

# Photogrammetry Notes and Observations

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# Contents

<b>Common Variables</b>	<b>2</b>
<b>Common Programs and Usage</b>	<b>3</b>
GDAL Binaries . . . . .	3
gdalinfo . . . . .	3
gdaldem . . . . .	5
<b>Camera Calibration Notes</b>	<b>7</b>
Intrinsic Parameters . . . . .	7
<b>Glossary</b>	<b>8</b>
<b>Bibliography and useful resources</b>	<b>9</b>
<b>Index</b>	<b>9</b>

# Common Variables

- $H$  - Height of the camera above ground, *Flying Height*
- $B$  - Distance between two image, *Air Base*

# Common Programs and Usage Notes

This section is dedicated to solving easy problems using common programs.

## GDAL Binaries

Many of the included gdal programs can be installed using a package manager.

**Ubuntu** sudo apt-get install gdal-bin

### gdalinfo

#### Description

*gdalinfo* is an application bundled with GDAL which provides the user with the ability to extract information about a particular geographic file to the console.

This application works on elevation information, vector files (KML, KMZ), imagery (NITF), and many more.

#### Information Provided

- Corner Coordinates
- Geographic Projection Used
- Image Raster Datatype
- Date Taken
- more Metadata and image info

#### Usage

```
./gdalinfo data/dted/w119/n036.dt2
```

```
Driver: DTED/DTED Elevation Raster
Files: data/dted/w119/n036.dt2
Size is 3601, 3601
Coordinate System is:
GEOGCS["WGS 84",
    DATUM["WGS_1984",
        SPHEROID["WGS 84",6378137,298.257223563]],
    PRIMEM["Greenwich",0],
    UNIT["degree",0.0174532925199433],
```

AUTHORITY["EPSG", "4326"]]  
Origin = (-119.00013888888884, 37.00013888888884)  
Pixel Size = (0.0002777777777778, -0.0002777777777778)  
Metadata:  
DTED\_VerticalAccuracy\_UHL=0007  
DTED\_VerticalAccuracy\_ACC=0007  
DTED\_SecurityCode\_UHL=U  
DTED\_SecurityCode\_DSI=U  
DTED\_UniqueRef\_UHL=G18 063  
DTED\_UniqueRef\_DSI=G18 063  
DTED\_DataEdition=02  
DTED\_MatchMergeVersion=A  
DTED\_MaintenanceDate=0000  
DTED\_MatchMergeDate=0000  
DTED\_MaintenanceDescription=0000  
DTED\_Producer=USCNIMA  
DTED\_VerticalDatum=E96  
DTED\_HorizontalDatum=WGS84  
DTED\_DigitizingSystem=SRTM  
DTED\_CompilationDate=0002  
DTED\_HorizontalAccuracy=0013  
DTED\_RelHorizontalAccuracy=NA  
DTED\_RelVerticalAccuracy=0009  
AREA\_OR\_POINT=Point  
Corner Coordinates:  
Upper Left (-119.0001389, 37.0001389) (119d 0'0.50"W, 37d 0'0.50"N)  
Lower Left (-119.0001389, 35.9998611) (119d 0'0.50"W, 35d59'59.50"N)  
Upper Right (-117.9998611, 37.0001389) (117d59'59.50"W, 37d 0'0.50"N)  
Lower Right (-117.9998611, 35.9998611) (117d59'59.50"W, 35d59'59.50"N)  
Center (-118.5000000, 36.5000000) (118d30'0.00"W, 36d30'0.00"N)  
Band 1 Block=1x3601 Type=Int16, ColorInterp=Undefined  
NoData Value=-32767  
Unit Type: m

## gdaldem

### Description

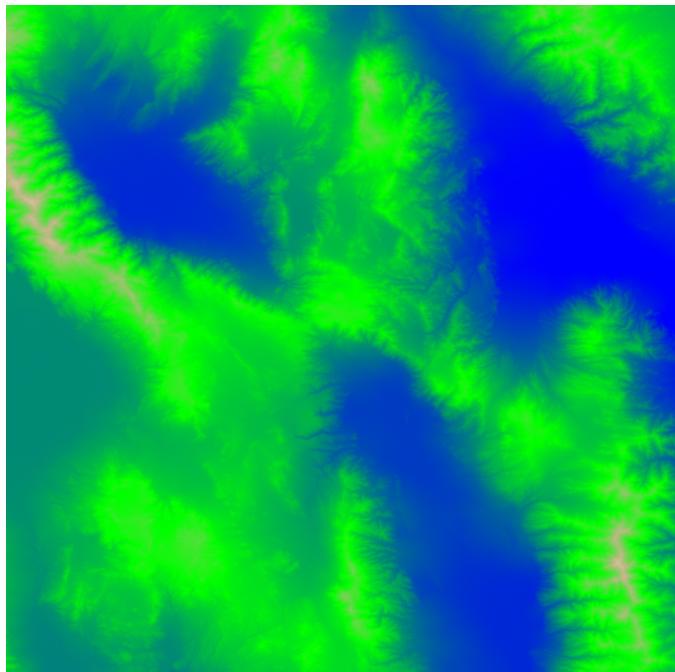
*gdaldem* is an application bundled with GDAL which provides the user with the ability to construct shaded relief and color maps for digital elevation models.

This application works on elevation information to include DTED and SRTM.

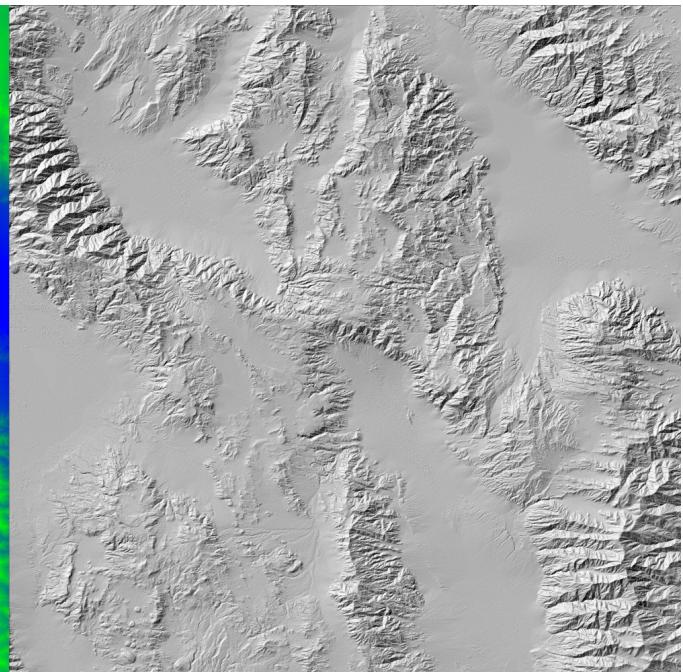
### Usage

```
# For color relief maps  
gdaldem color-relief data/dted/w118/n36.dt2 color_model.txt output.tif  
  
# For shaded relief maps  
gdaldem hillshade data/dted/w118/n36.dt2 output.tif -s 100000 -z 5  
  
# You can merge the images together with a t=0.7 such that Out(x,y) = t*Color(x,y) + (1-t)*Hill(x,y)  
# to get a great output image
```

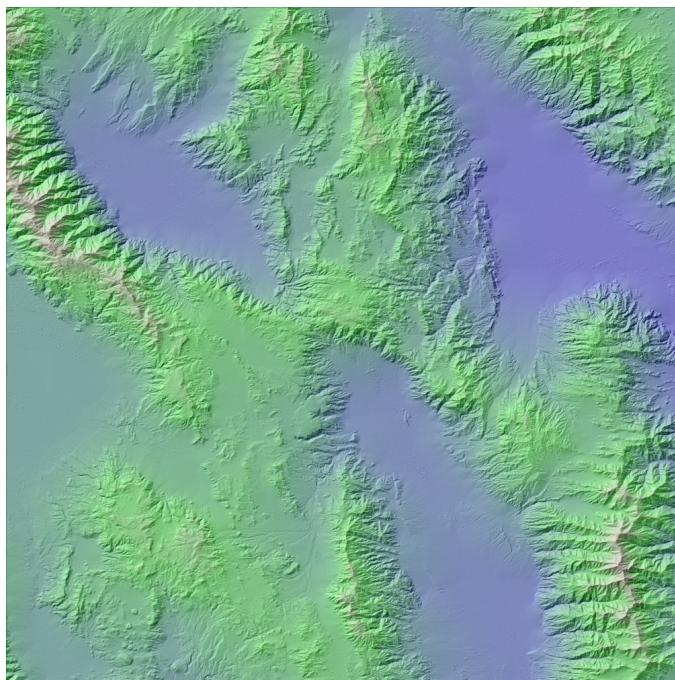
For more information, see manual pages and <http://developmentseed.org/blog/2009/jul/30/using-open-source-tools>



(a) Color Relief Results



(b) Hillshade Relief Results



(c) Merged Results

Figure 1: Results from typical *gdaldem* usage.

# Camera Calibration Notes

## Intrinsic Parameters

Common Intrinsic Camera Parameters

- Focal Length ( $f$ )
- Radial Distortion

# Glossary

**Aerotriangulation** The process of assigning ground control values to points on a block of photographs by determining the relationship between the photographs and known ground control points.. 8

**Boresight** Boresight is the physical mounting angles between an IMU and a digital camera. Basically, if the IMU defines a flight axis, the Boresight defines the angles from the axis of which the camera is pointing.. 8

**Bundle Adjustment** The process of simultaneously refining 3D coordinates derived from multiple viewpoints. This requires that the user has multiple 3d coordinates measured from multiple image pairs. This is often solved with Levenberg-Marquardt.. 8

**Focal Length** The distance between the focal point and the image plane. This is relevant as the focal length determines attributes such as the clarity of the image and the depth of field. It is an essential part of camera calibration.. 8

**Georectification** A method of stretching and warping an image to align with another map projectin or spatial data in GIS. This is comparable to Google Earth and other systems which implement overlays. If an image is rectified, Ground Control Points (GCP) can be used to create a transformation which aligns one image to the GIS data. This is different from orthorectification as well because it is assumed that the image is already orthorectified. Georectification just changes the projection and/or coordinate system.. 8

**Georeference** Same as Georectification . 8

**Orthorectification** A method of correcting an image to align with real-world coordinates on a map. This involves measuring the exact location of the image center as well as the camera angle. This is followed by the computation of the camera calibration parameters to remove camera and lens distortions. Finally, you may terrain induced distortions using DEM data.. 8

# Bibliography

- [1] Bon A. DeWitt and Paul R. Wolf. *Elements of Photogrammetry (with Applications in GIS)*. McGraw-Hill Higher Education, 3rd edition, 2000.

# Index

Aerotriangulation, 8

GDAL, 3, 5

gdaldem, 5

gdalinfo, 3

Georectification, 8

Georeference, 8

Orthorectification, 8