Justin

Software Manual

Reflects Software Version 20.06.2014

Revision 1.0

Last Revised December 15, 2014

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PREFACE

Thank you for choosing this JAVAD GNSS product. The materials available in this Software Manual (the "Manual") have been prepared by JAVAD GNSS for owners of JAVAD GNSS products. It is designed to assist owners with the operating of the Justin Software and its use is subject to these terms and conditions (the "Terms and Conditions").

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Symbols and Typographic Conventions

This Manual uses the following text conventions:

Example	Description.
About	Titles of dialog windows/boxes, names of menu options.

Screen Captures

This Manual includes sample screen captures. Your actual screen can look slightly different from the sample screen due to the receiver you have connected, operating system used and settings you have specified. This is normal and not a cause for concern.

Technical Support

If you have a problem and cannot find the information you need in the product documentation, contact your local dealer. Alternatively, request technical support using the JAVAD GNSS World Wide Web site at: www.javad.com.

To contact JAVAD GNSS Customer Support use the QUESTIONS button available on the www.javad.com.

General Description

Justin is an office software for processing the GNSS data. Justin is designed for a wide range of geodetic and topographic tasks. It combines a variety of post-processing tools, GIS interface, and cartographic features. The Justin discloses all advantages of the JAVAD technology and has been optimized to deal the highest precision with the least amount of operator invention**.**

Main Elements

- Various post-processing modes. Precise ephemeris type.
- Automatic project update in accordance with the Justin version
- Interactive mode of GNSS data post-processing
- Post-processing of static vectors up to 1000 km and kinematic data at up to 100 Hz
- Post-processing of kinematic data with a mobile base
- Post-processing of Stop&Go measurements
- Geodetic network adjustment (up to 3000 points) with user defined constraints
- Adjustment of the kinematic trajectories
- Events coordinates computing
- Mission planning
- Export/import data in various GIS and CAD file formats
- Vector maps, raster backgrounds, layer options (styles, labeling)
- Raster georeferencing
- Export of a project map to Google Earth, import Google Earth map to a project
- Multilingual interface
- Real time data processing using Internet connection
- Coordinate system editor and coordinate calculator
- Localization

System Requirements

Before installing Justin, ensure your computer satisfies the following system requirements:

- PC with Microsoft Windows 7, 8
- RAM 1 GB (minimal, 4 GB optimal).

1. Main window

Main window appears after program started. The program window elements are menu items, buttons, map, project, and status pane:

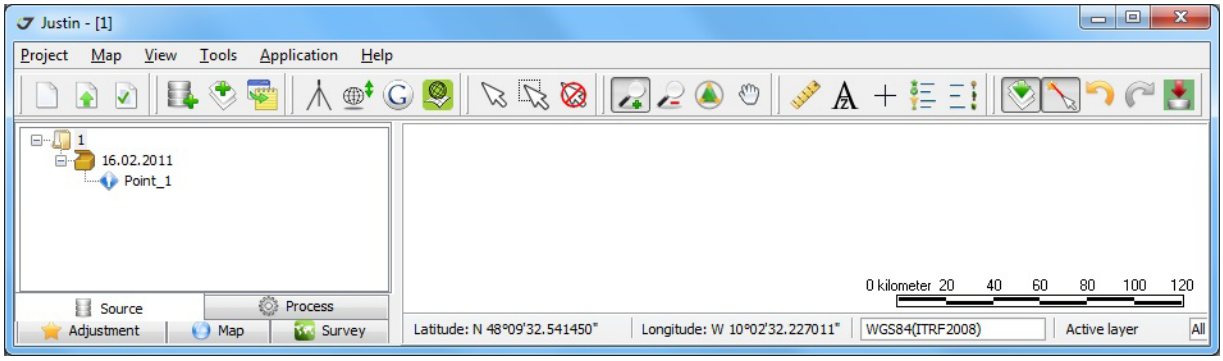


Figure 1. Main window

1.1. Main Menu

The items of main menu are the following:

Project. Use this item to open and close a project, to import and export files, to edit project properties, start export of cartographic layers to many popular exchange formats and Google Earth, load precise ephemeris from Internet.

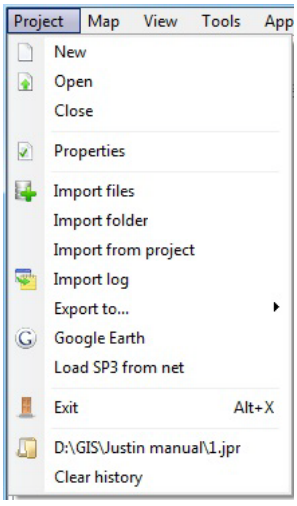


Figure 2. Project

Map. This item contents tools you need to work within cartographic window: panning, centering, zooming, measuring distances, adding vector and raster layers, etc.

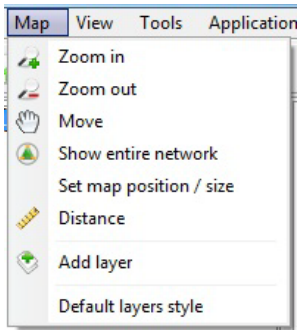


Figure 3. Map

- *Set map position/ size* menu item to edit window size, cancels user defined style, zoom, and the center map coordinates in the specified coordinate system can be set.

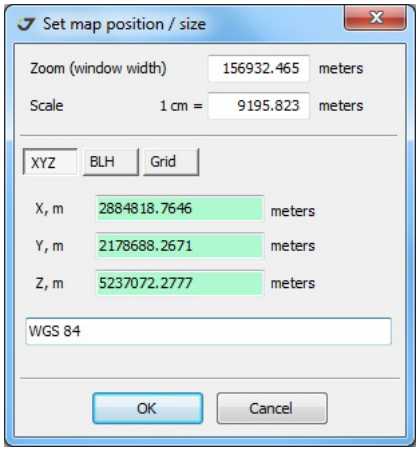


Figure 4. Set map position

- *Default layer styles* menu item cancels the style entered by the operator, and restores the default style for all layers except the dynamic and added layers.

View. This menu item offers to hide or show map and project panes. Many additional panes could be opened as well. The full description of the functions of menu items see in appropriate sections below.

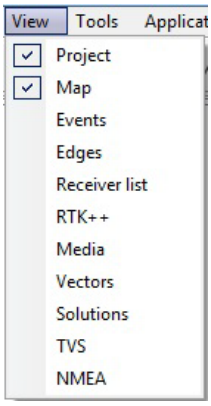


Figure 5. View

Tools item is designed for raster images georeferencing, calculating of global datum, calculating transformation parameters (localization) of plane coordinate systems, running the measurement scheduler, time converter, visualization of NMEA data stream coming via TCP / IP protocol, displaying precise ephemeris time schedule.

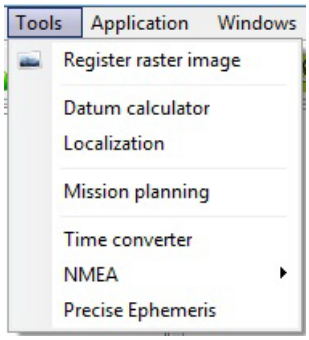


Figure 6. Tools

Options. This menu item is designed to setup the various program parameters, manage coordinate systems and datums with internal coordinate editor, manage program reference points database and antennas. More detailed description see in “Application” on page 40.

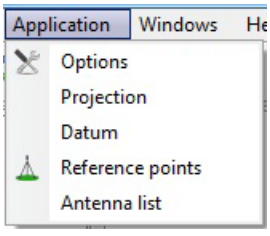


Figure 7. Application

Windows. This item is invisible initially. It appears when additional windows involve by operations. To make these windows visible, select the *Windows* menu item and point the window you want to see.

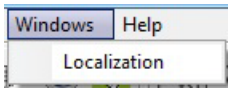


Figure 8. Windows

Help. It opens the Justin *About* window with the software version.

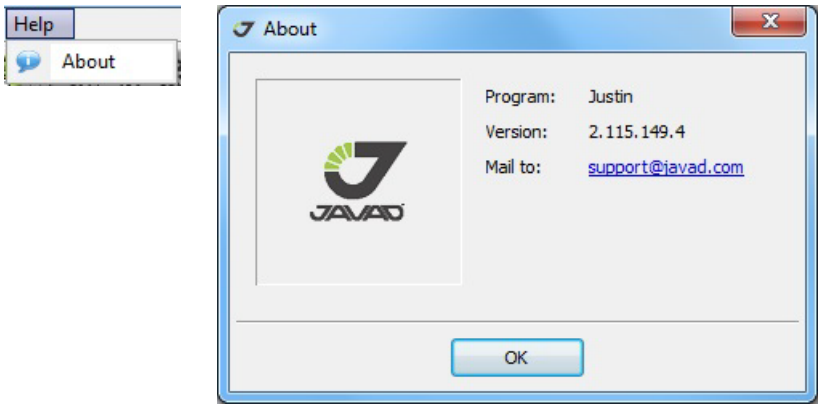


Figure 9. Help

1.2. Toolbar

The toolbar consists of many buttons, thru which the user can access the following program functions:

 - Create new project.

 - Open a project.

 - Open the project properties dialog window.

 - Import files into a project.

 - Add layer to cartographic window.

 - Open the report dialog.

 - Reference points manager.

 - Open internal Coordinate System Manager module.

 - Export layers into *Google Earth*.

 - Run external *Coordinate System Editor*.

 - Select on the map by pointer. Allows selecting an object.

 - Select on the map by rectangle. Allows multi-selecting objects in the specified rectangle area.

 - Cancel selection.

 - Zoom in the map.

 - Zoom out in the map.

 - Show entire network. Display entire project content in the Map pane.

 - Changes the cursor shape and allows moving the map views.

 - Allows changing the cursor to a cross-hair and measuring a distance in a project units. The distance displays in the Status bar.

 - Opens *Coordinates clipboard* window.

 - Legend.

 - Classifier.

 - Multilayer select (all layers became selectable).

 - Snapping mode.

 - Undo. Restores last Map View

 - Redo (is active after Undo  was clicked).

 - project file compression (green means the project size is up to 1GB, yellow up to 1.5 GB, red means the size is over 1.5 GB). Maximum project size is 2 GB. It could be extended by requirement.

1.3. Tab pane

Tab pane has the following tabs: *Data*, *Map*, *Survey*, *Processing*, and *Adjustment*. It displays accordingly the information for these tabs.

1.4. Cartographic window

See the detailed description in “Map” on page 30.

2. Legend

For convenience work with various types of data many conditional symbol are assigned. To see the symbol list (legend), click the button  .

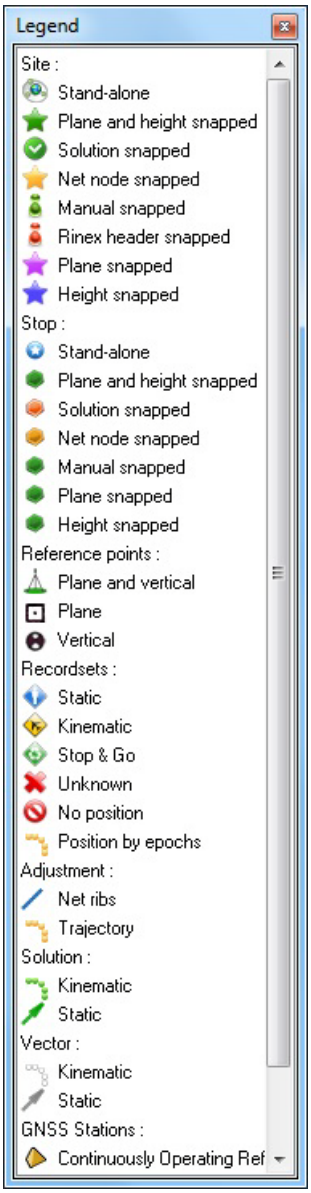


Figure 10. Legend

Below is the description of all items of the *Legend* window:

- Site (a particular place on the earth's surface, a point). Sites are defined according with predetermined tolerance radius (plane coordinates tolerance) in the topocentric coordinate system. It is necessary to distinguish between Sites and Recordsets. Recordset is a set of records in project database table. Recordsets are created as a result of import of GNSS data. If standalone position can be calculated, either the new Site is created or the Recordset is associated with the already existing Site. Thus, multiple Recordsets (sometimes called occupations) can be associated with one Site. To split Recordset and Site there is the option *Move to a new Site*. New Site will be created.

 – Standalone. The site which coordinates are not entered by the operator and are calculated as standalone. The coordinates of such point are two opportunities: a) if the flag Compute coordinates is unchecked, the receiver calculated epoch coordinates are averaged, and b) if the flag is set, the post-processed coordinates are averaged. This operation is reversible, you can return the Site to the position defined in the data file (point a), this may be important when a receiver was operated in the RTK mode.

 – Plane and height snapped. The Site with inherited from 3D reference point position.

 – Plane snapped. The Site with the link to the plane reference point position. By the adjustment such Site will be used as a reference when plane coordinates are calculating. The Site height interpretation corresponds to the height of the stand-alone mode.

 – Height snapped. The Site with the link to the height reference point position. By the adjustment such Site will be used as a reference when heights are calculating. The Site plane coordinates interpretation corresponds to the plane coordinates of the stand-alone mode.

 – Solution snapped. Coordinates are determined in post-processing. Since for any Site can be obtained many solution, the results of the latest solution are used.

 – Net node snapped. Coordinates of the Site comes from adjustment. The adjusted Site position can be only one. Rerun adjustment will update Site coordinates.

 – Manual snapped - a point with the manually entered coordinates. Such Sites are considered as free by adjustment. The manual entry allows to correct the positioning error that depends on error in standalone solution. The errors can appear by a erroneous files concatenation, due noisy data, false ephemeris, etc. Error in the Site positioning which exceeds 30 meters, effects on the post-processing results.

 – RINEX header snapped - a point with the coordinates taken from the header of RINEX file.

- Stop is a location on the earth's surface, point, survey point. It is created when you import GNSS data based on markers in files, or entered using software tools. Coordinates and properties of points vary depending on the type of their snapping.

 – Standalone. The point coordinates are defined on the basis autonomous processing of the pseudorange data performed as follows: a) if unchecked Calculate the coordinates (Section Import tab), then averaged satellite receiver, then averaged satellite receiver epoch position, otherwise Justin calculated positions.

 – Solution snapped. Solution snapped Stop has post-processed position. Stop & Go is point, whose position is defined during post-processing. For each point of Stop & Go can be obtained a variety of solutions, this item has the coordinates of the last solution.

 – Net node snapped. Adjusted Stop gets coordinates as a result of adjustment of kinematic post-processed solutions (multiple bases). Stop & Go point, whose position is defined during adjustment. The adjusted point position can be only one. By repeating the adjustment coordinates are updated.

 – Manual snapping. Manually entered coordinates of Stop&Go point.

- Reference point (a point with the fixed coordinates in defined coordinate system for the purpose of providing geodetic reference for other coordinates calculation).

 – Plane and height. 3D fixed point.

 – Plane. 2D fixed point.

 – Vertical. Height fixed point.

- Recordsets (sets of raw GNSS data).

 – Static. Recordset related to “Criterion for static”. Two recordsets with time overlap data generate “Vectors”.

 – Kinematic. Kinematic recordset is a not Static one.

 – Stop&Go. Kinematic recordset with event markers.

 – No position. Recordset has no ephemeris data or standalone solution is not accessible.

- Solution. (Data post-processed solution for Vector)

 – Kinematic. Kinematic data post-processed solution**.**

- Adjustment (Adjustment generated objects).

 – An edge is an object generated with nodes which are a subject of adjustment.

 – Trajectory. It is a result of kinematic data adjustment in multiple base mode.

- Vector

 –Kinematic. Kinematic trajectory is a track or epoch by epoch positions (Justin calculated or coming with raw GNSS data).

 – Static. Static Vector is an object created for two static recordsets with overlapped time. GNSS Stations.

- Permanent operating stations delivering GNSS data thru Internet.

 – Continuously Operating Reference Station (CORS).

 – Scripps Orbit and Permanent Array Center (SOPAC).

 – Event or time marker is a point created for non epochs instant time.

3. Source

The *Source* tab is used to display a list of data imported into the project named Recordset and Recordset management: picking, thinning, jps and RINEX conversion. After tab activation it becomes accessible object tree:

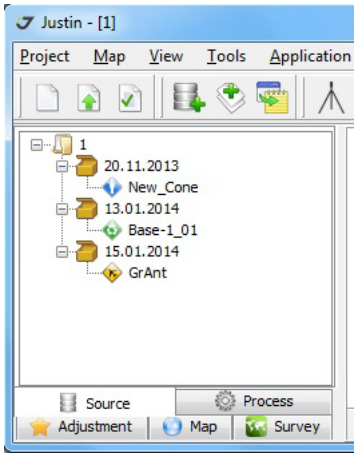


Figure 11. Source tab and objects tree

The general node is the name of the project. Its subnodes are groups that are created according to type of item sorting. The items may be sorted by days or by receivers.

There are three types of Recordsets:

– Static

– Kinematic

– Stop&Go

* - others recordsets

Recordsets for which it is impossible to calculate the position are marked .

By right-clicking on the project name, the following control will be accessible:

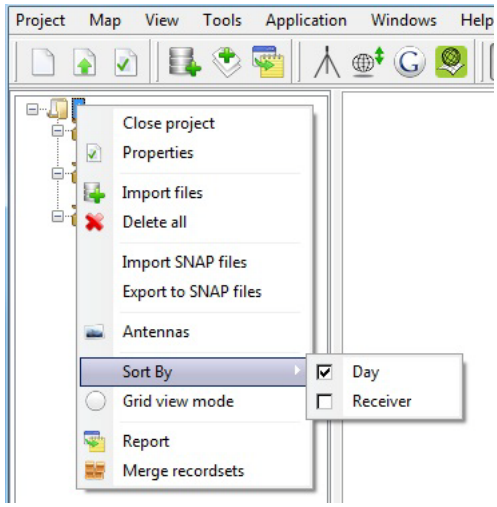


Figure 12. Project properties

- Close the project.
- Open *Project properties*.
- Import GNSS files into the project.
- Delete all data from the project.
- Import SNAP-files into the project.
- Export to SNAP-files.
- Sort the Recordsets by date or by receiver.
- Show the object tree in a grid mode.
- Create a report.
- Merge recordsets (the same satellite receiver identifier GNSS data can be merged if time gap does not exceed project limits (Scenario)).

By right-clicking on the name of the next level node, corresponding to the creation date of files, you can get access to the following:

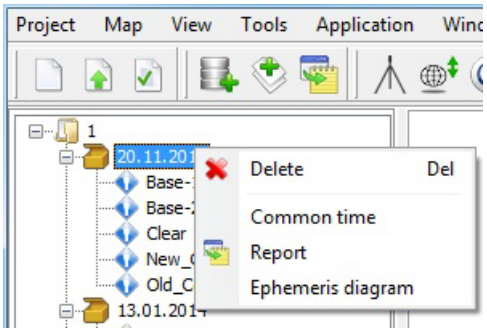


Figure 13. Date option

- Removing data from the project (all data with the measurements started this day).

- View common observation time for all Recordsets started this day.

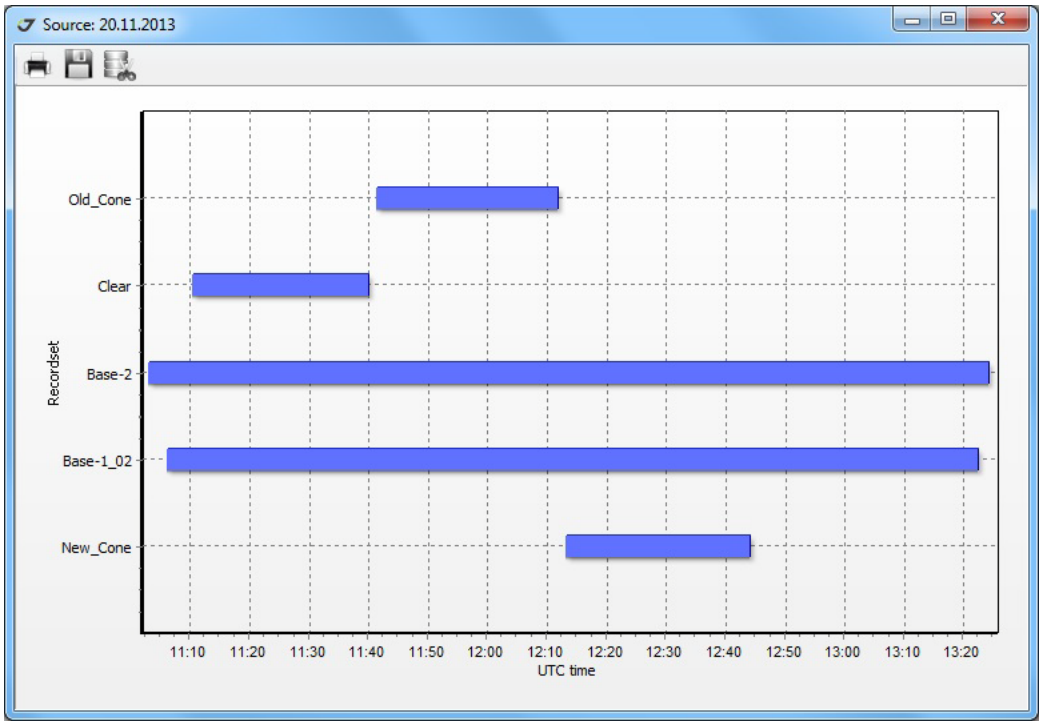


Figure 14. Observation time

- Open Report dialog.

- Open ephemeris diagram.

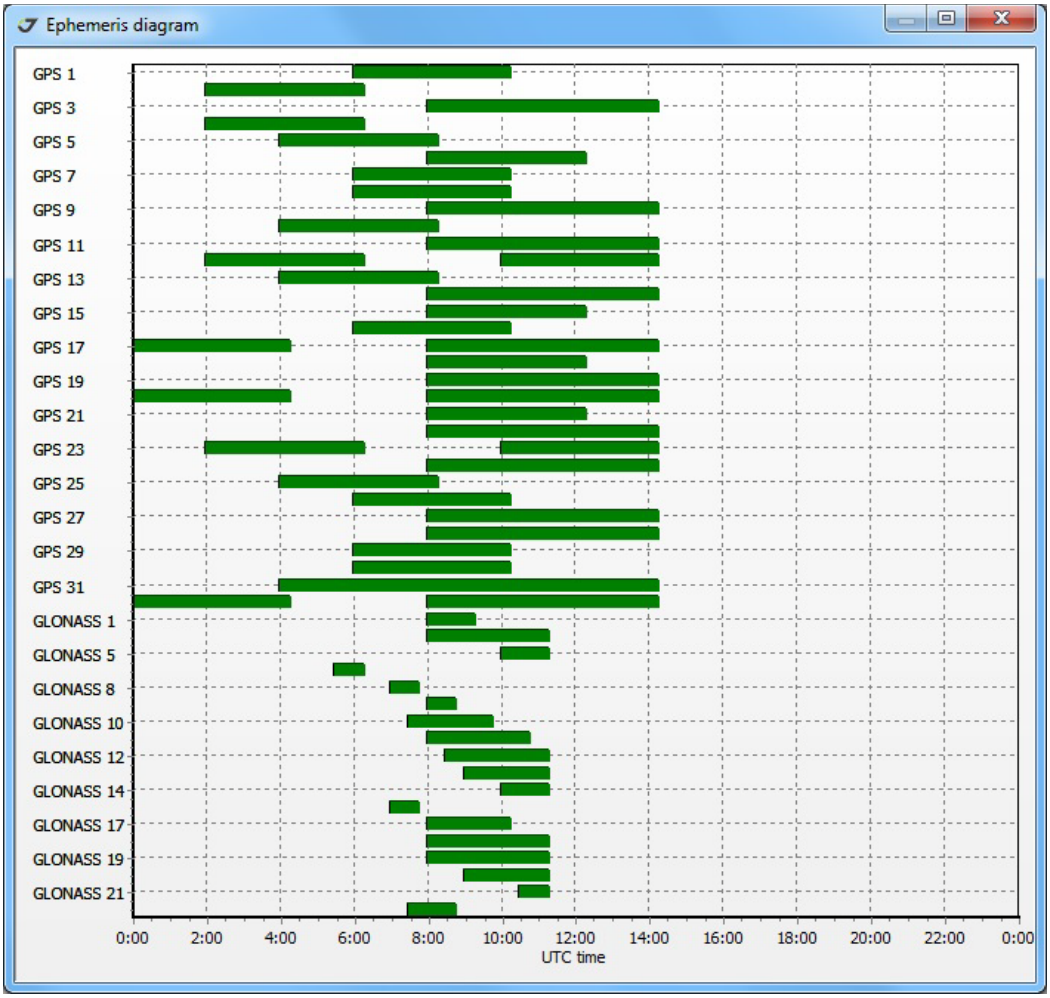


Figure 15. Ephemeris diagram

Recordset node options:

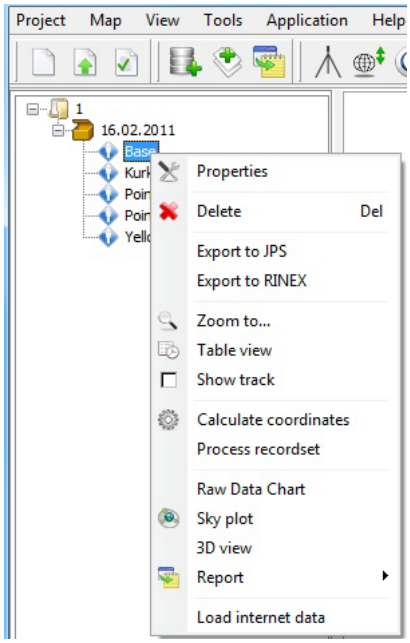


Figure 16. Recordset options

- Open the *Recordset properties* window:

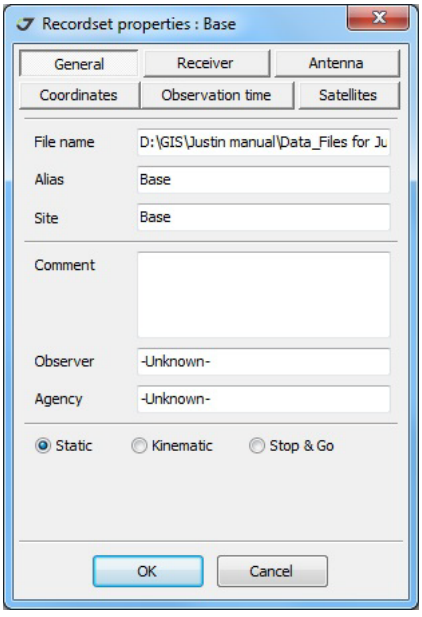


Figure 17. General tab

- The *General* tab of this window provides an overview of the Recordset properties and allows changing the type: Statics, Kinematic and Stop&Go. Here one is able to add comment and put down an alias.

- The *Receiver* tab contains information about the receiver and the minimum number of satellites per one epoch during the session.

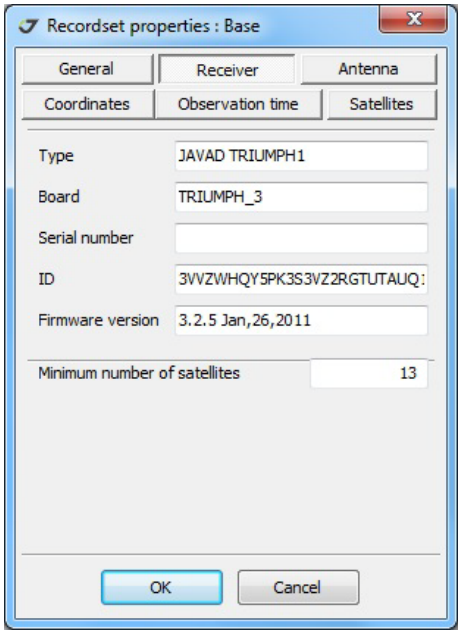


Figure 18. Receiver tab

- The *Antenna* tab shows information about antenna type, height and offsets. Here you can change the type of antenna or get additional information about antennas, clicking the button ..., which opens the window with antenna properties:

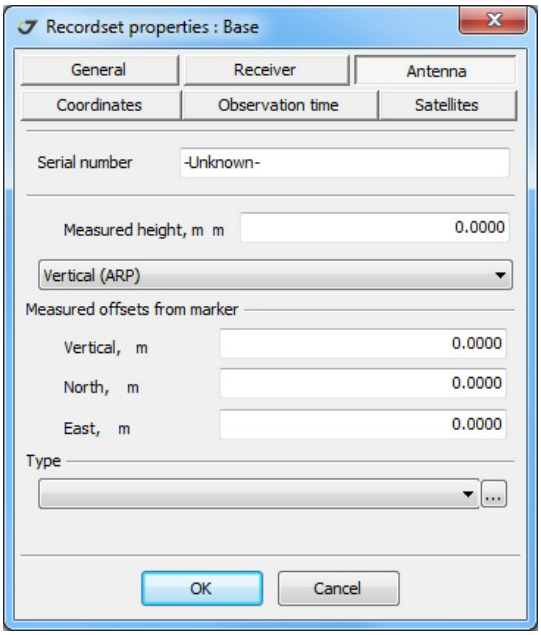


Figure 19. Antenna tab

- The *Coordinates* tab contains averaged coordinates, calculated for all epochs of the Recordset (excluding the most unreliable, which are rejected). The coordinates are shown in one of Coordinate Systems valid for the project: geocentric, ellipsoidal, grid or local. The choice depends on the available set of coordinate systems (see "Selecting project coordinate system" on page 117). RMS (root mean square) for kinematic samples could be very big.

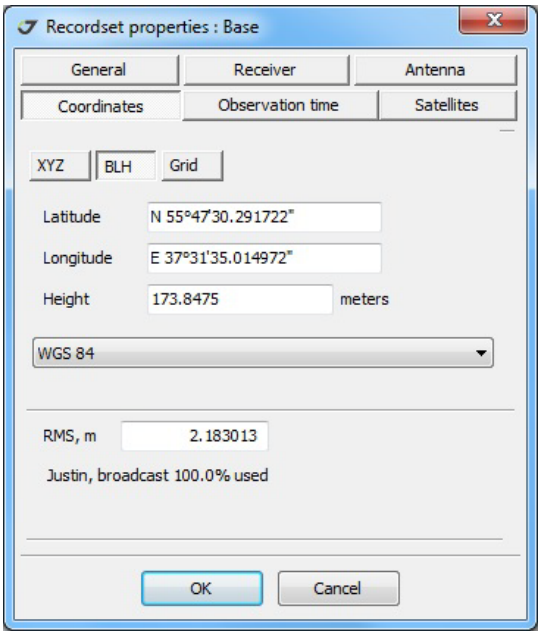


Figure 20. Coordinates tab

- The *Observation time* tab shows the start and final epoch time of the recordset, recording interval and the number of epochs in the recordset. Use the buttons [...], to update the epochs interval (*Interval*) and to correct the begin and end time of the Recordset.

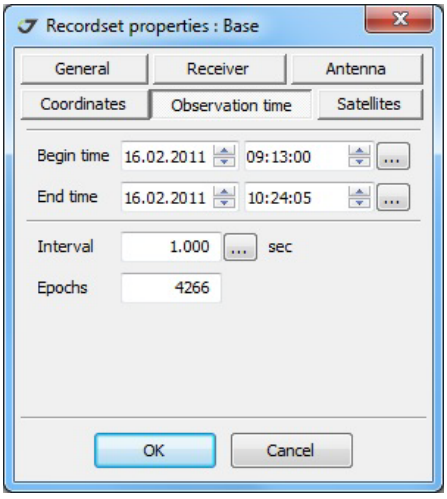


Figure 21. Observation time tab

- The *Satellites* tab contains information about satellites and GNSS data:

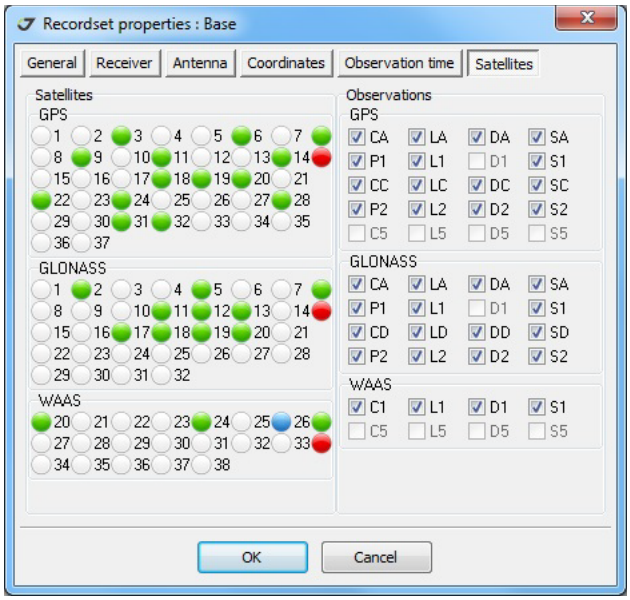


Figure 22. Satellites tab

- Delete a Recordset from the project.
- Export a Recordset to the jps file.
- Export a Recordset to the RINEX file, specifying if necessary satellites and observations that should be excluded (satellites should be mark in red, and for observations should be disabled corresponding boxes). You can also set the recording interval between epochs and specify the data. The start and end time for the file can be specified as well.
    - *Disable occupations* - exclude Stop&Go objects export;
    - *Disable clock offset* - exclude the receiver clock offset
    - *Use CA phase and Doppler* - use CA,CP instead of L1, P1.

Click OK to export.

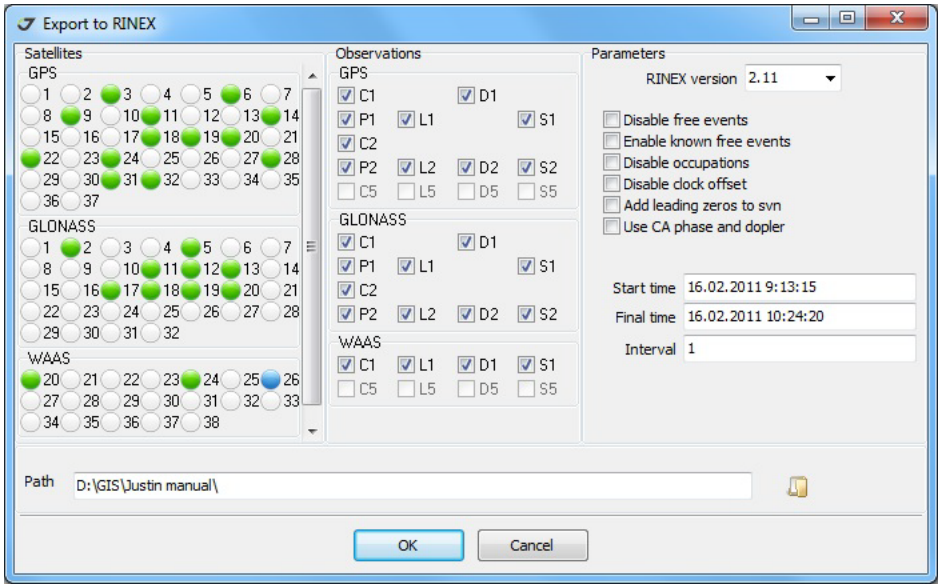


Figure 23. Export to RINEX

- Zoom in the map with the center relating the coordinates of the Recordset.
- Open an additional pane to display Recordsets as a table and show the epochs coordinates vertical profile.
- Show on the Map (Recordset layer) the points with coordinates calculated for each epoch or remove points from the map by clicking on the same item after the epochs were shown.

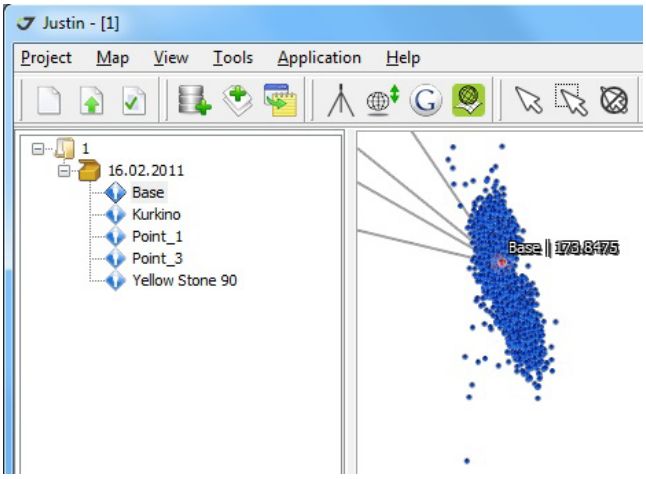


Figure 24. Epochs on the map

- Recalculate epoch coordinates.

- Show the raw data graphs.

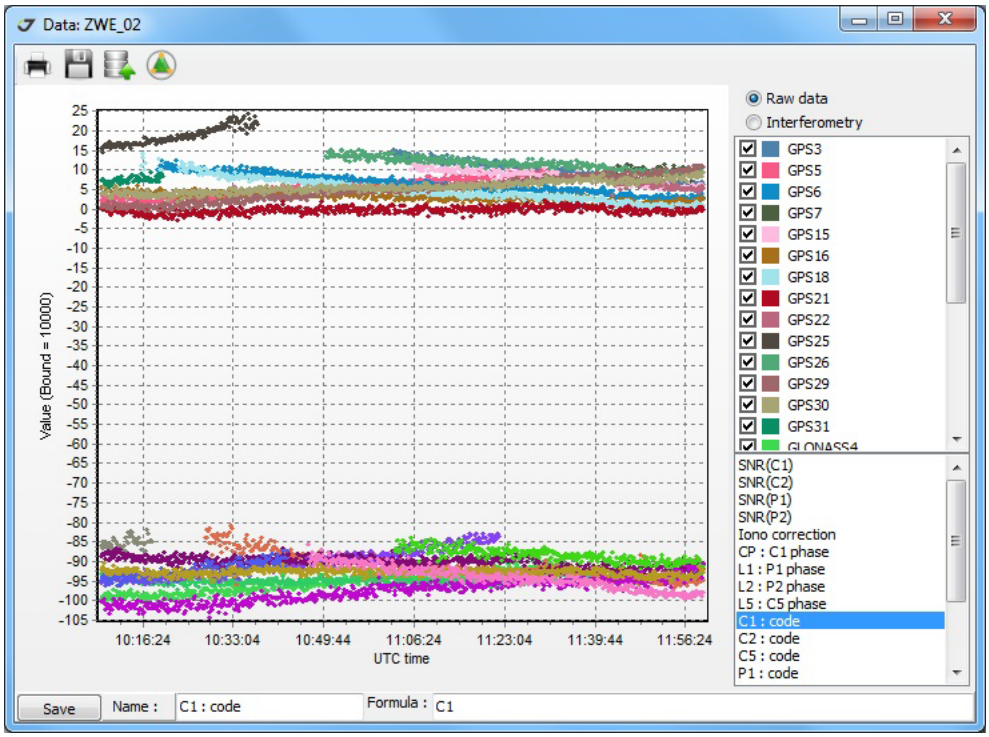


Figure 25. Raw data graphs

- Show the satellites track graph.

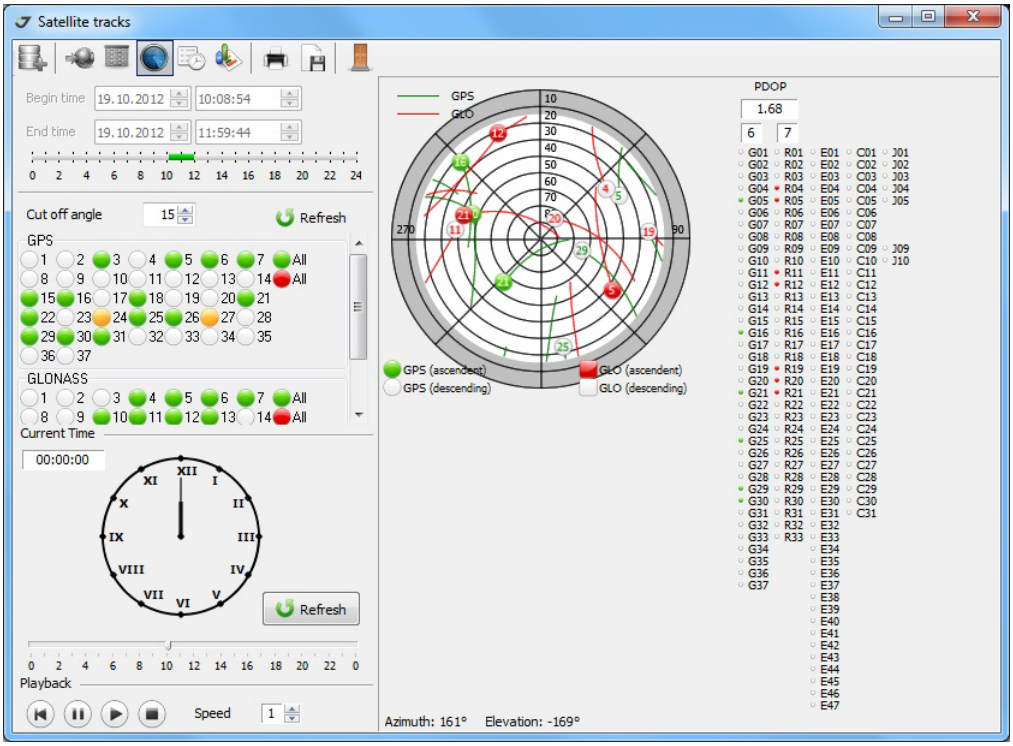


Figure 26. Satellite tracks graph

- Create a report.
- Download to the project the data from the Continuously Operating Reference Stations (CORS) in a range specified in *Project properties* ▸ *Internet data* tab. CORS stations or SOPAC layers should opened thru *Map* tab in advance. The data will be uploaded if Internet connection is available.

4. Map

The *Map* tab has two general nodes. In the *Project* group there are eleven standard layers as well as dynamics layers, created by user. The *Added layers* group includes all involved into the project layers thru option “Add Layer”.

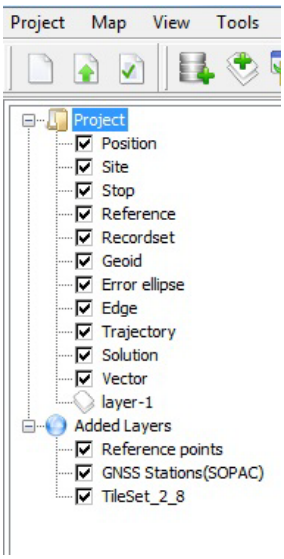


Figure 27. Map

Permanent standard layers are the following (see description of the objects in “Legend ” on page 16):

- *Site* - point objects which contains Recordset. Several Recordsets can be assigned to one Site *according Tolerance criteria.*
- *Stop* - point objects related to tagged time interval in kinematic data.
- *Reference* – Reference points.
- *Recordset* - epoch positions. Use show/remove track option in Recordset properties.
- *Geoid* - Geoid boundary.
- *Error ellipse* used to show adjustment error ellipses.
- *Edge* - line objects to show adjustment result.
- *Trajectory* - points for adjusted kinematic solution.
- *Solution* - *s*tatic (lines) and kinematic (collection of points -tracks) post-processing results.
- *Vector* - candidate for post-processing: lines for static data and tracks for kinematic data.
- *Position* - real time positions which comes from receiver or based on Justin real time solutions.

Dynamic layers are sets of the following objects: points, polylines, polygons, used for data import and export. Added layers can be either raster (aerial/space images, scanned map copies) or vector maps.

Layers can be made visible or hidden, depending on status of check box next to the layer title. Option can be activated with double clicking.

Layers, with icon can be made visible/hidden by clicking on this icon. If the icon is white, the layer is visible. If the icon is gray, the layer is hidden.

For the *Added layers* there is an order of drawing. The bottom layer in the list is drawn first. Next is second from the bottom and consistently to the first layer in the list. To move a layer in the list up/down, put the cursor on the layer item, and drag it with the mouse:

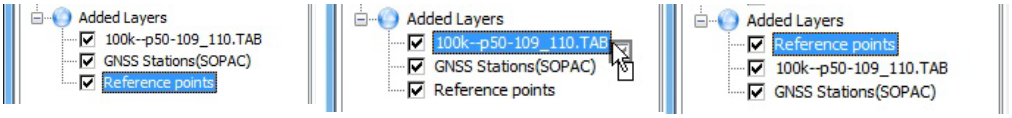


Figure 28. Added layers

Both groups, *Project* and *Added layers* have functions for working with layers in the group. To access these features, should put the cursor on the group name and press the right mouse button (and then, if necessary, select any item in the dialog box.)

For *Project* group all layers can be made visible at once; empty and dynamic layers can be deleted optionally:

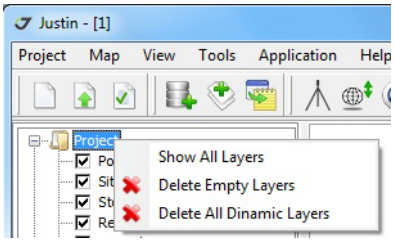


Figure 29. Project options for the Map tab

For *Added layers* group all layers can be removed, new layers can be added, and the layers with the following information can be added:

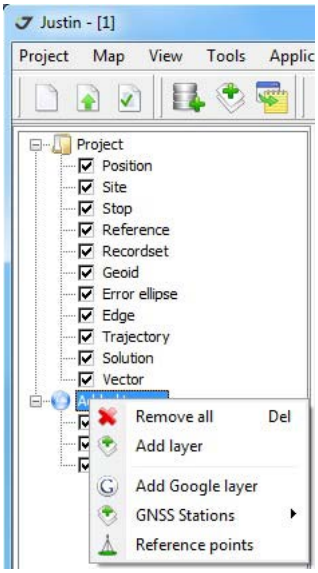


Figure 30. Added layers

1. *Add Google layer* - Space image of the area, related the size of Map Pane. Every time you are clicking an item Google Map snapshot according Map Window size and a position appears. After panning or zooming Map Window force Refresh option to get new image.
If an error occurred while downloading the image, it will not shown on the map. In this case, you need to re-call function *Add Google layer* or right-click on the *Google map* layer name and clicking *Refresh*.

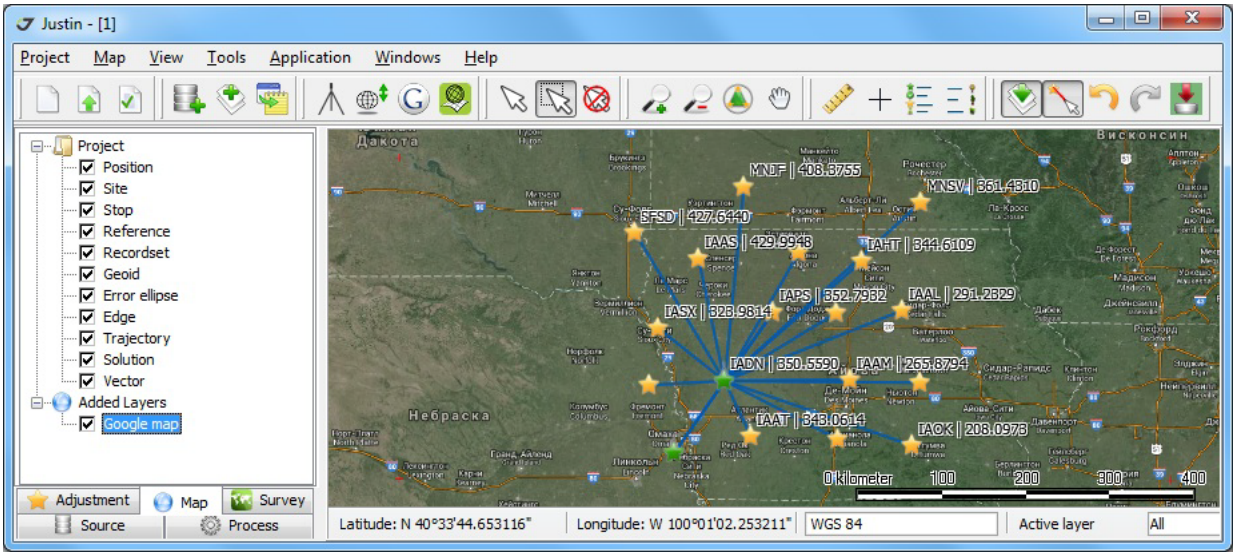


Figure 31. Google Map

2. *GNSS Stations* - - Continuously Operating Reference Station (*CORS*), - Scripps Orbit and Permanent Array Center (*SOPAC*).

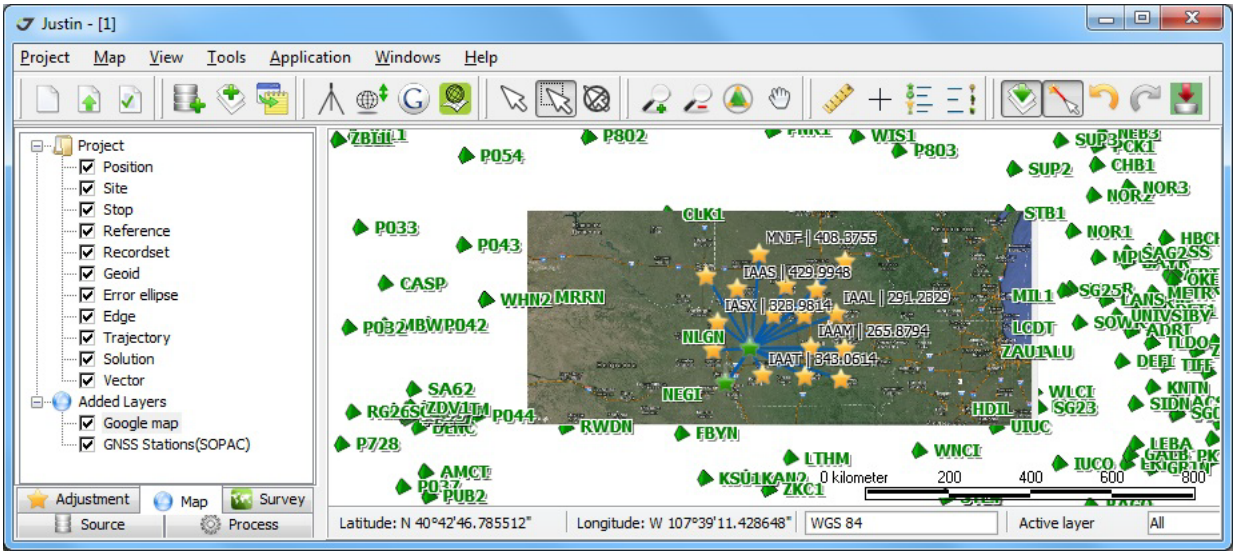


Figure 32. CORS

3. *Reference points* - all reference points available for using in the program (view of all program reference points accessible via Reference Points Manager). This option can be used to copy some reference points from program database to the project by selecting them on the map.

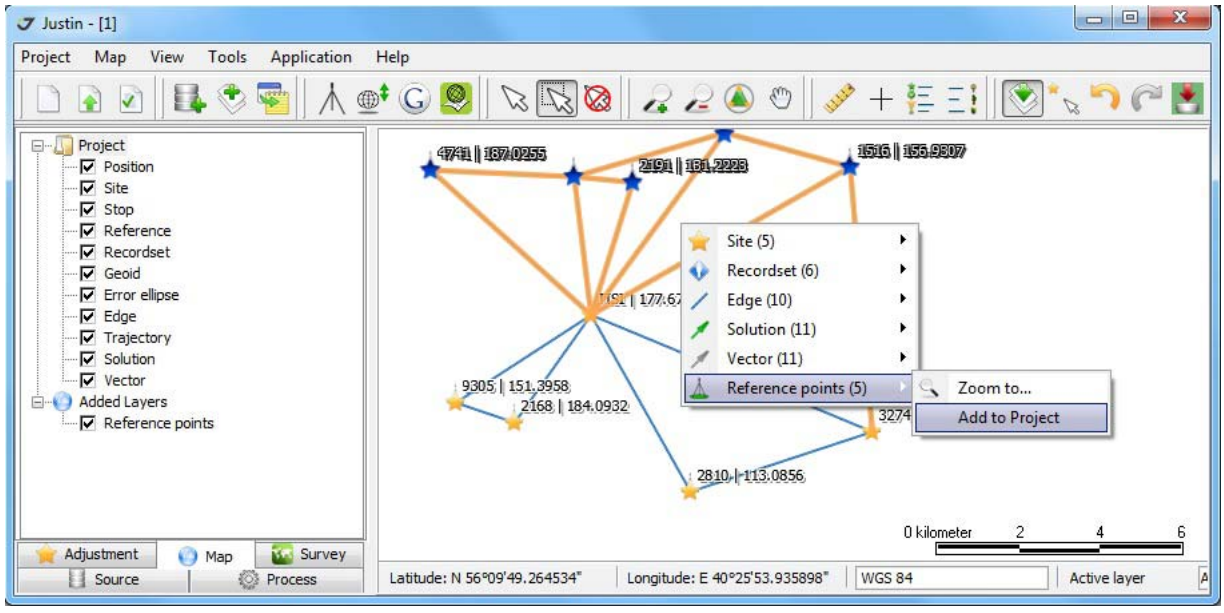


Figure 33. Reference points

To get access to a list of options assigned to the layer, click it and inspect a list. Layers properties differ depending on layer type. There three main types of layers in Justin - permanent, dynamic, and added. Permanent layers are generated automatically for a new project. Dynamic layers are created for survey

objects and vector maps which are imported from field software, TRIUMPH-VS/LS application and from files.

Below is description of layer properties:

- *Style* (available for all layers). Opens the *Layer style* for vector layers and *Raster style* window for images.
- *Show entire layer* (available for all layers except the error ellipses layer) scales and displays all items within the selected layer of the map.
- *Hide all layers except...* (for all layers) hides all layers except the selected layer.
- *Blunder style* (for layer edge) displays the *Layer style* window for blunder.
- *Only fixed* (for layer *Solution*). If selected, only fixed kinematic solutions will be displayed. If not selected, all the solutions are shown.
- *Drop layer* (for all layers except the permanent) removes the selected layer.
- *Rename* (for dynamic layers). Used to change the layer's name. To call this function, double-click on the layer name.
- *Export* (for dynamic layers) activates export functions for the selected layer, opens dialog window with exchange formats.

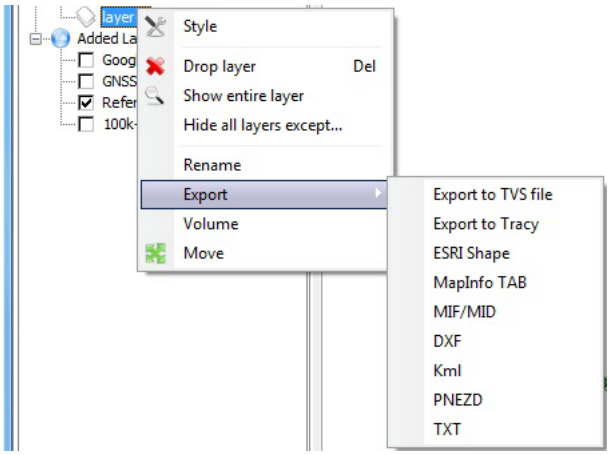


Figure 34. Export

- *Volume* (for dynamic layers) displays a minimum volume covering all points in a layer (3D convex) in cubic meters.

- *Move* - **(**for dynamic layers). Opens the *Move* window, within you can set the offset parameters.

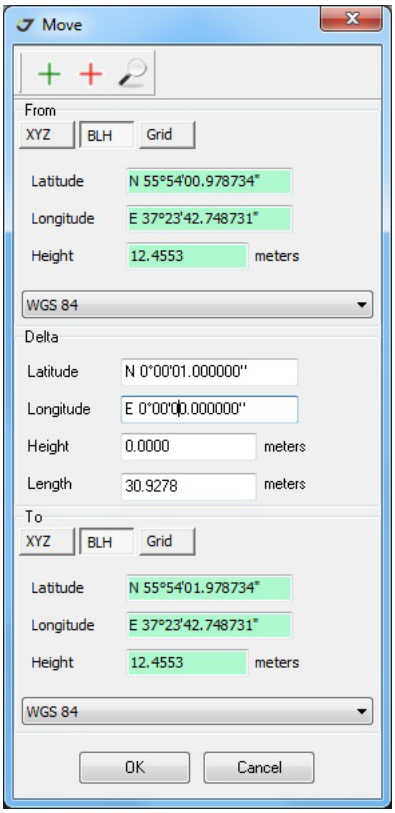


Figure 35. Move window

- *Georeferencing* (for the raster layers). Makes *Georeferencing* pane active for computing the raster image position.
- *Refresh* (for the *Google map* layer). Refreshes the raster image. The Internet connection is required.

4.1. Vector Layer Style Settings

For vector layers, *Layer style* window view varies. In the *Style* tab, you can customize the style (font, color, etc.) of the objects displayed on the map.

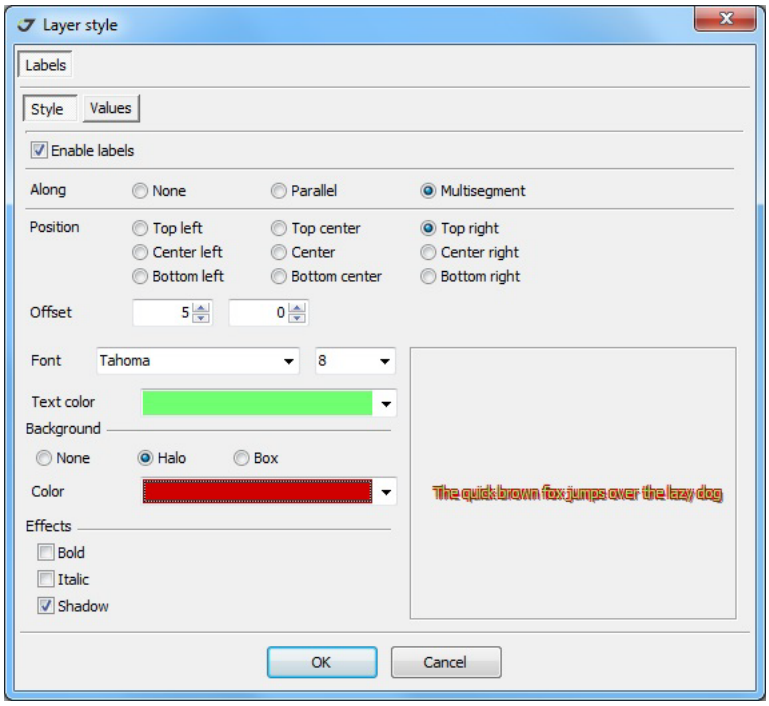


Figure 36. Layer style

Check *Enable labels* to show text data on the map.

In *Values* tab can be defined a set of labels. Select on the left pane the parameter and click arrow button  to move/remove an items. You can order items of the label with up and down arrows.

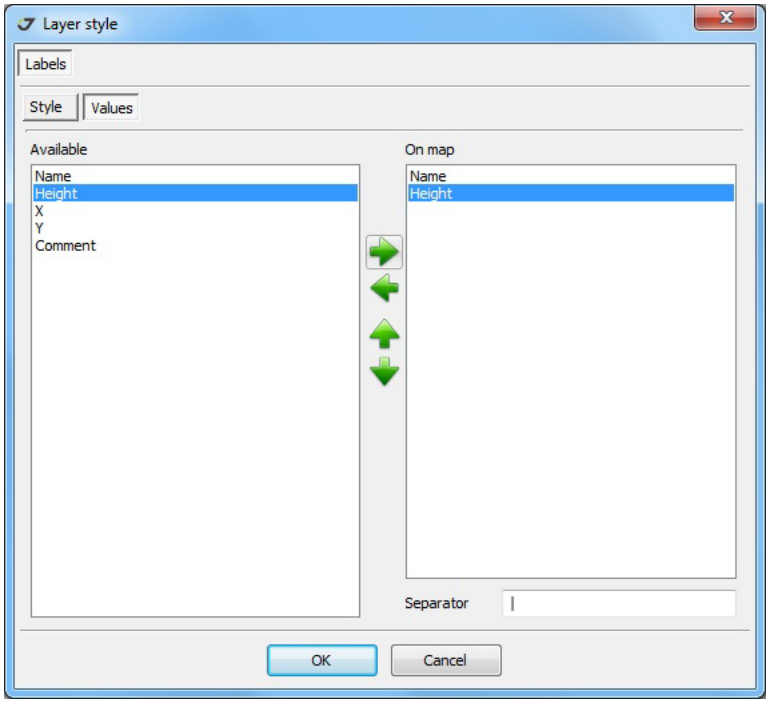


Figure 37. Layer style

- In the *Separator* field the separator between shown on the map labels can be specified. Click OK to accept new label style, or *Cancel* to return to the previous configuration.
- In the *Objects* tab color and other parameters of the shown on the map object are specified:

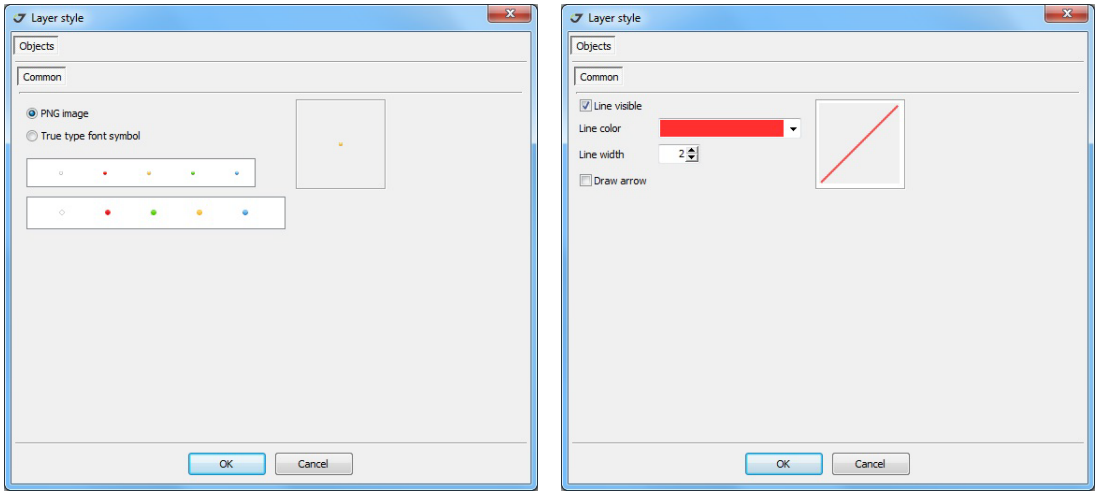


Figure 38. Cartographic layer style

The second tab level provides a selection of context object settings - Static, Kinematic, Point, Polyline, Polygon, etc. If a single object is selected or for all selected objects common parameter should be applied, use the *Common* tab.

For raster layers, the style setting window is called *Raster style*:

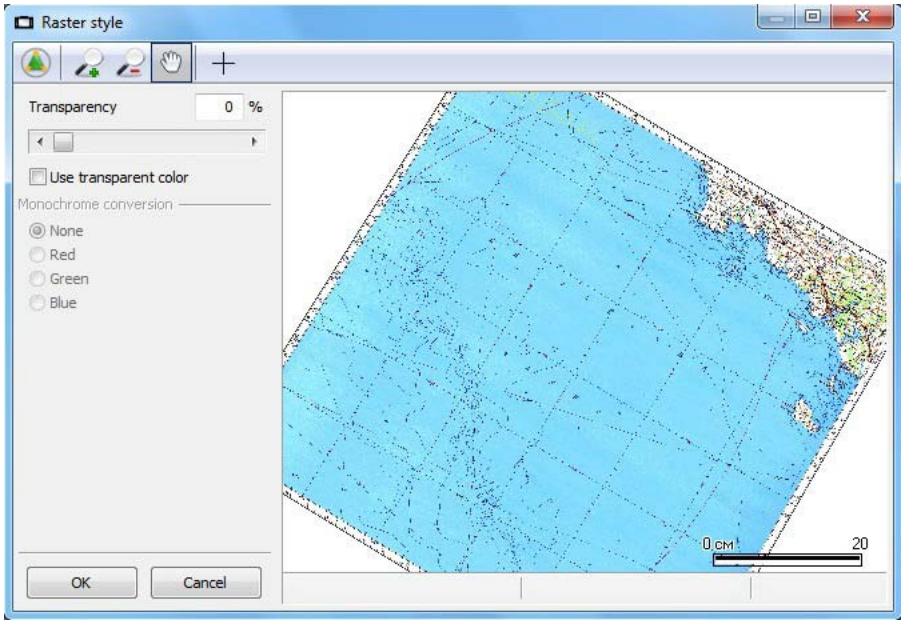


Figure 39. Raster style

In this window the map can be scaled, the image can be moved and the transparency level can be changed (parameter *Transparency*, which is shown as a percentage relative to the original).

4.2. Ruler

To measure distances between objects on the map the *Distance* tool is purposed. To activate it, click on the ruler icon  or select the items *Map* ▸ *Distance*.

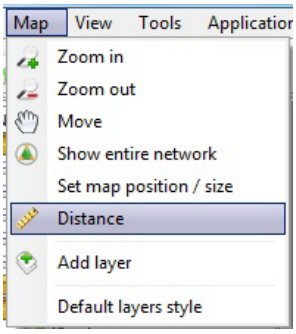


Figure 40. Distance

When the cursor is upon the map it will be drawn as a cross-hair and ruler:  .

Using the ruler the length of the straight and broken lines can be measured. The measurement information is displayed in the status bar.

In the status bar will shown two distances: cumulate distance (black line) and second one between last selected point and cursor (dotted line). After the first point was selected it is possible to switch distance measuring styles by clicking on a coordinates bar:

1. Map horizontal : - Horizontal distance in the map coordinate system.
2. Map slope : - Slope distance in the map coordinate system.
3. Ellipsoidal : - Arc length on the WGS84 ellipsoid.
4. Distance: - Slope distance.

Click the button with measuring type till desired type appears. To clear figures click right mouse button on the map. To quit the distance measuring mode, click or click *Map* ▸ *Distance*.

To measure the distance move the cursor to the start point and press the left mouse button, then move the cursor to another point and then press the left mouse button again (if the length of the polyline is measured, move the cursor to the third point, and so on).

There are two modes for distance measuring:

Free mode – the point is selected on the map without snapping it to the point object (the *Snap* button is inactive:).

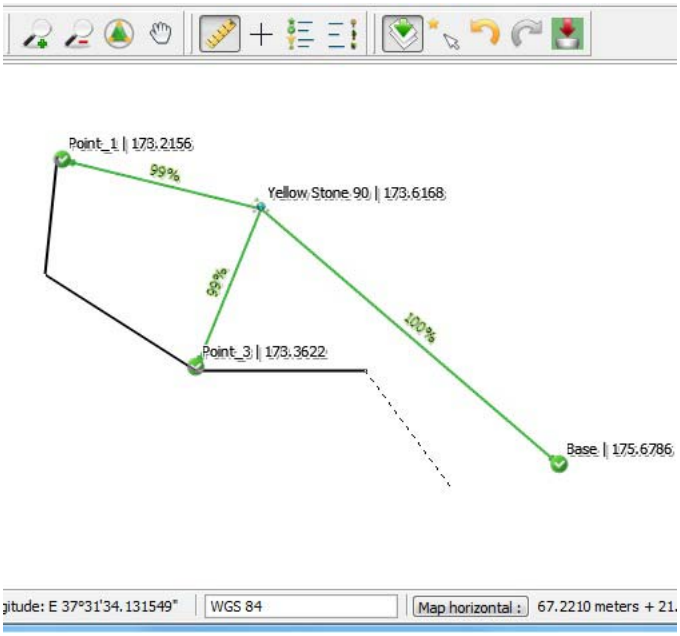


Figure 41. Free mode

2. *Snapping* – the point can be snapped to the object (the *Snap* button on Main toolbar is active .)

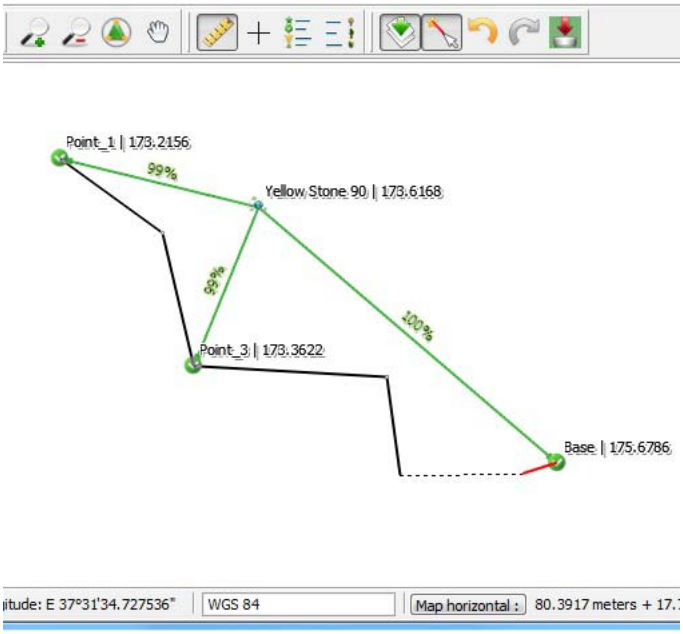


Figure 42. Mode with snapping

4.3. Direction

Angle measurement tool provides geodetic azimuth information (an angle between North direction and a direction to a point of interest in topocentric coordinate system). To do it more accurate way activate Snap button on a main toolbar and click .

Designate a direction on a map by clicking beginning and end points. Calculated value appears on a status bar Map horizontal : 136°50'13,0177" .

Note that the number is simultaneously copied in a clipboard. It is possible to paste it in any editable document.

5. Application

The main program settings and configuration are enclosed in the file param.jdb, which is stored in Justin folder. The structure of this file could be modified after running updated software version.

5.1. Options

To open the options window click *Application* ▸ *Options*.

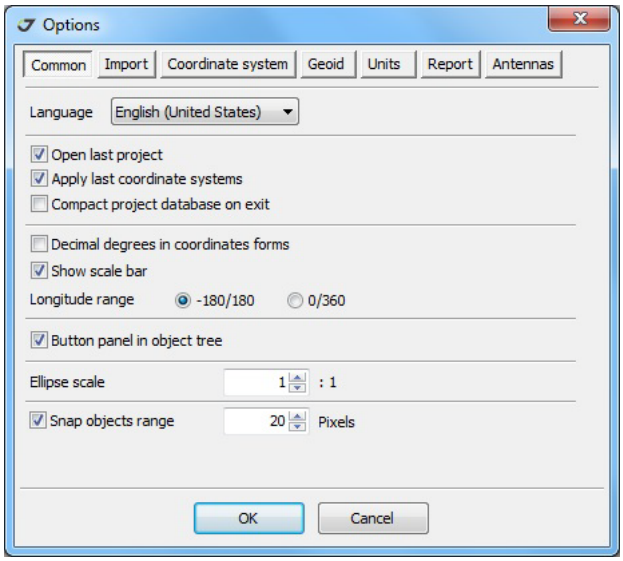


Figure 43. Options

Common

The *Common* tab allows setting the following:

- *Language* of program interface (from the list).
- Automatically *open last project*. Please note, if the corrupted project will be opened, the program can hang up every time after running. To avoid such hanging, move suspicious project to another folder or rename it.
- *Compact project database on exit* - Maximum size of Justin project is limited, you should compact project to avoid data lost if your project size is close to 2 GB. To reduce the database size and project size as well, compact the database at time.
- *Decimal degrees in coordinates forms* - the degrees in the coordinate forms will be shown in decimal values, otherwise in degrees, minutes, and seconds.
- *Show scale bar* - activates/hides scale bar.
- *Longitude range* - switches longitude format.

- *Panel button in object tree* - activates new control for the selected item; this menu duplicates the right button menu.

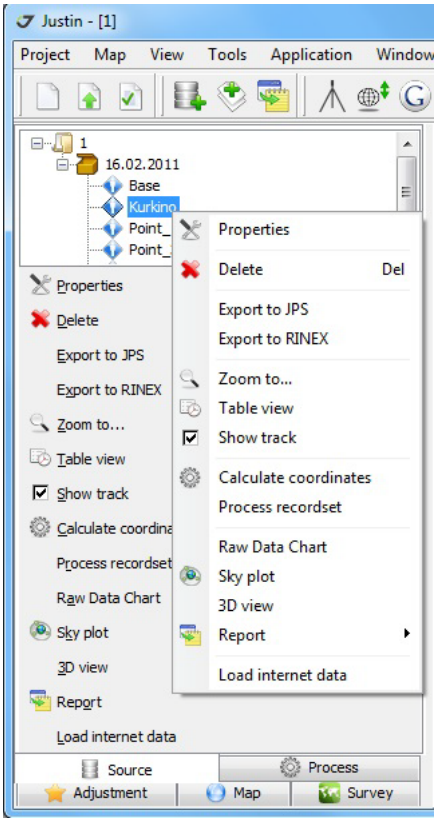


Figure 44. Menu

- *Ellipse scale* - the scale of the ellipses of error can be set.
- *Snap objects range* - supplies the function of the point *Snap*  (switches on/off snapping to point objects). When the mode of object is activated a red line joints cursor and object after clicking on a map.

Import

In this tab the parameters of GNSS file import can be specified:

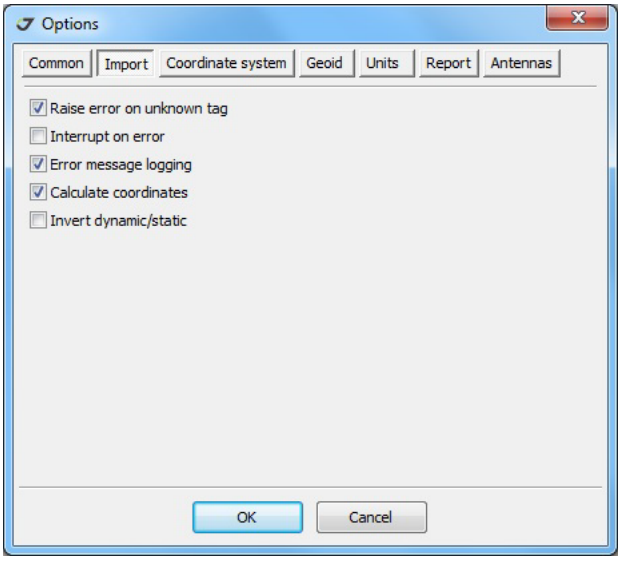


Figure 45. Import

- *Raise error on unknown tag* - adds warning to ImportLog.txt file.
- Interrupt (import) on error - stops import on error.
- Error message logging - creates ImportLog.txt file in a project folder.
- *Calculate coordinates* - recalculates receiver's epoch coordinates
- *Invert dynamic/static* - fix field operator fault in Stop&Go mode survey, when surveyor starts Static observation with Dynamic mode marker.

Coordinate system

See detailed description in the "Coordinate systems" on page 116.

Units

In the *Units* tab the metric units used in project can be selected. Select the units from the list.

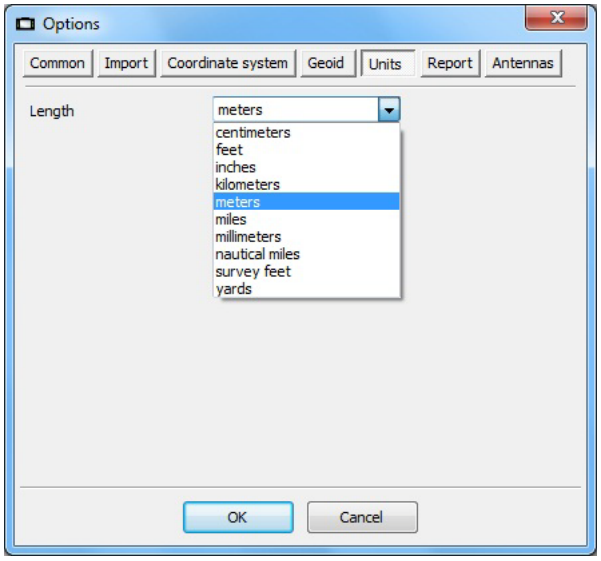


Figure 46. Units

Report

In the Report tab format and type of report can be specified:

- *Format* - report format can be selected from the drop-down list box. The format can be standard or country customized.
- *File type* (**.txt* or **.html*).
- *Separator* - the separator is specified in the edit field.

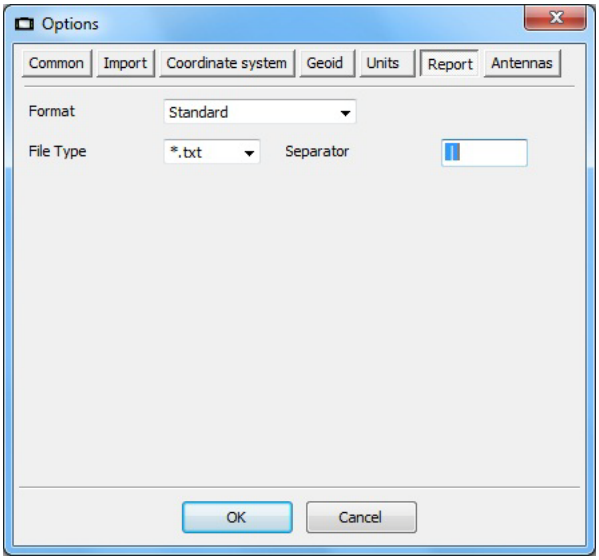


Figure 47. Report

Antennas

In the *Antennas* tab the type of antenna calibration is specified for post-processing engines. The antenna data base can be updated from the file *.db3 by clicking on the appropriate button.

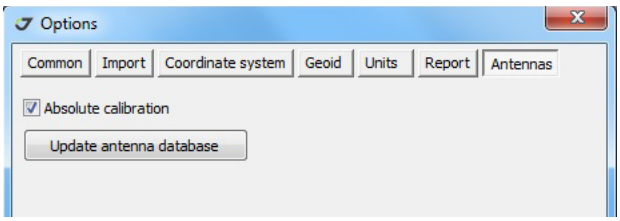


Figure 48. Antennas

6. Working with a project

The Justin software assumes the creation of the project. The only one project can be opened at one session. All changes are saved automatically by the project closing or by the opening of another project.

6.1. Project properties

This dialog appears after clicking *Project Property* or *New Project* options.

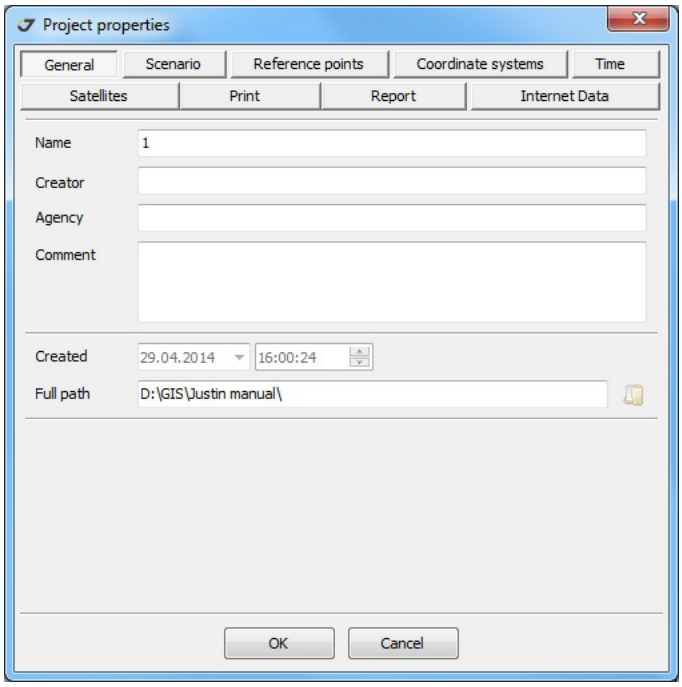


Figure 49. Project properties

There are the following tabs in this window:

The *General* tab contents the general information about the project.

- *Name* - project name.
- *Creator* and *Agency* – creator's/agency name which will be used in reports (can be empty).
- *Comments* – any comment to the project (can be empty).
- *Created* – the date the project was created (filled automatically).
- *Full path* – destination folder where the project is stored. All files created during the operation with the project will be saved in that folder. To see path click the *Browse* button  .

The *Scenario* tab is used to set the import parameters:

- Specify the number of epochs in the *Min recordset size* field.
- Specify the maximum number of epochs in the *Max epochs gap* field. If the max epoch gap exceeds the set value, a stream of imported data will be splitted by two Recordsets.
- Specify the value in the *Criterion for static* field, to distinguish Static and Kinematic recordsets by position accuracy (epoch positions differ more than (epoch RMS)*(Criterium for static)) from Site position.
- Specify the cut off mask in the *Cut off mask* field. It determines the lower limit of the satellite elevation to be used for navigational solution. By default, it is 12°.
- Create auto stop;
- Max.speed,m/c – max allowed receivers speed by the Stop object creation.
    - Max.epoch – max allowed epochs quantity for the Stop object creation.
- Specify the value of *Tolerance for static*. This criterion is used to set relation between recordsets and sites. If a distance from navigational solution to an existing site exceeds the criterion*RMS, a new site will be created. If the new site is nearer as specified to an existing site the new site will not be created.
- O-file tolerance – the same as above but for O-files import (Ashtech solution format data).
- RINEX coordinates – use the RINEX header coordinates as Recordset coordinates.
- Vectors range set metric limits for Vector creation;
- Min – min tolerance for Vector creation;
- Max – max tolerance for Vector creation;
- Moving Base – create Vector between two kinematic recordsets;
- Autostart
- Processing – starts processing automatically after import of data;
- Adjustment – starts adjustment automatically after processing;
- Datum – not used in the standard version;
- Scenario – saves settings or allows selecting the saved settings;
- Raw data interpolation to integer millisecond number (valuable for old Trimble receiver data);
- Merge recordsets – merging import data stream according receiver ID and Maximum epoch gap number;
- By default - restores all changed settings to initial.

Reference points tab is designed to copy reference points to the project.

Coordinate Systems tab is designed to copy coordinate systems to the project.

Time tab allows selecting time format for the project. The following formats are:

- GPS, Global Positioning System time, is the atomic time scale implemented by the atomic clocks in the GPS ground control stations and the GPS satellites themselves. GPS time was zero at 0h 6-Jan-1980 and since it is not perturbed by leap seconds GPS is now ahead of UTC by 15 seconds.
  - GPS time in format dd/mm/yyyy hh:mm:ss.sss, e.g: `04/05/2012 11:06:24.567`
  - GPS time in week's format www/ssssss.ss (number of the GPS week/seconds from the week beginning), e.g.: `1686/471984.234`
  - GPS time in seconds: `1020 164 784.567`
- UTC, Coordinated Universal Time.
- *Local time* in the format dd/mm/yyyy hh:mm:ss.ss, e.g.: `04/05/2012 11:06:24.567`. The local time zone is selected from the list. Local time differs from UTC by time zone offset.

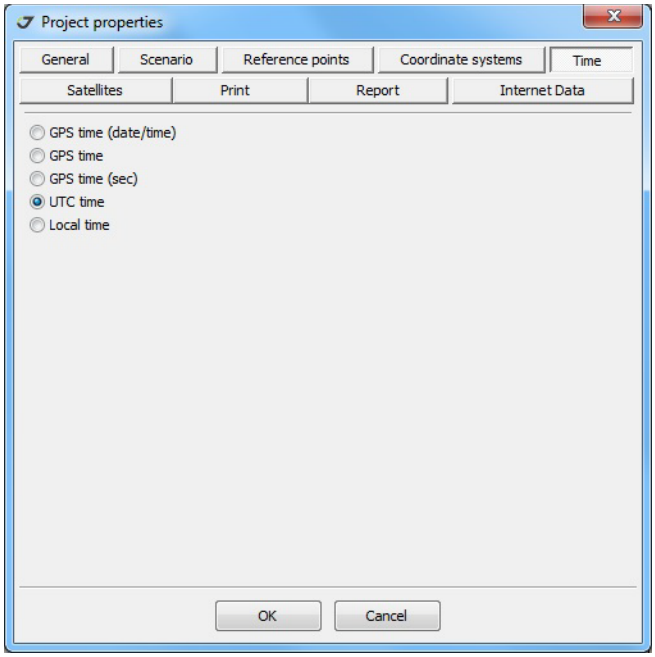


Figure 50. Timing settings

The *Satellites* tab allows selecting the satellites of various satellite system;

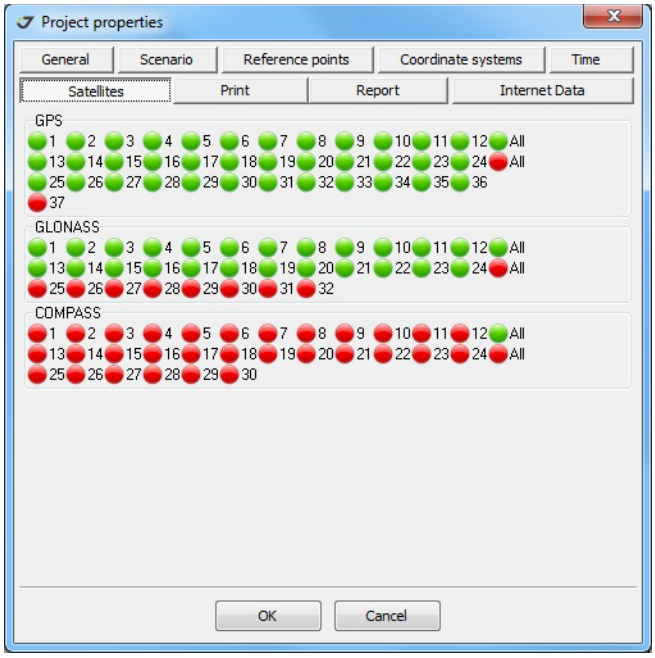


Figure 51. Satellites tab

In the *Print* tab the printer and print settings can be specified.

Report tab is used to specify a set of information that is included to the report generated when automatic processing (Autostart) is used;

Internet Data tab is used to determine the maximum distance from the selected Site to the permanent stations that provide access to GNSS data via the Internet, and to determine the epoch of the project (the date on which the coordinates of the reference points are calculated, if their speeds are known).

6.2. New project

To create new project perform the following:

1. Click  or click *Project* ▸ *New*:

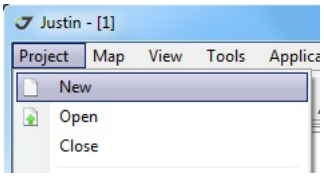


Figure 52. New project

2. Enter the name and specify the full path to the project file. Other entries are not mandatory.
3. To close the project without quitting the program click *Project* ▸ *Close*.

6.3. Import files to the project

To import files:

1. Click  button or click *Project* ▸ *Import files*:

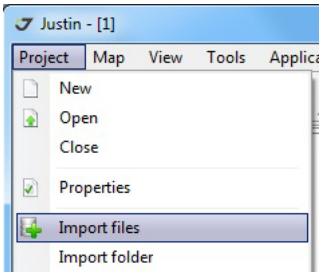


Figure 53. Import

2. In the *Import files* dialog window select the file type and file(s) from the list. Click *Open*:

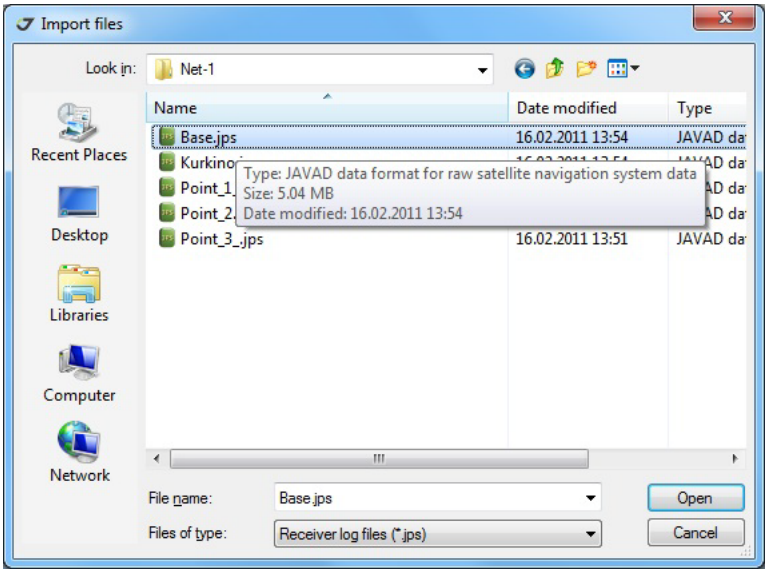


Figure 54. Select the file

The following file formats can be imported into *Justin*:

**.jps* – authorized JAVAD GNSS data

*.??O, *.??N, *.??G – files in RINEX format

**.txt*, **.csv* – text files

**.sp3* – precise orbit files

O.** – solution files (Ashtech O-file)

**.jst* – files with the coordinate systems description

**.apr* – files with the SOPAC coordinates

**.atx* – files with the information about satellites antennas

*.*bias* – file of delays of satellites between the codes CA and P1

*.*tvs* – files *TVS*

*.*kml* , *.kmz – *Google Earth* format

*.*dwg*,*.*dxf* – *AutoCad* format

*.*db* – *TVS* card format

*.*tracyjob* – *Tracy* format.

Import of *.jps files

To import *.*jps* format files, select from the list this type  (it can be associated with such icon), then click *Open*. The window with progress status appears. Authorized *.jps* files only could be imported into Justin Lite. To cancel import, click *Cancel*.

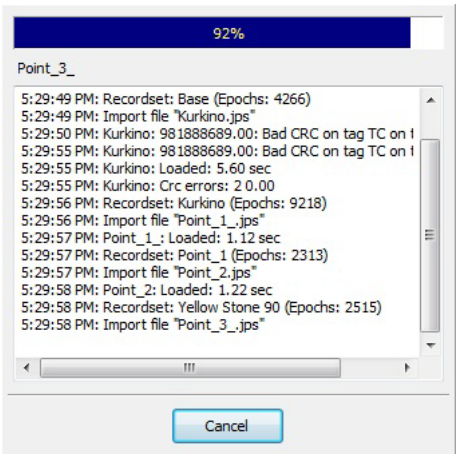


Figure 55. Import status

The imported files can be seen in the *Source* tab, as Recordsets and can be sorted by date or by receivers. Depending on standalone solution and epoch by epoch position tolerance recordsets fall into static and kinematic. Static Recordsets are linked to Points on the Map pane according default point tolerance criterion. Kinematic recordsets with special marker inside are treated as Stop&Go.

If recordset has no standalone position (no ephemeris, bad raw data) than it is marked with a red circle.

- static, - kinematic, Stop and Go, and - no position.

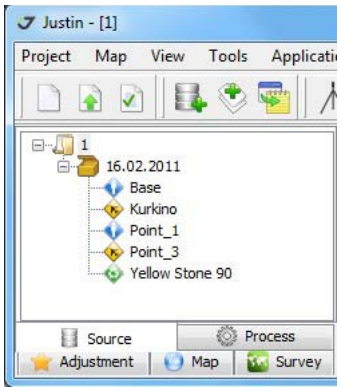


Figure 56. GNSS data import result

Import of *.tvs files

To import **.tvs* format files, select from the list this type. It can be associated with test.tvs icon, then click *Open*. The window with progress status appears. To cancel import, click *Cancel*.

TVS file format– it is special xml-structured exchange format designed for data transfer between TRIUMPH-VS/LS application and Justin/Justin Link. It describes objects geometry, attributes, structure of the coordinate system. After the retyping **.tvs* extension as **.kml,* it can be viewed with *Google Earth*.

The imported survey objects can be seen in the *Survey* tab; on the right will be points, polylines and parcels on the map displayed.

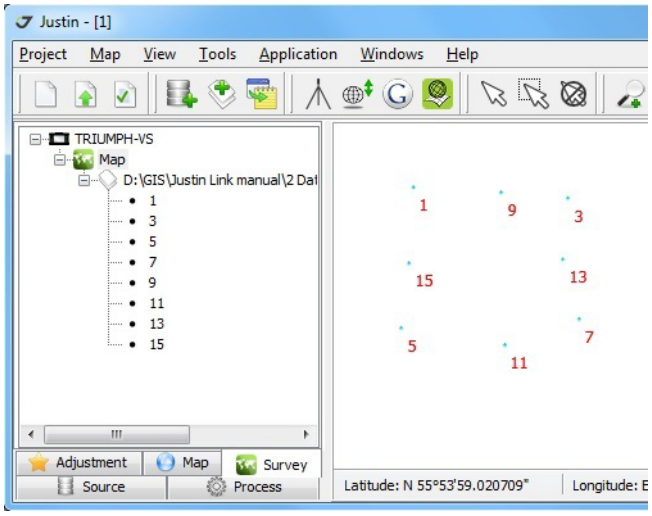


Figure 57. Imported data

Import of *.kml files

To import files in *Google Earth* (*. *kml*) format, select the file(s) from the list: this type is displayed like test.kml, then click *Open*. The window with progress status appears. To cancel import, click *Cancel*.

Google Earth format – is **.kml* file, which contents information about geometric objects and their attributes. Files properties can be seen in the *Survey* tab, in the folder; on the right will be points on the map displayed:

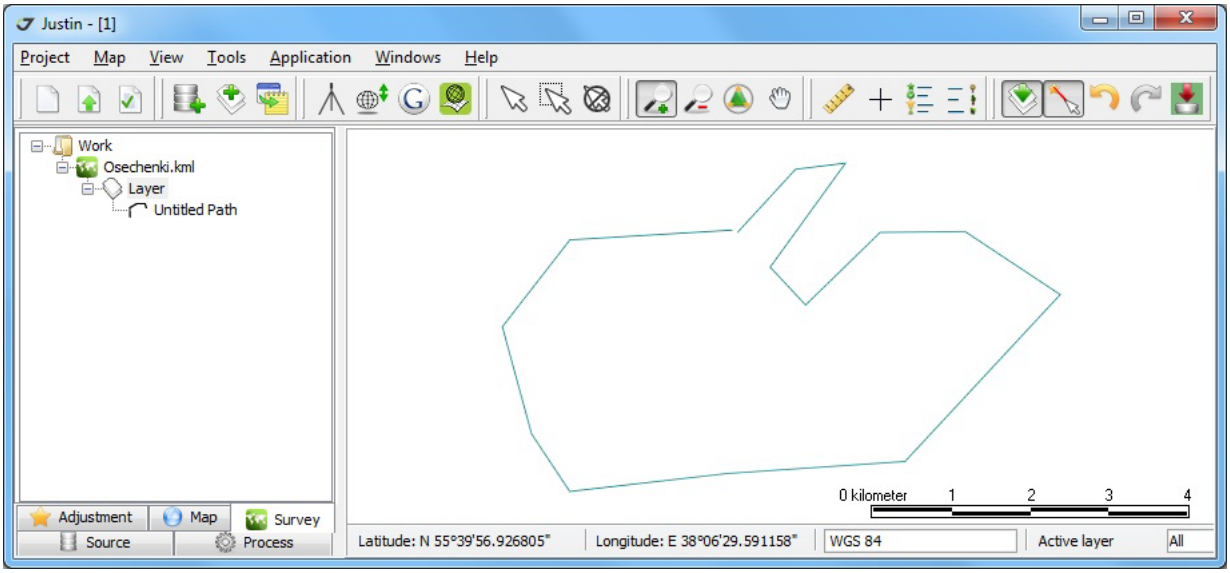


Figure 58. Import of kml files

Import of *.dxf files

To import files in *AutoCad* format R12 (**.dxf*) select the file(s) from the list: this type is displayed like test.dxf , then click *Open*. The window with progress status appears. To cancel import, click *Cancel*.

Exchange Format *DXF-files* (Autodesk company's format for AutoCad) - a file format with the extension **. dxf*, which contents geometry information. Before import the coordinate system should be selected in the window *Select the coordinate system*.

If you need to swap the axes (YX to XY), activate *Import XY* (lower left corner of the window). If you need to invert the coordinates system (i.e., X axe goes to the South, Y axes goes to the West), activate checkbox *Inverse*, then click OK.

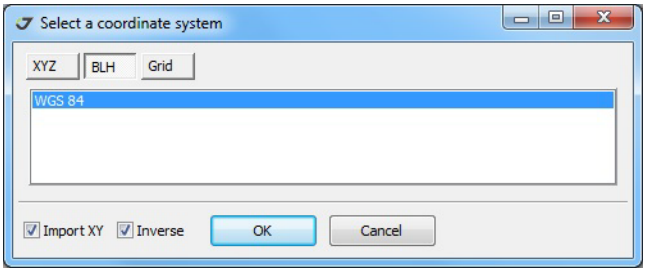


Figure 59. Coordinate system selecting

The imported files can be seen in the *Map* tab; on the right will be points on the map displayed:

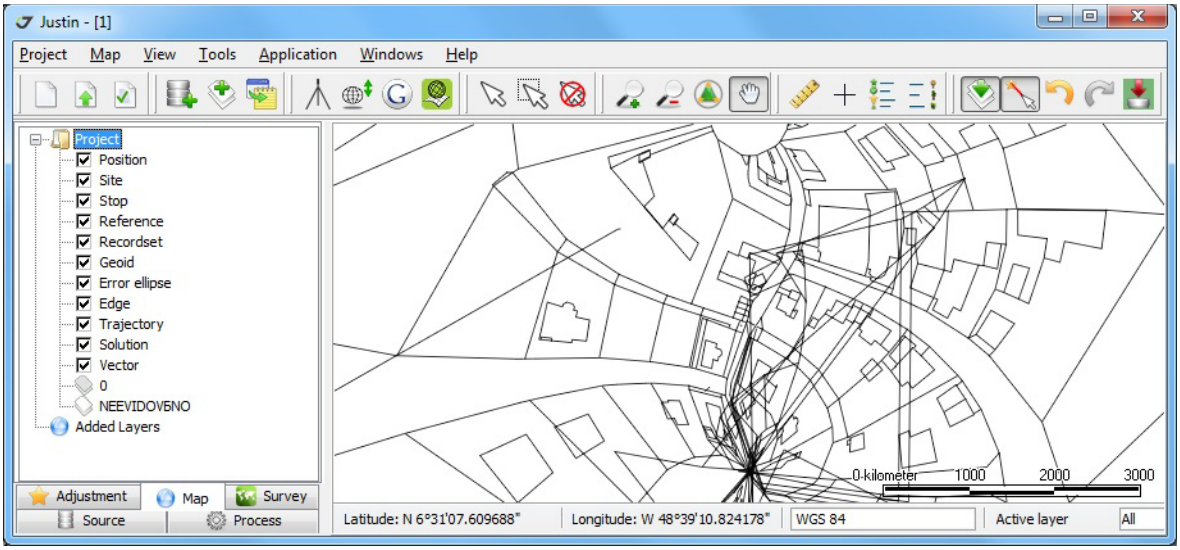


Figure 60. dxf layers

Import of *.db files

To import NS3-files (TRIUMPH-VS/LS application database) select the file(s) from the list: this type is displayed like data.db), then click *Open*. The window with progress status appears. To cancel import, click *Cancel*.

The NS3-files - it is special exchange format between external device and *NS3* software. It contains geometric objects, their attributes, structure and description of the coordinate system. The imported files can be seen in the *Survey* tab; on the right will be points on the map displayed:

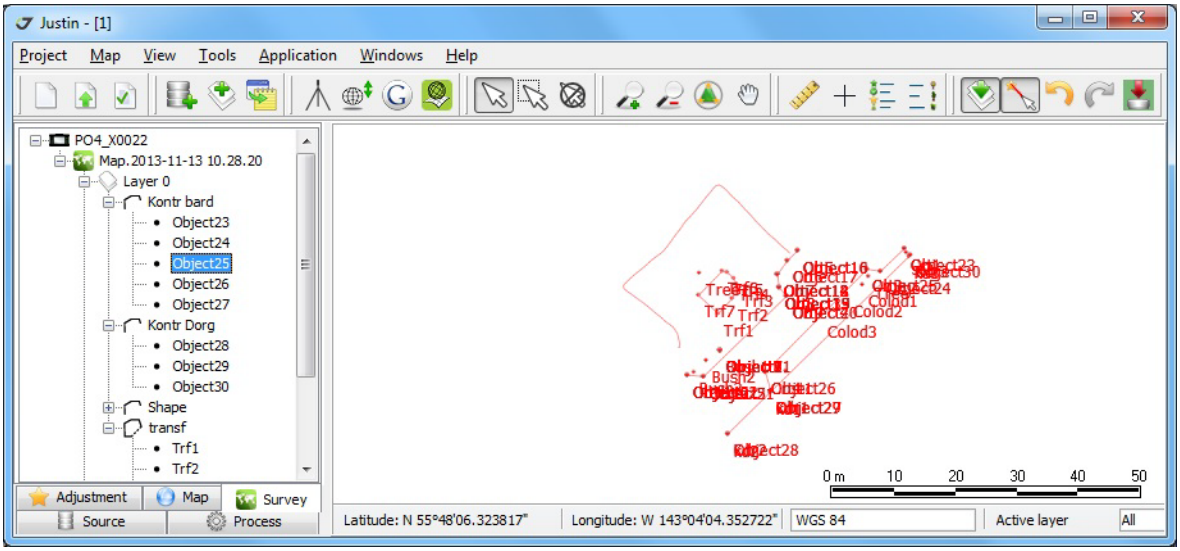


Figure 61. NS3 files import

Import of *.tracyjob files

To import files in the Tracy software format (*.*tracyjob*), select the file(s) from the list: this type is displayed like test.tracyjob), then click *Open*. The window with progress status appears. To cancel import, click *Cancel*.

Tracyjob-files it is special exchange format of the project created using JAVAD GNSS Tracy software.

The imported files can be seen in the *Survey* tab; on the right will be points on the map displayed:

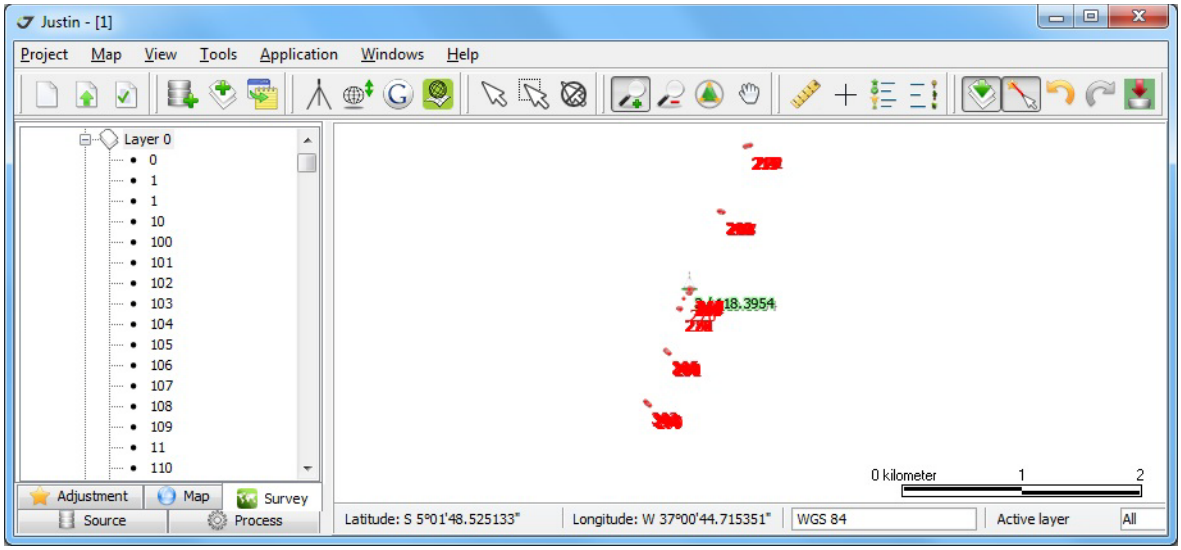


Figure 62. Imported Tracy project

Import of text files (coordinates and comments)

Text data (coordinates and comments) can be imported to the project. To import text files perform the following:

Click the button  or click *Project* ▸ *File import*. Select the file from the list (*Coordinates*) and click *Open*. The window with progress status appears.

To cancel import, click *Cancel*:

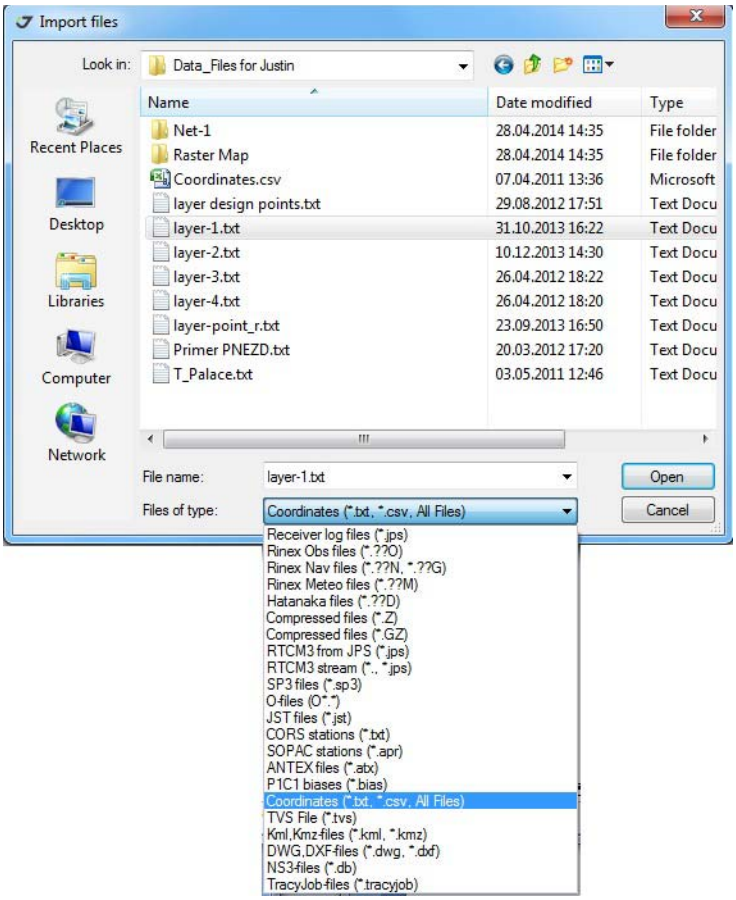


Figure 63. Import

Select the coordinate system:

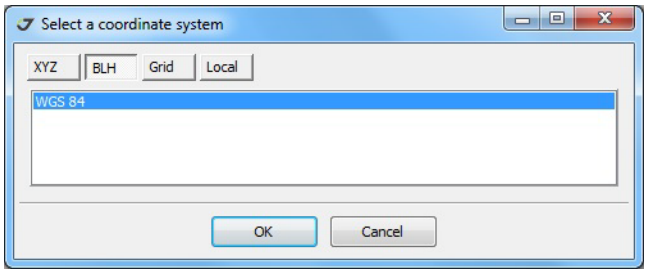


Figure 64. Select a coordinate system

- *XYZ* – Cartesian
- *BLH* – ellipsoidal
- Grid – a Cartesian coordinate system based on map projection and 7th parameters global to WGS84.
- Local - a Cartesian coordinate system based on map projection and two datums - global and local (4+3 parameters).

Select the coordinate system from the list and click OK. *txt* data format template window will appear:

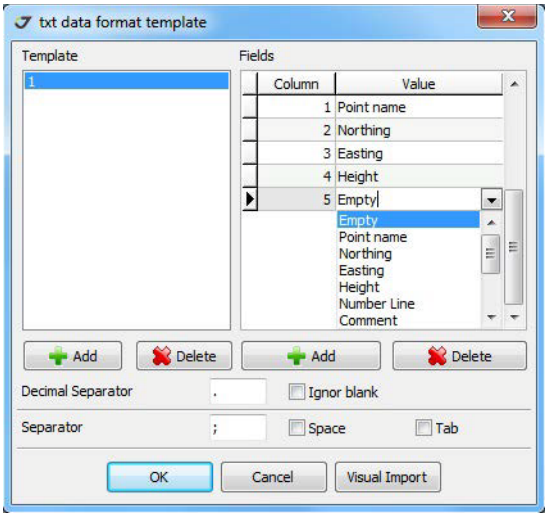


Figure 65. txt data format template

The data format template is formed depending on the type of the input coordinates and text file content. Below an example of import PNEZD format file: Point, Northing, Easting, Z-elevation, Description. The text is separated by commas, dot is used as the decimal separator.

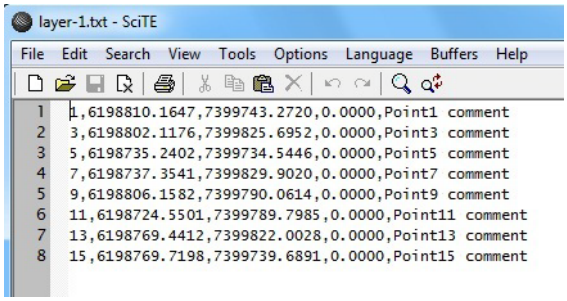


Figure 66. Text file in PNEZD format

Click left A*dd* and enter template name, click *Add* button on the right (in the *Fields* pane) five times, then by clicking on each separate field choose appropriate from the drop down list. Click *OK* to save the template, select it and click *Delete* on a left panel. If import was completed successfully the point objects will be shown on a new map layer.

In the case of more complicated text files extended template could be useful. Click *Visual Import* button (Figure 65). *Visual Import* window appears (Figure 71 on page 59). This template consists of three work zones: toolbar, left pane for source text file and a target regular table

If numeric values has been well recognized by *Justin*, and the points, which coordinates were imported, will appear on the screen; in the *Map* tab will be displayed initial file path and name.

Click *OK,* to save the template. To delete a template, select it and click *Delete*.

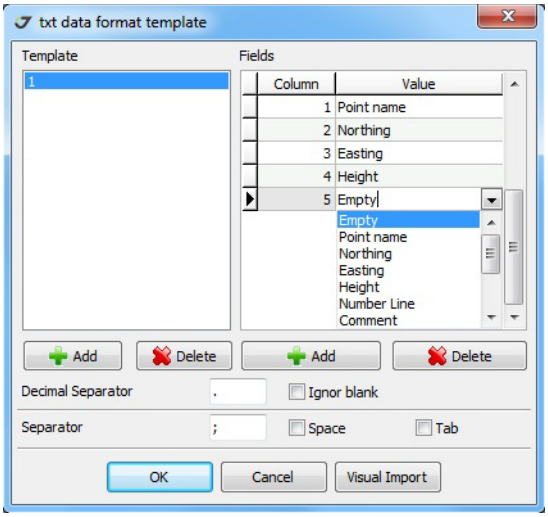


Figure 67. txt data formate template

After import is complete, the points will be shown on the screen, new layer will appear in the *Map* tab with the name of imported file.

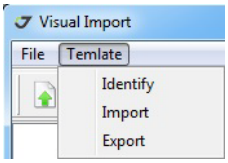


Figure 68. Visual import

To ignore the data from any column in the file, mark it as *Empty.* Comments and attributes will be merged is some columns are marked as *Comments* and *Attributes*.

Below is the example how to import text file different from PNEZD format.

Define parameters for each field using drop-down menu and the button , close each *Value*.

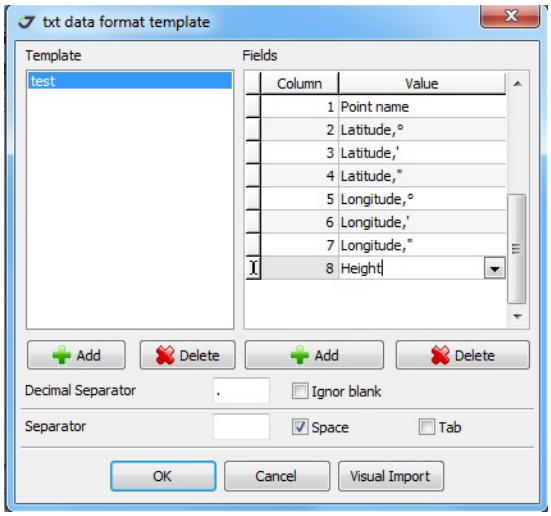
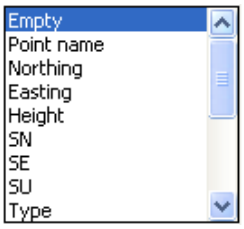


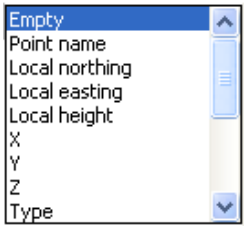
Figure 69. txt data format template

By the import the following formats are used:

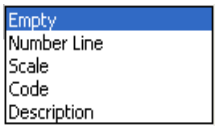
Reference points



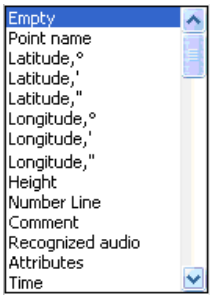
Local points



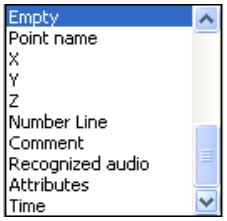
Classifiers



BLH Coordinates



XYZ Coordinates



Plane coordinates

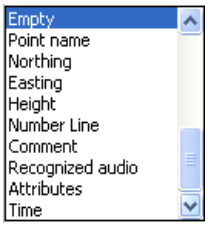


Figure 70. Parameters

To delete the template than focus on it and click the *Delete* button on the left. To delete the field, select it and click *Delete* button on the right.

If you suspect that imported file structure can be irregular, the visual import can be performed, the *Visual Import* window appears:

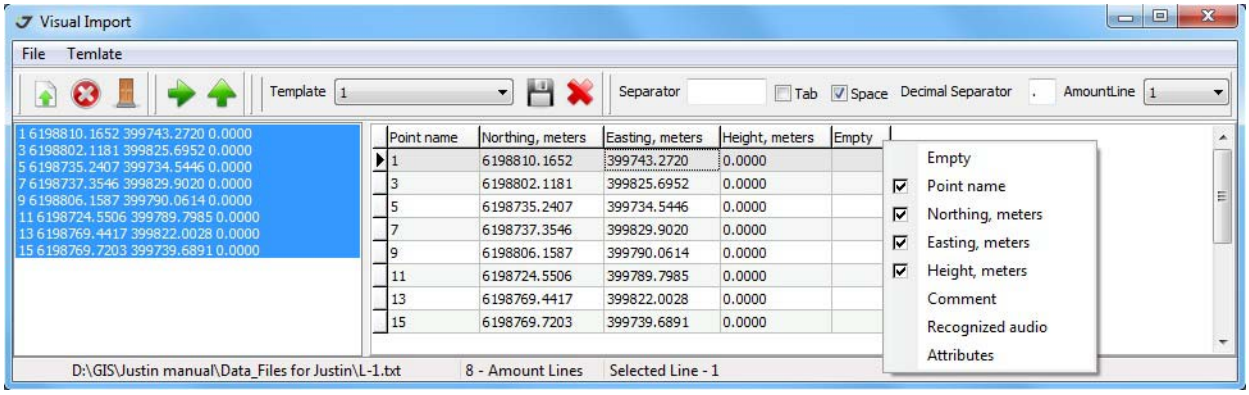


Figure 71. Visual import

This window consist of three work zones: tool bar (above), source text data on the left pane, and a table with recognized items on the right.

Tool bar has the following items (left to right): *Open file, Close file, Exit, Recognize (data), Import, Template (list), Save Template, Delete, Separator*, etc. These buttons are duplicated with the menu items:

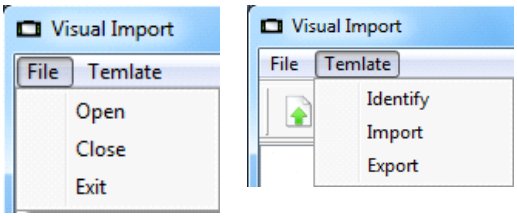


Figure 72. File and Template menu items

By opening the visual import window, on the left there is coordinates text file. It is possible to select the strings for import (All lines: press and hold *Alt+Shift*, or right-click and select the menu item *Select all*, select the strings by pressing *Ctrl*). The name of a template can be specified (in the *Template* window). If the template is not specified, set the separators, define the number of merged strings, and click the button  .

The selected lines will be duplicated on the right pane. If the template was specified, the columns will be arranged accordingly, otherwise every column will be marked as *Empty,* and you will be able to change the heading to any parameter from the drop-down list.

Use the right-click menu to operate with the objects:

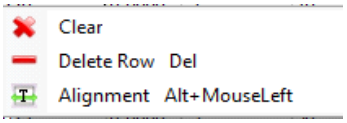


Figure 73. Right-click menu

- To delete the whole list of the data, right-click to call the menu and click *Clear.*
- To delete the row, click *Delete Row.*

- To align the columns click *Alignment*.

Click the import button  , after all values are defined in the table. The coordinates will be imported into a project, the points will appear on the map.

To save the template click  .

To define the decimal digits and recalculate column value according a formula specified by customer, click on the column header and select *Format* or *Formula*:

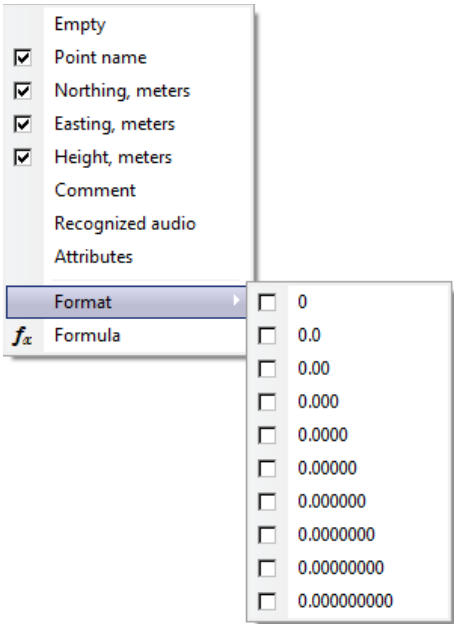


Figure 74. Format

If the *Formula* item was selected, the window *Enter the formula* appears. Enter the formula to the edit field. V - it is a value of a field in the selected column.

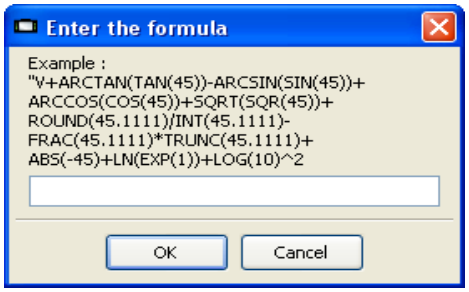


Figure 75. Enter the formula

If a template could not be applied to some strings, the next warnings will appear:

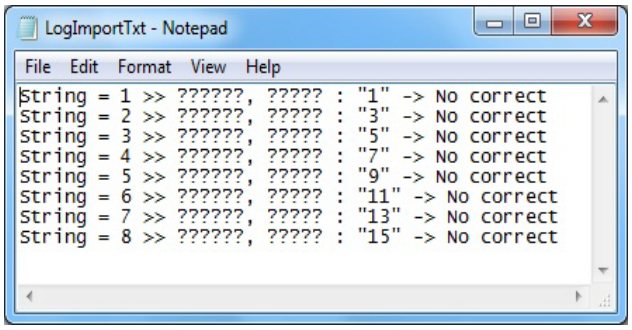


Figure 76. Incorrect data inserted

To ignore the data of some column in the file, it is necessary to mark is as *Empty*. *Comment* and *Attributes* types can be assigned to multiple columns, the contents of these columns will be merged.

You can switch between windows during visual import and perform other actions in the program. To display the previously hidden window of visual import, click *Windows* ▸ *Visual import*.

7. Post-processing

Post-processing is a *Vector* processing. *Recordset*s which have time overlapped GNSS observation sessions yield a *Vector*. A goal of post-processing is a *Solution*. Depending on a type of *Recordsets* we distinguish static or kinematic modes of post-processing. Type of *Recordset* is figured out just after importing GNSS data relative to *Criterium for static* in a project Scenario. So not static *Recordset* is a kinematic one. In the case of special markers - STATIC/DYNAMIC, were found in kinematic *Recordset*, we are treating it as Stop&Go type. We offer manual type editing thru *Recordset* properties dialog.

Post-processing could be run as a batch mode via *Vectors* item in a *Process* tab of project pane. Otherwise use *Selection* or *Selection by rectangle* tool in a main toolbar.

Static data post-processing yields *Solution* object which represents increment of coordinates from base to *rover Sites* in geocentric coordinate system and statistics. Static Solution is shown on a map on Solution layer as a line object. Kinematic data post-processing yields a set of solution vectors so-called fan. Kinematic Solution is shown on a map as a collection of point objects (track). Point positions are the end of solution vectors. Below we use a *base* and *rover* terms for *Vector*.

Static engine as well as kinematic one use so-called single differences of GNSS data.

7.1. Process

To get access to post-processing click *Process* tab on a project pane. The *Vectors* tree is structured by date of the beginning time of data span.

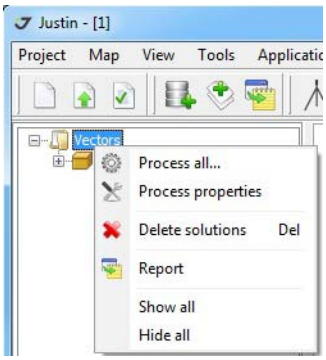


Figure 77. Processing

The next level of *Vectors* tree corresponds to *base* object. Sublevels are *rovers*. Base site FRED and rover site MHCB are indicated by static *Recordset* icons.

The last level of *Vectors* tree is intended for *Solutions* that appear under *rover* node after post-processing. Initially the *rover* node is empty. Reprocessing adds new Solution to an item.

Options:

- Process all - run post-processing for all not processed vectors in a batch mode;
- Process properties - static and kinematic post-processing settings;
- Delete solutions - deletion of all solutions;
- Report - publishing standard report. The report could be *txt* or *html* format according general settings specified in *Application*, *Options* item.
- Show all - show *Vectors* and *Solutions* objects on the map window.

Hide all - hide *Vectors* and *Solutions* objects on the map window.

Double click node to expand or close it.

Select somehow obsolete Vectors to hide them on a map and disable in post-processing and press *Del*. Double click in a check box MHCB / Site: MHCB to recover *Vector*.

There are practically unlimited number *Solutions* associated with a *Vector*.

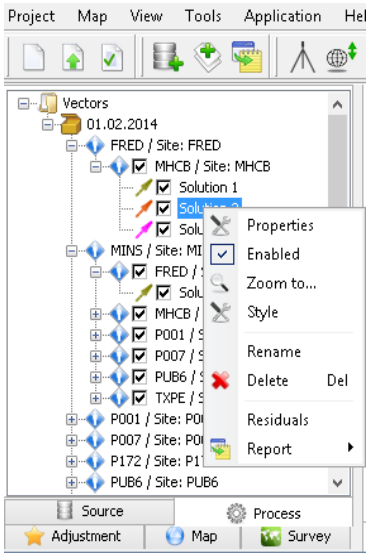
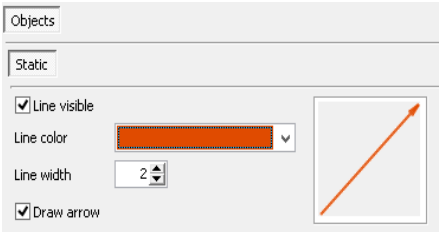


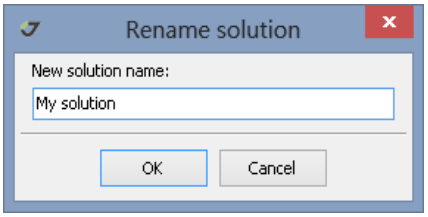
Figure 78. Menu

By clicking *Solution* item inspect a menu:

- *Properties* - opens *Solution* form;
- *Enabled* - validation for adjustment;
- *Zoom to* - shows *Solution* entire;
- *Style* - style customizing;



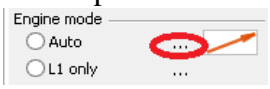
- Rename - opens a dialog



- *Residuals* - opens Residuals chart;
- *Report* - print a report;

7.2. Static post-processing settings

Process properties option are available thru *Vectors* menu.

- A static - engine specification. One engine only is available in a regular package.
- Use precise ephemeris - apply or ignore precise ephemeris in post-processing. While processing with precise ephemeris broadcasted ones are also required for *Run-time settings* dialog window (Figure 86 on page 70) Precise ephemeris have no action in a kinematic data processing;
- Cut off angle - minimum satellites elevation angle threshold; We do not recommend values less than 10º;
- Engine mode - preset GNSS data combination in post-processing. Detail explanation of code and phase combinations is widespread. Auto mode runs one of listed below modes. L1&L2 dual frequencies data mode designed for baselines shorter than 60 km. Wide Lane combination is first iteration step for longest baselines. We use so-called Ionofree combination for final dual frequencies carrier phase solution.
- By clicking 

field one may customize *Solution* style on a map window;

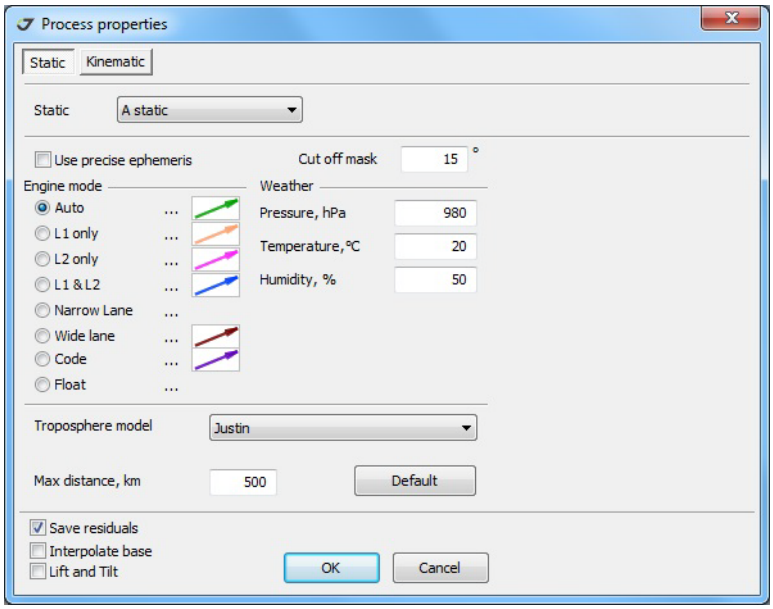


Figure 79. Process properties

- Weather - meteo parameters settings. Humidity value very affects to computed altitude.
- Troposphere model - one of the listed below: Justin, Zero, Simple, GCAT, MOPS, Goad&Goodman, NB(New Brunswik), Saastamoinen, Niell, Bernese. We recommend Justin model for sites with height difference less than 500 meters. Otherwise MOPS or NB models are preferable. Note that MOPS ignores external meteo parameters and operates with independent settings. Some models do not offer mapping function for precise computing of troposphere corrections;

- Max distance - maximum baselines length (in km). Focus on this very important item for batch processing. Over range *Vectors* are skipped without warning;
- Default - restore program settings;
- Save residuals - store residuals in a project database. Residuals are results of subtraction measured pseudoranges or carrier phases and theoretical distance from receiver to satellite. Keeping residuals make post-processing slower and can overload a project (maximum size 2 GB). In the meantime residuals chart is main tools to control post-processing result in a bad environment.
- Interpolate base - interpolate epoch GNSS data on *base* to reach solutions for every *rover* epoch position. We assume base and rover data sampling are different.
- Lift and Tilt - force processing of [RM] (Rotation Matrix) message. It makes sense for Triumph VS/LS receivers data.

Ambiguity validation procedure have been based on so-called LAMBDA method which yields contrast of Fisher-distribution. Contrast is ratio of the two minimum quadratic forms of the least square residuals - second minimum sum divided by first one.

We compute cumulative distribution function (CDF) for the Fisher distribution (value varies from 0 to 1) with numerator equals 2, denominator equals quantity of ambiguities and upper limit of integration equals contrast. F-ratio statistic given in percents. 100% value is for the best ambiguities resolving.

F-distribution refers to normal distribution of carrier phase residuals. Chi-squared test for normal distribution of residuals is significant when it based on enough long observation sessions for averaging noisy data.

Despite the differences of various GNSS post-processing software engines, assured integer ambiguity resolving procedure claims thirty minutes time span observation for *short* baselines (<10 km) with more than five satellites locked, dual frequencies measurements and a good environment. In the meantime above mentioned requirements are often enough to reach good single epoch carrier phase solution. In the last case F-ratio solution statistic expected to be equal 100% but it is not significantly estimated. We recommend to practice two bases - one rover network configuration and evaluate loop misclosure to check correct fixing of ambiguities.

When short baseline has been processed any values of F-ratio in a range 75% -100% could be acceptable if a quantity of discarded measurement is low (<5%). In fact, it is not a problem to increase F-ratio by dropping a satellite which deals biggest residuals (refer to Residuals Chart).

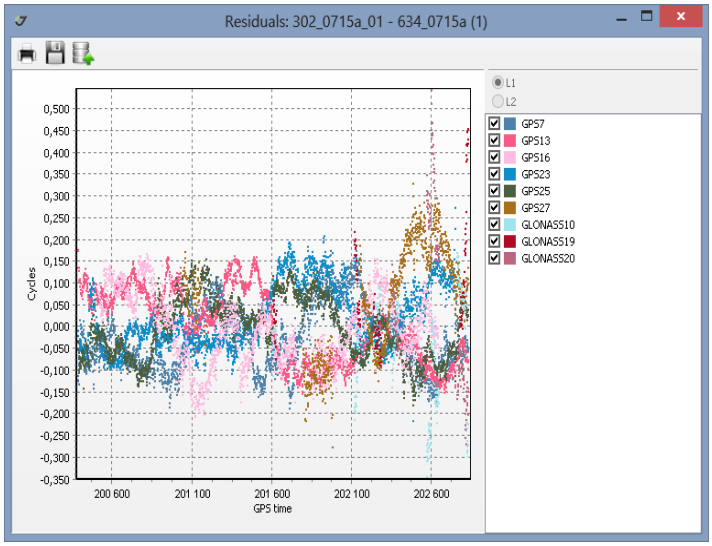


Figure 80. Residuals

Other major way to improve F-ratio is increasing of cut-off angle.

The addition of GLONASS and particularly BeiDou and QZSS data improves and significantly enhances LAMBDA searching procedure. To make any GNSS data enable/disable in post-processing use settings in a Project properties.

Evaluation of carrier phase data post-processing for baselines longer than 30 km dramatically differs from measurement taken over short baselines. Statistics evaluation works quite well over these baselines due to continuous observation sessions which deal enough measurements for resolving ambiguity. The problem is handling tropospheric and ionospheric delays which cannot be completely canceled in single differenced residuals which contains the signature of many unmodeled systematic biases. Loop misclosure test does not deal reliable accuracy estimation because loop vectors are so-called trivial. Next problem is in time correlation of carrier phase measurements. The ability to resolve ambiguity could be checked by splitting observation session, processing data independently and a comparison of positions and statistics. Full session result position must be approximately in a center of partial solutions.

7.3. Batch processing

Batch processing is continuously *Vector* by *Vector* post- processing. We offer to run batch processing from project pane as well from map pane. Upper level objects in Vectors tree suggests batch option.

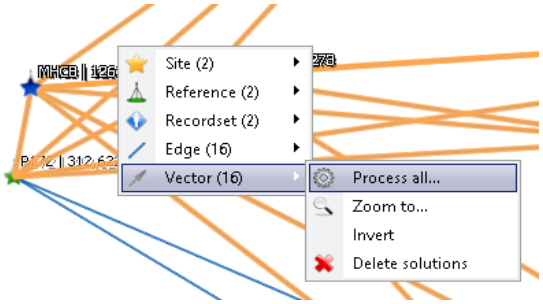


Figure 81. Process all

Use *Selection by rectangle* tool to accept multiple ***Vectors*** in batch processing.

- Activate button  on a main toolbar;
- Select several *Vectors* in a rectangle area on a cartographic window;
- Right click map to view batch processing menu (Figure 81). A quantity of selected object is indicated;
- Click *Process All* in submenu.
- Others submenu items:
- Zoom to - view selected object entirely.
- Invert - switching *Vectors* direction. It drops all old *Solutions* assigned to *Vector.*

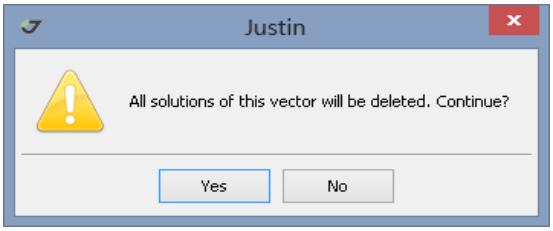


Figure 82. Warning

- Delete Solutions - it completely removes all *Solutions* from a project. Special warning (Figure 82) will be displayed.

Batch process window shows workflow status - completed solutions number, *Vector* in progress, time left. To interrupt batch process click *Cancel*. Just processed solutions will be saved. Processing is running in a modal mode to avoid conflicts in a project database.

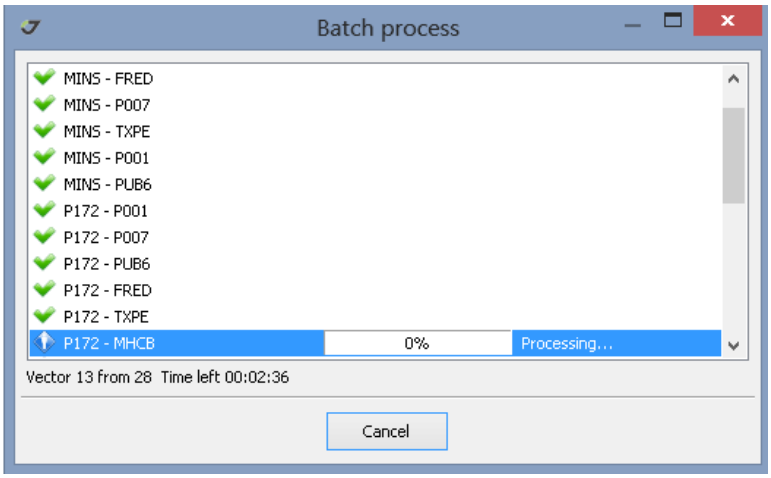


Figure 83. Batch process

As batch processing have been completed ProcessLog.txt file opens (Figure 84).

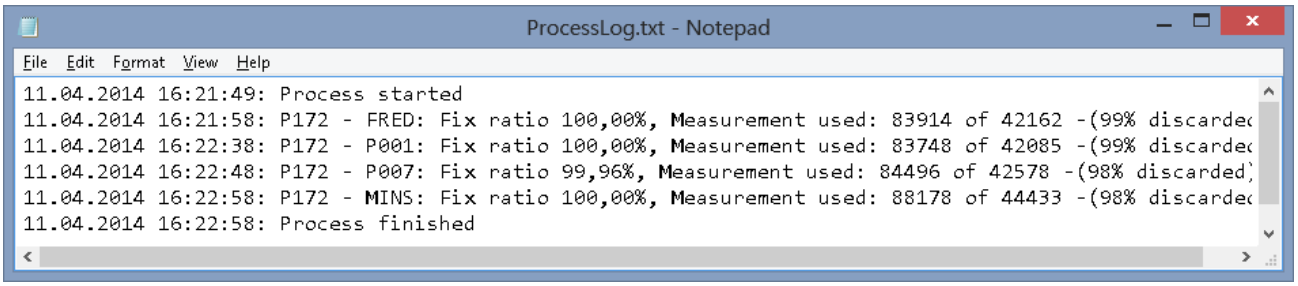


Figure 84. txt file

7.4. Single vector processing

Single vector post-processing is used for purposes:

- customizing settings for batch processing;
- processing in *Auto* mode does not deal good result;
- reprocessing *Vector* to get more *Solutions*;
- picking time intervals from session;

- skipping unwanted *Vectors* (rover - rover time overlap).

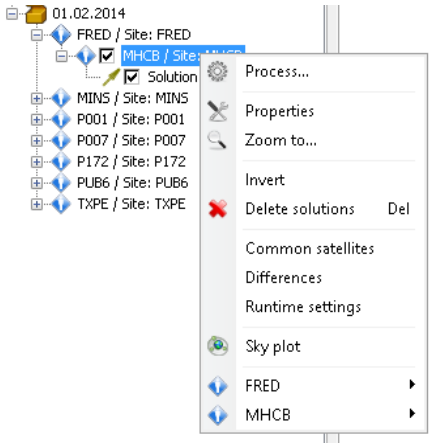


Figure 85. Single vector post-processing

The menu is available by clicking *Vector* item on project pane as well on map.

- *Process* - runs post-processing;
- *Properties* - opens *Vector* properties window;
- *Invert* - switch *Vector* direction
- *Delete Solutions* - drops all *Solutions;*
- *Common satellites* - opens a chart;
- *Differences* - opens a single and double GNSS data differences charts;
- *Runtime settings* - opens interactive dialog pane;
- *Sky plot* - opens a chart.
- *Recordset* item - provide access to *base* and *rover* standard properties dialog;

Interactive mode

Interactive *Vector* processing could be useful when more accurate positioning is to be carried out. Runtime settings control can be quite labor intensive if automated processing mode produces erroneous results.

To process single *Vector* as interactive right click it in a project or map panes and select *Runtime settings* option. Control pane will be opened in the bottom of program window. The purposes of the control are:

- omitting suspicious satellites;
- time interval figuring out;
- picking time intervals;
- forbidden some GNSS data;
- keeping residuals;
- make interpolation *base* data on the *rover* epoch;
- applying Lift&Tilt option (GREIS [RM] message processing);

In order to evaluate a *Solution* refer to *Residuals* chart and *Solution* statistics.

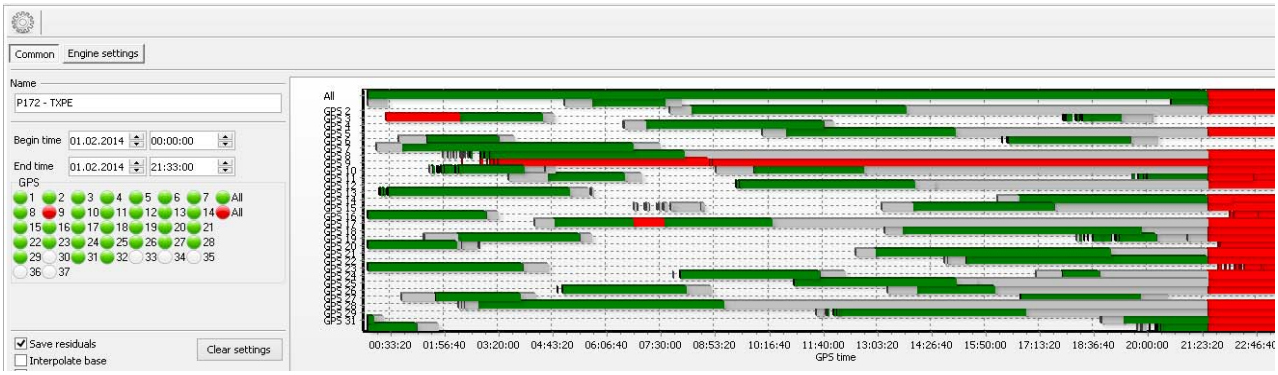


Figure 86. Observations

As regards Figure 86, all observations are presented with green, gray, yellow, blue and red strips. Green strip marks periods satellite location above cut-off elevation angle. Gray strip indicates periods when locked satellite was under cut-off angle. Yellows are unhealthy satellites. Blue strips indicates lost ephemeris data. Right and left mouse clicking on green part of strip causes to switching colors to red which means picking time intervals. To exclude internal interval press and hold *Ctrl* button. After that click right-left or left-right scopes. Take into account that second clicking will be on a red part of strip.

Engine settings tab switcher opens process properties windows shown on Figure 79 on page 64.

Click  button to run *Vector* processing with run-time settings.

7.5. Statistics

The validity of solution could be verified by using statistics. If the quantity of discarded measurements which equals total quantity of measurements minus quantity of used ones (*Num meas - Num used*) exceeds 20% then it make sense to reprocess *Vector* in manual mode.

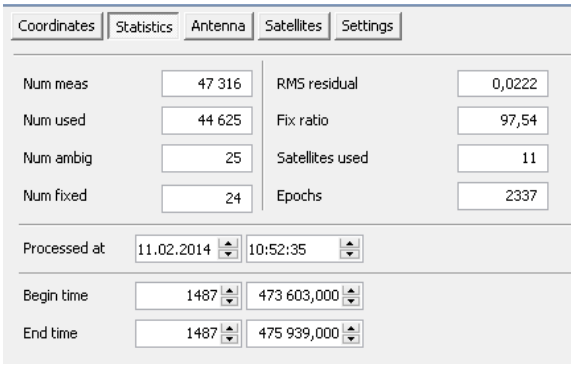


Figure 87. Statistics

Fix ratio is F-ratio statistic which was described above. Values in a range of 95-100% are considered as well ambiguities resolved.

RMS residuals value for *L1&L2* carrier phase fixed solution never exceed 0.05-0.06 meters. Otherwise ambiguities couldn't be resolved. Comparison of *Num ambig* and *Num fixed* values does not evaluate solution accuracy. It reflects multipath behavior and blinding GNSS signals obstacles. Therefore, no matter how much ambiguities were dropped. Investigate the correspondence of used satellites quantity and a number of fixed ambiguities. If this ratio in *L1&L2* mode is less 2 then either L1 or L2 data is corrupted.

7.6. Kinematic vector post-processing

Kinematic vectors processing as well as static ones could be run thru project pane or thru map window. Right click on selected *Vector* and hit *Process*. Batch vectors processing is available also. Use selection in rectangle tool for multiple data processing.

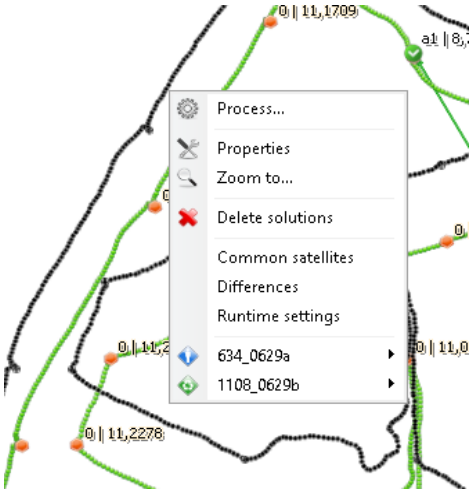


Figure 88. Kinematic vectors processing

Kinematic *Vector* option menu has no difference with static Vector one (Figure 85 on page 69), which was described in 7.3. We draw kinematic *Vector* on map as track without showing fan of rays coming from *base* to *rover* so it could hide map objects situation and hung redrawing. Base is specified in the bottom of drop-down window (634_0629a on Figure 88). To focus map on *base* Site select it and hit Zoom to.

If *Process properties* dialog window was involve via *Vectors* item in a project pane then process settings affects how not processed *Vectors* will run. Runtime settings affect how single Vector processing will run if one click  button.

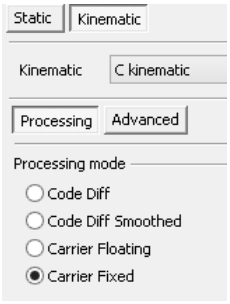


Figure 89. Kinematic

- C kinematic - is name of kinematic engine in regular *Justin* assembly.
- Code Diff - pseudorange data processing mode;
- Code Diff Smoothed - carrier-smoothed pseudorange data processing mode;
- Carrier Floating - carrier phase data processing mode without resolving ambiguities;
- Carrier Fixed - carrier phase data processing mode with resolving ambiguities;

Additional settings are available with *Advanced* tab.

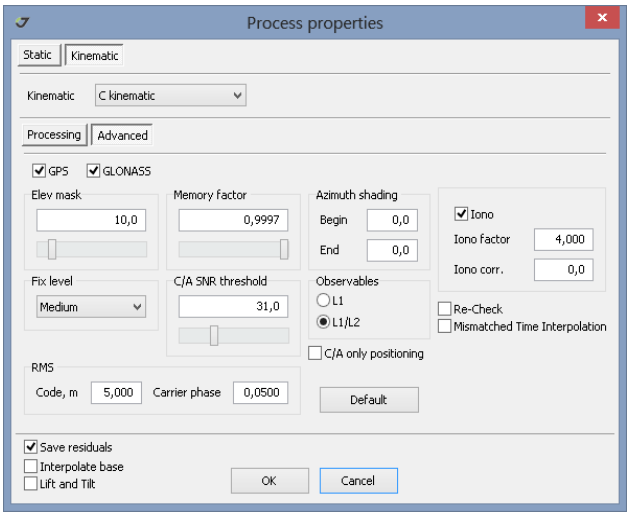


Figure 90. Process properties

Specification:

- GPS, GLONASS check boxes - enable/disable GPS or GLONASS measurements in processing;
- Elev mask - satellites elevation cutoff angle;
- Memory factor - priority item for high dynamic application that affects how fast left epochs will be dropped from computation;
- Fix level - contrast value. Low level corresponds to 4.
- C/A SNR threshold - limits data by C/A code energy value. Reasonable minimum equals 28.

- It is important to note that RINEX data may have L1 carrier phase measurements instead of C/A carrier phase. L1 signal energy is much low;
- Iono - ICD (Interface Control Document) ionospheric correction;
- Ionofactor - threshold parameters used for outliers rejection (Ionofactor * RMS), where RMS is rout mean square of residuals;
- Ionocorr - preset for ionospheric correction;
- Re-Check - autorun ambiguity resolving procedure every 7 epochs;
- Mismatched Time Interpolation - spline interpolation of skipped epoch position;
- C/A only positioning - ignores carrier phase data;
- RMS Code/ Carrier phase - accuracy preset for pseudoranges and carrier phase measurements; RMSs code/phase ratio is the most important parameters in ambiguity resolving procedure; Getting maximum fixed solution investigate optimal code and phase RMS values. Modify Memory factor parameters to eliminate unexpected rover dynamic effects. Decrease this value if jerks happened. Next step is customizing of Ionofactor parameter. Values from 2 to 4 make sense and acceptable. At last we recommend to softly increase cut-off elevation angle up to 15 degrees.

8. Adjustment

Geodetic network adjustment uses weighted least squares method for solving over-determined linear system.

$$AX = L, \quad [8.1]$$

Depend on 3D/2D adjustment mode the design matrix A has 3**n* or 2**n* rows (n - number of solutions) and a structure comprising +1 and -1. X is a matrix of unknown Node coordinates. The number of unknowns *m* equals the number of network nodes multiplied by 3 or 2 also. L is an array of *Solution* components d*X, dY, dZ.*

In the case of adjustment in geocentric linear equations system is:[8.2]

$$\begin{aligned} X_M - X_N &= dX; \\ Y_M - Y_N &= dY \\ Z_M - Z_N &= dZ \end{aligned}$$

where *X,Y,Z* are unknown coordinates of M and N network points.

The redundancy of the network adjustment problem is a number of rows minus the number of columns.

Subject to a weight matrix W solution of [8.1] is given by solving:

$A^T WAX = A^T WL$, [8.3]

Weight matrix W is a block diagonal matrix formed using *Solution* covariance matrices.

Network adjustment solves two main problem:

1. Post-processing solution accuracy estimation, outlier and blunder detection.

2. Calculation of final Site coordinates and statistics.

As much as coordinates are not a goal of the first problem it runs first in inner constrained mode. To overpass the singularity of normal matrix A^TWA we use singular value decomposition (SVD) method. The research of network adjusted in inner constraints mode is intended for detection and making odd from final adjustment results blunders and estimation of systematic errors impact.

The detection of blunder is treated using Pope's τ-test. This method computes standardized residuals $u_i = \frac{v_i}{\sqrt{q_{ii}}}$ [8.4],
detect blunders in iterations and remove suspicious data from design matrix. The iterations continue until all blunders have been disable and χ^2 test passed depend upon the significance level and the degree freedom. q_{ii} are diagonal elements of the cofactor matrix
$Q_{vv} = Q_{ll} - AQ_{xx}A^T$ [8.5], where
Q_{ll} is a block diagonal matrix of 3x3 dimension solution covariance matrices, $Q_{xx}$is inverse of A^TWA matrix.

τ-test treats solution as a blunder if a residual exceeds τ-value.

$\tau_{\frac{\alpha_o}{2},n-m}$ is determined in τ- distribution. $\alpha_o = 1 - (1-\alpha)^{1/n}$.

α is user defined significance level (68%, 95%,99%).

Level 99% corresponds to the most soft restriction and 68% level is the most strong.

Note that τ-test uses standardized residuals for blunder detection instead of its absolute value so small residuals could be treated as blunders also.

Least Squares method deals optimal results in geodetic adjustment if GNSS data post-processing solution errors are normally distributed. χ^2- test checks if solutions errors are normally distributed. It compares so-called unit weight error μ and χ^2 statistics.

$\chi_L^2 < \mu^2 = \frac{1}{n-k} \times V^TPV < \chi_H^2$, [8.6]

In fact χ^2 test estimates consistency of solution covariance matrix Q_{ll} relative to a posteriori statistic.

In the case of geodetic adjustment failed χ^2 test it indicates that some observation sessions were too short. Due to time correlation of GNSS data solution accuracy is overrated. In the meantime loop misclosure are often big and μ is out of limits.

Inner constraints adjustment runs in relative coordinate systems. To show inner adjustment result in a cartographic window we snap relative coordinated network to first listed reference point (if it exists) or to first listed site.

Second goal of adjustment are coordinates of measured ground points. To reach it the network must be snapped to ground reference points and final adjustment should be running under external constraints.

8.1. Network

To run adjustment switch to *Adjustment* tab in a Project pane. As well as adjusted subjects are *Solutions* than complete *Process* procedure in advance. Objective are *Nodes* which form *Edges* and *Loops.* In fact, *Edge* is adjusted *Solutions* which correspond to a *Vector.* There is a special layer to represent *Edges* in a map pane. *Nodes* category is intended to manage one of the main result of processing data - coordinates of target points. Roughly say Node is unknown value. Depending on adjustment mode the quantity of *Nodes* could be equal *Site* quantity (inner constraints mode, no data rejected), or could be less if some *Sites* were snapped to reference points.

Loop category deals simple additional estimation of post-processing data accuracy. The sum of *Solution* components along a loop is a misclosure. Loops detection and generation is running simultaneously with network adjustment procedure.

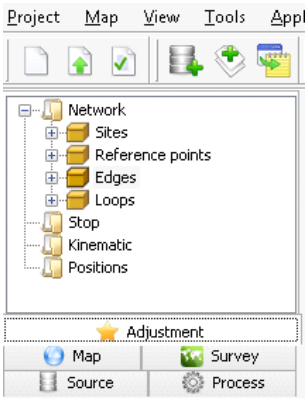


Figure 91. Adjustment

There are four upper items in *Adjustment* tab:

- Network - static solution network;
- Stop - survey points;
- Kinematic - trajectory;
- Positions - real time point coordinates.

Introduce a terminology:

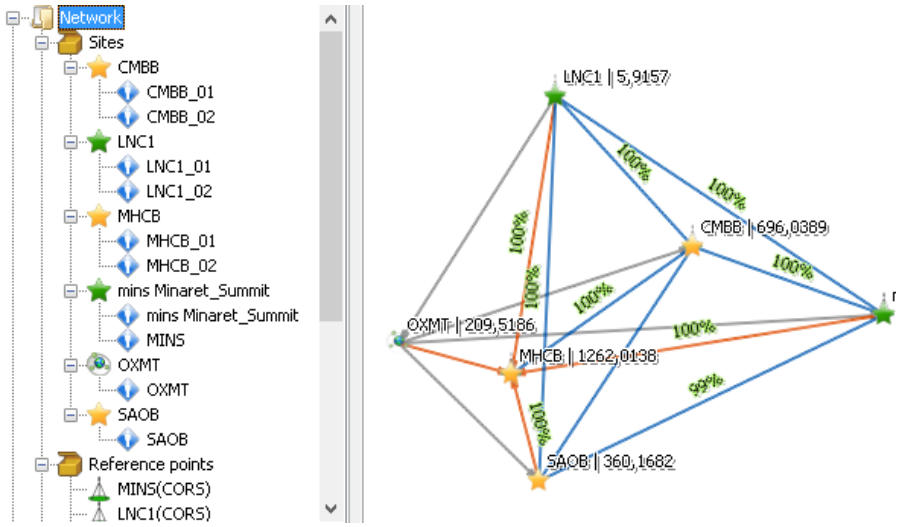


Figure 92. Network

1. *Site* – point objects shown on the map with cartographic sign relative to *Legend*. Initially *Sites* are generated for raw data *Recordsets* upon standalone solution. Cartographic sign of *Site* reflects it origin - standalone, manual input (do not considered as constraints in adjustment), snapped to *Reference point* or *Solution* or *Node*.

Par example, *Site* OXMT is on a standalone position, MHCB is on post-processing *Solution*, LNC1 snapped to reference point (Figure 92 on page 76).

2. *Reference points* – list of control ground points with postulated coordinates.

3. *Node* - point object which has no cartographic sign. As it was mentioned above a quantity of *Nodes* could be less that *Sites* quantity. Covariance matrix for *Sites* and *Nodes* could differ also.

4. *Edge* – linear object created thru adjustment. *Edge* connects two *Nodes* and forms a network. *Node* can share *Edges*. *Edges* are shown on a special map layer. There is *Edge* table is in adjustment report. It is used for residuals and relative error publishing.

Edge types:

- *Single ended* - edge that shares with a network one site only;
- *Bridge* - edge that connects loops. It does not form itself any loop;
- *Blunder* - edge that has not passed tau-test. By default blunders colored red;
- *Common* - others edges.

5. *Loops* - a list of independent loops generated under restriction of minimum edges quantity in a loop. Loop misclosure is indicated depending on adjustment mode (*XYZ/NEU*).

To get access to options of *Network* item point on it and right-click mouse button.

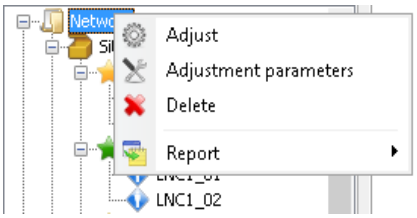


Figure 93. Menu

- *Adjust* – run network adjustment. Last adjustment data will be drop automatically;
- *Adjustment parameters* – involves a dialog window of adjustment parameters settings below.
- *Delete* – drops last adjustment;
- *Report* – generates standard report.

8.2. Adjustment parameters

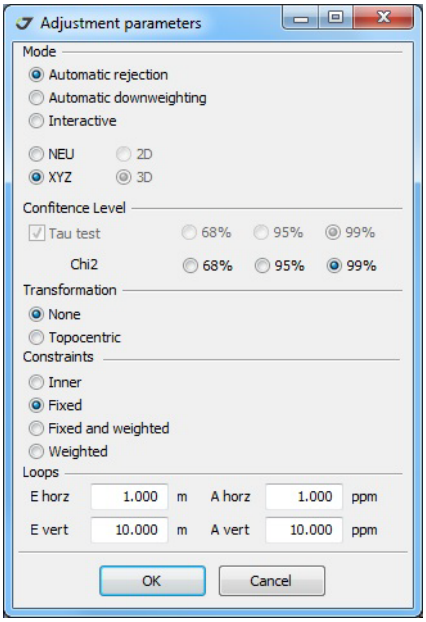


Figure 94. Adjustment parameters

Mode - scenario of blunders canceling:

- Automatic rejection - adjustment is running in iteration. Blunders are excluded step by step until they are canceled.
- Automatic down-weighting - adjustment is running in iteration. Blunders are down-weighted step by step until they are canceled.
- Reduction factor equals, where *u* is standardized residuals equals $e^{Abs(\frac{u}{\tau_0})}$, [8.4], is computed depending on defined confidence level.

- Interactive - adjustment in a dialog. The mode allows to down-weight or cancel a solution at each iteration step instead of batch blunder processing in above mentioned automatic mode.

Mode - blunders qualification in inner constraints adjustment:

- NEU - residuals are calculated in topocentric coordinate system (Northing, Easting, Up).There is additional specification 2D/3D to separate plane and vertical sources of errors. If an edge was marked as blunder in NEU 3D mode than it make sense to readjust network as 2D to exclude error in vertical components which happens due to wrong antenna height or type input.
- XYZ - residuals are calculated in geocentric coordinate system.

Confidence level:

Post-processed solutions that based on GNSS data obtained in short session of observation may have low absolute accuracy and a good statistics - small standard deviation errors (sigma - square route of diagonal elements of cofactor matrix). Thus its impact in adjustment is overvalued due to big values of weight matrix. In the meantime edge residuals mustn't exceed sigma more than in 2-5 times in the case of normal distribution of errors. Otherwise an edge should be detected as a blunder. Settings of confidence level limit allows to control blunder detection procedure.

From the other hand value of unit weight error must correspond to *Solution* accuracy. Regular μ value vary from 0.4 to 1.6. Formula [8-6] computes more accurate these limits using network number degrees of freedom and confidence level value. 99% level is the widest limit.

Blunder detection procedure affects to chi2 test. Control of confidence levels for both tests allows to pass to chi2 test well.

Transformation

Fixed constraints adjustment is running as localization (“Getting LCS” on page 88) if “Topocentric” option was selected. In this case unknowns values are not only Node coordinates but translation, rotation and scale parameters also. Instead of localization an adjustment as “Topocentric” does not store these parameters in program database.

Constraints

- *Inner* - adjustment of free network with no constraints. Residuals depend on network geometry and solution quality. It is a very important preliminary network adjustment which is running automatically for constrained network also. We recommend to accomplish it in advance separately as a best way for post-processing outliers cancellation.
- Inner constraints adjustment computes site positions in a relative coordinate system. Meantime results might be similar to those in a case of fixed constraints adjustment with one reference point.
- *Fixed* – adjustment which could be completed if a network was snapped minimum to one reference point. Otherwise a warning appears. Snapped *Sites* position left steady. Reference points accuracy statistic does not affect to residuals and computation;

- *Fixed and weighted* – adjustment is running similar to *Fixed* but reference points covariance matrix affects to residuals and positions computation;
- *Weighted* - sophisticated adjustment type which computes positions for reference points as well as for unknown *Sites*.

Loops

Constant E (in meters) and linear parameter A (in *ppm*) define acceptable limit for loop misclosure.

An equation is:$\Delta L = E \times \sqrt{N} + A \times L$, [8-7], where: N – edges quantity in a loop, L - length of loop.

Overpassed misclosure are colored in red in left project pane.

8.3. Interactive

This dialog window appears if interactive mode is running.

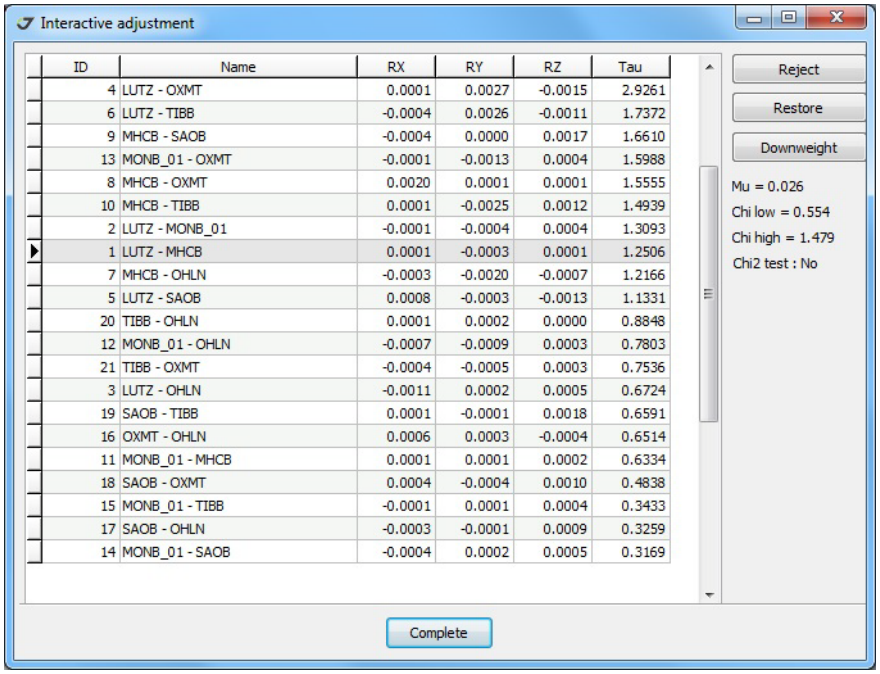


Figure 95. Interactive adjustment

There are a list network edges properties and statistics in a table. R*X,RY,RZ* are components of *Edge* residuals. Tau column includes maximum components of standardized residuals (*uX,uY,uZ*). Right of the table parameters of test are shown.

To exclude an *Edge* from adjustment select a row in a table and click *Reject*. Press and hold *Ctrl* or *Shift* button to exclude more *Edges* at once. By clicking *Reject*, *Restore*, *Downweight* button run readjustment. Dialog window (Figure 95) appears once more. *Complete* button is intended for final adjustment.

The main goal of interactive mode is a test achievement. To reach it we recommend to consequentially reject edges with maximum value in a *Tau* column. It is not possible to reject *Bridge* edge as network will

be splitted in two subnets. In this case a warning appears. A network could be adjusted in subnets by disabling *Solution* in advance before adjustment.

Rejected *Edge* is kept in a table but corresponding row shown in gray. For restoring it select row and click *Restore*.

After clicking *Downweight* button additional dialog window appears. Available value for correction parameter is in a range from 0 to 65536. *Solution* covariance matrix will be updated relative to correction value.

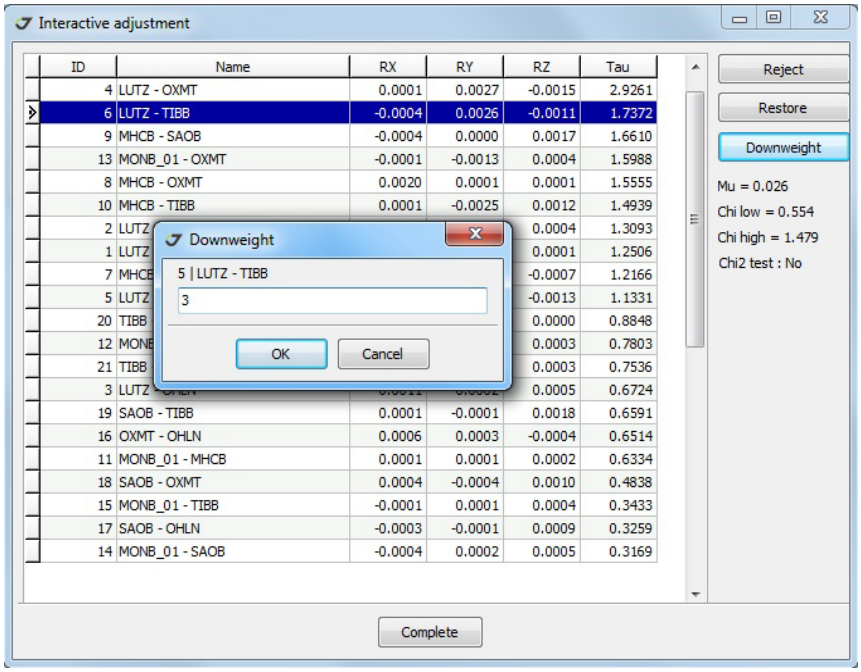


Figure 96. Downweight

Press *OK* to readjust network. Correction parameter will stored while interactive window (Figure 95 on page 79) is open.

8.4. Survey points adjustment (Stops)

In fact, *Stop* objects are averaged along epochs rover solution coordinates. In the case of multiple bases *Stop* positions could be adjusted.

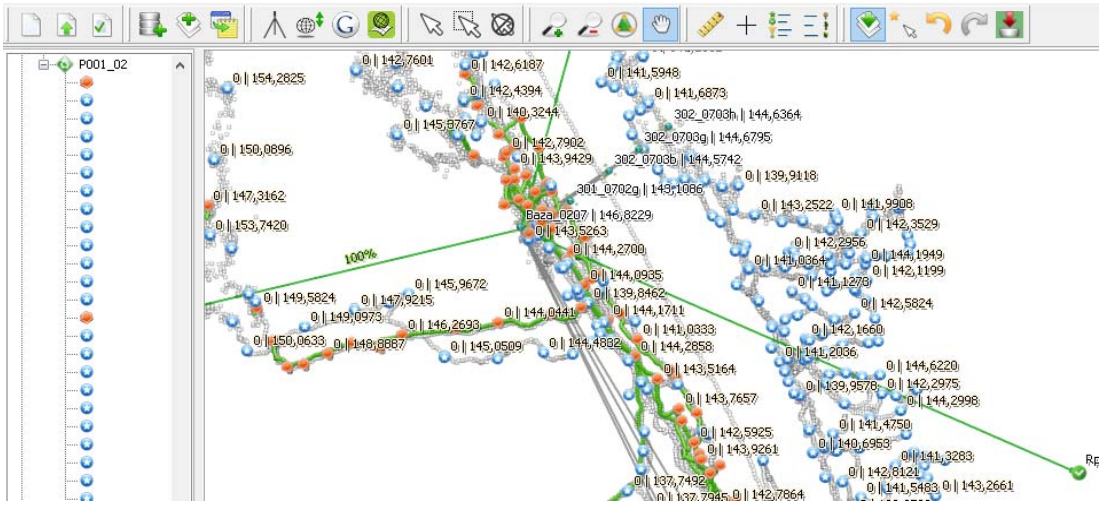


Figure 97. Stops

Focus on *Stop* node of Network object. This node is for *Recordsets* which were detected as Stop&Go type during import raw GNSS data (STATIC/DYNAMIC tags in JAVAD jps files or Static/Kinematic marker in RINEX). *Recordset* property could be updated manually.

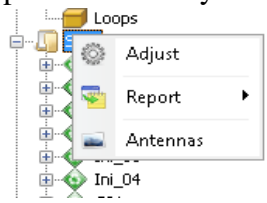


Figure 98. Stop options

Stop options:

1. *Adjust* – multiple bases kinematic solutions adjustment.

2. *Report* – standard report publishing.

3. *Antennas* – opening *Stop* antennas window for height and offsets editing. Antenna type editing denied as *Stop* object is, in fact, a time interval beside *Recordset* or *Solution*. Editing antenna type drops a *Solution.*

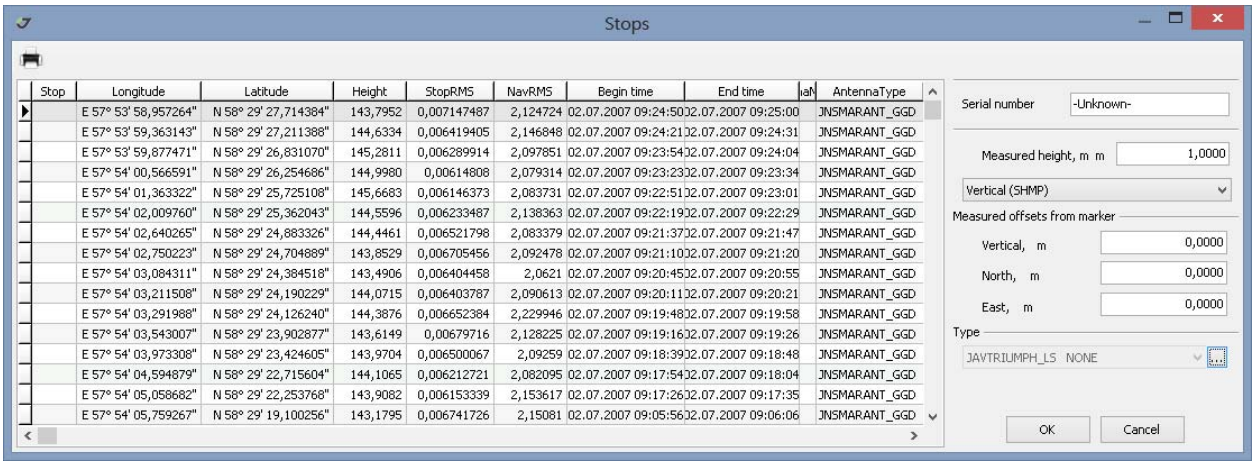


Figure 99. Stops

8.5. Kinematic adjustment

Kinematic adjustment could be running if multiple base solutions exist and Kinematic node is not empty. New trajectory object is intended for control adjustment workflow. Report option publish standard report.

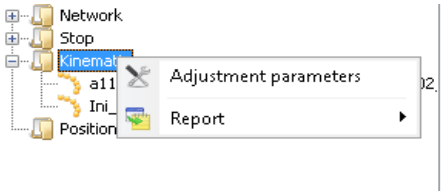


Figure 100. Menu

Settings

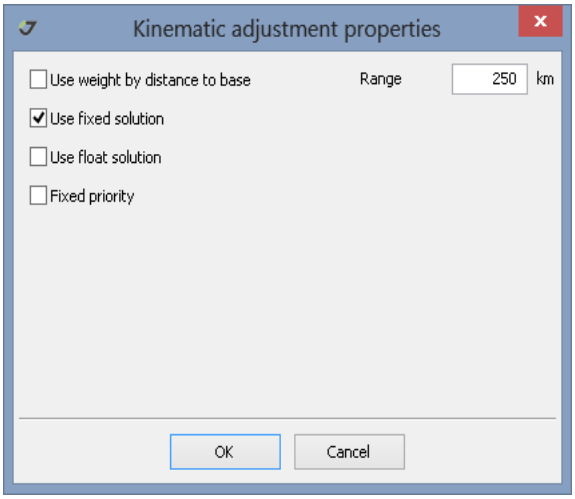
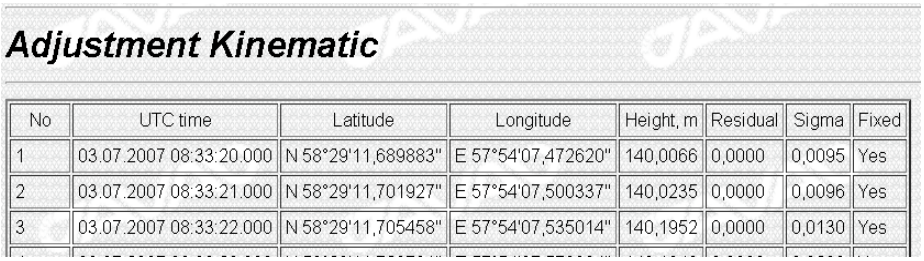


Figure 101. Adjustment properties

- Use weight - weighted adjustment with scaled covariance matrices by rout square of distance between base and rover epoch position;
- Use fixed solution - only fixed solutions are taken in account;
- Use float solution - both float and fixed solutions will be adjusted using epoch solution covariance matrices;
- Fixed priority - ignore float solution if fixed one exists.

Range parameter sets maximum acceptable for processing distance between base and rover epoch positions.

Report



Adjustment Kinematic

No	UTC time	Latitude	Longitude	Height, m	Residual	Sigma	Fixed
1	03.07.2007 08:33:20.000	N 58°29'11,689883"	E 57°54'07,472620"	140,0066	0,0000	0,0095	Yes
2	03.07.2007 08:33:21.000	N 58°29'11,701927"	E 57°54'07,500337"	140,0235	0,0000	0,0096	Yes
3	03.07.2007 08:33:22.000	N 58°29'11,705458"	E 57°54'07,535014"	140,1952	0,0000	0,0130	Yes

Figure 102. Report

Trajectory

Multiple bases kinematic data processing generates new trajectory object in the Kinematic mode with options:

1. *Adjust* – running kinematic solutions adjustment:

2. *Delete* – drop last adjustment from a project and redraw map;

3. Zoom to - show entire trajectory;

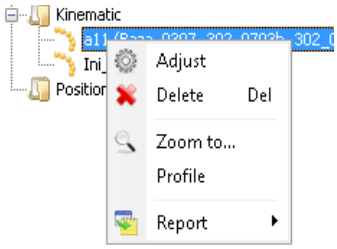


Figure 103. Node options

4. *Profile* – open new pane with epoch table and vertical profile.

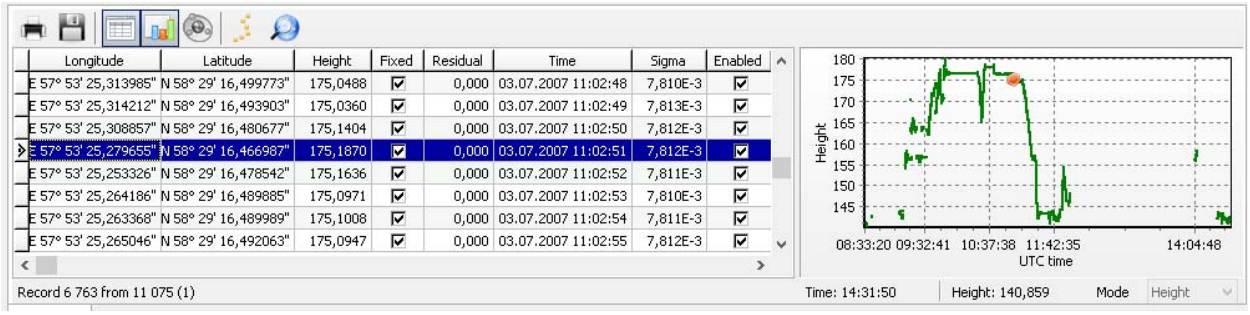


Figure 104. Profile

Selection row in the table pane generates orange colored circle on graph.

9. Localization

9.1. Introduction

The basic coordinate system which is used for data storing, post-processing and geodetic network adjustment is geocentric WGS-84. To transform coordinates to a local grid coordinate system (LCS) we need:

1. Reference ground points in a grid coordinate system.

2. Mathematical algorithms of conversion from WGS-84 into LCS.

Sequence of conversions is shown below.

1. Geocentric coordinate systems conversions done using Helmert transformation formula (Amendment 2 to RTCM STANDARD 10403.1): =

$$\begin{bmatrix} X_T \\ Y_T \\ Z_T \end{bmatrix} = \begin{bmatrix} dX \\ dY \\ dZ \end{bmatrix} + M \times R \times \begin{bmatrix} X_S \\ Y_S \\ Z_S \end{bmatrix} (1)$$

(X_S, Y_S, Z_S) - geocentric WGS 84, (X_T,Y_T, Z_T) - reference geocentric (S -Source, T - Target);

dX, dY, dZ - translations in X,Y,Z;

M - scale factor. M = (1 + dS *10^{-6}).

Values dS in a datum list are in a ppm (1ppm = 1*$10^{-6)}$.

Rotation matrix: $R = R_x \times R_y \times R_z$, where

$$R_x = \begin{bmatrix} \cos R_1 & \sin R_1 & 0 \\ -\sin R_1 & \cos R_1 & 0 \\ 0 & 0 & 1 \end{bmatrix}; R_y = \begin{bmatrix} \cos R_2 & 0 & -\sin R_2 \\ 0 & 1 & 0 \\ \sin R_2 & 0 & \cos R_2 \end{bmatrix}; R_z = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos R_3 & \sin R_3 \\ 0 & -\sin R_3 & \cos R_3 \end{bmatrix}, (2)$$

R_1, R_2, R_3 - angles between axes of source and target coordinate systems. Angles are calculated anticlockwise.

Inverse transformation formula:

$$\begin{bmatrix} X_s \\ Y_s \\ Z_s \end{bmatrix} = \frac{R^{-1}}{M} \left[\begin{bmatrix} X_T \\ Y_T \\ Z_T \end{bmatrix} - \begin{bmatrix} dX \\ dY \\ dZ \end{bmatrix} \right], (3)$$

Helmert conversion is a similarity transformation so scale factor is the same for each axes. A set of seven transformation parameters and an ellipsoid is geodetic datum. In a datum list parameter signs of translation correspond to transformation from WGS-84 to reference. Example: dX = +10 meters. X_{Ref} = $X_{\text{WGS 84}}$ + 10.

Transformation from geocentric to geodetic coordinate system (B - latitude, L - longitude, H - Height) could be done:

$$\tan L = Y/X$$

$$\tan B = \frac{Z}{\sqrt{X^2 + Y^2}} + \frac{e^2 \times N \times \sin B}{\sqrt{X^2 + Y^2}}, (4)$$

$$H = \frac{\sqrt{X^2 + Y^2}}{\cos B} - N$$

N - radius of curvature of prime vertical, e - eccentricity of ellipsoid.

Inverse transformation from geodetic to geocentric could be done using:

$$X = (N + H) \times \cos B \times \cos L$$

$$Y = (N + H) \times \cos B \times \sin L, (5)$$

$$Z = (N + H - e^2 \times N) \times \sin B$$

where e - major semi-axes of ellipsoid

In order to determinate geodetic to grid coordinate transformation, we must specify type and parameters of cartographic projection.

The distance along the normal to ellipsoid named geodetic height - H_{geod}.

Geodetic height can be calculated according to the formula:

$$H_{geod} = H_{ortho} + \zeta, \quad [6]$$

here H - geoid height undulation above the ellipsoid.

Geoid undulations are provided by a digital geoid models which are incorporated into JAVAD general data base of coordinate transformations - GeoData.

Final step of conversions (number 4 on a figure), is a localization (calibration) based on computing of 7-th parameters of a plane and a vertical conversion by least-squares procedure.

Plane transformation is given by formula similar to (1):

$$\begin{bmatrix} N_T \\ E_T \end{bmatrix} = \begin{bmatrix} dN \\ dE \end{bmatrix} + M \times R \times \begin{bmatrix} N_S \\ E_S \end{bmatrix}, (7)$$

where R = $\begin{bmatrix} \cos(\alpha - \sin\alpha) \\ \sin\alpha\cos\alpha \end{bmatrix}$

Formula (7) could be written as:

$$N_T = dN + M \times (N_S \times \cos\alpha - E_S \times \sin\alpha)$$

$$E_T = dE + M \times (N_S \times \sin\alpha + E_S \times \cos\alpha), (8)$$

dN, dE - translations along northing and easting axes.

N_S, E_S, N_T, E_T - (*Northing* and *Easting*) are plane coordinates. α - clockwise rotation angle. *M* - scale factor.

Inverse plane transformation is

$$\begin{bmatrix} X_S \\ Y_S \end{bmatrix} = \frac{R^{-1}}{M} \left[\begin{bmatrix} X_T \\ Y_T \end{bmatrix} - \begin{bmatrix} dX \\ dY \end{bmatrix} \right]$$

Vertical coordinate can be computed as

$$H_T = H_S + dH + \alpha_N \times N_S + \alpha_E \times E_S$$

H_S , H_T - heights in a source/target coordinate system, *dH* - height shifts, - angles with *Northing* and *Easting* axes.

Plane and vertical transformation parameters are computed separately thus local datum is so-called 4+3 datum emphasizing the difference with a global 7-th parameters datum given by formula [1]. To calculate four plane transformation parameters we need 2 points with postulated coordinates. In the meantime we need 3 points to determine 3 parameters of vertical transformation.

9.2. Getting LCS

Run localization procedure by clicking Localization option in a Tools item of Main program menu. Localization procedure uses project *Sites* coordinates for computing so we recommend to process GNSS data and adjust a network. Reference points can be used in localization as well.

Accuracy of localization procedure depends on inner adjustment errors, reference points consistency, cartographic projection type and parameters reliability.

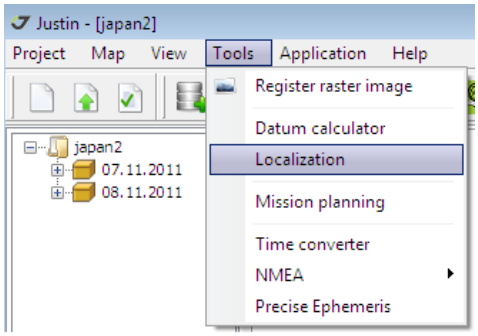


Figure 105. Tools ▸ Localization

Initially localization window offers four area to control a computing of local datum (Figure 106).

- Main menu - M;
- Tool bar - T;
- Settings panel - S;
- Input table - I;

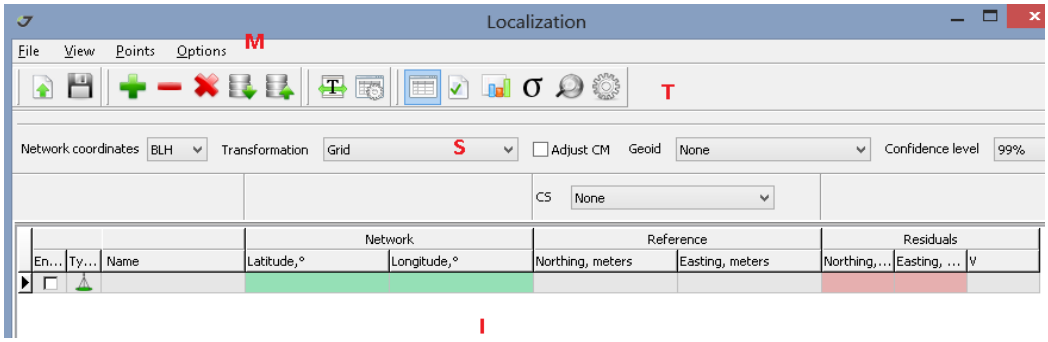


Figure 106. Localization window

9.3. Main menu

Items File View Points Options were designed for import/export data into the table, viewing of local systems parameters, templates management, table view structure controls.

File

The menu offers next option list:

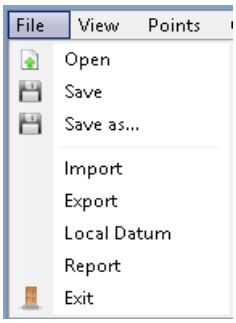


Figure 107. File item menu

Open - open a localization project from a database.

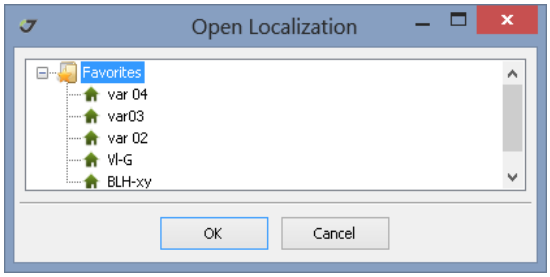


Figure 108. Open localization

Save - save (save as) completed localization

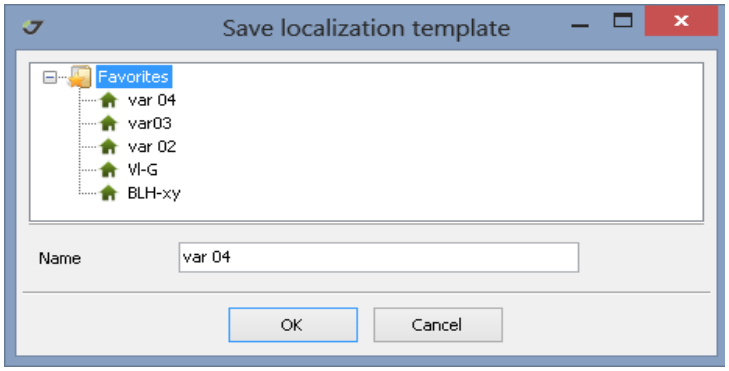


Figure 109. Save template

Import - open localization project from jcs (Justin coordinate system) format file.

Export - save completed localization into jcs format (Figure 110):

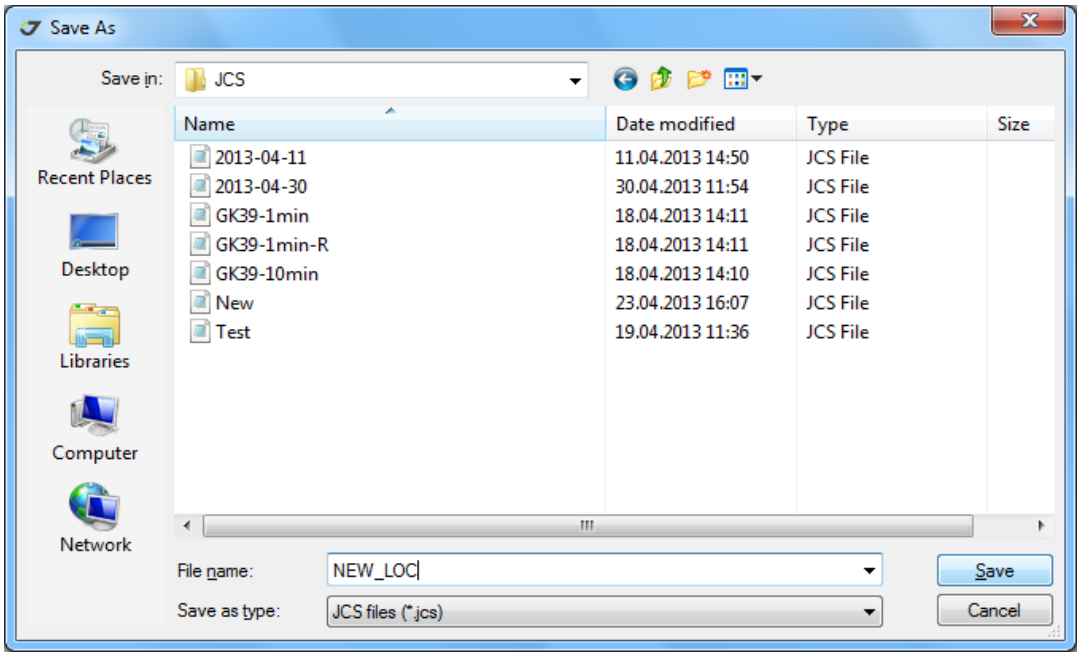


Figure 110. Localization Export

It's possible to store multiple localizations into a file (close localization window, switch to Project properties and Coordinate systems tab). According to this while importing from *.jcs file with multiple coordinate systems user should select appropriate localization from a list (Figure 111).

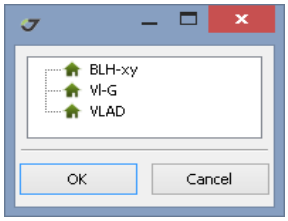


Figure 111. Coordinate system selection

Local datum - table view of datum parameters (Figure 112). There are all completed localization projects in the list. If *Apply last coordinate system* checked (*Main menu* ▸ *Application* ▸ *Options* ▸ *Common*) then last project localizations will be copied also.

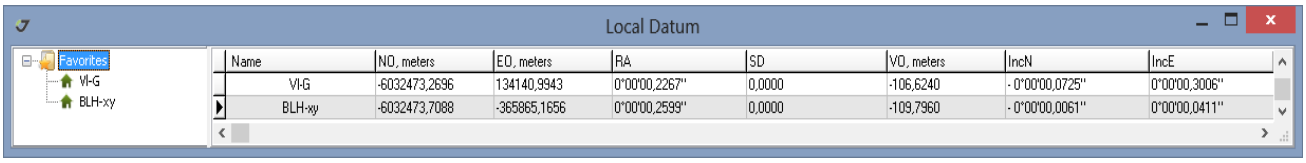
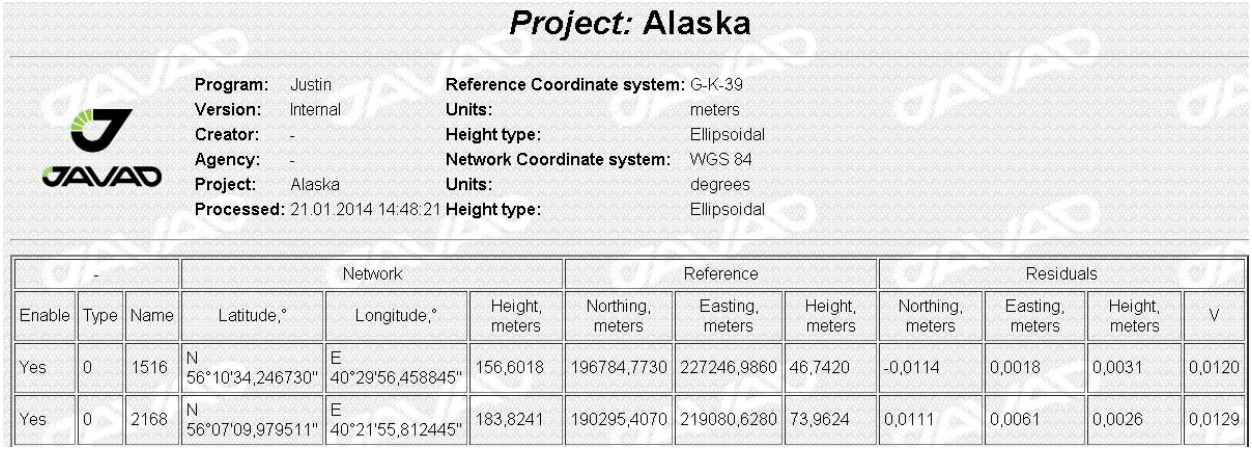


Figure 112. Local Datum

Report - publishing a document related to localization with an abstract, table of coordinates and statistics.



Project: Alaska

Program:	Justin	**Reference Coordinate system:**	G-K-39
Version:	Internal	**Units:**	meters
Creator:	-	**Height type:**	Ellipsoidal
Agency:	-	**Network Coordinate system:**	WGS 84
Project:	Alaska	**Units:**	degrees
Processed:	21.01.2014 14:48:21	**Height type:**	Ellipsoidal

-			Network			Reference			Residuals			
Enable	Type	Name	Latitude,°	Longitude,°	Height, meters	Northing, meters	Easting, meters	Height, meters	Northing, meters	Easting, meters	Height, meters	V
Yes	0	1516	N 56°10'34,246730"	E 40°29'56,458845"	156,6018	196784,7730	227246,9860	46,7420	-0,0114	0,0018	0,0031	0,0120
Yes	0	2168	N 56°07'09,979511"	E 40°21'55,812445"	183,8241	190295,4070	219080,6280	73,9624	0,0111	0,0061	0,0026	0,0129

Figure 113. Report

Close - drop localization window.

View

Drop down options of *View* menu compound localization window (Figure 114),

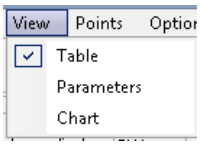


Figure 114. View item menu

Check Table, Parameters, Chart option to view Table (T), Parameters(P), Chart(C) panes (Figure 115).

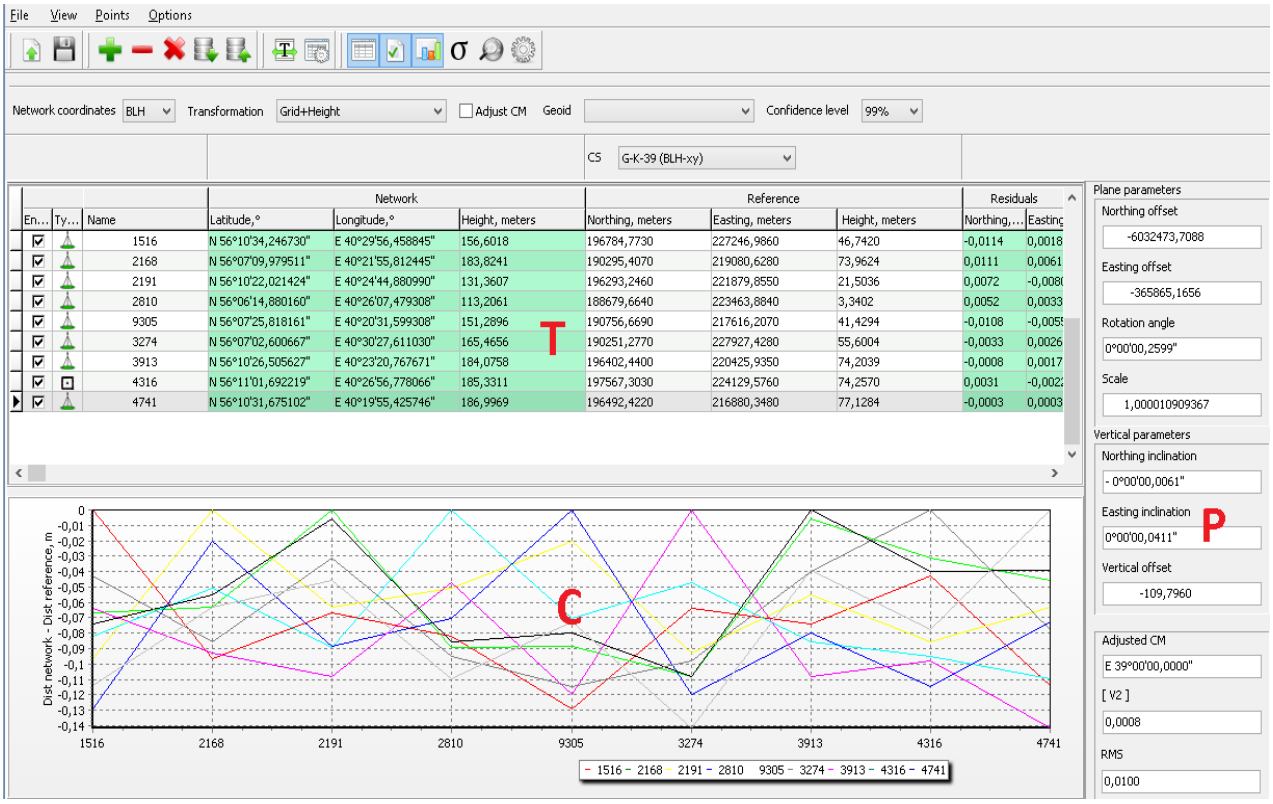


Figure 115. Localization window view

Points

Menu offers next options:

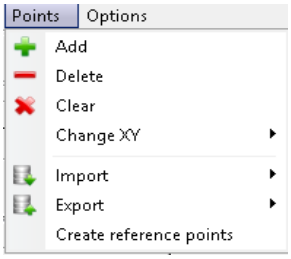


Figure 116. Points menu item

- Add - append a row to the table
- Delete - drop selected row
- Clear - drop all rows

- Change XY - swapping data between Northing/Easting columns in Network or Reference panes.

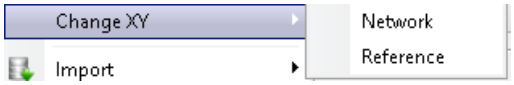


Figure 117. Change XY

- Import - import external source coordinate data: text files, *Pinnacle* software localization file format, program and project reference points.

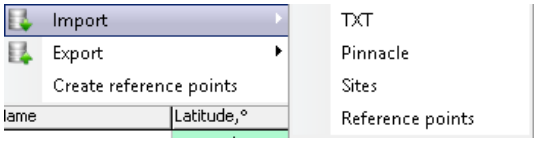


Figure 118. Import

- Export - upload coordinates as a text file or *Pinnacle* format file

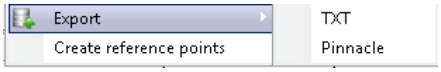


Figure 119. Export

- Create reference points - copy point into Justin program or project reference points database. Item is enable if localization has been successfully completed.

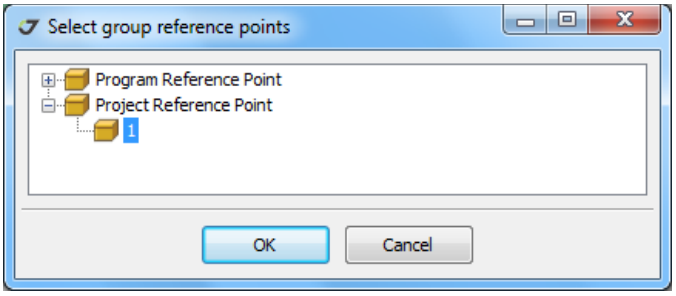


Figure 120. Reference points

Options

An item offers table view properties settings

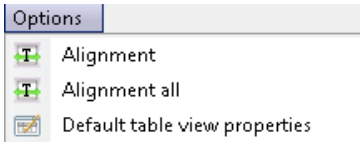


Figure 121. Options menu item

- Alignment - set column width according to maximum cell size
- Alignment - set all column according to maximum cell size
- Default table view properties - restore initial settings

9.4. Tool bar

Tool bar icons offer quick access to the most frequently repeated procedure.

 - open localization project

 - save localization

 - append a row to the table

 - delete a selected row

 - delete all rows

 - import coordinates into the table from a text file and ***Pinnacle*** format files

 - export coordinates from the table to text files and ***Pinnacle*** format files

 - set column width according maximum cell size

 - restore table view and data format by default

 - show/hide table

 - show/hide Parameters pane

 - show/hide a Chart

 - show/hide Sigmas columns

 - reserved to requests

 - run calculation

Coordinate data table

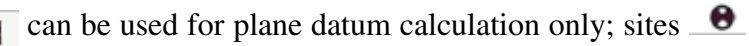
A table (Figure 122) is intended for input data by import and editing and residuals output. Table columns are joint in three blocks: *Network, Reference, Residuals.*

Network columns show coordinates from one of the project coordinate systems. As a rule they are coordinates of sites calculated with adjustment under inner constraints. *Reference* columns show coordinates of local plane coordinate system. *Residuals* show statistics

			Network			Reference			Residuals			
Enable	Type	Name	Latitude,°	Longitude,°	Height, meters	Northing, meters	Easting, meters	Height, meters	Northing,...	Easting, ...	Height, ...	V
☑		1516	N 56°10'34,246730"	E 40°29'56,458845"	156,6018	196784,7730	227246,9860	46,7420	-0,0114	0,0018	0,0031	0,0120
☑		2168	N 56°07'09,979511"	E 40°21'55,812445"	183,8241	190295,4070	219080,6280	73,9624	0,0111	0,0061	0,0026	0,0129
☑		2191	N 56°10'22,021424"	E 40°24'44,880990"	131,3607	196293,2460	221879,8550	21,5036	0,0072	-0,0080	0,0072	0,0130

Figure 122. Coordinate data table

Enable – enable/disable row data in calculation

Type – assign type of site. Sites marked as  can be used for plane datum calculation only; sites  can be used for vertical datum only; sites  can be used for both datums calculation.

To switch between reference points type left-click on a cell in *Type* column.

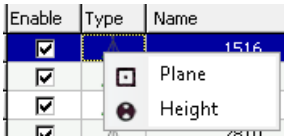


Figure 123. Switching between reference points

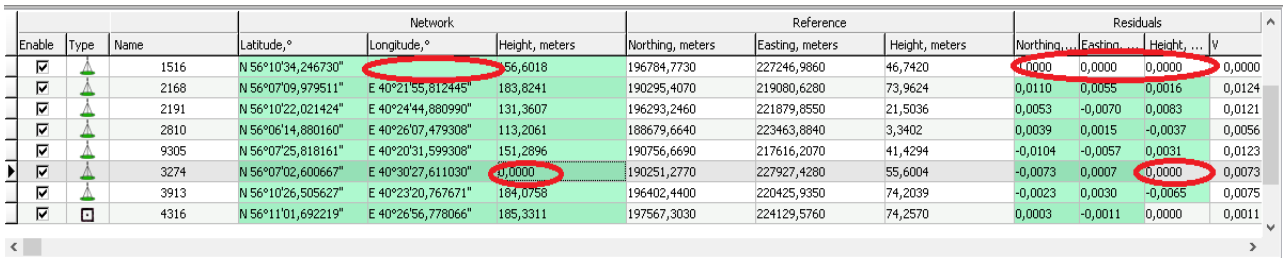
Network coordinates could be geodetic (Latitude, Longitude, Height), geocentric (XYZ) or grid (Northing, Easting, Height) types. Reference block coordinates are plane ones.

We use colors for data separation. *Justin* calculated coordinates (*Network* block) are shown above green background. Residual fields are shown in red initially. So localization is a kind of adjustment then we run tau-test for blunders detection. tau-test procedure compares residuals with a priori site accuracies. If Tau-test failed for some sites then corresponded fields shown in red.

Disabled rows are light Grey. In this case residuals equal to zero and appropriated fields are left blank.

For editing data in the input area do left double click on the field. To save input press *Enter* or pressing and holding left mouse button move cursor away from the field.

Empty fields in *Network* columns do not estimated in datum calculation. Residuals valued as a zeros. Empty fields in *Height* column affect how vertical datum will be calculated.



			Network			Reference			Residuals			
Enable	Type	Name	Latitude,°	Longitude,°	Height, meters	Northing, meters	Easting, meters	Height, meters	Northing, ...	Easting, ...	Height, ...	V
☑		1516	N 56°10'34,246730"		56,6018	196784,7730	227246,9860	46,7420	0,0000	0,0000	0,0000	0,0000
☑		2168	N 56°07'09,979511"	E 40°21'55,812445"	183,8241	190295,4070	219080,6280	73,9624	0,0110	0,0055	0,0016	0,0124
☑		2191	N 56°10'22,021424"	E 40°24'44,880990"	131,3607	196293,2460	221879,8550	21,5036	0,0053	-0,0070	0,0083	0,0121
☑		2810	N 56°06'14,880160"	E 40°26'07,479308"	113,2061	188679,6640	223463,8840	3,3402	0,0039	0,0015	-0,0037	0,0056
☑		9305	N 56°07'25,818161"	E 40°20'31,599308"	151,2896	190756,6690	217616,2070	41,4294	-0,0104	-0,0057	0,0031	0,0123
☑		3274	N 56°07'02,600667"	E 40°30'27,611030"	0,0000	190251,2770	227927,4280	55,6004	-0,0073	0,0007	0,0000	0,0073
☑		3913	N 56°10'26,505627"	E 40°23'20,767671"	184,0758	196402,4400	220425,9350	74,2039	-0,0023	0,0030	-0,0065	0,0075
☑		4316	N 56°11'01,692219"	E 40°26'56,778066"	185,3311	197567,3030	224129,5760	74,2570	0,0003	-0,0011	0,0000	0,0011

Figure 124. Adjustment

9.5. Information pane

By clicking  make new information pane to appear right of the table view. It shows transformation parameters as well as statistics of calculation. An example on the Figure 125 relates to localization of coordinate system based on Transverse Mercator projection.

Plane parameters:

- Northing offset - translation along Northing direction
- Easting offset - translation along Easting direction
- Rotation angle - clockwise rotation around plane perpendicular axe.
- Scale - scale factor

Vertical parameters:

- Northing inclination - angle measured from Northing direction;
- Easting inclination - angle measured from Easting direction;
- Vertical offset - height translation

Projection parameters:

- Adjusted CM - Central Meridian of Transverse Mercator projection which deals lowest rout mean square value.

- Statistics: [V2] - sum of square residuals; RMS - rout mean square value

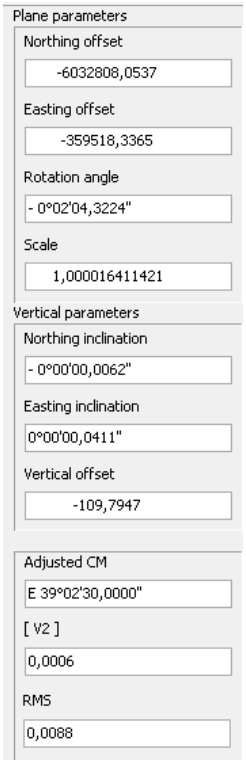


Figure 125. Plane parameters

Residual Chart

By clicking  make to open a chart of residuals.

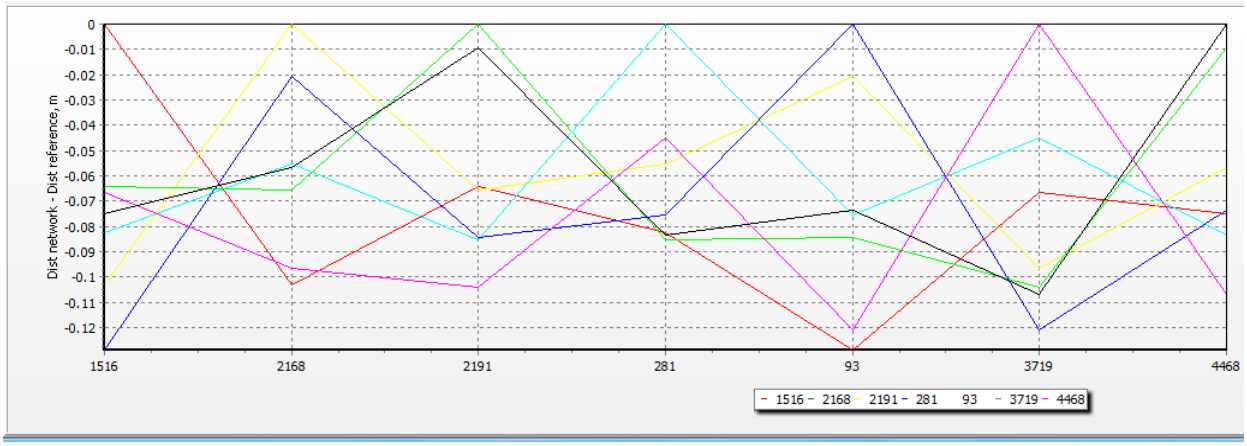


Figure 126. Chart of residuals

Residual chart may be useful for removing blunders in input. We calculate distances between corresponding points in a Network and Reference blocks and make a comparison. As a rule distances

which are in same row of the table must be close each other. All blunders could be easily detected and corrected with a chart.

9.6. Setting panel (pop-down menus)

A panel is intended for a table arrangement and for setup of a localization.f

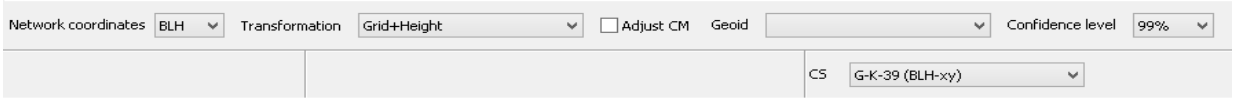


Figure 127. Panel

Network coordinates

Coordinates view setting affects how will be treated data imported into Network block of the table.

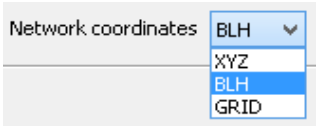


Figure 128. Network coordinates

Depending on the choice (XYZ - geocentric, BLH - geodetic, GRID - plane) it arranges table view and patterns of input data (refer to item Import into the table).

Anyway *Network coordinates* setting affects how data will be represented in table only. As it was mentioned above project database repository stores coordinates as WGS-84 coordinate systems. To deal data in any others coordinate systems we use fully determined straightforward conversions from WGS-84 with known datum and cartographic projection. Instead of a Network data block data in Reference coordinates columns of a table cannot be anyhow recalculated without localization as a local datum is primarily unknown.

To specify input reference data type select from a list user defined coordinate system with a special datum type - None.

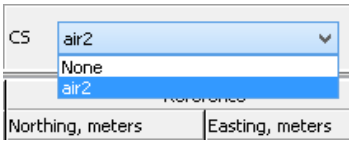


Figure 129. User defines coordinate system

None item is an unique special coordinate system intended for first time localization in the case of unknown cartographic projection.

Follow *Application* in main program menu, then click *Projection* option. Coordinate system category is a *Projection properties d*ialog window must be user defined. Datum is specified as *None*.

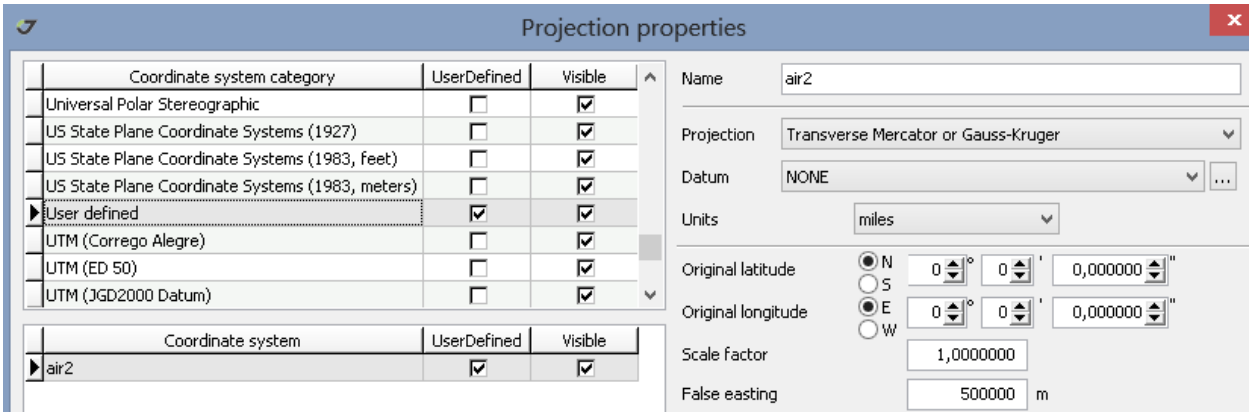


Figure 130. Projection properties

Transformation

This is a control for localization parameters calculation:

Grid - 4 plane parameters;

Height - 3 vertical parameters;

Grid+Height - full set of 7 (4+3) parameters.

Shifts only - 2 plane and 1 vertical translations. All rotations equal zero, scale equals 1.

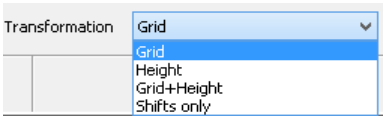


Figure 131. Transformation

Adjust CM

The check box runs iteration process for projection central meridian fitting (if central meridian exists).

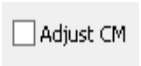


Figure 132. Adjust CM

We are searching for central meridian value that minimizes sum of squares of residuals. Searching range is 6 degrees zone around network middle point. Step of iteration along longitude equals 10".

Sum of squares of residuals is shown in column [V2] Figure 123 on page 95.

Geoid

Geoid menu offers a choice from a list of geoids from a folder c:\ProgramData\JAVAD GNSS\GeoData. To add a geoid to a list follow: *Application* ▸ *Options* ▸ *Geoid*.

If one of geoids was selected than all heights in Network block will be corrected for geoid undulations according to [6] on page 86.

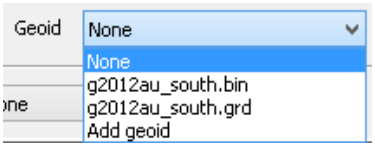


Figure 133. Geoid selection

There is a warning for points which are outside of selected geoid boundary (Figure 134).

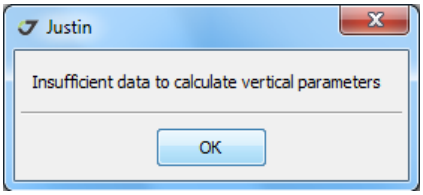


Figure 134. Warning

Confidence level

Confidence value used for calculation threshold in blunders detection procedure during τ-test.

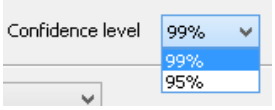


Figure 135. Confidence level

Value equals 95% corresponds to more narrow interval. It is more strict criterium than 99%

CS Reference

CS (*C*oordinate *S*ystems) option offers a choice from a list of user defined coordinate systems

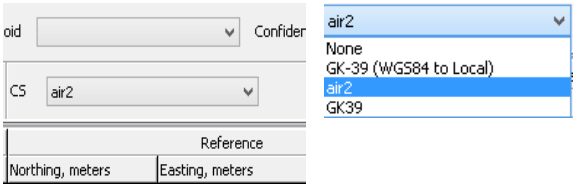


Figure 136. User defined coordinate system

An accuracy of calculation depends on network and reference coordinates as well as on reliable type of cartographic projection. Localization module does not calculate projection parameters except fitting of central meridian for Transverse Mercator projection.

If reference cartographic projection is unknown than select ***None***. In this case Oblique stereographic projection will be applied. Scale factor equals 1, central points is center of minimum boundary rectangle unclosed network.

CS Network

As a rule Network data are results of network adjustment. (all Sites are in WGS-84 in Justin project database). Main localization goal is a snapping of free network to control ground points (reference).

Meantime, cartographic projection have to be specified if data were imported from external sources as a grid (LCS) from text format file.

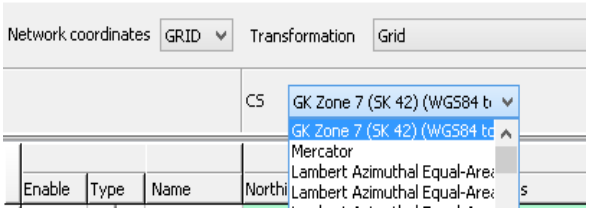


Figure 137. Network coordinates

otherwise a warning appears

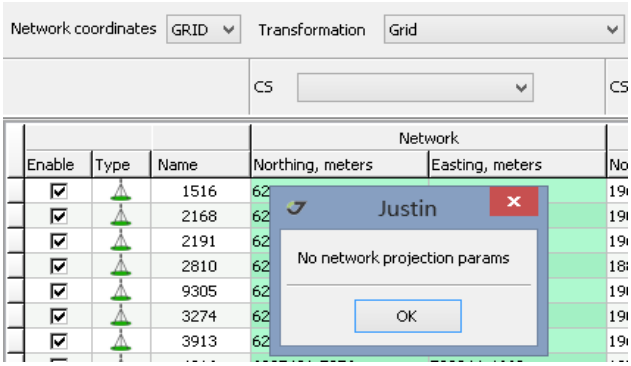


Figure 138. Warning

A sequence of coordinate transformations for network data in grid is:

Figure 139. A sequence of coordinate transformations for network data in grid

We check reliability of conversion (step 1 on Figure 139) doing inverse calculation from geodetic to grid. If parameters of cartographic projection are not convenient for imported data (not correct zone, scale,

central meridian) vice versa calculations get too big residuals (>0.01 meters) in initial Grid data and a warning appears.

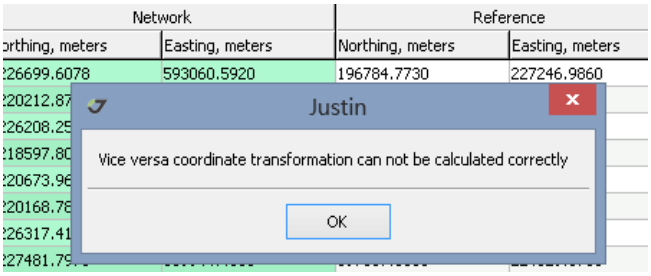


Figure 140. Warning

9.7. Import coordinates

Use *Points* ▸ *Import* options in a main Localization window to load data into the table.

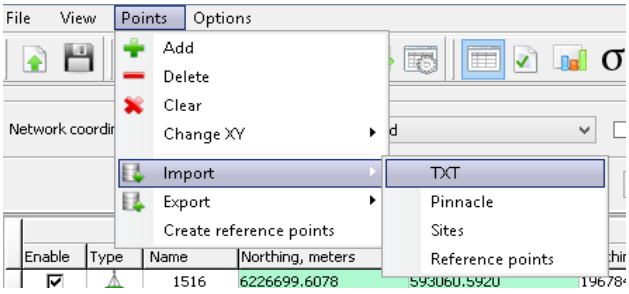


Figure 141. Loading data

Sites and *Reference points* items load data from running project. Otherwise click on a toolbar  button intended for import external text data.

Import external free format data

Free format text data could be loaded separately in Network and Reference blocks with a templates. A template appears automatically since text file has been opened. Items in a *Value* column have predefined style settings accessible via pop-down menu.

Below, there are examples for network data input as well as for reference ones.

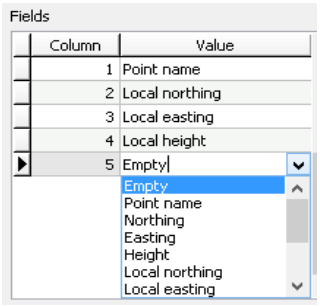


Figure 142. Import external free format data

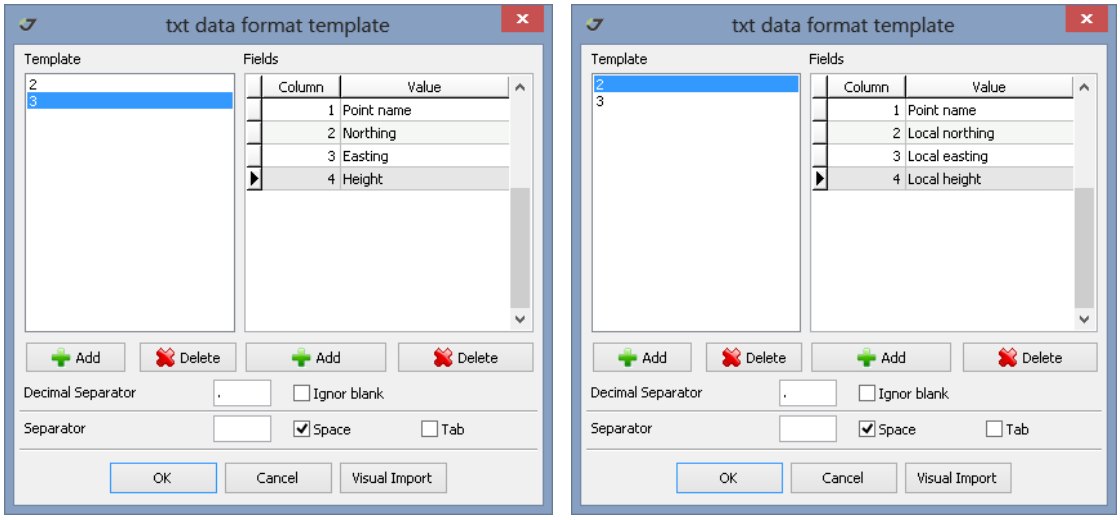


Figure 143. txt data template

Import Pinnacle format data

Select *Pinnacle i*tem (see Figure 144). Files of type are Pinnacle format (*.text). Click file name to load.

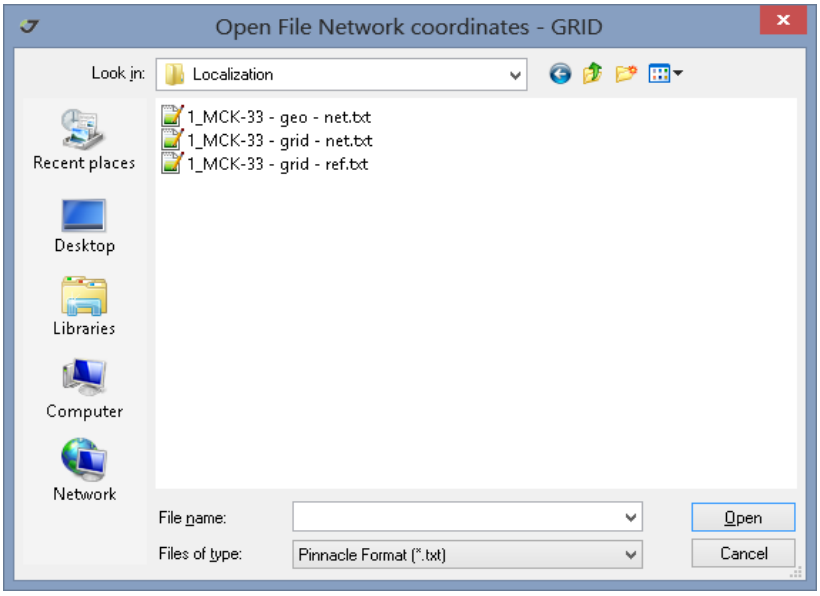


Figure 144. Loading data in Pinnacle format

Import sites from a project

Click *Sites* item. Check Sites to import as Network data in a dialog *Select Sites* (Figure 145).

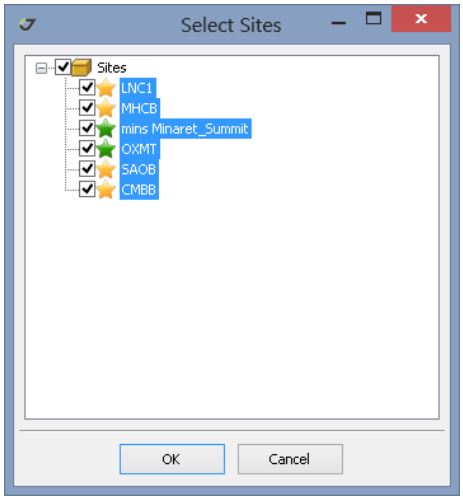


Figure 145. Import of sites

Import reference points

Click *Reference points* item (see Figure 146). It offers to check items from program data base as well as from a project. Check items which should be imported as Network data.

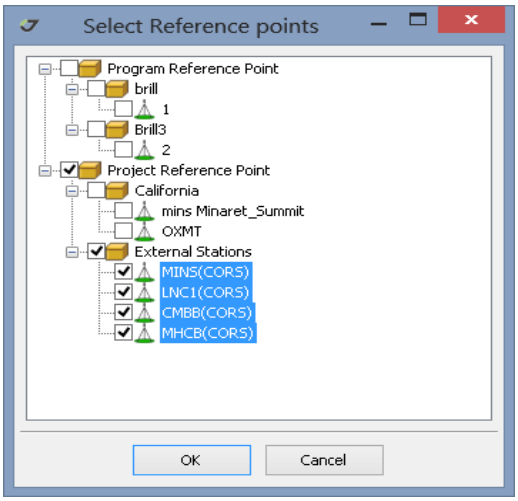


Figure 146. Import of reference points

Examples

One of most frequent asked question about a localization is related to dimension of area where accuracy of local datum “4+3” coordinates transformations will be compatible with calculations using global datums. Below we figured out two examples of localization.

We consider Transverse Mercator projection case (Figure 147). In first example (I) localization band overlaps 6 degrees zone and comes out of zone boundary 1º more. In second case (II) 3º band comes from centers of zone to a boundary under direction 45º. In both cases zone width equals 2'.

We use four points at the corner of the band as a reference in grid. Coordinates were calculated with a global datum.

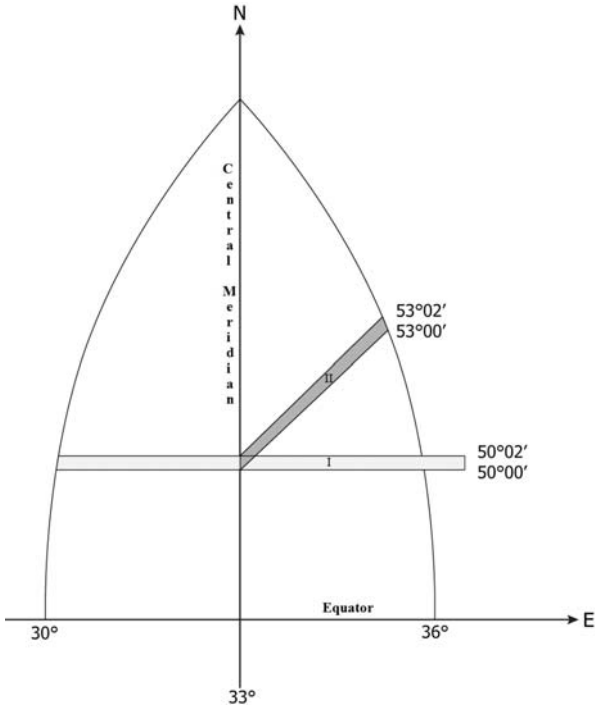


Figure 147. Transverse Mercator projection

In localization we ignored global datum parameters and got WGS-84 zero datum.

Assume that cartographic projection type and zone were known. Central meridian value was one of a goal of localization.

Tables at Figure 148 show residuals of localization for both cases. Resume that we could neglect very small residuals in a surveying and in a lot of geodetic applications.

So to reach a high accuracy we should know only type of cartographic projection of LCS.

				Network		Reference		Residuals		
	Enable	Type	Name	Latitude,°	Longitude,°	Northing, meters	Easting, meters	Northing...	Easting...	V
	☑		1	N 50°02'00.000000"	E 30°00'00.000000"	5548981.8946	285195.0788	0.0004	0.0003	0.0005
	☑		2	N 50°02'00.000000"	E 37°00'00.000000"	5552337.0813	786662.0578	0.0001	0.0003	0.0003
	☑		3	N 50°00'00.000000"	E 37°00'00.000000"	5548630.9990	786860.6143	-0.0001	-0.0003	0.0003
▶	☑		4	N 50°00'00.000000"	E 30°00'00.000000"	5545275.1214	285046.2101	-0.0004	-0.0003	0.0005

				Network		Reference		Residuals		
	Enable	Type	Name	Latitude,°	Longitude,°	Northing, meters	Easting, meters	Northing...	Easting...	V
	☑		1	N 50°02'00.000000"	E 33°00'00.000000"	5544666.7306	500117.1110	0.0001	-0.0001	0.0001
	☑		2	N 53°02'00.000000"	E 36°00'00.000000"	5882652.9202	701350.3735	-0.0003	-0.0003	0.0004
	☑		3	N 53°00'00.000000"	E 36°00'00.000000"	5878944.7597	701505.5947	0.0003	0.0003	0.0004
▶	☑		4	N 50°00'00.000000"	E 33°00'00.000000"	5540959.0735	500117.0940	-0.0001	0.0001	0.0001

Figure 148. Residuals of localization

In the case when the type and parameters of projection are known and a global datum was not determined a localization may be applied to create new coordinate system based on reference points. A discrepancies of reference point positions will overpass in localization by least square procedure in adjustment with fixed constraints and similar transformation.

We put tables on Figure for comparison results of coordinates transformations with Justin coordinate calculator based on 7 parameters global datum and two local datum (according case shown on Figure 147).

Central points of above mentioned zone was used as example. Maximum variance does not exceed 0.005 meters in the second case (slant zone).

Finally we pay attention how localization can value unknown central meridian of projection. We ran a procedure to calculate it in iteration. Reliable estimation of searching is RMS (root mean square) of residuals (Figure 149).

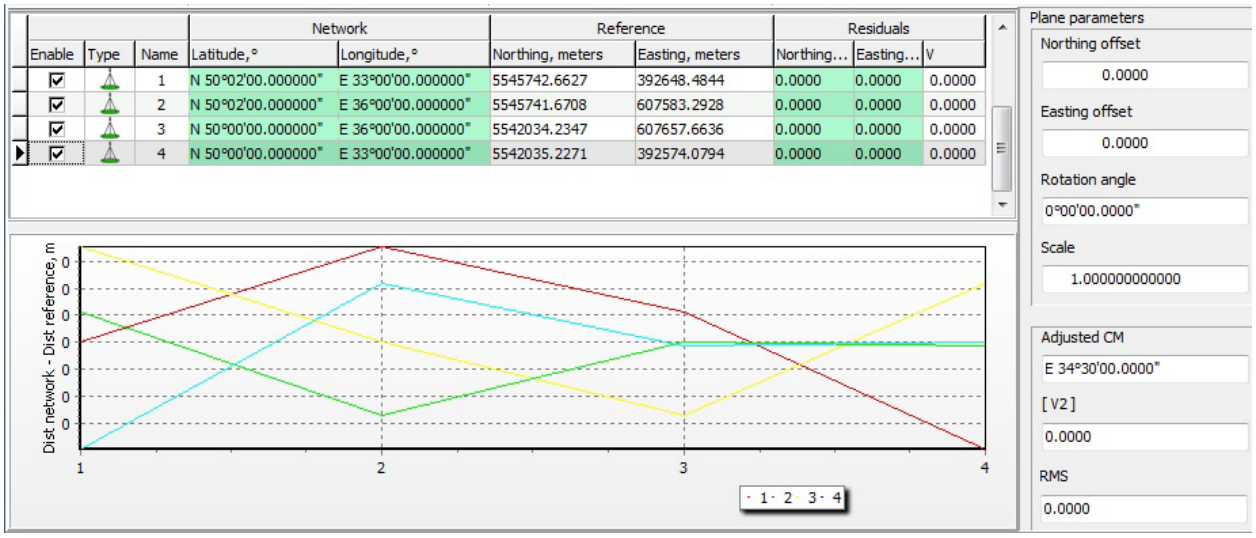


Figure 149. Reliable estimation of searching is RMS of residuals

We defined in Justin coordinate transformation on a some non zero global datum and Transverse Mercator projection with central meridian equals 34°30'05". Localization data were calculated on the base of the transformation for an area corresponded case II.

In a localization procedure we set WGS-84 datum and Transverse Mercator projection. We make central meridian calculation.

Results are on Figure 150. Iteration step equals 10" so estimated value has 5 mm difference with postulated value. In the meantime coordinates calculation yields accuracy above 0.0001 m.

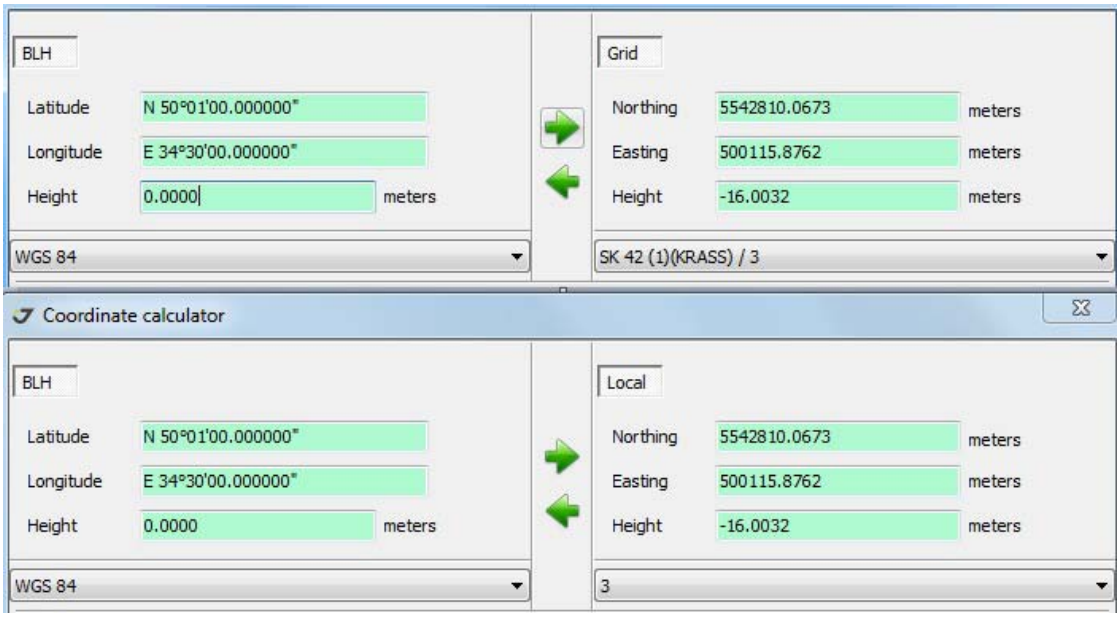


Figure 150. Results

Recommendations for applying:

- Adjustment with fixed constraints corrupts good results of GNSS network inner adjustment due to dependency from reference points. Localization may to scatter initial points irregularity and bring a results which meet project accuracy requirements.
- If adjustment in 2D/3D mode detects discrepancy in plane and vertical components of solutions it might has sense to switch from Helmert 7 parameters datum to local (4+3) one.
- Global datum of local coordinate system is unknown and cartographic projection determined.
- Reference points are determined as unknown grid. We can try Transverse Mercator with central meridian fitting or Oblique Stereographic projection for data approximation
- No quite good geoid model.

Above mentioned recommendations are valuable in combination with network adjustment under fixed constraints. In the meantime datum parameters could be used in other applications if coordinate transformations are required.

10. Datum calculator

To calculate the datum in Justin perform the following:

Click *Tools* ▸ *Datum calculator.*

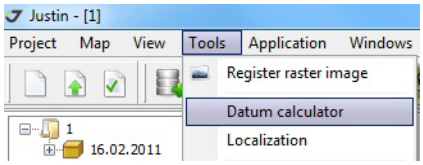


Figure 151. Datum calculator

In the *Datum calculator* window enter the calculated points coordinates to the *Network* columns, and reference points coordinates. See the full description of the toolbar icons in the “Localization” on page 85.

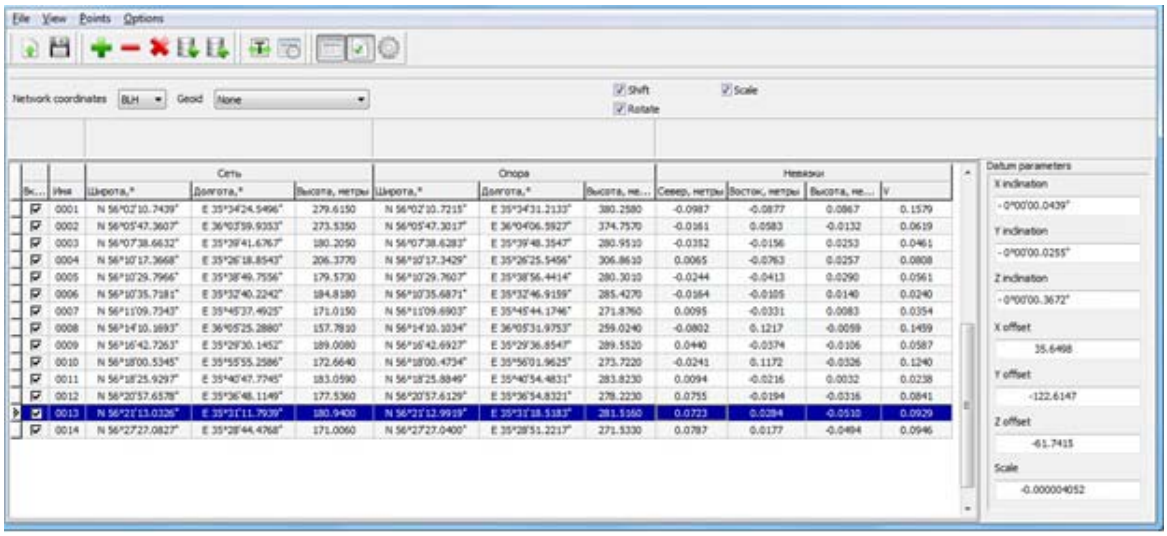


Figure 152. Data table

Define the geoid model if you use the orthometric heights. Check Shift, Rotate, and Scale boxes to set unknown parameters to compute.

To start calculations click  . In the Residuals columns will appear the point residual components and rms value. In the Datum parameters pane, will be shown the calculated parameters.

11. Reference points

Without reference points the coordinate transformations have formal sense. Adding reference points in the project is performed in two steps. The reference point have to be entered in a program database first. Then using the *Project properties* dialog the reference points are copied to a project. In fact, the reference point defines the coordinate system itself.

11.1. Adding reference points to the program database

To add the reference points to the program database, perform the following:

1. Left click the reference points button  or click *Options* ▸ *Reference points*:

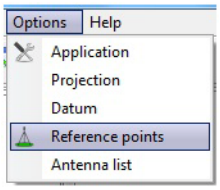


Figure 153. Reference points

2. In the Reference points window activate the *Reference List* tab and highlight *Reference points,* then right-click and call the menu. Select *Add group*.

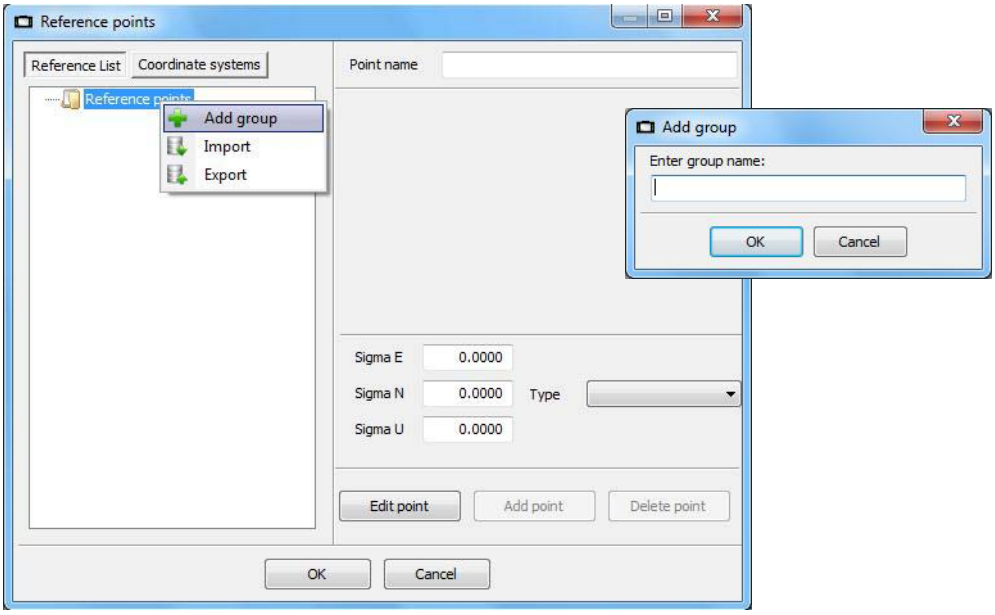


Figure 154. Add group

3. Enter the group name.
   Groups are used to simplify the search and copy of the reference points according any criterion: area, coordinate system, etc.

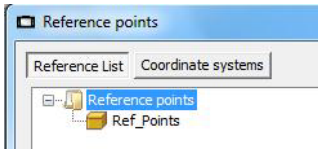


Figure 155. Group name

4. Select the group name and right-click to highlight it, them activate *Coordinate System* tab and select the needed coordinate system for the point. On the right pane appears the dialog box for the selected coordinate system:

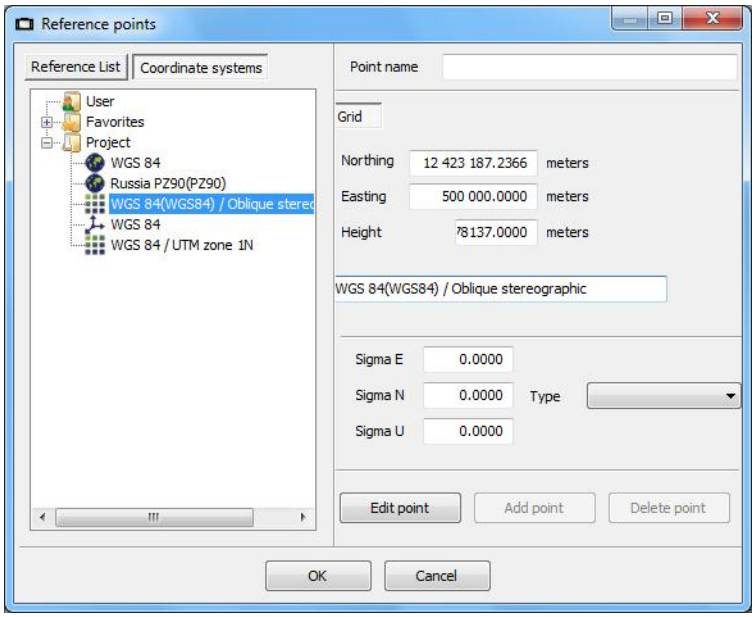


Figure 156. Select coordinate system

5. Click *Edit point* and enter point name, coordinates. Select the point type: plane, height, plane and height, enter coordinates sigmas if needed and click *Add point*. The point will be added to the group, and its coordinates will be added to the program database.

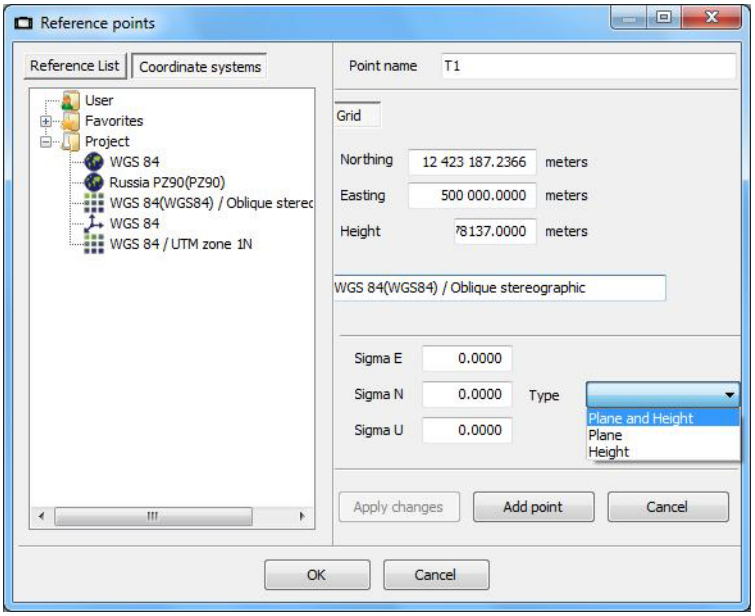


Figure 157. Edit coordinate system of the point

6. Repeat steps above to add more points. The list of these points will be displayed in the group:

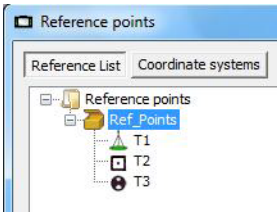


Figure 158. Group of the reference points

You can sort data in a list by right clicking upper item.

Depending on the type of referencing, all points will be marked with the following symbols:

- plane and height fixed;
- plane fixed;
- height fixed.

To manage the group of points use the right-click menu. The group can be renamed, deletes, the new points (**.jst*,**.csv*, **.txt* (see "Import files to the project" on page 49 for the detailed format description) can be imported to the group; one or more points can be exported to the **.jst* file.

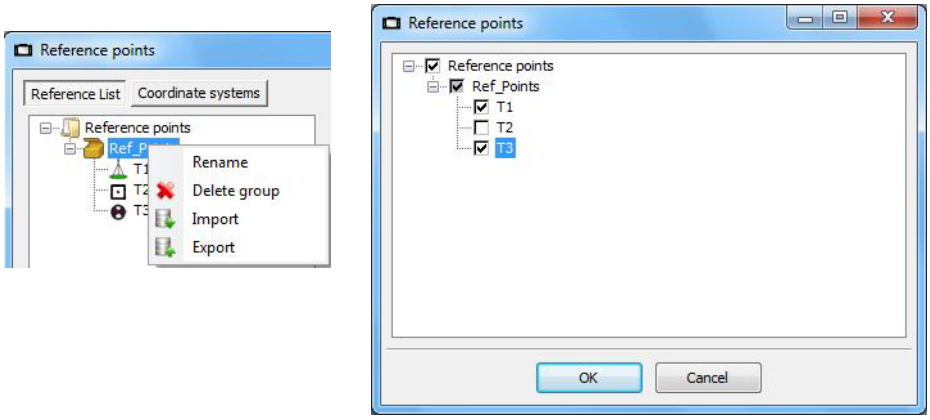


Figure 159. Right-click menu

The menu can be called by right-click on the point in the list. All operations will be applied to the selected point.

To rename the point and edit its coordinates and type, select the point in the group and on the right-click the *Edit point* button. Refresh the information by clicking appropriate button.

To delete the point, select it and click *Delete point*.

To save all changes click *OK* button in the *Reference points* window, otherwise all changes will be lost.

To move point into another group (if there are two and more groups), select the point and drag it:

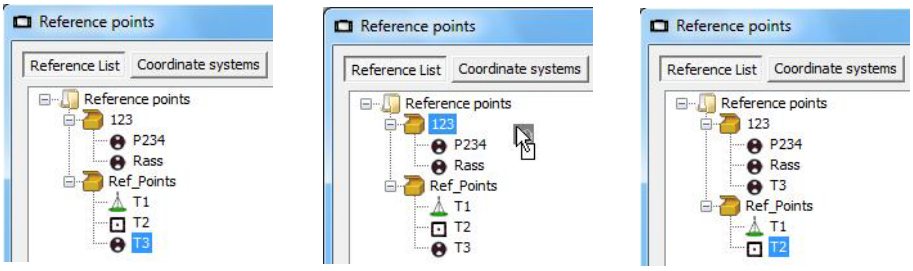


Figure 160. Drag and drop the point

The point will be removed from the initial group.

11.2. Copying the reference points to project database

To copy reference points to the project database, perform the following:

1. Click the  to create new project, or  to work with current project. Alternatively click *Project* ▸ *Properties*:

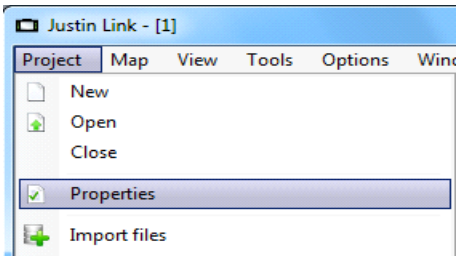


Figure 161. Project ▸ Properties

2. Click *Reference points* button, select the group name and click  , to copy it from the program to the project. The selected object will be copied to the project and its name appears in on the right in the *Project* folder.

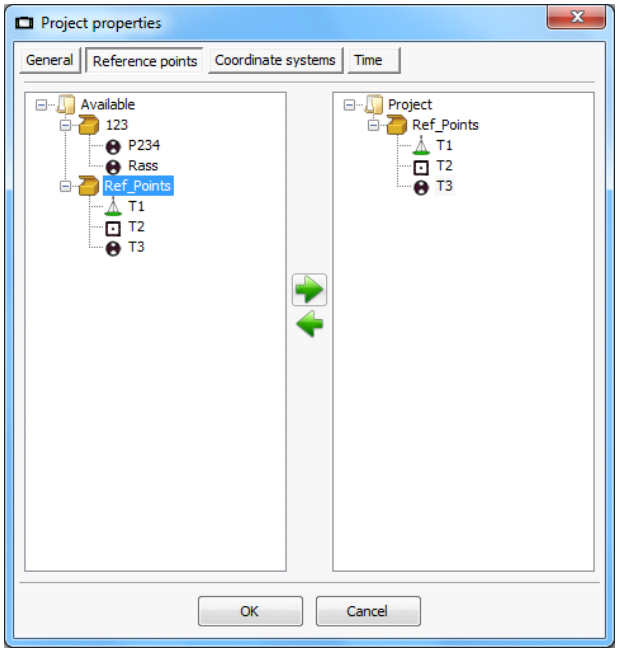


Figure 162. Adding referents

This operation is available for copying the reference points from program database, and vise versa from a project to the program database.

The reference points from the project can be copied to the program data base (*Available*), by clicking  .

Alternatively, drag the object on the left and drop it on the right. The object will be copied.

For the objects in the left part of the window the following menu items are available: *Add group, Import* (of the point(s) in *.jst* , **.csv*, **.txt* formats or of the group), *Rename, Delete group*:

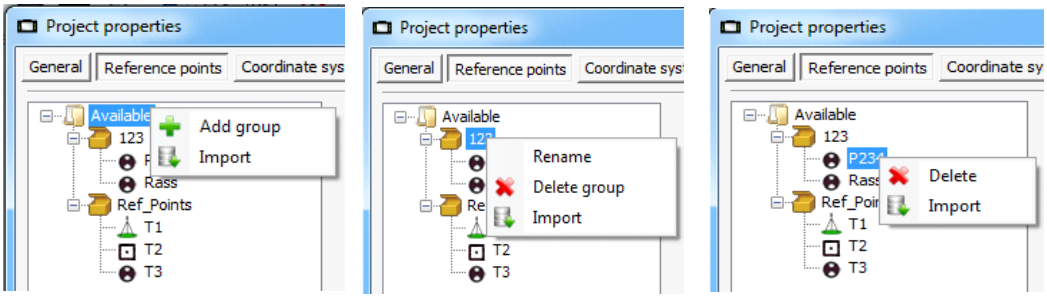


Figure 163. Right-click menu

For the objects on the right are available: *Import* (of the point(s) in *.jst* , **.csv*, **.txt* formats or of the group), *Delete group*, *Delete* (point):

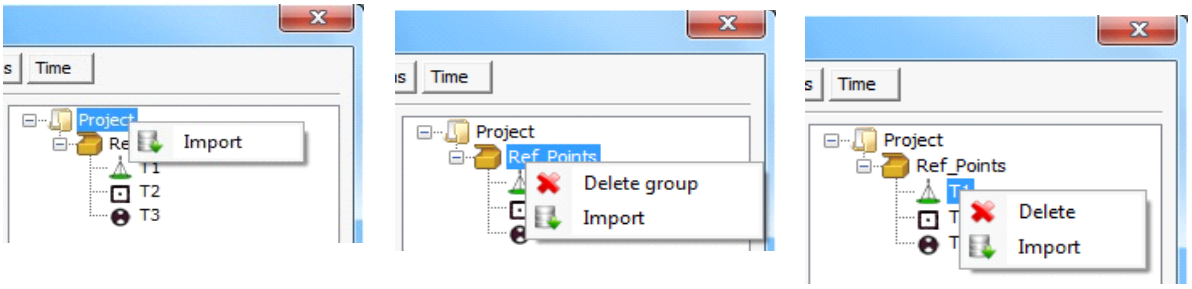


Figure 164. Right-click menu

To save all changes click *OK* button in the *Project properties* window, otherwise all changes will be lost.

11.3. Snapping Site to reference point

To snap a Site to a reference point (or to enter coordinates manually) select the needed Site in cartographic window and click right button. Click *Snap to...* menu item

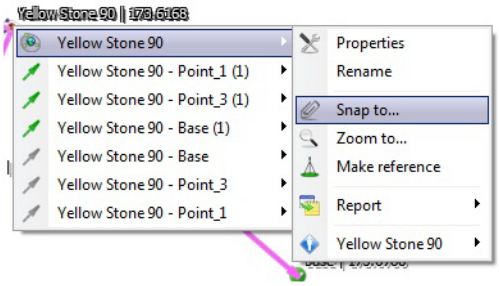


Figure 165. Snapping point to a reference point

In the *Reference points* window select the reference point the point will be snapped to and click *Snap to...* (Figure 166).

To correct the Site position on the map the manual entering of coordinates may be useful. The Sites snapped such way won't be considered as reference.

By choosing RINEX coordinates option the Site gets the coordinates from the RINEX-file header, if there is associated recordset, created by the import file in the RINEX format.

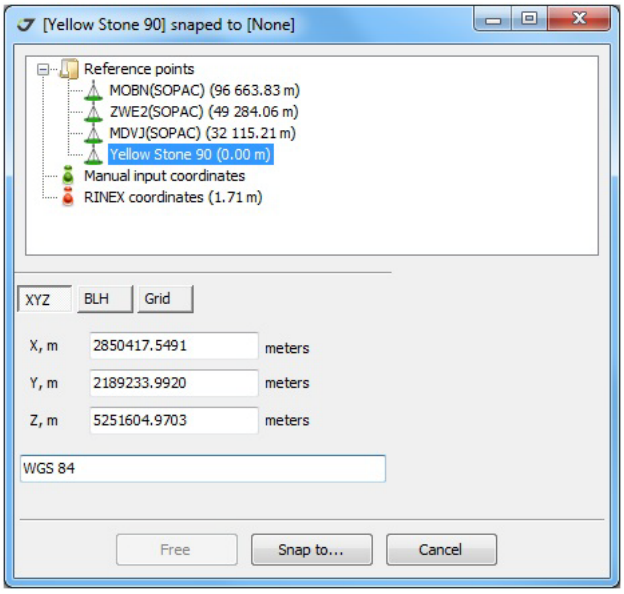


Figure 166. Point snapping information

12. Coordinate systems

Starting Justin version up 2.x.x.x, free application Coordinate System Editor data base GeoData should be used to create new coordinate systems. The application was designed to provide maximal compatibility of office and filed JAVAD GNSS softwares.

12.1. Creating new coordinate system

Justin internal coordinate module is mostly intended to keep the compatibility with version 1.x. It may be useful to users who are accustomed to a previous interface. Created with this module coordinate system can not be added to the *GeoData*, but they can be exported to the exchange format * .jcs, compatible with other office and field JAVAD software.

To add new coordinate system to the data base, first click *Options* ▸ *Projection.*

In the *Projection properties* window select the *User defined* row in top left part. When the *Add* button is active than the new system can be added.

Specify the name of coordinate system, projection type, datum, units, and projection parameters. Click *Add*. The new created coordinate system will appear in *Coordinate system* list.

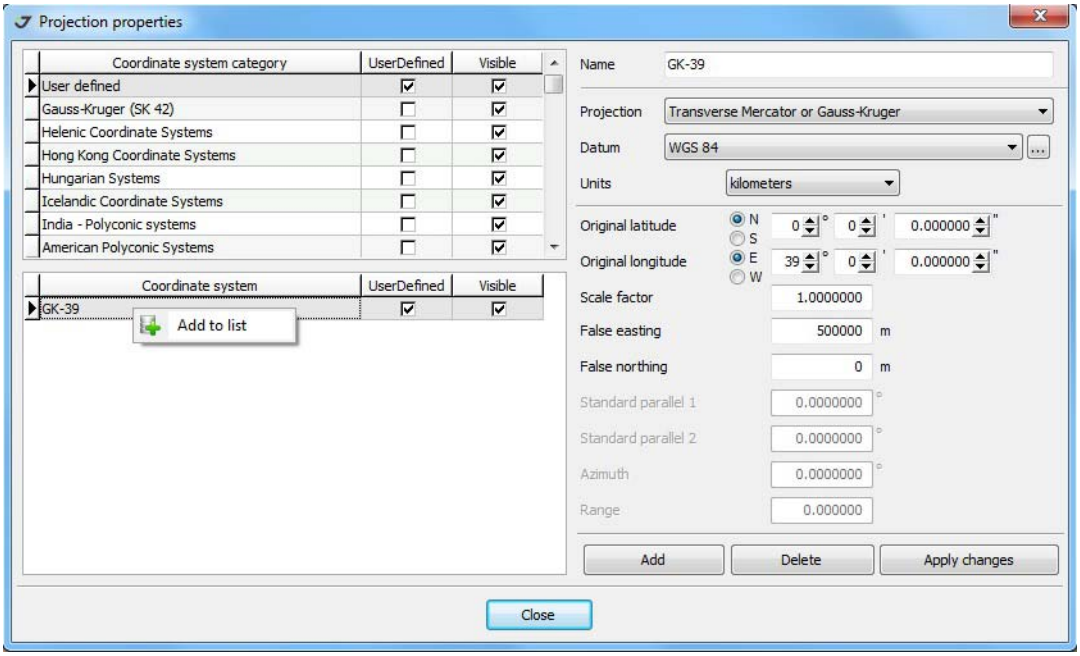


Figure 167. Adding user defined coordinate system

To delete user defined coordinate system, select it in the list and click *Delete*.

To create new coordinate system based on any existing, select the coordinate system in the list, on the right will be shown its parameters which can be edited. Click *Apply changes* to save the changes.

Add to list option allows adding created coordinate systems to the *Favorites*.

12.2. Selecting project coordinate system

Click *Project properties* ▸ *Coordinate system*. Initially the list of coordinate systems in the project is empty. To add the items to the list, use the folder *Favorites*. Folder *Favorites* could be empty too if you run Justin for the first time.

To add the coordinate systems to the *Favorites* list, perform the following:

1. Click *Options* ▸ *Application*:

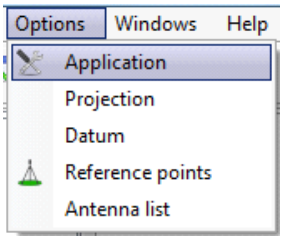


Figure 168. Options ▸ Application

2. In the *Options* window select *Coordinate system* tab. On the left there is coordinate systems tree. *Global* node is for worldwide coordinate systems; otherwise it is *Regional, User* node contains the customer's coordinate systems; *Favorites* node is for transferring coordinate systems to a project).

The coordinate system icon shows coordinate system type:

- Geocentric
- Geodetic
- Cartesian plane
- Local
- Height
- Geoid

On the right there is an information related to selected coordinate system. Switch to orthometric in Height field to apply a geoid. Join plane coordinate system with vertical datum from the list of systems.

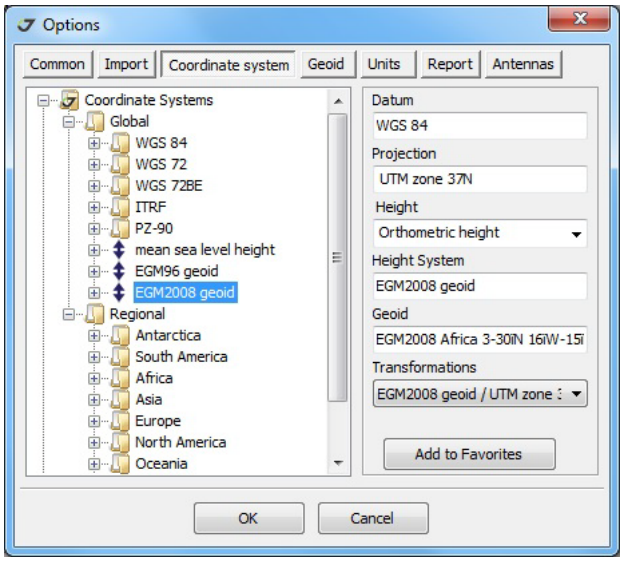


Figure 169. Coordinate system options

Click *Add*, and the coordinate system will be added to the *Favorites*. Repeat this with all systems you would like to add to the *Favorites*, then click *OK*.

Using right-click menu, the folders can be added or deleted from the *Favorites*. The coordinate systems can be removed from the folder, imported to the *Justin Coordinate Systems* format (**.jcs*) and exported to **.jcs*. Info data pane could be hidden to free room for Coordinate System name inspecting:

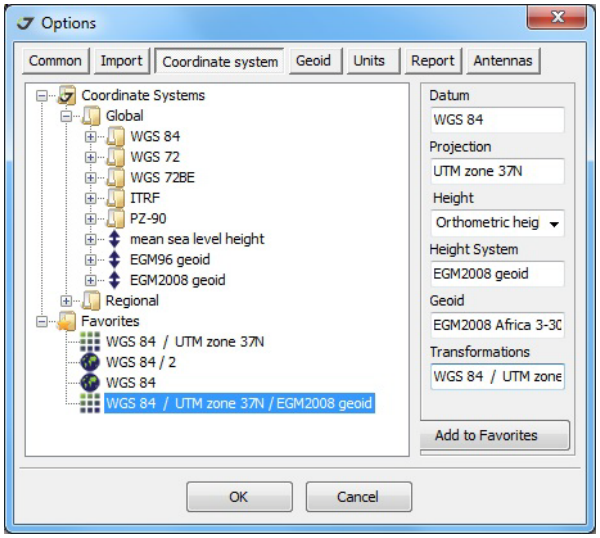


Figure 170. Add to Favorites

When the *Favorites* list is complete, click  or *Project* ▸ *Project properties*. In the *Project properties* window click *Coordinate systems* tab.

Select the coordinate system in the *Favorites* folder and drag it to the *Project* folder. Repeat this operation to add more coordinate systems..

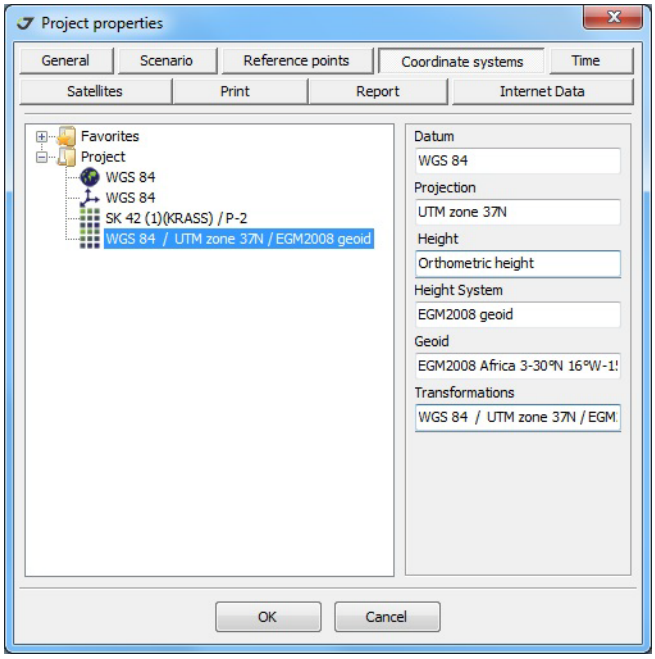
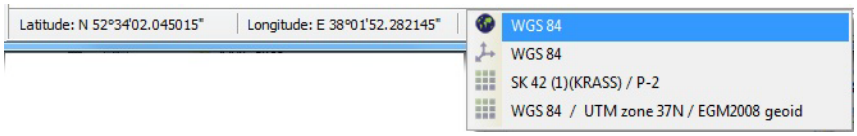


Figure 171. Selecting coordinate system

To switch between project coordinate systems, right-click on the control with the list of available coordinate systems and select the needed one. The coordinates in the left bottom program corner are matching active coordinate system.



The detailed information about coordinate system can be shown using *Show parameters* option:

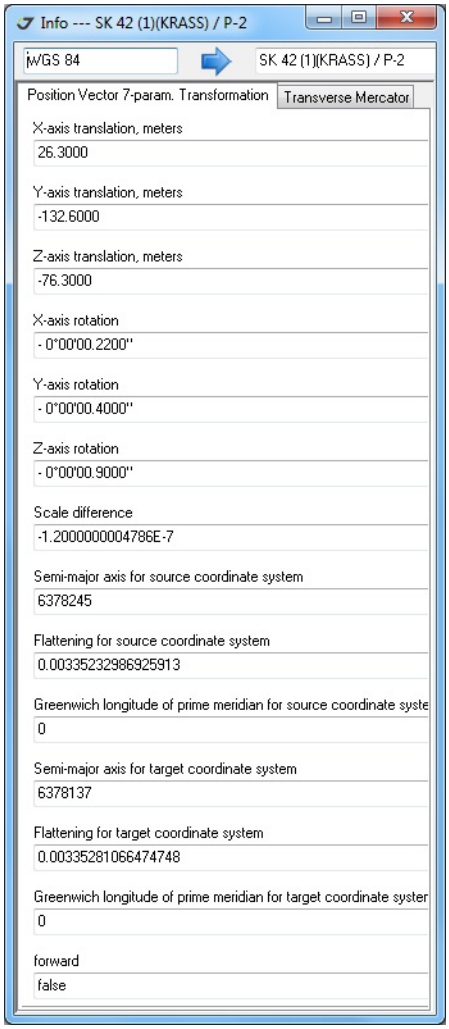


Figure 172. Detail coordinate system info

13. Datum

If you need to use a datum that isn't in the list of predefined datums, you can create a new one. To create a new datum, do the following steps:

From the *Options* menu, click *Datum*, it opens the *Datum properties* dialog window.

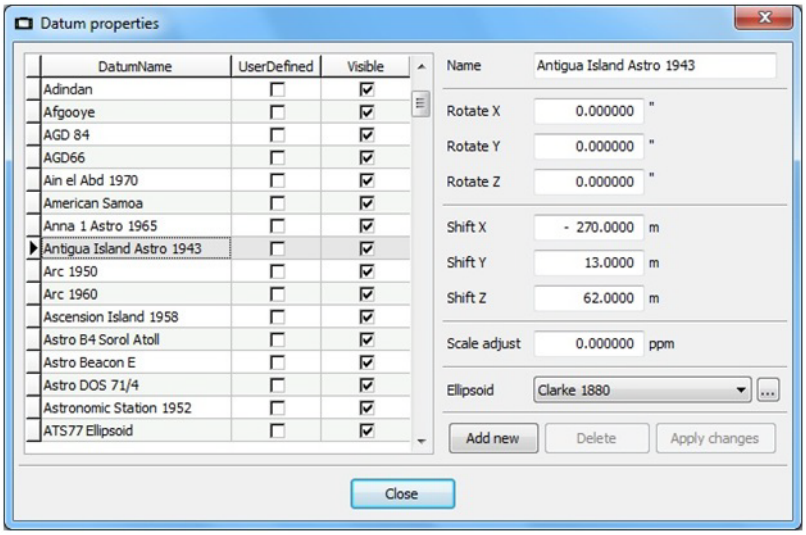


Figure 173. Datum properties

In the *Name* field, type a name for the new datum. Specify the rotation, shift, and scale adjust parameters in the corresponding fields. Click the *Add new* button. The new datum appears in the *DatumName* column as *UserDefined*. User defined datum can be deleted. Standard datums cannot be deleted from the list, the *Delete* and *Apply changes* buttons are inactive.

To edit the datum, click *Apply changes* after changes were made. Enable/disable flag in the *Visible* column to show/hide the datums in the *Projection properties* window.

All datum parameters are shown in the appropriate fields on the right after it is selected on the left.

To open the ellipsoid table, click ... next to *Ellipsoid* field. In the Ellipsoid properties window the selected ellipsoid parameters will be shown.

The ellipsoids cannot be edited. To add an ellipsoid to the list, contact JAVAD GNSS support.

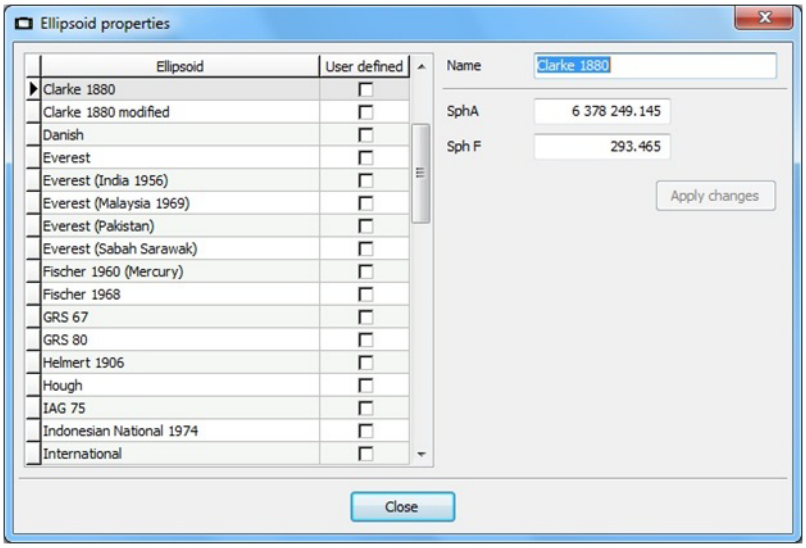


Figure 174. Ellipsoid properties

14. Antennas

14.1. Antenna properties

To add a new antenna to the antenna database, click *Options* ▸ *Antenna list*.

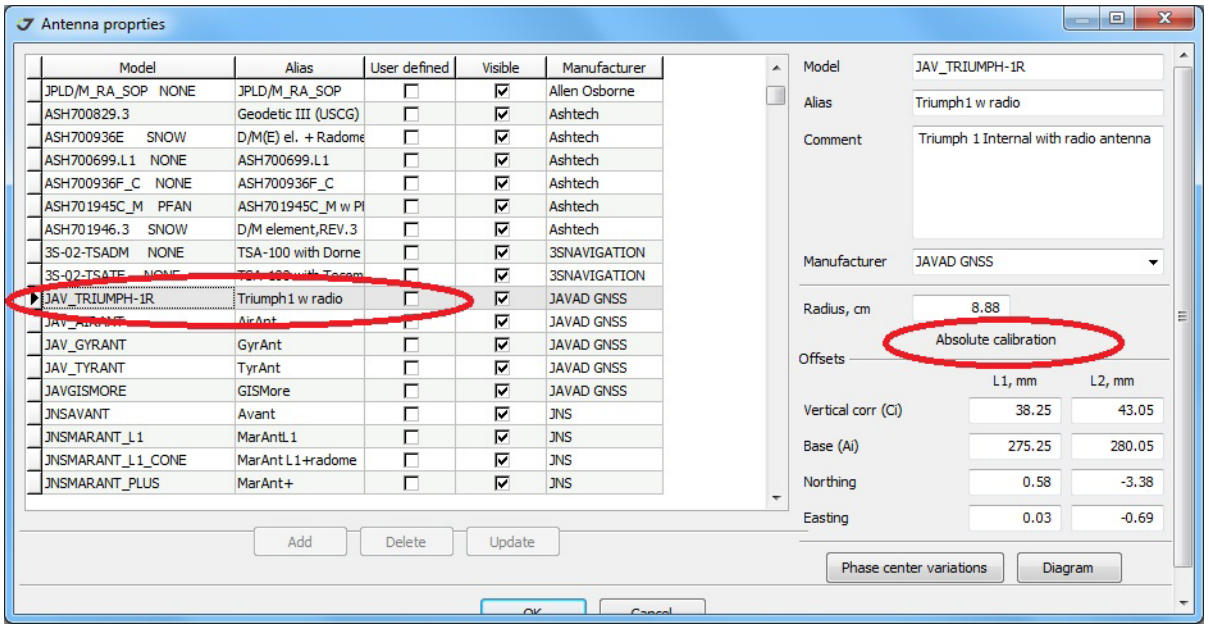


Figure 175. Antenna properties table

In the *Antenna properties* window the information about the antennas is presented. Select the antenna from the list and its specification will be shown on the right.

To add new antenna to the list, enter the antenna name to the *Model* field. Then click Add and add antenna properties. New added antenna is marked in the list as user defined.

To delete user defined antenna from the list, select the antenna and click *Delete*. To update antenna parameters (except name), click *Update*. The check mark *Visible* makes antenna visible/invisible in the antenna list in the *Recordset property* window. You can sort data in a table by right clicking field title.

Click *Diagram*, to see the antenna graph with description of the parameters, which should be entered for new antenna:

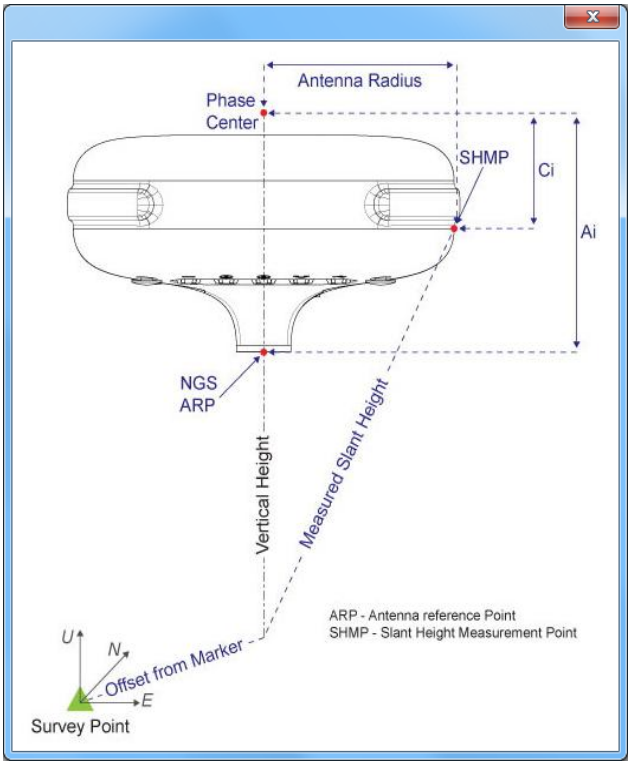


Figure 176. Geometrical antenna parameters

15. Surveying

The *Survey* tab includes the following object tree:

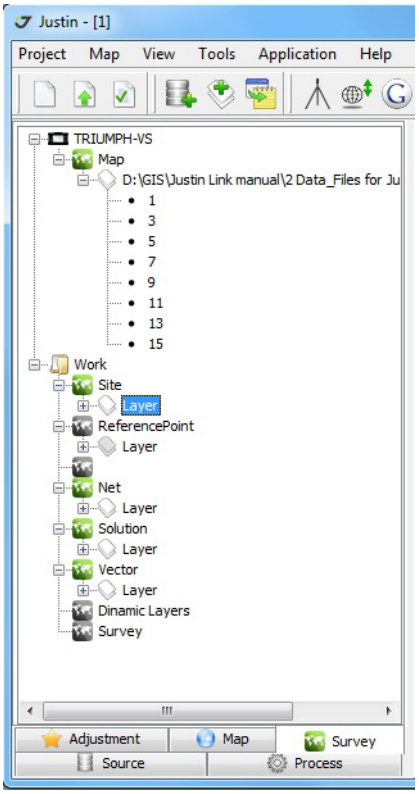


Figure 177. Survey tab

The main nodes are:

- -Receiver
- - Work - Folder

The sub node is *Map* - . It has the following sub nodes:

- Layers with the following objects:
  - point ,
  - polyline ,
  - parcel ,

Each item of the tree can be visible or hidden. To make the object visible or hide it, double click on the appropriate icon.

If the icon is active ( ), the layer is visible.

Otherwise icon is gray ( ), the layer is hidden.

All objects in the *Survey* tab have the same set of functions applicable to them (exception is *Work*, which does not have item *Properties*). The object functions can be opened by right button clicking and selecting from the list of items.

- *Properties* (unaccessible for *Work*). Opens the *Property* window (see “Properties”).
- *Style*. Opens *Layer style* window (see “Vector Layer Style Settings” on page 36).
- *Delete*. Deletes selected object.
- *Zoom*. Shows all objects on the map.
- *Google Speech*. Recognition audio information with the *Google Speech Recognition* service (see “Audio information recognition” on page 129).
- *Associated*. Denied update the field by Google Speech Recognition.
- *Associate by*. Indicates correspondence between items and Classifier (see “Classifier” on page 128).
- *View table*. Opens the *TVS* table (see “TVS Table” on page 134) for selected objects.
- *Export*. Opens *Export* window (see “Exporting data to exchange formats” on page 135).
- *Base snap to*. Snaps the base point coordinates to other coordinates (see “Properties”).

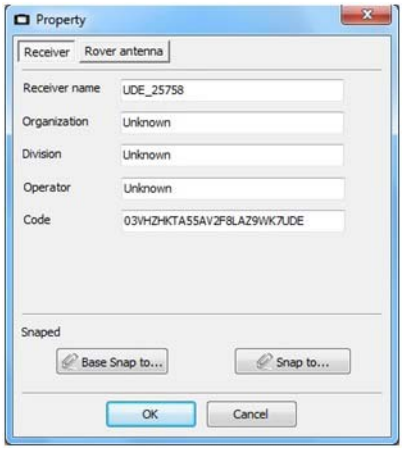
15.1. Properties

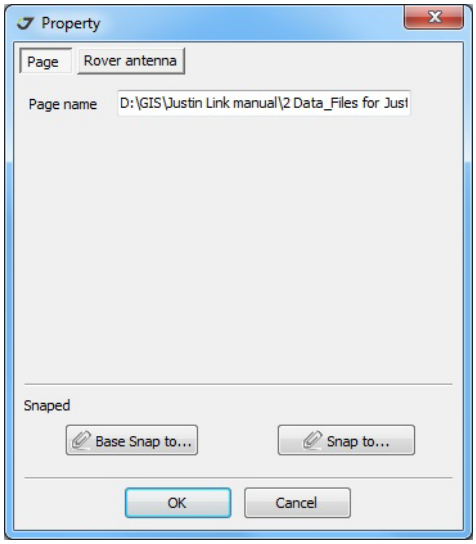
Depending on the object type the *Property* window’s view varies:

Receiver - Dialog for metadata,

Map - Dialog for operation in group with

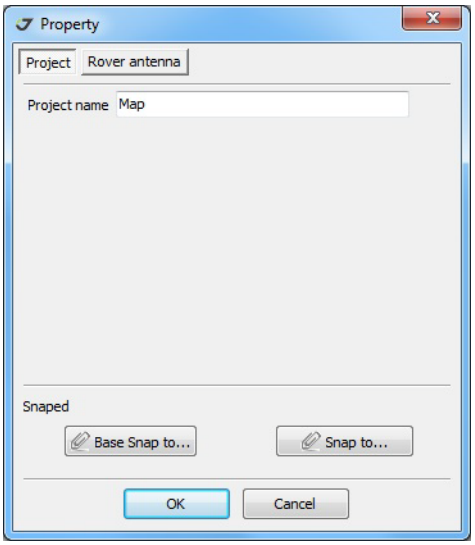
point snapping, offsets, antenna

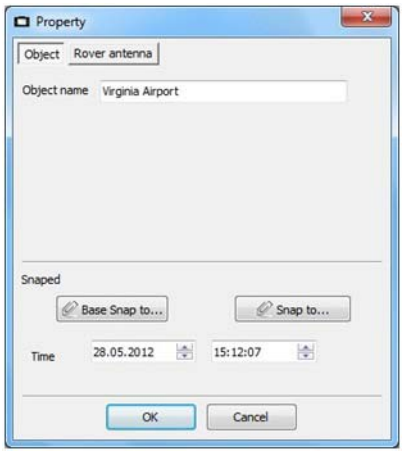




Layer - Group operation with a layer

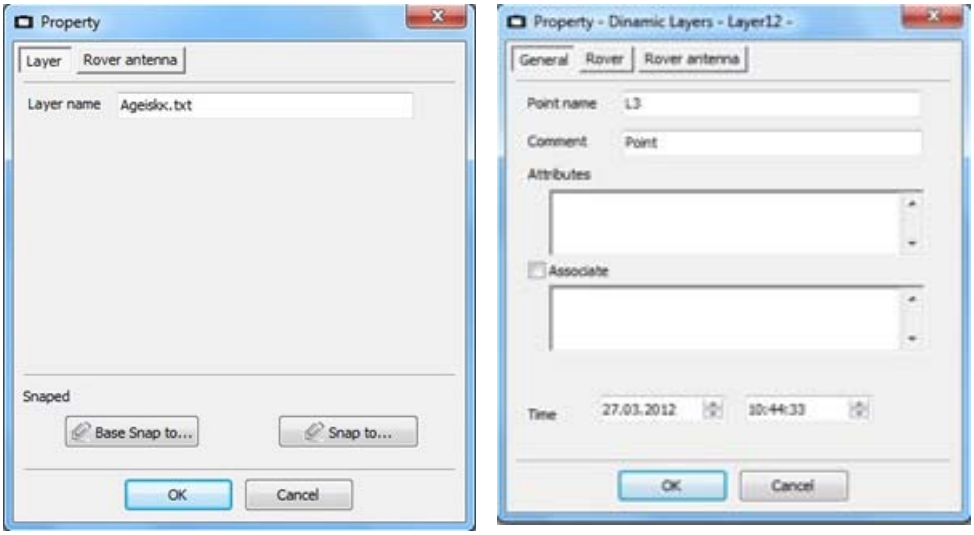
snapping, antenna properties, offsets





Object or - Single operation with

selected object

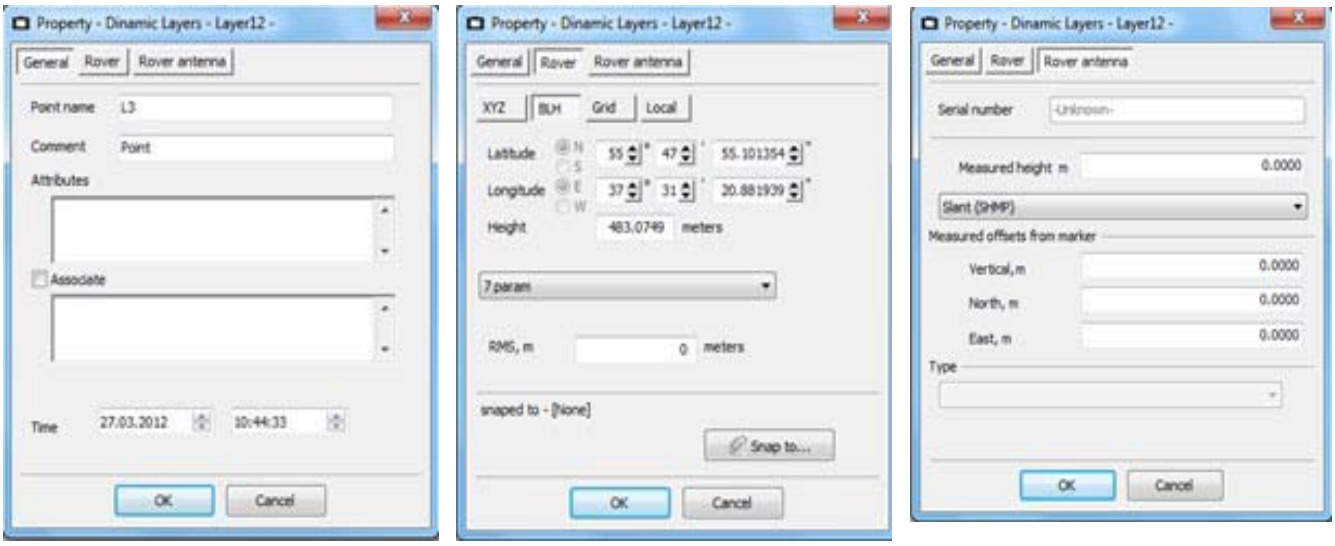


In the edit fields of the *Properties* window you can change the data, click OK to accept and save the changes, or *Cancel* to cancel editing

For points • there are additional tabs in the *Property* window: *Master* and *Rover.*

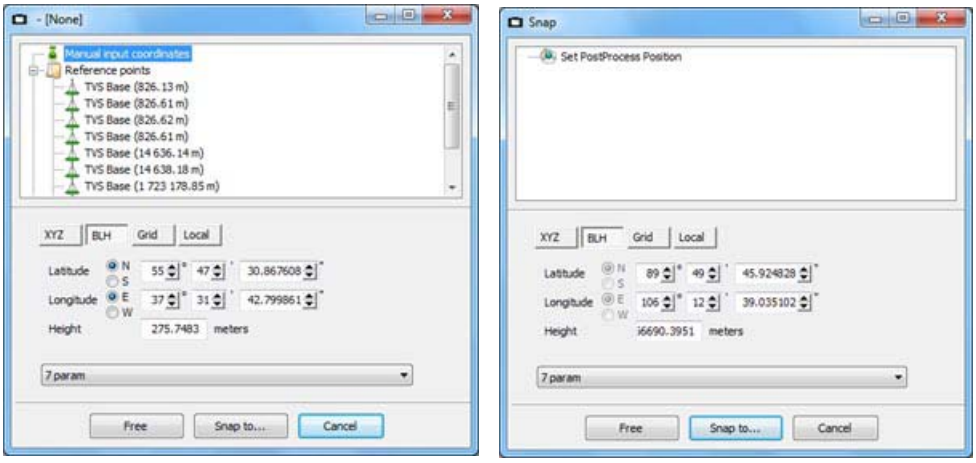
In the *Master* tab are displayed the coordinates of base point, according which Rover coordinates were calculated.

The *Rover* tab displays the coordinates of the object. In both boxes next to the active window there are strings with information about the item to which the object is snapped (otherwise [None] will be shown).



The coordinates can be shown in geocentric, ellipsoidal, grid or local systems. To select a particular system, select the appropriate tab. A check mark *Associate* indicates that this object will be used to re-call the function *Google Speech* and *Associate*.

For the windows above, there is another category of tabs. *Snap base to...* and *Snap to...* Clicking on them opens the window *[None]*:



So there are some opportunities to set point position - get from receiver, snap to some objects, manual input and postprocessing. You can modify alone point position with *Snap to. Base snap to.*. Option affects to all points referred to the base. Every survey point position are calculated in RTK or static postprocessing relative some base coordinates.

To implement the inverse operation, click *Free*, base coordinate point or object will have the value that they had before snapping. To cancel all changes and close the *[None]* window, click *Cancel*.

15.2. Classifier

Classifier is a customer structured table of predefined object styles. Object attributes are: scale, number, code, description, symbol. To activate the classifiers table, click *Classifier* icon  .

Classifier manager appears:

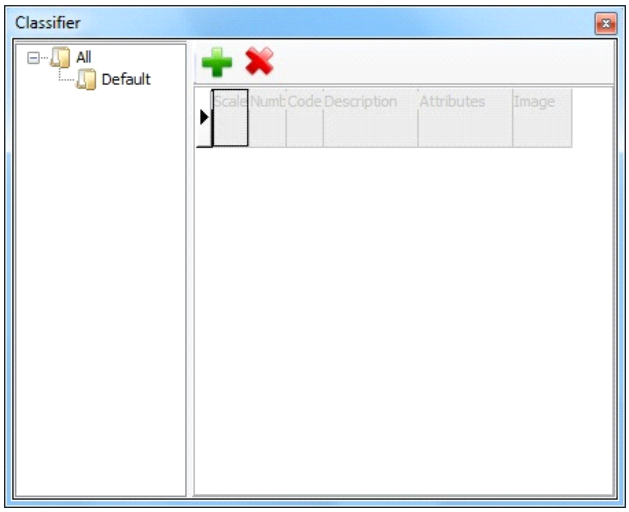


Figure 178. Classifier

To add the row and new classifier, click  , to delete selected row, click  .

Focus on one of the table fields and add appropriate information (scale, code, description). To input a symbol double click to the appropriate field, select the picture file and click *Open*. The classifiers table will be completed:

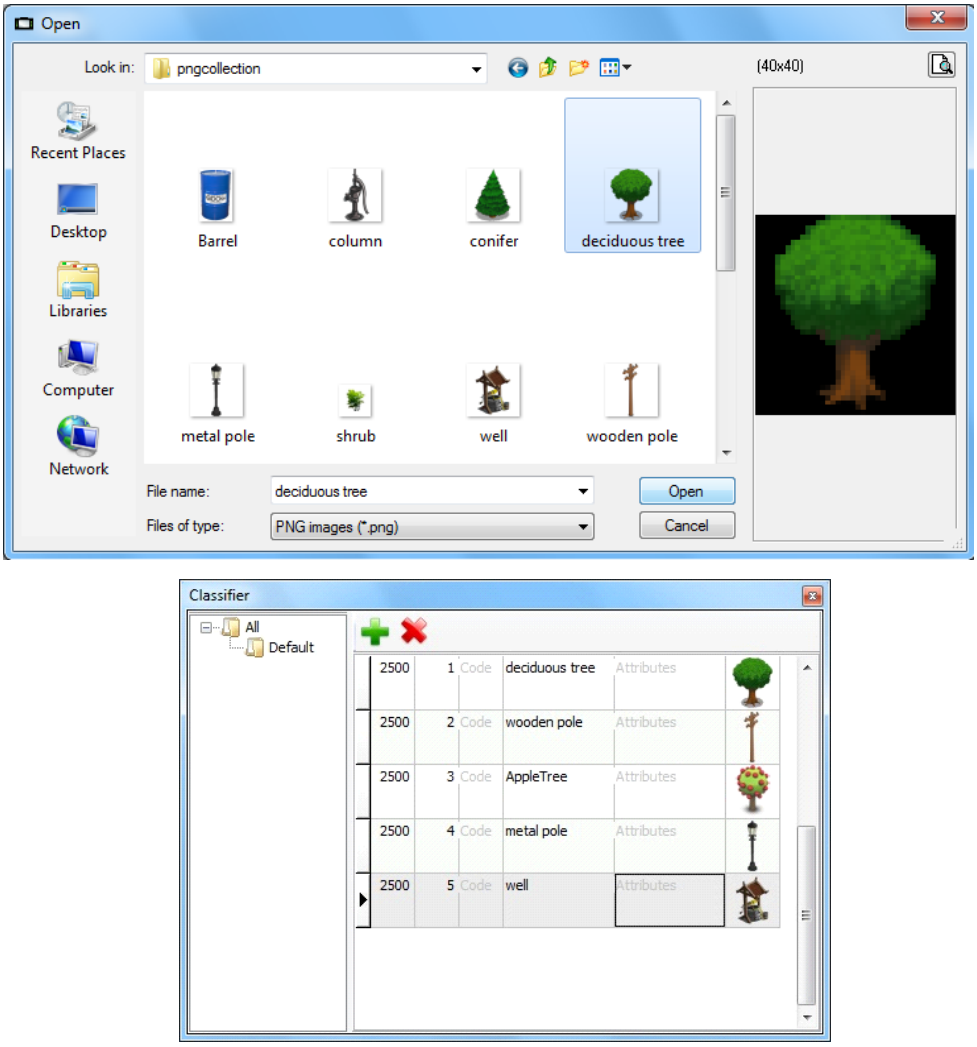


Figure 179. Classifiers table

To recall the classifier click  and *Classifier* window appears with all inserted information.

15.3. Audio information recognition

After having imported objects with audio data, this information could be recognizing using *Google Speech* option.

To put on the map an attributes data from *Classifier*, select the layer and call right button menu, then select *Style* menu item:

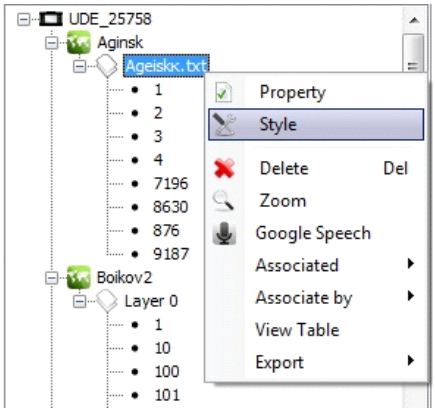


Figure 180. Style

Focus on the values you wish to be shown on the map, e.g. *Recognized audio*, and click  . The *Recognized audio* item appears on the right, and the special symbols on the map will have appropriate label.

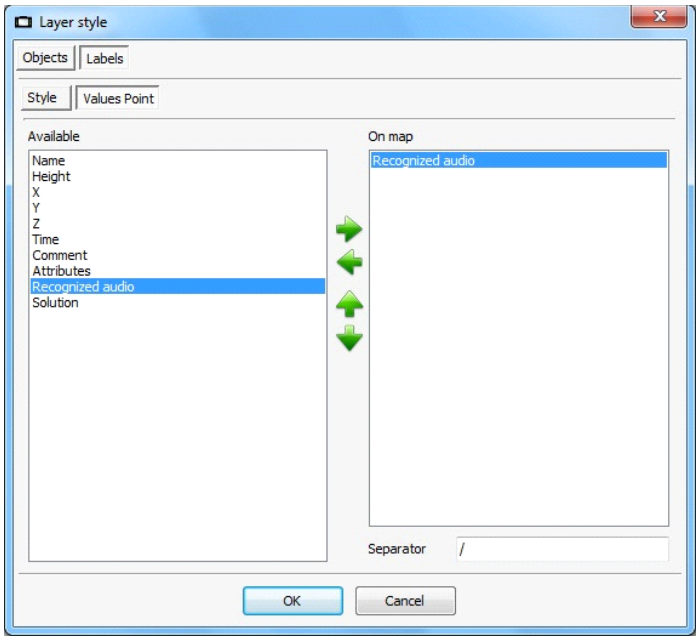


Figure 181. Layer style

To recognize audio click with right button on the layer name and select *Google Speech* menu item. The progress bar will show the status of recognition:

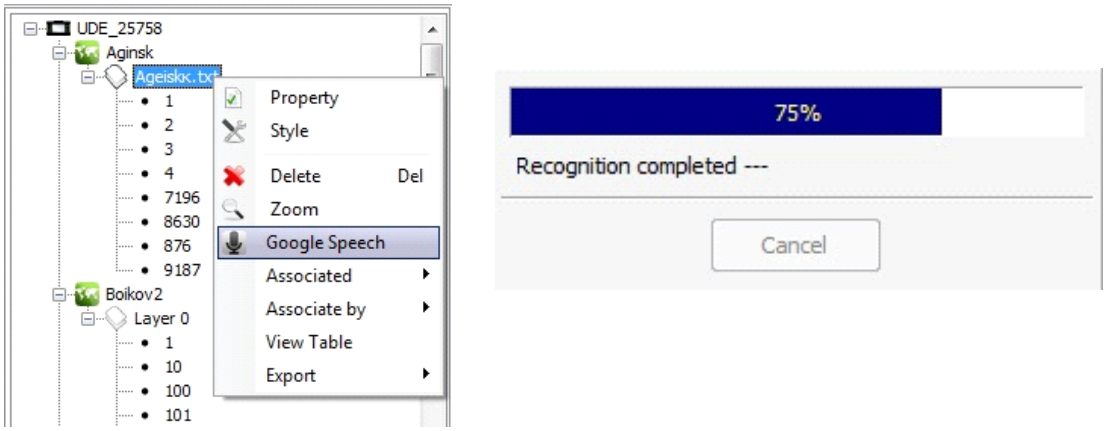


Figure 182. Google Speech

Classifier symbol will remove on the map last ones:

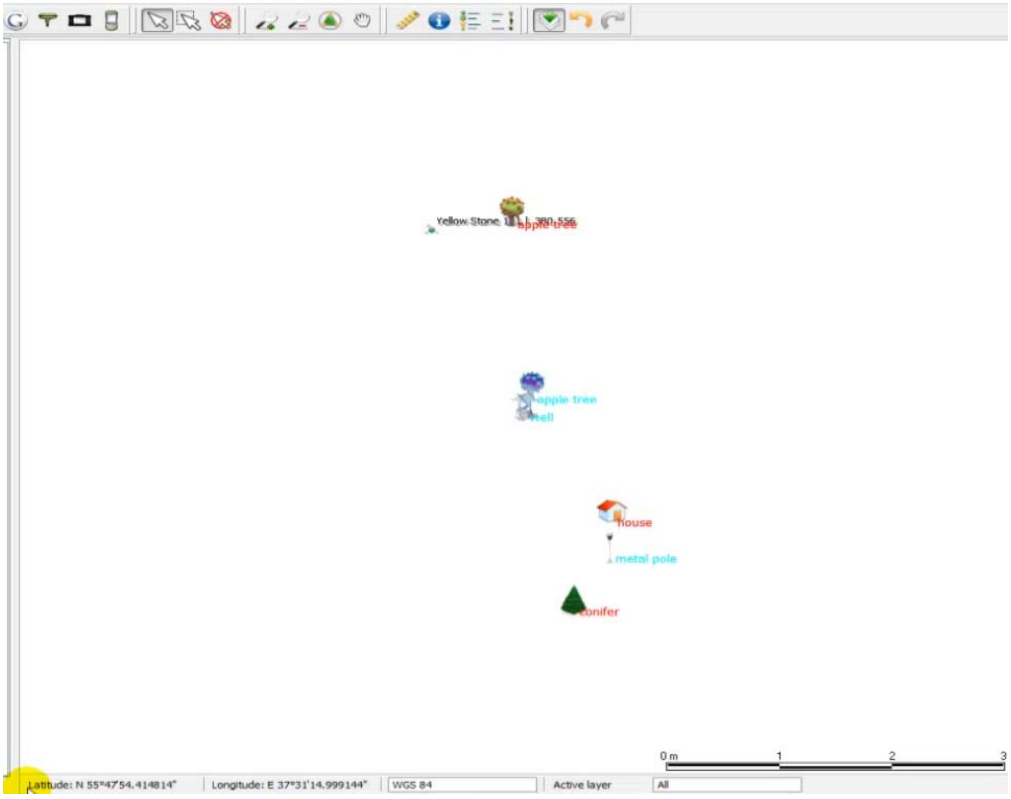


Figure 183. Classifier symbols

16. View

The list of *View* menu includes two permanent active items and some additional ones. Permanent items are Project and Map. They hide/make visible main left/right program pane.

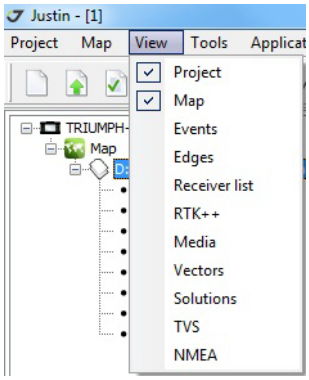


Figure 184. View

- *Receiver list* – opens the *Receivers* tab with the list of the receivers.

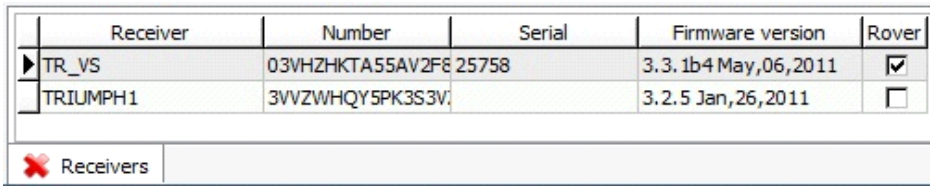


Figure 185. Receivers

The *Receiver* table shows type, serial number and firmware version of receivers. Here receiver could be marked as a rover, to prevent Vector generation between rovers.

- *Media* – opens the *Media* tab, for the purpose of playing of audio information.

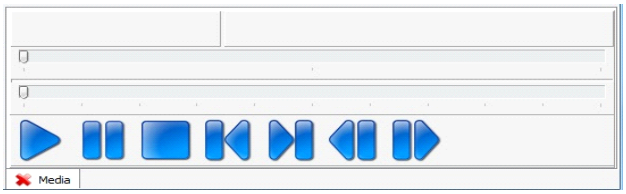


Figure 186. Media

- *Vectors* – opens the tab with the vector information. The check mark *Enable* allows making the selected vector visible or invisible on the map.

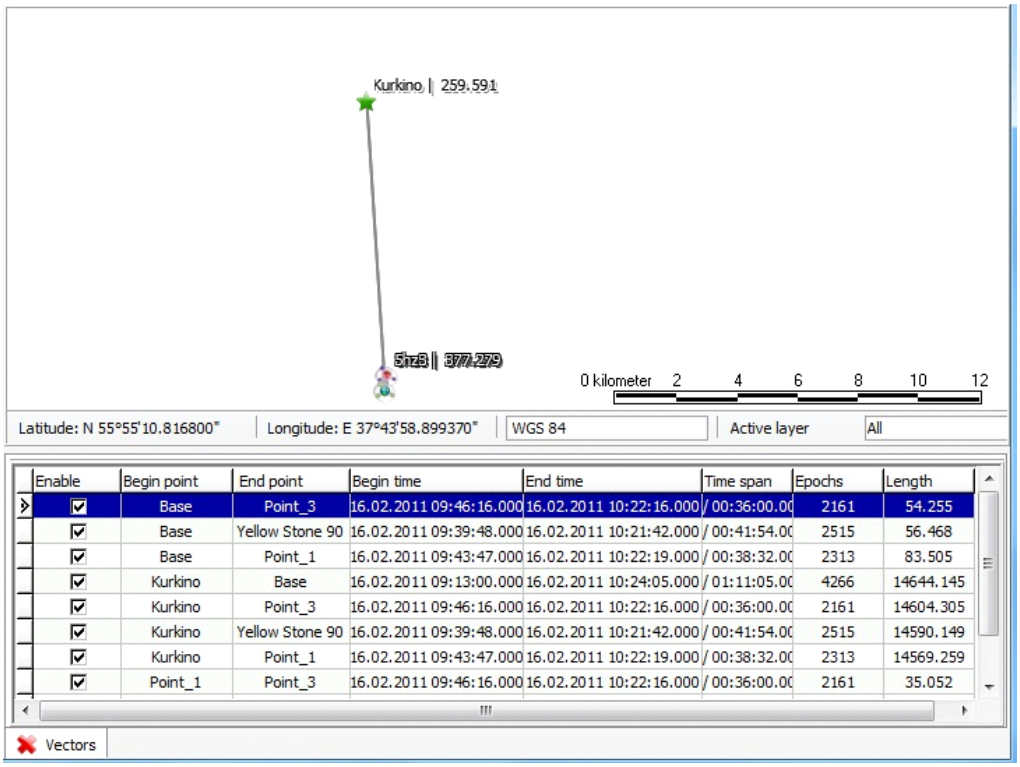


Figure 187. Vectors

- *TVS* – opens *TVS* tab with the information about *Survey* tab's objects (see detailed description in "TVS Table" on page 134).
- *NMEA* – opens the *NMEA* tab, where can be displayed the graph for the data of the appropriate dynamic layer. For the other layer type such graph are not available.

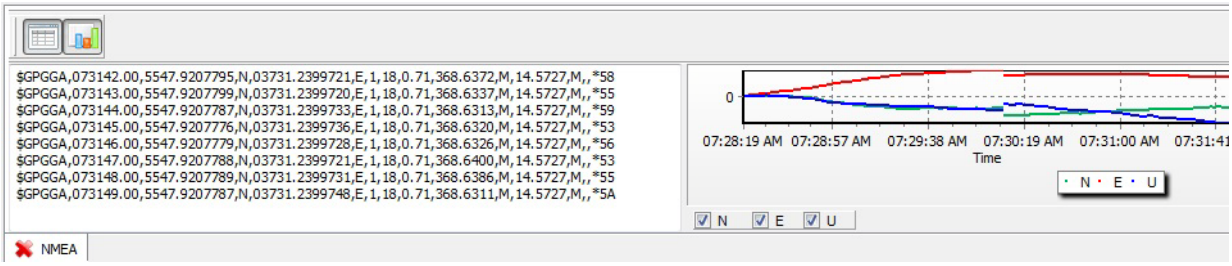
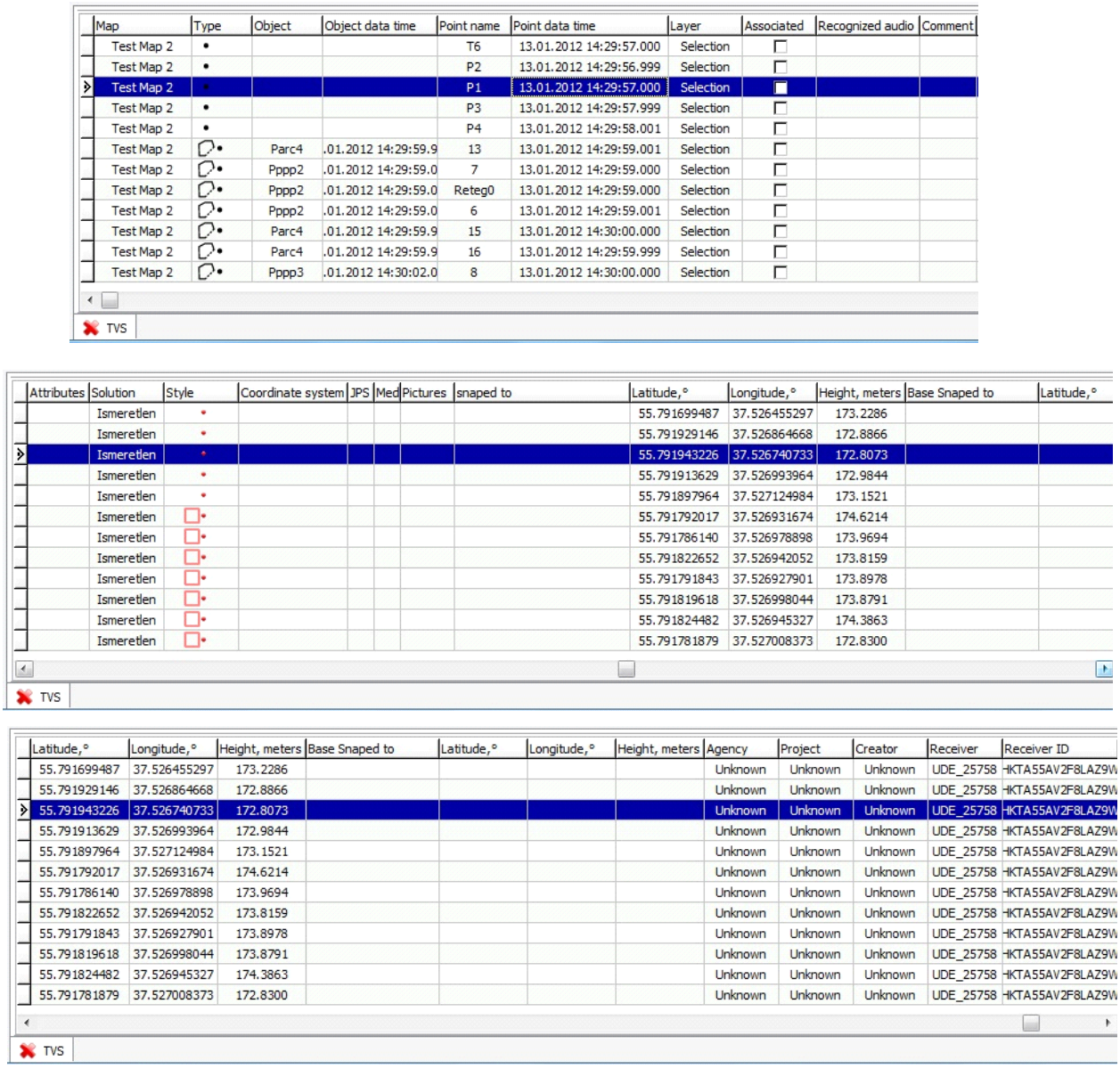


Figure 188. NMEA

16.1. TVS Table

The *TVS* table contains the information about the *Survey* tab's objects.



Map	Type	Object	Object data time	Point name	Point data time	Layer	Associated	Recognized audio	Comment
Test Map 2	•			T6	13.01.2012 14:29:57.000	Selection	☐		
Test Map 2	•			P2	13.01.2012 14:29:56.999	Selection	☐		
Test Map 2	•			P1	13.01.2012 14:29:57.000	Selection	☐		
Test Map 2	•			P3	13.01.2012 14:29:57.999	Selection	☐		
Test Map 2	•			P4	13.01.2012 14:29:58.001	Selection	☐		
Test Map 2	•	Parc4	.01.2012 14:29:59.9	13	13.01.2012 14:29:59.001	Selection	☐		
Test Map 2	•	Pppp2	.01.2012 14:29:59.0	7	13.01.2012 14:29:59.000	Selection	☐		
Test Map 2	•	Pppp2	.01.2012 14:29:59.0	Reteg0	13.01.2012 14:29:59.000	Selection	☐		
Test Map 2	•	Pppp2	.01.2012 14:29:59.0	6	13.01.2012 14:29:59.001	Selection	☐		
Test Map 2	•	Parc4	.01.2012 14:29:59.9	15	13.01.2012 14:30:00.000	Selection	☐		
Test Map 2	•	Parc4	.01.2012 14:29:59.9	16	13.01.2012 14:29:59.999	Selection	☐		
Test Map 2	•	Pppp3	.01.2012 14:30:02.0	8	13.01.2012 14:30:00.000	Selection	☐		

TVS

Attributes	Solution	Style	Coordinate system	JPS	Med	Pictures	snaped to	Latitude,°	Longitude,°	Height, meters	Base Snaped to	Latitude,°
	Ismeretlen	•						55.791699487	37.526455297	173.2286		
	Ismeretlen	•						55.791929146	37.526864668	172.8866		
	Ismeretlen	•						55.791943226	37.526740733	172.8073		
	Ismeretlen	•						55.791913629	37.526993964	172.9844		
	Ismeretlen	•						55.791897964	37.527124984	173.1521		
	Ismeretlen	☐•						55.791792017	37.526931674	174.6214		
	Ismeretlen	☐•						55.791786140	37.526978898	173.9694		
	Ismeretlen	☐•						55.791822652	37.526942052	173.8159		
	Ismeretlen	☐•						55.791791843	37.526927901	173.8978		
	Ismeretlen	☐•						55.791819618	37.526998044	173.8791		
	Ismeretlen	☐•						55.791824482	37.526945327	174.3863		
	Ismeretlen	☐•						55.791781879	37.527008373	172.8300		

TVS

Latitude,°	Longitude,°	Height, meters	Base Snaped to	Latitude,°	Longitude,°	Height, meters	Agency	Project	Creator	Receiver	Receiver ID
55.791699487	37.526455297	173.2286					Unknown	Unknown	Unknown	UDE_25758	HKTA55AV2F8LAZ9W
55.791929146	37.526864668	172.8866					Unknown	Unknown	Unknown	UDE_25758	HKTA55AV2F8LAZ9W
55.791943226	37.526740733	172.8073					Unknown	Unknown	Unknown	UDE_25758	HKTA55AV2F8LAZ9W
55.791913629	37.526993964	172.9844					Unknown	Unknown	Unknown	UDE_25758	HKTA55AV2F8LAZ9W
55.791897964	37.527124984	173.1521					Unknown	Unknown	Unknown	UDE_25758	HKTA55AV2F8LAZ9W
55.791792017	37.526931674	174.6214					Unknown	Unknown	Unknown	UDE_25758	HKTA55AV2F8LAZ9W
55.791786140	37.526978898	173.9694					Unknown	Unknown	Unknown	UDE_25758	HKTA55AV2F8LAZ9W
55.791822652	37.526942052	173.8159					Unknown	Unknown	Unknown	UDE_25758	HKTA55AV2F8LAZ9W
55.791791843	37.526927901	173.8978					Unknown	Unknown	Unknown	UDE_25758	HKTA55AV2F8LAZ9W
55.791819618	37.526998044	173.8791					Unknown	Unknown	Unknown	UDE_25758	HKTA55AV2F8LAZ9W
55.791824482	37.526945327	174.3863					Unknown	Unknown	Unknown	UDE_25758	HKTA55AV2F8LAZ9W
55.791781879	37.527008373	172.8300					Unknown	Unknown	Unknown	UDE_25758	HKTA55AV2F8LAZ9W

TVS

Figure 189. TVS

Double click on table item performs the following functions:

- *Map* – opens the window with map properties.
- *Object and Object data time* – opens the object properties window.
- *Point name, Point data time, Comments, Attributes* – opens the window with properties of the point.
- *Layer* – opens the layer properties.

- *Associated* – enables/disables *Google Speech* and *Associated with* functions.
- *Recognized audio* – starts *Google Speech*.
- *Style*- opens layer style window.
- *Sounds* – opens the window with audio information.
- *Images* – shows the images.
- *Company, Project, Receiver, Receiver ID* – opens project properties.
- *Type* – Opens the *Info* window, with the text information about object.

When you right-click on the cells *JPS, Sounds* and *Images* the standard Windows menu for the files will appear.

To sort the table, click the right mouse button on the column header. To align the column width press and hold *Alt* key and left-click on any location within the column. Use the *Shift* and *Ctrl* keys, to select multiple rows in the table. The following menu will appear:

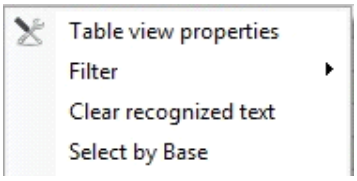


Figure 190. Menu

- *Table view properties* - opens the properties window.
- *Filter* - enables filter to display/hide the following parameters:
  - *Receiver* - hides all objects of receivers that do not belong to the receivers of selected objects.
  - *Map* – hides all objects of maps that do not belong to the maps of selected objects.
  - *Layer* – hides all objects of layers that do not belong to the layers of selected objects.
  - *Point* – hides all objects that do not belong to the selected objects.
  - *Clear* – clears the filter to display all objects of the Survey tab.
- *Clear recognized text* **-** removes the recognized text for selected object(s).
- *Select by Base* **-** selects all points belonging to the same base station.

17. Exporting data to exchange formats

Justin allows exporting project to many popular cartographic data to the exchange formats:

- *ESRI Shape* – ArcGIS
- *MapInfo Tab* – MapInfo
- *MIF/MID* – MapInfo
- *DXF* – AutoCad
- *Kml* – Google Earth
- *PNEZD* – text file, *Point Number, North, East, Elevation, Description*.
- *O-file* – Ashtech O-file;

- *TVS file* - exchange format between devices and *Justin;*
- *Tracy* - *Tracy* format;
- *TXT* - text file configured according a template.

17.1. Export of standard layers

Click *Project* ▸ *Export to...*, and select the needed format:

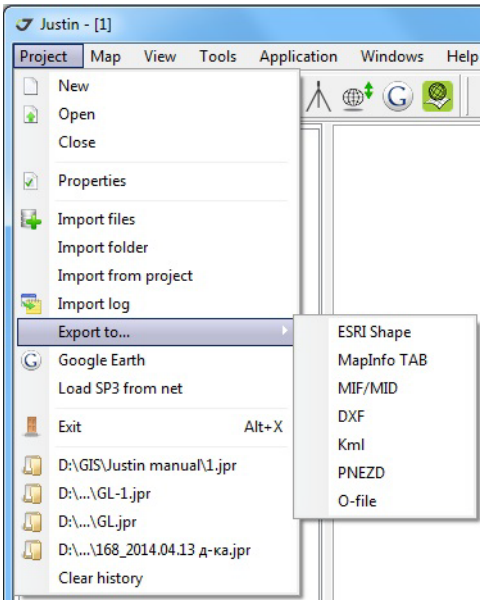


Figure 191. Export of the standard layers

17.2. Export of dynamic layers

To export a dynamic layer, select the layer in the *Map* tab, right-click and select *Export* menu item, and a format the layer will be exported to:

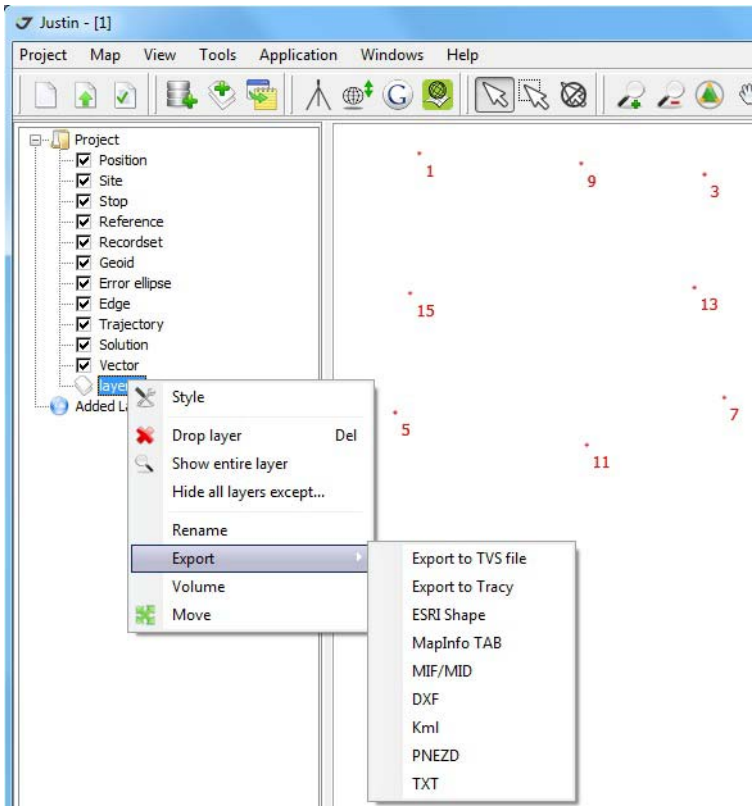


Figure 192. Export of dynamic layers

17.3. Export of survey objects

To export survey points, switch to the *Survey* tab and right-click on the *Device* icon ( ), *Map* ( ), *Layer* ( ), or *Object* (point- , polyline - , polygon -), then click *Export* menu item and select the format the points will be exported to:

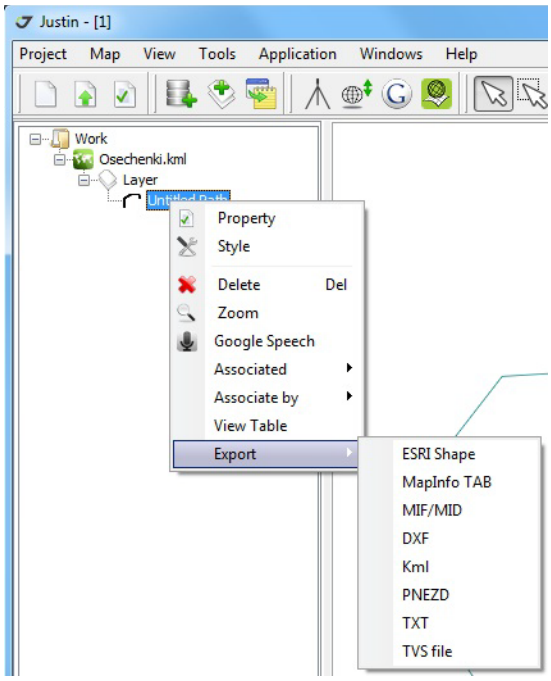


Figure 193. Export of survey objects

17.4. Export of map objects

To export object from the map, point on it using the tool  (*Select a point*) or several points using the tool *(Select in region* ), right-click to call menu, then click *Export* menu item and select the format the points will be exported to:

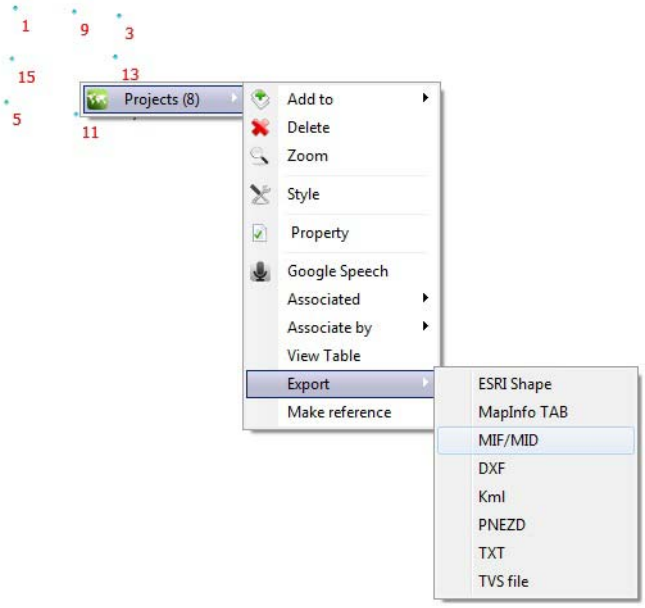


Figure 194. Export of map objects

18. Background layers

Using background layers brings geography information to map window. We deal some vector maps: world map (Countries), SPCS zone NAD 27/83 for USA, US Counties (County) and a map of Russian Federation regions.

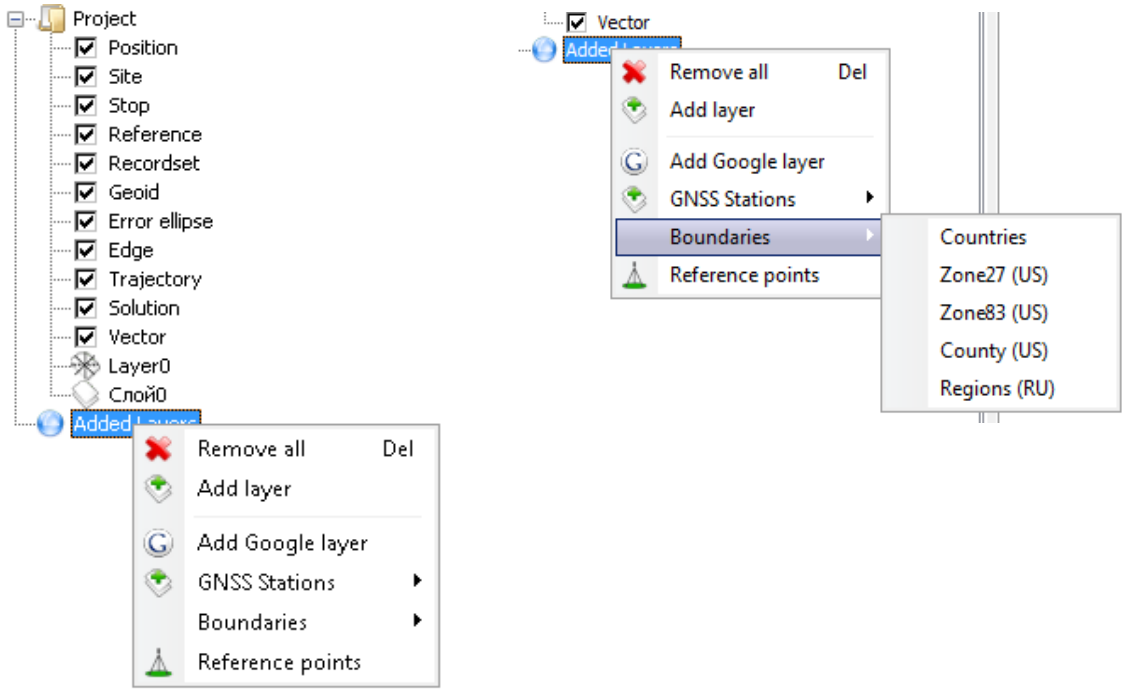


Figure 195. Added layers menu

To involve information window press and hold *Alt* button, activate  button then click on Map.

Figure 196. Information window

Temporary layers are available during the work session. Its will disappeared automatically when project is closed. Temporary layers are cartographic layers with the information imported from the following file formats:

- *Tab files – *.tab.*
- *GeoTIFF files – *.tif.*
- *Shape files – *.shp.*
- *Ozi files – *.map.*
- *MapInfo MIF files – *.mif.*

Note: File types *.bmp 32-bit and *.tiff with compression are not supported.

To add temporary layer to the project, click the button  , or click *Map* ▸ *Add layer*. Alternatively this menu item can be right-click called in the *Map* tab. Take in account that all third party vector/raster maps use independent datum lists which could differ from JAVAD company Geo database, so maps might be shifted, scaled or rotated related to survey data.

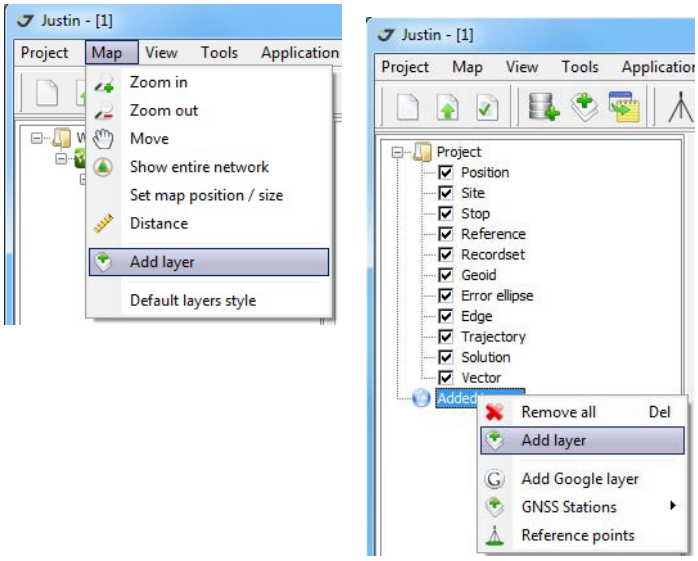


Figure 197. Add layer

Select the type and file. Click *OK*.

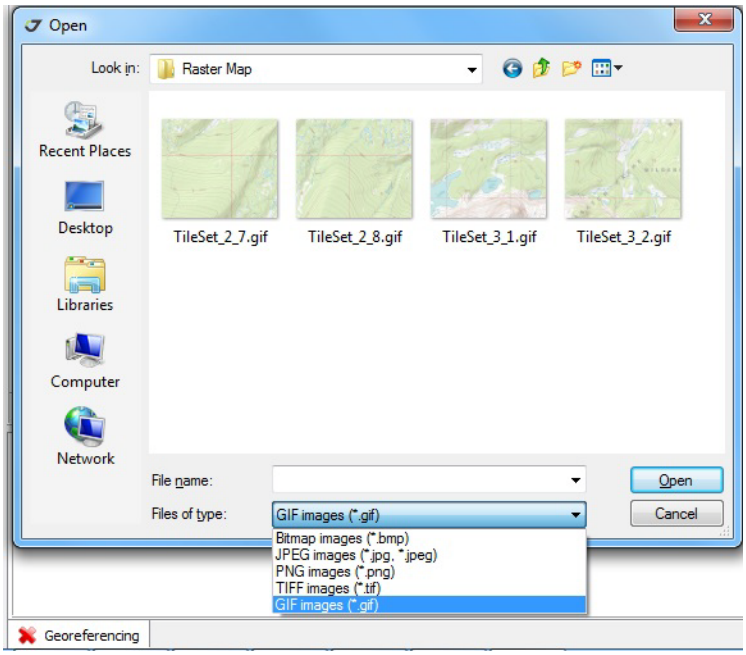


Figure 198. Open file

In the *Map* tab will appear an identifier of new layer in the *Added layers* part. A new layer will be added to the cartographic window. To display the full layer right click and select *Show entire layer.*

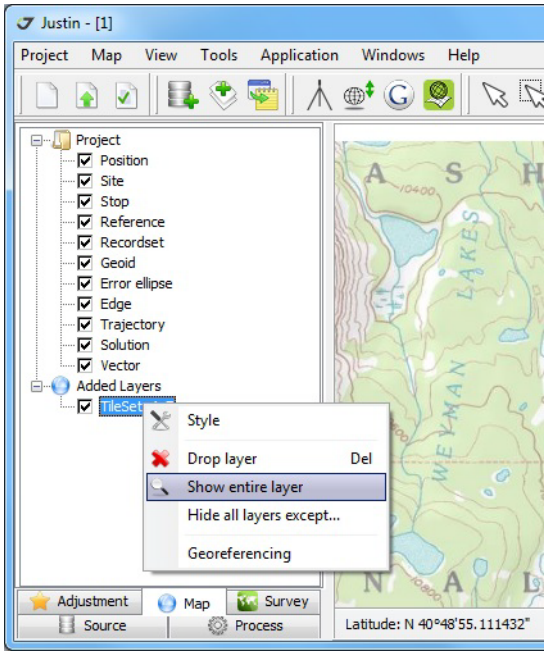


Figure 199. Show entire layer

Menu items for the added layers:

- Style - opens raster style window:

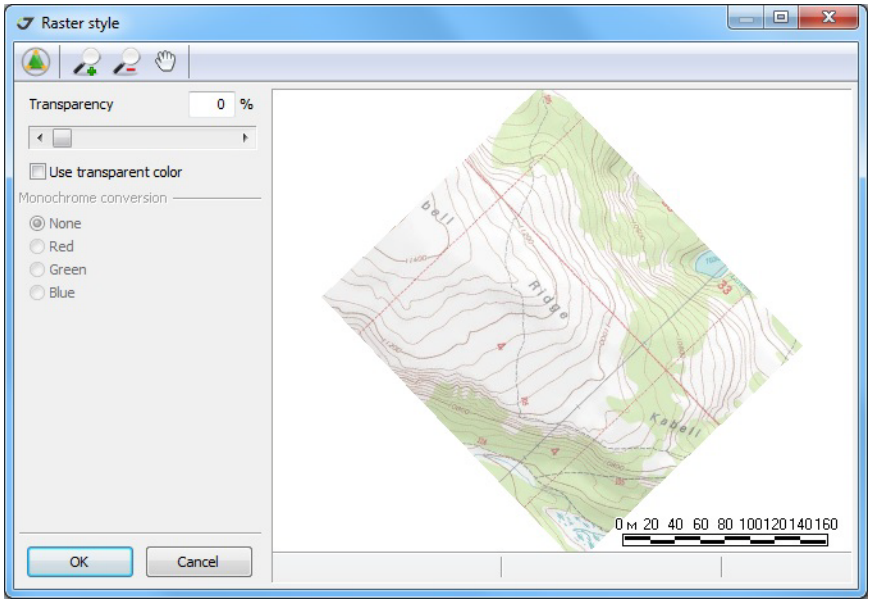


Figure 200. Raster style

On the main panel of *Raster style* window there are the following tools:

- Show entire image.
- Change scale.

- Move the map.

Using *Use transparent color* the transparency of the image can be set. For monochrome images background color intention can be changed (red, green blue).

- Delete layer - deletes the layer from the project.
- Show entire layer - the entire layer will be shown.
- Hide all layers except… - Hides all layers in the *Map* tab excepting the selected.
- Georeferencing - allows showing and editing georeferencing coordinates and save all changes.

19. Raster georeferencing

Raster georeferencing is the process of scaling, rotating and positioning the image to match a particular size and geodetic location.To register a raster image, perform the following steps:

1. Click *Tools* ▸ *Register raster image*. The *Open* dialog window appears.
2. Select the format of raster image file in the *Files of type* drop-down list.

Note: Justin can open the following types of files: BMP, JPG, JPEG, PNG, GIF, TIFF, *.bmp 32-bit, and *.tiff with compression formats are not supported.

Select the desired file and click *Open*. Raster image immediately appears on the map window. By default it will covers about 75% of map window. So you will make a registration process faster if a map window have been centered on right position previously.

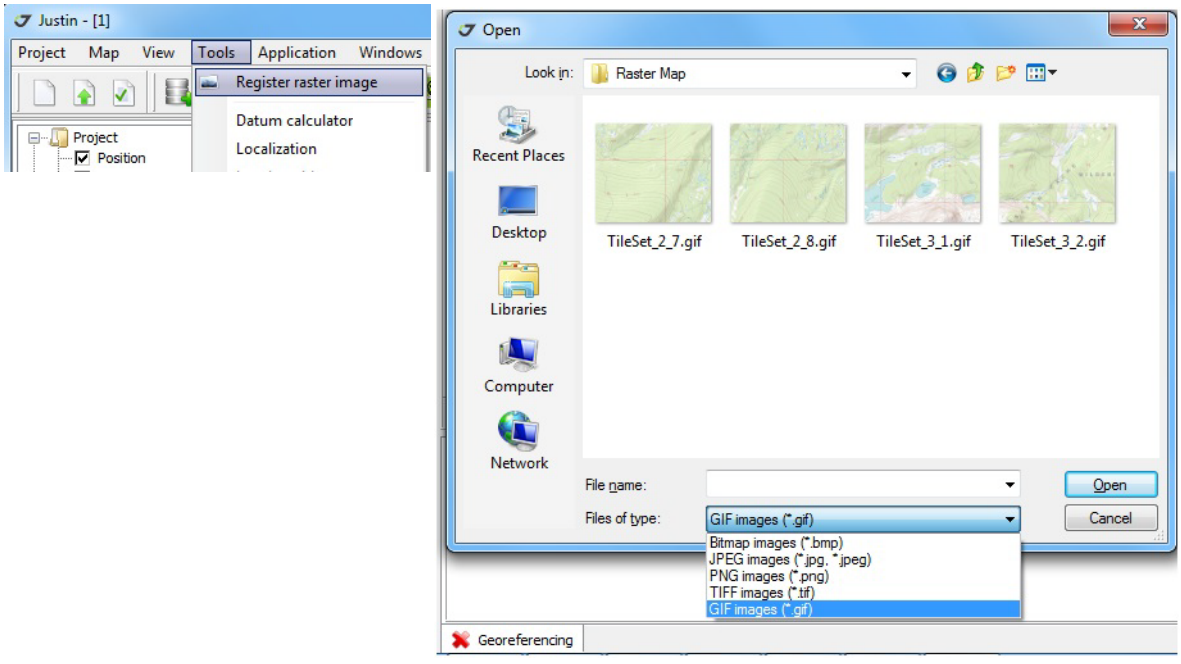


Figure 201. Register raster image

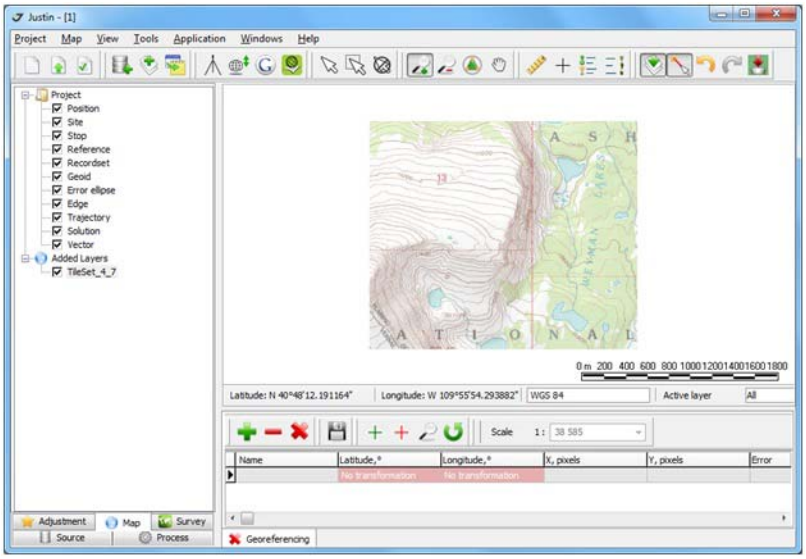


Figure 202. Raster image registration panel

3. Enter coordinates of the points in pixels or in geodetic coordinate system in a registration form.
4. Select the coordinate system available in the project.

The point coordinates can be entered in three ways.

First way

Zoom in the map area with the known position shape. Click  on the coordinate panel (on the left). The cursor will transform to cross-hair. Point on the position and double click.

The pointed position will be marked, and in the table new row appears. Coordinates are in screen pixels and in selected coordinate system. These coordinates could be corrected later.

Such way allows the user not inserting complete values, but editing only the last digits of the input. To finish point coordinates entering, right-click or click on the  button.

To edit the table highlight the needed row. On the right will be the parameters displayed. Change them using the following:

- Click *Map pixels*  , or *Map Coord*  , select the button on the map and edit the coordinates.
- Alternatively, the coordinates can be changed manually in the corresponding fields. After editing, click  , to refresh the image.

The button  allows you to zoom the image corresponding to the selected position. In the *Scale* window select the zoom.

To save the image to **.Tab* or **.Ozi* files, click  .

To delete the selected in the table point, use the button  ; with the button  the table can be updated to display the calculated errors:

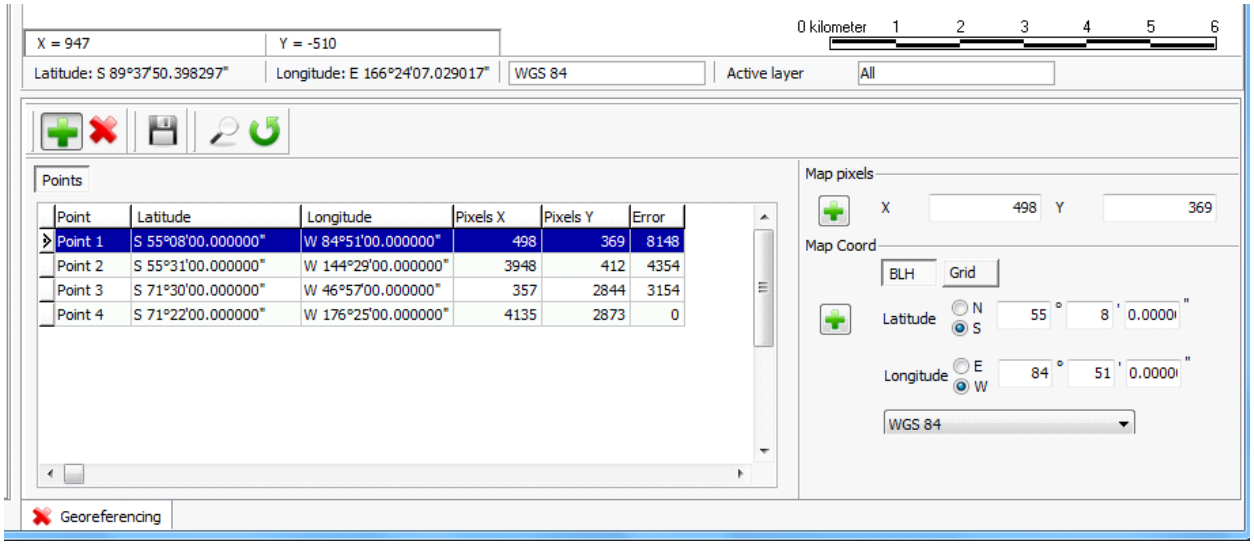


Figure 203. Table with the points' coordinates

Second way (optimal in combination with vector maps)

Switch to snapping mode with  . While a point on an active vector layer is in a snapping range of cursor a distance between the point and cursor is shown like a red line.

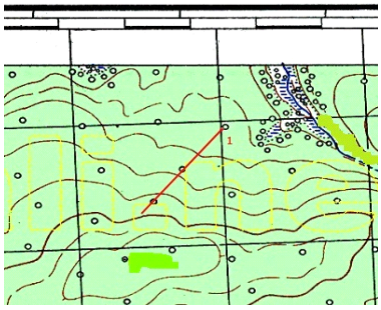


Figure 204. Red line between cursor and point

Point with a cursor to some place on the raster image. The object on the active layer and pointed place will be connected with the blue line. New row with the cursor position coordinates in pixels appears in a registration table.

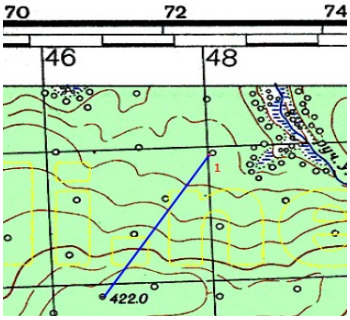


Figure 205. Blue line between cursor and point

Repeat the steps above with all needed points. The map on the screen will be displayed with the light blue lines, which fit on image to vector objects. The point coordinates can be edited if needed.

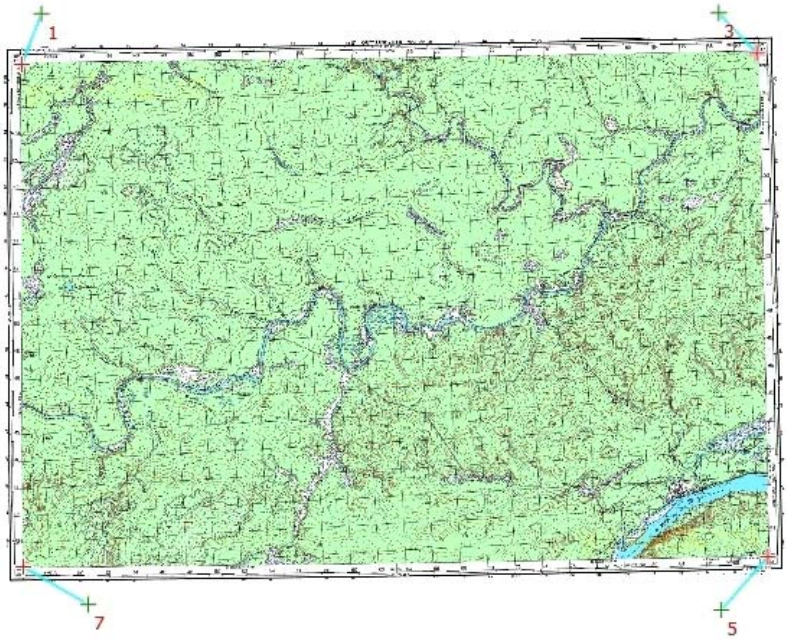


Figure 206. Snapping to vector map

To define snap object ranges, select *Options* ▸ *Application*, then in the *Options* window checkbox set *Snap objects range* in pixels:

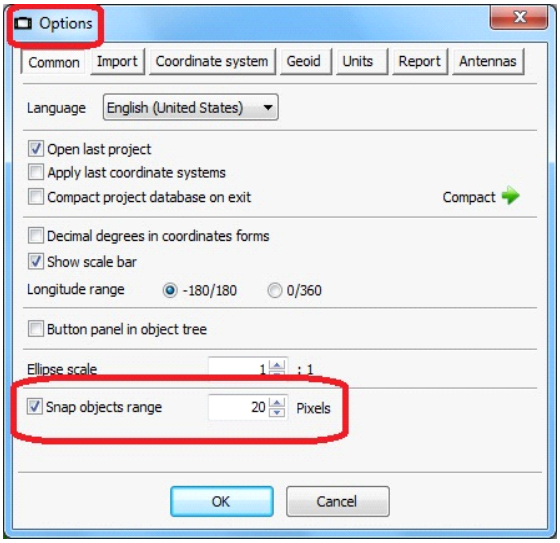


Figure 207. Snap objects range

One can easily create new vector layer for georeferencing. If the layer with the points for snapping was not created, it can be created manually:

Click the button  and select the needed points with the left click. Their coordinates will be added to the *Coordinates clipboard*. Later these coordinates can be edited in the table:

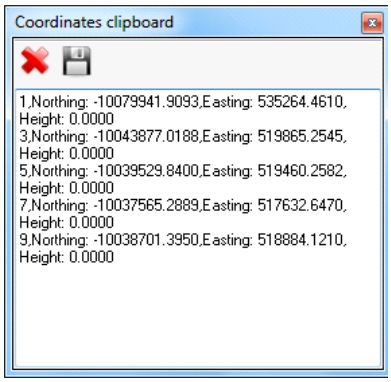


Figure 208. Coordinates clipboard

To save the points' coordinates in a new layer, click  :

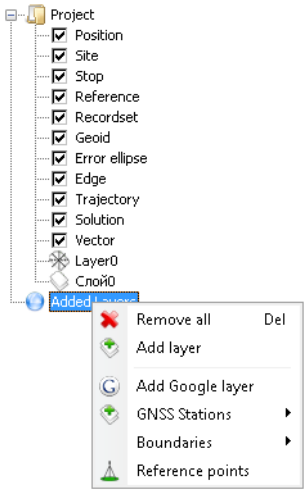


Figure 209. New Layer 0

As much layers can be added as needed. All layers elements can be visible, but in the calculations can be used only the elements of one layer (*Active*) or all elements of all layers (*Select all layers*).

To hide the layer, double click on the layer name, to make it visible, double click again.

With the button  the window *Coordinates clipboard* can be cleared from the inserted coordinates, and the points selected on the screen will be removed.

To save the coordinate input, click  , the coordinates will be saved in *.tab file. Enter the file name and click *Save*:

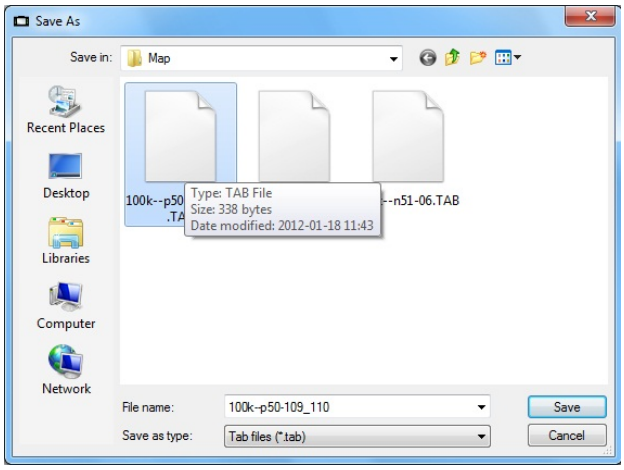


Figure 210. Save As window

The window *Select a coordinate system* appears. Select the coordinate system and click *OK*. If the *Add Coordinate System Info* option is not active, the coordinates system information won't added to the file

and *Justin Link* will ask about coordinate system next time. If this option was activated, the information about coordinate system will be added to the *TAB* file.

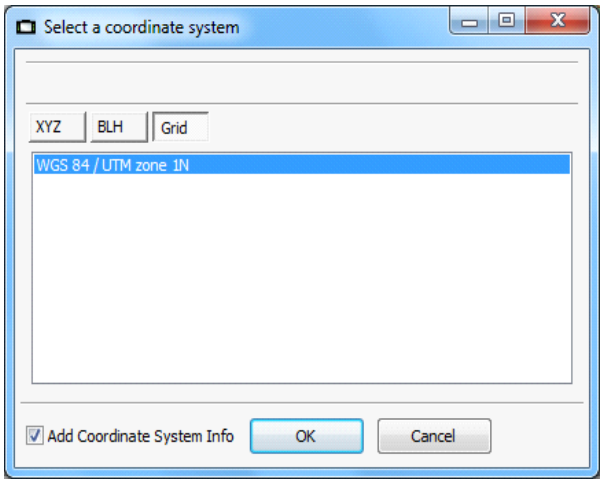


Figure 211. Select a coordinate system

Third way (fastest)

Zoom in the selected area of the map and point with the cursor the point with known coordinates, checking them in the status bar on the bottom of the window:

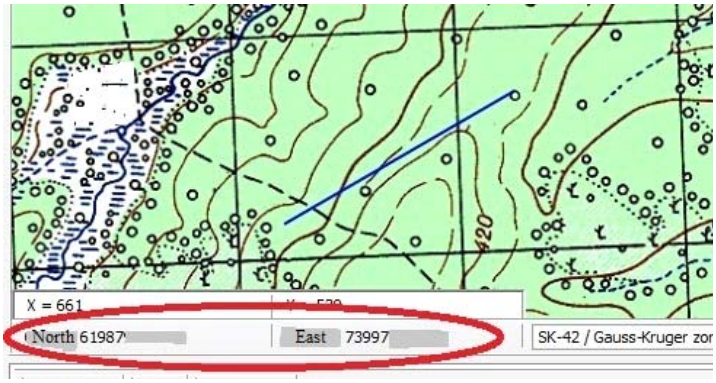


Figure 212. Selecting the point

When the cursor coordinates is close to known values (refer to status bar), right-click and move the cursor to the corresponding place on the image (blue line between points appears), right-click again. New row appears in the table. Edit this row if needed. Add more control points. The snapping will be shown by light blue lines.

20. Continuously Operating GNSS Stations

The National Geodetic Survey (NGS), an office of NOAA's National Ocean Service, manages a network of Continuously Operating Reference Stations (CORS) that provide Global Navigation Satellite System (GNSS) data consisting of carrier phase and code range measurements in support of three dimensional positioning, meteorology, space weather, and geophysical applications thru out the United States, its territories, and a few foreign countries. GNSS station option automatically updates and displays on the map the list of available CORS and SOPAC stations.

Information about stations is available on the *Map* tab ▸ *Added layers* ▸ *GNSS Stations.*

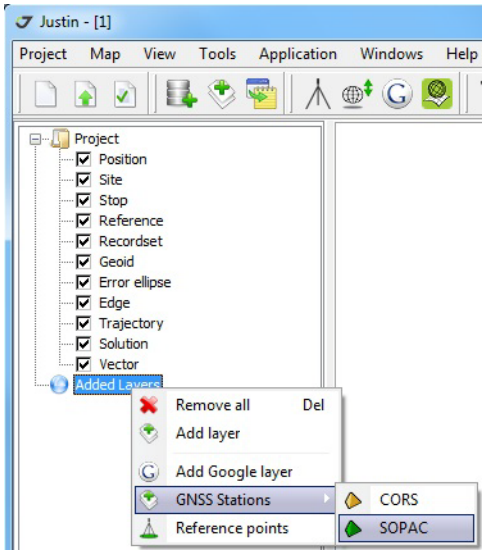


Figure 213. GNSS Stations

CORS and *SOPAC* layers can be displayed in the cartographic window at the same time.

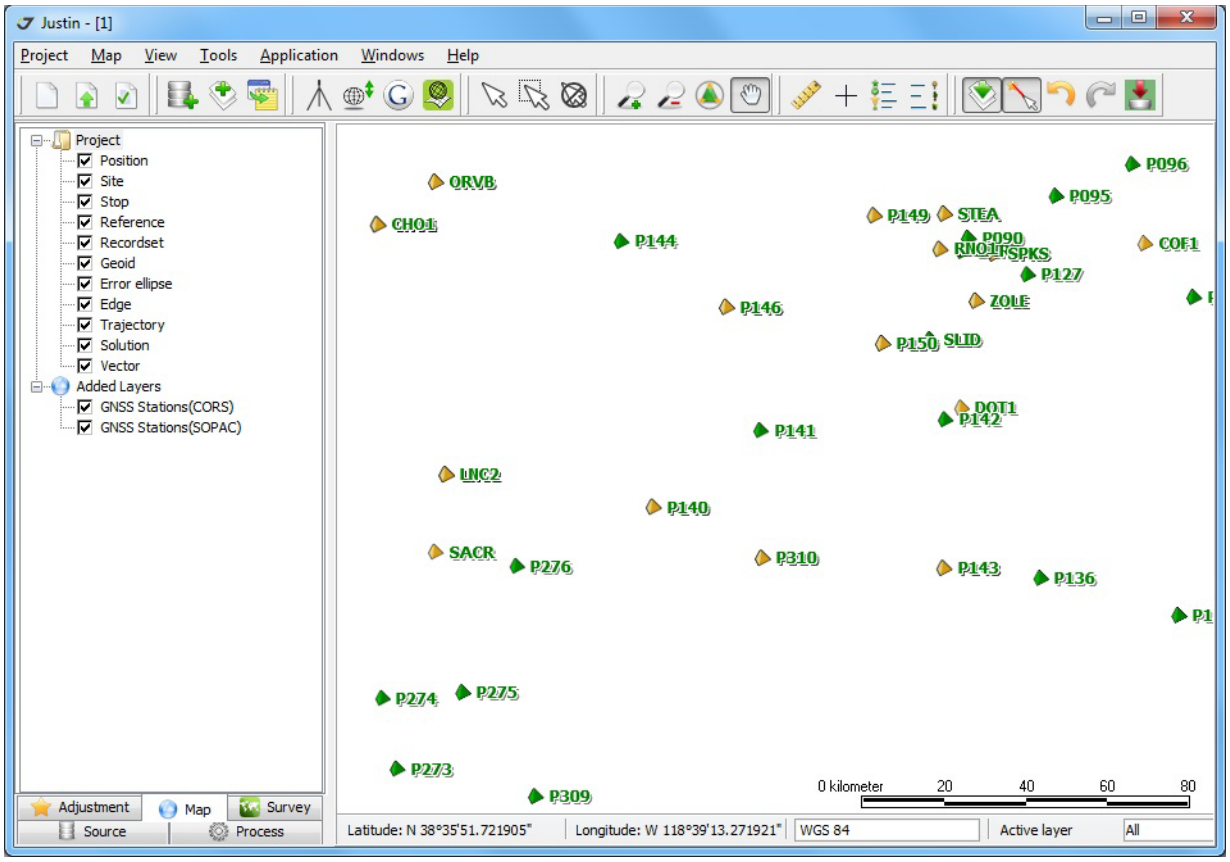


Figure 214. CORS and SOPAC layers

The same station of the CORS or SOPAC network can have multiple identifiers belonging to different realizations of the network. To access the data, select the desired ID on the map and click the right mouse button to call a drop-down menu:

- Load - load RINEX files. Specify the needed date.

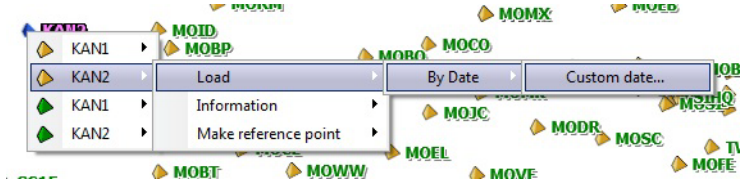


Figure 215. File load

When the download is complete, a new reference point with coordinates in the ITRF2008 and the date corresponding to the epoch specified for the current project in the *Internet* tab is completed. If the epoch of the project is not selected, the coordinates of the reference point are calculated at the date of measurement.

To download to the project the data from several stations, use *Select a rectangular area* item on the toolbar:

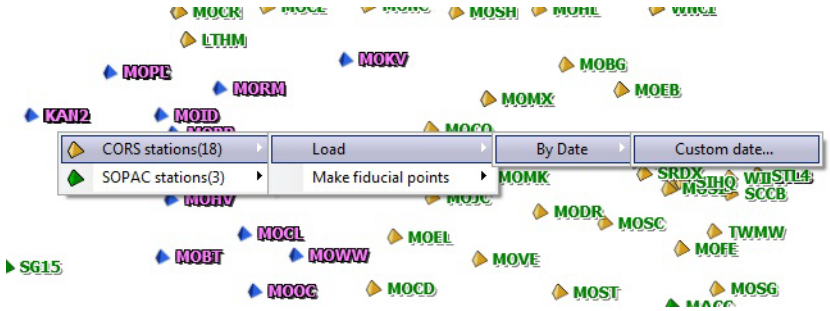


Figure 216. Request parameters

- Information - information about the point.

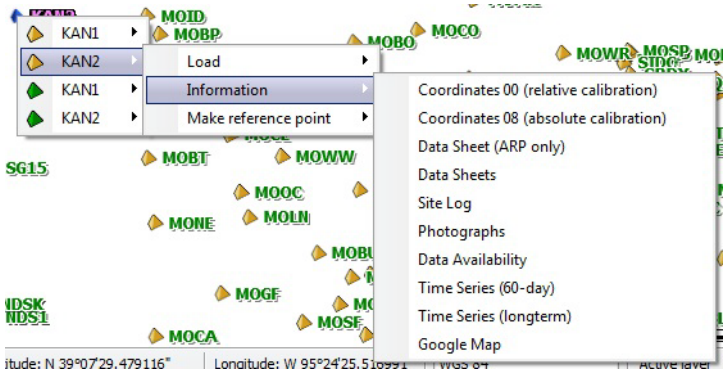


Figure 217. Information

- Make reference point - create a reference point with coordinates in ITRF2008 system:

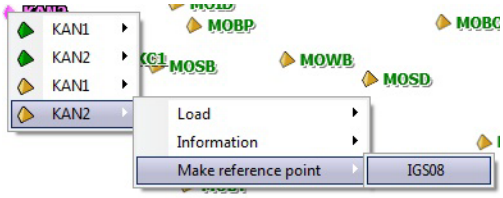


Figure 218. Make reference point

Date associated with reference point coordinates, can be seen in the *Reference Properties* window. If the epoch of the project is not specified and there are no any recordset in the project, the coordinates shown in the *Reference* field will correspond to catalog epoch, and in the *Calculation* field will be zero.

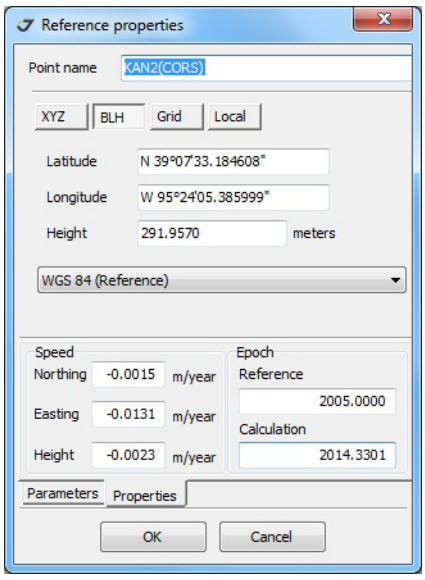


Figure 219. Reference properties

Load Internet data using the menu option *Load Internet data*. The GNSS station layers should be opened.

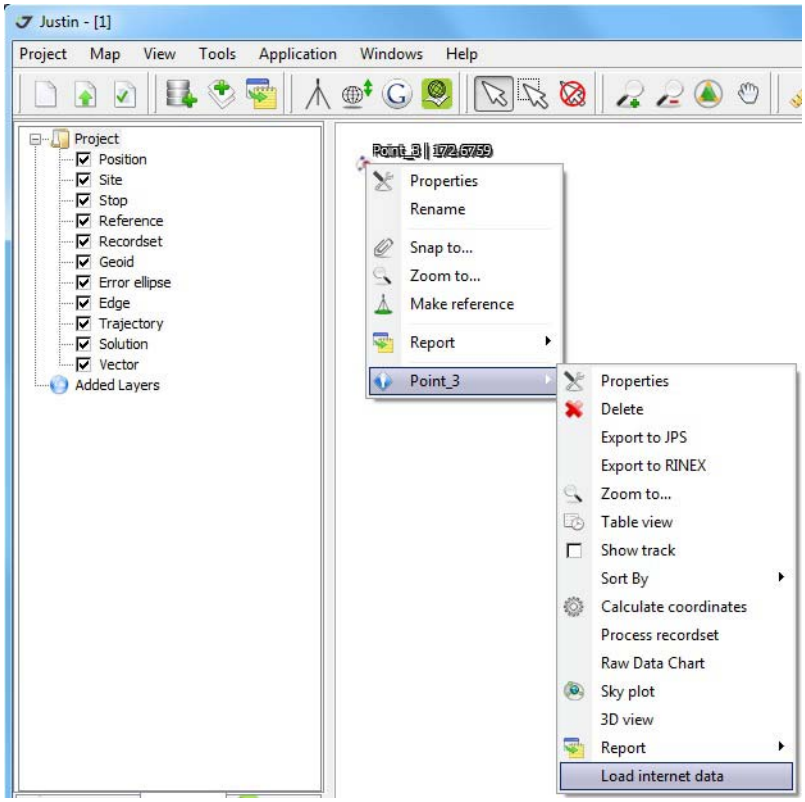


Figure 220. Load INTERNET data

In this case, the optimal accordingly geometry factor, set of three CORS points. For geodetic networks which use CORS as reference points, a special report close similar to the standard Internet post-processing service OPUS (NGS, USA) is designed.

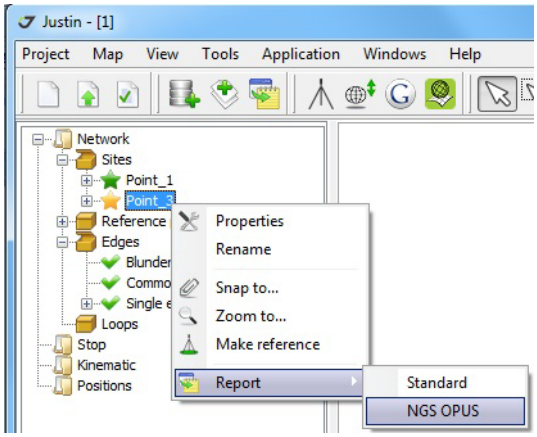


Figure 221. Report

21. Report

There are two types of format for reports in Justin. Click *Options* ▸ *Application* ▸ *Report* and select the format. It can be **.txt* or **.html*.

To generate a report, click  button on the tool bar and the *Report* window appears:

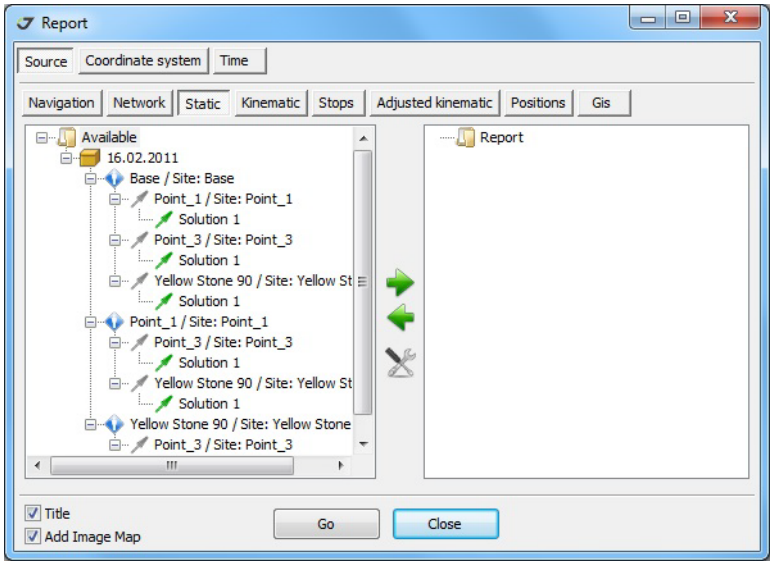


Figure 222. Report window

- *Source* tab: On the left there is the tree with items of the project. On the right there is the *Report* folder and mix set of the selected items.

At the beginning, the *Report* window is empty. Select an object on the right and click . This item will appear on the right.
To delete the items from the report pane, select them and click .
To set the table parameters click and the *Table parameters* window appears.

- In the *Coordinate system* tab the coordinate system for report is defined:

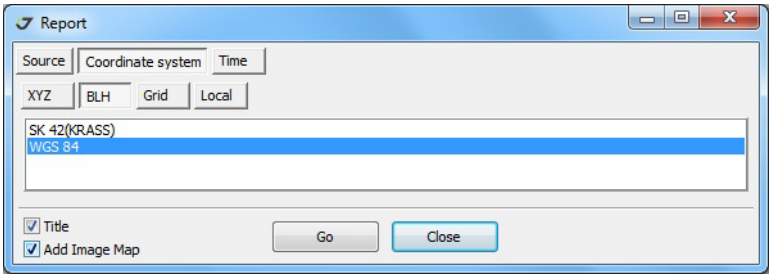


Figure 223. Coordinate system tab

- In the *Time* tab the time system can be set.

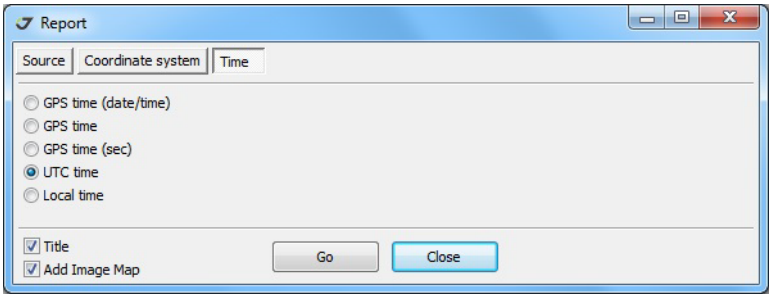
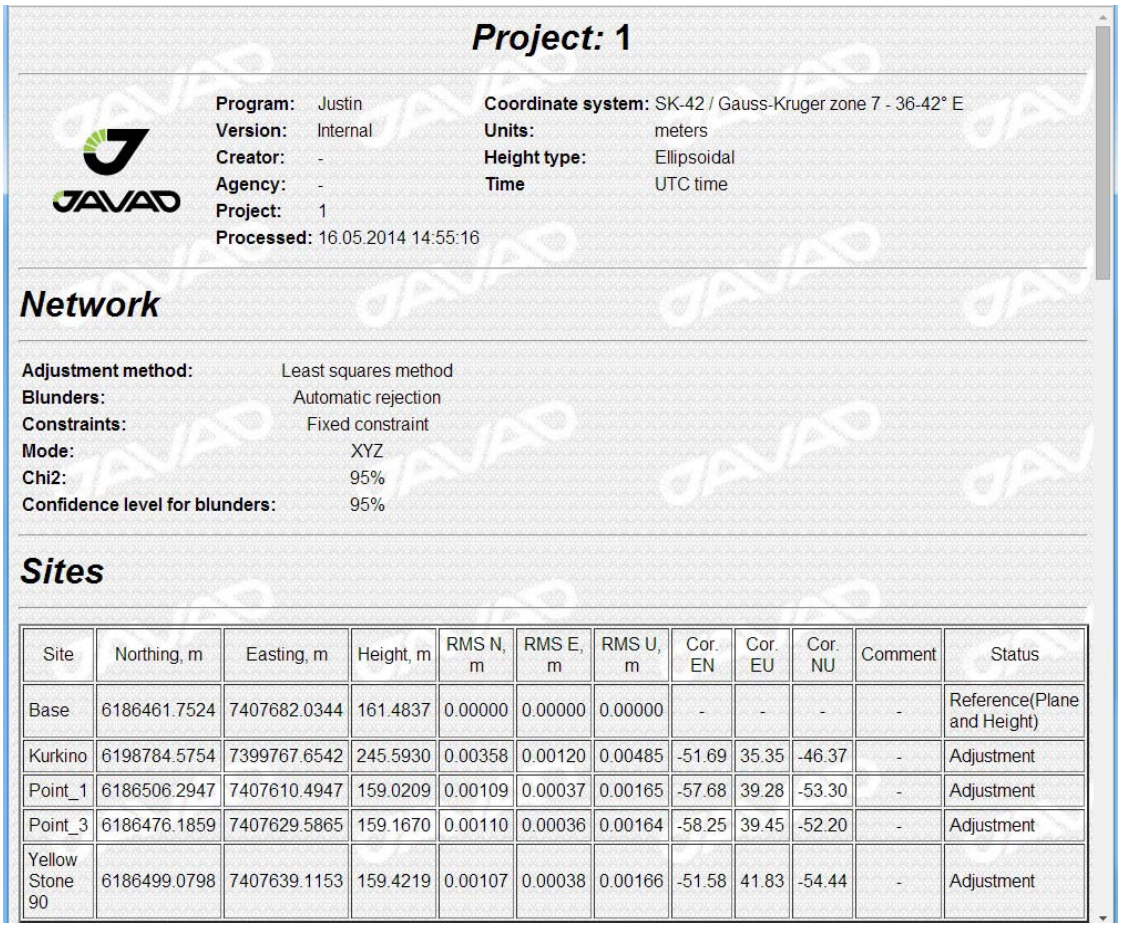


Figure 224. Time tab

In the lower left corner of the *Report* window there is *Title* check mark. This means that the log file will have a JAVAD logo and title with the general information. If enabled, the file will be created without title. If the **.html* format mode is active, the *Add map image* flag will be available and the map image will be added to the report.

When report design is completed, click *Go* button and the report will be generated in *html* or *txt* format*:*



Project: 1

Program: Justin
Version: Internal
Creator: -
Agency: -
Project: 1
Processed: 16.05.2014 14:55:16

Coordinate system: SK-42 / Gauss-Kruger zone 7 - 36-42° E
Units: meters
Height type: Ellipsoidal
Time UTC time

Network

Adjustment method: Least squares method
Blunders: Automatic rejection
Constraints: Fixed constraint
Mode: XYZ
Chi2: 95%
Confidence level for blunders: 95%

Sites

Site	Northing, m	Easting, m	Height, m	RMS N, m	RMS E, m	RMS U, m	Cor. EN	Cor. EU	Cor. NU	Comment	Status
Base	6186461.7524	7407682.0344	161.4837	0.00000	0.00000	0.00000	-	-	-	-	Reference(Plane and Height)
Kurkino	6198784.5754	7399767.6542	245.5930	0.00358	0.00120	0.00485	-51.69	35.35	-46.37	-	Adjustment
Point_1	6186506.2947	7407610.4947	159.0209	0.00109	0.00037	0.00165	-57.68	39.28	-53.30	-	Adjustment
Point_3	6186476.1859	7407629.5865	159.1670	0.00110	0.00036	0.00164	-58.25	39.45	-52.20	-	Adjustment
Yellow Stone 90	6186499.0798	7407639.1153	159.4219	0.00107	0.00038	0.00166	-51.58	41.83	-54.44	-	Adjustment

Figure 225. Report in html format

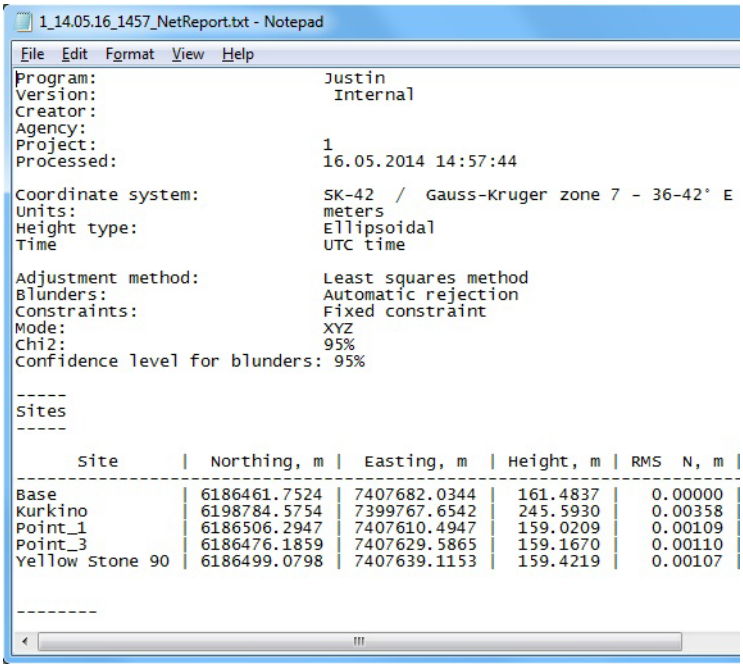


Figure 226. Report in txt format

22. Mission planning

Mission planning is intended to determine visibility for GPS, GLONASS, BeiDou, Galileo, QZSS satellite constellation and to define better conditions for observations.

Mission planning integrates with Justin, that allows you to access Mission planning from the Justin main menu, the Tools option, if a project is open.

22.1. Starting Mission planning

To start, click *Tools* ▸ *Mission planning*:

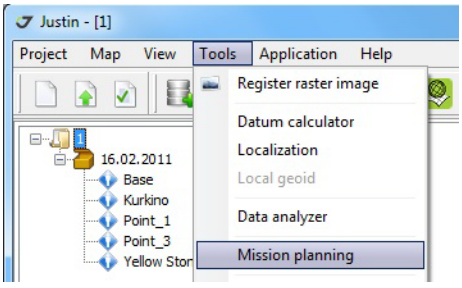


Figure 227. Tools ▸ Mission planning

22.2. Toolbar

The toolbar provides access to Mission planning options:

-  *-Input file with almanacs* – Opens the Almanac input dialog window to select an almanac and load it
-  - Opens the *Point list dialog* window to add a point to the point list;
-  - Opens the graphic window and allows inserting obstructions;
-  - Opens/Closes the sky plot to display satellites' paths tracks;

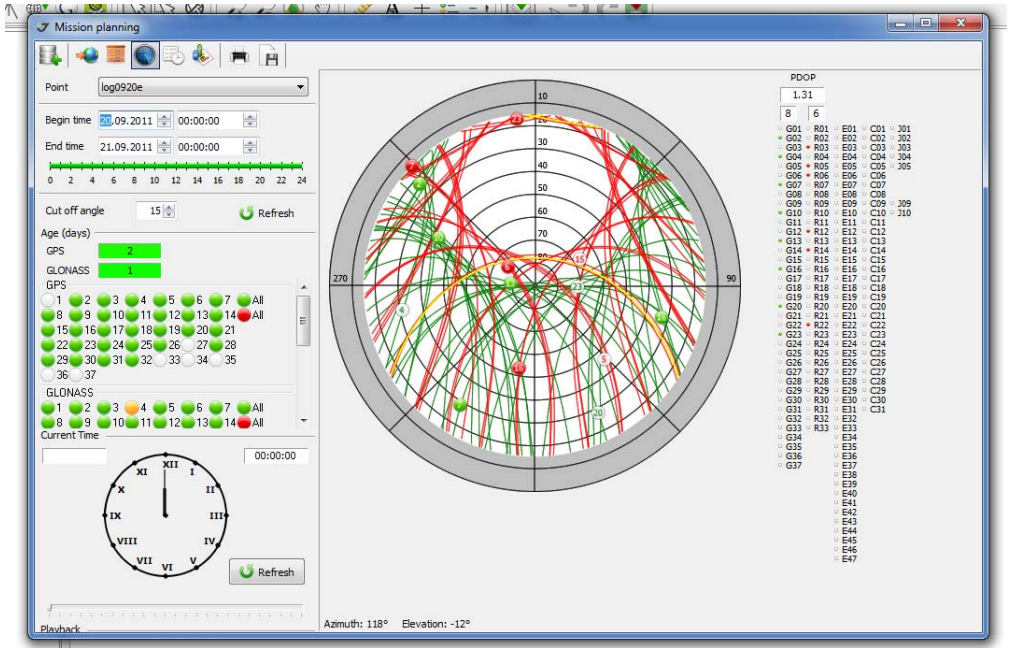


Figure 228. Orbits

-  - Displays/Hides the almanac for the selected satellite.;

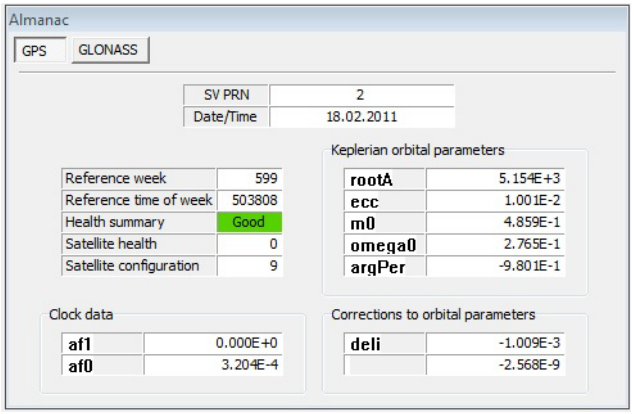


Figure 229. Almanac

-  - Displays/Hides satellites visibility, azimuth, elevation and DOPs graphs:

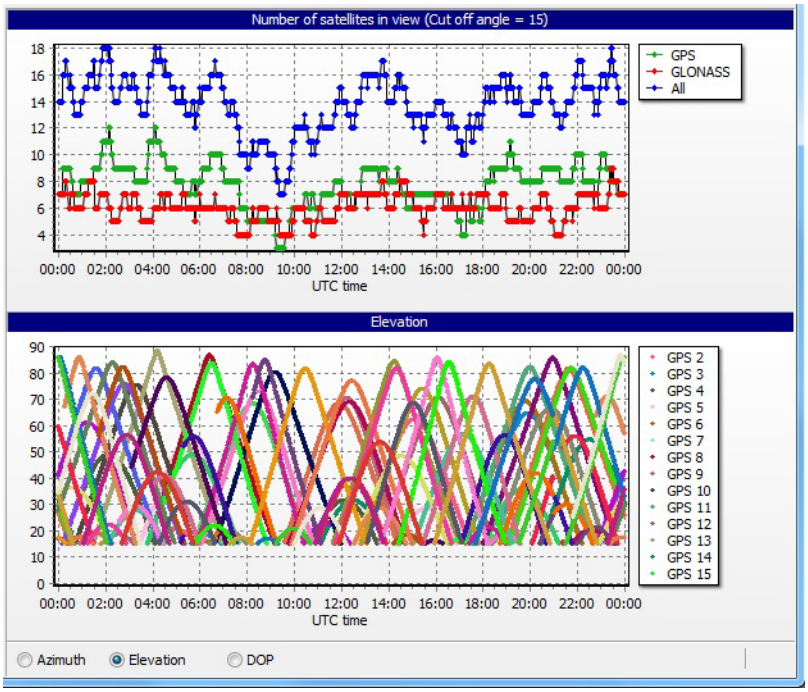


Figure 230. Satellites in view graph

-  - Prints satellites visibility, azimuth, elevation and DOPs graphs;

-  - Saves the graphs as images.

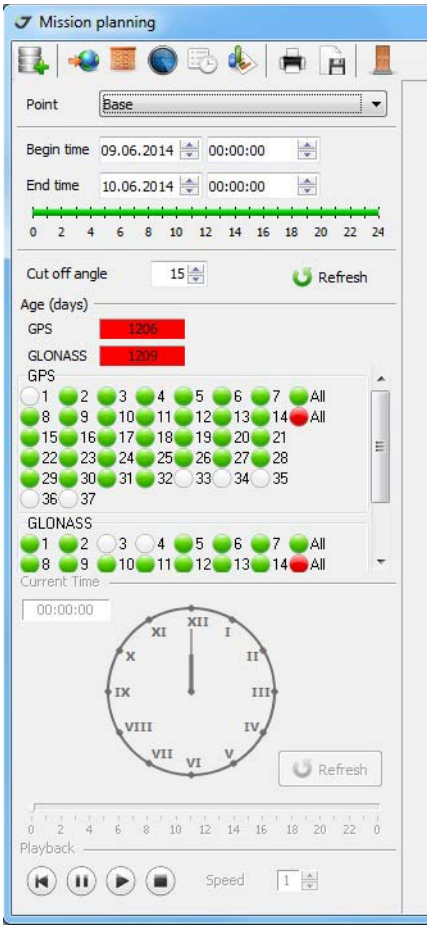


Figure 231. Mission planning

22.3. Loading an Almanac

Click  on the toolbar, it opens the *Almanac input* dialog window:

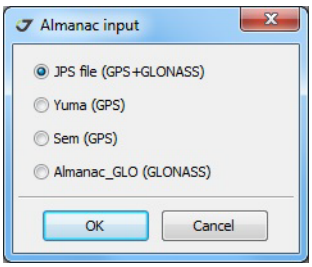


Figure 232. Selecting file type

Click one of the radio buttons, to open the *Select file with almanac* dialog window and select file containing the almanac. Click *OK*:

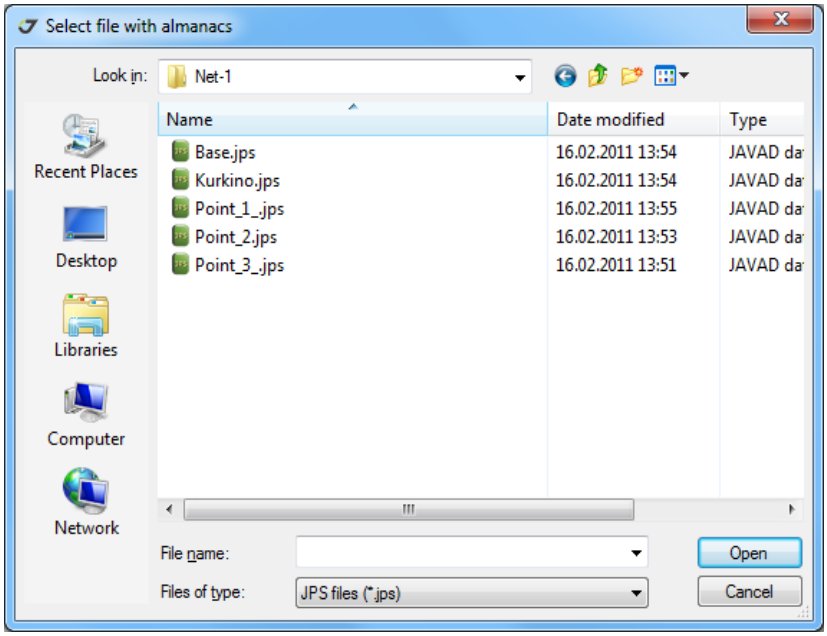


Figure 233. Select file

22.4. Point selection

To select a point, click  . The *Point List* window will appear.

If the mission planning was started and a project was opened you can select any point of the project.

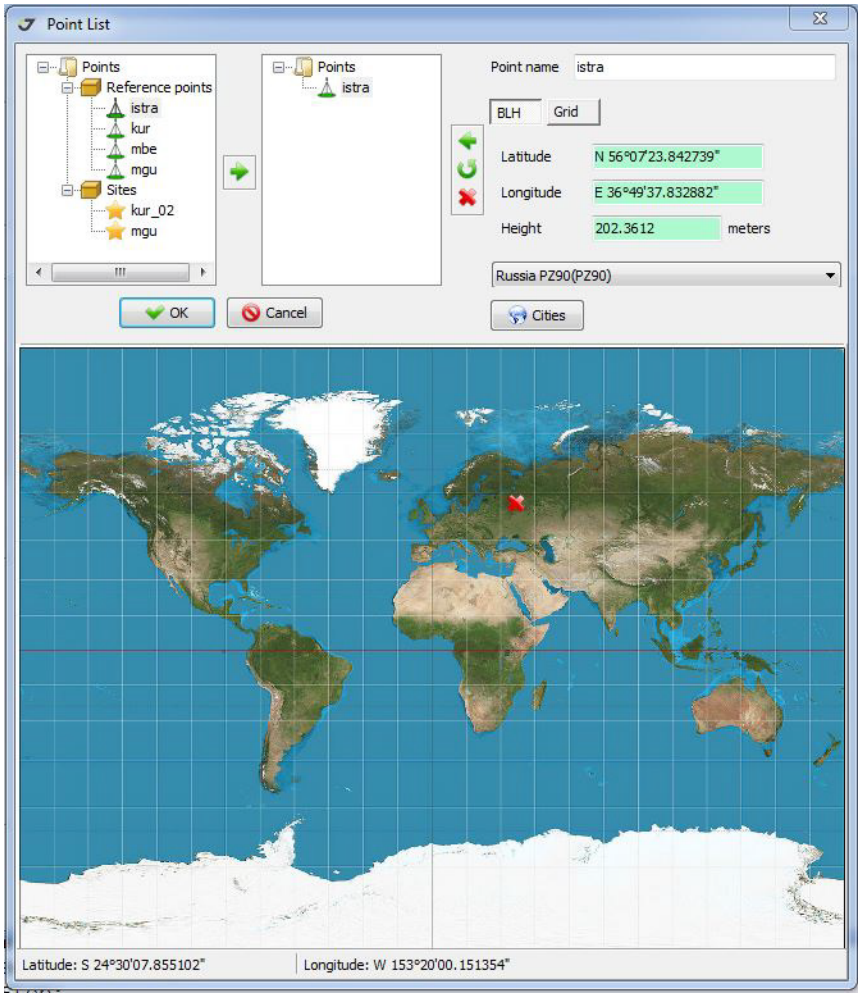


Figure 234. Point List

Select the point from the left pane of *Point List* window and click  . Point name appears on the right pane and its coordinates will be available for the selection in the *Point* list. Alternatively the point name can be entered manually. Click *OK*, to save entered points and close the dialog window

22.5. Inserting obstructions

You can draw, edit, and delete obstructions for the selected point. Locate the mouse pointer over the beginning point of the obstruction and click the left mouse button, it starts the obstruction and enables the buttons on the right of the plot:

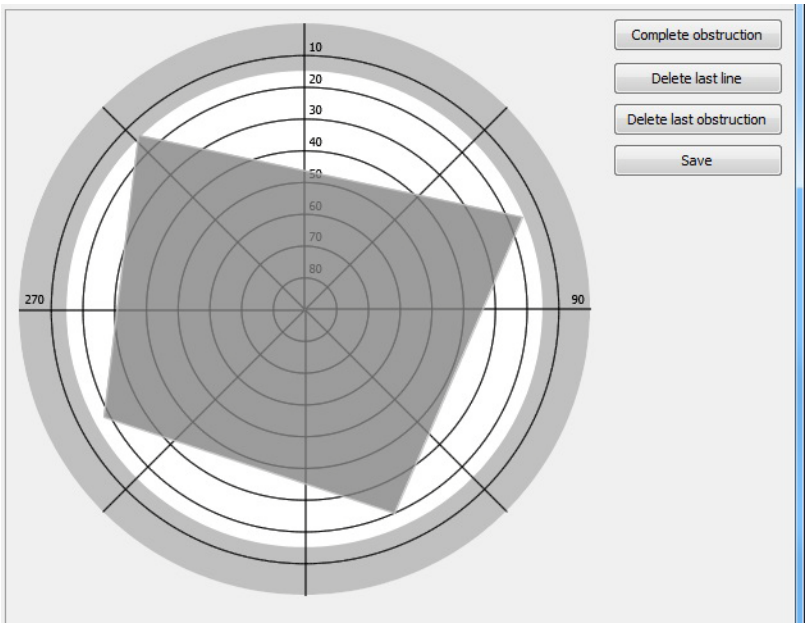


Figure 235. Obstructions

22.6. Settings

To select the point, use the drop-down list box:

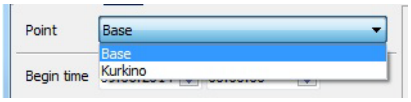


Figure 236. Point selection

The planning time interval can be set using the time scale.

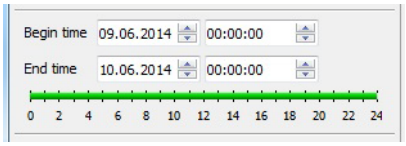


Figure 237. Time scale

The satellites can be selected using a menu.

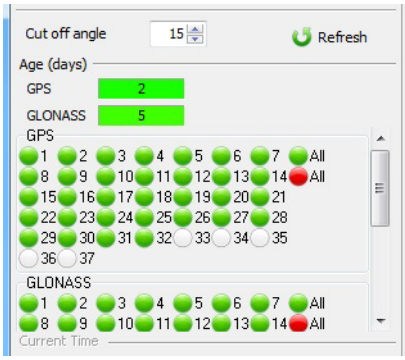


Figure 238. Satellites selection

The almanac age is displayed in the *Age (days)* field. Almanac becomes obsolete within 30 days from the date of issue. If almanac is old, these fields have a red background.

22.7. Animation

To animate satellites movements on the Sky plot, use the buttons of the *Playback* group and the Current time track bar.

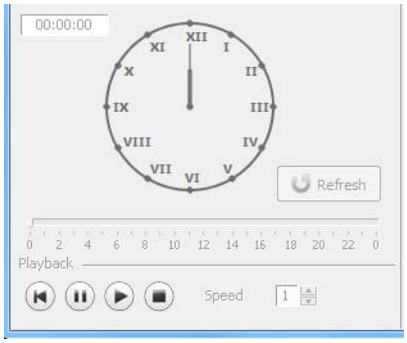


Figure 239. Animation

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