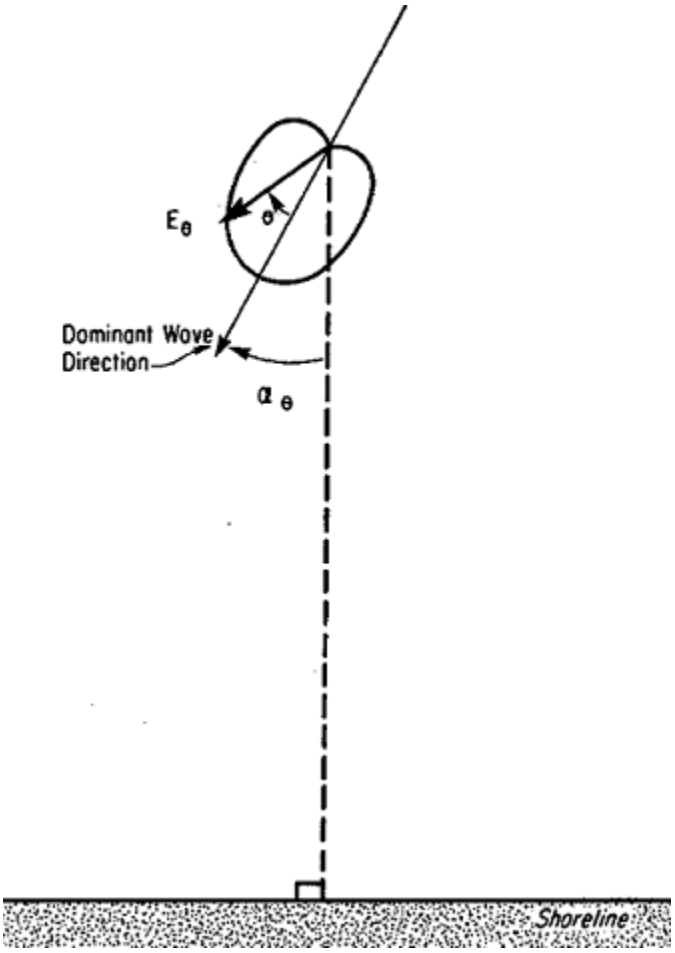

Figure 2. Wave refraction including directional spreading of wave energy

- **NEARSHORE WAVE BREAKIN ANALYSIS**

Goda (1975a, 1975b) developed a nearshore wave height prediction model for irregular waves that accounts for wave breaking, nonlinear wave shoaling, irregular wave setup, and surf beat. Surf beat is the longer period component of water level oscillation. Goda assumed that the deep water significant wave height, H_0, and the average period of the significant waves, T_s , are known or can be estimated. The wave heights are assumed to have a Rayleigh distribution in deep water and this distribution is used to characterize wave heights as the waves move into shallower water until a depth is reached where the waves begin breaking. Goda's approach allows the broken waves to reform at a lower height, so that the wave height.
Distribution is no longer described by the Rayleigh distribution. As the waves move into shallower water the nonlinear method developed by Shuto (1974) is used to estimate wave shoaling coefficients. Shuto's method of calculating shoaling coefficients usually gives somewhat higher waves than would be predicted using the conventional linear shoaling method. Nonlinear shoaling is consistent with the observed behavior of waves in shallow water and is

conservative when compared to linear shoaling. The offshore beach profile is assumed to be represented by a straight plane surface. Dissipation of wave energy by bottom friction is usually very small for typical sand beaches; therefore, bottom dissipation is neglected. Wave setup or setdown and surf beat are related to the wave breaking process and are accounted for. The radiation stress of the waves progressing toward the shore causes wave setup which can either increase or decrease the local water depth; a decrease is often referred to as setdown. Setdown occurs seaward of the breaker zone and setup occurs shoreward from the point where a significant number of the waves break. Surf beat is the longer period component of water level oscillation (periods from 20 seconds to several minutes) due to longer period irregularities in wave action. The magnitude of the surf beat is amplified in shallow water. Figure 3 shows the conditions used in this model.

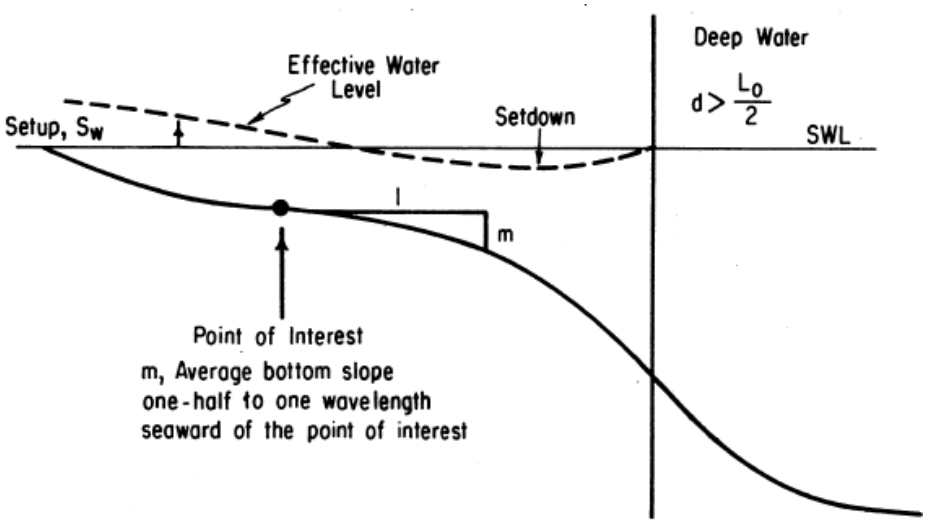

Figure 3. Definition.

The equivalent deep water wave height, $\boldsymbol{H_0'}$ is determined from

$$\boldsymbol{H_0' = K_R\, H_0} \qquad [3]$$

where H_0 is defined as the deep water significant wave height $\boldsymbol{H_0'}$ should also include diffraction or any other loss coefficients if they are significant.

The shallow water wave height condition parameters prediction by using a design curves obtained from Goda's analytical model (Seelig, 1978). The design curve described the five variables in the nearshore zone as:

(a) The maximum wave height, H_i, defined as the mean of the highest 1% of the waves.
(b) the significant wave height, Hs , defined as the mean of the highest one-third waves (the significant wave height is approximately equal to four times the root-mean-square (rms) surface elevation of a water level record).
(c) The root-mean-square (rms) wave height, H_{rms}.
(d) The mean wave height $\ddot{H}$.

(e) the wave setup, S_w

All of these variables are divided by the deep water significant wave height. The five variables are corresponded to the ordinate versus the ratio of the local Stillwater depth, ***d***, to the deep water significant wave height, $\boldsymbol{H_0'}$, on the abscissa. The design curves data is available for each wave steepness and for each **beach Slope [S].**

The ratio of the local Stillwater depth, = $\frac{d}{(gT^2)}$

The Offshore Wave Steepness H_0'/L_0

Depth-to-Height Ratio d/H_0'

Where

L_0 Deepwater wavelength = $1.56\,T_s^2$

d water depth at the point of interest

All design curve for all deep water wave types S∗ were converted to A Database linked to [NShore model – AL-Salem 2022].

To evaluate the nearshore parameters in NShore model, use the Design curves having the offshore slope, m, and offshore wave steepness (H_0'/L_0) closest to the values of interest. Enter the value of $/H_0'$, and select the curve of the parameter of interest. Five dimensionless parameters option can be predicted are presented as:

1. $\frac{S_w}{H_0'}$ Wave Setup / equivalent deep water wave height
2. $\frac{H_{rms}}{H_0'}$ Root-mean-square wave height / equivalent deep water wave height
3. $\frac{\bar{H}}{H_0'}$ Mean wave height / equivalent deep water wave height
4. $\frac{H_S}{H_0'}$ Significant wave height or average of the highest one-third waves / equivalent Deep water wave height
5. $\frac{H_1}{H_0'}$ Average of the highest 1-percent waves / equivalent deep water wave height

DISCUSSION RESULT AND MODEL VALIDATION PROCESS

Data source from Goda (1975a, 1975b) developed a nearshore wave height prediction model for irregular waves that accounts for wave breaking nonlinear wave shoaling, irregular wave setup by [NShore model].

Wave Refraction analysis

GIVEN

The wave period, T_s = 10 seconds

The Dominant deep water wave angle $\alpha_0 = 40°$

The Significant wave height, H_0 = 2.0 meters.

Wave condition selected [S∗] is wind/wave data

Beach slop [1 /100] 0.01
Shallow water depth 1.0 m

SOLUTION for K_R [refraction coefficient]
Run NShore model at interactive option as shown in Fig 4 shows
Input Deep water and Shallow water parameters then [RUN}
The wave refraction $K_R = 0.80$
The angle of nearshore wave energy vector $\alpha = 5.0°$.
The deep water equivalent wave height [$\boldsymbol{H'_0}$] is 1.6 m as shown in Equation 3.
Significant wave height at shallow water selected $H_s = 0.747$ m

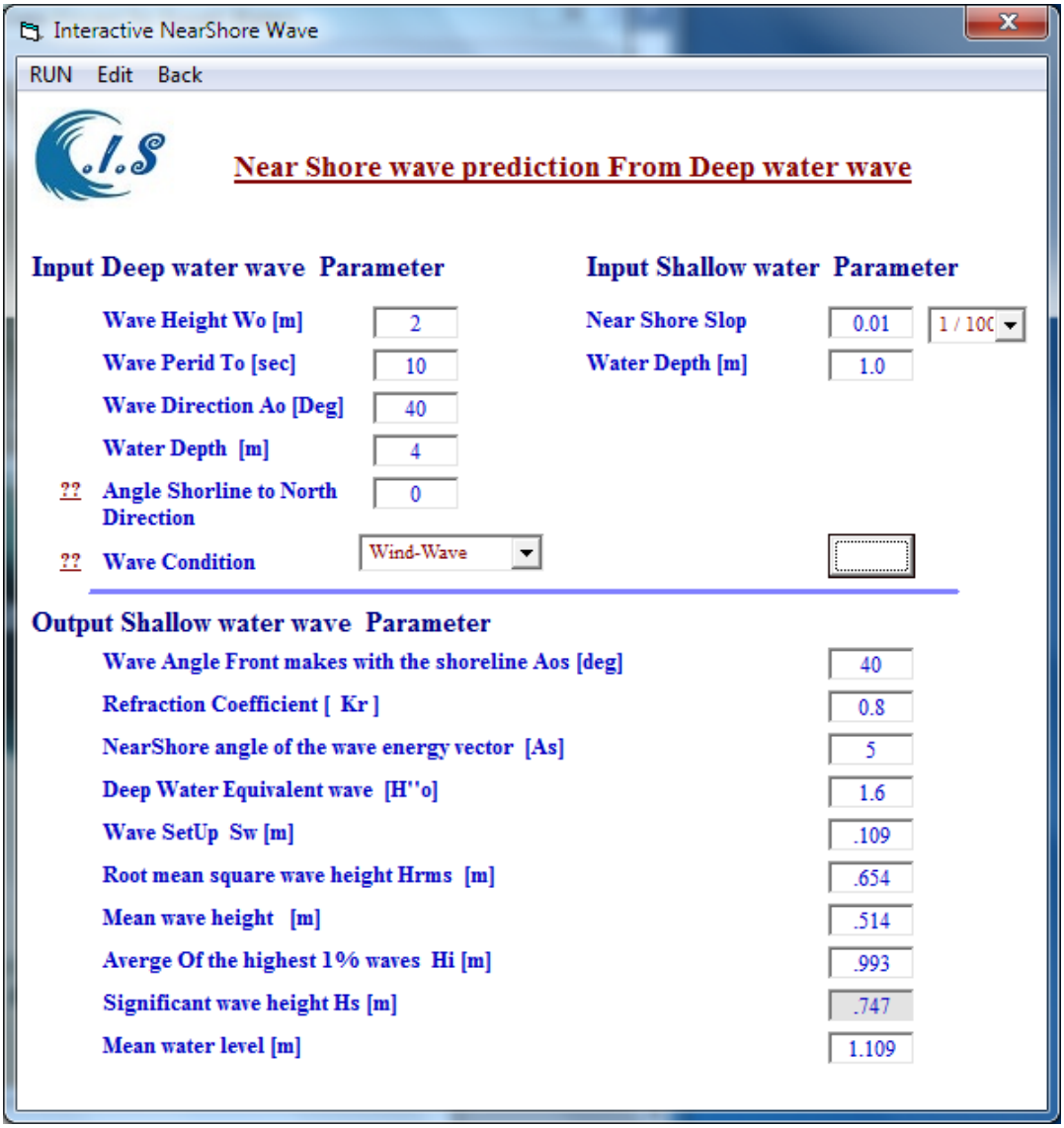

Figure 4. NShore model interactive option page with [H_0:2m T_0:10sec A_0:40^o]

Nearshore Wave Heights and Water Level Parameters

GIVEN
The wave period, T_s = 14 seconds
The Dominant deep water wave angle $\alpha_0 = 0°$
The Significant wave height, H_0 = 3.0 meters.
Wave condition selected [S*] is wind/wave data
Beach slop [1 /100] 0.01
Shallow water depth 6.0 m

SOLUTION for H_s
Run NShore model at interactive option as shown in Fig 5 shows
The wave refraction KR = 0.97
The angle of nearshore wave energy vector $\alpha = 2.0°$.
The deep water equivalent wave height [$\boldsymbol{H'_0}$] is 2.91 m as shown in Equation 3.
Significant wave height at shallow water selected H_s = 3.611 m

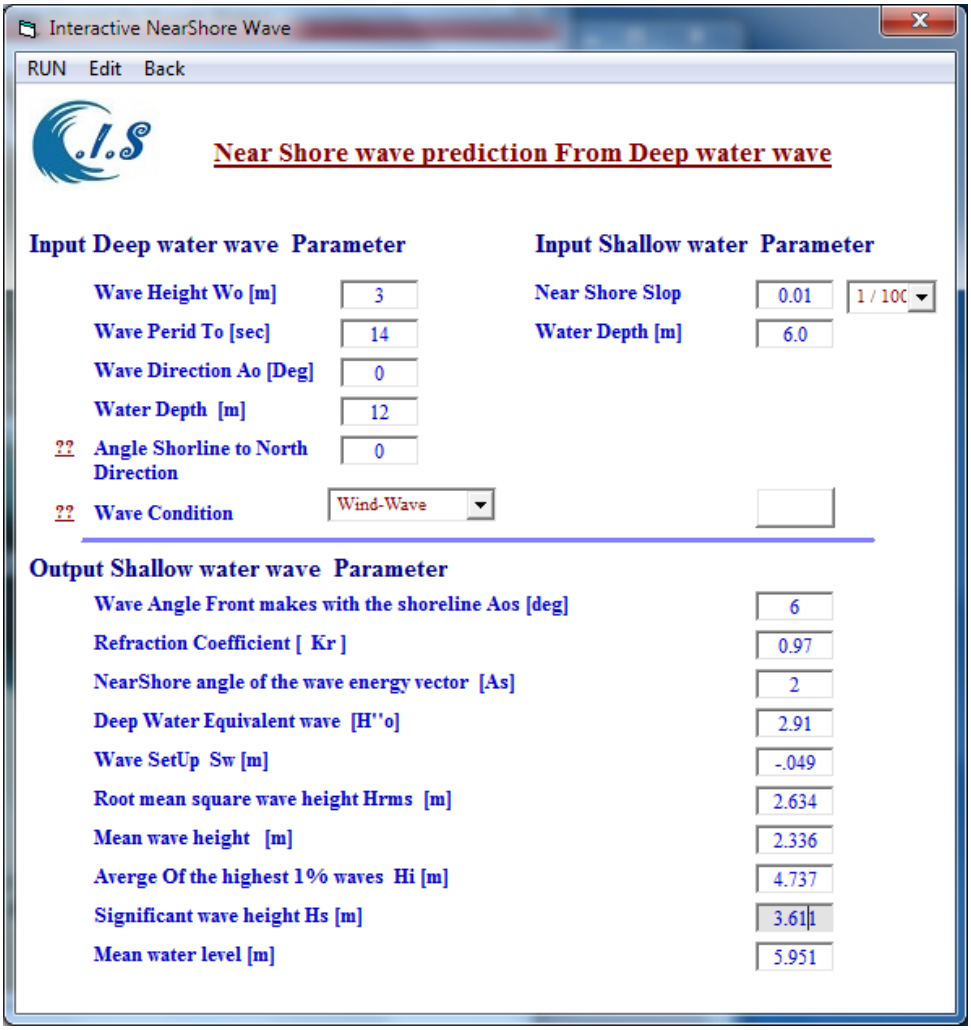

Figure 5. NShore model interactive option page with [H_0:3m T_0:14sec A_0:0°]

Sensitivity Analysis for NearShore wave height prediction for a selected Deepwater condition.

Data source from Goda (1975a, 1975b) to develop a nearshore wave height prediction.

In any given design situation the quality of the input information may vary. An important question to ask when predicting nearshore wave conditions is How sensitive are the predicted conditions to errors of uncertainty in the input parameters. The sensitivity of the predicted nearshore significant wave height to input parameters is illustrated below with an examples. A reference condition is chosen and nearshore significant wave heights are estimated. Each of the input parameters is then systematically varied and the results compared to the reference condition.

Case 1

The reference condition was selected to have the following input parameters:

H_0 = Deep water significant wave height (5.15 meters)

H_0' = Deep water equivalent wave height 5.0 m as shown in Equation 3.

T_0 = Wave period (10 seconds)

d = Nearshore water depths (1.0 to 3 meters)

s = Beach Slope (1/100)

From the reference condition the predicted nearshore significant wave height is slightly less than the deep water wave height for water depth of 1, 3 and 5 meters due to wave setdown as shown in Table 2 from God (1975a, 1975b) and Result predicted from NShore model [AL-Salem 2022].

Table 2. NShore model interactive option page to predict H_s with Reference Parameters [H_0:5.15m H_0':5m T_0:10sec A_0:0° and beach slop 1/100] no refraction.

	Goda (1975a, 1975b) Model data			**[AL-Salem 2022] NShore Model**			
Stillwater depth (m) **Reference d/H_0'**	1.0 0.2	3.0 0.6	5.0 1.0	1.0 0.2	3.0 0.6	5.0 1.0	
Condition							
Reference value	0.96	2.1	3.2	.994	2.187	3.204	*Fig-6*
Variation							
Water 1 m deeper	1.6	2.7	3.8	1.620	2.614	3.645	*Fig 7*
1/20 slope	1.3	2.6	3.9	1.286	2.726	3.710	*Fig 8*
H_0' = 6m	0.9	2.2	3.3	1.158	2.110	3.217	*Fig 9*
H_0' = 4m	0.9	2.1	3.1	0.797	2.082	3.101	*Fig 10*
α_0 = 45°, S* = 4	0.9	2.0	3.1	0.995	2.174	3.206	*Fig 11*
T_0 = 6 sec	0.8	1.9	2.8	0.984	1.878	2.835	*Fig 12*
T_0 = 18 sec	1.1	2.3	3.5	1.252	2.356	3.829	*Fig 13*

The predicted height decreases in shallow water to a value of 0.96 meter in a 1-meter water depth (still-water level). Systematic variations are made from the reference condition and from the resulting predicted nearshore wave heights given in Table 2. Comparisons with the reference condition and NShore model [Al-Salem 2022] were displayed in Table 2. Figures 6 to 13 display NShore model result with varying input parameter condition showing a good agreement with [Goda (1975a, 1975b)].

Figure 6. NShore model interactive option page with [H_0:5.15m T_0:10sec A_0:0° at water depth d= 1,3,and 5] beach slop [1/100]

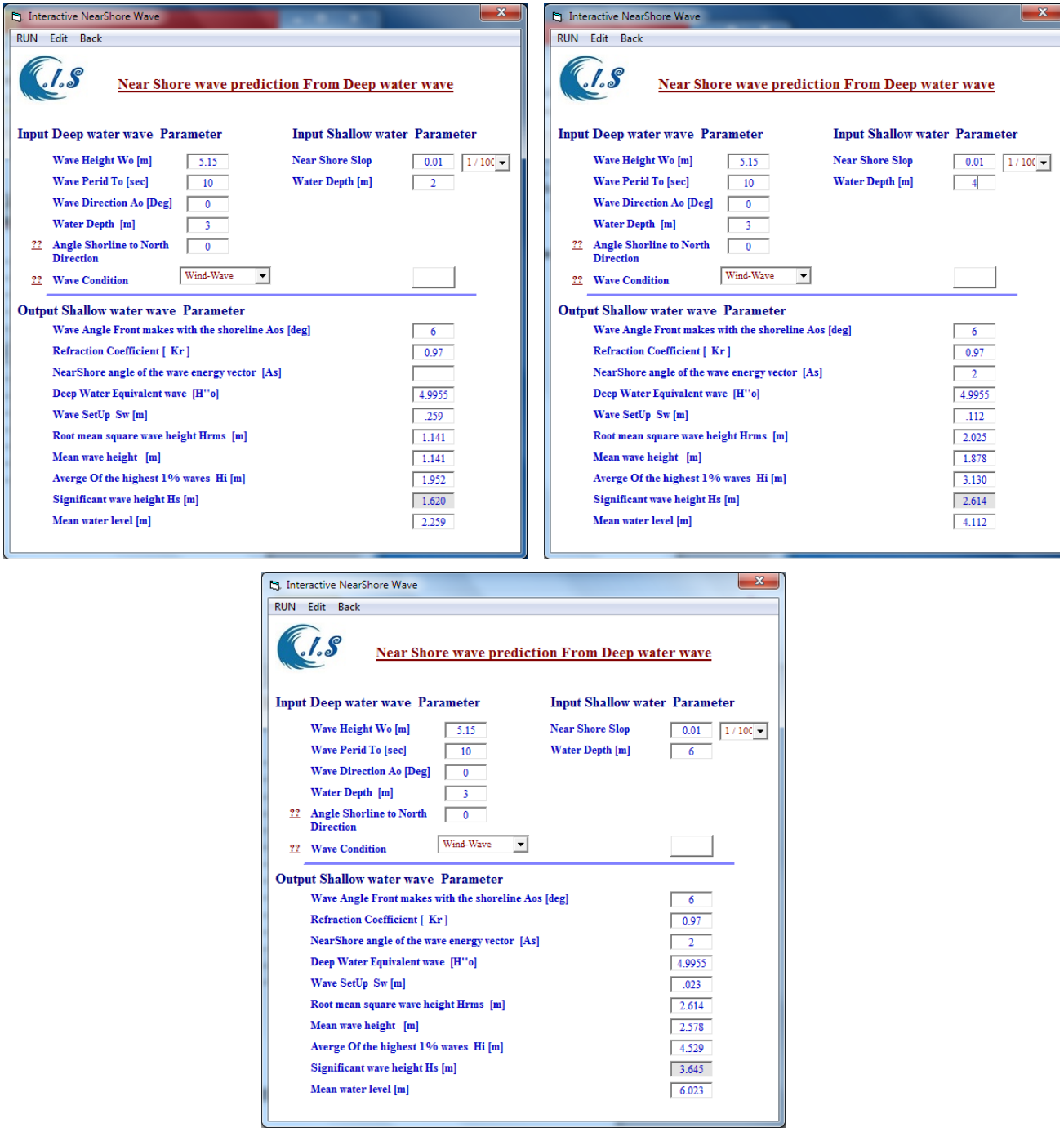

Figure 7. NShore model interactive option page with [H_0:5.15m T_0:10sec A_0:0º at water depth d= 2,4,and 6] beach slop [1/100]

Figure 8. NShore model interactive option page with [H_0:5.15m T_0:10sec A_0:0^o at water depth d= 1,3,and 5] beach slop [1/20]

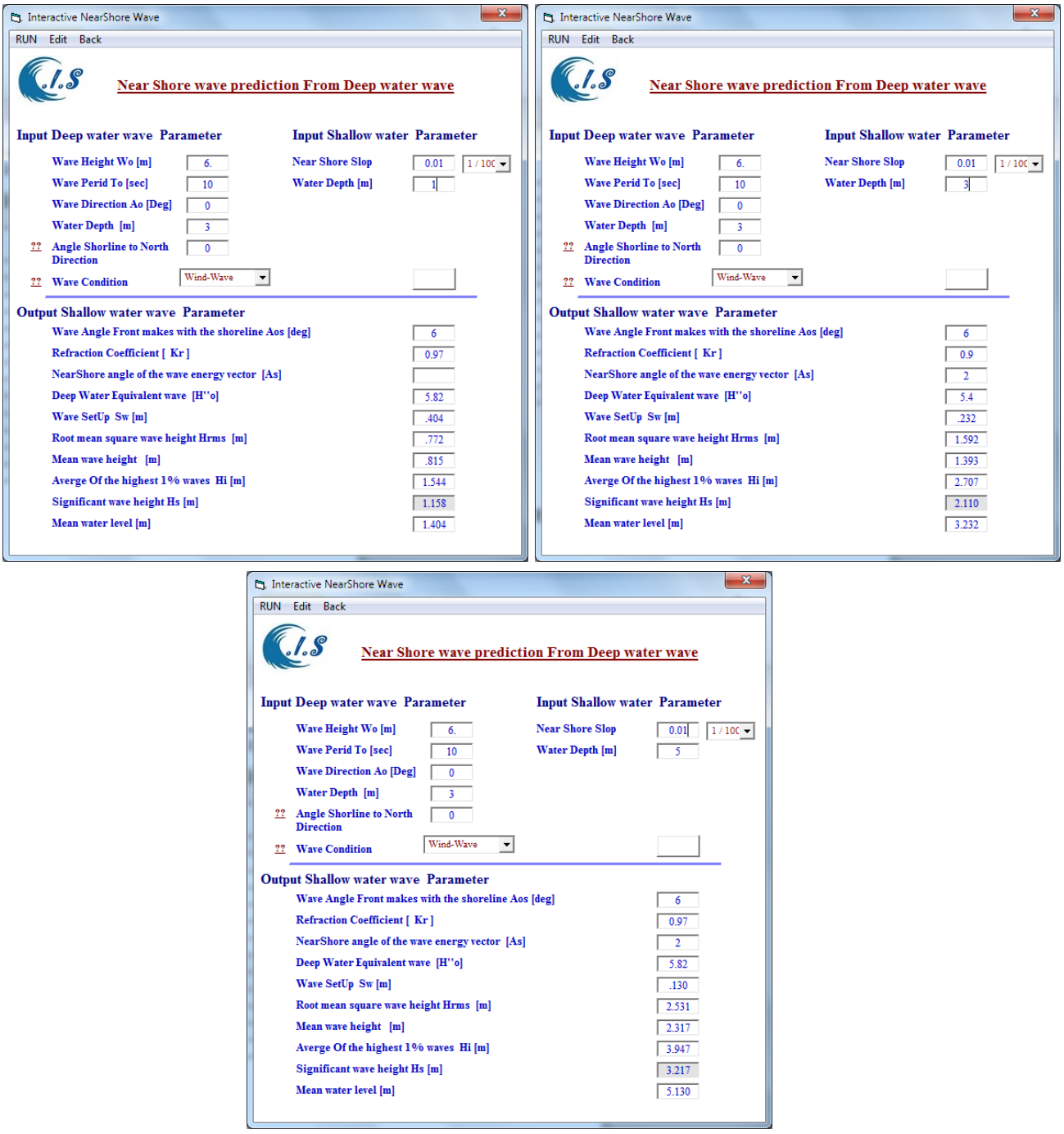

Figure 9. NShore model interactive option page with [H_0:6.1m T_0:10sec A_0:0º at water depth d= 1,3,and 5] beach slop [1/100] H'_0: 6m

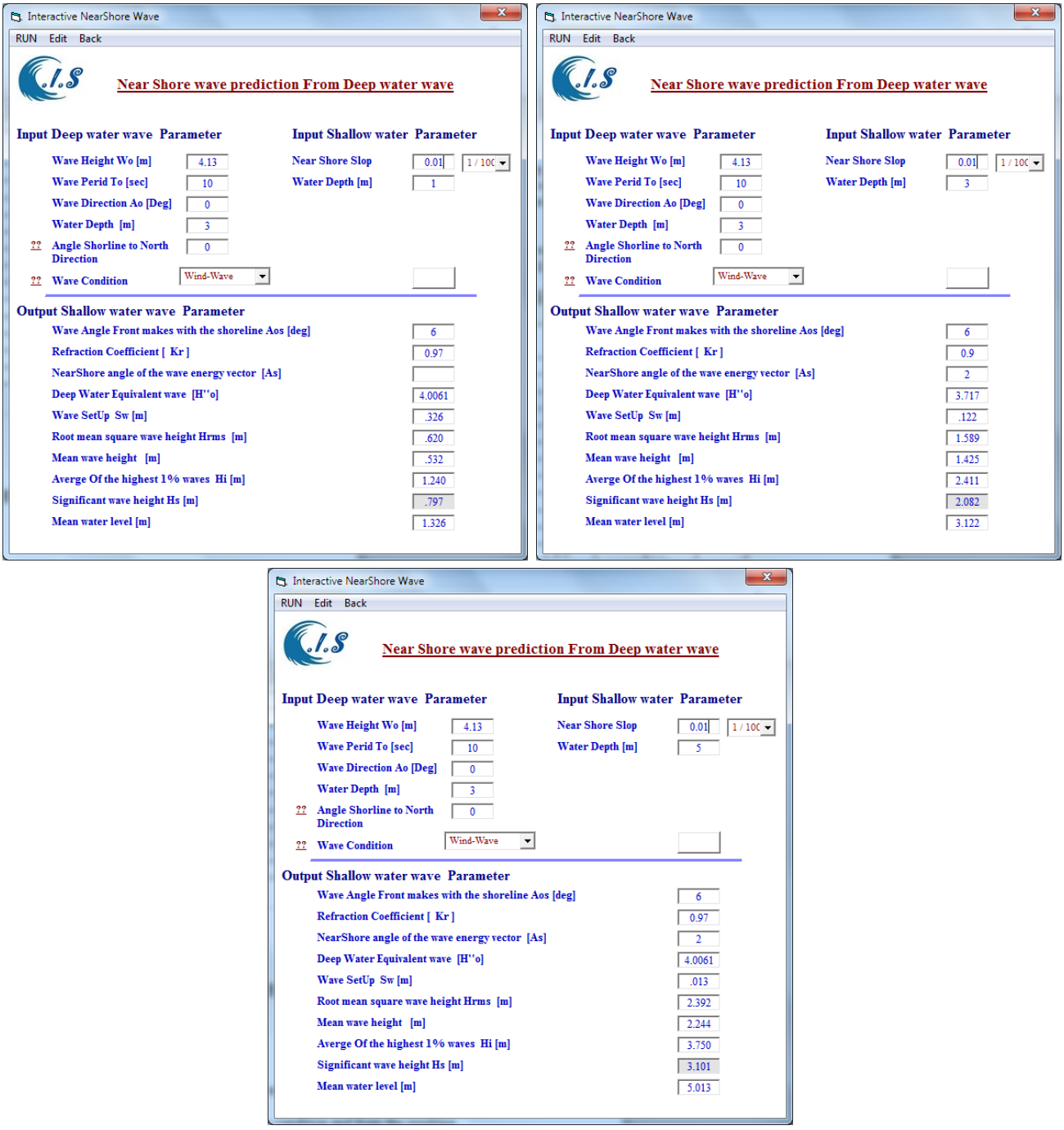

Figure 10. NShore model interactive option page with [H_0:4.13m T_0:10sec A_0:0º at water depth d= 1,3,and 5] beach slop [1/100] H_0': 4m

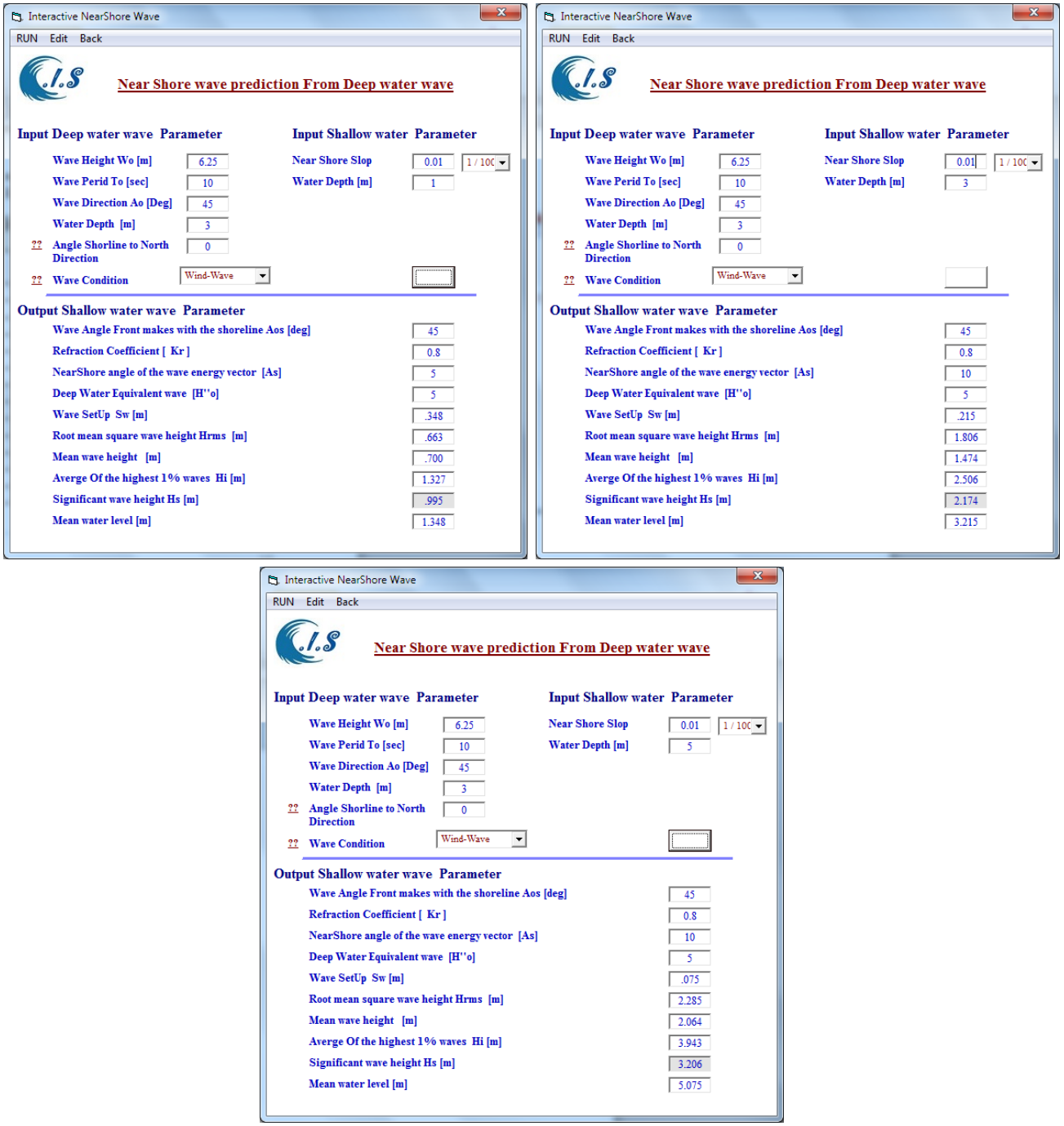

Figure 11. NShore model interactive option page with [H_0:6.25m T_0:10sec A_0:45° at water depth d= 1,3,and 5] beach slop [1/100] H'_0: 5m

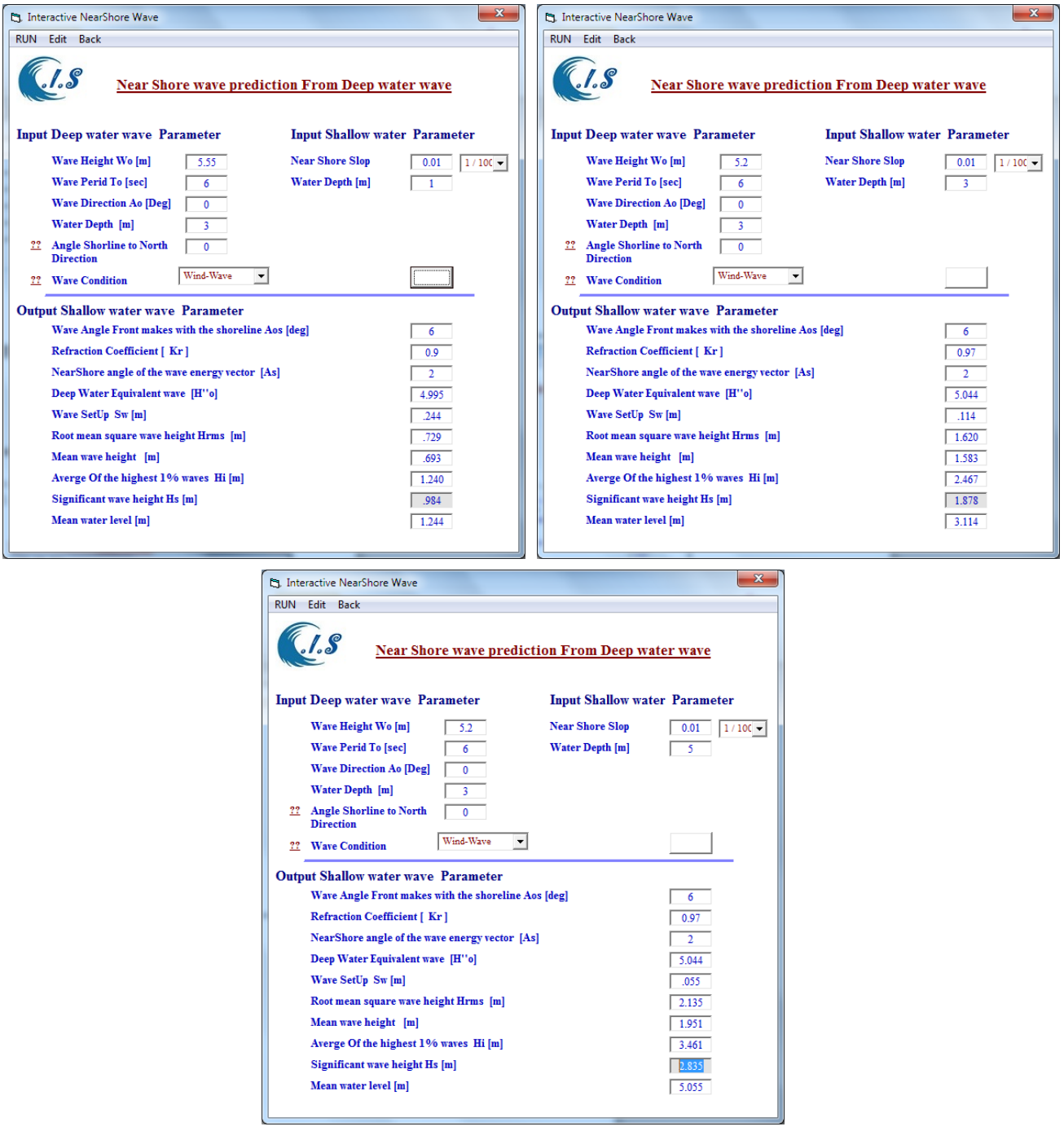

Figure 12. NShore model interactive option page with [H_0:5.2 m T_0:6 sec A_0:0° at water depth d= 1,3,and 5] beach slop [1/100] H_0': 5m

Figure 13. NShore model interactive option page with [H_0:5.2 m T_0:18 sec A_0:0º at water depth d= 1,3,and 5] beach slop [1/100] H'_0: 5m

Case 2

Data source from Goda (1975a, 1975b) to develop a nearshore wave height prediction.

The 13 September 1978 storm, a wave gage 2,250 meters beyond the end of the pier was used to record offshore wave height and period. Radar images were used to estimate dominant wave direction. Predicted tides and a profile survey of 8 September 1978 were used to determine water depth along the pier. Deep-water wave input parameter as follows:

- Wave hight H_0 = 1.66 m

- Wave Period T_0 = 4.52 sec
- Wave direction α_0 = 50^0
- Wave condition S_* = Wind-Wave [4]
- Beach slop **s** = 1 / 80

Table 3 and Figure 14 shows nearshore wave conditions. Observed and predicted wave height [Goda (1975a, 1975b)] compared to wave predicted from NShore model [Al-Salem 2022] at the FRF, 13 September 1978 shows a good agreements.

Table 3. NShore model interactive option page to predict H_s with Reference Parameters [H_0:5.15m H'_0:5m T_0:10sec A_0:0º and beach slop 1/100] no refraction.

		Observed Wave Conditions	Goda (1975a, 1975b)	Al-Salem 2022
Distance from Shore line	Shallow Water depth *d* m	Observed wave height H_s m	Predicted Wave Height H_s m	NShore model Wave Height H_s m
1.05068	1.24	0.981651	0.770642	0.852
2.348578	4.76	1.146789	1.211009	1.321
4.239802	5.68	1.082569	1.165138	1.321
6.613102	7.11	1.183486	1.192661	1.331
9.925835	9.33	1.422018	1.256881	1.372

Predicted, observed and NShore model wave heights are similar for most of the wave profile as shown in Fig 14, with the observed wave height in the shallowest water higher than predicted and NShore. Results show that the local significant wave height is primarily controlled by nearshore depth

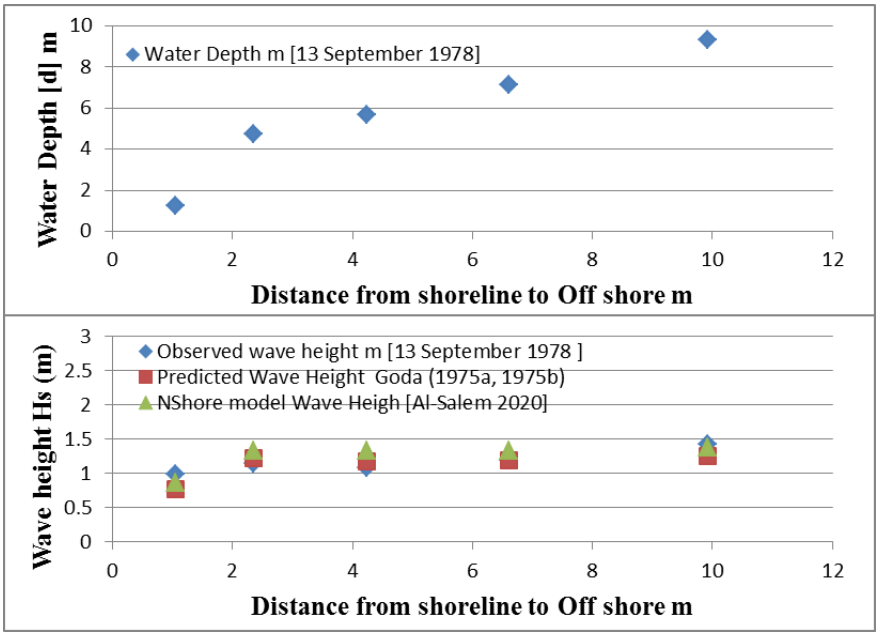

Figure 14. Observed and predicted wave height at the FRF, 13 September 1978 from Goda (1975a, 1975b) compared with Nshore model [Al-Salem 2022] for prediction of shallow wave at deffernt water depth

Case 3

Data source from Goda (1975a, 1975b) to develop a nearshore wave height prediction.
GIVEN:
Figure 15 display deep wave height condition.
. Deep-water wave input parameter as follows:

- Wave height H_0 = 2.41 m
- Wave Period T_0 = 6.9 sec
- Wave direction α_0 = 60^0
- Wave condition S_* = Wind-Wave [4]
- Beach slop s = 1 /100

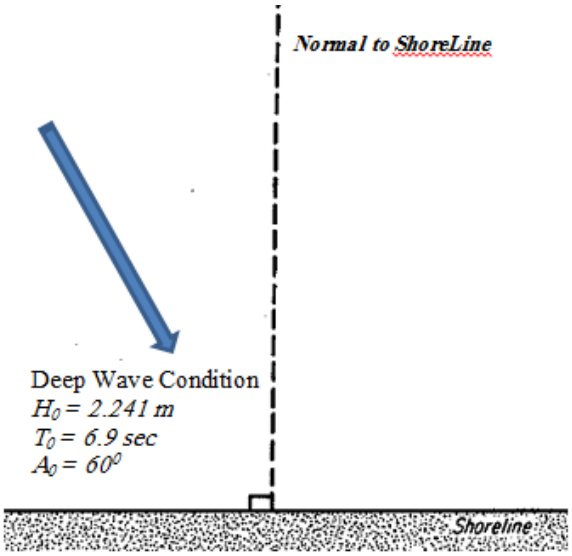

Figure 15. Deepwater Wave Condition

Table 4. NShore model interactive option page to predict H_s with Reference Parameters [H_0:2.41m T_0:6.9sec A_0:60º and beach slop 1/100]

	Goda (1975a, 1975b)			**NShore model [Al-Salem 2022]**		
Water Depth d_{swl} m	K_R	H'_0 **m**	H_s **m**	K_R	H'_0 **m**	H_s **m**
0.5	0.69	1.66	0.43	0.70	1.687	0.435
1.0	0.69	1.67	0.620	0.70	1.687	0.696
2.0	0.70	1.68	1.28	0.70	1.687	1.268
3.0	0.70	1.69	1.69	0.75	1.8075	1.825
4.0	0.71	1.70	1.75	0.75	1.8075	1.905
6.0	0.72	1.74	1.72	0.75	1.8075	1.825

Results show that the local significant wave height is primarily controlled by depth. In this Case,wave direction, refraction effects, and wave period are relatively unimportant input parameters. Table 4 shows has good agreement with [Goda (1975a, 1975b)] and NShore model [Al-Salem 2022] . Figure 16 display sample result for water depth d_{swl} 2.0 m. Figure 17 shows a good agreement of nearshore wave height prediction between NShore and Goda.

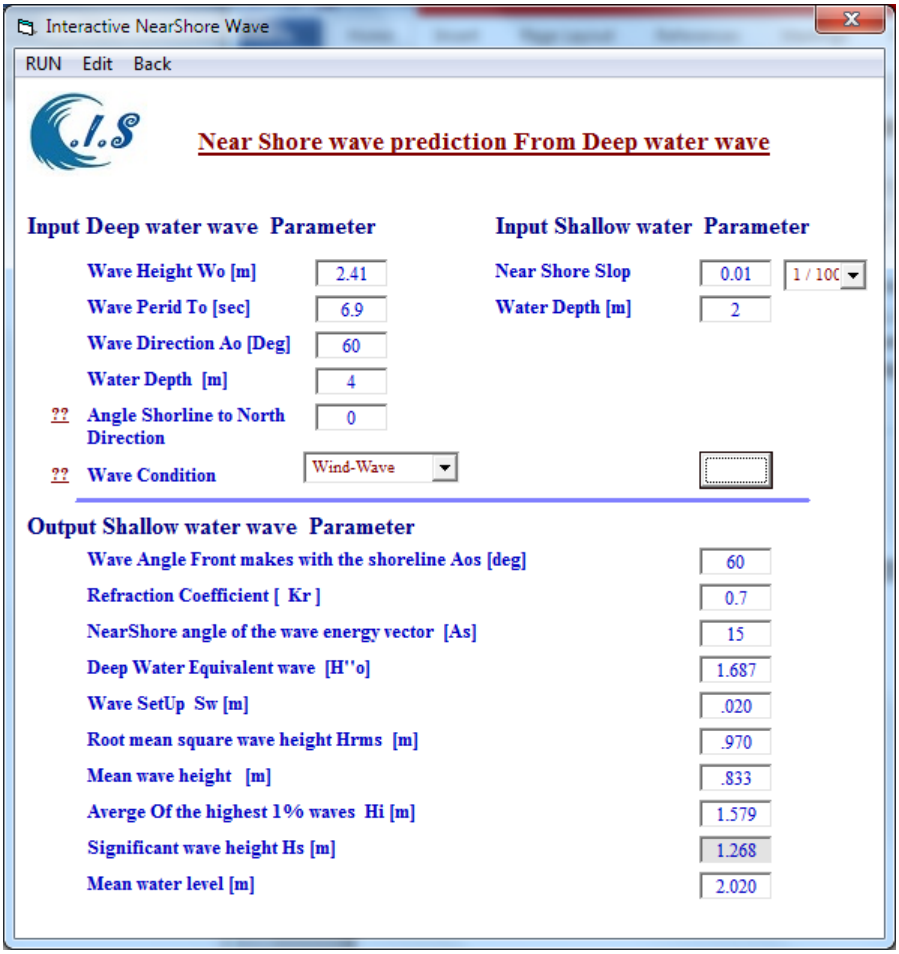

Figure 16. NShore model interactive option page with [H_0:2.41 m T_0:6.9 sec α_0:60^o at water depth d_{swl} :2.0m] beach slop [1/100]

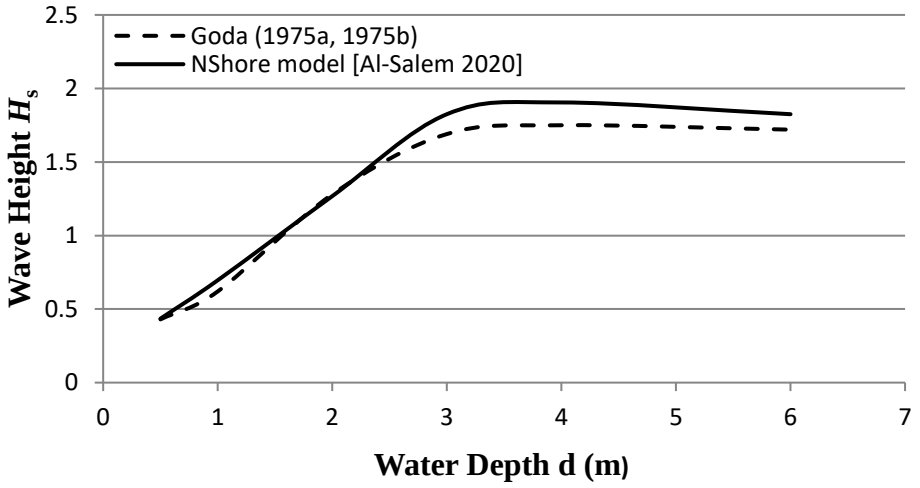

Figure 17. Comparison of Nearshore Wave height H_s predicted from NShore model to Goda (1975a, 1975b)

CONCLUSION

The NShore numerical model for prediction nearshore wave height by applying the methods developed by Goda (1975a, 1975b) and suggested by Goda, Takayama, and Suzuki (1978) for predicting nearshore irregular wave conditions for the case of continuously shallowing bottom contours have been presented in forms convenient for designers. The NShore model was presented by two operation system As PC version and Website version at web dress
[http:\\www.hceatkuwait.net\NShore.aspx].
A sensitivity analysis as shown in case 3 of the methods shows the relative importance of the input parameters on the predicted nearshore wave height. Comparison with observed wave height changes and prediction wave height were presented at [Goda (1975a, 1975b)] and NShore model [AL-Salem 2022] at case 2 for data source from FRF, 13 September 1978 shows a good agreements.

REFERNCE

Al-Salem k. and Al-Rashed A. 2022. “Prediction of NearShore Wave Conditions From Irregular Deep water Waves (NShore model)”. Website address: http://www.hceatkuwait.net/NShore.aspx.

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GODA Y., TAKAYAMA, T., and SUZUKI, Y., "Diffraction Diagrams for Directional Random Waves," *Proceedings of the 16th Conference on Coastal Engineering,* Port and Harbour Research Institute, Japan, 1978.

NShore Model Demonstration
P.C. Version

NShore model was developed based Coastal information system C.I.S. [Al-Salem 2005] for PC version as shown in Figure P1.

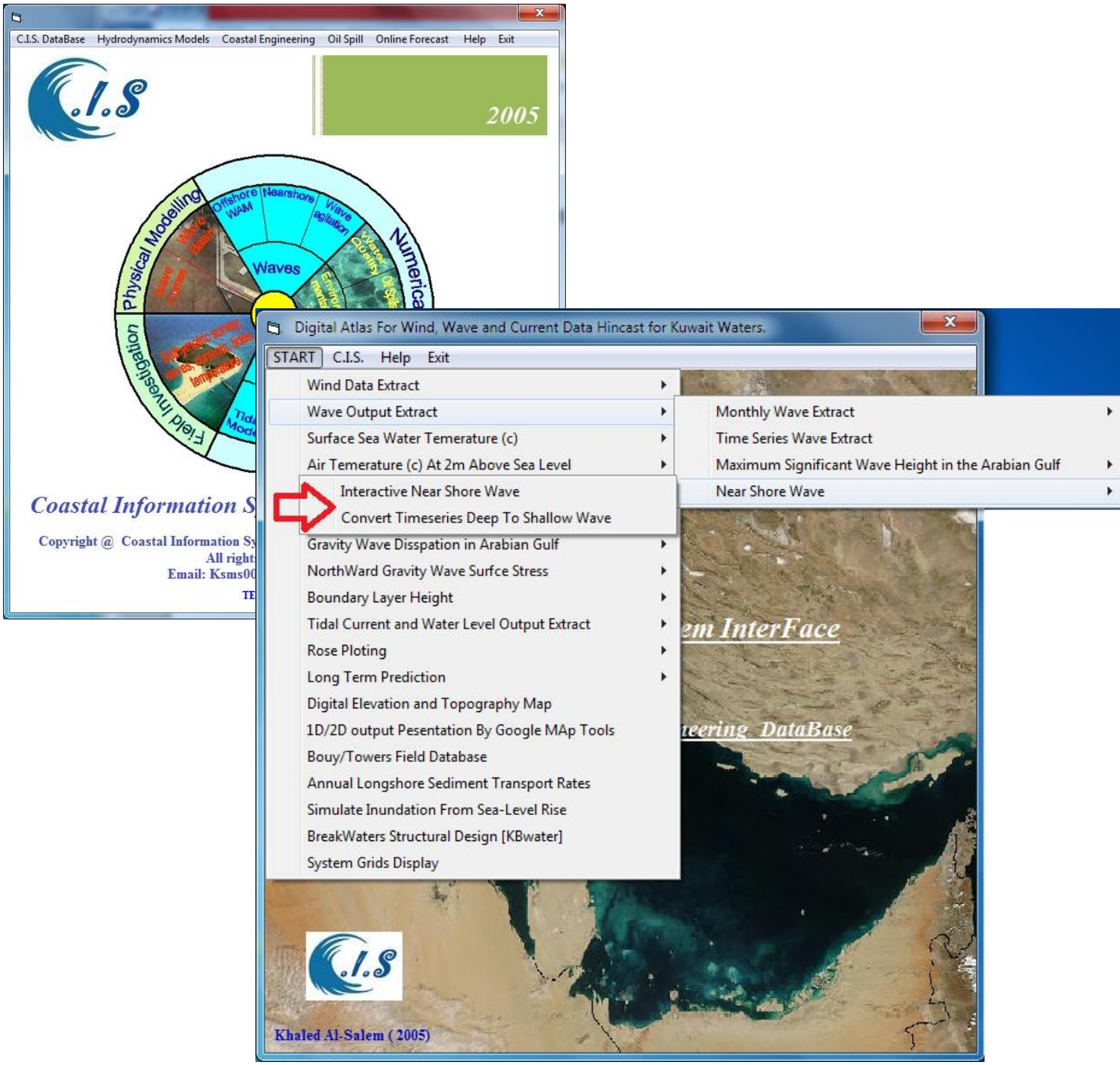

Figure P1. Coastal information system C.I.S

From Figure P1 user can run NShore model by select from drop list at [***Near shore wave***].
Then a new drop list will display as shown in Figure P1 to show that there are two options to run the model which are:

- Interactive NearShore Wave height
- Convert Timeseries Deep water wave height To Shallow Wave height

Option 1 [Interactive NearShore Wave]

If user selects option 1 then new page will display as shown in Figure P2.
Then user must input The Deep water wave height Condition as follows:

- Deep water wave Height m
- Deep water Wave Period sec
- Deep water Wave Angle deg
- Angle of Shoreline with respect to True North direction deg. [See Fig 15]
- Beach Slop s
- Shallow water depth [Interest depth location] m
- Wave Condition [For This version used *Wind-Wave*]

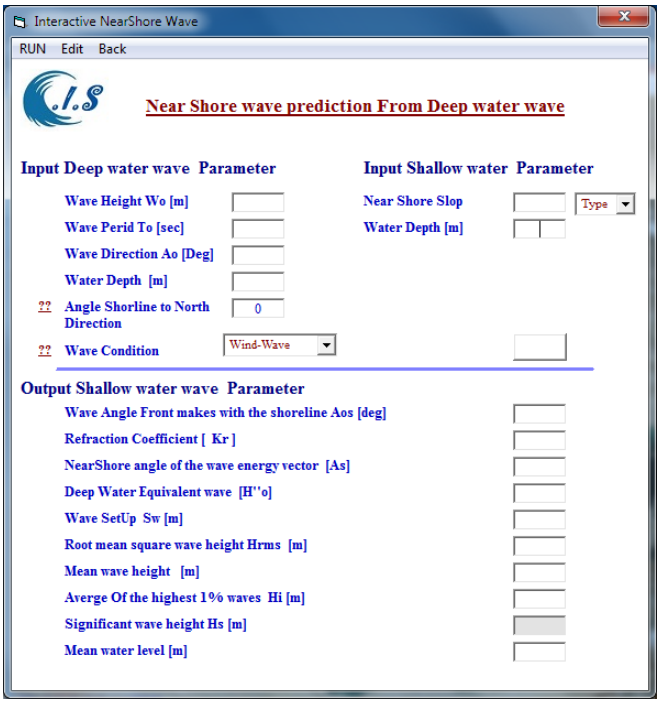

Figure P2

When all input data was entered as shown in Figure P3 user can select [RUN] to start the model.
Figure P3 display the output simulation.
Figure P4 display the output file created by the model

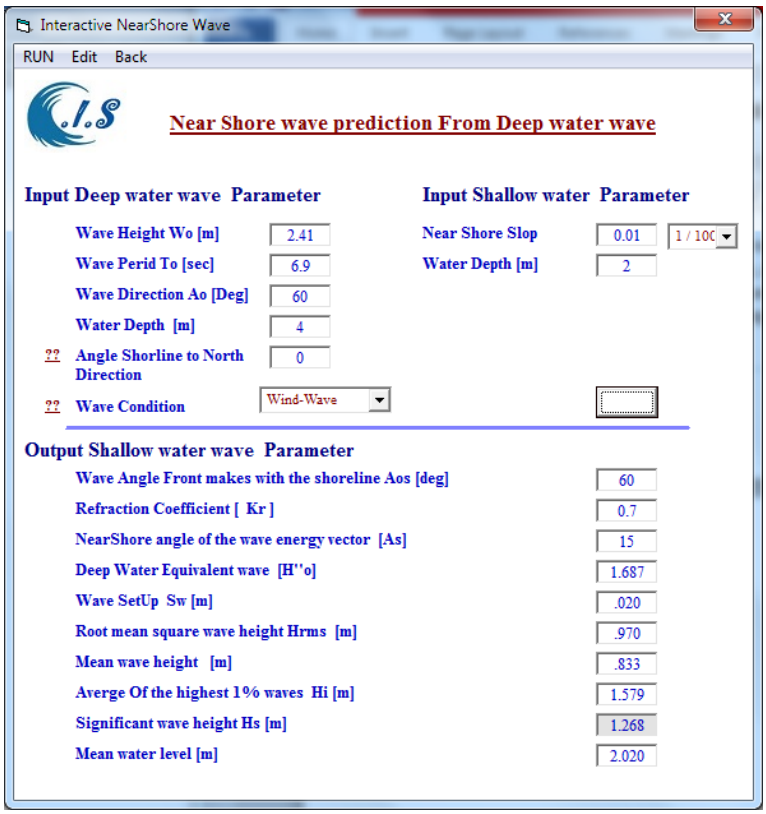

Figure P3

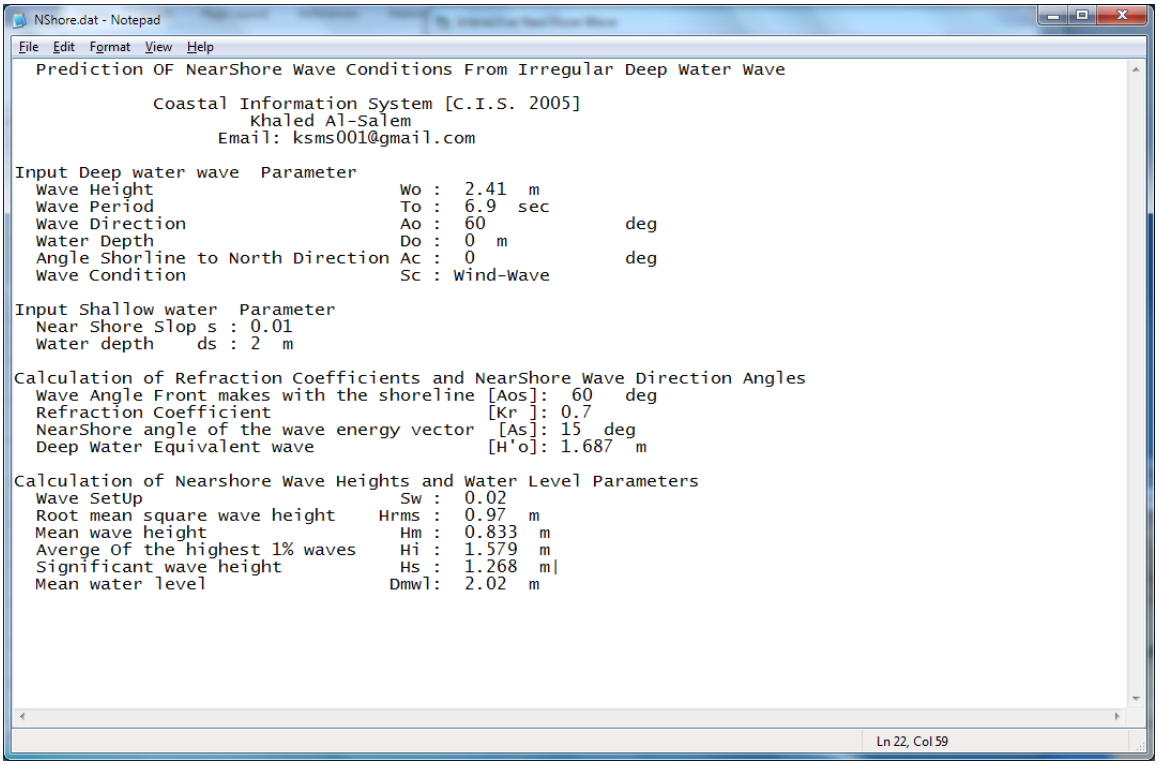

Figure P4

Option 2: Convert Timeseries Deep To Shallow Wave

If user selects option 2; this option was linked to Costal information System CIS database [AL-Salem 2005] for extraction Deep water wave height, direction and period data to do that is by the following steps:

1. Use deep water wave data file extracted from CIS
2. Use Created deep water wave data file by user [H_0, T_0 , α_0]

For using option 1 for creating Deep water wave Condition file from CIS user must follows:

- Run CIS interface as shown in Fig P1 then select
  WAVE OUTPUT EXTRACT
  TIME SERIES WAVE EXTRACT
- Figure P5 for user input require parameter as shown in Fig P5 as
  Start Time / End time
  Deep water location [Longitude/Latitude]
  Then run Extract data

- Then user must select EXPORT FILE to create Deep water wave file by select [NEARSHORE] button.
- Then the wave data file will transfer to NShore model by a default name [Wave1.txt) as display in Figure P6
- Figure P7 display sample of deep water wave height created by CIS interface

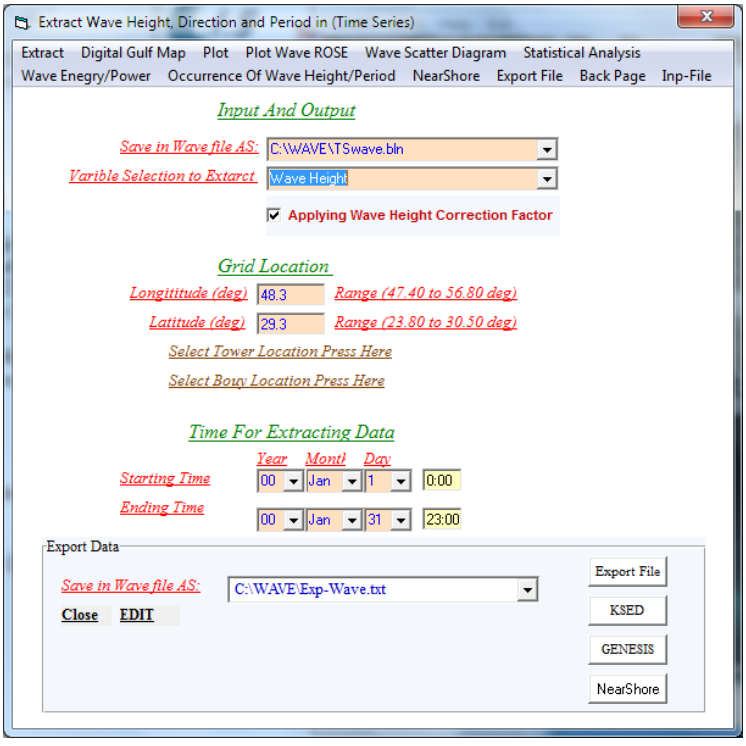

Figure P5

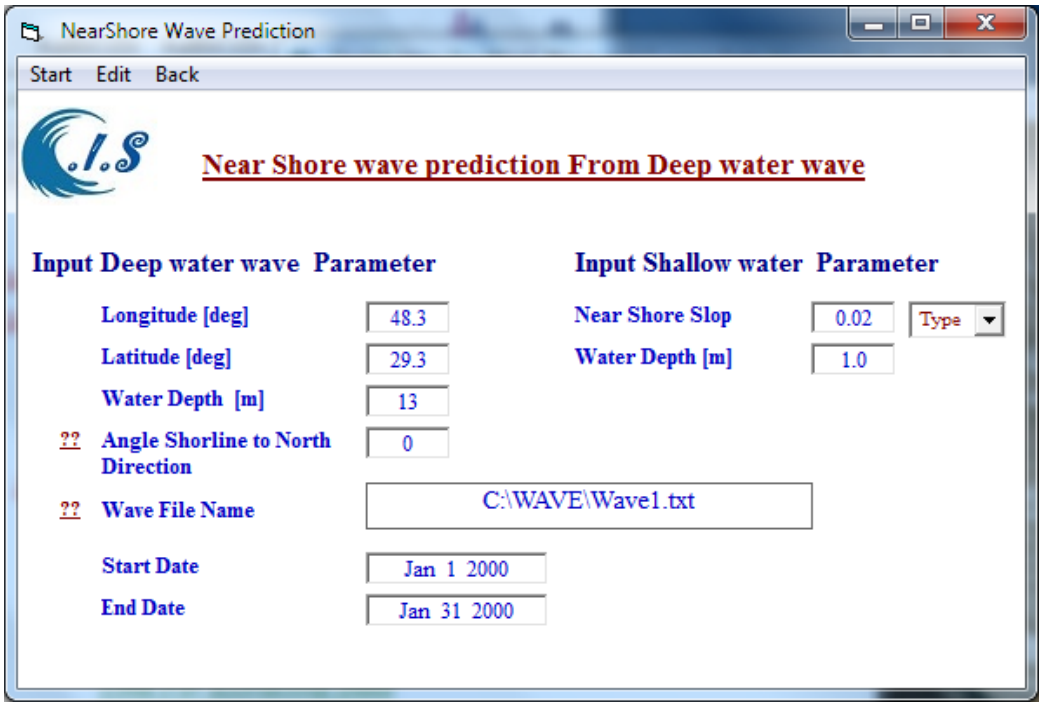

Figure P6

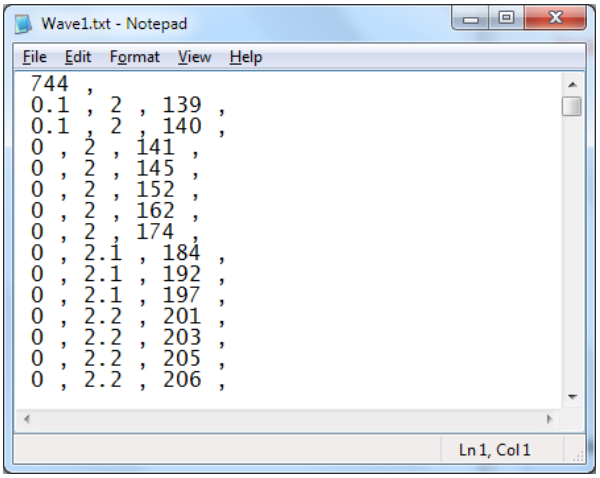

Figure P7

For using Option 2 for creating Deep water wave height Condition file must follows:

- Cerate text file data format must follow:
  - Number of data records ,
  - Deep water wave height , Wave periods , Wave direction ,
- A comma after each number is a must
- Then user must enter the created file Path and name in the [Wave file name] as shown in Fig P6.

After deep water wave file name entered, then user must input the following as in Figure P6:

- Input Deep water wave parameter

Longitude of Deep water location
Latitude of Deep water location
Deep water Depth [not use in Calculation]
Angle of Shoreline to True North [See Figure 15]

- Input Shallow water Parameter
  Beach Slop
  Water Depth at interested location [*d*]
- Input Wave File name
- Input Start Time
- Input End Time

When all input data was entered as shown in Figure P6 user can select [***START***] to start the model.
Figure P8 display the output file created by the model

```
                C.I.S.
    Coastal Information System DataBase
PREDICTION OF NEARSHORE WAVE CONDITIONS FROM IRREGULAR
            DEEP WATER WAVES

          [ Al-Salem K. 2005 ]
         Email: Ksms001@Gmail.com
           Tel  : 965 99016700
           WWW.hceatkuwait.net


Time Serious for Significant wave height and Periods Data Records
Selected Grid Location:
Longitude:  48  18.00E
Latitude :  29  18.00N
Deep Water Depth: 1.0
Date From: Jan  1  2000
Date To  : Jan  31  2000

Input Shallow water  Parameter
Near Shore Slop    : 0.02
Shallow Water Depth: 1.0

Total Time Records:  744  Hours
Wave Direction Measured From North Clockwise

Discribtion of Parameters for Nearshore Conditions
Ho     : Deepwater Significant Wave Height
To     : Wave Period
Ao     : Wave Direction
Shore  : ShoreLine Orintation angle from North
Normal: Normal direction of wave to shore line
KR     : Wave Refraction Coefficient
As     : Angle of Nearshore Wave Energy Vector
H'o    : DeepWater Equivalent Significant Wave Height
Sw     : Wave SetUp
Hrms   : Root-Mean-Square Wave Height
Hs     : Significant Wave Height at Select Water Depth [Shallow]
MWL    : Mean water level
                Calculation of Nearshore Wave Heights and Water Level Parameters.

 Ho      To   Ao     Shore  Normal  KR     As     H'o     Wave     Hrms     Hs       MWL
 m       sec  deg    Orint  Shore   Coefi  deg    m       SetUp    m        m        m
00.10   02.00  139.0  00.00  180.00  0.600  03.00  00.060  00.000  00.044  00.064  001.000
00.10   02.00  140.0  00.00  180.00  0.600  03.00  00.060  00.000  00.044  00.064  001.000
00.00   02.00  141.0  00.00  00.00   0.000  00.00  00.000  00.000  00.000  00.000  000.000
00.00   02.00  145.0  00.00  00.00   0.000  00.00  00.000  00.000  00.000  00.000  000.000
00.00   02.00  152.0  00.00  00.00   0.000  00.00  00.000  00.000  00.000  00.000  000.000
00.00   02.00  162.0  00.00  00.00   0.000  00.00  00.000  00.000  00.000  00.000  000.000
00.00   02.00  174.0  00.00  00.00   0.000  00.00  00.000  00.000  00.000  00.000  000.000
00.00   02.10  184.0  00.00  00.00   0.000  00.00  00.000  00.000  00.000  00.000  000.000
00.00   02.10  192.0  00.00  00.00   0.000  00.00  00.000  00.000  00.000  00.000  000.000
00.00   02.10  197.0  00.00  00.00   0.000  00.00  00.000  00.000  00.000  00.000  000.000
00.00   02.20  201.0  00.00  00.00   0.000  00.00  00.000  00.000  00.000  00.000  000.000
00.00   02.20  203.0  00.00  00.00   0.000  00.00  00.000  00.000  00.000  00.000  000.000
```

Figure P8

NShore Model Demonstration

Internet Version

Website: http://www.hceatkuwait.net\NShore.aspx

User must login to website address at: http://www.hceatkuwait.net\NShore.aspx
Then Figure V1 will display the main NShore model website page on internet as follows:

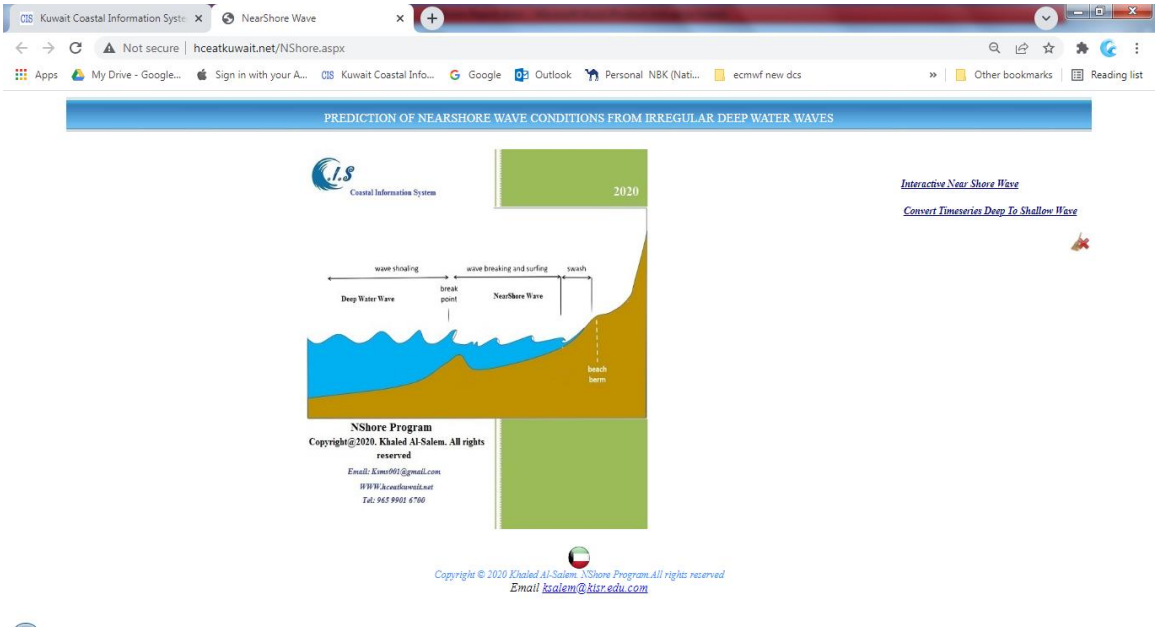

Figure V1

Figure V1 to shows that there are two options to run the model which are:

- Interactive NearShore Wave
- Convert Timeseries Deep To Shallow Wave

Option 1 [Interactive NearShore Wave]

If user selects option 1 then new page will display as shown in Figure V2.
Then user must input The Deep water wave height Condition as follows:

- Deep water wave Height m
- Deep water Wave Period sec
- Deep water Wave Angle deg
- Angle of Shoreline with respect to True North direction deg.
- Beach Slop s
- Shallow water depth [Interest water depth location] m
- Wave Condition [For This version used *Wind-Wave*]

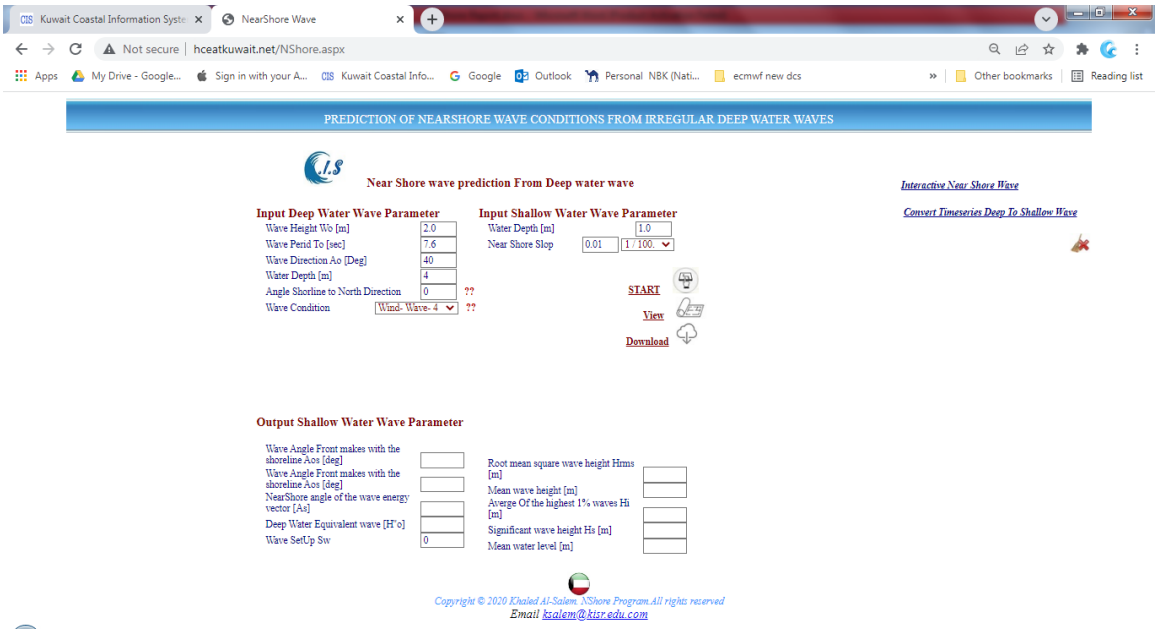

Figure V2

When all input data was entered; User can select [**START**] to start the model.
Figure V3 display the output simulation.
From Figure V3 user can do the following:

- View the output file created by the model as shown in Figure V4
- Download output file created by model

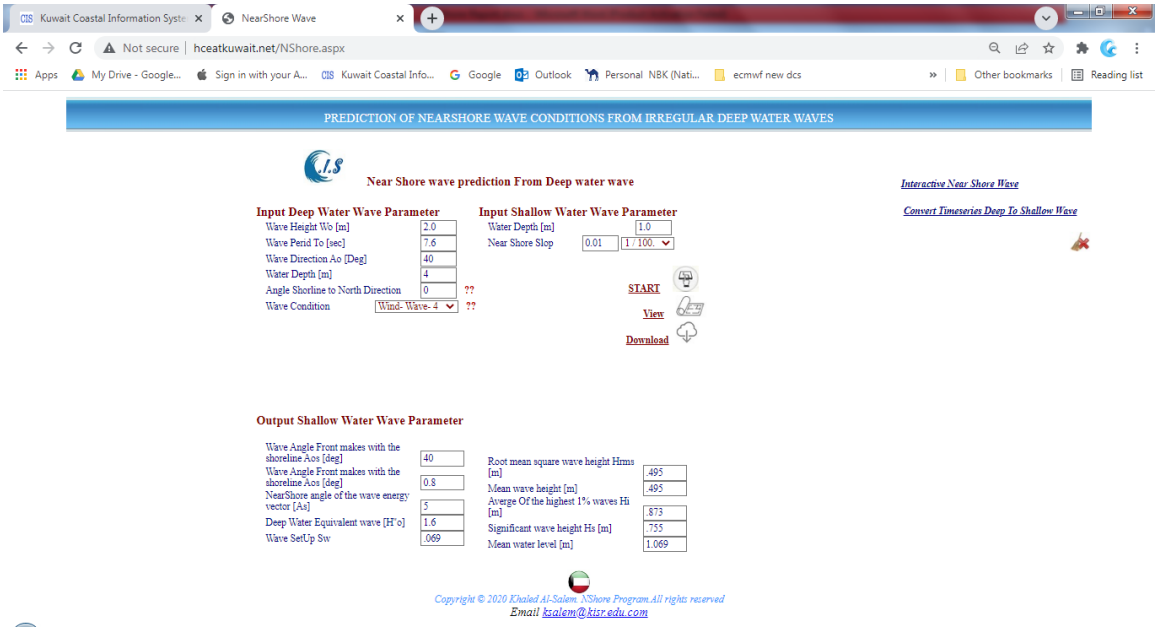

Figure V3

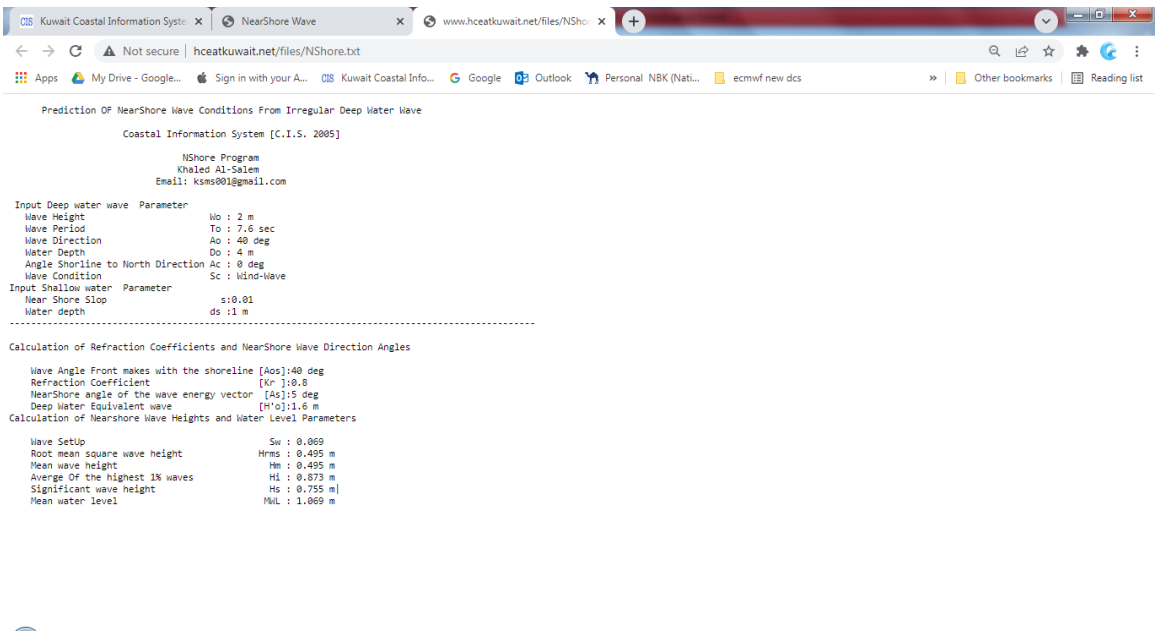

Figure V4

Option 2: Convert Timeseries Deep To Shallow Wave

If user selects option 2 as shown in Figure V5;
This option user can prediction nearshore wave height data from time series deep-water wave height data file. The data file can be entered or created by the following:

[1] Use deep water wave data file extracted from Costal information System CIS database [AL-Salem 2005].
[2] Use Created deep water wave height data file by user as follows:
Ndat, Total records,
[H_0, T_0 , α_0] Wave height , period , direction ,
[3] User can used pre-saved deep wave height data file by select [***Default Sample Deep Water Wave Data*** ***]*** as shown in Figure V6.

For using option 1 for creating Deep water wave Condition file from CIS user must follows:
Run CIS interface as shown in Fig P5 then select
WAVE OUTPUT EXTRACT
TIME SERIES WAVE EXTRACT
Then open the file created. User must copy the all data then pass in Data container as shown in Figure V6.
For using option 2 for creating Deep water wave Condition file by user must do following:
File data enter format as shown in Figure V6:
[1] Number of Data: **Ndat ,**
[2] Coordinate as [$\mathbf{H_0}$ **,** $\boldsymbol{T_0}$ **,** $\boldsymbol{\alpha_0}$,]
Note: Comma must follow each number
Note: Maximum Wave Data 8784 records
User can Update the input wave height data file by select [***Load data***]

Then user must save the data file by select [SAVE data]

User input require parameter for both options as shown in Fig V6 as

Water depth ***d*** [at interested location]

Beach slop ***s***

Shore line Angle from Normal direction ***θ***

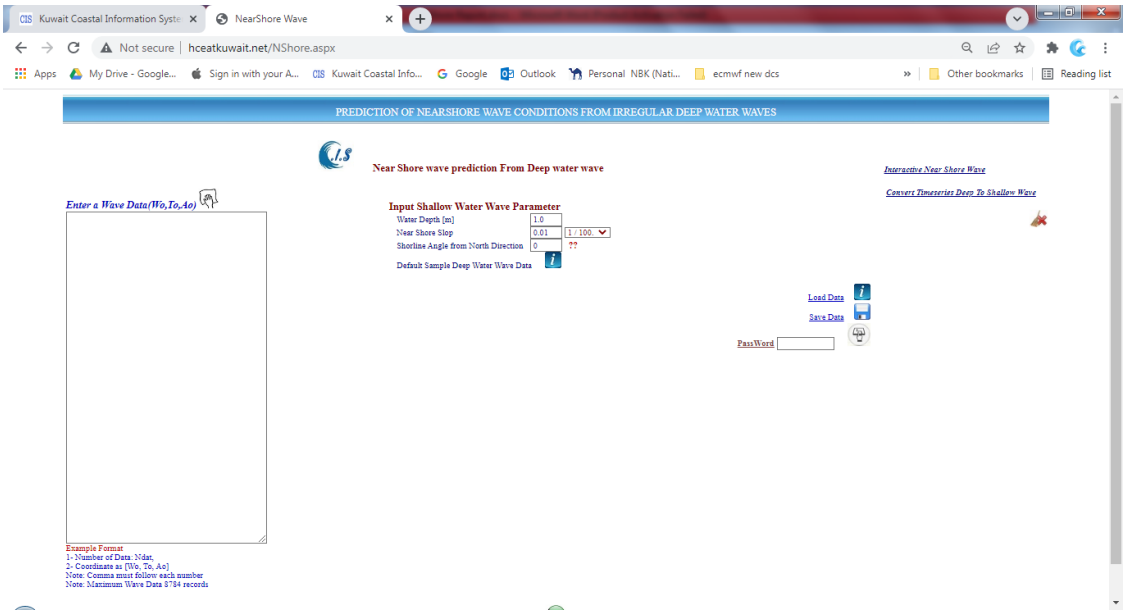

Figure V5

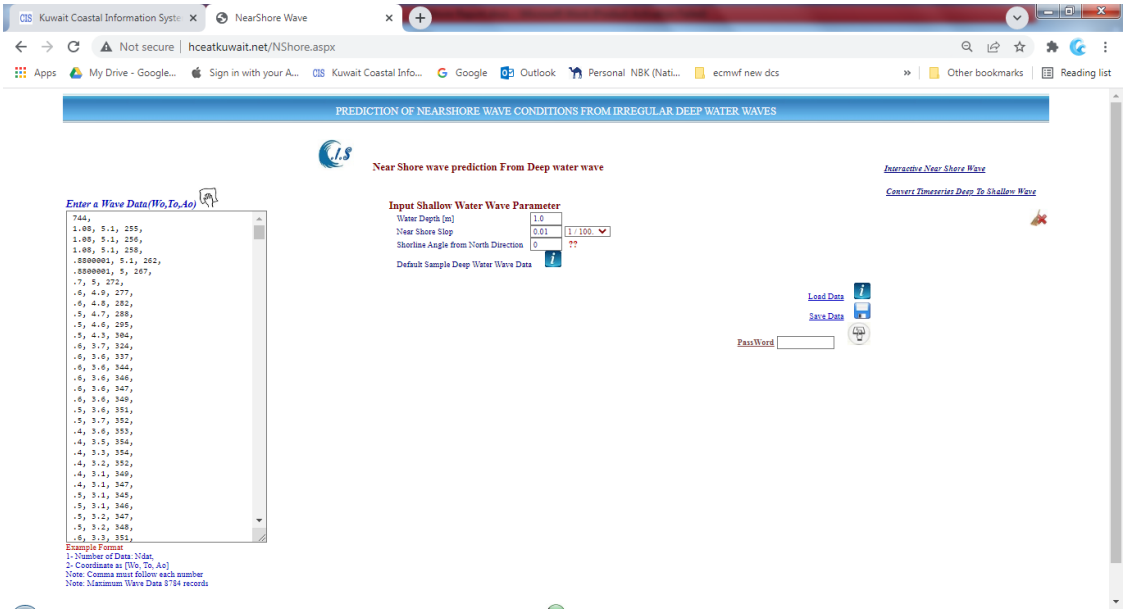

Figure V6

When all input parameters were entered as shown in Figure V6.
Then user must enter his access code at [***PASSWORD***] to start run the model by select [Run icon].
Figure V7 will display for user to select from ***Output Shallow Water Wave*** view options follows:

- View simulation data file [Snapshot from output file shown in Figure V8].
  [*User must refresh or reload page to update view file it is internet issue*]
- Download simulation data [Snapshot from output file shown in Figure V8]

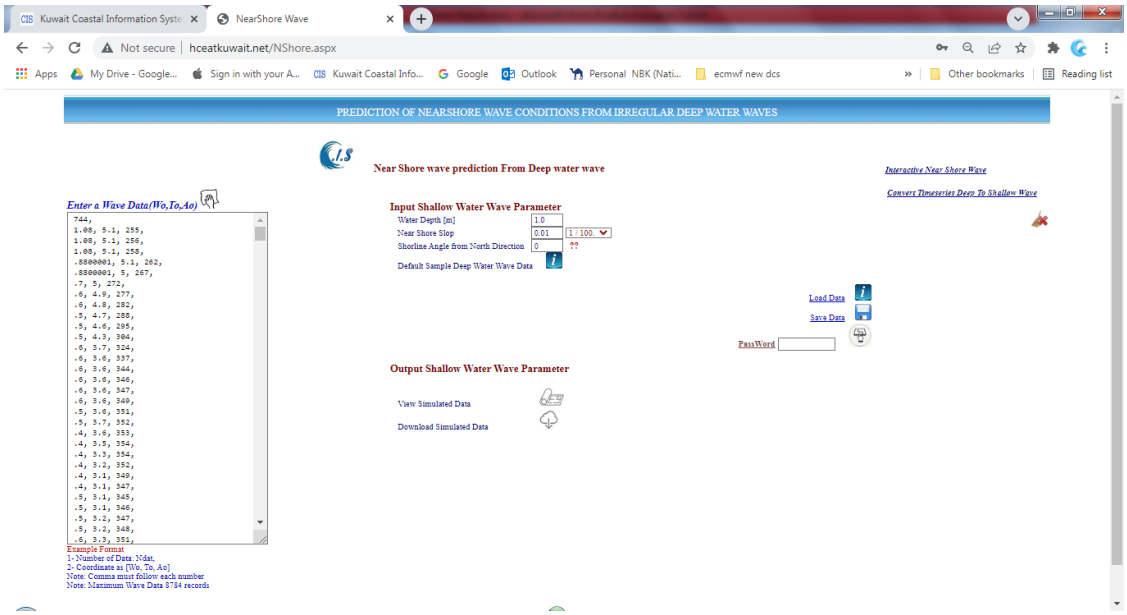

Figure V7

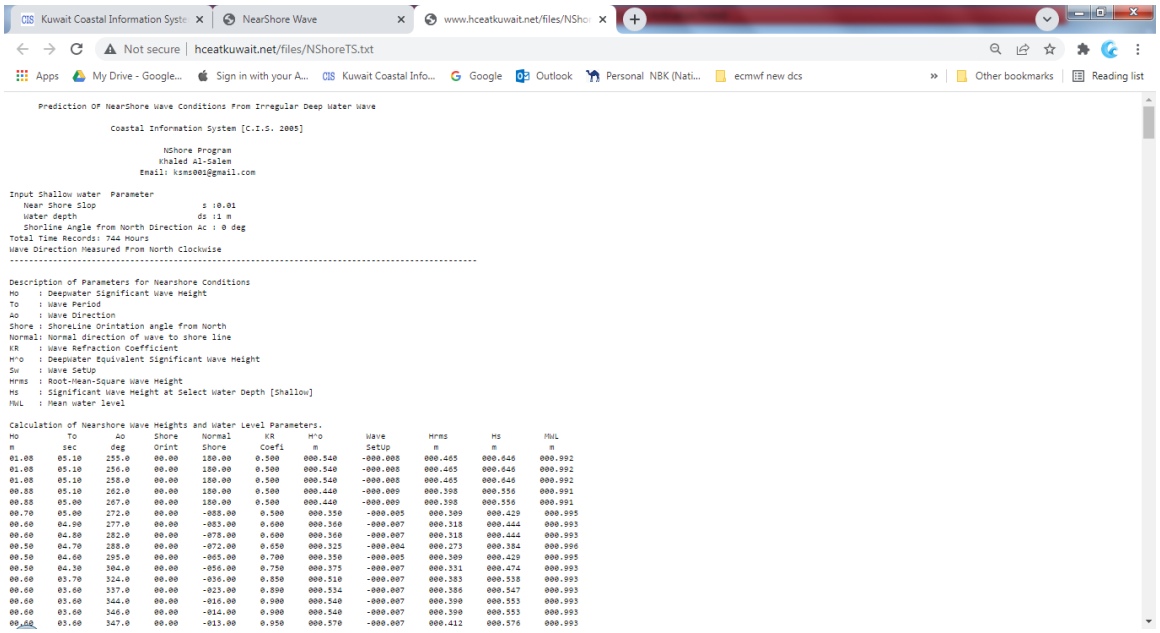

Figure V8