Display Options for MassGIS' 2005 1:5,000 Color Ortho Imagery

In order to preserve as much of the original, raw data as possible, Sanborn and MassGIS chose to minimize any processing that might enhance the imagery, leaving such techniques (e.g., stretching, contrast and brightness adjustment, etc.) to the user. Most GIS and image display software have tools that allow the user to customize the imagery's appearance by adjusting settings for stretch type, contrast and brightness, and display resampling. This page describes some methods users may wish to explore, in these categories:

Enhancing the imagery in ArcMap

Users should note that ArcMap will automatically apply a 2 standard deviation stretch to Tiff, JPEG2000, and ArcSDE formats of these images. This may result in a "too bright" appearance in some areas. ArcMap will NOT automatically apply any stretch to the MrSID images, which may result in a "dark" appearance. **Users can adjust the appearance of any format of these images by following the steps described on this page.**

As an example, here are three screen shots that use different methods to display the same area (for bands 1,2,3 at a scale of about 1:2,500), as displayed in ESRI's ArcMap 9.1 (particularly notice the appearance of the parking lot in the southwest corner of the intersection):

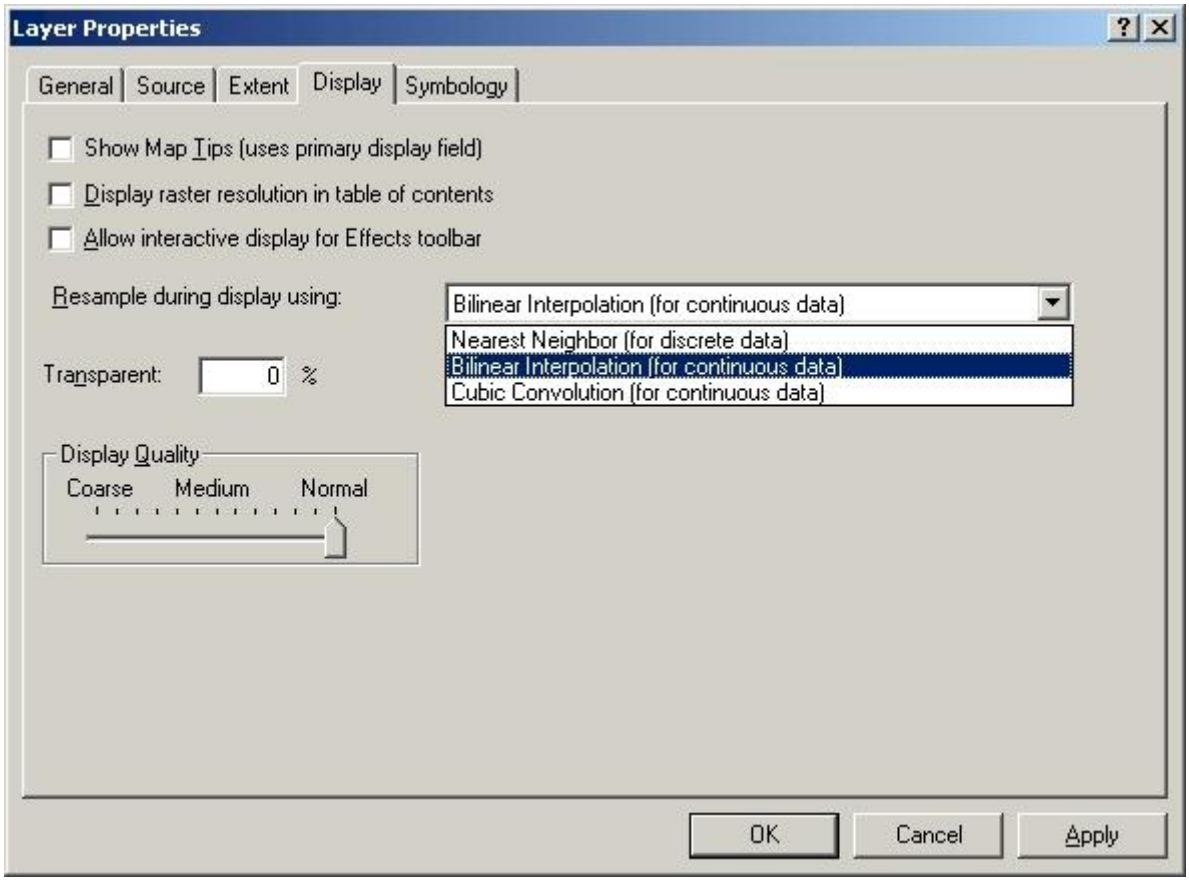
"Raw" image appearance
No stretch was applied.
The resample method during display is Nearest Neighbor (the default).

Default ArcMap enhancement
This is the default stretch, using a Standard Deviation of 2.
Statistics are calculated based on the entire raster dataset.
The resample method during display is Nearest Neighbor.

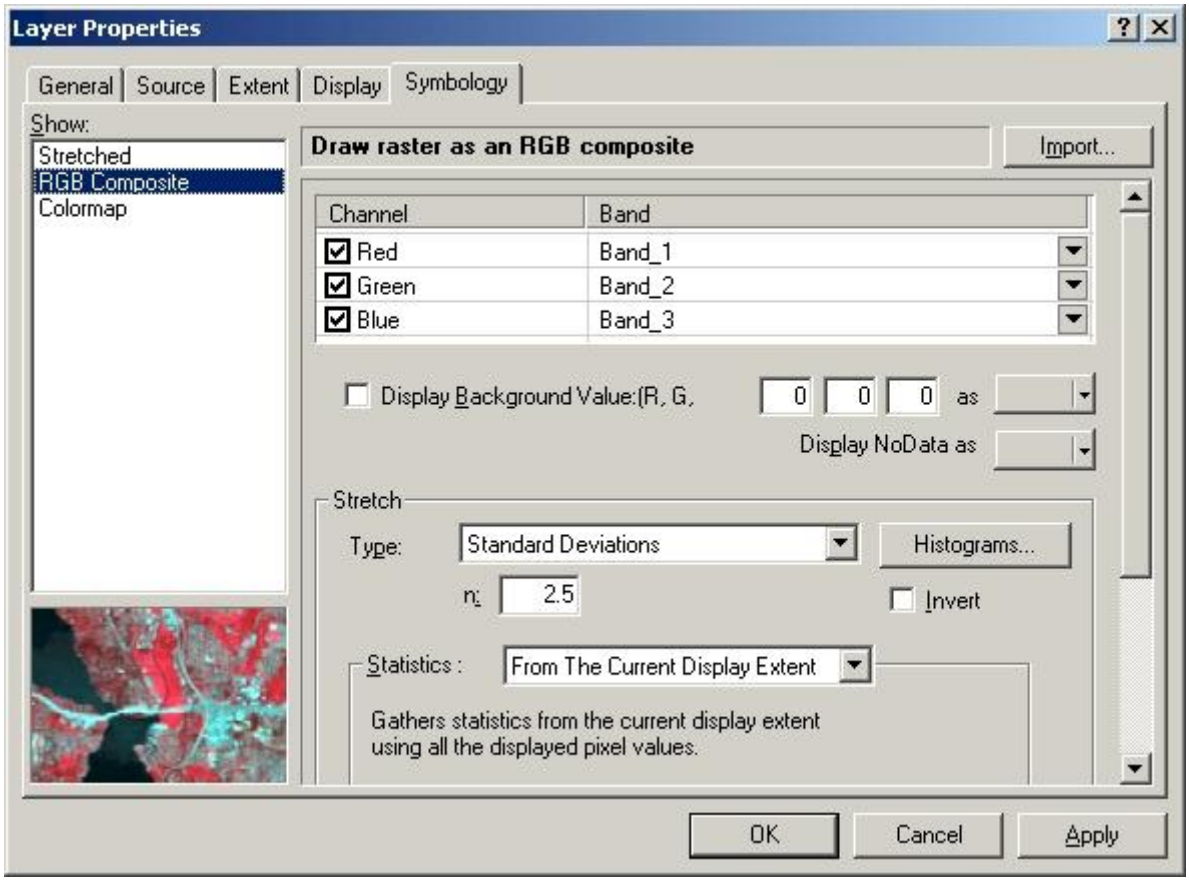
Custom ArcMap enhancement
This image uses a Standard Deviation stretch of 2.5.
Statistics are calculated based on the Current Display Extent.
The resample method during display is Bilinear Interpolation (for continuous data),
which yields a smoother appearance but does not affect brightness or contrast.
From the Effects toolbar, Contrast was set to +6% and Brightness to -4%.

View the ArcMap Layer Properties dialogs:
(These settings may be saved to a layer file (.lyr))

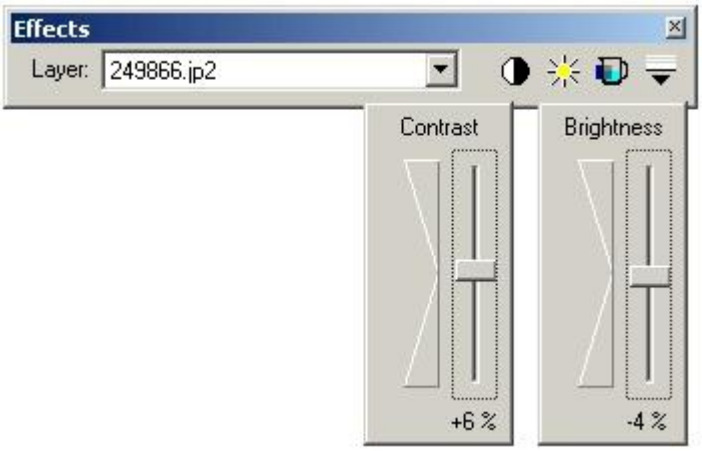
Display tab:



Symbology tab:



Effects Toolbar:



Another example of enhancement:

MassGIS' 2005 Color Ortho Imagery:
Comparing the effects of image enhancement to original, unmodified data
(as viewed in ESRI's ArcMap 9.1)

"Raw" image appearance
No stretch was applied.
The resample method during display is Nearest Neighbor (the default).

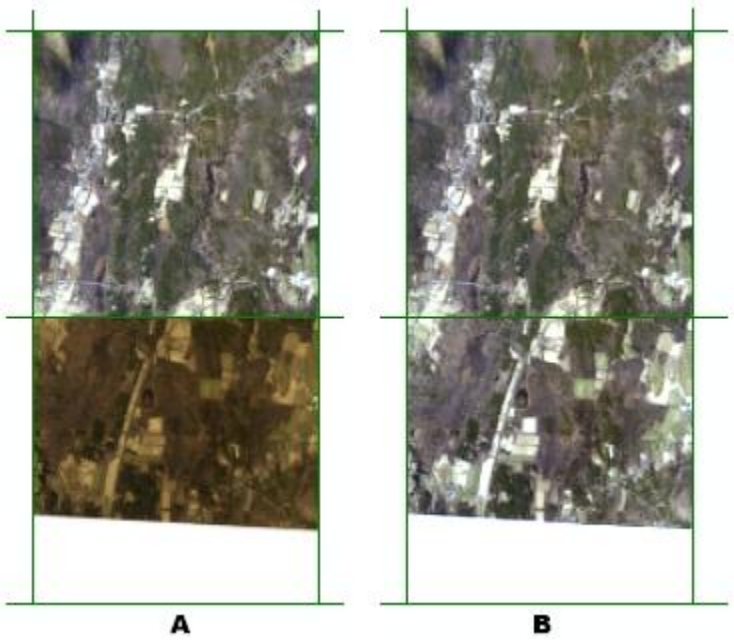
Custom enhancement
This image uses a Standard Deviation stretch of 2.5.
Statistics are calculated based on the Current Display Extent.
The resample method during display is Bilinear Interpolation (for continuous data), which yields a smoother appearance but does not affect brightness or contrast.

Tonal differences when displaying adjacent tiles

When displaying images stored as separate tiles, you may notice differences between adjacent images when a stretch is applied. This effect may be more pronounced in tiles along the border of the state because the pixel values in the 'nodata' areas (in the MrSID versions) are 255 (or close to it) in each band. When a stretch is applied and statistics are calculated, these bright pixel values can skew the overall calculation (as shown in example A).

To achieve the appearance in example B at left, where the two tiles appear nearly seamless, the statistics of the top image tile were saved to an .xml file and then applied to the bottom tile. These steps were done in ArcMap 9.1, as follows:

- In example A, a stretch was applied to the top tile to suit the user's preference.
- In the Layer Properties, Symbology tab, Stretch section, choose 'From The Current Display Extent' from the Statistics dropdown.
- Click 'Save as XML...' and save the file.
- In the Layer Properties of the bottom image in example B, Symbology tab, Stretch section, choose 'From Custom Setting (below)' from the Statistics dropdown.
- Click 'Load XML...' and select the .xml file produced from the top tile in example A and apply.



Printing Bug In ArcGIS 9.x

When using the Current Display Extent statistics option (described on this page), which allows for better contrast within a raster dataset, maps that are printed or exported that use this option will often have a striped pattern of the data in the output. The stripes can be characterized by actual data that is banded with different saturations or intensities. According to ESRI, this is a documented bug at 9.0. When a map is printed or exported, it is processed as long rectangular strips of data. Each strip of data has slightly different statistics and therefore, because of the Current Display Extent Stretching, a slightly different rendering contrast stretch is calculated. This can result in a striping or banding pattern on output.

There is no easy workaround for this issue at ArcGIS 9.0. Although the Custom Stretch option is available and will be applied to the entire raster layer, choosing the statistics is often difficult.

Here are a few possible workarounds offered by ESRI:

- It is very common that the Current Display Extent statistics option is used when inspecting the data at large scale (close to the data), and it is simply left on by accident. Be sure to check this and disable it if this option is not intended or necessary.
- Import the statistics from another raster dataset when possible, perhaps even a clipped version of the original data.
- If importing the statistics from another raster dataset is not possible, and the current data must be output, choose another stretching option.

At ArcGIS 9.1 or 9.2, **after enhancing the image to your liking**, the Current Display Extent statistics can be saved to an XML file. This XML file can then be loaded into the Custom Setting for statistics. Maps at 9.1 and 9.2 will then properly export or print using the Custom Statistics option. Testing at MassGIS has shown that this will work by following thses steps:

1. Use the "From Current Display Extent" option to get the image to look the way you want.

2. Go into the layer's Properties box and change the stats to "From Each Raster Dataset" and click Apply.
3. Change the stats back to "From Current Display Extent" and click Apply.
4. Click the 'Save as XML...' button (scroll down a bit to see it) and save an XML file on a local or network drive.
5. Change the stats to "From Custom Settings (below)"
6. Click the 'Load XML' button and choose the XML file you saved in step 4 above. Click OK in the 'Select Statistics for' dialog.
7. Click Apply and then OK.
8. Print (and there should be no banding on the paper map).

To preserve the appearance of certain areas of the image in your view extent, try zooming in on the data frame to a representative area in Map Layout mode, preferably an area with a lot of white or bright pixels, and saving the stats to XML, then zooming back out ot the full desired map extent.

Note that the banding does NOT appear when using the "From Each Raster Dataset" stats option. To simply print with this option:

1. Double-click the theme in ArcMap to bring up the Properties dialog.
2. In the Symbology tab select 'From Each Raster Dataset' from the Statistics dropdown (in the Stretch section) and click OK.
3. Then print as you normally would.

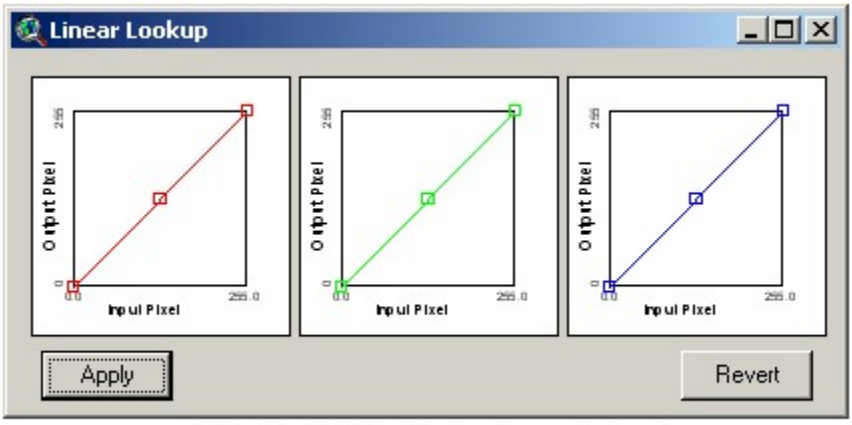
Some of the preceding section was taken from
http://support.esri.com/index.cfm?fa=knowledgebase.techarticles.articleShow&d=28692.

Enhancing Image Catalogs

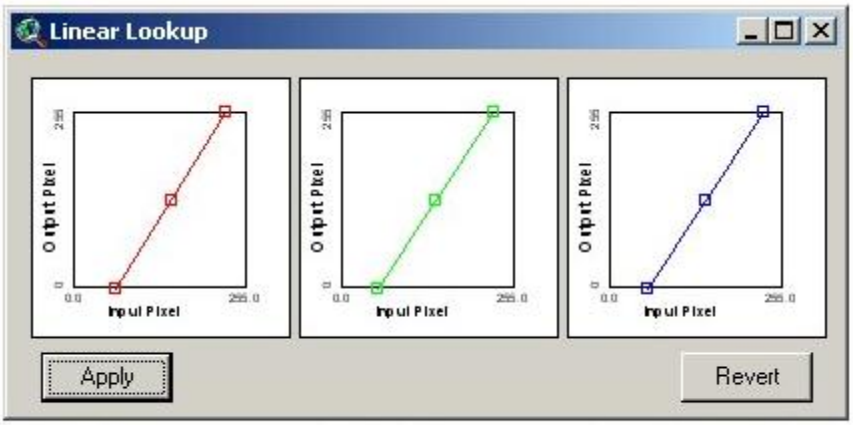
When displaying the image catalog (used in the Data Viewer 'A" button for the MrSID mosaic theme), the option to apply a stretch is not available in ArcMap because the Symbology tab is not present in the layer's Properties dialog. To enhance the appearance of the imagery, although to a lesser extent, users may use the Effects Toolbar (turn on from View > Toolbars) and adjust the Contrast and Brightness by moving the sliders to the desired setting. One suggested setting may be to increase the Contrast by 30% and decrease or increase the brightness slightly. This combination is just one suggestion, as the display may also be affected by computer monitor settings. Users are encouraged to experiment to achieve the desired look and feel of the imagery. When using the catalog, the Display tab is present in the layer's Properties dialog, and the resample method during display may be set to Bilinear Interpolation to yield a smoother appearance, if desired.

Enhancing Images in ArcView 3.x

In ArcView 3.x, users can alter the appearance by double-clicking the image theme to access the Image Legend Editor. Click the Linear button. This displays the Linear Lookup dialog box in which you can perform a piecewise linear stretch. See the ArcView 3.x Help for details on how to manipulate the graphs. You may achieve desirable results by changing the slope of each graph (making it steeper) from the "before" to the "after" in the following image, essentially increasing contrast and brightness:



"Before" -- this is the default, with no adjustment



"After" - how the graphs appear after adjustment to make them steeper. The lower left corners were moved to the right, and the upper right corners were moved to the left.

The result of a MrSID image with the above piecewise linear stretch applied is as follows:

Be aware, however, that each band must be adjusted separately, and disproportionately moving one graph compared to the others will throw off the color balancing.

With the Image Analysis extension, users have access to more tools, which allow for adjustment of brightness and contrast and the ability to apply various types of stretches; these settings may be saved to an .ail file. To use these tools, themes must be added as an Image Analysis Data Source (available for MrSID and Tiff files).

Contrast Stretched Set of Imagery

MassGIS has produced a set of pre-"Contrast Stretched" MrSID and JP2 data for users who do not have the software tools to modify the appearance of the original imagery as described on this page. For details see the Distribution section on the 2005 imagery datalayer page.

For the imagery please see:
http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/colororthos2005.html