

# Calibration Matters! Analysis of Landsat 5 Data with different calibration methods

Ronald W. Hayes

SGT, contractor to the U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS), Sioux Falls, SD 57198. 1-605-594-6531; hayes@usgs.gov, Work performed under USGS contract 08HQC0005

## Introduction

Too often we receive Level 1 Landsat products without paying attention to the calibration that has been applied to the data. For Landsat 5 (L5) Thematic Mapper (TM) products there has been 4 different radiometric calibrations used over the past 25 years from the U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS). Pre-launch, Internal Calibrator (IC), Look-Up Table 2003 (LUT03), and Look-Up Table 2007 (LUT07), have been used. It is important that one understands the differences that can exist in remote sensing science products when the calibrations change. ([http://landsat.usgs.gov/science\\_calibration.php](http://landsat.usgs.gov/science_calibration.php)) Calibrations tie together a legacy of data covering 36 years of Earth observations. However, the importance of ensuring that data is consistent is not clear to many in the user community. This poster will show how several common science applications differ, with all things being equal except calibration. Currently the USGS has begun distribution of all Landsat data at no cost to the user. Given the importance of having the latest calibrations for remote sensing applications users should download new products if their calibrations are out of date.

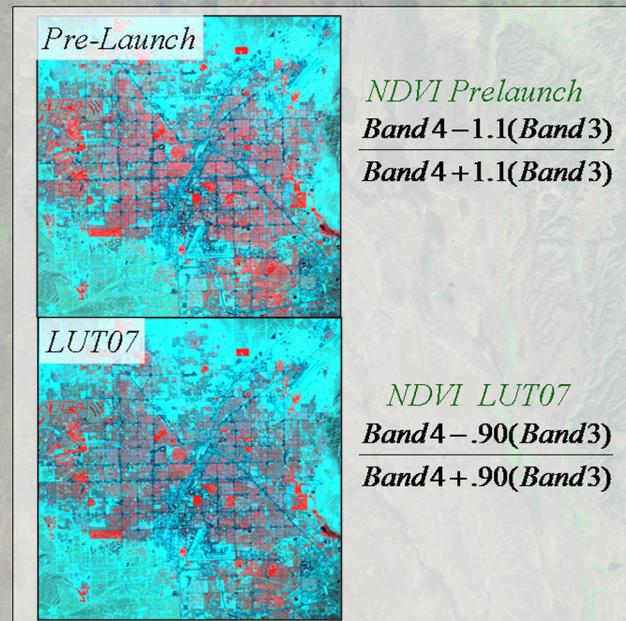
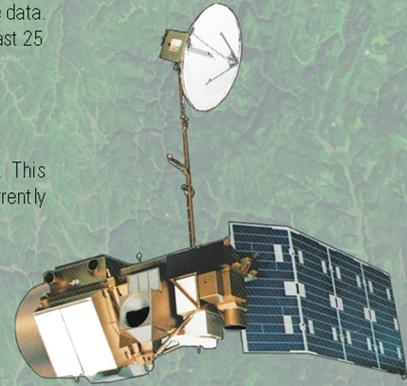


Figure 1 – Las Vegas, Nevada NDVI Pre-launch and LUT07 calibrations, compared visually.

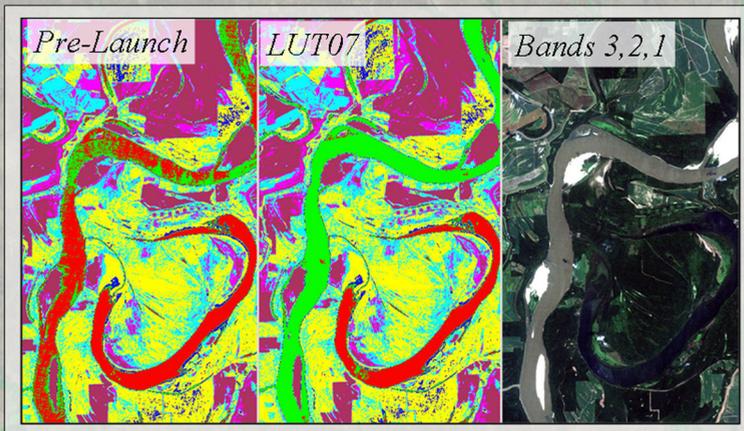


Figure 2 – Memphis, Tennessee Image classification using the same image processed with a pre-launch and LUT07 calibration method.  
CLASS 1 (Red) - Water (clear) / CLASS 2 (Green) - Water (sediment-filled) / CLASS 3 (Blue) - Indeterminate (forest, bare ground, cloud shadows) / CLASS 4 (Yellow) - Forest 1 / CLASS 5 (Lt turquoise) - Forest 2 + Bare Soil / CLASS 6 (Pink) - Veg 1 (crop/grass) CLASS 7 (Purple) - Veg 2 (crop/grass + sandbars)

## Transformations

Creating indices can amplify the effects of gain changes in individual bands by combining bands. The Normalized Difference Vegetative Index (NDVI), is one example. NDVI is created by transforming red (R) and near infrared (NIR) spectral band data into an entirely new image using mathematical formulas to calculate the value of each pixel. The Normalized Burn Ratio (NBR), is another example of a transformation using NIR (Band 4) and NIR (Band 7).

In the NDVI example right, the transformations differences can be seen. Although the same image was used to produce these, one can detect differences in vegetation intensity between the two products.

## Unsupervised Classifications

In unsupervised classification individual pixels are compared to cluster groupings to see which one it is closest to. A map is created of all pixels in the image, classified as to which cluster each pixel is most likely to belong. For the majority of the pixels, the cluster can be easily identified. However, many pixels on the fringe of features, called mixed pixels, may identify with more than one cluster if changes are made to the calibration. This analysis is intended to show how minor changes in calibration can cause class changes in the classification map. This is most evident in unsupervised classifications, but also affects supervised classifications, especially in the mixed pixel fringes.

## Acknowledgements

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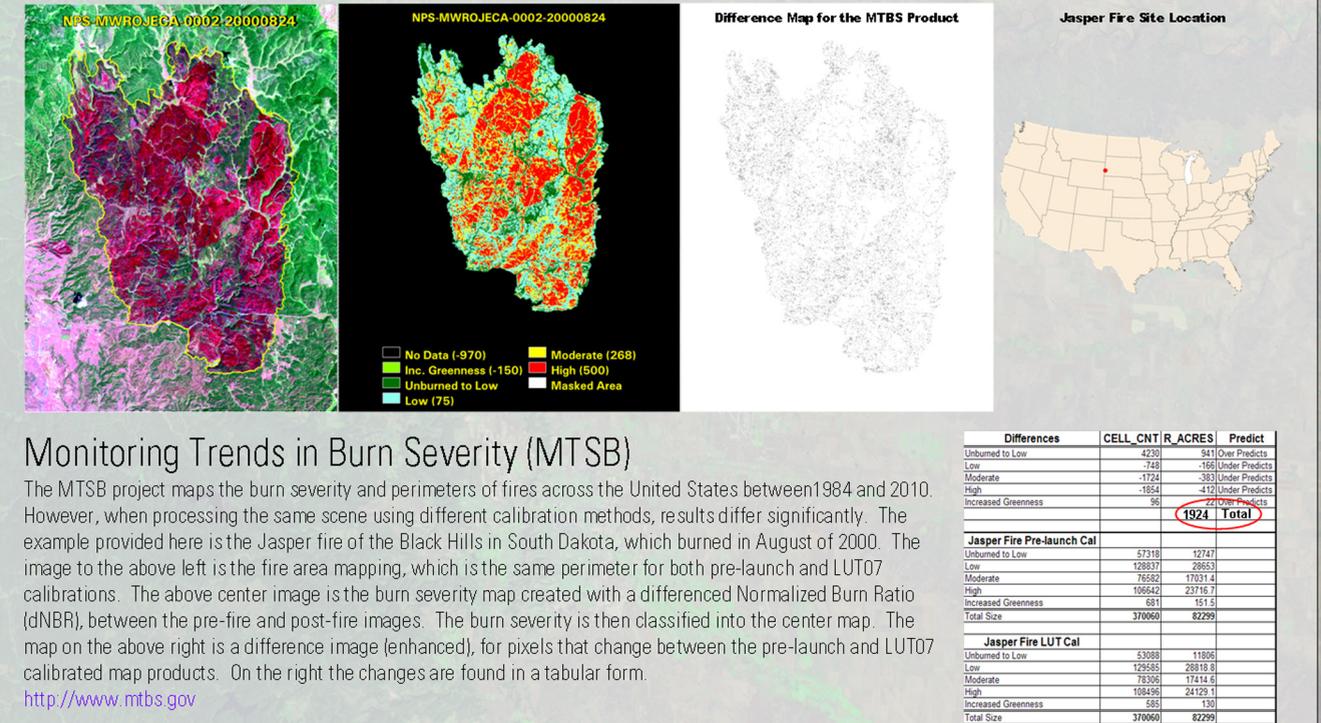
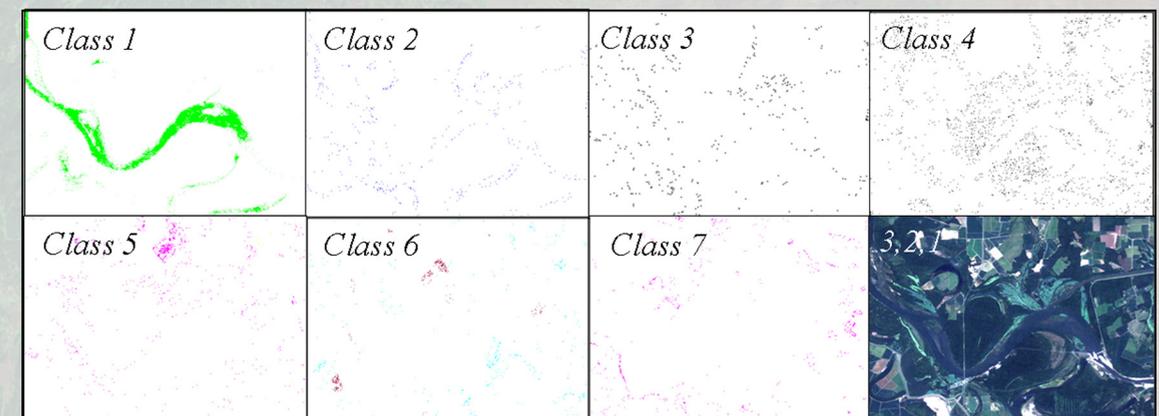


Figure 3 – MTSB, a practical example of a change in the results from calibration differences.



## Classification Difference Mapping

When comparing two classifications for datasets which only difference is the calibration, there are differences that can be easily seen in the map product as well as the statistics produced from the data. For this analysis the differences between classifications performed on pre-launch calibrated data vs. LUT07 calibrated data. The differences can be visualized in the class difference maps above, as well as tabular to the right. The change maps show each pixel that changed from one class to a different class between the two classifications. These data were processed using Isodata unsupervised classification with ENVI using 5% class thresholds.

Percentages	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Row Total	Class Total
Unclassified	0	0	0	0	0	0	0	0	0
Class 1	98.226	0.163	0	0	0	0	0	100	100
Class 2	1.172	97.538	0.296	0	0	0	0	100	100
Class 3	0	2.304	97.926	0.588	0	0	0	100	100
Class 4	0	0	1.775	97.942	1.318	0	0	100	100
Class 5	0	0	0	1.47	97.763	3.04	0	100	100
Class 6	0	0	0	0	0.919	96.33	2.834	100	100
Class 7	0	0	0	0	0.629	97.166	100	100	100
Class Total	100	100	100	100	100	100	100	0	0
Class Changes	1.775	2.467	2.074	2.058	2.237	3.67	2.834	0	0
Image Differenc	-1.609	-0.405	0.619	1.076	1.833	1.109	-2.347	0	0

Area (Square Meters)	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Row Total	Class Total
Unclassified	0	0	0	0	0	0	0	0	0
Class 1	3413621	57811	0	0	0	0	0	3419402	3419402
Class 2	61693	3450816	11267	0	0	0	0	3522775	3522775
Class 3	0	81504	3729036	21051	0	0	0	3831590	3831590
Class 4	0	0	67727	3692958	445371	0	0	3821514	3821514
Class 5	0	0	0	52672	3303488	84854	0	3441014	3441014
Class 6	0	0	0	0	31044	2688484	102311	2821839	2821839
Class 7	0	0	0	0	0	1750	3588216	3525776	3525776
Class Total	3475314	3538100	3808029	3522978	3379064	2792911	5416529	0	0
Class Changes	61693	87285	78994	73723	75576	102417	102311	0	0
Image Differenc	-55912	-14325	23561	38536	61950	30928	-84748	0	0

Figure 4 – Classification Difference Mapping, demonstrating how classes change given a change in gain levels.