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Software Test Description (STD) for the Globally Relocatable Navy Tide/Atmospheric Modeling System (PCTides)

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14. ABSTRACT The purpose of this Software Test Description (STD) is to establish formal test cases to be used by personnel tasked with the installation and verification of the Globally Relocatable Navy Tide/Atmospheric Modeling System (PCTides). This STD describes the test and evaluation criteria necessary to verify that the PCTides software has been properly implemented. Three test cases have been selected to exercise the software. The test inputs, expected results, criteria for evaluation of those results, and assumptions regarding the test itself are described. This document, along with the Software Requirements Specification (Preller et al., 2001) and the Software Design Description (Hubbert et al., 2001) form the standard documentation package for the OAML PCTides.					
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SOFTWARE TEST DESCRIPTION (STD) FOR THE GLOBALLY RELOCATABLE NAVY TIDE/ATMOSPHERIC MODELING SYSTEM (PCTIDES)

1.0 Scope

This Software Test Description (STD) establishes formal test cases to be used by personnel tasked with the installation and verification of the Globally Relocatable Navy Tide/Atmosphere Modeling System (PCTides).

1.1 Identification

PCTides is a high resolution hydrodynamic model that characterizes coastal flooding due to storm surges. It consists of a Mesoscale Atmospheric Prediction System (MAPS) and the Coastal Ocean Model (GCOM2D and GCOM3D), a 2- and 3-dimensional barotropic ocean model developed by the Global Environmental Modeling Services (GEMS). The PCTides products can be used in sea state and tidal forecasting, disaster planning and management, and coastal engineering and storm impact studies (Hubbert and McInness, 1999).

MAPS is a hydrostatic primitive equations model used to provide high resolution spatial representation of anemometer level winds and surface pressure field as atmospheric boundary conditions for the 2- or 3-dimensional barotropic ocean models (GCOM2D/3D). A turbulence closure scheme has been designed to allow the model to be run with its lowest model level at anemometer height, providing direct simulation of winds at this level. MAPS is capable of being run on varying spatial resolution anywhere in the globe.

GCOM2D is a depth-integrated shallow water model designed to model currents and sea levels on or near continental shelves. It features a wetting and draining algorithm for the simulation of coastal flooding due to tides or storm surge. GCOM3D is the three-dimensional counterpart of GCOM2D. It is a barotropic model for applications where current structure with vertical depth is required and tidal and wind forcing are dominant. In tropical applications, atmospheric forcing for GCOM2D/3D is provided by a hurricane vortex model rather than by MAPS.

1.2 Document Overview

This Software Test Description describes the test and evaluation criteria necessary to verify that the PCTides software has been properly implemented. Three test cases have been selected to exercise the software.

The test inputs, expected results, criteria for evaluation of those results, and assumptions regarding the test itself are described. This document has been prepared in accordance with the Software Documentation Standards for Environmental System Product Development, released in January 1999 and distributed by NAVOCEANO.

2.0 References

2.1 *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.

2.2 *PCTides Software Release*

Hubbert, G.D., Preller, R.H., Posey, P.G., and Carroll, S.N. (2001). Software Design Description (SDD) for the Globally Relocatable Navy Tide/Atmosphere Modeling System (PCTides). NRL Technical Memo NRL/MR/7322—01-8266.

Preller, R.H., Posey, P.G., Carroll, S.N., and Orsi, L.B. (2001). Software Requirements Specification (SRS) for the Globally Relocatable Navy Tide/Atmosphere Modeling System (PCTides). NRL Technical Memo NRL/MR/7322—01-8265.

Preller, R.H., Posey, P.G., Hubbert, G.D., Carroll, S.N., and Orsi, L.B. (2001). User's Manual for the Globally Relocatable Navy Tide/Atmosphere Modeling System (PCTides). NRL Technical Memo NRL/MR/7322—01-8268.

2.3 *General Technical Documentation*

Hubbert, G.D. and K.L. McInnes, (1999): A storm surge inundation model for coastal planning and impact studies. *J. Coastal Research*. **15**. 168-185.

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**: 25173-25194.

3.0 Test Preparations

Three complete test cases are provided to exercise the installed PCTides capability. These are delivered along with the PCTides software, including sufficient input data files for the user to replicate the results shown here. It is assumed that the PCTides software has been installed, according to separate instructions, before attempting these runs.

3.1 Hardware Preparation

The execution of PCTides does not require extensive hardware configuration or modification and can be easily loaded onto either the PC Windows/DOS or UNIX operating systems. In order to successfully execute PCTides there must be at least 256 MB of RAM. The system itself requires 400 MB of disk space in both the PC Windows/DOS and UNIX operating systems.

3.2 Software Preparation and Test Execution

The PCTides User's Manual provides specific instructions on the execution of the software. The model is run through use of a PC Windows interactive menu or a command prompt. Command prompt operation in the PC window environment is identical to UNIX operation.

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\gridgen : directory containing the ASA grid generator files-PC only.
- \gems\TESTAREA[1 2 3] : directory containing files for test case execution.

Note: The [1 2 3] in the TESTAREA directory denotes a choice between Test Case 1, Test Case 2 or Test Case 3. If working with Test Case 1, for example, the test directory would be \gems\TESTAREA1\.

Execution of all activities by command prompt should be carried out in the "work" directory. These directories are transparent when using the PC Windows interactive menu. If a UNIX system is used the notation for directories must be "/" instead of "\".

3.3 Description of Test Cases

The test cases chosen for PCTides verification reflect areas of varying location, bathymetry, grid resolution, and oceanographic characteristics. The cases reflect the most common run scenarios the user will encounter, such as running without wind forcing (Test Case 1), with winds (Test Case 2), and doing nested grid runs (Test Case 3). Each test case provides instructions for running the test, examples of input files, a map of the test area and brief examples of output files by which the user may compare test results.

3.4 Input Files

Three user specified input files must be edited or copied prior to running the test cases. The files are topog.dat file, stations.dat and gcom.dat. For Test Cases 1, 2 or 3, the user will copy an existing file provided upon installation of PCTides rather than creating their own.

3.4.1 Bathymetry File (topog.dat)

For a standard PCTides run, grid generation is a required input file for creating a new bathymetry. This is accomplished by editing the gridgen.dat file for the model domain of interest and then running `~/gems/gcom/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. However, for the purposes of these test cases an existing bathymetry is used. The user copies an existing topog.dat file using the command `cp ~/gems/TESTAREA[1 2 3]/topog.dat`. Appendix A provides an excerpt of a topog.dat file.

3.4.2 Stations File (stations.dat)

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 prior to model execution by setting up a "stations.dat" file. 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. An input file for station locations may be created in stations.dat, or an existing stations.dat file may be copied using `cp ~/gems/TESTAREA[1 2 3]/stations.dat`. 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 may be plotted at the end of the run for comparison with observations or tidal height predictions (".thp" files). A sample stations.dat file is shown on the following page.

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

3.4.3 Parameter File (gcom.dat)

The gcom.dat file is edited, or an existing gcom.dat file is copied into the "work" directory, to select the parameter options for the model run. A typical gcom.dat file is shown below.

Line	Parameter	Typical Value
1	wind flag (0=off, 1=on)	0
2	tide flag (0=off, 1=on, 2=on + tidal data assimilation)	2
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)	48

3.5 Tidal Boundary Conditions

Tidal boundary conditions are derived from the global tide model, Finite Element Solutions, version 95.1 (FES95.1/2.1) (Shum et al., 1997). 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	ol.dat
n2.dat	kl.dat
k2.dat	ql.dat

3.6 Wind Forcing

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. 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 an external directory for the NOGAPS/COAMPS output files.

These files are interpolated to the model grid and written to the binary sequential file "atmos.dat". PCTides has been updated to use the Navy's METCAST winds. Test Case 2 incorporates COAMPS winds to provide wind forcing to the GCOM model.

3.7 Nested Model Runs

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, so 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 too infrequent in order to pass sufficient information to the nested model, i.e. no greater than one 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=on or on + tidal data assimilation, nesting=on, inundation=off or on).
9. Run GCOM2D or GCOM3D.
10. Display results.

3.8 Output Files

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.

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". The ".tsd" file contains the station information, date, time, tidal current speeds and tidal current direction. The output time for this file is constant, i.e., ten or twelve minutes. Tidal current speeds are in knots and the current direction is in degrees from true north, where north equals 0°. As the model runs, the tidal predictions for the IHO tidal station closest to the selected model station are also written to a file with the station name and the extension ".thp". The ".thp" file contains the same information as the ".tsd" file. However, the observation station does not have the current information and so the current speed and direction columns contain zeros. The third output file, gcom.out, is a direct access file of the full horizontal array of tidal heights and tidal current velocities. It is required as an input file for the command `~/gems/gcom/omfield`, which takes the direct access file and converts it to an ASCII file for the horizontal array.

4.0 Test Descriptions

Three test cases are provided for the purpose of verifying the installation of PCTides on the user's system. In this STD, the test cases are simply presented so that the user may verify that each executes correctly.

4.1 Test Case 1

Test Case 1 area is located on the U.S. East Coast near Chesapeake Bay, Virginia. Figure 1 provides general information about the test area with a map of the model domain marking each of the eight times series stations. Test Case 1 will be run without winds (wind flag=0).

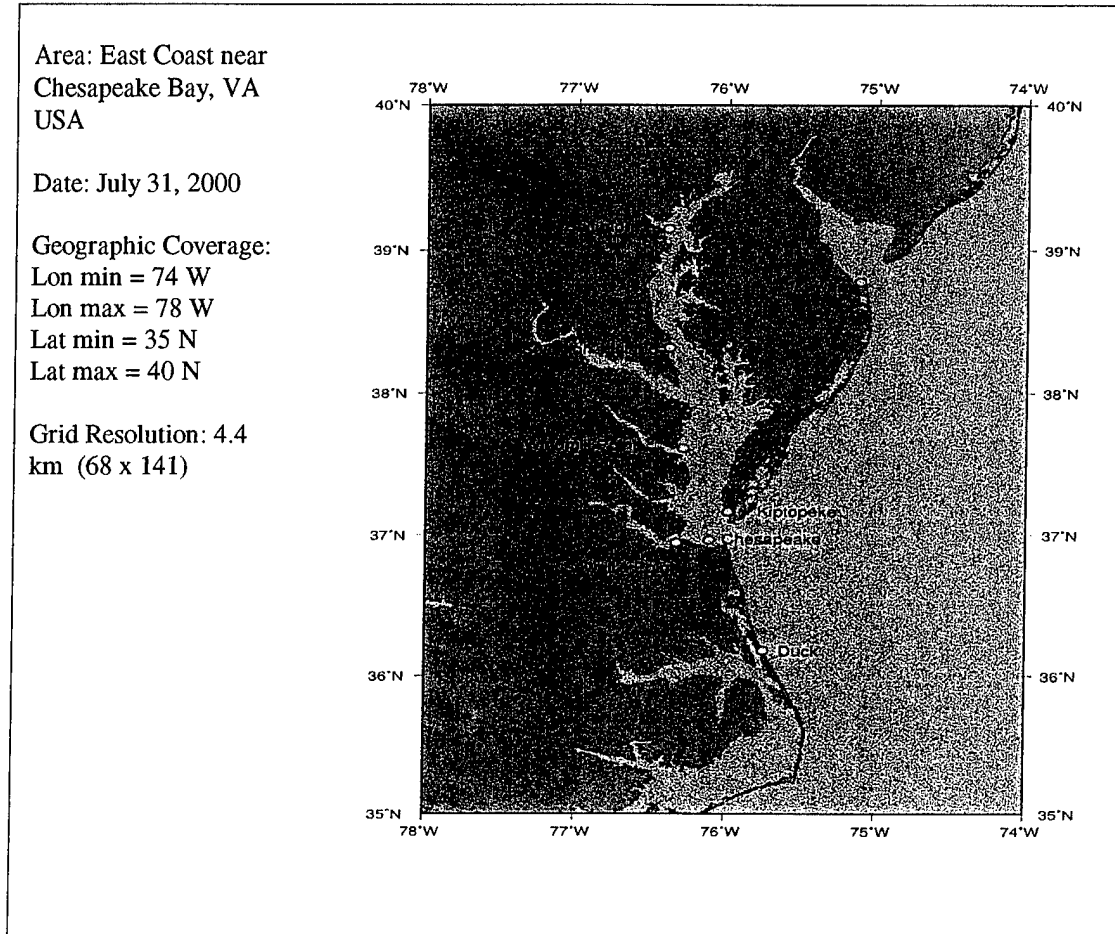


Figure 1. Test Case 1 grid information.

4.1.1 Test Case 1 Procedure

1. Copy existing topog.dat file:

```
cp          ~/gems/TESTAREA1/topog.dat
```

into the work directory: ~/gems/work/topog.dat .

See Appendix A for an excerpt from the topog.dat file.

2. Copy existing stations.dat file (See Figure 2):

```
cp          ~/gems/TESTAREA1/stations.dat
```

into the work directory: ~/gems/work/stations.dat .

36.18330	284.25339	duc	1
36.94670	283.67001	sew	1
36.96670	283.88699	che	1
37.61500	283.70999	wdm	1
37.16700	284.01199	kip	1
39.15000	283.60001	bal	1
38.32000	283.61499	sol	1
38.78000	284.88000	lew	1

Figure 2. Test Case 1 stations.dat file.

3. Copy existing gcom.dat file (See Figure 3):

```
cp          ~/gems/TESTAREA1/gcom.dat
```

into the work directory: ~/gems/work/gcom.dat .

	0	:	WIND FLAG (0=off, 1=on)
	2	:	TIDE FLAG (0=off, 1=on, 2=assimilate data)
	0	:	NESTING FLAG (0=off, 1=on)
	0	:	SCREEN FLAG (0=text, 1=vectors, 2=3Dmesh)
	0	:	INUNDATION FLAG (0=off, 1=on)
	6.0	:	OUTPUT FILE TIME INTERVAL (hours, 0=none)
0 0 31 07 2000	0.0	:	START TIME & TIME ZONE
			(hh,mm,dd,mm,yyyy -tides only)
	48	:	MAXIMUM MODEL RUN TIME (hours)

Figure 3. Test Case 1 gcom.dat file.

Note that the wind flag should be = 0 (no winds) and the tide flag is set to assimilate data (flag=2).

4. Run the model using the following three commands:

- a. `~/gems/gcom/tides`
Assimilates tidal data.
- b. `~/gems/gcom/gcom2d`
Runs the PCTides GCOM2D model.
- c. `~/gems/gcom/omfield`
Runs “omfield”, which changes “gcom.out” into an ASCII file, thus producing a full horizontal array of height, speed and direction. See the User’s Manual Section 4.6.1 for details on running “omfield”.

4.1.2 Expected Test Results

The execution of Test Case 1 results in a “gcom.out” file, a “.tsd” file and a “.thp” file for each station. The user should compare the “.tsd” and “.thp” files to check for accuracy in the model.

4.1.3 Model Output Results

The text of the “.thp” and “.tsd” files generated by Test Case 1 is provided in Figures 4 and 5 on the following page. The tables represent the first thirty lines of output from the files generated for the Kiptopeke Station. The user’s output files when compared with the examples should be identical. The example files for the remaining Test Case 1 stations are provided in Appendix B.

```
cape charles
37.2667 283.9833 0.0 4.0
```

```
12
```

```
Tide table tidal constituents
```

DATE	TIME	HEIGHT	SPEED	DIREC
20000731	0	0.43	0.00	0.0
20000731	12	0.46	0.00	0.0
20000731	24	0.49	0.00	0.0
20000731	36	0.52	0.00	0.0
20000731	48	0.53	0.00	0.0
20000731	100	0.55	0.00	0.0
20000731	112	0.56	0.00	0.0
20000731	124	0.56	0.00	0.0
20000731	136	0.56	0.00	0.0
20000731	148	0.55	0.00	0.0
20000731	200	0.54	0.00	0.0
20000731	212	0.52	0.00	0.0
20000731	224	0.50	0.00	0.0
20000731	236	0.47	0.00	0.0
20000731	248	0.44	0.00	0.0
20000731	300	0.41	0.00	0.0
20000731	312	0.37	0.00	0.0
20000731	324	0.33	0.00	0.0
20000731	336	0.28	0.00	0.0
20000731	348	0.24	0.00	0.0
20000731	400	0.19	0.00	0.0
20000731	412	0.14	0.00	0.0
20000731	424	0.09	0.00	0.0
20000731	436	0.03	0.00	0.0
20000731	448	-0.02	0.00	0.0
20000731	500	-0.07	0.00	0.0
20000731	512	-0.12	0.00	0.0
20000731	524	-0.17	0.00	0.0
20000731	536	-0.22	0.00	0.0
20000731	548	-0.26	0.00	0.0

Figure 4. Excerpt from "kip.thp" file for Test Case 1. Station is Cape Charles, Virginia, USA.

```
kip
37.1670 284.0120 0.0 2.9
```

```
12
```

```
DATA FROM THE REGIONAL OCEAN MODEL
```

DATE	TIME	HEIGHT	SPEED	DIREC
20000731	0	0.615	0.520	321.1
20000731	12	0.641	0.515	322.0
20000731	24	0.661	0.508	322.8
20000731	36	0.675	0.498	323.7
20000731	48	0.684	0.486	324.7
20000731	100	0.687	0.470	325.9
20000731	112	0.683	0.452	327.3
20000731	124	0.674	0.431	328.9
20000731	136	0.658	0.407	330.8
20000731	148	0.636	0.380	333.2
20000731	200	0.608	0.351	336.2
20000731	212	0.573	0.318	340.0
20000731	224	0.533	0.284	344.9
20000731	236	0.488	0.250	351.8
20000731	248	0.438	0.216	1.7
20000731	300	0.384	0.188	15.9
20000731	312	0.325	0.172	35.0
20000731	324	0.263	0.174	56.7
20000731	336	0.200	0.193	76.2
20000731	348	0.137	0.223	91.6
20000731	400	0.075	0.257	103.1
20000731	412	0.014	0.291	111.8
20000731	424	-0.047	0.322	118.4
20000731	436	-0.105	0.350	123.6
20000731	448	-0.161	0.374	127.5
20000731	500	-0.215	0.394	130.6
20000731	512	-0.267	0.412	132.9
20000731	524	-0.316	0.425	134.6
20000731	536	-0.364	0.436	136.0
20000731	548	-0.408	0.443	137.2

Figure 5. Excerpt from "kip.tsd" file for Test Case 1. Station is Kiptopeke, Virginia, USA.

4.1.4 Assumptions and Constraints

The successful replication of the preceding PCTides results is dependent on the application of identical input data files. It is essential, therefore, that the appropriate files be correctly installed and available to the models.

4.2 Test Case 2

Test Case 2 is located in Puget Sound near Seattle, Washington. Figure 6 provides general information about the test area with a map of the model domain marking the two times series stations. Test Case 2 will be run with winds (wind flag=1).

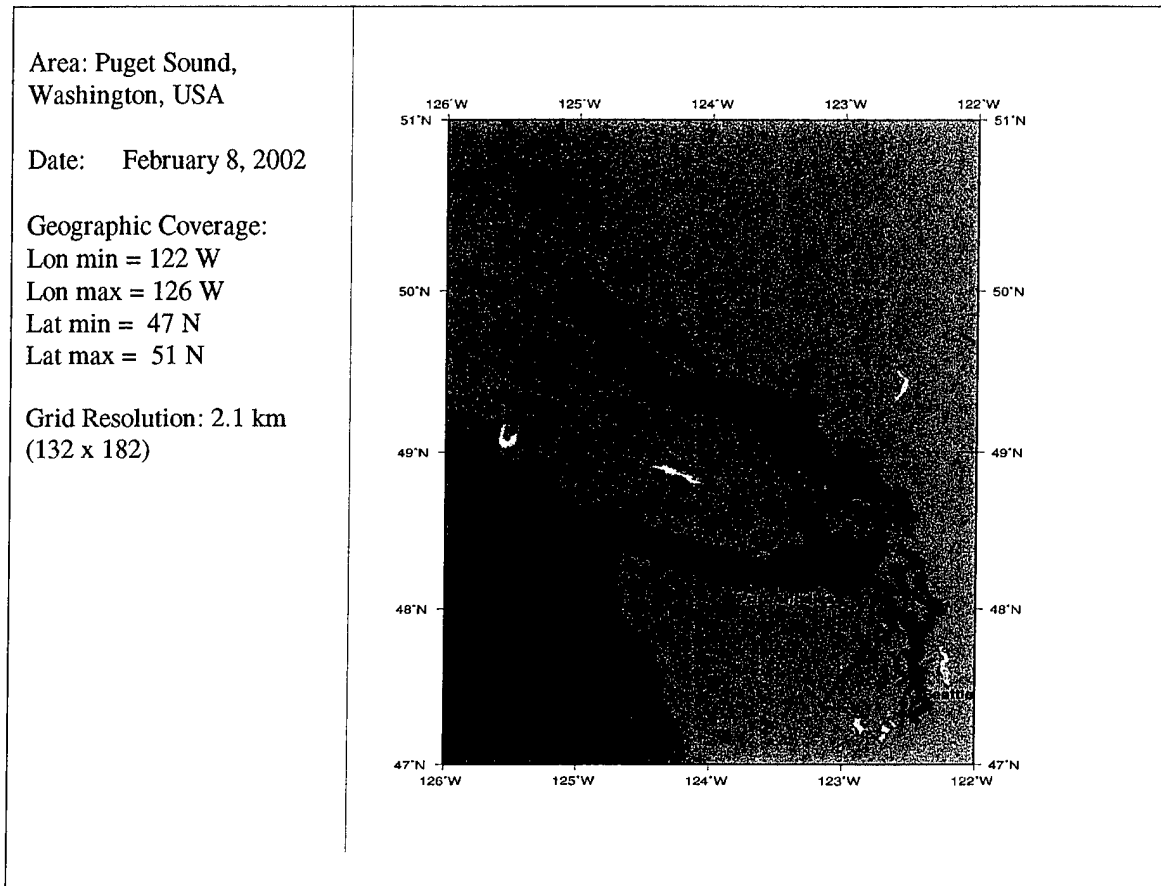


Figure 6. Test Case 2 grid information.

4.2.1 Test Case 2 Test Procedure

1. Copy existing topog.dat file to the work directory:

```
cp      ~/gems/TESTAREA2/topog.dat
```

```
to:     ~/gems/work/topog.dat .
```

See Appendix A for an excerpt from a sample topog.dat file.

2. Copy existing stations.dat file (Figure 7) into the work directory:

```
cp      ~/gems/TESTAREA2/stations.dat
to:     ~/gems/work/stations.dat .
```

48.18500	236.57001	ang	1
47.55000	237.59001	sea	1

Figure 7. Test Case 2 stations.dat file.

3. Copy existing gcom.dat file (See Figure 8) into the work directory:

```
cp      ~/gems/TESTAREA2/gcom.dat
to:     ~/gems/work/gcom.dat .
```

```
1 : WIND FLAG (0=off, 1=on)
2 : TIDE FLAG (0=off, 1=on, 2=assimilate data)
0 : NESTING FLAG (0=off, 1=on)
0 : SCREEN FLAG (0=text, 1=vectors, 2=3Dmesh)
0 : INUNDATION FLAG (0=off, 1=on)
6.0 : OUTPUT FILE TIME INTERVAL (hours, 0=none)
0 0 31 07 2000 0.0 : START TIME & TIME ZONE
                    (hh,mm,dd,mm,yyyy -tides only)
48 : MAXIMUM MODEL RUN TIME (hours)
```

Figure 8. Test Case 2 gcom.dat file.

Note that for Test Case 2 the wind flag is “on” (flag=1).

4. Prepare COAMPS Eastern Pacific wind forcing to use in the tide model. The following commands will take IEEE COAMPS E_PAC fields and write them into an ASCII file called atmos.dat. For this test, copy the atmos.dat file into the work directory:

```
cp      ~/gems/TESTAREA2/atmos.dat
to:     ~/gems/work/atmos.dat .
```

For Naval Oceanographic Office users, the code required to pull in the COAMPS fields for the atmos.dat file has been automated at NAVOCEANO.

5. Run the model using the following commands:

```
a. ~/gems/gcom/tides
    Assimilate tidal data.
```

- b. `~/gems/gcom/gcom2d`
Runs the PCTides GCOM2D model.
- c. `~/gems/gcom/omfield`
Runs “omfield”, which changes “gcom.out” into an ASCII file, thus producing a full horizontal array of height, speed and direction. See the User’s Manual Section 4.6.1 for details on running “omfield”.

4.2.2 Expected Test Results

The execution of Test Case 2 results in a “gcom.out” file, a “.tsd” file and a “.thp” file for both stations. The user should compare the “.tsd” files with the “.thp” files to check for accuracy in the model.

4.2.3 Model Output Results

The first thirty lines of output from the “.thp” and “.tsd” files generated by Test Case 2 is provided for the Seattle station in Figures 9 and 10. The user’s output files when compared with the examples should be identical. The example output for the Port Angeles station is listed in Appendix B, Figures B-15 and B-16.

```

seattle
47.6000 237.6667 0.0 0.0

```

12

Tide table tidal constituents

DATE	TIME	HEIGHT	SPEED	DIREC
20020208	0	-0.37	0.00	0.0
20020208	12	-0.51	0.00	0.0
20020208	24	-0.65	0.00	0.0
20020208	36	-0.80	0.00	0.0
20020208	48	-0.94	0.00	0.0
20020208	100	-1.08	0.00	0.0
20020208	112	-1.22	0.00	0.0
20020208	124	-1.35	0.00	0.0
20020208	136	-1.48	0.00	0.0
20020208	148	-1.60	0.00	0.0
20020208	200	-1.72	0.00	0.0
20020208	212	-1.82	0.00	0.0
20020208	224	-1.92	0.00	0.0
20020208	236	-2.00	0.00	0.0
20020208	248	-2.07	0.00	0.0
20020208	300	-2.13	0.00	0.0
20020208	312	-2.18	0.00	0.0
20020208	324	-2.21	0.00	0.0
20020208	336	-2.23	0.00	0.0
20020208	348	-2.23	0.00	0.0
20020208	400	-2.23	0.00	0.0
20020208	412	-2.20	0.00	0.0
20020208	424	-2.17	0.00	0.0
20020208	436	-2.12	0.00	0.0
20020208	448	-2.06	0.00	0.0
20020208	500	-1.98	0.00	0.0
20020208	512	-1.90	0.00	0.0
20020208	524	-1.80	0.00	0.0
20020208	536	-1.70	0.00	0.0
20020208	548	-1.58	0.00	0.0

Figure 9. Excerpt from the Seattle station "sea.thp" output file for Test Case 2.

```

sea
47.5500 237.5900 0.0 70.9

```

12

DATA FROM THE REGIONAL OCEAN MODEL

DATE	TIME	HEIGHT	SPEED	DIREC
20020208	0	-0.519	0.183	0.1
20020208	12	-0.635	0.192	2.3
20020208	24	-0.751	0.195	4.0
20020208	36	-0.868	0.198	6.0
20020208	48	-0.981	0.202	7.9
20020208	100	-1.090	0.203	9.8
20020208	112	-1.191	0.203	12.0
20020208	124	-1.286	0.202	14.3
20020208	136	-1.377	0.198	16.7
20020208	148	-1.466	0.192	19.2
20020208	200	-1.547	0.186	22.0
20020208	212	-1.618	0.178	25.1
20020208	224	-1.680	0.170	28.5
20020208	236	-1.731	0.162	32.2
20020208	248	-1.774	0.152	36.5
20020208	300	-1.805	0.141	41.9
20020208	312	-1.826	0.130	48.5
20020208	324	-1.840	0.119	56.9
20020208	336	-1.840	0.114	63.9
20020208	348	-1.830	0.107	72.6
20020208	400	-1.812	0.103	83.6
20020208	412	-1.779	0.103	94.4
20020208	424	-1.734	0.105	105.5
20020208	436	-1.681	0.112	116.4
20020208	448	-1.615	0.120	124.9
20020208	500	-1.545	0.130	132.6
20020208	512	-1.466	0.142	139.2
20020208	524	-1.378	0.153	144.6
20020208	536	-1.279	0.165	148.6
20020208	548	-1.174	0.176	152.3

Figure 10. Excerpt from the Seattle station "sea.tsd" output file for Test Case 2.

4.2.4 Assumptions and Constraints

The successful replication of the PCTides results shown above is, obviously, dependent on the application of identical input data files. It is essential, therefore, that the appropriate files be correctly installed and available to the models.

4.3 Test Case 3

Test Case 3 demonstrates a nested model scenario. It includes instructions and output for both the coarse and finer resolution model runs. The geographic location for Test Case 3 coarse run is the coastline of the United Kingdom including ten stations. The location for the nested case is along the Bristol Channel with one station near Ilfracombe, England. Figures 11 and 12 provide general information and maps for the coarse test area and the finer resolution nest region, respectively.

Area: Coastline of United Kingdom

Date: July 31, 2000

Geographic Coverage:

Lon min = 7.0 E

Lon max = 12.0 W

Lat min = 46.0 N

Lat max = 65.0 N

Grid Resolution: 9.5 km
(154 x 227)



Figure 11. Test Case 3 coarse area grid information.

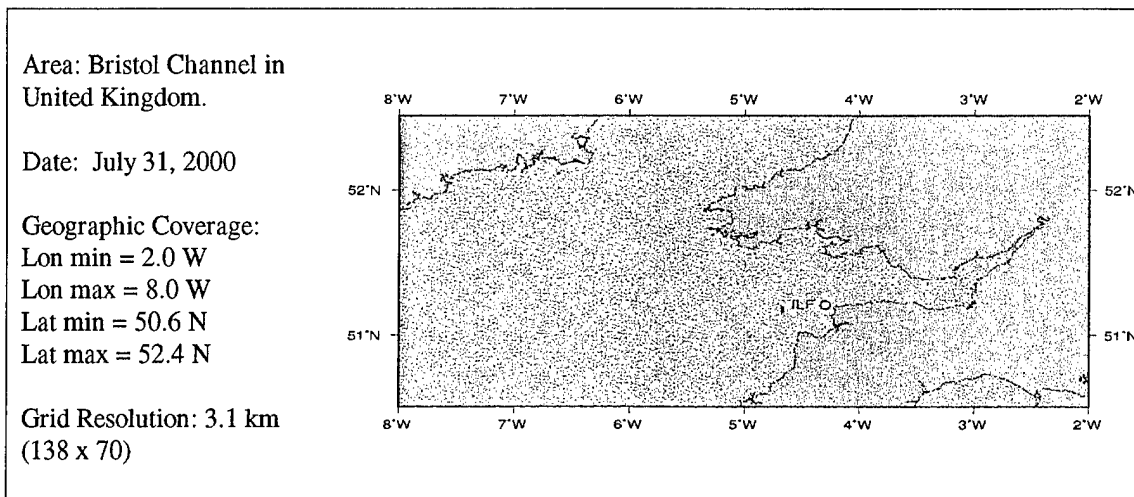


Figure 12. Test Case 3 nested area grid information.

4.3.1 Test Case 3 Test Procedure

Coarse Model Run

1. Copy existing topog.dat file into the work directory:

```
cp      ~/gems/TESTAREA3/topog_coarse.dat
```

```
to:     ~/gems/work/topog.dat .
```

See Appendix A for an excerpt from a sample topog.dat file.

2. Copy existing stations.dat file (See Figure 13):

```
cp      ~/gems/TESTAREA3/stations.dat
```

```
to:     ~/gems/work/stations.dat .
```

57.14500	357.92020	abe	1
51.21000	355.70001	ilf	1
51.04000	1.30000	dov	1
54.03000	356.60001	hey	1
53.63000	359.91010	imm	1
60.16000	358.75000	ler	1
53.50000	356.65021	liv	1
50.65000	0.05000	new	1
51.45000	0.72000	she	1
58.21000	353.66000	sto	1

Figure 13. Test Case 3 stations.dat file.

3. Copy gcom.dat file (See Figure 14) into the work directory:

```
cp          ~gems/TESTAREA3/gcom_coarse.dat  
to:         ~gems/work/gcom.dat .
```

Note that the Nesting Flag should be “off” (flag=0) for the coarse run. Test Case 3 is being run without winds; so the wind flag is also “off” (flag=0). The tide flag is set to assimilate data (flag=2).

```

0 : WIND FLAG (0=off, 1=on)
2 : TIDE FLAG (0=off, 1=on, 2=assimilate data)
0 : NESTING FLAG (0=off, 1=on)
0 : SCREEN FLAG (0=text, 1=vectors, 2=3Dmesh)
0 : INUNDATION FLAG (0=off, 1=on)
1.0 : OUTPUT FILE TIME INTERVAL (hours,0=none)
0 0 31 07 2000 0.0 : START TIME & TIME ZONE
(hh,mm,dd,mm,yyyy -tides only)
48 : MAXIMUM MODEL RUN TIME (hours)

```

Figure 14. Test Case 3 coarse run gcom.dat file.

4. Run the model using the following commands:

- a. `~/gems/gcom/tides`
Assimilates tidal data.
- b. `~/gems/gcom/gcom2d`
Runs the PCTides GCOM2D model.

The execution of this initial run of Test Case 3 results in a “gcom.out” file, a “.tsd” file and a “.thp” file for each station.

5. Save out the coarse run .tsd and .thp files under a new name, as seen in the example below using a “_c” after the station name. This allows for the finer resolution run to output new .tsd and .thp files and not overwrite the coarse run’s files.

```

mv abe.tsd abe_c.tsd
mv ilf.tsd ilf_c.tsd
mv dov.tsd dov_c.tsd
mv hey.tsd hey_c.tsd
mv imm.tsd imm_c.tsd
mv ler.tsd ler_c.tsd
mv liv.tsd liv_c.tsd
mv new.tsd new_c.tsd
mv she.tsd she_c.tsd
mv sto.tsd sto_c.tsd
mv abe.thp abe_c.thp
mv ilf.thp ilf_c.thp
mv dov.thp dov_c.thp
mv hey.thp hey_c.thp
mv imm.thp imm_c.thp
mv ler.thp ler_c.thp
mv liv.thp liv_c.thp
mv new.thp new_c.thp
mv she.thp she_c.thp
mv sto.thp sto_c.thp

```

Nested Run

1. Copy the existing nested grid topography to the work directory:

```
cp          ~/gems/TESTAREA3/topog.dat
```

```
to:         ~/gems/work/topog.dat .
```

2. Copy the gcom.dat for the fine resolution run (See Figure 15):

```
cp          ~/gems/TESTAREA3/gcom.dat
```

```
to:         ~/gems/work/gcom.dat .
```

Make sure that the nesting flag is turned “on” (flag=1), the tide flag is turned “off” (flag=0), and the wind flag is turned “off” (flag=0).

```
0 : WIND FLAG (0=off, 1=on)
0 : TIDE FLAG (0=off, 1=on, 2=assimilate data)
1 : NESTING FLAG (0=off, 1=on)
0 : SCREEN FLAG (0=text, 1=vectors, 2=3Dmesh)
0 : INUNDATION FLAG (0=off, 1=on)
1.0 : OUTPUT FILE TIME INTERVAL (hours, 0=none)
0 0 31 07 2000 0.0 : START TIME & TIME ZONE
                   (hh,mm,dd,mm,yyyy -tides only)
48 : MAXIMUM MODEL RUN TIME (hours)
```

Figure 15. Test Case 3 nested run gcom.dat file.

3. Run the model using the following commands:

- a. `~/gems/gcom/gcom2d`
Run the PCTides GCOM2D model.

- b. `~/gems/gcom/omfield`
Runs “omfield”. See the User’s Manual Section 4.6.1 for details on running “omfield”.

4.3.2 Expected Test Results

The execution of Test Case 3 results in a “gcom.out” file and a “.tsd” file for each station, for both the coarse and the finer resolution grids. The “.thp” files are also generated during both the coarse and high resolution runs.

4.3.3 Model Output Results

The following tables represent the first thirty lines of output from the nested run files generated for the Ilfracombe station. The output from the “.thp” file (Figure 16) provides the tide information for comparison with the “.tsd” files from the nested case. The output from the “.tsd” file generated by the nested run is shown in Figure 17. Results from the remaining nine stations of the coarse run are available in Appendix B, Figures B-17 through B-34. The user’s output files when compared with the examples should be identical.

```
ilfracombe
51.2167 355.8833 0.0 0.0
10
Tide table tidal constituents
DATE TIME HEIGHT SPEED DIREC
20000731 10 -3.82 0.00 0.0
20000731 20 -3.70 0.00 0.0
20000731 30 -3.55 0.00 0.0
20000731 40 -3.37 0.00 0.0
20000731 50 -3.17 0.00 0.0
20000731 100 -2.94 0.00 0.0
20000731 110 -2.69 0.00 0.0
20000731 120 -2.43 0.00 0.0
20000731 130 -2.14 0.00 0.0
20000731 140 -1.83 0.00 0.0
20000731 150 -1.51 0.00 0.0
20000731 200 -1.18 0.00 0.0
20000731 210 -0.83 0.00 0.0
20000731 220 -0.48 0.00 0.0
20000731 230 -0.12 0.00 0.0
20000731 240 0.25 0.00 0.0
20000731 250 0.62 0.00 0.0
20000731 300 0.99 0.00 0.0
20000731 310 1.35 0.00 0.0
20000731 320 1.71 0.00 0.0
20000731 330 2.05 0.00 0.0
20000731 340 2.39 0.00 0.0
20000731 350 2.71 0.00 0.0
20000731 400 3.01 0.00 0.0
20000731 410 3.30 0.00 0.0
20000731 420 3.56 0.00 0.0
20000731 430 3.79 0.00 0.0
20000731 440 4.00 0.00 0.0
20000731 450 4.19 0.00 0.0
20000731 500 4.34 0.00 0.0
```

Figure 16. Excerpt from the Ilfracombe station “ilf.thp” output file for Test Case 3.

```
ilf
51.2100 355.7000 0.0 22.9
10
DATA FROM THE REGIONAL OCEAN MODEL
DATE TIME HEIGHT SPEED DIREC
20000731 10 -3.522 0.273 45.2
20000731 20 -3.412 0.493 69.6
20000731 30 -3.037 0.532 74.9
20000731 40 -2.768 0.400 82.9
20000731 50 -2.376 0.188 130.9
20000731 100 -2.302 0.102 144.3
20000731 110 -2.347 0.101 39.3
20000731 120 -2.540 0.182 60.0
20000731 130 -2.254 0.259 72.1
20000731 140 -1.811 0.409 77.3
20000731 150 -1.384 0.546 72.0
20000731 200 -1.142 0.587 68.7
20000731 210 -0.989 0.604 66.3
20000731 220 -0.773 0.705 69.3
20000731 230 -0.491 0.762 69.1
20000731 240 -0.185 0.789 68.3
20000731 250 0.088 0.790 65.5
20000731 300 0.335 0.795 65.4
20000731 310 0.636 0.833 67.0
20000731 320 0.944 0.873 67.1
20000731 330 1.251 0.910 66.4
20000731 340 1.500 0.917 65.1
20000731 350 1.668 0.891 64.2
20000731 400 1.872 0.860 65.0
20000731 410 2.187 0.860 66.4
20000731 420 2.499 0.864 65.5
20000731 430 2.657 0.821 63.5
20000731 440 2.732 0.753 63.0
20000731 450 2.864 0.707 64.0
20000731 500 3.068 0.689 65.0
```

Figure 17. Excerpt from the Ilfracombe station “ilf.tsd” output file for Test Case 3 nest case.

It is expected that the higher resolution (nested) case results will compare better to observations than the coarser model results.

4.3.4 Assumptions and Constraints

The successful replication of the PCTides results shown above is, obviously, dependent on the application of identical input data files. It is essential, therefore, that the appropriate files be correctly installed and available to the models.

5.0 Acronyms and Abbreviations

ASA	Applied Sciences Associates
ASCII	American Standard Code for Information Interchange
COAMPS	Coupled Oceanographic and Atmospheric Mesoscale Prediction System
CPU	Central Processing Unit
DAMPS	Distributed Atmospheric Mesoscale Prediction System
DOS	Disk Operating System
E_PAC	Eastern Pacific
FES	Finite Element Solution
GCOM2D	Coastal Ocean Model 2-D
GCOM3D	Coastal Ocean Model 3-D
GEMS	Global Environmental Modeling Services
IEEE	Institute of Electrical and Electronic Engineers
IHO	International Hydrographic Office
MAPS	Mesoscale Atmospheric Prediction System
MB	Megabyte
NAVOCEANO	Naval Oceanographic Office
NOGAPS	Navy Operational Global Atmospheric Prediction System
NRL	Naval Research Laboratory
OAML	Oceanographic and Atmospheric Master Library
PC	Personal Computer
PCTides	Globally Relocatable Navy Tide/Atmosphere Modeling System
RAM	Random Access Memory
R & D	Research and Development
SDD	Software Design Document
SRS	Software Requirements Specification
STD	Software Test Description
UNIX	Workstation Operating System

Appendix A

Topog.dat File Example

```

CHESAP2
68 141 3 40.000 284.000 10.000 36.0000 40.2175 141.0000 4.4000
141
348.98 377.48 433.16 478.79 469.68 399.27 311.10 250.65
217.33 192.43 171.27 155.17 144.16 136.81 131.39 126.89
122.72 120.55 123.17 128.60 134.83 143.98 154.21 163.72
176.47 192.82 205.84 206.87 195.23 180.60 169.20 162.28
166.13 182.23 195.14 187.74 164.01 141.31 125.01 109.25
93.28 82.47 80.87 84.39 84.04 79.33 78.20 85.23
97.01 104.35 101.71 93.15 84.86 78.60 72.40 62.87
49.26 35.77 27.06 24.36 26.18 29.88 34.73 41.96
49.83 53.31 51.06 46.92
140
336.85 366.91 393.64 393.40 352.60 289.02 233.93 203.22
188.98 178.94 169.38 160.75 154.32 149.97 146.00 142.52
141.46 142.91 142.04 134.75 128.78 134.31 146.04 154.12
159.69 166.51 171.56 169.50 160.51 150.12 142.86 140.55
145.23 158.19 175.51 186.59 184.01 173.06 160.51 144.24
122.71 100.85 85.10 77.58 75.14 75.68 79.82 86.58
92.90 95.47 93.25 88.15 81.67 73.25 62.56 51.13
40.07 29.57 21.66 19.28 22.24 27.65 34.73 44.05
52.32 54.44 50.08 42.84
139
332.79 354.83 350.55 313.50 261.95 219.46 196.19 189.11
189.30 189.10 185.70 180.47 176.88 174.22 168.91 164.14
163.81 163.44 155.74 139.49 125.81 127.01 137.27 143.14
143.72 144.70 145.47 142.56 136.25 129.44 125.40 126.26
132.25 144.50 164.15 184.81 195.05 191.94 181.09 165.55
144.49 118.78 93.90 76.71 69.67 70.81 75.78 80.52
83.74 85.38 85.35 82.98 77.00 66.76 53.33 40.23
30.00 22.08 17.12 17.18 21.58 27.51 34.46 43.07
50.29 51.48 46.49 38.72
138
343.20 340.52 306.87 254.70 214.95 199.15 201.57 213.25
224.38 228.16 224.45 217.55 212.29 206.13 194.78 185.62
182.80 177.06 162.74 143.27 127.37 123.76 128.54 130.95
130.01 130.32 130.66 127.80 122.53 117.75 116.42 120.26
129.39 144.97 166.98 189.10 201.57 199.48 186.87 171.42
154.67 132.85 107.16 85.31 73.32 70.70 71.95 72.86
74.32 77.40 79.68 77.20 68.71 56.30 42.25 29.47
20.66 16.02 15.45 18.92 24.67 30.20 34.97 40.42
45.42 45.94 41.35 34.73
137
359.70 318.70 268.05 225.06 207.96 215.69 239.98 268.82
285.13 282.17 268.31 252.92 238.87 222.60 203.30 189.57
183.40 175.59 161.85 145.52 132.19 126.10 124.86 123.52
122.75 124.50 125.10 121.04 114.97 111.56 113.12 119.67
131.81 151.48 176.03 196.96 206.36 200.56 183.32 165.26
152.10 138.50 119.58 100.21 87.87 83.21 80.59 76.33
73.14 73.92 74.53 68.30 55.62 41.81 29.48 19.99
14.89 13.99 16.51 21.82 28.28 33.15 35.51 38.05
41.30 41.27 36.96 31.45
136
343.44 283.49 237.90 217.88 227.80 263.14 310.54 347.12
351.22 325.25 291.18 262.63 237.99 212.90 189.77 174.42
166.83 161.57 154.09 144.86 138.01 134.47 131.21 126.05
120.87 119.14 118.74 115.29 110.82 109.98 114.08 122.29
135.46 155.50 179.32 198.27 204.18 193.97 172.62 152.21
141.14 135.02 125.29 112.66 103.85 99.84 95.22 86.49
76.70 70.11 64.10 53.08 38.78 27.08 19.33 14.58
12.86 13.87 17.03 22.29 28.54 32.68 33.76 35.36
38.46 38.71 34.57 28.94

```

Appendix B

Test Case 1 Model Output Data

The following figures represent the first thirty lines of code from the “.thp” and “.tsd” files generated by the PCTides test run without winds, Test Case 1.

Station 1: Duck

portsmouth_elizabeth river
36.6667 283.7000 0.0 0.0

12

Tide table tidal constituents

DATE	TIME	HEIGHT	SPEED	DIREC
20000731	0	0.37	0.00	0.0
20000731	12	0.42	0.00	0.0
20000731	24	0.46	0.00	0.0
20000731	36	0.50	0.00	0.0
20000731	48	0.53	0.00	0.0
20000731	100	0.56	0.00	0.0
20000731	112	0.58	0.00	0.0
20000731	124	0.60	0.00	0.0
20000731	136	0.61	0.00	0.0
20000731	148	0.62	0.00	0.0
20000731	200	0.62	0.00	0.0
20000731	212	0.62	0.00	0.0
20000731	224	0.60	0.00	0.0
20000731	236	0.59	0.00	0.0
20000731	248	0.57	0.00	0.0
20000731	300	0.54	0.00	0.0
20000731	312	0.51	0.00	0.0
20000731	324	0.47	0.00	0.0
20000731	336	0.43	0.00	0.0
20000731	348	0.39	0.00	0.0
20000731	400	0.34	0.00	0.0
20000731	412	0.29	0.00	0.0
20000731	424	0.23	0.00	0.0
20000731	436	0.18	0.00	0.0
20000731	448	0.12	0.00	0.0
20000731	500	0.06	0.00	0.0
20000731	512	0.00	0.00	0.0
20000731	524	-0.05	0.00	0.0
20000731	536	-0.11	0.00	0.0
20000731	548	-0.17	0.00	0.0

duc

36.1833 284.2534 0.0 8.9

12

DATA FROM THE REGIONAL OCEAN MODEL

DATE	TIME	HEIGHT	SPEED	DIREC
20000731	0	0.896	0.177	274.7
20000731	12	0.890	0.158	276.8
20000731	24	0.877	0.137	279.8
20000731	36	0.856	0.116	284.1
20000731	48	0.828	0.095	290.5
20000731	100	0.793	0.075	300.9
20000731	112	0.752	0.059	318.4
20000731	124	0.705	0.051	345.8
20000731	136	0.652	0.056	15.9
20000731	148	0.594	0.074	37.2
20000731	200	0.531	0.098	50.0
20000731	212	0.463	0.125	58.0
20000731	224	0.390	0.152	63.4
20000731	236	0.313	0.178	67.3
20000731	248	0.231	0.202	70.4
20000731	300	0.147	0.223	72.9
20000731	312	0.061	0.241	74.9
20000731	324	-0.026	0.255	76.6
20000731	336	-0.110	0.266	78.1
20000731	348	-0.192	0.274	79.3
20000731	400	-0.270	0.280	80.3
20000731	412	-0.343	0.283	81.1
20000731	424	-0.412	0.284	81.7
20000731	436	-0.475	0.283	82.2
20000731	448	-0.533	0.279	82.6
20000731	500	-0.584	0.274	83.1
20000731	512	-0.629	0.265	83.6
20000731	524	-0.667	0.255	84.0
20000731	536	-0.698	0.244	84.5
20000731	548	-0.722	0.230	84.9

Figure B-1. Excerpt from “duc.thp” file for Test Case 1. Station is Portsmouth-Elizabeth River, NC, USA.

Figure B-2. Excerpt from “duc.tsd” file for Test Case 1. Station is Duck, NC, USA.

Station 2: Sewell's Point

```
old point comfort
37.0000 283.7000 0.0 4.7
12
Tide table tidal constituents
DATE TIME HEIGHT SPEED DIREC
20000731 0 0.46 0.00 0.0
20000731 12 0.49 0.00 0.0
20000731 24 0.52 0.00 0.0
20000731 36 0.54 0.00 0.0
20000731 48 0.55 0.00 0.0
20000731 100 0.56 0.00 0.0
20000731 112 0.56 0.00 0.0
20000731 124 0.56 0.00 0.0
20000731 136 0.56 0.00 0.0
20000731 148 0.55 0.00 0.0
20000731 200 0.53 0.00 0.0
20000731 212 0.51 0.00 0.0
20000731 224 0.48 0.00 0.0
20000731 236 0.45 0.00 0.0
20000731 248 0.42 0.00 0.0
20000731 300 0.38 0.00 0.0
20000731 312 0.34 0.00 0.0
20000731 324 0.29 0.00 0.0
20000731 336 0.25 0.00 0.0
20000731 348 0.20 0.00 0.0
20000731 400 0.14 0.00 0.0
20000731 412 0.09 0.00 0.0
20000731 424 0.04 0.00 0.0
20000731 436 -0.01 0.00 0.0
20000731 448 -0.07 0.00 0.0
20000731 500 -0.12 0.00 0.0
20000731 512 -0.17 0.00 0.0
20000731 524 -0.22 0.00 0.0
20000731 536 -0.26 0.00 0.0
20000731 548 -0.30 0.00 0.0
```

Figure B-3. Excerpt from “sew.thp” file for Test Case 1. Station Old Point Comfort, VA, USA.

```
sew
36.9467 283.6700 0.0 3.5
12
DATA FROM THE REGIONAL OCEAN MODEL
DATE TIME HEIGHT SPEED DIREC
20000731 0 0.408 0.172 307.5
20000731 12 0.438 0.172 307.5
20000731 24 0.463 0.172 307.5
20000731 36 0.484 0.170 307.3
20000731 48 0.499 0.166 306.7
20000731 100 0.509 0.161 305.4
20000731 112 0.515 0.156 303.7
20000731 124 0.516 0.152 301.7
20000731 136 0.512 0.147 299.0
20000731 148 0.504 0.142 295.7
20000731 200 0.491 0.136 292.1
20000731 212 0.473 0.131 288.3
20000731 224 0.451 0.125 283.7
20000731 236 0.425 0.119 278.4
20000731 248 0.395 0.112 272.4
20000731 300 0.362 0.106 266.0
20000731 312 0.326 0.100 258.7
20000731 324 0.288 0.093 249.9
20000731 336 0.247 0.087 239.3
20000731 348 0.206 0.082 226.6
20000731 400 0.164 0.077 211.6
20000731 412 0.121 0.075 194.1
20000731 424 0.076 0.079 175.8
20000731 436 0.030 0.088 159.8
20000731 448 -0.018 0.101 148.2
20000731 500 -0.067 0.115 140.8
20000731 512 -0.115 0.128 136.7
20000731 524 -0.163 0.139 134.7
20000731 536 -0.208 0.147 134.0
20000731 548 -0.251 0.153 134.2
```

Figure B-4. Excerpt from “sew.tsd” file for Test Case 1. Station is Sewell’s Point, VA, USA.

Station 3: Chesapeake

```
virginia beach
 36.8333 284.0333 0.0 6.1
12
Tide table tidal constituents
  DATE    TIME  HEIGHT  SPEED  DIREC
20000731    0   0.77   0.00   0.0
20000731   12   0.77   0.00   0.0
20000731   24   0.77   0.00   0.0
20000731   36   0.75   0.00   0.0
20000731   48   0.73   0.00   0.0
20000731  100   0.70   0.00   0.0
20000731  112   0.67   0.00   0.0
20000731  124   0.63   0.00   0.0
20000731  136   0.58   0.00   0.0
20000731  148   0.53   0.00   0.0
20000731  200   0.48   0.00   0.0
20000731  212   0.42   0.00   0.0
20000731  224   0.36   0.00   0.0
20000731  236   0.29   0.00   0.0
20000731  248   0.22   0.00   0.0
20000731  300   0.15   0.00   0.0
20000731  312   0.08   0.00   0.0
20000731  324   0.01   0.00   0.0
20000731  336  -0.06   0.00   0.0
20000731  348  -0.13   0.00   0.0
20000731  400  -0.19   0.00   0.0
20000731  412  -0.26   0.00   0.0
20000731  424  -0.32   0.00   0.0
20000731  436  -0.38   0.00   0.0
20000731  448  -0.43   0.00   0.0
20000731  500  -0.48   0.00   0.0
20000731  512  -0.52   0.00   0.0
20000731  524  -0.56   0.00   0.0
20000731  536  -0.59   0.00   0.0
20000731  548  -0.61   0.00   0.0
```

Figure B-5. Excerpt from “che.thp” file for Test Case 1. Station is Virginia Beach, VA, USA.

```
che
 36.9667 283.8870 0.0 7.7
12
DATA FROM THE REGIONAL OCEAN MODEL
  DATE    TIME  HEIGHT  SPEED  DIREC
20000731    0   0.569   0.516 269.4
20000731   12   0.593   0.509 268.4
20000731   24   0.611   0.500 267.5
20000731   36   0.624   0.488 266.4
20000731   48   0.631   0.473 265.3
20000731  100   0.634   0.456 264.1
20000731  112   0.631   0.436 262.8
20000731  124   0.623   0.414 261.2
20000731  136   0.609   0.389 259.6
20000731  148   0.589   0.362 257.8
20000731  200   0.564   0.332 255.6
20000731  212   0.533   0.300 253.1
20000731  224   0.496   0.266 249.9
20000731  236   0.454   0.231 245.7
20000731  248   0.408   0.194 239.6
20000731  300   0.358   0.158 230.3
20000731  312   0.305   0.126 215.4
20000731  324   0.247   0.106 191.6
20000731  336   0.187   0.108 162.5
20000731  348   0.125   0.133 139.5
20000731  400   0.064   0.169 125.3
20000731  412   0.005   0.209 116.6
20000731  424  -0.051   0.248 110.9
20000731  436  -0.104   0.286 106.8
20000731  448  -0.154   0.320 103.6
20000731  500  -0.202   0.350 101.1
20000731  512  -0.248   0.375  99.0
20000731  524  -0.293   0.395  97.1
20000731  536  -0.336   0.410  95.5
20000731  548  -0.375   0.421  93.8
```

Figure B-6. Excerpt from “che.tsd” file for Test Case 1. Station is Chesapeake, VA, USA.

Station 4: Windmill Point

stingray point light
37.5667 283.7333 0.0 6.5

12

Tide table tidal constituents

DATE	TIME	HEIGHT	SPEED	DIREC
20000731	0	0.05	0.00	0.0
20000731	12	0.07	0.00	0.0
20000731	24	0.09	0.00	0.0
20000731	36	0.11	0.00	0.0
20000731	48	0.13	0.00	0.0
20000731	100	0.15	0.00	0.0
20000731	112	0.17	0.00	0.0
20000731	124	0.19	0.00	0.0
20000731	136	0.20	0.00	0.0
20000731	148	0.21	0.00	0.0
20000731	200	0.22	0.00	0.0
20000731	212	0.23	0.00	0.0
20000731	224	0.24	0.00	0.0
20000731	236	0.24	0.00	0.0
20000731	248	0.24	0.00	0.0
20000731	300	0.24	0.00	0.0
20000731	312	0.24	0.00	0.0
20000731	324	0.24	0.00	0.0
20000731	336	0.23	0.00	0.0
20000731	348	0.22	0.00	0.0
20000731	400	0.21	0.00	0.0
20000731	412	0.19	0.00	0.0
20000731	424	0.18	0.00	0.0
20000731	436	0.16	0.00	0.0
20000731	448	0.14	0.00	0.0
20000731	500	0.12	0.00	0.0
20000731	512	0.10	0.00	0.0
20000731	524	0.08	0.00	0.0
20000731	536	0.06	0.00	0.0
20000731	548	0.04	0.00	0.0

Figure B-7. Excerpt from “wdm.thp” file for Test Case 1. Station is Stingray Point Light, VA, USA.

wdm
37.6150 283.7100 0.0 6.4

12

DATA FROM THE REGIONAL OCEAN MODEL

DATE	TIME	HEIGHT	SPEED	DIREC
20000731	0	0.011	0.160	357.3
20000731	12	0.038	0.178	2.2
20000731	24	0.060	0.192	6.7
20000731	36	0.077	0.206	10.9
20000731	48	0.095	0.216	14.2
20000731	100	0.113	0.224	16.5
20000731	112	0.129	0.232	18.0
20000731	124	0.143	0.240	18.9
20000731	136	0.156	0.246	19.5
20000731	148	0.171	0.247	19.8
20000731	200	0.185	0.246	20.3
20000731	212	0.197	0.243	20.9
20000731	224	0.208	0.238	21.7
20000731	236	0.215	0.231	22.6
20000731	248	0.220	0.224	23.5
20000731	300	0.223	0.214	24.4
20000731	312	0.224	0.204	25.2
20000731	324	0.223	0.191	26.2
20000731	336	0.221	0.177	27.3
20000731	348	0.217	0.161	28.7
20000731	400	0.210	0.144	30.5
20000731	412	0.202	0.126	33.0
20000731	424	0.191	0.107	36.4
20000731	436	0.179	0.086	41.6
20000731	448	0.166	0.066	50.1
20000731	500	0.152	0.048	66.6
20000731	512	0.137	0.038	99.1
20000731	524	0.120	0.044	136.5
20000731	536	0.101	0.065	158.1
20000731	548	0.074	0.090	169.2

Figure B-8. Excerpt from “wdm.tsd” file for Test Case 1. Station is Windmill Point, VA, USA.

Station 5: Baltimore

```
love point light
 39.0500 283.7167    0.0    6.1
12
Tide table tidal constituents
  DATE    TIME HEIGHT  SPEED  DIREC
20000731    0   0.04   0.00   0.0
20000731   12   0.02   0.00   0.0
20000731   24   0.01   0.00   0.0
20000731   36  -0.01   0.00   0.0
20000731   48  -0.02   0.00   0.0
20000731  100  -0.04   0.00   0.0
20000731  112  -0.06   0.00   0.0
20000731  124  -0.08   0.00   0.0
20000731  136  -0.10   0.00   0.0
20000731  148  -0.11   0.00   0.0
20000731  200  -0.13   0.00   0.0
20000731  212  -0.15   0.00   0.0
20000731  224  -0.16   0.00   0.0
20000731  236  -0.18   0.00   0.0
20000731  248  -0.19   0.00   0.0
20000731  300  -0.21   0.00   0.0
20000731  312  -0.22   0.00   0.0
20000731  324  -0.23   0.00   0.0
20000731  336  -0.24   0.00   0.0
20000731  348  -0.24   0.00   0.0
20000731  400  -0.25   0.00   0.0
20000731  412  -0.25   0.00   0.0
20000731  424  -0.25   0.00   0.0
20000731  436  -0.25   0.00   0.0
20000731  448  -0.24   0.00   0.0
20000731  500  -0.24   0.00   0.0
20000731  512  -0.23   0.00   0.0
20000731  524  -0.22   0.00   0.0
20000731  536  -0.20   0.00   0.0
20000731  548  -0.19   0.00   0.0
```

Figure B-9. Excerpt from "bal.thp" file for Test Case 1. Station is Love Point Light, MD, USA.

```
bal
 39.1500 283.6000    0.0    4.4
12
DATA FROM THE REGIONAL OCEAN MODEL
  DATE    TIME HEIGHT  SPEED  DIREC
20000731    0   0.596   0.743  130.8
20000731   12   0.607   0.757  130.8
20000731   24   0.610   0.766  130.9
20000731   36   0.607   0.770  130.9
20000731   48   0.597   0.770  130.8
20000731  100   0.577   0.766  130.7
20000731  112   0.548   0.757  130.6
20000731  124   0.508   0.740  130.5
20000731  136   0.453   0.714  130.2
20000731  148   0.383   0.682  129.8
20000731  200   0.308   0.640  129.3
20000731  212   0.203   0.585  128.9
20000731  224   0.101   0.522  129.4
20000731  236  -0.005   0.444  130.6
20000731  248  -0.109   0.352  132.6
20000731  300  -0.212   0.246  137.3
20000731  312  -0.318   0.122  154.4
20000731  324  -0.426   0.092  259.8
20000731  336  -0.531   0.256  289.8
20000731  348  -0.617   0.405  296.1
20000731  400  -0.691   0.517  299.1
20000731  412  -0.751   0.603  301.5
20000731  424  -0.803   0.675  304.1
20000731  436  -0.860   0.737  306.2
20000731  448  -0.924   0.793  307.6
20000731  500  -0.994   0.843  308.3
20000731  512  -1.069   0.890  308.7
20000731  524  -1.144   0.933  308.9
20000731  536  -1.217   0.973  309.0
20000731  548  -1.286   1.009  309.1
```

Figure B-10. Excerpt from "bal.tsd" file for Test Case 1. Station is Baltimore, MD, USA.

Station 6: Solomon's Island

Solomon's island
38.3167 283.5500 0.0 0.0

12

Tide table tidal constituents

DATE	TIME	HEIGHT	SPEED	DIREC
20000731	0	-0.23	0.00	0.0
20000731	12	-0.23	0.00	0.0
20000731	24	-0.23	0.00	0.0
20000731	36	-0.23	0.00	0.0
20000731	48	-0.22	0.00	0.0
20000731	100	-0.22	0.00	0.0
20000731	112	-0.21	0.00	0.0
20000731	124	-0.20	0.00	0.0
20000731	136	-0.18	0.00	0.0
20000731	148	-0.17	0.00	0.0
20000731	200	-0.15	0.00	0.0
20000731	212	-0.13	0.00	0.0
20000731	224	-0.11	0.00	0.0
20000731	236	-0.09	0.00	0.0
20000731	248	-0.07	0.00	0.0
20000731	300	-0.05	0.00	0.0
20000731	312	-0.02	0.00	0.0
20000731	324	0.00	0.00	0.0
20000731	336	0.02	0.00	0.0
20000731	348	0.05	0.00	0.0
20000731	400	0.07	0.00	0.0
20000731	412	0.09	0.00	0.0
20000731	424	0.12	0.00	0.0
20000731	436	0.14	0.00	0.0
20000731	448	0.16	0.00	0.0
20000731	500	0.18	0.00	0.0
20000731	512	0.19	0.00	0.0
20000731	524	0.21	0.00	0.0
20000731	536	0.22	0.00	0.0
20000731	548	0.23	0.00	0.0

Figure B-11. Excerpt from "sol.thp" file for Test Case 1. Station is Solomon's Island, Maryland, USA.

sol
38.3200 283.6150 0.0 8.3

12

DATA FROM THE REGIONAL OCEAN MODEL

DATE	TIME	HEIGHT	SPEED	DIREC
20000731	0	-0.202	0.125	177.4
20000731	12	-0.205	0.121	180.0
20000731	24	-0.206	0.116	182.9
20000731	36	-0.207	0.109	185.9
20000731	48	-0.207	0.099	189.6
20000731	100	-0.204	0.089	195.0
20000731	112	-0.197	0.082	202.3
20000731	124	-0.186	0.076	211.3
20000731	136	-0.173	0.071	222.0
20000731	148	-0.158	0.067	234.8
20000731	200	-0.143	0.066	249.8
20000731	212	-0.129	0.069	266.5
20000731	224	-0.117	0.077	283.1
20000731	236	-0.107	0.090	296.8
20000731	248	-0.097	0.107	306.7
20000731	300	-0.082	0.124	313.6
20000731	312	-0.065	0.140	318.2
20000731	324	-0.049	0.153	321.5
20000731	336	-0.030	0.165	324.1
20000731	348	-0.010	0.174	326.4
20000731	400	0.011	0.182	328.4
20000731	412	0.032	0.188	330.3
20000731	424	0.053	0.191	331.7
20000731	436	0.073	0.195	333.4
20000731	448	0.091	0.201	336.1
20000731	500	0.105	0.208	338.9
20000731	512	0.115	0.213	341.1
20000731	524	0.125	0.215	342.8
20000731	536	0.136	0.215	344.4
20000731	548	0.147	0.212	346.0

Figure B-12. Excerpt from "sol.tsd" file for Test Case 1. Station is Solomon's Island, Maryland, USA.

Station 7: Lewes

breakwater harbour
38.7833 284.9000 0.0 11.2

12

Tide table tidal constituents

DATE	TIME	HEIGHT	SPEED	DIREC
20000731	0	0.90	0.00	0.0
20000731	12	0.93	0.00	0.0
20000731	24	0.96	0.00	0.0
20000731	36	0.98	0.00	0.0
20000731	48	0.98	0.00	0.0
20000731	100	0.98	0.00	0.0
20000731	112	0.98	0.00	0.0
20000731	124	0.96	0.00	0.0
20000731	136	0.93	0.00	0.0
20000731	148	0.90	0.00	0.0
20000731	200	0.86	0.00	0.0
20000731	212	0.81	0.00	0.0
20000731	224	0.75	0.00	0.0
20000731	236	0.69	0.00	0.0
20000731	248	0.62	0.00	0.0
20000731	300	0.55	0.00	0.0
20000731	312	0.47	0.00	0.0
20000731	324	0.39	0.00	0.0
20000731	336	0.31	0.00	0.0
20000731	348	0.22	0.00	0.0
20000731	400	0.13	0.00	0.0
20000731	412	0.05	0.00	0.0
20000731	424	-0.04	0.00	0.0
20000731	436	-0.13	0.00	0.0
20000731	448	-0.21	0.00	0.0
20000731	500	-0.29	0.00	0.0
20000731	512	-0.37	0.00	0.0
20000731	524	-0.44	0.00	0.0
20000731	536	-0.51	0.00	0.0
20000731	548	-0.57	0.00	0.0

Figure B-13. Excerpt from "lew.thp" file for Test Case 1. Station is Breakwater Harbour, DE, USA.

lew
38.7800 284.8800 0.0 7.5

12

DATA FROM THE REGIONAL OCEAN MODEL

DATE	TIME	HEIGHT	SPEED	DIREC
20000731	0	0.842	0.398	291.8
20000731	12	0.877	0.391	289.6
20000731	24	0.905	0.381	287.4
20000731	36	0.924	0.370	285.2
20000731	48	0.936	0.358	282.9
20000731	100	0.939	0.344	280.7
20000731	112	0.934	0.328	278.5
20000731	124	0.922	0.312	276.3
20000731	136	0.901	0.293	274.0
20000731	148	0.872	0.273	271.3
20000731	200	0.834	0.250	268.3
20000731	212	0.790	0.224	264.7
20000731	224	0.738	0.197	260.1
20000731	236	0.679	0.166	254.7
20000731	248	0.614	0.134	248.2
20000731	300	0.545	0.104	240.3
20000731	312	0.472	0.080	225.7
20000731	324	0.396	0.070	198.1
20000731	336	0.317	0.078	168.2
20000731	348	0.235	0.102	148.8
20000731	400	0.153	0.137	138.8
20000731	412	0.072	0.178	134.4
20000731	424	-0.007	0.220	133.3
20000731	436	-0.079	0.253	132.0
20000731	448	-0.155	0.281	128.9
20000731	500	-0.237	0.305	128.1
20000731	512	-0.310	0.326	127.8
20000731	524	-0.379	0.344	126.5
20000731	536	-0.444	0.362	123.6
20000731	548	-0.507	0.371	121.1

Figure B-14. Excerpt from "lew.tsd" file for Test Case 1. Station is Lewes, DE, USA.

Test Case 2 Model Output Data

The following figures represent the first thirty lines of code from the “.thp” and “.tsd” files generated by the PCTides test run with winds, Test Case 2.

Station 1: Port Angeles

```
port angeles
  48.1333  236.5667    0.0  10.6
12
Tide table tidal constituents
  DATE    TIME HEIGHT  SPEED  DIREC
20020208    0  -1.12    0.00    0.0
20020208   12  -1.19    0.00    0.0
20020208   24  -1.25    0.00    0.0
20020208   36  -1.30    0.00    0.0
20020208   48  -1.35    0.00    0.0
20020208  100  -1.39    0.00    0.0
20020208  112  -1.42    0.00    0.0
20020208  124  -1.45    0.00    0.0
20020208  136  -1.46    0.00    0.0
20020208  148  -1.47    0.00    0.0
20020208  200  -1.48    0.00    0.0
20020208  212  -1.47    0.00    0.0
20020208  224  -1.46    0.00    0.0
20020208  236  -1.44    0.00    0.0
20020208  248  -1.42    0.00    0.0
20020208  300  -1.39    0.00    0.0
20020208  312  -1.35    0.00    0.0
20020208  324  -1.30    0.00    0.0
20020208  336  -1.25    0.00    0.0
20020208  348  -1.19    0.00    0.0
20020208  400  -1.13    0.00    0.0
20020208  412  -1.07    0.00    0.0
20020208  424  -1.00    0.00    0.0
20020208  436  -0.92    0.00    0.0
20020208  448  -0.85    0.00    0.0
20020208  500  -0.77    0.00    0.0
20020208  512  -0.69    0.00    0.0
20020208  524  -0.61    0.00    0.0
20020208  536  -0.52    0.00    0.0
20020208  548  -0.44    0.00    0.0
```

Figure B-15. Excerpt from “ang.thp” file for Test Case 2. Station is Port Angeles, Washington, USA.

```
ang
  48.1850  236.5700    0.0  113.3
12
DATA FROM THE REGIONAL OCEAN MODEL
  DATE    TIME HEIGHT  SPEED  DIREC
20020208    0 -1.078    0.667  277.3
20020208   12 -1.137    0.660  277.2
20020208   24 -1.189    0.649  277.2
20020208   36 -1.235    0.633  277.2
20020208   48 -1.273    0.611  277.1
20020208  100 -1.305    0.584  277.1
20020208  112 -1.332    0.556  277.1
20020208  124 -1.354    0.526  277.1
20020208  136 -1.367    0.492  277.1
20020208  148 -1.369    0.453  277.1
20020208  200 -1.368    0.411  277.1
20020208  212 -1.360    0.367  277.0
20020208  224 -1.346    0.322  277.0
20020208  236 -1.325    0.275  277.1
20020208  248 -1.298    0.225  277.3
20020208  300 -1.266    0.174  277.6
20020208  312 -1.230    0.123  278.3
20020208  324 -1.189    0.071  279.7
20020208  336 -1.143    0.019  289.7
20020208  348 -1.091    0.035  88.3
20020208  400 -1.035    0.089  92.4
20020208  412 -0.980    0.142  93.3
20020208  424 -0.922    0.192  93.5
20020208  436 -0.861    0.241  93.6
20020208  448 -0.802    0.286  93.6
20020208  500 -0.735    0.330  93.7
20020208  512 -0.666    0.371  93.7
20020208  524 -0.598    0.409  93.6
20020208  536 -0.531    0.441  93.5
20020208  548 -0.465    0.468  93.3
```

Figure B-16. Excerpt from “ang.tsd” file for Test Case 2. Station is Port Angeles, Washington, USA.

Test Case 3 Model Output Data

The following figures represent the first thirty lines of code from the “.thp” and “.tsd” files generated for the stations included in the coarse resolution portion of Test Case 3.

Station 1: Aberdeen

```

aberddeen
  57.1500  357.9167    0.0  17.4
Tide table tidal constituents
  DATE    TIME  HEIGHT  SPEED  DIREC
20000731    0    1.81    0.00    0.0
20000731   12    1.88    0.00    0.0
20000731   24    1.93    0.00    0.0
20000731   36    1.97    0.00    0.0
20000731   48    1.99    0.00    0.0
20000731  100    1.98    0.00    0.0
20000731  112    1.96    0.00    0.0
20000731  124    1.92    0.00    0.0
20000731  136    1.86    0.00    0.0
20000731  148    1.79    0.00    0.0
20000731  200    1.69    0.00    0.0
20000731  212    1.58    0.00    0.0
20000731  224    1.45    0.00    0.0
20000731  236    1.31    0.00    0.0
20000731  248    1.16    0.00    0.0
20000731  300    1.00    0.00    0.0
20000731  312    0.82    0.00    0.0
20000731  324    0.64    0.00    0.0
20000731  336    0.45    0.00    0.0
20000731  348    0.26    0.00    0.0
20000731  400    0.06    0.00    0.0
20000731  412   -0.13    0.00    0.0
20000731  424   -0.33    0.00    0.0
20000731  436   -0.52    0.00    0.0
20000731  448   -0.71    0.00    0.0
20000731  500   -0.88    0.00    0.0
20000731  512   -1.05    0.00    0.0
20000731  524   -1.21    0.00    0.0
20000731  536   -1.36    0.00    0.0
20000731  548   -1.49    0.00    0.0

```

Figure B-17. Excerpt from “abe_c.thp” file for Test Case 3. Station is Aberdeen, UK.

```

abe
  57.1450  357.9202    0.0    7.0
DATA FROM THE REGIONAL OCEAN MODEL
  DATE    TIME  HEIGHT  SPEED  DIREC
20000731    0    1.491    0.209  272.2
20000731   12    1.535    0.198  281.0
20000731   24    1.567    0.190  290.3
20000731   36    1.581    0.184  300.9
20000731   48    1.582    0.184  311.7
20000731  100    1.567    0.190  322.1
20000731  112    1.539    0.199  331.9
20000731  124    1.495    0.212  341.0
20000731  136    1.436    0.228  349.4
20000731  148    1.360    0.246  357.0
20000731  200    1.271    0.263    3.5
20000731  212    1.171    0.280    9.0
20000731  224    1.061    0.296   13.7
20000731  236    0.943    0.310   17.7
20000731  248    0.814    0.324   21.4
20000731  300    0.675    0.338   25.1
20000731  312    0.527    0.352   28.7
20000731  324    0.374    0.361   32.5
20000731  336    0.217    0.364   36.6
20000731  348    0.056    0.366   41.0
20000731  400   -0.107    0.367   45.6
20000731  412   -0.271    0.366   50.6
20000731  424   -0.435    0.365   55.8
20000731  436   -0.596    0.365   61.0
20000731  448   -0.749    0.363   66.1
20000731  500   -0.894    0.360   70.9
20000731  512   -1.029    0.356   75.7
20000731  524   -1.154    0.352   80.6
20000731  536   -1.268    0.348   85.0
20000731  548   -1.370    0.343   89.4

```

Figure B-18. Excerpt from “abe_c.tsd ” file for Test Case 3. Station is Aberdeen, UK.

Station 2: Dover

```

folkestone
51.0833 1.1833 0.0 0.0
Tide table tidal constituents
DATE TIME HEIGHT SPEED DIREC
20000731 0 2.54 0.00 0.0
20000731 12 2.36 0.00 0.0
20000731 24 2.16 0.00 0.0
20000731 36 1.96 0.00 0.0
20000731 48 1.75 0.00 0.0
20000731 100 1.53 0.00 0.0
20000731 112 1.31 0.00 0.0
20000731 124 1.09 0.00 0.0
20000731 136 0.86 0.00 0.0
20000731 148 0.63 0.00 0.0
20000731 200 0.40 0.00 0.0
20000731 212 0.17 0.00 0.0
20000731 224 -0.06 0.00 0.0
20000731 236 -0.30 0.00 0.0
20000731 248 -0.54 0.00 0.0
20000731 300 -0.79 0.00 0.0
20000731 312 -1.04 0.00 0.0
20000731 324 -1.28 0.00 0.0
20000731 336 -1.53 0.00 0.0
20000731 348 -1.78 0.00 0.0
20000731 400 -2.02 0.00 0.0
20000731 412 -2.26 0.00 0.0
20000731 424 -2.48 0.00 0.0
20000731 436 -2.69 0.00 0.0
20000731 448 -2.89 0.00 0.0
20000731 500 -3.06 0.00 0.0
20000731 512 -3.20 0.00 0.0
20000731 524 -3.31 0.00 0.0
20000731 536 -3.39 0.00 0.0
20000731 548 -3.43 0.00 0.0

```

Figure B-19. Excerpt from “dov_c.thp” file for Test Case 3. Station is Folkstone, UK.

```

dov
51.0400 1.3000 0.0 5.9
12 DATA FROM THE REGIONAL OCEAN MODEL
DATE TIME HEIGHT SPEED DIREC
20000731 0 0.653 0.000 1.8
20000731 12 0.612 0.000 1.8
20000731 24 0.570 0.000 1.8
20000731 36 0.514 0.000 1.8
20000731 48 0.461 0.000 1.8
20000731 100 0.000 0.000 1.8
20000731 112 0.358 0.000 1.8
20000731 124 0.306 0.000 1.8
20000731 136 0.256 0.000 1.8
20000731 148 0.204 0.000 1.8
20000731 200 0.000 0.000 1.8
20000731 212 0.087 0.000 1.8
20000731 224 0.021 0.000 1.8
20000731 236 -0.049 0.000 1.8
20000731 248 -0.125 0.000 1.8
20000731 300 0.000 0.000 1.8
20000731 312 -0.289 0.000 1.8
20000731 324 -0.372 0.000 1.8
20000731 336 -0.453 0.000 1.8
20000731 348 -0.533 0.000 1.8
20000731 400 0.000 0.000 1.8
20000731 412 -0.688 0.000 1.8
20000731 424 -0.761 0.000 1.8
20000731 436 -0.828 0.000 1.8
20000731 448 -0.889 0.000 1.8
20000731 500 0.000 0.000 1.8
20000731 512 -0.984 0.000 1.8
20000731 524 -1.016 0.000 1.8
20000731 536 -1.035 0.000 1.8
20000731 548 -1.041 0.000 1.8

```

Figure B-20. Excerpt from “dov_c.tsd ” file for Test Case 3. Station is Dover, UK.

Station 3: Heysham

```

barrow in furness
  54.1000  356.8000    0.0    0.0
Tide table tidal constituents
  DATE    TIME HEIGHT  SPEED  DIREC
20000731    0   3.77   0.00   0.0
20000731   12   3.50   0.00   0.0
20000731   24   3.21   0.00   0.0
20000731   36   2.88   0.00   0.0
20000731   48   2.54   0.00   0.0
20000731  100   2.18   0.00   0.0
20000731  112   1.81   0.00   0.0
20000731  124   1.43   0.00   0.0
20000731  136   1.04   0.00   0.0
20000731  148   0.66   0.00   0.0
20000731  200   0.27   0.00   0.0
20000731  212  -0.11   0.00   0.0
20000731  224  -0.48   0.00   0.0
20000731  236  -0.84   0.00   0.0
20000731  248  -1.19   0.00   0.0
20000731  300  -1.53   0.00   0.0
20000731  312  -1.85   0.00   0.0
20000731  324  -2.16   0.00   0.0
20000731  336  -2.45   0.00   0.0
20000731  348  -2.72   0.00   0.0
20000731  400  -2.97   0.00   0.0
20000731  412  -3.20   0.00   0.0
20000731  424  -3.40   0.00   0.0
20000731  436  -3.58   0.00   0.0
20000731  448  -3.72   0.00   0.0
20000731  500  -3.84   0.00   0.0
20000731  512  -3.93   0.00   0.0
20000731  524  -3.98   0.00   0.0
20000731  536  -3.99   0.00   0.0
20000731  548  -3.97   0.00   0.0

```

Figure B-21. Excerpt from "hey_c.thp" file for Test Case 3. Station is Barrow-in-Furness, UK.

```

12 hey
  54.0300  356.6000    0.0   11.2
DATA FROM THE REGIONAL OCEAN MODEL
  DATE    TIME HEIGHT  SPEED  DIREC
20000731    0   2.782  0.000  359.8
20000731   12   2.581  0.000  359.8
20000731   24   2.361  0.000  359.8
20000731   36   2.126  0.000  359.8
20000731   48   1.876  0.000  359.8
20000731  100   1.616  0.000  359.8
20000731  112   1.347  0.000  359.8
20000731  124   1.072  0.000  359.8
20000731  136   0.791  0.000  359.8
20000731  148   0.508  0.000  359.8
20000731  200   0.224  0.000  359.8
20000731  212  -0.057  0.000  359.8
20000731  224  -0.335  0.000  359.8
20000731  236  -0.608  0.000  359.8
20000731  248  -0.877  0.000  359.8
20000731  300  -1.141  0.000  359.8
20000731  312  -1.400  0.000  359.8
20000731  324  -1.650  0.000  359.8
20000731  336  -1.892  0.000  359.8
20000731  348  -2.122  0.000  359.8
20000731  400  -2.338  0.000  359.8
20000731  412  -2.537  0.000  359.8
20000731  424  -2.719  0.000  359.8
20000731  436  -2.880  0.000  359.8
20000731  448  -3.018  0.000  359.8
20000731  500  -3.131  0.000  359.8
20000731  512  -3.215  0.000  359.8
20000731  524  -3.270  0.000  359.8
20000731  536  -3.293  0.000  359.8
20000731  548  -3.284  0.000  359.8

```

Figure B-22. Excerpt from "hey_c.tsd" file for Test Case 3. Station is Heysham, UK.

Station 4: Immingham

```
hull saltend
53.7333 359.7500 0.0 4.0
Tide table tidal constituents
DATE TIME HEIGHT SPEED DIREC
20000731 0 -2.88 0.00 0.0
20000731 12 -2.83 0.00 0.0
20000731 24 -2.74 0.00 0.0
20000731 36 -2.62 0.00 0.0
20000731 48 -2.48 0.00 0.0
20000731 100 -2.31 0.00 0.0
20000731 112 -2.11 0.00 0.0
20000731 124 -1.89 0.00 0.0
20000731 136 -1.65 0.00 0.0
20000731 148 -1.39 0.00 0.0
20000731 200 -1.11 0.00 0.0
20000731 212 -0.82 0.00 0.0
20000731 224 -0.52 0.00 0.0
20000731 236 -0.21 0.00 0.0
20000731 248 0.10 0.00 0.0
20000731 300 0.41 0.00 0.0
20000731 312 0.72 0.00 0.0
20000731 324 1.02 0.00 0.0
20000731 336 1.31 0.00 0.0
20000731 348 1.60 0.00 0.0
20000731 400 1.86 0.00 0.0
20000731 412 2.11 0.00 0.0
20000731 424 2.34 0.00 0.0
20000731 436 2.55 0.00 0.0
20000731 448 2.73 0.00 0.0
20000731 500 2.88 0.00 0.0
20000731 512 3.01 0.00 0.0
20000731 524 3.10 0.00 0.0
20000731 536 3.17 0.00 0.0
20000731 548 3.20 0.00 0.0
```

Figure B-23. Excerpt from “imm_c.thp” file for Test Case 3. Station is Hull Saltend, UK.

```
imm
53.6300 359.9101 0.0 3.6
DATA FROM THE REGIONAL OCEAN MODEL
DATE TIME HEIGHT SPEED DIREC
20000731 0 -1.100 1.037 301.7
20000731 12 -1.127 1.017 302.6
20000731 24 -1.143 0.989 303.9
20000731 36 -1.146 0.955 305.3
20000731 48 -1.139 0.911 306.6
20000731 100 -1.118 0.860 307.8
20000731 112 -1.084 0.802 309.4
20000731 124 -1.037 0.736 311.2
20000731 136 -0.984 0.656 312.4
20000731 148 -0.918 0.553 311.7
20000731 200 -0.832 0.441 310.8
20000731 212 -0.739 0.321 310.7
20000731 224 -0.634 0.188 310.5
20000731 236 -0.487 0.045 294.5
20000731 248 -0.327 0.124 143.1
20000731 300 -0.174 0.266 141.9
20000731 312 -0.028 0.379 141.2
20000731 324 0.138 0.467 139.5
20000731 336 0.295 0.544 138.2
20000731 348 0.443 0.617 137.4
20000731 400 0.579 0.689 136.4
20000731 412 0.702 0.757 135.1
20000731 424 0.813 0.822 133.5
20000731 436 0.912 0.882 131.7
20000731 448 1.000 0.939 130.0
20000731 500 1.077 0.990 128.5
20000731 512 1.142 1.036 127.1
20000731 524 1.195 1.076 125.9
20000731 536 1.238 1.108 124.8
20000731 548 1.265 1.133 123.5
```

Figure B-24. Excerpt from “imm_c.tsd” file for Test Case 3. Station is Immingham, UK.

Station 5: Lerwick

```

lerwick
  60.1500 358.8667  0.0 28.7
Tide table tidal constituents
  DATE    TIME HEIGHT SPEED DIREC
20000731   0   0.64  0.00  0.0
20000731  12   0.57  0.00  0.0
20000731  24   0.50  0.00  0.0
20000731  36   0.42  0.00  0.0
20000731  48   0.34  0.00  0.0
20000731 100   0.25  0.00  0.0
20000731 112   0.16  0.00  0.0
20000731 124   0.07  0.00  0.0
20000731 136  -0.02  0.00  0.0
20000731 148  -0.11  0.00  0.0
20000731 200  -0.20  0.00  0.0
20000731 212  -0.28  0.00  0.0
20000731 224  -0.37  0.00  0.0
20000731 236  -0.45  0.00  0.0
20000731 248  -0.52  0.00  0.0
20000731 300  -0.59  0.00  0.0
20000731 312  -0.66  0.00  0.0
20000731 324  -0.71  0.00  0.0
20000731 336  -0.76  0.00  0.0
20000731 348  -0.80  0.00  0.0
20000731 400  -0.84  0.00  0.0
20000731 412  -0.86  0.00  0.0
20000731 424  -0.88  0.00  0.0
20000731 436  -0.89  0.00  0.0
20000731 448  -0.89  0.00  0.0
20000731 500  -0.88  0.00  0.0
20000731 512  -0.86  0.00  0.0
20000731 524  -0.83  0.00  0.0
20000731 536  -0.79  0.00  0.0
20000731 548  -0.75  0.00  0.0

```

Figure B-25. Excerpt from "ler_c.thp" file for Test Case 3. Station is Lerwick, UK.

```

12  ler
    60.1600 358.7500  0.0  7.4
DATA FROM THE REGIONAL OCEAN MODEL
  DATE    TIME HEIGHT SPEED DIREC
20000731   0   0.498  0.285 270.7
20000731  12   0.483  0.279 270.7
20000731  24   0.462  0.271 270.7
20000731  36   0.437  0.259 270.7
20000731  48   0.420  0.242 270.7
20000731 100   0.390  0.221 270.7
20000731 112   0.354  0.201 270.7
20000731 124   0.315  0.178 270.7
20000731 136   0.273  0.155 270.7
20000731 148   0.233  0.128 270.7
20000731 200   0.186  0.101 270.7
20000731 212   0.139  0.075 270.7
20000731 224   0.094  0.048 270.7
20000731 236   0.047  0.019 270.7
20000731 248   0.005  0.013  90.7
20000731 300  -0.041  0.045  90.7
20000731 312  -0.085  0.075  90.7
20000731 324  -0.126  0.107  90.7
20000731 336  -0.166  0.138  90.7
20000731 348  -0.205  0.169  90.7
20000731 400  -0.240  0.198  90.7
20000731 412  -0.271  0.226  90.7
20000731 424  -0.300  0.253  90.7
20000731 436  -0.326  0.278  90.7
20000731 448  -0.348  0.302  90.7
20000731 500  -0.366  0.324  90.7
20000731 512  -0.382  0.343  90.7
20000731 524  -0.394  0.359  90.7
20000731 536  -0.402  0.371  90.7
20000731 548  -0.405  0.380  90.7

```

Figure B-26. Excerpt from "ler_c.tsd" file for Test Case 3. Station is Lerwick, UK.

Station 6: Liverpool

new brighton
53.4333 356.9500 0.0 0.0
Tide table tidal constituents

DATE	TIME	HEIGHT	SPEED	DIREC
20000731	0	2.92	0.00	0.0
20000731	12	2.62	0.00	0.0
20000731	24	2.31	0.00	0.0
20000731	36	1.98	0.00	0.0
20000731	48	1.64	0.00	0.0
20000731	100	1.30	0.00	0.0
20000731	112	0.95	0.00	0.0
20000731	124	0.59	0.00	0.0
20000731	136	0.24	0.00	0.0
20000731	148	-0.12	0.00	0.0
20000731	200	-0.47	0.00	0.0
20000731	212	-0.82	0.00	0.0
20000731	224	-1.16	0.00	0.0
20000731	236	-1.50	0.00	0.0
20000731	248	-1.83	0.00	0.0
20000731	300	-2.16	0.00	0.0
20000731	312	-2.47	0.00	0.0
20000731	324	-2.76	0.00	0.0
20000731	336	-3.04	0.00	0.0
20000731	348	-3.30	0.00	0.0
20000731	400	-3.54	0.00	0.0
20000731	412	-3.76	0.00	0.0
20000731	424	-3.94	0.00	0.0
20000731	436	-4.09	0.00	0.0
20000731	448	-4.20	0.00	0.0
20000731	500	-4.28	0.00	0.0
20000731	512	-4.31	0.00	0.0
20000731	524	-4.30	0.00	0.0
20000731	536	-4.23	0.00	0.0
20000731	548	-4.13	0.00	0.0

Figure B-27. Excerpt from "liv_c.thp" file for Test Case 3. Station is New Brighton, UK.

liv
53.5000 356.6502 0.0 12.3
DATA FROM THE REGIONAL OCEAN MODEL

DATE	TIME	HEIGHT	SPEED	DIREC
20000731	0	4.151	1.497	310.6
20000731	12	3.751	1.487	308.7
20000731	24	3.326	1.467	306.9
20000731	36	2.879	1.438	305.0
20000731	48	2.414	1.401	302.9
20000731	100	1.933	1.357	300.7
20000731	112	1.441	1.307	298.2
20000731	124	0.940	1.254	295.3
20000731	136	0.430	1.200	291.9
20000731	148	-0.089	1.146	288.0
20000731	200	-0.617	1.094	283.5
20000731	212	-1.153	1.045	278.4
20000731	224	-1.692	1.001	272.6
20000731	236	-2.236	0.964	266.0
20000731	248	-2.783	0.935	258.9
20000731	300	-3.337	0.918	251.1
20000731	312	-3.893	0.910	242.7
20000731	324	-4.444	0.910	233.8
20000731	336	-4.982	0.916	224.4
20000731	348	-5.497	0.931	214.4
20000731	400	-5.981	0.957	204.0
20000731	412	-6.425	1.000	193.4
20000731	424	-6.821	1.062	183.0
20000731	436	-7.164	1.147	173.5
20000731	448	-7.445	1.248	165.4
20000731	500	-7.656	1.354	158.9
20000731	512	-7.794	1.453	154.0
20000731	524	-7.857	1.542	150.1
20000731	536	-7.828	1.618	147.0
20000731	548	-7.702	1.681	144.3

Figure B-28. Excerpt from "liv_c.tsd" file for Test Case 3. Station is Liverpool, UK.

Station 7: Newport

eastbourne				
50.7667	0.2833	0.0	0.0	
Tide table tidal constituents				
DATE	TIME	HEIGHT	SPEED	DIREC
20000731	0	3.13	0.00	0.0
20000731	12	2.92	0.00	0.0
20000731	24	2.68	0.00	0.0
20000731	36	2.42	0.00	0.0
20000731	48	2.14	0.00	0.0
20000731	100	1.84	0.00	0.0
20000731	112	1.52	0.00	0.0
20000731	124	1.19	0.00	0.0
20000731	136	0.85	0.00	0.0
20000731	148	0.51	0.00	0.0
20000731	200	0.16	0.00	0.0
20000731	212	-0.19	0.00	0.0
20000731	224	-0.53	0.00	0.0
20000731	236	-0.88	0.00	0.0
20000731	248	-1.21	0.00	0.0
20000731	300	-1.54	0.00	0.0
20000731	312	-1.85	0.00	0.0
20000731	324	-2.15	0.00	0.0
20000731	336	-2.44	0.00	0.0
20000731	348	-2.70	0.00	0.0
20000731	400	-2.94	0.00	0.0
20000731	412	-3.15	0.00	0.0
20000731	424	-3.33	0.00	0.0
20000731	436	-3.49	0.00	0.0
20000731	448	-3.61	0.00	0.0
20000731	500	-3.70	0.00	0.0
20000731	512	-3.75	0.00	0.0
20000731	524	-3.76	0.00	0.0
20000731	536	-3.73	0.00	0.0
20000731	548	-3.66	0.00	0.0

Figure B-29. Excerpt from "new_c.thp" file for Test Case 3. Station is Eastbourne, UK.

12	new				12
	50.6500	0.0500	0.0	6.1	
DATA FROM THE REGIONAL OCEAN MODEL					
DATE	TIME	HEIGHT	SPEED	DIREC	
20000731	0	1.947	0.134	271.3	
20000731	12	1.777	0.169	271.3	
20000731	24	1.590	0.200	271.3	
20000731	36	1.389	0.227	271.3	
20000731	48	1.175	0.252	271.3	
20000731	100	0.948	0.274	271.3	
20000731	112	0.709	0.295	271.3	
20000731	124	0.460	0.313	271.3	
20000731	136	0.205	0.331	271.3	
20000731	148	-0.054	0.349	271.3	
20000731	200	-0.309	0.367	271.3	
20000731	212	-0.559	0.385	271.3	
20000731	224	-0.803	0.400	271.3	
20000731	236	-1.037	0.413	271.3	
20000731	248	-1.271	0.423	271.3	
20000731	300	-1.490	0.429	271.3	
20000731	312	-1.687	0.434	271.3	
20000731	324	-1.862	0.436	271.3	
20000731	336	-2.020	0.437	271.3	
20000731	348	-2.159	0.435	271.3	
20000731	400	-2.279	0.431	271.3	
20000731	412	-2.380	0.424	271.3	
20000731	424	-2.462	0.412	271.3	
20000731	436	-2.523	0.393	271.3	
20000731	448	-2.562	0.367	271.3	
20000731	500	-2.578	0.334	271.3	
20000731	512	-2.572	0.294	271.3	
20000731	524	-2.542	0.248	271.3	
20000731	536	-2.486	0.195	271.3	
20000731	548	-2.402	0.135	271.3	

Figure B-30. Excerpt from "new_c.tsd" file for Test Case 3. Station is Newport, UK.

Station 8: Sheerness

```
coryton
  51.5333    0.5167    0.0    0.0
Tide table tidal constituents
  DATE    TIME HEIGHT  SPEED  DIREC
20000731    0    2.59    0.00    0.0
20000731   12    2.60    0.00    0.0
20000731   24    2.59    0.00    0.0
20000731   36    2.55    0.00    0.0
20000731   48    2.49    0.00    0.0
20000731  100    2.40    0.00    0.0
20000731  112    2.29    0.00    0.0
20000731  124    2.15    0.00    0.0
20000731  136    1.99    0.00    0.0
20000731  148    1.81    0.00    0.0
20000731  200    1.62    0.00    0.0
20000731  212    1.40    0.00    0.0
20000731  224    1.18    0.00    0.0
20000731  236    0.94    0.00    0.0
20000731  248    0.69    0.00    0.0
20000731  300    0.43    0.00    0.0
20000731  312    0.17    0.00    0.0
20000731  324   -0.09    0.00    0.0
20000731  336   -0.35    0.00    0.0
20000731  348   -0.61    0.00    0.0
20000731  400   -0.86    0.00    0.0
20000731  412   -1.10    0.00    0.0
20000731  424   -1.33    0.00    0.0
20000731  436   -1.54    0.00    0.0
20000731  448   -1.74    0.00    0.0
20000731  500   -1.92    0.00    0.0
20000731  512   -2.08    0.00    0.0
20000731  524   -2.22    0.00    0.0
20000731  536   -2.34    0.00    0.0
20000731  548   -2.43    0.00    0.0
```

Figure B-31. Excerpt from “she_c.thp” file for Test Case 3. Station is Coryton, UK.

```
12 she
  51.4674    0.7833    0.0    2.7
DATA FROM THE REGIONAL OCEAN MODEL
  DATE    TIME HEIGHT  SPEED  DIREC
20000731    0    1.354    1.052  230.9
20000731   12    1.497    1.012  229.0
20000731   24    1.591    0.970  227.6
20000731   36    1.678    0.920  226.1
20000731   48    1.756    0.863  224.4
20000731  100    1.819    0.798  222.2
20000731  112    1.862    0.728  219.3
20000731  124    1.886    0.654  215.4
20000731  136    1.893    0.576  210.2
20000731  148    1.880    0.495  203.1
20000731  200    1.849    0.421  193.0
20000731  212    1.809    0.361  178.5
20000731  224    1.752    0.318  157.1
20000731  236    1.672    0.325  131.2
20000731  248    1.584    0.387  109.7
20000731  300    1.488    0.477   95.8
20000731  312    1.381    0.572   87.1
20000731  324    1.258    0.653   81.6
20000731  336    1.134    0.720   77.6
20000731  348    1.011    0.776   74.4
20000731  400    0.868    0.825   71.8
20000731  412    0.693    0.867   69.9
20000731  424    0.543    0.900   67.3
20000731  436    0.373    0.927   65.1
20000731  448    0.239    0.952   62.5
20000731  500    0.104    0.974   60.0
20000731  512   -0.032    0.996   57.5
20000731  524   -0.158    1.010   55.8
20000731  536   -0.272    1.017   54.6
20000731  548   -0.377    1.018   53.6
```

Figure B-32. Excerpt from “she_c.tsd” file for Test Case 3. Station is Sheerness, UK.

Station 9: Stornoway

```

stornoway
  58.2000  353.6167    0.0    0.0
Tide table tidal constituents
  DATE    TIME  HEIGHT  SPEED  DIREC
20000731    0   -1.89    0.00    0.0
20000731   12   -1.96    0.00    0.0
20000731   24   -2.01    0.00    0.0
20000731   36   -2.04    0.00    0.0
20000731   48   -2.04    0.00    0.0
20000731  100   -2.03    0.00    0.0
20000731  112   -1.99    0.00    0.0
20000731  124   -1.93    0.00    0.0
20000731  136   -1.86    0.00    0.0
20000731  148   -1.76    0.00    0.0
20000731  200   -1.65    0.00    0.0
20000731  212   -1.52    0.00    0.0
20000731  224   -1.37    0.00    0.0
20000731  236   -1.21    0.00    0.0
20000731  248   -1.04    0.00    0.0
20000731  300   -0.86    0.00    0.0
20000731  312   -0.66    0.00    0.0
20000731  324   -0.47    0.00    0.0
20000731  336   -0.26    0.00    0.0
20000731  348   -0.06    0.00    0.0
20000731  400    0.15    0.00    0.0
20000731  412    0.35    0.00    0.0
20000731  424    0.55    0.00    0.0
20000731  436    0.74    0.00    0.0
20000731  448    0.93    0.00    0.0
20000731  500    1.10    0.00    0.0
20000731  512    1.26    0.00    0.0
20000731  524    1.41    0.00    0.0
20000731  536    1.55    0.00    0.0
20000731  548    1.66    0.00    0.0

```

Figure B-33. Excerpt from “sto_c.thp” file for Test Case 3. Station is Stornoway, UK.

```

12  sto
    58.2100  353.6600    0.0   15.4   12
DATA FROM THE REGIONAL OCEAN MODEL
  DATE    TIME  HEIGHT  SPEED  DIREC
20000731    0  -1.839    0.086  207.2
20000731   12  -1.905    0.091  206.4
20000731   24  -1.951    0.095  206.1
20000731   36  -1.981    0.098  205.8
20000731   48  -1.989    0.102  205.0
20000731  100  -1.975    0.104  205.1
20000731  112  -1.939    0.103  205.5
20000731  124  -1.877    0.100  204.9
20000731  136  -1.804    0.095  204.1
20000731  148  -1.712    0.088  205.4
20000731  200  -1.601    0.078  207.0
20000731  212  -1.465    0.069  208.2
20000731  224  -1.325    0.057  208.6
20000731  236  -1.173    0.043  209.9
20000731  248  -1.006    0.029  212.4
20000731  300  -0.827    0.015  224.1
20000731  312  -0.639    0.005  307.7
20000731  324  -0.447    0.019   11.1
20000731  336  -0.254    0.037   20.8
20000731  348  -0.059    0.055   24.8
20000731  400    0.127    0.072   29.7
20000731  412    0.314    0.088   30.8
20000731  424    0.500    0.106   30.4
20000731  436    0.677    0.122   31.3
20000731  448    0.840    0.138   33.1
20000731  500    0.986    0.152   35.1
20000731  512    1.120    0.164   36.8
20000731  524    1.245    0.177   38.0
20000731  536    1.351    0.188   38.6
20000731  548    1.444    0.199   39.0

```

Figure B-34. Excerpt from “sto_c.tsd” file for Test Case 3. Station is Stornoway, UK.