

# STWAVE



## What does it do?

- **STWAVE simulates**
  - depth-induced wave refraction and shoaling
  - current-induced refraction and shoaling
  - depth- and steepness-induced wave breaking, diffraction, wind-wave growth
  - wave-wave interaction and whitecapping that redistribute and dissipate energy in a growing wave field.
- **Provides** an easy-to-apply, flexible, and robust model for nearshore wind-wave growth and propagation.



# Use and Assumptions



## Why is it needed?

To describe quantitatively the change in wave parameters (wave height, period, direction, and spectral shape) between the offshore and the nearshore (typically depths of 40 m or less).

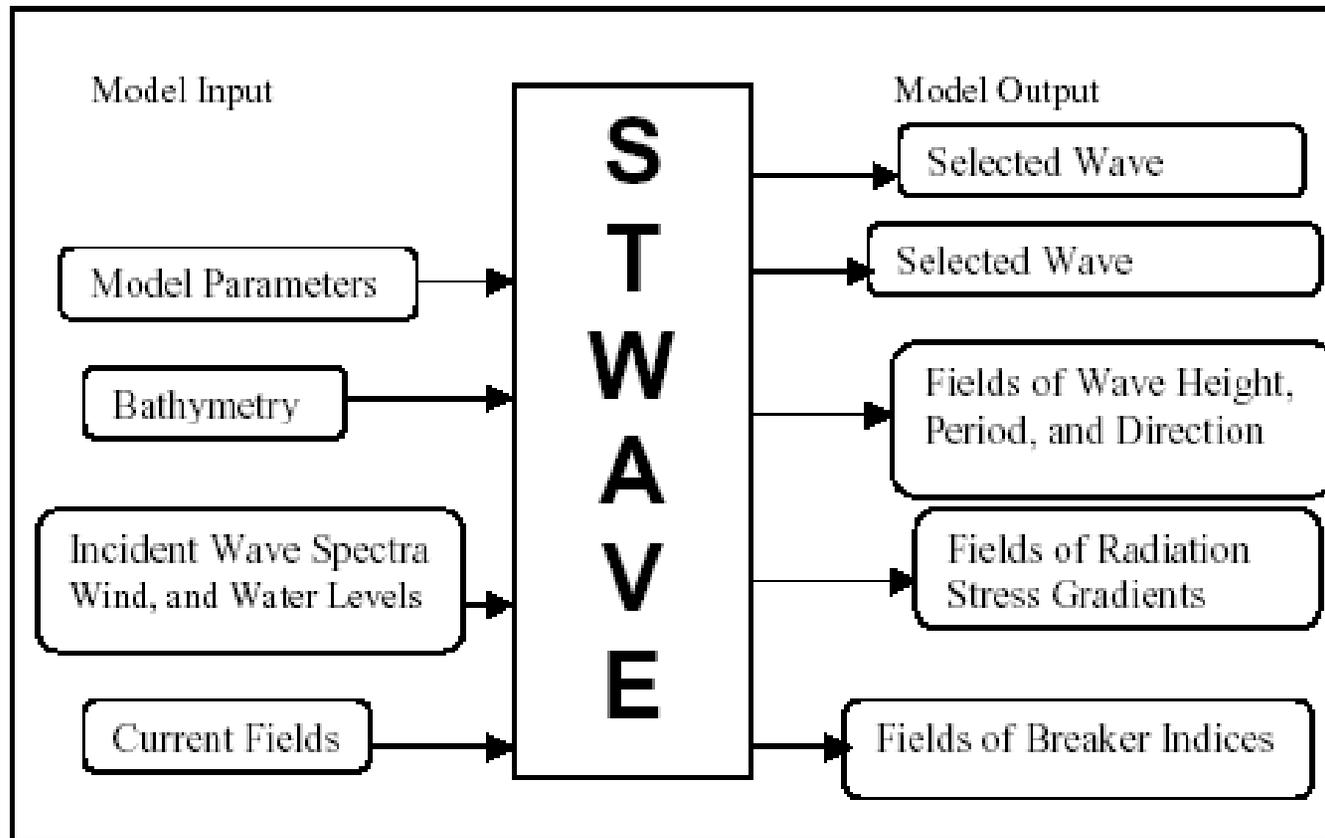
In relatively deep water, the wave field is fairly homogeneous on the scale of kilometers; but in the nearshore, where waves are strongly influenced by variations in bathymetry, water level, and current, wave parameters may vary significantly on the scale of tens of meters.

### Model Assumptions:

- a. Mild bottom slope and negligible wave reflection.*
- b. Spatially homogeneous offshore wave conditions.*
- c. Steady-state waves, currents, and winds.*
- d. Linear refraction and shoaling.*
- e. Depth-uniform current.*
- f. Bottom friction is neglected.*
- g. Linear radiation stress.*



# Model Input / Output



Spectra

Parameters

# CEDAS – NEMOS : STWAVE opening configuration screen

The screenshot shows the NEMOS - [STWAVE1] configuration window. The window title is "NEMOS - [STWAVE1]". The menu bar includes "File", "Window", and "Help". The toolbar contains icons for file operations and simulation control. The main area is divided into sections for simulation title, wind source terms, wind specifications, water level specifications, and current source terms. Each section has a "Constant Value for Simulation" option and a "Varies With Each Wave Event" option. The "Constant Value for Simulation" options have input fields with "0.0" and units (mps, deg, m). The "Current Source Terms Applied" section has a "Current Specifications" sub-section with a "Constant Current for Simulation" option and a "Varies With Each Wave Event" option. The status bar at the bottom shows "Configuration Files", "For Help, press F1", "NUM", "Friday, January 3, 2003", and "11:31:11 AM". The taskbar at the bottom shows the "start" button and several open applications: "Document1 ...", "NMLongOut...", "STWAVE", "Adobe Acro...", "CEDAS Cont...", "NEMOS - [S...", "Desktop", and "Friday".

**Title of simulation**

**Wind specification**

**Water level specification**

**Current field specification**



# Files Screen



**NEMOS - [STWAVE1]**

File Window Help

Icons: New, Open, Save, Print, Help, Mouse, Run, Stop, Info, Traffic Light

Pick Filename	Filename	
Configuration:	UNSAVED	
Spatial Domain		Clear
Spectrum File		Clear
Wind File		Clear
Water Levels		Clear
Current File		Clear
Field File		Clear
Station File		Clear
Printout File		Clear

Output directional spectral wave information to the station file  
 Output radiation stress terms  
 Output wave breaking indices

**Configuration file**

**Spatial Domain file (from GRIDGEN)**

**Spectrum file (from SPECGEN)**

**Wind information file**

**Water Level file**

**Currents file (from GRIDGEN)**

**Field file - results stored as binary file**

**Station file (from GRIDGEN)**

**Print file - examine results – text form**

**Output options**



# STWAVE within CEDAS



## Topics:

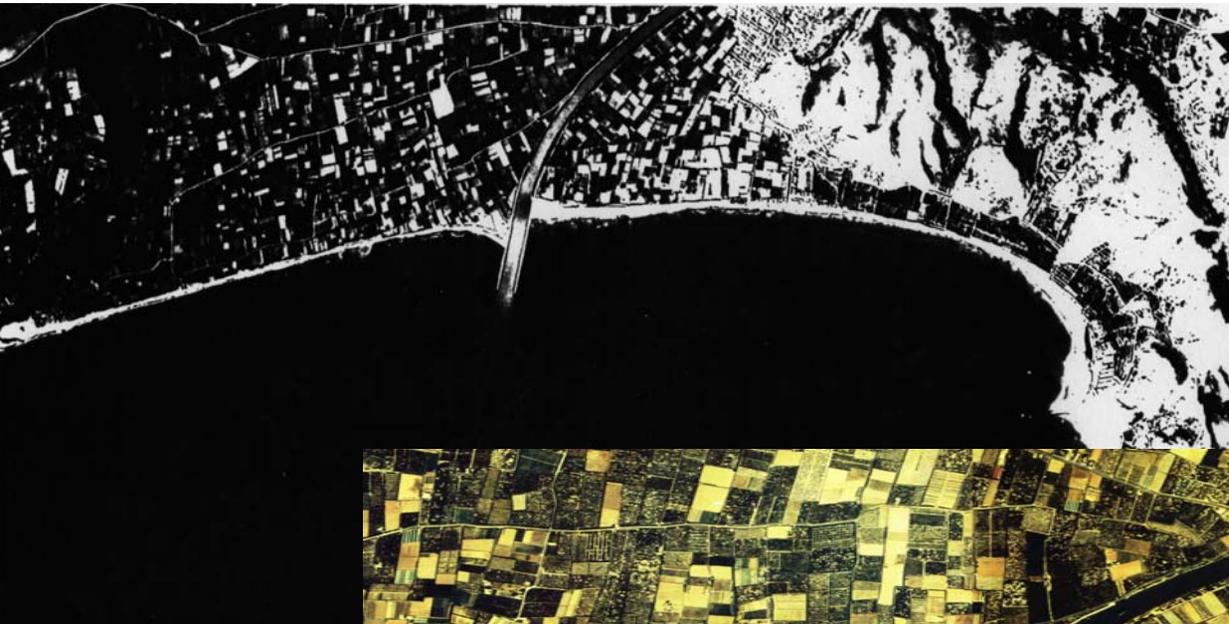
- Create a grid and specify “stations” for later gage analysis
- Prepare wave data for use in WSAV and SPECGEN
- Analyze wave data and produce a “permutation” file for use in SPECGEN
- Run SPECGEN to produce boundary conditions for STWAVE
- Run STWAVE and visualize results



The example chosen is a location on the coast of Spain.



# Ariel Photographs



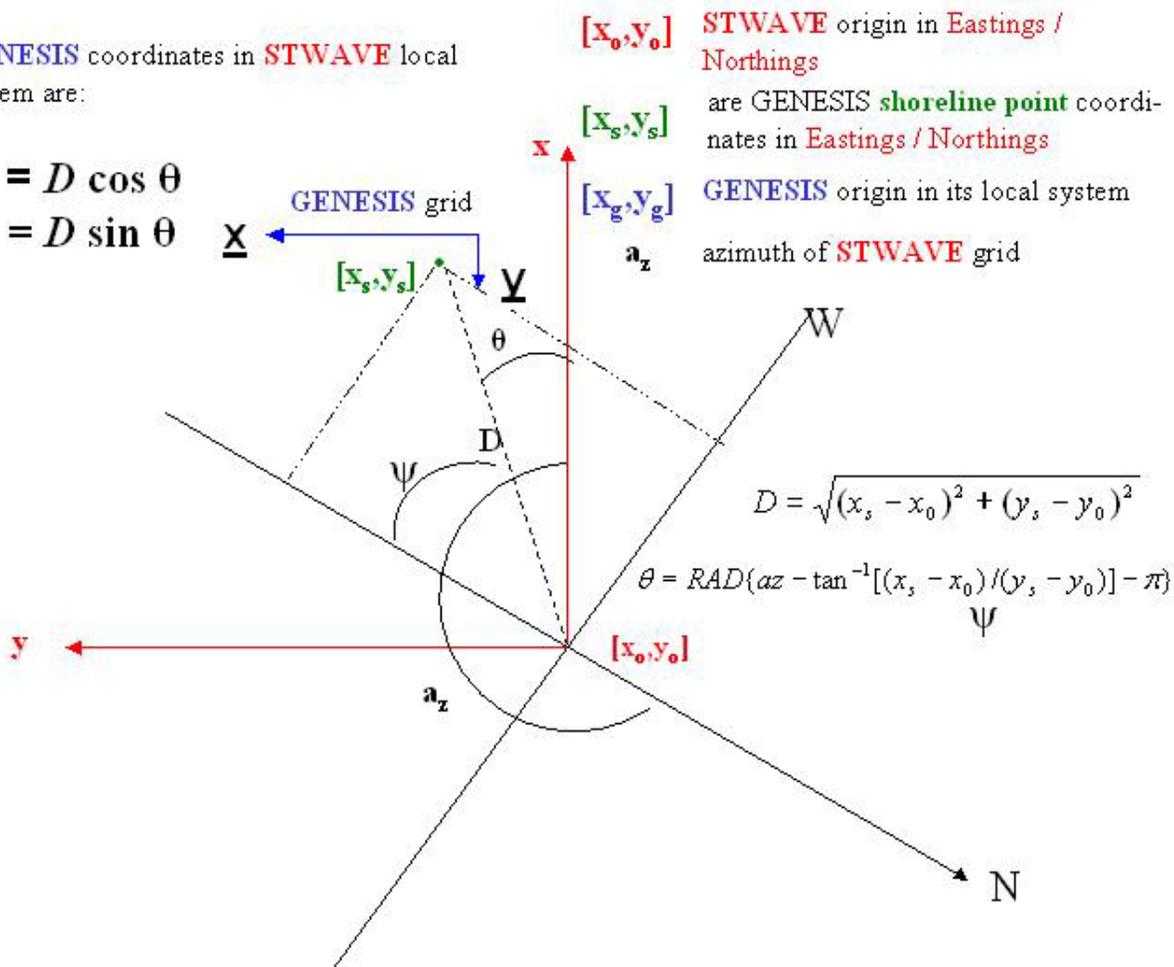
# STWAVE / GENESIS Axes Relationship



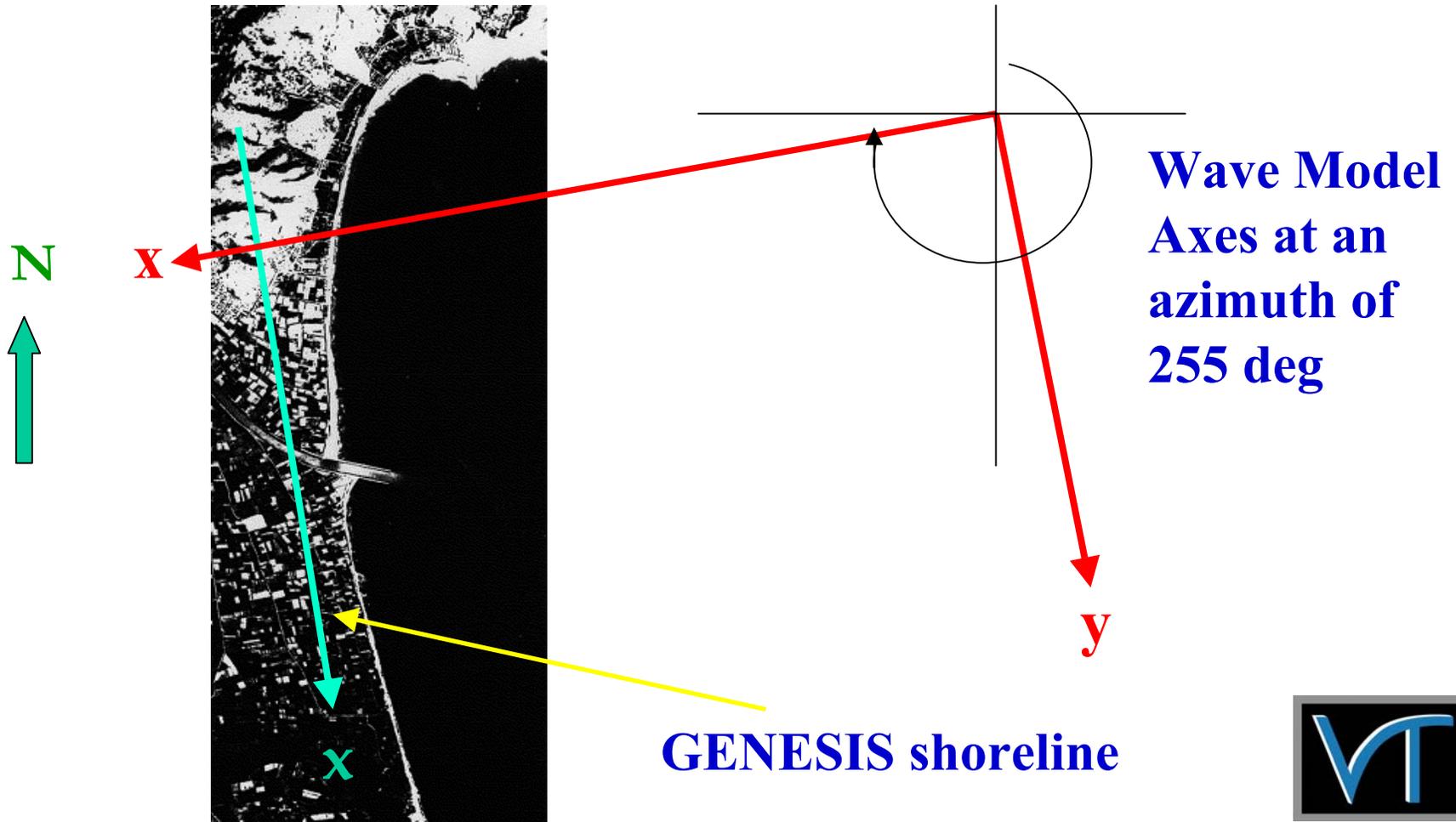
GENESIS coordinates in STWAVE local system are:

$$\underline{X}_s = D \cos \theta$$

$$\underline{Y}_s = D \sin \theta$$



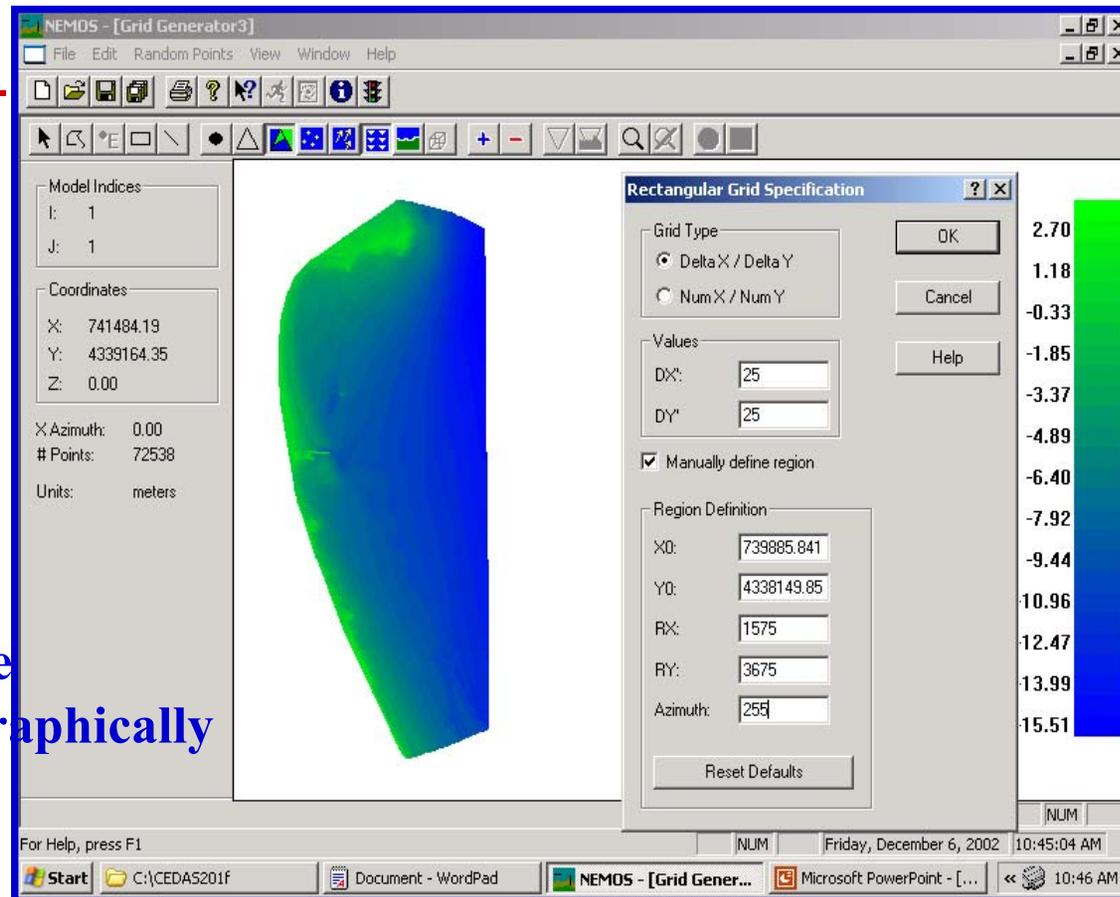
# STWAVE / GENESIS Axes



# Building a Grid



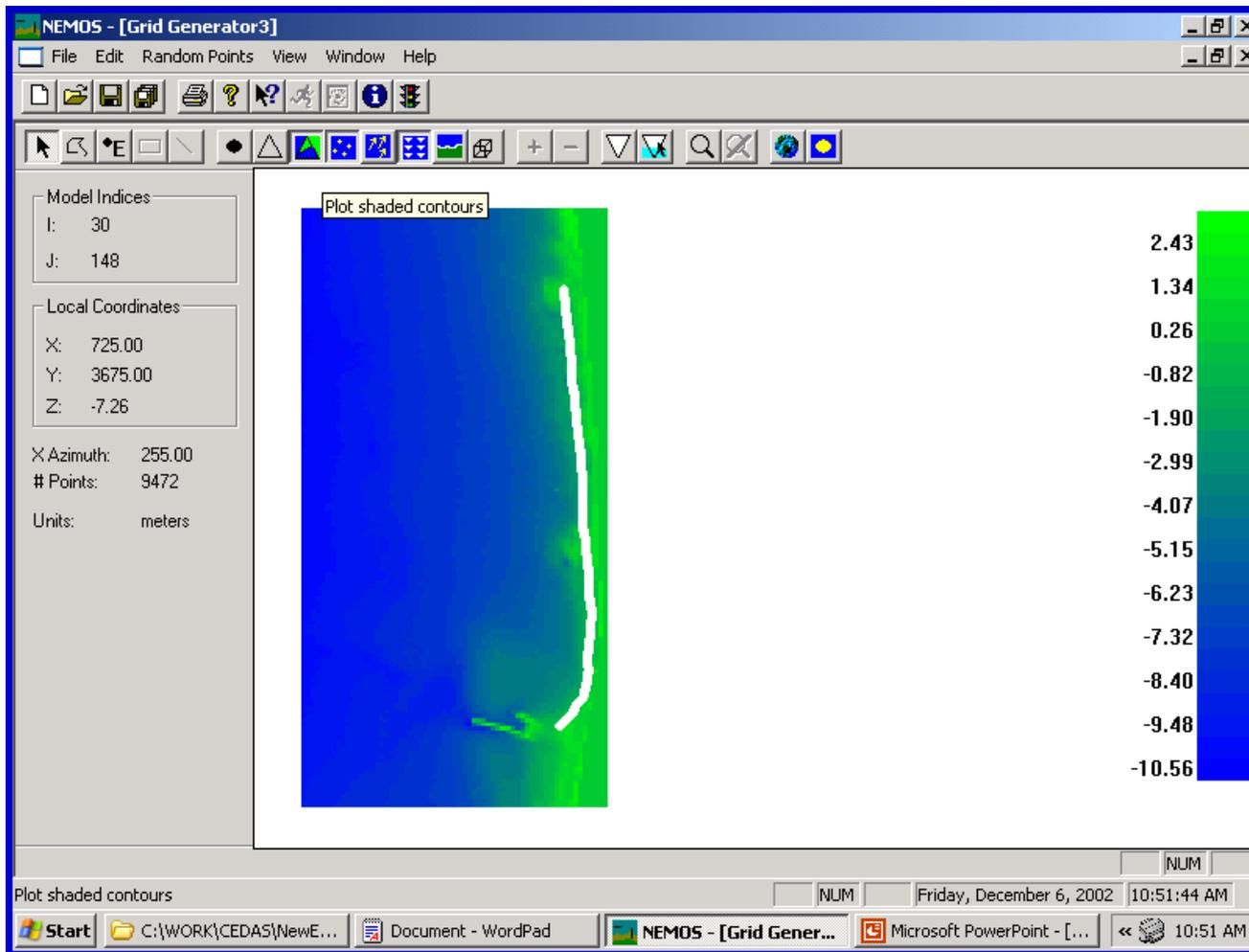
**STEP 1: Bathymetry data are imported into GRIDGEN – File JR\_bathyxyz.txt as Local. The grid is constructed by manually specifying the same origin coordinates, axes length, and azimuth as shown**



**The grid could have been constructed graphically**



# Insert Shoreline Points



**Step 2: Import**

**File:**

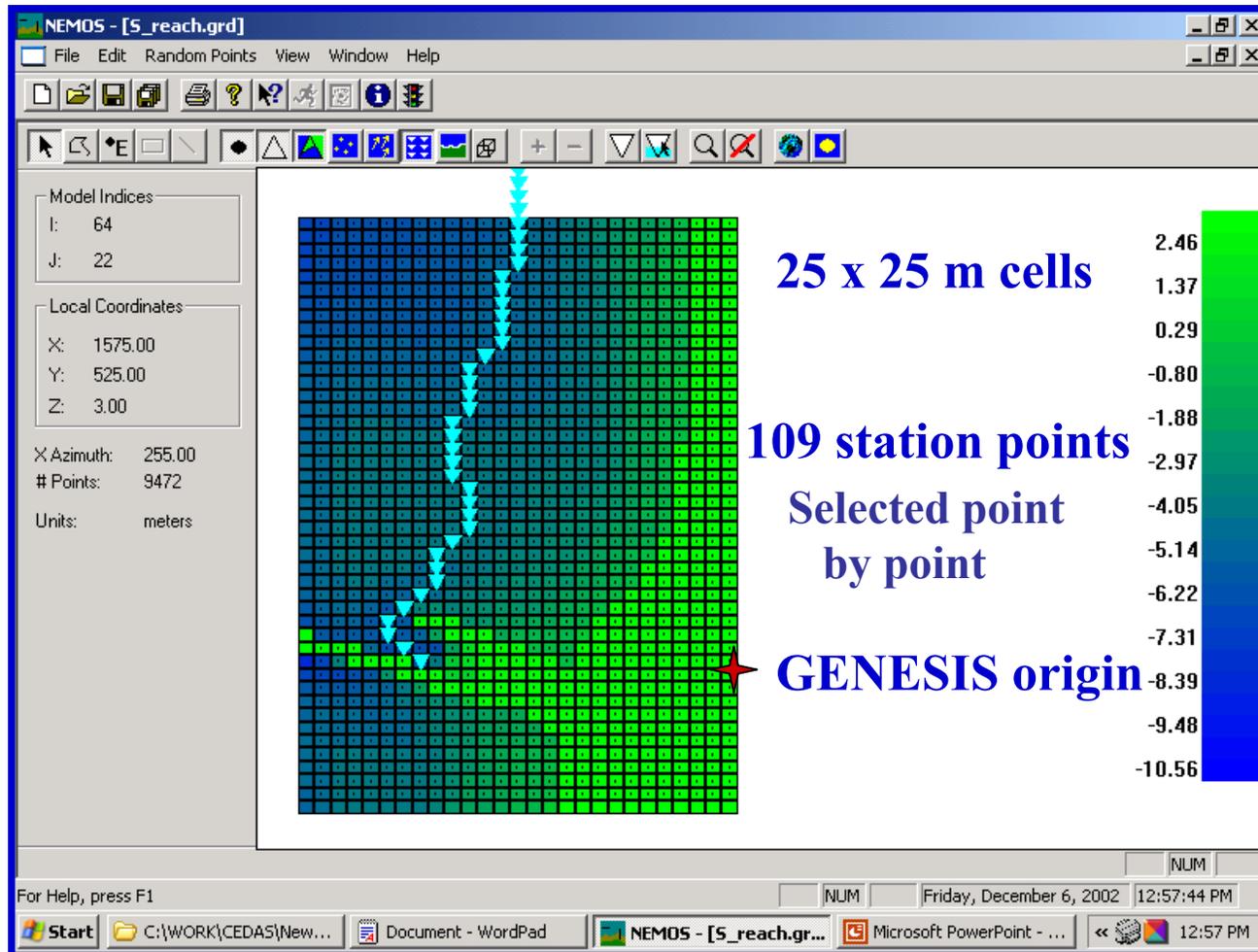
**J57shorelineXY.txt**



# Create GENESIS Grid



## Step 3



# Create GENESIS Grid



## Step 3 Cont'd

Cell wall 1  
coincides with  
center of wave  
grid cell

GENESIS origin  
lies  $\frac{1}{2} dx$  away

**GENESIS Grid Specifications**

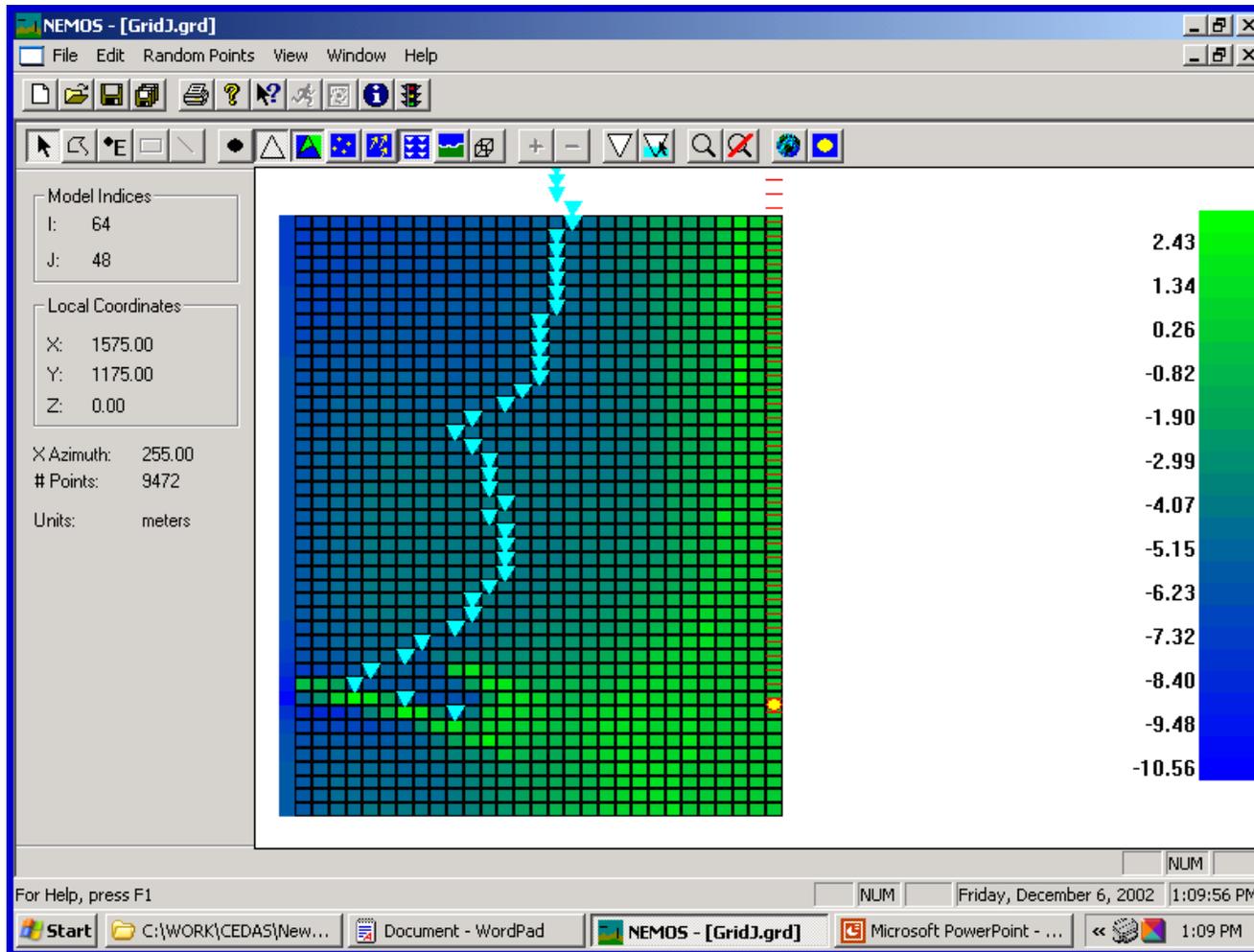
Easting of cell wall 1:	738490.68	OK
Northing of cell wall 1:	4337271.3	Cancel
dx:	25 (m)	
X-axis length:	2700 (m)	
Contour depth at first station:	5 (m)	
Stations should be created every	1 nth point	

Landward extent includes GENESIS axis

Cell wall 1



# Automated Station Selection

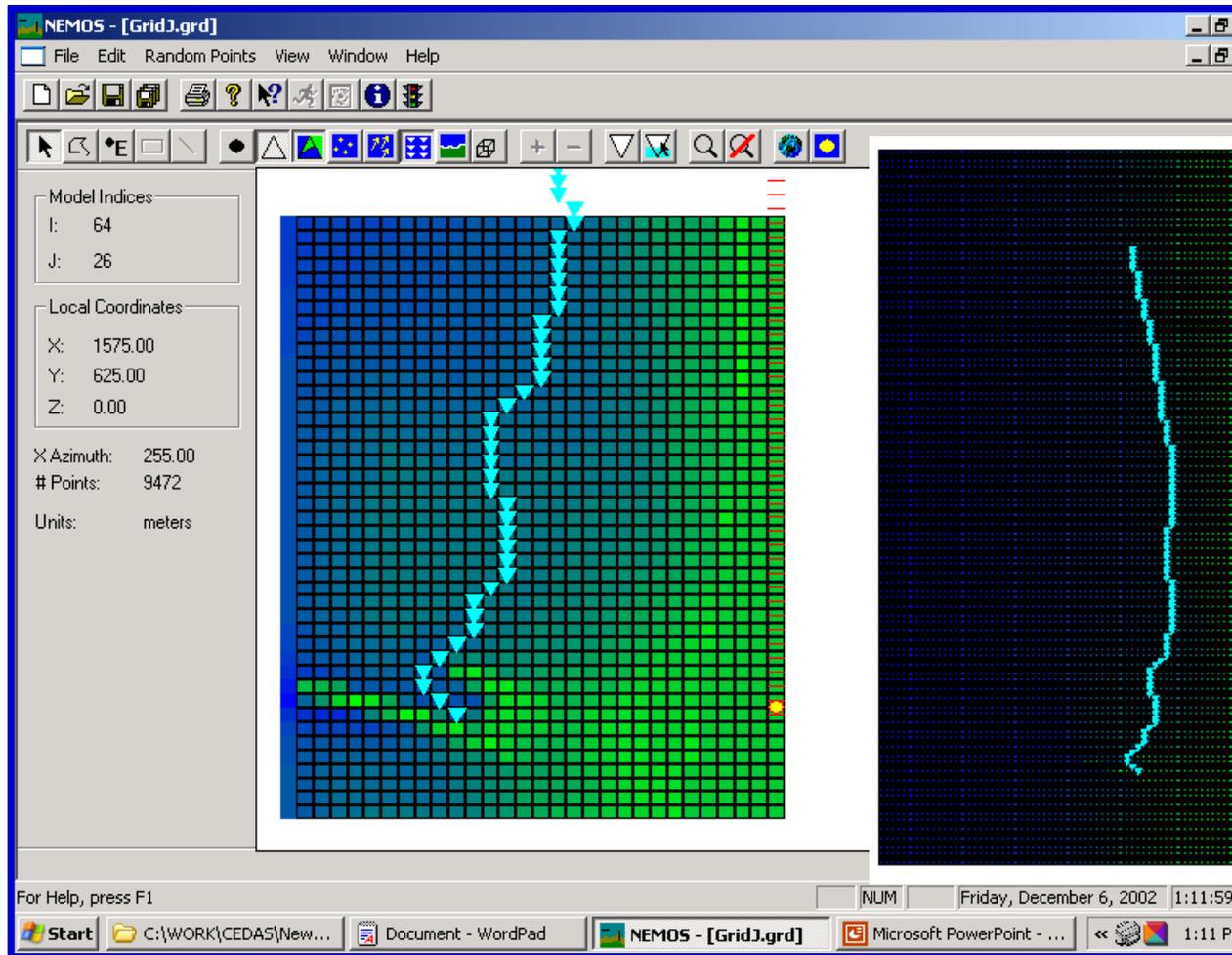


Stations placed column by column according to a depth closest to selected depth

Points adjusted by dragging



# Resulting Grid



**Step 4: Export  
the wave model  
SPD file (JCspd.nc)  
Station file (Jcsta.nc)**

**And the GENESIS  
SPD file (JCGENspd.nc)**



# Prepare Wave Data



The screenshot displays the NEMOS software interface with three main components:

- Data Table:** A table with columns A (Date), B (Time), C (Height), D (Period), and E (Direction). Rows 1-17 show data for 19760101 and 19760102. Rows 18-37 show data for 19760103 through 19760110. A red bracket on the right side of the table, spanning rows 1-17, is labeled "Missing data".
- Configuration Panel 1 (Top Right):** Contains settings for "Mean Water Depth at Datum" (20 m), "Horizontal Datum" (Local), "Vertical Datum" (Local), "World Coordinate System" (Provincial Cartesian), and "X" and "Y" coordinates (0 ft).
- Configuration Panel 2 (Bottom Right):** Contains settings for "Wave Component Name" (comp\_wave), "Station Name" (Boundary of Wave Grid), "Wave Height Units" (m), "Direction Convention" (Shore\_Ref 1), and "Azimuth of zero wave angle (clockwise from north)" (75).

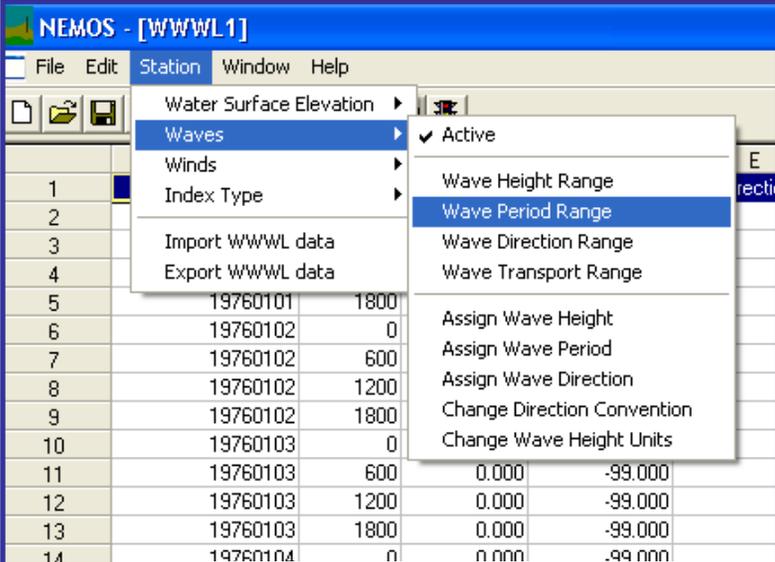
Import ASCII wave data file into WWWL

Specify location information

Specify direction convention



# Filtering Data



NEMOS - [WWWL1]

File Edit Station Window Help

Water Surface Elevation  
Waves  
Winds  
Index Type

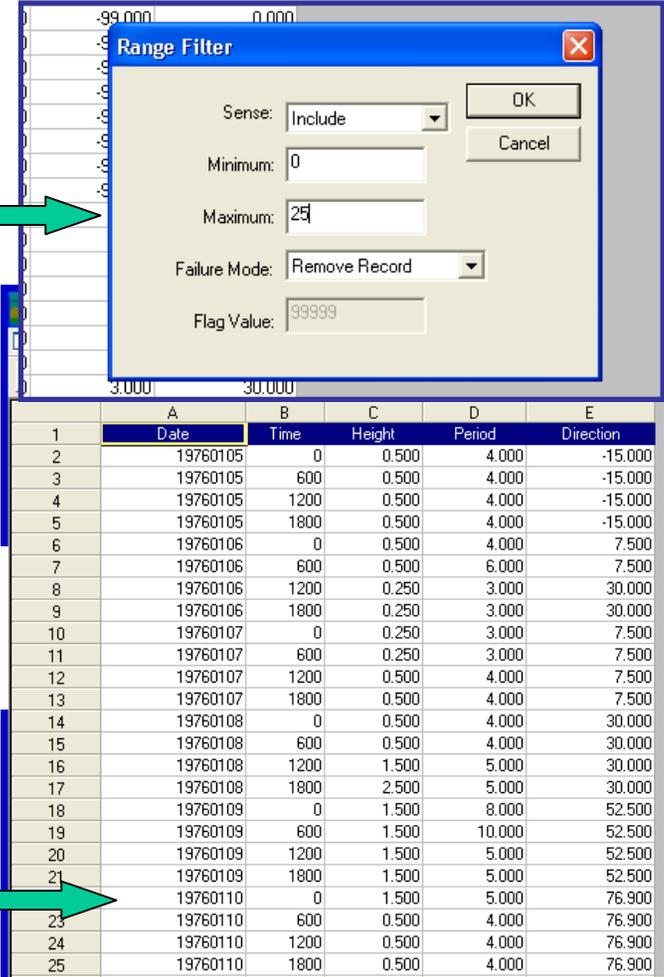
1 19760101 1800  
2 19760102 0  
3 19760102 600  
4 19760102 1200  
5 19760102 1800  
6 19760103 0  
7 19760103 600  
8 19760103 1200  
9 19760103 1800  
10 19760103 0  
11 19760103 600  
12 19760103 1200  
13 19760103 1800  
14 19760104 0

Wave Height Range  
Wave Period Range  
Wave Direction Range  
Wave Transport Range

Assign Wave Height  
Assign Wave Period  
Assign Wave Direction  
Change Direction Convention  
Change Wave Height Units

Filter the range of periods to remove missing data keyed with T = -99

	Date	Time	Height	Period	Direction
1	19760105	1200	0.500	4.000	
2	19760105	1800	0.500	4.000	
3	19760106	0	0.500	4.000	
4	19760106	600	0.500	4.000	
5	19760106	1200	0.500	4.000	
6	19760106	1800	0.500	4.000	
7	19760107	0	0.500	4.000	
8	19760107	600	0.500	4.000	
9	19760107	1200	0.500	4.000	
10	19760107	1800	0.500	4.000	
11	19760108	0	0.500	4.000	
12	19760108	600	0.500	4.000	
13	19760108	1200	1.500	5.000	
14	19760108	1800	2.500	5.000	
15	19760109	0	1.500	10.000	
16	19760109	1200	1.500	5.000	
17	19760109	1800	1.500	5.000	
18	19760110	0	1.500	5.000	
19	19760110	600	0.500	4.000	
20	19760110	1200	0.500	4.000	
21	19760110	1800	0.500	4.000	



Range Filter

Sense: Include  
Minimum: 0  
Maximum: 25  
Failure Mode: Remove Record  
Flag Value: 99999

	A	B	C	D	E
	Date	Time	Height	Period	Direction
1	19760105	0	0.500	4.000	-15.000
2	19760105	600	0.500	4.000	-15.000
3	19760105	1200	0.500	4.000	-15.000
4	19760105	1800	0.500	4.000	-15.000
5	19760106	0	0.500	4.000	7.500
6	19760106	600	0.500	6.000	7.500
7	19760106	1200	0.250	3.000	30.000
8	19760106	1800	0.250	3.000	30.000
9	19760107	0	0.250	3.000	7.500
10	19760107	600	0.250	3.000	7.500
11	19760107	1200	0.500	4.000	7.500
12	19760107	1800	0.500	4.000	7.500
13	19760108	0	0.500	4.000	30.000
14	19760108	600	0.500	4.000	30.000
15	19760108	1200	1.500	5.000	30.000
16	19760108	1800	2.500	5.000	30.000
17	19760109	0	1.500	8.000	52.500
18	19760109	600	1.500	10.000	52.500
19	19760109	1200	1.500	5.000	52.500
20	19760109	1800	1.500	5.000	52.500
21	19760110	0	1.500	5.000	76.900
22	19760110	600	0.500	4.000	76.900
23	19760110	1200	0.500	4.000	76.900
24	19760110	1800	0.500	4.000	76.900
25	19760110	1800	0.500	4.000	76.900

**Why filter?**  
To be able to analyze for statistical properties

Filter results



# Set Height, Period, and Angle Bands



W  
S  
A  
V

For Help, press F1

Band	Limit
1	0.25
2	0.50
3	1.50
4	2.50
5	3.50
6	4.50

Band	Limit
1	0.00
2	4.00
3	6.00
4	8.00
5	10.00
6	12.00
7	14.00

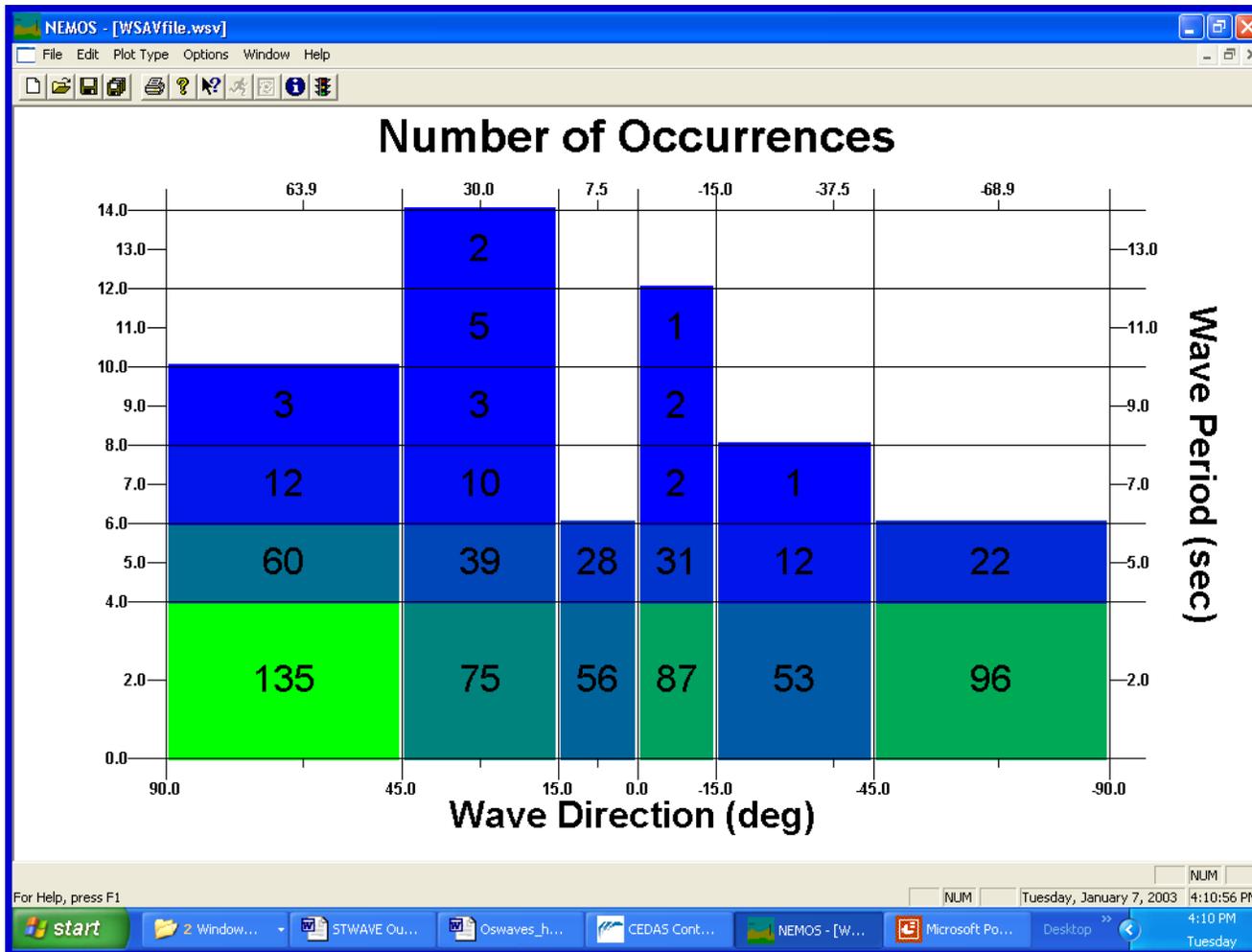
Band	Limit
1	90.00
2	45.00
3	15.00
4	0.00
5	-15.00
6	-45.00
7	-90.00

NUM Tuesday, January 7, 2003 3:43:57 PM  
start 2 Window... STWAVE Ou... Oswaves\_h... CEDAS Cont... NEMOS - [W... Microsoft Po... Desktop 3:47 PM Tuesday

Then choose Edit / Analyze



# WSAV Graphics



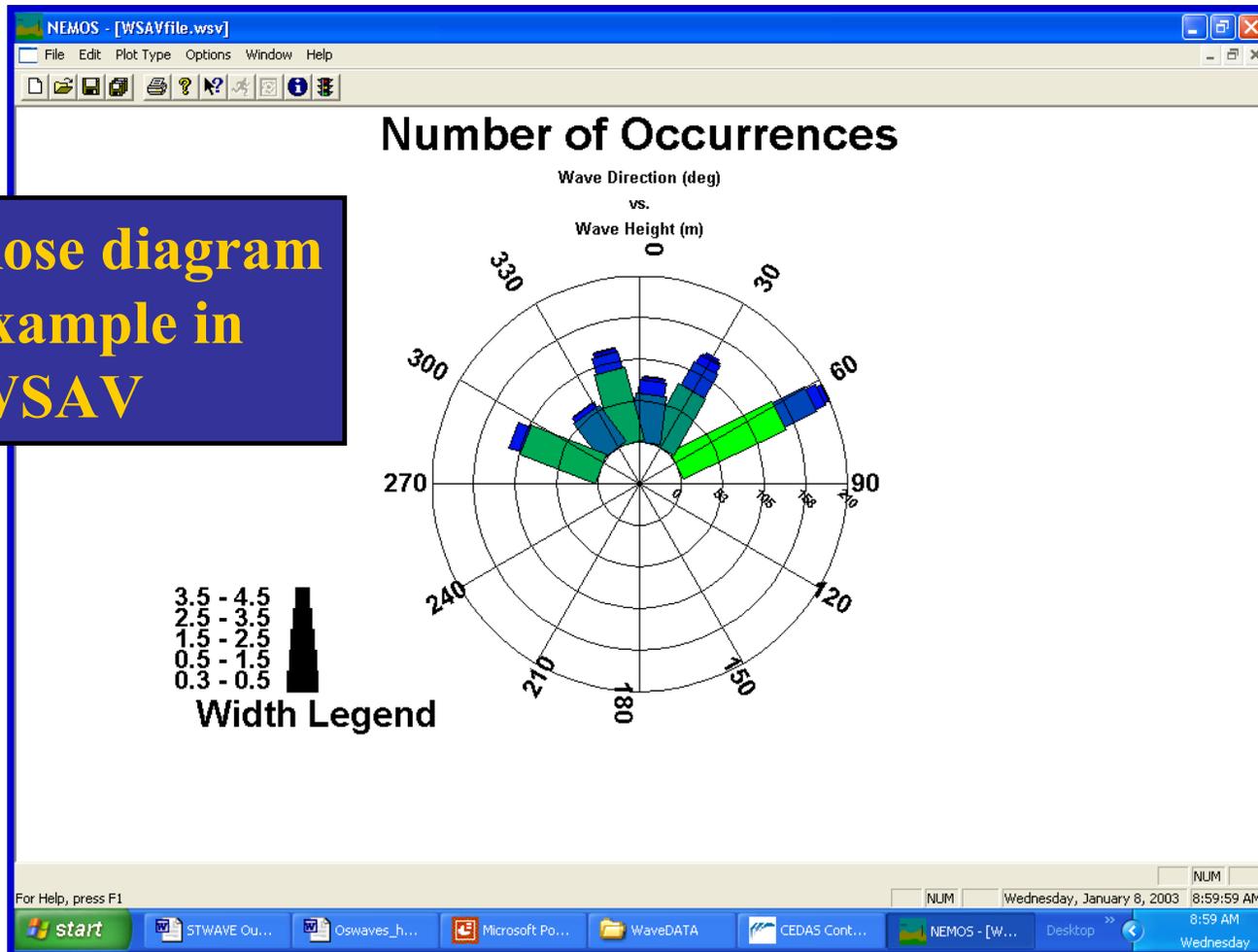
**Analysis:**  
**22 events selected**  
**Save permutation**  
**file for use in**  
**SPECGEN**



# WSAV Graphics



**Rose diagram  
example in  
WSAV**



# Run SPECGEN



Import wave permutation file and derive spectra

Derive Theoretical Spectra from (H, T, theta)

Index type: Integer

f(hz) Angle (deg)

No. 20 35

Min: 0 -85

Delta: 5 5

Constant gamma: 3.3 Apply

Constant nn: 4 Apply

Conserve energy

Water depth: 20 (m)

X-azimuth: 255 (deg fr N)

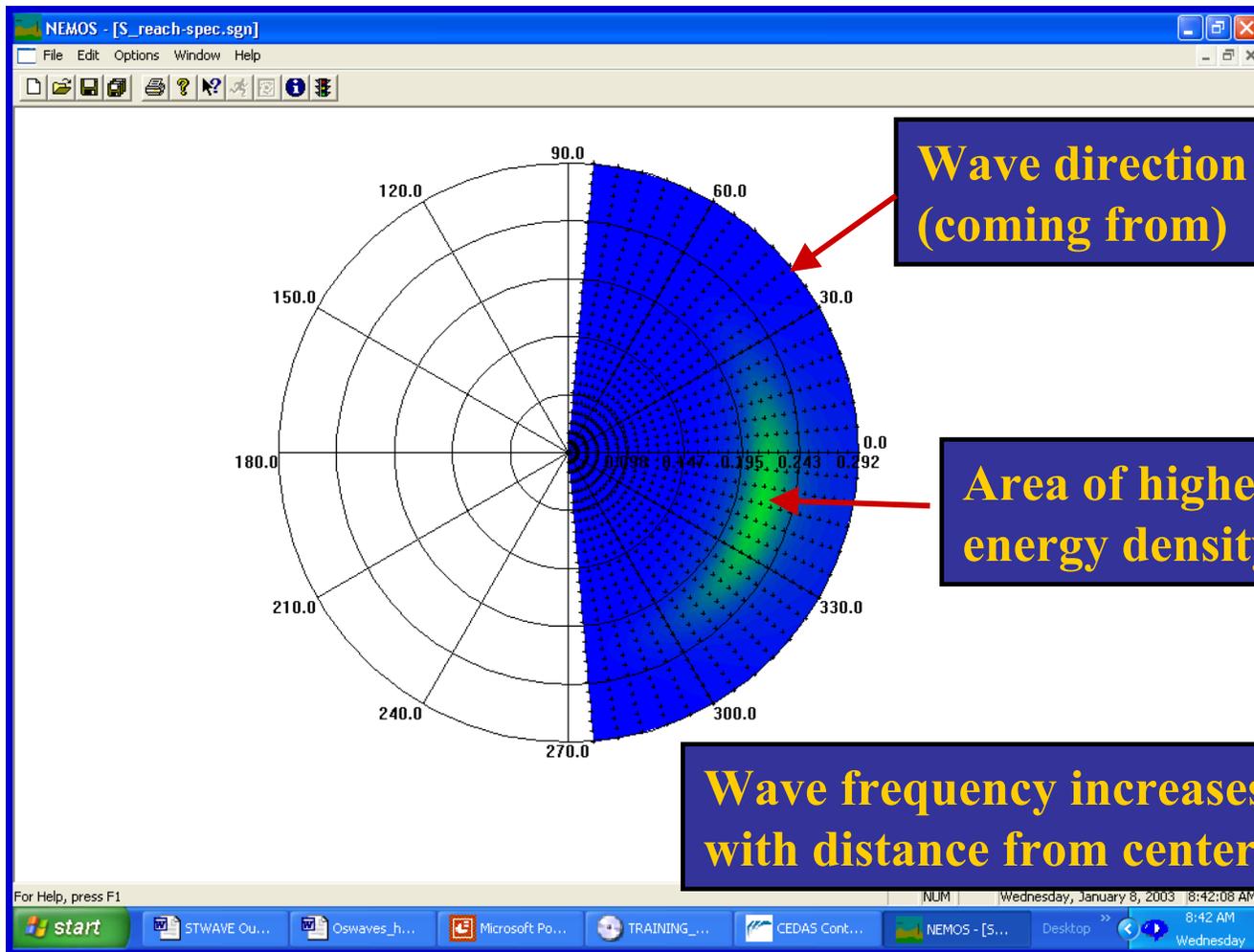
Index	H(m)	T (sec)	Local Angle (deg)	Gamma	nn
10101	0.25	4.03	63.88	3.30	4
20101	0.25	4.03	30.00	3.30	4
30101	0.25	4.03	7.50	3.30	4
40101	0.25	4.03	-15.00	3.30	4
50101	0.25	4.03	-37.50	3.30	4
60101	0.25	4.03	-68.90	3.30	4
10102	0.50	4.03	63.88	3.30	4
20102	0.50	4.03	30.00	3.30	4
30102	0.50	4.03	7.50	3.30	4
40102	0.50	4.03	-15.00	3.30	4
50102	0.50	4.03	-37.50	3.30	4
60102	0.50	4.03	-68.90	3.30	4
10202	0.50	6.00	63.88	3.30	4
20202	0.50	6.00	30.00	3.30	4

OK Cancel

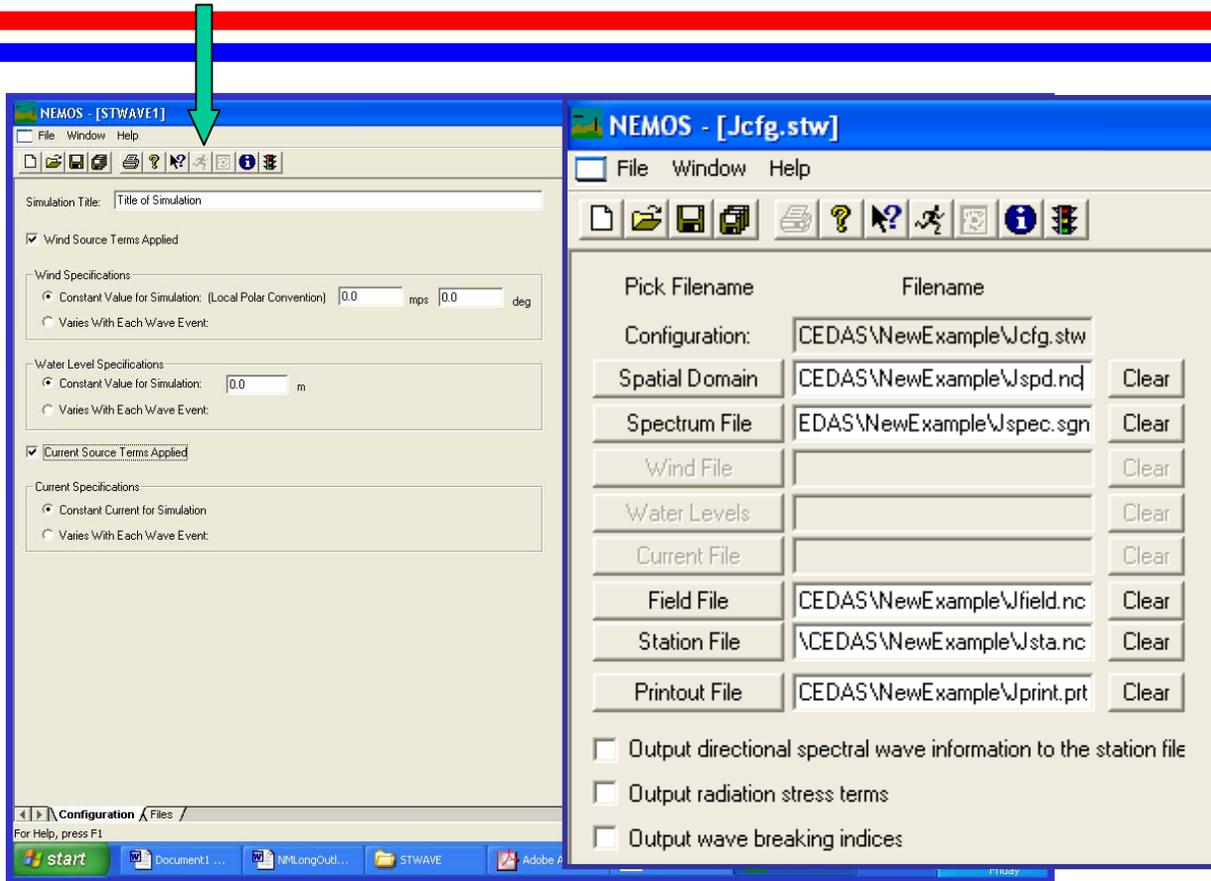
Specify frequency bins, frequency & direction spread controls. Water depth and azimuth are passed to SPECGEN through the permutation file.



# SPECGEN Graphics



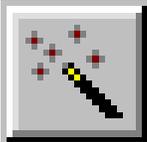
# Run STWAVE



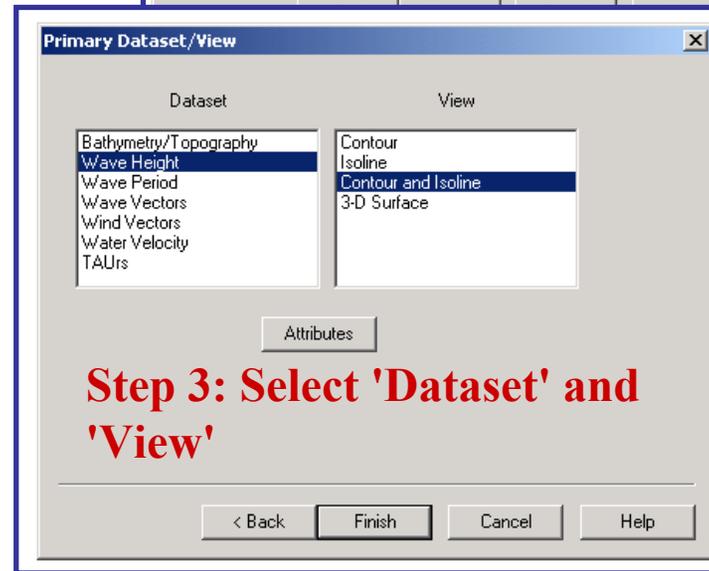
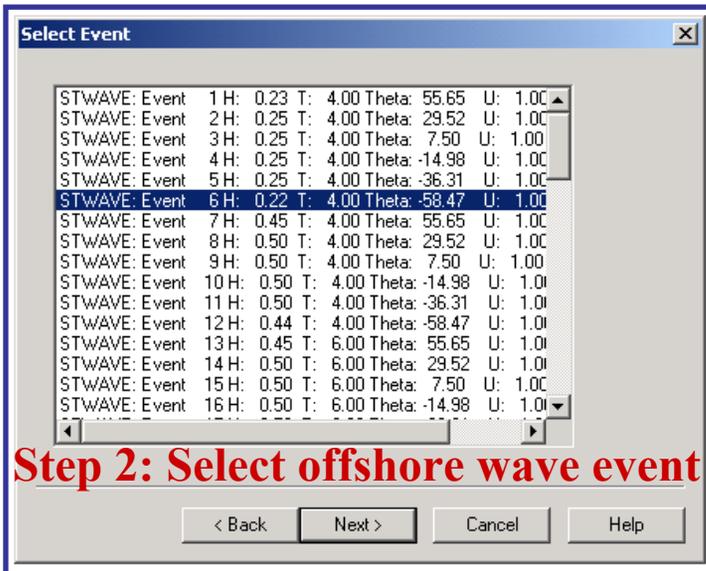
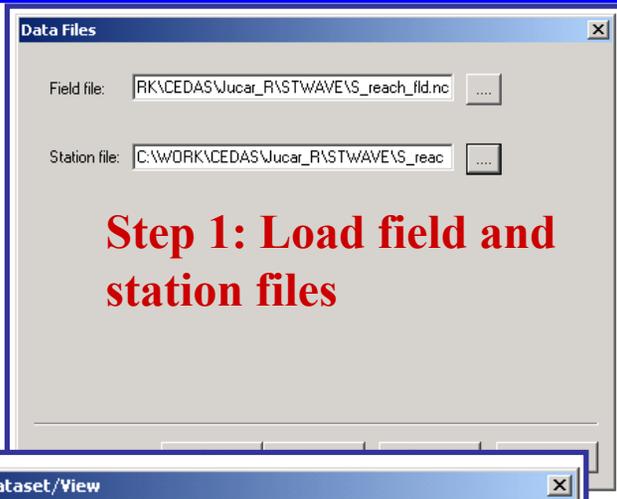
- Configuration file**
- Spatial Domain file (from GRIDGEN)**
- Spectrum file (from SPECGEN)**
- Wind information file**
- Water Level file**
- Currents file (from GRIDGEN)**
- Field file - results stored as binary file**
- Station file (from GRIDGEN)**
- Print file - examine results – text form**



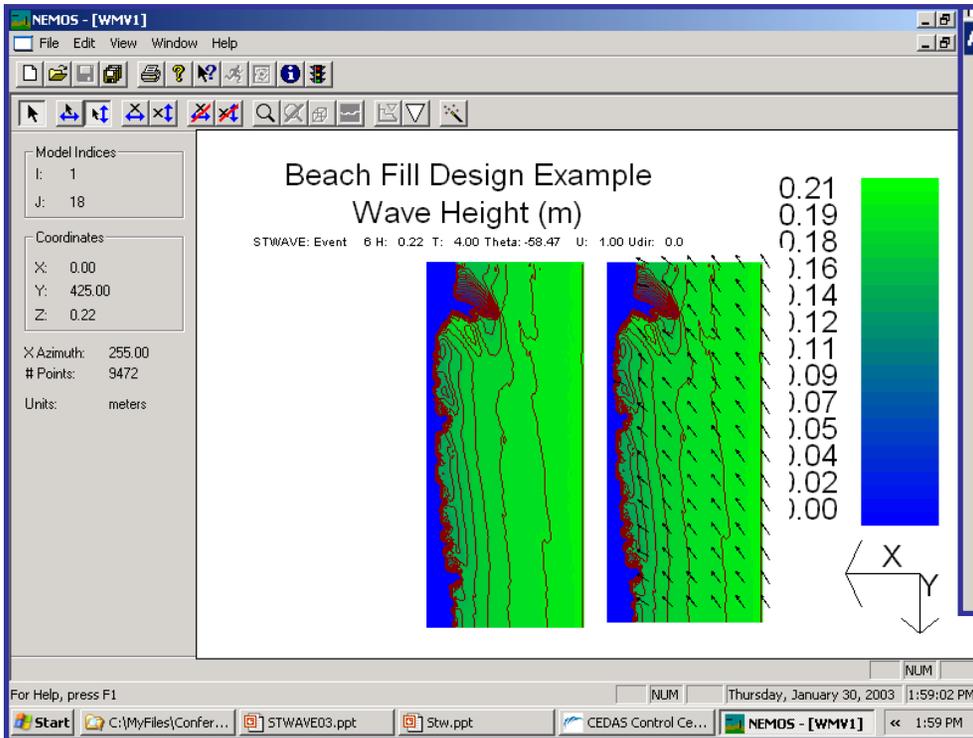
# WMV: Visualization



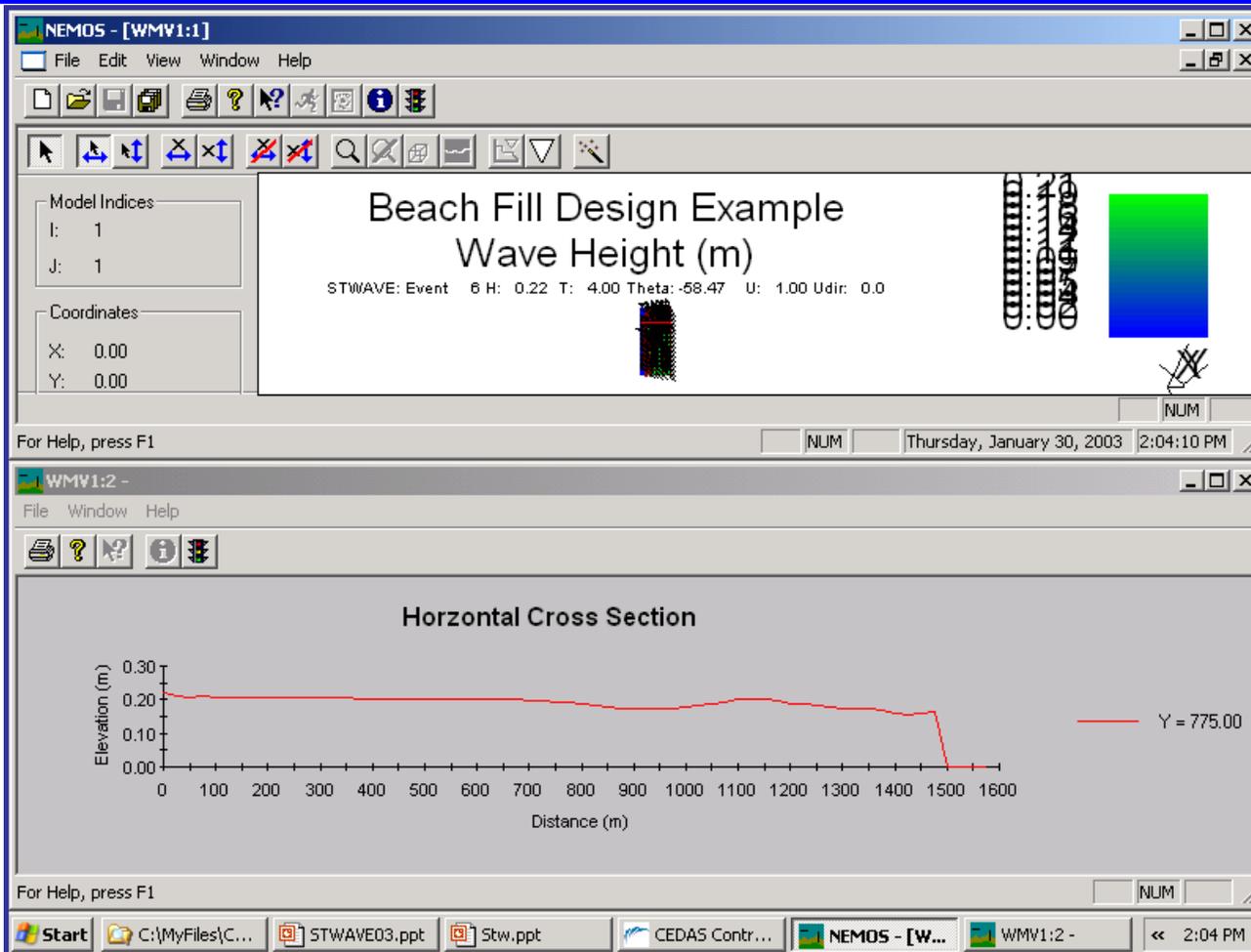
**The setup wizard is used to change the data being visualized**



# WMV: Visualization



# WMV: Visualization



 **Draw horizontal cross-section**

 **Move horizontal cross-section**

 **Delete horizontal cross-section**

