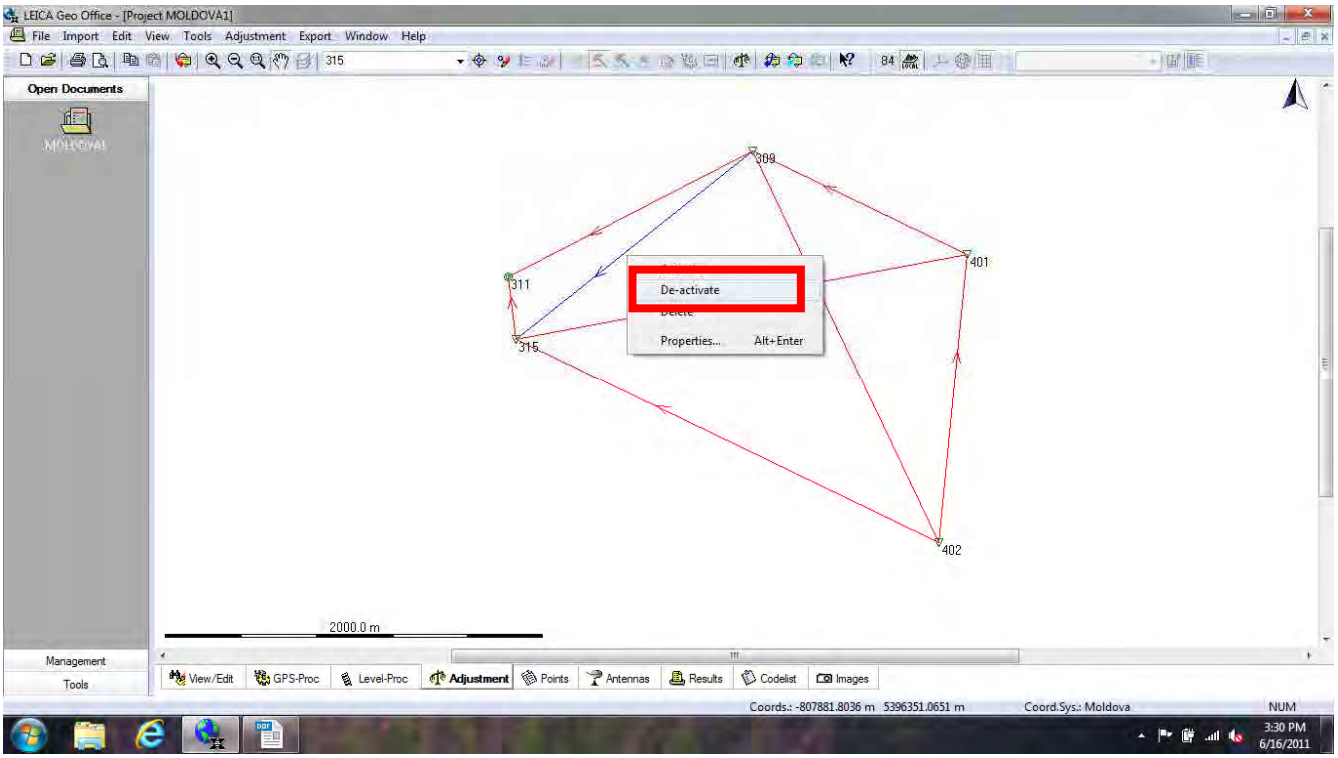
5. Network adjustment

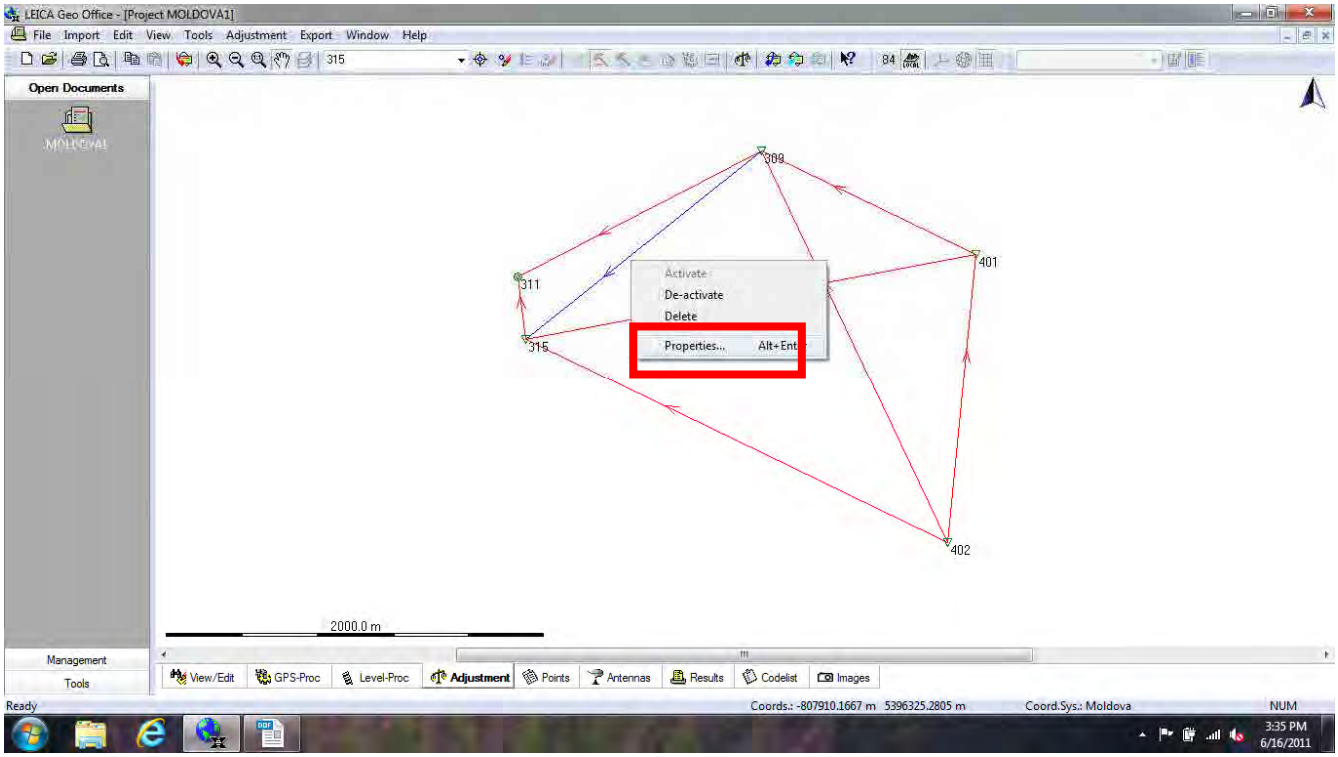
[Adjustment]→

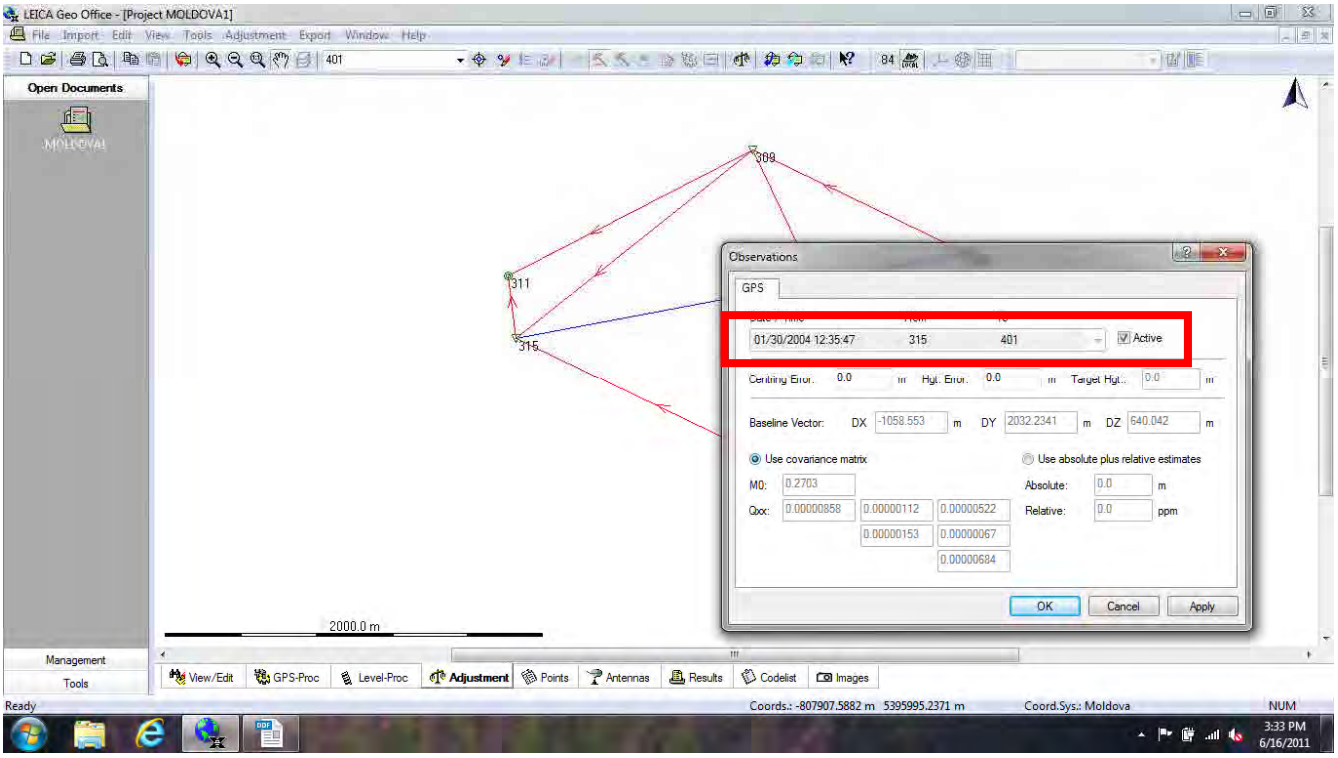
In case of unnecessary baseline for adjustment, Right click, then [De-activate]
In case of necessary baseline for adjustment, Right click, then [Activate (default)]



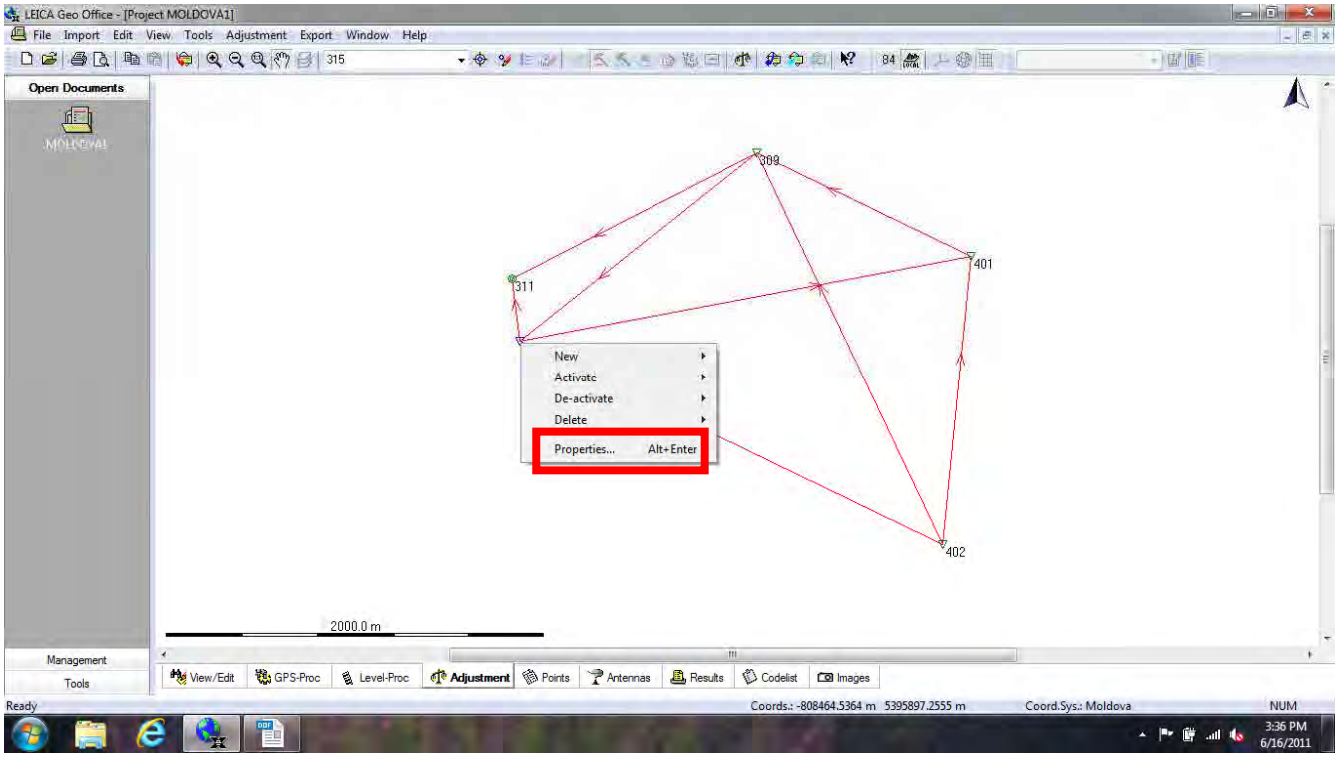
When you had multiple observation results on same baseline, and if you want to choose all baselines for adjustment →[Activate] on results

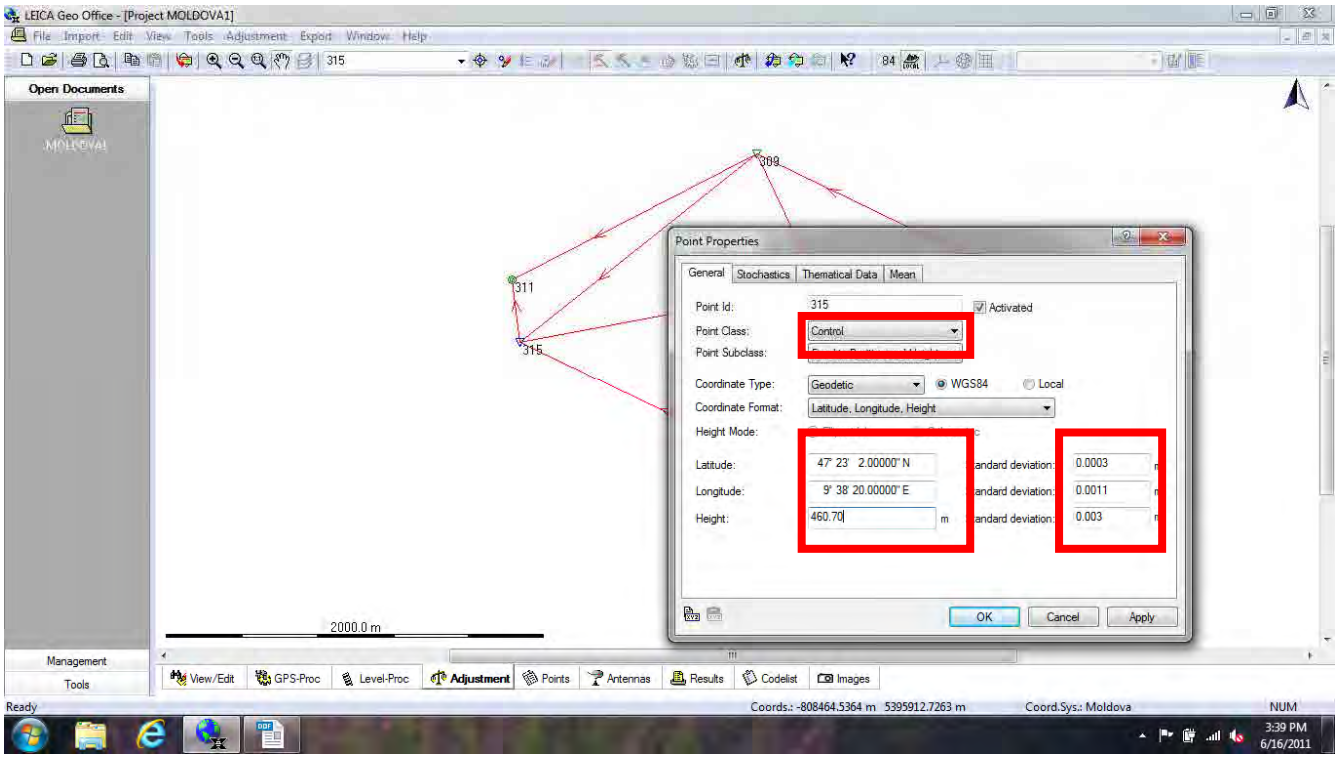
or if you want to choose baselines for inspection →[De-activate] on those results.



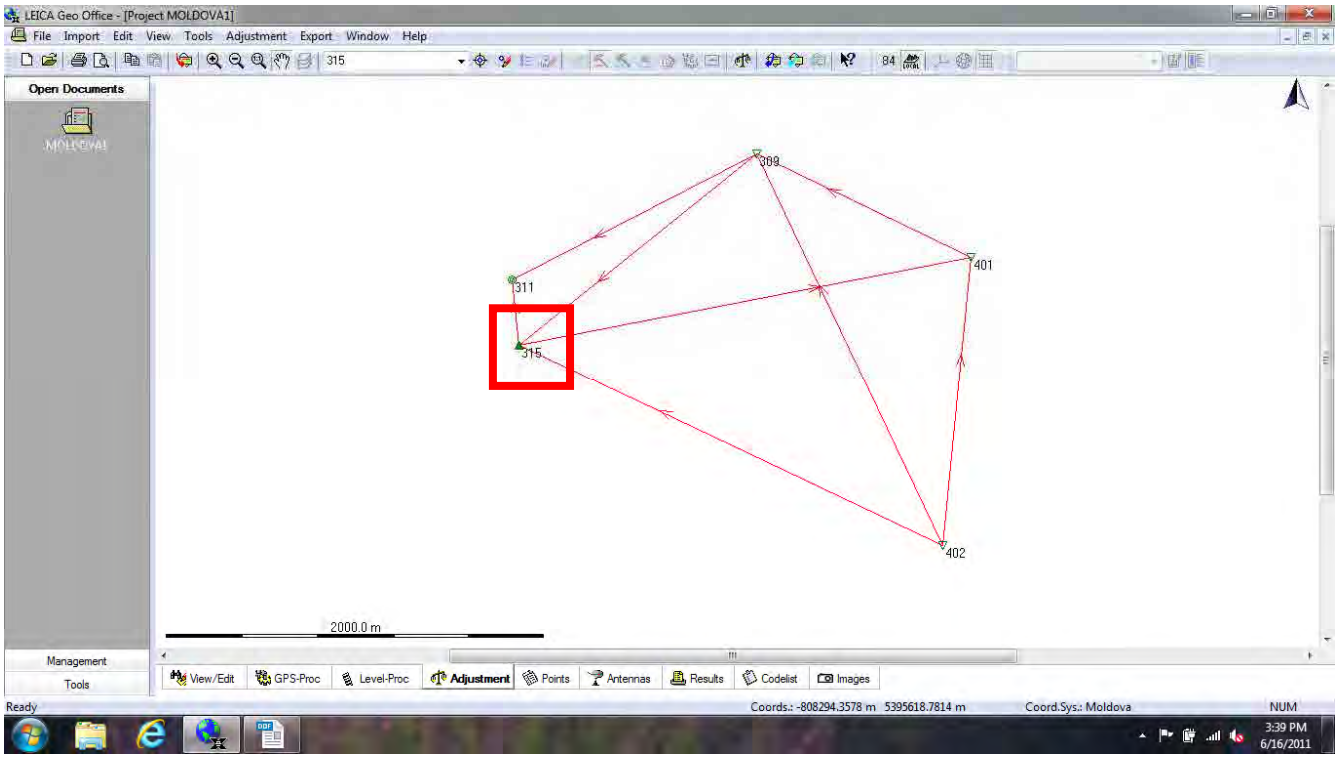


Given points: Right click on that point, then [Properties] →input coordinates and ellipsoidal height → on point class [Control] →"OK"

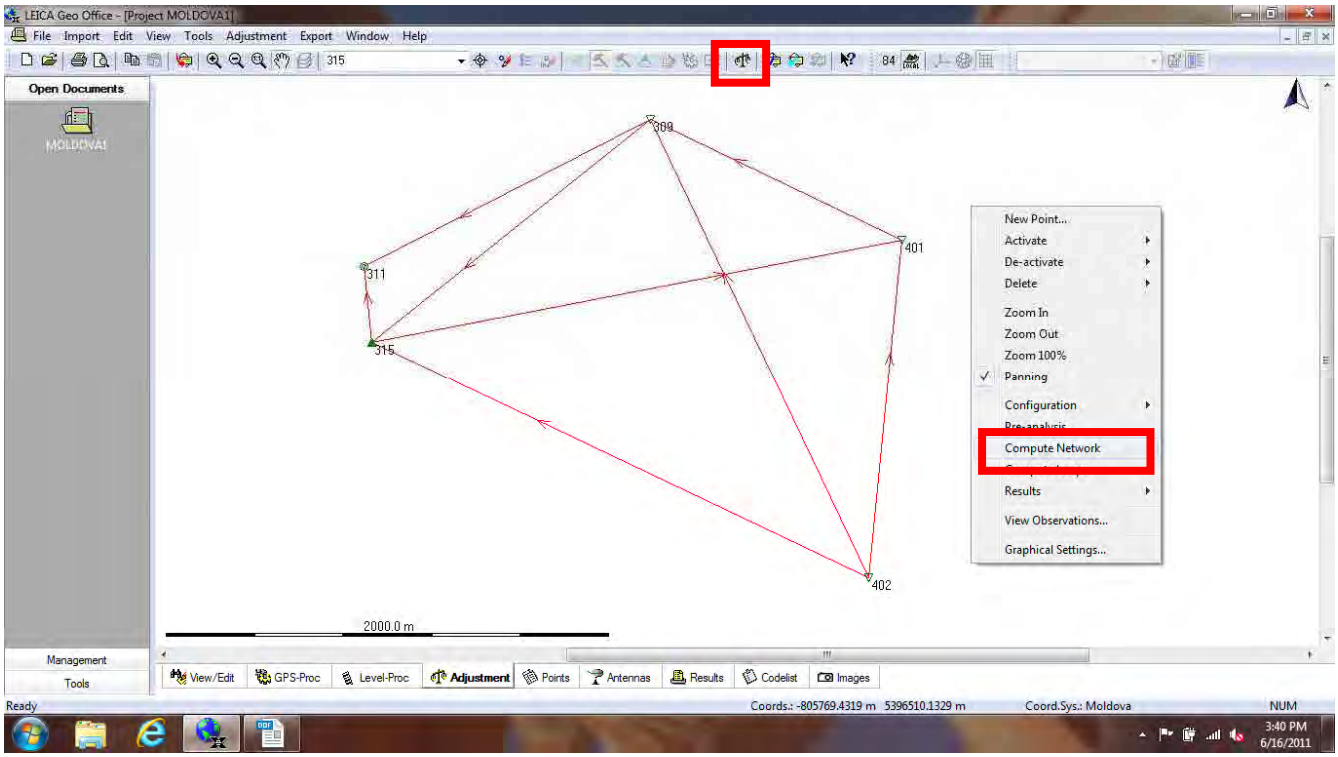




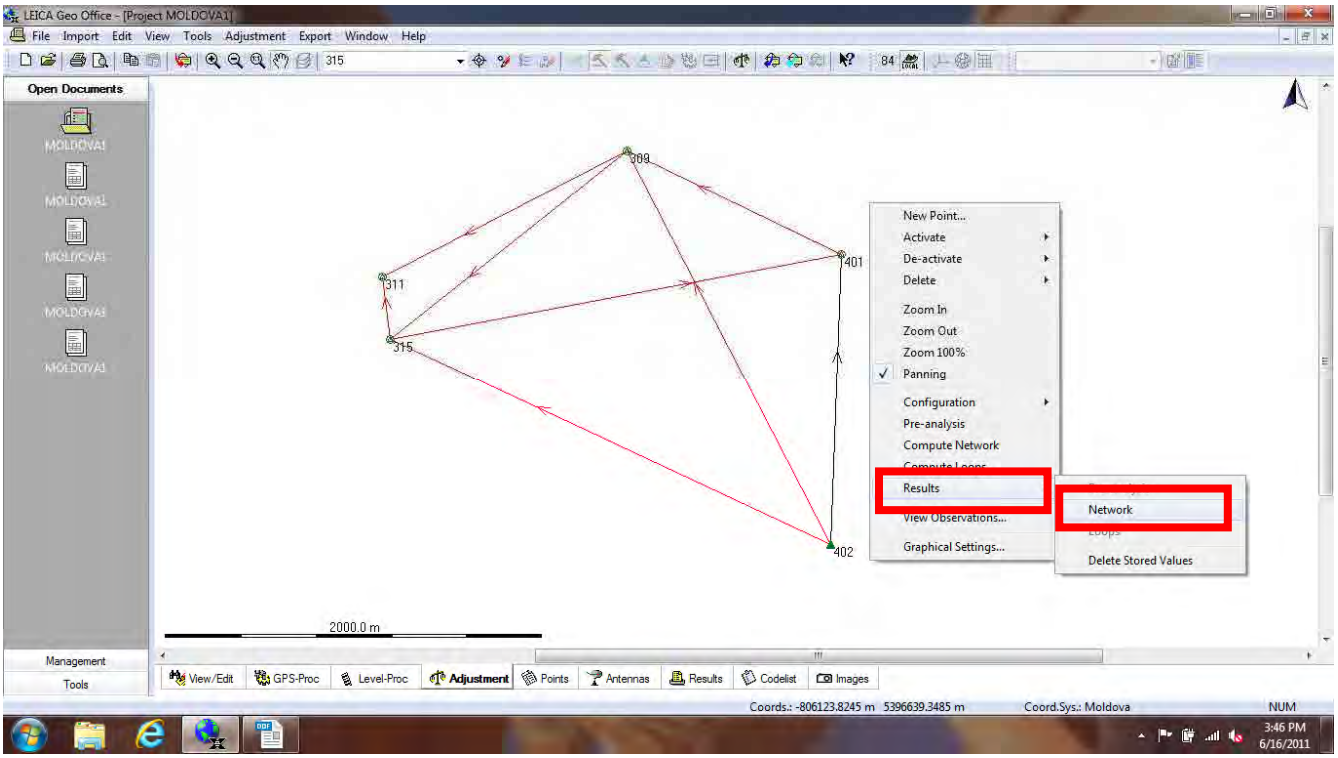
You can see changed symbol on figure.

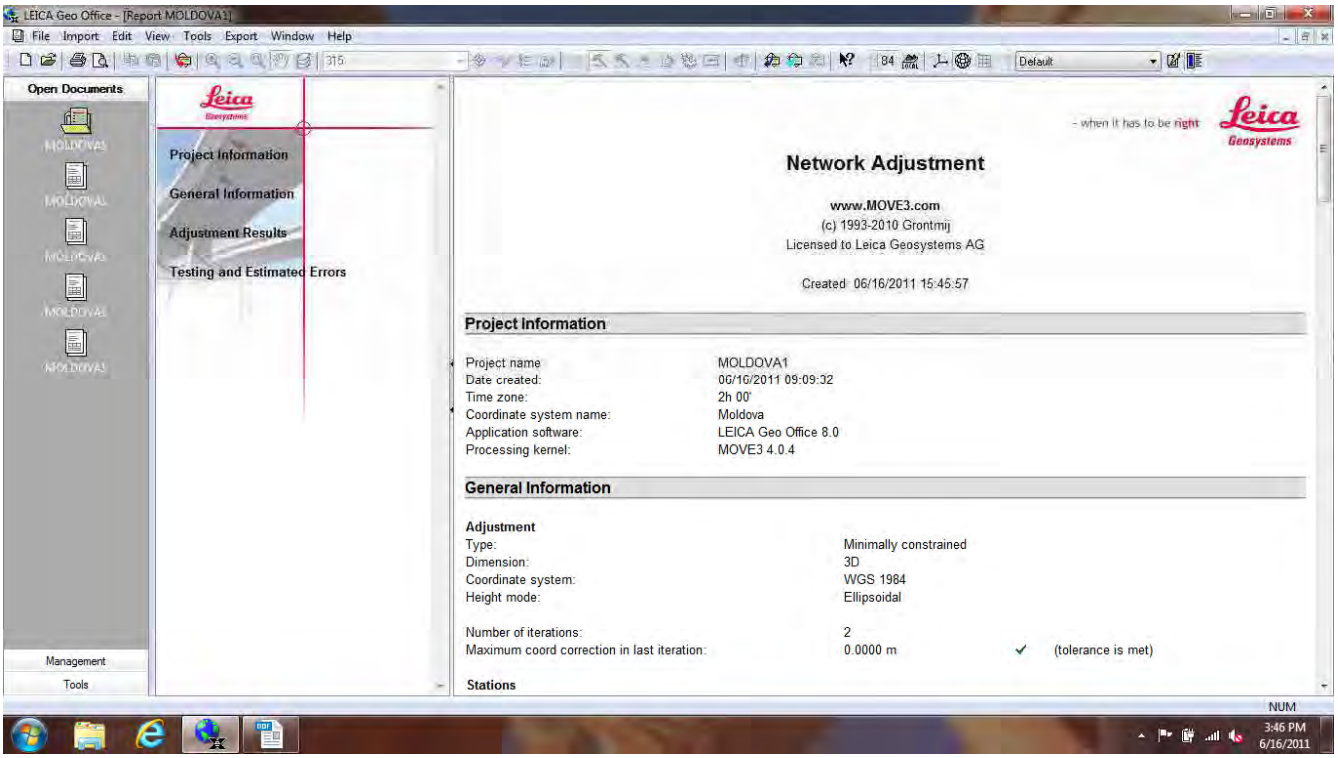


If you want calculate “Network Adjustment”, click “Network Adjustment” icon or right click on screen, then [Compute Network]→ automatic calculation

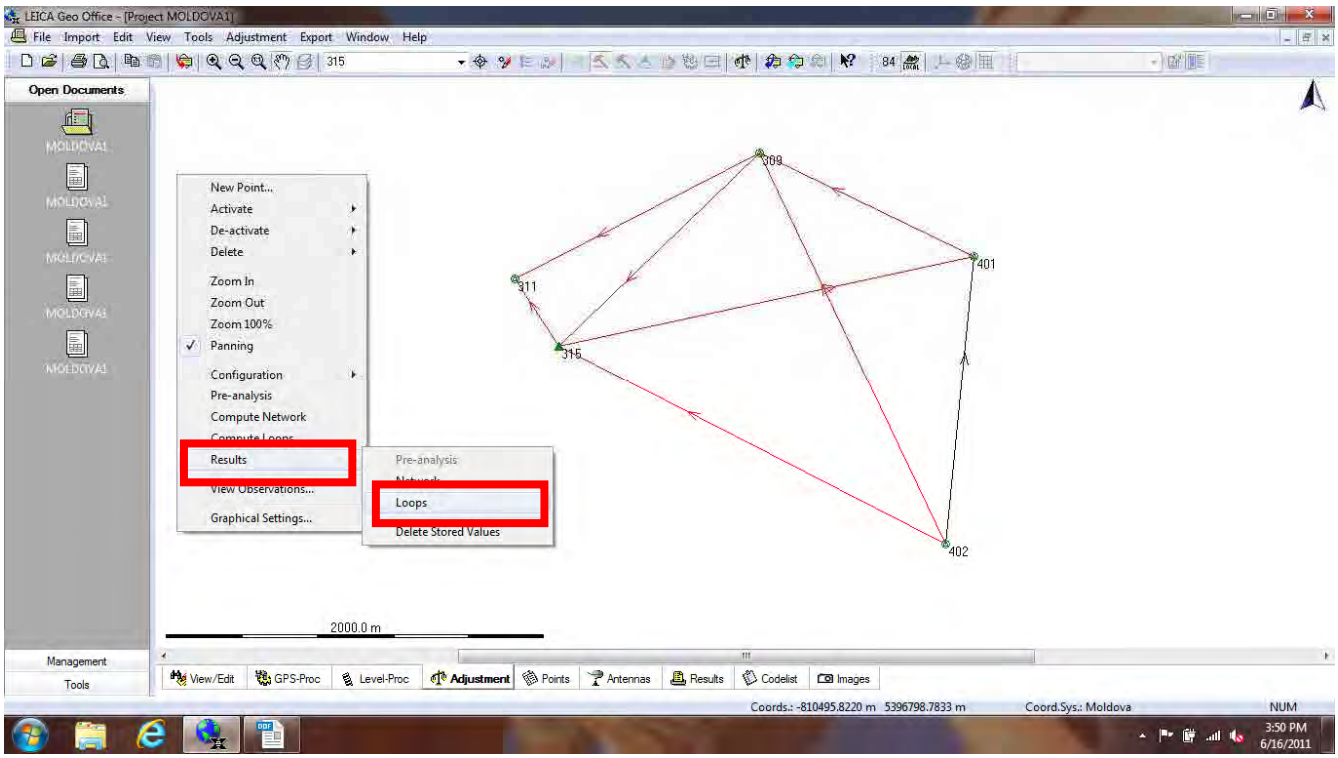


If you want show results, you can do it by [Results]

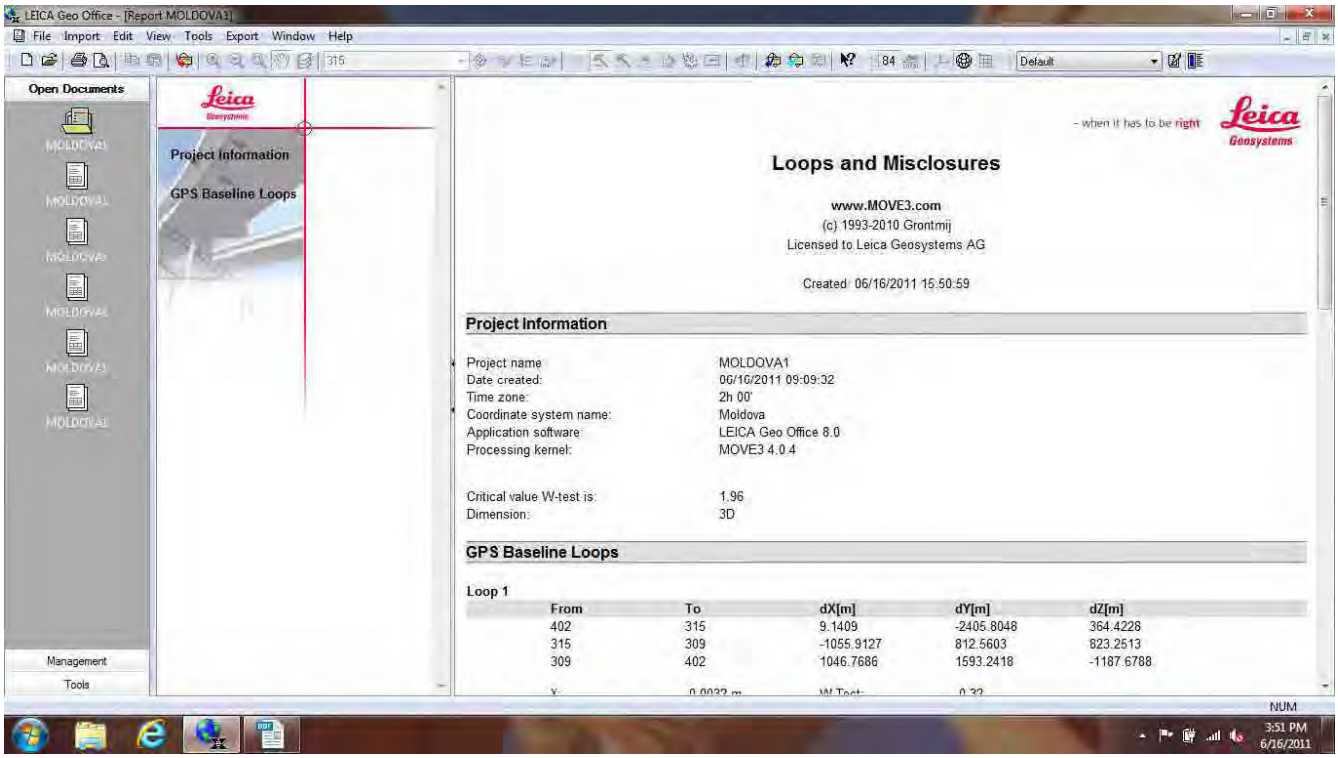




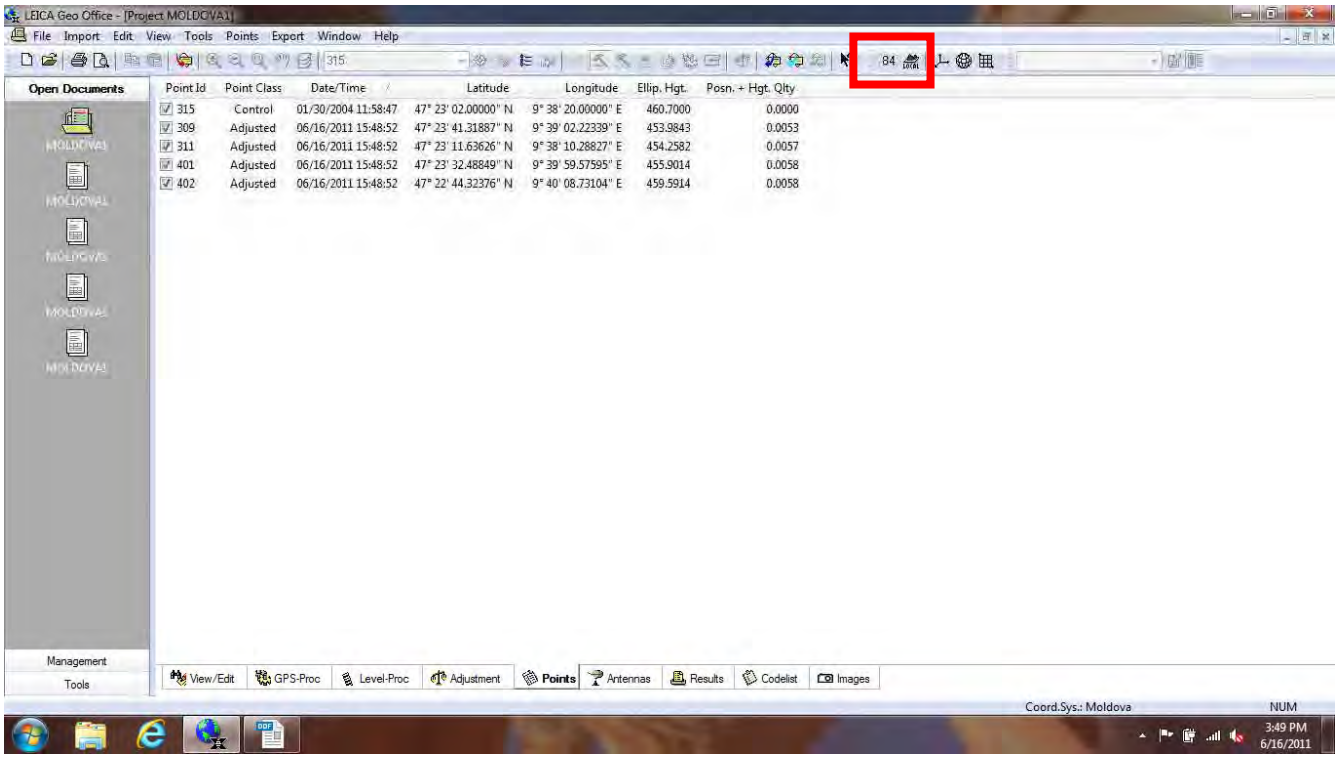
If you want calculate “Loops calculation” for inspection, [Compute Loops]→ automatic calculation



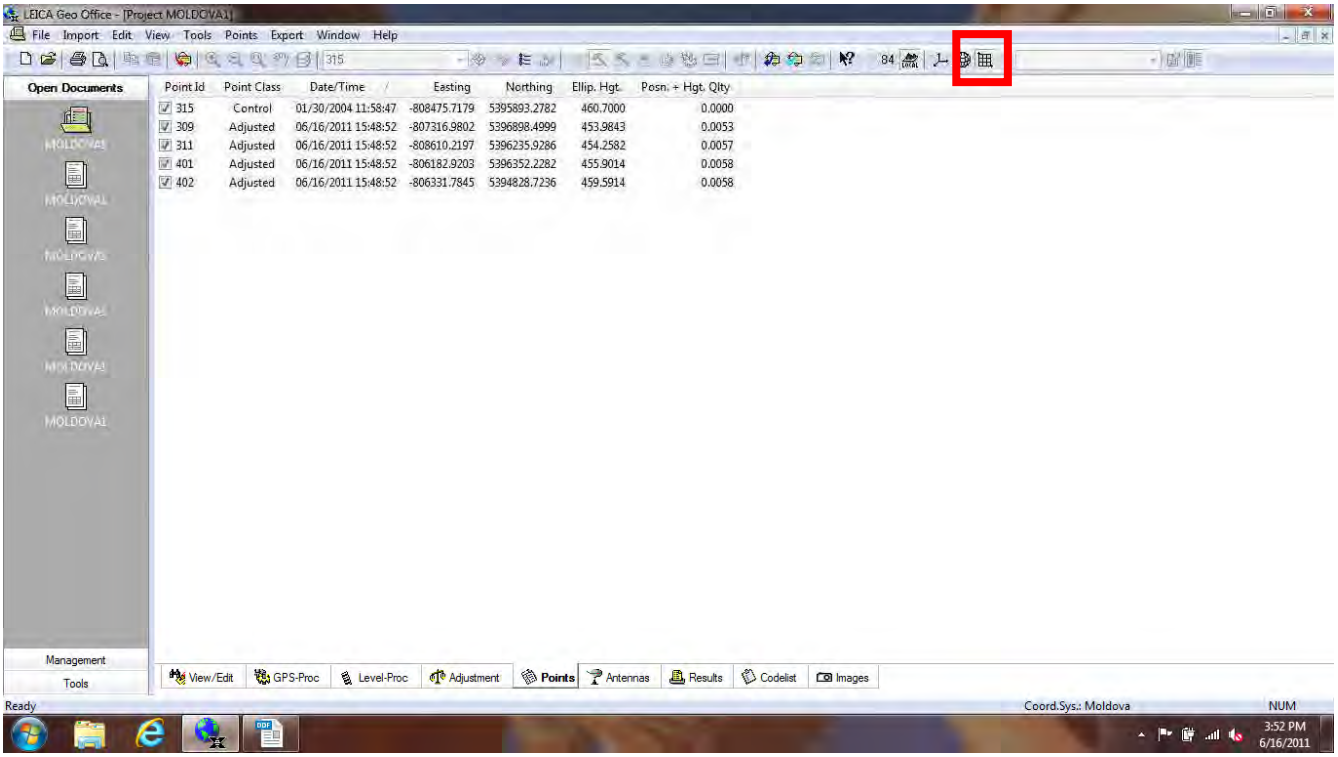
If you want show results, you can do it by [Results]



[Latitude, Longitude]



[X,Y Grid]



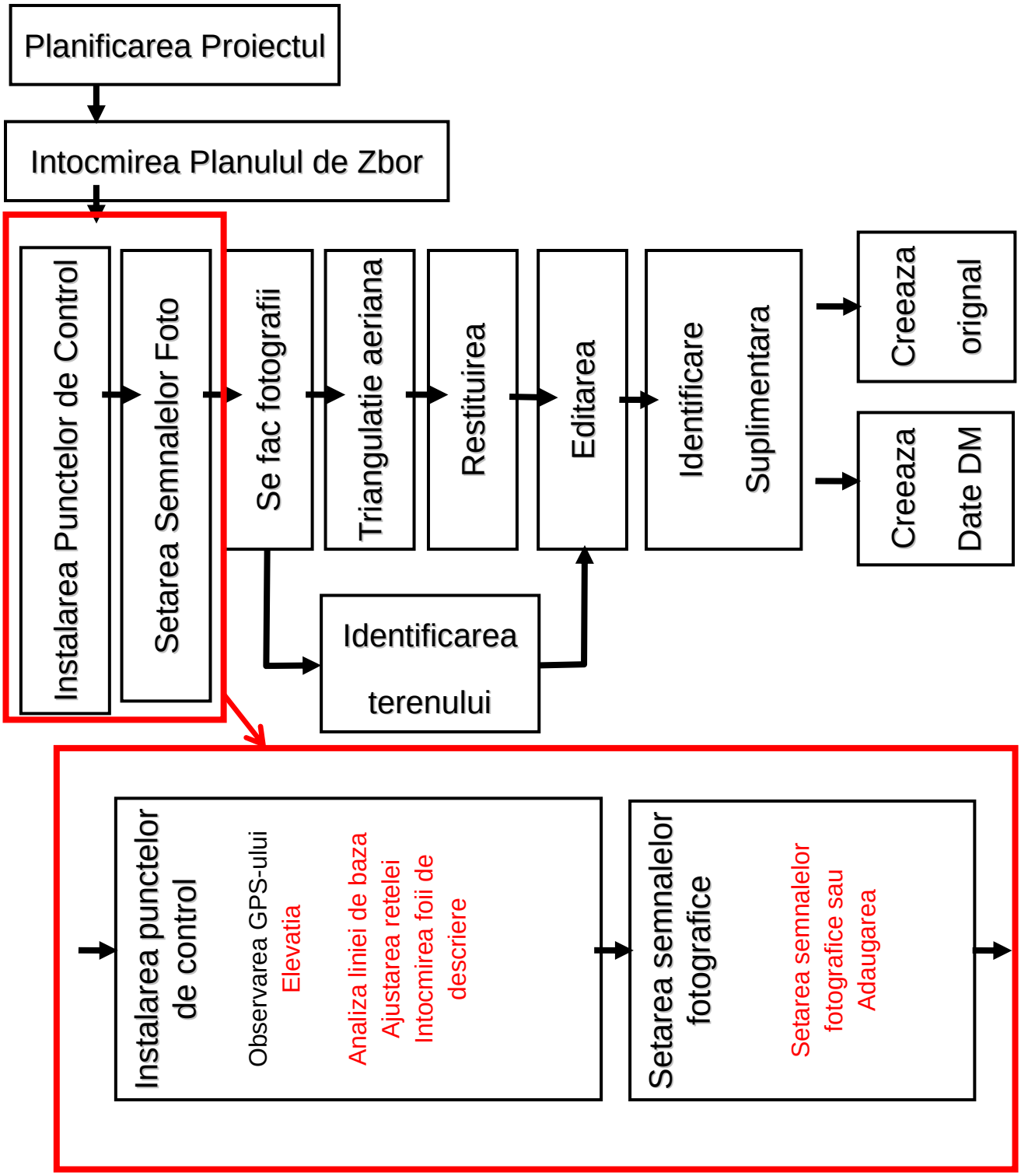
6. Trimble's raw data downloads

6-1. How to edit unnecessary parts of Rinex files

When you will use Rinex files, you have to remove unnecessary parts of Rinex files (~.08o) by manual operation. In a lot of cases, there are unnecessary parts on last of data.

24 Iunie 2011 (Vineri), 10:00 - 15:00, ALRC sala de conferinta 318

Cursul Proiectului



I. Analizarea Liniilor GPS si Ajustarea Retelei

“Manualul Geo Office”

II. Observarea Ordinara a Elevatiei

1. Observarea unui singur traseu, cu dubla functionare (inainte-inapoi) : Se implementeaza un nou studiu al nivelului de ridicare in zonele cu arii fara traseu national de referinta. Se observa linia ce inainteaza si se intoarce (dubla functionare), si se instaleaza un punct de control vertical la fiecare 4 km (total 28 de puncte inclusiv punctele adaugate).
2. Accentuarea valorilor nationale de referinta cu ajutorul punctelor. Se clarifica punctele pe o fotografie a vecinatatii valorilor de referinta si se instaleaza punctele.
3. Daca exista valori de referinta in vecinatatea unor noi (coordinate) puncte de control, se gaseste nivelul de ridicare prin observarea cea mai eficienta posibila. De asemenea, se gaseste elevatia pentru (coordonatele) punctele de control nou instalate pe (sau langa) noul traseu prin observarea cea mai buna. Pentru elevatia care nu poate fi observata direct, se decide indirect, prin luarea in consideratie a inaltimii geoidale.

- Numarul punctelor de control orizontale (Nh) si punctelor de control vertical (Nv) trebuie sa fie determinat cu ajutorul urmatoarei formule :

$$Nh = 4+2[(n-6)/6]+2[(c-3)/3]+[(n-6)(c-3)/30]$$

$$Nv = [n/12]c+[c/3]$$

Unde n – numarul modelelor la o cursa de zbor

C – numarul de curse de zbor.

Fractiile in rezultatul calculelor aratate in paranteze patrate [] trebuie sa fie rotungit.

Daca avem putine modele sau curse de zbor, si rezultatele calculelor in paranteze rotunde () sunt negative, rezultatele trebuie sa fie considerate ca valoarea 0 (zero).

Daca Nv este mai jos decat Nh, trebuie sa se atribuie aceeasi valoare ca Nh.

III. Setarea semnalelor fotografice si Implementarea pentru Studiul GCP

Materialul semnalului

Culoarea semnalului trebuie sa fie alba. Materialul precum calcar alb sau vopsea gri deschis, poate fi utilizat in acest scop. Culoarea alba previne supraexpunerea semnalelor in fotografiile aeriene.

Photo 6.1 Instalare si semnale folosind pietre vopsite

Cand are loc instalarea semnalului creat din var stins, se ia in considerare urmatoarele:

- **Se inlatura pamantul folosind o lopata sau o cazma**
- **Umple sapatura cu un strat subtire de var**
- **Adauga apa in var**
- **Lasa mixtura de var si apa sa se usuce**

Culoarea Fundalului

Se instaleaza semnalul pe o suprafata nereflectoare. Cand e posibil, selecteaza locuri cu suprafete intunecate. Evita suprafetele colorate in alb, gri deschis sau rosu (de exemplu sol rosu). Suprafetele cu aceeasi tonalitate de gri ca materialul semnalului, face dificila identificarea foto-controlului in fotografiile aeriene.

Aceasta reprezinta o idee eficienta pentru a arde iarba si vegetatia de langa semnal.

Adauga gramezi mici de pietre in jurul liniei semnalului, pentru a mari contrastul.

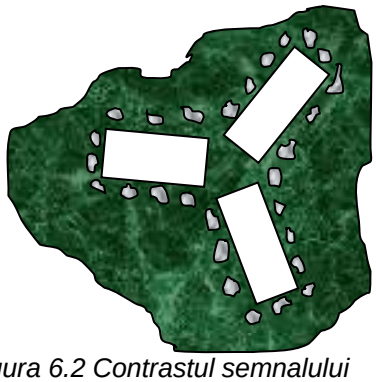


Figura 6.2 Contrastul semnalului

Marimea si forma semnalului

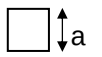
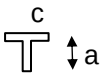
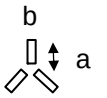
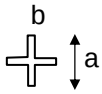
De tinut minte ca este **mai bine ca semnalul sa fie mai mare decit sa fie prea mic.**

Marimea minimala a semnului plutitor a unui plotter analitic este aproximativ 40 mμ. Proiectarea semnalului in fotografia aeriana nu trebuie sa fie mai mica decat marimea minimala a semnalului.

Semnalul este adesea supraexpus in fotografiile aeriene, citeodata pana la 30 %.

Tabelul urmator contine marimea recomandata a semnalelor foto-controlului comparate cu dimensiunile fotografiilor aeriene si altitudinile de zbor (lentile de marimi mari, lungimea focala 153 mm).

Table 6.1 Dimensiunea semnalelor foto-controlului

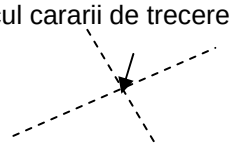
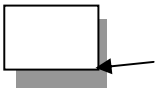
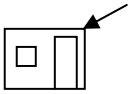
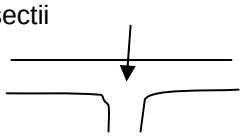
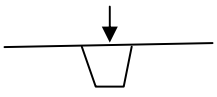
Forma	***Dimensiunea semnalelor foto-controlului***			
	Scara fotografiei 1:5,000	**Scara fotografiei 1:8,000**	**Scara fotografiei 1:10,000**	**Scara fotografiei 1:20,000**
	Altitudinea de zbor 800m	**Altitudinea de zbor 1,200m**	**Altitudinea de zbor 1,500m**	**Altitudinea de zbor 3,000m**
	a=0.4 m	a=0.5 m	a=0.6 m	a=1.2 m
	a=0.6 m b=0.2 m c=0.6 m	a=0.8 m b=0.3 m c=0.8 m	a=1.1 m b=0.4 m c=1.1 m	a=2 m b=0.6m c=2 m
	a=0.4 m b=0.2 m	a=0.6 m b=0.3 m	a=0.8 m b=0.4 m	a=1.2 b=0.55
	a=0.6 m b=0.2 m	a=0.8 m b=0.3 m	a=1.1 m b=0.4 m	a=2 m b=0.6 m
Rezolutia:	10cm	16cm	20cm	40cm

Rezolutia ALOS: 2.5m ≒ scara fotografica: 1/125,000、in cazul tipului A, a=7.5m

Identificarea punctelor de foto-control

Exista intotdeauna un pericol ca punctele de foto-control sa fie distruse inainte de infaptuirea fotografiei aeriene. In multe cazuri, va fi mai bine de utilizat caracteristici naturale ca foto-controlul, in loc de semnale artificale. Punctele naturale de foto-control trebuie sa fie usor de identificat in fotografiile aeriene. *Este esential sa se aleaga caracteristicile care pot fi vazute cu stereoscopul in ambele fotografii, de catre un singur model stereo.* Forma semnalului trebuie sa fie distincta si nu confundabila. Exemplu de puncte naturale de foto-control sunt arate in diagrama de mai jos. Un foto-control natural nu trebuie sa aiba coordonate in 3D. Cateodata valoare Z este cea mai importanta (se stie inaltimea).

Figure 6.7 Puncte naturale de foto-control

Mijlocul cararii de trecere 	Referinta inalta pe pamant in mijlocul cararii
Coltul acoperisului plat 	Selecteaza partea umbroasa a coltului. Referinta inalta in varful acoperisului 
Mijlocul unui copac mic sau arbust 	Selecteaza arbustii mici densi si simetrici. Referinta la nivelul pamantului 
Caracteristici naturale sau artificiale. 	Detaliile colorate deschis sau intunecat, care sunt usor de identificat in fotografii. Folositiva imaginatia !
La baza unui stalp de telefonie 	Doar valori Z 
Intersectii 	Valoarea Z doar in mijlocul intersectiilor 
Intersectia podului si raului 	Doar valoare Z 

Intocmirea Punctelor de foto-control

Fiecare punct de control identificat trebuie sa fie inclus in una dintre perechile de fotografii stereo, si trebuie sa fie acompaniat de o fisa de identificare, ce contine urmatoarele:

- **Numele punctului de control**
- **Numele cercetatorilor**
- **Data de instalare**
- **Plan schematic de identificare**
- **Doua fotografii ale terenului, impreuna cu orientarea lor**
- **Profilul terenului**
- **Identificarea perechii stereo si a numarului**

IV. Crearea Fisierului de descriere pentru GCP

→cf. “Exemplu de foaie”

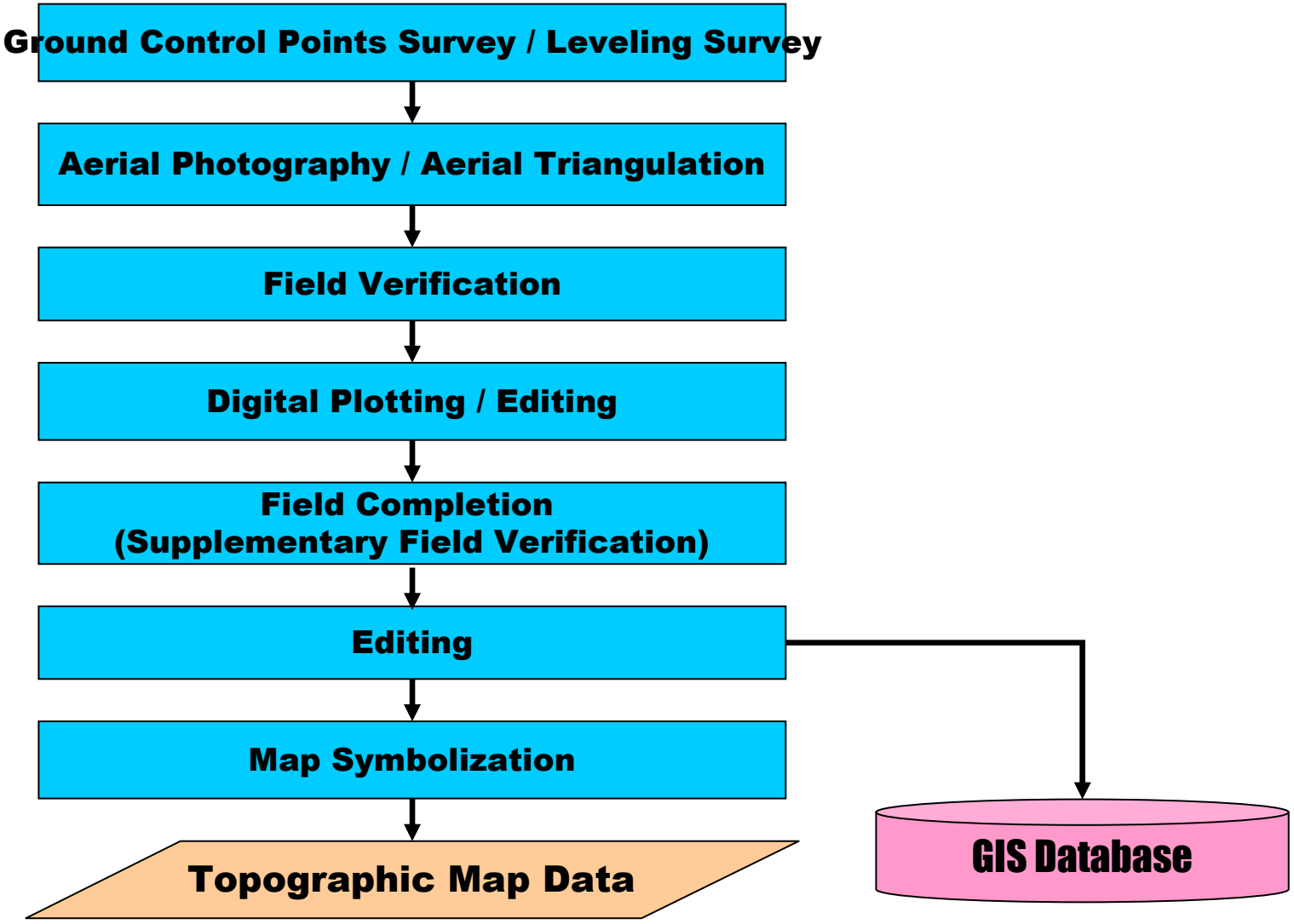
Field Verification

Field Verification
in
"PROJECT FOR CREATION OF DATABASE FOR BASE MAP FOR DEVELOPMENT OF NATIONAL SPATIAL DATA INFRASTRUCTURE IN THE REPUBLIC OF MOLDOVA"

The JICA STUDY TEAM

Akihiro SUGITA

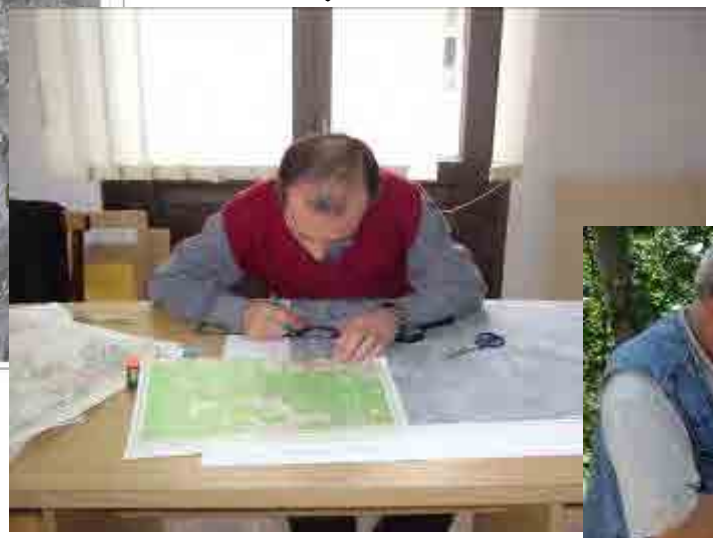
Basic Work flow of Mapping



Contents of Field Verification

Objective:
To verify geographic features and description items

Creating Ortho Photos



Preliminary Photo Interpretation with Ortho Photos and Existing Maps

Field Work

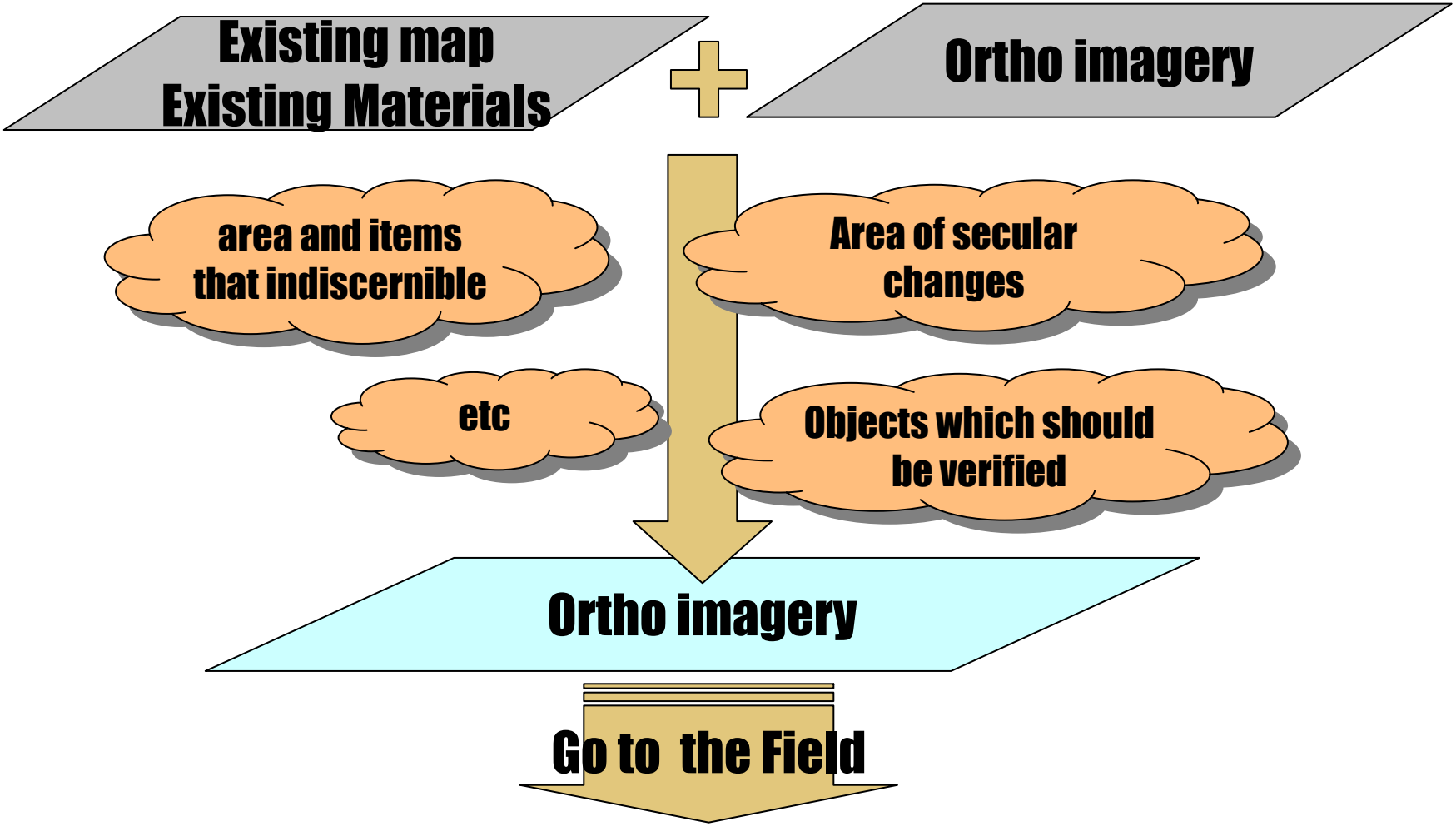
Preliminary Photo Interpretation

- Objective:

  Understanding of items to be verified, survey area, work volume before field verification in the field.

- Things to be done
  - Checking of collected materials
  - Collation of ortho image and existing map
  - Extraction of area that indiscernible or where secular changes
  - Checking for inconsistencies in the name, municipal boundaries, etc. in the various materials
  - etc

Basic concept of Preliminary photo interpretation



Field Verification

- Implementation
  - Verification of the results of preliminary photographic interpretation
  - Matters that are difficult or impossible to discern on the satellite images
  - Changes in the land surface conditions after capturing the satellite images or after producing the materials
  - Matters necessary for the application of Expression Standards
  - Matters related to annotations, administrative boundaries, etc.
  - Other necessary matters

Photo Interpretation Key

- Photo interpretation key is useful for operators of Digital Plotting to conduct correct and uniform photo interpretation.
- This will be made if needed.

Item	Symbol	Code Number
Church	+	**3522**
Ground photograph	Ortho No	6418SW
	Ortho scale	1:20000

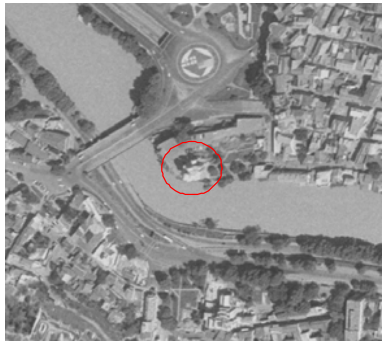
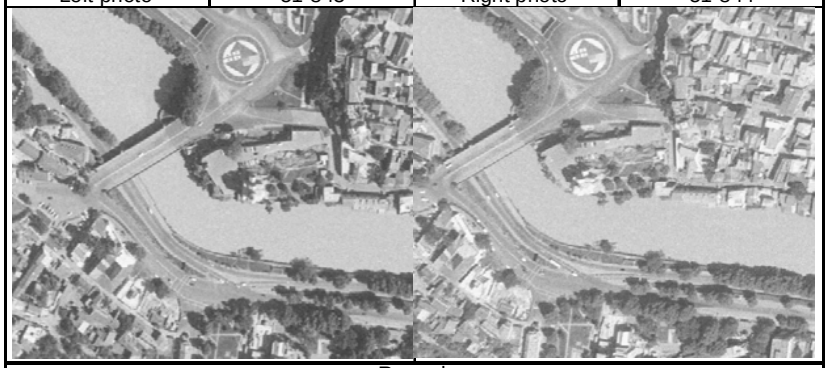


Photo scale 1:15000

Left photo	51-843	Right photo	51-844



Remark

This looks taller than ordinary houses and its roof is generally circle.
This is recognized easily if there is cemetery.

Materials to be used in the field

- Ortho imagery printed with UTM (WGS84) coordinate
- Handy GPS
- Digital camera (mounted GPS)
- Scaled ruler
- Color Pen
- Note
- Specification of data acquisition

Checking and Rechecking

- **Checking (by operator)**
  - Check for the presence of blank positions in the field identification area.
  - Check for omissions in the field identification and the conformity of the Documentation.
  - Check for the conformity of the different materials relating to administrative boundaries, geographic names, etc.
  - Check for inconsistencies between the various reference materials.
- **Rechecking (by leader)**
  - Check for the conformity of various items to be represented that are difficult to discern.
  - Check for the adequacy of the display of various names and administrative boundaries.
  - Check that the adjoining sheet is adequate.

Quality Control Record

- To control quality, records like this should be made.

Form 1-1
Quality Control Record

Field Identification and Compilation

Production of Topographic Base Map (Map Information) using satellite images

Area name		Scale		Period	From	Executing organization	Checker	
Name of municipality		Workload	km²		To	Operator	Work leader	

	Item	Omission	Error	Unnecessary
Control point, elevation point	Control point			
	Elevation point			
	Image control point			
River, lake, ocean	Shoreline (position, shape)			
	Relation with contour line			
	Dry driver			
	River centerline			
	Canal (aboveground, underground)			
	Name attribute (river, lake)			
	Annotation (river, lake, ocean, etc.)			
	Boundary line (river, coast, river mouth, lake)			
	Flow direction			
Road	Position, shape			
	Road edge			
	Bridge, tunnel, snowshed, stone steps, garden path			
	Retaining wall, cliff			
	Road centerline			
	Annotation, route name			
Railroad	Position, shape			
	Track centerline Bridge, tunnel			
	Annotation, line name			
	Station			
Building, etc.	Position, shape			
	Buildings (individual, overall)			
	Generalization			
	Building symbol (public facilities)			
	Attributes of public facilities (name, address, coordinate)			
	Building symbol (other symbols)			
	Annotation, building name			
Other structures	Toll gate, high tower, monument, chimney, antenna tower, oil well, gas well, light house			
	Transmission line, pipeline (aboveground, underground, elevated)			
	Wall, retaining wall, tunnel mouth (cave mouth)			
	Ferry			
	Weir, starling, water gate, breakwater			
	Dam			
	Annotation, structure			
Vegetation	Cultivated land, uncultivated land			
Specific site	Boundary of specific site			
	Cemetery, castle ruin			
	Hot spring, crater/fumarole, mining ground, quarry			
	Fishing port (principal, local)			
	Historic site, scenic spot, natural monument			
	SDF, factory, power station, etc.			
	Annotation, specific site			
Land area topography	Contour line (shape, position)			
	Contour line (value attribute)			
	Contour line (value annotation)			
	Cliff, rock			
	Sand and gravel area, swamp, perpetual snow			
	Waterfall symbol, annotation			
Water area topography	Contour line (shape, position)			
	Contour line (value attribute, annotation)			
	Lake bottom cliff			
	Mudflat			
	Tidal rock			
Administrative boundary	Administrative boundary (position, shape)			
	Administrative boundary			
	Administrative name			
	Indefinite boundary			
	Relation with features			
	Affiliation boundary			
Annotation	Portrayal vector			
	Residential area name			
	Hierarchy of Residential area name			
	Natural place name			
Remarks (quality control-related matters, etc.)				

*Put a slash (/) in the column if it is unnecessary.

Output of Field Verification

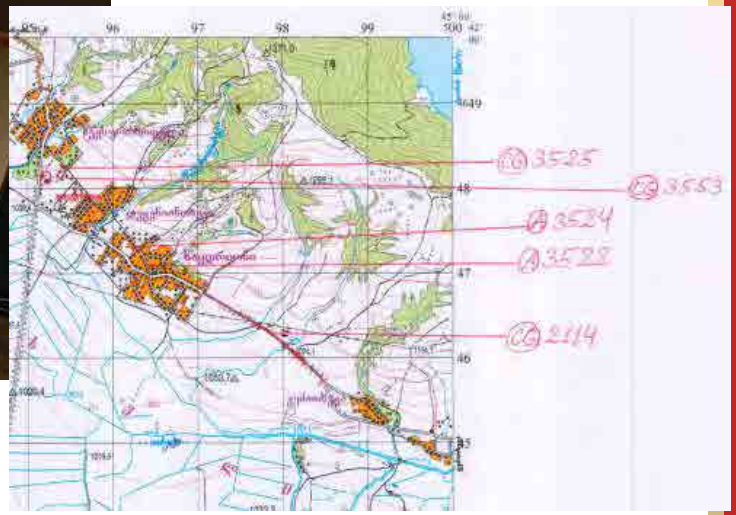
- Ortho photo imagery, etc or referenced materials that describe the field verification results
- Annotation verification chart
- Boundary / geographic name verification document and related map
- Quality control record
- Other materials

Field Completion

Objective:
To verify geographic features that were difficult to recognize on the aerial photos and confirm annotation, geographical name and so on.

Field Work

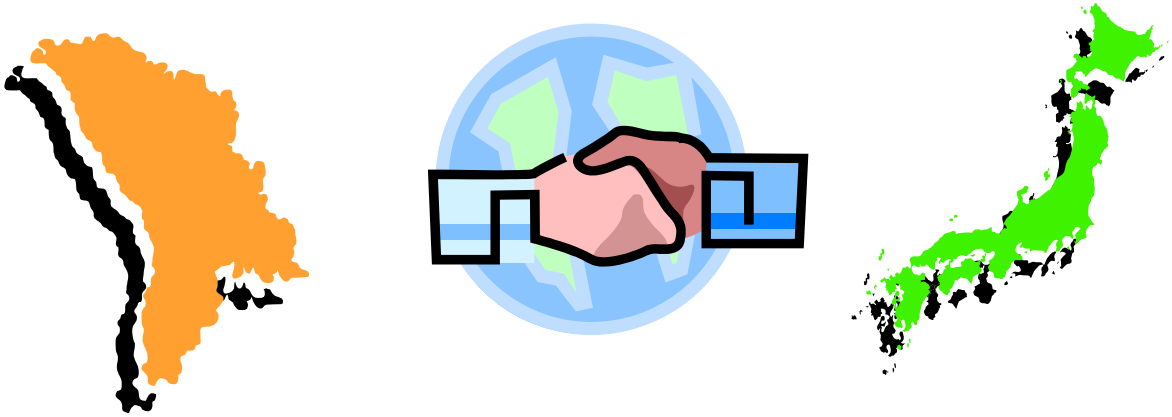
Noting corrected information in the field on the draft map



Result of Field completion

E N D

Thank you for the attention

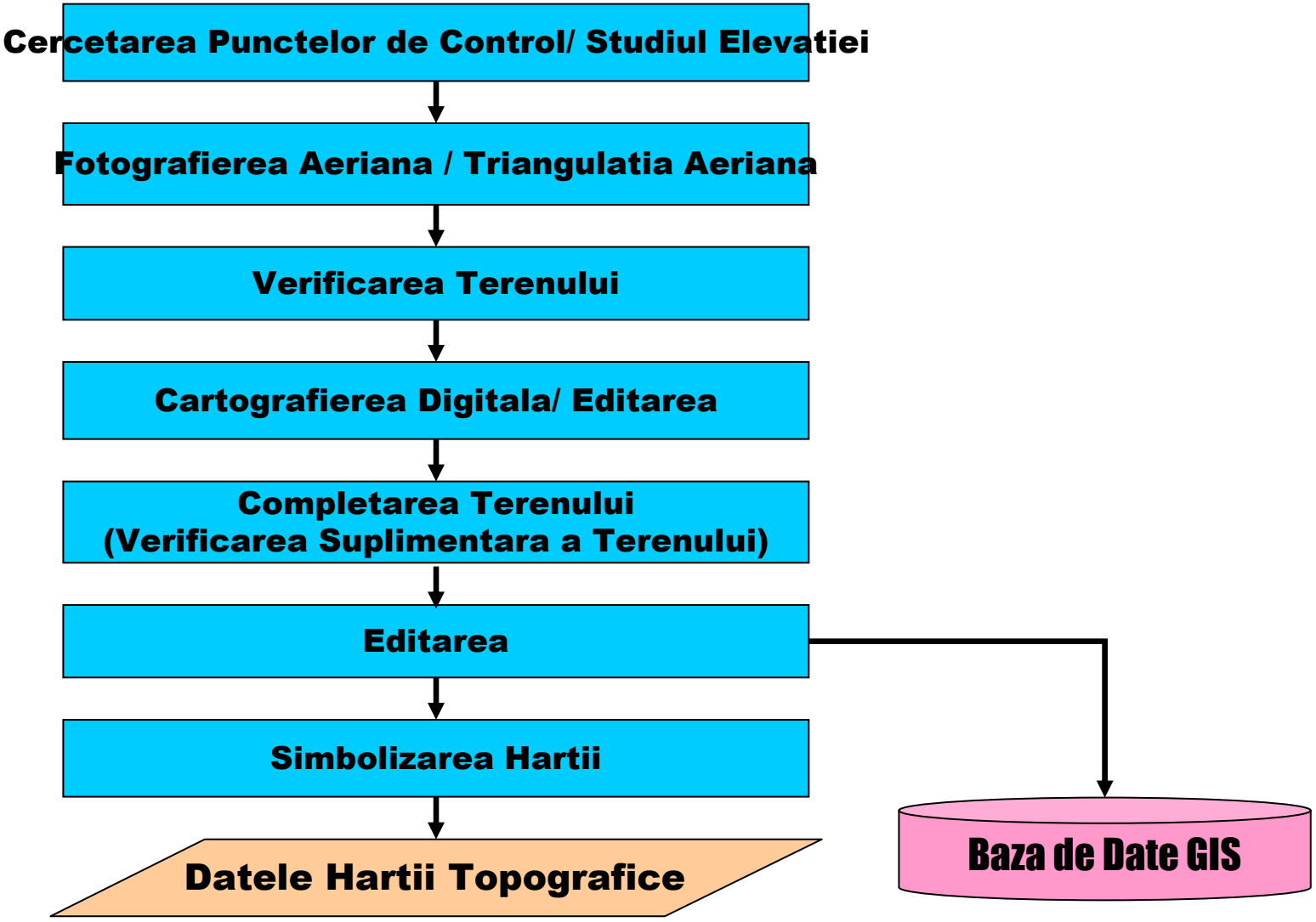


Verificarea Terenului
in
“PROIECT DE CREARE A BAZEI DE DATE PENTRU HARTA DE BAZA PENTRU DEZVOLTAREA INFRASTRUCTURII DE DATE SPATIALE NATIONALE IN REPUBLICA MOLDOVA”

Echipa de Studiu JICA

Akihiro SUGITA

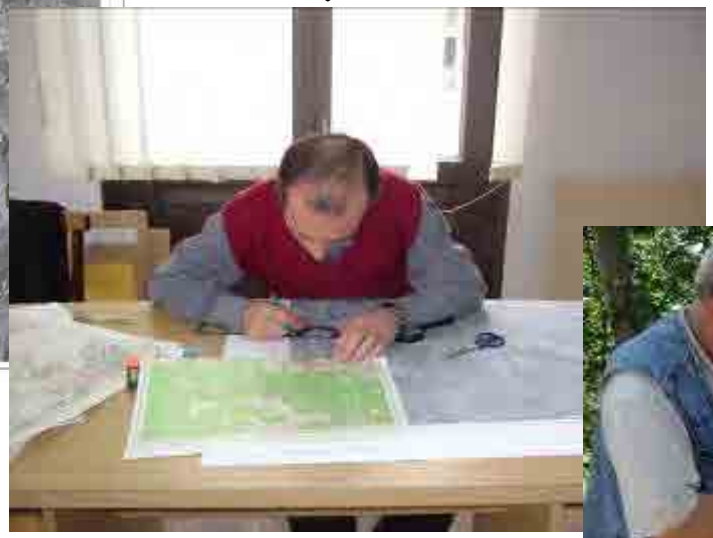
Panul de Lucru de Baza al Cartografierii



Cuprinsul Verificarii Terenului

Obiectiv:
Sa verifice trasaturile geografice si elementele descrise

Crearea Orto Fotografiilor



Interpretarea Fotografica Preliminara cu Orto Fotografii si Harti Existente

Lucru pe Teren

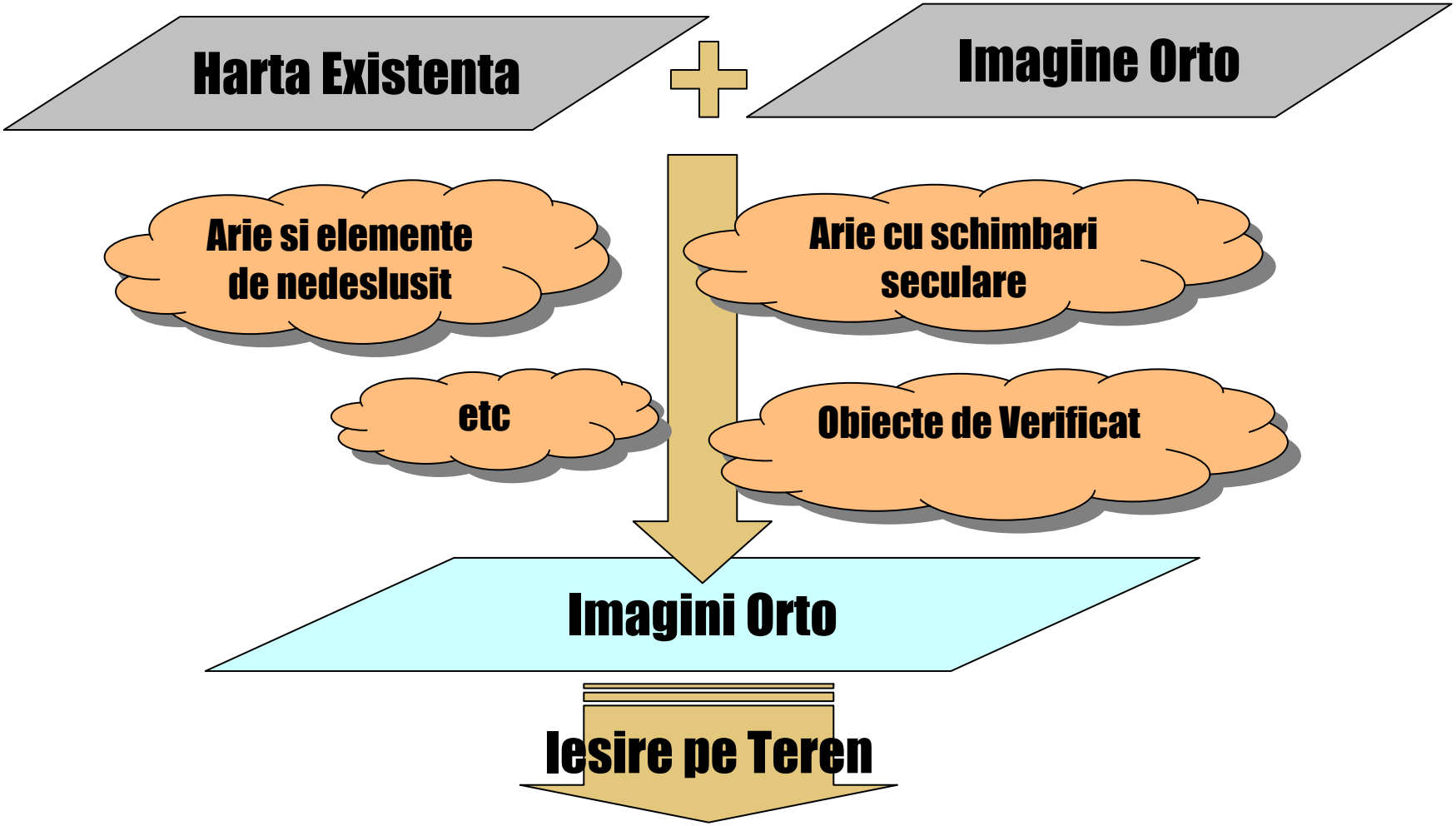
Interpretarea Fotografica Preliminara

- Obiectiv:

  Intelegerea elementelor necesare de verificat, ariei de cercetare, volumului de lucru, inainte de verificarea terenului pe teren.

- Lucruri de Indeplinit:
  - Verificarea materialelor colectate
  - Colationarea imaginilor orto si a hartilor existente
  - Extragerea ariei de nedeslusit sau a celei cu schimbari seculare
  - Verificarea neconcordantelor in nume, hotare municipale, etc. in numeroase materiale
  - etc

Conceptul de Baza a Interpretarii fotografice Preliminare



Verificarea Terenului

- Implementarea
  - Verificarea rezultatelor interpretarii fotografice preliminare
  - Materii greu sau imposibil de deslusit pe imaginile din sateliti
  - Schimbari in conditiile suprafetei pamantului dupa capturarea imaginilor din sateliti sau dupa producerea materialelor
  - Materii necesare pentru aplicarea Standardelor de Exprimare
  - Materii legate de adnotatie, granite administrative, etc.
  - Alte materii necesare

Cheia de Interpretare Fotografica

- Cheile pentru interpretarea fotografica sunt utile pentru operatorii Cartografierii Digitale, pentru a infaptui corect si uniform interpretarea fotografica.
- E infaptuita in cazul necesitatii

Item	Symbol	Code Number
Church	+	**3522**
Ground photograph	Ortho No	6418SW
	Ortho scale	1:20000

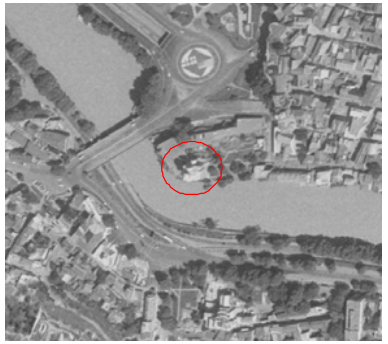
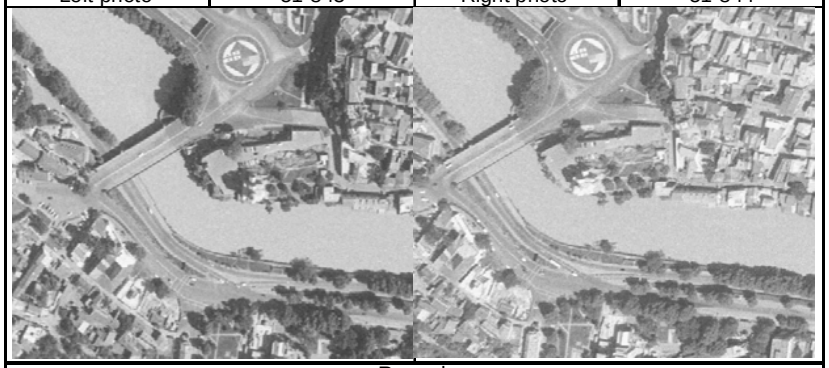


Photo scale 1:15000

Left photo	51-843	Right photo	51-844



Remark

This looks taller than ordinary houses and its roof is generally circle.
This is recognized easily if there is cemetery.

Materiale folosite pe Teren

- Imagini Orto imprimate cu coordonate UTM (WGS84)
- GPS mobil
- Aparat Foto Digital (cu GPS)
- Rigla gradata
- Stilou Color
- Note
- Specificarea datei de achizitionare

Verificarea si Reverificarea

- **Verificarea (de catre operator)**
  - Verificarea prezentei pozitiilor necompletate in zona de identificare a terenului.
  - Verificarea omiterilor in identificarea terenului si in comformitatea Documentatiei
  - Verificarea comformitatii a diferitelor materiale legate de granite administrative, denumiri geografice, etc.
  - Verificarea neconcordantelor dintre numeroase materiale de referinta.
- **Reverificarea (de catre conducator)**
  - Verificarea preciziei a numeroase elemente greu de deslusit, ce urmeaza a fi reprezentate
  - Verificarea compatibilitatii a numeroase denumiri si limite administrative.
  - Verificarea compatibilitatii fisierului adiacent.

Inregistrarea Calitatii Verificarii

- Pentru a controla calitatea, inregistrari asemanatoare ar trebui infaptuite.

Form 1-1
Quality Control Record

Field Identification and Compilation

Production of Topographic Base Map (Map Information) using satellite images

Area name		Scale		Period	From	Executing organization	Checker	
Name of municipality		Workload	km²		To	Operator	Work leader	

	Item	Omission	Error	Unnecessary
Control point, elevation point	Control point			
	Elevation point			
	Image control point			
River, lake, ocean	Shoreline (position, shape)			
	Relation with contour line			
	Dry driver			
	River centerline			
	Canal (aboveground, underground)			
	Name attribute (river, lake)			
	Annotation (river, lake, ocean, etc.)			
	Boundary line (river, coast, river mouth, lake)			
	Flow direction			
Road	Position, shape			
	Road edge			
	Bridge, tunnel, snowshed, stone steps, garden path			
	Retaining wall, cliff			
	Road centerline			
	Annotation, route name			
Railroad	Position, shape			
	Track centerline Bridge, tunnel			
	Annotation, line name			
	Station			
Building, etc.	Position, shape			
	Buildings (individual, overall)			
	Generalization			
	Building symbol (public facilities)			
	Attributes of public facilities (name, address, coordinate)			
	Building symbol (other symbols)			
	Annotation, building name			
Other structures	Toll gate, high tower, monument, chimney, antenna tower, oil well, gas well, light house			
	Transmission line, pipeline (aboveground, underground, elevated)			
	Wall, retaining wall, tunnel mouth (cave mouth)			
	Ferry			
	Weir, starling, water gate, breakwater			
	Dam			
	Annotation, structure			
Vegetation	Cultivated land, uncultivated land			
Specific site	Boundary of specific site			
	Cemetery, castle ruin			
	Hot spring, crater/fumarole, mining ground, quarry			
	Fishing port (principal, local)			
	Historic site, scenic spot, natural monument			
	SDF, factory, power station, etc.			
	Annotation, specific site			
Land area topography	Contour line (shape, position)			
	Contour line (value attribute)			
	Contour line (value annotation)			
	Cliff, rock			
	Sand and gravel area, swamp, perpetual snow			
	Waterfall symbol, annotation			
Water area topography	Contour line (shape, position)			
	Contour line (value attribute, annotation)			
	Lake bottom cliff			
	Mudflat			
	Tidal rock			
Administrative boundary	Administrative boundary (position, shape)			
	Administrative boundary			
	Administrative name			
	Indefinite boundary			
	Relation with features			
	Affiliation boundary			
Annotation	Portrayal vector			
	Residential area name			
	Hierarchy of Residential area name			
	Natural place name			
Remarks (quality control-related matters, etc.)				

*Put a slash (/) in the column if it is unnecessary.

Materiale pentru Verificarea terenului

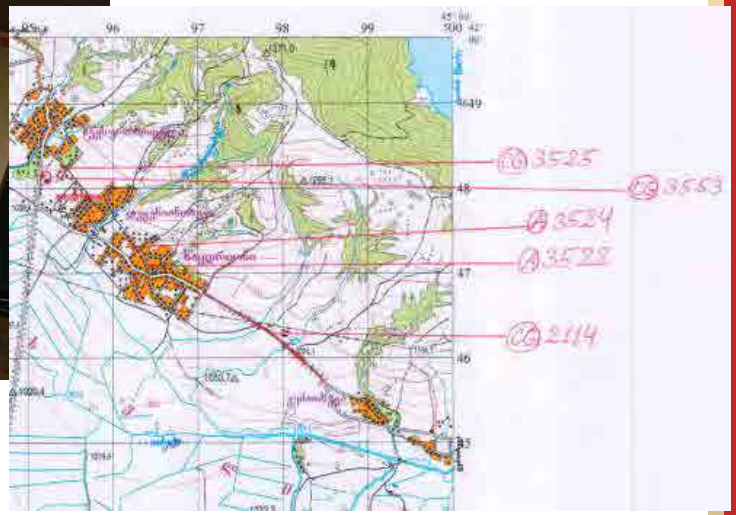
- Imagini ortofotografice, etc. sau materiale de referinta care descriu rezultatele in urma verificarii
- Tabela de verificare
- Hotare/ denumiri geografice, document de verificare si harti relationate
- Inregistrarea calitatii verificarii
- Alte materiale

Completarea Terenului

Obiectiv:
Sa verifice trasaturile geografice greu de recunoscut pe fotografiile aeriene si sa verifice adnotatia, denumirile geografice si altele.

Lucru pe Teren

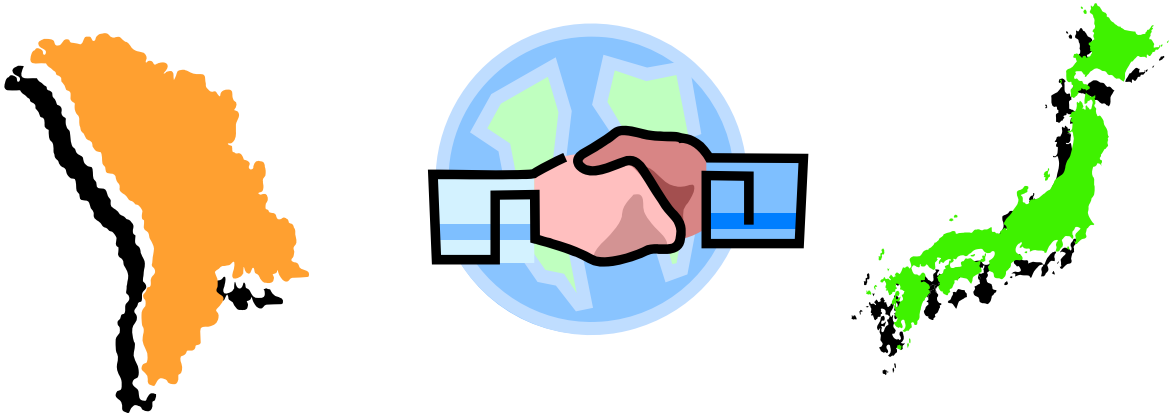
Observand informatia corectata pe teren pe harta – model



Rezultatul completarii Terenului

Sfarsit

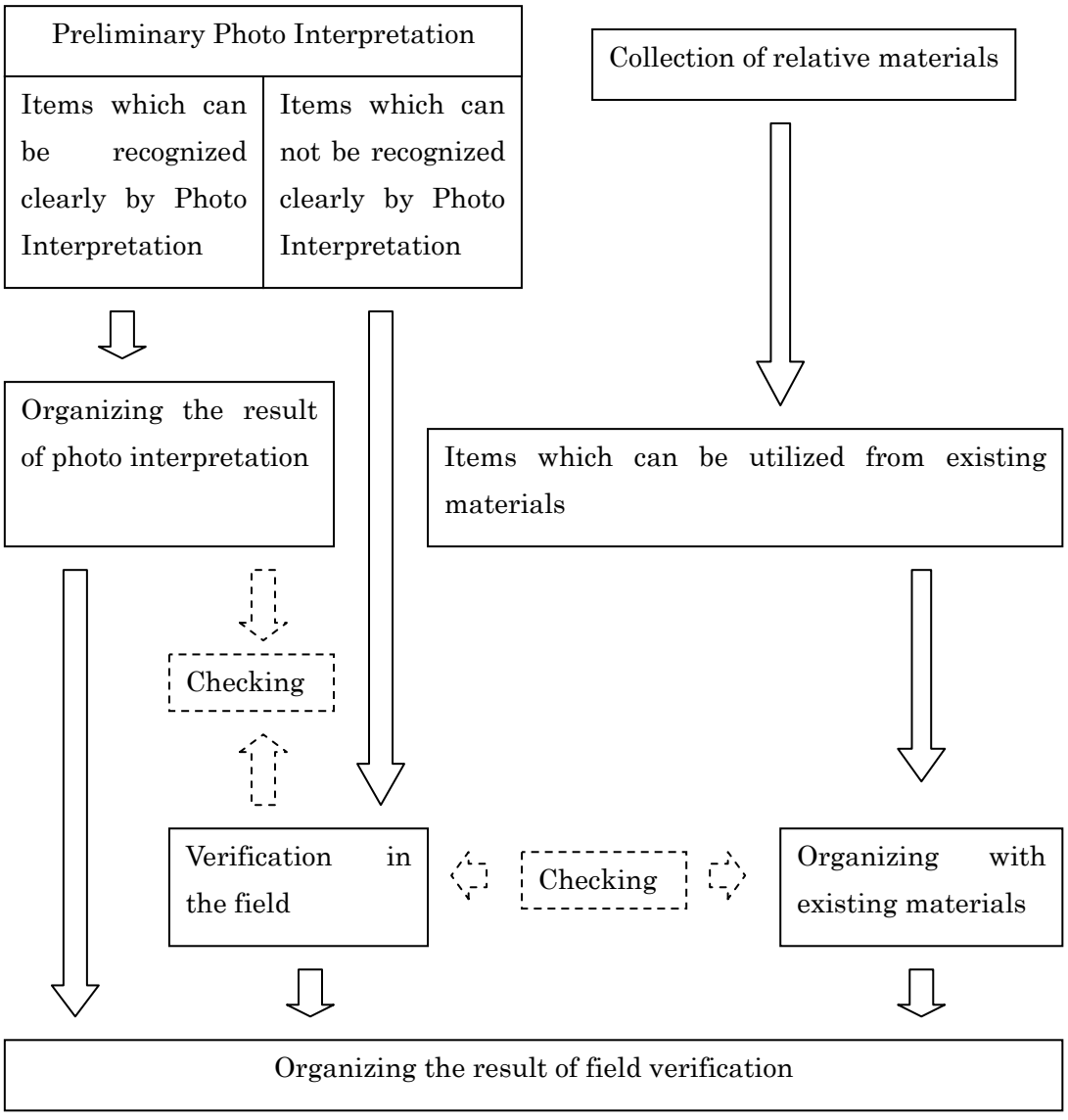
Va multumesc pentru Atentie



Guideline for Field Verification work (General)

Purpose of the field verification

Field verification refers to the verification of items, names, etc. shown on a topographic map to be created, writing the results on aerial photos or reference materials, and the creation of materials required for mapping and data compilation.



Flow chart of field verification

1. Planning and Preparation

For efficient execution of the field verification, firm schedule that orders proper programs must be presented as well as related documents in advance for launching field work at the earliest time.

1.1 Work planning

First of all, work planning maps; including the Study area, index sheets, printed ortho imagery map with grid (such as UTM); shall be prepared. A proper planning for required total working days, arrangement of working staffs and their organization, transportation (vehicle) arrangement, work process control and others shall be considered and included in the planning documents. Furthermore, following items shall also be considered in work planning process.

(i) Weather condition of the Study area.
(ii) Access roads condition of the Study area.
(iii) Village density of the study area.
(iv) Skill of assigned surveyor.
(v) Selection of the base station for accommodation, if necessary.

1.2 Preparation

All necessary equipments and materials for field verification shall be listed and prepared. Generally, following items are included:

(i) Printed imagery for the field verification covered the study area.
(ii) Existing topo-maps covering the study area.
(iii) Existing materials (railways, power lines, pipelines etc, if available).
(iv) New imagery (for confirmation on 3D (stereo), if required).
(v) The symbol table for field verification (required number; based on number of surveyors).
(vi) Panels (required number; based on number of surveyors).
(vii) Special pen for drawing (required number: red, blue, and green).
(viii) Spare ink (required number: red, blue, and green).
(ix) Sketch pencil for preliminary photo interpretation (required number of color pencil: red, blue, and green).
(x) Triangle ruler (required number).
(xi) Eraser (required number).

2. Photo Interpretation

It should be evaluated based on the shape, color, pattern of an object and situation of surrounding area on the imagery.

In general, the precision of photo interpretation is better in case of expert than beginner, color image than B&W (Black and White) and 3D than 2D. And, the precision is also better if some pre-information and characteristic of the site (that is, presence of land use types; such as, orchard area, paddy field area, industrial zone, religious area etc) are available beforehand.

Few examples of clue to interpretation are given as follows:

Ex.1: It can be guessed a school if there is a building with playground.

Ex.2: It can be guessed a mosque if there is a building with spire.

Ex.3: Usually paved road looks like black, un-paved road looks like white. (In case of B&W imagery)

Ex.4: Usually a railway is no wider than road and the curve is gentle.

Ex.5: A river (water area) looks black so it is easy to identify. (In case of B&W imagery)

Ex.6: If there is a road crossing a river there should be a bridge at the cross point.

Ex.7: Usually it is irrigation canal if there is straight black line among cultivated lands.

Ex.8: Usually it is paddy field if there is flat land divided by ridge.

Ex.9: Usually it is orchard if there are trees spaced at regular interval.

Ex.10: Usually it is chimney if there is a line shadow near factory building.

3. Preliminary Photo Interpretation

Preliminary photo interpretation is preliminary survey for classification of objects which should be verified in the field, judgment of necessity to verify objects in the field, and evaluating the effectiveness of existing materials.

For efficient execution of the field verification, easy identifiable objects must be marked on the printed ortho imagery using color sketch (soft) pencil with the help of existing topo-maps and other available relative information. Verification items such as buildings, facilities, objects (school, hospital, church, mosque, cemetery, station, stadium, monument, antenna, tank, well, source, bridge, wall, fence, power line, pipeline, bank, cliff etc) should be drawn with the predetermined symbols on the printed imagery for the field verification.

- Point of items

1) The where of urbanization
2) The where of dead Village
3) The where of shore line changed by bank protection work
4) The where of new construction of dam
5) The where of new construction, widening or improvement of roads
6) The where of new construction or double-tracking of railways
7) The where of shape changed of cemeteries and parks
8) The where of new construction or movement of public facilities such as churches, schools and so on
9) The where of new construction or abandonment of factories, power station and so on
10) The where of new construction of power lines, pipeline and so on
11) The where of new construction or improvement of canals

- Some Cautions:
  1) If necessary, the verification items should be confirmed by stereo imagery.
  2) Category of Road should be checked in the field. This is excluded during preliminary photo interpretation.
  3) Railway should be checked in the field. This is excluded during preliminary photo interpretation.
  4) Natural rivers will be delineated during plotting. This is excluded during preliminary photo interpretation. (Refer to existing topo-map for classification).
  5) Artificial waterline should be checked in the field. This is excluded during preliminary photo interpretation.
  6) Boundary of vegetation is excluded and it should be drawn after field verification..

4. Field Verification

With the help of topo-maps, the items should be verified in the field and drawn on preliminary interpreted images with the predetermined symbols. The name of items; such as administration (city, village), river, lake and marsh, mountain and mountain chain, and the others; should be checked from existing topo-maps and if there are some changes and addition, these should be updated using information collected.

4.1 Identification in the Field

The items which must be verified in the field are not only items which were marked during the

preliminary photo interpretation but also items which would be found in the field.

- Main Items:
  1) The verification items must be confirmed whether exist or not on the imagery of preliminary photo interpretation and drawn if it is exist.
  2) Buildings like new established school, hospital, church etc. should be verified and drawn.
  3) Objects like new installed monument, antenna, tank, well etc. should be verified and drawn.
  4) Facilities like new constructed bridge, fence, wall, power line, pipeline etc. should be verified and drawn.
  5) Road classification should be verified and drawn.
  6) Water line classification should be verified and drawn.
  7) Bank and cliff including their shifting should be verified and drawn.
  8) New cemetery should be verified and drawn.
  9) New plantation etc. should be verified and drawn.

4.2 Checking field verification data

After completion of field verification works, thorough check shall be carried out for missing survey sites (or items) and mismatching data between adjacent images. Re-survey must be executed immediately if there are some problems.

4.3 Points to be considered during field verifications

1) On the imagery for field verification, survey items shall be drawn using following color ink.
   - Red:
     - Symbols of buildings like school, church, hospital etc.
     - Facilities like dam, wall, fence, power line, pipeline etc excluding water pipeline.
     - Objects like monument, tank, antenna etc.
     - Road and railway (including bridge, culvert).
     - Bank, cliff and vegetation symbol.
   - Blue:
     - Water pipeline, other water lines.
     - Symbols of water well, water source, riffle, waterfall etc.
   - Green

- Vegetation limit
- Limit of big cemetery.
- Limit of orchard and plantation.

2) For drawing on the printed imagery for field verification, it is forbidden to use any undefined symbols.
3) Symbols of field verification must be drawn clearly for the understanding of every body.
4) In case of correction and addition of annotation, it must be written clearly for the understanding of every body.
5) In case of pricking the objects like church, antenna, well etc, the situation of surrounding of the point must be checked and mis-priking of different point on the imagery must be avoided.
6) In case of big city, consideration should be given to prepare separate imagery for each survey item; such as road classification, facility, objects, etc.
7) Power lines are checked and drawn in the field as accurate as possible. But, if these are not clear at the site, it should be drawn from the existing maps and data. (In the process of mapping it should be drown by interpretation, if possible.).
8) Vegetation limits are drawn by interpretation during plotting but if it is possible to get some data at the field, it should be drawn as sample data on the image using Red sketch (soft) pencil.
9) When there is a change in road classification, a certain check mark must be put at the change point.
10) General buildings are not necessary to draw in the field as these are input later by photo interpretation during plotting.
11) Footpath is basically not necessary to draw in the field as this is input later by photo interpretation during plotting.
12) Natural river is basically not drawn in the field as it is input later by photo interpretation during plotting.
13) For safety matter, it is not necessary to survey inaccessible roads. Rather, these are drawn by photo interpretation during plotting with information from neighbors and existing topo-maps.
14) Hearing should be executed with neighbors for efficient work.
15) Survey route must be selected beforehand for efficient work.
16) In case paper of printed imagery is not waterproof, workers must avoid touching by wet hands and raining for damage and change of color. If it is impossible to use printed imagery due to damages, it is better to reprint and rearrange on this

reprinted imagery.

17) It is better to carry handy GPS for estimating approximate position of the verification point.
18) Car trip meter is useful for estimation of distance between items.

5. Collection of Materials

The availability of existing data, such as transmission line, all kind of pipelines, and antenna must be checked in the related organizations. If available, these data should be collected and should be used in the field survey and digital mapping.

6. Inputting the Annotation Data

Confirmed annotation data in the field must be input in proper software by defined code, font, letter size, and letter interval.

- Caution:
  1) Its input items and defined input style must be checked.
  2) It must be checked carefully to be sure that there is no lacking input data.
  3) It must be checked carefully for typing mistake.

7. Quality Control

Verified Items on the printed imagery by field verification, annotated input data, and collected materials must be thoroughly checked. Main checking items are as follows:

1) Field verification ・・・・checking for field verification data. (above mention at 4.2)
2) Input annotation ・・・・lacking, mistake (mis-naming, mis-spelling).
3) Existing data collection・・evaluate usable or not.

8. Process Control

Every Monday, progress of the work must be checked and the work schedule must be adjusted.
If there are some delays, it should be operated to increase staffs quickly and execute on schedule.

9. Modification and Addition of Symbols

On this project, if there is some necessity for modifications or there are some objects that do not exist in the defined items, it must be informed Japan and ****** sides. It is possible to modify and add after agreement between both sides.

10. Safety Control

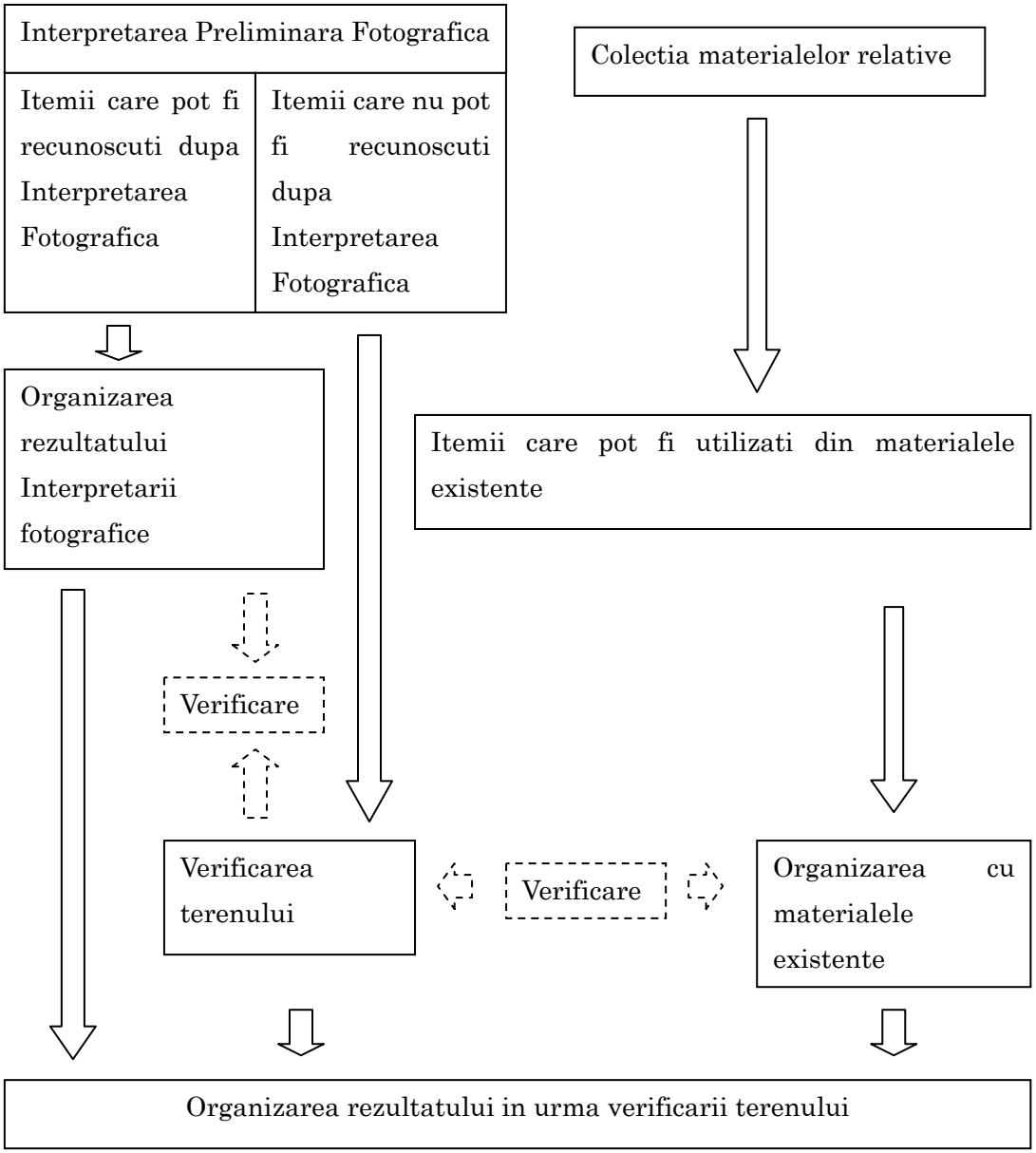
For smooth execution of the Project, every body must try so that there is no trouble and accident.

1) To avoid troubles with residents in the field.
2) To avoid to access dangerous zone and to execute excessive survey.
3) Every morning, parts of the assigned vehicle should be thoroughly checked. (tires, brakes, gears, radiator, oils, fuels and so on).
4) Driver must drive vehicle safely and followings are prohibited:
    - ◆ Driving over speed
    - ◆ Making other vehicle passing/overtaking impossible
    - ◆ Driving after taking alcohol
    - ◆ Overwork driving

Ghid pentru Verificarea Terenului (General)

Obiectivul verificarii terenului

Verificarea terenului se refera la verificarea itemilor, numelor etc., aratate pe harta topografica care va fi creata, inscriind rezultatele pe fotografii aeriene sau pe materiale de referinta, si se la crearea materialelor necesare pentru cartografiere si compilarea datelor.



Structura organizatorica a Verificarii Terenului

1. Planificarea si Pregatirea

Pentru o executare eficienta a verificarii terenului, atat orarul stabilit, care contine programe adecvate, cat si documentele relationate cu proiectul, trebuie sa fie prezentate in avans, pentru a incepe lucrul pe teren cit de curand posibil.

1.1 Planificarea Lucrului

Mai intai de toate, trebuie sa fie pregatite hartile de planificare a lucrului, incluzand aria de studiu, fisele cu cuprins, hartile orto-fotografice cu grila, imprimate (ca UTM). O planificare adecvata pentru zilele totale de lucru necesar, aranjamentul echipei lucratoare si organizarea lor, pregatirea transportului (vehicule), controlul lucrului si altele, trebuie sa fie considerate si incluse in planificarea documentelor. Mai mult, urmarirea acestor itemi, de asemenea, trebuie inclusa in procesul de planificare a lucrului.

(i) Starea timpului in zona de Studiu
(ii) Starea drumurilor pe terenul de Studiu
(iii) Densitatea satelor in zona de Studiu
(iv) Abilitatea cartografilor
(v) Selectarea statiei de baza pentru acomodare, daca e necesar.

1.2 Pregatirea

Toate echipamentele si materialele necesare pentru verificarea terenului trebuie sa fie enumerate si pregatite. Urmatorii itemi sunt inclusi:

(i) Imagini imprimate pentru verificarea terenului, care corespund zonei de studiu.
(ii) Existenta hartilor topografice a zonei studiate
(iii) Materialele existente (cai ferate, linii de electricitate, conducte etc, daca sunt valabile)
(iv) Imagini noi (pentru confirmarea in 3D (stereo), daca e necesar)
(v) Tabelul cu simboluri pentru verificarea terenului (numarul necesar, bazat pe numarul de topografi)
(vi) Panouri (numarul necesar, bazat pe numarul de topografi)
(vii) Pix special pentru desenat (numarul necesar: rosu, albastru si verde)
(viii) Mina de schimb (rosu, albastru si verde)
(ix) Creion de schite pentru interpretarea preliminara fotografica (numarul necesar de culori pentru creion: rosu, albastru si verde)
(x) Echer (numar necesar)
(xi) Radiera (numar necesar)

2. Interpretarea Fotografica

Trebuie sa fie evaluate pe baza formei, culorii, structurii unui obiect si pe baza situatiei zonei inconjuratoare din imagine.

In general, precizia interpretarii fotografice este mai buna in cazul unui expert decat al unui incepator, in cazul imaginii colore decat a celei alb-negru, 3D decat 2D. De asemenea, precizia este mai buna daca sunt stabilite din timp o informatie predeterminata, la fel si o caracteristica a terenului (prezenta tipului de teren folosit, precum zona de livezi, zona industriala, arie religioasa etc).

Cateva exemple-indici pentru interpretare sunt aratate mai jos:

Ex.1: Putem conclude ca avem o scoala, daca exista o cladire cu teren de joaca

Ex.2: Putem conclude ca avem o moschee, daca exista o cladire cu turn.

Ex.3: De obicei drumurile pavate sunt aratate cu negru, drumurile nepavate – cu alb (in cazul imaginilor incolore)

Ex.4: De obicei o cale ferata nu este mai lata decat drumul si curba este mica.

Ex.5: Un rau (zona apei) este aratat cu negru, astfel incat e usor de identificat. (in cazul imaginilor incolore)

Ex.6: Daca exista un drum care intersecteaza raul, trebuie sa fie si un pod in punctul de intersectie.

Ex.7: Avem un canal de irigatie daca exista o linie dreapta neagra printre terenurile cultivate.

Ex.8: Avem un teren de orez, daca exista un teren plat divizat de lanturi.

Ex.9: Avem o livada daca copacii sunt plasati la un anumit interval.

Ex.10: Avem un semineu daca exista umbra unei linii langa fabrica.

3. Interpretarea Fotografica Preliminara

Interpretarea fotografica preliminara reprezinta cercetarea preliminara pentru clasificarea obiectelor, care trebuie sa fie verificate pe teren, judecarea necesitatii de verificare a obiectelor de pe teren si evaluarea efectivului de materiale existente.

Pentru o executare eficienta a verificarii terenului, obiectele usor de identificat trebuie sa fie marcate pe orto-imaginile imprimate, utilizand creionul de desen (moale), si cu ajutorul hartilor topografice existente si a altor informatii relative accesibile. Itemii de verificare precum cladirile, facilitatile, obiectele (scoala, spital, biserica, cimitir, statie, stadion, monument, antena, fantana, pod, perete, linie de electricitate, conducte, stanci etc.) trebuie sa fie desenate cu simbolurile predeterminate pe imaginile imprimate pentru verificarea terenului.

- Itemi
  1) In cazul urbanizarii
  2) In cazul satelor nepopulate
  3) In cazul schimbarii liniei tarmului
  4) In cazul construirii unui nou baraj
  5) In cazul drumurilor nou construite, imbunatatite sau largite.
  6) In cazul cailor ferate nou construite
  7) In cazul schimbarii formei cimitirelor si parcurilor
  8) In cazul noilor constructii de facilitati publice, precum biserici, scoli si altele.
  9) In cazul noilor constructii sau abandonari a fabricilor, statiilor electrice si altele.
  10) In cazul noilor constructii a liniilor de electricitate, conducte si altele
  11) In cazul noilor constructii sau imbunatatirii canalelor.

- Cateva Precautii:
  1) Daca este necesar, itemii de verificare trebuie sa fie confirmati de imaginea stereo
  2) Categoria de Drumuri trebuie sa fie verificata pe teren. Aceasta este exclusa in timpul interpretarii fotografice peeliminare.
  3) Caile ferate trebuie verificate pe teren. Aceasta este exclusa in timpul interpretarii fotografice preliminare.
  4) Raurile naturale vor fi delimitate in timpul cartografierii. Aceasta este exclusa in timpul interpretarii fotografice preliminare.
  5) Apele artificale trebuie sa fie verificate din timp. Aceasta este exclusa in timpul interpretarii fotografice preliminare.
  6) Limitele vegetatiei sunt excluse si trebuiesc desenate dupa verificarea terenului.

4. Verificarea Terenului

Cu ajutorul hartilor topografice, itemii trebuie verificati pe teren si desenati in timpul interpretarii fotografice preliminare cu simboluri predeterminate. Numele itemilor, precum administrarea (oras, sat), rau, lac, munte si altele; trebuie sa fie verificate de la hartile topografice existente si daca exista anumite schimbari si aditii, acestea trebuiesc actualizate folosind informatia colectata.

4.1 Identificare pe Teren

Itemii care trebuie verificati pe teren, nu sunt doar itemii marcati in timpul interpretarii fotografice preliminare, dar si itemii care vor fi gasiti pe teren.

- Itemii Principali:
  1) Trebuie de confirmat daca itemii verificati exista sau nu pe imaginea interpretarii fotografice preliminare si desenati, daca acestia exista.
  2) Cladiri precum scoli, biserici, spitale, etc, care au fost infiintate recent, trebuie sa fie verificate si desenate.
  3) Obiecte precum monumente, antene, fantani etc., recent instalate, trebuiesc verificate si desenate.
  4) Facilitati precum pod, perete, linie de electricitate, conducte etc, recent construite, trebuie sa fie verificate si desenate.
  5) Clasificarea drumurilor trebuie sa fie verificata si trasata.
  6) Clasificarea apelor trebuie sa fie verificata si trasata.
  7) Stancile si falezele, inclusive adancimea lor, trebuie sa fie verificate si trasate,
  8) Cimitirele noi trebuie trebuiesc verificate si trasate.
  9) Plantatiile noi trebuie sa fie verificate si trasate.

4.2 Date de verificare a terenului

Dupa finisarea lucrului pe camp, trebuie sa se efectueze o verificare mai aprofundata a locurilor absente (sau itemi) si a datelor necorelate dintre imaginile adiacente. Re=examinarea trebuie sa fie executata imediat, daca exista anumite probleme.

4.3 Punctele care trebuie luate in consideratie in timpul verificarii terenului

1) Pe imaginea ajustata pentru verificarea terenului, itemii cartografici trebuie sa fie desenati, folosind urmatoarea culoare de cerneala.
   - Rosu:
     - Simbolurile cladirilor precum scoala, biserica,spital etc.
     - Facilitati precum baraj, bariera, conducte etc. excluzand conductele de apa.
     - Obiecte ca monumente, antena, rezervor etc.
     - Drumuri si cai ferate (inclusive poduri, canale de scurgere)
     - Simbolul barajelor, falezelor si vegetatiei
   - Albastru:
     - Conducte de apa si alte linii
     - Simbolurile fantanilor, surselor de apa, cascadelor etc

- Verde:
  - Conturul vegetatiei
  - Marginea cimitirelor mari
  - Marginea livezilor si plantatiilor

2) Pentru a desena pe imaginile imprimate ale terenului verificat, este interzis sa se foloseasca oricare symbol nedefinit.
3) Simbolurile terenului verificat trebuie sa fie desenate clar, pentru a fi intelese de oricine.
4) In cazul corectarii si aditionarii, trebuie sa fie scris clar, pentru a fi inteles de oricine.
5) In cazul implementarii obiectelor precum scoala, antena, fantana etc, situatia imprejurimilor punctelor trebuie verificata, iar implementarea gresita a obiectelor pe imagine, trebuie evitata.
6) In cazul oraselor mari, trebuie luata in considerare pregatirea imaginilor separate pentru fiecare punct cartografic, precum clasificarea drumurilor, facilitate, obiecte etc.
7) Liniile de electriciate sunt verificate si desenate pe camp cit de exact posibil. Dar daca acestea nu sunt clare pe teren, trebuiesc desenate de la hartile si datele existente. (In procesul de cartografiere, trebuie sa se deseneze dupa interpretare, daca este posibil).
8) Limitele vegetatiei sunt desenate dupa interpretare in timpul cartografierii, dar daca este posibil sa se obtina ceva date de pe teren, atunci trebuie sa se deseneze pe imagine, ca date simple, folosind creionul rosu de schitare.
9) Cand exista o schimbare in clasificarea drumurilor, un anumit semn de verificare trebuie sa fie pus in punctul schimbat.
10) Cladirile generale nu sunt necesare de desenate pe teren, intru cat acestea sunt incluse mai tarziu in timpul cartografierii.
11) Trotuarele nu sunt necesare de desenat pe teren, intru cat sunt incluse mai tarziu pe harta in timpul cartografierii.
12) Raul natural nu este desenat pe teren, intru cat este inclus mai tarziu in imagini in timpul cartografierii.
13) Pentru siguranta, nu este necesar de cercetat drumurile inaccesibile. Mai degraba sa fie desenate de interpretarea fotografica in timpul cartografierii, cu informatia despre vecinatati si hartile topografice existente.
14) Audierea trebuie sa fie executata cu vecinii, pentru un lucru mai efficient. Traseul de cercetare trebuie selectat mai inainte, pentru efectuarea unui lucru calitativ.

15) In cazul in care hartiile imaginilor imprimate nu sunt rezistente la apa, lucratorii trebuie sa evite ploile si atingerea acestora cu mainile umede, pentru a nu deteriora si a schimba culoarea. Daca este imposibil de utilizat imaginile imprimate din cauza deteriorarilor, este mai bine de reimprimat si de rearanjat imaginile.
16) Este mai bine de purtat un GPS de mana pentru estimarea aproximativa a pozitiei punctului verificat.
17) Kilometrajul masinii este util pentru estimarea distantei dintre itemi.

5. Colectarea Materialelor

Valabilitatea datelor existente, precum linia de transmisie, conductele si antenna, trebuie sa fie verificate in organizarile stabilite. Daca e valabil, aceste date trebuie colectate si utilizate in cercetarea terenului si in cartografierea digitala.

6. Introducerea Datelor Adnotate

Datele adnotate confirmate pe teren, trebuie sa fie introduse in software-ul corespunzator cu cod , marimea literei, font si intervalul literelor definite.

- Precautii:
  1) Itemii introdusi si stilul definit trebuie sa fie verificati
  2) Trebuie sa se verifice atent pentru a fi sigur ca nu lipseste nici o data.
  3) Trebuie sa se verifice atent daca nu exista greseli de tipar.

7. Calitatea Controlului

Itemii verificati ai imaginii imprimate, datele introduce si materialele colectate, trebuie sa fie verificate atent. Itemii principali de verificare sunt urmatorii.

1) Verificarea campului・・・・verificarea datelor terenului (mentionat mai sus la 4.2)
2) Adnotarea introdusa ・・・・lipsa, greseli (in denumire, ortografie)
3) Colectia de date existenta・・de evaluat daca sunt utilizabile sau nu.

8. Controlul Procesului

In fiecare luni, trebuie cercetat progresul lucrului si de intocmit planul lucrarilor. Daca exista anumite amanari, trebuie sa fie operate pentru a mari rapid personalul si pentru a executa conform orarului.

9. Modificarea si Aditionarea Simbolurilor

In acest proiect, daca este necesar de modificat sau daca sunt anumite obiecte inexistente in itemii definite, trebuie de informat Japonia si ******. Este posibil de modificat si de adaugat dupa acordul dintre ambele parti.

10. Controlul de Siguranta

Pentru executarea proiectului, fiecare trebuie sa incerce sa nu se intample accidente sau neplaceri.

1) Sa se evite neplacerile cu personalul de pe teren.
2) Sa se evite accesarea zonelor periculoase si executarea excesiva a cercetarii.
3) In fiecare dimineata, trebuie sa se verifice starea vehiculelor (radiator, uleiuri, combustibili, frane,).
4) Soferul trebuie sa conduca vehiculul in siguranta, astfel incat sunt interzise urmatoarele;
    - Conducerea cu viteza depasita
    - Crearea obstacolelor pentru celelalte masini
    - Conducerea in stare de ebrietate
    - Conducerea in afara lucrului

Aerial Triangulation & Digital Plotting

Ver.001

Aero Triangulation (AT) Manual for Digital Camera

Section 1 LPS – Settings and Interior Orientation

JICA Study Team (Kokusai Kogyo)
April, 2012

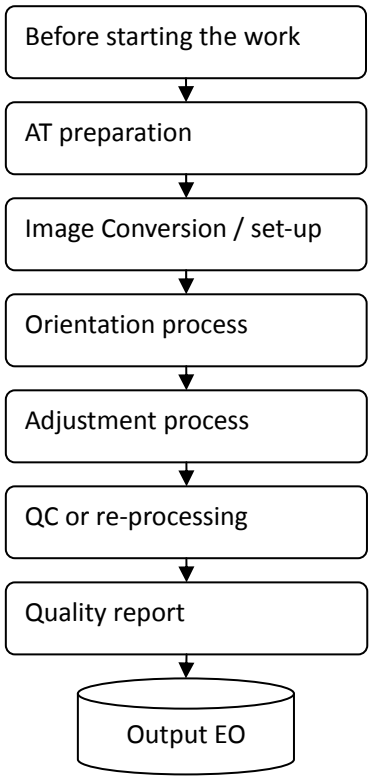
1. Outline

Purpose of this document is to explain about AT works using LPS – ORIMA software with images captured with digital camera system.

Image source for this project was captured with digital camera mounted with GPS (Global Positioning System) and IMU (Inertial Measurement Unit) system. Therefore exterior orientation (EO) parameters (XYZ, omega, phi, kappa) were already supplied through GPS/IMU. However, EO parameters derived only through GPS/IMU may not always carry the required accuracy; hence existing AT procedures such as relative and absolute orientation is also combined to enhance the output EO accuracy.

In this project, GPS/IMU data, GCP, and Imagery are brought onto LPS – ORIMA environment for digital AT.

2. Flow Chart



3. Work Contents

3.1. Before starting the work

It always helps user to check and prepare before starting actual work. Things may need to be aware are:

- Flight information (i.e. Photo scale, flight index, camera type, etc.).
- Specification of the project.
- Purpose of usage of imagery.

3.2. Preparation for AT

In order to execute digital AT; following data shall be prepared:

1. aerial photography

   Aerial photography image data.

2. GPS/IMU data

   EO file (X,Y, Z, Omega, Phi, Kappa) derived from GPS/IMU for each photo exposure point.

3. Camera Parameters

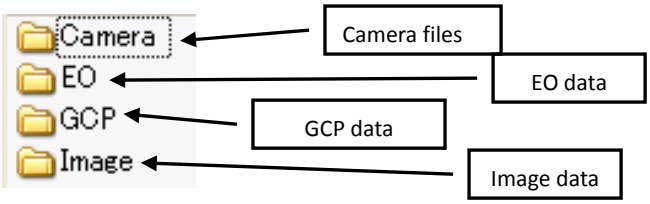
   Camera parameters (i.e. Focal length, PPS, PPA, Focal plain, Lens distortion, fiducial center)

4. GCP Data

   GCP outputs (survey point output and point index)

3.3. Pre data preparation and set-up

In this section, necessary preparation of datasets (aerial image, GCP, GPS/IMU data) in LPS environment is explained. Please create the working folders. (Make sure that you have enough disk space to process!). Sample folders are displayed below:



3.3.1. Aerial Image Data Preparation

In many cases, aerial images are stored as known and readable image format like TIFF. It is important to prepare source images in proper format and file name shall be edited (if necessary) so image files can be distinguished.

EX. Run_6_338.tif → 006_0338.tif

In this case, “Run_6” represents course name, and “338” represents the photo number. The file name should be changed as *006_0338.tif* in order to associate the photo number and GPS/IMU data.

In order to avoid any unknown error at the downstream work; any code, symbol, and double byte characters shall not be used in file name.

3.3.2. Editing GCP output

In order to read GCP output properly onto LPS, data delimiter and alignment sequence shall be checked and sorted if necessary.

GCP point name X Y Z (Space delimited)

LPS prefers “SPACE” delimited ASCII file instead of comma or tab delimited.

```
GCP-097 77348.943   482377.694  1.948
GCP-098 84093.356   479696.233  3.737
GCP-099 76874.383   480053.938  3.344
GCP-100 78762.451   476182.800  3.270
GCP-101 85456.532   475901.911  3.282
```

3.3.3. Editing GPS/IMU data

In this section, GPS/IMU data will be edited for LPS preferred format. Please see the red box area in figure below. Data where indicating “Course number” “ID” “Easting” “Northing” “Height” “Omega” “Phi” “Kappa” need to be extracted. Rest of information including header information can be deleted. However, please save the original GPS/IMU data; it contains valuable reference information such as ellipsoid type, coordinate system, and GPS antenna lever arm offsets.

Header information (Unnecessary for LPS EO)

```
*****************************************************************************
* AEROoffice V5.1f 2010-01-07
* Copyright by IGI mbH, 1996-2010
*
* Dongle-ID: 07D5-04C6-0253-A266
* Owner: Finmap, Kari Suominen
*
* Datamanager Outputfile
* 8/4/2010 10:28:36 AM
*
*****************************************************************************
*
* Project: 1_6_10
* Projectfile: C:¥PROJEKTIT¥Ilmakuvaus¥Ulkomaat¥SriLanka_10¥gps¥01_06_(1)¥1_6_10.aop
*
* Event Marks: C:¥PROJEKTIT¥Ilmakuvaus¥Ulkomaat¥SriLanka_10¥gps¥01_06_(1)¥work¥1_6_10_edit.aom
*
* Format Type: MATCH-AT
*
* Sensor-Leverarm: 0.100m 0.326m 0.345m (LMK2000 PH-SVY)
*
* Meridian Convergence corrected
*
* Coordinate system scalefactor correction for height applied
* Used Height above ground: 3050.00 meter
*
* Local Coordinate System:
* SLD-99-2_EGM96
* Define in:sri_lanka_sld_99_2.coo
*
*****************************************************************************
*
* Infos from the postprocessing logfile:
* AEROoffice V5.1f 2010-01-07
* Dongle-ID: 07D5-04C6-0253-A266
* Owner: Finmap, Kari Suominen
* 7/19/2010 9:25:57 AM
* Header of imported GPS File
* Project: 1_6_10_(1)
* Program: GrafNav Version 8.20.0522
* Profile: IGI AEROCTRL
* Source: GPS Epochs(Combined)
* ProcessInfo: Run (6) by Unknown on 06/28/2010 at 15:09:39
* Datum: WGS84, (processing datum)
* Master 1: Name KAIT1520, Status ENABLED
* GPS-Leverarm: 0.190m -0.024m -0.950m
*
*****************************************************************************
*
*
* Selected Units:
* Angular Units: Degree (0..360~)
* Length Units: Meter
*
* Format:
* ID Easting Northing Height Omega Phi Kappa
*
* Output of event data
* File will contain 203 online Events
*
# LINE 015
          2    127076.338    471129.134      3050.693     -0.03291     -0.28990      1.22045
          3    128893.825    471121.970      3050.737     -0.78228     -0.36868      2.74852
          4    130714.892    471125.313      3050.716     -0.40396     -0.27168      2.34250
          5    132580.338    471119.710      3051.280     -0.10545     -0.32210      2.61272
          6    134407.423    471123.242      3050.640      0.47388     -0.33312      2.47149
          7    136235.907    471118.953      3050.309      0.64270     -0.41794      2.34370
          8    138066.071    471112.843      3050.749      0.15844     -0.45961      2.51709
          9    139894.881    471111.707      3051.392      0.08827     -0.23945      2.77639
         10    141721.050    471115.581      3051.504      0.43898     -0.36033      2.97038
         11    143550.502    471114.699      3051.151      1.24546     -0.35665      2.30497
         12    145422.775    471103.501      3050.088     -0.61902     -0.18204      3.33353
         13    147249.384    471121.500      3049.196      0.96750     -0.23508      2.47466
         14    149071.930    471118.538      3049.982      0.09913     -0.54001      2.31429
         15    150894.003    471114.160      3050.869      0.13718     -0.32645      2.10129
         16    152762.146    471104.974      3050.417      0.39363     -0.25538      2.21805
         17    154589.188    471095.777      3049.684     -0.47875     -0.39271      2.55603
         18    156412.284    471105.992      3050.190      0.25810     -0.49311      2.40505
         19    158274.736    471110.508      3050.357      0.58996     -0.27995      2.08503
         20    160089.837    471100.517      3050.924     -0.27922     -0.31348      2.17217
```

Next step is trimming the data in following sequence:

“ID” “unique photo file name” “X” “Y” “Z” “Omega” “Phi” “Kappa”

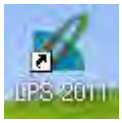
The “ID” must be unique and NOT using code or symbol. Delimiter should be either space or comma. Finished data should look like below; then it should be saved as *.dat. Please check the number of photo centers and number of images (tif) are same.

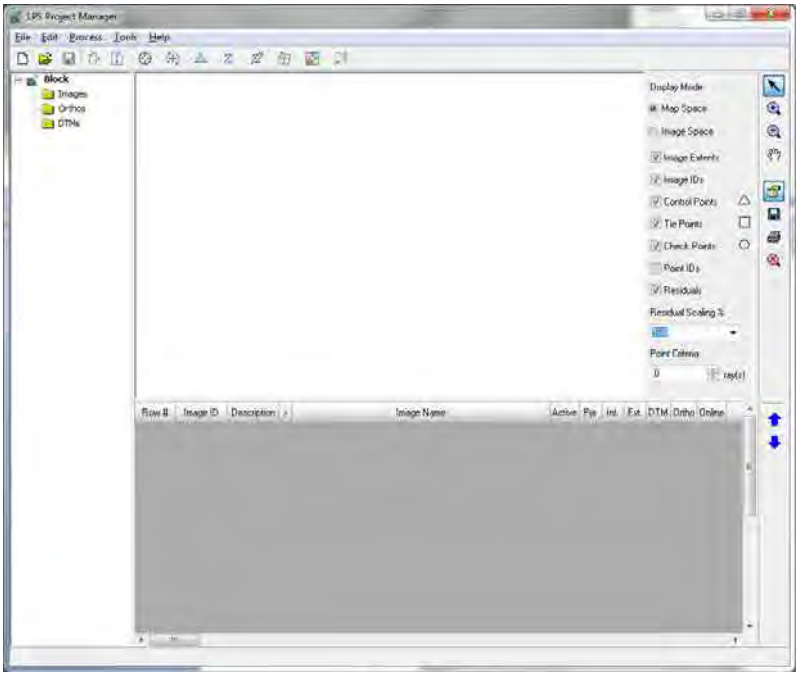
6360	006_0360	137910.22320	496767.95597	3044.82014	-0.80333	0.15874	1.35883
6361	006_0361	139732.60220	496763.35697	3044.46414	-0.47016	0.14709	1.47967
6362	006_0362	141555.14820	496769.80897	3044.67314	-0.89808	0.23762	2.13704

3.3.4. Creating BLK (block) file

At this stage, LPS is ready to boot up to start creating LPS block file (*.blk).

1. Start LPS 2011 by clicking the icon (LPS2011) or select the LPS 2011 from Start – Erdas 2011 – LPS2011 – LPS 2011. Then, LPS window will appear. Please see Appendix4 for tips of process check list.

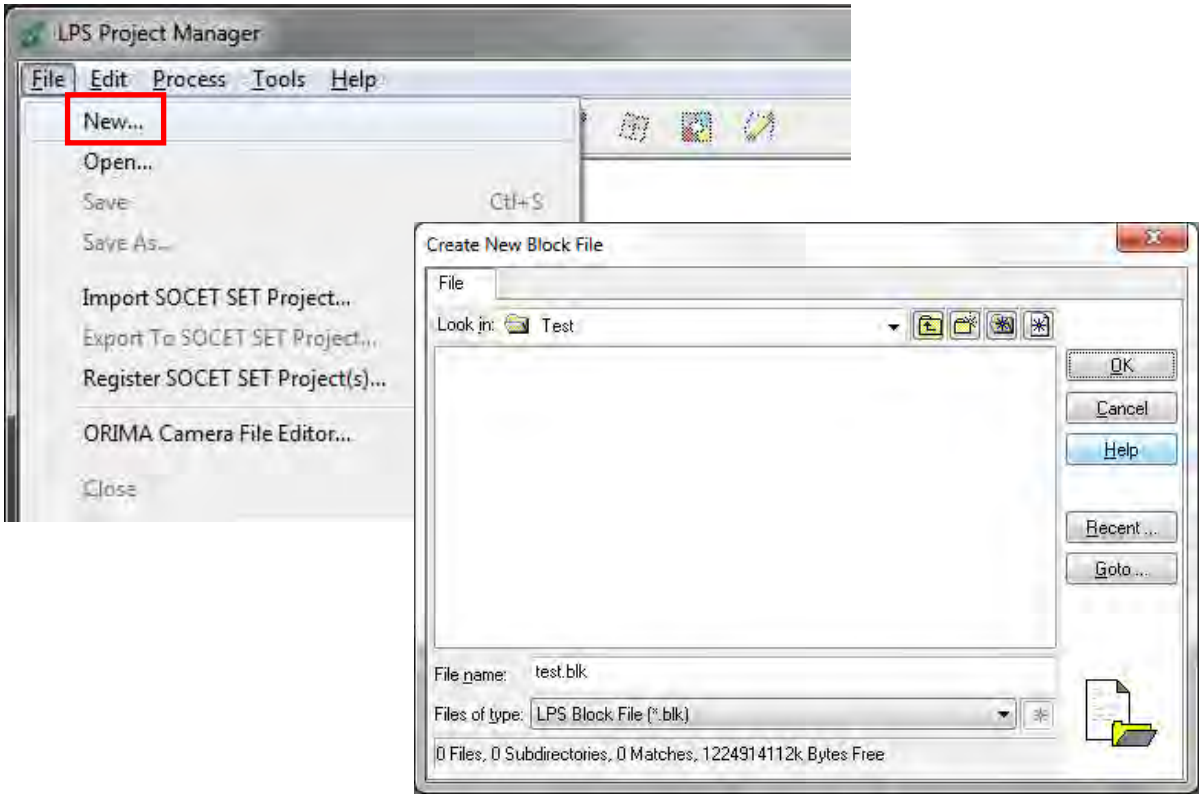




2. Creating block (*.blk) file

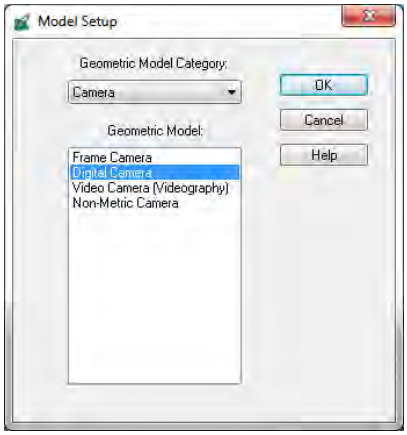
At this stage, camera information, coordinate system, necessary information about image data will be registered.

Select “File”; then “New”. And move to the appropriate folder where to create the block file; then name the file and click “OK” button to create and save the block file.



As block file gets saved; Model Setup dialogue appears and asks for Camera type.

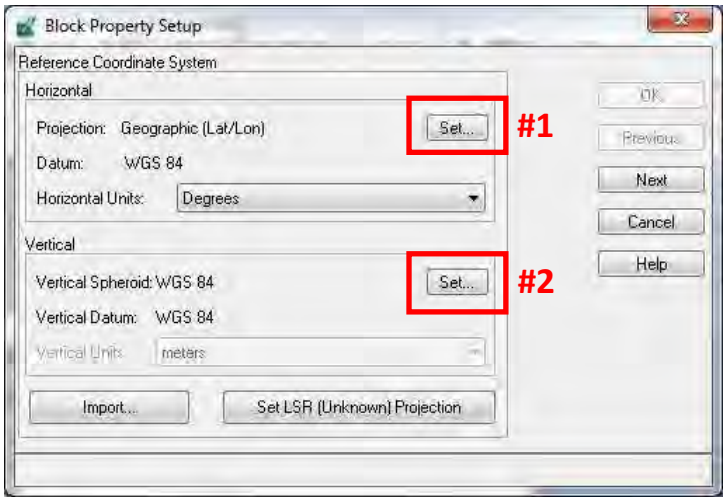
“Geometric Model Category” should be set to “Camera”. And “Geometric Model” should be set to “Digital Camera” and click “OK” to proceed.



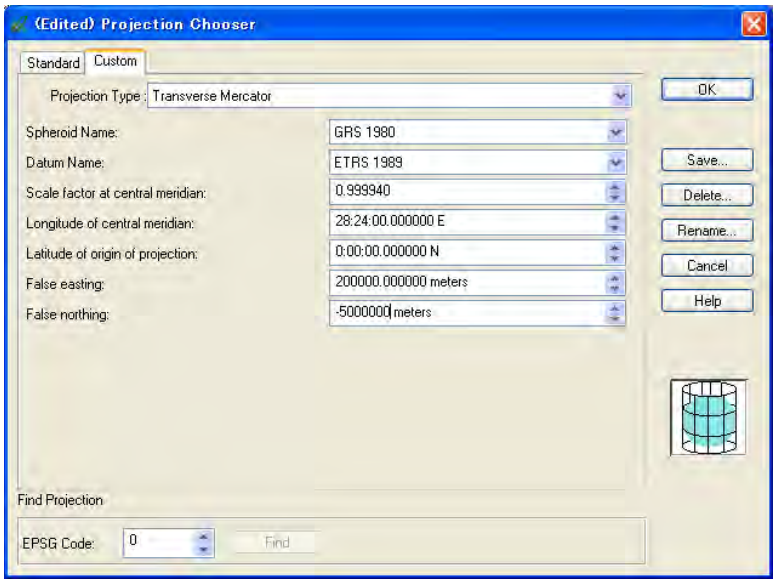
3. Setting up coordinate system

As Model Setup is completed, Block Property Setup dialogue will appear next. On this project; following Horizontal (defined as #1) and Vertical settings (defined as #2) shall be defined.

Each setting can be defined by clicking “set” button; then setting dialogue for each category will appear for data entry.



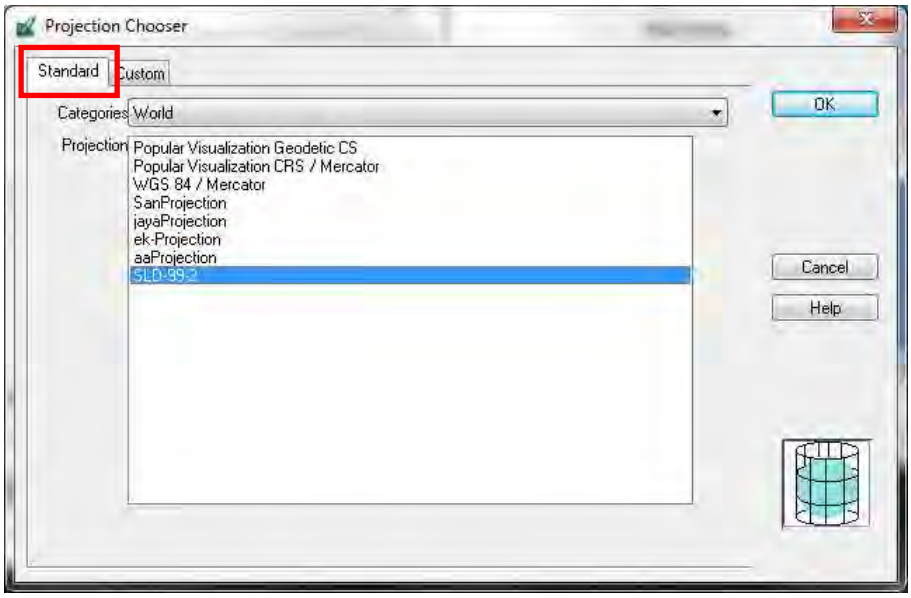
Horizontal Setting



Please click Save the information (coordinates) being registered.

LPS asks where to save the settings. Please name the coordinate settings in “Save as” and specify where the information will be saved in “In Category”.

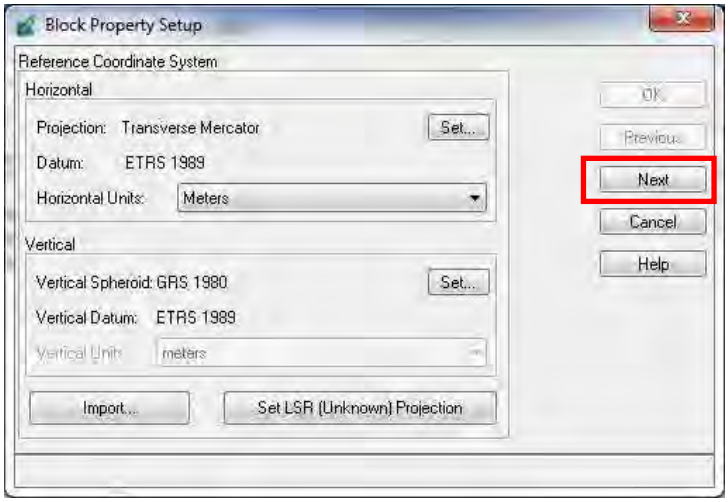
Once the setting is saved, from next time using same settings; the registered setting can be called from Standard tab.



Vertical Setting

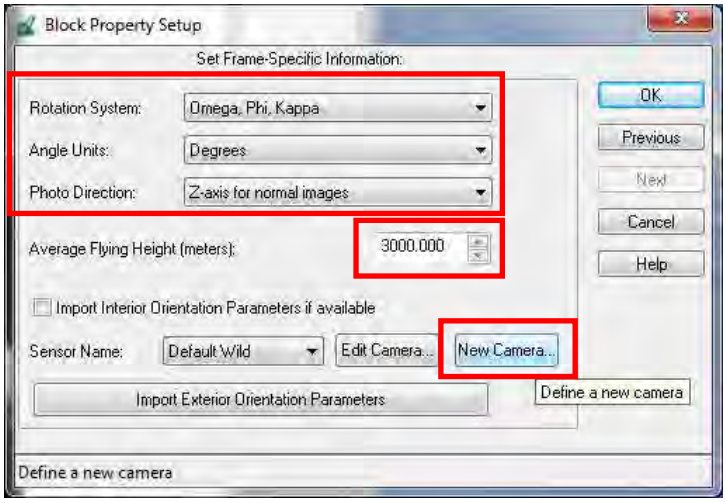
Please make sure Spheroid Name, Datum Name, Elevation Units, and Elevation Type. And Click "OK" to confirm.

Once both Horizontal and Vertical settings are entered; please click “Next” proceeding to “Set Frame Specific Information”.

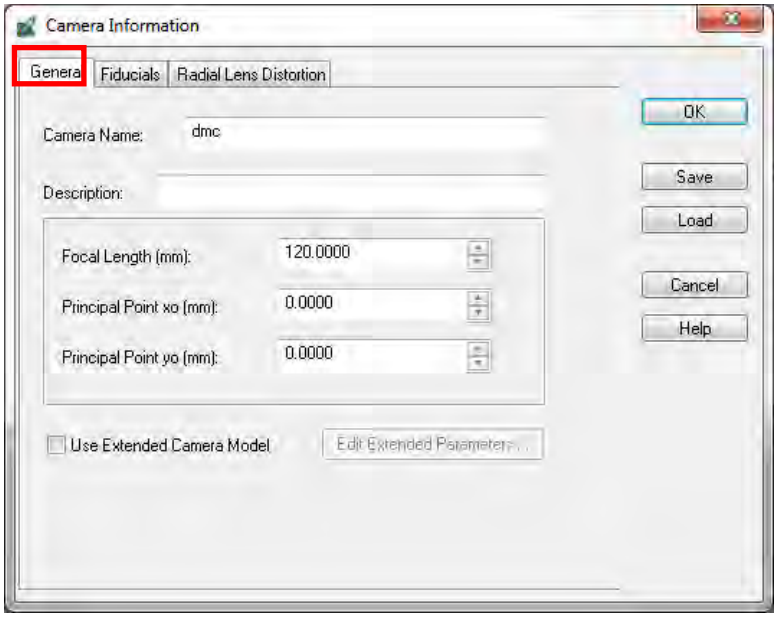


4. Setting Camera information

Click “New Camera” button to set the camera information. Then Camera information dialogue appears.

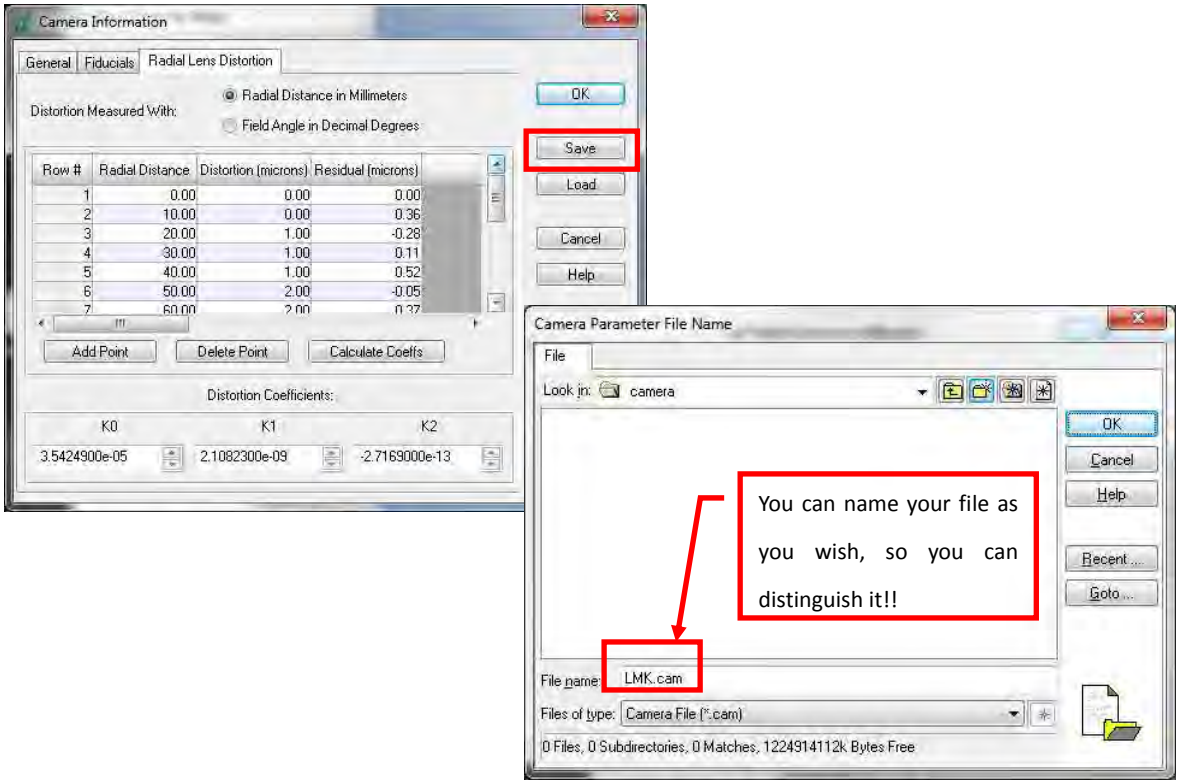


Please select General tabs and enter appropriate values.

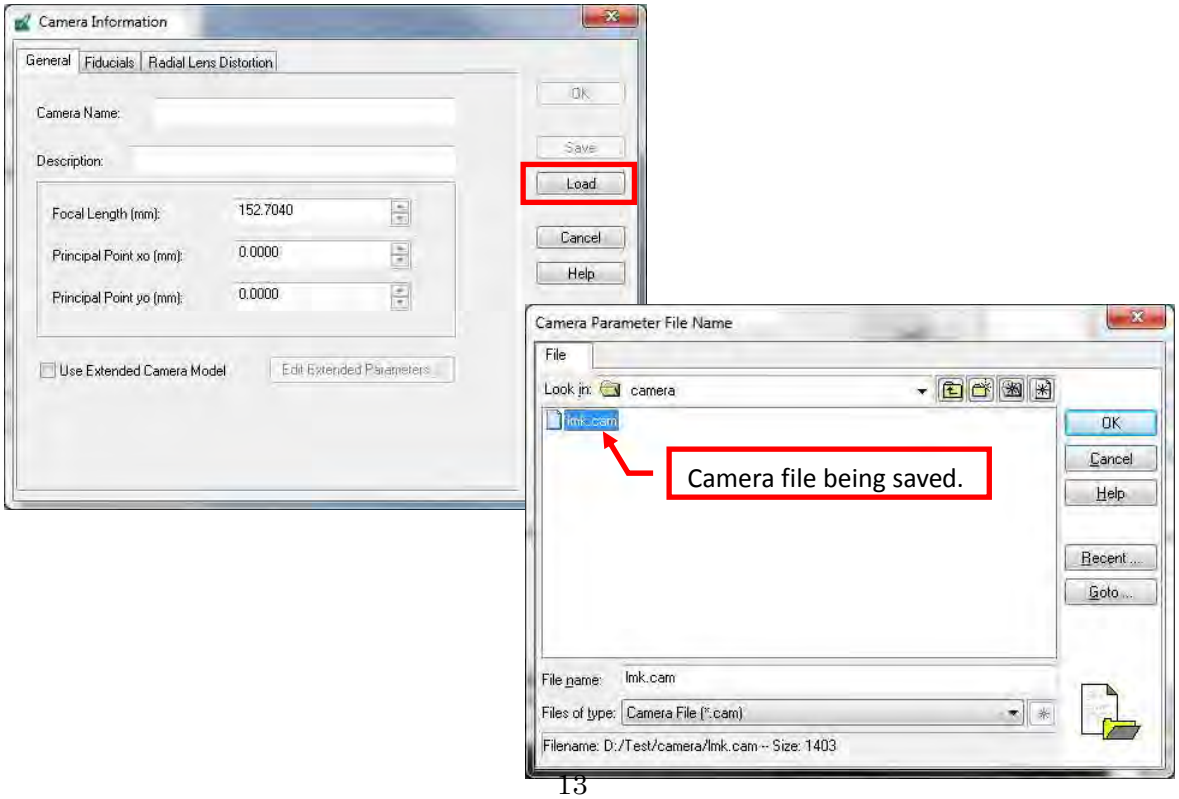


After setting of all tab; please click “SAVE” the camera file as *.cam file.

And camera file can be read again when the exactly same camera (same S/N and lens) will be used.



For next time you will call the camera file; please select “Load” to call the camera file.

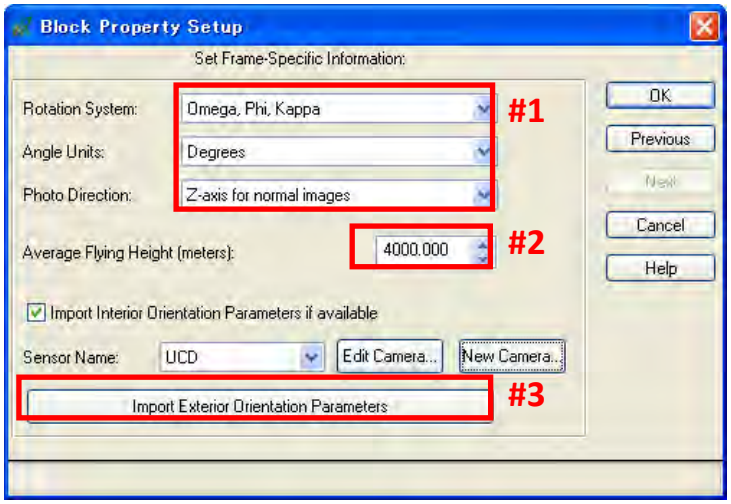


5. Importing GPS/IMU data

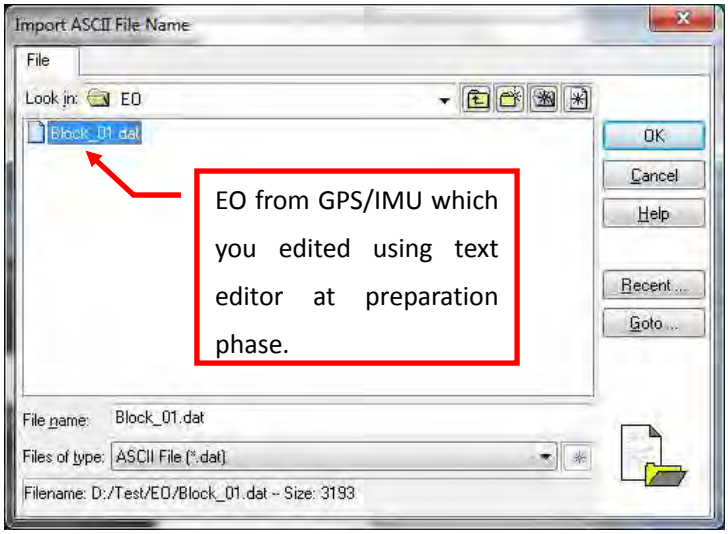
For this project, “Rotation System”, Angular Unit, Photo Direction” (= said as #1) as stated below.

These settings should be same as what GPS/IMU EO says.

Please enter the average flying height(= said as #2).

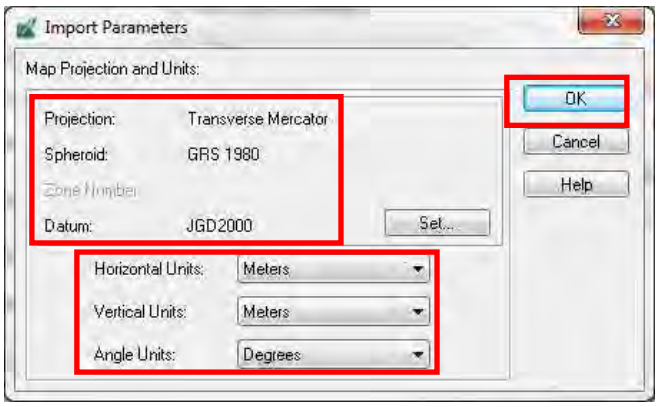


Then, click “Import Exterior Orientation Parameters” (= said as #3) to import GPS/IMU data. Then select the GPS/IMU data (*.dat). Before doing actual import; please check GPS/IMU data has following information: “ID” “Image file name” “X” “Y” “Z” “Omega” “Phi” “Kappa”

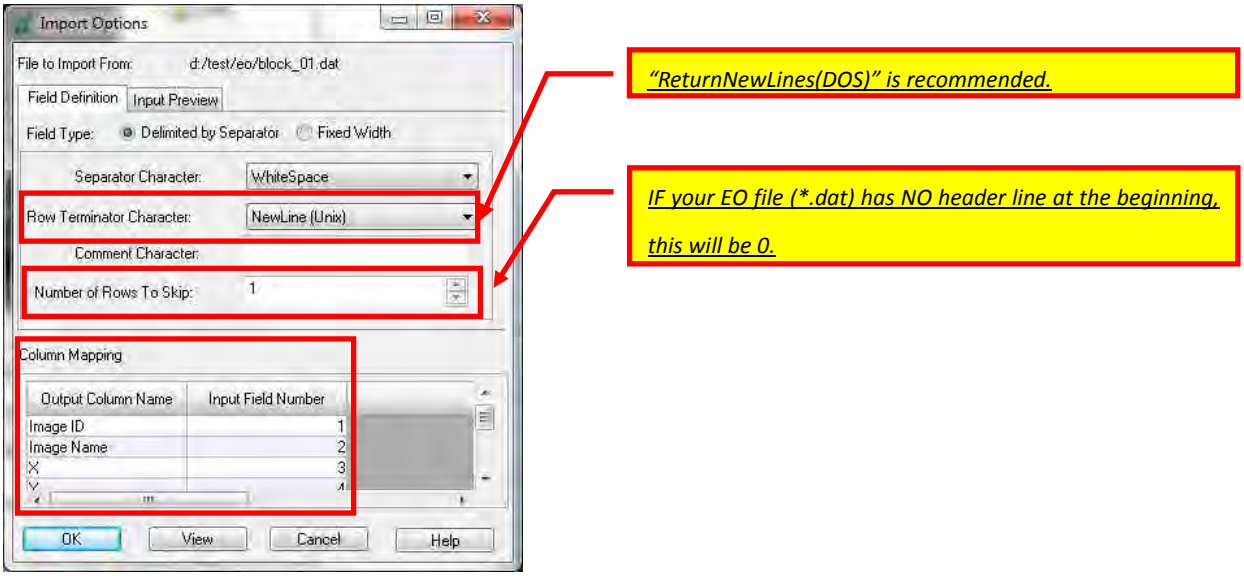


ID	Image file name	X	Y	Z	Omega	Phi	Kappa
6360	006_0360	137910.22320	496767.95597	3044.82014	-0.80333	0.15874	1.35883
6361	006_0361	139732.60220	496763.35697	3044.46414	-0.47016	0.14709	1.47967
6362	006_0362	141555.14820	496769.80897	3044.67314	-0.89808	0.23762	2.13704
6363	006_0363	143377.21320	496795.33797	3043.90214	-0.44889	-0.02442	2.51932
6364	006_0364	145244.66720	496819.27397	3045.05914	1.34166	0.47997	1.23275
6365	006_0365	147067.49520	496790.75597	3044.96314	0.92169	0.72936	0.14399
6366	006_0366	148887.54620	496760.17597	3045.59314	-1.85241	0.04430	1.67257
6367	006_0367	150706.65020	496801.89297	3044.21614	-1.10026	0.59484	3.34907
6368	006_0368	152569.91920	496824.19197	3042.95914	1.21157	0.73041	0.85317
6369	006_0369	154388.03520	496805.51397	3044.88114	0.28871	0.67086	0.87728
6370	006_0370	156207.14720	496796.42897	3044.60514	-0.65541	0.37376	1.66864
7290	007_0290	157681.95981	493597.97397	3048.56214	0.54750	-0.61583	180.55283
7291	007_0291	155832.59481	493593.06797	3048.99214	0.17853	-0.14576	180.88185

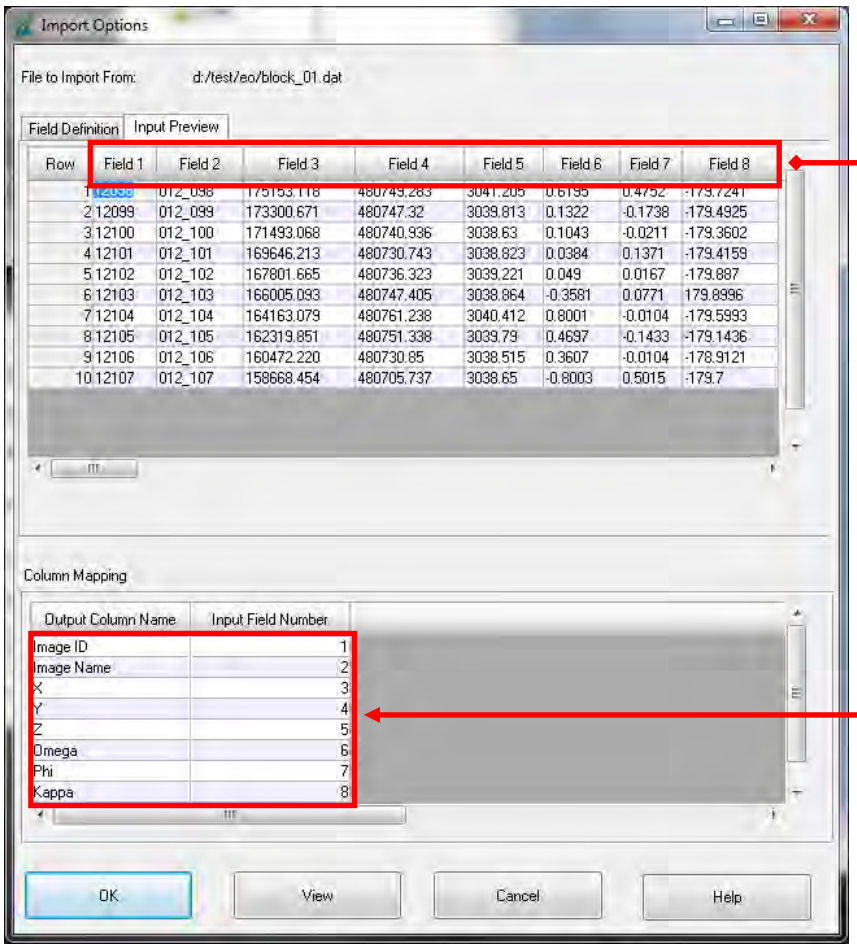
Please make sure Projection, Spheroid, Datum, and Units are being set correctly. Then click “OK” to verify.



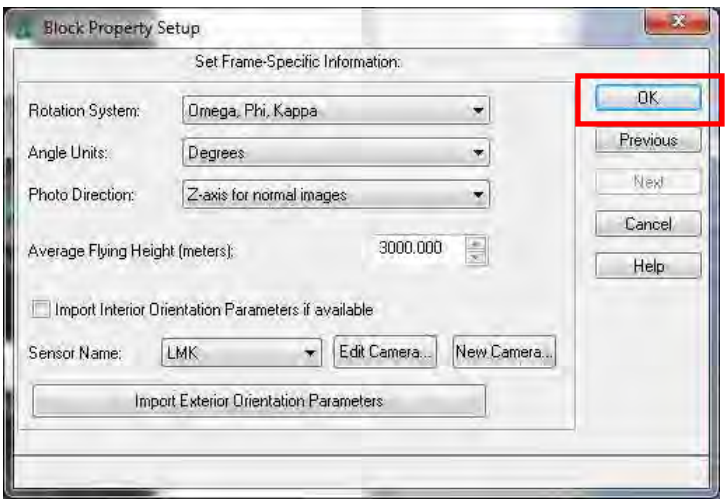
Then "Import Option" dialogue will appear. Please check here that each field shows appropriate information derived from GPS/IMU data. If not; please check GPS/IMU data (*.dat) line alignment is correct or assign correct column of information to match before proceeding into next phase. For the setting said below; LPS will skip reading very first line of GPS/IMU data (*.dat).



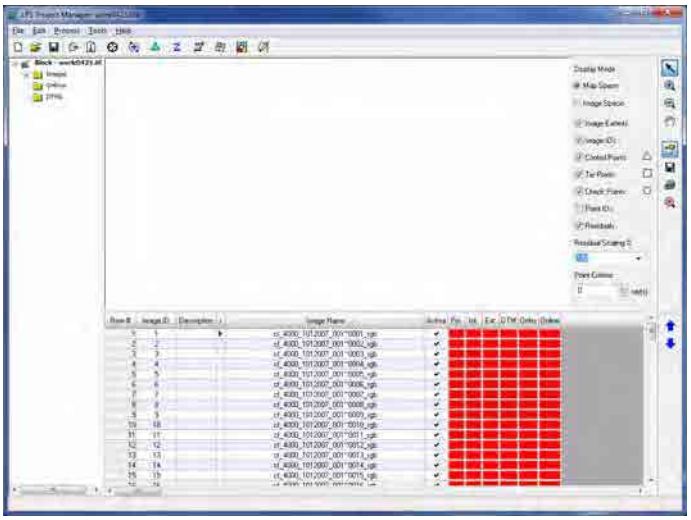
Please select "Input Preview" and make sure field of GPS/IMU data (*.dat) and what "Colum Mapping" number and fields are the same.



Please check that each Field is showing what Output Column Name is saying.

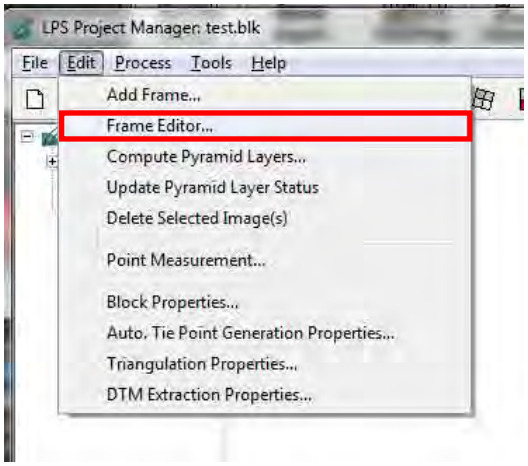


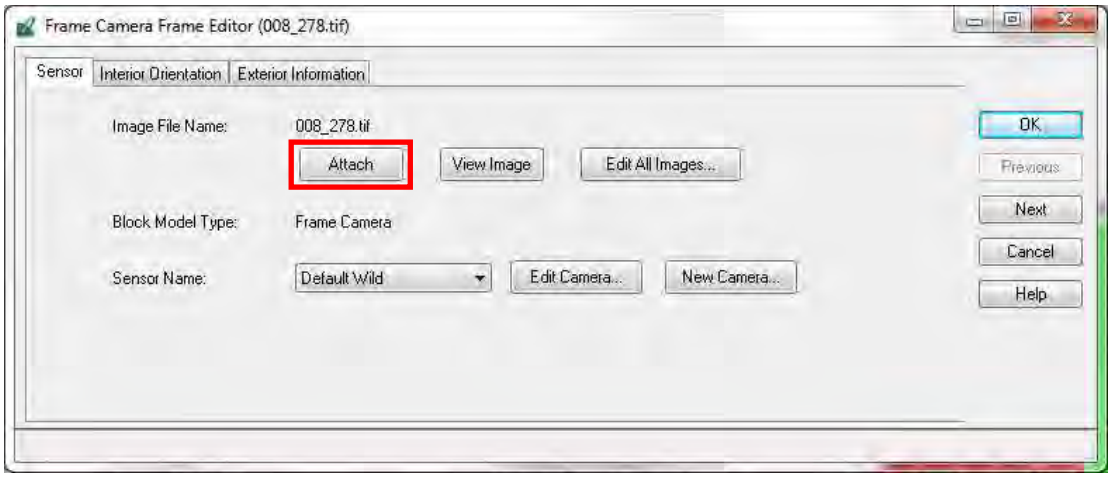
Click “OK” to finish importing the GPS/IMU data. At this stage, Block file setting is completed.

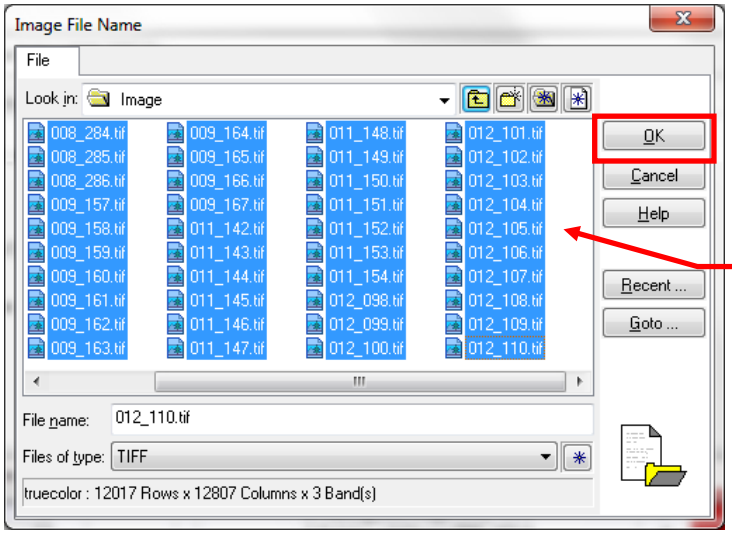


6. Registration of image files

From LPS main menu, select “Edit”, then select “Frame Editor”. Click “Attach” on Frame Editor Dialogue and select the original image files matched to what GPS/IMU data is pointing to and click “OK” to verify. This means the number and name of images will select here shall be the same number and ID from GPS/IMU data just imported at previous procedure.

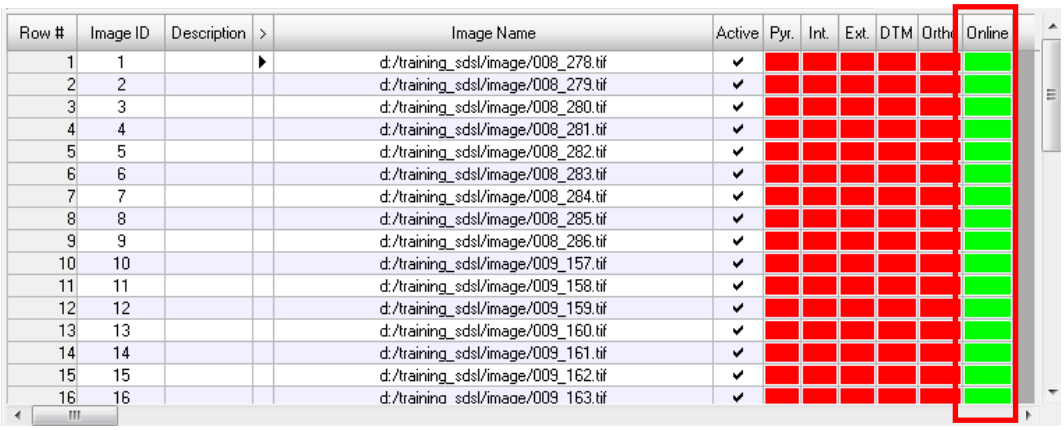






Selecting appropriate images and click "OK". Make sure that you selected ALL images here!

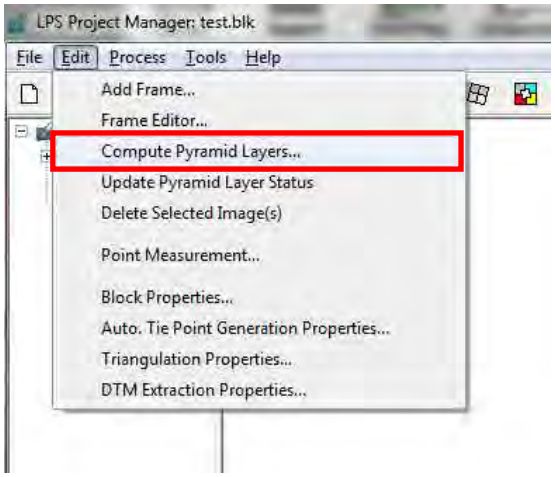
As images are selected; appropriate image shown in "Online" and now should be green.

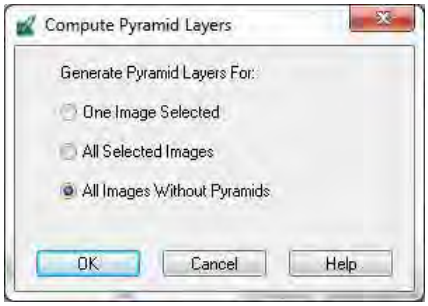


Row #	Image ID	Description	>	Image Name	Active	Pyr.	Int.	Ext.	DTM	Orth	Online
1	1		▶	d:/training_sdsl/image/008_278.tif	✔						
2	2			d:/training_sdsl/image/008_279.tif	✔						
3	3			d:/training_sdsl/image/008_280.tif	✔						
4	4			d:/training_sdsl/image/008_281.tif	✔						
5	5			d:/training_sdsl/image/008_282.tif	✔						
6	6			d:/training_sdsl/image/008_283.tif	✔						
7	7			d:/training_sdsl/image/008_284.tif	✔						
8	8			d:/training_sdsl/image/008_285.tif	✔						
9	9			d:/training_sdsl/image/008_286.tif	✔						
10	10			d:/training_sdsl/image/009_157.tif	✔						
11	11			d:/training_sdsl/image/009_158.tif	✔						
12	12			d:/training_sdsl/image/009_159.tif	✔						
13	13			d:/training_sdsl/image/009_160.tif	✔						
14	14			d:/training_sdsl/image/009_161.tif	✔						
15	15			d:/training_sdsl/image/009_162.tif	✔						
16	16			d:/training_sdsl/image/009_163.tif	✔						

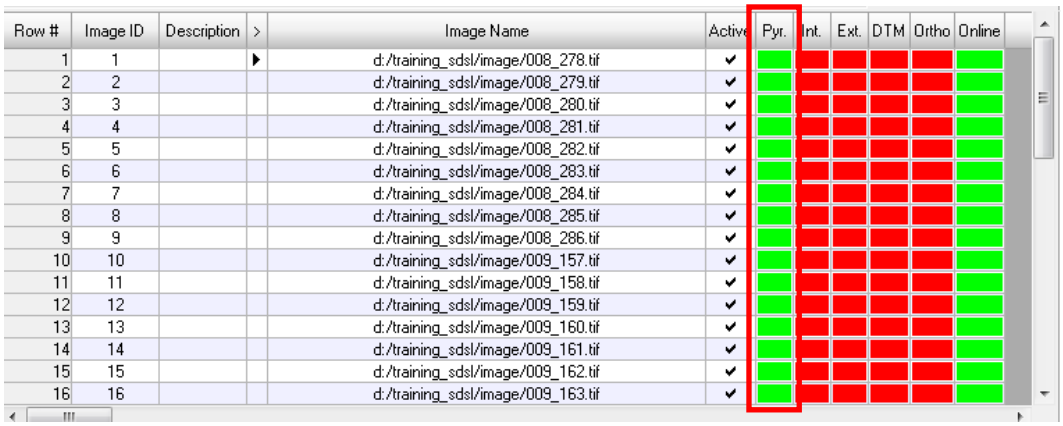
7. Creating Pyramid Layer

From LPS main menu, select "Edit", then select "Compute pyramid layer". Then Compute Pyramid Layer dialogue appears. Please check "ALL Images without Pyramids" then click "OK" to process the pyramid layer images. This means; the LPS will creates all original images into pyramid layer image. If there are many number of images need to be processed; this image conversion may take long time to finish. Pyramid image will create two files (*.aux and *.rrd) and their file size is about 30 – 40 % of original file. Therefore, enough disk space to convert and store the pyramid layer image should be checked before start doing this conversion.





As soon as data conversion into Pyramid layer is finished, appropriate images indicated in ”Pyramid (Pyr.)” change from red to green.

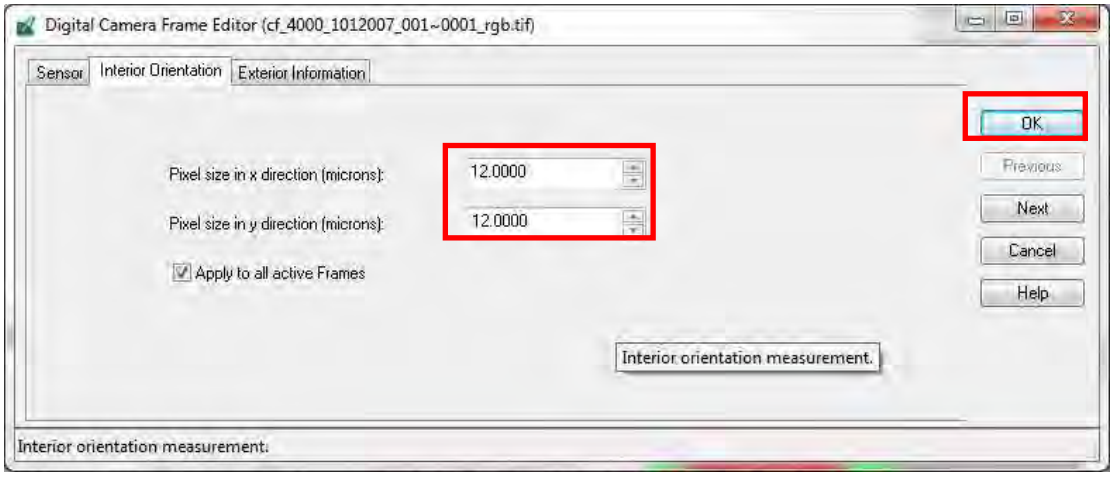


Row #	Image ID	Description	>	Image Name	Active	Pyr.	Int.	Ext.	DTM	Ortho	Online
1	1		▶	d:/training_sdsl/image/008_278.tif	✔						
2	2			d:/training_sdsl/image/008_279.tif	✔						
3	3			d:/training_sdsl/image/008_280.tif	✔						
4	4			d:/training_sdsl/image/008_281.tif	✔						
5	5			d:/training_sdsl/image/008_282.tif	✔						
6	6			d:/training_sdsl/image/008_283.tif	✔						
7	7			d:/training_sdsl/image/008_284.tif	✔						
8	8			d:/training_sdsl/image/008_285.tif	✔						
9	9			d:/training_sdsl/image/008_286.tif	✔						
10	10			d:/training_sdsl/image/009_157.tif	✔						
11	11			d:/training_sdsl/image/009_158.tif	✔						
12	12			d:/training_sdsl/image/009_159.tif	✔						
13	13			d:/training_sdsl/image/009_160.tif	✔						
14	14			d:/training_sdsl/image/009_161.tif	✔						
15	15			d:/training_sdsl/image/009_162.tif	✔						
16	16			d:/training_sdsl/image/009_163.tif	✔						

“Save” the block file up to date.

8. Interior Orientation

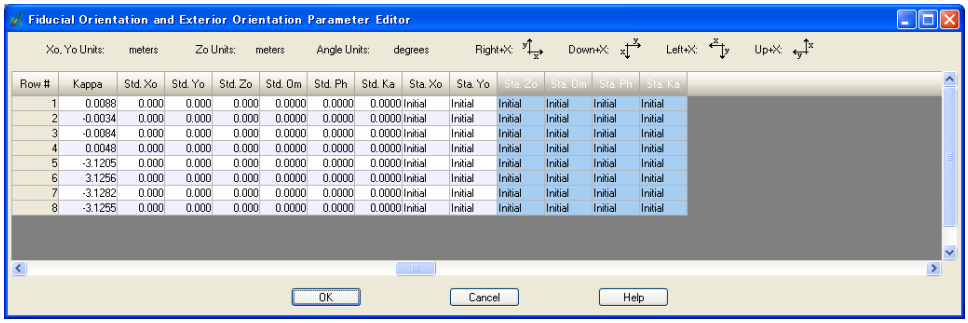
From LPS main menu, select “Edit”, then “Frame Editor”. From Frame Editor Dialogue, select “Interior Orientation”.



As Interior Orientation is finished, appropriate indicator for Interior Orientation “Int” change from red to green. “Save” the block file up to date.

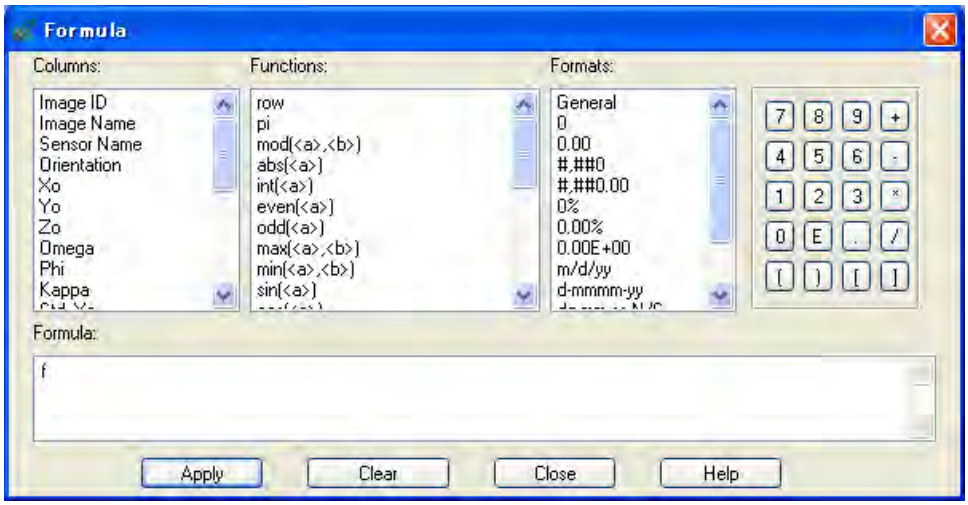
Row #	Image ID	Description	>	Image Name	Active	Pyr.	Int.	Ext.	DTM	Ortho	Online
1	1			d:/training_sdsl/image/008_278.tif	✔						
2	2			d:/training_sdsl/image/008_279.tif	✔						
3	3			d:/training_sdsl/image/008_280.tif	✔						
4	4			d:/training_sdsl/image/008_281.tif	✔						
5	5			d:/training_sdsl/image/008_282.tif	✔						
6	6			d:/training_sdsl/image/008_283.tif	✔						
7	7			d:/training_sdsl/image/008_284.tif	✔						
8	8			d:/training_sdsl/image/008_285.tif	✔						
9	9			d:/training_sdsl/image/008_286.tif	✔						
10	10			d:/training_sdsl/image/009_157.tif	✔						
11	11			d:/training_sdsl/image/009_158.tif	✔						
12	12			d:/training_sdsl/image/009_159.tif	✔						
13	13			d:/training_sdsl/image/009_160.tif	✔						
14	14			d:/training_sdsl/image/009_161.tif	✔						
15	15			d:/training_sdsl/image/009_162.tif	✔						
16	16			d:/training_sdsl/image/009_163.tif	✔						
17	17			d:/training_sdsl/image/009_164.tif	✔						
18	18			d:/training_sdsl/image/009_165.tif	✔						
19	19			d:/training_sdsl/image/009_166.tif	✔						
20	20			d:/training_sdsl/image/009_167.tif	✔						

Edite > FlameEditor>Exterior Orientation



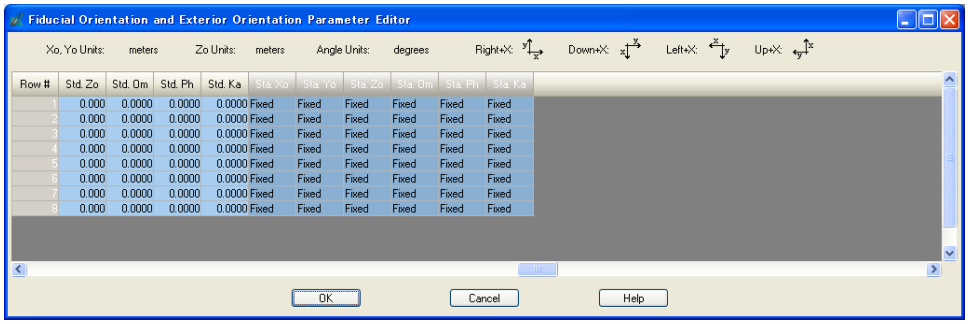
Right-click

Formula、



“f”

Click ”Apply ”



This concludes the steps of LPS setting and interior orientation. Next step will continue using ORIMA.

Ver.001

Aero Triangulation (AT) Manual for Digital Camera

Section 2 ORIMA – Relative and Absolute Orientation

JICA Study Team (Kokusai Kogyo)
April, 2012

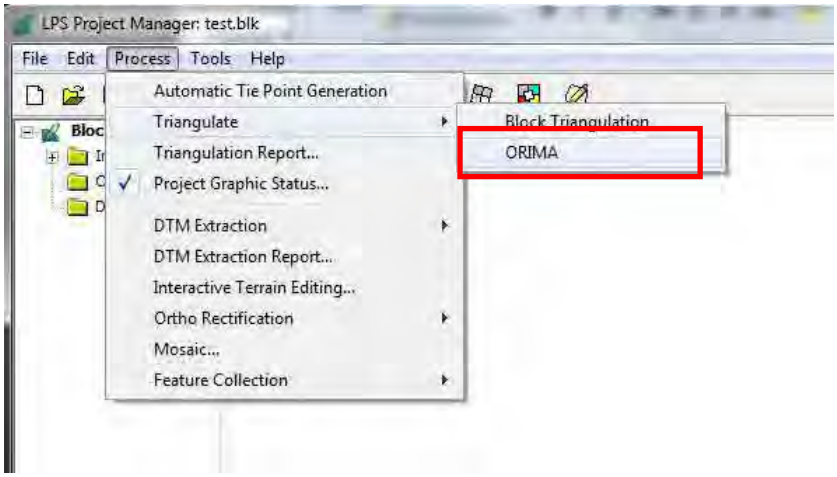
Outline – Section 2

1.1. Orientation - ORIMA

From this section, each orientation procedure (relative and absolute orientation) will be described. Each procedure is manipulated by ORIMA. Although the automated tie point measurement fashion will be used for efficient work, some additional manual point measurement may be required.

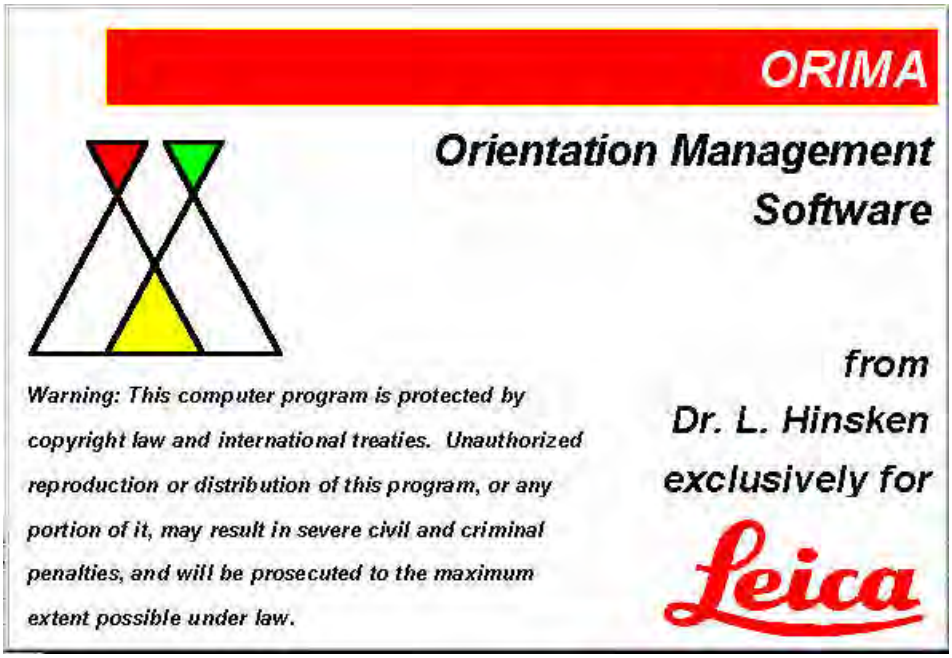
1.1.1. Registration onto ORIMA

ORIMA does not directory reads the LPS project file (*.blk); therefore new project file for ORIMA needs to be created. Please start ORIMA from “Process”, then “Triangulate” and select “ORIMA”.

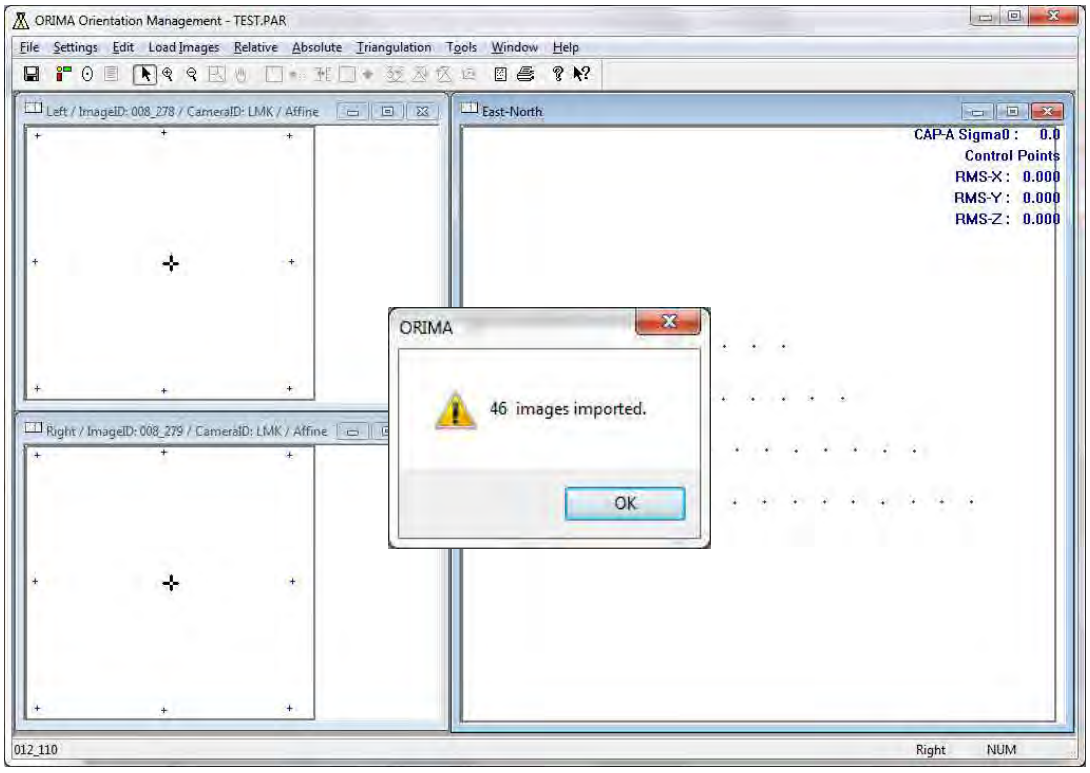


Information such as Operator ID, angular unit, and whether GPS/IMU data will be used or not have to be identified at this stage. “For this project”, setting should be as stated below (Operator ID can be anything though) and click “OK” to confirm. And this setting only required once at the beginning of the work.

After project file setting is done; the ORIMA application will be kicked off.



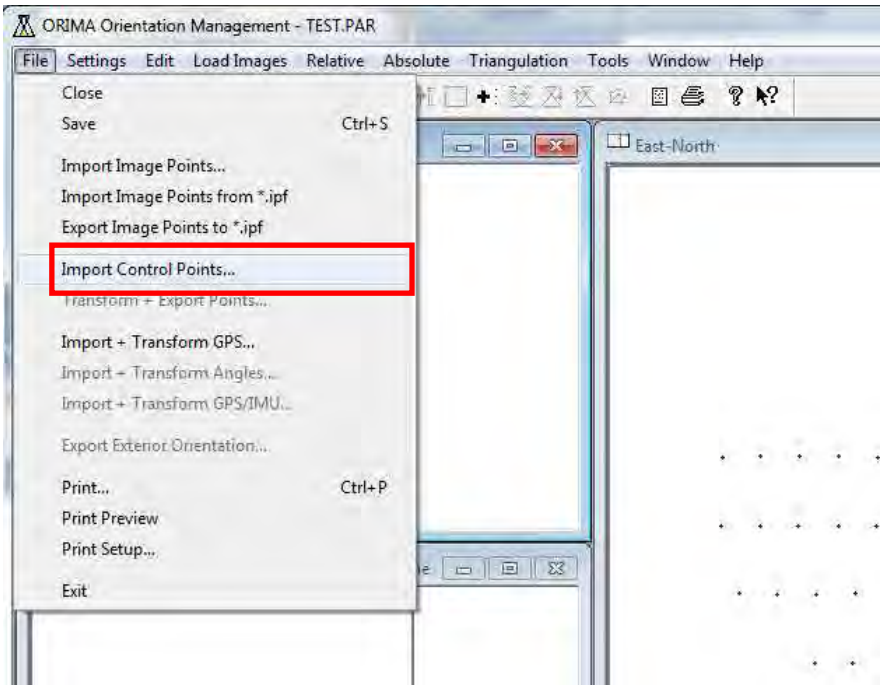
Click “OK” to proceed.



Importing GCP

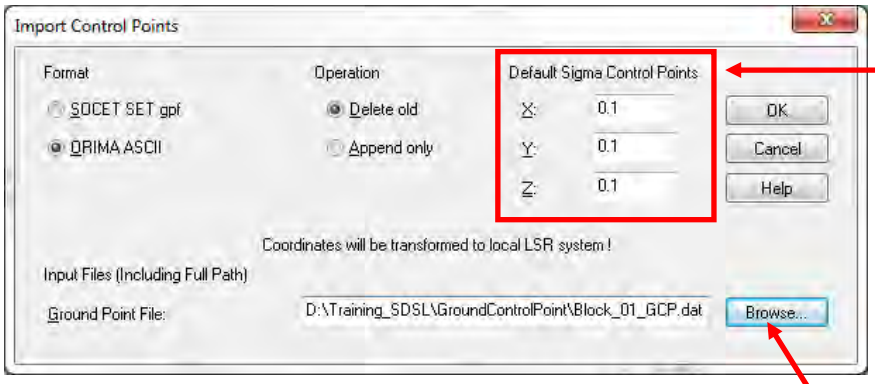
Next; GCP data shall be imported.

Please select “File”, then “Import Control Points”.

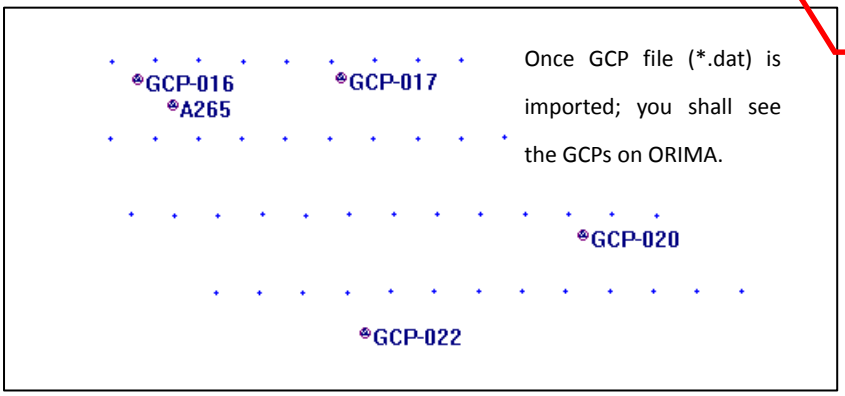


GCP output shall be prepared. It should be in space delimited ASCII format with order of ID X Y Z.

If preferred GCP residual threshold is known, it can be notified to ORIMA at this stage.



Accuracy of GCP should be entered here. Please consult with field survey team for these values before proceeding.

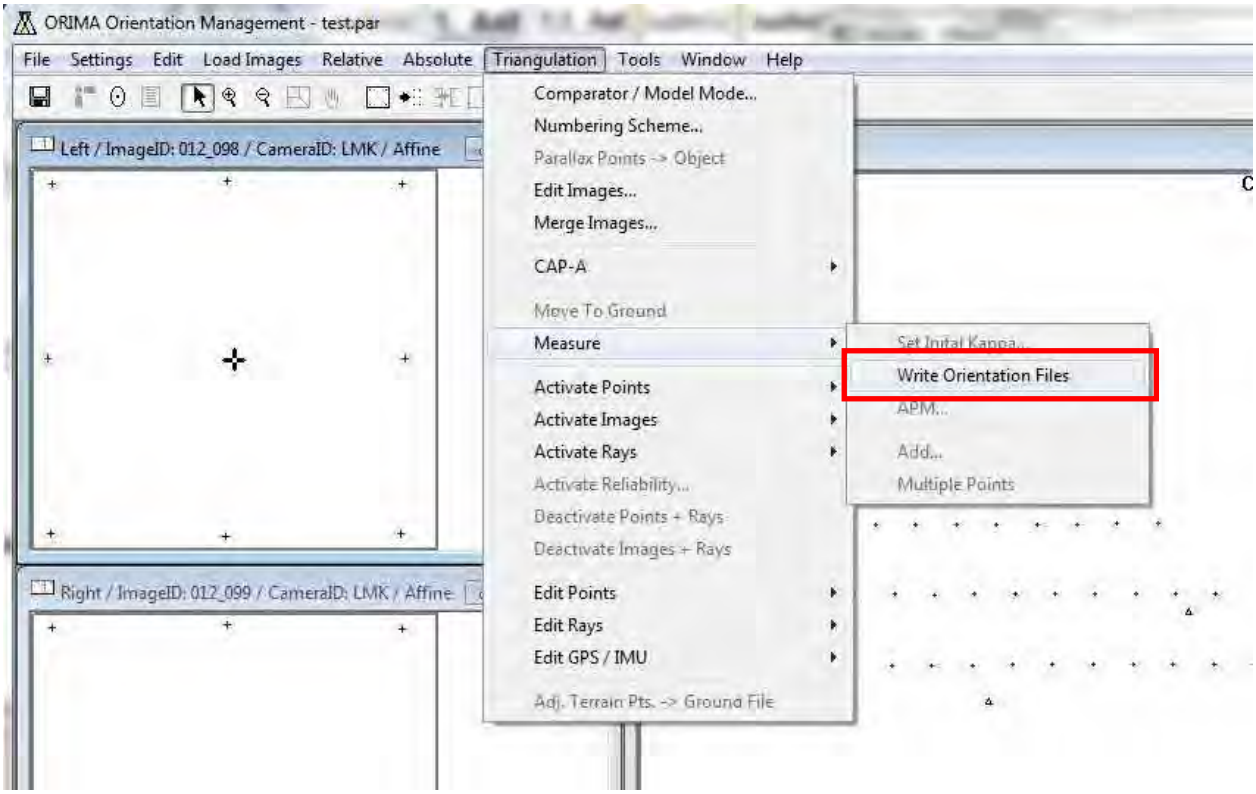


Once GCP file (*.dat) is imported; you shall see the GCPs on ORIMA.

Click on “Browse” and select the GCP file being created already.

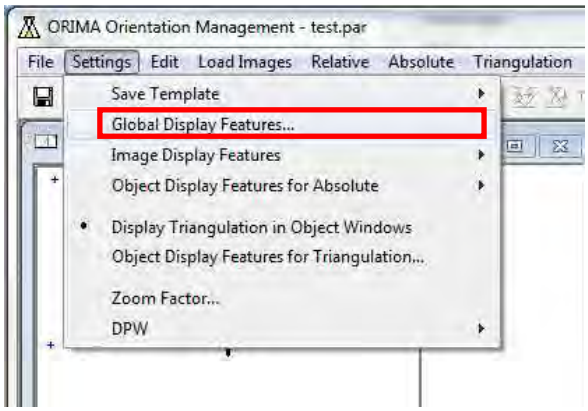
Please make sure all GCP area recognized here at the ORIMA window.

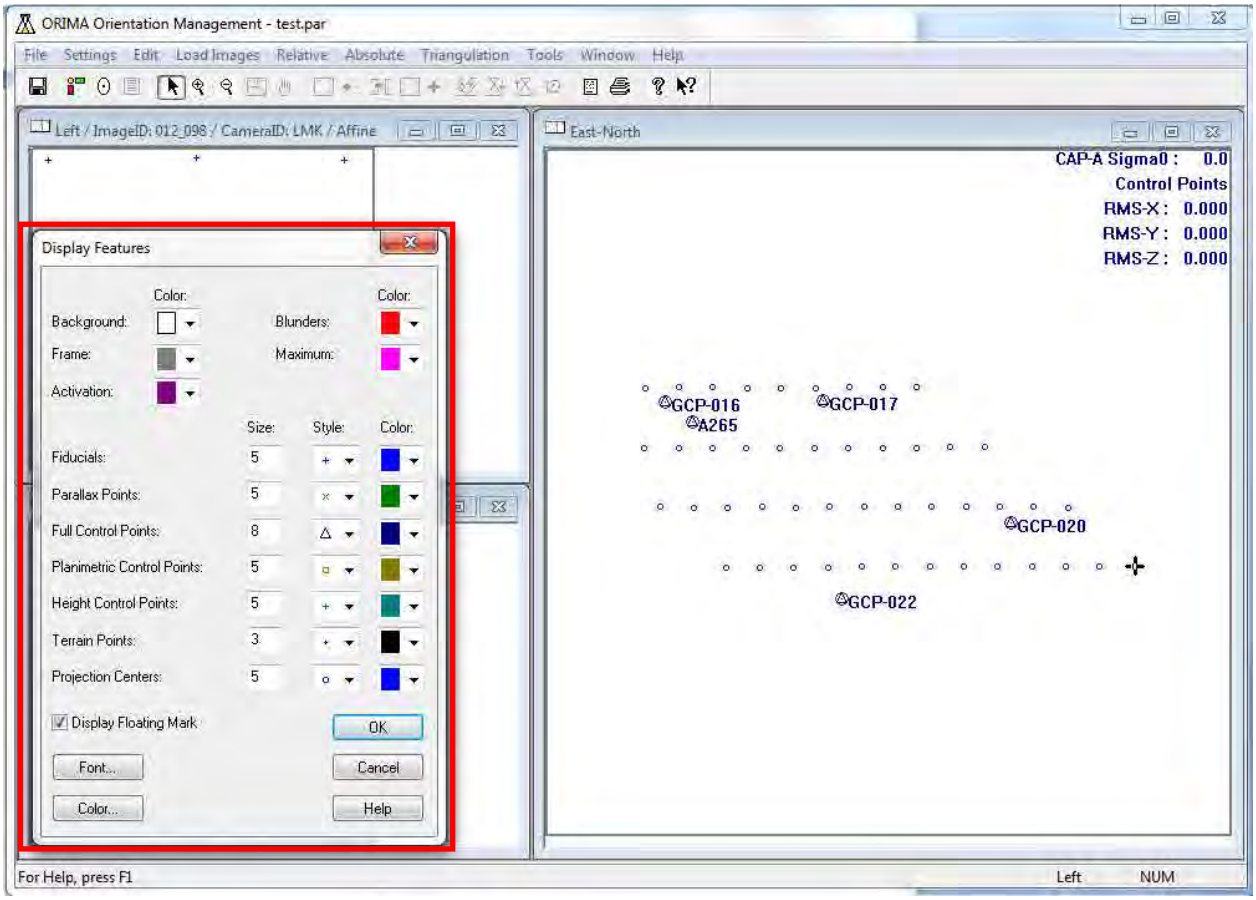
ORIMA does not automatically save the work steps have done into LPS block file (*.blk); hence the work must be saved manually by user by using “Write Orientation File” command.



Global Display Features

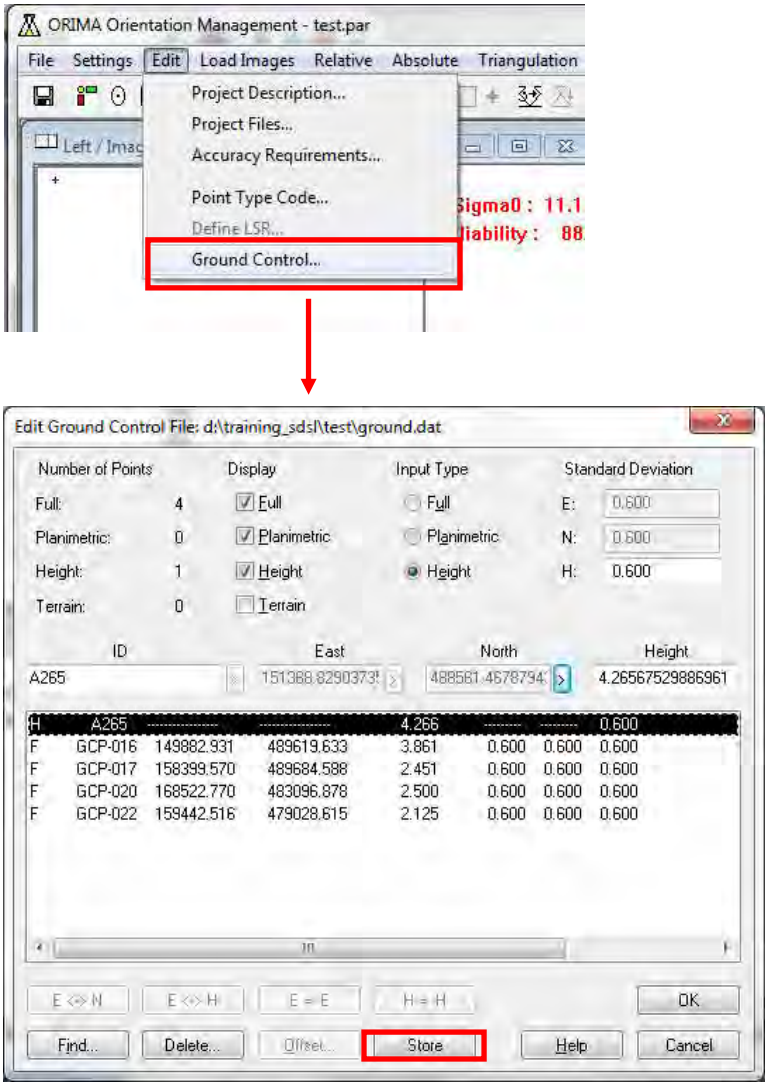
User can set his/her preferred display features on ORIMA window. This may help users to understand ORIMA work steps. If you wish to change the feature display settings, please go "Settings", and then select "Global Display Features". Then, "Display Feature" window will show up. User can change color, Size, and Style of features here.





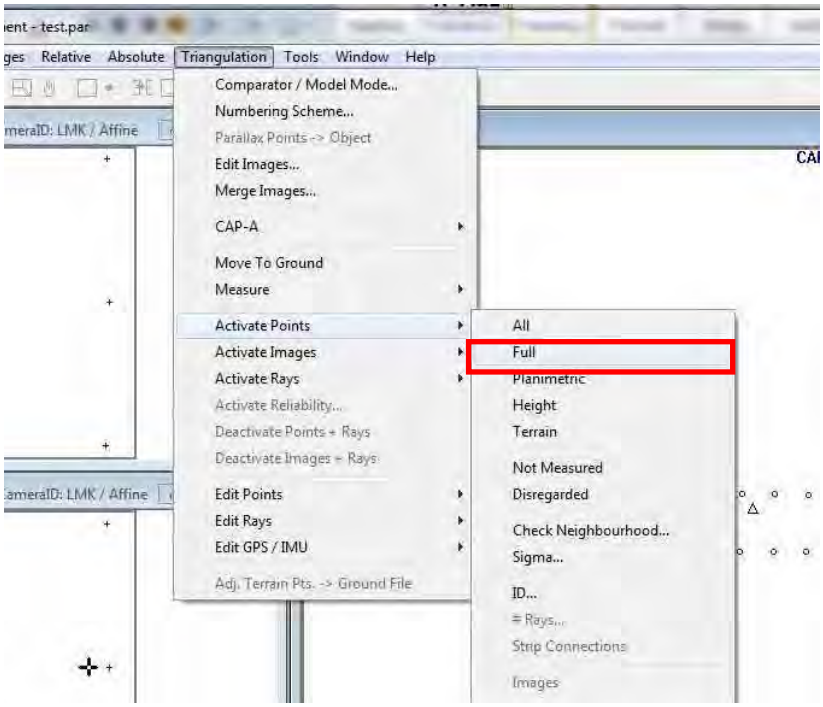
Editing GCP Status

IF user wishes to change the status (Full, Planimetric, or Height) of GCP which have already read into ORIMA, user can re-define it at ORIMA using this function. Please go to “Edit”; and then select “Ground Control”. You can select (highlight) the GCP you wish to change its status. Again, if user is satisfied about GCP status; this process can be skipped.

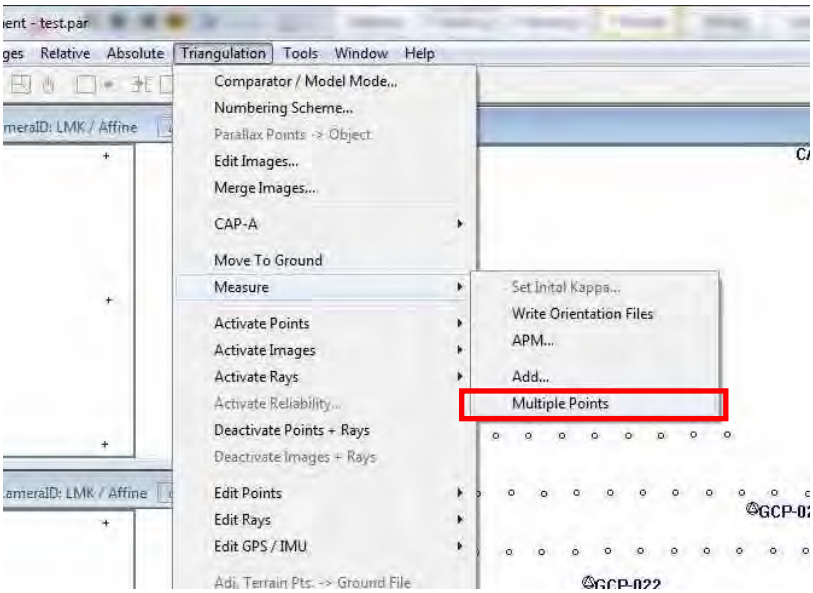


1.1.2. GCP Measurement

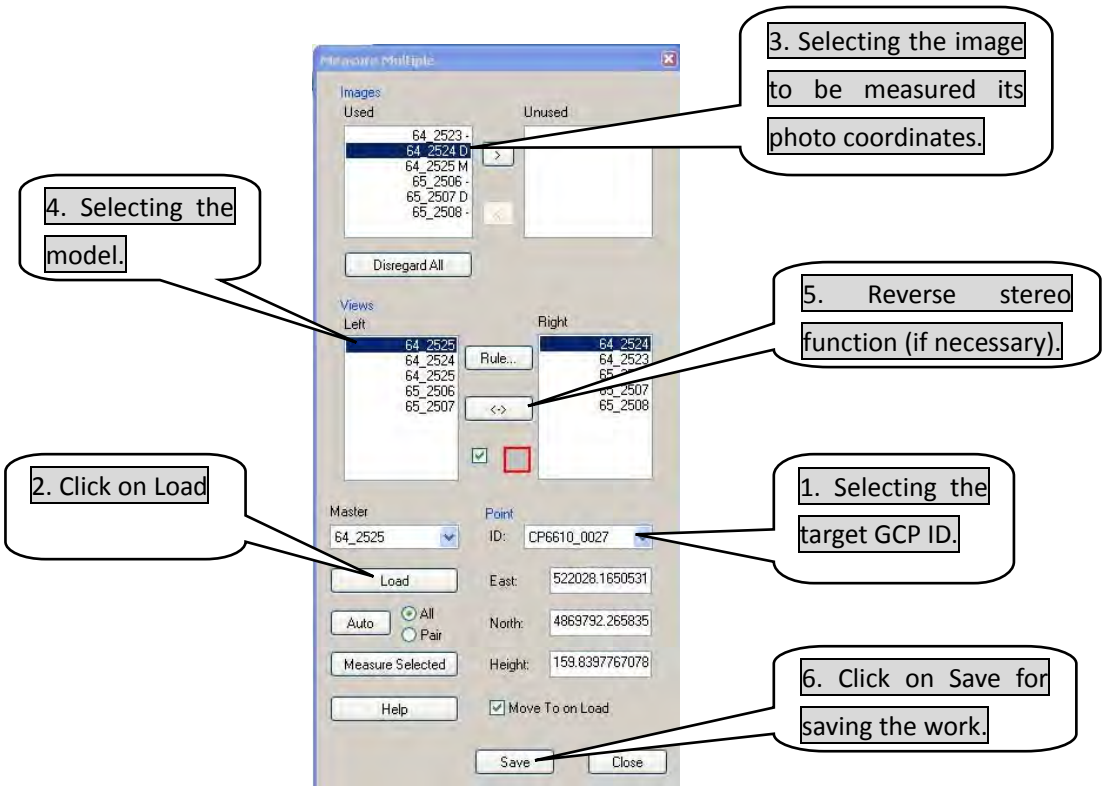
In ORIMA procedure, GCP measurement is executed before entering into relative orientation process. First, GCP which will be measured should be selected and activated. Please select “East-North” window; then select “Activate Points” then select “Full”. This” full” indicates all XYZ portion will be used. If there are points to be used only using either XY or Z portion; “Planimetric” or “Vertical” needs to be activated matching the status and purpose of GCP data. In order to start this process; please go to “Triangulation”, and then go to “Active Points” and select “Full”.



Actual measurement process now begins by selecting “Triangulation”, “Measure”, and then select “Multiple Points”.



Next is actual measuring process. All images which include assigned GCP will be called. Now GCP and image data should be selected at following order. At this point, GCP and flight index map will help guiding this measurement work process.



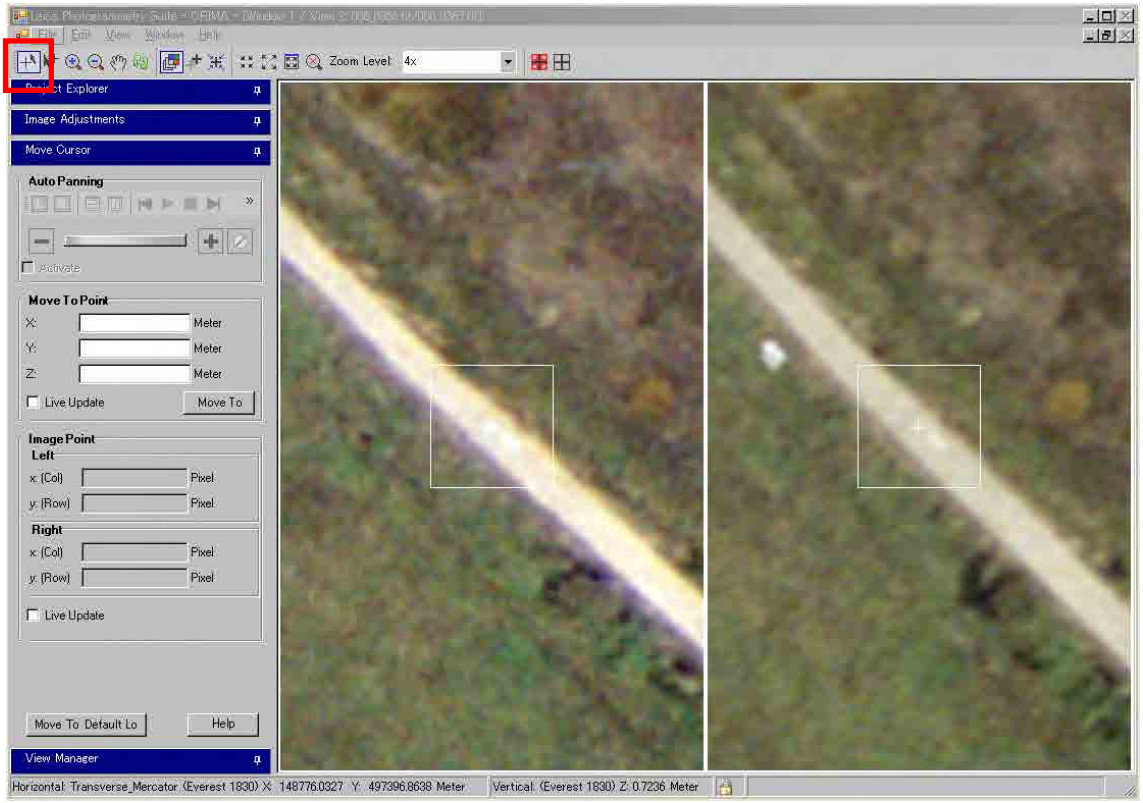
Measurement status is indicated as following characters at Image being selected for measurement. For example; image “64_2525M” means the image is measured.

“-“ = Images have not been measured yet.

“M” = Images have measured. It stands for Measured.

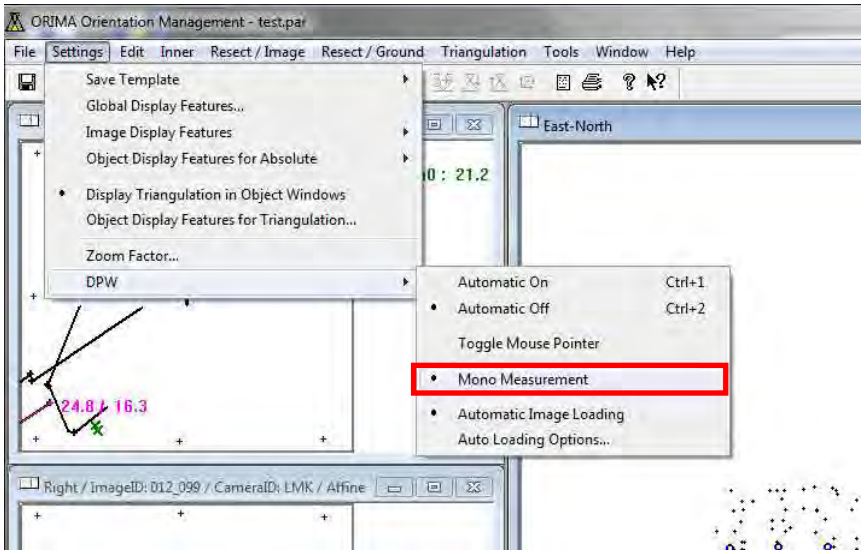
“D” = Images need to be re-measured. It stands for Disagree. If measurement result is NOT satisfied, double click on image name changing to this status.

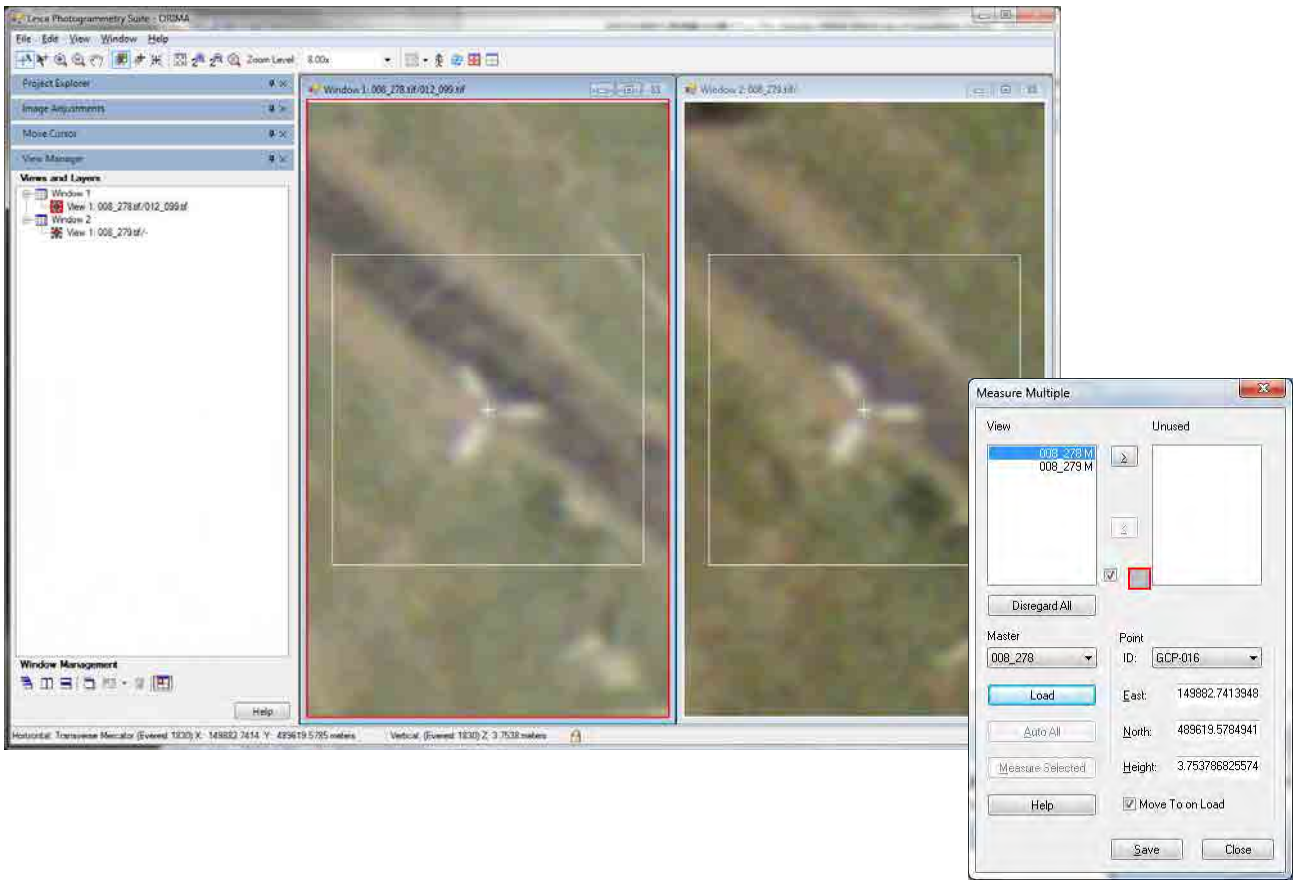
Image file being selected for measurement will have red color boundary around the image indicating image is in stereo mode. After the measurement is actually done, the white line box will appear in the image.



Mono measurement setting:

User can choose Mono Measurement instead. IF you wish to use this function, please select "Settings"; then go to "DPW" and choose "Mono Measurement" to activate it.

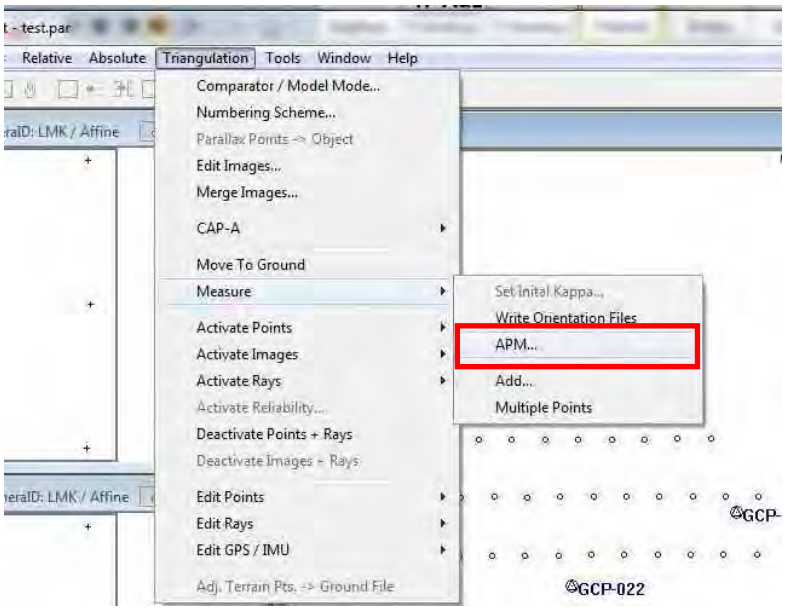




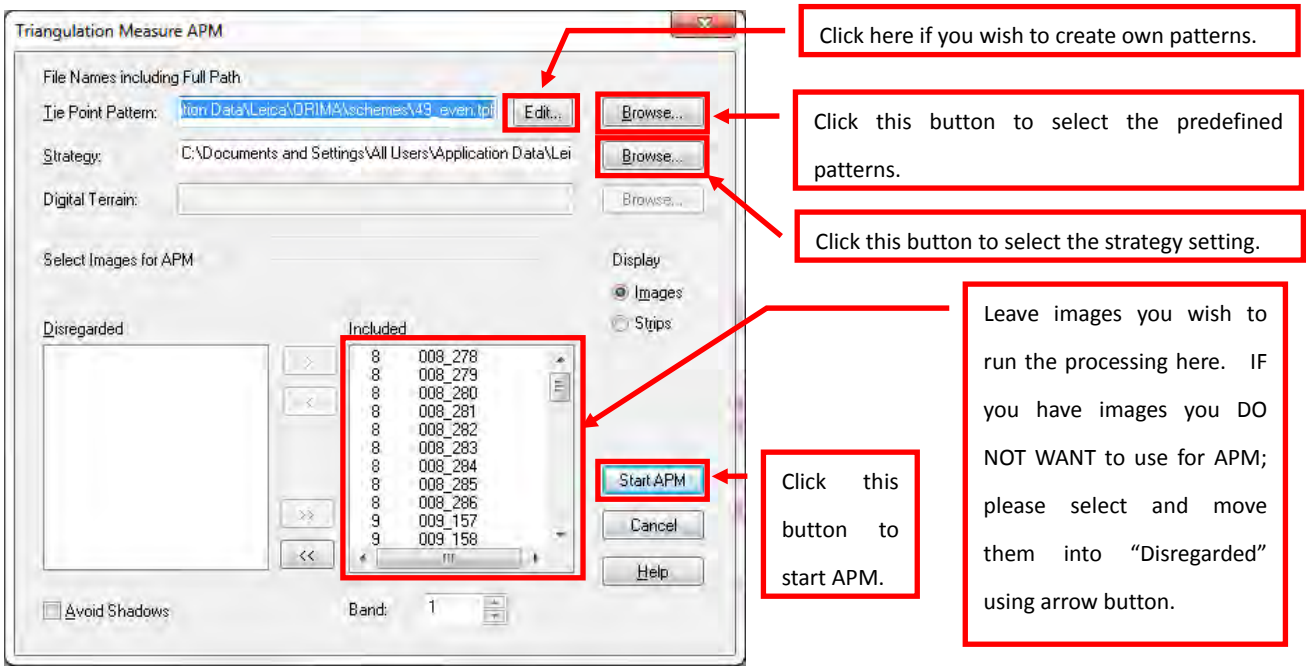
1.1.3. APM (Automated Point [Tie/Pass point] measurement)

In relative orientation, APM (Automatic point measurement) method will be used. ORIMA itself automatically selects many tie points first and discard the points have poor accuracy. Therefore it is basically wise telling ORIMA (software setting) to automatically collect the points for you.

First, please go to menu bar and select “Triangulation”, then “Measure” and select “APM” to start APM module.

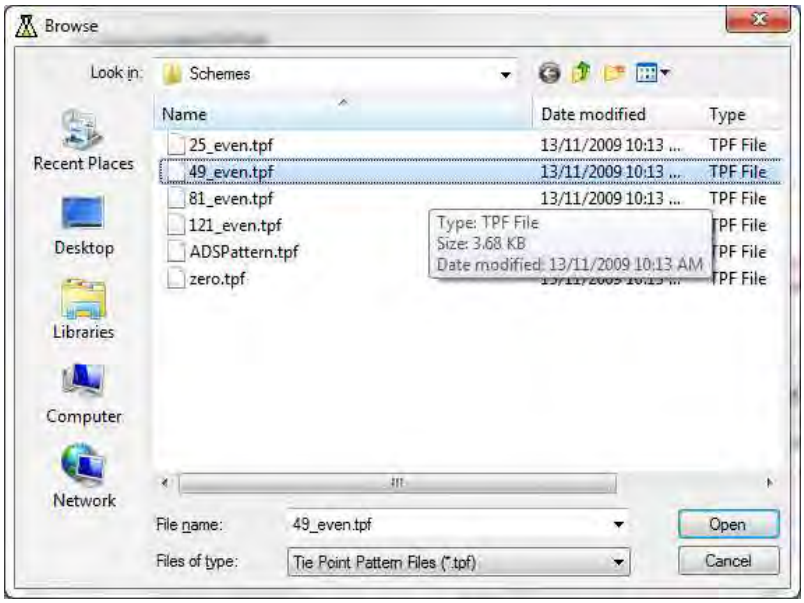


Please select stereo models that want to be processed. And number of tie point pattern should also be set at this time.

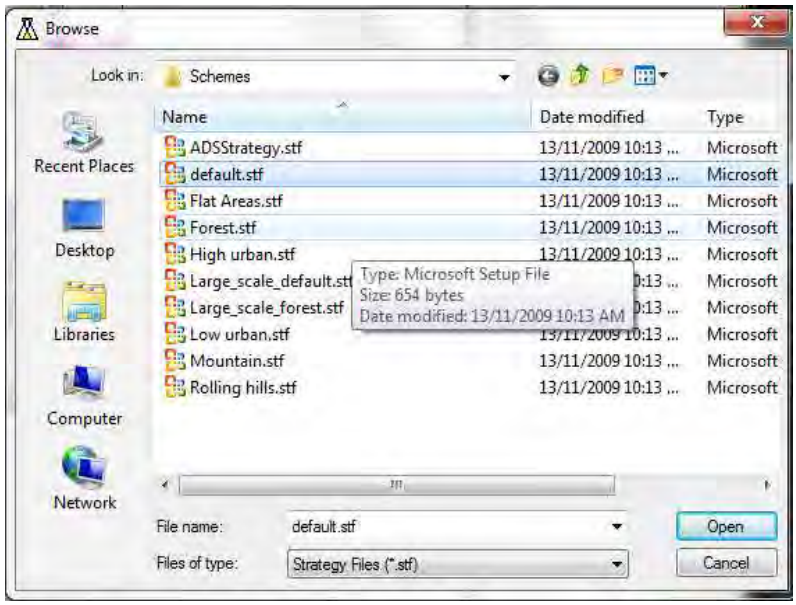


To set the tie point pattern, please click on “Browse” button at where saying “Tie Point Pattern”. Then select the appropriate predefined tie point pattern file (*.tpf). Predefined pattern files are even point pattern of 25 (5x5), 49 (7x7), 81 (9x9), and 121 (11x11). Where many unique features are found such as urban area, 25 or 49 should be good starting point. Where unique features are expected to be few such as mountain area; larger settings may be ideal to start.

Tie Point Pattern (Predefined settings):

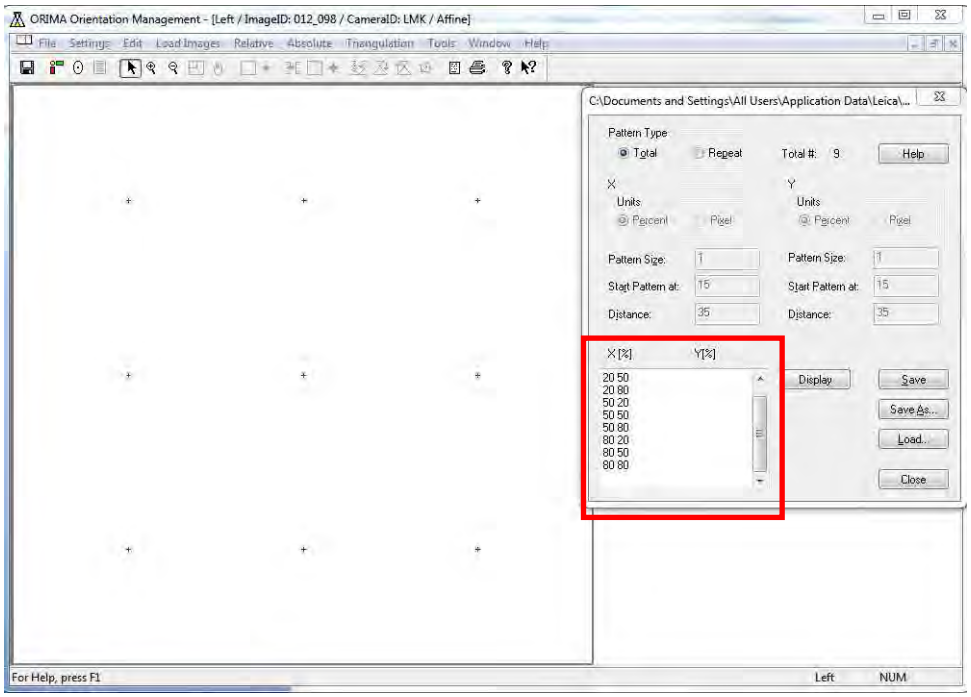


Strategy Settings:

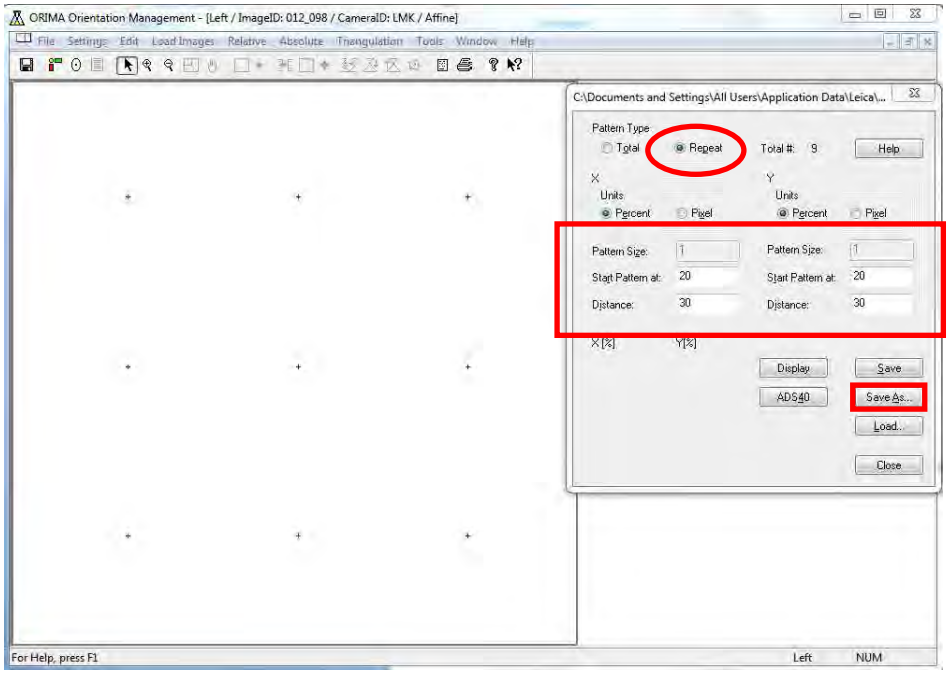


Manual setting of pattern file: Selecting “Edit” button.

User can define the post spacing of measuremant points manually.

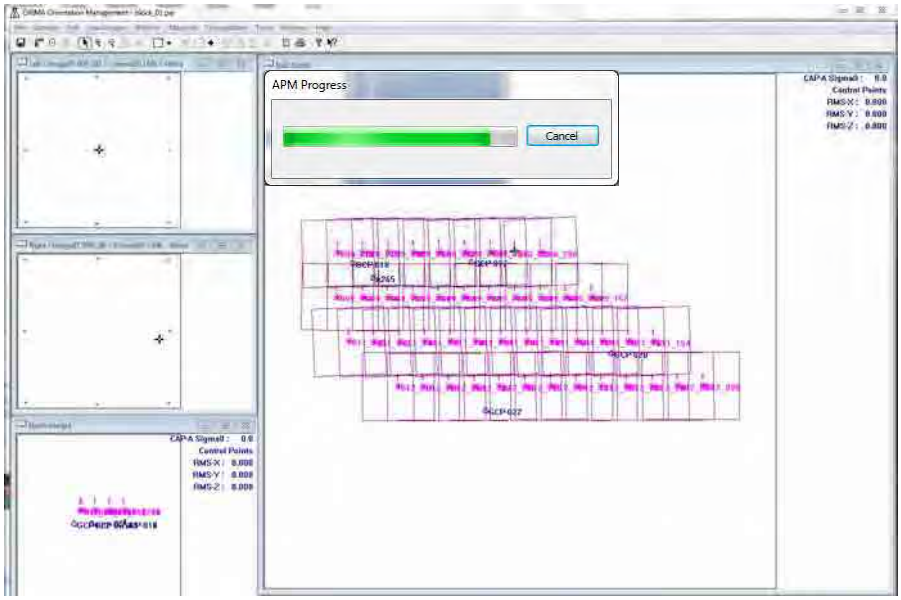


Or user can specify Pattern Type (Distance and start point in X and Y axis) : Repeat type



Please click “Save As” and name the unique file to save your own pattern file. Please be careful not to overwrite the existing (predefined files).

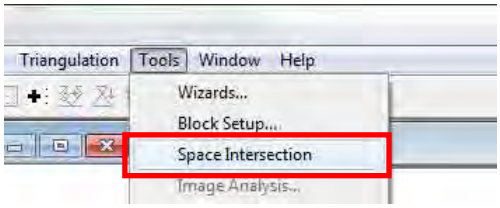
Once pattern file is selected and assigned, please press “Start APM” button to start automatic point measurement. Processing may take time depends on the complexity of features found in images, number of models being selected, and type of pattern files being assigned.



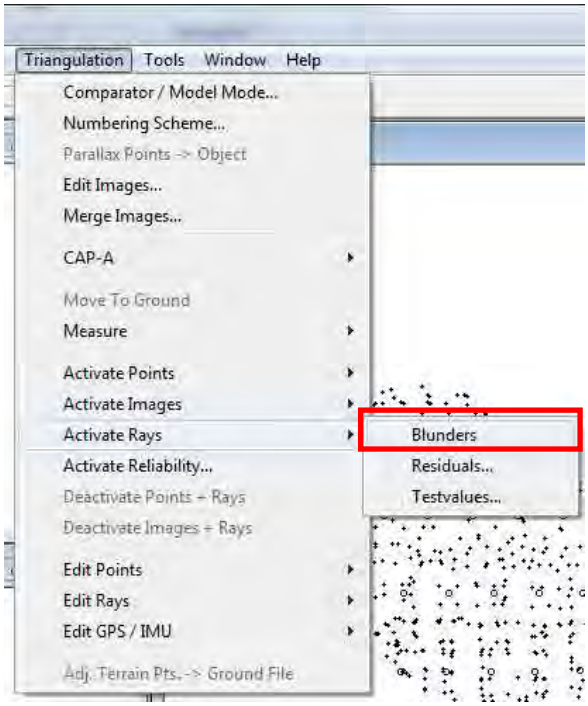
APM processing may take a time depends on pattern setting, strategy selection, and number of images.

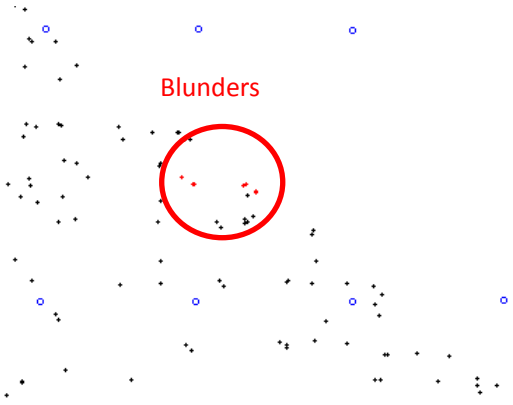
As APM process is finished, please use ”Write Orientation Files” command to send (saving) the result into LPS Block file.

Next step is to let the ORIMA to search, select, and discard the points may have unwanted accuracy and/or unnecessary to be used in next process. Please go to “Tools”, and then select “Space Intersection”.

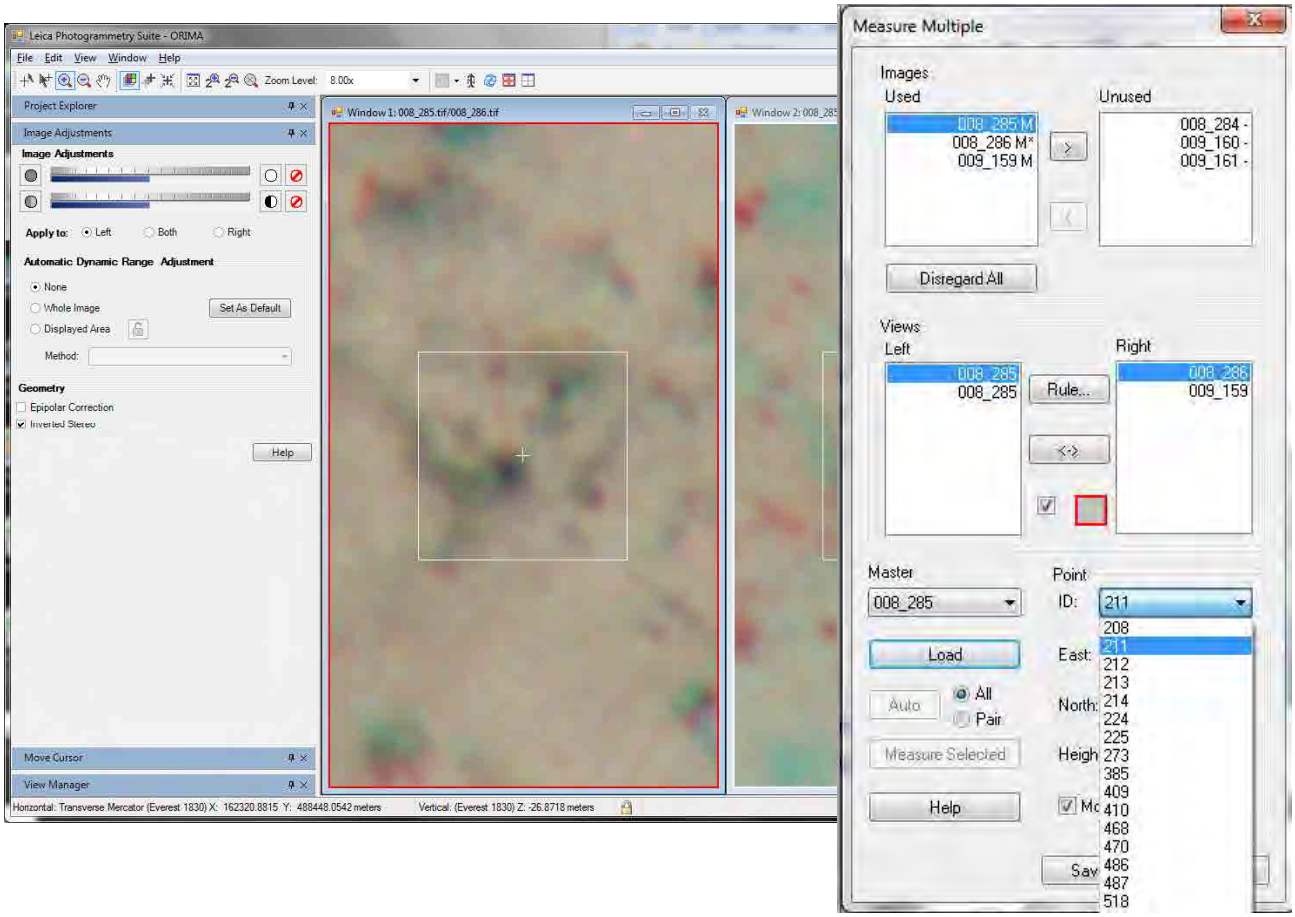


Then please go to “Triangulation”; then go to “Active Rays” and select “Blunders” making those blunder points active mode (= automatically selected and colored red).





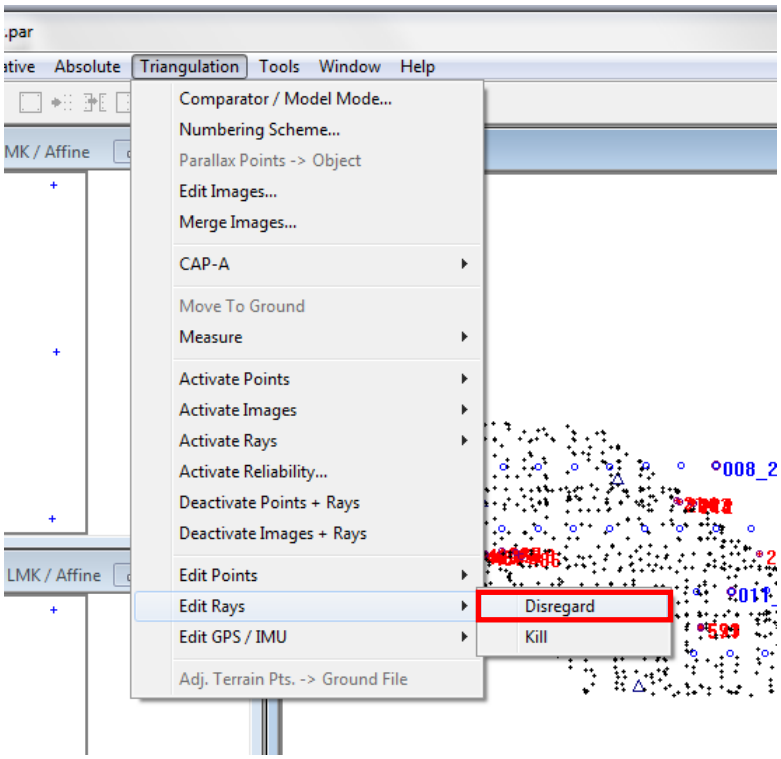
Once the blunder points are defined as active; now user can display APM points and check them or re-measure the points, and/or disregards the point. Please go to “Triangulation”, and select “Measure”; then select “Multiple Point”.



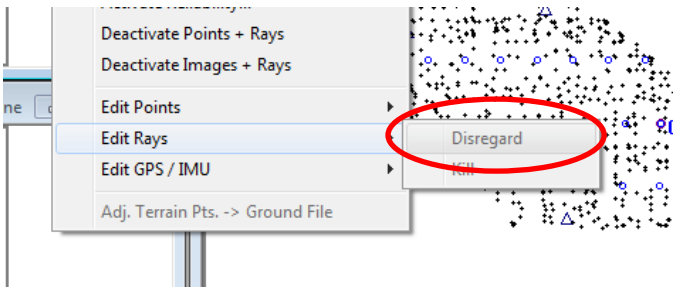
Now we see APM points are being read into “Measure Multiple” function. This function is very much alike to GCP measurement function; now we are reading APM points instead. Please reference the GCP measurement procedures.

Now any photo states M* means the point which ORIMA has classified as “Blunders ray”. Please pay extra attention to these points as you check the points. User needs to decide whether you wish to keep the points as it is (no change), or disregard it, or re-measure the same point, or measure the new point. After you check the all points; please click “Save” to save the results.

Next, please go to “Triangulation”; then go to “Edit Rays” and select “Disregard”. This function excludes those points have large residual. IF you agree that you DO NOT need points at all; inacceptable points can be completely deleted using “Triangulation”; then go to “Edit Rays” and select “Kill”.



Space Intersection process should be iterated until “Disregard” and “Kill” functions become no longer selectable. Once all unnecessary points are removed; Relative Orientation process (APM) is finished.

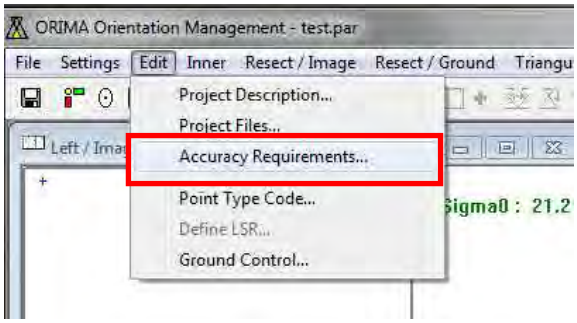


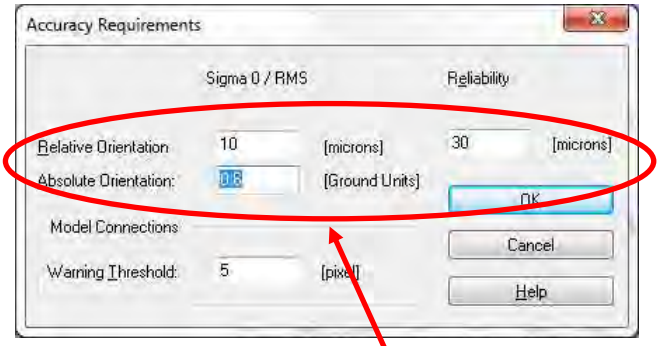
Please use “Write Orientation Files” command to save the result onto LPS block file.

1.2. Concept of Adjustment Computation (CAP-A)

There are two sets of adjustment computations will be executed. First is the computation executed only with tie point; No GCP is used. Second is the computation using both tie point and GCP. First computation only with tie points (without GCP) will previously reduce points with large residual, and it makes the second adjustment computation with GCP with concrete tie point bundle.

Please go to “Edit” then “Accuracy Requirements” to set the accuracy thresholds for Relative and Orientation results. Then click “OK” to proceed.





Initial Settings

Relative Orientation

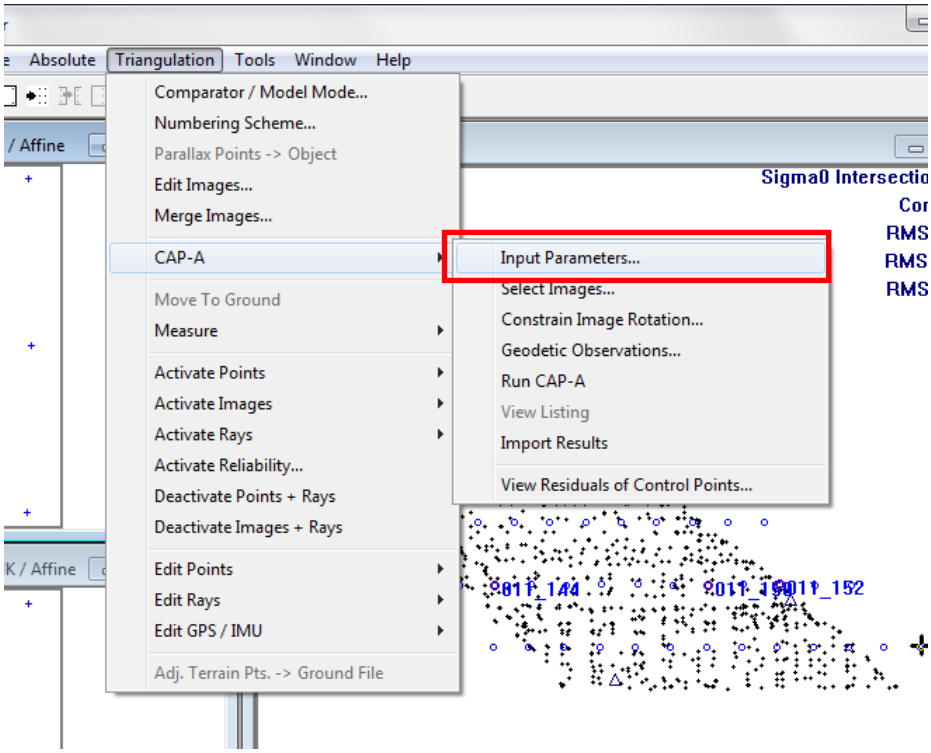
- Sigma 0/RMS 1/2 of 1 pixel resolution
- Reliability 1.5 times of pixel resolution

Absolute Orientation

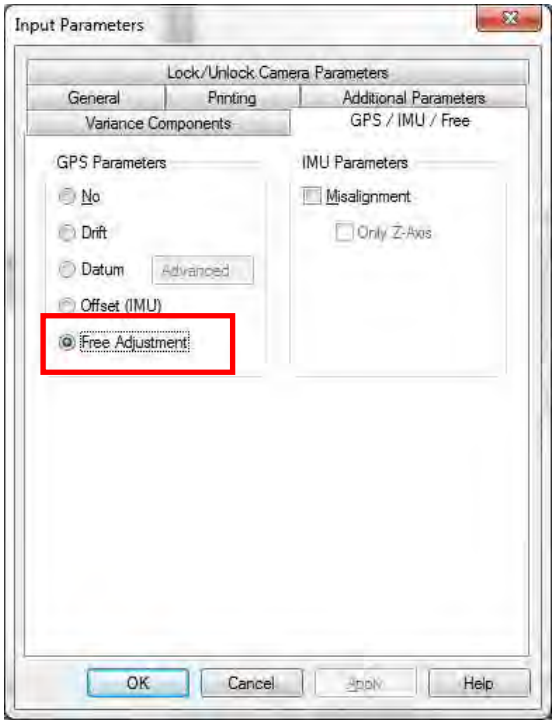
- Sigma 0/RMS 0.02% of AGL

1.2.1. Adjustment computation without GCP (Free Adjustment)

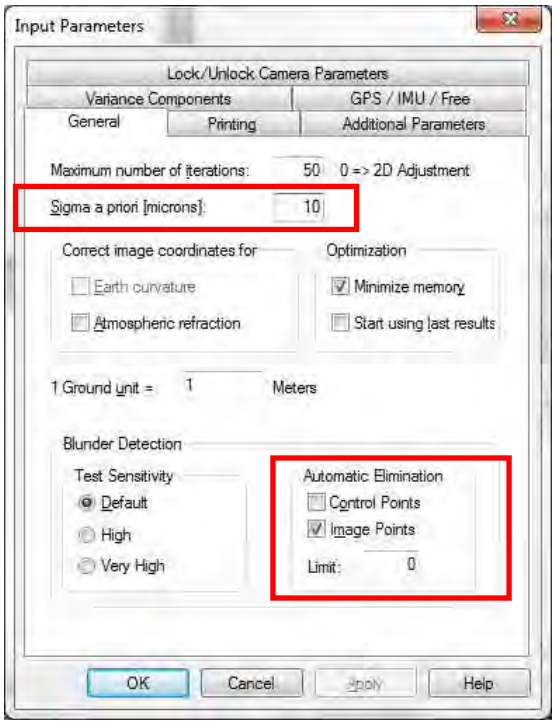
Please select “Triangulation”, then go to “CAP-A” and select “Input Parameters” to set the computation parameters.



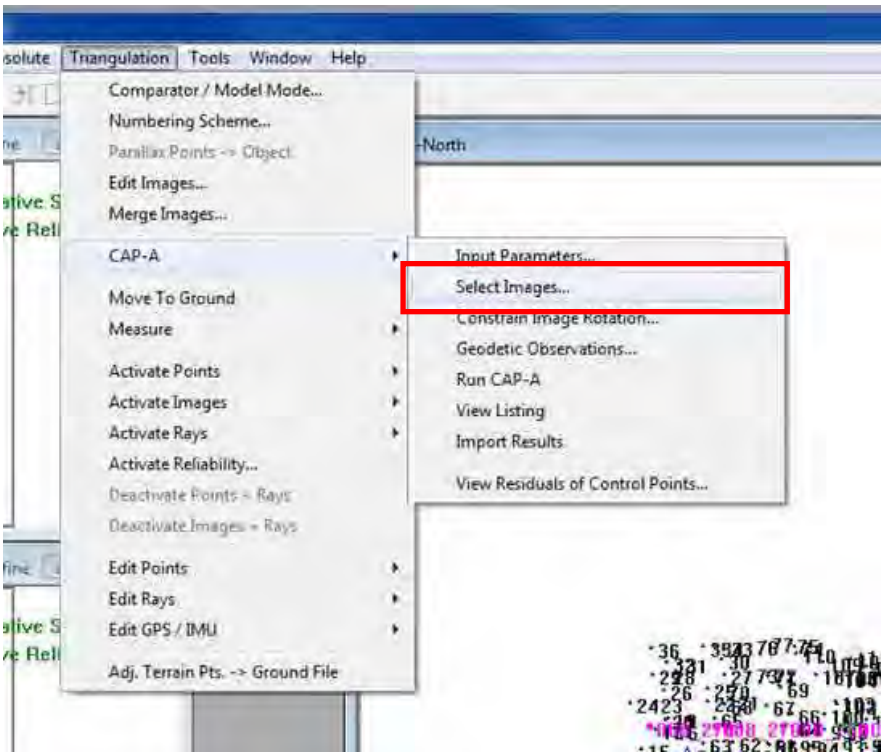
Please select “GPS/IMU/Free” tab and check on “Free Adjustment”.



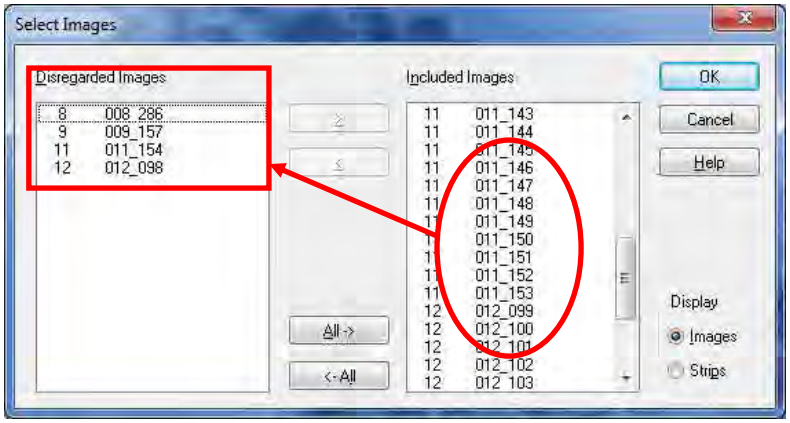
Please select “General” tab. “Sigma a priori” shall be set to about 1/2 of 1 pixel resolution. Please check OFF the “Control Points” of “Automatic Elimination”. Rest of settings should stay the default.



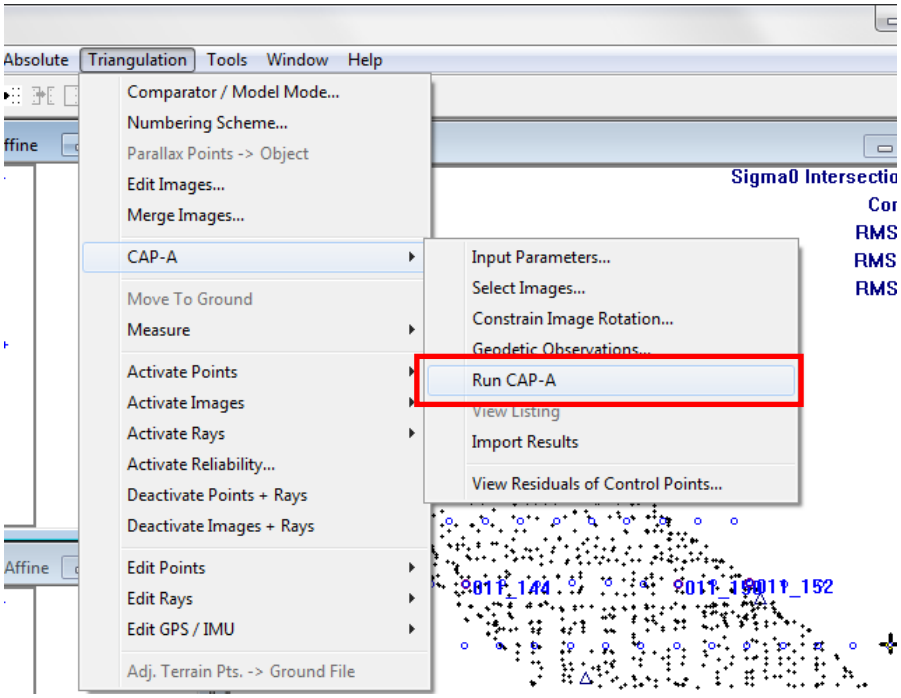
IF you have image(s) that you would like to ECCLUDE from your CAP-A computation; then there is an option to select images you wish NOT to be used. IF you have images to exclude; please go to "Triangulation; then select "Select Images". Please remember; this process may not always necessary.



Unwanted images should be selected and moved into "Disregarded Images". These images WILL NOT be used at CAP-A processing.

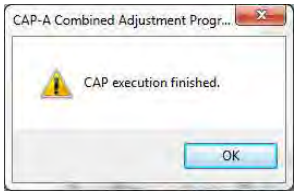


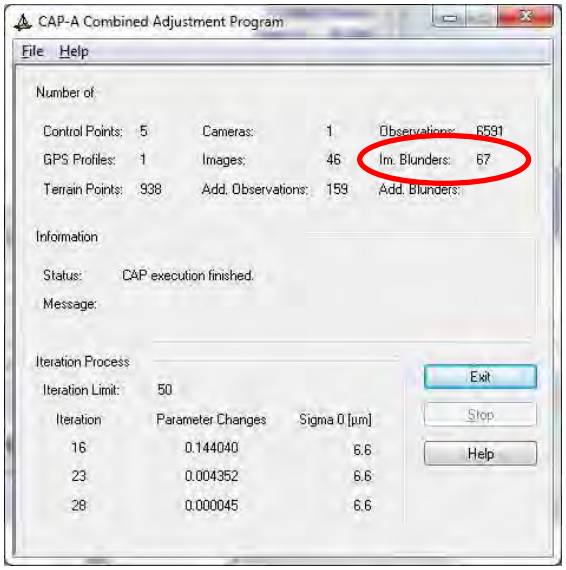
Please execute the computation with settings said above by selecting “CAP-A”, then “Run CAP-A”.



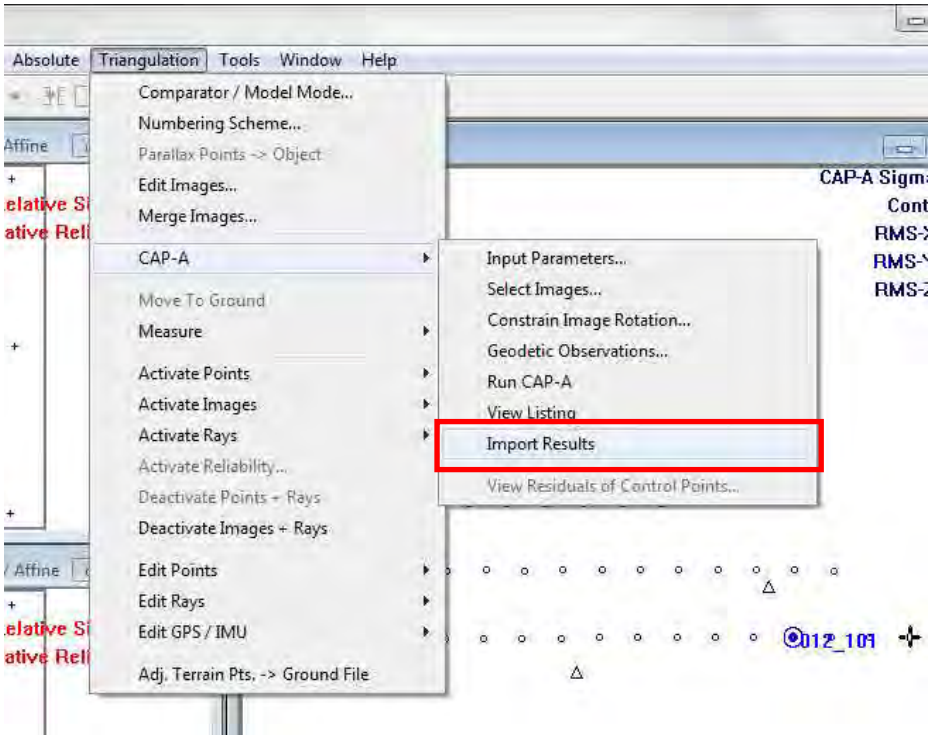
After the completion of adjustment process; we see (can be checked) some blunders are found.

Click “OK” to proceed.



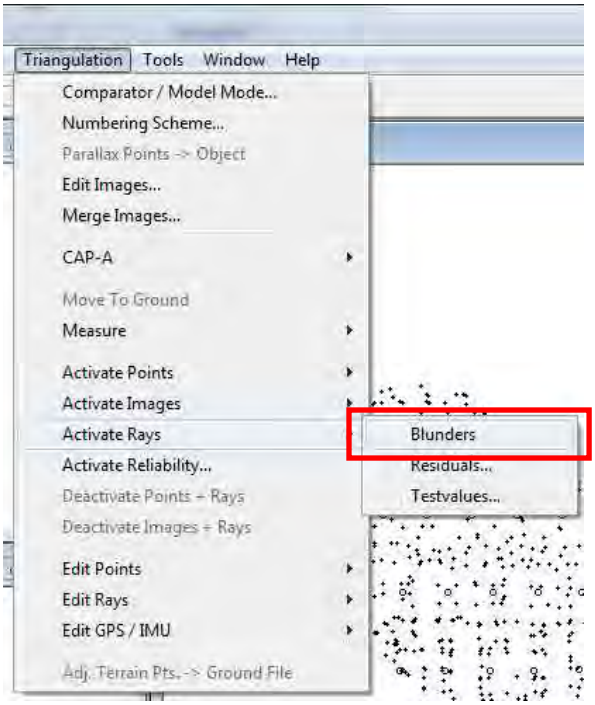


Now, please go to “Triangulation”; then go to “CAP-A” and select “Import Results”. It is important to do the “Import Results” to reflect the results of CAP-A. Now, please re-run (iteration) the CAP-A to exclude the blunders.

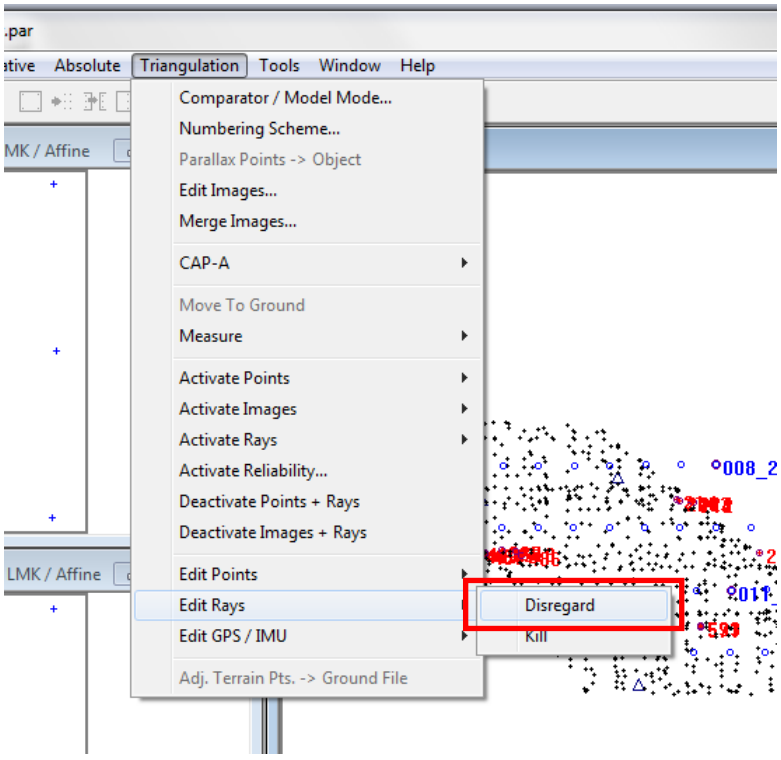


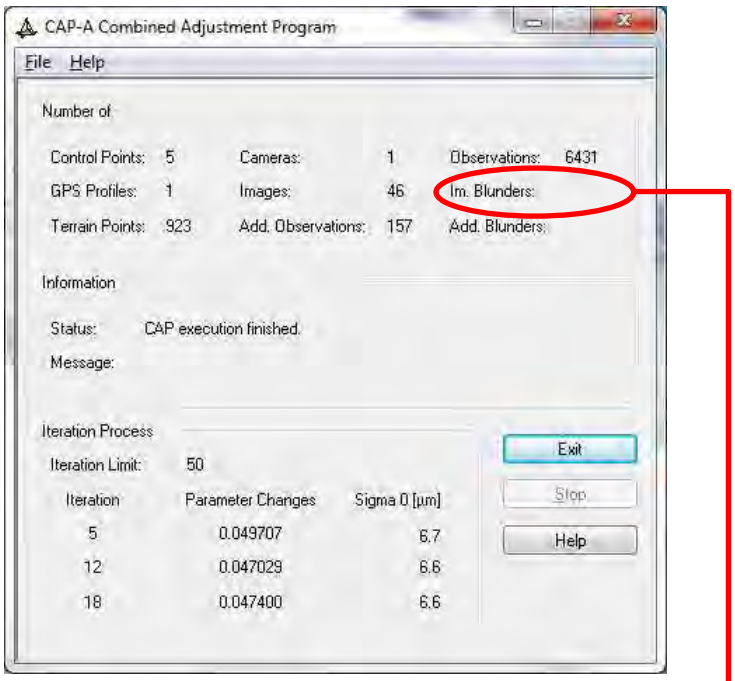
Then, please select “Active Rays”, then “Blunders” and “Edit Rays”, then “Disregard” to select and reduce the points with large residual. After this process, please select “CAP-A” and then select “Import Results” to save the result.

Active Rays > Blunders:



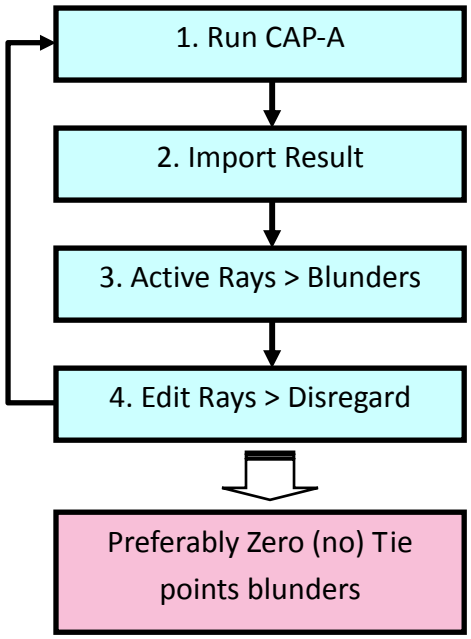
Edit Rays > Disregard:





Tie point blunders should be 0 (zero).

Following is *basic flow* of process iteration of CAP-A. Please be aware that this is basic flow of CAP-A processing; hence it is advised to check the result as you iterate this flow carefully. If you see the residuals may not be increased through iteration process; you might want to see actual points in "Multiple Measurement" tool and/or see the GCP measurement you have done are conflicting with CAP-A results.



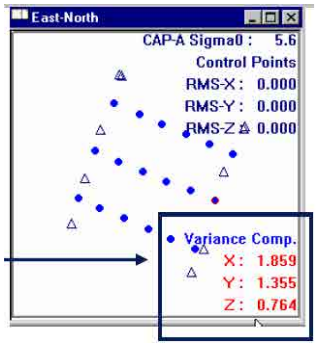
1.2.2. Adjustment computation using GPS/IMU and GCP

This process uses both GPS/IMU and GCP coordinates on its adjustment computation. Please select “Triangulation”, then go to “CAP-A” and select “Input Parameters” to set the computation parameters.

Please select “GCP/IMU/Free” tab and check on “Drift” indicating that this process will use GPS input data.

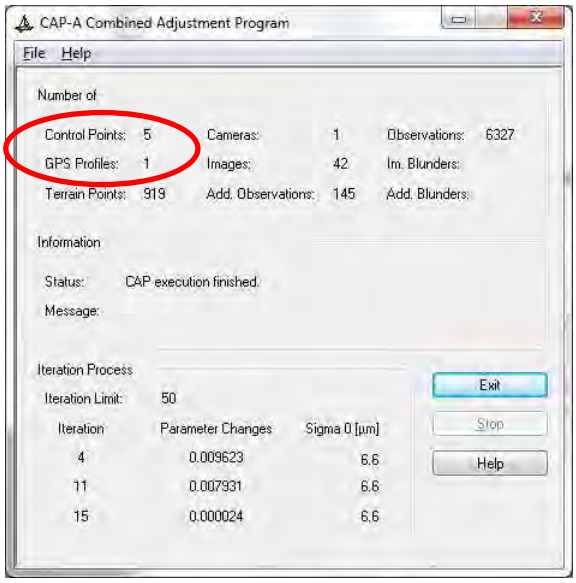
Please select “Variance Components” tab. For the first run, please use the default values. ORIMA itself will put the optimized values if the result from default value is not sufficient.

As result will be displayed in red after the computation; setting values may need to be optimized.



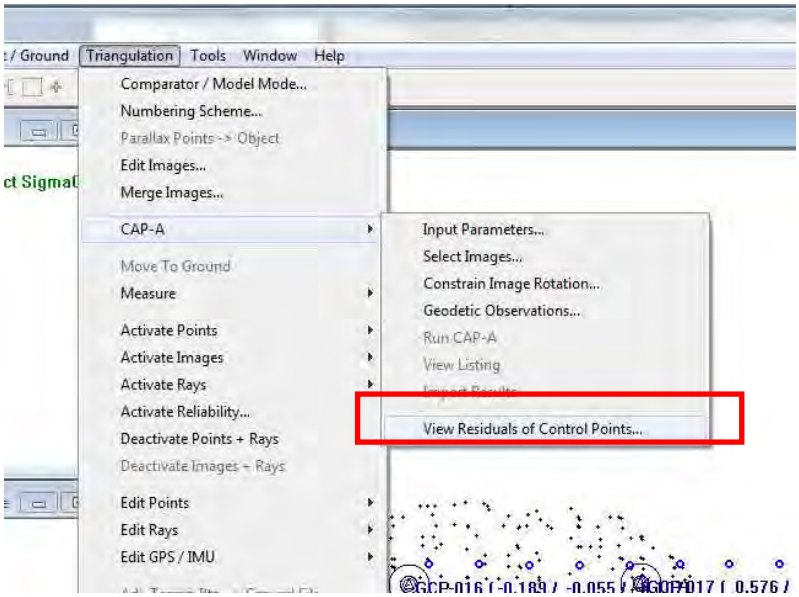
Please run the adjustment computation by selecting “Run CAP-A” with setting said above. Once the result values come small than what it had been set at “Sigma a priori”, then the computation had been successful.

If you see the blunders as part of result; please remove them with same steps explained above. But please make sure that photo coordinates of GCP are already removed. If the number of GCP is shown smaller than the number of measured points; this means blunders are removed.



Please reflect the computation result by using “Import Result” command that can be executed by clicking the appropriate icon shown below.

Please check Residuals of control Points by selecting “Triangulation” then “CAP-A” and “View Residuals of Control Points”.



Then, after importing the result in ORIMA; please use “Write Orientation Files” command to save the result onto LPS block file.

1.3. Checking the result and Reprocess (if required)

Please check the result of adjustment computation meeting the criteria and specification goals. This work is not only to check the computation result but also to look the procedures are correct. Therefore it shall be done even the computation result meets the specification.

1. Checking the report

Please watch for following points:

- Photo coordinates with large and/or outlier residual values.

```
  Point ID                                                  Observations       Residuals   Testvalues Redundancy Reliability
                                                                              (*1000)                            (*1000)
                                                            X          Y        X      Y       X      Y     X     Y       X     Y


  920                                                   -23.0852   21.2961  -1.2  -1.0   -0.2  -0.1  0.71 0.67   10.  11.
  922                                                   -31.9328  -10.3943  -0.3   0.7   -0.1   0.1  0.17 0.62   21.  11.
  924                                                   -20.1956  -11.6898  -0.3  -0.3   -0.1   0.0  0.17 0.63   21.  11.
  927                                                   -25.1385   21.0403   4.0  -0.2    0.5   0.0  0.71 0.67   10.  11.
  1174                                                   24.3040   26.0175   0.3   0.8    0.0   0.1  0.69 0.54   11.  12.
 Number of points: 54                                                   RMS:   1.9   1.4
```

- Any GCP residual that may have exceeded the quality goal.

```
 Maximum changes at control points:

 X:       0.1269    at Point ID.: OT6610_1037
 Y:      -0.1261    at Point ID.: CP6610_0027
 Z:       0.1684    at Point ID.: CP6610_0028

 RMS of changes at control points:

 X:       0.0605
 Y:       0.0694
 Z:       0.0967
```

- Other measured points should also be checked to see coming within the quality goal.

```
 T  351                                                     520315.3883 4866751.8259      124.3346   0.0647   0.0767   0.1494
 T  353                                                     520228.1103 4866870.8502      125.7644   0.0683   0.0687   0.1480
 T  354                                                     520311.0257 4866743.0057      123.9444   0.0650   0.0775   0.1499
 T  355                                                     520110.4762 4866902.4038      130.8279   0.0770   0.0683   0.1502
 T  356                                                     520168.3747 4866804.7380      127.6978   0.0733   0.0745   0.1510

                                                                                       RMS:   0.0574   0.0567   0.0818
 X-max.:   0.1013    at Point ID.: 42
 Y-max.:   0.0928    at Point ID.: 711
 Z-max.:   0.1579    at Point ID.: 755
```

- Please consider to re-measure the points have exceeded the quality goal. Also, please consider to execute following checking actions:

A) To check the taking photo coordinates process was correct.

B) To check imported coordinate values into ORIMA are as correct and same as the actual data source or printed coordinate values by comparing them.

C) To check if reserve (or called eccentric point) point was used instead of main GCP point or vise versa.

D) To check selected GCP are not biased either having incorrect XY or Z values. This can be checked by separating and using GCP into both XY and Z clusters to see each or both are incorrect.

E) To check if suspicious GCP point can be removed, and yet the result comes within the requirement. If yes, the suspicious point can be removed.

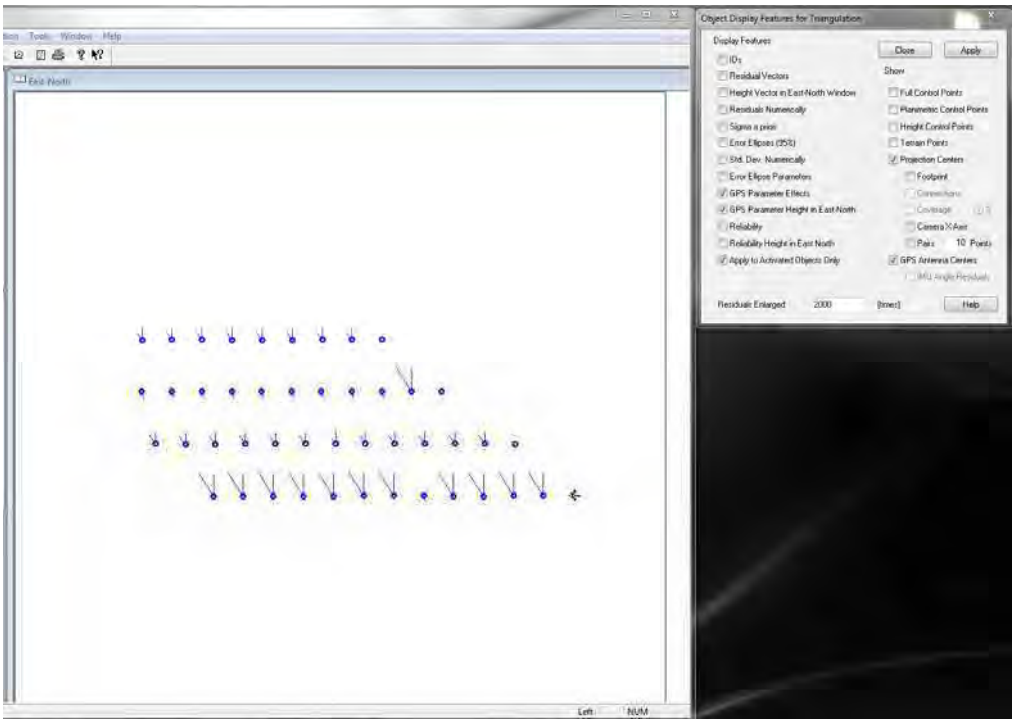
F) To check if suspicious GCP can not be removed from its nature of location and affecting other images; then please consult with GCP survey manager for action including the re-surveying of GCP.

2. Visual check of adjustment computation in ORIMA

ORIMA can analyze the computation result and supply a visual report to user. Although visual check information will be supplied, this only guides the user to see the trend of error or biases. So that combination of check of actual numerical values should also be done to support this checking phase

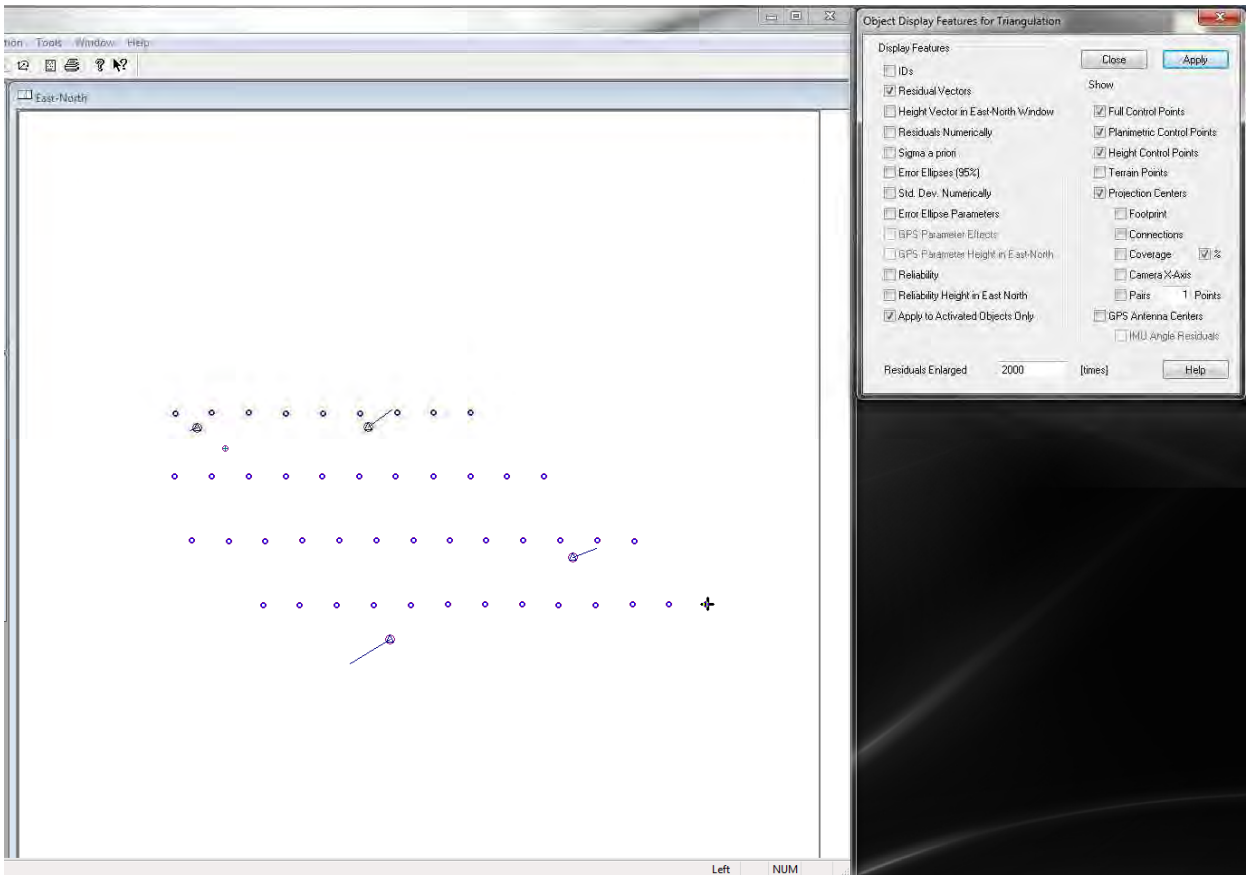
- To assess the value of GPS/IMU data

  As long as the GPS/IMU data shows uniform sequence in its data, data should be correct most of the case. If you see the data shows irrelevant order; then please check if data is correct or data may not be accurate enough to use. GPS/IMU data should be checked and reprocessed to see it can be used. Ultimately GPS/IMU data CAN BE withdrawn IF there is accurate, correctly distributed, and enough number of GCP to proceed the AT without GPS/IMU data. Also the user needs to understand to compromise that it will add extra time to execute the AT without GPS/IMU.



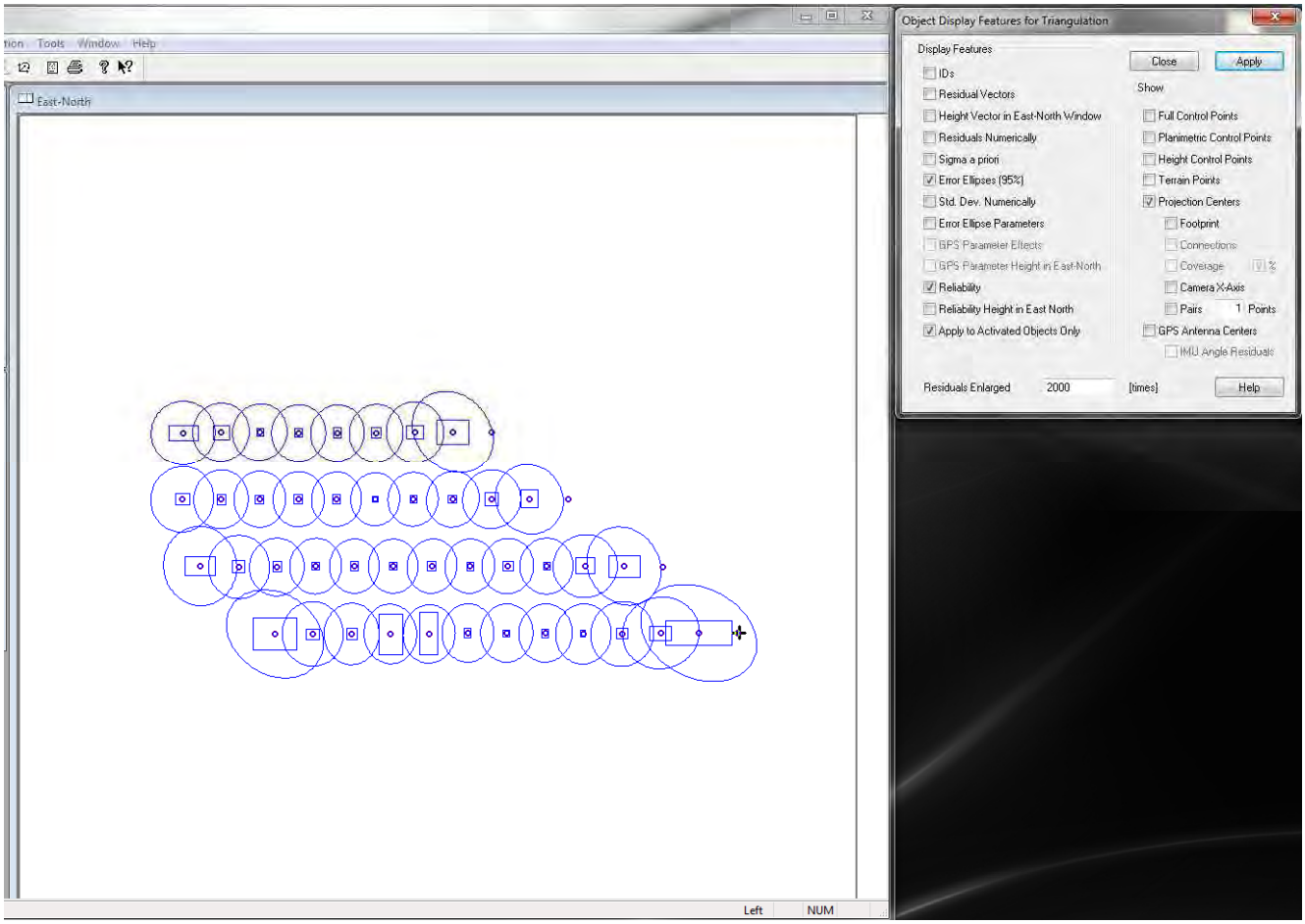
- To assess the residual of GCP

  When the user sees vectors pointing various directions; usually the results are on the good path.



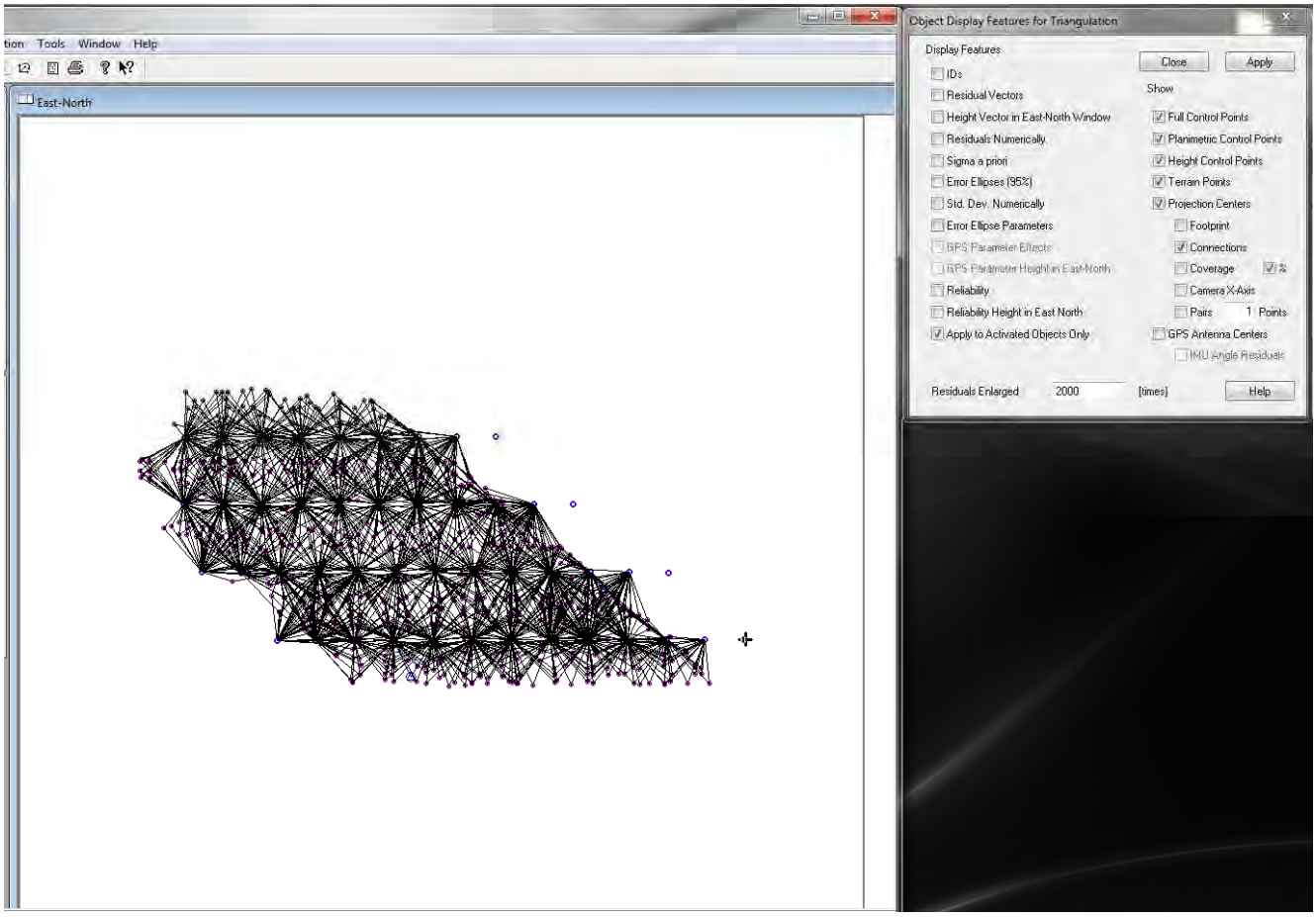
- To assess the Exterior Orientation (EO) result after the adjustment computation

  There are two objects will be displayed to show the quality status of EO file. One is Oval showing error level, and the other is rectangular showing credibility of accuracy for each photo center. When rectangular shows up larger than oval; those photo may have poor accuracy. When you see no oval and/or rectangular; it may also have some accuracy deficit.

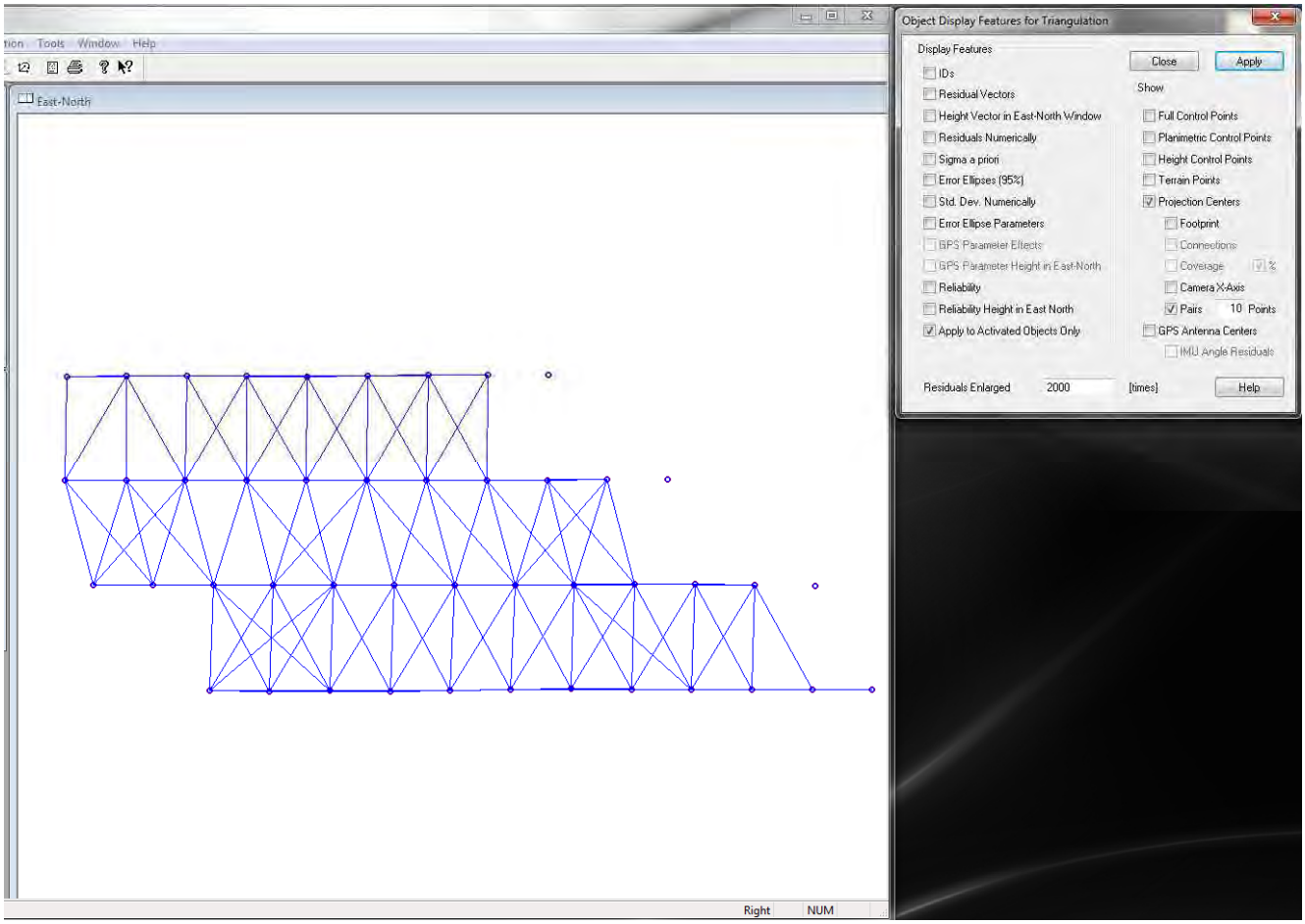


- To assess the tie point connection after the adjustment computation (point distribution)

  In this check, connection and distribution level of tie points is displayed. If the connection is weak due to weak point distribution or missing tie points, additional tie point need be measured.

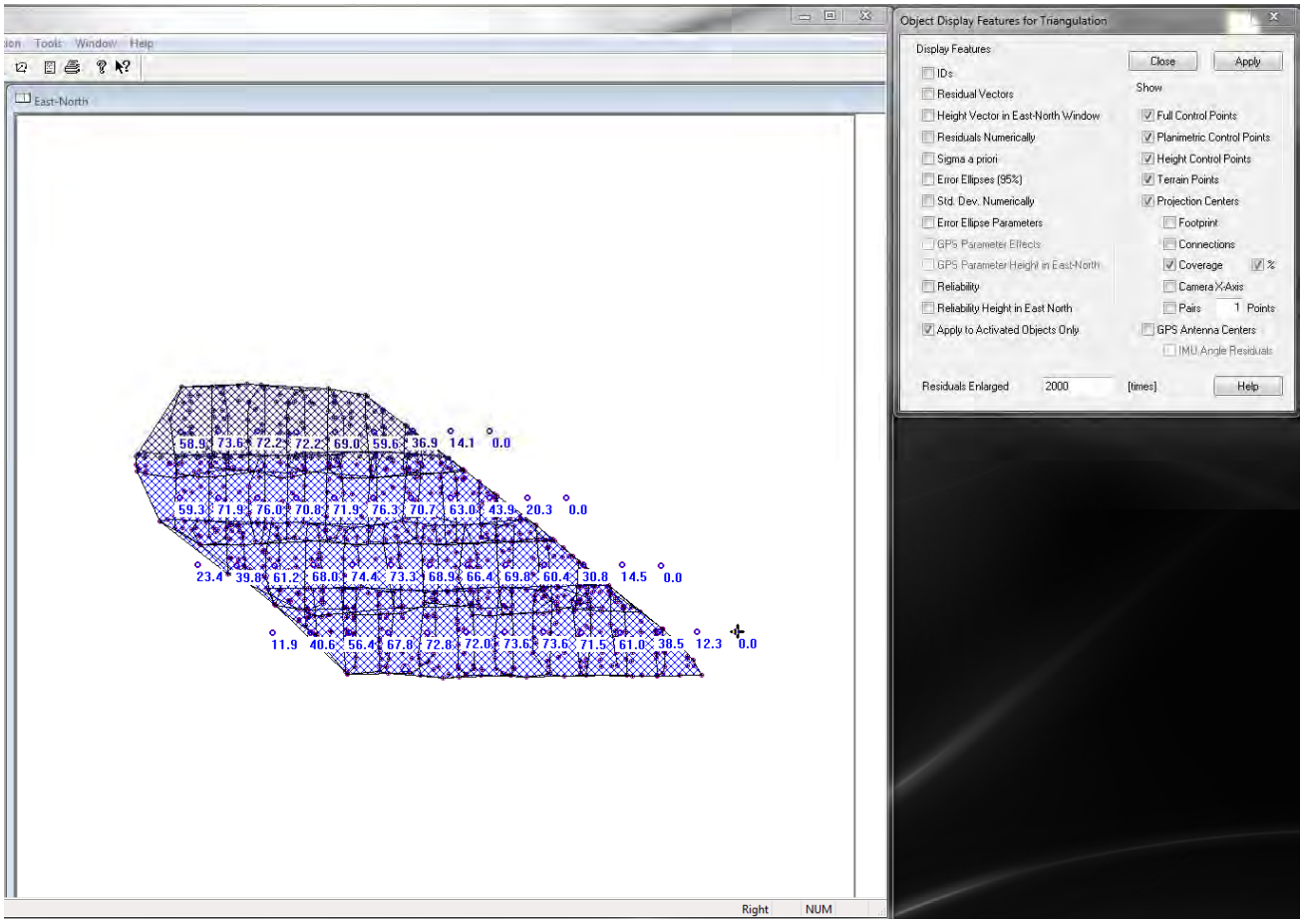


- At here, please check the number of points connecting between images.



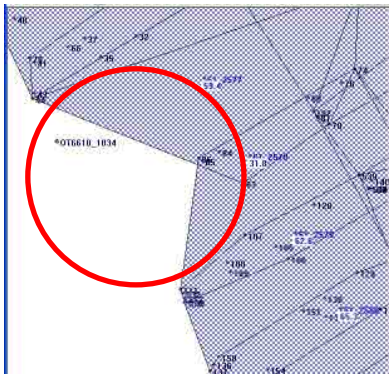
- To assess the tie point connection after the adjustment computation (Block polygon)

  In this check, tie points and computation result is displayed as polygon. If the connection is weak due to weak point distribution or missing tie points, additional tie point need be measured.

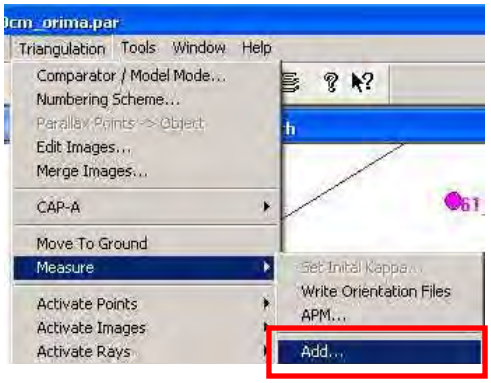


➢ Adding the tie point manually

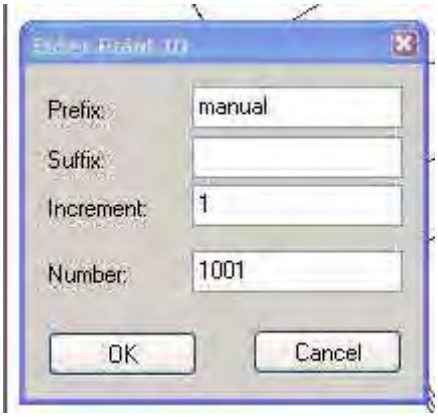
Through visual observations, area where tie points are insufficient might be found. Then, tie point should manually be added. Please see below for manual procedures.



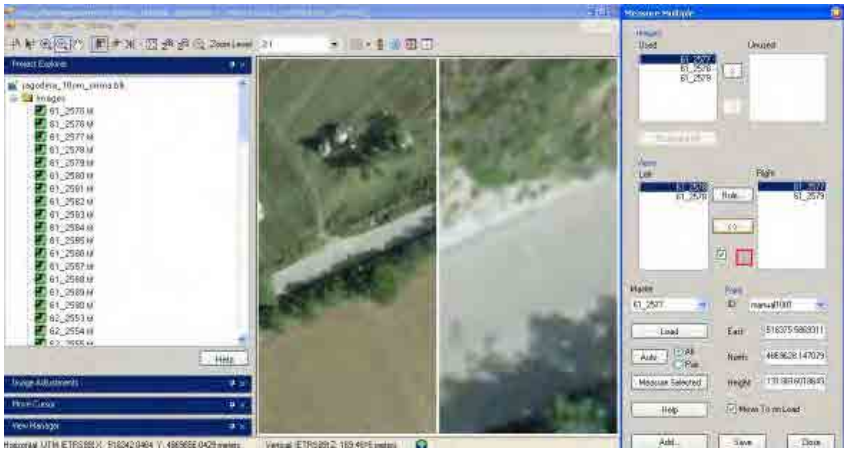
If you find the place you would like to add extra point; please select “Measure Add” to add the points. (This process may not necessary always.)



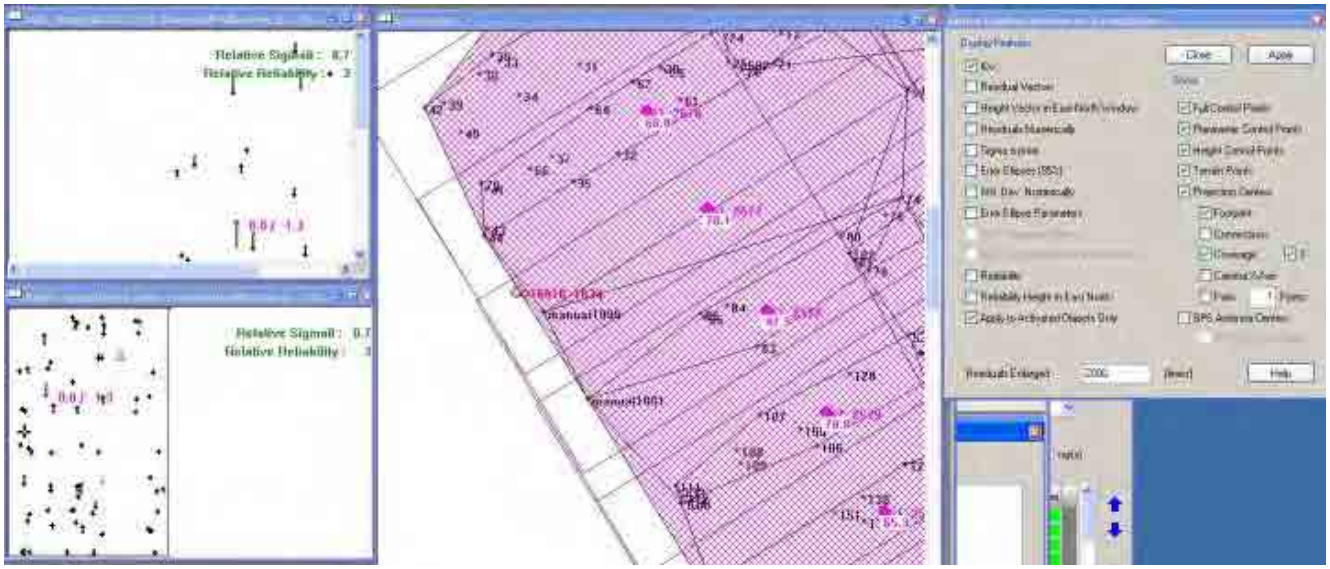
There will be a cursor to specify the place to add the point; so please click the appropriate place on ORIMA Orientation Management (East-North) window. Then please enter point ID and unique Prefix name to distinguish additional points from the rest. Please click “OK” to proceed.



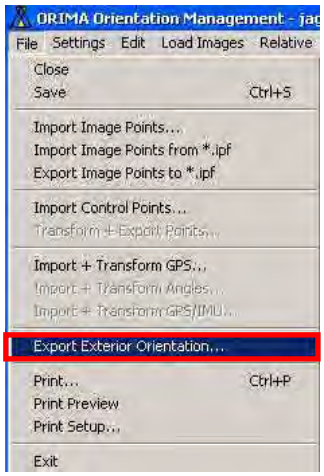
Now, same window as GCP measurement will appear. Please measure the additional tie point here with same manner as you do at GCP measurement procedures.



After the measurement, please execute the CAP-A again. And review the same observation steps to make sure new points are added and missing area is now covered by added points.



Now through the iteration of process and checking procedures; the AT process is finished. Please save the file and export it out to Exterior Orientation file by selecting “File” and then “Export Exterior Orientation”. Final EO file is now saved under working folder.



The output data (final EO) should be checked it is meeting the quality goal. Then, the data can be handed over to the next work phase. And please make the backup data of your project to other HDD or tape for future retrieval action.

Ver.001

Aero Triangulation (AT) Manual for Digital Camera

Section 3

JICA Study Team (Kokusai Kogyo)
April, 2012

1.1. Accuracy Management

Accuracy management of aerial triangulation is carried out by proving filling restriction of the residuals asked for the bundle adjustment calculation result.

The accuracy required in aerial triangulation has the " Residuals of Bundle " which shows the observation accuracy of photograph coordinates, and the " Residuals of Control Point " which shows the accuracy of ground coordinates.

It is inspected whether it is less than the value that specified these two standard deviation and the maximum errors to the work regulation.

1.1.1. Check of " Residuals of Bundle "

Refer to "Iteration" in a report for a Residuals of Bundle. The value of "Sigma0" applies standard deviation.

For example, when the Residuals of Bundle of the standard deviation of this work is 30micrometers, in the following cases, accuracy is not enough.

```
******** 4. Iteration ********


RMS values of weighted residuals of X and Y image coordinates

  Image ID.   ckt-89-1_c17_24                                    0.0175      0.0254
  Image ID.   ckt-89-1_c17_25                                    0.0187      0.0281
  Image ID.   ckt-89-1_c17_26                                    0.0200      0.0289
  Image ID.   ckt-89-1_c17_27                                    0.0213      0.0242
  Image ID.   ckt-89-1_c18_24                                    0.0187      0.0174
  Image ID.   ckt-89-1_c18_25                                    0.0223      0.0185
  Image ID.   ckt-89-1_c18_26                                    0.0198      0.0202
  Image ID.   ckt-89-1_c18_27                                    0.0195      0.0200
Additional observations:      0.0199

Sigma0:                       0.0319
Changes of parameters:        0.0000
```

1.1.2. Check of " Residuals of Control Point "

Refer to the "Control Point" in a report for Residuals of Control Point".The maximum error and standard deviation are displayed about the Control Point.

Control points

Point ID		Coordinates	SD.Post	SD.Prio	Resid.	Test	Redun	Int.Reli.
F No1	X	-32844.2668	0.1503	0.1000	0.2632	1.2	0.11	1.98 *
	Y	-34817.2593	0.1513	0.1000	-0.0383	-0.2	0.10	2.09
	Z	62.6762	0.1575	0.1000	-0.0478	-0.4	0.03	4.07
F No2	X	-30852.0841	0.1507	0.1000	-0.2181	-1.0	0.11	2.03
	Y	-34701.7216	0.1515	0.1000	0.1944	0.9	0.10	2.12
	Z	55.4865	0.1577	0.1000	0.0465	0.4	0.02	4.25
F No3	X	-32904.9598	0.1518	0.1000	-0.0208	-0.1	0.10	2.15
	Y	-37848.4947	0.1529	0.1000	-0.0497	-0.3	0.08	2.33
	Z	46.6359	0.1585	0.1000	0.0349	0.4	0.01	5.47
F No4	X	-30226.4943	0.1527	0.1000	-0.0243	-0.1	0.08	2.30
	Y	-37862.1763	0.1546	0.1000	-0.1063	-0.6	0.06	2.69
	Z	38.4043	0.1586	0.1000	-0.0337	-0.4	0.01	5.80

Maximum changes at control points:

X:	0.2632	at Point ID.: No1
Y:	0.1944	at Point ID.: No2
Z:	-0.0478	at Point ID.: No1

RMS of changes at control points:

X:	0.1717
Y:	0.1151
Z:	0.0412

It becomes a failure when exceeding the accuracy restriction.

1.1.3. Entry to Accuracy Control Table

An accuracy control table is needed in order that the 3rd person may check the accuracy of the carried-out aerial triangulation.

Accuracy Control Table for Aerial Trianguration

Project Name		Total No. of Model		Adjustment Method	Term		Company	Engineer	Kohei ISOBE
Digital Topographic Map (1/5,000)		No. of course	25	Bundle Adjustment	From	01-Aug-10	Kokusai Kogyo Co.	Inspector	SATORU NISHIO
		No. of Model	200		To	17-Dec-10			

Course Name	Flight Height (m)	Photo Number			No. of Model	No. of Control Points		No. of Eliminated Control Points		Residuals of Control Point				Residuals of Bundle	
										Holizontal		Vertical			
		From		To		Horizontal	Vertical	Horizontal	Vertical	S.D. (m)	Max (m)	S.D. (m)	Max (m)	S.D. (mm)	Max (mm)
1	5600	1	～	9	8	14	20	0	0	0.090	0.500	0.033	0.100	0.003	0.027
2	5600	1	～	9	8										
3	5600	1	～	9	8										
4	5600	1	～	9	8										
5	5600	1	～	9	8										
6	5600	1	～	9	8										
7	5600	1	～	9	8										
8	5600	1	～	9	8										
9	5600	1	～	9	8										
10	5600	1	～	9	8										
11	5600	1	～	9	8										
12	5600	1	～	9	8										
13	5600	1	～	9	8										
14	5600	1	～	9	8										
15	5600	1	～	9	8										
16	5600	1	～	9	8										
17	5600	1	～	9	8										
18	5600	1	～	9	8										
19	5600	1	～	9	8										
20	5600	1	～	9	8										
21	5600	1	～	9	8										
22	5600	1	～	9	8										
23	5600	1	～	9	8										
24	5600	1	～	9	8										
25	5600	1	～	9	8										
Limitation Values										1.120	2.240	1.120	2.240	0.015	0.030

Equipments	LPS ORIMA,CAP-A	Operator		Remarks	

Limitation Values for Residuals of Control Point and Residuals of Tie Point

Method	Points Type	S.D.	Max
Bundle Adjustment	Control	0.02% of fright height	0.04% of fright height
	Others	0.015㎜ in photo coordinate	0.030㎜ in photo coordinate

① record of work

Project Name: The name of the project is filled in.

Total No of Model: The number of courses and model number of an aerial photograph which were used for aerial triangulation are filled in.

Adjustment Method: The calculation method used for adjustment calculation is filled in.

Term : The period which worked is filled in.

Company : The name of an organization is filled in.

Engineer : The name of the group leader of the work is filled in.

Inspector : A check person is filled in.

② record of accuracy

Course Name: a photography course is filled in.

Flight Height(m): a photography altitude is filled in.

Photo Number: the photograph number of beginning and the endare filled in.

No. of Model: the number of models is filled in.

No. of Control Points: the number of the used reference points is filled in.

No. of Eliminated Control Points: The Control point excepted from adjustment calculation is filled in.

Residuals of Control Point: The residual of control point is filled in.

Residuals of Bundle: The residuals of bundle is filled in.

Limitation Values: The limit value of adjustment calculation is filled in.

Equipments: The name of the used equipment or software are filled in.

Operator: A worker's name is filled in.

Remarks: If it may mention specially.

Method: The adjustment calculation method is indicated is filled in.

Points Type: A control point or other points is filled in.

S.D.: The calculation method of the limit value of standard deviation is filled in. In this case, 0.02% of photography altitudes become that value.

Max: The calculation method of the limit value of the maximum filled in. 0.04% of photography altitudes become that value in this case.

The work of aerial triangulation is completed by the above work.