# THE STUDY ON MAPPING POLICY AND TOPOGRAPHIC MAPPING FOR THE INTEGRATED NATIONAL DEVELOPMENT PLAN OF THE PHILIPPINES


**EDITION 1**

**Table of Contents**

## 1. Introduction

The purpose of the Softcopy Exploitation Tool (SOCET SET®) software is to support imagebased softcopy applications such as map-making, mission rehearsal, and photo-interpretation.

SOCET SET generates databases and products such as Digital Terrain Models (DTM), reports, vector databases, orthophotos, image maps, and image mosaics. SOCET SET supports a wide variety of applications, including:

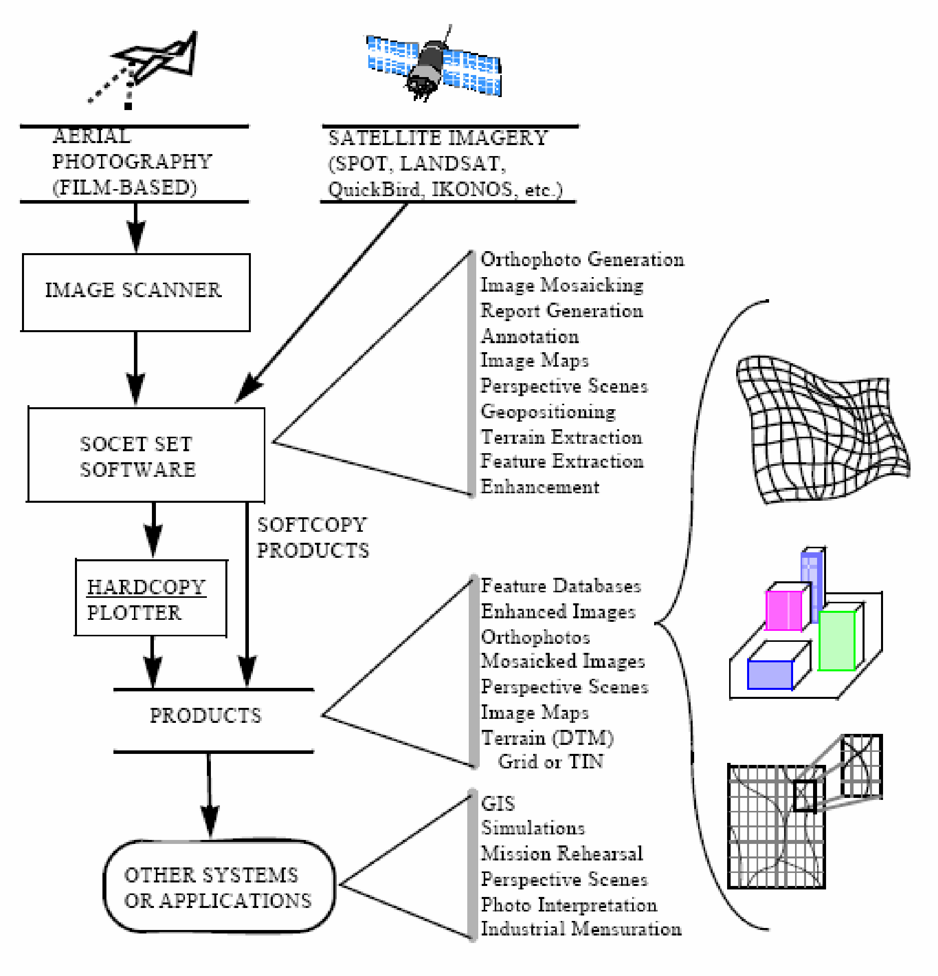
- Populating a GIS database (vector or raster)
- Producing image maps
- Civil engineering
- Mission planning
- Targeting
- Mission rehearsal
- Sensor research and development

The SOCET SET software consists of over sixty application functions that can be chained together to form a processing flow that inputs imagery, performs the requisite analysis, and produces the final hardcopy or softcopy products. This User's Manual describes the application functions in detail, including the following:

- Data import capabilities for imagery, feature, and terrain data
- Automatic extraction of Digital Terrain Model (DTM) elevation data
- Interactive graphical editing of DTM data
- Interactive two and three-dimensional feature data extraction
- Orthophoto generation
- Perspective scene generation
- Point positioning, three-dimensional mensuration, and targeting
- Image mosaicking
- Image enhancement
- Data export functions for softcopy databases (imagery, feature, and terrain data), and hardcopy products (image maps)

## 2. Typical Product System Flow

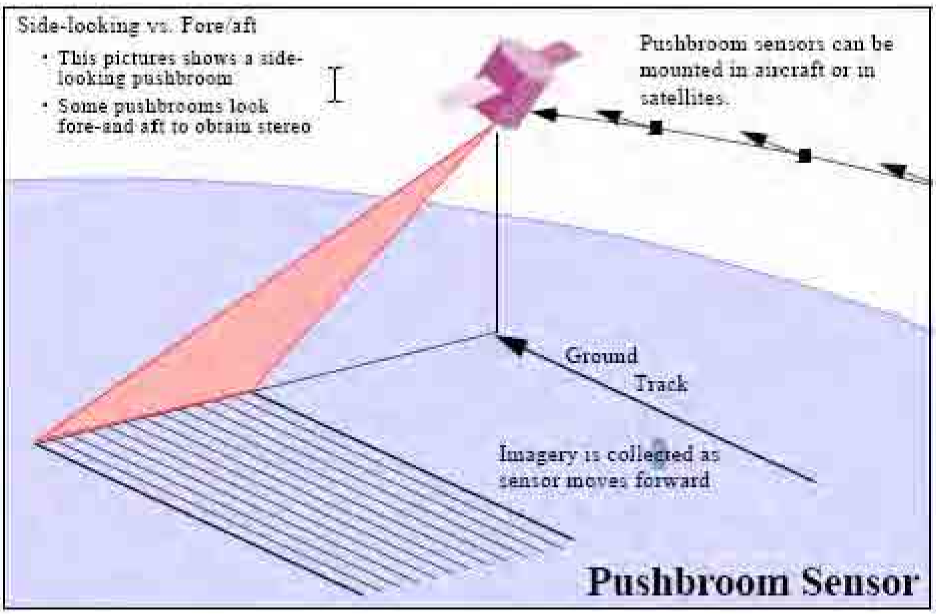
Imagery is input to SOCET SET from either a digital softcopy source, such as SPOT or Landsat, or by scanning film-based imagery. The workstation products are in either softcopy format (such as DTMs, vector databases, orthophotos, etc.) or hardcopy format (such as image maps or photorealistic perspective scenes).



### 3. Using Satellite Imagery

**Overview of SPOT, JERS, and IRS**

**SPOT, JERS, and IRS Imports read imagery and geo-referencing information from CD-ROM, magnetic tape, and disk media into SOCET SET. SPOT imagery is available from SPOT Image Corporation and other distributors. JERS imagery is distributed by NASDA. IRS imagery is available from various distributors.**




**When to Use SPOT Image Import**

You use SPOT Import when you have SPOT data and you want to exploit the image in the data set. You run SPOT Import after creating a project to hold the imagery. After importing a SPOT image, you can the proceed with Triangulation and then data extraction. SPOT Import works in projects with the Geographic, UTM, or Grid coordinate systems, but not the LSR coordinate system.

**Formats Supported**

SPOT imagery is supplied in a variety of formats and processing levels. The various formats are described below.

Categorized by spectral type, SPOT comes in several types:

- Multispectral without short-wave infrared (SWIR) (known as MLA or Xs) (3 bands)
- Multispectral with SWIR (known as Xi or I) (4 bands)
- Panchromatic (known as PLA, PAN, P, or M)

SOCET SET imports all the above types of SPOT imagery.

SPOT multispectral imagery comes in two formats: Band Interleaved (***BIL***) or Band Sequential
(BSQ). SPOT panchromatic imagery always comes in BSQ format. SOCET SET imports both

BIL and BSQ formats.
Your SPOT imagery may have been preprocessed by your supplier to assist with control or geopositioning.

There are four processing levels available from SPOT:

- 1A – Raw. This is unrectified data and the pixels may have non-uniform GSD.
- 1B – Rectified. The imagery has been resampled and geo-coded to a uniform GSD.
- 2 – Controlled. Controlled support data is provided that is based on GCPs.
- S – Stereo. A relative orientation has been performed on this SPOT stereo pair.

SOCET SET accepts processing levels 1A and 1B only. Processing level 1B is the most common type of SPOT imagery.

SPOT Image has introduced the DIMAP format. They are distributing all SPOT 5 data in this format and will be transitioning data from previous satellites to DIMAP. If you have a DIMAP data set, you must import it with SPOT DIMAP Import. SOCET SET supports the same SPOT DIMAP products as with previous formats, that is, SPOT full-scene 1A and 1B in both panchromatic and multispectral.

Finally, the SPOT tape format varies between SPOT distributors. SOCET SET accepts imagery in the standard format of the SPOT Image Corporation and in the standard format of the Canada Centre for Remote Sensing (CCRS) and Australian Centre for Remote Sensing (ACRES). The image formats processed by SOCET SET are taken from The SPOT Scene Standard Digital Product Format (S4-ST-73-01-SI), SPOT Image Corporation, 1995, and *Standard SPOT MLA/ PLA CCT Format* (DMD-TM85-428A), Canada Centre for Remote Sensing, 1985. SOCET SET supports the “CAP” data format.

Some CCRS SPOT data sets have a defect which causes the image to be shifted to the east or west. You can set a special environment variable when starting SOCET SET to fix the problem. There are two ways to set the variable. One is to add -setenv_no_arg CCRS_ROLL_INVERT to the file <install_path>/.socet_xxx, where “xxx” is the name of the machine you are working on. This method will always perform the correction for all CCRS SPOT imports until you edit the .socet_xxx file and take the instruction out. The other way is to start the SPOT Import task manually by typing:

```
% <install_path>/bin/start_socet -setenv_no_arg
CCRS_ROLL_INVERT -single spot 1 xxx.prj
```

where “xxx” is the name of your project. This method only performs the correction for that
particular import session.

Some SPOT images in the CCRS (Canadian) format contain an error in the sensor attitude data on the tape header, which make it impossible to control the image with SOCET SET. If you find this to be true, ask your tape supplier for a replacement tape. This is not a problem with SPOT tapes produced by the SPOT Image Corporation.

**Using SPOT images**

When creating a project which will include SPOT images, the geodetic datum must be based on an earth-centered ellipsoid such as WGS 84. The reason for this is that the SPOT satellite ephemeris and attitude data are based on an earth-centered system. Before importing your data, make sure your project has an origin near the center of your SPOT or JERS data set. It should be in the same hemisphere for Geographic projects, or the same UTM zone for UTM projects.

Interior Orientation is not required with SPOT images, since the sensor is a digital camera, resulting in a known, fixed relationship between each image pixel and the sensor lens.

SOCET SET can accommodate images from different sensors simultaneously. From the user's point of view, there is little difference between triangulating a block of frame images, SPOT images, or a mixture of both. When triangulating SPOT images, there are thirteen parameters which can be adjusted: the focal length, the 6 parameters of position and attitude, and the 6 first degree components of position and attitude with respect to time. Apriori estimates for these are obtained from the SPOT header data.

The recommended number of ground control points is 4–6 per model (or per multiple image strip if all images are from a single orbital pass.) Pointing accuracies range from 6–20 meters. If there are no ground control points available, the expected absolute distance error is approximately 500 meters. A single control point can correct for model offsets due primarily to timekeeping errors.

Two control points can correct for offset and azimuth errors.

**Outputs**

Outputs consist of an ASCII support file and a binary image file which is tiled with a header in a tiled format. The support file is created in the data directory used by the current project file. The display of support data is provided by the window popped-up from the main SPOT menu.

**Importing From CD-ROM**

SPOT Import recognizes the data format for SPOT Scene and CCRS CD-ROM products. On Unix, the CD-ROM must be mounted on the directory "/cdrom." If this is not the case, ask your system administrator to mount it there. The root directory of the CD ROM must have subdirectories called "scene01," "scene02," etc. for each scene on the disk. If you have difficulty importing, you can also try identifying the files with the Importing From Disk interface.

**Importing From Disk**

SOCET SET can use disk files for the SPOT data. There can be one single large file containing the Volume Directory File, Leader File, Imagery File, Trailer File, and Null Volume Directory File or these files can be kept separate. If the files have the SPOT Scene naming convention, e.g. vold_01.dat, lead_01.dat, imag_01.dat, trai_01.dat, null_01.dat, then you can click on just one of them and the rest will be filled in automatically. The disk file selection box also allows you to select more than one file. You can use this feature if you are having difficulty in importing a set of files and would like to try a different file ordering. The files are read in the order that you click on them. You can specify multiple files by clicking on them while holding the Control Key.

**Transferring Data From Tape to Disk**

You might want to transfer your data from a tape to disk so that it can be subsequently imported from disk on a different workstation. The steps to do this are as follows:

1. Mount the 9-track ***CCT*** on a tape drive. In this example the device name of the tape drive will be /dev/rmt/7n.
2. Use the <install_path>/bin/tape_struct executable to determine the files and record size.

% <install_path>/bin/tape_struct /dev/rmt/7n

As a result of this command the messages should reflect the file number and block size of the records in each file.

3. Edit the <install_path>/bin/copy_spot_to_disk script to reflect the input record block size. This script file should reflect the following commands which must be correct in order to copy records verbatim to disk files

```
dd ibs=360 if=/dev/rmt/7n of=vold_01.dat

dd ibs=3960 if=/dev/rmt/7n of=lead_01.dat

dd ibs=8640 if=/dev/rmt/7n of=imag_01.dat

dd ibs=1080 if=/dev/rmt/7n of=trai_01.dat

dd ibs=360 if=/dev/rmt/7n of=null_01.dat

mt -f /dev/rmt/7n rewind
```

Some older SPOT images were on two tapes at 1600 bpi for a single image. If there is a second tape involved, then repeat these first three steps for the second tape as well using _02.dat in place of _01.dat for the output files.

Strip off the first 8640 bytes from part 2 of the image which is imag_02.dat using the following command:

```
dd if=imag_02.dat of=strip_02.dat bs=8640 skip=1
```

Second, you then concatenate the following input files into one output file:

```
cat vold_01.dat lead_01.dat imag_01.dat strip_02.da
trai_01.dat null_01.dat > scene1
```

4. Now proceed to import the disk image file, as described under importing from disk.

## 3.1 Orthomosaicking

### 3.1.1 Preparation

3.1.1.1 Create new Datum (e.g. PRS92) and Grids (e.g. PTM and UTM)

To add a new datum or grid, the ASCII files in this directory (C:\SOCET_SET_5.3.0\Internal_dbs\GEODETIC) must be edited before running Create Project.

```
SUMMARY OF FILES OF GEODETIC.DAT AND GRID_PARAMETERS
----------------
geodetic.dat     - Contains numerical definitions of all
datums, including names.
                 - *****   N O T E : *****
```

```
                 Do not change any of the datum names
                 contained in this file!!!
                   ***********************
grid_parameters - Defines grid coordinate systems (state
plane, etc.)
geoid84.dat     - Defines mean sea level geoid; Binary
(non-ASCII) file
ellipsoid.dat   - Defines reference ellipsoids
geodetic.doc    - For reference only; not used by SOCET SET
software



DATUMS
------

To create a new datum, you must add the appropriate
information to file geodetic.dat

 -  *****  N O T E : *****
    Restrict new datum names (including the ID NUMBER)
    to 80 characters or less.
    *********************

The values for each datum in the geodetic.dat file are
arranged in pairs of lines.  The values for each column are
as follows.


Line 1:   Num D_name
          --- ------

Line 2:   E_code A F dA dF*10^4 dX eX dY eY dZ eZ G_code s
rX rY rZ use_approx
          ------ - - -- ------- -- -- -- -- -- -- ------ -
-- -- -- ----------

The last 5 values (s, rX, rY, rZ, use_approx) are optional.

Num = serial number of the entry within the file.
D_name = name of the datum (sometimes abbreviated,
         should be 80 characters or less).
E_code = 2 character code for the reference ellipsoid
corresponding to this datum
A = equatorial radius (semi-major axis) in meters.
F = flattening (defined below).
dA = difference between this datum's radius and
WGS84_radius            (reference only)
dF*10^4 = difference between this datum's flattening and
WGS84_flattening multiplied by 10,000 (reference only).
dX, dY, dZ = offset of this datum's ellipsoid with respect
to the centroid of the earth (WGS84), expressed in meters.
eX, eY, eZ = error estimates for the datum offsets (+ or -,
             expressed in meters).
```

```
G_code = EPSG Geographic CS Type Codes, Based on EPSG Datum.
         Numbers 4200-4999: valid codes
         Number 0: undefined
         For details, see the website:

http://www.remotesensing.org/geotiff/spec/geotiff6.html#6.3
.2.1
s = scale for 7 parameter transform.
rX, rY, rZ = Rotations for 7 parameter transform.
use_approx = if 0 use rigorous 7 parameter transform
             if 1 use approximate 7 parameter transform
```

NOTE: Use meters to specify earth radius and XYZ offsets. DO NOT USE FEET. If you are working in a feet-based project, the conversions will be performed automatically for you by SOCET SET. Use radians to specify rotation.

The file 'geodetic.doc' is provided for reference and is not used by the workstation. However, you should add an entry to the geodetic.doc file,for reference purposes.

GRIDS
-----
The file "grid_parameters" defines the various grids the operator may choose from when running the Project Creation function in SOCET SET.
This file is used by the Project Creation process to create a menu for the operator to select a grid. A grid must be added
to this file BEFORE running the project creation process if you want to use the grid. The format of the file is defined in comments in the file itself.

A grid is a localized coordinate system based on a map projection that is well suited to the local region. Every state has one or more grids defined, called 'State Plane' coordinate systems.

EARTH SHAPE
-----------
The oblateness of the earth may be expressed three different ways:

```
  flattening          = (a-b)/a;
  eccentricity        = sqrt (  (a**2  - b**2)  / a**2  );
  eccentricity_squared = (a**2  - b**2)  / a**2;

Where a = equatorial radius, and
      b = polar radius.
```

To compute ecc_squared from flattening, use this formula:

```
ecc_squared = f * (2 - f);
```

FEET VS. METERS
---------------

All distances in these files are measured in METERS. Distance values include:

- the earth radius
- XYZ offset of the datum
- XYZ offset error estimates of the datum
- false easting and northing

Do not use FEET units in these files!! If the coordinate system you are using is feet-based (as are many State Plane systems) don't worry: enter the data (false easting and northing) in these files in METERS, then select "Units = FEET" during the project creation process. Thereafter, all your input and output will be in FEET units. For more information, see the Project Management chapter of the DPW SOCET SET User's Manual.

**Sample file of geodetic.dat**

```
VERSION 1.0
################################################################################
########
#
# DO NOT CHANGE THE FIRST LINE (the 'VERSION' line)
#
# This file contains the parameters for specifying datums.
# Parameters for the standard datums are taken from
# NIMA document "Department of Defense World Geodetic System 1984,
# Its Definition and Relationships with Local Geodetic Systems",
# TR8350.2, Third Edition, Amendment 1 (3 January 2000),
# Appendices A.1, B.1-B.10 and C.1-C.2.
#
# NOTE:  This file replaces old versions of both datum.dat
#        and geodetic.dat.
#
# You can add lines to this file, to specify other datums, if you
# wish.  If you do, be sure to follow the existing format.  The
# values for each datum in this file are arranged in pairs of lines.
# See internal_dbs/GEODETIC/README for the format.
#
################################################################################
########
  1  WGS_72
    WD  6378135.00000  0.0033527795        2.000   0.00031000     0.0   1.0     0.0   1.0
0.0   1.0  4322
  2  WGS_84
    WE  6378137.00000  0.00335281066475    0.000   0.00000000     0.0   1.0     0.0
1.0     0.0   1.0  4326
  3  [ADI-M]_ADINDAN(Mean_Solution)
    CD  6378249.14500  0.0034075614     -112.145  -0.54750714  -166.0   5.0   -15.0
5.0   204.0   3.0  4201
  4. PHILIPPINE_(PPCS)
    CC  6378206.40000  0.00339007530393   -69.400  -0.37264639  -127.6220 0.0  -
67.2448 0.0
   E code        A                              F                        dA           dF*10^4
dX        eX         dY        eY
  -47.0431 0.0     0  0.99999893998  0.000014872241633  -0.000023769979580  -
      dZ        eZ  G_code       s                       rX                             rY
0.000007649875327  1
          rZ             use_approx
```

**Sample file of ellipsoid.dat**

```
VERSION 1.0
################################################################
#
#
#
# DO NOT CHANGE THE FIRST LINE (the 'VERSION' line)
#
#
#
#  This file contains reference ellipsoid names and their
#  associated constants.  Refer to NIMA document TR8350.2,
#  Third Edition, Amendment 1, 3 January 2000,
#  "Department of Defense World Geodetic System 1984",
#  Appendix A.1
#
#  You can add entries to this file if you desire.
#  When doing so, please use the following guidelines.
#
#  1.  Use underscores (_) instead of spaces in all
#      ellipsoid names.
#  2.  Make sure that you specify a unique 2-character
#      ID code for the new ellipsoid.  This will be
#      the same code that you will use in file
#      geodetic.dat for any datums that will use the
#      new ellipsoid.
#  3.  If you want to specify subclasses of ellipsoids
#      (similar to the Bessel 1841 and Everest
#      ellipsoids), the first character of the
#      subclass line must be a space.
#  4.  Equatorial radius, flattening and eccentricity
#      squared values are included in this file for
#      reference, but are not used by the software.
#      It is not critical that these values be
#      accurate in this file.
#
################################################################
#
#
# Ellipsoid Name                       ID Code   Equat. Rad(a)  Flattening(f)
Ecc_squared
# --------------                       -------   -------------    -------------    -----------
#
Airy_1830                                  AA      6377563.396    0.003340850641
0.006670539999
Australian_National                          AN      6378160.0      0.0033528918692
0.0066945418545
Bessel_1841
  Ethiopia,_Indonesia,_Japan_and_Korea       BR      6377397.155    0.003342773182
0.006674372231
```

| | | | |
|---|---|---|---|
| Namibia | BN | 6377483.865 | 0.003342773182 |
| 0.006674372231 | | | |
| Clarke_1866 | CC | 6378206.4 | 0.00339007530393 |
| 0.00676865799729 | | | |
| WGS_1972 | WD | 6378135.0 | 0.0033527795 |
| 0.0066943179 | | | |
| WGS_1984 | WE | 6378137.0 | 0.00335281066475 |
| 0.00669437999014 | | | |

**Sample file of grid_parameters**

```
################################################################################
###
#
#
#
# DO NOT CHANGE THE FIRST LINE (the 'VERSION' line)
#
#
#  This file is the grid file.  This file defines the various grid coordinate
#  systems that the operator may select when creating a SOCET SET project.
#  This file is used by several SOCET SET applications:
#
#   a) Project Create (selecting a Grid coordinate system)
#   b) Coordinate Measurement - CoordinateTransformation subwindow
#   c) Annotation - Gridlines / Ticks
#   d) Control Point Measurement - data entry coordinate system
#   e) Triangulation - Interactive Point Measurement
#
#  ADDING GRID DEFINITIONS TO THIS FILE
#  ---------------------------------------
#  If you want to create a grid coordinate system and use it in SOCET SET, follow
#  these steps:
#
#    1) Edit this file.  Add your new grid definition into this file.
#       It is usually easiest to copy an existing grid definition and change it
#       rather than typing-it in from scratch.
#       You may add your grid anywhere in this file after the first "VERSION" line.
#       Most users find it most convenient to place their grid as the first coord system.
#
#     2) You can delete other grid definitions out of this file if you want to.
#
#     3) Save this file back into /usr/geoset/internal_dbs/GEODETIC/grid_parameters
#
#     4) Start SOCET SET.  When you run Project Create, you will see your Grid in the
#        the list of grids when you select the Grid option under Coordinate Systems.
#
```

#
#
#
# FORMAT OF GRID DESCRIPTOR
# ------------------------------
# Each grid is described in three sections:
#
# (1) The first line describes the grid name and datum info.
# The grid name follows the keyword GRID_TYPE and may be any string you like:
# it sole purpose is to distinguish between the various grids in this file.
# The values for DATUM_NAME, DATUM, OFFSET and ERROR are those
contained
# in file geodetic.dat for the datum in question.

Grid Name | Name Of Datum | Earth Equatorial Radius | Eccentricity Squared | XYZ offset From earth center | Error estimates of XYZ offset From earth center

GRID_TYPE al_e_27 DATUM_NAME [NAS-C]_NAD_27(CONUS) DATUM 6378206.4 0.00676865799729 OFFSET -8 160 176 ERROR 5 5 6

# The numbers on this line can be in scientific notation (e.g. 6.69E-03) or in normal
# floating point notation (e..g 0.00669).
#
# The XYZ offset is measured from the center of the WGS_84 ellipsoid (Z axis up thru
# North pole; X axis thru Greenwich meridian; Y axis thru +90 degrees longitude).
#
#
# (2) The middle lines describe the projection. The possible projections are:
#
# TRANSVERSE_MERCATOR_PROJECTION
# CASSINI_SOLDNER_PROJECTION
# HOM_PROJECTION (Hotine)
# LAMBERT_CONFORMAL_PROJECTION
# MERCATOR_PROJECTION
# POLAR_STEREOGRAPHIC_PROJECTION
# POLYCONIC_PROJECTION
# STEREOGRAPHIC_PROJECTION
# TRANSVERSE_MERCATOR_PROJECTION
# UTM_PROJECTION

```
#    NEW_ZEALAND
#    SINUSOIDAL_PROJECTION
#
#       Each projection has a 2 to 4 lines of definition.
#       The content varies depending on the projection.  The syntax
#       for each projection is described below in the "sample" grids.
#       For example, for UTM:
#
#                       keyword
#                       defining the
#                       projection
#                          |
#                          V
#         PROJECTION_TYPE UTM_PROJECTION
#         ZONE 1
#
#
#   (3) The last line holds false easting and false northing (in meters).
#       These are positive offsets added to the projection coordinates to force
#       most values to be positive.  Generally, the Positive and Negative
#       false eastings are identical. IMPORTANT: If your grid does not
#       work properly, make the first and second numbers the same and
#       the third and fourth numbers the same, e.g.
#
#        F_NORTH_POS 10000000 F_NORTH_NEG 10000000 F_EAST_POS 500000
F_EAST_NEG 500000
#
#
#  FEET VS. METERS
#  -------------------
#  All distances in this file are measured in METERS.   Distance values include:
#
#      - the earth radius of the datum
#      - XYZ offset of the datum
#      - XYZ offset error estimates of the datum
#      - false easting and northing
#
#  Do not use FEET units in this file!!  If the grid coordinate system you
#  are using is feet-based (as are many State Plane systems) don't worry:
#  enter the data (false easting and northing) in this file in METERS, then
#  select "Units = FEET" during the project creation process.  Thereafter,
#  all your input and output will be in FEET units.  For more information,
#  see the Project Management chapter of the SOCET SET User's Manual.
#
#
#  FALSE EASTINGS AND NORTHINGS
#  --------------------------------
#  XY Coordinate values in a grid coordinate system are often negative (e.g.
#  X values are negative to the West of the origin point).  However, many grids
#  are defined to force the XY values to be always positive.  This is achieved NOT
#  by moving the origin point, but rather by adding artifical offsets to the
#  mathematically correct XY values.  These offets are called "false northing" and
#  "false easting".  These are usually large positive numbers.
```

```
#
#  There are two false values for X: false easting positive and false easting
#  negative.  The former is used when the X value is positive, and the latter
#  when the X value is negative.  The same for Y:  false northing positive and
#  false northing negative.
#
#  The false easting positive and false easting negative should be identical
#  (we are not aware of any coordinate system in which they differ).
#
#  The false northing positive and false northing negative are usually identical,
#  but will be different in some rare cases.  For example, the UTM grids
#  (transverse mercator, with origin at the equator) use different values
#  for false northing positive and false northing negative.
#
#  The false eastings and false northings are always defined in this file in
#  meters, even if you are defining a feet-based grid. If you are using a
#  feet-based grid, you may find the following conversion
#  table useful  (note: these values are based on the
#  International Foot definition; if you are using the U.S. Survey Foot, these
#  values are not valid):
#
#        FEET        METERS (use in the grid definition below)
#       -----------  ---------------------------------------
#         100,000      30,480
#         500,000     152,400
#       1,000,000     304,800
#       2,000,000     609,600
#
#


#  LATITUDE / LONGITUDE
#  ----------------------
#  All latitude and longitude locations are specified in radians, not degrees.
#  Degrees WEST of Greenwich are expressed as NEGATIVE radians.  For example,
#  118 degrees west is represented as  -2.059488517353309  radians.
#  If you have a location in degrees, and you need to convert it to radians, use
#  the degree-to-radian conversion program (activated under the Tools menu on the
#  main SOCET SET menu).
#
#
#  SCALE REDUCTION FACTOR:
#  -----------------------
#  The central scale factor is another way of expressing a scale reduction:
#  e.g. a scale reduction of 1:10,000 corresponds to a scale factor of 0.9999
#  This is used in transverse mercator, hotine oblique mercator, and
#  stereographic projections.
#
#
#  STATE PLANE DATUMS
#  ---------------------
#  The entire Unites States is covered by 122 grids called the State Plane grids.
#  There are two versions of the State Plane grids:  an older set based on the NAD 27
```

```
#  datum and a newer set based on the NAD 83 datum.  This file contains both
#  the old and the new state plane systems.  For example, California Zone 6 is
#  ca_6 (old, NAD-26) and ca_6_83 (new, NAD-83).  For reference, the two datums
#  used for State Plane grids are:
#
#      Datum      Equa.Radius    ecc_squared      XYZ offsets          XYZ Accuracies
#      ---------   ------------   ------------     ---------------------   --------------
#      NAD 27      6378206.4      0.00676865799729     -8.0   160.0   176.0    5   5   6
#      NAD 83      6378137.0      0.00669438002290      0.0     0.0     0.0    2   2   2
#
#
#  COMMENT LINES
#  -------------------
#  All lines in this file beginning with '#' are treated as comments and ignored.
#
#
#  ECCENTRICITY AND FLATNESS
#  ---------------------------
#  The oblateness of the earth may be expressed three different ways:
#
#    flattening           = (a-b)/a;
#    eccentricity         = sqrt (  (a**2  - b**2)  / a**2  );
#    eccentricity_squared = (a**2  - b**2)  / a**2;
#
#  Where a = equatorial radius, and
#        b = polar radius.
#
#  To compute ecc_squared from flattening, use this formula:
#
#     ecc_squared = f * (2 - f);
#
#
#   GEOTIFF
#   -------------
#   Each grid definition may  be followed by an optional GeoTiff ID number line.
#   The format is:
#      GEOTIFF  <id_number>
#   This line is optional, and if it does appear, it must be the final line
#   of the grid definition.   The ID numbers are obtained from the GeoTiff
```

**(a) Coordinate System**

Coordinate system for all control points carried out under the Philippine Plane Coordinate System (PPCS) in 1992.
The characteristics of the PPCS are:

(i) Spheroid Projection
Clarke's Spheroid of 1866

| | |
|---|---|
| Semi-Major Axis | : 6,378,206.4 |
| Semi-Minor Axis | : 6,356,583.8 |
| Flattering | : 1/294.98 |
| X Shift to WGS84 | : -127.6220m |
| Y Shift to WGS84 | : - 67.2448m |
| Z Shift to WGS84 | : - 47.0431m |
| X Rotation to WGS84 | : 3.06762 arc seconds |
| Y Rotation to WGS84 | :-4.90291 arc seconds |
| Z Rotation to WGS84 | :-1.57790 arc seconds |
| Scale Correction to WGS84 | : 1.06002ppm |

(ii) Projection
Transverse Mercator, in zones of two (2) degrees net width

(iii) Point of Origin
Intersection of the Equator and the Central Meridian of each zone, with Northing of 0 meter and Easting of 500,000 meters.

(iv) Scale factor at the Central Meridian : 0.99995

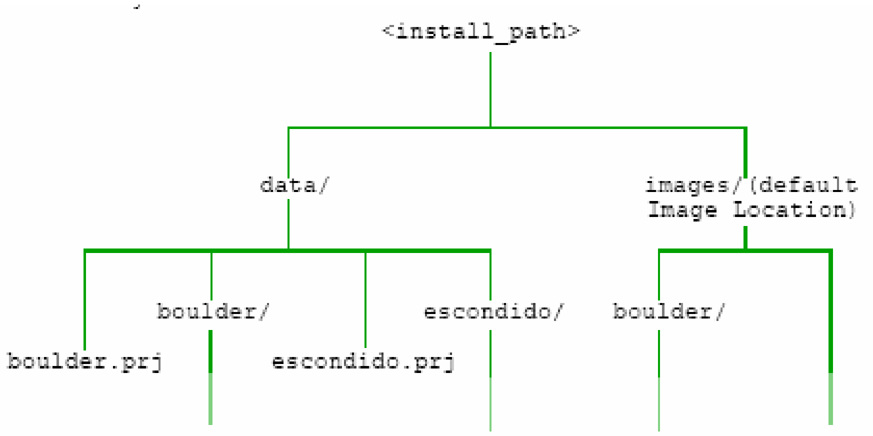
| Zone No | Central Meridian | Extent of Zone |
|---|---|---|
| I | 117° | 116° 00′ to 118° 30′ |
| II | 119° | 117° 30′ to 120° 30′ |
| III | 121° | 119° 30′ to 122° 30′ |
| IV | 123° | 121° 30′ to 124° 30′ |
| V | 125° | 123° 30′ to 127° 00′ |

Zone III was occupied for the project. Two (2) existing GPS stations, namely NVY-1 and ISB-2, which were established by National Mapping and Resources Information Authority (NAMRIA) in 1992, were chosen and applied as the Northing and Easting geographical coordinates datum for the project.

3.1.1.2 Establishing the path/directory where the images are to be located.

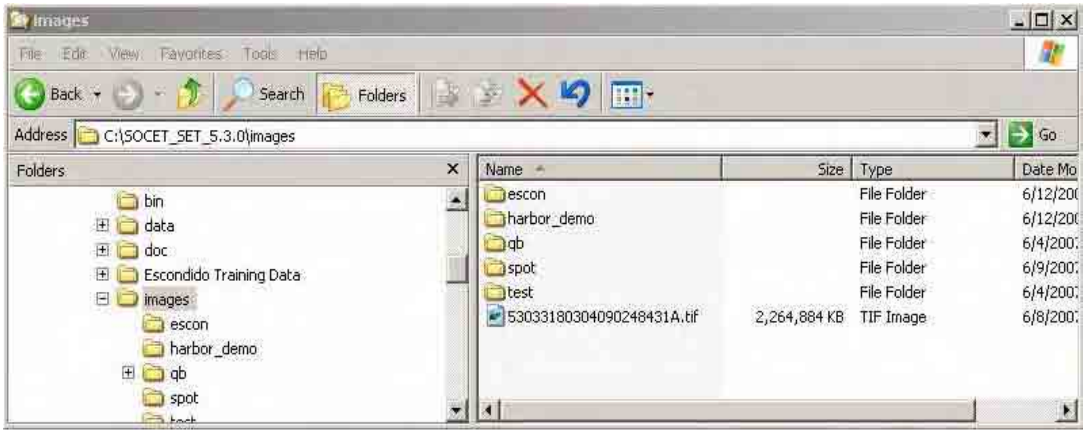
Before you can import or display imagery with the software, you must create a project. You can think of a project as a container holding the data for a set of images you are going to utilize. The data you extract from a set of imagery will be stored in the project directory that contains that set of imagery. When you create a project, you specify the coordinate system and datum to use for the project. You also will specify the disk directories of where the project and imagery data will be stored. Most importantly, you give your project a name. The name of the project file is the name you assigned to the project with the extension.prj when it was created. The software stores the definition of a project in a special project file.

SOCET SET uses the computer file system to store its project data. The following figure depicts the directory tree the software uses to store its data.



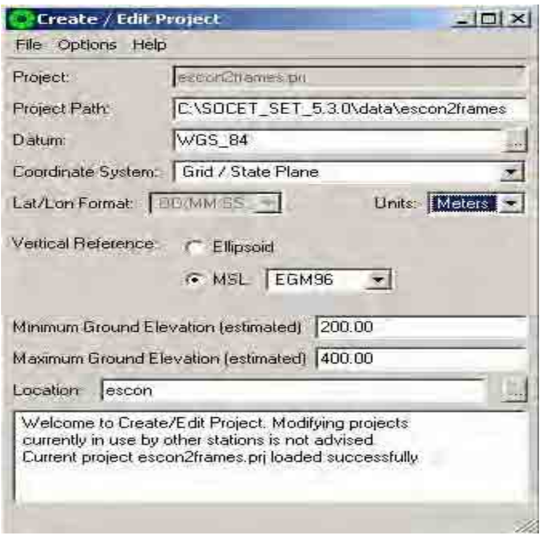

Most software applications require that you first load a project. Once you have loaded a project, you can then operate on the imagery and other data contained therein. You can import images into the project, triangulate the images, perform feature and terrain extraction, and create image products to export. The locations of the image files are defined by entities called Image Locations.

1. .Create the path/directory location of the image file.



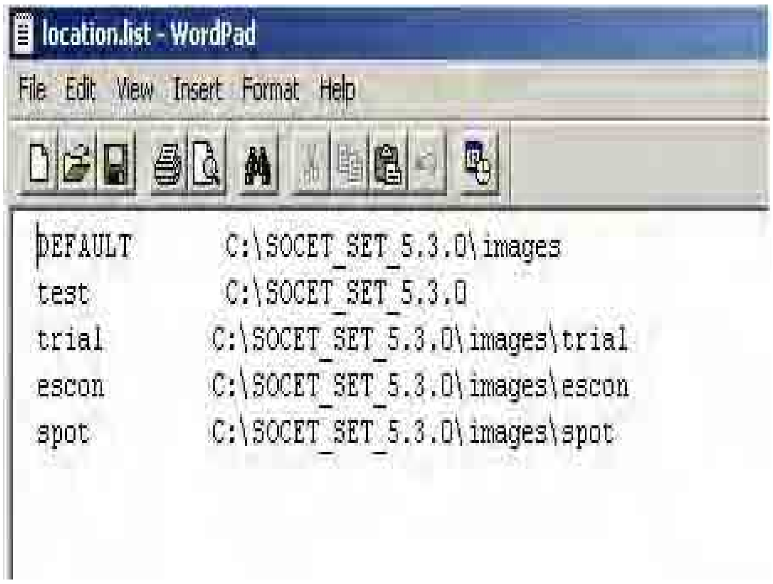

2. Open “SOCET SET 5.3.0” Click ”Project”, select “Create/Edit Project”


3. .A “Create/ Edit Project dialog box will appear. Click the browse button in the “Location “box.



4. A “File Location” dialog box will appear. Click “Edit Locations”  button

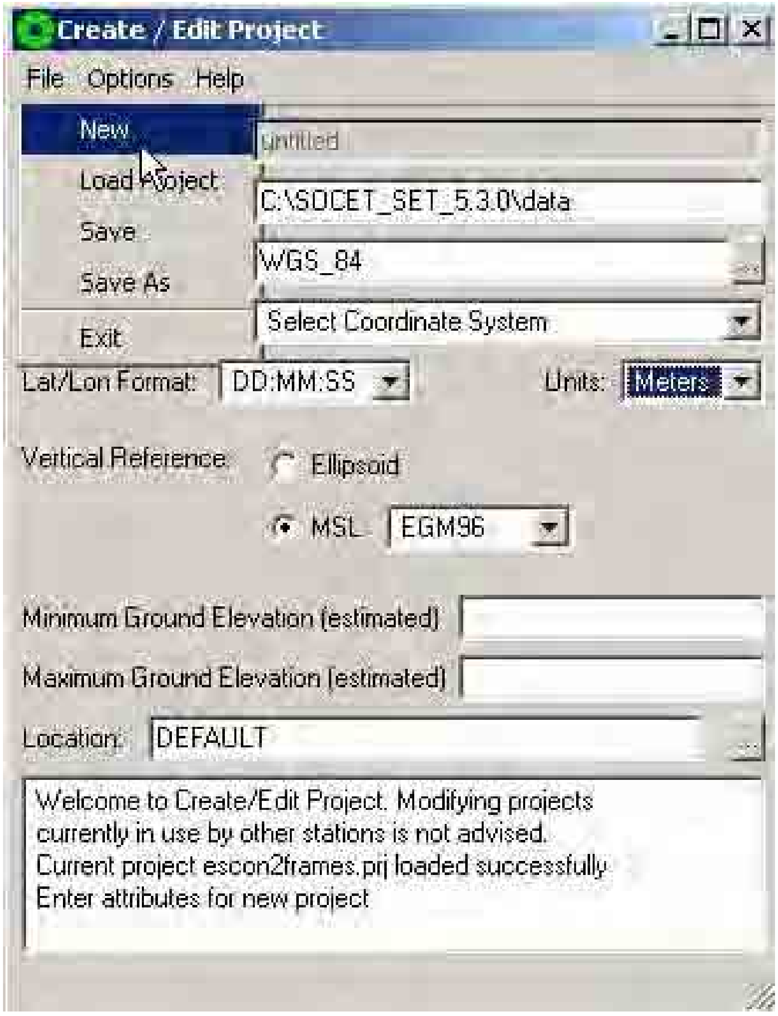

5. .A “location.list-WordPad” dialog box will appear. Type the directory (e.g. C:\SOCET_SET_5.3.0\images\spot). Then click “Save” .



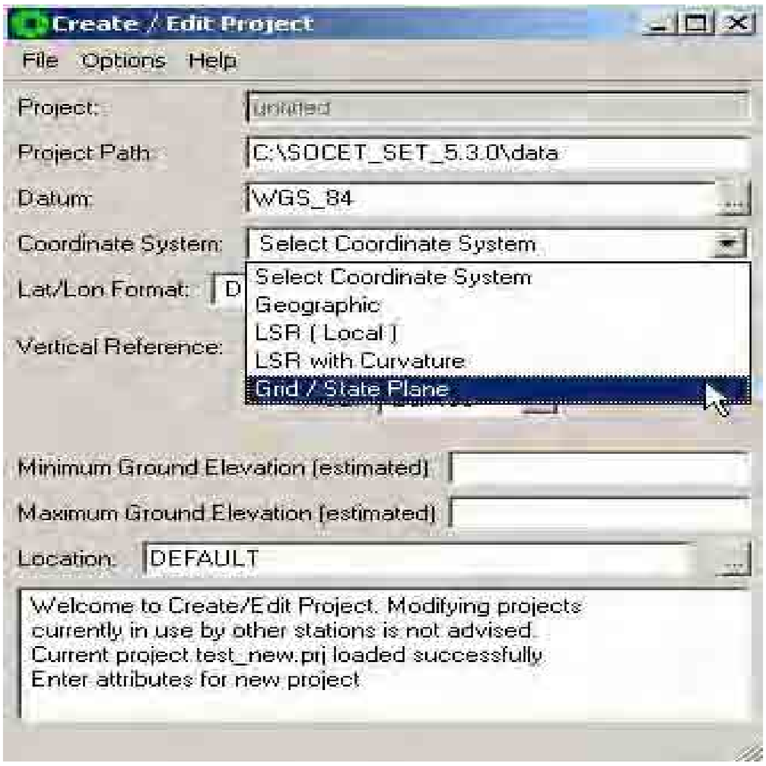
3.1.1.3 Creating Project.

You use Create/Edit Project to create your project. Since most SOCET SET applications require a project to be loaded, you must create a project before you can proceed with importing and extracting data.

1. .Click "File", select "New".



2. .Click the down arrow in the “Coordinate System” box and select “Grid / State Plane”.



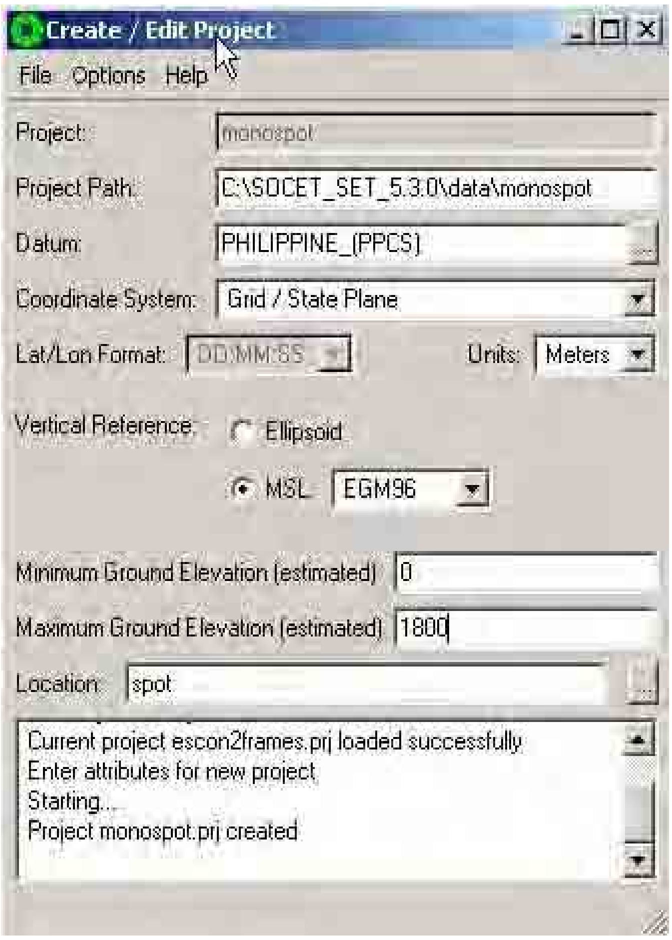

3. .A “Select a Coordinate System” dialog box will appear. Scroll down the arrow and select the desired coordinate system (e.g. Philippine_UTM_51N). Then click “OK”.

4. .Click the browse button in the location box. A “File Location” dialog box will appear. Select the image file location [e.g. spot (211451.2mb)] Then click “OK” .


5. .Type 0 in the “Minimum Ground Elevation (estimated) box and 1800 in the Maximum Ground Elevation (estimated) depending on the highest elevation of the project area. Click “File”, then click “Save”.

6. A “Project Name Selection” dialog box will appear. Type the desired project name (e.g. monospot) in the “Enter Project Name” box. Then click “OK” .


7. .Check the bottom box of the “Create / Edit Project” dialog box, if the project “monospot” was created.



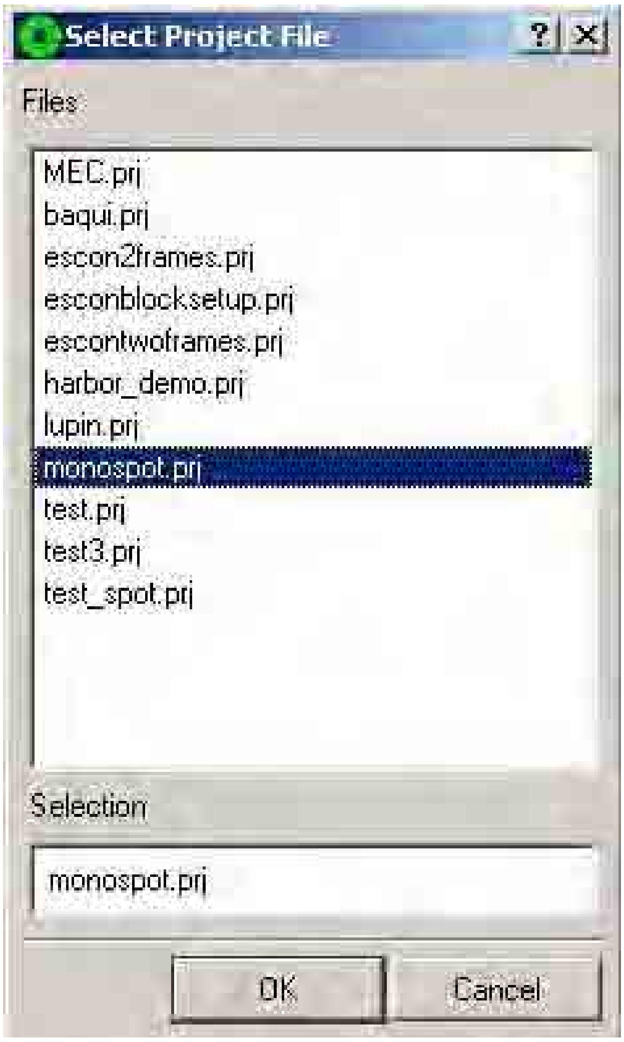
3.1.1.4 Importing the Image (SPOT DIMAP)

If you are importing SPOT data with three bands, you will see a popup menu asking which bands you want to import. If you select “All Bands (color)” the three bands will be merged into a single color (3-band) image file. The name of the support file will be what you entered in the name box. If you select “All Bands (grays)” the three bands will be put out as three separate monochrome images. The name of the support file(s) will be what you entered in the name box concatenated with “_band_n.sup,” where “n” is “1” “2” or “3” for the three bands. If you select “Band n only,” it will behave the same as “All Bands (grays),” except only the single band you select will be imported. For SPOT4, four bands are available.

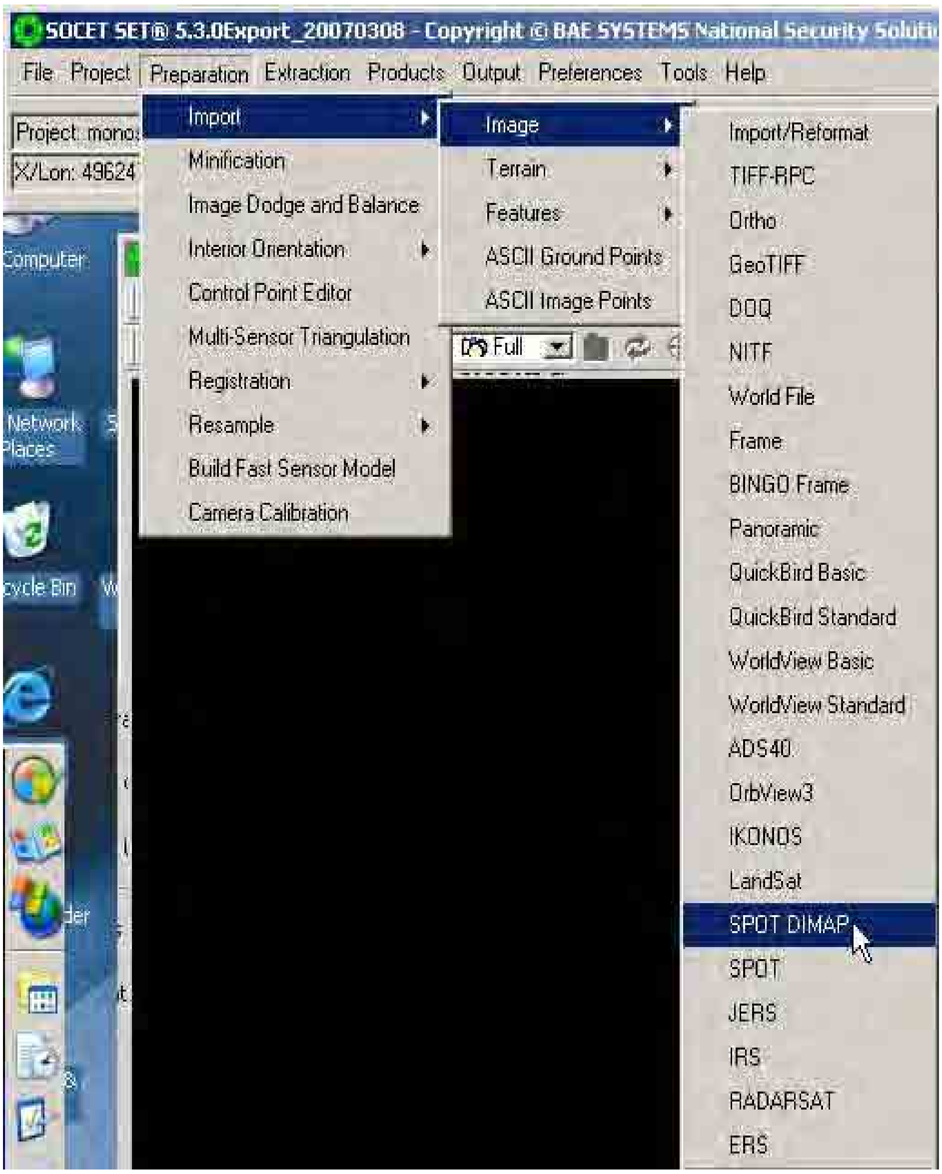
1. Click “File”, select “Load Project”.

2. A “Select Project File” dialog box will appear. Select the project name (e.g. monospot.prj) that was created. Then click “OK” .

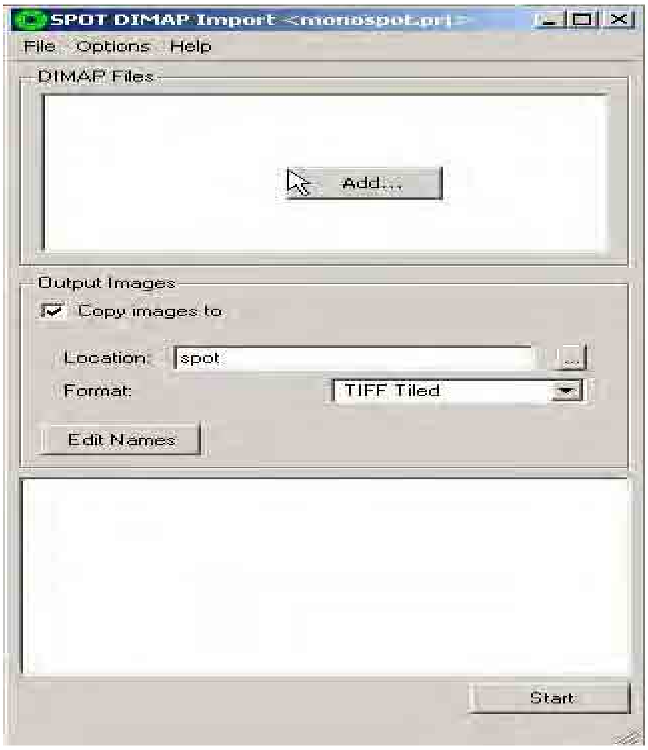




3. Click “Preparation”, select “Import”, select “Image” and then click “SPOT DIMAP”.

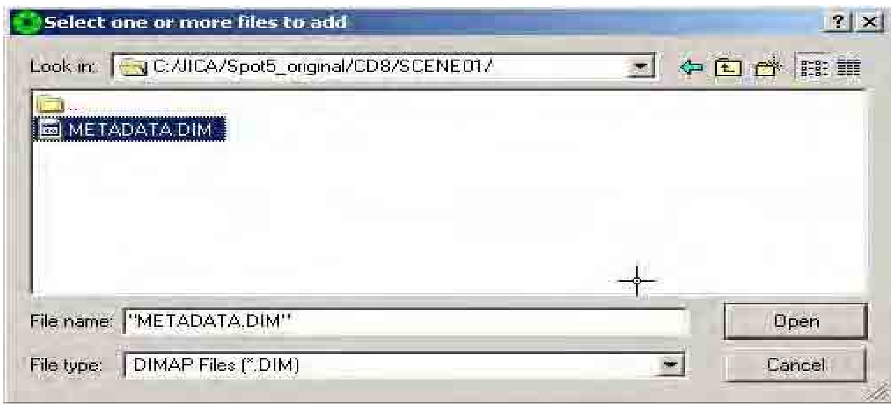


4. A SPOT DIMAP IMPORT<monospot.prj> dialog box will appear. Put mouse arrow inside the ‘”DIMAP files box and click right mouse button. Click the “Add” button.



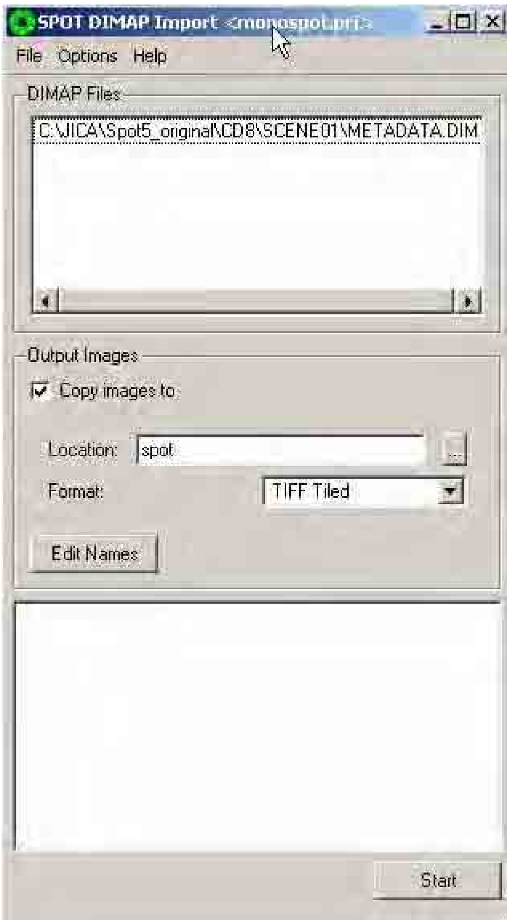

5. A “Select one or more files to add” dialog box will appear. Use the down arrow  in the “Look in” box, browse and locate the image file (e.g. METADATA.DIM) to add. Then click “Open” 

.

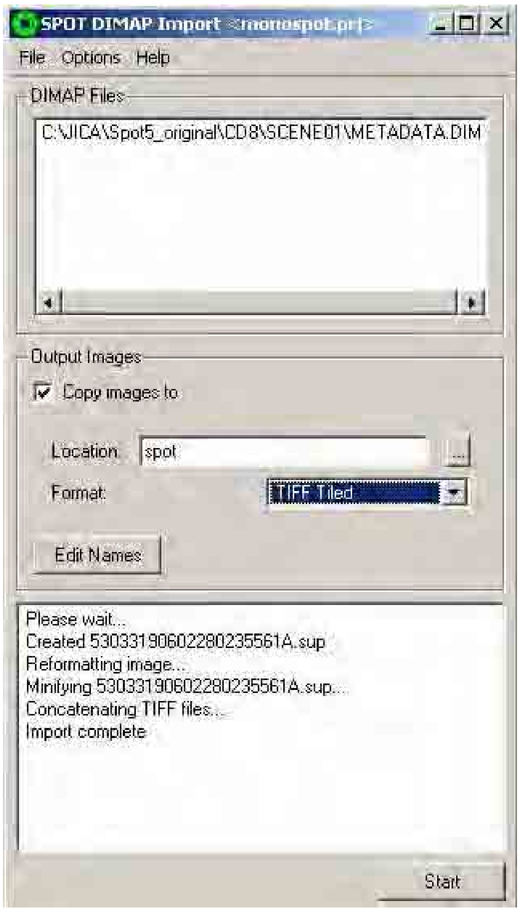


6. The selected image file will be reflected in the "DIMAP Files" box. Set Format to TIFF TILED. Then click "Start" 

.



7. See information at the bottom box and check if import is complete.

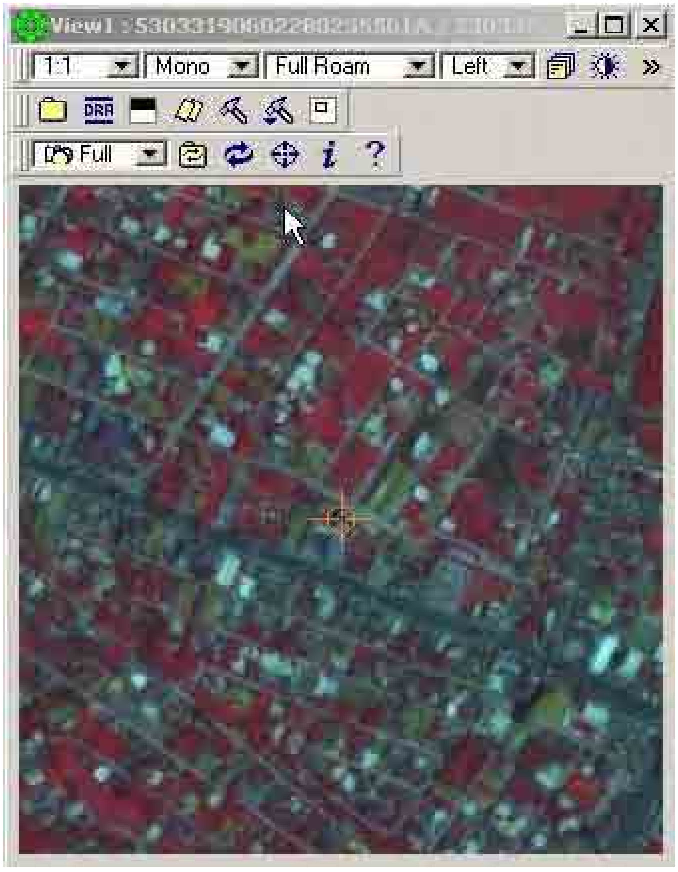



8. After importing the image, click “File”, select “Load Images”.

9. A “Image Loader” dialog box will appear. Click “Create” 

to create a view window. Select the image file name (e.g. 530331906022802355561A) and click “Load”.

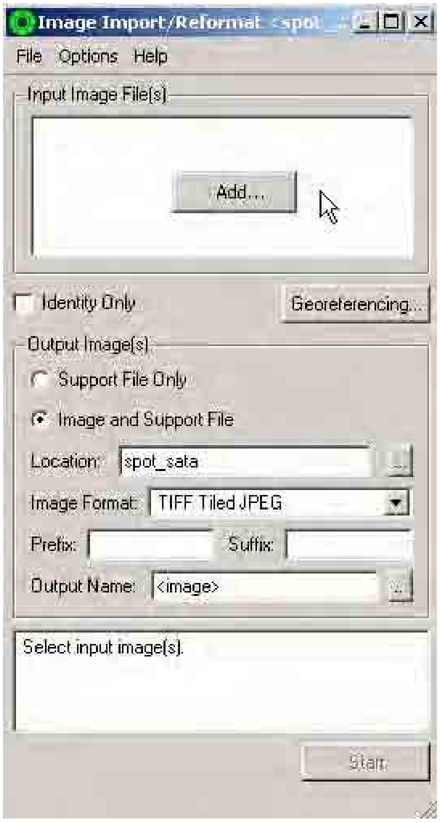

10. A view window will appear displaying the imported image (e.g. SPOT).



3.1.1.5 Importing the Image (Topographic Map)

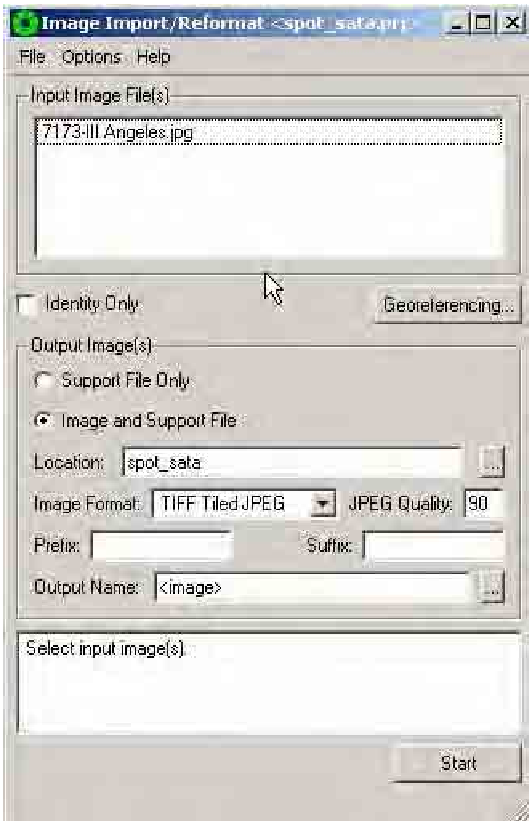
1. Click “Preparation”, select “Import”, select image, and click “World File”.


2. .An “Image Import” dialog box will appear. Put mouse arrow inside the “Input Image Files” box and click right mouse button. Click the “Add” button.

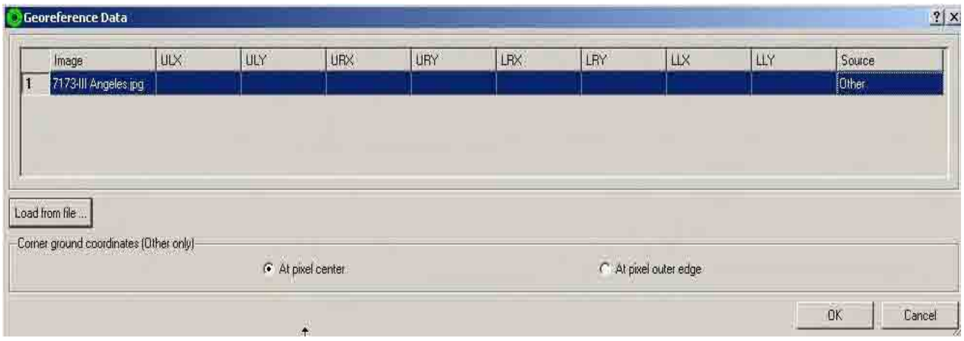


3. .A "Select one or more files to add" dialog box will appear. Use the down arrow in the "Look in" box, browse and locate the image file (e.g. 7173-III Angeles.jpg) to add. Then click "Open" Open .


4. The selected image file will be reflected in the "Input Image Files" box. Click "Georeferencing".

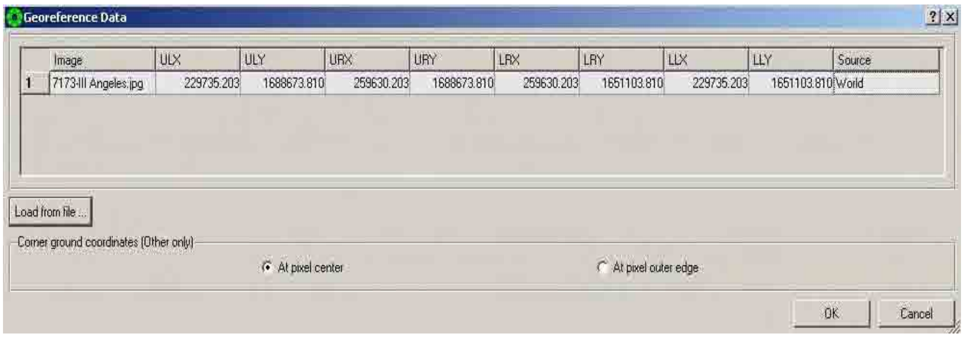


5. A "Georeference Data" dialog box will appear. Select "Other" under "Source" column. Click "Select World File". Click right mouse button.

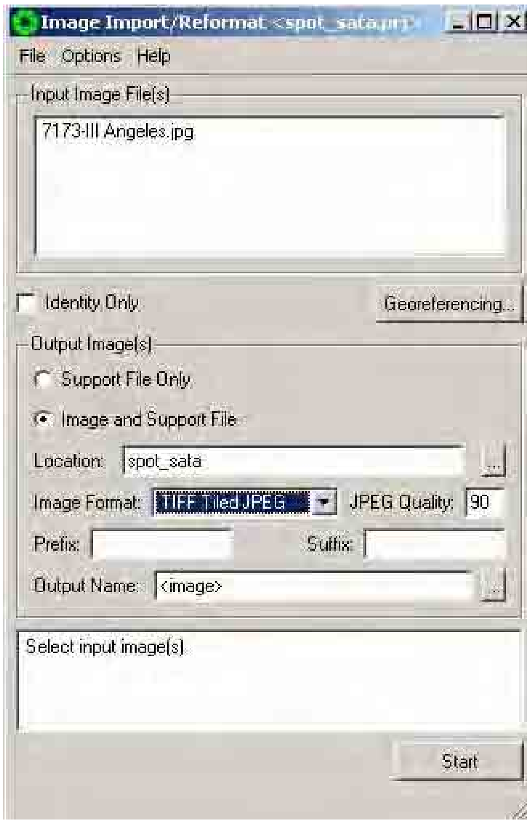



6. A "World File Selector" dialog box will appear. Select the required world file (e.g. 7173-III Angelse.jgw). Then click "Open".

7. The world file parameters will be reflected in the "Georeference Data" dialog box. Then click "OK".

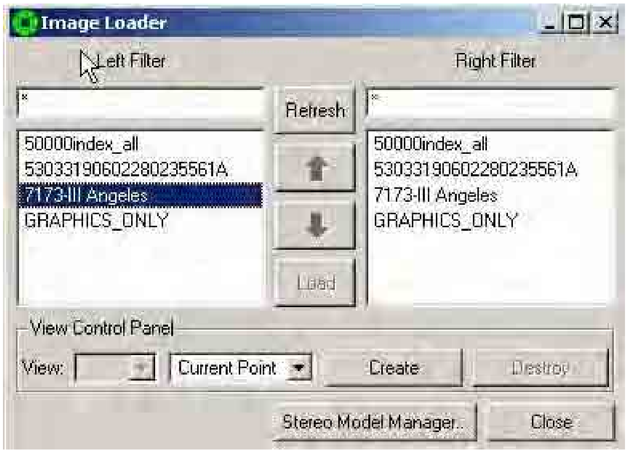



8. Set Image Format to TIFF Tiled JPEG. Then click "Start".



9. After importing the image (e.g.7173-III Angeles.jpg) is done, click "File", select "Load Images".


10. A "Image Loader" dialog box will appear. Click "Create" [Create] to create a view window. Select the image file name (e.g. 7173-III Angeles) and click "Load".



11. A view window will appear displaying the imported image (e.g. 7173-III Angeles).

### 3.1.2 Import Ground Controls and SPOT Images

Ground Point Import reads ground point data in an ASCII format into the internal Ground Point File Format. The input ASCII file is restricted to one ground point per line. Each ground point contains a point ID along with an (X,Y,Z) coordinate. This information can be in any order, butit must all be on one line.Obtaining this window is as simple as clicking ***Preparation* > *Import* >*ASCII Ground Point*** Import on the main workstation.


Ground point control types of horizontal, 3-dimensional, and vertical are used within SOCET SET. Ground points which have a value of 0.0 exactly will cause the control point type setting to change. If your data has a control point of 0.0 0.0 3.2, the point type will be set to vertical (Z only). If your data has a value of 2456.8 23778.9 0.0, the point type will be set to horizontal (X and Y only).

You use ASCII Ground Point Import to translate and import ground point data from an external source into the native SOCET SET ground point file format. The units of the data can be either decimal for UTM, grid, LSR, or Geographic projects (see below), or degrees minutes seconds for any project. Degrees minutes seconds must be entered as “+-DD:MM:SS.SSS”. The presence of two colons is mandatory. When you create a Geographic project, you specify a preference for coordinate display. If you import a file with decimal numbers into a Geographic project whose display preference is “dd.dddd” the numbers will be interpreted as decimal degrees. For all other Geographic projects, decimal numbers will be interpreted as radians.

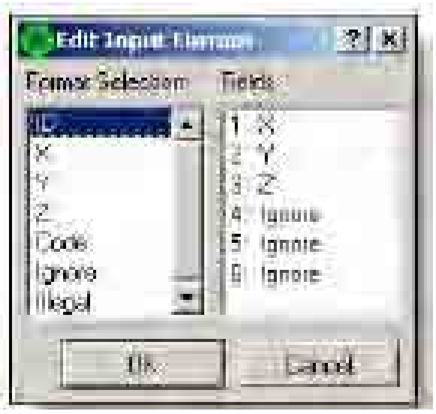
### Edit Input Format Option

This window provides you with a way to specify the order of the information in the input file. Click ***Options*** > ***Edit Input Format*** on the ASCII Ground Point Import window. You can save this ordering in an input format file for later use with other ground point files.

The Fields column on the right of the ASCII Ground Point Import window (above), indicates the current order. To change a field setting, select the desired format from Format Selection on the left. Then click on the appropriate field on the right.

There are seven format settings from which to select: ID, X, Y, Z, Code, Ignore, and Illegal.

- "Code" has no meaning for ASCII Ground Points.
- "Ignore" is used to ignore any information that may be specified in a field.
- "Illegal" indicates that a field should not contain any information. The entire point is discarded should any information be found in a field marked as "Illegal." The following are some examples of legal settings for the input fields.



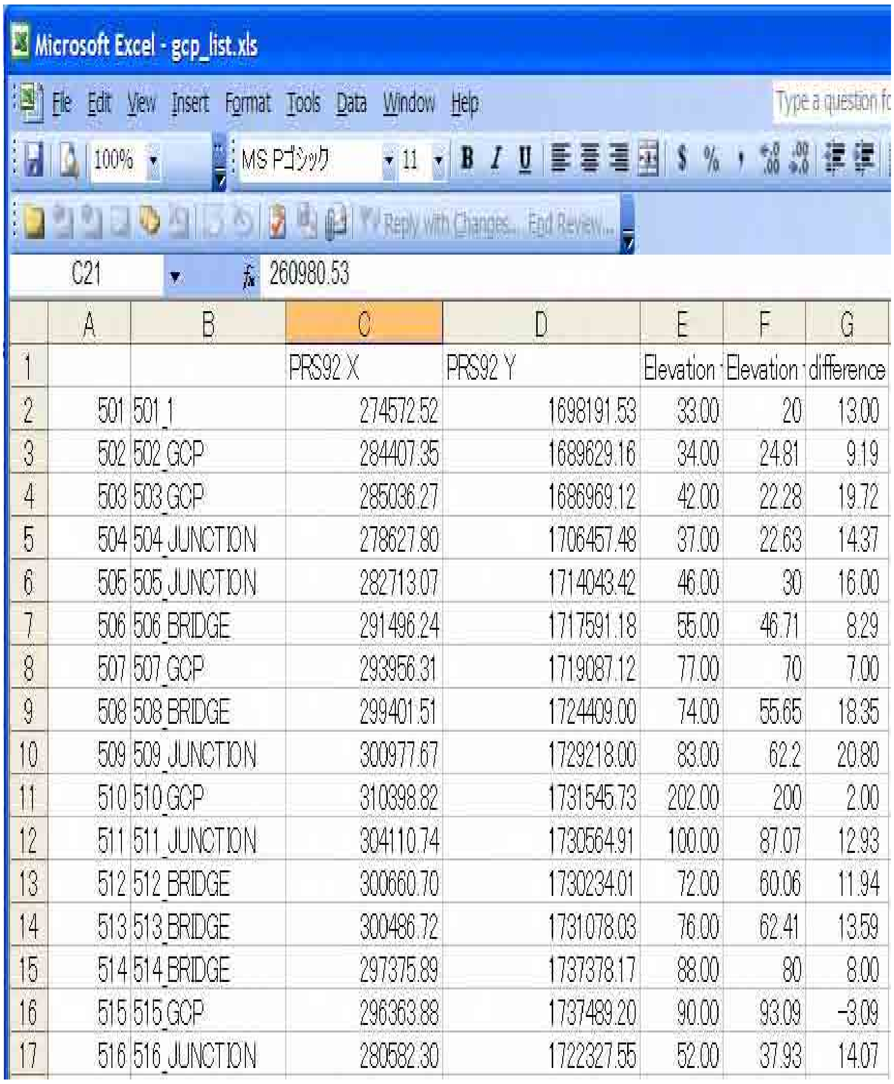

| EXAMPLE 1 | EXAMPLE 2 | EXAMPLE 3 |
|---|---|---|
| 1: ID | 1: Y | 1: Ignore |

| EXAMPLE 1 | EXAMPLE 2 | EXAMPLE 3 |
|---|---|---|
| 2: X<br>3: Y<br>4: Z<br>5: Ignore<br>6: Ignore | 2: X<br>3: Z<br>4: Illegal<br>5: Illegal<br>6: Illegal | 2: X<br>3: Y<br>4: Z<br>5: Code<br>6: Ignore |

3.1.2.1 Edit Ground Control Points file.

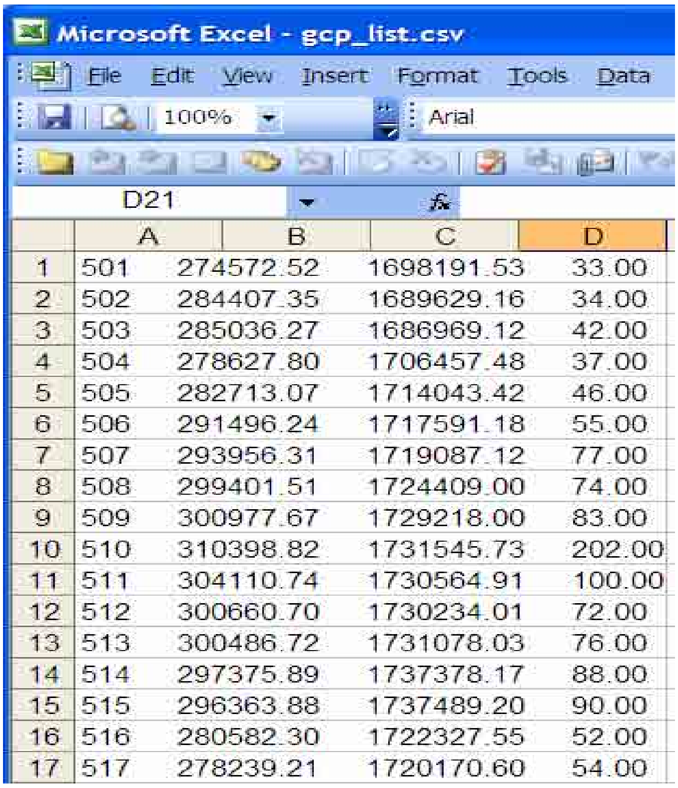
The GPS Ground Control Points file has several Field columns that need to be edited based on the seven Field column format settings (ID, X, Y, Z, Code, Ignore, and Illegal) being used in SOCETSET.

1. Open GPS Ground Control Points （text file) in Excel.




| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | | | PRS92 X | PRS92 Y | Elevation | Elevation | difference |
| 2 | 501 | 501_1 | 274572.52 | 1698191.53 | 33.00 | 20 | 13.00 |
| 3 | 502 | 502_GCP | 284407.35 | 1689629.16 | 34.00 | 24.81 | 9.19 |
| 4 | 503 | 503_GCP | 285036.27 | 1686969.12 | 42.00 | 22.28 | 19.72 |
| 5 | 504 | 504_JUNCTION | 278627.80 | 1706457.48 | 37.00 | 22.63 | 14.37 |
| 6 | 505 | 505_JUNCTION | 282713.07 | 1714043.42 | 46.00 | 30 | 16.00 |
| 7 | 506 | 506_BRIDGE | 291496.24 | 1717591.18 | 55.00 | 46.71 | 8.29 |
| 8 | 507 | 507_GCP | 293956.31 | 1719087.12 | 77.00 | 70 | 7.00 |
| 9 | 508 | 508_BRIDGE | 299401.51 | 1724409.00 | 74.00 | 55.65 | 18.35 |
| 10 | 509 | 509_JUNCTION | 300977.67 | 1729218.00 | 83.00 | 62.2 | 20.80 |
| 11 | 510 | 510_GCP | 310398.82 | 1731545.73 | 202.00 | 200 | 2.00 |
| 12 | 511 | 511_JUNCTION | 304110.74 | 1730564.91 | 100.00 | 87.07 | 12.93 |
| 13 | 512 | 512_BRIDGE | 300660.70 | 1730234.01 | 72.00 | 60.06 | 11.94 |
| 14 | 513 | 513_BRIDGE | 300486.72 | 1731078.03 | 76.00 | 62.41 | 13.59 |
| 15 | 514 | 514_BRIDGE | 297375.89 | 1737378.17 | 88.00 | 80 | 8.00 |
| 16 | 515 | 515_GCP | 296363.88 | 1737489.20 | 90.00 | 93.09 | -3.09 |
| 17 | 516 | 516_JUNCTION | 280582.30 | 1722327.55 | 52.00 | 37.93 | 14.07 |

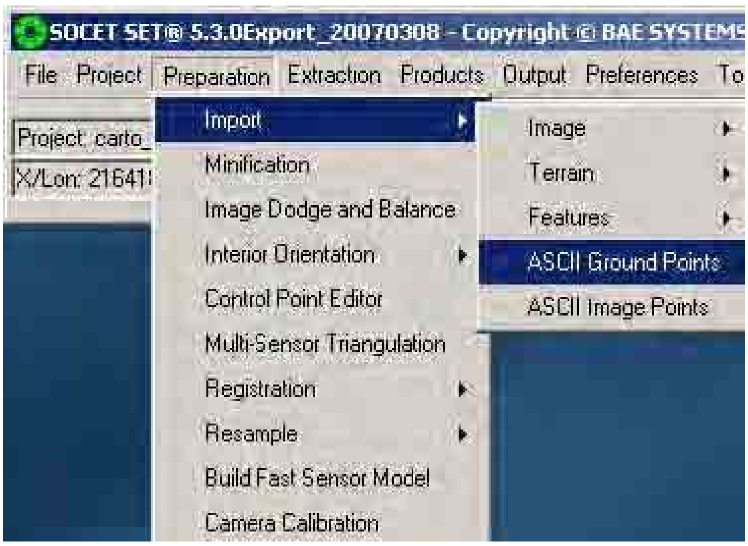
2. Delete unnecessary Field Columns. Then save file to *.csv format.




| | A | B | C | D |
|---|---|---|---|---|
| 1 | 501 | 274572.52 | 1698191.53 | 33.00 |
| 2 | 502 | 284407.35 | 1689629.16 | 34.00 |
| 3 | 503 | 285036.27 | 1686969.12 | 42.00 |
| 4 | 504 | 278627.80 | 1706457.48 | 37.00 |
| 5 | 505 | 282713.07 | 1714043.42 | 46.00 |
| 6 | 506 | 291496.24 | 1717591.18 | 55.00 |
| 7 | 507 | 293956.31 | 1719087.12 | 77.00 |
| 8 | 508 | 299401.51 | 1724409.00 | 74.00 |
| 9 | 509 | 300977.67 | 1729218.00 | 83.00 |
| 10 | 510 | 310398.82 | 1731545.73 | 202.00 |
| 11 | 511 | 304110.74 | 1730564.91 | 100.00 |
| 12 | 512 | 300660.70 | 1730234.01 | 72.00 |
| 13 | 513 | 300486.72 | 1731078.03 | 76.00 |
| 14 | 514 | 297375.89 | 1737378.17 | 88.00 |
| 15 | 515 | 296363.88 | 1737489.20 | 90.00 |
| 16 | 516 | 280582.30 | 1722327.55 | 52.00 |
| 17 | 517 | 278239.21 | 1720170.60 | 54.00 |

3.1.2.2 Import edited Ground Control Points File.

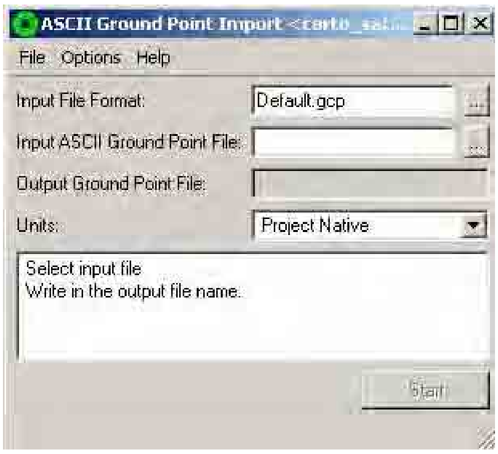
1. Click “Preparation”, select “Import, and click “ASCII Ground Point”.



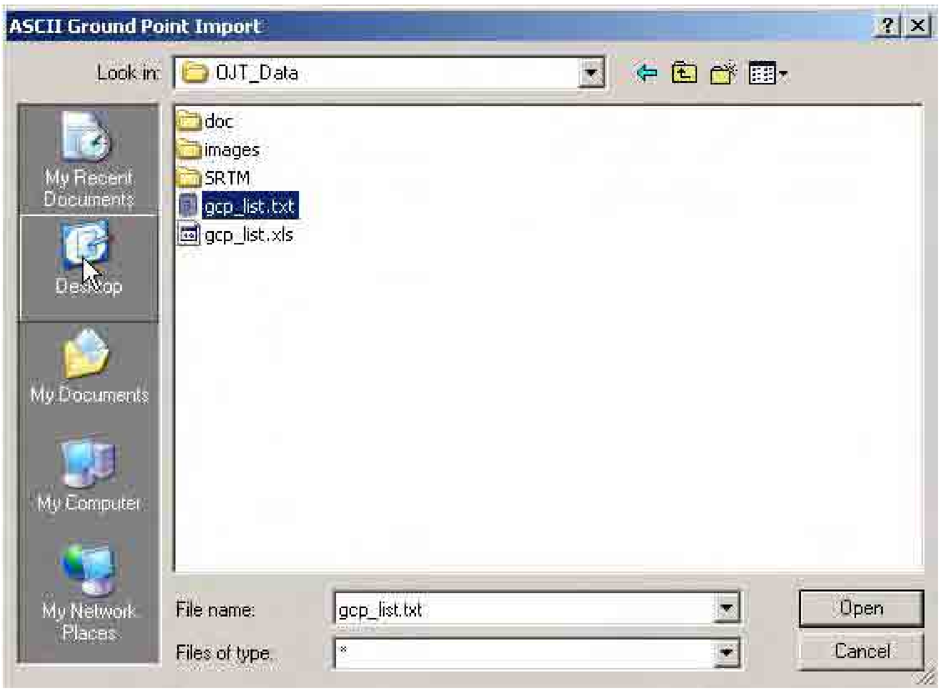
2. An ASCIII Ground Control Point Import dialog box will appear. Click the browse button in the "Input File Format'" box.


3. Another ASCIII Ground Control Point Import dialog box will appear. Select "Default.gcp". Then click "Save".

4. Click the browse button in the "Input ASCII Ground Control Point File" box.

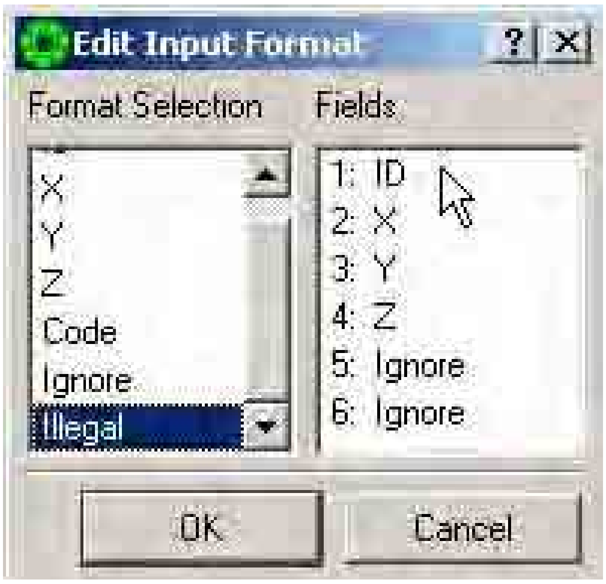



5. An "ASCIII Ground Control Point Import" dialog box will appear. Click the down arrow, browse and locate the directory where the gcp text file is located. Select the file (e.g. "gcp_list.txt"). Then click "Open".



6. Click “Options”, select “Edit Input Format”.


7. An “Edit Input Format” dialog box will appear. Select the settings in the “Format Selection” box the fields (e.g. ID, X, Y, Z) that were used in your gcp text file. Then click “OK”.



8. Type output ground point file name (e.g. gcp_spot) in the "Output Ground Point File" box.


9. Click "Options", select "Set Accuracy".

10. A “Set Accuracy” dialog box will appear. Type “7” in “X Accuracy” box, type “7” in “Y” Accuracy” box, and type “10” in “Z Accuracy” box. The values are the handheld GPS accuracy level in XYZ. Then click “OK”.


11. Click “Start”. Check the bottom box if conversion was successful.

### 3.1.2.3 Using Control Point Editor

Control Point Editor creates a file of control points, which are used by Triangulation. Use the Control Point Editor to create, view, edit, or change a file of control points.

One of the important features of the Control Point Editor is that it lets you input the control point data in one coordinate system, and save the file in a different coordinate system. Selecting an alternative datum changes the display and input values. These are converted to/from the underlying project datum for storage in the .gpf file. This could be used, for example, when you have a pair of well-controlled images in a UTM project, but you want to collect control points for a State Plane project.
The major capabilities of the Control Point Editor are as follows:

- Creates a new ground point file or modifies an existing ground point file.
- Saves the ground control points to the current project or a different project.
- Converts the list of points to any project’s coordinate system and datum.
- Measures (in three-dimensional space) ground points from controlled imagery.
- Drives the extraction cursor to a three-dimensional ground point location for any point in the list.
- Displays and accepts control point data in the current project’s coordinate system or an arbitrary coordinate system and datum.

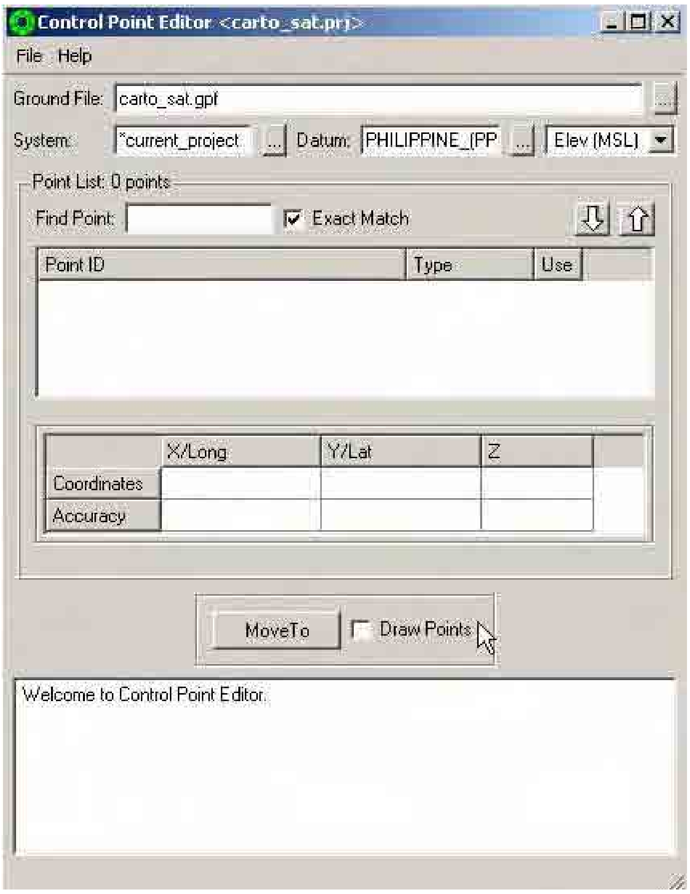
There are four ways to build a file of control points:

- The Control Point Editor,
- The Interactive Point Measurement window of Triangulation,
- Ground Point Import, and
- Coordinate Measurement Log.

If you decide to use Control Point Editor for inputting your control points, you should run it after you create a project, but before running Triangulation. If you are going to use well-controlled imagery (e.g. PPDB) to fabricate control points, you must import the well-controlled images before running Control Point Editor.

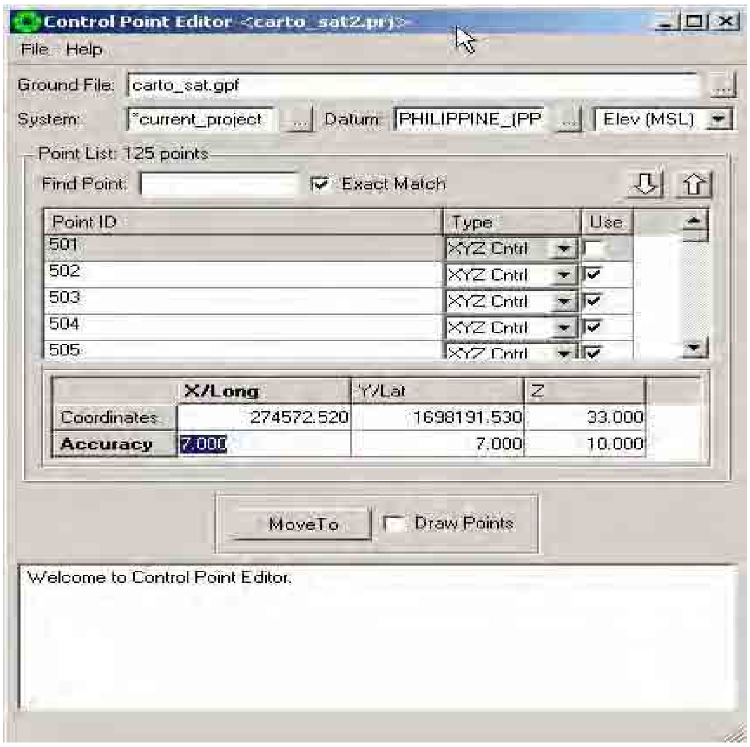
1. Click “Preparation”, select “Control Point Editor”.


2. A “Control Point Editor” dialog box will appear. Click the browse button in the “Ground File” box.

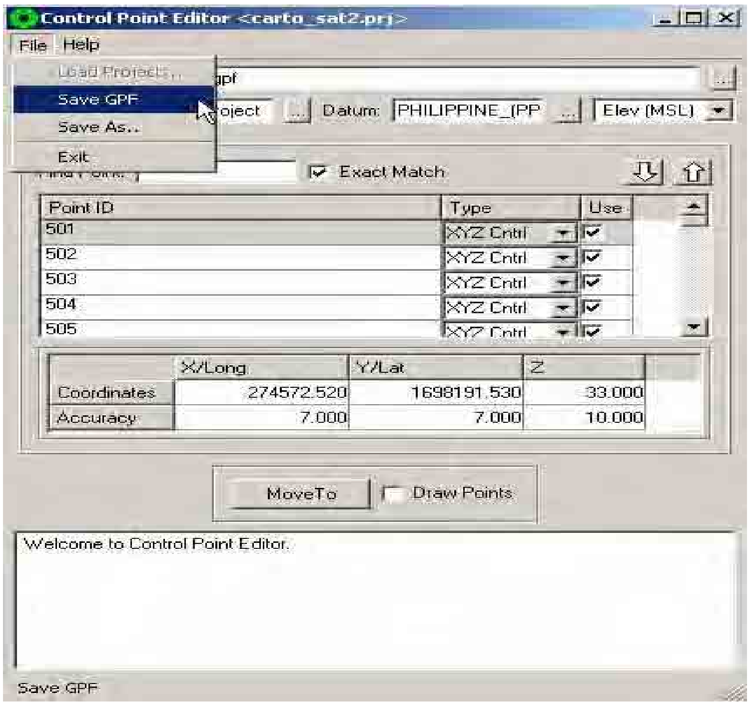


3. A "Select Ground Point File" dialog box will appear. Click the down arrow button in the "Look in" box and locate the folder of the imported ground control point. Then click "Save".


4. The GCP point ID will be reflected in the Point ID box. Select one point ID (e.g. 501), the coordinates XY and elevation Z will be shown in the Coordinates box. Edit the Accuracy values with respect to X/Long, Y/Lat, and Z.. Select another point ID and edit the accuracy. Repeat the procedures until all the needed point ID accuracy have been edited.



5. Click “File”, select “Save GPF.



### 3.1.3 Measurement of Image Coordinates (Points)

There are four ways to measure ground points in imagery:

- Automatic Point Measurement (APM) (in Triangulation)
- Interactive Point Measurement for APM
- Interactive Point Measurement (IPM) for Blunder Detection
- Interactive Point Measurement for Simultaneous Solve

The decision of whether to run IPM before of after APM depends on the kind of ground points you have. The following table gives some guidance:

| WHAT TO RUN | SITUATION |
|---|---|
| **APM before IPM** | You have a few control points; and you want to Solve (after APM) before running IPM so that it is easier to find the control points in IPM. |
| **IPM before APM** | You measure some control points and some tie points in IPM (in one image only), then you run APM to transfer these points to other images and to measure additional tie points. |
| **IPM only** | You have just one image. Or, you have lots of control points and you don't need tie points. |
| **APM only** | You have no control points. To interactively review the tie points measured by APM, you use IPM. Neither APM or IPM You have measured the image points on an analytical plotter, and imported them with ASCII Image Point Import, and are using Triangulation only for the Solve process. |

**Control Points** are points with known ground coordinates (XYZ, or XY, or Z). You must enter the location into the IPM window. Triangulation stores this data in the project Ground Point File. You must also use the extraction cursor to identify the control point in all the images in which the point is located. The image space positions are stored in the Image Point Files (IPF).

**Tie Points** are points on the ground that you can identify in two or more overlapping images, but you don't know the ground coordinate. You use the extraction cursor to identify the point in all the overlapping images. The image locations are stored in the Image Point Files (IPF). An entry is created in the Ground Point File (GPF) for each tie point. APM will create tie points automatically.

**Check Points** are points with known ground location (XYZ) that are not used in the solution, but are provided to help the operator perform a quality control check after the solution is complete. Check points are also called diagnostic points.

**Ground Point** is an umbrella term that includes Control Points, Tie Points, and Check Points.

**Image points** are the image space locations (in lines and sample coordinates) of Ground Points. A single image point is stored for every instance of a ground point in an image. For example, if a tie point is located in 4 overlapping images, and you measure it in 3 of the images, then 3 image points are stored. Image points are stored in the IPF files. An image point must be associated with some ground point. If you somehow have points in IPF files which are not reflected in the GPF file, transfer them using the ***Reset > Transfer*** Image Points menu selection.

**Ground Point Selection**
Ground Point consists of two tables containing ground point information. The upper table lists all ground points in the current Ground Point File. Clicking the LMB on any point in the table moves the extraction cursor to that point and loads the measured and unmeasured images.

**Image Point Section**
This area contains the image status list which displays all images containing the selected ground point. The point status is either locked or unlocked, measured or unmeasured. An X in the appropriate field indicates locked or measured. The Master field indicates which images are loaded left or right. The left master image is always used as the master when Auto Two or Auto All is selected.

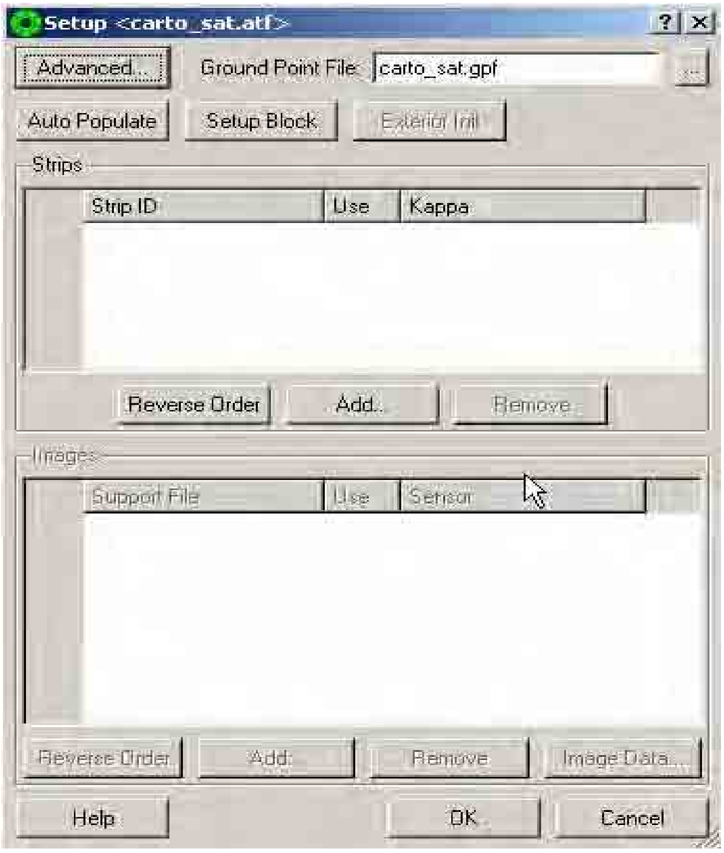
3.1.3.1 Opening an Automated Triangulation file.

1. Click "Preparation", select "Multi-Sensor Triangulation".

2. An "Automated Triangulation" dialog box will appear. Click "Setup".


3. A "Setup" dialog box will appear. Click "Add" 

.

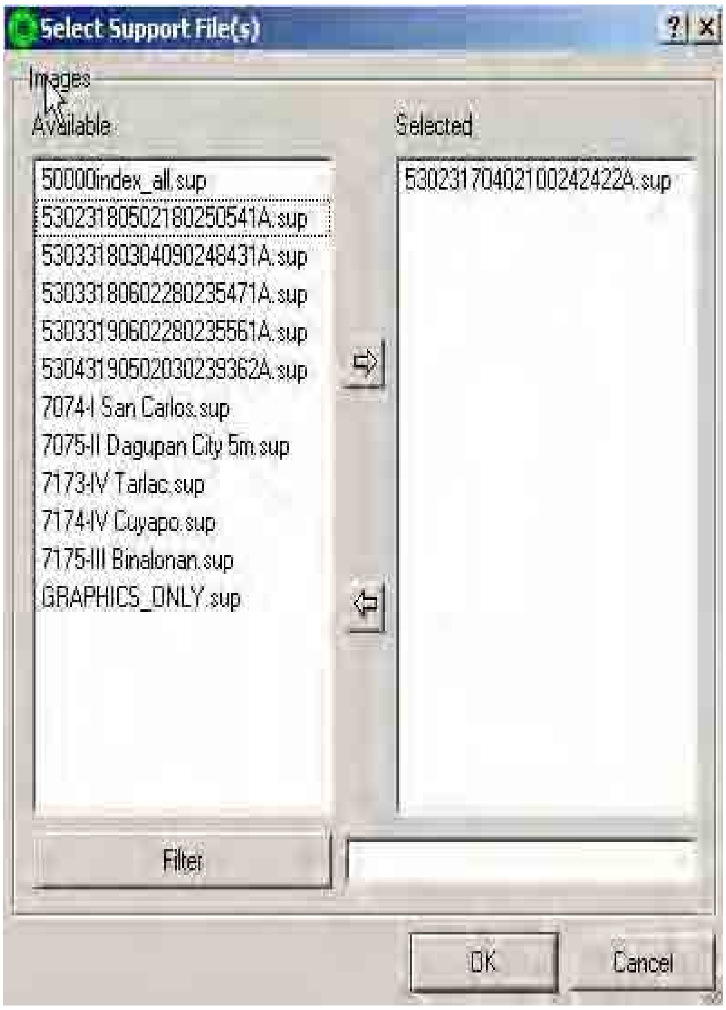


4. A “Strip ID Sequence” box will appear. Type a number (e.g. 1). Then click “OK” 

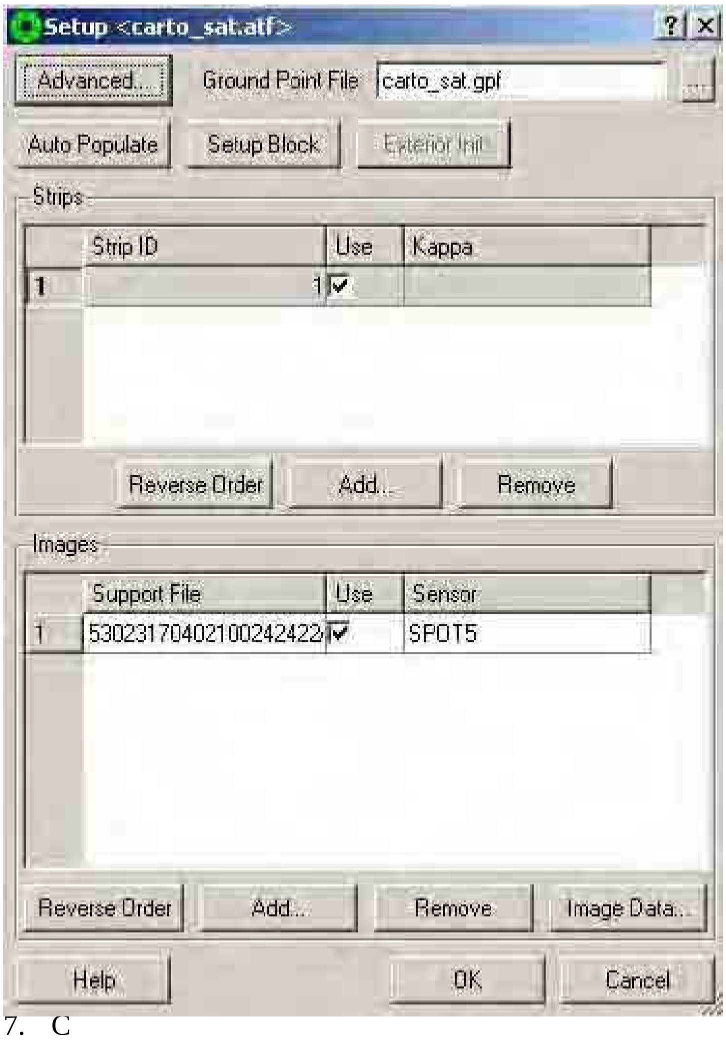
.


5. A “Select Support File(s)” dialog box will appear. Select the image (e.g. 53231704022100242422A.sup) in the “Available” box. Click the arrow  to copy the selected image to the “Selected” box. Then click “OK” 

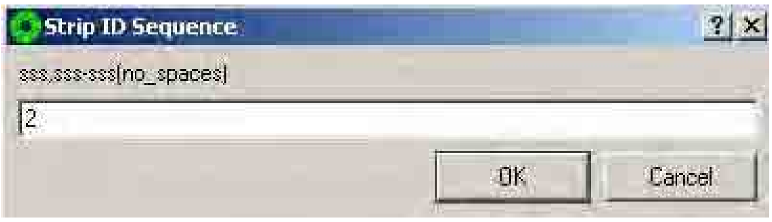
.



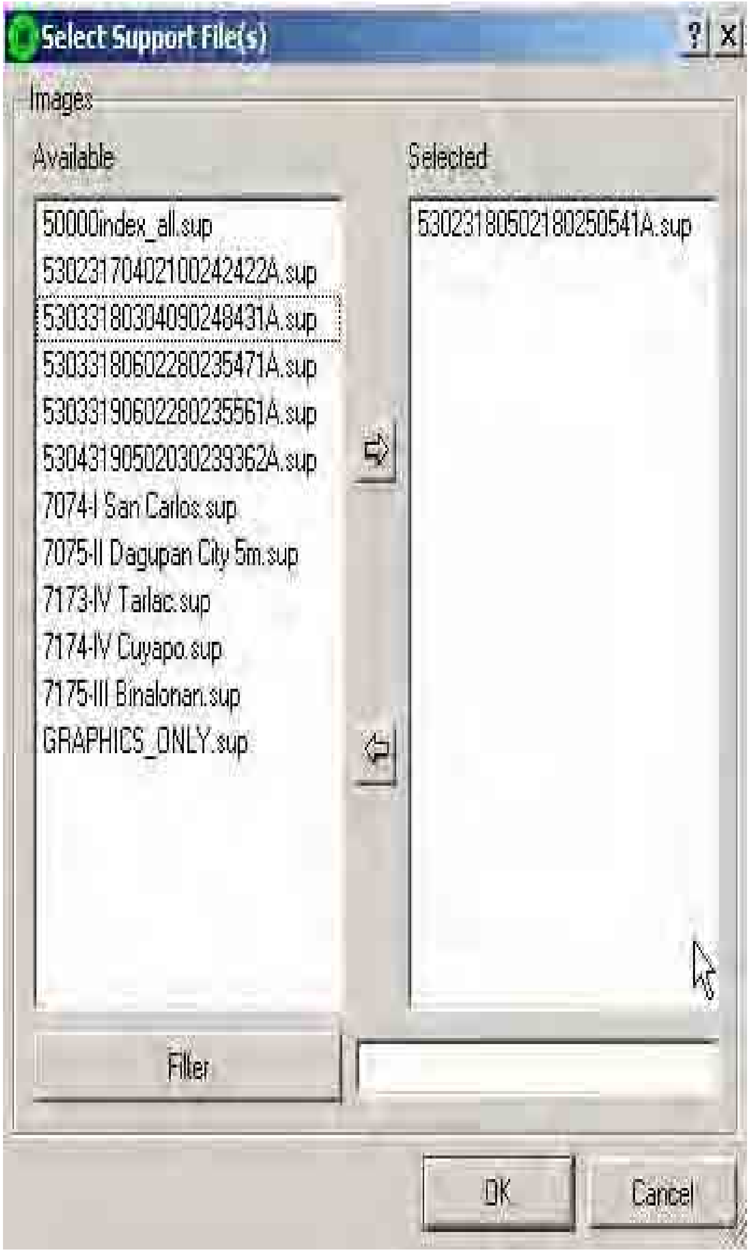
6. The created strip 1 will be reflected in the “Strips” box and the selected image (e.g. 53023170402100242422) will be reflected in the “Images” box.




7. C
lick “Add” under the “Strips” box. A “Strip ID Sequence” box will appear. Type the next number (e.g. 2). Then click “OK” .

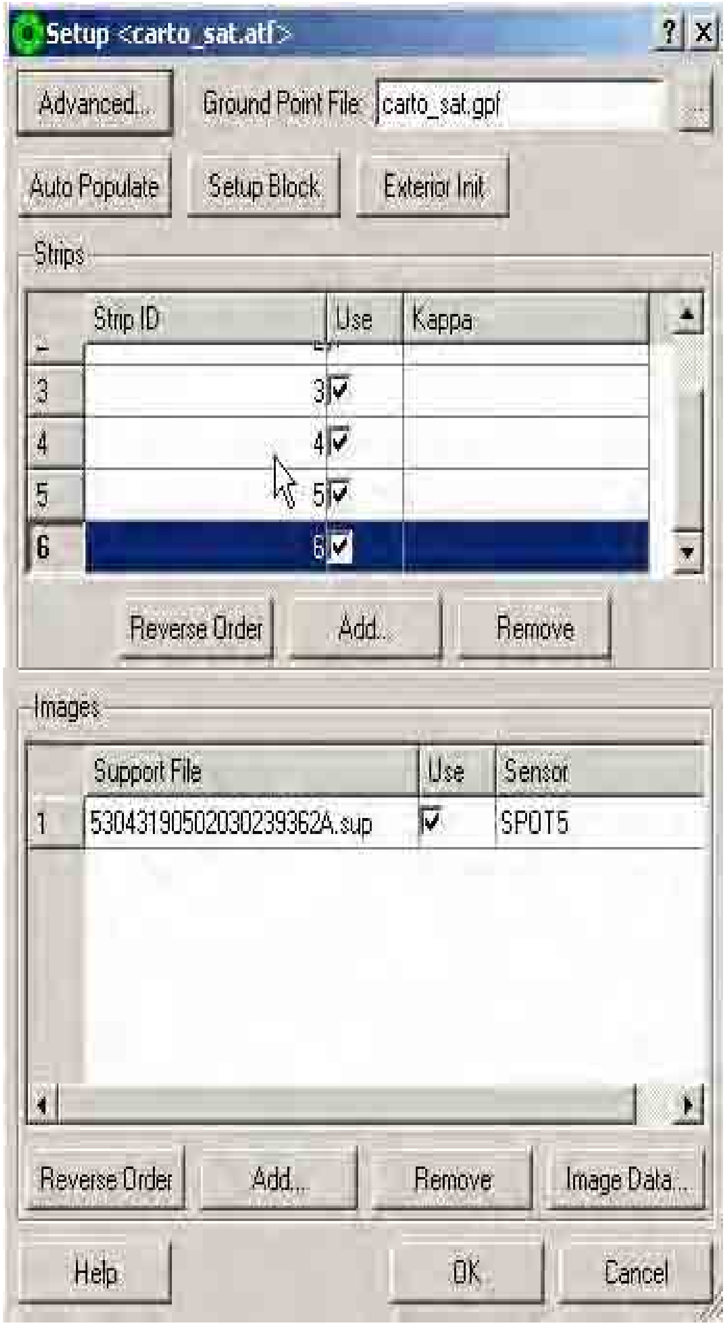



8. Select the next image corresponding to strip number 2. Click the arrow  to move the image to the "Selected" box. Then click "OK" .

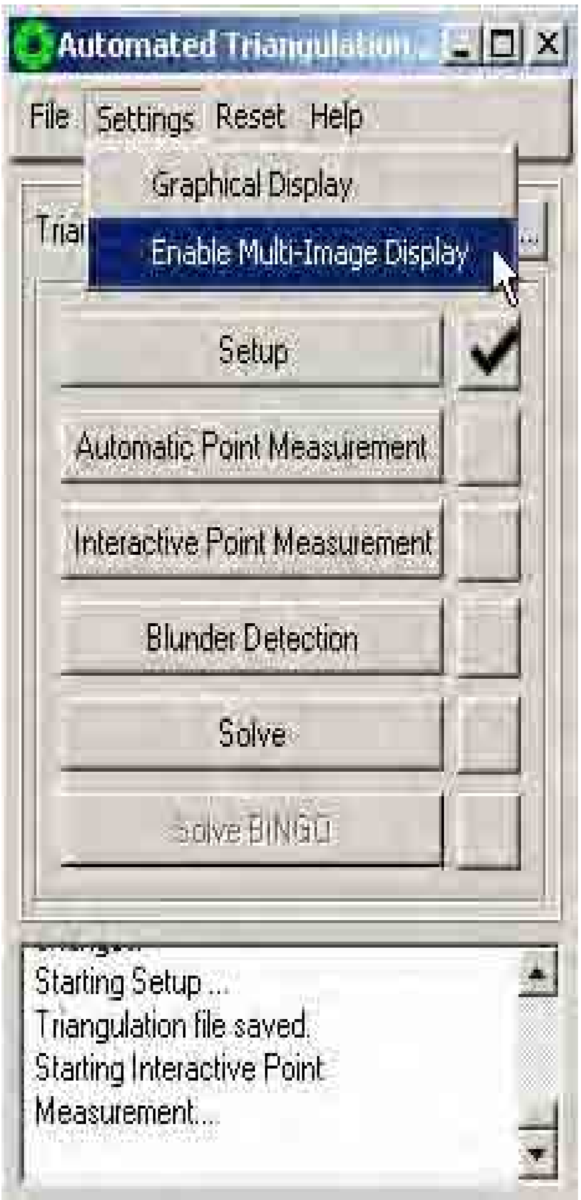


9. Repeat steps 7and 8 until all the needed images have been selected. Then click “OK” .





10. Click ”Settings” and select “Enable Multi-Image Display.

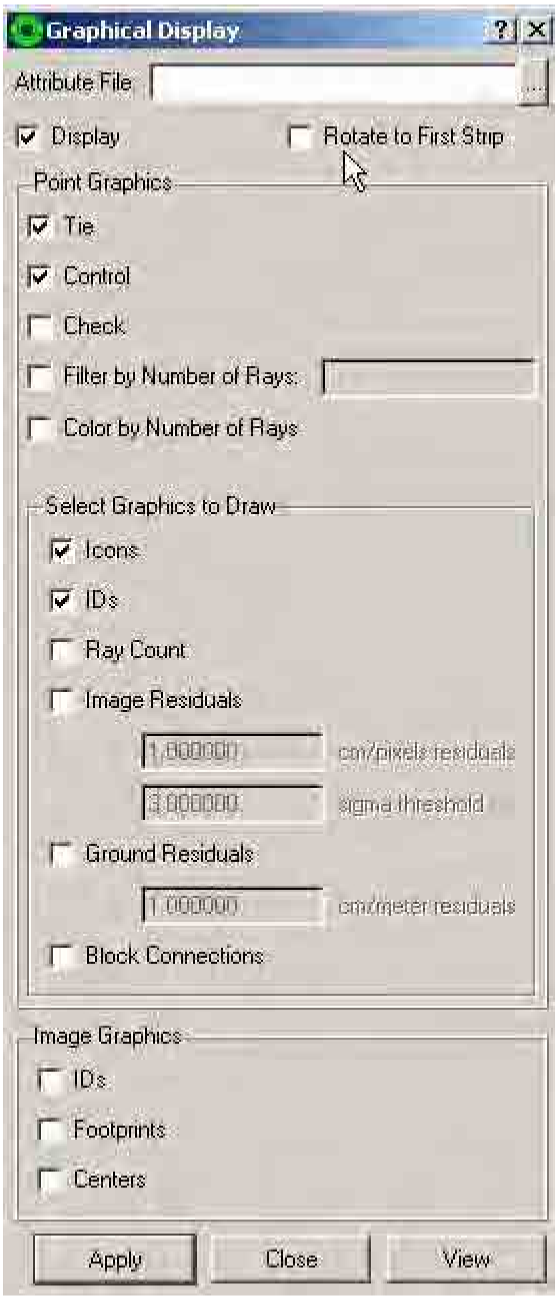


11. Click ”Settings”, select “Graphic Display”.

12. A “Graphic Display” dialog box will appear. Check “Tie” box, “Control” box, “Icon” box, and “IDs” box. Click ”Apply” 

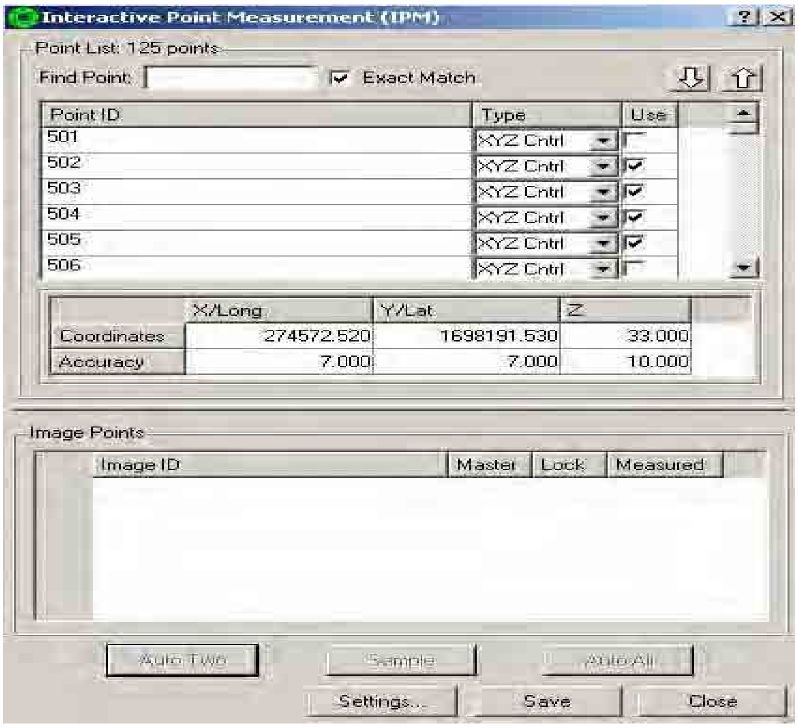
. Then click “Close” 

.



13. Click ”Interactive Point Measurement”.

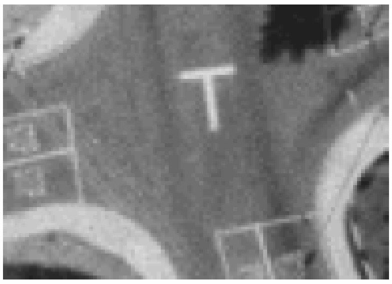

14. An ”Interactive Point Measurement” dialog box will appear.

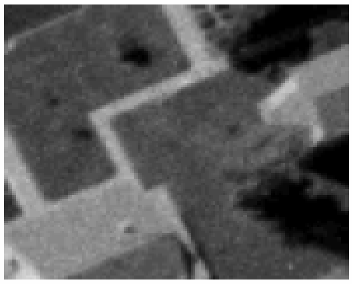


15. Select a point ID (e.g. 502) in the “Interactive Point Measurement” dialog box. The position of the selected point ID will be identified on the image. Move the cursor if necessary to adjust the location of gcp on the position described from the description data sheet.

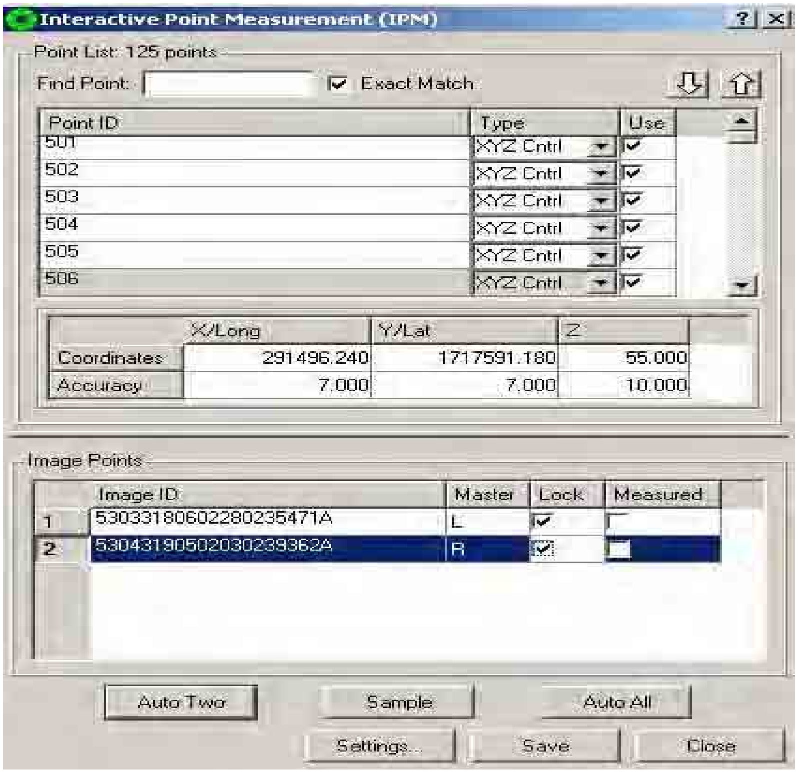
**Note**: It is a good idea to find the ground control markers in the image before you start measuring. It is very helpful to have a survey map or description data sheet that shows the ground control locations. Surveyors often use one of the following as ground control markers:

- A cross or T-shaped figure painted on the ground
- Some notable geographic feature, such as a bridge, hilltop, street intersection, building, flagpole, walkways, etc.

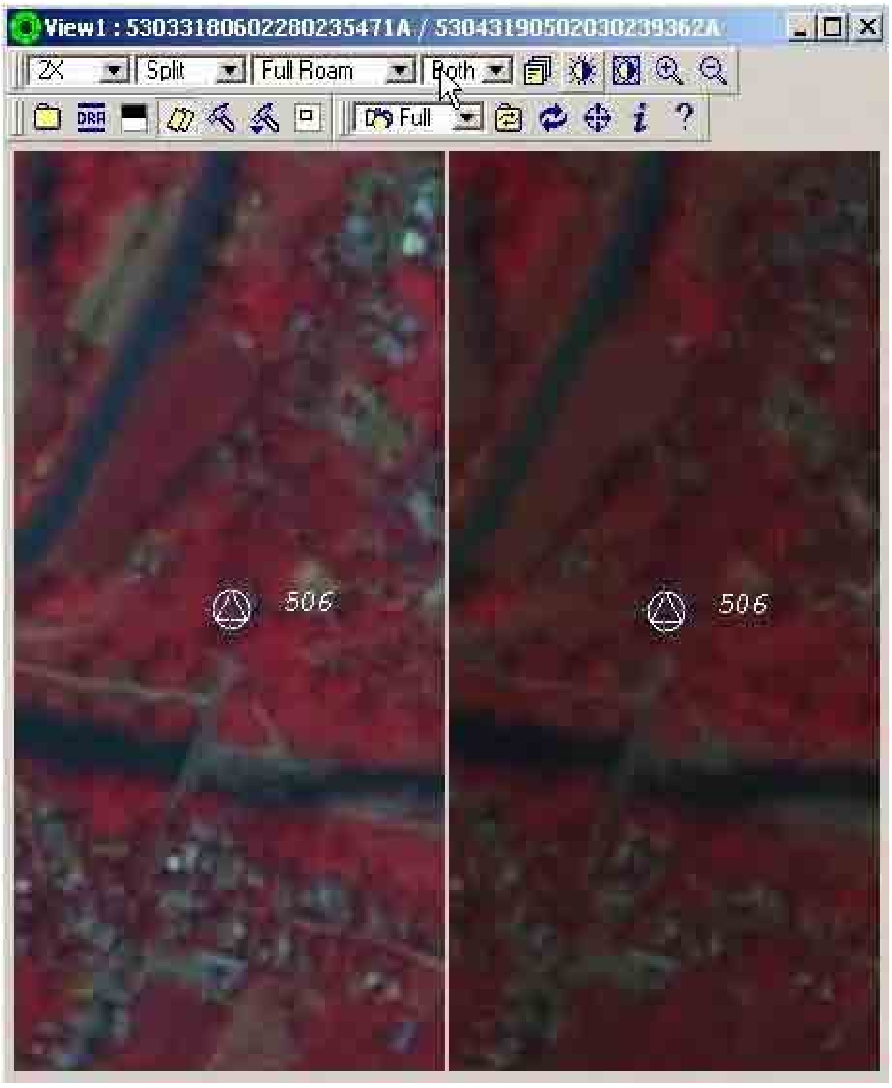




16. Once you have moved the cursor to the exact location, check “Lock” box in the “Image Points”. Click “Auto Two” button if the point ID number is within two images. Then click “Save”.



17. Select Next point ID (e.g. 506). Check “Lock” box in the “Image Points”. Click “Auto Two” button if the gcp is within two images (e.g. 53033180602280235471A and 53043190502030239362A). Then click “Save”.




**Note: If gcp is only within 1 image, just click “Sample” and then click “Save”**

18. Repeat steps 15 and 16 until all the required gcp’s have been measured.

### 3.1.4 Calculation/Inspection

3.1.4.1 Simultaneous Solve.

Simultaneous Solve performs a rigorous triangulation adjustment of a block of images to refine the estimates of their Triangulation parameters. Simultaneous Solve uses the weighted least squares method of adjustment in an iterative manner. It is capable of simultaneous adjustment of blocks of images taken by different sensors such as frame, panoramic, etc. It is also capable of recovering the interior geometry of the sensors via added parameters.

Simultaneous Solve requires the following input: image coordinates of control and tie points and their accuracies (image point files), ground coordinates of control points and their accuracies (ground point file), estimates of Triangulation parameters and their accuracies (support files and Triangulation file), and the interior geometry of the sensors (support files). All these data are automatically accessed by Simultaneous Solve without your intervention.

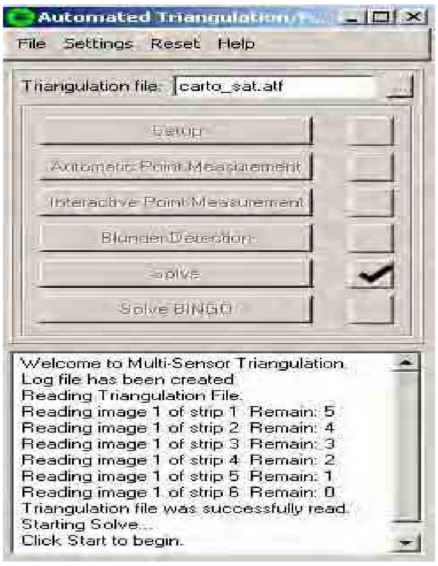
Simultaneous Solve uses a method known as “bundle adjustment” to determine the set of individual image parameter coefficients that minimizes the relative line/sample differences between points measured in overlapping images. The goal is to adjust the image parameters so that the position of a point in one image corresponds to the same point position in the other. If ground control is included, the parameters are adjusted so that the same image point corresponds to the same absolute position on all the overlapping images.

The method constructs a matrix of the linear equations and iteratively adjusts each of the independent image parameters until the solution converges below a pre-defined acceptance threshold. There are generally two problems that can happen with Simultaneous Solve: failure to converge, and excessive RMS residual error.

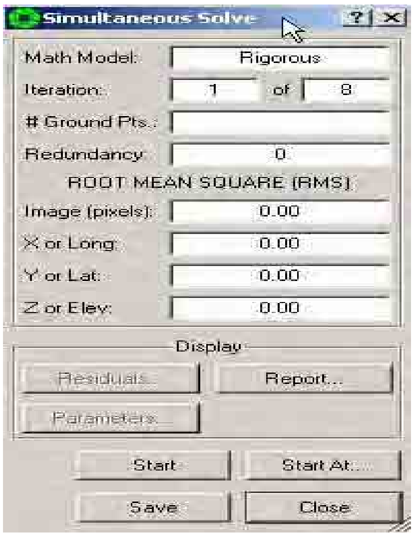
When you accept the solution, Simultaneous Solve will:

- Update the residual fields in the Ground Point File.
- Update the residual fields in each of the Image Point Files.
- Update the sensor model parameters in each of the Image Support Files.
- Write a Solution Accuracy Quality Report file (with extension .rep) in the project directory summarizing the image points, residuals, and solution quality.
- Write a second, more detailed Accuracy Summary Data report <atffilename>.atf.utri_rep. This contains information on QA statistics not available under the regular solve bundle adjustment method.

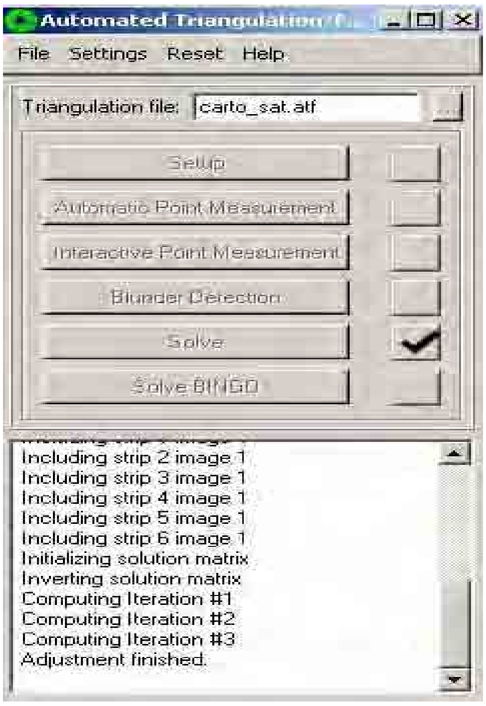
1. After measuring all the needed gcp, click “Solve” in the “Automated Triangulation” dialog box.




2. A “Simultaneous Solve” dialog box will appear. Click “Start” Start.



3. Check if adjustment of measured gcp is finished shown at the bottom window.




3.1.4.2 Multi-Sensor Triangulation Residual

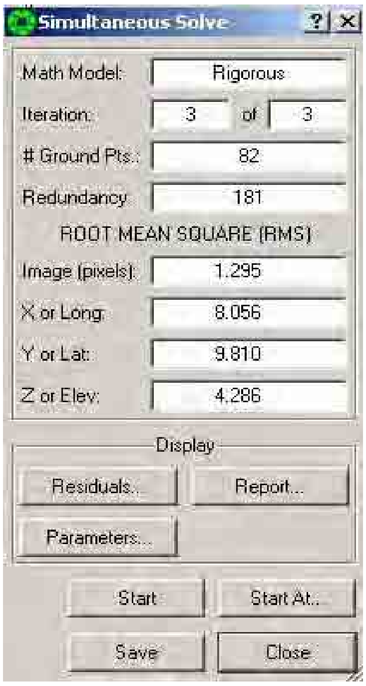
This window displays the residuals of image coordinates of all points and the residuals of ground coordinates of all control points. The residuals are displayed in a largest to smallest order based on image residuals.

The display residuals window provides a flexible interface to perform the following procedures:

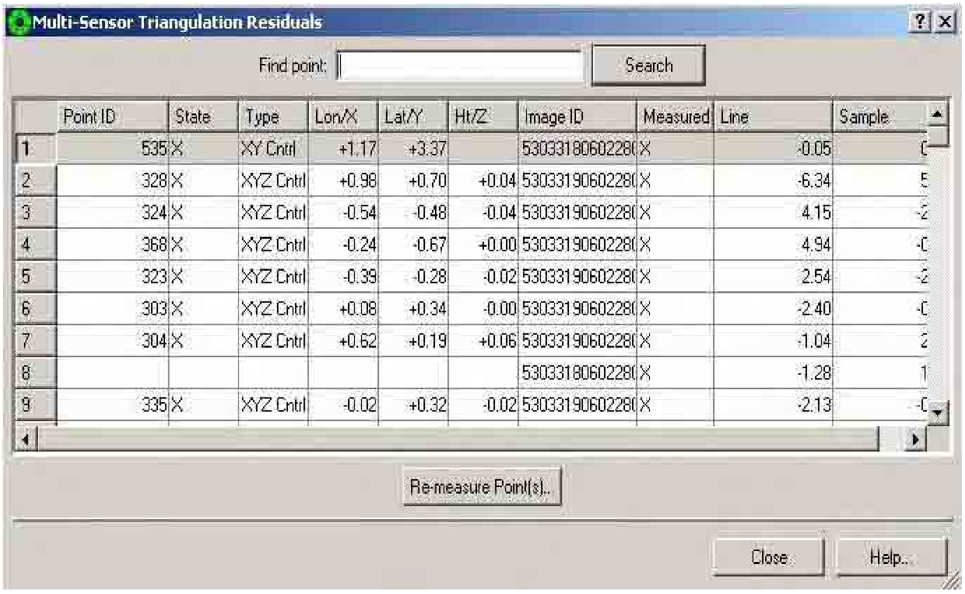
- View lists of residuals
- Change the ground point type
- Toggle ground points ON and OFF
- Toggle individual image measurements ON and OFF
- Re-measure points

1. Click “Residuals” 

in the “Simultaneous Solve” dialog box.




2. A “Multi-Sensor Triangulation Residual” dialog box will appear. An RMS (Root Mean Square) **below 1** is acceptable. If your RMS is above 1 you probably made a mistake in measurement. Review the residual values of each gcp and check the point ID which you think needs to be re-measured.



3.1.4.3 Reviewing and correcting GCP measurement with residual errors.

**Excessive RMS residual error**

The RMS of all the image residuals for the block is reported once convergence has been achieved. The acceptability of the RMS residual error depends on the sensor type and GSD but should be less than 1.0 pixel in most cases. Values greater than this indicate that one or more points is mismeasured and is skewing the solution excessively.

The Display Residuals menu can be selected to view the current image and ground residuals for all the measured points sorted by magnitude. Unfortunately, the largest residual points may or may not be the culprit in skewing the solution.

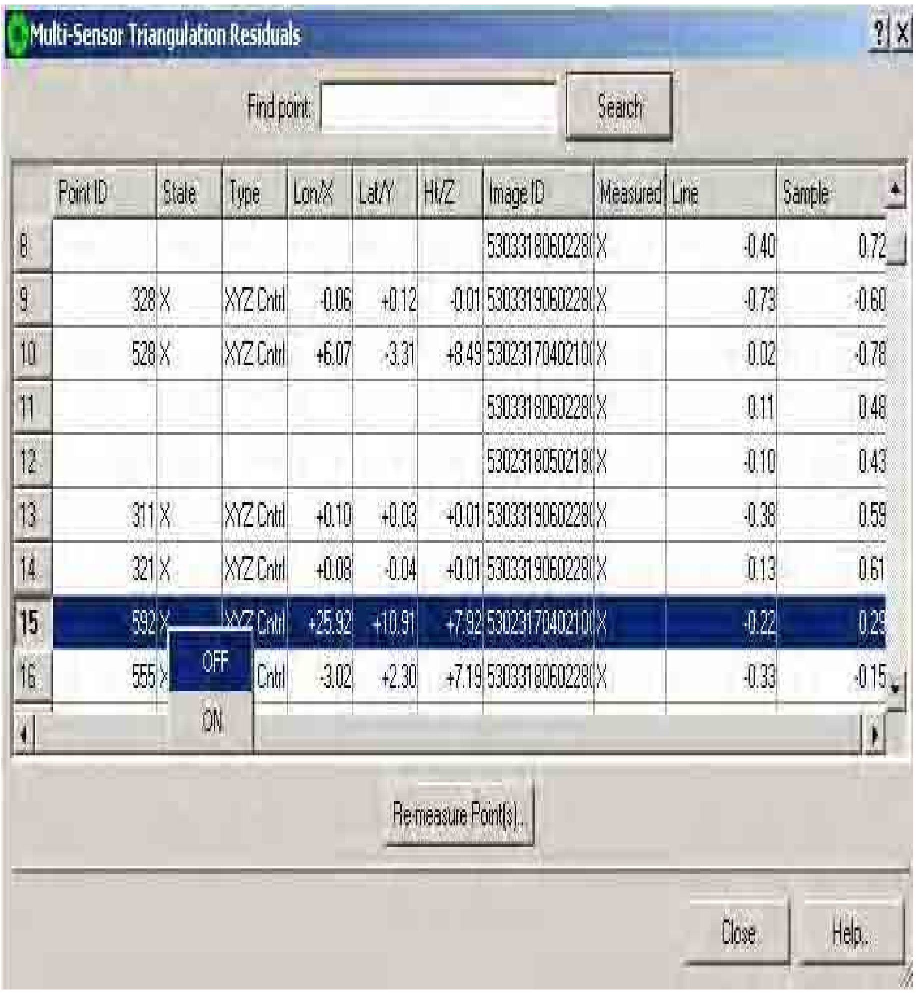
The first strategy should be to turn off all control points and attempt a relative solution first, unless the bad tie point is obvious.

If you examine a point with a high residual and it looks like it was well measured, you can skip it and try other points until you find one that is mismeasured. Examine points with even numbers of image overlaps over 2 (4, 6) and check the points between the first, third, fifth, etc. images to make sure that the point is measured at the same location.

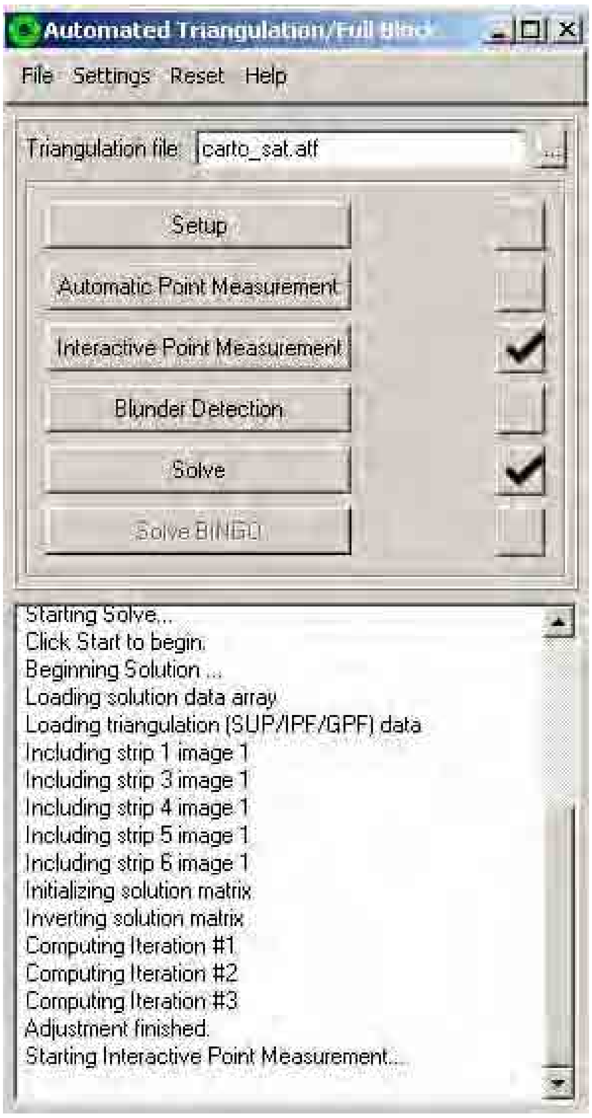
Also, move and remeasure points which are on rooftops or in trees. Trees tend to move somewhat in windy conditions, or are difficult to measure accurately and distort the solution when used for tie point locations.

It is recommended that solutions with excessive RMS error should be discarded and not Saved. It is likely that the resulting math models are degenerate, or at least worse than the existing approximate math model. If the relative solution (control points OFF) shows good RMS error results, the math model can be Saved and the control points can be later remeasured. Usually the problem is not the measurement but the absolute ground position specified for the point. You should confirm from the original hardcopy control database, or other sources, that you have the right coordinates for the right image point, and that the elevation data is consistent with the project units (feet vs. meters, MSL vs. Ellipsoid) as specified.

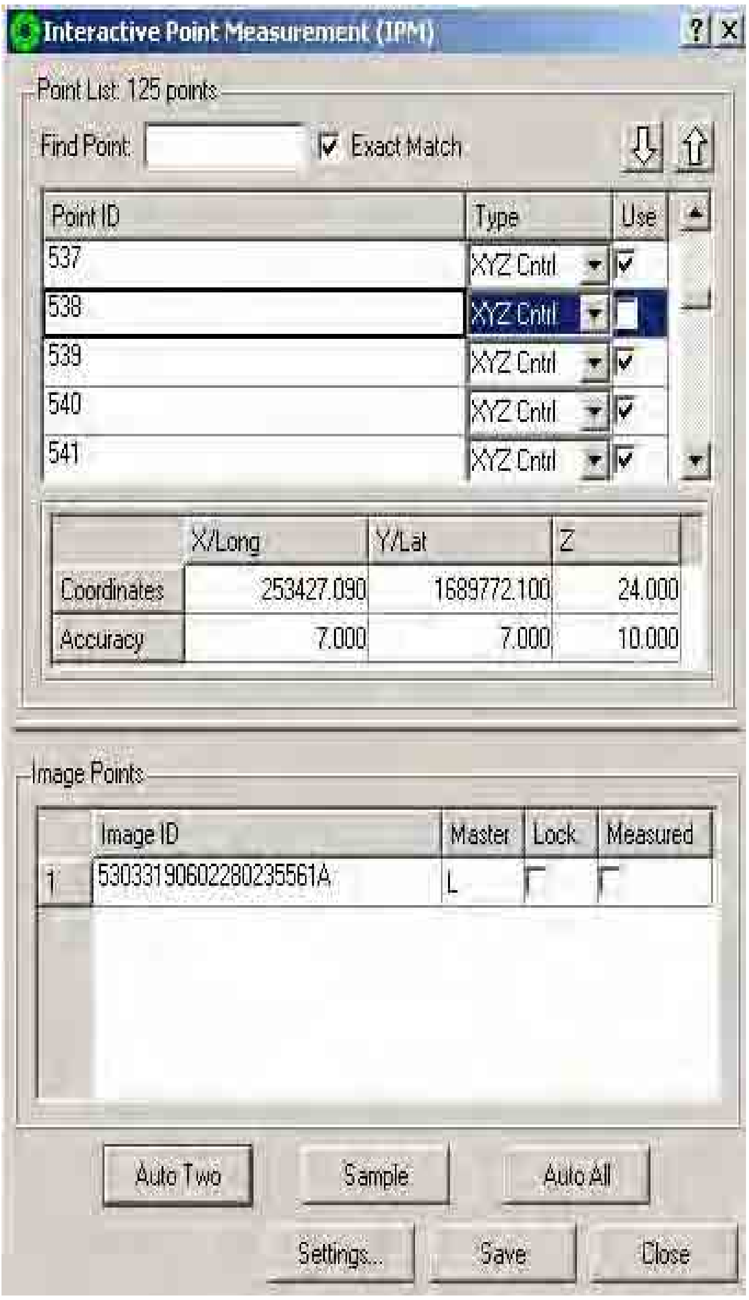
1. After all the measured points have been calculated, using the "Multi-Sensor Triangulation Residual" dialog box, identify and select point ID's which has a large Lon/X and Lat/Y value. Click right mouse button and select "OFF".



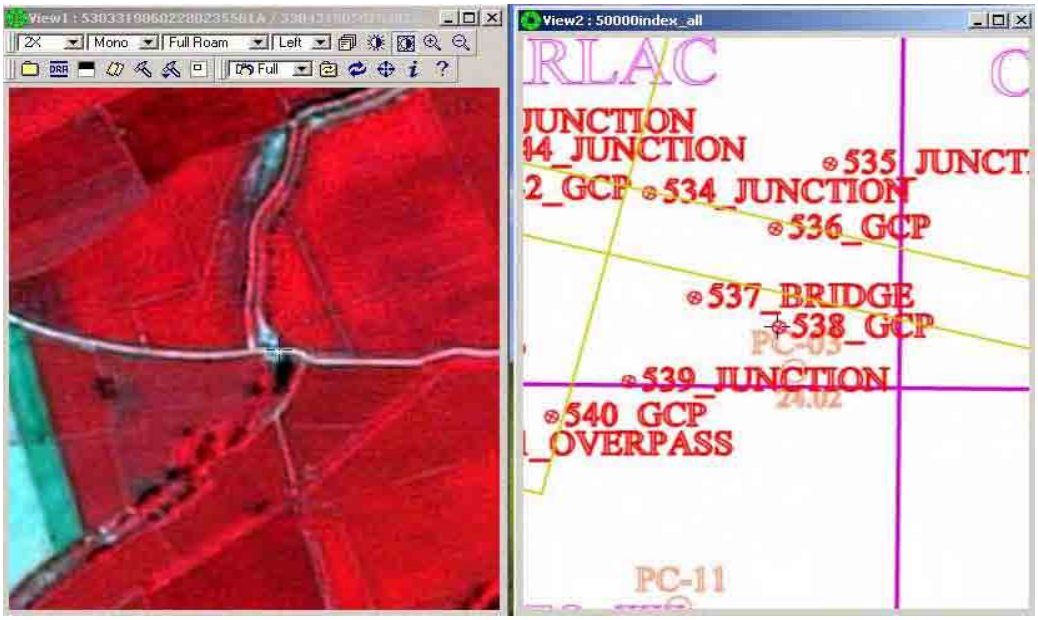
2. In the “Automated Triangulation/Full Block” dialog box, click “Interactive Point Measurement”.



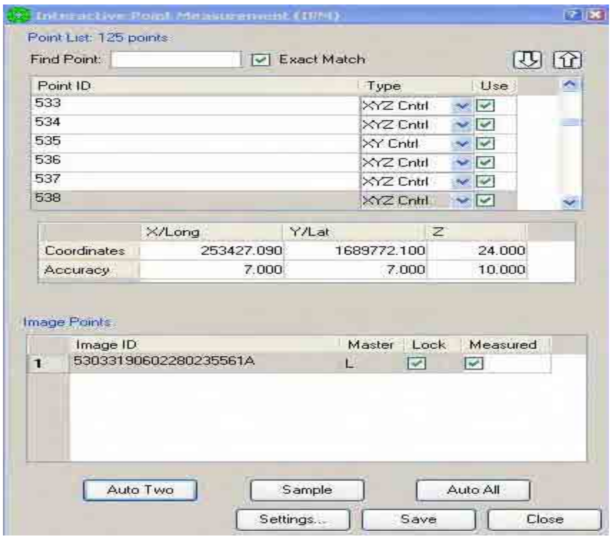
3. An “Interactive Point Measurement” will appear. Click the down arrow. Locate and select control points (e.g. 538) that were turned off.



4. The position of the select point ID (e.g. 538) will be identified on the image in view 1 and also in the gcp index in view 2. Set active view 1 and move cursor to a new position.

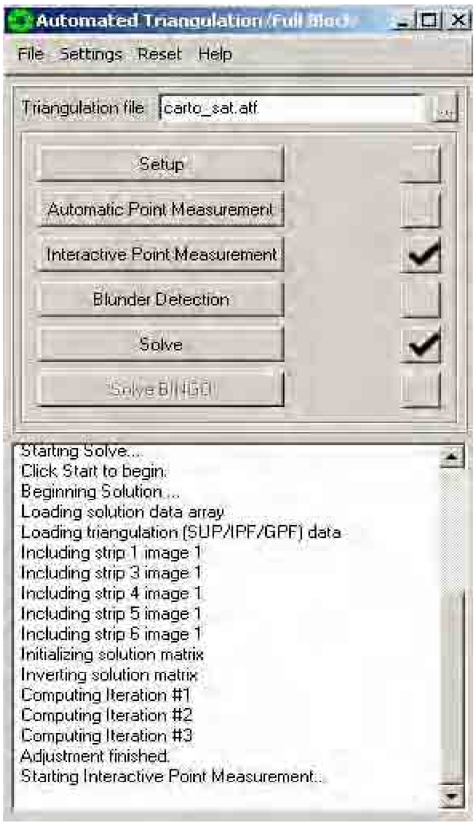



5. Check "Lock" in the "Image Points" box, select "Sample" and click "Save".

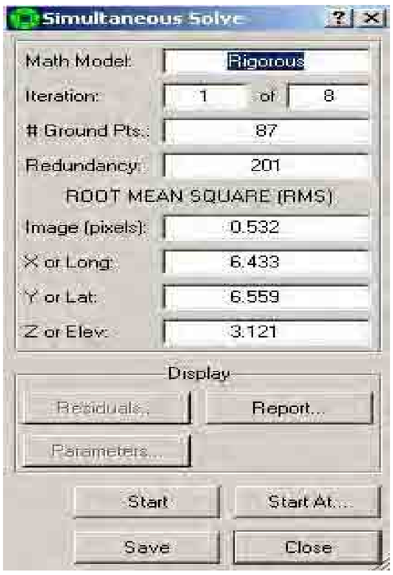



**Note:** Repeat steps 3 - 5 until all the control points that were turned off were selected, viewed and remeasured if necessary.

6. Click "Solve" in the "Automated Triangulation" dialog box.




7. A "Simultaneous Solve" dialog box will appear. Click "Start". Then check the RMS if value result is less than 1. Then Multi-Sensor Triangulation is ok.



### 3.1.5 Using SRTM Data

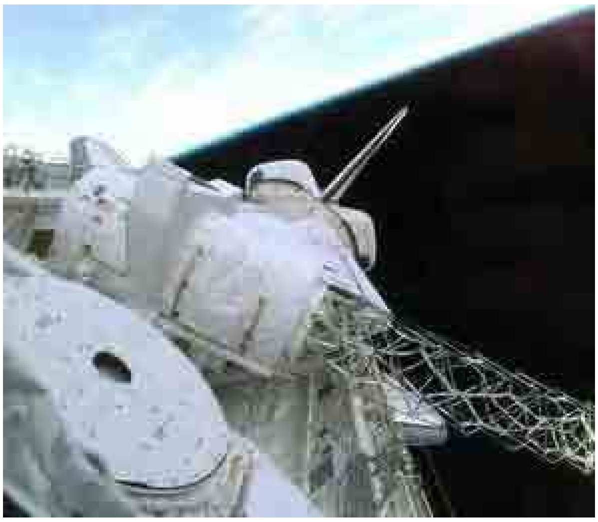
3.1.5.1 What is SRTM?

The Shuttle Radar Topography Mission (SRTM) is an international research effort that obtained digital elevation models on a near-global scale from 56 °S to 60 °N, to generate the most complete high-resolution digital topographic database of Earth to date. SRTM consisted of a specially modified radar system that flew onboard the Space Shuttle Endeavour during the 11-day STS-99 mission in February of 2000. To acquire topographic (elevation) data, the SRTM payload was outfitted with two radar antennas. One antenna was located in the Shuttle's payload bay, the other on the end of a 60-meter (200-foot) mast that extended from the payload bay once the Shuttle was in space. The technique employed is known as Interferometric Synthetic Aperture Radar.

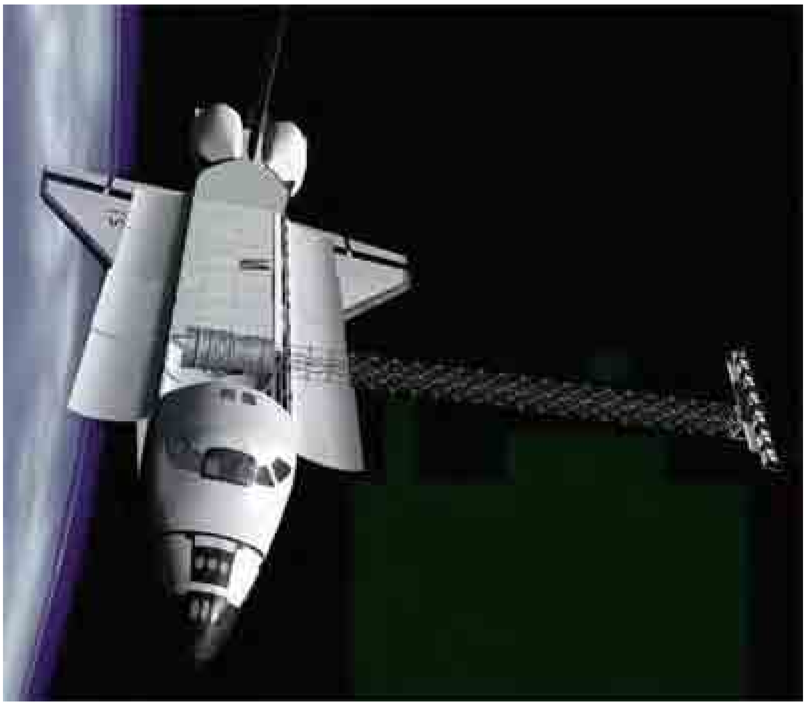
The elevation models are arranged into tiles, each covering one degree of latitude and one degree of longitude, named according to their south western corners. It follows that "n45e006" stretches from 45°00′N, 6°00′E to 46°00′N, 7°00′E and "s45w006" from 45°00′S, 6°00′W to 44°00′S, 5°00′W. The resolution of the cells of the source data is one arc second, but 1" data have only been released over United States territory; for the rest of the world, only three arc second data are available. Each one arc second tile has 3,601 rows, each consisting of 3,601 16 bit bigendian cells. The dimensions of the three arc second tiles are 1201 x 1201.

The elevation models derived from the SRTM data are used in Geographic Information Systems. They can be downloaded freely over the internet, and their file format (.hgt) is supported by several software developments.

The Shuttle Radar Topography Mission is an international project spearheaded by the U.S. National Geospatial-Intelligence Agency (NGA) and the U.S. National Aeronautics and Space Administration (NASA).



Part of the SRTM hardware is photographed through Endeavour's aft flight deck windows about halfway into the mission. The mast is deployed from the mast canister, and the main antenna can be seen behind the mast.



Artist representation of SRTM in space. Main antenna is located in the payload bay, the mast is deployed to 60 meters (200 feet), and the outboard antenna is attached to the end of the mast. (Courtesy of the German Aerospace Center)

Version 1 of the SRTM data consists of the original Digital Elevation Models produced by the SRTM project with data from the STS-99 mission in Feb., 2000, and delivered to the National Geospatial-Intelligence Agency (NGA.) These data are unedited and contain spurious data points in area of low radar backscatter such as water bodies.

Version 2 is the results of a substantial editing effort by the NGA and exhibits well defined water bodies and coastlines and the absence of spikes and wells (single pixel errors), although some areas of missing data ('voids') are still present. The Version 2 directory also contains the vectorized coastline mask used by NGA in the editing, called SRTM Water Body Data (SWBD), in shapefile format.

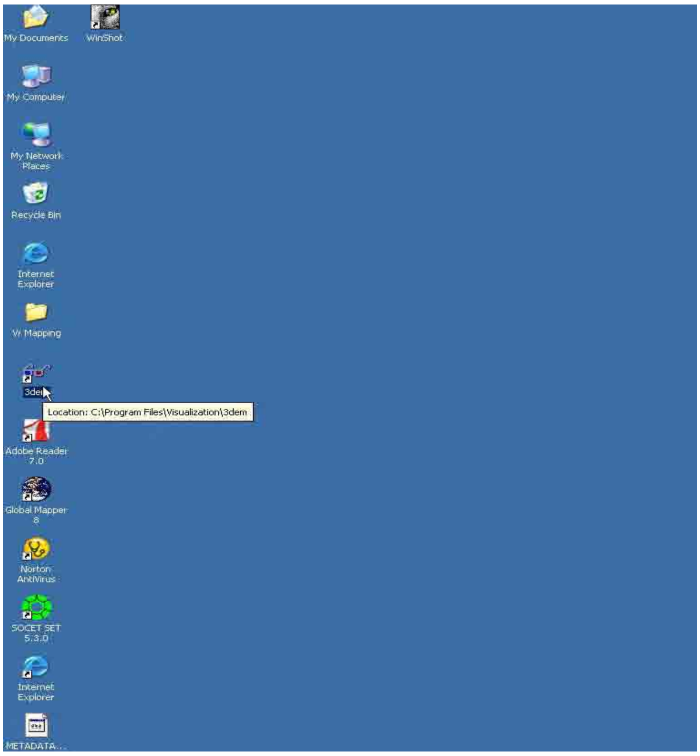
Version 2 is a superior product and it is recommended for most users.

3.1.5.2 Data download from internet

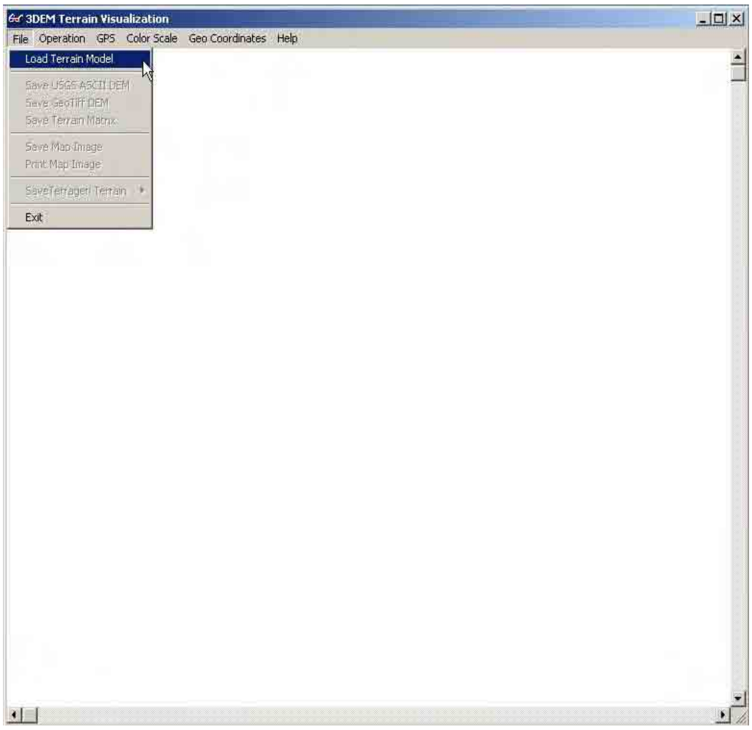
SRTM data can be downloaded from ftp://e0srp01u.ecs.nasa.gov/

3.1.5.3 Data modify by 3dem

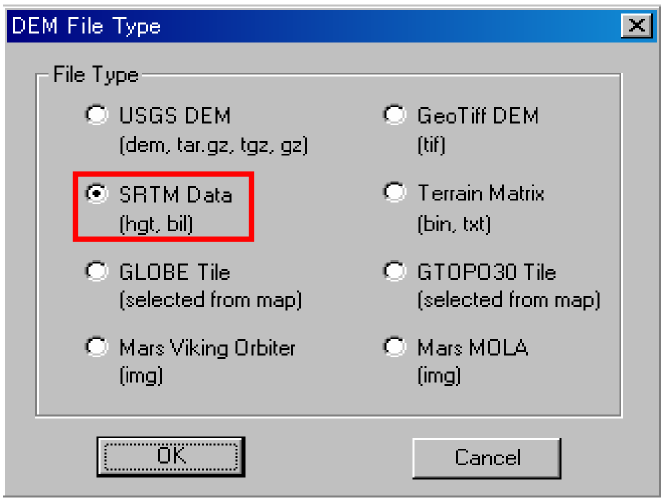
1. Click “3dem” icon on your desktop.



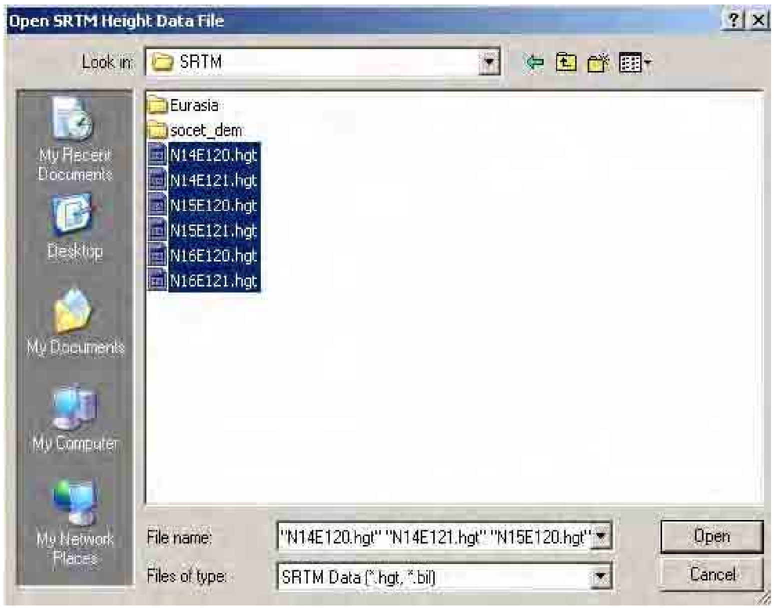

2. A “3DEM Terrain Visualization” window box will appear. Click “File”, select “Load Terrain Model”.



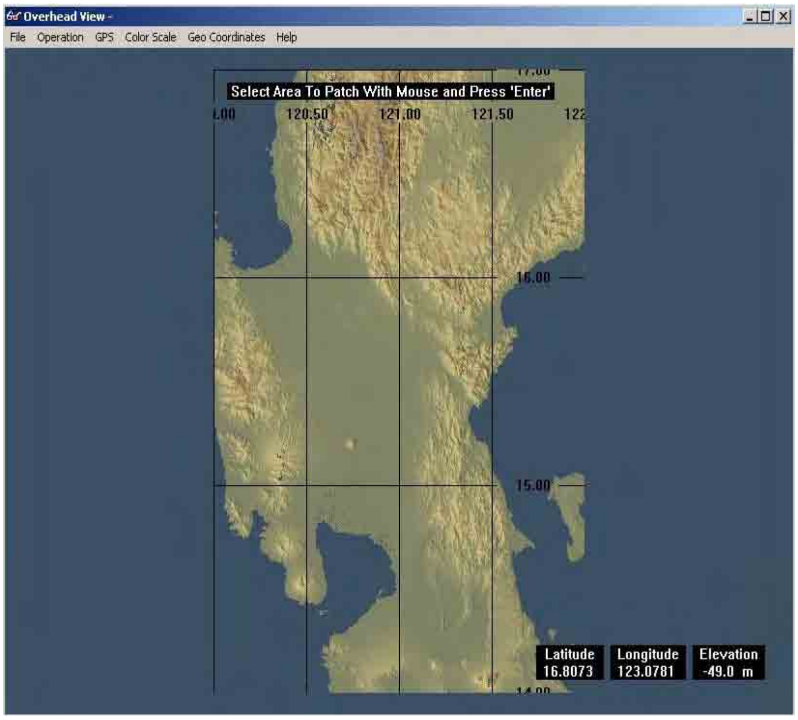
3. A “3DEM File Type” dialog box will appear. Check “SRTM Data (hgt,bil)”. Then click “OK”.




4. A “Open SRTM Height Data File” dialog box will appear. Click down arrow and browse the folder where the images (e.g. N14E120.hgt) are located. Select all the needed images. Then click “Open”.

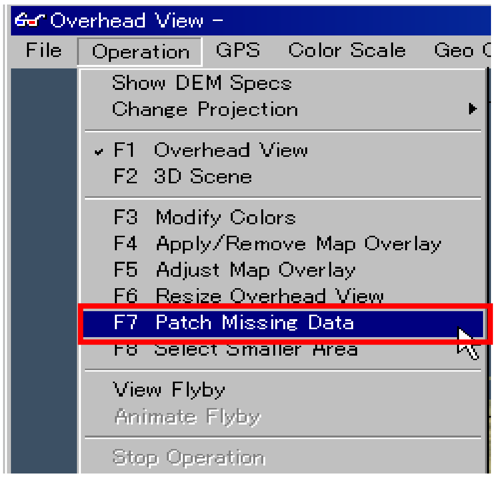



5. A “Overhead View” window box will appear.



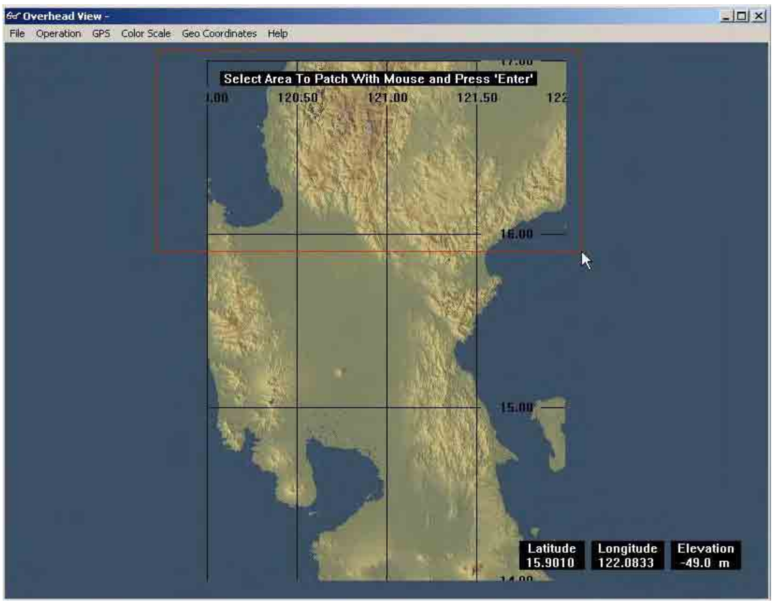

6. .Patch Missing Data

Occasionally it will be necessary to patch missing elevation data points in the digital elevation model. This is particularly true with the SRTM data, which may be sprinkled with obvious holes where elevation values are missing from the terrain grid. These holes can disfigure the 3D images of the terrain, and must be patched.
Click "Operation", select "Patch Missing Data"

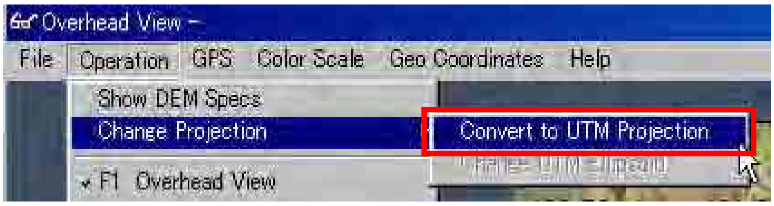



7. In the "Overhead View" box, using the pointer arrow draw a box covering portion of the whole image. Hit "Enter" in the keyboard. Press "F7" in each selection. Select several areas until you have selected the rest of the image. The

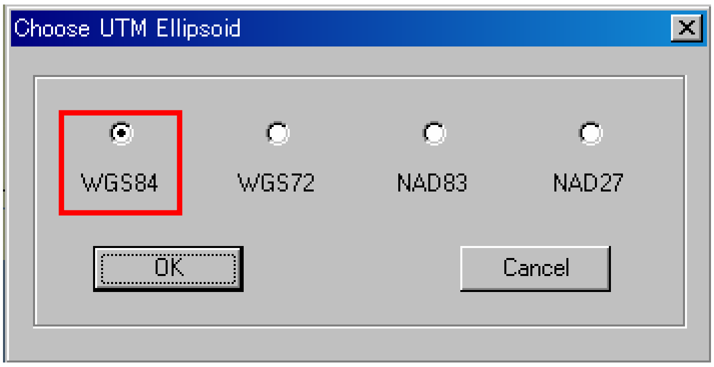
application cannot process the data if the area is done in one selection.



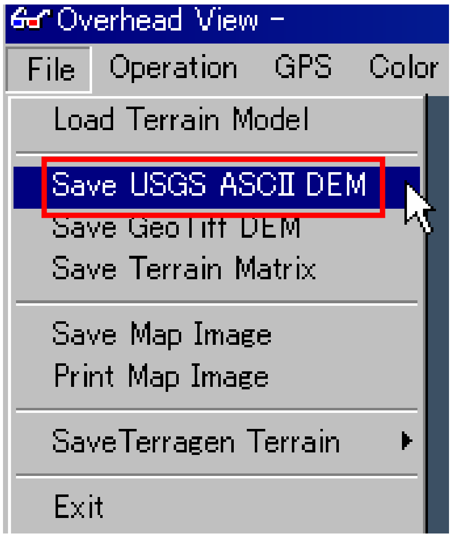

Click “Operation”, select “Change Projection”. Then click “Convert to UTM Projection”.



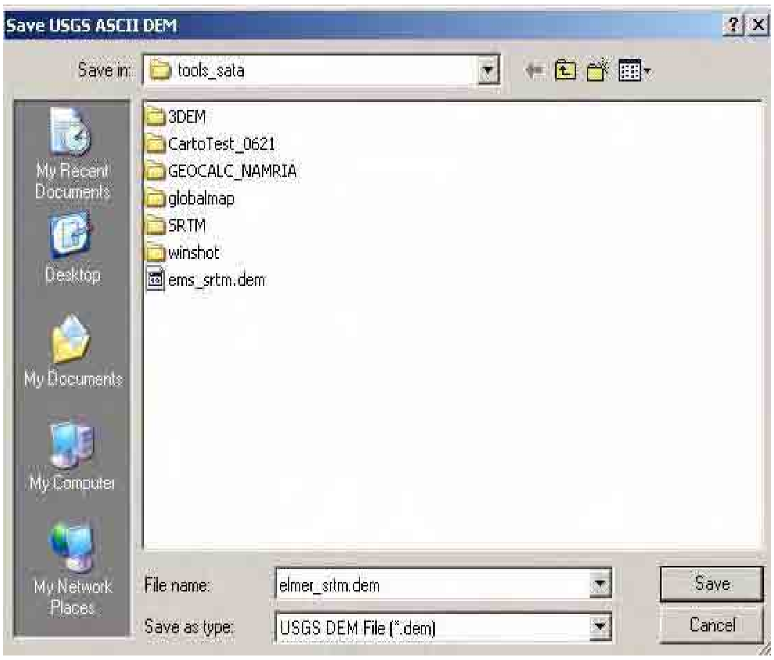

9. .Click “WGS84”. Then click “OK”.



10. .Click “File”. Then click “Save USGS ASCII DEM”.



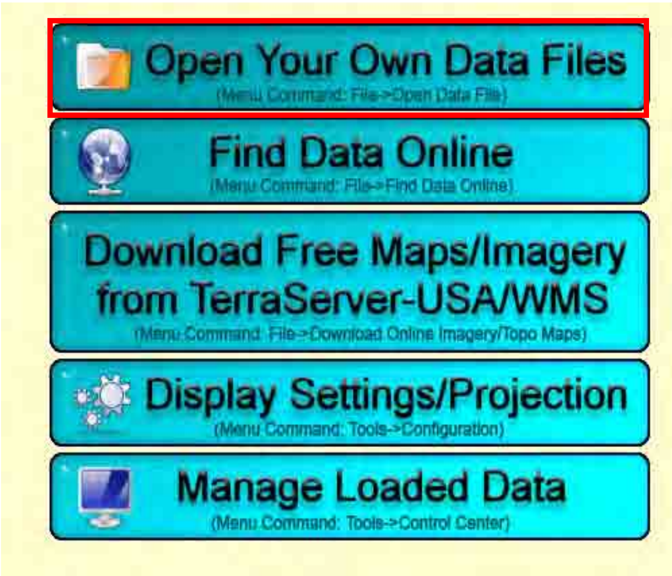

11. A “Save USGS ASCII DEM” dialog box will appear. Type the file name (e.g. elmer_srtm.dem) in the “File Name” box. Then click “Save”.



3.1.5.4 Convert Data to ArcGrid by GlobalMapper

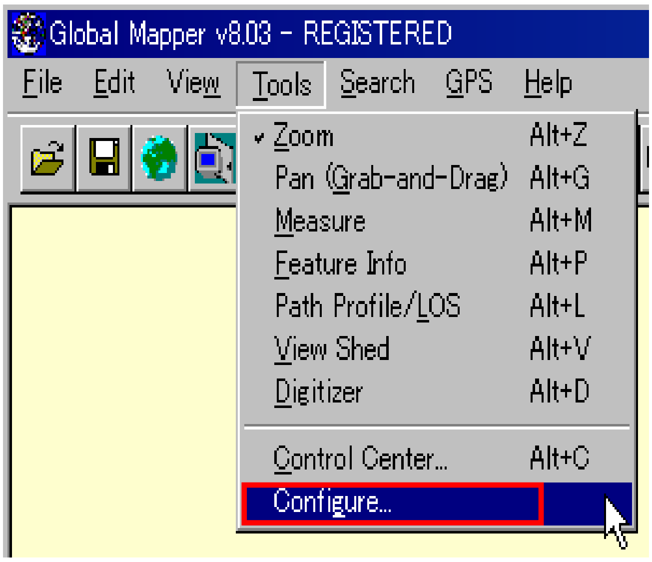
1. .Click “Global Mapper” on your desktop.


2. Click “Open Your Own Data Files”.

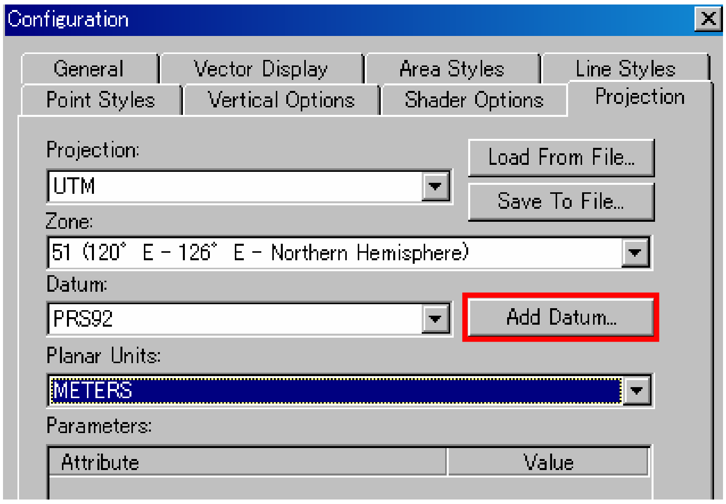


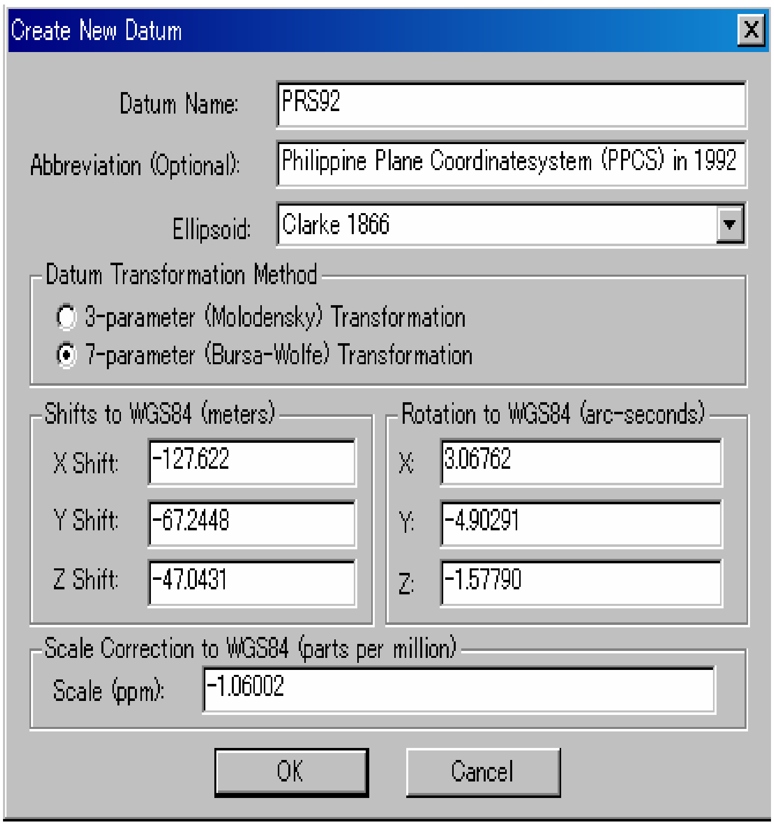
3. An “Open” dialog box will appear. Select the DEM file (e.g. ems_srtm.dem) that was created. Then click “Open”.


.Click “Tools” and select “Configure”.

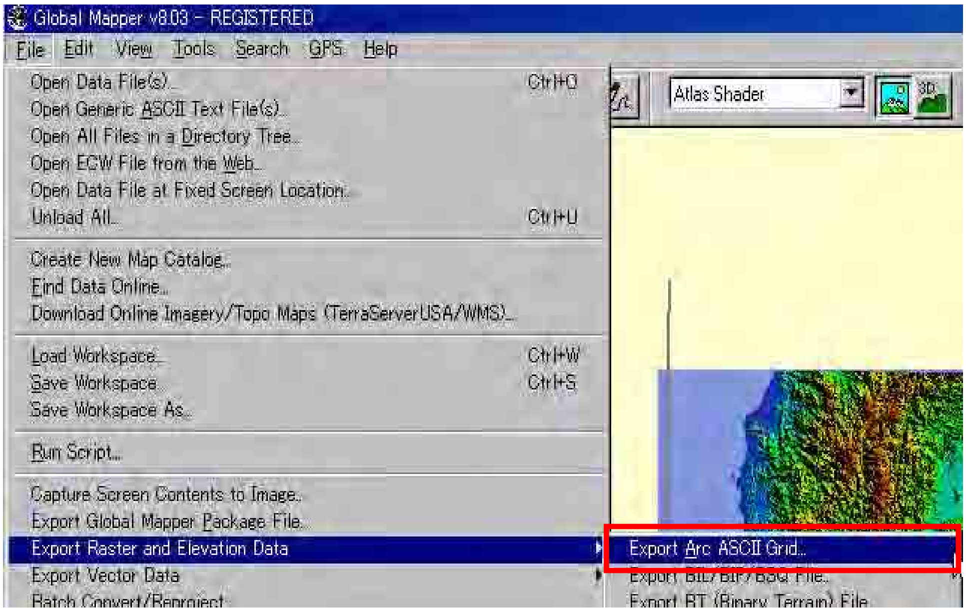


.A “Configuration” dialog box will appear. Set Projection parameters. Click “Add Datum” and set PRS92 datum parameters. Then click “OK”.

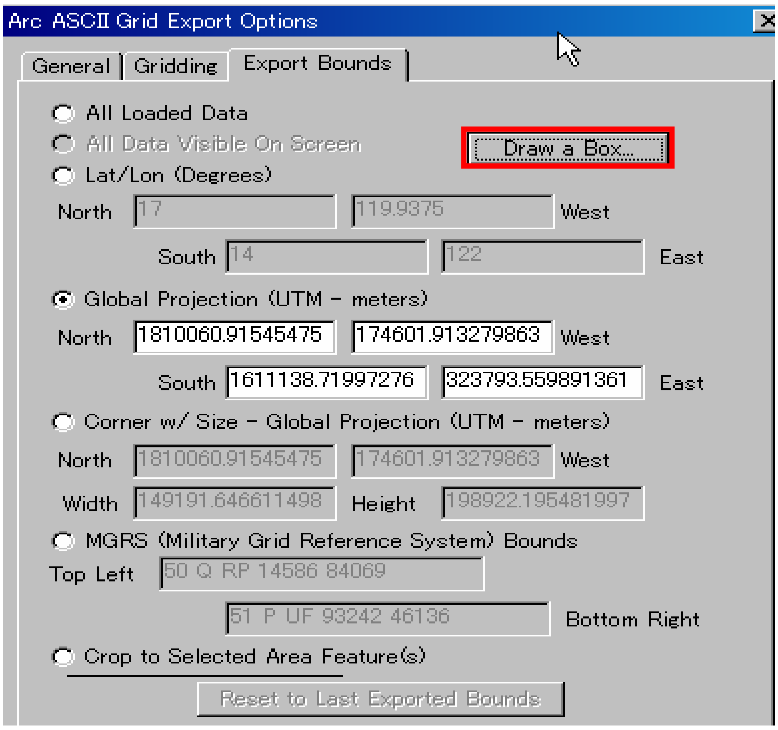


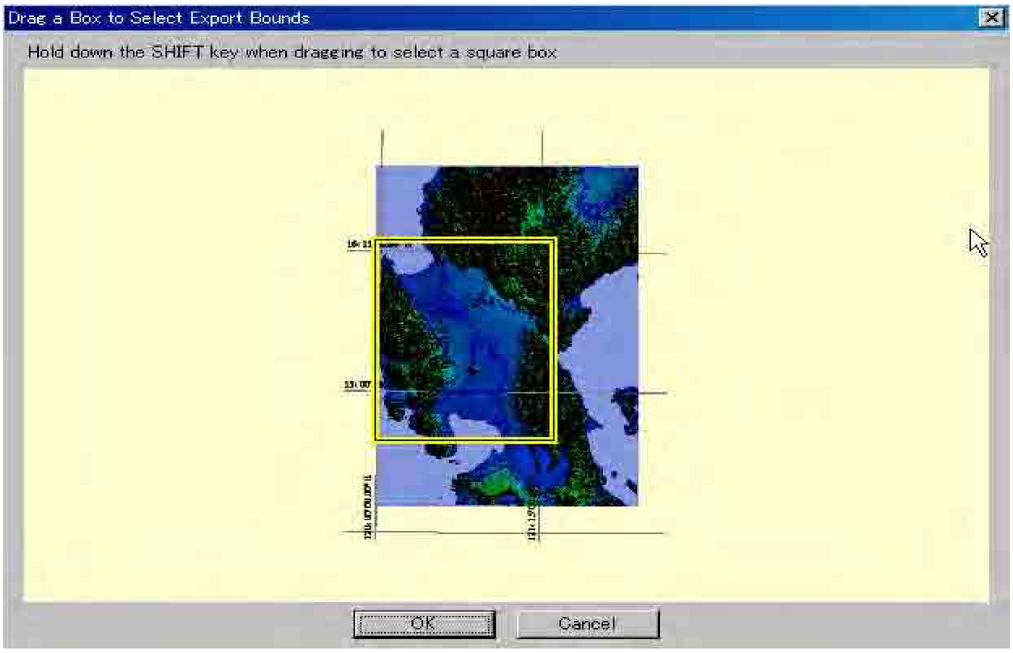

6. Click File", select "Export Raster and Elevation Data".    Then click "Export Arc ASCII Grid".




.An "Arc ASCII Export Options" dialog box will appear. Click "Export Bounds" tab. Then click "Draw a Box" button.



. Draw a box to select the area limit to be exported to Arc ASCII Grid File by SOCETSET.



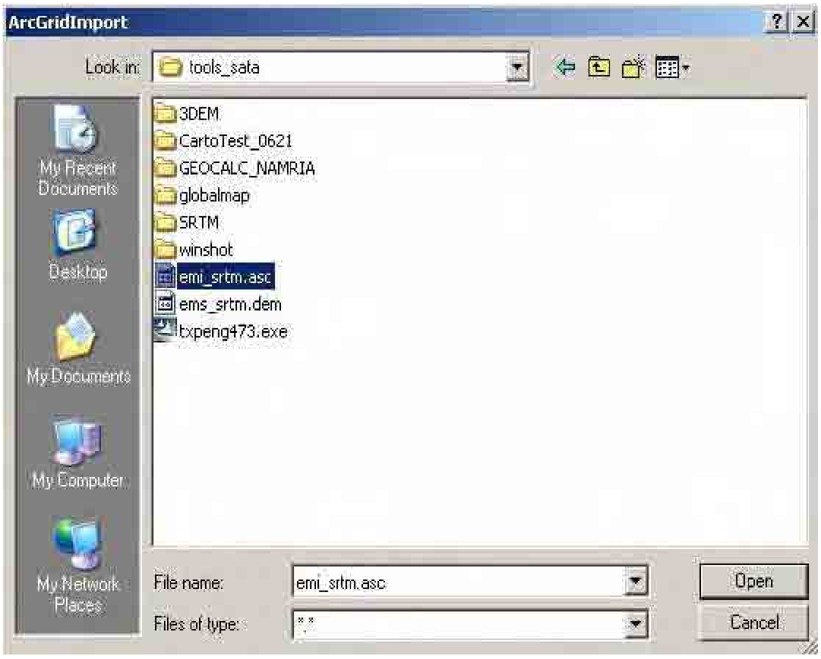

.Click “OK” in the “Arc ASCII Grid Export Options” and “Save As” dialog box will appear. Type the file name (e.g. emi_srtm.asc) in the “File Name” box. Then click “Save”.

3.1.5.5 Loading Arc ASCII Grid File into SOCETSET

1. .Open SOCETSET. Click “Preparation”, click “Import”, click “Terrain”, and select “ARC Grid”.


2. .An “ASCII ARC Grid Import” dialog box will appear.

3. .Click the Browse button. Locate and select the ASCII file (e.g. emi_srtm.asc) that was created. Then click “Open”.




4. .Type a file name (e.g. elmer_dtm.dth) in the “Output DTM File” box. Hit “Enter” in the keyboard. Then click “Start”.

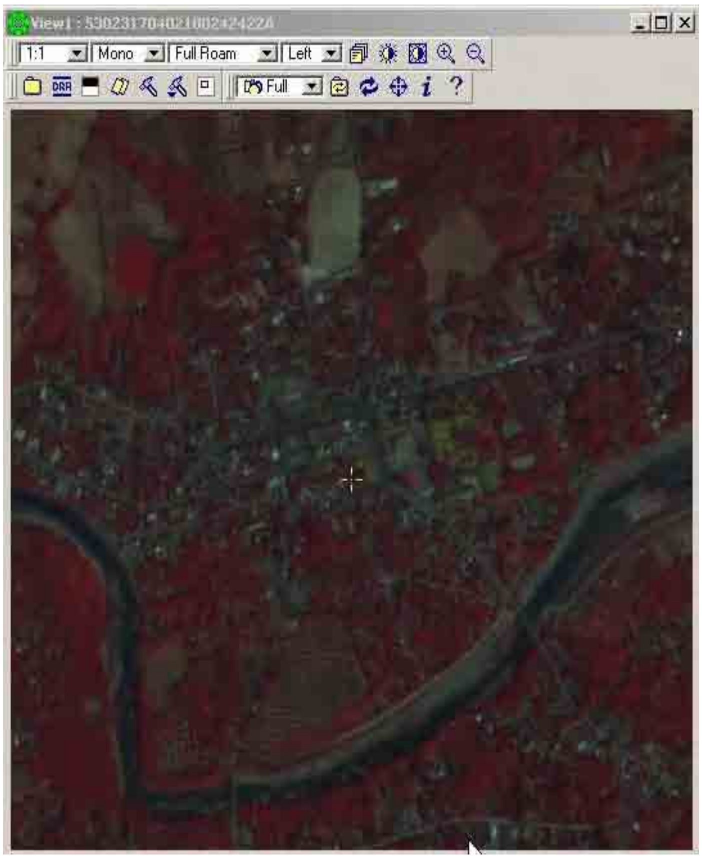

\

5. .Wait till the application process the conversion. Check the bottom box if conversion is successful.


6. .Click “File” and select “Load Images”.

7. .An “Image Loader” dialog box will appear. Create a view and select the required images to be used.


8. .The selected image (e.g. 53023170402100242422A) will be displayed in the view box created.



9. Click "Extraction", click "Terrain", and select "Interactive Edit".

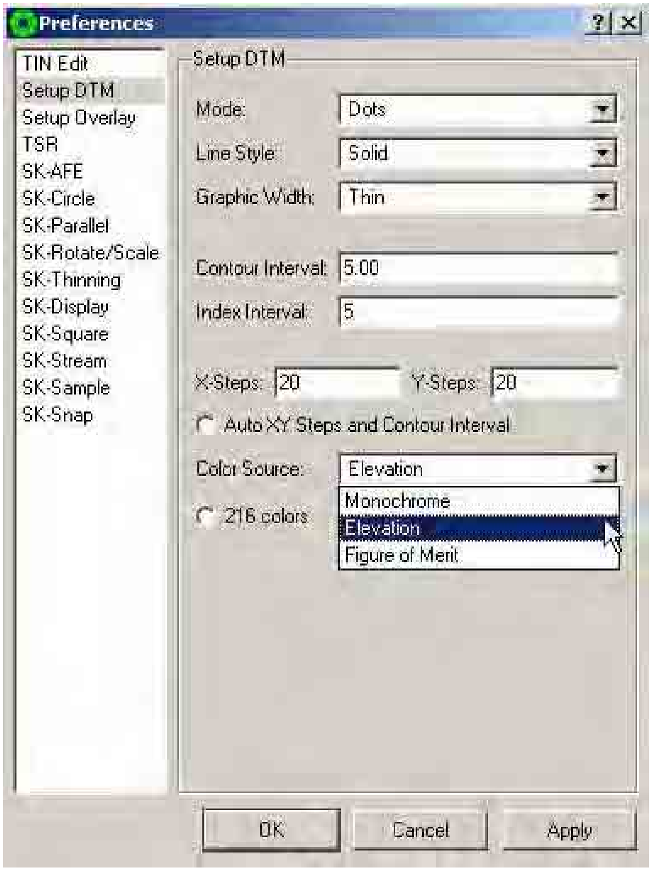

10. An "elmer_dtm – Interactive Terrain Edit" dialog box will appear. Click the "Open DTM" icon.


11. . A "Select a DTM" dialog box will appear. Select the dtm file (e.g. elmer_dtm). Then Click the "OK'.

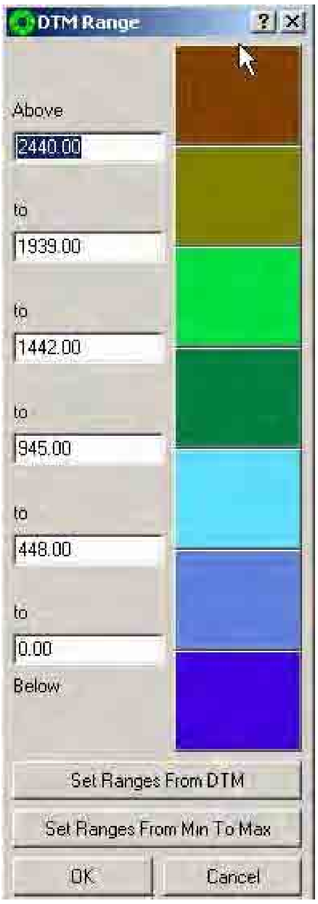
12. .Click “Setup DTM Graphis” icon in the “elmer_dtm – Interactive Terrain Edit” dialog box.


13. A “Preferences” dialog box will appear. Select “Elevation” in the “Color Source” box. Set “5” for “Contour Interval”, “5” for index Interval”. Set “20” for “X-Steps and “20” for “Y-Steps”. Then click “Edit Ranges”  button.



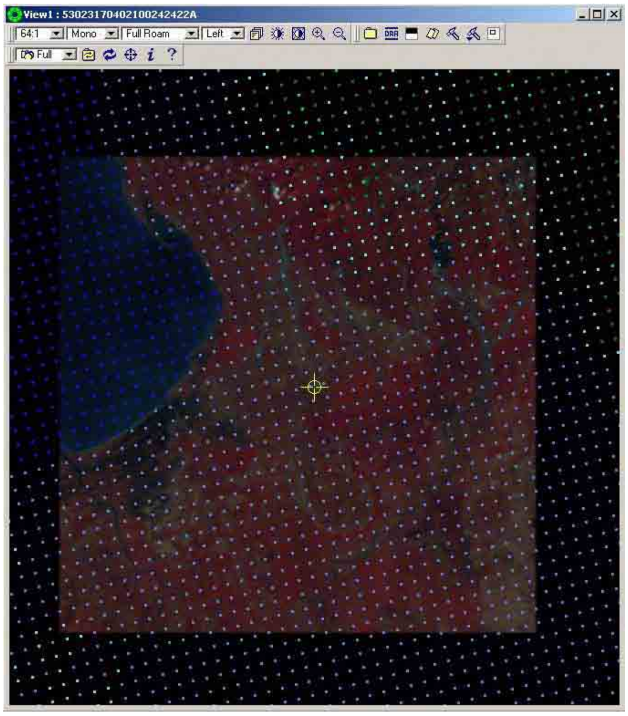


14. A “DTM Range” dialog box will appear. Set the elevation range boxes and the corresponding color for each range. Then click “OK”.

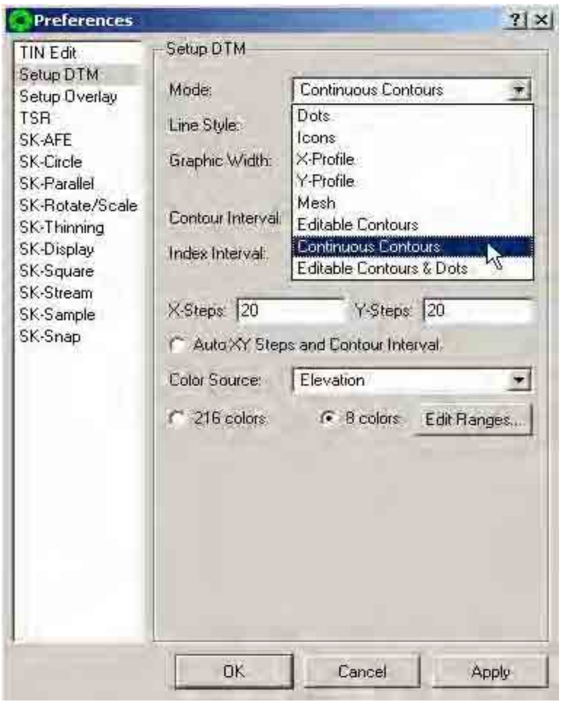



15. Click
“Draw Terrain Graphics” icon.

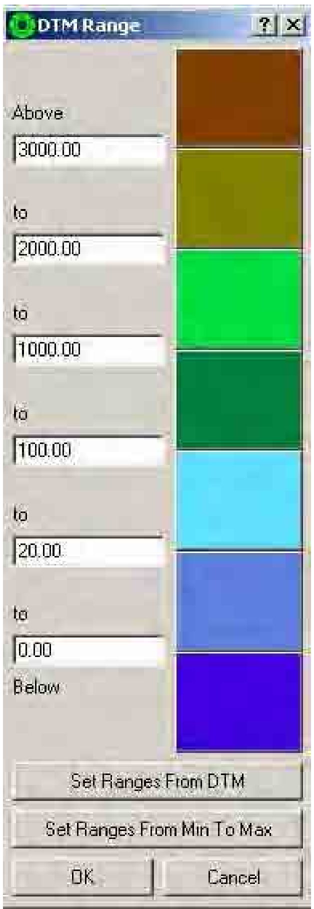
16. The mode (dots) selected in the “Preferences” dialog box will be displayed on the image.




17. Select “Continuous Contours” in the mode box. Then click “Edit Ranges”.

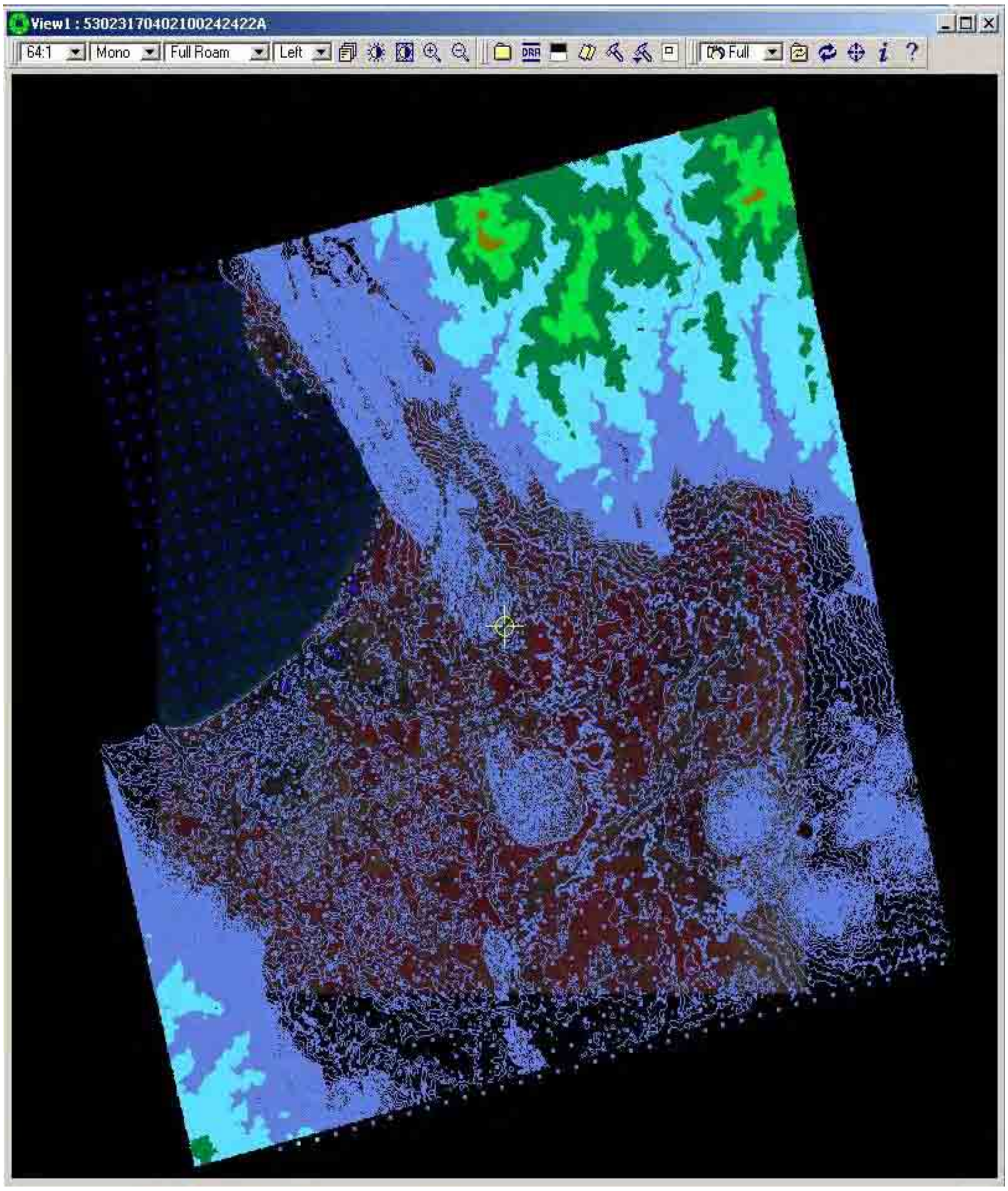


18. A “DTM Range” dialog box will appear. Set the elevation range boxes and the corresponding color for each range. Then click “OK”.



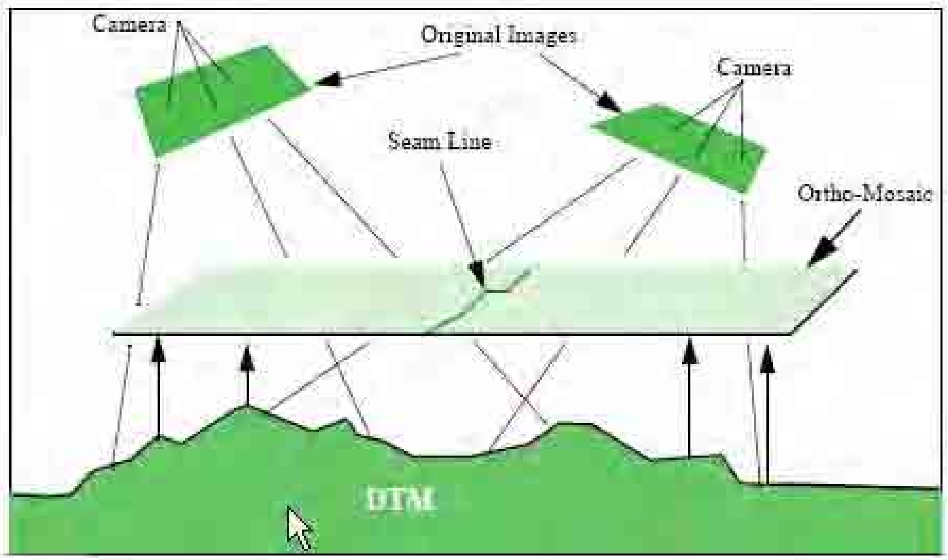

19. Click “Draw Terrain Graphics” icon.

20. The contours and the dots will be displayed on the image.



### 3.1.6 Orthomosaicking

In SOCET SET, a mosaic is an orthogonally corrected image produced (resampled) from one or more input images. An orthographic projection (parallel to Z axis) is used to project object space (ground space) to the output mosaic space. The mosaic process corrects the input images for all distortions due to camera geometry, terrain relief, radiometric adjustments, and radiometric seam feathering. The output image represents what you would see if you were looking straight down at the ground from an infinite distance above.




Its typical inputs include one or more controlled (triangulated) images or ortho-corrected images, a Digital Terrain Model (DTM) file, a feature database of seam polygons, and an output boundary.
Many of the inputs are optional and there are several options for radiometric balancing and feathering.

Mosaic can be run in batch or through the user interface. It permits making mosaics a "sheet at a time" from multiple images or single images as well as very large mosaic files. The options for joining the images include polygonal joining, most nadir joining, radiometric joining, and order of input (precedence). The most nadir option minimizes errors due to relief displacement since it uses the most orthogonal regions of each input image.

Mosaic has the unique capability to automatically balance the multiple input images for systematic differences caused by vignetting and hot spots as well as histogram enhancements. This is critical when mosaicking images of varying radiometric quality.

Mosaic is N bands in, N bands out and up to 2 byte in, 2 byte out. It will automatically generate a mosaic with the number of bands and bytes equal to the number of bands and bytes (up to 2) in the input imagery.

Mosaic permits the input of different types of images from different types of sensors and at different Ground Sample Distances (GSD). Since you can choose the output pixel size or ground sample distance, you can quickly create an overview of your mosaic for quality checking and refining your inputs.

The following is a list of options/capabilities:

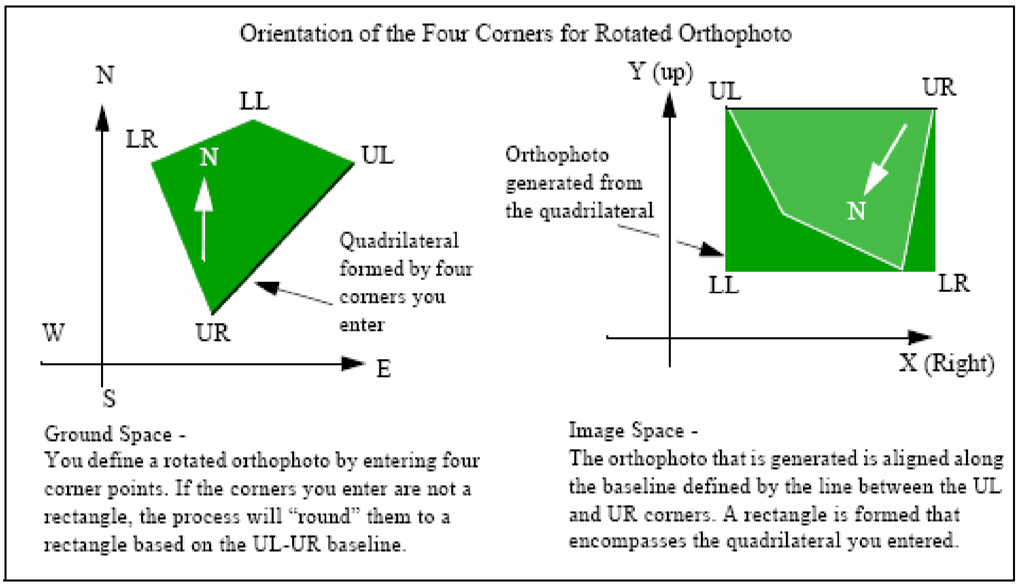
- Outputs any ground sample distance (pixel size).
- Constructs seamlines with “nearest nadir,” “radiometric,” or “input order (precedence),” methods. Can also use a feature file containing seam polygons (a polygon region for each input image).
- Crops the output on polygonal boundaries.
- Creates an output boundary of 2 or 4 points at any rotation angle.
- Re-samples images with nearest neighbor, bilinear, or bicubic methods.
- Can work without a DTM, using a single elevation for the correction surface.
- Inputs controlled images or orthophotos or mosaics.
- Automatically balances the images during mosaicking.
- Feathers imagery along the seams to reduce seam visibility.
- Combines black and white or color images from different sensor types and resolutions.
- Uses any project coordinate system including geographic.
- Can cut the output mosaic into rectangular “sheets”

**Shape and Orientation of the Orthophoto**

There are two ways you can specify the shape and size of the output orthophoto.

1. You can specify a rectangular orthophoto by entering the locations of two opposite corners (upper-right and lower-left). This approach also yields a rectangle oriented along lines of north-south and east-west.
2. You can create a rotated orthophoto by entering all four corners of the output boundary.

This permits you to output Mosaics that are rotated with respect to the project coordinate system north-south lines. You might use this capability, for example, to generate orthophotos that follow transportation routes. When you define the four corners of such a quadrilateral, the definitions of the corners can be confusing. The following figure illustrates the convention. The key point to remember is that the corners (UL, UR, LL, LR) are defined with respect to output image space, not ground space. Note that the generated mosaic will be a rectangle, regardless of the shape of the quadrilateral that you enter.



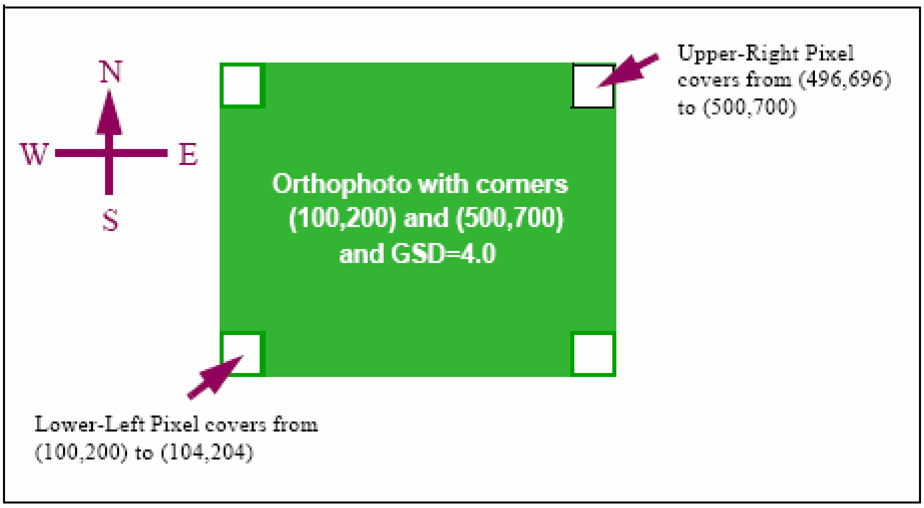
No

matter how you choose the shape, you may specify an orthophoto boundary that exceeds the extent of the input image(s). In this case, the orthophoto imagery is set to black where no input
imagery is available.

**Corner Point Definition**

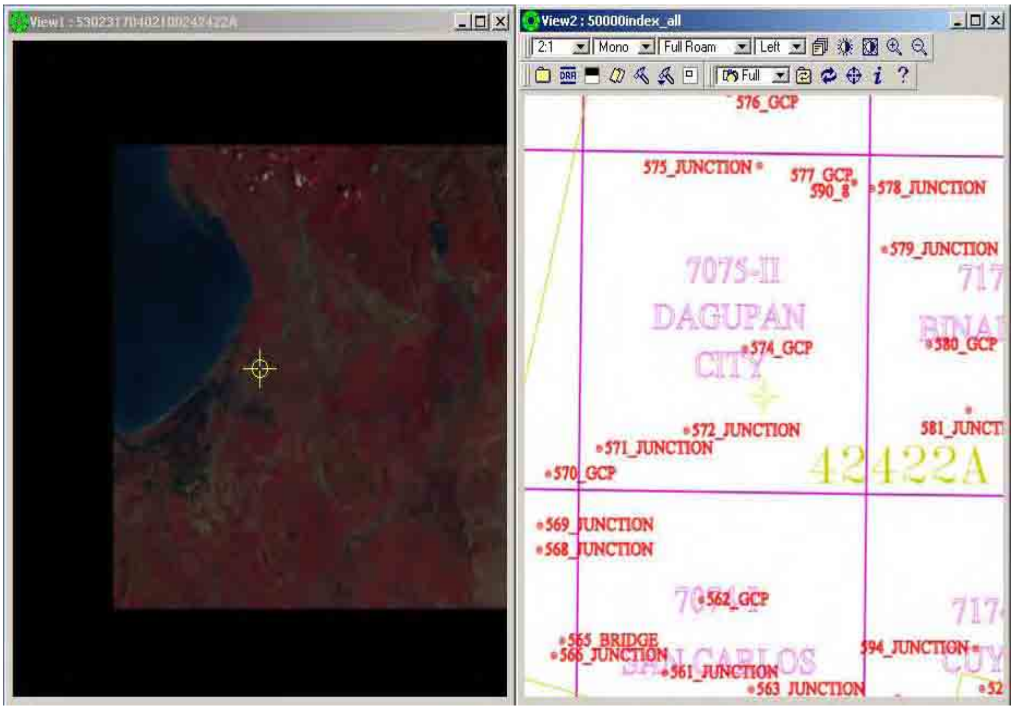
In two-corner boundary mode, the lower-left corner you enter is the “origin” of the corner definition. Orthophoto will always use the value you enter as the lower left corner of the lowerleft pixel of the orthophoto and the other corners will be an exact multiple of pixels (GSD intervals) from this corner. The corner locations represent the outer edges of the orthophoto pixels. For example, if you have a ground sample distance of 4 meters and the lower left corner is (100, 200) then the lower-left pixel extends from (100, 200) to (104, 204). And if the upper-right corner is (500, 700) then the upper-right pixel extends from (496, 696) to (500, 700). The size of this orthophoto is 400 x 500 meters, and the number of pixels is 100 x 125.

A consequence of this convention is that you can create abutting orthophotos by entering the same values for adjacent edges. For example, if your first orthophoto has a lower left corner of (100, 200) and an upper-right corner of (500, 700) then the abutting orthophoto of the same size to the right (east) will have corners of (500, 200) and (900,700). The abutting orthophoto to the north (of the same size) will have corners (100,700) and (500, 1200).



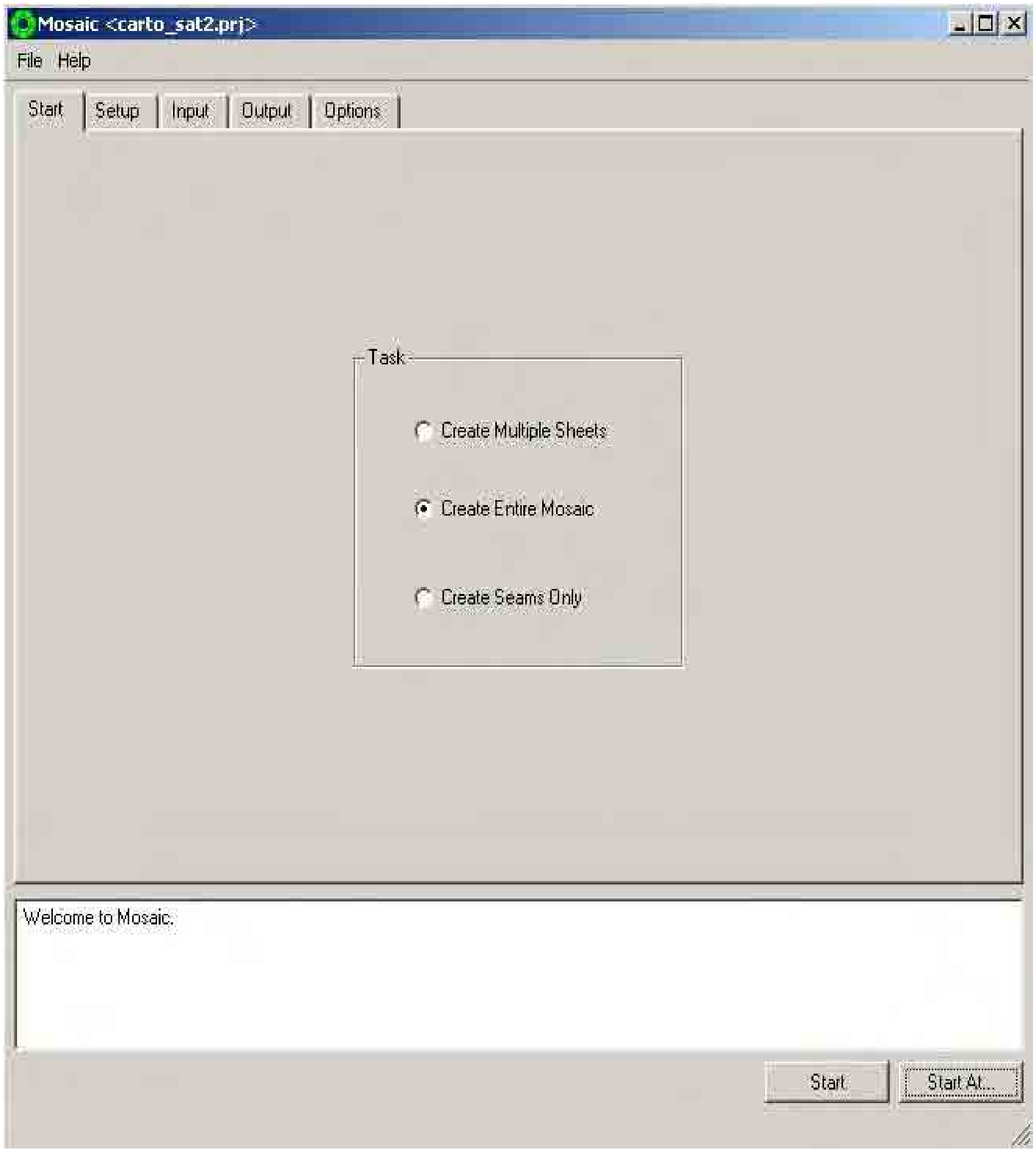
3.1.6.1 Orthomosaicking using one image

1. Open “SOCETSET” and load “Project”. Then load the satellite image (e.g. 530231704021002424222A) to be mosaic and the index image (e.g. 50000index_all) to be used to locate approximately the limit of the area to be processed.

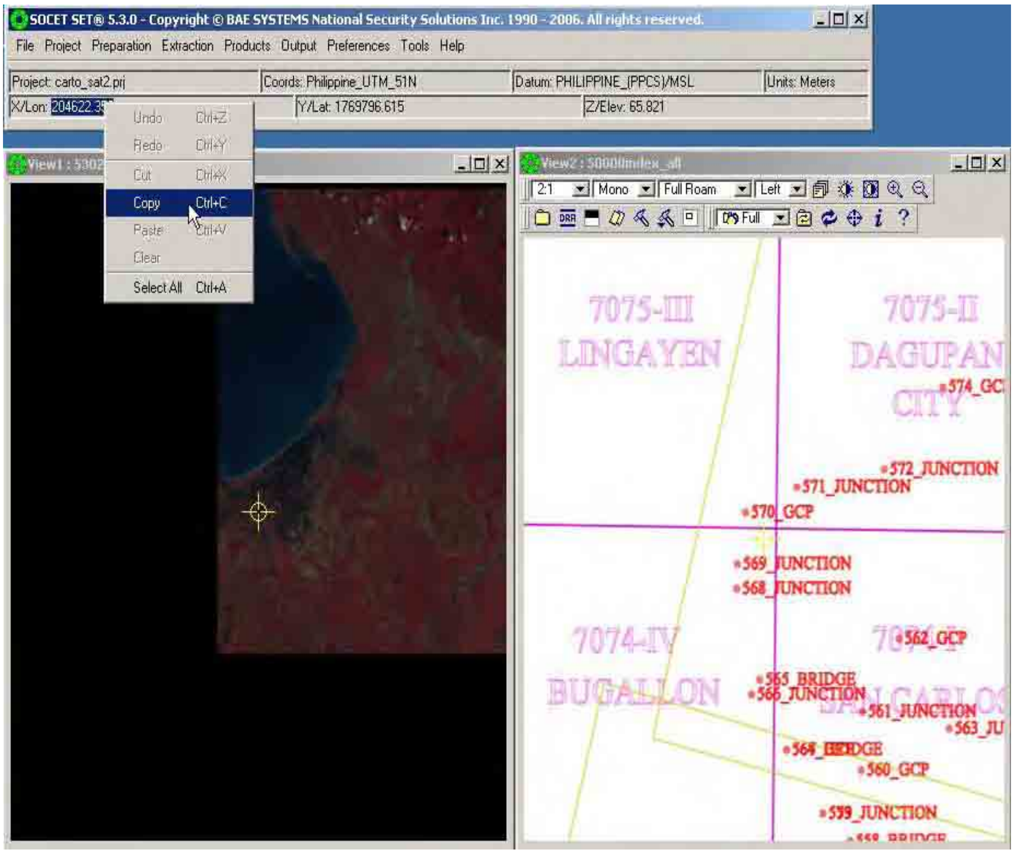



2. Click “Product”, click “Mosaic” and select “Mosaic.

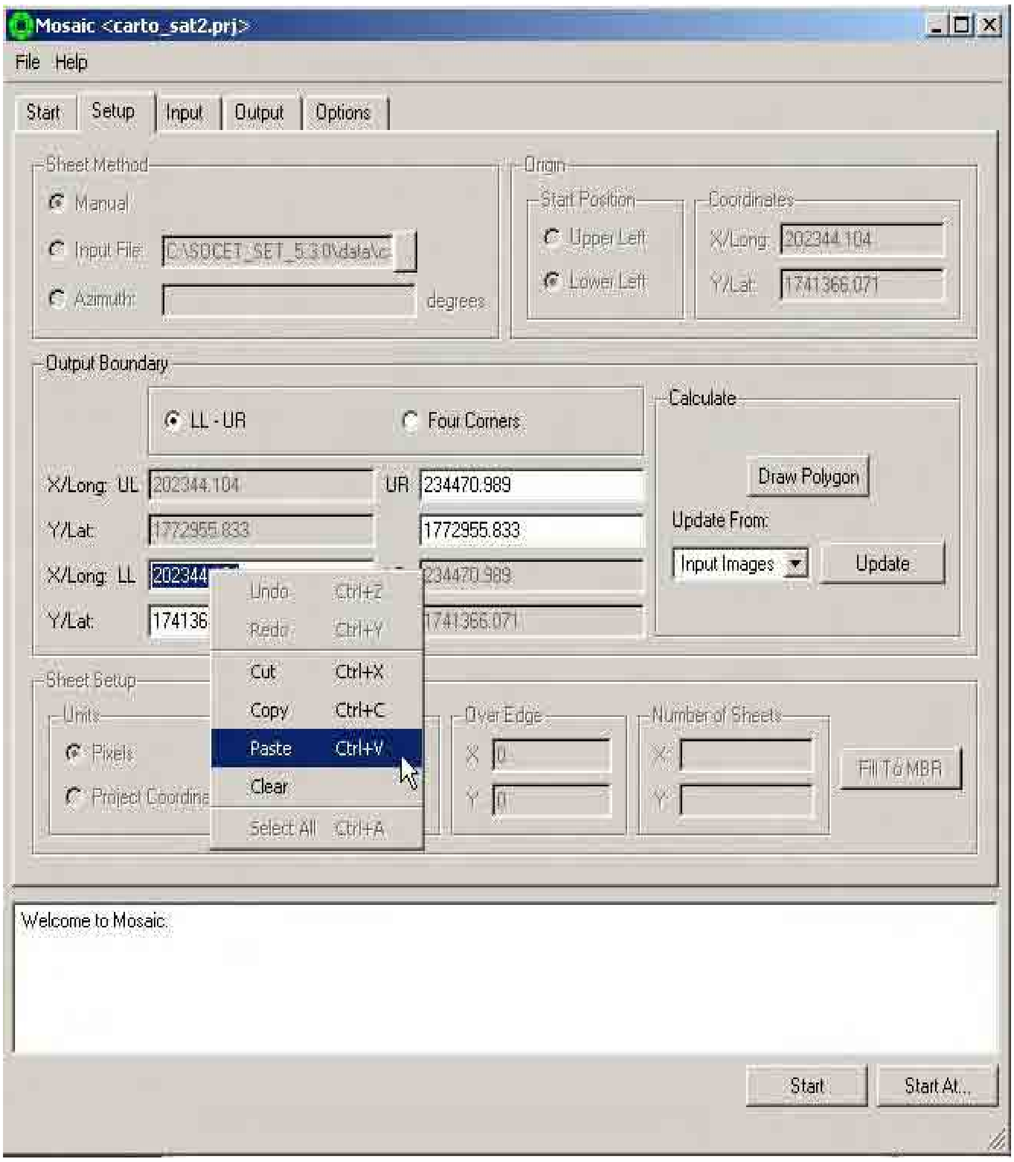
3. A “Mosaic” dialog box will appear. Click “Setup” tab.



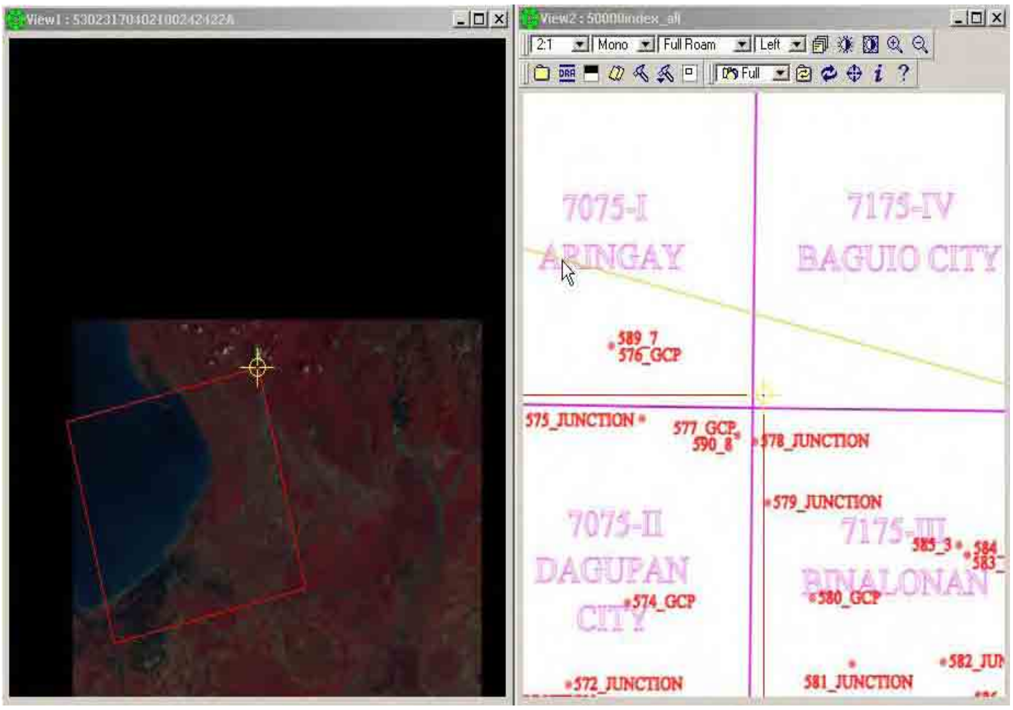
4. Using the 50000_index image, move cursor to the point at lower left corner of the map sheet (e.g. 7075-II Dagupan City) limit to determine the lower left coordinates. Highlight the X/Lon (e.g. 204622.352), click right mouse button and select copy.



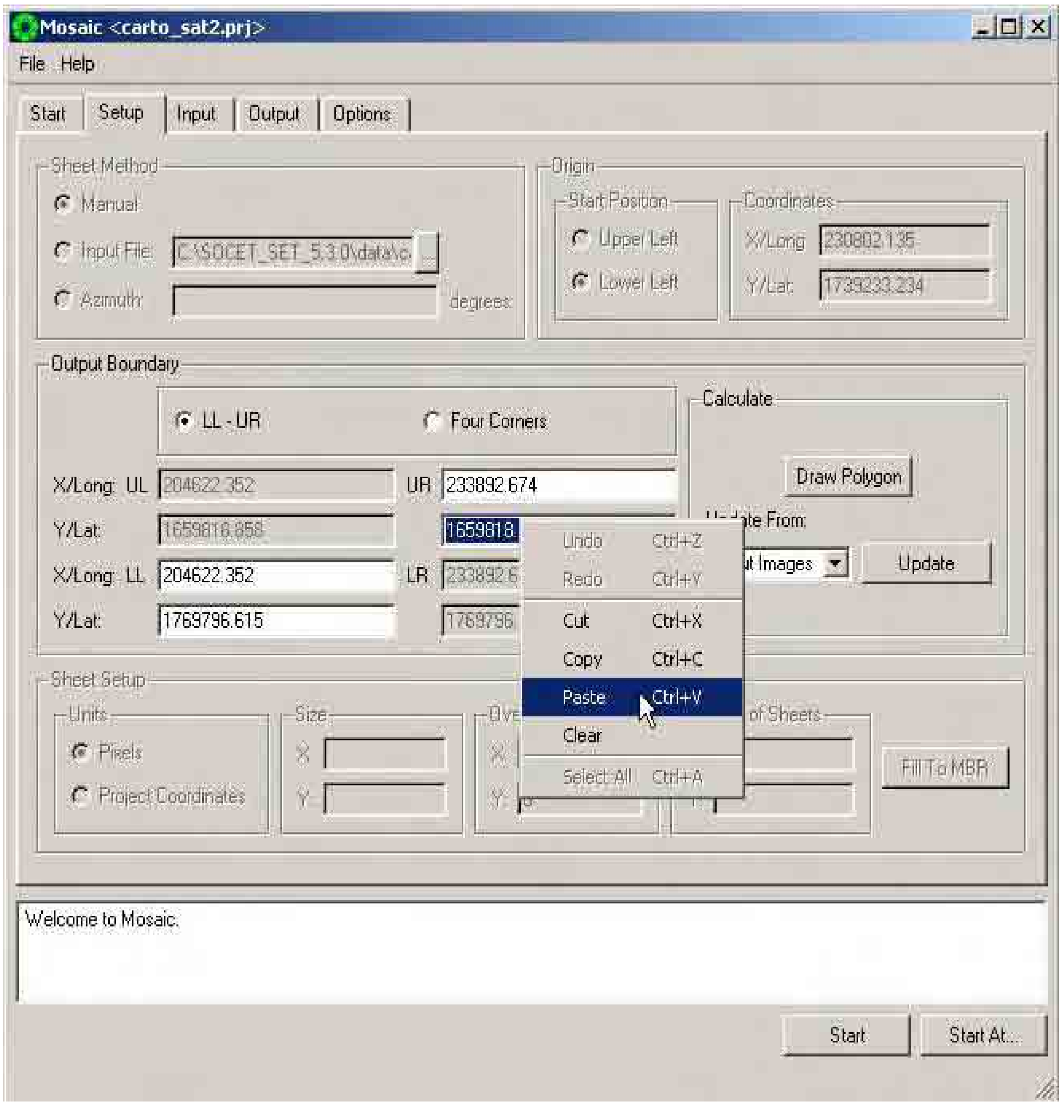
5. Paste the value in the ”X/Long. LL” box of the “Mosaic” dialog box. Repeat step, this time copy Y/Lat and paste it in ”Y/Lat” box.



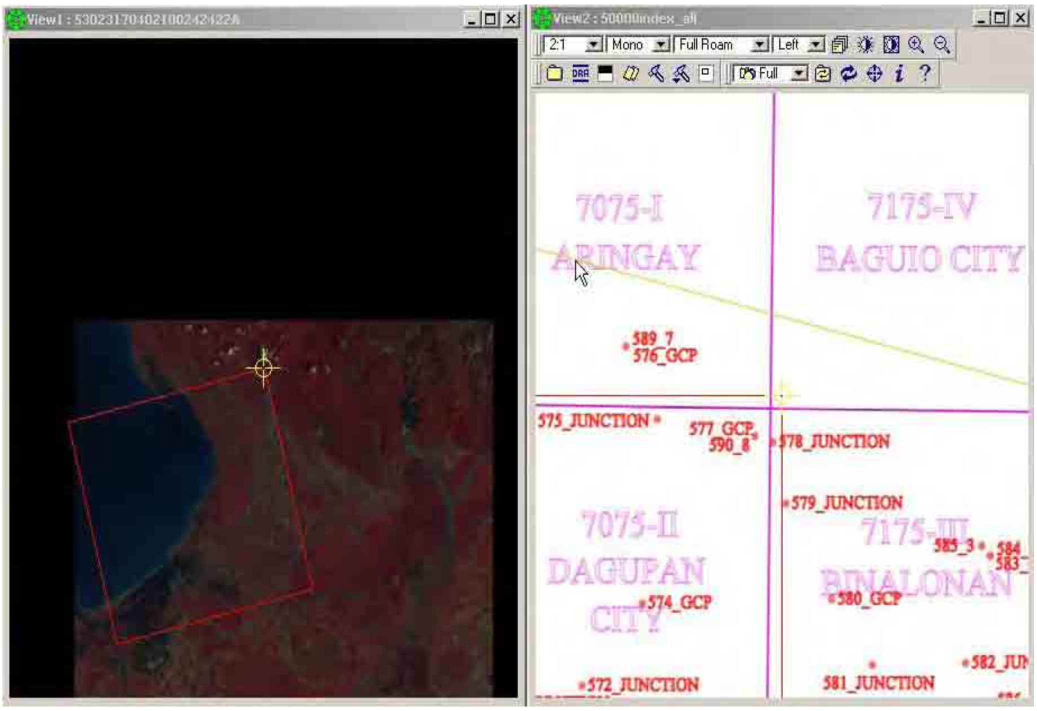
6. Move cursor to upper right corner of the map sheet (e.g. 7075-II Dagupan city) to determine the coordinates. Highlight X/Lon, click right mouse button and select copy.



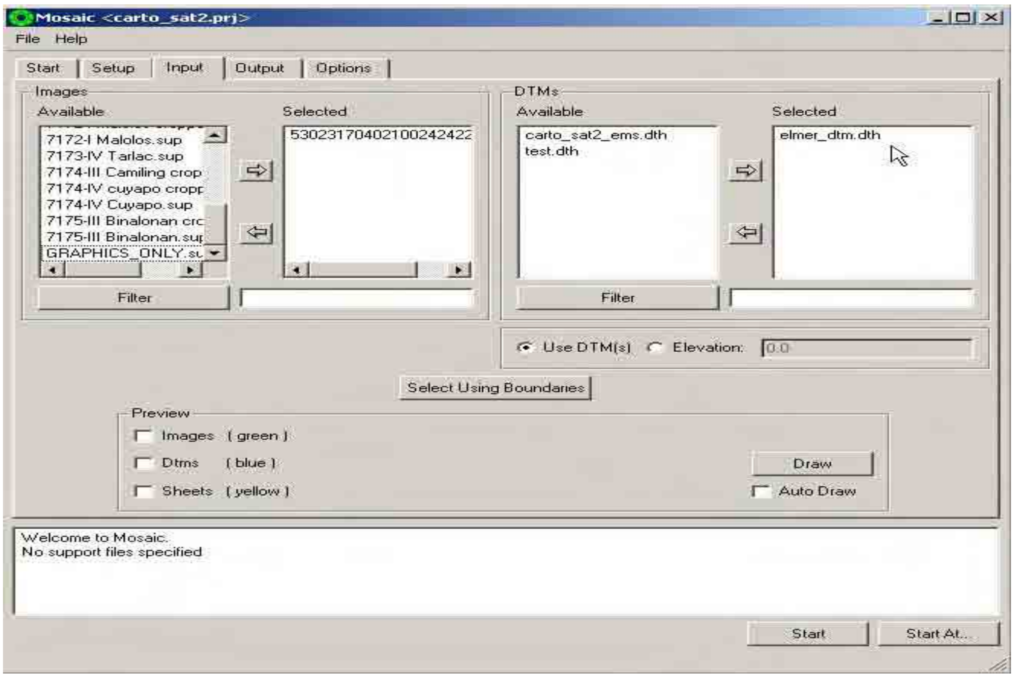
7. Paste the value in the X/Long. UR box of the “Mosaic” dialog box. Repeat step, this time copy Y/Lat and paste it in Y/Lat box.



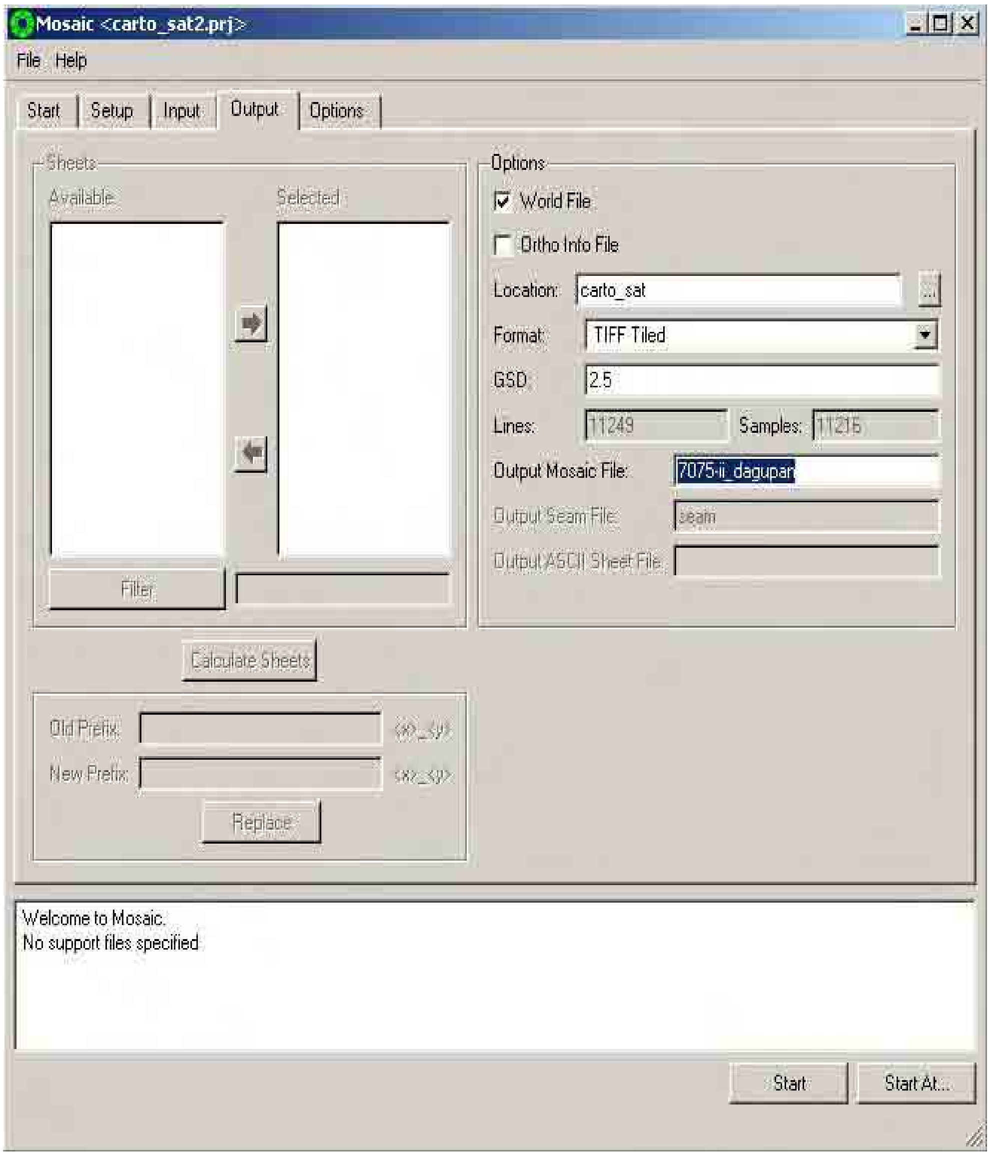
8. A polygon will be created.



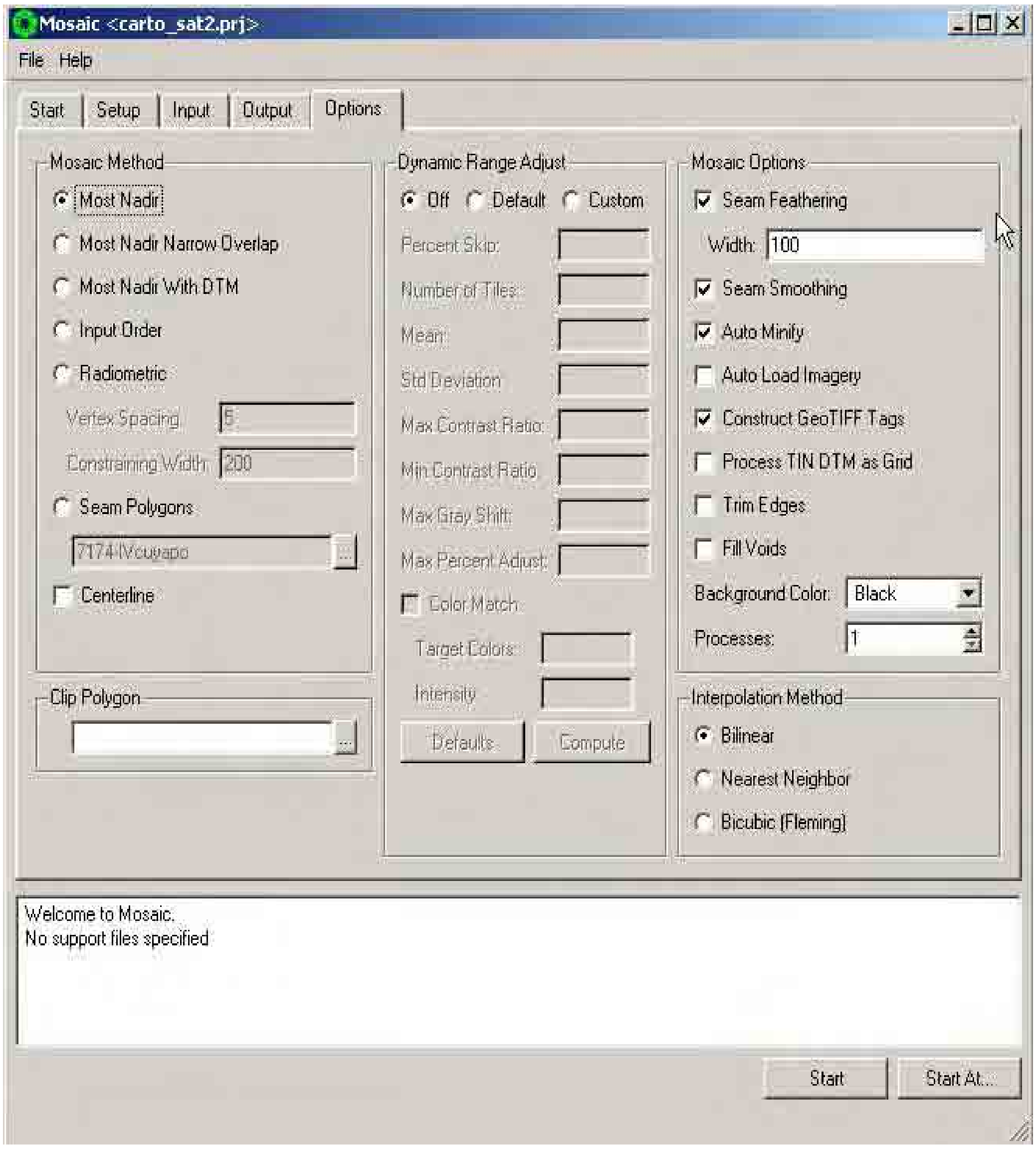

9. Click "Input" tab, select the needed satellite image in the "Available" image box and click arrow. Select the DTM file (e.g. elmer_dtm.dth) in the "Available" DTM box and click arrow.



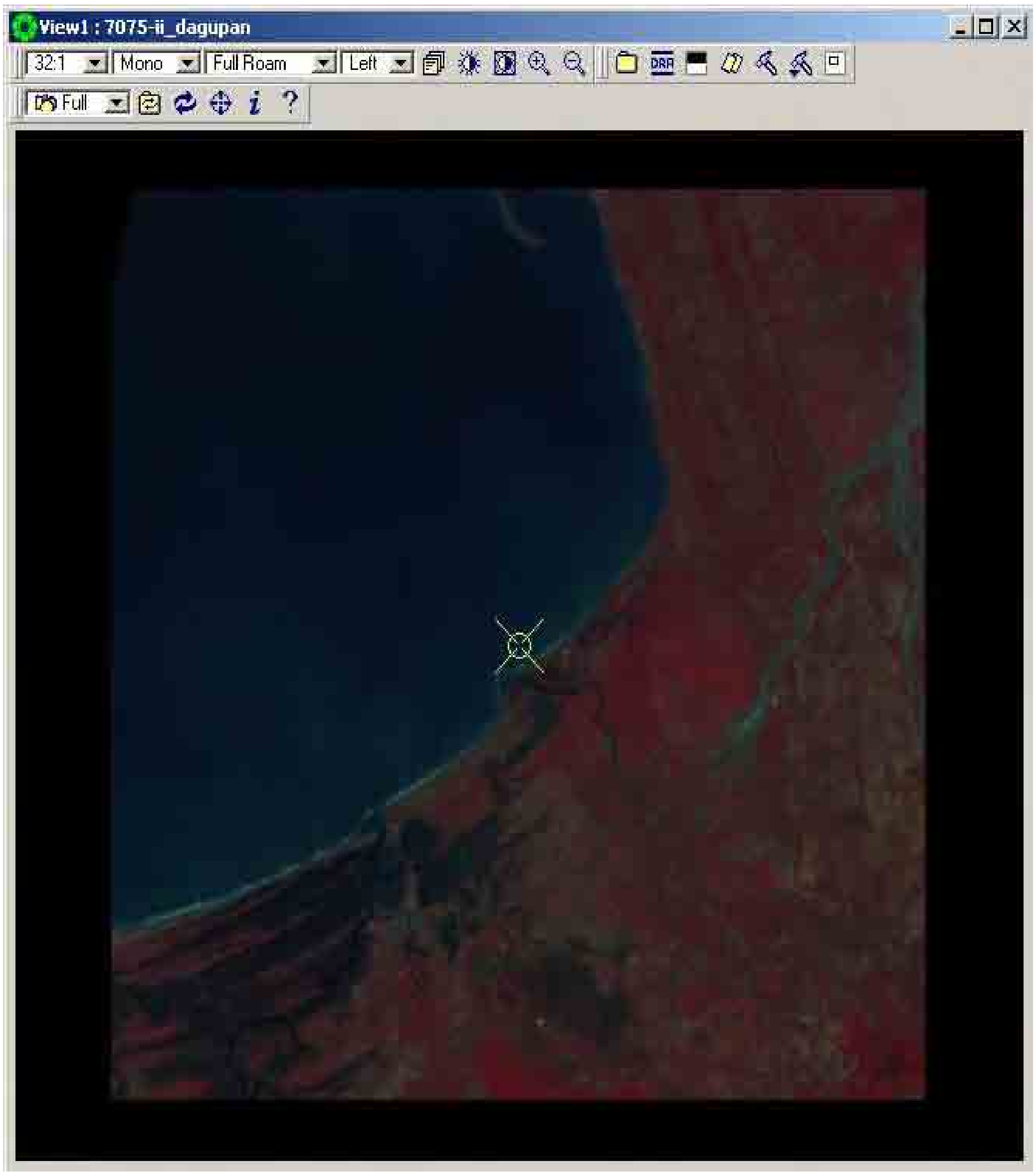
10. Click “Output” tab, check “World File”. Set “TIFF Tiled” in “Format. Set “2.5” in “GSD” (Image Resolution). Type output file name (e.g. 7075-II_dagupan) in the “Output Mosaic File” box. Locate and select project file (e.g. carto_sat) same as the one created in the “Create Project”.



11. Click “Options” tab, check “Most Nadir”. Set width to “100”. Check “Seam Feathering”, “Seam Smoothing”, “Auto Minify”, “Construct GeoTIFF Tags” and “Bilinear”. Then click “Start”.



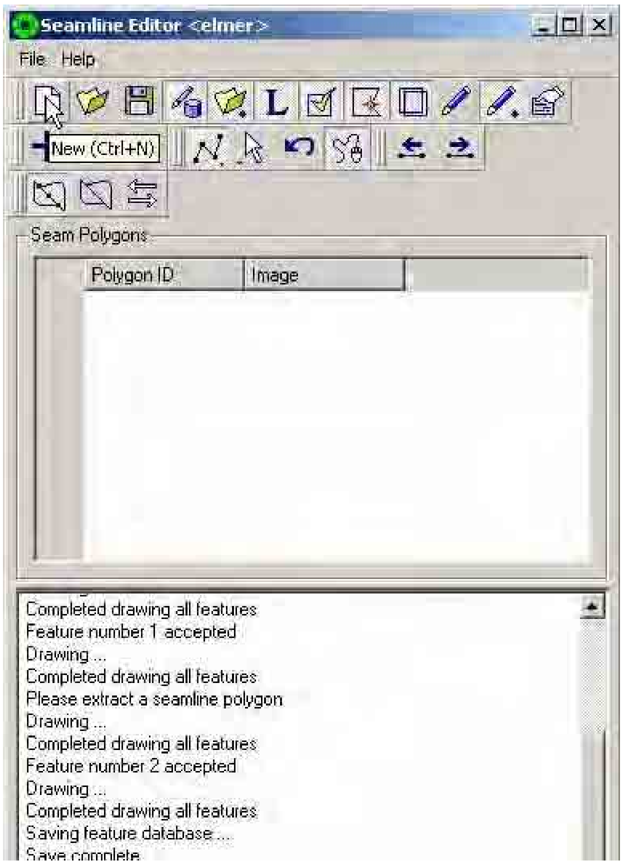
12. After processing, create a view window and load the image (e.g. 7075-II_dagupan)



3.1.6.2 Orthomosaicking using two images

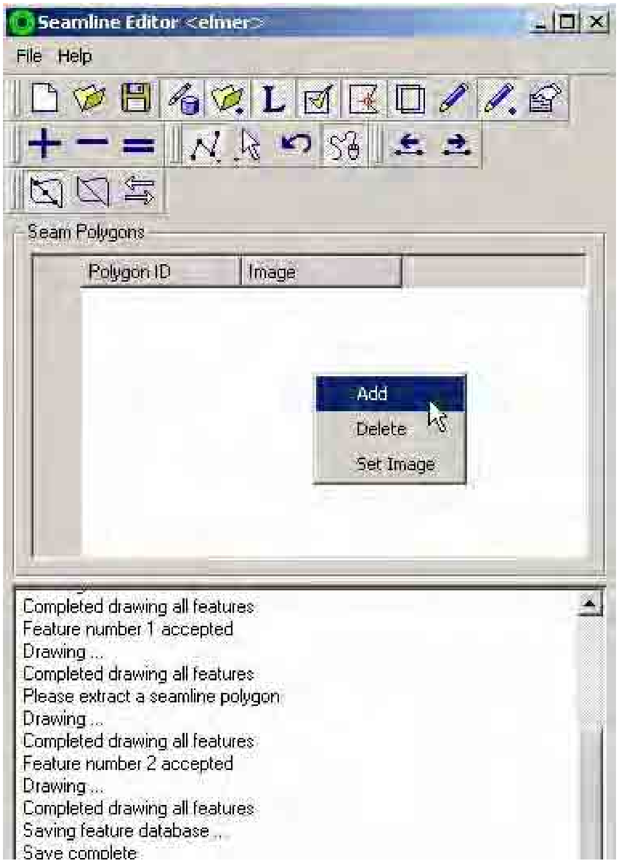
1. Click "Products", select "Mosaic", and click "Seamline Editor".


2. A "Seamline Editor" dialog box will appear. Click the "New" icon.



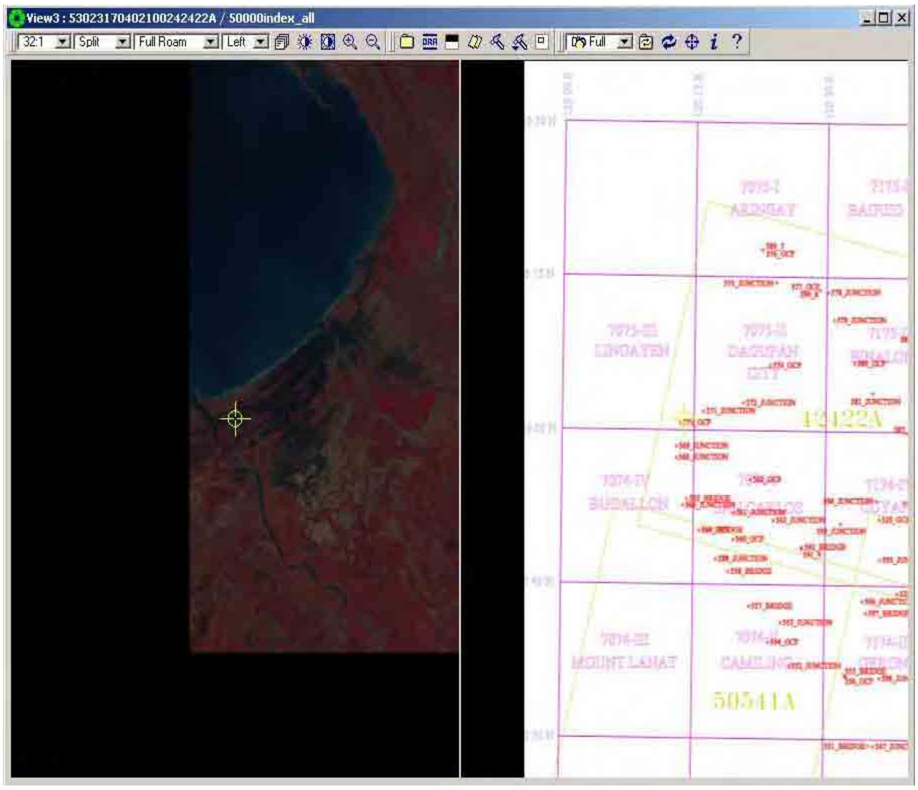
3. A ”Select a FDB” dialog box will appear. Type desired name (e.g. elmer). Then click “OK”.


4. Put mouse arrow inside the “Seam Polygons” box and click right mouse button. Click the “Add” button.

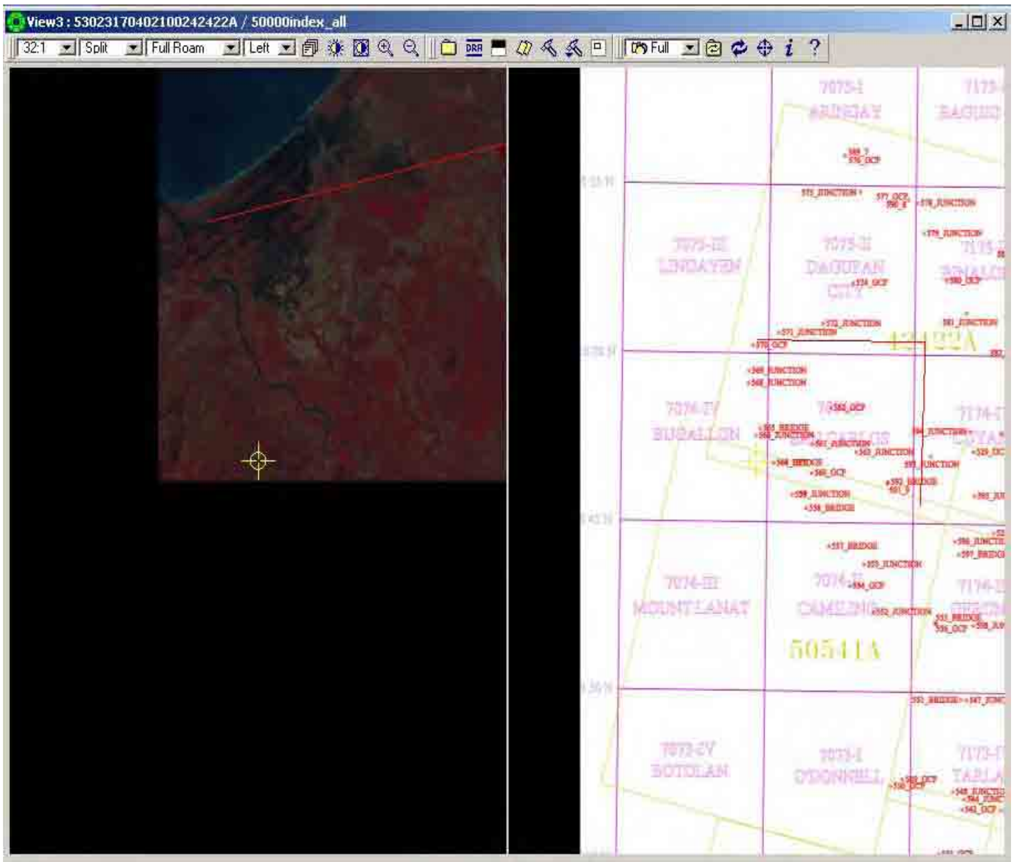


5. A “Select An Image” dialog box will appear. Select the required image (e.g. 53023170402100242422A.sup). Then click “OK”.

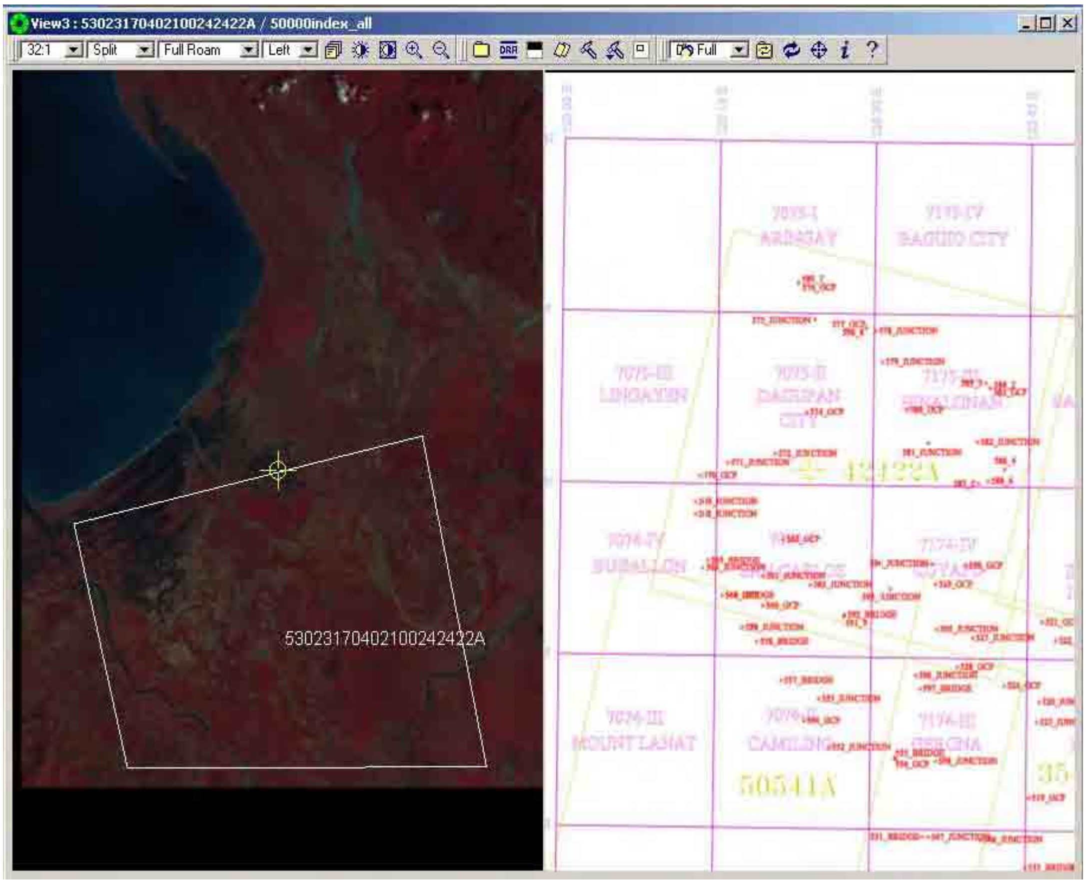

6. The selected image will be displayed in the view window. Split the view window showing the selected image on one side and load the index image on the other side.



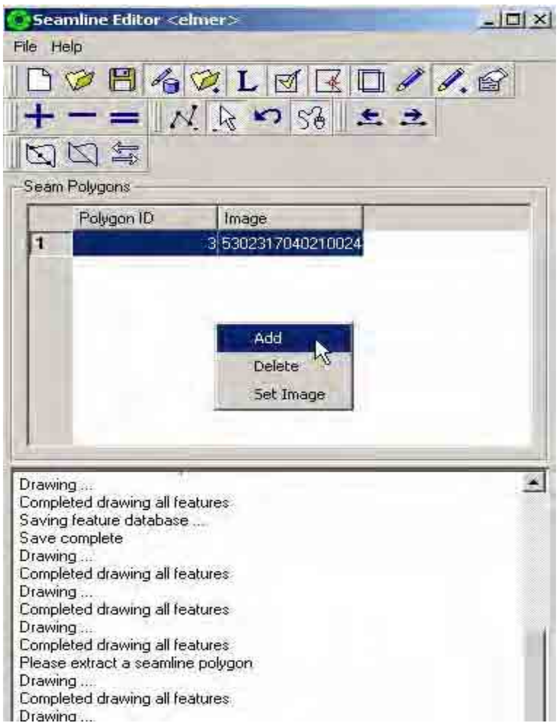
7. Hit “F3” in the keyboard and start digitizing the corners of the polygon covering the area limit of the image included in the map sheet (e.g. 7074-I_San Carlos). The index image will serve as the basis in determining the approximate position of the corners of the polygon that will cover the image limit.



8. Click right mouse button to close the polygon. Hit “F3” again to stop the digitizing process.

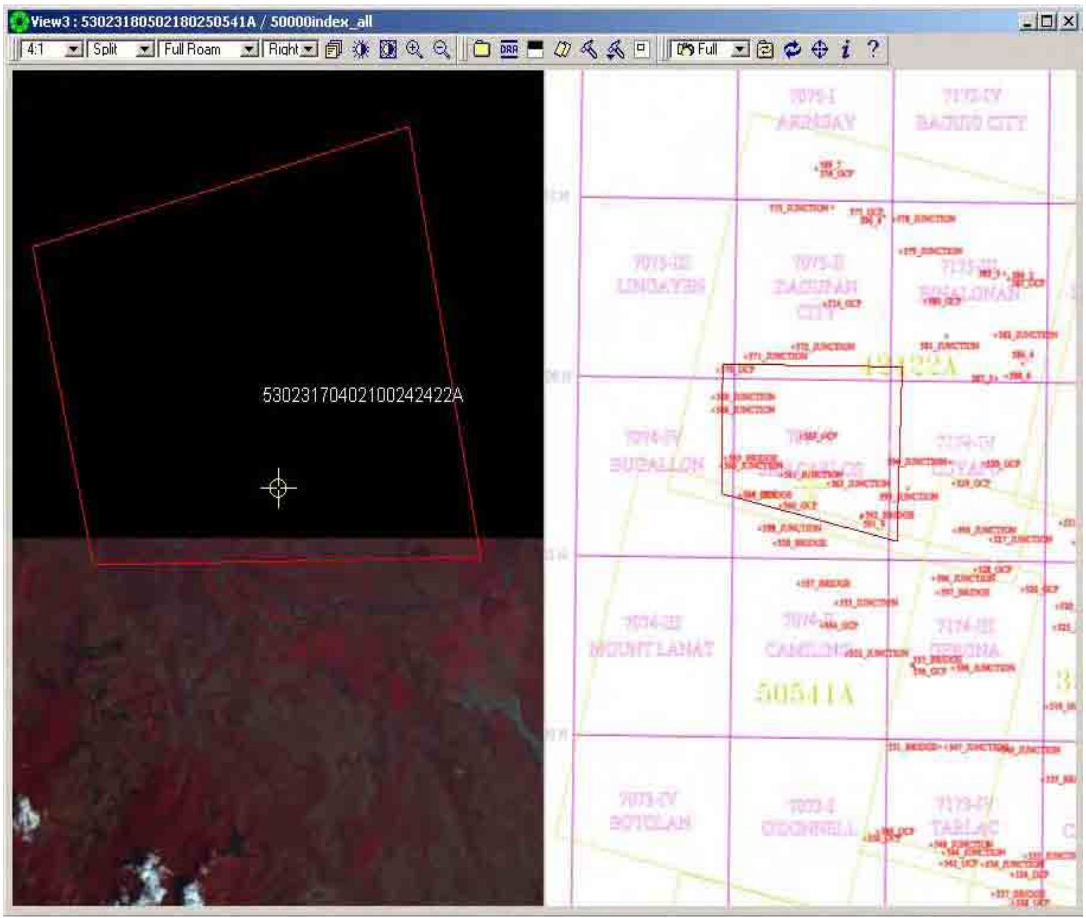


9. Since the map sheet (e.g. 7074-I_San Carlos) is covered by two images, we must select the next image. Put mouse arrow inside the "Seam Polygons" box and click right mouse button. Click the "Add" button.

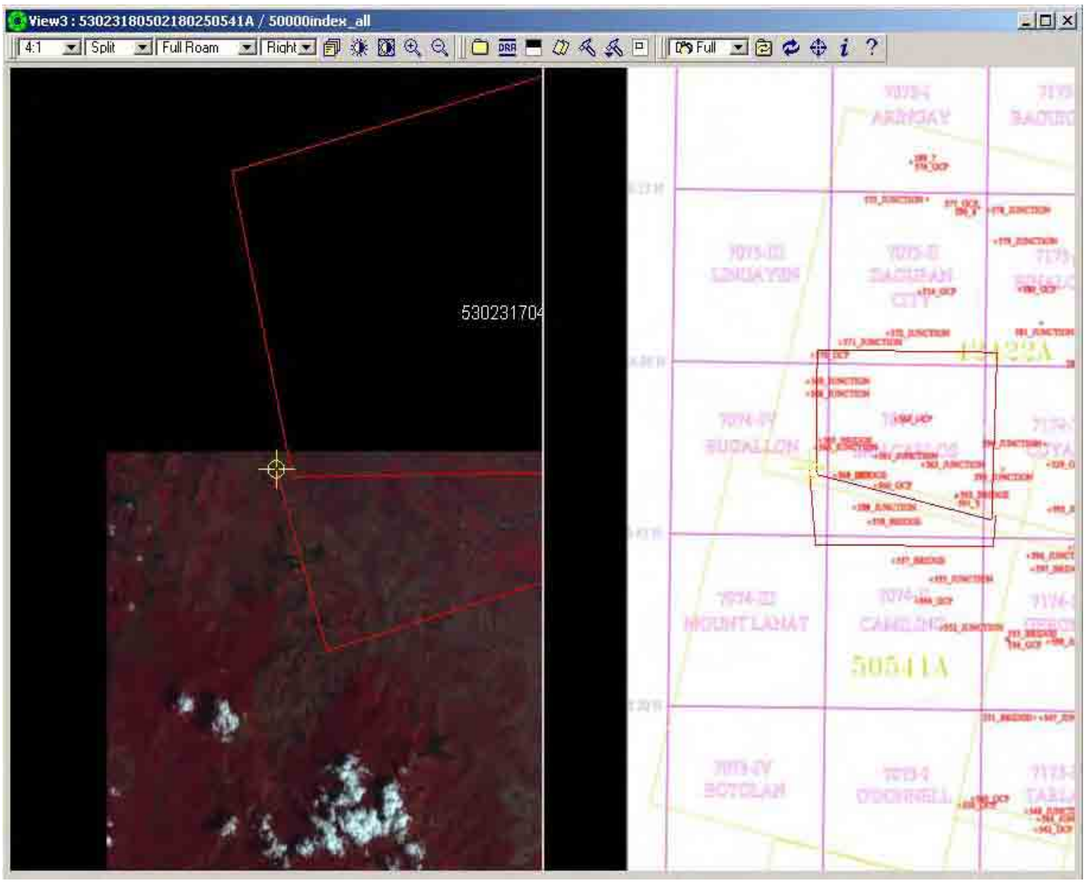



10. In the "Select An Image" dialog box, select the next image (e.g. 53023180502180250541A). Then click "OK".

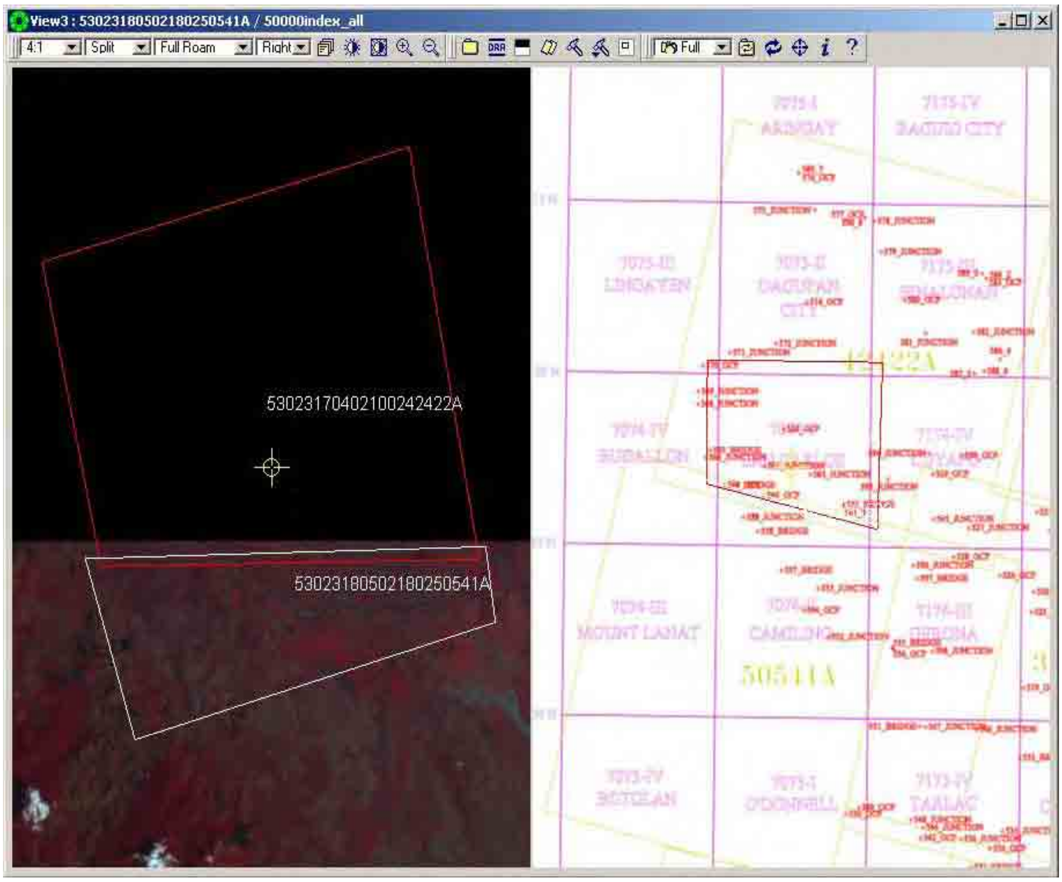
11. The selected mage will be displayed in the view window.



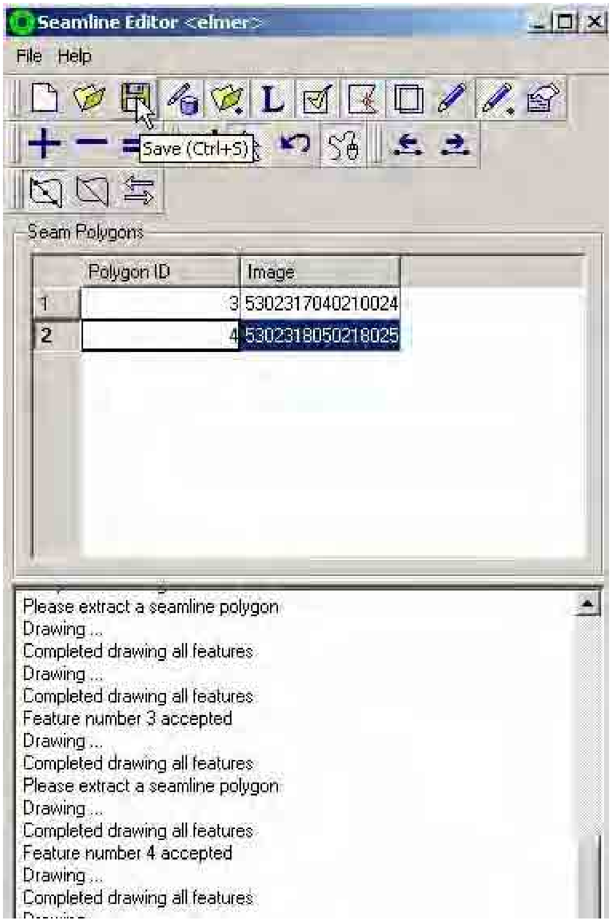
12. Hit "F3" in the keyboard and start digitizing the corners of the polygon covering the area limit of the other image included in the map sheet (e.g. 7074-i_San Carlos). The index image will be the basis in determining the approximate position of the corners of the polygon that will cover the image limit.



13. Click right mouse button to close the polygon. Hit “F3” again to stop the digitizing process.

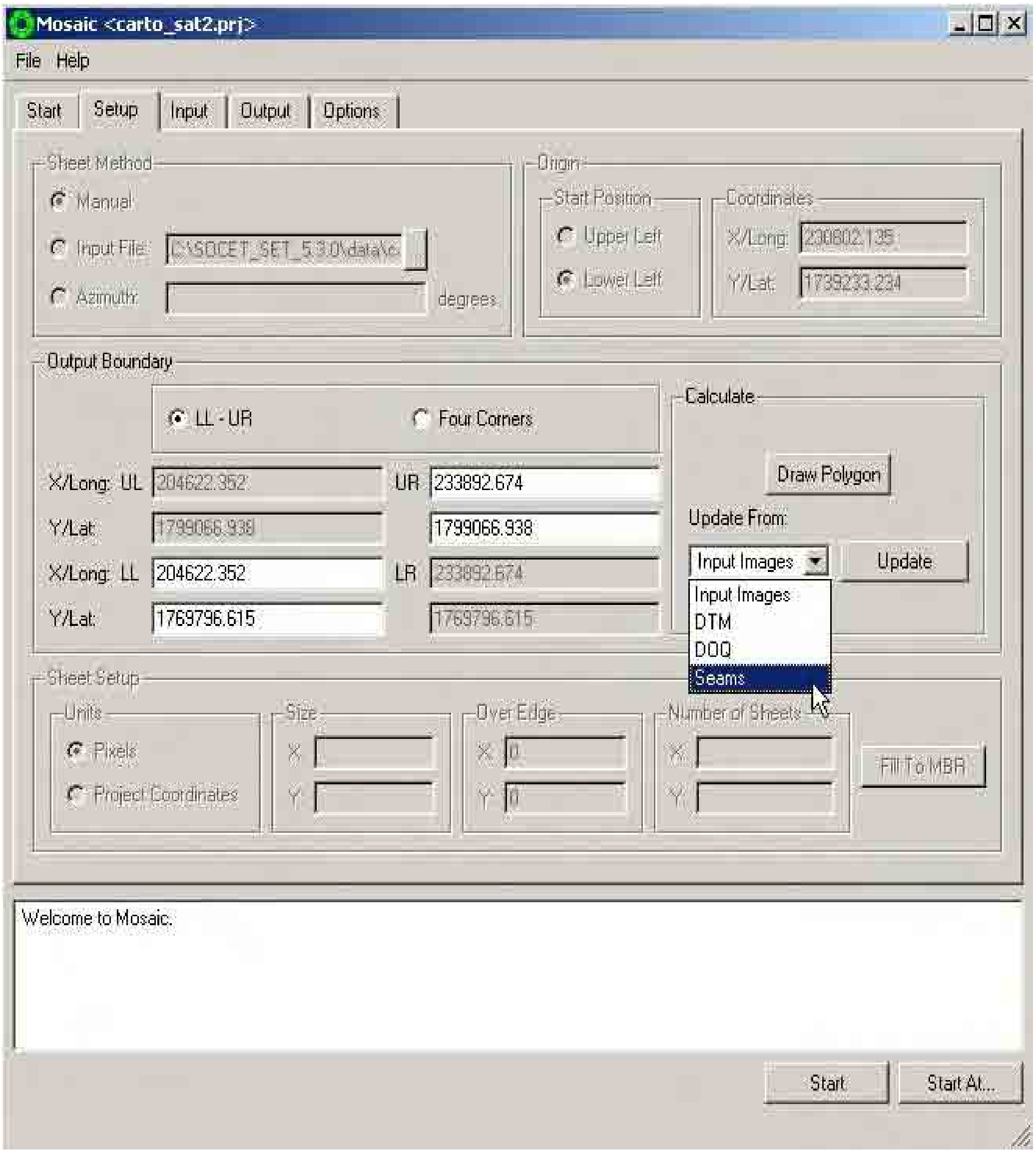


14. Click “Save” icon.

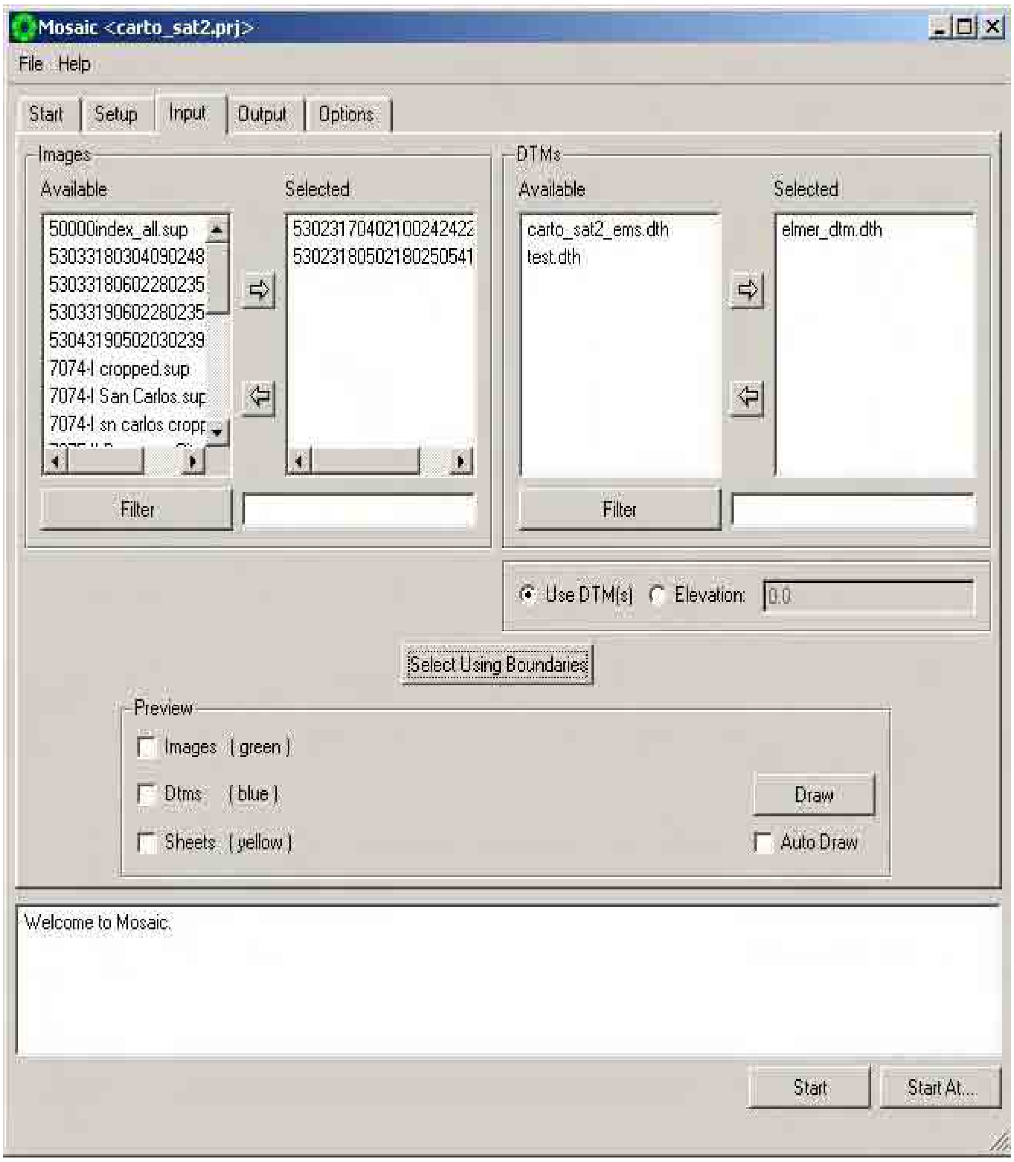



15. Click “Products”, select “Mosaic” and click “Mosaic.

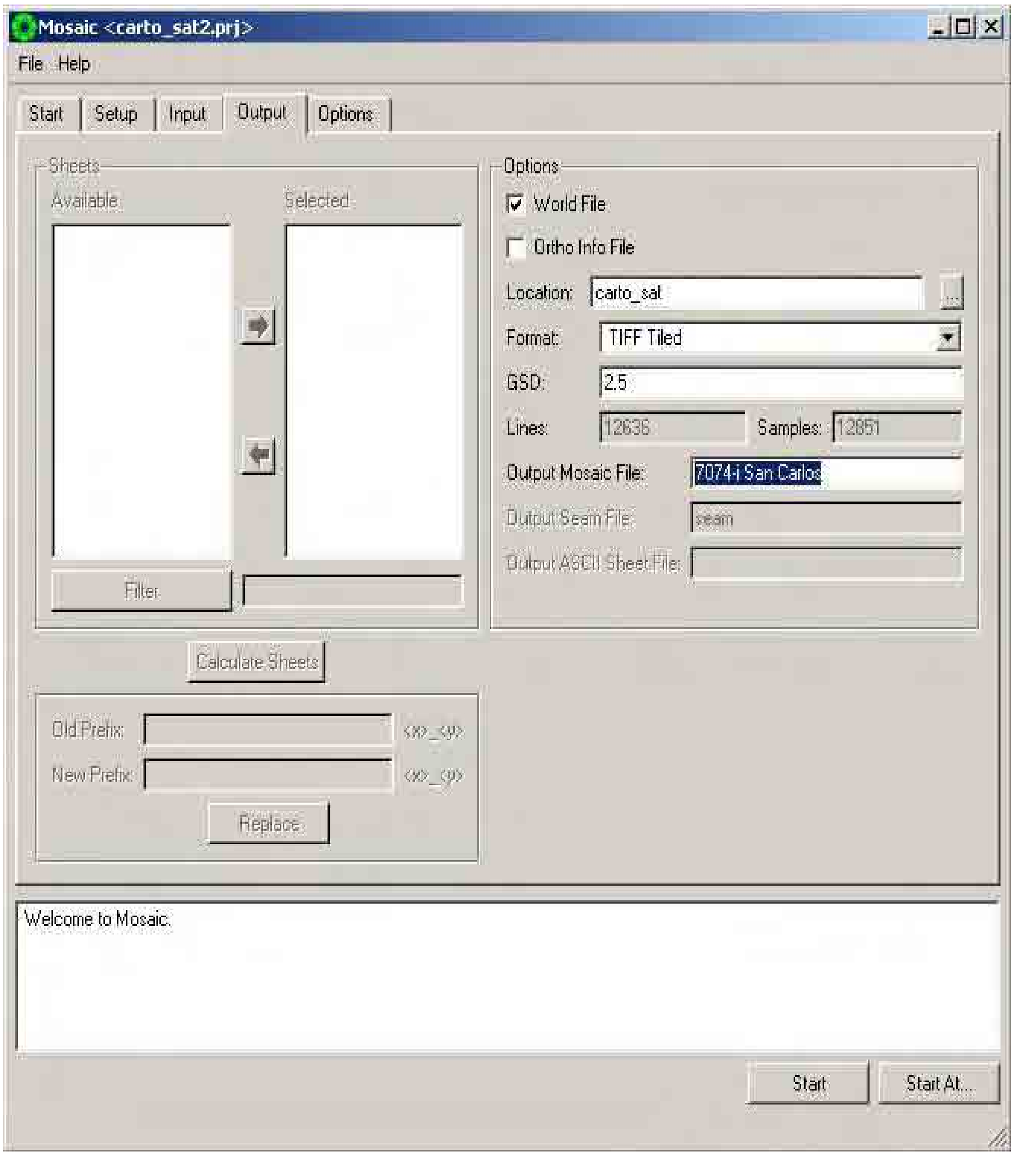
16. A “Mosaic” dialog box will appear. Click “Setup” tab. Click down arrow and select “Seams” in the “Update From” box.



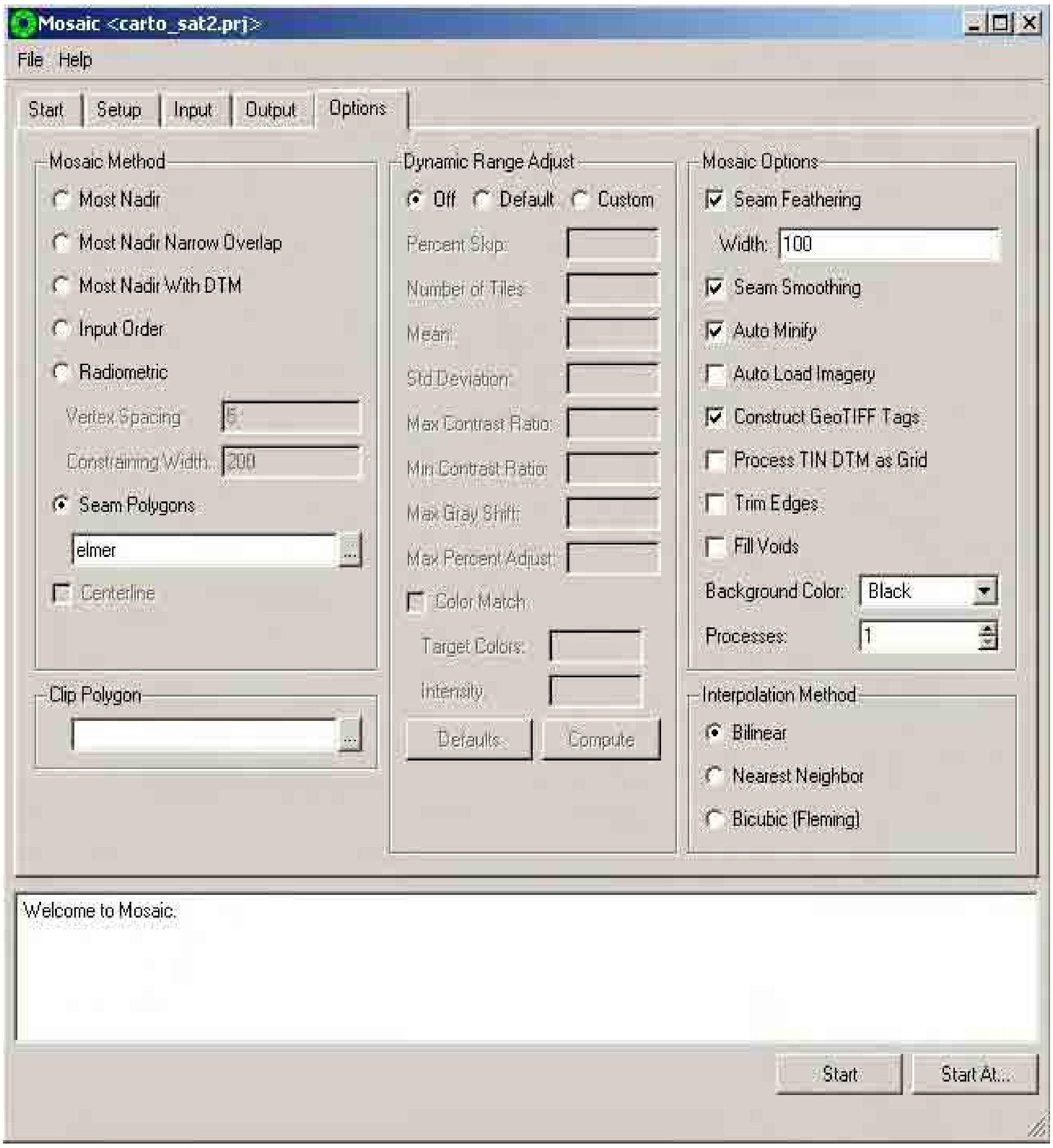
17. Click “Input” tab. Select the needed images (e.g. 530231704021002424222A and 53023180502180250541A), click the arrow to transfer it to the “Selected” box. Select the created DTM (e.g. elmer_dtm.dth), click the arrow to transfer it to the “Selected” box.



18. Click “Output” tab, check “World File”. Set “TIFF Tiled” in “Format. Set “2.5” in “GSD” (Image Resolution). Type output file name (e.g. 7074-I San Carlos) in the “Output Mosaic File” box. Locate and select project file (e.g. carto_sat) same as the one created in the “Create Project”.

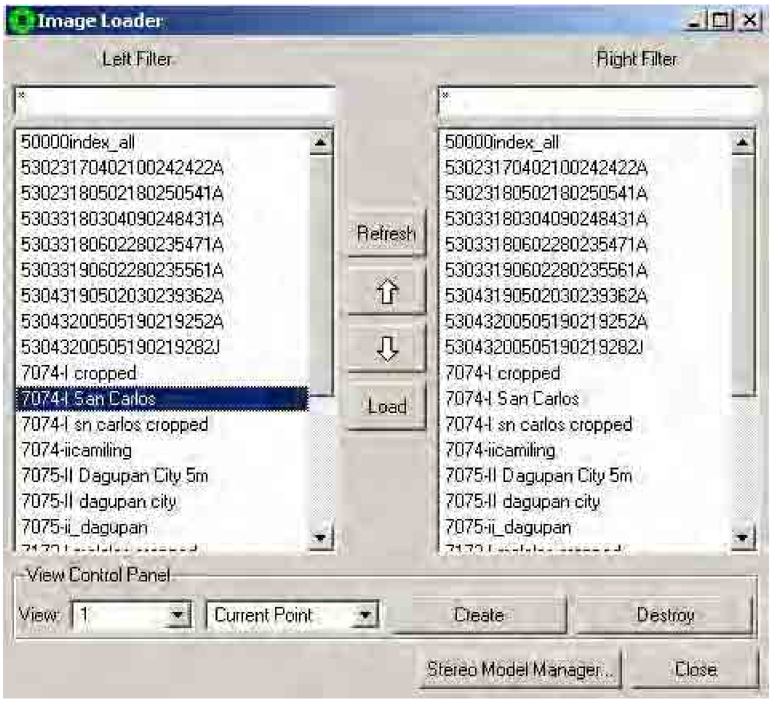


19. Click “Options” tab. Check “Seam Polygons”, browse and locate the seam polygon file (e.g. elmer). Set width to “100”. Check “Seam Feathering”, “Seam Smoothing”, “Auto Minify”, “Construct GeoTIFF Tags” and “Bilinear”. Then click “Start”.



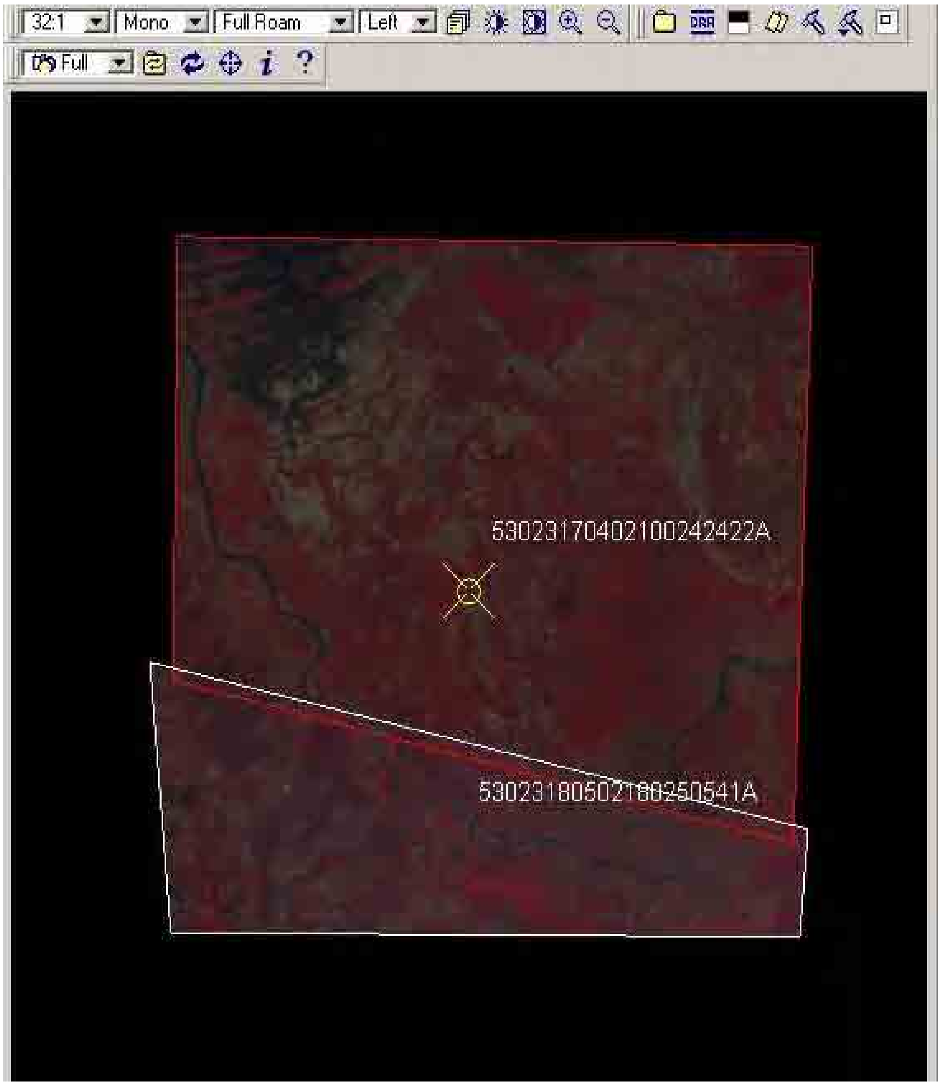
20. After processing, Click "Project", select "Load Images".


21. Create new view window. Select the image (e.g. 7074-I San Carlos) that was processed, Then click "Load".

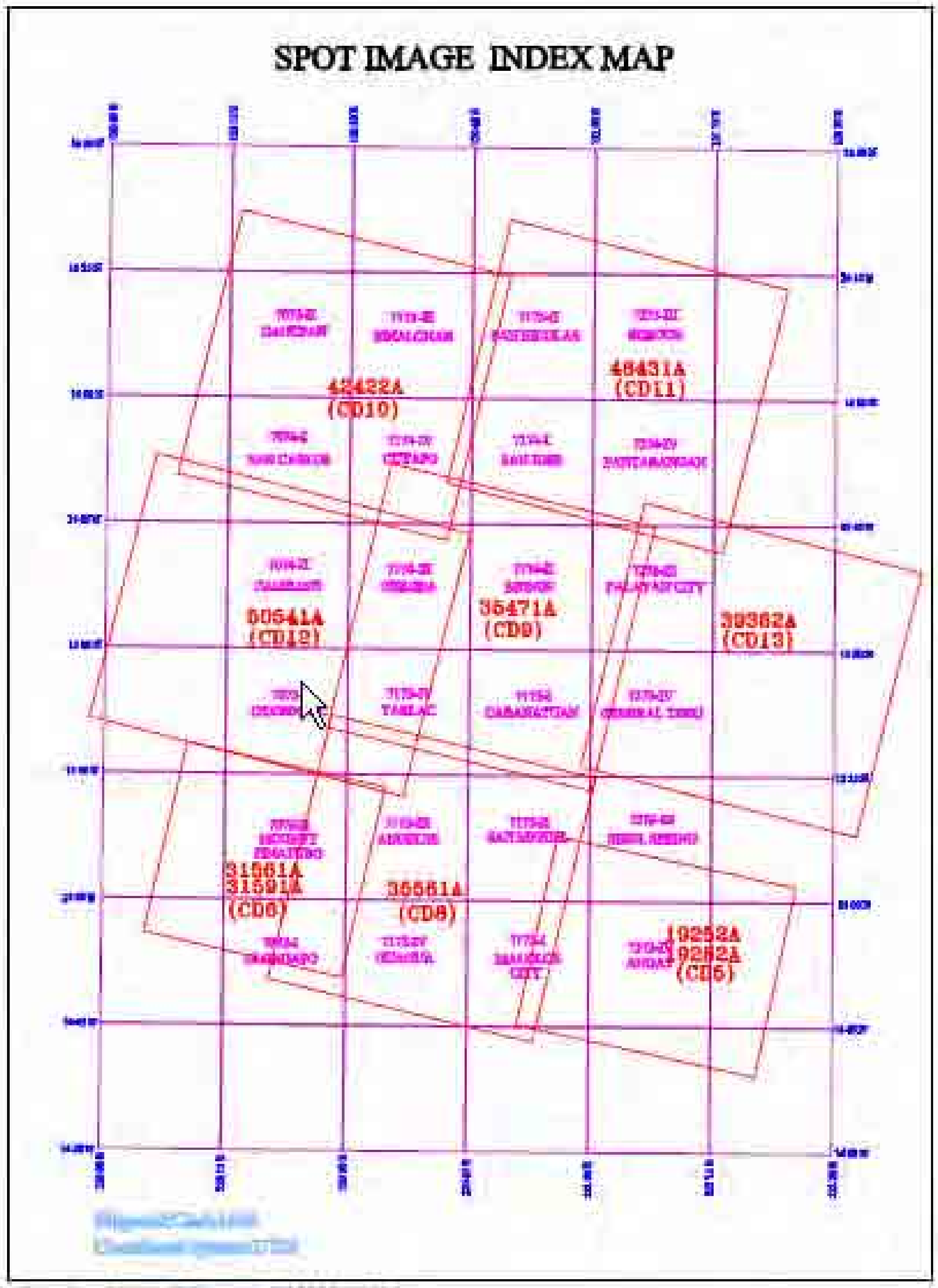


### 3.1.7 Product

The mosaic image will be displayed in the image view window.



## 4. SPOT Image Index Map




\Index_Map_PRS03_2007may.dgn 2007/05/12 13:46:41