FSI

Four-dimensional Stormcell Investigator

D-2D Extension
And
Graphical User Interface

Guide for Users

OB8.3
Version 1.3

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Greg Stumpf
Decision Assistance Branch

NWS - MDL

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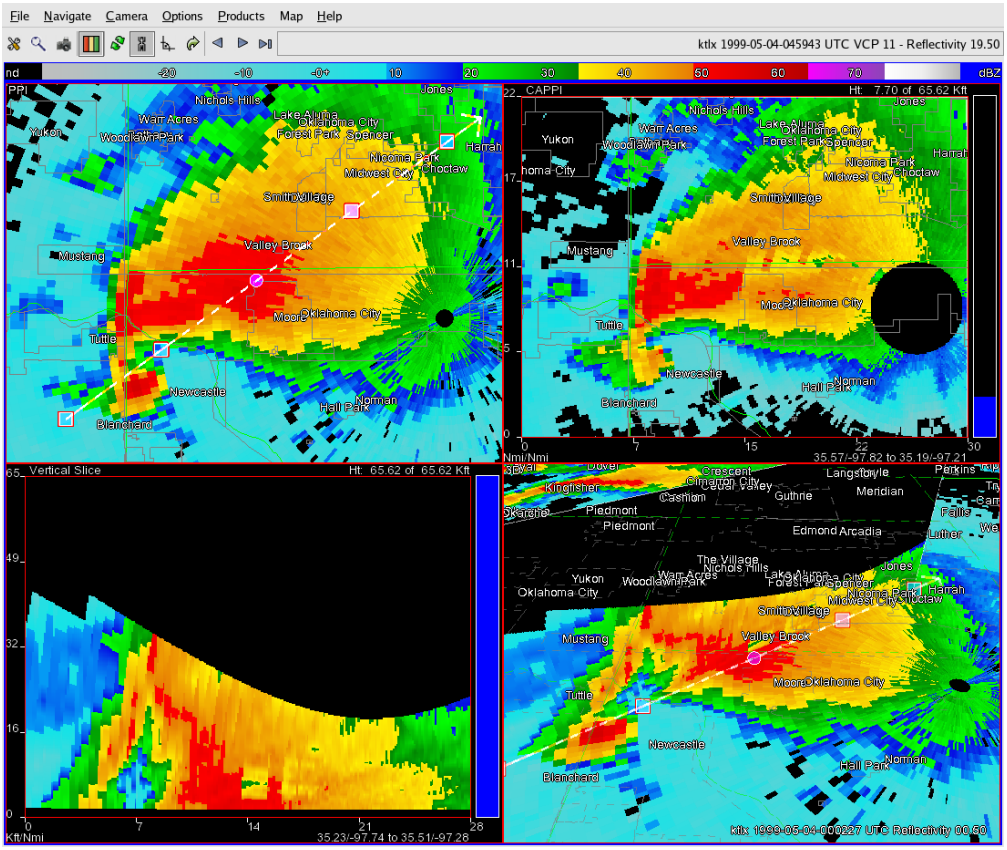
-INTRODUCTION-

The **F**our-dimensional **S**tormcell **I**nvestigator (FSI) is an innovative base radar data display application that is based on the National Severe Storms Laboratory (NSSL) Warning Decision Support System – Integrated Information (WDSSII) graphical user interface (wg). This technology allows users to create and manipulate dynamic cross-sections (both vertical and at constant altitude), such that one can "slice and dice" storms and view these cross-section data in three-dimensions and across time. The FSI is a 4-panel display depicting base radar data from a variety of linked two- and three-dimensional representations. An AWIPS D-2D extension is used to launch this application into an independent window.



We will make this user guide as comprehensive as possible – sort of an "FSI for Dummies" document. Accompanying this lengthy user guide will be a short FSI Quick Reference Guide which can be used to access the most commonly used functionality of the FSI.

Also bear in mind that this user guide only describes the knobology of the FSI. Information about how to scientifically analyze severe storms in three-dimensions for warning decision making is part of the training materials prepared by the NWS Warning Decision Training Branch.

Once Upon A Time…

In the pre-WSR-88D era, many radar consoles allowed operational meteorologists to manually control the radar beam, including some rudimentary capabilities to view vertical cross-sections (e.g., the Range-Height Indicator, or RHI). These radar display and control capabilities allowed research and operational meteorologists to amass expertise in the horizontal and vertical structure and evolution of severe storms, and allowed for the development of the first operational guidelines for diagnosing base radar data in identifying supercell storms (a.k.a. the "Lemon Technique"). The WSR-88D operates using automated volume coverage patterns, and display techniques to convert elevation scan data into vertical cross-sections is not very user friendly.

The Future of Radar Analysis is here…

The many benefits of the FSI are as follows:

- Improved vertical cross-sections: Dynamic placement and re-position of a cross-section reference line showing real-time updates to the cross-section data. Cross-sections are no longer a one-time requested RPG product, and are instead generated on-the-fly using 8-bit data.
- Constant Altitude cross-sections (CAPPIs): 8-bit radar data plotted at constant altitude eliminates the need to sample elevation scan data for altitude or reset elevation angle choices in four-panel displays. Cross-section control is also dynamic, showing real-time updates to the cross-section data.
- 3D visualization: 8-bit radar data from elevation scans, vertical cross-sections, and CAPPIs are plotted as 2D textures in 3D space. A forecaster can zoom, pan, pitch, yaw, and fly about the data in 3D.
- Virtual Volumes: No volume scan is incomplete. As new elevation scans are updated, they replace the old elevation scans in the virtual volume one-by-one. This means that there are full volumes of data available at all times for cross-sections and data perusal.
- Access to a much larger data inventory: An "All-Tilts" product only allows the forecaster to peruse a sequential order of elevation scan frames. For a 64 frame limit in VCP12, that only comprises 5 volume scans. The FSI allows the user to access any elevation scan in the radar data inventory RPS list for up to 2 hours of 8-bit data for all elevation scans.

What's new for OB8.3?

The first version of the FSI was released in OB8.2. There are several enhancements to the FSI for OB8.3.

Data Sampling (Readout)

Readout is a continuous data sampling capability using a linked cursor on the four panels. The sampled value field will "color fill" using the same color corresponding to the product's color map. Data readouts on the CAPPI or Vertical Cross Section panels will show a corresponding multiple readouts on the 3D panel, in three-dimensions.

Super-resolution Data

FSI8.3 will display super-resolution reflectivity, velocity and spectrum width data when connected to a radar running ORPG10 and later versions. FSI will display the "highest resolution available." At the time of the release of FSI8.3, this means that data at elevation angles below 1.8° will be displayed as super-resolution data.

Polarimetric Data

FSI8.3 will display the new polarimetric radar data moments (Z_{dr}, ρ_{hv}, KDP) as well as Hydrometeor Classification Algorithm (HCA) output at all elevation angles once these products become available from the radars.

GUI enhancements

The Button Panel has been updated to include new buttons, remove unused buttons, and button names are replaced with mouse-over windows. The buttons are also smaller and "iconified" to give more room for the radar analysis four-panel display. The Preferences GUI has been slightly updated to include more preference settings, and the tab selection replaced with a menu tree selection method. The colormap legend has been moved to the top of the four panels and stretched. The PPI and 3D panels are now titled.

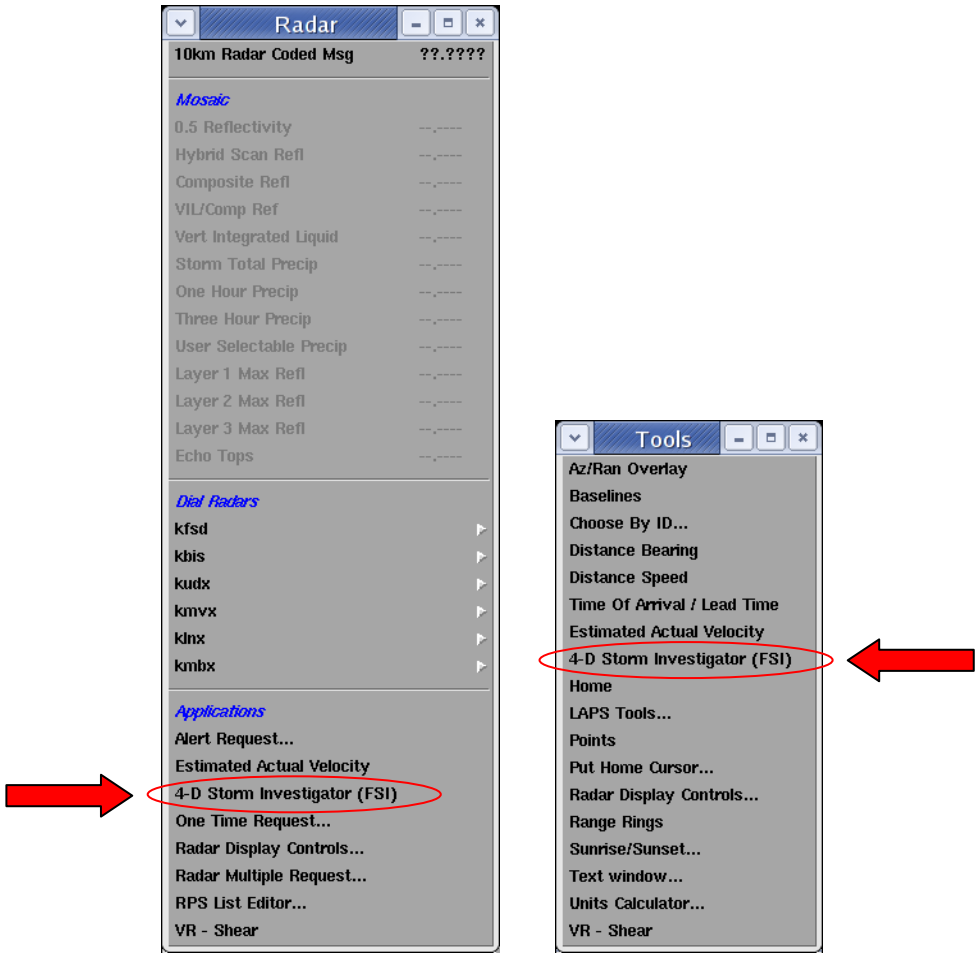
Enhanced performance using Projection Shaders (OpenGL 2.0+)

The texture drawing capability has been upgraded to consume only about 40% of the RAM (memory) of the OB8.2 version of FSI when browsing normal-resolution 8-bit data. This upgrade was necessary for display of super-resolution data, which consumes more memory. Super-resolution data uses about the same amount of resources in OB8.3 as did normal-resolution data in OB8.2. Also, the drawing speed has nearly doubled. This allows for either a higher sampling resolution (160 x 160 pixels) at the same draw speed as OB8.2 (the default), or the original OB8.2 sampling resolution (80 x 80 pixels) at a faster draw speed.

-THE FSI EXTENSION IN D-2D-

Loading the Extension

The FSI extension is loaded and automatically made editable by selecting the **4-D Storm Investigator (FSI)** selection within either 1) the **Applications** section of the drop down **Radar** menu, or 2) the **Tools** menu.



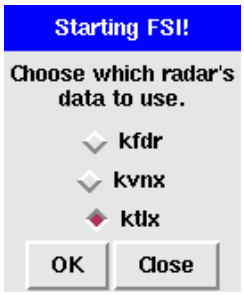
Once the extension is loaded, the legend will list that extension with the instructions on how to launch the FSI ("FSI, when editable, Right-click over storm (Editable)"

You unload the FSI extension in the normal way you unload any depictable on the D-2D pane – by holding the right mouse button over the legend until the pop-up table appears, then select "Unload".

Launching the FSI

Center your cursor over the storm of interest on your D-2D pane, and click the Right mouse button. If your WFO only has one dedicated radar, the FSI window will automatically open, with the data already centered on your storm of interest, using the radar data matching either your WFO's dedicated radar.

If your WFO uses more than one dedicated radar, or your backup radars are turned on for SCAN, a radar selection GUI will open. Choose the radar you wish to observe, and click the "ok" button.



The following FSI display initial conditions will be reset to these values each time you launch or re-launch the FSI from the D-2D:

Product = Reflectivity at 0.5° at the latest time
Location = centered in latitude/longitude of mouse click on the D-2D
Zoom Altitude = 50 meters (about the size of a large supercell storm)
CAPPI Altitude = 2 km (~6.5 kft)
Vertical Cross-Section Altitude = 20 km (~65 kft)
3D Rotate = 360° (pointing north)
3D tilt = 0.75 (slightly tilted off the vertical)
Storm Motion Vector = as set by Radar Product Controls

All other display preferences (e.g., loop parameters) will be retained from the previous FSI session. These preferences are unique to each individual username.

NOTE: The new LX workstations are equipped with two video graphics cards, one which supports 2D applications, and the other which supports 3D applications such as the FSI. The FSI cannot be launched on the 2D display, and a pop-up window will appear to remind users if this is attempted

NOTE: Only one FSI display is designed to running at any one time per workstation. If you attempt to launch another FSI display using another mouse click to the D-2D pane, the original FSI window will reposition to a new storm location.

-THE FSI WINDOW-

A Summary of the FSI Components

- Linked four-panel design, with a constant elevation angle panel, a CAPPI panel, a Vertical Cross-section panel, and a panel displaying the data in three-dimensions.
- D2D All-Tilts "look and feel" radar volume browsing controls.
- Animation (looping) controls for the added 4th dimension.
- Keyboard shortcuts ("hotkeys") for selection of elevation angles, volume scan times, radar products, and other navigation short-cuts (e.g., reset to zenith view).
- Rapid panning, zooming, pitch and yaw of 3D data.
- Dynamic cross section capabilities (vertical and horizontal). Users can manipulate the location of a cross section reference line using mouse controls, and cross-section textures will dynamically update on-the-fly in the other panels.

What do you see when the FSI is launched?

Menu Bar

At the very top of the FSI window, you will see a series of drop-down menu selections (**File, Navigate, Camera, Options, Products, Map, Help**). A Left Mouse click on any of these words will drop down its corresponding menu. A second Left Mouse click on any of the selections will execute the action specified.

Note that for most of the selections in the drop-down menus, the list will include two columns. The left-hand column is a description of the action taken. The right-hand column is a corresponding Hotkey. For any command that has a corresponding Hotkey, that command can alternatively be executed by pressing that key or combinations of keys (if combined with Shift, Ctrl, or Alt) on the keyboard. You will find that for many of the menu selections, the Hotkey controls will be the preferred method for selection, as they require fewer mouse clicks to execute which allows for more rapid selection and rapid successive selections.

We will describe only a few of these menu options in this section. The other menu options are described in later sections, and can be accessed by clicking the menu word above (these are links to future sections in this user guide).

File

Save Settings: This action will save your current settings to a configuration file that is stored on your user account, without exiting the FSI. **Note:** only one configuration file is available per user.

Reset Settings to Default and Exit: This action will restore the FSI default settings, and overwrite these default settings to your personal configuration file. It will then exit the FSI, since the configuration file can only be loaded upon launching the FSI. Users will need to relaunch the FSI for the default settings to take effect.

Exit: This action will save your current settings to a configuration file that is stored on your user account, and exit the FSI.

Help

About FSI: This shows a pop-up window containing information about the FSI. This pop-up window is closed using its **Close** button.

NOTE: A link to a PDF version of this user guide may be added here in the future.

The second row

The second row in the FSI window contains the Button Panel and the Radar Status Bar.

Button Panel

The Button Panel begins on the left with a series of button selections (**Preferences, Snapshot, Color Key, Loop, Auto-Update, Isosurfaces, Plan View, Reset**). After that there are three navigation buttons **(Back, Next, Latest)**. Moving the cursor over any of these buttons without clicking (a "mouseover"), will pop-up the name of the button.

A Left Mouse click on any of these will execute the button action. Some of these buttons are toggle buttons. If the action is toggled, the background color of the button will turn to a darker gray.

Preferences

This button will open up the **Edit Preferences** pop-up window. More information about setting preferences is provided in the **Setting Preferences** section.

Readout (Data Sampling)

This button toggles continuous data sampling off/on. Its default position is off. More information about using the data readout/sampling capabilities is provided in the **Data Sampling** section.

Snapshot

This button will open up the **Take Snapshot** pop-up window. More information about taking and saving screen image captures is provided in the **Taking Snapshots** section.

Color Key

This button toggles the color key off/on under the FSI Button Panel. Its default position is on.

Loop

This button toggles looping (animation) off/on. Looping Preferences can be changed using the **Edit Preferences > Loop** selection. Its default position is on.

Auto-Update

This button toggles the automatic updating of radar data off/on. Any time the currently browsed elevation angle is updated, the display will update to show the new data (without changing elevation angle). Its default position is on upon startup of the FSI. Any time the user navigates back in time away from the latest virtual volume scan, the Auto-Update button automatically turns off. Any time the user navigates forward in time back to the latest virtual volume scan, the Auto-Update button automatically turns back on. The **"A" Hotkey** also toggles the Auto-Update.

Plan View

This button resets the viewing angle of the **3D Flier** window to be from 90° elevation (zenith view, top down), and positions North to point straight up. Its default position is on. Anytime the user changes the viewing angle in the 3D Flier window, the button will automatically turn off. The **"P" Hotkey** also toggles the Plan View.

Reset

This button restores the FSI display to the initial conditions from when you last launched the FSI from the D2D, including the lat/lon position of the last mouse click on D2D. This is a handy feature in the event you accidentally move away from your storm of interest and "lose your bearings."

Back

This button steps the display back one volume scan interval while maintaining constant elevation scan. If you move the mouse over the button without pressing it, a pop-up window will display a preview of the date and time of the elevation scan that you would navigate to if you press the button.

Next

This button steps the display forward one volume scan interval while maintaining constant elevation scan. If you move the mouse over the button without pressing it, a pop-up window will display a preview of the date and time of the elevation scan that you would navigate to if you press the button.

Latest

This button steps the display forward one or more volume scan intervals to the latest volume scan while maintaining constant elevation scan. If you move the mouse over the button without pressing it, a pop-up window will display a preview of the date and time of the elevation scan that you would navigate to if you press the button.

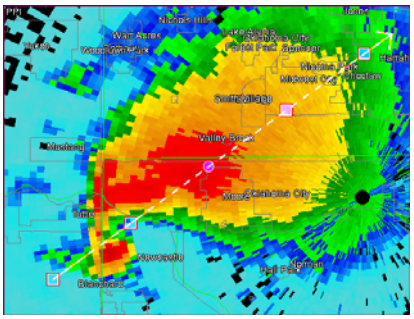
Radar Status Bar

To the right of these buttons is **Radar Status Bar**. This is a continuously-updating readout showing the date, time, VCP, and elevation angle of the most recently-completed elevation scan from the radar and product being viewed.

NOTE: if you resize the FSI window smaller than the default dimensions, the Radar Status Window may disappear. Stretch the FSI window horizontally just enough in order for it to reappear.

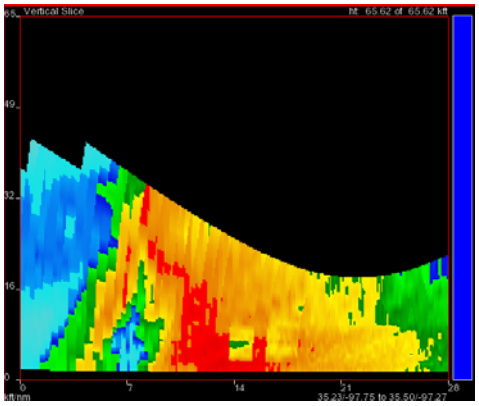
Plan Position Indicator (PPI) Panel

Underneath the menu and button rows are the four main FSI panels. The upper left panel displays the base radar data at a constant elevation scan. In old radar parlance, the "Plan Position Indicator", or PPI, was the electronic scope that displayed the live radar data on a plan view, as viewed from top-down. This method of viewing radar data became the *de facto* standard in the WSR-88D and AWIPS world. In other words, the PPI panel displays the radar data in the way that is most familiar with meteorologists. The viewing angle within this angle is fixed at 90° (top-down) with north facing up. The radar data and map overlays are projected "flat earth", which is a plane at zero-altitude (above radar level) to avoid parallax. Continuous pan and zoom controls are available. Within this window is the vertical cross-section control tool, which is used to control the vertical cross section texture location. More information on how to use the PPI panel and the cross-section control tool is given later.



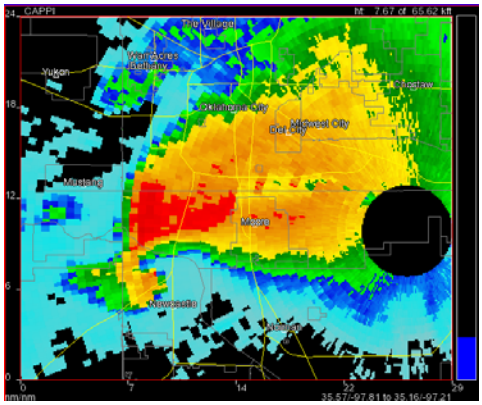
Vertical Dynamic Cross Section (VDX) Panel

The lower left panel displays the base radar data sampled from each elevation scan along a vertical plane that is represented by the vertical cross-section control tool in the PPI window. The cross-section tool allows the user to change the location of the cross-section, and the data in this display will dynamically update on the fly. This panel displays radar data vertically from the side, and the view is locked perpendicular to the plane of the cross-section. More information on how to use the VDX panel is given later.



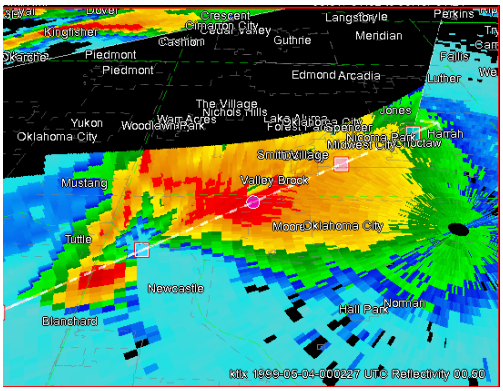
Constant Altitude Plan Position Indicator (CAPPI) Panel

The upper right panel displays the base radar data at a constant altitude above the radar elevation. Just prior to the advent of the WSR-88D network, a digital radar processor was added to several of the old radars which sampled the base radar data from within a constant altitude horizontal cross-section from whichever elevation scans intersected it. Now this capability is back in the hands of the radar meteorologist, but with one added feature – the CAPPIs are dynamic, allowing the user to change the sampling altitude on the fly. The viewing angle within this angle is fixed at 90° (top-down) with north facing up. Continuous pan and zoom controls are available. More information on how to use the CAPPI panel is given later.



Three-Dimensional Flier (3DF) Panel

The radar data in this panel will be plotted in true 3D earth coordinates. Shown will be the selected elevation angle of data in the PPI panel plotted on a conical surface, as well as any vertical or horizontal cross-section planes that are being displayed in the VDX and CAPPI panels respectively. All the surfaces will be represented in 3D space. These three data surfaces can be independently toggled off or on. The user will have continuous zoom and pan controls, as well as continuous 3D rotation controls. The view can be quickly reset to a zenith viewing angle at any time. Within this window is the vertical cross-section control tool, which is used to control the vertical cross section texture location. More information on how to use the 3DF panel is given later.



PPI Panel Usage

The Data Area

The main portion of this panel contains the radar data viewing area. The radar data are plotted using polar coordinates (azimuth versus range), at the highest available resolution data as defined by the AWIPS RPS list (8-bit, or even Super-Resolution data when available).

Zoom

Hold down the **Middle** mouse button to initiate a continuous zoom function. Push the mouse away from you to zoom in for a closer view. Pull the mouse toward you to zoom out for a wider view. Release the mouse button when completed. Note that any zoom action is simultaneously repeated in the CAPPI and 3DF panels.

Pan

Hold down the **Left** mouse button to initiate a continuous pan function. Drag the mouse to "pull" the image to the desired location. Release the mouse button when completed. Note that any pan action is simultaneously repeated in the CAPPI and 3DF panels.

Vertical Cross-Section Control Tool

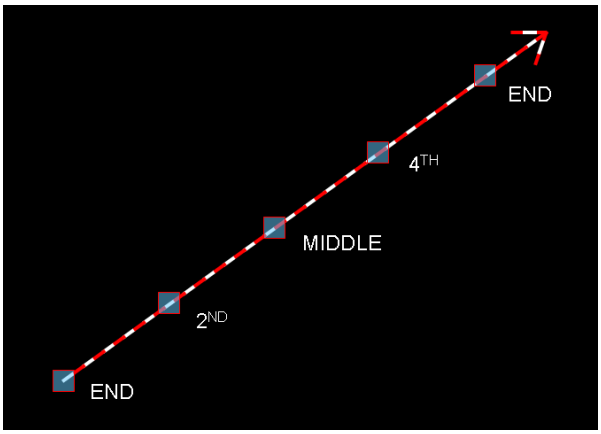
Move the mouse to one of the Blue Boxes on the red and white dashed arrow and hold down the **Left** mouse button to begin interacting with the tool. Drag the mouse to "pull" the blue box to the desired location. Release the mouse button when completed.

Interacting with the following blue boxes will provide these actions:

End Boxes
This will move the cross section line keeping the opposite end box position constant.

Middle Box
This will move the entire cross section line, keeping the line parallel to its previous positions.

Second and Fourth Boxes
This will rotate the cross section line keeping the middle box position constant.



Note that the arrow will always point to the east, and represents the data on the right side of the VDX panel.

VDX Panel Usage

The Data Area

The main portion of this panel contains the radar data viewing area. These data are derived by computing the "intersection" of an imaginary vertical plane of data with a complete "virtual volume" of base radar data. The data are derived from the polar-coordinates, and thus are the highest resolution available. Note that this vertical plane of data actually wraps the curved 3D surface of the earth, like a ribbon, in order to maintain constant altitudes along the section. This can be illustrated by viewing very long cross-sections in the 3DF panel.

When the cross-section coordinates are in the process of dynamically changing through the various actions available, the data will temporarily "down-sample" to a rectilinear grid. The resolution of this grid is set to 80 x 80 pixels by default (this can be changed using the Preferences button). Once the re-positioning of the cross-section is completed, the data will re-draw at the highest resolution available, in polar coordinates.

Reading the Legends

The upper right portion of this panel contains a height legend, showing the current height and the maximum allowable height in kft.

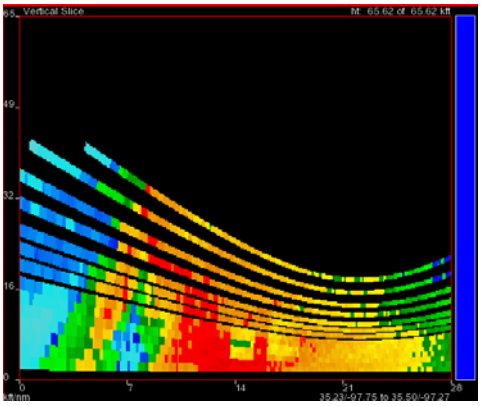
The Y-axis also contains tick marks and labels for the height in kft.

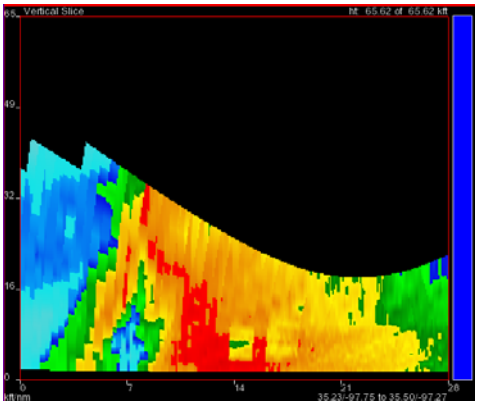
The X-axis contains tick marks and labels for the horizontal distance in nm. Note that the 5 tick marks correspond to the 5 blue boxes on the Vertical Cross-Section Control Tool.

The lower right portion of the panel shows the latitude/longitude coordinates of the End Boxes of the cross-section, in decimal degrees.

Interpolation Toggle

The **"I" Hotkey** will toggle interpolation on and off on the vertical cross-sections and the CAPPIs simultaneously. The default state of the FSI is for interpolation to be toggled on. The interpolation scheme will "fill in" the data between the elevation scans in order to present a "more complete" cross-section. However, turning the interpolation scheme off gives the user a better idea of which locations in space the radar is actually scanning. There are significant gaps in coverage since the radar beam is 1.0° wide (in the horizontal and vertical), and elevation angle differences can frequently be greater than 1.0°, especially at higher elevations. The figure below shows the effect of interpolation off (left) and on (right).





The interpolation scheme in the vertical between adjacent beam centerlines, and is not an image smoothing technique. This is important for the CAPPI cross-sections (described later).

Change Vertical Height

Move the cursor to the vertical blue bar on the right hand side of this panel. Then, hold down the **Left** mouse button and drag the top of the blue bar up or down to change the height of the vertical cross-section window. Release the mouse button when completed. The cross-section vertical height will simultaneously change in both the VDX and the 3DF panels (NOTE: The viewing angle in the 3DF panel must be anything other then 90° (top-down) in order to view these changes in that window). As you change the vertical height, note the changes in the upper right legend and the Y-axis values.

Change Horizontal Width

CAUTION: This action is very sensitive to small mouse movements, and is typically not the desired way to change the length of the cross-section. Instead, we suggest using the Vertical Cross-Section Control Tool.

Move the cursor to any position within the VDX "data area". Then, hold down the **Middle** mouse button to initiate the horizontal width change function. Push the mouse away from you to narrow the horizontal width. Pull the mouse toward you to widen the horizontal width. Release the mouse button when completed. The cross-section horizontal width will simultaneously change in both the PPI, VDX, and 3DF panels. As you change the horizontal width, note the changes in the X-axis values.

Change Position

CAUTION: This action is very sensitive to small mouse movements, and is typically not the desired way to change the position of the cross-section. Instead, we suggest using the Vertical Cross-Section Control Tool.

Move the cursor to any position within the VDX "data area". Then, hold down the **Left** mouse button to initiate the position change function. Drag the mouse to "pull" the cross-section to the desired location. Release the mouse button when completed. The cross-section position will simultaneously change in the PPI, VDX, and 3DF panels.

CAPPI Panel Usage

The Data Area

The main portion of this panel contains the radar data viewing area. These data are derived by computing the "intersection" of an imaginary constant altitude surface with a complete "virtual volume" of base radar data. The data are derived from the polar-coordinates, and thus are the highest resolution available. Note that this surface of data actually wraps the curved 3D surface of the earth, like the surface of a hollow sphere, in order to maintain constant altitudes above the earth. This can be illustrated by viewing very large CAPPIs in the 3DF panel.

When the CAPPI height or position is being dynamically changed, the data will temporarily "down-sample" to a rectilinear grid. The resolution of this grid is set to 80 x 80 pixels by default (this can be changed using the Preferences button). Once the re-

positioning of the CAPPI is completed, the data will re-draw at the highest resolution available, in polar coordinates.

Reading the Legends

The upper right portion of this panel contains a height legend, showing the current height and the maximum allowable height in kft.

The X- and Y-axes contain tick marks and labels for the horizontal distance in nm.

The lower right portion of the panel shows the latitude/longitude coordinates of the upper-left and lower-right corners of the CAPPI, in decimal degrees.

Change Vertical Height

Move the cursor to the vertical blue bar on the right hand side of this panel. Then, hold down the **Left** mouse button and drag the top of the blue bar up or down to change the height of the CAPPI. Release the mouse button when completed. The CAPPI height will simultaneously change in the 3DF panel (NOTE: The CAPPI surface must be toggled on in the 3DF panel in order to view those changes in that window). As you change the vertical height, note the changes in the upper right legend.

Zoom

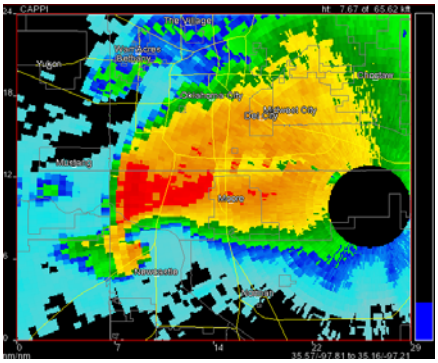
Hold down the **Middle** mouse button to initiate a continuous zoom function. Push the mouse away from you to zoom in for a closer view. Pull the mouse toward you to zoom out for a wider view. Release the mouse button when completed. Note that any zoom action is simultaneously repeated in the PPI and 3DF panels.

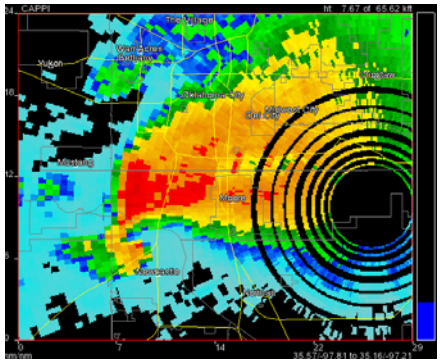
Pan

Hold down the **Left** mouse button to initiate a continuous pan function. Drag the mouse to "pull" the image to the desired location. Release the mouse button when completed. Note that any pan action is simultaneously repeated in the PPI and 3DF panels.

Interpolation Toggle

The **"I" Hotkey** will toggle interpolation on and off on the vertical cross-sections and the CAPPIs simultaneously. The default state of the FSI is for interpolation to be toggled on. The interpolation scheme will "fill in" the data between the elevation scans in order to present a "more complete" cross-section. However, turning the interpolation scheme off gives the user a better idea of which locations in space the radar is actually scanning, and more importantly, where the radar is not scanning. There are significant gaps in coverage since the radar beam is 1.0° wide (in the horizontal and vertical), and elevation angle differences can frequently be greater than 1.0°, especially at higher elevations.





The interpolation scheme in the vertical between adjacent beam centerlines, and is not an image smoothing technique. This is important for the CAPPI cross-sections since there can be significant gaps in coverage. These gaps are filled in be data just above and below these gaps. If they were filled in from the "sides" (horizontally), significant visualization errors would result.

3DF Panel Usage

The Data Area

The main portion of this panel contains the radar data viewing area. All data shown in this panel is plotted in three-dimensional space, using an earth-centric coordinate system where the origin is located at the center of the earth "sphere". The radar data are represented as two-dimensional surfaces, or "textures" plotted in 3D space with latitude, longitude, and altitude coordinates. For example, the earth's surface is plotted as a sphere, and a low-resolution image can be toggled using the Maps function if a user desires to easily illustrate this. Radar data is plotted at constant elevation angle (as "cones"), constant altitude (as a section of a sphere at a higher altitude than the earth sphere), and vertical cross section "ribbons". The user can zoom, pan, pitch, yaw, and fly about and through the data in 3D.

Reading the Legends

The main portion of this panel contains a color key legend, showing data values and corresponding colors used to plot the data at those values. This color key is shared by all four panels.

The lower right portion of the panel shows the 4-letter radar ID, the date and time in UTC (YYYYMMDD-HHMMSS), the radar product (Reflectivity, Velocity, Storm-Relative Velocity, or Spectrum Width), and the elevation angle in degrees. The extra information within the brackets can be ignored.

Toggling the cross-section surfaces
You can toggle the two cross-section surfaces off and on independently.

Vertical Cross-Section Surface
The **"X" Hotkey** will toggle this surface on or off. The default state is for this surface to be turned on.

CAPPI Surface
The **"C" Hotkey** will toggle this surface on or off. The default state is for this surface to be turned off.

Vertical Cross-Section Control Tool
In the 3DF panel, at the base of the Vertical Cross-Section Surface is another vertical cross-section control tool with Blue Boxes on a red and white dashed arrow. This tool is used exactly like the vertical cross-section tool in the PPI Window.

NOTE: If the viewing angle in the 3DF Panel is set to a 90° plan view, the Vertical Cross-Section Surface will appear as just the Vertical Cross-Section Control Tool (since you are looking straight down on the vertical surface from the top).

3D Rotate
In the "3D world", the rotate function changes your viewing angle while maintaining a constant viewing distance and constant viewing location.

Hold down **Shift** key and **Left** mouse button to initiate the rotate function. Slide mouse toward you to increase viewing angle, away to decrease viewing angle, left to rotate view clockwise, or right to rotate counterclockwise. Release the mouse button when completed. Note that any rotate action produces no affect in the PPI and CAPPI panels.

The North Arrow
In the "3D world" it is very important for the user to have a sense of their orientation in both the vertical and horizontal. Therefore, the FSI provides a "North Arrow". This cursor only remains visible while rotating, zooming, or panning, and on the PPI, CAPPI, and 3DF panels. Note that the North Arrow never changes position or orientation on the PPI or CAPPI panels, as these are 2D data panels. On the 3DF panel, the North Arrow will point in the direction of the North Pole. The cursor is also always plotted to be tangent to the earth's "flat" surface, so if the image is tilted from a 90° viewing angle, the cursor will appear "squashed". With a little practice, you will see how this cursor will aid you in your orientation.

3D Zoom
In the n the "3D world", the zoom function changes your viewing distance while maintaining a constant viewing angle and constant viewing location.

Hold down the **Middle** mouse button to initiate a continuous zoom function. Push the mouse away from you to zoom in for a closer view. Pull the mouse toward you to zoom out for a wider view. Release the mouse button when completed. Note that any zoom action is simultaneously repeated in the PPI and CAPPI panels.

3D Pan

In the "3D world", the pan function changes your viewing location while maintaining a constant viewing angle and constant viewing distance. This is similar to the view a "flying airplane" would have if they flew without changing altitude.

Hold down the **Left** mouse button to initiate a continuous pan function. Drag the mouse to "pull" the image to the desired location. Release the mouse button when completed. Note that any pan action is simultaneously repeated in the PPI and CAPPI panels.

Resetting to a Plan View

The **"P" hotkey**, or the **Plan View button** will reset the 3DF view to a fixed at 90° (top-down) with north facing up.

Selecting Radar Products

RPS List

NOTE: In order to view any 8-bit base radar products from all elevation angles, your AWIPS RPS list must include the base radar products from all of these elevation angles for each of your dedicated radars. Although the SRM product is not required to be in the RPS list (it is computed on the fly in the FSI), it is also recommended to be included. You may need to raise your RPS limit to allow more products in order to include all of these products and elevation angles.

Reflectivity (Z)

When the FSI is launched, the 8-bit Reflectivity data at 0.5° is automatically loaded. But if you are ever browsing one of the other radar products, the **"Z"** hotkey will select the Reflectivity product. Alternatively, the **"1"** hotkey on the alphanumeric keyboard (not the numeric keypad) will also select Reflectivity.

Velocity (V)

The **"V"** hotkey will select the ground-relative 8-bit Velocity product. Alternatively, the **"2"** hotkey on the alphanumeric keyboard (not the numeric keypad) will also select Velocity.

Storm-Relative Velocity Map (SRM)

The **"S"** hotkey will select the ground-relative 8-bit Storm-Relative Velocity (SRM) product. Alternatively, the **"3"** hotkey on the alphanumeric keyboard (not the numeric keypad) will also select SRM.

Spectrum Width (SW)

The **"W"** hotkey will select the ground-relative 4-bit Spectrum Width product. Alternatively, the **"4"** hotkey on the alphanumeric keyboard (not the numeric keypad) will also select Spectrum Width.

Z/SRM8 toggle (Cycle)

As with D-2D, the decimal key on the numeric keypad (and **not** the period key on the alphanumeric keyboard) will toggle the display between the Reflectivity (Z) and the Storm Relative Velocity Map (SRM) product. NOTE: There is no method for fading between these two products in the FSI. Unfortunately, the OpenGL graphics libraries that FSI is built upon do not allow this feature.

Super-Resolution Radar Products

How to select Super-Resolution Products

The FSI is designed to display the highest-resolution reflectivity, velocity and spectrum width data products available for each selected elevation angle. If the FSI is connected to a radar running ORPG10 (or a later version), and the super-resolution products are being ingested into AWIPS via the RPS lists for those radars, then the FSI will display the super-resolution data rather than the normal resolution data at elevation angles where super-resolution data is available. At the time of the release of FSI8.3, this means that data at elevation angles below 1.8° will be displayed as super-resolution data. Here is a comparison of the data resolutions (where 'SR' is 'super-resolution):

Product	Azimuthal Sampling	Range Resolution
Reflectivity	1.0°	1000 m
SR Reflectivity	0.5°	250 m
Velocity	1.0°	250 m
SR Velocity	0.5°	250 m
Spectrum Width	1.0°	250 m
SR Spectrum Width	0.5°	250 m

There are no special hotkeys to toggle between super-resolution data and normal resolution data. Use the same hotkeys to select Reflectivity, Velocity, Storm-Relative Velocity, and Spectrum Width as before. The displayed data will always be the highest resolution data available at that elevation angle. Vertical cross-sections and CAPPIs will be built from a blend of super-resolution data at the lowest elevation angles, and normal resolution data above.

NOTE: If users desire to view the normal resolution data at every elevation angle, then the px1:$FXA_HOME/data/FSIproducts.txt configuration file must be edited to exclude the super-resolution products from the list (SDR = 153, SDV = 154, SDW = 155). With your ITO, please refer to the Choice of Products section in this manual for information on how to make this configuration change for all users and all workstations.

Selecting Dual-Polarization Radar Products

Differential Reflectivity (Z_{dr})

The **"D"** hotkey will select the ground-relative 8-bit dual-polarization Differential Reflectivity (Z_{dr}) product. Alternatively, the **"5"** hotkey on the alphanumeric keyboard (not the numeric keypad) will also select Z_{dr}.

Correlation Coefficient (CC or RhoHV or ρ_{hv})

The letter (not the number) **"O"** hotkey will select the ground-relative 8-bit dual-polarization Correlation Coefficient (RhoHV, ρ_{hv}) product. Alternatively, the **"6"** hotkey on the alphanumeric keyboard (not the numeric keypad) will also select CC.

NOTE: This product name is labeled "RhoHV" in FSI8.3, and not CC as in D2D.

Specific Differential Phase (KDP)

The **"K"** hotkey will select the ground-relative 8-bit dual-polarization Differential Reflectivity (KDP) product. Alternatively, the **"7"** hotkey on the alphanumeric keyboard (not the numeric keypad) will also select KDP.

Hydrometeor Classification Algorithm (HC or HCA)

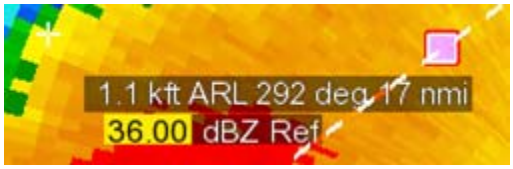
The **"H"** hotkey will select the ground-relative 8-bit dual-polarization Hydrometeor Classification Algorithm (HCA) product. Alternatively, the **"8"** hotkey on the alphanumeric keyboard (not the numeric keypad) will also select HCA.

NOTE: This product name is labeled "HCA" in FSI8.3, and not HC as in D2D.

Sampling the Radar Data

Enabling and Using Readout (Data Sampling)

The **"R"** hotkey, or the Readout button in the Button Panel, will toggle the data sampling capability off/on. Once the data sampling capability is toggled on, simply move your mouse cursor over the location to be sampled. When sampling on any of the four panels, there will be corresponding shadow cursors also continuously sampling on the other panels. The data readout information will be displayed just down and to the right of the cursor. The typical format of the cursor readout looks like this:

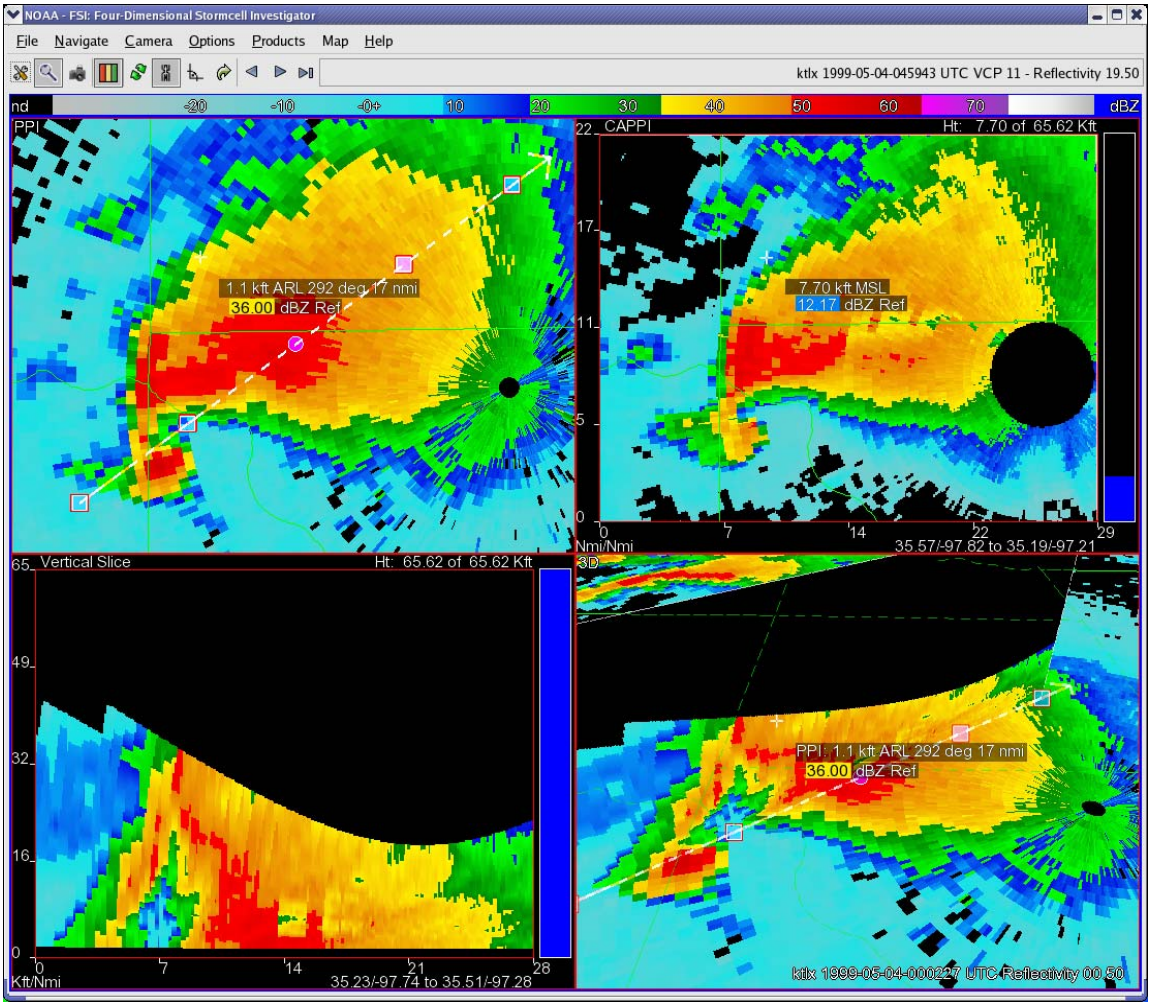


With the default Readout Preference settings, the fields on the first line include height (kft Above Radar Level), and azimuth (degrees) and range (nm) from the radar. The first

field on the second line is the data value, with a background box color coded to match the corresponding color table choice for that value. The color of the text within that box is "contrast adjusting" (black for light backgrounds, white for dark backgrounds). The remaining fields on the second line are the data value units, and the data value name.

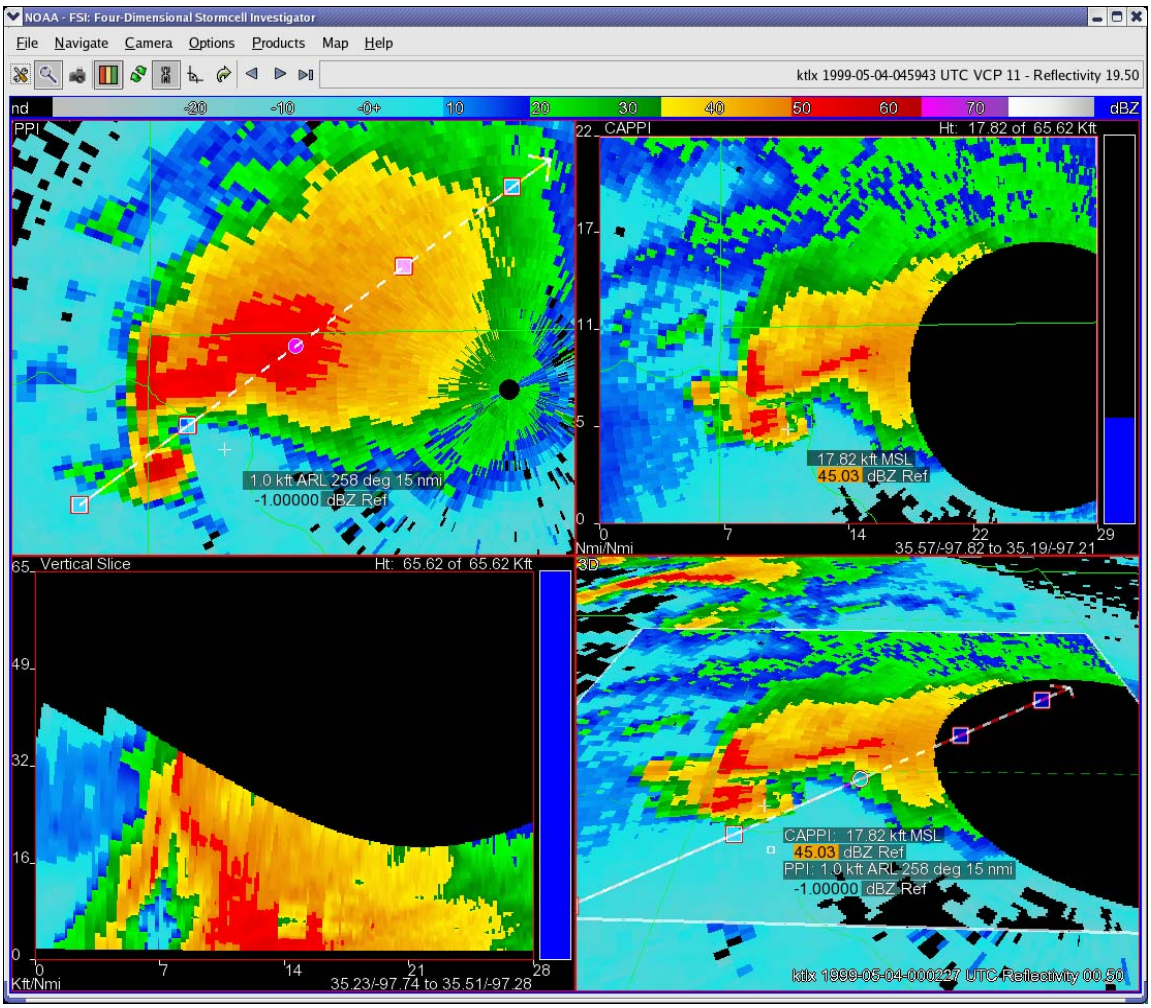
Sampling on the PPI Panel

The following figure illustrates the behavior when the mouse cursor is sampling data while centered over the PPI Panel in the upper left. There are corresponding shadow cursors also continuously sampling on the other panels, except the Vertical Slice.



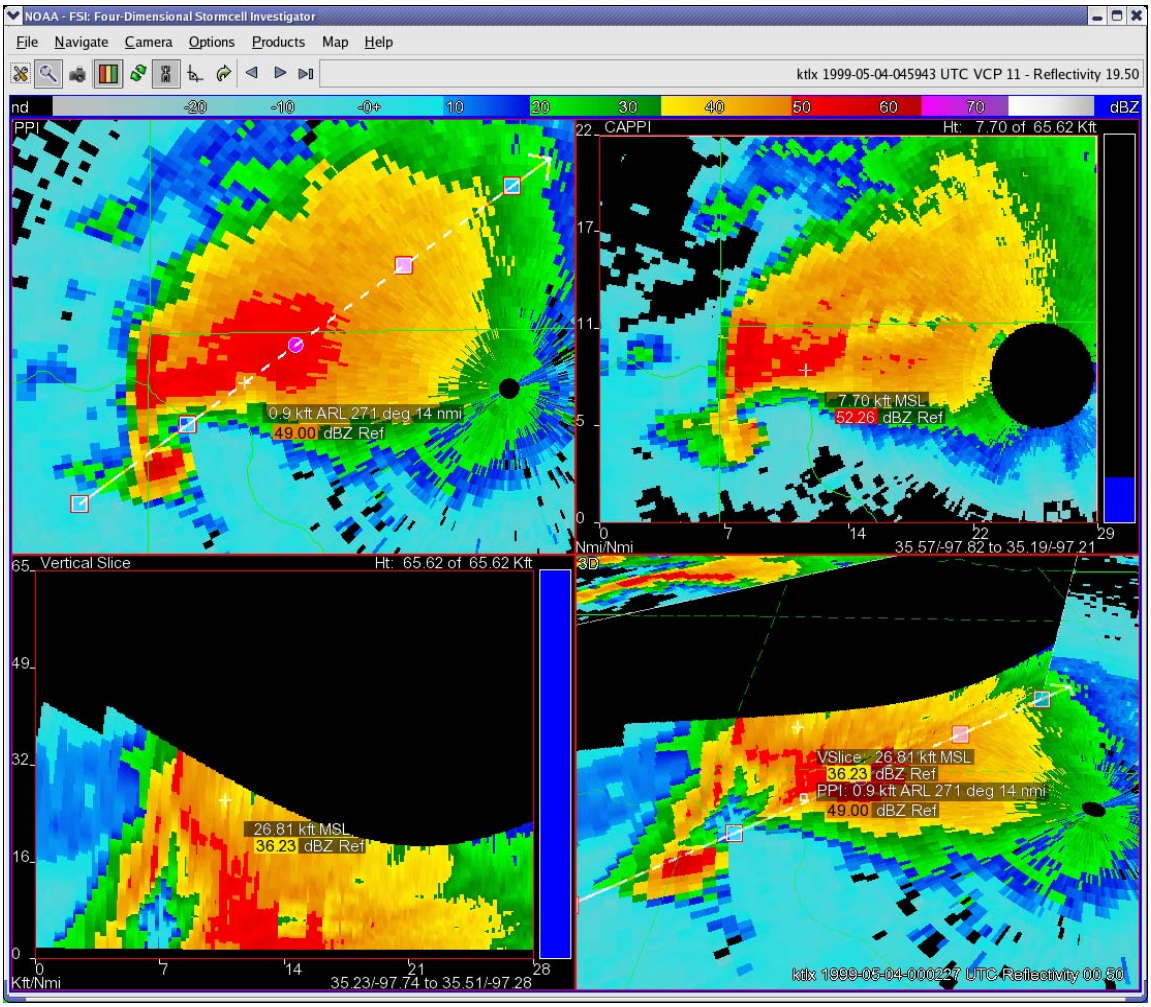
Sampling on the CAPPI Panel

The following figure illustrates the behavior when the mouse cursor is sampling data while centered over the CAPPI Panel in the upper right. There are corresponding shadow cursors also continuously sampling on the other panels, except the Vertical Slice. There can be multiple stacked cursor readouts shown in the 3D panel. A linked "shadow" cursor (+) on the 3D panel provides the PPI readout (along the cross-section line). If the CAPPI texture is toggled on, a second cursor (□) provides the CAPPI readout.



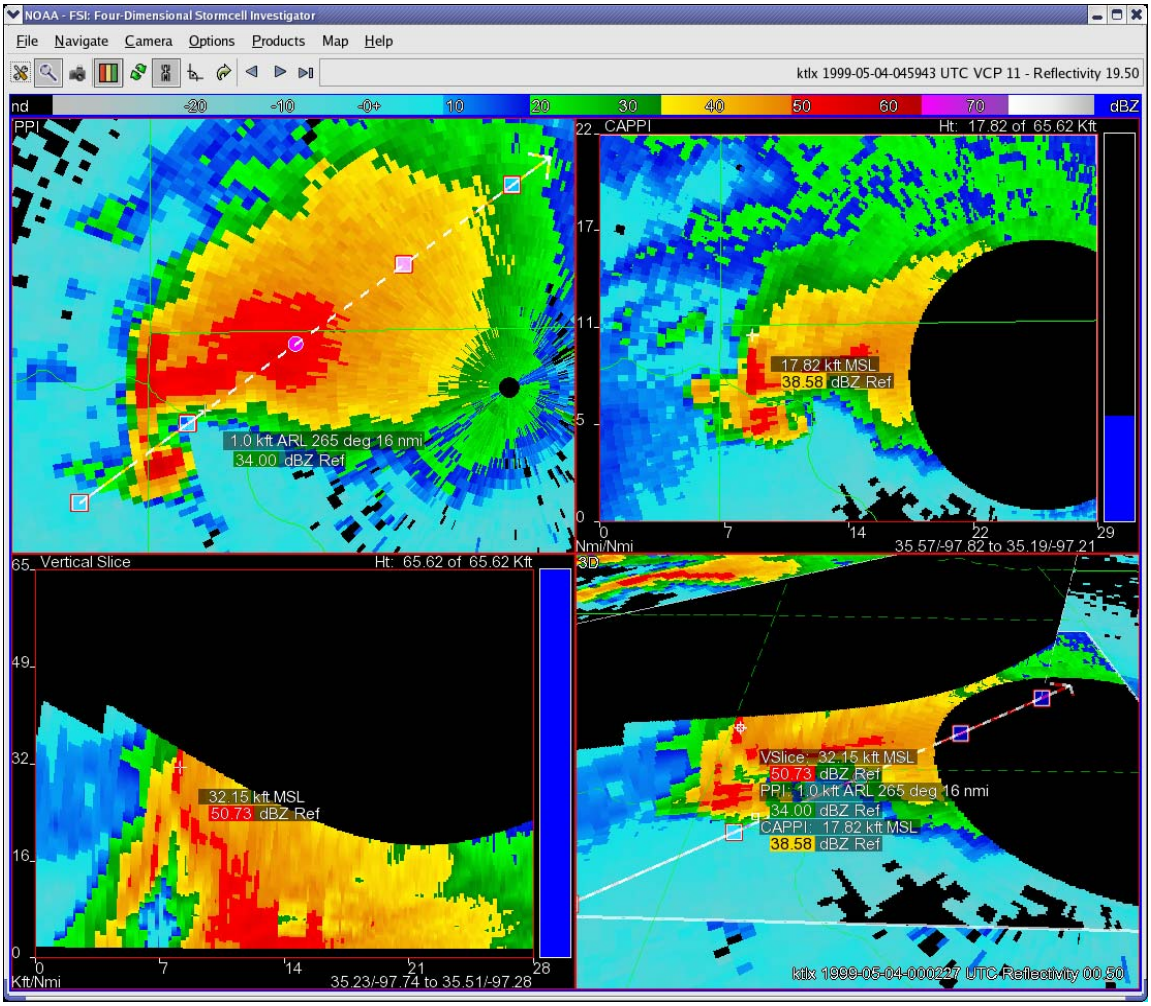
Sampling on the Vertical Cross-Section Panel

The following figure illustrates the behavior when the mouse cursor is sampling data while centered over the Vertical Cross Section Panel in the lower left. There are corresponding shadow cursors also continuously sampling on the other panels. There can be multiple stacked cursor readouts shown in the 3D panel. A linked cursor (+) provides the VSlice texture (if turned on) in the 3D panel. A second linked "shadow" cursor (□) provides the 3D panel providing the PPI readout (along the cross-section line). If the CAPPI texture is toggled on, a third cursor (□) provides the CAPPI readout.



Sampling on the 3D Panel

The following figure illustrates the behavior when the mouse cursor is sampling data while centered over the 3D Panel in the lower right. When sampling 3D panel (lower-right), there will be cursor readouts for each texture that is toggled on, provided the cursor is touching that texture. Up to three readouts can be displayed, and each will be labeled with the corresponding panel from which the sampled data is from ("VSlice:", "PPI:", or "CAPPI:").



When more than one texture is being sampled in the 3D window, each readout is stacked vertically:

Readout location accuracy

Users may notice that when zoomed in very close to the radar data that the sampled data value does not exactly match the value of the sampled gate under the cursor and it may be off in location by up to a whole gate in the range or azimuthal direction. This is because the method at which the 3D image textures are drawn in three dimensions, under the default Preference settings, "tiles" the texture into multiple-gate tiles (sometimes up to 100 or more gates) which are flat surfaces on the exponential (4r/3) conical surface of the swept radar beam path surface. For fast processing, the data readout uses the actual beam path equation, and sometimes these locations don't exactly match.

To gain accuracy such that the readout values always match the cursor location precisely, the 3D textures would have to be drawn such that each sample gate is treated as one tile. This "**Use Triangles over Textures**" option is available under the Advanced Preference Settings. However, the tradeoffs for better accuracy are 1) slower rendering of images (takes longer to draw more tiles), and 2) more RAM usage. Image rendering is about 5 times slower when using triangles over textures. This can affect the speed of volume browsing, although once an image is rendered and stored in the memory cache, browsing is fast using those cached images. Also, since the images are comprised of many more tiles, the memory cache usage is about twice as great when using texture drawing. When using triangles, users must be aware that workstation performance could be degraded, especially if FSI is used in conjunction with several instances of D2D running All-Tilts products with many frames (e.g., 64 frames) loaded.

Browsing the Radar Data

Virtual Volume Scans

Radars scan in sets of elevation angles known as "volume scans". In the current paradigm of WSR-88D algorithms, any products created using data from every elevation scans are created after the last elevation angle of every volume scan. This includes the rudimentary cross-section product than can be requested from the ORPG. These volume scan products are only available once per volume scan and update only as fast as the volume scan update rate.

Virtual volume scans, on the other hand, are comprised of the latest elevation angle at any one time, such that a complete set of elevation angles is available for processing all the time. For example, consider a radar that begins scanning at the 0.5° elevation angle, and continues upward through all elevation angles until the 19.5° elevation angle. Once all of the elevation angles have been scanned, the first "traditional" volume scan is completed. Next, the radar will now scan the 0.5° elevation angle again to start the next "traditional" volume scan. In the virtual volume scan world, that new 0.5° elevation angle will replace the previously scanned 0.5° elevation angle. The virtual volume scan now updates, and will be comprised of this new 0.5° angle, and the remaining elevation angle data from the previous traditional volume scan. At this point, radar and display applications can be recalculated using this virtual volume of data. Next, the second

elevation angle will be scanned, and it will replace the previous data at that same elevation angle, once again updating the virtual volume scan, and radar and display applications run again (in rapidly updating fashion).

In the FSI, the vertical cross-sections and the CAPPIs are all built using the latest virtual volume scan when the user is perusing data on the current virtual volume scan. Users will note that both of these cross-sections will re-draw upon the receipt of a new elevation scan, about every 15-30 seconds.

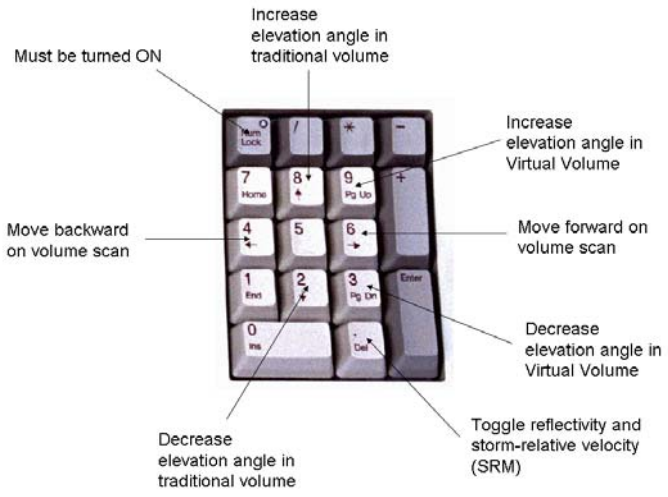
However, if the user decides to browse past data, or elevation scans which are not on the current virtual volume scan, then that cross-section data will represent the data for the traditional volume scan matching the elevation angle being browsed.

AutoUpdate

The AutoUpdate feature is automatically switched from the on position to the **off** position when the user browses out of the current virtual volume. The AutoUpdate feature will automatically switch back to the **on** position if the user returns to the current virtual volume while browsing. Note that at any time, the user can manually toggle the AutoUpdate feature back on while browsing older data, and if so, the display will automatically move forward to the latest virtual volume while maintaining a constant elevation angle. Note that any time the currently browsed elevation angle is "AutoUpdated"; the display will update to show the new data without changing elevation angle.

Numeric Keypad

The numeric keypad is mapped as the main volume browser. **In order for the keypad to operate, the NumLock must be toggled to the ON position.** Note that when referring to hotkeys on the numeric keypad, we will refer to the **non-numeric and numeric** designations of that key, to avoid confusion with the numbered keys along the top row of the main computer keyboard. The figure below shows a mapping of the functionality of the volume browsing controls.



Changing Elevation Angle

As with cross-sections using the virtual volume scans, browsing that data is dependent on the choice of browsing hotkeys as well as the elevation angle that is currently being browsed. The user can change the elevation angle of the data within the current "live" virtual volume scan, or within past traditional volume scans with a different set of hotkey functions.

Pg Up (9)

This increases the elevation angle within the current virtual volume scan. When the most recent elevation angle (as shown in the Radar Status Bar) is reached via browsing, another PgUp command will move up to the next elevation angle from the previous traditional volume scan. Continuing PgUp commands will eventually "wrap" through the entire virtual volume. This means that a PgUp command executed on the highest elevation angle in the virtual volume (e.g., 19.5°), will bring you to the 0.5° elevation angle within the virtual volume.

Note the times of the products when browsing the virtual volume scan. They will always increase in time while using the PgUp command, except when moving between the most recent elevation angle in the virtual volume, to the next higher elevation angle.

Pg Dn (3)

This decreases the elevation angle within the current virtual volume scan. This has the exact opposite effect of the PgUp command, always moving down in elevation scan through the current virtual volume.

Note the times of the products when browsing the virtual volume scan. They will always decrease in time while using the PgDn command, except when moving between the most recent elevation angle in the virtual volume, to the next lower elevation angle.

Up Arrow (8)

This increases the elevation angle within a traditional volume scan, and is used for browsing data from past (not current) volume scans. The times of the products will always increase in time while using the Up Arrow command, including when moving from the highest elevation angle in the traditional volume scan (e.g., 19.5°) to the lowest elevation angle (0.5°), such that the browser will move forward to the next traditional volume scan. Note that once the most recent elevation scan as depicted in the Radar Status Bar is reached, the Up Arrow key will have no effect (at least, until the next elevation scan comes in).

Down Arrow (2)

This decreases the elevation angle within a traditional volume scan, and is used for browsing data from past (not current) volume scans. This has the exact opposite effect of the Up Arrow command, always moving down in elevation scan and backwards in time through past traditional volume scans.

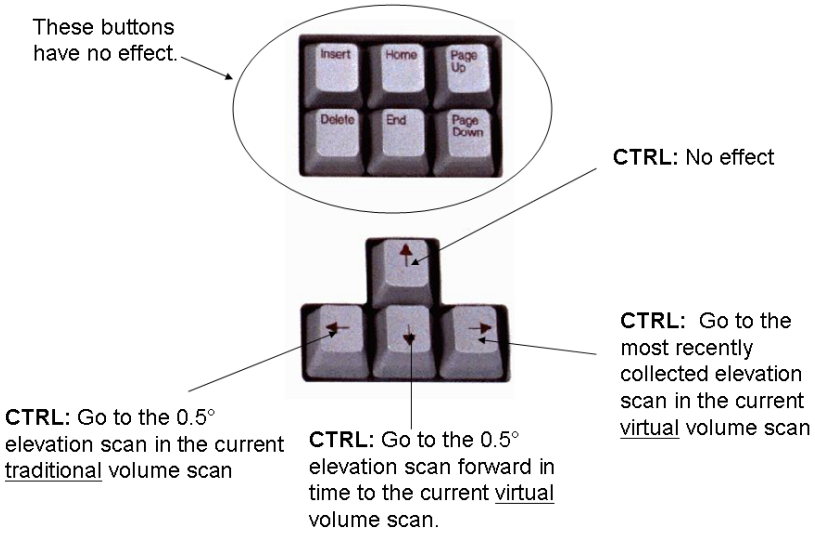
Changing Scan Time at Constant Elevation Angle

Right Arrow (6)
This moves **forward** in time exactly one volume scan interval while maintaining constant elevation angle. Once the browser is on the most current virtual volume scan, this arrow will have no effect.

Left Arrow (4)
This moves **backward** in time exactly one volume scan interval while maintaining constant elevation angle.

Special Volume Browsing Hotkeys

NOTE: These special volume browsing keys use the arrow keys that are **not part of the numeric keypad**. They will be referred to without a corresponding numeric key designation. The figure below shows a mapping of the functionality of the volume browsing controls. You must hold the **Ctrl** key along with these arrow keys for the following functionalities.



Ctrl-ArrowLeft
This moves the display to the 0.5° elevation scan in the traditional volume scan you are currently viewing. If you are within the current virtual volume scan, this moves the display to the 0.5° elevation scan in that virtual volume.

Ctrl-ArrowDown
This moves the display to the 0.5° elevation scan forward in time to the current virtual volume scan. If you are already within the current virtual volume scan, this moves the display down to the 0.5° elevation scan in that virtual volume. This key will toggle the **AutoUpdate** feature on if it is off.

Ctrl-ArrowRight
This moves the display to the most recently collected elevation scan in the current virtual volume scan, the elevation scan that matches that shown in the **Radar Status Bar**. This key will toggle the **AutoUpdate** feature on if it is off.

Ctrl-ArrowUp
This hotkey has no effect.

More Hotkeys and the rest of the Menu Bar

Navigate
A full list of the traditional volume navigation hotkeys, and some alternative volume browsing hotkeys, is obtained by clicking the **Navigate** selection on the **Menu Bar**. You can also select any of these functions by left clicking the menu selection.

Camera
A list of some alternative display navigation hotkeys is obtained by clicking the **Camera** selection on the **Menu Bar**. You can also select any of these functions by left clicking the menu selection.

Options
A list of additional display option hotkeys is obtained by clicking the **Options** selection on the **Menu Bar**. You can also select any of these functions by left clicking the menu selection.

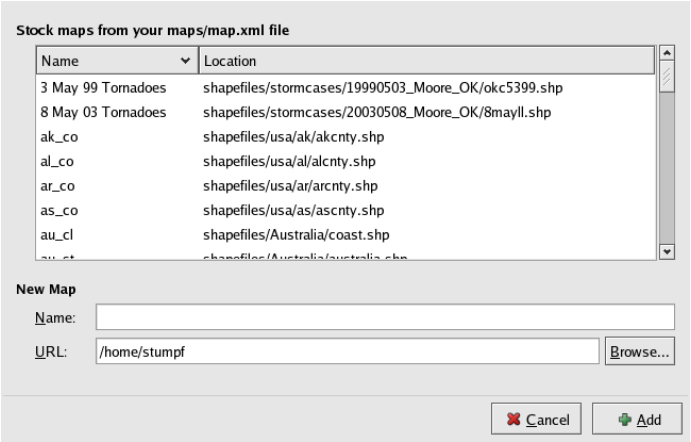
Products
A list of the product selection hotkeys is obtained by clicking the **Products** selection on the **Menu Bar**. You can also select any of these functions by left clicking the menu selection.

Map
Map overlays can be added, hidden, and removed using the **Map** selection on the **Menu Bar.** Individual Map overlay attributes can also be changed here, such as map colors and line thickness.

Clicking this menu selection will bring up a drop-down menu listing all the currently loaded maps (if any). For any maps which are already loaded, you can left click on the map name, and a sub-menu will appear allowing you to make the map invisible or visible (without unloading the map from the display), or remove (unload) the map completely from the display. For some maps, you may also be able to change the map color and the map line thickness, as well as turn on a label from a list of attributes.

Important information about the Cities overlay
The Cities overlay is a certain kind of shapefile known as a "point" shapefile. Point shapefiles can be displayed without attribute labeling (just point icons), or with a label (e.g., NAME). FSI does not display point shapefiles efficiently, and as such, when a label is turned on, FSI performance will slow down. One alternative is to instead use the Urban Bounds map, which is handled more efficiently by FSI.

Adding new maps and displaying custom map shapefiles
At the bottom of the menu is the **Add Map** selection. Clicking **Add Map** opens the **New Map GUI**, which allows user to select maps from the list, type in an explicit map file location, or browse to a map file to load new maps. After making the selection, the **Name** field must contain an (arbitrary) map name, if not already specified. Note that the FSI only displays shapefile (.shp) formatted maps.



Setting Preferences

This button will open up the **Edit Preferences** pop-up window. The following preference selections are available, accessible in a menu tree on the left-hand side:

Display
These preferences determine the resolution of your display.

Fonts
The user can select the font size of the labels on the display here. The default setting is 12 pixels.

Units
The user can select the units of measurement for the display. The default setting is English units.

Data Readout > Cursor Data Fields
The user can toggle the format of the cursor sampling readout. The default setting is for Azimuth/Range and Height above Radar to be toggled on, and Height above MSL to be toggled off.

NOTE: FSI does not compute Height above Ground. This capability may be added in a future version.

Resolution > Elevation Scan
We recommend that the users do not change the Radial Set Accuracy setting. The default setting is 2 radials per degree.

Resolution > 2D Resolution (CAPPI, Vertical Slice)
When the CAPPIs and Vertical Dynamic Cross-Sections coordinates are in the process of dynamically changing through the various actions available, the data will temporarily "down-sample" to a rectilinear grid (n*n), or Drag Sample Rectangle. Once the re-positioning of the cross-section is completed, the data will re-draw at the highest resolution available, in polar coordinates.

This preference allows the user to change the resolution of the down-sampled grid. The default setting is 160, for a 160 x 160 pixel resolution. Making this value larger will improve the resolution of the down-sampled dynamic cross-sections, but at a cost of reduced performance ("choppier" dynamic slicing). Making this value smaller will reduce the resolution of the down-sampled dynamic cross-sections, but will improve the performance of the dynamic slicing (more fluid).

Cache
These preferences control the memory cache. **It is recommended that only advanced users use these preferences**, as they will affect the amount of memory usage by the FSI on the LX workstation, and could affect the entire workstation performance. For more information, consult the section on Memory Management in this guide.

Looping
These preferences control the animation settings of the FSI.

Preview
This data graphically displays the animation settings below. The bar at the top shows the number of frames in white, and the first and last frame dwell time in blue. Underneath lists the amount of time that one loop will animate in real-time. Under that lists the amount of data, in minutes, that one loop represents. Note that none of these fields are interactive with the mouse, and only change based on settings changed in the fields described next.

Data > Frame Interval
This sets the number of minutes per radar frame in the loop. It is recommend that this value is set to the approximate volume scan update time for the particular VCP you are viewing (5 min for VCP 11, 4 min for VCP 12, 6 min for VCP 21, and 10 min for VCPs 31 or 32).

It is important to note that the FSI animation controls have been designed for multiple sources of data (multiple radars and sensor), and are not keyed to individual single radar volume scan times. The frame intervals essentially "take a snapshot" of the radar state at those particular times. For example, if the volume scan update rate is 5 minutes, and the Frame Interval is set to 2 minutes, then the following results:

Frame 1: 0 min, volume scan 1
Frame 2: 2 min, volume scan 1
Frame 3: 4 min, volume scan 1
Frame 4: 6 min, volume scan 2
Frame 5: 8 min, volume scan 2
Frame 6: 10 min, volume scan 3
Frame 7: 10 min, volume scan 3
Frame 8: 10 min, volume scan 3
Frame 9: 10 min, volume scan 4
Frame 10: 10 min, volume scan 4
Frame 11: 10 min, volume scan 5
…and so on…

Data > Number of Frames
This sets the number of frames you want in the loop.

Speed > Frame Display Time
This sets the number of milliseconds that a single frame is shown in real-time during the loop.

Speed > First Frame Dwell
This sets the length of the first frame dwell in seconds.

Speed > Last Frame Dwell
This sets the length of the last frame dwell in seconds.

Options > Rock Loop
If checked, the loop will rock forward and backward in time. If not checked, the loop will only operate in forward time.

Snapshot

These preferences determine where and how your screen snapshots are saved.

Output Location > Directory

The user may use the **Browse** button to choose a directory in which to save snapshot images, or simply write the directory path in the dialog window.

Output Location > Filename

This string determines the format of the snapshot image file name. The **Help** button will provide a list of the Substitution codes that are preceded by the percent (%) symbol.

Dimensions > Use Custom Size for Snapshots

Clicking this toggle button will allow you to set a custom size for your snapshot images. Otherwise, they will be saved in the native resolution of your display. You can set the **Width** and the **Height** (in pixels) of your snapshot size here.

Advanced Settings

These settings are typically only to be used by advanced users under guidance from an FSI expert or your ITO. Only one advanced setting will be described in this guide.

Advanced Settings > OpenGL > Rendering

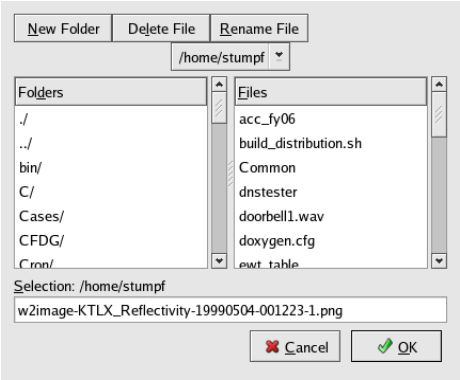
The default selections have **Use Projection Shaders** and **Use Level-of Detail Culling** toggled on, and these should always remain turned on. It is recommended that the only other toggle that users should change is **Use Triangles over Textures**. Toggle this on if the users decide to increase the accuracy of sampling the radar data. The trade-offs for using the option are discussed in the Readout Location Accuracy section.

Close

Clicking this button at the bottom of the GUI will close the **Edit Preferences** GUI and save all your settings.

Taking Snapshots

Clicking the Snapshot key in the Button Panel opens the **Snapshot GUI**. A default filename selection will be first given, based on the parameters set in the Snapshot Preferences. However, you can save the file as any name, to any folder, using the browsing tools in the GUI. FSI saves images in PNG (.png) image format only.



-CONFIGURATION-

Choice of Products

px1:$FXA_HOME/data/FSIproducts.txt

Editing this file on **px1** will determine which radar products will be used for the base radar product data in FSI. For Z, V, and SW, users have a choice of 4-bit (level16), 8-bit (level256) normal resolution, and 8-bit (level256) super-resolution base radar data in FSI. Although 4-bit data is not recommended due to its low resolution, it is available as a choice if needed. 8-bit super-resolution data are preferred and are set as the default product selection. For dual-polarization products, 8-bit is also preferred.

NOTE: These procedures should be carried out with the assistance of your ITO.

Because super-resolution data is only available for Z, V, and SW products at elevation angles below 1.8° (at this time), both normal-resolution and super-resolution Z, V, and SW products are defined in this configuration file. If a user desires to only view normal-resolution products at every elevation angle in FSI, then the three super-resolution product choices in the configuration file need to be commented out and moved below the "end-of-file" line (-1). Note that this change will affect the processing of radar products for every user on every workstation in the WFO. There are no separate controls on the FSI GUI for super-resolution and normal-resolution products; the highest available resolution is always displayed.

NOTE: In order to display any of the above products in FSI, they must be included in your RPS list. Of particular note, in order to display full volumes of data in FSI, you must have every elevation scan in the VCP defined in the RPS list.

NOTE: You cannot define both a 4-bit and 8-bit product for the data type (e.g., 4-bit and 8-bit Reflectivity).

Radar List

The FSI is designed to allow display of base products only from your WFO's dedicated radar list. You can also display radar products from your WFO's backup radar list as well. To add more radars, ask your ITO to edit:

/data/fxa/tstorm/scanBackupRadarList.txt

and change the third number on each row from a 0 (off) to a 1 (on) to include it for FSI. Start a backup radar request via the RMR if needed. Your ITO should then restart the **FSIprocessor**.

NOTE: The OB8.3 version of the FSI will not have the capability to display any Terminal Doppler Weather Radars (TDWR) your WFO may have access to. This capability will hopefully be added to a future version.

Individual User Configuration

Default Configuration

For first time users of FSI, the program will first start up using a default configuration preference file. As individual users begin to change their preferences, these new preference will be saved into their user configuration file, so that when FSI is restarted on the user account, those preferences will be loaded.

NOTE: The FSI only allows one configuration file per user account.

File > Reset Settings to Default and Exit

This action will restore the FSI default settings, and overwrite these default settings to your personal configuration file. It will then exit the FSI, since the configuration file can only be loaded upon launching the FSI. Users will need to relaunch the FSI for the default settings to take effect.

Color Maps

Default Colormaps

The default colormaps installed with FSI match the D2D defaults for 8-bit Z, V, SRM, SW, ZDR, CC (RhoHV), KDP, and HC (HCA) products.

Changing Colormaps

Currently, there are no colormaps selection or editing tools within the FSI (this may be added in later versions). In order to change the colormaps, one must replace the default colormap file with an alternative colormap file.

NOTE: This procedure should be carried out with the assistance of your ITO. You must be careful not to remove the original colormap files during this process.

You must change the colormaps from the command line in Linux at the workstation. These changes will only take affect for that workstation, and for all users of that workstation. Once the change is made, hit the Preference button and navigate to Advanced Settings > Cache > Clear Color Maps to load the new colormap.

Reflectivity Colormaps

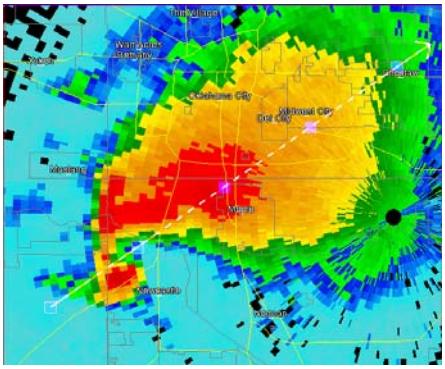
To change the Reflectivity colormap:

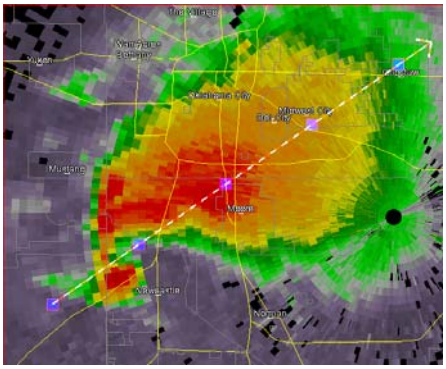
```
cd $W2_CONFIG_LOCATION/colormaps
cp <new_colormap_file> Reflectivity
```

For example, NSSL supplied their default colormap as an alternative to the AWIPS default. To change to the NSSL colormap:

```
cd $W2_CONFIG_LOCATION/colormaps
cp Reflectivity_nssl Reflectivity
```

Here is a side-by-side comparison of the two Reflectivity colormaps:





To restore the default Reflectivity colormap:

```
cd $W2_CONFIG_LOCATION/colormaps
cp Reflectivity_awips Reflectivity
```

Velocity Colormaps

To change the Velocity colormap:

```
cd $W2_CONFIG_LOCATION/englishUnits/colormaps
cp <new_colormap_file> Velocity
```

For example, WDTB supplied an alternative Velocity colormap to the AWIPS default. To change to the WDTB colormap:

```
cd $W2_CONFIG_LOCATION/colormaps
cp Velocity_wdtb5 Velocity
```

To restore the default Velocity colormap:

```
cd $W2_CONFIG_LOCATION/englishUnits/colormaps
cp Velocity_awips Velocity
```

Spectrum Width Colormaps

To change the Spectrum Width colormap:

```
cd $W2_CONFIG_LOCATION/englishUnits/colormaps
cp <new_colormap_file> SpectrumWidth
```

To restore the default Spectrum Width colormap:

```
cd $W2_CONFIG_LOCATION/englishUnits/colormaps
cp SpectrumWidth_awips SpectrumWidth
```

Differential Reflectivity Colormaps

To change the Differential Reflectivity colormap:

```
cd $W2_CONFIG_LOCATION/englishUnits/colormaps
cp <new_colormap_file> Zdr
```

To restore the default Differential Reflectivity colormap:

```
cd $W2_CONFIG_LOCATION/englishUnits/colormaps
cp Zdr_awips Zdr
```

Correlation Coefficient Colormaps

To change the Correlation Coefficient colormap:

```
cd $W2_CONFIG_LOCATION/englishUnits/colormaps
cp <new_colormap_file> RhoHV
```

To restore the default Correlation Coefficient colormap:

```
cd $W2_CONFIG_LOCATION/englishUnits/colormaps
cp RhoHV_awips RhoHV
```

NOTE: This product name is labeled “RhoHV” in FSI8.3, and not CC as in D2D.

Specific Differential Phase Colormaps

To change the Specific Differential Phase colormap:

```
cd $W2_CONFIG_LOCATION/englishUnits/colormaps
cp <new_colormap_file> Kdp
```

To restore the default Specific Differential Phase colormap:

```
cd $W2_CONFIG_LOCATION/englishUnits/colormaps
cp Kdp_awips Kdp
```

Hydrometeor Classification Algorithm Colormaps

To change the Hydrometeor Classification Algorithm colormap:

```
cd $W2_CONFIG_LOCATION/englishUnits/colormaps
cp <new_colormap_file> HCA
```

To restore the default Hydrometeor Classification Algorithm colormap:

```
cd $W2_CONFIG_LOCATION/englishUnits/colormaps
cp HCA_awips HCA
```

NOTE: This product name is labeled "HCA" in FSI8.3, and not HC as in D2D.

Use of Desktops to manage D-2D and FSI

2D versus 3D desktops

The LX workstations are equipped with two video graphics cards. One card supports 3D graphics rendering, and the left and middle monitors are connected to that card. The second card supports only 2D graphics, and the right monitor is connected to that card. If the FSI is launched from a D-2D that is running on the right desktop, a pop-up window will appear reminding users that the FSI will not run on that monitor. The FSI can only be launched from the left and middle desktops.

Single versus Multiple Desktop Use

When the FSI is launched from a D-2D running on one of the 3D desktops (left or middle), the FSI application window will appear on the same desktop as the D-2D from which the FSI was launched. The data in the FSI can be re-positioned by another right-mouse click on the D-2D from which it was running. However, in order to do this effectively, the user may have to minimize or hide the FSI window while working with the D-2D on that desktop.

One solution to this problem is to use both 3D desktops (left and middle) together to control the FSI. To do this, load and launch the FSI from one of the 3D desktops. Then, on the other 3D desktop, load the FSI extension to that D-2D as well. Then, from <u>either</u> D-2D on either 3D desktop, a right-click will re-position the data in the FSI. In other

words, one can control the FSI from the D-2D on the opposite 3D desktop, as long as the FSI extension is loaded to it as well. This allows a user to use a D-2D and the FSI on independent desktops.

Another solution would be to launch the FSI from a D-2D initiated from a different virtual desktop on the same monitor. This FSI can be controlled by any D-2D from any of the virtual desktops on any of the 3D monitors.

NOTE: Launching more than 3 instances of D-2D and the FSI on a single workstation may negatively affect workstation performance. If workstation performs suffers, you may "dial-down" the FSI Memory Management settings.

Extra or Fewer Workstations

Configuring FSI for extra or fewer workstations

The default FSI is configured to only run on the workstations listed by the environmental variable **LX_WORKSTATIONS**. Each workstation is configured to be a "client" of the FSI Radar index files that are located on the px1 server. If the number of workstations at a WFO changes (workstations are added or removed), the FSI must be reconfigured using the following procedure.

NOTE: This procedure should be carried out by the ITO.

Shut down any open FSI windows on the workstations. Then, as user **fxa@px1**, run the following commands:

```
cd $FXA_HOME/bin
./stopFSIprocessor
./createRssdConf.sh
./startFSIprocessor
```

To verify the changes, the contents of the **px1:$FXA_HOME/.rssd.conf** file look something like this:

```
Client: lx1
Client: lx2
Client: lx3
Client: lx4
Client: lx5

Path: /data/fxa/tstorm
```

So that each lx workstation listed in **LX_WORKSTATIONS** is now listed as a client workstation.

NOTE: Only lx workstations with the approved Hewlett-Packard PC hardware are guaranteed to work with FSI. Other workstations comprised of different hardware

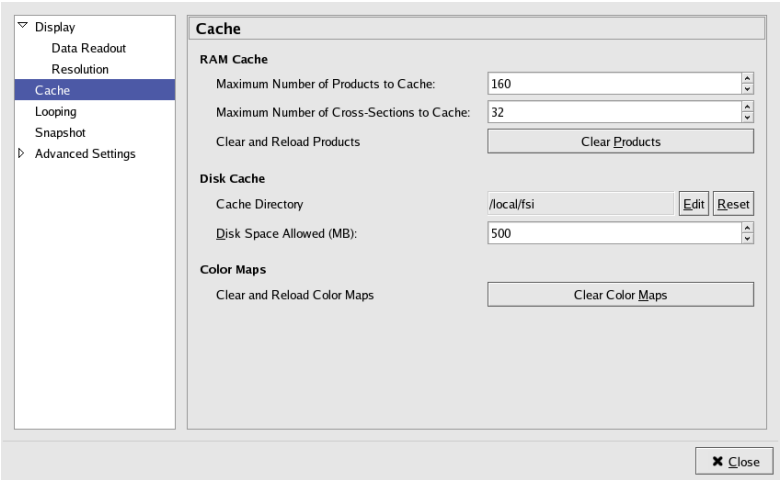
configurations may not be compatible with FSI. Also, the **createRssdConf.sh** script only adds lx workstations to the client list. In order to add non-baseline systems, you must manually edit the **px1:$FXA_HOME/.rssd.conf** file (as user **fxa**) to have the appropriate list of workstation clients. To add or delete workstations within the client list, simply follow the format above. Then stop and restart the FSIprocessor.

Memory Management

The FSI memory "cache"

The FSI is graphics intensive, and requires the use of the Random Access Memory (RAM) in order the "cache" products and textures in memory for faster volume browsing. The RAM on the LX workstations is currently limited to 2 GB, with an additional 2 GB of swap space. The FSI uses a considerable portion of that RAM with its default RAM cache settings (160 Products, 32 Cross-Sections); about 300-400 MB of the RAM can be in use while using the FSI, *while zoomed in at storm scale (see note below)*. The D-2D and other AWIPS display applications also require use of the RAM. For example, one D-2D with a 64 frame all-tilts product loaded requires about 450 MB of RAM. It is advised that users be cautious about how many D-2D products and other applications are running on any workstation that FSI is being used. For example, running three D-2Ds with 64 frame all-tilts and the FSI on one workstation is not advised. If you see the performance of the workstation becoming sluggish, it is likely that the RAM and swap limits have been exceeded (and the workstation starts "thrashing" memory with hard drive space).

NOTE: This procedure should be carried out with the assistance of your ITO.



The FSI cache can be controlled by the **Preferences > Cache** GUI. If a user wishes to devote more memory to other applications besides the FSI, the user can dial down the number of Products and Cross-Sections to cache. However, the result of this is that images will take slightly longer to re-load to the FSI display as they are browsed, as they are instead read in from a secondary cache on the hard drive. Smaller cache size means slightly degraded performance in browsing. The trade-off to using a large cache for FSI is that fewer applications or all-tilts frames can be loaded in D-2D.

NOTE: It is not recommended that you use the FSI as a regional scale monitoring tool. If you zoom out to a large scale and set up an animation, the RAM usage can rise to up and over 1 GB. However, if this is desirable, you can dial down the RAM setting numbers to reduce the RAM usage, trading off FSI browsing speed performance.
One way to "clear" the memory cache is to select the "**Clear Products**" button or resetting or exiting the FSI. The result is that the cache is cleared, but new products and textures will need to be re-cached in order to enjoy rapid browsing of the data.

NOTE: Never change the Secondary (Hard Drive) cache settings.

-TROUBLESHOOTING-

No radar data is being displayed, and FSI is in a one-panel mode

There are several known reasons for this condition:

The FSIprocessor and/or rssd has stopped running

With the assistance of your ITO, check the process list ('ps –lef' from the command line) on the **px1f** machine to see if the **FSIprocessor** or **rssd** processes are running. If either or both are not running, issue these commands as user **fxa@px1f**

stopFSIprocessor
startFSIprocessor

The products in RPS list do not match those in FSIproducts.txt

The **px1f:/awips/fxa/data/FSIproducts.txt** file determines which products the FSI will process. These product numbers must also be defined in your RPS list for each radar. If they do not, you must edit either file so that the product numbers that FSI is requesting have a corresponding entry in the RPS list. Ask for ITO assistance when editing the **FSIproducts.txt** file.

The 0.5° Reflectivity product is not in the RPS list

The FSI requires this one product, at a minimum, to launch. Edit your RPS list to include the 0.5° Reflectivity product. Be sure you include the product number corresponding to that listed in the **FSIproducts.txt** file (see above).

Incomplete volume scans, and FSI is in a four-panel mode

Check to see if you have *all* the elevation angles in your VCPs defined in your RPS list. For Reflectivity and Velocity, 8-bit (level 256) data are preferred. For Spectrum Width, only 4-bit (level16) data are viewable.

NOTE: If the elevations scans below 1.8° are missing, most likely, super-resolution products are defined in an RPS list for a radar that does not produce super-resolution products (e.g., pre-ORPG10). You need to remove the super-resolution products from

that radar's RPS list in order for FSI to process the normal-resolution products at the lowest elevation angles.

No maps to choose from in Maps menu

This is a symptom with the users' personal configuration file default reset problem described at the end of the last section. To fix this, exit FSI, from the command line, type **fsi_def** from the command line, and then restart FSI.

No storm motion

AWIPS users choose the storm motion vector (SRM) from the AWIPS **Radar Display Controls**. If a user chooses the WarnGen motion, the SRM vector will be set to the vector of the last warning issued from that workstation. If the user chooses "Average Storm Motion from STI", the FSI will use a default vector of 240° at 25 kts. Otherwise, if the user chooses to use a "Custom Storm Motion", the storm motion must be set to something other than zero.

/awips/fxa/data/localizationDataSets/OAX/userMotion.txt is of zero size

When a workstation is re-localized (required for FSI install), it "zeroes" out the **userMotion.txt** file. In order to get values in there again, you need to make any change in your **Radar Display Control** settings for storm motion. That message will then go away, and FSI will use the motion setting you just entered.

-WHAT FSI MAY OFFER IN THE FUTURE-

Some of these upgrades are tentative based on resource and budget allocation within the AWIPS program.

OB9.0

Terminal Doppler Weather Radar (TDWR)

Support for TDWR data, and its unique interlaced volume coverage pattern.

Beyond… (AWIPS2)

Colormap Editor

A graphical user interface (GUI) to create and edit colormaps for the various radar products.

BCD format map files

In addition to shapefile map support, support for AWIPS's own BCD format map files.

3D Volume Rendering and Isosurfaces

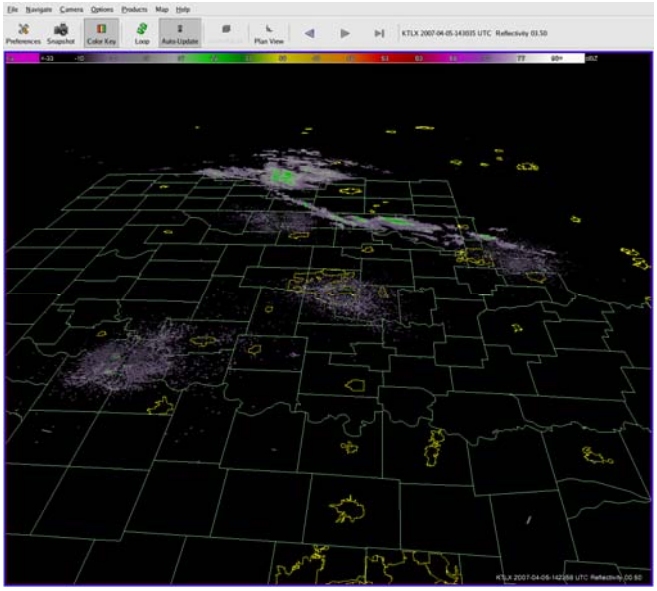
True 3D capabilities! Radar data is represented on 3D isosurfaces in 3D space, with dynamic isosurface selection. 3D Volume Rendering with continuous "alpha" (transparency) settings for any data level, for multiple semi-transparent isosurfaces and "lit volumes".

Elevation Scan Data Advection

Time-to-space correction for elevation scan data to remove the artificial "drift" of radar data due to the time differences between collection of elevation scan data. All elevation scans in the virtual volumes will be time-to-space corrected to one of the elevation scans (either the latest, or the 0.5° elevation angle tilt). This will allow the user to analyze the true storm core tilt, and removes the spatial discontinuities seen between the latest and earliest elevation scans in the virtual volume.

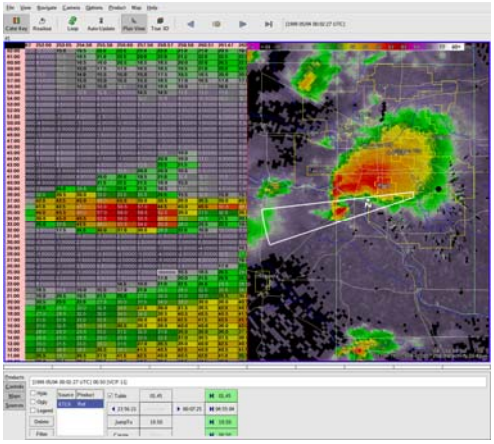
Display of single radars from multiple locations concurrently

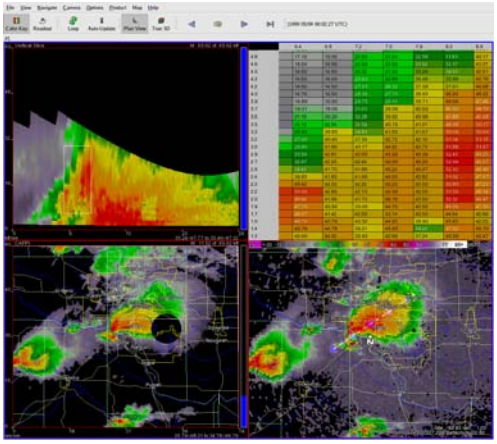
Currently, the FSI is set up to view radar data from a single radar source only. The foundation application of FSI, the WDSSII GUI (wg), is capable of displaying multiple data sources, including multiple sources of single-radar data. See example below with KTLX, KINX, KVNX, and KFDR.



"B-Scan"

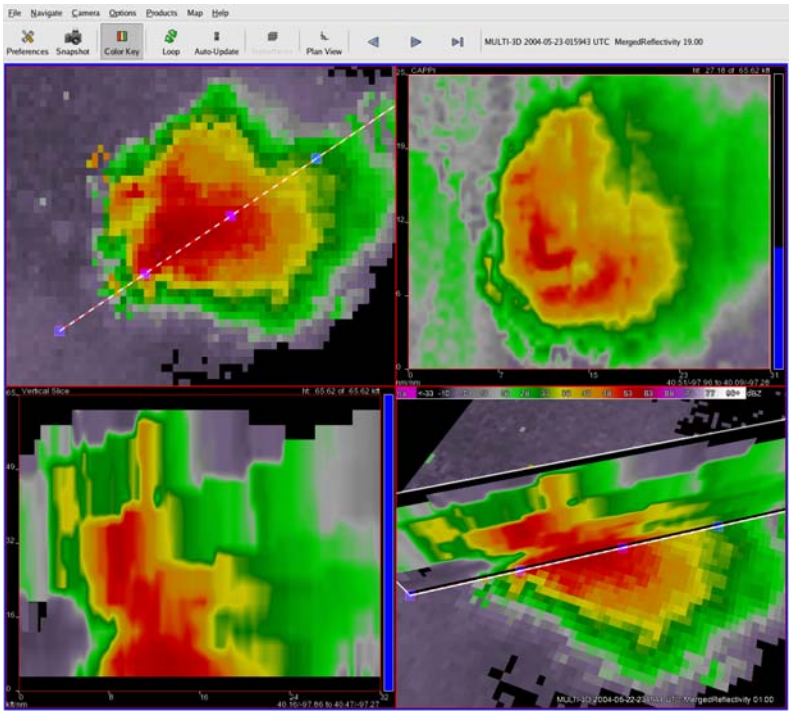
A unique data readout capability opens a new window that shows the individual sample volume values (color coded) on a Cartesian grid. The values are continuously sampled as the cursor moves over the data. This can be done in the PPI, CAPPI, Vertical Cross Section panels. A prototype example of a PPI and Vertical Cross Section B-scans are shown in the next two figures.





3D grids of Multiple-Radar data

The National Mosaic Quantitative Precipitation Estimation (NMQ) project is underway, and soon, 3D grids of data combined from multiple-radars will be available as a data stream from NCEP and made available to AWIPS for flood applications. The WDSSII GUI is capable of displaying these multiple-radar grids, and the FSI will be capable of slicing and dicing these grids as well. See example below.



Near-Storm Environment (NSE) thermodynamic data integration

Adding the capability to include NSE thermodynamic data in the cursor readout, as well as including temperature data on the vertical cross-sections (e.g., the height of the melting level). A novel concept may also be introduced – the Constant Temperature PPI (CTPPI), which would allow the user to dynamically change the height of a constant temperature surface using a slider bar similar to the CAPPI. These capabilities would be highly desirable for analysis of polarimetric variables in relation to updraft development/strength and winter storm analysis.

-FSI MAILING LIST-

The listserv mailing list '**awips-fsi**' is available for information, news, discussion, and feedback on the FSI. The MDL developers that are responsible for the FSI are members of this list, and are available to answer any questions. We also envision that, as the list grows, your peers can become a valuable resource for information.

To join, navigate your browser to the Lyris ListManager

http://infolist.nws.noaa.gov/read/all_forums/

and hit the Subscribe button on the right side of the **awips-fsi** row. You may need to hit the "Show More" button to reveal the entire list of mailing lists.

-FURTHER READING-

- 22nd AMS Severe Local Storms Conference Paper, Presentation
- 32nd AMS Radar Conference Paper, Presentation
- 1st NWS Severe Weather Warning Technology Workshop Presentation
- NWS Operational Services Improvement Plan (OSIP) Statement of Need (SON), Project Plan (PP), and Concept of Operations.

-POINTS OF CONTACT-

Greg Stumpf, Team Lead, CIMMS and NWS/MDL, Norman, OK,
work: 405-325-6773, cell: 405-826-8644

Tom Filiaggi, NWS/MDL, Boulder, CO, 303-497-6578

Dr. Stephan B. Smith, NWS, 301-713-1768 ext 160

Mike Magsig, NWS/WDTB, Norman, OK, 405-325-2995

APPENDIX A: FSI QUICK REFERENCE GUIDE

Action	Procedure
CAMERA VIEW MANIPULATION	
PAN	PPI, CAPPI, VDX, 3DF: Hold Left Mouse, drag image
ZOOM	PPI, CAPPI, VDX, 3DF: Hold Middle Mouse; slide toward (away) from you to zoom in (out)
CAPPI HEIGHT	CAPPI: Left Click and drag blue bar on right of panel
3D ROTATE	3DF: Hold Shift-Left Mouse, slide toward (away) to increase (decrease) viewing angle; slide mouse left (right) to rotate view clockwise (counterclockwise)
INTERPOLATE	CAPPI, VDX, 3DF: Hit **"I"**
PLAN VIEW	3DF: Hit **"P"**
TOGGLE VERTICAL CROSS-SECTION	3DF: Hit **"X"**
TOGGLE CAPPI	3DF: Hit **"C"**
VERTICAL CROSS-SECTION (VSLICE) POSITION	
SWING ENDPOINTS	Left Click and drag blue box on either **end**
MOVE LINE	Left Click and drag the **middle** blue box
ROTATE	Left Click and drag the **2nd or 4th** blue box
PRODUCT SELECTION	
REFLECTIVITY	Hit **"Z"** or Hit **"1"** on the alpha keyboard (top row)
VELOCITY	Hit **"V"** or Hit **"2"** on the alpha keyboard (top row)
SRM	Hit **"S"** or Hit **"3"** on the alpha keyboard (top row)
SPECTRUM WIDTH	Hit **"W"** or Hit **"4"** on the alpha keyboard (top row)
ZDR	Hit **"D"** or Hit **"5"** on the alpha keyboard (top row)
CORRELATION COEFFICIENT	Hit the letter **"O"** or Hit **"6"** on the alpha keyboard (top row)
KDP	Hit **"K"** or Hit **"7"** on the alpha keyboard (top row)
HYDRO CLASS	Hit **"H"** or Hit **"8"** on the alpha keyboard (top row)
Z/SRM8 TOGGLE	Hit **"."** **(the decimal key on the numeric keypad)**
VIRTUAL VOLUME BROWSING (*NUMLOCK MUST BE ON)	
UP ELEVATION	Numeric Keypad: **Pg Up (9)**
DOWN ELEVATION	Numeric Keypad: **Pg Dn (3)**
LATEST 0.5° TILT	Arrow Keypad: **Ctrl-ArrowDown**
LATEST TILT	Arrow Keypad: **Ctrl-ArrowRight**
FORWARD IN TIME	Numeric Keypad: **Right Arrow (6)**
BACK IN TIME	Numeric Keypad: **Left Arrow (4)**
TRADITIONAL VOLUME BROWSING (*NUMLOCK MUST BE ON)	
UP ELEVATION	Numeric Keypad: **Up Arrow (8)**
DOWN ELEVATION	Numeric Keypad: **Down Arrow (2)**
DOWN TO 0.5° TILT	Arrow Keypad: **Ctrl-ArrowLeft**
MANAGING THE APPLICATION	
TOGGLE AUTO UPDATE	Hit **"A"**
TOGGLE DATA SAMPLING/READOUT	Hit **"R"**
RESET DISPLAY	The **Reset** button
EXIT	From Menu Bar: **File > Exit**