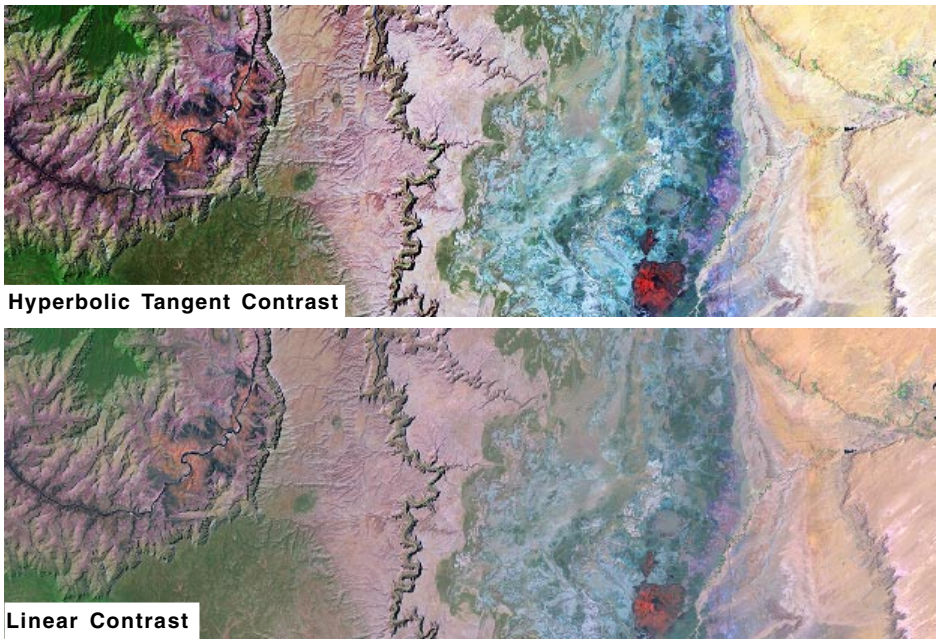
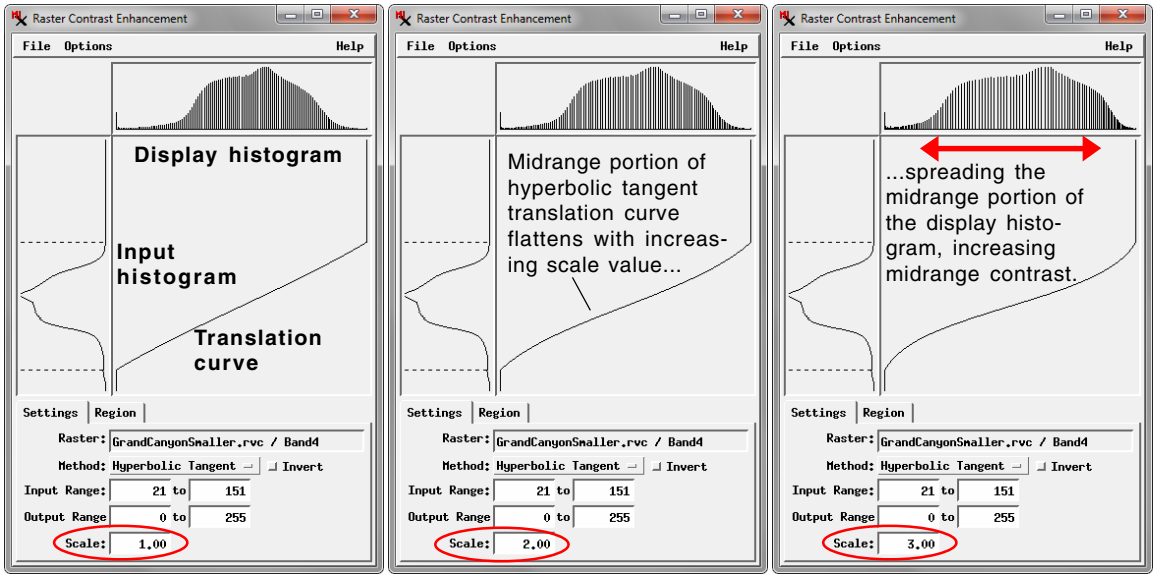
Hyperbolic Tangent Contrast Enhancement

The Hyperbolic Tangent contrast enhancement method uses the hyperbolic tangent trigonmetric function to produce a nonlinear translation of raster values to display values to improve image contrast. Input and output range limits that you set in the Raster Contrast Enhancement window are automatically honored by this method. The Hyperbolic Tangent method is supplied with an adjustable scale parameter that you can use to fine-tune the amount of contrast enhancement.

At low values of the Scale factor (less than 1) the hyperbolic tangent translation curve is close to linear. As the scale factor is increased, the translation curve flattens in the middle and steepens at either end (see illustrations below). As a result, the midrange portion of the display histogram is stretched at the expense of both high and low values, increasing image contrast for midrange values without greatly shifting the mean brightness. You can adjust the low and high cutoffs for the input range along with the Scale factor to produce the desired combination of image brightness and contrast.

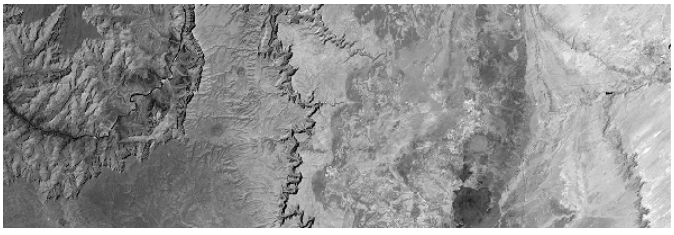


Portion of Landsat image display with bands 7,4,2 assigned to Red, Green, and Blue, respectively. Lower illustration has Linear contrast used for all bands. Upper illustration has Hyperbolic Tangent contrast (scale = 3.0) used for all three bands, resulting in improved image contrast and color.

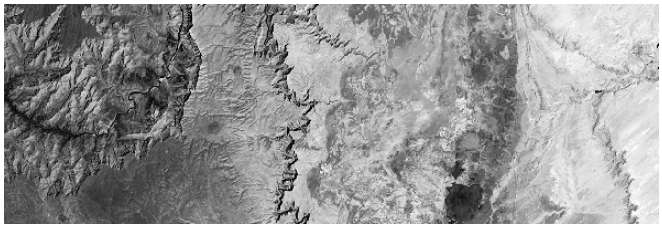


Scale = 1.0 **Scale = 2.0** **Scale = 3.0**

The Hyperbolic Tangent contrast method uses a nonlinear translation curve to convert raster values to display values. Increasing the scale value for this method flattens the midrange portion of the curve while steepening the low and high ends. This has the effect of spreading the midrange portion of the display histogram while keeping the darkest and lightest tones within the specified limits.



Hyperbolic Tangent contrast, scale = 1.0



Hyperbolic Tangent contrast, scale = 3.0