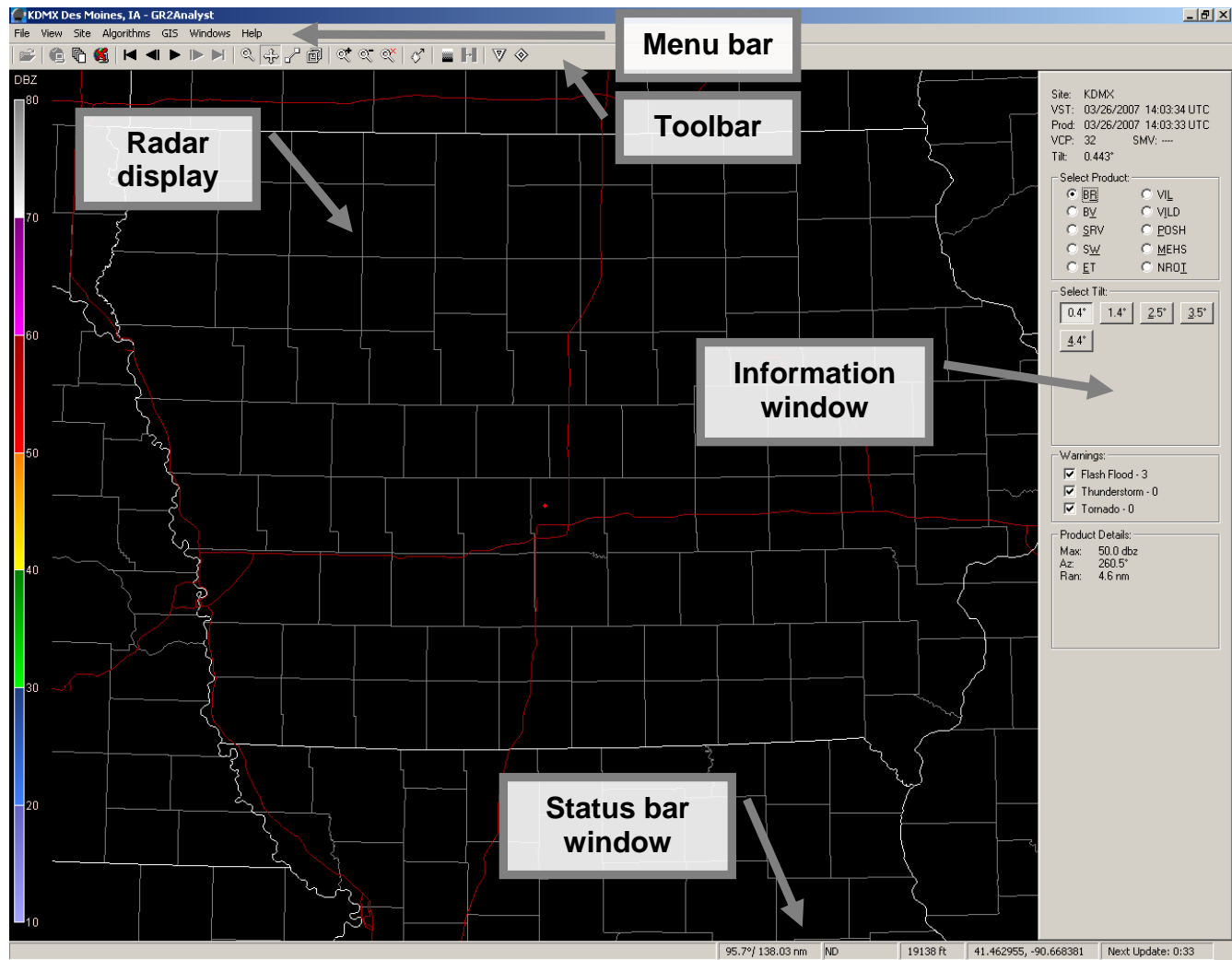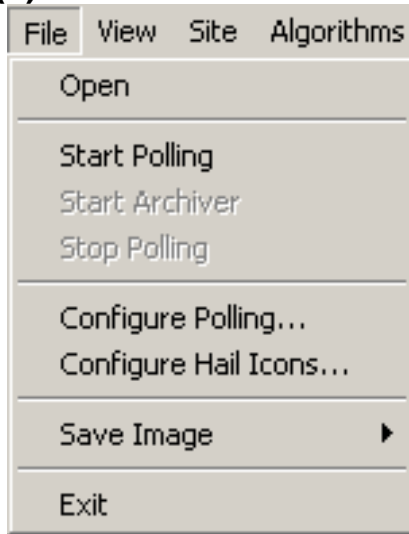# 1. Interface overview



## i.  Menu bar

The menu bar contains seven drop-downs:  File, View, Site, Algorithms, GIS, Windows, and Help.

## (a) File

**Open:** Allows you to open one or more radar files.

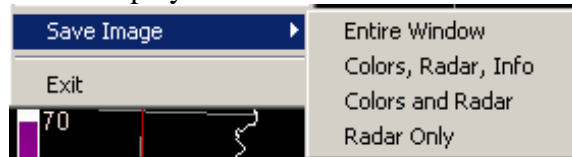**Start Polling:** Tells the software to download radar data as it becomes available.

**Start Archiver:** Downloads previous radar scans to create a loop; the default is one hour of data.

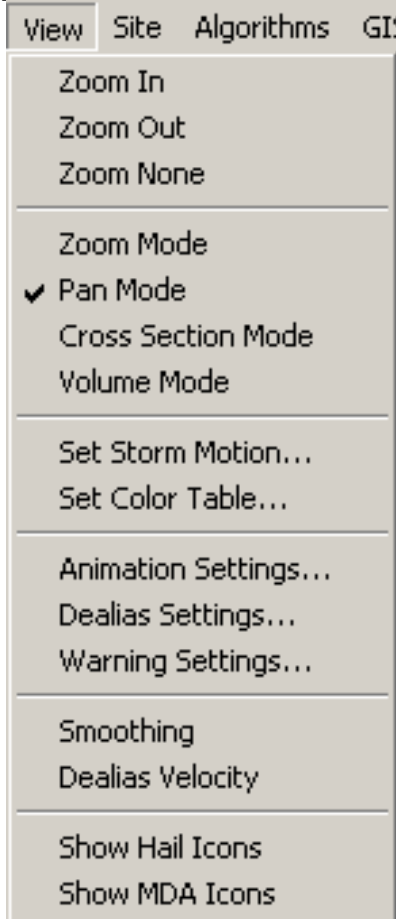**Stop Polling:** Tells the software to stop downloading radar data.

**Configure Polling:** Poll data from some internet source, such as *http://mesonet.agron.iastate.edu/data/nexrd2/raw/*. You can adjust how often you want the software to check for new data and how long to retain files for (e.g. the length of the loop).

**Configure Hail Icons:** You can configure at what calculated hail size a hail icon will show up on the radar display, as well as at what increments you want the software to display the next highest hail size icon.

**Save Image:** You can save a screenshot of the entire GR2AE window; the radar display, color scale, and information window; the radar display and color scale; or just the radar display.

**Exit:** Exits the program.

## (b) View

Zoom In
Zoom Out
Zoom None

Zoom Mode
✔ Pan Mode
Cross Section Mode
Volume Mode

Set Storm Motion...
Set Color Table...

Animation Settings...
Dealias Settings...
Warning Settings...

Smoothing
Dealias Velocity

Show Hail Icons
Show MDA Icons

**Zoom Pane:** Zooms in or out on the center of the current view of the radar display; Zoom None returns you to the default zoomed-out view. You can also zoom with your mouse's scroll wheel.

**Mouse Pane:** Changes the mouse cursor's function to one of four functions:
- To zoom, select "Zoom Mode" and click and drag to create a box that will be your new zoom level. The center of the new zoom level will be where you initially clicked. You can also zoom with your mouse's scroll wheel.
- To pan, select "Pan Mode" and click and drag across the radar display.
- To perform a cross section, select "Cross Section Mode" and click and drag a line across the area you want to have a cross section of (pops a new window).
- To create a volumetric display, select "Volume Mode" and click and drag a box over the area you want to see a 3D display of, similar to how the zoom mouse function works (pops a new window).

**Set Storm Motion:** Allows you to manually enter the speed and direction of a storm to calculate SRM.

**Set Color Table:** Allows you to choose a color table for any of the radar products.

**Animation Settings:** Allows you to adjust how "long" the smooth zoom takes, as well as how far you zoom when clicking the "zoom in" or "zoom out" buttons. Also allows you to adjust how fast the loop animates and how long to dwell on the last frame.

**Dealias Settings:** Allows you to configure the program to change velocity data that cannot be resolved with AE's algorithm to show as No Data and to use the downloaded sounding data.

**Warning Settings:** Allows you to select which server to use for polling warnings, what color to use for each warning, and how thick the warning outline will be. To change the color of a warning, click on the color button and a standard Windows color picker dialog will pop.
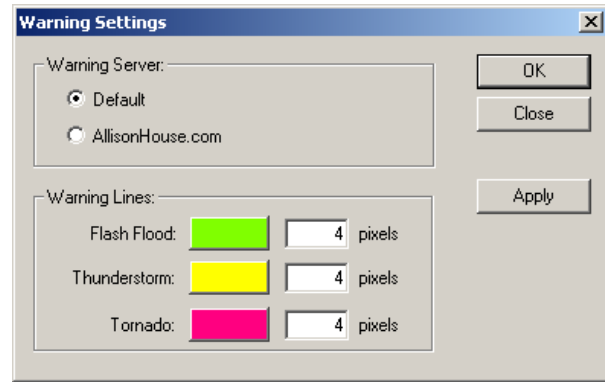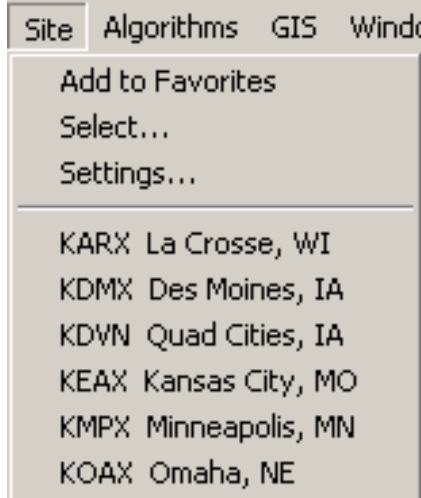
**Smoothing:**  Smoothes the radar product you're viewing via interpolation.

**Dealias Velocity:**  Uses the AE algorithm to dealias the velocity.

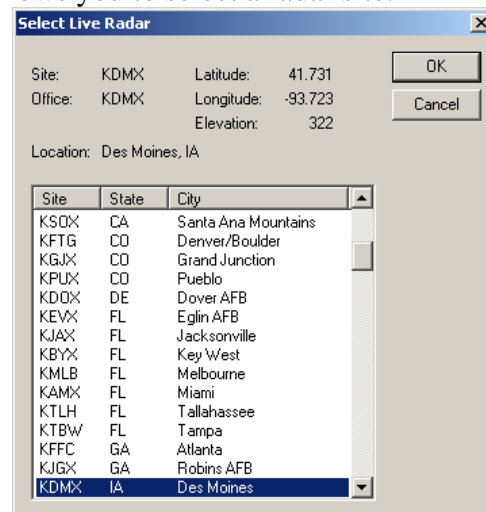**Show Hail Icons:**  Toggles displaying the GR2AE hail icons.

**Show MDA Icons:**  Toggles displaying the GR2AE Mesocyclone Detection Algorithm icons.

## (c)  Site



**Add to Favorites:**  Adds the currently viewed radar site to your Favorites pane.

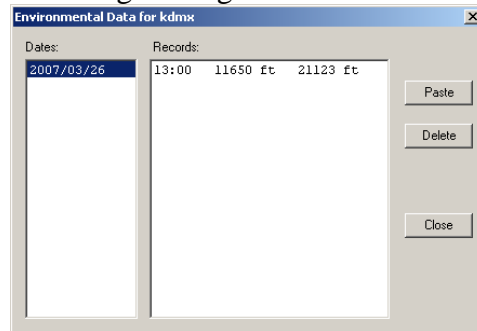**Select:**  Allows you to select a radar site.

**Settings:** Allows you to change the radar site that appears when you first open the program and to add radar sites to your Favorites.

**Favorites pane:** Your Favorite radar sites will appear here.

## (d) Algorithms

Algorithms   GIS   Windows   H

Environment Settings...
Algorithm Settings...
MDA Settings...
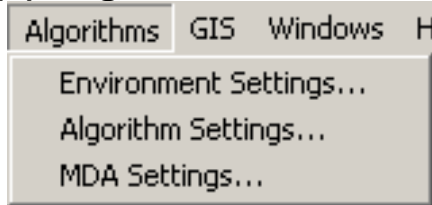
**Environment Settings:** Displays hail environment data settings for the current radar site: Time and the 0ºC and -20ºC levels (in feet) are displayed. AE will automatically download this information if you are polling radar data. If no sounding data can be found, the program defaults to 10,000 and 20,000 feet. You can insert archived sounding data acquired from *http://raob.fsl.noaa.gov*; keep the wind units in knots and the output as FSL Format (ASCII text). Once the information is displayed, you can paste it into the Environment Settings dialog box.

Environmental Data for kdmx

Dates:               Records:

2007/03/26      13:00     11650 ft     21123 ft

Paste

Delete

Close

**Algorithm Settings:** This also affects the hail algorithm output. The defaults should be 56 dBZ and 18.5 dBZ.

Algorithm Settings

Max VIL DBZ:  999.0        OK

Echo Tops DBZ:  18.5        Cancel
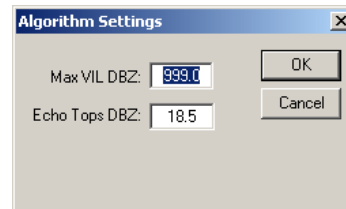
**MDA Settings:** The Mesocyclone Detection Algorithm uses the NROT (normalized rotation) product to find areas of relatively strong rotation. The MDA has different standards for vertically stacked rotations at different distances from the radar site. Storms with a base above 10,000 feet or VIL of 5 or more are not tested. It is best to leave the default values. Locations that pass the MDA tests are displayed on the radar as a colored triangle:

- Green (weak)
- Yellow (moderate)
- Red (strong)
- Purple (extreme)
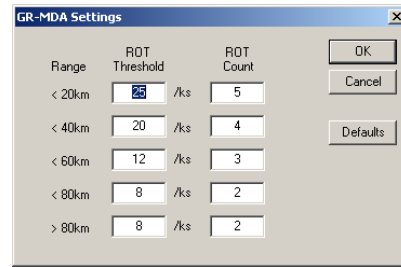
## (e) GIS
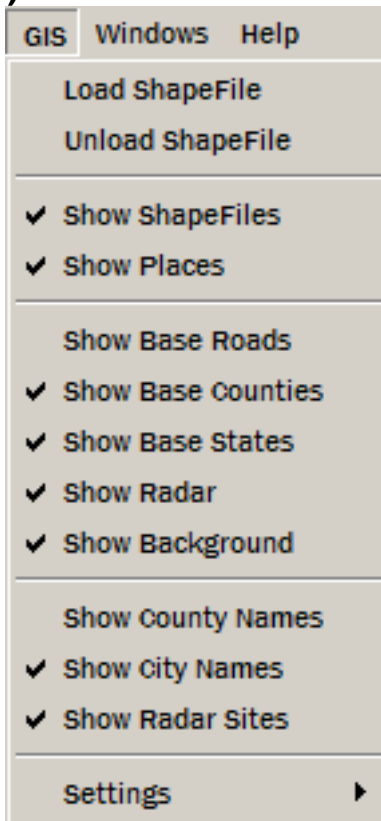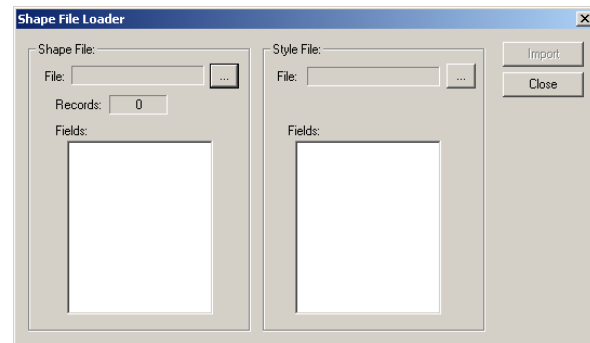


**Load Shapefile:** Brings up a dialog that allows you to load individual shapefiles (e.g. roads in a county) and a style file (which tells the program how to read the shapefile). Information on how to use shapefiles and style files is in the appendix.



**Unload Shapefile:** Brings up a dialog that allows you to remove individual shapefiles.
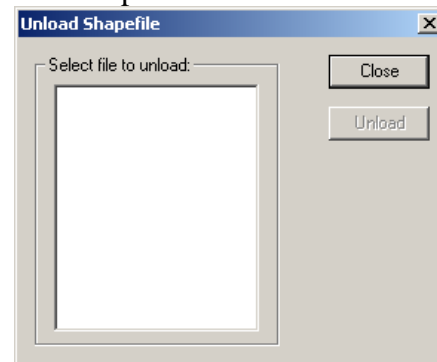


**Show Shapefiles:** Toggles the display of your loaded shapefiles.

**Show Places:** Toggles the display of your loaded placefiles.

**Show Base Roads:** Toggles the display of the roads that come with the program. They are accurate to the resolution of the radar.

**Show Base Counties:** Toggles the display of county outlines.

**Show Base States:**  Toggles the display of state outlines.

**Show Radar:**  Toggles the display of radar data.

**Show Background:**  Toggles the display of a background image, if you have one loaded (such as a topographical image).

**Show County Names:**  Toggles the display of county names.

**Show City Names:**  Toggles the display of city names.

**Show Radar Sites:**  Toggles the display of nearby radar sites.  Clicking on a radar site will take you to that site.
**Settings:**  Allows you to customize some of the GIS options.
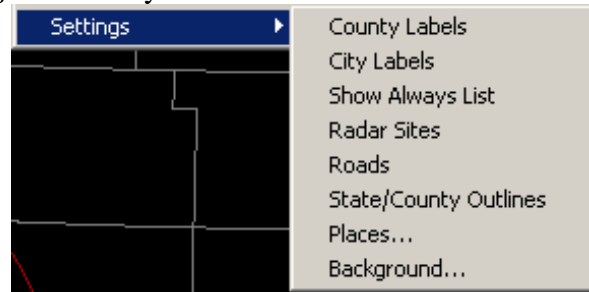


**County Labels:**  Allows you to change the font type, size, and color for county names when they are displayed.
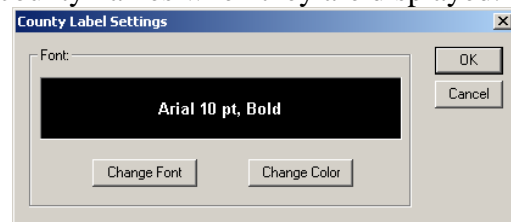


**City Labels:**  Allows you to configure at what zoom level specific city types will appear on the radar display.  Also allows you to change the font type, size, and color for city names when they are displayed.

**Show Always List:** Allows you to select which cities you would like to always appear on the radar display. Cities are listed in alphabetical order from the upper-left drop-down menu. You can add or remove cities from your Show Always list with the buttons in the middle of the dialog.

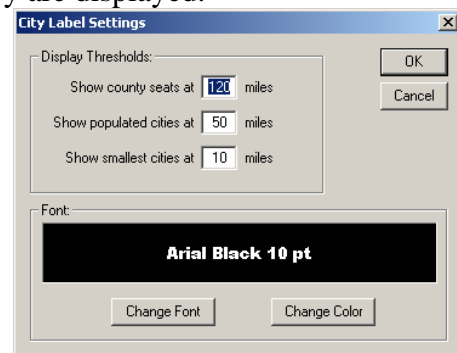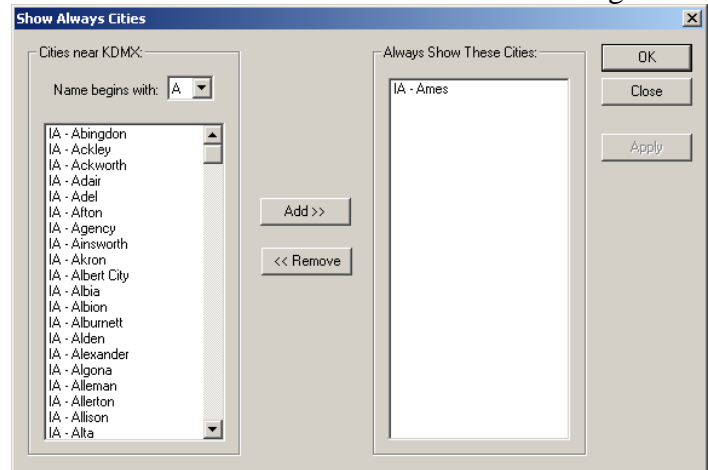**Radar Sites:** Brings up a standard Windows text dialog that allows you to select the font type, size, and color for radar sites when they are displayed.

**Roads:** Allows you to select what color Interstate highways display as, as well as the color and at what zoom level US Highways, state highways, and other highways appear.

**State/County Outlines:** Allows you to select what color you would like state and county outlines to appear as, using the standard Windows color picker.

**Places:** Brings up a standard Windows text dialog that allows you to select font type, size, and color for your locations imported from a text-based placefile.

**Background:**  Allows you to select a solid background color behind the radar (by clicking on the colored panel next to "Fill Color") or to insert a bitmap image as a background (such as a topographical map).  If you have a bitmap background, search for it using the "…" button next to the "File" box.  *Note:*  Downloaded maps will include a text file that will tell you what your latitude and longitude ranges are.
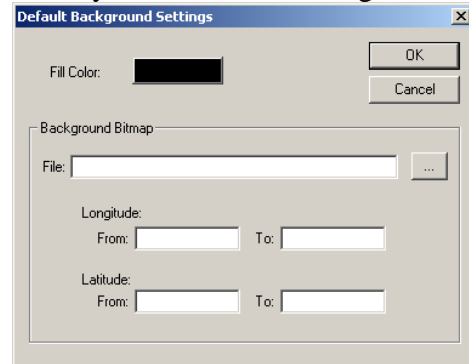
## (f) Windows



**Load Warnings:**  Tells the program to poll tornado, severe thunderstorm, and flash flood warnings.

**Show GPS Monitor:**  If you are running GR2AE on a laptop with a GPS device connected to it, the program will display in icon showing your position on the radar.  This function is really only useful while storm chasing.

**Show Placefile Manager:**  Displays a window that allows you to load, delete, and rearrange placefiles.  The folder icon is for loading a placefile; the "X" is for deleting the placefile you have selected; and the arrows move the placefile you have selected so you can rearrange the order in which they appear.  To display a placefile, select the left checkbox next to the placefile name.  To draw a placefile as an underlay, select the right checkbox (it will only draw as an underlay if the left checkbox is also marked).
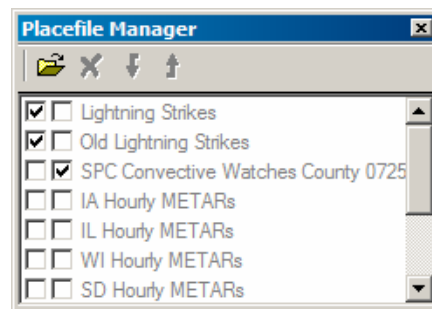


**Show Warnings Window:**  Displays a window that lists all tornado, severe thunderstorm, and flash flood warnings in the nation.  The top panel of the dialog is the type, location, and time of the warning; clicking on a warning will bring up the warning text in the bottom panel of the dialog.

**One Panel:**  Displays one panel for radar data.  This is the default.

**Two Panels:**  Displays two panels for radar data.  Click on one of the panels and then one of the radar products to have that radar product appear in that particular panel. The color scale on the left side of the radar display will change based on which panel you've selected.
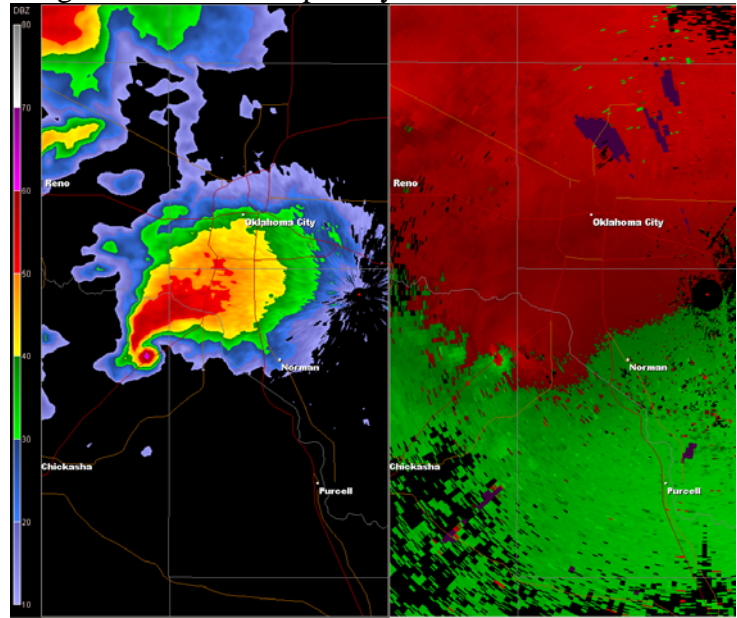


**Four Panels:**  Displays four panels for radar data.  You can display different radar products using the same procedure as the one listed above.
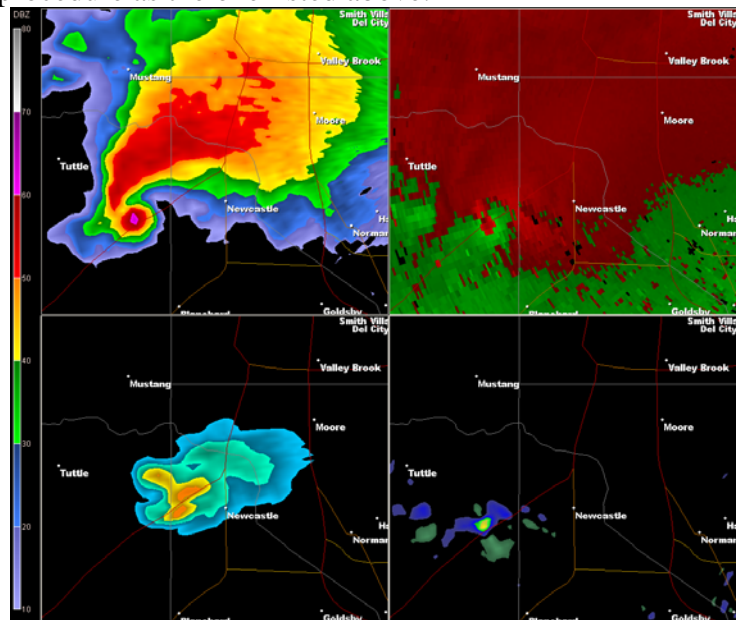


**Save Panel Settings:**  Allows you to save your two- or four-panel settings to quickly load for later use.

## ii. Toolbar

The toolbar is located below the menu bar. It contains eight panes, as described below.

### (a) Open

**Open file:** Allows you to open saved radar files.

### (b) Archiving and polling pane

**Start polling:** The software will download radar data as it becomes available.

**Start archiver:** The software will download previous radar scans to create a loop.

**Stop polling:** The software will stop downloading radar data.

### (c) VCR pane

**First frame:** Displays the first frame in the loop.

**Previous frame:** Displays the previous frame of the loop.

**Start/pause:** Pauses the loop when playing; plays the loop when paused.

**Next frame:** Displays the next frame of the loop.

**Last frame:** Displays the final frame of the loop.

**(d) Mouse pane**

**Zoom mouse:** The mouse cursor becomes a zooming tool. Click and drag to display a zoom box. The zoom centers on where you initially clicked. You can also zoom with your mouse's scroll wheel.

**Pan mouse:** The mouse cursor becomes a panning tool. Click and drag to move around the radar display.

**Cross-section mouse:** The mouse cursor allows you to create a cross-section. Click and drag the mouse to display a line; this will be your cross-section.
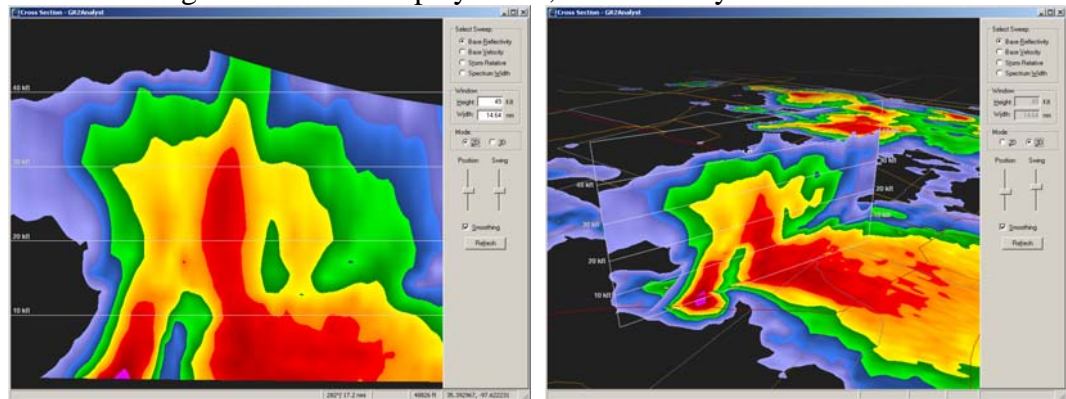


10,000 foot height bars are located across the cross-section radar display. The yellow line is the 0ºC height; the red line is the -20ºC height. Click and drag to move around the display; use the scroll wheel on your mouse to zoom in and out.

A number of options are available on the right-hand side of the display:
- *Select Sweep:* Allows you to select which radar product you would like to view.
- *Window:* Allows you to change what how high and wide to have the 2D display appear.
- *Mode:* Allows you to switch between a 2D and 3D cross-section view.
- *Position and Swing:* Moving the Position bar slides the vertical cross-section back and forth; moving the Swing bar turns the vertical cross-section about a point.
- *Smoothing:* Smoothes the product you're viewing.
- *Refresh:* If a new volume scan has been completed while you were in the cross-section window, clicking this button will update the display.

**Volume mouse:** The mouse cursor allows you to create a volumetric display. Click and drag to display a box (similar to the zoom box) that illustrates the region that will appear in a new volumetric display window (page 19).

**(e) Zoom pane**

**Zoom in:**  Zooms in on the radar display, centered on the current center of the display.  You can also zoom in by scrolling your mouse's scroll wheel away from you.

**Zoom out:**  Zooms out on the radar display, centered on the current center of the display.  You can also zoom out by scrolling your mouse's scroll wheel toward you.

**Zoom none:**  Returns to the initial zoom level.

**(f) Storm motion**

**Set storm motion:**  Allows you to enter in a direction and speed to create a storm-relative motion.  Azimuth is the direction from which the storm is coming (e.g. 0 degrees is north)
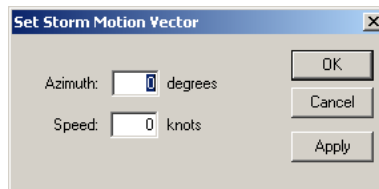
**(g) Interpolation pane**

**Smoothing:**  Smoothes the particular radar product you're viewing via interpolation.  The program will remember what products for which you have smoothing enabled.

**Dealias velocities:**  Attempts to dealias velocities, both base and storm relative.

**(h) Algorithm icon pane**

**MDA icon:**  Toggles displaying the GR2AE Mesocyclone Detection Algorithm icons.

**Hail icon:**  Toggles displaying the GR2AE hail icons.

## iii. Radar display
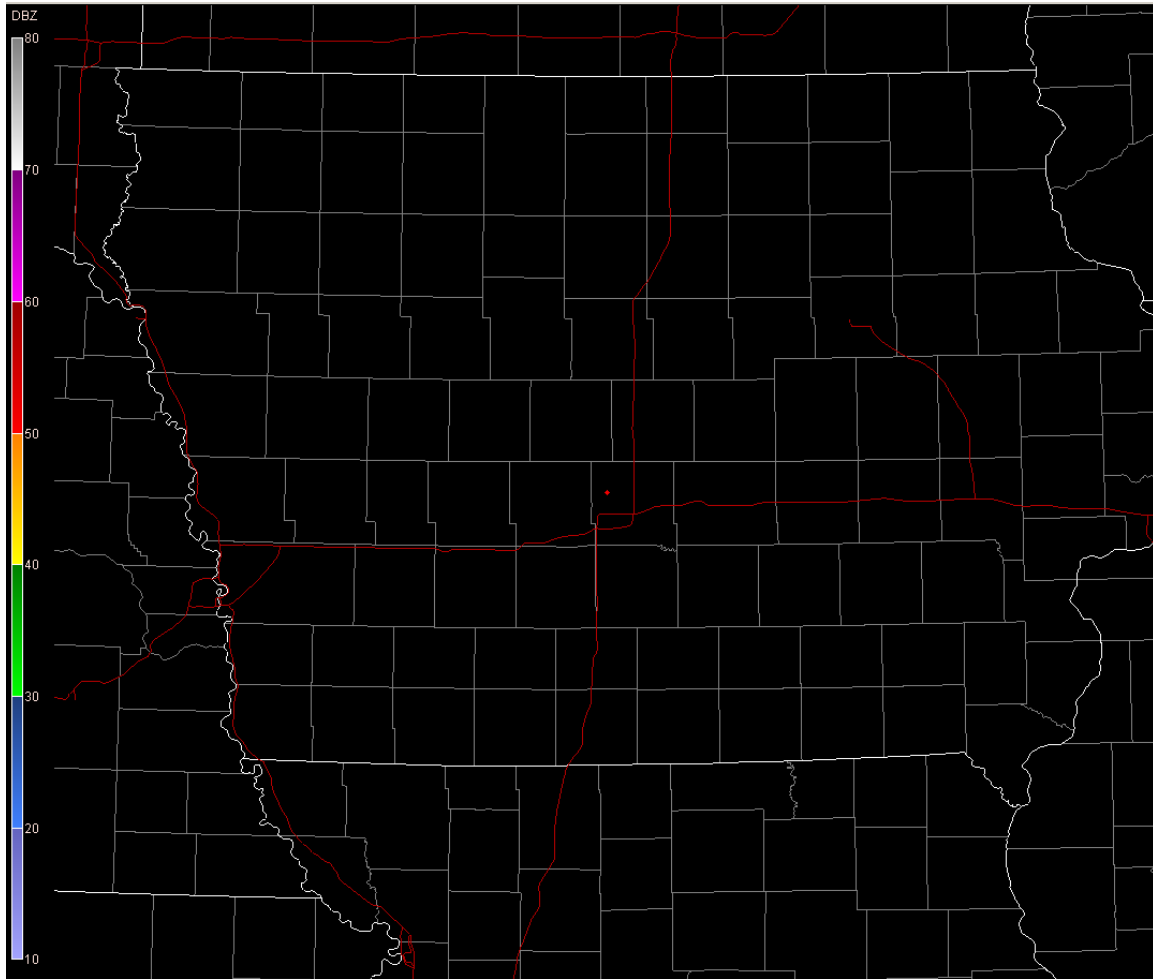


The radar display will always show a background (either a solid color or an imported bitmap) and can show all sorts of data:  radar products (with a color scale located on the left of the display), weather warnings, roads, the radar site (red diamond), state and county borders, city and county labels, shapefiles, and placefiles.  You can also perform several functions by right-clicking on the radar display.

| Zoom None |
| Place Marker Here |
| Remove Marker |
| Place Home Here |
| Remove Home |
| ✔ Measure From Marker |
| Measure From Home |
| Measure From Radar |
| Storm Motion From Marker |

**Zoom None:**  Returns to the initial zoom level.

**Place Marker Here:**  Places a square where you right-clicked.

**Remove Marker:**  Removes the marker.

**Place Home Here:**  Places a "+" where you right-clicked.

**Remove Home:**  Removes the home "+."

**Measure From Marker:**  Displays the distance between your marker and the current position of the mouse cursor, in nautical miles.  The distance is shown in the status bar (page 21)

**Measure From Home:**  Same as above, but measures from Home.

**Measure From Radar:**  Same as above, but measures from the radar site.

**Storm Motion From Marker:**  Calculates SRM for a single storm:
- Go a few frames back from the end of the loop.
- Place a marker on a part of the storm you can follow easily through the frames (e.g. knob of a hook echo).
- Go to the last frame of the loop.
- Find where your point on the storm has moved to, right-click it, and select "Storm Motion From Marker."
- GR2AE will calculate the storm's direction and speed to generate SRM for that particular storm.

## iv. Information window

```
Site:   KDMX
VST:    03/26/2007 14:03:34 UTC
Prod:   03/26/2007 14:03:33 UTC
VCP:    32        SMV: ----
Tilt:   0.443°

┌─ Select Product: ──────────┐
│  ⊙ BR          ○ VIL       │
│  ○ BV          ○ VILD      │
│  ○ SRV         ○ POSH      │
│  ○ SW          ○ MEHS      │
│  ○ ET          ○ NROT      │
└────────────────────────────┘
┌─ Select Tilt: ─────────────┐
│  [0.4°]  [1.4°]  [2.5°]  [3.5°] │
│  [4.4°]                    │
│                            │
└────────────────────────────┘
┌─ Warnings: ────────────────┐
│  ☑ Flash Flood - 3         │
│  ☑ Thunderstorm - 0        │
│  ☑ Tornado - 0             │
└────────────────────────────┘
┌─ Product Details: ─────────┐
│  Max:  50.0 dbz            │
│  Az:   260.5°             │
│  Ran:  4.6 nm             │
└────────────────────────────┘
```

**Site:**  The radar site you're currently viewing.

**VST:**  The time the volume scan was created.

**Prod:**  The time the currently selected product was created.

**VCP:**  The VCP for the currently selected product.

**Tilt:**  The tilt angle for the currently selected product.  If a product has no tilt angle (such as POSH), "---" will be displayed.

**Select Product:**  Allows you to select any of the following radar products:
- BR:  Base Reflectivity
- BV:  Base Velocity
- SRV:  Storm Relative Velocity (note that SRV is the same as BV unless you manually set SRV)
- SW:  Spectrum Width
- ET:  Echo Tops
- VIL:  Vertically Integrated Liquid
- VILD:  VIL Density
- POSH:  Probability of Severe Hail
- MEHS:  Maximum Expected Hail Size
- NROT:  Normalized Rotation ($> |1|$ is "significant," $> |2.5|$ is "extreme."  Positive values are counter-clockwise rotation; negative is clockwise.)

**Select Tilt:**  Allows you to select the tilt angle of the currently selected product (if it has different angles; otherwise, this area will be blank).  Buttons with an underscore under the first number are tilt angles from the previous volume scan.

**Warnings:**  Toggles each severe weather warning on and off.  The number indicates how many of that type of weather warning are currently in effect in the nation.

**Product Details:**  Provides a few miscellaneous details about the currently viewed product, such as maximum dBZ or maximum/minimum velocities.

## v. Status bar
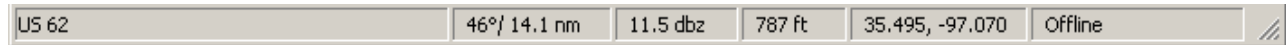
| US 62 | | 46°/ 14.1 nm | 11.5 dbz | 787 ft | 35.495, -97.070 | Offline | |

| US 62 | |

**Road or shapefile name:**  Displays text for what road or shapefile the mouse cursor is over.

| 46°/ 14.1 nm |

**Azimuth and distance:**  Displays the azimuth and distance from the reference point you selected in the right-click menu (Marker, Home, or Radar).

| 11.5 dbz |

**Product value:**  Displays the value of the product the mouse cursor is over.

| 787 ft |

**Height above radar:**  Displays the height of the center of the radar beam in the location the mouse cursor is over.

| 35.495, -97.070 |

**Lat/Lon of cursor:**  Displays the latitude and longitude for the location the mouse cursor is over.

| Offline |

**Polling status:**  Displays "Offline" if polling is disabled, "Downloading" if a radar product is being downloaded, or "Time remaining:  [mm:ss]" when waiting for a new product to arrive.  "[mm:ss]" is when the next poll for data will occur, in minutes and seconds.  If polling of a product fails, "Retrying in [mm:ss]" will be displayed.

# 2. Volumetric display
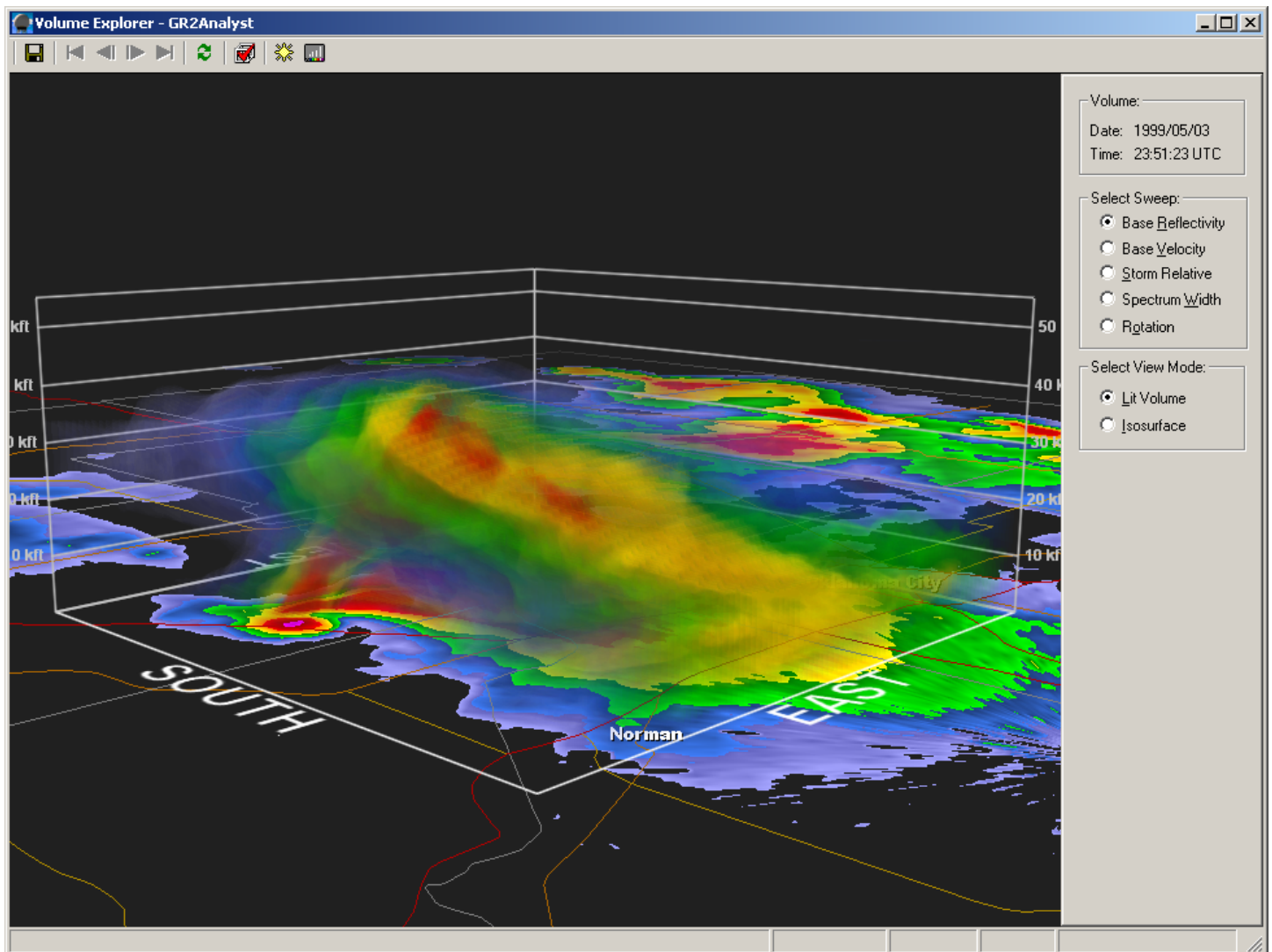


The volume explorer allows the user to see a three-dimensional, volumetric representation of the radar display.

## i. Toolbar

**Save:** Saves a screenshot of the volume window.

**VCR buttons:** Same function as in the main radar window: first frame, previous frame, next frame, final frame.

**Refresh:** If a new volume scan has been completed while you were in the volume window, clicking this button will update the display.

**Volume settings:** Allows you to alter the number of samples taken along the x and y axes for the creation of the volume. Increasing these numbers decreases system performance.
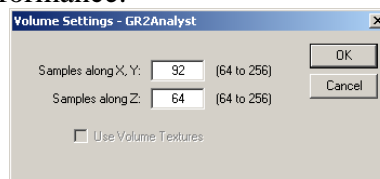


**Volume light:** Allows you to alter how light appears to show on the volume. Altering each of the options produces different lightning effects. The defaults are generally quite satisfactory.
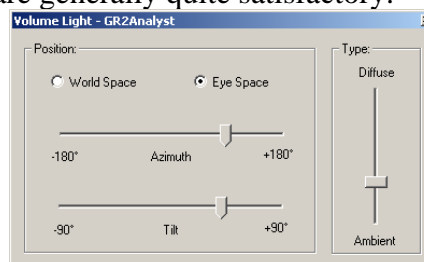


**Alpha settings:** Allows you to alter how colors show up in the lit volume and isosurface modes. Right-clicking on the dialog brings up a menu that allows you to save or load alpha table presets. They are saved in *\Documents and Settings\[user name]\Application Data\GR2Analyst\VolumeData*. (In Windows Vista, use the "Roaming" folder in your "[user name]" directory.)

- *Lit volume:* Your cursor will appear as a crosshair. Click and drag the color line to alter the transparency of different colors. Pulling the line all the way to the top results in no transparency for those values; pulling the line to the bottom results in total opacity for those values. A number will appear in the title bar of the dialog, indicating what your currently selected product's value is.
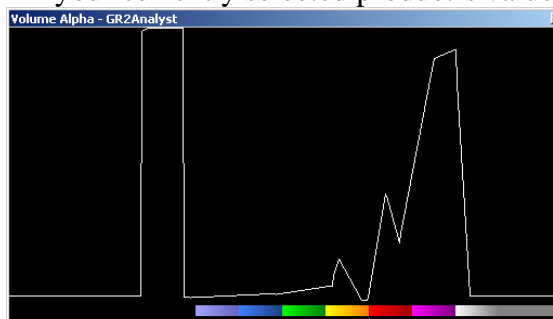
- *Isosurface:* Your cursor will appear as oppositely facing horizontal arrows. Click and drag the white triangle below the color bar. This will adjust your isosurface value.
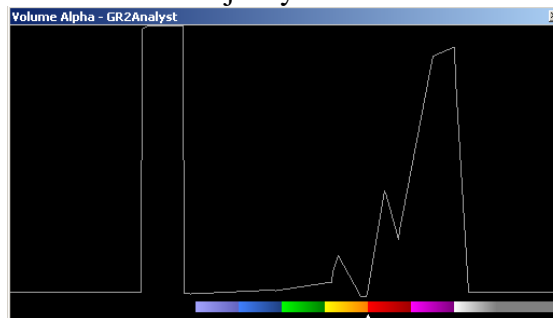


## ii. Volume pane

**Date:** Displays the date the volume scan was completed.
**Time:** Displays the time that the volume scan was completed.

## iii. Select sweep pane

Allows you to display a lit volume or isosurface for base reflectivity, base velocity, storm relative velocity, spectrum width, and rotation.

## iv. Select view mode pane

Allows you to display the radar data as a lit volume (with varying, customizable transparencies) or as an isosurface (with a customizable isosurface value).

## v. Radar display

Shows your radar data the way you chose to display it, as well as roads, city names, and county names (if turned on). Two height walls are displayed, with a bar every 10,000 feet. The yellow line is the 0ºC height; the red line is the -20ºC height.. At the base of the walls are cardinal direction markers.

Click and drag to rotate around the display. Use the center scroll wheel of your mouse to zoom in and out.

# 3. Appendix

This appendix serves to cover some of the basic "extra" features of the program.

## i. Color tables

Pre-made color tables are available on a few websites; the largest selection is at *www.grlevelxstuff.com*.  You have to register on the site to download them, but registration only takes a couple minutes.

To make your own color table, open up Notepad and use the following as a guide.  Note that this is for color tables that have a gradient; I'm assuming that solid color tables wouldn't be particularly helpful.

```
; Glowing Reflectivity

Units: DBZ
Step: 5

Color:  5    18   73   103   78    164   215
Color:  20   126  240  126   22    92    42
Color:  35   255  246  2     255   79    0
Color:  50   251  4    9     150   0     0
Color:  65   146  0    195   255   0     255
Color:  75   255  255  255   255   255   255
Color:  80   255  255  255
```

- The first part with the semicolon is simply a **comment**.  If you want to insert comments anywhere in the file, just precede the line with a semicolon.
- The next part gives the **units** for whatever color table you're making:  BR (DBZ); BV, SRV (KTS); SW (KTS); ET (KFT); VIL (kg/m2); VILD (kg/m3); POSH (%); MEHS (in); NROT (NROT).
- Following that is the **steps**.  This is how often a tick on your color table will be labeled.  If you want a tick and label to appear every five (5) units, use "5."
- Next are the **color statements**.  The first column is at what value a breakpoint in the color is to occur.  The next three columns are the beginning color, in RGB.  The last three columns are the colors you want that gradient to end with, in RGB.  The software will interpolate the colors in between.
- Negative values can be used, such as for clear-air mode reflectivity or for velocities.
- If you're making a velocity color table, include `RF:   R  G  B` before the other color statements.  RF is the color for range-folded regions.
- Save your color table as a .pal, as in "mycolortable.pal"

## ii. Shapefiles and placefiles

Shapefiles that can be used in GR2AE include all roads/streets in a county, lake outlines and rivers, railroads, city limit outlines, etc. Placefiles are either static or dynamic; static placefiles include highway marker signs, weather radio transmitter sites, and anything else you can think of that you would want to have displayed on the screen. Dynamic placefiles change with time, such as METAR observations, SPC watch boxes, storm reports, and so on (but they do not loop). You can find both shapefiles and placefiles at numerous locations on the internet.

*Shapefiles:*

The most commonly used shapefile in the GR products is all roads/streets. You can download the shapefiles at *http://arcdata.esri.com/data/tiger2000/tiger_download.cfm*, selecting Iowa, then "Line Features – Roads" from the "Select by Layer" drop-down menu. You'll also need something called a style file, which tells GR2AE how to read and display the shapefile. One should already be installed with the program. Once you've downloaded and unzipped the shapefiles, GR2AE is able to use them. Just follow the "Load Shapefile" procedure from page 6.

*Placefiles:*

It is beyond the scope of this manual to describe how to create placefiles from scratch. Fortunately, many useful placefiles are available free of charge. To load a new placefile, follow the "Placefile Manager" procedure from page 10.

## iii. Backgrounds

While topographical backgrounds aren't particularly useful, they do make the display look a bit nicer. To have a topographical background, download one from any of the sites listed below and unzip the file. You will have a bitmap and a Notepad file that will include the latitude/longitude ranges for the map. To load a topographical background, follow the procedure from page 9.

- *www.allisonhouse.com/grlevelx/maps*
- *www.myweatherstations.com/grsmaps.shtml*
- *http://www.grlevelxstuff.com* (requires registration)

## iv. Archived data

If you want to view archived radar data for case studies or curiosity, two sources are available.

- *http://hurricane.ncdc.noaa.gov/pls/plhas/has.dsselect* - data to 1991
- *http://mesonet.tamu.edu/products/RADAR/nexrad/CRAFT* - one-month archive

To view the data, unzip the files and open the files of your choice in GR2AE.