CENTRE FOR WATER RESEARCH

ARMS Lite User Manual

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Contents

CHAPTER 1

Introduction

1.1 Aquatic Realtime Management System

ARMS (Aquatic Realtime Management System) is a decision support system to aid managers and operators of surface water bodies (reservoirs, lakes, rivers, estuaries, coastal oceans). Its underlying philosophy is to provide an automated software system that requires minimal maintenance to monitor and forecast the conditions of surface water resources, and to notify relevant staff of current conditions on a regular basis.

ARMS is an automated software package that manages historical and real-time water resource data, has a user friendly visualisation interface, posts information on the internet, provides real-time and forecast numerical modelling capabilities, sends messages via email on the status of water resources, and computes decision support indices to aid in operational management. ARMS provides decision support over a variety of surface water resources (lakes, reservoirs, rivers, estuaries, marine coasts) to aid in the management of water supply, water quality, pollutant spills, flooding, and environmental lows. ARMS is an excellent decision support tool for water authorities, hydropower operators, and environmental regulators. ARMS functions on a variety of computing platforms and operating system environments.

1.2 Capabilities

ARMS was designed to require minimal human interaction and to provide useful information to water resource managers in a real-time manner. ARMS provides the following functionality:

1. Real-time data management from automated monitoring
2. Management of historical water resource databases
3. Real-time simulations of current conditions
4. Up-to-date forecast simulations
5. Email alerts of monitoring failures, incidents, and events
6. Web posting of summary status reports, simulations, and alerts
7. Quality control for data consistency
8. User-friendly visualisation of data and simulations

1.3 Benefits

ARMS provides the following benefits for water resources management:

1. Automated real-time monitoring and numerical forecasting of key operating parameters with an email service to alert staff of monitoring failures and incidents
2. Automated web postings of the current and forecast conditions of surface waters inclusive of decision support indices for sustainability
3. Assessment and control of intervention strategies for reservoir water quality such as destratification devices, withdrawal strategies, and chemical dosing
4. Scenario analysis to reduce nutrient, suspended sediment, and pathogens and optimise placement of water supply intakes in reservoirs, lakes, and rivers
5. Carbon sequestration estimates in lakes and reservoirs
6. Real-time monitoring and forecasting of river water quality below dams, tributaries, sewage treatment plants, and other point and distributed sources
7. TDML (Total Daily Maximum Load) monitoring and modelling of catchments and rivers
8. Real-time monitoring and forecasting, and rapid assessment of pollutant or toxic spills in surface waters
9. Assessment of reservoir withdrawal strategies to meet downstream fish habitat and environmental guidelines
10. Investigate options to reduce costs of water treatment
11. Increased government and public access to real-time water resources information
12. Water balance accounting for water supply purposes
13. Assessment of risk management strategies

1.4 ARMS Lite

ARMS Lite is lite weight version of ARMS designed for running the suite of CWR models and for visualising the model input and output files. It contains all the interactive visualisation of the full ARMS version but is unable to do any data processing or connect to any databases.

The ARMS GUI

2.1 GUI Layout

The key components of the ARMS GUI are shown in Figure 2.1. Each GUI component is discussed in detail in the following sections.

2.2 Menu Bar

The menu bar provides access to the key user interactions.

2.2.1 File Menu

The File menu has the following actions.

Open: Open a particular file. Currently ARMS can open the following files.

1. ELCOM Boundary Condition Files
2. ELCOM Bathymetry Files
3. ELCOM Output NetCDF files
4. DYRESM Input Files
5. DYRESM Simulation NetCDF Files
6. FIELD Profile Data files. (see Chapter 5)
7. ARMS Configuration XML files for editing
8. ARMS File List xml files.

Recent: Gives a list of recently opened files.

Close: Closes the active tab in the ARMS Working Window. To close files model input/output files that have appeared in the Resources tree right click on the file and select close.

Close All: Closes all tabs in the ARMS Working Window.

Save: Save the currently active tab to file.

Save As: Save the currently active tab to a new file.

Save All: Save all tabs to file.

Save open File List: Save a list of all the currently open model input/output files to a XML file. This file can then be opened using the open menu and all files in the list will be reopened. This is useful for quickly re-opening a number of files after a restart.

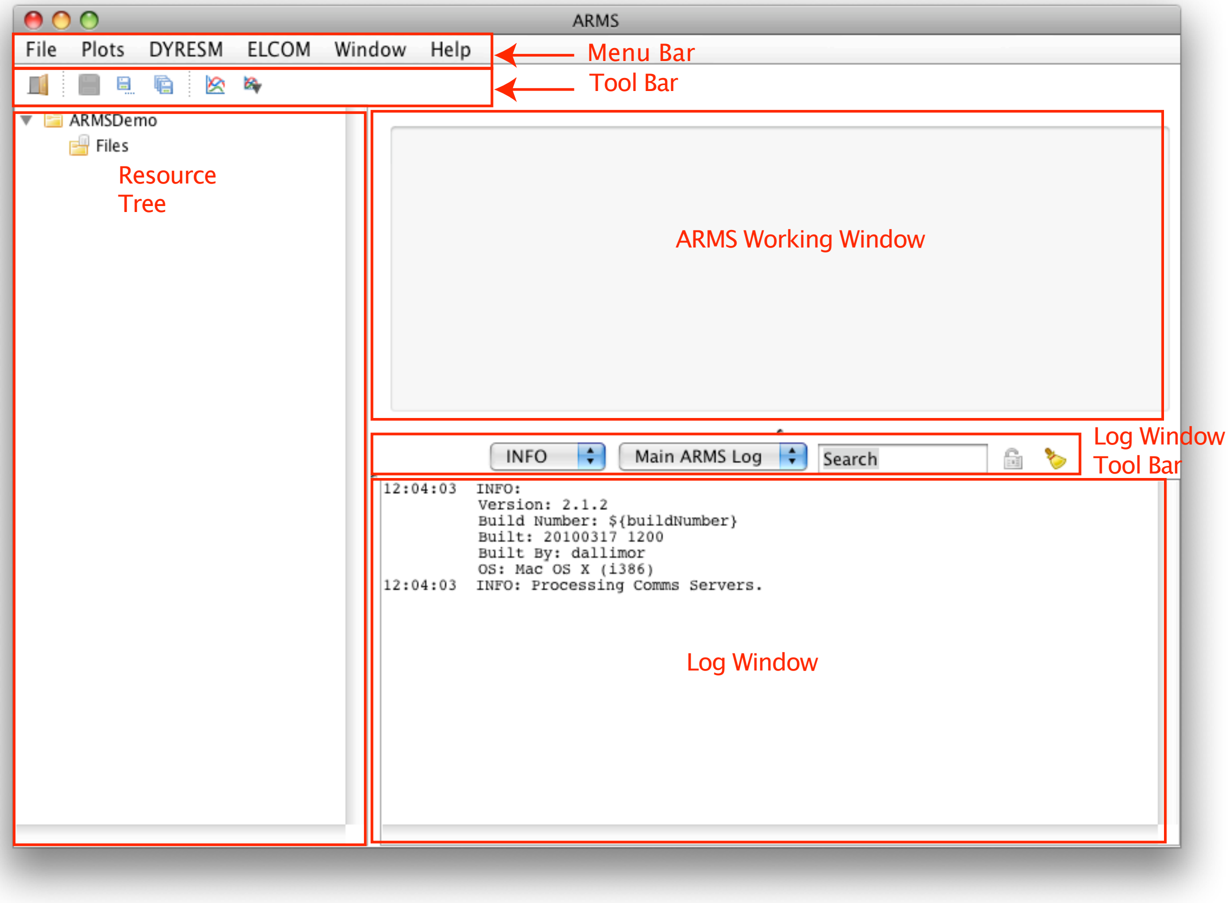

Figure 2.1 ARMSGUI Components

Save Log: Save the contents of the log window to a file. Note that the full log is automatically saved to the logs directory in the ARMS Workspace.

Change Workspace: Displays a dialog box allowing the user to select a new ARMS Workspace. A checkbox allows the user to set the new Workspace as the default.

Preferences: Displays a dialog for modifying basic preferences.

Quit: Quit ARMS.

NOTE for Apple Macintosh users the **Preferences** and **Quit** menus appear under the **ARMS** menu.

2.2.2 Plots Menu

The Plots menu has the following actions.

Recent: Gives a list of recently run Custom Plot files.

Select Plot File: Displays a file open dialog for selecting a plot file to run.

New: Creates a new empty plot configuration file. Note: It is generally easiest to generate plot files using the interactive plotting.

2.2.3 DYRESM Menu

The DYRESM menu allows users to run the DYRESM-CAEDYM model and its support programs. For the DYRESM menu actions. see Chapter 3.

2.2.4 ELCOM Menu

The ELCOM menu allows users to run the ELCOM-CAEDYM model and its support programs. For the ELCOM menu actions see Chapter 4.

2.2.5 Window Menu

The Window menu allows the Log Window to be shown or hidden.

2.2.6 About Menu

The About Menu displays a window giving Version information for ARMS executable.

2.3 Tool Bar

The tool bar allows easy access to a number of the key activities found in the menus. The icons match up with those shown in the menu bar and if the mouse is left over an icon for a period of time a tool tip will appear giving the name of the action.

2.4 ARMS Working Window

The ARMS Working Window is a tabbed component used to display a number of different objects. It is used when editing configuration files and when viewing data in a spreadsheet.

2.5 Log Window

The Log Window displays logger information including warnings and errors. It is used to display output from model executables and ARMS processing tasks. Note the log window by default displays only the last 500 lines of information but the the full log is automatically saved to the logs directory in the ARMS Workspace. The number of lines displayed in the log window can be set by right clicking on the log window and selecting 'Set Buffer Size'.

2.6 Log Window Tool Bar

The Log Window Toolbar allows the user to change the functionality of the log window. The Drop down box showing 'INFO','WARN' and 'ERROR' controls the level of information shown. For example if set to 'ERROR' only error events will be shown but if set to 'WARN' it will show both warning and error events. The second drop down box is primarily used for the full ARMS program and allows users to select between different logs.

The search field can be used to find text within the log window. Entering text and send pressing the return key will underline all instance of the text with in the log window. Pressing return again will cycle between the different instances.

The lock icon toggles the scrolling state of the window. When the lock is open and greyed out the window will automatically scroll to the bottom when new events are logged. Toggling means the window will remain in its current position.

The broom icon will clear all text from the log.

CHAPTER 3

Running DYRESM-CAEDYM

3.1 Introduction

ARMS Lite is capable of running DYRESM - CAEDYM and all it support programs via the **DYRESM** menu in the GUI. Before running any DYRESM executables the location of the CWR Model executable files needs to be given in the ARMS Preferences. To open the Preferences panel use the **File→Preferences** Menu (or **ARMS→Preferences** on a Apple Mac). The 'CWR Executables Directory' gives the Location of the directory containing CWR executables. It can be absolute (eg:C:`\cwrsoft\bin`) or relative to the ARMS WorkSpace (eg:/models/elcom/bin/).

3.2 Creating a DYRESM Simulation File

As discussed in the DYRESM User manual. Prior to running the DYRESM-CAEDYM model a DYRESM Reference and Simulation file must first be created using the **createDYref.exe**, **createDYsim.exe**, and **extractDYinfo.exe** programs. This process is simplified in ARMS Lite by using the **DYRESM→Create DYRESM-CAEDYM Sim-File** menu. Selecting this menu displays a dialog for choosing the location of the required and optional configuration files (Figure 3.1). To create a Reference and Simulation File, you will need to select all the files listed, except for the optional Artificial Mixing File and CAEDYM Configuration file. As DYRESM-CAEDYM simulations are often setup with all files having the same base name and just different extension the dialog box has been configured to automatically fill file fields when the DYRESM Configuration File is changed. This is done be searching the parent directory of DYRESM Configuration File and searching for files with the same name and the appropriate extension.

When OK is clicked the various executables are then spawned as external processes with the output shown in the ARMS log window. The user should review the log window for any warnings and error messages.

3.3 Running DYRESM-CAEDYM

dycd.exe is the main DYRESM-CAEDYM executable. **dycd.exe** takes one input file the 'DYSIM.nc' file created in the previous step. Selecting the **DYRESM→Run DYCD Simulation** menu brings up a dialog for choosing the location of a **DYSIM.nc** file. The user merely selects the appropriate file and hits **OK**. **dycd.exe** is then spawned as an external process with the output shown in the ARMS log window. The user should review the log window for any warnings and error messages.

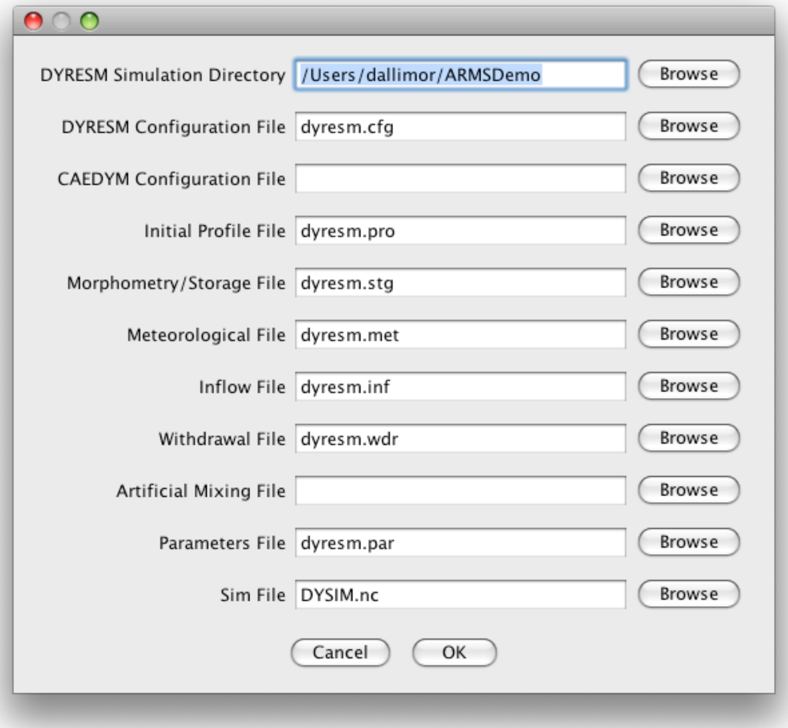

Figure 3.1 DYRESM Sim File Creation File Creation dialog

Running ELCOM-CAEDYM

4.1 Introduction

ARMS Lite is capable of running ELCOM - CAEDYM and all it support programs via the **ELCOM** menu in the GUI. To run an ELCOM simulation the ELCOM *datablock* input file needs to use the new *idatablock=3* datablock format. Information on the new datablock format can be found in the ELCOM manual. Old datablock files can be converted to the new format using the **Convert datablock to V3** item under the **ELCOM** menu.

Before running any ELCOM executables the location of the CWR Model executable files needs to be given in the ARMS Preferences. To open the Preferences panel use the **File→Preferences** Menu (or **ARMS→Preferences** on a Apple Mac). The 'CWR Executables Directory' gives the Location of the directory containing CWR executables. It can be absolute (eg:C:`\cwrsoft\bin`) or relative to the ARMS WorkSpace.

4.2 Running pre_elcom.exe

pre_elcom.exe is used to convert the raw ELCOM bathymetry and boundary condition text files in to Fortran binary files as used by the main ELCOM code. For information on setting up the **pre_elcom.exe** files see the ELCOM user manual.

Selecting the **ELCOM→Run pre_elcom** menu brings up a dialog for choosing the location of a **run_pre.dat** file. The user merely selects the appropriate file and hits **OK**. **pre_elcom.exe** is then spawned as an external process with the output shown in the ARMS log window (Figure 4.1). The user should review the log window for any warnings and error messages. Once the **pre_elcom** executable has finished the user needs to manually copy the output *unf* files to the appropriate location in their ELCOM run directory (eg:/models/elcom/bin/).

4.3 Running createCDsim.exe

createCDsim.exe is used to create the CAEDYM.nc NetCDF simulation file used if CAEDYM is being run in an ELCOM-CAEDYM simulation. **createCDsim.exe** takes one input file a '.con' control file which links to other text files. For information on setting up the **createCDsim.exe** files see the CAEDYM user manual.

Selecting the **ELCOM→Run createCDsimexe** menu brings up a dialog for choosing the location of a CAEDYM **.con** file and the location for the output CAEDYM.nc file (Figure 4.2). The user merely selects the

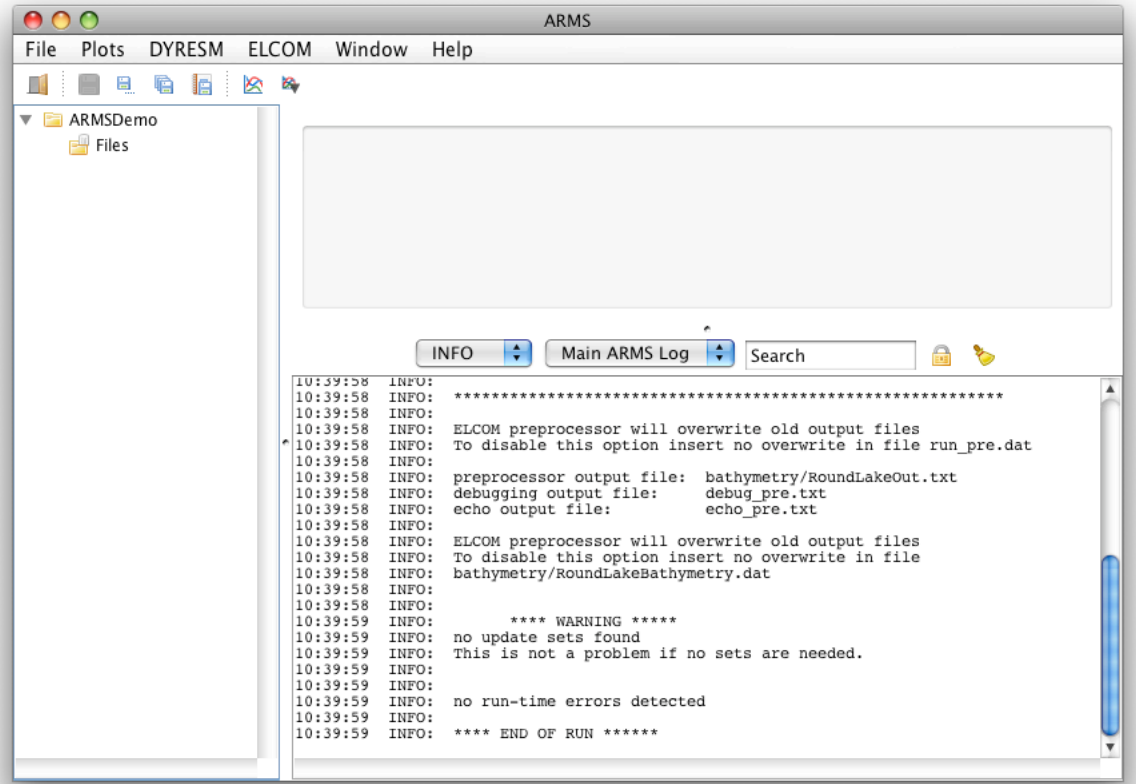

Figure 4.1 ARMS Window Showing pre_elcom log

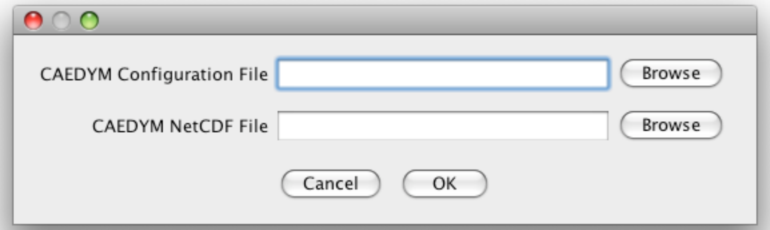

Figure 4.2 createCDsim File selection dialog

appropriate files and hits **OK**. The CAEDYM.nc file should be located in the same directory as the ELCOM run_elcom.dat file. **createCDsim.exe** is then spawned as an external process with the output shown in the ARMS log window. The user should review the log window for any warnings and error messages.

4.4 Running ELCOM-CAEDYM

elcd.exe is the main ELCOM-CAEDYM executable. **elcd.exe** takes one input file a 'run_elcom.dat' control file which links to other text files, the CARDYM.nc file and the '.unf' file outputs from **pre_elcom.exe**. For information on setting up the **elcd.exe** files see the ELCOM user manual.

Selecting the **ELCOM→Run ELCD Simulation** menu brings up a dialog for choosing the location of a **run_elcom.dat** file. The user merely selects the appropriate file and hits **OK**. **elcd.exe** is then spawned as an external process with the output shown in the ARMS log window. The user should review the log window for any warnings and error messages. After the ELCOM simulation is complete ARMS will automatically run the **dbconv_v3.exe** on all output *unf* files and create the corresponding NetCDF files in a **ncfiles** directory.

4.5 Editing ELCOM Bathymetry Files

ARMS Version 2 introduced the ability to do some simple manipulations of ELCOM bathymetry files using a graphical editor. To edit a bathymetry file first open it in ARMS using the **File→Open** menu. For this manual we will use the bathymetry file from the Round Lake ELCOM example. When we open the 'RoundLakeBathymetry.dat' file a new resource called 'RoundLakeBathymetry' appears in the Resource Tree under the Files folder (Figure 4.3).

Right clicking on the Bathymetry resource creates a popup menu where users can interact with the resource. The file can be refreshed, closed or opened in the default system text editor. To graphically edit the bathymetry file select the **Edit Bathymetry** action. This creates a new window as shown in Figure 4.4. The bathymetry file editor has three major components:

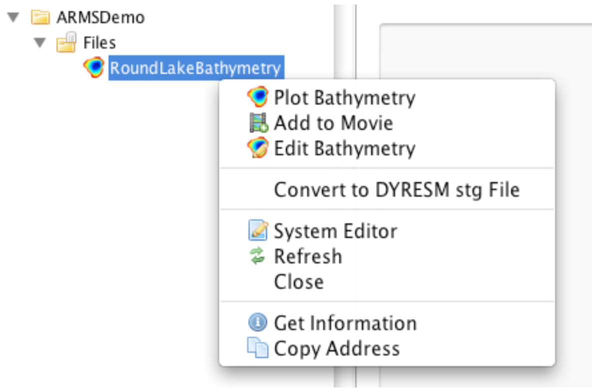

Figure 4.3 The ELCOM Bathymetry File Resource. Right clicking on the resource creates a popup menu for interacting with the resource.

1. a toolbar for selecting which tool is being used. A description of each of the tools is given below.
2. a display window for showing the bathymetry depth data.
3. a status bar which gives information on the location of the mouse. As the mouse pointer is moved around the display window the status bar updates showing the x,y location in ELCOM co-ordinates, the i,j location in ELCOM co-ordinates, the latitude and longitude and the depth of the cell.

There a number of ways in which the user can interactively modify a figure, interactions can be called from the Figure Toolbar or by Right Clicking on an axes. The actions available when right clicking on the plot are shown in Figure 4.5. These actions are summarised below.

4.5.1 Tools

The various tool actions each operate on an individual cell when the cell is clicked on. Selecting a tool action will change the mouse pointer to match the toolbar icon of the tool. Users then can manipulate the bathymetry by clicking on a cell. The currently selected tool is shown with a color icon. The available tools are:

Zoom: by clicking and dragging the user can zoom in on a region of interest. Double clicking with the zoom tool returns the figure to the default zoom level.

Pan: allows the user to interactively move the center of the figure without changing the zoom level.

Increase bathymetry height: this tool will increase the height of the cell that is clicked on. The height adjustment is set in the text box on the toolbar.

Decrease bathymetry height: this tool will reduce the height of the cell that is clicked on. The height adjustment is set in the text box on the toolbar.

Interpolate in X direction: this tool sets the bathymetry to a linear interpolation of the cell above and

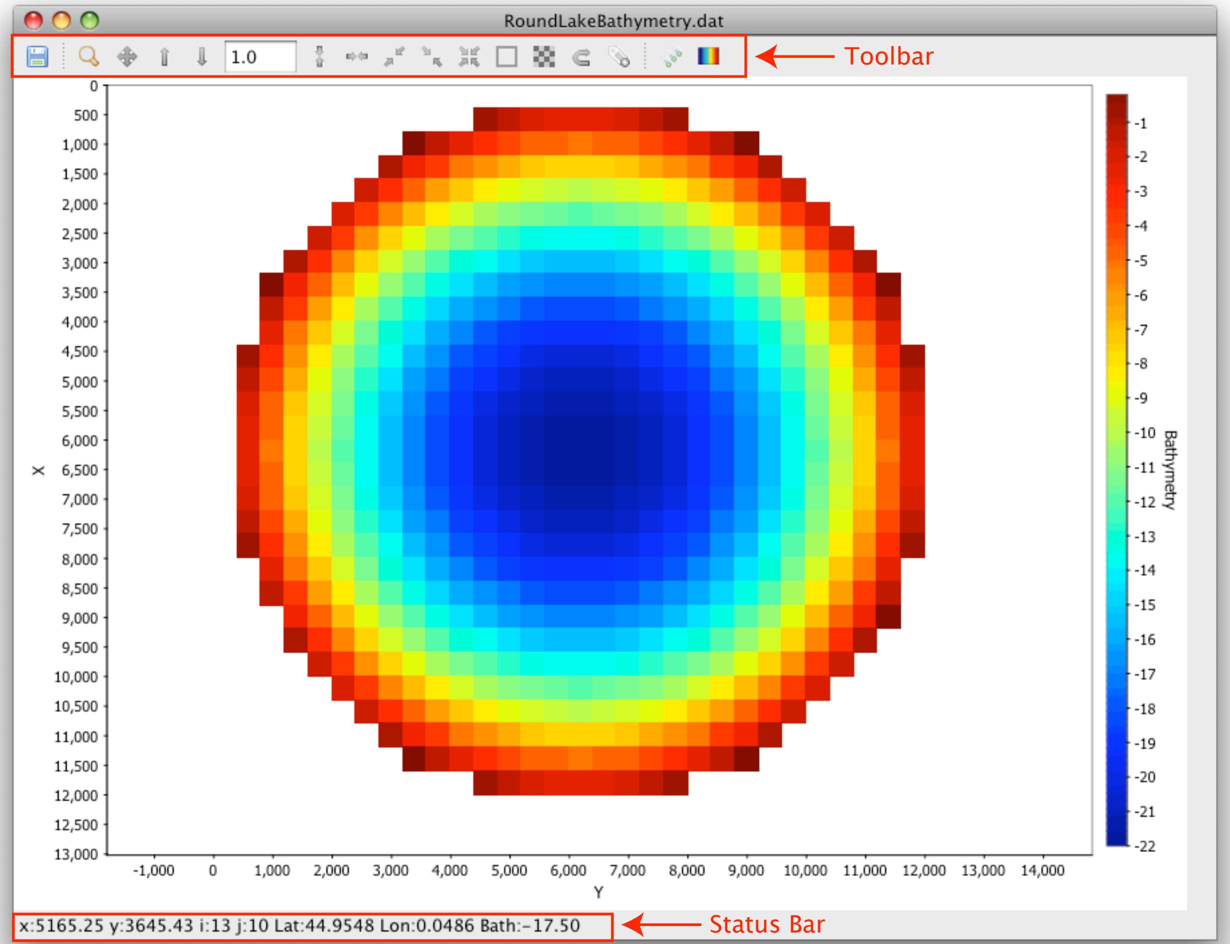

Figure 4.4 The ELCOM Bathymetry File Editor.

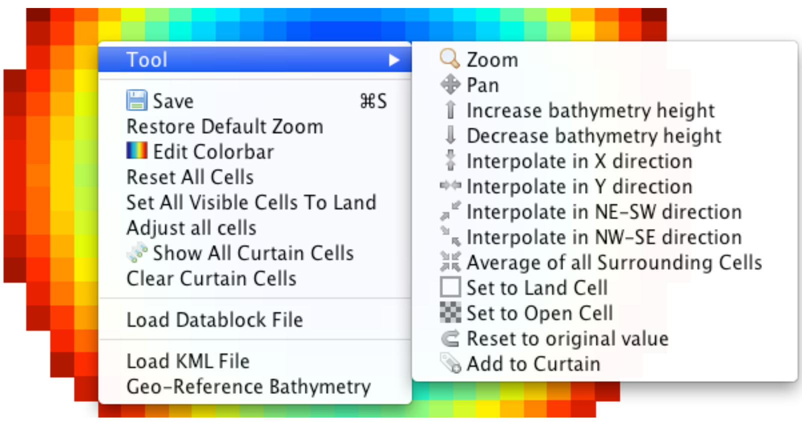

Figure 4.5 The available Bathymetry File editing options.

the cell below.

Interpolate in Y direction: this tool sets the bathymetry to a linear interpolation of the cell to the left and the cell to the right.

Interpolate in NE-SW Direction: this tool sets the bathymetry to a linear interpolation of the cell diagonally to the bottom left and the cell to the top right.

Interpolate in NW-SE Direction: this tool sets the bathymetry to a linear interpolation of the cell diagonally to the top left and the cell to the bottom right.

Average of all Surrounding Cells: this tool sets the bathymetry to a an average of the eight surrounding cells. Only non-land cells are used.

Set to Land Cell: set the cell clicked on to a land cell.

Set to Open Cell: set the cell clicked on to an open boundary condition cell.

Reset to original value: reset the cell to the original value.

Add to curtain: this tool is used for generating a list of locations for a curtain in an ELCOM datablock file. When a cell is clicked on a small square with a red outline and filled black is drawn in the cell. As additional cells are selected the previous cells are shown with a filled white square (Figure 4.6). The **Show All Curtain Cells** action then attempts to find all cells between the selected points. The cells are displayed in the bathymetry editor window (Figure 4.7) and the location of all cells is shown in the main ARMS Log Window (Figure 4.8). The text in the Log Window can be simply copied from the log and pasted into an ELCOM datablock XML file.

4.5.2 Other interactions

There are number of non-tool interactions that can be performed from the toolbar or the right-click popup menu. These actions are summarised below:

Save allows the modified file to be saved. This only save the text bathymetry file. To use the new bathymetry file in an ELCOM simulation **pre_elcom.exe** needs to be re-run.

Restore Default Zoom resets the axes limits to the default zoom level showing the full bathymetry.

Edit Colorbar initiates a dialog for modifying the colorbar for colored plots. Users can change the colormap used and the limits of the colour scale.

Reset All Cells resets all cells to the original values.

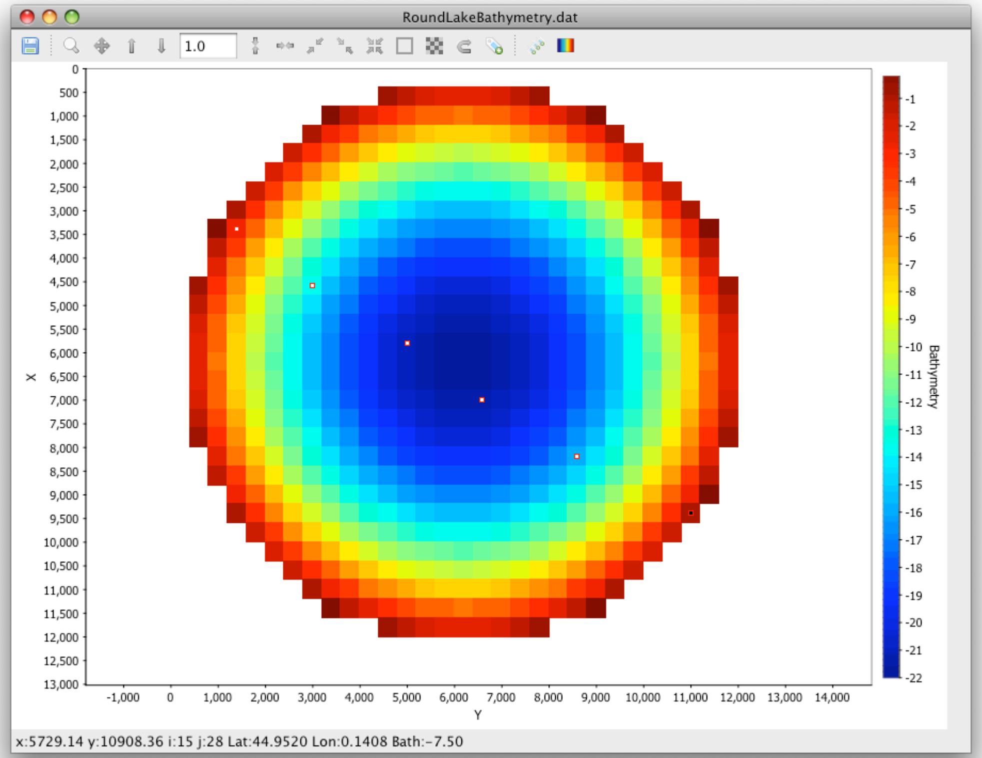

Figure 4.6 Selection of Curtain Cells.

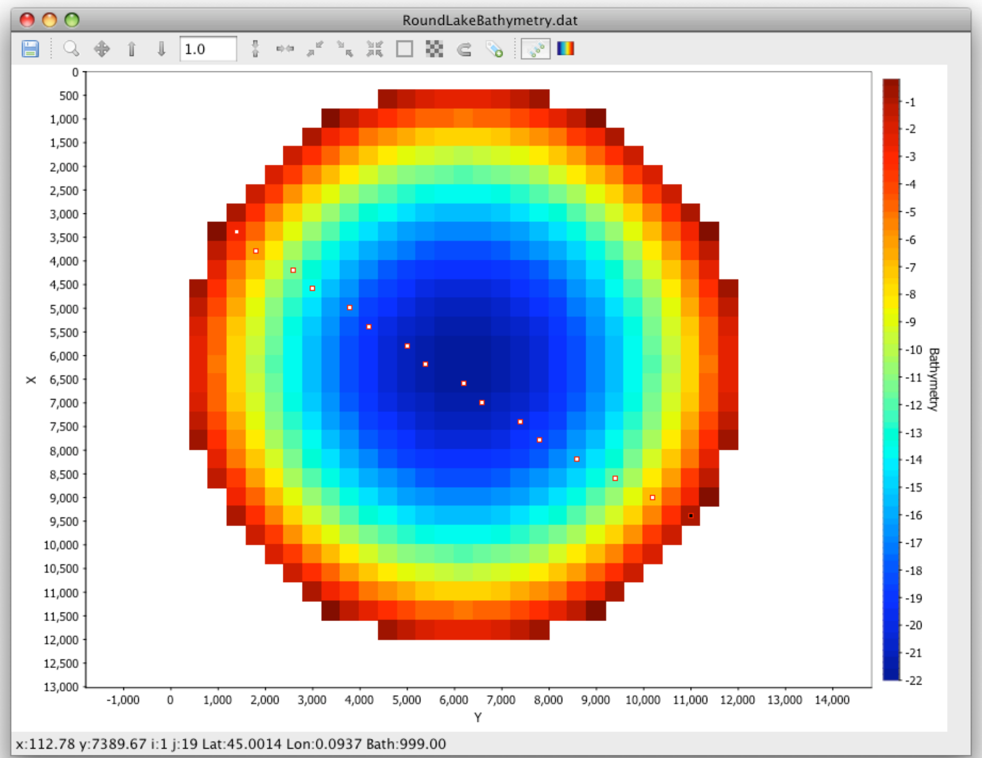

Figure 4.7 Generation of all Curtain Cells.

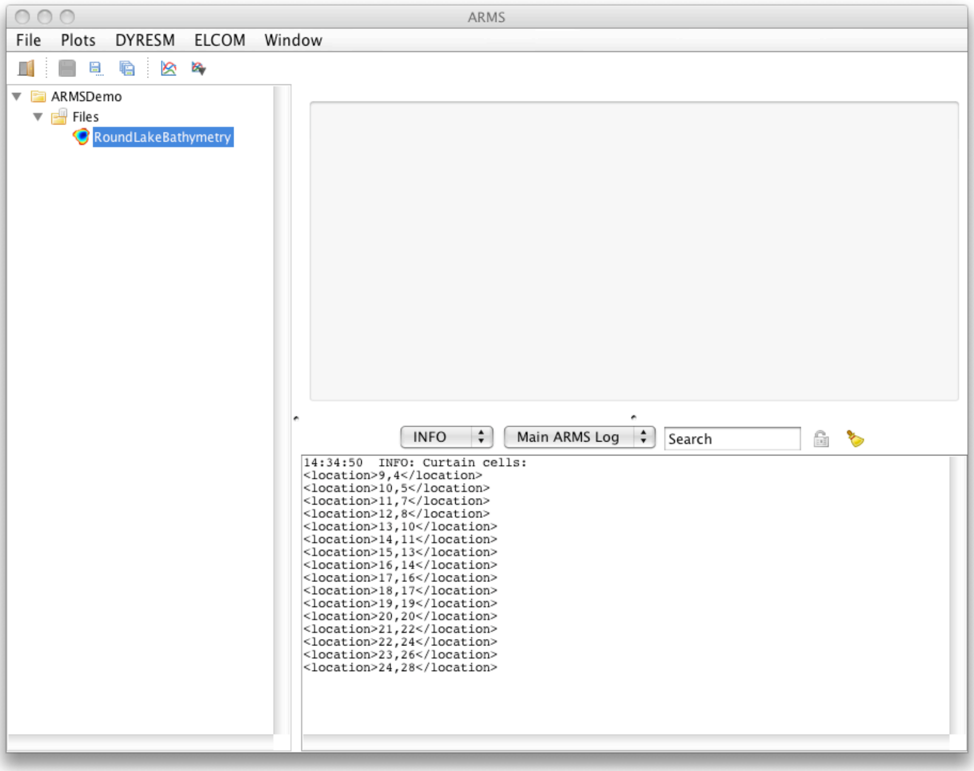

Figure 4.8 ARMS Log Window showing selected curtain cells for a datablock file.

Set All Visible Cells To Land will set all the cells shown in the window to land. Users can then zoom into a selection of the bathymetry and set it to land.

Adjust All Cells will prompt the user to enter a value by which all non-land cells will be offset by.

Clear Curtain Cells clears any selected curtain cells.

Load datablock file will load in a user selected datablock file and plot the location of all curtains.

Load KML file will load in a Google Earth generated KML Outline file and plot it as a black line in the Bathymetry Editor Window (Figure 4.9). The **Geo-Reference Bathymetry** action can then be used to adjust the latitude and longitude of the bathymetry file to match up with KML file. The basic steps for geo-referencing a bathymetry file are

1. in Google Earth create an outline around the ELCOM site.
2. load the ELCOM bathymetry File into ARMS and open up the bathymetry file editor.
3. load the KML file into the Bathymetry Editor.
4. Using the The **Geo-Reference Bathymetry** action adjust the latitude, longitude and north angle of the bathymetry file to get the best fit of the bathymetry file to the outline.
5. Save the bathymetry file and run **pre_elcom**.

The latitude and longitude of the bathymetry file are the co-ordinates of the top left corner of the bathymetry.

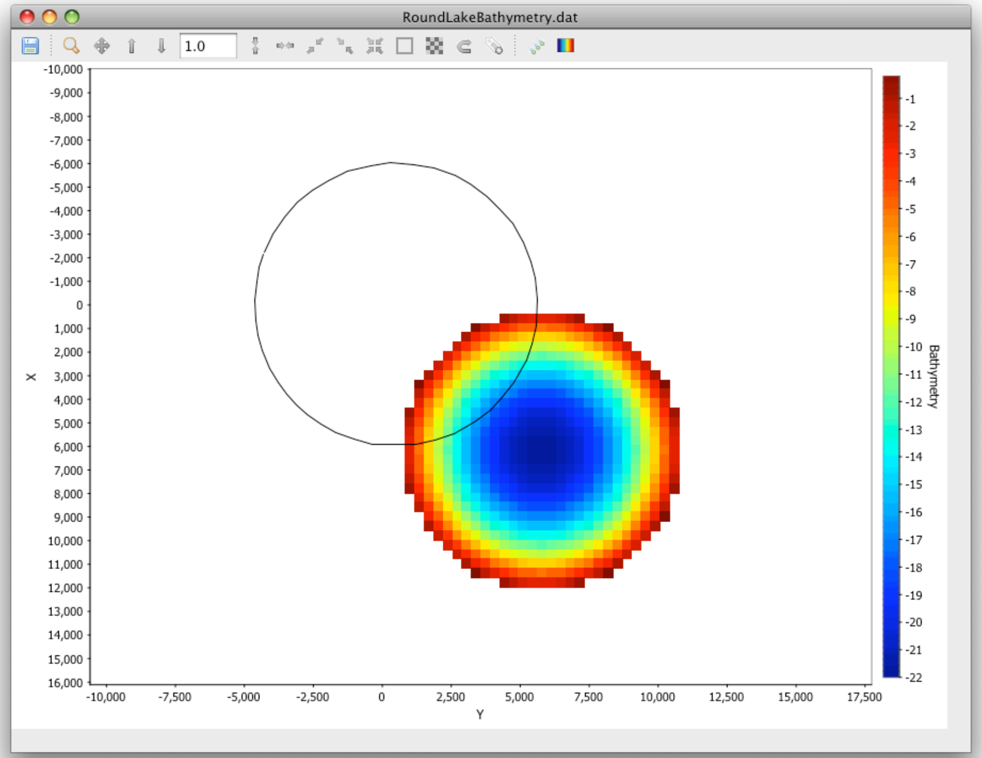

Figure 4.9 ELCOM Bathymetry Editor showing a Google Earth Generated KML file.

Once a file has been geo-referenced the correct latitude and longitude data will be given in all output NetCDF files.

CHAPTER 5

Field data file

To allow users to be able to compare model results to measured field data a simple text file format for profile field data has been specified. The field data file contains a series of data blocks, one for each measurement period. Data are organised in vertical columns for measured variables. The fields required for each data block are as follows.

ORDINAL DATE	Number of depths		
ORDINALDATE_value	ndepths_value	surface_level	
DEPTH	VARIABLE 1	VARIABLE 2	VARIABLE 3
depth_1	$\text{var}_1\text{\_value}_1$	$\text{var}_2\text{\_value}_1$	$\text{var}_3\text{\_value}_1$
...	...	...	...
depth_n	$\text{var}_1\text{\_value}_n$	$\text{var}_2\text{\_value}_n$	$\text{var}_3\text{\_value}_n$
EOF			

The $surface\_level$ value is optional and gives the water level height. If not present it is assumed to be zero. Using the $surface\_level$ allows improves visualisation when comparing model and simulation results where the water level changes significantly.

Note: The order of variables must not change from one measurement period to the next. This means that the all measured variables must be present in each data block. If no data is recorded, use a no data flag value such as -999.

Each data block must have the **same** number of columns, but the number of rows **can vary**, to allow for different depth resolutions to be included on different days

An example of field data file is shown below.

```
Yr_Jul_day layers surface_level
1998126    3      180.1
DEPTH WTR_TEMP DO  PH   PO4   TP    NH4   NO3   TN    SiO2 FBOD CHLA SSOL1   SBOD   SIZE1
0.3   17.2     8.5 8.44 0.036 0.103 0.064 1.320 1.490 9.9  7.0  10.7 -999.0  -999.0 -999
2.8   17.0     8.3 8.48 0.027 0.052 0.056 1.060 1.204 9.1  5.5  13.2 5.3     -999.0 -999
5.7   16.7     7.9 8.34 0.026 0.057 0.090 1.080 1.228 9.2  4.7  18.9 -999.0  -999.0 -999
Yr_Jul_day layers surface_level
1998140    3      180.1
DEPTH WTR_TEMP DO  PH   PO4   TP    NH4   NO3   TN    SiO2 FBOD CHLA SSOL1   SBOD   SIZE1
0.3   19.4     7.5 7.88 0.029 0.068 0.092 1.000 1.236 10.6 3.4  9.4  -999.0  -999.0 0.18
2.8   18.1     7.4 7.86 0.033 0.144 0.090 1.020 1.098 11.4 3.4  10.9 6.6     -999.0 -999
5.7   17.9     6.3 7.68 0.019 0.088 0.132 1.040 1.524 12.4 2.7  16.1 -999.0  -999.0 0.27
Yr_Jul_day layers surface_level
```

```
1998154    3      180.2
DEPTH WTR_TEMP DO  PH   PO4   TP    NH4   NO3   TN    SiO2 FBOD CHLA SSOL1   SBOD   SIZE1
0.3   23.2     8.9 7.97 0.041 0.062 0.098 0.720 1.524 11.3 10.1 13.4 -999.0  -999.0 -999
2.8   21.8     7.2 7.70 0.052 0.078 0.098 0.720 1.590 11.9 8.9  16.0 13.8    -999.0 -999
5.7   20.3     3.5 7.19 0.063 0.110 0.106 0.820 1.722 14.1 8.3  16.6 -999.0  -999.0 -999
Yr_Jul_day layers surface_level
1998168    3      180.4
DEPTH WTR_TEMP DO  PH   PO4   TP    NH4   NO3   TN    SiO2 FBOD CHLA SSOL1   SBOD   SIZE1
0.3   24.8     6.9 7.60 0.076 0.099 0.112 0.700 1.188 11.5 5.4  16.7 -999.0  -999.0 0.05
2.8   22.9     5.3 7.26 0.056 0.084 0.166 0.760 1.130 11.0 5.6  15.7 6.4     -999.0 -999
5.7   22.2     3.7 6.98 0.067 0.083 0.244 0.860 1.072 12.1 5.3  16.5 -999.0  -999.0 0.06
Yr_Jul_day layers surface_level
1998185    3      180.38
DEPTH WTR_TEMP DO  PH   PO4   TP    NH4   NO3   TN    SiO2 FBOD CHLA SSOL1   SBOD   SIZE1
0.3   28.7     7.3 6.90 0.060 0.053 0.100 0.120 0.274 10.5 0.4  6.2  -999.0  -999.0 -999
2.8   28.1     6.8 6.92 0.089 0.067 0.110 0.200 0.430 10.8 0.5  6.4  3.3     -999.0 -999
5.7   24.8     2.9 6.74 0.189 0.162 0.344 0.420 0.888 9.3  0.5  7.1  -999.0  -999.0 -999
Yr_Jul_day layers surface_level
1998200    3      180.36
DEPTH WTR_TEMP DO  PH   PO4   TP    NH4   NO3   TN    SiO2 FBOD CHLA SSOL1   SBOD   SIZE1
0.3   25.7     8.9 8.22 0.101 0.388 0.218 0.380 0.826 15.8 3.1  52.7 6.7     3.7    0.12
2.8   25.6     8.5 8.18 0.084 0.442 0.148 0.500 1.268 14.5 2.9  52.9 11.7    4.7    -999
5.7   24.9     5.3 7.50 0.109 0.383 0.202 0.560 1.270 22.0 2.1  39.4 3.6     4.1    0.13
```

CHAPTER 6

Plotting

6.1 Introduction

This section details the interactive plotting of model files. For this chapter we will focus on ELCOM-CAEDYM and make use of the ELCOM Round Lake example. Visualisation of DYRESM-CAEDYM files or Database resources in the full ARMS Version is carried out using exactly the same methodology.

6.2 1-Dimensional Time Series Data

1-Dimensional Data includes ELCOM boundary condition data, ELCOM aggregate profile NetCDF files, ELCOM outflow NetCDF files and inflow/meteorological data in a DYRESM simulation file. Lets start by loading in the ELCOM Meteorological boundary condition file 'IdealisedMetDataJan2005.dat' using the **File→Open** menu. A new folder called 'IdealisedMetDataJan2005' appears in the Resource Tree under the Files folder. Expanding this file shows us all the boundary conditions in the file as shown in Figure 6.1.

To plot a resource, right click on it and navigate to **Plot→New Figure** in the popup menu (Figure 6.2). When selected the user is presented with a dialog for selecting the date range of the plot (Figure 6.3). By default ARMS fills the start and end date values with the start and end dates of the data. The dialog window provides functions for selecting the last n days, resetting to default values and setting the end date to the current value. Clicking OK will produce a figure showing the boundary condition data for the selected period. For example the Air Temperature data is shown in Figure 6.4.

Additional data can be added to the figure right clicking on a resource and navigate to **Plot→Add To Figure** in the popup menu (Figure 6.2). This will display a window (Figure 6.5) where the user can select how the data will be added to the figure. The dialog allows the user to select which figure the data will be added to (the figure number is displayed in the title bar of each figure). Users can choose to add the data in a new axes or add it to an existing axes. If data is added as a new axes the axes is created at the bottom of the figure window (Figure 6.6). If data is added to an existing axes the user can optionally use the right Y-Axis for the scale (Figure 6.7). The **New Figure** and **Add To Figure** commands allow the

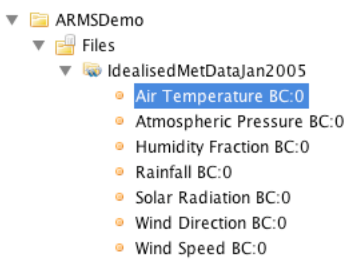

Figure 6.1 Resource Tree showing all boundary condition data in IdealisedMetDataJan2005.dat

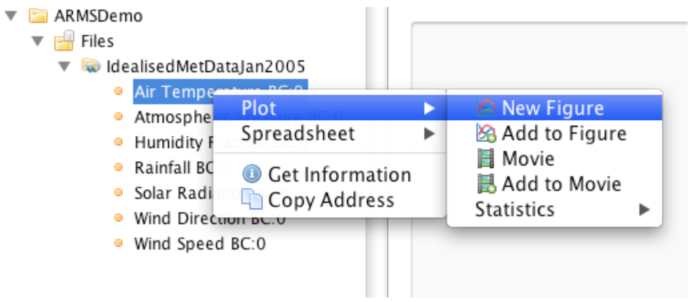

Figure 6.2 Right-Click Plot Popup menu for a Boundary Condition Resource

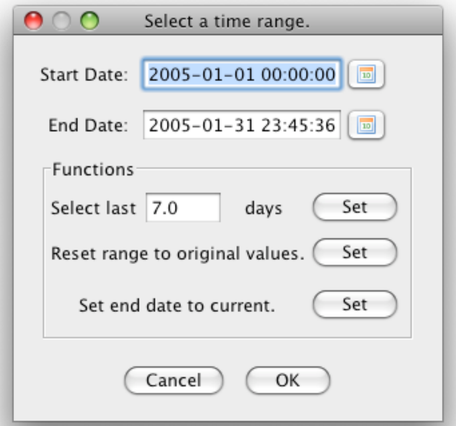

Figure 6.3 Plot date range selection

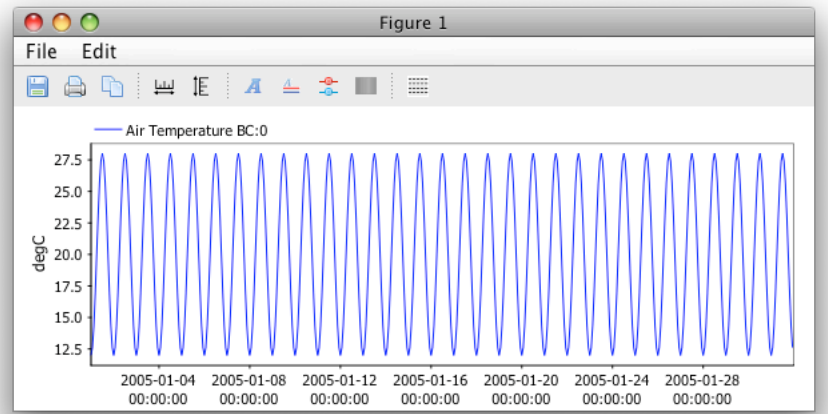

Figure 6.4 Air Temperature Data

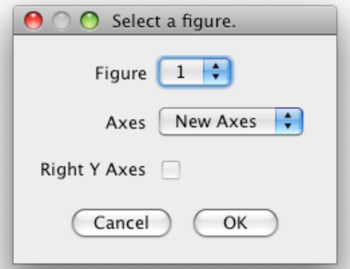

Figure 6.5 Plot add to figure dialog

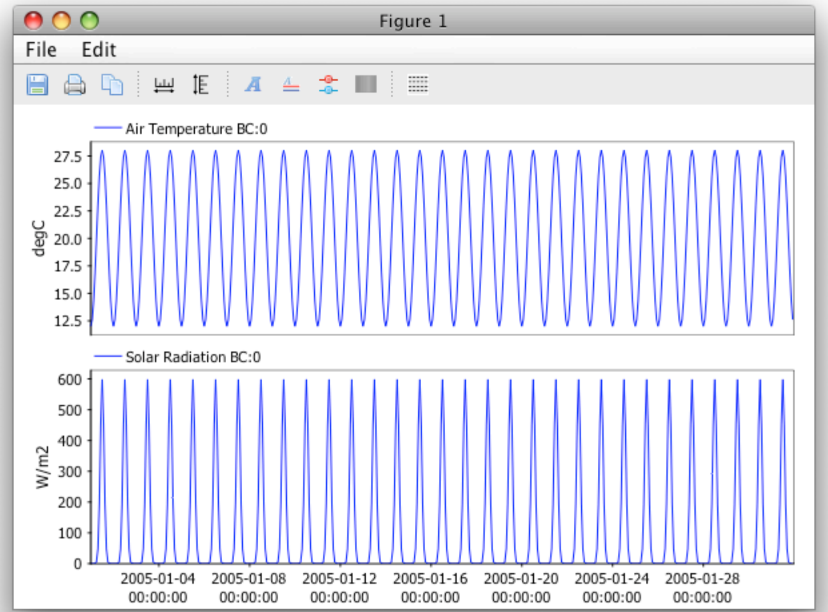

Figure 6.6 Air Temperature and Shortwave Radiation data on separate axes

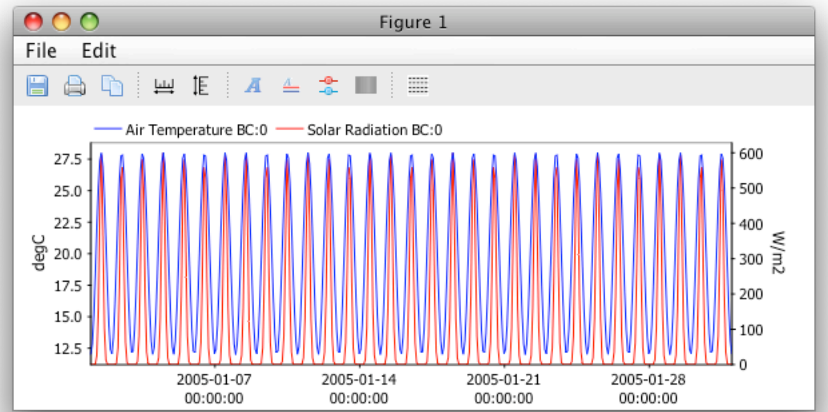

Figure 6.7 Air Temperature and Shortwave Radiation data on the same axes. Shortwave radiation uses the right y axes scale

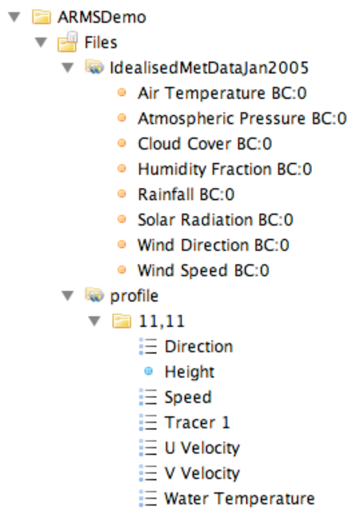

Figure 6.8 Resource Tree showing all data in profile.nc

user to quickly and intuitively produce plots of the data resources.

6.3 Profile Time Series Data

1-Dimensional Data includes ELCOM profile boundary condition data, ELCOM profile NetCDF files, profile data in a DYRESM simulation file and Field Data files (Chapter 5). Lets start by loading in the ELCOM 'profile.nc' output file using the file using the **File→Open** menu. A new folder called 'profile' appears in the Resource Tree under the Files folder. Expanding this file shows us all the outputs in the file as shown in Figure 6.8. In addition if the profile file contains both the U and V velocity components then ARMS will also show *Speed* and *Direction*. The three blue dot-dashs indicate the data is profile time series data.

Right clicking on a profile time series resource shows the various plotting options available (Figure 6.9). **Plot→New Figure** and **Plot→Add To Figure** work the same as for 1-Dimension data but produce colour heatmap plots of the data values against time and depth. An example of a Temperature profile plot is shown in Figure 6.10.

The **Plot→1 Depth/Height (New Figure)** and **Plot→1 Depth/Height (Add To Figure)** actions allow the user to plot a line plot of the data at a particular depth below the surface or height above the ELCOM datum.

The **Plot→1 Profile (New Figure)**, **Plot→1 Profile (Add To Figure)** and **Plot→Last Profile** actions plot profile line plot of data at one time vs depth. For **Plot→1 Profile (New Figure)** and **Plot→1 Profile (Add To Figure)** the user must select the date to be plotted.An example line plot at two different dates is shown in Figure 6.11.

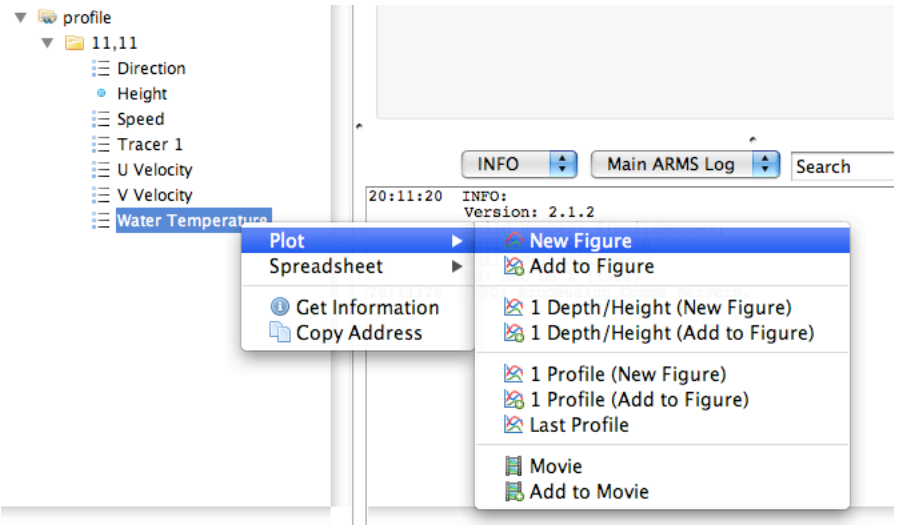

Figure 6.9 Profile Resource plotting options

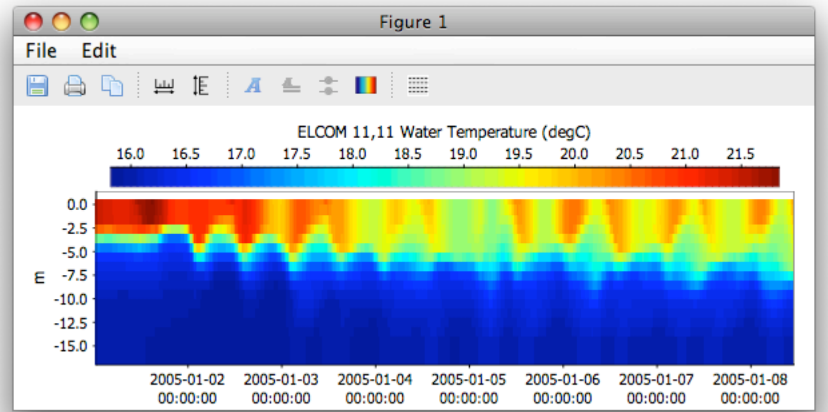

Figure 6.10 Example Profile Plot

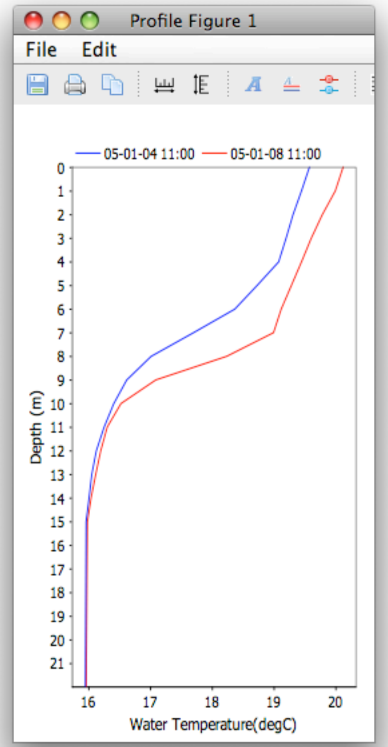

Figure 6.11 Example Profile Line Plot

6.4 Plot Interactions

ARMS provides a number of ways in which the user can interactively modify a figure, interactions can be called from the Figure Menu Bar, the Figure Toolbar or by Right Clicking on an axes. For interactions that affect only one axes if the action is selected form the Menu or Toolbar it will act on the last clicked on axes. The actions available when right clicking on the plot are shown in Figure 6.12. These actions are summarised below.

Save allows the user to save a figure as PNG image file.

Save Plot XML Configuration allows the user to save a Custom Plot Configuration file which can then be used by ARMS to regenerate the current plot.

Print open a dialog to print the figure.

Copy copy the figure to the operating systems clipboard. Once in the clipboard the figure can be pasted into other applications such as Microsoft Word.

Modify Date-Limits modify the date limits of this figure. The figure will be regenerated using the new limits.

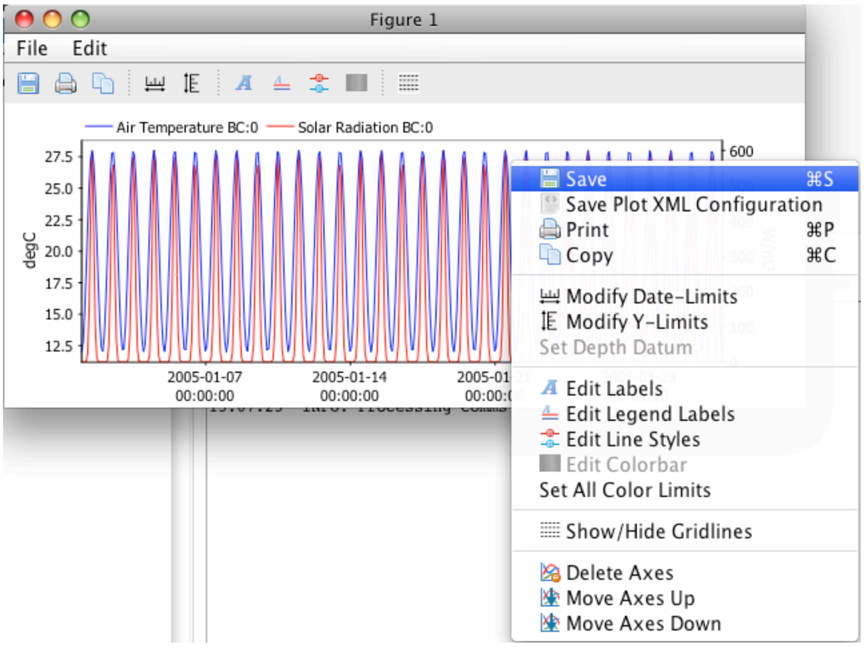

Figure 6.12 Right clicking on an axes allows the user to modify the plot

Modify Y-Limits modify the y axis limits of this axes.

Edit Labels allows users to add a Title to the plot and modify the axes labels and fonts. The date format for the date axes can also be changed. The date format uses two lines of dates and makes use of the Java Simple-Dateformat date field identifiers (see http://java.sun.com/j2se/1.4.2/docs/api/java/text/SimpleDateFormat.html for more information).

Edit Legend Labels allows users to change the default label shown in the legend above the plot.

Edit Line Style allows users to change the colour and line style for each data source. Users can also add shape markers at the data point locations.

Edit Colorbar initiates a dialog for modifying the colorbar for colored plots. Users can change the colormap used and the limits of the colour scale.

Set All Color Limits allows users to change the colour limits on all axes at once. This is especially useful when comparing model results to field data.

Show/Hide Gridlines toggles the visibility of grid lines on the axes.

Delete Axes delete the selected axes from the figure.

Move Axes Up move the selected axes up the figure.

Move Axes Down move the selected axes down the figure.

Creating Movies

7.1 Introduction

ARMS Lite has the ability to generate multi-axes movies from ELCOM simulation results. Movies can show ELCOM curtains or sheets changing in time and can also show the progression of boundary condition data. Movies can be built interactively from the resource tree and then either played in the ARMS window or saved to a movie file.

7.2 Curtain and Sheet Data

ELCOM curtain and sheet NetCDF output files can be opened in ARMS as easily as other files. Lets start by loading in the ELCOM output file 'curtain_NS.nc' from the Round Lake Example using the **File→Open** menu. A new folder called 'curtain_NS' appears in the Resource Tree under the Files folder. Expanding this file shows us all the output variable in the file as shown in Figure 7.1.

To create a movie of a resource, right click on it and click **Movie** in the popup menu. This will create a movie window. For example the Curtain Temperature data is shown in Figure 7.2. The time range of the movie is automatically set to the full range of the file being plotted. The movie axes has a number of interactions similar to time series and profile line plots. The date of the current frame is shown in the top right corner of the movie. In addition at the right of the toolbar are six icons for playing and traversing the movie (Figure 7.3). The icons allow the user to play the movie, to skip one frame/timestep in either direction, to skip one day in either direction or to select a date.

7.3 Time Series Data

Movies can also be created from 1-Dimensional or Profile Time Series data (as used in Chapter 6). For example we can create a movie of the air temperature boundary condition data in 'IdealisedMetDataJan2005.dat' by right clicking on the resource and navigating to **Plot→Movie** in the popup menu. This will create a movie figure similar to Figure 7.4. As the movie is played the vertical black line showing the current date moves from left to right across the axes. Alternatively by right clicking on the date axes and selecting the **Set Moving Date Range** action the axes can be set to a 'Moving Date Axes'. For a moving date axes the current date always remain in the center of the axes and the data traverses from right to left as the movie is played. The 'Moving Date Axis Delta' parameter controls the amount of data shown either side of the current date in days.

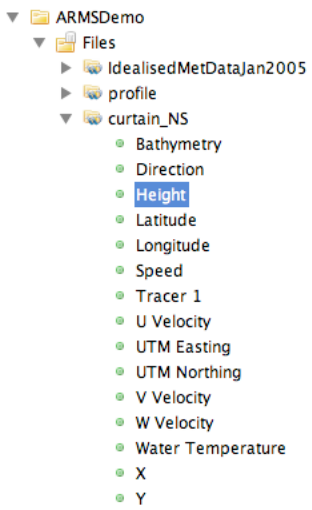

Figure 7.1 Resource Tree showing all output variables in curtain_NS.nc

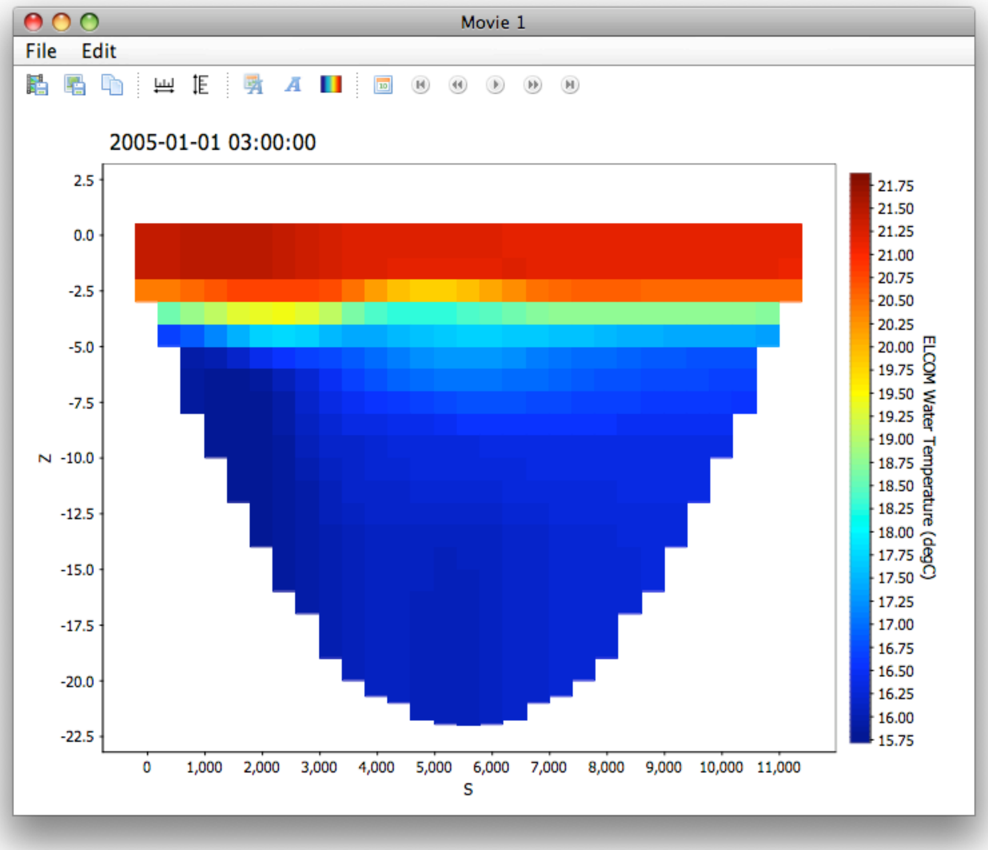

Figure 7.2 An example of a movie window showing Water Temperature in a curtain

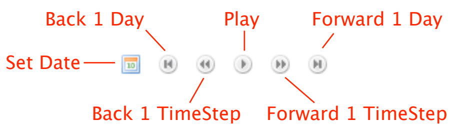

Figure 7.3 The movie toolbar for traversing simulation time

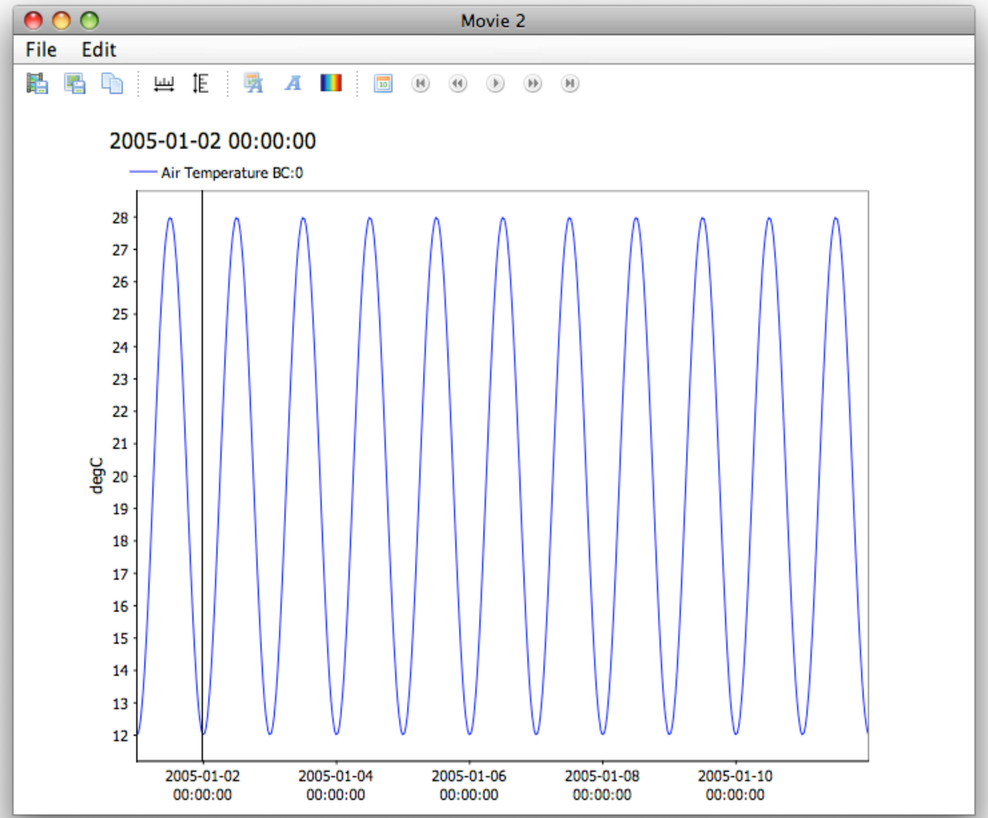

Figure 7.4 An example of a movie window showing Air Temperature boundary condition data

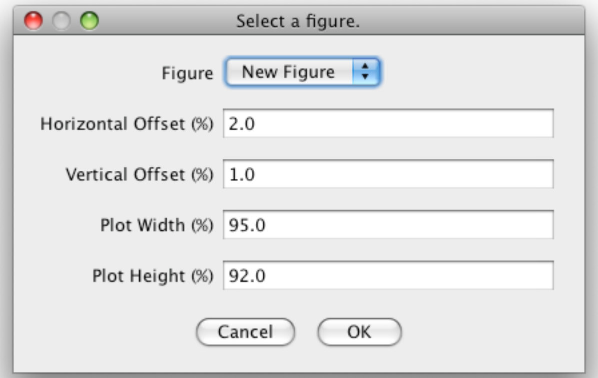

Figure 7.5 The Add to Movie dialog

7.4 Multi-Axes Movie

To create a movie showing more than one datastream uses the **Add to Movie** action. This action bring up a dialog where users can choose the figure to add to (or create a new figure) and the position of the new axes. The **Add to Movie** dialog is shown in Figure 7.5. The horizontal and vertical offsets give the position of the bottom left corner of the new axes relative to bottom left corner of the figure. The values are percentages of the figure width and height. The Plot width and height are the width and height of the axes (including axes labels) as percentages of the figure width and height.

The best way to show how multi axes movies are created is via an example. In this example we will create a movie with the air temperature boundary condition data on the top of the figure and the curtain water temperature on the bottom. To do this we right click on the Air Temperature boundary condition resource and select **Plot→Add To Movie**. In the Add to Movie dialog we select new Figure. Leave the Horizontal Offset and Width of the plot at 2% and 95% so the axes covers the full width of the plot. Set the Vertical Offset and Height of the plot to 50% and 45% so that the figure will start half way up the plot and have a height of 45% of the window. The results of this is shown in Figure 7.6.

To add the Curtain data right click on it and click **Add To Movie**. In the Add to Movie dialog we choose the Figure we have just created. Leave the Horizontal Offset and Width of the plot at 2% and 95% so the axes covers the full width of the plot. Set the Vertical Offset and Height of the plot to 1% and 49% so that the figure will start half way up the plot and have a height of 49% of the window. The results are shown in Figure 7.7. Axes positions can be adjusted after they have been added by right clicking on the axes and selecting the **Set Position** action.

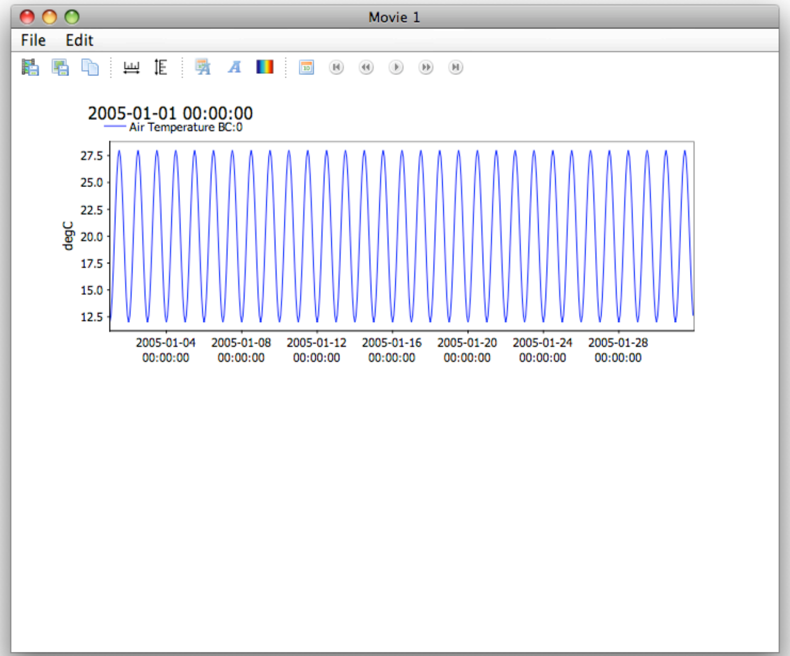

Figure 7.6 A movie figure window with air temperature data in the top half of the window

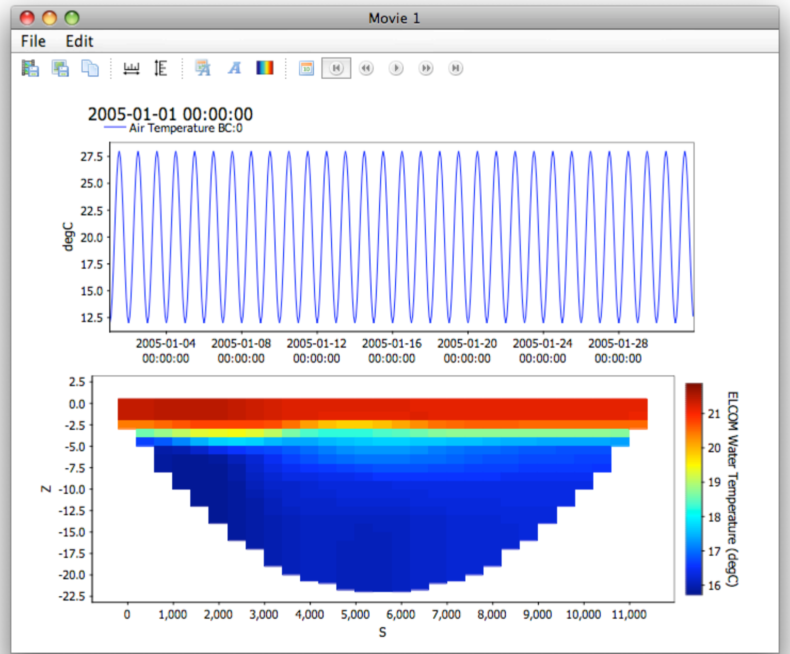

Figure 7.7 A movie figure window with air temperature data in the top half of the window and a curtain of water temperature in the bottom

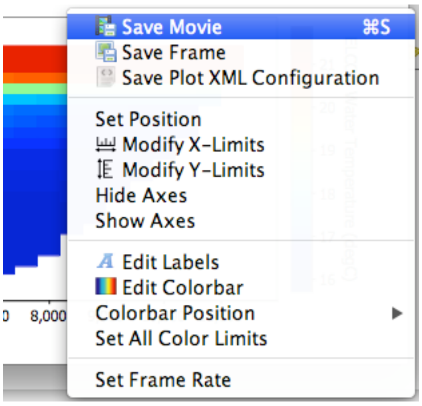

Figure 7.8 Right clicking on an axes allows the user to modify the plot

7.5 Movie Interactions

ARMS provides a number of ways in which the user can interactively modify a movie figure, interactions can be called from the Figure Menu Bar, the Figure Toolbar or by Right Clicking on an axes. For interactions that affect only one axes if the action is selected form the Menu or Toolbar it will act on the last clicked on axes. The actions available when right clicking on the plot are shown in Figure 7.8. These actions are summarised below.

Save allows the user to save the movie as a Windows 'avi' or Quicktime 'mov'. When a movie is saved the user is first presented with a dialog to select the name of the movie to save. Once a file is selected the a second dialog appears allowing the user to set a number of options (Figure 7.9) where

Frame Rate gives the frame rate for the movie in frames per second.

Start and **End** gives the start and end frame for the movie.

Interval allows only every n^{th} frame to be output to the movie.

Compression Codes set the codec to be used for compressing the movie with the external program **ffmpeg**. To use compression the location of the **ffmpeg** executable must be specified in the ARMS preferences. For information on **ffmpeg** see http://ffmpeg.org. Windows users can download a pre built executable at http://ffmpeg.arrozcru.org/autobuilds/. The h264 code will generally provide the biggest compression. For window users the msmpeg4v2 code will allow movies to be inserted into Powerpoint but does not provide the best compression.

Save Frame allows the user to save the current figure as PNG image file.

Save Plot XML Configuration allows the user to save a Movie Plot Configuration file which can then be used by ARMS to regenerate the current plot.

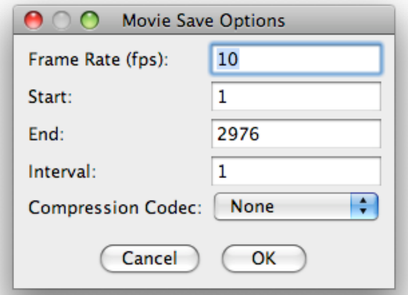

Figure 7.9 The Movie save options dialog

Copy copy the current frame to the operating systems clipboard. Once in the clipboard the figure can be pasted into other applications such as Microsoft Word.

Set Position move the location of this axes in the figure window.

Modify X-Limits modify the y axis limits of this axes.

Modify Y-Limits modify the y axis limits of this axes.

Hide Axes remove the axes from view and just show the data.

Show Axes show the axes.

Edit Labels allows users to add a Title to the plot and modify the axes labels and fonts. The date format for date axes can also be changed. The date format uses two lines of dates and makes use of the Java SimpleDateformat keys see http://java.sun.com/j2se/1.4.2/docs/api/java/text/SimpleDateFormat.html for more information.

Colorbar Position allows the location of the colorbar relative to the axes to be changed.

Edit Colorbar initiates a dialog for modifying the colorbar for colored plots. Users can change the colormap used and the limits of the colour scale.

Set All Color Limits allows users to change the colour limits on all axes at once. This is especially useful when comparing model results to field data.

Set Frame Rate set the maximum frame rate when playing the movie through the ARMS figure window.

7.5.1 Sheet Axes

When plotting Sheet data a few additional interactions are possible. These are

Show Velocity Arrows show velocity arrow vectors for the sheet data.

Set Quiver Scale brings up a dialog for setting the scale of the arrows. The value of the **scale** is the size of a 1 m/s velocity in metres in the x and y grid scale.

Set Quiver Legend brings up a dialog for displaying an arrow to show the velocity scale. The x and y location are for the start of a legend arrow in grid coordinates. The u and v velocities give the size and direction of the legend arrow.

Set Quiver Colour allows the user to change the colour of the velocity arrows.

Set Quiver Spacing allows the velocity field to be sub-sampled. The x and y directions can be sub-sampled at different rates.

Show/Hide Gridlines toggles the display of lines surrounding the grid cells.

Load Datablock File brings up a dialog box where the user can select a datablock file. The location of curtains in the datablock is then shown on the sheet axes.