MeteoExplorer 1.3
User Guide

February 2014

Contents

Chapter 1 Introduction to MeteoExplorer

1.1 Introducing MeteoExplorer

MeteoExplorer is a cross-platform software for analyzing and rendering atmospheric science and geoscience data. It supports popular data formats including WMO GRIB1/GRIB2, NetCDF, GrADS, and MICAPS, and provides some basic GIS functionalities. Developed with C++, MeteoExplorer as a native application enjoys the advantages of providing high performance while at the same time requiring low system resources. MeteoExplorer is designed to support all popular desktop platforms including Microsoft Windows, GNU Linux, and SGI Irix operating systems.

1.2 MeteoExplorer Primary Features

Below is a list summarizing the primary features of MeteoExplorer:

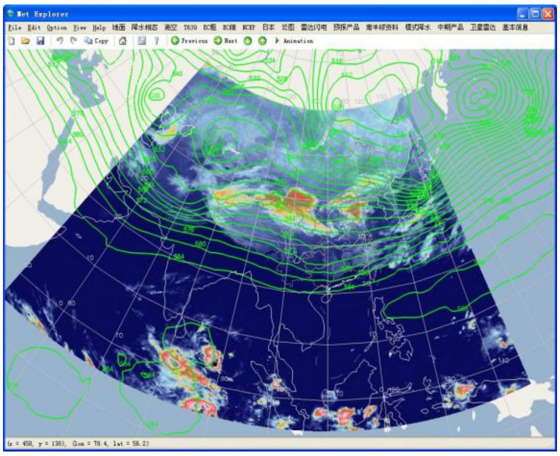
- Graphics layer management (show, hide, properties configurations, navigation and animation);
- Objective analysis of physical elements in surface or upperair soundings data;
- Isoline analysis and shading of gridded field;
- Streamline analysis of wind field;
- Computation of physics elements;
- NetCDF data process and display;
- WMO GRIB1/GRIB2 data process and display;
- GrADS data process and display;
- MICAPS data process and display;
- ESRI shapefile process and display;
- Satellite nephogram data display and animation, support AWX, GPF and HDF format;
- Interactive composition of synoptic chart (command undo/redo, automatic save);
- Meso-scale synoptic analysis;
- Creation of cross-section graphics;
- Map zoom, pan, projection and clipping;
- Full screen display and zoom to area;
- Page layout and configuration;
- Quick navigation via thumbnail view of graphics layers;
- Save screen shot as image file (support formats: BMP, JPG, PNG);
- Vector graphics exported to clipboard or saved as EMF file (Windows version only);
- System configuration (dynamic menu);
- Fast switch of user interface language on the fly.

1.3 Technical Advantages

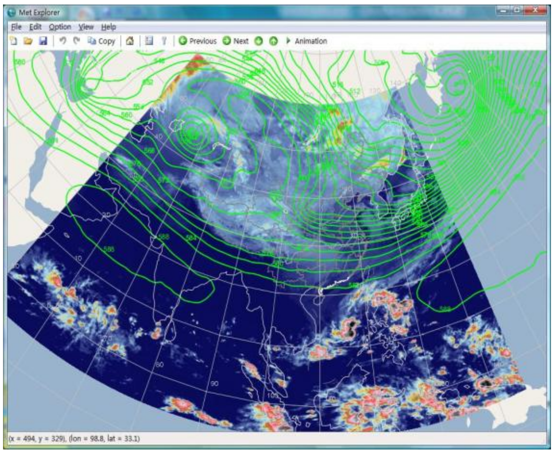
Compared with other meteorological and geographic information system software, MeteoExplorer enjoys the following advantages:

1, Cross-platform support

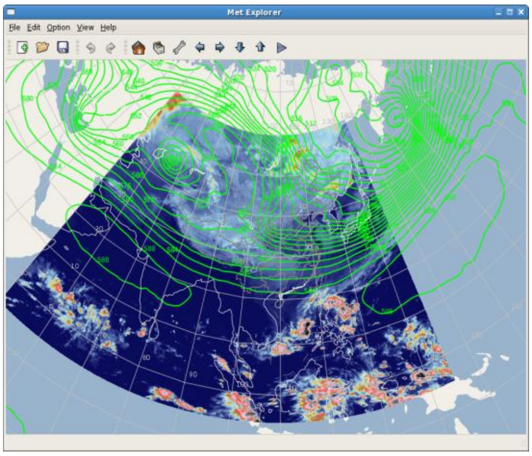
MeteoExplorer is designed to support as many mainstream platforms as possible from the very beginning, so that users may use MeteoExplorer in their favorite platforms. In addition, to maximize runtime performance, MeteoExplorer is implemented as a native application instead of an interpreted application like that implemented in JAVA or .NET. For now MeteoExplorer supports Windows XP/Vista/7/8, Redhat Enterprise Linux 5/6, and SGI Irix operating systems. Figure 1-1 shows the screenshots of MeteoExplorer running under Windows XP (A), Windows Vista (B), Redhat Enterprise Linux 5 (C), and SGI Irix (D).



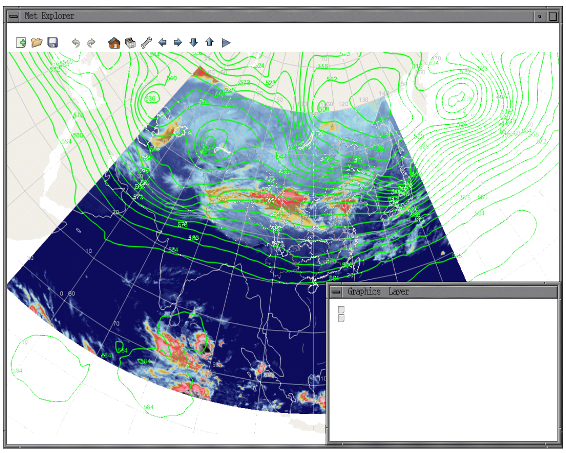
(A) Windows XP



(B) Windows Vista



(C) Redhat Enterprise Linux 5



(D) SGI Irix 6.5

Figure 1-1: MeteoExplorer supports Windows XP/Vista/7/8, Redhat Enterprise Linux 5/6, and SGI Irix operating systems.

2, Runtime performance and user experience matter

With the rapid development of atmospheric science and meteorological technologies, researchers and professionals demand their productivity tools to be capable of delivering higher efficiency and graphics rendering performance, that is, they hope the tools can analyze and visualize more volume data in less time. With these requirements in mind, MeteoExplorer is designed to emphasize performance from the very beginning, and to hopefully bring fluid user experience and promote working productivity of users. In practical implementation, we choose C++ for native development, instead of interpreted programming languages such JAVA, C# and Visual Basic, to maximize program performance, while as the same time reduce application requirements for system resources. In addition, we make use of OpenGL and DirectX hardware acceleration technology to enhance graphics rendering speed. Both of the approach aim to bring fast, fluid user experience.

3, Vector graphics output in a what-you-see-is-what-you-get way

In atmospheric science operations and research, the demands from researchers and professionals have increased tremendously. They hope an application can not only analyze and visualize more volume data in less time, but also export the rendered screen contents to an image file of various formats. In this way, they can use the exported image files as part of their products and research results in presentation or publications.

To meet the demand, a multifunctional graphics rendering engine that incorporating multiple graphics rendering technologies is proposed. This engine has the following advantages. First, it not only provides high rendering performance enjoyed by hardware acceleration rendering technology, but also supports vector graphics output thanks to the software rendering technology. Second, for the application powered by the proposed engine, the rendering technology can be switched from one to another on the fly and the application restart is not required. The display properties of the graphics and images are preserved after the switch. Third, it is convenient to port the proposed rendering engine to operating systems and computing devices of different architectures. Fourth, it is able to generate image file of various compression formats. The proposed graphics rendering engine has been implemented into MeteoExplorer.

Figure 1-2 gives an illustration that the rendering contents of Figure 1-1B is copied and then pasted into Microsoft Word. Figure 20-1 (page 180) provides another example that the same content is pasted into Microsoft PowerPoint.

The formats of exported graphics include both raster graphics such as JPG, BMP, and PNG, and vector graphics such as Windows Enhanced Meta Format (EMF), which is required by most academic journals and technical publications thanks to its lossless attribute insensitive to image zoom.

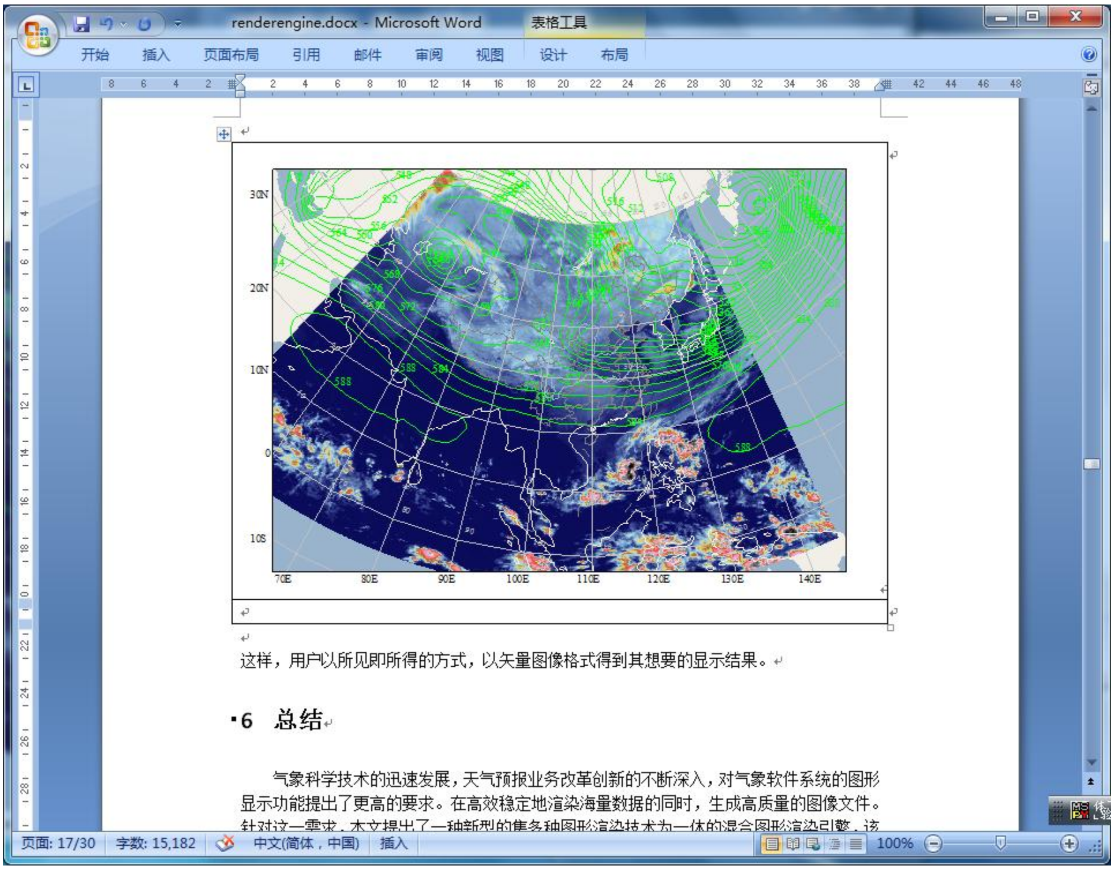


Figure 1-2: In MeteoExplorer, the screen content can be copied to the system clipboard and therefore used by other applications. In this figure, the clipboard content is copied into Microsoft Word.

4, Advanced objective analysis technology

MeteoExplorer provides advanced objective analysis method that meets the requirements of real-world weather analysis operation. Isolines of analytical field not only agree well with observatory station data, but are as elegantly smooth as those manually drawn by forecasters. An example is given in Figure 1-3 that shows the analytical field of 500hPa geopotential field on March 23, 2012.

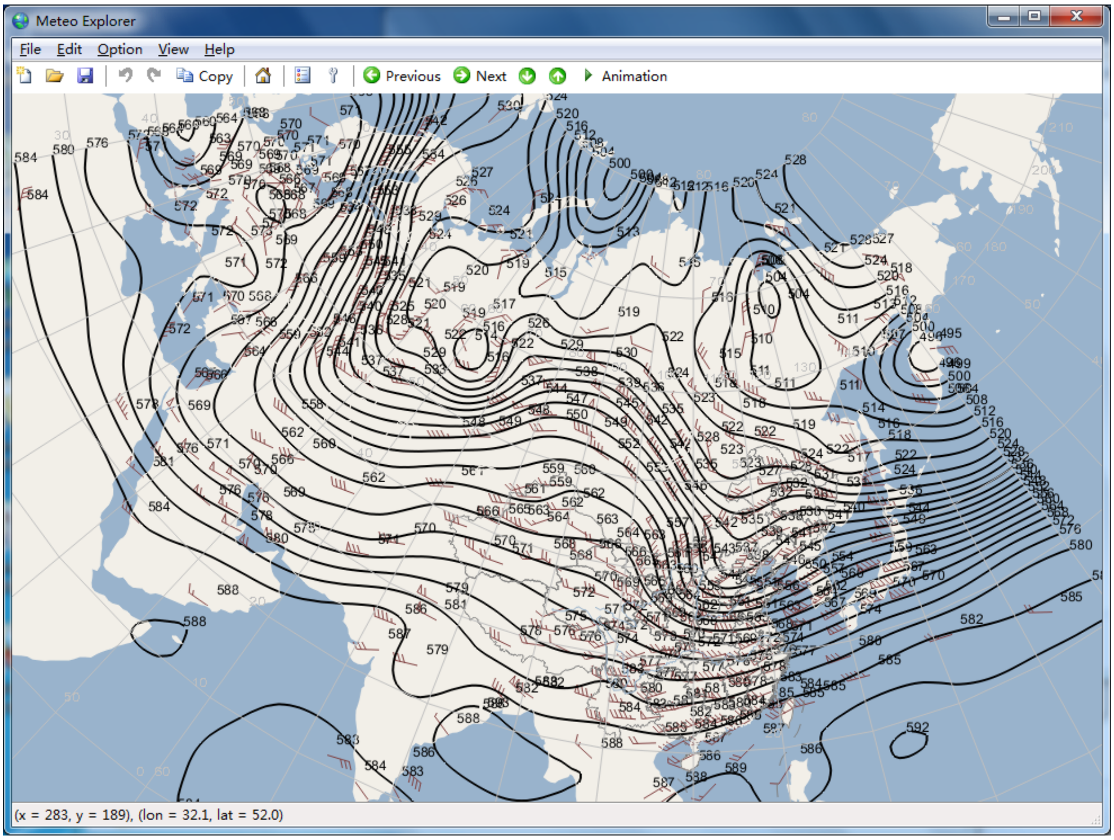


Figure 1-3: Objective analytical field of 500hPa geopotential field on March 23, 2012.

5, Support all popular atmospheric science data formats

As the main functionality of MeteoExplorer is to analyze and visualize atmospheric science data, it has to support as many data formats as possible. For now MeteoExplorer supports WMO GRIB1/GRIB2, NetCDF, HDF, GrADS, MICAPS, and ESRI shapefile.

By providing support for the mainstream atmospheric science data, we hope to help users increase their productivity so that they may concentrate more on work or research while at the same time spend less time on chores of processing data.

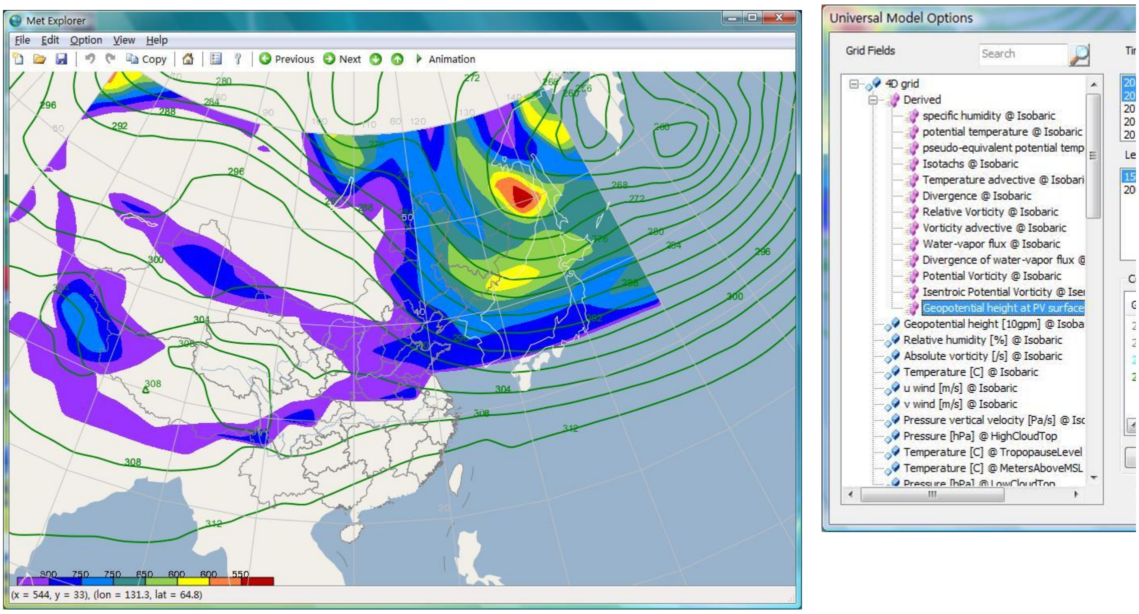


Figure 1-4: MeteoExplorer supports WMO GRIB1/GRIB2, NetCDF, HDF, GrADS, MICAPS, and ESRI shapefile. This figure shows the analytic result of a NCEP global forecast system (GFS) data encoded in WMO GRIB2 format.

MeteoExplorer is able to not only analyze physical elements in the original data set, but calculate derived elements as well. For example, MeteoExplorer can calculate potential temperature, potential vorticity and so on from basic elements like pressure, temperature, and wind. The process of calculating derived elements can be referenced in Chapter 6 (page 69). Figure 1-4 shows the analytic result of a NCEP global forecast system (GFS) data encoded in WMO GRIB2 format. In the figure, the green contours represent 500hPa geopotential height field and the shaded contours represent geopotential height field at 1.5 geopotential vorticity unit.

1.4 Use MeteoExplorer on Mobile Devices

Over the past couple of years, the industry of information technology has enjoyed a fast paced evolution, in which mobile computing devices such as smart phones, tablet computers have formed a new computing platform that is as important as traditional personal computers like desktop and laptop computers. There mobile devices, with the advantages of being convenient to carry, long standby time, and an intuitive touch-oriented manipulations, have been playing more and more roles in both personal and enterprise computing.

In the field of atmospheric science and geographic information science (GIS), software support is the key for these all-new mobile computing devices to play their parts. It is necessary to port existent software applications that target desktop computers to mobile devices. MeteoExplorer touch is such an endeavor to port desktop-oriented MeteoExplorer to mobile-oriented Windows 8 and Windows RT. Figure 1-5 shows the screen shot of MeteoExplorer Touch running on Windows RT operating system.

Figure 1-5: Screenshot of MeteoExplorer Touch running on emulated Microsoft Windows RT operating system.

MeteoExplorer touch is a certified Windows store application and provides a native experience in that:

- It focuses on information by offering a fully immersive experience.
- It implements a fully hardware accelerated graphics rendering engine.
- It participates in the Metro style experience in Windows 8 by including Appbar, application execution state management, device orientation handling and so on.
- The interface and controls are designed to be there when you need them and out of view when you don't.
- It provides the stick-to-your-finger responsiveness of the touch support for panning and zooming.

For users of interested, please visit home page of MeteoExplorer Touch at www.eastmodelsoft.com/software/metouch.htm to get more information.

1.5 Online Resources

If you have any questions or want to give us your suggestions, please visit the home page of MeteoExplorer at www.eastmodelsoft.com/software/mexplorer.htm to get more information, including notes of latest software release, help documentations, email support, and discussion forum.

Chapter 2 Installation and Configuration

2.1 System Requirements

Supported operating systems

- Microsoft Windows XP/Vista/7/8;
- Red Hat Enterprise Linux (RHEL) 5/6;
- SGI Irix 6.5;

Processor and RAM

X86 PC: Intel Pentium 2.4GHz with 1GB RAM is minimal; Intel Core 2 Duo 1.5GHz with 2GB RAM is recommended.
SGI RISC workstation: MIPS R16000A 800MHz with 1GB RAM.

Graphics adaptor and display

The graphics adaptor should support at least OpenGL 1.2 or DirectX 9;
Screen resolution of 1024×768 pixels is minimal; 1600×900 is recommended.

2.2 Install MeteoExplorer

2.2.1 Download

One can visit MeteoExplorer download web page at www.eastmodelsoft.com/downloads.htm to download the latest release of MeteoExplorer.

2.2.2 Install MeteoExplorer under Windows

In spite of the fact MeteoExplorer for Windows is released in 32-bit binary, thanks to the WoW64 (Windows 32-bit on Windows 64-bit) emulator of Windows operating system, MeteoExplorer can run under both 32-bit and 64-bit Windows.
You need to download either the file ‘me-win32-1.3.nnnn-setup.zip’ or the file ‘me-win32-1.3.nnnn- files.zip’, where nnnn stands for the build number. The larger value of this number, the newer the release. The former file is a standard Windows installer that is recommended to most users; the latter file is indeed a compressed file containing the binary, library, resource, and documentation files of MeteoExplorer. Users need to uncompress the downloaded file first. For the latter file, one can execute the file ‘mexplorer.exe’ from the extracted folder to launch MeteoExplorer. So no installation process is required. For the former file, there are two files (mesetup.exe and MeSetup.msi) and one folder (vcredist_x86).
To begin the setup process, all one has to do is to execute mesetup.exe. First the welcome screen

pops up as shown in Figure Figure 2-1.

Figure 2-1： The first step of MeteoExplorer installation process: the welcome screen.

Click “Next” to enter the select installation folder page (Figure Figure 2-2).

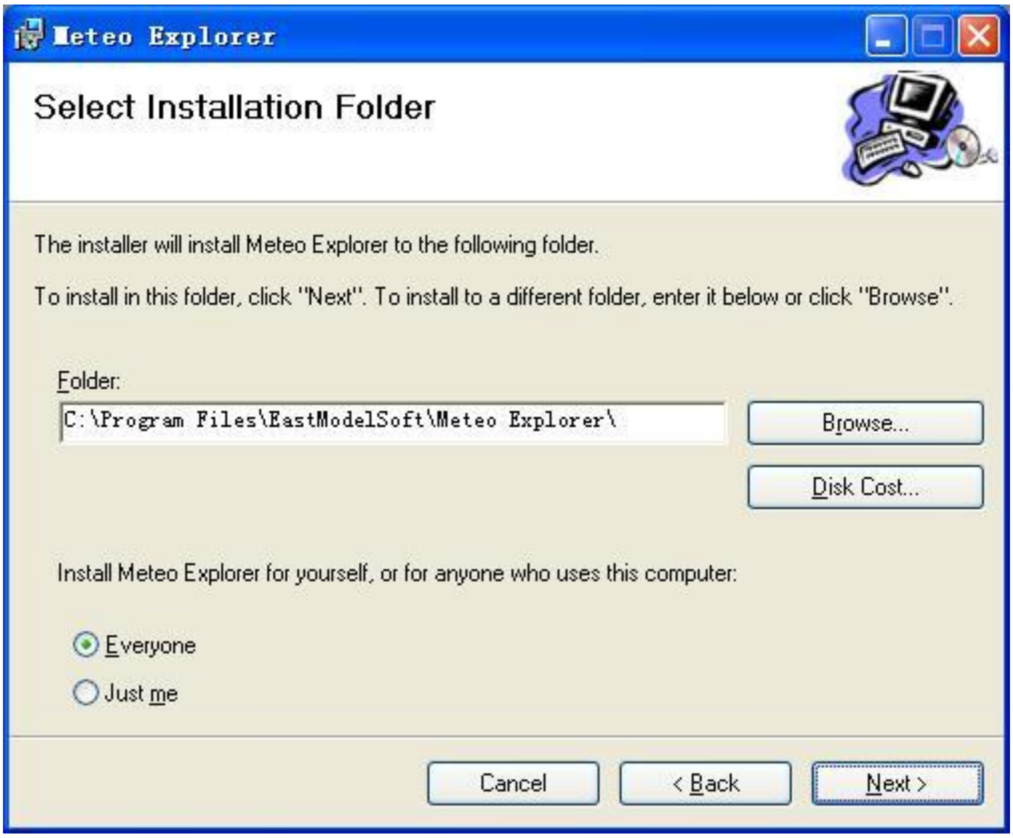


Figure 2-2: MeteoExplorer installation folder selection page.

In the ‘Select Installation Folder’ page, one may change the installation folder of MeteoExplorer. In addition, one can also choose whether to install MeteoExplorer for yourself, or for anyone who uses the computer. Select “Everyone” to install the program menus and desktop shortcut of MeteoExplorer to the shared system menu; select ”Just me” to install the program menus and desktop shortcut of MeteoExplorer to user’s private menu. After the selection, click “Next” to enter the ‘Confirm Installation’ page (Figure Figure 2-3).

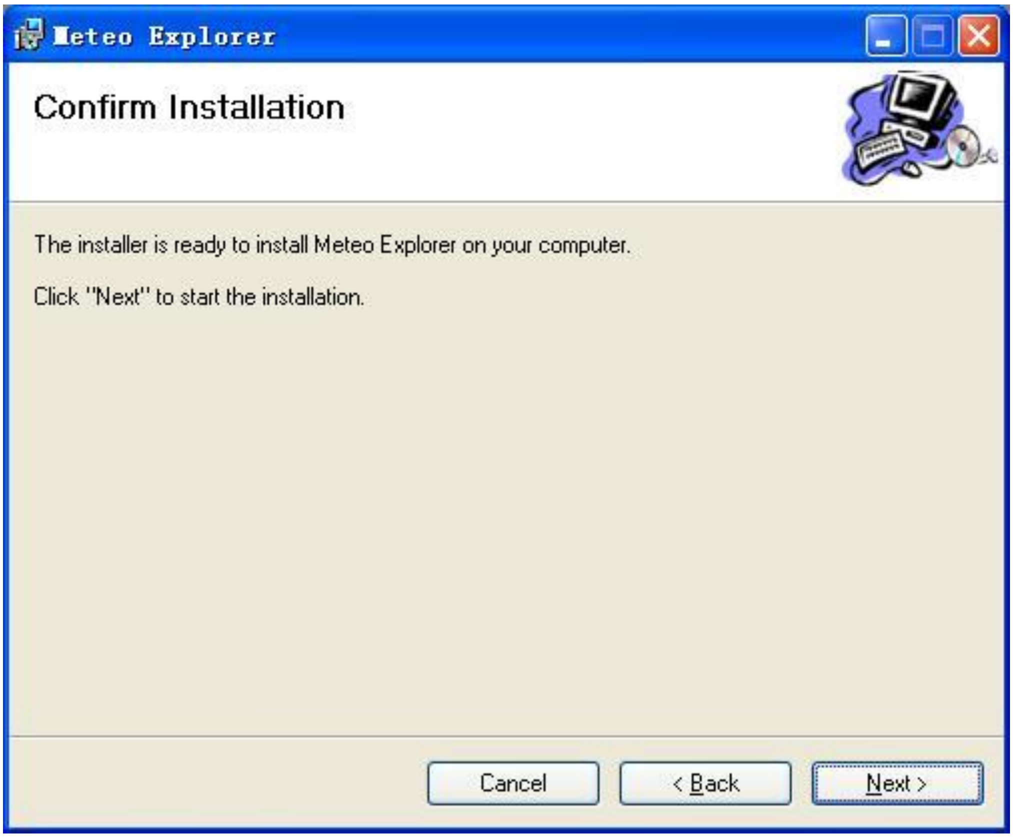


Figure 2-3: MeteoExplorer 'Confirm Installation' page.

In the 'Confirm Installation' page, one may click "Next" to start the installation process, or click "Cancel" to cancel the installation process. One may also click "Back" to go back to the previous steps and change settings if necessary.

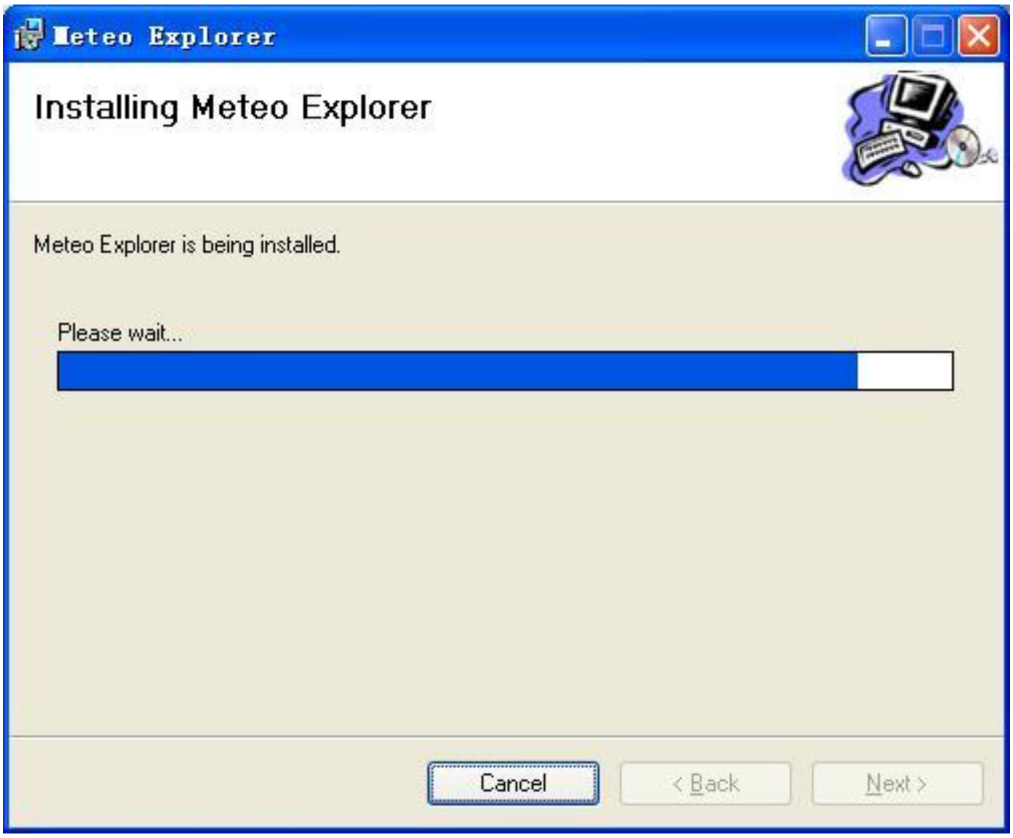


Figure 2-4: The ‘Installing MeteoExplorer’ page.

Figure Figure 2-4 is a screen shot of ‘Installing MeteoExplorer’ page. As MeteoExplorer depends only on Microsoft Visual C++ x86 redistributable, the installation process should take less than one minute to complete. After a successful installation, the ‘Installation Complete’ page should appear as shown in Figure Figure 2-5.

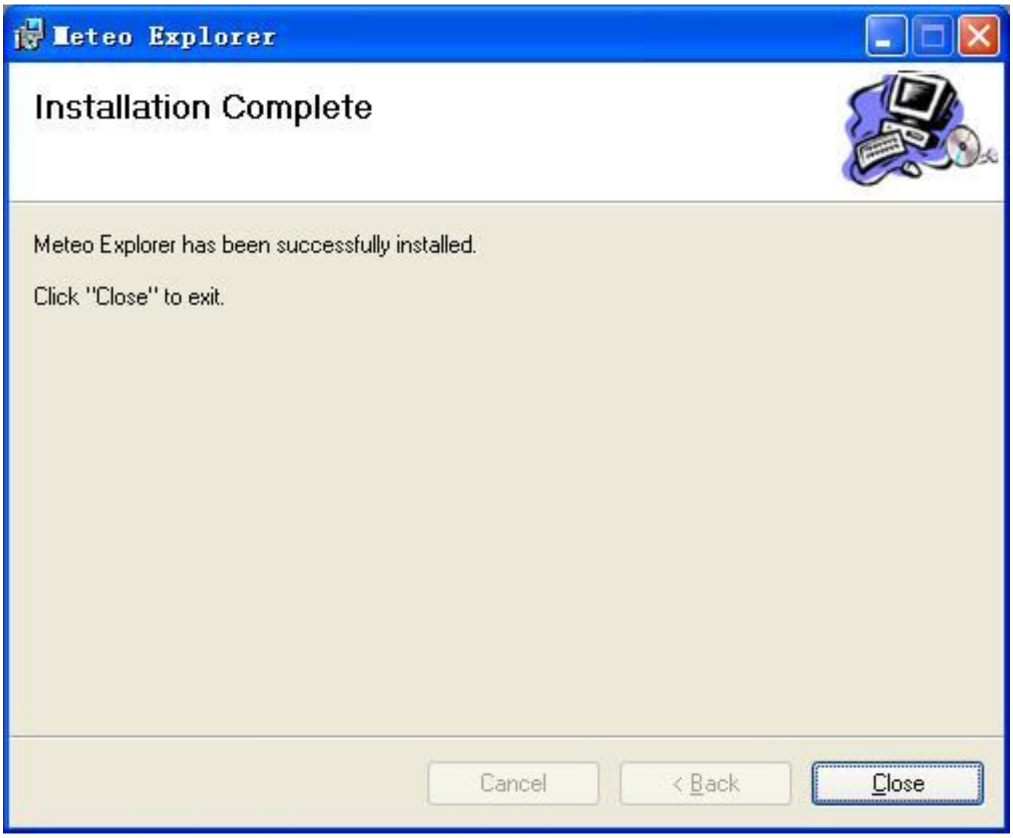


Figure 2-5: After a successful installation, the 'Installation Complete' page should appear.

After a successful installation, the program menus and desktop shortcut of MeteoExplorer is added to the system.

2.2.3 Install MeteoExplorer under Linux

Unlike Windows operating system, there is no WOW64 equivalent simulator in Linux. As a result, users have to determine if her operating system is 32-bit, or 64-bit. A simple method to detect the system is run the **uname** command**.**

```
$ uname -a
```

where the parameter 'a' stands for output all information. In the output information, one should check the words like i686, i386, or x86_64. If one sees x86_64, then her system is 64-bit, otherwise here system may be 64-bit.
For 32-bit system, one should download the file 'install.sh' and 'me-linux-1.3.nnnn-i386.tar.gz'. For 64-bit system, one should download the file 'install.sh' and 'me-linux-1.3.nnnn-x86_64.tar.gz'. After the download, one has to put the two files in the same folder and execute the installation script 'install.sh' with root privilege:

```
$ chmod +x install.sh
$ su
Password: [enter your password for root account]
# ./install.sh /opt
Remove old files …
```

Copy installation files to /var/mexplorer
Done.

By default, MeteoExplorer is installed to /usr/local/meteoexplorer. However, the installation script 'install.sh' accepts one parameter that is used as the installation folder. To change the installation folder, the user may provide a customized folder as illustrated in the example above, in which MeteoExplorer is installed to /opt/meteoexplorer.

2.3 Add Resource File

MeteoExplorer support MICAPS resource files including menu resource file, nephogram palette resource file and so on. To use your own resource files, all one has to do is to copy her files to the MeteoExplorer installation folder. By default, the Windows installation is 'C:\Program Files\EastModelSoft\MeteoExplorer', the Unix/Linux installation is '/usr/local/meteoexplorer/bin'.

2.3.1 Show/hide menus specified in menu resource file

A bundle file in MICAPS contains a number of entries, each of which serves as a wildcard referencing certain meteorological data files. A menu resource file contains a cascade of entries, each of which specifying a bundle file. Only one menu resource file is used by MeteoExplorer and the file has to be named as 'micapsDataMenu.txt' and copied to MeteoExplorer installation folder.

MeteoExplorer by default does not show the menu items given by the menu resource file, even if there exists one. To show the corresponding menus, the user may select the menu item "Option, Show Data Menu".

The formats of the MICAPS menu resource file can be referenced in MICAPS user manual.

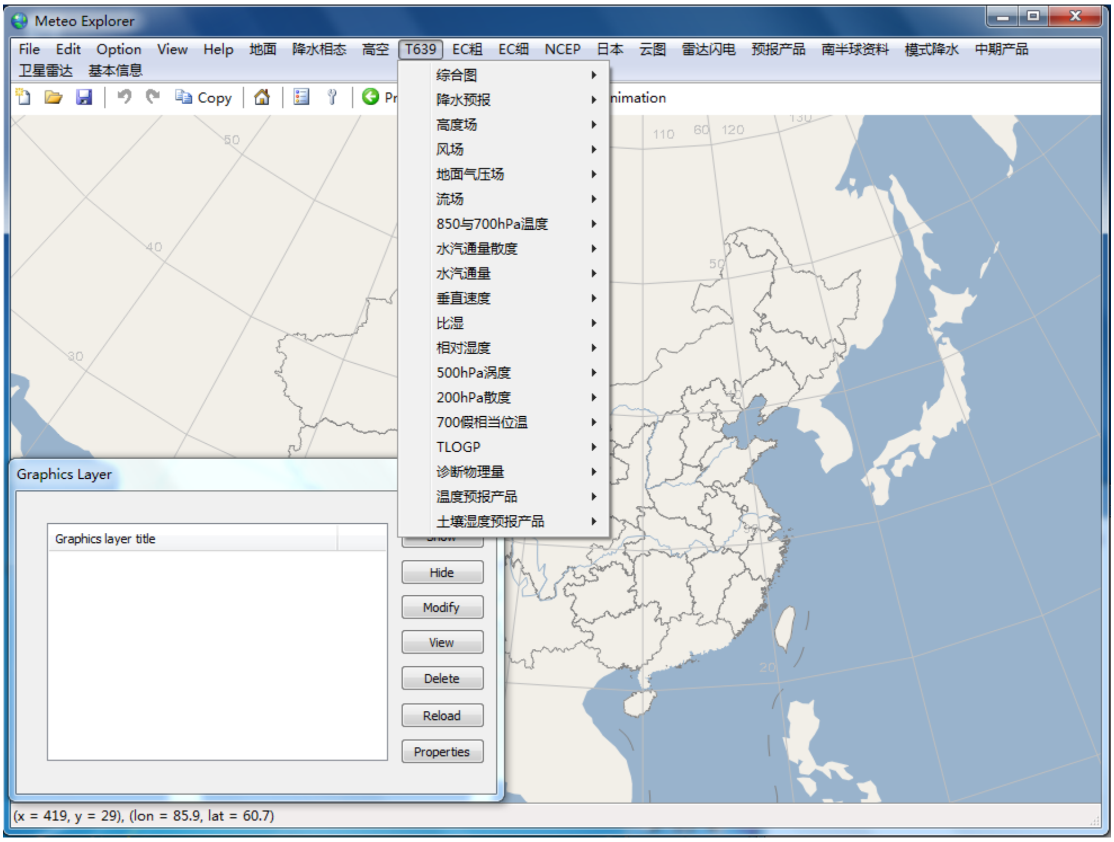


Figure 2-6: MeteoExplorer supports MICAPS menu resource file.

2.3.2 Customize nephogram palette

MeteoExplorer supports MICAPS nephogram palette resource file. A nephogram palette is divided into four categories: infrared (I), RADAR reflection (R), visibility light (V), and Watervapor (W). There are at most ten palettes for each category with indices 00 to 09. So the third palette in the RADAR reflection category should be named as R-02.pal. MeteoExplorer by default provides 10 palettes for each of the four categories. Nonetheless, users can replace the default palettes with their own palettes by copying the palette resource files to the MeteoExplorer installation folder. The formats of the MICAPS nephogram palette resource file can be referenced in MICAPS user manual.

2.4 Uninstall MeteoExplorer

2.4.1 Uninstall MeteoExplorer under Windows

There are two ways to uninstall MeteoExplorer under Windows. The first method is to use ‘Programs, Uninstall a program’ in control panel. In the dialog (Figure 2-7), select Meteo Explorer and then click “Uninstall” button.

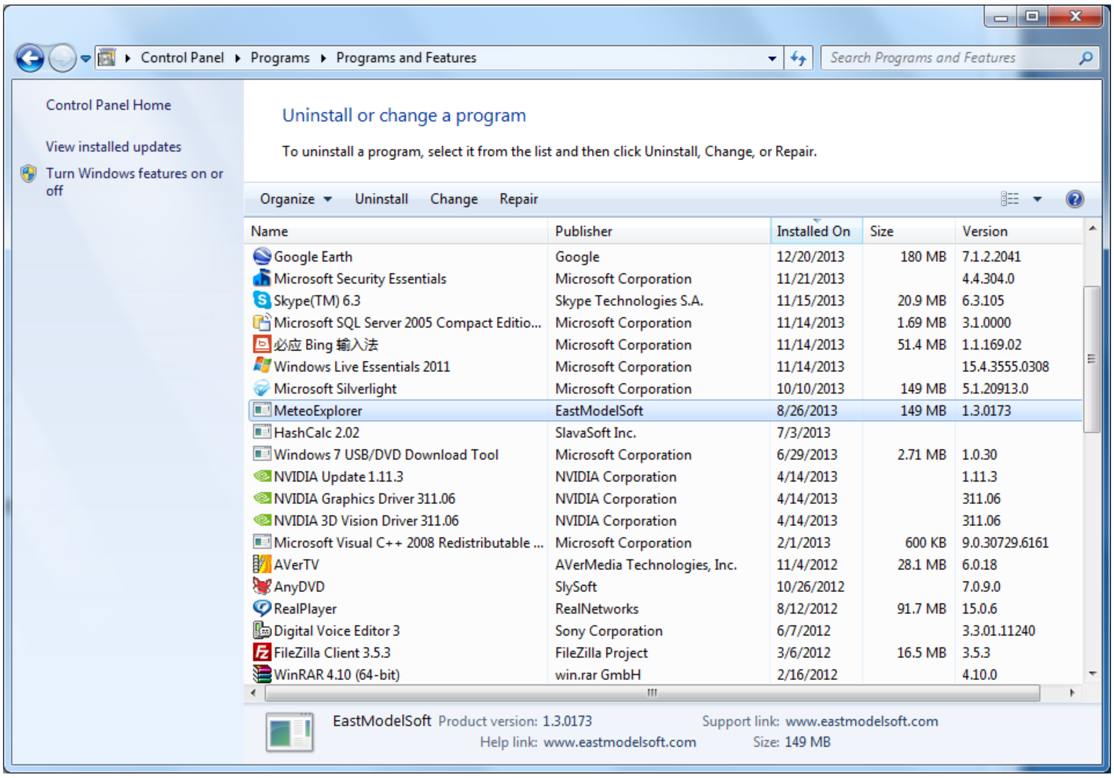


Figure 2-7: One way to uninstall MeteoExplorer under Windows is to use 'Programs, Uninstall a program' in control panel.

The second method is to select 'Uninstall MeteoExplorer' shortcut in program menus of MeteoExplorer, which can be found from 'Start, All Programs, MeteoExplorer'.

2.4.2 Uninstall MeteoExplorer under Linux

To uninstall MeteoExplorer under Linux, just remove the MeteoExplorer installation folder. For example, if MeteoExplorer is installed in folder '/usr/local/meteoexplorer', execute the following commands:

$ cd /usr/local

$ su

Password: [enter your password for root account]

rm –rf meteoexplorer

Notes that the last command require root privilege.

Chapter 3 MeteoExplorer Basics

3.1 The Application Main Window

The main window of MeteoExplorer is shown in Figure Figure 3-1 (Windows release) and Figure Figure 3-2 (Unix/Linux release).

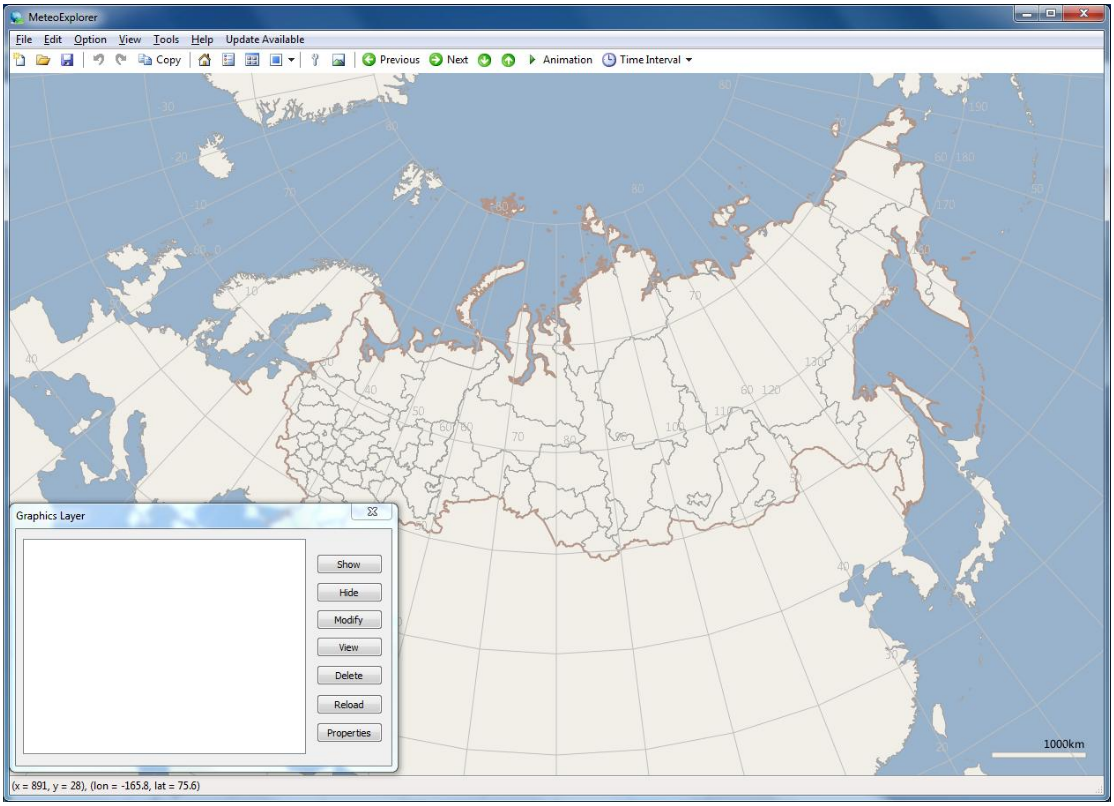


Figure 3-1: The user interface of MeteoExplorer's main window under Windows 7.

The design of MeteoExplorer user interface (UI) follows the general guide line of a desktop Windows application. The user interface contains title bar, menus, tool bar, central canvas, auxiliary window (layer management window in the figures), and status bar. The Windows and Unix/Linux release share the same UI layout but different styles, in particular icons. This design choice makes the UI of MeteoExplorer to be consistent with the operating system.

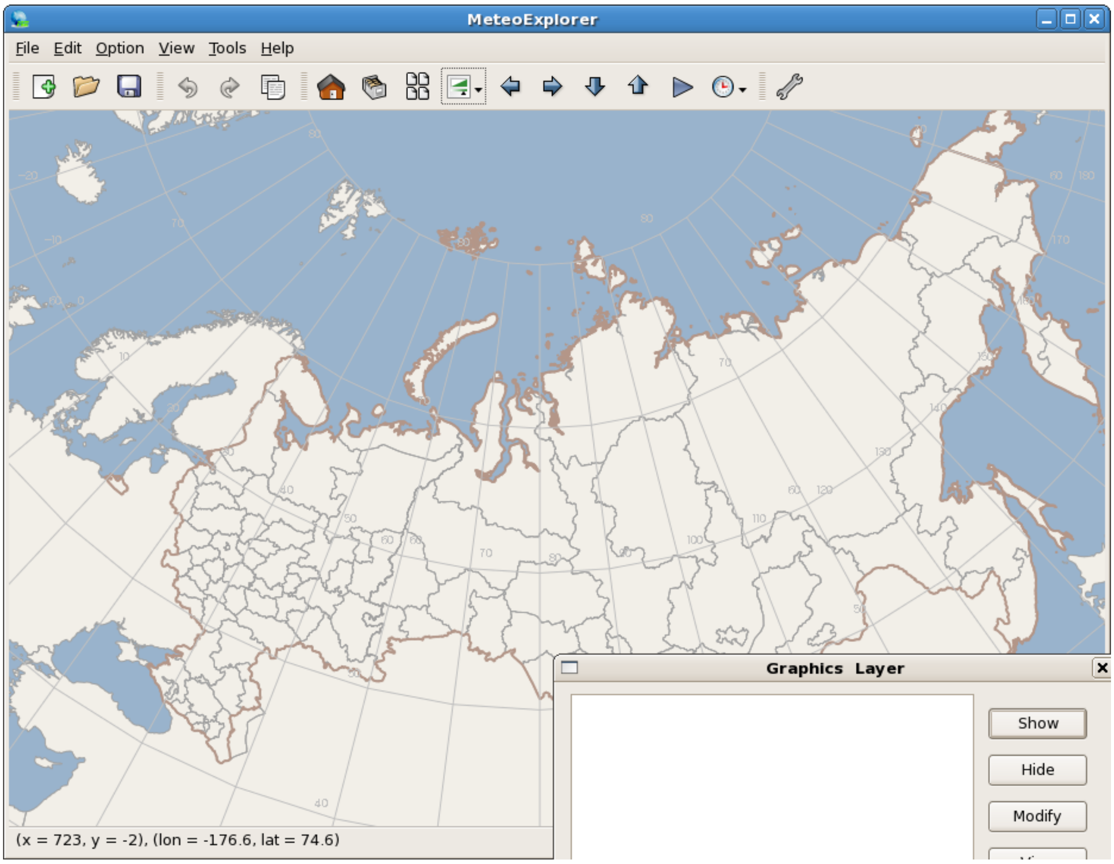


Figure 3-2: The user interface of MeteoExplorer's main window under CentOS Linux 5.

3.2 Menus

Application menus provide a comprehensive way for users to access all features of MeteoExplorer. The following subsections introduce the functions of each top-level menu of MeteoExplorer.

3.2.1 File

Table 3-1 lists all the menu items along with their functions under the 'File' menu.

Table 3-1: The menu items along with their functions under the 'File' menu.

Menu Item	Function	Shortcut
New	Create a new synoptic char layer. See Chapter 15.	Ctrl+N
Open	Open a data file and create a graphics layer after a successful analysis of the data.	Ctrl+O
Save	Save the current edited synoptic chart to MICAPS-format data file.	Ctrl+S
Save As	Save the current edited synoptic chart to MICAPS-format data file, but with another file name.	Ctrl+A
Save As Image	Save the rendering contents of main window to an image	Not Available

	file. Supported formats include bitmap (BMP), Joint Photographic Experts Group (JPG), and portable network graphics (PNG). See Chapter 20.	(NA)
Export As EMF	Save the rendering contents of main window to an EMF file. See Chapter 20.	NA
Exit	Exit the application.	Ctrl+Q

3.2.2 Edit

Table 3-2 lists all the menu items along with their functions under the ‘Edit’ menu.

Table 3-2: The menu items along with their functions under the ‘Edit’ menu.

Menu Item	**Function**	**Shortcut**
Undo	Undo the last modification in editing the synoptic chart. See Chapter 15.	Ctrl+Z
Redo	Redo the last modification in editing the synoptic chart. See Chapter 15.	Ctrl+Y
Copy	Copy the rendering contents of main window to the system clipboard. For Windows build, the copied contents are encoded in EMF format; For Unix build, the contents are encoded in bitmap format. See Chapter 20.	Ctrl+C
Insert, Picture	Insert a picture from a disk image file to the current edited synoptic chart. See Chapter 15.	NA

3.2.3 Option

Table 3-3 lists all the menu items along with their functions under the ‘Option’ menu.

Table 3-3: The menu items along with their functions under the ‘File’ menu.

Menu Item	**Function**	**Shortcut**
Preferences	Open “User Preferences” dialog to allow users configure all application preferences. See section 3.8.	NA
Projection and Map	Open “Map and Projection” dialog to let users configure cartographic projections and map parameters. See Chapter 4.	NA
Customize Layout	Customize layout of central canvas. See Chapter 5.	NA
Show Data Menu	Show or hide menus imported from MICAPS menu resource file. See section 2.3.1.	NA

3.2.4 View

Table 3-4 lists all the menu items along with their functions under the 'View' menu.

Table 3-4: The menu items along with their functions under the 'View' menu.

Menu Item	Function	Shortcut
Graph Layer Manager	Show or hide graphics layer management window. See section 3.5.	NA
Thumbnail View	Toggle between overlaid view and thumbnail view of all graphics layers. See section 3.6.	NA
Layout, Browse View	Set the layout of central canvas to browse view. See section 5.1.	NA
Layout, Image Export View	Set the layout of central canvas to image export view. See section 5.1.	NA
Go To, Previous Time Instance	Step back one time instance and create a new graphics layer for the element corresponding to the select graphics layer. The new graphics layer will replace the old one. See section 3.5.	Alt+Left
Go To, Next Time Instance	Step forward one time instance and create a new graphics layer for the element corresponding to the select graphics layer. The new graphics layer will replace the old one. See section 3.5.	Alt+Right
Go To, Lower Level	Move downwards the adjacent lower level and create a new graphics layer for the element corresponding to the select graphics layer. The new graphics layer will replace the old one. See section 3.5.	Alt+Down
Go To, Higher Level	Move upwards the adjacent higher level and create a new graphics layer for the element corresponding to the select graphics layer. The new graphics layer will replace the old one. See section 3.5.	Alt+Up
Time Animation	Start time animation. See section 3.5.	NA
Time Interval	Choose the time interval for time animation.	NA
Zoom to Area	Zoom and pan the base map so that it will fit to the specified area. See section 3.4.2.	NA
Full Screen	Toggle between full-screen and windowed mode. See section 3.4.2.	F11

3.2.5 Tools

Table 3-5 lists all the menu items along with their functions under the 'Tools' menu.

Table 3-5: the menu items along with their functions under the ‘Tools’ menu.

Menu Item	Function	Shortcut
Synoptic-Scale Toolbox	Open synoptic-scale chart composition toolbox. See Chapter 15.	NA
Meso-Scale Toolbox	Open meso-scale chart composition toolbox. See Chapter 16.	NA
Create Cross Section	Open the ‘Cross-Section’ auxiliary window to allow users create cross-section graphics. See Chapter 18.	NA

3.2.6 Help

Table 3-6 lists all the menu items along with their functions under the ‘Help’ menu.

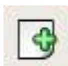
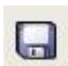
Table 3-6： The menu items along with their functions under the ‘Help’ menu.

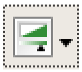
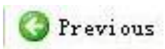
Menu Item	Function	Shortcut
Contents	Open “MeteoExplorer User Guide” documentation with the default PDF viewer on users’ system.	F1
MeteoExplorer Home page	Open MeteoExplorer home page at www.eastmodelsoft.com/software/mexplorer.htm to get oneline resources.	NA
About MeteoExplorer	Open “About MeteoExplorer” dialog to show the build number, copyright information.	NA

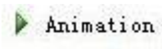
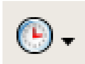
3.3 Toolbar

Toolbar of MeteoExplorer provides users with a more convenient access to the mostly used functions. Each toolbar button corresponds to a menu item and shares the same function of that menu item. Table 3-7 summarizes all toolbar buttons along with their functions.

Table 3-7: MeteoExplorer toolbar buttons along with their functions.

Toolbar button	Icon of Windows build	Icon of Linux build	Function
New			Create a new synoptic char layer. See Chapter 15.
Open			Open a data file and create a graphics layer after a successful analysis of the data.
Save			Save the current edited synoptic chart to MICAPS-format data file.
Undo			Undo the last modification in editing the synoptic chart. See Chapter 15.

Redo			Redo the last modification in editing the synoptic chart. See Chapter 15.
Copy			Copy the rendering contents of main window to the system clipboard. For Windows build, the copied contents are encoded in EMF format; For Unix build, the contents are encoded in bitmap format. See Chapter 15.
View, Home			Restore the zoom scale and pan offset to initial values.
Graphics Layer Manager			Show or hide graphics layer management window. See section 3.5.
Thumbnail View			Toggle between overlaid view and thumbnail view of all graphics layers. See section 3.6.
Layout			Set the layout of central canvas to browse view or image export view. See section 5.1.
Synoptic-Scale Toolbox			Open synoptic-scale chart composition toolbox. See Chapter 15.
Create Cross Section			Open the 'Cross-Section' auxiliary window to allow users create cross-section graphics. See Chapter 18.
Go To, Previous Time Instance			Step back one time instance and create a new graphics layer for the element corresponding to the select graphics layer. The new graphics layer will replace the old one. See section 3.5.
Go To, Next Time Instance			Step forward one time instance and create a new graphics layer for the element corresponding to the select graphics layer. The new graphics layer will replace the old one. See section 3.5.
Go To, Lower Level			Move downwards the adjacent lower level and create a new graphics layer for the element corresponding to the select graphics layer. The new graphics layer will replace the old one. See section 3.5.

Go To, Higher Level			Move upwards the adjacent higher level and create a new graphics layer for the element corresponding to the select graphics layer. The new graphics layer will replace the old one. See section 3.5.
Time Animation			Start time animation. See section 3.5.
Time Interval			Choose the time interval for time animation.

3.4 Central Canvas

3.4.1 Zooming, panning and rotating

Standard zoom: To zoom in, double click left mouse button or move the mouse wheel forward; to zoom out, double click right mouse button or move the mouse wheel backward.

Smooth zoom: smooth zoom differs from standard zoom in that the zoom scale changes smoothly during the manipulation. To zoom in, hold the middle mouse button and move forward; to zoom out, hold the middle mouse button and move backward. Release the mouse button to end the manipulation.

Rubber band box zoom: Press and hold Ctrl key and right mouse button, then drag the mouse and create a rubber band box that starts from the initial position and ends at current mouse position (Figure Figure 3-3）. Release the mouse to end the manipulation. The geographic area defined by the rubber band box is zoomed to the entire canvas (Figure Figure 3-4）.

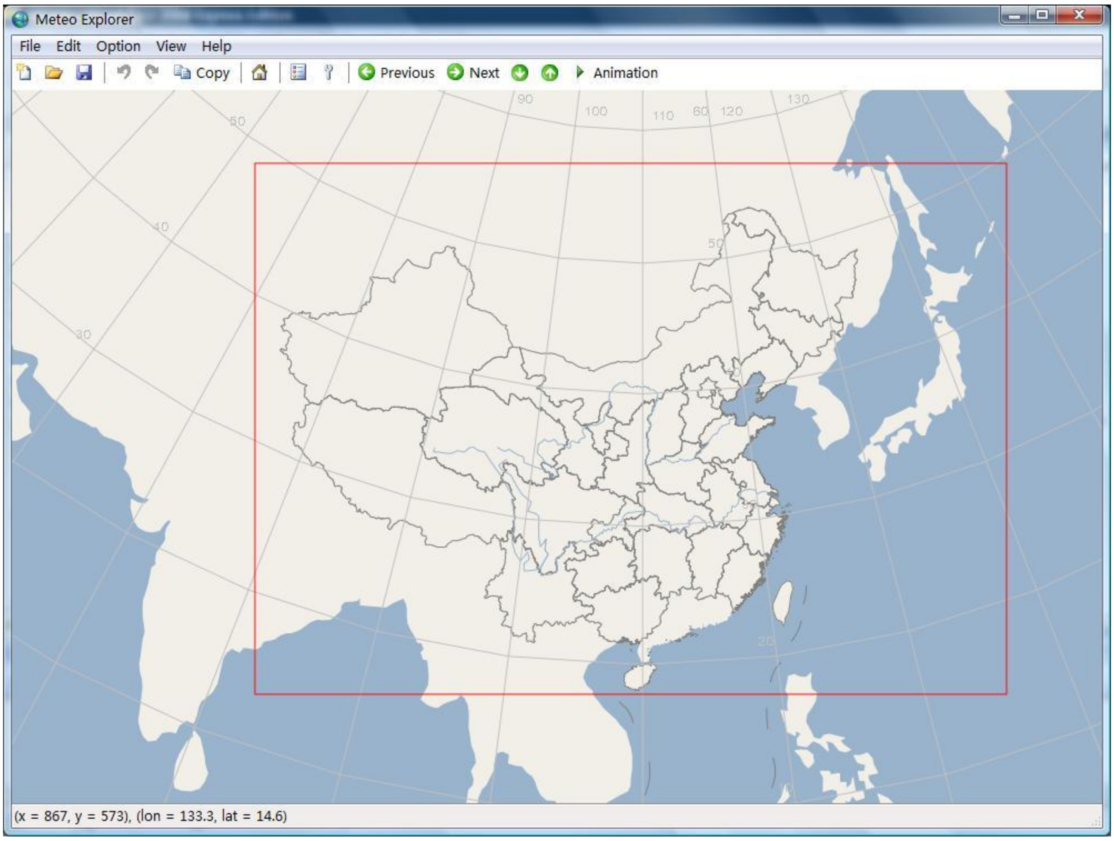


Figure 3-3: To do a rubber band box zoom manipulation, press and hold Ctrl key and right mouse button, then drag the mouse and create a rubber band box (the red box in this figure) that starts from the initial position and ends at current mouse position.

Pan： Hold the left or middle mouse button and then drag. Release the mouse button to end the manipulation. When mouse is moved inside the central canvas, the geographic position (longitude and latitude value) corresponding to the mouse pointer position is shown on the status bar.

Reset zoom and pan offset to initial values: click the 'Home' button on toolbar to reset the zoom scale and pan offset to initial values.

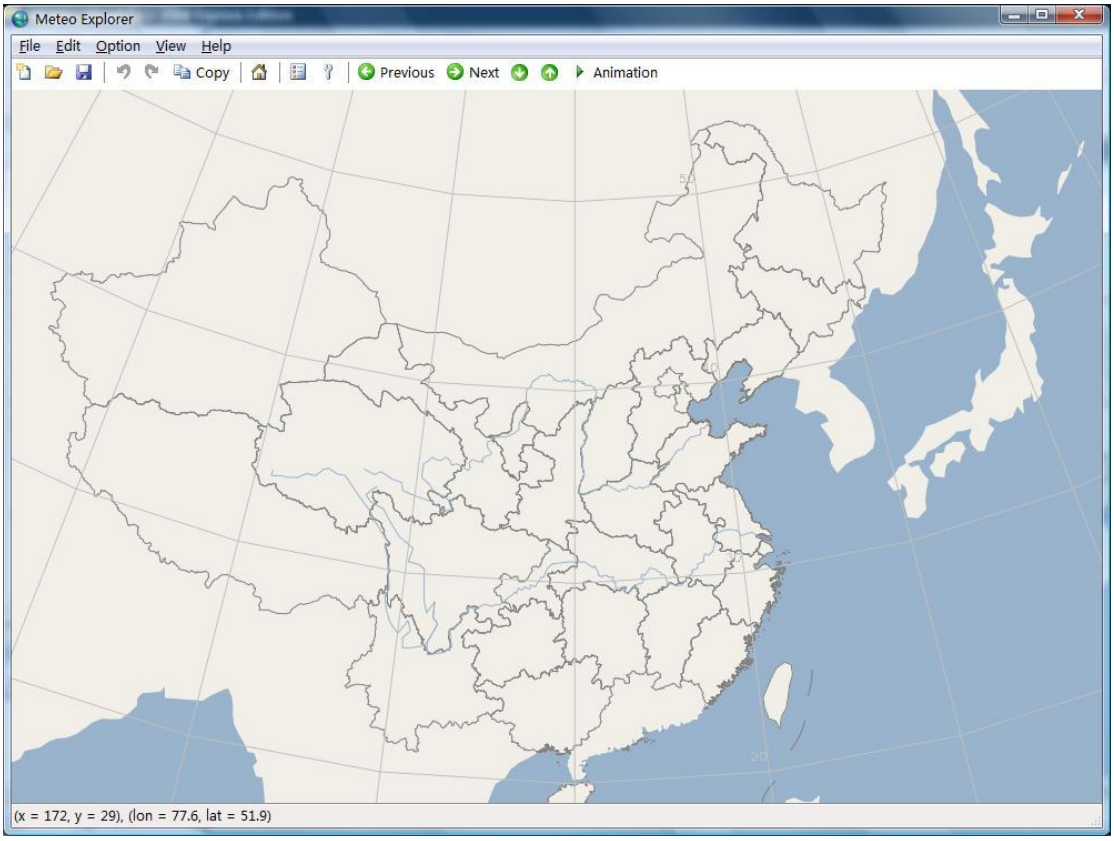


Figure 3-4： Release the mouse to end a rubber band box zoom manipulation. The geographic area defined by the rubber band box is zoomed to the entire canvas.

3.4.2 Zoom to the specified area

The zoom-to-area feature helps users to precisely define a geographic region that occupies the entire canvas. To do this, one may select the menu item 'View, Zoom to Area' to open the 'Zoom to Area' dialog (Figure Figure 3-5). In the dialog, one may enter value of start (end resp.) longitude (latitude resp.) and then click "OK" button.

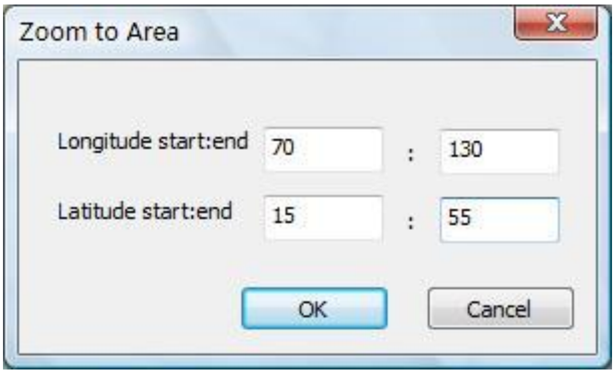


Figure 3-5: MeteoExplorer provides zoom-to-area feature to help users to precisely define a geographic region that occupies the entire canvas

In this example, we specify the longitude range to be east 70~130 degrees, and latitude range to be north 15~55 degrees. The zoomed map is shown in Figure Figure 3-6.

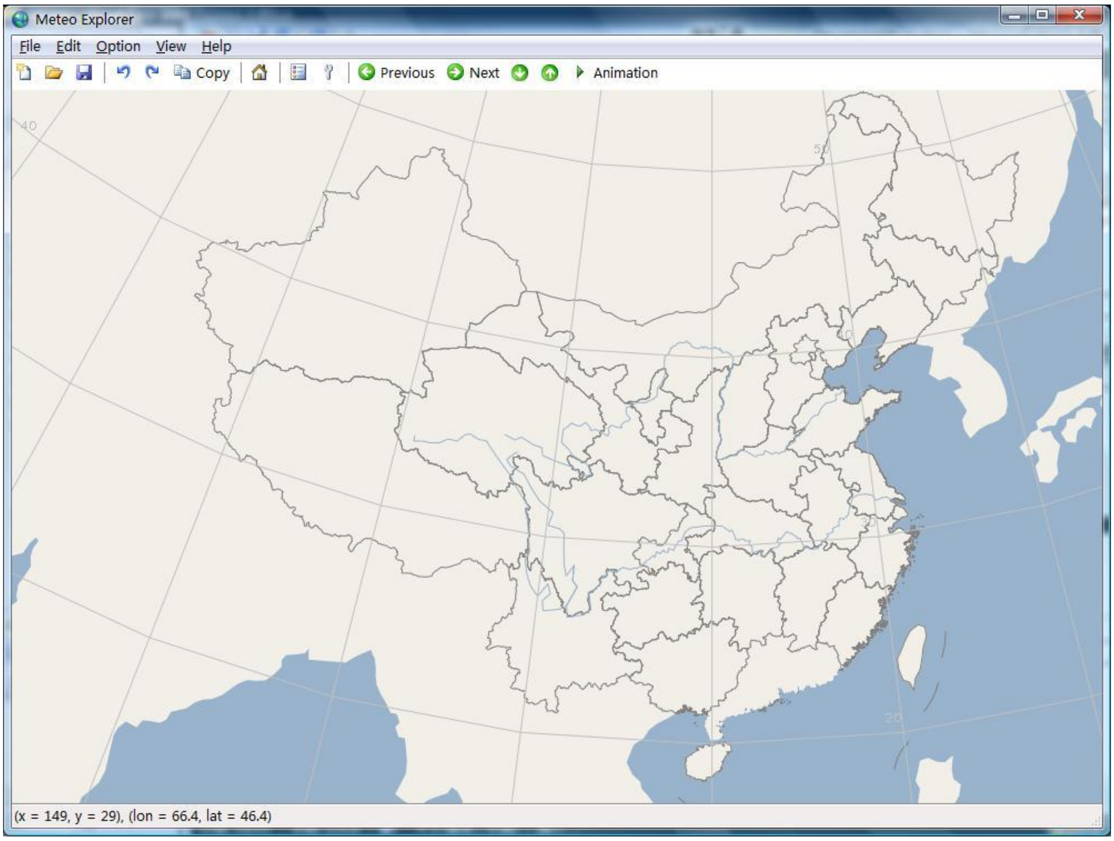


Figure 3-6: The zoomed map after the user specifies the longitude range to be east 70~130 degrees, and latitude range to be north 15~55 degrees.

Tip: In MeteoExplorer, east hemisphere corresponds to 0~180 degrees, west hemisphere corresponds to -180~0 degrees; north hemisphere corresponds to 0~90 degrees, and south hemisphere corresponds to -90~0.

3.4.3 Full screen mode

MeteoExplorer supports full screen display mode, though by default it runs in windowed display mode. To toggle between these two modes, users may select menu item “View, Full Screen” or press F11 key. In full screen display mode, users may also press ESC key to switch back the windowed display mode.

3.5 Graphics Layer Management

3.5.1 Graphics Layer Organization

In MeteoExplorer, a *graphics layer* is logically a set of graphics objects that form a collection. In practice, a graphics layer can either a collection of weather symbols, or a complex synoptic chart that consists of station observations, contours, troughs, and so on. In general, MeteoExplorer creates a graphics layer from a data file. This practice is similar to the graphics layer concept in other meteorological applications.

When a graphics layer corresponding to a data file consists of information of a single element at a single time instance and at a single level (for example, a graphics layer that represents 2013-02-20_12:00:00 500hPa geopotential height), we can perform a number of operations to the layer. Such operations include but are not necessarily limited to show, hide, edit, view file content, remove, refresh, navigate, and configure display properties. A description of these operations can be referenced in Table 3-8. Under such an organization, all graphics layers are arranged in a linear form. So in the graphics layer management window of MeteoExplorer 1.2 (Figure 3-7), each graphics layer is represented by one list item.

When a graphics layer is used to represents a numerical model output data file, which consists of multiple physics elements, each of which in turn has several time instances and levels, the operations mentioned in the last paragraph no longer seem appropriate. For example, what does navigation mean for such a graphics layer?

In order to apply the aforementioned operations to graphics layers of different types, we enhance the graphics layer management functionality in MeteoExplorer 1.3. In the new graphics layer management scheme, all graphics layers are organized into a tree structure (Figure 3-8), with each layer corresponding to a tree node. The tree nodes are classified into two categories based on their depth level. The node with depth level of one correspond to the graphics layer created from a data file; whereas the node with depth level of two represents the graphics layer created by analyzing the given element at given time instance and level from a numerical model data set. A graphics layer of level two is always a child of a graphics layer of level one, therefore can be called *sub-layer*. Let us illustrate the organization scheme with Figure 3-8. This figure shows that the user has opened three data files: the first file contains the data of a 850hPa temperature gridded field. The second one is a NCEP data file encoded in WMO GRIB2 format. Two sub-layers are created by analyzing 500hPa geopotential height field and 500 hPa temperature filed in the NCEP data. The third file corresponds to a composed synoptic chart. As shown in the figure, MeteoExplorer use three level-one tree nodes to represent the graphics layers created from a data file, and two level-two tree nodes to denote the graphics sub-layers created by analyzing a single element in the NCEP data.

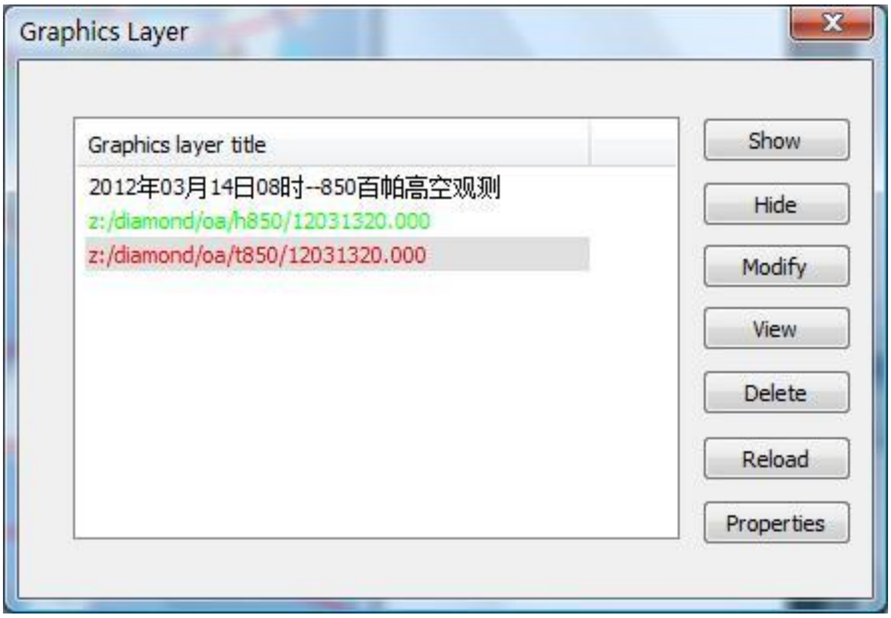


Figure 3-7: The old graphics layer organization use a linear style in which each list item corresponds to a graphics layer, as shown in the graphics layer management window of MeteoExplorer 1.2.

To facilitate users' manipulation of graphics layers, MeteoExplorer provides a few features:

1. If a graphics layer has a contour, the contour color will be used as the color of title text shown in graphics layer window. Otherwise, the color of title text is black or gray, depending on the visibility of the layer.
2. When a graphics layer is hidden, its title in graphics layer window is drawn in gray.
3. For a numerical model data file that consists of multiple elements, levels and times, the icon of the corresponding layer is represented with ; By contrast, the icon of a simple data file is .
4. The icon of the current edited graphics layer is represented with  .
5. When a graphics layer is selected, the background of its title text is highlighted in blue.

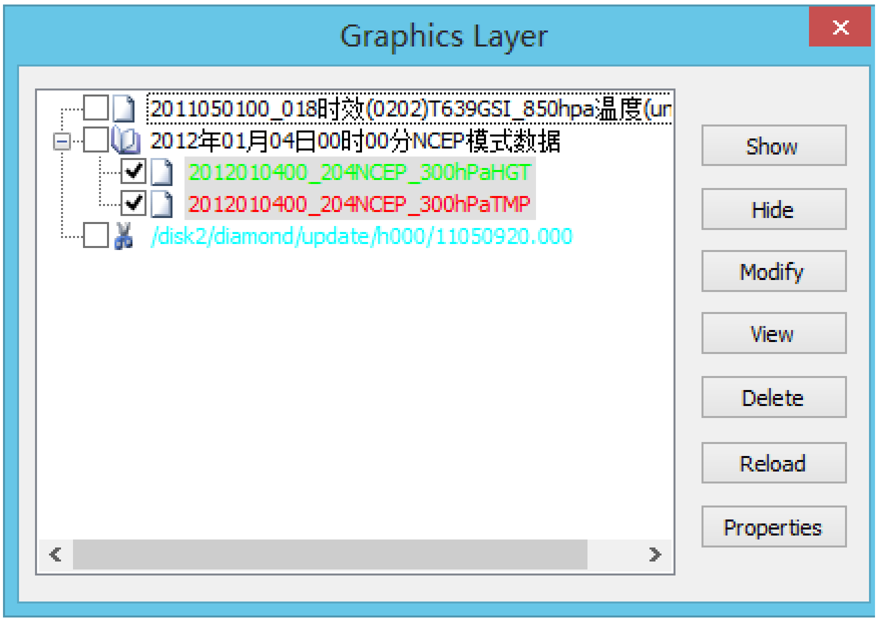


Figure 3-8: In the graphics layer management scheme of MeteoExplorer 1.3, all graphics layers are organized into a tree structure, with each layer corresponding to a tree node.

3.5.2 Basic Graphics Layer Operations

Table 3-8 describes the graphics layer operations provided by each button of graphics layer management window.

Table 3-8: The graphics layer operations provided by MeteoExplorer.

Button name	**Description of the operation**
Show	Show the selected graphics layers in the main window of the application.
Hide	Hide the selected graphics layers. The graphics layers that are hidden will be invisible in the application window.
Modify	Set the edit status of the selected graphics layer to be TRUE. Users may edit the graphics objects in the layer. Note that only one graphics layer can be edited at a time.
View	View the content of the data file corresponding to the selected graphics layer. MeteoExplorer will launch the default text editor application on user's system. This operation only makes sense for non-binary data file.
Delete	Delete the selected graphics layers.
Reload	Re-read and re-analyze the data files corresponding to the selected graphics layers. Replace the graphics layers with the new ones. This feature is helpful when the data files are often updated.
Properties	Open the "Graphics layer properties" dialog to let users configure the

	display properties of the selected graphics layer. Note that only one graphics layer can be configured at a time.

3.5.3 Single Layer Operations

The manipulated objects of the above operations are selected graphics layers. Users can select or deselect a layer by clicking the layer title. If a layer is not selected, a single click of the title will make it selected. If a layer is selected, a single click of the title will make it unselected. When a graphics layer is selected, the background of its title text is highlighted in blue.
Besides using the action buttons in graphics layer management window, there is an alternative but more convenient way to toggle to visibility status of a layer: just click the checkbox control next to the graphics layer title. In addition, users can double click the layer title to open the "Graphics layer properties" dialog. In both cases, no selection operation is need at all!

Tip: It is more convenient to use the checkbox control next to the graphics layer title to toggle visibility status of a layer, and double click the title to open the "Graphics layer properties" dialog.

MeteoExplorer also provides a context menu for operations on a single graphics layer. To bring up this context menu, just right click title of the interested layer (Figure 3-9).

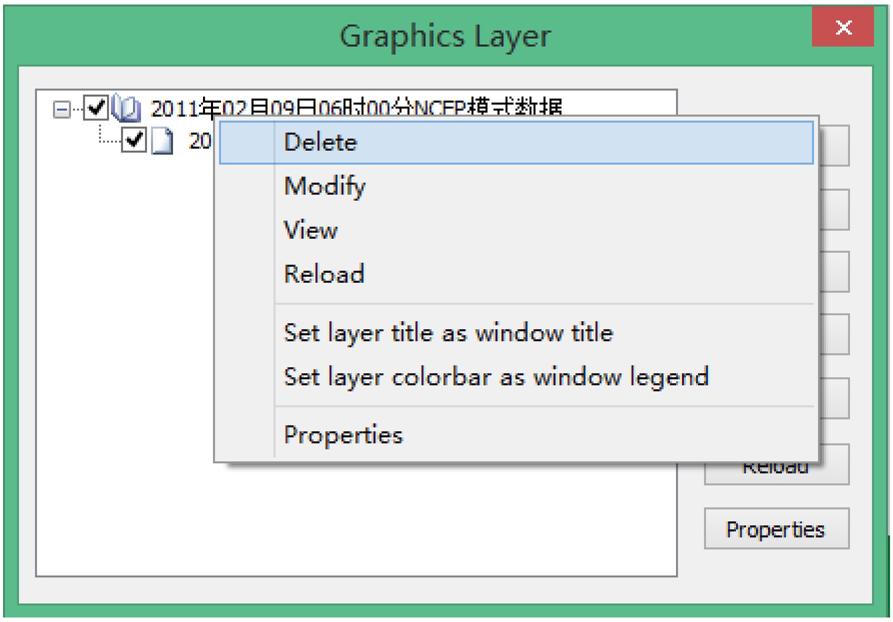


Figure 3-9: The context menu provides convenient access to commonly used operations on a single graphics layer.

There are two more operations for a single graphics layer: "Set layer title as window title" and

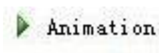
"Set layer colorbar as window legend". Both of the operations are related to the canvas layout configuration. Please reference Chapter 5 (page 57) for the description of these two operations.

3.5.4 Graphics Layer Navigation and Animation

Meteorological data are usually organized in five dimensions, apart from 2D horizontal field, other dimensions are:

- levels;
- time frames;
- elements.

A graphics layer is usually a graphic representation of 2D field data of a certain level, time, and element. It is a common operation for users to go back or forward one or more time frames in order to observe the development of atmospheric dynamic. Time navigation differs from animation in that users have to manually change the time frame.

To perform time navigation or animation, users have to select the layers of interested in the first place, then uses the corresponding menu items, toolbar buttons that are describe in Table 3-4. For time animation operation, the toolbar buttons will change based on the current state. Before animation starts, the toolbar button is 

(Windows build) or  (Unix/Linux build). During the animation process, the button image is changed to 

(Windows build) or  (Unix/Linux build).

Users can change the time interval between two consecutive time frames during navigation or animation. To do this, select the menu time "View, Time Interval" or its corresponding toolbar button (Figure 3-10). Four choices are available, among which the option "Automatic" means to use time interval between consecutive time frames in the data set.

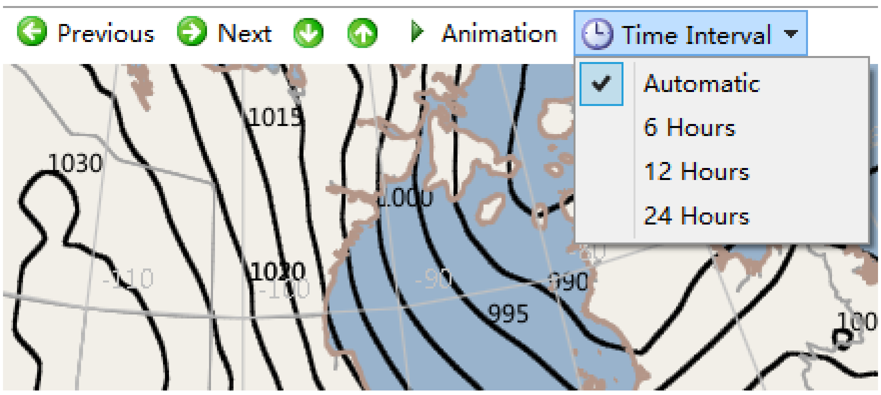


Figure 3-10: Users can change the time interval between two consecutive time frames during navigation or animation.

Users can also set the animation period between two consecutive time frames by selecting the menu item "Option, Preferences". This will open the "Preferences" dialog as shown in Figure 3-12 (page 37).

3.5.5 Differences in Graphics Layer Operations for Different Type of Data Files

As discussed in section 3.5.1 (page 29), the organization structure of the data differs substantially among different type of files. While MICAPS data file usually store the data for a single physics element at a single time instance and level, numerical model output file in general store a lot of physics elements at all time instances and levels. As a result, a single graphics layer operation may have slightly difference meanings for different type of files. Table 3-9 provides a comparison of what a graphics layer operation can do for MICAPS data file and numerical model output file.

Table 3-9: A comparison of what a graphics layer operation can do for MICAPS data file and numerical model output file.

Data / Operation	MICAPS data file (level one tree node)	Numerical model output file (level one tree node)	Numerical model output file (level two tree node)
Show	Show the selected graphics layers.	Identical to left	Show the selected sub-layers. The selected sub-layers will not be shown if its parent is hidden.
Hide	Hide the selected graphics layers.	Identical to left	Hide the selected sub-layers.
Modify	Set the edit state of the selected graphics layer to TRUE. Users may edit the graphics objects in the layer.	Invalid operation	Invalid operation
View	Open data file corresponding to the selected graphics layer.	Invalid operation	Invalid operation
Remove	Remove the selected graphics layers.	Remove the selected graphics layers along with associated sub-layers	Remove the selected sub-layers. If all sub-layers of a graphics layer are removed, this parent layer is removed as well.
Reload	Refresh the graphics layer by re-loading and analyzing its data file	Identical to left	Invalid operation
Properties	Open the "Graphics layer properties" dialog to let	Open the "Universal Model" dialog to let	Open the "Graphics layer properties" dialog

	users configure the display properties of the selected graphics layer.	users add a new graphics layer of the physics element in the data set.	to let users configure the display properties of the selected sub-layer.
Navigate in time	Read and analyze the data file contains the element in the adjacent time instance of the element of the selected graphics layer. The data files should be stored in the same folder and named by time information.	Identical to left	Extract and analyze the data of the element in the adjacent time instance to the element of the selected graphics layer.
Navigate in level	Read and analyze the data file contains the element in the adjacent level of the element of the selected graphics layer. The data files should be stored in the same folder and named by level information.	Identical to left	Extract and analyze the data of the element in the adjacent level to the element of the selected graphics layer.

3.6 Thumbnail View

There are two view modes in MeteoExplorer, overlaid view and thumbnail view. In overlaid view for example Figure 6-13 on page 83, all graphics layers are drawn one over another, in the order of their creation time. In thumbnail view, thumbnail images of all visible graphics layers are drawn one besides another. So the thumbnail view gives users a quick glance of all visible graphics layers. Figure 3-11 offers an illustration of thumbnail view of six graphics layers.

To toggle between the two views, users may select the menu item “View, Thumbnail View” or corresponding toolbar button  (Windows build) or  (Unix/Linux build). Note that hidden layers will not be shown in thumbnail view. For a graphics layer created from a numerical model data file (see Chapter 6) that consists of multiple sub-layers, a thumbnail image is created for each sub-layer.

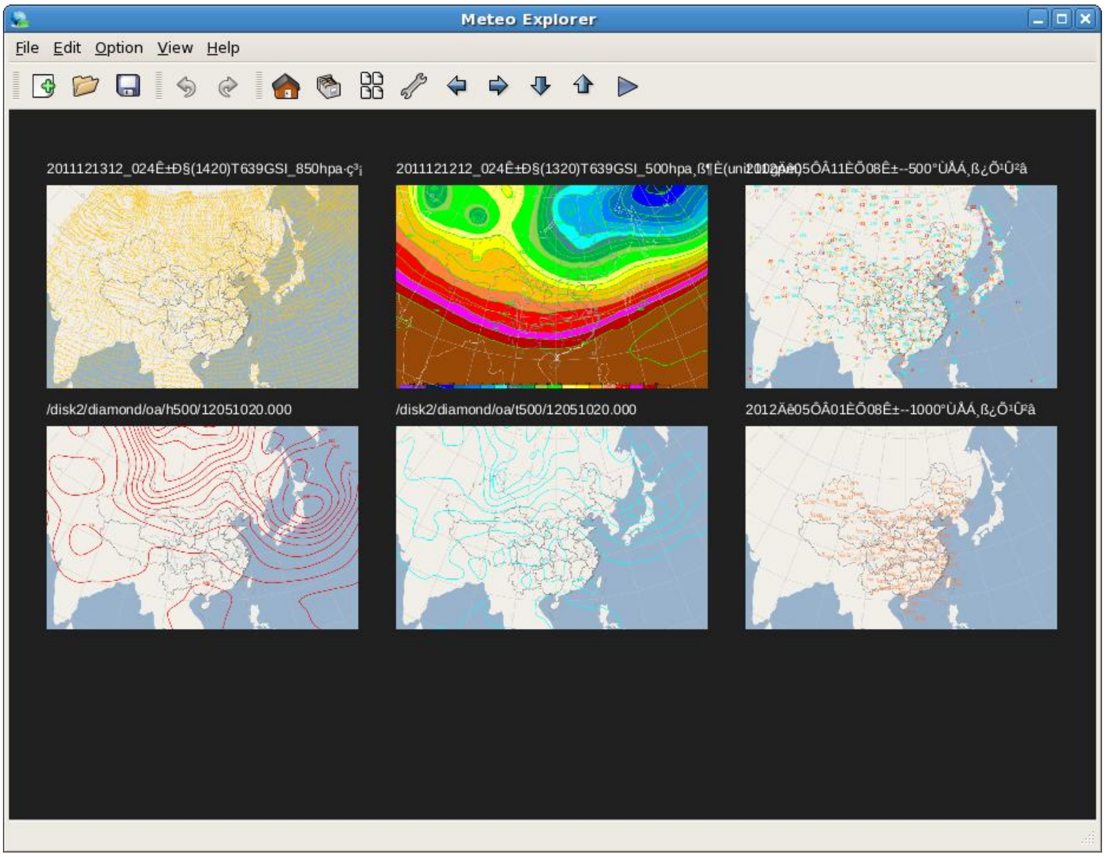


Figure 3-11: The thumbnail view of six graphics layers.

3.7 Status bar

Except MeteoExplorer is in full-screen mode or thumbnail view mode, the screen coordinate and geographical position corresponding to the mouse pointer position is shown on status bar.

3.8 User Preferences

MeteoExplorer provides a number of options to let users customize the application's behavior. To configure these options, one should select the "Option, Preference" menu item to open the "Preferences" dialog (Figure 3-12).

For now MeteoExplorer provides seven options:

- Render graphics with hardware acceleration;
- Adjust screen contents based on map scale;
- Smooth linestrip when drawing synoptic chart;
- Show graphics layer title in canvas;
- Animation period;
- User interface language;
- Data source directory.

3.8.1 Switch between software and hardware rendering

MeteoExplorer has incorporated a multifunctional graphics rendering engine that is able to switch between hardware acceleration rendering and software rendering[1]. This innovative graphics rendering engine is our answer to the increasing demand on graphics output capabilities from atmospheric science operations and research. First of all, the hardware acceleration rendering technique provides high rendering performance and fluid user experience, both of which improve user's productivity. Second, software rendering is the key to high-quality vector graphics output. Third, software rendering can serve as a backup solution when user has incompatibility issues in her computer system. For example, when a user remotely logs into her PC, MeteoExplorer can automatically switch to software rendering mode. This is a common practice employed by other commercial software such as Microsoft Word、Internet Explorer.
Hardware acceleration rendering is turned on by default in MeteoExplorer. to toggle between the two rendering modes, check or uncheck the "Render graphics with hardware acceleration" control as shown in Figure 3-12.

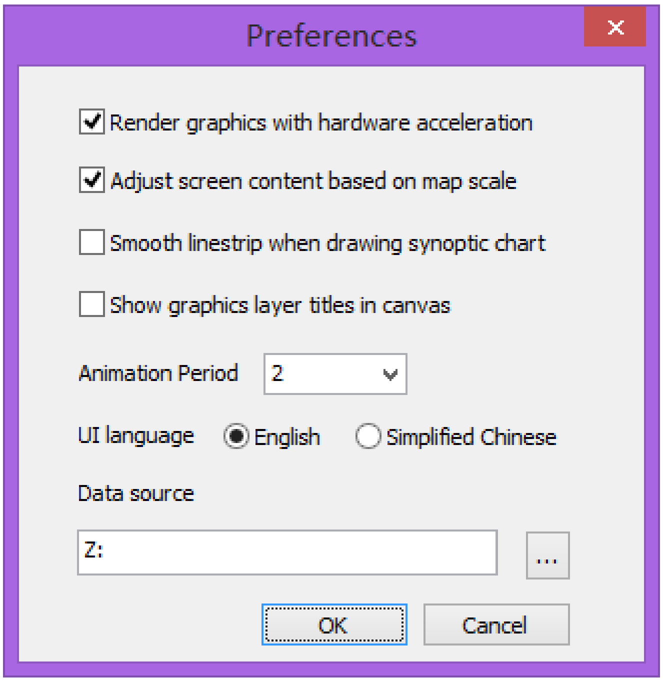


Figure 3-12: MeteoExplorer provides a number of options to let users customize the application's behavior.

3.8.2 Adjust screen contents based on map scale

The second option is to adjust the count of graphics objects rendered on the screen based on the current map scale. This option is turned on by default. The motivation behind this option is that

[1] Software rendering is only available in Windows build of MeteoExplorer.

some meteorological data distribute densely and irregularly inside certain geographic range. A typical set of examples of such data include high-resolution gridded field, wind field, rainfall field, surface plot data, and city forecast data. If all the graphics objects are rendered at once, there will be a couple of serious issues:

First, rendering huge amount of data leads to poor app performance;

Second, when map proportional scale is large, the graphics objects representing the data are cluttered and users may not have a clear view of the data.

A solution to the issue is to adjust the rendering content based on the current proportional scale of the map. The idea is to draw more (less respectively) graphics objects at the map scale decreases (increases respectively).

As an example, let us take a look at Figure 3-13. In this figure, the 24-hour valid range precipitation field forecasted by ECWMF on January 1, 2013 is shown. Here the map scale is 1000 kilometers and consecutive grid points are shown with a distance of 2.5 degrees.

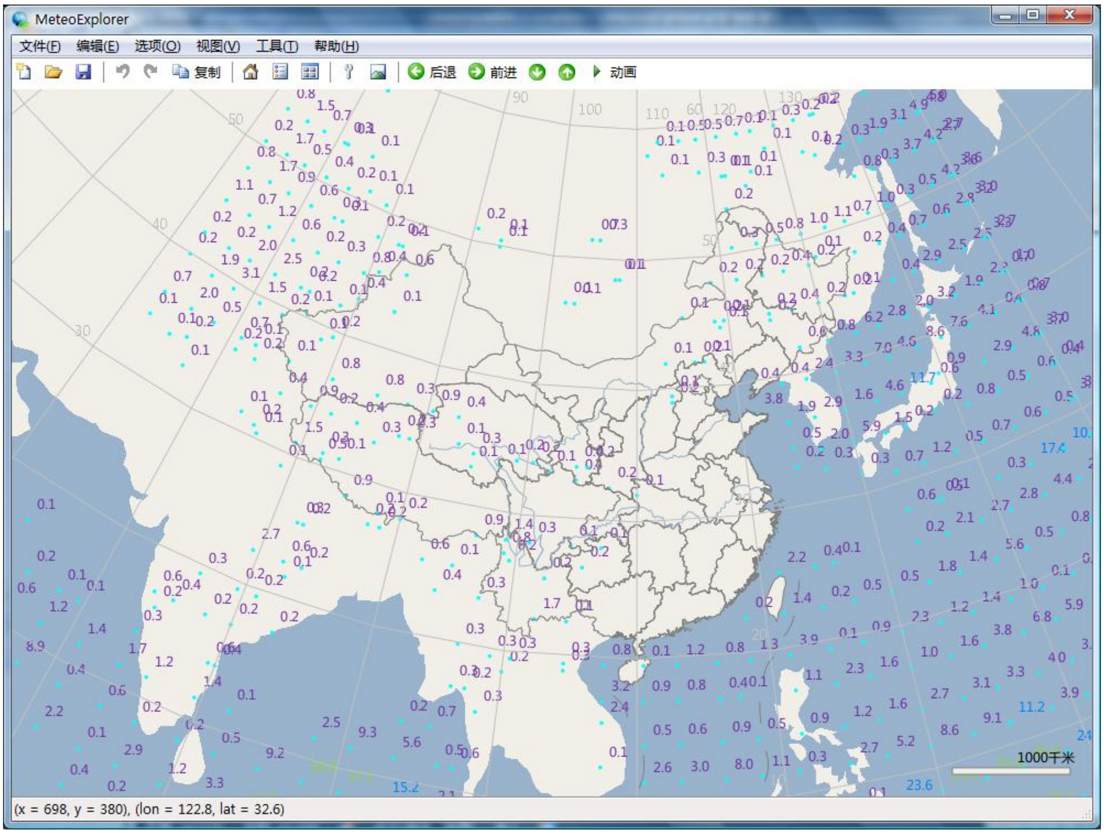


Figure 3-13: The rendered result of the 24-hour valid range precipitation field forecasted by ECWMF. Here the map scale is 1000 kilometers and consecutive grid points are shown with a distance of 2.5 degrees.

When the user zooms in the map to the extent that the map scale is 100 kilometers, consecutive grid points are shown with a distance of 0.5 degrees (Figure 3-14).

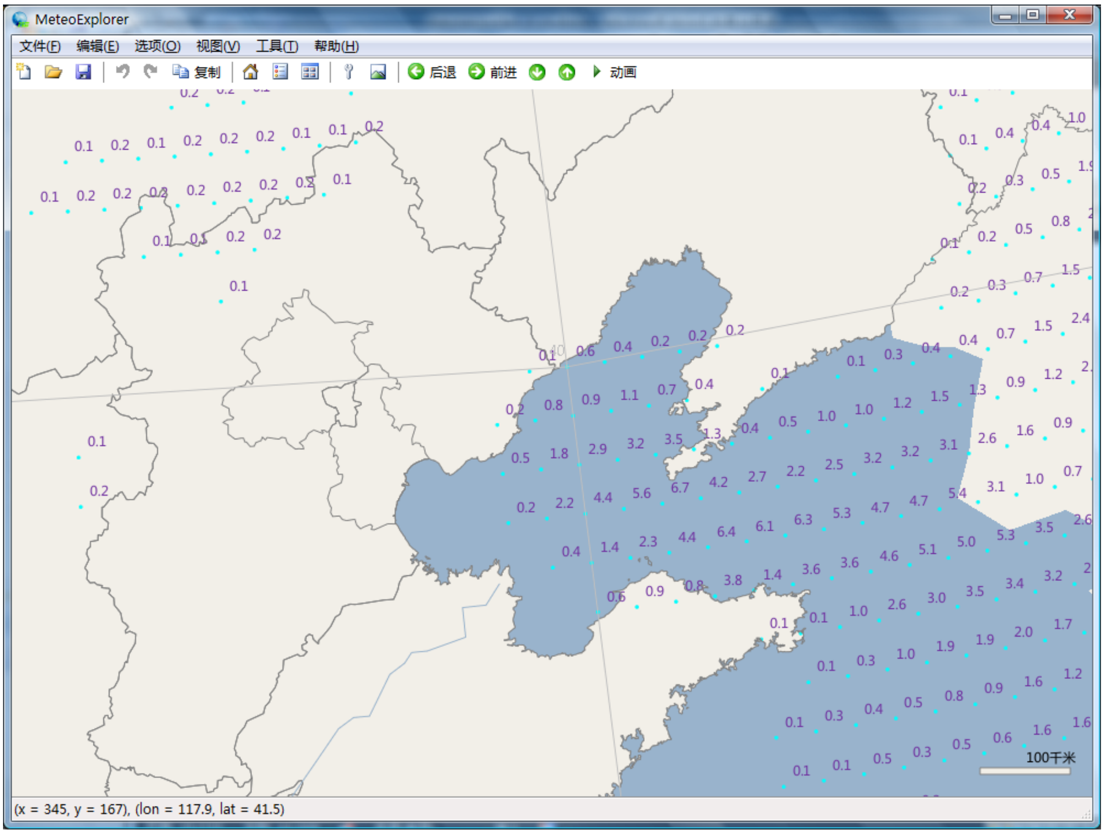


Figure 3-14: When the map scale is 100 kilometers, consecutive grid points are shown with a distance of 0.5 degrees.

The point is the density of screen contents are adjusted at a relatively reasonable level based on the map scale. Let us see a comparison to justify the point. Figure 3-15 shows a surface plot data when the "Adjust screen content with map scale" option is turned on. Users are encouraged to compare this figure with Figure 7-1 on page 85. It can be seen from the comparison that dynamic content adjustment can not only enhance rendering performance, but improve readability as well.

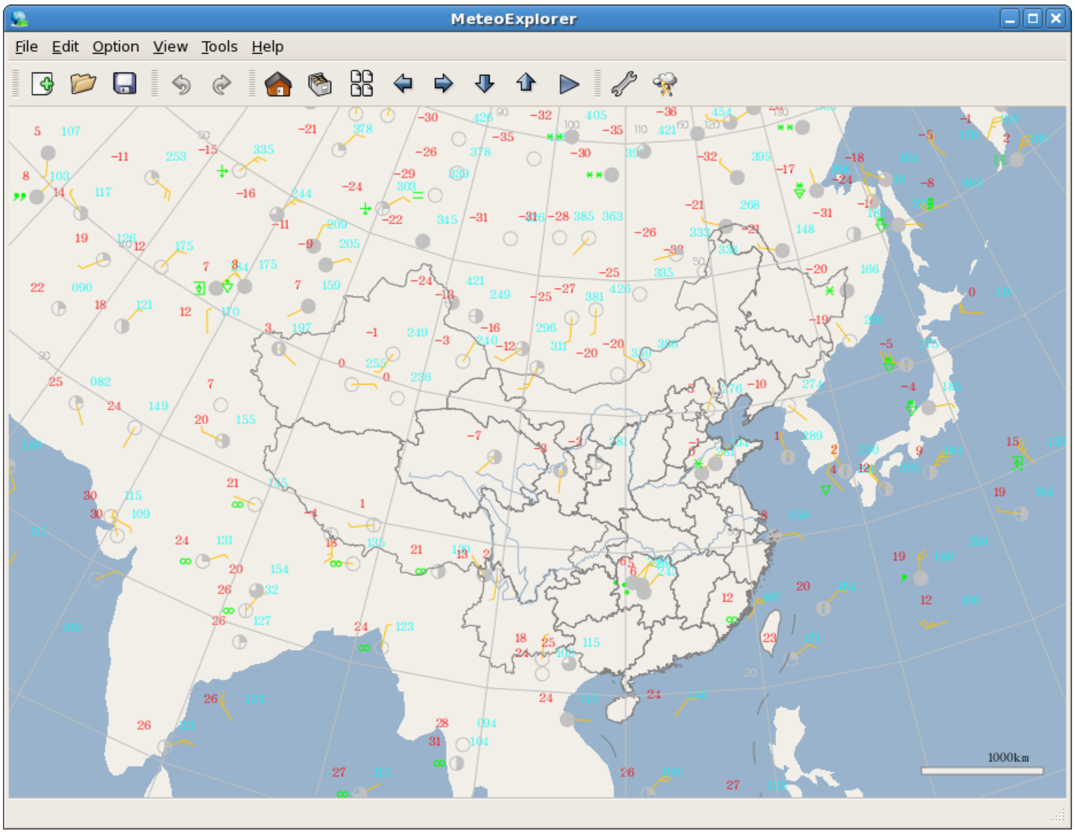


Figure 3-15: The rendered result of a surface plot data when the “Adjust screen content with map scale” option is turned on.

3.8.3 Smooth line strip when drawing synoptic chart

MeteoExplorer provides an interactive environment for users to draw the predefined symbols and geometric shapes. The way a user draws a line strip is to draw a number of anchor points that determine the shape of the line strip. In implementation, MeteoExplorer calculates the line strip based on the cubic spline interpolation of the polygonal line linking the anchor points.
When a user draws a line strip by consecutively plotting a number of anchor points, MeteoExplorer can provide a preview of the line strip by drawing the spline interpolated line from the polygonal line. To turn on this feature, user should select the “Smooth linestrip when drawing synoptic chart” checkbox control. Figure 3-16 shows spline interpolated line while the user plots a line strip. Users may disable this feature by deselect this control. To give a comparison, Figure 3-17 shows polygonal line linking the same anchor points used in Figure 3-16.

For a detailed description on how to plot synoptic chart in MeteoExplorer, please reference Chapter 15 on page 141.

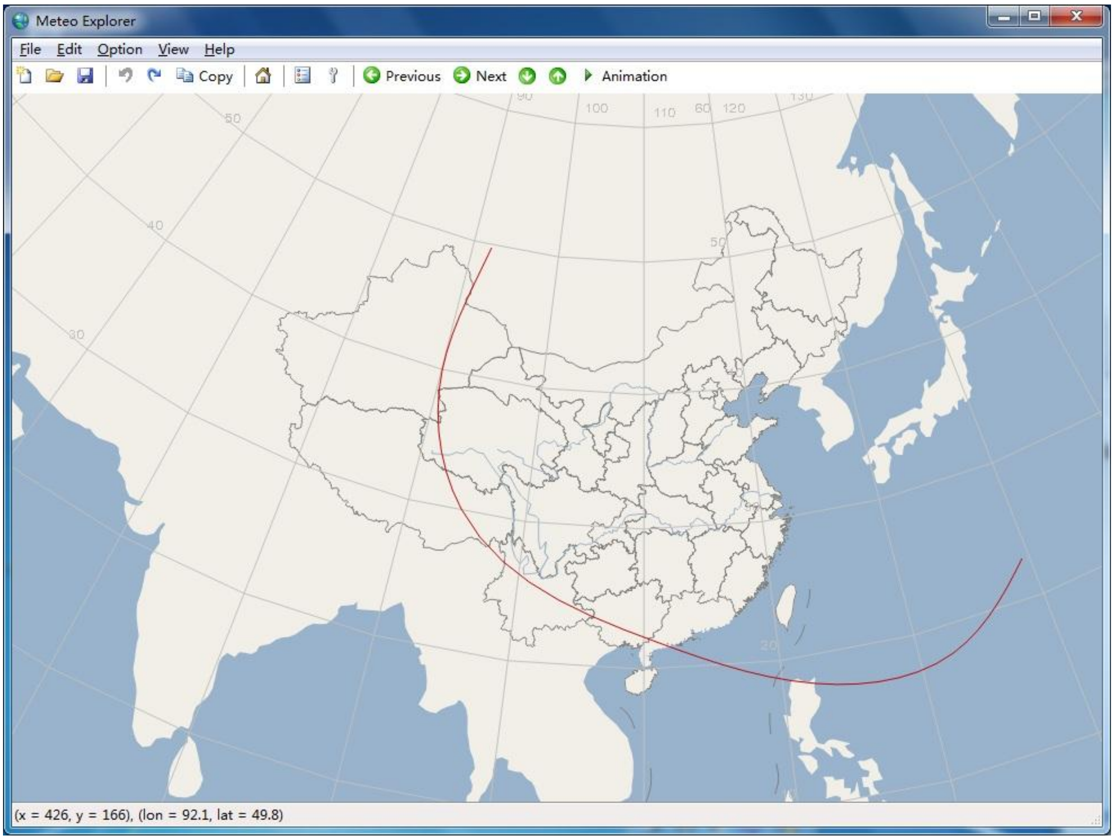


Figure 3-16: When the “Smooth linestrip when drawing synoptic chart” feature is turned on, MeteoExplorer shows the spline interpolated line from the polygonal line linking the anchor points.

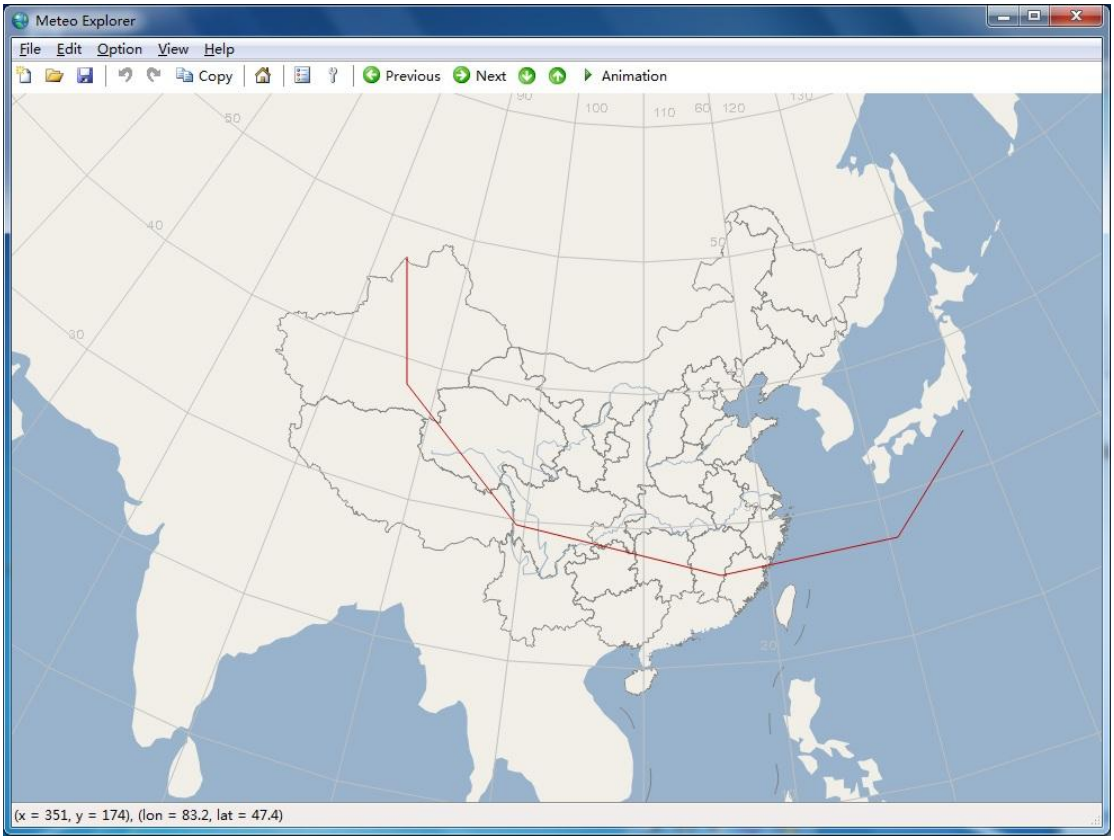


Figure 3-17：When the “Smooth linestrip when drawing synoptic chart” feature is turned off, MeteoExplorer just shows the polygonal line linking the anchor points.

3.8.4 Switch user interface language

MeteoExplorer provide two user interface (UI) languages: English and Simplified Chinese. Users may select the language of their favorite using the “Preferences” dialog without quit the application[2]. Under the hood, MeteoExplorer chooses one of the two languages on its startup process by detecting the first language used in user’s operating system.

[2] Only English language is available in Linux build of MeteoExplorer.

Chapter 4 GIS functionalities

This chapter introduces the basic geographic information system (GIS) features provided by MeteoExplorer.

4.1 Cartographic Projection Settings

MeteoExplorer supports a number of commonly used cartographic projections:

- Lambert conic conformal
- Mercator
- Polar Stereographic of north pole
- Polar Stereographic of south pole
- Equidistant Cylindrical
- Cylindrical Equal Area
- Orthographic

Each projection has its own parameters, among which longitude and latitude of projection are shared by all projections. Table 4-1 summarizes the definitions of projection longitude and latitude of all supported projections in MeteoExplorer.

Table 4-1: Summarization the definitions of projection longitude and latitude of all supported projections in MeteoExplorer.

Projection	**Projection Longitude**	**Projection Latitude**
Lambert conic conformal	Longitude of natural origin	Latitude of natural origin
Mercator	Longitude of natural origin	Latitude of first standard parallel
Polar Stereographic of north pole	Longitude of natural origin	Latitude of natural origin
Polar Stereographic of south pole	Longitude of natural origin	Latitude of natural origin
Equidistant Cylindrical	Longitude of projection center	Latitude of true scale
Cylindrical Equal Area	Central Meridian	Standard Parallel
Orthographic	Longitude of projection center	Latitude of projection center

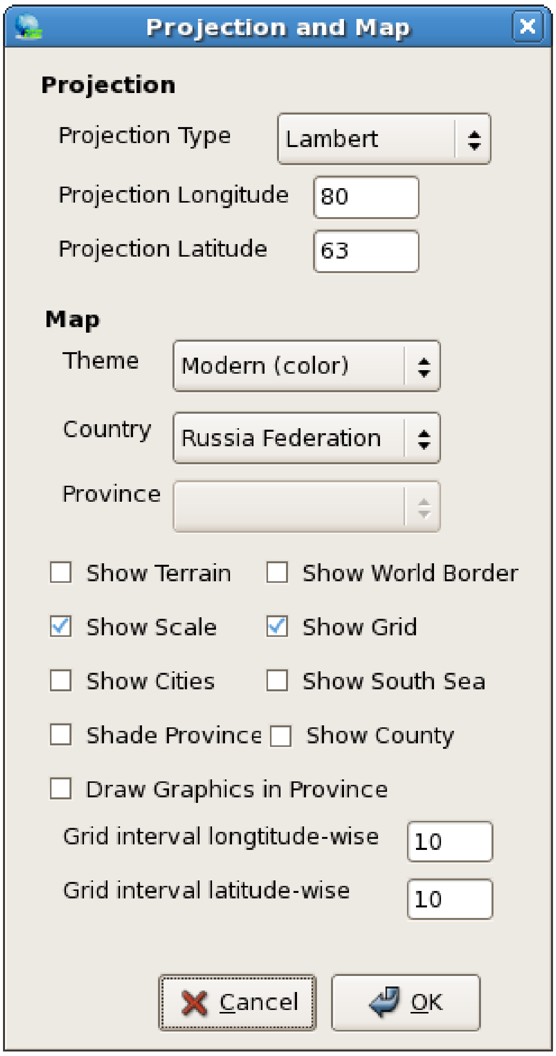


Figure 4-1: User can configure map and projection settings using MeteoExplorer's "Map and Projection" dialog.

To configure projection settings, please select the menu item "Option, Projection and Map" to open the "Projection and Map" dialog as shown in Figure 4-1. Users may choose a projection type via the "Projection Type" combobox, and set projection center parameters in the "Projection Longitude" and "Projection Latitude" edit box.

During its launch process, MeteoExplorer loads projection settings of last session from its configuration file. If the configuration file is not available, it will automatically detect geographic location information on user's system and load pre-defined projection settings based on the location. For example, if a user's system location is set as "United States", then the pre-defined projection settings with projection type being Lambert, and the projection center being (90W, 30N) is loaded. Figure 4-2 shows the re-projected map when the projection center is changed to (80W, 30N). Figure 4-3 shows the re-projected map when the projection is changed to Mercator and (longitude, latitude) is changed to (110E, 40N).

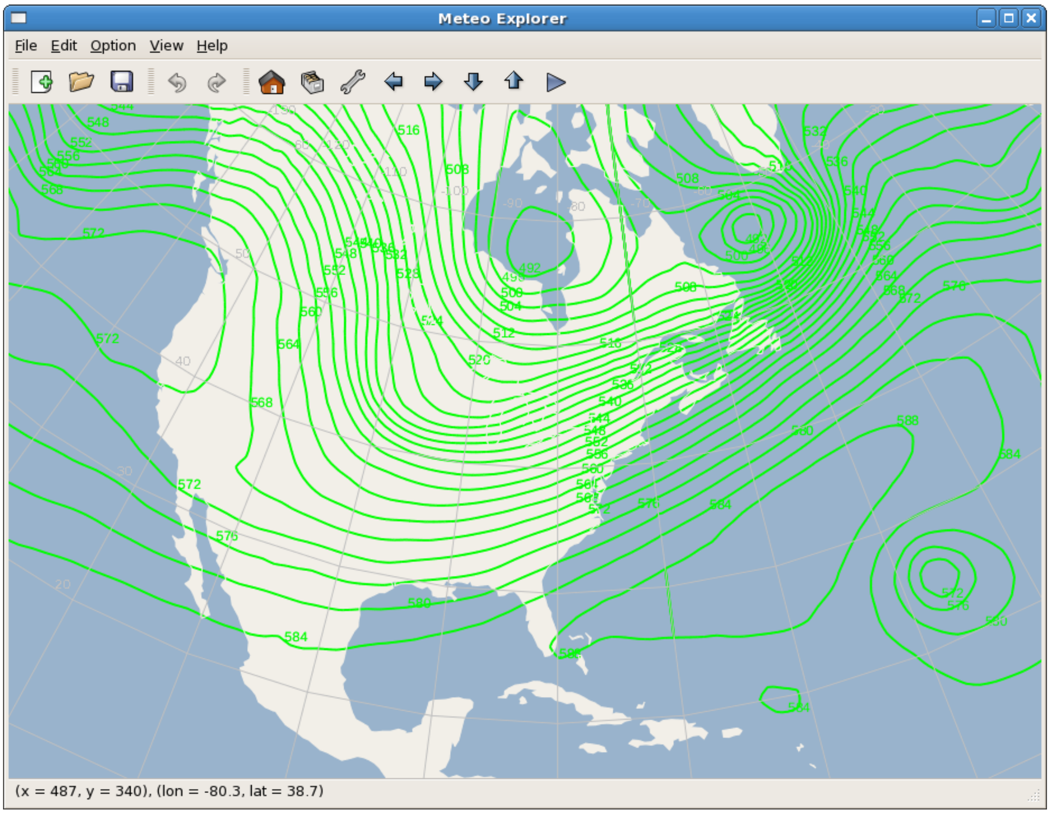


Figure 4-2：the re-projected map when the projection (longitude, latitude) is changed to (80W, 30N).

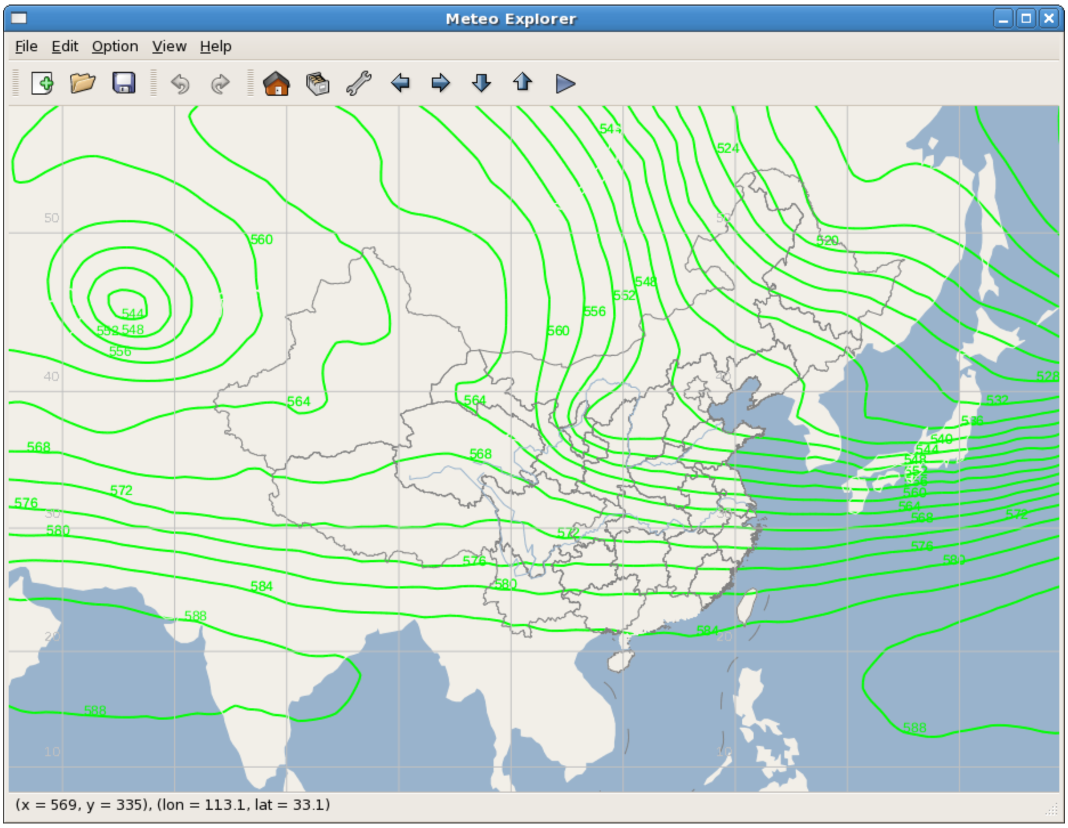


Figure 4-3: the re-projected map when the projection is changed to Mercator

and (longitude, latitude) is changed to (110E, 40N).

4.2 Base Map Settings

4.2.1 Theme

MeteoExplorer provides three pre-defined theme:

- Operation. In the operation theme (Figure 4-4), the background is black and the land and ocean is not distinguished. The operation theme has its merit of offering sharp contrast between the graphics objects and the background, therefore fits for the case when large volume of data are rendered.

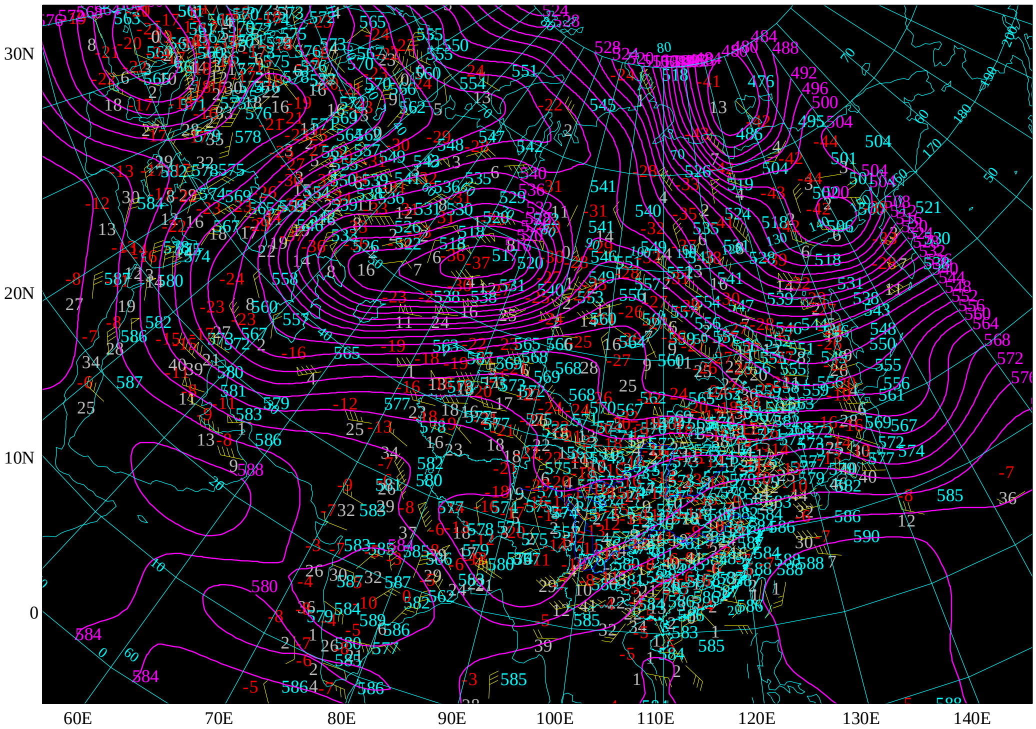


Figure 4-4: In the operation theme, the background is black and the land and ocean is not distinguished. The operation theme fits for the case when large volume of data is rendered.

- Publishing: in the “Publishing” theme as shown in Figure 4-5, the background is white and the land and ocean is not distinguished. All graphics objects are drawn either in black or in gray-scale. This theme is suitable for saving the screenshot of application window to an image file used for publication or presentation.

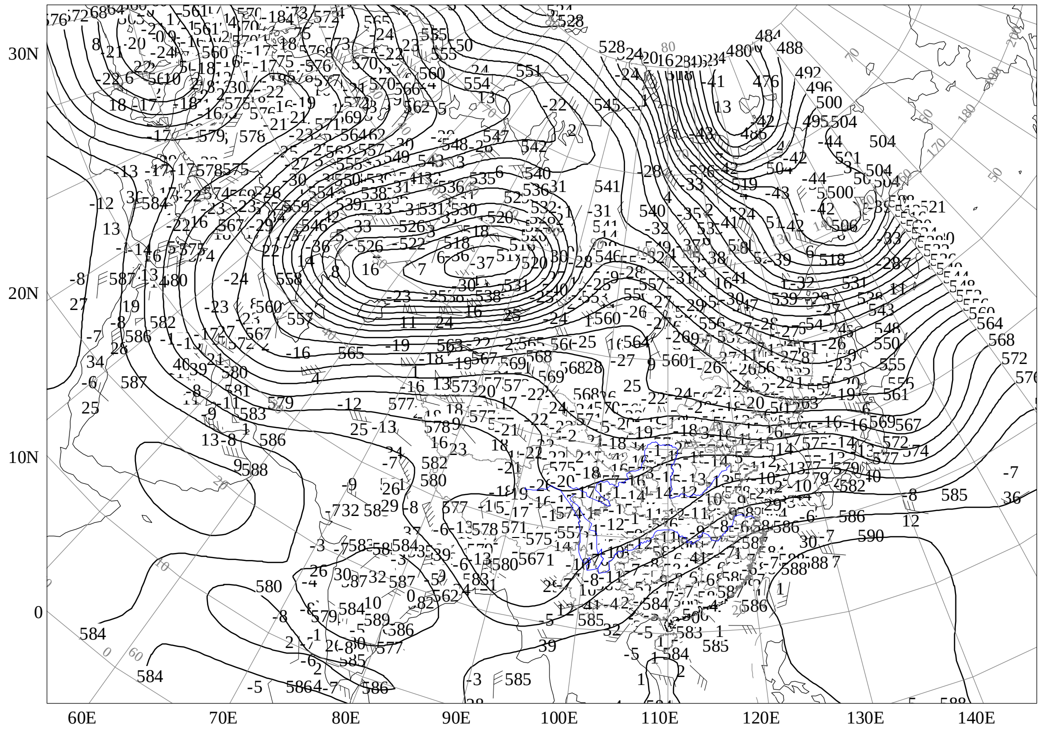


Figure 4-5: In the “Publishing” theme, the background is white and the land and ocean is not distinguished. This theme is suitable for saving the screenshot of the application window to an image file, and using the file for publication or presentation.

- Modern: The “Modern” theme is the default theme of MeteoExplorer. As shown in Figure 4-6, the ocean is drawn in light blue and the land is drawn in white. This color scheme is similar to some popular map applications such as Bing Map or Google Map.

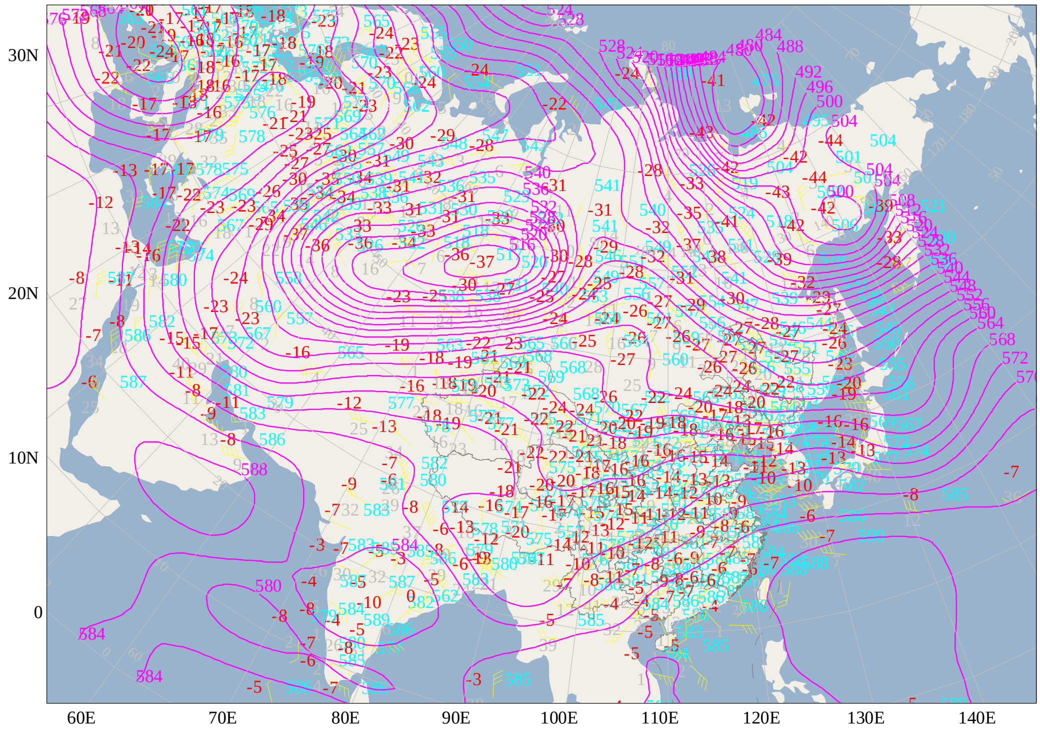


Figure 4-6：The “Modern” theme is the default theme of MeteoExplorer. In this theme, the ocean is drawn in light blue and the land is drawn in white.

To change the theme, please use the “Theme” combobox in the “Projection and Map” dialog.

4.2.2 Country and Region

MeteoExplorer provides pre-defined map and projection settings for 79 countries and regions in the world. They are the global, Algeria, Antarctica, Argentina, Australia, Austria, Bahrain, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Iraq, Ireland, Israel, Italy, Japan, Jordan, Korea, Democratic People’s Republic of, Korea, Republic of, Kuwait, Latvia, Lebanon, Liechtenstein, Lithuania, Luxembourg, Malaysia, Malta, Mauritania, Mexico, Mongolia, Morocco, Netherlands, New Zealand, Norway, Oman, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia Federation, Saudi Arabia, Serbia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Thailand, Trinidad and Tobago, Turkey, Ukraine, United Kingdom, United States, Uruguay, Venezuela, Viet Nam, and Yemen. More countries and regions will be added in future releases.

When MeteoExplorer is launched, the country and region will be set based on the location settings in user’s system. To change to another country or region, use the “Country and Region” combobox in the “Map and Projection” dialog. Figure 4-7 shows the rendered map when the user selects “World”.

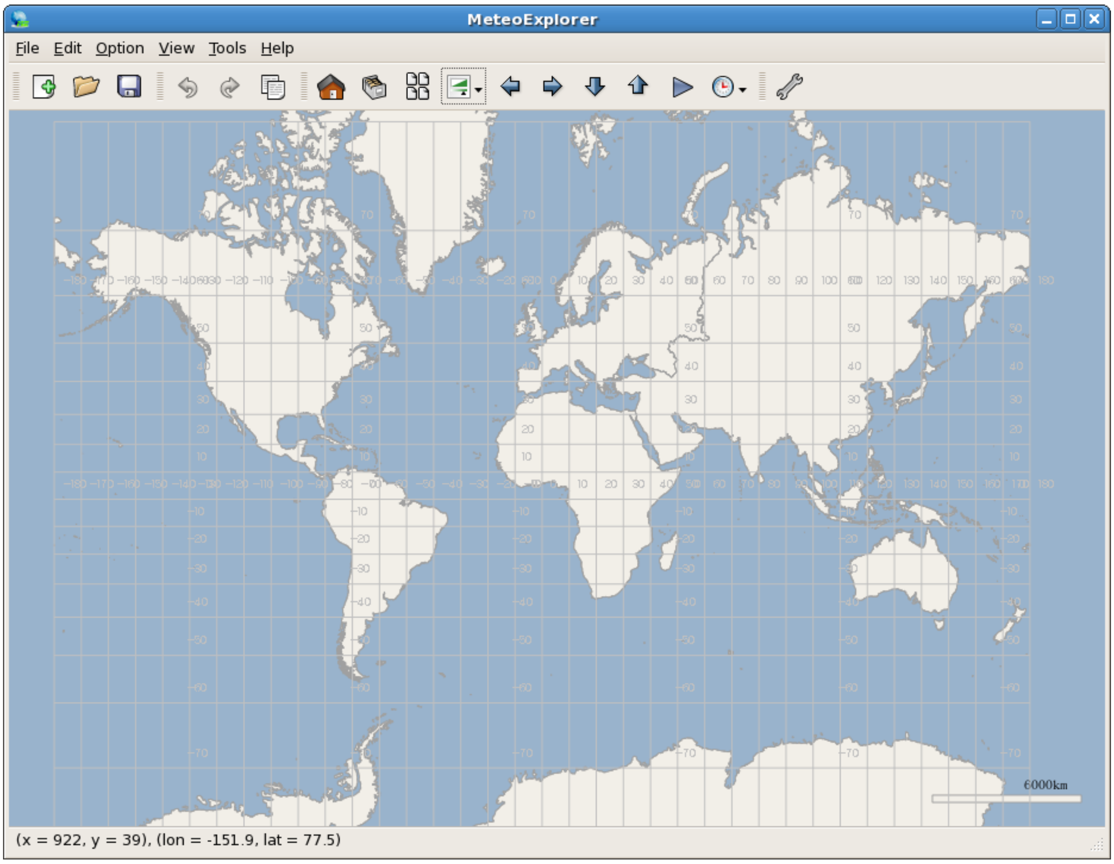


Figure 4-7: The rendered map when the user selects “World” from the “Country” combo-box control in the “Projection and Map” dialog.

4.2.3 Topology Terrain

MeteoExplorer represents the world topology terrain height using a pre-configured color scheme as shown in Figure 4-8.

The topology terrain is not shown by default in MeteoExplorer. To show topology terrain, select the “Show Terrain” check box in the “Projection and Map” dialog.

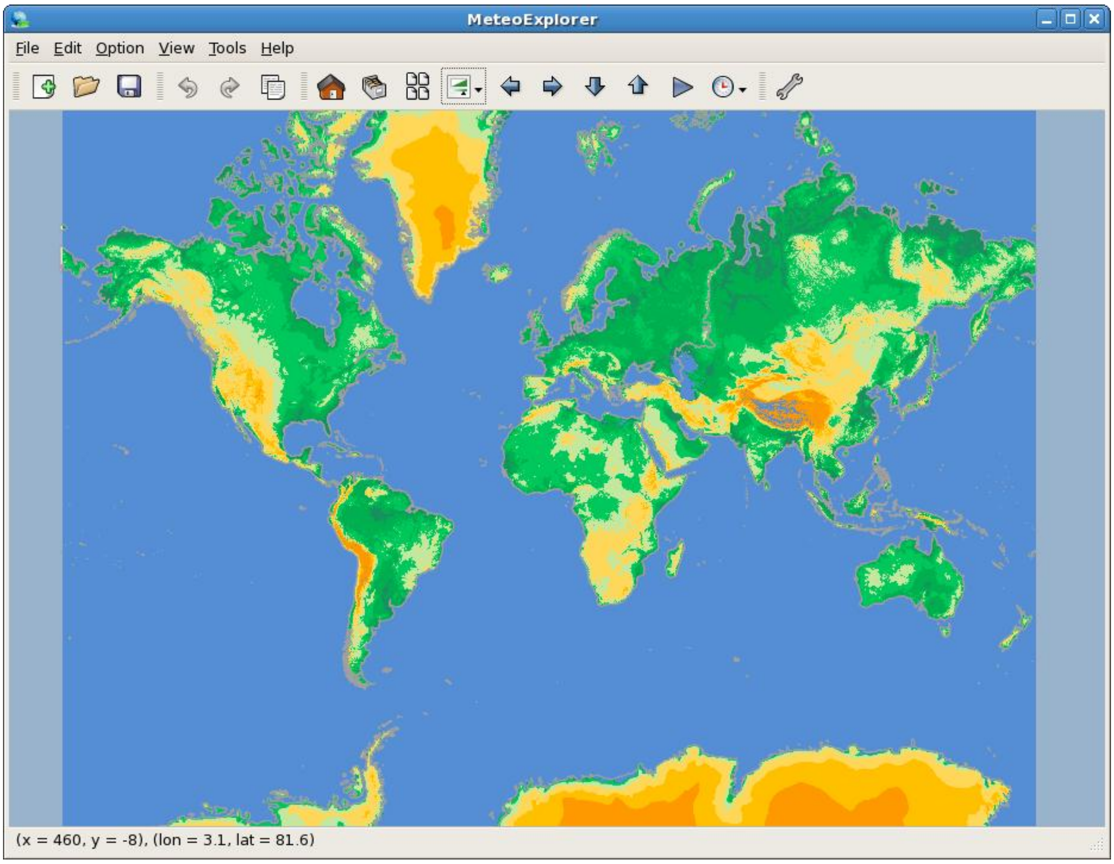


Figure 4-8: The topology terrain shown in MeteoExplorer.

4.2.4 Single State/Province Display and Shading

This feature of state/province shading is meant to draw the states/provinces of a country in different colors. Figure 4-9 shows the result of rendering provinces of Canada. The option is turned off by default. To turn it on, users can select the “Shade Province” checkbox in the “Projection and Map” dialog.

Users can also choose to show only one state/province of a country. To do this, select the province of interested from the “Province” combo-box control. Figure 4-10 shows the result of show only British Columbia province of Canada. For this time, the show-only-one-state feature is applicable to eleven countries: Australia, Brazil, Canada, China, France, Germany, Italy, Japan, Spain, Great Britain, and United States. More countries and regions will be added in future releases.

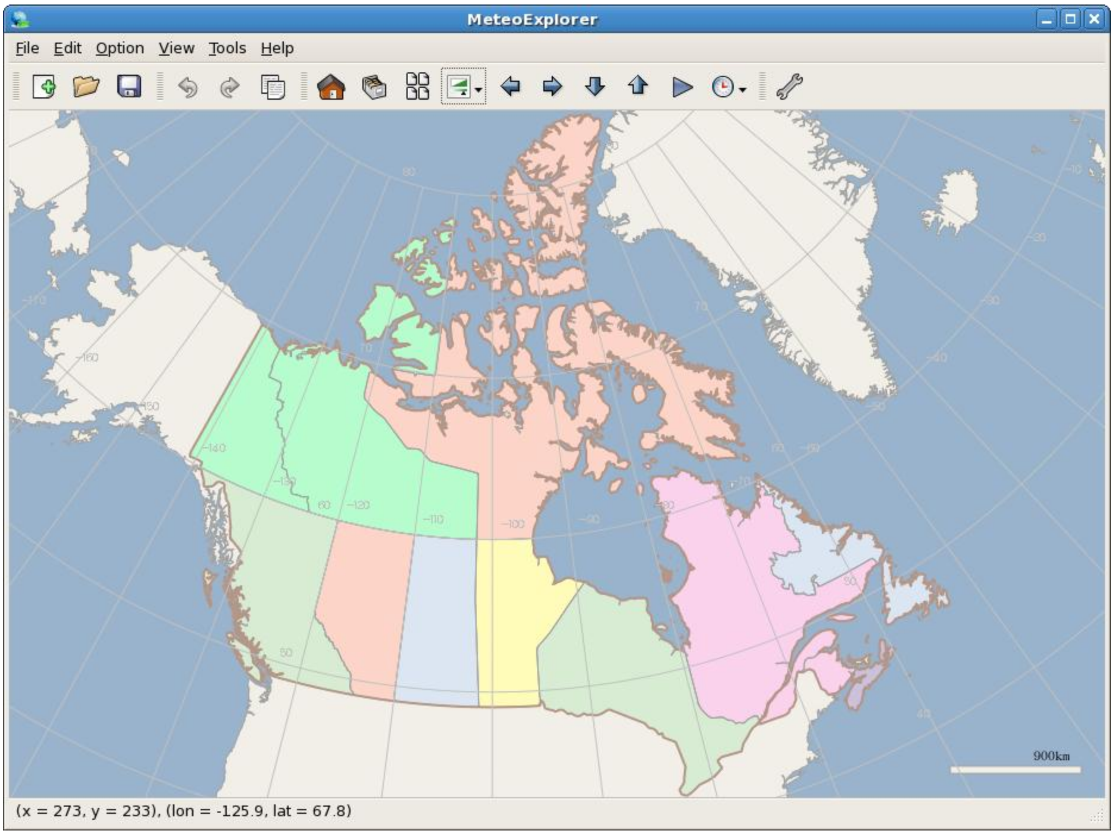


Figure 4-9: The rendered map when the “Shade Province” is selected.

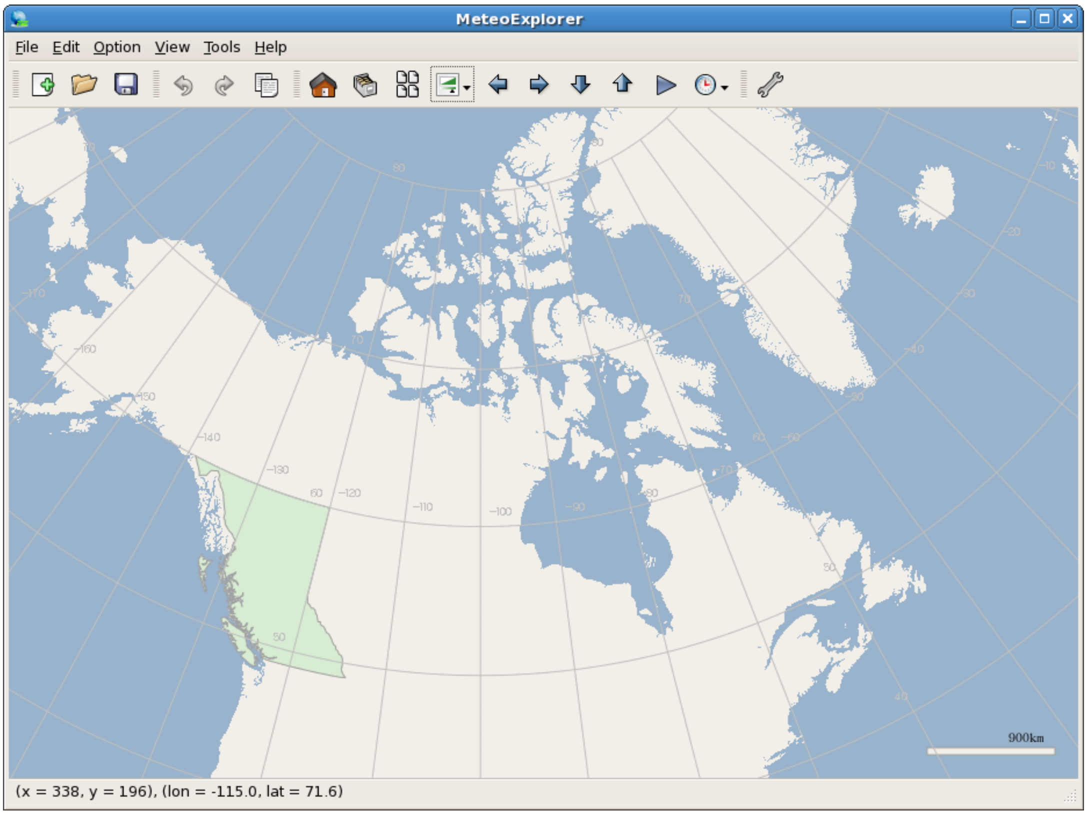


Figure 4-10: The rendered map when only British Columbia province of Canada is selected.

4.2.5 Drawing Graphics inside a Region

Meteorological scientists and professionals often require that the graphics objects are drawn inside a specified region, such as the country or state border. This feature is available in MeteoExplorer and disabled by default. To turn on this feature, select the “Draw Graphics in Your Country” checkbox in the “Map and Projection” dialog. The mask region that defines the graphics is specified in “Country” control. Figure 4-11 shows the shaded isolines of sea level pressure field on July 28, 2012. All the graphics objects are drawn inside the country border of the United States.

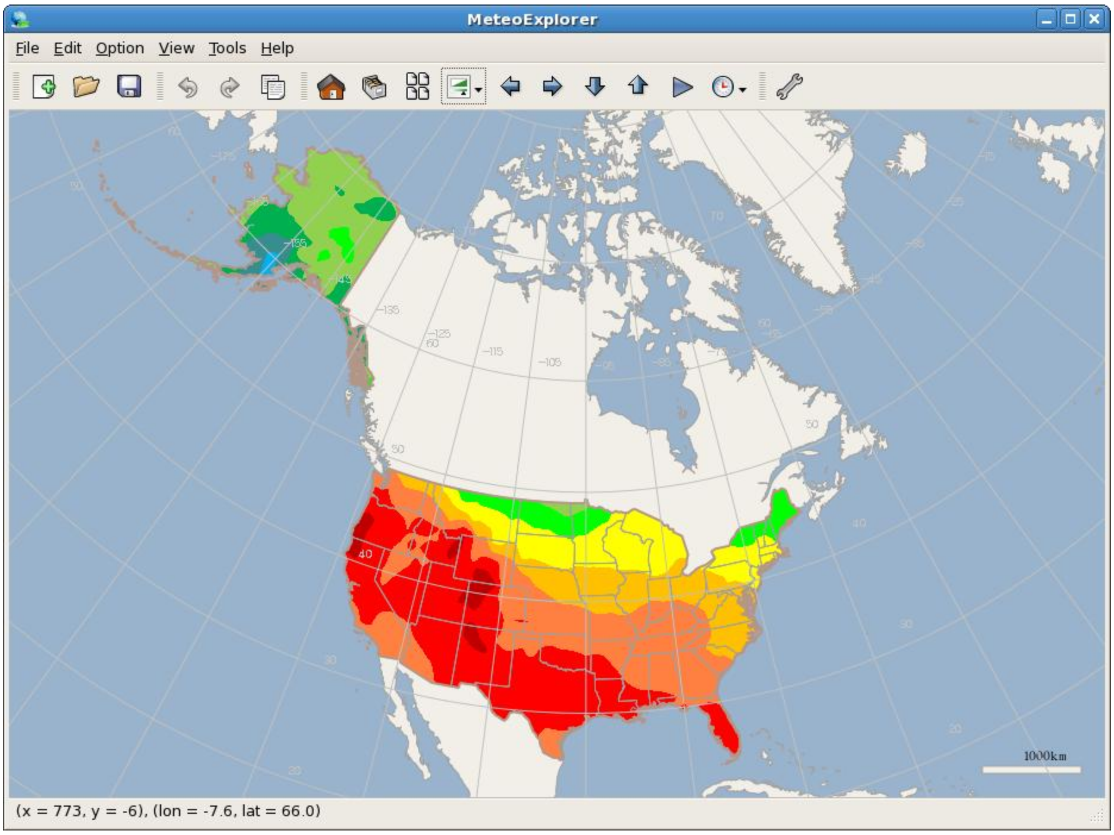


Figure 4-11: The shaded isolines of sea level pressure field. All the graphics objects are drawn inside the country border of the United States.

Figure 4-12 is another demonstration illustrating the feature. In this case, the same sea level pressure field is drawn inside Alaska of the United States.

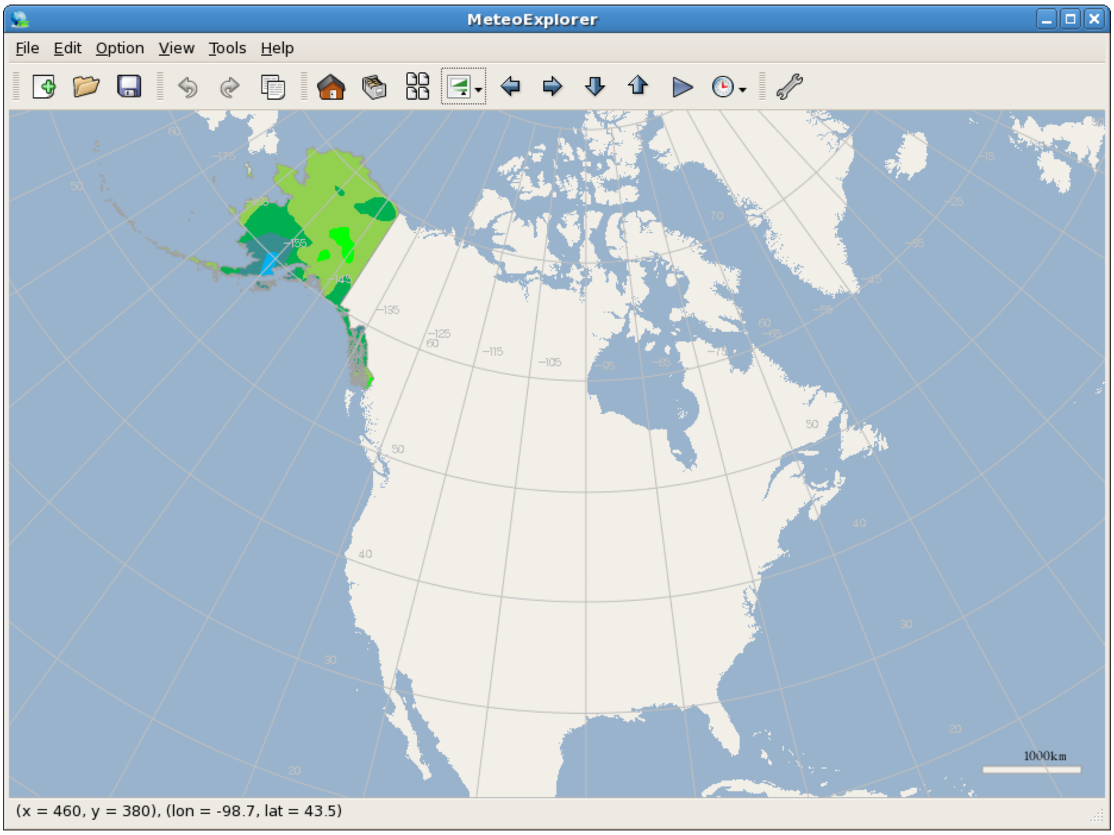


Figure 4-12: The sea level pressure field is drawn inside the Alaska state of the United States.

4.2.6 Show South China Sea

As shown in Figure 4-13, when the user selects “Show South Sea” checkbox in the “Map and Projection” dialog, an image of South China Sea is drawn at the bottom corner of the application window. This option is only enabled when users choose China is the “Country” combo-box.

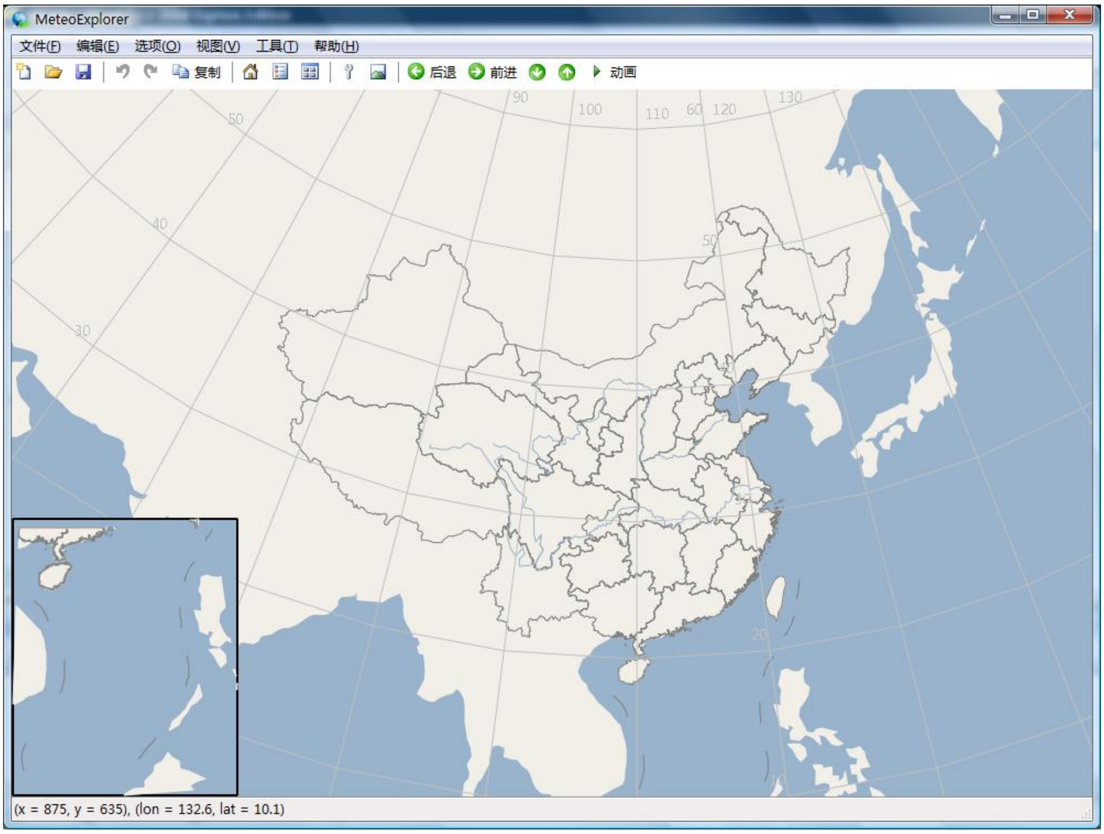


Figure 4-13: When the user selects “Show South Sea” checkbox in the “Map and Projection” dialog, an image of South China Sea is drawn at the bottom corner of the application window.

4.2.7 World Administrative Areas, Map Scale, and Grid Lines

Apart the features described in the previous sections, the remaining features are all self-explanatory. Figure 4-14 shows map of Japan when “Show County” option is selected and “Show Grids” option is deselected. Figure 4-15 shows map of Europe when “Show World Border” option is selected.

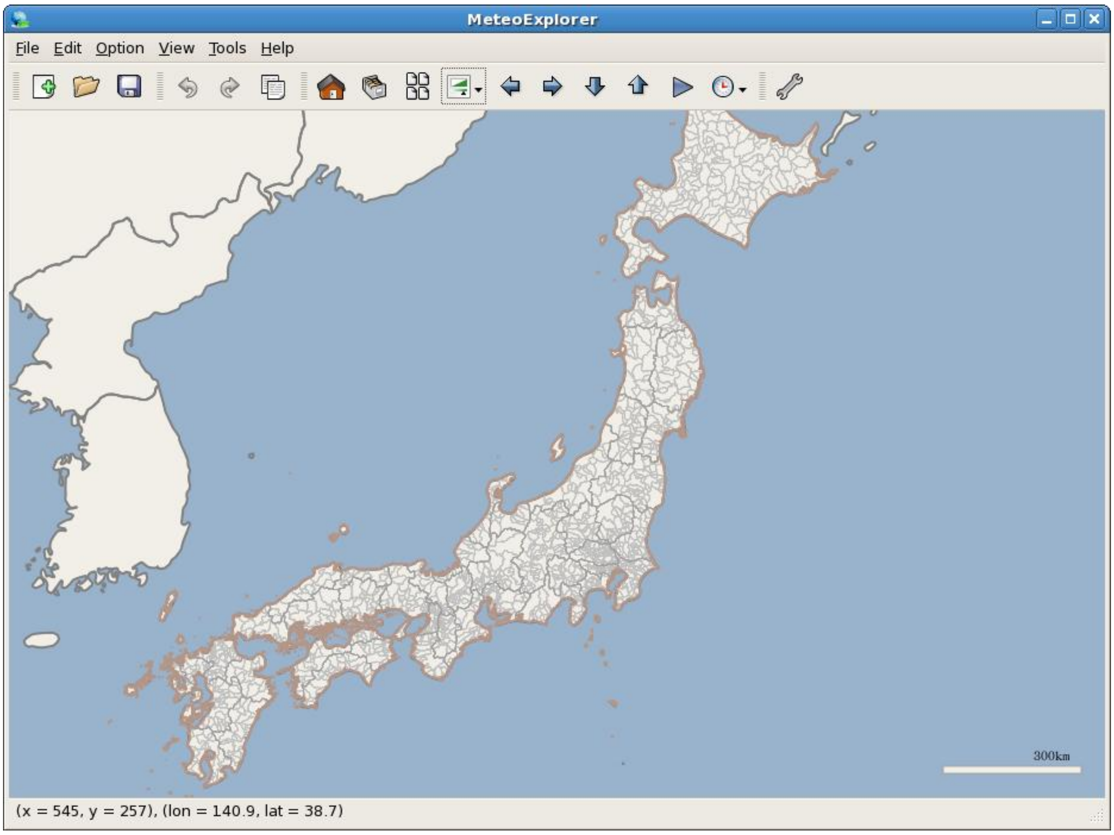


Figure 4-14: The map of Japan when “Show County” option is selected.

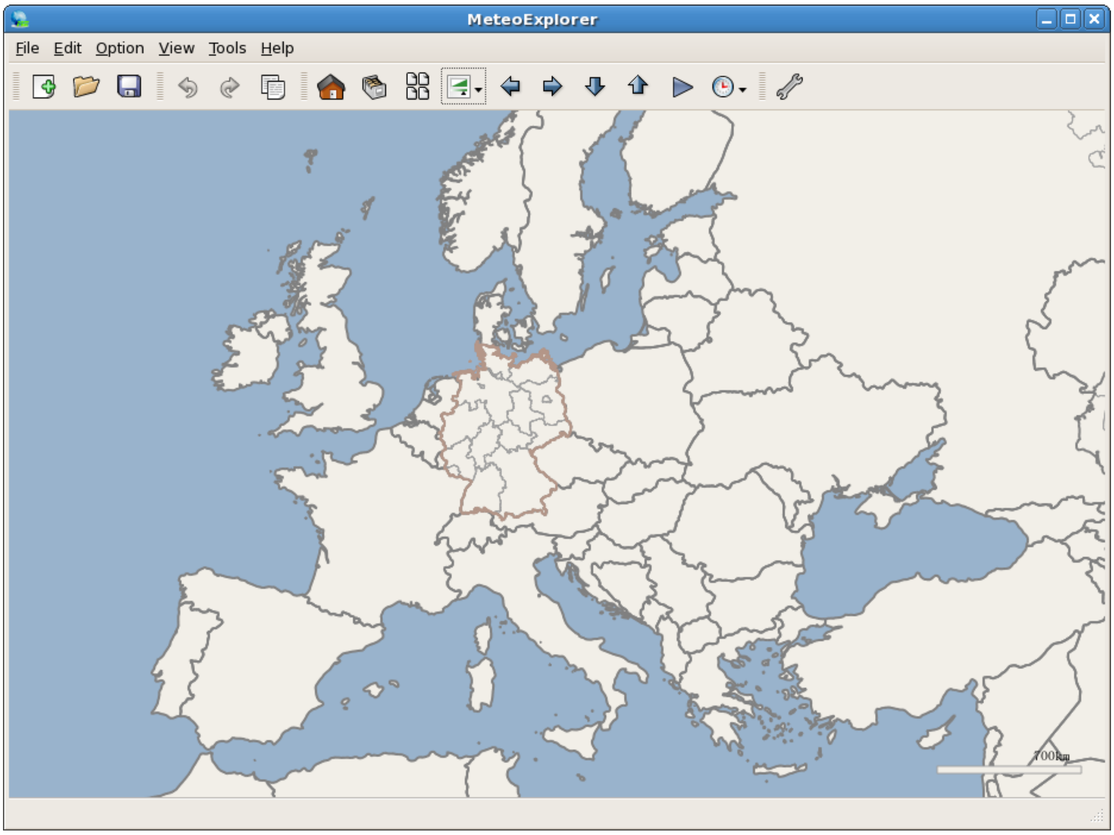


Figure 4-15: The map of Europe when “Show World Border” option is selected.

Chapter 5 Page Layout

In meteorological operation and atmospheric science research, users often need to customize contents rendered in the application window. The rendered contents include all kinds of graphics elements such as the graphics objects organized with layers, titles, legends, insets, and so on. The customization usually involves adjustment of position and size of the graphics elements. The *page layout* refers to the organization of position and size of all the graphic elements rendered inside the application window. MeteoExplorer provides the basic layout support. In short it provides two predefined layout views: *browse view* and *image export view*, and offers the "page layout settings" dialog to allow user perform customizations.

5.1 Page Layout Design

The layout functionality is not implemented in MeteoExplorer 1.2 release, in which the base map takes the whole screen estate. Some graphics elements like legend, inset are overlaid on top of the base map, whereas the other elements like title do not have their own estate. As a result, the graphics rendering quality is rather limited and does not satisfy users' requirements.
Nonetheless, the classic view has its own advantage in that it provides larger visual content and therefore gives users more information. It is preferable in the case when users just browse the data. So we call this view as **browse view**.

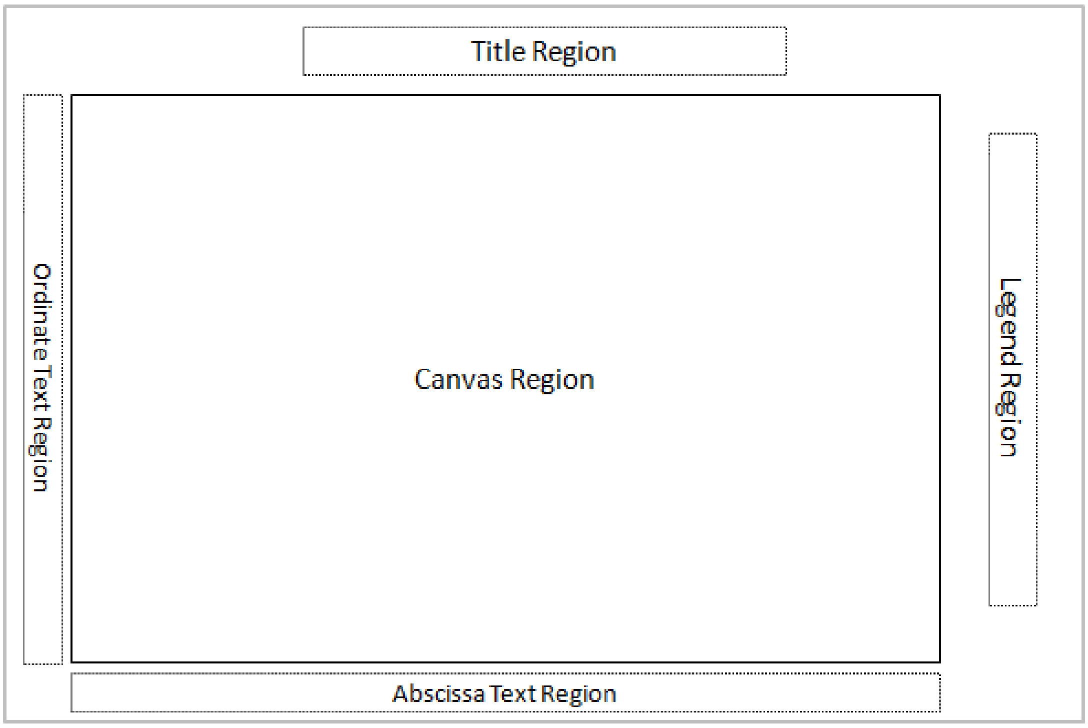


Figure 5-1: The position and size of primary graphics elements in image export view.

When the user wants to export the screen content to an image file or copy it to the system clipboard, it is a common practice that the rendered graphics objects should be restricted inside a region (we call it canvas in MeteoExplorer) and other elements like title, legend should be added to the screen. We call this layout view as **image export view**. In all MeteoExplorer provides two views: the classic browse view and new image export view. Figure 5-1 illustrates the default position and size of primary graphics elements in image export view.

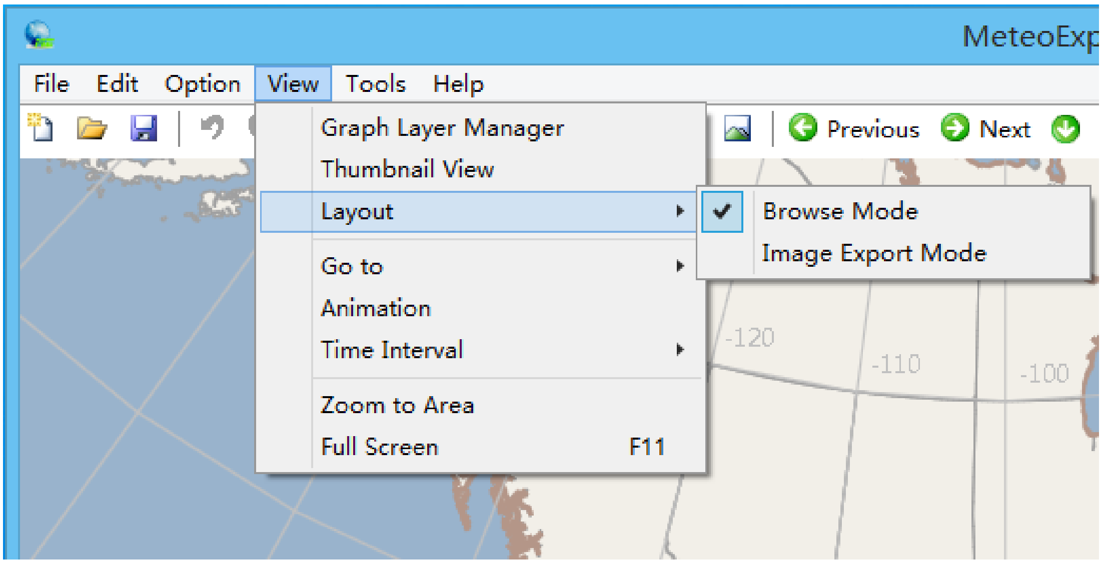
In the default design of image export view as shown in Figure 5-1, the title region is in the top part of the page, and the legend region is near the right edge. The canvas region locates in the center of the page and takes most of the screen estate. To the left (bottom respectively) of the canvas region, there locates the ordinate text region (the abscissa text region respectively). The list below summarizes the functionality of each region:

- Title Region: the title is shown in this region. MeteoExplorer provides two titles: primary title and secondary title. Users can set the contents of the titles.
- Legend Region: the region where the legends are drawn. Typical legend examples include the color bar of shaded contour, the color bar of satellite image texture, and symbol description of synoptic chart.
- Canvas Region: This is the region in which all graphics objects are drawn. In browse view, the canvas is as large as the whole screen. In image export view however, the canvas is reduced to make up room for other graphics elements.
- Ordinate Text Region: the description text of ordinate is shown in this region. When the map is drawn in the canvas, the latitude line values are often used as text.
- Abscissa Text Region: the description text of abscissa is shown in this region. When the map is drawn in the canvas, the longitude line (Meridian) values are often used as text.

It should be noted that the layout illustrated in Figure 5-1 is just the default arrangement provided by MeteoExplorer. Users can adjust the position and size of all the five regions at their will. Except for the abscissa and ordinate region, any two regions can intersect with or included by one another.

5.2 Select Page Layout View

As described in the previous section, MeteoExplorer provides two layout views: browse view and image export view. The default layout of MeteoExplorer is the browse view. To switch between the two views, one may select the menu item “View, Layout” or the corresponding toolbar button as shown in Figure 5-2.



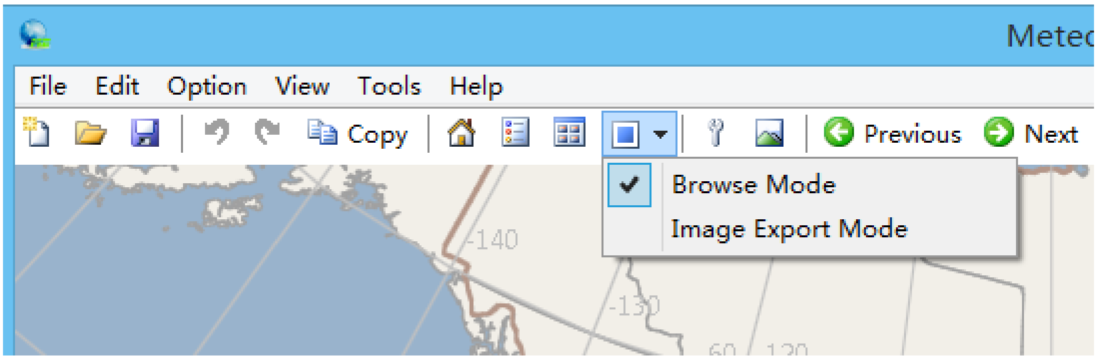


Figure 5-2: To switch between the two views, one may select the menu item "View, Layout" or the corresponding toolbar button.

Figure 5-3 shows the rendering results of the graphics of Figure 6-13 (page 83) in image export view. As shown in the figure, in image export view, the rendering of all graphics objects is restricted inside the canvas region. The map grid line values are used as axis description text.

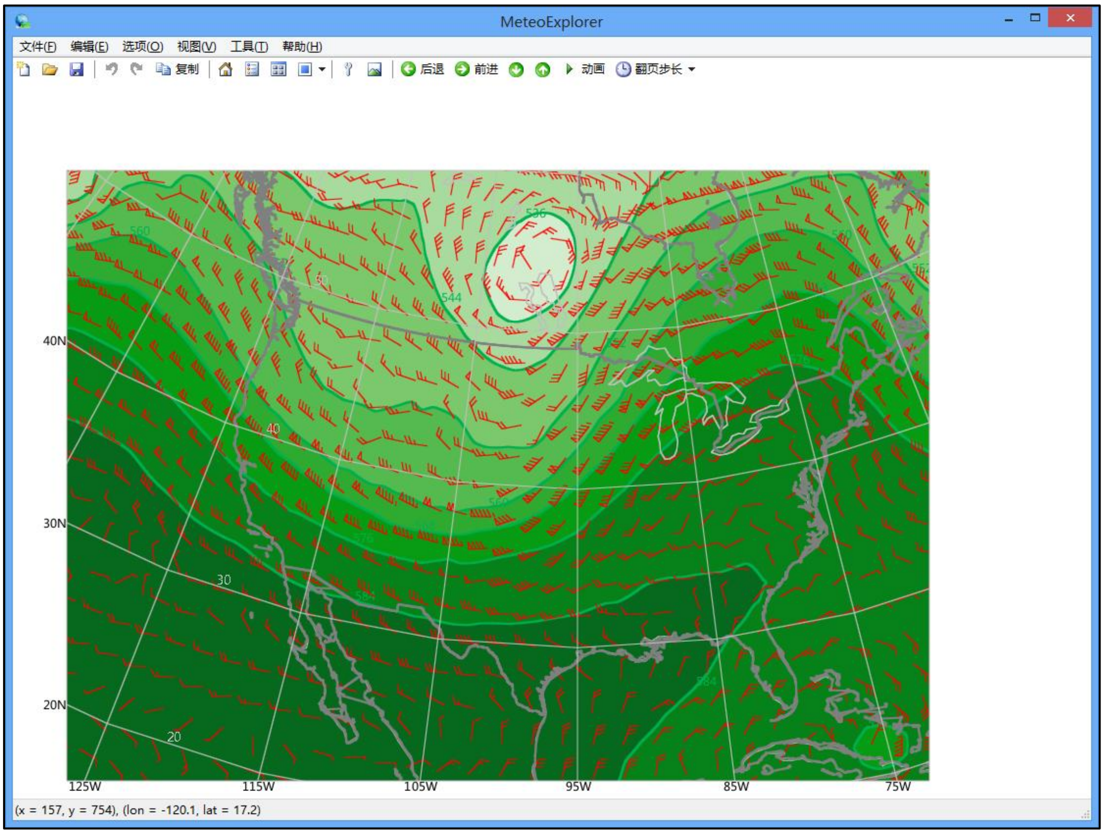


Figure 5-3: In image export view, the rendering of all graphics objects is restricted inside the canvas region.

5.3 Set Title and Legend with Information of a Graphics Layer

It can be seen in Figure 5-3 that MeteoExplorer does not add title and legend to the page when the user switches to the image export view. Instead, it provides two ways to allow users to add title and legend manually. The first approach is to add these graphics elements using the "Page Layout Settings" dialog, which will be introduced in section 5.4. The second approach is to set title and legend using the information of graphics layers.

In MeteoExplorer, every graphics layer is represented by a title as can be seen in Figure 3-8 on page 31). MeteoExplorer provides a feature to let the user use the graphics layer title as the page title. To do this, one first right-clicks a graphic layer whose title will be used as page title in the "Graphics Layer" window. This will bring up a context menu (Figure 5-4). Choose the menu item named "Use layer title as window title".

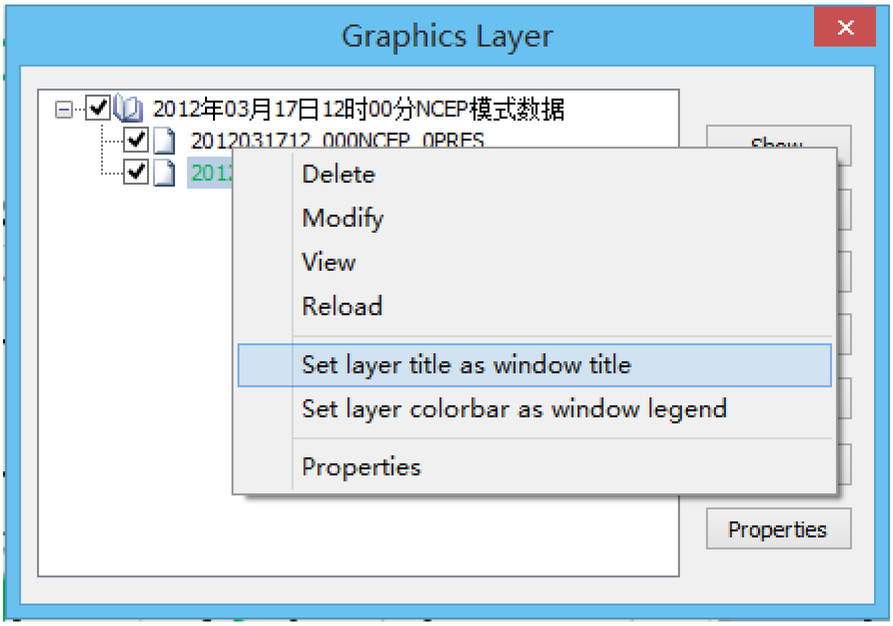


Figure 5-4: Right-clicks a graphic layer whose title will be used as page title in the “Graphics Layer” window. This will bring up a context menu. Choose the corresponding menu item to use the graphics layer title (legend respectively) as page title (legend respectively).

The same procedure can be used to set the page legend with graphics layer legend. In this case, one chooses “Use layer colorbar as window legend” from the context menu. An exception is that a graphics layer may not have a legend like contour color bar. In this case, the operation is invalid and no legend will be added to the page. Figure 5-5 illustrates an example in which the graphics layer title (legend respectively) is used as the page title (legend respectively).

An advantage of using the graphics layer title (legend respectively) as the page title (legend respectively) is that the latter will be changed accordingly with the former. For example, when the user navigates or animates the graphics layer, the page title and legend will also be updated. This automatic update frees the user from the trouble to manually change the page title and legend during navigation.

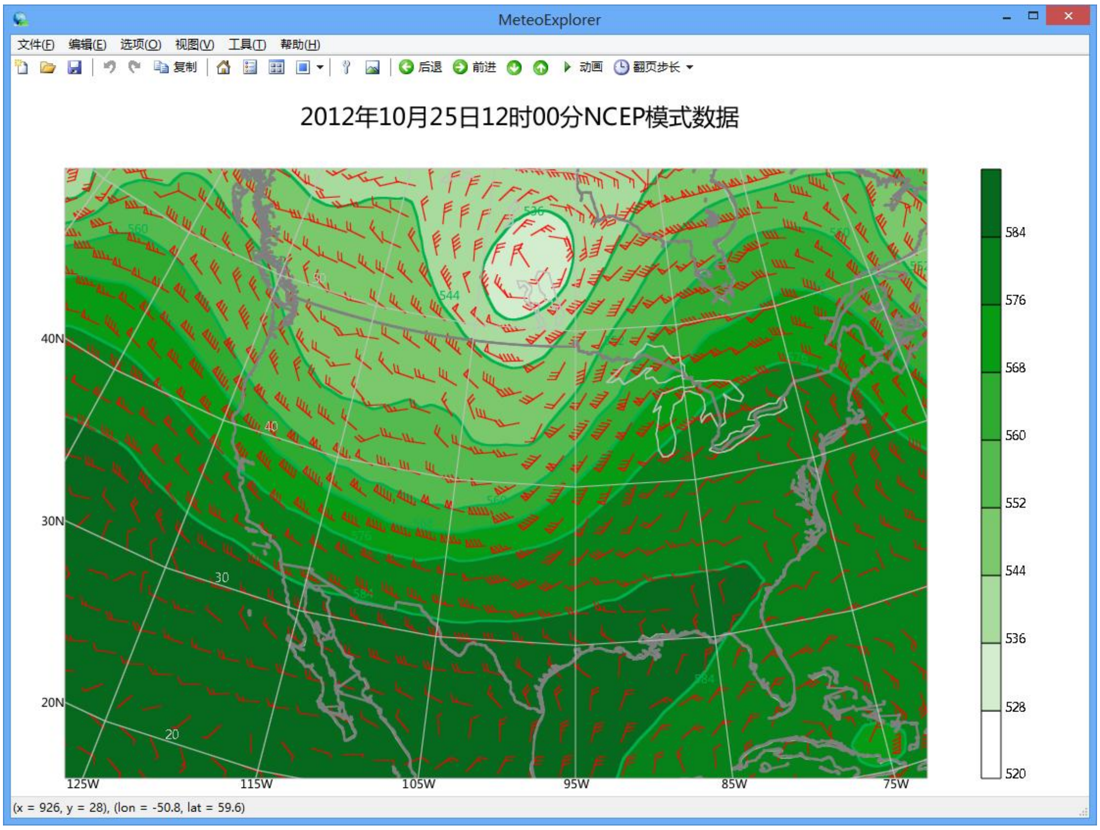


Figure 5-5: An example that the graphics layer title (legend respectively) is used as the page title (legend respectively).

5.4 Layout Setup

To open the “Page Layout Settings” dialog (Figure 5-6, Figure 5-8, and Figure 5-9), all one has to do is to select the “Options, Page Layout” menu item. The controls in the “Page Layout Settings” dialog are organized into three tabs that correspond to title, canvas, and legend respectively. In each tab, the controls in upper part of the dialog are used for layout customization. At lower part of the dialog, a preview control is provided to give a live visual indication of the position and size of title, canvas, and legend region.

5.4.1 Preview

As can be seen in Figure 5-6, there is a preview region in the lower part of the “Page Layout Settings” dialog. In the preview region, a couple of rectangles are used to represent the application window, title region, canvas region, and legend region respectively. Except for the largest rectangle that represents the application window[3], the position and size of the other rectangles will change in accordance with the position and size of the corresponding regions. In addition, when the user changes the tab, the corresponding rectangle of the region will be filled

[3] Indeed the size of the rectangle representing the application window is in proportion to the actual size of the application window. So the size of the rectangle may vary depending on your display resolution.

with gray color. Take Figure 5-6 for example, the title region is filled in gray as the user switches to the title tab and changes title settings in the upper part of the dialog. This feature is designed to give users a visual indication as to which region settings are modified.

5.4.2 Title

In "Page Layout Settings" dialog, the controls are grouped into three pages: title page, canvas page, and legend page. When the "Page Layout Settings" dialog is opened for the first time, the title page is displayed and the other two are hidden, as shown in Figure 5-6. In the title page, users can change the "Top Margin" and "Left Margin" control values to adjust the position of title region, and modify the "Height" and "Width" control values to increase or decrease the title region size. Note that the unit of all these four controls is pixels. If you choose to use the graphics layer title as the page title, please selected the checkbox "Use the Graphics Layer Title as Page Title". Otherwise, deselect this control to make "Primary Title" and "Secondary Title" control enabled, and then enter the title contents.

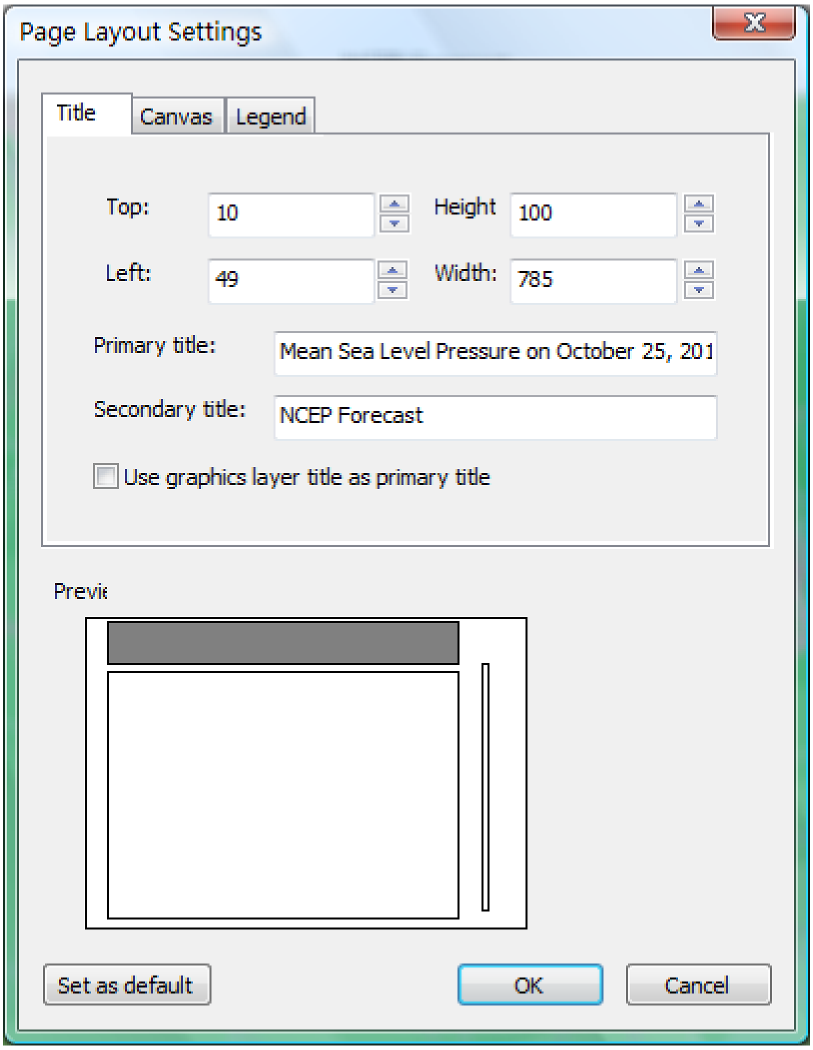


Figure 5-6: In "Page Layout Settings" dialog, the controls are grouped into three tabs: title tab, canvas tab, and legend tab. Users can change the position and

size of the title, canvas, and legend region using these controls.

When the user adjusts the position and size of the tile region, the corresponding rectangle in the preview section will be updated accordingly.

Figure 5-7 gives an example of adding primary title and secondary title to the page shown in Figure 5-5.

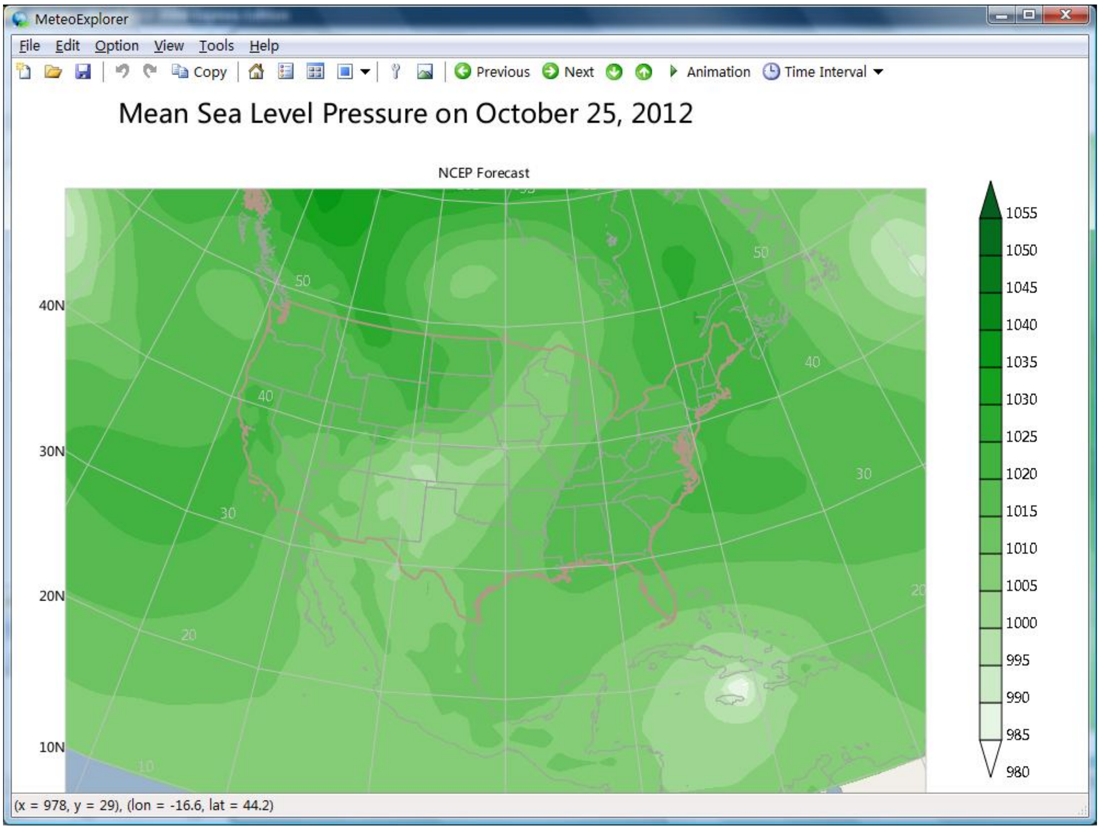


Figure 5-7: Users can opt to add primary and secondary title content manually instead of use graphics layer title.

5.4.3 Canvas

As described in the previous section, the canvas page inside the “Page Layout Settings” dialog is not displayed when the dialog is opened for the first time. However, users can switch to the canvas page by click the canvas tab.

In the canvas page of the dialog as shown in Figure 5-8, users can change the position and size of the canvas region, choose to use the map grid line values as axis description text, or alternatively enter the abscissa and ordinate text manually. When the user makes the modification of the position and size of the canvas region, the corresponding rectangle in the preview section will be updated accordingly.

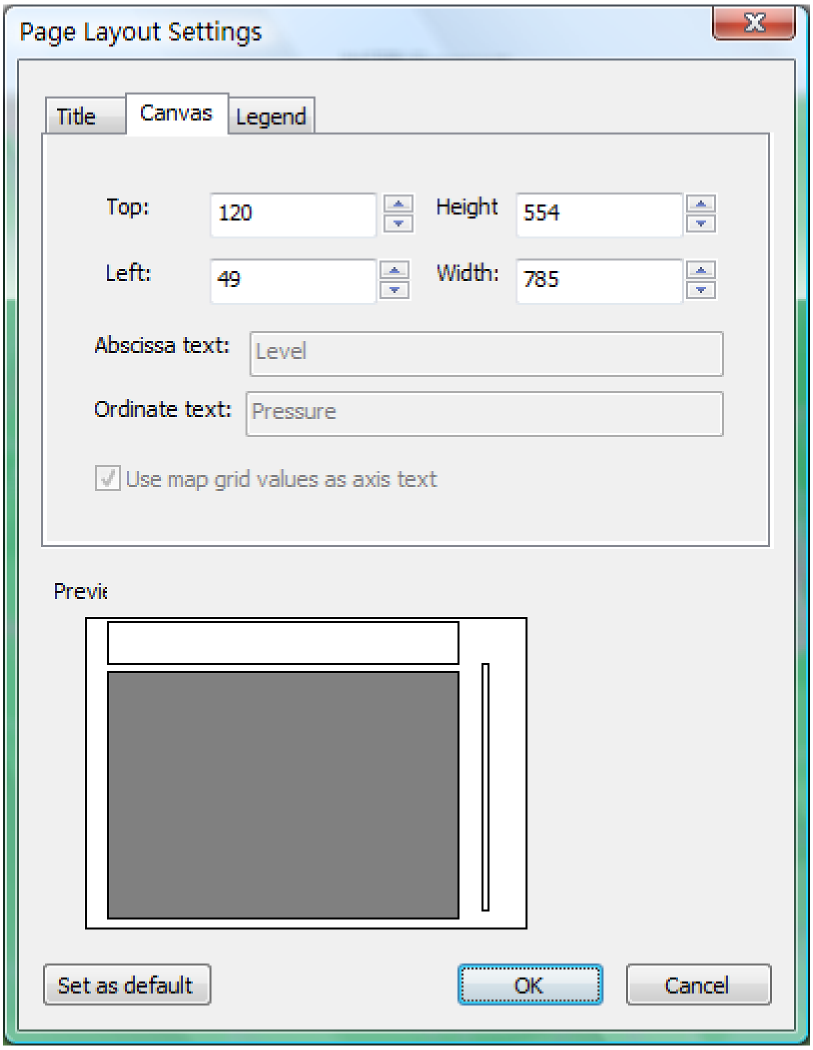


Figure 5-8: In the canvas page of the dialog, users can change the position and size of the canvas region, choose to use the map grid line values as axis text description, or enter the abscissa and ordinate text manually.

5.4.4 Legend

In the legend page of the "Page Layout Settings" dialog as shown in Figure 5-9, users can change the position and size of the legend region, select legend style, and specify the legend unit. When the user makes the modification of the position and size of the legend region, the corresponding rectangle in the preview section will be updated accordingly.

MeteoExplorer provides five legend styles:

- Horizontal bar with square endings
- Horizontal bar with triangle endings
- Vertical bar with square endings
- Vertical bar with triangle endings
- Blocks arranged in vertical direction

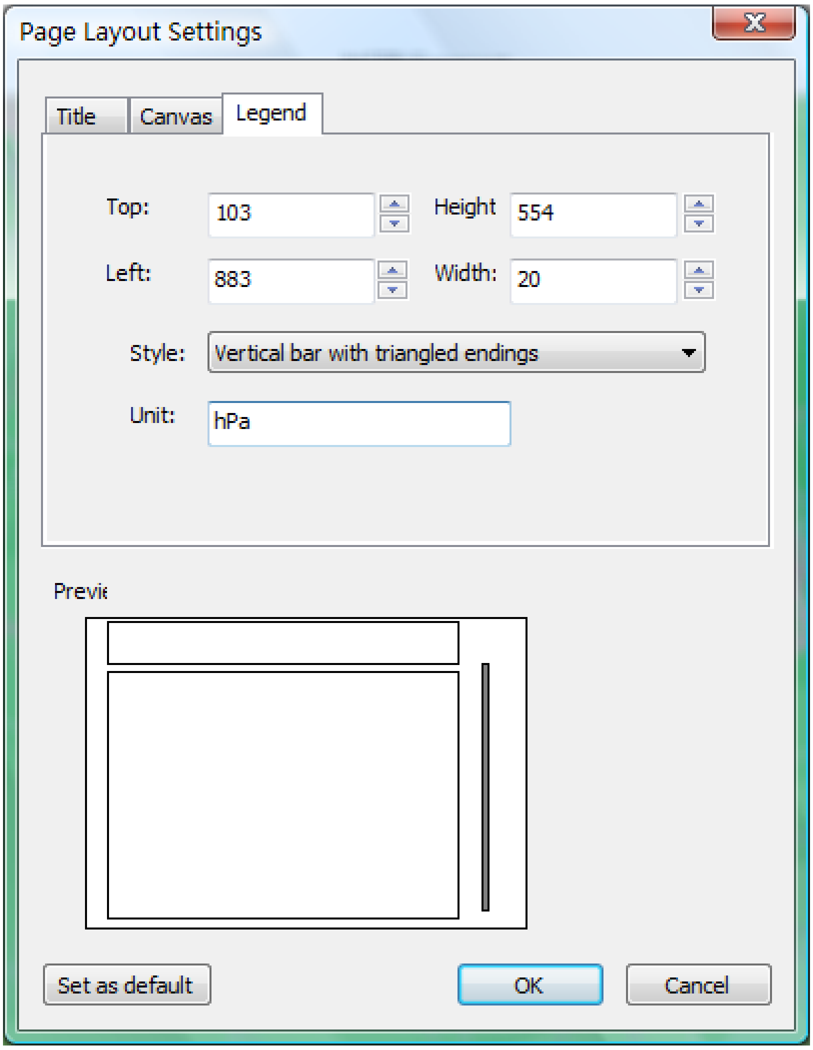


Figure 5-9: In the legend page of the dialog, users can change the position and size of the legend region, select legend style, and enter the legend unit.

The legend style in Figure 5-5 is “Vertical bar with triangle endings” and that in Figure 5-7 is “Vertical bar with square endings”. Figure 5-10 shows the shaded contour of objective analysis of a rainfall field. The legend style in the figure is “Blocks arranged in vertical direction”.

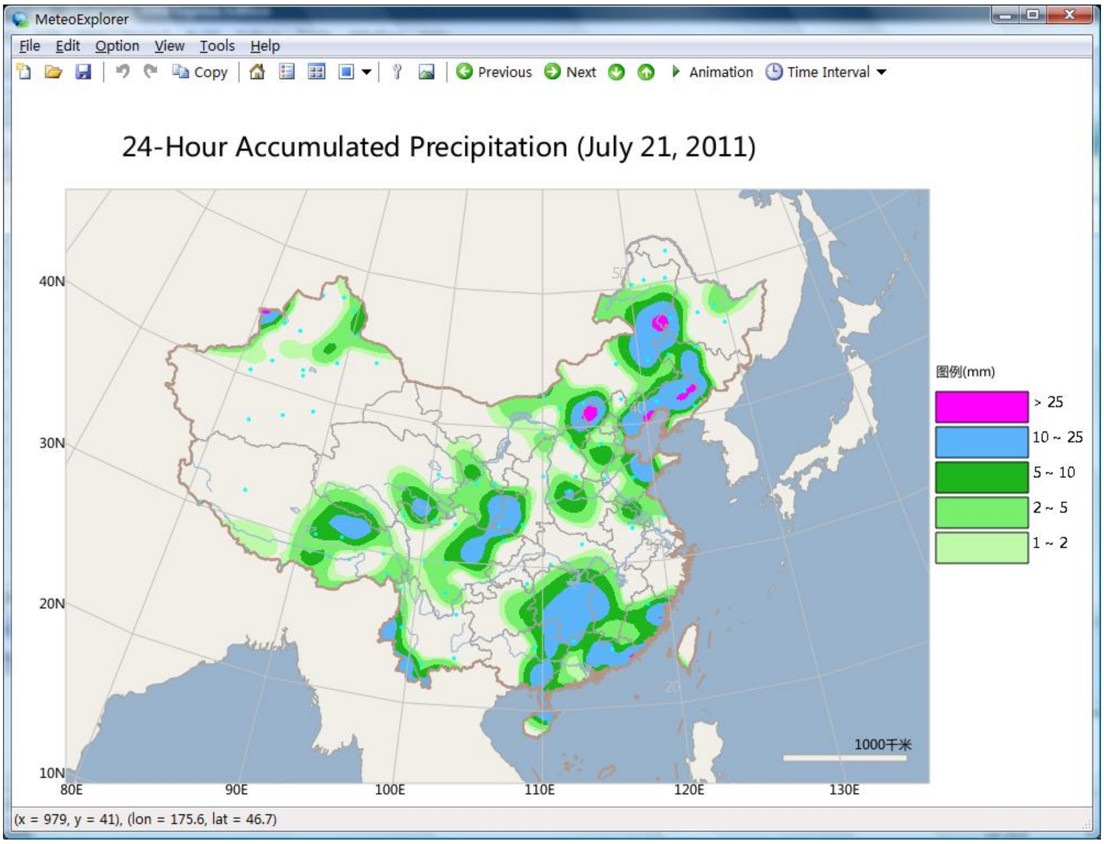


Figure 5-10: The legend style in the figure is “Blocks arranged in vertical direction”.

Chapter 6 Analysis and Visualization of Numerical Model Data

MeteoExplorer supports several popular data formats used in atmospheric science field, including WMO's GRIB1 and GRIB2, GrADS, HDF, and NetCDF. These data formats have something in common in that data are organized in five-dimension: physics element, time, altitude or pressure in vertical direction, latitude in the direction of meridian and longitude in the direction of equator. Correspondingly, MeteoExplorer proposes a data structure call "universal model data" to represent these five-dimensional data. The advantages of the universal model data structure are:

- The universal model data structure is also organized in five dimensions, and is optimized for common operations like insertion, removal, and search.
- The universal model data structure is designed to be flexible in order to represent as many data formats as possible. It has manages to describe some major data formats including GRIB1, GRIB2, NetCD, and GrADS under its paradigm, and thus provide a universal interface for display, analysis and so on that can be used by high modules.

6.1 WMO GRIB1/GRIB2 Data Visualization

To open a WMO GRIB1/GRIB2 data file, the user may select the menu item "File, Open", or click the toolbar button , or use the shortcut key "Ctrl+O" to open the file picker dialog. And then select the data file in the dialog. User may also drag and drop the data file from file manager into MeteoExporer window.

Tip: To open a file in MeteoExplorer, an alternative and more convenient way is to drag and drop the file from file manager into MeteoExporer window.

Let us demonstrate how to analyze and display a GRIB1/GRIB2 data file using a NCEP GFS data file on January 4, 2012 (the file name is GFS_Global_2p5deg_20120104_0000.grib2).
After the user opens the file, MeteoExplorer will first attempt to read the content of the file and represent the data with universal model data structure. It then will extract the data of the first physics element at its first time instance and first level, and do the isoline analysis or stream line analysis to create a new graphics layer, which will be displayed in the application window. As shown in Figure 6-1, MeteoExplorer does an isoline analysis of the geopotential height element at 10hPa level to create a graphics layer and show it in the application window.

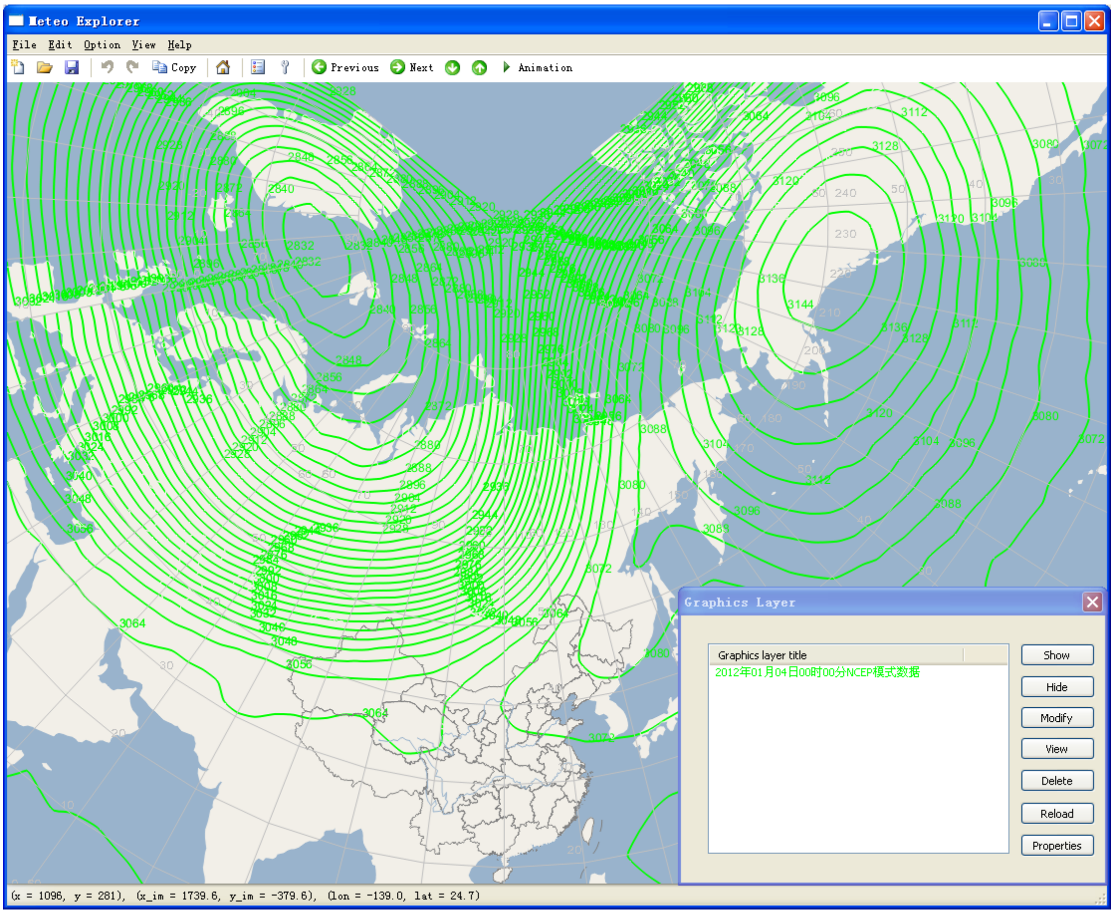


Figure 6-1: MeteoExplorer extracts the data of the first physics element at its first time instance and first level, and does the isoline analysis or stream line analysis to create a new graphics layer, which will be displayed in the application window.

6.1.1 Universal Model Options Dialog

The first graphics layer created by MeteoExplorer when processing a GRIB1/GRIB2 data file may not be the graphics that users are interested. It is there just to show a successful read of the file. To create the graphics of interested, users have to do necessary operations using the “Universal Model Options” dialog (Figure 6-2). To bring up this dialog, the user may in the “Graphics Layer” window (for example Figure 3-8 on page 31) select the top-level layer and then click the “Properties” button on the right, or double-click the top-level layer.

The layout of the “Universal Model Options” dialog is plain. On the left column there is a list view control that lists all the physics elements in the data. Each item in the list contains the information of a physics element: name, unit, and level. Take the selected item “Geopotential height [10gpm] @ Isobaric” shown in Figure 6-2 for instance. The item indicates that the name of physics element is Geopotential height, unit is 10gpm, and surface level is isobaric. The order of the items in the list view is same as the order of physics elements stored in the GRIB data file. All the elements are grouped based on their dimension. A two-dimensional (2D) element means corresponding data contains just a horizontal field of one time frame and one level. A three-dimensional (3D) element means the corresponding data contains horizontal fields of multiple levels but only one time frame. A four-dimensional (4D) element means the corresponding data contains horizontal fields of multiple levels, at multiple time frames.

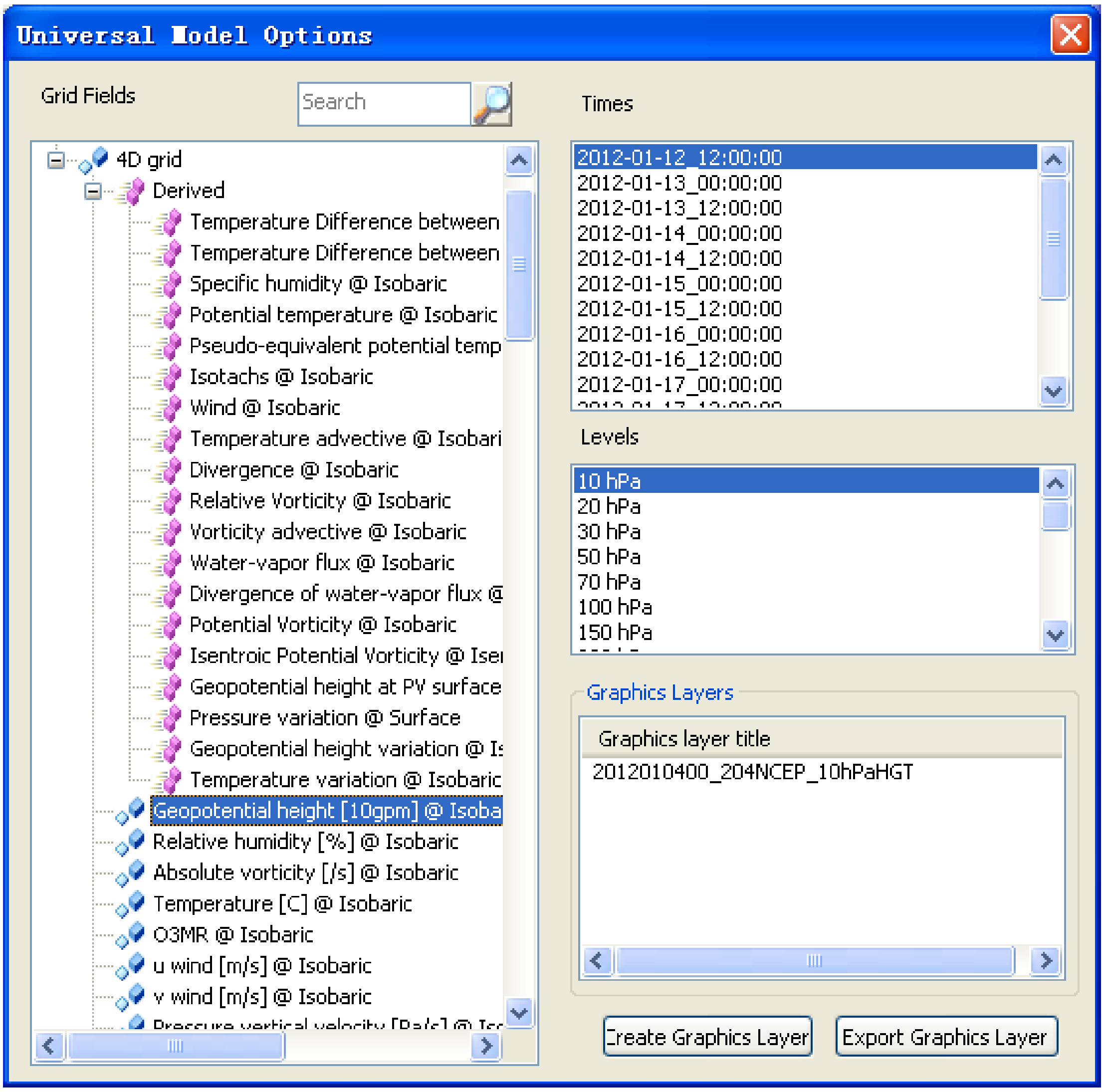


Figure 6-2: The layout of the “Universal Model Options” dialog.

Besides the items (colored in blue) corresponding to the elements stored in the data file, additional items (colored in pink) that represent the derived physics elements that are calculated from the elements in the data are also listed. Take the item “specific humidity @ Isobaric” for example, the physics element specific humidity is not the elements stored in the data, but it can be calculated from temperature and pressure whose data are stored in the data.

For now MeteoExplorer supports the computation of the following physics elements:

- Difference between temperature and dew-point temperature;
- Specific humidity;
- Potential temperature;
- Pseudo-equivalent potential temperature;

- Isotachs;
- Wind;
- Temperature advective;
- Divergence;
- Relative vorticity;
- Vorticity advective;
- Water-vapor flux;
- Divergence of water-vapor flux;
- Potential vorticity;
- Isentropic potential vorticity;
- Geopotential height at potential vorticity surface;
- Temperature difference between 850hPa and 500hPa isobaric layer.

When an item from the list view on the left is selected, its time and level information will be obtained by MeteoExplorer and listed in the “All Times” and “All Levels” list view control respectively on the right.

6.1.2 Isoline Analysis of Gridded Field

After you have become familiar with the “Universal Model Options” dialog, it is time to create a graphics layer for the physics elements you are interested. The first step is to select a physics element from list view control on the left. After the selection, the time and level information of the selected element will be respectively listed in the “All Times” and “All Levels” list view control on the right. Select the time instances and levels from the controls. Note that only one physics element can be selected at a time, but users can select multiple time instances and levels by clicking the items while holding the Ctrl key. The selected items will be highlighted in dark blue. Figure 6-3 illustrates that the user has selected the derived physics element “Geopotential height at PV surface”, with the time 2012-01-12_12:00:00 and level of 1.5 PV unit.

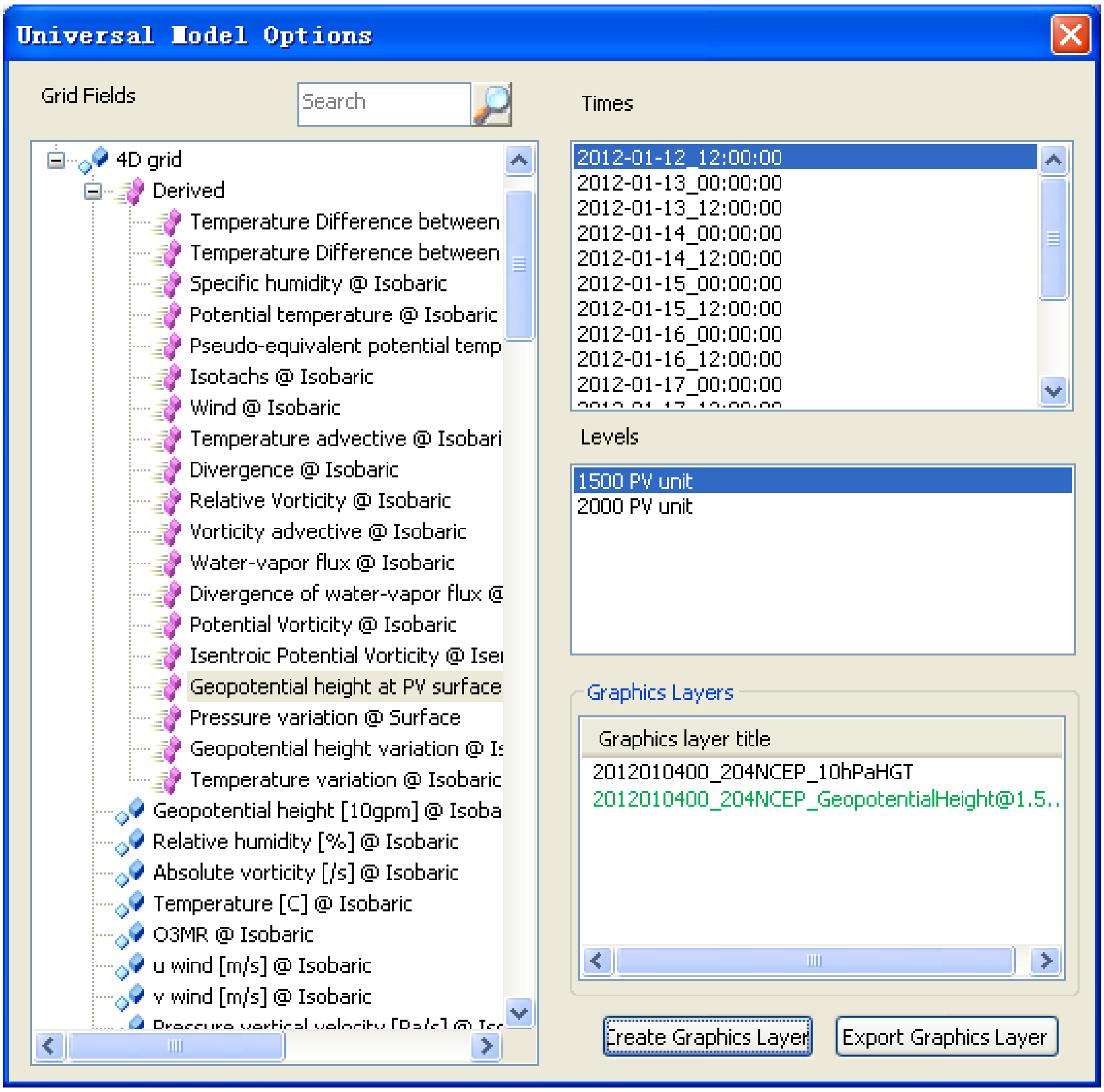


Figure 6-3: After the selection of physics element, time instances and levels, users can click the “Create Graphics” button to generate an isoline representation of the data.

After the selection of physics element, time instances and levels, users can click the “Create Graphics Layer” button to start the isoline analysis of the gridded field corresponding to the selection. For a successful analysis, the generated isoline graphics layer will be shown in the application window (Figure Figure 6-4) and its layer title is listed in “Graphics Layers” list view on the right of Figure 6-3. In Figure Figure 6-4, the red contour is the isoline representation of the Geopotential height at PV surface of 1.5 PV unit.

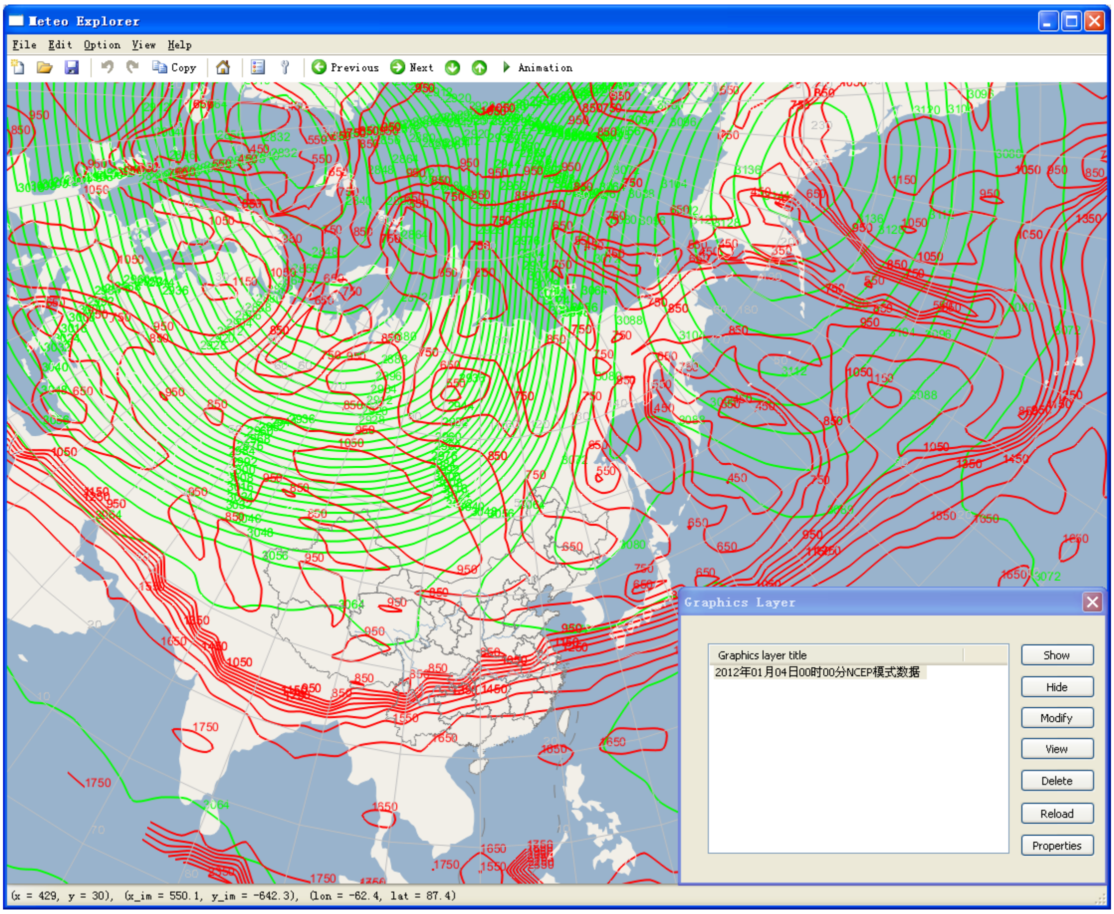


Figure 6-4: For a successful analysis, the generated isoline graphics layer will be shown in the application window.

6.1.3 Change Layer Properties

After creating the graphics layers, users often need to change their properties. To do this, the user should turn to the “Graphics Layer Management” window introduced in section 3.5 (page 29). From there the user selects the graphics layer whose display properties are to be modified, and then select the “Properties” button.

In MeteoExplorer, each type of graphics layer corresponds to a specific properties setup dialog. For a contour graphics layer created from gridded field data as shown in Figure Figure 6-4, it corresponds to the “Isoline Analysis and Display” dialog (Figure 6-5). For a stream layer as shown in Figure 14-1 (page 135), it corresponds to the “Stream line analysis and Display” dialog of Figure 14-2 (page 136).

We are discussing the “Isoline Analysis and Display” dialog in this section and leave the discussion of the “Stream line analysis and Display” dialog in section 6.1.4. As shown in Figure 6-5, the ”Isoline Analysis and Display” dialog can be divided into two parts: the top part contains the controls for configure isoline analysis settings:

- Start and End Longitude: the horizontal analysis range of the gridded field. The east hemisphere is 0~180 degrees, and the west hemisphere is 180~360 (-180~0) degrees.

- Start and End Latitude: the vertical analysis range of the gridded field. The north hemisphere is 0~90 degrees and the south hemisphere is -90~0 degrees.
- Isoline values in triplet (start, increment, end): users can set the isoline values by specifying start, increment, and end values. This method applies to the case the difference between two consecutive isoline values is a constant.
- Isoline values in discreate (comma to separate): users can set the isoline values by explicitly specifying them one by one.
- Shade isoline: Enable or disable isoline shading.
- Smoothing: smooth the grid field before isoline analysis. The available smoothing methods are: none, 5-point, 9-point, and Gaussian weighted.

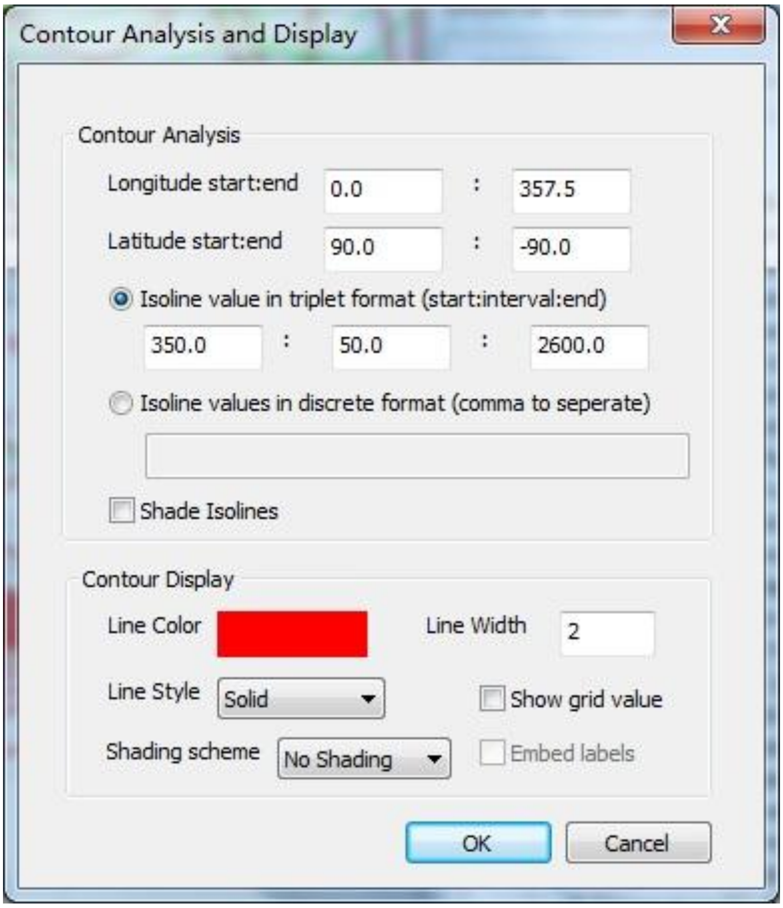


Figure 6-5: Users can modify isoline analysis settings in the upper part of "Isoline Analysis and Display" dialog.

The bottom part of the "Isoline Analysis and Display" dialog contains controls for users to modify isoline display properties:

- Line color;
- Line width;
- Line style, including solid, dashed, an dotted line;
- Show Grid-Point Values: show or hide values of grid points.
- Shading Scheme: let users to choose a shading scheme, available options are none, rainbow, aqua, white-green, white-blue, yellow-red, and white-gray.

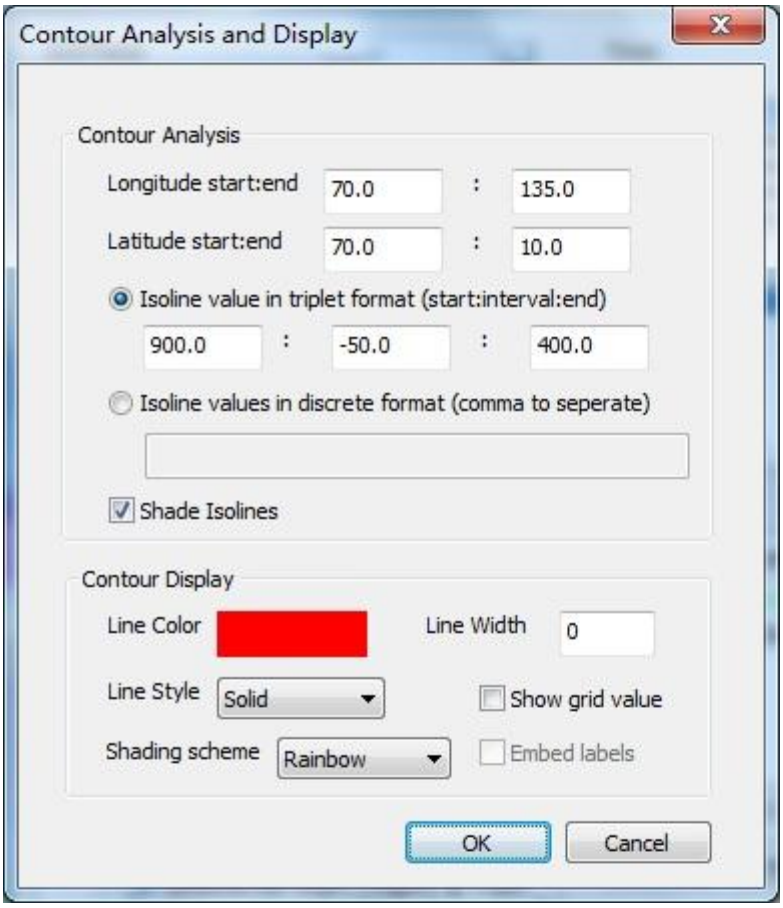


Figure 6-6: Users can modify isoline display settings in the lower part of "Isoline Analysis and Display" dialog.

Now let us demonstrate the process of configuring isoline analysis and display properties with the example of calculating geopotential height at 1.5 (PV unit) PV surface as illustrated in Figure 6-3 and Figure Figure 6-4. Figure 6-6 shows the four modifications of the use. First, the user reduces the analytic range of the gridded field from global to east-Asia area (70~135E,10~70N). Second, the user decrements the isoline values to 400~900. Third, the isoline shading option is turned on. Fourth, the user changes the line width to 0, hence make the isoline symbols invisible.

After the modification, the user may click the "OK" button to make the changes taking into effect. Figure 6-7 shows the analytic results for the modified settings.

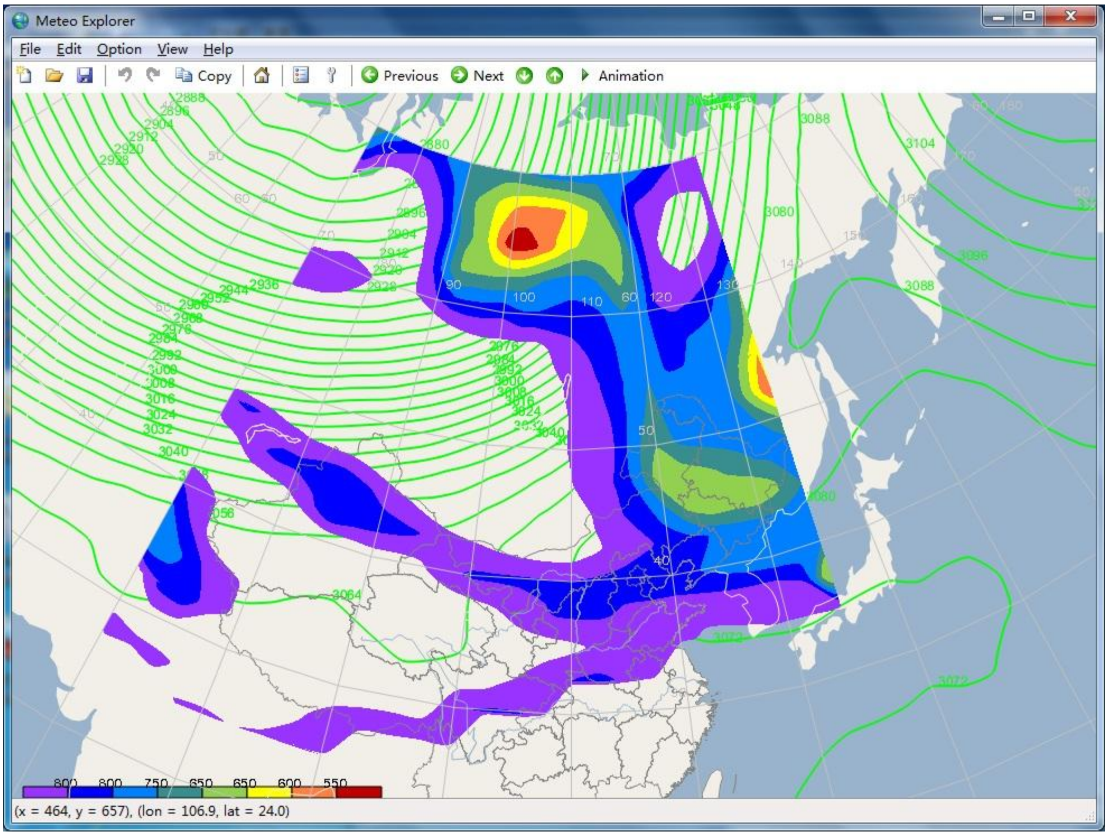


Figure 6-7: The analytic shaded isolines for the modified isoline analysis and display settings.

Tip: The isoline symbols will be invisible if the line width property is changed to 0.

6.1.4 Stream Line Analysis of Wind Field

Wind field is an important reference in synoptic analysis operations. In numerical model output data files however, wind data is stored in its horizontal and vertical component commonly referred to as U and V. As a result, users may have to do an extra step to generate wind field graphics by calculating the wind vector from U and V. Fortunately such a step is not necessary as in MeteoExplorer as the application provides a convenient way to do this.

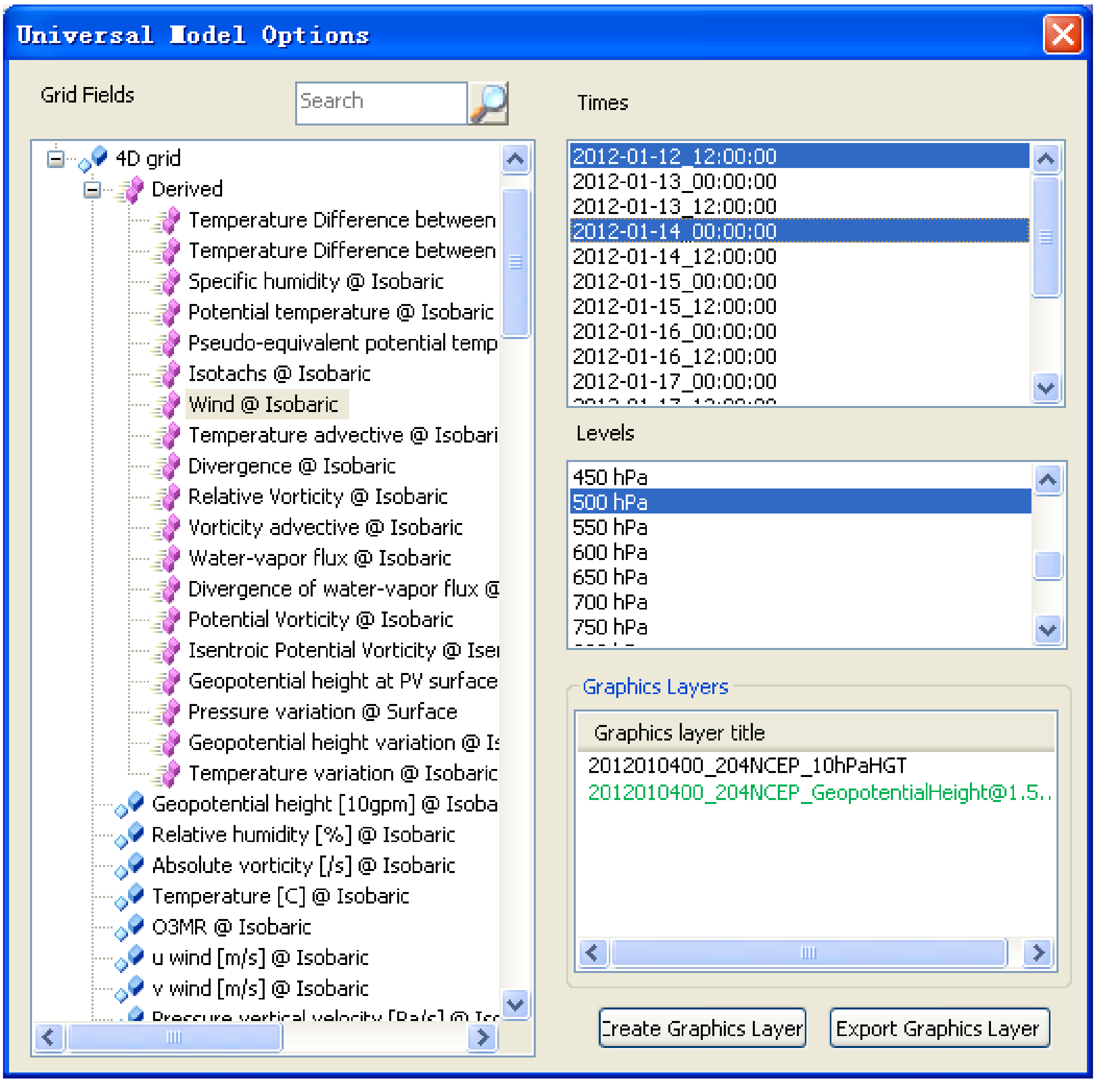


Figure 6-8: To create a graphics layer for wind field, the user should first select the item named "Wind@isobaric" from the "Element" list view on the left, and then select the time instances and levels from the "All Times" and "All Levels" list view respectively. Finally, the user clicks the "Create Graphics Layer" button to start the analysis.

The procedures to create a graphical representation for the wind field are similar to those to create a contour representation of the gridded field. One first need bring up the "Universal Model Options" dialog by selecting the top-level layer in "Graphics Layer" dialog and then clicking the "Properties" button on the right.

As shown in Figure 6-8, the user should first select the item named "Wind@isobaric" from the "Element" list view on the left, and then select the time instances and levels from the "All Times" and "All Levels" list view respectively. Here multiple selection of times and levels are possible. Finally, the user clicks the "Create Graphics Layer" button to start the analysis. The generated wind field graphics layer will be shown in the application window and the layer title will be added to the "Graphics Layer" window as shown in Figure 6-9.

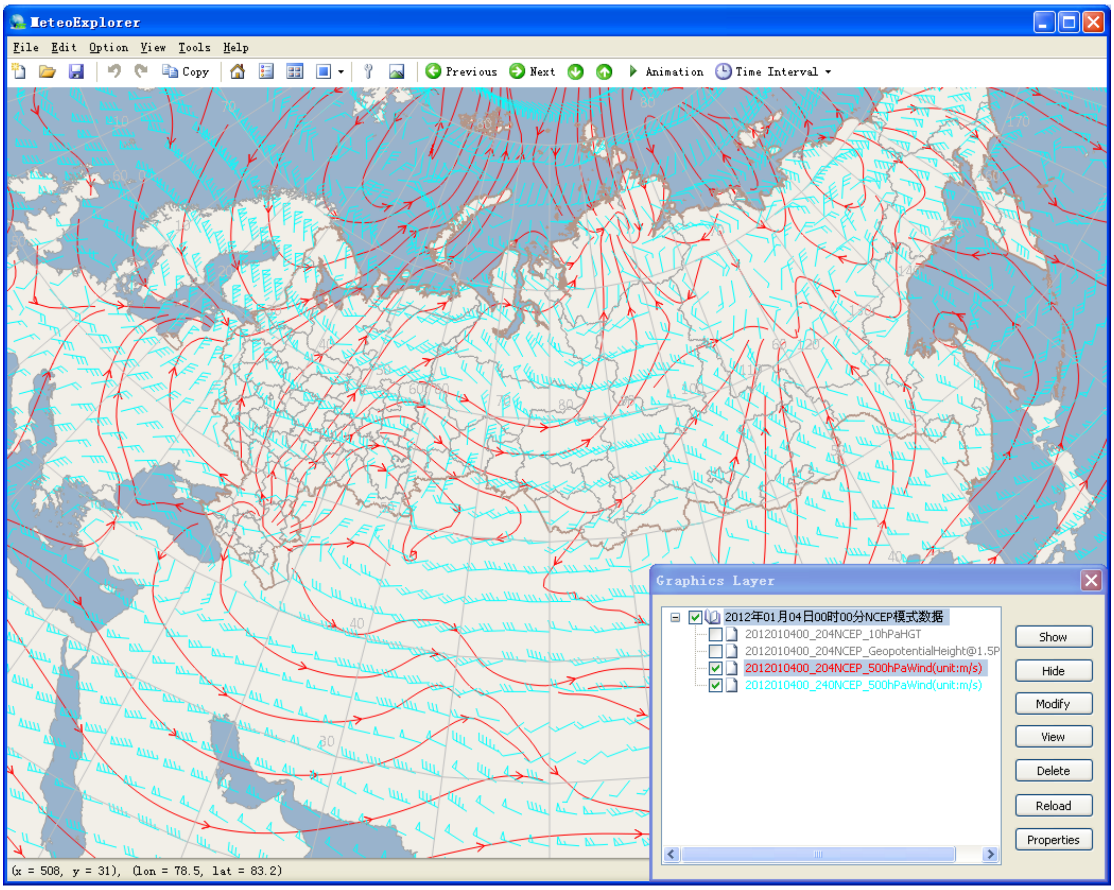


Figure 6-9: The generated wind field graphics layer based on the selection in Figure 6-8 is shown in the application window.

To change the display properties of a wind field graphics layer, one can follow the same way used to change the isoline graphics layer. In detail, one should first select the graphics layer in "Graphics Layer" window, and then select the "Properties" button. This operation will open the "Streamline Options" dialog as shown in Figure 6-10. In the dialog, users can configure all kinds of settings from changing display properties such as output type (including stream line, wind barb, and arrowhead) to creating derived physics field like divergence, vorticity, and isotachs. For a complete discussion of the "Streamline Options" dialog, please refer to Chapter 14 on page 135.

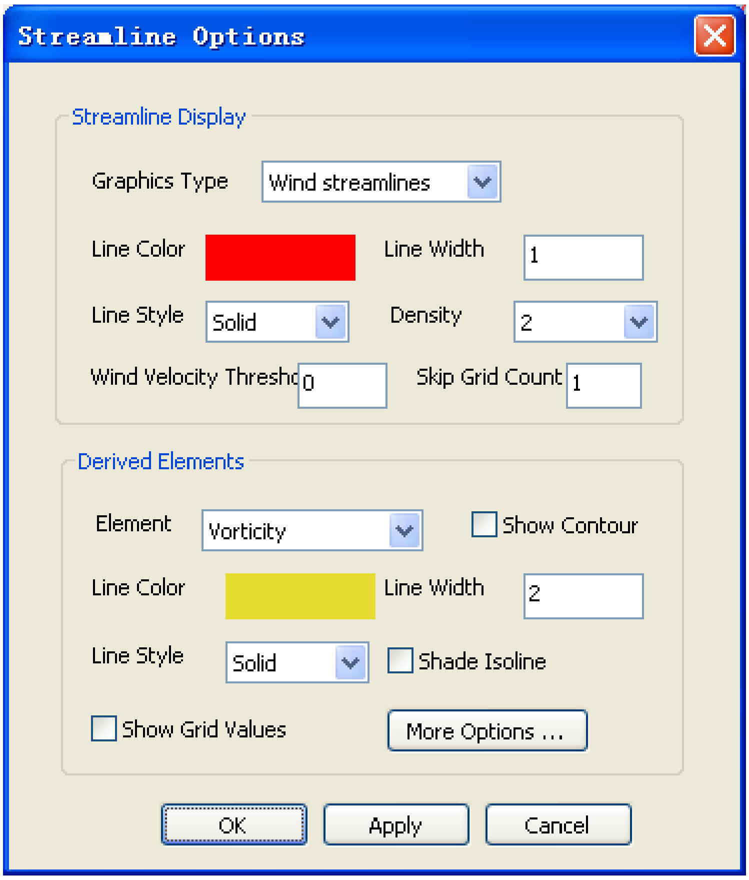


Figure 6-10: Users can configure wind field graphics layer settings using the "Streamline Options" dialog.

6.1.5 Export Analytic Graphics Layers

MeteoExplorer provides a feature to let user save the data of the analytic graphics layers to a disk file in either GrADS or MICAPS encoding format. To do this, users first select the graphics layers to be exported in the "Graphics Layers" list of "Universal Model Options" dialog as shown in Figure 6-8, then click the "Export Graphics Layer" button. In the "Save As" dialog, enter the file name and click OK.

6.2 GrADS Data Visualization

For data files encoded in GrADS format, MeteoExplorer adopts the same processing method it uses for GRIB1/GRIB2 data files. A GrADS data set often consists of two and more files. One of them is so called control file (with the extention .ctl) that contains a complete description of the binary data as well as instructions on where to find the data and how to read it. The other files are binary data files.

To open GrADS data files in MeteoExplorer, one only needs to open the control file (.ctl). Figure 6-11 shows a GrADS-encoded data file output from the Weather Research and Forecasting Model

(WRF) numerical model. Two graphics layers are created. One is the potential temperature at 100hPa pressure level (drawn in red solid line), the other is wind at 700hPa pressure level (drawn in yellow stream lines).

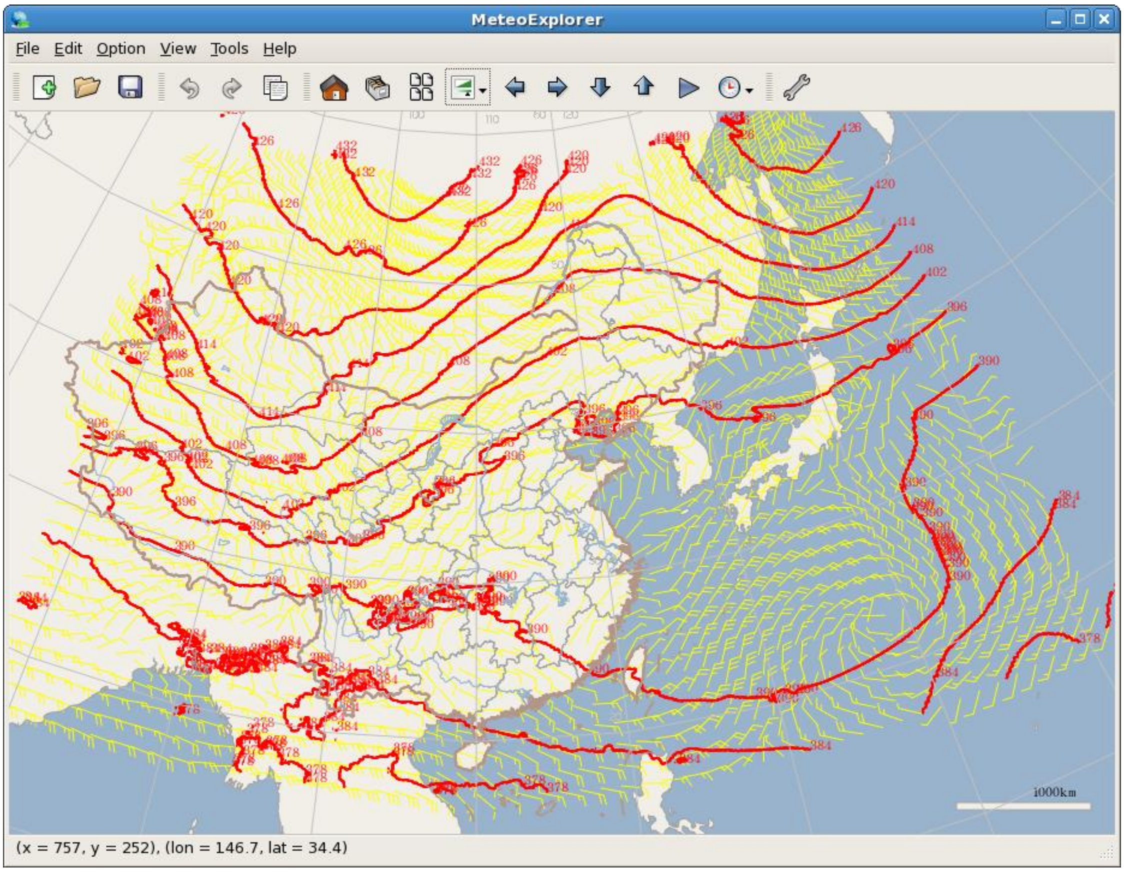


Figure 6-11: MeteoExplorer reads a GrADS-encoded data file output from WRF numerical model. Two graphics layers are created. One is the potential temperature at 100hPa pressure level (drawn in red solid line), the other is wind at 700hPa pressure level (drawn in yellow stream lines).

6.3 NetCDF Data Visualization

Compared to the GRIB1/GRIB2 and GrADS data format, the NetCDF enjoys a wider range of usage not just limited to atmospheric science field. Many numerical models such as WRF encode their data files with NetCDF format. Since its birth, NetCDF has introduced three formats. The earliest format is called classic format. The 64-bit offset format was introduced in version 3.6. In release version 4.0, the newest NetCDF4/HDF5 format is introduced. For now MeteoExplorer supports the classic format and the 64-bit offset format. Support of NetCDF4/HDF5 format will be added in the future.

The process of creating and configuring properties of graphics layers from a NetCDF data file is the same as that from GRIB or GrADS data files. Figure 6-12 gives an example of the “Universal Model Options” dialog after MeteoExplorer successfully reads a NetCDF-encoded file output from WRF model. As can be seen from the figure, the tree view on the left lists all the elements stored in the data file.

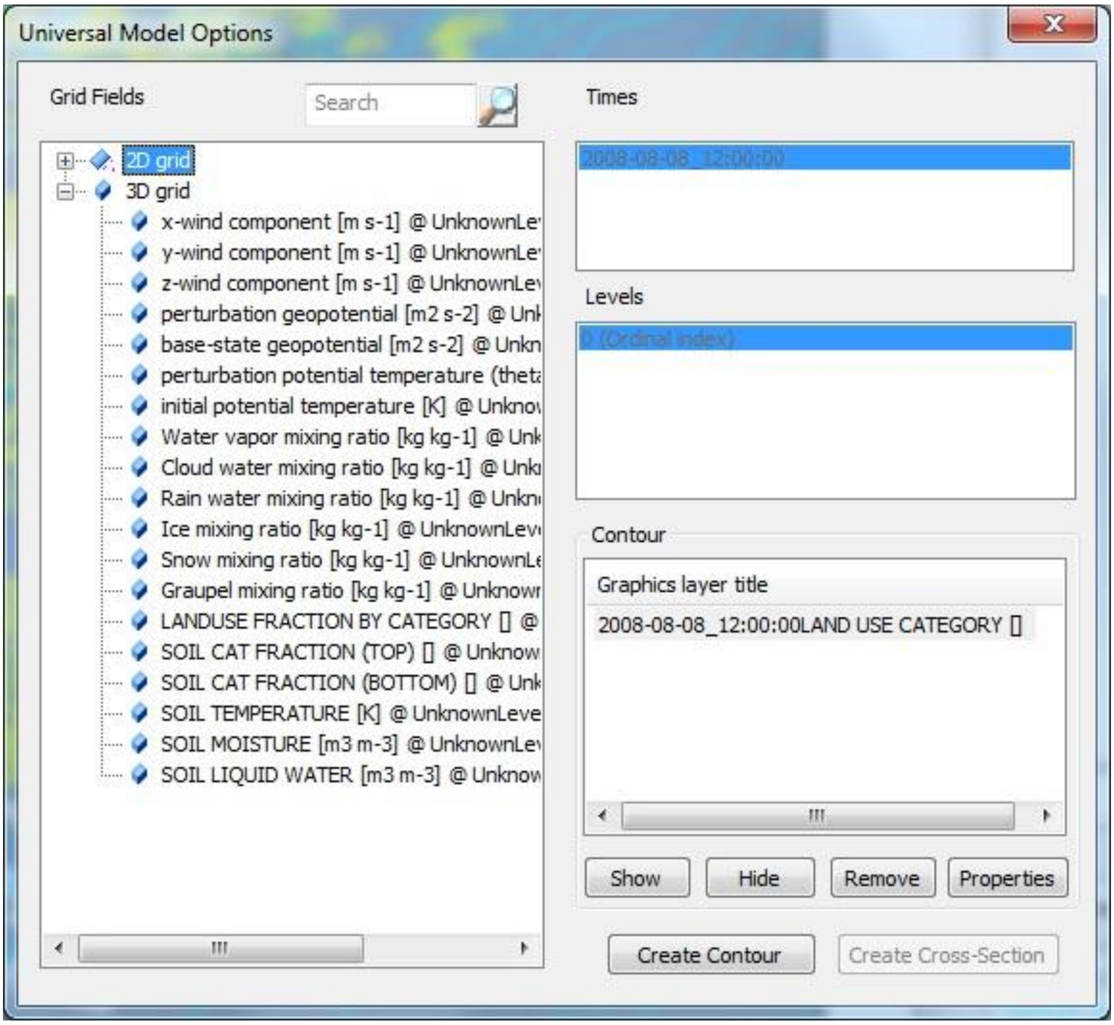


Figure 6-12: An example of the “Universal Model Options” dialog after MeteoExplorer successfully reads a NetCDF-encoded file output from WRF model. The tree view on the left lists all the elements stored in the data file.

As another example of visualizing NetCDF data files, Figure 6-13 shows the sea level pressure (shaded green), 500hPa height (black lines), and wind in the north American region on October 25, 2012, when hurricane Sandy reached its climax.

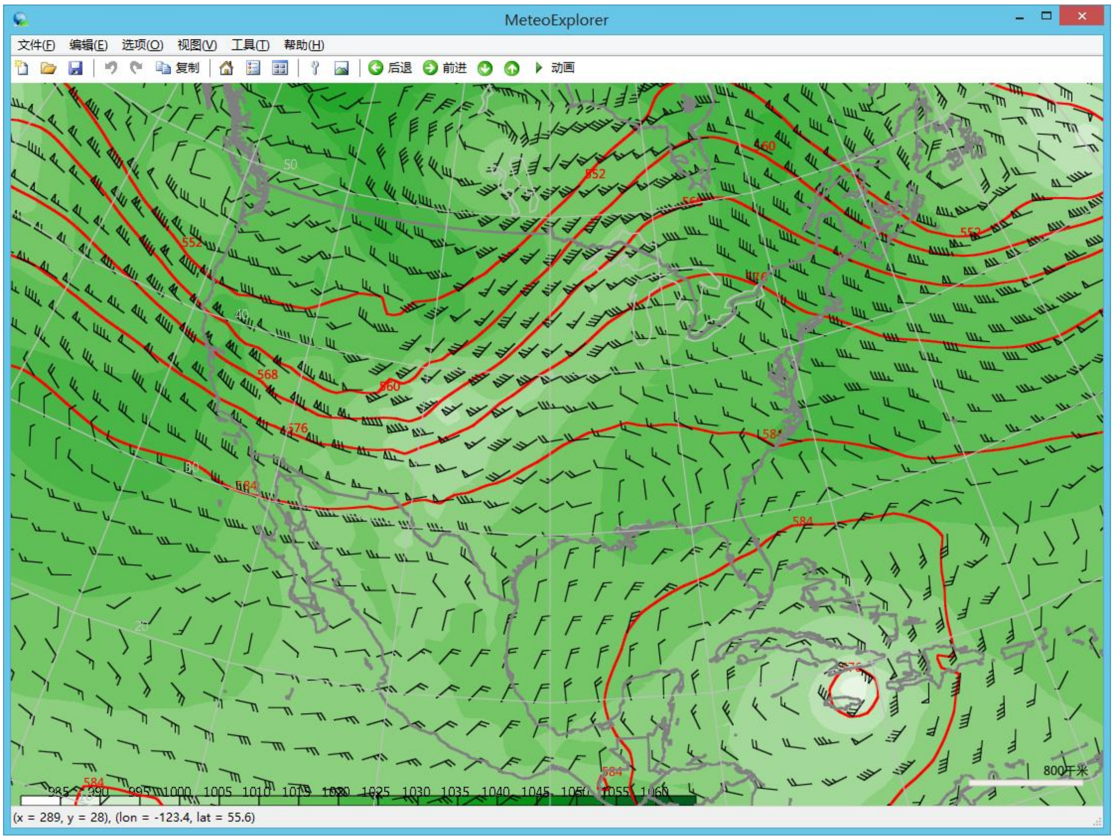


Figure 6-13: MeteoExplorer shows sea level pressure (shaded green), 500hPa height (black lines), and wind in United States on October 25, 2012, when hurricane Sandy reached its climax.

Chapter 7 Surface Station Data Analysis and Display

MeteoExplorer supports surface station observation data such as MICAPS type-1 data file. To open a surface observation data file, the user may select the menu item "File, Open", or click the corresponding toolbar button to open the file picker dialog. And then select the data file in the dialog. User may also drag and drop the data file from file manager into MeteoExporer window. Figure 7-1 shows that a graphics layer analyzed from the surface observation data is rendered in MeteoExplorer.

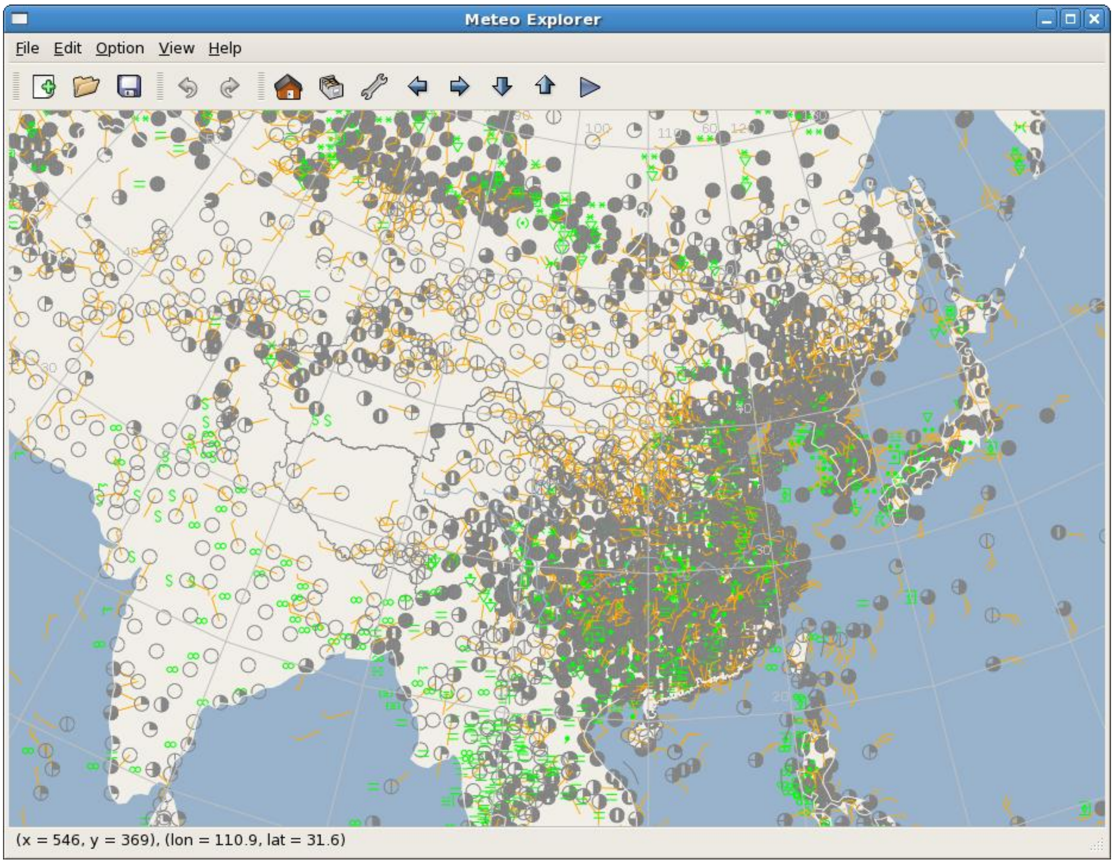


Figure 7-1: MeteoExplorer supports analysis and display of surface station observation data.

7.1 Configure Display Properties of Elements in Surface Station Data

Since there are usually quite a number of stations in a surface observation data set, and there are dozens of weather elements (pressure, temperature, wind etc.) in one station observation, MeteoExplorer by default only shows three elements: wind velocity and direction, cloud coverage amount, and present weather. On the other hand, if all elements are shown, the content rendered in the window will be too overcrowded.

Despite the default rendering scheme, MeteoExplorer provides users with the ability to show or hide certain weather elements via the "Surface Plot Options" dialog as shown in Figure 7-2. To open this dialog, one has to first select the graphics layer corresponding to the surface data file in the "Graphics Layer" window, and then select the "Properties" button.

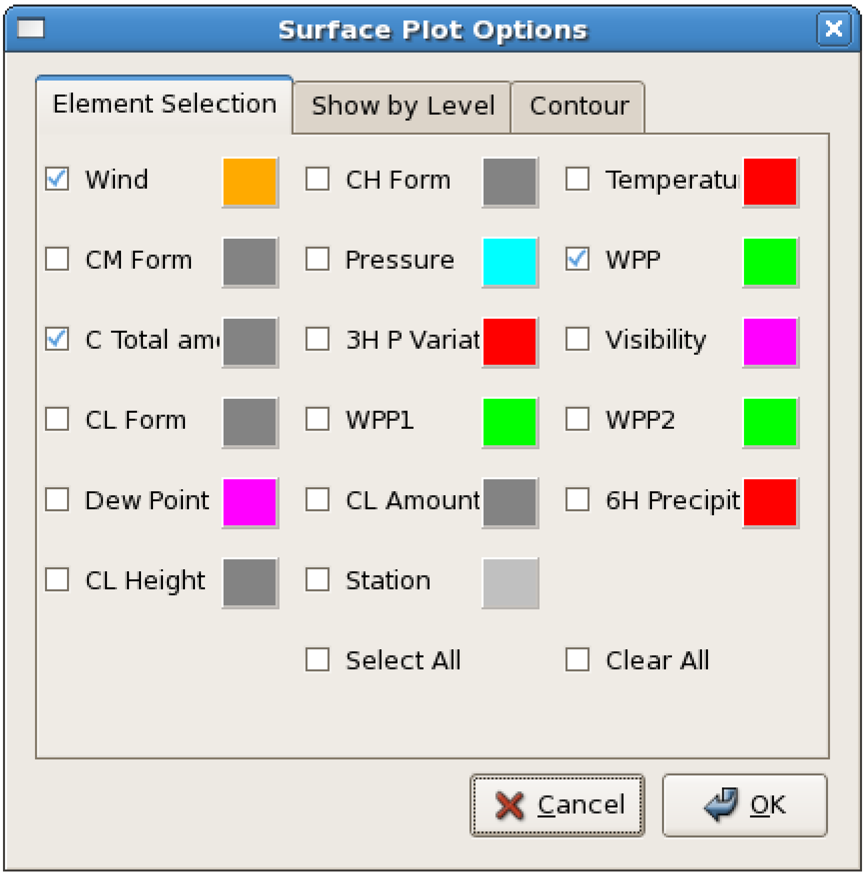


Figure 7-2: In the "Elements Selection" page of the "Surface Plot Options" dialog, users can show or hide, change the color of certain weather elements.

There are actually two pages in the "Surface Plot Options" dialog, one is the "Element Selection" page, and the other is "Contour" page, which will be described in details in section 7.2.

In Figure 7-2, a checkbox control is used to show or hide a weather element. The colored button on the right of the checkbox represents the rendered color of the corresponding weather element rendered in the canvas. Take Figure 7-2 for example, the color of the button next to the wind checkbox is orange. This indicates the wind symbol is drawn in orange in the application window as shown in Figure 7-1. Click the colored button will open the color picker dialog as shown in Figure 7-3. In this dialog, users can change the color by specifying red, green, blue, and opacity component values via either the slide control, or the edit control.

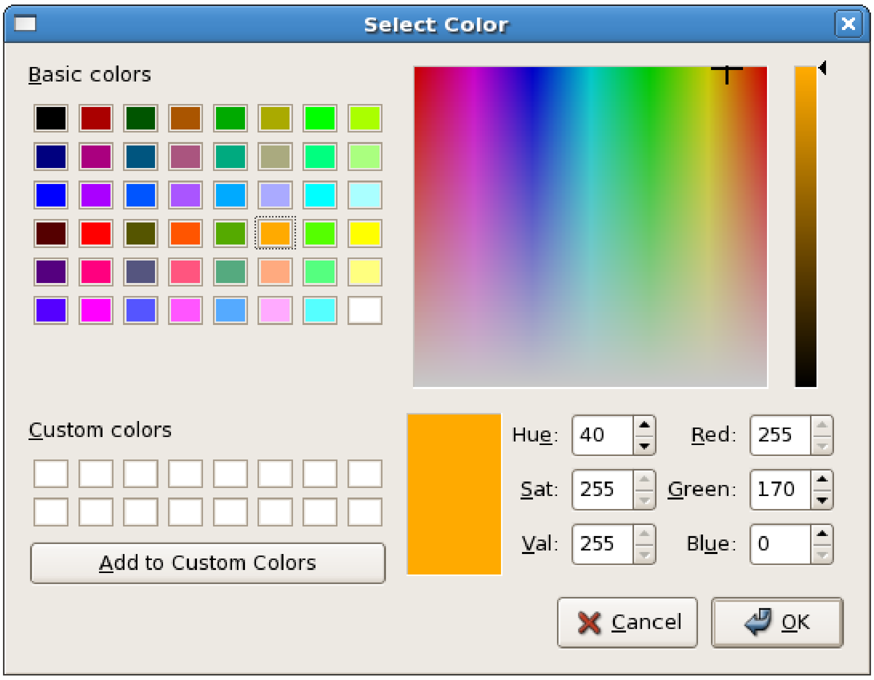


Figure 7-3: In the color picker dialog, users can change the color by specifying red, green, blue, and opacity component values via either the slide control, or the edit control.

Table 7-1 gives a description of the weather elements shown in Figure 7-2.

Table 7-1: A description of all the weather elements shown in the "Elements Selection" page of the "Surface Plot Options" dialog.

Control Name	**Weather Element**	**Control Name**	**Weather Element**
Wind	Wind drawn in the form of barbs	High Cloud Form	High cloud form
Temperature	Temperature	Mid Cloud Form	Mid cloud form
Pressure	Sea level pressure	Present Weather	Present weather phenomenon
Total Cloud Amount	Total amount of cloud coverage	3H Pressure Variation	Pressure variation within last 3 hours
Visibility	Visibility	Low Cloud Form	Low cloud form
Past Weather 1	Past weather phenomenon within last 12 hours	PastWeather 2	Past weather phenomenon within last 24 hours
Dew point	Dew point temperature	Low Cloud Amount	Amount of Low cloud coverage
6H Precipitation	Accumulated Precipitation within last 6 hours	Low Cloud Height	Low cloud height
Station	Observatory station		

In the "Elements Selection" page of the "Surface Plot Options" dialog, there are two additional checkbox controls left unexplained. They are "Select All" and "Clear All". Selecting the former will show all the elements in the data set, whereas selecting the latter will hide all the elements. In Figure 7-7 shows rendered results in which only pressure and wind elements are visible. Figure 7-9 shows the situation where all elements are hidden.

7.2 Objective Analysis of Elements in Surface Station Data

Objective analysis is one of the most important features in MeteoExplorer. For surface observation data, users can do objective analysis in the "Contour" page of the "Surface Plot Options" dialog as shown in Figure 7-4.

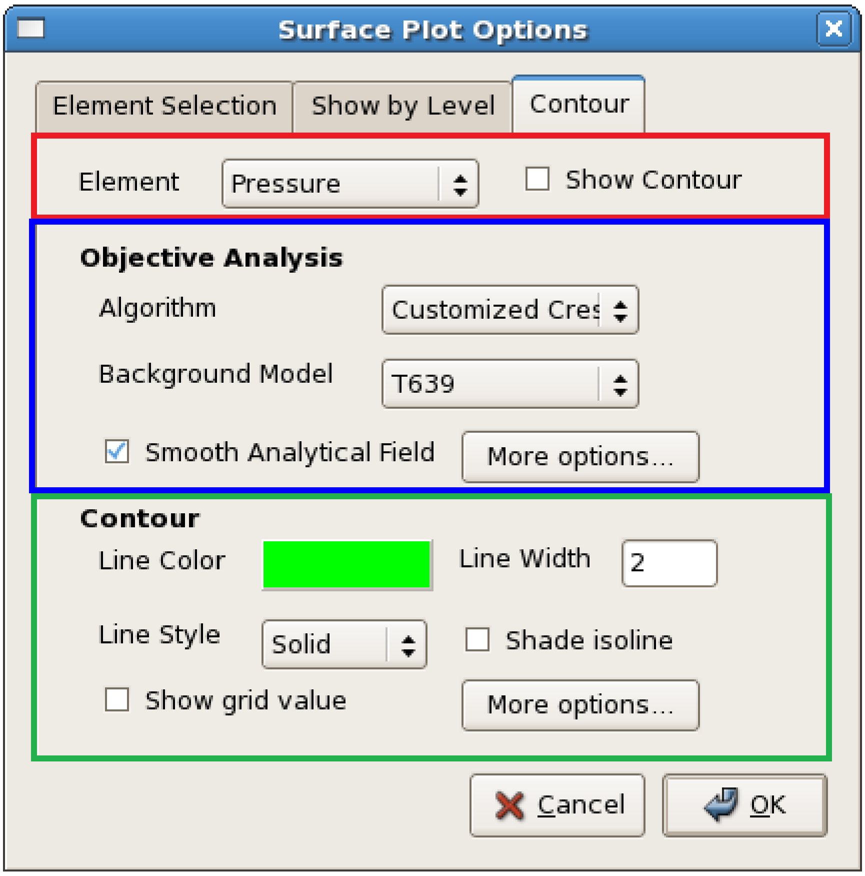


Figure 7-4: In MeteoExplorer, users can do objective analysis of surface station data in the "Contour" page of the "Surface Plot Options" dialog.

The layout of controls in the "Contour" page shown in Figure 7-4 consists of three parts:
The top part outlined in red is used to for objective analysis. The combo box control "Elements" let users to choose a weather element for objective analysis. For surface station observation data, the candidate elements include sea level pressure, temperature, dew point temperature, precipitation (rainfall), and isotachs. The checkbox "Show Contour" serves two purposes. First, if the selected weather element is not analyzed, check this control and click the "OK" button at the

bottom of the dialog will let MeteoExplorer perform objective analysis of the selected element and generate a contour graphics layer representing the analyzed result. Second, if the selected weather element has already been analyzed, check (uncheck respectively) this control will show (hide respectively) contour graphics layer representing the analyzed result in the application window.

The middle part named "Objective Analysis" is outline in blue. It contains controls for changing objective analysis parameters:

- Algorithm. This combo-box control provides several objective analysis method for users:
  - Cressman analysis;
  - Barnes analysis;
  - Customized Cressman using background model and outlier detection;
  - Optimal Interpolation;
  - Surface Fitting.
- Background Model. As objective analysis method is an iterative correction method, it needs to initial value to start from. In algorithm implementation, the numerical model forecast field at zero hour forecast time range is used as the initial values for the iteration. MeteoExplorer provides the following options:
  - No Background;
  - China T639 numerical forecast model;
  - ECMWF numerical forecast model;
  - Japan numerical forecast model;
  - NCEP global forecast system (GFS) numerical forecast model;
  - WRF numerical forecast model.
- Smooth Analytical Field. When the user exports the graphics to an image file, she requests that Isolines of analytical field not only agree well with observatory station data, but are as elegantly smooth as possible. To meet this demand, MetroExplorer implements the ability to smooth the analytic field with cubic B-spline interpolation, and provides this feature as an option. Therefore when the user wants visually elegant isolines and does not mind sacrificing analytic accuracy to some extent, she may select this option.

In addition to the above three options, MeteoExplorer provides more options but hide them by default in the "Contour" page of "Surface Plot Options" dialog. To see these additional options, one may click the "More Options" button to open the "Objective Analysis Options" dialog as shown in Figure 7-5. Below is a description of these options.

- The three edit controls on the top row of "Longitude Start/Interval/End" and three edit controls on the second row of "Latitude Start/Interval/End" define the geographic range and resolution of analysis field. Here a longitude value between 0~180 degrees represents east hemisphere and a value between 180~360 (or -180~0) represents west hemisphere. A latitude value between 0~90 represents north hemisphere and a value between -90~0 represents south hemisphere.
- The other controls "Algorithm", "Background Model", and "Smooth Analytic Field" are indeed identical to the controls in Figure 7-4.

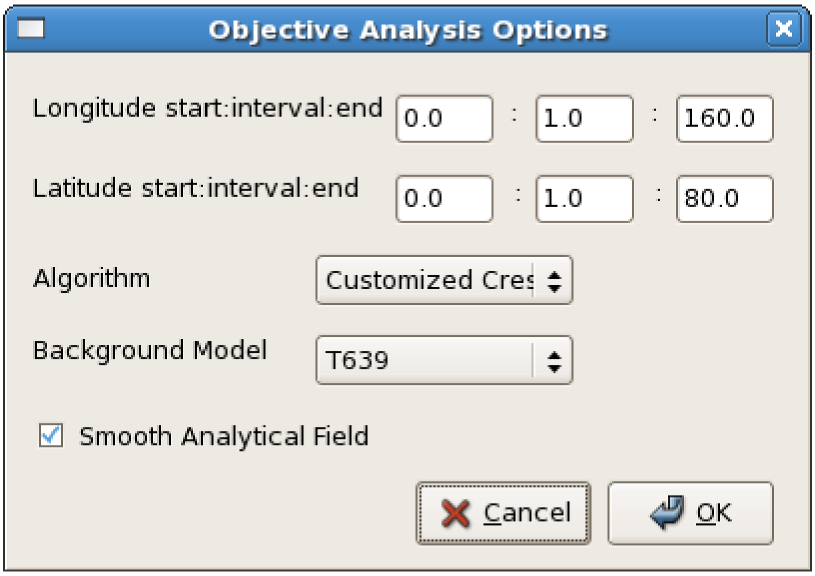


Figure 7-5: User may need to open "Objective Analysis Options" dialog to see all the options of objective analysis.

The bottom part of the page named "Contour Display" (outlined in green in Figure 7-4) consists of controls for changing contour graphics properties, including color, width, style of contour line, shading color scheme, whether or not to show values at grid point. Again only part of contour display options are shown in this page. For a complete configuration of contour display options, one may click the "More Options" button to open "Contour Analysis and Display" dialog (Figure 7-6).

The "Contour Analysis and Display" dialog provides all the options for configuring contour graphics layers. The controls in this dialog are divided into two groups. The top part is the "Contour Analysis" group and the bottom part is the "Contour Display" group.

The "Contour Analysis" group contains the following controls:

- Geographic range for contour analysis. The "Longitude start:end" and "Latitude start:end" controls altogether define the area in which the contours are rendered. By default, contour analysis range is identical to the range of analytic field. That is, the contours are rendered within the range of analytic field. The user may specify a contour analysis range that is no larger than the range of analytic field. Figure 7-10 gives an illustration in which contour analysis range that is smaller than the range of analytic field.
- Isoline analysis values. In MeteoExplorer, there are two ways for users to specify the isoline analysis values. The first way is set the isoline values by specifying start, increment, and end values. This method is suitable for the case where the difference between two consecutive isoline values is a constant and the range of isoline values is large. The second way is to set the isoline values by explicitly specifying them one by one. This method is usually used in the case that users are interested only in a small number of isoline values. To choose the first method, please select "Isoline values in triplet format (start:interval:end)", otherwise, select "Isoline values in discreate format (comma to separate)".
- Shade isoline. Select this option to shade isolines. Figure 7-9 gives such an example.
- Smooth options. It is a common practice to smooth the gridded field before perform isoline analysis in order to obtain a visually pleasing result. In addition, for high resolution gridded

data, smoothing the field help to remove the roughness in the analytic isolines. MeteoExplorer provides three smoothing methods: “Five Points”, “Nine Points”, and “Gaussian Weighted”. To select a method, choose a candidate item from the “Smoothing” combo box control.

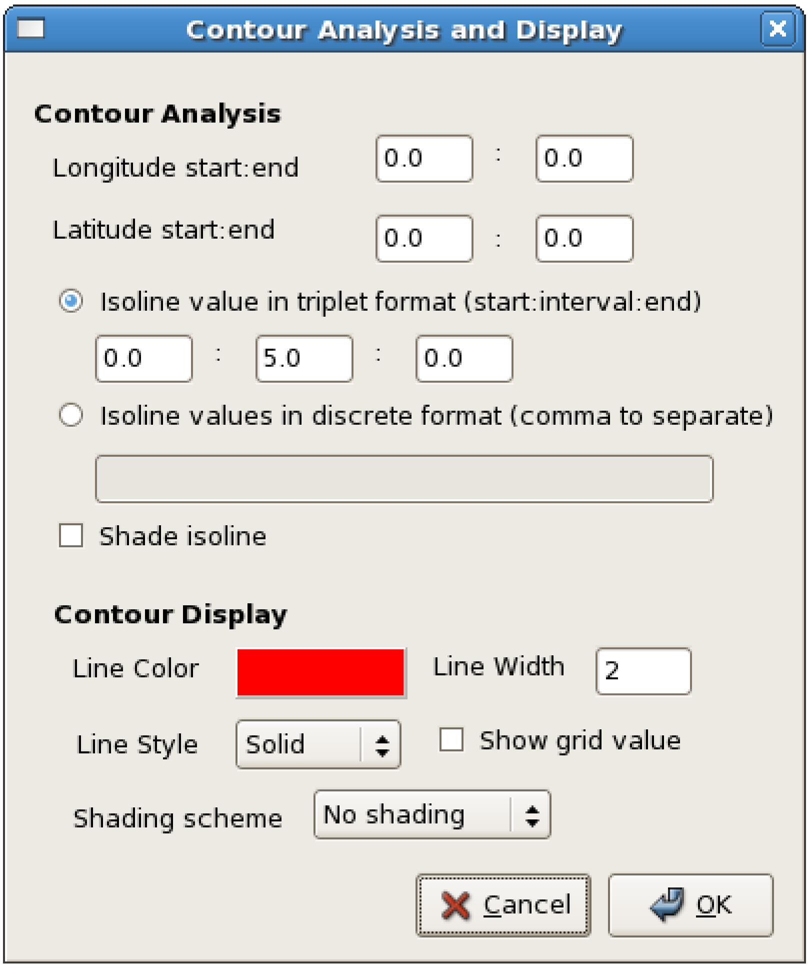


Figure 7-6: The “Contour Analysis and Display” dialog provides all the options for configuring contour graphics layers.

The “Contour Display” group contains the following controls:

- Contour line color, width and style. The styles include solid, dotted, and dashed line.
- Show grid value. Show the grid values at each grid position.
- Shading scheme. The options include no shading, rainbow, aqua, white green, white blue, yellow red, and white gray.

Let us summarize of steps on how to perform an objective analysis operation of a weather element in surface station data in MeteoExplorer:

1. Use the combo box control “Elements” to choose a weather element for objective analysis, and then check the “Show Contour” control next on the right.
2. Optionally configure objective analysis parameters and contour display properties.
3. Click the “OK” or “Apply” button to let MeteoExplorer perform objective analysis of the

selected element and generate a contour graphics layer representing the analyzed result. The difference between the “OK” and “Apply” button is that the former will close the dialog after making the users changes take into effect whereas the latter will keep the dialog.

The order of step 2 and 3 can be exchanged, that is, users can generate a contour graphics first and then customize the result by adjusting the parameters.

Figure 7-7 shows objective analysis result of sea level pressure in red contour lines at 12 o’clock UTC on March 23, 2012. In the figure sea level pressure and wind are also shown in cyan and orange respectively.

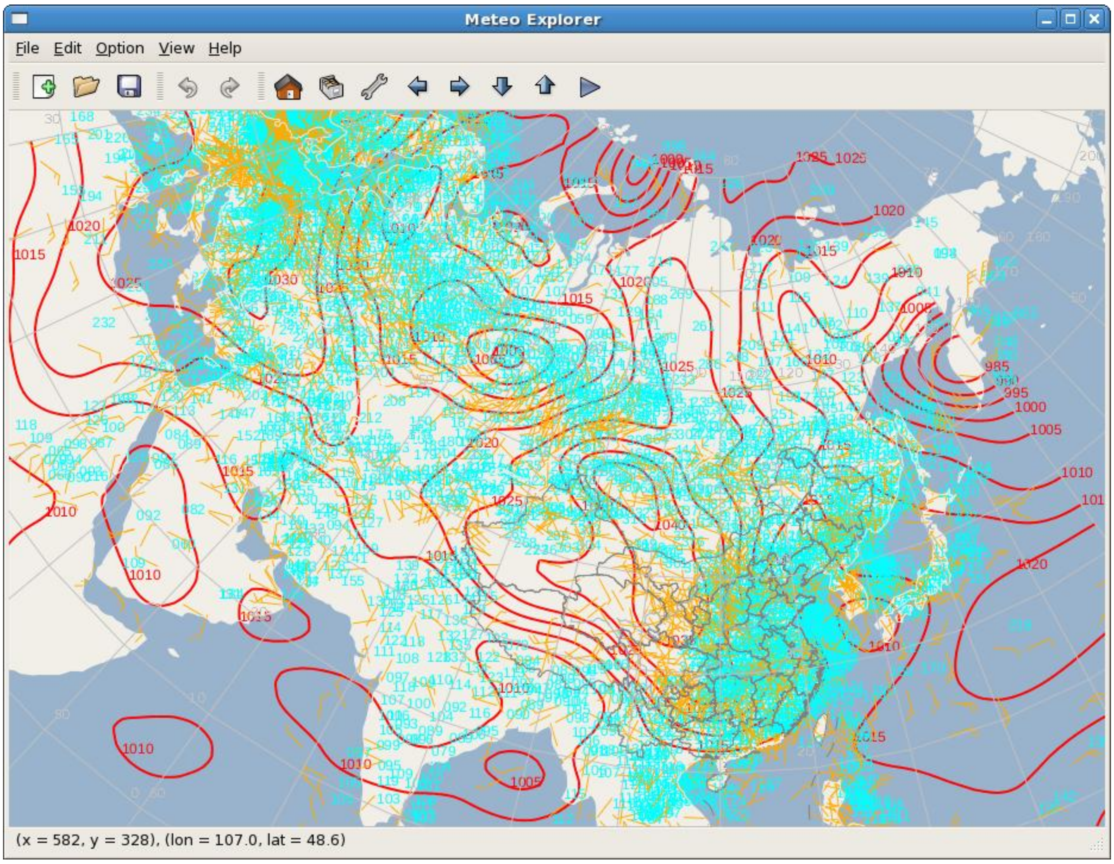


Figure 7-7：The red contour represents objective analysis result of sea level pressure. The sea level pressure and wind are also shown.

Users may generate a contour graphics first and then customize the result by adjusting the parameters. In Figure 7-8, the shading scheme is changed to rainbow and the line width is changed to zero so that the line will be invisible. The customized result is shown in Figure 7-9.

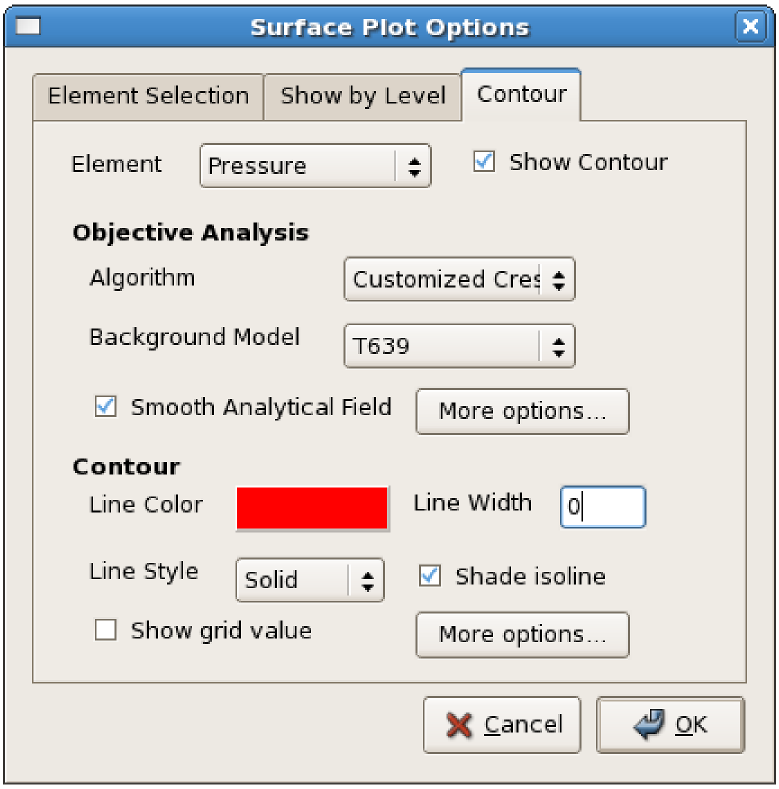


Figure 7-8: In this illustration, the shading scheme is changed to rainbow and the line width is changed to zero so that the line will be invisible.

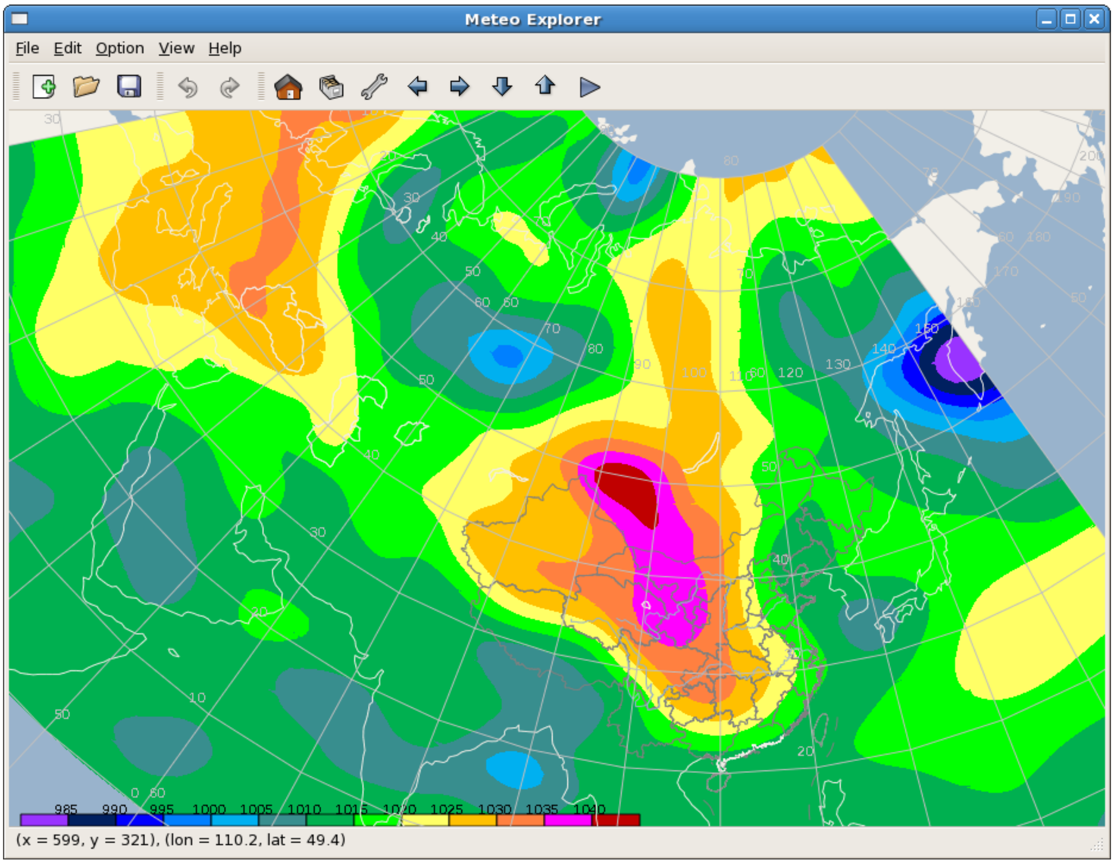


Figure 7-9: The customized objective analysis result based on the configuration

in Figure 7-8.

The geographic range in the “Contour” page is obtained from the station observation data. Figure 7-10 illustrates another customization example in which the geographic range is reduced to 70~140E, 10~60N, and the increment of isoline values is set to 2.5 10gpm.

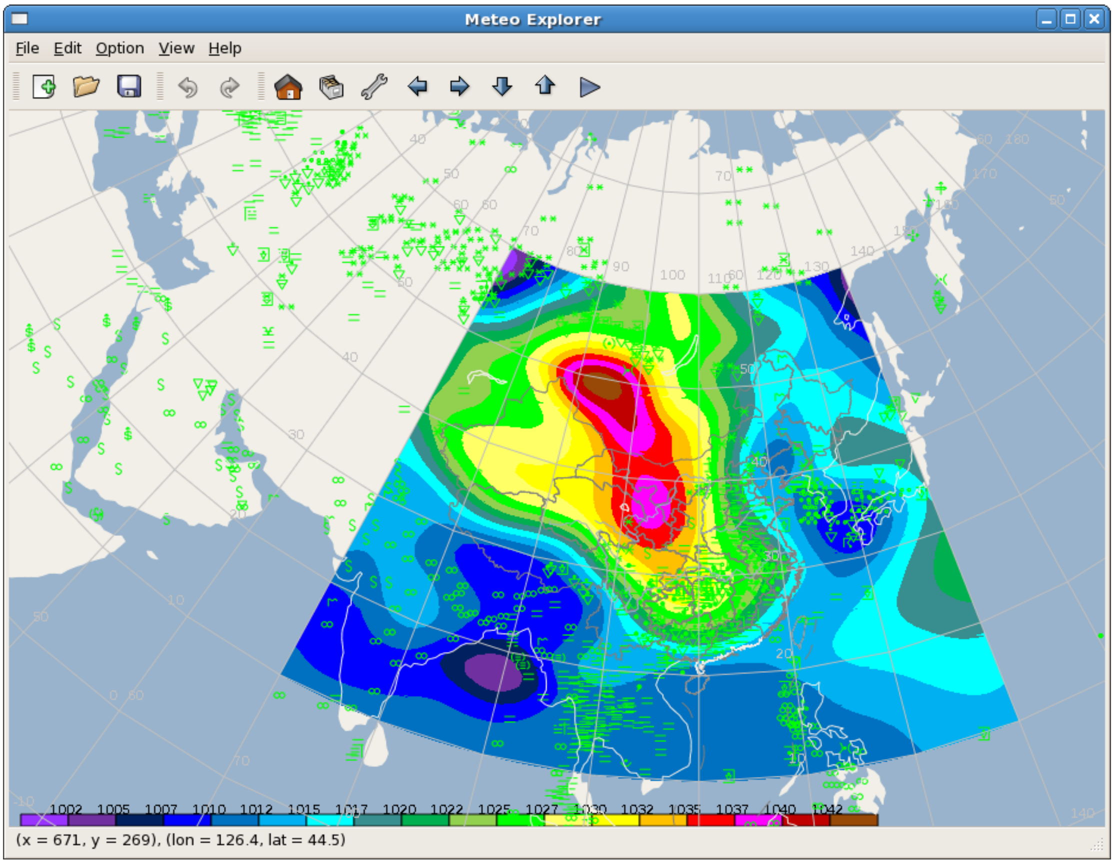


Figure 7-10: The analytic contour in which the contour analysis range is smaller than the range of analytic field.

Chapter 8 Upper-Air Soundings Data Analysis and Display

The upper-air soundings observation is another important data commonly used in meteorological operation and research. MeteoExplorer supports GrADS station data and MICAPS upper-air plot data (also known as MICAPS type-2). Figure 8-1 shows a graphics layer representing an upper-air data set in MeteoExplorer.

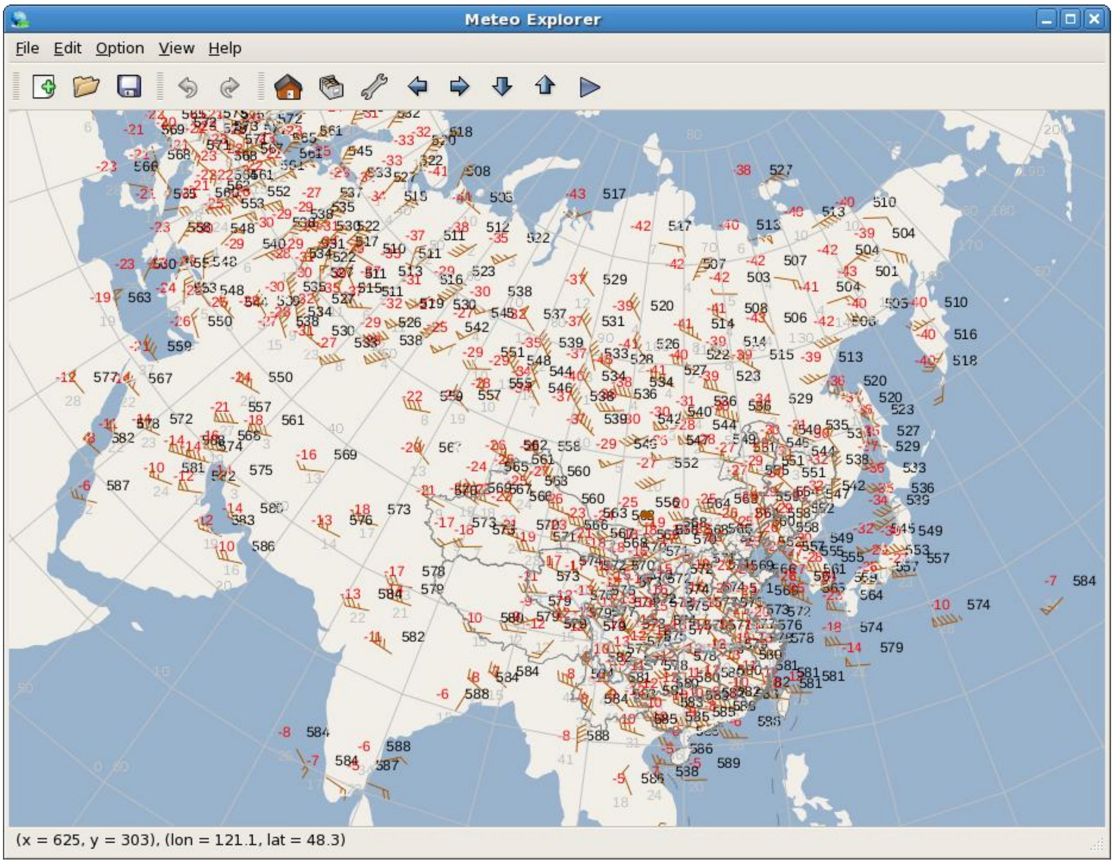


Figure 8-1: MeteoExplorer supports upper-air soundings observation data such as GrADS station data and MICAPS type-2 data.

8.1 Configure Display Properties of Elements in Upper-air Soundings Data

Compared with the surface plot station data, there are fewer elements in an upper-air soundings data. Usually an upper-air soundings data set consists of wind direction and velocity, geopotential height, temperature, dew-point temperature. As a result, MeteoExplorer shows all these elements in the canvas window. Nonetheless, users can still configure the visibility state and display properties of each element with the "Elements Selection" page of "Upper-air Plot Options" dialog as shown in Figure 8-2.

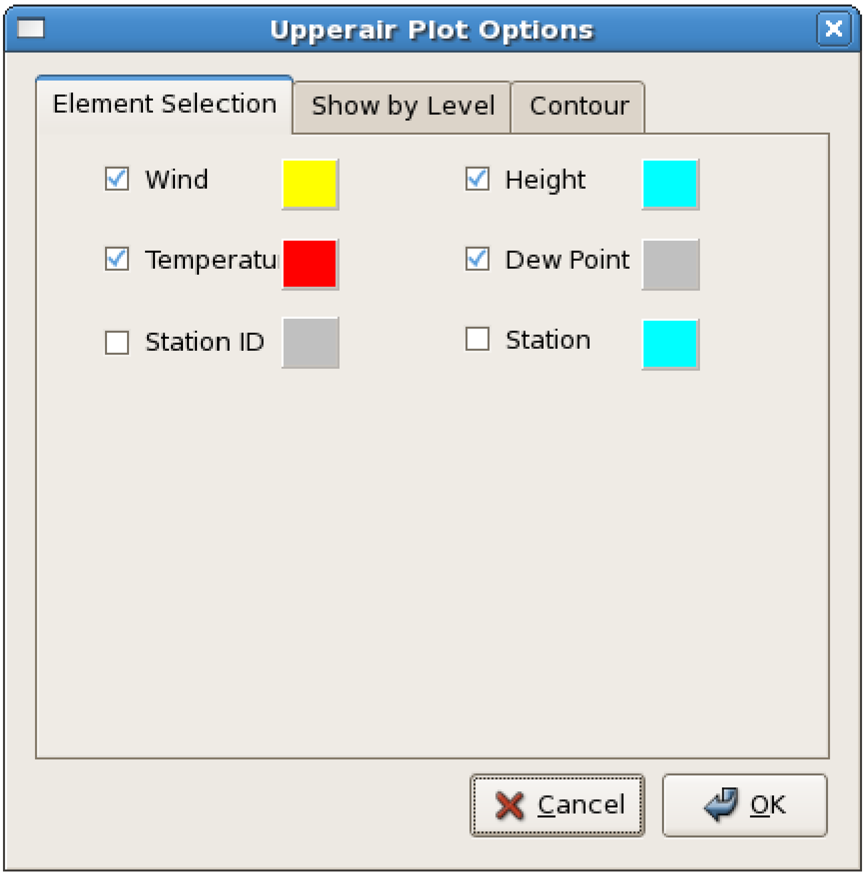


Figure 8-2: Users can configure the visibility state and display properties of each element with the "Elements Selection" page of "Upper-air Options" dialog.

In Figure 8-2, a checkbox control is used to show or hide a weather element. A weather element will be shown if the checkbox control is check, and hidden if unchecked. The colored button on the right of the checkbox represents the color of the corresponding weather element rendered in the canvas. Take Figure 8-2 for example, the color of the button next to the temperature checkbox is red. This indicates the temperature is drawn in red in the application window as shown in Figure 8-1. A mouse click of the button will open the color picker dialog as shown in Figure 7-3 (page 87). In this dialog, users can change the color by specifying red, green, blue, and opacity component values via either the slide control, or the edit control.
Table 8-1 gives a description of the weather elements shown in Figure 8-2.

Table 8-1: A description of all the weather elements shown in the "Elements Selection" page of the "Upperair Plot Options" dialog.

Control Name	Weather Element	Control Name	Weather Element
Wind	Wind	Height	Geopotential height
Temperature	Temperature	Dew point	Dew-point temperature

Station ID	Number of observation station	Station	Geographic position of observation station

One may notice that in the "Elements Selection" page, there are two more checkbox and color button pairs named "Station ID" and "Station". They respectively represent the number and geographic location of a station. The geographic location of a station is drawn as a dot.

8.2 Objective Analysis of Elements in Upperair Soundings Data

Users can do objective analysis in the "Contour" page of the "Upper-air Plot Options" dialog as shown in Figure 8-3.

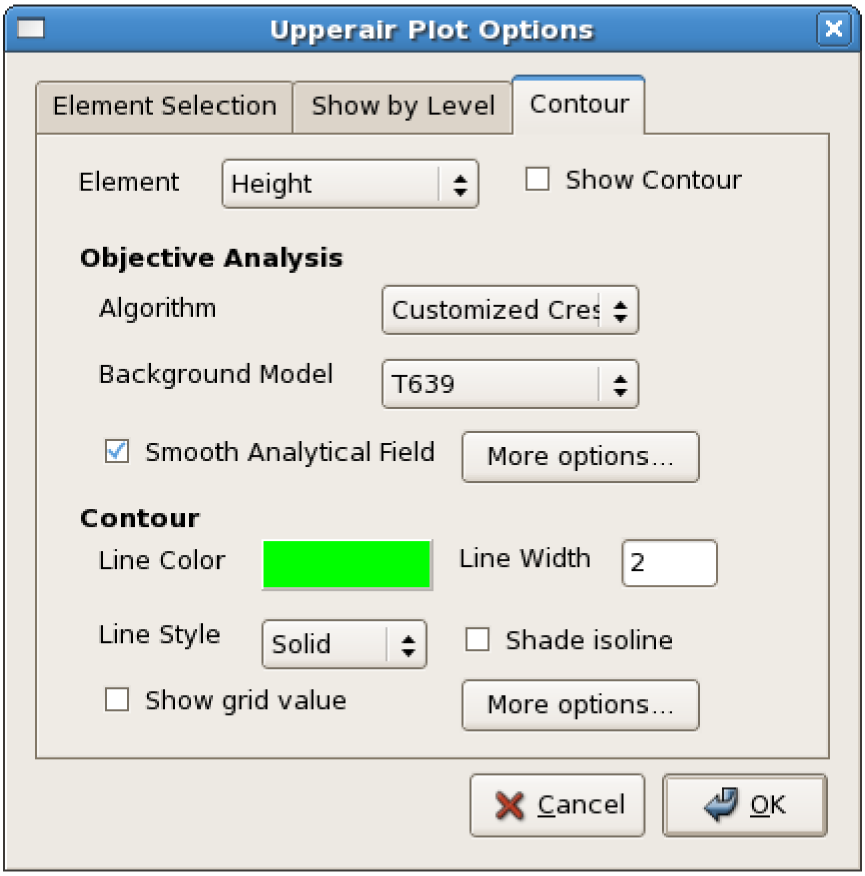


Figure 8-3: In MeteoExplorer, users can do objective analysis in the "Contour" page of the "Upper-air Plot Options" dialog.

The layout of controls in Figure 8-3 is identical to that in Figure 7-4 (page 88).
The combo box control "Elements" let users to choose a weather element for objective analysis. For upper-air soundings data, the candidate elements include geopotential height, temperature, dew point temperature, and isotachs. The checkbox "Show Contour" serves two functions. First, if the selected weather element is not analyzed, check this control and click the "OK" or "Apply" button at the bottom of the dialog will let MeteoExplorer perform objective analysis of the

selected element and generate a contour graphics layer representing the analyzed result. Second, if the selected weather element has already been analyzed, check (uncheck respectively) this control will show (hide respectively) contour graphics layer representing the analyzed result in the application window.

The middle part named “Contour Analysis” contains controls for changing objective analysis parameters and the bottom part named “Contour Display” consists of controls for changing contour graphics properties. As these controls serve the same purpose as those in Figure 7-4, users are recommended to reference section 7.2 on page 88 for the description of these controls.

Figure 8-4 shows objective analysis result of geopotential height in black lines at 8 o’clock UTC on March 30, 2012. In the figure, the black numerical numbers represent geopotential height of all stations.

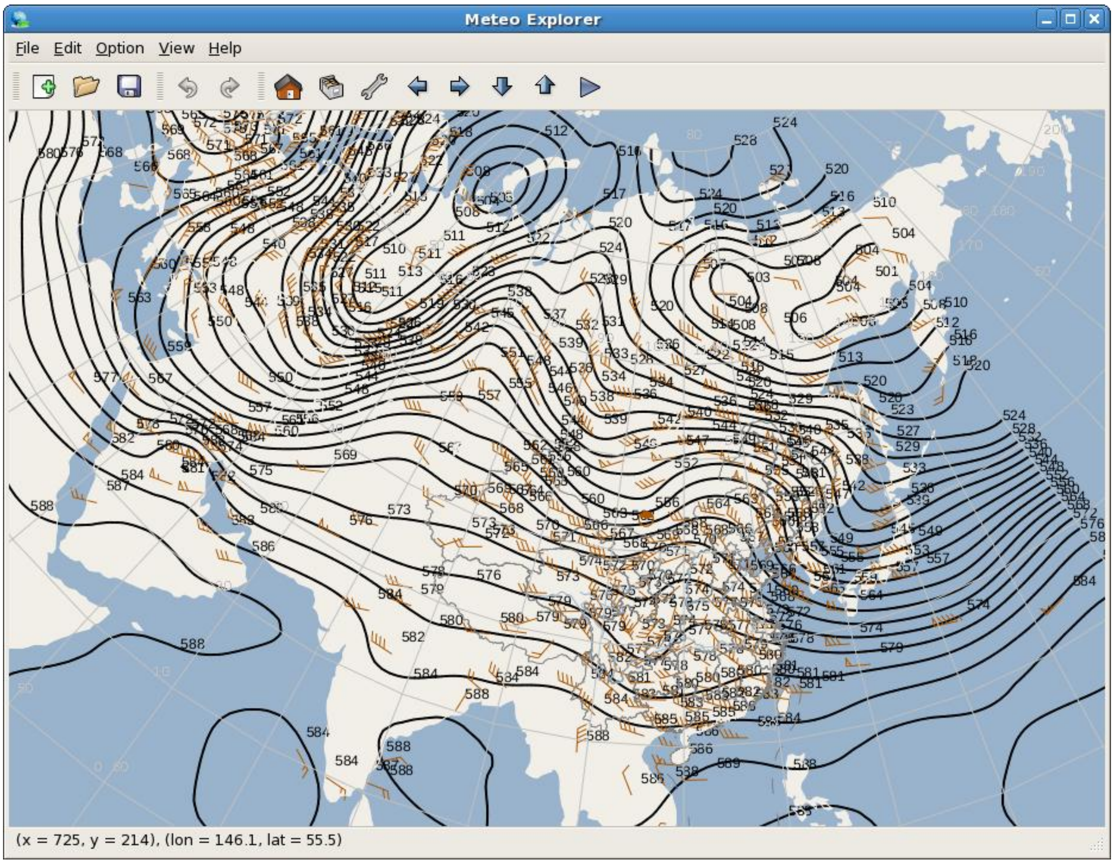


Figure 8-4: The black contour represents objective analysis result of geopotential height. The geopotential height and wind of all stations are also shown.

Users can customize the objective analysis result by adjusting parameters in the “Contour” page. Figure 8-5 shows the objective analysis result of geopotential height in shaded contour and temperature in black contour lines for the same data as in Figure 8-4.

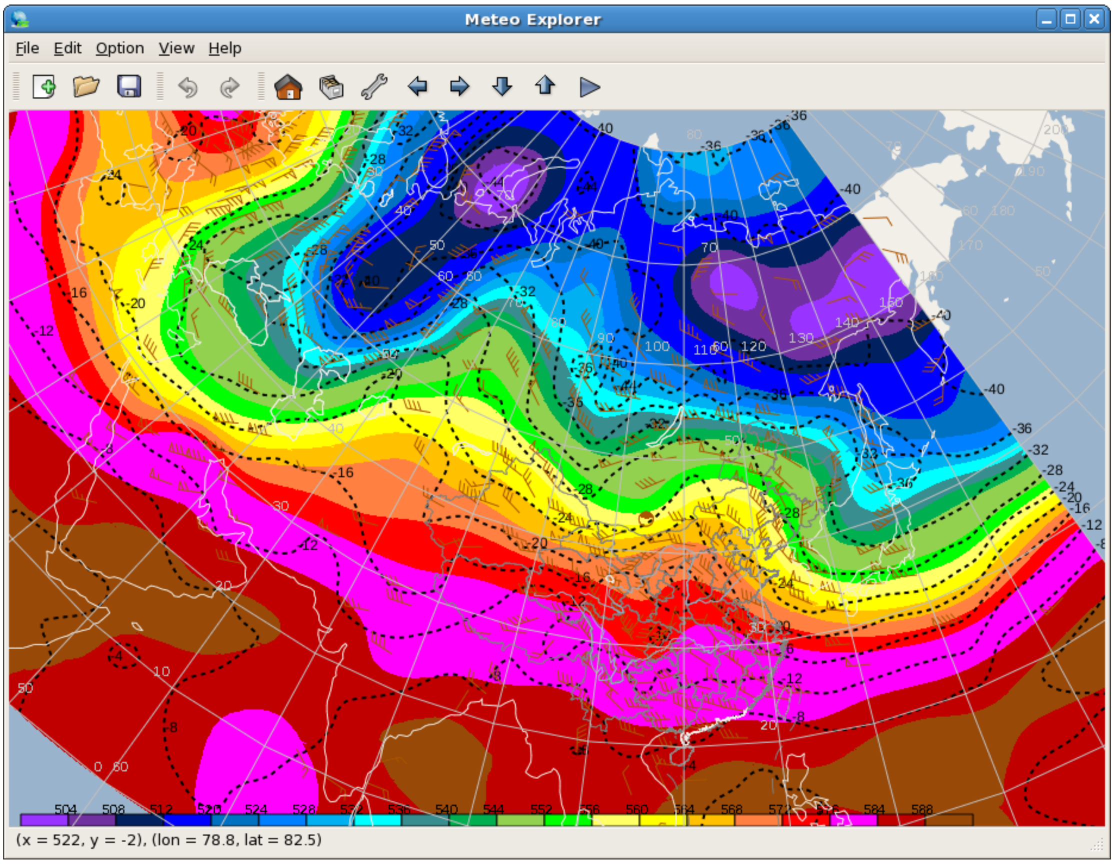


Figure 8-5: The objective analysis result of geopotential height in shaded contour and temperature in black contour lines.

Chapter 9 Single Element Station Data Analysis and Display

The single element station data is commonly used to store observation data of a certain weather element such as pressure variation, temperature variation, precipitation and so on. The GrADS station data and MICAPS type-3 data are often used to represent single element station data. In this chapter, the processing of single element station data will be described.

9.1 Configure Display Properties of Station Observation Data

One starts to process the single element station data by opening the data file in MeteoExplorer. Figure 9-1 shows the twenty-four hour accumulated rainfall at 8 o'clock UTC on July 26, 2011.

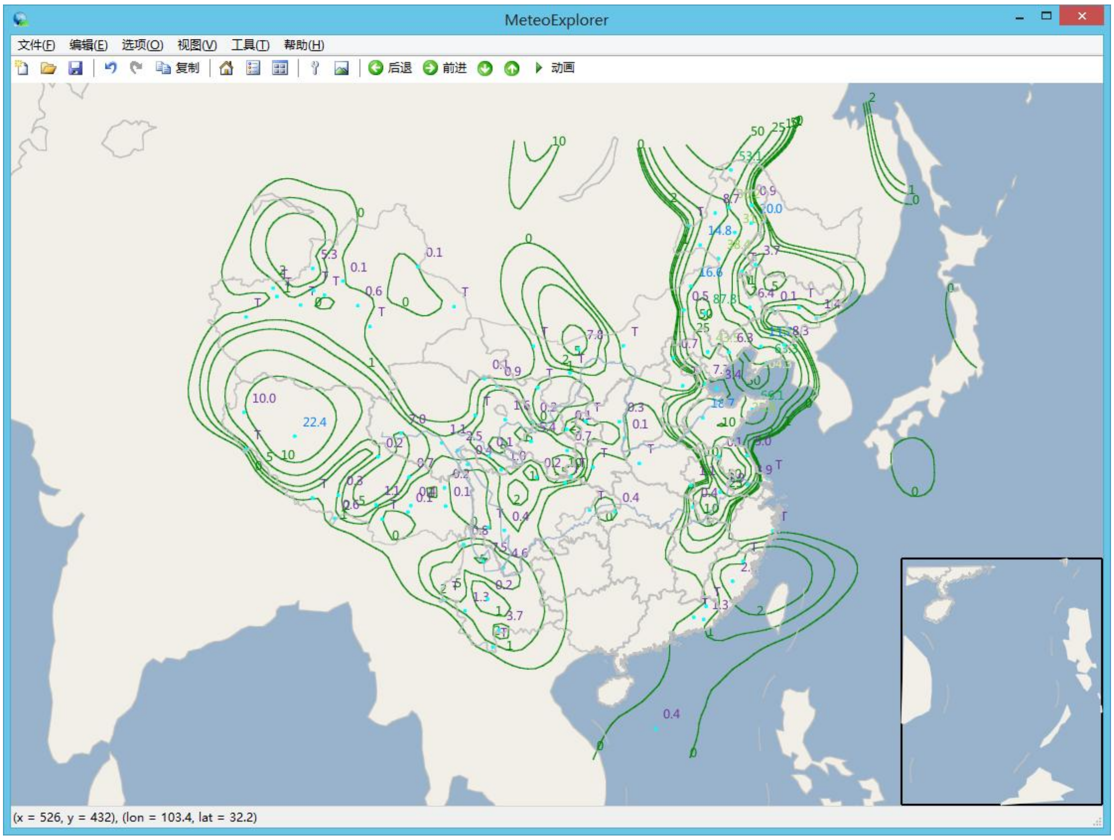


Figure 9-1: MeteoExplorer supports GrADS station data and MICAPS third data type, that is, the single element station data. In this figure, the rainfall and associated objective analytic contour are shown.

By default, MeteoExplorer shows the observation data and geographic position of all stations in the data set. Similar to surface plot station data of Chapter 7 and upper-air soundings data of Chapter 8, users can customize the element display properties in "Elements Selection" page of "Single Element Station Data Options" dialog as shown in Figure 9-2.

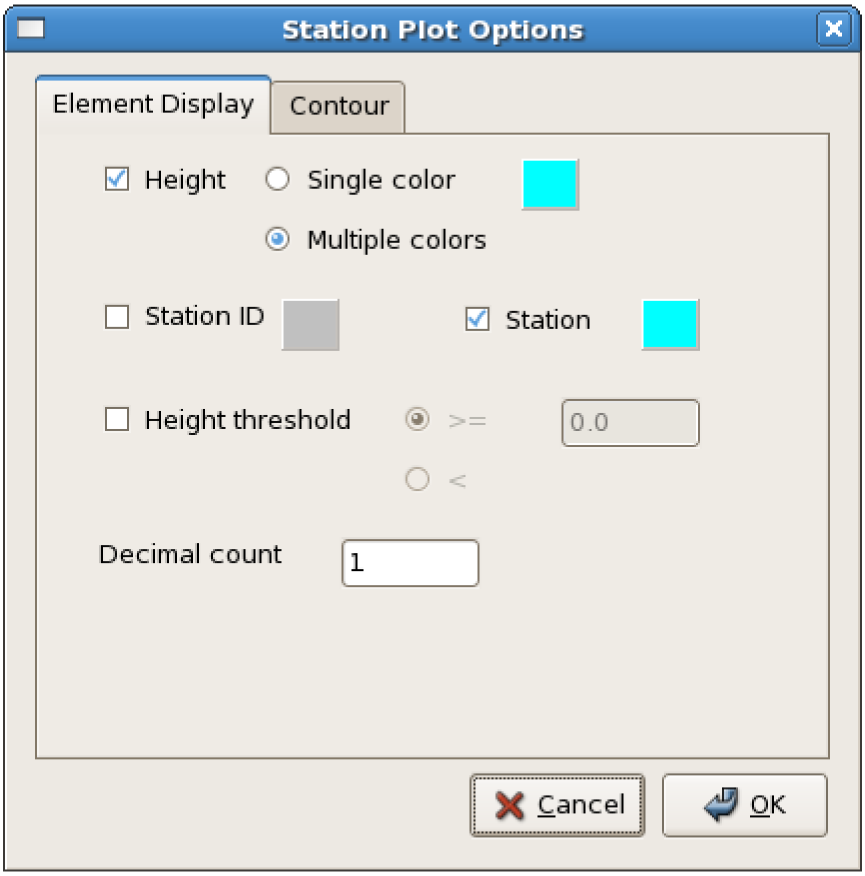


Figure 9-2: Users can customize the element display properties in "Elements Selection" page of "Station Plot Options" dialog.

Let us introduce the controls in Figure 9-2:

- The "Height" checkbox. This control is used to control the visibility state of the element. When it is checked, the element value is shown in the application window. When it is unchecked, the element values will not be shown.
- The "Single Color" and "Multiple Colors" radio button. These two controls define the color scheme. If "Single Color" is selected, then all the station values will be rendered in the same color as shown in Figure 9-3. In this case users can customize the color by mouse clicking the button on the right the "Height" checkbox to open the color picker dialog as shown in Figure 7-3 7-3 (page 91). If "Multiple Colors" is selected, then the colors of the text representing the station value are different as shown in Figure 9-1.
- The "Station ID" and "Station" checkbox. These two controls determine the visibility status of the station identifier and geographic position. Moreover, users can use the button on the right to select the color for these two properties.
- The "Threshold" checkbox. When this control is checked, the ">=" and "<" ratio button, and the edit control will be enabled. Users can enter the threshold value in this edit control. For example, when a user selects the ">=" ratio button and enter "0" in the edit control, only the

stations with observation value that is larger and equal to 0 will be shown.

- The "Decimal Count" edit control. This control specifies the decimal count of observation value shown in the application window. For example, when the user set the decimal count to 1, the observation value 12.57 will be shown as 12.6; when the user set the decimal count to 0, the observation value 12.57 will be shown as 13.

Figure 9-3 is the twenty-four hours temperature variation at 8 o'clock UTC on December 9, 2011. In the figure, the text of observation value is drawn in single (black) color. The cyan dot represents the geographic location of the station, whose identification number is not shown. The threshold is set to be larger and equal to zero, and decimal count is set as 1.

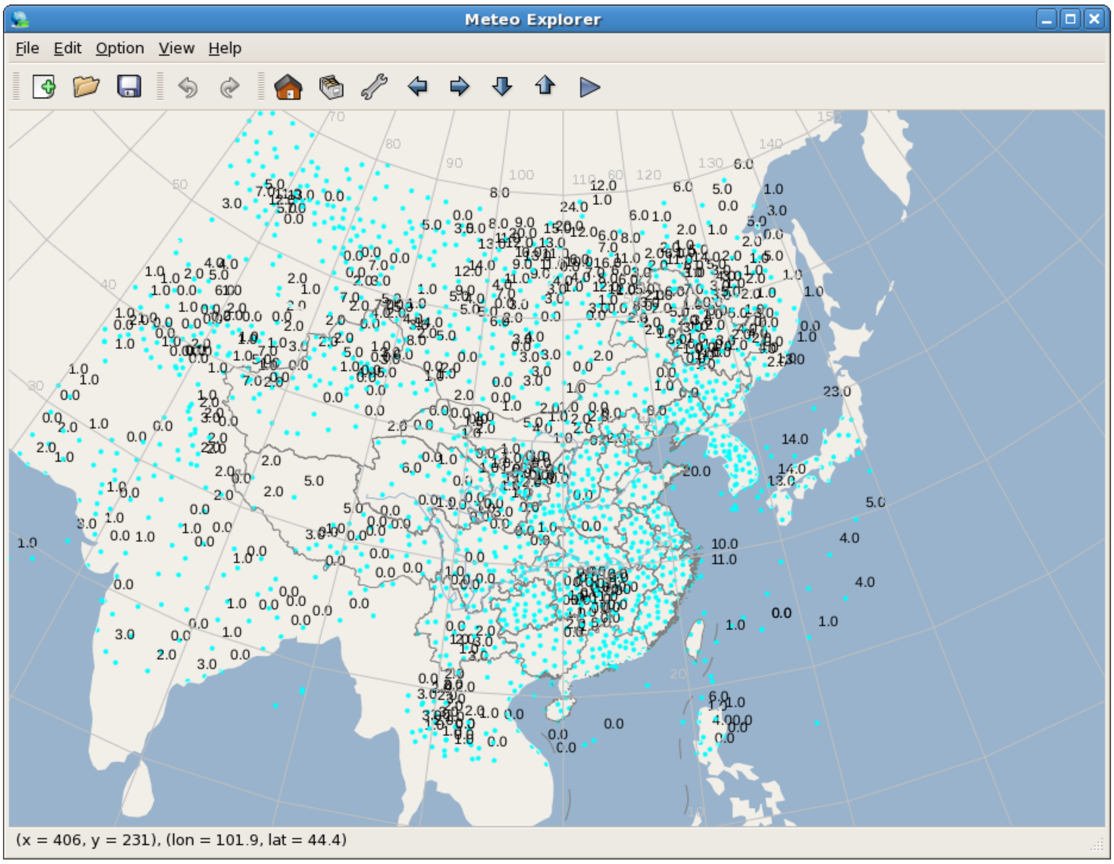


Figure 9-3: Rendering of the graphics layer created from twenty-four hours temperature variation station data.

9.2 Objective Analysis of Station Observation Data

Similar to surface station data and upper-air soundings data, MeteoExplorer provides the objective analysis functionality for single-element station data via the "Contour" page in "Station Plot Options" dialog as shown in Figure 9-4.

The layout of controls of Figure 9-4 is identical to that of Figure 8-3 (page 97) and Figure 7-4 (page 88). On the top of the page there is a "Show Contour" checkbox. As the data consists of only one element, the "Element" combobox is not there any longer. The checkbox "Show

Contour" serves two purposes. First, if the selected weather element is not analyzed, check this control and click the "OK" or "Apply" button at the bottom of the dialog will let MeteoExplorer perform objective analysis of the element and generate a contour graphics layer representing the analyzed result. Second, if the selected weather element has already been analyzed, check (uncheck respectively) this control will show (hide respectively) contour graphics layer representing the analyzed result in the application window.

The middle part named "Contour Analysis" contains controls for changing objective analysis parameters and the bottom part named "Contour Display" consists of controls for changing contour graphics properties. As these controls serve the same purpose as those in Figure 7-4, users are recommended to reference section 7.2 on page 88 for the description of these controls.

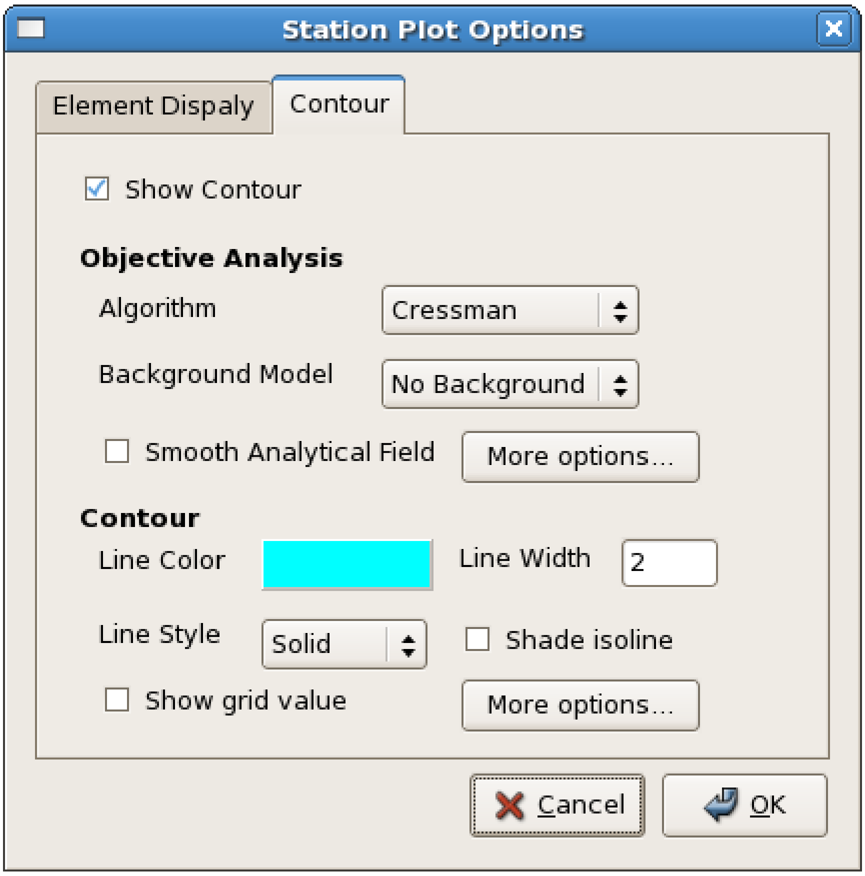


Figure 9-4: MeteoExplorer provides the objective analysis functionality for single-element station data via the "Contour" page in "Station Plot Options" dialog.

Let us take the shading scheme for example. Meteorologists usually use the aqua color table as the shading scheme for rainfall data as shown in Figure 9-5. To do this, one first selects the "Isoline values in discreate (comma to spate)" ratio button to enable the edit control below. Then enter the isoline values "1,2,5,10,25,50". Next one sets the "Line Width" to 0 and selects the aqua color table, the third item in the "Shading Scheme" combo box control. Finally, click the "OK" or "Apply" button to make the changes into effect. Note that the "Draw Graphics in Province" (see reference at section 4.2.5, page 52) feature is also used to restrict the graphics output within the administration border of China.

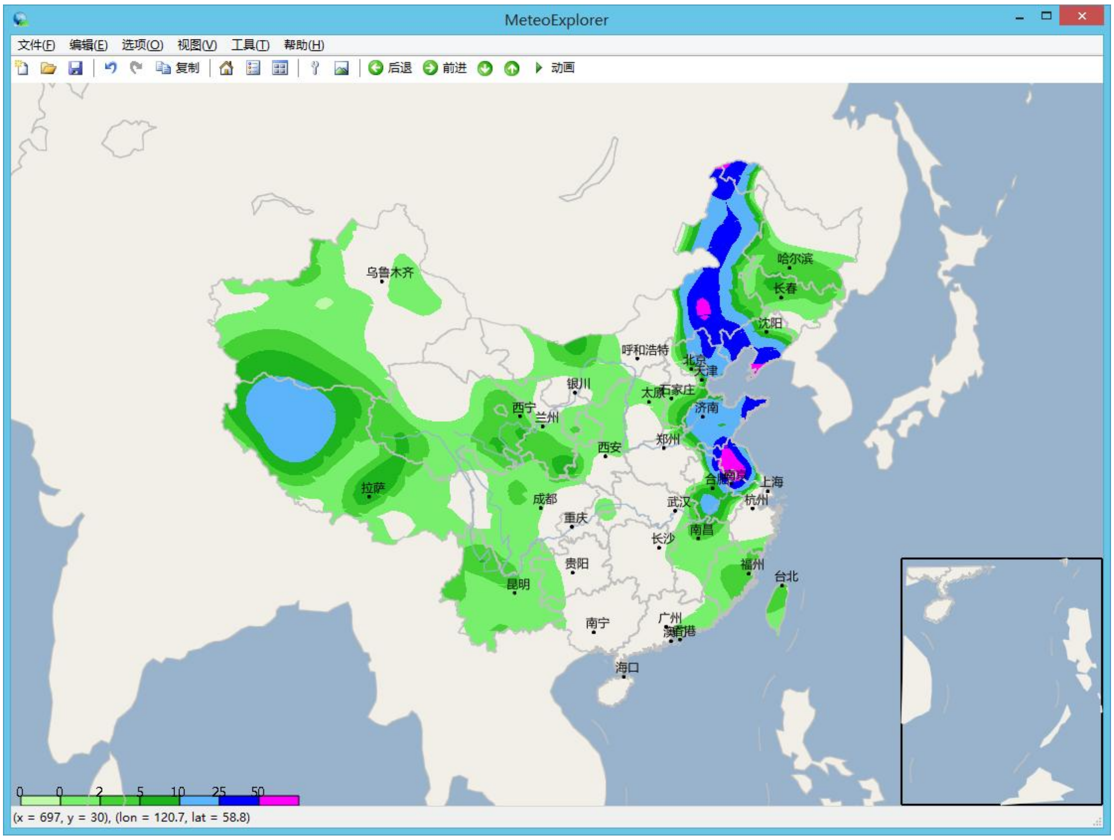


Figure 9-5: The objective analysis result of 24 hour accumulated rainfall is represented with the shaded contour with aqua color table.

Figure 9-6 shows the objective analysis result of twenty-four hours temperature variation represented using shaded contour with the rainbow color table, the second item in the “Shading Scheme” combo box control. The station data of this temperature variation field is indeed shown in Figure 9-3. The customization process is identical to that used in Figure 9-5, with the only exception that the isoline values are specified with the start, increment, end value of -10, 2, 10 respectively.

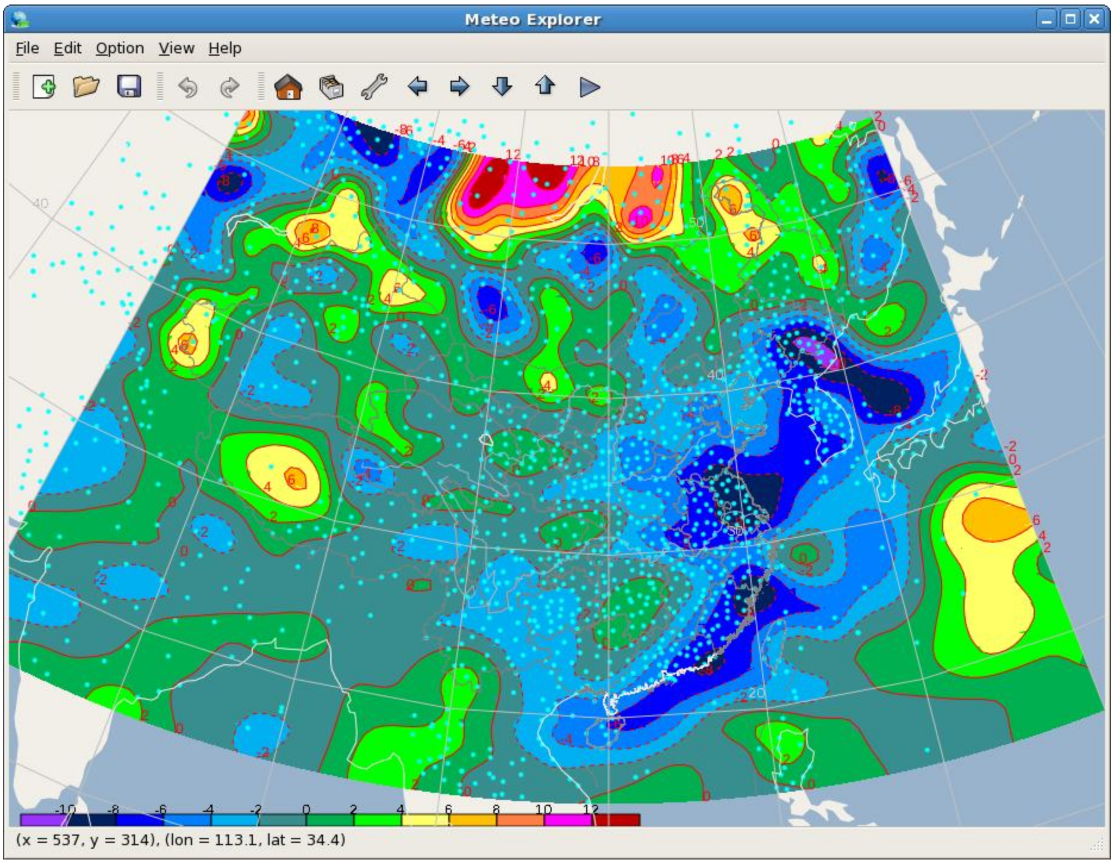


Figure 9-6: The objective analysis result of twenty-four hours temperature variation represented with shaded contour with the rainbow color table.

Chapter 10 Gridded Data Analysis and Display

Gridded data is the most commonly used data store form in meteorological research and operation as nearly all meteorological data such as numerical model output, satellite nephogram etc. are stored in gridded form. The popular data encoding formats include WMO GRIB1/GRIB2, NetCDF, GrADS, MICAPS all support gridded data.

As contour analysis and display is a primary method to process the gridded data, MeteoExplorer provides the “Contour Analysis and Display” dialog (Figure 6-5 on page 75) to help accomplish these tasks. In section 错误！未找到引用源。 (page 错误！未定义书签。) and section 7.2 (page 88), a number of features of contour analysis and display has been described. This chapter will demonstrate all the features with comprehensive real-world examples.

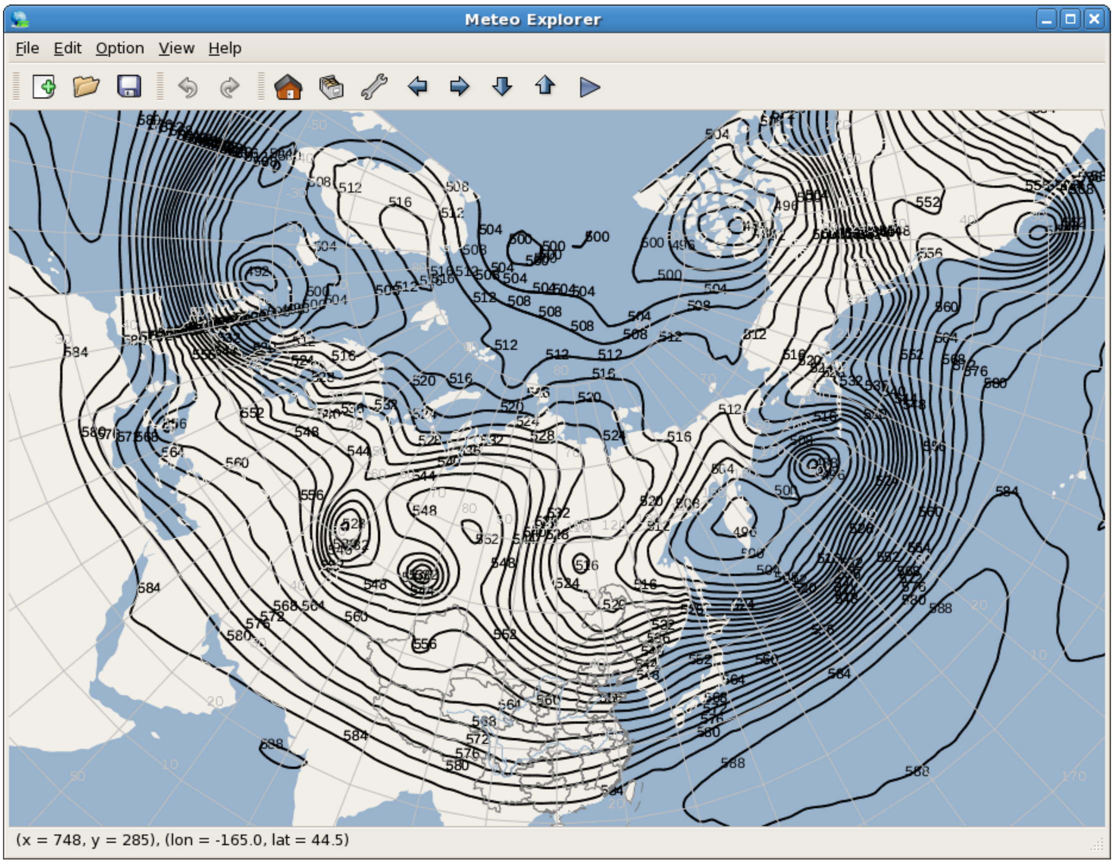


Figure 10-1: Contours of 24-hour forecast of 500hPa geopotential height gridded field at zero o’clock on December 12, 2011

To open the “Contour Analysis and Display” dialog, one first has to open a gridded meteorological data file with supported encoding formats including GRIB1/GRIB2, NetCDF, GrADS, and MICAPS type-4. These files are usually created by a numerical model program. A graphics layer will be created to serve as the graphical representation of the data file. Select this layer in the "Graphics Layer" window, and then click the "Properties" button. For the graphics layer created from a universal model data file, one should select the level-two sub-layer instead of the level-one layer. The concept of sub-layer can be referenced in section 3.5.1 on page 29.

10.1 Configure Geographic Range for Isoline Analysis

In "Contour Analysis and Display" dialog, the initial values of the controls "Start Longitude", "End Longitude", "Start Latitude", and "End Latitude" are obtained from the geographic range of the corresponding layer representing the gridded data file. For example, Figure 10-1 shows the contours of 24-hour T639 forecast of 500hPa geopotential height field at zero o'clock on December 12, 2011, and Figure 10-2 shows the corresponding "Contour Analysis and Display" dialog.

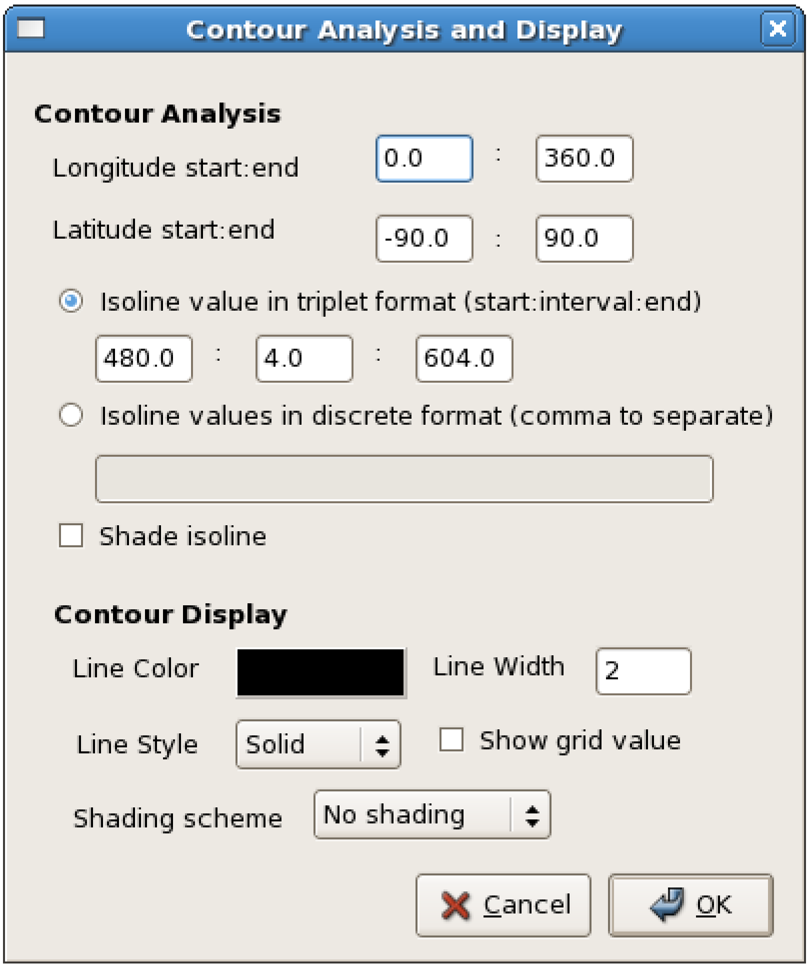


Figure 10-2: "Contour Analysis and Display" dialog corresponding to the graphics layer shown in Figure 10-1.

As can be seen from Figure 10-2, the geographic range of T639 numerical model output gridded field is global, with longitude value between 0 and 360 degrees and a latitude value between -90 and 90 degrees. Users can change the geographic range by modifying the values in "Start Longitude", "End Longitude", "Start Latitude", and "End Latitude" control. Take Figure 10-3 for instance, the geographic range is reduced to 0~180E and 0-80N, the area including European and Asia. The analytic contours are shown in Figure 10-4.

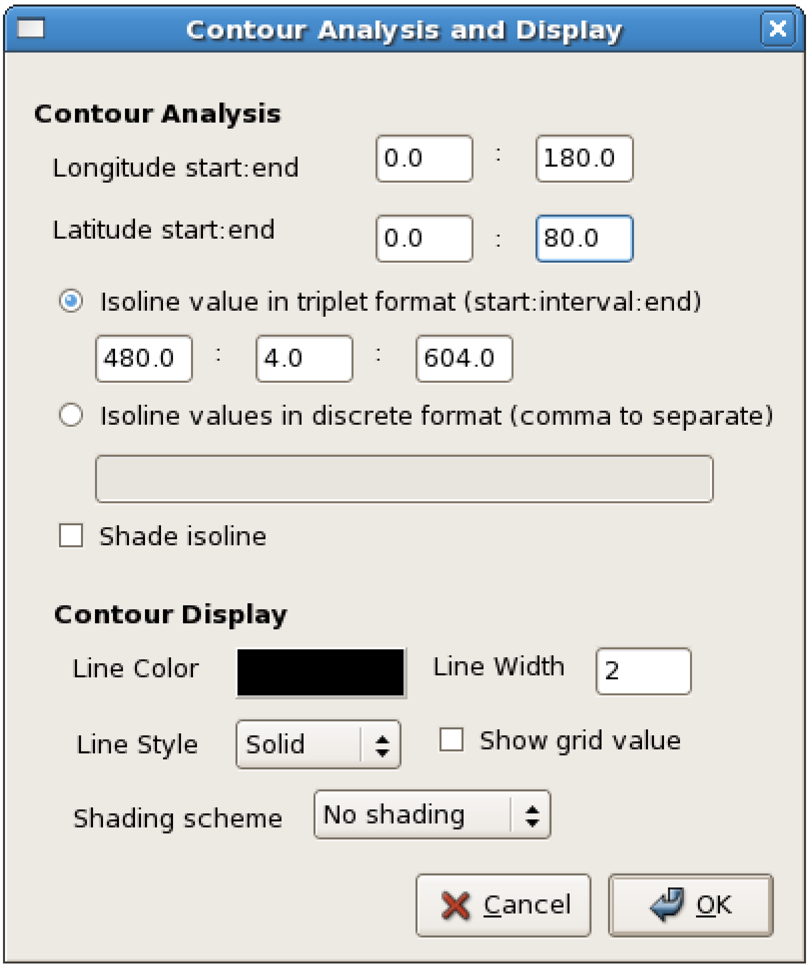


Figure 10-3: As an example, the geographic range is reduced to 0~180E and 0-80N, the area including European and Asia.

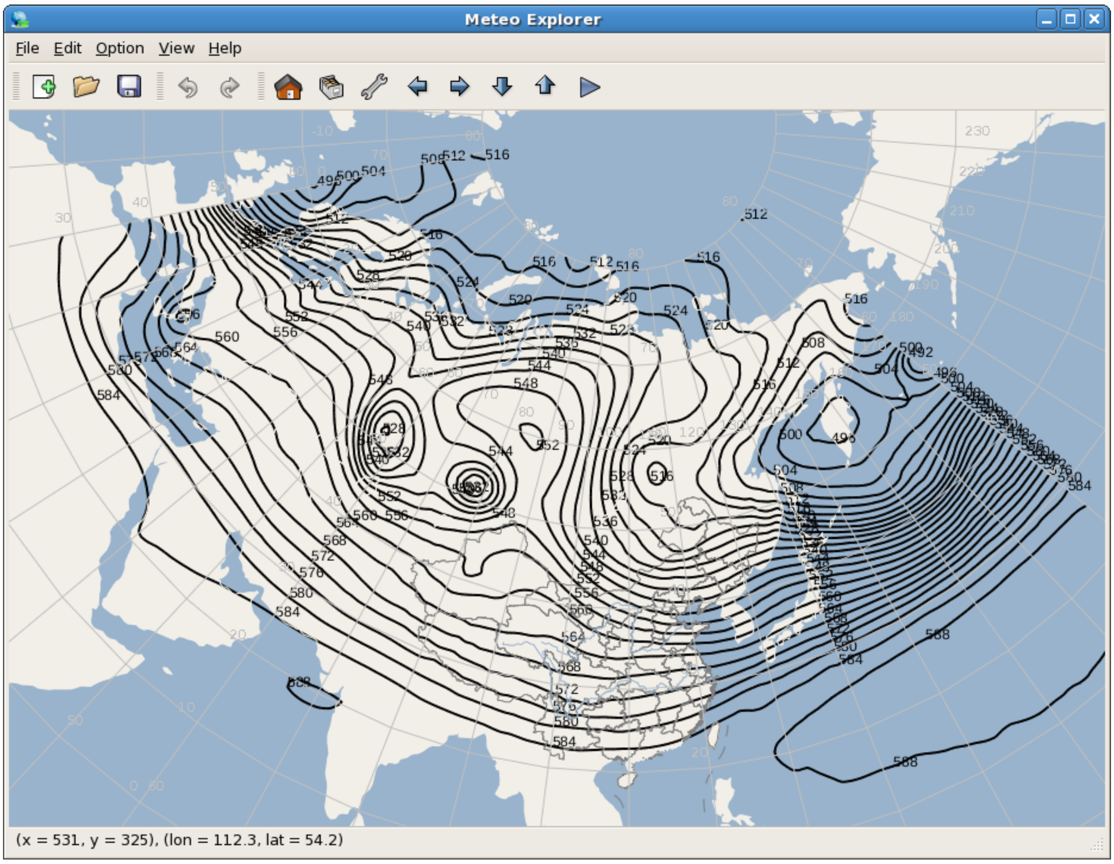


Figure 10-4: The analytic contours are confined to the area encompassing European and Asian.

10.2 Configure Isoline Analysis Values

In MeteoExplorer, there are two ways for users to specify the isoline analysis values. The first way is set the isoline values by specifying start, increment, and end values. This method is suitable for the case where the difference between two consecutive isoline values is a constant and the range of isoline values is large. The second way is to set the isoline values by explicitly specifying them one by one. This method is usually used in the case that users are interested only in a small number of isoline values. For example, in summer, forecasters usually need to locate the subtropical high by specifying the isoline value to 588 10-meters, and find the high temperature area by setting the isoline value to 40 Celsius degrees.

Figure 10-5 gives an illustration in which users specify the isoline values to be 568, 576, and 584 10-meters. Note that one should separate values with commas. The analytic result is shown in Figure 10-6.

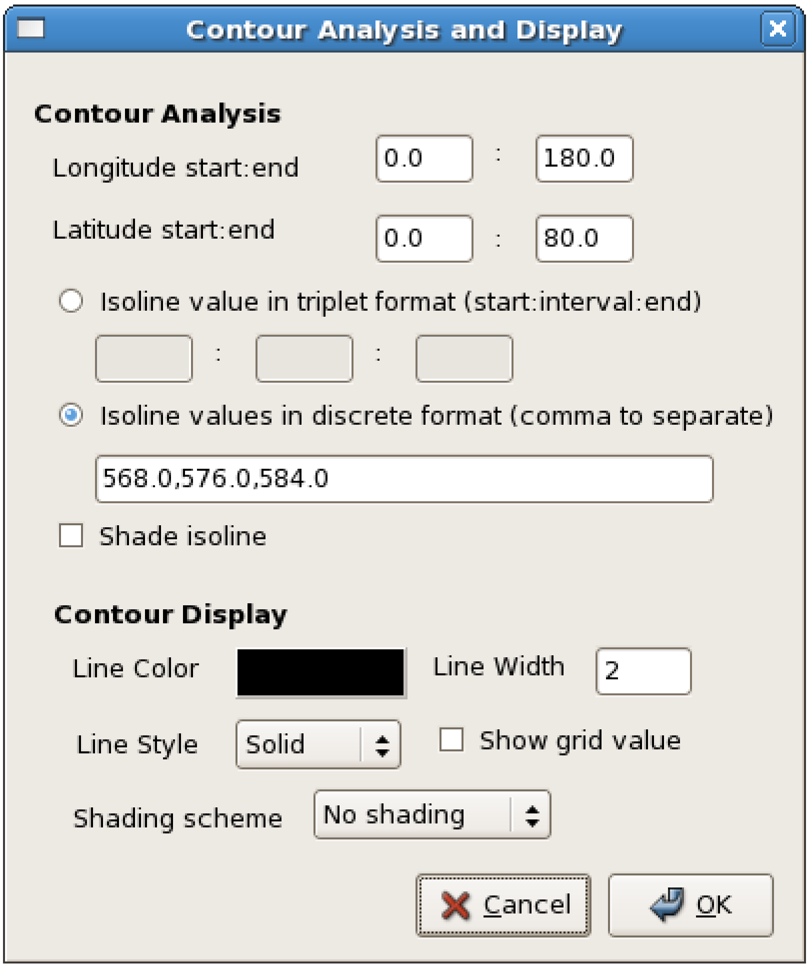


Figure 10-5: In MeteoExplorer, there are two ways for users to specify the isoline analysis values. The first way is set the isoline values by specifying start, increment, and end values. The second way is to set the isoline values by explicitly specifying them one by one.

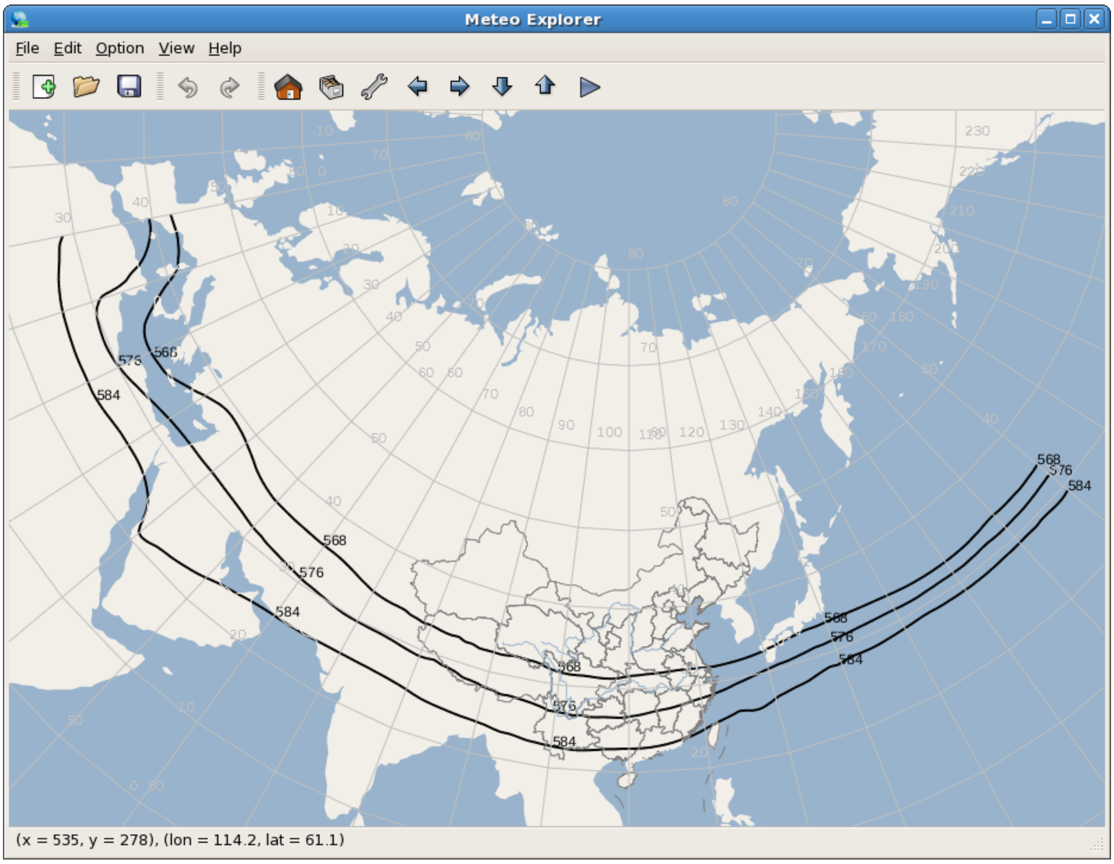


Figure 10-6: The analytic isolines when users specify values of 568, 576, and 584 10-meters.

10.3 Configure Isoline Display Properties

In “Contour Analysis and Display” dialog, users are able to change the isoline display properties including color, width, and style. By assigning different properties to different graphics layers, it is more convenient for users discriminate between multiple layers or quickly find the weather elements of interested. This feature is more helpful when the current theme is “Publishing” (see reference to section 4.2 (page 46).

Figure 10-7 shows a 500hPa geopotential height field along with a temperature field of T639 model at zero o’clock on December 31, 2012. Since all the graphics objects are rendered in gray scale under “Publishing” theme, the properties such as line width and style become the primary attributes that differentiate layers from each other. Take Figure 10-7 for example, the contour of geopotential height is drawn in thin solid lines, while the contour of temperature is drawn in thick dashed lines.

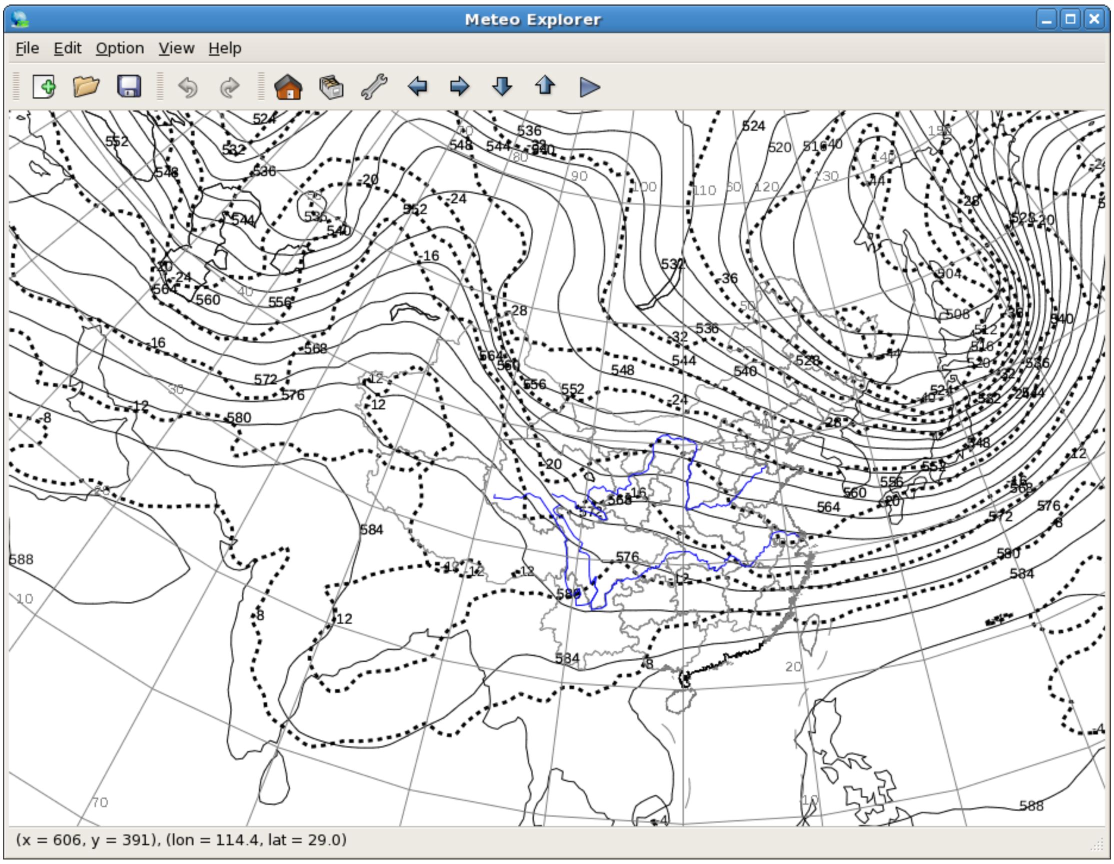


Figure 10-7: The contour properties such as line width and style may help users to differentiate graphics layers from each other.

10.3.1 Isoline Shading

Shading is an alternative output type for isoline graphics. In MeteoExplorer, users can choose to shade the isoline with the “Shade isoline” control in “Contour Analysis and Display” dialog.

Compared to the isoline analysis, the result of isoline shading depends on the order of isoline values users have specified. Usually users specify isoline analysis values in increasing order. This works fine for most of the gridded field, where grid points with small values take up most of the space and grid points with large values residing inside the field like small hills. Figure 7-9 on page 93 is one of such examples.

However there are a couple of weather elements whose grid point value distribution takes on an opposite characteristics. A special case is that grid points with large values take up most of the space and grid points with small values residing inside the field like small upside-downed hills. In practice, a contour analysis with increasing analysis values for such as grid point value distribution usually does not yield satisfactory result. Figure 10-9 gives an illustration of isoline shading of geopotential height on iso-potential vorticity (PV) surface. The data is actually the geopotential height on potential vorticity surface with 2 PV units at six o’clock on January 2, 2010. The isoline analysis parameters are given in Figure 10-8, that is the start, increment, end value are 450, 50, 950 10-meters.

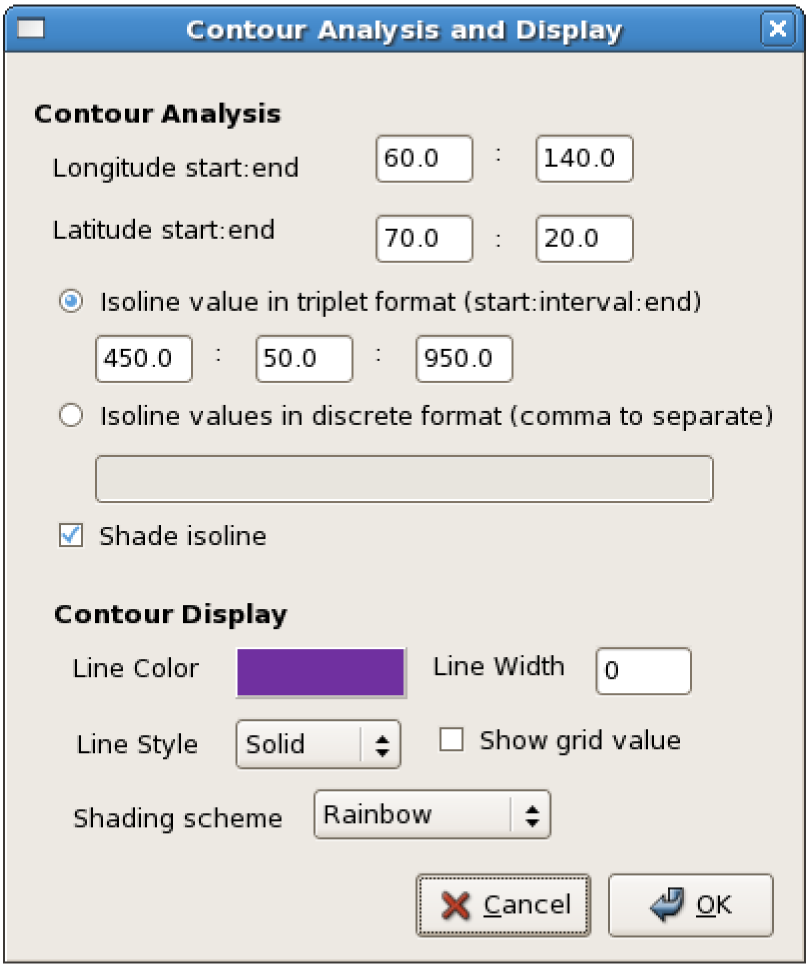


Figure 10-8: The isoline analysis parameters for the shaded contour shown in Figure 10-9.

It can be seen from Figure 10-9 that for the gridded field of geopotential height on iso-potential vorticity surface, the values of most of the grid points are large. This characteristic corresponds to the fact the most of the shaded contour is covered with dark red color, which represents the large value. This shaded contour is usually not what users expect.

To deal with this issue, developers of MeteoExplorer managed to improve the isoline shading algorithm and proposed a two-way isoline shading algorithm. In the new algorithm, isoline tracking can be processed in both increasing and decreasing order.

It should be noted that the region where the grid point value is larger than first analysis value is not shaded. Therefore, if the user does not want the area with large grid point values to be shaded, she can specify a lager value as the starting isoline analysis value, or equivalently specify isoline analysis values in decreasing order. In Figure 10-10, the start, increment, end value are 950, -50, 450 10-meters respectively.

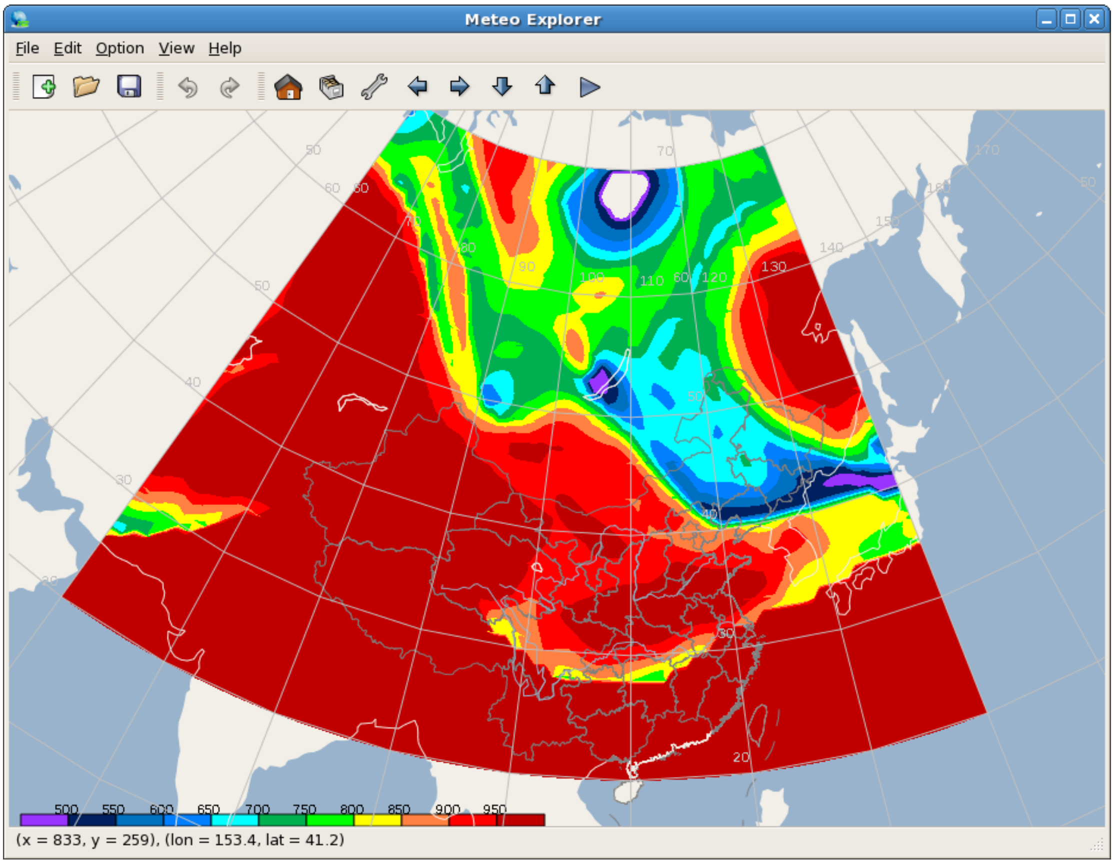


Figure 10-9: Shaded contour of geopotential height on iso-potential vorticity (PV) surface with 2 PV units.

Tip: For a gridded field in which the values of most of the grid points are large, users are recommended to specify isoline analysis values in decreasing order so that the large-value regions won't be shaded.

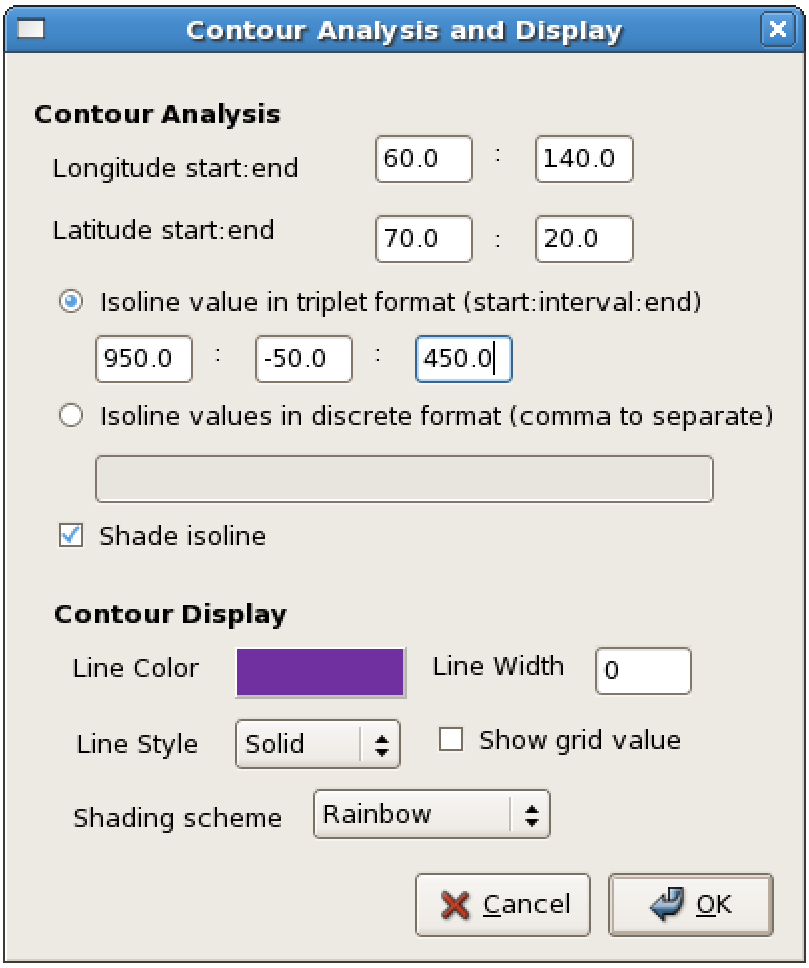


Figure 10-10：For a gridded field in which the values of most of the grid points are large, users are recommended to specify isoline analysis values in decreasing order.

Figure 10-11 shows the shaded contour of the same grid field analyzed in Figure 10-9 but with decreasing isoline analysis values as shown in Figure 10-10.

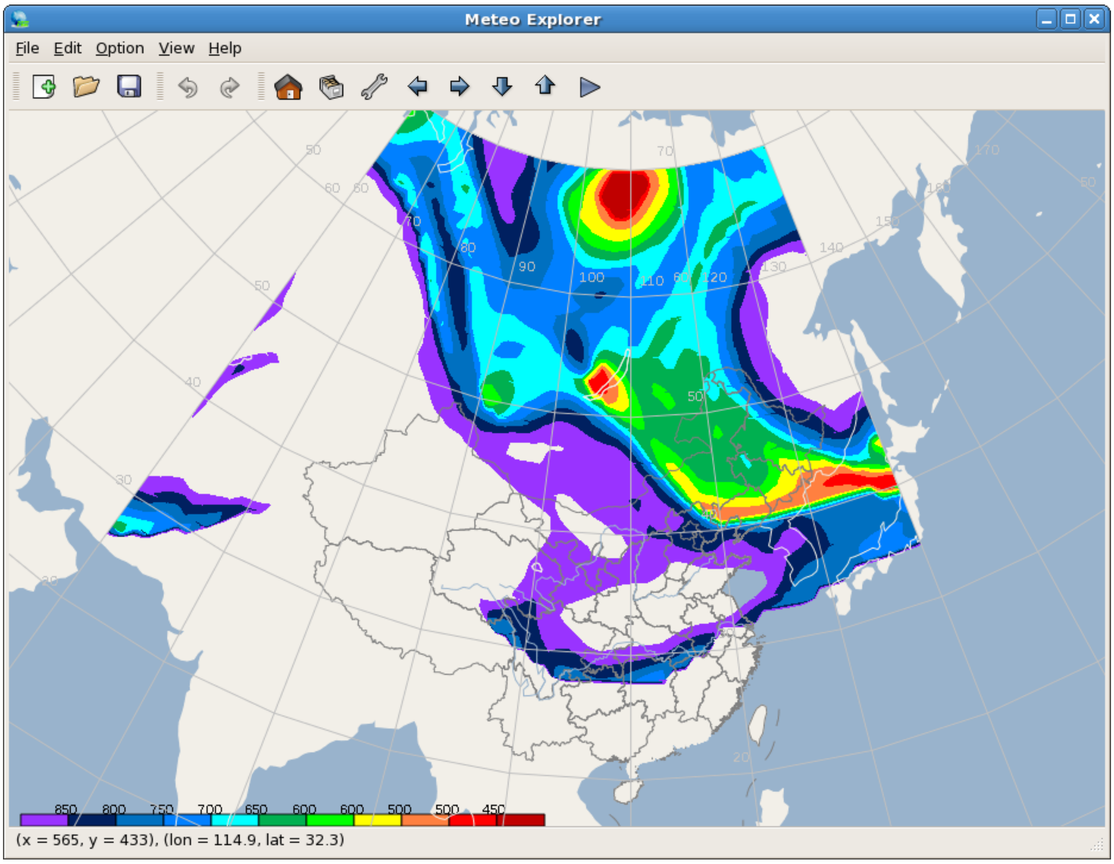


Figure 10-11: shaded contour of the same grid field analyzed in Figure 10-9 but with decreasing isoline analysis values.

10.4 Smoothing

It is a common practice to smooth the gridded field before perform isoline analysis in order to obtain a visually pleasing result. In addition, for high resolution gridded data, smoothing the field help to remove the roughness in the analytic isolines.

MeteoExplorer provides three smoothing methods: “Five Points”, “Nine Points”, and “Gaussian Weighted”. To select a method, choose a candidate item from the “Smoothing” combo box control in “Contour Analysis and Display” dialog.

As an illustration, Figure 6-11 (page 81) shows the analytic contour of 100hPa potential temperature (in red solid lines) and 700hPa stream lines (in yellow lines) of a WRF model output file. Since the spatial resolution of the model is as high as 0.24×0.24 degrees, there is a pronounced jagged effect in the analytic contour. Figure 10-12 shows analytic contour of 100hPa potential temperature with a Gaussian smoothing before the isoline tracking. Compared to the result of Figure 6-11, the analytic contour is far more smooth and elegant.

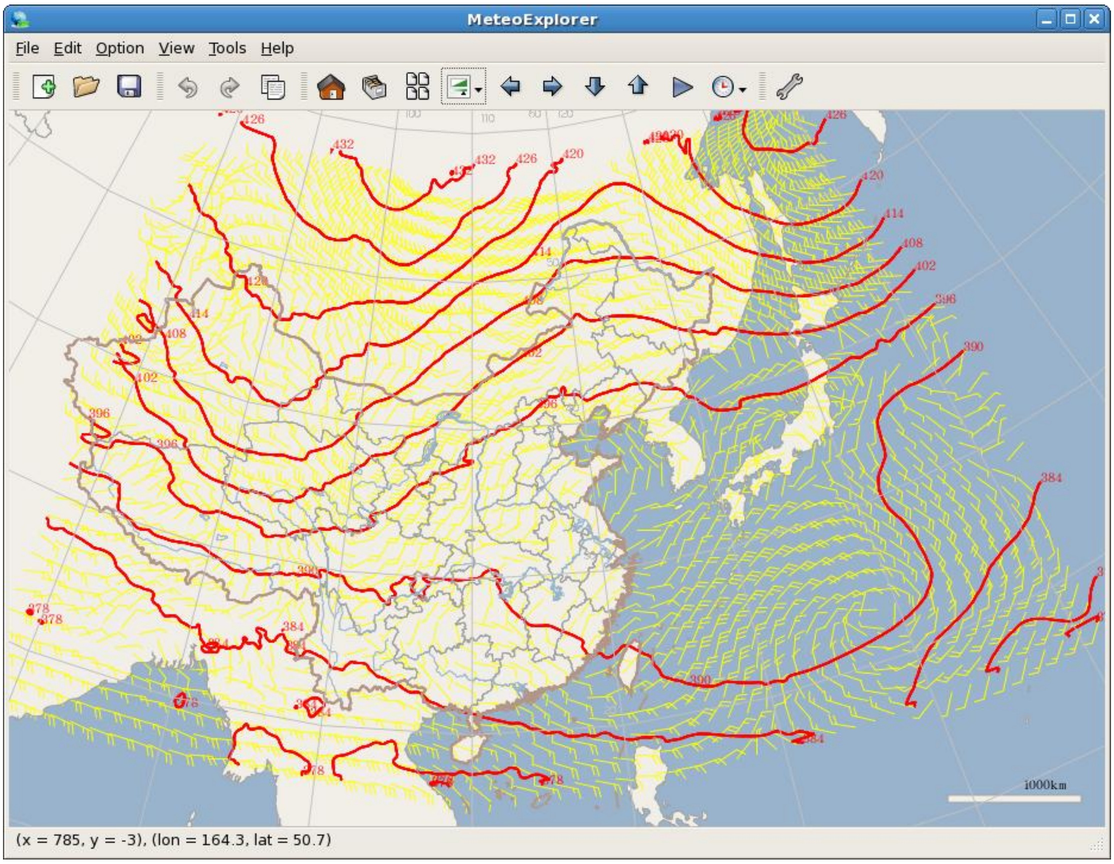


Figure 10-12: The analytic contour of 100hPa potential temperature with a Gaussian smoothing before the isoline tracking. Compared to the result of Figure 6-11, the analytic contour is far more smooth and elegant.

10.5 Show Grid-Point Values

To show numerical values of grid points, one may select the "Show Grid-Point Values" checkbox control in the "Contour Analysis and Display" dialog. Figure 10-13 gives an illustration that the grid point values of a 500hPa temperature field are shown along with the contour.

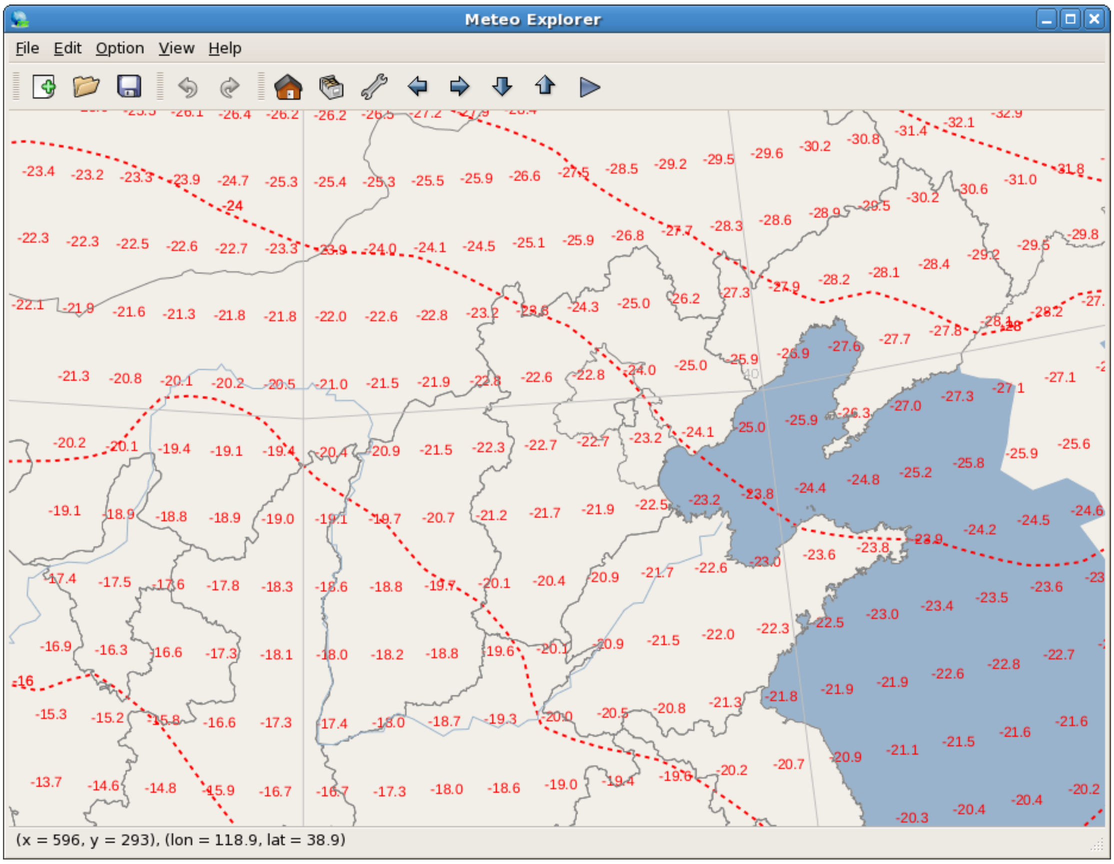


Figure 10-13: To show numerical values of grid points, one may select the “Show Grid-Point Values” checkbox control in the “Contour Analysis and Display” dialog.

Chapter 11 Vertical Soundings Data Analysis and Display

MeteoExplorer 支持 MICAPS 第 5 类数据和 L 波段探空数据。

11.1 Soundings Analysis Window Layout

当您打开 MICAPS 第 5 类数据或者 L 波段探空数据文件后，MeteoExplorer 会自动打开如图 11-1 所示的探空分析（Soundings Analysis）窗口。

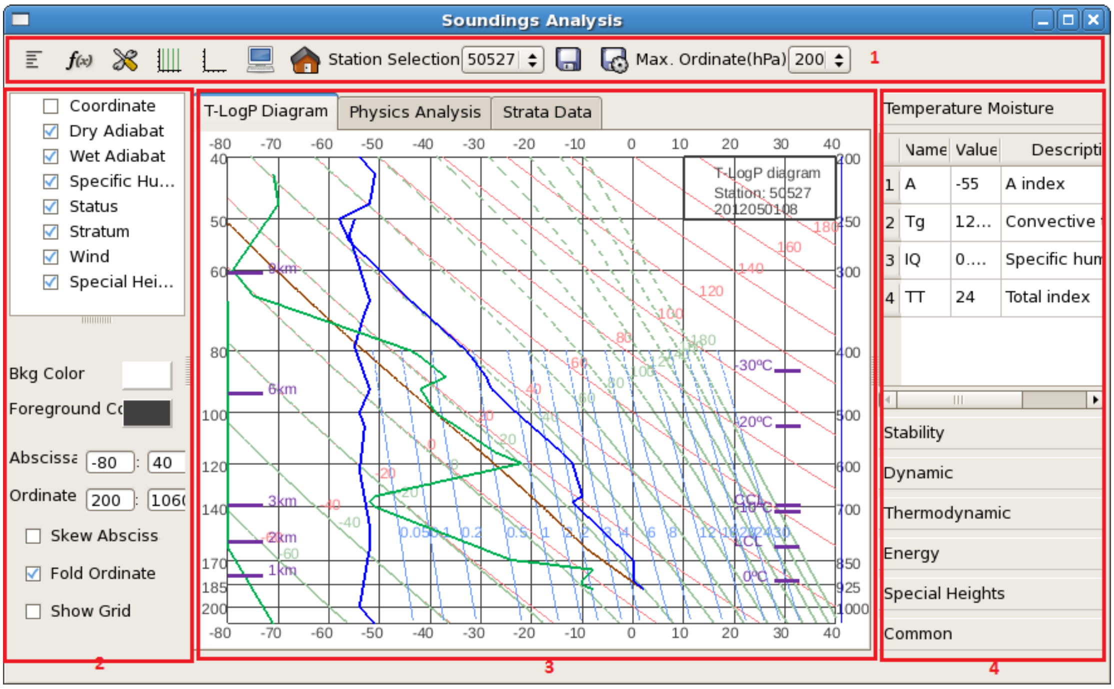


图 11-1：探空分析窗口默认布局由五个部分组成：最上端的工具栏（1），下面从左至右依次为：要素显隐选择与属性设置子窗口（2），探空数据显示子窗口（3），和物理量数值列表显示子窗口（4）。此外，还有风矢显示子窗口。

尽管探空分析窗口界面比较复杂，我们可以将其分为图中标记的五个部分：

1. 工具栏；
2. 探空要素显隐选择与属性设置子窗口；
3. 探空数据显示子窗口；
4. 物理量数值列表显示子窗口；
5. 此外，还有如图 11-2 所示的风矢显示子窗口，该子窗口默认设置下不显示。

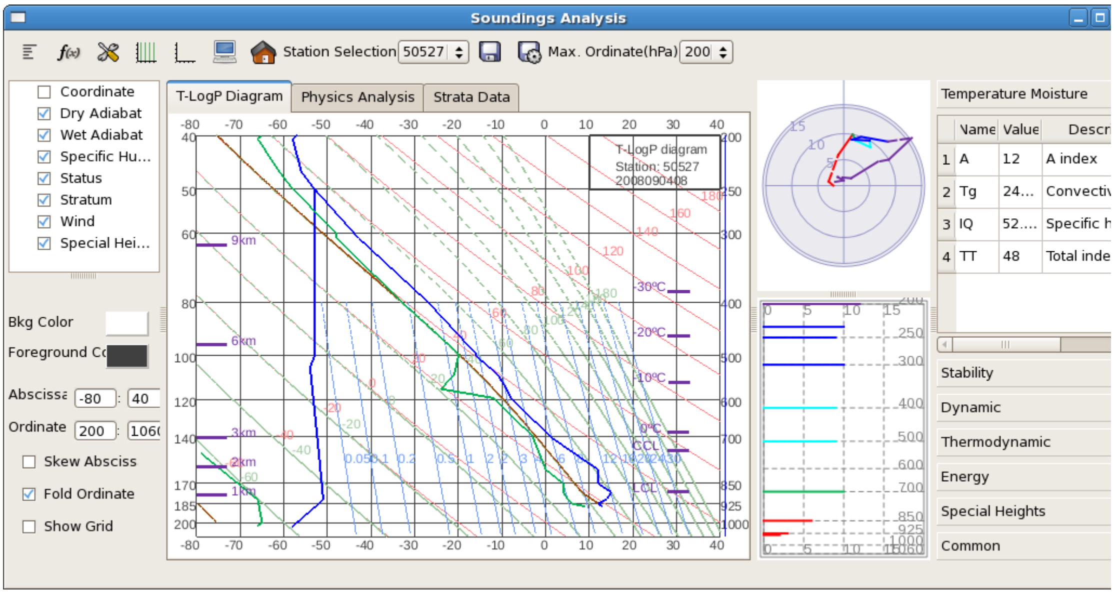


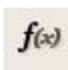
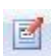
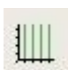
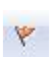
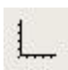
图 11-2：风矢显示子窗口位于探空数据显示子窗口的右侧，该子窗口默认设置下不显示，然而用户可以通过工具栏中的“显示/隐藏风矢窗口”按钮来显示给窗口。

下面具体介绍各个子窗口所提供的功能。

11.1.1 Toolbar

探空分析窗口的工具栏位于窗口的标题栏下方，它提供了完成常用命令的控件。表 11-1 对工具栏中所有控件的功能进行了总结。

表 11-1：探空分析窗口的工具栏中所有控件的功能。

控件名称	Windows 版本中控件图像	Unix/Linux 版本中控件图像	控件功能
显示/隐藏风矢窗口			显示/隐藏风矢窗口。
显示/隐藏物理量窗口			显示/隐藏物理量窗口。
显示/隐藏属性设置窗口			显示/隐藏属性设置窗口。
直斜转换			控制对数压力图中横坐标温度刻度线是沿垂直方向还是倾斜方向。
纵坐标折叠			控制是否在对数压力图中纵坐标范围内显示两个压力范围。
窗口背景颜色			将探空数据显示子窗口的背景颜色在黑色和白色之间切换。

默认视图			将对数压力图的大小和位置还原到初始状态。
复制到剪贴板			将窗口显示的内容以矢量图形格式复制到剪贴板（Windows 版本）。或者窗口显示的内容保存为图片文件（Unix 版本）。
保存到文件			将当前的探空数据保存到文件。
测站选择			选择分析、显示数据所对应的站点。

由表可以看出，除了探空数据显示子窗口之外，其它三个子窗口的可见状态都可以被设置。图 11-3 给出了只显示探空数据显示子窗口时的屏幕截图。

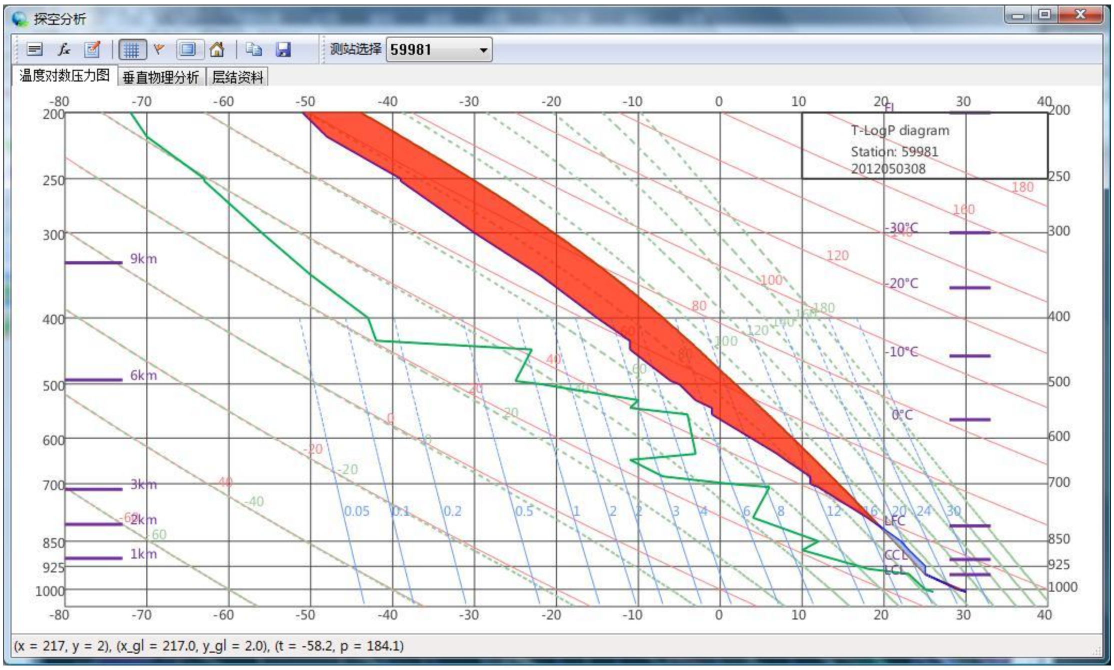
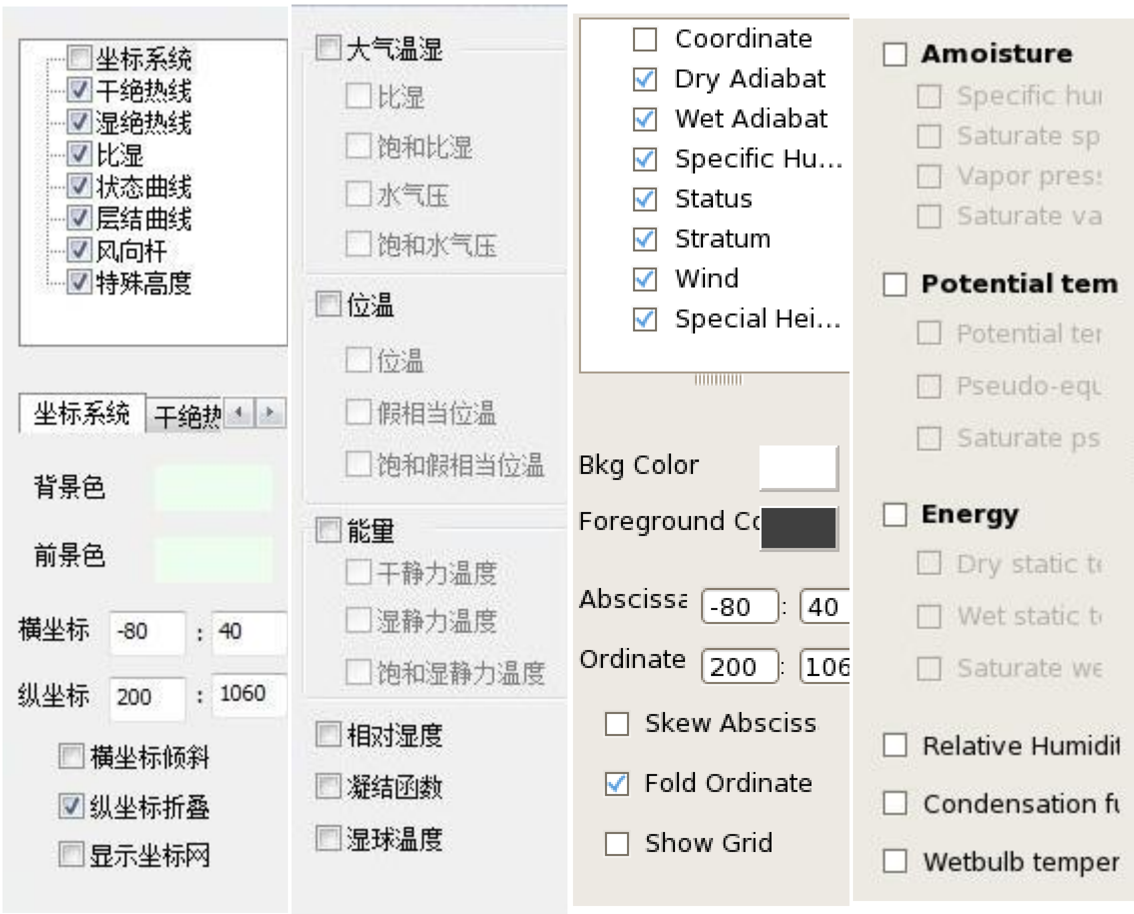


图 11-3：在探空分析窗口中，除了探空数据显示子窗口之外，其它三个子窗口的可见状态都可以根据需要进行显示或者隐藏。

11.1.2 Elements Selection and Properties Configuration

如图 11-1 所示，要素显隐选择与属性设置子窗口位于探空分析窗口的最左侧，这个窗口实际上又包括了两个子窗口：对数压力图子窗口（图 11-4 中 A 和 C）和物理量子窗口（图 11-4 中 B 和 D）。其中 A、B 为 Windows 版本中的设计，C、D 为 Unix 版本中的设计。



A　　B　　C　　D

图 11-4：要素显隐选择与属性设置子窗口又包括了两个子窗口：对数压力图子窗口和物理量子窗口。在程序运行期间，这两个子窗口只有一个是可见的。

在程序运行期间，对数压力图属性设置子窗口和物理量属性设置子窗口只有一个是可见的，其可见状态由探空数据显示子窗口中的显示内容而定。当探空数据显示子窗口显示对数压力图时，对数压力图属性设置子窗口处于可见状态（如图 11-2 所示）；当探空数据显示子窗口显示物理量时，则物理量属性设置子窗口处于可见状态（如图 11-5 所示）。

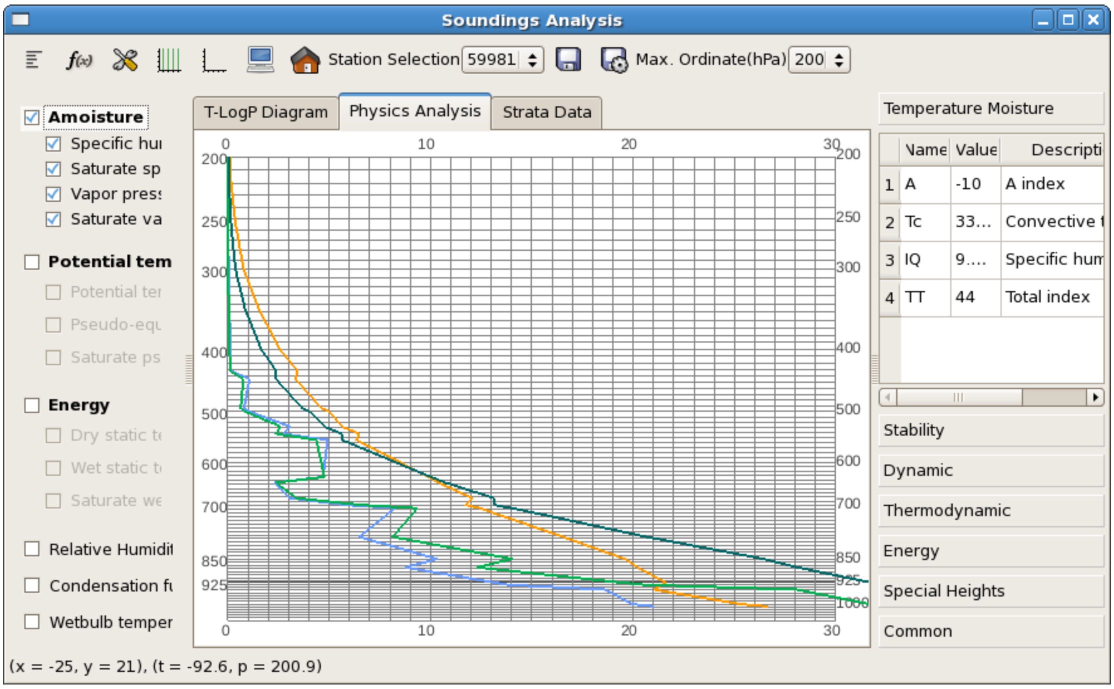


图 11-5：当探空数据显示子窗口显示物理量时，则物理量属性设置子窗口处于可见状态。

对数压力图属性设置子窗口（图 11-4 中 A 或 C）上方是一个树形控件，它提供了显示或者隐藏某一显示要素的功能，这些显示要素有：

- 对数压力图坐标系；
- 干绝热线；
- 湿绝热线；
- 比湿；
- 状态曲线；
- 层结曲线；
- 风向杆；
- 特殊层高度。

选中的要素在探空数据显示子窗口中显示，否则将不被显示。当用鼠标单击树形控件中的某一要素时，对数压力图属性设置子窗口下方会显示出被选中要素对应的属性设置控件。例如在图 11-4A 中，当选中“坐标系统”要素后，方法会出现背景色、前景色、纵坐标、横坐标范围、纵坐标折叠等选项。

与对数压力图属性设置子窗口相比，物理量属性设置子窗口（图 11-4B）比较简洁，当选中某一要素后，该要素将在探空数据显示子窗口中显示，这些物理量要素可以分为六类：

- 大气温湿（包括比湿、饱和比湿、水气压和饱和水气压）
- 位温（包括位温、假相当位温、饱和假相当位温）
- 能量（包括干静力温度、湿静力温度和饱和湿静力温度）
- 相对湿度
- 凝结函数
- 湿球温度

11.1.3 Soundings Data Display Window

探空数据显示子窗口位于探空分析窗口的中部，该子窗口又包括了三个页面：

- 对数压力图（T-LogP Diagram）页面（图 11-2）；
- 物理量分析（Physics Analysis）页面（图 11-5）；
- 层结数据（Stata Data）页面（图 11-6）；

用户可以点击选项页控件在这三个页面之间切换。

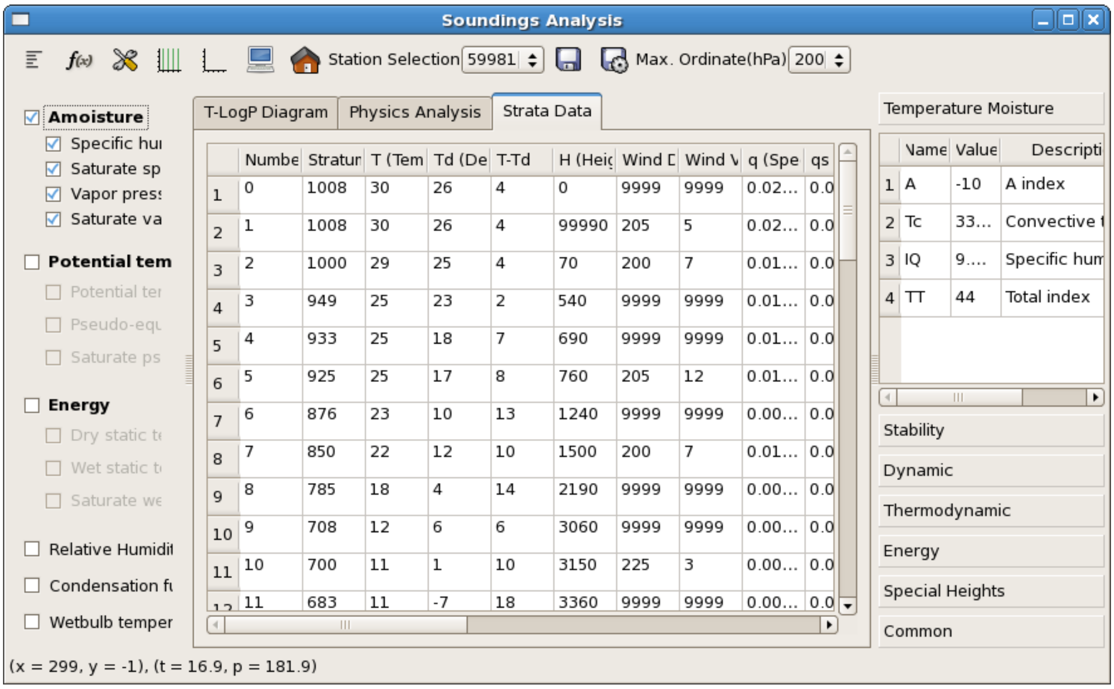


图 11-6：用户可以点击选项页控件在探空数据显示子窗口的三个页面之间切换。本图显示了层结数据页面。

如果当前显示的页面是对数压力图或者是物理量分析图时，当鼠标在图上移动时，鼠标光标所在点的坐标值、及所对应的气压和温度值将显示在最底端的状态栏中。

11.1.4 Wind Velocity Window

风矢显示子窗口（图 11-7）位于探空分析窗口的右侧，在默认设置下处于隐藏状态，用户可以通过点击工具栏中的“显示/隐藏风矢窗口”按钮使之处于可见状态。风矢显示子窗口的上方是风向盘，半径表示风速，绘制的折线表示风向，折线的每一段代表一个层次。折线的颜色表示层次范围，700hPa 以下为红色，500hPa 至 700hPa 为绿色，300hPa 至 500hPa 为浅蓝色，200hPa 至 300hPa 为蓝色，200hPa 以上为紫色。

风矢显示子窗口的下方是风速图，横坐标为风速，纵坐标为层次，风速的大小以线段的相对长度表示。线段的颜色表示层次范围，颜色的选取与风向盘中的颜色配置方案相同。

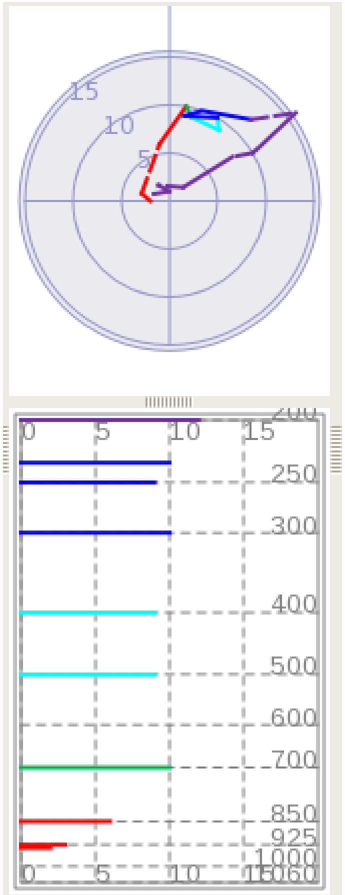


图 11-7：风矢显示子窗口包括上方的风向盘和下方的风速图。

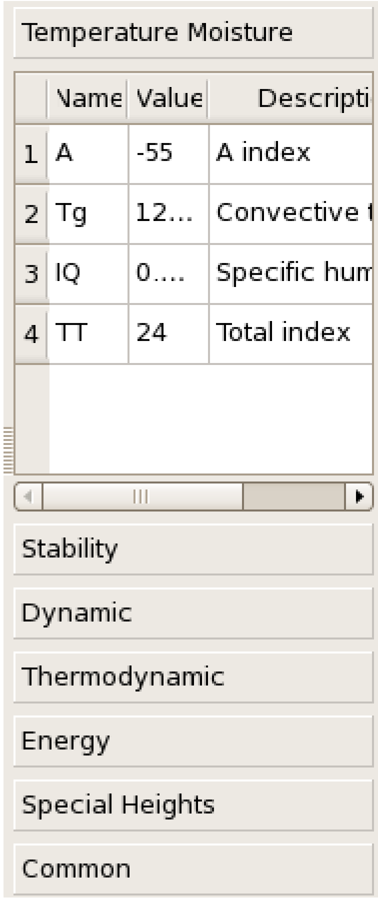


图 11-8：物理量数值列表显示子窗口。

11.1.5 Physics Indices Data Display Window

物理量数值列表显示子窗口（图 11-8）位于探空分析窗口的最右侧。它给出了由当前所选站点的观测值计算得到的物理量数值。这些物理量根据类型分为 6 组，具体说明请见下一节。

11.2 Calculation of Physics Indices

表 11-2 列出了 MeteoExplorer 的探空分析窗口中物理量指数计算列表子窗口中给出的物理量信息，包括其所属类别，常用符号表示，英文名称和中文名称。

表 11-2：MeteoExplorer 物理量指数计算列表窗口中给出的物理量信息。

类别	物理量符号	英文名称	中文名称
大气温湿类（Temperature and Moisture）	A* Tc IQ TT	A index Convective temperature Specific humidity integration Total index	A 指数 对流温度（或对流指数） 整层比湿积分 总指数

层结稳定度类（Stability）	SI*	Showalter index	沙氏指数
	K*	K index	K 指数
	mK	Modified K index	修正 K 指数
	DCI	Mod convection index	修正对流指数
	LI	Lifted index	抬升指数
	SLW		斯拉维指数
	Wd_C	Stationary energy convective stability	静力能对流稳定度
	Wd_D	Dry stationary stability	干静力稳定度
	Wd_L	Stationary energy potential stability	静力能潜在稳定度
	Wd_P	Stationary energy geopotential stability	静力能位势稳定度
	Wd_S	Stationary energy conditional stability	静力能条件稳定度
	BLI	Best lifted index	最大抬升指数
	Faust	Faust index	Faust 指数
	IC	Convective stability index	对流稳定度指数
	ICC	Barber convective stability index	Barber 对流不稳定度指数
	ILC	Conditional convective stability index	条件对流稳定度指数
	JI	Jefferson index	杰斐逊指数
	TMJ	Modified Jefferson index	修正杰斐逊指数
	Teffer	Teffer index	Teffer 指数
	ChTT	Charba total index	Charba 修正总指数
	mKO	Second K index	第二 K 指数
	Shr	Shear of Richardson number	粗理查逊数切变
	Ls	Dry warm cover index	干暖盖指数
动力类（Dynamic）	w_cape*	Maximum rising velocity	最大上升速度
	w_cin	Maximum inhibitive rising velocity	最大抑制上升速度
	Wm	Cloud maximum rising velocity	云中最大上升速度
	MDPI		潜在下冲气流指数
	VV	Gale index	大风指数
热动力类（Thermodynamic）	SSI*	Storm strength index	风暴强度指数
	SWISS00	First Swiss strom index	瑞士第一雷暴指数
	SWISS12	Second Swiss strom index	瑞士第二雷暴指数
	SWEAT	Strong weather threat	强天气威胁指数
	TQG		通气管指数
	SRH	Storm relative helicity	风暴相对螺旋度
	Dm	Diameter of maximum hail	经验估计最大雹块直径
能量类（Energy）	CAPE*	Convective available	对流有效位能

	CIN* GCAPE EHI BRN WCAPE	potential energy Inhibitive available potential energy Normalized available potential energy Energy helicity index Bold Richardson number Pseudo convective available potential energy	抑制有效位能 归一化有效位能 能量螺旋度 粗理查逊数 伪对流有效位能
特殊高度厚度类（Special Level and Layer）	Dc aa4 aa8 ZH* Zm20H Zm30H LCL_P* LCL_T EL_P* EL_T LFC_P* LFC_T CCL_P CCL_T YDC_P YDC_T Wd_EL Ld_EL Hd_020 Hd_204	 Level of zero Celsius degree Level of -20 Celsius degree Level of -30 Celsius degree Pressure at level of condensation level Temperature at level of condensation level Equilibrium level Temperature at equilibrium level Level of free convection Temperature at level of free convection Convective condensation level Temperature at convective condensation level	Doswell 云厚度 参加对流厚度 参加对流厚度 零度层高度 -20 度层高度 -30 度层高度 抬升凝结高度 抬升凝结处温度 平衡高度 平衡高度处温度 自由对流高度 自由对流高度处温度 对流凝结高度 对流凝结高度处温度 理论云顶高度 理论云顶高度处温度 不稳定 Cape 处宽度 不稳定 Cape 处长度 混合相层 BB 增长层（0 度与-20 度的位势高度差） 混合相层 BB 增长层（-20 度与-40 度的位势高度差）

Chapter 12 Typhoon Track Data Display

MeteoExplorer supports typhoon track data for example MICAPS type-7 data. Figure 12-1 shows the real and forecast track of typhoon WASHI that developed in 2011.

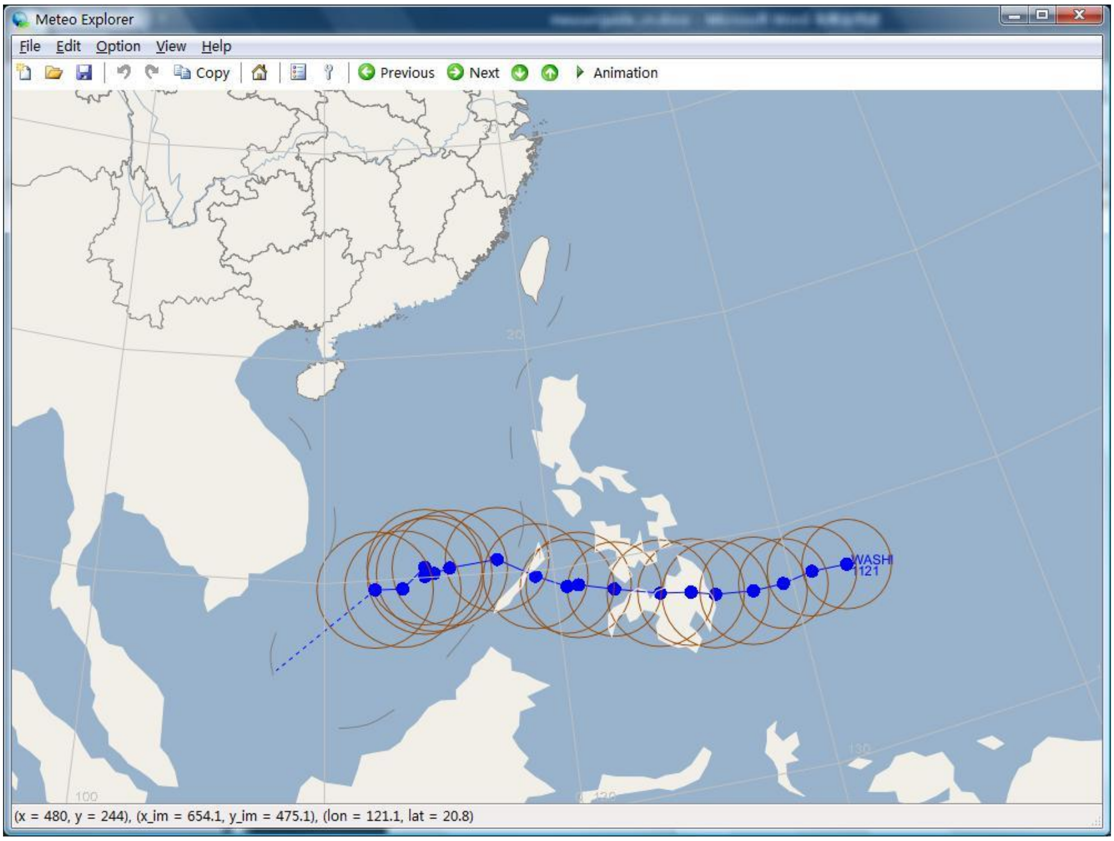


Figure 12-1: The real and forecast track of typhoon WASHI that developed in 2011 is shown in MeteoExplorer.

12.1 Configure Display Properties of Typhoon Track Data

By default, MeteoExplorer shows the typhoon name, number, location, real and forecast track, and seven-scale wind circle. However, users may configure the display properties of a typhoon track layer via "Typhoon Options" dialog as shown in Figure 12-2. Here is a short introduction of each control in the dialog.

- Typhoon Name: show or hide name of the typhoon.
- Typhoon Number: show or hide number of the typhoon.
- Forecast Center: show or hide typhoon forecast center.
- Position: show or hide all the locations on the typhoon track.

- Track: show or hide real track of the typhoon.
- Forecast Track: show or hide forecast track of the typhoon
- Wind scale 7 circle: show or hide seven-scale wind circle of the typhoon.
- Wind scale 10 circle: show or hide ten-scale wind circle of the typhoon.

In addition, one may click the colored button on the right of a typhoon property to open the color picker dialog as illustrated in Figure 7-3 (page 87). This will change the color of the corresponding property shown in the application window.

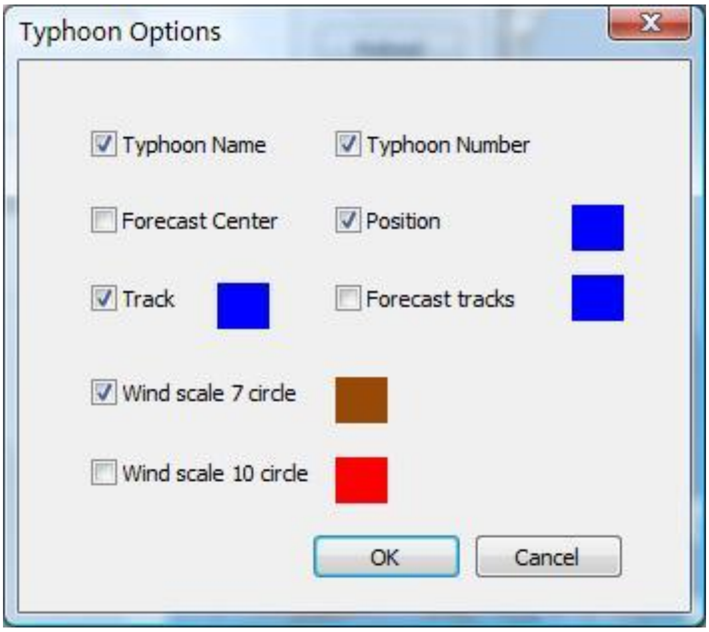


Figure 12-2: Users may configure the display properties of a typhoon track layer via “Typhoon Options” dialog.

Chapter 13 City Forecast Data Display

MeteoExplorer supports MICAPS type-8 data, that is, the city forecast data. Figure 13-1 shows the city forecast at 20 o'clock on June 20, 2010

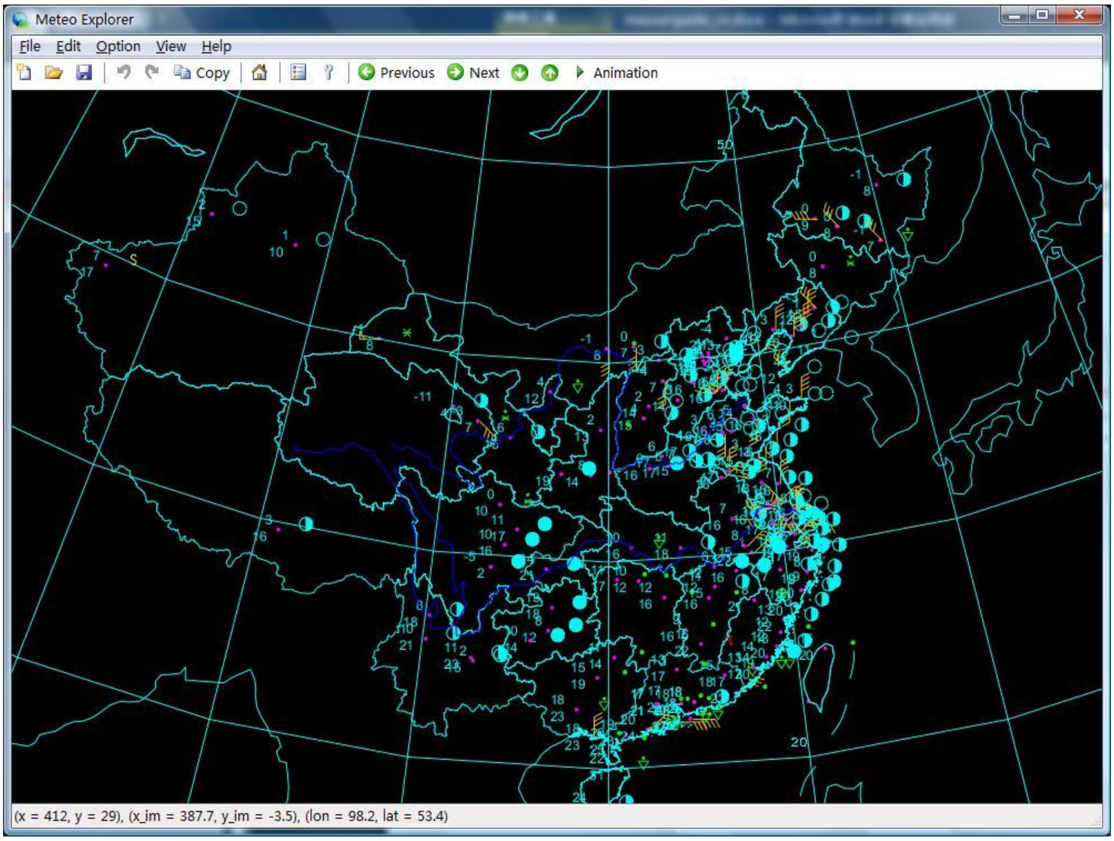


Figure 13-1: MeteoExplorer supports city forecast data.

13.1 Configure Display Properties of City Forecast Data

Users may configure the display properties of a city forecast graphics layer via "City Forecast Options" dialog as shown in Figure 13-2. Here is a short introduction of each control in the dialog:

- 12 Hour Wind and 24 Hour Wind: wind velocity and direction in 12 and 24 hours respectively.
- 12 Hour Weather and 24 Hour Weather: weather phenomenon in 12 and 24 hours respectively.
- Min Temperature and Max Temperature: minimum and maximum temperature in a day.
- Station ID: station identifier.
- Station: geographic location of the station.

In addition, one may click the colored button on the right of a typhoon property to open the color picker dialog as illustrated in Figure 7-3 (page 87). This will change the color of the corresponding property shown in the application window.

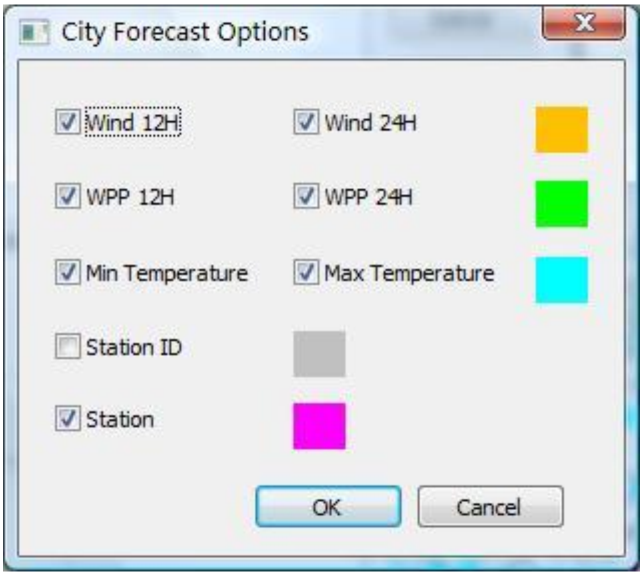


Figure 13-2: Users may configure the display properties of a city forecast graphics layer via “City Forecast Options” dialog.

Chapter 14 Streamline Data Analysis and Display

For wind field, MeteoExplorer provides three output types including stream line, wind barb, and wind arrow. In addition, the application let users calculate derived physical elements like divergence, vorticity, and isotachs.

14.1 Configure Display Properties of Streamline Data

Figure 14-1 shows the 850hPa wind field in stream line output form of a NCEP FNL (final) analysis data set at zero o'clock UTC on January 1, 2010.

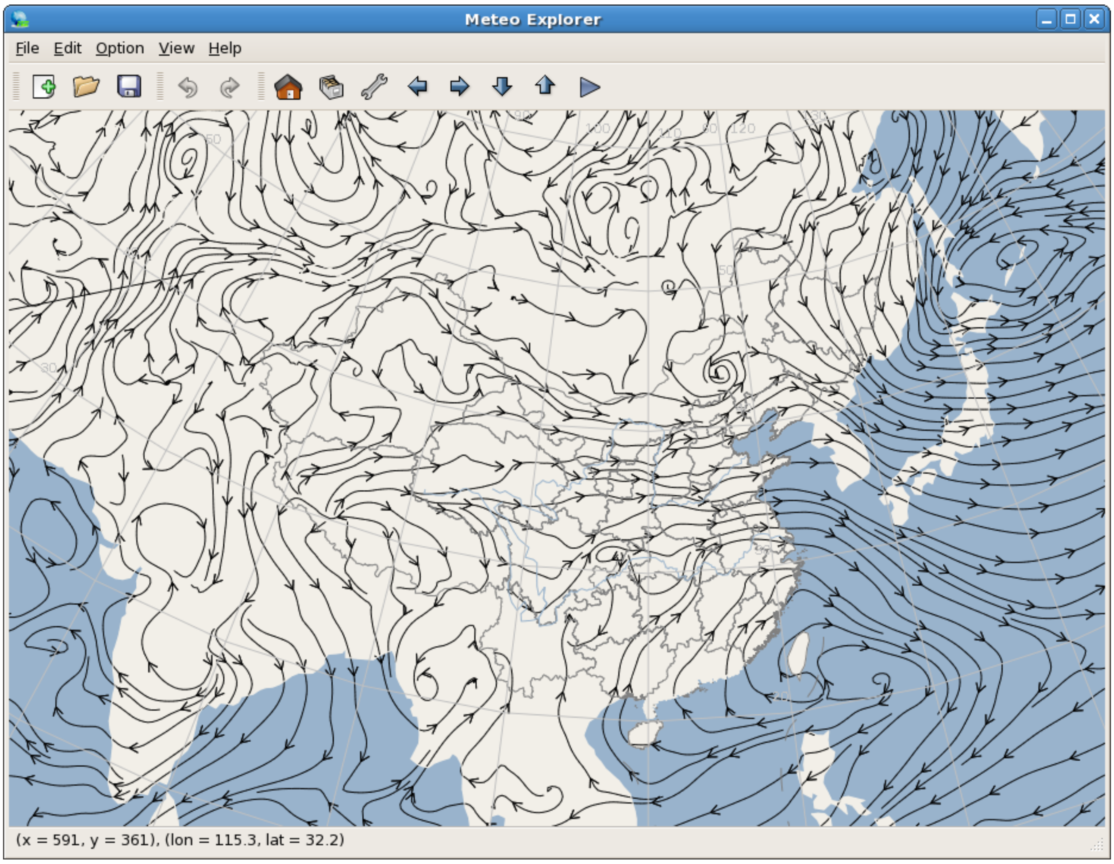


Figure 14-1: MeteoExplorer shows a wind field from a NCEP FNL (final) analysis data set in stream line output form.

To modify the display properties of the wind field graphics layer, please select the layer in the "Graphics Layer" window, and then click the "Properties" button. This operation will open the "Streamline Options" dialog as shown in Figure 14-2.

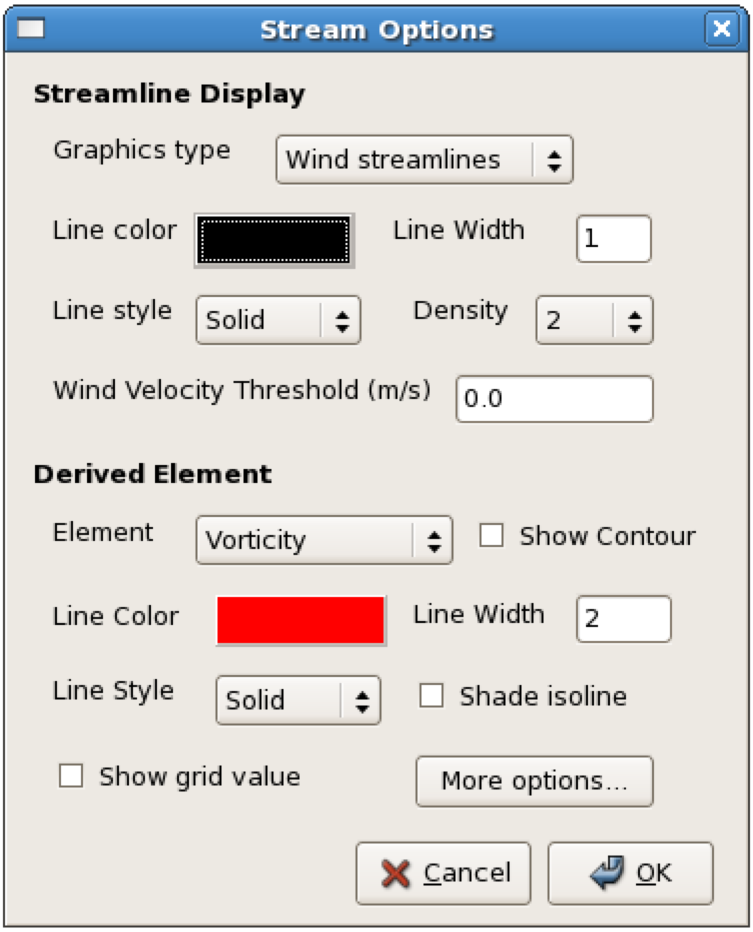


Figure 14-2: MeteoExplorer provides the "Streamline Options" dialog for users to configure display properties of wind field graphics layer.

The "Streamline Options" dialog (Figure 14-2) consists of two parts. The top part is named "Streamline Display" and the bottom part is named "Derived Element".

Here is a detailed explanation of each control in the "Streamline Display" group:

- Graphics Type. MeteoExplorer supports three output forms of a wind field, including streamline, wind barbs, and wind vector arrows. Figure 14-1 and Figure 14-4 shows the streamline output, Figure 14-3 shows the wind arrow output, and Figure 14-5 illustrates the output of wind barbs.
- Streamline Color, Streamline Width, and Streamline Style. These properties also apply in wind barb and wind vector arrow output forms.
- Density. There are four density levels for streamline output represented from 1 to 4, where 1 represents the least density, and 4 represents the largest density. Figure 14-3 and Figure 14-4 shows the wind vector arrow output with density value of 2 and streamline output with density value of 4 respectively.
- Skip Grid Count. The number of grids that are skipped when drawing the wind barbs or wind vector arrows, that is, every "Skip Grid Count" grid is drawn. For example, when the skip grid count is 4, only the first, fifth, ninth … grids are drawn. This option is usually use for high-resolution wind field to avoid clutter of too many wind symbols.
- Wind Velocity Threshold (m/s). This option applies in wind barb and wind vector arrow

output type. Only the grids whose wind velocity is larger than the threshold are drawn. Figure 14-5 shows the wind barbs output when the wind velocity threshold is 10 m/s.

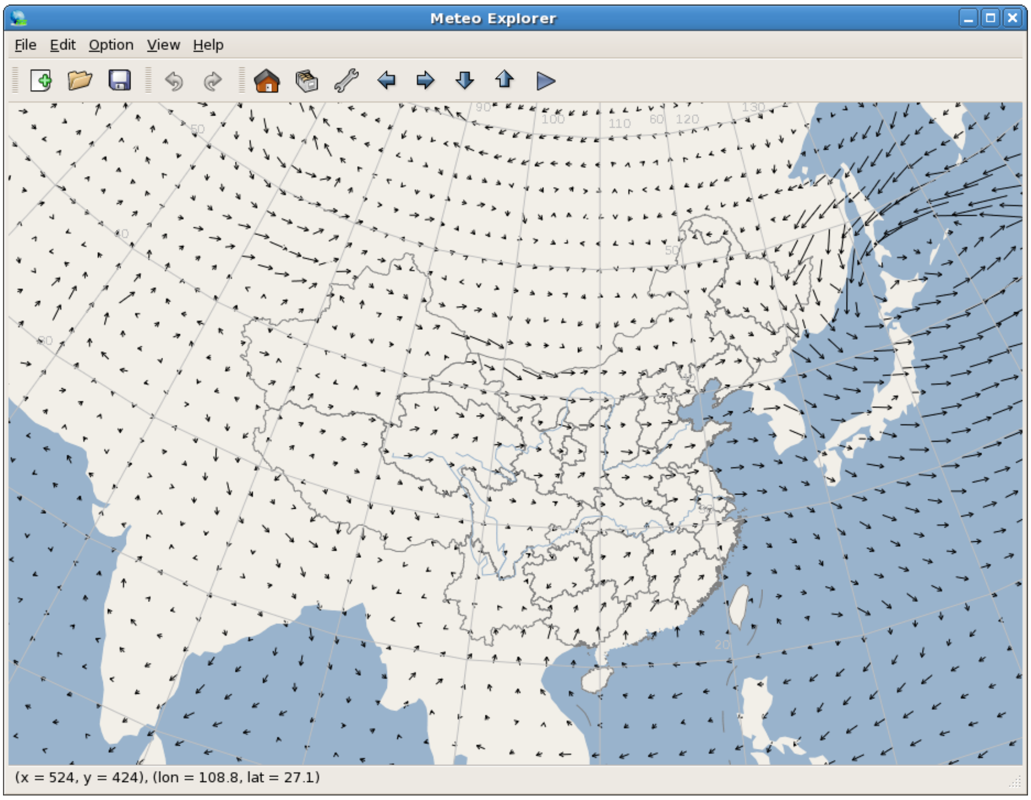


Figure 14-3: Wind vector arrow output with a density value of 2.

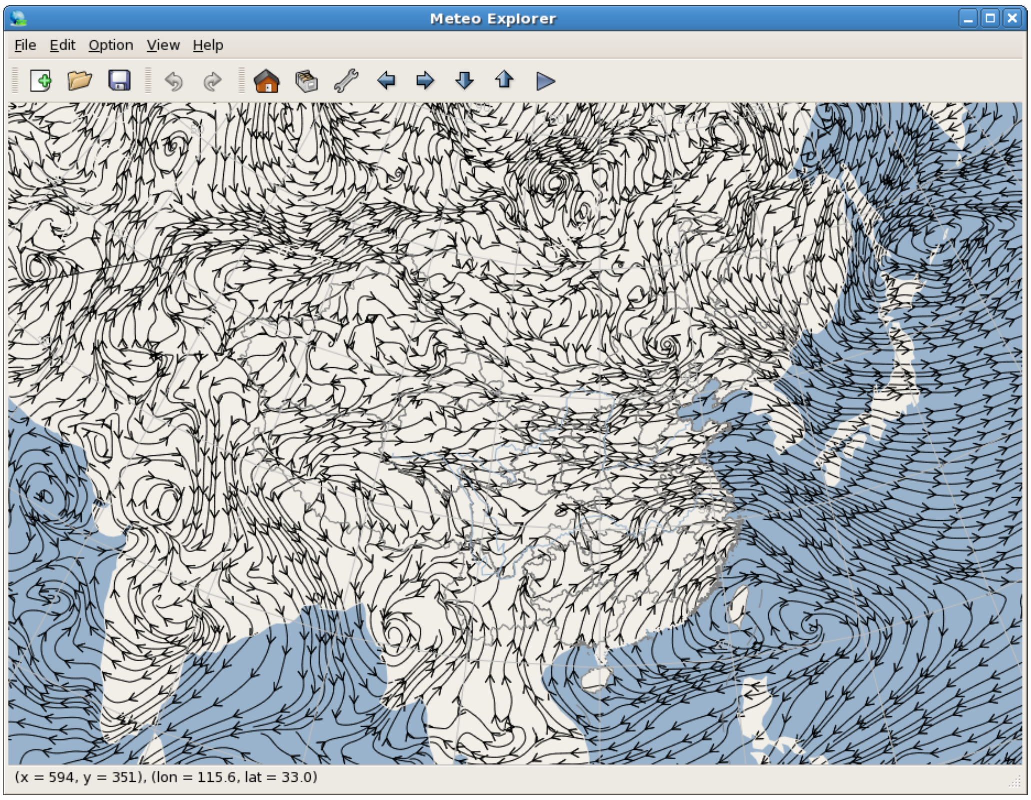


Figure 14-4: Streamline output with a density value of 4.

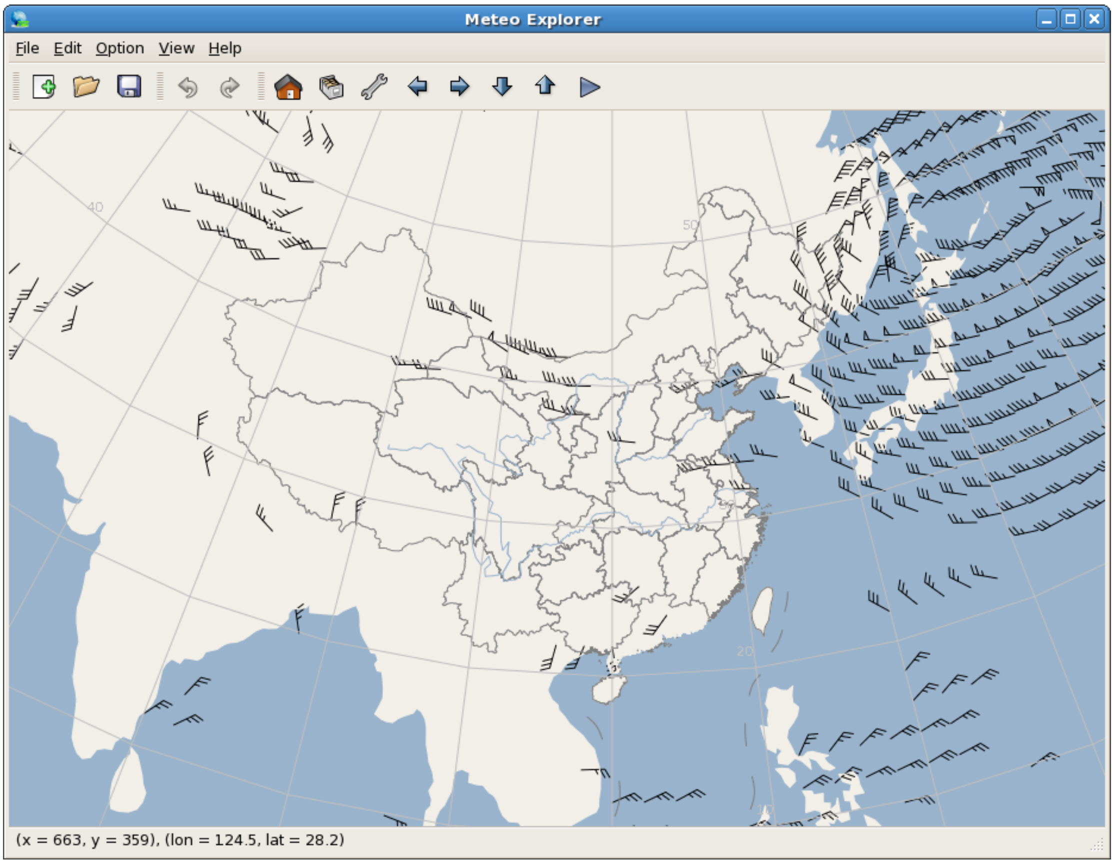


Figure 14-5: Wind barbs output when the wind velocity threshold is 10m/s.

14.2 Calculating Derived Physics Elements from Wind Field

The "Derived Elements" part of the"Streamline Options" dialog plays a similar role to Figure 7-4 (page 88). Let us introduce them one by one:

- Elements: The combo box control "Elements" let users to choose a weather element for isoline analysis. For wind field, the candidate elements include divergence, vorticity, and isotachs. The checkbox "Show Contour" serves two functions. First, if the selected weather element is not analyzed, check this control and click the "OK" or "Apply" button at the bottom of the dialog will let MeteoExplorer perform contour analysis of the selected element and generate a contour graphics layer representing the analytic result. Second, if the selected weather element has already been analyzed, check (uncheck respectively) this control will show (hide respectively) contour graphics layer representing the analyzed result in the application window.
- Stream line (or wind barb, wind arrow) color, width, and style.
- Shading scheme. The options of shading scheme are rainbow, aqua, white green, white blue, yellow red, and white gray.
- Show grid-point values. Whether or not to show values at grid point.

Again only part of contour display options are shown in this page. For a complete configuration of contour display options, one may click the “More Options” button to open “Contour Analysis and Display” dialog (Figure 7-6). Users may reference section 7.2 (page 88) for detailed description on how to configure contour properties.

Let us summarize the steps on how to perform a contour analysis of whether elements of wind field in MeteoExplorer:

1. Use the combo box control “Elements” to choose a weather element for contour analysis, and then check the “Show Contour” control next on the right.
2. Optionally configure contour analysis parameters and contour display properties.
3. Click the “OK” or “Apply” button to let MeteoExplorer perform contour analysis of the selected element and generate a contour graphics layer representing the analyzed result. The difference between the “OK” and “Apply” button is that the former will close the dialog after making the users changes take into effect whereas the latter will keep the dialog.

The order of step 2 and 3 can be exchanged, that is, users can generate a contour graphics first and then customize the result by adjusting the parameters.

Figure 14-6 shows the analytic contour of vorticity field overlaid on top of Figure 14-5. Figure 14-7 shows the shaded analytic contour of isotachs overlaid on top of Figure 14-5.

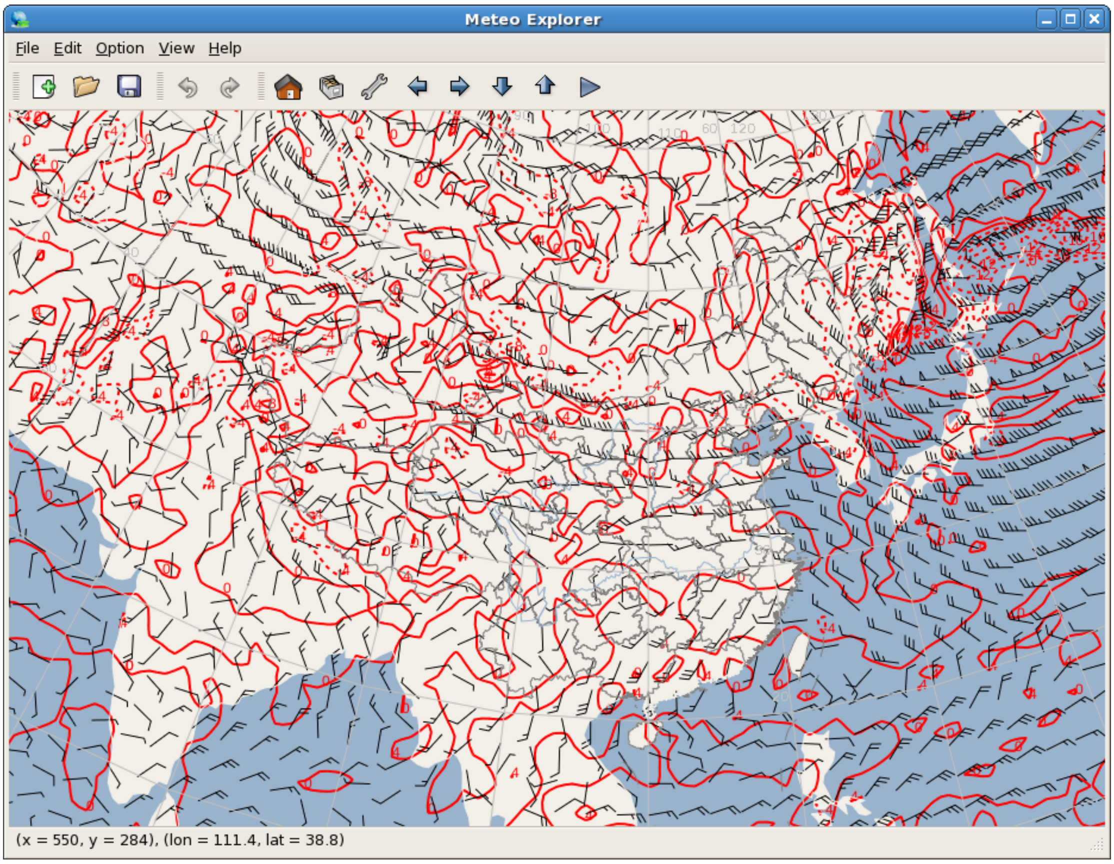


Figure 14-6: The analytic contour of vorticity field overlaid on top of Figure 14-5.

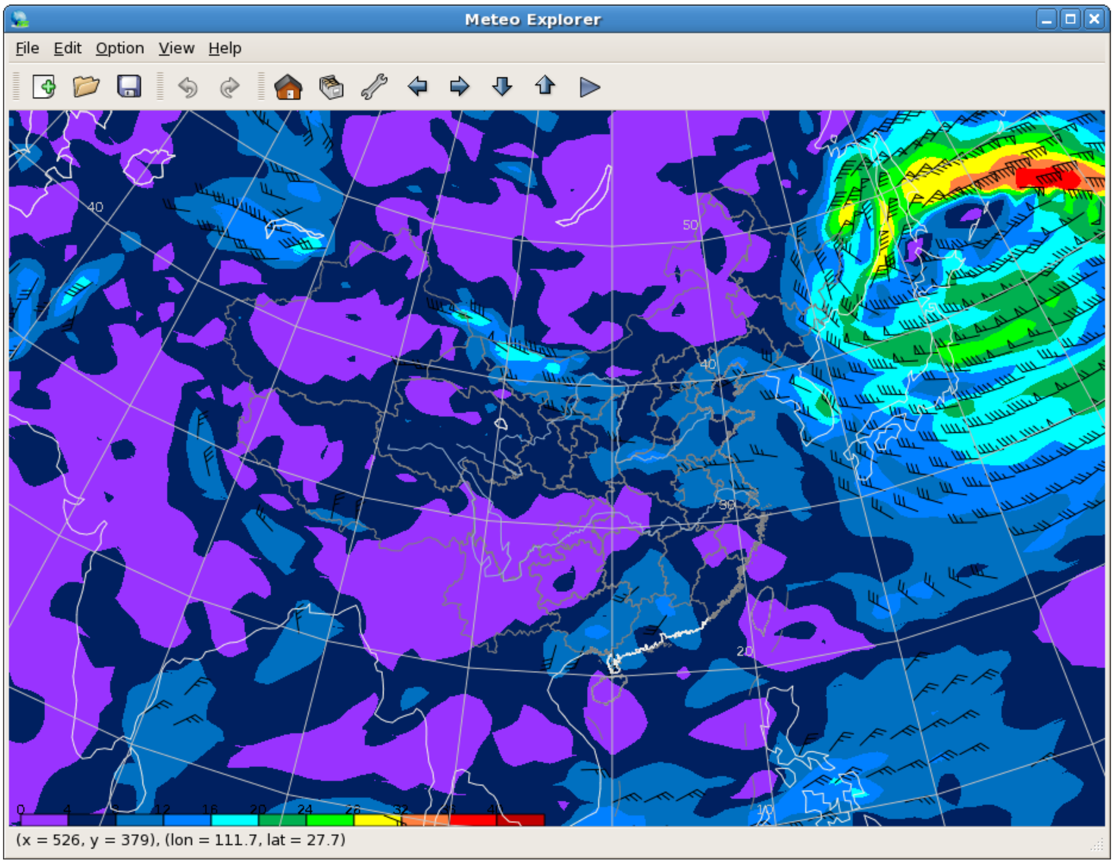


Figure 14-7: The shaded analytic contour of isotachs overlaid on top of Figure 14-5.

Chapter 15 Interactive Composition of Synoptic Chart

MeteoExplorer 支持天气图的交互制作，即用户能够以交互的方式在程序窗口内绘制各种天气符号，修改天气符号的属性，并将所绘制的天气图图层保存到磁盘文件中。

15.1 Introducting Synoptic Scale Toolbox

要开始天气图的交互制作，首先需要打开如图 15-1 所示的天气图制作工具箱。

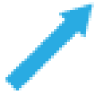
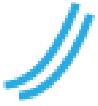
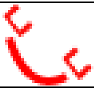
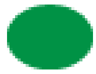
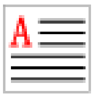
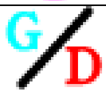
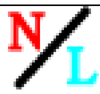
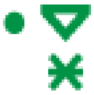
图 15-1：用户通过使用天气图制作工具箱在程序窗口内绘制、编辑各种天气符号。

方法是选择菜单项“View, Synoptic Scale Toolbox”，或者点击工具栏中的 （Windows 版本）或者 （Unix/Linux 版本）按钮。表 15-1 给出了工具箱中每个按钮的作用和含义。

表 15-1：天气图制作工具箱中各个按钮的作用和含义。

按钮图像	含义	按钮图像	含义	按钮图像	含义
	静风		三级风		四级风

	五级风		六级风		七级风
	八级风		九级风		十级风
	十一级风		十二级风		小雨
	中雨		大雨		暴雨
	大暴雨		特大暴雨		阵雨
	轻冻雨		冻雨		雨加雪
	小雪		中雪		大雪
	暴雪		阵雪		浮尘
	扬沙		沙尘暴		轻沙尘暴
	晴天		多云		阴天
	轻雾		雾		雷暴
	冰雹		霜冻		旋转风
	台风		槽线		暖锋
	锢囚锋		静止锋		冷锋

	箭头符号		双实线		35 度温度线
	霜冻线		闭合等值线		填充区域
	文字		高低值中心		冷暖中心
	地面单点符号		等值线		修改等值线
	等值线标值		裁剪与移动		漫游

15.2 Using Synoptic Scale Toolbox

当打开天气图制作工具箱后，默认被选中的按钮是漫游按钮。用户使用鼠标左键单击某一按钮以选中该按钮。被选中的按钮上面将显示一个红色圆圈，以帮助用户识别当前选中的按钮。此外，工具箱下方的 Selection 后面将显示被选中的按钮的含义。

小提示：天气图制作工具箱被选中的按钮上面将显示一个红色圆圈，以帮助用户识别当前选中的按钮。此外，工具箱下方的 Selection 后面将显示被选中的按钮的含义。

根据天气符号的不同，其绘制方法是不一样的。但是我们可以把具有相同绘制方法的天气符号分为一类，然后分别介绍每一类天气符号的绘制方法。MeteoExplorer 中把所有天气符号七类。下面具体介绍每一类天气符号的绘制方法。

15.2.1 Point-Type Weather Symbol

单点型天气符号包括静风，小雨，中雨，大雨，暴雨，大暴雨，特大暴雨，阵雨，冻雨，轻冻雨，雨加雪，小雪，中雪，大雪，暴雪，阵雪，浮尘，扬沙，沙尘暴、轻沙尘暴，晴天，多云，阴天，雾，轻雾，雷暴，冰雹，霜冻，台风，地面单点符号和文字。

单点型天气符号的绘制方法比较简单，用户在选中相应的按钮后，只需用鼠标左键单击被绘制符号所在的位置，该天气符号将在程序窗口中显示，并被加入到当前编辑图层中（关于如何将一个图层设置为编辑状态请参考第 3.5 节 29 页）。

除添加文字符号外，单点型天气符号没有属性设置。当选中文字符号时，天气图绘制工具箱的下方会出现颜色选择按钮（图 15-4A）。单击该按钮打开如图 7-3（第 87 页）所示的颜色选择对话框。文字符号的默认颜色为红色，用户可以更改为需要的颜色。当用户用鼠标左键在程序窗口中单击被绘制符号所在的位置后，将会打开添加注释（Add Annotation）对话框（图 15-2）。在“Enter text”编辑控件中输入被添加的文字后，单击“OK”按钮将文字

添加到当前编辑图层中。或者单击“Cancel”按钮取消本次操作。

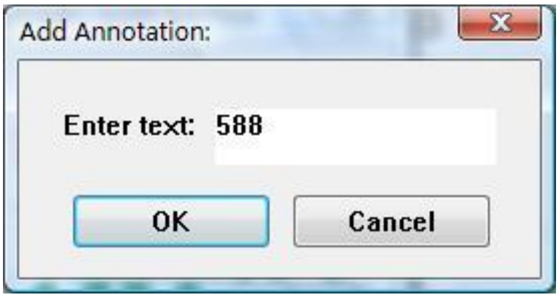


图 15-2：用户通过添加注释（Add Annotation）对话框将将文字添加到当前编辑图层中。

15.2.2 Vector-Type Weather Symbol

矢量型天气符号包括从三级风、四级风到十二级风这十个符号，以及旋转风。矢量型天气符号的绘制方法是用户在绘制开始时单击鼠标左键确定天气符号所在的位置，然后移动鼠标调整天气符号的方向，最后单击鼠标左键确定天气符号的方向和长度。

矢量型天气符号的属性只有颜色一项可供修改，这与文字符号相同（图 15-4A）。

15.2.3 Binary Choice Point-Type Weather Symbol

这是一类特殊的单点型天气符号，这种天气符号与另一个天气符号共享天气图绘制工具箱中的一个按钮。多态单点型天气符号包括高低压中心，冷暖中心，和等值线标值。

一个多态单点型天气符号的具体形态与用户所使用的鼠标键有关。例如高低压中心被看作是同一种天气符号，用户单击鼠标左键时，生成高压中心；用户单击鼠标右键时，生成低压中心。冷暖中心也是这样，用户单击鼠标左键时，生成暖中心；用户单击鼠标右键时，生成冷中心。对于等值线标值，当用户单击鼠标左键时会打开如图 15-3 所示的添加等值线标值（Add isoline label）对话框。用户输入等值线标值后点击“OK”按钮以添加标值。用户单击鼠标右键时，程序会自动将用户上一次输入的等值线标值直接加入到编辑图层中，免去了用户操作等值线标值对话框的麻烦。

多态单点型天气符号没有属性需要设置。

图 15-3：用户使用添加等值线标值对话框将等值线标值加入到编辑图层中。

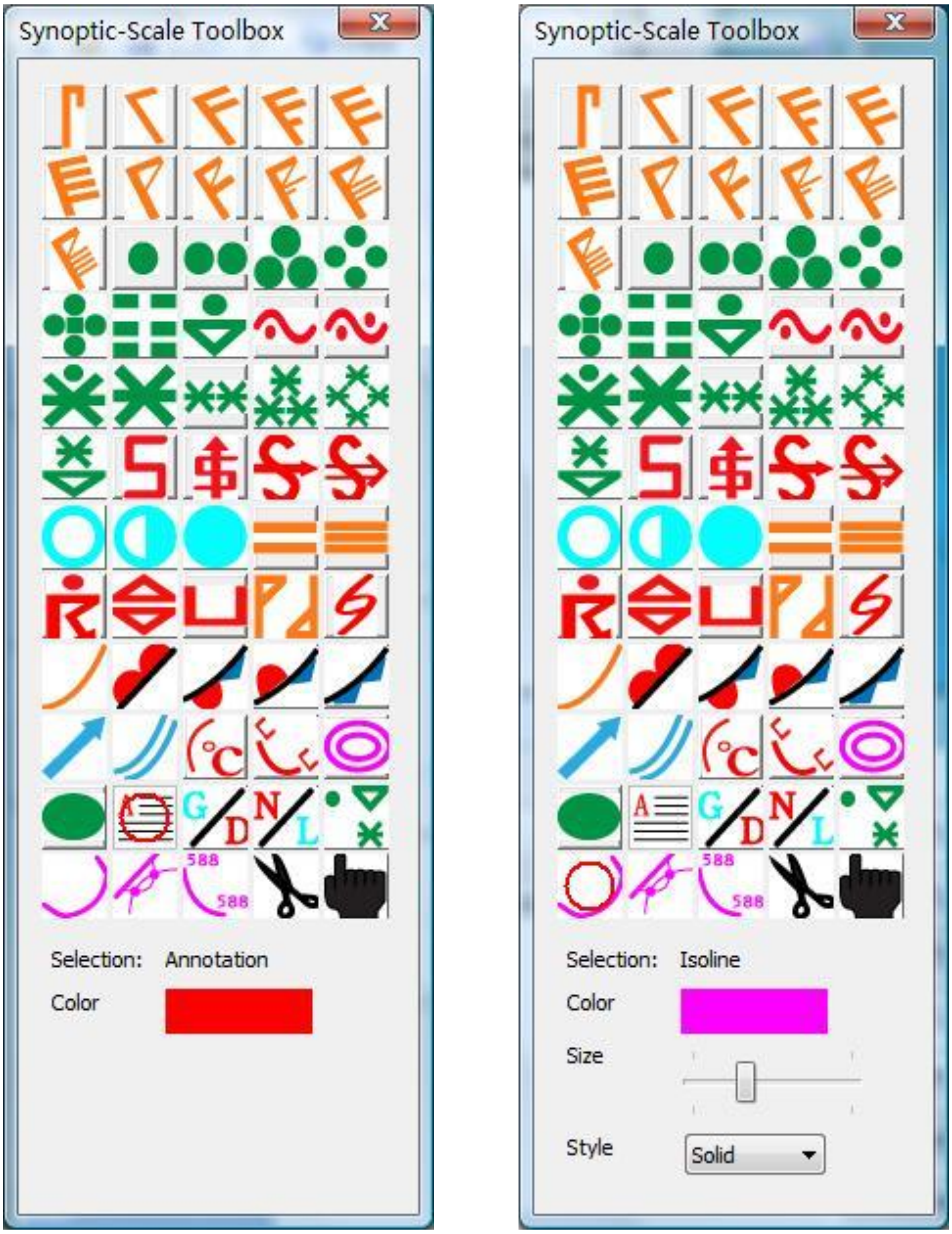
15.2.4 Line-Type Weather Symbol

曲线型天气符号的命名是由于用户在绘制这些天气符号通常要画出一条闭合或者非闭合的曲线。曲线型天气符号包括槽线，暖锋，锢囚锋，静止锋，冷锋，箭头，双实线，35 摄氏度温度线，霜冻线，闭合等值线，填充区域和等值线。

要绘制曲线型天气符号，用户首先单击鼠标左键确定曲线的起点，然后多次单击鼠标左键来给出控制点的位置，这些控制点决定了曲线的走向和长度。最后单击鼠标右键确定曲线的终点。

在程序实现上，MeteoExplorer 通过将这些用户绘制的控制点运用样条理论进行平滑处理，计算得到对应的曲线。MeteoExplorer 支持在用户绘制曲线的同时将样条平滑的结果实时地显示出来。我们将这一功能称为预览。要打开预览功能，请选择“Option, Preferences”菜单项，在偏好设置（Preferences）对话框中，选中“Smooth linestrip when drawing synoptic chart”。图 3-16（第 41 页）显示了打开绘制曲线预览功能时曲线的显示结果；图 3-17（第 42 页）显示了关闭绘制曲线预览功能时曲线的显示结果。

在曲线型天气符号中，箭头，双实线，35 摄氏度温度线，霜冻线，填充区域可以设置符号的颜色。闭合等值线和等值线可以设置颜色，线宽和样式（图 15-4B）。MeteoExplorer 根据当前用户选择的天气符号，动态地在在天气图制作工具箱的底部显示或者隐藏符号颜色选择按钮（color）、符号尺寸滑动条（size）、和符号样式下拉列表（style）控件。



A B

图 15-4：MeteoExplorer 根据当前用户选择的天气符号，动态地在在天气图制作工具箱的底部显示或者隐藏符号颜色选择按钮（color）、符号尺寸滑动条（size）、和符号样式下拉列表（style）控件。

15.2.5 Modification of Line-Type Weather Symbol

当用户在天气图制作工具箱中选择“修改等值线”按钮，并在程序窗口中移动鼠标时，如果当前鼠标光标位于某一天气符号上，则该天气符号将被高亮显示。图 15-5 显示了预报员在编辑一张 500hPa 高空填图时，将鼠标移动到一条标值为 512 位势十米的等高线上时，

该等高线被高亮显示为黑色，以区别于其它显示为绿色的等高线[4]。

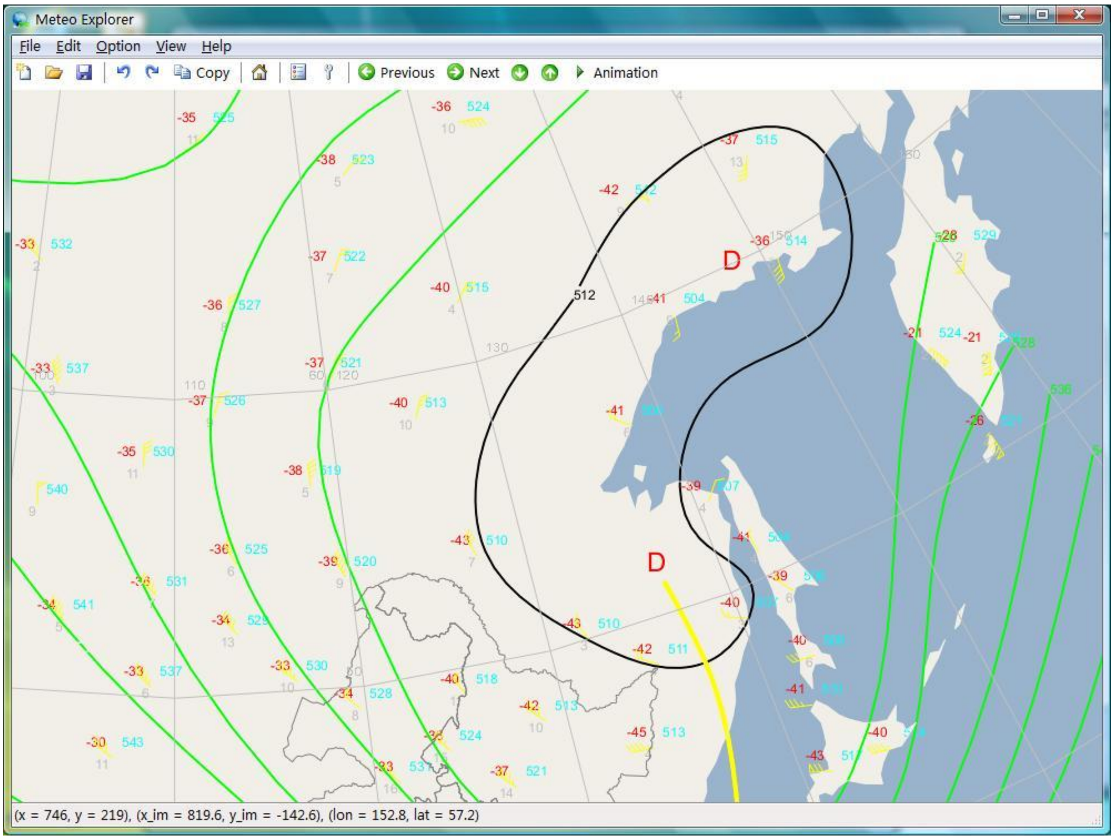


图 15-5：用户在天气图制作工具箱中选择“修改等值线”按钮，并在程序窗口中移动鼠标时，如果当前鼠标光标位于某一天气符号上，则该天气符号将被高亮显示。

当一个天气符号被高亮显示时，即表明该天气符号处于被编辑状态。MeteoExplorer 将处于编辑状态的天气符号用高亮显示，以帮助用户区分当前被编辑的天气符号与其它天气符号。

因此，当用户希望编辑修改某一曲线型天气符号时，首先通过将鼠标光标移动到该天气符号上使其高亮显示。然后开始画线。请注意，您修改线条时所画的第一个点必须落在处于高亮显示的天气符号上。否则该天气符号将退出被编辑状态。修改线条的画线方式与添加线条相同，即单击鼠标左键指定第一个及其后面的控制点，单击鼠标右键指定最后一个控制点并结束画线。如图 15-6 所示，如果控制点位于被编辑的线条上，则该控制点被显示为一个小方块。整个修改线条以红色显示，以区别于被编辑的线条。图 15-7 显示了修改后的等高线。

小提示：您修改线条时所画的第一个点必须落在处于高亮显示的天气符号上。否则该天气符号将退出被编辑状态。

[4]高亮显示的颜色取决于当前的主题样式，在业务主题中高亮显示颜色为白色。

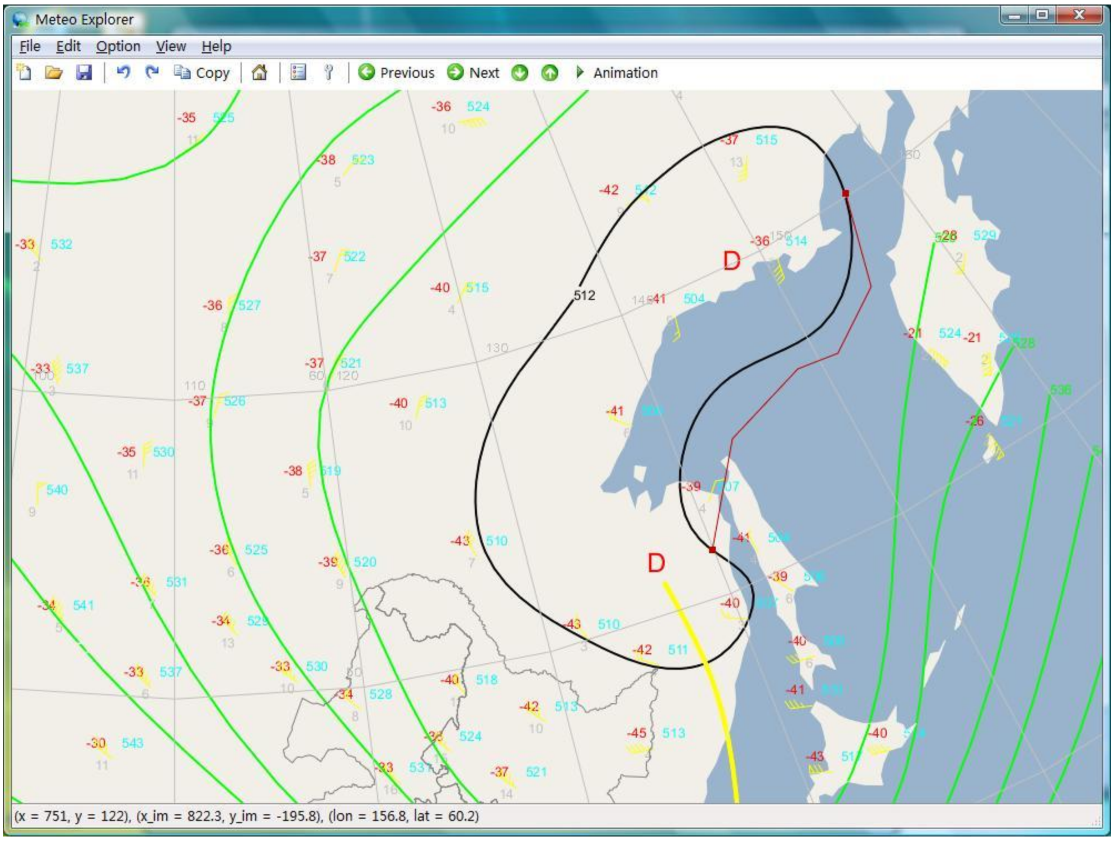


图 15-6：当控制点位于被编辑的线条上，该控制点被显示为一个小方块。整个修改线条以红色显示，以区别于被编辑的线条。

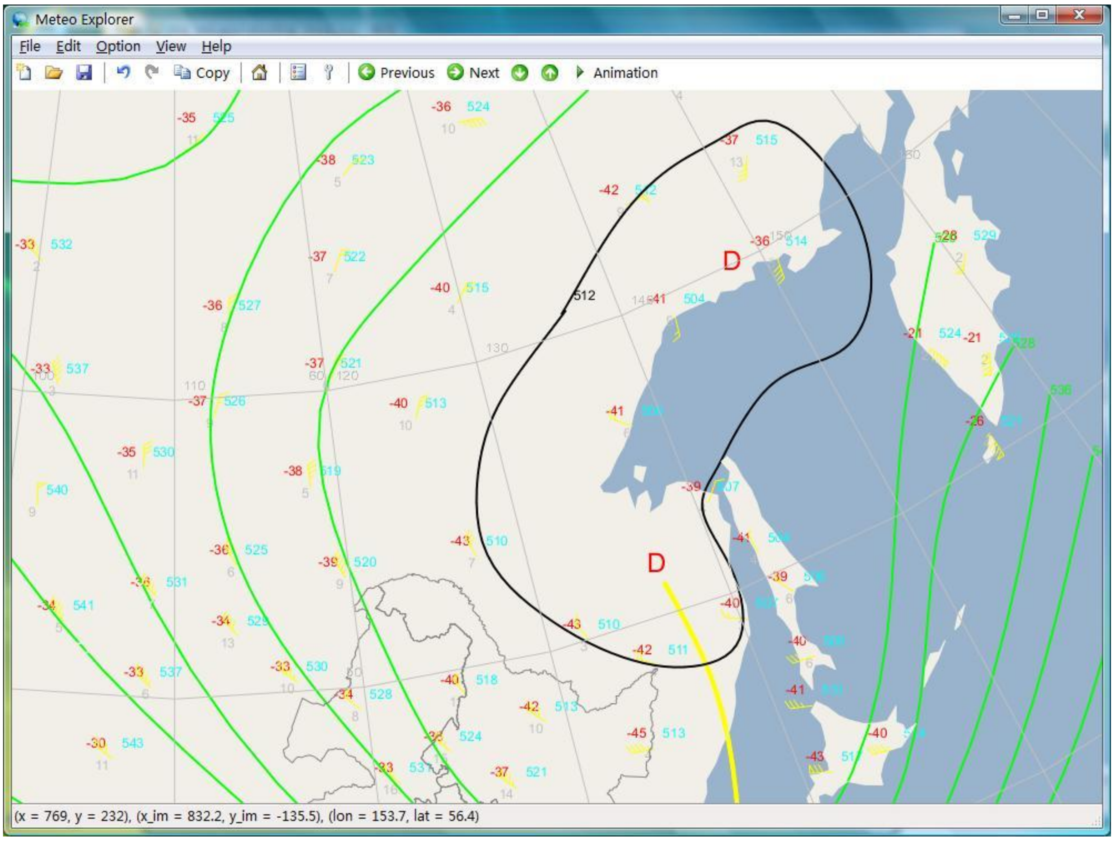


图 15-7：根据图 15-6 所示的修改线条为标准，修改后的等高线。

以上修改等高线的方法适用于所有曲线型天气符号。

15.2.6 Move and Cut of Weather Symbol

要移动或者剪切某一天气符号，首先将鼠标光标移动到该天气符号上使其处于高亮显示状态（即被移动或剪切状态）。使用鼠标左键拖曳该天气符号使其移动，释放鼠标左键结束移动操作；使用鼠标右键单击该天气符号将其剪切。

作为本节的最后，我们用表 15-2 对七类天气符号所包含的成员及其绘制方法做了总结，以供用户快速参考。

表 15-2：七类天气符号所包含的成员及其绘制方法。

类型名称	**操作方法**	**包含的天气符号**
单点型天气符号	在程序窗口中天气符号所在位置处单击一次鼠标左键。	所有的天气符号（如雨，雪，台风等）。
矢量型天气符号	用户在绘制开始时单击鼠标左键确定天气符号所在的位置，然后移动鼠标调整天气符号的方向，最后单击鼠标左键确定天气符号的方向和长度。	表示风的符号。
多态单点型天气符号	在程序窗口中天气符号所在位置处单击一次鼠标左键或者右键。	高低压中心，冷暖中心，等值线标值。
曲线型天气符号	用户首先单击鼠标左键确定曲线的起点，然后多次单击鼠标左键来给出控制点的位置，这些控制点决定了曲线的走向和长度。最后单击鼠标右键确定曲线的终点。	等值线，槽线，各种类型的锋面，霜冻线，填充区域等。
曲线型天气符号的修改	将鼠标光标移动到被修改的天气符号上使其处于高亮显示状态（即被编辑状态）。以添加曲线型天气符号相同的方法绘制修改线条。	
天气符号的移动和剪切	将鼠标光标移动到被移动或者剪切的天气符号上使其处于高亮显示状态（即被移动或剪切状态）。使用鼠标左键拖曳该天气符号使其移动，释放鼠标左键结束移动操作；使用鼠标右键单击该天气符号将其剪切。	

15.3 Undo and Redo

操作命令的撤销与恢复是文字、图形编辑软件中必备的两项功能，在这一点上 MeteoExplorer 也不例外。用户可以通过菜单项“File，Undo”，或者工具栏上的（Windows 版本）或者（Unix/Linux 版本）按钮，或者快捷键组合“Ctrl+Z”实现撤销功能。对于恢复功能，用户可以通过菜单项“File，Undo”，或者工具栏上的（Windows 版本）或者（Unix/Linux 版本）按钮，或者快捷键组合“Ctrl+Y”实现。

15.4 Automatic Save

MeteoExplorer 支持将当前编辑的天气图交互图层保存为 MICAPS 第 14 类数据文件。操作步骤是首先在图层管理窗口中将待保存的图层设置为被编辑图层（关于图层的操作请参考第 3.5 节，第 29 页）。然后选择菜单项“File，Save”或者快捷键组合“Ctrl+S”以打开文件保存对话框，输入保存文件的文件名并确认。当您希望以其它名称保存时，请选择菜单项“File，Save As”或者快捷键组合“Ctrl+A”以打开文件保存对话框，输入保存文件的新文件名并确认。

当用户退出 MeteoExplorer 的时候，如果还有未被保存的天气图交互图层，则 MeteoExplorer 会提示用户是否在不保存当前编辑图层的情况下退出程序（图 15-8）。如果用户选择“确定”，则程序在不保存当前编辑图层的情况下退出；如果用户选择“取消”，则程序继续运行而不退出。

MeteoExplorer 还有自动保存当前编辑图层的功能，以防止当程序异常退出时造成用户已有编辑工作的丢失。在实现上，MeteoExplorer 会定时地将每个可编辑图层保存到临时文件中，保存的位置一般为操作系统中放置用户临时文件的目录。如 Windows Vista 中的保存用户临时文件的目录通常为“C:\Users\YourLoginName\AppData\Local\Temp”，其中 YourLoginName 是系统的登录用户名。临时文件的命名规则为 m14_yyyymmddhh_rrrrr.tmp，其中 yyyymmddhh 为临时文件的创建时间，rrrrr 为 5 位随机整数。当 MeteoExplorer 正常退出时，会将所有打开的临时文件删除。当 MeteoExplorer 异常退出时，所有的临时文件会保存在用户的临时目录中，供用户恢复数据使用。

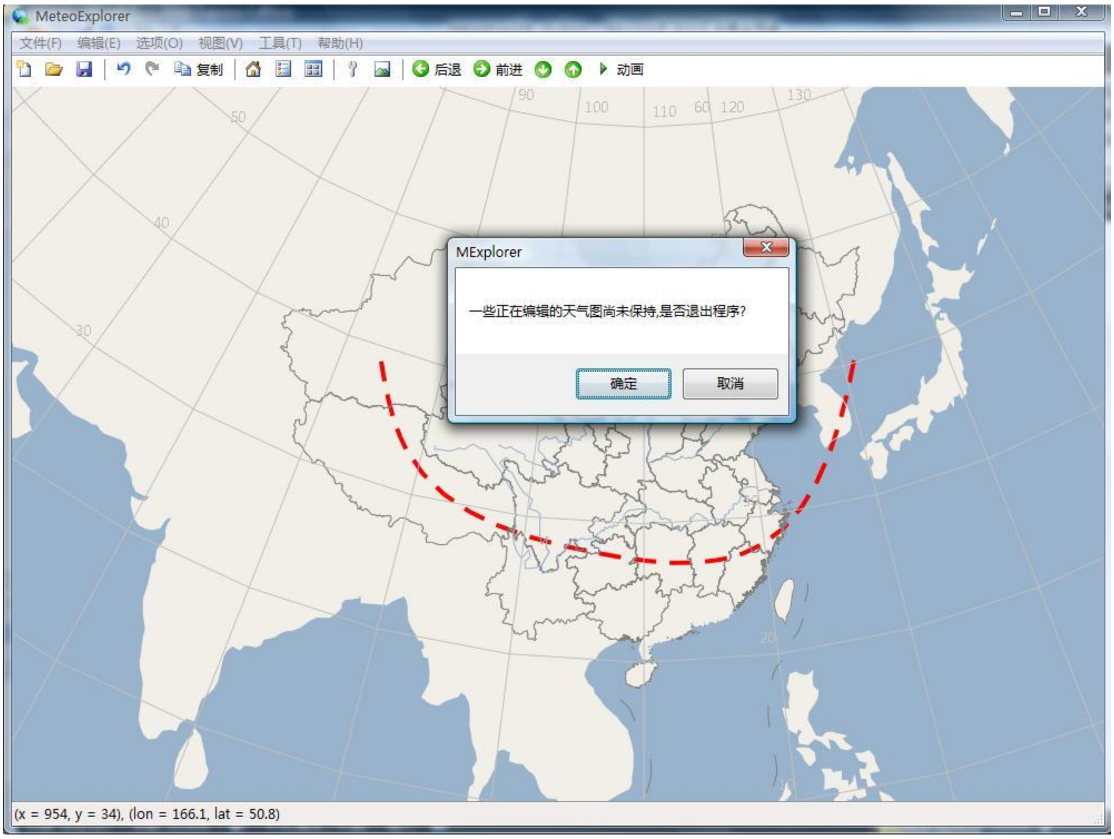


图 15-8：当用户退出 MeteoExplorer 的时候，如果还有未被保存的天气图交互图层，则 MeteoExplorer 会提示用户是否在不保存当前编辑图层的情况下退出程序。

Chapter 16 Meso-Scale Weather Analysis

从 1.2 版本开始，MeteoExplorer 加入了中尺度天气分析功能，支持用户以交互的方式绘制中尺度天气符号，修改天气符号的属性，保存编辑结果到磁盘文件。

16.1 Introducing Meso-Scale Toolbox

MeteoExplorer 中的中尺度天气分析功能是通过中尺度工具箱的形式实现的。要打开如图 16-1 所示中尺度工具箱，请选择菜单项“工具，中尺度工具箱”。

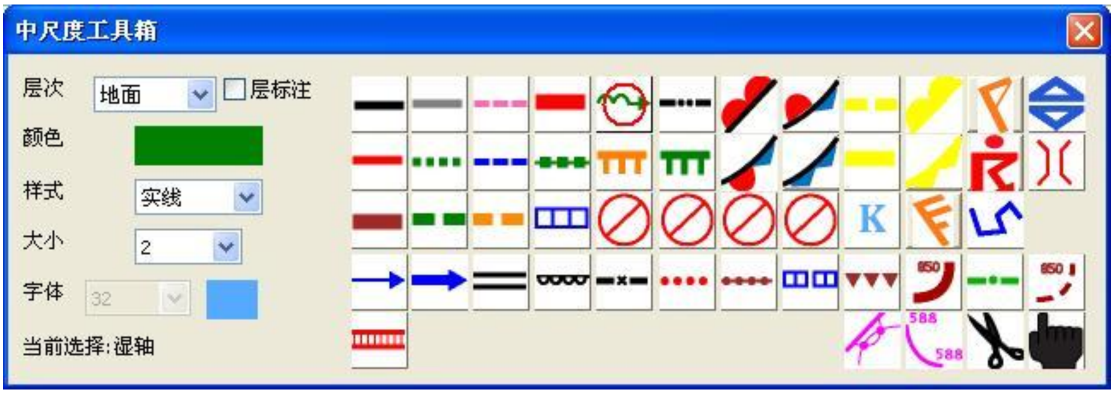
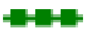
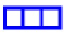
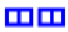
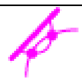
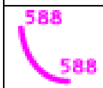


图 16-1：MeteoExplorer 中的中尺度天气分析功能是通过中尺度工具箱的形式实现的。

中尺度工具箱中控件布局可以分为两部分，右边的一组按钮给出了所有的天气符合，用户通过点击某一按钮以选中某一天气符合。表 16-1 给出了中尺度工具箱中每个按钮的作用和含义。左边的控件给出了当前所选符号的属性，包括层次、是否带层标注、颜色、样式、大小、字体大小、字体颜色。

表 16-1：中尺度工具箱中每个按钮的图像与含义。

按钮图像	含义	按钮图像	含义	按钮图像	含义
	等压线		等风速线		3 小时显著升压线
	等假相当位温线		湿轴		飑线
	暖锋		静止锋		过去 12 小时槽线
	过去 12 小时暖锋		七至八级风		冰雹
	等温度线		等露点温度线		3 小时显著降压线
	250hPa 季节温度特征线		干舌		湿舌

	锢囚锋		冷锋		过去 12 小时切变线
	过去 12 小时冷锋		雷暴		龙卷风
	槽线		显著湿区		850hPa 与 500hPa 温度差
	24 小时变高线	K	冷堆		风向杆
	折线		显著流线		最大风带
	切变线		干线（露点锋）		辐合线
	温度脊（暖脊）		12 小时显著降温区		24 小时变温
	温度槽（冷槽）		带标注的槽线		等比湿线
	带标注的未来 24 小时槽线		急流核		修改等值线
	添加等值线标值		剪切/移动		漫游

由表 16-1 可以看出，中尺度工具箱与天气尺度工具箱中有 12 个符号是相同的，它们是：暖锋、静止锋、七至八级风、冰雹、锢囚锋、冷锋、雷暴、槽线、修改等值线、添加等值线标值、剪切/移动和漫游。

16.2 Using Meso-Scale Toolbox

当打开中尺度工具箱后，默认被选中的按钮是漫游按钮。用户使用鼠标左键单击某一按钮以选中该按钮。被选中的按钮上面将显示一个红色圆圈，以帮助用户识别当前选中的按钮。此外，工具箱左侧下方的“当前选择”后面将显示被选中的按钮的含义。

尽管不同天气符号的绘制方法不同，但是我们还是可以按照上一章的方法，把具有相同绘制方法的符号分为一类。下面具体介绍每一类天气符号的绘制方法。

16.2.1 Point-Type Weather Symbol

中尺度工具箱中的单点型天气符号不多，只有冰雹、雷暴、龙卷风、冷堆共四个。单点型天气符号的绘制方法比较简单，用户在选中相应的按钮后，只需用鼠标左键单击被绘制符号所在的位置，该天气符号将在程序窗口中显示，并被加入到当前编辑图层中（关于如何将一个图层设置为编辑状态请参考第 3.5 节、第 29 页）。

在这四个符号中，只有冷堆符号可以设置显示属性，包括字体大小和颜色。

16.2.2 Vector-Type Weather Symbol

矢量型天气符号包括七至八级风和风向杆这两个符号。矢量型天气符号的绘制方法是用户在绘制开始时单击鼠标左键确定天气符号所在的位置，然后移动鼠标调整天气符号的方向，最后单击鼠标左键确定天气符号的方向和长度。

这两个符号都没有显示属性可以设置。

16.2.3 Line-Type Weather Symbol

中尺度工具箱中绝大部分符号都是曲线型天气符号，包括等压线、等风速线、3 小时显著升压线、等假相当位温线、湿轴、飑线、暖锋、锢囚锋、过去 12 小时槽线、过去 12 小时暖锋、等温度线、等露点温度线、3 小时显著降压线、250hPa 季节温度特征线、干舌、湿舌、静止锋、冷锋、过去 12 小时切变线、过去 12 小时冷锋、槽线、显著湿区、850hPa 与 500hPa 温度差、24 小时变高线、折线、显著流线、最大风带、切变线、干线（露点锋）、辐合线、温度脊（暖脊）、12 小时显著降温区、24 小时变温、温度槽（冷槽）、带标注的槽线、等比湿线、带标注的未来 24 小时槽线、急流核。

要绘制曲线型天气符号，用户首先单击鼠标左键确定曲线的起点，然后多次单击鼠标左键来给出控制点的位置，这些控制点决定了曲线的走向和长度。最后单击鼠标右键确定曲线的终点。在第 15.2.4 节（146 页）中提到的绘制曲线时的平滑预览功能同样适用于中尺度工具箱中所有的曲线型天气符号。

在显示属性设置方面，除了暖锋、锢囚锋、过去 12 小时暖锋、静止锋、冷锋、过去 12 小时冷锋、槽线之外，其它符号都可以设置颜色、样式和线宽。而除了干舌、湿舌、带标注的槽线、带标注的未来 24 小时槽线这四个符号带层标注外，其它曲线型天气符号在默认设置下不带层标注。

16.2.4 The Rest Weather Symbols

剩下的符号，包括修改等值线、添加等值线标值、剪切/移动、和漫游在上一章中已经做了详细的讲解。它们的使用方法请参考第 15.2.3 节、第 15.2.5 节、和第 15.2.6 节的内容，这里不再重复。

16.3 Automatic Save

在操作命令的管理以及编辑图层的自动保存功能的实现上，MeteoExplorer 对天气尺度工具箱和中尺度工具箱采用了相同的实现机制，因此在第 15.3 节“Undo and Redo”和第 15.4 节“Automatic Save”中提到的内容，在本章依然适用。

Chapter 17 Nephogram and RADAR Data Display

MeteoExplorer supports MICAPS thirteenth data type, that is, the satellite nephogram and RADAR data files, which are often encoded in AWX, GPF, HDF format.

17.1 Configure Palettes for Nephogram

To open a satellite nephogram or RADAR data file, one first select the menu item "File, Open" or click the corresponding toolbar button to open the file picker dialog. Then select the data file in the dialog. Figure 17-1 shows the infrared channel of a FY2 satellite nephogram at sixteen o'clock on September 11, 2010.

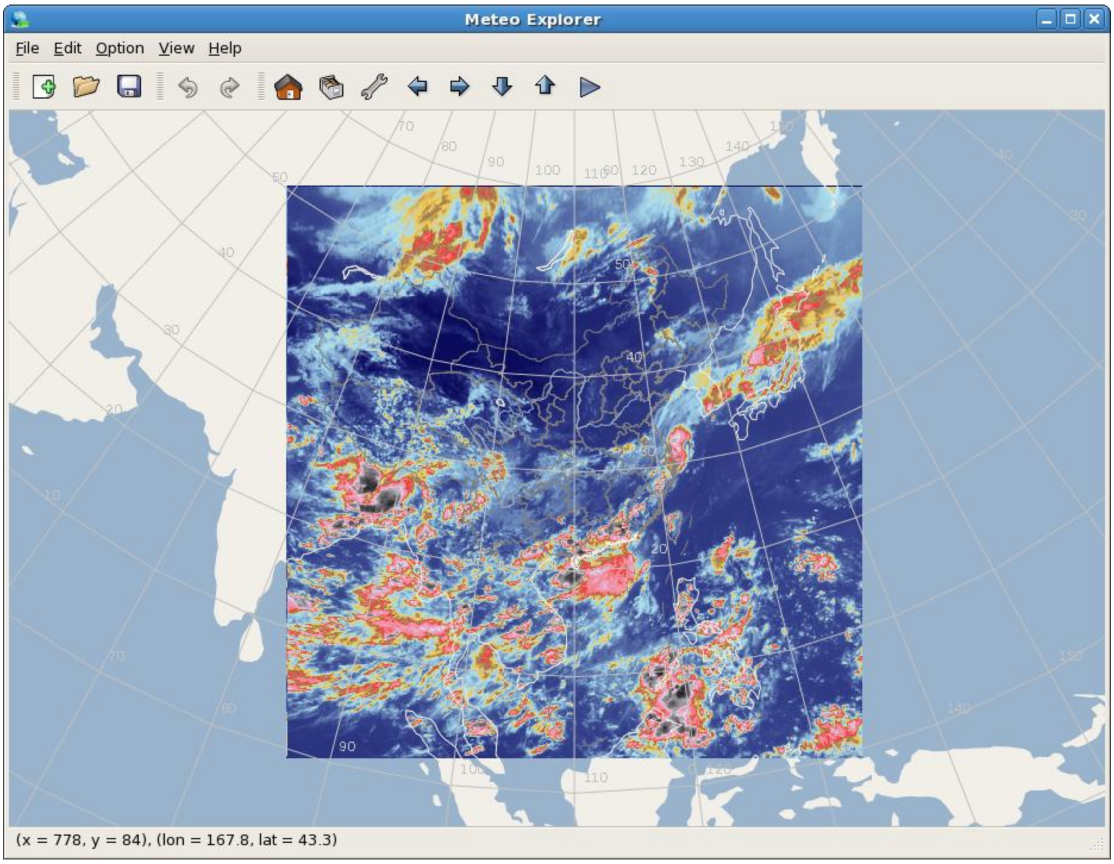


Figure 17-1: MeteoExplorer shows the infrared channel of a FY2 satellite nephogram.

Figure 17-2 show another satellite nephogram on December 9, 2011 and the data file is encoded in AWX format.

The primary display property of a satellite nephogram or RADAR graphics layer is the color palette. MeteoExplorer provides the "Nephogram Options" dialog for users to configure the palette as shown in Figure 17-3.

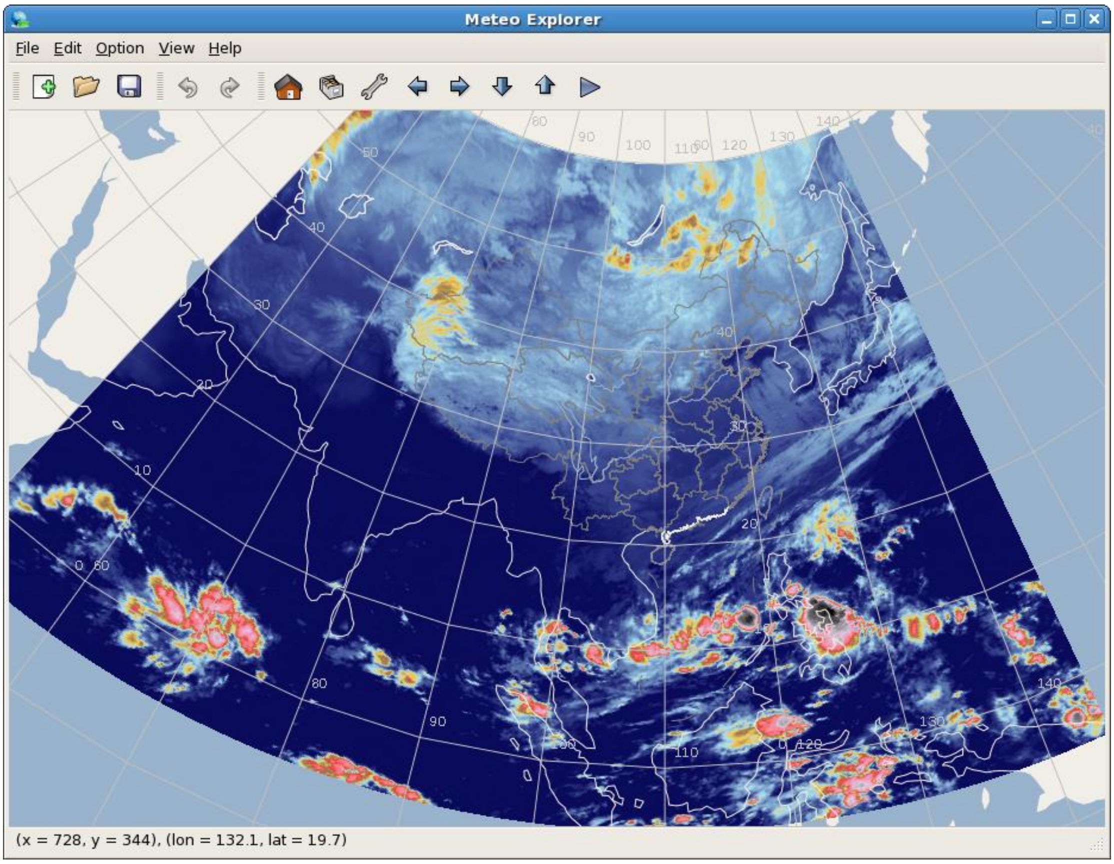


Figure 17-2: MeteoExplorer shows the infrared channel of a satellite nephogram encoded in AWX format.

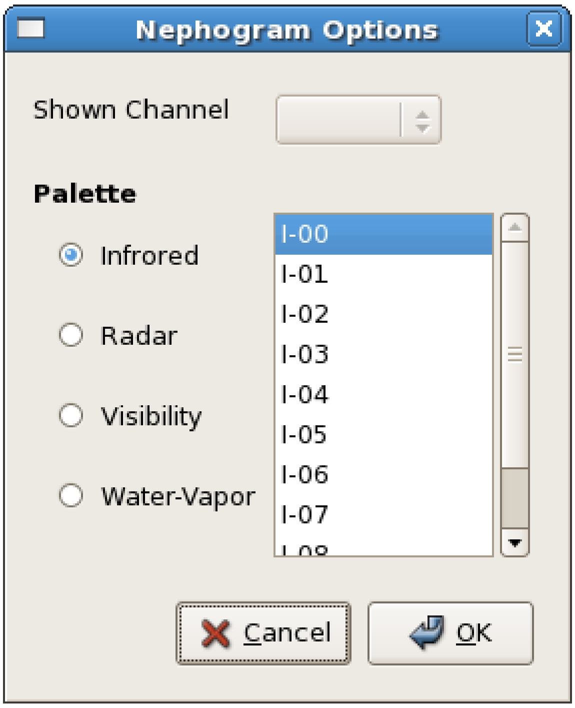
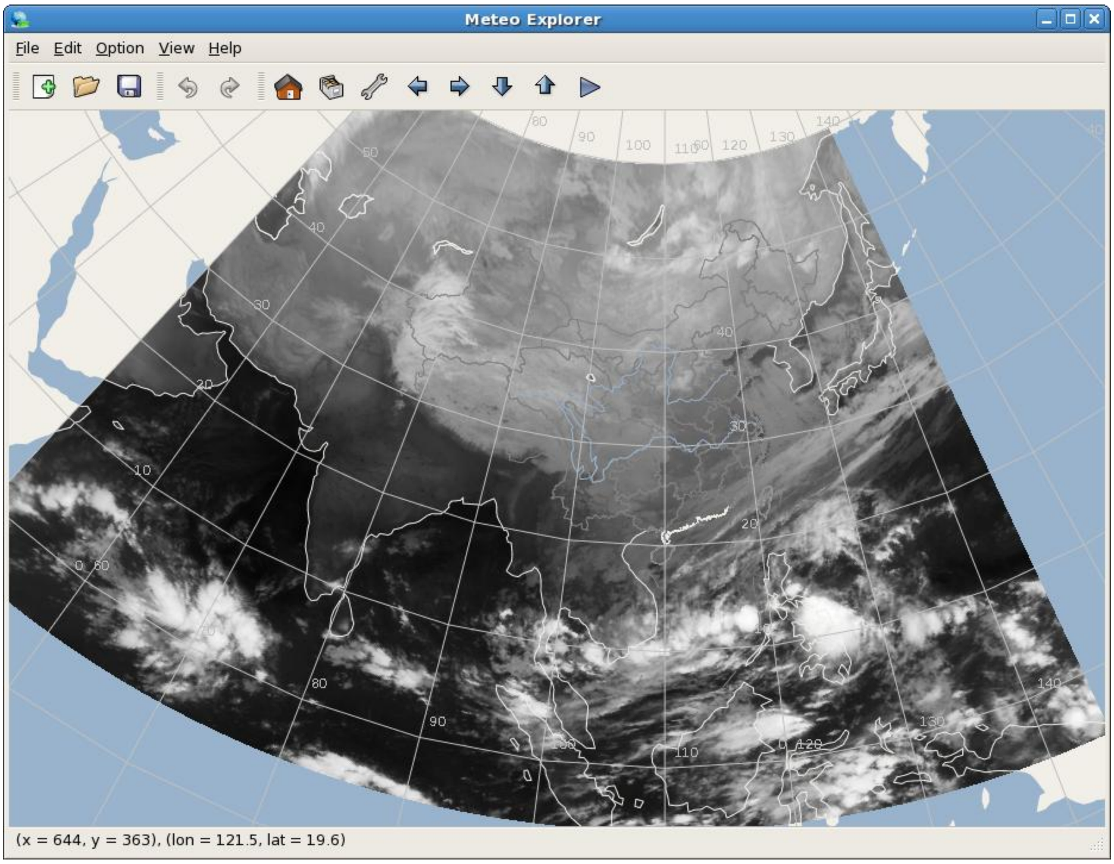


Figure 17-3: MeteoExplorer provides the "Nephogram Options" dialog for users to configure the palette.

At the top of the "Nephogram Options" dialog there is "Shown Channel" combobox control, which defines the channel that is visible at the moment. A nephogram consists of at least one channel data. If a nephogram data file has only one channel of data, the "Shown Channel" control will be disabled as shown in Figure 17-3. On the other hand, if a nephogram data file has more than one channel of data, the "Shown Channel" control will be enabled as shown in Figure 17-8.

The controls in the middle and bottom part of the dialog are used to select palette. MeteoExplorer organizes the palettes into four categories: Infrored, Radar, Visibility, and Water-vapor. Each category has ten palettes numbered from 00 to 09. To select a palette, the user should first select a category on the left, and then select one of the ten palettes on the right.

Figure 17-4 shows the same satellite nephogram graphics layer of Figure 17-2 with the second palette in the Infrored category.



Fiugre 17-4: This figure shows the same satellite nephogram graphics layer of Figure 17-2 but with the second palette in the Infrored category.

17.2 RADAR Data Display

The procedures to process a RADAR data file are identical to those of a satellite nephogram data file. Figure 17-5 shows a RADAR mosaic image at eight o'clock on May 7, 2012. A RADAR graphics layer shares the same dialog as a satellite nephogram graphics layer.

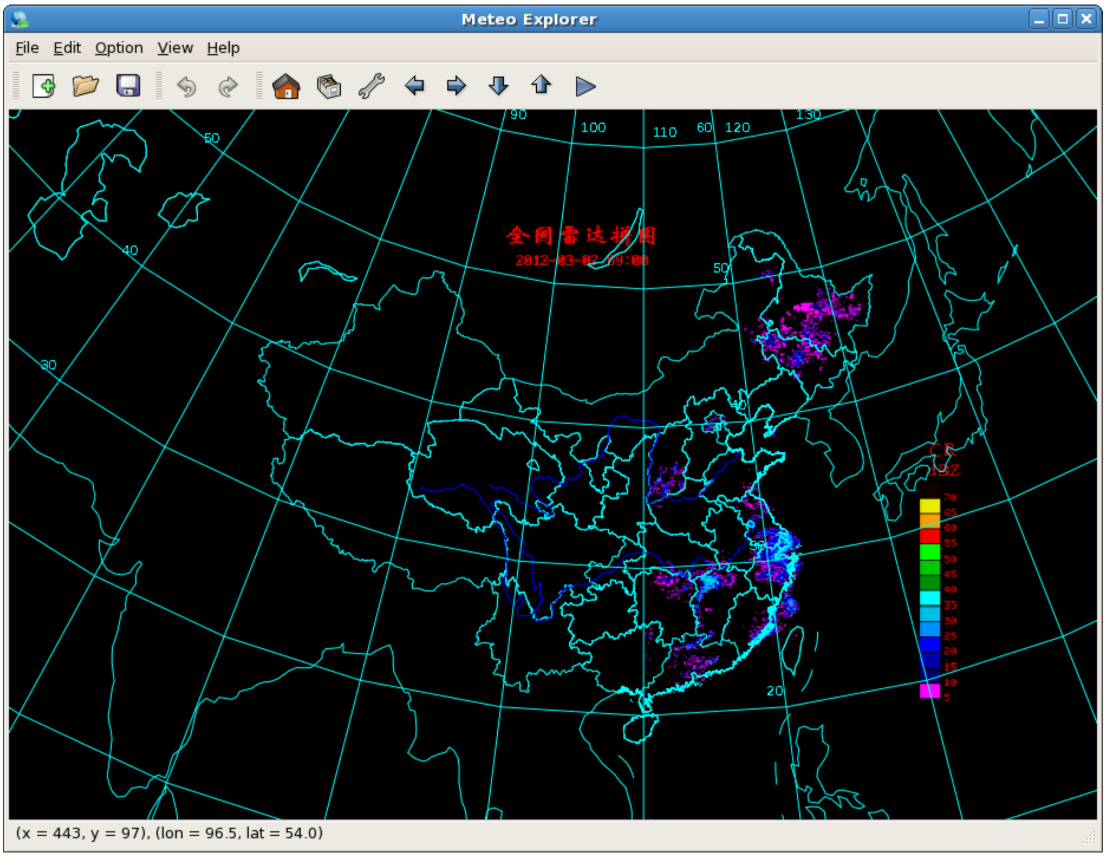


Figure 17-5: A RADAR mosaic image is shown in MeteoExplorer.

17.3 Configure Palettes for Multi-Channel High-Resolution Nephogram

Section 17.1 demonstrates MeteoExplorer's support of single-channel satellite nephogram data. The application also supports multi-channel high-resolution nephograms.

Figure 17-6 shows a multichannel nephogram graphics layer encoded in GPF format. Since the size of a multi-channel high-resolution nephogram data file is usually large, it takes a longer time to load such a file.

Tip: Since the size of a multi-channel high-resolution nephogram data file is often large, it takes a longer time to load such a file.

For a multi-channel nephogram graphics layer, the "Shown Channel" combobox control will be enabled as shown in Figure 17-8 so that users may select one of the channels for visualization.

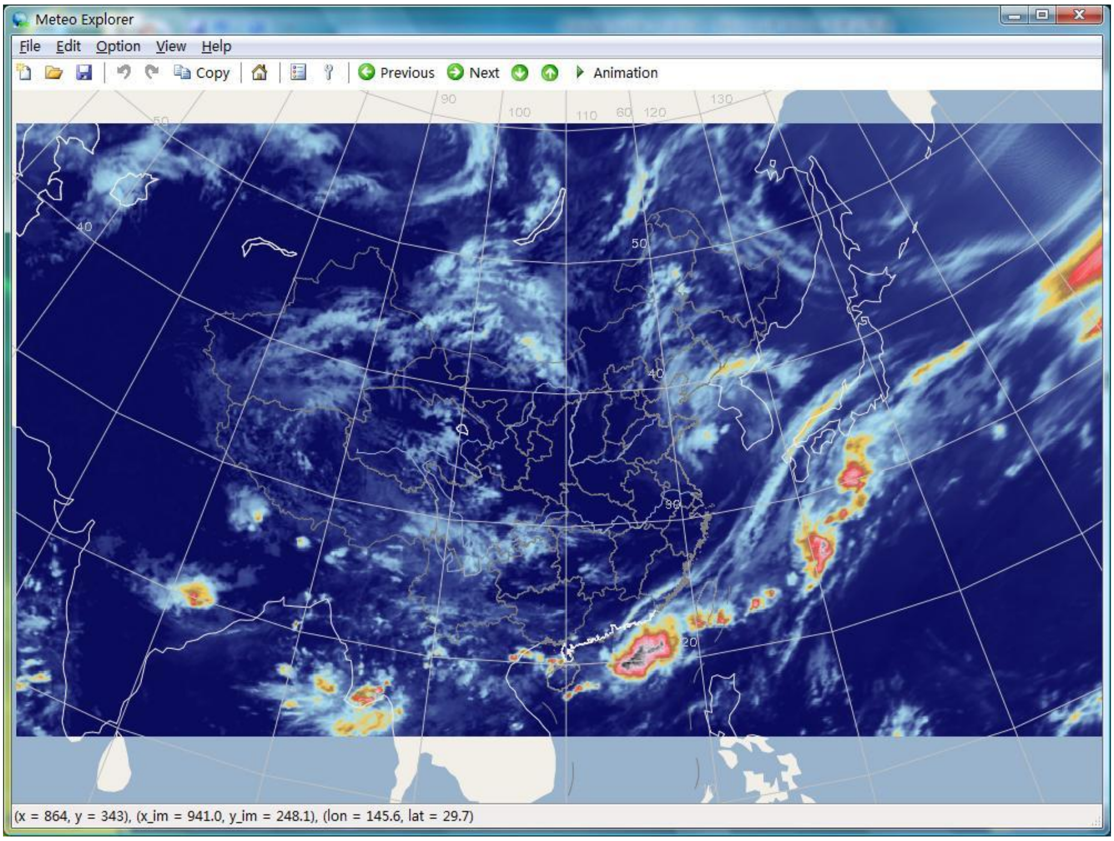


Figure 17-6: Visualization of a multi-channel high-resolution nephogram data file encoded in GPF format.

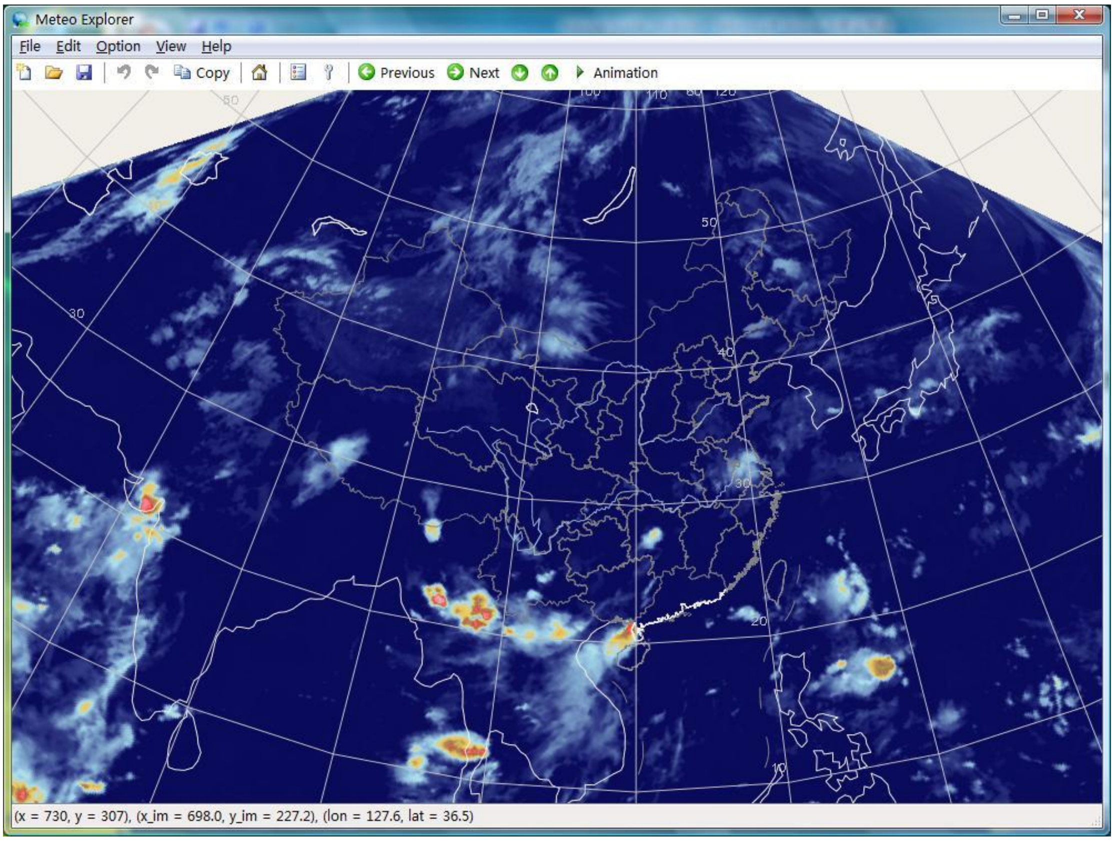


Figure 17-7: Visualization of a multi-channel high-resolution nephogram data

file encoded in GPF format.

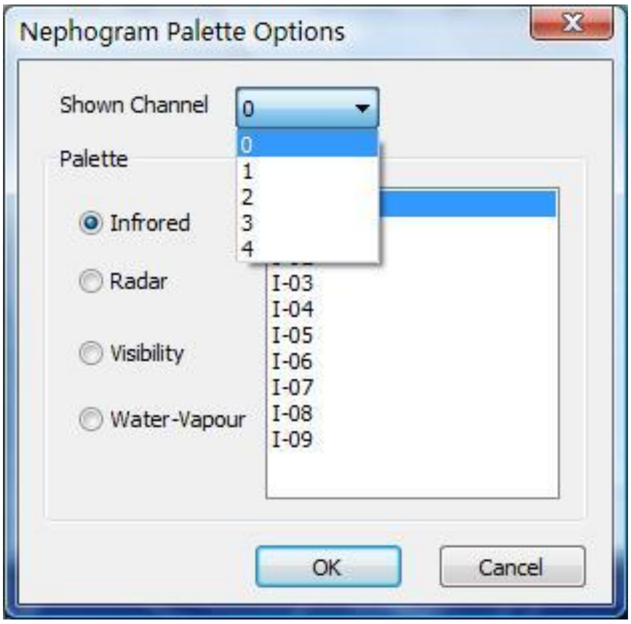


Figure 17-8: For a multi-channel nephogram graphics layer, the “Shown Channel” combobox control will be enabled so that users may select one of the channels for visualization.

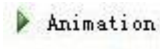
17.4 Customize Palette

MeteoExplorer provides users with the ability to customize nephogram palettes. MeteoExplorer organizes the palettes into four categories: Infrored (I), Radar (R), Visibility (V), and Water-vapor (W). Each category has ten palettes numbered from 00 to 09. For example, the resource file for the last palette in Infrored category is named I-09.pal. If user wants to replace default I-09 with her own palette, she can write a new palette file by following the predefined palette format and named it I-09.pal. And then copy the new file to the MeteoExplorer installation folder that is introduced in section 2.2 on page 9.

The format is nephogram palette file is simple. In the beginning of the file, there is a row specifying how many colors are used in the palette. Note that the keyword “ncolors” cannot be changed. Then the file includes lines of red/blue/green components that define a single color. The example below illustrates a 256 gray-scale palette:

ncolors=256
0 0 0
1 1 1
2 2 2
…
254 254 254
255 255 255

17.5 Animation

Play animation with a collection of nephograms is a common operation users require. To start an animation, the user should first select the nephogram graphics layers of interested in the "Graphics Layer" window, and then click the "Animate" button 

(Windows build),  (Unix/Linux build) on the toolbar. Once the animation starts, the "Animate" button will be changed to 

(Windows build),  (Unix/Linux build. To stop the animation, the user may click the same button.

It should be noted that the nephogram or RADAR data files used for an animation should be put in the same directory. In an animation, MeteoExplorer will sort these files by their names, and load and visualize them one by one. What the last file in the directory is processed, the animation will repeat by playing the first file in the directory.

In fact, animation is just a special form of graphics layer navigation in which the data files are processed and visualized one after another, but in an automatic instead of manual manner. Therefore users can do animation for all kinds of graphics layers in MeteoExplorer.

Tip: Animation is just a special form of graphics layer navigation in which the data files are processed and visualized one after another in an automatic manner. Therefore users can do animation for all kinds of graphics layers.

Chapter 18 Cross Section Graphics

剖面图是气象科研、业务人员常用的图形分析、显示方式之一，因此剖面图制作功能是气象软件必备的一项功能。MeteoExplorer 于 1.2 版本中新增了这项功能。

18.1 Preparation

在 MeteoExplorer 中制作剖面图，请首先选择菜单项“工具，制作剖面图”，或者点击工具栏中的“制作剖面图”按钮（），以打开剖面图窗口（图 18-1）。在开始状态下，由于还没有制定数据源以及剖面所在的空间位置，因此窗口中并没有显示任何图形。

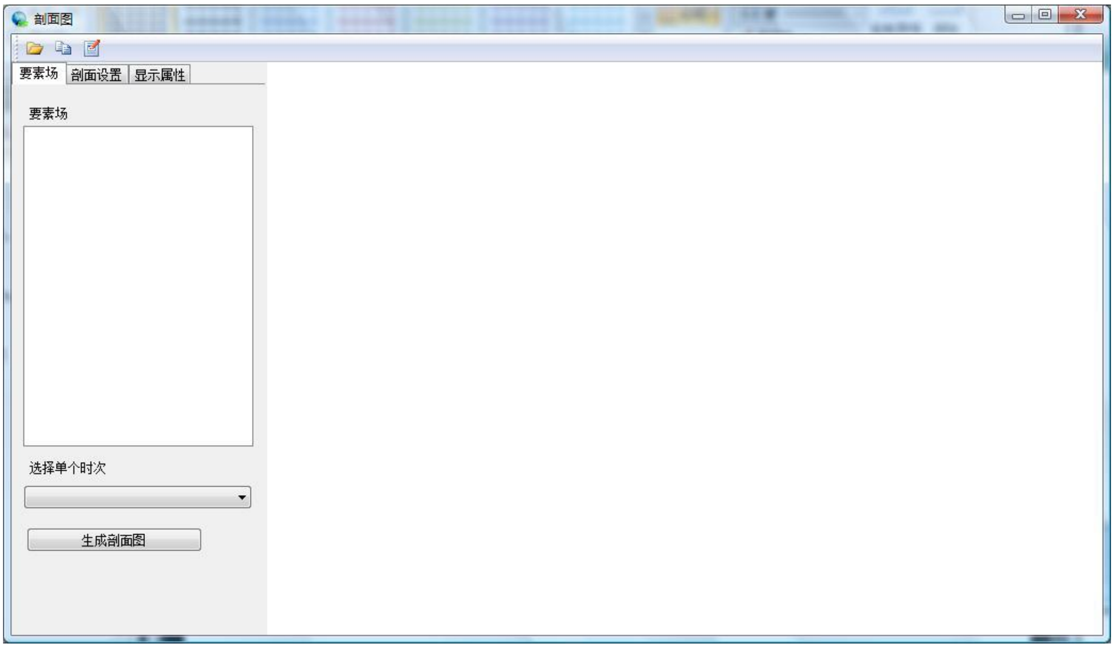


图 18-1：通过选择菜单项“工具，制作剖面图”，或者点击工具栏中的“制作剖面图”按钮来剖面图窗口。开始状态下剖面图窗口并没有显示任何图形。

18.1.1 Toolbar

表 18-1 给出了剖面图窗口中工具栏中每个按钮的含义及功能。通过使用“复制到剪贴板”按钮控件，用户可以轻松地将窗口显示内容以 EMF 矢量图的格式复制到剪贴板，以满足出版或者撰写文章的需要。另外两个按钮的功能将在接下来的两个小节中详细介绍。

表 18-1：剖面图窗口工具栏中每个按钮说明及其功能。

控件名称	按钮上的图像	控件功能

选择数据文件		单击此按钮打开“打开文件”对话框。用户在此选择制作剖面图的数据文件。
复制到剪贴板		将窗口显示内容以 EMF 矢量图的格式复制到剪贴板。
绘制剖面空间		在程序主窗口中以交互的方式绘制剖面图所在的空间位置。

18.1.2 Specify the data source files

要指定剖面图的数据源文件，请点击剖面图窗口工具栏中的“选择数据文件”按钮，并在接下来出现的打开文件对话框中选择制作剖面图所需要的数据源文件。目前 MeteoExplorer 只支持以 NetCDF、GRIB1/GRIB2、和 GrADS 编码格式存储的模式数据文件，并以文件的扩展名来判断该文件的编码格式。因此请您为您的数据文件加上适当的扩展名。NetCDF 文件的扩展名为 nc；GRIB1（GRIB2）文件的扩展名为 grib（grib2）；GrADS 文件的扩展名为 ctl。

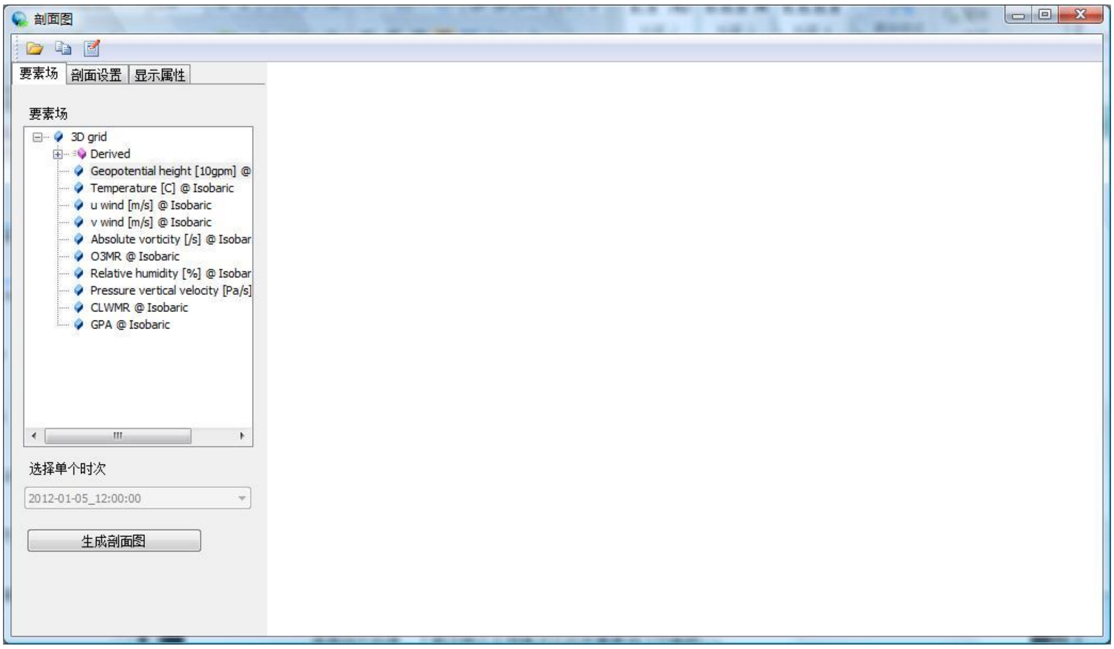


图 18-2：当成功的打开一个模式数据文件后，文件中所有三维及其以上结构的要素将会以显示在窗口左侧名为“要素场”的树型结构控件中。

当成功的打开一个模式数据文件后，文件中所有三维及其以上结构的要素将会以显示在窗口左侧名为“要素场”的树型结构控件中（图 18-2）。由于二维结构的要素无法用来制作剖面图，因此二维结构的要素将不被显示。如果一个数据文件中没有三维及更高维度结构的要素的话，那么 MeteoExplorer 认为这个数据文件无效，即无法用于制作剖面图。

当用户需要改变数据源文件时，可以再次点击“选择数据文件”按钮，然后选择新的文件。这时，原来的数据源文件将不再有效。如果当前已经有制作好的剖面图，那么这些剖面图将基于新的数据源文件重新制作生成。

小提示：

- 目前 MeteoExplorer 只支持以 NetCDF、GRIB1/GRIB2、和 GrADS 编码格式存储的模式数据文件，请确保您的数据文件使用了恰当的扩展名。NetCDF 文件的扩展名为 nc；GRIB1（GRIB2）文件的扩展名为 grib（grib2）；GrADS 文件的扩展名为 ctl。
- 通过再次点击“选择数据文件”按钮，并选择新的文件，您可以改变数据源文件。这时，原来的数据源文件将不再有效。

18.1.3 Plot a Apatial Location

要制作剖面图，除了指定数据源外，我们还要给出剖面的空间位置。MeteoExplorer 提供了两种指定剖面的空间位置、即起始经纬度的方法：
第一，以交互的方式在 MeteoExplorer 主窗口的地图底图上绘制一条线段，线段的起点和终点所对应的经纬度位置即剖面的起始经纬度；
第二，在剖面图窗口左侧的属性设置子窗口的“剖面设置”页面中，通过输入起始经纬度数值来确定剖面的空间位置。
下面就详细介绍这两种方法。

交互绘制一条线段确定剖面的空间位置

要以交互的方式确定剖面的空间位置，首先请点击工具栏中的“绘制剖面空间”按钮，点击后剖面图窗口将自动最小化到系统任务栏，同时 MeteoExplorer 主窗口处于所有窗口的最上一层以接受用户输入。绘制线段的方法与第 15.2.2 节“ Vector-Type Weather Symbol”（第 145 页）中介绍的绘制方法相同，即首先单击鼠标左键确定线段的起点，然后移动调整线段的走向和长度，最后单击鼠标左键确定线段的终点。

绘制完毕后，线段将显示在 MeteoExplorer 主窗口中，同时线段的两个端点处将显示端点所对应的经纬度数值（图 18-3）。此外，在已经指定了有效的数据源的情况下，剖面图窗口的图形显示区中将显示剖面图的坐标系，以表示制作剖面图的准备工作已经完毕（图 18-4）。注意到剖面图窗口左侧的属性设置子窗口的当前页面变为“剖面设置”页面，以方便用户查看线段端点的经纬度数值。

在“剖面设置”页面中通过输入起始经纬度数值来确定剖面的空间位置

另外一种确定剖面空间位置的方法是在“剖面设置”页面中直接指定起始经纬度数值。如图 18-4 所示，用户可以直接在“开始经度”、“开始纬度”、“终止经度”、和“终止纬度”这四个编辑控件中输入经纬度数值，然后点击页面下方的“应用更改”按钮来指定剖面的空间位置。用户在“剖面设置”页面中所做的修改也将反映到程序主窗口显示的剖面线段上。

实际操作中，用户往往可以同时使用这两种方法来调整剖面的空间位置。

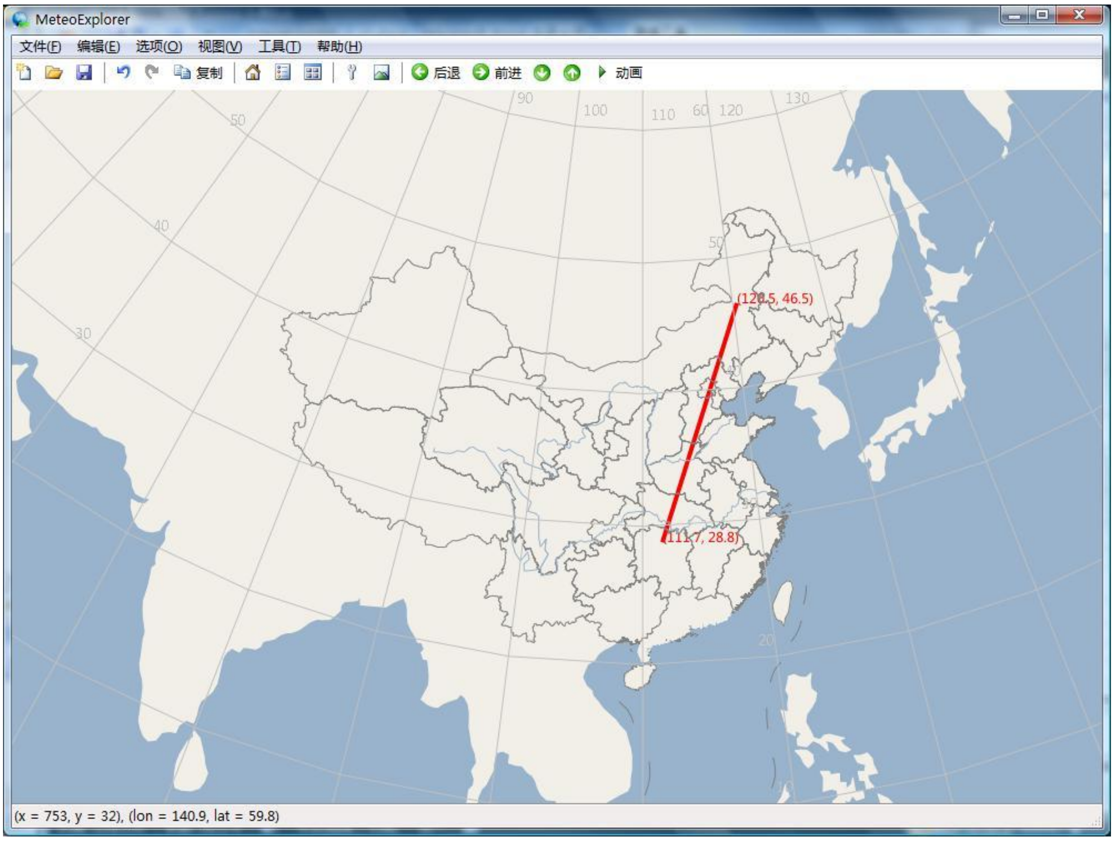


图 18-3：绘制的线段将显示在 MeteoExplorer 主窗口中，同时线段的两个端点处将显示端点所对应的经纬度数值。

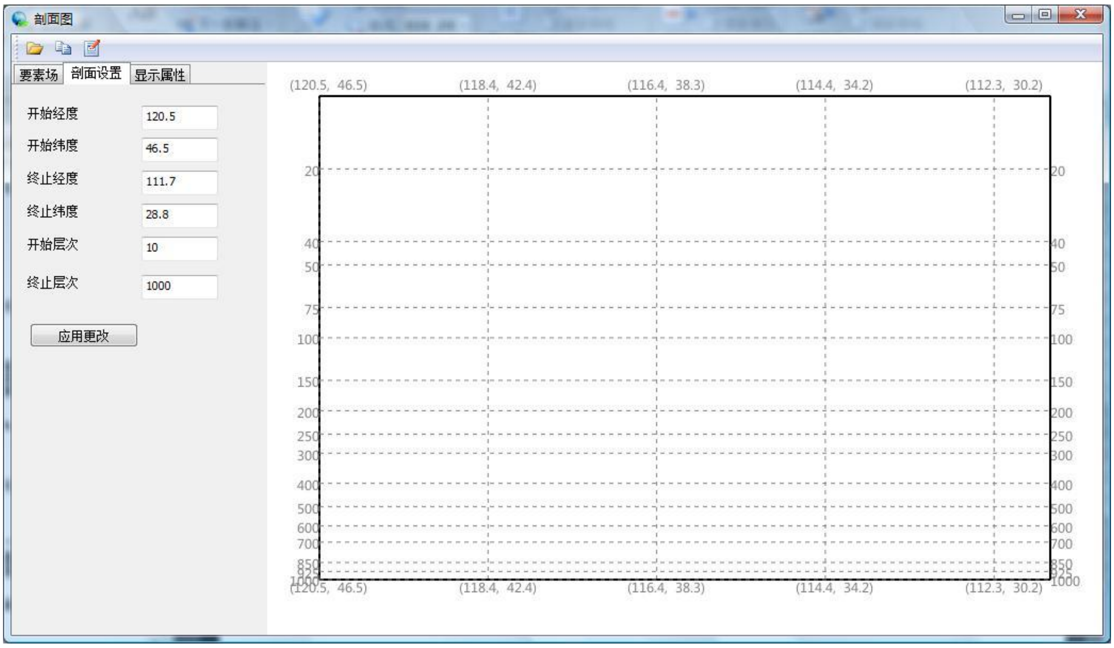


图 18-4：当用户指定了有效的数据源，并成功地绘制了剖面线段后，剖面图窗口的图形显示区中将显示剖面图的坐标系，以表示制作剖面图的准备工作已经完毕。

总之，第 18.1.2 节和第**错误！未找到引用源。**节所介绍的内容正是制作剖面图之前的两项准备工作。需要指出的是，这两项准备工作的顺序是任意的。

小提示:指定数据源文件和绘制剖面空间位置线段是制作剖面图的两项必须的准备工作。然而这两项准备工作的顺序是任意的。

18.2 Create and Configure Cross Section Graphics Layer

18.2.1 Create a Cross Section Graphics Layer

当准备工作完成以后,生成剖面图的工作将非常简单。用户所需要做的就是在"要素场"树型控件中选择一个物理量要素,然后在"选择单个时次"控件中选择想要的时次[5]。最后点击"生成剖面图"按钮。新生成的剖面图将显示在剖面图窗口右侧的子窗口中。

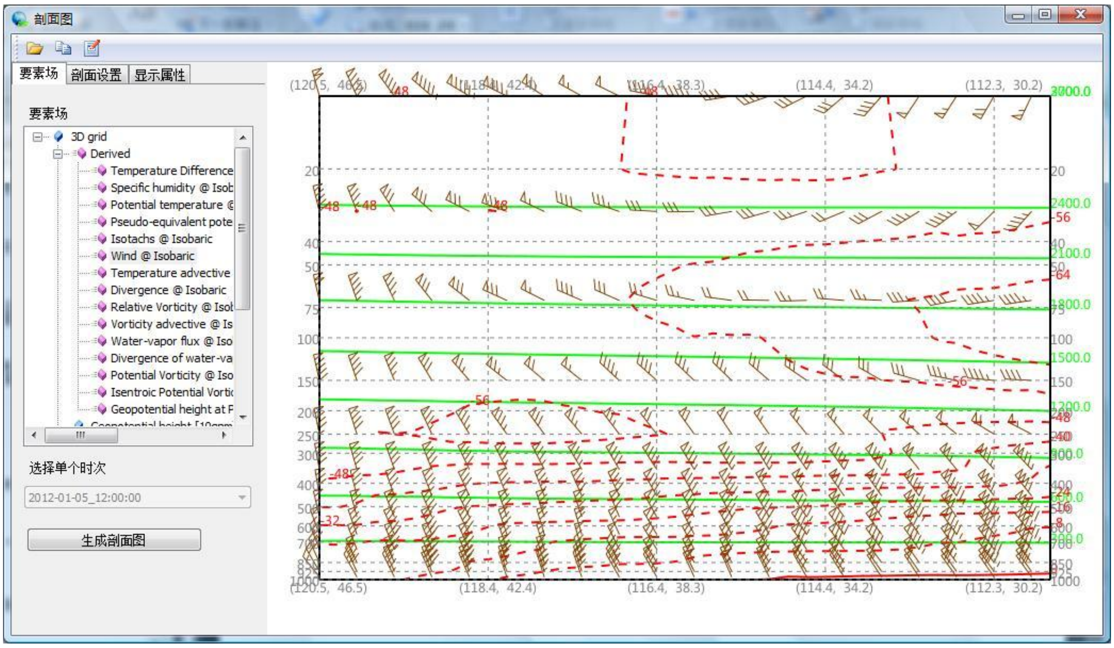


图 18-5:生成剖面图的步骤为:首先在"要素场"树型控件中选择一个物理量要素,然后在"选择单个时次"控件中选择想要的时次。最后点击"生成剖面图"按钮。

图 18-5 显示了用户选择位势高度(绿色实线)、温度(红色虚线)和风场(棕色风杆)后生成的三个剖面图。

18.2.2 Configure Display Properties of a Cross Section Graphics Layer

在 MeteoExplorer 的剖面图窗口中,每个生成的剖面图都被看作一个图层,这样,所有

[5] 如果被选择的要素只有一个时次,那么"选择单个时次"控件将处于禁用状态。

生成的剖面图将按照图层的方式进行管理，如图 18-6 所示。

A　　　　　　　　B

图 18-6：所有已生成的剖面图以图层的方式进行管理。使用方法与第 3.5 节“Graphics Layer Management”中介绍的使用方法相同。此外，页面下方的属性控件内容由所选图层的类型决定。A 显示了格点型图层的属性控件，B 显示了风场图层的属性控件。

要对剖面图图形的显示属性进行设置，请首先在剖面图窗口的属性设置子窗口中选择“显示属性”页面以切换到该页面。此页面的上半部分以列表的形式列出了所有已生成的剖面图。列表下方是名为“显示”、“隐藏”、“删除”、和“属性”四个按钮。图层列表与四个按钮的使用方法与第 3.5 节“Graphics Layer Management”（第 29 页）中介绍的图层使用方法相同。当选中了一个图层，然后点击“属性”按钮后，会在页面的下半部分显示一系列该所选图层相关的控件。例如图 18-6A 显示了格点型图层的属性控件；图 18-6B 显示了风场图层的属性控件。用户可以通过修改这些控件的数值来改变图层的显示属性，并通过点击“应用属性修改”按钮使新的属性生效。

18.2.3 Modification of Vertical Range

在剖面图的实际应用中，用户往往只关心某一高度范围内的数据内容，因此，MeteoExplorer 在剖面图窗口中增加了设置起始高度层次的功能。

要设置显示高度范围，请在剖面图窗口左侧的属性设置子窗口中选择“剖面设置”页面以切换到该页面。然后修改“开始层次”或“终止层次”编辑控件的内容，最后点击“”按钮湿修改生效。图 18-7 显示了在图 18-5 的基础上，将开始层次改为 200hPa，并将温度等值线填色后的显示结果。

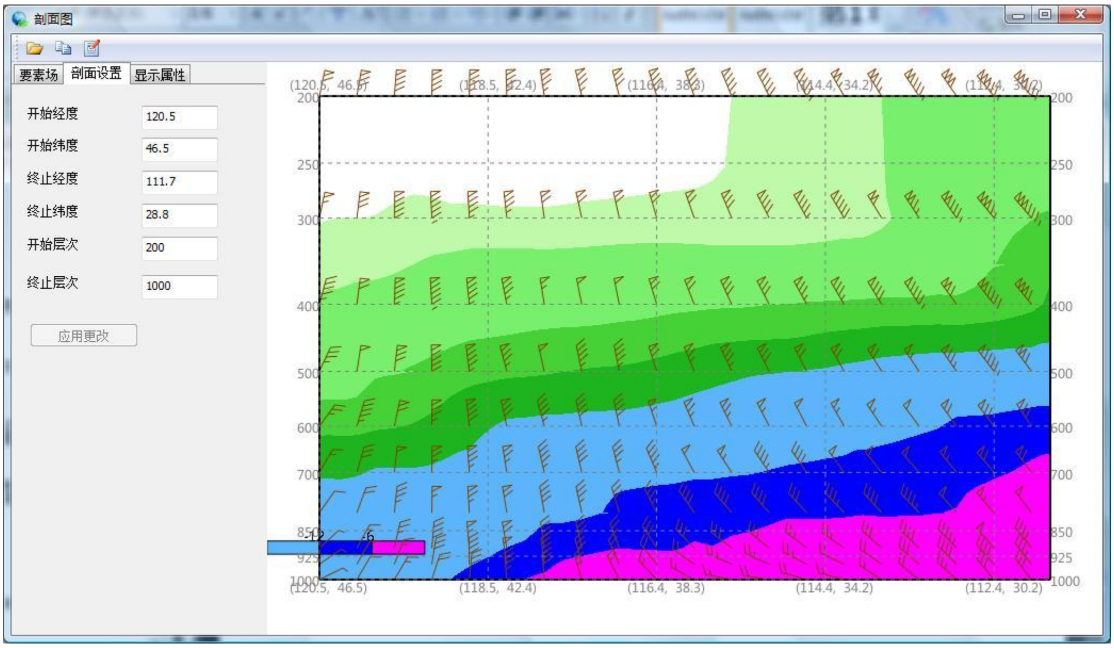


图 18-7：用户可以通过修改剖面图铅直方向上显示范围，和每个图层的显示属性来定制图形显示结果。

Chapter 19 New Type Data Display

从 Chapter 6 到 Chapter 17，我们介绍了常用的气象数据的分析与显示。近些年来，大量新型的非常规数据得到了广泛地使用。MeteoExplorer 也开始逐步增加对这些非常规数据的支持。

19.1 Stamp Graphics Display

邮票图是集合预报中一种常用的显示方式。在 MICAPS 中专门用第 118 类数据来表示邮票图。打开邮票图文件的方法与打开其它文件的方法相同，图 19-1 显示了一幅 2012 年 9 月 22 日 00 时欧洲中心数值模式海平面气压的集合预报。

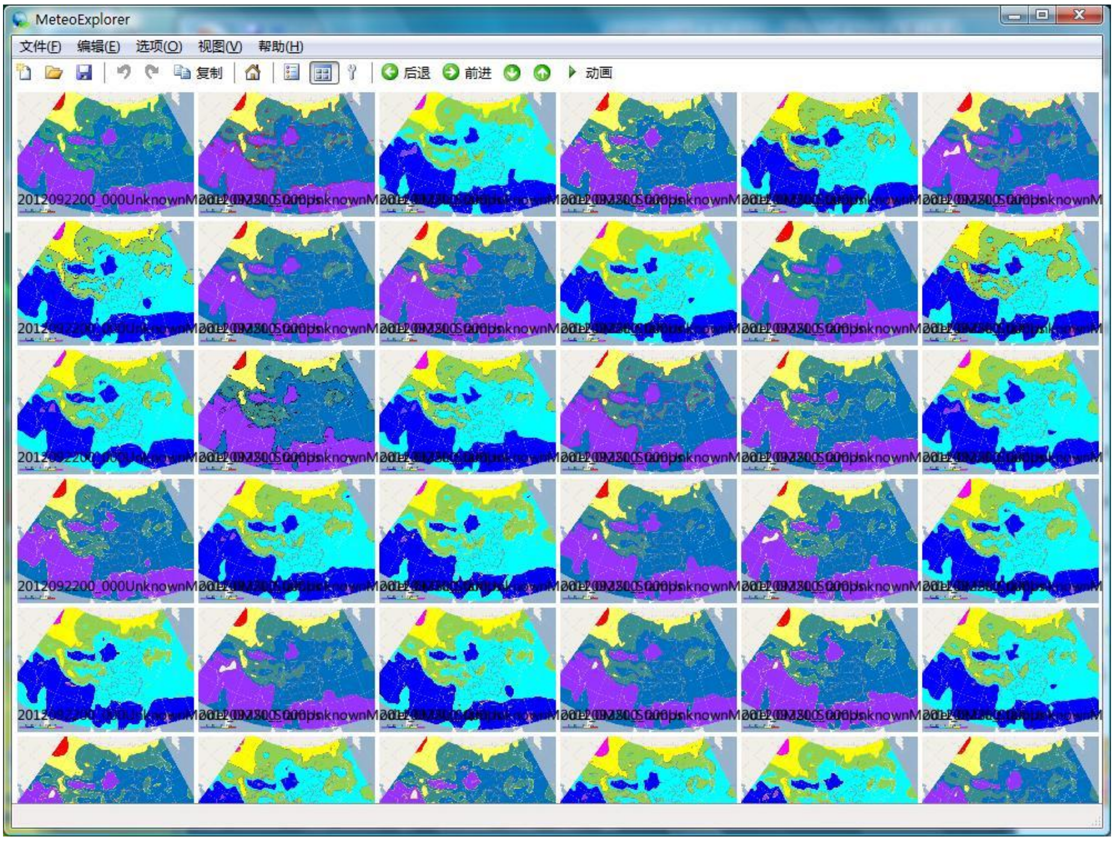


图 19-1：MeteoExplorer 对于邮票图文件默认以缩略图的形式进行显示。本图显示了一幅 2012 年 9 月 22 日 00 时欧洲中心数值模式海平面气压的集合预报。

注意到图 19-1 中工具栏中的“缩略图显示”按钮（）处于按下状态，表示 MeteoExplorer 对于邮票图文件默认以缩略图的形式进行显示。另一种显示方式就是 MeteoExplorer 常用的图层叠加形式。如图 19-2 所示，用户可以点击“缩略图显示”按钮将 MeteoExplorer 的显示方式切换回图层叠加形式。这时主窗口中将显示邮票图中的第一个成员。

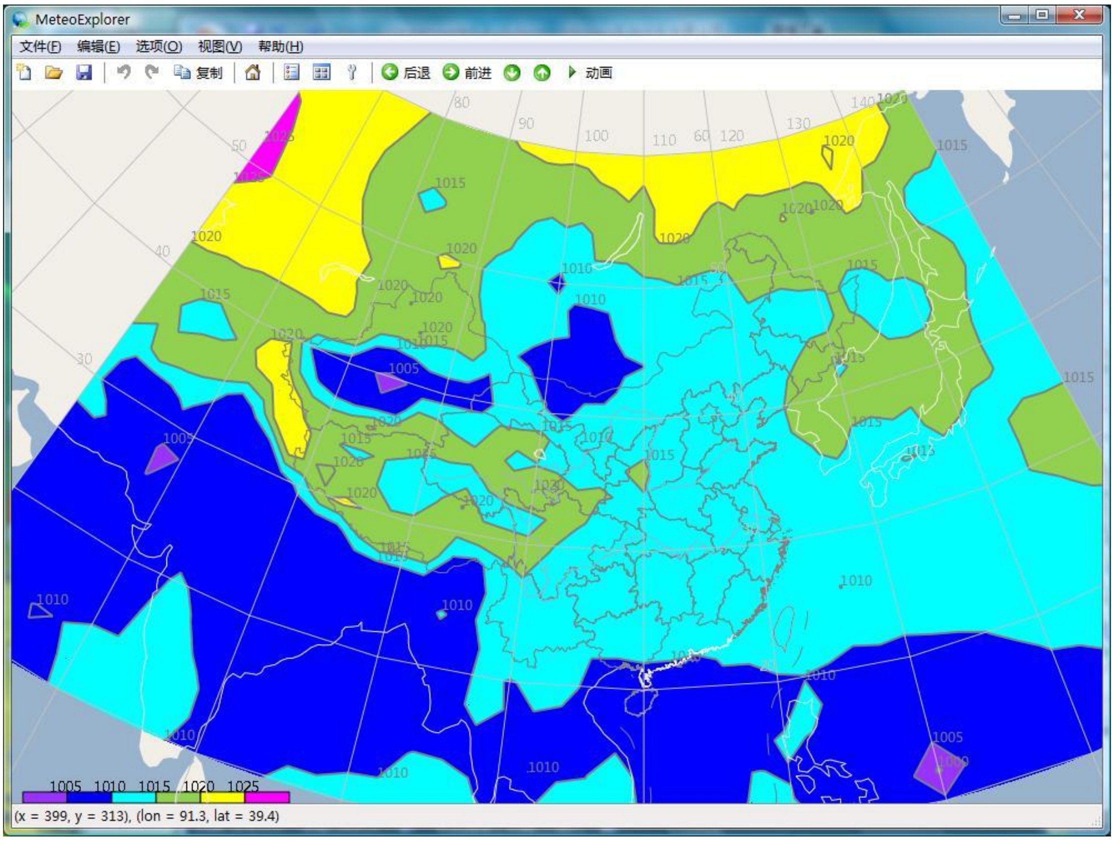


图 19-2：用户可以点击“缩略图显示”按钮将 MeteoExplorer 的显示方式切换回图层叠加形式。这时主窗口中将显示邮票图中的第一个成员。

19.2 L-Band Soundings Data Analysis and Display

L 波段探空数据取自加密的自动观测站，其中包含的高空温度、气压、相对湿度和风等气象要素数据已经成为天气分析和预报的重要依据。L 波段探空数据又分为分数据和秒数据两种。

MeteoExplorer 对 L 波段探空数据的操作、显示方式与对 MICAPS 第五类数据的操作、显示方式是一致的。因此请您参考 Chapter 11（第 121 页）以了解如何对 L 波段探空数据进行操作并设置显示属性。当成功打开一个 L 波段探空数据文件后，MeteoExplorer 会显示如图 19-3 所示的探空分析（Soundings Analysis）窗口。图 19-3 显示的是 2011 年 2 月 9 日 00 时的 L 波段探空观测分数据。

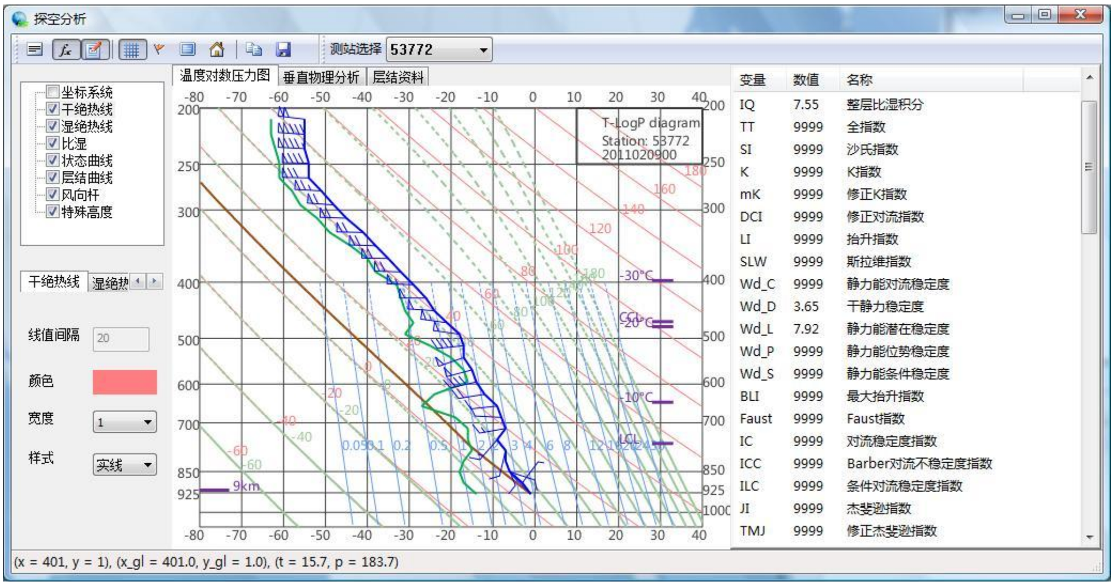


图 19-3：MeteoExplorer 对 L 波段探空数据的显示方式与对 MICAPS 第五类数据的显示方式是一致的。当成功打开一个 L 波段探空数据文件后，MeteoExplorer 会显示探空分析（Soundings Analysis）窗口

从 1.3 版本开始，MeteoExplorer 对地理信息系统功能进行了增强。例如，MeteoExplorer 1.3 版本使用了全新的地图数据，包括全球陆地边界、行政国界、河流、世界主要国家和地区的国界和省界。数据准确、来源具有权威性和很高的可信度。此外，MeteoExplorer 1.3 版本增加了对一些常用地理信息系统数据的支持，如 ESRI 公司的 shapefile 数据格式等。

19.3 ESRI Shapefile Display

Shapefile 数据格式由 ESRI 公司提出，以非拓扑几何结构另加属性信息的形式保存了空间地理信息数据。借助其处理速度快，可编辑的优势，Shapefile 数据格式已经成为地理信息系统领域中最常用的数据交换格式。

一个 shapefile 数据集至少包括基础文件名相同，但扩展名不同的三个数据文件：

- .shp：保存定点数据。
- .shx：保存.shp 文件中的索引数据。
- .dbf：保存.shp 文件的属性信息。

要在 MeteoExplorer 中打开一个 shapefile 数据文件，请打开 shapefile 数据集中扩展名为.shp 的文件。当成功的打开一个 Shapefile 数据文件后，MeteoExplorer 主窗口中将显示对应 Shapefile 数据文件的图层。图 19-4 显示了打开 GADM 提供的韩国行政国界 Shapefile 数据后的图形显示结果。

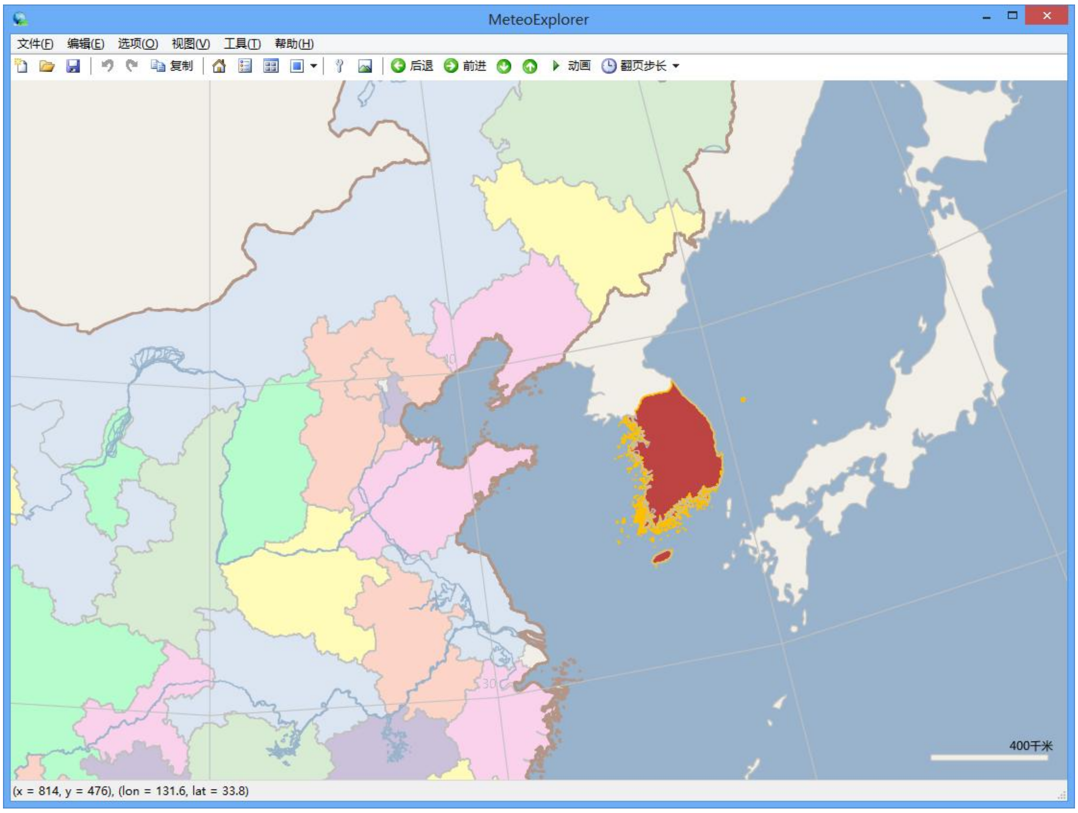


图 19-4：本图显示了打开 GADM 提供的韩国行政国界 Shape 数据后的图形显示结果。

一个 Shapefile 数据文件通常包含三种类型的形状：点、线和多边形。对于点类型或者线类型的形状，MeteoExplorer 直接在主窗口中绘制点或直线。对于多边形类型的形状，MeteoExplorer 除了绘制多边形的边界之外，还对内部进行填充。用户可以通过如下图所示的“Shape 图层属性”对话框设置图层的显示属性。要调出该对话框，请在顶部的应用程序工具栏中选择相应的 shape 图层。

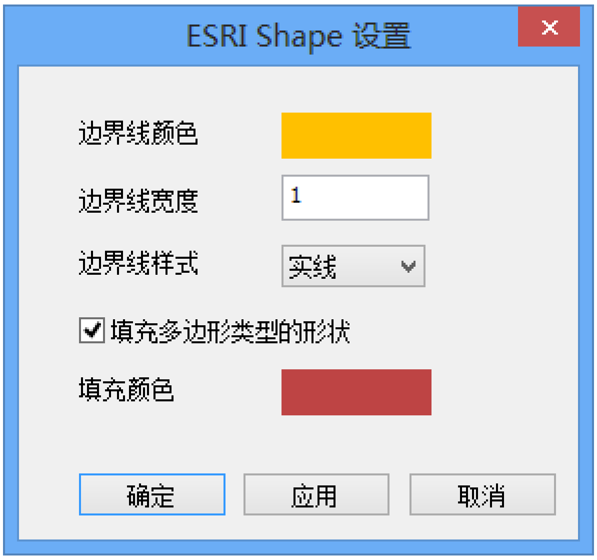


图 19-5：用户可以通过“ESRI Shape 图层设置”对话框来设置图层的显示

属性。

图 19-6 给出了对于图 19-4 中的图层，当用户将边界线颜色设置为黑色，并取消多边形内颜色填充后的显示结果。

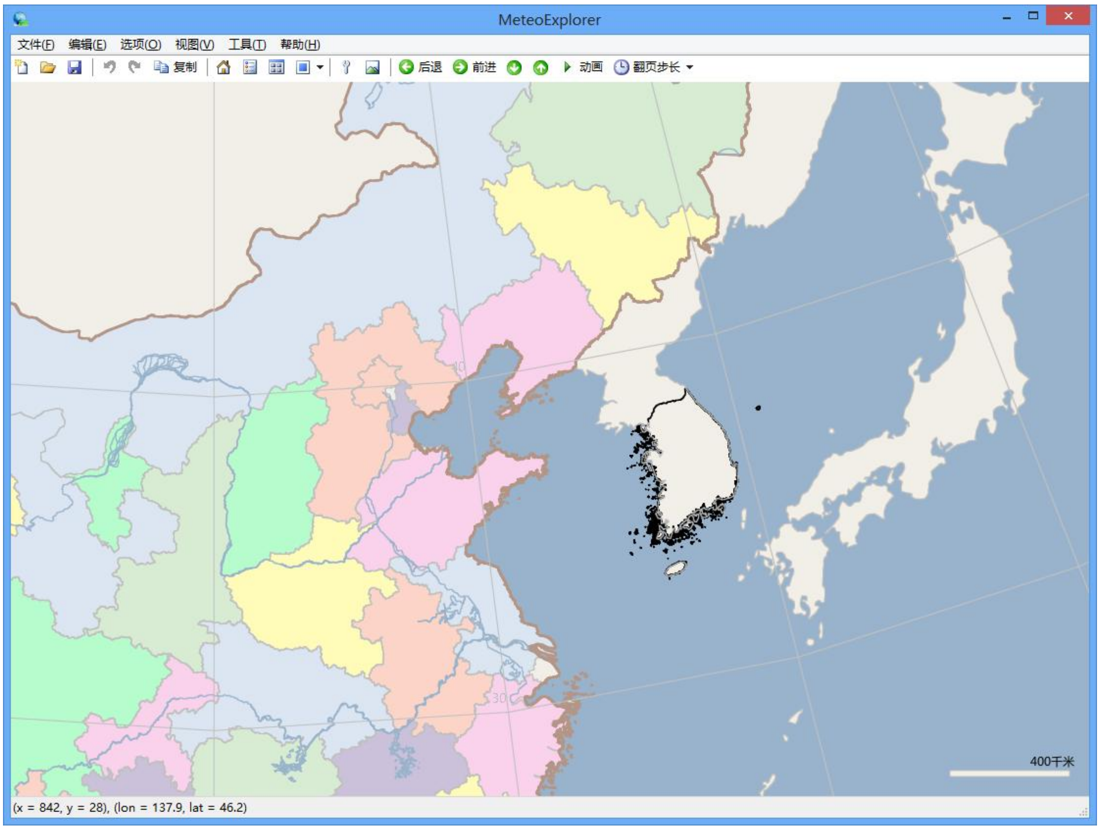


图 19-6：对于图 19-4 中的图层，当用户将边界线颜色设置为黑色，并取消多边形内颜色填充后的显示结果。

Chapter 20 Weather Map Export

20.1 Save as Image File

MeteoExplorer provides the feature to save the rendered contents of application window as an image file. The supported formats include bitmap (BMP), Joint Photographic Experts Group (JPG), and portable network graphics (PNG). To use this feature, users may select the menu item "File, Save As Image" and then enter the file name to be created.

20.2 Save as Windows EMF file

MeteoExplorer is able to save the rendered contents of application window to a Windows EMF (Enhanced Meta Format) file[6]. EMF format is popular vector graphics format that is insensitive to image zoom manipulation. Along with Postscript and PDF, EMF is one of vector graphics formats that are required by technical publications and academic journals.

20.3 Copy to Clipboard

Apart from saving screen contents to an image file, MeteoExplorer can also copy screen contents to system clipboard, so that screen contents can be pasted to another graphics editing software. To perform this operation, users should select the menu item "Edit, Copy", or click the corresponding toolbar button, or use keyboard shortcut "Ctrl+C".
Figure 20-1 illustrates an example in which the screen contents are pasted into PowerPoint.

[6] The feature of saving as Windows EMF file is only available in Windows build.

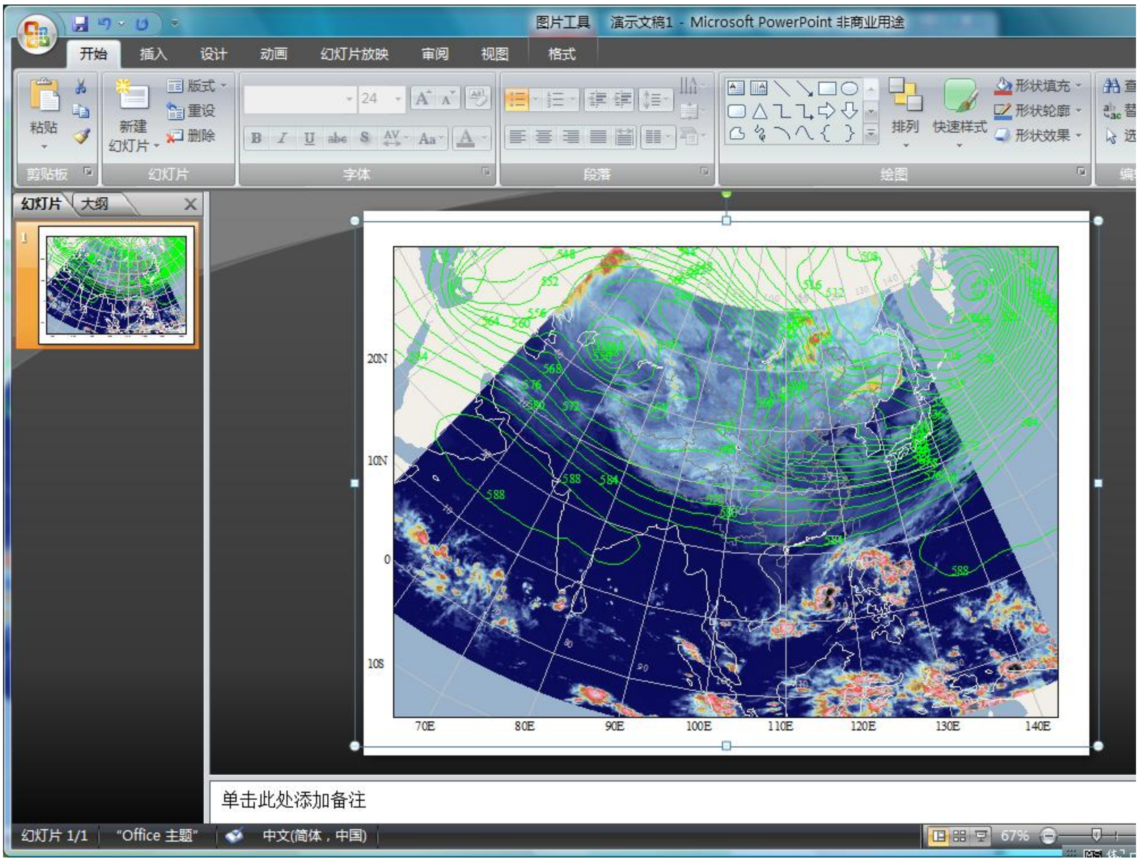


Figure 20-1: MeteoExplorer can also copy screen contents to system clipboard, so that screen contents can be pasted to another graphics editing software.

Figure 20-2 shows another example in which screen contents as rendered in Figure 5-7 (page 64) are pasted in bitmap format into GNU GIMP software, a popular image manipulation program on Linux.

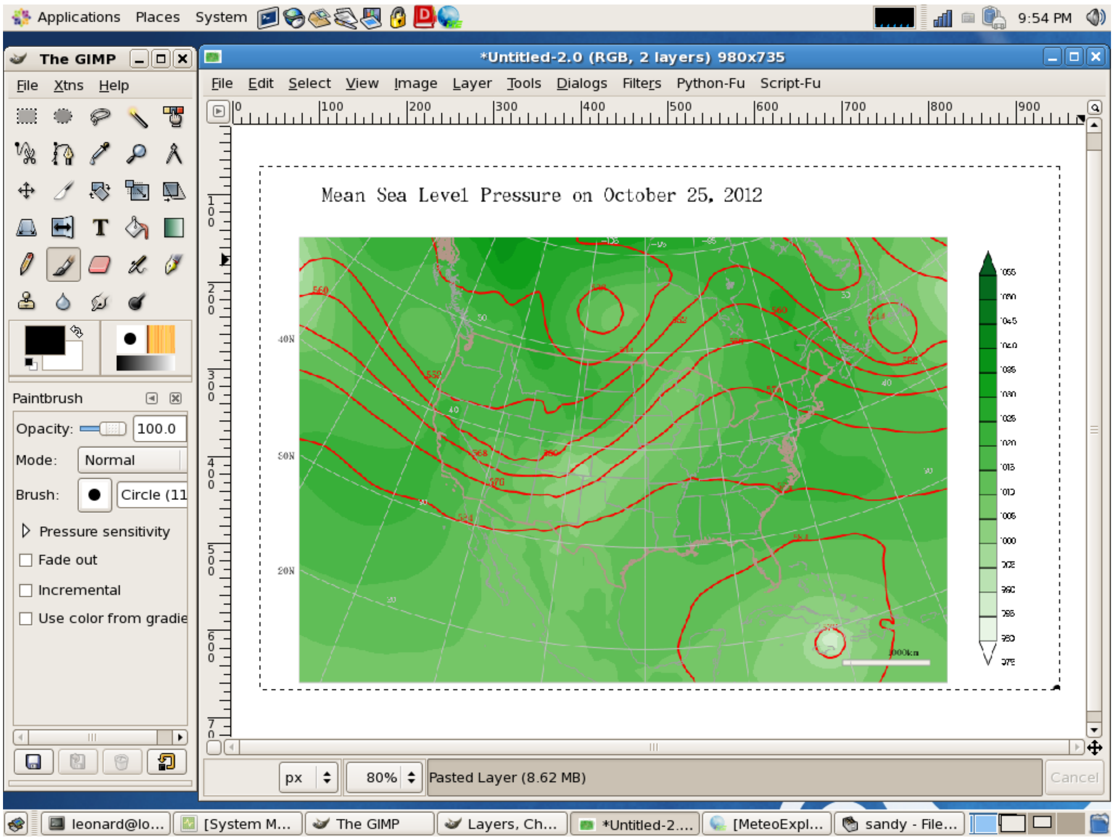


Figure 20-2: Screen contents are pasted in bitmap format into GNU GIMP software.