GeoCell User Manual

Version 1.8.16

April 2013

ABSTRACT

GeoCell is a stand-alone executable program offering a cross-platform GUI that exposes OSSIM library functionality. This document provides guidelines for operations.
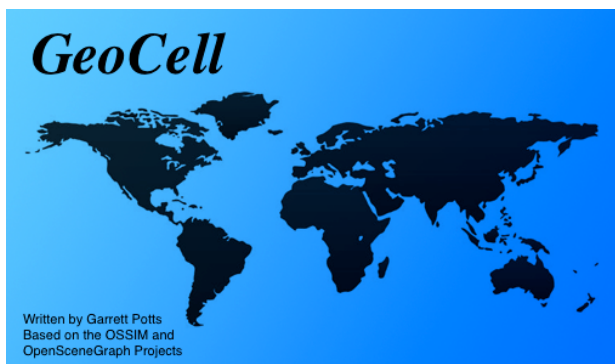
DRAFT

Table of Contents

1 Overview

TBD

2   Basic Operations

This section describes the basic procedures required for GeoCell operations.

2.1   *Load Images*

Images can be loaded either individually or as members of a project file. A project file defines file paths and other parameters associated with a group of related images. OMAR has the capability to select images and export (download) a project file, along with associated image files (including geometry, overview, and histogram), for use in GeoCell.

2.1.1   GUI

To load an image or project via the GUI, select File->Open Image or File->Open Project and choose the desired file using the Open dialog box, as shown in **Figure 1**.

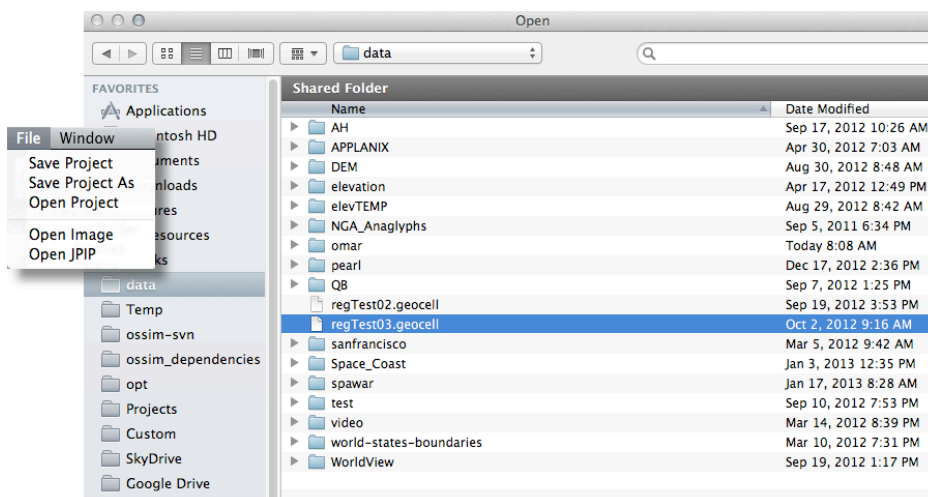Figure 1. Image/Project File Selection

2.1.2   Command Line

Project files may be opened via command line in the following manner:
```
geocell —project /path/to/project/file
```
            or
```
geocell /path/to/project/file.gcl    (with gcl extension)
```

Using the example from paragraph 2.1.1:
```
geocell —project /data/regTest03.geocell
```
            or
```
geocell /data/regTest03.gcl
```

2.2 Open Display Windows

After loading, image chains must be selected to create the corresponding image display windows. With reference to **Figure 2**, follow these steps to create displays:

1. Expand the source entry list by clicking on the small triangle next to "Source"
2. Select desired sources and right-click to reveal pop-up menu
3. Select "Chains", then "Affine" for raw images or "Default" (or "Map Projection") for orthorectified images
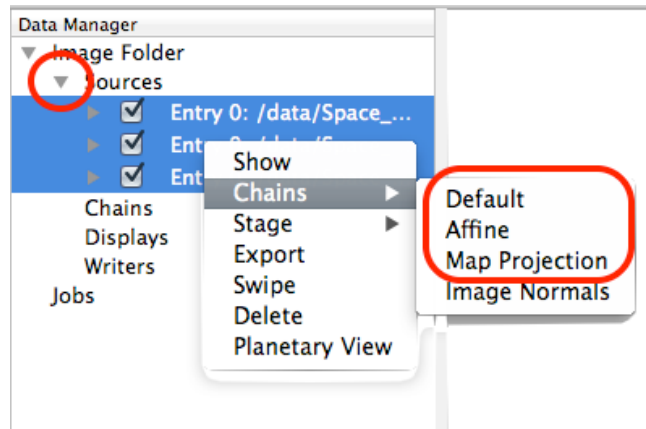

Figure 2. Chain Selection

3   Visual Exploitation

This section describes the functions related to GeoCell's visual image manipulation capabilities.

3.1   *Image Combiners*

GeoCell has access to OSSIM's collections image combiners. This section provides examples of several of those functions, using a raster map and image for clarity.

3.1.1   Blend

The blend procedure is described as follows:
1. Load two images
2. Select both **Reprojection Chains** in *Chains*, right-click and choose *Combine>Blend*
3. An **ossimBlendMosaic** is created in *Chains* (see **Figure 3**)

Figure 3. Image Blend

3.1.2   Feather

The feather procedure is described as follows:
1. Load two images
2. Select both **Reprojection Chains** in *Chains*, right-click and choose *Combine>Feather*
3. An **ossimFeatherMosaic** is created in *Chains* (see **Figure 4**)

Figure 4. Image Feather

3.1.3 Combiner From Factory

Use of a combiner not explicitly available in the *Combine* menu is described as follows:

1. Load two images
2. Select both **Reprojection Chains** in *Chains*, right-click and choose *Combine>Select from Factory*
3. A selection window is displayed, as shown in **Figure 5**
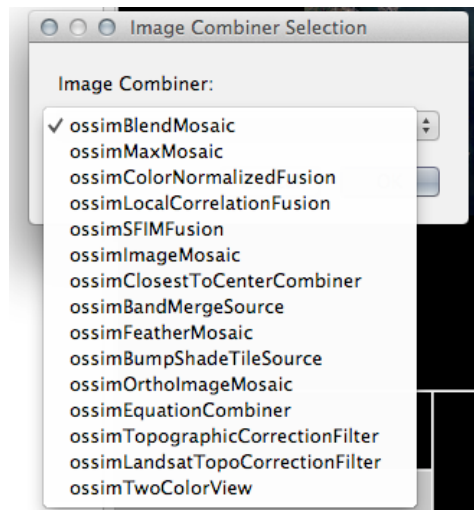
Figure 5. Combine Selection Window

4. Select desired filter; for example, an **ossimTwoColorView** is created in *Chains* (see **Figure 6**)
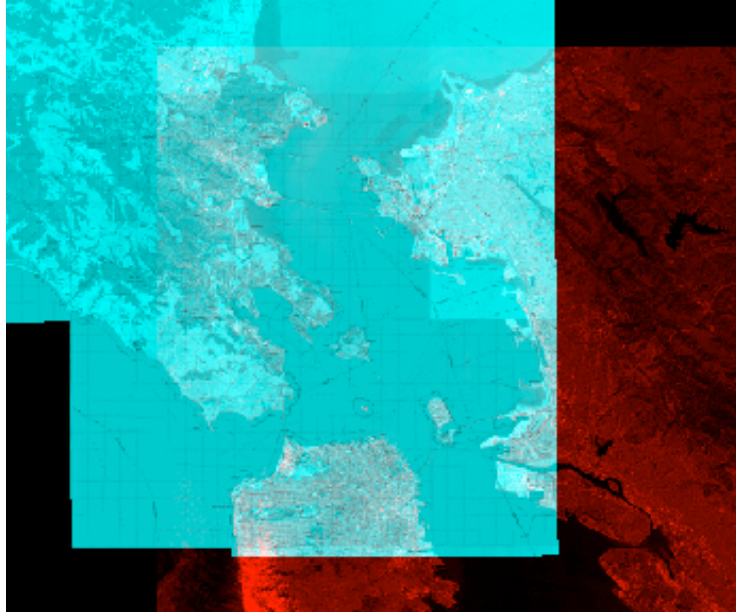
Figure 6. Two-Color Multiview

3.2   Digital Terrain Model Usage

3.2.1   Hill Shade

The hill shade procedure allows creation of a pseudo 3D view. It is described as follows:

1. Load an overlay image and DTM reformatted to raster (e.g. srtm_xx.ras)
2. Select srtm_xx.ras in *Sources*, right-click and choose *Chains>Image Normals*
   a. A **Normals Chain** is created in *Chains*
   b. Expansion of the entry allows manipulation of its filter properties; for example, the gain of the **ossimImagePlaneNormalFilter** has been changed in **Figure 7**
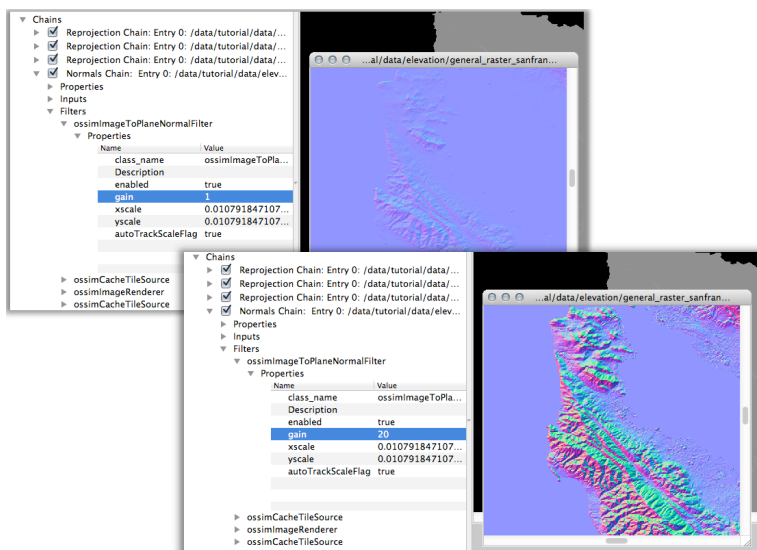
Figure 7. ossimImagePlaneNormalFilter Properties

3. Select the map + Normals Chain in *Chains*, right-click and choose *Combine>Hill Shade*
    a. A **ossimBumpShadeTileSource** is created in *Chains*
    b. Expansion of the entry allows manipulation of its filter properties; for example, the hill shade light source azimuth and elevation angles are shown in **Figure 8**
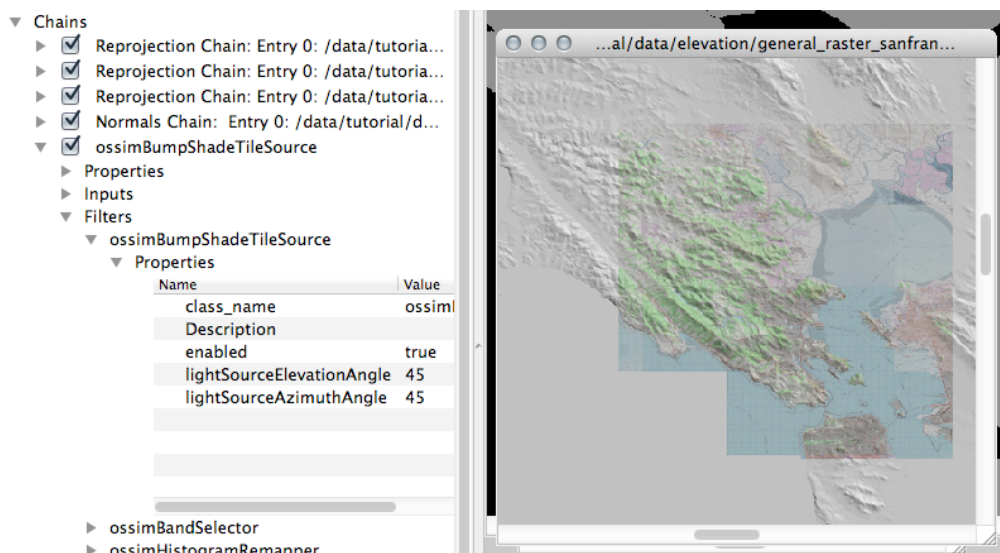
Figure 8. Hill Shaded Map

3.3 Planetary View

Planetary view provides the capability for advanced 3D viewing. Activation of this view is described as follows:

1. Load image(s) of choice
2. Select all in *Chains*, right-click and choose *Planetary View* from context menu
3. Press *<Select Syncing>* and select *Full*

4. Image Viewer (map or image) display and control:
   - Left-click/roam induces synchronized motion in all displays, including the Planetary Viewer
   - Wheel moves image up/down
   - Shift/wheel turn zooms in/out
5. Planetary Viewer display and control:
   - Note that both images appear mosaicked
   - Left-click/roam moves image within display window
   - Right-click/roam zooms image within display window
   - Middle-click/roam (*not* wheel turn) induces eye point motion
     - ✓ up/down - raises/lowers look angle
     - ✓ right/left - rotates azimuth
   - Hot keys reset
     - ✓ lower case 'u' rotates back to north-up
     - ✓ upper case 'U' resets eye view to nadir
   - At higher look angles, relief should be visible in background
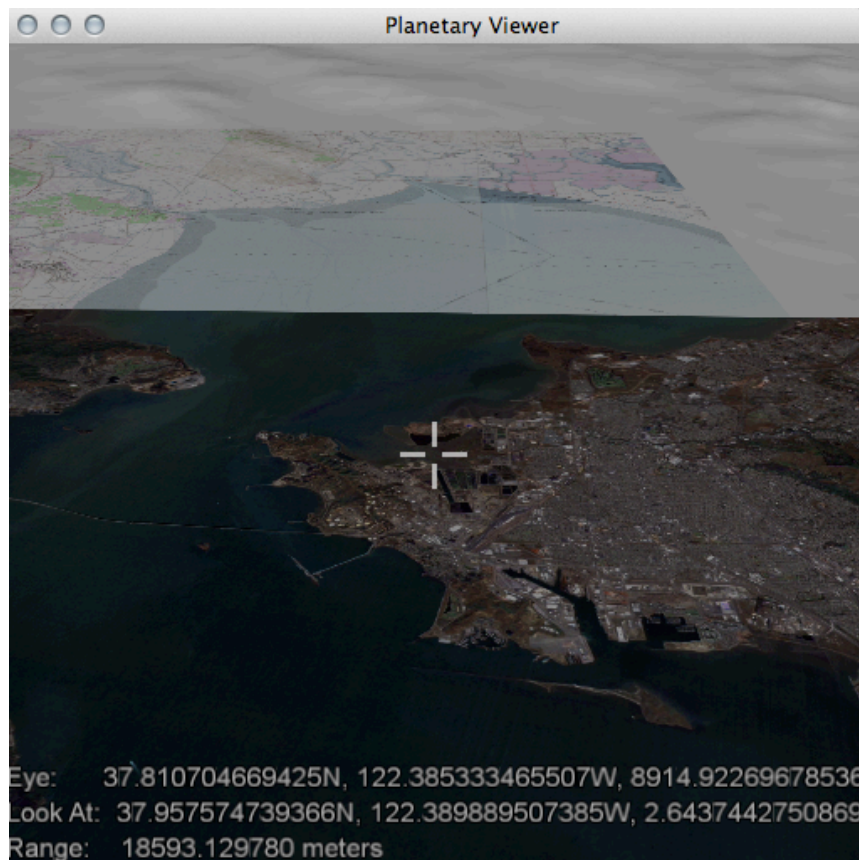
Figure 9. Plantary Viewer

4   Metric Exploitation

This section describes the functions related to GeoCell's photogrammetric exploitation capabilities.

4.1   Selecting Images

The metric exploitation processes are controlled by the tabbed Metric Exploitation window, which is initiated from the Exploitation Mode menu, as shown in **Figure 10**.
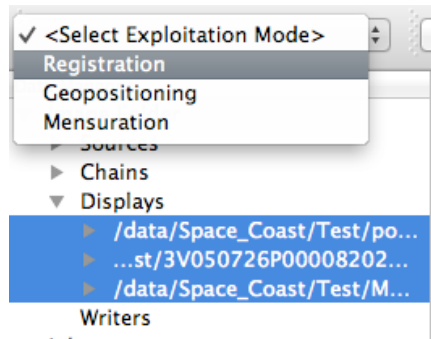
Figure 10. Registration Window Selection

Prior to selecting the desired operation, the applicable images must be selected after first expanding the displays list by clicking on the small triangle next to "Displays". If no images (or too few) are selected, an error pop-up is displayed, as shown in **Figure 11**.
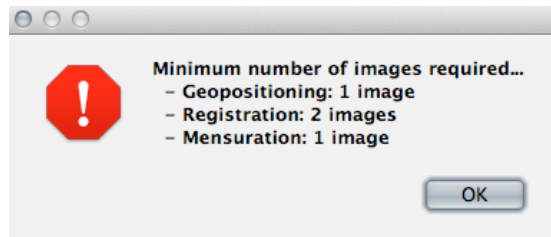
Figure 11. Error Pop-up for Too Few Images

All metric exploitation components are controlled via the Metric Exploitation window, as shown in **Figure 12**. Its tabs are active based on the selected mode, with the Image Summary tab always active. The **Dismiss** button hides the window, but maintains the mode. The window can be revealed again by reselecting the mode or by clicking in the Data Manager area and pressing the 's' key. The Reset Mode button resets to the no mode state and removes all measured points.
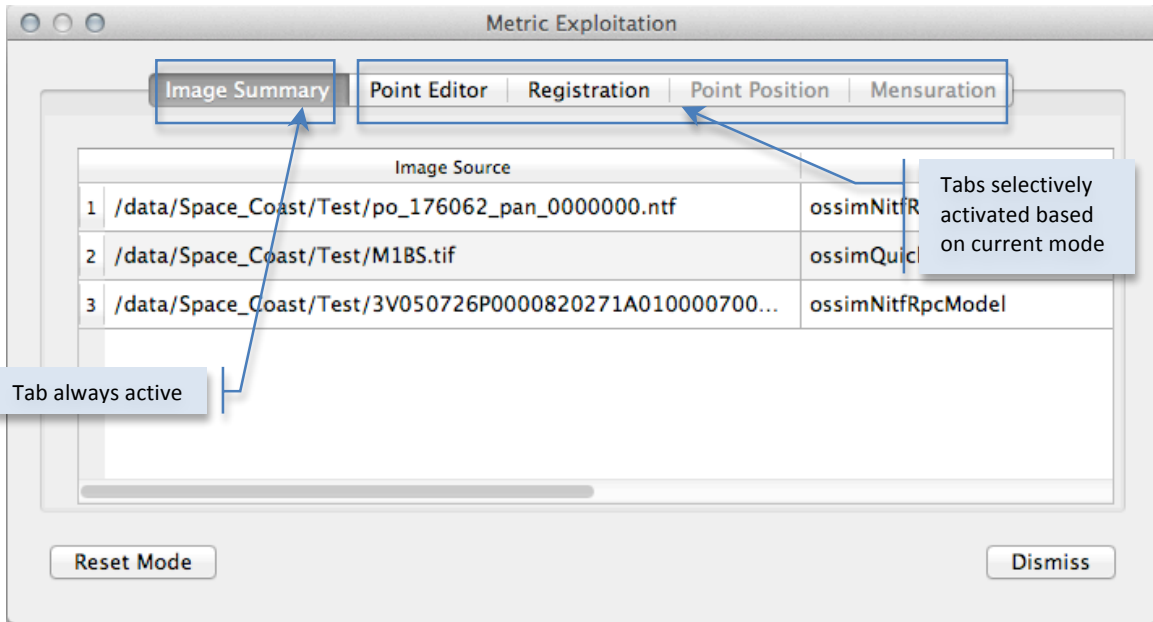
Figure 12. Metric Exploitation Window

4.2 Geopositioning

This section describes geopositioning component of metric exploitation. The point positioning function is <u>NOT CERTIFIED FOR TARGETING</u>. The Point Position tab is illustrated in **Figure 13**.
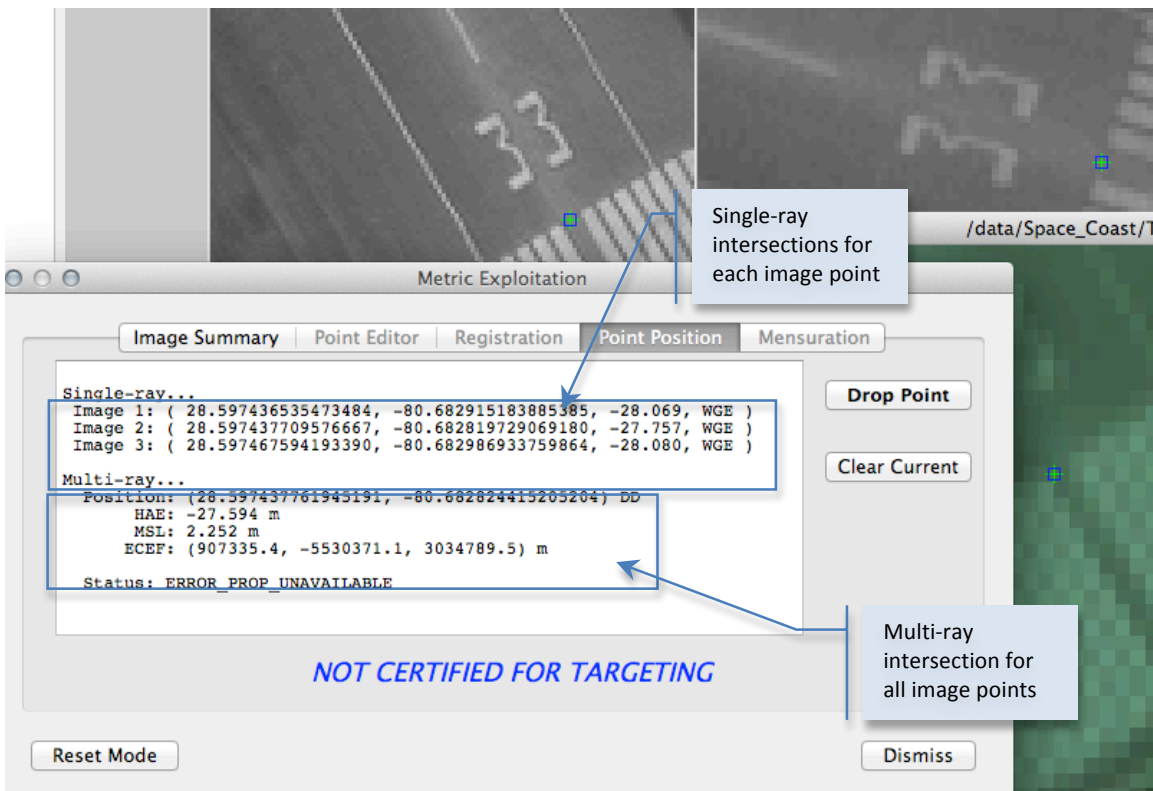
Figure 13. Point Position Tab

After measuring the corresponding point in each image, press the ***Drop Point*** button to execute the intersection ("point drop"). The results are written to the summary window. These results include individual single-ray intersections with the elevation surface and one multi-ray spatial intersection using all image rays. The display uses the following abbreviations:

1. DD: longitude, latitude in decimal degrees
2. HAE (also WGE): height above ellipsoid (WGS84)
3. MSL: height above mean sea level
4. ECEF: earth-centered earth-fixed Cartesian frame

4.3   Image Registration

The objective of registration is to adjust camera model error parameters to minimize projection error (residuals) for tie points appearing in all the images. This is not just a "cosmetic" bias removal, the sensor model is being used, and the adjusted error model parameters can be saved for downstream uses.

Image registration requires the measurement of tie points common to the image overlap areas. Based on the differences between the measured and projected point positions, selected image parameters are adjusted through a mathematical process known as a *bundle adjustment*.

4.3.1   Register Images

The Metric Exploitation-Registration tabbed window is composed of three tabs that are described in the following paragraphs.

4.3.1.1 Image Summary Tab

The Image Summary tab is illustrated in **Figure 14**.
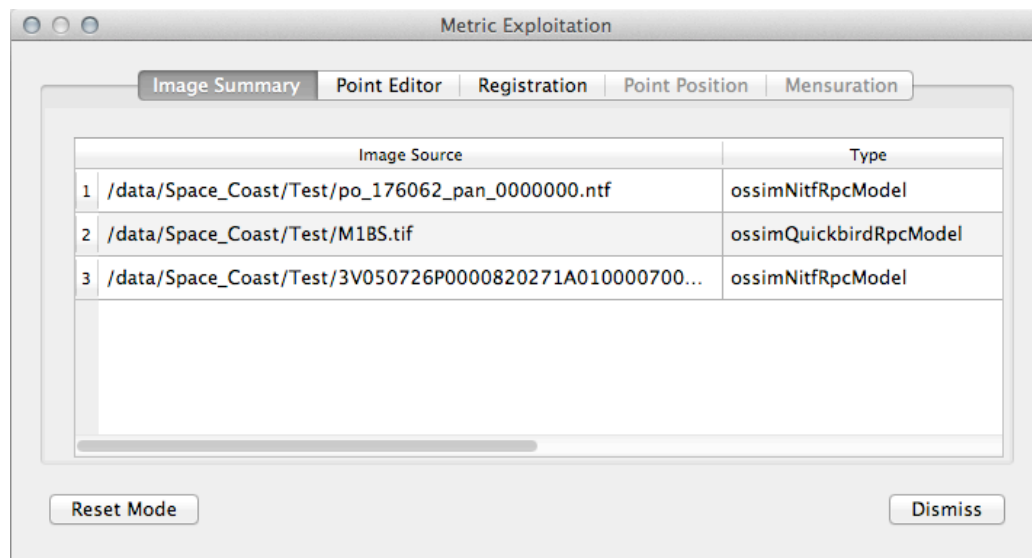
Figure 14. Image Summary Tab

This tab, which is primarily informational, provides a convenient view of the images and their associated types. A right-click context menu is available off the row header for each image, as shown in **Figure 15**. The context menu can be used to toggle the control status of the image (indicated by appending a "C" to the image number) and to display its Parameter Adjustments summary window.
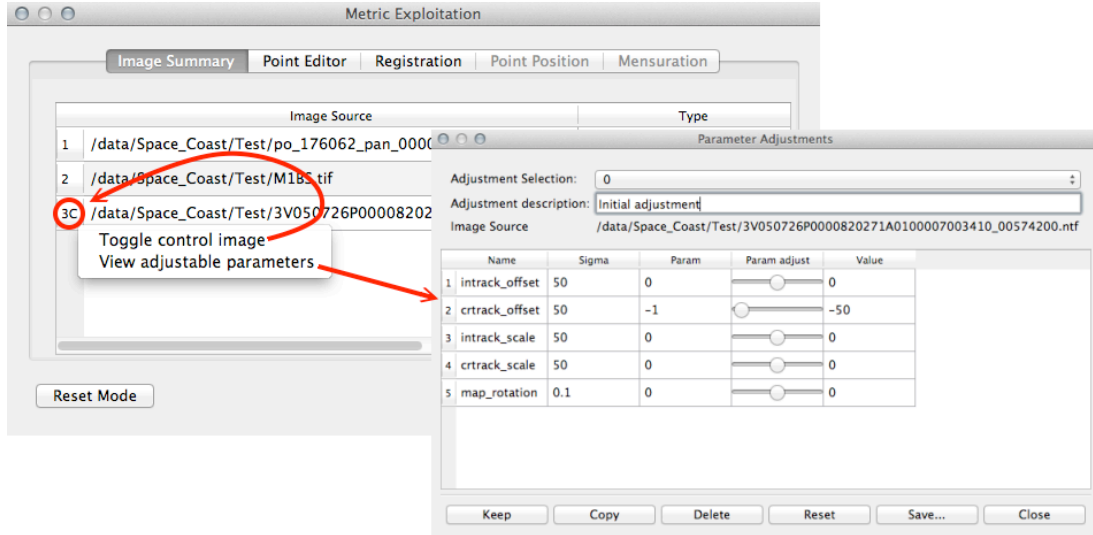
Figure 15. Image Context Menu

4.3.1.2 Point Editor Tab

The Point Editor tab is illustrated in **Figure 16**. Follow these steps to add tie points:
1. Press the ***New Point*** button to create a new table column and increment the current point indicator (below the ***New Point*** button).
2. Measure the current tie point in each image. The corresponding table cell will turn yellow.
3. For any point, after the first image has been measured, clicking on the point header will preposition all images to the corresponding position.
4. Any individual image point measurement can be toggled to inactive (indicated by red) by clicking on the cell. The point's symbol will also turn red and it will not be included in the solution.
5. Clicking on its column header revisits any tie point.
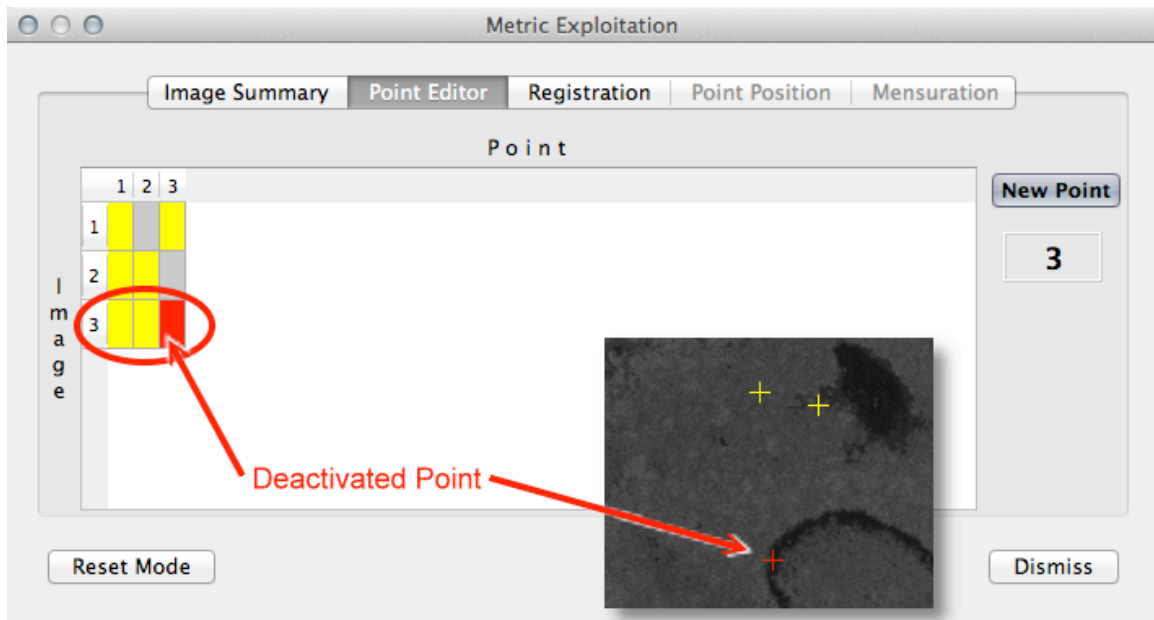
Figure 16. Point Editor Tab

4.3.1.3 Registration Tab

The Registration tab is illustrated in **Figure 17**. Upon completion of tie point measurement, press the **Register** button to execute the registration solution. A detailed solution report is written to the summary window. See paragraph 4.3.2 for a description of the report content. If the results are satisfactory, press the **Accept** button to save the parameter adjustments. Press **Clear** to remove the report, ignore the solution, and perform additional tie point editing.
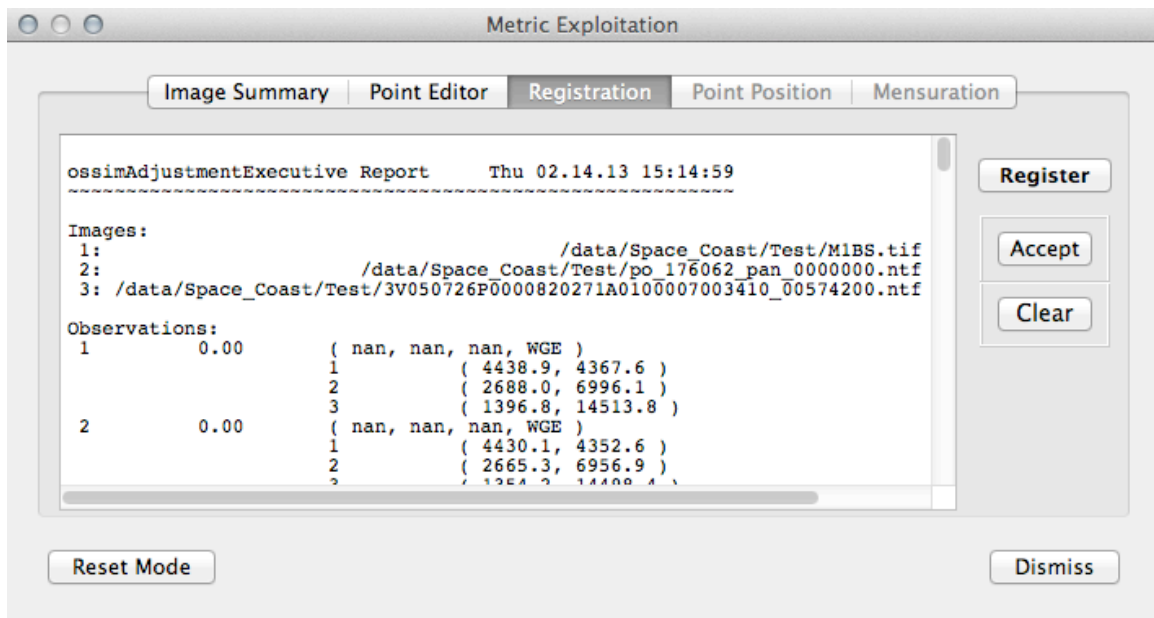
Figure 17. Registration Tab

4.3.2   Review Registration Report

The summary window shown in **Figure 17** contains a detailed solution report. The report content is described in the annotated example below.

Number of adjustable image parameters

```
ossimAdjustmentExecutive Report      Tue 02.19.13 10:18:55
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Images:
 1:                      /data/Space_Coast/Test/po_176062_pan_0000000.ntf    nPar:  5
 2: /data/Space_Coast/Test/3V050726P0000820271A0100007003410_00574200.ntf    nPar:  5
 3:                               /data/Space_Coast/Test/M1BS.tif             nPar:  5

Observations:
 1      0.00    ( nan,  nan,  nan,  WGE )
                 1     ( 2664.9,  6957.3 )
                 2     ( 1353.9,  14498.8 )
                 3     ( 4429.7,  4352.8 )
 2      0.00    ( nan,  nan,  nan,  WGE )
                 1     ( 2687.2,  6996.5 )
                 2     ( 1396.7,  14513.9 )
                 3     ( 4438.6,  4367.7 )
 3      0.00    ( nan,  nan,  nan,  WGE )
                 1     ( 2759.6,  6786.7 )
                 2     ( 1309.9,  14306.7 )
                 3     ( 4466.0,  4283.5 )

 Iteration 0...
 Measurement Residuals...
 observation    image     samp     line    initial_meas
             1      1    -13.6     -8.9    ( 2664.9,  6957.3 )
             1      2     -9.4     -4.7    ( 1353.9,  14498.8 )
             1      3     -7.8     -5.1    ( 4429.7,  4352.8 )

             2      1    -13.7     -9.3    ( 2687.2,  6996.5 )
             2      2     -9.1     -4.1    ( 1396.7,  14513.9 )
             2      3     -7.7     -5.4    ( 4438.6,  4367.7 )

             3      1    -13.1     -8.7    ( 2759.6,  6786.7 )
             3      2     -9.0     -4.1    ( 1309.9,  14306.7 )
             3      3     -7.9     -5.5    ( 4466.0,  4283.5 )

                  Mean:  -10.1     -6.2     RMS:    10.4    6.5

 Iteration 1...
 Parameter Corrections...
  n  im       parameter    a_priori   total_corr   last_corr  initial_std    prop_std
  1   1    intrack_offset   0.00000    -4.42692    -4.42692    50.00000     25.13001
  2   1    crtrack_offset   0.00000    -6.07293    -6.07293    50.00000     28.72990
  3   1     intrack_scale   0.00000    -2.06101    -2.06101    50.00000     49.55460
  4   1     crtrack_scale   0.00000     8.96572     8.96572    50.00000     42.26942
  5   1      map_rotation   0.00000     0.00600     0.00600     0.10000      0.09838
  6   2    intrack_offset   0.00000    -3.45761    -3.45761    50.00000     25.89186
  7   2    crtrack_offset   0.00000    -2.44296    -2.44296    50.00000     31.14816
  8   2     intrack_scale   0.00000    -3.20288    -3.20288    50.00000     48.28139
  9   2     crtrack_scale   0.00000     3.58490     3.58490    50.00000     40.63788
 10   2      map_rotation   0.00000    -0.00018    -0.00018     0.10000      0.09395
 11   3    intrack_offset   0.00000    -5.15540    -5.15540    50.00000     11.65369
 12   3    crtrack_offset   0.00000    -5.39114    -5.39114    50.00000     15.80003
 13   3     intrack_scale   0.00000     6.69311     6.69311    50.00000     38.37173
```

Tie point ground coordinates
- "nan" indicates uninitialized
- actual coordinates indicate generated from control image

Tie point image coordinates (s,l)

Tie point summary list

Initial ("iteration 0") image space discrepancies (residuals)

Data summary subgroups repeat for each iteration

Adjustable parameter corrections

```
14  3     crtrack_scale     0.00000    -4.60951    -4.60951    50.00000    45.34128
15  3     map_rotation      0.00000    -0.00367    -0.00367     0.10000     0.09936
```

```
Observation Corrections...
  n          observation      a_priori   total_corr    last_corr  initial_std    prop_std
  1                   1      28.59735     3.92079      3.92079     50.00000    22.61567
                            -80.68278    -2.71886     -2.71886     50.00000    22.91156
                            -26.83644     0.17051      0.17051     50.00000    28.04424

  2                   2      28.59700     3.47060      3.47060     50.00000    22.56157
                            -80.68255    -2.52333     -2.52333     50.00000    22.85947
                            -28.33215     2.04273      2.04273     50.00000    28.06490

  3                   3      28.59890     3.31765      3.31765     50.00000    22.66972
                            -80.68181    -2.38507     -2.38507     50.00000    22.90460
                            -29.76113     1.41584      1.41584     50.00000    28.05215
```

Ground coordinate corrections

```
Measurement Residuals...
 observation    image    samp     line     initial_meas
          1        1    -0.1     -0.0    ( 2664.9,  6957.3 )
          1        2     0.0     -0.1    ( 1353.9, 14498.8 )
          1        3    -0.0      0.3    ( 4429.7,  4352.8 )

          2        1    -0.1     -0.0    ( 2687.2,  6996.5 )
          2        2     0.0      0.0    ( 1396.7, 14513.9 )
          2        3     0.2     -0.1    ( 4438.6,  4367.7 )

          3        1     0.2      0.0    ( 2759.6,  6786.7 )
          3        2    -0.0      0.1    ( 1309.9, 14306.7 )
          3        3    -0.2     -0.2    ( 4466.0,  4283.5 )

_____Mean:     0.0     -0.0     RMS:     0.1       0.1
```

Image measurement residuals

```
 Iteration 2...
Parameter Corrections...
  n im      parameter      a_priori   total_corr    last_corr  initial_std    prop_std
  1  1    intrack_offset    0.00000    -4.42816    -0.00124    50.00000    25.12279
  2  1    crtrack_offset    0.00000    -6.06469     0.00824    50.00000    28.75264
  3  1     intrack_scale    0.00000    -2.06194    -0.00092    50.00000    49.55560
  4  1     crtrack_scale    0.00000     8.97259     0.00687    50.00000    42.25599
  5  1     map_rotation     0.00000     0.00599    -0.00000     0.10000     0.09838
  6  2    intrack_offset    0.00000    -3.45382     0.00379    50.00000    25.89526
  7  2    crtrack_offset    0.00000    -2.44302    -0.00006    50.00000    31.17639
  8  2     intrack_scale    0.00000    -3.20447    -0.00158    50.00000    48.27970
  9  2     crtrack_scale    0.00000     3.57827    -0.00663    50.00000    40.63471
 10  2     map_rotation     0.00000    -0.00015     0.00003     0.10000     0.09394
 11  3    intrack_offset    0.00000    -5.15030     0.00510    50.00000    11.65931
 12  3    crtrack_offset    0.00000    -5.38992     0.00121    50.00000    15.78122
 13  3     intrack_scale    0.00000     6.67994    -0.01318    50.00000    38.39727
 14  3     crtrack_scale    0.00000    -4.61720    -0.00769    50.00000    45.33730
 15  3     map_rotation     0.00000    -0.00367     0.00000     0.10000     0.09936
```

```
Observation Corrections...
  n          observation      a_priori   total_corr    last_corr  initial_std    prop_std
  1                   1      28.59735     3.92032    -0.00047     50.00000    22.61620
                            -80.68278    -2.71938    -0.00052     49.99998    22.90708
                            -26.83644     0.17089     0.00038     50.00000    28.04453

  2                   2      28.59700     3.47040    -0.00019     50.00000    22.56179
                            -80.68255    -2.52389    -0.00057     49.99999    22.85459
                            -28.33215     2.04298     0.00026     50.00000    28.06496

  3                   3      28.59890     3.31785     0.00020     50.00000    22.66964
                            -80.68181    -2.38592    -0.00085     49.99999    22.89936
                            -29.76113     1.41519    -0.00066     50.00000    28.05243
```

```
Measurement Residuals...
 observation    image    samp     line     initial_meas
          1        1    -0.1     -0.0    ( 2664.9,  6957.3 )
```

```
      1       2      0.0     -0.1    ( 1353.9, 14498.8 )
      1       3     -0.0      0.3    ( 4429.7,  4352.8 )

      2       1     -0.1      0.0    ( 2687.2,  6996.5 )
      2       2      0.0      0.0    ( 1396.7, 14513.9 )
      2       3      0.2     -0.1    ( 4438.6,  4367.7 )

      3       1      0.2      0.0    ( 2759.6,  6786.7 )
      3       2     -0.0      0.1    ( 1309.9, 14306.7 )
      3       3     -0.2     -0.2    ( 4466.0,  4283.5 )

_____Mean:    -0.0     -0.0    RMS:     0.1      0.1


ossimAdjustmentExecutive Summary...
  Valid Exec:          true
  Nbr Ground Pts:      3
  Nbr Image Points:    9          Observation
  Nbr Images:          3          metrics
  Nbr Parameters:      15
  ------------------------
  Solution Converged: true
  Solution Diverged:  false       Iteration
  Max Iter Exceeded:  false       convergence
  Max Iterations:     7           information
  Convergence Crit:   5.0%

  SEUW Trace...
    Iter        SEUW
       0      36.918
       1       0.622
       2       0.622                    Standard error
                                        of unit weight
Tue 02.19.13 10:18:55                   per iteration
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~     ~~~~~~~~~~~~~
```

Post-solution summary

Additionally, the following terminology is used in the summary report:
1. a_priori: provisional estimate of parameter/ground coordinate
2. total_corr: total correction for all iterations
3. last_corr: correction computed from last iteration
4. initial_std: standard deviation of provisional estimate
5. prop_std: propagated standard deviation
6. SEUW: standard error of unit weight

At a top level, the following factors generally indicate an acceptable solution:
1. Solution converged, as illustrated in the example above
2. Decreasing/stabilized SEUW
3. Reasonable corrections to adjustable parameters and ground points

4.3.3 Save Adjusted Parameters

The adjusted parameters may be saved in the standard OSSIM geometry file format
(.geom) by using the Parameter Adjustments window referenced in paragraph 4.3.1.1.

This action is selective, that is, each image parameter set must be saved independently using the **Save…** button, as shown in **Figure 18**. The adjustment is also labeled with the date and time.
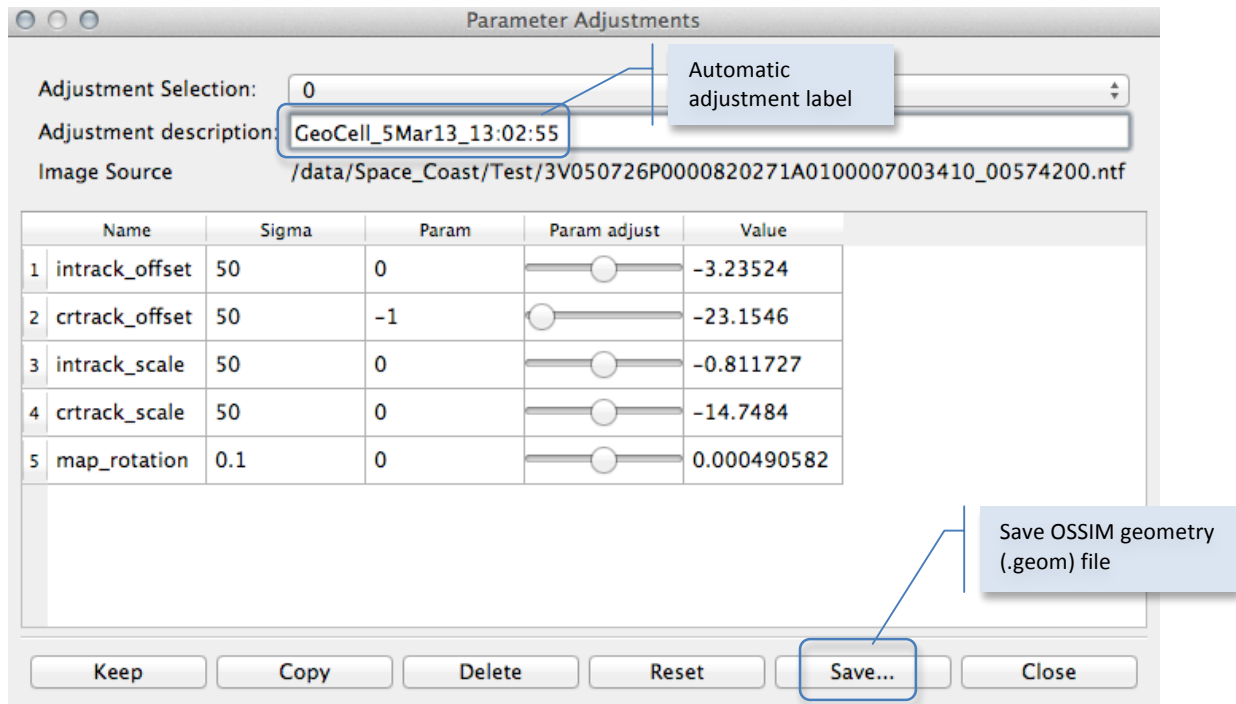

Figure 18. Parameter Adjustments Window - Saving Parameters

4.4 Mensuration

TBD