User's Manual of

Java Package for Creating IBM Control File

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1. Introduction

DROG3DDT, a 3-dimensional particle tracking package implemented in FORTRAN 77 (Blanton 1995; Werner et al. 2001) has been widely used in various individual-based particle tracking models. A control file (hereafter referred to as the IBM control file) has to be prepared for providing the initial information for the model run. The information may include the particle releasing date, time, locations, time step of the prognostic particle tracking, and the frequency to output results. A front-end oriented Java package has been developed at the Northeast Fisheries Service Center/National Oceanic and Atmospheric Administration, Woods Hole, MA. It is aimed at providing a convenient way of creating the IBM control file. It consists of a set of graphic user interface (GUI) and some background java applications. The document explains the GUI structures and their implementations, the procedures to run the package. The data structures of the IBM control file are also explained.

It is noted that the IBM control file is also called the '.ind' file (IND file) in other widely used IBM packages (Blanton 1995). The IBM control file created by the present package is consistent in format with the IND file with additional parameters in place of some comment lines of the latter (section 2.23).

2. Graphic User Interface

2.1 Components

2.1.1 Main Frame

A main frame, *Create IBM Control File*, is first populated when the module is initiated; see Figure 1. It comprises of the following components:

Date/Time The first two rows are the text fields for specifying the date and time particles should be released. They are listed in the following:

Year: four-digit integer
Month: integer, 1-12
Day: integer, l-30 (31)
Hour: integer, 0-23
Minute: integer, 0-59
Second: integer, 0-59
Number of Tracking Days: duration of the model run in days
Time Step (sec): time step of the IBM model run in seconds

Horizontal Locations The particle locations can be specified either manually via

the GUI *Map Frame* or via a polygon file; see Figure 2. The GUI provides the following three ways for manually specify the particle locations:

(1) To chose the locations individually by clicking various points in *Map Frame;* see Figure 2(a);

(2) To specify a region of interest in rectangular shape via a mouse drag within *Map Frame*; see Figure 2(b). The spatial separation between the particles is determined by values in the two text fields, *Number of Particles along Lon Dimension* and *Number of Particles along Lat Dimension*, which represent the number of the particles along the zonal and meridianal directions, respectively. In detail, say the (lon0, lat0) and (lon1, lat1) are the longitudes and latitudes at the top left and lower right corners of the rectangular, respectively; and the N_{lon} and N_{lat} represent the values of the above two text fields. The separations along the zonal and the meridinal directions, (ΔLat, ΔLon), respectively, equal to

$$\Delta Lat = (lon1 - lon0)/(N_{lon} - 1), \text{ and}$$
$$\Delta Lon = (lat1 - lat0)/(N_{lat} - 1).$$

(3) To specify a region of interest in rectangular shape by specifying the boundary longitudes and latitudes at the text fields, *Left Longitude (W), Right Longitude (W), Upper Latitude (N)* ,and *Lower Latitude (N),* which represent the longitudes and latitudes at the top left and lower right corners of the rectangular, respectively. The remaining is the same as (2).

A fourth way to specify the region of interest is via an ASCII file which defines a polygon of any arbitrary shape; see Figure 2(c). To do this, users need to skip the above procedures and continues with the following. The polygon file name is asked after clicking the *Create Ctrl File* button.

Vertical Depth The initial particle depth is specified at the text field, *Particle Depth (m).* The input number can be either positive or negative. Some conversion is done in background.

Track/Print Control It consists of the following two text fields.

Tracking Control (iTrack) Text Field: number of the model time-steps to update the particle locations

Printing Control (iPrint) Text Field: number of the model time-steps to output the particle locations

Create Control File A *Create Ctrl File* frame appears when the *Create Control File* button is clicked. It is for creating the IBM control file. It consists of two check boxes and three buttons; see Figure 3. The check boxes are the *Read (lon, lat) Polygon File* and *Use GUI Map for Location*, respectively. They are mutually exclusive. The three buttons are the *Specify Result File Name, Specify Ctrl File Name,* and *Done File Naming.*

Read (lon, lat) Polygon File: Check on this box to specify the region within which particles are initially located according to the vertices coordinates defined in a polygon file. After checking the box, a file browser window prompts for users to select the polygon file.

Use GUI Map for Locations: manually specify the initial particle locations as described in the previous paragraphs.

Specify Result File Name: specify the name of the result file. Clicking on this button prompts a file browser window for the filename specification. It is noted that this result file is not the IBM control file, but the file for holding the results of the IBM run. This parameter does not exist in the IND file of DROG3DDT package.

Select IBM Ctrl File: select the IBM control file. Check this box prompts a file browser window for filename selection.

Done File Naming: close the *Create Ctrl File* frame.

View Locations in CTRL File Click on this button prompts the *Select CTRL File* window for users to select an IBM control file. The particles' horizontal locations defined in the selected IBM control file are displayed in the frame of *Model Domain Map.*

Quit Click on this button ends the GUI session and returns Unix command prompt.

2.1.2 Frame of Model Domain Map

This frame provides the GUI for users to manually specify the initial horizontal locations of particles. It displays the model domain setup and marks the particle locations after each mouse click; see Figure 2. Note that there are four ways to specify the locations as described in the previous section, (1) direct mouse click on the map, (2) mouse drag on the map to define a region of interest in rectangular shape, (3) assigning the longitude and latitude ranges at relevant text fields in *Main Frame*, and (4) data input from a polygon file. The first way specifies the definite locations of each individual particle, while the other three define a region within which the particles are initially distributed. Knowing the numbers of particles along the longitudinal and latitudinal dimensions, the actual particle locations are calculated by assuming that the particles are evenly distributed along each dimension.

2.2 Source Codes and Data Files

2.2.1 Source codes:

CtrlFileFrm.java - Populate a frame for selecting ways to specify particle locations (manually or input from the polygon file) and the names of the IBM control and result files; see Figure 3.

DateTimeP.java - populates the top portion of *Main Frame* to define the releasing date and time of the target particles. It is labeled as 'Initial Date/Time of Particles' in *Main Frame;* see Figure 1.

FileDialogPth.java - populates a dialog window for filename specification.

LeftPanel.java - coordinates the population of the GUI components in *Main Frame,* including the date/time panel, location panel, and the command buttons.

LocationP.java - populates the GUI components to specify the initial particle locations and the model mode options. It shows as the middle part of the *Main Frame,* with the title of 'Initial Locations of Particles'; see Figure 1.

MapC.java - populates the map frame of the model domain; see figure 2. It displays the model domain, mesh setup, and the initial particle locations.

mCtrl.java - coordinates the population of various GUI components*;* see Figure 1. It calls the classes, namely LeftPanel.java, DateTimeP.java, and LocationP.java, and controls the command buttons, *Create CTRL File, View Locations In CTRL File,* and *Quit.*

2.2.2 Input File:

DomainGrid.dat – consists of longitude and latitude definitions of the vortices of each finite element cell. The format is as follows:

lon(i, 1), lon(i, 2), lon(i, 3), lat(i, 1), lat(i, 2), lat(i, 3), i = 1, 2, …, N

where i denotes the sequence number of the cells of the model mesh and N is the total number of cells. N equals 18784 for the present domain grid file, DomainGrid.dat. The followings are two sample lines.

```
-76.160132 -76.174569 -76.141227 36.991048 36.947784 36.955234
-63.784436 -63.813644 -63.785169 44.446234 44.424254 44.401780
```

SamplePolygonFile.dat – a sample file holding the longitude and latitude definitions of the vortices of a polygon. The format is as follows:

lon(i) lat(i) , i = 1, 2, …, N

where i denotes the sequence number of the vortices of the polygon and N is the total number of vortices in the polygon. Refer the file, SamplePolygonFile.dat, for details.

2.2.3 Output File

The output file from the package run is the IBM control file. Its format is consistent with the IND file. The contents of each line are as follows:

Line 1: Comment Line, ‘`Particle Tracking Control File (*.ind)`’
Line 2: model run time step in seconds, duration in days, name of result file
Line 3: Comment Line, ‘`# of model time steps between DROG3DDT outputs (ITRACK)`’
Line 4: Number of Model Time Steps between the Particle Position Updates
Line 5: Comment Line, ‘`# of drog position updates between drogue outputs (IPRINT)`’
Line 6: Number of Model Time Steps between the Particle Position Output
Line 7: Comment Line, ‘{# grid scaling factors}’
Line 8: Grid Dimension Scaling Factor for Horizontal Coordinates
Line 9: Comment Line, ‘{# drog scaling factors}’
Line 10: Particle Coordinate Scaling Factors for Initial Positions
Line 11: Comment Line, ‘{number of starting drogs}’
Line 12: Number of Initial Particle Positions
Line 13: Comment Line: ‘{Starting positions/date/lon,lat (x,y,z, year, yearDay, lon, lat)}

The remaining lines list the initial positions (x, y, z) in meter, year (year), year day (yearDay), longitude (lon), and latitude (lat). The initial horizontal positions (x, y) are converted from the corresponding (lon, lat) relative to the coordinates , (lon0, lat0), of the projection reference center, which are hard coded in the programs. The default values are (-69.0, 40.0). Note that the essential difference between the present IBM control file and the IND file lies in line 2 and the lines after line 13. On line 2, the original comment line is replaced by two floating point numbers (model run time-step in seconds and duration in days) and a string (name of result file). The lines after line 13 consists of seven columns, rather than the three in the IND file. The first three are the same as the IND file and the later four are newly added. The following is an example file. See also the file, sampleIbmCtrlFile.ind, for more details.

```
Particle Tracking Control File (*.ind)
7200.0 5.0 myResultFilename
# of model time steps between DROG3DDT outputs (ITRACK)
1
# of drog position updates between drogue outputs (IPRINT)
1
{# grid scaling factors}
1.0 1.0 1.0
{# drog scaling factors}
1.0 1.0 1.0
{number of starting drogs}
 100
{Starting positions/date (x,y,z, year, yearDay)}
278812.0836843122 89434.92742344132 -25.0 2002 0.0 -65.725 40.8
278812.0836843122 113841.68851898331 -25.0 2002 0.0 -65.725 41.017
...
...
```

3. Procedures for Program Run

3.1 Compile

To compile the Java source codes, issue the following command in the directory where the Java source codes locate:

> *javac *.java*

3.2 Run

To start the GUI, issue the following command at UNIX/Linux C-shell prompt:

> *setenv CLASSPATH nameOfDirectoryHoldThisJavaPackage*
> *java mCtrl*

Two frames, *Create IBM Control File* and *Model Domain Map Frame*, appear. Go through the following steps to create the IBM control file via the *Main Frame:*

(1) Specify the date/time information at the following text fields:

Year, Month, Day, Hour, Minute, Second,
Number of Tracking Days, and
Time Step (sec)

(2) Specify particle locations:

Horizontal Locations: Users can manually specify the parameters in the text fields of the *Main Frame* or graphically through the *Map Frame,* follow the procedures described in section 2.2.1 and define the values of the following text fields:

Particle Depth (m),
Number of Particles along Lon Dimension, and
Number of Particles along Lat Dimension

If users tend to specify the region of interest using a polygon file, skip this step and continue the following step.

(3) Specify time steps for particle position update and output:

Define the values of the following two text fields:

Tracking Control (iTrack), and
Printing Control (iPrint)

(4) Click the *Create CTRL File* button. There prompts the *Create Ctrl File* frame.

Check the box, *Read (lon, lat) Polygon File,* if users wish to specify the region of interest via a polygon file; or else check the box, *GUI Map for Locations,* which uses the information from the GUI manipulation at (2) for particle locations.

Click the button, *Specify Result File Name,* to specify the result filename.

Click the button, *Specify CTRL File Name,* to specify the IMB control filename.

Click the button, *Done File Naming,* to complete the creation of the IBM control file.

After the above manipulation, the particle locations display on the *Map Frame.* If they are not as expected, repeat the above procedures.

View CTRL File Click the button, *View CTRL File* and select an IBM control file via the file browser window shown right after the click. The particles' horizontal locations defined in the selected IBM control file are displayed in the frame of *Model Domain Map.*

Quit Click the button, *Quit,* to quit the program run.

References

Blanton, B. O., 1995: DROG3D - User's Manual for 3-Dimensional Drogue Tracking on a Finite Element Grid with Linear Finite Elements. University of North Carolina, Chapel Hill, NC, 13pp.

Werner, F. E., J. A. Quinlan, R. G. Lough, and D. R. Lynch, 2001: Spatially-explicit individual based modeling of marine populations: a review of the advances in the 1990s. *Sasia* **86**: 411-421.

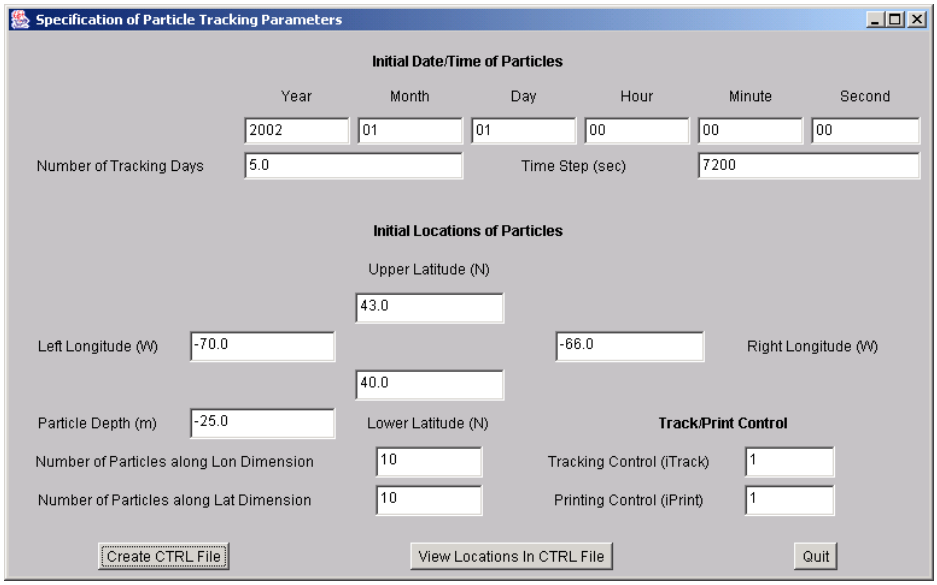

Figure 1 – Main Frame

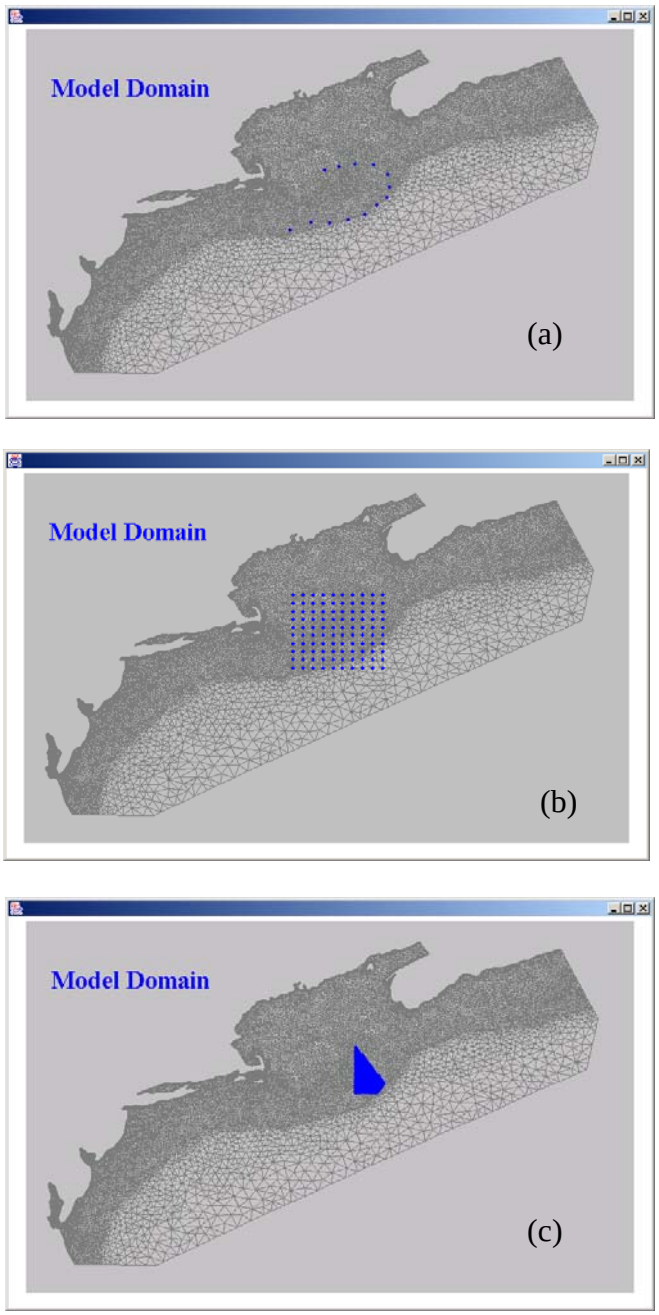

Figure 2 - Setup Initial Particle Locations

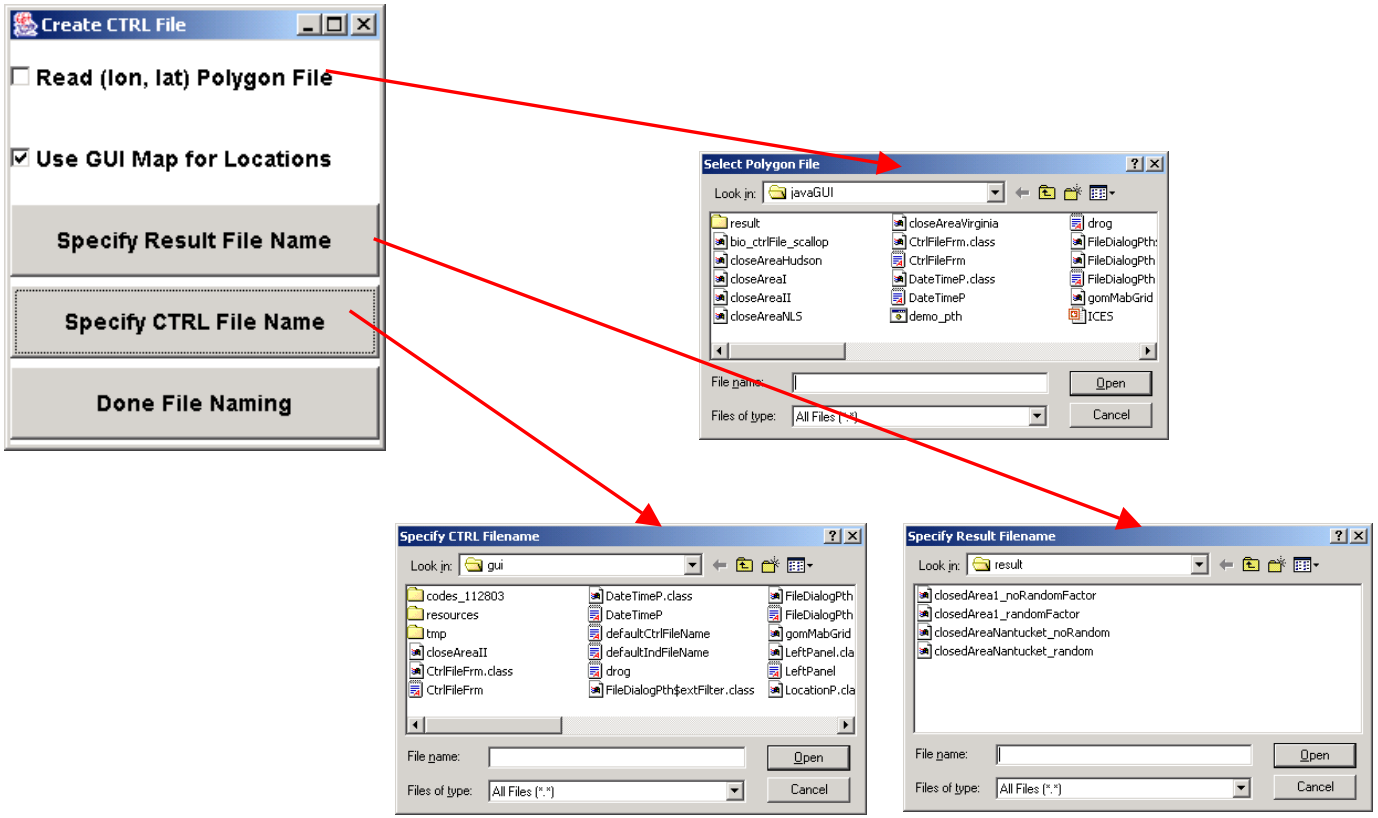

Figure 3 – Create IBM Control File