



The Normalized Burn Ratio (NBR) - Brief Outline of Processing Steps

Acquire adequate Landsat TM or ETM+ scenes:

Determine timing requirements: *initial* or *extended* assessment.

Pre- and Post-fire scenes should match phenologically as much as possible.

Search for available scenes using web browsers

Landsat 7 ETM+: <http://edclxs2.cr.usgs.gov/L7ImgViewer.shtml/>

Landsat 5 TM: <http://earthexplorer.usgs.gov/> (follow links to Landsat TM)

Check availability of already-purchased data before ordering.

Get Terrain Corrected data.

With data in hand, explore data in false-color composite images, study burn characteristics.

Transform raw data to *Radiance* (L_i) and "at-satellite" *Reflectance* (R_i) for Bands 4 and 7.

$$L_i = DN_i * G_b + B_b; \quad R_i = (L_i * \pi * d^2) / (Esi_b * \cos(z_s))$$

DN_i = per-pixel raw brightness value.

G_b and B_b = per-band gain and bias from scene header.

d^2 = daily earth-sun eccentricity from lookup table.

Esi_b = per-band exoatmospheric solar irradiance from published L5 and L7 tables.

z_s = per-scene solar zenith angle (90-solar elevation angle reported in scene header).

Determine if atmospheric normalization is necessary, and if so, do it if for Bands 4 and 7.

Generate an NBR image for each scene, pre- and post-fire:

$$NBR = (R_4 - R_7) / (R_4 + R_7);$$

Generate the differenced (or delta) NBR:

$$dNBR = NBR_{prefire} - NBR_{postfire}$$

This isolates burned from unburned areas, provides a quantitative measure of absolute change in NBR. Practical data range ≈ -500 to $+1300$ when scaled by 10^3 .

Apply a linear grayscale to the data range of -800 to 1100 , and study this image carefully.

Define the burn perimeter using combined automated and on-screen digitizing from the **dNBR**.

Make an initial cut at severity thresholds in false color. A seven-tiered configuration may be useful. Ordinal severity levels and *example* range of **dNBR** (scaled by 10^3) are shown:

<u>SEVERITY LEVEL</u>	<u>ΔNBR RANGE</u>
Enhanced Regrowth, High	-500 to -251
Enhanced Regrowth, Low	-250 to -101
Unburned	-100 to +99
Low Severity	+100 to +269
Moderate-low Severity	+270 to +439
Moderate-high Severity	+440 to +659
High Severity	+660 to +1300

(These value ranges are flexible; scene-pair dependent; shifts in thresholds ± 100 points are possible. **dNBR** less than about -550, or greater than about +1350 may occur, but usually are *not* considered burned. Rather, they likely are anomalies caused by miss-registration, clouds, or other factors not related to real land cover differences.)