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US Army Corps
of Engineers
Waterways Experiment
Station

User's Manual for the NODDS/ WOSM Interface

by Zeki Demirbilek, Steven M. Bratos

WES

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Prepared for U.S. Naval Research Laboratory

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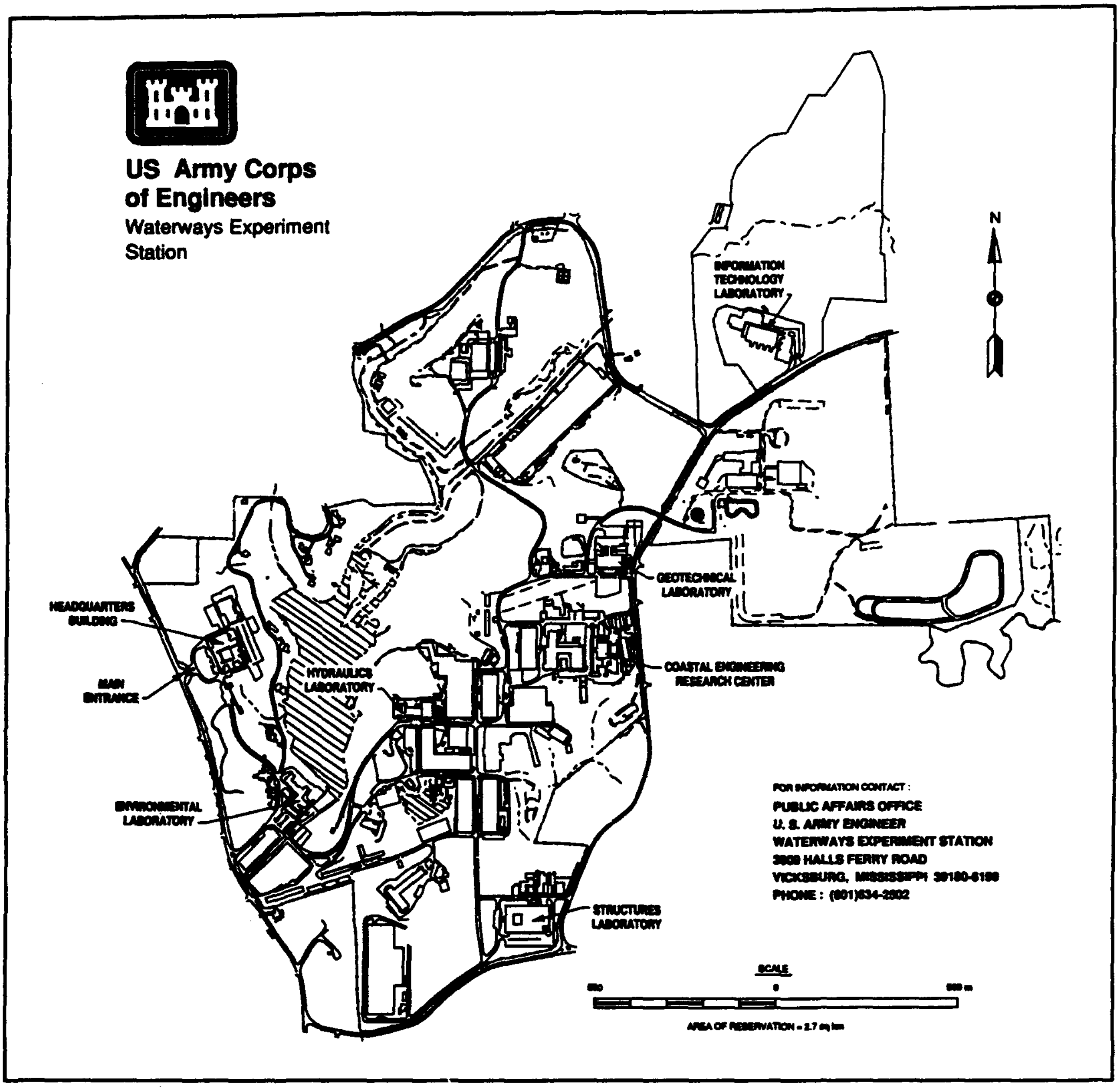

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Contents

Preface

This study was authorized by the U.S. Naval Research Laboratory (NRL), Stennis Space Center, MS, and was conducted by personnel of the Coastal Oceanography Branch (COB), Research Division (RD), Coastal Engineering Research Center (CERC), of the U.S. Army Engineer Waterways Experiment Station (WES). The study was conducted during the period May through August 1993. Dr. John Harding and Mr. Kenneth McDaniel, NRL, oversaw progress of the study.

This report was prepared by Dr. Zeki Demirbilek and Mr. Steven M. Bratos, both of COB. The work was performed under the direct supervision of Dr. Martin C. Miller, Chief, COB, and Mr. H. Lee Butler, Chief, RD, and under the general supervision of Mr. Charles C. Calhoun, Jr., Assistant Director, CERC, and Dr. James R. Houston, Director, CERC.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard, EN.

1 Description of NODDS and NODDS/WOSM Interface

Study Overview

The U.S. Naval Research Laboratory at Stennis Space Center, Mississippi, has granted a contract to the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center (CERC) at Vicksburg, MS, to integrate the Navy Oceanographic Data Distribution System (NODDS) with the Worldwide Oil Spill Model (WOSM). The contract has started in May 1993 and completed in September 1993.

There are three components to this study: NODDS and WOSM systems and their interface. NODDS and WOSM are each large data manipulation and processing systems that were developed prior to this project. The philosophy used in building an interface for NODDS and WOSM was that it connect the two but not require modification to either system. Although the interface appears to be part of the WOSM system for this application, and it does use components from WOSM, it is not part of the commercially available WOSM software package. The interface has been constructed as a module of WOSM to facilitate data transfer, using the same graphical user interface tools available in WOSM. Structured in this way, the interface is straightforward to use, reducing several steps if it were otherwise built separately. However, it is not required to have the WOSM system for the interface to work; the interface may be used independent of WOSM.

WOSM is a stand-alone oil spill model system for use in oil spill response decision support, planning, research, training, and contingency planning. The WOSM user interacts with spill models and supporting environmental data through a graphical interface. The WOSM interface facilitates the import and manipulation of data and the set-up and operation of the WOSM models. This user manual describes the NODDS-WOSM interface, how it is used to access data generated from within NODDS, and how to manipulate these data for input to the WOSM spill models. Full documentation for the WOSM software is contained in a separate manual.

WOSM is a proprietary software that has been developed by Applied Science Associates, Inc. (ASA), 70 Dean Knauss Drive, Narragensett, Rhode Island 02882 for a consortium of oil companies and government agencies of the United States and Canada, WES being one of the participants.

Separate documents exist describing NODDS. The user should be familiar with NODDS and WOSM systems before using the interface. The purpose of this report is to describe the interface component in detail. Chapter 1 of the report was prepared by the WES Coastal Engineering Research Center (CERC), and describes the essential features of the NODDS and NODDS/WOSM interface. Chapters 2 and 3 were prepared by ASA and have been revised at CERC. Chapter 2 is the system manual, presenting features shared between two systems, the NODDS/WOSM interface and WOSM. Chapter 3 is a step-by-step description of the NODDS/WOSM interface system.

Since the interface relies heavily on importing and converting wind, current, and temperature data from NODDS, essential information about this system and its data fields used in the interface will first be presented in this report. In particular, a step-by-step procedure is provided for retrieving NODDS raw data to be used in oil spill modeling. These raw data are imported through the interface module where extensive data processing tasks develop input for WOSM.

Data processing tasks include reading, displaying, and editing NODDS data and grid information, checking all or specific data values over the grid, extracting NODDS grid parameters, subsetting large data sets from NODDS for comparatively smaller WOSM applications, and converting subset data to the WOSM format. The interface may also create and switch between scenarios, transfer external files directly to scenarios, and allow viewing, editing, and printing raw data from NODDS.

The NODDS/WOSM interface performs the following tasks: (a) imports raw data from NODDS, (b) provides a review of the raw data through graphical user tools similar to those available in the WOSM, (c) permits users to select from large sets of environmental input data base a subset for oil spill simulation studies, and (d) performs automatic data conversion functions for winds, currents, and air and sea surface temperatures for oil spill simulations with WOSM. Although an overall understanding of oil spill modeling techniques and algorithms would be useful, this interface eliminates the need for the user to have an in-depth knowledge of data preparation tasks associated with WOSM.

Input information for winds, currents, and temperatures required for WOSM is automatically prepared in the correct format by the NODDS/WOSM interface module. In fact, there is little left outside the interface for the user to do to perform a simulation, i.e., specifying a spill site and oil type. Consequently, oceanographic/environmental data from other sources may also be passed through the interface for conversion provided the data are in compliance with the NODDS data structure. However, other special conversion options available in the WOSM system may also be used.

NODDS System

NODDS was first developed in 1982 as a means to make environmental products developed by the Fleet Numerical Oceanographic Center (FNOC) at Monterey, CA, available to oceanography facilities and detachments that have no direct access to these data. Through the years, the system has grown in use as product support has expanded. Once the user has defined the environmental data products desired for a specific area, NODDS calls FNOC and requests the data fields from a security shell in a host mainframe computer.

Communication is handled through a licensed software package available "off-the-shelf." For each field/product, the requested data are extracted from one of the global databases as a compacted ASCII transmission. The transmissions are small and efficient since information related to the area of extraction is limited, and only data pertinent to the specified region are transmitted. Once the raw data are received by the requestor, NODDS further permits data review in a ready display format that includes contouring, streamlining, shading, velocity and direction vectors for winds and currents worldwide, and global air and sea temperature information.

This document contains instructions for proper and effective use of the NODDS system to retrieve necessary data including winds, currents, and sea surface and air temperatures for NODDS/WOSM interface. Although the presented instructions minimize the need for NODDS/WOSM interface users to be very familiar with the NODDS system, it is highly recommended that for a detailed description of NODDS, users refer to the NODDS user and documentation manuals. It is assumed that the user has only a basic understanding of the NODDS data formats and how to extract data from NODDS and into ASCII files. The NODDS/WOSM integration begins with ASCII data files generated from within the NODDS system, as described below.

NODDS data are generated primarily by numerical models, and may be supplemented by remote sensing. NODDS data file names contain important information about the content of each file. Summary information for NODDS data is provided below to further familiarize the user in the use of the NODDS system, its data structure, and interpretation of the extracted data and to allow an accurate NODDS/WOSM interfacing. These data must be used in conjunction with instructions in the NODDS documentation and user's manuals.

How to Get ASCII Files

To obtain ASCII files of the extracted data, the following line should be inserted into the PLOTMAP.BAT file located in the directory C:\NODDS\BATS at the location shown:

(plotmap.bat partial listing)

```
rem now run the batch file to contour and plot winds
rem
command /c runbatch
rem INSERT THE NEXT LINE for NODDS\WOSM
INTERFACE
if exist *.??G copy *.??G C:\NODDS\FIELDS\DATA
del *.??G
del runbatch.bat
```

Step-by-step Procedure for Retrieving NODDS Data

Steps for retrieving NODDS data include defining an area, selecting products, retrieving data, converting data, and displaying data.

Each of these include several steps of their own, which are described below.

Define an area

Follow these steps:

Select "DEFINE AREA" under the "FIELDS/AREAS" menu.
Then select either
"MERCATOR" : this is for retrieving global fields such as winds from NOGAPS. Use the mouse to define an arbitrary area, then "ACCEPT" and "SAVE" it and name it.
Or select
"SPECIAL REGIONS" : this is for retrieving regional fields such as the Gulfstream OTIS currents or NORAPS winds. The areas are predefined, but the user must create a particular application for this area by clicking the mouse on it and naming it.

Select products

Follow these steps:

Choose "SELECT PRODUCTS" under the "FIELDS/AREAS" menu. Click the mouse on the desired map area icon.
Select products from the list. The products to be selected for NODDS/WOSM integration will generally be

Surface air temp (Celsius)
Surface winds (knots)
Surface currents (cm/sec)
Sea surface temp (Celsius)

Select forecast times (generally pick all available times).

Retrieve an area

Follow these steps:

Select "RETRIEVE AREA" under the "DATA MANAGER" menu. Choose the map area icon desired with mouse.
Select "CONTINUE".

From this point, everything should be automatic and files will be retrieved from FNOC in ASCII format and placed in the directory C:\NODDS\DATA. These are the files to be supplied to the

NODDS/WOSM interface. The user will also need to move the "MAPTXT.DAT" file corresponding to the area to the directory C:\NODDS\FIELDS\DATA. These files provide grid dimension, and longitude/latitude information required to read the data files. The data files in NODDS are called "products" or "fields."

Convert data

This menu item allows the user to visualize one of the ASCII files in a standard full screen editor. The steps necessary are:

Choose map area icon.
Select one product at one forecast time.
Output to disk file.
Enter path and disk file name.

Display data

This menu item is used to display a plot picture of the field/forecast time of interest. Follow these steps:

Select "MAP" under the "DISPLAY" menu.
Choose the map area icon.
Select products/forecast times of interest (3 or fewer).

From this point, the user can select "MORE" to plot other products/forecast times for the area or print the plot.

Another useful item on the display menu is "MULTIMAP," which allows creation of up to four plot pictures on one screen.

NODDS Scenarios and Fields

Scenarios

A scenario is an application or area for which data are to be retrieved. It may be created from the global (NOGAPS), regional (NORAPS), or special areas. A scenario may be entirely new or it may be a predefined area that exists in NODDS. Three scenarios are described here to illustrate features, data products, grid parameters including grid size and resolution, watch hour and forecast times, file description, and other variables to be extracted from data products retrieved from NODDS.

The three scenarios (SCEN1, SCEN2, and SCEN3) have been used in the testing of the NODDS/WOSM interface. Differences are described under each scenario to ensure proper interpretation and usage for the NODSS/WOSM interface. Some common features of three scenarios will first be explained.

Fields

Meteorological and oceanographic variables for which data of any kind are available from NODDS are called "fields." Therefore, all data files will hereafter either be called "fields" or "files," interchangeably. Only selected fields from NODDS will be used for developing and testing the interface. These are:

Surface Air Temperature
Surface Winds (U-component)
Surface Winds (V-component)

Surface Currents (U-component)
Surface Currents (V-component)
Surface Sea Temperature

Data for each of these fields come to NODDS from several different numerical models, and the resolution of the data varies with the source.

The general form of the data field is:

xNNmddhh.ffy

where for the above fields these descriptors become

x the letter "A" for the first three fields
the letter "B" for the last three fields

NN is a 2-digit field designator number. For the above fields NN is:

Surface air temp	07
Wind (U-comp)	58
Wind (V-comp)	59
Current (U-comp)	32
Current (V-comp)	33
Sea surface temp	10

The parameter m is a one-digit number for the month of the year NODDS data set is valid. Note that NODDS uses the Radax numbering scheme to designate months. Radax numbering is: 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C (e.g., the month of December is "C").

The remaining parameters are as follows:

dd	two-digit number for the day of month NODDS data set is valid
hh	watch-hour for data set
ff	two-digit number for GMT time of the data set
y	this parameter will be either the letter "T," indicating files are for information only, or the letter "G," indicating files are to be used in the interface

Example: The interface file for the u-component of the surface wind from a 12-hr forecast interval for 0800 hr on 22 January 1993 would either have file designation A5812200.12G or A5812212.00G.

Although fields for three different scenarios appear to have identical descriptors, it is important to remember that files are different in content and resolution when importing and/or interpolating data from these files in the NODDS/WOSM interface.

Unless otherwise stated, the resolution of data from the NOGAPS (global) is 2.5°. In general, the resolution of data from the NORAPS (regional) is 0.5°. As newer numerical models become operational in the NODDS or other Navy or DoD programs feeding into the NODDS, this resolution may change.

A scenario may be constructed using only NOGAPS (e.g., SCEN1) or NORAPS (SCEN2). However, when data for some fields are not available using either of these systems, a scenario may have to be defined using a combination of NOGAPS and NORAPS (e.g., SCEN3).

MAPTXT.DAT File

To find the coordinates of the area for which data are valid, a MAPTXT.DAT file is provided in each scenario. There are two MAPTXT files in the SCEN2 for the reasons given. The MAPTXT.DAT file(s) includes information related to the area coordinates, grid increment (resolution), and grid mesh sizes in latitude and longitude. This file is created automatically by NODDS upon the completion of data retrieval. Only part of the information in the MAPTXT.DAT file may directly be used.

The information in the MAPTXT.DAT file is listed in two columns, and both must be used with great care for a correct interpretation of the data. It is strongly recommended that files ending with *.??T be viewed and carefully evaluated before use. In general, the *.??T files provide a better description of the parameters needed for the interface. The *.??T files are not standard products available from NODDS at all times and for all scenarios. These are provided only when users request the "display data" option, and in some cases these are not provided at all. However, the *.??G files are the standard products the user gets at all times, and therefore, we must use the *.??G files for data values. The *.??G files are data files, but these lack information related to the forecast times, grid specs, resolution, etc., which may be important input for the interface. Other aspects of the individual scenarios will be presented next.

Test Scenarios

The features of three test scenarios are described next.

Scenario #1 (SCEN1)

This corresponds to the NOGAPS/GLOBAL oil spill scenario in the NODDS\WOSM interface. The coordinates of the NODDS data set region are:

Lower left corner :	2.5° N,	32.5° W
Lower right corner:	2.5° N,	7.5° W
Upper right corner:	22.5° N,	7.5° W
Upper left corner :	22.5° N,	32.5° W

There are eleven columns and nine rows in the grid. The grid increment is 2.5°.

Surface air temperature (A07mddhh.ffG), surface wind U-component (A58*.ffG) and surface wind V-component (A59*.ffG) are from NOGAPS and all three have 2.5° resolution. The surface current U-component (B32*.ffG), surface current V-component (B33*.ffG), and sea surface temperature (B10*.ffG) are from GLOBAL/OTIS/TOPS, and all three have 2.5° resolution.

Files ending with *.??T are provided for information only. These files may be used in the interface for finding grid specs by referring to the top lines. If viewed in their entirety, users may also find NODDS grid coordinates.

Files ending with *.??G are the gridded data files. Use these for data import and interpolating in the NODDS\WOSM interface.

Scenario #2 (SCEN2)

This corresponds to the NORAPS/GULFS oil spill scenario in the interface. This means that data are mixed and come from two different sources that may or may not have the same resolution. Therefore, in this scenario we will be working with two different MAPTXT.DAT files, two different regions, and two different grids, one being the subset of the other. The two data sources are defined next.

The coordinates of the region for A*.ffG files are:

Lower left corner :	27.5° N,	87.5° W
Lower right corner:	27.5° N,	52.5° W
Upper right corner:	52.5° N,	52.5° W
Upper left corner :	52.5° N,	87.5° W

The MAPTXT.DAT file associated with the A*.ffG files is named MTXTA.DAT. Note that there are 71 columns (longitude) and 51 rows (latitude) in this grid, called GRID1, with a grid increment of 0.5°. The MTXTA.DAT file indicates that "...grid lon 15 and grid lat 11 and grid increment 2.5°...". However, it can be seen from the corresponding data files that these values are incorrect. This is an example of why the user must be careful when using information from the MAPTXT.DAT file. In this case, it is necessary to look both at the MTXTA.DAT file, and to check one of the A*.??T files to find the correct grid information. Note that different grid information is found from two sets of NODDS files, and the correct values are those from A*.??T files. These values must be used in the interface.

The B*.??G files come from the GULFS/OTIS/TOPS high-resolution databases, which are sometimes called HIRES. The coordinates of the region for B*.??G files are:

Lower left corner :	30.0° N,	77.5° W
Lower right corner:	30.0° N,	52.5° W

Upper right corner:	45.0° N,	52.5° W
Upper left corner :	45.0° N,	77.5° W

The MAPTXT.DAT file associated with the B*.??G files has been named MTXTB.DAT. Once again, we need to look at both MTXTB.DAT and one of the B*.??T files to get correct parameters for the interface. Note that there are 51 columns (longitude) and 31 rows (latitude) in this grid. The grid increment is 0.5°. The second grid will be called GRID2.

GRID2 is a subset of GRID1. A common database should first be constructed in the interface from these two grids to ensure temporal (time) and spatial (space) consistency between data of the A* and B* files. Once this is done, proceed as with other scenarios. As stated earlier, files ending with *.??T are provided for information only, and files ending with *.??G are to be used in the interface.

Scenario #3 (SCEN3)

This corresponds to the NORAPS/OTHERS oil spill scenario in the interface. This scenario is similar to SCEN2 since it uses mixed data sources of different resolution for A*.ffG and B*.ffG files. The currents and sea surface temperature are from the global resolution data source while winds and surface air temperature are from a regional source. The difference between SCEN3 and SCEN2 is that SCEN3 has a single area from which all data come, and therefore, there is only one regional grid.

Coordinates of the NODDS data set region (Middle East) are:

Lower left corner :	12.5° N,	27.5° E
Lower right corner:	12.5° N,	62.5° E
Upper right corner:	37.5° N,	62.5° E
Upper left corner :	37.5° N,	27.5° E

There is one MAPTXT.DAT file for this case. Parameter information in this file should be corrected to read:

71 columns, 51 rows, 0.5° resolution for A*.ffG files
15 columns, 11 rows, 2.5° resolution for B*.ffG files

Surface air temperature (A07mddhh.ffG) and surface winds U-component (A58*.ffG) and surface winds V-component (A59*.ffG) are from NORAPS. All three have 0.5° resolution over a 71 by 51 grid mesh.

Surface currents U-component (B32*.ffG), surface currents V-component (B33*.ffG), and sea surface temperature (B10*.ffG) are from GLOBAL/OTIS/TOPS and all three have 2.5° grid resolution over a 15 by 11 grid mesh. Files ending with *.??T are included for information purpose, and are not used in the interface. Files ending with *.??G should be used for data import and interpolating in the interface.

NODDS Data for Interface

Due to inconsistencies between MAPTXT.DAT and the data files related to parameters such as the grid size, grid resolution, and number of grid cells (or nodes), it is necessary to introduce the following adjustments for computing these parameters. Data may not be read correctly without making the adjustments. The interface performs calculations as described below. The type of adjustments made to obtain correct parameters for the interface depend on the type of scenario considered.

NOGAPS (Global)

This is the "SCEN1" scenario defined earlier. The following steps apply:

a) Read from the second column of MAPTXT.DAT file the top two numerical values (format is I6) for lines "top of screen" and "bottom of screen." Divide these numbers by 10,000 to obtain top and bottom latitudes. Information in the first column defines whether latitudes should be north "N" or south "S".

b) Read from the first column of the MAPTXT.DAT file numerical values for lines "baslon" and "mgrds mm ngrds nn". Divide the baslon value by 10. If the resulting number is greater than 180.0, Then the left longitude of the grid area for the scenario is computed as follows:

$$long1 = baslon-360$$

Otherwise, the left longitude is

long1 = baslon

c) To compute the right longitude of the grid or scenario area use the following formula:

long2 = long1 + (mgrds-1) * 2.5

Note that long1 and long2 will be west "W" if their values are negative numbers. Otherwise they are east "E".

NORAPS (Regional)

This is the "SCEN2" scenario described above. It consists of two different grids of the same resolution and, therefore, SCEN2 has two MAPTXT.DAT files. These were named MTXTA.DAT (corresponding to the A*.**G fields) and MTXTB.DAT (corresponding to the B*.**G fields). Consequently, there are two grid areas for SCEN2. To find latitudes of the grid areas, follow step (a) in the above global case. To find the left longitude of the grid areas, use the following formulas:

long1 = baslon - 360 If baslon > 180.0.
= baslon If baslon < 180.0.
hrcol = (mgrds-1) * 5 + 1
hrrow = (ngrds-1) * 5 + 1

The right longitude of the grid areas is given by

long2 = long1 + (hrcol-1) * 0.5

SPECIAL (Others)

This is "SCEN3" scenario test case. This has one grid and thus one MAPTXT.DAT file, but it consists of two groups of fields with different resolution. The A*.**G fields have 0.5° resolution while the B*.**G fields have 2.5° resolution. Consequently, for B*.**G fields the formulas for the global case apply (NOGAPS Section). To determine the number of grid columns and rows for A*.**G fields, use the formula for the regional case.

Data characteristics

Surface winds (A58 and A59 fields) are measured in knots and data values are multiplied by 10 (e.g. 89/10 = 8.9 knots). Currents (B32 and B33 fields) are measured in centimeters per second and data values are multiplied by 10 (e.g. -273/10 = -27.3 cm/sec). Surface air temperature (A07 field) is measured in degrees Celsius and data values are multiplied by 10. Sea surface temperature (B10 field) is also measured in degrees Celsius and data values are multiplied by 10.

The format for all data values in the *.G files is 13I6, that is, each entry in these ASCII files is written with format I6 and there are 13 values on a row. The data files are arranged in a special way. Data values are sequential starting with (1,1), (1,2), (1,3),....(1,hrcols) for the first grid row, followed by the values for the second row, followed by the third row and so on. As an example for a grid consisting of 20 (cols) x 15 (rows), the data file will look like this:

```
(1,1) (1,2)....................(1,13)
(1,14)...........(1,20) (2,1)....(2,6)
(2,7)............................(2,20)
(3,1)..........(Etc)....
```

The grid for this example is as follows:

```
(15,1)............................(15,20)
........
.......
......
.....
...
...
(1,1).............................(1,20)
```

The sign convention for winds and currents is U positive toward the east and V positive toward the north.

In general, maximum forecast time in NODDS is 72 hr and the forecast interval is 12 hr. However, there can be gaps in these forecasts, and files may not always be available for every 12-hr period. The data files for a scenario will usually appear in the following forecast sequence:

A0792312.00G
A0792312.12G
.24G
.36G
.48G
.64G
.72G

In order to ensure that the various fields are being correctly used for any arbitrary simulation time in the interface, it is necessary to carefully point to those NODDS files obtained from a forecast. This requires checking the watch hour and forecast time of each field and selecting other fields with identical times.

Consider a field, B3272300.12G, in which 72300 = watch hour, and 12 = forecast time. The corresponding wind field (say A58) may either be A5872300.12G or A5872312.00G. To select the correct fields, take the watch hour the forecast was created on and add the forecast time to it. The resulting time can be used for selecting fields that will coincide temporally. Therefore, for field B3272300.12G, add 72300 and 12 (= 72312) to get the resulting simulation time (month, day, hour). Similarly, for wind field A5872312.00G, 72312 + 00 = 72312 is the resulting simulation time (month, day, hour).

For fields A5872312.72G and B3272300.72G from the same forecast, the simulation time is not as straightforward. It is computed as 72312 + 72 = 72612 = resulting simulation time (month, day, hour), while for current field B3272300.72G we have 72300 + 72 = 72600 = resulting simulation time (month, day, hour), indicating that current in this case is 12 hr less than the winds. Note that air temperature A07 will always be the same as winds while the sea surface temperature B10 has a single forecast time (constant in time).

Differences in watch hour and forecast times for fields/products are listed below for test scenarios described earlier. This is to illustrate that forecast times for fields may be different in any scenario. For the test scenarios we have:

SCEN1	current B32/33	72 hr (12 hr incr.)	72300.12G
	sea surf temp B10	0 hr	72312.00G
	air temp A07	72 hrs (12 hr incr.)	72312.00G
	wind A58/59	72 hrs (12 hr incr.)	72312.00G

SCEN2	current B32/33	36 hr (12 hr incr.)	72300.12G
	sea surf temp B1	0 hr	72300.00G
	air temp A07	36 hr (12 hr incr.)	72312.00G
	wind A58/59	36 hr (12 hr incr.)	72312.00G
SCEN3	current B32/3	72 hr (12 hr incr.)	72300.12G
	sea surf temp B1	0 hr	72312.00G
	air temp A07	48 hr (12 hr incr.)	72300.12G
	wind A58/59	48 hr (12 hr incr.)	72300.12G

In summary, care has to be exercised in matching winds, currents, and temperatures. The procedure described here has been successfully implemented and tested in the interface.

User's Guide for Interface

Directory structure

In general, the hierarchy of the WOSM directory structure is as follows:

```
—WOSM——┬—CONVERT
  ┌────┘
  ├DATA——————┬—DATA_DEF
  │  ┌───────┘
  │  ├—DOCUMENT
  │  ├—FONTS
  │  ├—HELP
  │  ├—ICONS
  │  ├—MODEL
  │  ├—SUB_STUB
  │  └—SYSTEM
  └—LOC_DATA——area_name——┬—COAST
  ┌──────────────────────┘
  ├—CURRENTS
  ├—DEPTHS
  ├—GIS——GISDATA
  ├—GRIDS
  ├—ICE
  ├—KEYS
  ├—NOTEBOOK
  ├—OUTDATA
  ├—RUNDATA
  └—WINDS
```

The user must create directories in WOSM for locations in which the NODDS/WOSM interface will be applied. Although it is possible in principle to place a directory called NODDS anywhere under the WOSM directory tree, it is recommended that a NODDS subdirectory be created as WOSM\LOC_DATA\WORLD\NODDS. The scenarios SCEN1, SCEN2, and SCEN3 for which the interim ASCII data are obtained from the NODDS database should then be located under the NODDS directory in WOSM. The directory structure should look like the following:

WOSM\LOC_DATA\WORLD\NODDS\SCEN1
WOSM\LOC_DATA\WORLD\NODDS\SCEN2
WOSM\LOC_DATA\WORLD\NODDS\SCEN3

The ASCII files of the original environmental data extracted from NODDS for scenarios SCEN1, SCEN2, and SCEN3 should be copied to the above directories. Following the conversion to WOSM format, the files for SCEN1, SCEN2, and SCEN3 will all be put back in the appropriate directories preceding NODDS in the above directory structure. This means converted wind and current files for SCEN1, SCEN2, and SCEN3 will be placed into the directories named WOSM\LOC_DATA\WORLD\WINDS and WOSM\LOC_DATA\WORLD\CURRENTS, respectively.

The current scenario identification is retained in the file named WOSM\LOC_DATA\WORLD\NODDS**currscen.sav**. This file may be edited with a text editor to change scenarios, should the system not permit switching between scenarios.

Menus (Buttons)

The names of menus (or buttons) in the NODDS/WOSM interface may be renamed to meet the U.S. Navy's preference or to coincide with terminology common throughout other Navy models. To make desired changes, the listed *.SFN files may be edited in the directory WOSM\DATA\SYSTEM. The files containing various button names are:

NODDS.SFN	Side Menu
SCENARIO.SFN	SCENARIO submenu
VIEWTYPE.SFN	VIEW NODDS submenu
NODDSEDIT.SFN	EDIT FILES submenu
SUBSET.SFN	The SUBSET submenu
NODDSTYPE.SFN	NODDS -> WOSM submenu
NODDSCURR.SFN	NODDS -> WOSM Currents submenu

Execution

To start the NODDS/WOSM interface:
cd WOSM
Type WOSM
Select DATA in the main menu option
Select IMPORT NODDS DATA option under DATA menu

Components

Interface menus include:

SCENARIO: create, copy files, change, toggle, and delete
VIEW NODDS: winds, currents, air temp, sea temp
EDIT FILES: edit maptxt and data files, list all files
SUBSET NODDS: by framing nodes, individual cells;
clear, save, retrieve subset
CONVERT NODDS to WOSM: winds, currents, air and sea temps.

Each of the above interface menu options is stand-alone with primary functions as listed. These interface menus include a secondary set of buttons that is sometimes followed by a third set of buttons or fill-in type menus or answering questions. The interface supports a minimal set of tools with which to correct and make consistent data files. A text editor is provided in the interface for the user to view and correct files. Screen printing capabilities are also available.

The first three interface menu items perform various data management functions and each of these consists of sub-menus to carry out special tasks. For example, SCENARIO button allows user to change between the oceanographic scenarios, VIEW NODDS button steps through a vector display or color contours of the NODDS data, and EDIT FILES allows browsing all files in the scenario directory.

The SUBSET NODDS menu assists the user in selecting a particular data set from larger data sets available in the NODDS. The subset is provided for two reasons: (a) WOSM may not need, or may not be able to utilize, all NODDS data; and (b) to optimize computer resources when NODDS data files are transformed to the WOSM data file structure.

The last menu in the interface performs tasks necessary for developing WOSM input files from selected NODDS data. This is where the actual conversion from NODDS to WOSM is made. Preparation of input is the heart of WOSM usage. Consequently, converting the user-supplied NODDS data to a format acceptable for WOSM is the essence of the WOSM/NODDS interface. Working with the assumption that few, if any, NODDS/WOSM interface users will be familiar with the specifics of the WOSM system, the conversion was designed to be automatic and thus eliminate the need for an in-depth knowledge of the WOSM system and reduce human errors. A brief description of file types generated in the course of the conversion process will be presented to familiarize users with the various products.

NODDS/WOSM Conversions

Winds

This conversion produces one *.WND file per node for all times. Since this is done for every node in the subset, the user should be careful not to select a large number of nodes. The conversion generates binary files. Each file is a single time series at the node location created from all times NODDS winds are available. WOSM will spatially interpolate these multiple time series files to create a spatially interpolated wind observation for every surface spillet at each time step. Note that the maximum number of wind records WOSM accepts is 10. The file designation is in the form mmddIIJJ.WND where II and JJ are NODDS grid node numbers.

Currents

WOSM uses several forms of current files which include *.TID, *.LLU, *.DIR, and *.DIX as designators. The NODDS/WOSM interface embodies all three conversion options to generate either *.LLU, or *.DIR, or *.DIX files. These special WOSM files are briefly explained here.

The *.TID files refer to ASCII files for tidal currents. Tidal currents when available from NODDS, should be in the *.TID format described in the WOSM manual.

*.LLU files are ASCII files of the background currents. These are snap-shots (i.e., one moment or one time step) of the current field at all latitude and longitude nodal points.

*.DIR files are binary files of both background and tidal constituents. The user creates separate *.DIR files for background and tidal currents, and then joins these files to make a *.DIR file for WOSM.

*.DIX files are binary files containing time step data from a hydrodynamic model.

In the NODDS/WOSM interface, the *.LLU files are created in the chronological order in which the resulting files contain two lines of header information. The first line is the conversion factor, the second line is yr,mm,dd,hr, and the third line is lat, lon, u, and v velocity values. There will be separate files for each time step (i.e., one file for t_1, one for t_2, etc. where t_1, t_2 are NODDS time steps such as 00, 12-hr, etc.). Each of these files covers the entire grid node for every NODDS time step. The resulting file designation is mmddwhft.LLU where wh =watch hour, ft=forecast time from NODDS. Note that *.LLU files need not be regularly spaced, and there is one snapshot file for the entire field at a time.

The user can generate time series files from these *.LLU files. This requires transforming *.LLU files to the time series format (*.DIX) for WOSM. The user may pick the *.LLU files in chronological order to construct a *.DIX file, or, alternatively, may include all *.LLU files, or configure the *.DIX file based on the time the simulation is to be performed. For example, if the user desires to have no currents in the first 12 hr of simulation, the corresponding *.LLU file should be excluded while constructing the *.DIX file.

In other applications except NODDS, the user may have to construct a *.DIX file outside the interface. In this case, the following steps should be followed:

DATA
CURRENTS
IMPORT CURRENTS
LONG/LAT CURR
CREATE A NEW GRID (this is the hydro grid,i.e., window area,set cell sizes for x and click to the water region)
USE EXISTING GRID
ESC
give a name for the grid

At this step, the user is provided a listing of *.LLU files. After the user has selected the *.LLU file, a moving lighted circle over the hydro grid will appear, indicating that NODDS data are being interpolated onto the WOSM current (also called hydro) grid. The interpolation is done using the 10 closest observations based on the Cressman scheme (i.e., weighted distance. See WOSM documents for details). The interpolation gives a single value at the center of each hydro cell. Now the user has created the *.DIX file that WOSM needs, but recall that this is the background current file and it does not include tidal currents. If tidal currents are desired to be added to background currents, the second conversion option (*.DIR) should be selected.

The *.DIR conversion is for snapshot files (i.e., one time file), and therefore, this conversion feature allows the user to combine the background currents with the tidal currents. It is emphasized that the user cannot make time series files (i.e., *.DIX) from *.DIR files. Once the user has created *.DIR files, tidal currents may be added to the background currents using standard WOSM procedures (see WOSM user's manual). However, all pertinent steps have been incorporated into the interface and thus the interface automatically performs this procedure for the user.

Temperatures

Temperatures are not the primary driving forces in oil spill modeling, and therefore, a single numeric temperature is used over the entire spill area in WOSM. The NODDS to WOSM conversion generates an arithmetic average value of air and sea surface temperatures over the selected NODDS subset nodes. The user should look at the result files, and record these temperatures for later use. Note that the user is to specify temperatures when running WOSM.

The NODDS/WOSM interface generates direct input files of winds, currents, and temperatures necessary to run WOSM. To run the model menu, the user should next create a land-water grid (*.SQL), assign shore types, select active oil type, and specify the spill site. In addition, the user may also set model computing and output parameters, and specify types of spill processes and algorithms to be considered in the simulation.

Modes of Simulation (Run Options)

WOSM has four simulation options (see WOSM user's manuals). The preparation of input data and conversion of the externally supplied information all go hand in hand with the type of run option that the user has in mind. A good understanding of alternatives for performing different types of oil spill scenarios is prerequisite. Therefore, selection of which of the above converted files should be used in the four different run options available in WOSM system depends on the type of simulation the user will subsequently perform. The user must be familiar with the specifics of the four simulation alternatives to avoid making unnecessary conversions and supplying inappropriate input. To assist the user, a brief description of run options is provided here.

The TRAJECTORY ONLY option estimates the oil trajectory, to determine where and when the oil spill will impact. This is the quickest run option since it does not involve fate predictions. The processes included in this modeling option are:

- Advection
  - Drift rate
    - Constant
    - Varied with wind speed
  - Drift angle
    - Constant drift angle
    - Variable with wind speed
    - Ekman drift

- Shoreline interaction
  - Sticky shorelines
  - Slippery shorelines

The TRAJECTORY & FATES run option includes evaporation, emulsification, sedimentation, and biodegradation of oil. With these processes, both the trajectory and mass balances (rate of volumes) are computed. These are:

- Advection
  - Drift rate
    - Constant
    - Varied with wind speed

- Drift angle
  - Constant drift angle
  - Variable with wind speed
  - Ekman drift

Spreading
- Mackay thick slick
- Mackay thin slick
- Generic form

Evaporation
- Mackay evaporative exposure
- Distillation cuts
- Aromatic fractions
- Measured curve

Dissolution
- User-defined rate
- Mackay & Leinonen

Entrainment
- Audenson
- Mackay
- Generalized form
- Delvingne and Sweeney

Emulsification
- Mackay
- Instantaneous

Biodegradation
- First order decay
- User-defined rate

Sedimentation
- Constant rate
- CERCLA

Shoreline interactions
- Sticky shorelines
- Slippery shorelines
- COZOIL -> water column
- COZOIL -> water surface

Generic Sink
  User-defined decay
  User-defined loss

The STOCHASTIC run option may be appropriate to answer the following question: "given the mean conditions, what can be expected to occur at a certain site?" This run option requires a long time series (5 years or longer) data for oil spill estimates to be meaningful. To perform this type of simulation, historical wind records supplied in certain format as probabilistic input may be provided. These can be supplied either as Markov or probability matrices (speed versus direction probabilities). Formats of these input types and examples are included in the WOSM manual. With these input data, WOSM performs multiple runs (times) to establish probabilistic trajectory estimates using different sampling of winds with the same currents at each time step of simulation. Only then may the spread in data and effect of seasonal variability on oil spill be quantified. The processes included in this modeling option are:

Advection
  Drift rate
    Constant
    Varied with wind speed
  Drift angle
    Constant drift angle
    Variable with wind speed
    Ekman drift

Shoreline interaction
  Sticky shorelines
  Slippery shorelines

The RECEPTOR run mode should be used for the following condition: "I am not concerned about oil spills from a specific site, but rather I am concerned about protecting a location of interest. For this purpose, I want to know the quantity of the oil spill, where will it come from, and when will it arrive at the location of interest?" Answering these questions determines how one should plan to protect a particular location. In essence, this implies running WOSM backward, and therefore, this run option is sometimes called the "reverse oil spill scenario," or simply the stochastic run in reverse. Note that it will be necessary to place a receptor site for this mode of simulation. The processes modeled under this run option are:

Advection
- Drift rate
  - Constant
  - Varied with wind speed
- Drift angle
  - Constant drift angle
  - Variable with wind speed
  - Ekman drift

Shoreline interaction
- Sticky shorelines
- Slippery shorelines

In summary, the NODDS/WOSM interface is designed to prepare necessary input for oil spill modeling worldwide using a set of oceanographic data fields from NODDS version 3.1. The interface is configured as a stand-alone module of the WOSM system, but its use does not depend on WOSM. The interface allows a speedy preparation of winds, currents, and temperatures input for WOSM. Extensive data manipulation tools are provided in the interface, including data viewing, plotting, contouring, editing, subsetting, and selecting.

Since the interface is designed for NODDS version 3.1, note that if changes are made in the format of NODDS data files or the MAPTXT.DAT file, the interface must also be modified.

It is recommended that an on-line user's guide be developed, particularly for users of the NODDS/WOSM interface. This product should be a "how to" step-by-step procedure to aid users in performing oil spill modeling tasks. This need is obvious since the majority of NODDS/WOSM interface users are expected to have little or no opportunity to be trained in oil spill modeling. This guide will also be useful for in-house training of Navy personnel.

2 System Description for Interface

Several features are used throughout NODDS/WOSM for such purposes as data display and file specification. Either the keyboard or mouse may be used to select menu options and respond to queries. The mouse may be used to select the desired option or response as described in this chapter. The keyboard may also be used either by moving to the desired option using the arrow keys and then pressing ENTER, or by typing the highlighted letter of the menu option or response (e.g., press Y to select Yes). In forms which have OK and the ESC key (or ESC) buttons at the top, these actions can be initiated by using the mouse to click on the desired button. From the keyboard, the OK option can be selected by pressing the CTRL and ENTER keys simultaneously. Press the ESC key to escape. Most processes in WOSM can be halted by pressing the ESC key.

Using the Mouse

The mouse is used to select menu options and for many of the data entry procedures. To use the mouse, move the arrow cursor which appears on the monitor to the desired position and click the left button of the mouse. The term 'click' is used throughout the text to indicate that the mouse button is to be depressed and released. If the option requires the button to be held down, it is specifically stated. The left button is always used unless otherwise noted.

Map Windows

ZOOM

The model options which involve the display of spatial features (specifically, viewing environmental data, entering the spill location, and viewing model predictions) allow the user to zoom to areas of specific interest.

To access this capability, click on the ZOOM option of the sidebar at the right of the monitor screen. The following options will appear:

Create window. Makes a new window inside the current map. Use the mouse to locate the intersection of the perpendicular lines at any corner of the desired area to zoom into, and click the left mouse button to fix the point. Create the desired zoom window by moving the mouse. Click the mouse again when the box surrounds the desired zoom area. Note that when viewing mapped data, the zoomed area displayed maintains a fixed aspect ratio. This is done to keep the shoreline and displayed data from becoming highly distorted, as would be the case if the height and width of the zoom box were widely different.

Zoom in. Provides the capability to return to previous zoom windows. Each time the ZOOM IN sub-option is selected, the zoom window is created at a scale larger than that at which the current window is being displayed. The user can go back to any number of previous zoom windows.

Zoom out. Returns the user to the previous (larger) window.

Unzoom all. Returns the map to its original (default) scale.

Global pan. Allows the user to move the zoom window to a different area on the base map. The user must already be zoomed into an area before selecting this option. A display box will appear showing the entire base map with a yellow box around the area being zoomed into. Click on the ESC button to leave the GLOBAL PAN mode without changing the window. Click on the PAN button at the top of the box to move to a new zoom area. Use the mouse to reposition the box and click to set the location. The map display will then change to the newly selected position, remaining at the same scale as the previous zoom window.

Pan pt → pt. Pan point-to-point re-orients the zoom window. For example, if an island appears in the lower left corner of the map and you want it in the center of the map, use this option to re-orient the window while maintaining the scale. Click first on the point you want to move (in this case, the island). Then move the mouse to where you want the island to appear on the new display (in this case, the center of the screen) and click. The new zoom window will be displayed.

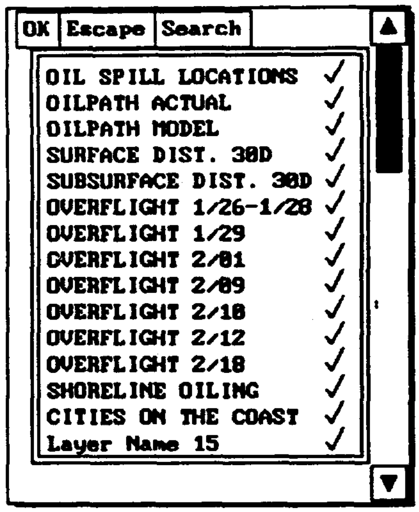
Spy glass. Provides a magnified view of any area displayed on the map. A display box will appear. Click on the ESC button or press the ESC key to leave this mode. Click on the SPY GLASS button to initiate the magnified view feature. The mouse cursor will change to a "?" icon. As the mouse is moved around, the area around the cursor will be magnified in the display box. Note that the size and position of the display box can be changed as described later in Chapter 2.

REDRAW

This feature is used to redraw the map, erasing any data displayed (except for GIS data, which are turned on/off using the F6 key). REDRAW does not modify the scale of the displayed map.

Information Windows

Selecting an Item or File Name. Many user interactions occur through moveable, pop-up windows (See the example at right). Information windows are used whenever the user is prompted to select from a list of items or file names, or to view text, such as in help files. To select a file name or item from a list, either click the mouse on the name or item (it will be highlighted) or use the up/down arrows of the keyboard to move through the list. Use the ENTER key to select the highlighted item or name. When the selection has been made, click the OK button with the mouse or the CTRL-ENTER key combination. To leave the list without selecting anything, click the mouse on the ESC key or hit the Esc key.



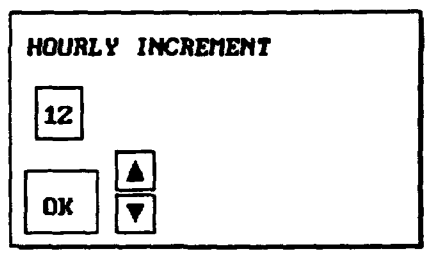
To search the list for a text string, click on the SEARCH button at the top of the form and enter the string. The search feature is not case sensitive and may contain up to 12 characters. The search function searches down the list from the present cursor position.

If the list contains more lines than fit in a window, an up/down scroll bar with arrows will appear on the right margin of the window. Click on the up arrow to scroll up the list, and click on the down arrow to scroll down. The page-up and page-down keys may be used to move through the list one page at a time. Note the "elevator" that runs up and down the right margin of the window showing the relative position within the list or file. By positioning the mouse pointer over the elevator and holding down the left mouse button, the elevator may be dragged up and down, scrolling through the file.

Viewing text. Text files may be viewed within pop-up windows in a similar fashion to file name and item selections described above. Additionally, text files may be printed from a window by pressing the PRINT button with the left mouse button. The option to send the file to a printer or to an ASCII file is then presented. If the printer option is selected, the file is sent to the default printer.

Selecting a Number

A standard format is used when it is necessary to specify a number (e.g., number of days, time increment). A box appears in which the default value is shown. To the right of the default value are up and down arrows. Click on the up/down arrows located to the right of the default value to increase or decrease the time increment shown. Click on OK (at the bottom of the box) when satisfied with the number shown in the box.



Alternatively, the keyboard may be used to change the default value. Enter the desired number from the keyboard and press ENTER (or click on OK) to continue.

Whenever the model asks the user to select a number, there will be a range of possible values. The value can not be increased or decreased beyond this range. If a value outside the range is entered, the computer will sound a warning tone, and a new value must be entered.

Use of Function Keys

The keyboard function keys are used in various menus within WOSM. The function keys are not active in the main menu. Function key capabilities may be accessed either by pressing the desired function key or clicking on the function key box at the bottom of the monitor. The uses of the function keys are as follows:

F1-Help. Accesses a help document specific to the module you are working in. Use the scroll and text search features described in Chapter 2.

F2-Display options. Changes the options displayed on maps. A listing will appear displaying the options available for the map you are viewing. A check mark next to the option indicates it is turned on. Click on the desired options to toggle them on/off. Click on the OK box at the top of the list to exit, saving all checked options as the new defaults.

F3 -Distance. Determines the distance between two points. When this option is selected, the cursor will change to a cross. Position the cross over the first location and click the mouse to fix the point. Then move the cursor to the second location and click the mouse once more. The distance between the two points on which you clicked will be displayed. The units of the measured distance are set under the SYSTEM → SYSTEM PARAMETERS option of the main menu to be either kilometers or nautical miles. Click the mouse a third time to erase the distance display.

F4-Color key. Displays a color key. Select the key to be displayed from the list which appears. A box outline will appear on the monitor. Use the mouse to move the box to the desired location, and click to set the position. A key explaining the significance of the colors used will be displayed.

F5-Point location. Returns the latitude (N-S) and longitude (E-W) location of the point indicated by the mouse cursor. Latitude and longitude are displayed in decimal degrees at the lower right of the screen. The location is initially displayed in degrees and decimal minutes. Press the F5 key to get the location in degrees, minutes, and seconds; and press it again to get decimal degrees. Repeatedly pressing the F5 key will loop through this sequence of display units. The location shown is the position at the center of the cross-hair cursor. Move the mouse to change the cursor's position. Click the right button mouse to leave the location mode or press the ESC key.

F6-GIS layers. Turns on/off GIS layers for display. A listing of the 50 possible data layers will appear. A check mark next to the option indicates it is turned on. Click on the desired layers to toggle them on/off. Click on the OK box at the top of the list to exit, saving all checked layers as the ones to be displayed.

F7-Working location. Changes the current location. Select the desired location from the list of available locations which appears.

F8-Data display. Displays environmental data on the base map. Select the type of data to be displayed (currents, land/water grid, shoreline types) from the options which appear.

A list of the available files will be presented. Select the file to be displayed. For currents a second list will appear giving the current components stored in the selected file. Select the current component you want to see displayed. If a tidal component is selected, the display will loop through the tidal cycle, updating the current vectors at 1.0-hr intervals.

F9-Current zoom. To display an inset showing the whole study area with a box around the area you are currently zoomed into.

F10-Print. To send the graphic display on the screen to the printer or to a .PCX file. If you select the printer, a form will appear asking you to specify the number of copies to be printed and the type of printer. Click on the printer field or press ENTER to get a list of printers.

If the .PCX file is selected, a box will appear in which the user must enter the name of the file to be created. It will be given a .PCX extension and be placed in the \WOSM directory.

To quit from either print function without printing, press the ESC key.

These function keys are not enabled in some modules. If a function key is not enabled for the particular module in which you are working, you will get no response when pressing that key.

Data Entry Forms

Throughout WOSM, forms are used for data entry. The forms contain a number of fields for entering data. Move between fields by pressing the ENTER or TAB keys to move sequentially. Click the mouse on a specific field to jump around the form. When one field is filled in, the user will automatically be moved to the next sequential field. An example data entry form is shown in Figure 2.1.

Four types of data can be entered on forms, but each field accepts only one type of data. The four types are:

- Character - any combination of letters, numbers and characters.
- Whole number - any non-decimal number (integer).
- Decimal number - any number (real), the decimal point is not necessary unless the value is less than 1.0.
- Multiple choice - the choices are listed for the user. Multiple choice fields are designated by a button with a triangle in it which appears only when the user is in the field. When the user clicks or presses ENTER, a list of available choices will be presented, either as a scroll-bar list or as a push-button list.

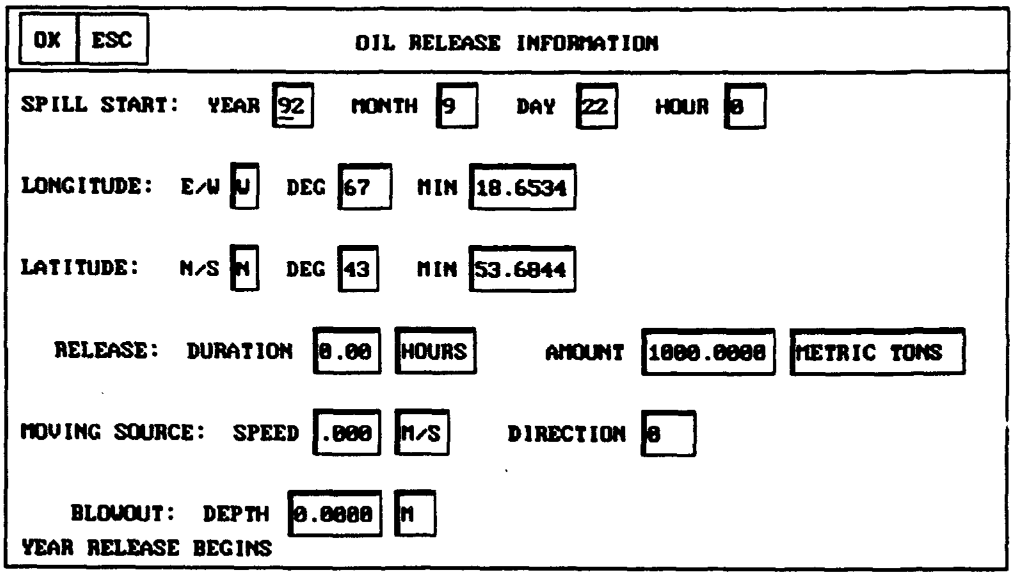


Figure 2.1. Example data entry form

Number fields have a range of acceptable values associated with them. If the user enters a number outside the acceptable range, a beep will sound and the user must enter a valid number before leaving the field.

At the bottom of the form, a help message will appear specific to the field that the user is in. It will prompt the user for the type of data required.

To exit from a form, saving all the data entered, click on the OK box at the top of the form, or press the CTRL and ENTER keys simultaneously.

To exit the form without saving any of the data entered (i.e., keeping the initial values), click on the ESC box or press the ESC key.

Information Messages

Two methods are used to provide information about status or to deliver help or warning messages.

The bar across the bottom of the WOSM display generally shows buttons that allow the user to access the function keys using the mouse. In some modules, however, the bar is used as an information bar to keep the user apprised of the status of calculations or to prompt him through a process.

Information bars also appear within the map display to signal the end of calculations or to deliver warning messages. These bars will remain in place until the user clicks the mouse or presses any key to clear them.

Data Display Box

A data display box is used in many modules for displaying data in additional to what is shown on the underlying map. The ZOOM PAN and SPY GLASS features, the F9 key window location option, and certain GIS displays are among the many uses of the data display box.

The box may be manipulated in two ways; size and location. To change its size, position the mouse cursor over the lower right corner button. Holding the mouse button down, drag the corner to expand or contract the size of the box. Release the button when the desired size is reached. To move the box, position the mouse inside the box. Holding the mouse button down, drag the box to its new location, and release the button.

To erase the data display box, click on the ESC button inside the box, click the mouse anywhere outside the box, or press the ESC key. Other buttons besides ESC may be used in the data display box depending on its application. If so, their functions are discussed elsewhere in this text.

3 Details of NODDS/WOSM Interface

To run the WOSM/NODDS interface, start the WOSM program, click on the **DATA** button in the main menu, and select **IMPORT NODDS DATA** from the drop-down menu. All NODDS data manipulations are accomplished from within this module. Figure 3.1 shows the WOSM/NODDS interface. This chapter describes the commands in the WOSM/NODDS interface as a sequence of steps for converting NODDS data for use with the WOSM spill models.

Follow the steps below to get NODDS data into the interface, view the imported data, select a portion of the imported data to use in an oil spill, and convert the selected subset data to WOSM format.

1. **Create NODDS output files in ASCII format.** The NODDS user creates data files of selected data from within the NODDS program. Data types include winds, currents, and air and sea temperatures. The data files must be in ASCII format for use on a DOS-based PC. (See Appendix A for example files for each of the NODDS data types.)

2. **Create geographic area in WOSM.** Using WOSM, create the area where spill modeling will take place. The WOSM area must exist prior to the NODDS-to-WOSM data conversion. The process of creating an area in WOSM is described in Section 2.3 of the WOSM manual.

3. **Copy the NODDS data files to a WOSM directory.** The NODDS data files for each WOSM geographic location will be placed in sub-directories beneath a directory named NODDS. Each WOSM geographic location will have a NODDS directory. An empty NODDS

directory will be created for each new WOSM geographic area created. Figure 3.2 shows the WOSM directory tree. Notice the NODDS directories beneath both of the locations in the directory structure. For each NODDS sce-ario created, a subdirectory under the NODDS directory must be created to hold all the NODDS data files for a single scenario. In the example in Figure 3.1, three scenarios exist, SCEN1, SCEN2, and SCEN3; however, only SCEN1 is shown (see also Figure 3.3).

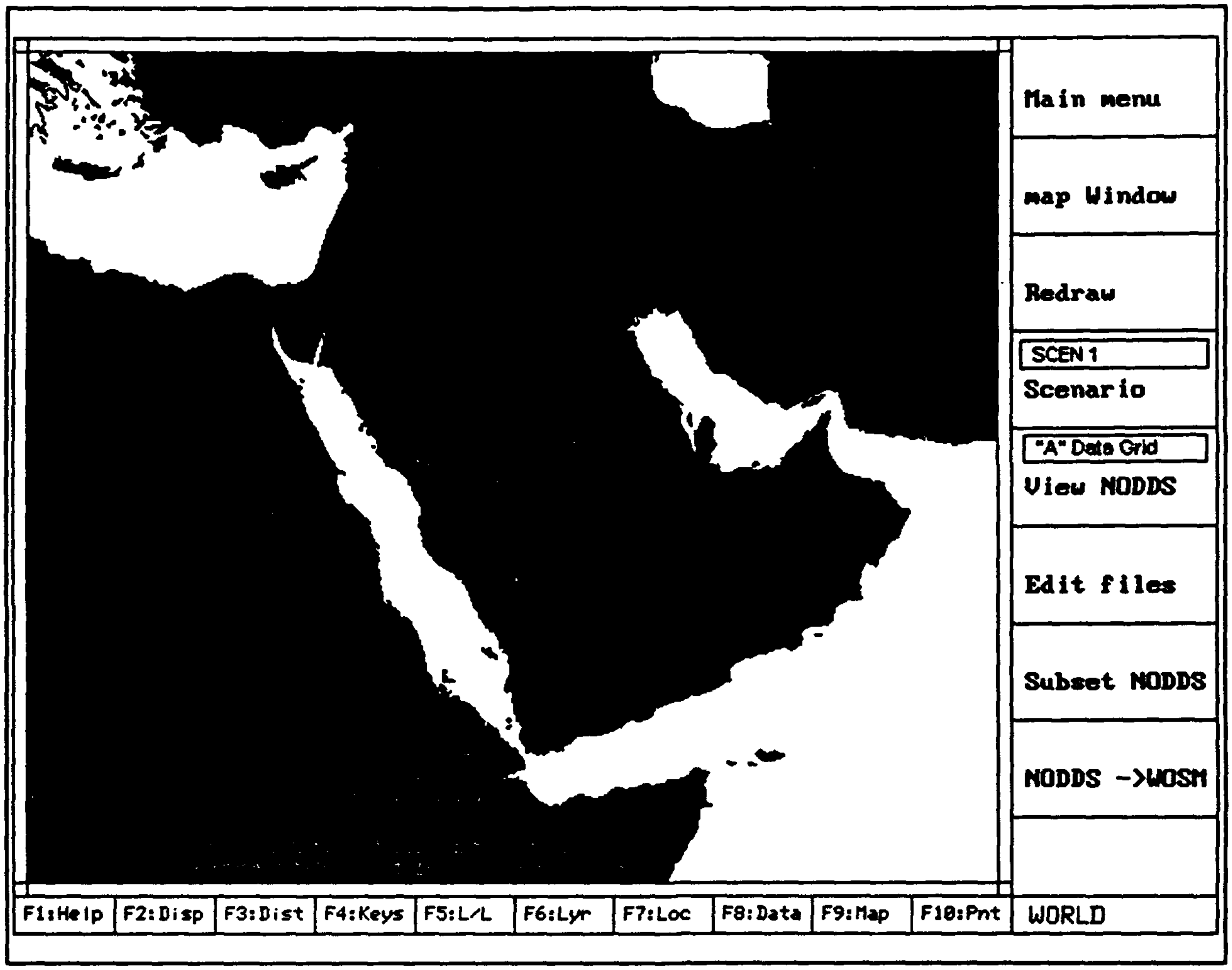


Figure 3.1. The NODDS/WOSM user interface

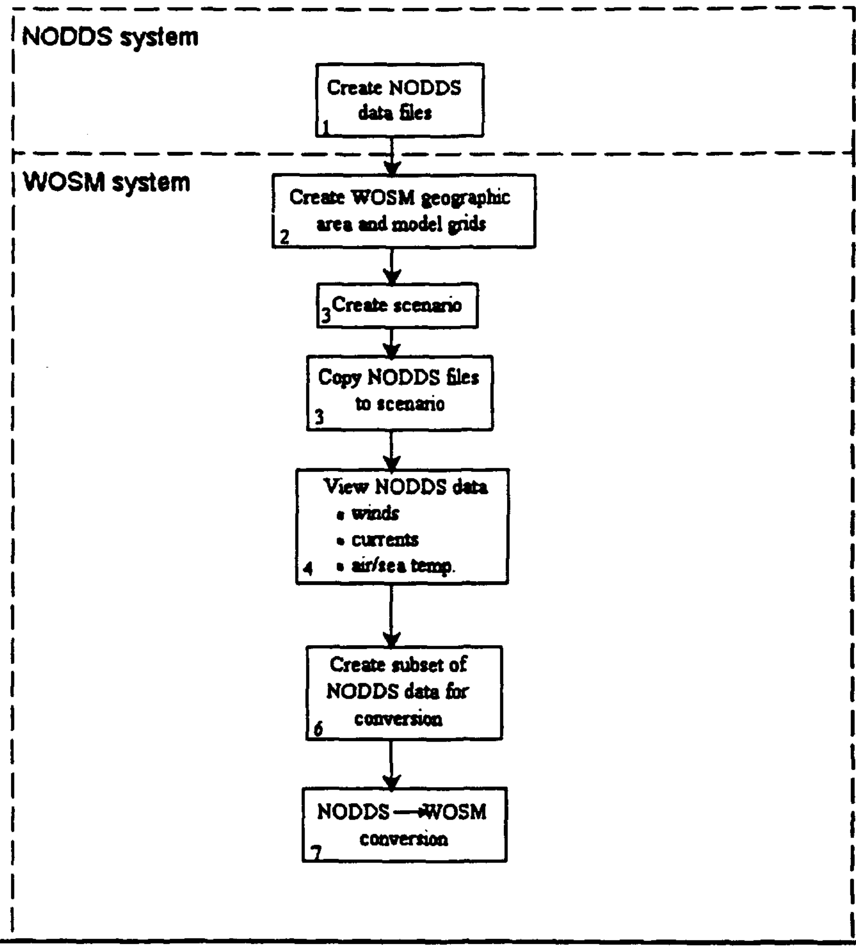


Figure 3.2. Flowchart illustrating the NODDS to WOSM data conversion steps

The first step in moving NODDS data files to the WOSM directory is to create a scenario directory (Figure 3.3). Proceed through the following steps:

A. Start the WOSM program. From the main menu select DATA. From the DATA MENU select IMPORT NODDS DATA. This will load the NODDS module.

B. Select SCENARIO. The SCENARIO pull-down menu will list four options:

Create Scenario
Copy Files
Change Scenario
Delete Scenario
Toggle Grid

Create scenario. Enter a scenario name in the form when prompted. This name will be used to create the directory to hold the NODDS files and the name entered will be used throughout the NODDS/WOSM program to refer to the data files for this scenario. Once this is done, the newly created scenario will also be the current scenario and any command issued within the NODDS module will operate on this scenario. The current scenario name is displayed as an inset to the SCENARIO button in the side menu.

Copy files. Enter the DOS path pointing to where the NODDS data files are stored in the form. Next, from the list displayed, select the scenario name to which the data files are to be copied. The NODDS data files will now be copied to the selected scenario.

Change scenario. To make a different scenario the current scenario, click this option and select a scenario name from the list presented.

Delete scenario. Enter this option to delete an existing scenario. Note that all data files and directories associated with the selected scenario will also be deleted. Care must be exercised in selecting this option.

Toggle grid. Toggle between the two NODDS grid types for the current scenario. This enables the user to subset each of the grids in a scenario.

4. View the NODDS data on the map. Once the NODDS data files have been copied to the appropriate directory (see item 3 above), the data may be viewed within a grid on the map. The NODDS grid for the current scenario will be displayed on the screen without any of the NODDS data. Zoom into the NODDS grid using the ZOOM menu commands as described in Section 2.2 of the WOSM manual and proceed through the following steps to view the different data types:

From the side menu select VIEW NODDS. A pull-down menu will list the four data types for viewing. Choose WINDS, CURRENTS, AIR TEMPERATURE, or SEA TEMPERATURE.

Winds. Draws wind vectors in the NODDS grid starting with the first time step available in the data file. Each grid node contains one vector representing the magnitude and direction of the wind at the node point. The name of the NODDS data file being displayed is shown in the message line at the bottom of the screen. To view the data in the next time step, click the right mouse button or hit the right arrow key. To view a previous time step, click the left mouse button or hit the right arrow key.

Winds
Currents
Air Temperature
Sea Temperature
Wind Scale
Current Scale

Currents. Draws the current vectors in the NODDS grid starting with the first time step available in the data file. Each grid node contains one vector representing the magnitude and direction of the current at the node point. The name of the NODDS data file being displayed is shown in the message line at the bottom of the screen. To view the data in the next time step, click the right mouse button or hit the right arrow key. To view a previous time step, click the left mouse button or hit the right arrow key.

Air Temperature. Draws the NODDS grid, filling each cell with a color that corresponds to a temperature value. The temperature value for each grid cell is calculated by averaging the temperatures from the nodes at the corner of each cell. To view a key showing the temperature range associated with each color, hold down the CTRL key and press K. This will bring a list of map keys to the screen. Select the key named AIRTEMP.KEY and the key will be displayed on the screen.

Sea Temperature. Draws the NODDS grid, filling each cell with a color that corresponds to a temperature value. The temperature value for each grid cell is calculated by averaging the temperatures from the nodes at the corner of each cell. To view a key showing the temperature range associated with each color, hold down the CTRL key and press K. This will bring a list of map keys to the screen. Select the key named AIRTEMP.KEY and the key will be displayed on the screen.

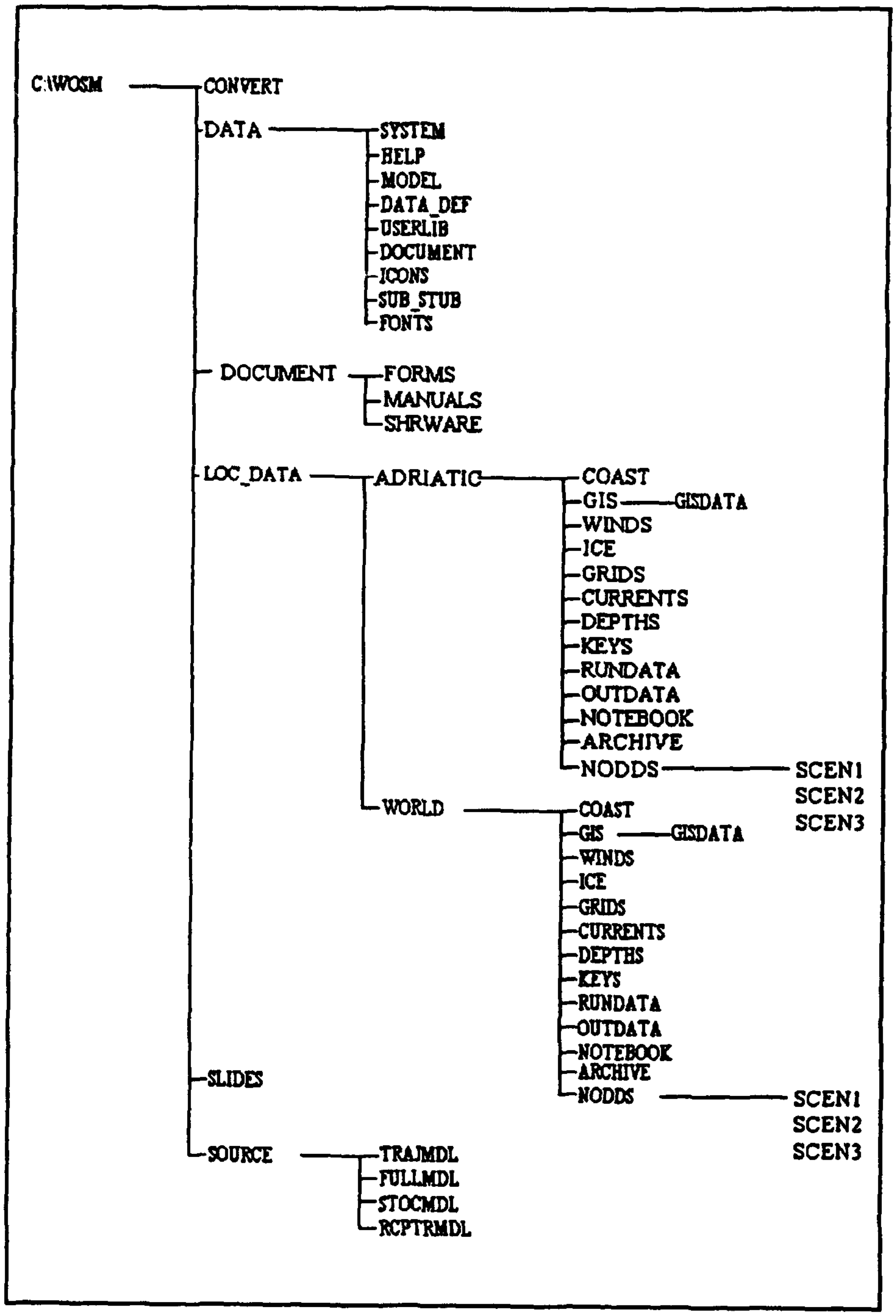


Figure 3.3. NODDS/WOSM directory tree

Helpful Commands for Viewing Data. The message bar at the bottom of the screen displays the name of each NODDS data file as it is displayed.

CTRL Keys. Use the control key commands to view color keys, and draw the coastline over the grid.

CTRL-H Lists the control key functions.

CTRL-M Draws the coastline over the gridded data.

CTRL-K Brings a list of map keys to the screen. Choose AIRTEMP.KEY for the air temperature key or SEATEMP.KEY to view the sea temperature key.

5. Editing NODDS Data Files. There may be times when the user needs to view or edit the NODDS data files. Two types of files may be edited. Map files are files which describe the NODDS grids. Data files are those used to store the NODDS wind, current, air and sea temperature data.

From the side menu select EDIT FILES. The following options are available for editing NODDS files:

Edit Map File
Edit Data File
View File

Edit Map Files. Presents the user with a list of the map files in the current scenario. Select one to edit and the file will appear in a window. Edit or print the file from this window.

Edit Data Files. Presents the user with a list of all the data files in the present scenario. Select one to edit and the file will appear in a window. Edit or print the file from this window.

View File. Lists all files within the present scenario. Select a file to view.

Warning: The map and NODDS data files are used by the NODDS/WOSM program and need to be in a specific format. Do not change the format of these files when editing or the software will not operate properly.

6. Select the NODDS Data to be Converted to WOSM. Once the NODDS data files are copied to the appropriate directory, a subset of these data must be selected for conversion to the WOSM data format for use in the spill models. A subset is a collection of NODDS grid nodes. No NODDS data are selected for conversion when the NODDS module is loaded, even though a scenario has been created and is current. The user must first create a subset, then perform the conversion. During the conversion to the WOSM format, all the data in the subset of one type (wind, current, etc.) are converted. Note that there are different NODDS grid resolutions and that subsets may be created from all. Use the GRID TOGGLE button under SCENARIO to switch between grids.

> **Warning:** Large numbers of WOSM data files can be generated when doing the conversions, requiring large amounts of disk space. As an example, for a subset of NODDS data containing 20 nodes, 20 wind files are generated. For the same subset of 20 nodes, current data spanning a 72-hr period at 6-hr increments would generate 260 (20 nodes x 13 time steps) WOSM current files. The user must use discretion when selecting NODDS data for conversion to WOSM and not select more data than necessary. The ideal situation is to create a subset of NODDS nodes that cover the area to be modeled so that the data are adequately represented. Figure 3.4 shows a NODDS/WOSM screen with a selected subset.

Creation of a subset is accomplished as follows:

From the side menu select SUBSET NODDS. From the drop-down menu, select one of the following commands:

Frame Grid Nodes
Individual Nodes
Clear Subset
Save Subset
Retrieve Subset

Frame Grid Nodes. Select a group of grid nodes for inclusion in the subset. With the left mouse button, click one corner of a rectangle surrounding the nodes to be selected. Move the cursor to the opposite corner of the rectangle and click the left mouse button again to

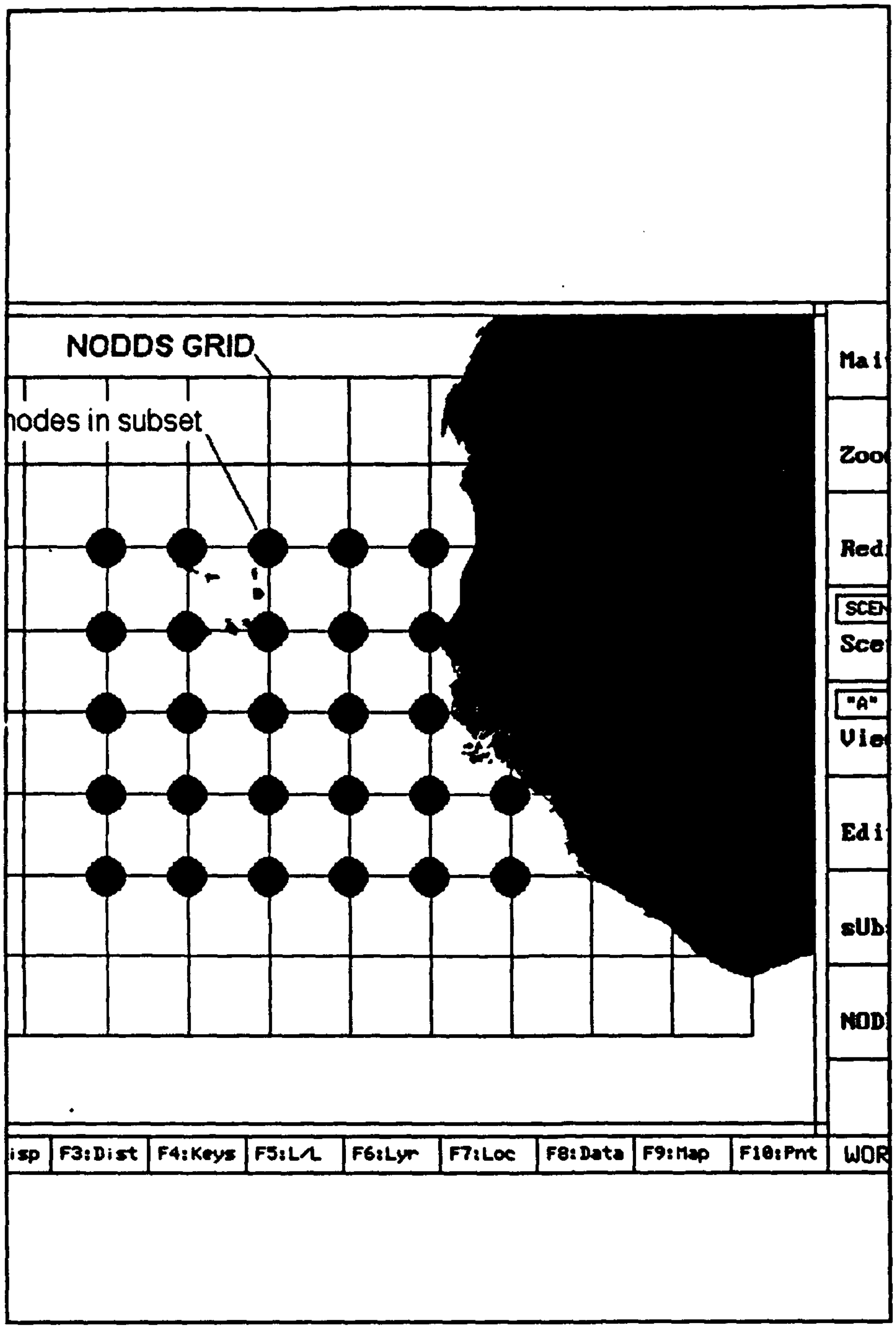


Figure 3.4. NODDS grid and data subsets

complete the rectangle. Nodes within the rectangle will become part of the subset. Nodes which are part of the subset will be displayed as colored circles. To remove a group of nodes from the subset, select them a second time.

Individual Nodes. Select a group of grid nodes for inclusion in the subset. With the left mouse button, click on a single node to make it part of the subset. Nodes that are part of the subset will be displayed as colored circles. To remove a node from the subset, click on the node a second time.

Clear Subset. Select this option to remove all nodes from the current subset.

Save Subset. Saves the current subset using the name supplied. This option allows the user to save a subset for later use. The NODDS to WOSM conversion will operate on whichever nodes are in the current subset and it is not necessary to save a subset in order to convert it to WOSM; however, if the user toggles to a new grid without saving the current subset, the subset will be lost.

Retrieve Subset. Lists all existing subsets by name. Choose the one to use for conversion to WOSM.

7. Convert NODDS Data to WOSM Format. Once a subset is defined or an existing subset selected as the current one, convert the wind, current, air or sea temperature data from NODDS to WOSM format for each of the nodes in the current subset. The conversion always operates on the current subset, and each data type (e.g. wind, current, etc.) is converted separately.

The WOSM files created in the conversion are placed in the appropriate subdirectory for the data type. Wind files are written to the WINDS subdirectory for the current WOSM location and current files to the CURRENTS subdirectory. The WOSM wind time series files created are named using the month and day of the NODDS watch hour, and the row and column number of the NODDS grid node. For example, a file name of 82357.WND would be for August 23 at the node on row 5, column 7 in the NODDS grid. A similar convention is used for current files. Current file names consist of the month, day, watch hour, and forecast hour for the NODDS data (e.g. 8231272.LLU). More details and examples have been given earlier in Chapter 1.

Convert the NODDS data using the following options:

Winds
Currents
Air Temperature
Sea Temperature

Wind. Wind data are written to binary files in the WINDS subdirectory for the present WOSM location. These wind files are read directly by the spill models at run time. The NODDS data from each node in the subset are written to wind time series files. Each node corresponds to a single time series at the node location. All the NODDS wind data from all time periods for the selected nodes are used to create the time series. The WOSM spill models will spatially interpolate a wind value at the spill site using multiple time series files.

Current. The current data are written to ASCII files in the CURRENTS subdirectory of the present WOSM location and given a .LLU extension. Each NODDS time slice is written to a single LLU current file. These files contain current data for all nodes in the subset for a single time. The .LLU current file contains the year, month, day and hour of the data, and the current velocity and direction at each of the node locations for all nodes in the subset. (The .LLU file format is explained in Appendix A.)

Air Temperature. Air temperatures for each subset of the NODDS data are written to an ASCII file and displayed in an information window. The average temperature from all the nodes in a subset are displayed. One average temperature is listed for each time step in the NODDS data file and an overall average temperature for the entire time is given. Record the temperature for later use. When specifying the spill scenario in WOSM, the user must type in an air temperature value.

Sea Temperature. Sea temperature for each subset of the NODDS data are written to an ASCII file and displayed in an information window. The average sea surface temperature for each time step from all the nodes in a subset are displayed, as well as an overall average temperature. Record the temperature for later use. When specifying the spill scenario in WOSM, the user must type in a sea temperature value.

Appendix A

Data Files and Format Information

CURRENT LATITUDE, LONGITUDE, U, V, FILE FORMAT (.LLU)

```
This File Name: \WOSM\DATA\DATA_DEF\datadef.LLU
          Date: 29dec92
        Author: Tatsusaburo Isaji
       Purpose: defines '\CURRENTS\filename.LLU'

filename   : \WOSM\LOC_DATA\location\CURRENTS\???????.LLU

howToOpen  : OPEN(,FORM='FORMATTED',ACCESS='SEQUENTIAL')

purpose    : provides an intermediate ASCII based transfer file for
             multiple time step hydrodynamic data produced by a
             third party. Velocity locations are not organized in
             gridded fashion (as ??????.TGC) so each line needs
             longitude and latitude coordinate.

written by: external

general    : Each file corresponds to a certain time step.
-------------------------------------------------------
First line : unit information
             xxx = conversion factor for U, V values to m/s

Second line: time info. yr, mo, day can be zero but must be typed
             yr mo day hour ! free format read (hour can be
real*4)

Third  line: first of data line, longitude latitude in decimal
degrees.
             Longitude must be negative if in western hemisphere,
             latitude negative in southern hemisphere.

             longitude latitude U V

******************  sample data  ******************************
       1.00 = to meter/sec
 0 0 0 1.00 = time
-121.680020 48.141997 0.017881 0.000226
-121.820685 48.148991 0.017881 0.000226
-121.855850 48.150389 0.094032 -0.965583
-121.891015 48.151787 0.017881 -0.185502
-121.927783 48.153190 -0.020194 0.148821
-123.040303 48.230811 0.055957 -0.111210
.
.
.
```

NODDS SURFACE CURRENT DATA FILE

B32 SURFACE CURRENT (CMS/SEC) 1000110000501 0000
1 10 9999 9999 105250000 0000 0000 0000 11610.0C

-79	-32	-30	-4	-64	-35	6	-27	15	-52	-119	54	94
157	126	51	36	34	3	54	-28	7	86	39	52	115
94	-31	-58	-27	-6	-15	59	-72	22	41	48	47	-78
-80	-44	24	17	111	-186	-313	-298	-207	-272	-73	-93	-26
-93	-24	88	-160	-102	-53	-16	-16	-13	0	37	-119	-167
29	-138	-98	-171	-177	-197	-70	58	-12	-92	-148	-15	-87
-138	-218	-158	-207	-247	-103	-27	-57	-75	74	-208	-179	-70
-71	-127	-276	-330	-273	-211	-44	184					

NODDS SURFACE WIND DATA FILE

A58 SURFACE WIND (KNOTS) 0000010000501 0012
1 10 9999 9999 105250000 0000 0000 0000 006.1941

-98	-51	-46	-67	-88	-90	-81	-73	-66	-56	-43	-4	19
24	16	5	0	-6	-18	-28	-27	-9	3	13	27	40
45	37	21	7	0	-1	10	-41	-39	-13	22	45	37
19	16	21	22	18	-93	-91	-60	-15	18	21	16	28
43	45	25	-112	-105	-83	-51	-18	9	34	58	71	66
35	-112	-98	-89	-81	-56	-3	51	82	90	79	44	-112
-94	-95	-102	-86	-29	35	72	83	76	48	-117	-106	-105
-106	-98	-69	-30	8	37	52	42					

NODDS SURFACE AIR TEMPERATURE FILE

A07 SURFACE AIR TEMPERATURE(CELSIUS) 0013110000510 0000
1 5 9999 9999 105250000 0000 0000 0000 00310.00

246	243	244	247	249	248	244	239	235	233	234	255	256
255	253	252	254	253	247	239	233	230	257	259	257	253
252	256	258	251	239	231	230	252	253	251	247	248	255
260	253	240	233	237	244	244	242	238	240	251	261	259
252	248	251	234	236	233	227	229	242	261	274	280	281
274	225	230	226	220	220	234	259	289	314	322	303	222
225	223	219	220	229	254	297	339	357	336	227	224	225
231	234	232	246	291	345	378	372					

NODDS SURFACE SEA SURFACE TEMPERATURE FILE

B10 SEA SURFACE TEMPERATURE (C)   1002110000510 0000
1   1 9999 9999 105250000 0000 0000 0000 00310.00

269	271	272	271	265	263	264	253	250	250	255	277	276
276	279	272	269	272	274	267	264	259	273	275	273	272
268	267	272	272	270	265	262	270	273	269	262	263	269
273	272	268	267	263	257	249	263	259	263	270	272	269
259	262	263	242	244	250	254	254	254	269	264	250	252
266	238	241	240	241	232	240	258	252	239	235	248	236
233	234	233	224	219	224	232	231	232	242	237	232	230
231	225	217	204	202	209	218	222					

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13. ABSTRACT *(Maximum 200 words)*

This report describes elements of a graphical user interface system developed between the World Oil Spill Model (WOSM) and the U.S. Navy's Oceanographic Data Distributon System (NODDS) database. Although both the NODDS and WOSM systems are briefly described, the emphasis of this report is on the coupling of these two stand-alone systems. Versatility of the interface is illustrated with three worldwide oil spill scenarios.

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