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EZSurv™
Baseline Processing

October 10th 2012

2012 - Training documents

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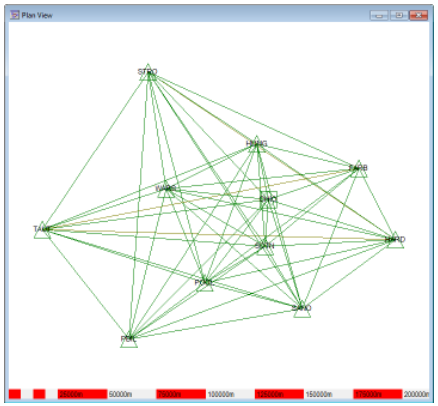
What is a Baseline

- It is a ***3D vector between two Sites***. A baseline can be defined between two sites if they have simultaneous GNSS observations.
- The ***simultaneous time required*** to define a baseline may vary (5, 10, 30, 60 min) depending on few parameters like vector's length, sky visibility and multipath at both sites.
- In EZSurv™ you can have multiple observations of the same baseline.
- Typically, a baseline is expected to be accurate at the centimeter level.
- Multiple site connections (through baseline vectors) will define a network that may require a least-square adjustment to obtain unique/optimal results.



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Baseline Accuracy

Horizontal Accuracy : ***3mm + 0.1ppm (Static) or better***

Vertical Accuracy : ***5mm + 0.5ppm (Static) or better***

We can meet the one in black (post-processing) *when baseline or kinematic are using the same antenna at the base and the remote receiver.*

Precision and reliability may be subject to anomalies due to multipath, obstructions, satellite geometry, and atmospheric conditions. The specifications stated recommend the use of stable mounts in an open sky view, EMI and multipath clean environment, optimal GNSS constellation configurations, along with the use of survey practices that are generally accepted for performing the highest-order surveys for the applicable application including occupation times appropriate for baseline length. Baselines longer than 30 km require precise ephemeris and occupations up to 24 hours may be required to achieve the high precision static specification.

To be done only once

Mixing Antennas

Parameters defining a GNSS antenna

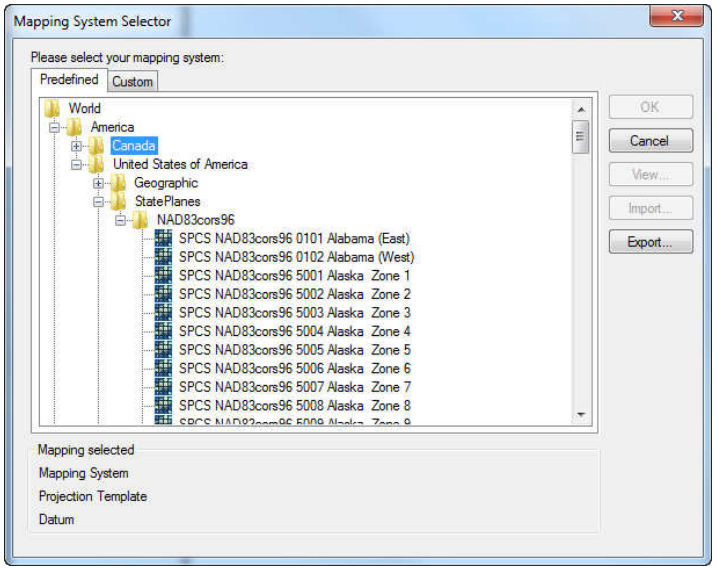
- ***When mixing antennas in a same project, it is important to properly set their associated parameters.***
- In the Post-Processor, you can model all these parameters.
- You can also use the NGS model.
- See «Default Parameters Setting» training Module to set your Antenna model.

If you input a «zero» radius, it is because you are measuring vertical height

To be done only once

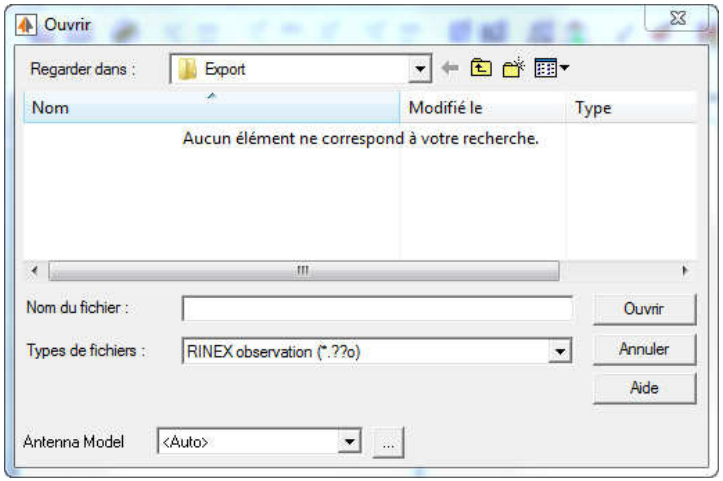
Set your Mapping System/datum

- Set your mapping coordinates using the **Mapping Systems** dialog, under **Tools > Mapping Systems > Selector** from the main menu.
- From this dialog, you can select an existing mapping system. You can create new ones using **Tools > Mapping Systems > Editor**, these new mapping systems will be available under the **Custom** Tab of the **Tools > Mapping Systems > Selector**



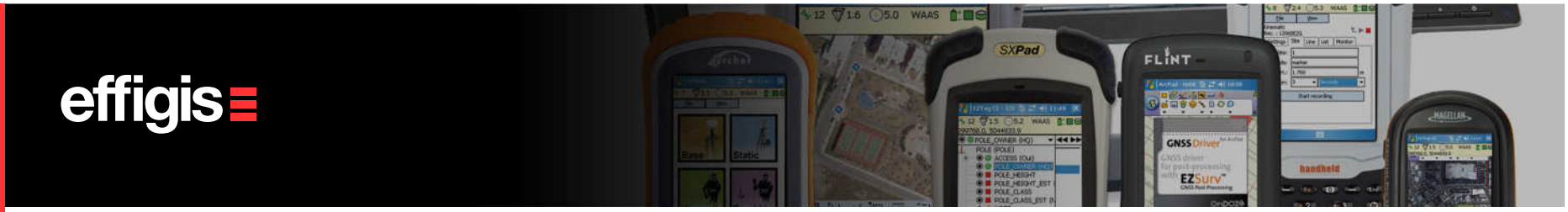
See the «Mapping Systems» training Module.

Importing GNSS observations



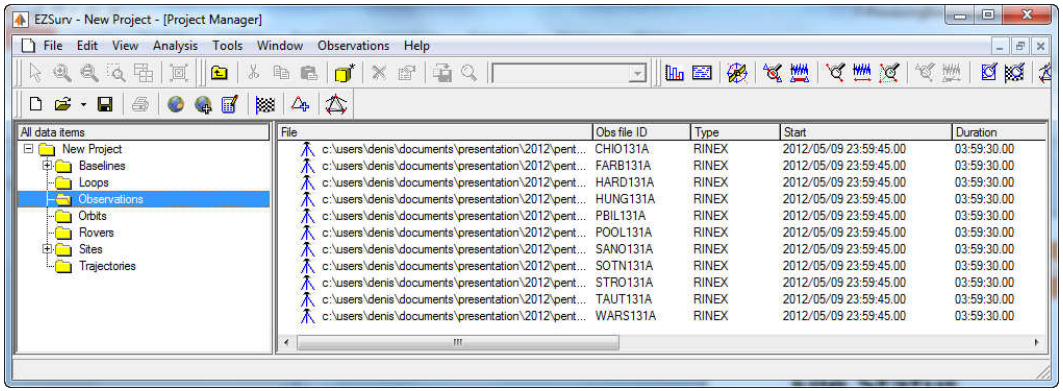
Same as importing rover files

- You can click on the  icon from the **Project Manager** toolbar.
- Or simply drag and drop your GNSS files in the **Observations** folder from the **Project Manager** Window.
- RINEX files may be processed as long as a Licensed receiver requires it as a reference (must be imported after License receiver files).
- Importing the GNSS data files will automatically import associated orbit files (if they are present).

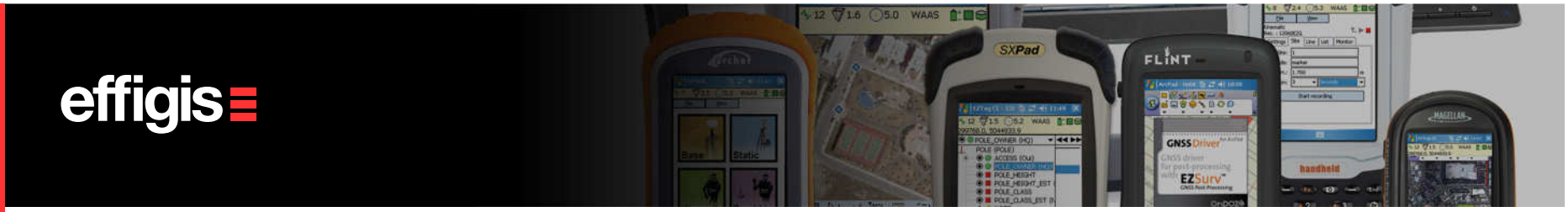


File Status

When your static files are imported, ***make sure they are set as static (tripod icon).*** Otherwise select the file, right-click and set them as static. Baselines are created using static files.



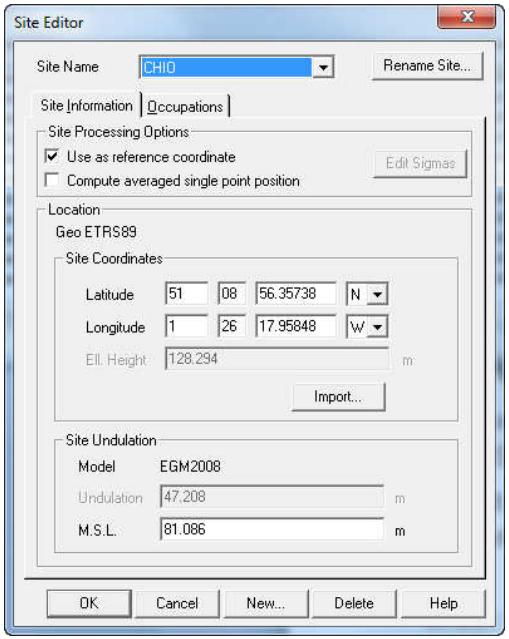
*To import files automatically set as static, go to **Tools > Option Data File Tab** and set «File contains no site» and «File contains one site» as **Static** (using the drop down box)*



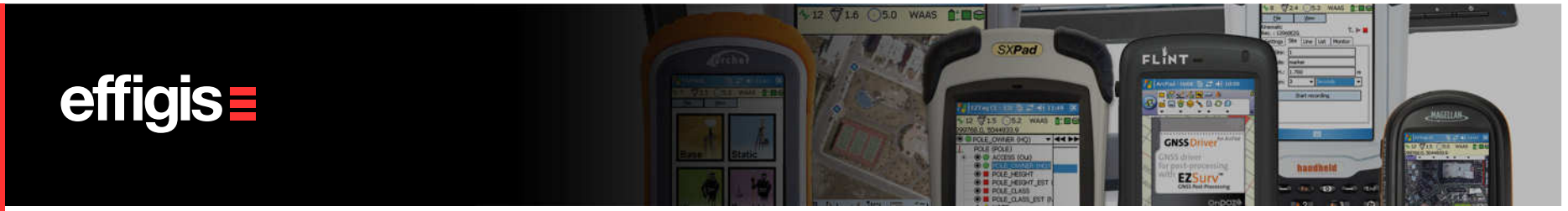
Setting Reference Site (1/2)

If you have occupied a known marker with your GNSS receiver :

- In **Edit > Site…**. use the **Site Editor** to select this reference site (Site name drop down box).
- Check the «Use as reference coordinate» (the coordinate field can now be edited).
- Input your known coordinate with respect to the Mapping System (or geographic system).
- You may have more than one reference.



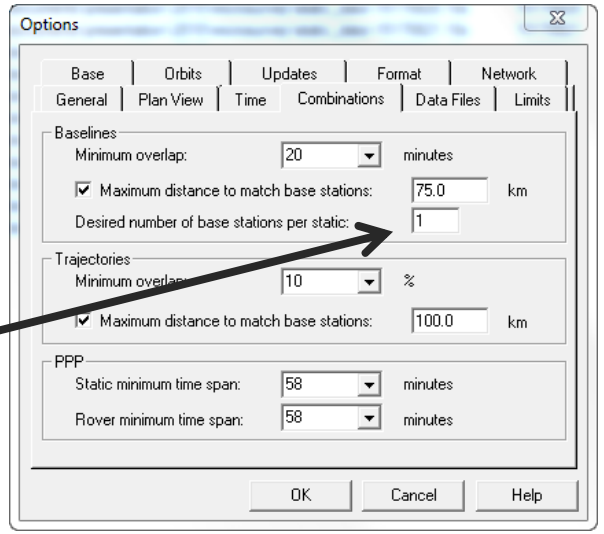
Input MSL height if a geoid is selected, otherwise input an ellipsoidal height



Setting Reference Site (2/2)

To tie your network to reference site(s) provided by a nearby Base Station Providers (like CORS):

- Select your Base Station Provider in the **Base** tab from **Tools > Option.**
- Make sure that the *Search for Base Stations* option is checked in the **Process Parameters** dialog box.
- Select the **Combinations** tab from **Tools > Options**. In the Baselines section, input the maximum distance between your marker and the base station as well as the number of Base Stations to tie your network



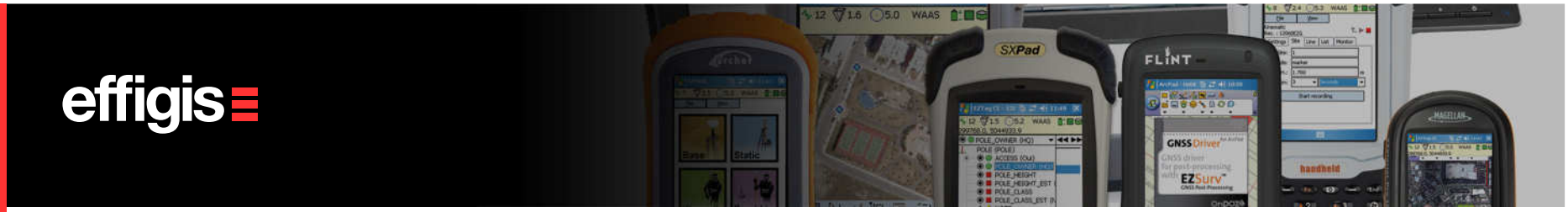
*This last method of geo-referencing a network **may retrieve a lot of base station data if it is not properly used** (for example if you have a network with a lot of stations)*

Processing Baselines

Simply launch the processing by tapping the F9 key

The Post-Processor will process as follows:

- Find all possible baselines among the submitted static data set that meet combination settings (**Combination** tab in **Tools > Options**).
- If required, search and download data from selected Base Station Provider.
- Start the baseline calculation by following a rigorous coordinate seeding starting from reference site(s).
- Generate baselines residuals and results.
- Output a Process Summary.



Baselines – Process Summary

Last Process Summary

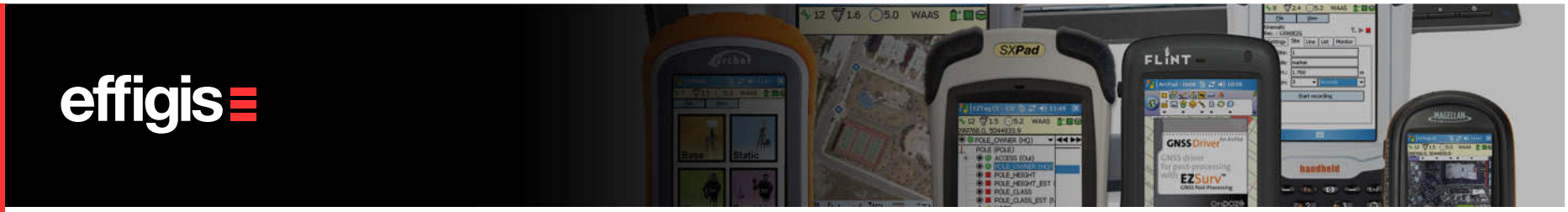
Last Processed

LAST PROCESS SUMMARY
EZSurv 2.91

Project	New Project
Processing Date	2012/06/09 22:02:27.29 (UTC)
Mapping System	Geo ETRS89
Projection Template	Geographic
Datum	European Terrestrial Reference System - 1989
Geoid Model	EGM2008 [EGM2008 Und_min2.5x2]

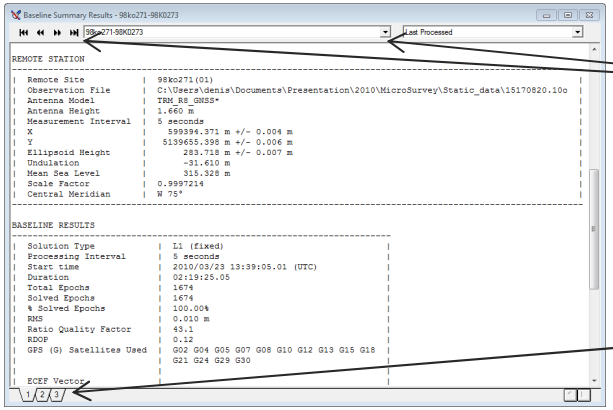
BASELINES

Baseline/occ	Status	Solution	Length (m)	RMS (m)	RDOP	Ratio	Duration	# Sat	Number of epochs Total	Solved	% Solved
POOL-SANO											
01	SUCCESS	L3 (fixed iono-free)	51210.297	0.016	0.07	49.9	03:59:30.00	18	480	480	100.00
POOL-SOTN											
01	SUCCESS	L3 (fixed iono-free)	35841.582	0.014	0.07	38.6	03:59:30.00	18	480	480	100.00
POOL-STRO											
01	SUCCESS	L3 (fixed iono-free)	110638.810	0.022	0.08	6.8	03:59:30.00	18	480	480	100.00
POOL-TAUT											
01	SUCCESS	L3 (fixed iono-free)	86669.810	0.021	0.07	26.0	03:59:30.00	18	480	480	100.00
POOL-WARS											
01	SUCCESS	L3 (fixed iono-free)	51380.676	0.018	0.07	20.7	03:59:30.00	18	480	480	100.00
POOL-CHIO											
01	SUCCESS	L3 (fixed iono-free)	53140.396	0.014	0.07	22.3	03:59:30.00	18	480	480	100.00
POOL-FARB											
01	SUCCESS	L3 (fixed iono-free)	97554.403	0.017	0.07	11.4	03:59:30.00	18	480	480	100.00



Baselines – Analysis Views

Baseline results are available under **Analysis > Baseline Results > Baseline Summary**. There is a text summary with all statistics and there is «carrier phase residuals plot» available for each calculated baseline.



REMOTE STATION

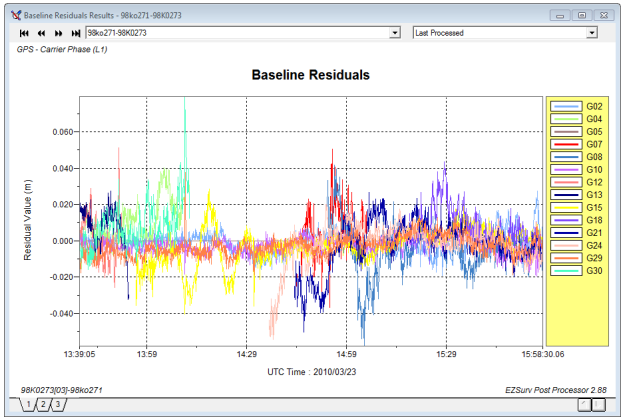
Remote Site	98ko271(01)
Observation File	C:\Users\denis\Documents\Presentation\2010\MicroSurvey\Static_data\15170820.10o
Antenna Model	TRM_R8 GNSS*
Antenna Height	1.660 m
Measurement Interval	5 seconds
X	599394.371 m +/- 0.004 m
Y	5139655.398 m +/- 0.006 m
Ellipsoid Height	283.718 m +/- 0.007 m
Undulation	-31.610 m
Mean Sea Level	315.328 m
Scale Factor	0.9997214
Central Meridian	W 75°

BASELINE RESULTS

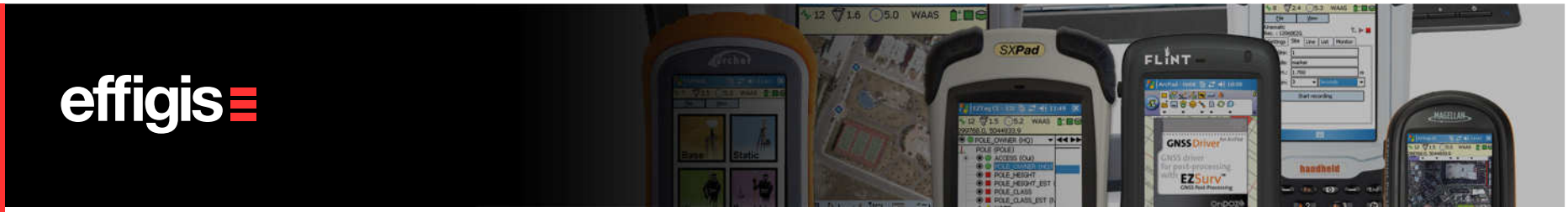
Solution Type	L1 (fixed)
Processing Interval	5 seconds
Start time	2010/03/23 13:39:05.01 (UTC)
Duration	02:19:25.05
Total Epochs	1674
Solved Epochs	1674
% Solved Epochs	100.00%
RMS	0.010 m
Ratio Quality Factor	43.1
RDOP	0.12
GPS (G) Satellites Used	G02 G04 G05 G07 G08 G10 G12 G13 G15 G18 G21 G24 G29 G30
ECEF Vector	

Navigate through each baseline using the VCR control or the drop down box.

Bottom tabs here will give results for multiple baseline occupations.



All text reports can be saved (right click, Save As…)

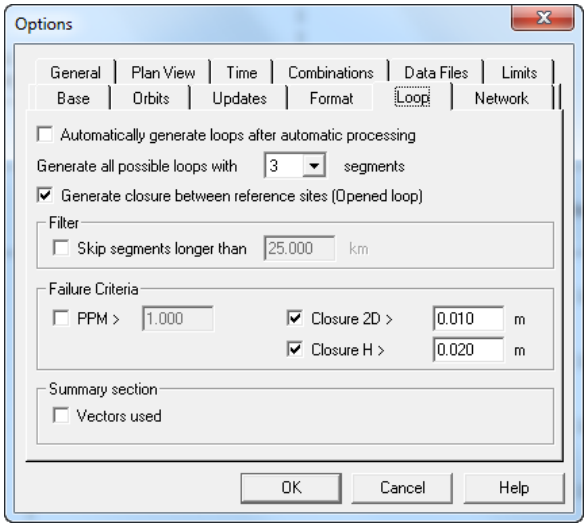


Automatic Loop Closures

With EZSurv™you can easily verify baseline fits using a simple loop closure utility. Loops a generated automatically using some user parameters.

- Under **Tools > Options**, **Loop** Tab you can set all necessary parameters to automatically generate loops.
- You can generates loops of 2, 3 or 4 legs. Loop of 2 legs are simply common vectors.
- You can also generates open loops between reference sites

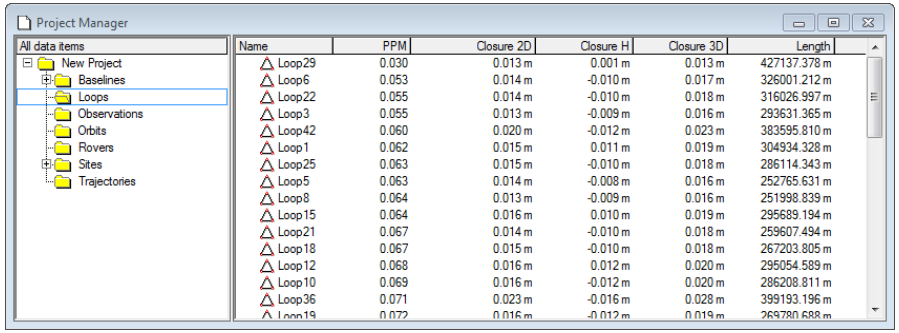
Open loops are supported between two reference points



Loop Closures

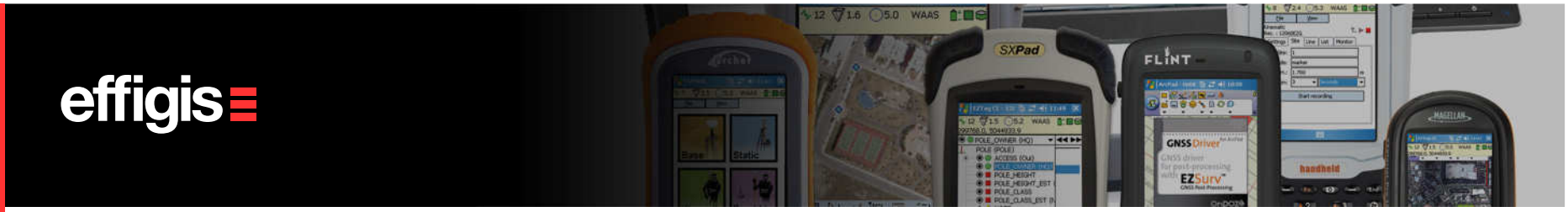
After setting your loop parameters, there are two ways to generate loops:

- Under **Tools > Process Manual > Generate Loops**
- In the **Project Manager** windows, select the Loops folder, rigth click on the right section of the windows and select «Generate loops», then all possible loops (meeting your parameters) will be listed



Name	PPM	Closure 2D	Closure H	Closure 3D	Length
Loop29	0.030	0.013 m	0.001 m	0.013 m	427137.378 m
Loop6	0.053	0.014 m	-0.010 m	0.017 m	326001.212 m
Loop22	0.055	0.014 m	-0.010 m	0.018 m	316026.997 m
Loop3	0.055	0.013 m	-0.009 m	0.016 m	293631.365 m
Loop42	0.060	0.020 m	-0.012 m	0.023 m	383595.810 m
Loop1	0.062	0.015 m	0.011 m	0.019 m	304934.328 m
Loop25	0.063	0.015 m	-0.010 m	0.018 m	286114.343 m
Loop5	0.063	0.014 m	-0.008 m	0.016 m	252765.631 m
Loop8	0.064	0.013 m	-0.009 m	0.016 m	251998.839 m
Loop15	0.064	0.016 m	0.010 m	0.019 m	295689.194 m
Loop21	0.067	0.014 m	-0.010 m	0.018 m	259607.494 m
Loop18	0.067	0.015 m	-0.010 m	0.018 m	267203.805 m
Loop12	0.068	0.016 m	0.012 m	0.020 m	295054.589 m
Loop10	0.069	0.016 m	-0.012 m	0.020 m	286208.811 m
Loop36	0.071	0.023 m	-0.016 m	0.028 m	399193.196 m
Loop19	0.072	0.016 m	-0.012 m	0.019 m	269780.688 m

Right click and select «Analyse» to get a detail report



Loop Closure Report

To generate a detail Loop Closure report, you can also go to **Analysis > Loop Summary**

All text reports can be saved (right click, Save As…)

Loop Summary

```
LOOP SUMMARY
EZSurv 2.91

-------------------------------------------------------------------------
|  Project                 |  New Project                               |
|  Segments per loop       |  3                                         |
|  Failed criteria         |  Closure 2D > 0.010 m, Closure H > 0.020 m  |
|..........................|............................................|
|  Number of loops         |  165                                       |
|  Number of failed loops  |  44 (26.67%)                               |
-------------------------------------------------------------------------

Statistics for ALL loops
-----------------------------------------------------
|                |            |  ___Closure___  |         |
|                |     Length |    2D       H   |     PPM |
|                |        (m) |    (m)      (m) |         |
|----------------+------------+-----------------+---------|
|  Best          |            |  0.000  -0.001  |  0.000  |
|  Worst         |            |  0.051   0.013  |  0.139  |
|  Average loop  |  257198.566|  0.007   0.004  |  0.027  |
-----------------------------------------------------

Loop26 (Closed - 0.139 ppm)
-------------------------------------------------------------------------------------------------------
|                                |                          |  ____________ECEF Vector____________  |            |
|  Segment          Occ          |  Solution                |          DX          DY          DZ  |     Length |
|                                |                          |         (m)         (m)         (m)  |        (m) |
|--------------------------------+--------------------------+---------------------------------------+------------|
|  SOTN-STRO          01         |  L3 (fixed iono-free)    |   -71532.248   -55580.552   55734.992  | 106360.000 |
|  STRO-HARD          01         |  L3 (iono-free)          |    71645.738   121777.497  -54900.122  | 151581.311 |
|  HARD-SOTN          01         |  L3 (fixed iono-free)    |     -113.492   -66196.990    -834.867  |  66202.352 |
|                                |                          |                                       |            |
|--------------------------------|--------------------------|---------------------------------------|------------|
|  Closure                       |                          |       -0.002       -0.045       0.003  | 324143.663 |
|  Closure 2D   0.045 m          |                          |                                       |            |
|  Closure H    0.002 m          |                          |                                       |            |
|  Closure 3D   0.045 m          |                          |                                       |            |
-------------------------------------------------------------------------------------------------------
```

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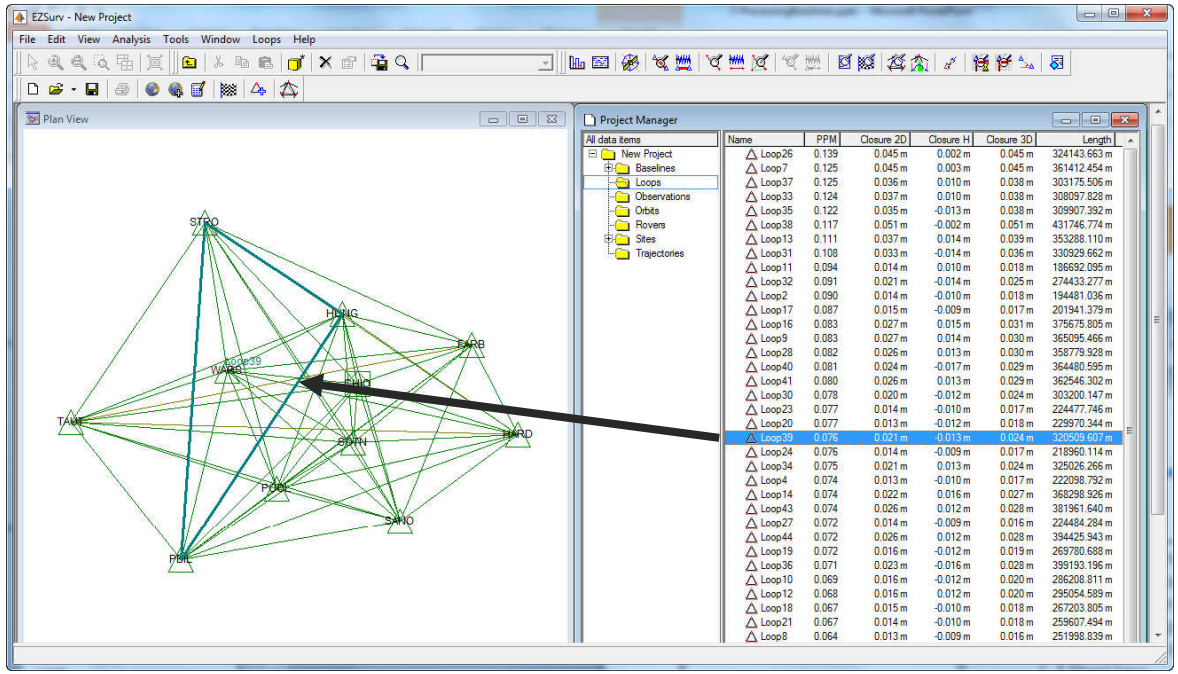
Loop Closure – Plan View



Tile your windows with the Project Manager (Loop folder) and the Plan View. When you select a loop in the Project Manager, it is highlighted in the PlanView

All text reports can be saved (right click, Save As…)

Sites Positions – Before adjustment

After post-processing, you have access to a list of all your positions in **Analysis > Survey Sites > Post-Processed Coordinates**.

Post-Processed Coordinates

POST-PROCESSED COORDINATES
EZSurv 2.91

Project	New Project
Geoid Model	EGM2008 [EGM2008 Und_min2.5x2]
Mapping System	Geo ETRS89
Projection Template	Geographic
Datum	European Terrestrial Reference System - 1989

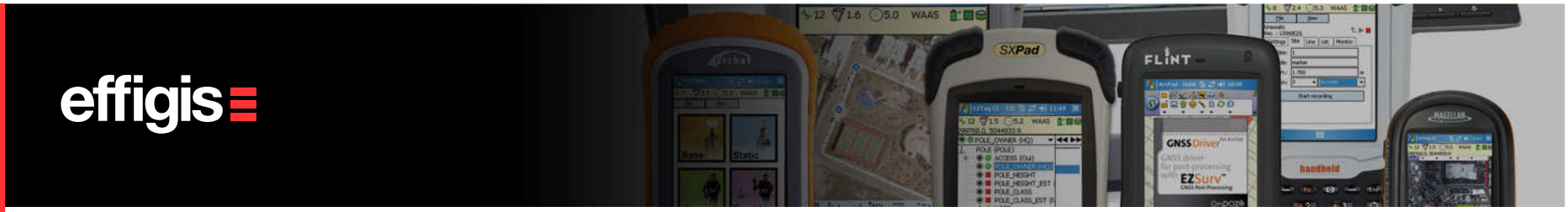
Sites from Baselines

Site	Solution	Position Latitude	Position Longitude	Position EllHgt (m)	Position MSL (m)	Standard deviation Lat (m)	Standard deviation Lon (m)	Standard deviation Hgt (m)	Baseline count
FARB	*	N 51°16'47.74246"	W 0°46'21.72914"	112.626	66.135	*	*	*	10
HARD	*	N 50°56'58.91113"	W 0°31'43.26565"	65.870	20.070	*	*	*	10
HUNG	*	N 51°24'15.42245"	W 1°30'50.20689"	183.174	135.305	*	*	*	10
PBIL	*	N 50°31'18.39291"	W 2°27'26.97200"	107.462	58.313	*	*	*	10
POOL	*	N 50°46'33.05321"	W 1°54'38.01322"	68.750	20.959	*	*	*	10
SANO	*	N 50°39'01.16468"	W 1°12'46.74627"	91.129	44.651	*	*	*	10
SOTN	*	N 50°56'15.72090"	W 1°28'13.57961"	73.719	26.833	*	*	*	10
STRO	*	N 51°44'22.62753"	W 2°18'05.03604"	72.934	23.130	*	*	*	10
TAUT	*	N 51°01'24.21696"	W 3°04'43.40468"	80.458	29.191	*	*	*	10
WARS	*	N 51°12'17.36674"	W 2°10'54.12133"	177.513	128.539	*	*	*	10

* Not adjusted

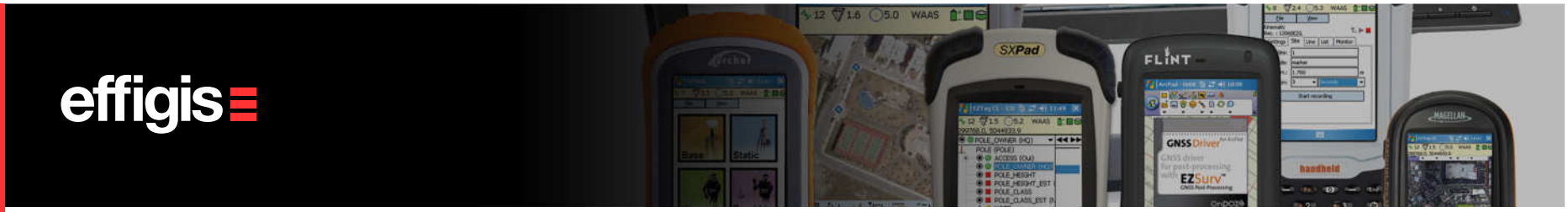
Number of baseline tied to the site

*Solution type as well as standard deviations **<u>are not displayed if a site is connected to more than one baseline</u>**. If you adjust your sites (least-squares), then all standard deviations from the least-squares adjustment will be displayed*



Baseline – Exporting sites Positions

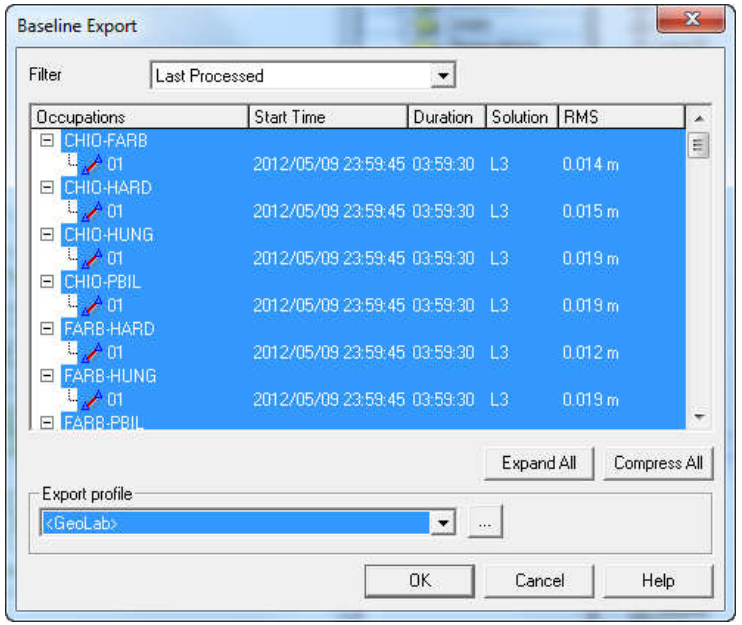
- Your network of vectors need an adjustment, before exporting your final site positions, you must adjust them. Otherwise your positions results will not be optimum.
- This adjustment will also provide better accuracy statistics for your positions
- The training document «least-squares adjustment» covers this part
- Export is done through the Tools/export/sites



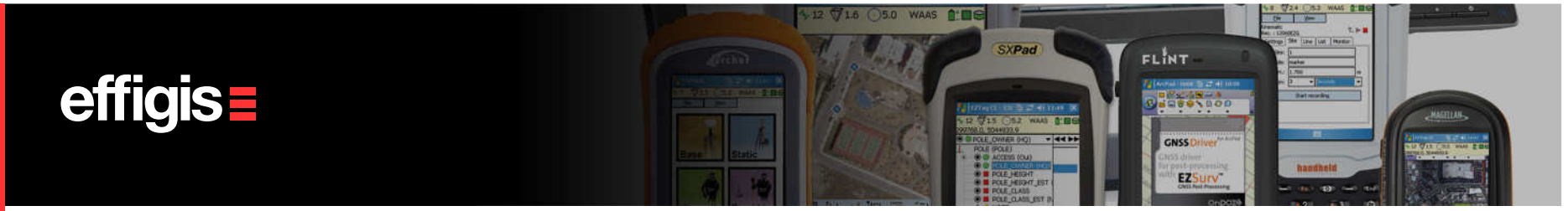
Baseline – Exporting Vectors

If you want to adjust your vectors in your own least-squares adjustment package, baseline components can be exported in GEOLAB format or in customable CSV format.

- Select the Baselines to be exported and select, in the «Export profile» section, your format.
- Then click OK, (overwrite the proposed file name and location if needed).



Tools > Export > Baselines.

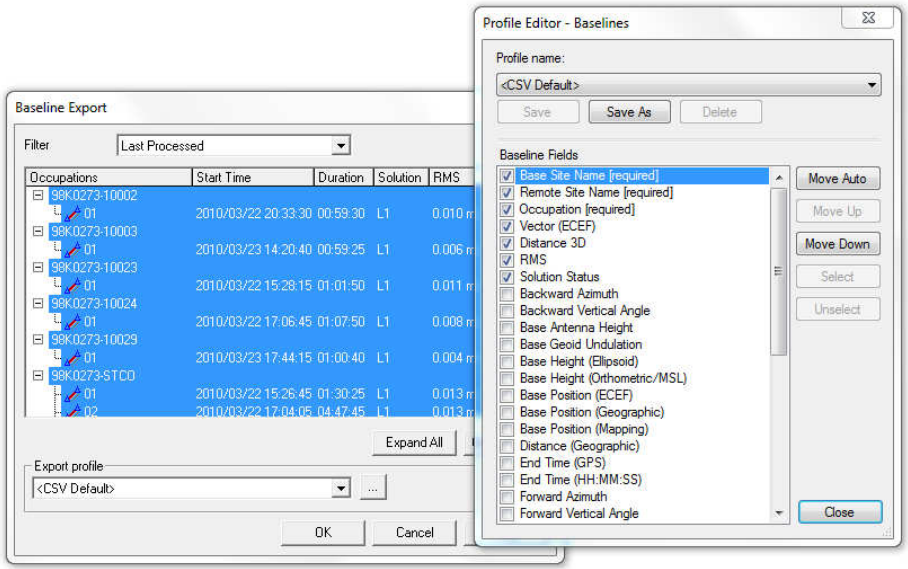


Baselines– CSV Export

CSV export can be configured as you want. All parameters related to a baseline can be exported. You can configure a CSV output and save it using a profile

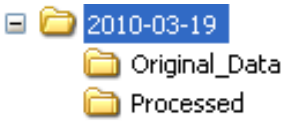
Tools > Export > Baselines…

- Click ... to access the Profile Editor
- Then select your parameters, order them using the «Move up» and «Move down»
- Save your selection under a specific profile name



Baseline – Saving your Project

- As previously mentioned, before saving your Post-Processor project, it is suggested to manage the survey files on a daily basis. Each daily folder should contain a subfolder for the GNSS observations and a subfolder to hold the post-processed project files. A Post-Processor project generates many files.



- Save your Post-Processor project (a location is proposed).
- The SPR file can be reopened any time to add more data, unless you move, delete some files of the project or you edit the folder path.
- To move your project to another folder or computer, create an archive. Select **File > Archive Project…**
- Select **File > Open Archived Project…** to reopen an archived project.

Baselines Processing in Short

Few easy steps to get the job done

- Import all your static data
- Set your reference coordinate (one or few reference stations)
- Launch the automatic processing (F9)
- Export you're your Baseline components
- Or ***adjust your vector and export your positions***

Few settings to be done once

- The antenna model
- Mapping system
- Unit of measure
- Process parameters