



Creating Custom Map Overlays

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Authors:

Jeff Fisher

Aaron Jaques

2621 Wasco Street / PO Box 1500 / Hood River, OR 97031

(541) 387-2120 phone / (541) 387-2030 fax

www.cloudcaptech.com / sales.cct@goodrich.com / support.cct@goodrich.com



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1 Introduction

Piccolo Command Center (PCC) and ViewPoint both support user-created map overlays that allow the user to create and import custom maps and other GIS imagery. However, a single image does not contain enough information to be placed on the map. The map must also have information about the location and size of the image relative to the Earth. This document details the process - also known as geo-referencing - of locating an image on the map for use as an overlay in PCC or ViewPoint.

2 The GeoTIFF Format

A standard file format for geo-referenced imagery is the GeoTIFF format. Details of a GeoTIFF file are somewhat ambiguous since there are two different formats that can go by the same GeoTiff name.

2.1 Single-File GeoTIFF

One type of GeoTIFF consists of a TIFF (Tagged Image File Format) image with tags embedded within the image file that contain detailed information about the image and its orientation with respect to the Earth. Because these tags are not recognized by most image editing software, it is difficult to create a single-file GeoTIFF without the appropriate software application. We recommend using [Global Mapper](#) for this purpose.

2.2 GeoTIFF World Files

The other type of GeoTIFF file consists of an image file with a separate text file that specifies the location and size of the image. The format of the world file contents is shown in **Table 1**.

Note: The official specification does not include a definition of the units, or a way to indicate which units or projection is being used.



All map overlay imagery is assumed to be projected using an equidistant cylindrical projection. For more information, please see the relevant [Wikipedia article](#).

Since this can be confusing, for our purposes we have specified the units and projection for each of the pieces of information contained in the world file. If a GeoTIFF is loaded with a world file that contains data in other units or another projection, the image will not appear on the map and may cause the map to malfunction.

2.2.1 World File Contents

The world file for a GeoTIFF consists of a single reference point - which gives the latitude and longitude of the upper-leftmost pixel in the image - and two scale factors, which indicate the amount of distance in degrees latitude and longitude represented by each pixel. The order of these parameters is detailed in Table 1. One other important thing to note is that everything is specified in degrees; because the degree is a relatively large unit of measurement, the precision of the numbers is very important. In general, each number in the world file should have at least six digits of precision for the image to align well on the map.

Table 1 - GeoTIFF World File Format

Line	Description	Units
1	Vertical distance covered by each pixel, starting from the top-left corner.	Degrees/pixel
2	Reserved, always zero.	N/A
3	Reserved, always zero.	N/A
4	Horizontal distance covered by each pixel, starting from the top-left corner.	Degrees/pixel
5	Longitude of the top-left corner.	Degrees
6	Latitude of the top-left corner.	Degrees

2.2.2 File Types and Naming Conventions

GeoJPEG and GeoPNG images can be constructed in the same way as GeoTIFF images. The difference is how the image is formatted. In order for the world file to be recognized, it must have the same name as the image it corresponds to. The world file extension must have the image file extension's first and last letters followed by a "w". Examples are shown in **Table 2**.

Table 2 - World File Naming Conventions

Image file name	World file name
SFO4meter.tif	SFO4meter.tfw
Yuma.jpg	Yuma.jgw
HeathrowRoads.png	HeathrowRoads.pgw

3 Map Overlay Procedure

To demonstrate the process of creating a map overlay, we will use an example GeoTIFF created using satellite imagery of [San Francisco International Airport](#) available on our website.

The upper left corner of the image shown in **Figure 1** is located at 37.646846813°N, 122.407014°W. These numbers are used for lines 5 and 6 in the world file as shown in **Figure 2**. (Refer to **Table 1** for a description of each value.)

Each pixel in the image is also known to be exactly 0.0000896762 degrees wide, from left to right, and -0.000072442648 degrees tall, from top to bottom. These numbers are then added to the world file on lines 1 and 4, respectively, and the world file is complete.



Because the image is referenced to the top left pixel, the distance to the next pixel down will generally be south. This means that the vertical scale parameter (line 4 in Figure 2) will almost always be negative.

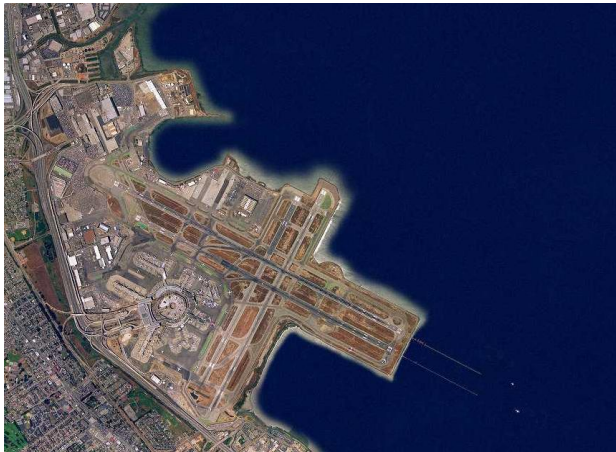


Figure 1 - San Francisco International Airport

```

1  0.0000896762
2  0.0000000000
3  0.0000000000
4  -0.000072442648
5  -122.4070140
6  37.646846813

```

Figure 2 - Example World File Contents

4 Other Projections

Both Piccolo Command Center and ViewPoint utilize a geospatial mapping toolkit called [OSSIM](#). The OSSIM toolkit supports a number of map projections whose parameters can be specified in a .geom text file. Geom files provide additional options for geo-referencing raster images in CCT's applications rather than using world files.

Note that if you have a tool which can re-project images (such as [Global Mapper](#)), it may be easier to re-project the image to use an equidistant cylindrical projection and a world file rather than use a geom file. Once the image has been warped and referenced to the correct projection, it is then ready to be imported into PCC or ViewPoint.

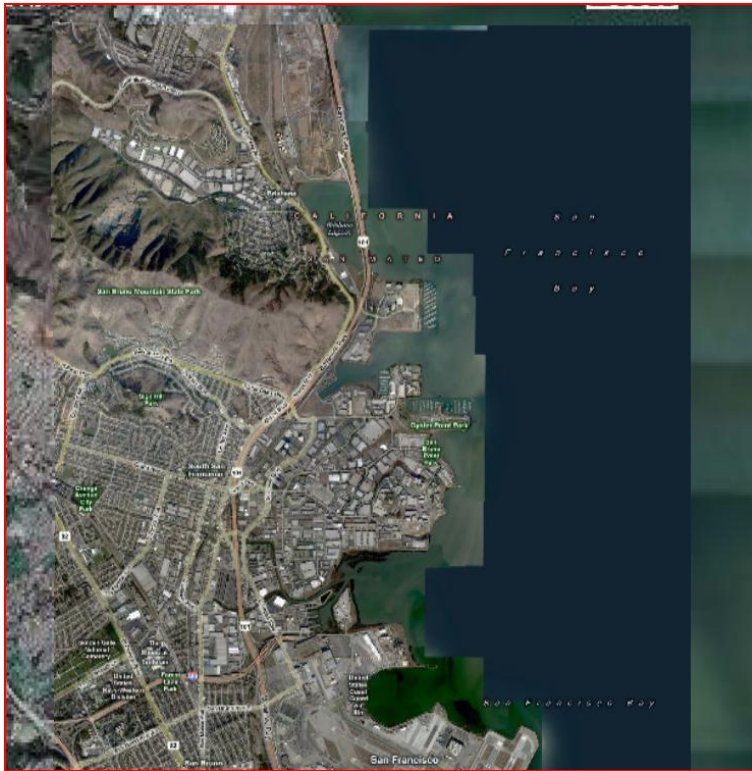
4.1 Geom File Usage

A .geom file contains a number of parameters that are specified by a parameter name, followed by a colon and then one or more values. To tie a geom file to an image the geom file must have the same name as the image with a ".geom" extension. For example, an image named "SFO.png" would have a corresponding "SFO.geom". Here is an example geom specifying parameters to geo reference an image of SFO using an equidistant cylindrical projection:

```

pixel_scale_units: degrees
pixel_scale_xy: ( 0.000085914589, 0.000085914589)
tie_point_units: degrees
tie_point_xy: ( -122.431640625000, 37.705078125000)
type: ossimEquiDistCylProjection

```



4.2 Supported Projections

The following is a listing of different projections and their associated values that can be specified in a geom file. Note that these values are for reference only, and have been populated with default or invalid values.

Additional Notes:

- Parameters can be omitted from the .geom file, in which case defaults will be used.
- Tuples such as `tie_point_xy: (-122.431640625000, 37.705078125000)` are specified relative to (longitude, latitude).
- Tie points refer to the north-western part of the image, IE pixel (0,0).
- In general, the most important parameters that need to be specified are: type, units, tie points, and scales.

AlbersProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
std_parallel_1: 29.5
std_parallel_2: 45.5
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimAlbersProjection
```

AzimEquDistProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimAzimEquDistProjection
```

BonneProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0.0002777777777777778
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (0,-30.715087890625)
type: ossimBonneProjection
```

BngProjection

```
central_meridian: -2
datum: OGB-M
elevation_lookup_flag: 0
ellipse_code: AA
ellipse_name: Airy
false_easting_northing: (400000,-100000)
false_easting_northing_units: meters
major_axis: 6377563.396
minor_axis: 6356256.909
origin_latitude: 49
pixel_scale_units: meters
pixel_scale_xy: (1,1)
scale_factor: 0.9996012717
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimBngProjection
```

CassiniProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimCassiniProjection
```

CylEquAreaProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimCylEquAreaProjection
```

EquiDistCylProjection

central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: degrees
pixel_scale_xy: (8.99320592250271e-006,8.99320592250271e-006)
tie_point_units: degrees
tie_point_xy: (0,0)
type: ossimEquiDistCylProjection

Eckert4Projection

central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimEckert4Projection

Eckert6Projection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimEckert6Projection
```

GnomonicProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimGnomonicProjection
```

LambertConformalConicProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
std_parallel_1: 40
std_parallel_2: 50
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimLambertConformalConicProjection
```

LlxyProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: degrees
pixel_scale_xy: (8.9831528412e-006,8.9831528412e-006)
tie_point_units: degrees
tie_point_xy: (0,0)
type: ossimLlxyProjection
```

MercatorProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
scale_factor: 1
tie_point_units: meters
tie_point_xy: (0,-7.08115455161362e-010)
type: ossimMercatorProjection
```

MillerProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimMillerProjection
```

MollweidProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimMollweidProjection
```

NewZealandMapGridProjection

```
central_meridian: 173
datum: GEO
elevation_lookup_flag: 0
ellipse_code: IN
ellipse_name: International 1924
false_easting_northing: (2510000,6023150)
false_easting_northing_units: meters
major_axis: 6378388
minor_axis: 6356911.946
origin_latitude: -41
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (2509988.40110452,6022958.28893546)
type: ossimNewZealandMapGridProjection
```

ObliqueMercatorProjection

```
central_meridian: 0
central_point1_lat: -5
central_point1_lon: -5
central_point2_lat: 5
central_point2_lon: 5
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
scale_factor: 1
tie_point_units: meters
tie_point_xy: (6.46137975691828e-010,-1.34898722663758e-009)
type: ossimObliqueMercatorProjection
```

OrthoGraphicProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimOrthoGraphicProjection
```

PolarStereoProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (0,-6378137)
type: ossimPolarStereoProjection
```

PolyconicProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimPolyconicProjection
```

SinusoidalProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimSinusoidalProjection
```

StereographicProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimStereographicProjection
```

TransCylEquAreaProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
scale_factor: 1
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimTransCylEquAreaProjection
```

TransMercatorProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
scale_factor: 1
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimTransMercatorProjection
```

UpsProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (2000000,2000000)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 81.114528
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (2000000,-10637318.6717609)
type: ossimUpsProjection
```

UtmProjection

```
central_meridian: 3
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (500000,0)
false_easting_northing_units: meters
hemisphere: N
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pcs_code: 32631
pixel_scale_units: meters
pixel_scale_xy: (1,1)
srs_name: EPSG:32631
tie_point_units: meters
tie_point_xy: (166021.443083703,0)
type: ossimUtmProjection
zone: 31
```

VanDerGrintenProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
pixel_scale_units: meters
pixel_scale_xy: (1,1)
tie_point_units: meters
tie_point_xy: (0,0)
type: ossimVanDerGrintenProjection
```

SpaceObliqueMercatorProjection

```
central_meridian: 0
datum: WGE
elevation_lookup_flag: 0
ellipse_code: WE
ellipse_name: WGS 84
false_easting_northing: (0,0)
false_easting_northing_units: meters
major_axis: 6378137
minor_axis: 6356752.3142
origin_latitude: 0
path: 34
pixel_scale_units: meters
pixel_scale_xy: (1,1)
satellite_type: 5
tie_point_units: meters
tie_point_xy: (nan,nan)
type: ossimSpaceObliqueMercatorProjection
```

QuadProjection

```
datum: WGE
height: 0
ll_lat: nan
ll_lon: nan
lr_lat: nan
lr_lon: nan
type: ossimQuadProjection
ul_lat: nan
ul_lon: nan
ul_x: nan
ul_y: nan
ur_lat: nan
ur_lon: nan
width: 0
```