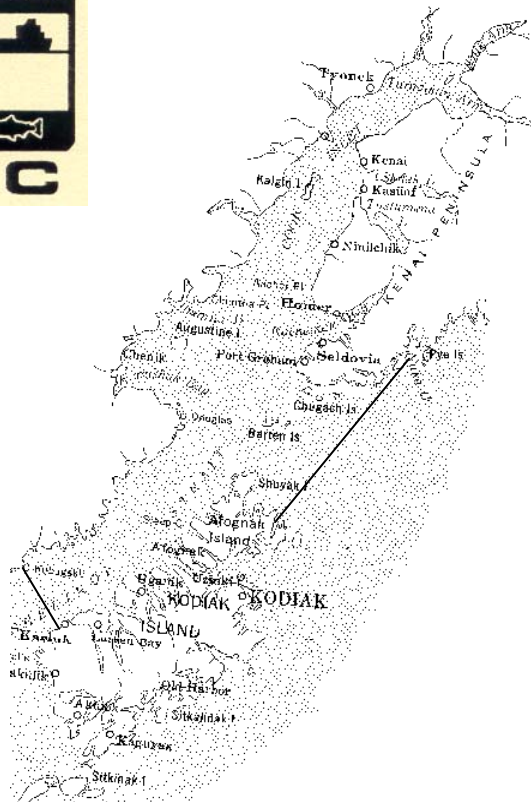
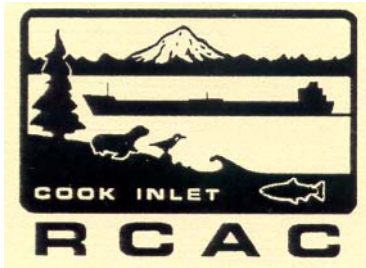


USER'S MANUAL FOR THE COOK INLET OIL SPILL MODEL Version 2.01 - February 29, 2000



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Table of Contents

1.	Table of Contents	2
2.	Introduction.....	4
3.	Initial Installation	4
4.	The User Interface.....	5
5.	The Model.....	5
4.1	Purpose.....	5
4.2	Initialization	5
4.3	Cook Inlet Bathymetry.....	5
6.	Program Features	6
7.	The Interface Elements	7
6.1	View Window	8
6.1.1	Area Bitmap	8
6.1.2	Inset Bitmap	8
6.1.3	Shore Scale.....	8
6.2	Main Window	8
6.2.1	Spill Date and Time	8
6.2.2	Spill Amount.....	8
6.2.3	Coordinates	9
6.2.4	Spill Source Location.....	9
6.2.5	Velocity Vectors	9
6.2.6	Spill Type.....	9
6.2.7	Particles sticking to shore	9
6.2.8	Menus.....	10
6.3	Status Window	11
6.3.1	Start Date and Time	11
6.3.2	Simulation Time.....	11
6.3.3	Spill Coordinates.....	11
6.3.4	% Released.....	11
6.3.5	% On Shore	11
6.3.6	% Weathered.....	11
6.4	Wind Control Window.....	11
6.4.1	Wind Speed Scroll Bar.....	11
6.4.2	Wind Speed Text Box.....	12
6.4.3	Wind Direction Compass.....	12
6.4.4	Wind Direction Text Box.....	12
6.5	Tide Window	12
8.	Running the Model	12
7.1	Tracking the Spill.....	13
7.2	Currents.....	13
7.3	Spill Representation.....	13
7.4	The Spill's Fate	13

7.5 Permanent Record.....	13
9. Example	14
10. References.....	14
11. Contacts.....	14
12. Caveat	15

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2. Introduction

This manual describes how to use Version 2.01vb6 of the Cook Inlet Oil Spill Model (CIOSM). This version is designed for use with any monitor capable of a pixel resolution of at least, 640 X 480. The model checks the user's screen resolution setting and adjusts the windows accordingly, without user intervention. This adjustment makes the windows as large as possible without adding extra confusion for users not familiar with monitor settings.

The manual describes the installation and operation of the model. This includes the setup, the function of the controls shown on the screen, the units and limits of each control, and the initialization procedure. An example is also provided.

“Model” includes the interface that the user uses to interact with the model and the entire suite of software subroutines, which are invisible to the user. The word “program” may be used in lieu of “model,” but the two meanings are equivalent. The subroutines (procedures) control the program flow and how that flow occurs. The procedures are coded in Microsoft Visual Basic.–Visual Basic is similar to conventional basic, but includes many commands that generate and manipulate the buttons and other controls that form the models graphical interface.

It is not the intent of this manual to explain the Visual Basic language or to describe how it can be used to alter the model. The "install" version contains only a "compiled" version of the model, that is, not the source code. The current version of the model is similar to the previous version of the model, CIOSM 2.0. Changes include conversion from 16-bit VB-4 to 32 VB-6 as well as fixing miscellaneous bugs including our own Y2K problem. The user will note that they are now required to type in 4 digits for the year. CIOSM 2.0 used a mask and only the last two digits of the year which led to the model trying to calculate the tides based on the year 1900. This has now been fixed.

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3. Initial Installation

Although CIOSM can be run on less powerful computers, for a more satisfactory performance the user should have at a minimum a Pentium processor with a clock rate of 200 megahertz PC with 64 megabytes of RAM and a high-resolution, color monitor with a 17 inch screen. About 30 megabytes of hard disk space is required for the program and its data files. The program is written as a 32-bit application and will run on Windows[®] 95 or better operating systems

The model files are provided on CD-ROM, a Zip diskette, or can be downloaded from CIRCAC's web page (contact CIRCAC for the web address). To install the model, use the file manager to find the setup file (SETUP.EXE) and double click. The setup program will lead the user through the setup process. CIOSM.EXE is the application file and comprises the executable portion of the model. A number of other files will be installed to provide the interface and associated files containing velocities, water depths, and tidal constants.

4. The User Interface

The screen that is first visible when the CIOSM program is executed is an example of a Graphical User Interface, or GUI (pronounced goo-ee). Its purpose is to facilitate interaction between the user and the model.

The GUI consists of numerous objects placed inside windows, which are, themselves, objects. Some of the objects are under direct user control, and others simply report model status and convey other information to the user. Both types of objects are called “controls.” The ultimate output of the model, the spill’s trajectory, is simply a reporting of the model’s status by certain controls. These controls will be described in detail in a subsequent section.

5. The Model

4.1 Purpose

The purpose of the Cook Inlet Oil Spill Trajectory Model is to track the trajectory (path) of surface floating oil (or other substances) after the user has input initial conditions about the spill and wind conditions. Other surface-floating substances can also be tracked with this model. The remainder of this section describes briefly how this trajectory is represented on the computer monitor and how the tracking is accomplished.

4.2 Initialization

The program is first executed by double clicking the application program, CIOSM. Initially, the interface shown in Figure 1 appears on the screen. To begin the program, the initialization process is started using the *Initialize* command found in the *Operation* menu (*Operation|Initialize*). In keeping with Window’s standards, the Alt+I shortcut-key combination can be used in lieu of the mouse. A pause then occurs as the program loads, then maps the Cook Inlet depth data, and finally loads the velocity files. These files are large and can take several minutes or more to load. The function that the program is executing (that is, loading bathymetry, mapping, or loading velocity data) is simultaneously displayed in a text box immediately above the gauge which indicates the progress in implementing that function.

4.3 Cook Inlet Bathymetry

A bathymetric map of the project area is generated in the picture box with the name “View,” (the name appears in the panel near the top margin of each window). This box uses about half of the interface as shown in Figure 2. Depths are presented in shades of blue, gray, and black with the darker shades representing the deeper water. Land is represented in green. The model then pauses for additional user input. Notice that Kalgin Island shows up as to individual land (green) portions. Even though the island is contiguous, given the scale of this image and the grid sizes, this is the most accurate representation.

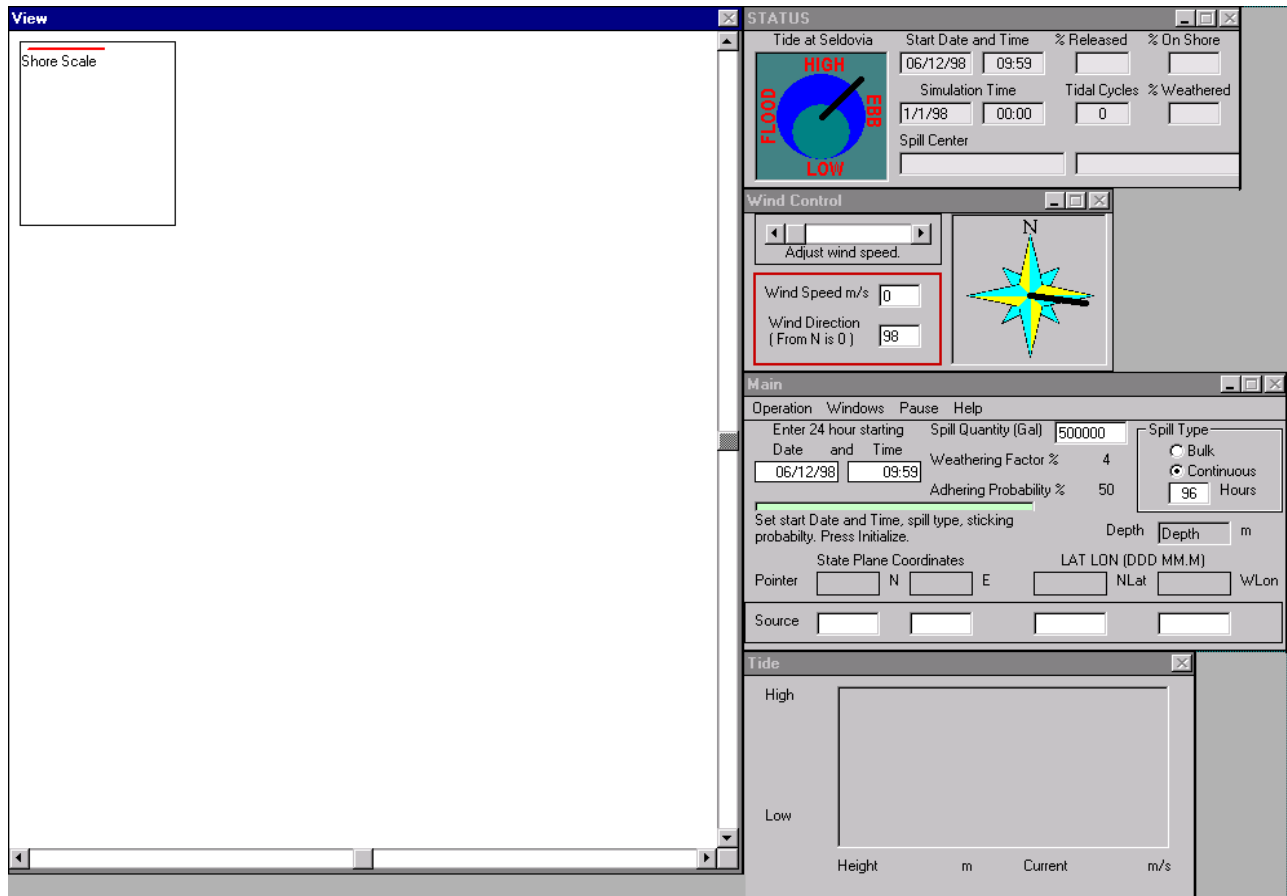


Figure 1. Initial screen image on startup

The entire model area is too large to be conveniently shown on a single stationary map. Scroll bars on the bottom and right-hand-side of the “View” window are provided to assist in displaying the area of interest. Alternatively, the user can move around the model area by clicking locations in the inset picture box showing the entire area at a reduced scale.

The shoreline appears irregular because the entire area is being represented on a grid made up of horizontal and vertical lines. Only at the intersections of these grid lines can a depth or a velocity value be prescribed. Version 2 of the model contains water depths at about 40,000 intersection points. Shorelines must be placed on these intersections. Since these intersections occur on one-kilometer centers, a smooth shoreline is not possible. Other modeling schemes can better represent shorelines, but they have other disadvantages.

6. Program Features

The following features are used or available in this model:

- A HELP menu is available on the program to provide additional information about the program.

- A modified version of the hydrodynamic model TRIM (see for example Cheng et. al. 1993) was used to calculate the tidal currents.
- The surface-floating oil (or other floating substance) is assumed to travel at a velocity equal to two to four percent of the wind speed. The wind and tidal the velocity components are combined

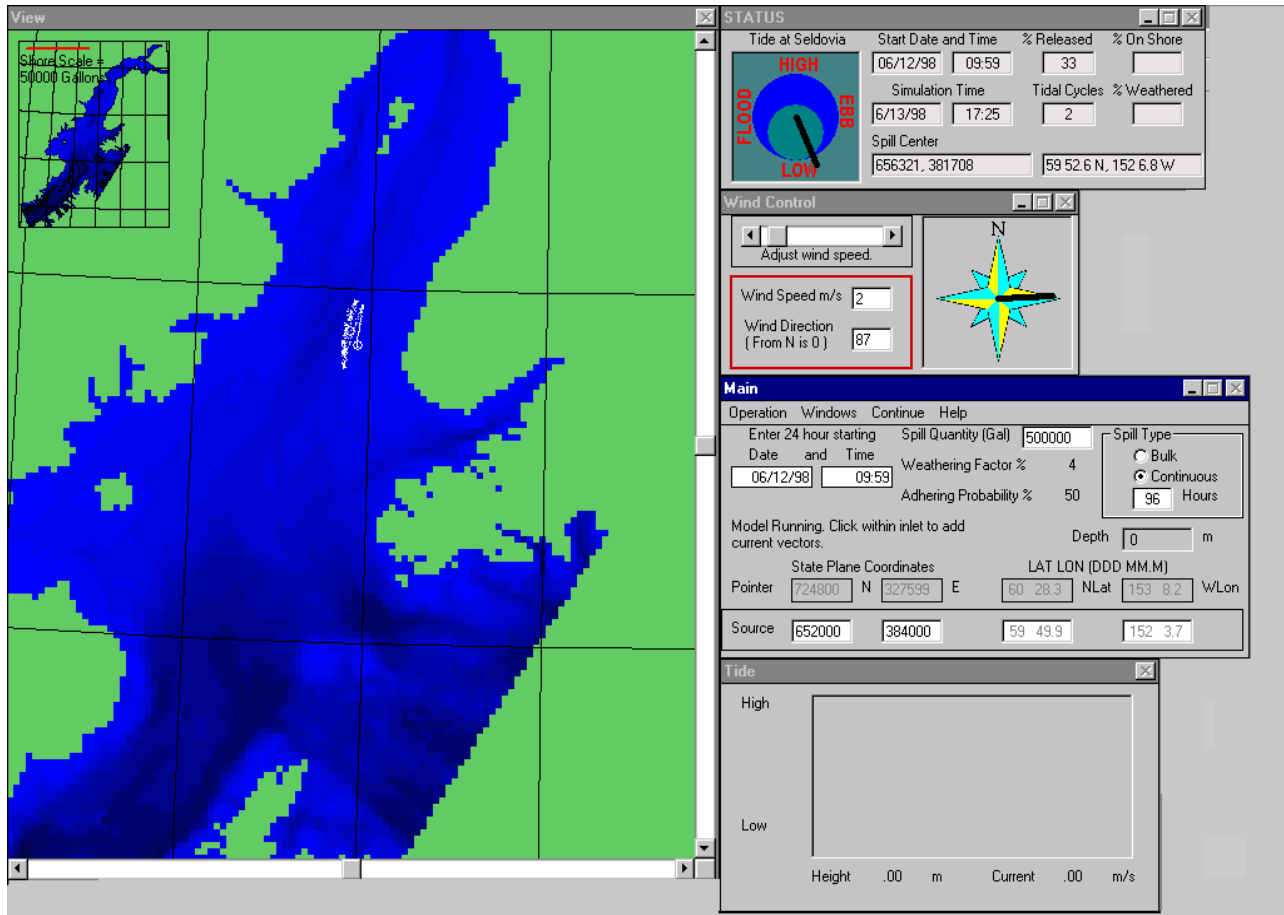


Figure 2. Screen image during model run.

as vectors. In addition the oil undergoes a random movement that simulates turbulent mixing.

7. The Interface Elements

As mentioned, the initial interface is shown in Figure 1 and when the command, “*Initialize*,” is executed, Figure 2 will appear following a pause during which depths and tidal velocity files are read. Initialize is found under the **Operation Menu** on the “Main” window. There are five separate windows visible on the screen. These are named (name in upper left-hand-corner of each window) “View,” “Status,” “Wind Control,” “Main,” and “Tide.” Windows are themselves objects, and contain other objects such as text boxes, dials, radio buttons, command buttons, scroll bars, gauges, and picture boxes. Most of these are standard objects (controls) supplied with the Visual Basic

developer's program, but others have been generated specifically for this project by combining picture boxes and graphics. Each window and its objects will be individually described.

6.1 View Window

6.1.1 Area Bitmap

The "View" window contains the project area bitmap. Since the entire area cannot be displayed simultaneously at a convenient scale, horizontal and vertical scroll bars are provided to allow viewing access to the entire project area. After initializing but before running the model, the first left mouse click in the Area Bitmap will set the location of the spill. The second and subsequent left clicks (up to 100) will set the location of the cells where the current telltales will be displayed. After the model starts running, depth and location at the cursor will be displayed in the appropriated text boxes in the "Main" window simply by moving the cursor over the bitmap. Also while running, a right click on the water portion of the bitmap will cause the tide curve for that location to be displayed in the "Tide" window. The instantaneous tide will march across the tide chart as a red bar (changing from the normal black color). The instantaneous depth and current will also be displayed below the horizontal axis of the tide chart.

6.1.2 Inset Bitmap

An inset map of the project area is also provided in this window as a separate bitmap. This can be used to alternatively move around the project area simply by clicking with the mouse to the appropriate area.

6.1.3 Shore Scale

The final item on this window is the Shore Scale given as a single red horizontal bar. This is the symbol that will appear along the shore of the area bitmap as a percentage of the spill droplets wash onto, and stick to, the beach. This portion is removed from the spill calculations and the length of this line indicates the amount that has become permanently stuck to the shore (the scale appears at the top of the "View" window). Those droplets which do not stick, continue to be tracked by the program, and may wash back into the inlet.

6.2 Main Window

6.2.1 Spill Date and Time

Two text boxes below the label, "Enter 24 hour starting date and time," are provided to enter the spill's beginning date and time. These are necessary so the correct times can be ascribed to the spill's behavior by establishing the correct times for the tide and current predictions. Times should be entered as Alaska Standard Time (AST). AST is one hour earlier than Alaska Daylight Time.

6.2.2 Spill Amount

A text box is also provided to indicate the estimated size of the spill in barrels. This is for user convenience and does not affect the trajectory calculations.

6.2.3 Coordinates

While the model is running, it is often desirable to point to an area on the map with the mouse arrow and to be provided with the position of that arrow. There is a row of four text boxes that will provide this information (given a label of "pointer" on the left side of this window). The first two boxes display the location in Alaska state-plane coordinates in meters and the other two in North Latitude and West Longitude.

6.2.4 Spill Source Location

The location of the spill source is entered in one of two ways after the program has been initialized, but before the model begins running (the model will not run without a spill location). These methods are:

- The user can execute a single mouse click after pointing the arrow to the desired position on the project bitmap. Once placed with the mouse, the spill location can be changed by clicking and dragging to a new location. The spill cannot be placed over land.
- The Alaska state plane coordinates can be entered directly into the text boxes provided.
- The spill position can also be input in latitude and longitude. This is initiated by executing a mouse click while the arrow is positioned on either of the Alaska state plane coordinate text boxes. A dialog box will be displayed and the latitude and longitude of interest can be input into the appropriate text boxes. These can then be converted to state plane coordinates or used to set the spill locations directly by executing the appropriate command buttons.

These positioning techniques will produce a large red cross on the map at the nearest grid intersection. Moving and removing this spill location will be discussed in the "Running the Model" section.

6.2.5 Velocity Vectors

This feature is not specifically a control, but is described here because of its close association with other features of this window. After the spill source has been placed on the map, continued mouse clicks on the map will designate locations where velocity vectors for the surface currents will be generated. Up to 100 such locations are possible and they can be specified before or after the model begins to run. The velocity is represented with a telltale originating at the cell selected and whose length and direction indicate the relative speed and current direction. The magnitude of the speed can also be displayed as mentioned above.

6.2.6 Spill Type

On the right side of this window is a frame with two radio buttons and a text box. These are to indicate whether the spill is a bulk spill (released at a single instant in time) or a continuous spill (released over extended period). The default choice is the bulk spill. If the spill is continuous, then the time (in hours) must be entered in the text box. Each spill consists of 1,000 particles that are tracked by the model, and in the continuous spill mode, these points are released uniformly over the time specified by the user.

6.2.7 Particles sticking to shore

When oil contacts the shore, it may stick or not depending on shore conditions and oil type. This model relies on a user specified field to indicate the likelihood of the oil's fate on contacting land. In

the text box labeled "Sticking Probability %," the user can specify the likelihood that an individual oil droplet (one of the 1,000 particles) will become permanently stuck to shore on contact. The default sticking probability is 50 percent.

6.2.8 Menus

The "Main" window has a menu bar containing the main menu headings: **Operation**, **Windows**, **Continue** (or **Pause**), and **Help**. The **Window Menu** provides access to the **Status**, **Wind**, and **Tide Windows**. The **Continue Menu** is a toggle switch between **Continue** and **Pause** mode so that the model can be "paused" during its operation. The **Help Menu** provides access to Contents and About Submenus. The Contents Submenu provides information about the program, its installation, and operation, and contains an example for demonstrative purpose. The About Submenu provides information about the model including who developed it and why. The menu of major importance is the Operation Menu.

Operation Menu

This menu contains eight submenus that provide a number of necessary and helpful features. They will be described in order of their appearance. Not all are simultaneously available to the user but are enabled only as needed.

- Properties Submenu--Displays a dialog box in which the user can modify the Adhering Probability and Weathering Factor. The user also can choose to accept the default values for these properties.
- Initialize Submenu--Executing this choice causes the bathymetry to be read and mapped producing the project map in the View Window, and the velocity data files to be read.
- Run Submenu--Executing this choice (only after initializing) causes the diffusion information to be calculated and the model to begin tracking the spill. If the spill location has not been specified, a message box will appear with this information and the model will not begin until this function is completed.
- Relocate Submenu--The relocate feature allows the spill to be moved *en masse* in the event the actual location and the modeled location differ. This might occur, for example, if the correct winds were not input into the model which can easily happen given the scarcity of wind information available for Cook Inlet.
- Reset Submenu--This function allows the initial spill to be relocated and the model run again. All other information, time, properties, and wind will retain their previous values unless reset. This allows for numerous scenarios to be rerun without resetting the default values or waiting for the velocity information to be reread.
- Trace Submenu--This useful feature allows a black path line to be drawn wherever the spill moves. It maintains a history of the spill's progress.
- Print Submenu--This feature allows the spill information to be printed. On execution, a dialog box will appear which has two option buttons (Line and Color) and two command buttons (Get Image and Print). The user must first choose whether to have the spill superimposed on a color image of the project area (similar to the actual bitmap in the "View" Window), or whether it should appear on a black and white line drawing, which would be more useful for faxing the results. Once this choice is made, the user displays the image with the "Get Image" command. This image can then be printed. This is not intended as an elaborate printing feature but rather a simple way of communicating the spill location. The line option uses a simple algorithm to

determine the coastline and then superimposes the oil spill. The color option prints the condensed image from the "View" window. For more detailed output the user should use a screen capture program.

- Quit Submenu--Exits model after executing the confirmation feature.

6.3 Status Window

6.3.1 Start Date and Time

These two text boxes simply echo the date and time (AST) when the spill occurred as specified by the user (see "Main" window above).

6.3.2 Simulation Time

The model operates much faster than nature. The model date and time (beginning with the date and time of the spill origin) is provided in these two text boxes.

6.3.3 Spill Coordinates

The center of mass (centroid) of the spill will be displayed in the text box labeled "Spill Center." The coordinates are in decimal degrees of latitude and longitude.

6.3.4 % Released

If the spill is the continuous type, it will flow uniformly from the source at a rate determined by the user's hour specification (discussed later). The percentage released from the spill at the current spill time is given in the text box beside the label "% Released."

6.3.5 % On Shore

This box keeps track of the percentage of the spill that has stuck to the shore and has been removed from the calculations. It depends on the sticking probability as input by the user (or left as the default value).

6.3.6 % Weathered

This box keeps track of the percentage of the spill that has become weathered to the point of being removed from the calculations. It depends on the weathering factor as input by the user (or left at the default value).

6.4 Wind Control Window

6.4.1 Wind Speed Scroll Bar

Wind speed can be entered in one of two ways. The first, with the scroll bar where the speed is changed by adjusting the position of the scroll bar by dragging it with the mouse and the second by using the text box. Wind is provided in knots. This can be done before the model starts to run and changed "on the fly" by the user while the model is running.

6.4.2 Wind Speed Text Box

As the wind speed is changed using the scroll bar, its value is echoed in the “Wind Speed” text box. The wind can also be entered directly into the text box after initialization and before the model begins to run.

6.4.3 Wind Direction Compass

On the right side of this window is a picture box displaying a compass rose with a thick black radial line. The intersection of this line with the perimeter of the star determines the wind direction (wind direction is conventionally given as the “from” direction). By clicking with the mouse at other points on the star the wind direction can be changed. This may also be used to change the wind direction at any time during the simulation or “on the fly”.

6.4.4 Wind Direction Text Box

This text box functions similarly to the wind speed text box. Directions generated on the compass will be echoed in the “Wind Direction” text box.

6.5 Tide Window

The final window on the interface is the "Tide" window. This window is used to display the predicted tidal level at any location in the project area. It is activated by placing the mouse arrow on the area of interest and right clicking the mouse button. The high and low tide for the selected location is provided on the left side of the window. The tidal curve is represented as a bar graph. As time progresses, the color of a particular bar changes from black to red as the tide at that location attains the value given by a particular bar.

The instantaneous tidal height and current are also provided in text boxes directly under the tide curve.

8. Running the Model

The model must first be initialized which is done from the *Operation Menu*. This causes the bathymetry and the velocity data to be read and the bottom to be mapped. The user should input several initial conditions for the model to operate properly. The sequence is not particularly important, and certain conditions can be changed as the model progresses. Besides the “View” window, there are four additional windows that are used for model input and to display model status. Each of these windows have already been described.

To run the model, a spill location must first be selected. The three methods to accomplish this have been described above. Once the location appears on the map (indicated with a red X), its position can be readjusted by selecting it with the mouse and dragging it to a new location. The spill location can be removed only by either restarting or resetting model. Note: restarting will cause a lengthy delay as the velocity files are reloaded.

It is now prudent to enter the date and time of the spill, the type of spill (bulk or continuous), the spill quantity, and its properties. The wind information should also be entered. The wind and properties of the spill substance can be changed as the program runs should new information become available. The model run begins from the *Operation Menu*. If an oil spill source has not been prescribed at this point, an error message will appear and the model will not proceed. Before the model actually begins to run, there is a second, but much shorter, pause while the model calculates the turbulent mixing based on the magnitude of the tidal currents.

7.1 Tracking the Spill

Once the model begins, the red X will be replaced with a white, unfilled circle indicating the source location (it will not change position). The model then begins tracking the hypothetical oil spill using smaller white dots to simulate the spill. Each spill, regardless of whether it is a bulk or continuous spill is represented by 1,000 white dots. A second white, unfilled circle, identical to the source indicator, also appears. This circle represents the centroid or center of mass of the spill and its position changes with the spill trajectory.

7.2 Currents

The model also provides a way to observe the currents within the project area. Once the spill source has been designated, additional mouse clicks will designate locations where velocity vectors will be displayed. Up to a hundred locations can be designated and designations can even be made while the model is running. The currents are shown as straight lines that point in the current's direction; the length of these lines indicates the relative current speed.

7.3 Spill Representation

The model can simulate either bulk or continuous spill types. Each spill, regardless of type, is represented by 1,000 white dots. In the bulk type, the spill is assumed to occur at a single instant in time; the continuous spill is released over a time span selected by the user.

7.4 The Spill's Fate

The oil amount will be reduced in one of three ways: by being transported out of the project area, by becoming stuck on land or by weathering (and sinking). The user can select the probability that any of the 1,000 white oil droplets will stick when it makes contact with land. If it does stick, it is assumed to be removed from the spill, and its progress is no longer tracked. Although the model no longer tracks particles that have become stuck to land, it does indicate their presence with a red horizontal line. This line is similar to a single bar on a bar graph. The longer the line the higher percentage of oil that has become grounded. It is possible at some point to have all the oil grounded and the model continue to run without tracking any oil particles. A scale is given at the top of the view window.

7.5 Permanent Record

A permanent record of the date, time, and position (decimal degrees of latitude and longitude) of the spill's centroid is written to the file "SPILCNTR.TXT." This file is saved and can be viewed as a text file when the program is terminated. If several runs are to be made, this file should be renamed to avoid it being overwritten by the next program run.

9. Example

The user wishes to model a spill for 12 hours with a prevailing wind of 14 knots (about 7 meters/sec) coming from the East. After 12 hours the discharge stops, but the spill continues to be tracked. The default values for Adhering Probability (50%) and the Weathering Factor (4%) will be accepted.

The model is started by double clicking the CIOISM.EXE and then single clicking the Initialize submenu item. The model will take some time to read in the bathymetry data, construct a Cook Inlet depth map, and read in the water velocity data. When initialization is complete, a map of Cook Inlet will be displayed on the interface. The light blue indicates shallower water and the dark areas the deeper water. Islands are also shown. The depths (in meters) are shown as the cursor travels over the water area in the "View" window.

The spill type is set to continuous and 12 (for 12 hours) is entered into the associated "Hours" text box. The spill is assumed to be released uniformly over 12 hours; a bulk spill would release all oil at the start of the spill. The date and time of the spill are entered in the appropriate "appropriate" "Status" window text boxes.

The user must then choose a location for the oil spill by methods described above. The user can also select locations where velocity vectors will be displayed by continuing the mouse clicks on the wet portion of the project area map.

The wind direction is set to 90 degrees (from the east) and the wind speed is set to 7 meters/second (about 14 knots) and the Run submenu item is then executed to begin the model.

The user will then observe the model run. Clicking on the map will add velocity vector display locations. The wind speed or direction may be changed "on the fly" as the model is operating. The model may also be paused or reset.

Finally, as the oil reaches the shore, sticking is indicated by a red horizontal. The length of the bar is the relative amount of droplets that have stuck at that point. The model will continue to track the spill until all of it is either stuck on shore, weathered and off the surface, or out of the project area. The user can also relocate the spill if information indicates that its true location differs significantly from the model's simulation.

10. Reference

Cheng, R.T., V. Casulli, and J.W. Gartner, 1993, "Tidal, Residual, Intertidal, Mudflat (TRIM) model and its applications to San Francisco Bay, California", *Estuarine, Coastal, and Shelf Science*, VOL. 36, pp. 235-280

11. Contacts

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Engineering, phone: (907) 338-6626, e-mail: djones@micronet.net; or Bryan Pearce, Pearce Engineering, phone: (207) 866-2296, e-mail: brp@maine.edu .

12. Caveat

The authors have made every attempt to make an accurate calculation of the tides and currents within the time and funding constraints of the project. CIRCAC cannot guarantee these values and they should not be used for navigation.