**Introduction**

According to the USGS, surface mining is the largest cause of topographic change in the United States. This project serves to demonstrate the use of remote sensing techniques in assessing environmental changes caused by one type of surface mining, Mountain Top Removal mining (MTR). We will look at vegetation loss at a mining site in West Virginia, as well as topographic changes caused by this mining technique.

Mountain top removal is a method to expose coal seams for processing on steep terrain in the Appalachian region of the United States. The process begins with the clear-cutting of large swaths of land, removing all vegetation. Rock is typically displaced by blasting, either removing the top or a ridge from a mountain. This can result in as much as 400 feet of elevation change. The blasted rock, the “spoil” is usually dumped into adjacent valleys creating “valley fills”. These valley fills have proven to have environmental impact on local watersheds. Finally, with the mountain now opened, exposing the coal seam, the processing of coal can begin. Upon completion of mining operations, the area is reclaimed/replanted with new vegetation, sometimes attempts are made to restore the original contours.

**Study Site**

For examining regional change, the area defined by the WV Geological and Economic Survey as the “Approximate region of present and projected major mountaintop removal mining activity”, was selected. A mine specific site to look at in greater detail for both NVDI and topographic change was also identified. For this purpose, the Twilight MTR site, located in Boone County West Virginia owned by Progress Coal (Massey Energy) was used because of its permitting date, active operation and massive production.

**Project Data**

Prior to beginning analysis, Landus 5 Thematic Mapper (TM) images were obtained using the USGS Earth explorer, this satellite was chosen because it offered a long-term look at the study area. The images are generally from the same month/year (May-July), although obtaining exact imagery dates was not possible.

Mountaintop mining is a used to expose coal seams for processing on steep terrain in the Appalachian region of the United States. The process begins with the clear-cutting of large swaths of land, removing all vegetation. Rock is typically displaced by blasting, either removing the top or a ridge from a mountain. This can result in as much as 400 feet of elevation change. The blasted rock, the “spoil” is usually dumped into adjacent valleys creating “valley fills”. These valley fills have proven to have environmental impact on local watersheds. Finally, with the mountain now opened, exposing the coal seam, the processing of coal can begin. Upon completion of mining operations, the area is reclaimed/replanted with new vegetation, sometimes attempts are made to restore the original contours.

**Mountaintop Mining Site**

A mountaintop mining site in reclamation near Kirk, WV.

![Image](https://example.com/image.jpg)

**Image Caption**

Mountain Top Removal Mining: Detecting Change in West Virginia

**Mountain Top Removal Mining**

Mountain Top Removal Mining (MTR) is a method to expose coal seams for processing on steep terrain in the Appalachian region of the United States. The process begins with the clear-cutting of large swaths of land, removing all vegetation. Rock is typically displaced by blasting, either removing the top or a ridge from a mountain. This can result in as much as 400 feet of elevation change. The blasted rock, the “spoil” is usually dumped into adjacent valleys creating “valley fills”. These valley fills have proven to have environmental impact on local watersheds. Finally, with the mountain now opened, exposing the coal seam, the processing of coal can begin. Upon completion of mining operations, the area is reclaimed/replanted with new vegetation, sometimes attempts are made to restore the original contours.

**DEM Change Detection Methods**

In an attempt to quantify the topographic changes caused by mountaintop removal valley fills, digital elevation model (DEM) differencing was examined as a technique for capturing this change. First, two DEMs were collected with enough temporal distance to show the effects of the mining activity. For clarity these DEMs were clipped to the mining area permit area for the Twilight MTR surface mine site identified earlier.

![Image](https://example.com/image.jpg)

**Image Caption**

Above, on the left is the mask image generated from the segmentation image. This mask was then applied to the difference image to produce the image on the right. Vector layers were then added to the image with the green representing the mining permit boundary, and the blue representing valley fill permit areas. Five years into mining operations the valley fill image on the left is showing dramatic elevation gains. The permit boundaries show that this method is fairly accurate for identifying topographic change due to mountain top removal mining and valley fills. Foils, R0/F were added to the masked image, and converted to classes so that elevation changes for each identifiable area in the mine could be recorded.

**DEM Surface Modeling**

In order to look at the topographic change in a way that may be most meaningful to someone not used to dealing with remotely sensed data 3D surface projects were next created. While ENVI provides these tools, the 3D models displayed here were created with the software DEM. After the first DEM 2001 Landsat 5 image was saved as a 3 band true-color geotiff,

**Topographic Modeling**

ENVI’s topographic modeling features were also employed to visually compare the two DEMs for the mine site.

**References**


Mike-Karyniki, Mike and Robert J. Camp. 2012. “Surface Mining in Appalachia: Challenges and Opportunities.” Tufts University Department of Geography.

Next, the 2000 LANDSAT 5 image was draped over the 2003 DEM at its native pixel resolution.

**NDVI Change Statistics**

The Twilight MTR study area consisted of 62.7 sq. miles. Between 1987 and 2008, 77.717% of vegetation values range from means for measuring density of vegetation, val-

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**DEM Differentiating**

NDVI images were created for the mine site study area using Landus data from 1987 and 2008. Five control points were selected visually in areas where there was suspected to be no change, and a constant value was calculated as the average difference over the five points. This constant was added to the values on the image with the lower raw values.

**NDVI Normalized Difference Vegetation Index**

**Topographic Modeling**

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**References**
