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User's Manual for the Globally Relocatable Navy Tide/Atmosphere Modeling System (PCTides)

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14. ABSTRACT
The purpose of this user's guide is to describe the steps needed to set up and run a tide model as part of the Globally Relocatable Tide/ Atmospheric Models System (PCTides). It includes detailed examples and instructions on how to set up a grid and model bathymetry, how to generate a tidal forecast using a 2- or 3-dimensional barotropic ocean model and how to view forecast products. Instructions are included for the set up of a surge forecast using hurricane winds and pressures generated by a hurricane model that is included in the PCTides system. This user's guide contains an appendix that provides instruction on how set up and run a globally relocatable mesoscale atmospheric model. This model may be used to provide surface wind and pressure forcing for the ocean model when other operational Navy winds are not available.

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TABLE OF CONTENTS

Table of Figures

1.0 INTRODUCTION

The Computer Software Configuration Item (CSCI), identified as the Globally Relocatable Navy Tide/Atmosphere Modeling System (PCTides) consists of a 2- and 3-dimensional barotropic tide/surge model, called the Global Environmental Modeling Services Coastal Ocean Model (PCTides GCOM2D and GCOM3D), and a Mesoscale Atmospheric Prediction System (MAPS).

GCOM2D is a two-dimensional depth-integrated shallow water model designed to characterize sea level and currents on or near continental shelves. It features a wetting and drying algorithm for simulating coastal flooding due to tides or storm surge.

GCOM3D is the three-dimensional counterpart to GCOM2D. It is a barotropic model for applications where current structure with vertical depth is required and tidal and wind forcing are dominant. Atmospheric forcing for GCOM2D/3D is provided by the MAPS system or by an analytical hurricane vortex model for tropical applications.

MAPS is a hydrostatic primitive equations model designed to provide high-resolution representations of anemometer level winds and surface pressure as atmospheric boundary conditions for GCOM2D and GCOM3D. To this end, the turbulence closure scheme has been designed to allow the model to be run with its lowest model level at anemometer height, thus providing a direct simulation of the winds at this level. The equations of motion are coded in advective form and solved using a semi-implicit time differencing scheme ensuring that the model is both robust and economical to run, even in regions of steep terrain.

Manuscript approved August 9, 2001.

2.0 APPLICATION

2.1 Description of PCTides Usage

This manual describes in detail the procedures for running the Navy Relocatable Tide/surge modeling system consisting of the 2- and 3-dimensional barotropic tide/surge models (GCOM2D and GCOM3D) developed by the Global Environmental Modeling Systems group. The system is platform independent and may be run in the PC Windows environment driven by an interactive menu or at the command prompt under DOS mode or the UNIX operating systems. The menu provides a logical structure for the user to set up the required environment to carry out a simulation with either GCOM2D or GCOM3D in any part of the world's oceans. Both models may be driven by tides and/or surface winds and pressures. Prior to running a model, the winds and pressures may be entered manually, generated using the hurricane model, or obtained from a MAPS or Navy operational product such as the Navy Operational Global Atmospheric Prediction System (NOGAPS), the Distributed Atmospheric Mesoscale Prediction System (DAMPS), or the Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS). Output stations, at which time series predictions of sea levels and currents are stored, may be specified. Display options allow the plotting of spatial fields or time series of sea levels and ocean currents.

This manual details the running of the system using the PC Windows interactive menu or the command prompt. Command prompt operation is exactly the same in the PC environment as in the UNIX environment. A separate technical manual compliments this document and contains the mathematical formulation, solution procedure and code of each of the models as well as flow charts and descriptions of the programs and sub-programs (SDD; Hubbert et al., 2001).

2.2 Directory Structure

The directory structure for operational use of the system is as follows:

\gems\work	: working directory in which all calculations are carried out
\gems\data	: directory containing all tidal and topographical files used by GCOM
\gems\gcom	: code directory containing all executable code
\gems\tctracks	: store for historical hurricane tracks
\gems\gridgen	: directory containing the ASA grid generator files – PC only

(Note: the file "asagrid.ini" must be placed in the \windows directory)

<u>UNIX note</u> : if running under UNIX remember to use "/" instead of "\"

These directories are transparent to the PC Windows interactive menu (gcommenu) user whereas the command prompt user should carry out all activities in the "\gems\work" directory.

2.3 Running Environment

The GCOM running environment is illustrated in the flow diagram in Figure 1 where the relationship between the components of the system and associated files can be seen.

Further understanding of the system may be obtained in the PC Windows menu where the menu procedures are also supported with help functions for all actions of choice. The help is obtained by pressing the "F1" key while the cursor is on the input box in question.

2.4 Document Organization

This manual documents the procedures for setting up and running the ocean models driven by surface winds and pressures and/or tides. Each Section illustrates the two methods of running the system by referring to the appropriate PC Windows menu option and giving the appropriate command to be entered at the command prompt.

The basic logic that underlies operation of the system through the PC Windows menu structure or the command prompt is shown in Figure 2.

3.0 LIMITATIONS AND ASSUMPTIONS

In order to successfully execute PCTides there must be at least 256 MB of RAM. The system itself requires 400 MB of disk space.

At present there is no graphics package associated with the UNIX version of PCTides.

4.0 OPERATING GUIDELINES

This Section of the User's Manual discusses several key aspects of PCTides.

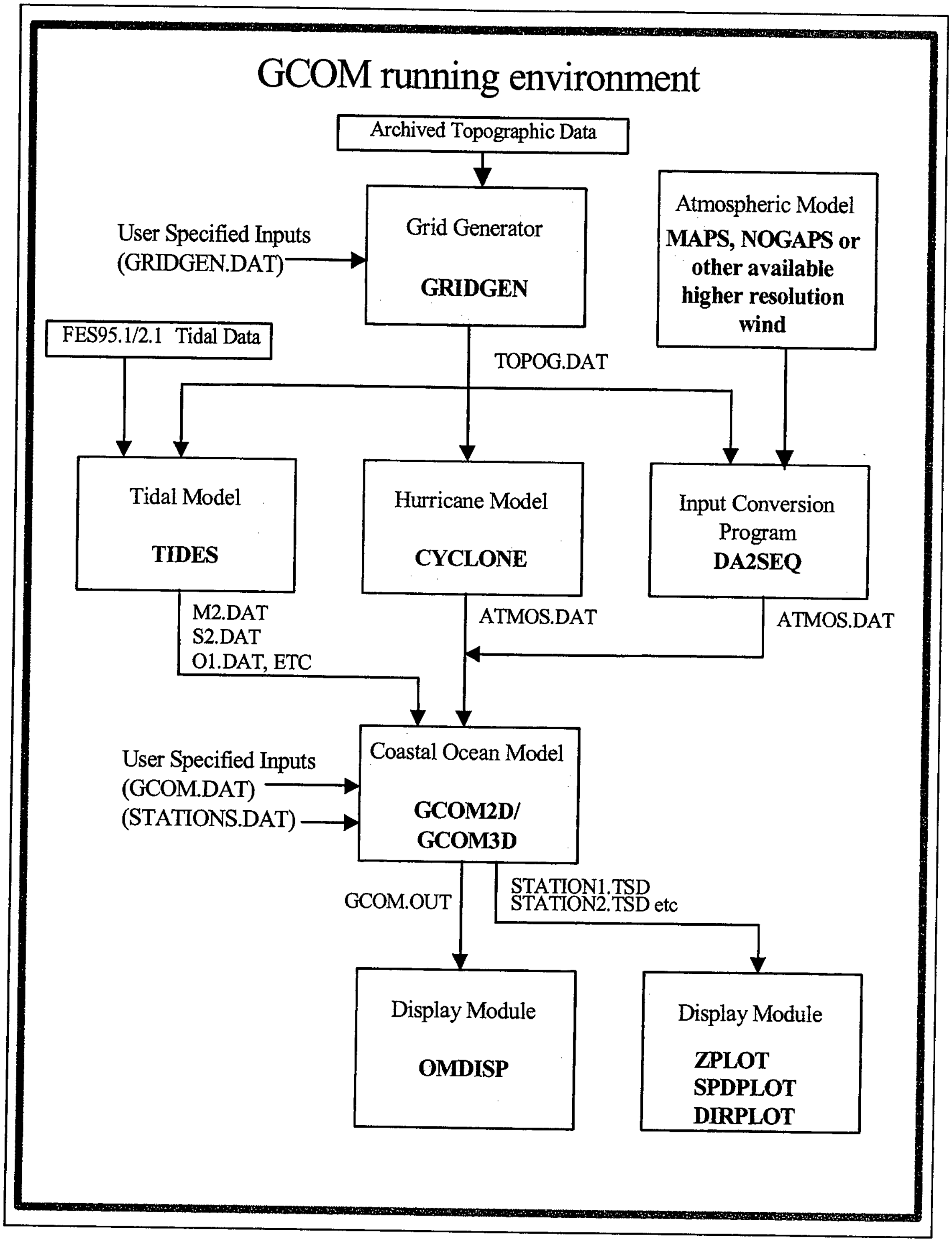

Figure 1: Flow diagram for the GCOM system.

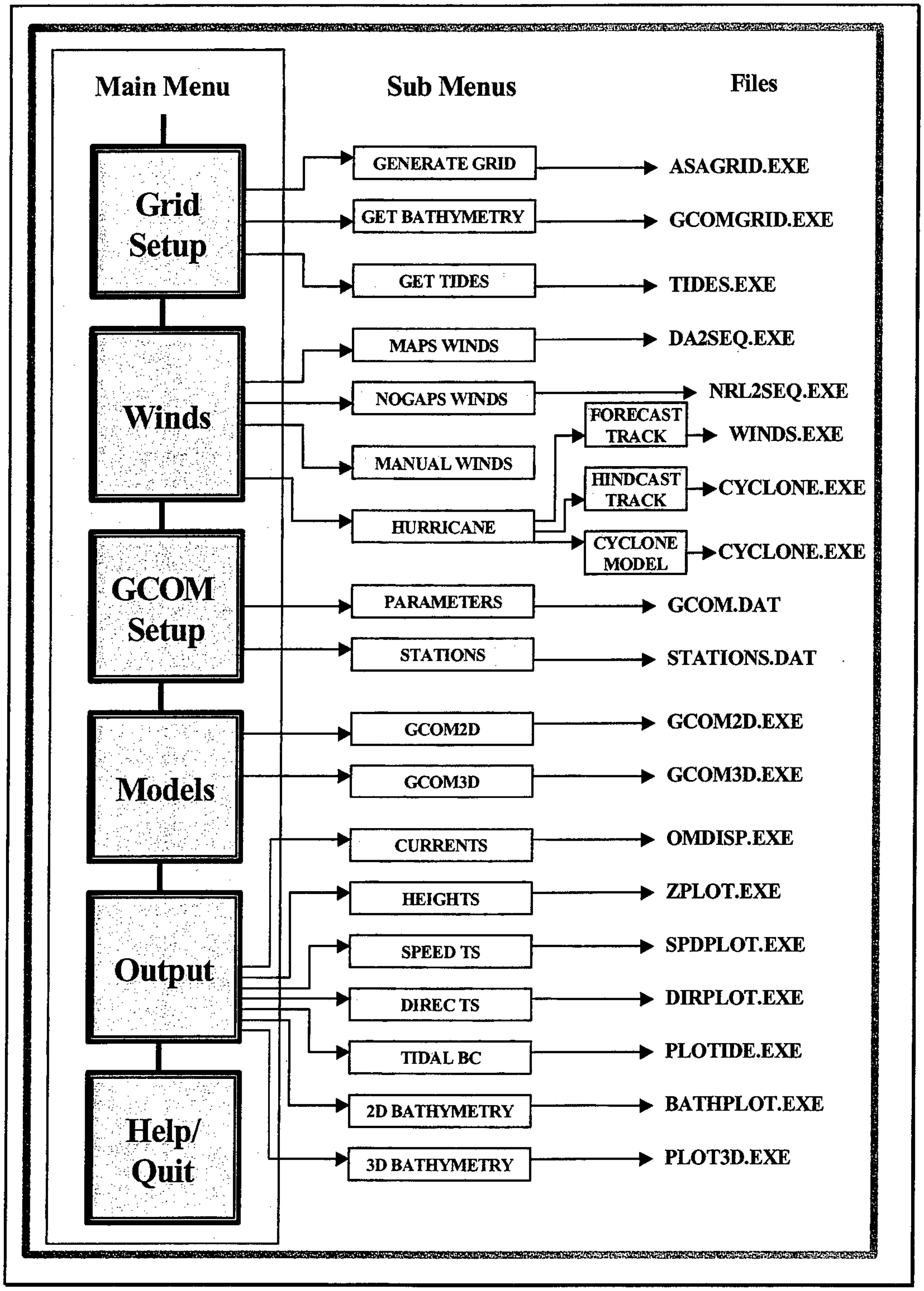

Figure 2: Chart illustrating the PC Windows Menu and related files.

4.1 GRID SETUP

4.1.1 Grid Generation

The first task is to define the model domain.

Command prompt

To define the model domain at the command prompt the user should edit the file "gridgen.dat", in the "\gems\work" directory structured as follows:

Line	Parameter	Typical value
1	Arbitrary Title	Persian Gulf
2	Grid Projection Flag (**do not change**)	3
3	Southern Latitude Limit	22.0000
4	Northern Latitude Limit	31.0000
5	Western Longitude Limit	46.0000
6	Eastern Longitude Limit	60.0000
7	Standard Grid Spacing (kms)	10.0

Note: Longitudes are in the range 0 to 360E. Latitudes are in the range –90S to +90N.

Menu

The "Generate Grid" menu option (Figure 3) is selected which initiates the Applied Sciences Associates (ASA) grid selection program (Figure 4). This software allows the user to zoom in and create a new region by selecting the area for the model grid on the map using the mouse. Once the ASA grid selection program is initiated, the screen will display six drop down menus. The user should use only the "zoom" and "gems" menus, however, the following is a brief description of the options found in the other four. Under the "file" option, the "geographic location" should be set to "gems/gridgen". The base map selected should be "world.bdm" or "landpoly.bdm" to generate the global base map. Other selections will bring up specific regional basemaps. The "new locations" options should not be changed. The "display" setting should show the green outlined "land" box checked, the display lat/long box checked, the "degree representation" should be set to DD MM.MM, the "vector units" should be in knots and the map projection should be set to "XY Cartesian". Other options should not be chosen. Printer options are machine dependent. Selections under the "zoom" menu are self-explanatory. The Pan to Point option allows the user to select a location and move the grid with respect to that location. Selections under the "GIS" and "Tools" menus should not be modified. The "Window" menu should not be modified and should be set at c:\gems\gridgen:gisdata". Buttons under the drop down menus should not be used, except for the circled +/- buttons that allows the user to zoom in/out without going into the drop down menu.

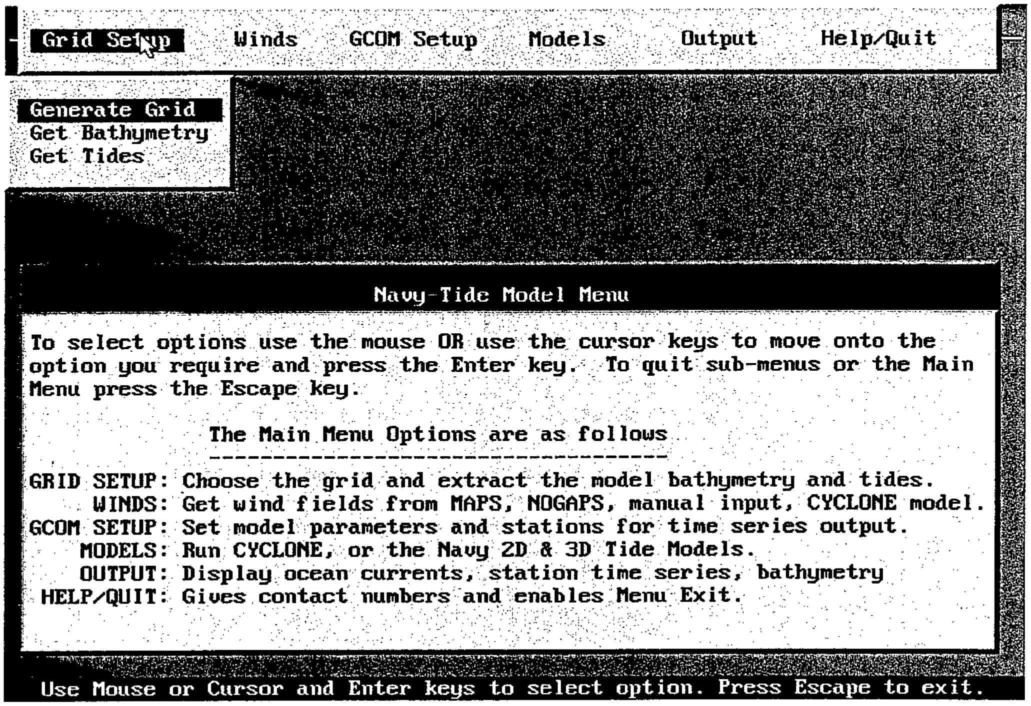

Figure 3: Grid setup menu option.

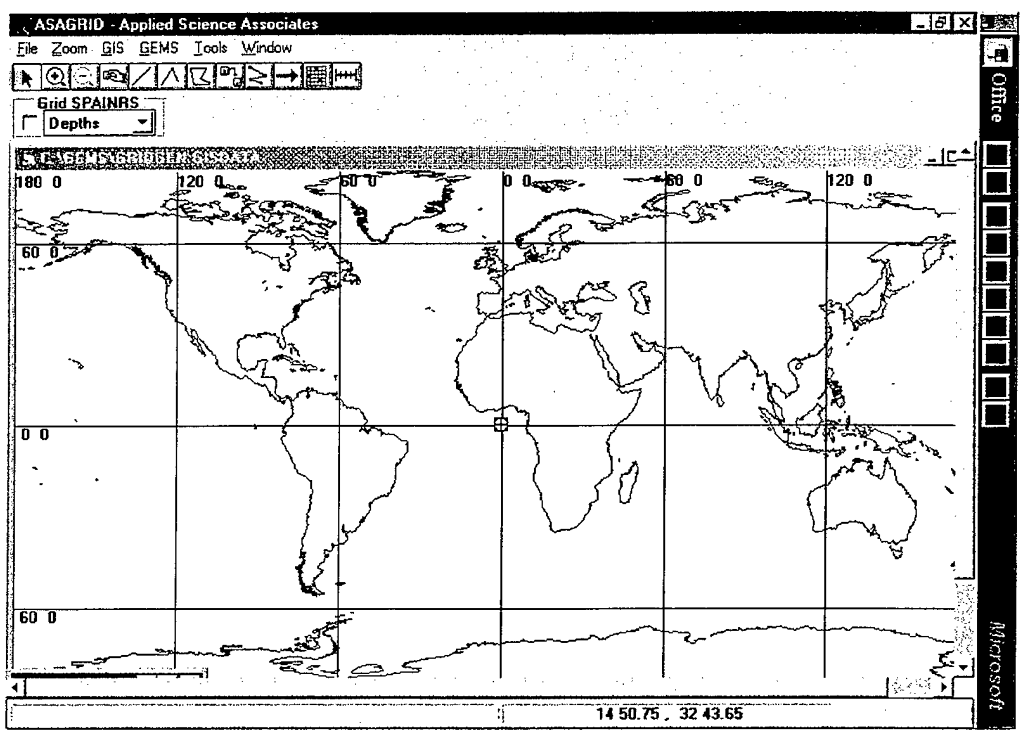

Figure 4: Grid generation global map.

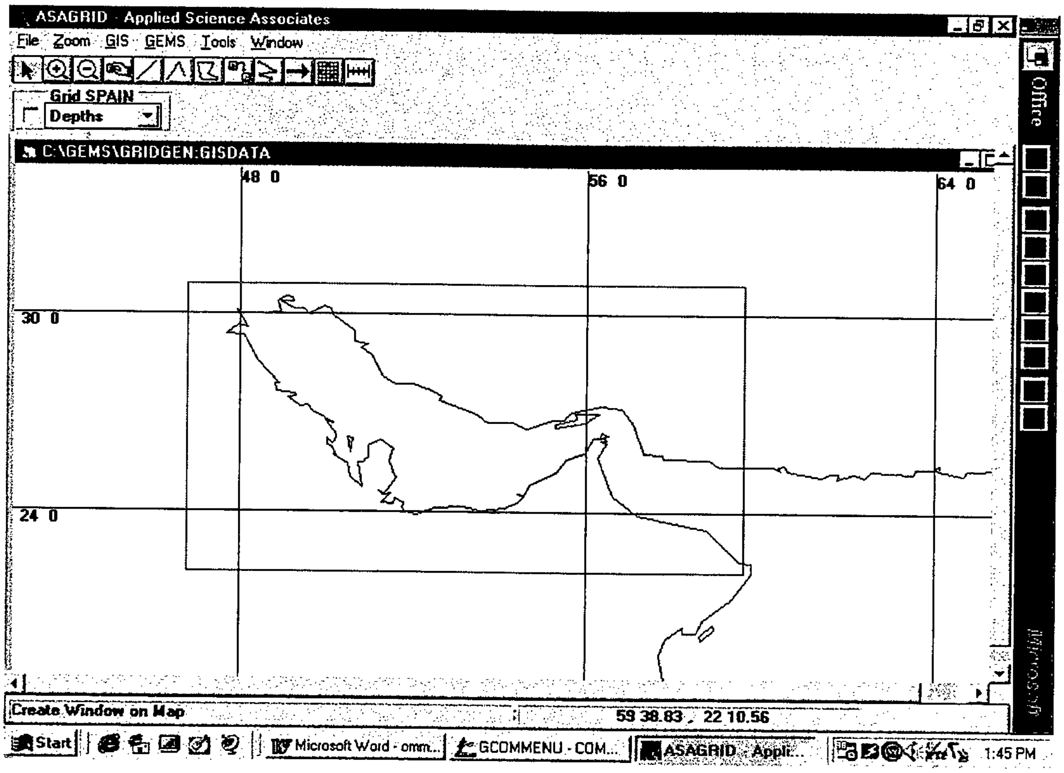

Figure 5: Zoomed map of Persian Gulf with model region selected.

To illustrate the procedure (Figure 5), a model grid for the Persian Gulf is set up. If a global map does not appear when the grid generator is brought up, click on "Zoom" and click again on "UnZoom All" and it should appear. The user then zooms in to the region of interest (click on "Zoom" and select "Create Zoom Window") and selects the model grid area with the mouse by holding the left button down while moving from one corner of the proposed grid to the corner diagonally opposite (Figure 5). A panel appears (Figure 6) in which the maximum grid dimensions can be set (Note: coarse grids run faster but may give poorer results, however **do not create grids with either dimension over 200**) and a unique output file name specified for identification and storage. The global bathymetric data sets are then interrogated and the bathymetry and topography for the model grid region are displayed in an adjustable color code (Figure 7). The setting in the upper left corner labeled "GRID Filename (PGULF)" may be changed to the "cell" mode to draw the model grid squares.

On completion, the ASA grid generator writes an ASCII file to the "\gems\gridgen\depths" directory with an extension ".asc". The name of the file is the name entered by the user when setting the grid dimensions. This ASCII file contains the latitude and longitude limits of the region selected.

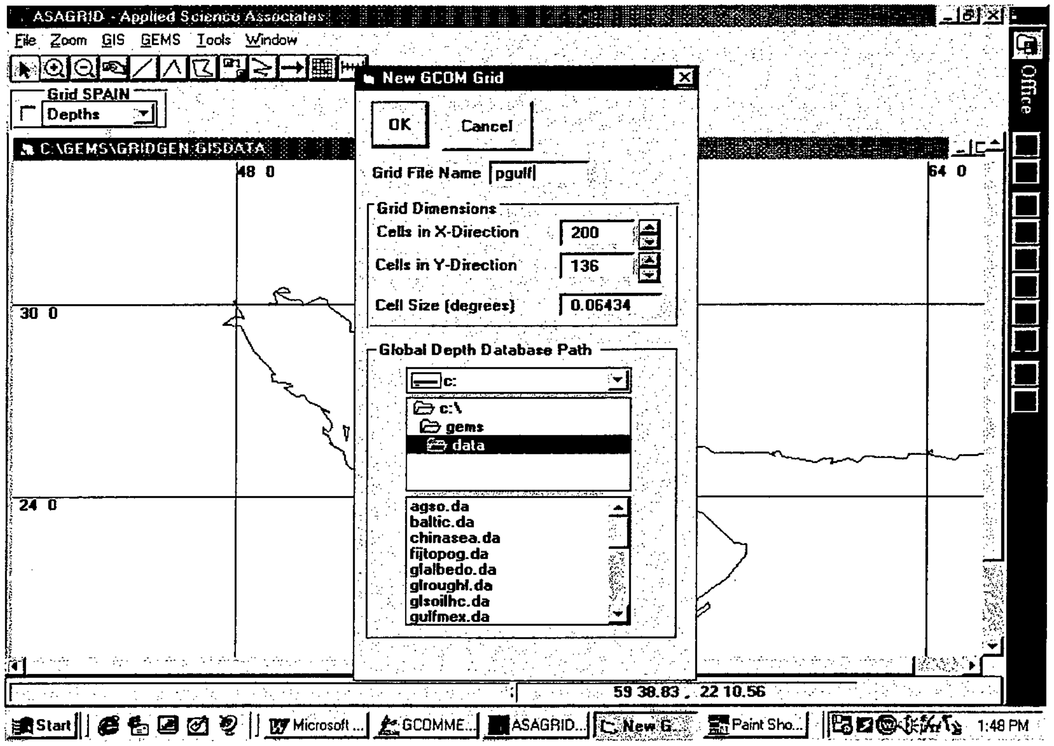

Figure 6: Panel for specifying maximum grid dimensions and grid region name.

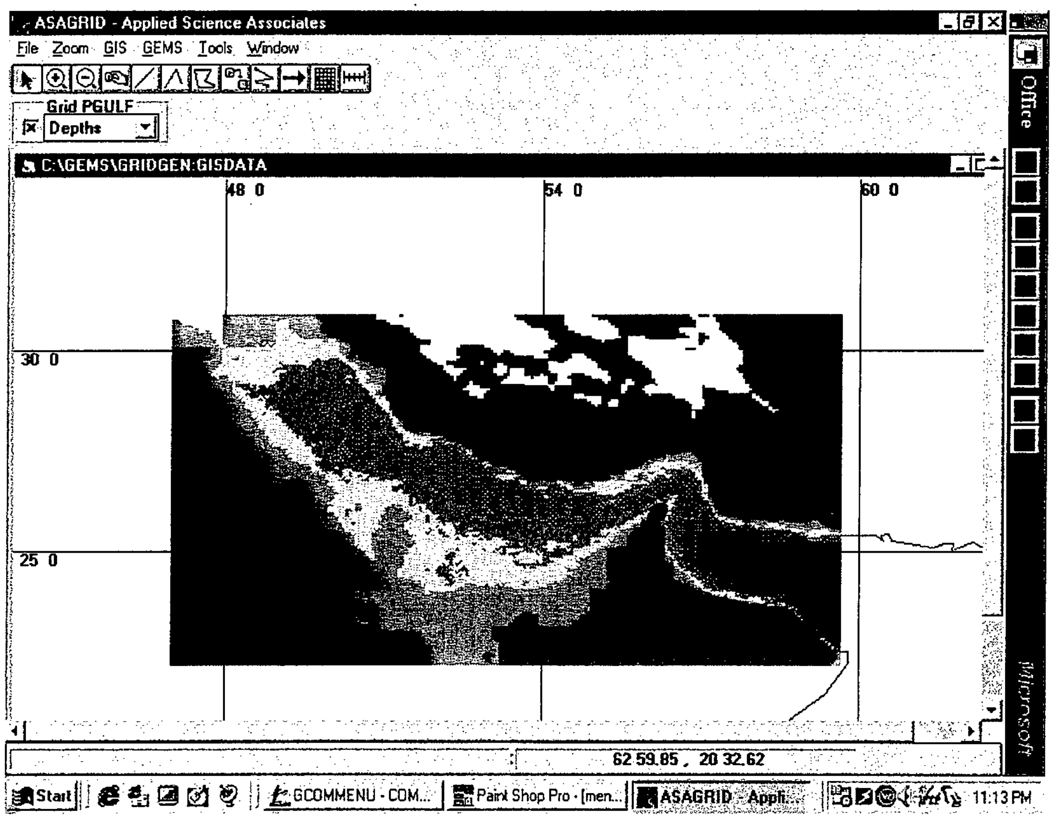

Figure 7: Color-coded bathymetry and topography for the selected region.

4.1.2 Bathymetry

The next task is to generate the bathymetric grid. The ocean bathymetry/land topography data was generated from the Navy DBDB-V data and USGS land topography data. Both data sets were interpolated to a 3-minute grid.

Command prompt

To generate the bathymetric grid for the model domain at the command prompt the user should run the program "gridgen" which reads the latitude and longitude limits and resolution stored in the "gridgen.dat" file. "Gridgen" calculates the bathymetry and topography from the global direct access files and writes the data to the file "topog.dat" in the "\gems\work" directory.

In order to check the region and/or the bathymetry it is advisable to plot the data by running the program "bathplot". This program plots the bathymetry at a specified contour interval and the topography displayed in color-coded height bands. If the region is not satisfactory, the user should return and select an adjusted region and repeat the process. If the bathymetry is of poor quality for the resolution required then refer to the general comments in Section 4.1.3.

Menu

To set up the bathymetry in the format required by the model select "Get Bathymetry" (Figure 8). This brings up a panel (Figure 9) that shows previously stored model grid regions and any of these may be specified in the entry box. For this case "pergulf" is entered and after pressing "escape" the bathymetry and topography for the grid are calculated from the global direct access files by the program "gemsgrid" which reads the latitude and longitude limits stored in the "pergulf.asc" file. "Gemsgrid" writes the bathymetry and topography to the file "topog.dat" in the "\gems\work" directory.

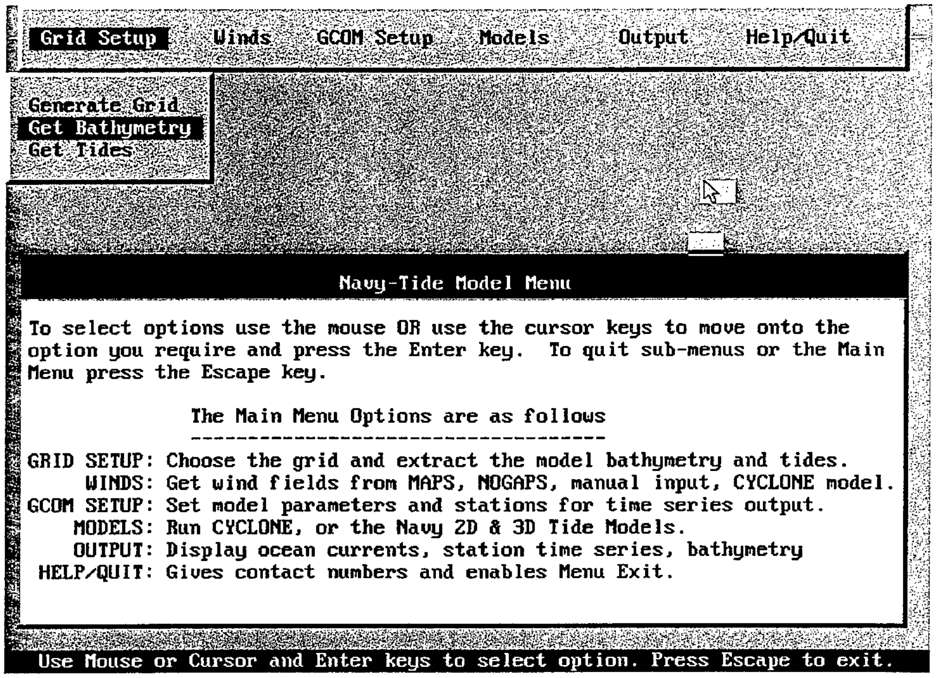

Figure 8: "Get Bathymetry" selection.

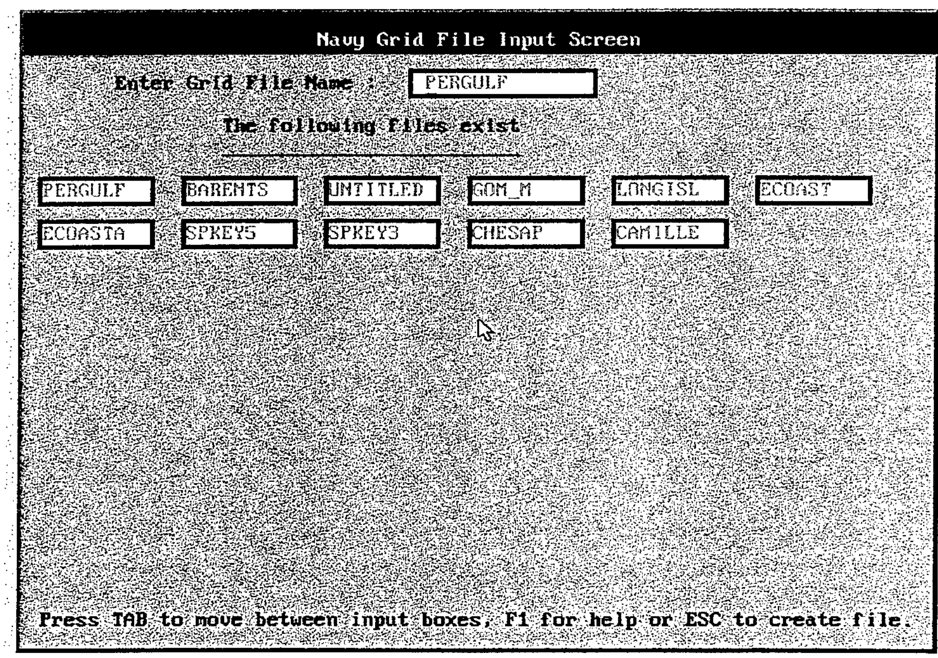

Figure 9: Selection of required model grid region.

In order to check the region and/or the bathymetry it is advisable to plot the data by returning to the main menu and selecting "Output" and then "2D Bathymetry" (Figure 10). The bathymetry will then be plotted at a selected contour interval and the topography displayed in color coded height bands (Figure 11). If the region is not satisfactory, the user should return and select an adjusted region and repeat the process. If the bathymetry is poor quality for the resolution required, refer to Section 4.1.3 for general comments. A 3-D plot of the model bathymetry may be obtained by selecting "Output" and then "3D Bathymetry" from the menu.

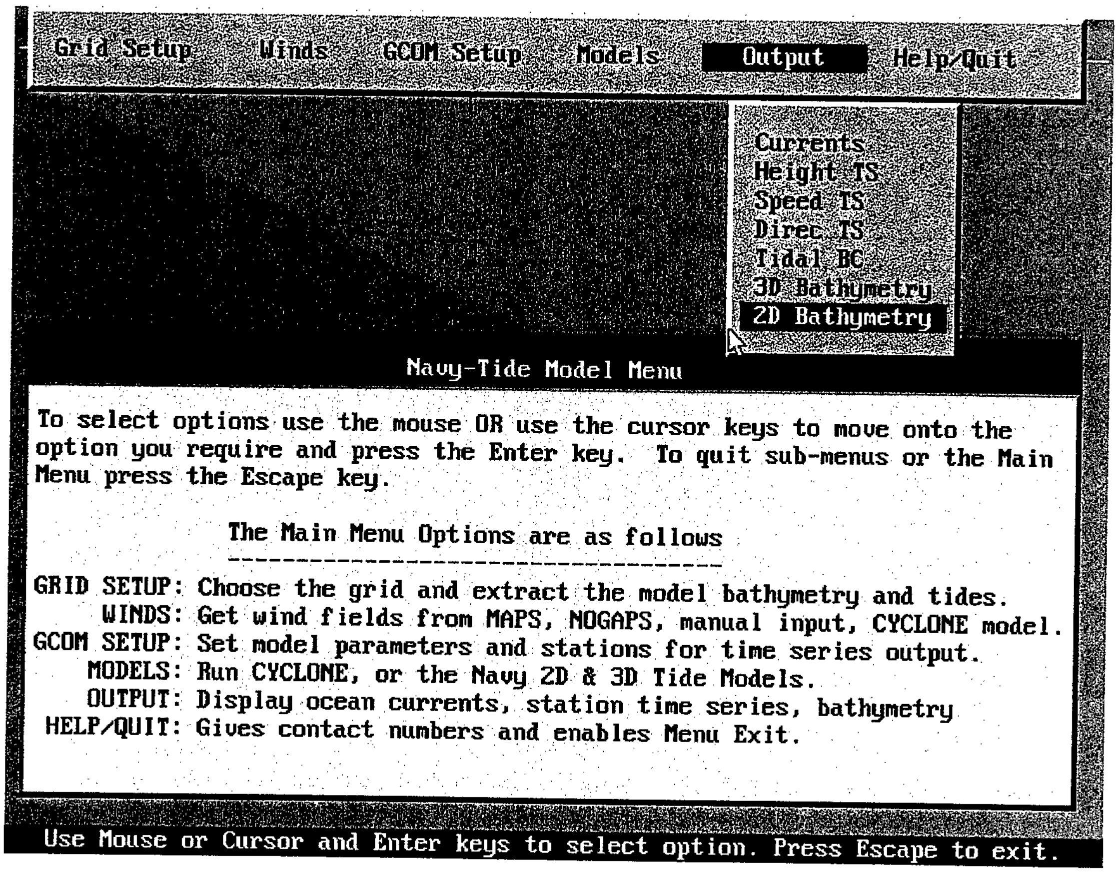

Figure 10: Selecting "2D Bathymetry" display.

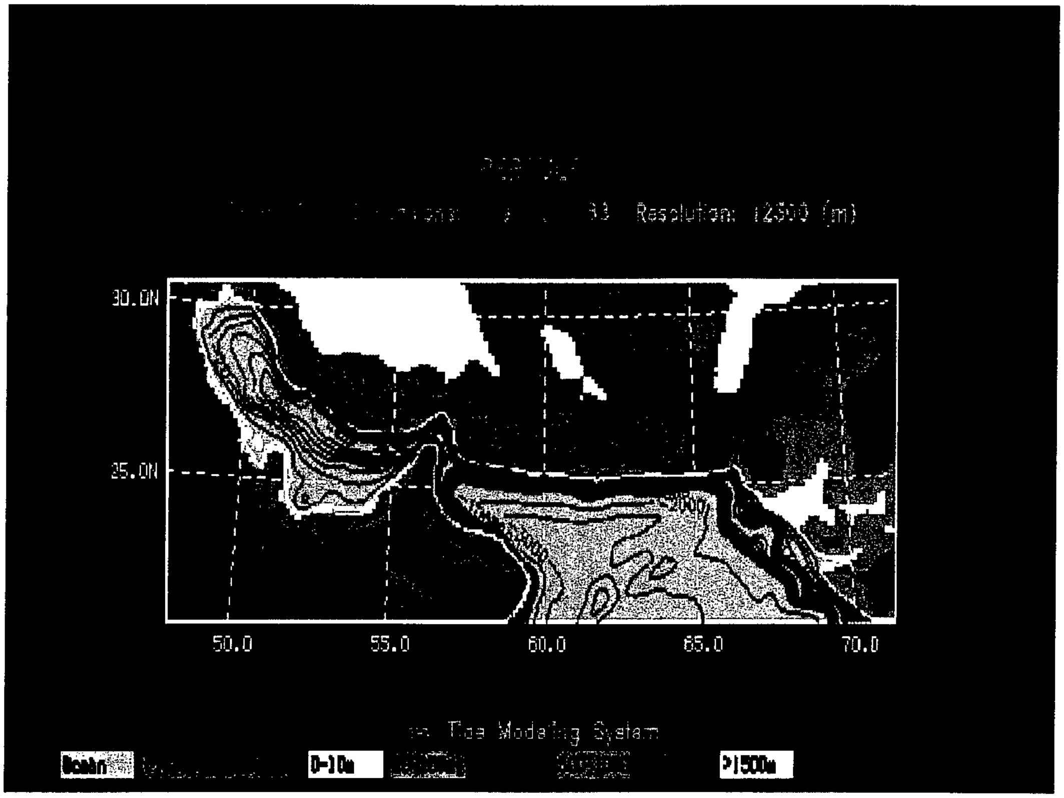

Figure 11: Bathymetry contours and topography for selected model grid.

4.1.3 General Comments on Grid Generation/Bathymetry

a) The following issues should be considered when selecting the model region:

- The global tides are on a grid with a half-degree resolution and therefore open boundaries should cover several degrees to obtain reasonable boundary conditions.
- Consult the map of global tide model amplitude and phases (Figure A1), to assure the open boundaries are located in a region where global tides exist. Examples of regions where global tides do not exist are: the Persian Gulf, the Red Sea, the Baltic Sea, and the NE Canada/US Coast.
- It is wise to give some thought to the placement of the open boundaries. Try to establish straight open boundaries and avoid short ocean boundary segments that create ocean grid corners.
- If possible avoid complex bathymetry on open boundaries.
- If results are required in a bay or inlet be sure that the resolution is high enough to model the ocean dynamics of the region.
- Consider what is important to tell the model about the bathymetry/ topography of the region. For example do not have an open boundary half way down a small bay – let the model know that it is a bay by placing the boundary on the land.

- For best results, use grid resolution of 10 (+/-5) km.

b) The procedure for generating the bathymetric grid is to firstly set up the model grid on the chosen map projection (Lambert Conformal) and then to extract the bathymetry/topography for each grid point. The latitude and longitude of the grid point is determined and then all of the direct access topography files (".da" files) are searched to find the value at that location from the highest resolution ".da" file covering that point. This procedure is repeated for each model grid point so that it is possible for values to be obtained from more than one ".da" file if the model grid spans more than one ".da" file region. If the bathymetry for the model domain appears to be poor quality it may be desirable to create a new ".da" file of higher resolution digitized data for that region. This procedure is explained in the Software Design Description (SDD; Hubbert et al., 2001). The existing ".da" files are summarized in the following table:

File Name	Southern Limit	Northern Limit	Western Limit	Eastern Limit	Resolution (minutes)
World.da	-90	90	0	360	3.0
Gulfmex.da	15	35	260	285	0.3
Wustopog.da	28	40	219	249	1.0
Yellosea.da	25	42	117	131	0.6
Pergulf.da	21	33	45	71	1.0
Chinasea.da	13	25	105	121	1.0
Baltic.da	53	61	14	26	1.0
Medsea.da	29	36	349	43	1.0
Timorsea.da	-18	-8	122	133	0.3
Oztralia.da	-46	-6	110	156	1.2
Fijtopog.da	-20	-15	176	181	0.5
Tastopog.da	-44	-39	143	150	0.5

4.2 TIDES

Tidal boundary conditions were derived from the global tide model, Finite Element Solutions, version 95.1 (FES95.1/2.1) (Shum et al., 1997) (See Appendix A for global tidal boundary conditions). Tidal boundary conditions are derived for the model region from the global tidal files for eight constituents by determining the grid from the topography file and then writing the files:

m2.dat	2n2.dat
s2.dat	o1.dat
n2.dat	k1.dat
k2.dat	q1.dat

These files contain the amplitude and phase of the tidal constituent in time zone zero (Greenwich). The amplitude or phase can be plotted with "plotide" (PC users only). During plotting an option is given to compare with local observations (stored in the "data" directory in "tcanals.dat") both graphically (Figure 12) and with root mean square errors written to the screen and stored in the file "plotide.log". This gives the user an idea of how accurate the global tidal files are in the model region and therefore indicates the expected accuracy of the model output.

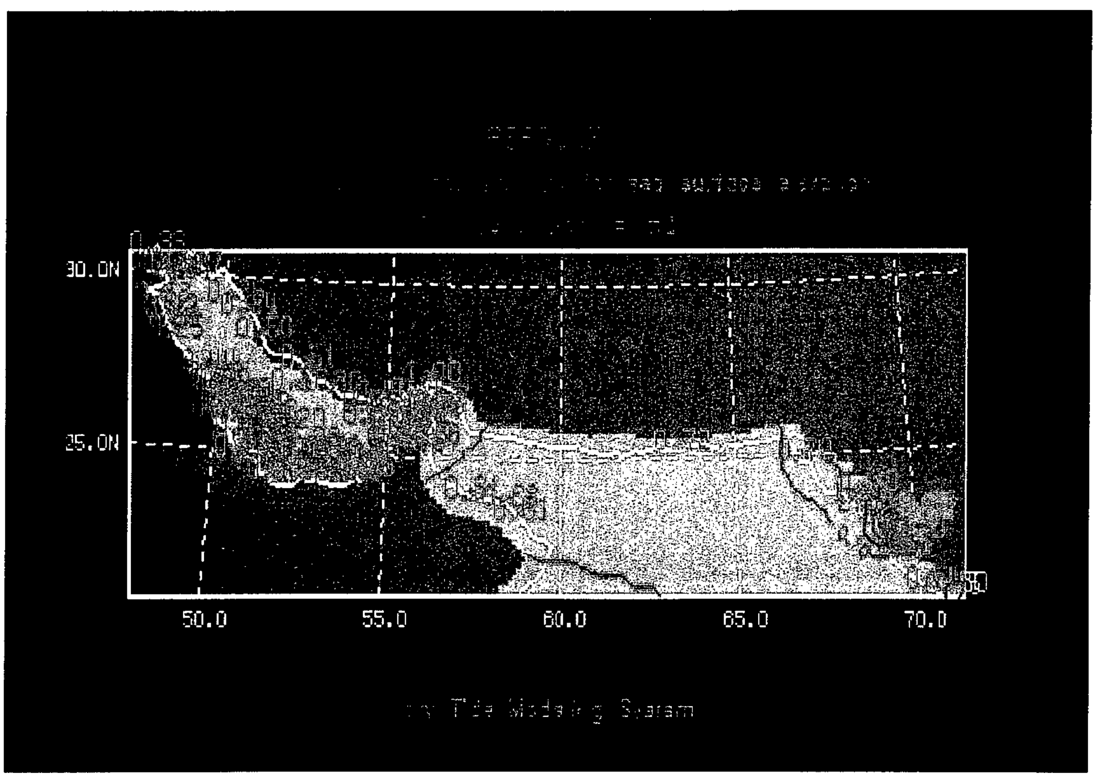

Figure 12: Amplitude contours of the M2 tide in the Persian Gulf plotted with the observed values.

Figure 12 shows the contours (meters) of the amplitude of the M2 tidal constituent derived from the global tidal database for the model region in the Persian Gulf. The observed amplitudes (meters) at tidal stations in the Persian Gulf are also plotted for comparison. The user should notice two important things from this plot:

1. The contour lines are too short to carry labels so the user should look at the screen text or in the output file ("plotide.log") to compare the global tidal values with data.
2. There are no contours in the Western part of the grid showing that the global tidal files do not have values in the Persian Gulf and therefore it is not possible to run a model of only the Persian Gulf.

Note: The user must make sure there is global tidal data along all its open boundaries.

<u>**Command prompt**</u>

Run "tides".

For display run "plotide" (PC only).

<u>**Menu**</u>

Tidal boundary conditions are derived by selecting "Get Tides" (Figure 13). The amplitude or phase can be plotted by selecting "Output" and "Tidal BC" (Figure 14).

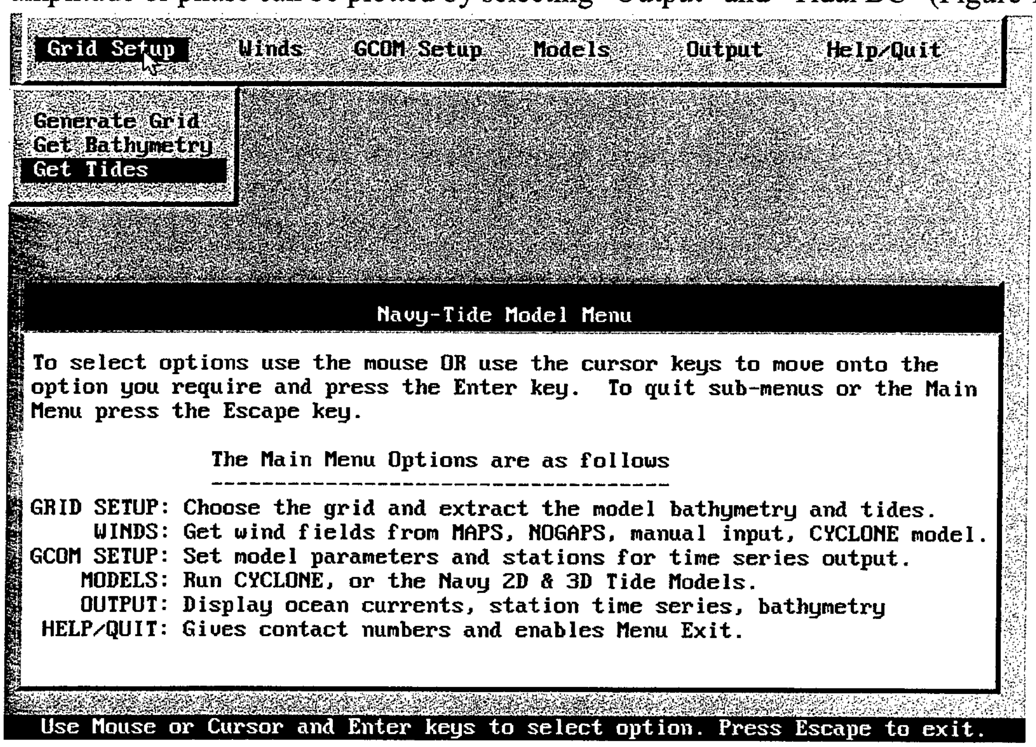

Figure 13: "Get Tides" selection.

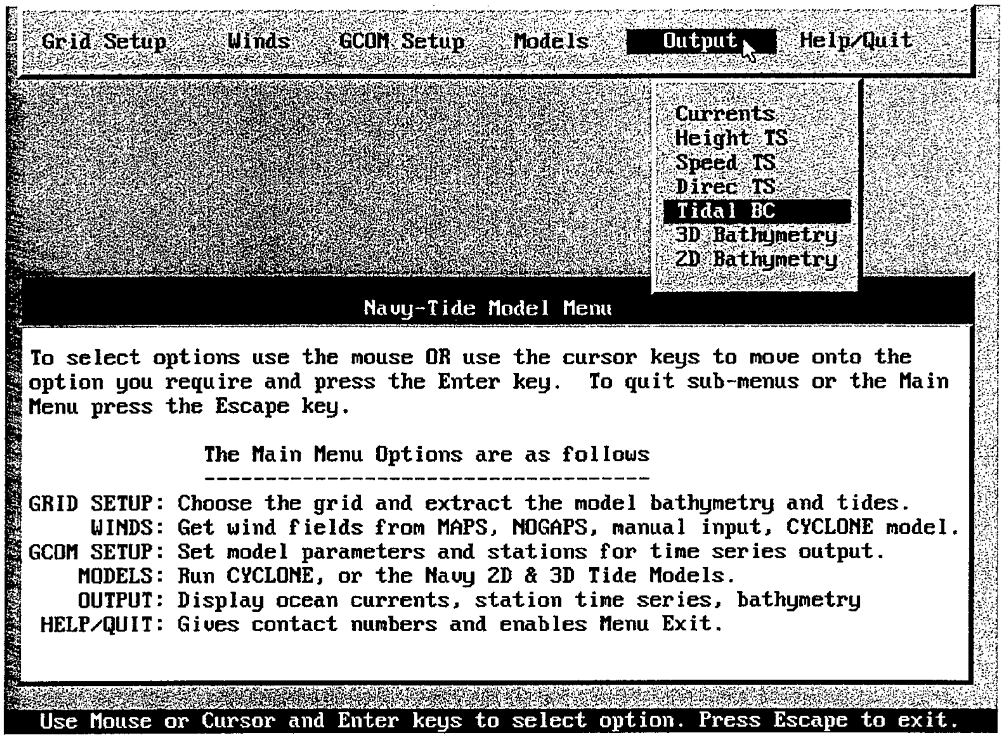

Figure 14: Selecting to plot a tidal boundary condition.

4.3 WINDS

The winds to force the ocean model may be derived from a Navy Product wind (NOGAPS, DAMPS, or COAMPS) or MAPS field, entered manually or developed using the hurricane model. A more complete guide to operation of the MAPS model is given in Appendix C.

4.3.1 Model Output Winds

The Navy Product wind or MAPS files may be used to derive surface winds and atmospheric pressures to force the ocean model. The system looks in the "\gems\work" directory for the NOGAPS or MAPS output files, which are named:

nogaps.000	maps.000
nogaps.006	maps.006
nogaps.012	maps.012

etc. (the file extension refers to the hour of the forecast)

These files are interpolated to the model grid and written to the binary sequential file "atmos.dat".

Note: PCTides has been updated to use the Navy's METCAST winds. For a brief discussion of how these are used, see Appendix B.

<u>**Command prompt**</u>

Run "da2seq".

<u>**Menu**</u>

Model winds may be derived using the menu by selecting "Maps Winds" or "NOGAPS Winds" (Figure 15).

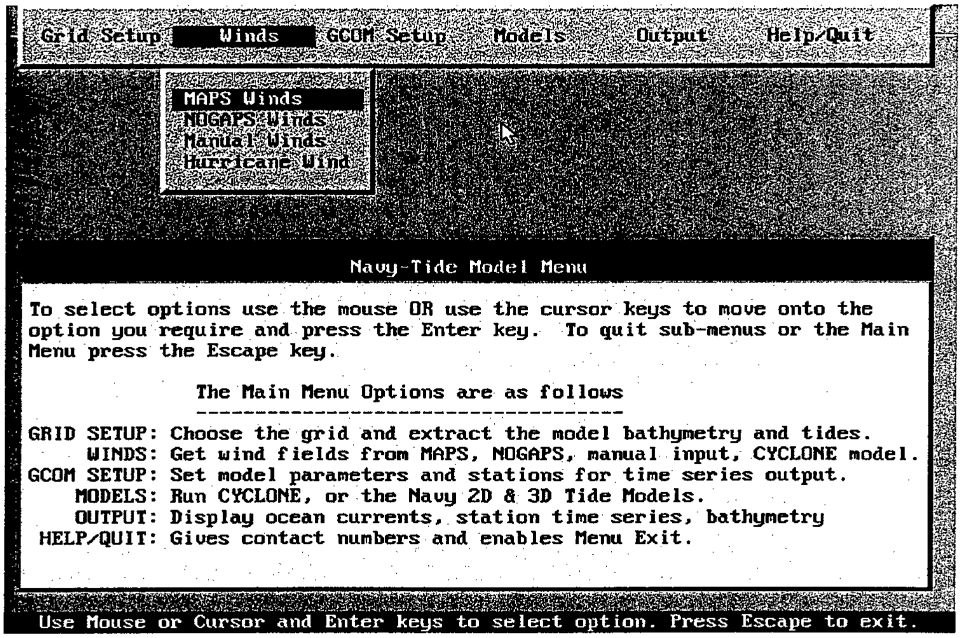

Figure 15: Wind forcing selection menu.

4.3.2 Manual Winds

Winds may also be entered manually. This option is useful if no other winds are available or if the model is running over a small area where the user believes the local wind station observations and/or forecasts may be more accurate (or available) than model output winds. This method becomes less accurate in larger model regions for which the spatial variation of the winds is not accounted.

The user specifies the start date and hour and the local time zone and then inputs wind speeds (in knots) and directions (the direction in degrees, clockwise from true north, from which the wind is coming) at specified time intervals from the start time.

On completion these data are put on the model grid by referring to the "topog.dat" file and written to the "atmos.dat" file. This produces a time varying, but spatially constant, wind file.

Command prompt

Edit "winds.dat".

Run "winds".

Menu

Select "Manual Winds". Enter the required data in the "manual winds" panel (Figure 16).

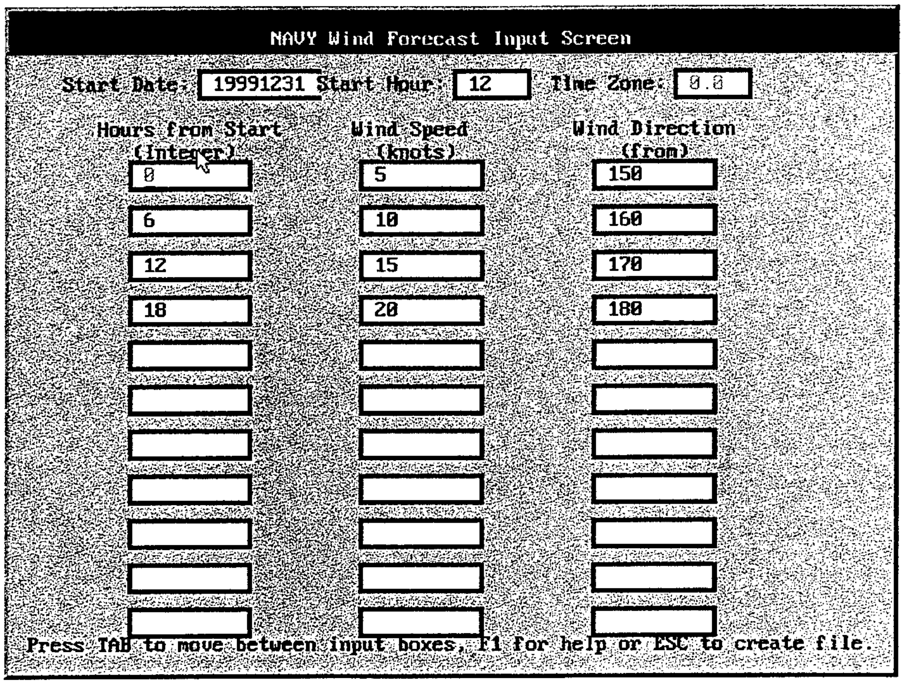

Figure 16: Manual wind entry panel.

4.3.3 Hurricane Winds

A special hurricane/cyclone vortex model is available in PCTides. This model takes in track parameters and develops wind and atmospheric pressure fields. Options for entering forecast track data for real-time usage or the simulation of historical events (hindcasts) are provided.

4.3.3.1 Forecast Track

The forecast track is defined in the "cyclone.dat" file. The menu offers a more interactive method of establishing the track than can be done at the command prompt so they are described separately. The structure of this file is as follows (with sample values at end of line):

Line	Parameter	Typical Value
1	Environmental pressure (hPa)	1005
2	Holland "b" parameter (see SDD)	1.75
3	Dummy integer parameter	0
4	Output time step (hours)	0.5
5	Dummy real parameter	0.0
6	Plot flags (wind, MSLP, dummy)	1 0 0
7	Time zone	8.0
8	Date, Time, Latitude, Longitude, Pressure, Radius of Maximum Winds	19990322 0400 -20.80 114.50 915.0 33.0
9	repeat line 8 for each time step	

<u>Command prompt</u>

The user must edit the "cyclone.dat" file to set up the track data. Do not adjust "Dummy" values. The Holland "b" value of 1.75 may be used in most cases.

<u>Menu</u>

In the menu environment after selecting "Hurricane Wind" and then selecting "Forecast track" (Figure 17) a panel appears (Figure 18) which enables the forecast track data to be entered. The track is defined by entering the required parameters concerning the initial state of the hurricane (latitude, longitude, central pressure, speed, radius of maximum winds, date and time) and then specifying its expected coastal crossing point or destination.

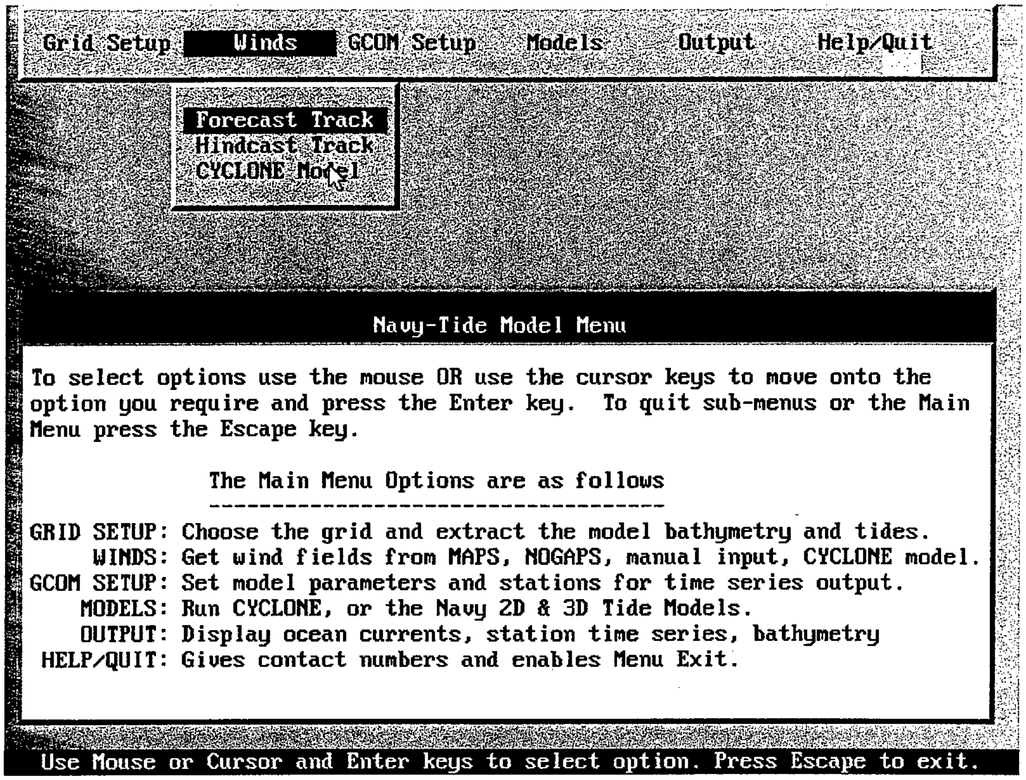

Figure 17: Forecast track menu selection.

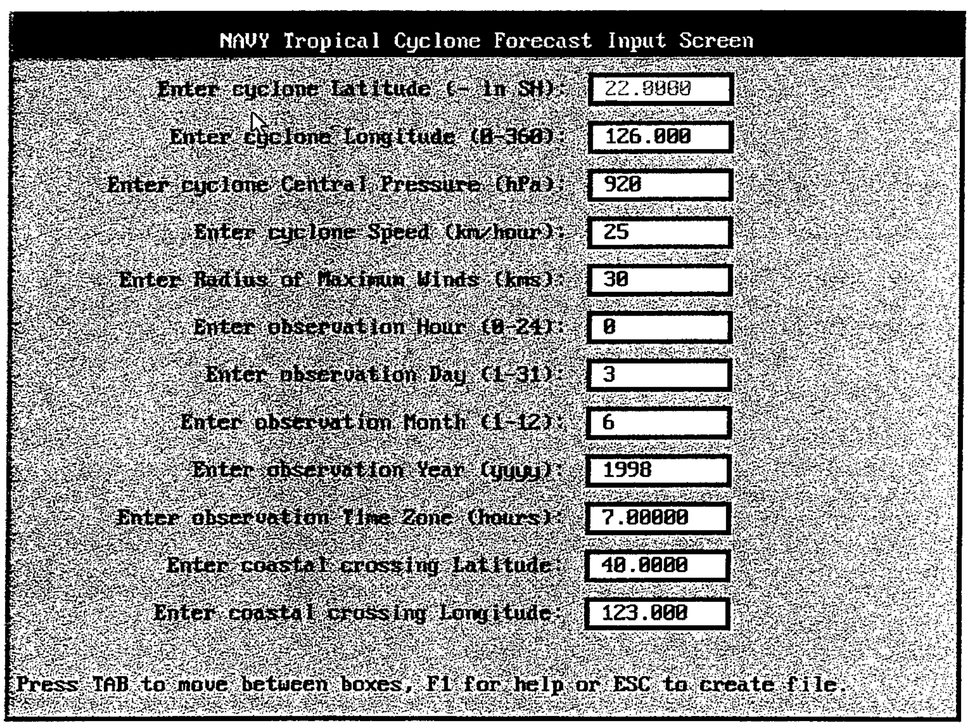

Figure 18: Entry panel for hurricane forecast data.

4.3.3.2 Hindcast Track

Historical tracks can be hindcast from stored track files by recovering the historical track file from "\gems\tctracks" where it is stored with a ".trk" extension. New historical track files can be created by copying the format of existing files and allocating an appropriate name (less than 9 characters).

<u>Command prompt</u>

Copy required track file from "\gems\tctracks" to "cyclone.dat" in the "\gems\work" directory.

Edit the "cyclone.dat" file to adjust the start time if required.

<u>Menu</u>

Select "Hurricane Wind" and then "Hindcast Track" from the menu (Figure 19) and a list of stored track files will appear (Figure 20). Enter the name of the required hurricane track file. The historical storm data will then be displayed (Figure 21). The user may then adjust the start time if it is not necessary to simulate all of the hurricane track (for example if the hurricane is still well away from the coast at the beginning of the track).

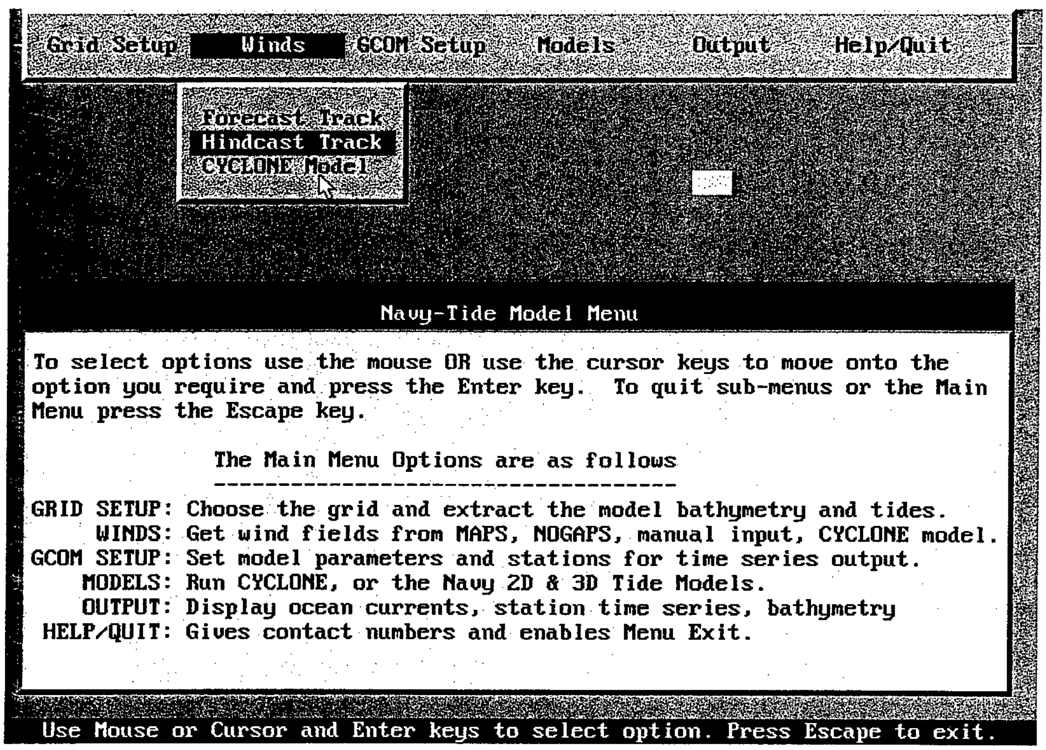

Figure 19: Hindcast track menu selection.

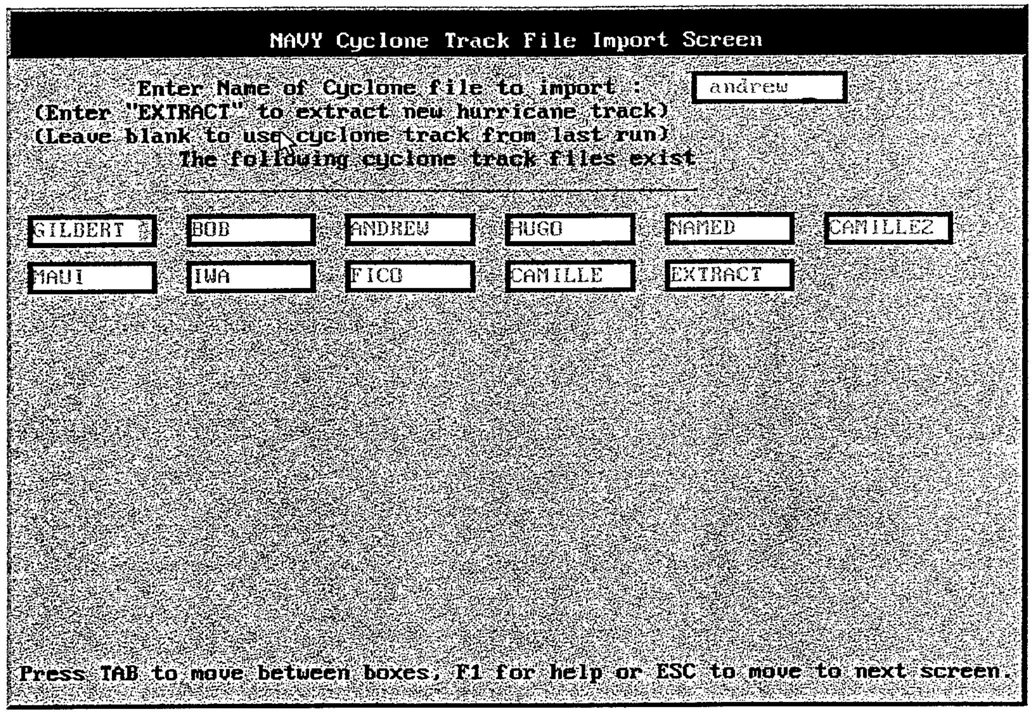

Figure 20: Historical storm track data selection panel.

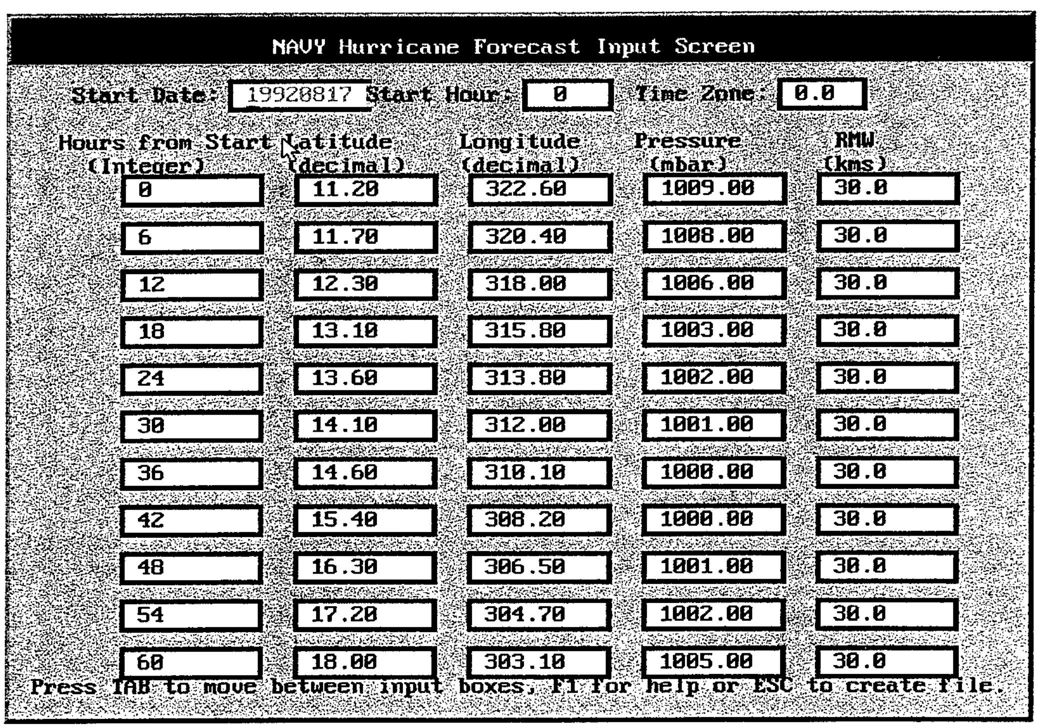

Figure 21: Historical storm data.

4.3.4 Hurricane Model

After a forecast or hindcast track file is established, the hurricane model can be run to generate wind and pressure fields (Figure 23) on the model grid by referring to the "topog.dat" file.

Command prompt

Run "cyclone".

Menu

Select "CYCLONE Model" (Figure 22).

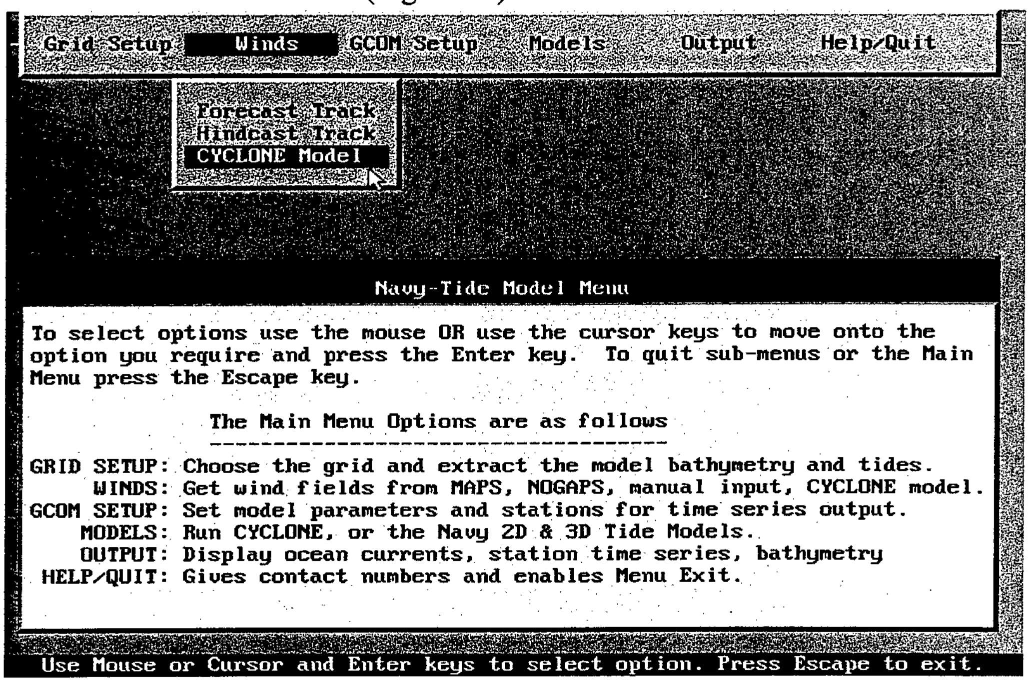

Figure 22: Cyclone Model.

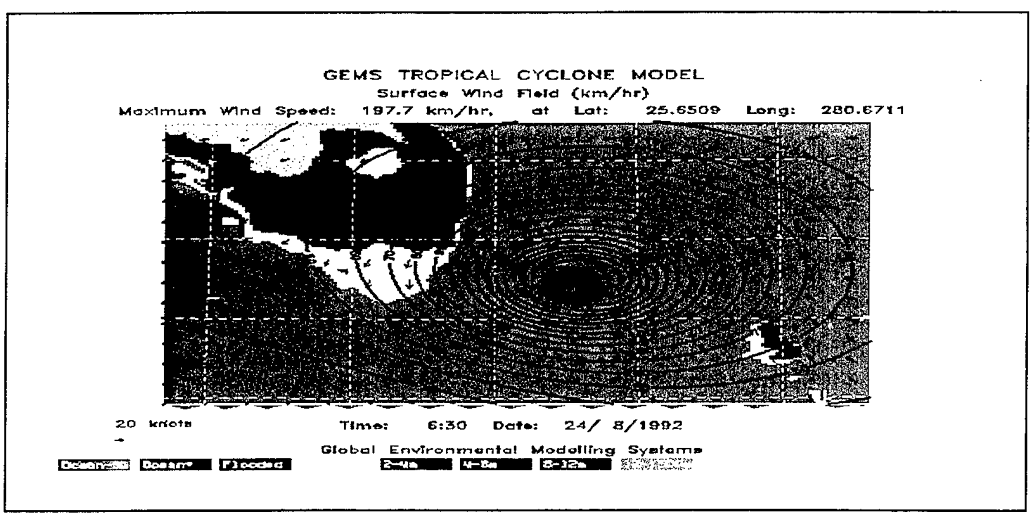

Figure 23: Hurricane model simulation (Hurricane Andrew).

4.4 GCOM Setup

Before running the ocean model the user must set a few parameters which control the type of forcing and model output.

4.4.1 Parameters

These parameters must be specified for the model run. They are stored in the file "gcom.dat" which has the following structure (sample values at end of line):

Line	Parameter	Typical Value
1	wind flag (0=off, 1=on)	1
2	tide flag (0=off, 1=on, 2=on + tidal data assimilation)	1
3	nesting flag (0=off, 1=on)	0
4	screen flag (0=text, 1=vectors)	0
5	inundation flag (0=off, 1=on)	0
6	output file time interval (hours, 0=none)	1.0
7	tidal start time, time zone (hh,mm,dd,mm,yyyy,hours)	00 00 23 06 1999 19.0
8	maximum model run time (hours)	168

4.4.1.1 Wind Flag

The wind flag allows the user to turn the winds "off" (flag=0) or "on" (flag=1). When using winds from a Navy product/MAPS or the hurricane model, the flag will need to be on, whereas for pure tidal modeling the flag needs to be off.

4.4.1.2 Tide Flag

Tidal forcing can be turned "off" (flag=0) or "on" (flag=1 or 2). The tidal forcing may be included with (flag=2) or without (flag=1) tidal data assimilation. If data assimilation is turned on the "tcanals.dat" file in the "\gems\data" directory is scanned for stations within the model region (the tcanals.dat file consists of the International Hydrographic Office's (IHO) tide station observations). The tidal constituent amplitude and phase at these stations are used to predict tidal heights, that are then used to nudge the model solution. The predicted tidal heights for locations nearest the output stations specified by the user (see Section 4.4.2) are written out to files with the station name and the extension ".thp". These files may be used for comparing with the model output time series.

NOTE: It is important to remember when nesting that the tides should be included as forcing on the coarse grid (flag=1 or 2) but when the fine grid is run the tides need to be turned off (flag=0).

4.4.1.3 Nesting Flag

GCOM2D may be nested inside a previous run of either GCOM3D or GCOM2D. Similarly GCOM3D may be nested inside a previous run of either GCOM3D or GCOM2D. The model will look for the output file from the previous run to nest inside, therefore it is important to make sure the two runs (coarse and fine grids) are consecutive. Nesting may be turned "on" (flag=1) or "off" (flag=0). The sequence of events for a typical nesting run is as follows:

1. Create a bathymetry grid for the coarse model domain.
2. Generate tides for the coarse domain.
3. Generate winds for the coarse domain.
4. Set the key parameters for the coarse model run (winds=on, tides=on, nesting=off, inundation=off, output file time interval=not to infrequent in order to pass sufficient information to the nested model – i.e. no greater than 1 hour for tidal modeling).
5. Run GCOM2D or GCOM3D.
6. Create a bathymetry grid for the fine model domain within the coarse domain.
7. Generate winds for the fine domain.
8. Set the key parameters for the fine model run (winds=on, tides=off, nesting=on, inundation=off or on).
9. Run GCOM2D or GCOM3D.
10. Display results.

4.4.1.4 Screen Flag

The default value for the screen flag under PC Windows is "graphics on" (flag=1) however, running under UNIX the screen flag must be set to zero to turn to "graphics off" (or text) mode. Text mode may be used on the PC if desired and the user will then only see a time series log for station 1 on the screen as the model runs.

4.4.1.5 Inundation Flag

Normally inundation is "off" (flag=0) however for storm surge and coastal inundation modeling the flag needs to be on (flag=1). This flag only applies to GCOM2D and must be off for GCOM3D. GCOM2D will run slower with the inundation flag on as the coastline is no longer fixed and the advance (or retreat) of the ocean is being modeled each time step.

4.4.1.6 Output File Time Step

The output file time step controls how often the sea level and ocean current fields are written to the "GCOM.OUT" sequential binary file. Normally the output file time step should be chosen to suit the users display requirements. When nesting, however, the output file time step should be frequent enough to pass sufficient information to the nested model (e.g. no greater than 1 hour for tidal modeling).

4.4.1.7 Tidal Start Time

The start time option is for cases where only tidal forcing is included. If wind forcing is used the start times are set by the wind file. The standard mode of running the tide model is with the time zone set to 0.0 or GMT. However, if required, the user may input the local time.

Command prompt

Edit "gcom.dat".

Menu

Select "Parameters" (Figure 24).

Set parameters in the input panel (Figure 25).

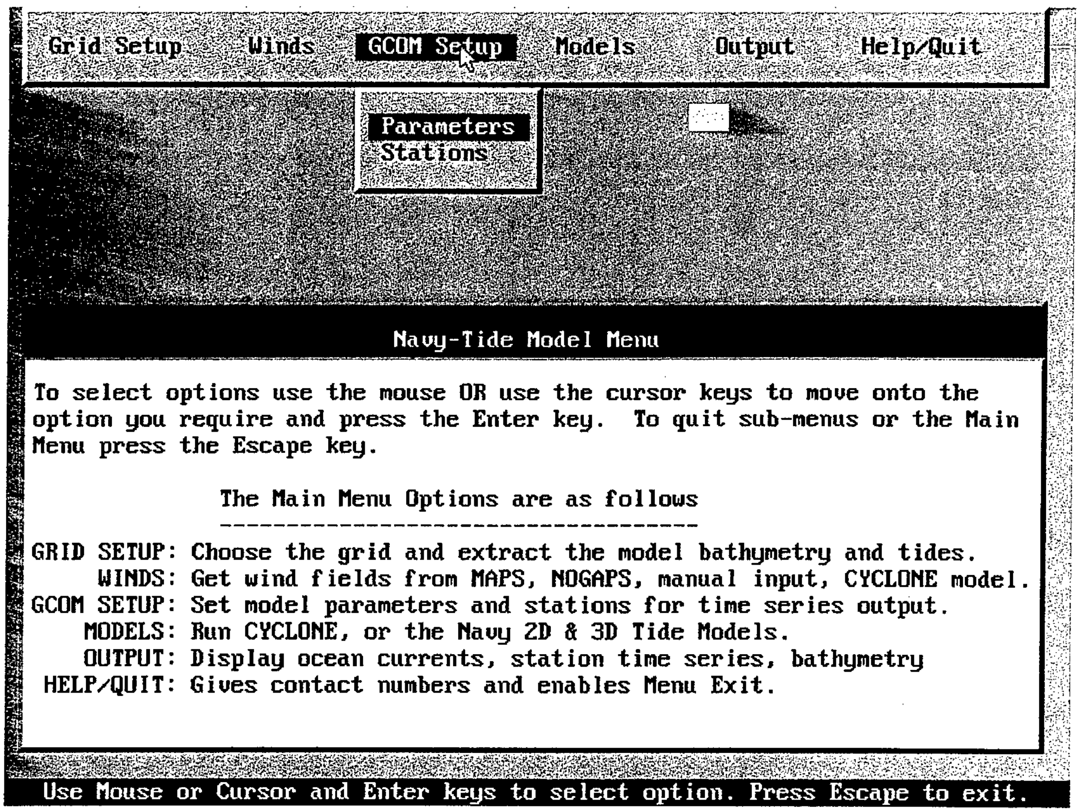

Figure 24: Model parameter menu selection.

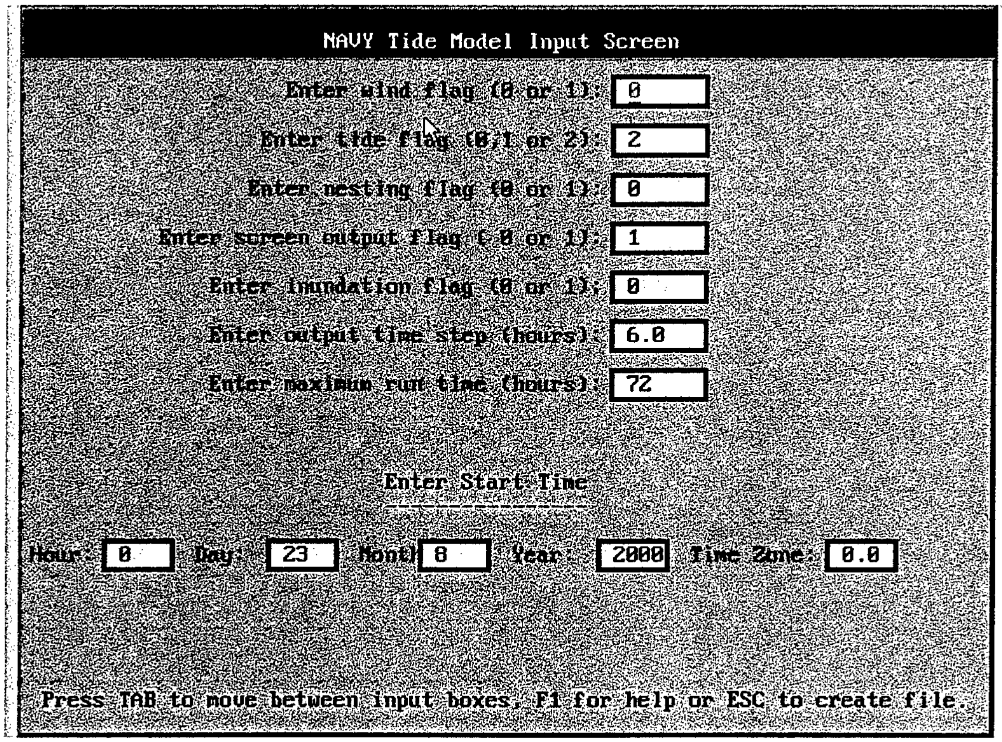

Figure 25: GCOM parameter entry panel.

4.4.1.8 Model Run Time

This option allows extra user control over the model run time. The model will run as long as the wind file has winds or until the maximum time set, whichever is earlier.

4.4.2 Stations

One of the features of the model is to produce time series output of sea levels and ocean currents at specified locations. The location of these "stations" must be defined before the model is run by setting up the "stations.dat" file. During the model run, time series data of sea levels, current speeds and directions are written to files with the station name and a ".tsd" extension. These files can be plotted at the end of the run for comparison with data or tidal height predictions (".thp" files).

The "stations.dat" file may have up to 12 stations defined, one per line, as latitude, longitude, and name. The user is advised to have at least one output station defined for each model run. The format for the "stations.dat" file is as follows:

Latitude (-90.0 to 90.0)	Longitude (0 to 360 E)	Station Name (max 8 characters)	Model Output Level (1 for GCOM2D)
26.17000	56.55000	Pgulf1	1
26.70000	56.28000	Pgulf2	1
24.00000	58.00000	Pgulf3	1
26.50000	53.40000	Pgulf4	1
25.67000	52.40000	Pgulf5	1
24.45000	53.37000	Pgulf6	1
27.00000	49.72000	Pgulf7	1
29.27000	50.33000	Pgulf8	1
29.83000	48.72000	Pgulf9	1

Note: The simplest way of determining the latitude/longitude location of each station is to first proceed to the main menu output Section and select "2-D Bathymetry". The user should determine station latitude and longitude values that "fit" within the selected grid from this figure. (See Section 4.5 "Models" for a method to check the station locations.) The set of stations defined for a model region can be saved with a ".stn" extension in the "\gems\work" directory and recalled for later model runs.

<u>**Command prompt**</u>

Copy a ".stn" file to "stations.dat" and/or edit "stations.dat".

<u>**Menu**</u>

Select "Stations" (Figure 26).

Select a stored stations file (Figure 27).

Edit the station data (Figure 28) and save (exit).

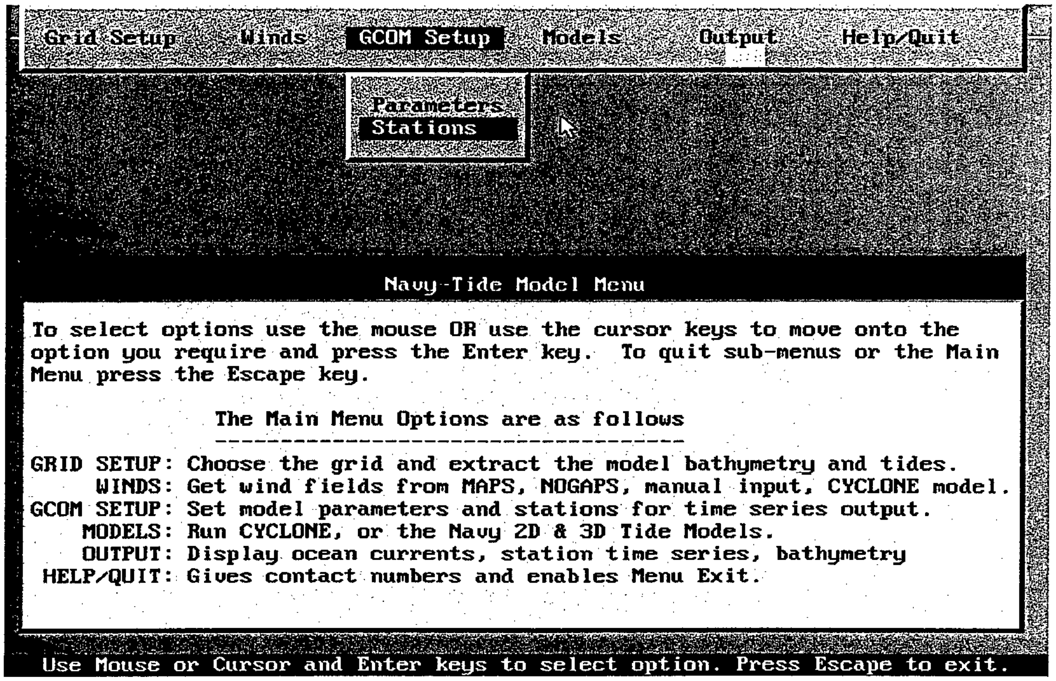

Figure 26: GCOM Setup menu selection.

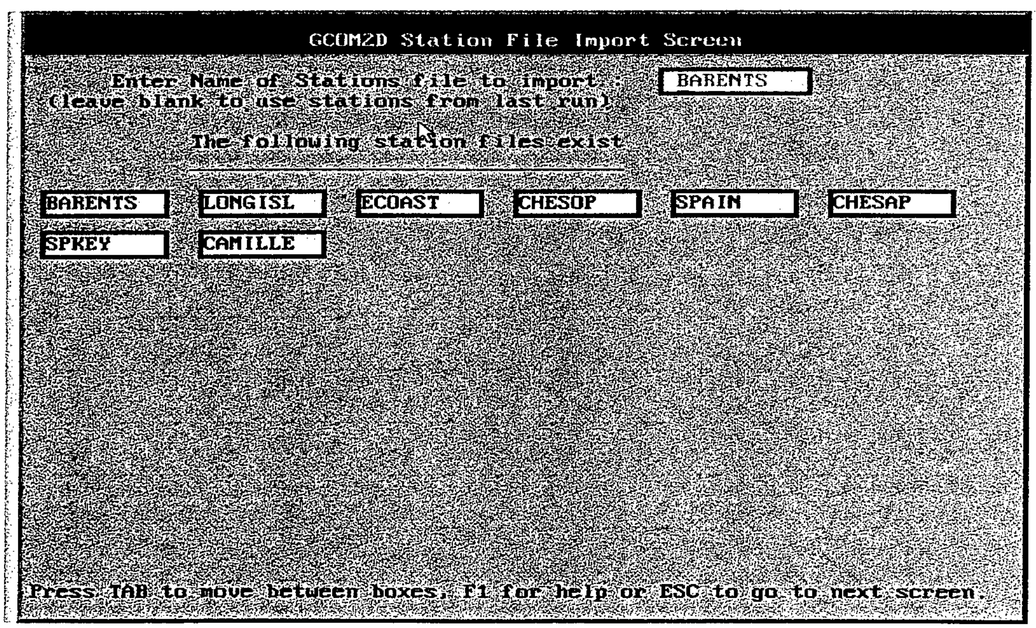

Figure 27: Stored station data selection panel.

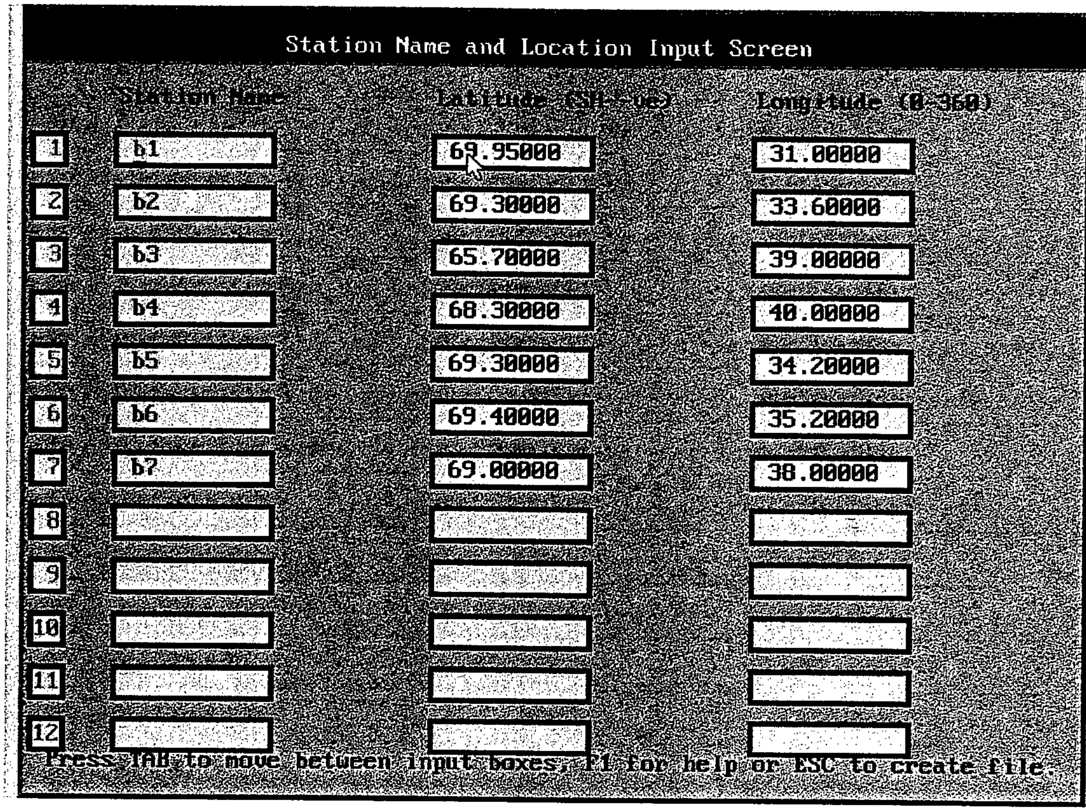

Figure 28: Station location data (checking stored data or entering new data).

4.5 MODELS

Either GCOM2D or GCOM3D may be run using the same set up data. The user would normally use GCOM3D only if near-surface currents were required. GCOM2D is faster and is used to predict sea levels as a result of tidal and/or hurricane forcing. GCOM2D can also simulate the inundation of coastal regions as a function of tidal ebb and flood or storm surge.

Command prompt

Run "gcom2d" or "gcom3d".

Menu

Select "GCOM2D" or "GCOM3D" (Figure 29).

Once the model run begins, numerical data will appear on the screen. This data will list the stations input into the station file and the depths at that location associated with the model topography. If the values are "negative" it indicates that the point you have chosen is "on land" and you must adjust the location of that grid point to a location close by, but over water as defined by the model grid. Inconsistencies between this and the apparent location of the station points in the "2-D topography" plot are due to the capabilities of the plotting package.

Note: Choosing appropriate point locations may take the user a few iterations.

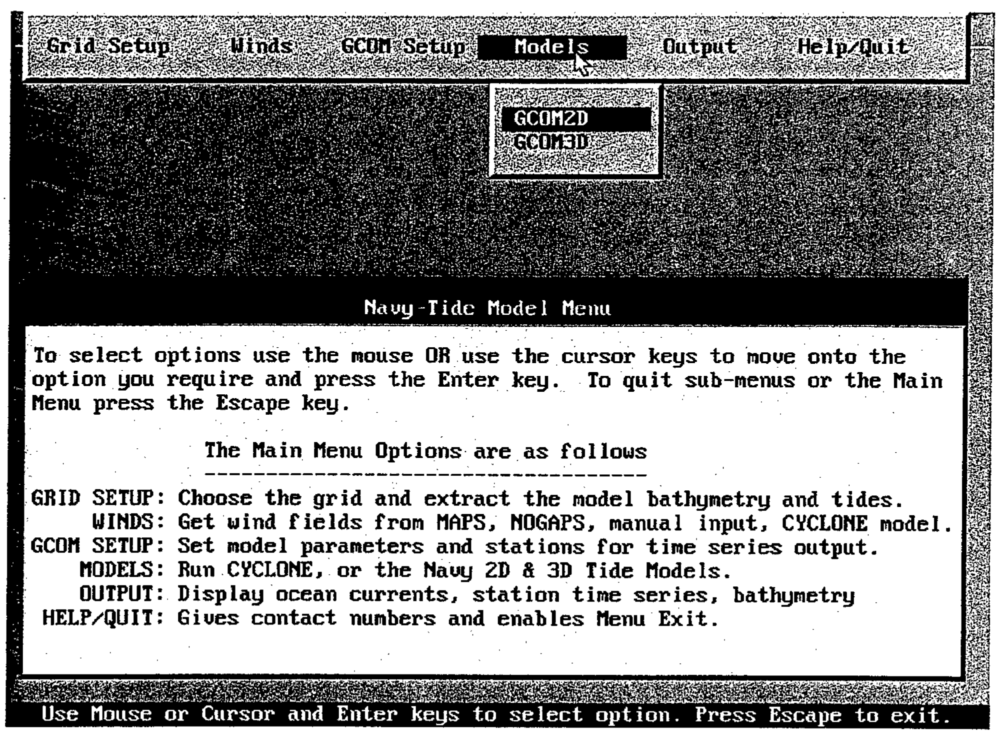

Figure 29: Model selection.

4.6 OUTPUT DISPLAY

Various forms of display options are available for the PC user. The display code has been written for the PC and so there are no display options when running under UNIX. The display options may be run under the PC Windows Menu or at the command prompt.

4.6.1 Ocean Currents and Sea Levels

Both GCOM2D and GCOM3D write output fields to the sequential binary file "gcom.out" at each model output time step. Currents and sea levels from this file may be displayed by running "omdisp" which offers an interactive menu to set display options. The "omdisp" menu appears in both the menu and command prompt environments and each entry parameter is supported with an "F1" help function to explain the option.

<u>**Notes:**</u>

- The user is referred to the "F1" help function in the display menu for descriptions of each parameter option.
- The "fine grid" option reads data from the last run of GCOM2D or GCOM3D. The "coarse grid" option reads data from the penultimate run of GCOM2D or GCOM3D.
- Only bathymetry, sea levels, and currents can be plotted as the other options (temperature, salinity, and SST refer to baroclinic output).
- The vector scaling option allows the user to change the appearance of the current vectors.
- The output level is "1" for GCOM2D and for near surface currents in GCOM3D.
- The latitude and longitude limits of the model domain are displayed and the user may choose to plot sub-regions of that area (i.e. zoomed plots).

<u>**Command prompt**</u>

Run "omdisp" and set display options in the menu panel (Figure 31).

<u>**Menu**</u>

Select "Currents" (Figure 30) and set display options in the menu panel (Figure 31). Hit "Esc" key to display plots initially. Press "Enter" to scroll through the series of plots. Press "Enter" after the last plot to be returned to the menu panel (Figure 31) and then press "Esc", making sure you have not selected an output field to be plotted and the user will be returned to the main menu.

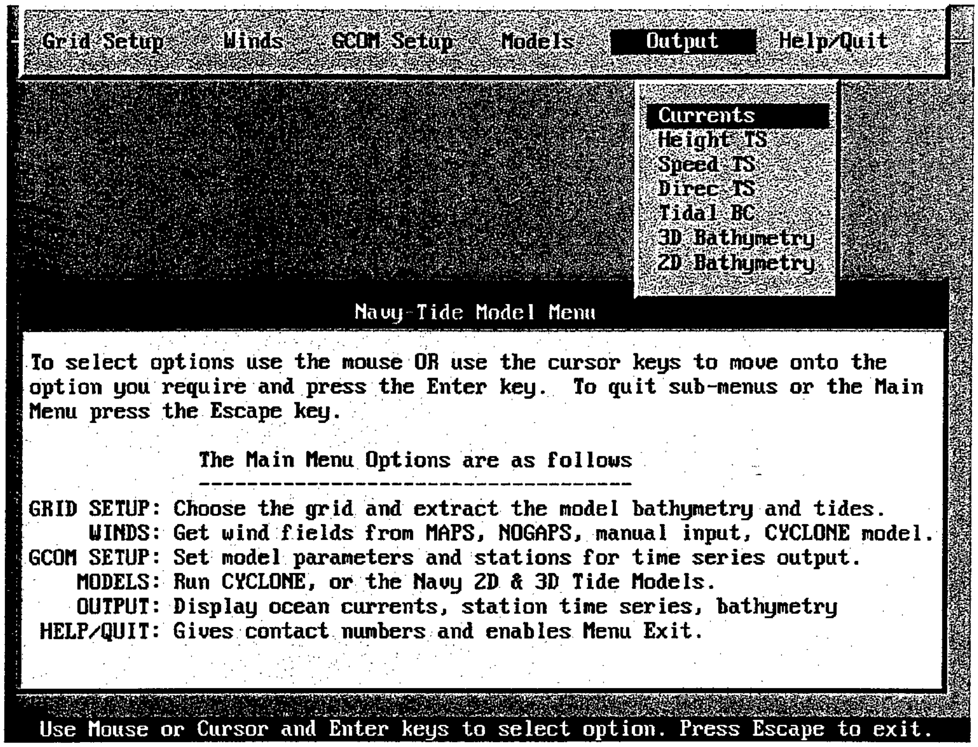

Figure 30: Output display menu selection.

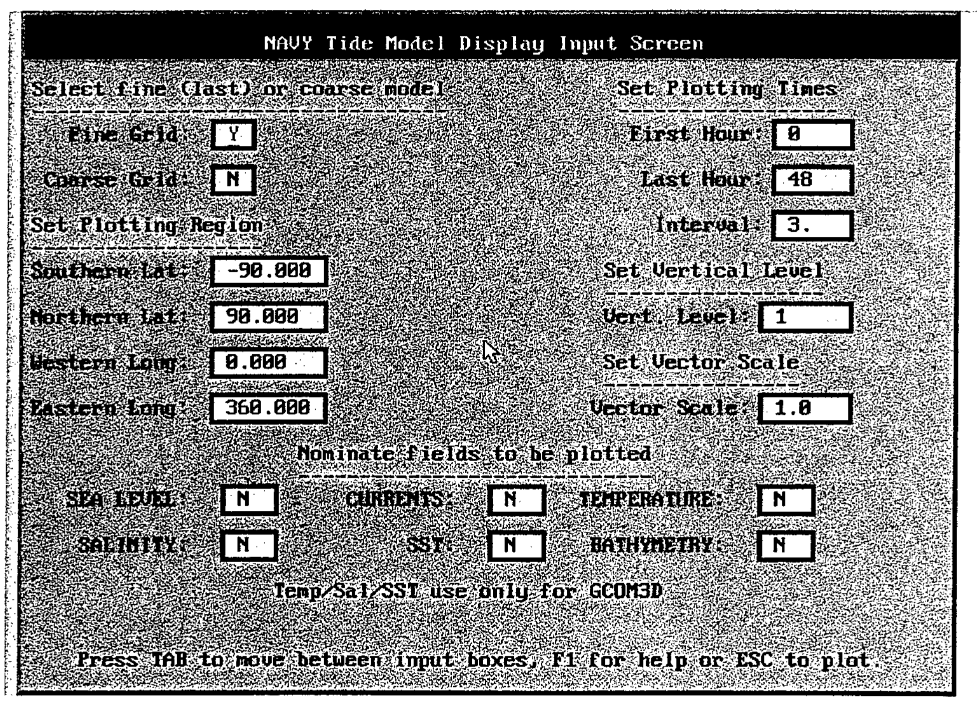

Figure 31: Ocean model horizontal fields display menu.

4.6.2 Sea level time series

When the user specifies stations in the menu or edits the "stations.dat" file the model produces time series output at those locations and writes to a file with the station name and an extension of ".tsd". If data assimilation has been chosen for the model run then the tidal predictions for the closest IHO tidal station to the selected model station are written to a file with the station name and the extension ".thp". Both these file types may then be plotted in the following manner.

Command prompt

Run "zplot" and specify the input file.

Menu

Select "Height TS" (Figure 30) and specify the input file. Station#.tsd is the output time series at the model station location while Station#.thp is the time series of the closest IHO point. Note these two may not be at the same location. Also note that the color scheme for several time series is as follows for the first six time series plotted on the same screen: Green, Red, Blue, Pink, Yellow, Purple.

Note: The time series, tidal boundary conditions and bathymetry plots require interactive input from the user. Unless a specific plot is needed (such as overlaying two time series), the user should hit "enter" until the plot appears on the screen. To return to the menu, the user should hit "enter" once again.

4.6.3 Current Speed and Direction Time Series

As described in Section 4.6.2 the time series of current speeds and directions are part of the ".tsd" files and may be plotted in the following manner.

Command prompt

Run "spdplot" or "dirplot" and specify the input station.

Menu

Select "Speed TS" or "Direc TS" (Figure 30) and specify the input station.

4.6.4 Tidal Amplitudes and Phases

The tidal forcing from the global tidal files may be plotted as described in Section 4.2 in the following manner.

Command prompt

Run "plotide" and specify the tidal constituent file (m2.dat, o1.dat etc. as defined in Section 4.2).

Menu

Select "Tidal BC" (Figure 30) and specify the tidal constituent file (m2.dat, o1.dat etc. as defined in Section 4.2).

4.6.5 Three-Dimensional Bathymetry

A three-dimensional surface mesh plot of the model bathymetry (and topography) may be obtained with the program "plot3d". This program reads the "topog.dat" file and offers choices of viewing rotation angle (0-360 from due south) and viewing elevation angle (0-90). This program may be run in the following manner.

Command prompt

Run "plot3d".

Menu

Select "3D Bathymetry" (Figure 30).

4.6.6 Two-Dimensional Bathymetry

A two-dimensional contour plot of the model bathymetry and color-coded topography may be obtained with the program "bathplot". This program reads the "topog.dat" file and allows the user to set the minimum plotting contour (meters). The color coding of the topography is defined on the bottom of the plot. This program may be run in the following manner.

Command prompt

Run "bathplot".

Menu

Select "2D Bathymetry" (Figure 30).

5.0 FUNCTIONAL DESCRIPTION

For a discussion of the functional description see the accompanying Software Design Description (SDD) manual (Hubbert et al., 2001).

6.0 TECHNICAL REFERENCES

6.1 Software Documentation Guidelines

Oceanographic and Atmospheric Master Library Summary. Naval Oceanographic Office, System Integration Department. OAML-SUM-21F. April, 1998.

Software Documentation Standards for Environmental System Product Development. Naval Oceanographic Office, System Integration Department. OAML-SDS-59A. January, 1999.

6.2 PCTides Software Release

Hubbert, G. D., R. H. Preller, P. G. Posey and S. N. Carroll, "Software Design Description for the Globally Relocatable Navy Tides/Atmosphere Modeling System (PCTides)," NRL/MR/7322—01-8266, Naval Research Laboratory, Stennis Space Center, MS, 2001.

6.3 General Technical Documentation

Shum, C.K., Woodworth, P.L., Andersen, O.B., Egbert G.D., Francis, O., King, C., Klosko, S.M., Le Provost, C., Li, X., Molines, J.M., Parke, M.E., Ray, R.D., Schlax, M.G., Stammer, D., Tierney, C.C., Vincent, P., and Wunsch, C.I., (1997) Accuracy Assessment of Recent Ocean Tide Models. *J. Geophys. Res.*, **102** (11): 25173-25194.

7.0 NOTES

7.1 Acronyms

ASA	Applied Sciences Associates
ASCII	American Standard Code for Information Interchange
COAMPS	Coupled Ocean Atmosphere Mesoscale Prediction System
CSCI	Computer Software Configuration Item
CSC	Computer Software Component
DAMPS	Distributed Atmospheric Mesoscale Prediction System
FES	Finite Element Solution
GCOM2D	Coastal Ocean Model 2-D
GCOM3D	Coastal Ocean Model 3-D
GEMS	Global Environmental Modeling Systems
GMT	Generic Mapping Tool
IHO	International Hydrographic Office
MAPS	Mesoscale Atmospheric Prediction System
NOGAPS	Navy Operational Global Atmospheric Prediction System
NRL	Naval Research Laboratory
OAML	Oceanographic and Atmospheric Master Library
PC	Personal Computer
PSI	Planning Systems Incorporated
SDD	Software Design Description
SRS	Software Requirements Specification
SSC	Stennis Space Center
STD	Software Test Description
UNIX	Workstation Operating System

APPENDIX A – GLOBAL TIDAL BOUNDARY CONDITIONS

A description of The Finite Element Solutions 95 versions 1 and 2.1 (FES95.1/2.1) are documented in a paper by Shum et al., (1997) describing this model and several other global tide models. The FES95.1/2.1 model differs from the earlier FES94.1 model by assimilating tidal solutions derived from TOPEX/POSEIDON (T/P) altimetry data. The difference between FES95.1/2.1 is that in FES95.1 only the M_2 and S_2 constituents have been corrected while in FES95.2.1 N_2, K_1 and O_1 have also been corrected.

Figure A1 shows the global Coamplitude and Phase of the M2 Tidal component from the FES95.1/2.1 model.

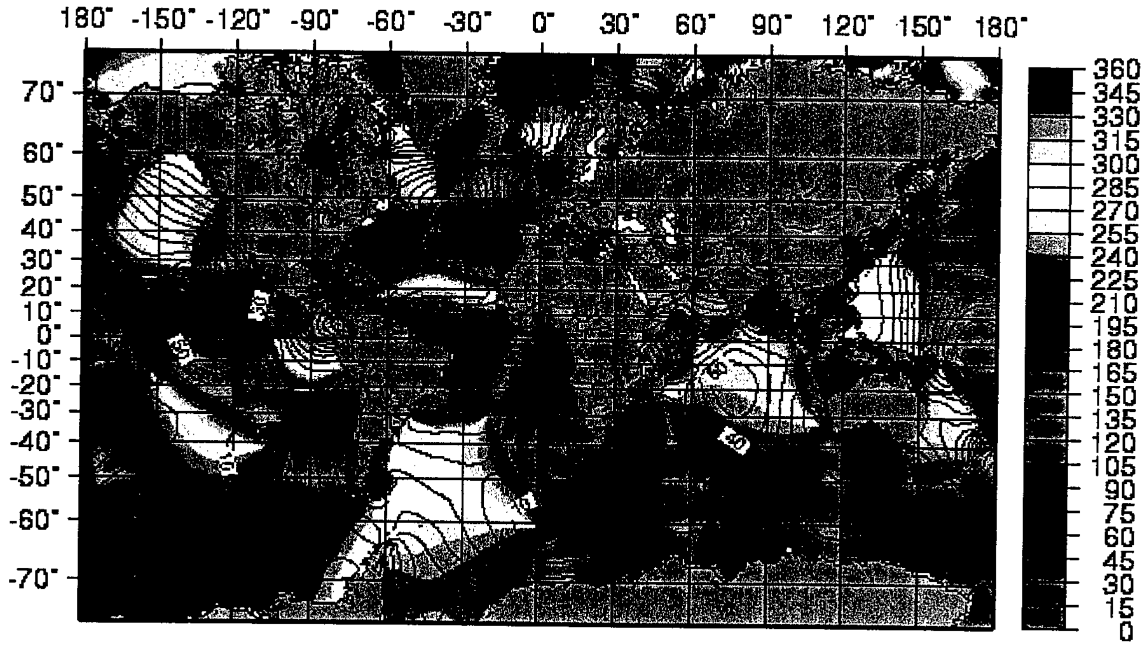

Figure A1: M_2 Coamplitude and Phase Tidal Component.

APPENDIX B – METCAST ATMOSPHERIC FORCING

Since April 2001, PCTides has been using atmospheric forcing available through METCAST. METCAST is officially supported and distributed by Fleet Numerical Meteorology and Oceanography Center (FNMOC) in Monterey, California. Through METCAST, a user can retrieve various atmospheric forcing (surface air pressure, 10-meter wind forcing and surface air temperature). A user can retrieve this atmospheric forcing from either the Navy Operational Global Atmospheric System (NOGAPS) or any the various Coupled Ocean and Atmospheric Prediction Systems (COAMPS) models. NOGAPS forecasts are produced with a resolution of 1 degree while the COAMPS forecasts are produced with a higher resolution of 0.2 degrees.

In order to run using the METCAST fields, you must first have the METCAST software loaded on your NT machine. Installation and data retrieval is very easy and well documented. The user will need to "schedule" the necessary atmospheric forcing. As stated above, PCTides requires two atmospheric fields (surface pressure and 10 meter winds).

By now the pre-selected METCAST fields have been retrieved and stored on the local disk drive under c:\jmvwin\noddsfls.

Before running the preprocessor, the user will need to make sure that the appropriate model grid has been selected through the PCTides menu. This has to be done first so that the atmospheric fields will be interpolated to the correct grid. To begin the preprocessor phase, click Start, up to Relocatable Tide Model, over to preprocessor. The preprocessor icon will run a job that asks the user to select (from a given list which includes NOGAPS, COAMPS Central America, COAMPS Eastern Pacific, COAMPS Europe, COAMPS Western Pacific, COAMPS Southwest Asia or COMAPS Western Atlantic) the appropriate atmospheric forcing needed for the model run. The user must remember to set the winds parameter to (winds = 1) from the PCTides menu in order to use the winds.

After the preprocessor finishes, the model (GCOM2d) is ready to run.

APPENDIX C

USER'S MANUAL

FOR THE

MESOSCALE ATMOSPHERIC PREDICTION SYSTEM

(MAPS)

July 2001

1.0-C INTRODUCTION

The Computer Software Configuration Item (CSCI), identified as the Mesoscale Atmospheric Prediction System (MAPS), is a subset of Globally Relocatable Navy Tide/Atmosphere Modeling System (PCTides). It is a hydrostatic primitive equations model designed to provide high- resolution representations of anemometer level winds and surface pressure as atmospheric boundary conditions for PCTides GCOM2D and GCOM3D. To this end, the turbulence closure scheme has been designed to allow the model to be run with its lowest model level at anemometer height, thus providing a direct simulation of the winds at this level. The equations of motion are coded in advective form and solved using a semi-implicit time differencing scheme ensuring that the model is both robust and economical to run, even in regions of steep terrain.

2.0-C APPLICATION

2.1-C Description of MAPS Usage

This manual describes in detail the procedures for running the GEMS Mesoscale Atmospheric Prediction System (MAPS) and supporting software. The system is platform independent and may be run in the PC Windows environment driven by an interactive menu or at the command prompt under DOS mode or the UNIX operating systems. The menu provides a logical structure for the user to set up the required environment to carry out a simulation with MAPS in any part of the world. The model is driven by nesting within fields obtained from NOGAPS or some higher resolution wind fields. The atmospheric fields are output at all model vertical levels. Time series predictions of surface wind speeds and directions are stored at specified output stations. Display options allow the plotting of the spatial fields at any vertical level or time series of surface wind speeds and directions.

This manual details the running of the system using the PC Windows interactive menu or the command prompt. Command prompt operation is exactly the same in DOS mode as in the UNIX environment. The SDD contains the mathematical formulation, solution procedures, and code for MAPS as well as a flow charts and descriptions of the programs and sub-programs (Hubbert, et. al., 2001).

2.2-C Directory Structure

The directory structure for operational use of the system is as follows:

\gems\work	:	working directory in which all calculations are carried out
\gems\data	:	directory containing all climatological and topographical files used by MAPS
\gems\maps	:	code directory containing all executable code
\gems\gridgen	:	directory containing the ASA grid generator files – PC only

Note: the file "asagrid.ini" must be placed in the \windows directory

UNIX note	:	if running under UNIX remember to use "/" instead of "\"

These directories are transparent to the PC Windows interactive menu (mapsmenu) user whereas the command prompt user should carry out all activities in the "\gems\work" directory.

2.3-C Running Environment

The MAPS running environment is illustrated in the flow diagram in Figure C1 where the relationship between the components of the system, and associated files, can be seen.

Further understanding of the system may be obtained in the PC Windows menu where the menu procedures are also supported with help functions for all actions of choice. The help is obtained by pressing the "F1" key while the cursor is on the input box in question.

2.4-C Document Content and Organization

This manual documents the procedures for setting up and running MAPS and its supporting software. Each Section illustrates the two methods of running the system by referring to the appropriate PC Windows menu option and giving the appropriate command to be entered at the command prompt.

The basic logic that underlies operation of the system through the PC Windows menu structure or the command prompt is shown in Figure C2.

3.0-C LIMITATIONS AND ASSUMPTIONS

None.

4.0-C OPERATING GUIDELINES

This Section of the User's Manual discusses several key aspects of MAPS.

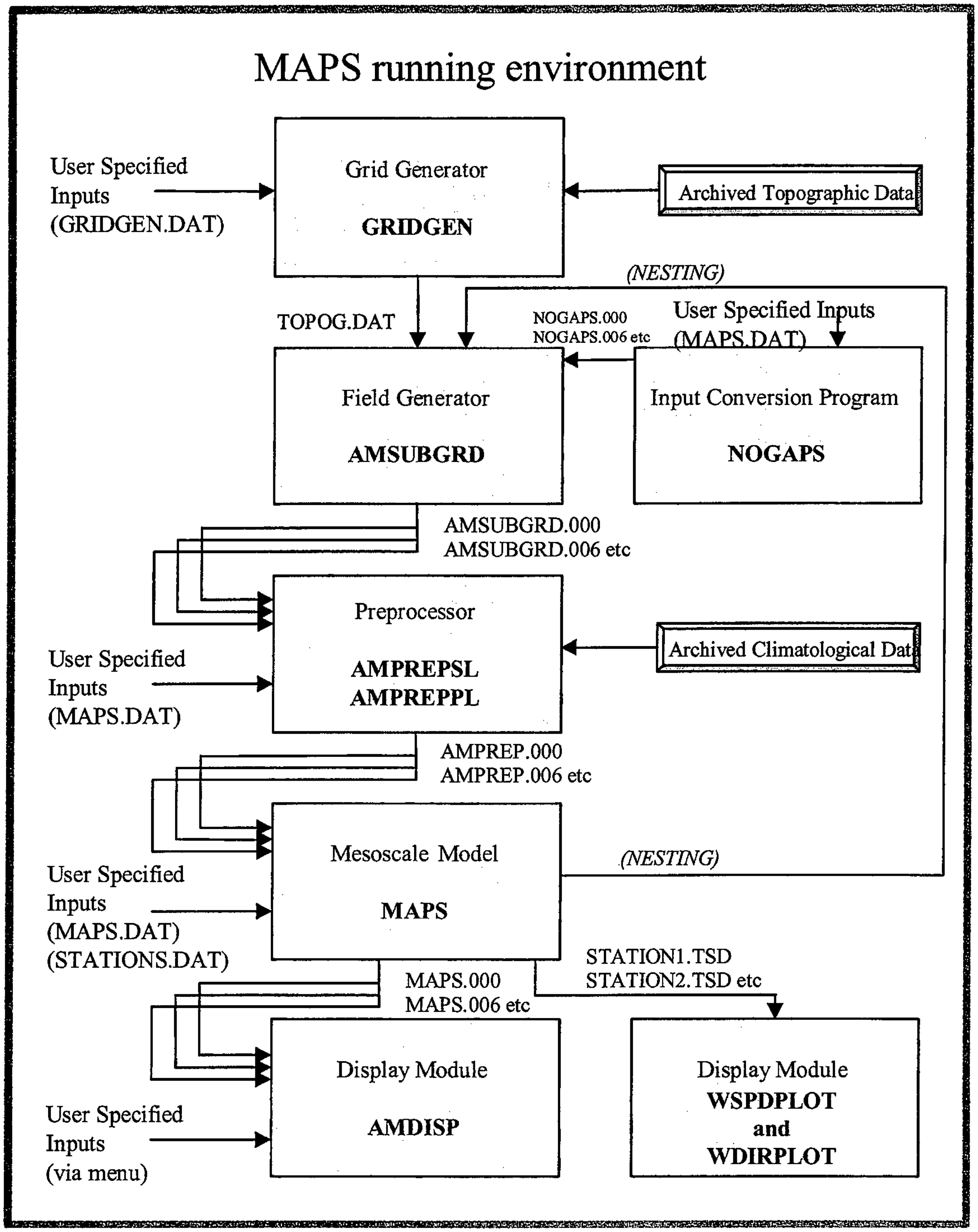

Figure C1: Flow diagram for the MAPS system.

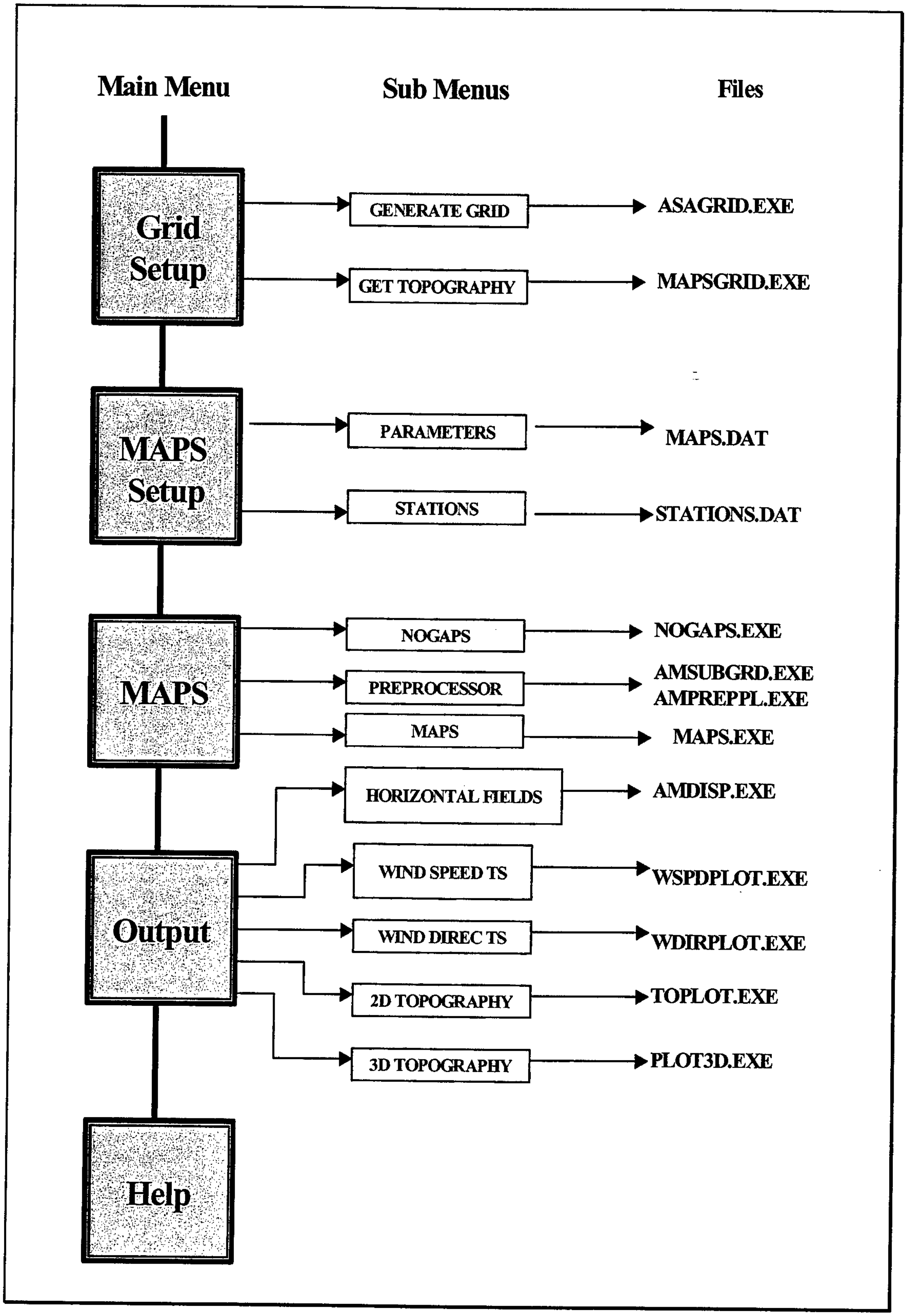

Figure C2: Chart illustrating the MAPS PC Windows Menu and related files.

4.1-C Grid Setup

4.1.1-C Grid Generation

The first step is to define the model domain.

Command prompt

To define the model domain at the command prompt the user should edit the file "gridgen.dat", in the "\gems\work" directory structured as follows:

Line	Parameter	Typical value
1	Arbitrary Title	Spain
2	Grid Projection Flag (**do not change**)	3
3	Southern Latitude Limit	28.0000
4	Northern Latitude Limit	43.0000
5	Western Longitude Limit	343.0000
6	Eastern Longitude Limit	2.0000
7	Standard Grid Spacing (km)	20.0

Note: Longitudes are in the range 0 to 360E. Latitudes are in the range –90S to +90N.

Menu

The "Generate Grid" menu option (Figure C3) is selected which initiates the Applied Sciences Associates (ASA) grid selection program (Figure C4). This software allows the user to zoom in and create a new region by selecting the area for the model grid on the map with the mouse (Figure C5). See Section 4.1.1 for a detailed description on grid setup.

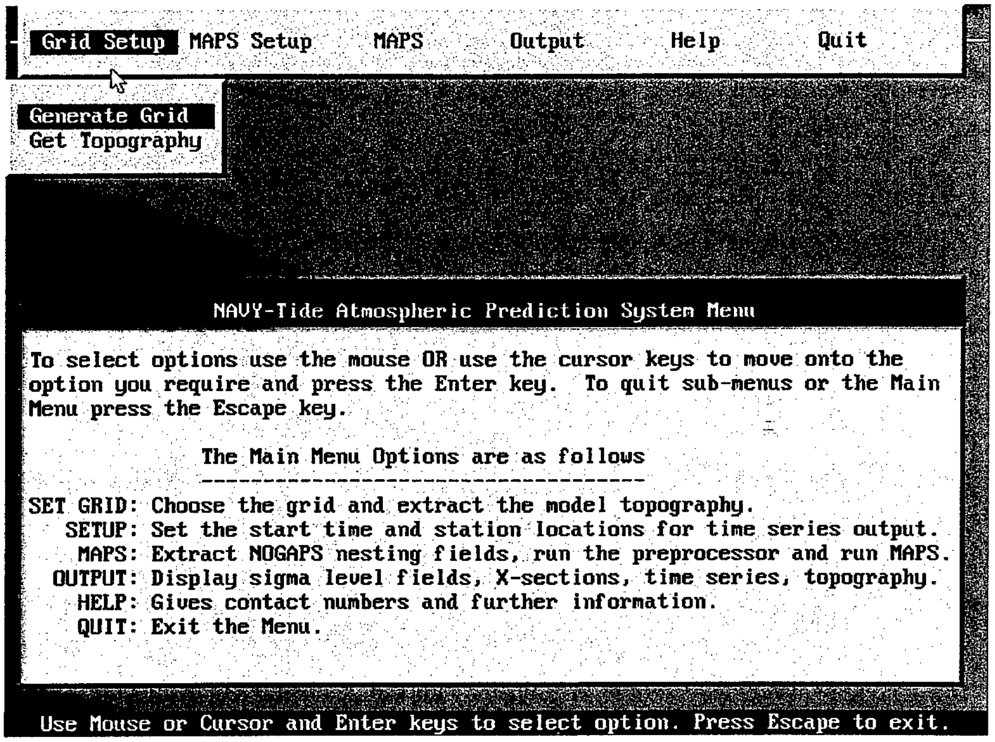

Figure C3: Grid setup menu option.

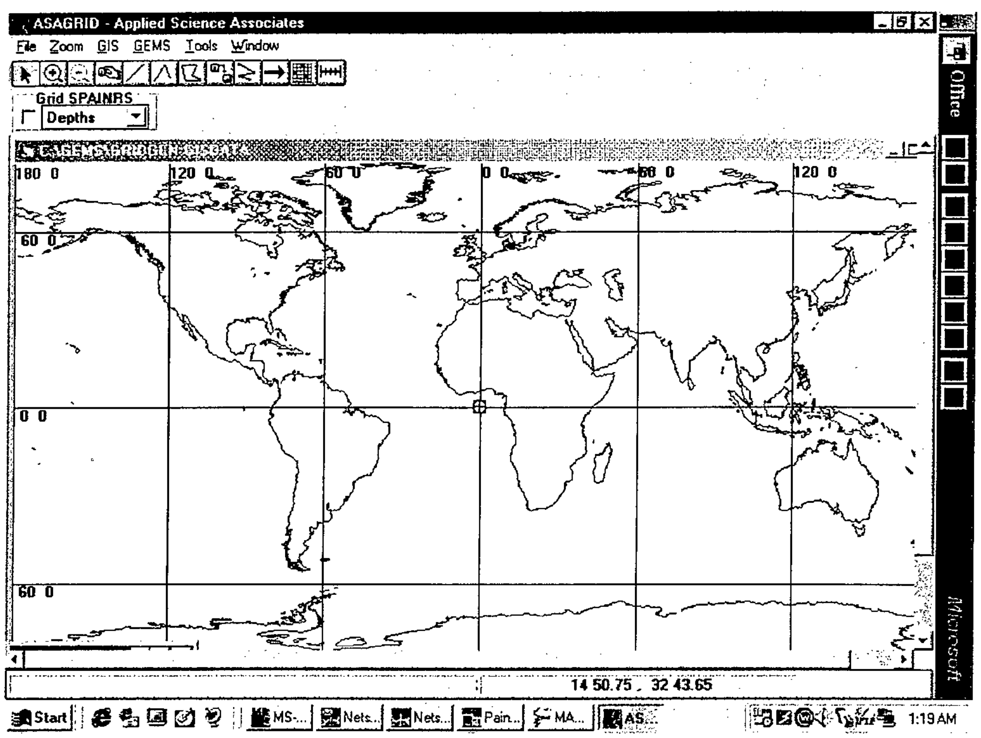

Figure C4: Grid generation global map.

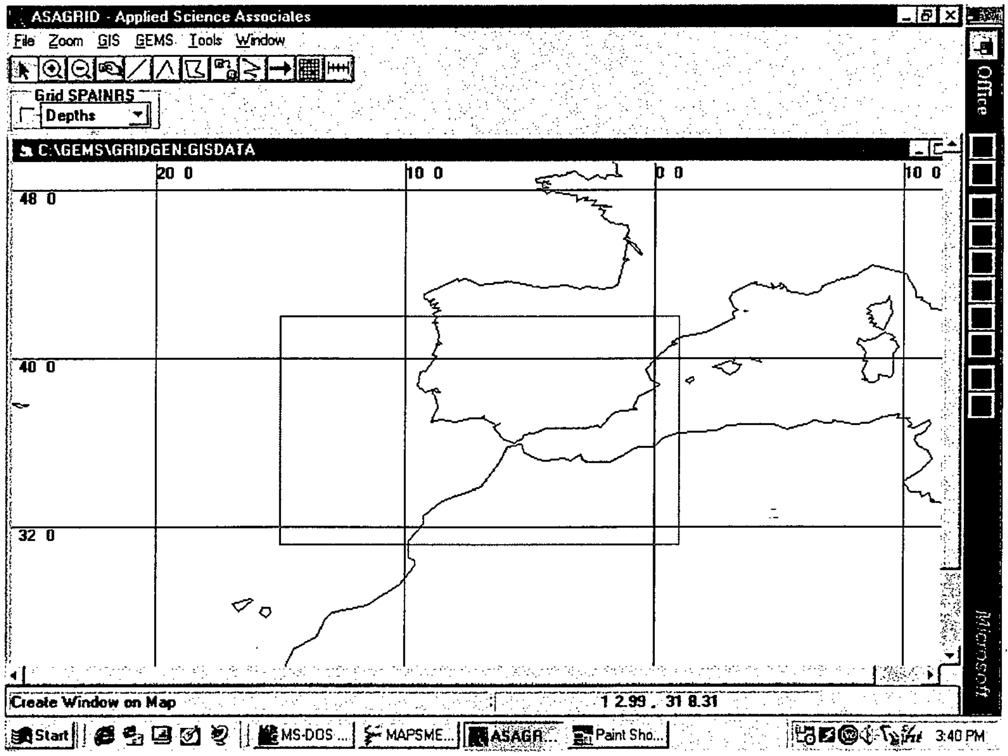

Figure C5: Zoomed map with model region over Spain selected.

To illustrate the procedure (Figure C5) a model grid over Western Europe with Spain in the center is set up. If a global map does not appear when the grid generator is brought up, click on "Zoom" and click again on "UnZoom All" and it should appear. The user can then zoom in to the region of interest (click on "Zoom" and select "Create Zoom Window") and may select the model grid area with the mouse by holding the left button down while moving from one corner of the proposed grid to the corner diagonally opposite (Figure C5). A panel appears (Figure C6) in which the maximum grid dimensions can be set (**Note: coarse grids run faster but may give poorer results, however do not create grids with either dimension over 100**), and a unique output file name specified for identification and storage. The global topographic data sets are then interrogated and the topography for the model grid region is displayed in an adjustable color code (Figure C7). The setting in the left corner labeled "GRID" filename ("spain.rs") may be changed to the "cell" mode to draw the model grid squares.

On completion the ASA grid generator writes an ASCII file to the "\gems\gridgen\depths" directory with an extension ".asc". The name of the file is the name entered by the user when setting the grid dimensions. This ASCII file contains the latitude and longitude limits of the region selected.

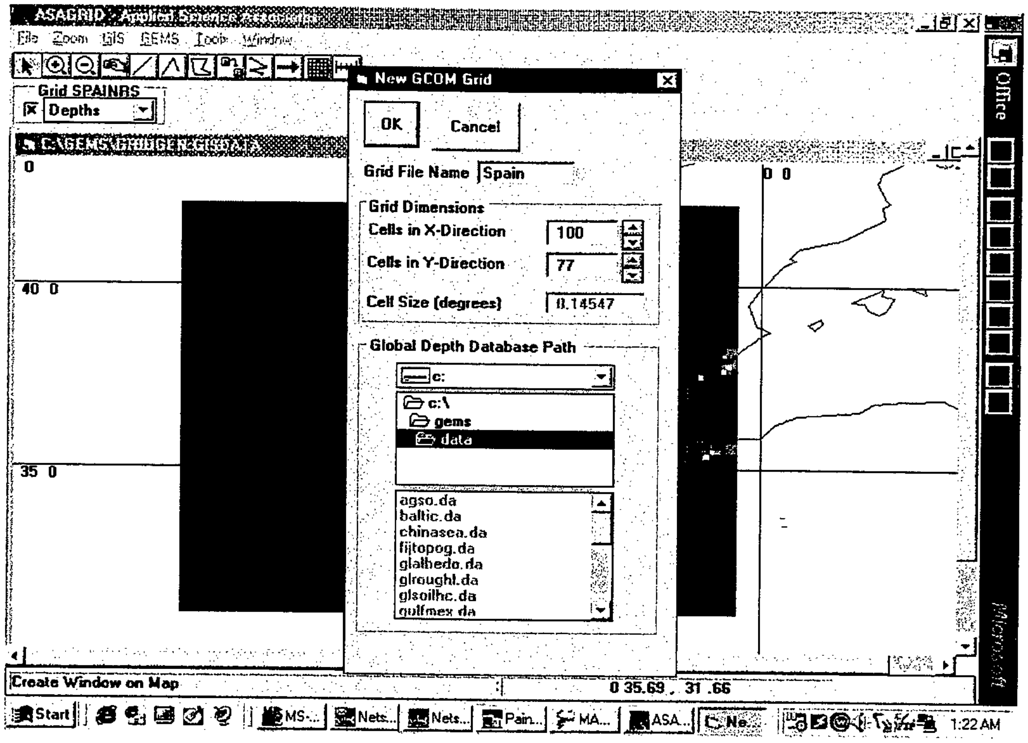

Figure C6: Panel for specifying maximum grid dimensions and grid region name.

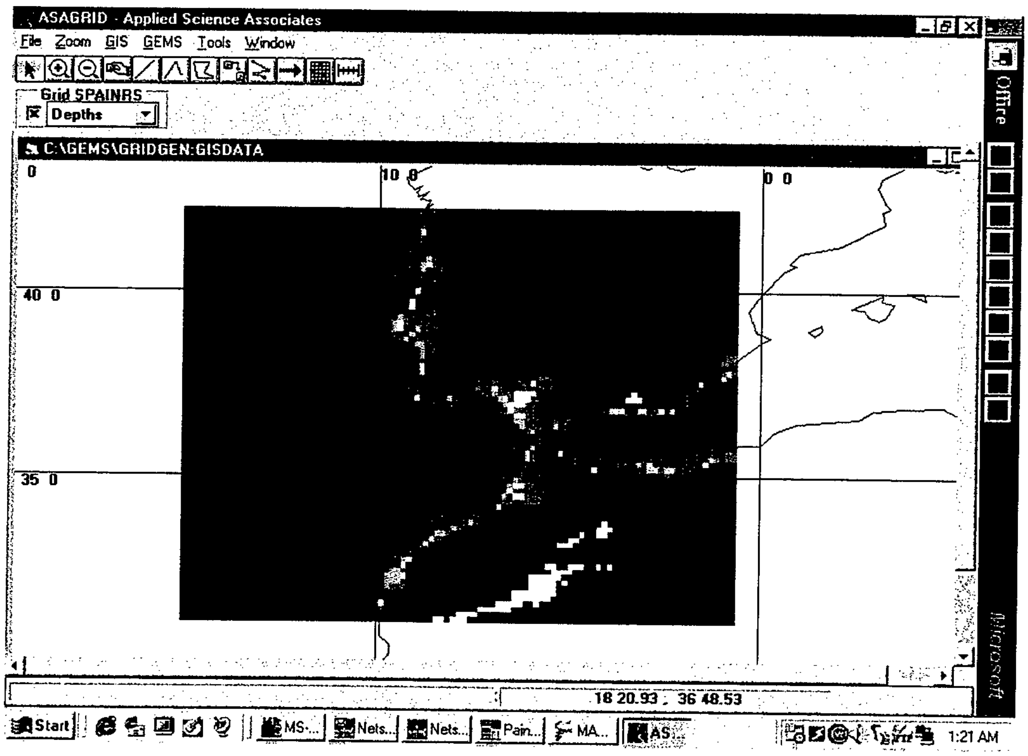

Figure C7: Color-coded topography and bathymetry for the selected region.

4.2-C Topography

The next task is to generate the topographic grid. The ocean bathymetry/land topography data base was generated from the Navy DBDBV bathymetry, interpolated to a 3 minute grid and a USGS land topography data base also interpolated to a 3 minute grid.

Command prompt

To generate the topographic grid for the model domain at the command prompt the user should run the program "gridgen" which reads the latitude and longitude limits and resolution stored in the "gridgen.dat" file. "Gridgen" calculates the topography and bathymetry from the global direct access files and writes the data to the file "topog.dat" in the "\gems\work" directory.

In order to check the region and/or the topography it is advisable to plot the data by running the program "toplot". This program plots the topography at a specified contour interval and also displays topography in color-coded height bands. If the region is not satisfactory, the user should return and select an adjusted region and repeat the process. If the topography is poor quality for the resolution required refer to the general comments in Section 4.3-C.

Menu

To set up the topography in the format required by the model select "Get Topography" (Figure C8). This brings up a panel (Figure C9) that shows previously stored model grid regions and any of these may be specified in the entry box. For this example, "spain" is entered and, after pressing "escape", the topography and bathymetry for the grid are calculated from the global direct access files by the program "mapsgrid". "Mapsgrid" reads the latitude and longitude limits stored in the "spain.asc" file and writes the topography and bathymetry to the file "topog.dat" in the "\gems\work" directory.

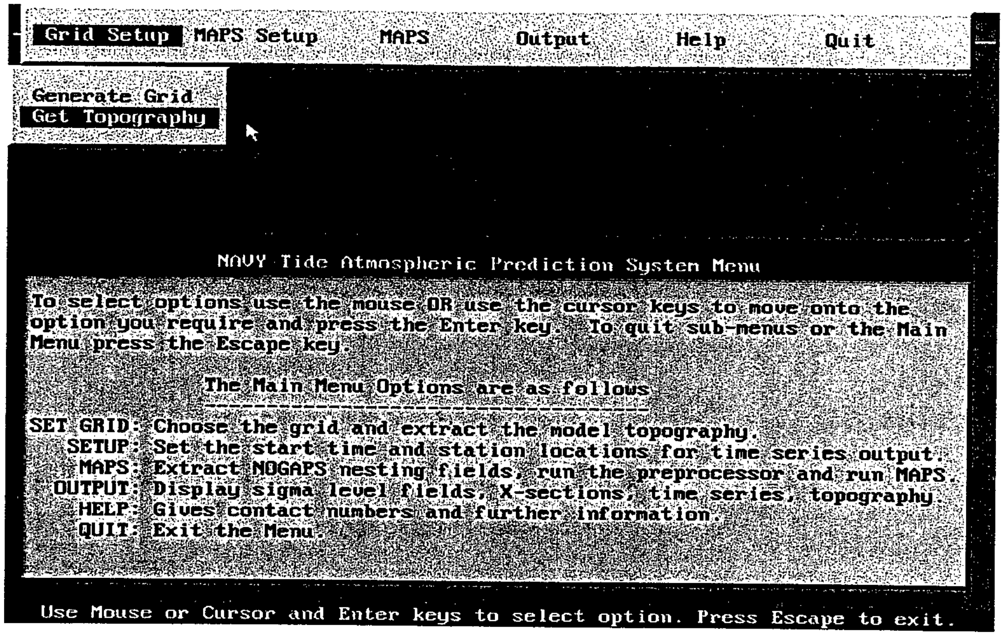

Figure C8: "Get Topography" selection.

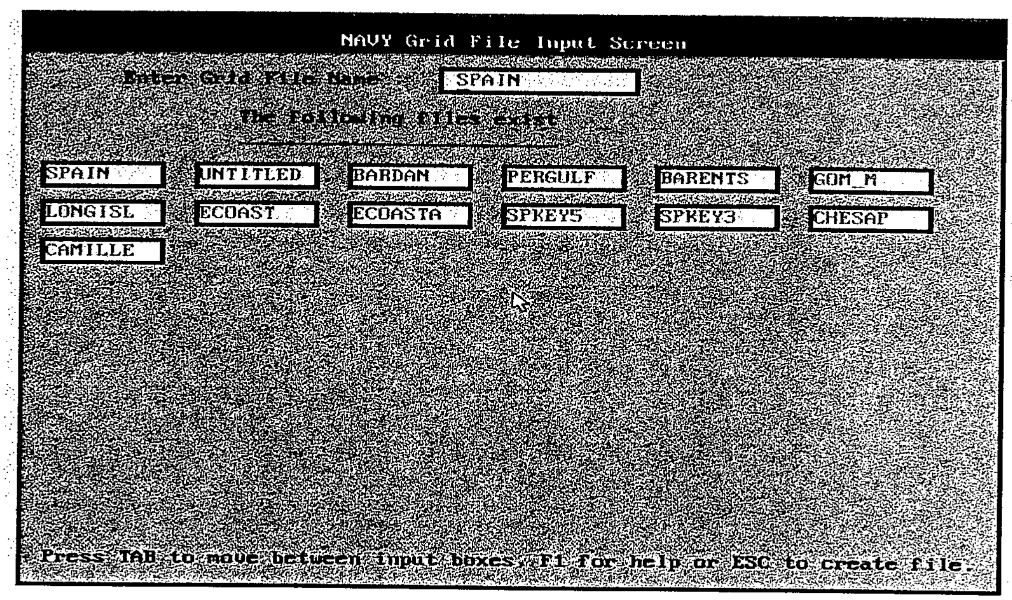

Figure C9: Selection of required model grid region.

In order to check the region and/or the topography it is advisable to plot the data by returning to the main menu and selecting "Output" and then "2D Topography" (Figure C10). The topography will then be plotted at a selected contour interval and displayed in color-coded height bands (Figure C11). If the region is not satisfactory, the user should return, select an adjusted region, and repeat the process. If the topography is poor in quality for the resolution required, refer to Section 4.3-C for general comments. A 3-D plot of the model topography may be obtained by selecting "Output" and then "2-D Topog" from menu.

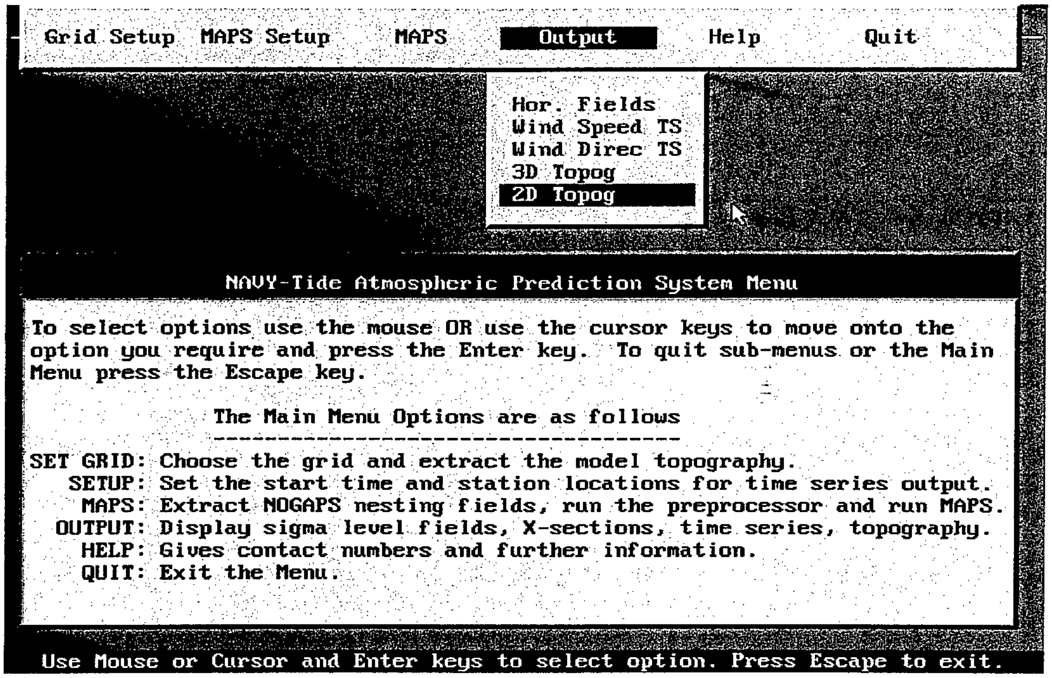

Figure C10: Selecting "2D-Topography" display.

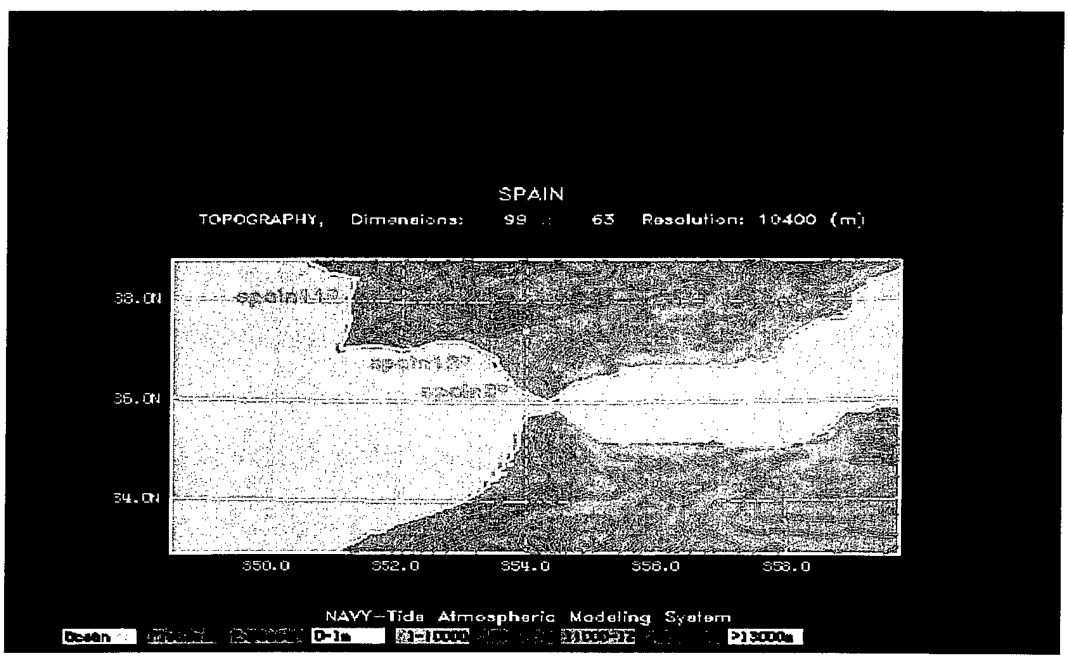

Figure C11: Topography contours for selected model grid showing the location of time series output stations.

4.3-C General Comments on Grid Generation

a) The following issues should be considered when selecting the model region:

- The NOGAPS fields that are used for nesting are on a grid with one-degree resolution and therefore open boundaries should cover at least five degrees to obtain reasonable boundary conditions.
- It is wise to give some thought to the placement of the open boundaries. If possible avoid complex topography on or near open boundaries.
- If results are required in areas of complex topography be sure that the resolution is high enough to model the physics of the region.
- Consider what is important to tell the model about the topography of the region and make sure the locations of interest are well inside the domain.
- For best results, use grid resolution of 10 (+/-5)km.

b) The procedure for generating the topographic grid is to first set up the model grid on the chosen map projection (Lambert Conformal) and then to extract the topography/bathymetry for each grid point. The latitude and longitude of the grid point are determined and all direct access topography files (".da" files) are searched to find the value at that location from the highest resolution ".da" file covering that point. This procedure is repeated for each model grid point so that it is possible for values to be obtained from more than one ".da" file if the model grid spans more than one ".da" file region. If the topography for the model domain appears to be poor quality it may be desirable to create a new ".da" file of higher resolution digitized data for that region. This procedure is explained in the SDD (Hubbert et al., 2001). The existing ".da" files are summarized in the following table:

File Name	Southern Limit	Northern Limit	Western Limit	Eastern Limit	Resolution (minutes)
World.da	-90	90	0	360	3.0
Gulfmex.da	15	35	260	285	0.3
Wustopog.da	28	40	219	249	1.0
Yellosea.da	25	42	117	131	0.6
Pergulf.da	21	33	45	71	1.0
Chinasea.da	13	25	105	121	1.0
Baltic.da	53	61	14	26	1.0
Medsea.da	29	36	349	43	1.0
Timorsea.da	-18	-8	122	133	0.3
Oztralia.da	-46	-6	110	156	1.2
Fijtopog.da	-20	-15	176	181	0.5
Tastopog.da	-44	-39	143	150	0.5

4.4-C MAPS Setup

Before running the atmospheric model, the user must set several parameters that control the type of forcing and model output.

4.4.1-C Parameters

These parameters must be specified for the model run. They are stored in the file "maps.dat" which has the following structure (sample values at end of line):

Line	Parameter	Typical Value
1	Nesting Model Name (NOGAPS or MAPS)	nogaps
2	NOGAPS UNIX File Path	/net/omaha/export/posey/disk2/graeme/
3	Start Time (hh,dd,mm,yyyy)	00 23 06 1999
4	Maximum Run Time (Hours)	24
5	Number Of Sigma Levels	16
6	Sigma Levels	0.100 0.200 0.250 0.300 0.400 0.550 0.700 0.780 0.850 0.900 0.950 0.975 0.990 0.995 0.998 0.999
7	Output File Time Interval (Hours, 0=None)	6
8	Time Step Factor (0 <-> 1)	0.95

4.4.1.1-C Nesting Model Name

MAPS may be nested inside NOGAPS or a previous run of MAPS. When nesting inside a coarse grid MAPS run the model will look for the output file from the previous run. Therefore, it is important to make sure the two runs (coarse and fine grids) are consecutive.

4.4.1.2-C Nesting Model Path

This line specifies the path on the UNIX workstation where the NOGAPS files will be found. When nesting in a previous run of MAPS the NOGAPS UNIX path is redundant.

4.4.1.3-C Start Time

The start time must coincide with an analysis time of the nesting model. For NOGAPS this is either at 0Z or 12Z each day. When nesting in MAPS this time must be the analysis time of the coarse grid MAPS run.

4.4.1.4 -C Maximum Run Time

This option allows extra user control over the model run time. The model will run as long as the nesting files exist or until the maximum time set, whichever is earlier.

4.4.1.5-C Sigma Levels

The number of sigma levels and the values used by MAPS should not be changed without very good reason. The levels are presently set to values that are near optimum for stability, resolution of the boundary layer and speed. The lowest level is set to 10 meters to provide winds that can be directly used to force ocean models. The maximum number of levels is 20.

4.4.1.6-C Output File Time Step

The output file time step controls how often the atmospheric fields are written to the "MAPS.xxx" direct access output binary files (where "xxx" represents the forecast hours from analysis time). Normally the output file time step should be chosen to suit the users display requirements. When nesting however the output file time step should be frequent enough to pass sufficient information to the nested model – e.g. no greater than 3 hours.

4.4.1.7-C Time Step Factor

This factor is provided to give the user some control over the model time step that is calculated internally. If the model "blows up", the time step reduction factor may be reduced to produce a shorter model time step that may enable the model to get past the problem. If this does not solve the problem the user is advised to change the model domain to take the open boundaries away from high topography.

Command prompt

Edit "maps.dat".

Menu

Select "Parameters" (Figure C12).

Set parameters in the input panel (Figure C13).

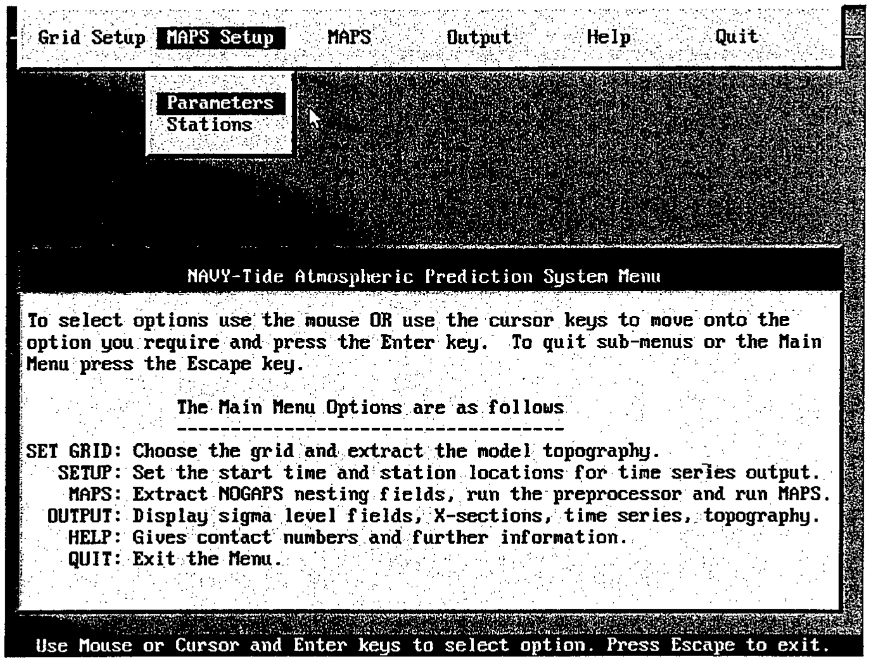

Figure C12: Model parameter menu selection.

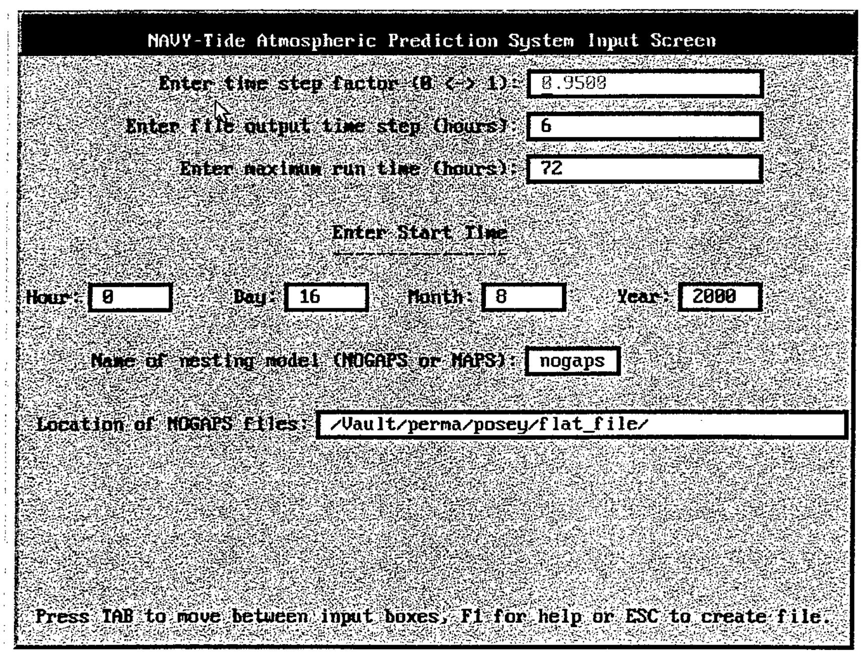

Figure C13: MAPS parameter entry panel.

4.4.2-C Stations

One of the features of the model is to produce time series output of surface wind speeds and directions at specified locations. The location of these "stations" must be defined before the model is run by setting up the "stations.dat" file. During the model run, time series data of wind speeds and directions are written to files with the station name and a ".tsd" extension. These files can be plotted at the end of the run for comparison with data or for site specific forecasting.

The "stations.dat" file may have up to 12 stations defined one per line, as latitude, longitude, and name. The user is advised to have at least one output station defined for each model run. The set of stations defined for a model region can be saved with a ".stn" extension in the "\gems\work" directory and recalled for later model runs. The format for the "stations.dat" file is as follows:

Latitude (-90.0 to 90.0)	Longitude (0 to 360 E)	Station Name (max 8 characters)
49.0000	355.2200	spain1
47.2000	356.5500	spain2
46.8000	357.7700	spain3
45.8500	358.3300	spain4
44.6300	358.5000	spain5
43.6500	358.0500	spain6
43.9700	354.3000	spain7
36.1000	353.8000	spain8
41.7000	350.8000	spain9
39.3500	350.2400	spain10
37.9500	351.0000	spain11
36.7000	353.1300	spain12

Command prompt

Copy a ".stn" file to "stations.dat" and/or edit "stations.dat".

Menu

Select "Stations" (Figure C14).

Select a stored stations file (Figure C15).

Edit the station data (Figure C16) and save (exit).

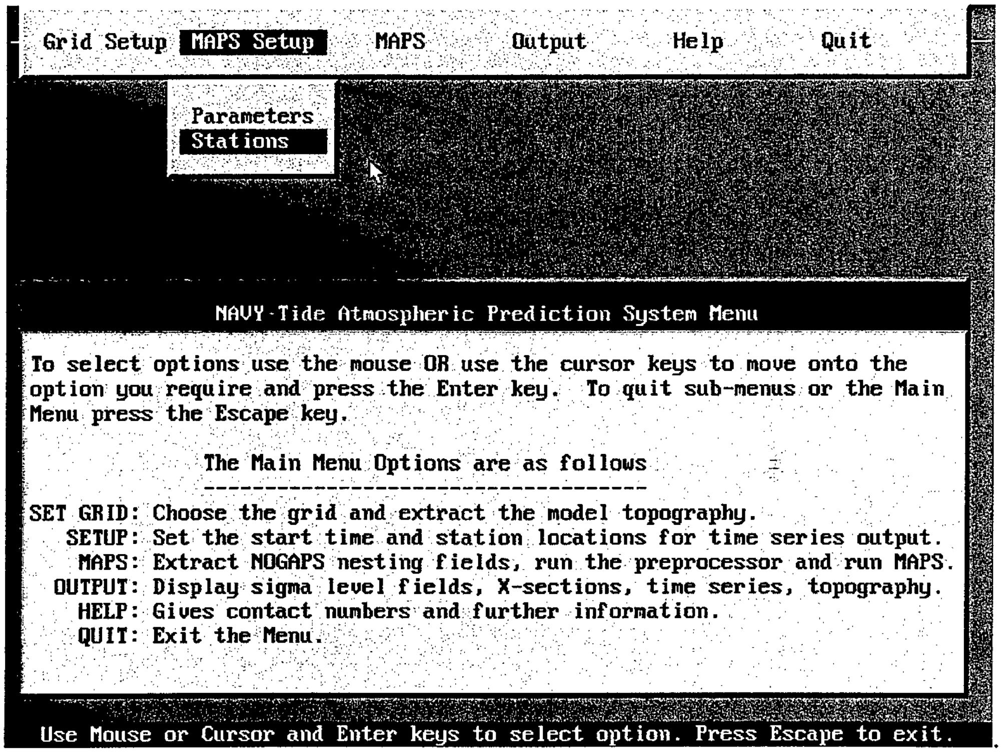

Figure C14: MAPS Setup menu selection.

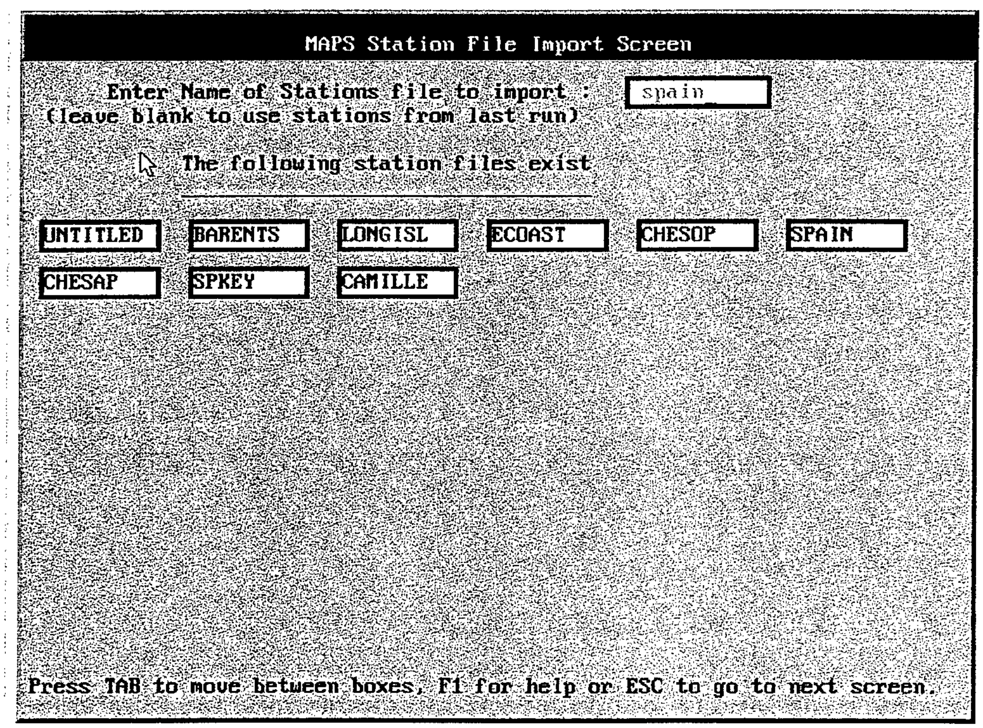

Figure C15: Stored station data selection panel.

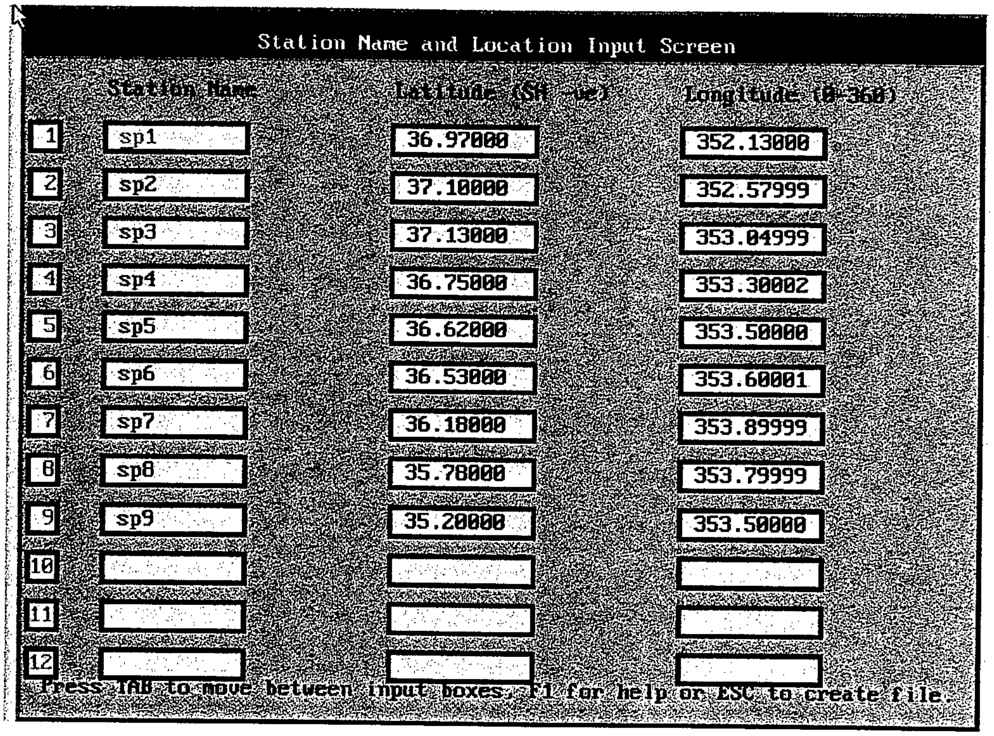

Figure C16: Station location data (checking stored data or entering new data).

4.5-C MAPS Nesting Fields

4.5.1-C Obtain analysis and forcing fields

Before running MAPS it is necessary to obtain analysis and forcing fields in which the model will be nested. The NOGAPS fields are stored on a UNIX workstation and it is necessary to run the data extraction program on that UNIX box. If MAPS is to be run on a PC there must be a network connection to the UNIX box and the UNIX "root" directory of the "\gems\work" directory must be mounted as drive "h". This Section describes the methods for obtaining nesting fields and then preprocessing them into the form required by MAPS.

If the user requires NOGAPS fields it is necessary to use the UNIX system as the NOGAPS output is stored under the UNIX system (path defined in "maps.dat").

Note: If a higher resolution nesting inside a previous MAPS run is being carried out then the user may remain within the existing environment (PC or UNIX) to obtain the nesting fields, ignore the steps in this Section, and proceed directly to the next Section.

Two files must be present in the working directory before extracting the nesting fields:

a) "maps.dat" which sets the nesting model (MAPS or NOGAPS), the path of the NOGAPS files (if required) and the analysis time.
b) "topog.dat" which defines the region required.

Command prompt

In all other steps for running the system, the method is exactly the same at the UNIX command prompt as it is at the DOS mode command prompt. In the case of extracting the nesting fields from NOGAPS, however, the DOS method is more complex due to the need to communicate between the PC and the UNIX workstation.

UNIX

Run the program "nogaps" which extracts the NOGAPS fields for a region slightly larger than the area defined by "topog.dat". The output files are named "nogaps.000", "nogaps.006", "nogaps.012" etc., where the file extension denotes the forecast hour.

PC

There are two methods of communicating between the PC and the UNIX workstation. It is important for the user to remember in this step that an ASCII file on a PC is not the same as an ASCII file on a UNIX workstation and a conversion must take place. These two methods are as follows:

4.5.2-C ftp connection

- ftp, (in ASCII mode) - transfer the files "maps.dat" and "topog.dat" to the "\gems\work" directory on the UNIX workstation.
- Log on to the UNIX workstation and change directories to "\gems\work".
- Run "nogaps".
- Run "da2ascii" to convert the nogaps output files to ASCII. These files are called "ascii.000", ascii.006" etc.
- Log off and return to the PC "\gems\work" directory.
- ftp, (in ASCII mode) - transfer the "ascii.000" etc. files from the UNIX workstation to the PC.
- Run "ascii2da" to convert the ASCII files back to the binary direct access files "nogaps.000" etc.

4.5.3-C Mounted drive connection

- Copy the files "maps.dat" and "topog.dat" to the "h" drive and convert to UNIX ASCII format with the commands "dos2unix topog.dat h:\gems\work\topog.dat" and "dos2unix maps.dat h:\gems\work\maps.dat".
- Log on to the UNIX workstation and change directories to "\gems\work".
- Run "nogaps".
- Run "da2ascii" to convert the nogaps output files to ASCII. These files are called "ascii.000", ascii.006" etc.
- Convert each ASCII file to PC ASCII format via the UNIX command "todos" by executing "todos ascii.000 amascii.000" for each ASCII nogaps file (a script file would be a good idea to save doing this for each file).
- Log off and return to the PC "\gems\work" directory.
- Run "getngaps" to convert the ASCII files back to the binary direct access files "nogaps.000" etc.

Menu

Select "NOGAPS Fields" (Figure C17).

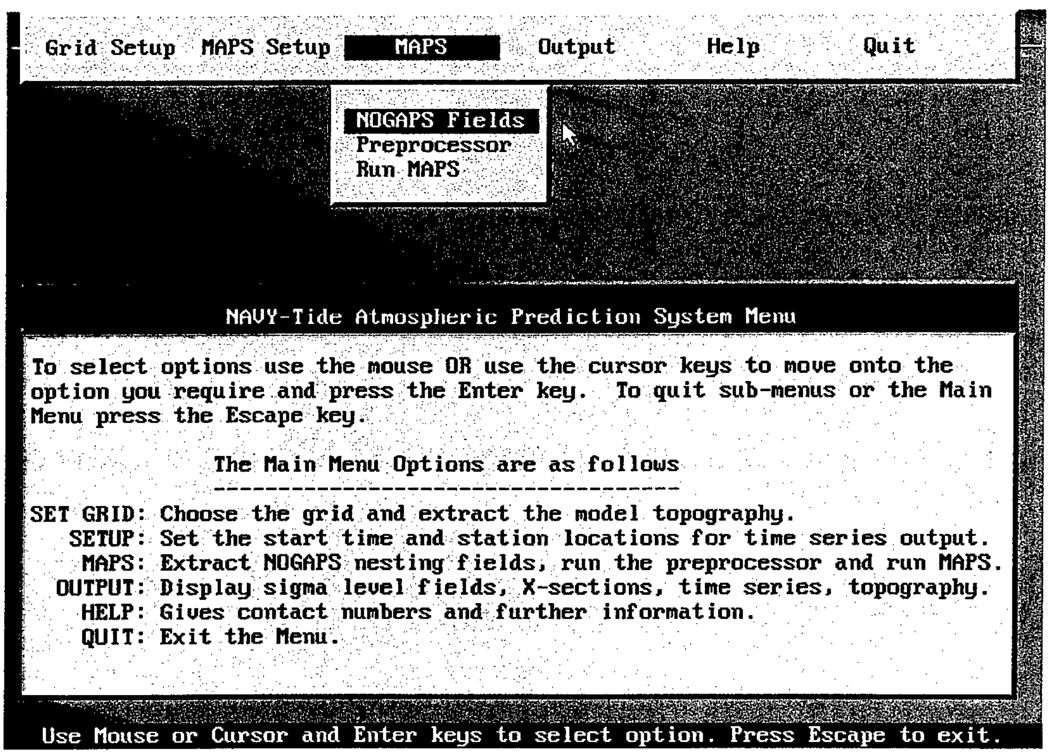

Figure C17: MAPS preprocessing and run selection.

4.5.4-C Preprocessing the Nesting Fields

To save disk space the NOGAPS nesting fields are extracted on a domain larger than that defined by "topog.dat" but not on the entire global domain. Nesting inside a previous MAPS run provides the same situation where nesting fields are available on a domain larger than that defined by "topog.dat".

The next step is therefore to interpolate the nesting fields to the domain defined by "topog.dat" and this function is carried out by "amsubgrd" which produces the output files "amsubgrd.000", "amsubgrd.006", "amsubgrd.012" etc. (the file extension refers to the hours after analysis).

Next the fields are interpolated vertically to the required sigma levels defined in "maps.dat") by "ampreppl" or "amprepsl". There are two preprocessing options because the NOGAPS fields are interpolated vertically from pressure levels to sigma levels (hence "ampreppl") whereas MAPS nesting fields are interpolated from sigma levels to sigma levels (hence "amprepsl"). The preprocessor also includes climatological surface fields (albedo, roughness length etc.) in the preprocessor output files "amprep.000", "amprep.006", "amprep.012" etc.

<u>**Command prompt**</u>
Run "amsubgrd" and then "ampreppl" (for nesting in NOGAPS) or "amprepsl" (for nesting in MAPS.

<u>**Menu**</u>
Select "Preprocessor" (Figure C17).

4.6-C MAPS Required Files

MAPS requires the following files present in the "\gems\work" directory before it is run.

a) "maps.dat"
b) "stations.dat"
c) "amprep.000" and as many "amprep" files as are necessary to define the model run duration. These files do not have to be spaced evenly in time. So MAPS can run if, for example, the analysis file "amprep.000" is present together with "amprep.006", "amprep.012" and "amprep.024". The missing "amprep.018" file will, presumably, improve the results if it is present.

<u>**Command prompt**</u>
Run "maps".

<u>**Menu**</u>
Select "Run MAPS" (Figure C17).

4.7-C MAPS Output Display

Various forms of display options are available for the PC user. The display code has been written for the PC so there are no display options when running under UNIX. The display options may be run under the PC Windows Menu or at the command prompt.

4.7.1-C Horizontal Fields

MAPS writes output fields to the direct access binary files "maps.000", "maps.006", "maps.012" etc. at each model output time step (defined by the file extension). Single level (e.g. surface pressure) and multi-level (e.g. winds) fields from the model run may be displayed by running "amdisp" which offers an interactive menu to set display options. The "amdisp" menu appears in both the menu and the PC command prompt environments and each entry parameter is supported with and "F1" help function to explain the option.

<u>Notes:</u>

- The user is referred to the "F1" help function in the display menu for descriptions of each parameter option.
- If the user plots the MAPS output the "Set Vertical Levels" option shows the lowest sigma level as the default vertical level. This may be changed to any other level set originally in the "maps.dat" file. If the user plots the NOGAPS output (Global Model), the "Set Vertical Levels" option shows the lowest NOGAPS pressure level as the default vertical level. This may be changed to any legitimate NOGAPS pressure level.
- The latitude and longitude limits of the model domain are displayed and the user may choose to plot sub regions of that area (i.e. zoomed plots).

<u>Command prompt</u>

Run "amdisp" and set the options in the menu panel (Figure C19).

<u>Menu</u>

Select "Horizontal fields" (Figure C18) and set the options in the menu panel (Figure C19).

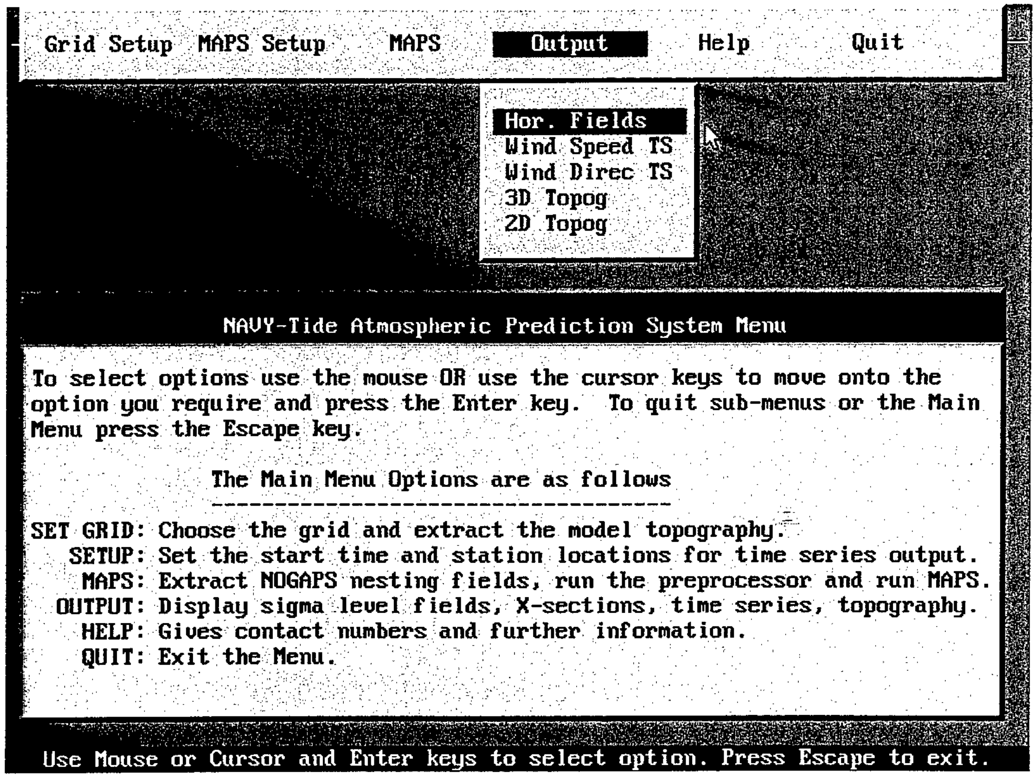

Figure C18: Output display menu selection.

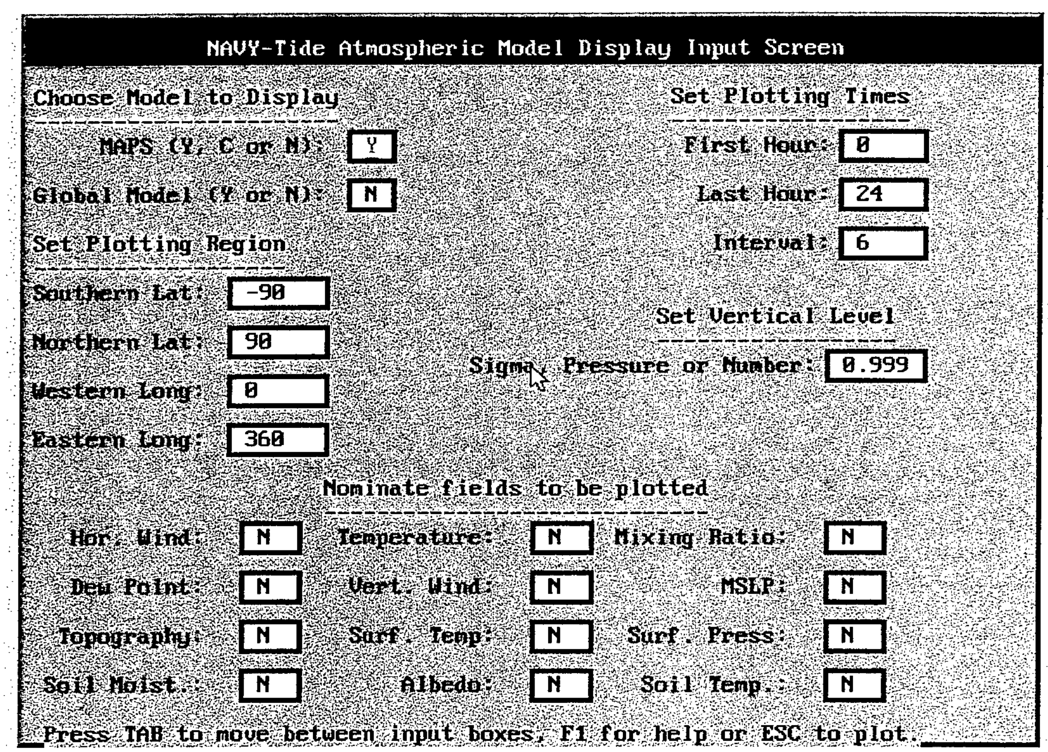

Figure C19: Atmospheric model fields display menu.

4.7.2-C Wind Speed and Direction Time Series

When the user specifies stations in the menu or edits the "stations.dat" file the model produces time series output at those locations and writes to a file with the station name and an extension of ".tsd". Wind speeds and directions from these file types may then be plotted in the following manner.

Command prompt

Run "wspdplot" or "wdirplot" and specify the input station.

Menu

Select "Wind Speed TS" or "Wind Direc TS" (Figure C18) and specify the input station.

Note: The horizontal fields, windspeed and direction, and topography plots require interactive input from the user. Unless a specific plot is needed (such as overlaying two time series), the user should hit return (enter) until the plot appears on the screen.

4.7.3-C Three-Dimensional Topography

A three-dimensional surface mesh plot of the model topography (and bathymetry) may be obtained with the program "plot3d". This program reads the "topog.dat" file and offers choices of viewing rotation angle (0-360 from due south) and viewing elevation angle (0-90). This program may be run in the following manner.

Command prompt

Run "plot3d".

Menu

Select "3D Topog" (Figure C18).

4.7.4-C Two-Dimensional Topography

A two-dimensional contour plot of the model topography may be obtained with the program "toplot". This program reads the "topog.dat" file and allows the user to set the minimum plotting contour (meters). This program may be run in the following manner.

Command prompt

Run "toplot".

Menu

Select "2D Topog" (Figure C18).

5.0-C FUNCTIONAL DESCRIPTION

For a discussion of the functional description see the accompanying Software Design Description (SDD) manual (Hubbert et al., 2001).

6.0-C TECHNICAL REFERENCES

6.1-C Software Documentation Guidelines

Oceanographic and Atmospheric Master Library Summary. Naval Oceanographic Office, System Integration Department. OAML-SUM-21F. April, 1998.

Software Documentation Standards for Environmental System Product Development. Naval Oceanographic Office, System Integration Department. OAML-SDS-59A. January, 1999.

6.2-C PCTides Software Release

Hubbert, G. D., R. H. Preller, P. G. Posey and S. N. Carroll, "Software Design Description for the Globally Relocatable Navy Tides/Atmosphere Modeling System (PCTides)," NRL/MR/7322—01-8266, Naval Research Laboratory, Stennis Space Center, MS, 2001.

7.0-C NOTES

7.1-C Acronyms

ASA	Applied Sciences Associates
ASCII	American Standard Code for Information Interchange
COAMPS	Coupled Ocean Atmosphere Mesoscale Prediction System
CSCI	Computer Software Configuration Item
CSC	Computer Software Component
DAMPS	Distributed Atmospheric Mesoscale Prediction System
GCOM2D	Coastal Ocean Model 2-D
GCOM3D	Coastal Ocean Model 3-D
GEMS	Global Environmental Modeling Systems
GMT	Generic Mapping Tool
MAPS	Mesoscale Atmospheric Prediction System
NOGAPS	Navy Operational Global Atmospheric Prediction System
NRL	Naval Research Laboratory
OAML	Oceanographic and Atmospheric Master Library
PC	Personal Computer
PSI	Planning Systems, Incorporated
SDD	Software Design Description
SRS	Software Requirements Specification
SSC	Stennis Space Center
STD	Software Test Description
UNIX	Workstation Operating System