

Contouring and Advanced Visualization



- Contouring
 - Underlay your oneline with an image
- Geographic Data Views
 - Auto-created geographic data visualization
- Emphasis of Display Objects
 - Make specific objects standout on your oneline
- Dynamic Formatting
 - Allows for Conditional Dynamic Formatting of Onelines and Case Information Displays
- Geographic Information System (GIS) Support
 - Reading ESRI Shapefiles (*.shp/*.dbf/*.shx groups)
 - Read existing coordinate data



Contouring Visualization

Contouring Visualization



- What is Contouring used for?
- Using the Contour Options Dialog
- Examples
 - Bus Voltage Magnitudes
 - Line MVA Percentage Loadings
 - Line PTDFs
 - Many more...
- Recommendations on using Contouring

Uses of Contouring

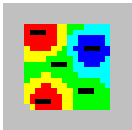


- Analyze large amounts of information all at once
- Get an overview at a glance
- Monitoring data
- Presenting data

Contour Options Dialog



- Contour Options Dialog is used to control the contouring used on a oneline
- Note: Contouring is only available while in Run Mode
- Contour Options Dialog can be viewed by
 - Contouring option on oneline local menu
 - **Onelines** ribbon tab → **Contouring**



Contour Options Dialog - Contour Type Left Side



Select object type to contour.
Only object types currently
present on the oneline will be
displayed.

Select the value you want
to contour

Used for doing “line contours”

Recalculate does the same
thing as OK, but does not
close the dialog.

Contour Options Dialog - Contour Type Right Side



Contour Options

Contour Type | Contour Type Options | Custom Color Map

Contour Type

Object

☒ Bus ☐ Generator

☐ Line ☐ Substation

☐ Interface ☐ Zone

☐ Area ☐ Injection Group

Value

Voltage: Per Unit Magnitude Find...

Filter Object Values

Define...

Pixel Options

Data Points per Line 15

No Data Color

Specific Color

Color Map % 50

Color Key

☒ Draw Color Key

Title Voltage: Per Unit Magnitude

Entry Labels Dec.Pts. Scalar

pu 3 1.0000

☐ Use Equal Spacing

Values

☐ Use absolute value

☐ Ignore Above Max

Maximum 1.100 pu

Break High 1.050 pu

Nominal 1.000 pu

Break Low 0.950 pu

Minimum 0.900 pu

☐ Ignore Below Min

☐ Ignore Zero Values

Interpretation Fixed values

☐ Save Contour Image with Online

☐ Continuously Update Contours

Recalculate Contours

Save to AXD...

Load from AXD...

OK Remove Cancel Help

Choose the Color Map you want

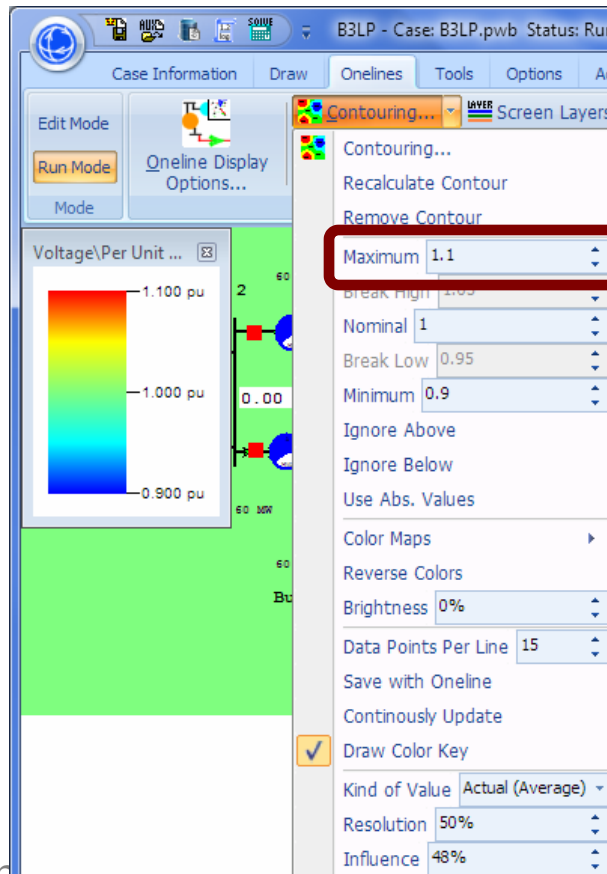
Set the brightness of the colors

Define the range of values in the color map

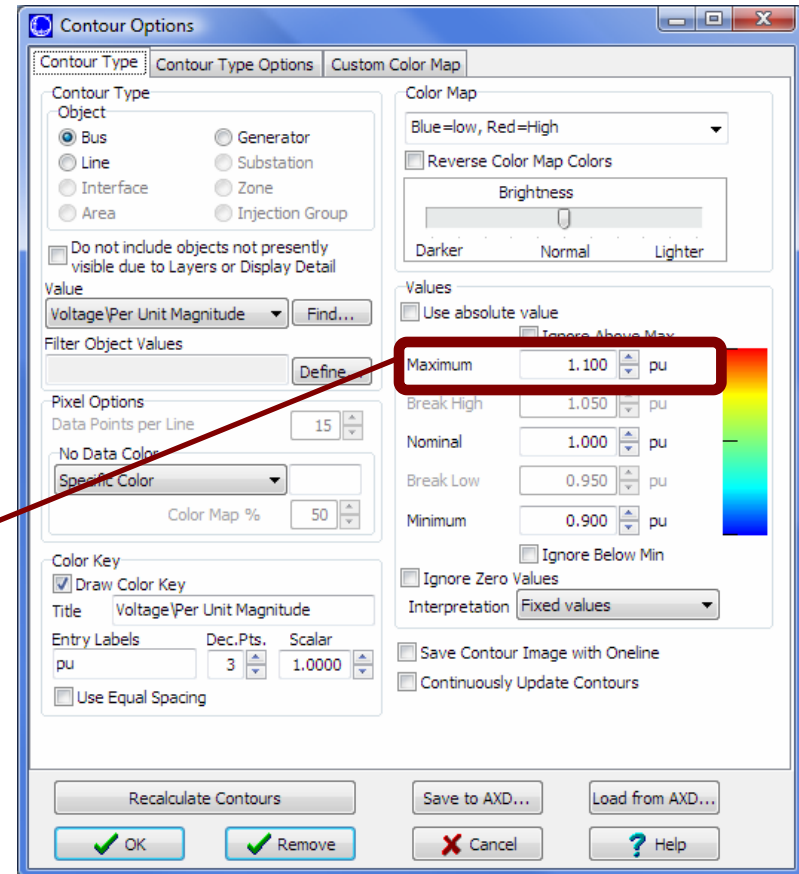
Contour Options Toolbar



- Select the contouring drop-down to show the same options available in the dialog.



Same Setting



Contour Options Dialog - Contour Type Options



Area of influence
about each
contoured point

Dynamic
contouring
adjusts
influence region
according to
density of data
points

If Use Fade To
Value is
checked, then

Percentage at
which contour
begins to fade
towards the
Fade To Value

Set contour
resolution

Contour Type

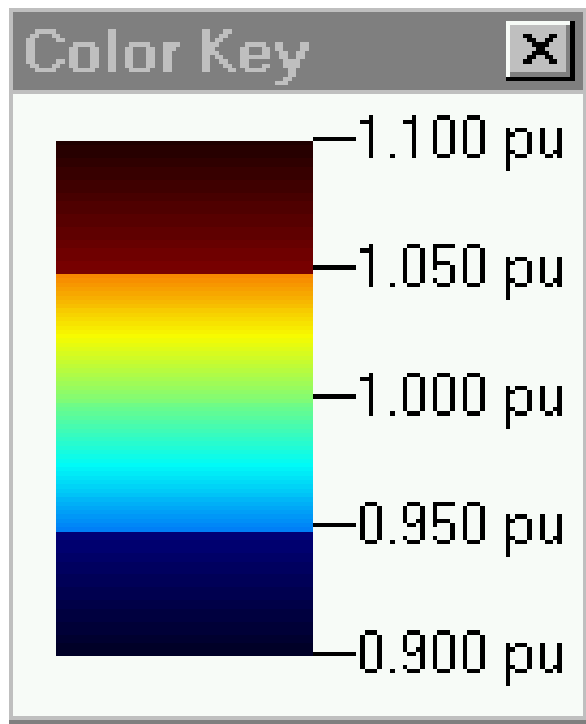


- Specify the type of display object that should be used for contouring
- Specify the value of the respective object to use
- Specify an Advanced Filter... to reduce what is contoured.

Values



- These define the values used in the color maps. (The color key displays the values)



Maximum

(all values above are mapped to dark red)

Break High

Nominal

Break Low

Minimum

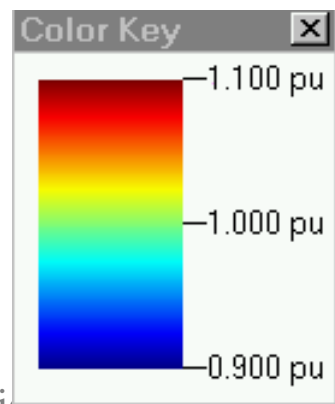
(all values below are mapped to dark blue)

Color Maps

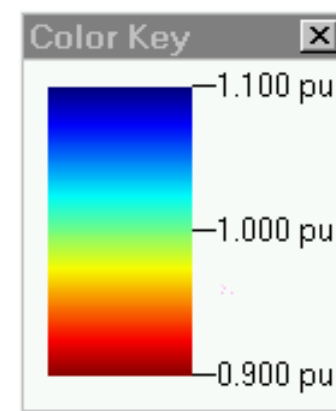


- Simulator offers several default Color Maps
- For contours for which both low and high values are of significance (such as Bus Voltages) the following color maps are recommended

Blue = Low,
Red = High



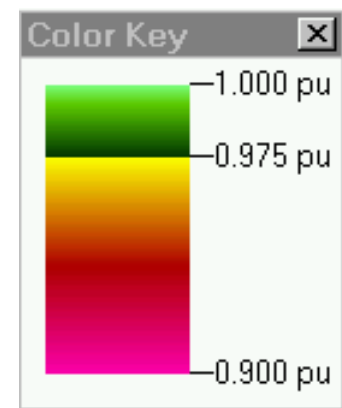
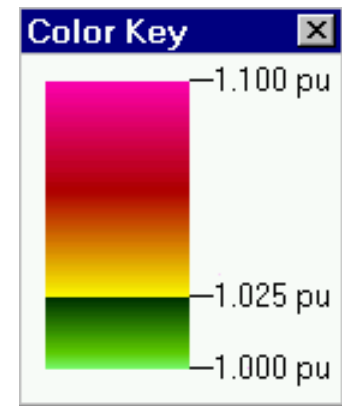
Reverse Colors
To get this



Color Maps



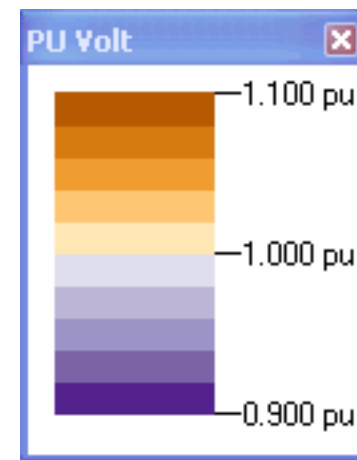
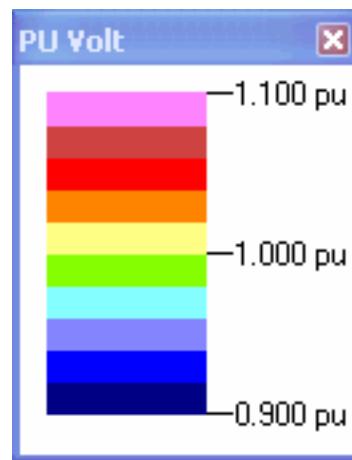
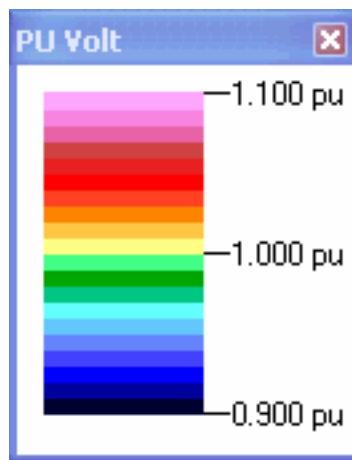
- For contours for which only high values are significant, Radar Map High Limits is recommended
- For contours for which only low values are significant, Radar Map Low Limits is recommended



Discrete Color Maps



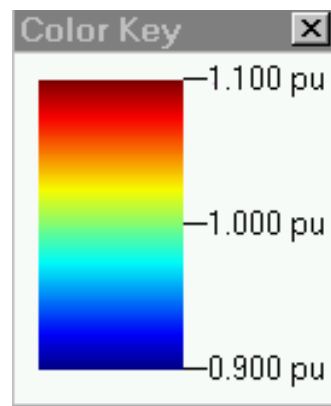
- Simulator also comes with several discrete color maps.
- Some examples are shown below.



Draw Color Key



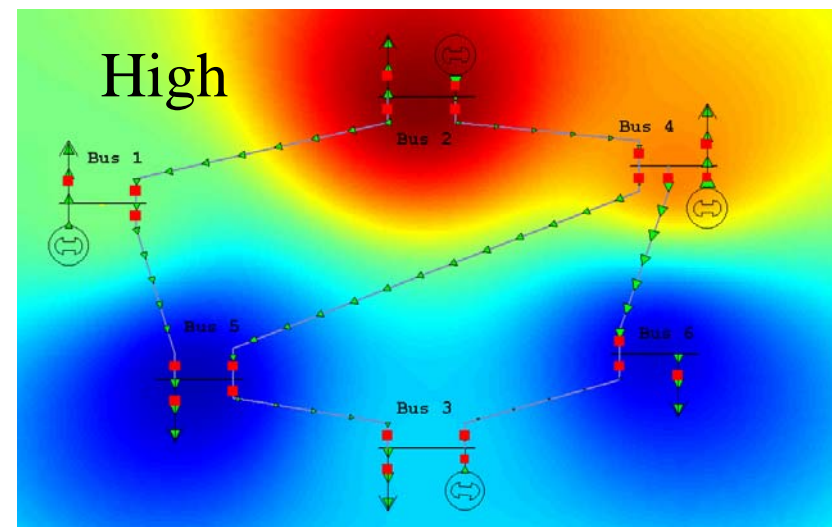
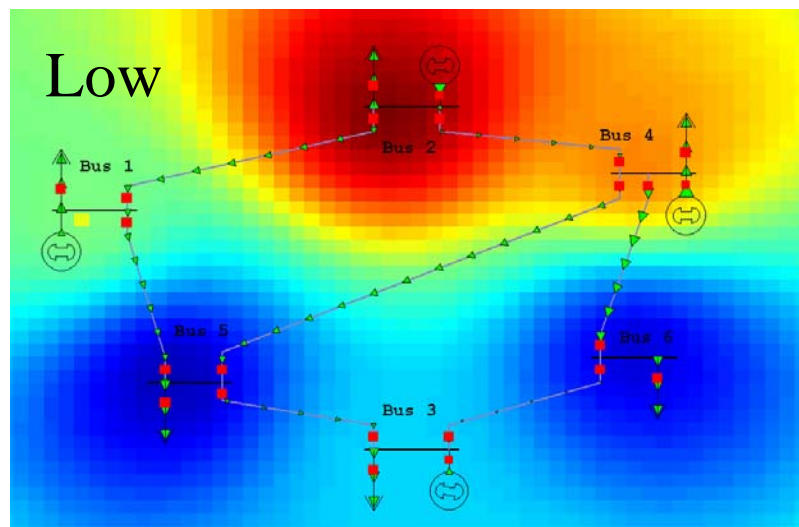
- Checking Draw Color Key tells Simulator to draw a “color key dialog” along with the contour
- The color key dialog looks like:



Contour Resolution



- Sets the resolution of the contour
- High means a better picture with more computation time required
- Low means a “grainy” picture with less computation time

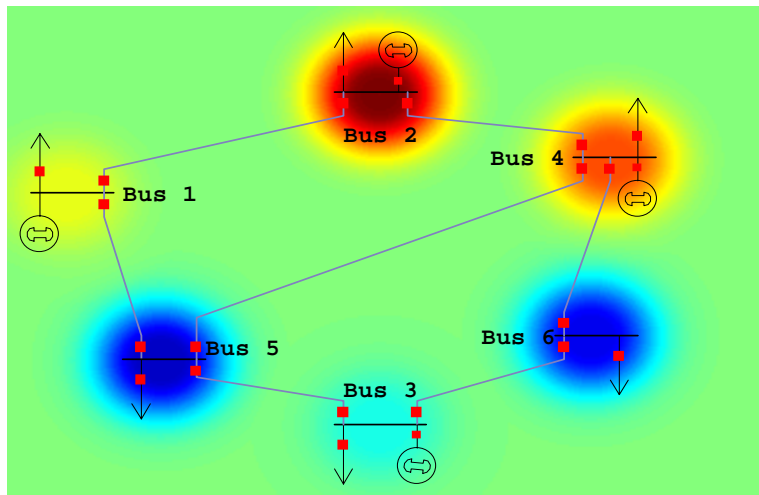


Influence Region

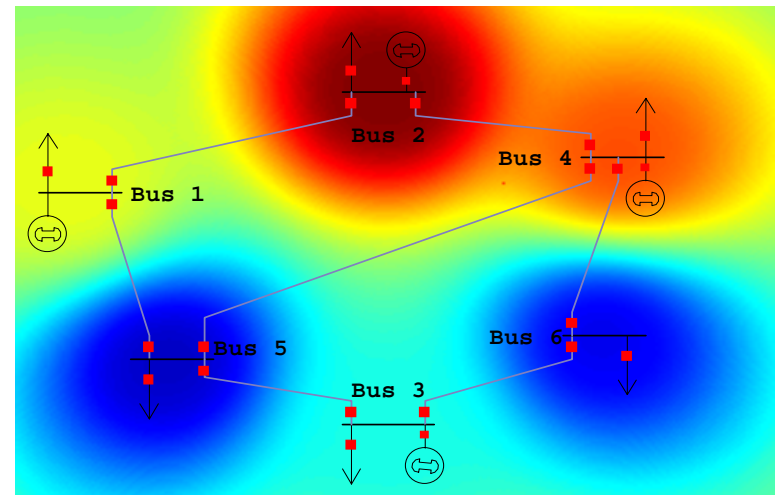


- Controls how large the “influence distance” is for a data point.

Influence Region Small



Influence Region Large

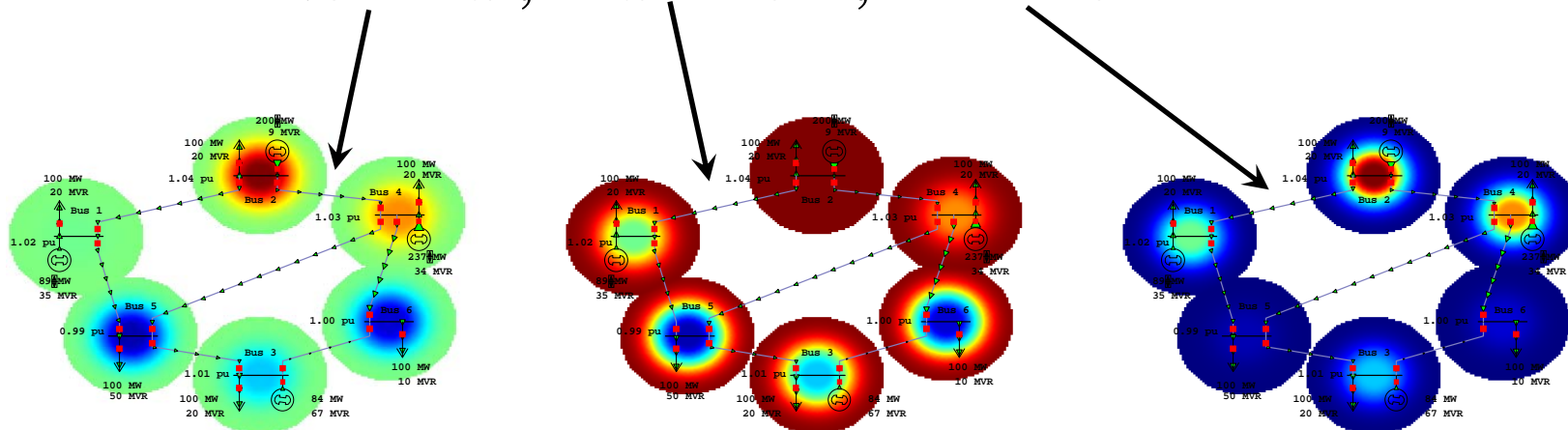


Note: These images are using the **Fade To Value**

Fade To Value



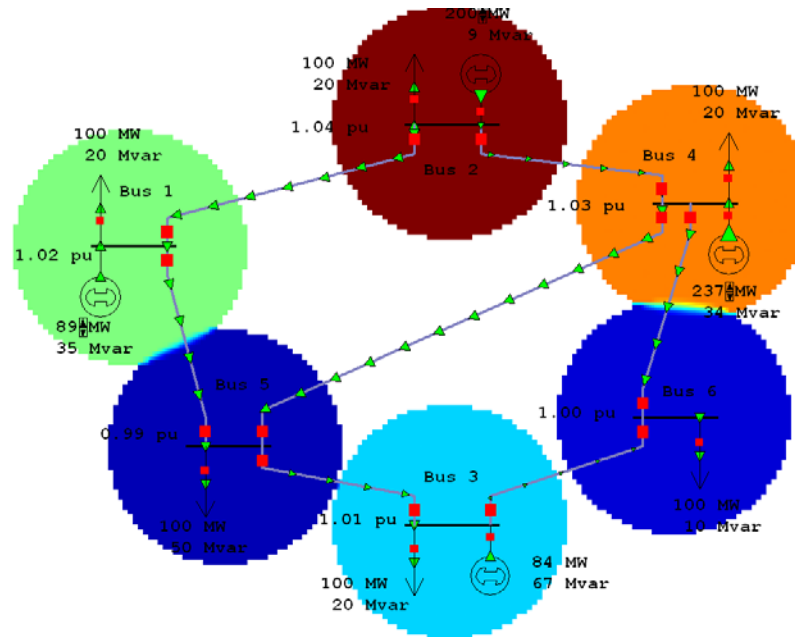
- As a value's influence moves away from the actual data point, the value “fades” to a user-specified value.
 - The same data is contoured in the figures below with different Fade To Values
 - Nominal, Maximum, Minimum



Use Fade To Value



- Uncheck the **Use Fade To Value**
 - Same picture as previous slide but we are no longer *fading*



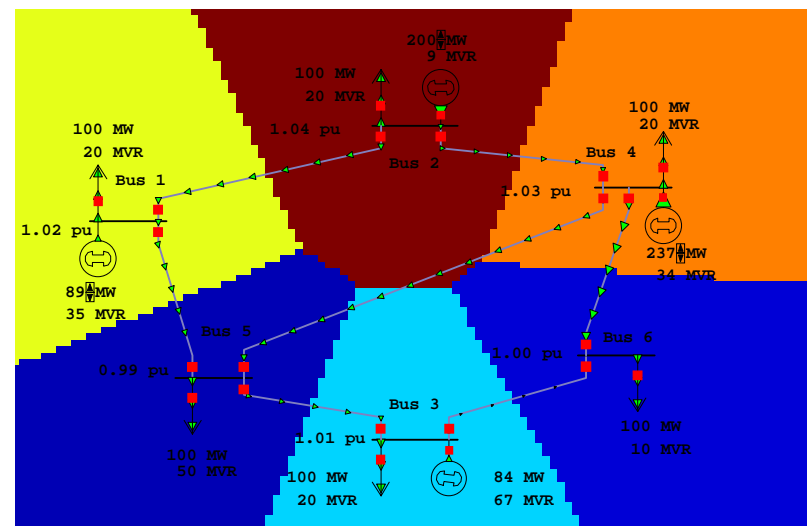
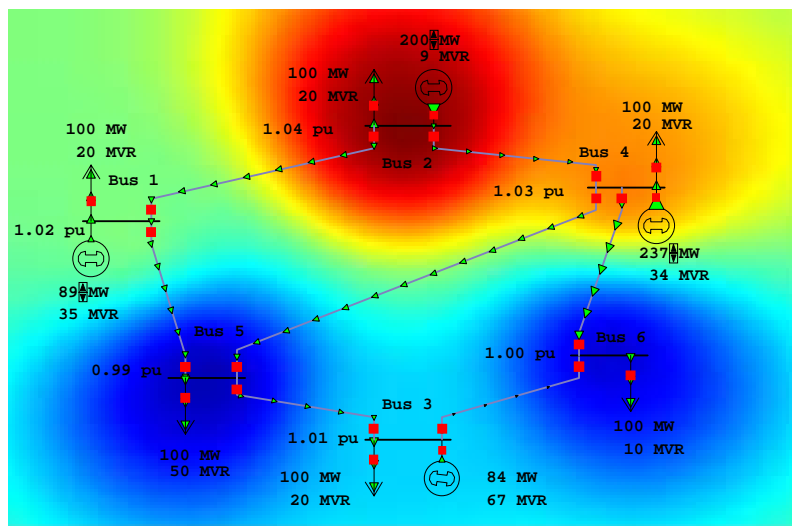
Kind of Value: Actual Value



- Actual Value (Weighted Average) and Actual Value (Only Closest) both attempt to visualize the values of particular points.

Weighted Average creates a gradient by weighting colors by their distance from data points

Only Closest creates a color based only on the value of the closest data point



Kind of Value: Density of Values

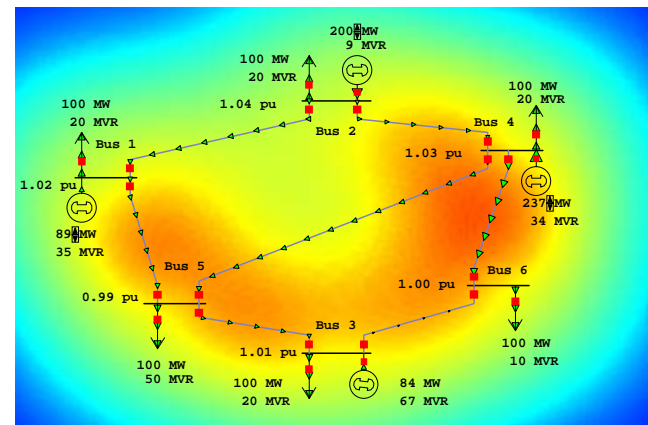
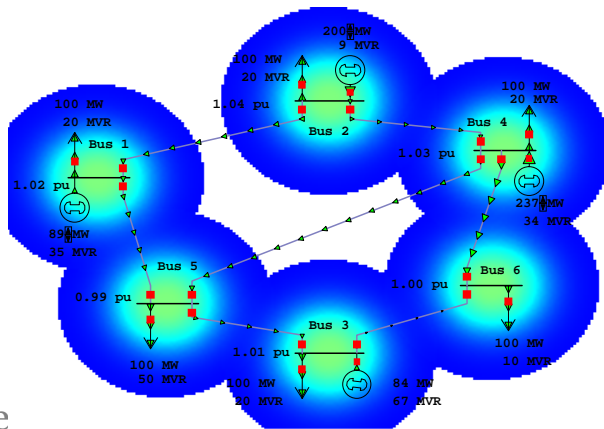


- Density of Values causes the colors on the contour to represent a Weighted Sum
- Useful when you want the following two situations to be equivalent
 - 1 bus with 600 MW of load
 - 6 buses next to each other with 100 MW of load each

Kind of Value: Density of Values



- When using this option, the Influence Region has a great impact on the contour image created
 - Increasing the Influence Region, will cause the “sum” to be taken over a larger number of data points which will increase the values shown in the contour.

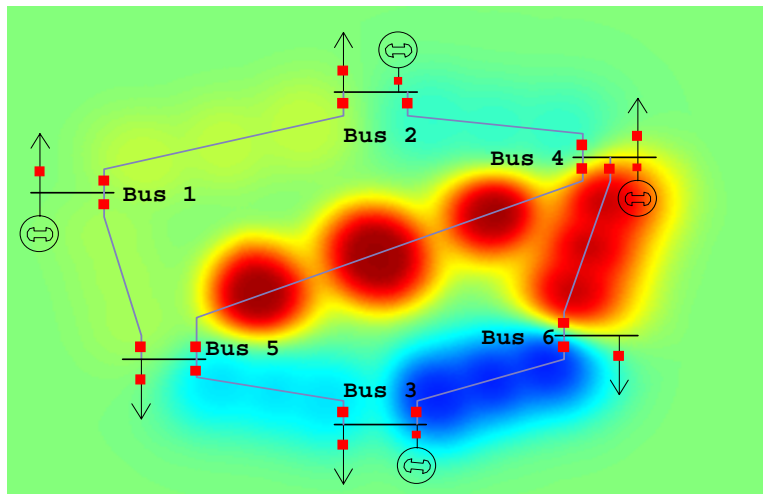


Data Points Per Line

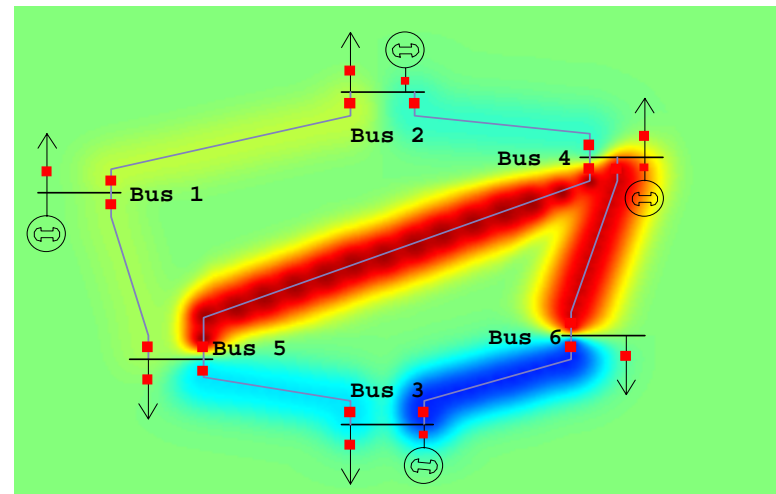


- Specifies the number of points used to represent a line in the contour algorithm

Data Points Per Line = 3



Data Points Per Line = 15

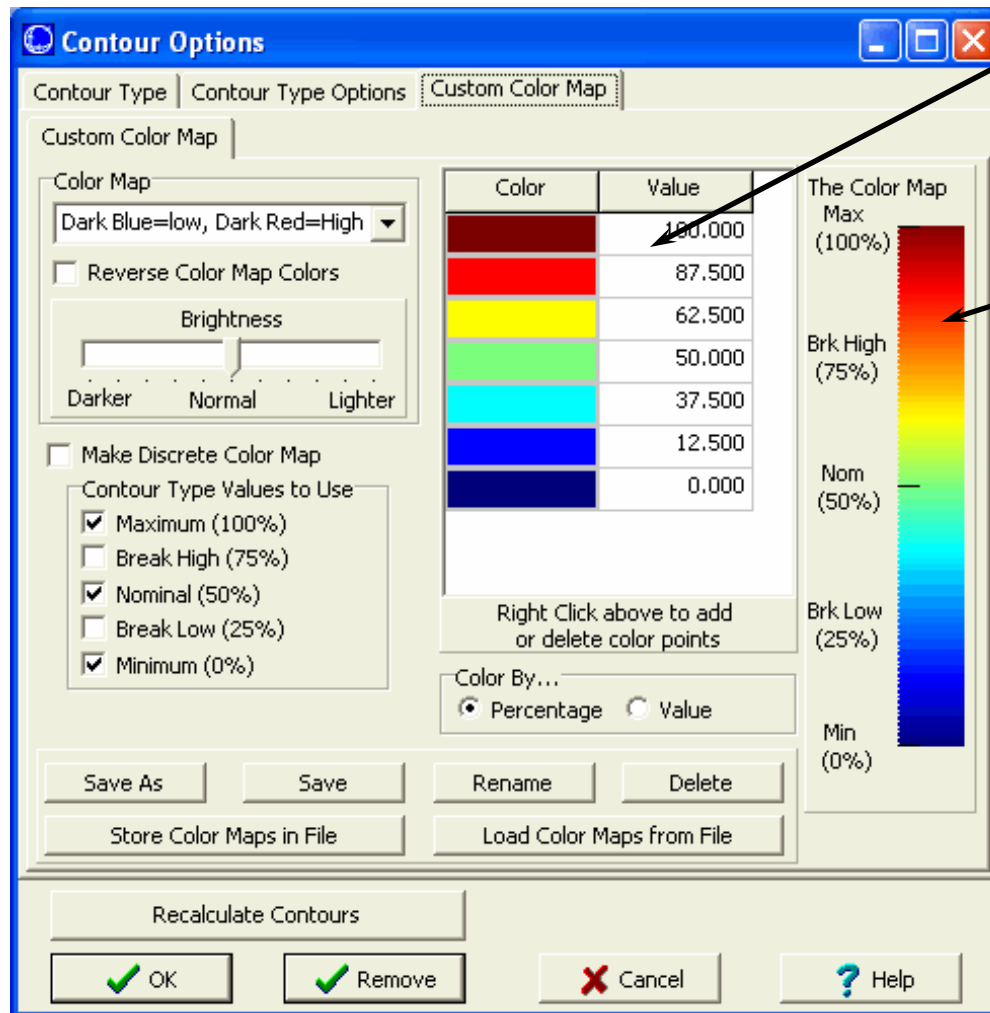


Continuously Update Contours



- Sets Simulator to regenerate a contour each time the system is updated.
- You can animate the contour by checking this
- Note: Because Simulator must now calculate the contour at each time step, this may slow down the simulation
 - Try reducing the resolution to speed up the animation

Custom Color Maps



Set range of color map

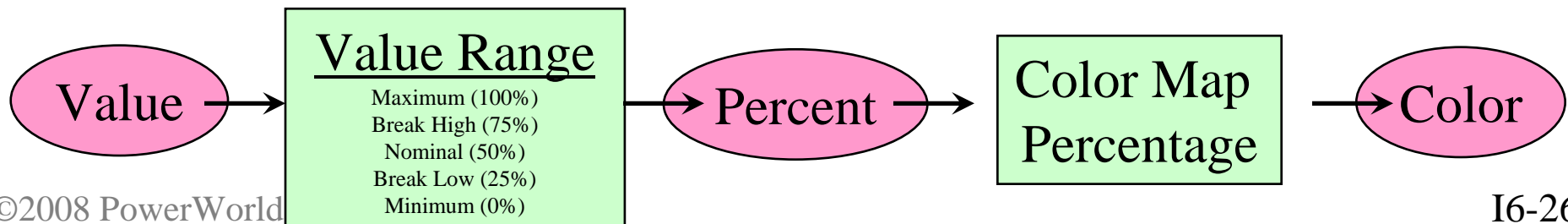
Shows custom color map as changes are made

Create custom color maps designed to show any contoured values highlighted in a specific manner

Color By... Percentage



- Color by Percentage takes the Value and maps it to a Percentage using the Maximum,... Minimum Values specified on the first tab
 - The percentage is then mapped to a color using the Color Map
 - Advantage: Color Maps can be reused
 - Bus Per Unit Voltage, Marginal Cost, anything can use same
 - Disadvantage: You can only specify 5 values that map to specific colors



Color By... Value



- Color By Value removes the intermediate percentage
 - Value is mapped directly to Color using the Color Map
 - Advantage: You can be more precise with your coloring
 - You want to color bus objects by AREA Number using 20 specific colors
 - Disadvantage: You can't easily reuse the Color Map.

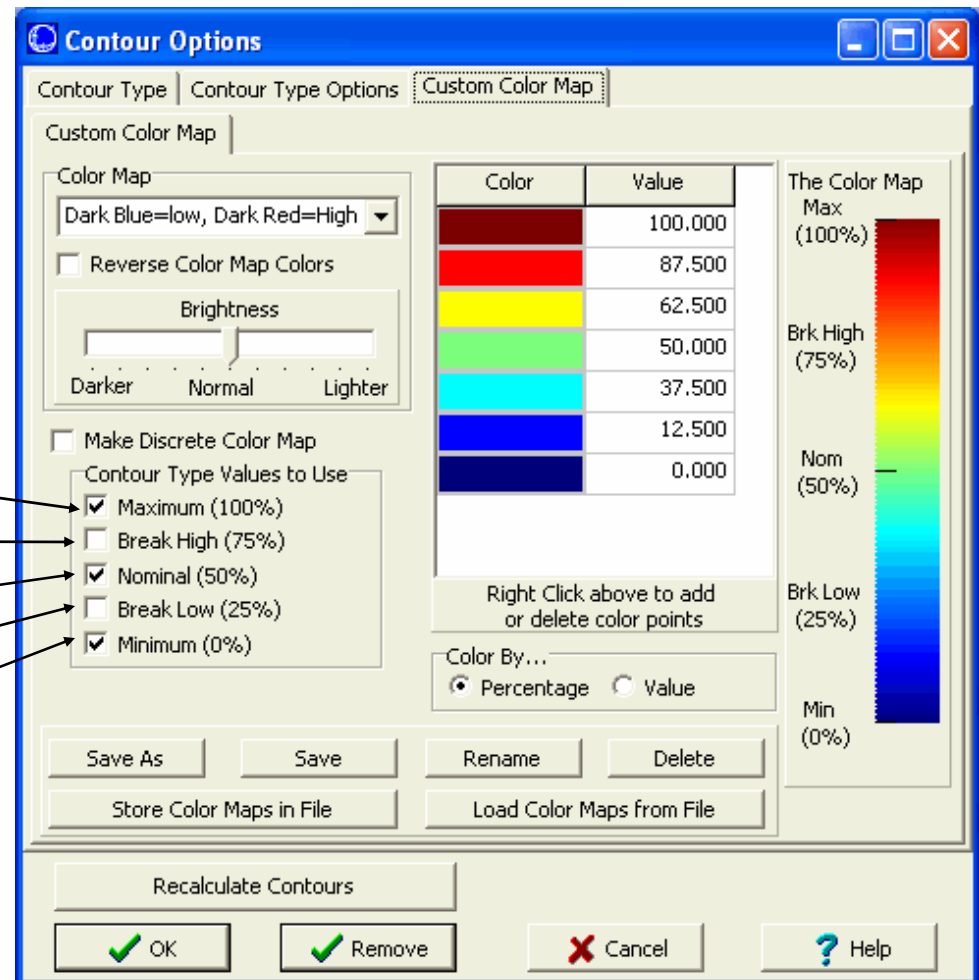


Defining the Color Map

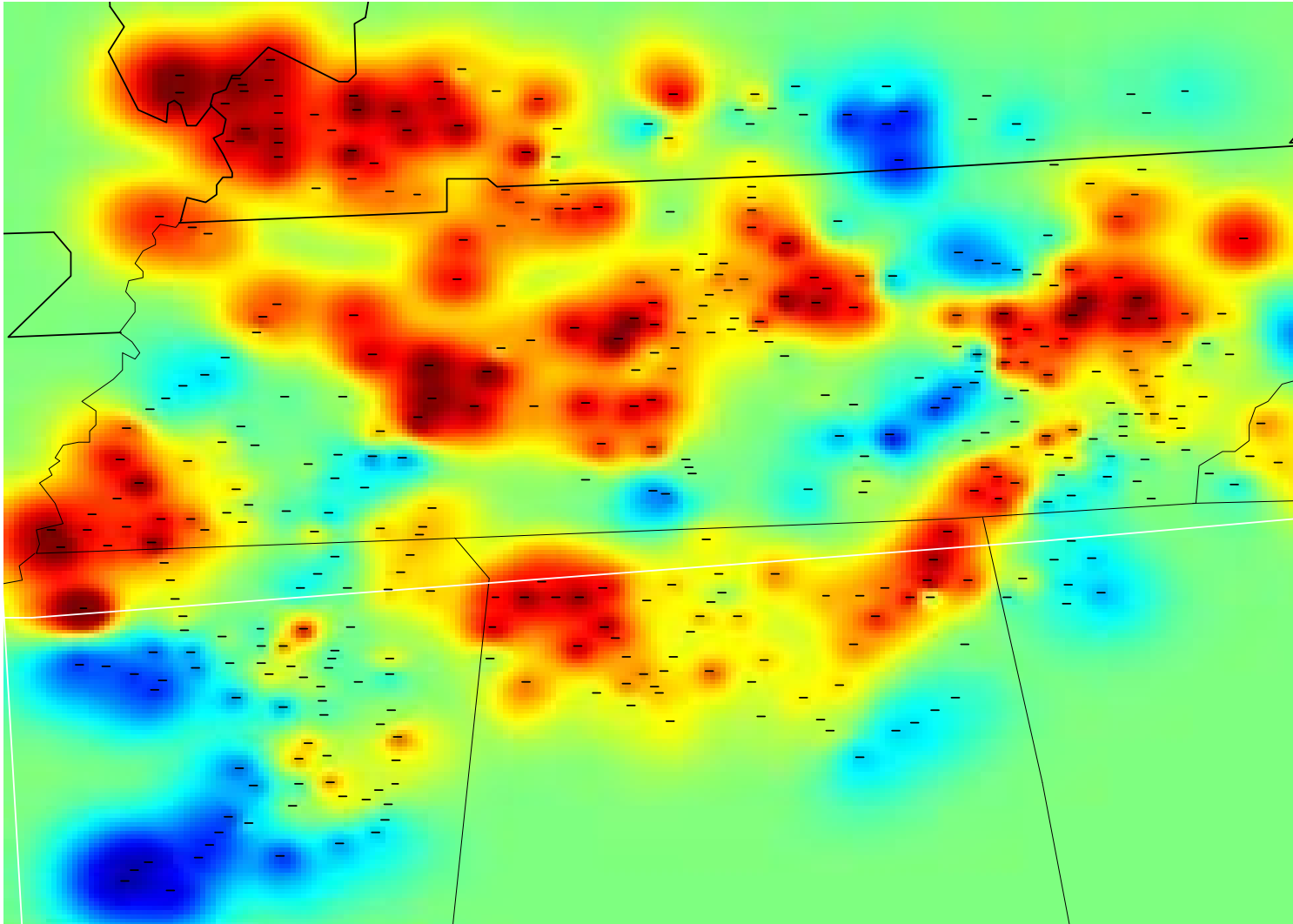


- “Percentages” map to values defined on Contour Type Tab.

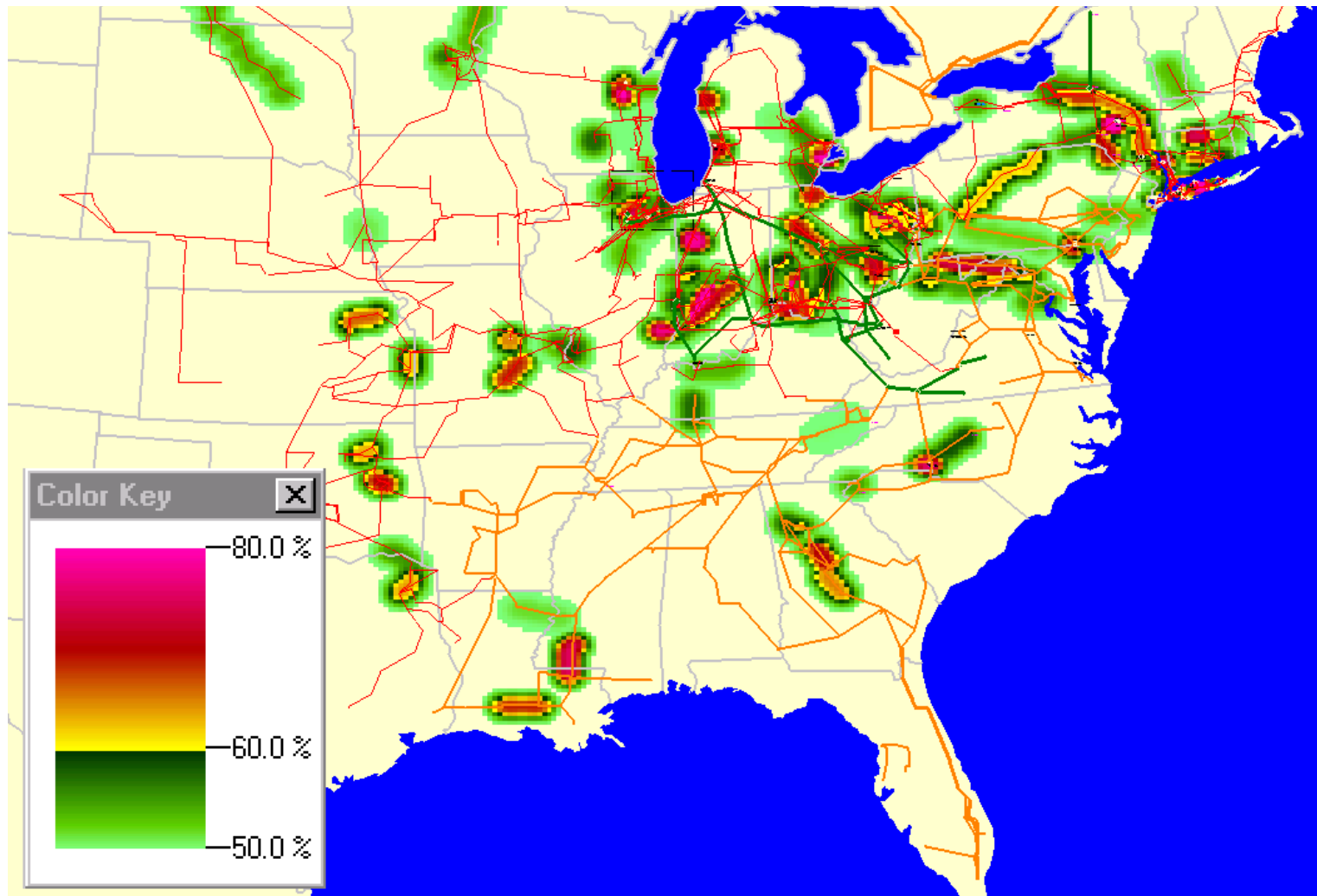
Abs Max = 100%
Lim Max = 75%
Nominal = 50%
Lim Min = 25%
Abs Min = 0%



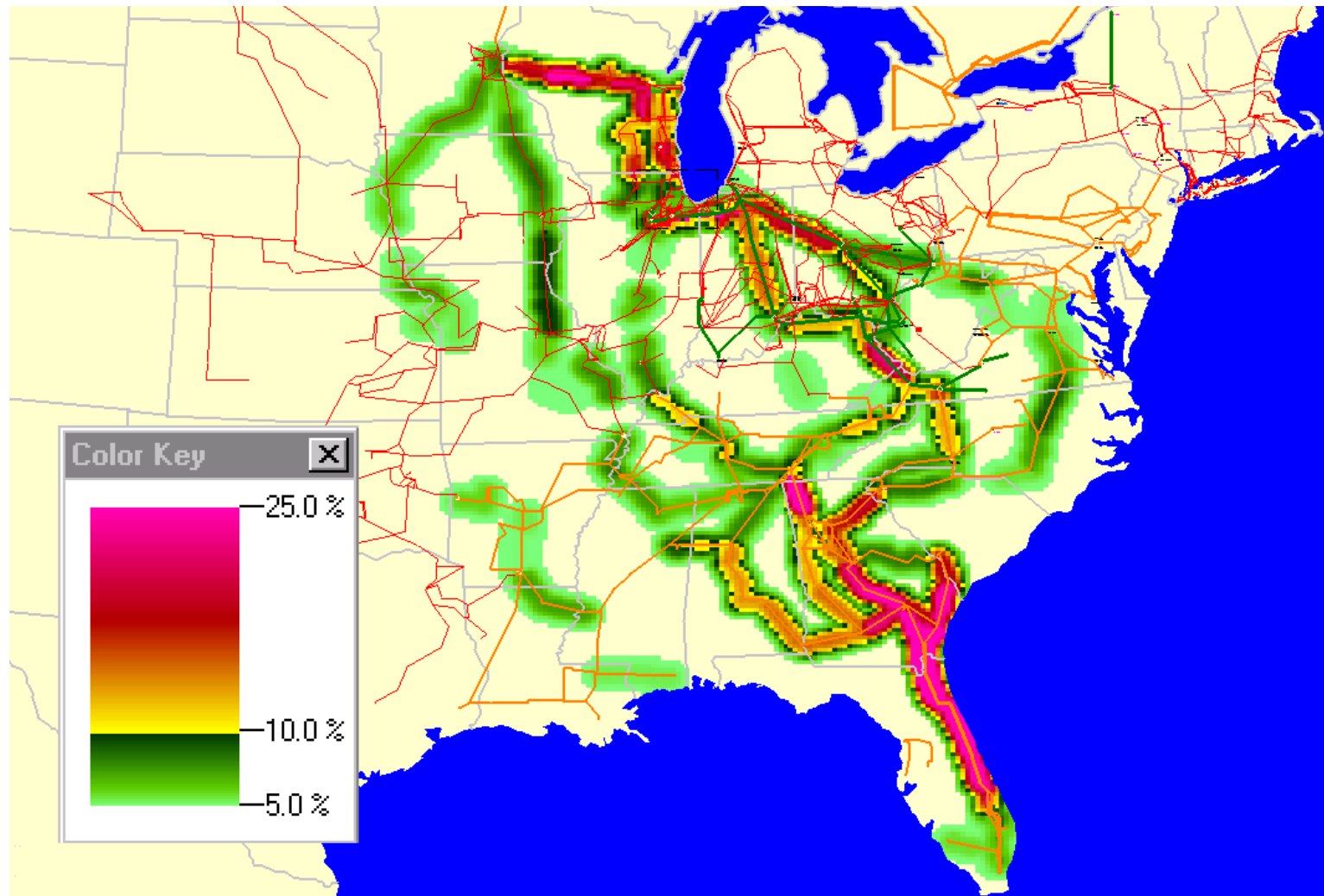
Bus Voltages in TVA at 161 kV



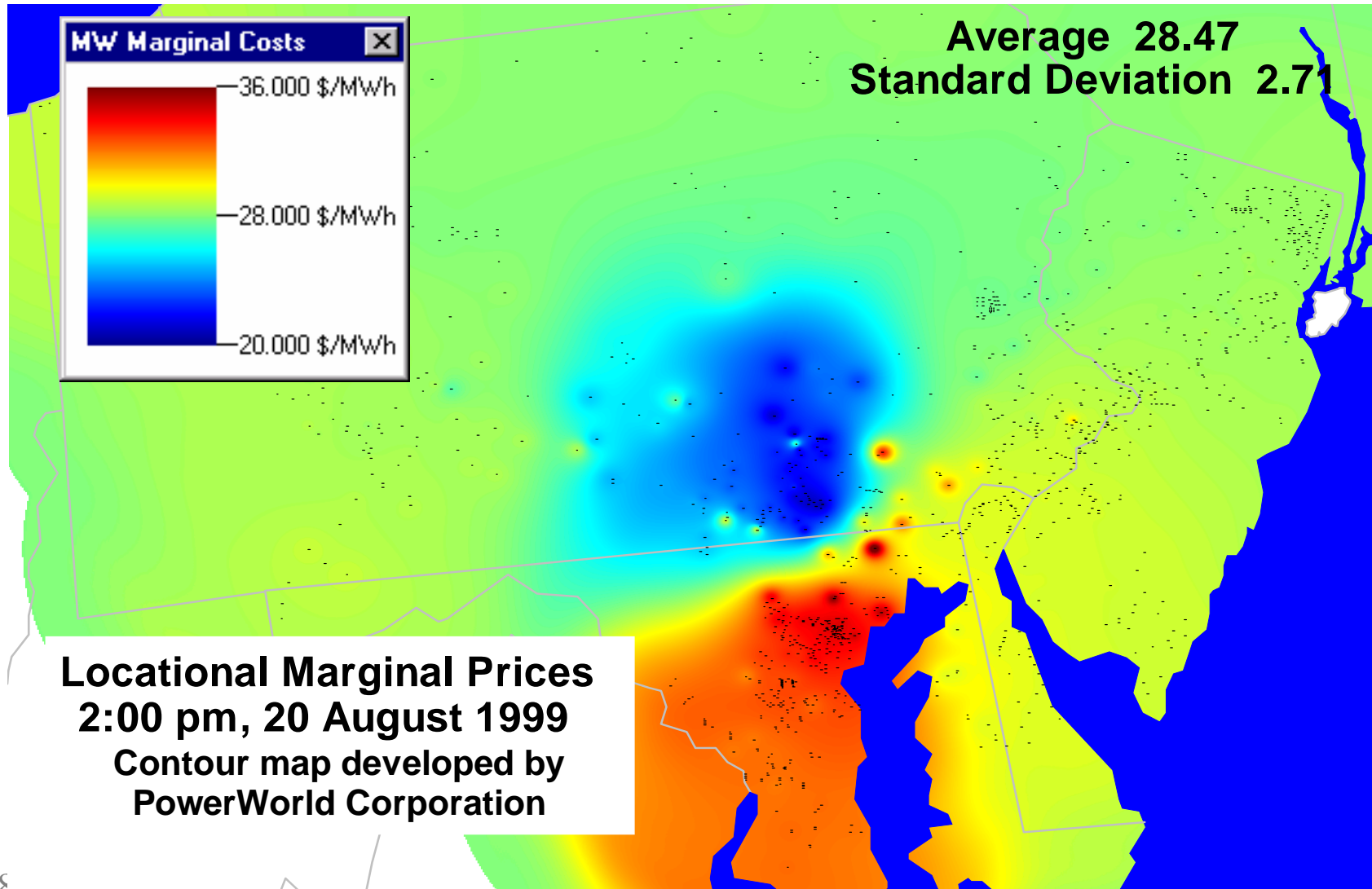
Line MVA Flow Percentage in the Eastern Interconnection



Power Transfer Distribution Factors (PTDFs)



Marginal Prices in PJM for 2:00 PM on August 20, 1999



Recommendations for Contouring



- Task-specific displays
 - Make your onelines so that they only convey one idea
 - For instance: don't show line pie charts on a bus voltage display. This creates clutter.

Voltage Contouring



- Sometimes run into strange contours due to LTCs.
- To avoid this, create onelines that only have one voltage level's buses displayed
 - Can create a different oneline for each voltage level if desired



Geographic Data Views

Geographic Data Views



- Allow quick creation and formatting of graphical representations of devices
 - Buses, generators, loads, switched shunts, transmission lines, substations, areas, zones, super areas, and injection groups
- Longitude and latitude coordinates must be specified with bus and/or substation records to place objects geographically on a display

Geographic Data Views



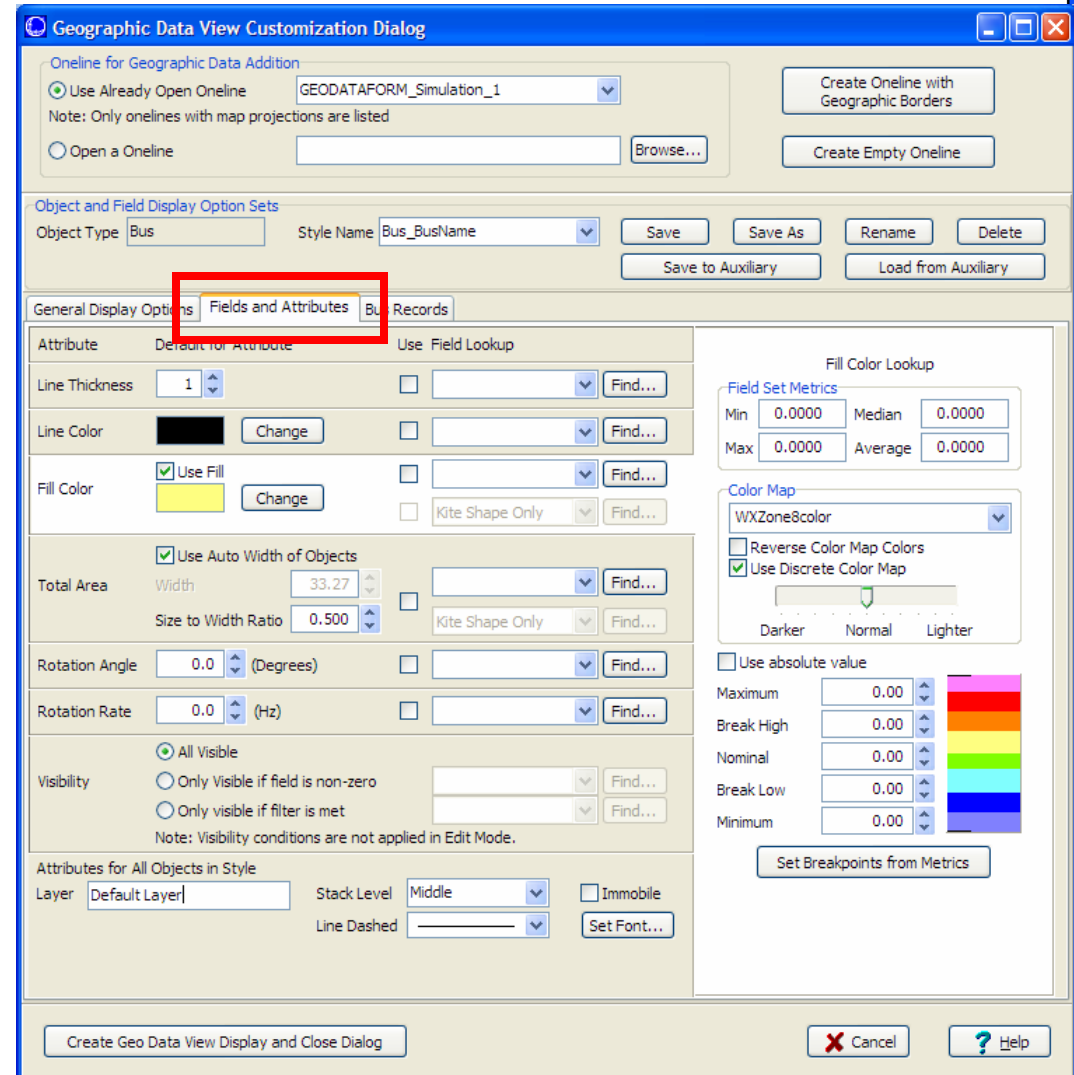
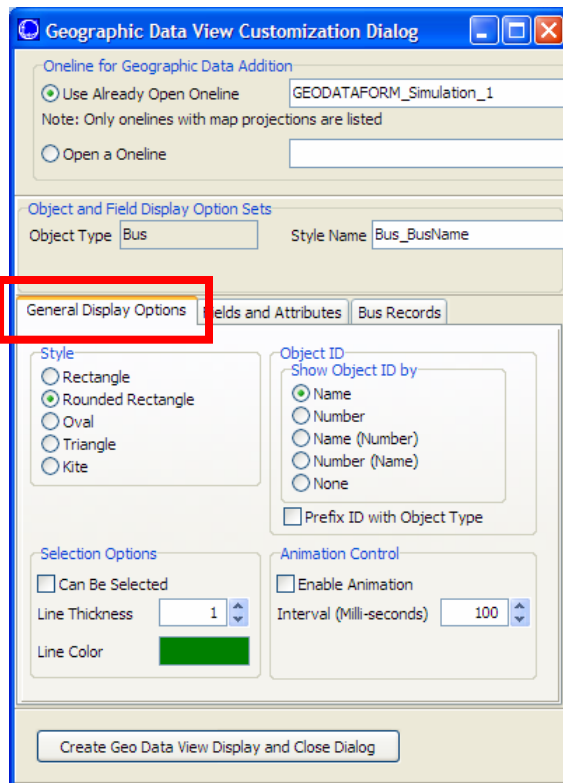
- Data field values used to format objects based on different attributes
 - Line Thickness, Line Color, Fill Color, Total Area, Rotation Angle, Rotation Rate, Visibility
- Options for creating available from the Case Information Toolbar under the **Geo** menu
- Geographic data view objects can be added to existing or new onelines

Geographic Data Views

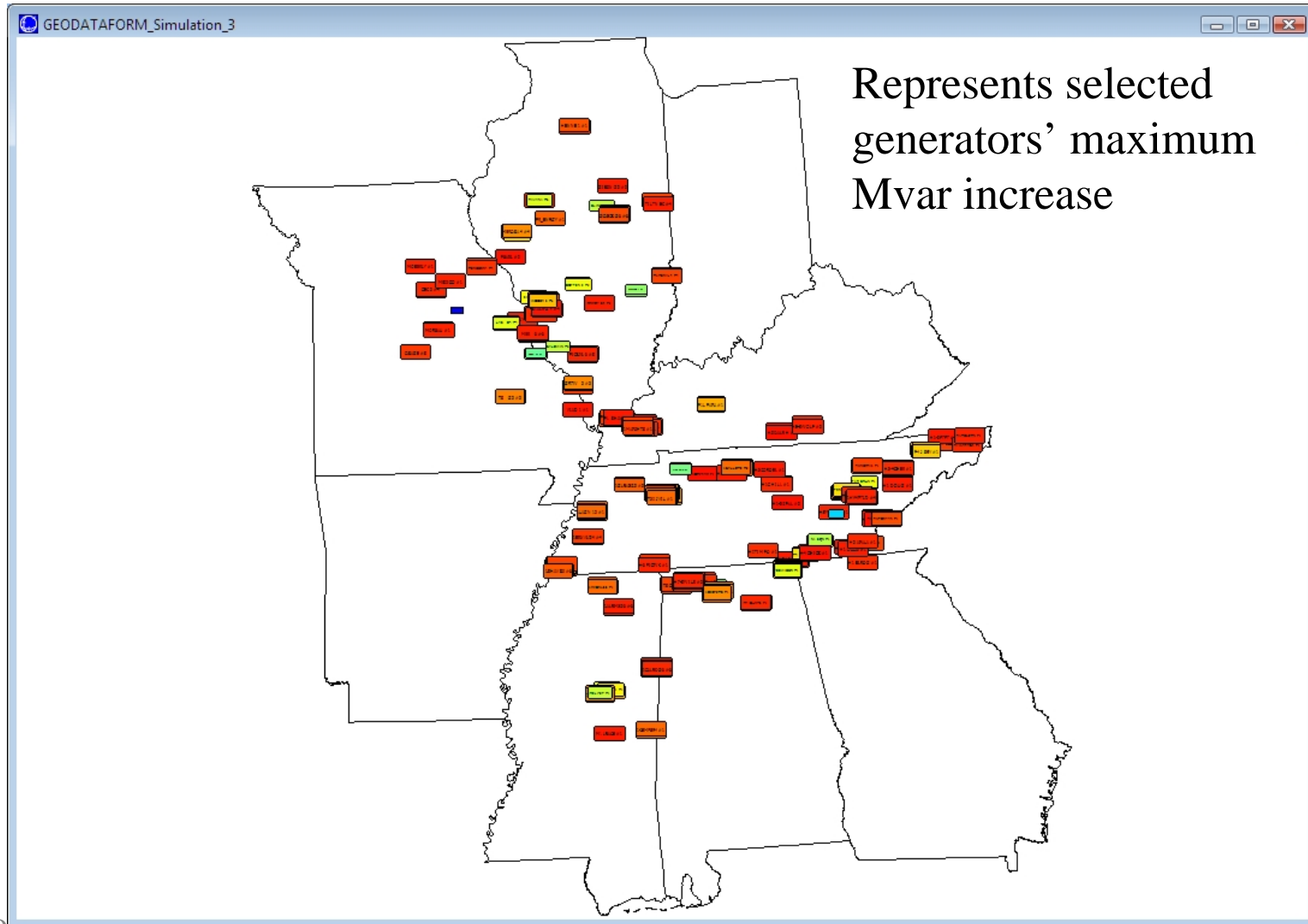


- Geographic Data View Styles contain the set of options that dictate how a Geographic Data View object will look
 - Multiple objects will use the same style
 - Styles are dependent on the type of object being displayed

Geographic Data Views: Customization Dialog



Geographic Data Views





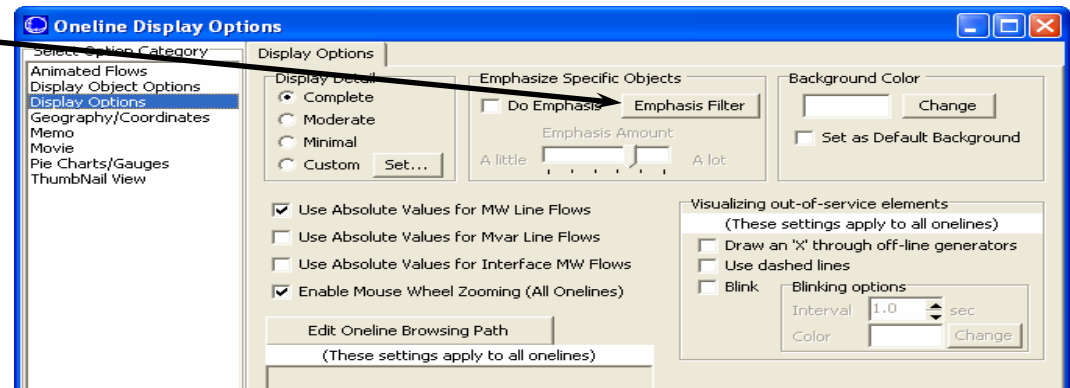
Emphasis of Display Objects

Emphasis of Display Objects



- Emphasis of Display Objects
 - Make specific objects stand out on your oneline
 - Builds on the Select by Criteria abilities
 - Combines this with the use of graphical *alpha blending* which merges two images together
 - To get to this
 - Go to the **Options** ribbon tab and select **Online Display**

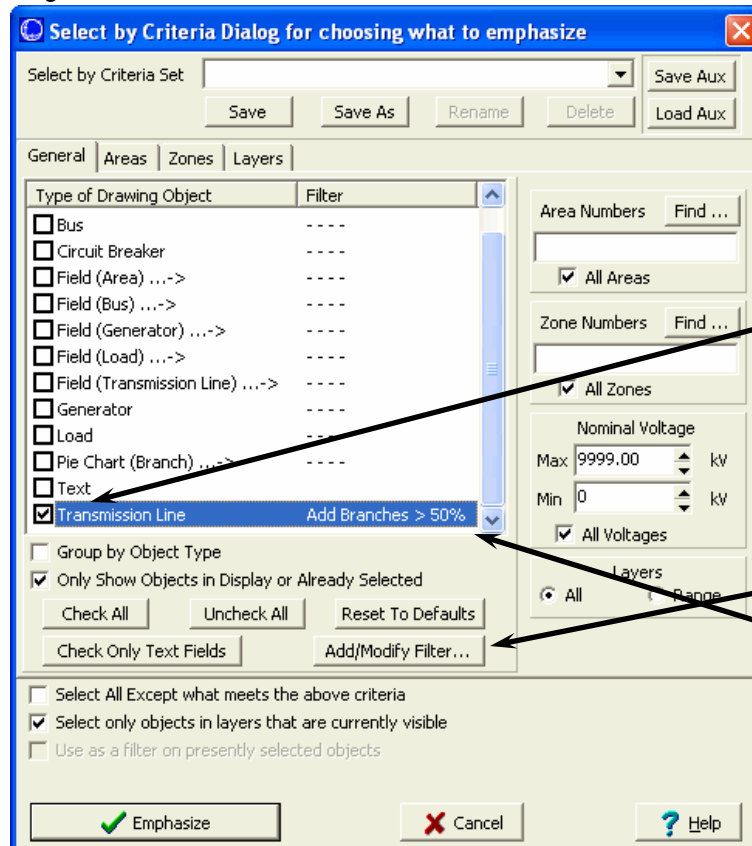
Options and click
Emphasis Filter
on **Display Options**
page



Select by Criteria Dialog for choosing what to emphasize



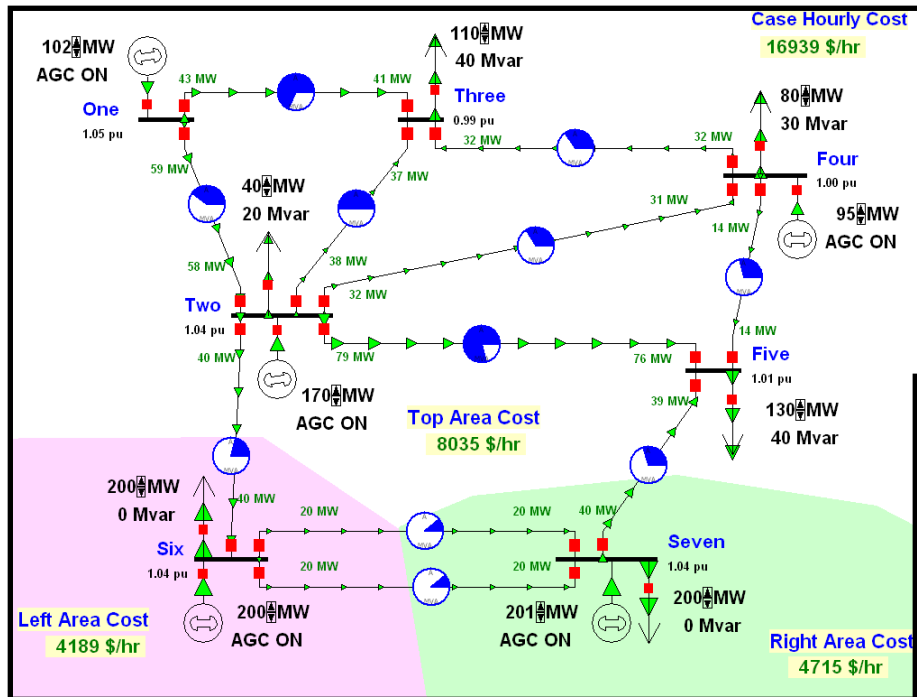
- Select what to emphasize works just like Select by Criteria



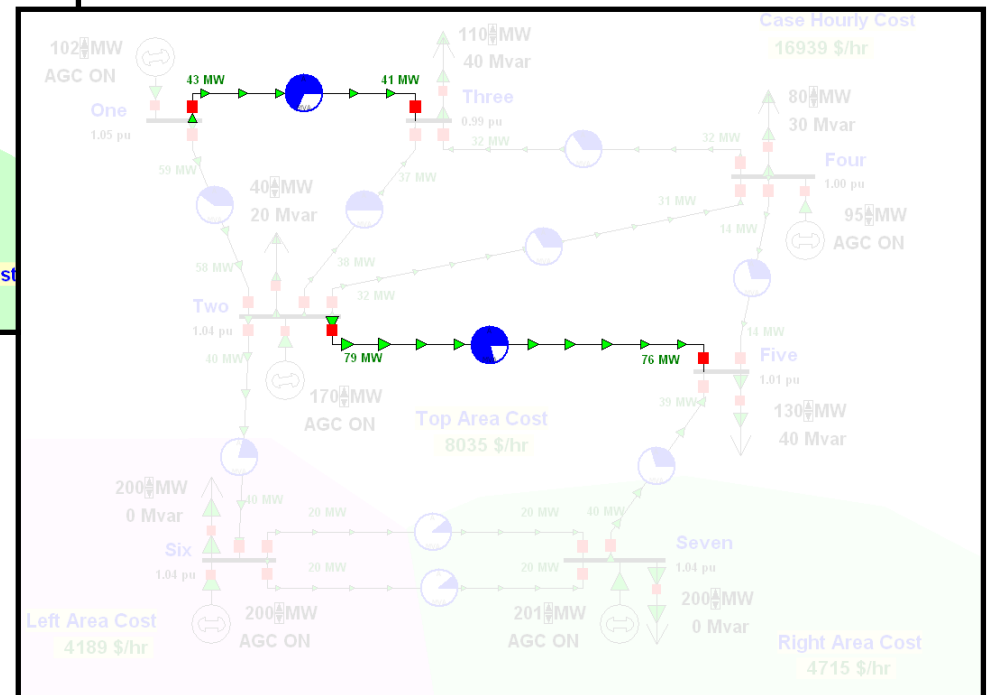
Choose all Transmission Line Objects

Click Add/Modify Filter to define an Advanced Filter called *Add Branches > 50%*

Example image using the b7flat.pwb case and diagram



Lines above 50% loading are emphasized



Emphasize Specific Objects

☒ Do Emphasis Emphasis Filter

Emphasis Amount

A little A lot

Vary the amount of emphasis



Dynamic Formatting

Dynamic Formatting



- Dynamic Formatting
 - Allows for Conditional Dynamic Formatting of Onelines and Case Information Displays
 - Builds on existing features: Select by Criteria AND Advanced Filtering
- Go to the **Onelines** ribbon tab and select **Dynamic Formatting**, then pick which of the two levels of formatting you want
 - With the Case: Case Info / All Views and Onelines
 - Can apply to case information displays, bus views, sub views, and ALL onelines
 - With Individual Oneline: Active Oneline
 - Will apply to only a single oneline

Dynamic Formatting Dialog: Case Info / All Views And Onelines



Temporarily make the formatting not active

Choose Object Type

Choose an Advanced Filter

Choose the screen objects this should apply to → or case information

You can also FORCE an object to be visible

Choose Format Attributes

Choose Fields to apply to for some kinds of objects

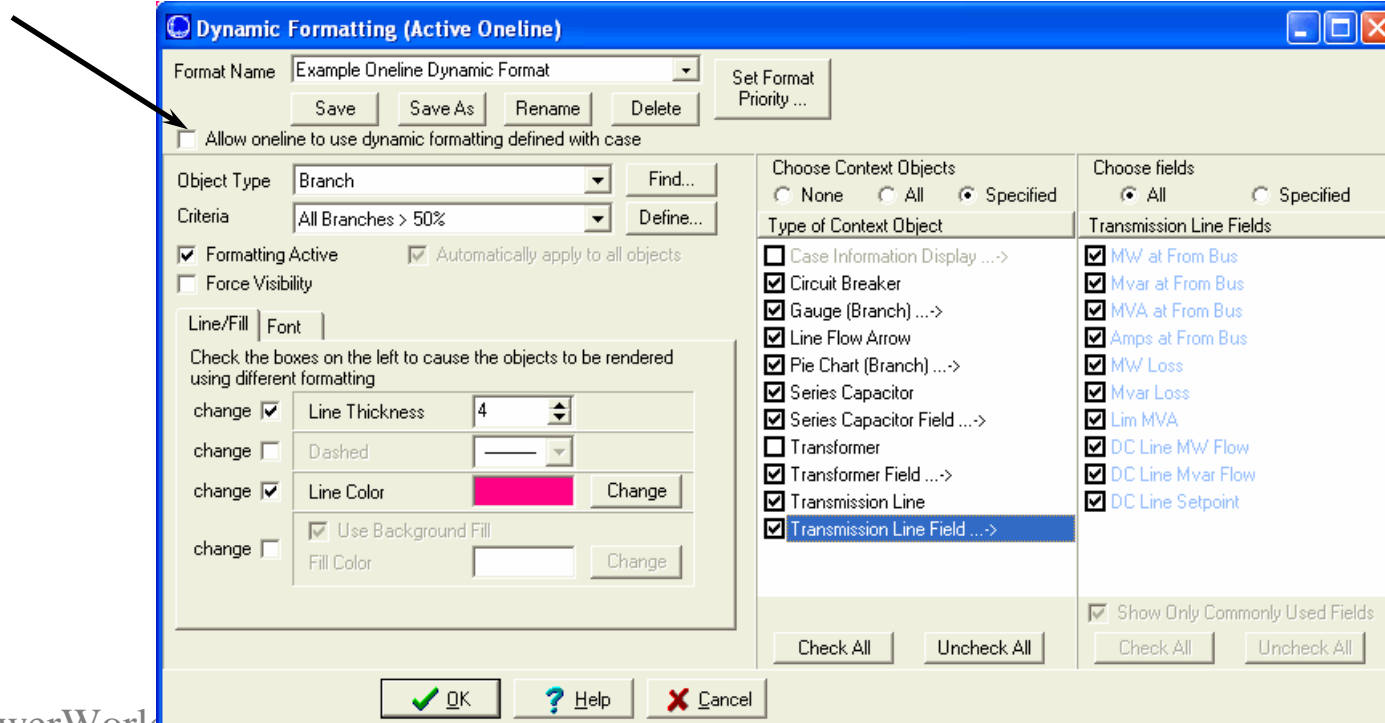
Only some attributes apply to case information displays

Dynamic Formatting Dialog: Active Oneline

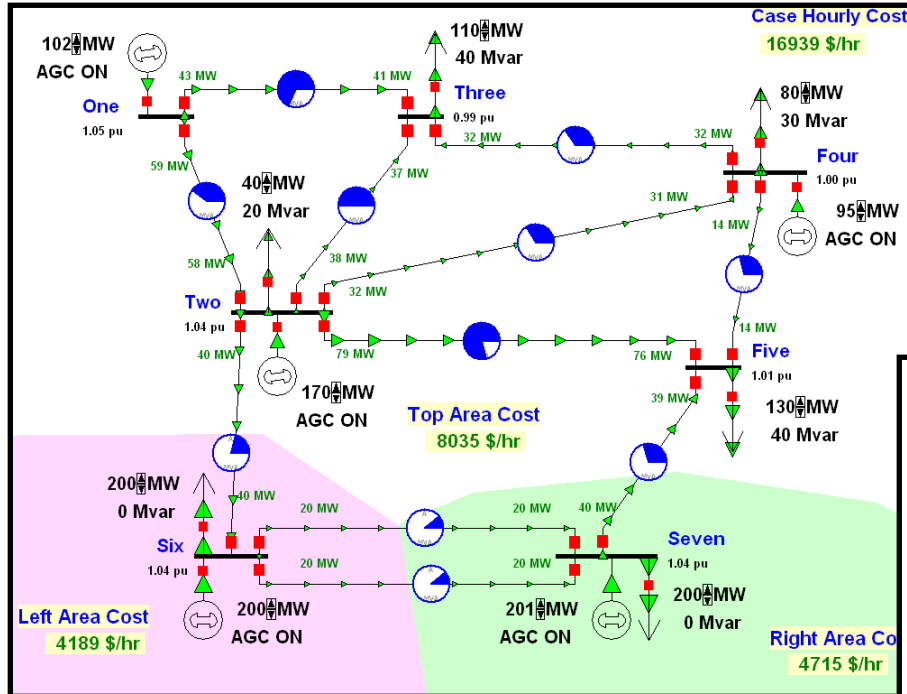


- For an active oneline formatting, it's the same, except that it only applies to this oneline

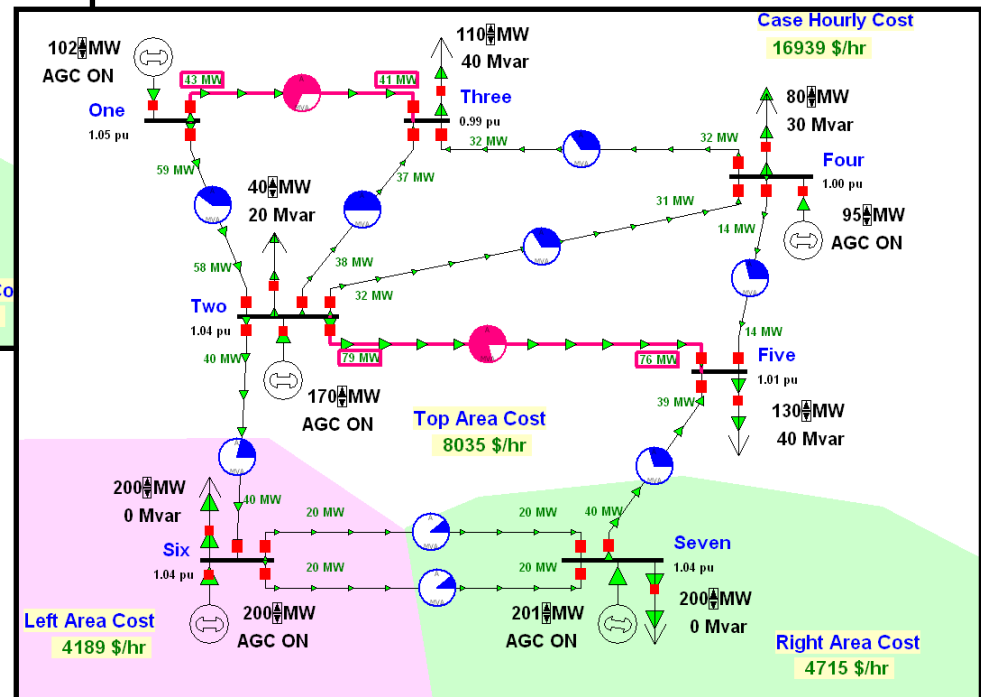
Specify whether the oneline makes use of the dynamic formatting defined with the case



Example Formatting of Lines Loaded above 50% in Pink



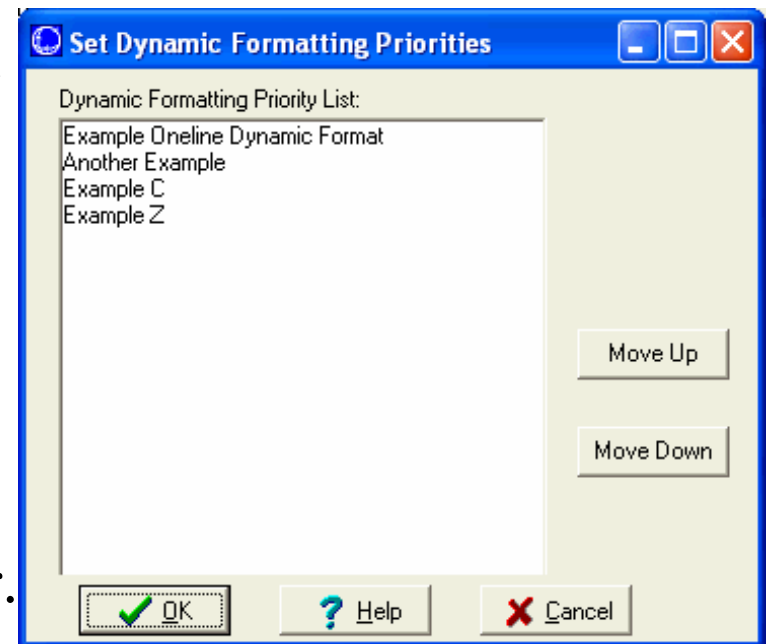
Lines above 50% loading are thick and pink



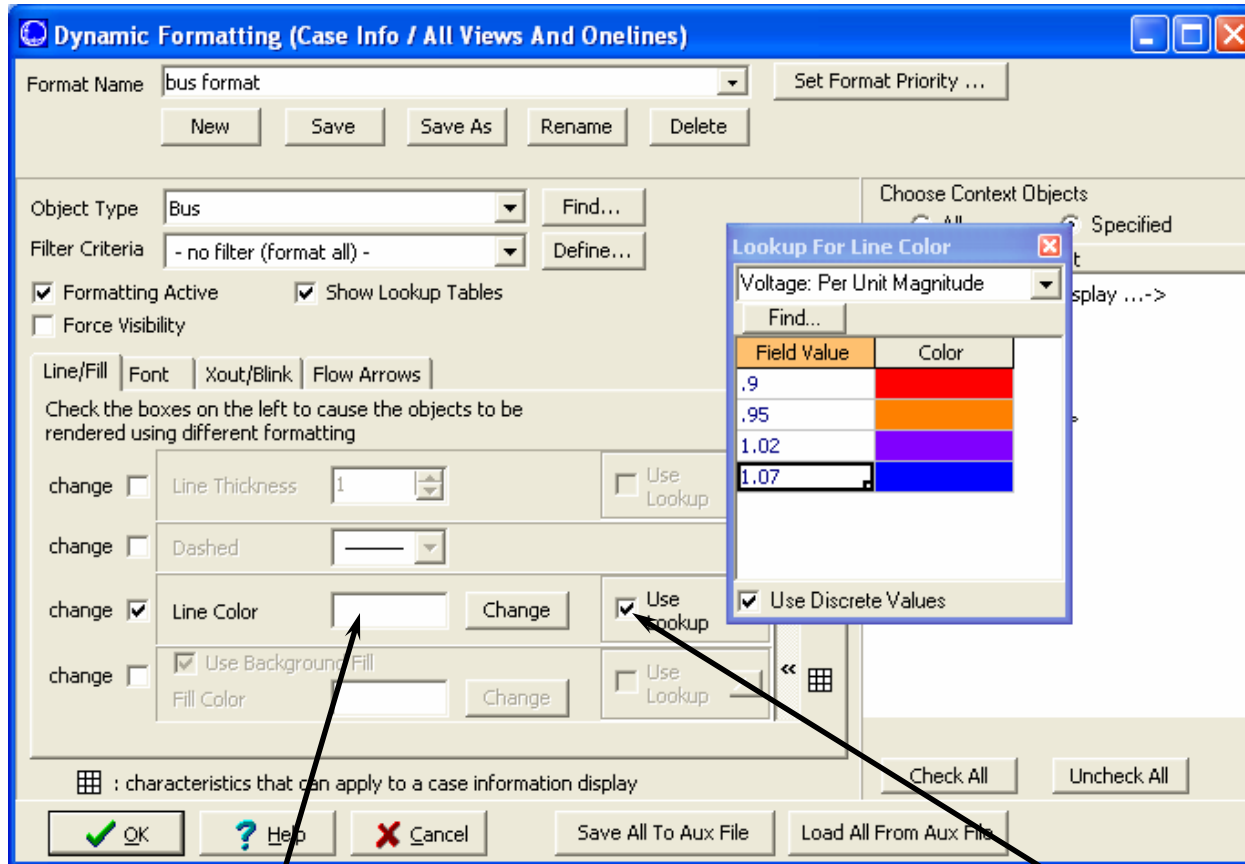
Dynamic Formatting Priority



- You can specify several dynamic formatting choices.
- It is possible that they will “conflict” with one another.
- A priority must be specified.
 - Specific oneline dynamic formats always have priority over case dynamic formats
 - Within the individual class, you must click the Set Format Priority... Button to give a priority order.



Dynamic Formatting Lookup Tables



Lookup tables allow the definition of a table of field values and corresponding characteristic values. For this example, bus object line color will change based on the value of the per unit voltage magnitude.

Color if field value is less than the lowest defined value in the table

Must check Use Lookup

Geographic Information System (GIS) Support



Geographic Information System Support

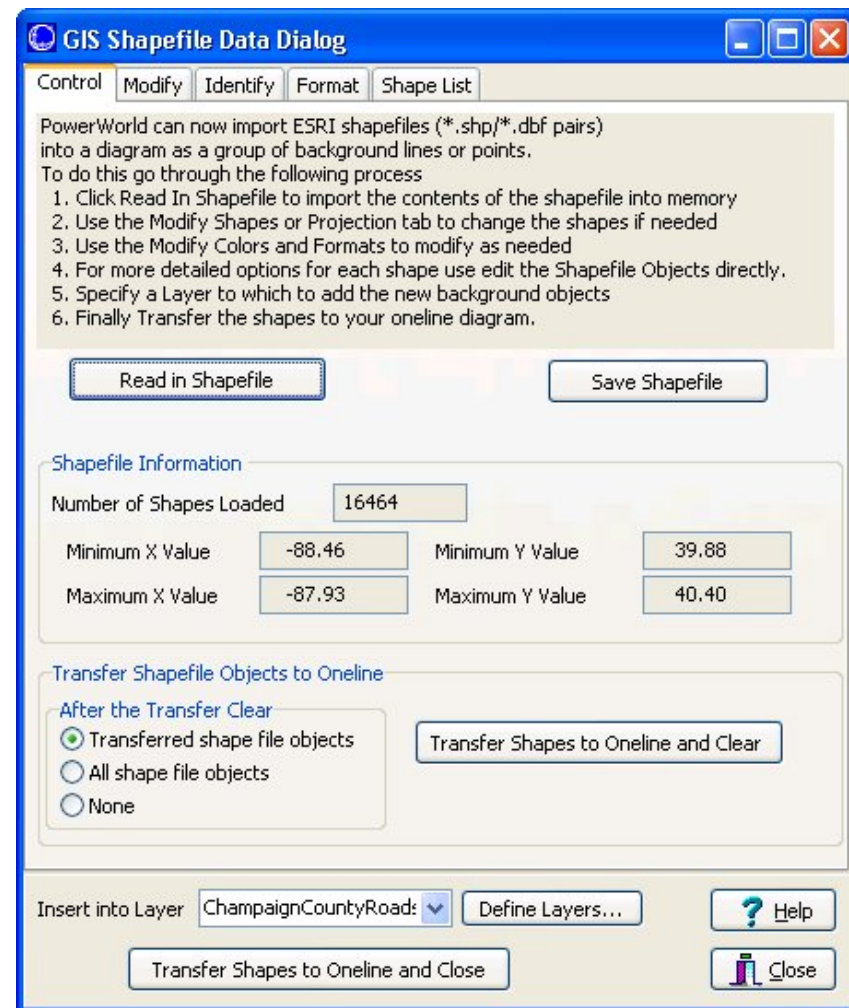


- Geographic Information System (GIS) Support
 - Reading ESRI Shapefiles (*.shp/*.dbf/*.shx groups)
 - To open a shapefile go to the **Onelines** ribbon tab and select **GIS Tools → Insert GIS Data from Shapefile**
 - Additional options under **Onelines → GIS Tools**

GIS Shapefile Data Dialog: Control Tab



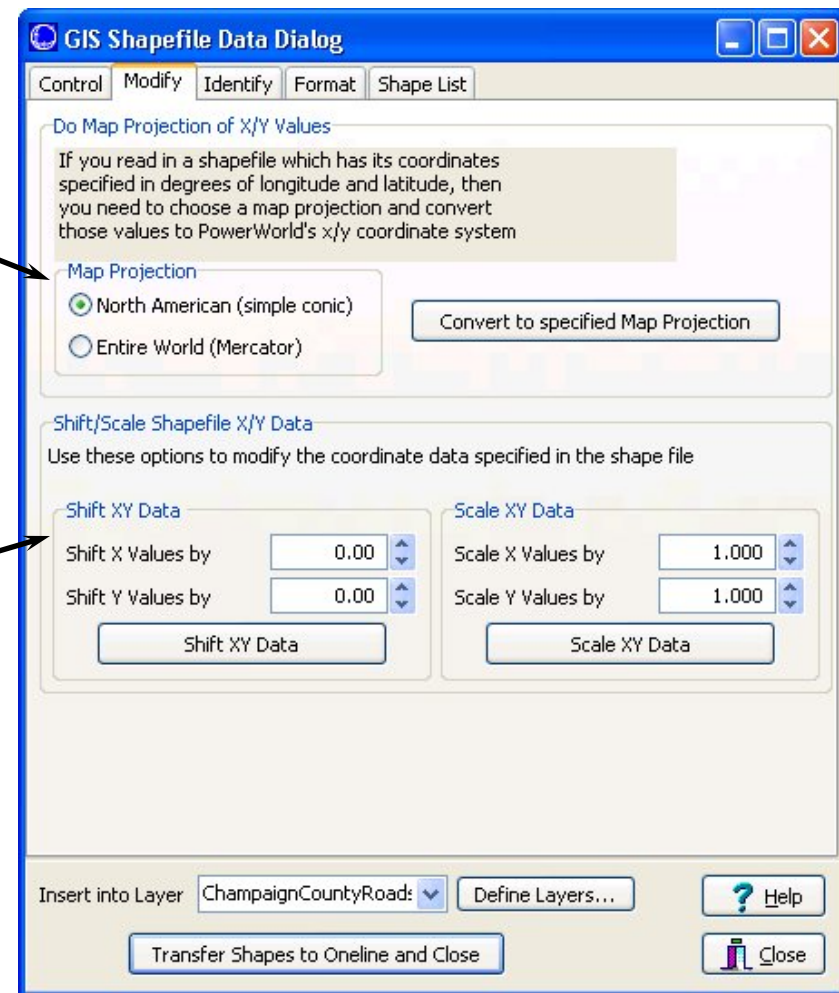
- Click on **Read in Shapefile** to import the Shapefile contents into Memory
- Use the **Modify** tab to modify the x/y coordinate of shapes
- Use the **Identify** tab to assign identifier for display auxiliary files and link supplemental data
- Use **Format** tab to modify the colors and format of the shapes
- **Shape List** tab lists all of the objects in the file and their corresponding attributes
- Click **Transfer Shapes to Online...** to place shapes on the online



GIS Shapefile Data Dialog: Modify Tab



- If Shapefile is specified in Longitude/Latitude Coordinates, Convert to a map projection
- You may also modify the XY data by shifting or scaling it.



GIS Shapefile Data Dialog: Identify Tab



- Specify identifying string to use for uniquely identifying objects in display auxiliary file
- Link to supplemental data to provide identification for filtering, dynamic formatting, Select by Criteria, and custom hints

GIS Shapefile Data Dialog

Control Modify Identify Format Shape List

Identification String for Display Auxiliary Files

Prefix Attribute Suffix

Record Number

Linkage to Supplemental Data

☐ Link Display Objects to Supplemental Data

Supplemental Classification New...

Attribute for Supplemental Data Name CENSUS1

Insert into Layer ChampaignCountyRoad: Define Layers...

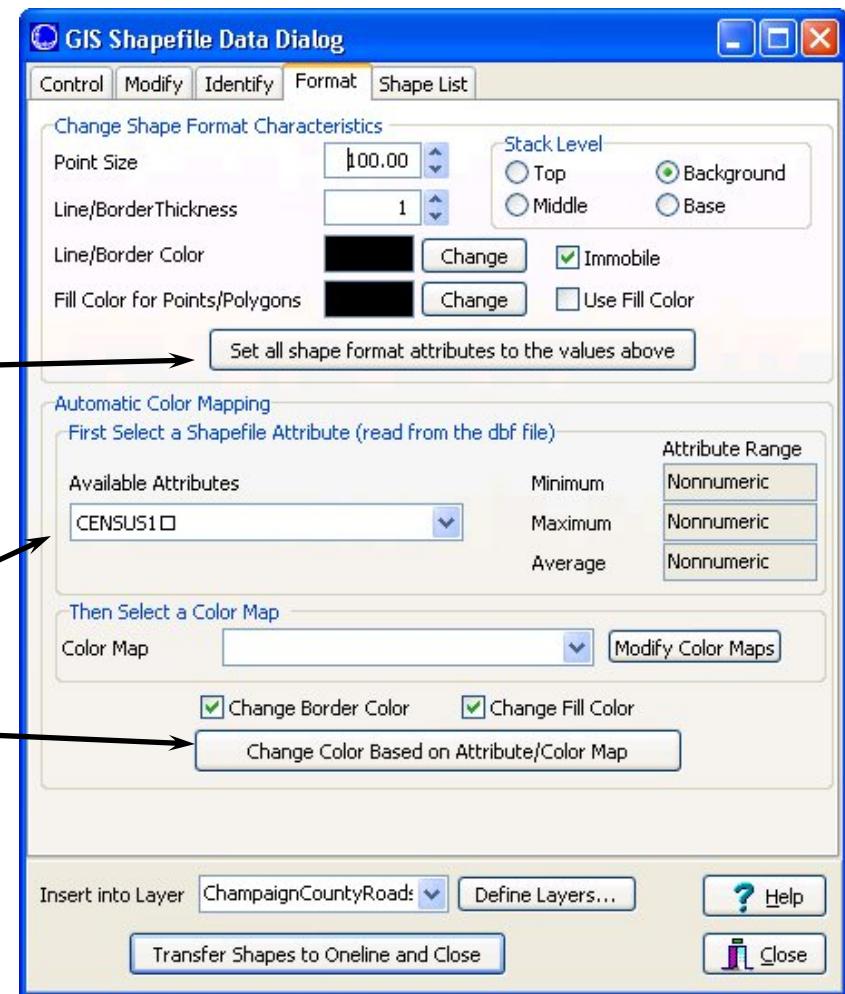
Transfer Shapes to Online and Close

Help Close

GIS Shapefile Data Dialog: Format Tab



- Modify the format of all the objects by choosing new attributes and clicking the button
- You may color using a Color Map if one of the data columns from the *.dbf file can be mapped accordingly



GIS Shapefile Data Dialog: Shape List Tab



- Finally, if you want more control, modify the attributes of the shapes directly.

Info from *.shp file

Specify the Format
of each shape

Data from
*.dbf file

Record Number	Object Type	Include	Immobile	Thickness	Color	Fill Used	Fill Color	Stack Level	TLID	ENODE	TNODE	LENGTH
1	Polyline	YES	YES	1		NO		Background	8798686	12432	12431	0.10804
2	Polyline	YES	YES	1		NO		Background	8798687	11630	11629	0.27830
3	Polyline	YES	YES	1		NO		Background	8798688	12128	11630	1.93137
4	Polyline	YES	YES	1		NO		Background	8798689	12128	12407	0.89390
5	Polyline	YES	YES	1		NO		Background	8798690	12128	12126	0.99958
6	Polyline	YES	YES	1		NO		Background	8798692	12132	12128	0.99874
7	Polyline	YES	YES	1		NO		Background	8798693	12132	12434	0.99329
8	Polyline	YES	YES	1		NO		Background	8798694	11803	12132	1.01531
9	Polyline	YES	YES	1		NO		Background	8798695	11626	11803	0.92873
10	Polyline	YES	YES	1		NO		Background	8798696	11626	11628	0.35268
11	Polyline	YES	YES	1		NO		Background	8798697	11626	11439	0.79709
12	Polyline	YES	YES	1		NO		Background	8798698	12435	12434	1.01299
13	Polyline	YES	YES	1		NO		Background	8798699	12135	12134	0.19212
14	Polyline	YES	YES	1		NO		Background	8798700	11615	11518	0.24516
15	Polyline	YES	YES	1		NO		Background	8798701	11615	11624	0.29751
16	Polyline	YES	YES	1		NO		Background	8798702	11805	11804	0.38205
17	Polyline	YES	YES	1		NO		Background	8798703	11805	11699	0.57595
18	Polyline	YES	YES	1		NO		Background	8798704	11805	12098	0.95183
19	Polyline	YES	YES	1		NO		Background	8798706	12140	12139	0.49932
20	Polyline	YES	YES	1		NO		Background	8798707	11585	11605	0.54973
21	Polyline	YES	YES	1		NO		Background	8798708	11809	11805	1.01154
22	Polyline	YES	YES	1		NO		Background	8798709	11809	11585	0.97587

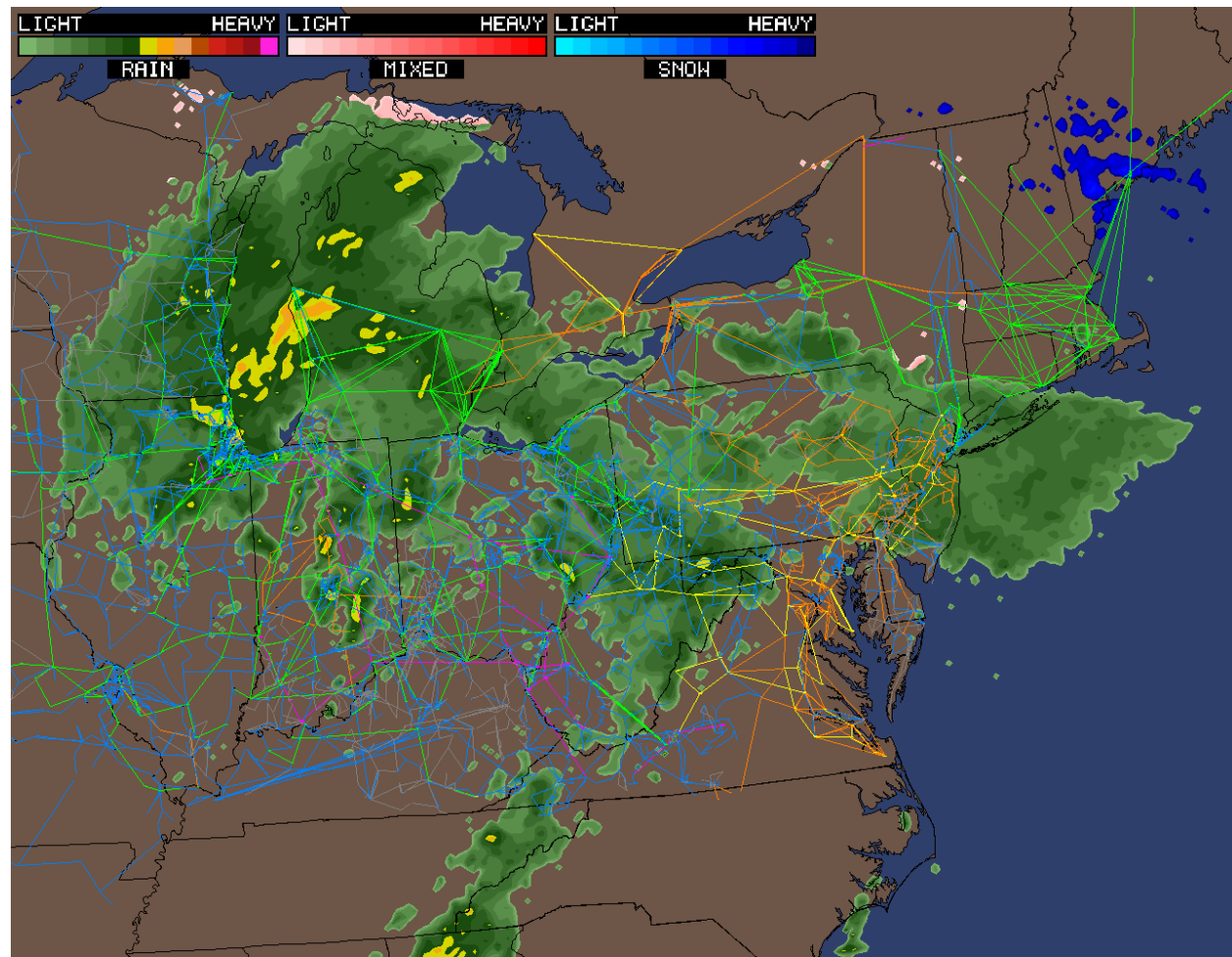
Insert into Layer: ChampaignCountyRoads Define Layers... Help

Transfer Shapes to Online and Close Close

Example GIS Shapefile: Reading a Radar Image



A Weather
Precipitation
Radar Image on
a Oneline

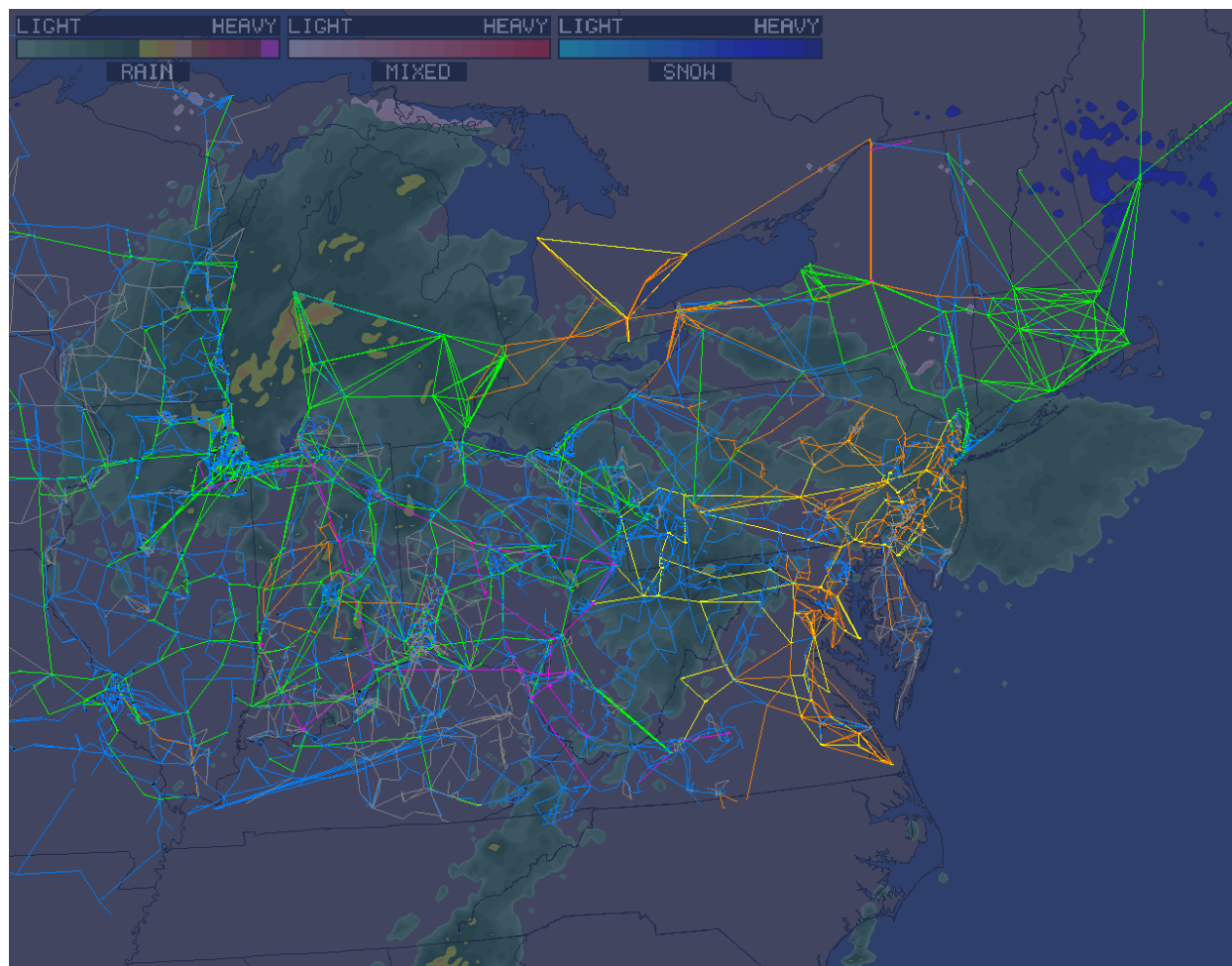


Combining GIS and Emphasis: Transmission System Emphasized



A Weather
Precipitation
Radar Image on
a Oneline

Transmission
System
Emphasized

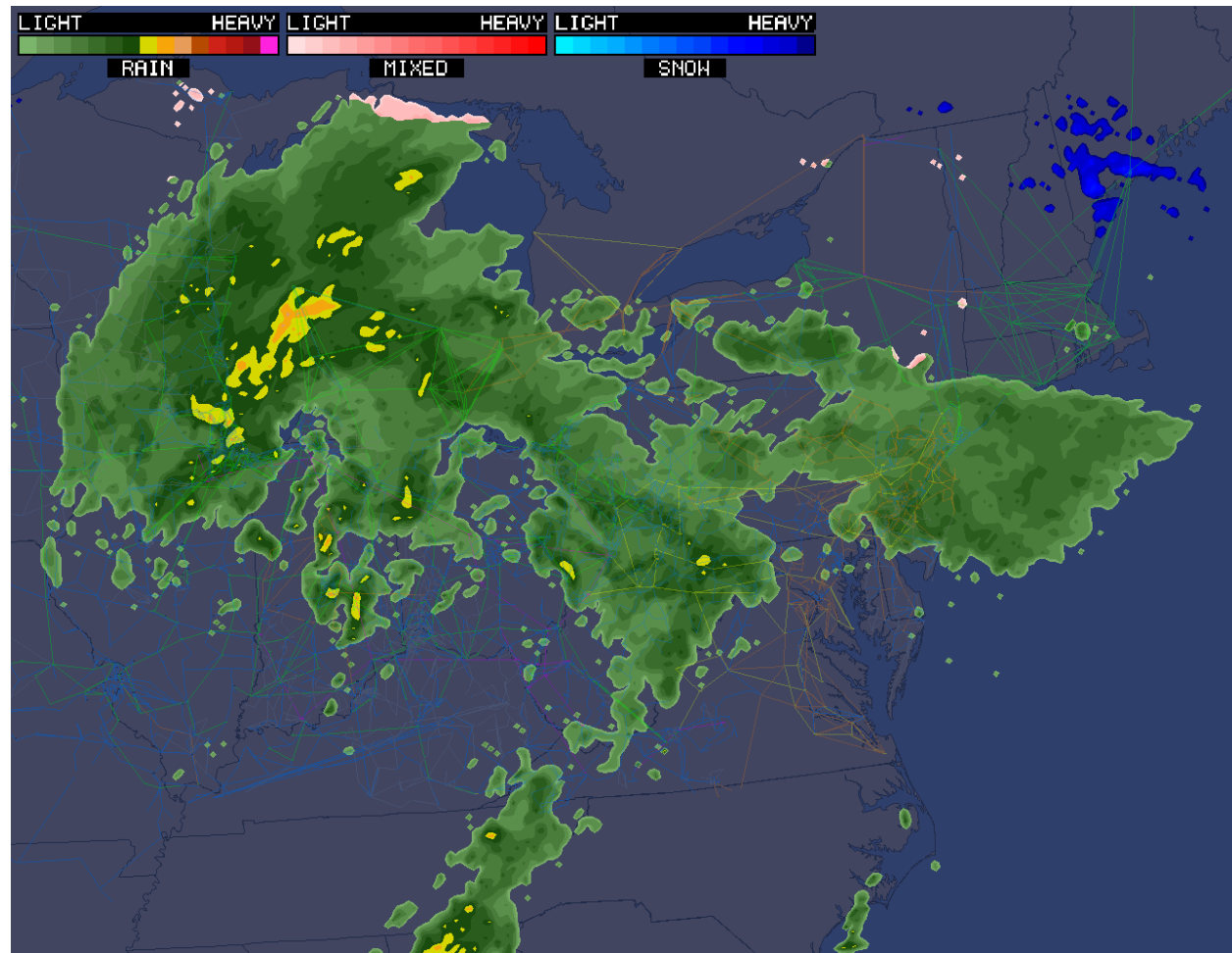


Combining GIS and Emphasis: Weather Radar Emphasized



A Weather
Precipitation
Radar Image on
a Oneline

Weather Radar
Emphasized



Additional GIS Tools



- Export Oneline as Shapefile
 - Create shapefile containing a single type of display object from a oneline display
- Great Circle Distance
 - Calculate the distance between two points of longitude, latitude
- Measure Lines
 - Measure the distance between points on the display by drawing a line connecting them
- Populate Lon,Lat with Display X,Y
 - Populate the Longitude and Latitude fields of buses and substations with location of the corresponding object on the oneline display
- Display shapefile database information with object created from shapefile
 - Right-click on object and select local menu option **Show Shapefile Fields**