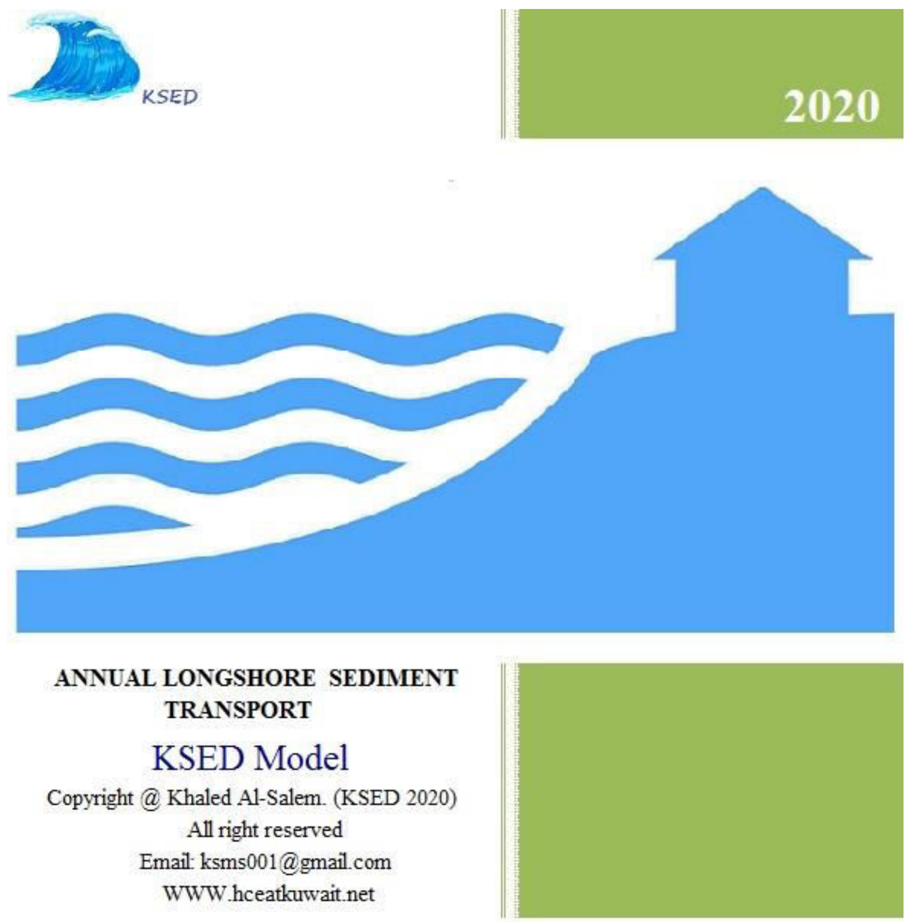
KSED Model

Technical Report



Annual Long shore Sediments Transport and Long shore Current For Kuwait and Arabian Gulf Waters

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ABSTRACT

Annual longshore sediment transport rate and its cross-shore distribution in the surf zone are essential to many coastal engineering and science studies. Practical engineering applications such as beach response in the vicinity of coastal structures, beach-fill evolution and re-nourishment requirements, and sedimentation rates in navigation channels all require accurate predictions of longshore sediment transport rates. Formula proposed by Kamphuis (1991), which includes wave period, a factor that influences breaking, gave good estimates. Examination of the cross-shore distribution of longshore sediment transport indicates that there are three distinct zones of transport: the incipient breaker zone, the inner surf zone, and the swash zone, with each zone contributing a different fraction to the total transport rate. Transport in the incipient breaker zone was influenced by breaker type, transport in the inner surf zone was controlled by depth, and transport in the swash zone showed dependencies on wave height and, in particular, wave period. Swash zone transport was found to have a significant contribution to the total transport rate.
Arguably the most widely used model for estimating total longshore sediment transport rate is the "CERC" formula (Shore Protection Manual, 1984). The model was based on the assumption that the total longshore sediment transport rate is proportional to longshore energy flux.

INTRODUCTION

The prediction of reliable estimates of longshore sediment transport is of considerable practical importance in coastal engineering. An example is the evaluation of sediment budgets for coastal areas with and without structures (breakwaters, groins). Another example is the long-term stability of beach protections and beach nourishments. Most research on longshore transport has concentrated on sand sized sediment, but research on longshore transport along gravel/shingle beaches, which are quite common along mid- and high-latitude (formerly glaciated) parts of the world, has been very limited.

The most widely used formula for longshore transport (LT) is the CERC equation (Shore Protection Manual, US Army Corps of Engineers, 1984). This method is based on the principle that the longshore transport rate (LT, incl. bed load and suspended load) is proportional to longshore wave power P per unit length of beach; LT=K P, with K=calibration coefficient. The CERC formula has been calibrated using field data from sand beaches. The CERC formula does not account for particle size and beach slope. It is only valid for sandy conditions. Sediment transport occurs in two ways:

1- Bed load transport, where particles roll or move in small jumps in a small layer close to the bed.
2- Suspended load transport, where particles are suspended in the water without contact with the bed. Bed load transport typically occurs for low bed shear stresses, obviously still above the critical value, while suspended load occurs with higher bed shear stresses.

In coastal waters the sediment transport processes are strongly affected by the high-frequency waves introducing oscillatory motions acting on the particles. The high-frequency (short) waves generally act as sediment stirring agents; the sediments are then transported by the mean current.

THEORETICAL ANALYSIS

In coastal waters the sediment transport processes are strongly affected by the high-frequency waves introducing oscillatory motions acting on the particles. The high-frequency (short) waves generally act as sediment stirring agents; the sediments are then transported by the mean current. Field experience over a long period of time in the coastal zone has led to the notion that storm waves cause sediments to move offshore while fair-weather waves and swell return the sediments shorewards. During conditions with low non-breaking waves, onshore-directed transport processes related to wave-asymmetry and wave-induced streaming are dominant, usually resulting in accretion processes in the beach zone. During high-energy conditions with breaking waves (storm cycles), the beach and dune zone of the coast are attacked severely by the incoming waves, usually resulting in erosion processes. For practical reasons the suspended transport in coastal waters will be subdivided into current-related and wave-related transport components. The net annual longshore transport (in m3 per year) of sand, gravel or shingle at the beach based on an annual offshore wave climate as input (total 365 days including days without wind H=0). The angle of the wave propagation vector is defined with respect to the north, see Figure 1, this direction differs 180 degrees from the direction from which the waves are coming. Similarly, the angle of the shore normal is also defined with respect to the north. Refraction theory is used to determine the nearshore wave climate. Three longshore transport formulas as [CERC, Kamphuis and van Rijn] will be used in KSED program for prediction of Annual longshore sediments transport.

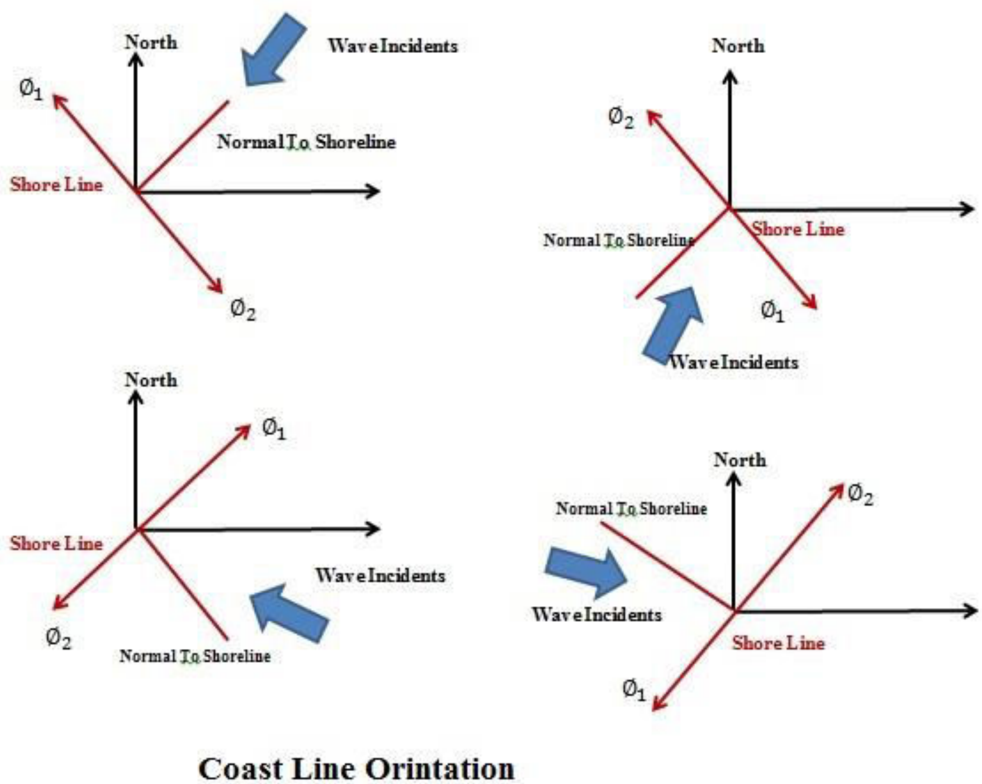


Figure 1. Definition of the angle of wave propagation with respect to Shoreline

The Kamphuis (1991) method is given by:

$$Q_{t-mass} = 2.33\rho_s/(\rho_s - \rho)(T_p)^{1.5}(tan\beta)^{0.75}(d_{50})^{-0.25}(H_{s,br})^2[\sin(2\theta_{br})]^{0.6}$$

Where:
Q_{t-mass}= longshore sediment (dry mass in kg/s)
$H_{s,br}$=significant wave height at breaker line (m);
θ_{br}=wave angle at breaker line (^{o})
d_{50}=median particle size in surf zone (m)
$tan\beta$ = beach slope
T_p = peak wave period
p= porosity factor (0.4).
The modified Kamphuis (Mil-Homens et al., 2013) method is given by:

$$Q_{t-mass} = 1.5\rho_s/(\rho_s - \rho)(T_p)^{0.89}(tan\beta)^{0.86}(d_{50})^{-0.69}(H_{s,br})^{2.75}[\sin(2\theta_{br})]^{0.5}$$

In CERC formula (Shore Protection Manual, 1984) the model, based on the assumption that the total longshore sediment transport rate is proportional to longshore energy flux, is given as:

$$Q_{t,mass} = 0.023(1-p)\rho_s g^{0.5}(\gamma_{br})(H_{s,br})^{\frac{5}{2}}[\sin(2\theta_{br})]$$

Using:
p = porosity = 0.4
$\rho s = 2650\ kg/m^3$
γbr = breaking coefficient = 0.8

$$Q_{t,mass} = 128(H_{s,br})^{\frac{5}{2}}[\sin(2\theta_{br})]$$

with:
$Q_{t,mass}$ = longshore transport rate (dry mass, in kg/s),
$H_{s,br}$ = significant wave height at breaker line;
θ_{br} = wave angle at breaker line (between wave crest line and coastline; or between wave Propagation direction and shore normal direction).
The coefficient 128 has dimensions and $H_{s,br}$ is in meters. The most important parameters are the wave height and the wave angle. The second equation is a rather crude formula, not showing any influence of the particle diameter and the beach/surf zone slope. Therefore, the CERC-formula is only valid for a narrow range of conditions as represented by the calibration data. The formula is most valid for sandy ocean coasts.

Formula of Van Rijn (2014) is given, which is a simple general expression for the computation of longshore transport of sand, gravel, and shingle (0.1 to 100 mm). The effects of additional currents due to tide and wind are included. The longshore sediment transport according to Van Rijn (2014) is:

$$Q_{t,mass} = 0.00018 K_{swell} \rho_s g^{0.5} (tan\beta)^{0.4} (d_{50})^{-0.6} (H_{s,br})^{3.1} [\sin(2\theta_{br})]$$

With:

K_{swell} = Swell factor.

The above equation includes the effect of swell waves. Low-period swell waves in the range of 1 to 2 m produce significantly larger transport rates (factor 1.5) compared to wind waves of the same height (H_{rms} = H). This effect can to some extent be taken into account by using a correction factor to the longshore transport rate, if the percentage of swell waves (in terms of wave height) of the total wave height record is known. Herein, it is proposed to use a swell factor, as follows:

$$K_{swell} = 1.5\left(\frac{p_{swell}}{100}\right) + 1\left(1 - \frac{p_{swell}}{100}\right) = 0.015\ p_{swell} + (1 - 0.01\ p_{swell})$$

With:

p_{swell} = percentage of low-period swell wave heights of the total wave height record (about 10% to 20% for sea coasts and 20% to 30% for ocean coasts). Some values are: K_{swell} =1.05 for p_{swell} =10%; K_{swell} =1.1 for p_{swell} =20% and K_{swell} =1.5 for p_{swell} =100%. If swell is absent (or unknown), then K_{swell} = 1. The equation can also be expressed, as:

$$Q_{t,mass} = 0.0006 K_{swell} \rho_s (tan\beta)^{0.4} (d_{50})^{-0.6} (H_{s,br})^{2.6} [V_{wave}]$$

Where

$$V_{wave} = 0.3 (g H_{s,br})^{0.5} (sin2\theta_{br})$$

with:

V_{wave} = wave-induced longshore current velocity (m/s) averaged over the cross-section of the surf zone based on the work of Bagnold (1963) and Komar (1979).

This equation is linear in velocity. Additional velocities in the surf zone due to tide and wind can be simply taken into account by schematizing the tidal period in two blocks, as follows

$$V_{total} = V_{wave} + 0.01 p_1 V_1 + 0.01 p_2 V_2$$

Where

V_1= representative velocity in positive longshore direction due to wind and tide.

V_2= representative tidal velocity in negative longshore direction due to wind and tide.

p_1= percentage of time with positive flow (about 50%).

p_2= percentage of time with negative flow (about 50%).

The peak longshore velocities in the surf zone due to wind and tide are approximately in the range of 0.1 m/s for micro-tidal to 0.5 m/s for macro-tidal conditions. Generally, there is a slight asymmetry in the wind-generated velocities in the main wave (wind) direction. Using this approach, a slight asymmetry in the velocities due to wind and tide (V_1 larger than V_2 or reversed) can be taken into account. The effect is zero in fully symmetric tidal flow (p_1 = 50%, p_2 = 50%, V_1 = -V_2).

To Compute the Surf zone width X_b as shown in the following Figure.

$X_B = \frac{D_B}{S} + X_s$ $\quad X_B$ Width of wave Breaking line to shoreline

S Beach Slops and D_B Depth at Breaking Line

$$\frac{D_B}{L_0} = \left[\left(\frac{H_0}{L_0}\right)^2 \frac{\cos\emptyset_0}{\gamma_b{}^2\ 2\sqrt{2\pi}}\right]^{\frac{2}{5}}$$

From [Newton-Rhapson method.] Water depth at breaking L. D_B

To simulate the appropriate breaker index for random waves [Thornton, Wu, and Guza (1984)] presented criteria for random breaking waves based on field and laboratory data for the following: Can be used the approximation

$$\gamma_{b-s} = 0.603 + 2.147\,\beta\,[30.685\,\beta - 5.192)\left[\frac{H_0}{L_0}\right] \qquad \textit{based on Significant wave height}$$

γ Breaking index = H_B / D_B

$L_0 = 1.56\,T^2$ *wave lenght for deep water*

$L_s = T\,\sqrt{gh}$ *wave lenght for Shallow water*

T is the wave period, and h is the water depth. Wave height at breaking line can be calculate [Larson and Kraus, 1989] as follows

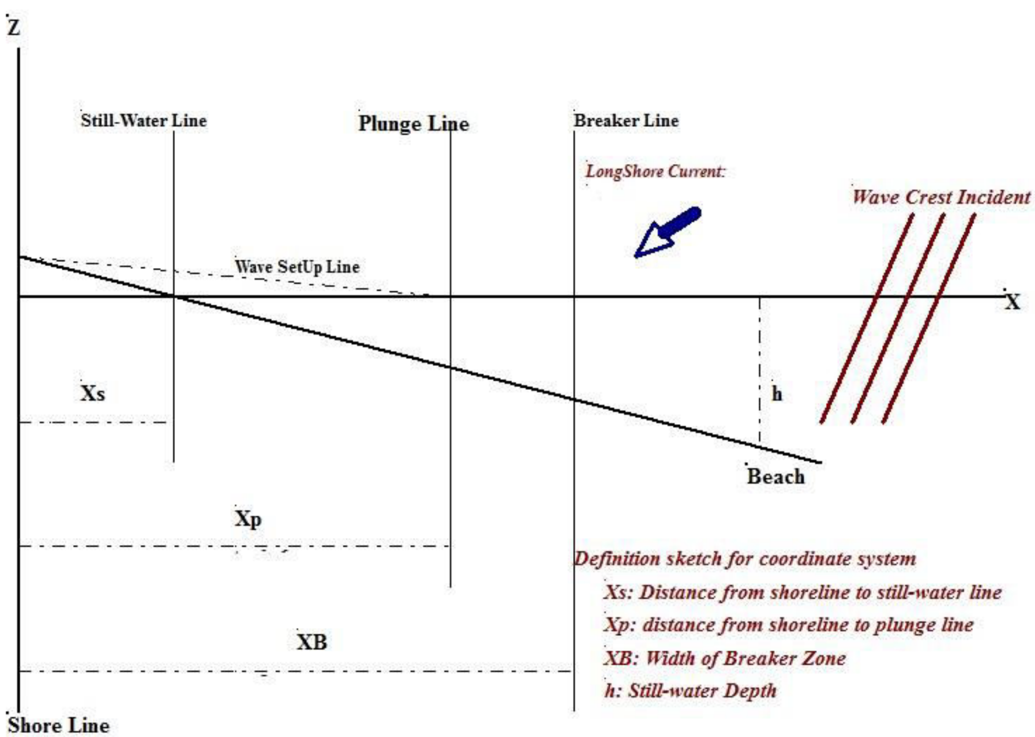
$$H_b = 0.53H_0\,\{\frac{H_0}{L_0}\}^{-0.24}$$

$X_s = KX_p$

where $K = [\,1 + \frac{8}{\gamma^2}\,]^{-1}$

H_B Wave height at Breaking Line

$X_p = X_B - 3H_b$ Distance of Plunge Line to Shoreline



Discussion Result and Model validation process

Case 1. Input Data used from Report of:
"A SIMPLE GENERAL EXPRESSION FOR LONGSHORE TRANSPORT OF SAND, GRAVEL AND SHINGLE". Leo C. van Rijn. [https://www.leovanrijn-sediment.com/papers/Longshoretransport2013.pdf].

Comparison of measured and predicted with computed longshore transport predicted from KSed model for coarse-grained beaches (0.68-1 mm) shows in Table 1 for coarse-grained beaches more than 7-19mm predicted zero transport. All computed transport rates of the measured values, predicted and KSed model prediction as shown in Table 1. The new longshore transport formula used in KSed model yields rather good results compared to laboratory experiments and predicted with small irregular waves and shingle type sediment under a very steep slope of 1 to 1.5.From table 3 KSed model show a good agreements with field sites measurements and laboratory experiments data. Figure 2 snap shot for 'Onslow beach, NC,USA(Wang,1998)" Simulation output.

Table 1. Longshore transport data of coarse-grained field sites, laboratory experiments and Predicted from KLSC model [al-Salem 2021] by Kamphuis 1991

	Input wave parameters					Q_{t-max}		
Field and laboratory data	***D50***	**Tan(β)**	***Hs***	***α***	***Tp***	***Mea-Sured***	***Pred-icted***	***KSed model***
	mm		*m*	*deg*	*sec*	*(kg/s)*	*(kg/s)*	*(kg/s)*
Onslow beach, NC,USA(Wang,1998)	2.25	0.094	0.85	12	6	5.3	5.5	5.9
Canaveral beach, FL,USA(Wang,1998)	0.9	0.115	0.65	9	3.5	2.4	3.4	1.67
Melbourne beach, FL,USA(Wang,1998)	1.5	0.158	0.7	2.5	3.5	0.75	1.02	1.03
Lido Key beach, FL,USA(Wang,1998)	0.68	0.105	0.53	14	3.7	4.9	3.2	1.64
Redington beach, FL,USA(Wang,1998)	0.85	0.125	0.5	8.4	4.5	1.9	1.5	1.64
Redington beach, FL,USA(Wang,1998)	0.9	0.026	0.45	19.2	4.5	1.05	1.21	0.62
Indian Rocks, FL,USA(Wang,1998)	1.38	0.191	0.27	10	2.8	0.35	0.21	0.21
Indian Rocks, FL,USA(Wang,1998)	1.29	0.152	0.2	8.2	3.8	0.25	0.073	0.21
Cape Thompson(Moore and Cole 1960)	1	0.091	1.66	25	5.5	67	133	30
Lab. Exp. Ir. Waves G-H; Burcharth 1988	19	0.2	0.13	15-30	1.8-2.5	0.005	0.01	0-0

D50 particle size; **tanβ** beach/surf zone slope; ***Hs,*** significant wave height at breaker line;
α wave angle to shore normal at breaker line; ***Tp*** peak wave period,
[Q(m^3/sec) => 739 Q (kg/sec)]
Q-predicted from KLSC model used based [Watanabe formula]
Data source:[https://www.leovanrijn-sediment.com/papers/Longshoretransport2013.pdf].

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                KSED Program
        Developed by Khaled Al-Salem (2020)
For Prediction of Longshore Sediment Transport Qnet/Qgross
          ANNUAL LONGSHORE TRANSPORT Rate
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Sediment density [kg/m3]                                 : 2650
Bulk density of sand bed[0 to 20%]                       : 1600
Percentage of mud in bed (range of 0 to 20%)             : 0
Percentage of offshore swell waves (H>1m, T>10s)[0 to 40%]: 10
Positive Tidal current vel. (50% of time)[m/s]           : 0.05
Negative Tidal current vel. (50% of time)[m/s]           : -0.1
OFF Shore Wave Height Depth(m)                           :  9

Profile Location Number                                  :  1
Slope surf zone (Beach slope)                            : 0.094
Incident Wave height (m)                                 : 0.85
Wave Period (sec)                                        : 6
Wave Angle (from North) (deg)                            : 135
Shore Line Orintation (from North) (deg)                 : 123
Wave angle to Normal shoreline (deg)                     : 12
Sediment size (D50) (mm)                                 : 2.25
Wave Breaking Index                                      : 0000.6001
Distance from Shoreline to Still-Water (m)               : 0000.5940
Distance from Shoreline to Plung Line  (m)               : 0013.7890
Width of Breaking Zone (m)                               : 0016.4770
Mean Wave Height at Breaking Line(m)                     : 0000.896
Mean Wave Angle at Breaking Line(deg)                    : 0005.675
Mean Wave Depth at Breaking Line(m)                      : 0001.493
Mean Wave Lenght at Breaking Line(m)                     : 0022.326
Longshore Current[Deriven by wave] (cm/s)                :  17.5
Effective Longshore Current        (cm/s)                :  15

   Annual Longshore Sediment Transport Rate from Different Techn.

                                       Gross          Net                  From
                                     Transport      Transport      V-North        V-South
                                       (m3/D)         (m3/D)        (m3/D)         (m3/D)
-----------------------------------------------------------------------------------------------
   Kamphuis Original 1991   =           711            711            0              711
   Kamphuis modified 2013   =           184            184            0              184
   CERC Method              =           1201           1201           0              1201
   Van Rijn 2014            =           153            153            0              153
```

Figure 2. Snap shot for Simulation output of KSed model.

Case 2. Long-term sand case; Richards Bay along Ocean coast of East Africa, South Africa

Input Data used from Report of:
https://www.leovanrijn-sediment.com/papers/Longshoretransport2013.pdf

Richards Bay harbour is situated on the East African coast. The approach to the harbour is protected by two breakwaters. The local coastal topography north of the breakwaters is characterised by a relatively straight coastline with a narrow beach. The beach borders a relatively flat inland coastal plain at about 30 to 40 m above mean sea level. The local coast north of the port is a soft cliff type coast covered with bushes. The height of the cliffs varies in the range of 5 to 15 m. The beach is relatively narrow (about 50 m) and consists of fine to medium, reddish brown sand (grain sizes are in the range of 0.2 to 0.3 mm). Based on detailed studies, Swart (1981) concluded that the net longshore transport at Richards Bay is about 0.8 millions m3/year towards the north-east. His results were confirmed by Laubscher et al. (1991). Comparison of measured and predicted with computed longshore transport predicted from KSed model using wave paramters input as shows in Table 2. All computed transport rates of the measured values, predicted and KSed model prediction as shown in Table 3. The new longshore transport formula used in KSed model yields rather good results compared to Computed and measured. From Table 3 KSed model show a good agreements with field sites measurements and Computed result data. Figure 3 Computed output Sheet from KSed model for Net longshore transport sediments at Richards Bay, South Africa.

Table 2. Frequency of occurrence (number of days per year; total 365) based on offshore wave data of Corbella and Stretch (2012)

Wave direction to North (degrees)	Wave direction to shore normal (degrees)	Wave height $H_{s,o}$= 4m T_p= 22 s	Wave height $H_{s,o}$= 3m T_p= 18 s	Wave height $H_{s,o}$=2.25 m T_P=15 s	Wave height $H_{s,o}$=1.75m T_p= 13 s	Wave height $H_{s,o}$=1.25 m T_p= 11 s	Wave height $H_{s,o}$=0.75 m T_p=10 s	Total (days
75 (255)	-60	0 days per year	2 days per year	1	6	10	2	19
105 (285)	-30	0.3	3	8	30	41	6	88
135 (315)	0	0.8	5	11	29	46	8	99
165 (345)	30	0.9	8	17	44	69	11	119
All waves directions		2	18	37	109	166	27	357

Wave direction=direction to North from which the waves are coming (between brackets: the wave direction in which the waves are going); Shore normal (angle to north)=315;
positive wave angle to shore normal yields transport to north-east (dominant transport direction)
Beach slop $\tan_b$= 0.02.

Table 3 Computed net longshore transport at Richards Bay, South Africa result compared with KSed model prediction used [Kamphuis 1991]

Input parameters	Computed longshore transport rate to north (m3/year)	Computed longshore transport rate to south (m3/year)	Computed Net longshore transport rate (m3/ye	Measured net longshore transport rate (m3 /yea	Predicted From **KSed Model** net longshore transport rate (m3/yea
Grain size D_{50}=0.0002 m	1,350,000	780,000	570,000	650,000 (±150,000)	486,768
Grain size D_{50}=0.0003 m	1,065,000	615,000	450,000		439844

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LONGSHORE TRANSPORT (number of days  0days)
==============================================================

Sediment density [kg/m3]                                  : 2650
Bulk density of sand bed[0 to 20%]                        : 1600
Percentage of mud in bed (range of 0 to 20%)              : 0
Percentage of offshore swell waves (H>1m, T>10s)[0 to 40%]: 10
Positive Tidal current vel. (50% of time)[m/s]            : 0.05
Negative Tidal current vel. (50% of time)[m/s]            : -0.1
Calibration factor[(default=1)]                           : 1
OFF Shore Wave Height Depth(m)                            :  30
Wave Data Records                                         :  23

Profile Location Number:  1
Slope surf zone (slope from waterline to depth)tanB    : 0.02
Shore Normal angle to North (deg)                      : 315
Sediment Size (D50) (m)                                : 0.0002
Longitude\Latitude(UTM)                                : 219118.3 \\ 3241600
Mean Wave Height at Breaking Line(m)                   : 2.199
Mean Wave Lenght at Breaking Line(m)                   : 87.056
Mean Wave Angle at Breaking Line(deg)                  : -3.644
Mean Negarive Longshore Current[Deriven by wave] (cm/s): -59.9
Mean Postive  Longshore Current[Deriven by wave] (cm/s):  55.1

   Annual Longshore Sediment Transport Rate(in m3 per year)from Different Techn.

                                        Gross         Net              From
                                      Transport    Transport     V-North        V-South
                                        (m3)         (m3)          (m3)            (m3)
-------------------------------------------------------------------------------------------------
   Kamphuis Original 1991  =            2132116      486768       -822674        1309442
   Kamphuis modified 2013  =            1493921      371888       -561017        932905
   CERC Method             =            3810131      788930       -1510601       2299530
   Van Rijn 2014           =            2238606      361555       -938526        1300080
```

Figure 3. Computed output Sheet from KSed model for Net longshore transport sediments at Richards Bay, South Africa.

Case 3**:** Computed longshore current distribution for Thornton and Guza (1986, 1989-4 Feb) Data and compared with KSed model result using the input wave parameters list in Tables 4 and 5. The simulation output for sediments transport rate display at Figure 4 from the computed longshore current distribution from Thornton and Guza (1986, 1989) and KSed model (AL-Salem K. 2020) shows satisfying agreements. Figure 5 show snap shot of KSed model result.

Table 4 Model input parameters Thornton and Guza (1986, 1989-4 Feb)

Root-mean square wave height	0.56 m
Significant wave height	0.735m
Wave period	14.2 sec
The wave front makes with the Normal shoreline (α in degrees)	9.0^0
Beach slope [1 : 26]	0.038
Mean sediment diameter D_{50}	0.23 mm
Sediment density	2650 kg/ m^3
[Depth in which wave measurements were made]	3.8m

Table 5. Thornton and Guza (1989) Field Measurements of 4 February (Slope from Profile 0.038)

Distance from Shoreline (m)	Depth (m)
10.39	0.52
13.39	0.65
16.45	0.78
19.41	0.89
22.21	1.01
25.34	1.16
28.26	1.24
31.31	1.34
34.46	1.42
38.58	1.56
43.16	1.7
60.62	2.37
72.42	3.03
84.16	3.79

Data Source: https://erdc-library.erdc.dren.mil/jspui/bitstream/11681/4585/1/13150.pdf
"Dredging Research Program: NMLONG: Numerical Model for Simulating the Longshore Current. Report 1. Model Development and Tests"

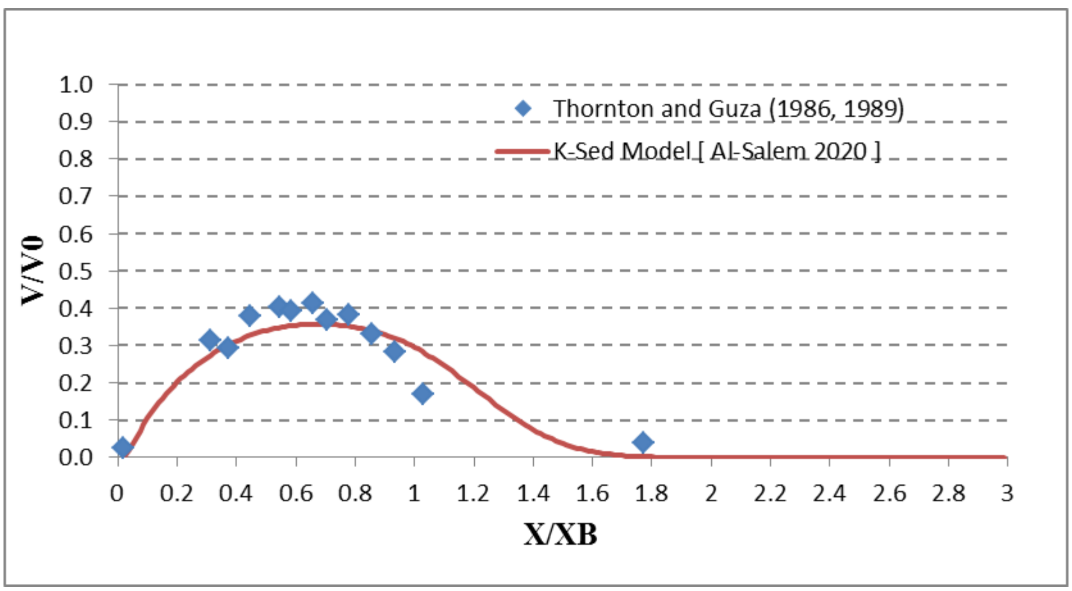

Figure 4. Computed longshore current distribution for Thornton and Guza (1986, 1989 data Feb.4) and KSed model (AL-Salem K. 2020).

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                 KSED Program
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          ANNUAL LONGSHORE TRANSPORT Rate
==============================================================

Sediment density [kg/m3]                                  : 2650
Bulk density of sand bed[0 to 20%]                        : 1600
Percentage of mud in bed (range of 0 to 20%)              : 0
Percentage of offshore swell waves (H>1m, T>10s)[0 to 40%]: 10
Positive Tidal current vel. (50% of time)[m/s]            : 0.05
Negative Tidal current vel. (50% of time)[m/s]            : -0.1
OFF Shore Wave Height Depth(m)                            :  3.8

Profile Location Number                                   :  1
Slope surf zone (Beach slope)                             : 0.038
Incident wave height (m)                                  : 0.735
Wave Period (sec)                                         : 14.2
Wave Angle (from North) (deg)                             : 135
Shore Line Orintation (from North) (deg)                  : 126
Wave angle to Normal shoreline (deg)                      : 9
Sediment Size (D50) (mm)                                  : 0.23
Wave Breaking Index                                       : 0000.6002
Distance from Shoreline to Still-Water (m)                : 0001.3279
Distance from Shoreline to Plung Line  (m)                : 0030.8198
Width of Breaking Zone (m)                                : 0032.9858
Mean Wave Height at Breaking Line(m)                      : 0000.722
Mean Wave Angle at Breaking Line(deg)                     : 0005.093
Mean Wave Depth at Breaking Line(m)                       : 0001.203
Mean Wave Lenght at Breaking Line(m)                      : 0048.579
Longshore Current[Deriven by wave] (cm/s)                 :  14.1
Effective Longshore Current        (cm/s)                 :  11.6

   Annual Longshore Sediment Transport Rate from Different Techn.

                                         Gross         Net              From
                                       Transport    Transport     V-North      V-South
                                         (m3/D)       (m3/D)       (m3/D)       (m3/D)
----------------------------------------------------------------------------------------------
   Kamphuis Original 1991  =              1412         1412          0          1412
   Kamphuis modified 2013  =              458          458           0          458
   CERC Method             =              627          627           0          627
   Van Rijn 2014           =              184          184           0          184
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Figure 5. Snap shot of the Computed longshore current distribution for Thornton and Guza (1986, 1989-4 Feb) Data and compared with KSed model result.

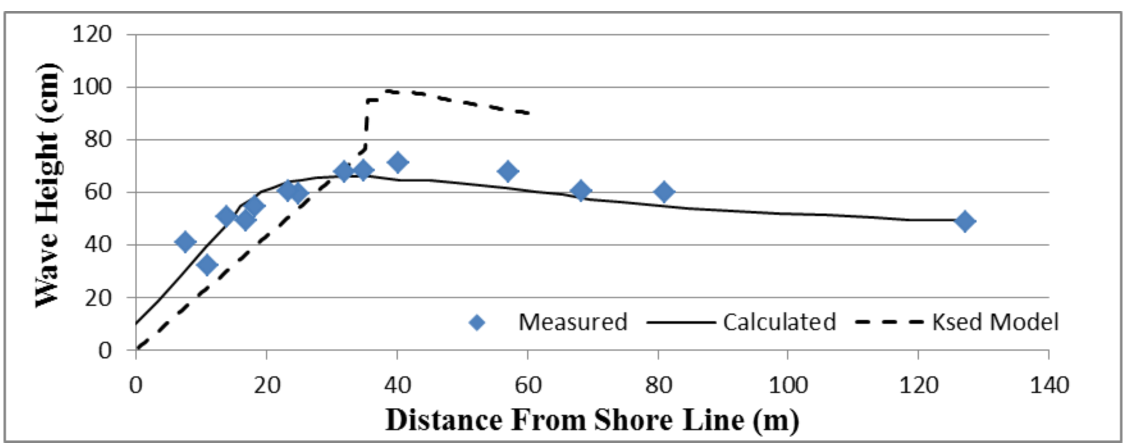


Figure 6. Computed Wave height distribution for Thornton and Guza (1986, 1989 data Feb.4) and KSed model (AL-Salem K. 2020).

Case 4: Computed longshore current distribution for [Thornton and Guza (1986-89) -3 Feb)] Data and compared with KSed model result using the input wave parameters list in Table 6 and 7. Figure 7 display the computed longshore current distribution from Thornton and Guza (1986-Feb. 3 data) and KSed model (AL-Salem K. 2020) shows satisfying agreements. Figure 8 show snap shot of KSed model result. Figure 9 display wave height prediction compared.

Table 6 Model input parameters [Thornton and Guza (1986) -3 Feb)

Root-mean square wave height	0.55 m
Significant wave height	0.78 m
Wave period	14.3 sec
The wave front makes with the Normal shoreline (α in degrees)	7.8^0
Beach slope [1 : 20.7]	0.0483
Mean sediment diameter D_{50}	0.23 mm
Sediment density	2650 kg/ m^3
Depth in which wave measurements were made	4m

Data Source: https://erdc-library.erdc.dren.mil/jspui/bitstream/11681/4585/1/13150.pdf
"Dredging Research Program: NMLONG: Numerical Model for Simulating the Longshore Current. Report 1. Model Development and Tests"

Table 7. Thornton and Guza (1989) Field Measurements of 3 February (Slope from Profile 0.0483)

Distance Offshore m	Depth m
6.93	0.37
9.93	0.5
12.99	0.65
15.95	0.8
18.75	0.94
21.88	1.11
24.8	1.24
31	1.48
35.12	1.65
39.7	1.77
57.16	2.28
68.96	3.02
80.7	3.8
128.6	6.51

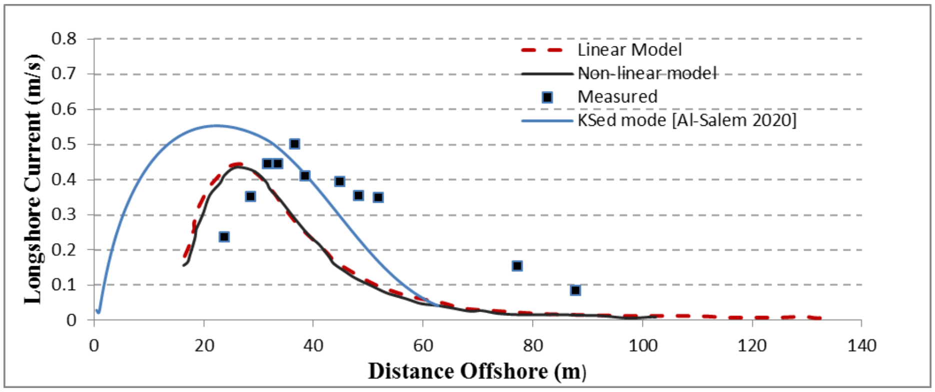


Figure 7. Computed longshore current distribution for Thornton and Guza (1986, 1989 Data Feb.3) and KSed model (AL-Salem K. 2020).

```
|               KSED Program
         Developed by Khaled Al-Salem (2020)
For Prediction of Longshore Sediment Transport Qnet/Qgross
          ANNUAL LONGSHORE TRANSPORT Rate
==============================================================

Sediment density [kg/m3]                                  : 2650
Bulk density of sand bed[0 to 20%]                        : 1600
Percentage of mud in bed (range of 0 to 20%)              : 0
Percentage of offshore swell waves (H>1m, T>10s)[0 to 40%]: 10
Positive Tidal current vel. (50% of time)[m/s]            : 0.05
Negative Tidal current vel. (50% of time)[m/s]            : -0.1
OFF Shore Wave Height Depth(m)                            :  4

Profile Location Number                                   :  1
Slope surf zone (Beach slope)                             : 0.0483
Incident wave height (m)                                  : 0.78
Wave Period (sec)                                         : 14.3
Wave Angle (from North) (deg)                             : 135
Shore Line Orintation (from North) (deg)                  : 127.2
Wave angle to Normal shoreline (deg)                      : 7.8
Sediment Size (D50) (mm)                                  : 0.23
Wave Breaking Index                                       : 0000.6000
Distance from Shoreline to Still-Water (m)                : 0001.0846
Distance from Shoreline to Plung Line  (m)                : 0025.1871
Width of Breaking Zone (m)                                : 0027.4821
Mean Wave Height at Breaking Line(m)                      : 0000.765
Mean Wave Angle at Breaking Line(deg)                     : 0004.435
Mean Wave Depth at Breaking Line(m)                       : 0001.275
Mean Wave Lenght at Breaking Line(m)                      : 0050.372
Longshore Current[Deriven by wave] (cm/s)                 :  12.7
Effective Longshore Current        (cm/s)                 :  10.2

   Annual Longshore Sediment Transport Rate from Different Techn.

                                        Gross          Net                     From
                                      Transport      Transport      V-North          V-South
                                       (m3/D)         (m3/D)         (m3/D)           (m3/D)
------------------------------------------------------------------------------------------------
   Kamphuis Original 1991   =            1770           1770           0                1770
   Kamphuis modified 2013   =            622            622            0                622
   CERC Method              =            634            634            0                634
   Van Rijn 2014            =            207            207            0                207
```

Figure 8. Snap shot of the Computed longshore current distribution for Thornton and Guza (1986, 1989-3 Feb) Data and compared with KSed model result.

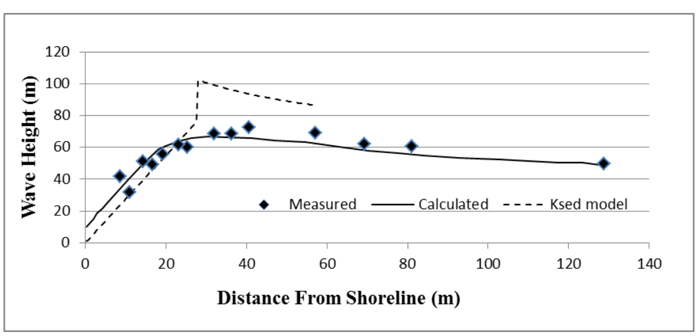


Figure 9. Computed Wave height distribution for Thornton and Guza (1986, 1989 data Feb.4) and KSed model (AL-Salem K. 2020).

KSED Model Demonstration
P.C. Version

Then Figure 1 will display the main KSED main page on PC computer as follows:

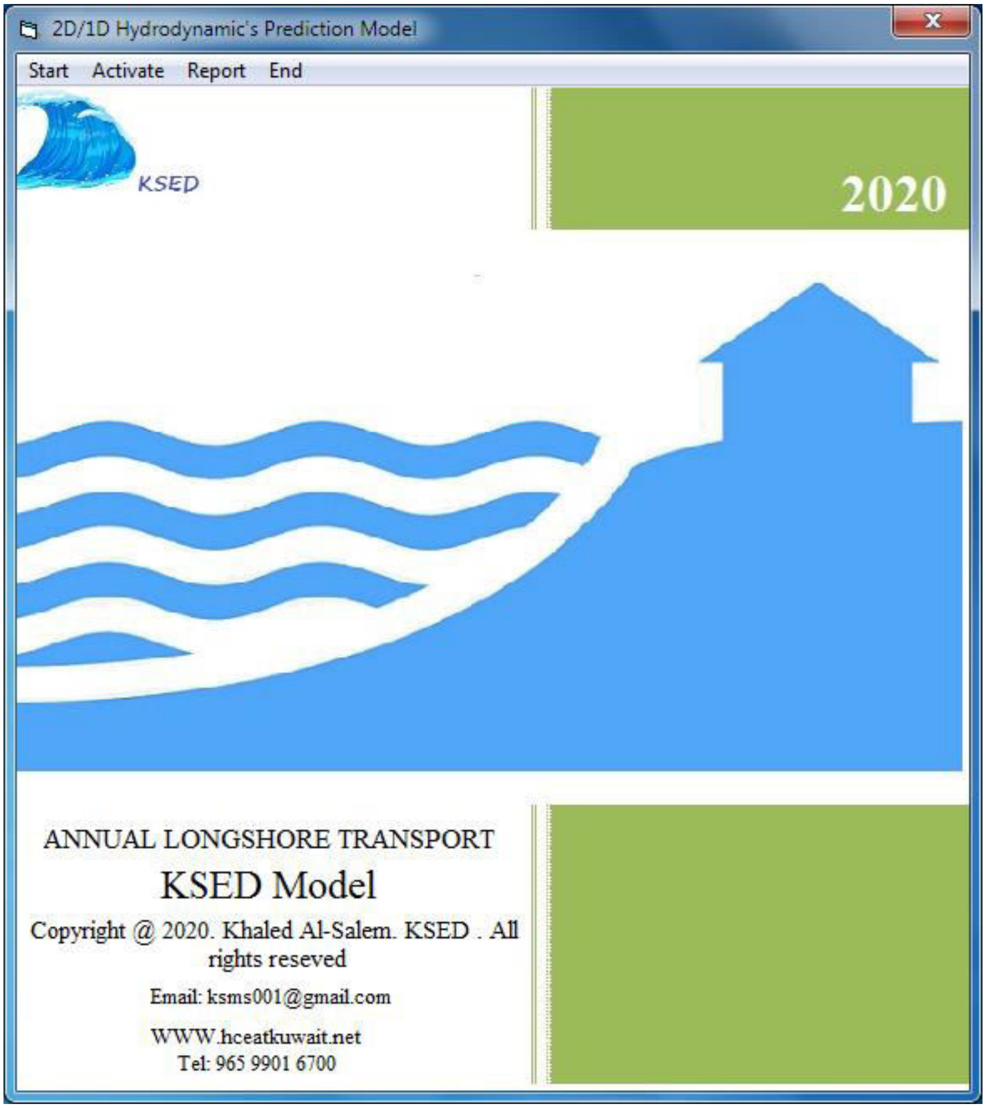


Figure 1. KSed Model Main Page

Ksed model main page display the following

1- Start model simulation
2- Activation for user to setup hos access code provide from Operator. User can get access code by send a request from Operator at Email [Ksms001@gmail.com].
1. 3-Display KSed model report and user manual in a PDF file.

If used clicked on Start Figure 2 will display as

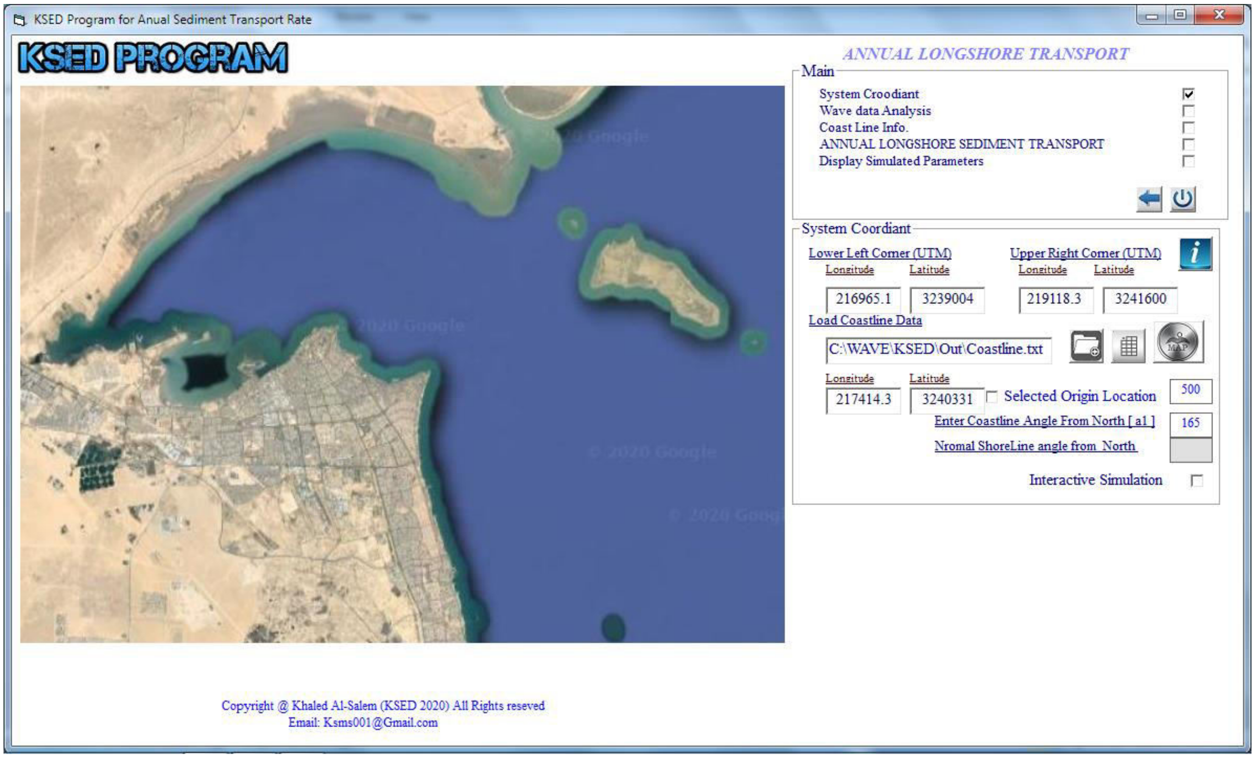


Figure 2. Main model Setup Page

Figure 2 display a number of options show at Main Box for user to start new project at listed:
Section 1. These option section are for Annual Longshore Sediment analysis.

1- System Coordinate.
2- Input Wave Data analysis.
3- Coastal Line data Information.
4- Analysis Longshore Sediment Transport.
5- Display Sediment Parameters.

Section 2. Option for Interactive Longshore Sediment analysis and Current
User select a check box [Interactive Simulation] at System Coordinate Box.

To strat new project for Annual Longshore Sediment Transport user selected

Section 1: as Annual Sediment Transport

User select ***System Coordinate check box*** this option allow user to do the following

Load file name for project map by select [].

View map data select [ ]

Draw map data select [ ]

After map has been drawn on screen user must Click an location where sediment to calculated. Then user must enter shoreline Orientation angle measured from True North.

Then draw map by select [ ]. User can adjust the angle as shown in Figure 3. Figure 4 show sample of map data format [Data could be Degrees or UTM].
From Figure 3 user find out the angle coastal line from North will used later for sediment transport calculation and the angle normal to Shore line from North also displayed.

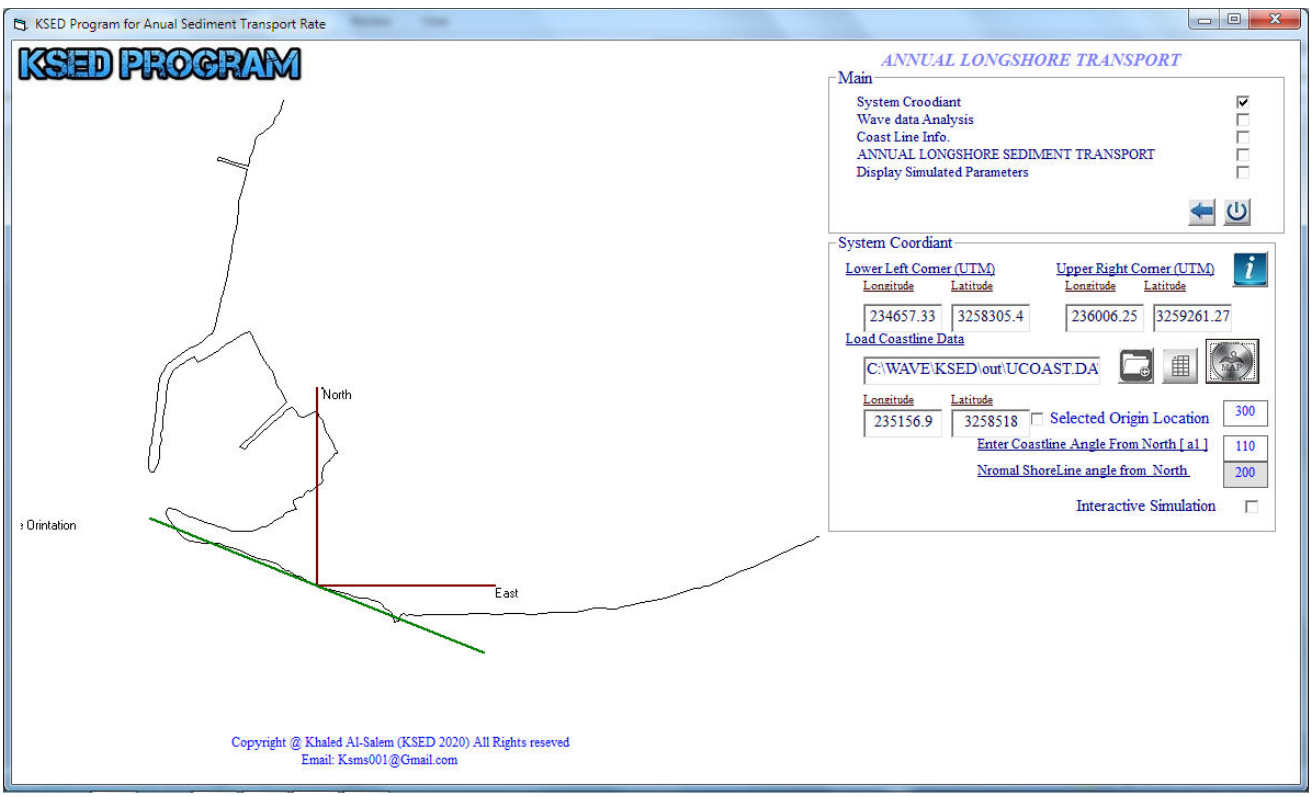


Figure 3. Show Coastal Line Orientation Setup

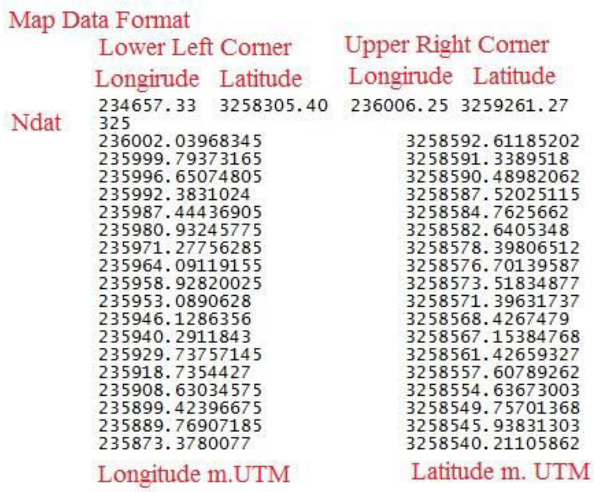
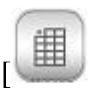


Figure 4. Map data Format

User select ***Wave Data Analysis check box*** this option allow user to do the following

To input Wave data at [Wave height-m, Period-sec and Direction-deg]. User must select from Figure 2. Check box of ***Wave Data analysis***. Then Figure 5 will display for user to select the following:

1- User must select input wave data file by select []. To view data select [].
   Input data format must be as displayed in Figure 8.
2- user must select ***[RUN WAVE ANALSIS***] . to start analysis wave data input.
3- At This point user can generate Band Wave Data based Wave angle selection for more detailed simulation by check on [***Setup Limits degrees for Wave Band Width Direction for Occurrence of Wave Height and Period option***] .
   Figure 6 will display user to select lower band angle and Upper band Angle. Then select close. IT user all wave data between to angle only for Simulation.
4- User Then Select ***Load Wave Analyzed wave data*** as shown in Figure 5.
5- If user want to see Table selected [Table of wave Band width data selected] by select again the Check box figure 6 will display then user select Edit [***TABLE]*** . Figure 7 will display data table created.

Input Wave Data file can input in TWO ways as:
1- Formatted wave data file as described above and file shown in Figure 8.
2- Unformatted wave data file as displayed in Figure 9. In this option user must enter the wave file name in textbox [***Enter Output wave file***]. Then don't Select [Run Wave Analysis] only select [***Load Wave Analyzed wave data***].

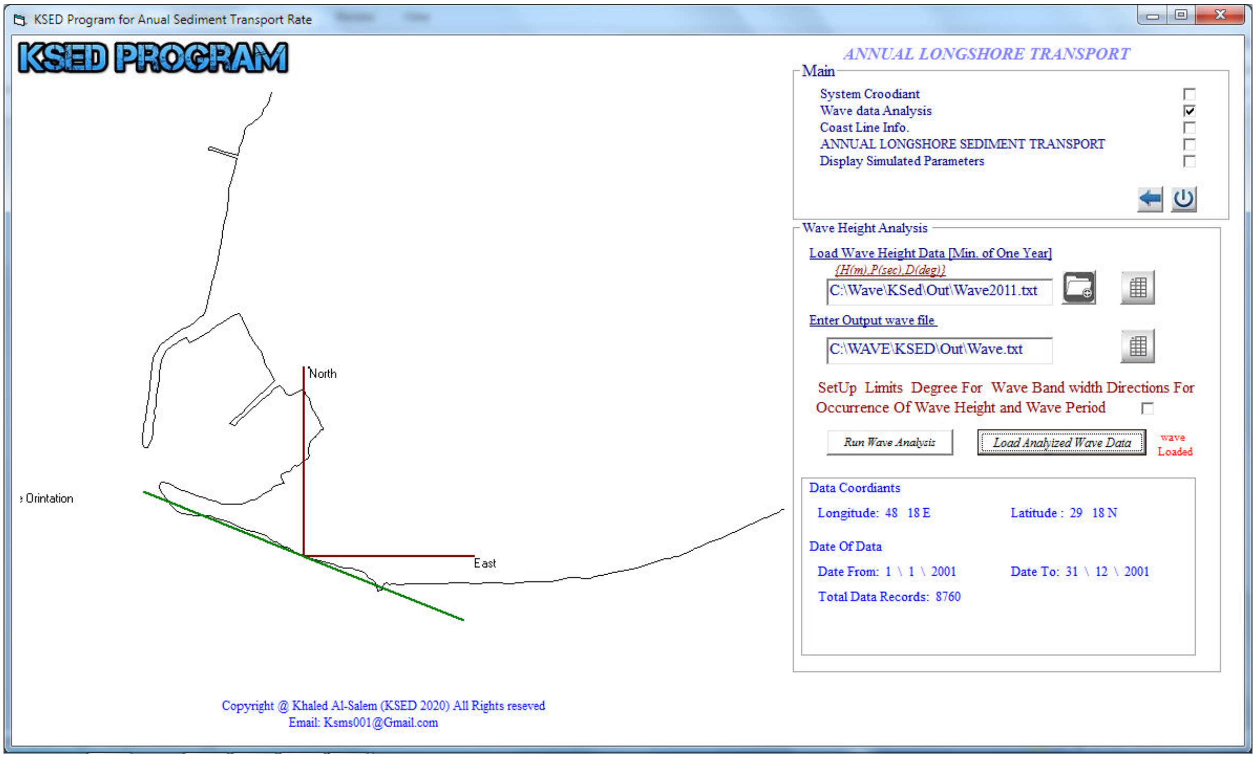


Figure 5. Wave Data Input Analysis and Options

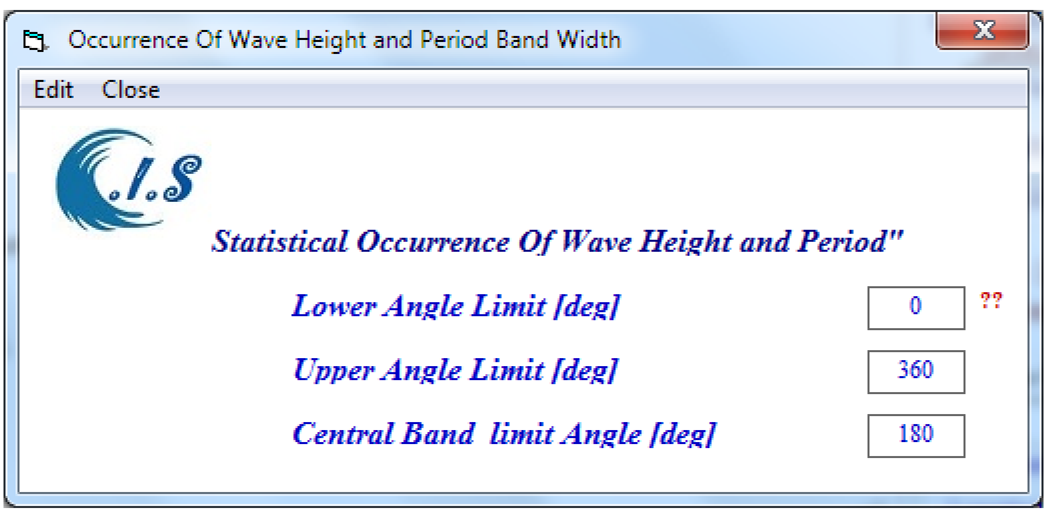


Figure 6. Setup Limits degrees for Wave Band Width Direction

table.txt - Notepad

File Edit Format View Help

```
                                 Coastal Information System DataBase [C.I.S.]
                                           [ Al-Salem K. 2005 ]
                                         Email: Ksms001@ Gmail.com
                                            Tel  : 965 99016700
                                             www.hceatkuwait.net
Deep wave Data Location:Longitude:  48   18 E
                       :Latitude :  29   18 N
Strat                  :Date From:  1  \  1  \  2001
End                    :Date To:  31  \  12  \  2001
Total Time Records:      8760 Hours
Total Analysis Records:  8760 Hours
Wave Direction Measured From North Clockwise

                                     For  360 -degree Band width
                               Range Angle:  0   360  Centered :180 DEG
                               Occurrence Of Wave Height and Wave Period
```

Wave Period [T, Seconds]

H[m]	0.0-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-6.0	6.0-7.0	7.0-8.0	8->	
0.00-0.10	0000000	0000735	0001917	0000408	0000020	0000000	0000000	0000000	0000000	3080
0.10-0.25	0000000	0000026	0001141	0000419	0000021	0000000	0000000	0000000	0000000	1607
0.25-0.50	0000000	0000021	0002849	0000507	0000065	0000009	0000000	0000000	0000000	3451
0.50-0.75	0000000	0000000	0000049	0000454	0000007	0000000	0000000	0000000	0000000	510
0.75-1.00	0000000	0000000	0000000	0000085	0000003	0000000	0000000	0000000	0000000	88
1.00-1.25	0000000	0000000	0000000	0000018	0000003	0000000	0000000	0000000	0000000	21
1.25-1.50	0000000	0000000	0000000	0000001	0000002	0000000	0000000	0000000	0000000	3
1.50-1.75	0000000	0000000	0000000	0000000	0000000	0000000	0000000	0000000	0000000	0
1.75-2.00	0000000	0000000	0000000	0000000	0000000	0000000	0000000	0000000	0000000	0
2.00-2.50	0000000	0000000	0000000	0000000	0000000	0000000	0000000	0000000	0000000	0
2.50-3.00	0000000	0000000	0000000	0000000	0000000	0000000	0000000	0000000	0000000	0
> 3.00	0000000	0000000	0000000	0000000	0000000	0000000	0000000	0000000	0000000	0
Total	0000000	0000782	0005956	0001892	0000121	0000009	0000000	0000000	0000000	8760

Ln 1, Col 1

Figure 7. Table of Wave Band Width Direction Occurrence of Wave Height and Period

```
                 C.I.S.
   Coastal Information System DataBase
          [ Al-Salem K. 2005 ]
         Email: Ksms001@Gmail.com
           Tel  : 965 99016700
           www.hceatkuwait.net
Longitude:  48   18 E
Latitude :  29   18 N
Date From:  1  \  1  \  2001
Date To:  31  \  12  \  2001
Total Time Records:,  8760 , Hours
Wave Direction Measured From North Clockwise
 0.1           2.6           300
 0.1           2.6           302
 0.1           2.6           303
 0.1           2.6           304
 0.1           2.6           305
 0.1           2.6           306
 0.1           2.5           307
 0.1           2.5           307
 0.1           2.5           307
 0.1           2.5           307
 0.1           2.4           307
 0.1           2.3           307
 0.1           1.9           304
 0.2           1.9           149
 0.3           2.3           151
 0.3           2.4           148
 0.3           2.4           147
 0.3           2.4           148
 0.2           2.4           147
 0.2           2.3           145
 0.2           2.3           142
 0.3           2.3           138
 0.2           2.4           134
 0.2           2.4           133
```

Figure 8. Formatted Wave Data File sample

Sample of Unformated wave data

N0 of data — Indexe

8760	0			
4.16666666666667E-02		0.1	2.6	300
4.16666666666667E-02		0.1	2.6	302
4.16666666666667E-02		0.1	2.6	303
4.16666666666667E-02		0.1	2.6	304
4.16666666666667E-02		0.1	2.6	305
4.16666666666667E-02		0.1	2.6	306
4.16666666666667E-02		0.1	2.5	307
4.16666666666667E-02		0.1	2.5	307
4.16666666666667E-02		0.1	2.5	307
4.16666666666667E-02		0.1	2.5	307
4.16666666666667E-02		0.1	2.4	307
4.16666666666667E-02		0.1	2.3	307
4.16666666666667E-02		0.1	1.9	304
4.16666666666667E-02		0.2	1.9	149
4.16666666666667E-02		0.3	2.3	151
4.16666666666667E-02		0.3	2.4	148
4.16666666666667E-02		0.3	2.4	147
4.16666666666667E-02		0.3	2.4	148
4.16666666666667E-02		0.2	2.4	147
4.16666666666667E-02		0.2	2.3	145
4.16666666666667E-02		0.2	2.3	142
4.16666666666667E-02		0.3	2.3	138
4.16666666666667E-02		0.2	2.4	134
4.16666666666667E-02		0.2	2.4	133
N0 Day= 1/24 If Wave data hourly		H	Period	Angle

Figure 9. Unformatted Wave Data File sample

User select ***<u>Coastal Line data Information check box</u>*** this option allow user to input require parameter data for model to run. Figure 10 display for user to what coastal parameter need to be input. Positive and negative tidal generated current are assumed in the model these data collected from literature.

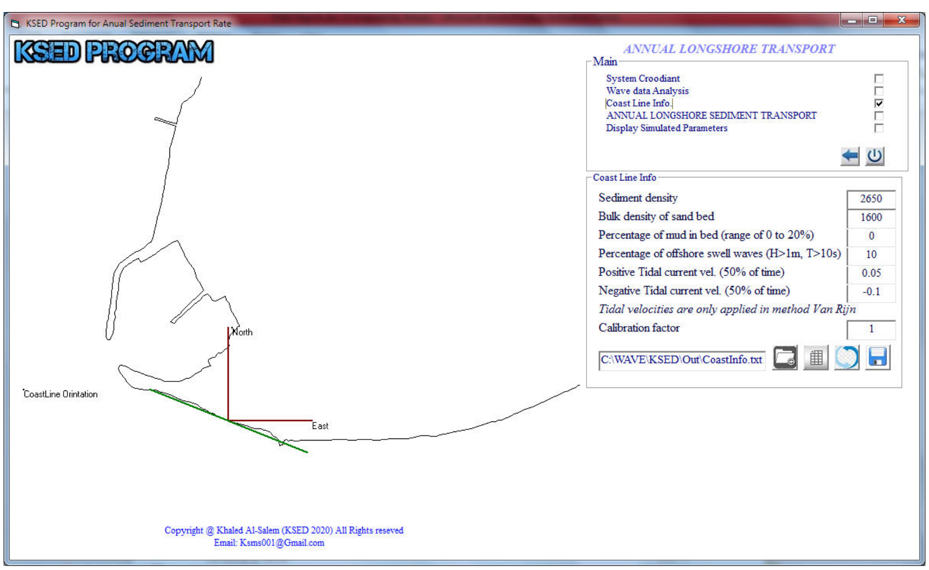


Figure 10. Coastal Information Data

User select ***Analysis Longshore Sediment Transport.check box*** this option allow user to start model simulation as shown in Figure 11.

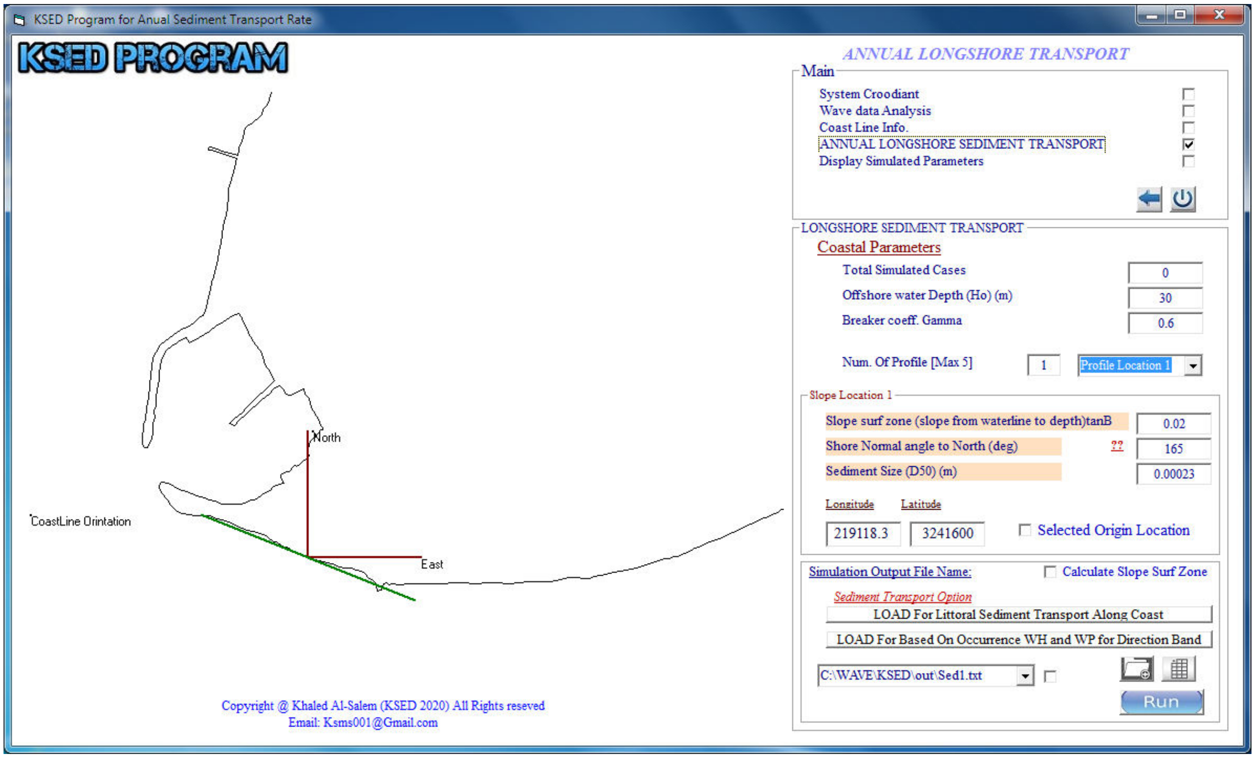


Figure 11. Screen for model Simulation options.

From Figure 11 user must enetr the following:

1- Depth of Wave data used in meter

2- Breaker Coefficient Gamma [As constant used 0.6]

3- KSed model can Simulate maximum of Five different location in same time by enetr data for each profile location as shown in Figure 11.

4- From Drop list user can the profile number to enter the require data as follow
  - Profile Slop data
  - Shore normal angle to north where found in Figure 3 in section 1.
  - Sediment Size D50
  - Location by click on map to get Longitude/Latitude but user must check box for each profile to get data.

5- Output file name must be entered.

6- The simulation option is loading wave data in two type as follows:

   1- Annual Simulation by select [***LOAD for Littoral sediment Transport Along Coast***] To simulate all wave data enter.

   2- To simulate only the selected Wave Band width as [***LOAD for based On Occurrence WH and WP for Direction Band***]

7-To Start project simulation is by click on []

To View Result file [] as shown in Figure 12

```
                KSED Program
        Developed by Khaled Al-Salem (2020)
For Prediction Of Longshore Sediment Transport Qnet/Qgross
LONGSHORE TRANSPORT (number of days  365days)
==============================================================

Sediment density [kg/m3]                                  : 2650
Bulk density of sand bed[0 to 20%]                        : 1600
Percentage of mud in bed (range of 0 to 20%)              : 0
Percentage of offshore swell waves (H>1m, T>10s)[0 to 40%]: 10
Positive Tidal current vel. (50% of time)[m/s]            : 0.05
Negative Tidal current vel. (50% of time)[m/s]            : -0.1
Calibration factor[(default=1)]                           : 1
OFF Shore Wave Height Depth(m)                            :  30
Wave Data Records                                         :  8760

Profile Location Number:  1
Slope surf zone (slope from waterline to depth)tanB    : 0.02
Shore Normal angle to North (deg)                      : 115
Sediment Size (D50) (m)                                : 0.00023
Longitude\Latitude(UTM)                                : 219118.3 \\ 3241600
Mean Wave Height at Breaking Line(m)                   : .187
Mean Wave Lenght at Breaking Line(m)                   : 3.337
Mean Wave Angle at Breaking Line(deg)                  : 6.606
Mean Negarive Longshore Current[Deriven by wave] (cm/s): -16.4
Mean Postive  Longshore Current[Deriven by wave] (cm/s):  21.2

   Annual Longshore Sediment Transport Rate(in m3 per year)from Different Techn.

                                        Gross          Net                From
                                      Transport     Transport      V-North        V-South
                                        (m3)          (m3)          (m3)            (m3)
-------------------------------------------------------------------------------------------------
   Kamphuis Original 1991   =           5317          4841          -238          5079
   Kamphuis modified 2013   =           2788          2538          -126          2663
   CERC Method              =           44441         41067         -1687         42754
   Van Rijn 2014            =           8681          7806          -438          8243
```

Figure 12.A snap shot Screen for Simulation output.

User select ***Display Sediment Parameters check box*** this option allow user to View Graphical simulation results as shown in Figure 13.
Figure 13 allow user to select type output to view it graphical as follows:

1- To Graph simulated Parameter user must select from Droplist as follows:
- Selected Profile No[model have 1 To 5 profiles]
- Select Time Limits [User can view Annual or Monthly]
- Select Parameters as:
  - A-Wave height at Break Line as in Figures 14 and 15
  - b- Wave length at Break Line
  - c- Wave angle at Break Line
  - d- Wave-Driven LongShore Current   as in Figures 16 and 17

2- user can Save Any Image by selected [ ]

3- By [ ] to displat most of Simulated parameters as shown Figure 18

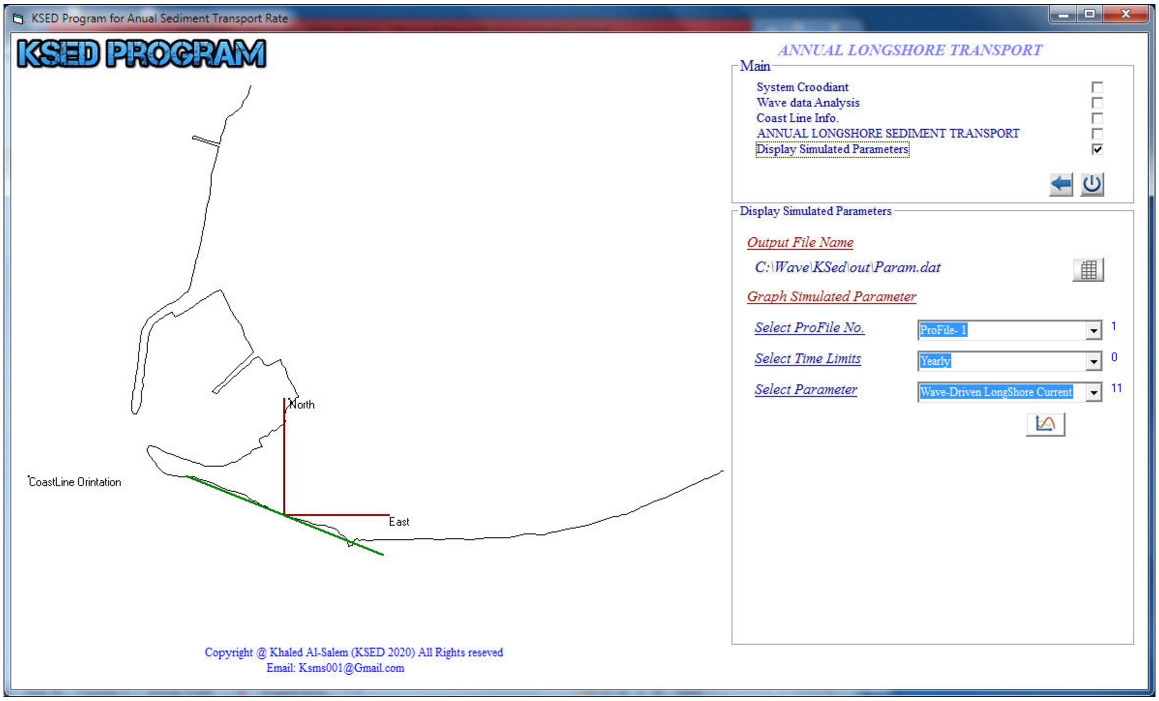


Figure 13.A Display Sediment Parameters Screen

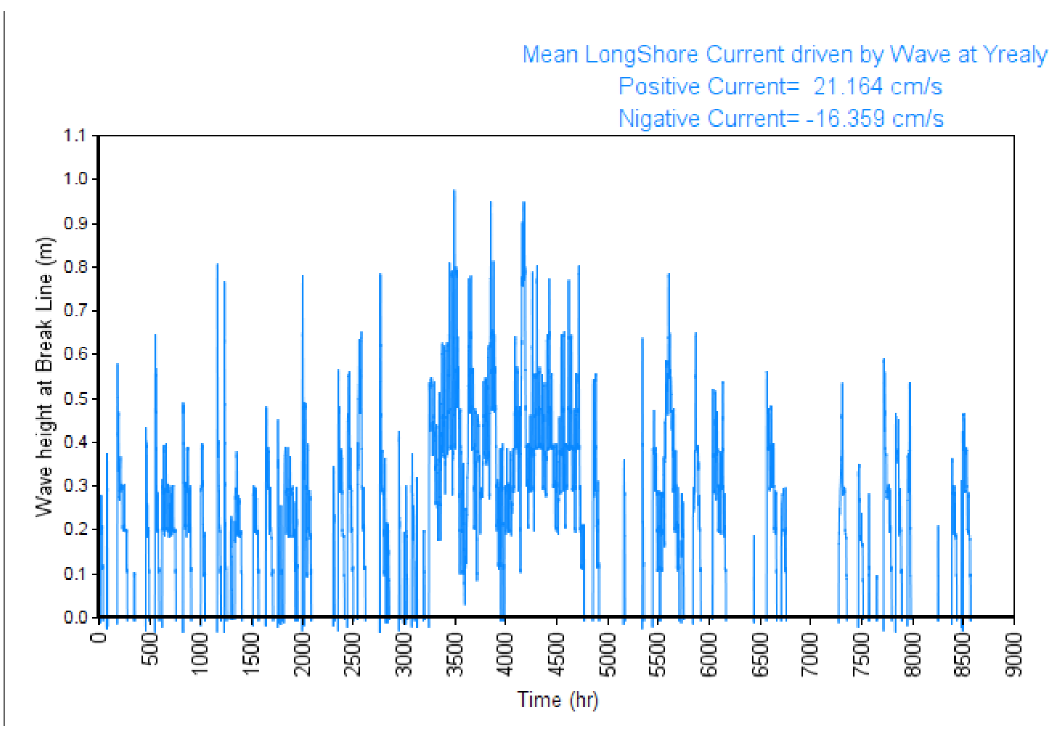


Figure 14.A Wave height at Break Line Annual

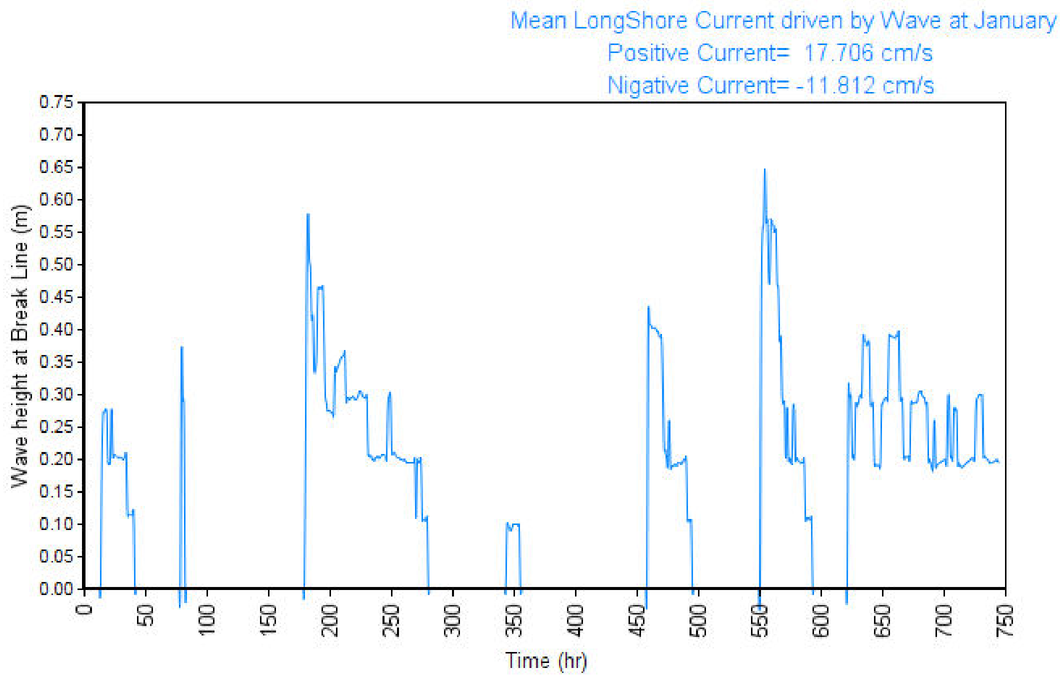


Figure 15.A Wave height at Break Line month of January

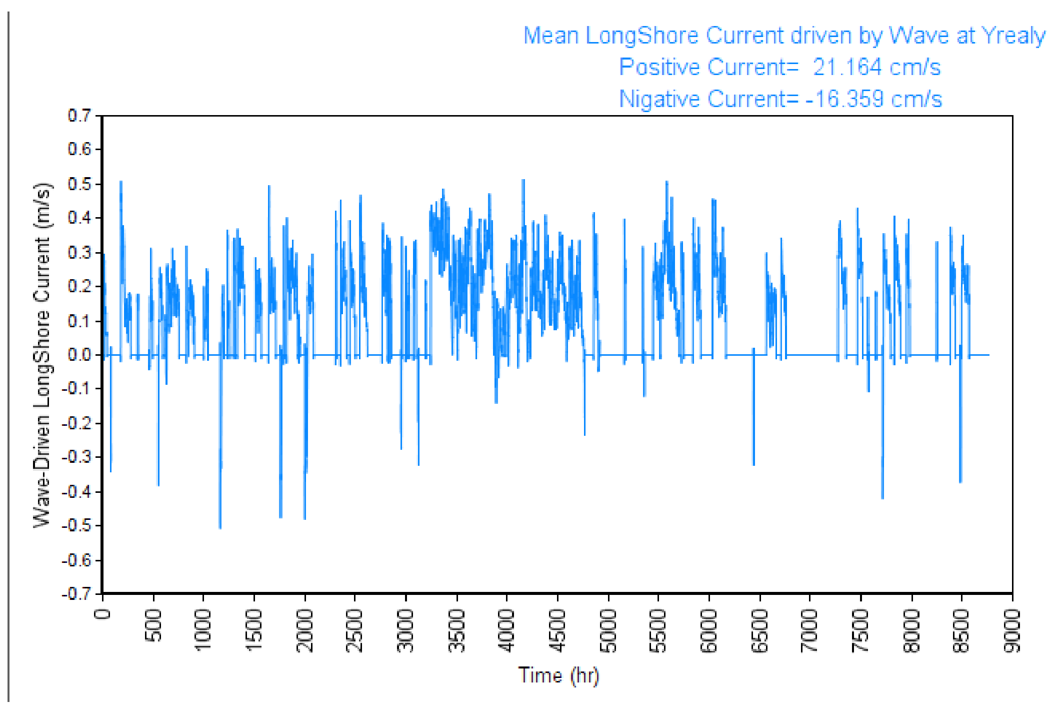


Figure 16. Wave-Driven LongShore Current Annual.

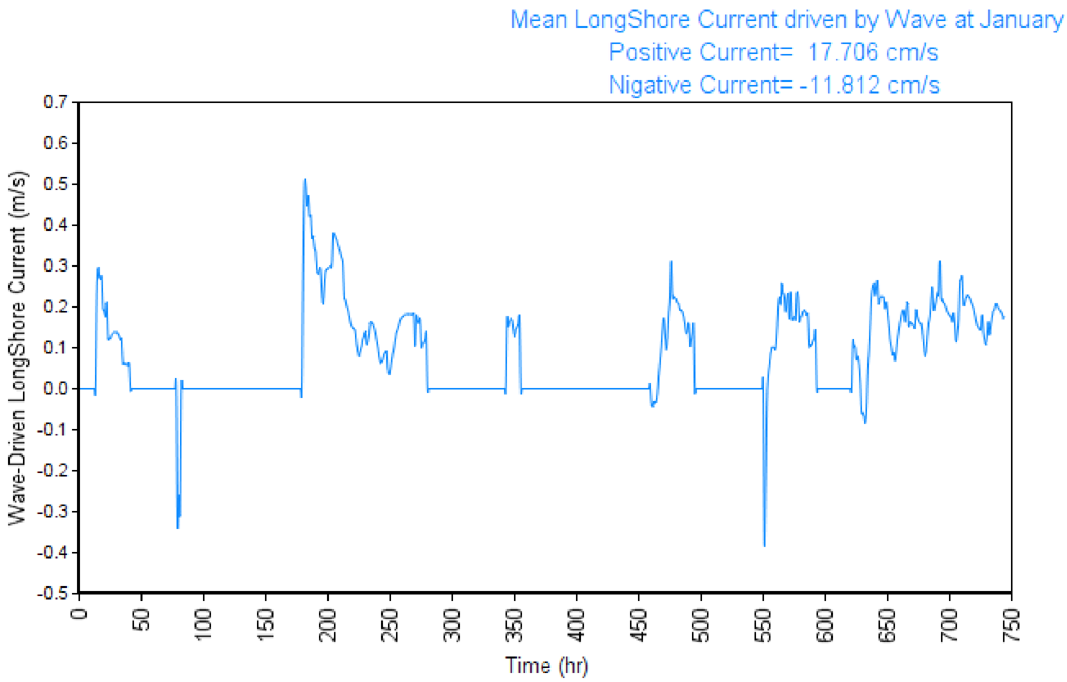
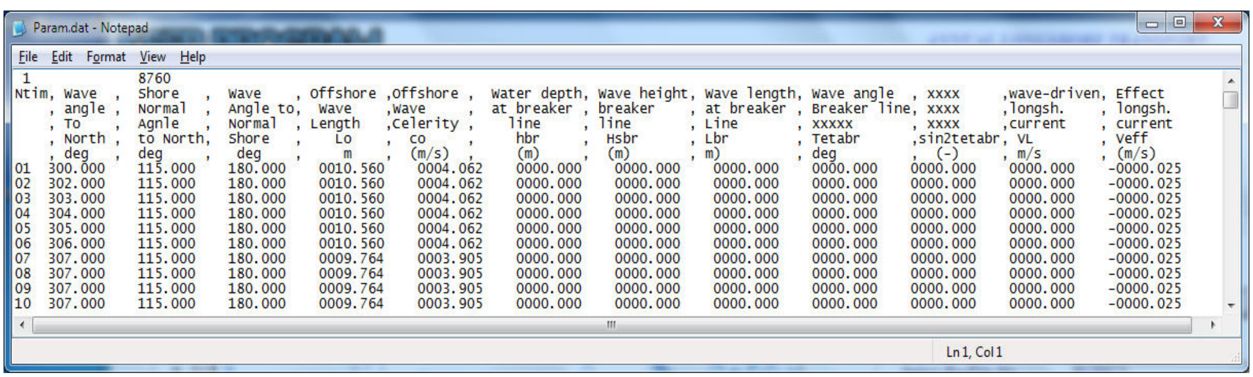


Figure 17. Wave-Driven LongShore Current month of January.



Param.dat - Notepad

File Edit Format View Help

1		8760										
Ntim,	Wave , angle , To , North , deg ,	Shore , Normal , Agnle , to North, deg ,	Wave , Angle to, Normal , Shore , deg ,	Offshore , Wave , Length , Lo , m ,	,Offshore , ,Wave , ,Celerity , co , (m/s) ,	Water depth, at breaker , line , hbr , (m) ,	Wave height, breaker , line , Hsbr , (m) ,	Wave length, at breaker , Line , Lbr , m) ,	Wave angle , Breaker line, xxxxx , Tetabr , deg ,	xxxx , xxxx , xxxx ,sin2tetabr, (-) ,	,wave-driven, ,longsh. , ,current , VL , m/s ,	Effect longsh. current Veff (m/s)
01	300.000	115.000	180.000	0010.560	0004.062	0000.000	0000.000	0000.000	0000.000	0000.000	0000.000	-0000.025
02	302.000	115.000	180.000	0010.560	0004.062	0000.000	0000.000	0000.000	0000.000	0000.000	0000.000	-0000.025
03	303.000	115.000	180.000	0010.560	0004.062	0000.000	0000.000	0000.000	0000.000	0000.000	0000.000	-0000.025
04	304.000	115.000	180.000	0010.560	0004.062	0000.000	0000.000	0000.000	0000.000	0000.000	0000.000	-0000.025
05	305.000	115.000	180.000	0010.560	0004.062	0000.000	0000.000	0000.000	0000.000	0000.000	0000.000	-0000.025
06	306.000	115.000	180.000	0010.560	0004.062	0000.000	0000.000	0000.000	0000.000	0000.000	0000.000	-0000.025
07	307.000	115.000	180.000	0009.764	0003.905	0000.000	0000.000	0000.000	0000.000	0000.000	0000.000	-0000.025
08	307.000	115.000	180.000	0009.764	0003.905	0000.000	0000.000	0000.000	0000.000	0000.000	0000.000	-0000.025
09	307.000	115.000	180.000	0009.764	0003.905	0000.000	0000.000	0000.000	0000.000	0000.000	0000.000	-0000.025
10	307.000	115.000	180.000	0009.764	0003.905	0000.000	0000.000	0000.000	0000.000	0000.000	0000.000	-0000.025

Ln 1, Col 1

Figure 18.A snap shot Screen for Simulation output Parameters.

Section 2. Option for Interactive Longshore Sediment analysis and Current

User select a check box [***Interactive Simulation***] at System Coordinate Box in Figure 2. Figure 19 will display for to start new project.

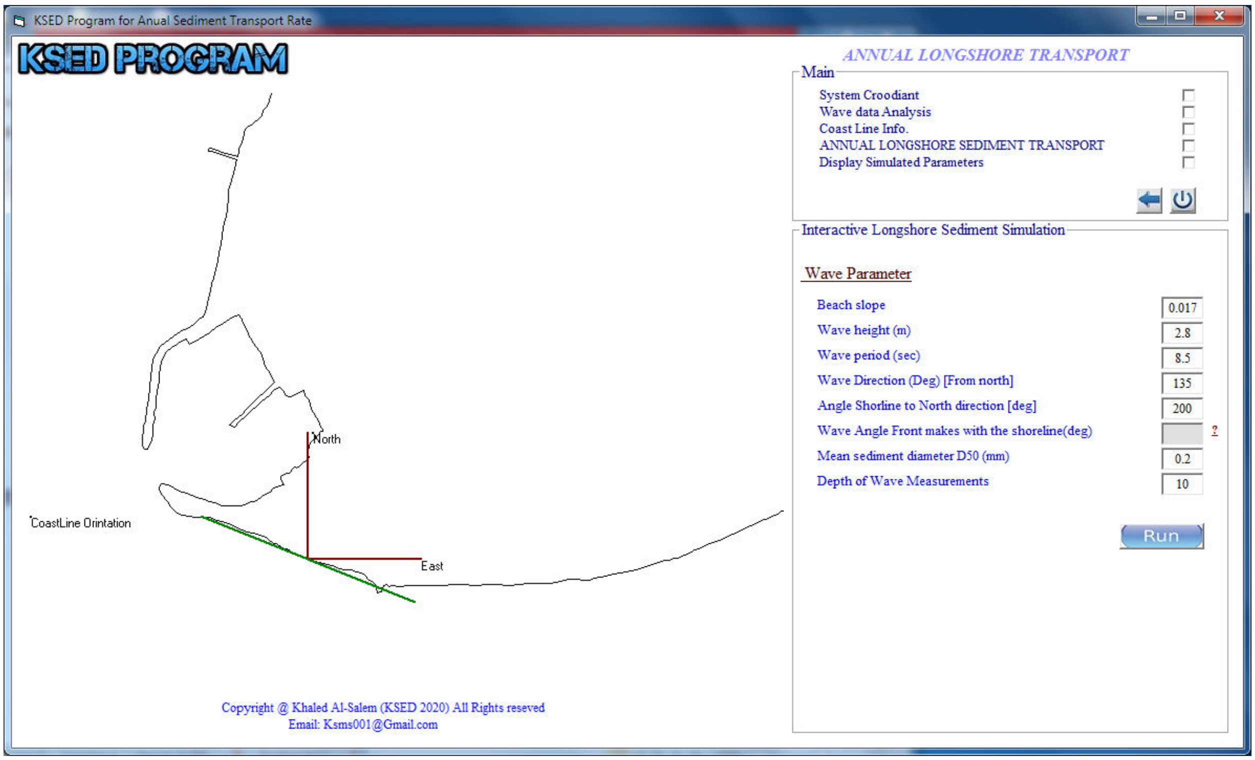


Figure 19. Main Screen for Interactive simulation option

To start simulate user must input the following Parameters require by model as follows:

1- Profile slop
2. 2-Offshore Wave height [Significant wave height Hs] in meters
2- Wave Period in meter
3- Wave direction From North [deg]
4- Angle of Shore line From North [deg] can be found from Figure 3 section 1.
3. 6-Mean Sediment diameter D_{50} (mm)
4. 7-Depth of Offshore wave height data.

Then user must select [Run] to run model. Figure 20 will display for user to view output screen and Plot parameters options.

Then two Button will display as in Figure 20 for user to follow:
1- To display Longshore Current predicted and Total long sediment transport from two formula [Watanabe Formula and Engelund-Hansen formula] user select [ ] as shown in Figure 21

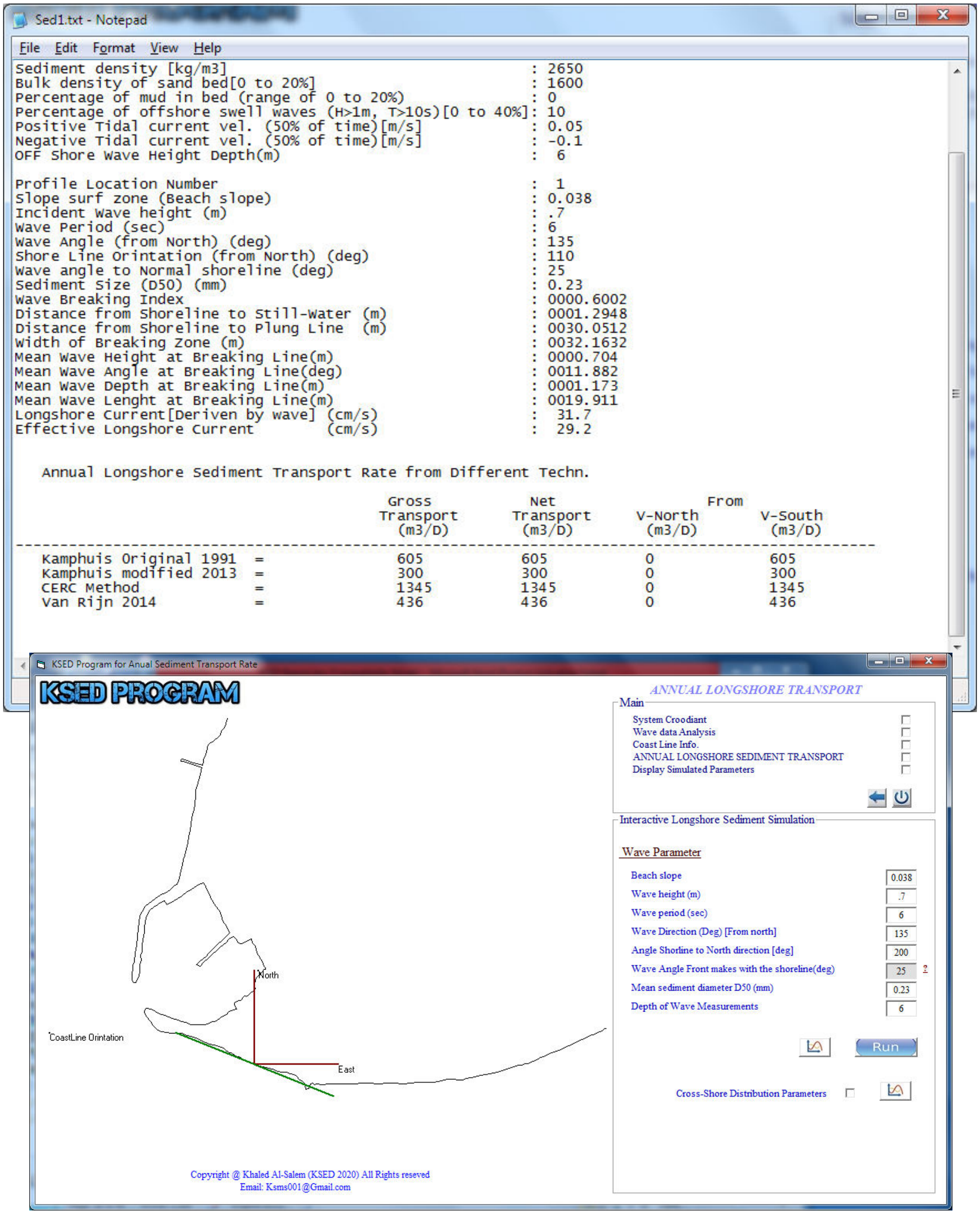


Figure 20.A snap shot Screen for Simulation output Parameters and Plot options.

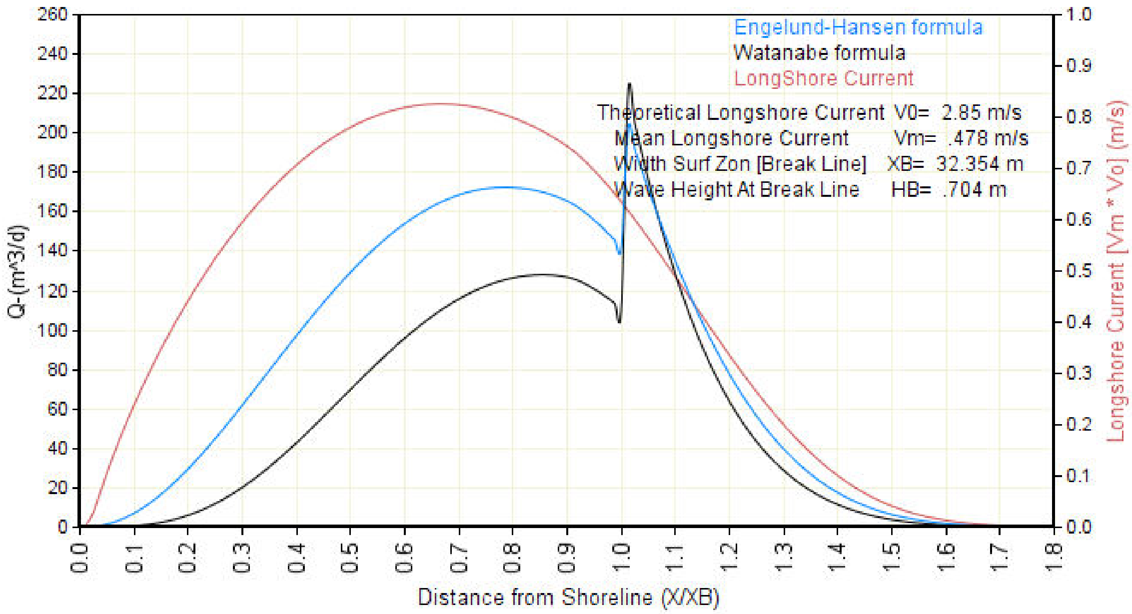


Figure 21. Longshore current and sediment transport distribution from shoreline to Wave Breakline.

2- To View Other simulated parameters user check box [***Cross-Shore Distribution Paramter***] as shown in Figure 20. Figure 22 will display for user.
User must check any parameter to plot. Only Shore line user must load shore line data by select [] to select file name. Shoreline data must in format as shown in Figure 23
Figure 24 display Supper Imposed all Parameter plot Options after selected from Figure 22.

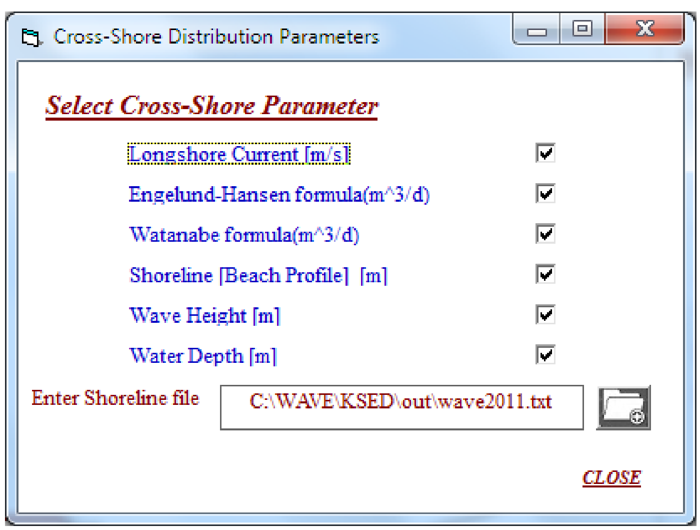


Figure 22. Parameter plot Options.

Shoreline Data file

```
102    No of Data
0      1
10     -0.2
19     -0.5
29     -0.6
40     -0.6
49     -0.7
59     -0.7
70     -0.7
80     -0.8
89     -0.8
100    -0.8
110    -0.8
119    -0.8
130    -0.8
140    -0.8
149    -0.8
159    -0.8
170    -0.8
179    -0.8
189    -0.8
200    -0.8
210    -0.8
219    -0.8
230    -0.8
240    -0.8
249    -0.8
X      Y
```

Figure 23. Sample of Formatted shoreline data file

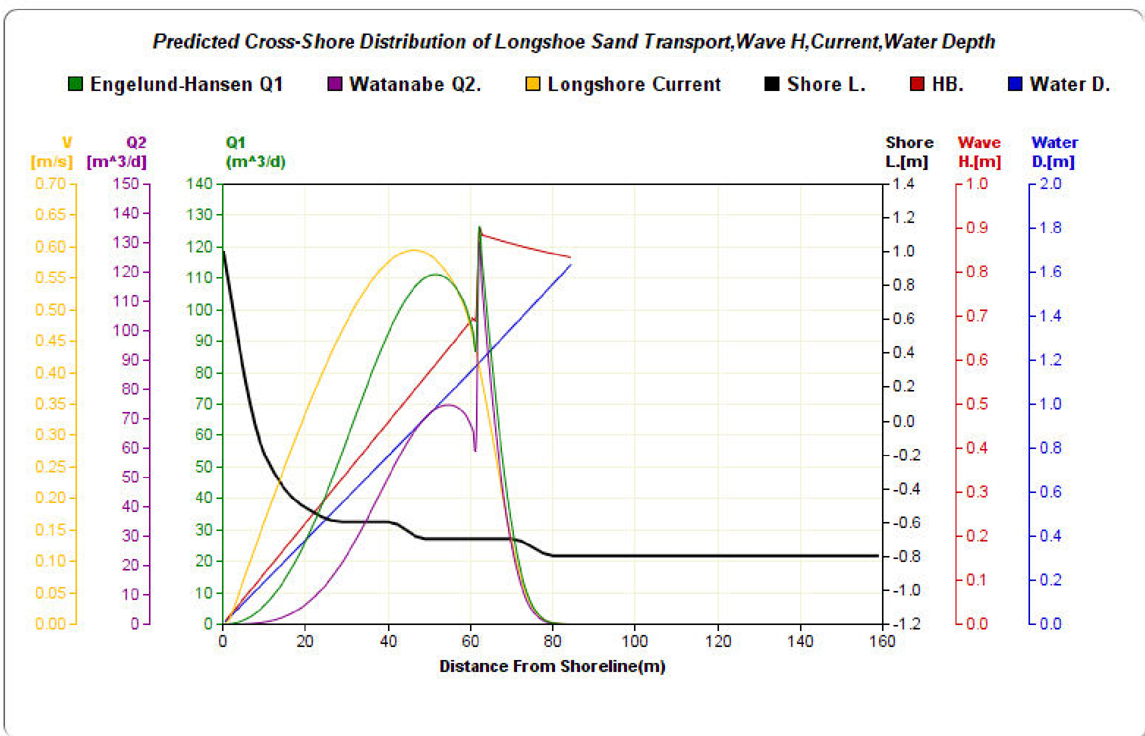


Figure 24. Supper Imposed all Parameter plot Options

KSED Model Demonstration

Internet Version

Website: WWW.hceatkuwait.net\Web_pas\KSED\KSed.aspx

User must login to website address at: WWW.hceatkuwait.net\Web_pas\KSED\KSed.aspx
Then Figure 1 will display the main KSED website page on internet as follows:

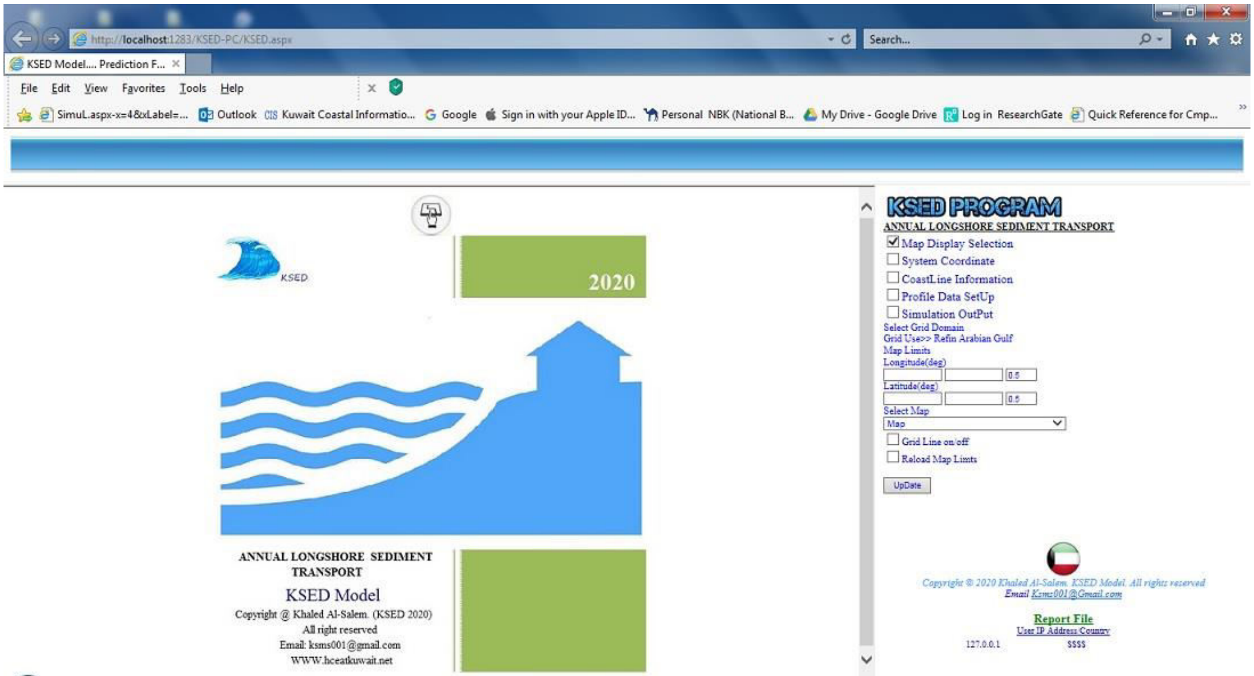


Figure 1. KSED model Website main Page.

MAP Display Selection

User should display the Arabian Gulf/Kuwait Coast map by select [Map Display Selection Check box] from Figure 1 then a number of option will display as:

1. Selection of Different coast map of Arabian Gulf Water from [**DropBox**]
2. Check for Display X/Y axis grid line as check box[**Check On/ Uncheck OFF**]
3. If user want to reload the previous map select check on the Chekbox for [**Reload Map**]

Then from Figure 1 user must select { **UPDATE** }Button to Load and store data the selection Then new button for Display the map will show as [**MAP SHOW**] as shown in Figure 2

System Coordinate Information

User from Figure 1 check on [**System coordinate CheckBox**] Figure 3 will display for user to set The coastal line information as follows

1. Coastline Reference Coordinate
2. Origin Coordinate
3. Coastline System Orientation

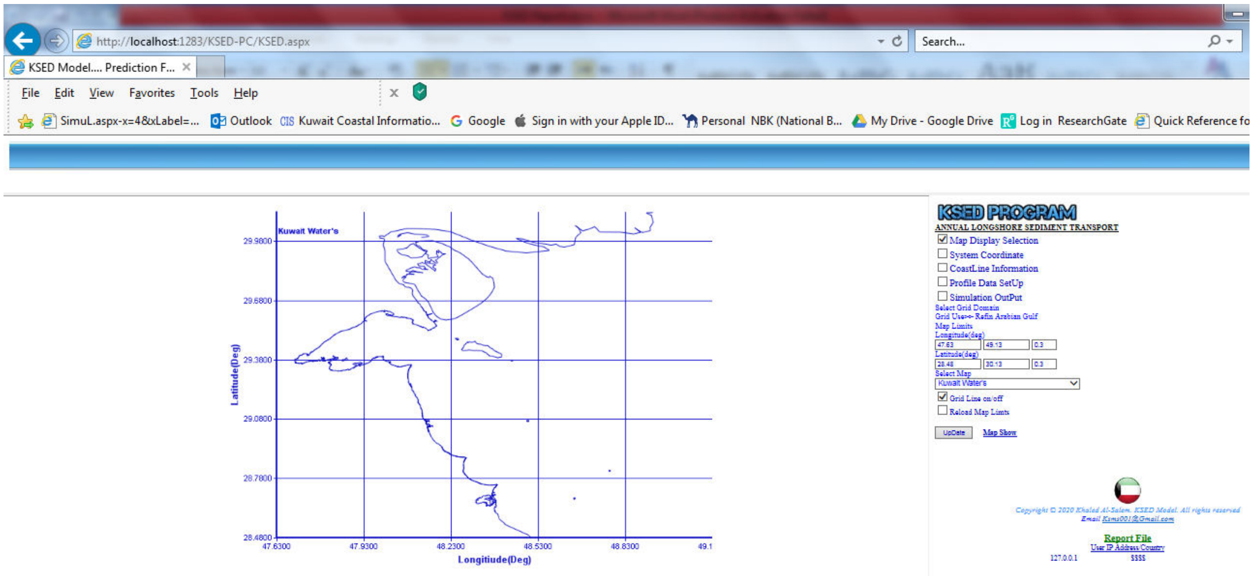


Figure 2. Map Display

In this setup user should select the coastline parameters data as follows

- The Upper/Lower corner data are the coastline reference map
- Origin coordinate is points close to coastline were to calculation the Azmith Angle as shows in Figure 3.
- Enter the [**Coastline Angle From North**] is the angle axis of shoreline orientation from TURE North as discussed and display in Figure 3.Figure 4 display how to calculate the Azmith angle for north.
- Enter the [**Axis-L**:] is the axis shoreline length (just for display on map for user)
- Shoreline Data should be entered as formatted data(x,y) in meters. To display a sample discussed data user select [ ] info button Figure 4 will display to data format.
- Coastline data can be upload as file to the system But for security this option can be done only by Operator [ksms001@gmail.com]. Send data to upload for user work.

User can display the coastline and the orientation of the axis by select [Coastline] as shown in Figure 5. Also user can update the coastline data select [ ].

Last option in this section is to assign the entered data to select profile location. A profile location is a location at coastline where the beach profile will collect to find the BEACH SLOPE angle. In KSED model can be assign up to 5 profiles location. From [**Setup Profile** **]** a droplist of 5 profile to select as shown in Figure 3. But user can Manually enter profile data will be discussed next sections.

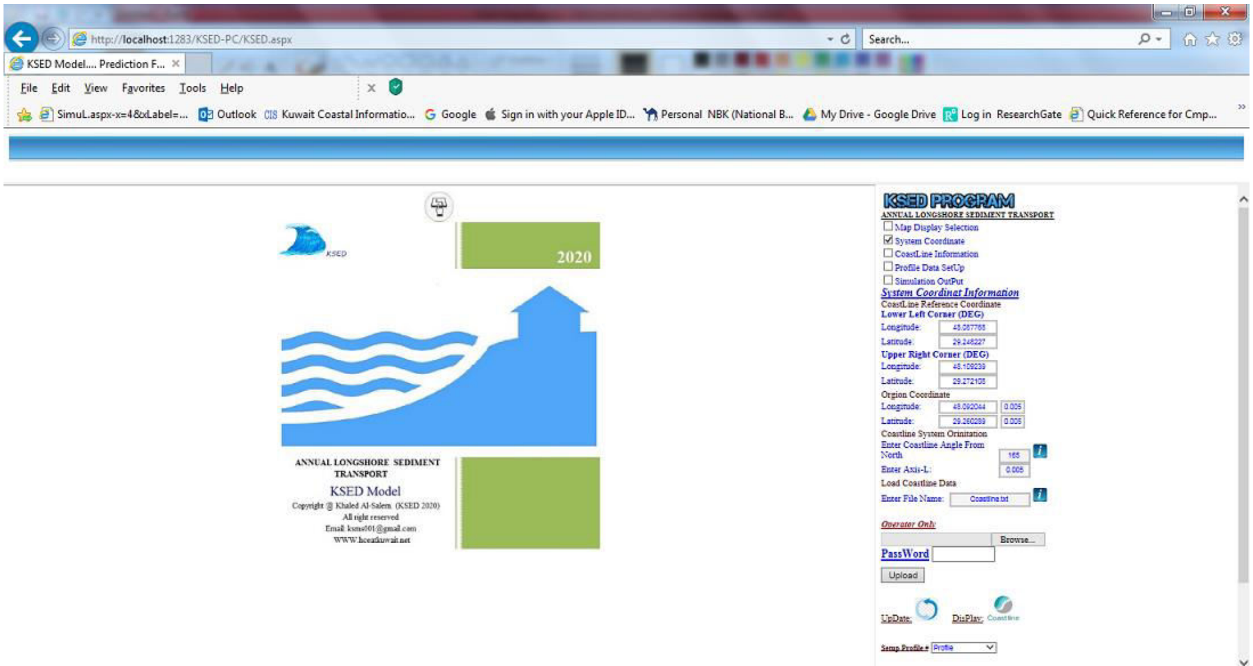


Figure 3. System Coordinate Information for Selected Coastline

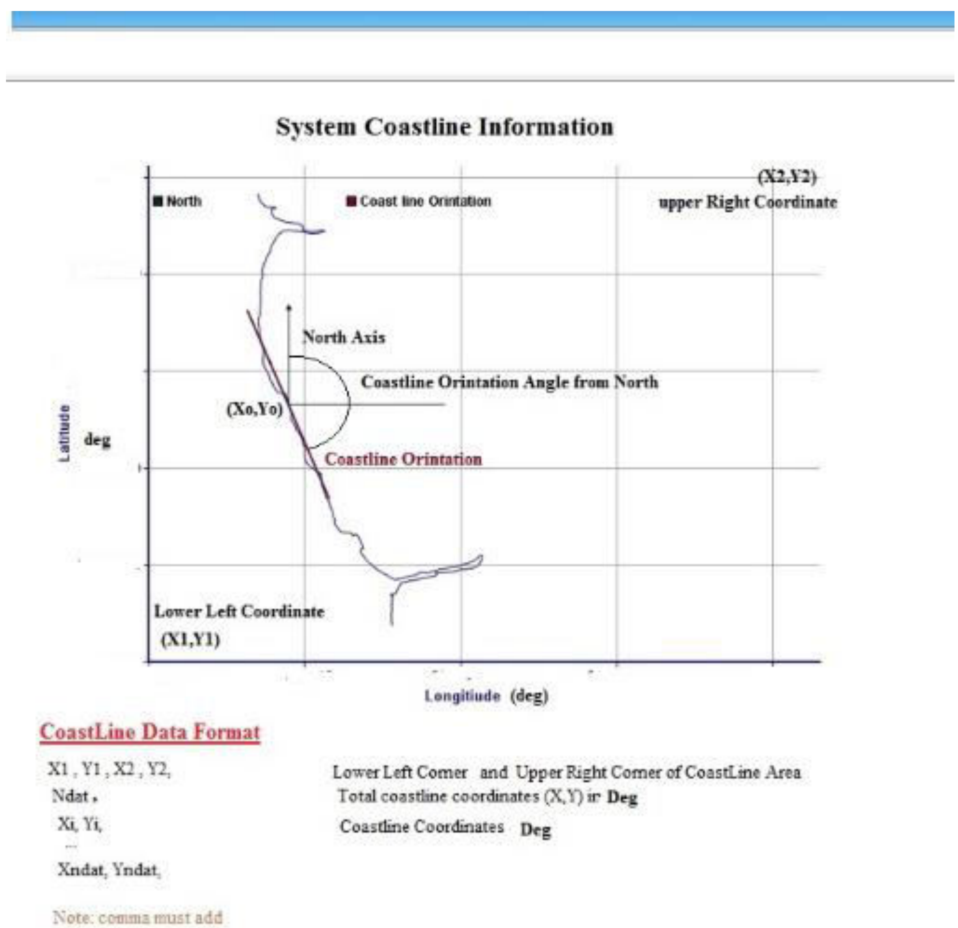


Figure 4

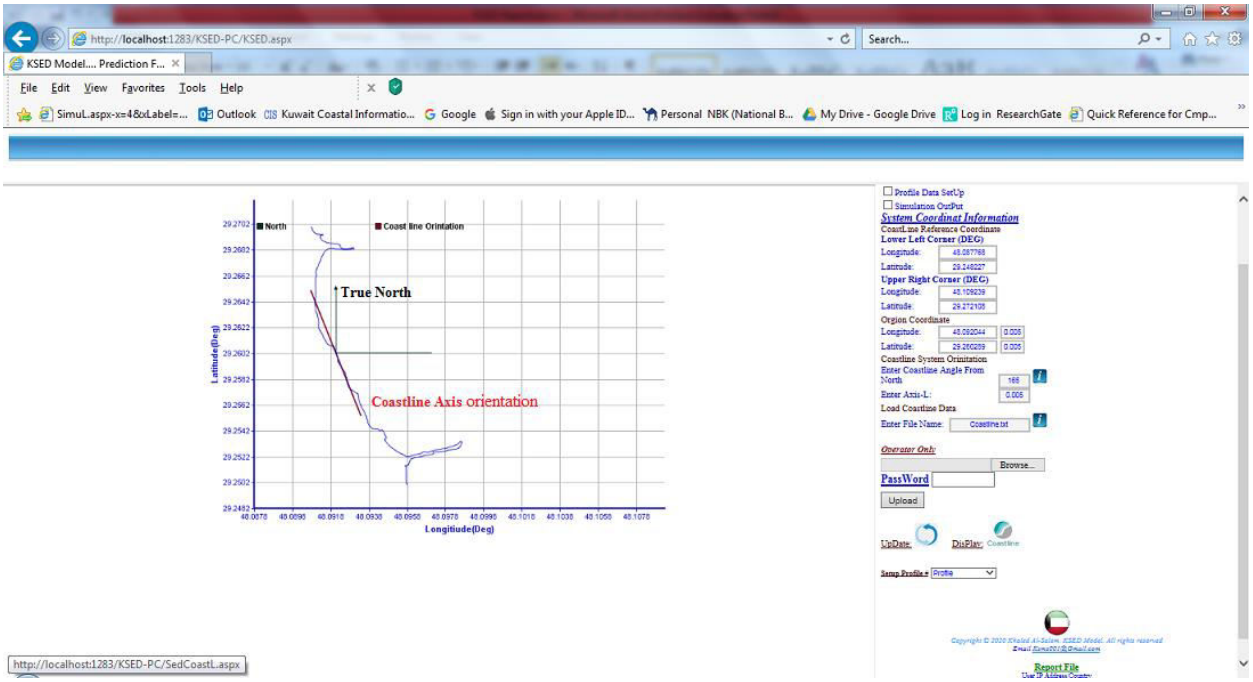


Figure 5. Coastline Axis Orientation Display

Coast Line Information

From Figure 3 user should check on [**Coast Line Information**] Check box to display the selected coastal parameters for sediment and Longshore currents as shown in Figure 6 for the following:

- Sediment Density.
- Bulk density of sand bed.
- Percentage of mud in bed (range of 0 to 20%).
- Percentage of offshore swell waves (H>1m, T>10s).
- Positive Tidal current vel. (50% of time).
- Negative Tidal current vel. (50% of time).
  (Tidal velocities are only applied in method Van Rijn)

Then user must save the data. The system will load the file in simulation later.

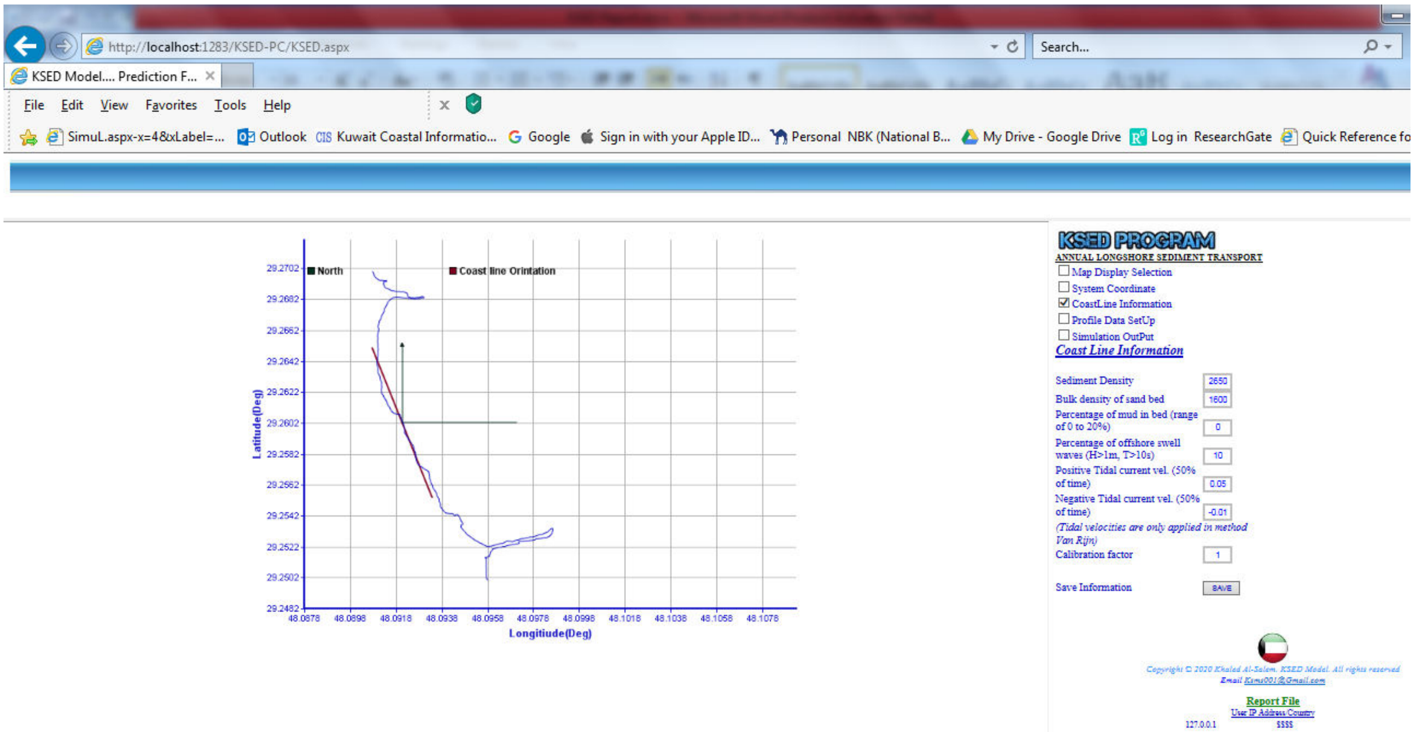


Figure 6

LONGSHORE SEDIMENT TRANSPORT

From Figure 6 user must check [**LongShore Sediment Transport**] checkbox Figure 7 will display for user to continue setup calculation sediment transport process.
In this section user must enter profile data and number of profiles to be simulated or can be reload from previous run as follow:

- User should enter Number of Profile location to be simulated
- From Droplist user select a profile parameter to be open to update data as shown in Figure 8
  Data each profile selected as:
  Profile 1
  1. Slope surf zone (slope from waterline to depth)tanB
  2. Shore Normal angle to North (deg)
  3. Sediment Size (D50) (m
  4. Offshore wave water Depth (Ho) (m

  Profile Location
  - Longitude
  - Latitude:

To find the profile slop angle for selected beach location slope of the surf zone is by select option [] . From Figure 9 user calculated the slope of the surf zone of selected beach profile by the following:

1. User must enter data of the beach profile by:
    - Enter number of Point as [NO ,]
    - Enter X,Y point for beach profile as [NOx , NOy ,] in meter
    - Note: a **comma** must follows each number
2. Or user can copy and passed the data in the text area
3. User must select [] to calculate the Profile Slop in Degree and the best fit line equation display at Figure 9.
4. User must get the slop angle to select Profile no.

Or user can Reload data from Previous Run by select **[Reload previous profile data]**

When all data profile are entered user must select [**<u>Load Wave Index Data</u>** ] to load Wave height, period and direction data recorded for each profile location from the database of KSED model system and analysis the wave data for KSED model simulation.

To start simulation user must enter [ASSIGN PASSWORD] the select [

To display the result user must checkbox [**Simulation Output**] From Figure 8. Figure 10 will display for user a number of options to select as follows:

<u>OutPut Simulation Display</u>

1. <u>Display Report File</u> 
   To display simulation output file as shown in Figure 11

2. <u>Download Report File</u> 
   To download simulation output file

<u>Plot Simulation Display</u>

- <u>Calculation Methods</u> 

  Select a simulation method to plot Annual GROSS sediment transport and Net Annual sediments transport as Bar graph as shown in Figure 12
- <u>Display==>></u> 
  To display a select Plot as shown in Figure xxx

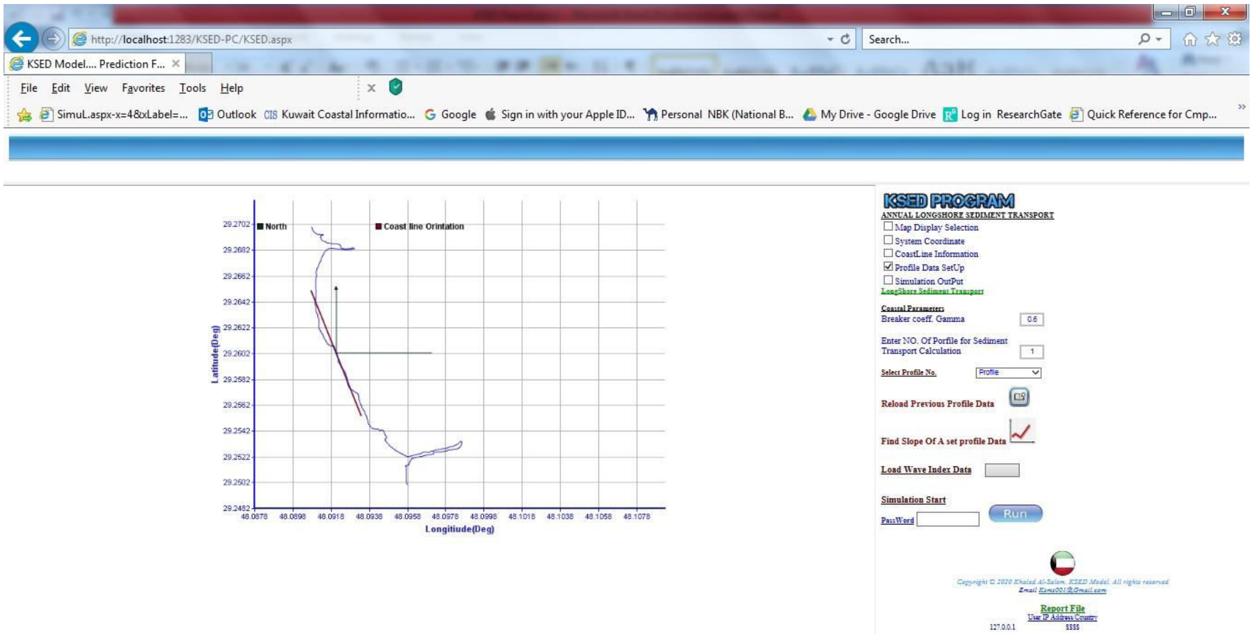


Figure 7

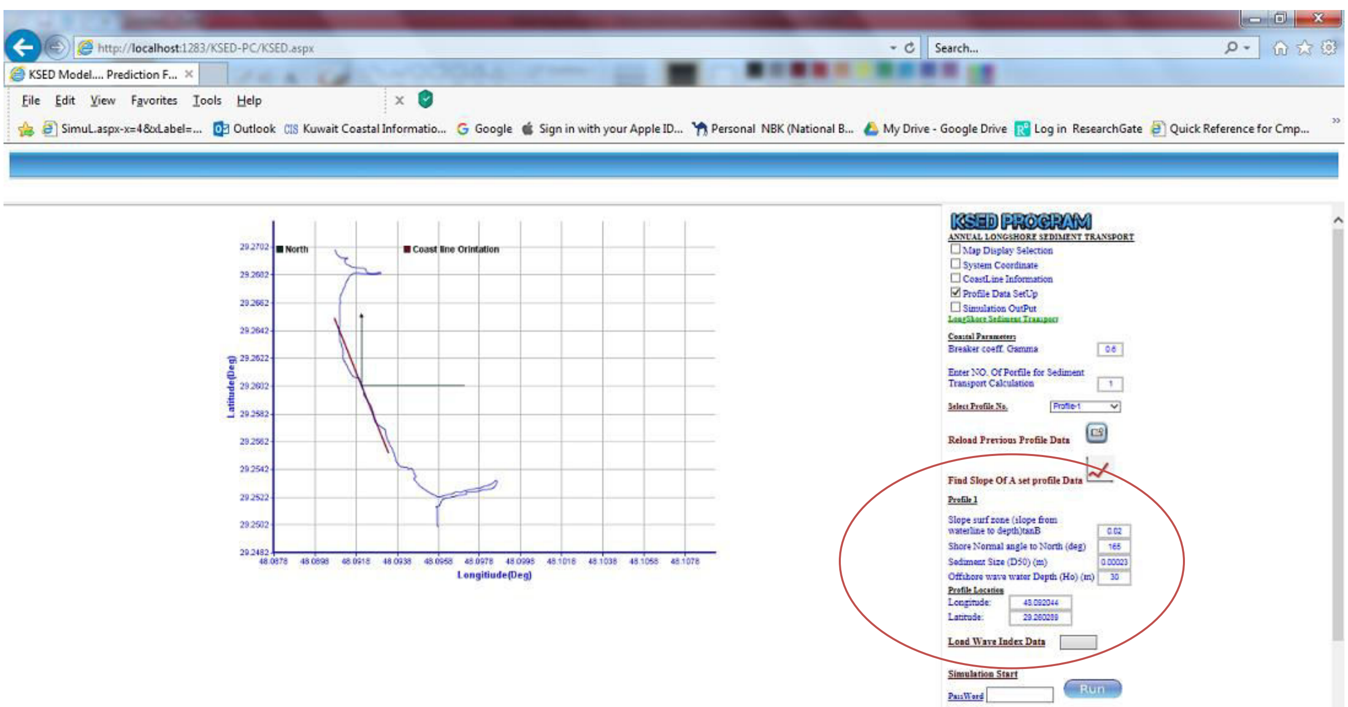


Figure 8

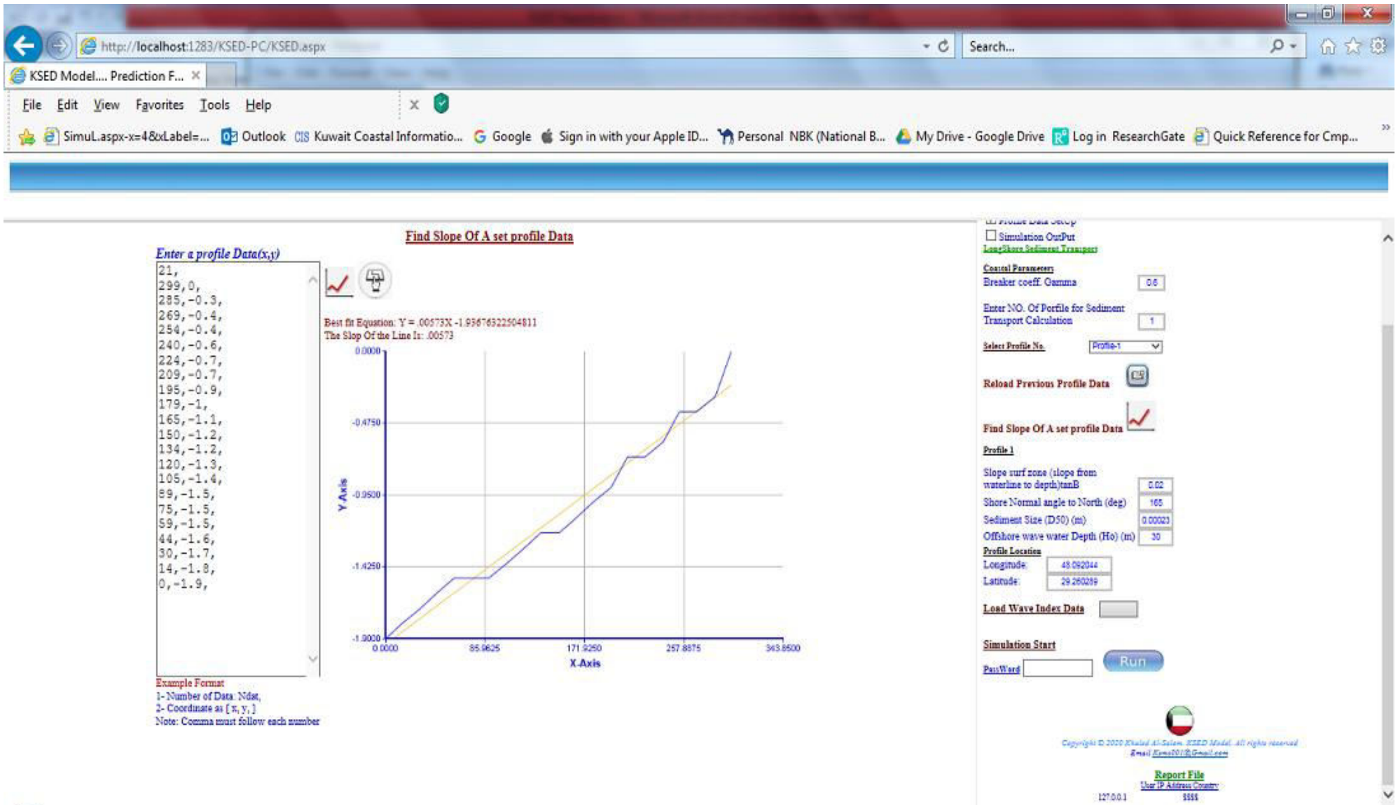


Figure 9

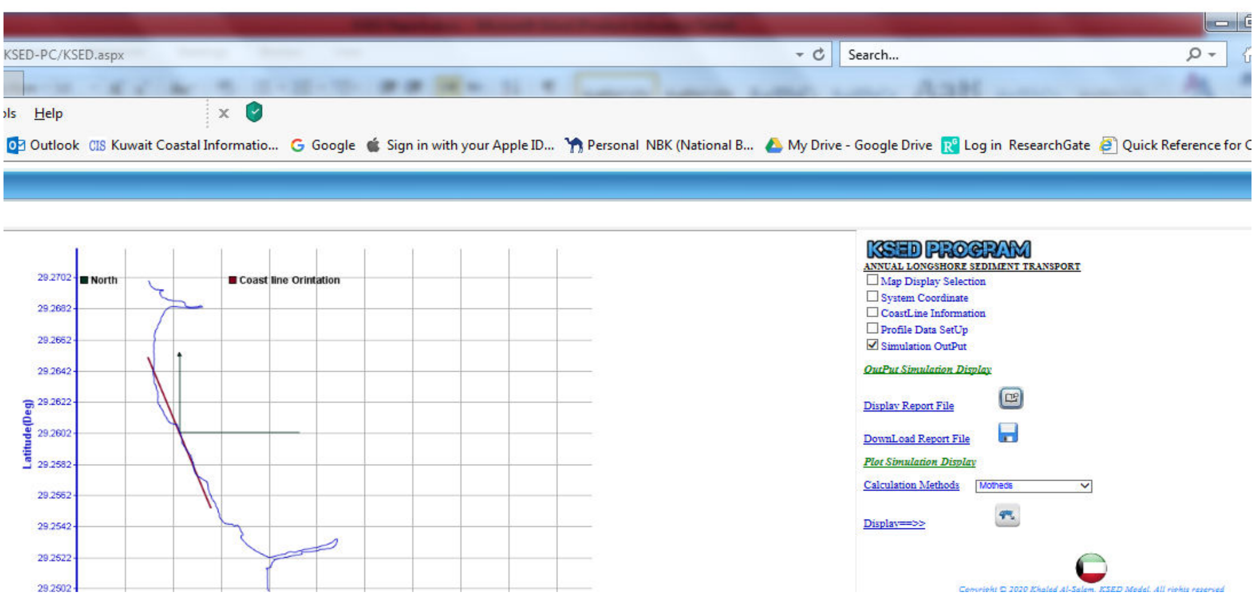


Figure 10

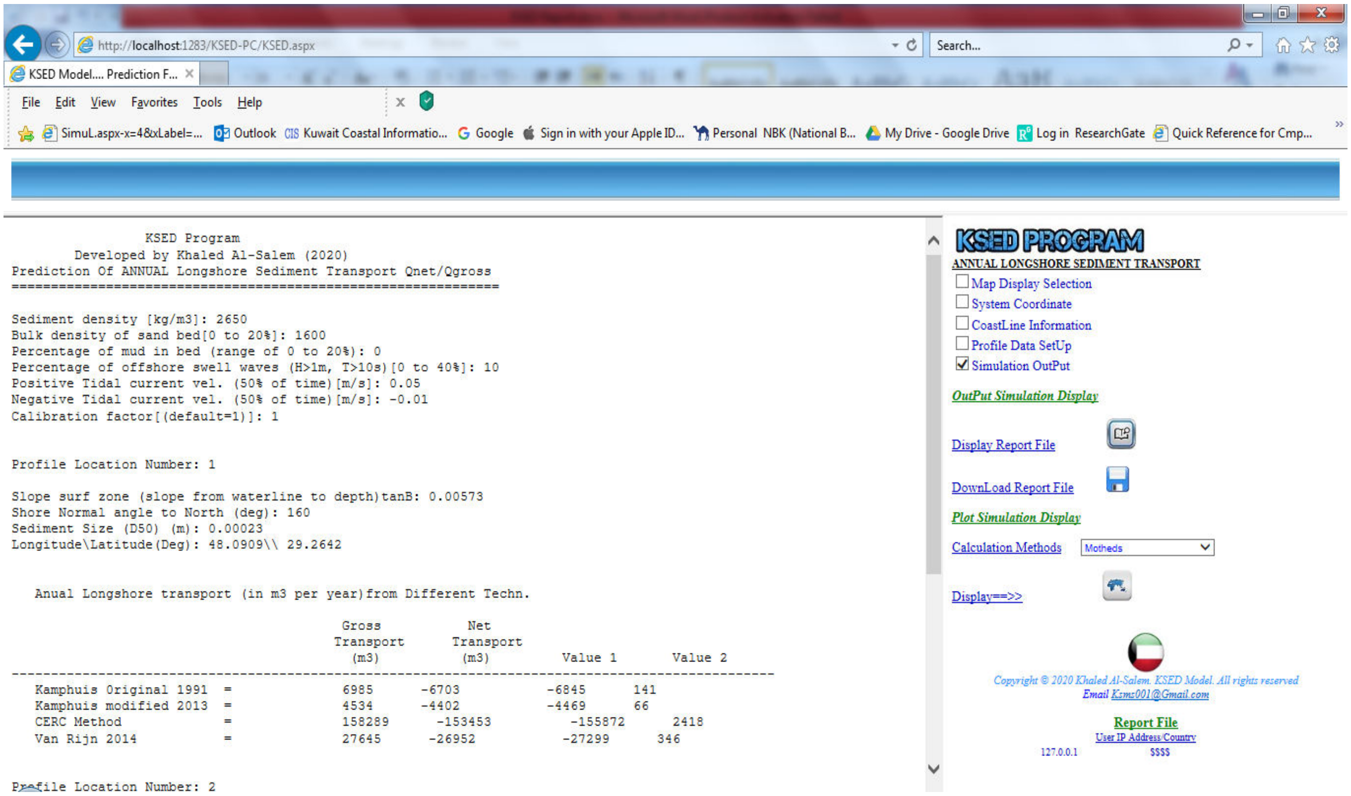


Figure 11

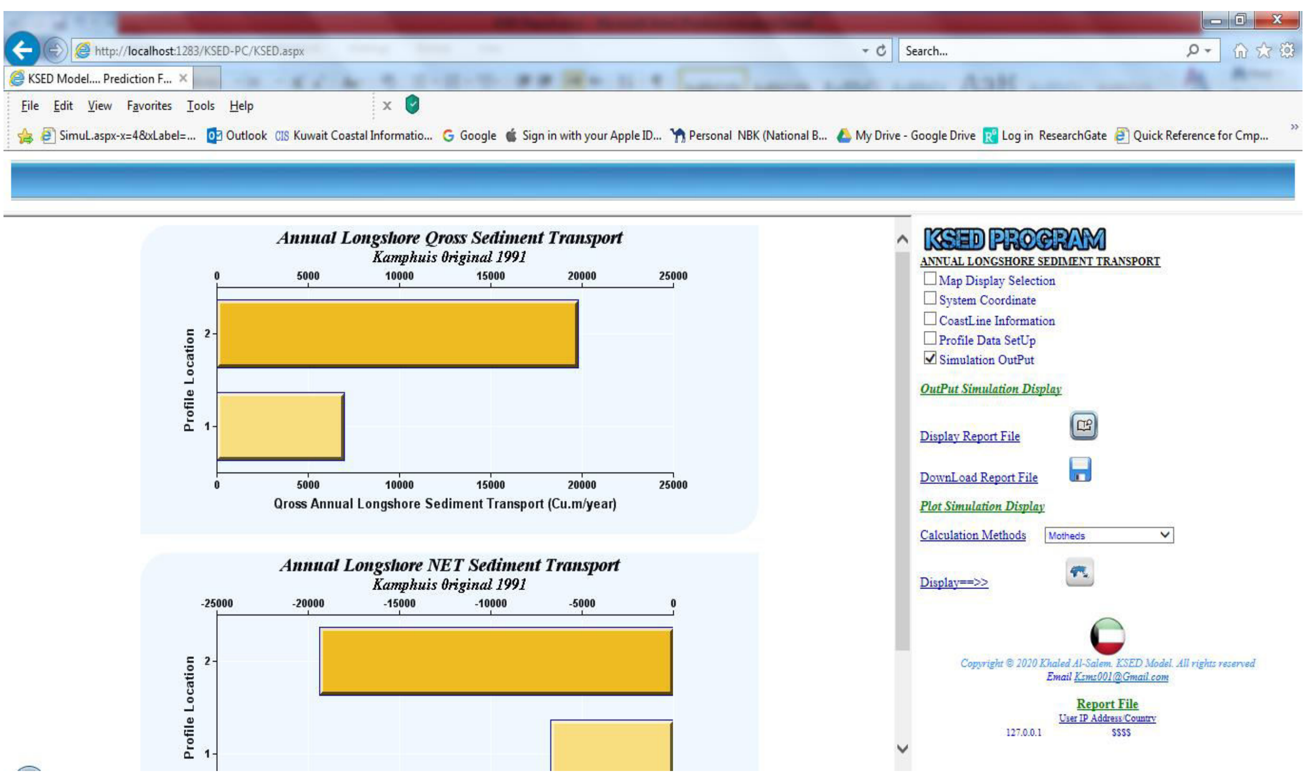


Figure 12

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