"Kwave model" for Wind-Wave Prediction for Kuwait Waters and Arabian Gulf
Based on
the New Relationship Technique

Developed By

Khaled Al-Salem

July 2005

<u>*User Interface For Prediction of Wave "Kwave Model"*</u>

Introduction.

A new Wind-Wave prediction technique is developed for hind-cast, now-cast and forecasting of wave height conditions over the Kuwaiti territorial water. It is an interactive, online model. The computer simulation time required for this new relationship technique for wave history prediction in very little. The present technique is validated is named as **Kwave model**. The results of this technique are compared with WAM model results and are found to be good.

Procedure for Stand-Alone Usage of "Kwave Model"

Kwave model is an interactive model and easy to use for any user with a little experience in a computer usage. Fig. 1 will display after user click on **Kwave Icon** this

figure shows that the model has two main option as option 1 is for Kuwait waters station and option 2 is for Arabian Gulf station and each option (1,2) has also two sub-main option as sub-main option 1 for interactive mode and sub-main option 2 for time series mode. Sub-main option 2 for time series mode has also two options, as shown in fig 2 for Random wind data file or for hind cast wind data from wind data bank (1993 to 2004).
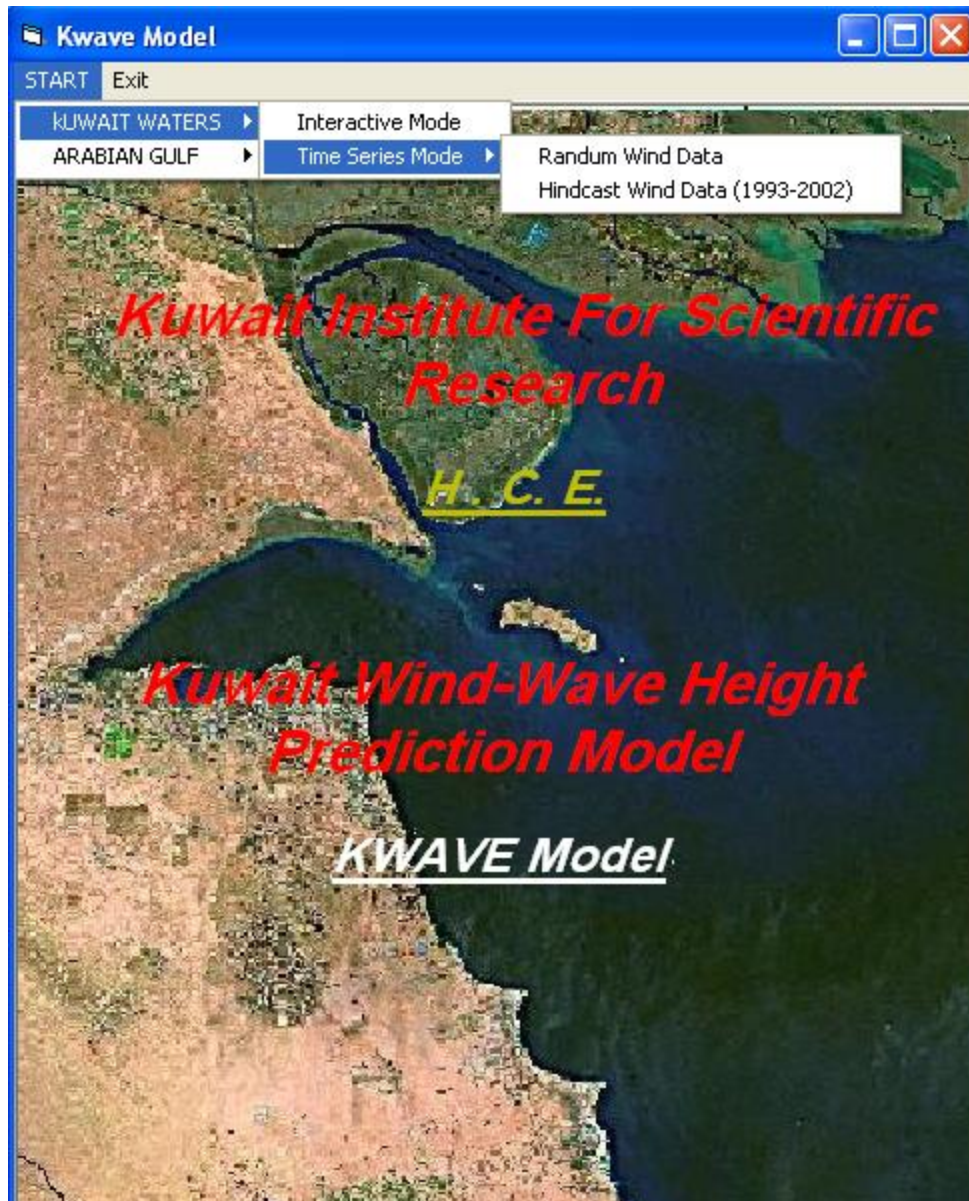

Fig. 2.

To start the kwave model, is to click on start option as shown in fig. 1 then two option mode will appear on fig. 1 for user to select as:

1. Option 1. for Kuwait waters locations.
2. Option 2. for Arabian gulf locations.

If user selected option 1 for **Kuwait water** then fig. 2 will be display. Fig. 2 display anther two option as follows:

1. Sub-Option 1 is for interactive mode as shown in fig. 3
2. Sub-Option 2 is for time series mode.

If user selected sub-option 1 in the **Interactive Mode**, fig. 3 will be display for user to enter the input data required as follows:
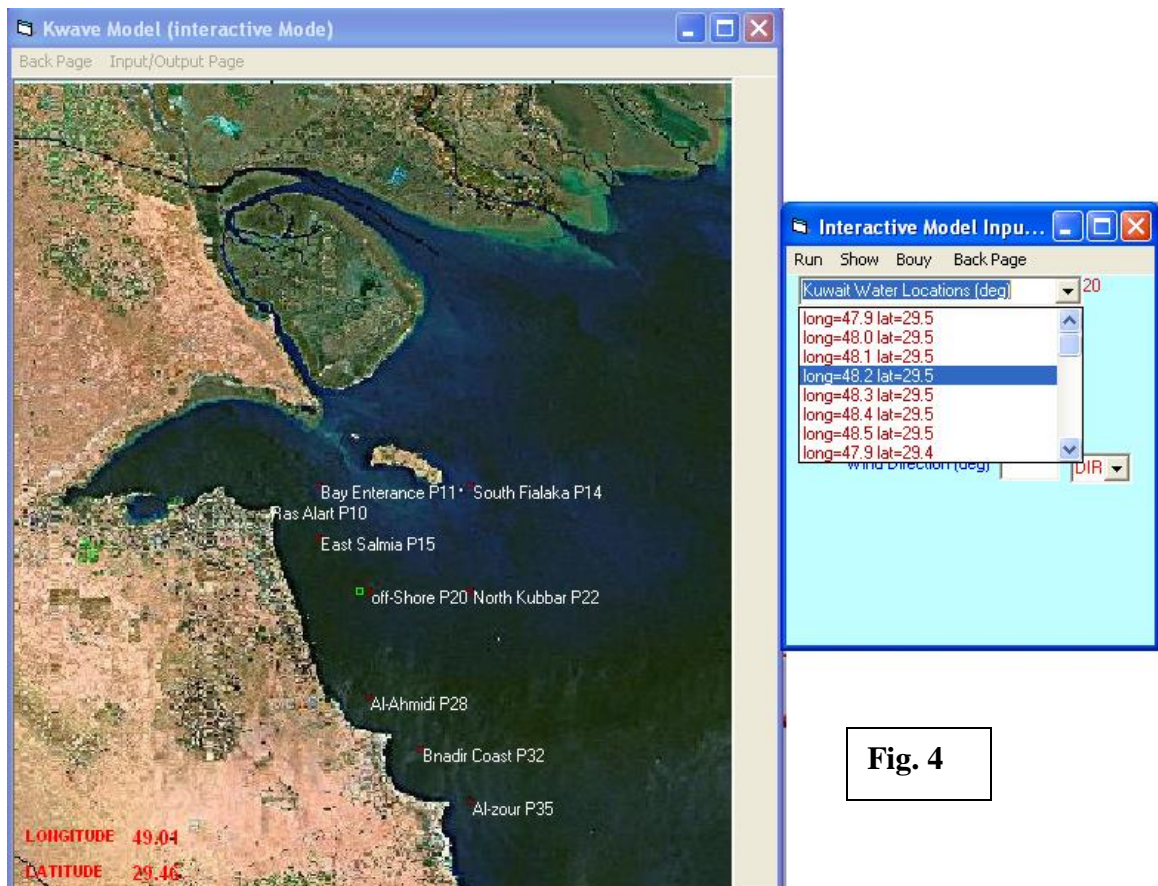
1- To enter the location where the wave condition to be predicted as

    a- Use the mouse to click on the map page then a check location page will display for user for location checking as shown in fig. 3.

    b- Use the drop down list on the input/output page to select the location as shown in fig. 4.

    c- Input the Longitude (deg) , latitude (deg) and low water depth in meter manually as shown in input/output page.

2- To enter wind data. User must enter wind speed (m/s) and wind direction (deg or use the drop down direction list).

3- Click On **RUN** to predict the wave condition at the selected location.

Fig. 5 shows prediction output result for wave condition as :-
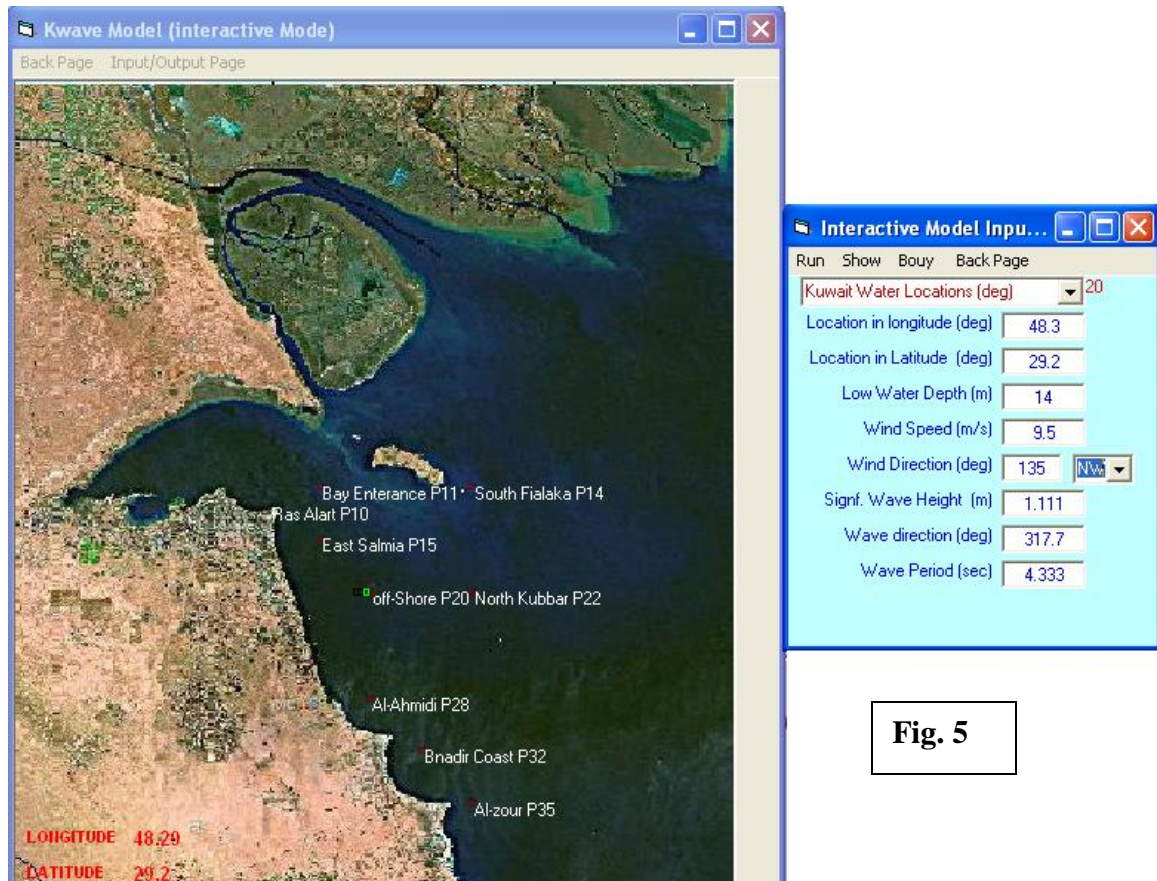
    - Wave Height (m)
    - Wave Direction (deg)
    - Wave Period (sec)
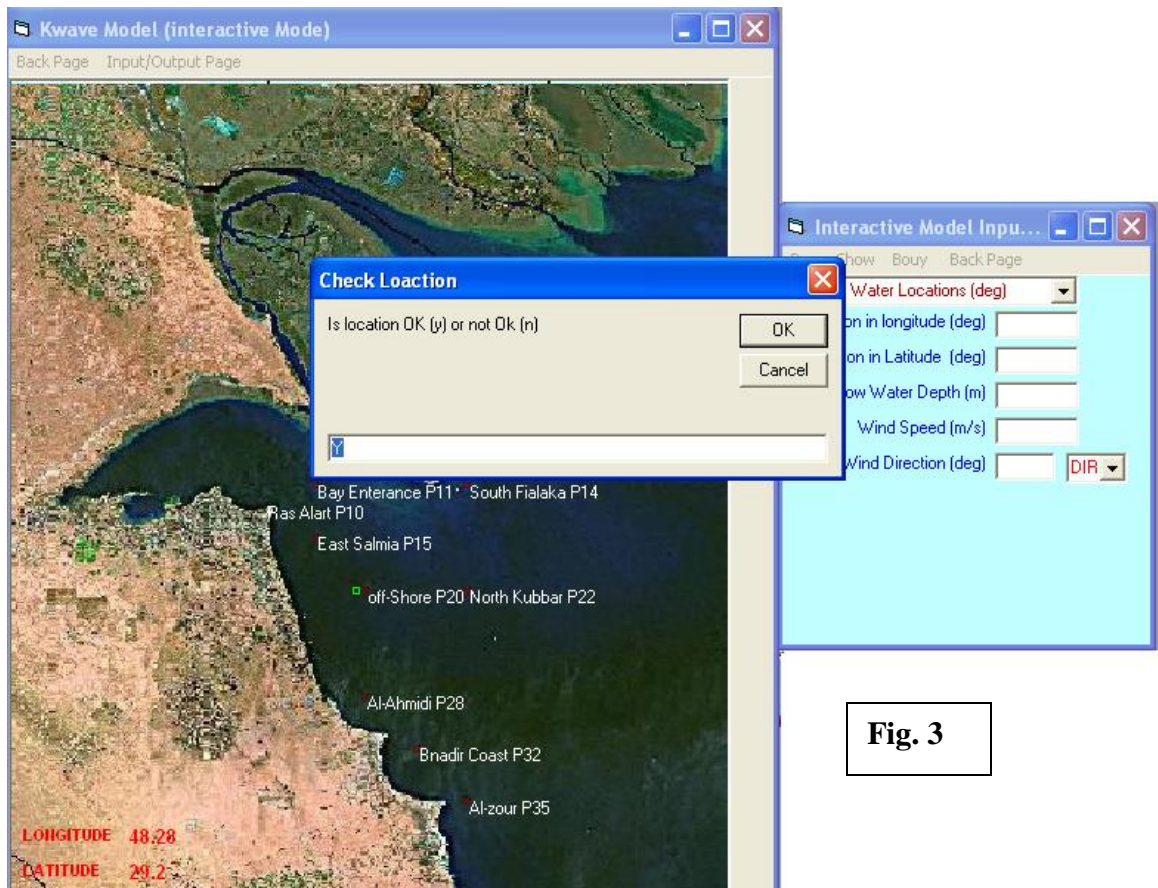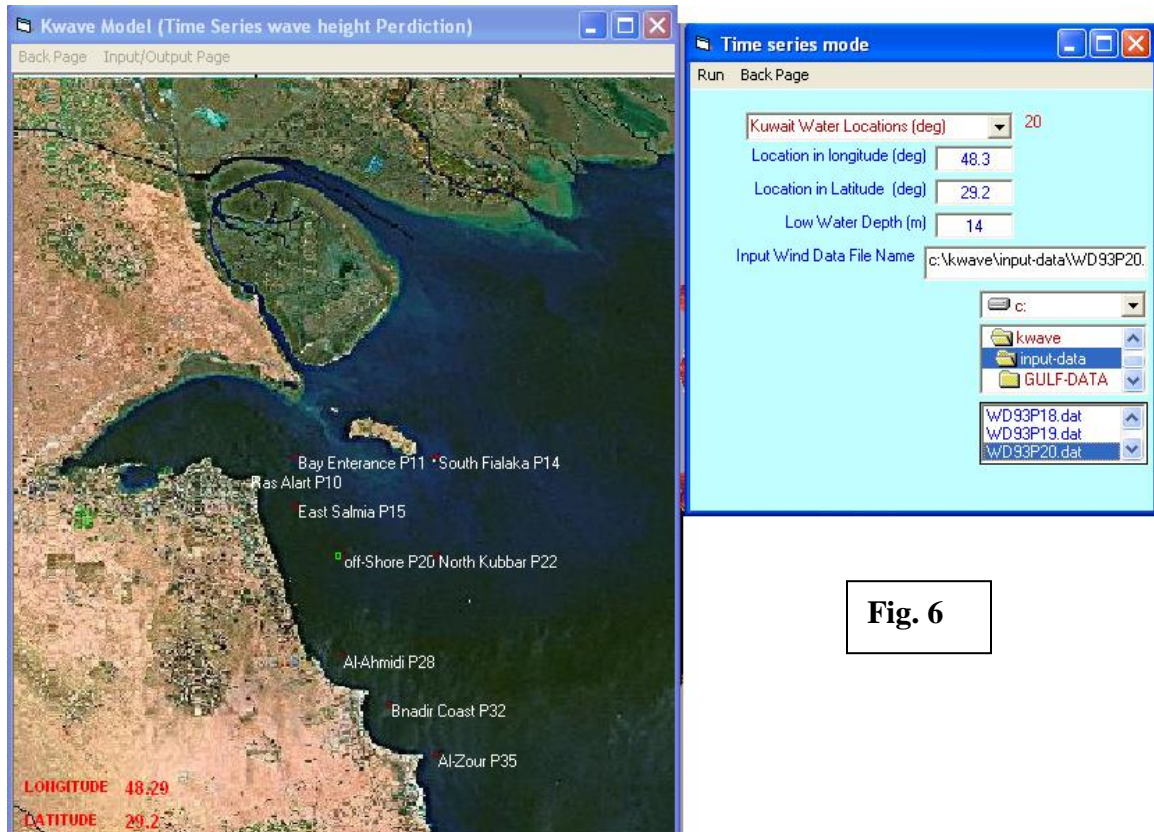
Fig. 3

Fig. 4

Fig. 5

If user selected in **Kuwait water mode** sub-option 2 in the **Time series mode**, fig. 2 will be display two sub-option for user to select as :-

       1- Sub-Option 1 Random Data.

       2- Sub-Option Hind cast wind data (1993-2004)

If sub-option 1 (**Random Data**) where selected fig. 6 will be display for user to enter the input data required as follows:

1-To enter the location where the wave condition to be predicted as

    a- Use the mouse to click on the map page then a check location page will be display .

    b- Use the drop down list on the input/output page to select the location.

    c- Input the Longitude (deg) , latitude (deg) and low water depth in meter manually as shown in input/output page.

2-To enter wind data file. User must enter wind data file using file directory selection or input file name manually in fig. 6. Wind data file contain wind direction (deg) and wind speed (m/s) for one day, one month or a year.


Fig. 6

User should click on **RUN** as shown in fig. 6 to simulate the prediction model. Fig. 7 will be display for user the result of the wave prediction in plotting form as shown in fig.8. A drop down list will shown in fig. 7 for user to select the type of result presentation as (wave height, wave period or wave direction) at the selected location. The Wave prediction result will be store in :

  a- Wave Height store in file name (Wave.bln)

  b- Wave Period store in file name (Perd.bln)

  c- Wave Direction store in file name (Dirc.bln)
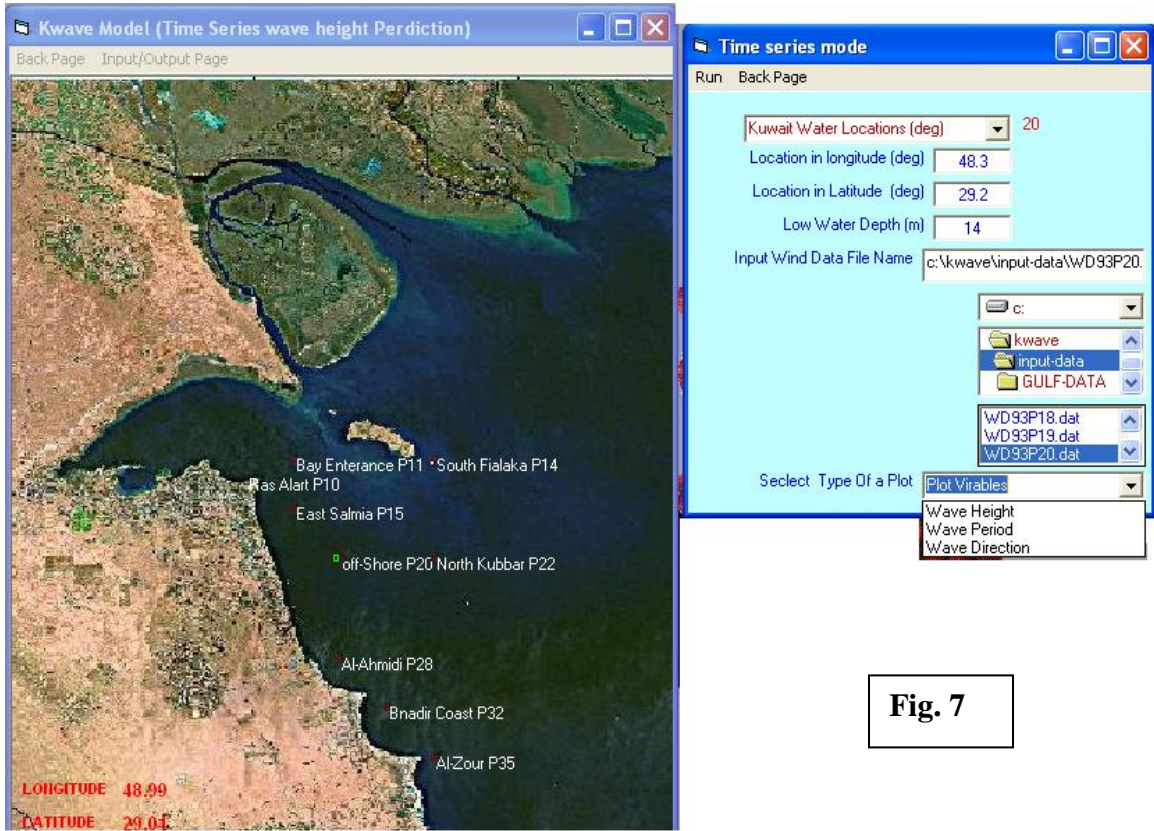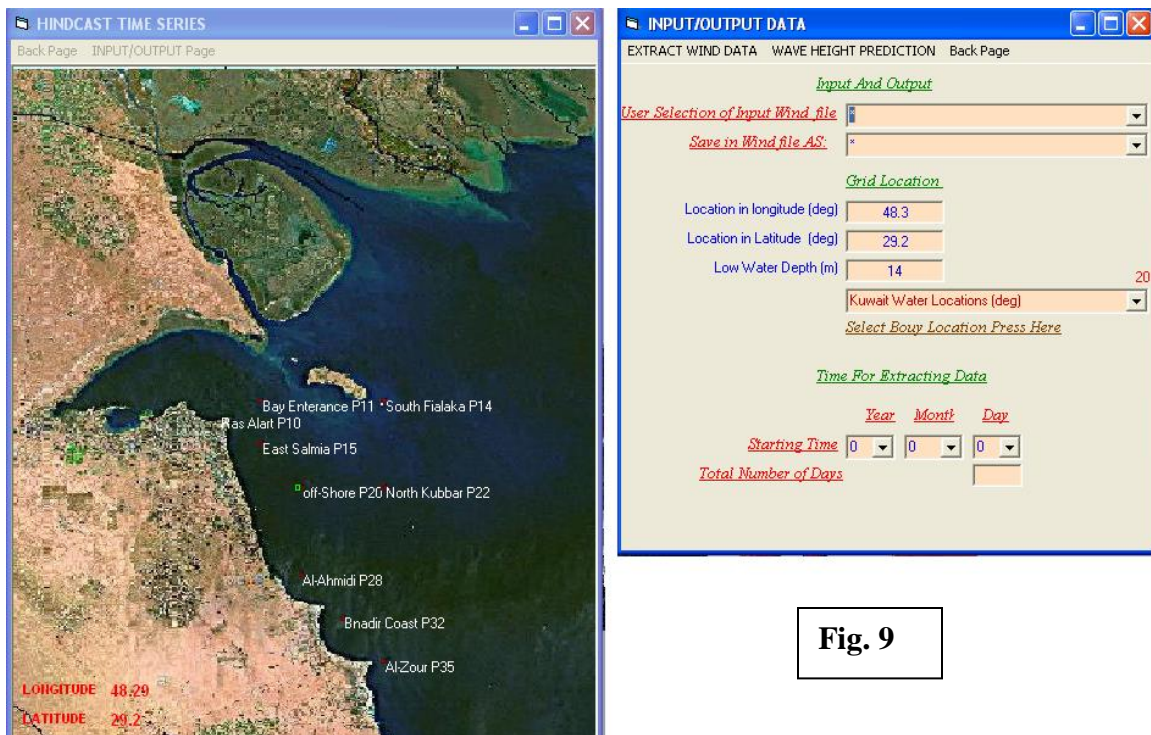
Fig. 7
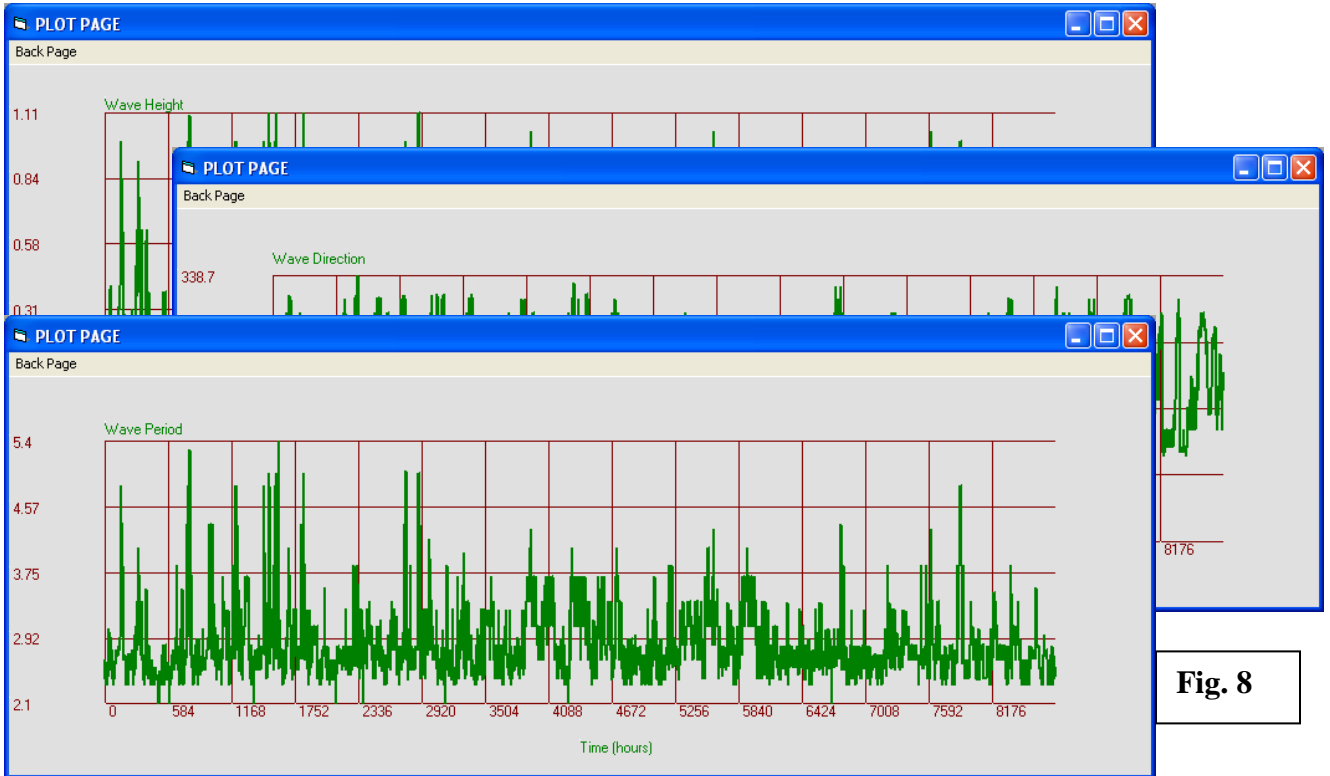
Fig. 8

If user selected in **Kuwait water mode** sub-option 2 in the **Time series mode**, fig. 2 will be display two sub-option for user to select as :-

      1- Sub-Option 1 Random Data.

      2- Sub-Option Hind cast wind data (1993-2004)

If sub-option 1 (**Hind cast wind data**) where selected fig. 9 will be display for user to enter the input data required as follows:

1-To enter the location where the wave condition to be predicted as

      a- Use the mouse to click on the map page then a check location page will be display.

      b- Use the drop down list on the input/output page to select the location.

      c- Input the Longitude (deg) , latitude (deg) and low water depth in meter manually as shown in input/output page.
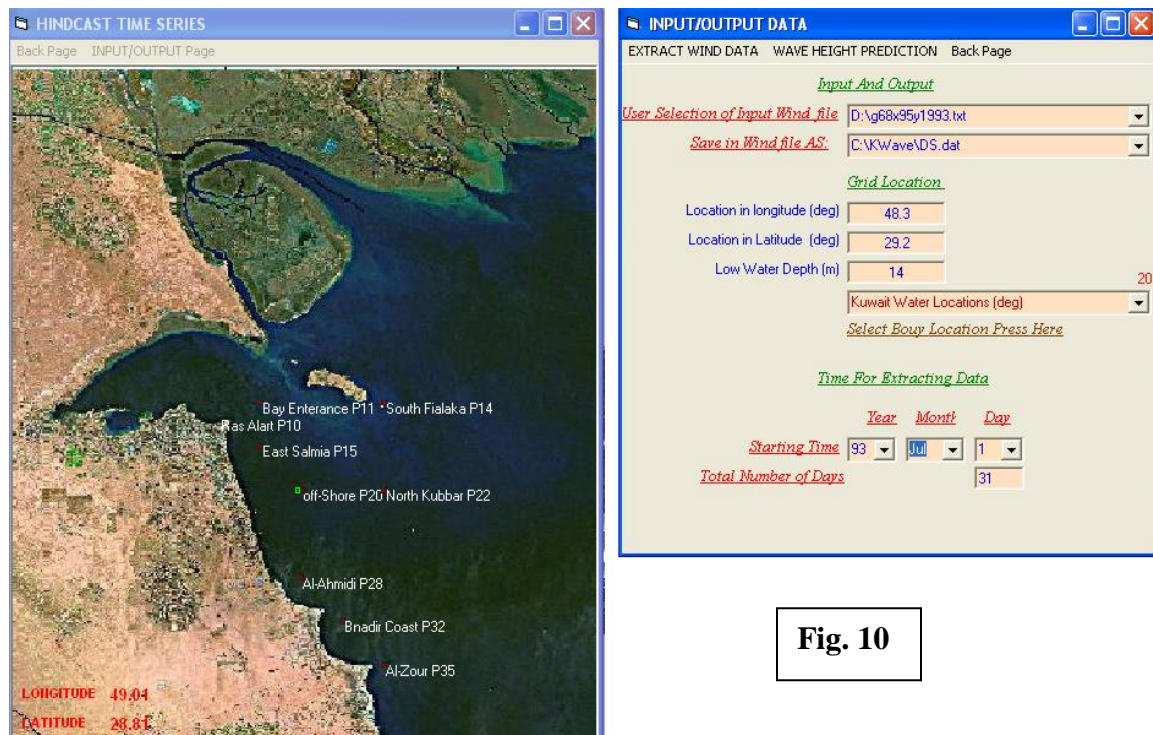

Fig. 9

2-To Extract the wind data from the wind data bank (1993 to 2004). User must select the wind data year by using the drop down list .

3-Enter file name where the extracted wind data will be stored. If drop down list in selected a default file name will be selected as (DS.dat).

4-Enter the time for extracting wind data by using the drop down list as:

- Year number (must be consisting with wind data seclect from data bank in 2)
- Month (if month selected the first day or starting day of the month and last day of the month or the total days will be atomically displayed.
- Day will be displayed in Total number of days (if user want to simulate one year the total days for extracting wind data must be enter as 365 day)

Fig. 10 shows the total input for extracting wind data from (June,1,1993 to June, 31, 1993) .


Fig. 10

Then user must select **Extracting Wind Data.** Fig 11 will display the wind data extracting simulation model.

Then user must select Wave **Height Prediction** to simulate the prediction model. Fig 12 will display for user the result of the wave prediction in plotting form as shown in fig. 13. A drop down list will shown in fig.12 for user to select the type of result presentation as (wave height, wave period or wave direction) at the selected location. The Wave prediction result will be store in :
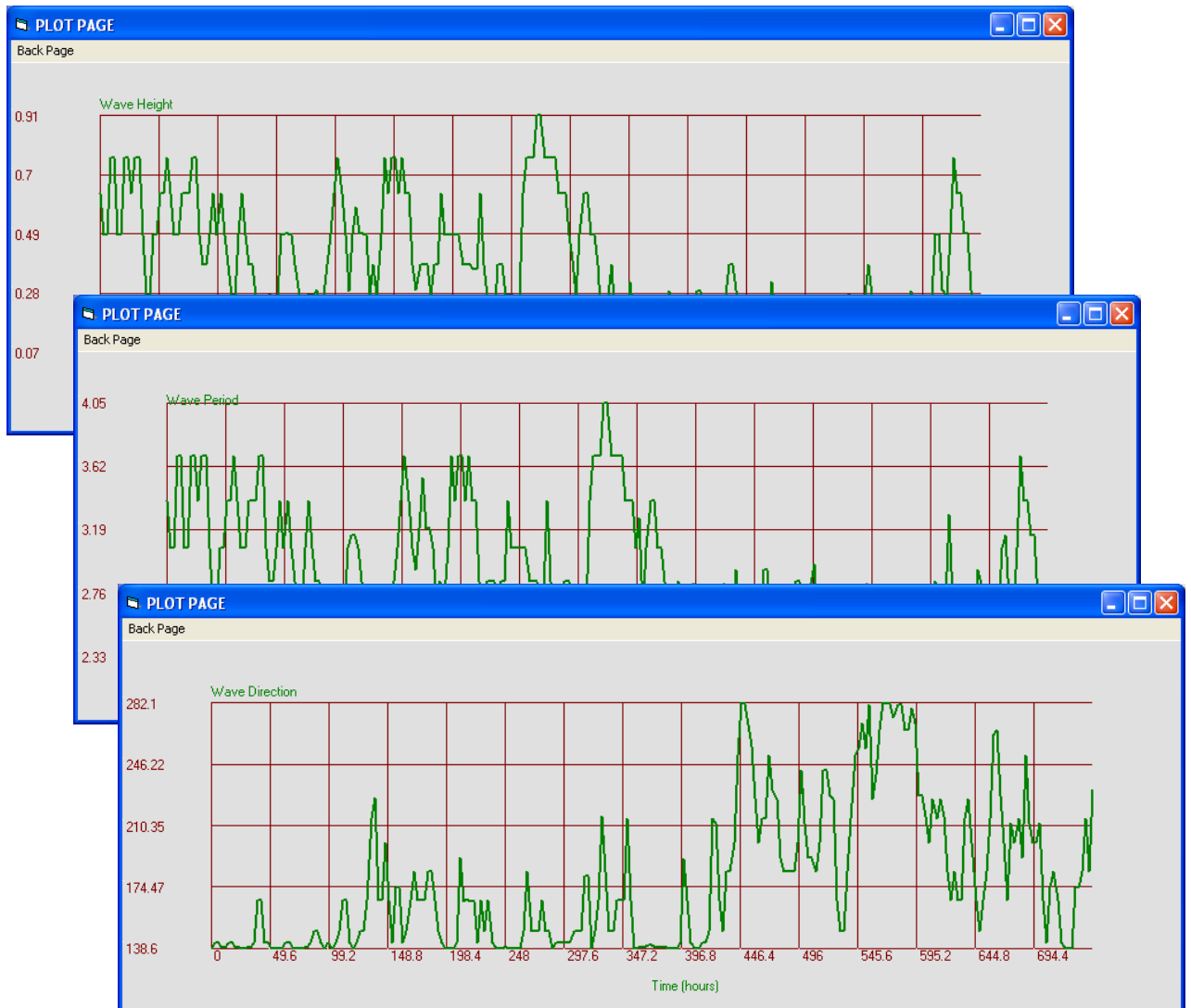
a- Wave Height store in file name (Wave.bln)

b- Wave Period store in file name (Perd.bln)

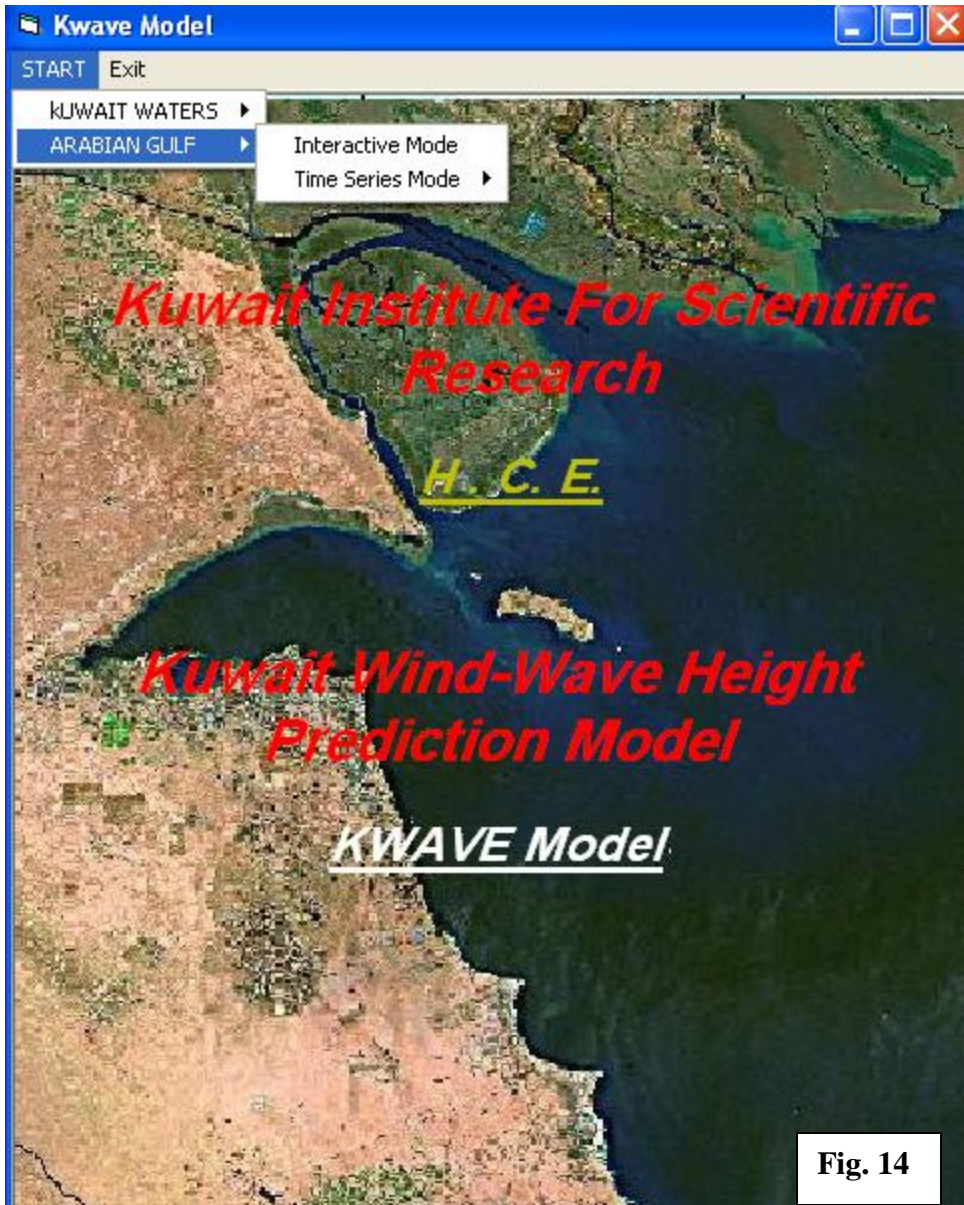c- Wave Direction store in file name (Dirc.bln)
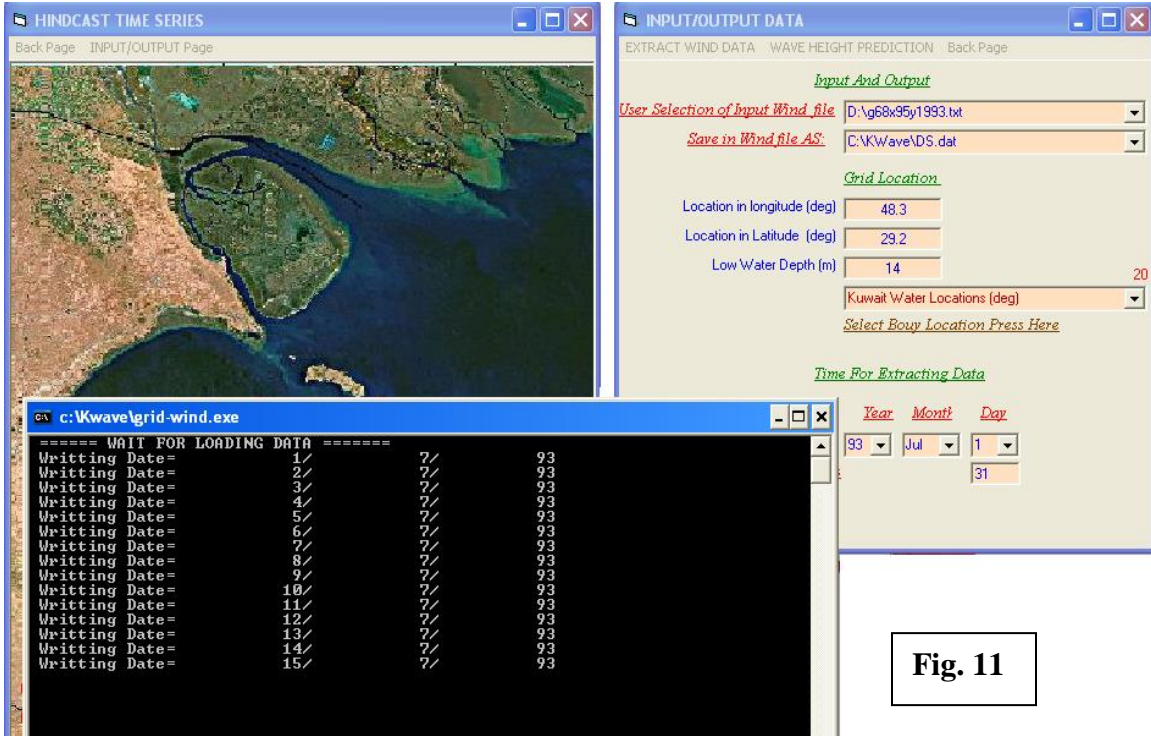
Fig. 11
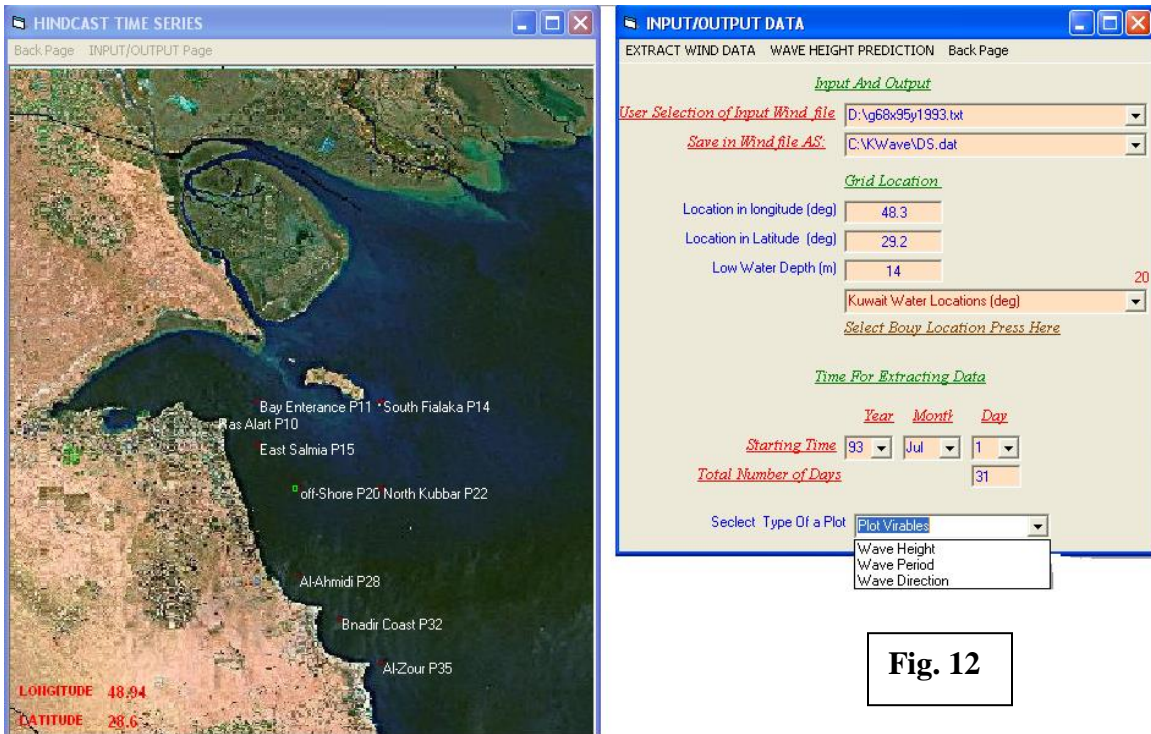
Fig. 12

Fig. 13

If user selected option 2 for **Arabian Gulf** then fig. 14 will be display. Fig. 14 display anther two option as follows:

3. Sub-Option 1 is for interactive mode as shown in fig. 14.
4. Sub-Option 2 is for time series mode as shown in fig. 14.

Fig. 14

If user selected sub-option 1 in the **Interactive Mode**, fig. 15 will be display for user to enter the input data required as follows:

1- To enter the location where the wave condition to be predicted as:-

a- Use the mouse to click on the map page then a check location page will display for user for location checking as shown in fig. 15.

b- Use the drop down list on the input/output page to select the location as shown in fig. 15.

c- Input the Longitude (deg) , latitude (deg) and low water depth in meter manually as shown in input/output page.

2- To enter wind data. User must enter wind speed (m/s) and wind direction (deg or use the drop down direction list).

3- Click On **RUN** to predict the wave condition at the selected location.

Fig. 16 shows prediction output result for wave condition as :-

- Wave Height (m)
- Wave Direction (deg)
- Wave Period (sec)
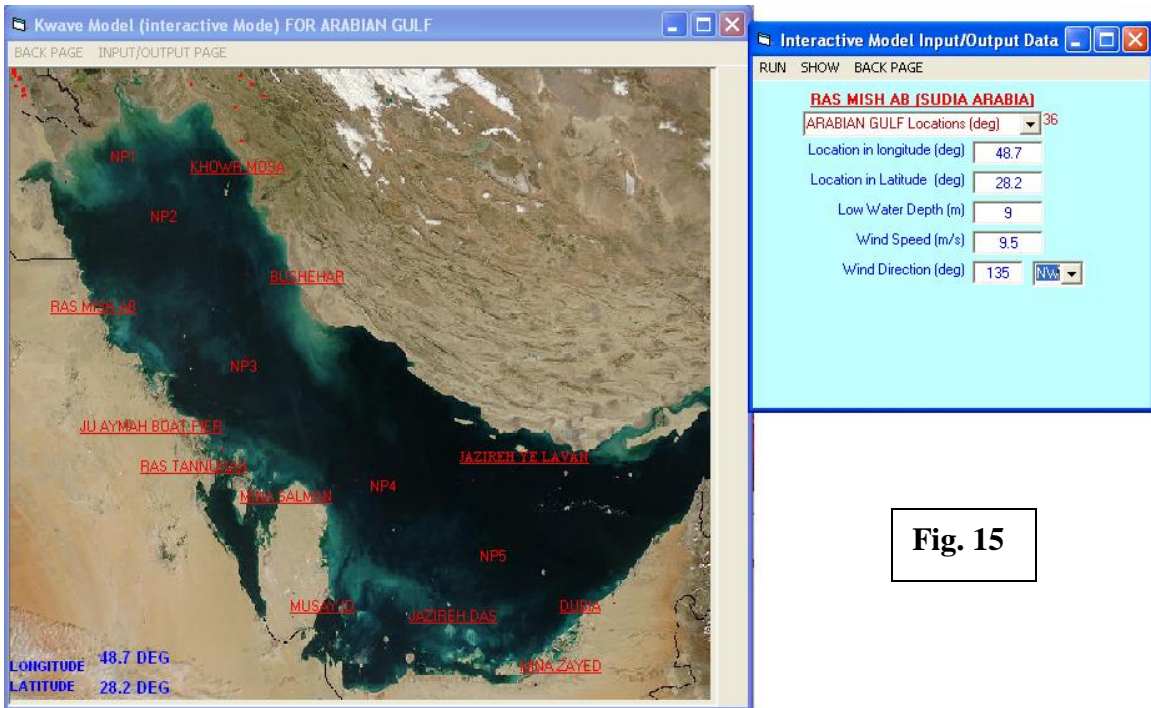
Fig. 15
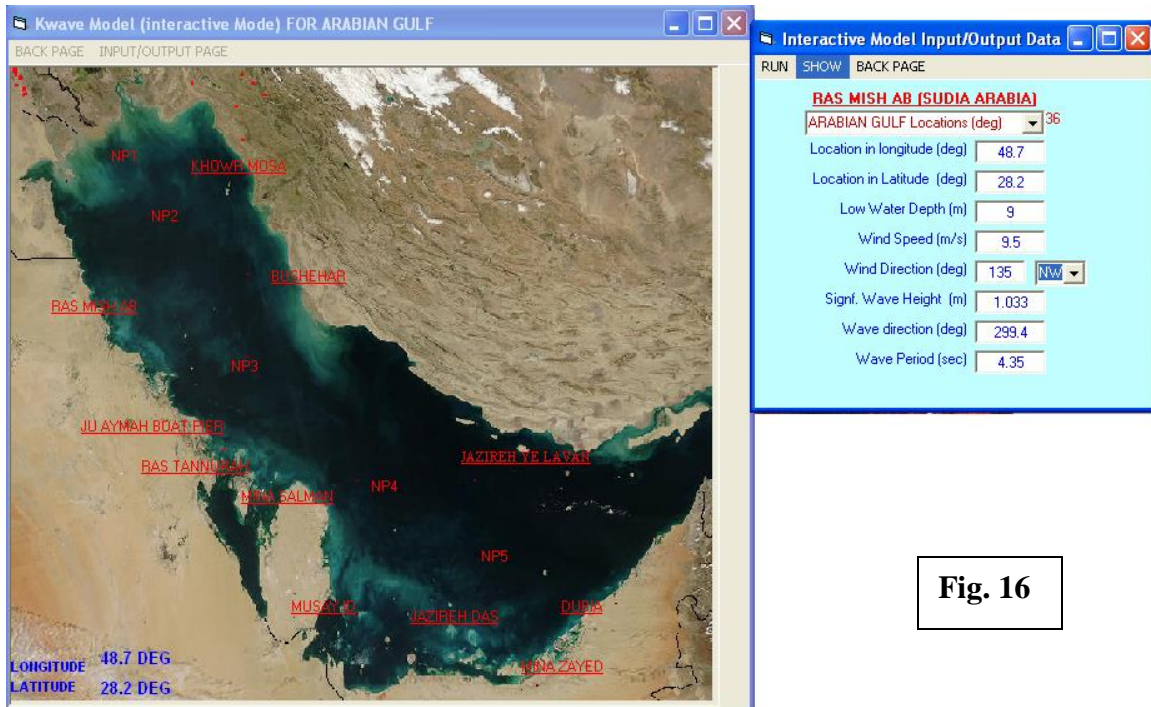
Fig. 16

If user selected in **Arabian gulf** sub-option 2 in the **Time series mode**, two sub-option will display for user to select as:-

   1- Sub-Option 1 Random Data.
   2- Sub-Option Hind cast wind data (1993-2004)

If sub-option 1 (**Random Data**) where selected fig. 17 will be display for user to enter the input data required as follows:

1-To enter the location where the wave condition to be predicted as

   a- Use the mouse to click on the map page then a check location page will be display .

   b- Use the drop down list on the input/output page to select the location.

   c- Input the Longitude (deg) , latitude (deg) and low water depth in meter manually as shown in input/output page.

2-To enter wind data file. User must enter wind data file using file directory selection or input file name manually in fig. 17. Wind data file contain wind direction (deg) and wind speed (m/s) for one day, one month or a year.

15
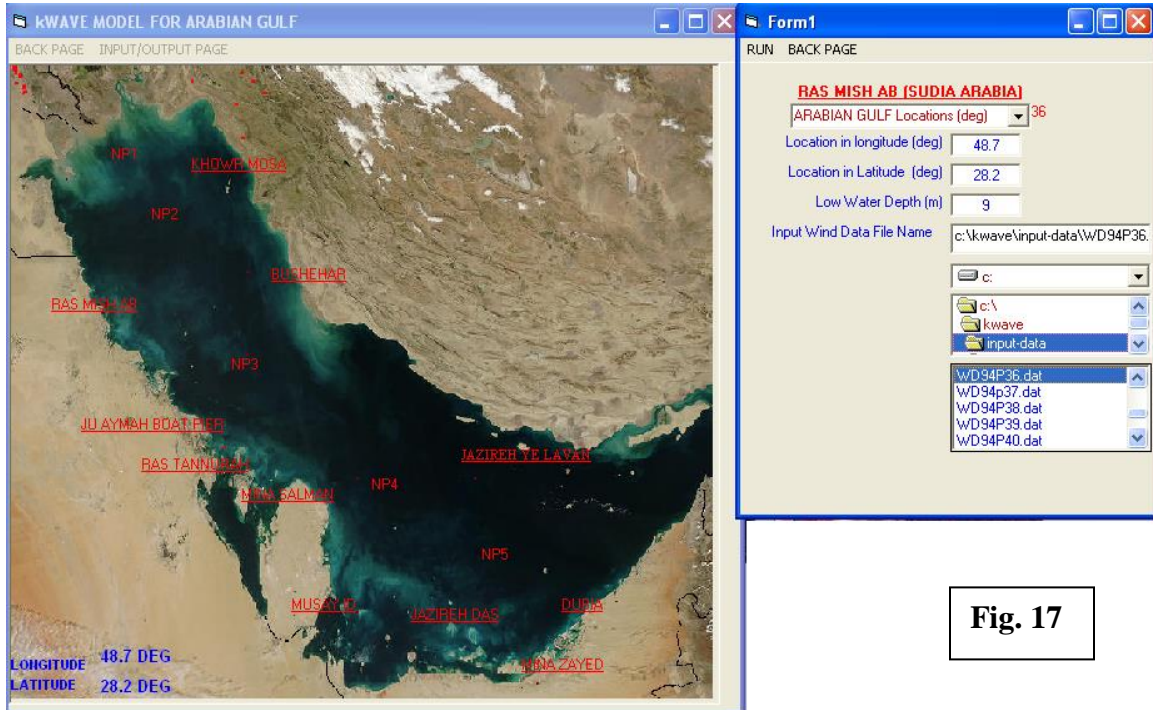
Fig. 17

Then user should click on **RUN** as shown in fig.17 to simulate the prediction model. Fig. 18 will be display for user the result of the wave prediction in plotting form as shown in fig.19. A drop down list will shown in fig.17 for user to select the type of result Presentation as (wave height, wave period or wave direction) at the selected location. The Wave prediction result will be store in:-
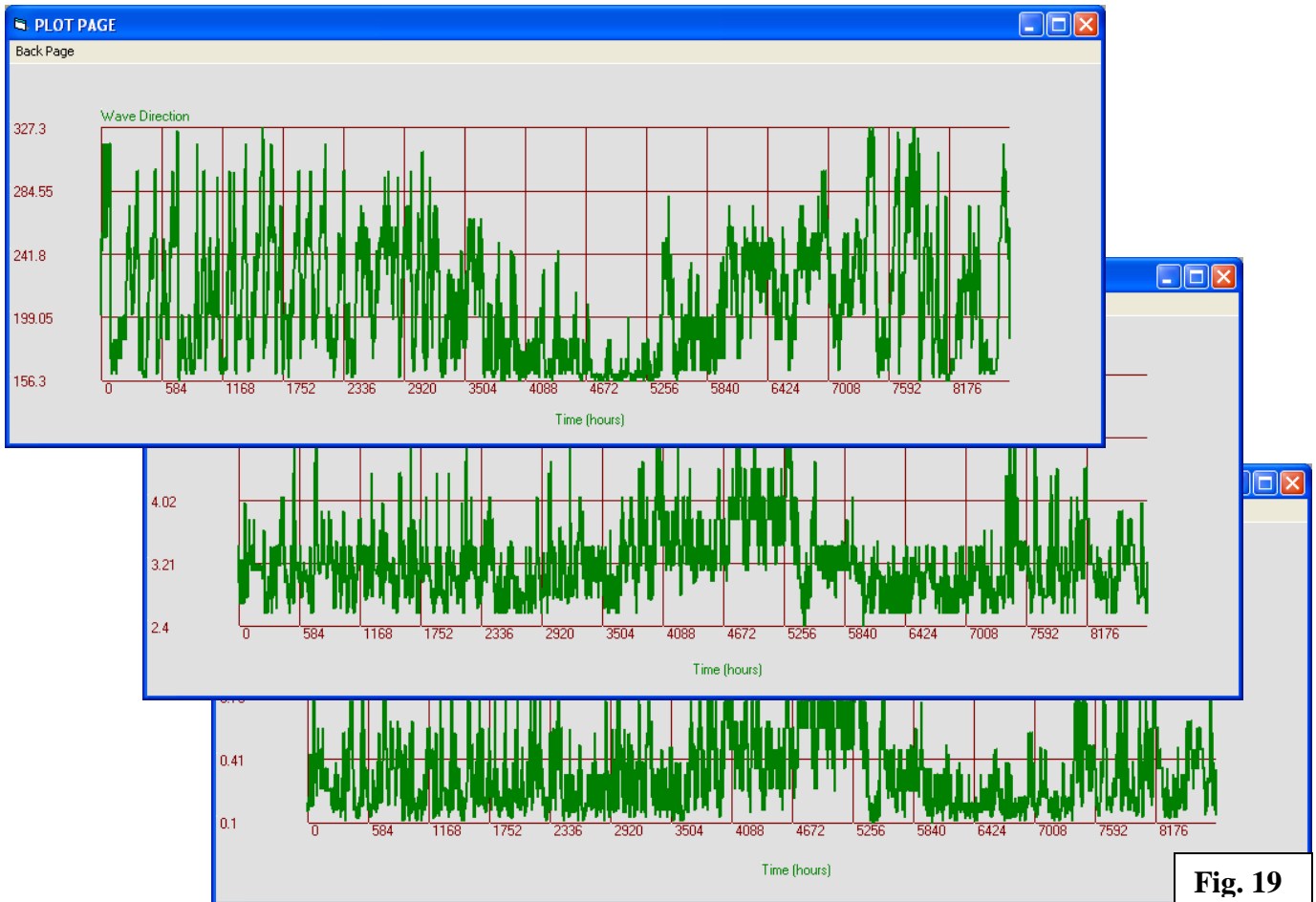
  a- Wave Height store in file name (Wave.bln)

  b- Wave Period store in file name (Perd.bln)

  c- Wave Direction store in file name (Dirc.bln)

Fig. 18

Fig. 19
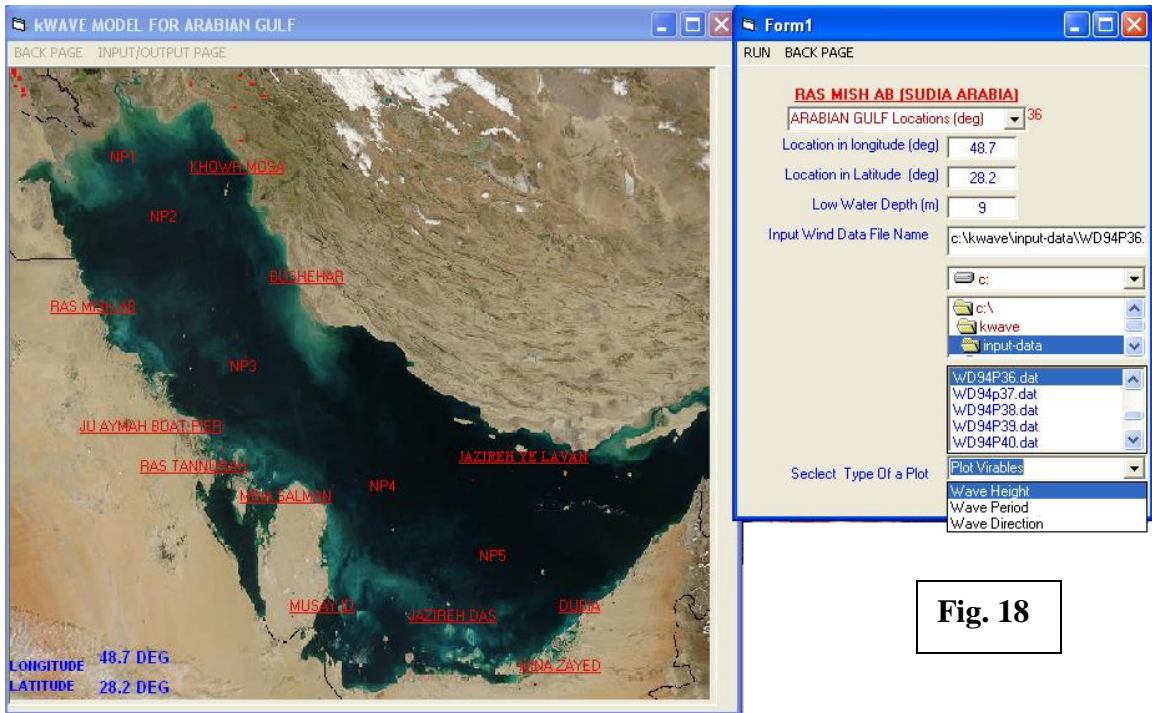
If user selected in **Arabian Gulf mode** sub-option 2 in the **Time series mode**, two sub-option will be display for user to select as :-

      3- Sub-Option 1 Random Data.

      4- Sub-Option Hind cast wind data (1993-2004)

 If sub-option 1 (**Hind cast wind data**) where selected fig. 20 will be display for user to enter the input data required as follows:

1-To enter the location where the wave condition to be predicted as

      a- Use the mouse to click on the map page then a check location page will be display.

      b- Use the drop down list on the input/output page to select the location.

      c- Input the Longitude (deg) , latitude (deg) and low water depth in meter manually as shown in input/output page.

 2-To Extract the wind data from the wind data bank (1993 to 2004). User must select the wind data year by using the drop down list .

3-Enter file name where the extracted wind data will be stored. If drop down list in selected a default file name will be selected as (DS.dat).

4-Enter the time for extracting wind data by using the drop down list as:

      - Year number (must be consisting with wind data seclect from data bank in 2)

      - Month (if month selected the first day or starting day of the month and last day of the month or the total days will be atomically displayed.

      - Day will be displayed in Total number of days (if user want to simulate one year the total days for extracting wind data must be enter as 365 day)

Fig. 10 shows the total input for extracting wind data from (June,1,1993 to June, 31, 1993) .

Then user must select **Extracting Wind Data.** Fig 20 will display the wind data extracting simulation model.

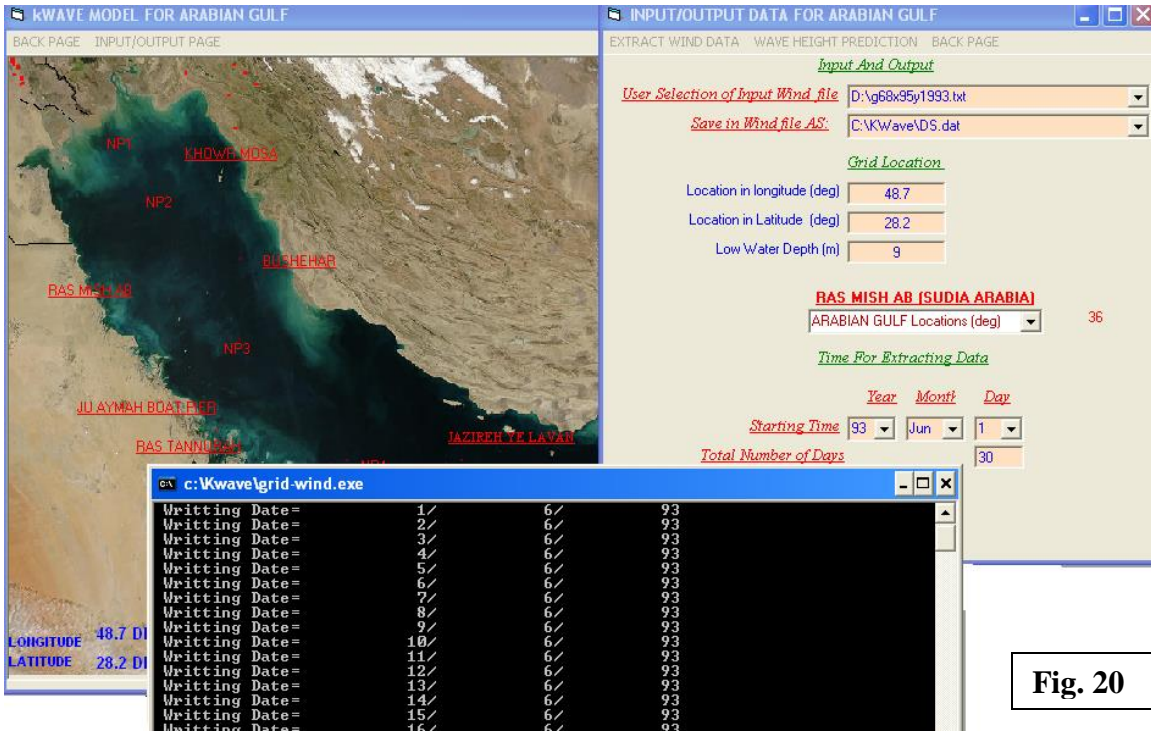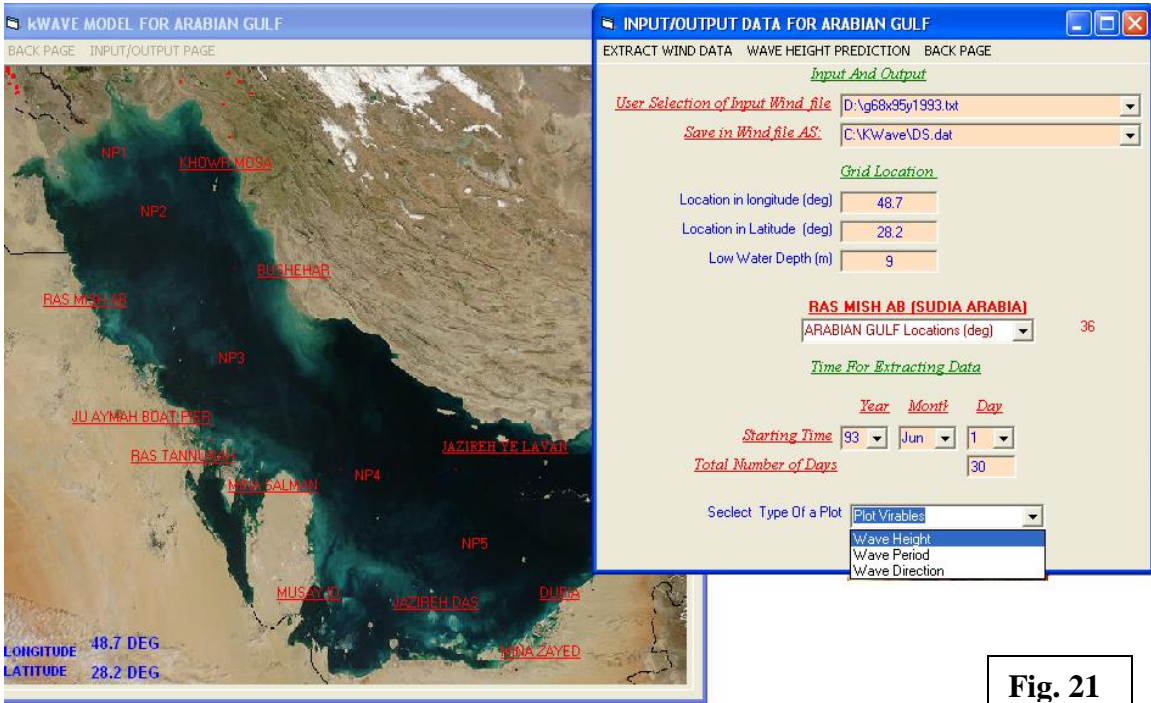Then user must select Wave **Height Prediction** to simulate the prediction model.

Fig. 20

Fig. 21

19

Fig 21 will display for user the result of the wave prediction in plotting form as shown in fig. 22. A drop down list will shown in fig. 21 for user to select the type of result presentation as (wave height, wave period or wave direction) at the selected location. The Wave prediction result will be store in :

   a- Wave Height store in file name (Wave.bln)

   b- Wave Period store in file name (Perd.bln)

   c- Wave Direction store in file name (Dirc.bln)
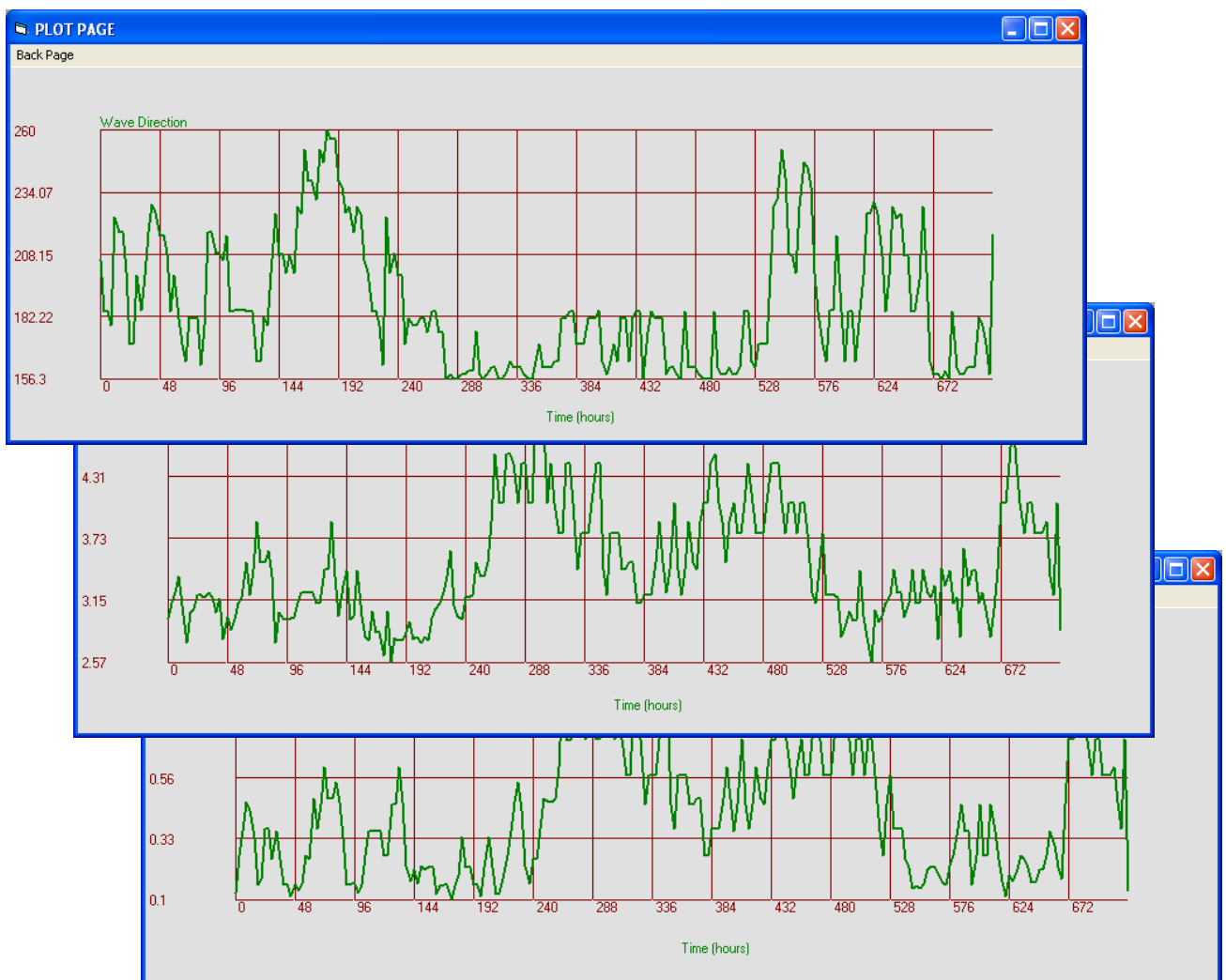
**Fig. 22**

Model Results And Validation

Kwave model is a model developed to predict wave condition over Kuwait waters uses the relationship technique. Fig.23 shows the locations for which the comparison was made between the **WAM Model** and **KWAVE Model**   for wave prediction condition at AL-Fintas, Kuwait.


Fig. 23. **Kuwait Terrestrial Water**

Figs. 24 shows the validation of the wave prediction condition between WAM model output results and the data were recorded from the Bouy at AL-Fintas coast (1993, 1994). The comparison and validation of the wave prediction from **Wam Model** is found to be good result.

Figs 25 to 33 shows the validation of wave height, period and direction prediction from Kwave Model and Wam Model at Kuwait Water And the Arabian Gulf.
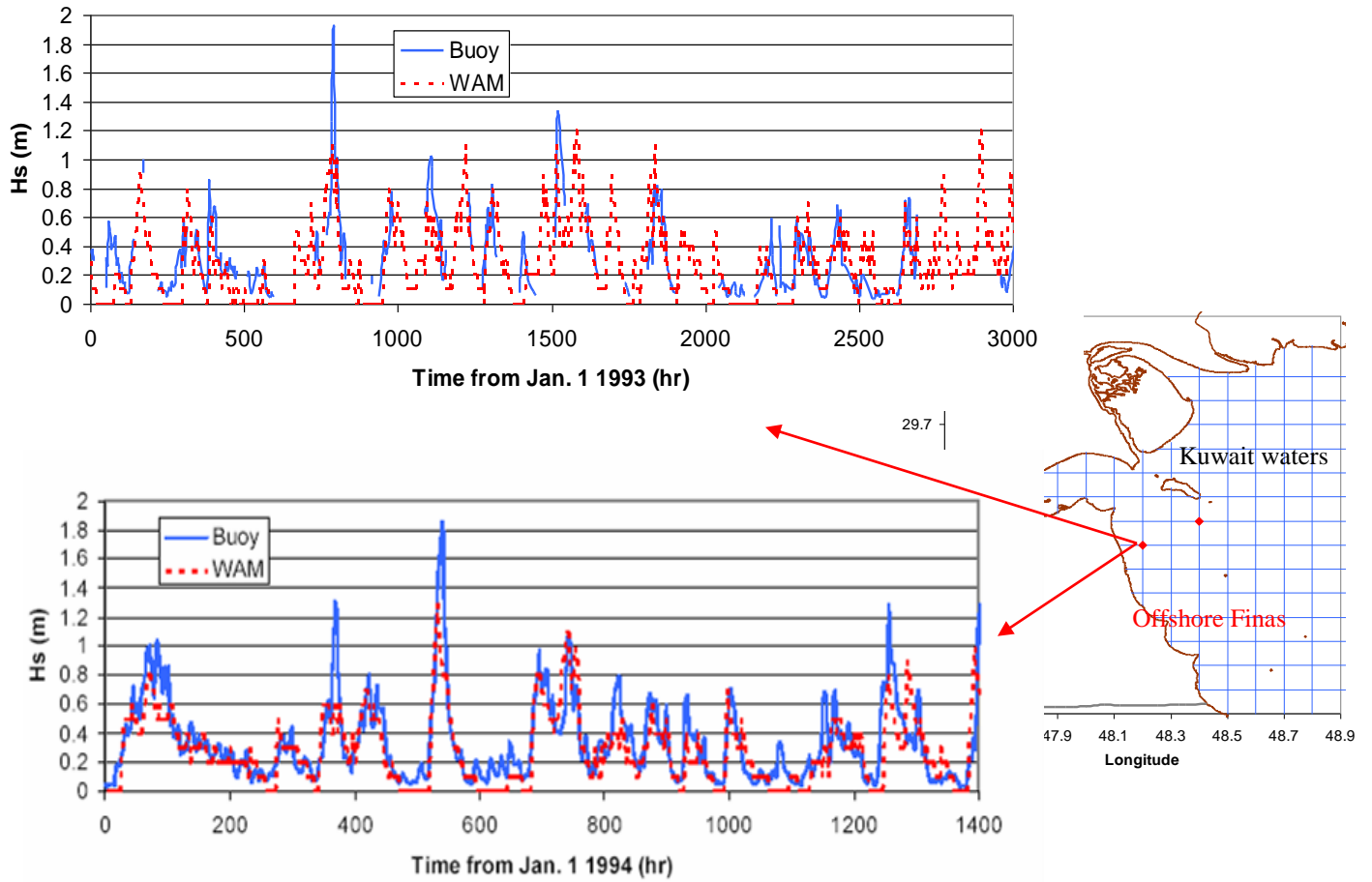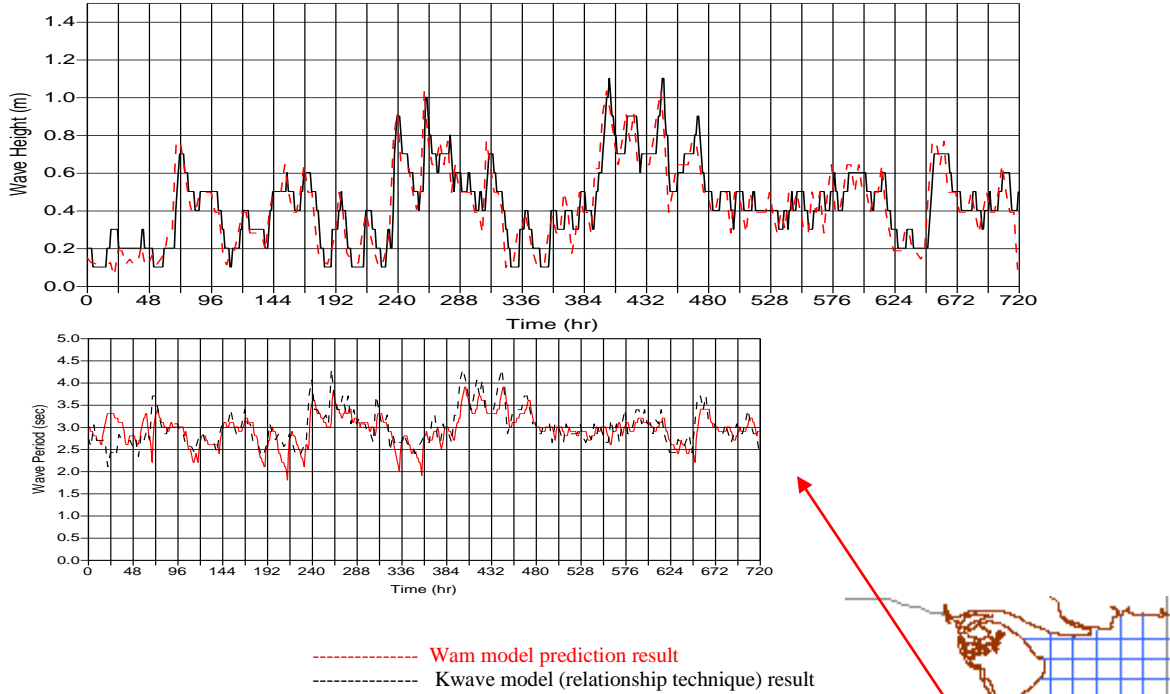
Fig. 24. **Comparison between Measured and Predicted Wave Height (OffShore Al-Fintas at Longitude 48.3 deg and Latitude 29.2 deg) for data from year 1993 and 1994.**
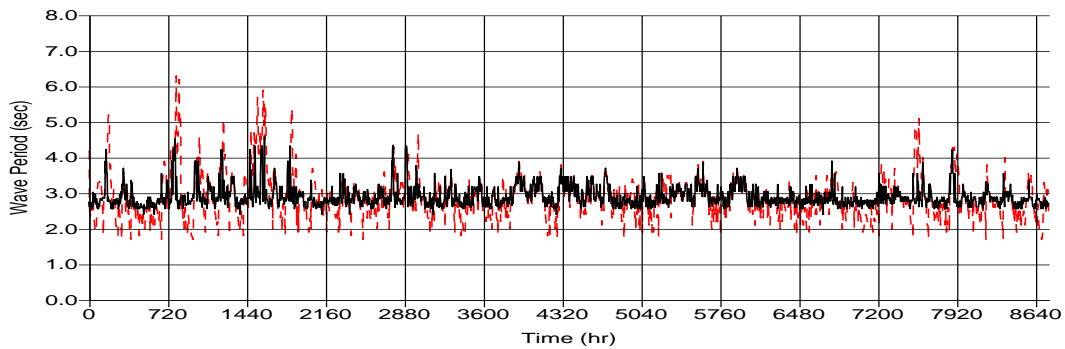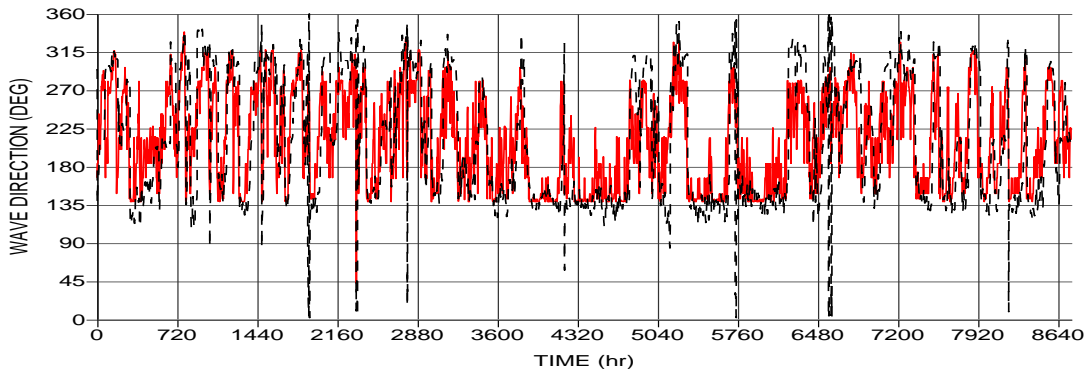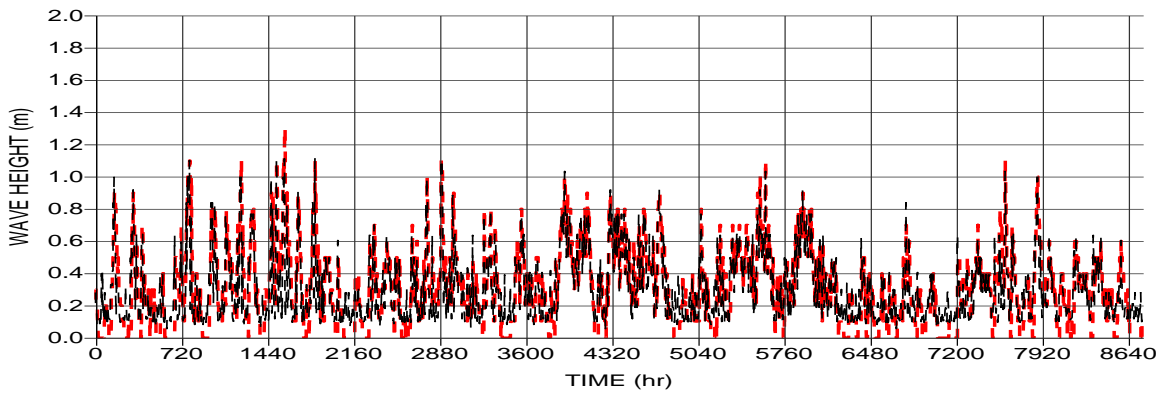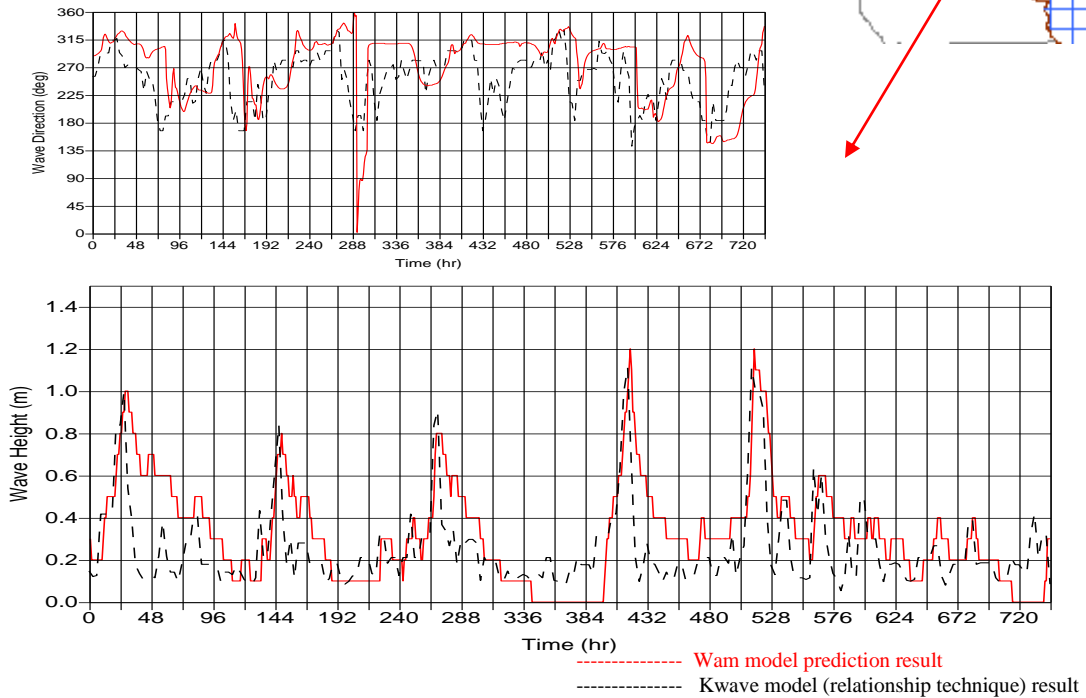
--------------- Wam model prediction result
--------------- Kwave model (relationship technique) result

Fig. 25. **Comparison between Wam model and Kwave model Predicted Wave
Height, Direction and Period at (OffShore Al-Fintas at Longitude 48.3 deg
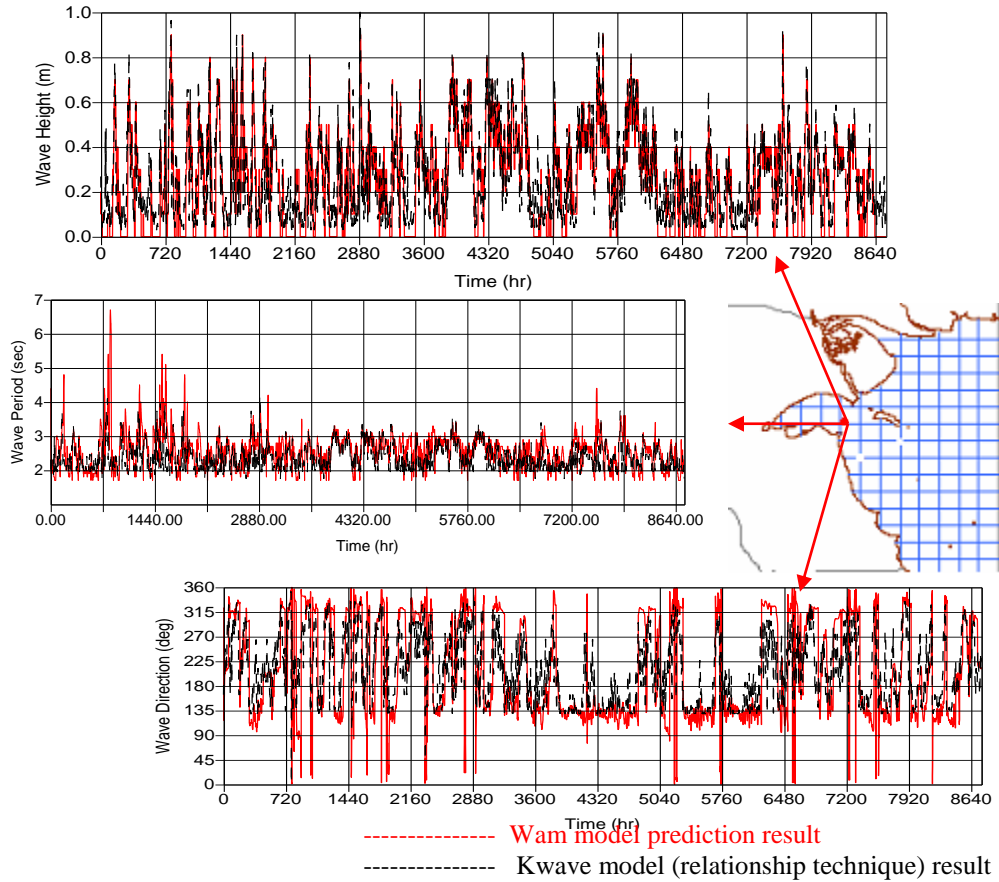And Latitude 29.2 deg at low water depth 14 m) for year 1993.**

---------------- Wam model prediction result
--------------- Kwave model (relationship technique) result

Fig. 26. **Comparison between Wam model and Kwave model Predicted Wave Height and Period at (OffShore Al-Fintas at Longitude 48.3 deg and Latitude 29.2 deg) for June 1994.**
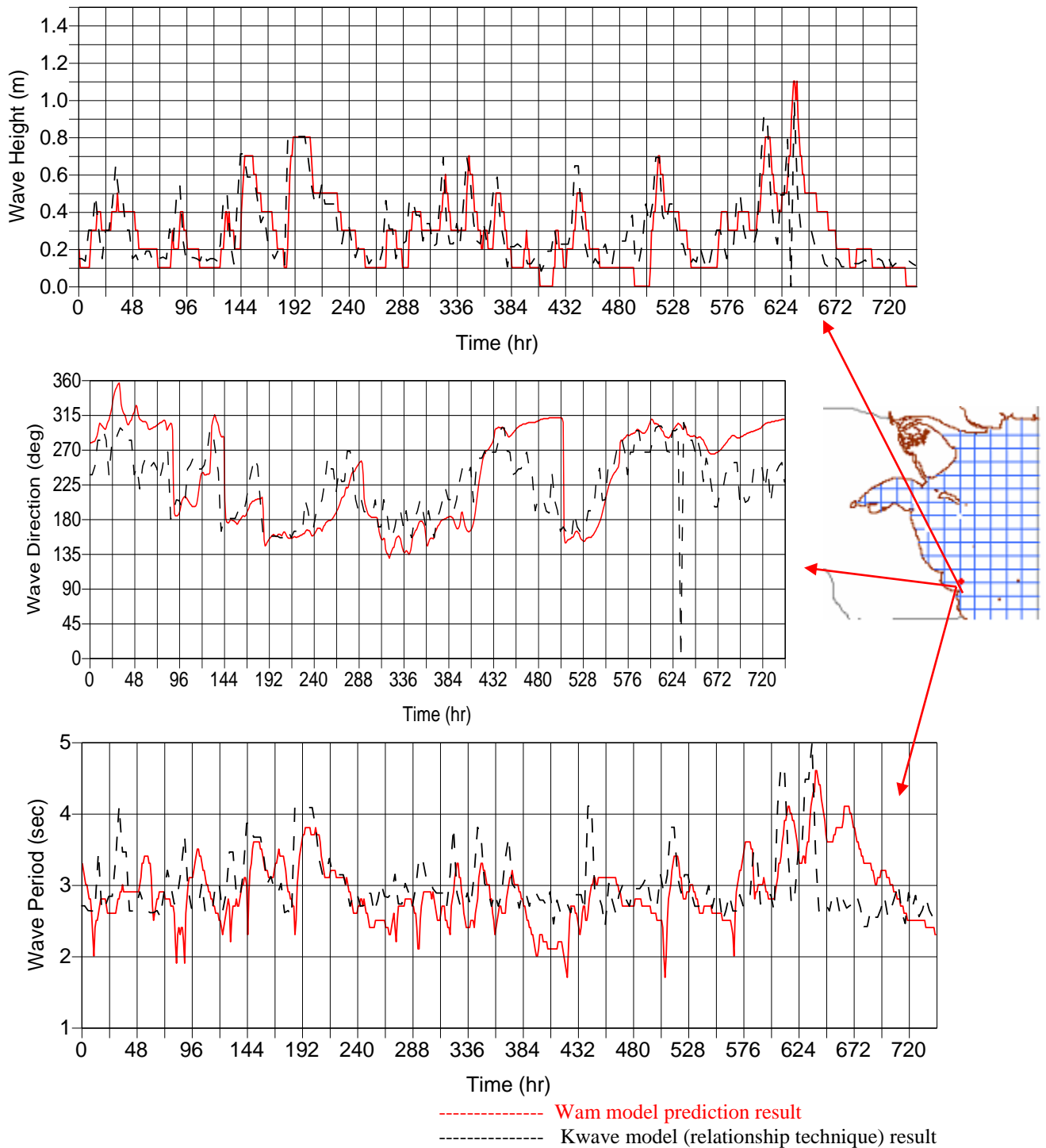

--------------- Wam model prediction result
--------------- Kwave model (relationship technique) result

Fig. 27. **Comparison between Wam model and Kwave model Predicted Wave Height and Direction at (OffShore Al-Fintas at Longitude 48.3 deg and Latitude 29.2 deg) for Mach 1996.**

Fig. 28. **Comparison between Wam model and Kwave model Predicted Wave Height, Direction and Period at (Entrance of Kuwait Bay at Longitude 48.2 deg and Latitude 29.4 deg at low water depth 6 m) for year 1993.**

--------------- Wam model prediction result
--------------- Kwave model (relationship technique) result

Fig. 29. **Comparison between Wam model and Kwave model Predicted Wave Height, Direction and Period at (East of Al-Zour coast at Longitude 48.4 deg and Latitude 28.8 deg at low water depth 10 m) for year 1995.**

RAS MISH AB
 (Saudi Arabia)
Longitude= 48.7 deg
Latitude   =28.2 deg
Low water depth= 9 m

Fig. 30
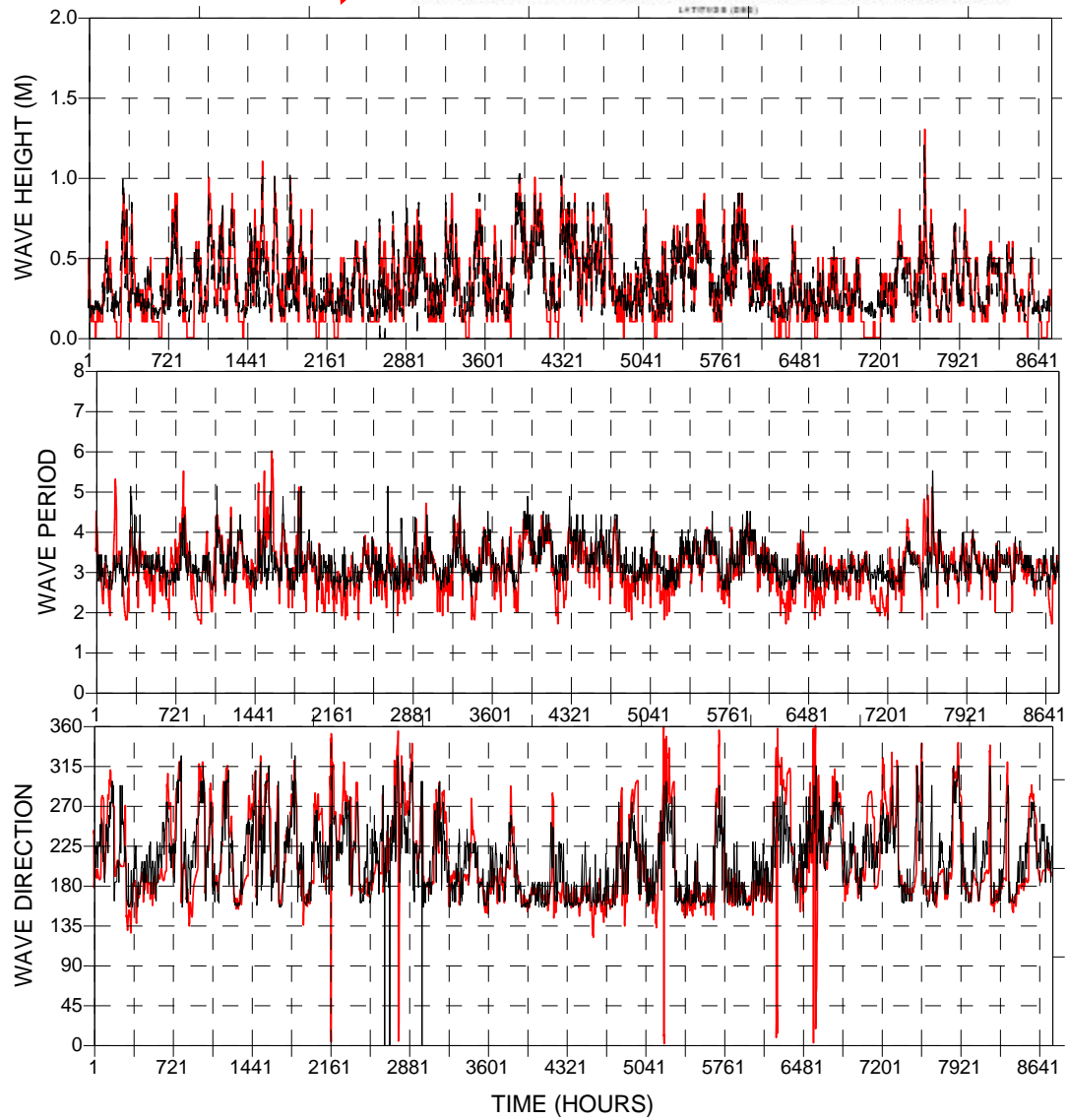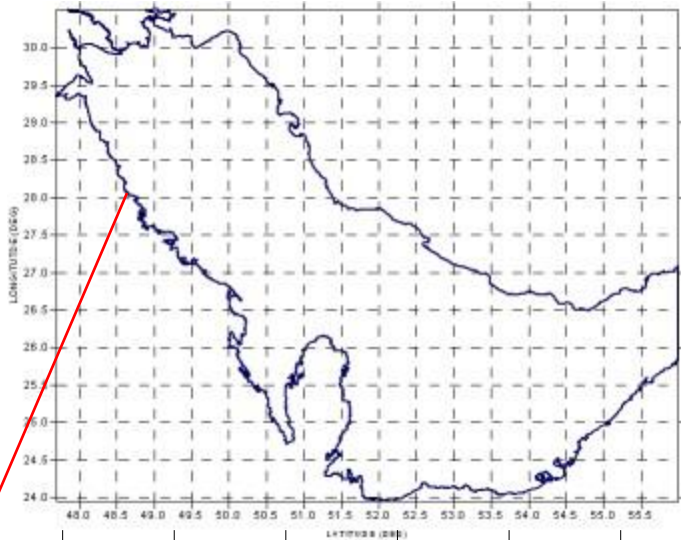
RAS MISH AB (SUDIA ARABIA) 1993

- – – – KWAVE MODEL PREDICTION
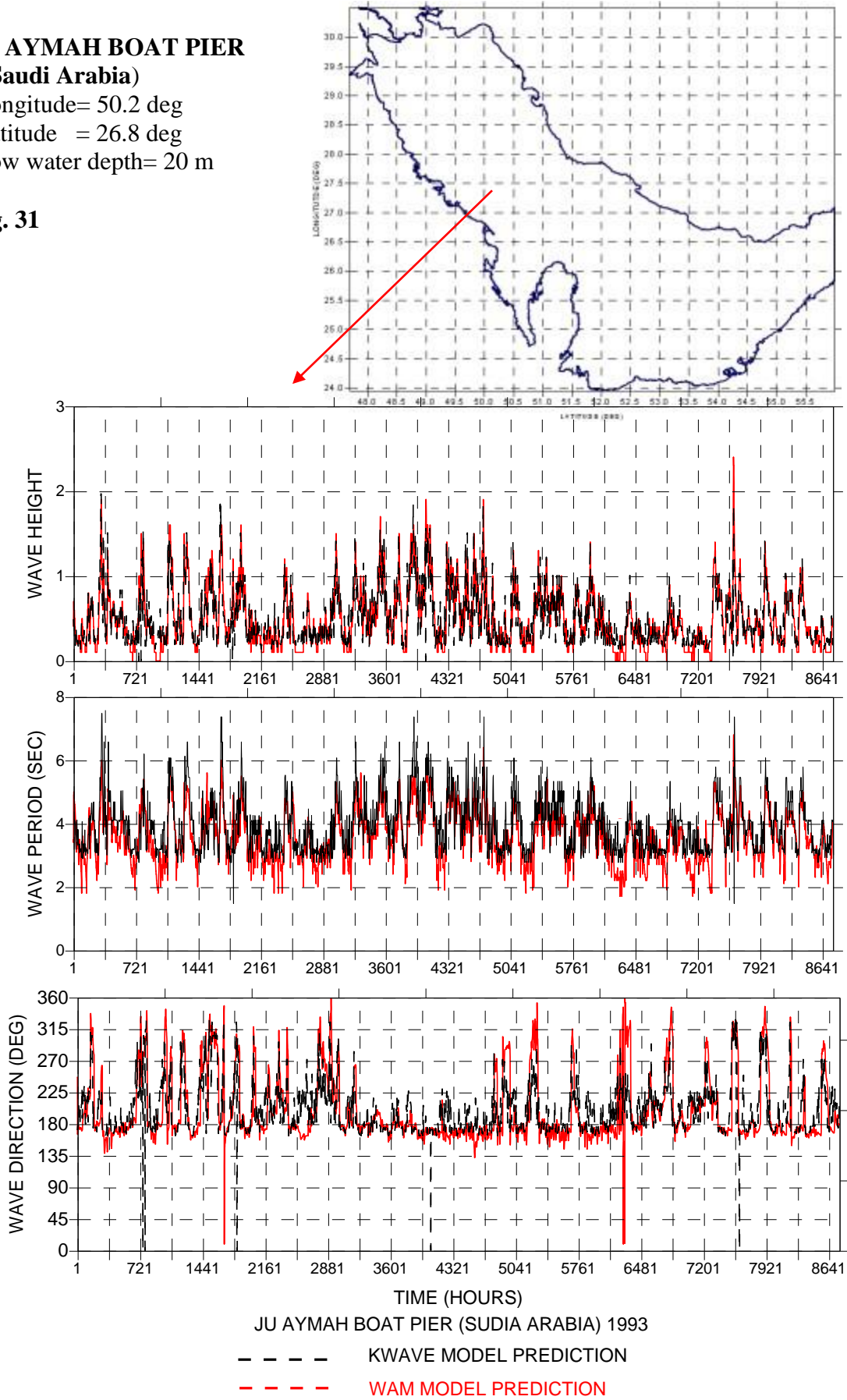- – – – WAM MODEL PREDICTION

27

JU AYMAH BOAT PIER
 (Saudi Arabia)
 Longitude= 50.2 deg
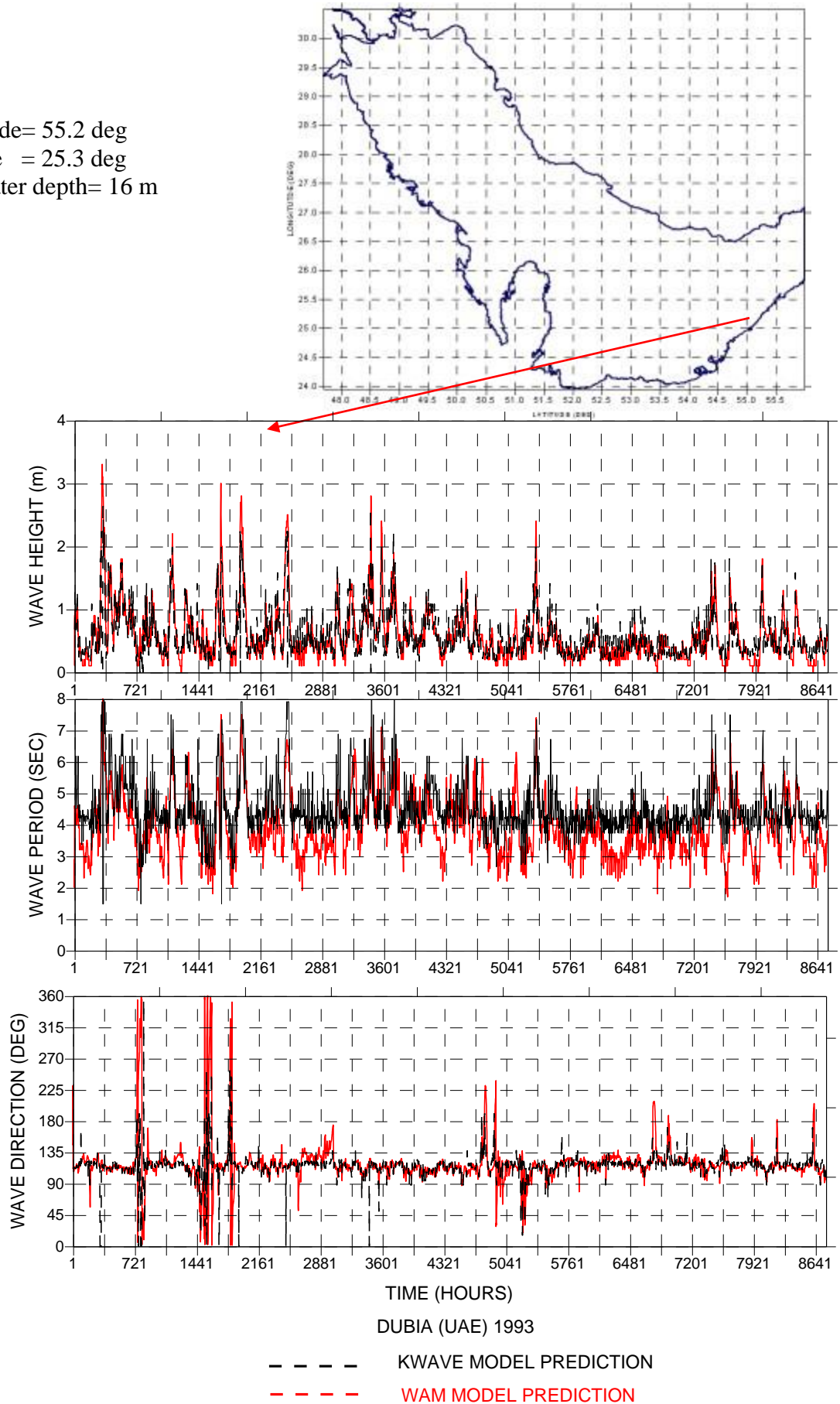 Latitude   = 26.8 deg
 Low water depth= 20 m

Fig. 31

TIME (HOURS)

JU AYMAH BOAT PIER (SUDIA ARABIA) 1993

― ― ― ―   KWAVE MODEL PREDICTION

― ― ― ―   WAM MODEL PREDICTION

DUBIA
 (UAE)
Longitude= 55.2 deg
Latitude   = 25.3 deg
Low water depth= 16 m

Fig. 32

DUBIA (UAE) 1993

KWAVE MODEL PREDICTION

WAM MODEL PREDICTION

BUSHEHAR
(IRAN)
Longitude= 50.5 deg
Latitude   = 28.5 deg
Low water depth= 55 m

Fig. 33

BUSHEHAR (IRAN) 1993

- - - -   KWAVE MODEL PREDICTION

- - - -   WAM MODEL PREDICTION