

B8. Using CMS-Wave

The most recent CMS-Wave code developed is Version 3.2. Several new capabilities and advanced features in this version include:

- Full-plane wind-generation of waves
- Automatic wave run-up calculation
- Infra-gravity wave calculation
- Nonlinear wave-wave interaction
- Muddy bottom (additional wave dissipation)
- Binary file output
- Selection of multiple processors
- Permeable structure
- Spatially varied wind input
- Spatially varied spectral input
- Grid nesting

The SMS interface has not been updated for many of the new features.

B8.1. Grid Generation

Now that all modifications to the CMS-Flow grid alternatives have been finalized, the wave grid can be generated from the Flow grid. CMS-Wave grids are typically generated from scatter datasets, but can be a mirror image of the flow grid if the boundary condition (BC) locations are close enough to force both the tide and waves from the same BC area. In the near future, CMS will have the option to be run fully inline, where only one grid will contain all of the information needed to run both CMS-Wave and CMS-Flow.

The CMS-Wave IJ triad should be adjusted where the I-direction is pointing in the dominant wave direction, or more specifically from the open ocean. This means that it will be 180 deg off as compared to the CMS-Flow grid. Therefore, after the CMS-Flow grid is generated, the model domain should be set to include all major reaches of the bay, extending laterally a couple kilometers from the inlet and extending seaward well beyond the anticipated reach of the ebb jet. A good rule of thumb for setting the ocean boundary for inlet modeling is to place the boundary three or four times the length of the ebb jet (leaving provision for extreme discharges, such as during storm surge). The given bathymetry ends at approximately four times the length of the ebb jet at Shark River.

- Transforming the CMS-Flow grid to a CMS-Wave Grid
 1. Open one of the generated grids rt-click the Grid in the SMS list, and click on *Duplicate*, select the copied grid (copy) to activate it, and go to *Data, Switch Current Model* (Figure B 8.1-1),

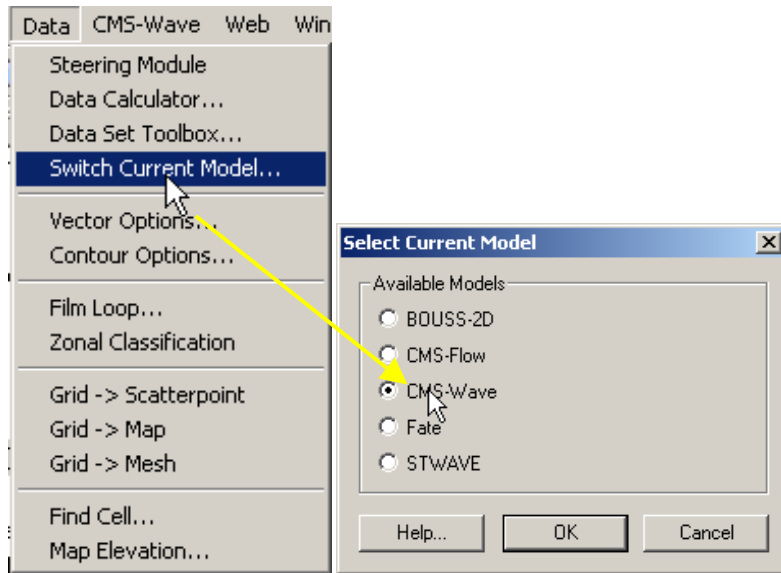


Figure B 8.1-1. Data Options, Switch Current Model: Available Models.

2. Change the Model from *CMS-Flow* to *CMS-Wave*, click *OK*, and rename the grid by rt-clicking on the copy name and clicking *Rename*,
3. Set the jetty and groin cells to rubble-mound type structures by selecting the cells (Figure B 8.1-2), and rt-click, *Cell Attributes...*, and select a *Rubble-mound* from the *Structure Type*, click *OK*.
4. *File, Save As, Wave.sim* (selecting the *Save As Type* as a .sim for simulation) in the folder with the CMS-Flow grid.

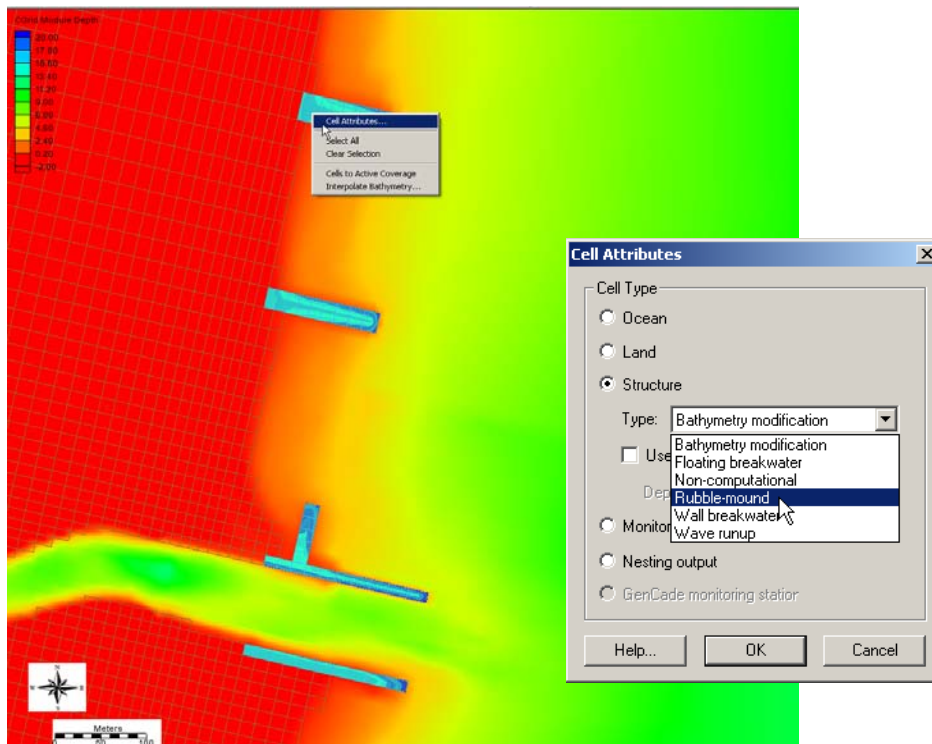
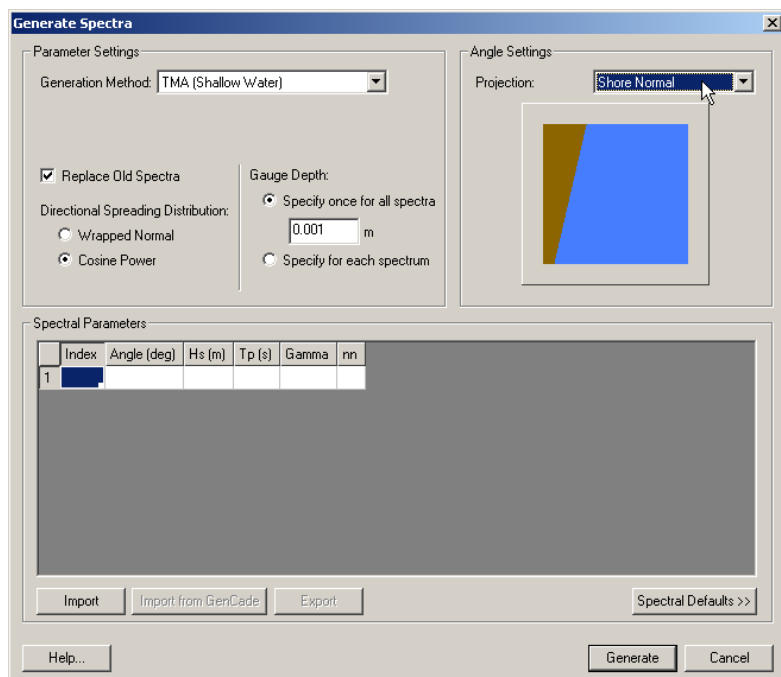


Figure B 8.1-2. Setting structure cells in CMS-Wave

B8.2. Model Control and Input Spectra

Now that all modifications to the CMS-Wave grid are complete, the spectral waves or wave parameters can be generated for the wave grid. Full (directional) spectra can be imported into the SMS for the CMS-Wave, as well as simplified wave parameters (angle, wave height, and period, etc).

- Adding Wave Parameter Generated Spectra to CMS-Wave
 1. Click on *CMS-Wave, Spectral Energy*, and select *Create Grid* (wave spectra can be imported),
 2. Click *OK* for the default spectral properties, and then click *Generate Spectra* to bring up the window to input wave parameters (Figure 30),
 3. Open the Excel spreadsheet *44025buoy_199902.xls* and select the wave parameters (1 month, Feb 1999), copy and paste this into the *Generate Spectra – Spectral Parameters* section (Figure B 8.2-1), click *Generate, OK*.
 4. Go to CMS-Wave, Model Control, and turn on *Allow wetting and drying* and *Bed friction* (Figure B 8.2-2),
 5. Users can also specify constant or varied forward and backward reflection coefficients in *Settings*.
 6. Water level and wind information are optional source as specified under *Wave Source* in addition to the spectral input data.
 7. *File, Save As, Wave.sim* (selecting the *Save As Type* as a .sim for simulation) in the folder with the CMS-Flow grid.



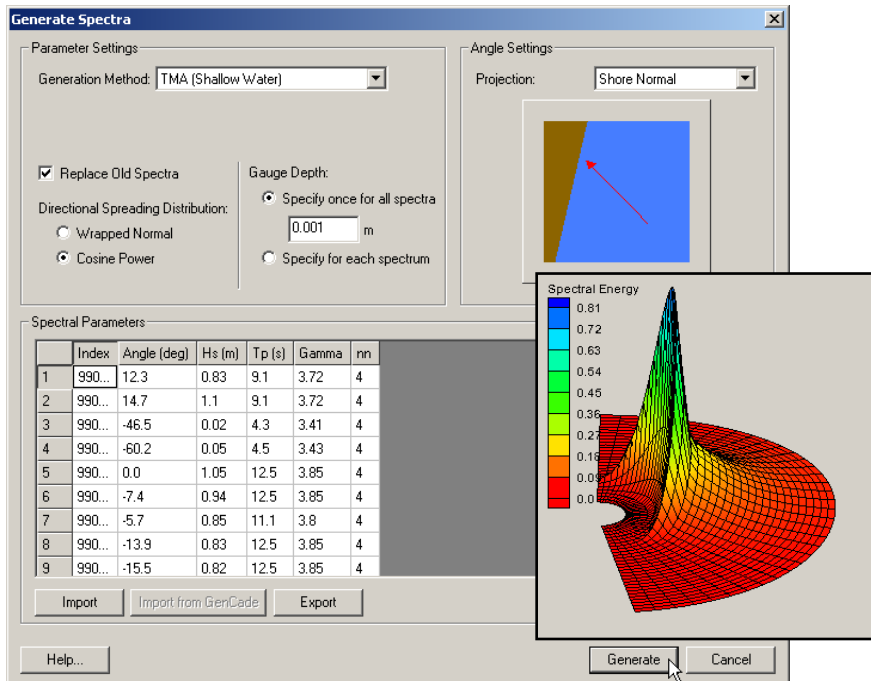


Figure B 8.2-1. Top Generating wave spectra from wave parameter input; Bottom: Generated wave parameters with a snapshot of spectral output.

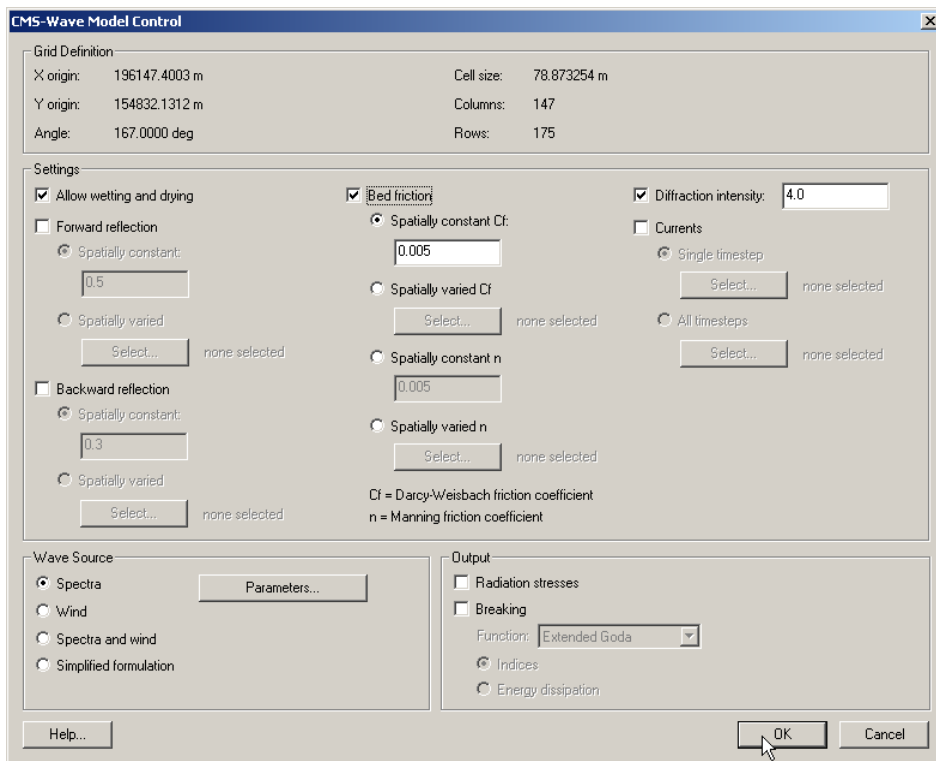


Figure B 8.2-2. CMS-Wave model control options

B8.3. Providing Sea Buoy Data to CMS-Wave

Directional spectral data collected by NDBC or CDIP buoys can be processed as alternative source for wave input to CMS-Wave. Two examples are given below using CDIP 154 and NDBC 44025 standard spectral files for December 2009.

- NDBC buoy data – run **ndbc-spectra.exe** (FORTRAN) to read the NDBC standard directional wave file and generate the CMS-Wave input spectral *.eng.
 1. Download the NDBC standard monthly directional wave spectral file from <http://www.nodc.noaa.gov/BUOY/buoy.html> (e.g., 44025_200912) - see Figure B 8.3-1 to Figure B 8.3-4 for accessing NDBC spectral data from the Web.
 2. In the DOS window, run **ndbc-spectra.exe**, shown in Figure B 8.3-5.
 3. Responding to the on-screen input, type the NDBC spectral filename
 4. Type the starting timestamp (default value is 0) for saving output files
 5. Type ending timestamp (default is 99999999) for saving output files
 6. Type the time interval (hr) for saving output data
 7. Type 2 to save the CMS-Wave *.eng and *.txt files
 8. Type the CMS-Wave input spectrum filename (*.eng)
 9. Type the local shoreline orientation (the CMS-Wave grid y axis) in clockwise polar coordinates (deg, positive from North covering the sea, e.g., 180 deg for St Mary's Entrance, FL/GA, or 360 deg - the wave grid orientation angle in *.sim)
 10. Type the NDBC buoy location water depth (m) and then the CMS-Wave seaward boundary mean water depth (m), e.g. Buoy 44025 has a nominal depth of 36.3 m relative to Mean Sea Level
 11. Type 1 to include wind or 0 to skip the wind input information
 12. Type 1 or 2 or 3 for different choice of calculated frequency bins to complete the run.
 13. The output files include *.txt, *.eng, *.out (time series of wave parameters at the buoy), and *.dat (time series of shoreward wave parameters at the CMS-Wave offshore boundary).

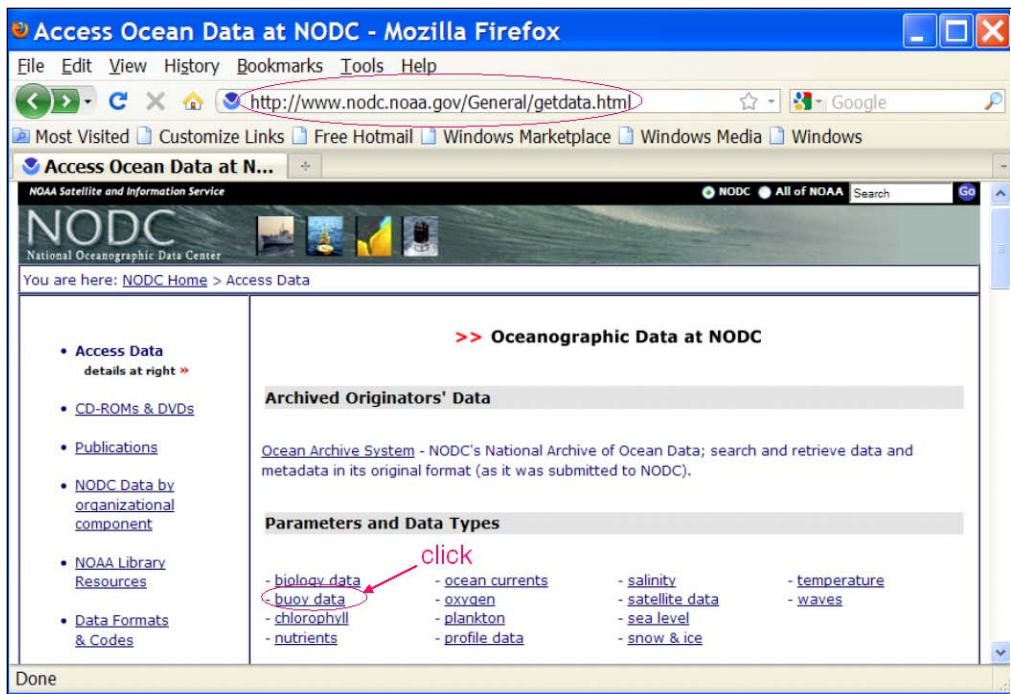


Figure B 8.3-1. NODC buoy data access website.

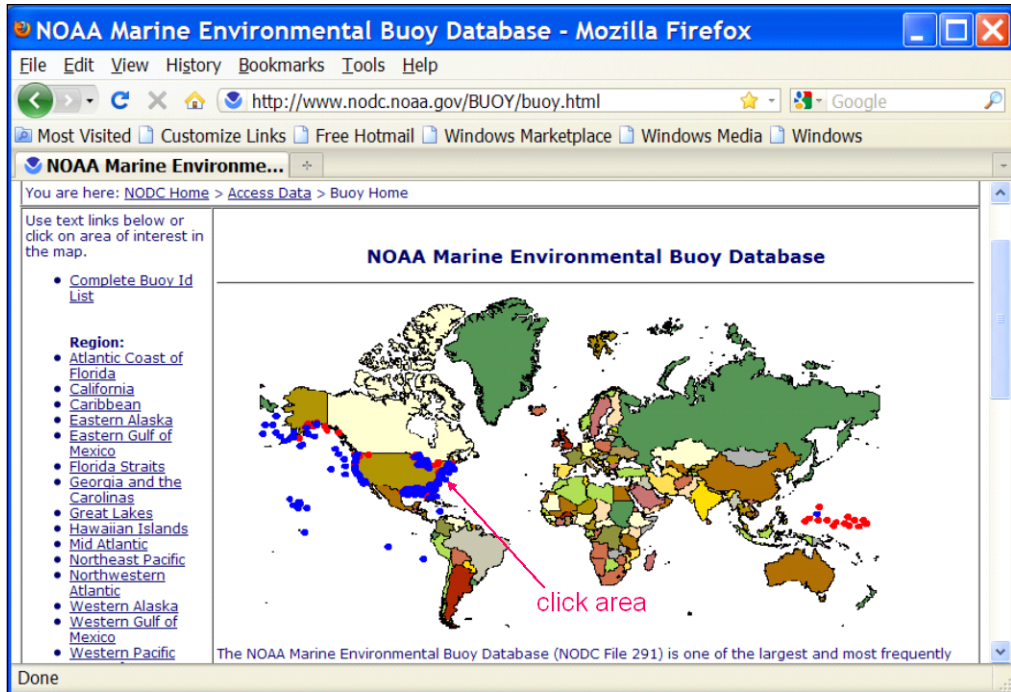


Figure B 8.3-2. NODC buoy data access world map.

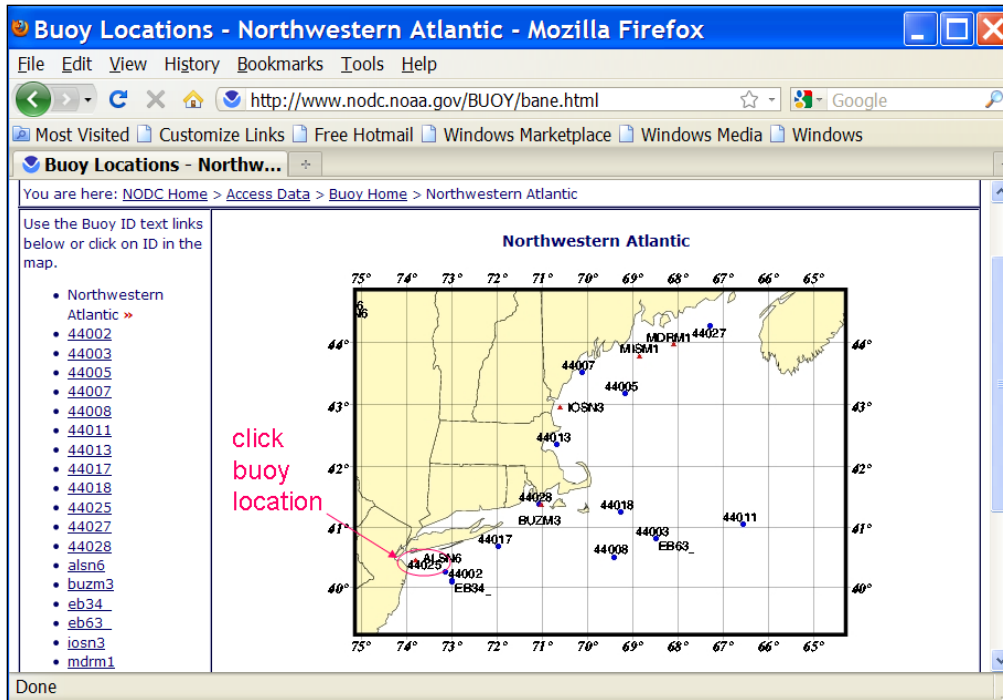


Figure B 8.3-3. NODC buoy data access regional map.

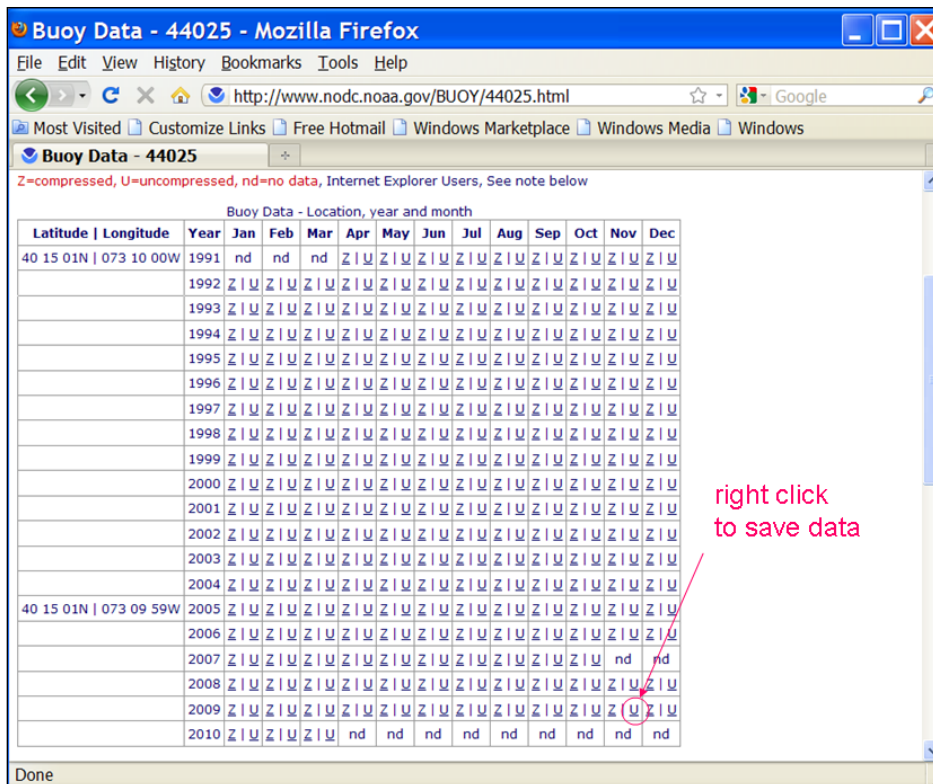


Figure B 8.3-4. NDBC buoy spectral data download website.

```

c:\ Command Prompt
C:\Mydocuments\CIRP-Jax7-9Feb2011-Workshop\Shark-River-Inlet-CMS-Wave>ndbc-spectra
Type in an NDBC buoy CD-ROM filename
  (e.g., 46042_95.11)
44025_200912
Type starting time stamp (yymmddhh or 0)
0
Type ending time stamp (yymmddhh or 99999999)
99999999
Type the time interval (hr) for the output data
  (e.g., 3 for 0 3 6 9 12 15 18 21 hr result
       6 for 0 6 9 12 18 hr result
       0 for writing out all of the result)
3
Type 1 to write a full 2-D spectral file
  or 2 to write a CMS-Wave spectral file
  or 0 to skip:
2
Type output spectrum filename (*.eng)
2009.eng
*** Output NDBC full-plane wave parameter file
2009.out
*** Output CMS-Wave parameter file
2009.txt
Output CMS-Wave spectrum file
2009.eng
Output half-plane parameter file
2009.dat
Type the local shoreline orientation (y-axis)
in polar coordinates (deg, positive from North
covering the sea, e.g., 180 deg for St Marys,
Entrance, FL/GA)
193
Type the offshore NDBC buoy depth (m)
36.3
Type the seaward grid boundary depth (m)
20
Type 1 to include wind data in the CMS-Wave file
  0 to skip
1
Type 1 to select 30 frequencies: .04, .05, ..., 0.33
  (3 to 25 sec, for general ocean wave growth)
  2 to select 40 frequencies: .06, .07, ..., 0.45
  (2.2 to 17 sec, for full-plane GOM wind sea)
  3 to select 42 frequencies: .04, .05, ..., 0.45
  (2.2 to 25 sec, for full-plane sea with bay)
1
station id number =      44025
ending wave parameter time stamp =      10010100
ending wave spectrum time stamp =      10010100
C:\Mydocuments\CIRP-Jax7-9Feb2011-Workshop\Shark-River-Inlet-CMS-Wave>

```

Figure B 8.3-5. Run ndbc-spectra.exe in DOS.

- CDIP buoy data - run **cdip-spectra.exe** (also FORTRAN code) to read the CDIP standard directional wave file and generate the CMS-Wave input *.eng file. Download the CDIP wave file from <http://cdip.ucsd.edu/?nav=historic&sub=data> (e.g., sp154-200912) – see Figure B 8.3-6 to Figure B 8.3-8.

Run **cdip-spectra.exe** in the DOS window similar to **ndbc-spectra.exe** – see Figure B 8.3-9. Because CDIP spectral file already contains the buoy location depth information, **cdip-spectra.exe** will not prompt for this depth input. For processing either NDBC or CDIP data, users shall check and manually fill any data gaps in *.eng and *.txt files (using the first available spectral data from the neighboring time interval).

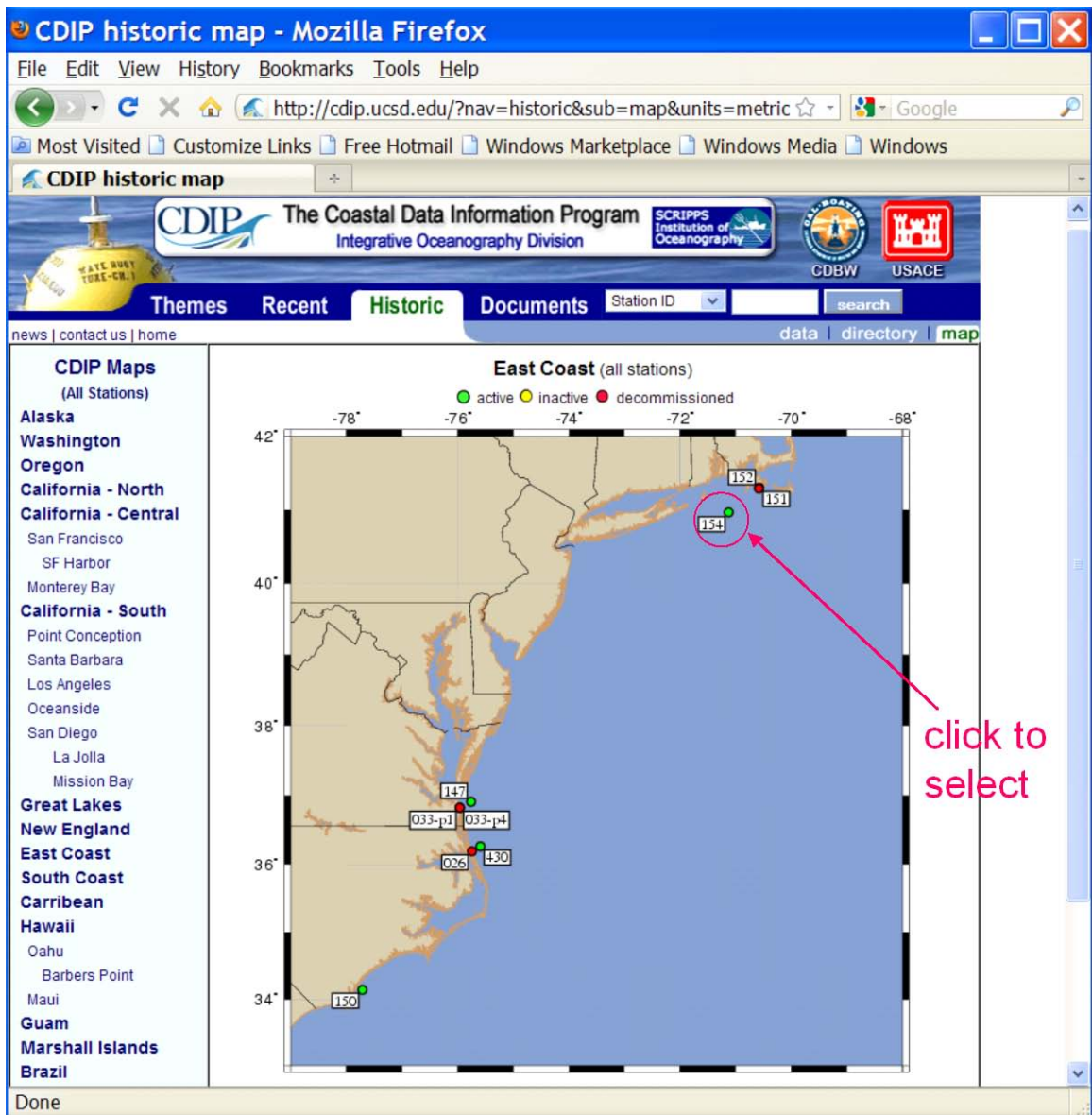


Figure B 8.3-6. CDIP buoy data access website.

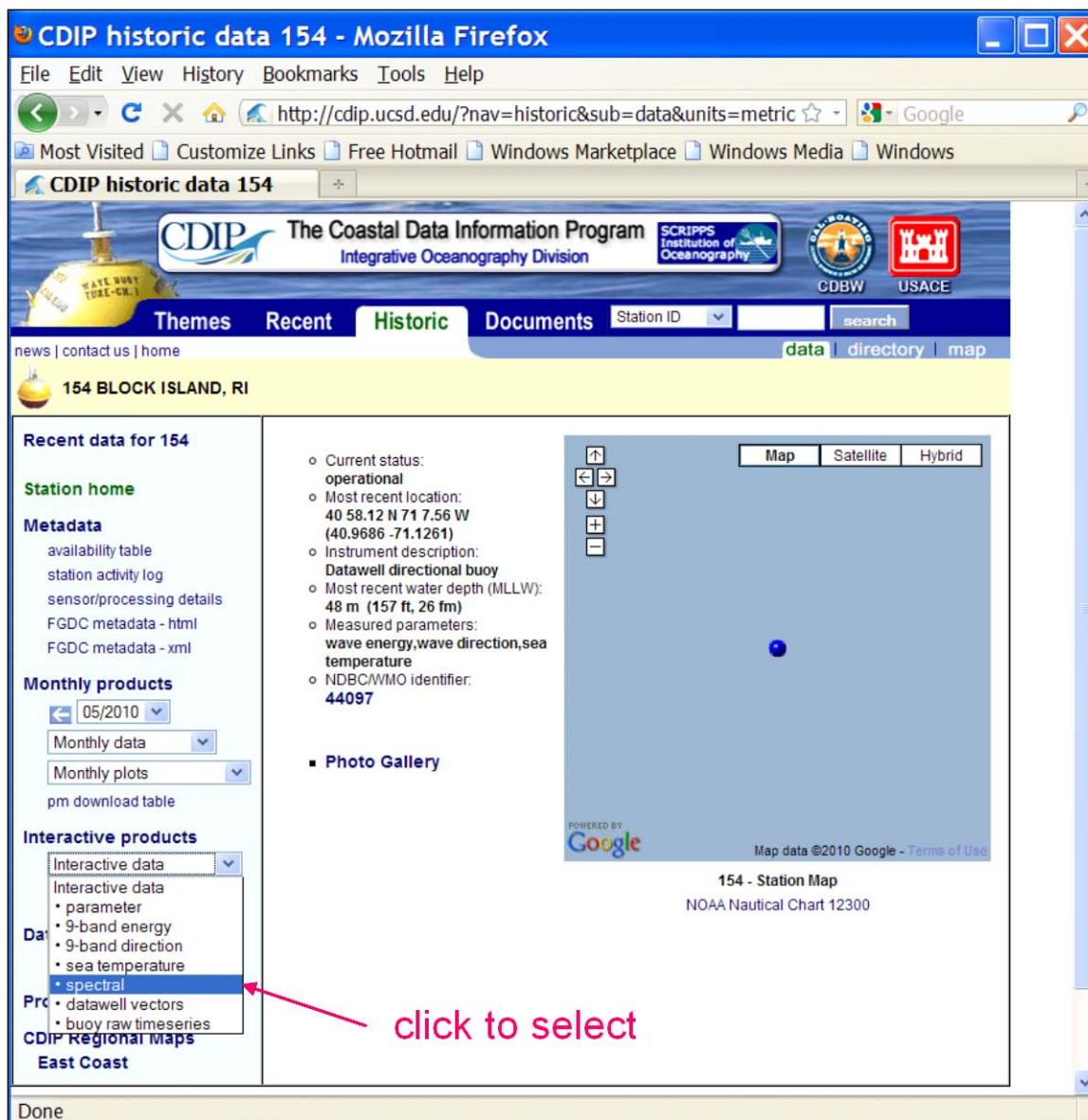


Figure B 8.3-7. CDIP buoy data access website.

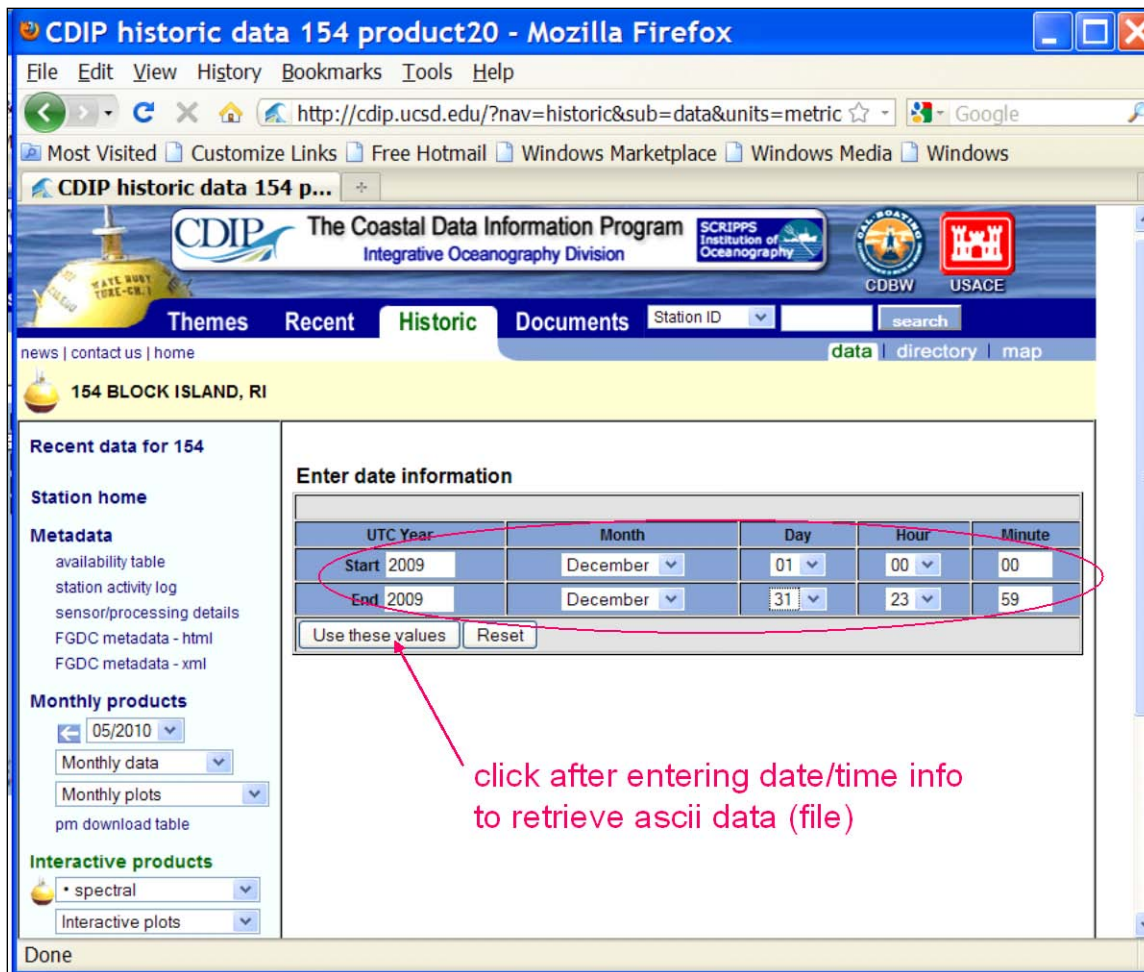


Figure B 8.3-8. CDIP buoy spectral data download website.

```
C:\ Command Prompt
C:\Mydocuments\CIRP-Jax7-9Feb2011-Workshop\Shark-River-Inlet-CMS-Wave>cdip-spectra
Type in an CDIP (SCRIPPS) gauge data filename
(e.g., sp098_c32b201.txt)
sp154_200912
input starting time stamp (yymmddhh or 0)
0
input ending time stamp (yymmddhh or 99999999)
99999999
Type 0 to output all available results
or n to output exact every n-hr data
3
Type 1 to write a full 2-D spectral file
or 2 to write a CMS-Wave spectral file
or 0 to skip:
2
Type output spectrum filename (*.eng)
2009-sp154.eng
*** Output CDIP full-plane wave parameter file
2009-sp154.out
*** Output CMS-Wave parameter file
2009-sp154.txt
Output CMS-Wave spectrum file
2009-sp154.eng
Output half-plane parameter file
2009-sp154.dat
*** Type the local shoreline orientation (y-axis)
in polar coordinates (deg, positive from North
covering the sea, e.g., 180 deg for St Marys,
Entrance, FL/GA)
193
CDIP buoy location depth (m) = 48.00000
Type the seaward grid boundary depth (m)
20
Type 1 to select 30 frequencies: .04,.05, ..., 0.33
(3 to 25 sec, for general ocean wave growth
2 to select 40 frequencies: .06,.07, ..., 0.45
(2.2 to 17 sec, for full-plane GOM wind sea
3 to select 42 frequencies: .04,.05, ..., 0.45
(2.2 to 25 sec, for full-plane sea with bay
1
station id = sp154_200912
ending wave parameter stamp = 9123124
C:\Mydocuments\CIRP-Jax7-9Feb2011-Workshop\Shark-River-Inlet-CMS-Wave>
```

Figure B 8.3-9. Run cdip-spectra.exe in DOS.

B8.4. Post-processing CMS-Wave Results

This section describes three FORTRAN codes, **concatwav.exe**, **pkcmswave.exe**, and **pkcmswave1.exe** to assist in handling the CMS-Wave output information. Three MATLAB codes, **fig1sets.m**, **fig2sets.m**, and **fig4sets.m**, are provided to plot and compare calculated wave parameters and/or measured data (NDBC or CDIP buoys).

An example is provided as a simple CMS-Flow explicit steering run of the Shark River application (run 2009.sim and 2009.cmcards for a total of 12-hr simulation with 3-hr steering interval – a 10-min run time with 3-processors assigned to CMS-Flow).

- **concatwav.exe** - this FORTRAN code merges all individual cycle *.wav files from a CMS-Flow explicit and CMS-Wave steering (coupling) run into one single *.wav. Running **concatwav.exe** requires enter a text file that lists all or more individual *.wav files in sequential order (one-column format) – a sample text file **concat.dat** is provided that has included the first 200 cycle *.wav filenames. Users can avoid this code if a **std.dat** file (a modified copy of standard *.std to overwrite all individual *.std files generated in the steering process) is prepared with the 7th control parameter **IWET** set to -2 before running the steering. **IWET = -2** will output a total.wav file include all individual cycle *.wav. In the present time, users should manually prepare the **std.dat** and set **IWET = -2** for this option. In the SMS11 Beta and future SMS release, users can simply set **IWET = -2** in the standard *.std (the **std.dat** is no longer required).
1. Under the DOS window, run **concatwav.exe** in the folder with all steering cycle *.wav files
 2. Responding to the on-screen input, type the name of a text file that lists all or more individual *.wav files in sequential order, or simply type the sample file 'concat.dat' that includes the first 200 cycle *.wav filenames (by using 'concat.dat', the output total.wav will include up to a maximum of 200 cycle *.wav) – see Figure B 8.4-1 to merge all 5 cycles *.wav into one total.wav file.

```
C:\Mydocuments\CIRP-Jax7-9Feb2011-Workshop\Shark-River-Inlet-CMS-Wave\test2>concatwav
read a file with the list of all *.wav file
concat.dat
concat.dat
1swsteer.wav
2swsteer.wav
3swsteer.wav
4swsteer.wav
5swsteer.wav
6swsteer.wav

C:\Mydocuments\CIRP-Jax7-9Feb2011-Workshop\Shark-River-Inlet-CMS-Wave\test2>
```

Figure B 8.4-1. Run concatwav.exe.

- **pkcmswave.exe** – this code will extract the calculated wave height, period and direction information from *.wav for a single cell in the model grid. The output file is ‘online.dat’ that lists the extracted wave information (in sequential order) using the Wave Information Studies (WIS) short format (11-column format: id, year, month, date, hour, sig wave height, peak period, mean period, mean wave direction, wind speed, wind direction) – show all direction in the meteorological convention.
 1. In the DOS window, run **pkcmswave.exe**
 2. Responding to the on-screen input, type the CMS-Wave wave output *.wav filename
 3. Type the year (last two digits of a calendar year), e.g. type ‘11’ for 2011
 4. Type the local shoreline orientation (the CMS-Wave grid y axis) in clockwise polar coordinates (deg, positive from North covering the sea, e.g., 180 deg for St Mary’s Entrance, FL/GA, or 360 deg - the wave grid orientation angle in *.sim)
 5. Type a single cell i and j indices (two integer numbers) saving wave parameter information
 6. Type the starting timestamp (default value is 0) and ending timestamp (default is 99999999) for saving output files – see Figure B 8.4-2 to run **pkcmswave.exe** to extract wave information at Cell (69, 92) from total.wav.

```

C:\Mydocuments\CIRP-Jax7-9Feb2011-Workshop\Shark-River-Inlet-CMS-Wave\test2>pkcmswave
type a matrix filename
(e.g., cmswave.wav)
total.wav

type year(i2) for output
9

Type in the CMSWAUE y-axis orientation in the polar
coordinates (deg, positive from North covering
sea, = 360 - cmswave grid orientation in *.sim
e.g., 248 deg at the CR mouth, Texas)
193

total doman nx,ny=          138          212

type a cell ix and iy for 1-line output
69 92

type start & end time stamps(i8) for save
(e.g., 0 and 99999999)
0
99999999

9120103
9120106
9120109
9120112
9120115

C:\Mydocuments\CIRP-Jax7-9Feb2011-Workshop\Shark-River-Inlet-CMS-Wave\test2>

```

Figure B 8.4-2. Run pkcmswave.exe.

- **pkcmswave1.exe** – this code will extract the calculated wave height, period and direction information from the monitoring station output file selhts.out (exists only if the monitoring station data is specified in the *.std) for a single station. The output file is 'oneline.dat' that lists the extracted wave information in the WIS short format. The selhts.out file has a 15-column format:

Column 1 - spectrum label (or timestamp)

- 2 - i index in Cartesian (i,j) or ij index in Quad-tree mesh
- 3 - j index in Cartesian (i,j) or 0 (dummy) in Quad-tree mesh
- 4 - significant wave height (m)
- 5 - spectral peak wave period (sec)
- 6 - mean wave direction (deg, local coordinate system)
- 7 - swell height (m)
- 8 - swell wave period (sec)
- 9 - swell direction (deg)
- 10 - local-generated wave height (m)
- 11 - local-generated wave period (sec)

- 12 - local-generated wave direction (deg)
- 13 - wave breaking index (non-zero for breaking)
- 14 - max water elevation mark (m), include wave run-up if calculated
- 15 - flow discharge rate (m*m/sec) at structure cells if calculated

Note: Specify IWET = -1 or -3 to save swell and local sea data in selhts.out (swell is shown in Columns 7 to 9, and local sea in Columns 10 to 12)

1. In the DOS window, run **pkcmswave1.exe**
2. Responding to the on-screen input, type the CMS-Wave monitoring station output filename (e.g., selhts.out)
3. Type the year (last two digits of a calendar year) for the data, e.g. type '11' for 2011
4. Type the local shoreline orientation (the CMS-Wave grid y axis) in clockwise polar coordinates (deg, positive from North covering the sea, e.g., 180 deg for St Mary's Entrance, FL/GA, or 360 deg - the wave grid orientation angle in *.sim)
5. Type a single cell i and j indices (need to be a monitoring station cell given in *.std)
6. Type the starting timestamp (default value is 0) and ending timestamp (default is 99999999) for saving output files – see Figure B 8.4-3to run pkcmswave1 to extract wave information for Cell (69, 92) from selhts.out.

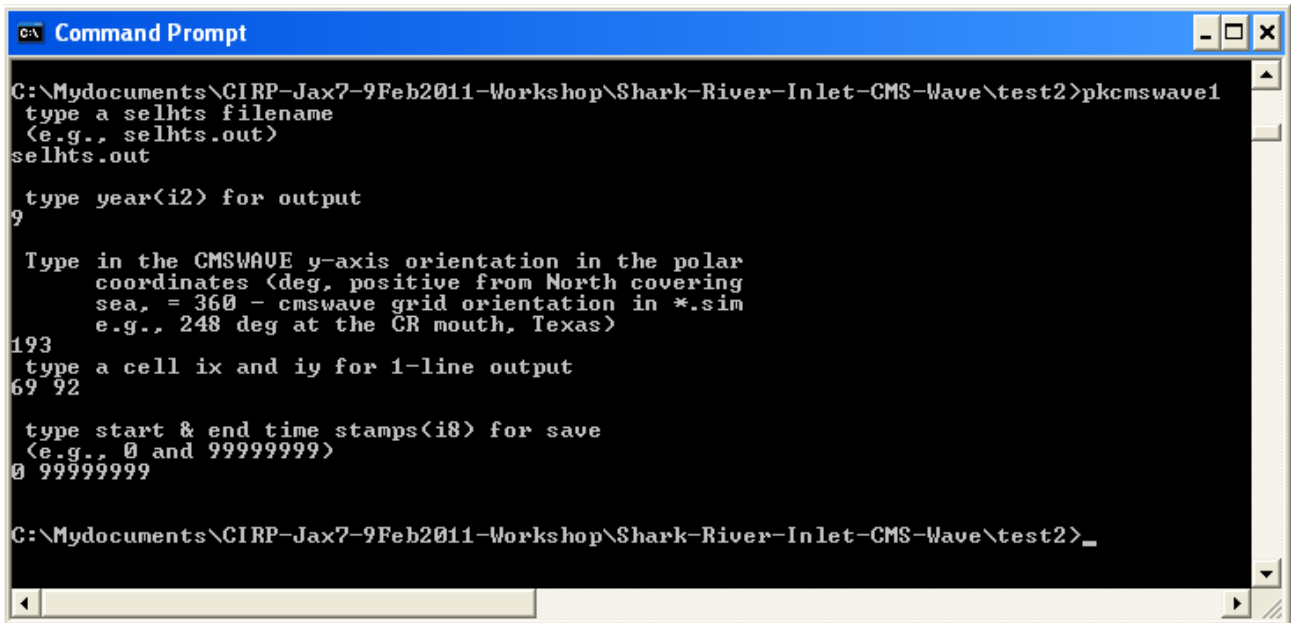


Figure B 8.4-3. Run pkcmswave1.exe.

- **fig1set.m** (or **fig1set.exe**)– this MATLAB code reads a WIS short format file and plots the time series of wind and wave parameter data.

1. In the MATLAB console, go to the folder with the `fig1set.m` code, type 'fig1set' and press *Enter* to run (or in the DOS folder, run **fig1set.exe**)
2. Responding to the on-screen input window, browse and open (read) the WIS sort format file of interest (e.g., 4602509d.dat)
3. Enter 1 for plots shown in the Metric system (m, m/sec) or 2 in English system (ft, knot)
4. Type the year (last two digits of a calendar year) for the data, e.g. 11 for 2011
5. Type starting month id number in the plot, e.g. 1 for January, 2 for February, etc.
6. Type ending month id in the plot, e.g. 3 for March, 13 for January of the following year, or enter 0 to input starting and ending dates in the same month
7. Type starting and ending days to display the data plot or type "0 0" and *Enter* to skip this option
8. Type the title (text) for the plot or simply press *Enter* to skip this option, to complete the run – see Figure B 8.4-4 to run **fig1set.m** or **fig1set.exe** to plot NDBC Buoy 44025 data (2009-ndbc.out) for December 2009.

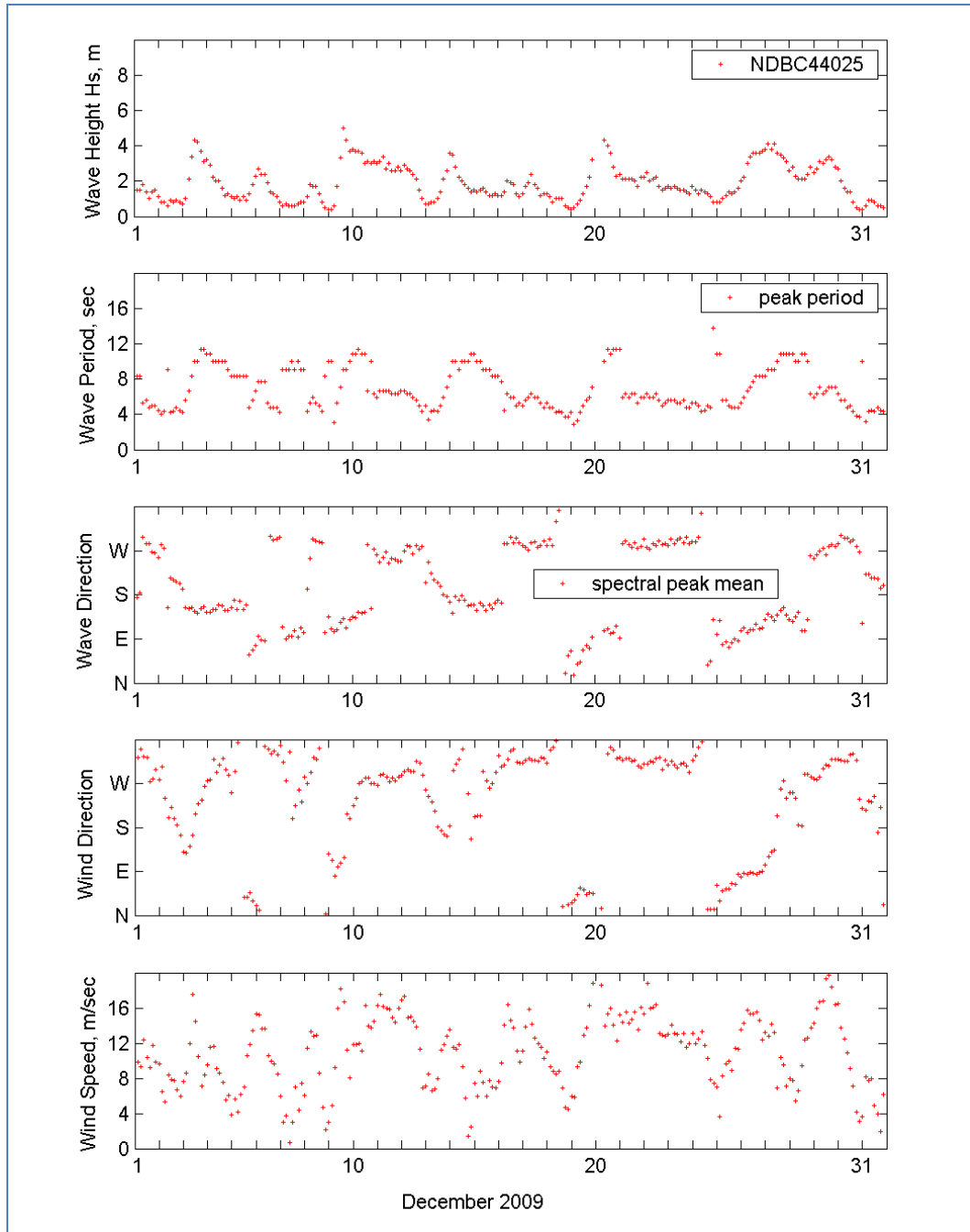


Figure B 8.4-4. Run fig1set.m.

- **fig2sets.m** in MATLAB (or **fig2sets.exe** in the DOS command window) – this code is similar to **fig1set.m** except it is capable of reading and plotting the time series of wind wave data from two or three WIS short format files. Run **fig2sets.m** following similar steps as run **fig1set.m** – see Figure B 8.4-5 to plot NDBC 44025 and CDIP 154 (2009-sp154.out) for December 2009.

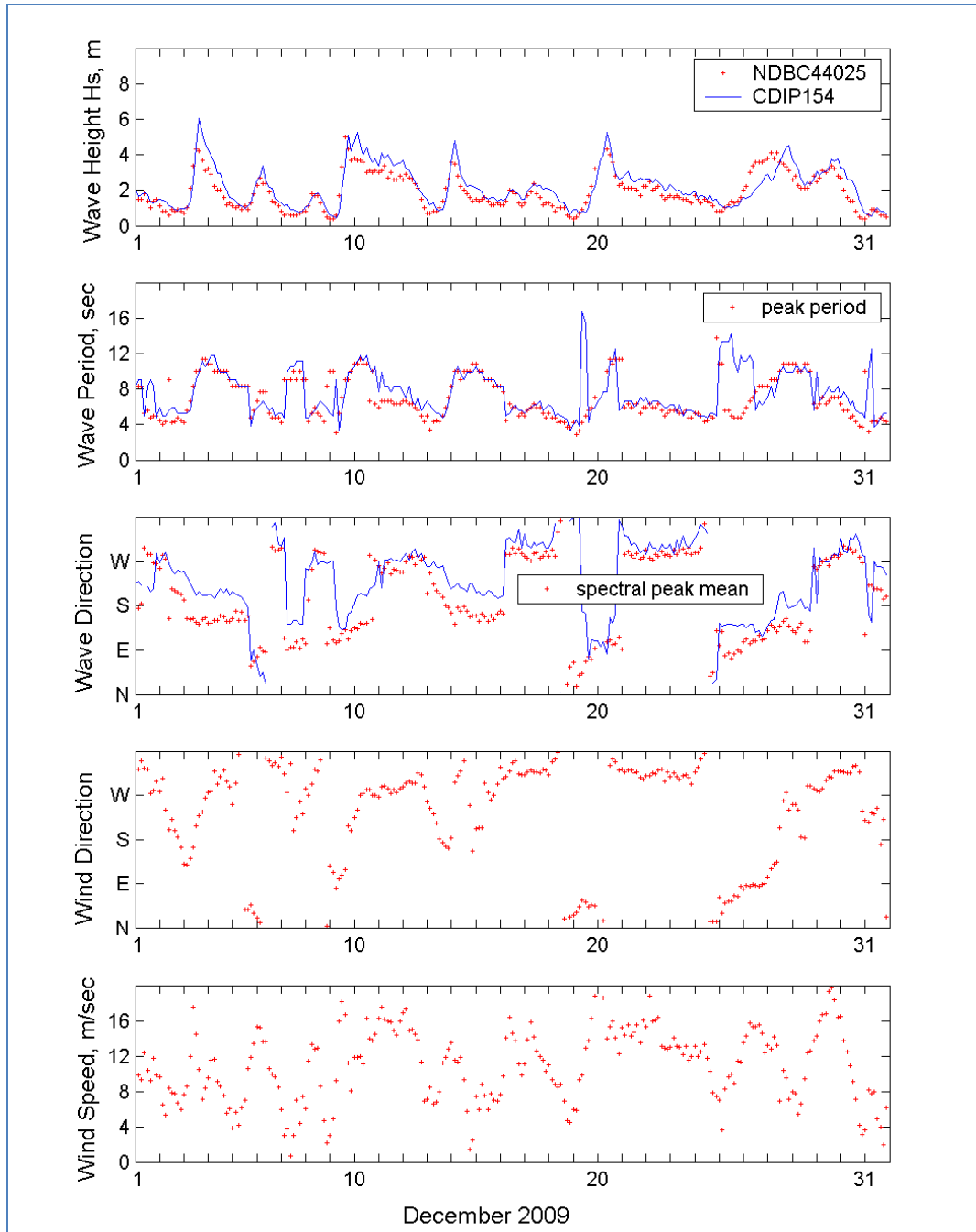


Figure B 8.4-5. Run fig2sets.m.

- **fig4sets.m** (or **fig4sets.exe** in DOS) – this code is similar to **fig1set.m** and **fig2sets.m** except it is capable of reading and plotting the time series of wind wave data from three or four WIS short format files. Run **fig4sets.m** following similar steps similar as run **fig1set.m** or **fig2sets.m** – see Figure B 8.4-6 to plot NDBC 44025, CDIP 154, and these two sets of data transformed to the CMS-Wave grid offshore boundary (2009-ndbc.dat and 2009-sp154.dat).

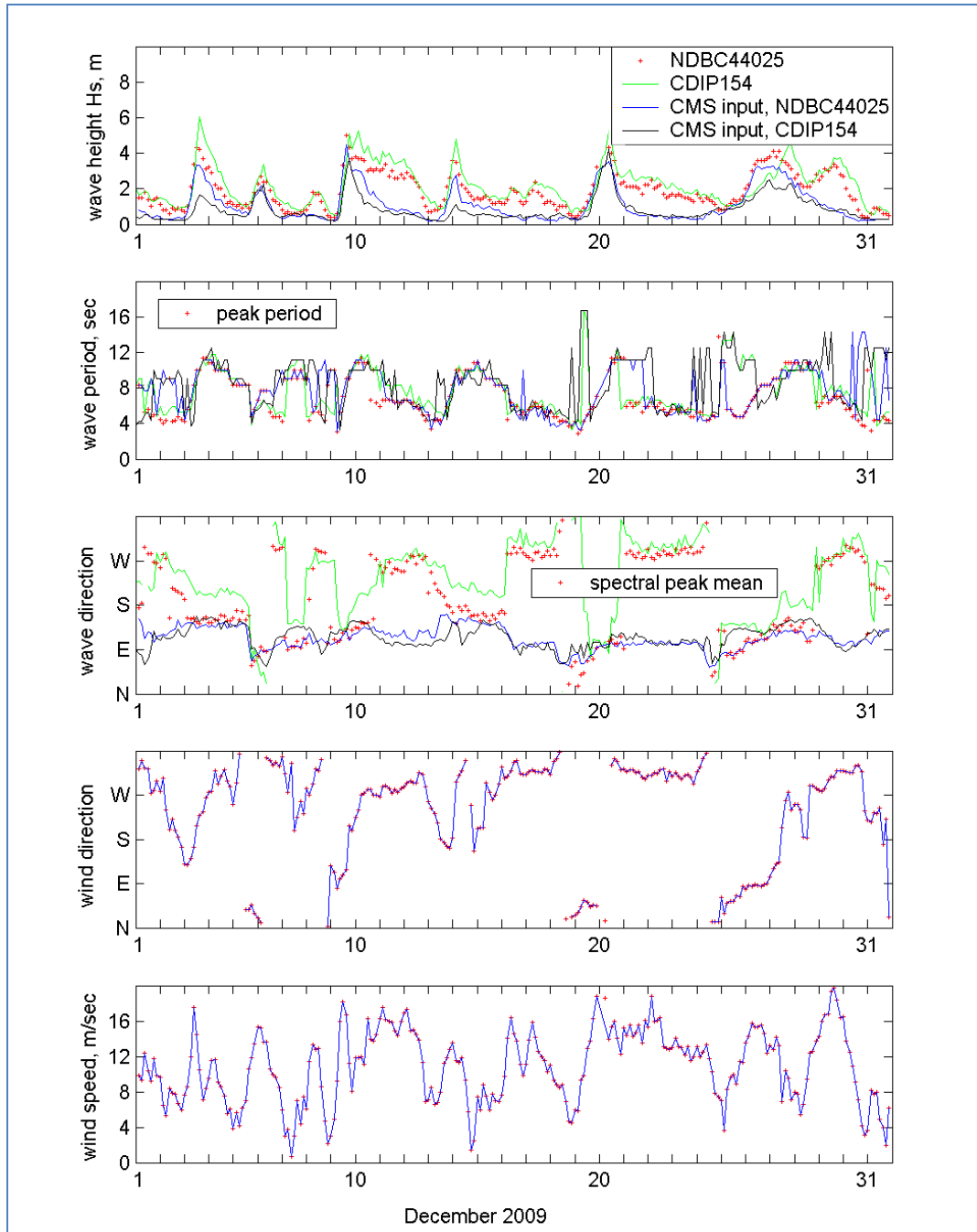


Figure B 8.4-6. Run fig4sets.m.