Digital Photogrammetric System

PHOTOMOD

Version 8.1

USER MANUAL

Orthophotomaps creation (Windows x64)

RACURS

Table of Contents

1. Purpose of the document 5
2. About program 5
    2.1. Purpose and main definitions 5
    2.2. Main conventions and terms 6
    2.3. Input data 7
    2.4. Output data 8
3. Start of work 9
4. Interface and its elements 10
    4.1. Work area interface 10
    4.2. Brief description of main menu 12
    4.3. The main toolbar 13
5. Workflow of mosaic creation 14
    5.1. Recommended sequence of actions when processing a new project 15
6. Mosaic project creation 16
    6.1. Project menu 16
    6.2. Creating new project 17
    6.3. Mosaic project import 19
    6.4. Project information 20
7. Images block forming 20
    7.1. Images menu 20
    7.2. Adding images 21
    7.3. Image selection 22
    7.4. Images preview 23
    7.5. Setup of image background color 25
    7.6. Image pyramid creation 27
    7.7. Editing of block images 28
    7.8. The Images list 29
    7.9. Checking source project images 32
    7.10. Replacing images 34
8. Cutlines creation 35
    8.1. Cutlines menu 35
    8.2. Requirements of the cutlines creation 36
    8.3. Creating areas without background (useful areas) 37
    8.4. Clouds calculation 43
    8.5. Automatic mode of cutlines creation 46
    8.6. Cutlines creation control 52
        8.6.1. Checking correspondence between cutlines and images 52
        8.6.2. The cutlines errors coverage map 53
        8.6.3. Cutlines out of the useful areas coverage map 55
        8.6.4. Cloud coverage maps 57
    8.7. Editing cutlines 58
        8.7.1. Including regions into cutlines mode 59
        8.7.2. Intersection of polygons with the same name 61
    8.8. Cutlines attributes 62
    8.9. Cutlines info 64
    8.10. Using external vector polygons 66
9. Brightness adjustment 66
    9.1. Brightness adjustment parameters 70
    9.2. Local brightness adjustment parameters 74
    9.3. Dodging 78
10. GC/tie points 79
    10.1. General information 79
    10.2. Ground control and tie points layer 81

10.2.1. Attributes of Ground control and tie points layer 82
10.3. Triangulation points management instruments 83
10.3.1. The “Points catalog” window 84
10.3.2. The “Points measurement” window 86
10.3.3. The “Reference map” window 92
10.3.4. GC/Tie points menu 97
10.4. Measurement of GCPs 98
10.4.1. Addition ground control points in manual and semi-automatic modes 99
10.4.2. Automatic searching of ground control points 104
10.5. Tie points measurement 107
10.5.1. Addition tie points in manual and semi-automatic modes 107
10.5.2. Automatic mode measurement of points 110
10.6. Synthetic points employment 112
10.6.1. Operation procedure 113
10.7. Parameters of GC/tie points measurement 116
10.8. Editing ground control and tie points 119
11. Splitting into sheets 122
11.1. Sheets menu 122
11.2. Requirements of cutting into sheets 123
11.3. Splitting into sheets by the specified parameters 124
11.3.1. Creating sheets taking into account the work area 127
11.4. Sheets creation modes 128
11.5. Project sheets list 131
11.6. Generators of splitting into sheets 132
11.6.1. Standard orthomap sheet frames generator 132
11.6.2. Custom orthomap sheet frames generator 134
11.7. Sheets status management 137
11.8. Attributes of sheets 139
11.9. Setting output parameters 141
12. Using auxiliary data 143
12.1. Misc (Miscellaneous) menu 143
12.2. Images layout 143
13. Mosaic creation 146
13.1. Mosaic menu 146
13.2. Setup mosaic parameters 147
13.2.1. General information 147
13.2.2. Mosaic’s main parameters 148
13.2.3. Mosaic output parameters 152
13.2.4. Using of GC/Tie points parameters 156
13.2.5. Additional parameters 158
13.3. Creation of output mosaic sheets 159
13.3.1. Distributed processing 162
13.3.2. Distributed processing of PHOTOMOD MegaTIFF 164
Appendix A. Program parameters 167
A.1. General parameters 167
A.2. Preview parameters 170
Appendix B. Raster data georeference 172
B.1. Raster data georeference with manual data input 175
B.2. Raster data georeference using points file 178
B.3. Raster data georeference using reference raster and vector map(s) 182
Appendix C. Notation sheets system 187
Appendix D. Creating marginalia for orthophotomap 187
D.1. Workflow for creating marginalia 188
D.2. Marginalia parameters 190

D.2.1. Marginalia 1:2000 190
D.2.2. Marginalia 1:5000 196
D.2.3. Marginalia 1:10 000 202
D.2.4. Marginalia 1:25 000 211
D.2.5. Marginalia 1:50 000 221
D.3. Arbitrary marginalia parameters 231
D.3.1. Batch marginalia file names editing 235

1. Purpose of the document

The current User Manual contains information about orthophotomaps creation using *PHOTOMOD GeoMosaic* program. This program is designed to merge the georeferenced orthorectified imagery and create the orthomosaic from them. The main part of document contains description the technology of mosaic creation in the *GeoMosaic* program.

2. About program

2.1. Purpose and main definitions

The *GeoMosaic* program (hereinafter is referred to as “program”) is purposed to create the orthomosaic from georeferenced orthorectified aerial and satellite imagery, splitting of created orthomosaic with the capable of saving sheets in popular raster file formats.

The *GeoMosaic* program includes to the full version of *PHOTOMOD* system and also could be produced separately.

The orthomosaic is the single image, which obtained during the brightness adjustment and merging the multiple georeferenced orthorectified images. The orthoimage is the image, obtained after the transformation from the central projection to the orthogonal projection with automatic removal of distortions, which were caused by the imaging equipment, elevation angle and relief.

One of the most common scenarios of *GeoMosaic* use is creating a mosaic from orthorectified images obtained as a result of processing the project in *PHOTOMOD* (see the “Orthorectification” User Manual).

Thus, *PHOTOMOD* output data are at the same time *GeoMosaic* input data, and creation and processing of the project in *PHOTOMOD* is a possible stage of preparation of raw data for further processing using *PHOTOMOD GeoMosaic* (depending on the nature of source data).

The program provides the following features:

- creating the orthomosaic from the source images;
- radiometric images correction (filtration, color balance, brightness, contrast, etc.);
- *pan-sharpening* – process of merging multispectral and panchromatic images (see “The pan-sharpening operation” chapter of the “General information” User Manual);
- correction (removing visual defects) of images in the *DustCorrect module* (see the “Dust Correct” chapter of the “Project creation” User Manual);

The module provides processing for Windows BMP and Stripped SingleScale TIFF without compression images only.

- automatic cutlines creation considering areas without background and cloudiness on images;

- different modes of creation and edition cutlines;
- splitting output mosaic into sheets depending on parameters;
- GCP adding and measurement their coordinates on images;
- tie points adding and measurement their coordinates on images;
- local and global brightness adjustment;
- smoothing areas along cutlines for creating mosaic image;
- import/export of cutlines, sheets borders. ground control points, etc.;
- loading DEM and accuracy control of DTM creation (see the 'Creating DTM' User Manual).

2.2. Main conventions and terms

The program uses the following conventions and terms:

- *Orthomosaic* – orthoimage, created from source images during brightness adjustment and merging georeferenced orthoimages;
- throughout this User Manual, the *orthomosaic*, created from the source images, is referred to as 'output mosaic' or 'mosaic';
- *Orthoimage* is a georeferenced image prepared from a perspective photograph or other remotely-sensed data in which displacement of objects due to sensor orientation and terrain relief have been removed;
- *Cutline* is the boundaries of the specified area from the source image, which will be included in the output mosaic. The vector polygons are used for the cutlines creation. The common boundaries of neighbouring cutlines are completely topologically coincide, i.e. the areas of source images, selected using the cutlines, which are the single area without overlaps and 'gaps';
- *Useful area* contains substantial part of image and excludes input background of image;
- *Mosaic's background* – background of output mosaic, without image, which has color defined by user. Each output mosaic file contain it;
- Source images in mosaic project also have background, which calls *background color of source images* in the system;
- *Sheet* – a part of output mosaic, which is saved in individual file with chosen format; edges of sheet are vector polygons;

- *Active sheet* – a sheet, from which the output mosaic file will be create;
- *Inactive sheet* – a sheet, excluded from the output mosaic;
- *Work area* – vector polygons which define the boundaries of the output orthomosaic's content. If the user finds it necessary to **use work area boundary** (see Section 13.2.2), the areas outside this area will be filled with the *mosaic's background*.

The *work area* makes it possible to limit the content of the orthomosaic to a polygon (or polygons) of an arbitrary shape, what can be useful if user need to create a mosaic only within some object, for example, a settlement.

The system provides for creating *sheets* of an output mosaic taking into account the *work area* of interest, which makes it possible to avoid sheets completely filled with the *mosaic's background* (see Section 11.3.1).

- *Source image* (source image of mosaic project) – source georeferenced orthoimage;
- *Reference image* is the raster image on the same area, but with more accurate georeference, then source images of mosaic project;
- *Pyramid* is a set of resampled copies of image;
- *Global brightness adjustment* means transformation equally applied to all pixels of each source image;
- *Local brightness adjustment* is a transformation applied along cutlines of images that are merged into mosaic with a smoothing going down to the image central point and mosaic edges.

2.3. Input data

The sources data for mosaic creation in the *GeoMosaic* program are the orthoimages, referenced to the coordinate system, in the files of following formats:

- Tag Image File Format (TIFF) TIFF и GeoTiff format, included tags for saving of georeferenced information;
- Windows Bitmap File (BMP);
- VectOr Raster Maps (RSW) raster formats of *GIS Panorama* software;
- ERDAS IMAGINE (IMG) ERDAS system raster format;
- NITF (NITF);
- JPEG (JPEG);

- GIF (GIF);
- PNG (PNG);
- USGS DEM (DEM);
- PCIDSK (PIX) raster format with georeference in the heading developed by PCI Geomatics company;
- JPEG2000 (JP2) raster format with jpeg compression and georeference in the heading developed.

The program also provides the ability to load and process of palette images in TIFF, GIF and BMP files format.

PHOTOMOD output data (orthorectified imagery obtained as a result of project processing) are at the same time possible *GeoMosaic.* input data.

The source images can be placed to resources of the active profile as well as to conventional *Windows* file system.

2.4. Output data

The program provides the supporting of multiple raster formats to export the output mosaic sheets. The program also provides the output formats to export the georeference data. The cutlines, sheet boundaries and tie points, created in the mosaic project, are stored in vector files of internal format. The program supports the multiple import/export formats of vector data.

The output file size in JPEG2000 and ECW formats cannot exceed 500 MB.

Table 1. Output data

Output data	File formats	File placement
Mosaic project	X-GMOS internal format	in the active profile resources
Cutlines and tie points (vector data)	X-DATA internal vector format	in the active profile resources
External georeferenced data for mosaic sheets	• PHOTOMOD GEO • MapInfo TAB • ArcWorld (`*.tfw`, `*.pbw`)	in *Windows file system*
Mosaic sheets (orthoimages)	• TIFF и GeoTIFF (`*.tiff`, `*.tif`) • Windows Bitmap File (`*.bmp`) • Panorama raster (`*.rsw`)	in *Windows file system*

Output data	File formats	File placement
	• ERDAS IMAGINE (*.img) • NITF (*.nitf) • JPEG (*.jpg, *.jpeg) • PNG (*.png) • Microstation (*.gfn) • PCIDSK (*.pix) • JPEG2000 (*.jp2) • PHOTOMOD MegaTIFF (*.prf) • ECW (*.ecw) • WebP (*.webp)	

3. Start of work

Before the beginning work in the program define the folder, in which are placed the sources data. The program allows to place the files with the source data in the folders of *Windows* file system, as well as in the profile resources.

Activate this profile when the source images placing in the profile resources. Supported file formats list of source images see in Section 2.3.

Description of resource system see in the General Information User Manual.

To start the program perform one of the following:

- choose the **Start › Programs › PHOTOMOD 8 x64 › GeoMosaic***;*
- double click the *PHOTOMOD Geomosaic* icon on the desktop;
- in the context menu of *System Monitor module in* (the  icon in the*Windows*system tray) choose **GeoMosaic**;
- start the *PHOTOMOD* system and choose the **Rasters › GeoMosaic**.

4. Interface and its elements

4.1. Work area interface

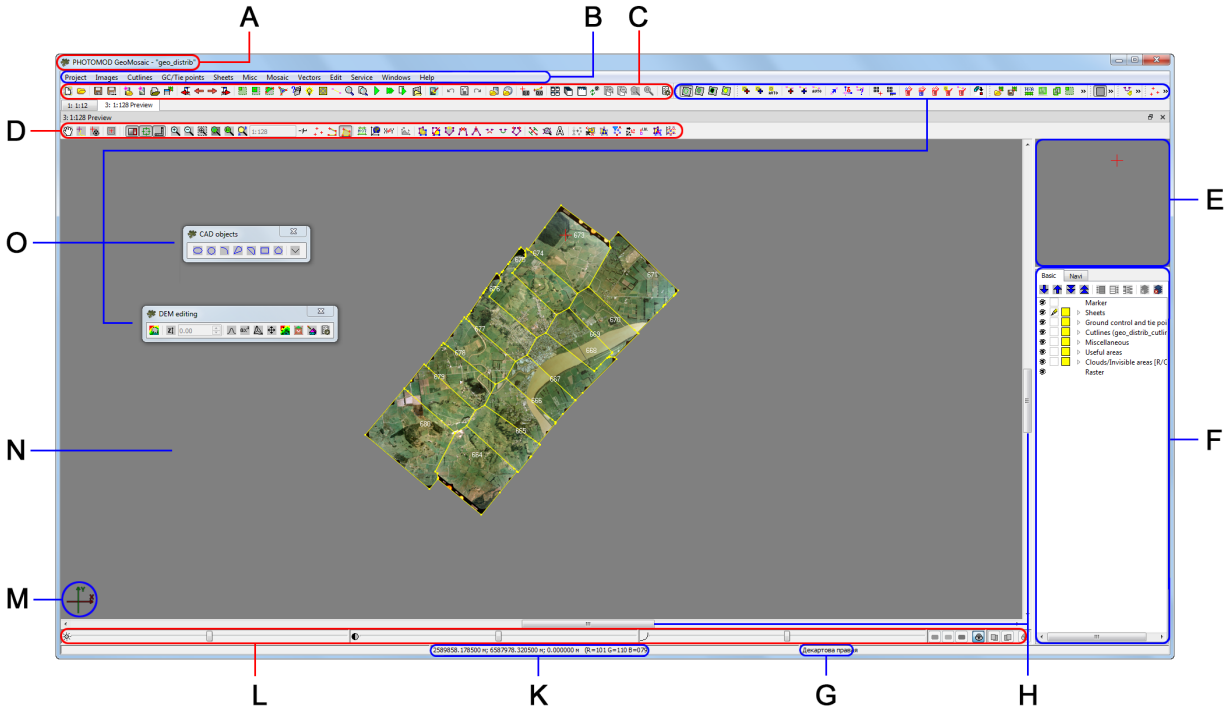


Fig. 1. The GeoMosaic program

The GUI contains the following elements:

- title with name of opened project (*A*);
- the main menu bar (*B*);
- the main toolbar is used for quick main program functions access (*C*);
- the additional toolbars is used for quick miscellaneous program functions access (*O*);

The system interface is flexible for customizing the locations of additional toolbars according to the user's needs. Additional toolbars can either be fixed in designated sections of the work area (top or bottom, right or left) or undocked by the user and placed in any place in the 2D window.

Depending on the user-set interface configuration, docked additional toolbars can be partly minimized (some buttons will be hidden). Docked (optionally minimized) subtoolbars are displayed as one line, vertical or horizontal, depending on their location.

By default, additional toolbars are docked at the top of the workspace, to the right of the main toolbar. Additional toolbars are marked with a special icon located on the left or top (de-

pending on the location) edge of the panel. To maximize the toolbar, click » (⌄) on the right (at the bottom).

Undocked additional toolbars are always displayed horizontally, in one line, in a fully maximized form. To undock a toolbar (or pinpoint it in any place), move the cursor over the ⋮ icon and, holding down the **left mouse button**, drag the toolbar to the area of its targeted location (the cursor's shape changes (✥) when it is possible to capture the toolbar).

- the 2D-window, used for data displaying, contains the following elements:
  - the toolbar is used for the 2D-window modes managing (*D*);

    A `number/total` sheets/images is shown in header of the individual 2D-window.

  - the work area is used for viewing and processing with loaded data of mosaic project (*N*);
  - the navigation bar is used for fast moving on the specified block images area of mosaic project (*E*);

    To do this, click on the chosen point in **Navigation bar**. To set the layers visibility, move to the **Navi** tab in the *layer manager*.

  - the *Layer manager* is used for managing of mosaic project layers (*F*);
  - the axes direction of project coordinate system (*M*);
  - the status bar is used for viewing current real (ground) and pixel marker coordinates and brightness, contrast and gamma data adjustment in the work area (*G, K, L*);

    GSD value is displayed to the right of the current marker coordinates (excluding radiometric correction windows).

    RGB brightness values are displayed to the right of the current marker coordinates. When placing the marker within the work area, the following brightness values are displayed: `R=128 G=128 B=128`.

    When place marker is on the area out of image or on background (in **Preview** window), brightness is indicated as *NULL*.

  - scroll bar in 2D-window (*H*).

The system interface is flexible for customizing the locations of 2D-windows according to the user's needs. The 2D-window can either be fixed in designated sections of the work area (by default) or undocked by the user and placed in any place in the work area.

To undock 2D-window (or pinpoint it in any place), move the cursor over the window title and, holding down the **left mouse button**, drag the window to the area of its targeted location.

Use the button on the right side of the window title to undock a docked window.

For convenience, the system also allows you to maximize some key 2D windows, “stretching” them to the full width of the screen work area. Thus, such a window can be displayed in three states – “docked”, “undocked”, and “maximized”.

To stretch a 2D window (for example, a window displaying a block scheme) to the full width of the screen, perform the following:

1. Undock the 2D window. The maximize button is displayed in the main toolbar of *that window*;

2. Click in the toolbar. The window fits the full width of the screen work area. The main toolbar of the window displays the restore button;

3. [optional] To restore down, click .

To quickly return a window to the previous configuration, double-click the **left mouse button** on the window title

Several similar windows docked within one work area make up a group of tabs (e.g., 2D windows). To go to the desired tab, **left-click** on its title. To close a tab (and the corresponding window), click in the tab title.

4.2. Brief description of main menu

The program main menu contains the menu items for mosaic creation, vector data processing, additional applications starting and setting parameters.

Table 2. Main menu

Menu	Function
Project	to create, open and save mosaic project, and also obtain information about project
Images	to form images block of mosaic project
Cutlines	purposed for cutlines creation and also provides features for calculating areas without background (useful areas) and cloudiness
GC/tie points	purposed for searching and measurement ground and tie points in the cutlines region to adjust the stitching along the neighbour cutlines
Sheets	purposed for mosaic splitting and managing active status of sheets
Misc	purposed for additional data retrieving
Mosaic	purposed for defining the output parameters of mosaic and creating the sheets of mosaic with saving in output format files

Menu	Function
Vectors	purposed for creating, editing, import/export of vector data (see the menu description in 'Vectorization' User Manual)
Edit	purposed for modes choosing to select and draw vector objects, to transform curves, repeat/cancel the last operation (see the menu description in 'Vectorization' User Manual)
Service	purposed for applications launching, additional data loading (e.g., DEM), general parameters setting, coordinate system editing, etc.
Windows	to open additional toolbars and windows: new 2D-window, Marker and Measurements windows, Objects attributes window (see the chapter "*General system's windows*" of the 'General information' User Manual)
Help	to start the 'Help' system
Exit	purposed for closing of GeoMosaic program

4.3. The main toolbar

Table 3. Brief description of main toolbar

Buttons	Function
	to create a new project
	to open a mosaic project from active profile resources
	to save a mosaic project
	to save a mosaic project with new name in active profile resources
	to add images out of active profile resources
	to add images from active profile resources
	to open images list
	to open sheets list
	to open **Points catalog** window
	to open current and previous images in individual 2D-images
	to open next image
	to open previous image
	to open current and next images in individual 2D-images
	to set on a single sheet creation mode
	to create a sheet around marker
	to turn on the cutlines fast manual editing mode
	to create a new cutline as a small rectangle polygon in the place of the node (the point where three or more cutlines converge). This polygon can be further edited by the user.
	to define the output parameters for creation of mosaic
	to rebuild brightness adjustment for all block scheme
	to enable using of ground control points
	to enable using of tie points
	to open the **Preview** window for all project
	to open the **Preview** window for current sheet

Buttons	Function
	to start the mosaic creation
	to start building a mosaic for selected active sheets according to the specified settings and parameters in the distributed processing mode
	to start building a mosaic and creating an output file for the selected sheet
	to load an image from file to the individual raster layer
	to launch the *DustCorrect module* to edit MS-TIFF images (see the “Dust Correct” chapter of the “Project creation” User Manual)
	to undo the last action (see the ’General information about system’ User Manual)
	to display the list of last actions (see the ’General information about system’ User Manual)
	to redo the last undone action (see the ’General information about system’ User Manual)
	to load a georeferenced image from file, located in the file system, for more precise correspondence of cutlines area
	to load web-map
	to open the **Marker** window (see the menu description in ’Vectorization’ User Manual)
	to open the **Measurements** window (see the menu description in ’Vectorization’ User Manual)
	to tile 2D-windows
	to stack 2D-windows
	to arrange 2D-windows in a tabsheet
	to arrange 2D-windows evenly
	to refresh all 2D-windows; to perform re-calculating of brightness adjustment click the button holding the **Shift** key
	to close all 2D-windows
	to close all 2D-windows with opened images (except **Preview** window)
	to zoom in, in all windows with opened images (**Shift+* [NumPad]**)
	to zoom out, in all windows with opened images (**Shift+/ [NumPad]**)
	to fit data to page, in all windows with opened images
	to display data in 1:1 scale, in all windows with opened images
	to open a window of display mode parameters (see Appendix A)

5. Workflow of mosaic creation

Both the sequence of procedures and the program’s functionalities involved are largely driven by the properties of the project under processing itself, i.e., quality and homogeneity of source data, possibility to use reference information, as well as the nature of output data and their requirements (both accuracy and visualization quality aspects).

Possible scenarios for using the *GeoMosaic* program can be divided, for clarity, into two groups:

- Creating a new photomosaic using well-suited and homogeneous data, for example, as one option, orthorectified images previously obtained as a result of processing the project in the *PHOTOMOD*.

  Such a scenario (considered as a general case) is described in this manual as a recommended sequence of actions when creating and processing a new project (see Section 5.1).

- Refining an existing orthomosaic (or earlier created *PHOTOMOD GeoMosaic* project) using inhomogeneous data obtained from various sources, complicated by the specific terrain, the inability to use reference information, and the need to correct local areas of the mosaic (or add new areas to the mosaic).

  Such tasks may place increased demands on the user's experience and qualifications, and their solution may require a deviation from the standard order of operations when processing a project and the use of additional program capabilities (for example, specifying the referencing).

  Describing all possible situations is beyond this manual; however, some recommendations concerning the most frequent unusual cases are given below in the framework of the described recommended sequence of actions when processing a standard project.

5.1. Recommended sequence of actions when processing a new project

Creation of mosaic implies a number of following actions:

1. Creating of mosaic project (see Section 6).

2. Loading of images in the mosaic project (see Section 7):

   - images adding;

   - setting of transparency for the background color of source images (see Section 7.5).

3. Defining of channels set for mosaic.

   Use the **Mosaic** tab in the **Mosaic parameters** window to define the channels (see Section 13.2.2).

4. Defining of the *output* coordinate system for mosaic and using it for storing of vector data (the cutlines, sheets boundaries and tie points).

Use the **Misc** tab to specify the save parameters of vector data in output coordinate system (see Section 13.2.5). The output coordinate system for mosaic is defined in the **Mosaic parameters** window on the **Mosaic** tab (see Section 13.2.2).

5. Estimation of work areas for cutlines creation: Creating areas without background and areas with clouds (see Section 8).

6. Cutlines creation and editing (see Section 8).

It is not necessary to create cutlines only if block of initial images with joining boundaries, i.e. if images block is without overlaps and 'gaps', is used.

7. [optional] Performing brightness adjustment of mosaic areas: global and local brightness adjustment, seams feathering (see Section 9.1).

8. [optional] Ground control or synthetic points employment, stitching the cutlines regions by tie points (see Section 10). Setup parameters of GC/Tie points employment (see Section 13.2.4).

Using GC/tie points is not a mandatory stage of project processing and is generally not required when using correct and homogeneous input data. It is recommended to use this tool with some degree of caution, only in cases where it is really necessary to achieve the desired results.

If project processing requires GC/tie point using, manual editing of cutlines (see above) is strongly recommended *after* completing work with triangulation points

9. Splitting into sheets and selection for creating of output files (see Section 11).

10. Setup the output parameters for mosaic creation: pixel size, map scale, mosaic sheets file format, etc. (see the Section 13.2.2 and Section 13.2.3).

11. The mosaic creation with saving of the mosaic sheets in the files of selected format, also in the distributed processing mode.

6. Mosaic project creation

6.1. Project menu

Table 4. Brief description of 'Project menu'

Menu items	Function
New	is used for creation of the new mosaic project
Open	is used to open the saved mosaic project from file with the `*.x-gmos` extension in the resources of active profile
Recent	to choose and open one of recent projects

Menu items	Function
Import	to import mosaic project from the *.x-gmos file
Save	to save the opened mosaic project in the file with the same name and the *.x-gmos extension in the resources of active profile
Save as	to save the opened mosaic project in the new file and the *.x-gmos extension in the resources of active profile
Save work environment	to save the project work environment – a set of project opened layers (e.g. vector data, raster images opened to transfer GCPs or DEM) in a file *.x-work in active profile resources
Load work environment	to load project work environment data from a file *.x-work saved in active profile resources
Statistic	to open the project statistic window

6.2. Creating new project

Choose the **Project › New** or click the button on the main toolbar; The following blank service vector layers are created automatically and displayed in the *Layer manager*:

- *Useful areas*;
- *Clouds/Invisible areas*;
- *Ground control and tie points*;
- *Miscellaneous*;
- *Sheets*;
- *Cutlines.*

Service layers couldn't be closed or saved as a separate vector layer.

The mark near the Clouds/Occluded zones layer name means that this layer is not available for manual editing at the moment (see Section 8.4).

The name project in the title of main program's window is marked with *, if the project was changed. The names of layers to which unsaved changes have been made are marked in a similar way.

Mosaic project is saved to *.x-gmos file.

Choose the **Project › Save** to save the mosaic project. All changes in project layers are saved.

Choose the **Project › Save as** to save the mosaic project with new name and define name and path in active profile resources.

Choose the **Project › Open** or click the button on the main toolbar to open existed mosaic project.

The program provides opportunity to load the following additional data in the project:

- choose the **Misc › Load metadata to current layer** to load images metadata to the current active layer;

Metadata – structured information about data in the image file,

It is recommended to choose *Cutlines* or *Miscellaneous* layers to correct load of metadata. Metadata could be load only into a system layer.

- choose the **Misc › Load nadir and central points** to load nadir and central points to the *Miscellaneous* layer.

It is possible to work with project without source raster images (e.g. only to view project parameters or cutlines). In this case images display as a grid in 2D-window.

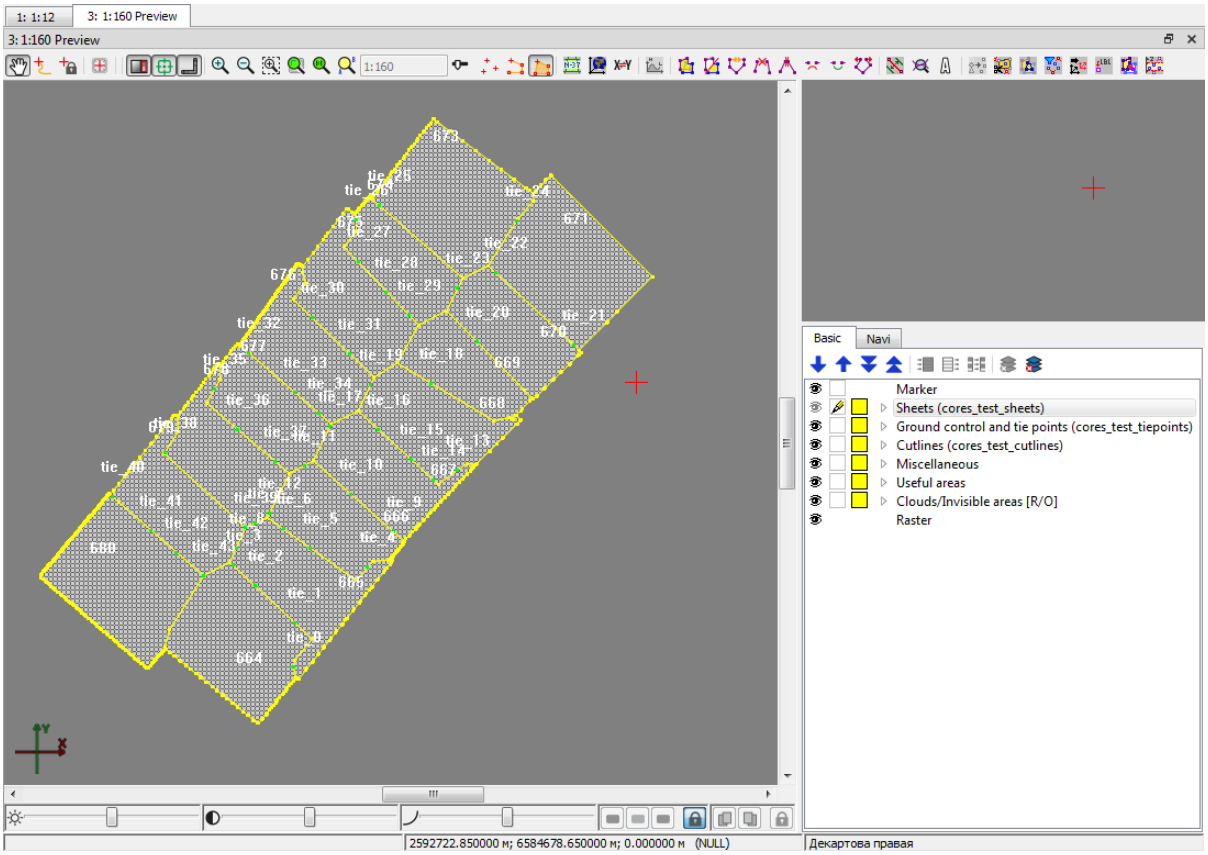


Fig. 2. Project without source images

6.3. Mosaic project import

The program allows to import parameters of other project without changing set of source images

To import project parameters to opened project choose the **Project › Import**.

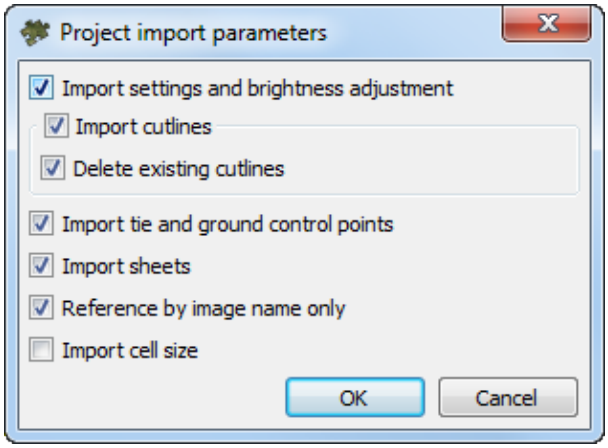


Fig. 3. Mosaic project import parameters

The **Project import parameters** window allows to choose type of the following data to import:

- **Import settings and brightness adjustment** – allows to import parameters of the **Mosaic** tab on the **Mosaic parameters** window, and also parameters of local and global brightness adjustment from the **Brightness adjustment** tab;
- **Import cutlines** – to import cutlines layer, associate these cutlines with images of current project;
  - [optional] set the **Delete existing cutlines** checkbox to delete cutlines from opened project during the import;
- **Import tie and ground control points** – allows to import tie and ground control points and to associate then with images of current project;
- **Import sheets** – allows to import parameters of splitting mosaic into sheets and to allow these parameters for current project;
- **Reference by image name only** – to compare imported cutlines only by image name, not by path;
- **Import cell size** – to import the output mosaic cell size.

All data import to the service layers of project. Layers with imported data are marked in the *Layer manager*.

6.4. Project information

To view information about the project choose **Project › Statistic**.

The **Statistic** window, which contains the following information, opens:

- quantity of source images;
- quantity of channels;
- bytes per sample;
- quantity of total/active mosaic sheets;
- mosaic size in megabytes;
- output raster size in pixels.

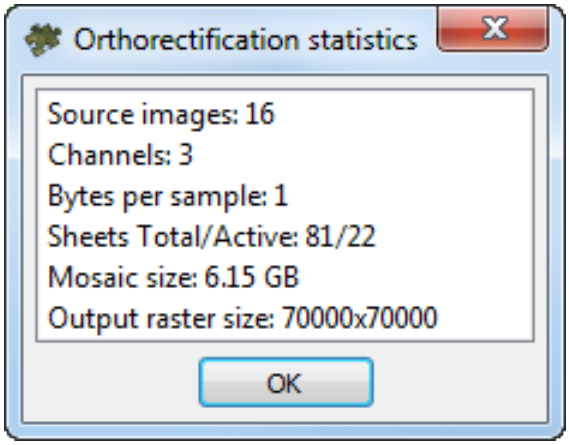


Fig. 4. Project information

7. Images block forming

7.1. Images menu

Table 5. Brief description of Images menu

Menu items	Function
Add images from files	is used for the selecting image files, locating in the file system, and adding to mosaic project
Add images from resources	is used for selecting image files, locating in the resources of active profile, and adding to mosaic project
Add images › From files (from folder)	is used for automatic selection of all images from the specified folder of *Windows file system*

Menu items	Function
Add images › From resources (from folder)	is used for automatic selection of all images from the specified folder of active profile and adding to mosaic project
Add images › Add from files list	to use the text file, containing the full network paths to the images (useful when the project files are located in different local and network folders), for adding the images to mosaic project
Delete selected images	to delete from project the images that are selected using selection of appropriate vector objects, for example, source images boundaries, cutlines, areas without background
Delete images outside active sheets	to delete the images outside active sheets from mosaic (see Section 11)
The Images list window	to open the added images list for editing list, search images by name, view the selected image and its properties; define images background color; show tie points residuals
Open selected images	is used to open in separate 2D-windows those images, with highlighted boundaries (see Section 12)
Check source images	is used for the checking of the project images (see Section 7.9)
Create pyramids	to create the overview pyramid set for the fast images refreshing on screen (the *pyramids* are saved in the files with the `*.pyr` extension in the *Pyramid* folder during this process)
Distributed pyramids creation	to use distributed processing for pyramid creation of loaded images
Delete pyramids	to delete all external pyramids, created for loaded images (with the exception of the pyramids currently in use)
Transparent background color	contains menu items to set up transparency images background color
ImageWizard	to open the **ImageWizard** utility to manage links to images (see the “ImageWizard. Adjustment of images” chapter of the “Creating project” User Manual)

7.2. Adding images

The step forming of source images block follows after the mosaic project creation. It implies a number of following actions:

1. Loading source images and forming block images of mosaic project.

2. Setting transparency for the background color of source images to exclude the background from the output mosaic.

The program provides the following possibilities to load source images into the project:

- to add source images manually from files
  - in active profile resources – choose the **Images › Add images from resources** or click the  button;
  - in the*Windows* file system folder – choose **Block › Add images from files** or click the  *button.*

Shift and **Ctrl** keys are used to select multiple files.

- to add source images automatically;

Automatic selection is recommended when large number of source raster files are located in the folder along with files of other formats, and/or when source images are located in several subfolders of the selected folder.

  - from folder in active profile resources – choose the **Images › Add images › From resources (from folder)**;
  - from the*Windows* file system folder – choose the **Images › Add images › From files (from folder)**.

To search raster images in subfolders, set on the **Search in subfolders** checkbox.

It is possible to search and add files only with selected extension. The type of mask like `*.*` is used for this (e.g., `*.tiff`).

- to add set of source images create a text-file with the list of images paths and choose **Images › Add images › Add from files list**.

The text-file should contain list of *full* network paths to source images files.

It is possible to change output channels, if images with channel, that is absent in loaded images, were added to the project.

7.3. Image selection

The program allows selection one of group of images in the *Miscellaneous*, *Cutlines* or *Useful areas* layers and also in the window with source image.

The following options are provided for images selection:

- the **Misc › Source images outlines** menu item is used to create image borders as vector polygons on the *Miscellaneous* layer. Images are selected corresponding to selected polygons;

  If there are selected objects on the non active *Miscellaneous* layer, will be selected images corresponding to these objects.

- if there are selected polygons on the *Cutlines* or *Useful areas* layers, will be selected images corresponding to selected polygons;

- if there are selected objects on the active 2D-window, will be selected image in this window only.

7.4. Images preview

Images block opens automatically in the **Preview** window after adding images to the mosaic project.

To display all images in the **Preview** window, choose the **Mosaic › Preview** or click the  button of the main program toolbar.

Images are displayed in the **Preview** window automatically after adding to the mosaic project. In order to disable automatic displaying of images, set off the checkbox in the **Preview** tab of the **Parameters** window (see Section A.2).

Each image of mosaic project is a raster images, insert to a rectangle.

Background without image has defined color. In program it calls *mosaic's background* and each output mosaic file contain it.

By default is used black background color. Background doesn't display in the **Preview** window.

To display output mosaic background in the **Preview** window, set off the **Transparent mosaic background on preview** checkbox in the **Preview** tab of the **Parameters** window (see Section A.2).

The **Background color** parameter on the **Mosaic** tab in the **Mosaic parameters** window allows to chose (see Section 13.2.2).

Source images in mosaic project also have background, which calls *background color of source images* in the system.

It is recommended to exclude this background from output mosaic. To do this set the transparency of background color (see Section 7.5).

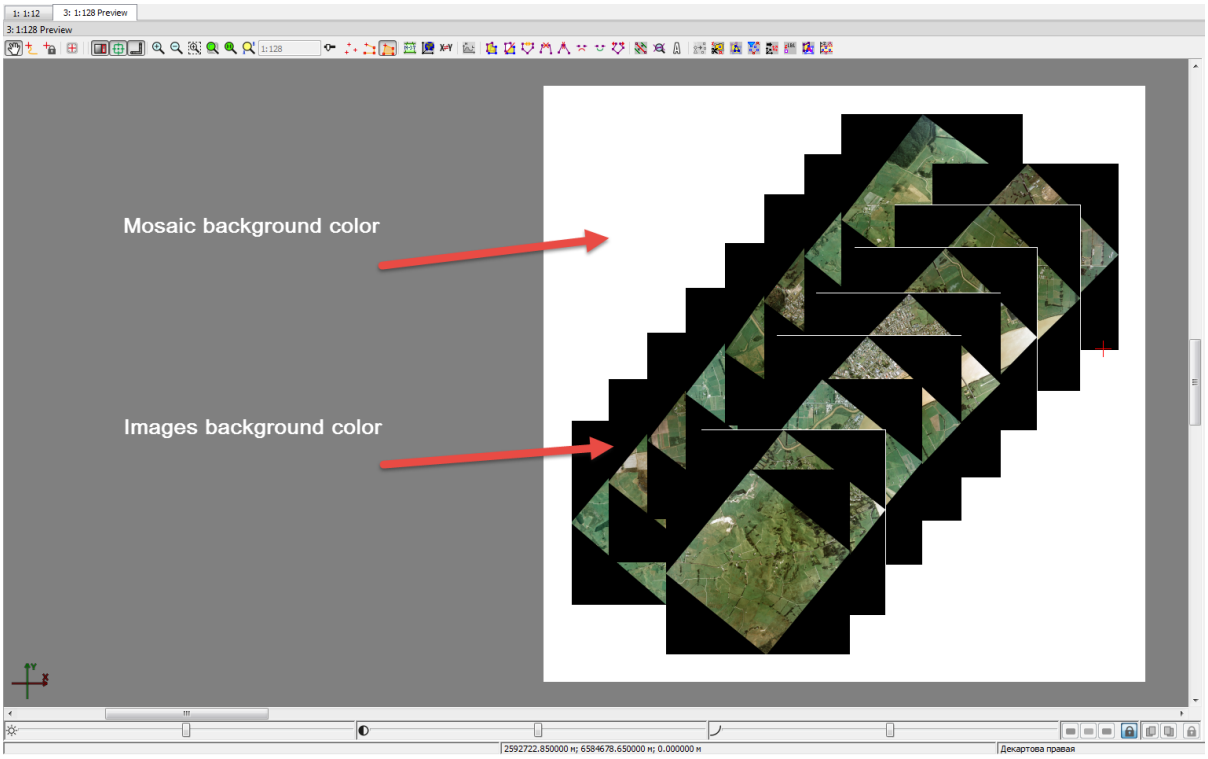


Fig. 5. Mosaic's background and background color of original images (without transparency)

Perform one of the following to open images of mosaic project in separate 2D-windows:

- choose the **Images › Project images list** to open **Images list** window. Select the images in the list and click the button.

  In order to highlight multiple images, press and hold the **Ctrl** or **Shift** key while clicking mouse or use selecting tools in **Images list** window (see Section 7.8).

- choose the **Misc › Source images outlines** to create image borders as vector polygons. Select borders of images and choose the **Images › Open selected images**.

  To select more than one object, stretch the rectangle along with pressed **Shift** key with one of the group selection instruments on **Tools** toolbar.

  The system also provides for selecting objects using a freeform polygon ( ).

  Create a polygon by holding **Shift** while moving the cursor sequentially in the work area of the 2D window. To complete the creation of a polygon, set the last vertex of the polygon by double-clicking the **left mouse button**. To delete the last created vertex, press **Esc**.

The following buttons on main toolbar are used to pass to previous or to next image:

- – to display previous image;

- – to display next image.

If there is no opened 2D-windows (image) or preview windows, the button allows to open the last image in the project, – the first image.

The following buttons on main toolbar are used to pass to previous or to next image:

- – to display current and previous images in separate 2D-windows;
- – to display current and next images in separate 2D-windows.

To open any georeferenced orthoimage of acceptable raster format in separate 2D-window, choose the **Mosaic › Open image** or click the button on the main toolbar and choose image file.

In case the same folder contains a `*.rmc` file, the correction parameters for the selected image will be loaded

7.5. Setup of image background color

It is recommended to setup of transparency image background color after image loading into mosaic project to create mosaic correctly.

Setup of transparency background color of input image is highly recommended when there are areas inside images with the same color as background and you need to consider these areas in output mosaic as transparent, i.e. to produce mosaic with 'gaps' without fill of input background color or using reference image. The **Transparent background inside cutlines** parameter is used to consider useful areas transparency (see Section 13.2.2).

Perform one of the following to setup transparency for the background color of source images:

If background is not homogeneous in color, use the **Source rasters background color range** parameters (see Section 13.2.2).

- in case of white background color of source images, choose the **Images › Transparent background color › White**;
- in case of black background color of source images, choose the **Images › Transparent background color › Black**;
- choose the **Images › Transparent background color › Auto** to assign automatically images background color and set up transparency to all mosaic project images.

In case of arbitrary background color of source images, choose the **Images › Project images list** or click the button on the main toolbar. The **Images list** window opens. Select the images to define the images background color and click the button (see detailed description in Section 7.8).

Due to the peculiarities of preprocessing, some satellite images can have two background colors at the same time (black and the second one is arbitrary), which must be taken into account during processing. For correct processing of such images, perform the following:

1. To take into account the arbitrary background color of source images, choose the **Images › Project images list** or click the button on the main toolbar. The **Images list** window opens. Select the images to define the images background color and click the button (see detailed description in Section 7.8).

2. To take into account the black background color of source images, choose the **Mosaic › Parameters** or click the button on the main toolbar. The **Mosaic parameters** window opens. Open the **Brightness adjustment** tab set the **Additional check for black background** checkbox.

Choose the **Images › Transparent background color › None** to cancel transparency setting for images background color.

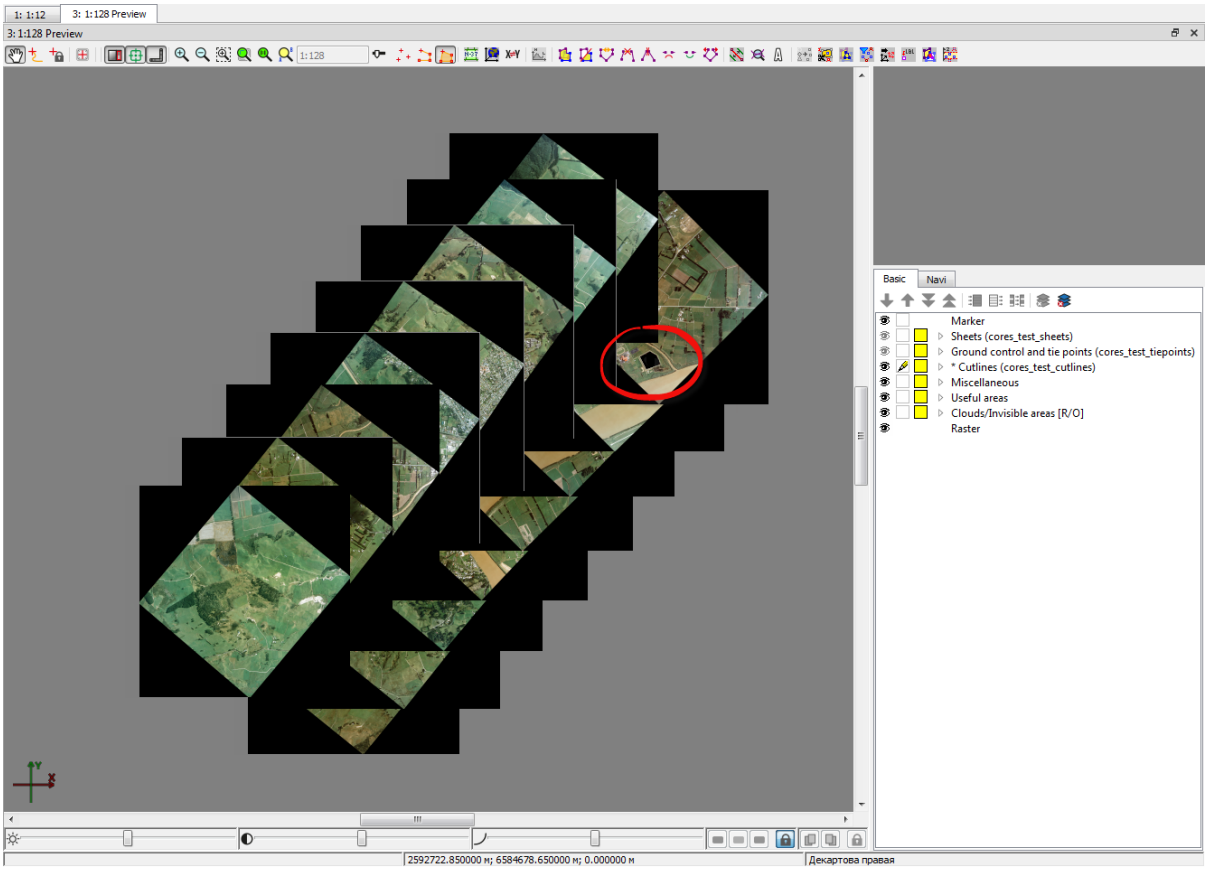


Fig. 6. Black color of images background

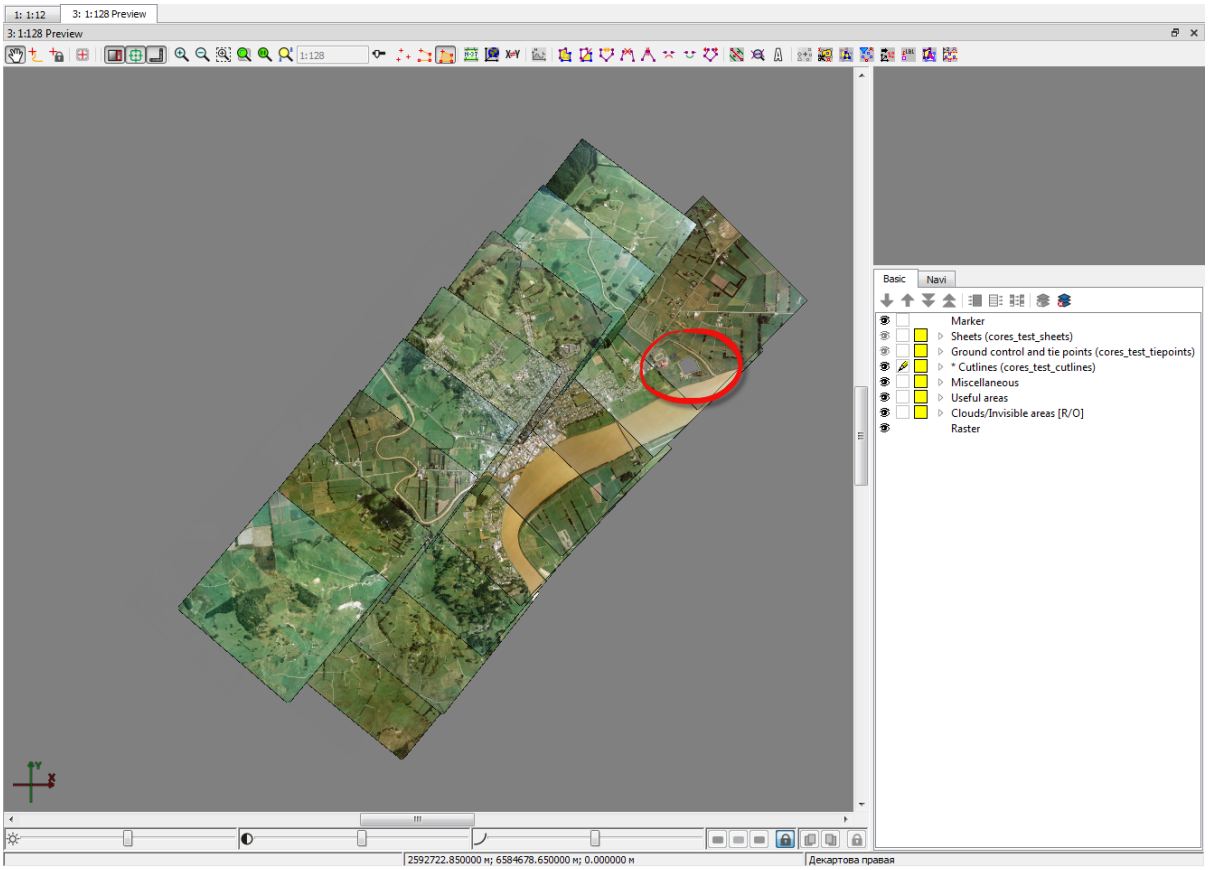


Fig. 7. Transparency setting for black color of images background

7.6. Image pyramid creation

To fast images redraw on a screen it is possible to create image pyramid.

Pyramid is a set of resampled copies of image.

The pyramids are saved to the files with the `*.pyr` extension in the *Pyramid* folder.

PHOTOMOD software supports already existing third-party image pyramids, if available (`*.ovr`).

Choose the **Images › Create pyramids** for creating the overview pyramid.

In case of large data volumes it is recommended to use distributed processing. Perform the following actions to create pyramids using distributed processing:

1. Add images to the project.

2. Change settings and run the distributed processing server/client (see the '*Distributed processing*' chapter in the 'General information about system' User Manual).

3. Choose **Images › Distributed pyramids creation**. The **Create pyramids** window opens.

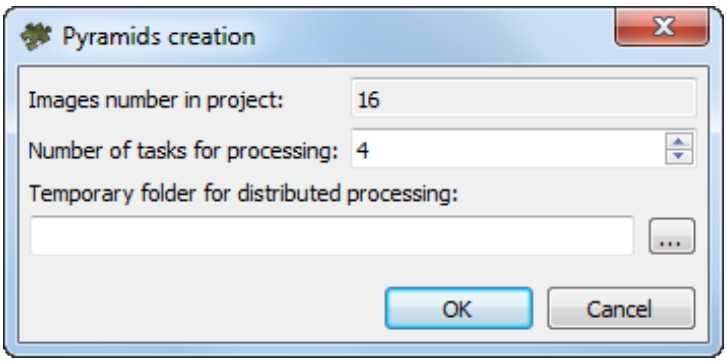


Fig. 8. Pyramid's distributed processing parameters

The total **Number of images in project** displays in the window.

4. Specify **Number of tasks for processing**, which are processed by one computer.

It is recommended to set quantity of tasks in proportion to quantity of used cores, but not more than 25 tasks.

5. Select the **Temporary folder for distributed processing** in the resources of active profile for temporary data storing.

6. Click OK. Distributed processing tasks are created and the system shows a message about number of created tasks.

7.7. Editing of block images

Perform one of he following actions to delete the images from the mosaic project:

- select the image in the **Preview** window and choose the **Images › Delete selected images**;

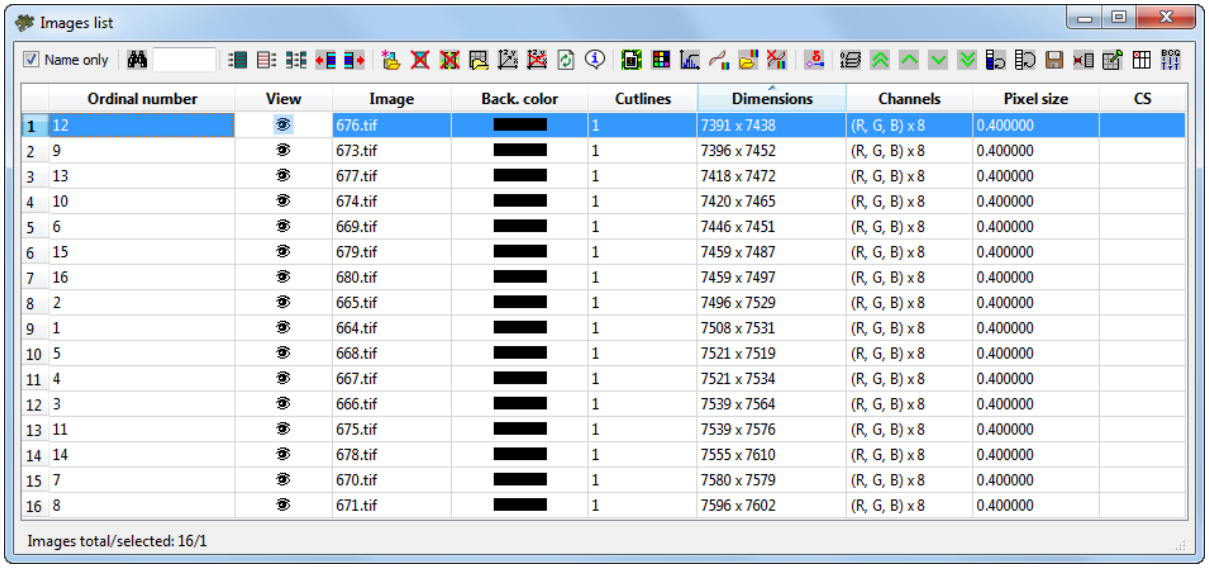
- choose the **Images › Project images list**. The **Images list** window opens. Select the images in the list and click the  button.

  To select multiple images use Shift and Ctrl keys or use selecting tools in **Images list** window (see Section 7.8).

Also the program provides a possibility to delete images outside of active sheets border (see Section 11). After sheets creation define the activity of sheets and choose the **Images › Delete images outside active sheets** to do this.

7.8. The Images list

The **Images list** window is provided to view and edit the images list of mosaic project. To open the **Image list** window choose the **Images › Project images list** or click the button of the main program toolbar.



	Ordinal number	View	Image	Back. color	Cutlines	Dimensions	Channels	Pixel size	CS
1	12		676.tif		1	7391 x 7438	(R, G, B) x 8	0.400000	
2	9		673.tif		1	7396 x 7452	(R, G, B) x 8	0.400000	
3	13		677.tif		1	7418 x 7472	(R, G, B) x 8	0.400000	
4	10		674.tif		1	7420 x 7465	(R, G, B) x 8	0.400000	
5	6		669.tif		1	7446 x 7451	(R, G, B) x 8	0.400000	
6	15		679.tif		1	7459 x 7487	(R, G, B) x 8	0.400000	
7	16		680.tif		1	7459 x 7497	(R, G, B) x 8	0.400000	
8	2		665.tif		1	7496 x 7529	(R, G, B) x 8	0.400000	
9	1		664.tif		1	7508 x 7531	(R, G, B) x 8	0.400000	
10	5		668.tif		1	7521 x 7519	(R, G, B) x 8	0.400000	
11	4		667.tif		1	7521 x 7534	(R, G, B) x 8	0.400000	
12	3		666.tif		1	7539 x 7564	(R, G, B) x 8	0.400000	
13	11		675.tif		1	7539 x 7576	(R, G, B) x 8	0.400000	
14	14		678.tif		1	7555 x 7610	(R, G, B) x 8	0.400000	
15	7		670.tif		1	7580 x 7579	(R, G, B) x 8	0.400000	
16	8		671.tif		1	7596 x 7602	(R, G, B) x 8	0.400000	

Fig. 9. The Images list window

The main part of the window contains a table of mosaic project images with the following information:

- `Ordinal number`;
- `View` – visibility images in the preview window;
- `Image` – attribute for full path to image file;

  Set the **Name only** checkbox on to display image file name only;

- `Background color` – background color of source images, specified during setting of background color transparency;
- `Cutlines` – information about presence/absence and quantity of cutlines created for the image;
- `Dimensions` – image size in pixels;
- `Channels` – channels number and number of bytes per pixel;

Points sorting in columns of the list is performed by mouse click on the column header.

Double click to image name allows to open 2D-window of source image and all data for this image (cutlines, sheets borders, etc.).

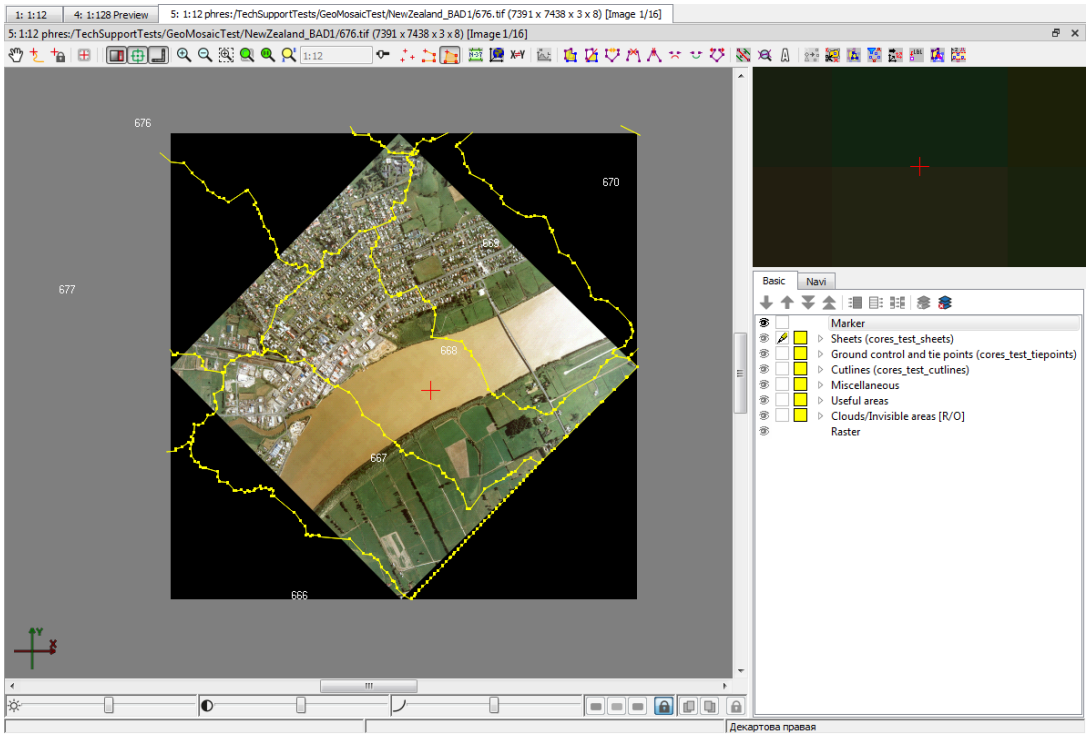


Fig. 10. Project image

Toolbar and standard selection and searching tools are placed in upper part of window. Number of `Images total/selection` displays in the status bar of the window.

Table 6. The toolbox of 'Images list' window

Buttons	Function
	to search for an image by name (part of name) in the list
	to select all images in the table
	to unselect all images in the table
	to invert selection of images in the table
	to highlight images, selected in the table, on active layer
	to highlight image, selected in 2D-window, in the table
	to add images out of active profile resources
	to open the **ImageWizard** utility to manage links to images (see the "ImageWizard. Adjustment of images" chapter of the "Creating project" User Manual)
	to remove selected images from project
	to remove from the project images without cutlines (in the **Cutlines** column is shown the '**–**')

Buttons	Function
	to set coordinate system for selected images
	to clear coordinate system for selected images
	to open selected image in 2D-window
	to refresh table of images and recalculate quantity of cutlines, which fall into images
	to display information about selected image (path, size, channels)
	to clear selected images background color
	to set arbitrary images background for selected images
	to apply auto levels to selected images (see the “General information about system” User Manual)
	to perform the radiometric correction for selected images (see the “General information about system” User Manual)
	to load radiometric correction parameters from a `*.rmc` file
	to delete radiometric correction for selected images
	to show tie points residuals for current image (see Section 10.5)
	to restore the default order of images after changing
	to move selected image at the head of the list;
	to move selected image up the list;
	to move selected image down the list;
	to move selected image at the end of the list;
	to invert selected images or group of images
	to reverse images in the table
	to save the list of selected images and their file paths in a text file
	to remove each n-th images from project
	to select *several* images from the project as a ’reference’ images to apply global brightness adjustment

Selected reference images will not be changed during adjustment. Histograms of other mosaic images will be corrected in accordance with chosen (’reference’) images.

For correct brightness adjustment using one or more reference images *selected in the **Images list** window*, make sure that the **By average brightness** option is selected in the **Global adjustment** section of the **Brightness adjustment** tab in the **Mosaic parameters** window;

Brightness adjustment using several reference images (located in different parts of the mosaic) can be useful when processing projects containing large number of images.

	to open the **Columns list** window, to manage the additional columns, containing information from images metadata, if it exists (for the scanner satellite images for example)
	to display in the **Preview** window changes of brightness, contrast and gamma data settings in the work area (G, K, L) made in a *single image 2D window without closing it*

In order to display in the **Preview** window changes of brightness, contrast and gamma data settings in the work area made in a *single image 2D window* (without closing it), perform the following:

1. Make sure that the **Use brightness pre-correction** checkbox is set in the **Brightness adjustment** tab in the **Mosaic parameters** window, and **None** option is selected in the **Global adjustment** section;

2. Click the button in **Images list** window;

3. Click the button of the main program toolbar. Brightness, contrast and gamma data changes will be displayed in the **Preview** window.

The system allows to save radiometric correction parameters to `*.rmc` files in order to apply these parameters to other images. Perform the following actions to do this:

1. Select image in the list;

2. Setup parameters and perform radiometric correction of selected image;

3. Click the button and define a folder to save radiometric correction parameters in file with `*.rmc` extension;/

4. Choose image for correction in the list;

5. Click the button. The **load correction parameters** window opens;

6. Choose parameters file file and click OK. Correction parameters apply to selected images.

A RMC-file is created for each of selected images. Further, these files can be used during operations related with GC/tie points and mosaic creation.

7.9. Checking source project images

The system provides for checking source project images. The following parameters can be checked:

- available image files (according to specified paths to these files);
- correct image formats and extensions;
- available georeferenced data (files).

To check project images, perform the following:

1. Choose **Images › Check source images**;

2. Wait for the operation to complete:

- [optional] If all project images have been verified, an appropriate info message is issued:

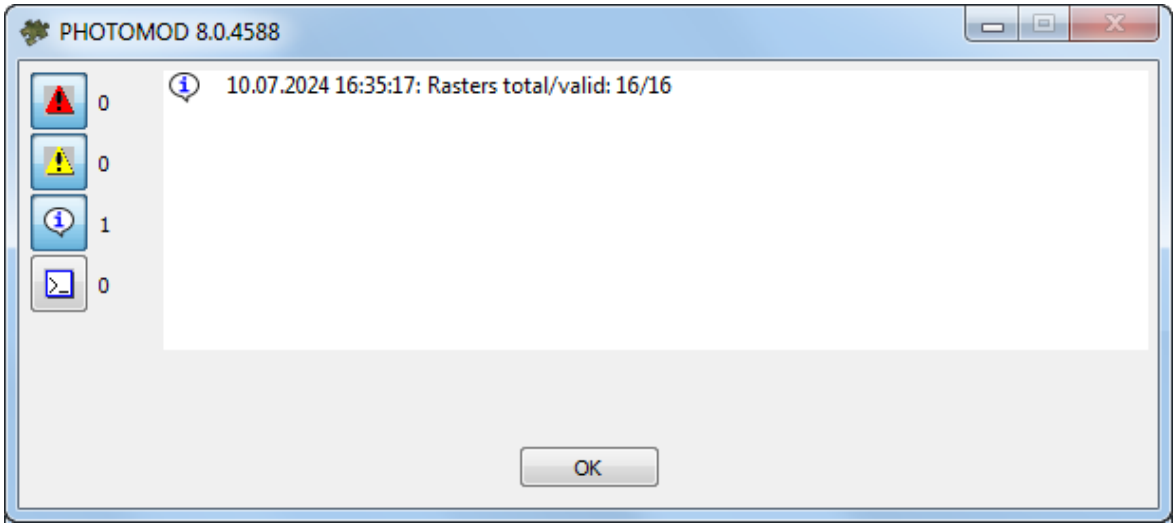


Fig. 11. An informational message

- [optional] If a part of the project images has not been verified, the following windows are displayed in turn:

  1. A dialog box informing about the number of images that have not been verified:

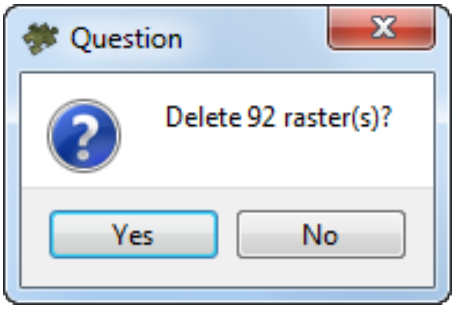


Fig. 12. A dialog box

     - [optional] Click **Yes** to delete images that have not been verified from the project and proceed to the error window;
     - [optional] Click **No**, not to delete images and proceed to the error window.

  2. The error window

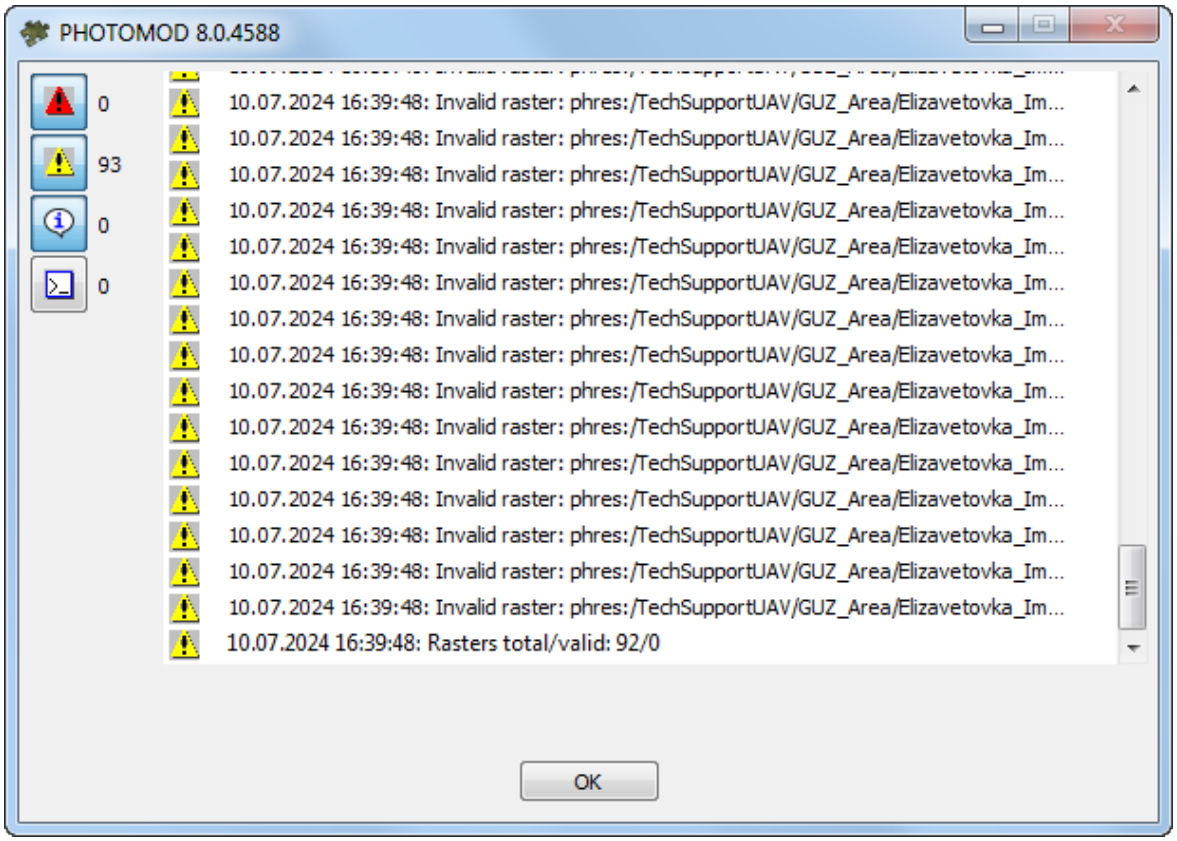


Fig. 13. An informational message

7.10. Replacing images

When processing a project, it may be necessary to completely or partially replace the project images with their copies having identical names but located in a different folder (in the *Windows* file system or in the active profile resources).

Project images can be located both in the *Windows* file system and in the active profile resources, both in one folder and in several different folders. Cutlines can refer to images by the full path to the image file (in the *Windows* file system or in the active profile resources) or by the image name only.

If it is necessary to replace images in an already processed project, the following procedure is recommended:

1. Open the **Image list** window (see Section 7.8);
2. Delete the required images;
3. Add new images with the same names instead of the deleted ones. These added images may have a different location;

4. To refer the cutline to the added image, select the required cutline and open the **Cutline info** window (see Section 8.9). To disregard the image path and refer the cutline by image name only, set the **Name only** checkbox in the **Cutline Info** window.

It is strongly discouraged to create projects with non-unique image names. If there are images with duplicate names in the project, it is strongly recommended to use only full paths to images for referring to cutlines.

8. Cutlines creation

8.1. Cutlines menu

Table 7. Brief description of the Cutlines menu

Menu items	Function
Clear	to delete cutlines, i.e. to clear the *Cutlines* layer completely (without closing of this layer)
Open	to open cutlines saved earlier in vector file `*.x-data` in active profile resources
Import	see “Import of vector objects” in the “Vectorization” User Manual
Export	see “Export of vector objects” in the “Vectorization” User Manual
Build...	to setup parameters of automatic cutlines creation and to start cutlines build operation, also in the distributed processing mode
Area to cutlines addition mode	to add areas to cutlines during their editing (see the Section 8.7.1)
Save	to save vector data file with cutlines
Save as	to save cutlines in vector file `*.x-data` with new name
Useful areas	to calculate useful areas in automatic mode
Clouds/Invisible areas	to calculate cloudy areas in automatic mode
Verify	to control cutlines correctness
Parameters	to redefine attributes of the *Cutlines vector layer*
Cutline properties	to view and edit attribute values of selected cutline
Split cutlines into sheets	to split cutlines according to boundaries of created sheets (see the Section 8.7)
Reference cutlines to images	to attach vector polygons obtained from a third-party source to project’s images according to their geometric location for further use as cutlines (see Section 8.10)
Replace current node by new cutline	to create a new cutline as a small rectangle polygon in the place of the node (the point where three or

Menu items	Function
	more cutlines converge). This polygon can be further edited by the user

If the vertices of adjacent cutlines located next to a node vertex are too close to it, then when user tries to **replace current node by new cutline**, the appropriate error message is displayed: **Inserting cutline is too small**. If this system message appears, manually delete the vertices closest to the node and try to repeat this operation by clicking the  button in the main toolbar.

8.2. Requirements of the cutlines creation

The stage of cutlines creation follows after the forming the block images of the mosaic project.

Cutline is a vector polygon defining the images area, which will be included in output mosaic.

Combination of automatic and manual cutlines creation, with clouds selection, optional use of DEM, as well as definition of the cutlines type by attributes provide high quality the stitching of the areas during the output mosaic creation.

In case of automatic cutline creation, the resulting vector layer is primarily available for collaborative editing by several users and has `*.cx-data` extension (see “Co-editing vector layers” and “Co-editing topologically connected vector objects” of the “Vectorization” User Manual).

When copying *PHOTOMOD GeoMosaic* containing cutlines, it is important to pay special attention to whether the **vector data link to the project** (see Appendix A). In case the appropriate checkbox is set and cutlines (or other vector layers) from another project are used during the current project processing, then when saving the project being processed, all the above vector layers are saved as copies belonging with this project.

Performing the following steps is recommended for the cutlines creation:

1. [optional] Creating areas without background and areas with clouds.
2. Automatic cutlines creation (also in the distributed processing mode).
3. Editing cutlines: manual editing of vector polygons and their attributes in the *Cutlines* layer.

There are following rules to go by when creating the cutlines for building of the high quality mosaic:

- cutlines should not have intersections and self-intersections. The common boundaries of the neighbour cutlines should be fully correspond;
- I.e. all areas of the source images, outlined by cutlines, form one united coverage without overlaps or gaps;

- It is not recommended to draw cutlines over elevated objects (bridges, buildings, utility poles, etc), otherwise if the **Seams feathering** checkbox in the **Mosaic parameters** window in the **Brightness adjustment** tab is set on, the smearing effect is possible;

It is recommended to cross extended objects at right angle or create cutline not less than 1.5 cell size apart from extended objects border.

- it is recommended to create cutline parallel to brightness edge on enough distance from it.

8.3. Creating areas without background (useful areas)

It is recommended to create areas without background before creating cutlines and set the background transparency of source images.

Useful area contains substantial part of image and excludes input background of image. Useful areas are vector polygons on the *Useful areas* layer.

Useful areas are used as well as setup of input background color transparency to create cutlines.

There is no need to create useful areas prior to cutlines creation in the following cases:

- there is no background on images;
- manual editing (specification) of useful areas is not required;
- there is no need to select (create) cloudy areas on source images to consider them during cutlines creation.

Useful areas creation may exclude a necessity to setup transparency of input background color.

Useful areas along with other information, such as background color, cloudy areas, cutlines are located near files with images. Files with image description have `x-feat` extension.

For useful areas creation use menu **Cutlines › Useful areas**.

Table 8. Brief description of menu 'Useful areas'

Menu items	Function
Build	to define parameters and calculate useful areas automatically as vector polygons on the *Useful areas layer*
Clear	to clear *Useful areas* layer (without closing of this layer); at that information about useful areas is *not*

Menu items	Function
	deleted from files of images description `*.x-feat`, that allows to restore created useful areas
Open	to restore recently created useful areas if the *Useful areas* layer was cleared using menu item **Cutlines › Useful areas › Clear**, and then to display them in the Preview window
Save	to save useful areas in files of images description `*.x-feat` after drawing them manually or editing areas without background calculated automatically
Delete all	to completely clear the *Useful areas* layer without possibility to restore the useful areas, i.e. to clear the layer along with deleting information in files of images description `*.x-feat`
Delete for selected images	to delete useful areas, created for selected images, along with information in files with images description `*.x-feat`

For automatic calculation of useful areas perform the following actions:

1. Choose **Cutlines › Useful areas › Build**. The **Settings** window opens.

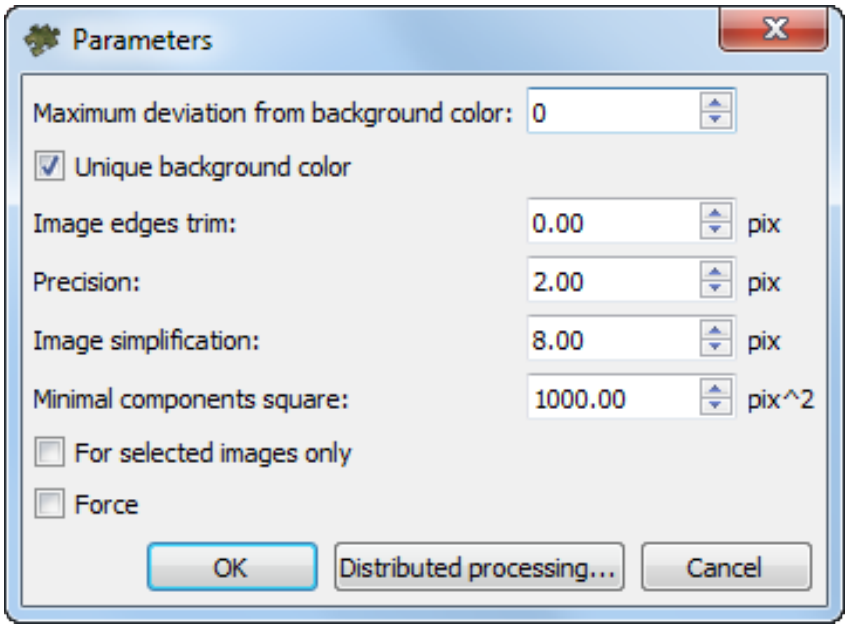


Fig. 14. Useful areas parameters

2. [optional] in case of areas on images with color equal to background color, set on the **Unique background color** checkbox and set the **Maximum deviation from background color** to define a range of color, which presents in background of source images;

3. Set the **Image edges trim** value to setup offset distance from background boundary and the image substantial area (in pixels);

4. Set the **Precision** of calculation of areas boundaries (this value influences on number of nodes in polygon to be created);

5. **Image simplification**, in pixels;

   Preliminary simplification of images makes it possible to reduce the time spent on constructing the boundaries of useful areas and reduce the number of their vertices, thus avoiding unjustified complexity of their configuration.

   Specific optimum values of simplification are to be chosen individually for each project, depending on the project type and geometry of initial data.

   It is not recommended to reduce default values for UAS and central projection projects, that have quite large image overlapping.

   When processing satellite scanner survey projects that have small image overlapping, reducing this parameter can be feasible for the purpose of increasing the quality of boundary construction.

   When setting this parameter, it is recommended to take into account the previously set **Precision** of calculation of areas boundaries (see above). The **Precision** and **Image simplification** values that differ by several orders of magnitude, are not advisable

   Preliminary **image simplification** before the construction of useful areas' boundaries is to be performed only if the **unique background color** checkbox is set (see above).

6. Set the **Minimal components square** to specify image area value, that will be used as area minimal threshold for useful areas creation.

7. [optional] To calculate useful areas for selected images only, set on the **For selected images only** checkbox;

8. [optional] Set the **Force** checkbox on to *recalculate* already calculated and restore deleted useful areas. At that information in files with images description `*.x-feat` also refreshed;

9. Click OK to calculate useful areas.

   To use distributed processing in calculation of useful areas, perform the following:

   1. Change settings and run the distributed processing server/client (see the "Distributed processing" chapter in the "General information about system'' User Manual).

   2. Click the **Distributed processing** button. The **Distributed processing of useful areas** window opens.

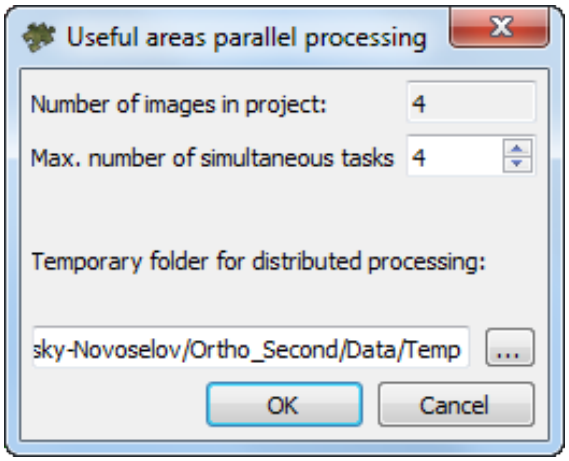


Fig. 15. Creating areas without background (useful areas)

The total **Number of images in project** displays in the window.

3. Define the **Max. number of simultaneous tasks** for tasks number on which the process of useful areas creation will be divided.

   It is recommended to set quantity of tasks in proportion to quantity of used cores, but not more than 25 tasks.

4. Select the **Temporary folder for distributed processing** for temporary data storing.

5. Click OK. Distributed processing tasks are created and the system shows a message about number of created tasks.

There is an example of automatic useful areas calculation:

1. Source image has black input background. There are areas with input background color inside the image.

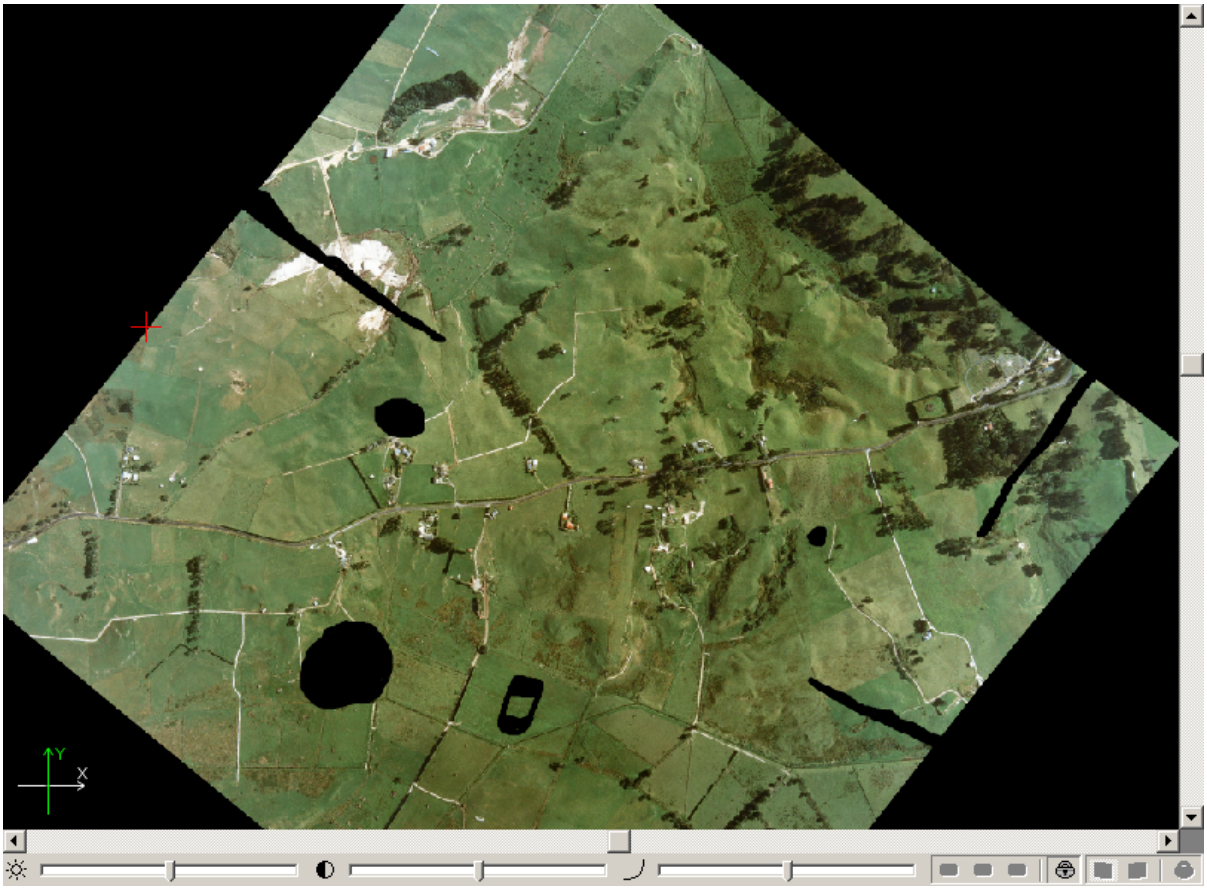


Fig. 16. Source image

2. Set the **Unique background color** checkbox in the **Parameters** window to consider 'insets' during useful areas creation.

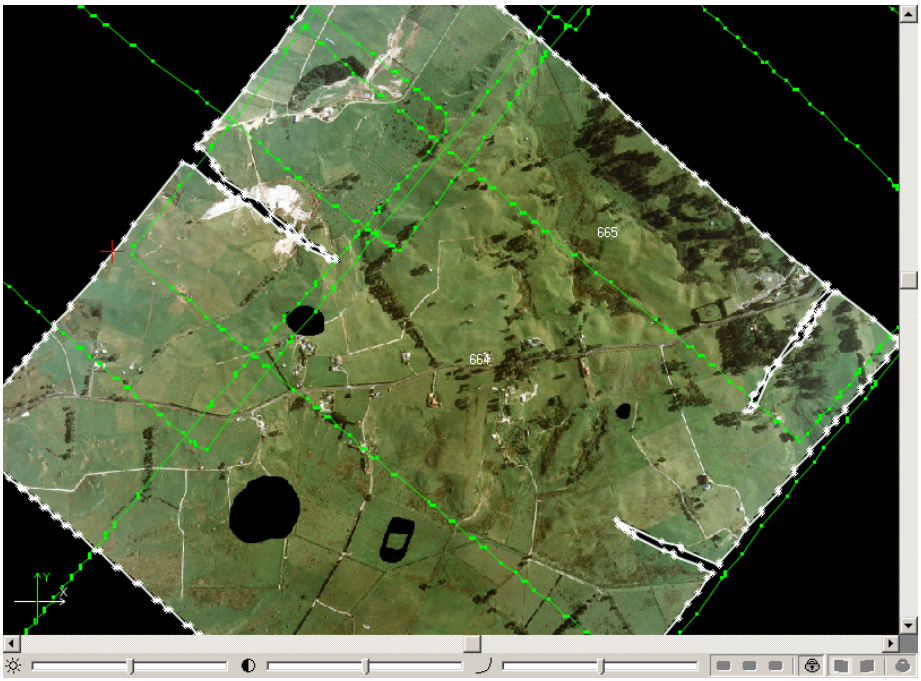


Fig. 17. Useful area in case of unique background color

3. Clear the **Unique background color** checkbox in the **Parameters** window to create useful areas roughly, almost without considering 'insets'. Closed areas of black color inside image are not considered as a background and are included to useful area.

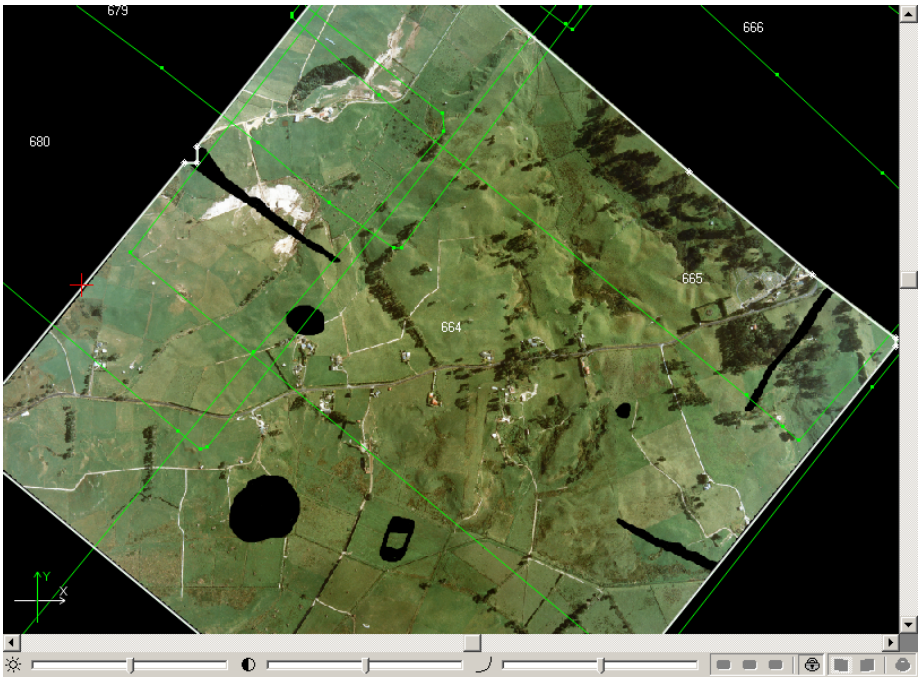


Fig. 18. Useful area in case of non-unique background color

8.4. Clouds calculation

In order to calculate cloudy areas and exclude them during cutlines creation the system provides possibility of their automatic recognition and calculation. Cloudy areas are vector polygons on the *Clouds/Invisible areas* layer.

It is necessary to create useful areas prior to creating of cloudy areas.

The **Cutlines › Clouds/Invisible areas** menu is used to create cloudy areas.

Table 9. Brief description of menu 'Clouds/Invisible areas'

Menu items	Function
Build	to setup parameters and automatically calculate cloudy areas as vector polygons on the *Clouds/Invisible areas*
Clear	to clear the *Clouds/Invisible areas* layer (without closing the layer); at that information about clouds is *not* deleted from files of images description `*.x-feat`, that allows to restore created clouds
Open	to restore existing clouds if the *Clouds/Invisible areas* layer was cleared using menu item **Cutlines › Clouds/Invisible areas › Clear**, and to display them in the **Preview window**
Save	to save clouds in files of images description `*.x-feat` after editing of clouds calculated automatically or after drawing them manually (see below)
Save for selected images	to save cloudy areas created just for selected images to files of these images description `*.x-feat` after editing of clouds calculated automatically or after drawing them manually
Delete all	to clear the *Clouds/Invisible areas* layer completely without possibility of restoring cloudy areas, i.e. to clear the layer along with information deleting from files of images description `*.x-feat`
Delete for selected images	to delete clouds created for selected images, and to delete information from files of images description `*.x-feat`

Useful areas along with other information, such as background color, cloudy areas, cutlines are located near files with images. Files with image description have `*.x-feat` extension.

The user cannot edit the Clouds/Occluded zones layer manually directly after project loading, since this may lead to data loss in case if the `*.x-feat` file already contains data on the areas containing clouds.

To make this layer editable, either first **Open** the area data (or make sure that they are absent after executing this command), **Build** areas with clouds again, or **Delete all** relevant data from the `*.x-feat` file (confirming this action).

The mark near the Clouds/Occluded zones layer name means that this layer is not available for manual editing at the moment.

Automatic clouds detection principle consists in search on image for bright enough and homogeneous areas, where there is grey color with area not less then specified.

To calculate cloudy areas automatically perform the following actions:

1. Choose **Cutlines › Clouds/Invisible areas › Build**. The **Clouds detecting parameters** window is opened.

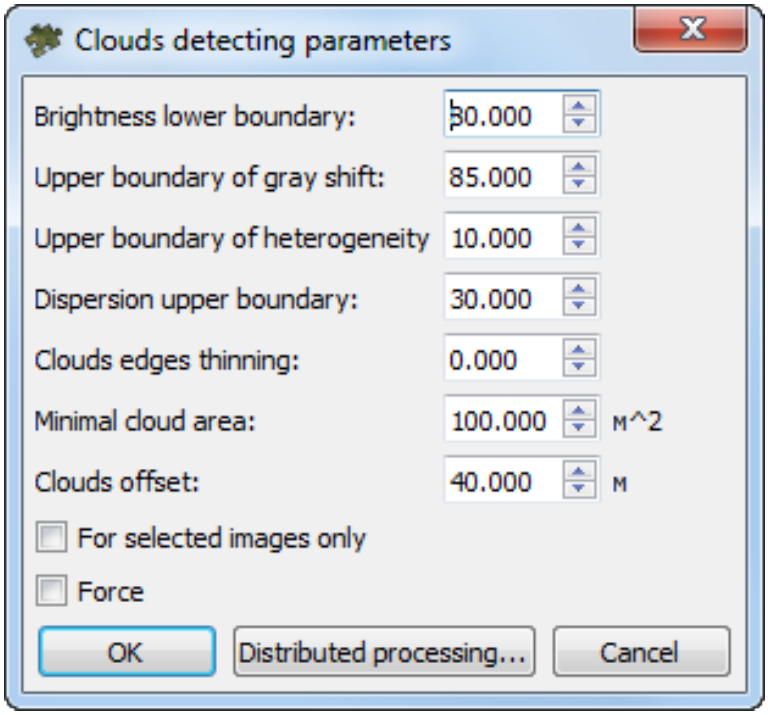


Fig. 19. Parameters of cloudy areas building

2. Specify the following parameters of automatic clouds detection:

   - **Brightness lower boundary** – allows to define range of brightness for clouds detection – to specify lower brightness threshold (from 0 to 100, where 100 – maximal brightness), if the brightness is more that the threshold it is considered as possible cloud;

- **Upper boundary of grey shift** – allows to define maximal deviation from grey color that present in clouds (from 0 to 100, where 0 – grey color, when R, G, B values are equal);
- **Upper boundary of heterogeneity** – allows to define range of heterogeneity in clouds – to specify maximal deviation from homogeneity (from 0 to 100, where 0 – homogeneous area);
- **Dispersion upper boundary** – allows to define range of dispersion in clouds – to specify upper dispersion threshold (from 0 to 100);
- **Clouds edges thinning** – allows to define a degree of clouds boundaries thinning (filtering of vector polygons vertices) from 0 to 100, where 0 – boundaries without thinning; 100 – 'rough' maximally filtered boundaries;
- **Minimal cloud area** – allows to define minimal area of cloud, when this area is not considered as cloud, i.e. clouds of small size will be excluded from selection;
- **Clouds offset** – allows to setup offset in meters around the cloud detected (to exclude shadow or half-transparent part of cloud).

3. [optional] To calculate cloud areas for selected images only, set on the **For selected images only** checkbox.

4. [optional] Set on the **Force** checkbox to recalculate already calculated and restore deleted cloud areas. At that information in files with images description `*.x-feat` also refreshed.

5. Click OK to search and calculate cloudy areas.

   To use distributed processing in calculation of cloudy areas, perform the following:

   1. Change settings and run the distributed processing server/client (see the '*Distributed processing*' chapter in the 'General information about system' User Manual).

   2. Click the **Distributed processing** button. The **Distributed processing of useful areas** window opens.

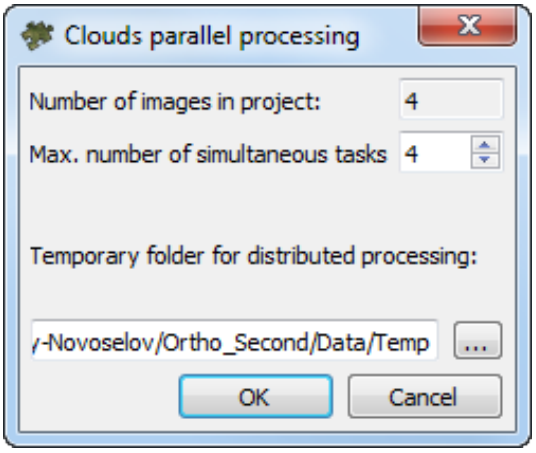


Fig. 20. Creating cloudy areas

The **Number of images in project** field displays the number of source project images.

3. Define the **Max. number of simultaneous tasks** for tasks number on which the process of cloudy areas creation will be divided.

   It is recommended to set quantity of tasks in proportion to quantity of used cores, but not more than 25 tasks.

4. Select the **Temporary folder for distributed processing** for temporary data storing.

5. Click OK. Distributed processing tasks are created and the system shows a message about number of created tasks.

8.5. Automatic mode of cutlines creation

The program provides opportunity to create cutlines in automatic mode with one of two algorithms: *Voronoy diagram*, and more *detailed algorithm* which is specially recommended for images with urban or rural building.

Performing the following steps is recommended for the cutlines creation:

1. Use the fast Voronoy diagram method.
2. Estimate the results of cutlines creation.
3. [optional] Edit the cutlines in vector objects drawing mode, if necessary.
4. If the results are not acceptable apply detailed algorithm of cutlines creation.

In this case cutlines are created bypassing separate objects (houses) and crossing roads at the right angle.

Perform the following actions for automatic cutlines creation:

1. Choose the **Cutlines › Build**. The **Cutlines creation parameters** window opens.

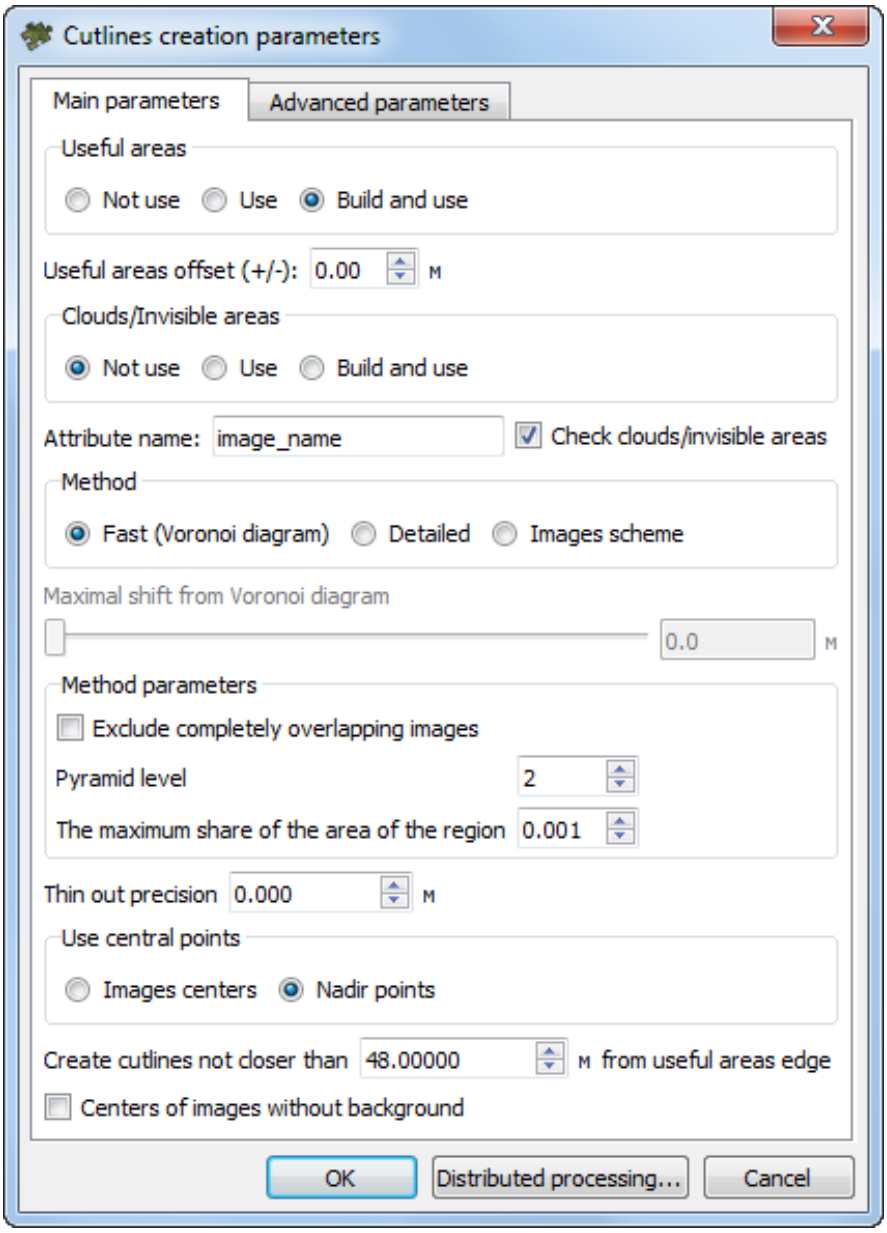


Fig. 21. Parameters of automatic cutlines creation

2. In the **Useful areas** section choose one of the following options of using useful areas during cutlines creation:

- **Not use** – allows to not use useful areas, when the background is absent on source images;
- **Use** – is used to use pre-created (automatically or manually) useful areas;

While creating cutlines considering useful areas it is *not recommended* to use orthoimages with JPEG-compression.

- **Build and use** (by default) – allows to calculate useful areas automatically and use these areas for cutlines creation.

Calculated useful areas don't display in 2D-window and don't save on the *Useful areas layer*.

The **Build and use** mode is used by default if the assign automatically images background color was chosen.

3. [optional] In the **Useful areas offset** input field specify positive or negative value of distance in meters to crop(-) or add (+) fields of working area, which is defined by created useful areas.

The **Useful areas offset** value should be much less than the **Maximal shift from Voronoy diagram** parameter's value.

4. In the **Clouds/Invisible areas** section choose one of the following options of clouds considering during cutlines creation:
   - **Not use** (by default) – allows to not use cloudy areas;
   - **Use** – is used to use pre-created (automatically or manually) cloudy areas;
   - **Build and use** – allows to calculate clouds automatically and consider them during cutlines building in automatic mode.

Calculated cloudy areas don't display in 2D-window and don't save on the *Clouds/Invisible areas* layer.

5. In the **Attribute name** input field specify the attribute name of the *Cutlines* vector layer, where the full path to the image is stored (by default, `image_name`).

It is necessary to specify the attribute to perform automatic matching of the cutlines with images prior to mosaics building, or for preview creation.

6. Check the **Check clouds/invisible areas** checkbox to exclude 'gaps' in created cloudy areas in output mosaic.

The main idea of clouds check is, that the system tries to use reference image to replace a cloud (entirely or partially) if the reference image does not contain the cloud in this place, otherwise, the cloud will stay on the output mosaic.

7. In the **Method** section choose one of the following methods of automatic cutlines creation:

   - **Fast (Voronoy diagram)** – this method consists in splitting all the area of cutlines creation into polygons based on proximity to nadir points or, if the latter are not given, to image centers;
   - **Detailed** – more 'fine' algorithm for Voronoy diagram building, In this case edges of Voronoiy's diagram, belonging to two different images, are replaced by broken lines, which provide optimal images joining.
     - **Maximal shift from Voronoi diagram** – at zero value you will get Voronoy diagram, if the value is one – maximal area is used for cutlines creation. This algorithm allows to calculate estimation function on images. Cutlines are created on lines in such a way, that maximal value of this function on them is minimal among all possible lines (minimax method).
   - **Images scheme** – is a process where installation of source images without a background is used for the first approximation of constructing cuts.

8. [optional] To **exclude completely overlapping images** from processing when creating cutlines, set the appropriate checkbox;

   Almost complete overlap of images can occur when working with data that have a high degree of overlap and is due to the fact that when processing images, areas with a minimum off-nadir angle are used whenever possible. If this checkbox is set, redundant images are completely excluded from processing, what, in turn, helps to avoid unreasonably complicated cutline configurations.

   The redundancy of small cutlines may appear if, for some reason, only a small area of one of the images is involved in processing. Such a situation may affect negatively the quality of the output mosaic. The **maximum share of the area of the region** input field is to exclude such images from processing, thereby optimizing the number of created cutlines

9. [optional] The system allows you to choose the project image **pyramid level** to be used during cutline creation. Constructing cutlines using less detailed versions of images can significantly increase the system's performance (due to a noticeable decrease in the quality of constructing cutlines, which occurs with a high degree of probability);

10. [optional] Specify the **Thin out precision** the appropriate input field;

    At first, cutlines are created with sub-pixel accuracy (taking into account the **pyramid level** of images the user selected for cutline construction; see above). Further, the vertices of

overdetailed cutlines are thinned out. The **Thin-Out Precision** is the maximum distance (a perpendicular) from the initial cutline fragment to the unit segment of the output polygon that approximates it (in the current project units of measurement).

11. In the **Use central points** section define location of images centers which are used for Voronoy diagram creation:

    - **Nadir points** (recommended if any);
    - **Images centers** considering or not images background.

    The **Centers of images without background** checkbox allows not to consider images background when use centers of images.

12. [optional] In the **Create cutlines not closer than [ ] m from useful areas edge** input field specify minimal distance in meters from working area boundary to create cutlines, if source images have small overlap.

13. [optional] Open the **Advanced parameters** tab to set the parameters of the **detailed** algorithm (see above).

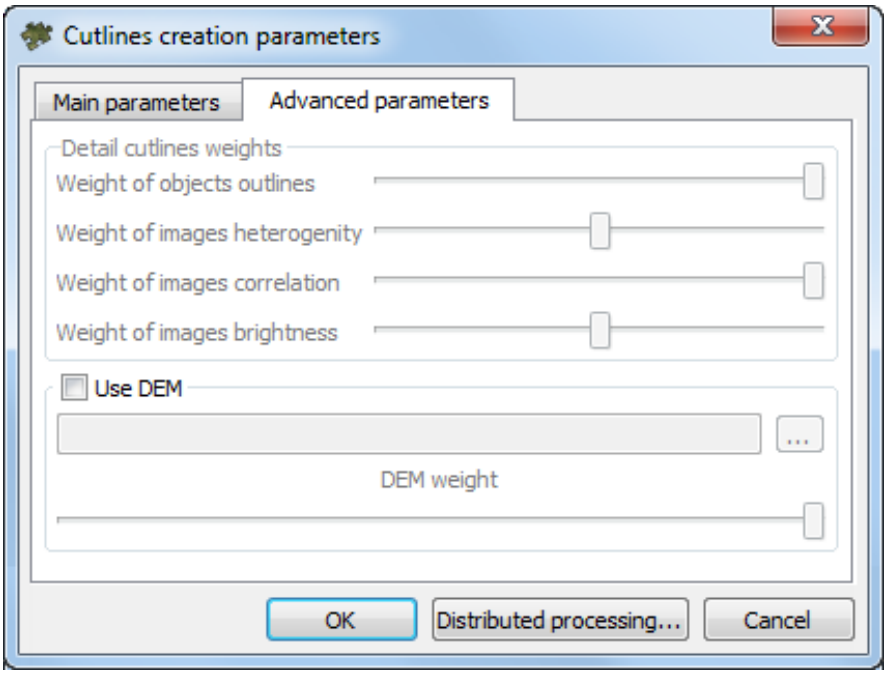


Fig. 22. Detailed method cutline creation parameters

Setup the following additional parameters:

- **Weight of objects outlines** – allows to avoid separate objects (houses) during cutlines creation or to cross them at the right angle (in case of roads);

- **Weight of images heterogeneity** – allows to avoid small cities and settlements during cutlines creation, including also urban blocks, since at certain pixel size settlements look more heterogeneous, comparing with forested areas, agricultural fields, etc;
- **Weight of images correlation** – the bigger the differences in vicinity of pointon adjacent images, the bigger this component for each point;
- **Weight of images brightness** – is used for cutlines creation in darkened areas of images, where human eye is less receptive to images inconsistency;
- [optional] The **Use DEM** checkbox allows us to take into account the terrain relief when creating cutlines (if available).
  - **DEM weight** – the greater the weight of the DEM, the better the cutlines wrap around the objects displayed on DEM.

It is recommended to be used for the imagery of highlands for creating cutlines taking into account lowlands, but not mountain peaks. It is also recommended in case of presence of buildings in the imagery to create cutlines between houses (if the buildings are displayed on DEM).

14. Click OK to start process of cutlines creation.

To create orthoimages in distributed processing mode, perform the following actions:

1. Change settings and run the distributed processing server/client (see the “Distributed processing” chapter in the “General information about system” User Manual).
2. Click the **Distributed processing** button. The **Cutlines distributed processing** window opens.

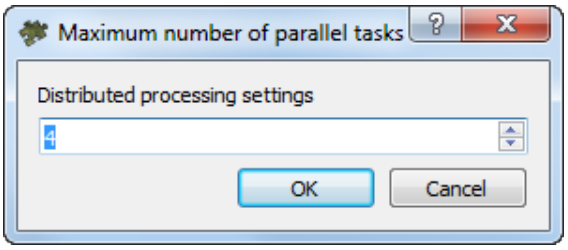


Fig. 23. Cutlines distributed processing parameters

3. Define the **maximum number of parallel tasks** – the tasks number on which the process of cutlines creation will be divided.
4. Click OK to create distributed processing tasks.

The vector polygons are created in the *Cutlines* layer after the process completion. Created cutlines are displayed in the **Preview** window.

15. [optional] if necessary, edit parameters and start automatic procedure of cutlines creation and/or edit cutlines manually considering recommendations to cutlines creations.

16. Choose the **Cutlines › Save** to save the created cutlines in the `*.x-data` files of the active profile resources.

    Choose the **Vectors › Export** to export the cutlines into other formats (see the "Vectorization" User Manual).

8.6. Cutlines creation control

The program provides possibility to find and display errors of cutlines creation. The special coverage maps are used for that. These maps are vector layers with polygons, that display the following potentially problematic areas:

- Totally cloudy areas on the project images, that may lead to the appearance of "gaps", after the cutlines creation;
- The existing "gaps" in the current cutlines;
- The cutlines out of the useful areas.

The cutlines creation control instruments are located in **Cutlines › Verify** submenu.

Table 10. Brief description of the Verify menu

Menu items	Function
Assigning to images	to check correspondence between cutlines and images of a project in order to find images without cutlines and/or cutlines which are not attached to images
Topology	to find the errors of cutlines creation and build the "gaps" map
Out of the useful areas	to find the cutlines out of the useful areas and build an appropriate map
Cloudless / visible area	to find areas with full clouds coverage and build the *potential* "gaps" map

8.6.1. Checking correspondence between cutlines and images

Cutlines › Verify › Assigning to images – is used for checking correspondence between cutlines and images of a project in order to find images without cutlines and/or cutlines which are not attached to images or to remove images.

When the check is complete, an appropriate info message is issued that displays the number of images without cutlines and the number of cutlines not associated with images.

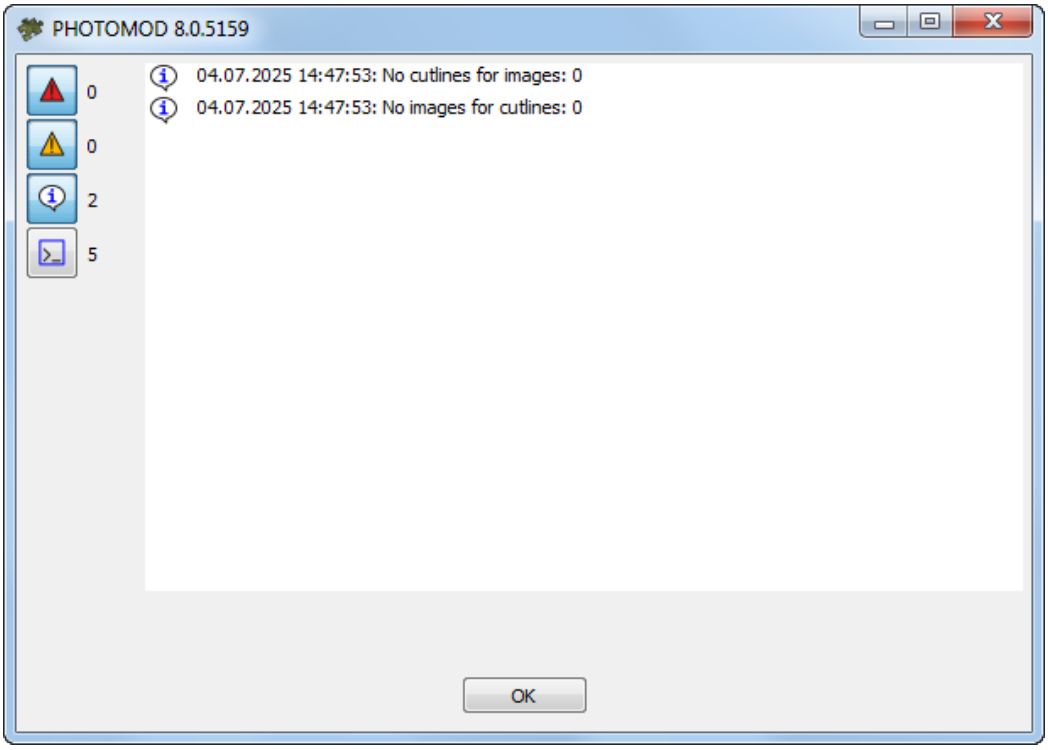


Fig. 24. The information window

If any are detected, after the above information window is closed by the user, the **Preview** window automatically opens, where, in the *Cutlines* layer, the system will highlight all detected cutlines that are not associated with images.

For easier search of cutlines not associated with images in the Preview window, make the *Cutlines* layer active and, without deselecting the automatically selected objects in this layer, select **Windows › Objects list**.

In the **Objects list** window that opens, set the **Only selected** checkbox and click . As a result, the **Objects list** window will display the list of found cutlines that are not associated with images. Clicking the left mouse button on the appropriate line in the table in the **Objects list** window allows you to move the cursor in the 2D window to the area of the appropriate cutline.

8.6.2. The cutlines errors coverage map

To find errors in cutlines, choose **Cutlines › Verify › Topology**. The system displays window which contains information about the quantity of topological errors in cutlines creation:

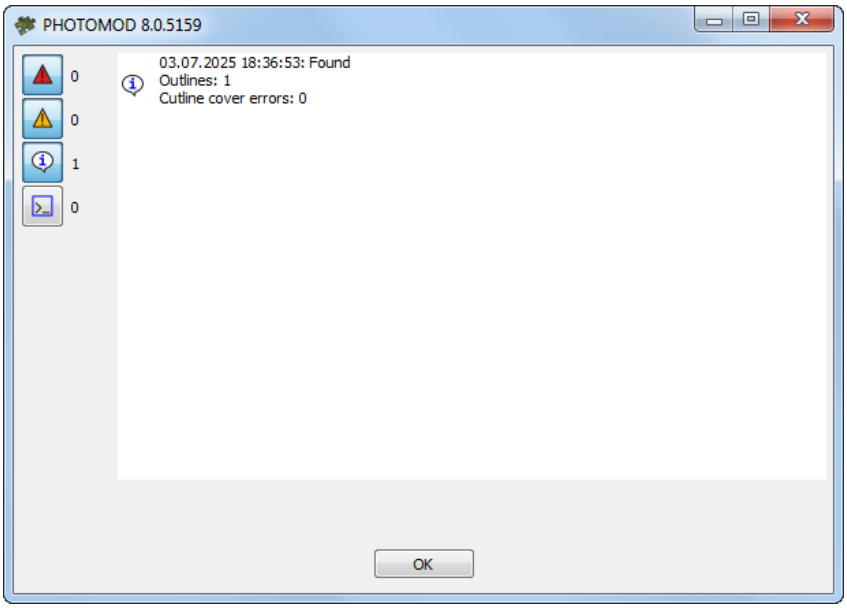


Fig. 25. No errors found in current cutlines

The *Cutlines coverage map* layer is created. The layer contains the images block border and, optionally, polygons that mark the “gaps” in cutlines. These polygons have a red fill and `hole` label.

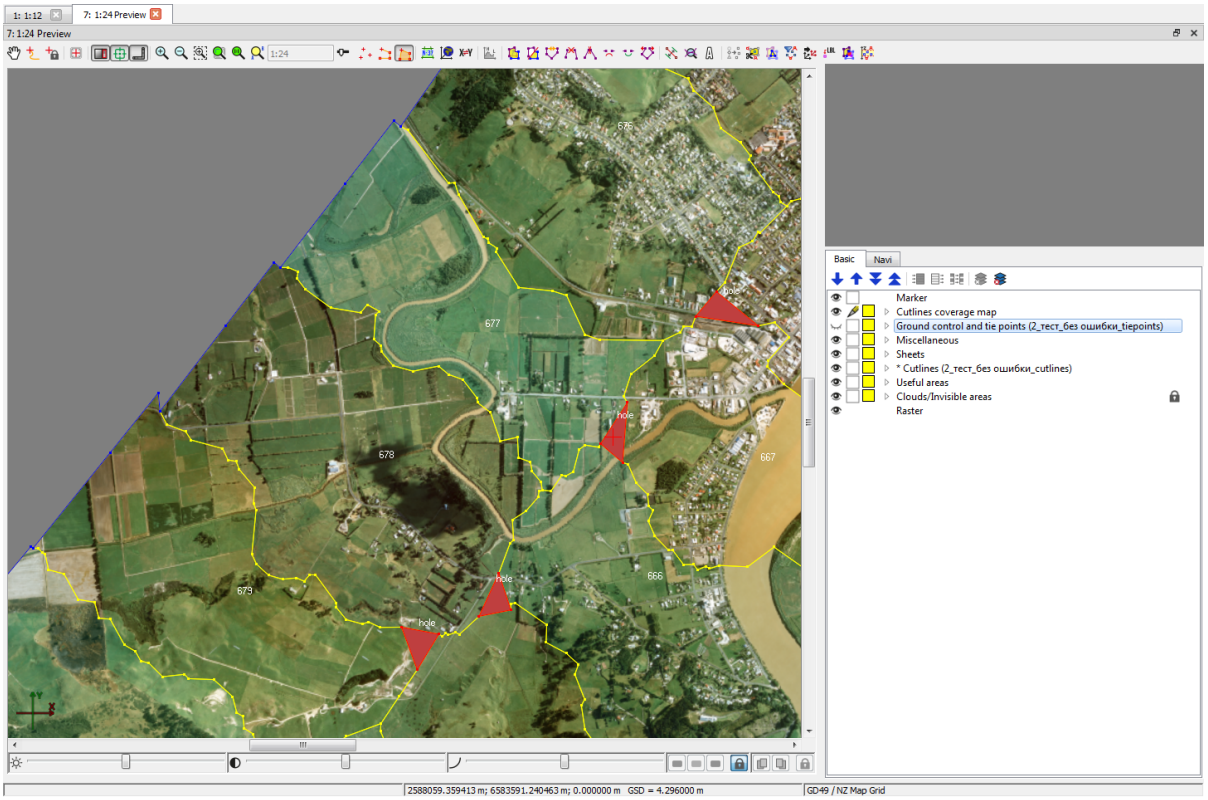


Fig. 26. The “gaps” in cutlines

8.6.3. Cutlines out of the useful areas coverage map

To find the cutlines out of the useful areas, choose **Cutlines › Verify › Out of the useful areas**. The system displays window which contains information about the quantity of such errors in cutlines creation:

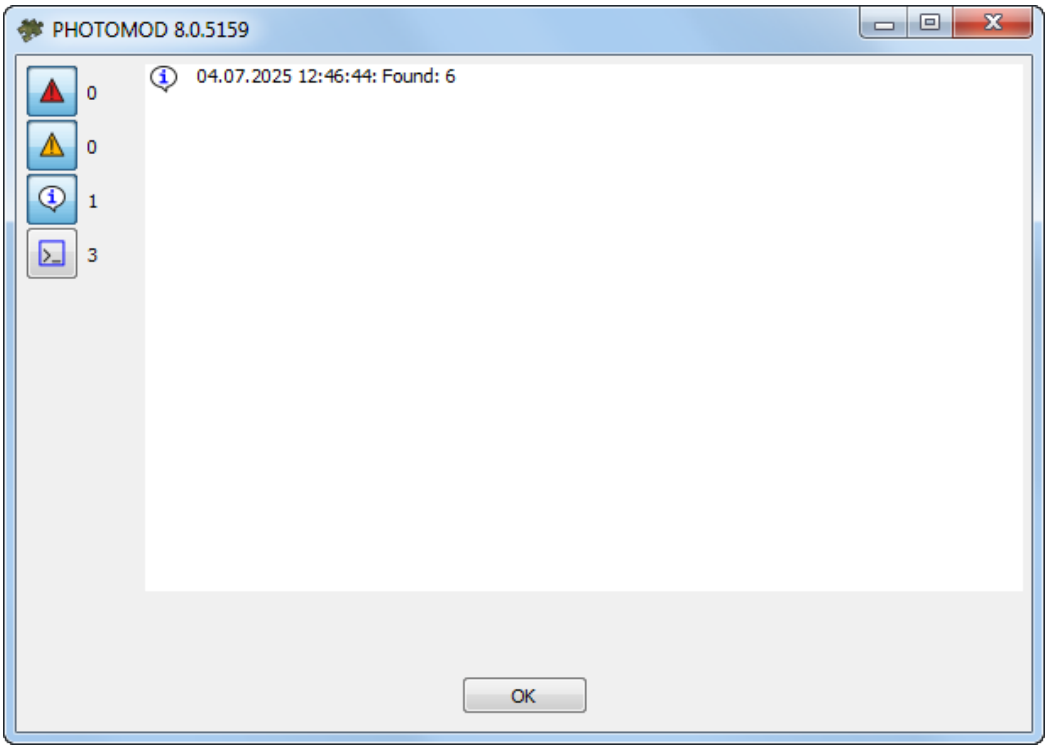


Fig. 27. The information window

The *The out of useful areas* layer is created. The layer contains the images block border and, optionally, polygons that mark the “gaps” in cutlines.

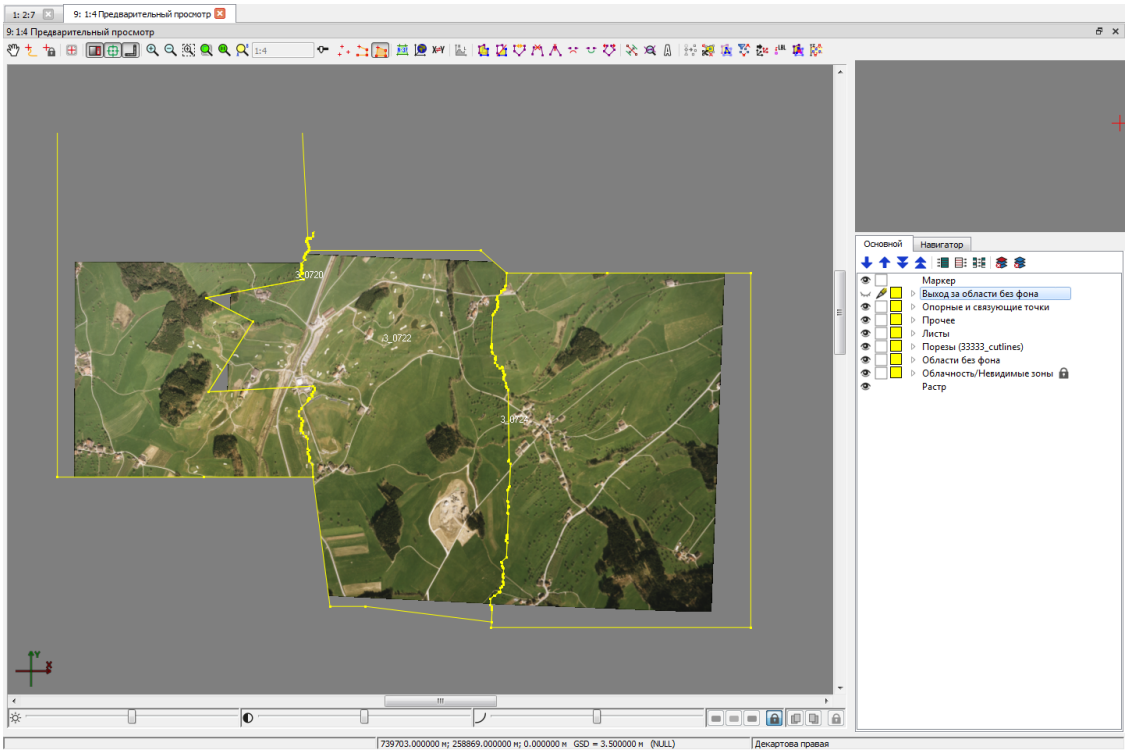


Fig. 28. The project with incorrect input data and inaccurate cutlines

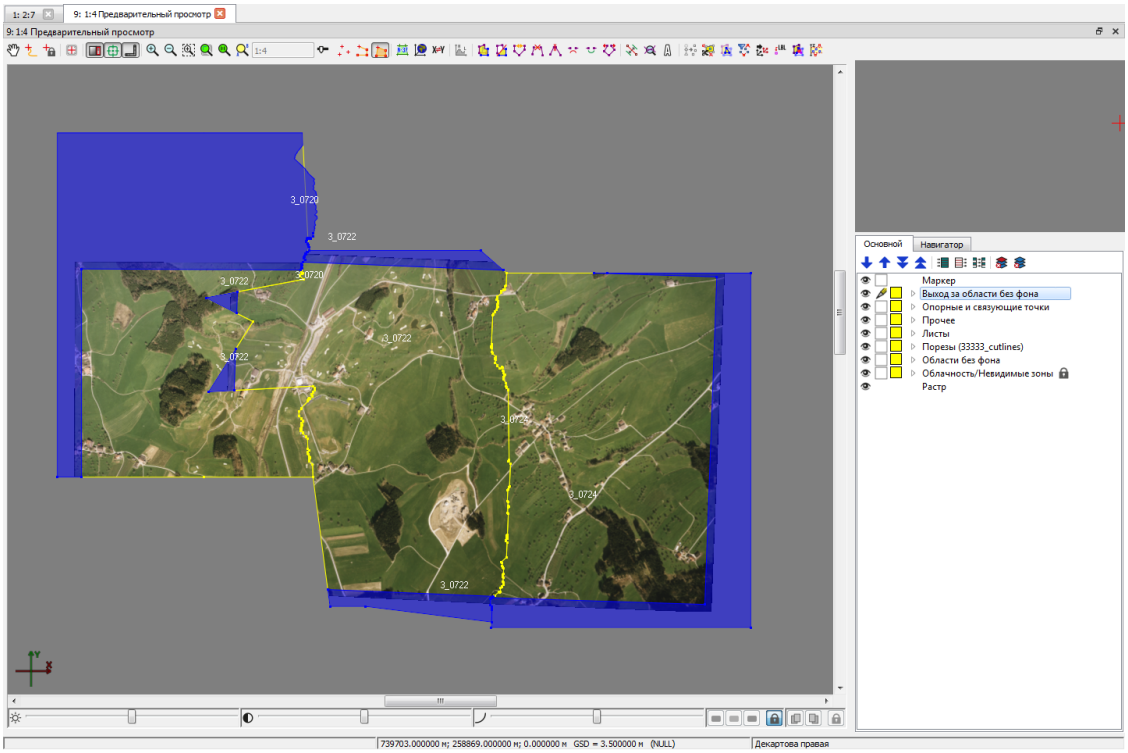


Fig. 29. The polygons that display the cutlines parts out of the useful areas (marked by blue)

8.6.4. Cloud coverage maps

Perform the following to find areas with full clouds coverage on images:

1. Choose the **Cutlines › Verify › Cloudless / visible area**. The **Cutlines creation parameters** window opens;

2. Choose the **Build and use** in the **Clouds/Invisible areas** section and setup the rest parameters if necessary;

3. Click OK. Wait until the operation is complete. The system displays the window which contains information about quantity of areas with full cover of clouds:

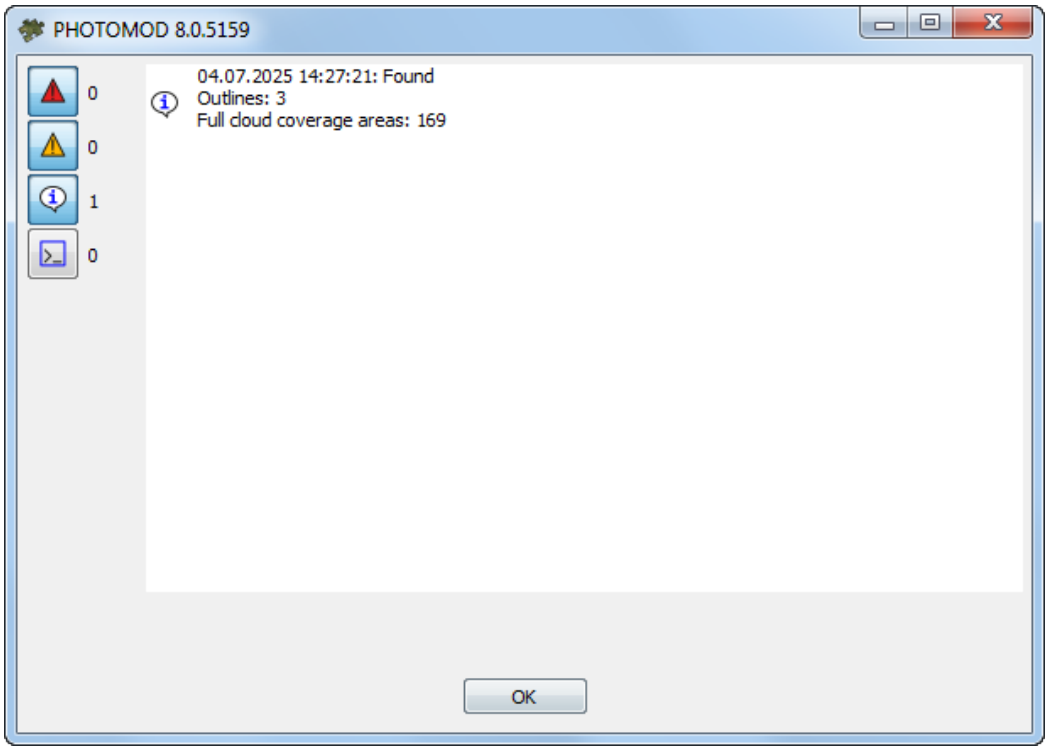


Fig. 30. The information window

4. The *Cloudless coverage/Visible areas map* layer is created. The layer contains the images block border and, optionally, polygons that mark the areas with full clouds coverage. These polygons have a red fill and `hole` label:

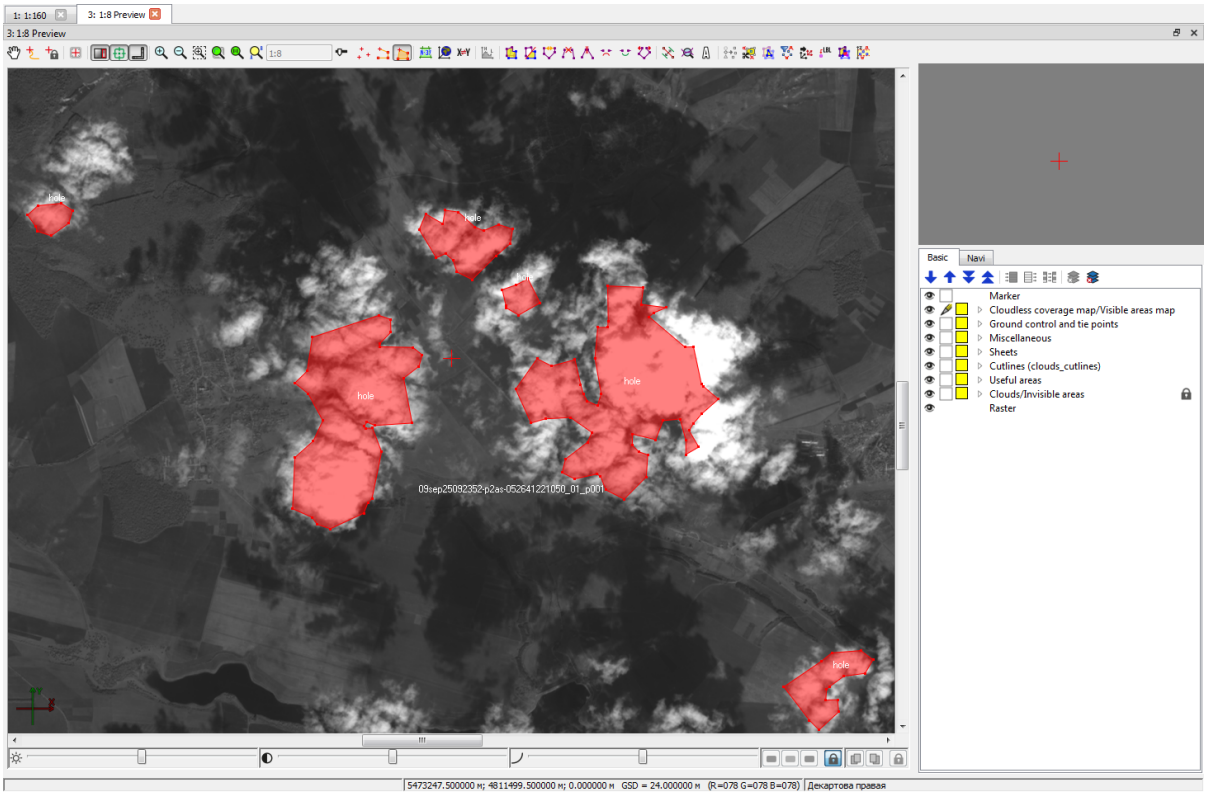


Fig. 31. Totally clouded areas

8.7. Editing cutlines

The following options are provided for cutlines editing:

- to delete all cutlines, i.e all vector objects from the *Cutlines* layer, choose the **Cutlines › Clear**;
- to edit cutlines manually is used the standard tools of **Vectors** menu (see the “Vector objects editing”, “Topological operations” and “Co-editing topologically connected vector objects” chapters in “Vectorization” User Manual);

  If new cutline creates manually it is assigned that image, the center of which is the closest to the created cutline.

- the **Vectors › Topology › Verify topology** menu item is used for verify topology (see the “Vectorization” User Manual);

  See also Section 8.6.2 of current manual.

- to create a cutline inside an existing cutline are used modes which could be switched on the **Cutlines type** additional toolbar.

  The buttons of the **Cutlines types** additional toolbar are used to choose the type of cutlines:

  - **Image** – to use main image in cutline area;
  - **Transparent with reference image** – to use reference image in cutline area (by default it is supposed to use a nearby image into the cutline area);
  - **Background** – to use the output mosaic background color in cutline area, which sets in the **Parameters** window (see the Section 13.2);

    The system also enables using background color *beyond* cutlines of the **Background** type. To do this, set the **Fill background color outside "Background" cutlines** checkbox in the **Geomosaic** tab in the **Settings** window (**Service › Settings**).

  - **Transparent without filling** – to use transparent without filling in cutline area.

- the **Cutlines › Split cutline into sheets** menu item allows to split cutlines into polygons by sheets' borders. Polygons are saved in a new vector layer and contain all citline's attributes.

  To use this function it is required to create or load into project both cutlines and sheets.

- **Cutlines › Replace current node by new cutline** – to create a new cutline as a small rectangle polygon in the place of the node (the point where three or more cutlines converge). This polygon can be further edited by the user.

  If the vertices of adjacent cutlines located next to a node vertex are too close to it, then when user tries to **replace current node by new cutline**, the appropriate error message is displayed: **Inserting cutline is too small**. If this system message appears, manually delete the vertices closest to the node and try to repeat this operation by clicking the button in the main toolbar.

8.7.1. Including regions into cutlines mode

The system provides for quick manual cutline editing. The feature of this method is that there is no need for manual editing (including, removing, or moving) of each vertex of a cutline under processing. The system allows the user to quickly specify the desired shape of edited cutlines, after which it automatically rebuilds these objects.

The main scope of this tool is to change the configurations of adjoining segments of adjacent cutlines. Such a need may arise, for example, if adjoining segments of cutlines

(built automatically) intersect any one-piece object (for example, a building) in project images. In this case, it would be most practical to merge the “boundary” created by cutlines with the boundaries of the object itself, thus leaving it within a single cutline.

For this, perform the following:

1. Make the *Cutlines* layer active;

2. Click in the main toolbar, to enable the mode to include a region into a cutline (or choose **Cutlines › Include regions into cutlines**);

3. Choose **Window › Toolbars › Tools**;

4. Click in the **Tools** bar that opens;

5. Create a freeform polygon by holding down the **Shift** key, sequentially moving the cursor in the 2D window work area, and clicking the **left mouse button**. The created polygon must meet the following conditions:

   - The first polygon vertex is to be within the so-called parent cutline, whose boundaries are supposed to be expanded by changing the configuration of adjacent segments;

   - The polygon must intersect the editable “boundary”, covering areas of at least two vector polygons created by the editable cutlines.

   The created polygon is visually displayed using black boundaries and a dark fill. To complete the creation of a polygon, set the last vertex of the polygon by double-clicking the **left mouse button**. Press **Esc** to delete the last created vertex. After completing the creation of the polygon that defines the new cutline shape, the edited cutlines are automatically rebuilt.

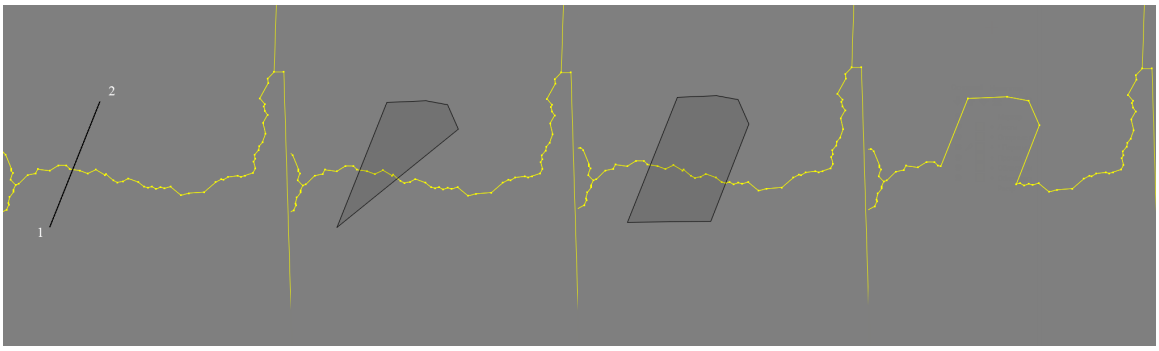


Fig. 32. Creating a polygon that defines the nature of changes in the configuration of adjacent segments of neighboring cutlines

Cutline rebuilding operations can be cancelled using the **Undo Log** (see “Undo editing operations” in the “Vectorization” User Manual).

For this operation, the rectangular marquee tool can also be used (the button in the **Tools** bar).

The above guide and the illustration describe the most obvious common use of this tool. When editing more than two cutlines (or cutlines with a more complex initial shape) using this tool, note the following:

- The results of the operation depend on the number of cutlines involved, their initial relative position, as well as on the shape and size of the polygon that determines their new configuration;
- In any case, the change in the mutual configuration of the cutlines is carried out by increasing the “parent” cutline, which, in turn, is determined by the location of the first vertex of the polygon created in the **Include regions into cutlines** mode;
- Small cutlines that are completely covered by a user-created polygon (i.e., falling entirely within the “expanding” cutline) will be “absorbed” by this cutline (deleted).

8.7.2. Intersection of polygons with the same name

The system provides for creating a polygon that describes the area of intersection of two other polygons located in different layers and having the same values of the selected attribute.

For this, perform the following:

1. Create or load two layers with vector polygons (cutlines). The layers must contain intersecting 2D polygons having the same attributes (the same names and equal values);
2. Make one of those layers editable;
3. Choose **Vectors › Attributes › Intersection of corresponding polygons**. The **Layers selection** window opens:

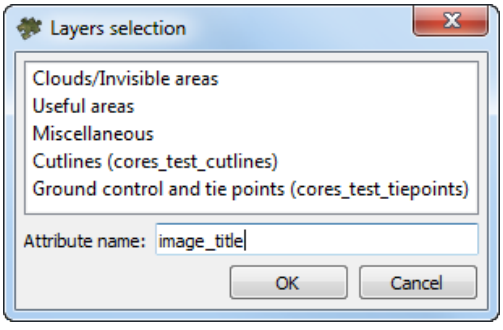


Fig. 33. The Layers selection window

4. Select the second layer that contains the above polygons;

5. Enter polygon **attribute name**;

6. Click OK. After the operation is complete, an info message on the number of objects created in the new vector layer appears.

   The polygons created describe the areas of intersection of parent polygons from different layers. They are also assigned the attribute of the parent objects used during the operation.

8.8. Cutlines attributes

The attributes of the Cutlines layer extend the capabilities of editing cutlines. Basing on the attributes, the cutline gets the name and type (see also the “Vector objects attributes” chapter of the “Vectorization” User Manual).

In the case, where the imported objects have another attributes, the capability of setting attributes provides the correct import of cutlines, created in third party software.

By default, the *Cutlines* layer has following attributes used to store information about cutlines:

- *image* – attribute for full path to image file;
- *image_title* – attribute for cutline name (equal to image name – source or reference image);
- *rgn_type* – the cutline type attribute;
- *ref_image_name* – the filename of reference image attribute, used in the cutline area.

For editing the *Cutlines* layer attributes perform the following:

1. Choose the **Cutlines › Parameters**. The **Cutlines parameters** window opens.

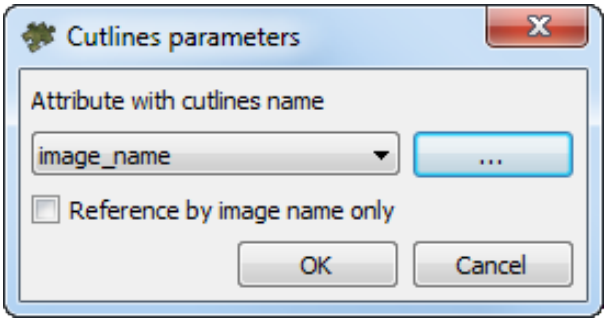


Fig. 34. Cutlines parameters

The default attribute name is displayed in the **Attribute with cutlines name** list.

2. To edit attribute choose attribute name from the list or click the ... button to add new attribute. Input the name of new attribute and click OK.

3. [optional] Set on the **Reference by image name only** checkbox to comparison cutlines only by image name, not by path.

To set these parameters for a single cutline, select the required cutline and open the **Cutline info** window (see Section 8.9). To disregard the image path and refer the cutline by image name only, set the **Name only** checkbox in the **Cutline info** window.

Editing of vector layer attributes, including editing of attribute name and attribute deleting are used in cutlines import. Choose the **Vectors › Export** to export the cutlines into other formats (see Vectorization User Manual).

It is strongly discouraged to create projects with non-unique image names. If there are images with duplicate names in the project, it is strongly recommended to use only full paths to images for referring to cutlines

Perform the following actions to view and edit attributes of the *Cutlines* layer and attributes values of selected cutline:

1. Select a cutline in the **Preview** window.

2. Choose the **Window › Object attributes** or click the button of the **Vectors** additional toolbar. The **Object attributes** window opens.

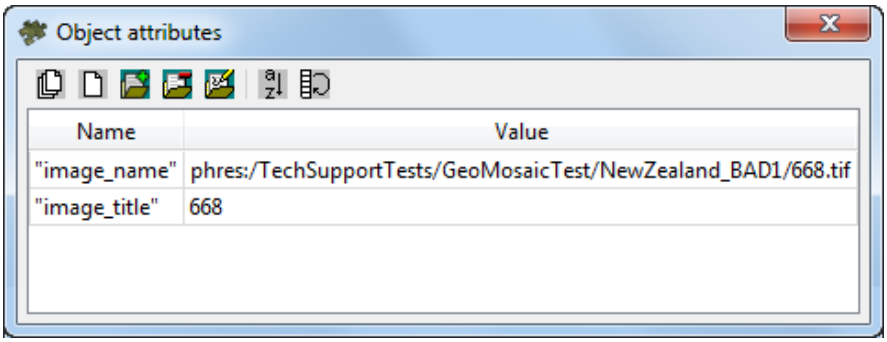


Fig. 35. Cutlines attributes

The following buttons are used to create and edit attributes table:

- – allows to delete all attributes of selected objects;
- – allows to delete common attributes of selected objects;
- – allows to open the **Add attribute** window to define name, type and value of attribute;

-  – allows to delete current field of attribute table;
-  – allows to open the **Edit attribute** window to edit parameters of selected attribute;
-  – allows to sort attributes of selected objects;
-  – allows to invert attributes of selected objects.

Attributes may have the following values:

- for *image* – full path to main image file;
- for *image_title* – cutline name (is automatically generated from name of file with source image);
- for *rgn_type* – cutline type:
  - 1– complies to the **Image** type;
  - 2 – complies to the **Transparent from reference image** type;
  - 3 – complies to the **Background** type;
  - 4 – complies to the **Transparent without filling** type.
- for *ref_image_name* – full path to reference image file, providing that the cutline type is the Transparent from reference image, i.e.*rgn_type* = 2.

3. Double-click the string of the **Value** input field and insert another value for changing of attributes value.
4. Press **Enter** to save or press **Esc** to cancel.

8.9. Cutlines info

To view and change information about several cutlines perform the following:

1. Make the *Cutlines* layer active.
2. Select a cutline in the **Preview** windows.
3. Choose **Cutlines › Cutline properties**. The **Cutline info** window opens.

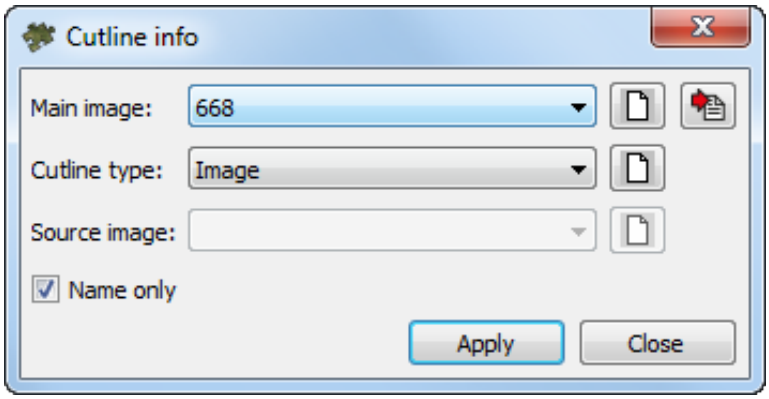


Fig. 36. The information about cutline

4. In the **Main image** field (corresponds to the *image* attribute value) shows full path to file of main image, for which the cutline was created. To edit the field value open the list and select another image of the project.

   To return to current main image click the button. To clear the list click the button.

5. Choose one of the **Cutline type** from the list corresponds to the *rgn_type* attribute value):

   - **Image** to use main image in area of cutline;
   - **Transparent from reference image** to use reference image (fallen into cutline area) in area of cutline specified in the Source image field;
   - **Background** to color the cutline area with output mosaic background color (see Section 13.2.2), that is used for coloring of any terrain objects on images;
   - **Transparent without filling** to apply transparency to the cutline area.

   To clear the list click the button.

6. [optional] In the **Source image** (corresponds to the *ref_image_name* attribute value) shows full path to file of reference image (fallen into cutline area), if the image is used for the cutline with the **Transparent from reference image** type. In order to select a reference image use a list of project images.

   To clear the list click the button.

7. [optional] To use only the image name (without considering the full path to the image) for referring the image to the cutline, set the **Name only** checkbox..

   To refer all project cutlines by image name only, set the **Reference by image name only** checkbox in the **Cutline attributes** window (see Section 8.8).

   The need to consider only the image name may arise, for example, when project images are partially replaced by copies with the same names located in a different folder (see Section 7.10).

   It is strongly discouraged to create projects with non-unique image names. If there are images with duplicate names in the project, it is strongly recommended to use only full paths to images for referring to cutlines.

8. Click the **Apply** button to apply changes.

8.10. Using external vector polygons

The system provides for using cutlines of **image** type ( , see Section 8.7) created in third-party programs. *GeoMosaic* can attach third-party vector polygons that have no attributes to project's images according to their geometric location for further use as cutlines.

For this, perform the following:

1. Import third-party cutlines into the *PHOTOMOD* resource system (see "Import of vector objects" in the "Vectorization" User Manual);

   Imported vector objects are to be polygons.

2. Load these objects as cutlines from `*.x-data` file in the active profile resources (see Section 8);

3. Choose **Cutlines › Attach cutlines to images**;

4. After operation completion, check the values of these objects' attributes (see Section 8.8);

5. Save data.

9. Brightness adjustment

The system allows to adjust brightness and contrast features of cutlines areas during their merging (the *global* and *local* brightness adjustment of output mosaic) and options of smoothing areas along cutlines, to create uninterrupted mosaic image.

To do so, the **Brightness adjustment** tab of the **Mosaic settings** window is used.

Global brightness adjustment means transformation equally applied to all pixels of each source image (see Section 9.1).

Local brightness adjustment is a transformation applied along cutlines of images that are merged into mosaic with a smoothing going down to the image central point and mosaic edges. Processing of each pixel during the local brightness adjustment depends on its coordinates (see Section 9.2).

To perform the brightness adjustment of output mosaic do the following:

1. Select **Mosaic › Parameters**. The **Mosaic parameters** window opens;
2. In **Mosaic parameters** window open the **Brightness adjustment** tab;
3. [optional] set the global brightness adjustment parameters;
4. [optional] set the local brightness adjustment parameters;
5. [optional] set the general parameters of brightness adjustment;
6. [optional] set the parameters of smoothing areas along cutlines;
7. Click OK to save all the parameters set in the **Brightness adjustment** tab;
8. Select **Mosaic › Brightness adjustment** or click the button on the main toolbar to rebuild brightness adjustment for all block scheme.

If after cutlines editing you need to rebuild brightness adjustment, choose the **Mosaic › Brightness adjustment**.

In case of large data volumes it is recommended to use distributed processing. Perform the following actions to rebuild brightness adjustment using distributed processing:

1. Set the brightness adjustment parameters in the **Brightness adjustment** tab of the **Mosaic settings** window and click OK;
2. Click the button on the main toolbar;
3. Change settings and run the distributed processing server/client (see the '*Distributed processing*' chapter in the 'General information about system' User Manual).
4. Choose **Mosaic › Distributed global brightness adjustment**. The **Brightness adjustment distributed processing** window opens.

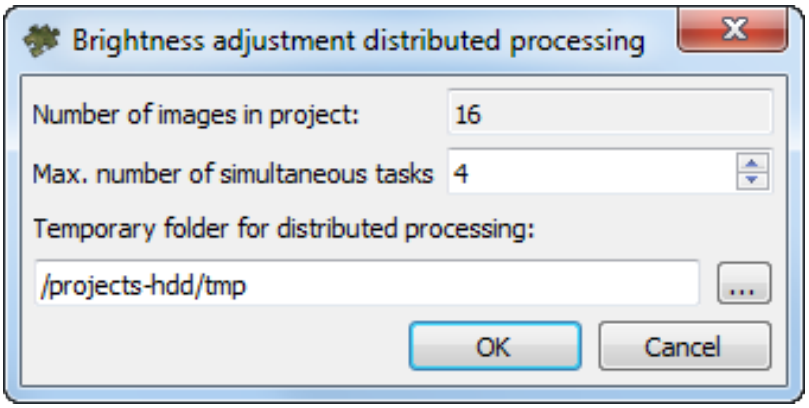


Fig. 37. Brightness adjustment distributed processing parameters

The total **Number of images in project** displays in the window.

5. Specify **Number of tasks for processing**, which are processed by one computer.

   It is recommended to set quantity of tasks in proportion to quantity of used cores, but not more than 25 tasks.

6. Select the **Temporary folder for distributed processing** in the resources of active profile for temporary data storing.

7. Click OK. Distributed processing tasks are created and the system shows a message about number of created tasks.

8. After the end of distributed processing click the button on the main toolbar to reopen the mosaic project from active profile resources.

To clear all data about brightness adjustment choose **Mosaic › Clear brightness adjustment**.

The system does not allows for mosaic brightness adjustment when building a mosaic in the distributed processing mode ( ), nor in the mode of MegaTIFF distributed processing ( ). Herewith, brightness adjustment can be a part of the process of mosaic building in the normal course ( ).

Building a mosaic in the distributed processing mode ( ) is available either for projects with previously performed brightness adjustment, or if brightness adjustment is disabled when setting mosaic parameters (i.e. brightness adjustment is not included in the list of tasks to be executed when building a mosaic in the distributed processing mode). Otherwise the system gives the following warning:

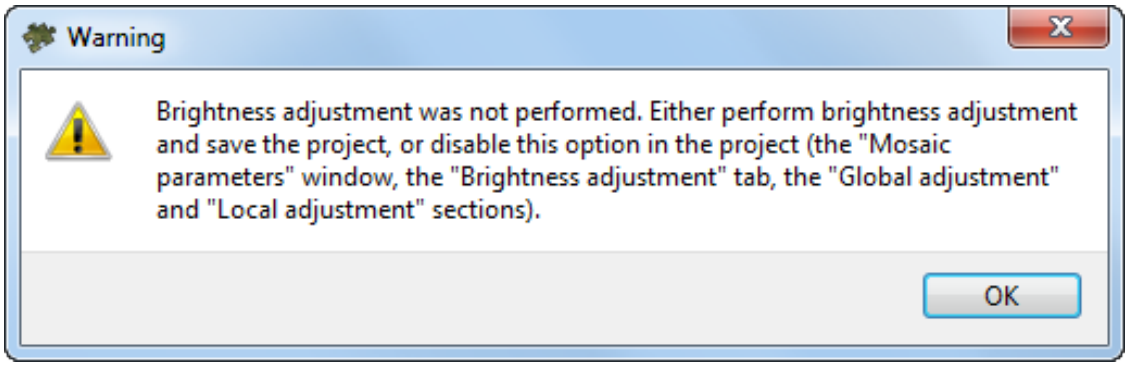


Fig. 38. A warning when starting distributed processing

In case of this warning, to start distributed processing, perform the following:

- [optional] make brightness adjustment previously and save the project ();
- [optional] disable brightness adjustment previously in the **Mosaic parameters** window:
  - In the **Mosaic parameters** window, **Brightness adjustment** tab, **Global adjustment** section, choose **None**;
  - In the **Mosaic parameters** window, **Brightness adjustment** tab, **Local adjustment** section, clear the **On** checkbox.

9.1. Brightness adjustment parameters

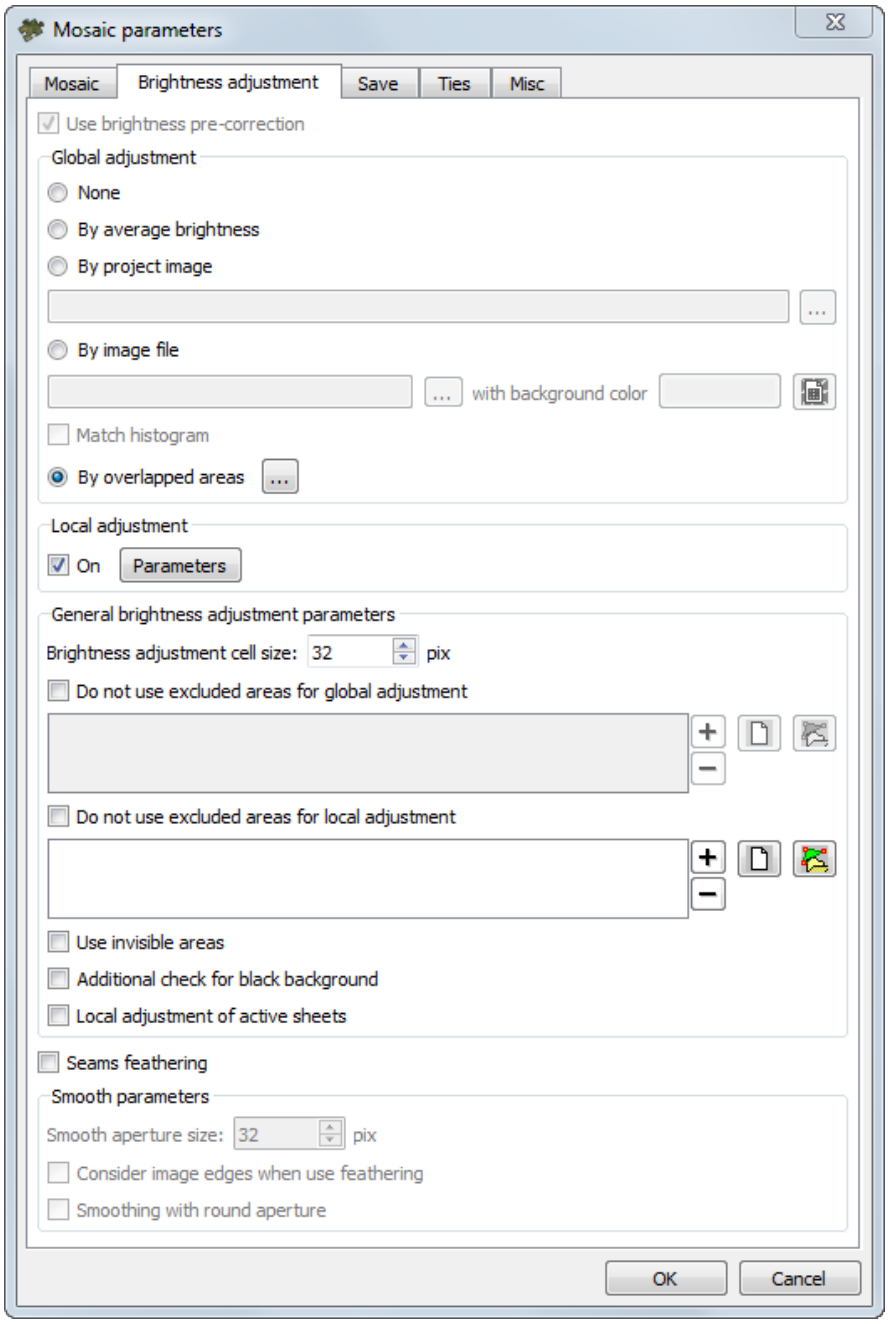


Fig. 39. Brightness adjustment parameters

The **Use brightness pre-correction** checkbox allows to consider preliminary BCG-correction of source images while output mosaic is created.

Brightness pre-correction does not consider in case of any method except **None** was chosen in the **Global adjustment** section.

It is recommended to set on the **Use brightness pre-correction** checkbox if there are a lot of cloud areas on scanner images.

In the **Global brightness adjustment** section choose the way of the brightness adjustment for all block:

- **None** – allows to use images without adjustment;
- **By average brightness** – allows to apply brightness adjustment using average images brightness;

At that brightness and contrast of all images are set to values, found using averaging of brightness and contrast values calculated over all mosaic images. This method is recommended when there are big differences between brightness' of images, but each of them contains relatively smooth scenes.

It should be noted that in case of scenes with sharp different brightness within one image (for example 'sea' and 'coast') this method may produce incorrect brightness adjustment results.

- **By project image** – allows to apply global adjustment by project image: histograms of mosaic images are corrected in accordance with chosen project ('reference') image. To select the reference image is used the ... button;

It is recommended to use image located in the middle of images block as a reference. It is not recommended to use this method in case of abnormal local brightness fluctuations ('trends') on images, since in this case you can face a problem of smooth increasing or reducing of the brightness and contrast from the reference image to the block edges right up to complete 'lightening' ('blackening').

The system allows to adjust brightness by several reference images (located in different parts of the mosaic) what can be useful when processing projects containing large number of images.

To select the reference image is used the  button in **Images list** window. For correct brightness adjustment using one or more reference images *selected in the* ***Images list*** *window*, select the **By average brightness** adjustment in the **Global adjustment** section.

- **By image file** – allows to apply global brightness adjustment using brightness from chosen file. Histograms of mosaic images are corrected in accordance with chosen image file. To load image is used the ... button.

The  button serves for background color transparency setting for the selected image. For example, if the image background is black, it is required to select black color in the opened **Color** window. The  button allows to clear background color transparency settings for the selected image.

- **By overlapped areas** – allows to apply global brightness adjustment by overlapping images. To set the adjustment parameters, use the ... button.

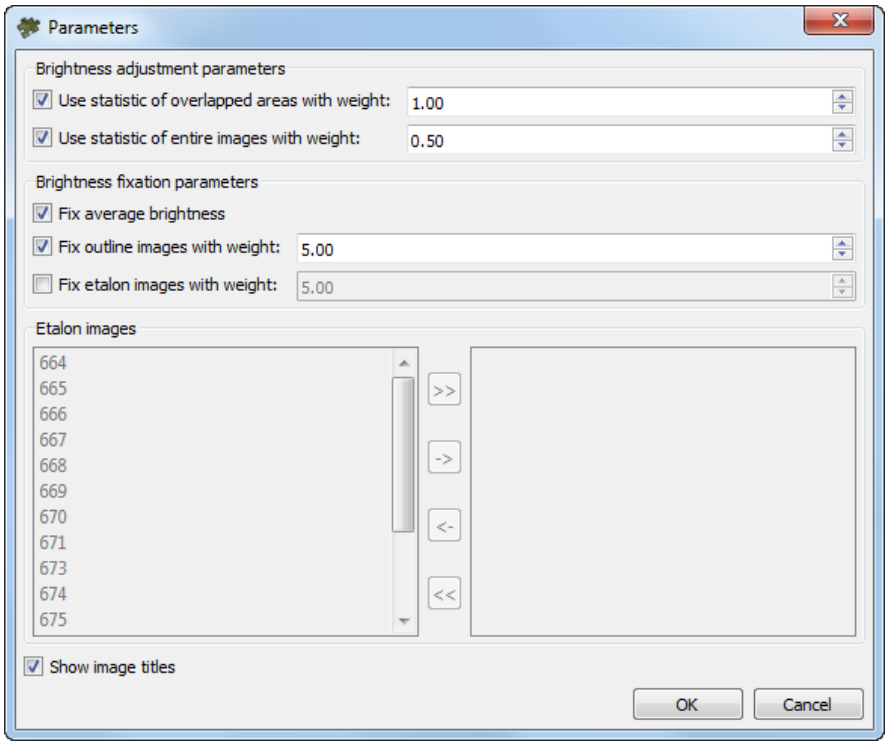


Fig. 40. Brightness adjustment parameters (by overlapped areas)

- **Use statistic of overlapped areas with weight** – allows to take into account (with preassigned weight) brightness of the images' overlapping areas during global brightness adjustment;

- **Use statistic of entire images with weight** – allows to take into account (with preassigned weight) brightness of every entire image during global brightness adjustment;

  If the images' brightness in a block significantly differ, it is recommended to set a small value.

- **Fix average brightness** – allows to save average brightness of images in block after global brightness adjustment;

- **Fix outline images with weight** – allows to save (with preassigned weight) brightness of images on the block borders;

- **Fix etalon images with weight** – allows to save (with preassigned weight) brightness of reference (etalon) images;

The **Match histogram** checkbox allows to apply full (non-linear) brightness adjustment with histogram matching. Otherwise only mean of distribution and standard deviation are matched.

Set the **On** checkbox in the **Local adjustment** to apply local brightness adjustment along cutlines of images that are merged into mosaic. If you would like to specify local brightness adjustment parameters click the **Parameters** button (see Section 9.2).

Also set up the following **general brightness adjustment parameters**:

- **Brightness adjustment cell size** – allows to specify a size of a cell (in pixels), which is used for brightness estimation and correction;
- **Do not use excluded areas for global adjustment** – allows to apply global adjustment in mosaic areas, defined by vector polygon's edges;

Vector polygons should be stored in file in active profile resources. The + button allows to open file with polygons. The ... button allows to choose another file, instead the opened. The − button allows to remove the selected file from the list. The button allows to remove all the files from the appropriate list. The button allows to display the selected layer of vector polygons in both the *Layers Manager* and in a 2D window.

- **Do not use excluded areas for local adjustment** – allows to apply global adjustment in mosaic areas, defined by vector polygon's edges;

Vector polygons should be stored in file in active profile resources. The + button allows to open file with polygons. The ... button allows to choose another file, instead the opened. The − button allows to remove the selected file from the list. The button allows to remove all the files from the appropriate list. The button allows to display the selected layer of vector polygons in both the *Layers Manager* and in a 2D window.

- **Use clouds** – allows to consider areas with clouds in brightness adjustment;
- The **Additional check for black background** checkbox allows to make the areas of source imagery with black background transparent in the output mosaic;

Due to the peculiarities of preprocessing, some satellite images can have two background colors at the same time (black and the second one is arbitrary), which must be taken into account during processing. For correct processing of such images (to take into account the black background color), set the **Additional check for black background** checkbox.

To take into account the arbitrary background color of source images, choose the **Images › Project images list** or click the button on the main toolbar. The **Images list** window opens. Select the images to define the images background color and click the button (see detailed description in Section 7.5).

- The **Local adjustment of active sheets** checkbox allows to apply brightness adjustment only to images, located on active mosaic sheets.

Set this checkbox on only if distributed processing without saving adjustment parameters was performed. In this case number of tasks should be equal to number of active sheets.

For **seams feathering** set on the appropriate checkbox and define the following parameters in the **Smooth parameters** section:

- **Smooth aperture size** – allows to define the size of smoothing zone along cutlines;
- **Consider image edges when use feathering** – allows to smooth seams on the edges of images block, where may be no statistics enough for correct smoothing.
- **Smoothing with round aperture** – allows to turn on the mode of pixel-by-pixel smoothing along cutlines.

Using this function results in increasing of time required for rebuilding brightness adjustment.

Set this checkbox if the results of smoothing along cutlines are not satisfactory, especially in case of the presence of large water-tables in the project.

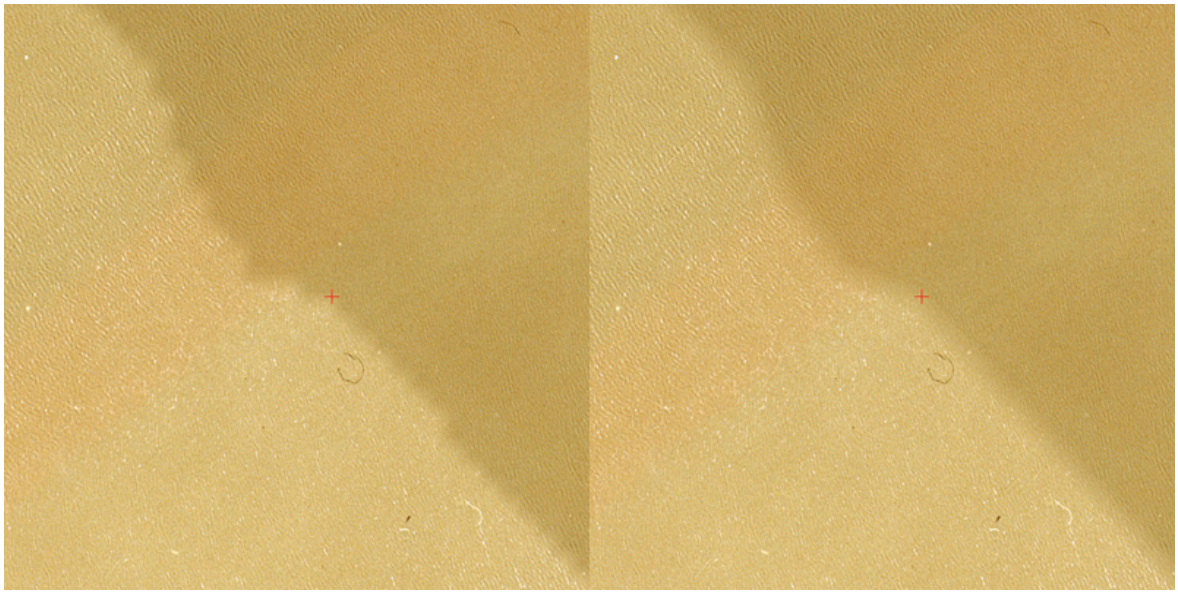


Fig. 41. Smoothing with round aperture is not applied to the area (water-table) (left) and smoothing with round aperture is applied to the area (right)

9.2. Local brightness adjustment parameters

Local brightness adjustment is a transformation applied along cutlines of images that are merged into mosaic with a smoothing going down to the image central point and mosaic edges. Thus during local brightness adjustment each pixel of the image is processed depending on its coordinates. At that the program performs simultaneous change of brightness (additive component) and contrast (multiplicative component) of initial images.

For preliminary estimation of local brightness adjustment choose the **Misc › Local adjustment**. In the **Preview** window you will see a grid of fragments (rectangles), used

for statistics collection for local brightness adjustment. The fragments are vector objects located on the *Miscellaneous* layer.

The brightness adjustment rebuilding ( ) should be already performed. The **On** checkbox must set beforehand (the **Local adjustment** section in the **Brightness adjustment** tab of the **Mosaic parameters** window).

Rectangles have the following colors depending on area, which is used for statistic acquisition:

- green – to obtain statistic between images;
- blue – to obtain statistic between strips;
- red – to obtain statistic on mosaic edges;
- yellow – to obtain statistic inside of separate images.

The program provides possibility to edit grid of fragments as vector objects on the *Miscellaneous* layer (see the “Vectorization” User Manual).

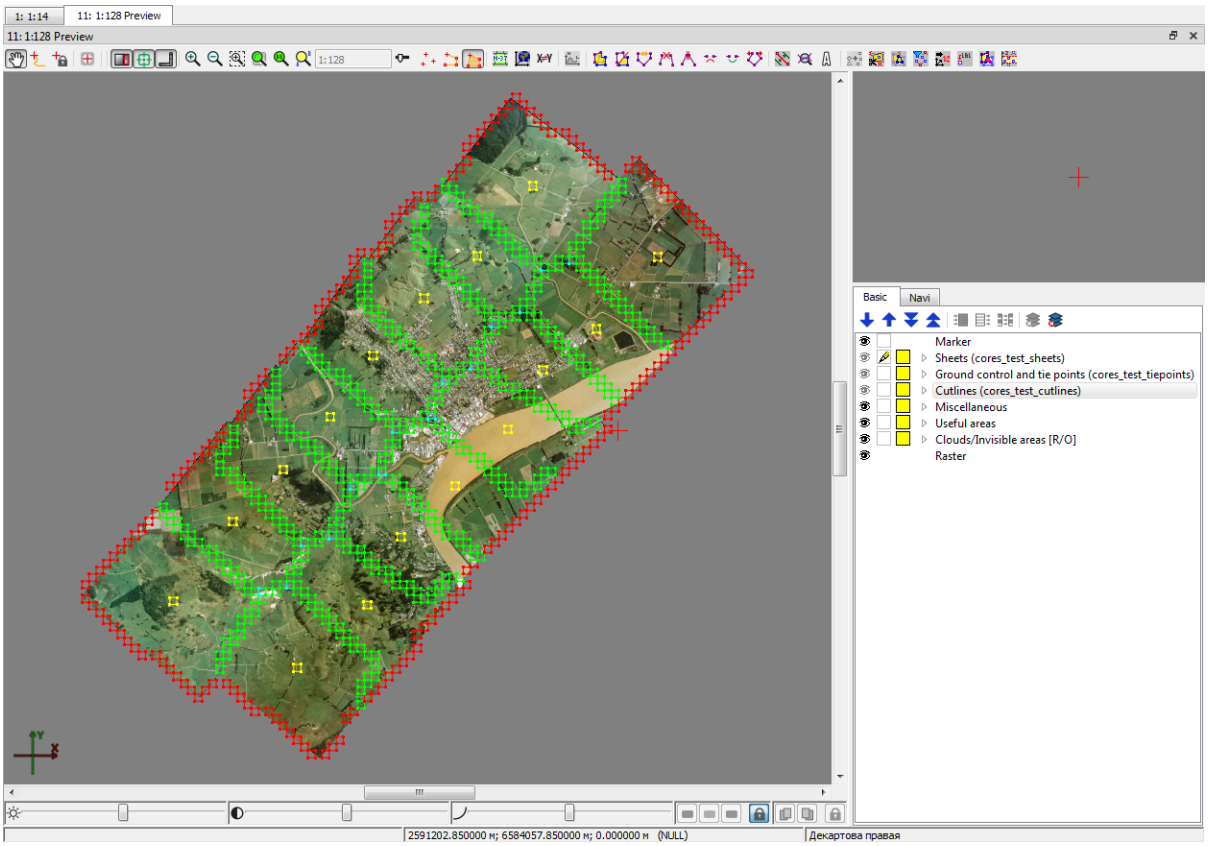


Fig. 42. Preliminary estimation of local brightness adjustment

To set the parameters local brightness adjustment you should perform the following:

1. Choose the **Mosaic › Parameters**. The **Mosaic parameters** window opens.

2. Click the **Brightness adjustment** tab. In the **Local adjustment** section set the **On** checkbox and then click the **Parameters** button. The **Local adjustment parameters** window opens.

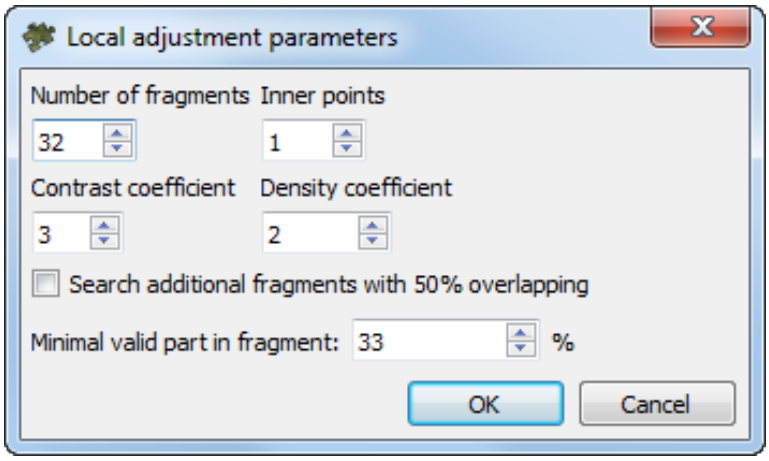


Fig. 43. Local brightness adjustment parameters

3. Define images **Number of fragments** used to create a model of local brightness adjustment.

   In case of color difference inside one fragment in nearby images inconspicuous or homogeneous along the cutline, only one fragment is enough to collect statistics.

   In case of color difference inside one fragment between images remarkable or heterogeneous, it is necessary to increase number of fragments to consider brightness change.

   In case of increasing number of fragments, number of pixels in each fragment hold constant. In this case image from one layer of pyramid is used for brightness adjustment. In case of increasing number of fragments, brightness adjustment perform more precise, but slower.

4. Set the **Inner points** – number of points inside image and on mosaic edges, where brightness should not be changed.

   Insufficient quantity of these points leads to creation brightness artefacts while distance from cutlines. Quantity over leads to unacceptable results of local brightness adjustment along cutlines.

5. [optional] If errors in contrast of source images leads to not enough adjustments quality or to errors in local brightness adjustment, increase the **Contrast coefficient** value from 2 to 7 for better results.

6. Set the **Density coefficient** – a thinning ratio for the grid of fragments (rectangles) on mosaic edges (marked red in the illustration above).

The thinning ratio in the picture is equal to one (the fragment grid is not thinned). The recommended **Density coefficient** value is 2.

7. [optional] In case if not enough statistic data for local brightness adjustment, program provides possibility shift of fragment's grid relative to cutlines. For this set on the **Search additional fragments with 50% overlapping** checkbox.

8. [for scanner images with small overlaps] In case of small overlaps, cutline could be located too close to edge of image, so image background is include to cutline area. In this case set the **Minimal valid part in fragment** – minimal part of image in fragment, when statistics data is collected.

9. Click OK.

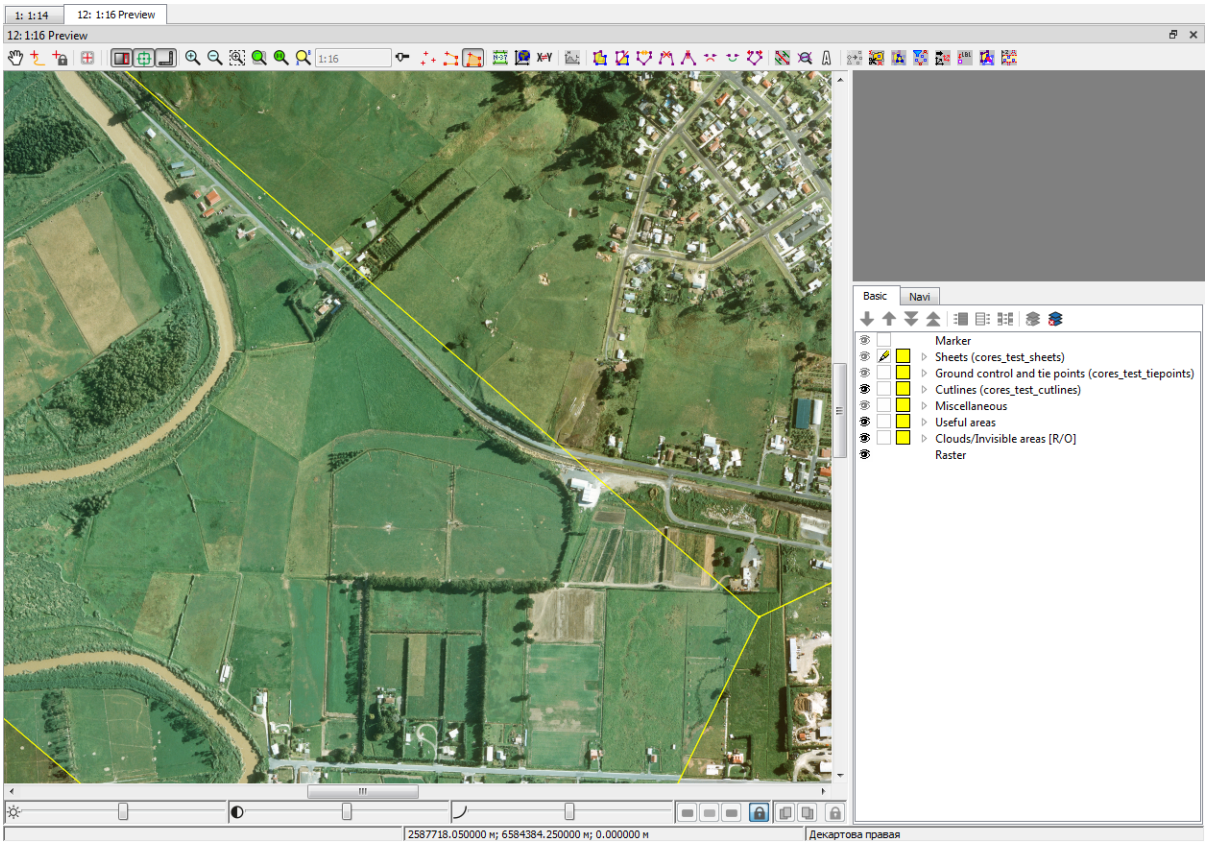


Fig. 44. Area without local adjustment

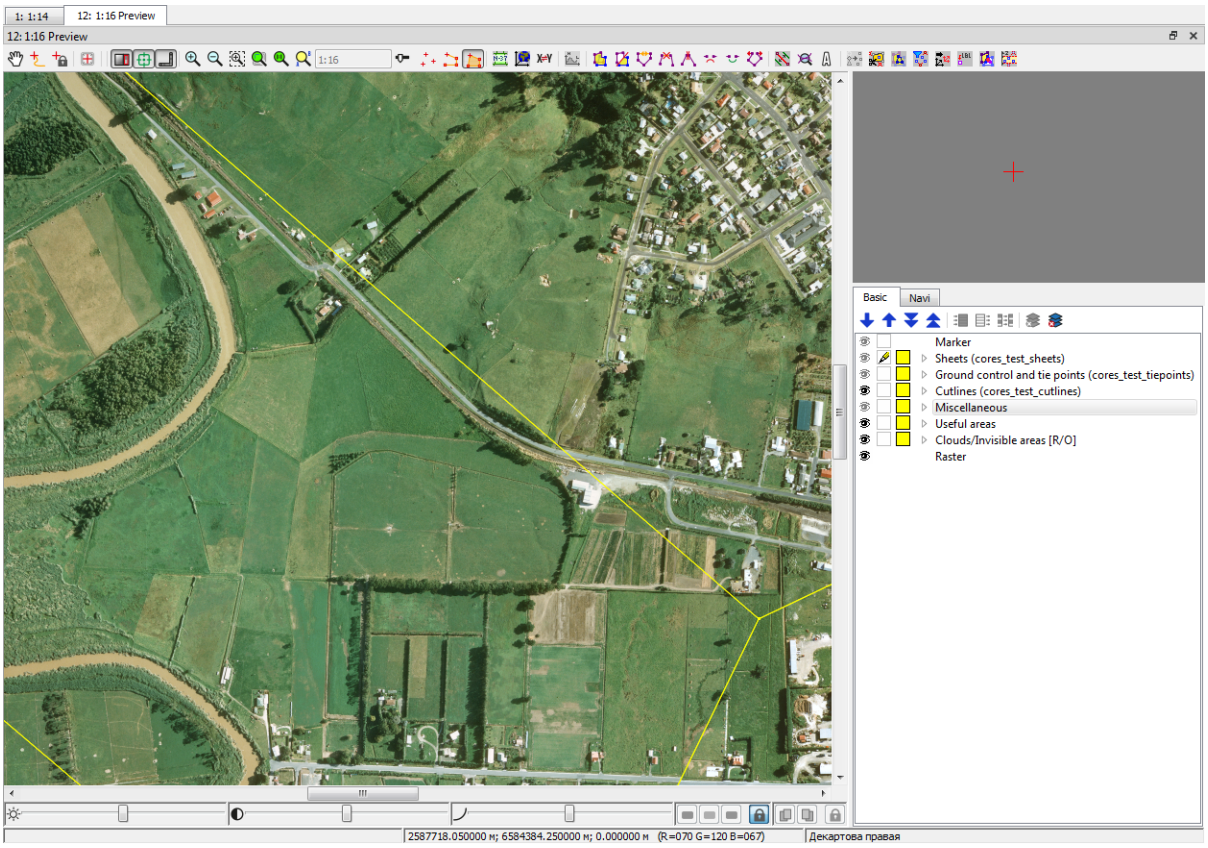


Fig. 45. Area with local adjustment

9.3. Dodging

Dodging – means brightness adjustment of the *single* image.

To employ this function you should perform the following:

1. Select **Images › Project images list...** or click button. The **Image List** window opens.

2. Select the image you need to transform in **Image List** window and click the button. The **Radiometric correction** window opens.

3. Click the button in **Radiometric correction** window. The **Filters** menu opens.

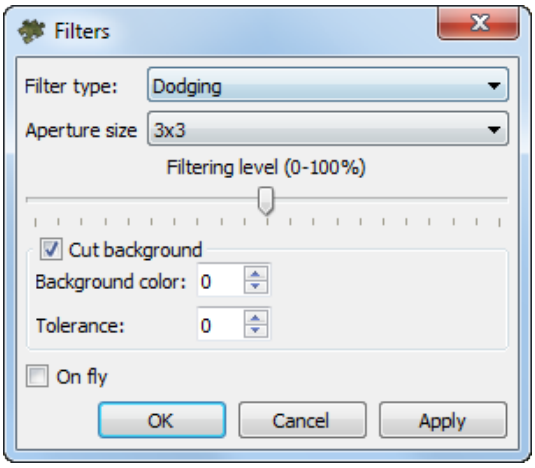


Fig. 46. The filters menu

4. Choose the **Dodging** filter, set aperture size and filtering level.

   Recommended filtering level – 100%.

5. [optional] By default the **Cut background** checkbox is set. This function allows not to take into account the background on image edges during the correction. To exclude background parts from the correction, set the following parameters:

   - **Background color** – value of background color;

     If the 0 value is set in the **Background color** field, background also will be changed during the correction.

   - **Tolerance** – deviation from background color value.

6. Click OK.

10. GC/tie points

10.1. General information

You may use GC/tie points to transform the project images, which, if applied correctly, allows for more accurate alignment of photomosaic elements with each other. The parameters for transforming images under the influence of triangulation points are configured by the user in the **GC/tie points** tab of the **Mosaic** parameters window (see Section 13.2.4).

Using GC/tie points is not a mandatory stage of project processing and is generally not required when using correct and homogeneous input data. It is recommended to use

this tool with some degree of caution, only in cases where it is really necessary to achieve the desired results.

The choice of the types of triangulation points used, as well as the method and degree of their influence on the images, is determined by both the characteristics of the input data and the requirements for the output mosaic. When using several types of triangulation points together, it is necessary to constantly take into account that the final transformation of the image is determined by the integrated influence of all existing points. Accordingly, the processing of the project is affected by the order of entering points of certain types, their mutual arrangement, and the settings currently in effect.

In any case, the use of GC/tie points causes the transformation of the mosaic's images, which, in general, is a troublesome aspect and may have a negative impact in the future, for example, if it is necessary to re-process previously created mosaics (a common situation is the correction or updating of any local areas of the mosaic that were previously changed because they fell into the zone of influence of the points).

GeoMosaic involves the following types of triangulation points:

- *Ground control points* – points with known geodetic coordinates that can be measured by the project images in case of available ground control data. Images are transformed according to the user-defined parameters.

  Optionally, they are used for primary control, for example, if it is necessary to construct (or, more often, re-construct) a mosaic using inhomogeneous materials obtained in different times from different sources.

- *Tie points* are the same point locations in overlapped images. Measuring tie point coordinates involves establishing a connection between the same point on the ground in two (or more) source mosaic project images in the vicinity of cutlines.

  Those points are the main (and often the only necessary) photo control instrument, solving the most frequent problem of more accurate aligning of images' sections in the vicinity of cutlines. Tie points also change images according to the user-defined settings.

  Tie points are solely used for transforming source images exactly close to cutline. It is not recommended to measure the tie points far away from the cutlines to avoid the rough transformation of images. Also, it is not recommended measuring points on the extended objects (for example, on the roads), buildings and low-contrast areas.

- *Synthetic point* are a highly specialized type of points used by *PHOTOMOD GeoMosaic* and are used only in special cases (for example, when it is impossible to use reference data and/or when processing a project containing images with significant distortions, which are caused, for example, by mountainous terrain).

Unlike GCPs or tie points, which transform an image according to the settings specified in the **GC/tie points** tab of the **Mosaic** parameters window, synthetic points allow you to shift an entire image manually according to the shift direction and range of the synthetic point created in advance by the user.

Manual image shift allows you, first of all, to achieve its *visual* correct arrangement; for example, correctly align elongated objects (rivers, roads, etc.), especially when the appearance of the resulting mosaic is the most important.

Thus, synthetic points are partly, very conditionally, similar in purpose to GCPs, but, unlike “real” GCPs, they cannot improve the accuracy of the output data. Synthetic points affect the location of images only when the **Using of ground control and synthetic points** checkbox is set (see Section 13.2.4).

Correct shifting of an image, in exact accordance with the direction and range of displacement of the synthetic point, is possible only in the case of no influence on the image from other points—synthetic, GCPs, or tie points.

Therefore, the most optimal scenario for using synthetic points is their separate (or primary) use, with subsequent measurement of points of other types, for example, tie points (see below).

Depending on the nature of the input data and the user’s goals, the following, to a certain extent conditional, scenarios for using GC/tie points are possible:

- Primary creation of GCPs, followed by measuring the tie points, for more correct alignment of the areas of the images near the cutlines;
- Using only tie points, which may be sufficient in many cases;
- Use of synthetic points for visual alignment of images, with possible further measurement of tie points, depending on the tasks at hand.

10.2. Ground control and tie points layer

The Ground control, tie and synthetic points are displayed in *Ground control and tie points* vector layer. The points data is stored in the vector objects additional attributes (see Section 10.2.1). In order to obtain the brief information about triangulation point, select the point on editable layer *Ground control and tie points* (or in **Points catalog** window table) and choose the **GC/Tie points › Point info** (or click the  button in **Points catalog** window toolbar).

In the opened **Orthorectification statistics** window you can see the following data:

- point’s name (with `tie` prefix for tie point, `gcp` for GC point and `synthetic` for the synthetic point);
- number of images where the point is measured;

- path to file of each image where the point is measured.

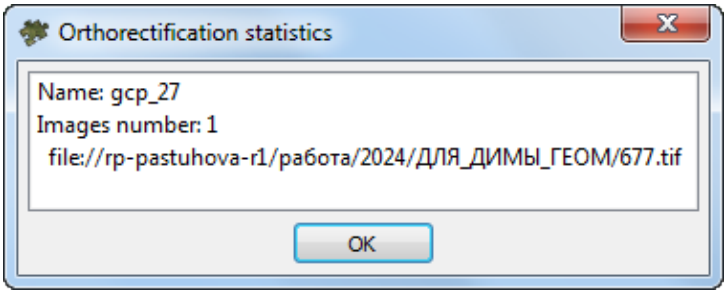


Fig. 47. Brief information about ground control point

10.2.1. Attributes of Ground control and tie points layer

After tie/GC point measuring the information about measured point is saved to attributes of the *Ground control and tie points* layer.

This functionality is intended for viewing information about a point only. Change of points' attributes is strongly discouraged. The appropriate tools for work with triangulation points are intended for editing points (see Section 10.3).

To view point's attributes data perform the following actions:

1. Make the *Ground control and tie points* layer editable.
2. Select a point in the **Preview** (or **Points catalog**) window by mouse clicking.
3. Choose the **Window › Object attributes** or click the button of the **Vectors** additional toolbar. The **Object attributes** window is open.

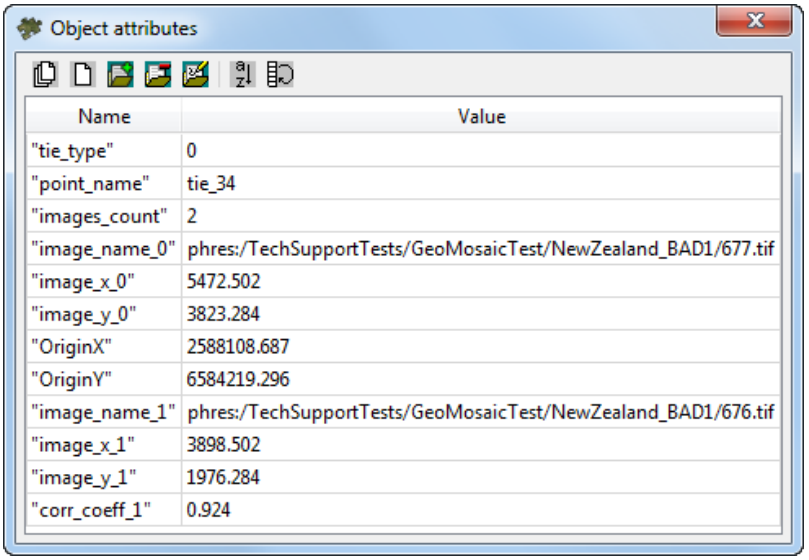


Fig. 48. Tie point attributes

Point's attributes contain the following data:

- *tie_type* – contains information about type of point (with 0 value for tie point, 1 for GCP and 2 for synthetic point);
- *points_name* – contains a name of point (with `tie` prefix for tie point, `GCP` for GCP and `synthetic` for synthetic point);
- *image_count* – shows a number of images where the point is measured;
- *image_name_image_number* – contains a path to one of the image files where the point is measured;
- *image_x_image_number* – contains X-coordinate of the point on one of the images;
- *image_y_ image_number* – contains Y-coordinate of the point on one of the images;
- *OriginX* – contains X-coordinate of the point;
- *OriginY* – contains Y-coordinate of the point;
- [for points found with correlator] *corr_coeff* – correlation coefficient of point.

10.3. Triangulation points management instruments

The list of triangulation points (GCPs, tie and synthetic points) is displayed in the **Points catalog** window. GCP ant tie point coordinates are measured in the **Points measurement** window. The reference image (or web map) is loaded into the **Reference map** window. This window is used to measure GCPs together with the **Points measurement** one.

The program provides three modes of tie/GCPs measurement:

- Manual mode measurement of points without correlator;
- Semi-automatic mode measurement of points using correlator;
- Automatic mode measurement of points using correlator.

The correlator parameters are used for measurement ground control/tie points with correlator in semi-automatic or automatic mode. The **GC/tie points › Parameters** menu item us used to view and edit correlator parameters values (see Section 10.7).

Synthetic points are measured and used in the Preview window.

Changes made to images by a triangulation point take effect immediately after its creation, according to settings specified in the **GC/tie points** tab of the **Mosaic** parameters window (see Section 13.2.4).

If needed, in order to refresh the **Preview** window, click the button in *GeoMosaic* main toolbar.

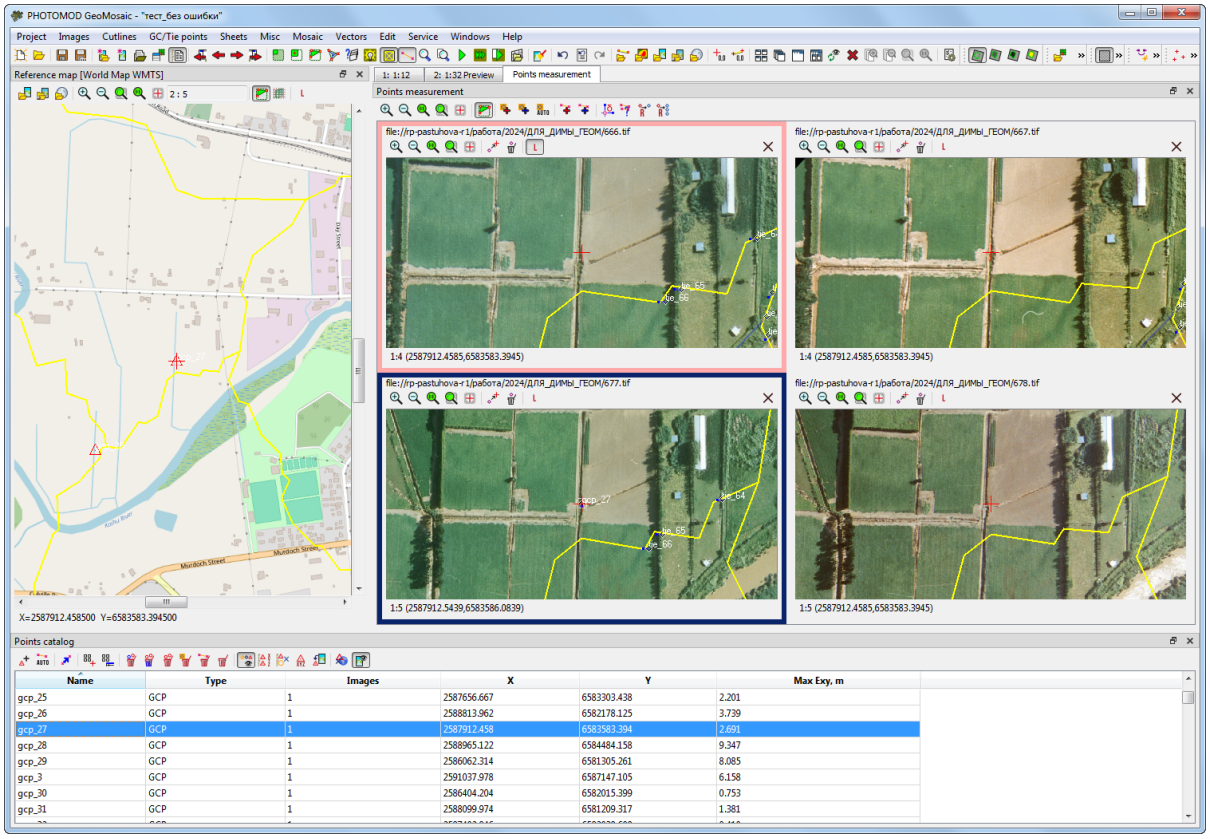


Fig. 49. The Points catalog, Points measurement and Reference map (with loaded web map) windows

10.3.1. The “Points catalog” window

The **Points catalog** window contains a list of all triangulation points of a project (ground control, tie and synthetic points) and also tools for points editing.

To open the **Points catalog** window click the button on the main *PHOTOMOD GeoMosaic* toolbar.

The list of triangulation points is a table. Points sorting in columns of the list is performed by mouse click on the column header.

Table 11. Table columns (list of points)

Buttons	Functions
Name	displays point’s name (with `tie` prefix for tie point, `gcp` for GC point and `synthetic` for the synthetic point)

Buttons	Functions
Type	displays point's type (tie, GCP or synthetic)
Images	displays a number of images where the point is measured
X	displays X-coordinate of the point
Y	displays Y-coordinate of the point
Max Exy	displays point residual by XY

The **Points catalog** window is located at the lower part of the 2D-window by default. The system interface is flexible for customizing the locations this window according to the user's needs.

The **Points catalog** window can either be fixed in designated sections of the work area (top or bottom, right or left) or undocked by the user and placed in any place in the 2D window.

To undock the **Points catalog** window (or pinpoint it in any place), move the cursor over the window title and, holding down the **left mouse button**, drag the window to the area of its targeted location.

Use the button on the right side of the window title to undock a docked window.

To quickly return a window to the area where it was docked last time, double-click the **left mouse button** on the window title

Buttons of the toolbar allow to input, edit and filter triangulation points. The toolbar instruments is also used for viewing of selected point measurements on project images in the **Points measurement** window (see Section 10.3.2).

Table 12. Toolbar of the Points catalog window

Buttons	Functions
	to add the synthetic point to the images (in **Preview** window)
	to start operation of tie points automatic search and measurement for the entire images block using correlator
	to display the error vectors in *Miscellaneous* layer. 'Bad' points have error vectors noticeably different from other points in size and direction
	opens **Points measurement** window with initial images, which contain marker position in **Preview** window. In order to open only two images, enable the appropriate mode ( )
	opens **Points measurement** window with initial images, which contain point selected in **Points catalog** / **Preview** windows
	to remove selected points (any type)
	to remove blunders of tie/GC points automatic measurement: allows to reject those points, which measurement value results in shift of images relatively each other at distance more than specified (in meters)
	to remove all triangulation points
	to remove only ground control points

Buttons	Functions
	to remove only tie points
	to remove only synthetic points
	to display all types of triangulation points in **Points catalog**, **Points measurement** and **Preview** windows
	to display only GC points
	to display only tie points
	to display only synthetic points
	to display in **Points catalog** window only points on opened images in the **Points measurement** window
	to display the **Orthorectification statistics** window containing the brief information about selected point (see above)
	to open the **Reference map** window
	to enable mode, that allows to open the **Points measurement** window only with two images, which contain marker position in **Preview** window ()

10.3.2. The “Points measurement” window

General information

In order to measure coordinates of triangulation points (tie and GCP) in manual mode and editing points coordinates with errors obtained after automatic measuring of tie points coordinates, the system provides the **Points measurement** window.

To open the **Points measurement** window, perform one of the following actions:

- [optional] click the  button in the **Points catalog** window toolbar, to open the **Points measurement** window with initial images, which contain marker position in **Preview** window;
- [optional] click the  button in the **Points catalog** window toolbar, to open **Points measurement** window with initial images, which contain point selected in **Points catalog** / **Preview** windows.

The **Points measurement** window represents a set of two windows – the main **Points measurement** window and the **Triangulation points** window.

The main **Points measurement** window displays selected images in separate windows and contain tools used to perform triangulation points measurement. The **Triangulation points** window is a catalogue of all triangulation points along with their measurements data and contains tools for work with points catalogue.

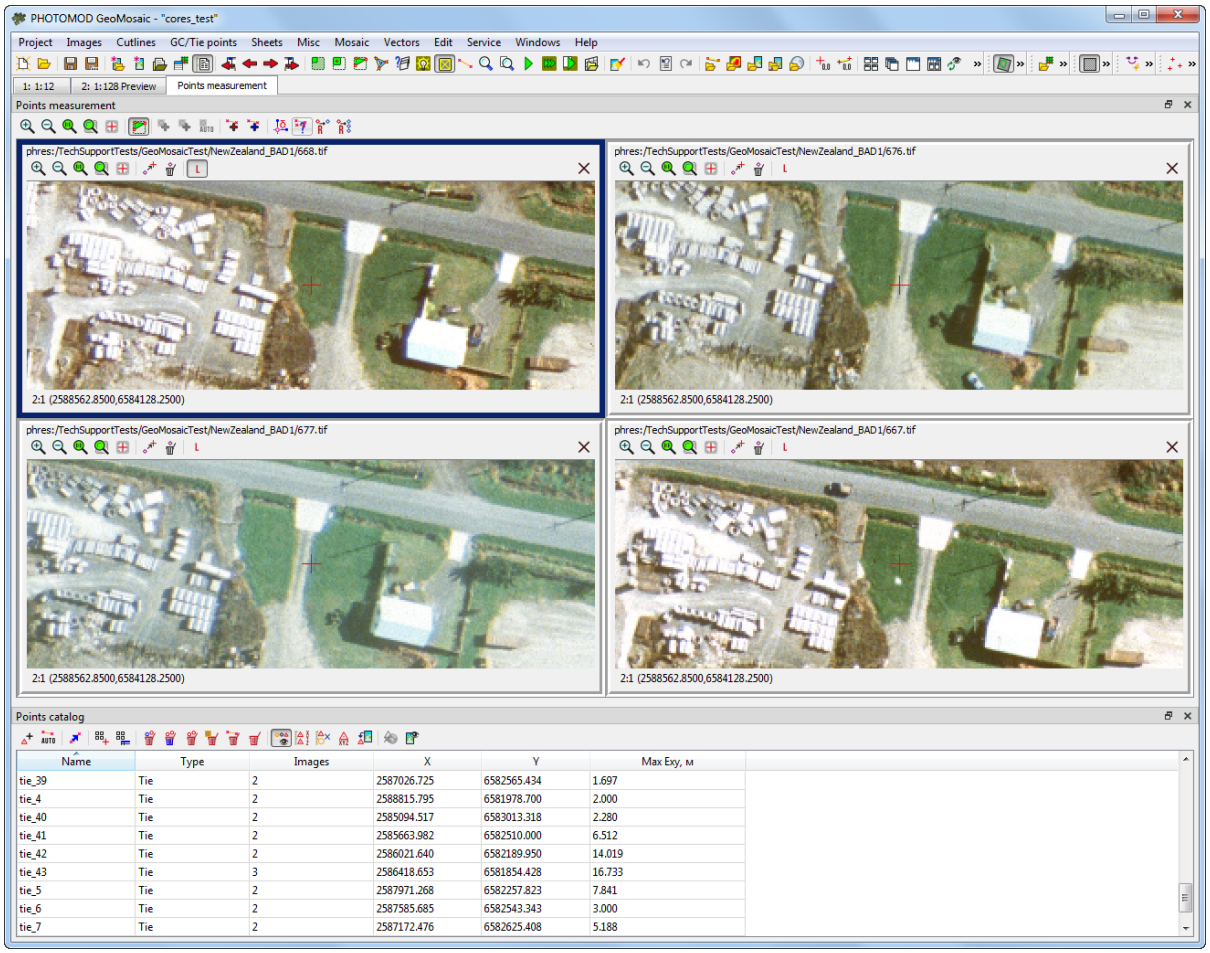


Fig. 50. The “Points measurement” window

A work in the **Points measurement** and **Triangulation points** windows is synchronized in the following way:

- when choosing a triangulation point *on one of the images using mouse double click* the system automatically starts search for selected point on the opened images of the window and search of appropriate point on the terrain, if the point is not measured on the image. Besides, the point will be also automatically highlighted in the triangulation points catalogue;

- when choosing a triangulation point *in a catalogue using mouse click* the point will be shown on opened images of the window automatically, if the point is measured on these images and/or a search of appropriate point on the terrain, if the point is not measured on opened image;

- when choosing a triangulation point *in a catalogue using mouse double click* all images where the point is measured are opened automatically (marker is located to the place ofmeasurement);

- filtering of display of different points types in catalogue and on opened images is also synchronized.

When the window is opened marker is placed to estimated position of the point.

Synthetic points are not displayed in **Points measurement** window.

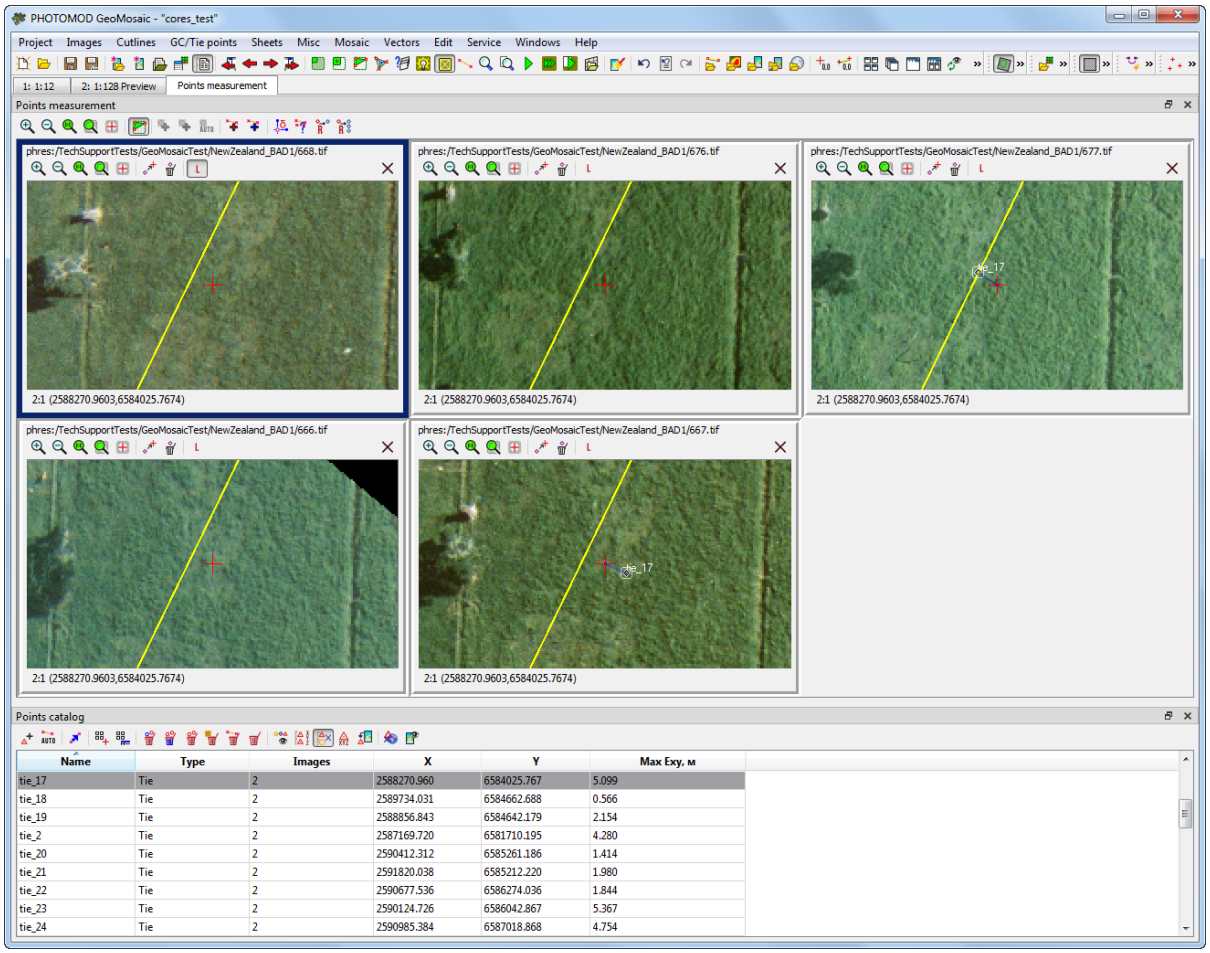


Fig. 51. Search for a point on terrain with measured coordinates and without measured coordinates

The “Points measurement” window workflow

The main part of the **Points measurement** window is used to measure/edit triangulation points on project images with or without correlator.

It contains the following interface elements:

- the main toolbar, that is used to apply different operations *to all opened images*. The toolbar contains buttons used to manage images zoom, images selection for measurements, measuring/editing of triangulation points coordinates and transfer of GCP from georeferenced maps;

- windows of opened images, each of them display an image and its name, and contains its own toolbar and status bar.

During triangulation points measurement in the **Points measurement** window the following concepts are used in the system:

- *The active image* – image displayed in the window selected by mouse click on image window. The *active* image window is highlighted by blue frame;
- *The "left" image* – a status assigned to one of opened windows, that is used to correlate other images with this one during measurement of tie points using correlator.

To define one of opened images as a "left" one (including active image), click the L button located in the toolbar of this image.

Fig. 52. The main part of the Points measurement window

Table 13. Toolbar of the Points measurement window

Buttons	Functions
	to zoom in an image by one step (*)
	to zoom out an image by one step (/)
	to fit to page data of opened layers (**Alt+Enter**)
	to fit to page data of opened layers (**Alt+Enter**)
	to center image by marker in working area of 2D-window
	to hide/show *cutlines* in windows of opened images
	to measure ground control point in manual mode without correlator
	to measure ground point in semi-automatic mode using correlator

Buttons	Functions
	to run automatic search and measurement of GCP on the whole images block using correlator
	to measure tie point in manual mode without correlator
	to measure ground point in semi-automatic mode using correlator
	to edit a measurement of selected tie/GC point
	to setup correlator parameters used for tie/gc points measurement in semi-automatic or automatic mode
	to correlate the *active* image with the *"left"* one to add a new tie point using correlator (see the "Manual measurement of tie points coordinates" chapter in "Aerial triangulation" User Manual)
	to correlate all opened images with the *"left"* one to perform measurement of new tie point coordinates using correlator (see the "Manual measurement of tie points coordinates" chapter in "Aerial triangulation" User Manual)

Windows of opened images

Each of project images opened in the **Points measurement** window is displayed in a separate child window.

One of the images windows is the *"left"*, another is *active* (see above). The "left" window may be also an active window at the same time. Images shown in the "left" and active windows are used for correlation during tie points measurement.

When the **Points measurement** window opens, the images containing selected point are opened in viewing windows automatically.

Each child image window contains the following interface elements:

- buttons of upper toolbox used to work with image:
  -  – to zoom in an image by one step (*****);
  -  – to zoom out an image by one step (*/*);
  -  – to fit to page data of opened layers (**Alt+Enter**);
  -  – to display data in 1:1 scale, when one pixel of the image corresponds to one pixel on the screen;
  -  – to center image by marker in working area of 2D-window.
  -  – allows to move and add selected point to marker's position;
  -  – allows to remove measurement results for point selected on image;

- L – allows to select image as a “left” one, with which the rest images will be correlated, if tie points coordinates were measured using correlator.

- working area used to display image, its name and path in the resources of the active profile in the upper left part;

- the status bar displaying image zoom ratio, marker position coordinates (in pix and mm).

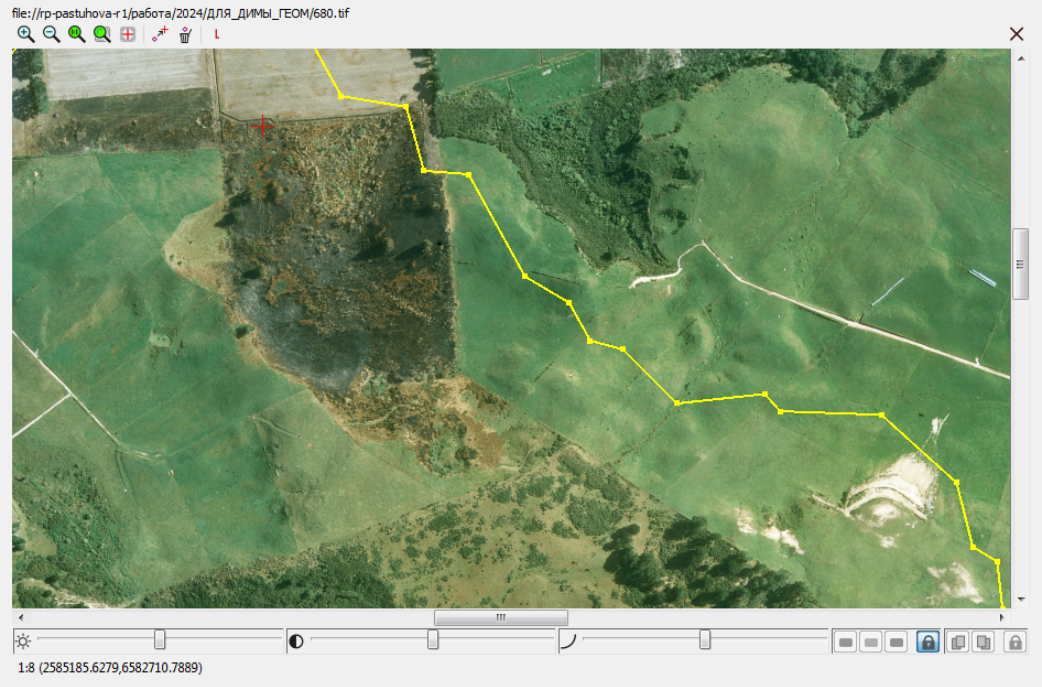


Fig. 53. Image window (the scrollbars and panel used to adjust the image brightness, contrast and gamma-correction are displayed)

To display the panel used to adjust the image brightness, contrast and gamma-correction for a single image or both images of a stereopair use the **Shift+F8** shortcut.

Use **left mouse button** to select the image.

The , , sliders are used to adjust a brightness, contrast and gamma-correction of a stereoimage. Tools located in the right part allow to select the color channels, which correction settings will be applied to.

It is possible to setup parameters for all channels at once if the button is pressed down, otherwise the system allows to setup individual channel.

Fig. 54. Panel used to adjust image brightness and contrast

To restore brightness and contrast settings to default values, right click the settings panel and select the **Reset** item in drop-down menu.

Brightness, contrast and gamma settings are not restored after the restart.

The **Ctrl+F8** shortcut allows to show/hide scroll bars in the active image window.

To move an image in the window the system provides the *panoramic mode* – moving an image using mouse move along with pressed **Alt** key.

10.3.3. The “Reference map” window

Georeferenced external data (raster and web-maps) for the same terrain as project images, are used as a basis to obtain GCP coordinates and measurement of the GCP on project images.

Main purpose of the **Reference map** window – load of georeferenced data in order to use them for adding GC points and measurement their coordinates on project images.

To open the **Map** window, open the **Points catalog** window and click the  button of the window toolbar.

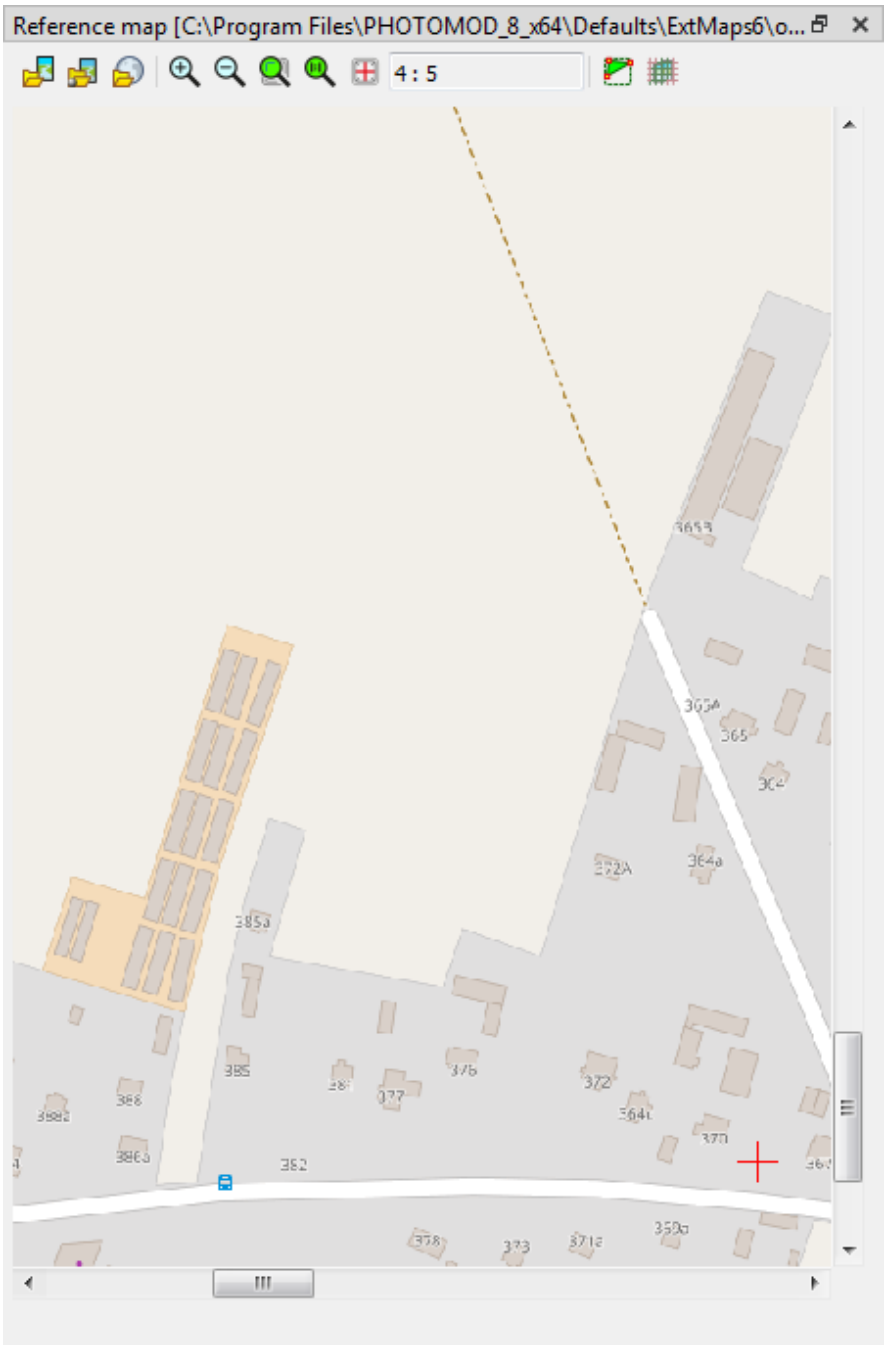


Fig. 55. The Reference map window

In addition to the reference data itself, the work area of the **Reference map** window can also display some layers open in the 2D window, such as sheets and cutlines.

There is a toolbar in the top of the window. In the status line of the **Reference map** window the marker's position coordinates on the georeferenced map are shown.

It is possible to move the whole image in the working area of the **Reference map** window in panning mode by moving mouse with pressed left button along with holding pressed the **Alt** key.

Table 14. The Reference map window toolbar

Button	Functions
	to open a window used to select a raster map file located out from active profile resources, which have one of the raster formats supported by GDAL library
	to open a window used to select a raster map file from active profile resources
	to open a window used to select a source of geospatial data of WMS format and to load web-maps, located on specified area
	to manage a zoom of the whole image of the window working area (see the Section 10.3.2). The 1:1 field is used to display a current zoom
	to center image in working area by marker (**F7**)
	позволяет показать/скрыть *листы*
	позволяет показать/скрыть *порезы*
	allows to select image as a “left” one, with which the rest images will be correlated, if tie points coordinates were measured using correlator

Prepare and load georeferenced data

The system supports using of the following georeferenced data: raster maps and web-maps to acquire GCP data. Prior to use georeferenced maps perform the following actions:

1. Prepare the input data in the following way:

   - for raster data specify a folder out of active profile resources to place a raster format file supported by GDAL library and georeference file with the same name.

     The need for a separate georeference file depends both on the raster file format on the whole and characteristics of a particular file, due to its origin.

     Thus, for example, GeoPDF and GeoTIFF images initially contain georeference data, what, however, is not true by default for an arbitrary file with `*.pdf` or `*.tiff` extensions.

     In turn, formats of some images (for example, `*.bmp`) do not provide for including georeference data and require obligatory separate georeference files.

     The system allows to georeference scanned cartographic raster material using points with known geodetic coordinates (see the Appendix B).

   - in case of working with a web map – make sure that the Internet connection is available.

2. Open the **Points catalog** window;

3. Open the **Points measurement** window;

4. Open the **Reference map** window;

To load a raster map, perform the following actions:

1. Click the button. The **Loading images** window opens;

2. Select a raster map file and click the **Open** button.

To load a raster map from active profile resources, perform the following actions:

1. Click the button. The **Open** window opens:

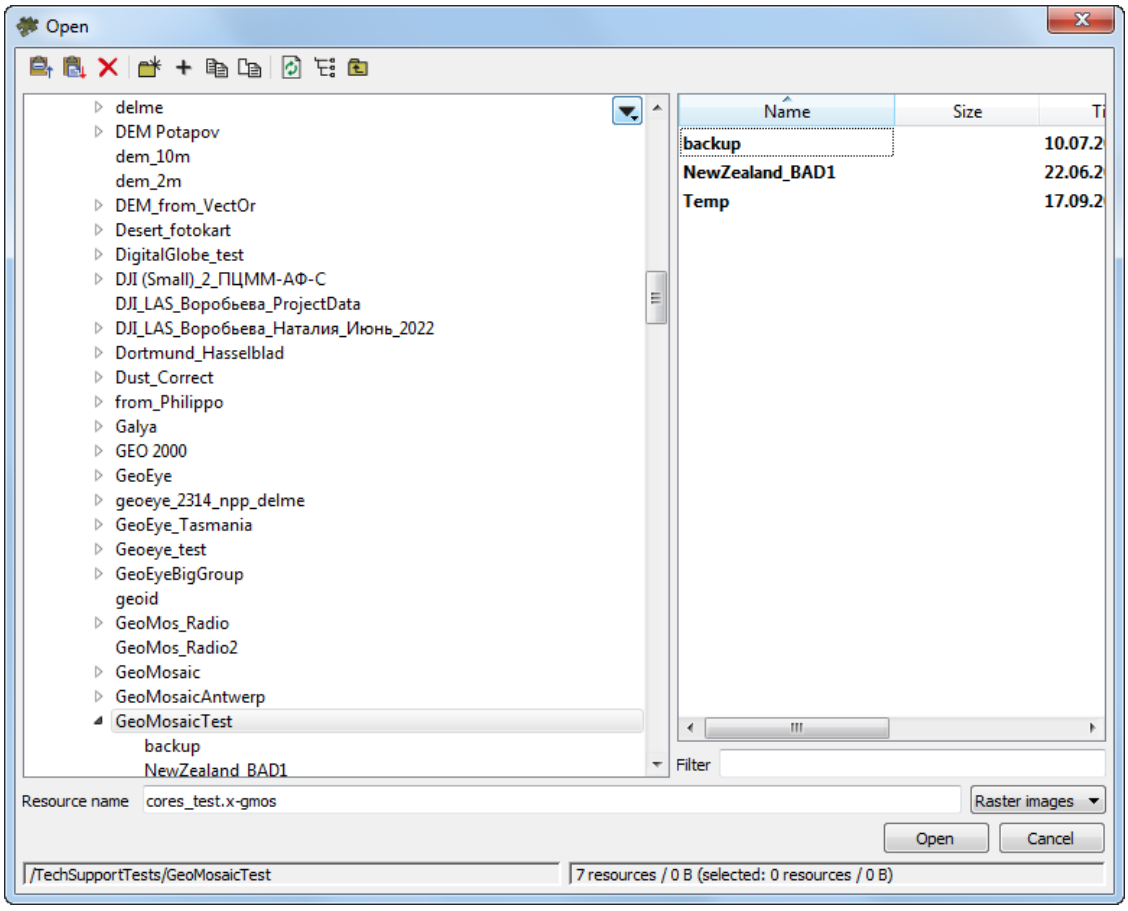


Fig. 56. Parameters of raster map loading

2. Select raster map file in active profile resources and click the **Open** button.

Perform the following actions to load a web-map to a project:

1. Click the button.

2. [optional] During the **Load web-map** window first launch, the **Parameters** window opens at first:

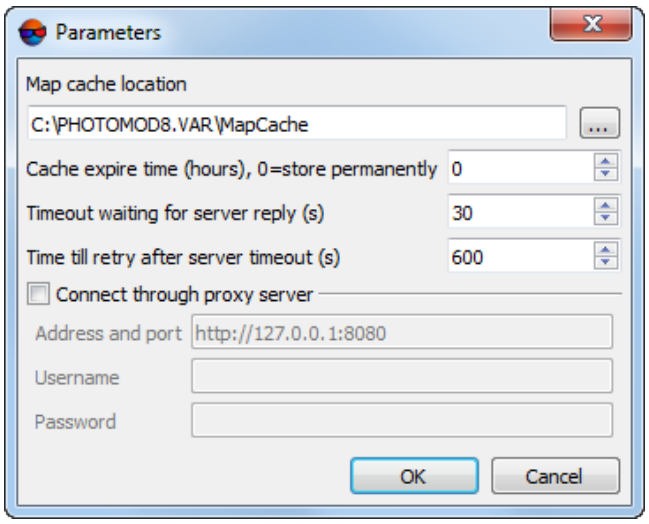


Fig. 57. Parameters of web-map loading

3. [optional] Setup parameters of the web-map loading.

4. Click OK. The **Load web-map** window opens.

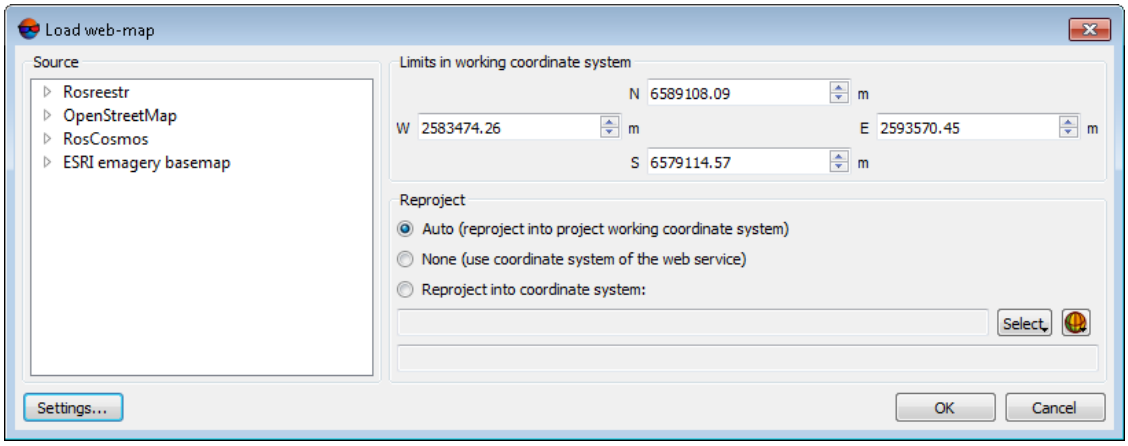


Fig. 58. Parameters of web-map loading

5. In the **Source** list select a source of georeferenced data:

   - `Rosreestr` – cadastral map of Russia produced by The Federal Service for State Registration, Cadastre and Cartography (Rosreestr).

     - `Base Map` – basic geography map;

- Cadastre Map.

- OpenStreetMap (OSM) – non-commercial free world map;
- RosCosmos;
- ESRI.

6. [optional] Define a working area to load a web-map.
7. In the **Reproject** section define a coordinate system of loaded web-map using the following way:
   - **Auto** – automatic transformation to coordinate system of a project;
   - **None** – use coordinate system of the web-service;
   - **Reproject into coordinate system** and specify necessary coordinate system.
8. Click OK.

10.3.4. GC/Tie points menu

The **GC/tie points** menu items, that are partially duplicated by the **GC/tie points** toolbar buttons, are used to measure ground control/tie points.

The **Ties** tab of the **Mosaic parameters** window purposes to setup options of using ground control and tie points for adjustment.

Table 15. Brief description of the GC/Tie points menu

Menu items	Function
Clear	to delete all tie/gc points from *Ground control and tie points* layer
Open	to open tie/gc points previously saved in vector file with *.x-data extension in active profile resources
Save	to save tie/gc points to vector file in active profile resources with the same name and *.x-data extension
Save as	to save tie/gc points to vector file in active profile resources with different name and *.x-data extension
Add ground control points	opens sub-menu for measurement of GCP in manual, semi-automatic and automatic modes
Add tie points	opens sub-menu for measurement of tie points in manual, semi-automatic and automatic modes
Remeasure	to edit a measurement of selected tie/gc point

Menu items	Function
Show windows by marker	opens 2D-windows with initial images, which contain marker position
Show windows by current point	opens 2D-windows with initial images, which contain selected tie point
Finish measurement	to close the 2D-windows with the source images and return to the **Preview** window for viewing the results of cutlines stitching by measured points
Show residuals	to display residuals reveals 'bad' points, having error vectors noticeably different from other points in size and direction
Create attributes with residuals	to create the `residual_tie` attribute having a value equal to a residual at this tie point
Delete by maximal residual	to remove blunders of tie/gc points automatic measurement: allows to reject those points, which measurement value results in shift of images relatively each other at distance more than specified (in meters)
Parameters	to setup correlator parameters used for tie/gc points measurement in semi-automatic or automatic mode
Information about a point	shows brief information about selected tie/gc point

10.4. Measurement of GCPs

Ground control points – a points with known geodetic coordinates and which are a source points in aerial triangulation. The program provides the option of using reference data for measuring GCPs on the source images – the *reference image* or different web-maps (in this case the internet connection is needed).

The *reference image* is the raster image on the same area, but with more accurate georeference, then source images of mosaic project. I.e the reference image is used as standard for measuring GCPs, from which is defined the correspondence between the source images. The coordinates of terrain point on the reference image is assigned the same terrain point on the source images.

General workflow on GCP transfer includes the following steps:

1. Load of georeferenced data (reference map);
2. Selection of terrain point on the map and search for the point on project images;
3. Transfer the point from the map – add/measure of point's coordinates on project images;
4. [optional] Editing of the GC point.

For GCP measurement it is necessary define in advance a type of transformation which will be applied automatically on edges of images block while GCP measurements are accumulating. Perform the following actions to do this:

1. Choose the **Mosaic › Parameters**. The **Mosaic parameters** window opens.
2. Set on the **Using of ground control and synthetic points** checkbox on the **Ties** tab.
3. In the **Images edges section** select: **No changing**, **2D-Shift**, **Projective**.
4. [optional] Set on the **Affected area** checkbox to limit influence of ground control point to adjustment and specify the value in meters.

If the **Affected area** checkbox is set of, maximal distance of ground control point influence is image border.

10.4.1. Addition ground control points in manual and semi-automatic modes

Perform the follows for defining correspondence between the source images by control point on reference image in manual or semi-automatic mode:

1. Open the **Points catalog** and **Reference map** windows in turn;
2. In the **Reference map** window, load a reference image or a web map:

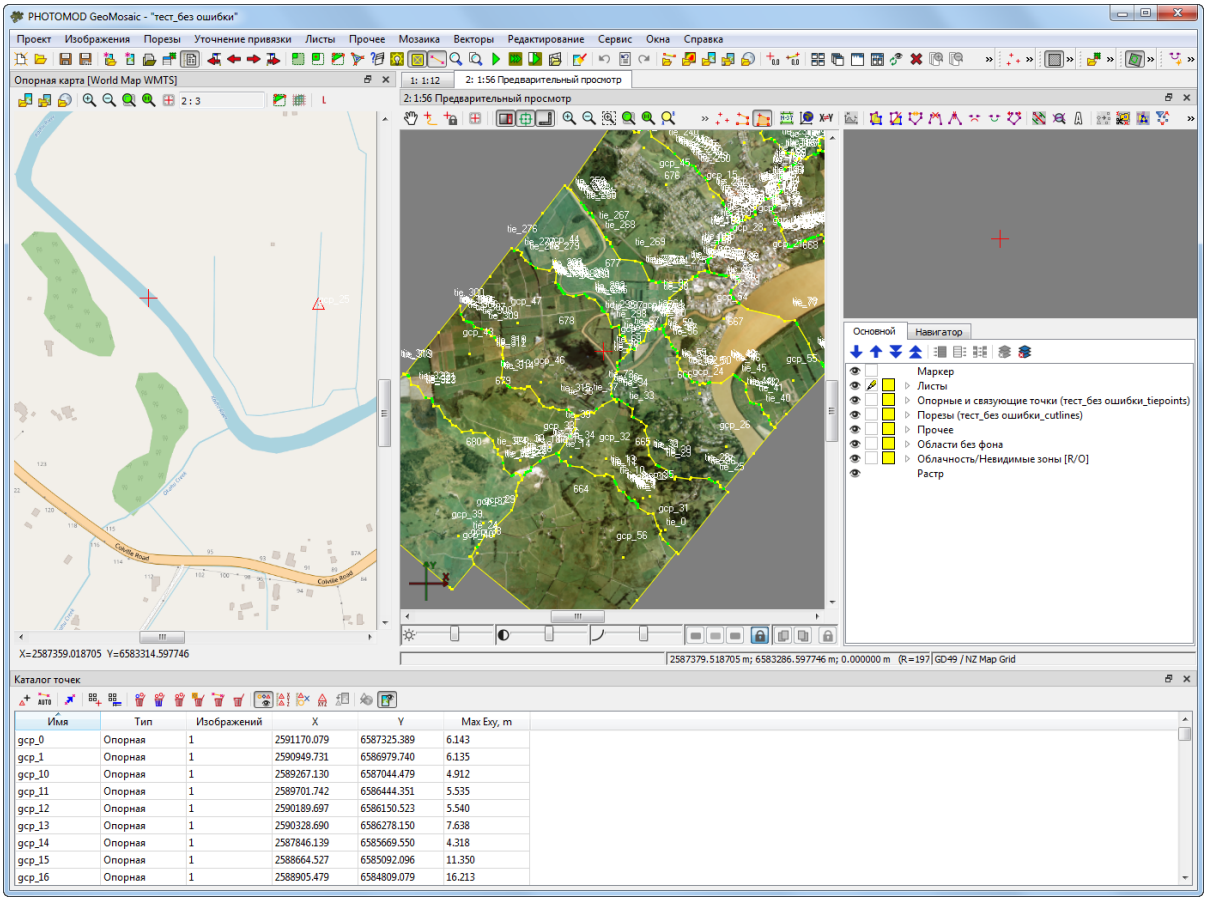


Fig. 59. Point catalog and Reference Map (with loaded web map) windows

3. In the **Reference map** window, find a place in the loaded reference data that is suitable for creating a GCp. Move the marker there. Without moving the marker, synchronize the marker position in the **Reference map** and **Preview** windows by double-clicking the **left mouse button** in the **Reference map** window;

4. Click in the main **Points catalog** toolbar. The **Points measurement** window opens:

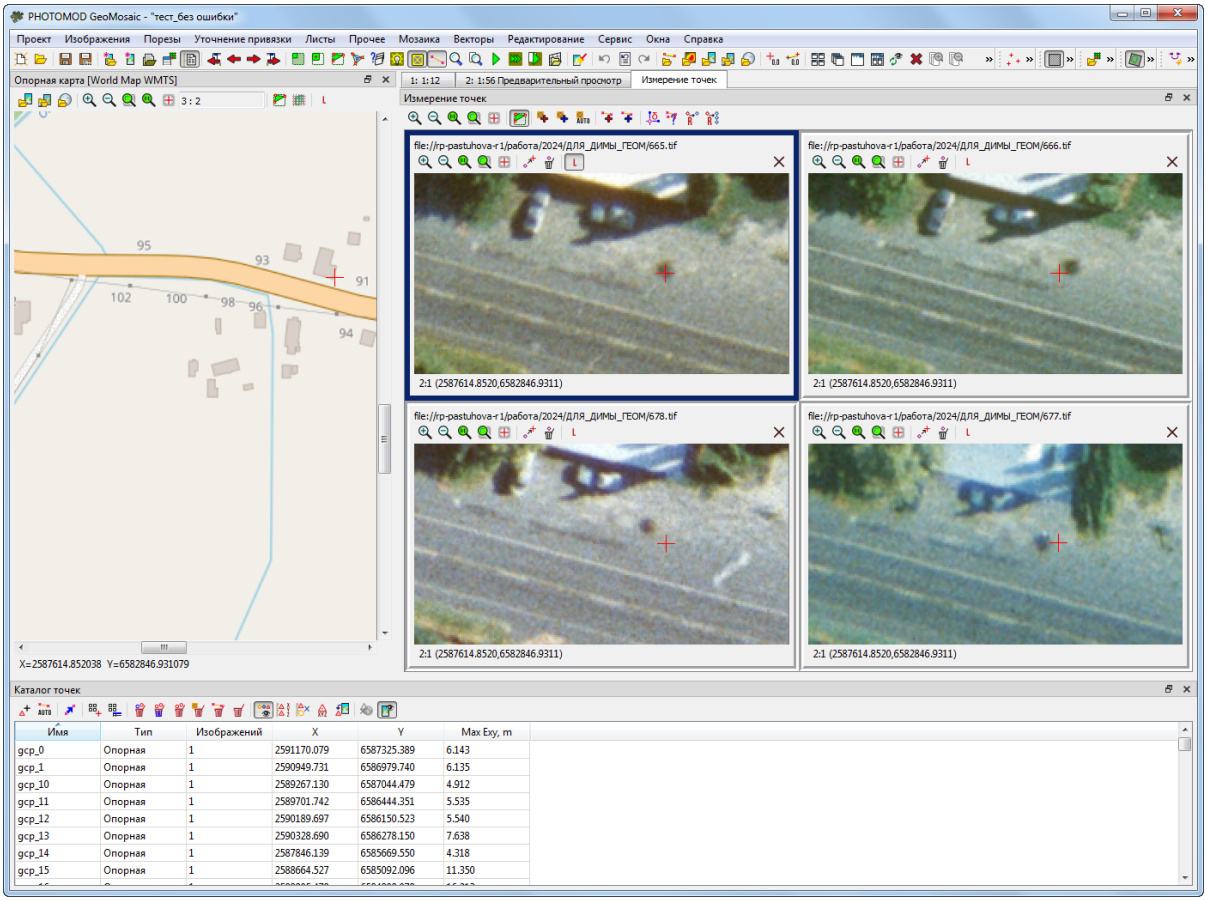


Fig. 60. Point catalog, Reference Map, and Measure points windows (opened after marker synchronization)

5. Correct the marker position in the windows of open images in the **Points measurement** window:

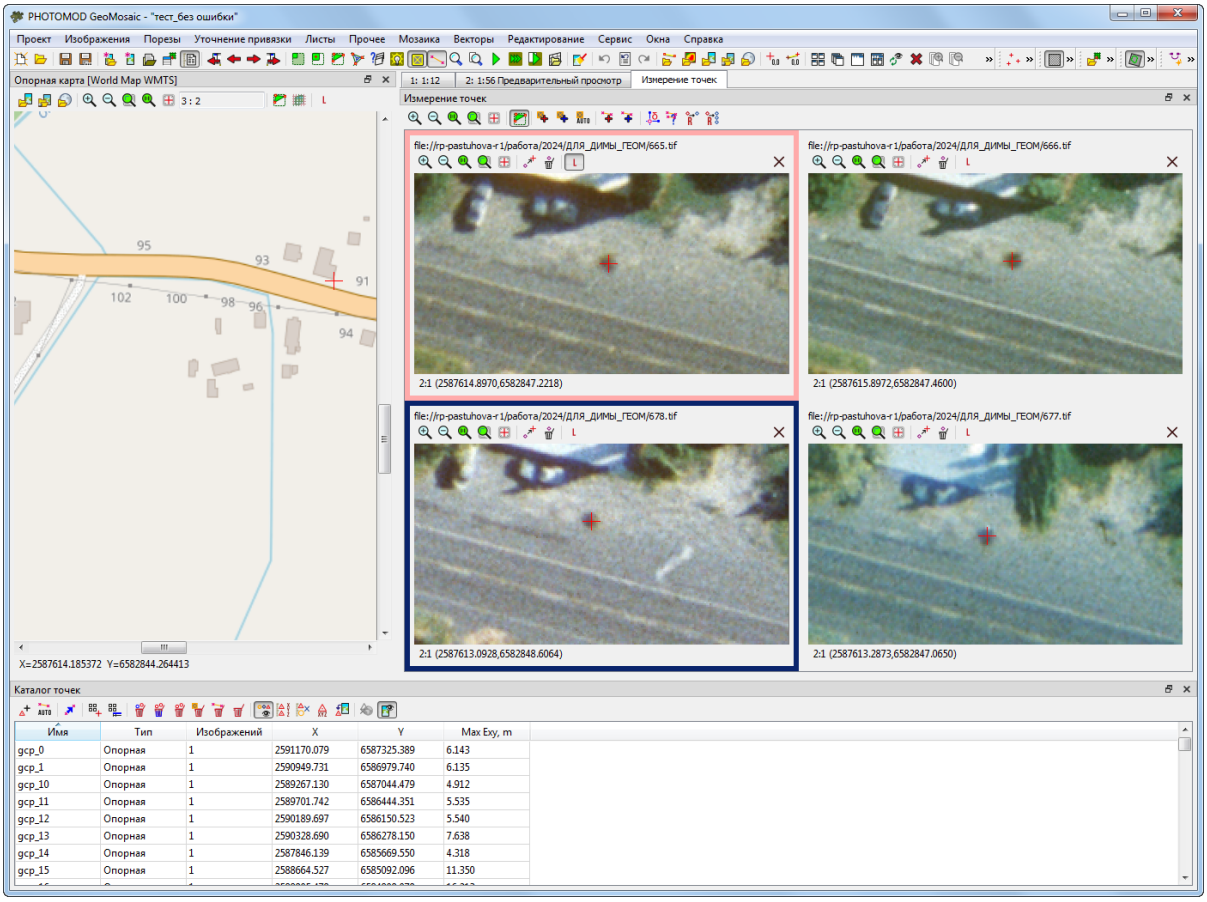


Fig. 61. Point catalog, Reference Map, and Measure points windows (corrected marker's position)

6. Perform one of the following actions to add GC point:

   - [optional] click the button of the **Points measurement** window toolbar to add point manually;

   - [optional] In case a raster image is used as reference data, the system provides for measuring GCPs in a semi-automatic mode using a correlator.

     It is recommended to set the Correlator parameters before the start working.

     [optional] click the L button in the **Reference map** window toolbar (to set the reference image as the "left" image) and then click the button of the **Points measurement** window toolbar to add point in semi-automatic mode.

     After correlation operation one of the following events will occur:

     ○ if the system failed to calculate correlation coefficient, the `Bad point` warning will appear. It may contain the error description:

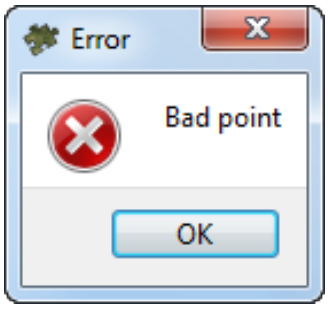


Fig. 62. The warning message

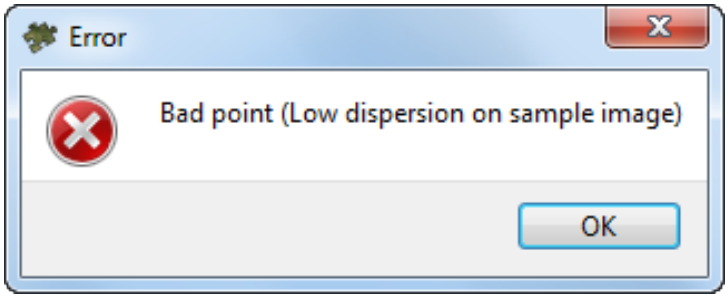


Fig. 63. The warning message

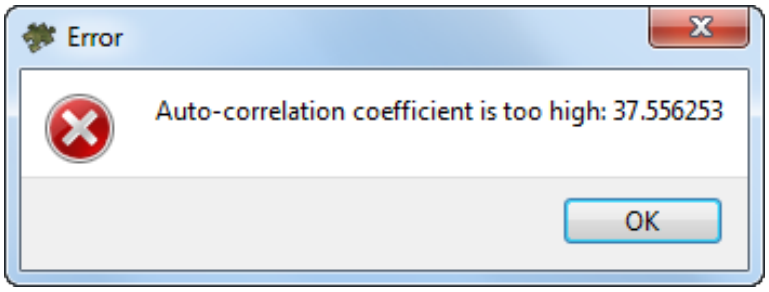


Fig. 64. The warning message

Max. auto-correlation coefficient (specified in **Ties** tab of the **Mosaic parameters** window) allows to control auto-correlation of a point, i. e. a degree of point's uniqueness in some its vicinity on the left image.

The more the auto-correlation radius value, the less the point's uniqueness and the more probable its incorrect comparison with the right image even when the correlation coefficient is high.

- if correlation coefficient is calculated successfully, the **New GCP** window opens. It allows to analyse correlation coefficients and make a decision whether to add a new GC point.

  The window displays created point **name** and calculated correlation coefficients:

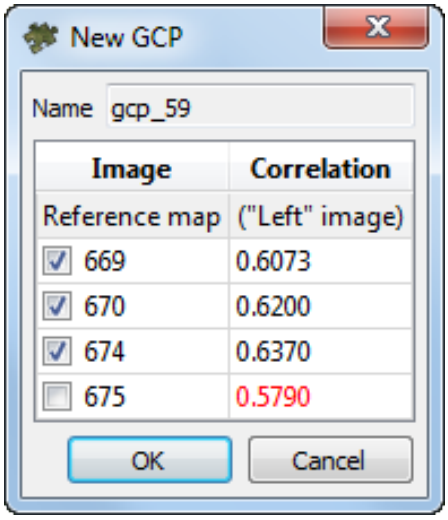


Fig. 65. Correlation of all opened images with the “left” image (reference raster)

Data display in the coefficients table depends on **Min. correlation** value, specified in the **Ties** tab.

To add a point select images in the list (set appropriate checkboxes) and click OK, otherwise click the **Cancel** button.

7. Repeat the steps described above, to measure another GC points. Hence a GC points are created on the sources image with coordinates taken from the reference image. The source images in the **Preview** window are refreshed taking into account the stitching by added points.

If needed, in order to refresh the **Preview** window, click of the *GeoMosaic* main toolbar

10.4.2. Automatic searching of ground control points

The program provides opportunity of search and add Ground Control points on the reference and source mosaic project images in the automatic mode (in case if the raster reference data is used). For automatic searching of corresponding points on the reference image and source images of mosaic project perform the following actions:

It is recommended to set the Correlator parameters before the start working.

1. Sequentially open the **Points catalog**, **Reference map** and **Points measurement** windows;

2. Load reference raster image in the **Reference map** window. Click the L button in the **Reference map** window toolbar, to set the reference image as the “left” image;

3. Click the AUTO button on the **Points measurement** window toolbar;

4. [optional] If the *Grid* layer has not been previously created, it is requested to do it:

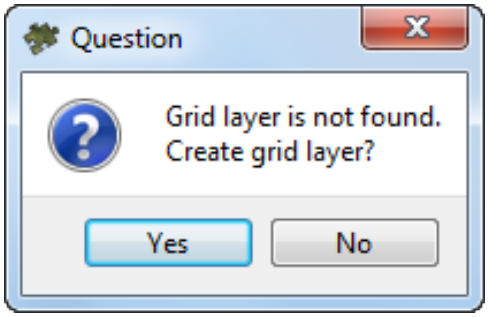


Fig. 66. The dialog box

5. Click **Yes** to setup the **Grid properties** in appropriate window (see the “Regular grid of nodes” chapter in “DTM Generation” User Manual):

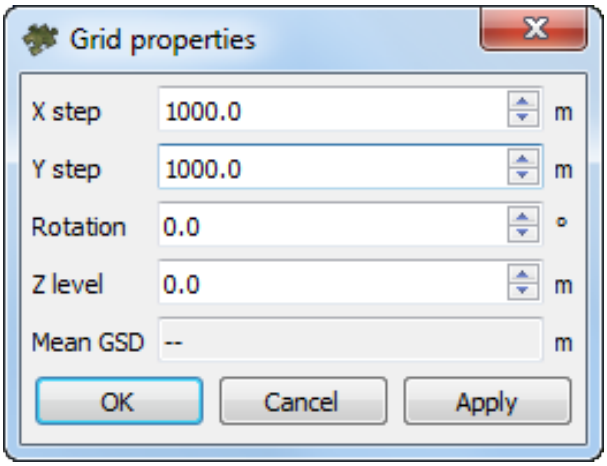


Fig. 67. The Grid properties window

Click **Ok** to create a work area of the grid.

6. The **Points measurement parameters** window opens:

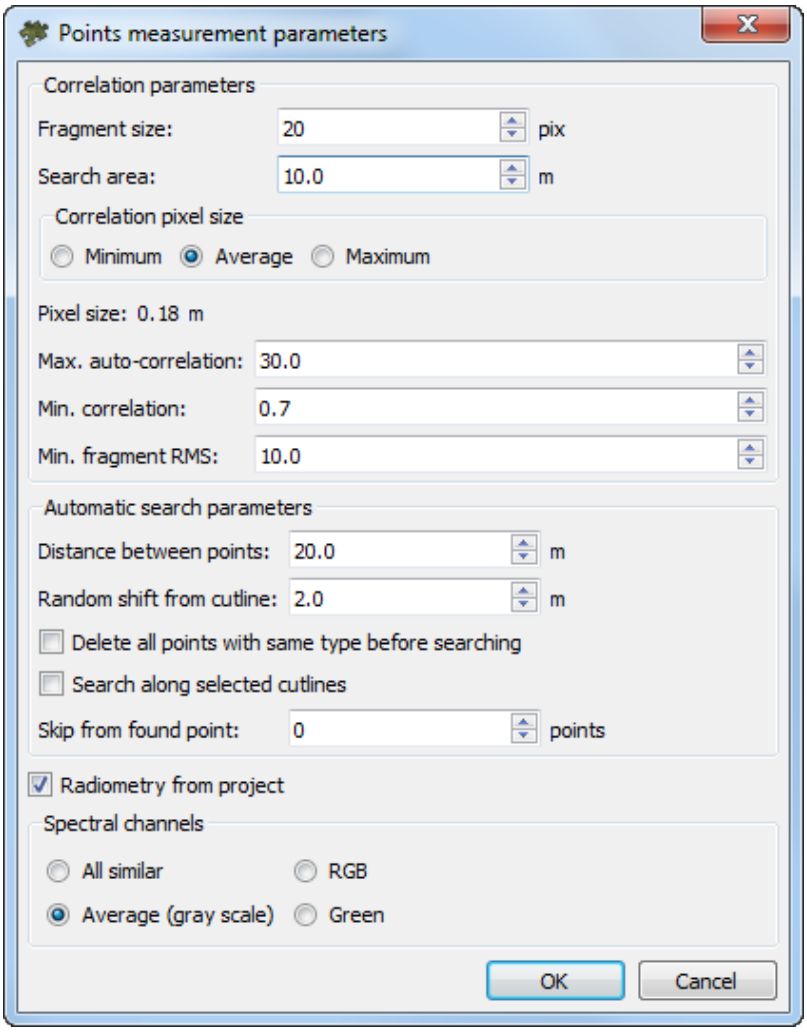


Fig. 68. Points measure parameters window

7. Set the correlator parameters;
8. Click OK to start searching process;
9. [optional] in order to delete all existing GC points before searching, click **Yes**.

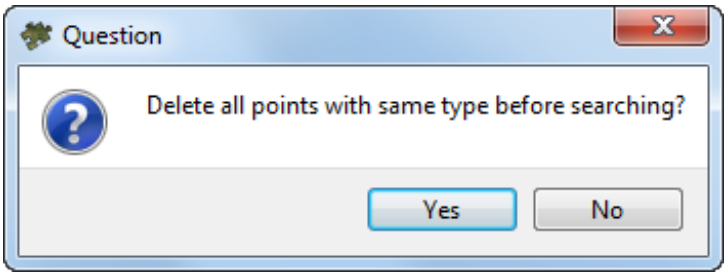


Fig. 69. The dialog box

10.5. Tie points measurement

Tie points – the same points on the terrain on adjacent project images. Tie points measurement consists in defining correspondence between projections of the same terrain point on two or more source images of the mosaic project in the vicinity of cutlines.

Tie points are solely used for transforming source images exactly close to cutline. It is not recommended to measure the tie points far away from the cutlines to avoid the rough transformation of images. Also, it is not recommended measuring points on the extended objects (for example, on the roads), buildings and low-contrast areas.

For tie points measurement it is necessary define in advance a type of transformation which will be applied automatically on edges of images block while tie points measurements are accumulating. Perform the following actions to do this:

1. Choose the **Mosaic › Parameters**. The **Mosaic parameters** window opens.
2. Set on the **Using of tie points** checkbox on the **Ties** tab.
3. In the **Images edges section** select: **No changing**, **2D-Shift**, **Projective**.
4. [optional] Set on the **Affected area** checkbox to limit influence of ground control point to adjustment and specify the value in meters.

If the **Affected area** checkbox is set of, maximal distance of ground control point influence is image border.

10.5.1. Addition tie points in manual and semi-automatic modes

Perform the follows for defining correspondence between the source images in manual or semi-automatic mode:

1. Create cutlines;

A pre-requisite for measurement of tie points is the presence of cutlines created.

2. Open the **Points catalog** window;
3. Select the point in the vicinity of cutlines in the **Preview** window set the marker in this place to add the tie point.
4. Click the  button it the **Points catalog** window toolbar. The **Points measurement** window opens:

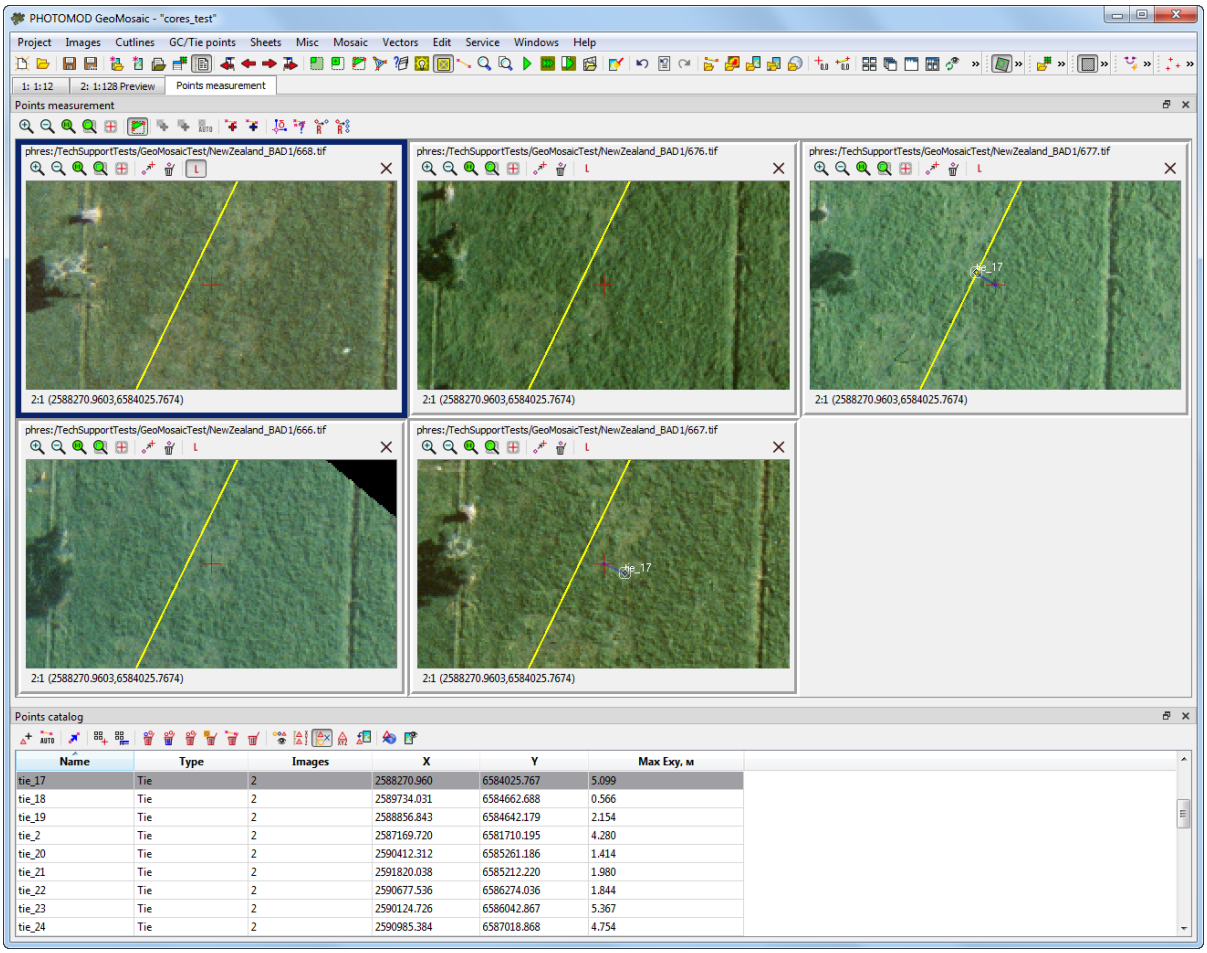


Fig. 70. The Points catalog and Points measurement windows

5. Edit the marker position in the windows with opened images;

6. Perform one of the following actions to add tie point:

   - [optional] click the button of the **Points measurement** window toolbar to add point manually;

   - [optional] click the L button in the one of the windows with opened images toolbar (to set this image as the “left” image) and then click the button of the **Points measurement** window toolbar to add point in semi-automatic mode.

     It is recommended to set the Correlator parameters before the start working.

     After correlation operation one of the following events will occur:

     - if the system failed to calculate correlation coefficient, the `Bad point` warning will appear. It may contain the error description:

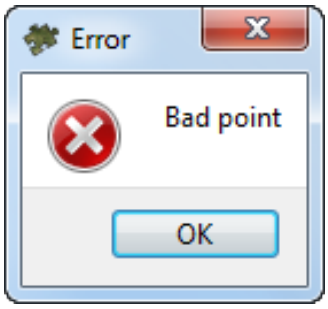


Fig. 71. The warning message

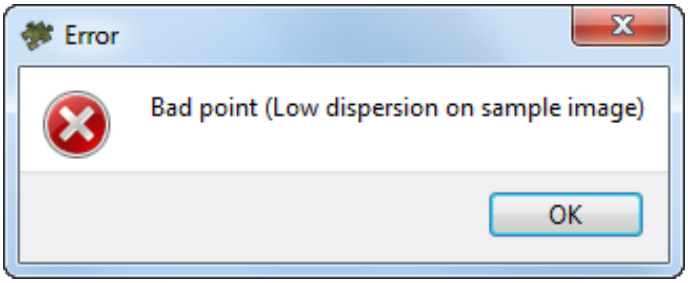


Fig. 72. The warning message

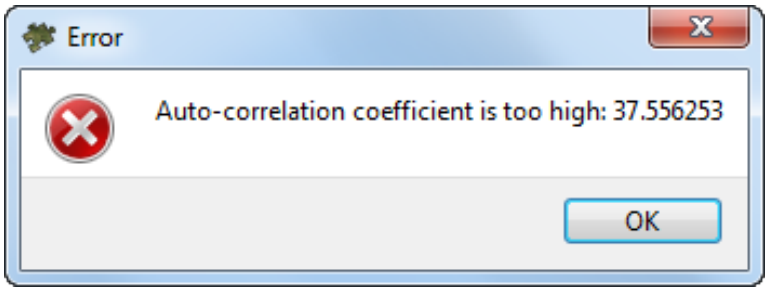


Fig. 73. The warning message

Max. auto-correlation coefficient (specified in **Ties** tab of the **Mosaic parameters** window) allows to control auto-correlation of a point, i. e. a degree of point's uniqueness in some its vicinity on the left image.

The more the auto-correlation radius value, the less the point's uniqueness and the more probable its incorrect comparison with the right image even when the correlation coefficient is high.

- if correlation coefficient is calculated successfully, the **New tie point** window opens. It allows to analyse correlation coefficients and make a decision whether to add a new GC point.

  The window displays created point **name** and calculated correlation coefficients:

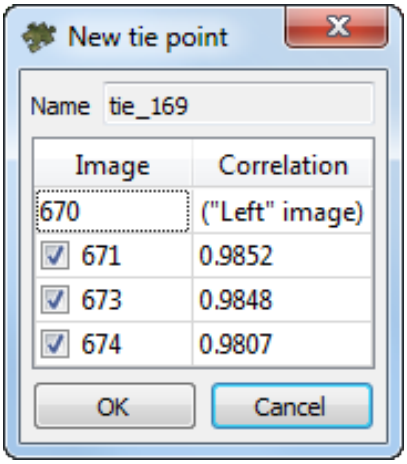


Fig. 74. Correlation of all opened images with the “left” image

Data display in the coefficients table depends on **Min. correlation** value, specified in the **Ties** tab.

To add a point select images in the list (set appropriate checkboxes) and click OK, otherwise click the **Cancel** button.

7. Repeat the steps described above, to measure another tie points. The source images in the **Preview** window are refreshed taking into account the stitching by added points.

If needed, in order to refresh the **Preview** window, click of the *GeoMosaic* main toolbar

10.5.2. Automatic mode measurement of points

The automatic mode implies the automatic searching of tie points using correlator on all block images of project in the vicinity of cutlines.

Perform the following actions for measuring of tie points in automatic mode:

1. Create cutlines.

A pre-requisite for measurement of tie points is the presence of cutlines created in the Cutlines layer. Otherwise, the message about that cutlines must be created is shown. And measuring of tie points is not possible.

2. Choose the **GC/Tie points| Add tie points › Add automatically** for start automatic measuring of tie points or click the button in the **Points catalog** window toolbar. The **Points measure parameters** window opens.

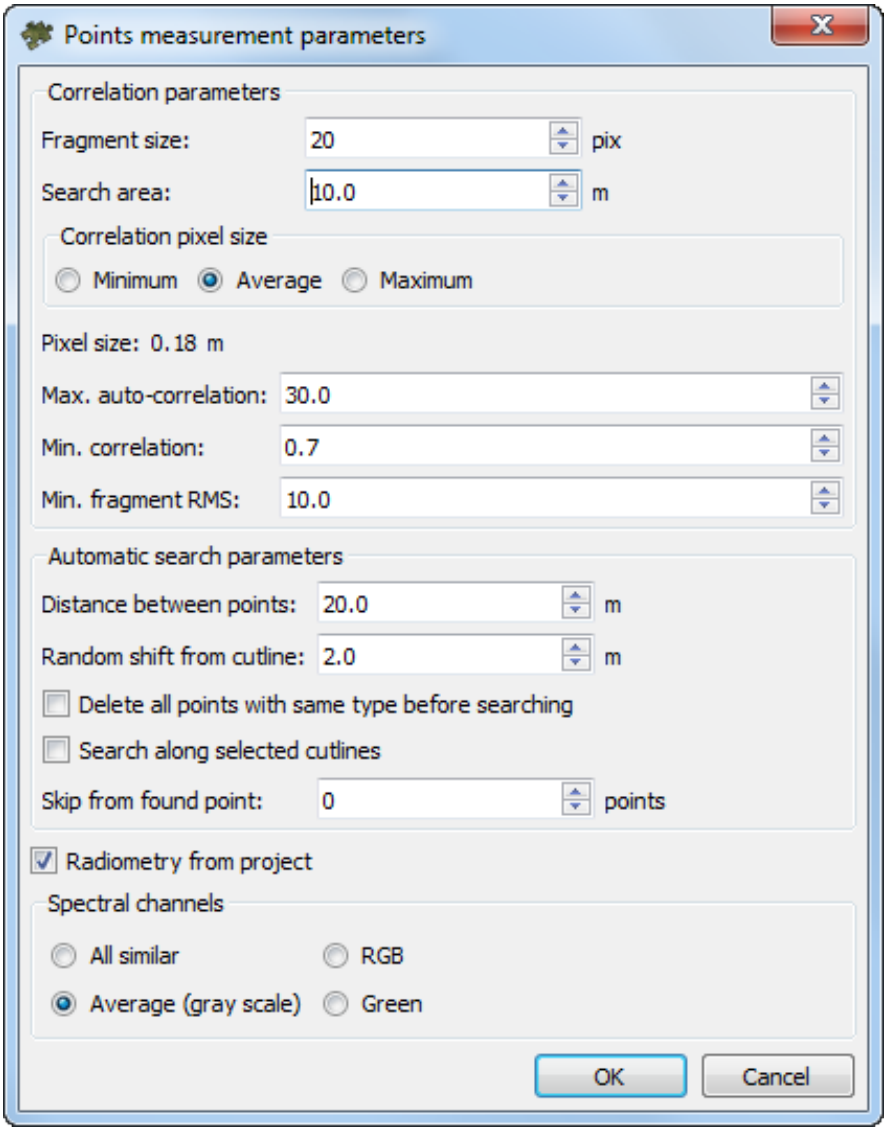


Fig. 75. Points measure parameters window

3. Set the correlator parameters.

4. Click OK to start searching process.

After points measurements the **Using of tie points** mode is set on automatically.

Perform the following actions for measuring points in the vicinity of cutlines in the distributed processing mode:

1. Change settings and run the distributed processing server/client (see the “Distributed processing” chapter in the “General information about system” User Manual).

2. Click the **Distributed processing** button. The **Ties points distributed processing** windows opens.

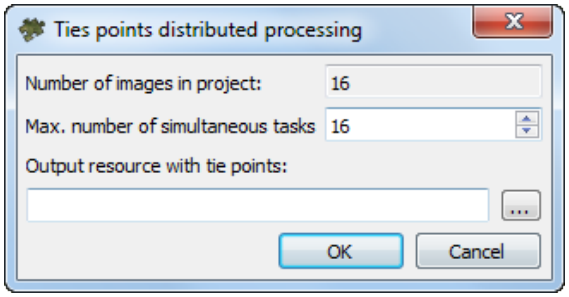


Fig. 76. Parameters of distributed processing for measuring tie points

   The **Number of images in project** displays number of created cutlines in the mosaic project.

3. Set the **max. number of simultaneous tasks**.

4. Define the output file name and path.

5. Click OK. Distributed processing tasks are created and the system shows a message about number of created tasks.

Estimate the stitching quality of cutlines in the result of the automatic measuring of tie points in the **Preview** window. If necessary, edit the measurement of added tie points.

10.6. Synthetic points employment

Synthetic point are a highly specialized type of points used by *PHOTOMOD GeoMosaic* and are used only in special cases (for example, when it is impossible to use reference data and/or when processing a project containing images with significant distortions, which are caused, for example, by mountainous terrain).

Unlike GCPs or tie points, which transform an image according to the settings specified in the **GC/tie points** tab of the **Mosaic** parameters window, synthetic points allow you to shift an entire image manually according to the shift direction and range of the synthetic point created in advance by the user.

Manual image shift allows you, first of all, to achieve its *visual* correct arrangement; for example, correctly align elongated objects (rivers, roads, etc.), especially when the appearance of the resulting mosaic is the most important.

Thus, synthetic points are partly, very conditionally, similar in purpose to GCPs, but, unlike “real” GCPs, they cannot improve the accuracy of the output data. Synthetic points affect the location of images only when the **Using of ground control and synthetic points** checkbox is set (see Section 13.2.4).

Correct shifting of an image, in exact accordance with the direction and range of displacement of the synthetic point, is possible only in the case of no influence on the image from other points—synthetic, GCPs, or tie points.

Therefore, the most optimal scenario for using synthetic points is their separate (or primary) use, with subsequent measurement of points of other types, for example, tie points (see below).

10.6.1. Operation procedure

To create a synthetic point and use it to transform a project's image, perform the following:

1. Open the **Points catalog** window clicking in the *PHOTOMOD GeoMosaic* main toolbar;
2. In the **Preview**, find an area on the project's image block that could benefit from manual transformation using a synthetic point;
3. Move the marker to the desired position:

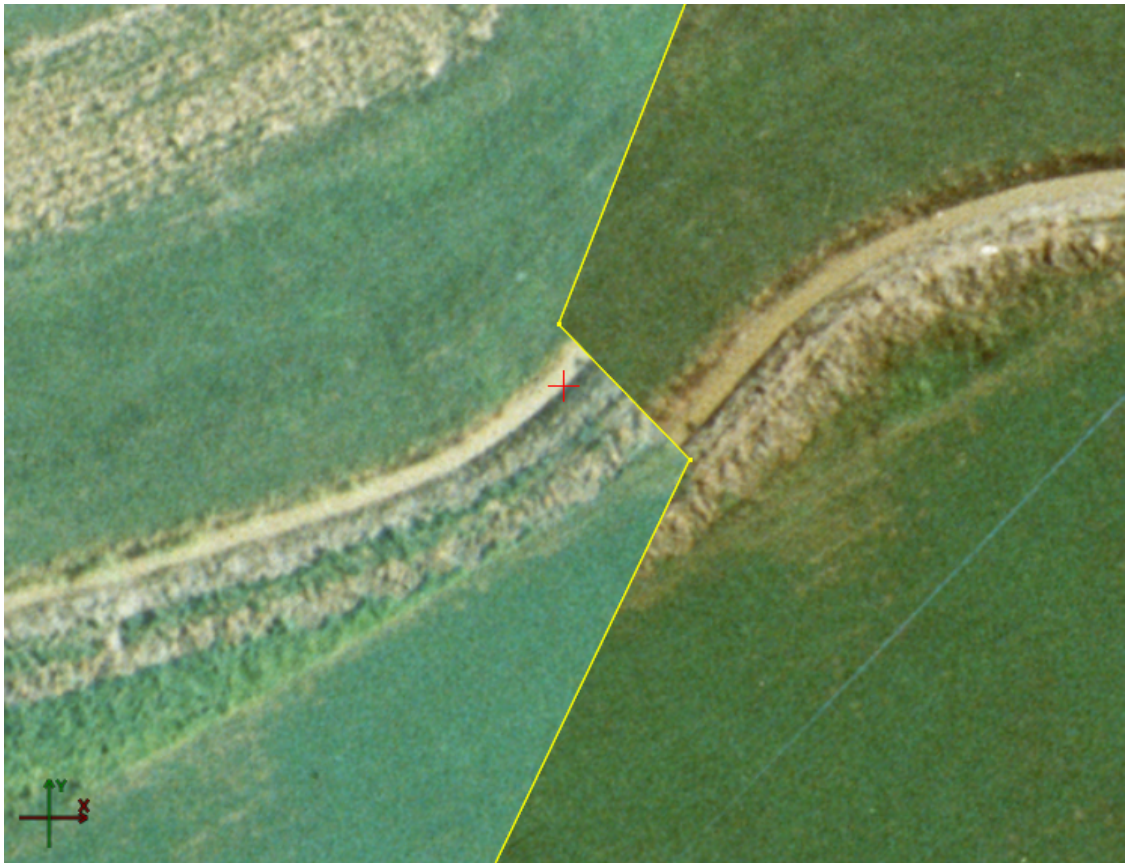


Fig. 77. The elements of an extended object (road) are poorly aligned with each other in adjacent images

4. Click in the **Points catalog** toolbar. The created point is displayed in the **Points catalog** and **Preview** windows

The **Using of ground control and synthetic points** mode is enabled automatically.

A synthetic point can be linked to a single image. The point's belonging to the image is determined by its location relative to the cutlines during its creation. The creation of a synthetic point leads to a certain transformation of the image

Fig. 78. A synthetic point is created

5. [optional] Double-click the **left mouse button** to select a synthetic point

6. While holding the **left mouse button** and **Ctrl**, move the synthetic point in the desired direction and to the required distance, based on the expected need to shift the image;

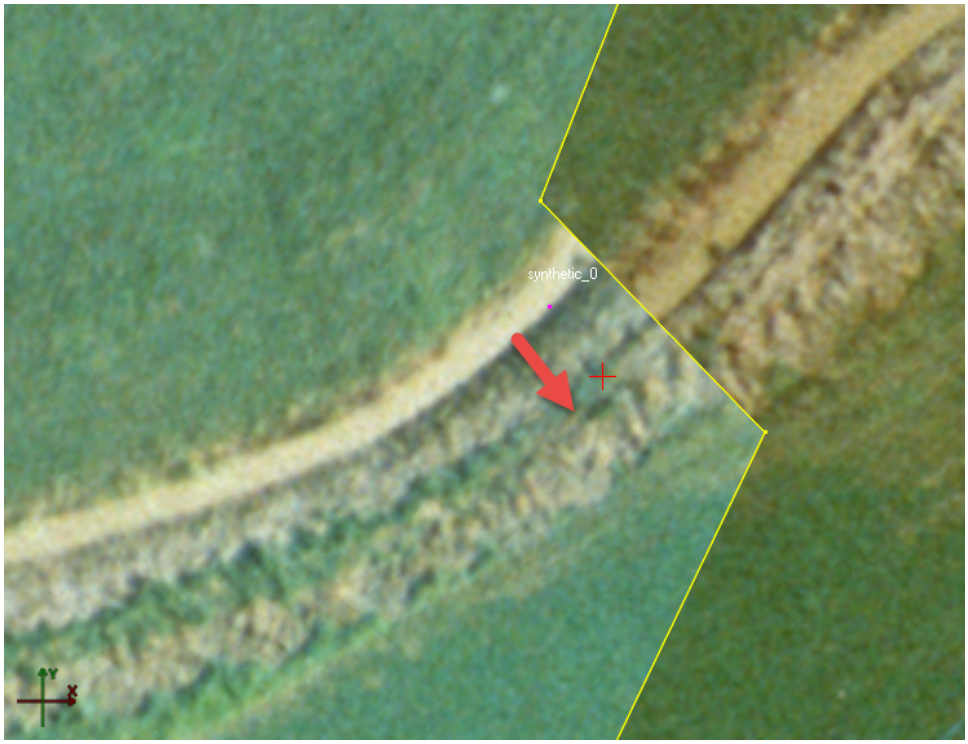


Fig. 79. Expected shift of the synthetic point

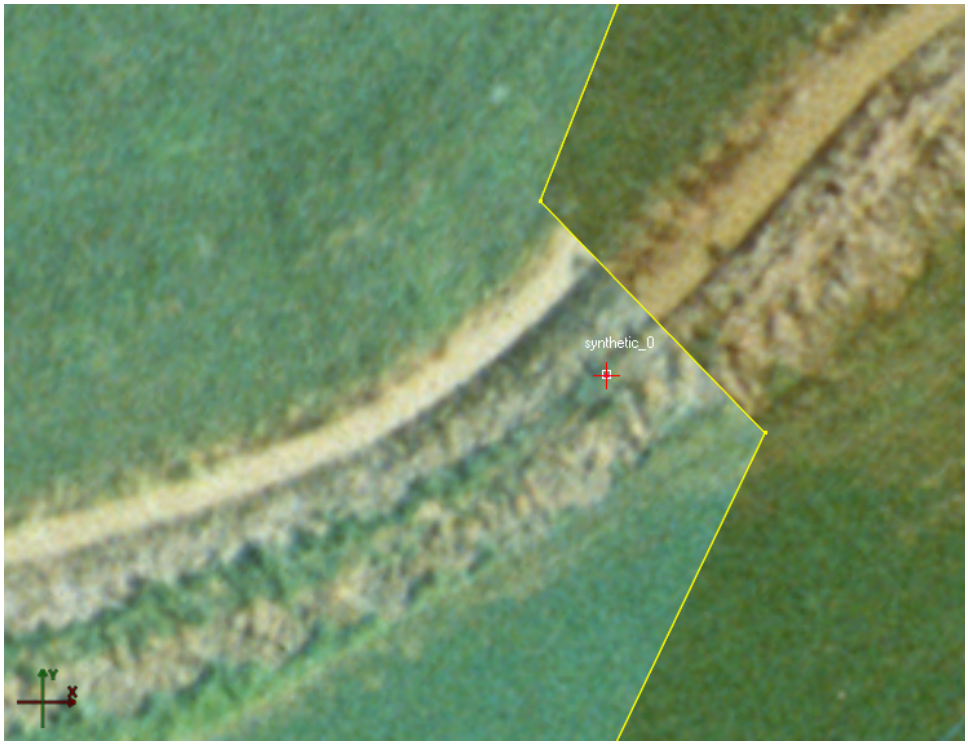


Fig. 80. The point was moved using standard vector object editing tools

7. Press **Enter**. The relevant image is reconstructed in accordance with the user-specified shift of the synthetic point.

If needed, in order to refresh the **Preview** window, click  of the *GeoMosaic* main toolbar.

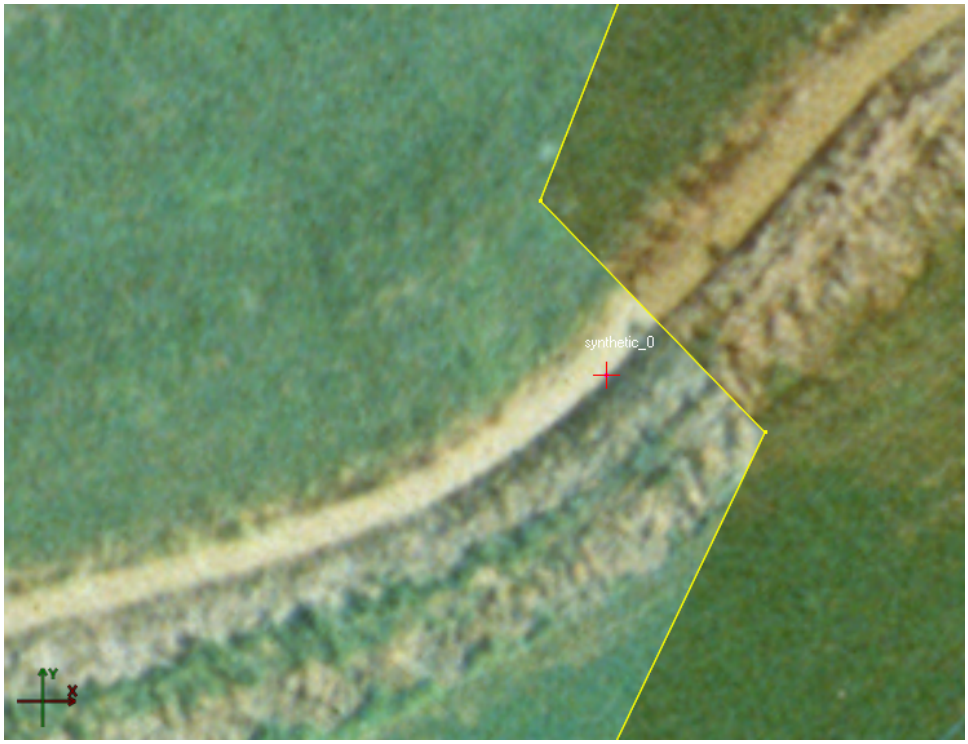


Fig. 81. The image is transformed

8. [optional] To cancel the changes made by a synthetic point, delete it. For this, select the point in the **Preview** or **Points catalog** window and press **Delete** (or click  in the **Points catalog** toolbar).

To remove all synthetic points, click  in the **Points catalog** toolbar

In order to temporarily eliminate the influence of synthetic points, clear the **Using of ground control and synthetic points** checkbox in the **Mosaic** parameters window

10.7. Parameters of GC/tie points measurement

For measuring of tie/ground control points in semi-automatic and automatic mode the following correlator parameters are used:

You go to this window automatically when starting automatic measurement of GC or tie points.

If you configure the automatic tie point measurement parameters, this window also allows you to switch to tie point measurement in distributed processing mode (see above).

To proceed to setting these parameters yourself, for example, during semi-automatic measurements of GC/tie points using the correlator, select **GC/tie points › Parameters**.

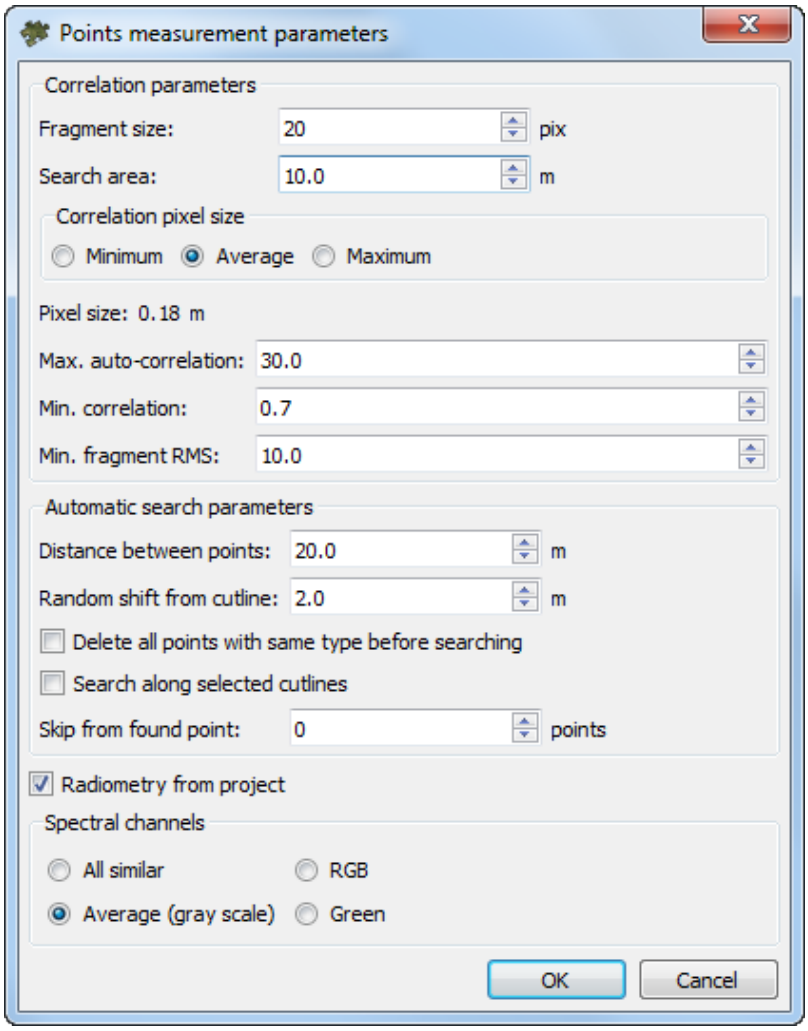


Fig. 82. Points measure parameters

The **Correlation parameters** section allows to specify the following parameters of points measure:

- **Fragment size** – allows to define a size (in pixels) of a fragment which contains the point indicated on one image in vicinity of cutline;
- **Search area** – allows to define a search area (in meters) of appropriate point on another image;
- **Correlation pixel size** – allows to define a value of a pixel size of images, where correlation to be performed, if the images have different pixel size;
- **Max. auto-correlation** – allows to control auto-correlation of a point, i. e. a degree of point's uniqueness in some its vicinity on the left image;

The more the auto-correlation radius value, the less the point's uniqueness and the more probable its incorrect comparison with the right image even when the correlation coefficient is high.

- **Min. correlation** – allows to define minimal acceptable value of correlation coefficient. Points that have correlation threshold below specified value are not considered during adding (the `Bad point` warning appears).

Correlation threshold is defined considering source data quality.

- **Min. fragment RMS** – allows to define a brightness value of image fragment. The less the value, the worse the correlation.

The **Automatic search parameters** section allows to set up the following parameters:

- **Distance between points** – allows to define a distance between points searching along the cutline in the automatic mode;
- **Random shift from cutline** – allows to define acceptable deviation from cutline when searching a point in automatic mode;
- **Delete all points with same type before searching** – allows to clear the Ground control and tie points layer from GCP or tie points before start a search of points;
- **Search along selected cutlines** – allows to search points only along selected cutlines. Set the checkbox off to search along all cutlines;
- **Skip from found point** – allows to skip set quantity of points from measured point.

The **Radiometry from project** checkbox allows to use data on radiometric correction from the RMC-file.

- The **Spectral channels** section allows to choose the following image spectral channels:
  - **All similar** – spectral channels, which are the same for project images, are used;
  - **RGB** – red, blue, and green channels are used;
  - **Average (gray scale)** – one channel is used, which is the arithmetic average for all available channels of images and sketches;
  - **Green** – the green channel of images and sketches is used as the most clear.

10.8. Editing ground control and tie points

The procedure for working with synthetic points is described in Section 10.6.

Since input data for *GeoMosaic* are georeferenced imagery and the use of triangulation points is due to the *potential* need to *transform* images for more accurate alignment of mosaic elements, then editing triangulation points in *GeoMosaic* actually resolves into the following:

- Correcting gross errors of point locations in images (for example, after automatic point search);
- Deleting points (in case the influence of a particular point on the images was eventually considered undesirable by the user).

The program allows you to quickly delete points of any type directly in the **Preview** window. For this, make the *Ground control and tie points* layer editable, select the point by left-clicking, and press **Delete**.

When analyzing error vectors (which represent the difference between the location of a point in the image and its position in the output mosaic after all transformations have been performed), it is necessary to take into account that they are influenced by both geometric distortions inherent in the input georeferenced data and transformations of the project images caused by the integrated influence of existing triangulation points of all types.

Thus, tie and ground control points can not only make the necessary changes to the image block but also, in part, if certain conditions are met, serve as a tool for monitoring the accuracy of the input orthorectified images.

A noticeable discrepancy between the error values and the visual correctness of the location of points in the images (for example, large error vectors for a tie point that is correctly measured in all images, or, vice versa, small errors for a point that has evidently incorrect measurements) may, when excluding the influence of other factors, such as transformations from GC or synthetic points, indicate significant distortions of the input orthoimages, which may be typical for images displaying man-made objects or terrain with mountainous relief.

The main tool for managing triangulation points is the **Points catalog** window. To open it, click  in the main program toolbar. The system provides for the following ways to delete points using the tools in this window:

Buttons	Functions
	to remove selected points (any type)

Buttons	Functions
	to remove blunders of tie/GC points automatic measurement: allows to reject those points, which measurement value results in shift of images relatively each other at distance more than specified (in meters)
	to remove all triangulation points
	to remove only ground control points
	to remove only tie points
	to remove only synthetic points

To edit the location of a *tie* point, perform the following:

1. Выделите точку в таблице окна **Каталог точек** и нажмите на кнопку в панели инструментов этого окна (или дважды щелкните **левой клавишей мыши** по нужной строке в таблице) Открывается окно **Points measurement**.

   Select the point in the **Points catalog** window's table and click in the toolbar of this window (or double left-click the appropriate row in the table). The **Points measurement** window opens.

   You can edit the point **Name** by double-clicking the cell in appropriate column.

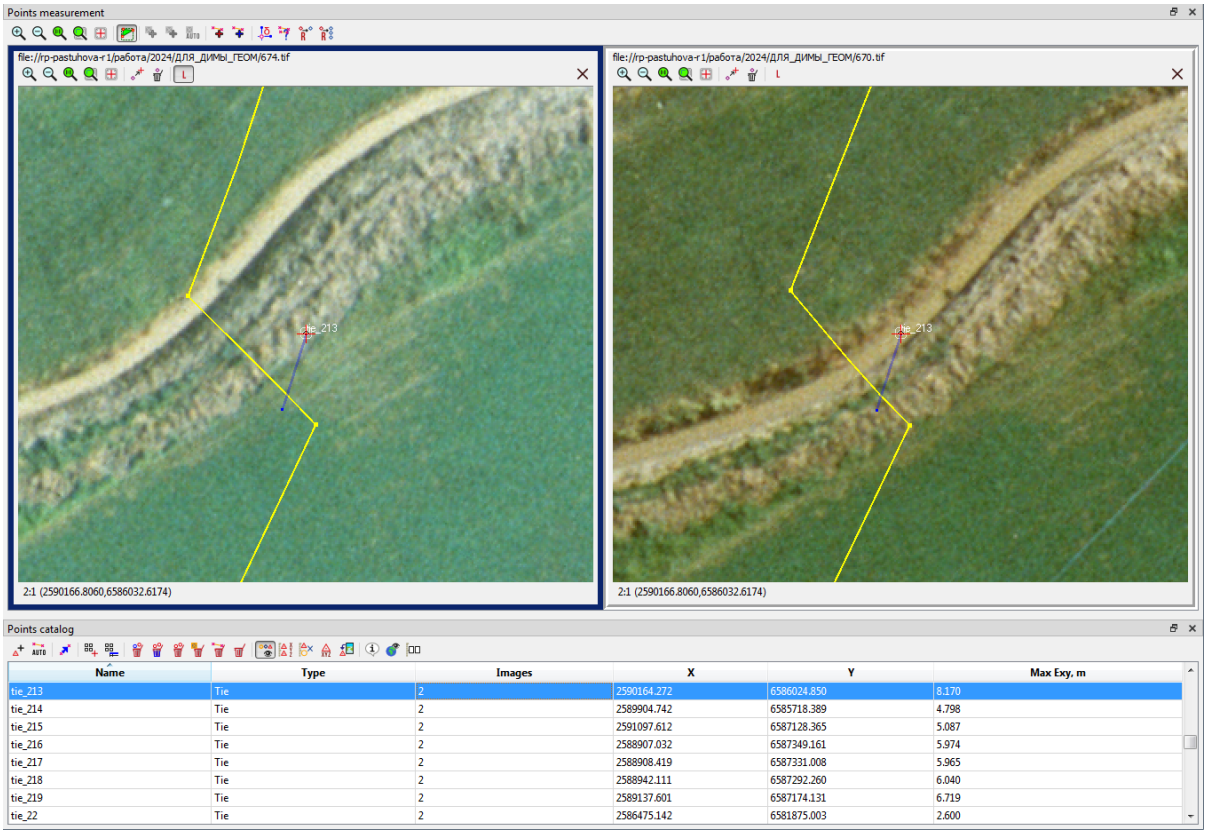


Fig. 83. The Points measurement window that displays a tie point with incorrect locations in the images

2. To change the location of a point in the images, move the marker to the required location in the windows of open images and click in the main **Points measurement** window toolbar.

   To change the location of a point in *one* of the images, move the marker to the required location in the window of the open image and click in this window toolbar.

3. Close the **Points measurement** window. If necessary, to refresh the **Preview** window, click in the main *GeoMosaic* toolbar.

Для того чтобы отредактировать положение *опорной точки* выполните следующее:

To edit the location of a *ground control point*, perform the following:

GeoMosaic does not provide manual input or correction of GCP's geodetic coordinates. The user can correct erroneous measurements of a point in images, delete a ground control point or create a new one.

1. Open the **Reference map** window and load reference data;

2. Select the point in the **Points catalog** window's table and click in the toolbar of this window (or double left-click the appropriate row in the table). The **Points measurement** window opens:

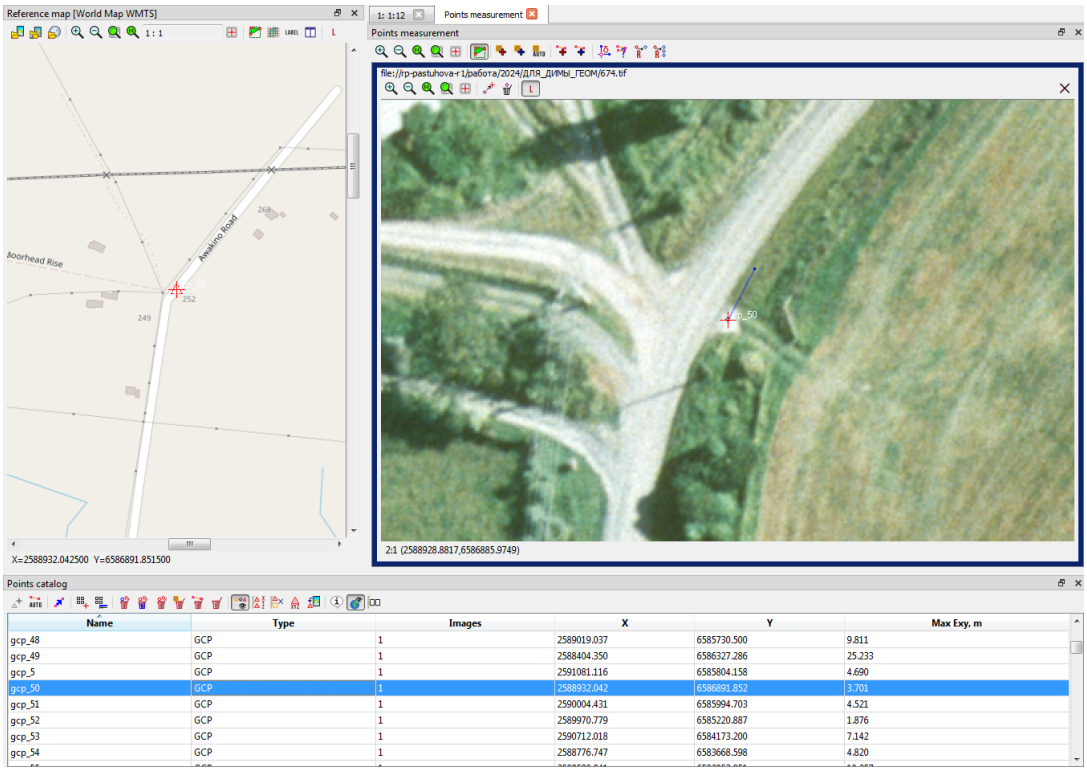


Fig. 84. The Points measurement window displaying a ground control point

3. To change the location of a point in the images, move the marker to the required location in the windows of open images and click in the main **Points measurement** window toolbar.

   To change the location of a point in *one* of the images, move the marker to the required location in the window of the open image and click in this window toolbar.

4. Close the **Points measurement** window. If necessary, to refresh the **Preview** window, click in the main *GeoMosaic* toolbar.

11. Splitting into sheets

11.1. Sheets menu

The **Sheets** menu is used for splitting mosaic into sheets for saving their in the separate files of selected output format. The sheets boundaries are the vector polygons in the *Sheets* layer.

Items of the **Sheets** menu items are partly duplicate by buttons of the additional **Sheets** toolbar.

Table 16. Brief description of Sheets menu and toolbar

Menu items	Function
Clear	to delete the created sheets boundaries, i.e delete all vector objects from the *Sheets* layer without closing of this layer
Open	to open sheets boundaries, which were been saved in the vector file with the `x-data` extension in the resources of active profile
Import	see “Import of vector objects” in the “Vectorization” User Manual
Export	see “Export of vector objects” in the “Vectorization” User Manual
Save	to save the sheets boundaries in the `x-data` file in the resources of active profile
Save as	to save the sheets boundaries in new file with the `x-data` extension in the resources of active profile
Sequential splitting	to define the sequential splitting parameters of block images area and start the process of sheets boundaries creation by the specified parameters
Full mosaic sheet	to create the single sheet covering all block images
Split into sheets by images	to create the sheets from each image of block
Single sheet creation mode	to create the single sheet with arbitrary boundaries from any part of block images
Create sheet around marker	to create sheet with set size relative to marker position

Menu items	Function
Create sheets around point objects	to create sheets with set size relative to the each point object position
Project sheets list	to display table with information of project sheets
Create standard orthomap sheet frames	to create notations sheets of specified scale
Create custom orthomap sheet frames	to create sheets of several orthomaps, created in local coordinate system, grouped by cutlines and limited by notation frame
Activate all sheets	to make all sheets *active* (include to the process of mosaic creation)
Deactivate all sheets	to make all sheets *inactive* (exclude from the process of mosaic creation)
Activate selected sheets	to activate selected sheets for creating mosaic
Deactivate selected sheets	to exclude selected sheets from the mosaic creation
Set sheets status by rasters	to select only sheets containing at least part of block image for creation of output mosaic files (input background color on the images edges is taken into consideration), i.e the value of status attribute will be equal to '1' (active status) for boundaries of non-empty sheets
Set sheets status by useful areas	to select only sheets containing at least part of block image for creation of output mosaic files (input background color on the images edges is taken into consideration), i.e the value of status attribute will be equal to '1' (active status) for boundaries of non-empty sheets
Invert sheets status	to invert the status of all created sheets
Select active sheets	to select on block scheme all *active* sheets
Select non active sheets	to select on block scheme all *inactive* sheets
Sheets activation mode	to choose sheets activation mode
Parameters	to define the output parameters for creation of output mosaic
Sheet info	to obtain and modify information about selected sheet
Split work areas into sheets	to create output mosaic *sheets* taking into account the given *work area*

11.2. Requirements of cutting into sheets

The program allows cutting the output mosaic into sheets for saving them in the separate files.

At least one active sheet for all or selected area is required to start mosaic creation.

To display sheets borders is used the *Sheets* layer, which contains attributes of sheet name and activity status. The program provides different ways of splitting mosaic areas

into sheets, selecting active sheets for creating output files and setting up output parameters.

Throughout this User Manual, the *Active sheet* is referred to as sheet, from which the output mosaic file will be created. The *Inactive sheet* is referred to as sheet, excluded from the output mosaic.

It is recommended to pass the following number of actions during the mosaic sheets creation:

1. Definition of the mosaic output coordinate system (see description of the **Output coordinate system** panel in Section 13.2.2).
2. Splitting block images into sheets, i.e creating sheets boundaries (the vector objects with the attributes for storing information about sheets in the Sheets layer).
3. Editing attribute values and sheets boundaries.
4. Managing sheets status.
5. Setting output parameters of sheets.
6. Creating output sheets of mosaic (see Section 13.3).

11.3. Splitting into sheets by the specified parameters

Perform the following actions for splitting block images into sheets by specified parameters:

1. Choose the **Sheets › Sequential splitting** or click the  button in the **Sheets** toolbar. The **Sheets splitting parameters** window opens.

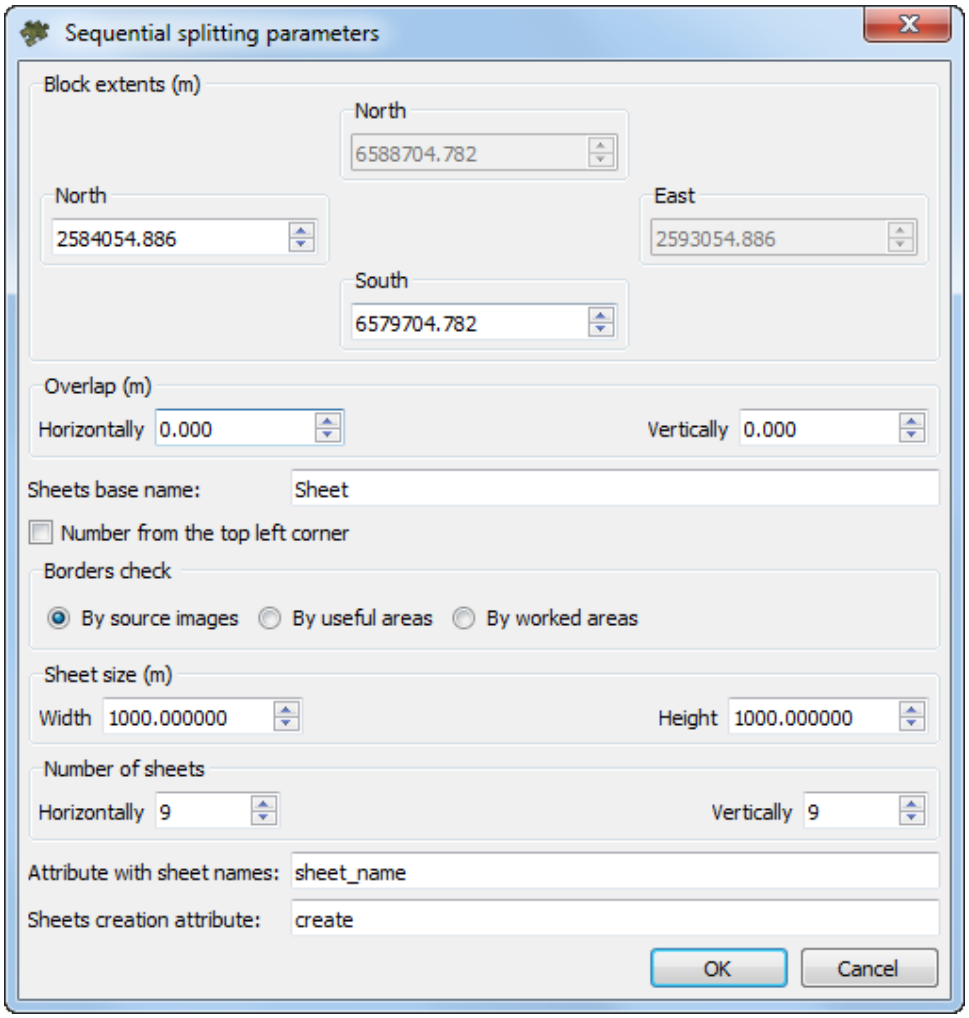


Fig. 85. Parameters of sequential splitting

2. Define the following parameters of splitting:

   - **Block extents** – allows to specify the area boundaries (in meters) for splitting;
   - **Overlap** – allows to define the overlap size (in meters) by width and/or height;

     By default the sheets are created without overlap (dock).

   - **Sheets base name** – allows to define the sheets name prefix (by default – *Sheet*);

     It contains the serial number of sheets row (upward) and serial number of the sheet in a row (left to right). The rest of the sheet name is generated by program automatically.

By default, if sequential splitting is used, the sheet numbering starts from the *lower-left corner*. To set the sheet numbering from the *upper-left corner*, set the **Number from the top left corner** checkbox.

- Choose, how should the system perform the **borders check** – **by source images**, **by useful areas** or **by worked areas**;
- **Sheet size** – allows to specify sheet size (in meters) by width and/or height;

The modifying sheet size leads to recalculation of sheets number in the specified splitting area.

- **Number of sheets** – allows to specify the number of sheets by width and/or height;

The splitting begins from the bottom left corner of the specified splitting area in accordance with specified number of sheets and sheet size. Thus, sheet size not recalculated when the modifying number of sheets.

- **Attribute with sheet names** – allows to define the name of attribute for storing the sheet names;
- **Sheets creation attribute** – allows to define the attribute name for storing information about sheet status. By default the *create* is proposed.

3. Click OK. The process of sheets creation starts. The sheets boundaries are created in the *Sheets* layer and displayed in the **Preview** window.

All sheets, falling within block images, are active.

Active sheet is shown by green outline and has not color filling. Inactive sheet is shown by red outline and red transparent filling, by default.

The **GeoMosaic | Preview** tab of the **Settings** window is used to select color and set up transparency options for inactive sheets (see Section A.2).

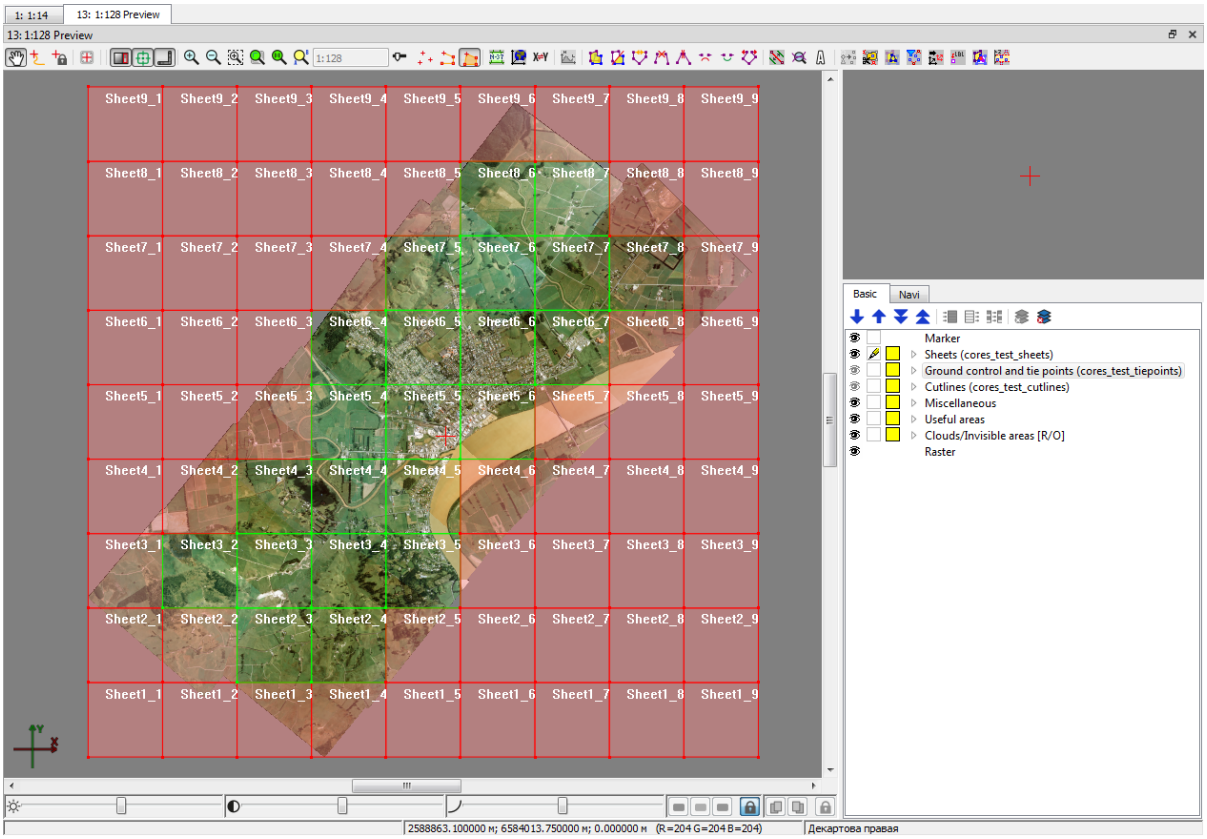


Fig. 86. Sequential splitting

11.3.1. Creating sheets taking into account the work area

The system provides for creating *sheets* of an output mosaic taking into account the *work area* of interest, which makes it possible to avoid sheets completely filled with the *mosaic's background*. For this, perform the following:

1. Split the mosaic into sheets (see Section 11.3);
2. Load the work area boundary into the layer manager (see Section 13.2.2);
3. Choose **Sheets › Split work areas into sheets**. A vector layer is created that contains polygons which are the previously created sheets bounded by the work area. The value of the `name` attribute of each of the specified polygons corresponds to this attribute value from the "parent" sheet;
4. Save the created vector layer in the active profile resources;
5. Choose **Sheets › Clear**;
6. Choose **Sheets › Open**, to open the previously saved vector layer (see item **4**);

7. [optional] Save the mosaic project if needed.

11.4. Sheets creation modes

The program provides the following opportunities for sheets creation:

- *full mosaic sheet from all images* – allows to create one sheet including all block images;
- *one sheet with arbitrary boundaries* – allows to create one sheet with arbitrary boundaries from the any part of block images;
- *splitting into sheets by images* – allows to create separate sheet from each image of mosaic project;
- *creating sheet around marker* – allows to create one sheet in the marker region.
- *creating sheets around point objects* – allows to create sheets with set size relative to the each point object position.

Choose the **Sheets › Full mosaic sheet** or click the button in the **Sheets** toolbar.

Perform the following actions for creating the single sheet:

1. Choose the **Sheets › single sheet creation mode** or click the button in the **Sheets** toolbar.
2. Stretch the rectangle in the **Preview** window along with pressed **Shift** key.

Choose the **Sheets › Split into sheets by images** or click the button in the **Sheets** toolbar. The sheet boundaries are created for each image.

Perform the following actions for creating sheet around marker:

1. Set the market in area where mosaic sheet will be created.
2. Choose the **Sheets › Create sheet around marker**. The **Sheet creation parameters** window opens.

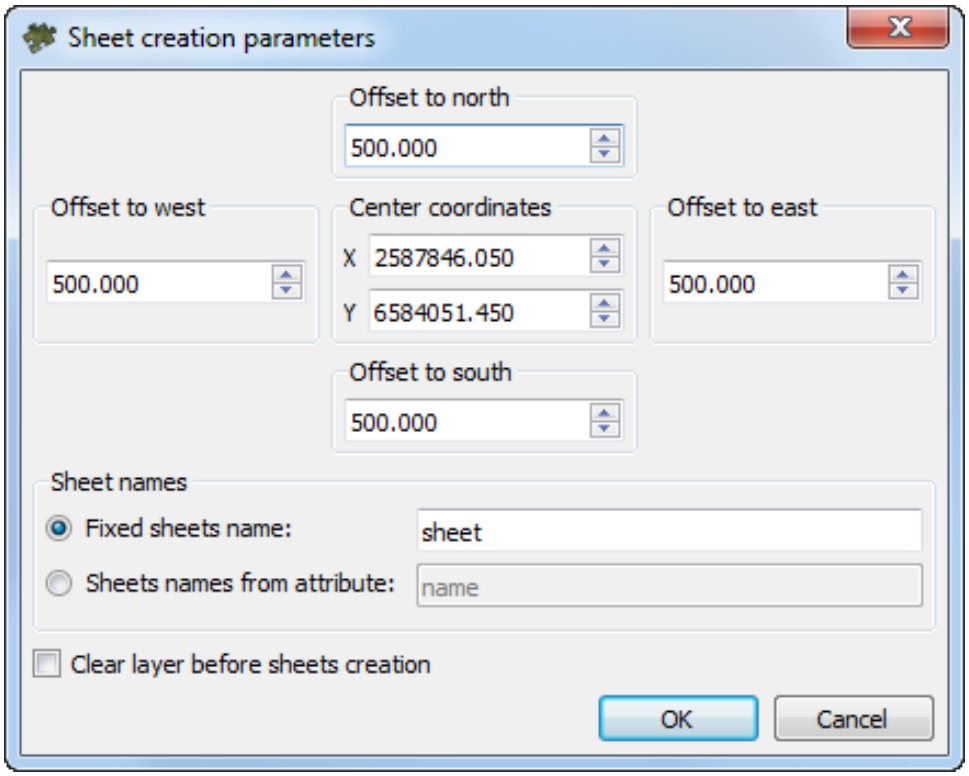


Fig. 87. Sheet creation parameters

3. [optional] Set manually the **Center coordinates** by **X** and **Y**, with respect to which the sheets boundaries will be calculated.

4. Set the distance from sheet center (marker position) to its border in the **Offset to north**, **south**, **west** and **east** fields accordingly.

5. [optional] By default, new sheet is created in the existed *Sheet* layer, not depending on data in this layer. To create sheet around marker in the layer without data, set on the **Clear layer before sheet creation** checkbox.

6. Choose the way of creating sheet name in the **Sheet names** section:

   - Input the **fixed sheet name**;
   - **Sheets names from attribute** – define the name of attribute for storing sheets name in appropriate field.

   By default, each new sheet is named as *sheet*.

7. Click OK to create the mosaic sheet.

Perform the following actions for creating sheets around point objects:

1. Load or create non-Geomosaic vector layer, containing point objects.

2. Choose the **Sheets › Create sheets around point objects**. The **Sheet creation parameters** window opens.

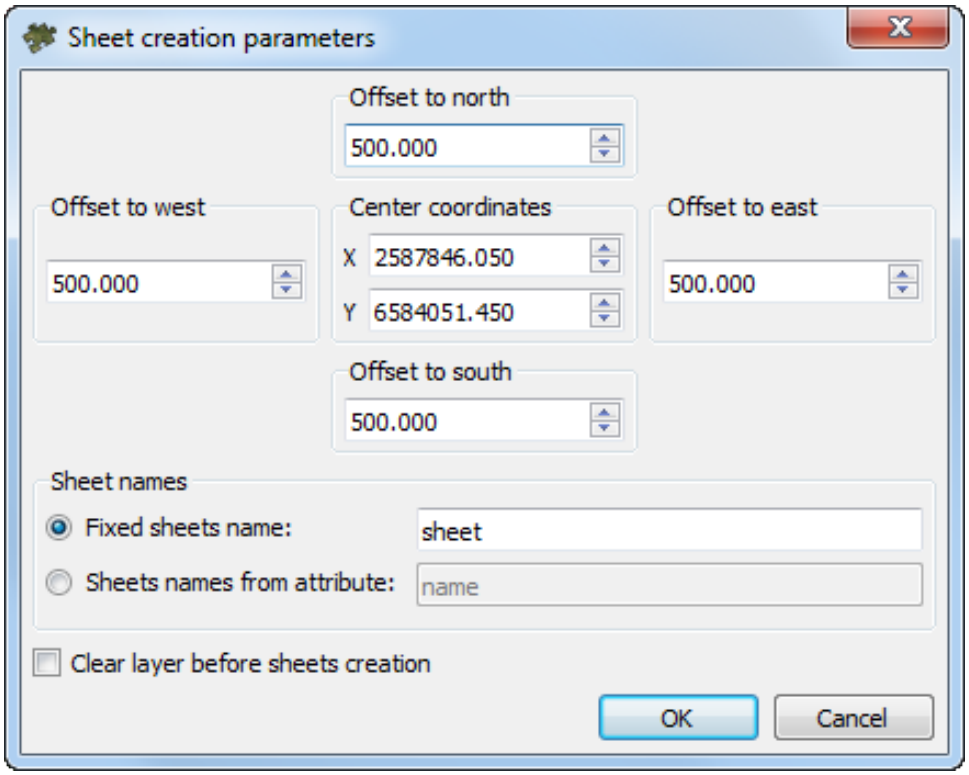


Fig. 88. Sheet creation parameters

3. [optional] In the **Center coordinates** section set the offset (by **X** and **Y**) between point objects and sheets centers.

4. Set the distance from sheets centers to its borders in the **Offset to north**, **south**, **west** and **east** fields accordingly.

5. [optional] By default, new sheet is created in the existed *Sheet* layer, not depending on data in this layer. To create sheet around marker in the layer without data, set on the **Clear layer before sheet creation** checkbox.

6. Choose the way of creating sheet name in the **Sheet names** section:

   - Input the **fixed sheet name**;
   - **Sheets names from attribute** – define the name of attribute for storing sheets name in appropriate field.

By default, each new sheet is named as *sheet*.

7. Click OK to create the mosaic sheets.

11.5. Project sheets list

The program provides possibility to view project sheets list and to edit sheets.

To display the sheets list choose the **Sheets › Project sheets list** or click the button on the main or **Sheets** toolbar.

To sort the table contents by the values of selected column, click on the column name.

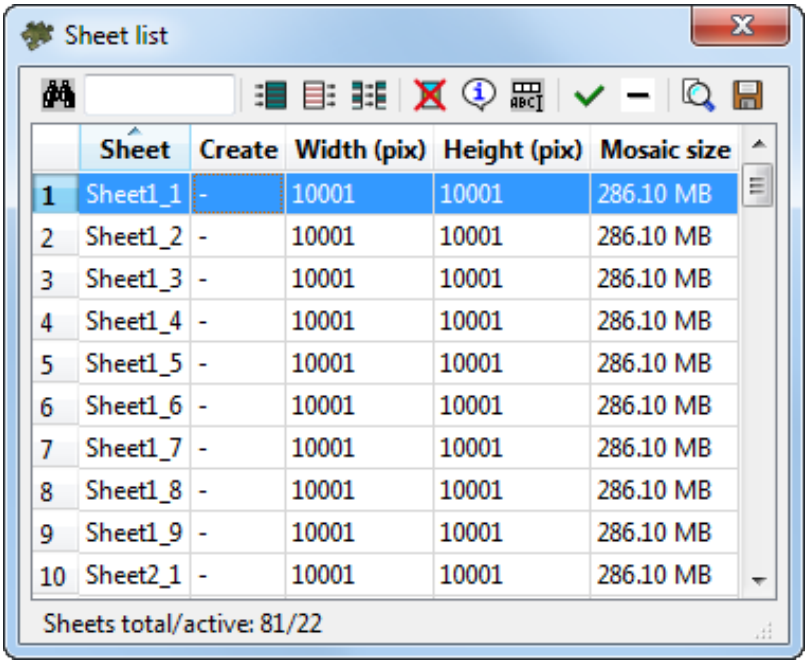


Fig. 89. Project sheets list

The table with information about all project sheets is displayed in the **Sheets list** window. The table contains the following columns:

- **N** – serial number of record;
- **Sheet** – the sheet name;
- **Create** – sheets active status;
- **Width/Height** – linear size of sheet (in pixels);
- **Mosaic size** – estimated size of output sheet in megabytes.

Double click on row in table allows to edit information about selected sheet. It allows to change sheet name or active status.

Table 17. The toolbox of 'Sheets list' window

Buttons	Function
	to search for an image by name (part of name) in the list
	to select all sheets in the list
	to deselect all sheets in the list
	to invert selection of sheets in the table
	to remove selected sheets
	to edit information about selected sheet – name and active status
	to make selected sheet active
	to make selected sheet non active
	to open the Preview window for current sheet
	to save the list with names of selected sheets in text file

11.6. Generators of splitting into sheets

11.6.1. Standard orthomap sheet frames generator

The program provides possibility to split orthomap for notation sheets of chosen scale (see Appendix C), which consist of vector polygons.

Generators of splitting into sheets are used to:

- to split orthomaps into sheets by images;
- for further use in the *GeoMosaic*program.

Orthomap sheets generation is available if project coordinate system is geodetic (latitude-longitude) or based on map projection.

Perform the following to split survey area to notation sheets of chosen scale:

1. Choose **Sheets › Create standard orthomap sheet frames**. The **Generate standard sheets** window opens.

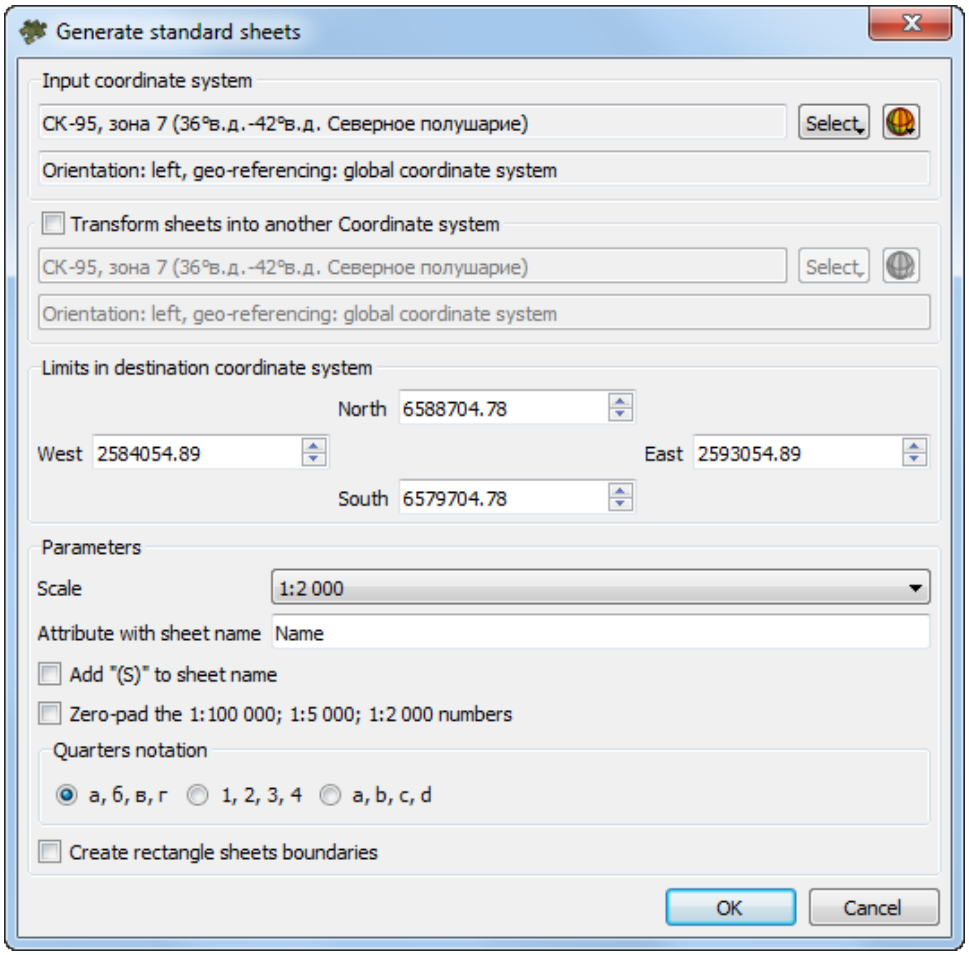


Fig. 90. Standard orthomap sheet frames generator parameters

2. The **Input coordinate system** in which you perform splitting into sheets (for example, the project coordinate system) is displayed in the appropriate section. In order to immediately recalculate the output sheets into another coordinate system after creating them, set the **transform sheets into another coordinate system** checkbox and configure the relevant parameters.

Recalculation of created sheets into another coordinate system can be performed later, using a separate command: **Vectors › Geometry › Convert coordinate system** (see the "Change objects coordinate system" chapter in "Vectorization" User Manual). The checkbox **transform sheets into another coordinate system** allows you to optimize data processing within the framework of a single operation (instead of two consecutive ones).

Sometimes it may be necessary to perform splitting into sheets in a coordinate system different from the project CS (input), but then save the sheets in it. In this case, change the coordinate system in which the splitting should be performed in the **Input coordinate system** section, then set the **transform sheets into another coordinate system** checkbox and specify the source coordinate system in this section.

3. [optional] In the **Limits in destination coordinate system** section are specified coordinates of area borders for splitting into sheets. To change area size input coordinates of corners in the **North**, **West**, **East**, **South** fields.

4. Choose the scale of orthomap in the **Scale** section.

5. [optional] In case when 1:5 000 or 1:2 000 scale is chosen, set on the **Create outscribed rectangles for sheet** checkbox.

6. In the **Parameters** section define the following settings:

    1. In the **Attribute with sheet name** specify the name of attribute for the sheet name.

    2. [optional] To clarify map position, located in south hemisphere, set on the **Add '(S)' to sheet name** checkbox.

    3. [optional] Set on the **Zero-pad the 1:100 000; 1:5 000; 1:2 000 numbers** checkbox in order to notation of 1:100 000, 1:5 000 and 1:2 000 scale sheets was wrote correctly.

    4. [optional] It is possible to choose one of the **Quarters notation** in the appropriate section.

7. Click OK. The splitting orthomaps into sheets with specified notation process start. When the process is completed the **Sheets parameters** window opens.

8. [optional] Change the attribute names or values if necessary and click OK.

11.6.2. Custom orthomap sheet frames generator

Program provides possibility creating sheets from several orthomaps, merged by cutlines and created in local coordinate system.

Perform the following to split orthomaps by notation sheets in local coordinate system:

1. Choose **Sheets › Create custom orthomap sheet frames**. The **Generate arbitrary sheets** window opens.

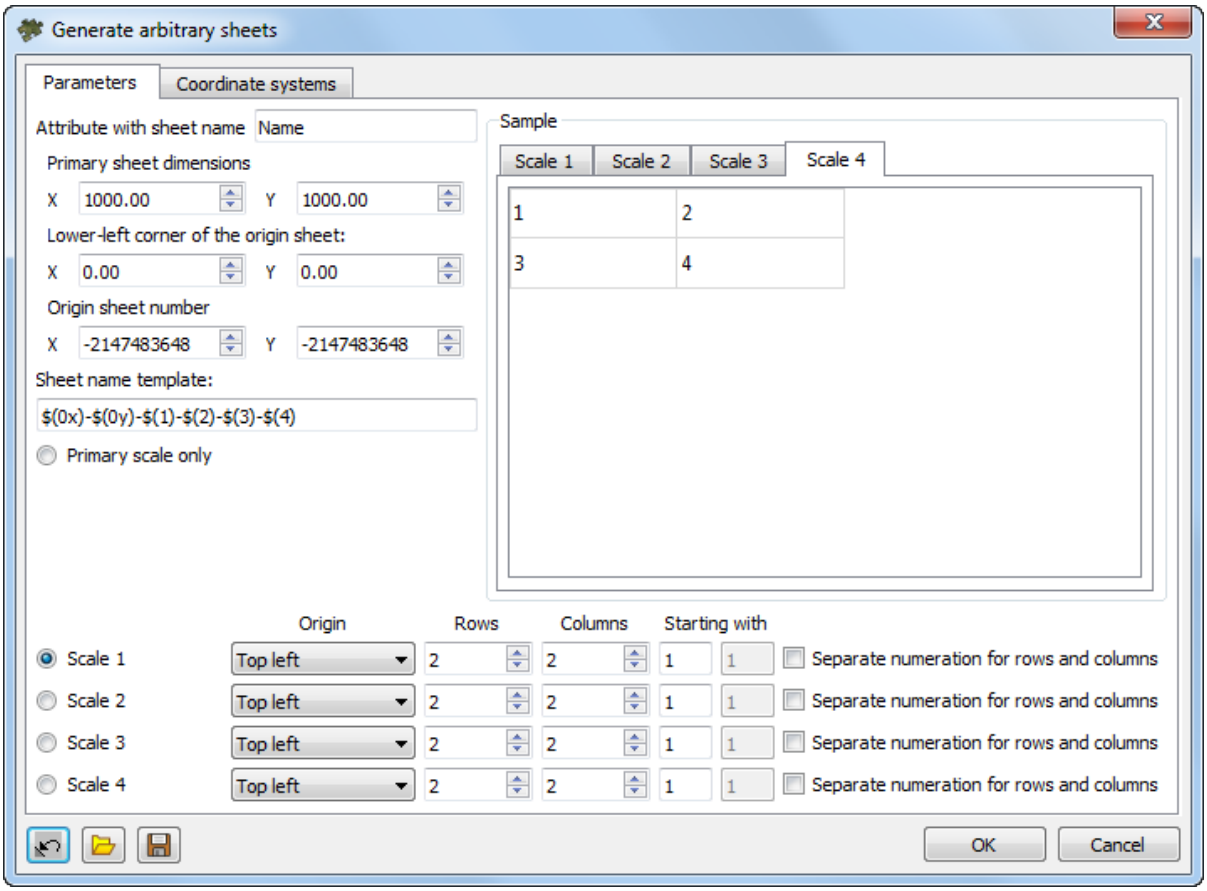


Fig. 91. Custom orthomap sheet frames generator parameters

2. [optional] To load parameters from file click the button.

3. [optional] Choose the **Primary scale only** to use one base sheet.

4. Specify the following parameters of primary scale sheet:

In case of using the custom orthomap sheet frames generator it is possible up to 5 levels splitting orthomaps in to sheets: primary and 4 additional scales. Each next level is created by splitting the previous level.

1. In the **Attribute with sheet name** specify the name of attribute for the sheet name.

2. In the **Primary sheet dimension** field specify the primary scale sheet size.

3. In the **Lower-left corner of the origin sheet** input coordinates of the origin sheet.

Choose the reference point lower and left from work area. The coordinates of origins of the others sheets are calculated based on this information.

4. In the **Origin sheet number** input a number of sheet that starts numeration.
5. In the **Sheet name template**: `$(0x)-$(0y)-$(1)-$(2)-$(3)-$(4)`, where
   - `$(0x)` – number by X on primary scale;
   - `$(0y)` – number by Y on primary scale;
   - `$(1), $(2), $(3), $(4)` – number on the first and next levels in case if the **Separate numeration for rows and columns** checkbox is set off;
   - `$(1x)` – number by X in case if the **Separate numeration for rows and columns** checkbox is set on;
   - `$(1y)` – number by Y in case if the **Separate numeration for rows and columns** checkbox is set on.

   Notation with all types, except using Roman numerals, could be created.

5. [optional] Specify the following parameters of primary scale sheet:
   1. Choose one of the template: **Scale 1**, **Scale 2**, **Scale 3**, **Scale 4**.
   2. Choose the **Origin** of the additional level from the list. By default the top-left corner is set as origin.
   3. Input number of **Rows** and **Columns**.
   4. Input arbitrary symbol (letter or number) as a start sheet number in the **Starting with** fields.

   All changes of parameters are shown in the **Sample** table.

6. Setup the appropriate parameters in **Coordinate systems** tab:

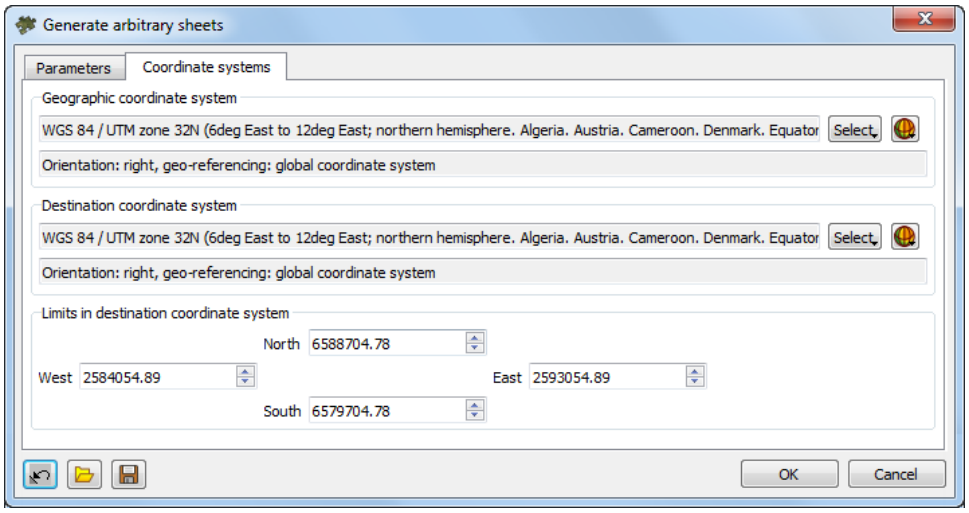


Fig. 92. Custom orthomap sheet frames generator parameters

- In the **Geographic coordinate system** section choose the input coordinate system, which is used to specify splitting into sheets by latitude and longitude.
- In the **Destination coordinate system** section choose the coordinate system to recalculate coordinate system of sheets during splitting into sheets.
- [optional] In the **Limits in destination coordinate system** section are specified coordinates of area borders for splitting into sheets. To change area size input coordinates of corners in the **North**, **West**, **East**, **South** fields.

7. [optional] To save parameters click the button. To reset parameters to default click the button.
8. Click OK. The splitting orthomaps into sheets with specified notation process start. When the process is completed the **Sheets parameters** window opens.
9. [optional] Change the attribute names or values if necessary and click OK.

11.7. Sheets status management

Each sheet has name and active status, specified in the *Sheets* layer.

In the **Sheets** menu and in the **Sheets** toolbar the following facilities provided to change sheets status:

- to make all sheets active choose the **Sheets › Activate all sheets** or click the button;
- to make all sheets non-active choose the **Sheets › Deactivate all sheets** or click the button;

- to make selected sheets active choose the **Sheets › Activate selected sheets** or click the button;
- to make selected sheets non-active choose the **Sheets › Deactivate selected sheets** or click the button;
- to invert sheets status choose the **Sheets › Invert sheets status** or click the button;
- to make sheets, which fall into images entirely including their background, active and to simultaneously make the rest of sheets non-active, choose the **Sheets › Set sheets status by rasters** or click the button;
- to make sheets, which fall into images without their background, active and to simultaneously make the rest of sheets non active, choose the **Sheets › Set sheets status by useful areas** or click the button.

In order to use provided modes of sheets activation you should activate the Sheets layer and choose in the **Sheets › Sheets activation mode** menu one of three modes:

- **Select for activation** – by default, this mode assumes standard selection of sheets and further assigning them 'active' or 'non-active' status. In order to select sheets drag a rectangle along with pressed **Shift** key, and use one of group selection modes from the **Tools** toolbar;
- **By first sheet** – this mode allows to change sheets status without sheets selection. Drag a rectangle in this mode along with pressed **Shift** key. The sheets that fall into the rectangle, obtain the status of the first sheet of the rectangle created;
- **Use selection mode** – this mode allows to change sheets status without sheets selection too. At that, status of sheets that fall into rectangle created along with pressed **Shift** key, depends on a group selection tool selected in the **Tools** toolbar (see the "Vectorisation" User Manual).

The system also provides for selecting objects using a freeform polygon ( ).

Create a polygon by holding **Shift** while moving the cursor sequentially in the work area of the 2D window. To complete the creation of a polygon, set the last vertex of the polygon by double-clicking the **left mouse button**. To delete the last created vertex, press **Esc**.

To select sheets use the following modes:

- to select 'active' sheets choose the **Sheets › Select active sheets** or click the button;
- to select 'non-active' sheets choose the **Sheets › Select non-active sheets** or click the button.

11.8. Attributes of sheets

Each sheet is given the name and defined sheet status using the attributes of the Sheets layer. The capability of presetting provides correct import of sheets, which were created in third party software, in case when the imported objects have another names of attributes for storing information about sheet (see the Vectorization User Manual).

By default the *Sheets* layer contains the following names of attributes:

- *create* – for storing information about sheet status;
- *sheet_name* – for storing sheet name.

To change the default attributes of the *Sheets* layer perform the following:

After changing attributes it is necessary to rebuild existed sheets.

1. Choose the **Sheets › Parameters** or click the button in the **Sheets** toolbar. The **Sheets parameters** window opens.

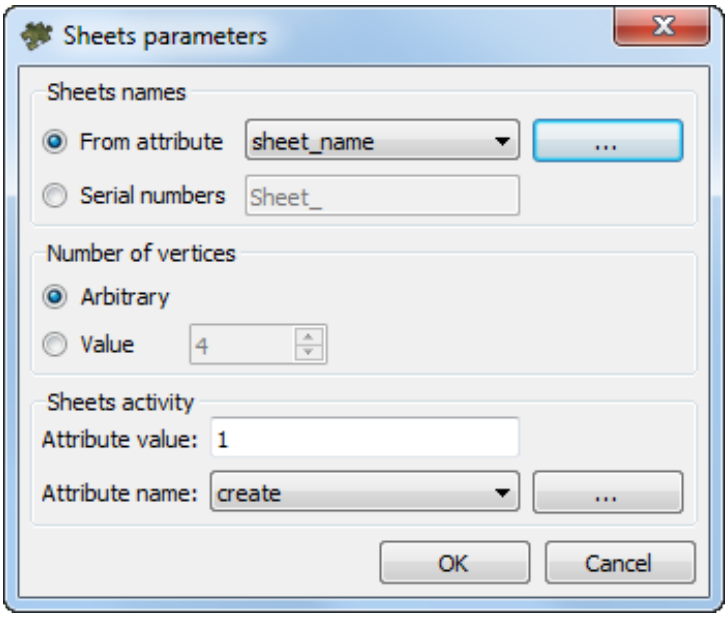


Fig. 93. Setting attributes names

2. Choose the way of creating sheet name in the **Sheet names** section:
   - **From attribute** – define the new name of attribute for storing sheets name: select the name from list or specify it using the ... button;
   - **Serial numbers** – specify prefix of sheets names manually.

3. In the **Sheets activity** section define the following settings:

   - in the **Attribute value** field specify the value of attribute, chosen in the list, whereby list is marked as active;

   - choose the **Attribute name** from the list for storing information about sheet status or specify new name using the ... button.

4. Click OK. Thus, after the completion of splitting process, the data about the sheet name and sheet status will be stored in the defined attributes irrespective of splitting mode.

Perform the following actions for obtaining and editing information about a sheet:

1. Select the sheet boundaries by double click in the **Preview** window.

2. Choose the **Sheets › Sheet info**. The **Sheet info** window opens.

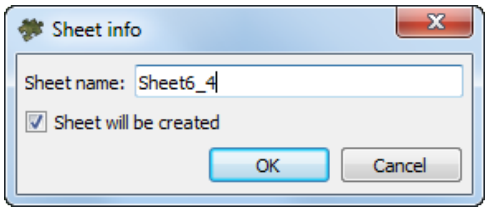


Fig. 94. Values of cutline attribute

Window contains the following information:

- the **Sheet name** field corresponds to the *sheet_name* attribute value;

- the **Sheet will be created** checkbox corresponds to the sheet status is active.

Perform the following actions to view and edit attributes values of selected sheet:

1. Select the sheet boundaries by double click in the **Preview** window.

2. Choose the **Window › Object attributes** or click the button of the **Vectors** additional toolbar. The **Object attributes** window opens.

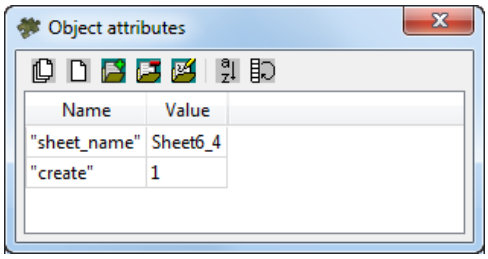


Fig. 95. Values of sheet attributes

The following buttons are used to create and edit attributes table:

- – allows to delete all attributes of selected objects;
- – allows to delete common attributes of selected objects;
- – allows to open the **Add attribute** window to define name, type and value of attribute;
- – allows to delete current field of attribute table;
- – allows to open the **Edit attribute** window to edit parameters of selected attribute;
- – allows to invert attributes of selected object;
- – allows to sort attributes of selected objects.

Also the window contains the table with at least two rows:

- *create* attribute– the '1' value corresponds to the active sheet status, the '2' value corresponds to the inactive sheet status;
- sheet_name *attribute*– contains the name of selected sheet.

The image name in the attribute is generated automatically and depends on the splitting mode and parameters.

3. Click the string of the **Value** input field and insert another value for changing of attributes value.
4. Press **Enter** to save or press **Esc** to cancel.

There are also other facilities in the program interface that provide fast managing of the sheet activity status (see Section 11.7).

11.9. Setting output parameters

The output parameters allow to define the method of *output files* naming and criteria of selection sheets for creating *output files*.

Perform the following actions to set up output parameters:

1. After splitting part of block images into sheets, editing boundaries and sheets attributes, choose the **Sheets › Parameters** or click the button on the **Sheets** toolbar. The **Sheets parameters** window opens.

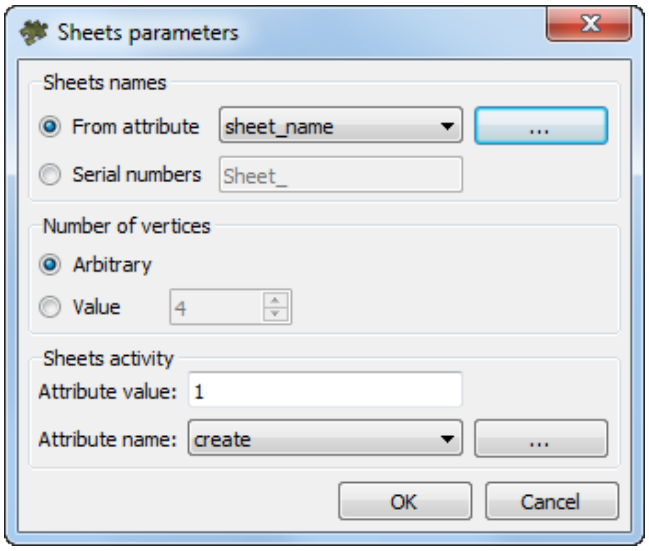


Fig. 96. Sheets parameters

2. Choose the way of creating sheet name in the **Sheet names** section:

   - **From attribute** – allows to use the value of selected attribute;
   - **Serial numbers** – allows to use serial numbers and define the file name prefix.

   In this case, while creating mosaic, the sheet names are generated as follows: *Prefix+Sheet serial number*.

3. In the **Number of vertices** section defines criterion of sheets selection for creating output files by number of vertices within sheets boundaries.

   - **Arbitrary** – sheets selection by number of vertices within the boundaries of created sheets is not performed;
   - **Value** – allows to select sheets by number of vertices and specify the number of vertices in the input field.

4. In the **Sheets activity** section perform the selection of sheets for creating output files by the attribute values:

   - define the **Attribute value**, whereby list is marked as active;
   - choose the **Attribute name** which set the sheets activity.

5. Click OK. Sheets activity changes automatically depending on parameters.

12. Using auxiliary data

12.1. Misc (Miscellaneous) menu

The **Misc** menu is used to show in the **Preview** window an auxiliary data that may be considered during mosaics creation. For auxiliary data (that is vector data) the *Misc* layer is provided.

Table 18. Brief description of Misc menu

Menu items	Function
Clear	to delete all vector objects created in the *Misc* layer
Open	to load data from a file saved in active profile resources
Save as	to save the *Misc* layer data to vector file with different name and `*.x-data` extension in active profile resources
Local adjustment	to show in the **Preview** window a grid of fragments for preliminary estimation. The grid of fragments is intended for collecting of statistics data of local brightness adjustment (see Section 9.2)
Source images outlines	to show in the **Preview** window boundaries of source images with background
Source images layout	to create polygons by images frames with background
Source images useful areas layout	to create polygons by images frames without background
Synchronize cutlines selection	to select image with selected cutline automatically; it is necessary to display frames of source images before that with the **Misc › Source images outlines** menu item.
Load metadata to current layer	to load images metadata to current active layer
Load nadir and central points	to load coordinates of nadir and central points to the *Miscellaneous* layer
Convert metadata from AUX to X-FEAT	to convert orthomap metadata, created in third party software, to the system interior format
Save images borders from metadata to MIF/MID	to save images borders as vector objects in the orthophotomap; could be used only for othopohoto created by satellite images
Check completeness of rasters	to check the completeness of output rasters. After performing the procedure information message is displayed. Such errors may occur as a result of network failure.

12.2. Images layout

The program provides possibility to create polygons by images frames with background or by images edges without background. **Misc › Source images layout** and **Misc › Source images useful areas layout** menu item are used for that.

Choose the **Misc › Source images layout** to create polygons by images frames with background.

The following attributes are assigned to each created polygon:

- *image_name* – the name of image which is in the polygon, and the path to the image file;
- *bytes_ps* – bytes per sample;
- *aver_pix_size* – average GSD size;
- *img_width* – image width;
- *img_height* – image height.

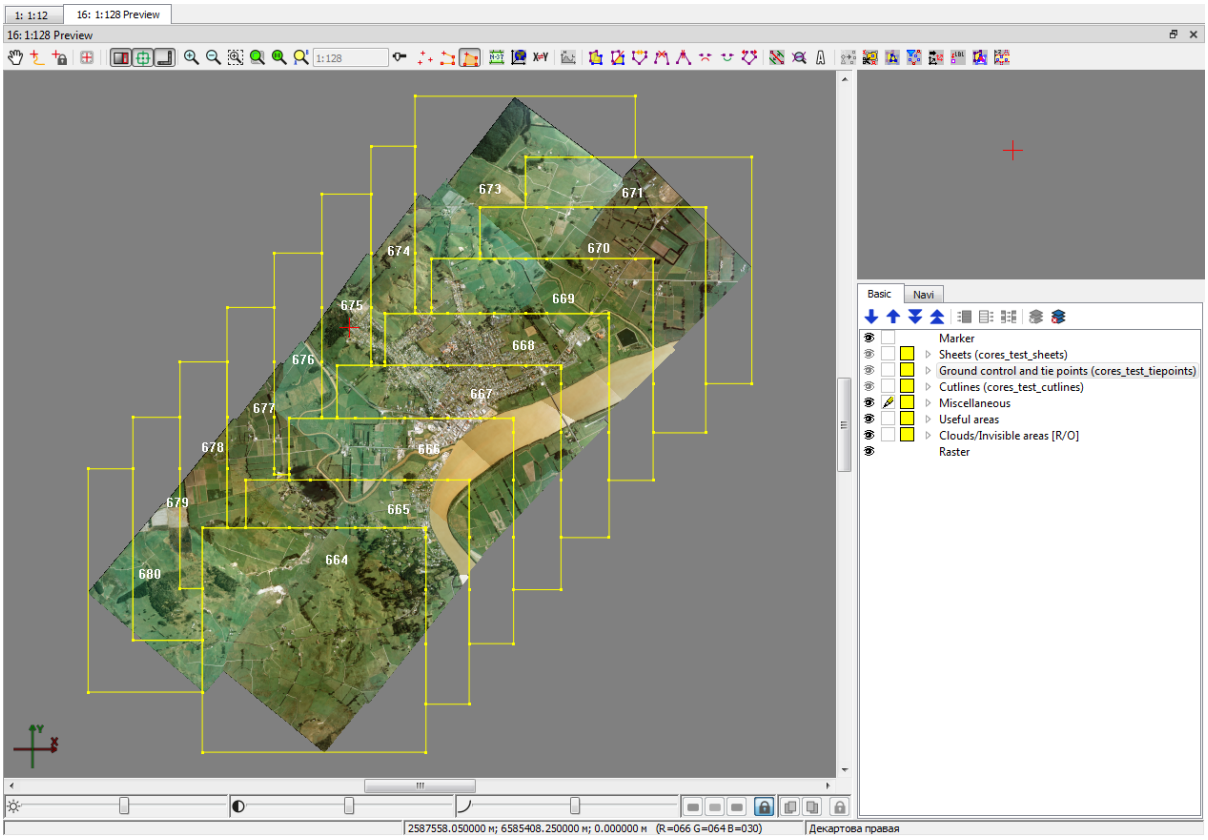


Fig. 97. Creation polygons by images frames with background

Perform the following to create polygons by images frames with background:

1. Choose the **Source images useful areas layout**. The **Parameters** window opens.

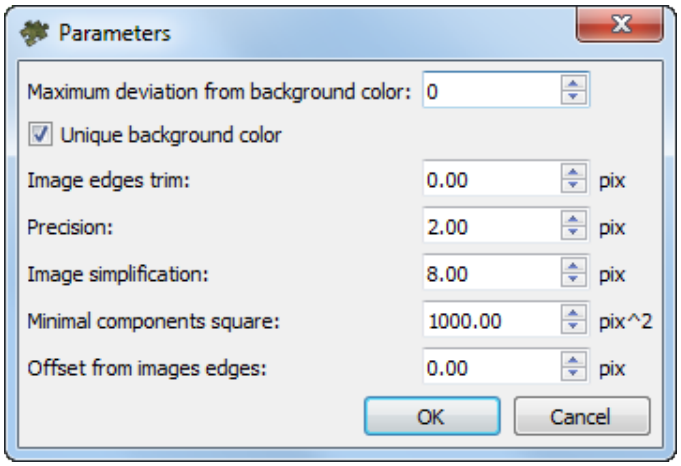


Fig. 98. Parameters of creation polygons by images frames without background

2. [optional] in case of areas on images with color equal to background color, set on the **Unique background color** checkbox and set the **Maximum deviation from background color** to define a range of color, which presents in background of source images.

3. In the **Image edges trim** specify the offset from images border in pixels.

4. Specify the **Precision** of calculation of areas boundaries (this value influences on number of nodes in polygon to be created).

5. **Image simplification**, in pixels;

Preliminary simplification of images makes it possible to reduce the time spent on constructing the boundaries of polygons and reduce the number of their vertices, thus avoiding unjustified complexity of their configuration.

Specific optimum values of simplification are to be chosen individually for each project, depending on the project type and geometry of initial data.

It is not recommended to reduce default values for UAS and central projection projects, that have quite large image overlapping.

When processing satellite scanner survey projects that have small image overlapping, reducing this parameter can be feasible for the purpose of increasing the quality of boundary construction.

When setting this parameter, it is recommended to take into account the previously set **Precision** of calculation of areas boundaries (see above). The **Precision** and **Image simplification** values that differ by several orders of magnitude, are not advisable

Preliminary **image simplification** before the construction of polygons boundaries is to be performed only if the **unique background color** checkbox is set (see above).

6. In the **Minimal components square** specify the minimal square of the image, below which polygon is not created.

7. [optional] To create polygons not exactly by image frame, but by some distance from it, specify the negative value in the **Offset from images edges** in pixels to create polygons inside frame, or positive value to create them outside.

8. Click OK to start polygons by images frames without background creation.

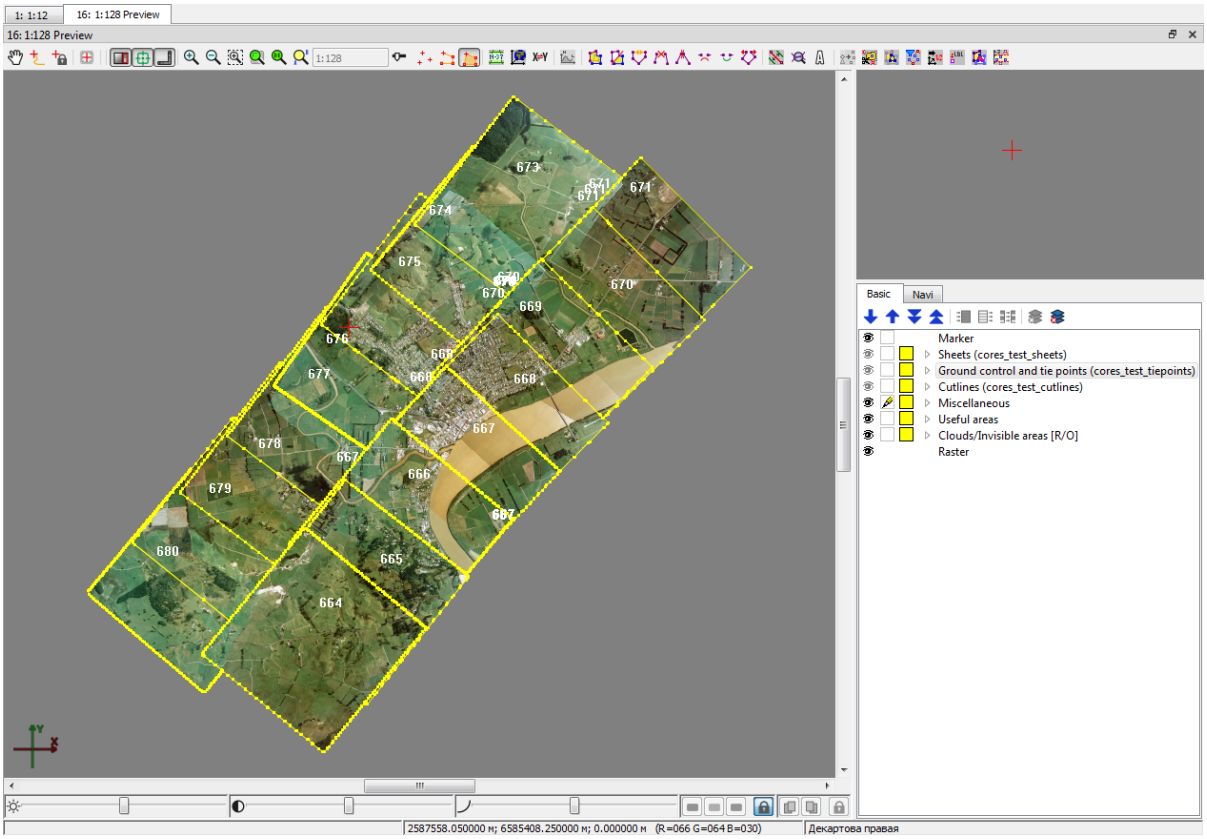


Fig. 99. Creation polygons by images frames without background

13. Mosaic creation

13.1. Mosaic menu

Table 19. Brief description of Mosaic menu

Menu items	Function
Parameters	to setup parameters of mosaic preview and creation, as well as brightness adjustment and output data save
Preview	to open Preview window for the entire block of loaded images considering data processing results

Menu items	Function
Preview (current sheet)	to open Preview window for the selected sheet of mosaic
Clear brightness adjustment	to clear all data about brightness adjustment
Brightness adjustment	to rebuild local adjustment after cutlines change
Distributed global brightness adjustment	to use distributed processing to brightness adjustment
Build full mosaic	to start mosaic building and creation of output files for selected active sheets
Build current sheet	to start of mosaic building and creation of output file for selected sheet
Distributed processing	to start mosaic creation for specified active sheets considering user settings and parameters in distributed processing mode
Distributed processing of PHOTOMOD MegaTIFF	to start mosaic creation using distributed processing with splitting of active sheets
Open image	to open any image of acceptable raster format for preview in the application window
Save parameters preferences	to save mosaic parameters setting for further use them in other mosaic projects (see a description of the **Use saved mosaic settings** option in Appendix A)

13.2. Setup mosaic parameters

13.2.1. General information

To setup mosaic building parameters, choose the **Mosaic › Parameters** or click the button on the main toolbar. The **Mosaic parameters** window opens.

The window contains the following groups of parameters:

- main parameters of mosaic building on the **Mosaic** tab (see Section 13.2.2);
- parameters of local and global brightness adjustment on the **Brightness adjustment** tab (see Section 9.1);
- parameters of ground control and tie points usage for adjustment on the **Ties** tab (see Section 13.2.4);
- parameters of output mosaic sheets on the **Output** tab (see Section 13.2.3);
- additional parameters on the **Misc** tab (see Section 13.2.5).

To save parameters of mosaic creation (for using in other projects), choose the **Mosaic › Save parameters preferences**.

Saved output mosaic settings are load automatically on the program launch. To load default mosaic settings into the **Mosaic parameters** window at the program start, set off the **Use saved mosaic settings** checkbox on the **GeoMosaic** tab in the Settings window (see Appendix A).

13.2.2. Mosaic's main parameters

The **Mosaic** tab of the **Mosaic parameters** window purposes to setup main options of mosaic building.

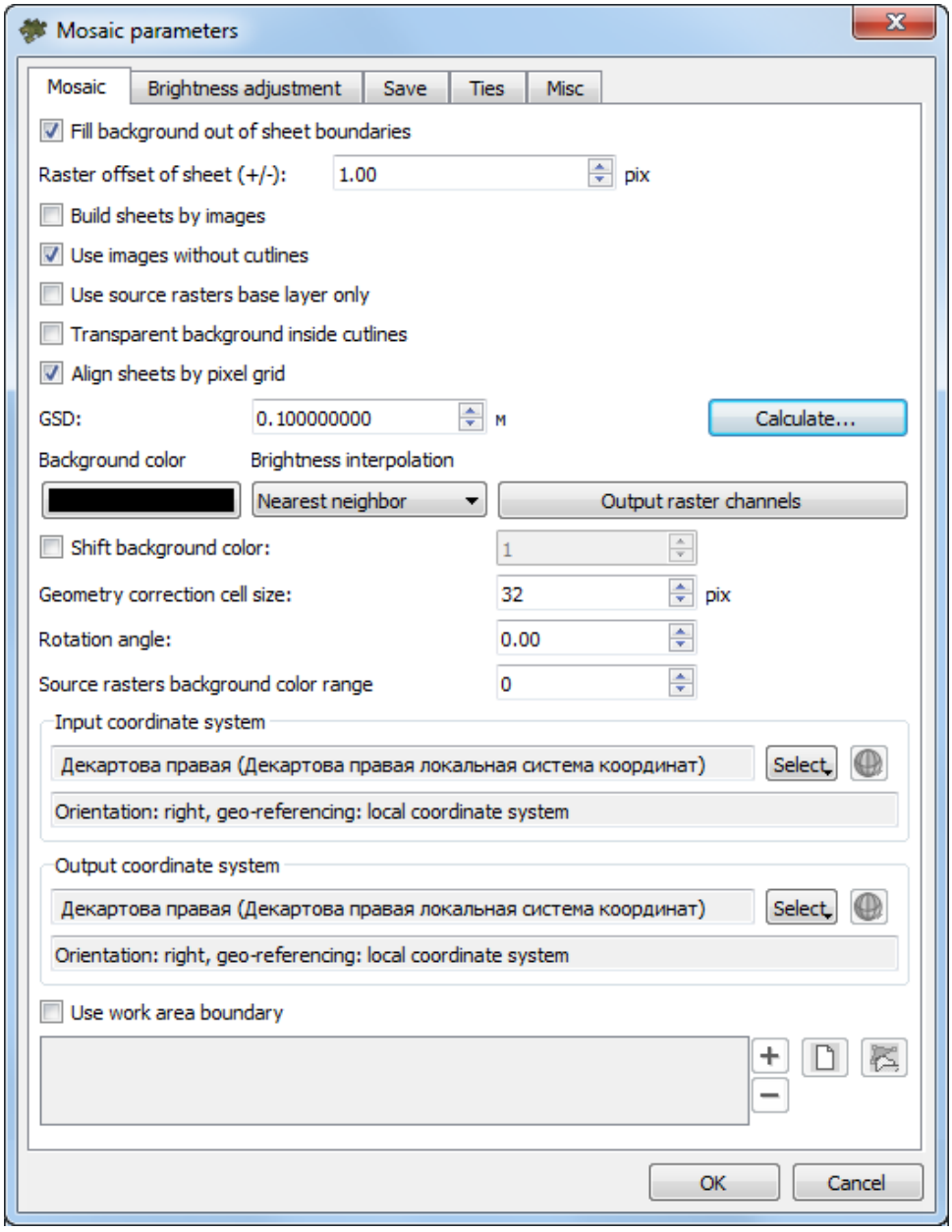


Fig. 100. The 'Mosaic parameters' window

The **Mosaic** tab is used for setting the following parameters of output mosaic:

- **Fill background out of sheet boundaries** – allows to specify a type of filling outside of sheet boundaries in the output mosaic. Otherwise, the images of adjacent sheets are used for the filling;
- **Raster offset of sheet** – allows to specify a buffer zone size on the sheet borders (in pixels);
- **Build sheets by images** – defines a content of sheets when creating a mosaic that is split on sheets by images. If the checkbox is set on, each sheet will contain the only image corresponding to the sheet, i.e. the mosaic will be not created. If the checkbox is set off, each sheet will contain all images that fall into this sheet;

The option is used to perform only export of initial images into different coordinate system or export to files of other raster formats.

After splitting of sheets by images, sheets names in attributes of the *Sheets* layer should be the same as images names.

If the **Build sheets by images** checkbox is set on, mosaic is not built.

- **Use images without cutlines** – allows to use images without cutlines for preview and mosaic creation (see also a description of means of images order change when creating mosaic without cutlines in Section 7.8);
- **Use source rasters base layer only** – allows to use a base layer of initial images pyramid if the mosaic is created using docking (not overlapped) images without creating cutlines. If this checkbox is set off the program uses a pyramid layer corresponding to specified resolution, i. e. the pyramid layer is taken based on the **Cell size** parameter value;
- **Transparent background inside cutlines** – allows to use transparency for areas with input background color inside cutlines;

To apply this parameter it must be set transparency for background color of original images (see Section 7.5).

- **Align sheets by pixel grid** – allows to set the parameters of pixel-by-pixel aligning of sheet frames when exporting mosaic's sheets:
  - If the **Align sheets by common grid** checkbox is set when exporting mosaic's sheets, sheet frames are aligned (shifted) according to pixel mosaic's grid;
  - If the **Align sheets by common grid** checkbox is cleared, mosaic sheets are created independently of each other according to initial vector sheet frames.

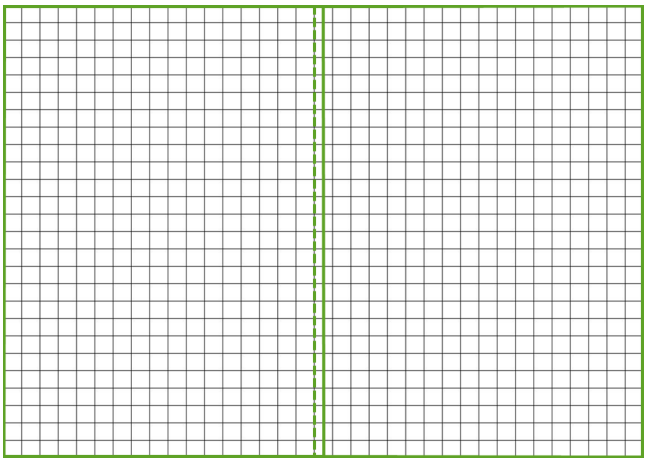


Fig. 101. Aligning the sheets by common grid

- **Cell size** – allows to specify the size of output mosaic cell on the terrain. The cell size by default is equal to the cell size of the first image of mosaic project;

  The **Calculate** button allows to set a mosaic size in pixels and recalculate its cell size accordingly.

  The accuracy of this parameter (a number of decimal places) takes precedence over general system's settings of numbers of decimal places set in the **Settings** window (**Service › Settings › Modules › Decimal places › Orthorectification/Geomosaic**, see the "Setup of modules start" section of the "General system's parameters" User Manual).

- **Background color** – allows to set a color for mosaic background, since output mosaic always inscribes into a rectangular raster shape;

  The **Transparent mosaic background on preview** parameter influences on background color of mosaic in the **Preview** window (see Section A.2).

  - **Shift background color** – allows to specify a shift of colour, for some pixels on the substantial part of image (inside cutlines), if color of these pixels coincides with defined colour of output orthoimages background, after the orthotransformation.

    During an orthophoto creation, images are subjected to geometric transformations and resampling. As a result of such operations, the color of some informative pixels of the raster image may by chance precisely match the chosen output image background color.

    For example, if an image contains three standard channels (RGB) and the user-set *output background color* is black (R=0, G=0, B=0), then, if the color shift was set as 1, pixels inside the cutlines, whose color became black after the processing, will be considered as (R=1, G=1, B=1).

    The color shift direction depends on user-set output background color and given color shift absolute value. For the white background color (R=255, G=255, B=255), for example, the RGB values will decrease.

- **Resampling method** – allows to choose the brightness interpolation mode during orthomosaic creation: **bilinear**, **cubic** or **nearest neighbour**;
- **Output raster channels** – opens the window **Output image parameters**, used for specifying the following parameters:

  By default quantity and structure of channels are defined by first added image.

  - **Use radiometric from RMC-files** – allows to use data of radiometric correction from RMC-file, if correction was done preliminary, for example – in the *Raster Converter* module (see the 'General information' User Manual);

    If the `Monochrome output` checkbox is set on, this channel could be use as a channel in output file.

    If the checkbox is set on, auto levels or radiometric correction could be applied to selected images.

  - **Channels list** – contains list of source (left) and selected for using in orthorectification channels (right);

    Quantity and structure of channels are forming with buttons of the **Channels list** section.

  - **Data format** – allows to choose format of output image: **8 bit** or **16 bit**;
  - **Monochrome output** – allows to create output file with one grayscale channel.

    In case of monochrome output it is impossible to choose structure of channels.

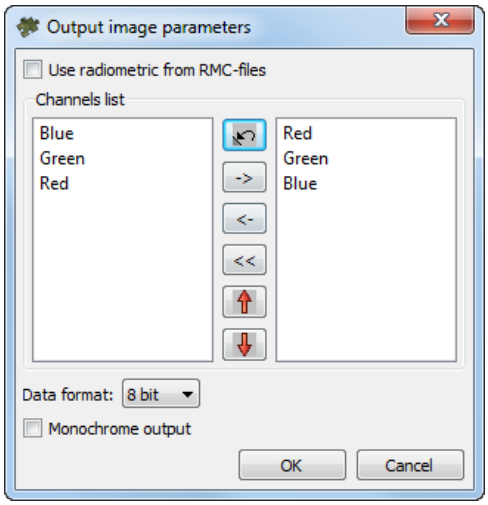


Fig. 102. Output channels parameters

- **Geometry correction cell size** (in pixels) allows to increase significantly data processing speed setting sizes of image fragments to process in accelerated mode.

  If **Geometry correction cell size** is equal to one, each image pixel undergoes complex geometric transformations during processing, what provides the maximum accuracy of mosaic creation at, often, practically unacceptable time expenditures.

  Increasing the geomety correction cell size allows a user to select the optimal ratio of data processing speed and output mosaic quality. In this case, only the four extreme pixels of the cell undergo geometry correction to the full cycle of geometric transformations, while the main content of the cell is interpolated by the bilinear interpolation method.

  Default 32 pixel **Geometry correction cell size** is optimal in most cases.

- **Rotation angle** – allows to setup a rotation angle (in degrees) of mosaic's images;

  Is used if a block of initial images has elongated shape and you need to remove unnecessary background area in rectangular window of created mosaic.

- **Source rasters background color range** – allows to define a deviation from selected background color of initial images, i. e. to specify a range of color, existing in initial images background (see Section 7.5);

Also the **Mosaic** tab allows to choose **Input** and **Output coordinate system** if they are different to the project's coordinate system.

To **use work area boundary** (see Section 2.2), set the appropriate checkbox and specify the path (in the active profile resources) to the prearranged vector layer containing at least one polygon.

The + button allows to open file with polygons. The ... button allows to choose another file, instead the opened. The − button allows to remove the selected file from the list. The button allows to remove all the files from the appropriate list. The button allows to display the selected layer of vector polygons in both the *Layers Manager* and in a 2D window.

Data in the **Preview** window (if open) will be updated taking into account the loaded work area boundary.

The system provides for creating *sheets* of an output mosaic taking into account the *work area* of interest, which makes it possible to avoid sheets completely filled with the *mosaic's background* (see Section 11.3.1).

13.2.3. Mosaic output parameters

The **Save** tab of the **Mosaic parameters** window allows to setup options of mosaic output.

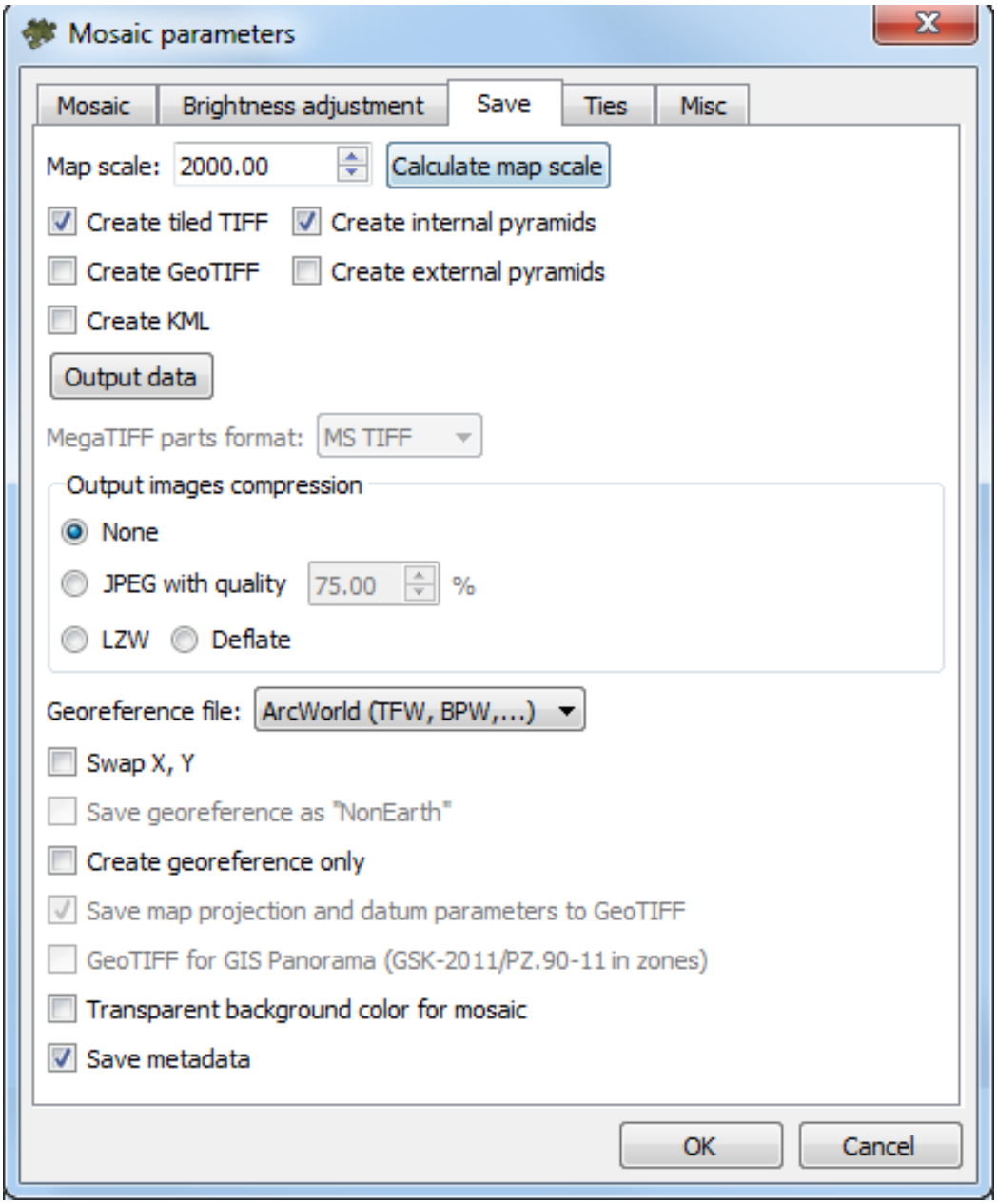


Fig. 103. Mosaic output parameters

The **Map scale** field allows to set the scale of output orthoimages.

The **Calculate map scale** button allows to calculate a scale and map sheet size (in meters) and print resolution.

Information on the printing resolution of an output image (*dpi*, *dpm*) is recorded in the metadata of `*.tiff` and `*.bmp` images, respectively. *DPI* is dots per inch and *DPM* is dots per millimeter.

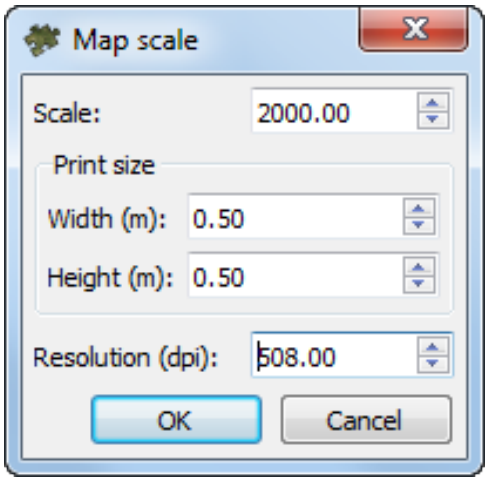


Fig. 104. Map scale

When creating an orthoimage, various additional data can also be created depending on the input **File type**. For this, set or clear the following checkboxes:

- **Create tiled TIFF** – an orthoimage will be created as a MS-TIFF file;

  Creation of MS-TIFF files (so called tiled TIFFs) is available only if **TIFF/BigTIFF** (`*.tiff`, `*.tif`) **File type** was preselected in **Output** window.

  If the **Create tiled TIFF** checkbox is cleared – a `*.TIFF` file is created with a standard line data record format.

  - **Create internal pyramids** – allows for creating pyramids inside MS-TIFF output images for quick redrawing of images on the screen in case of changing the viewing scale.

    To use internal pyramids, the viewer must support the MS-TIFF format.

- **Create external pyramids** – allows for creating pyramids as additional files saved in a separate folder;

  Creation of external pyramids is available only if **TIFF/BigTIFF** (`*.tiff`, `*.tif`) **File type** was preselected in **Output** window.

  It is recommended to create external pyramids for large orthoimages in case when the MS-TIFF format with internal pyramids is not used for orthoimage recording (**Create tiled TIFF** and **Create internal pyramids** checkboxes are cleared).

  Creation of external pyramids for MS-TIFF files is not provided.

- **Create GeoTIFF** – output orthoimages created in GeoTIFF format with pyramids;

Creation of GeoTIFF is available only if **TIFF/BigTIFF (*.TIF, *.TIFF) File type** was preselected in **Output** window.

- **Create KML** – allows to create additional file in `*.kml` format, e.g. to show results in the *Google Earth*;

It is necessary to choose global coordinate system as output to create file in `*.kml` format.

`*.kml`-files are creating both for all block and each image individually.

[optional] Select the **MegaTIFF parts format**, **MSTIFF** or **JPEG 2000** if **PHOTOMOD MegaTIFF** (`*.prf`) files were selected as **File type** in the **Output** window.

The **Output images compression** allows to set up the compression parameters of output mosaic sheets:

- **None** – files are created without compression;
- **JPEG with quality .. %** – TIFF-files are creates with set quality of JPEG-compression;

Default compression level is 75 %, that provides the 5-7 times compression of initial image volume.

- **LZW** – TIFF-files are creates with LZW-compression;
- **Deflate** – TIFF-files are creates with deflate compression.

Also the **Output** tab allows to set the following parameters of saving files during mosaic creation:

- **Georeferenced file** – allows to select the format of the additional file created;
- **Swap X, Y** – allows to swap X,Y coordinates;
- **Save georeference as 'NonEarth'** – allows you to save georeference as NonEarth coordinate system, when saving the resulting mosaic in *MapInfo* format;

Used if *MapInfo* system does not support coordinate system of mosaic project.

- **Create georeference only** – allows to create just georeference files of sheets without building mosaic sheets (i. e. without files creation);
- **Save map projection and datum parameters to GeoTIFF** – allows to save the appropriate additional parameters to metadata of TIFF-file;

Used if it was decided to **Create GeoTIFF**.

To record this information, GeoTIFF tags with `34736` and `34737` codes are used (if the checkbox is cleared, this information is disabled and the default values are used – `PHOTOMOD GeoReference`).

In any case, the image metadata include the coordinates of the image's upper left corner; the image rotation matrix, including the pixel size and coordinates of the image's upper left corner; the type of coordinate system; the units of the coordinate system; and the EPSG (GeoTIFF) code, if available.

- **GeoTIFF for GIS Panorama (GSK-2011/PZ90.11 in zones)** – allows to save the appropriate parameters of coordinate system to metadata of TIFF-file;

Used if it was decided to **Create GeoTIFF**, for the further processing in *Panorama* software.

- **Transparent background color** – allows to set the output background color which is shown in *MapInfo* and *GIS Map 2011* systems, as transparent, when saving the resulting orthoimage in *MapInfo* or *GIS Map 2011* formats, chosen in the **File type** list in the **Output** window;

To save an orthophoto in the *MapInfo* format, choose the **File type** used by this program in the **Output** window and set the **Georeferenced file** that is to be **MapInfo TAB**.

To save an orthophoto in the *GIS Map 2011* format, choose **Panorama raster** (`*.rsw`) in the **File type** list in the **Output** window.

- **Save metadata** – allows to save images metadata in the `*.x-feat`-file: background colour, number of channels and its settings.

The **Output data** button allows to open the **Output** window to select format and target folder of output mosaic sheets.

13.2.4. Using of GC/Tie points parameters

The **Ties** tab of the **Mosaic parameters** window purposes to setup options of using ground control and tie points for adjustment.

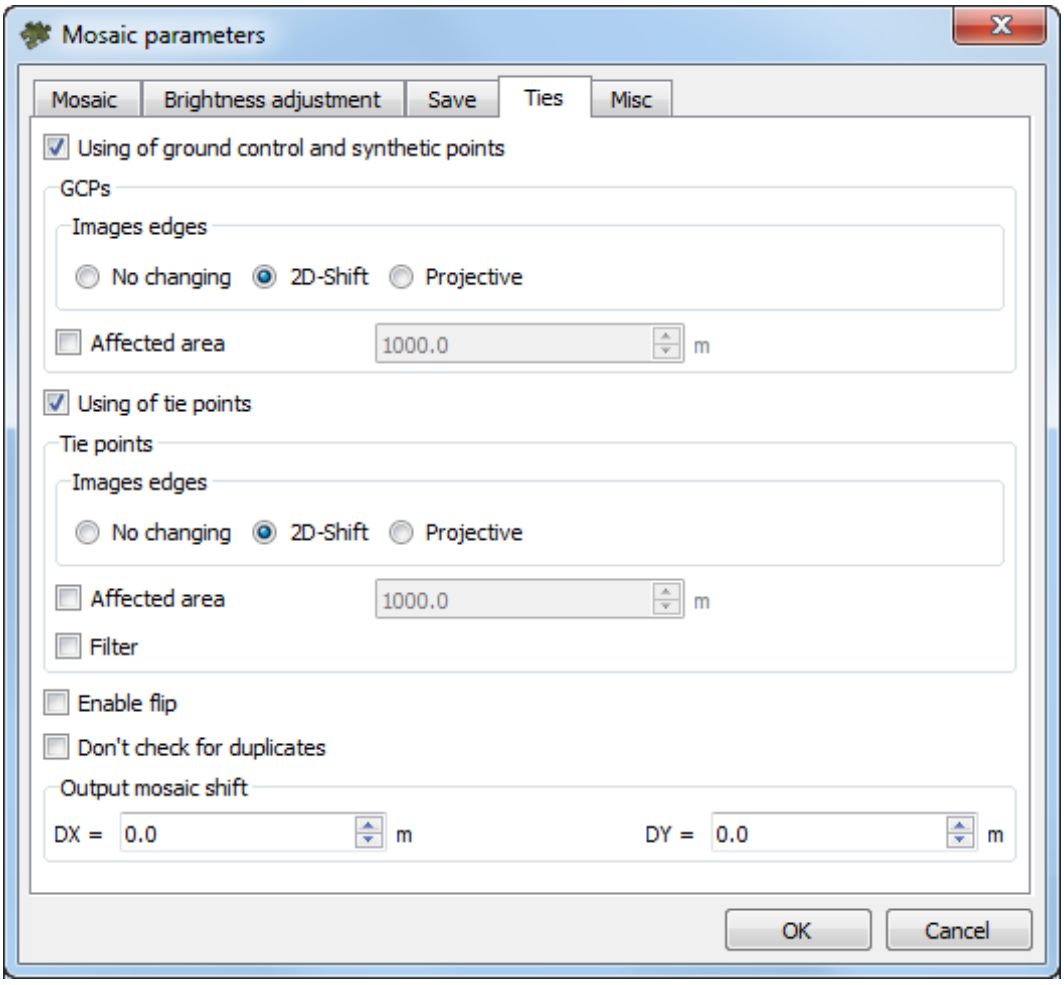


Fig. 105. Using of GC/Tie points parameters

The **Using of ground control and synthetic points** checkbox allows to use ground control points for more precise correspondence of cutlines area.

The **GCPs** section allows to set the following parameters of using ground control points:

- **Images edges** – allows to choose type of transforming which applies on images edges:
  - **None** – allows not to consider images edges;
  - **2D-Shift** – edges consider by average plane parallel shift;
  - **Projective** – to consider edges is used the projective transformation.
- **Affected area** – allows to define maximal distance of ground control point influence in meters.

If the **Affected area** checkbox is set off, maximal distance of ground control point influence is image border.

The **Using of tie points** checkbox allows to use tie points for more precise correspondence of cutlines area.

The **Tie points** section allows to set the following parameters of using tie points:

- **Images edges** – allows to choose type of transforming which applies on images edges:
  - **None** – allows not to consider images edges;
  - **2D-Shift** – edges consider by average plane parallel shift;
  - **Projective** – to consider edges is used the projective transformation.
- **Affected area** – allows to define maximal distance of tie point influence in meters;

If the **Affected area** checkbox is set off, maximal distance of ground control point influence is image border.

- **Filter** – allows to filter part of points during geometric model creation.

The **Enable flip** checkbox allows to invert direction affect of point.

The **Output mosaic shift** section allows to set an output mosaic shift by the coordinate axes (**DX**, **DY**) in meters.

13.2.5. Additional parameters

The **Misc** tab allows to to setup additional options of creating mosaic.

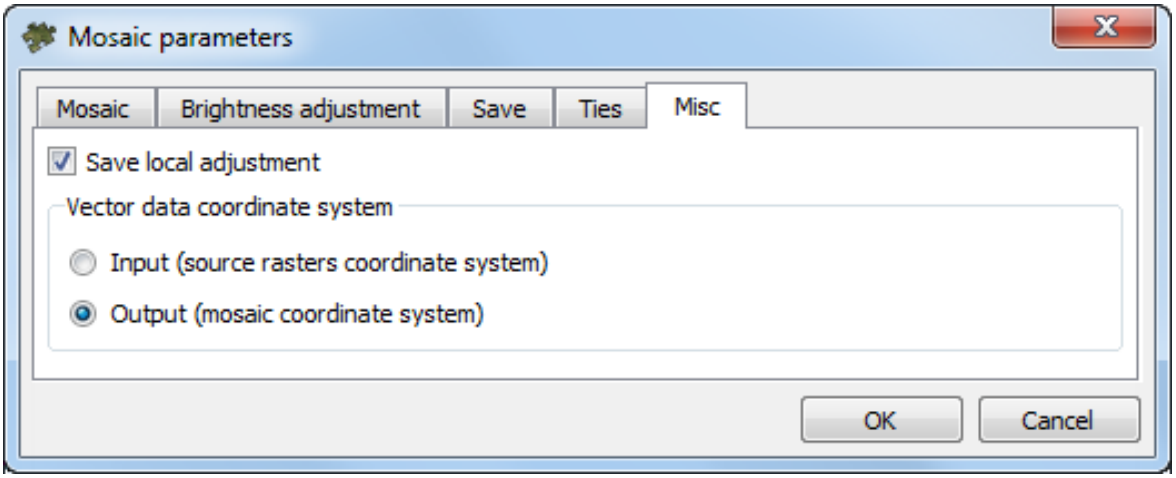


Fig. 106. Additional parameters

The **Save local adjustment** checkbox allows to turn on/off saving of parameters and settings of local brightness adjustment to file of mosaic project.

The **Vector data coordinate system** section allows to select input or output coordinate system of a project for storing of vector data (cutlines, sheets boundaries, tie points etc.).

It is recommended to select output coordinate system (by default), since it is impossible to re-calculate coordinate system during sheets creation. Coordinate system of initial images and output mosaic are specified on the **Mosaic** tab.

13.3. Creation of output mosaic sheets

For creation of resulting output product – georeference files and sheets of mosaic (orthophotos) in specified coordinate system and scale – perform one of the following actions:

- [optional] to create output orthophoto for current sheet perform the following:

  1. On the *Sheets* layer select a border of a sheet, for which the output file will be created;

  2. Choose the **Mosaic › Build current sheet** or click the  button on the main toolbar. The **Save as** window opens. Specify the name, format and output file location in *Windows* file system. Default file name is a name of sheet stored in attributes of the *Sheets* layer.

- [optional] To create output orthophotos for several mosaic sheets perform the following:

  1. Define active sheets on the *Sheets* layer, for which the output files will be created (see Section 11);

  2. Choose the **Mosaic › Build full mosaic** or click the  button on the main toolbar. The **Sheets file** window opens. Specify format and target folder for output files;

  3. The **Output** window opens. Configure or confirm pre-configured orthoimage parameters:

     Preliminary access to the **Output** window is possible via the **Output data** button located in the **Save** tab of the **Mosaic parameters** window. When you start building the mosaic, the **Output** window opens for final confirmation of the settings.

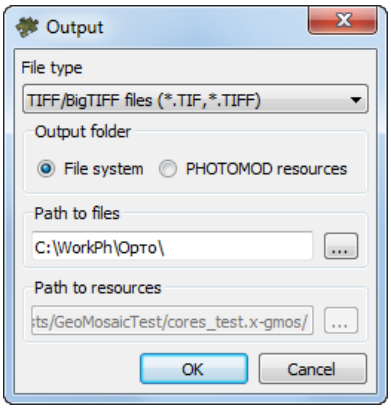


Fig. 107. Output parameters

Set the following parameters:

- Choose **File type** for output orthoimages from drop-down list.
  - **TIFF / BigTIFF files** (`*.tiff`, `*.tif`);
  - **Windows Bitmap** (`*.bmp`);
  - **Panorama raster** (`*.rsw`);
  - **ERDAS IMAGINE** (`*.img`);
  - **NITF** (`*.nitf`);
  - **JPEG** (`*.jpg`, `*.jpeg`);
  - **PNG** (`*.png`);
  - **Microstation** (`*.gfn`);
  - **PCIDSK** (`*.pix`);
  - **JPEG2000** (`*.jp2`);
  - **PHOTOMOD MegaTIFF** (`*.prf`);
  - **ECW** (`*.ecw`);
  - **WebP** (`*.webp`).
- Select an **output folder** location:
  - [optional] in **file system**;

- click the ... button to specify the **path to files**.

■ [optional] in **PHOTOMOD resources**.

- click the ... button to specify the **path to resource**.

Click OK.

4. [optional] If the **Panorama raster** (`*.rsw`) **File type** was chosen in **Output** window (see paragraph **3** above), the **Panorama map selection** window opens:

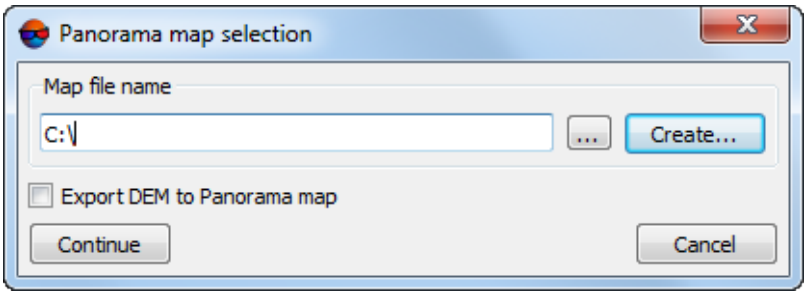


Fig. 108. Parameters of Panorama map export

Set name and path for the map file with one of the following ways:

○ click the ... button to export the map `*.sit`-file;

○ click the **Create** button to create a new Panorama map (`*.sit`), input filename and click the **Save** button;

○ to export DEM that is used in orthomap creation, set on the **Export DEM to Panorama map** checkbox.

The following files are created with orthophoto:

- mosaic sheets in chosen format;
- reference files;
- the file with `*.prj` extension, with information about coordinate system in OGC WKT format.

A file name with `*.prj` extension corresponds to the project's name.

The WKT (well known text) format is a common text format of coordinate system description developed according to *ISO* standards (International Standardization Organization) and standards of *Open Geospatial Consortium*, an international organization committed to making quality open standards for the global geospatial community.

13.3.1. Distributed processing

To create orthoimages in distributed processing mode, perform the following actions:

1. Change settings and run the distributed processing server/client (see the “Distributed processing” chapter in the “General information about system” User Manual).

2. Choose the **Mosaic › Distributed processing**. The **Mosaic distributed processing** window opens.

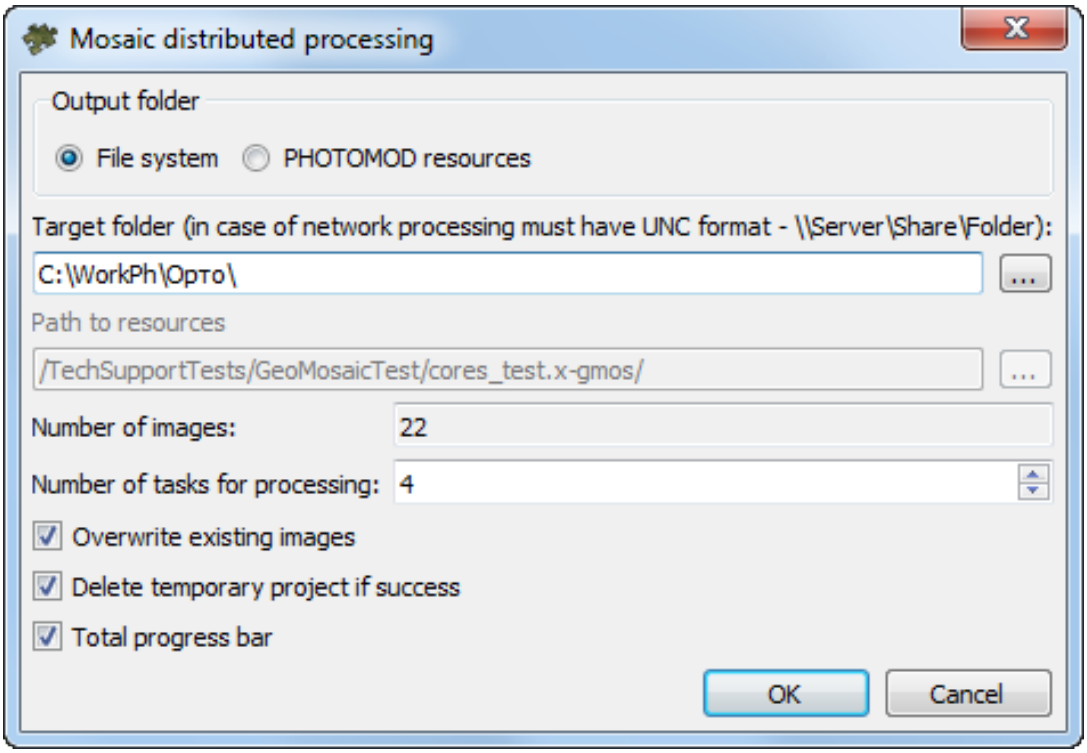


Fig. 109. Mosaic’s distributed processing parameters

Save the orthorectification project if it was changed.

3. Choose the **output folder** location:

   - **File system**;

     - Define **Target folder** for output orhoimages.

       In case of network processing path mast have `\\Server\Share\Folder` format.

   - **PHOTOMOD resources**.

- Specify the **path to resources**.

4. The **Number of sheets** displays in the window. Set the **Number of tasks for processing** based on one kernel for one task.

5. [optional] By default in distributed processing mode only that sheet are creating that have not created yet. Set on the **Overwrite existing sheets** to overwrite preliminary created orthoimages.

6. [optional] By default if process was completed successfully, temporary project is deleted. Set the appropriate checkbox off not to delete temporary files.

7. Set the **Total progress bar** checkbox, to keep the progress bar open when distributed processing tasks are completed (see “Progress bar for distributed processing” in the “General information” User Manual).

8. Click OK. Distributed processing tasks are created and the system shows a message about number of created tasks.

The system does not allows for mosaic brightness adjustment when building a mosaic in the distributed processing mode ( ), nor in the mode of MegaTIFF distributed processing ( ). Herewith, brightness adjustment can be a part of the process of mosaic building in the normal course ( ).

Building a mosaic in the distributed processing mode ( ) is available either for projects with previously performed brightness adjustment, or if brightness adjustment is disabled when setting mosaic parameters (i.e. brightness adjustment is not included in the list of tasks to be executed when building a mosaic in the distributed processing mode). Otherwise the system gives the following warning:

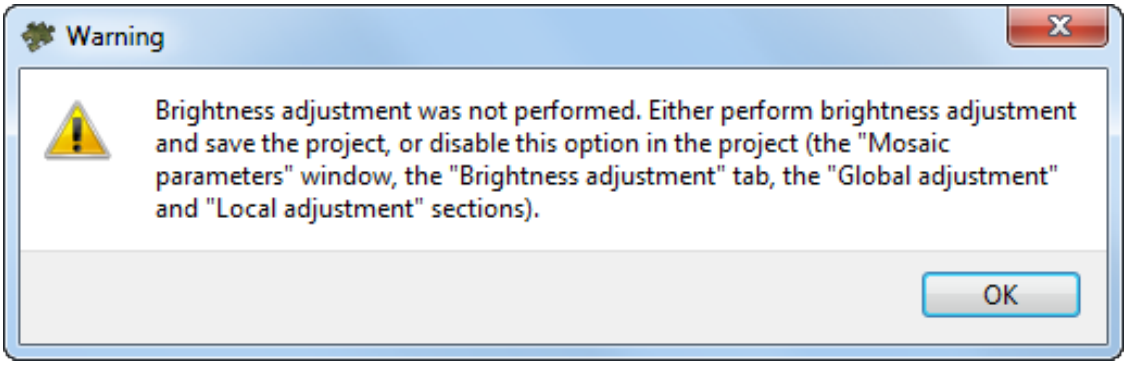


Fig. 110. A warning when starting distributed processing

In case of this warning, to start distributed processing, perform the following:

- [optional] make brightness adjustment previously and save the project ( );
- [optional] disable brightness adjustment previously in the **Mosaic parameters** window:

- In the **Mosaic parameters** window, **Brightness adjustment** tab, **Global adjustment** section, choose **None**;
- In the **Mosaic parameters** window, **Brightness adjustment** tab, **Local adjustment** section, clear the **On** checkbox.

13.3.2. Distributed processing of PHOTOMOD MegaTIFF

To create orthoimages in MegaTIFF format in distributed processing mode, perform the following actions:

1. Change settings and run the distributed processing server/client (see the '*Distributed processing*' chapter in the 'General information about system' User Manual).
2. Choose the **Mosaic › Distributed processing of PHOTOMOD MegaTIFF**.

   Save the mosaic project if it was changed.

   The **Mosaic distributed processing** window opens.

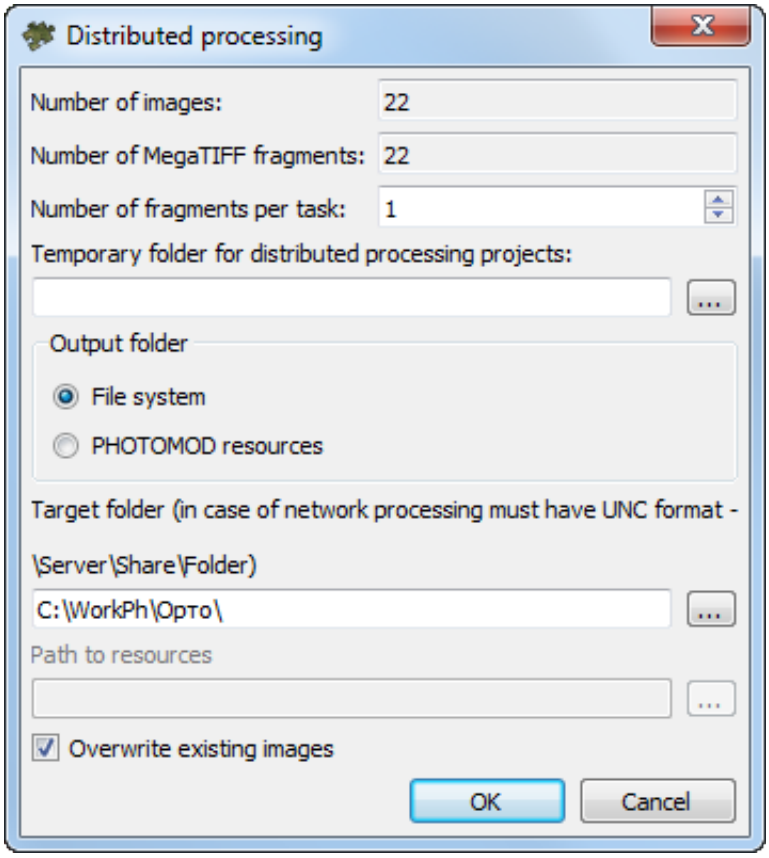


Fig. 111. Mosaic's distributed processing parameters

The total **Number of sheets** and **Number of MegaTIFF fragments** are displays in the window.

The system allows to change **Maximum size of MegaTIFF "fragment"** value. Upper limit of file size included to MegaTIFF files set – 8 192 MB; file size by default – 1 024 MB (see the "System settings" chapter of the "General system's parameters" User Manual).

3. Set the **Number of fragments per task**. It is recommended to define this parameter depending on computer hardware performance. Recommended approximate **Number of fragments per task** is **Number of MegaTIFF fragments** / number of processor cores ratio.

When setting distributed processing, it is also necessary to take into account the network capacity. For example, for 1 Gbit/s local network the recommended **Max tasks** is no more than 4.

To set **Max tasks** quantity choose **Service › Distributed processing › Monitor** and press the  button (see the "General information" User Manual).

4. Define path for temporary files of distributed processing.

5. Choose the **output folder** location:

   - **File system**;
     - Define **Target folder** for output orhoimages.

In case of network processing path mast have `\\Server\Share\Folder` format.

   - **PHOTOMOD resources**.
     - Specify the path to resources.

6. [optional] By default in distributed processing mode only that sheet are creating that have not created yet. Set on the **Overwrite existing sheets** to overwrite preliminary created mosaic sheets.

7. Click OK. Distributed processing tasks are created and the system shows a message about number of created tasks.

8. [optional] in case if the any **File type**, except **PHOTOMOD MegaTIFF**, was chosen in **Output** window, the appropriate warning message opens:

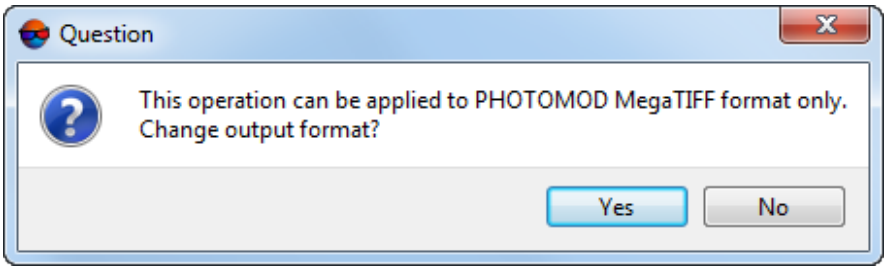


Fig. 112. The warning message

Set the correct **File type** (**PHOTOMOD MegaTIFF**) to continue the orthorectification in MegaTIFF format in distributed processing mode ( ).

The system does not allows for mosaic brightness adjustment when building a mosaic in the distributed processing mode ( ), nor in the mode of MegaTIFF distributed processing ( ). Herewith, brightness adjustment can be a part of the process of mosaic building in the normal course ( ).

Building a mosaic in the distributed processing mode ( ) is available either for projects with previously performed brightness adjustment, or if brightness adjustment is disabled when setting mosaic parameters (i.e. brightness adjustment is not included in the list of tasks to be executed when building a mosaic in the distributed processing mode). Otherwise the system gives the following warning:

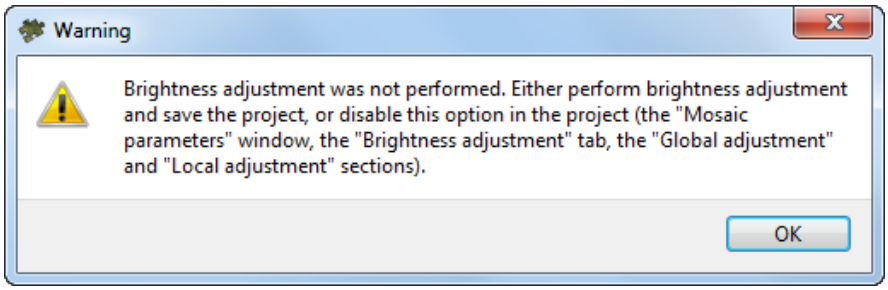


Fig. 113. A warning when starting distributed processing

In case of this warning, to start distributed processing, perform the following:

- [optional] make brightness adjustment previously and save the project ( );
- [optional] disable brightness adjustment previously in the **Mosaic parameters** window:
  - In the **Mosaic parameters** window, **Brightness adjustment** tab, **Global adjustment** section, choose **None**;
  - In the **Mosaic parameters** window, **Brightness adjustment** tab, **Local adjustment** section, clear the **On** checkbox.

Appendix A. Program parameters

A.1. General parameters

Programs provides possibility to setup general parameters of program and mosaic preview parameters on the **Preview** tab. See the description of general parameters of the program in the 'General system's parameters' User Manual.

To set up common program parameters choose the **Service › Settings** or click the button on the main toolbar. The **Settings** window opens.

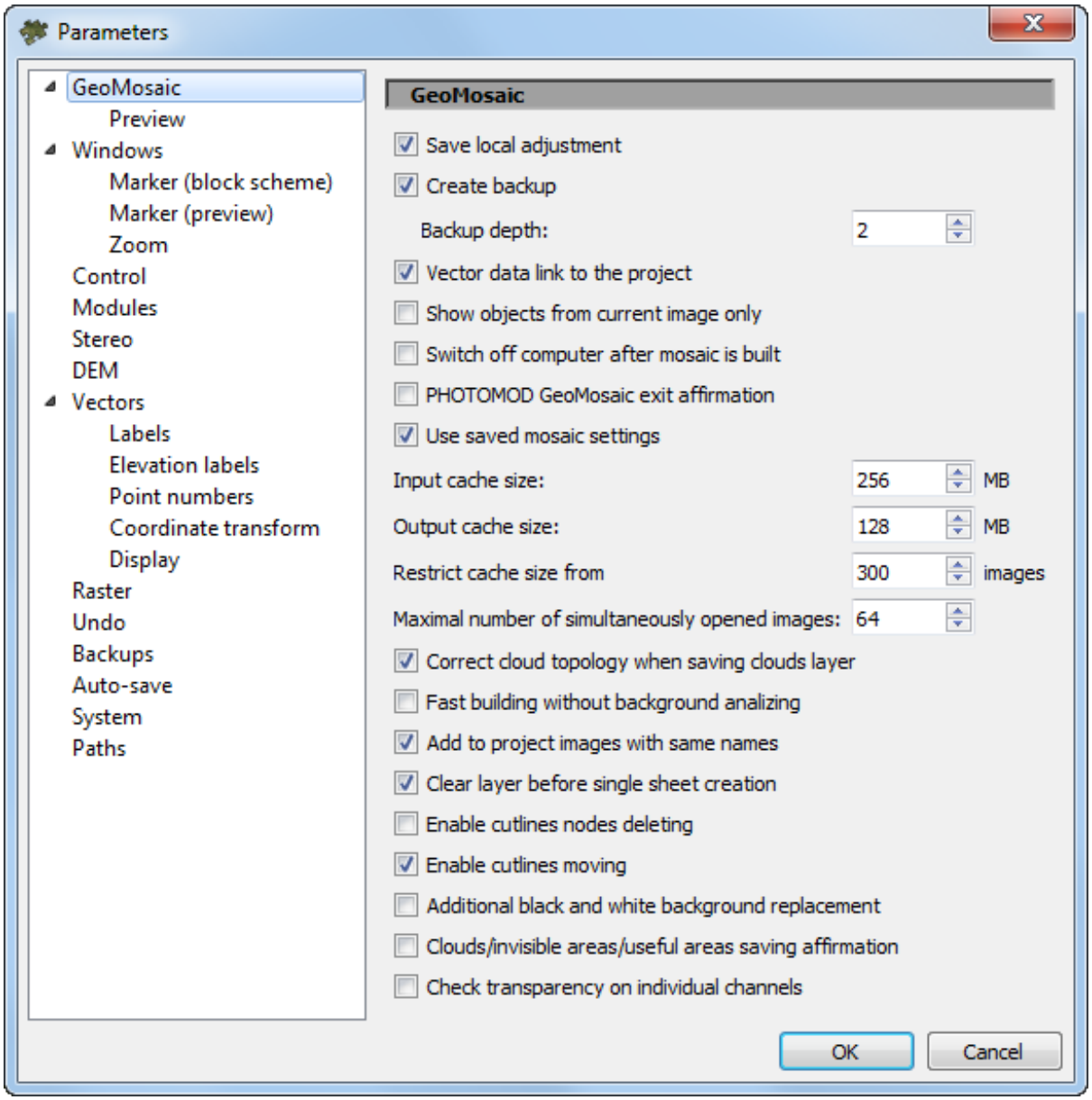


Fig. A.1. Common parameters

The **GeoMosaic** tab allows to setup the following general settings:

- **Save local adjustment** – allows to turn on/off saving of parameters and settings of local brightness adjustment to file of mosaic project;
- **Create backup** – allows to setup automatic save of mosaic project backups to active profile resources;

  In the **Backup depth** field the number of backup projects copies is displayed.

- **Vector data link to the project** – allows to save (in the first time) all external data with names attached to project name automatically (e.g. `project name_sheets.x-data`);

  In case this checkbox is set and cutlines (or other vector layers) from another project are used during the current project processing, then when saving the project being processed, all the above vector layers are saved as copies belonging with this project.

  Otherwise, there are still possible troubles due to the fact that the same vector object was edited several times during the processing of several different projects.

  Note that in case of automatic creation such vector objects as *cutlines* in *PHOTOMOD GeoMosaic*, the created vector layer is primarily available for collaborative editing by several users and has `*.cx-data` extension (see “Co-editing vector layers” and “Co-editing topologically connected vector objects” of the “Vectorization” User Manual).

- **Show objects from current image** – allows to display vector objects relating only to image opened in the **Images preview** window (see Section 7.4);
- **Switch off computer after mosaic is built** – allows to setup computer automatic switch off after completion of mosaic creation;
- **PHOTOMOD GeoMosaic exit affirmation** – allows to show a prompt on confirmation of exit from the program when user tries to close main program window;
- **Use saved mosaic settings** – allows to load previous mosaic parameters when program starts;
- **Input cache size** – allows to set the limitation of the cache size for reading images (by default 256 Mb);
- **Output cache size** – allows to set the limitation of the cache size for recording images (by default 100 Mb);
- **Restrict cache size from** – allows to set max images number, when cache size is 5 Mb per image, otherwise the cache size has limited to 0.5 Mb per image;

- **Maximal number of simultaneously opened images** – allows to set limit on the opened images number in the formats JPEG, NIFF, IMG, PIX (in the case of a lot of images, it is recommended to convert the images files to the TIFF-format files);
- **Correct cloud topology when saving clouds layer** – allows to correct topology errors of vector polygons automatically on layer *Clouds/Invisible areas* while it is saving;
- **Fast building without background analysing** – allows to build fast mosaic without transparency of input background color;
- **Add to project images with same names** – allows to add images with the same names, which store in different folders;
- **Clear layer before single sheet creation** – allows to delete all vector objects from the *Sheets* layer before creation of single sheet;
- **Enable cutlines nodes deleting** – allows to delete node of cutline – point, where three or more cutlines are connected.
  - If checkbox is cleared – a points, nearest to deleted node, are connected against each other;
  - If checkbox is set – a “hole” appears, after the point is deleted.

Use **Cutlines › Replace current nod by new cutline** to create a new cutline as a small rectangle polygon in the place of the node (the point where three or more cutlines converge). This polygon can be further edited by the user.

If the vertices of adjacent cutlines located next to a node vertex are too close to it, then when user tries to **replace current node by new cutline**, the appropriate error message is displayed: **Inserting cutline is too small**. If this system message appears, manually delete the vertices closest to the node and try to repeat this operation by clicking the button in the main toolbar.

- **Enable cutlines moving** – allows to enable/disable the movement of cutlines on the images, if the checkbox is not set, only the vertices of the cutlines are moving;
- **Additional black and white background replacement** – allows to use both black and white color in the background;

For correct consideration of several background colors, set the **Shift background color** checkbox in the **Mosaic** tab of the **Parameters** window (**Mosaic › Parameters**).

- **Fill background color outside “Background” cutlines** – beyond “Background” cutlines the output mosaic background color is used which is to be determined in the **Parameters** window (see Section 13.2);

- The checkbox, activating the **Clouds/invisible areas/useful areas saving affirmation** when the programs close (if any changes have been made);
- The checkbox, allowing to **check transparency by channels** when setting *background color of source images* (see Section 7.5).

For example, if an image contains three standard channels (RGB) and the user-set *background color of source images* is black (R=0, G=0, B=0), then, if the checkbox was set, pixels whose intensity value corresponds to the given one (zero), at least in one of the channels, will also be considered transparent.

In case of incorrect compression of source raster images (before their processing in *PHOTOMOD*), separate pixels may appear on the border between the background and the content of the image, actually initially belonging to the background, but, in the end, slightly different from its original color.

Transparency check over individual channels makes it possible to consider such pixels as transparent, in case if the original image background is black (R=0, G=0, B=0), or, for example, white (R=255, G=255, B=255).

This checkbox is not recommended, if the *background color of source images* is arbitrary, since all pixels whose intensity values match the color selected by the user, will be processed as transparent, at least within one channel.

A.2. Preview parameters

The **Preview** tab is used to specify display parameters of mosaic.

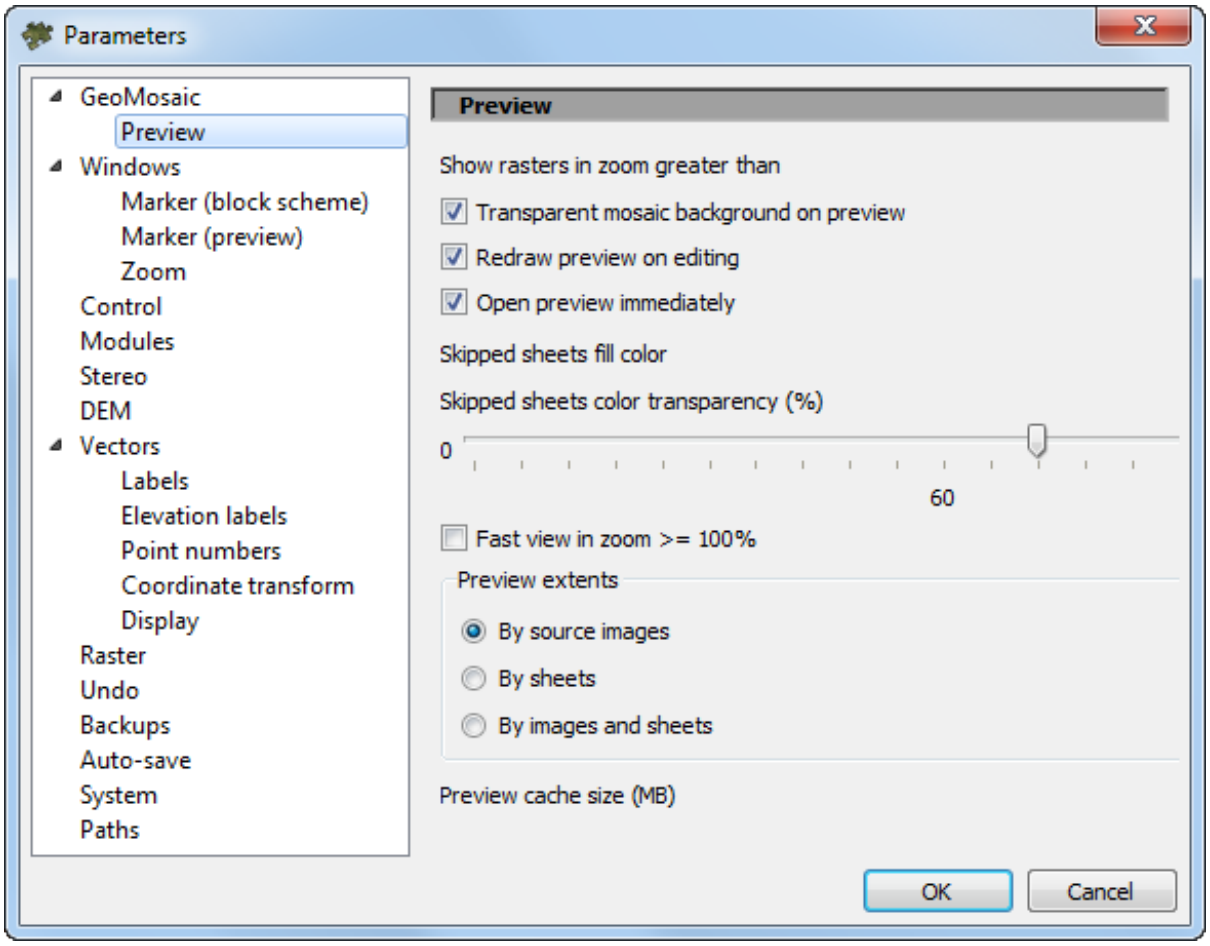


Fig. A.2. Preview parameters

The **Preview** tab allows to setup the following mosaic visualization options:

- **Show rasters in zoom greater than** – allows to setup a zoom at which a visualizing of mosaic project images in the **Preview** window begins;
- **Transparent mosaic background on preview** – allows to setup a transparency of output mosaic background visible in the **Preview** window (see Section 7.4);
- **Redraw preview on editing** – allows to set automatic refreshing of mosaic data in the **Preview** window during editing of vector objects – cutlines and change points;
- **Open preview immediately** – allows to show added images in the **Preview** window right away (see Section 7.4);
- **Skipped sheets fill color** – allows to select a fill color to show inactive sheets of mosaic (i.e. sheets excluded from output files creation). To adjust the transparency degree for selected color is used the **Skipped sheets color transparency (%)** slider (see Section 11.8);

- **Fast view in zoom < = 100%** – allows to display images block as a scheme in the **Preview** window when zoom out (is recommended for large images blocks);

  It is recommended to set on this parameter while processing of large image blocks.

- **Preview extents** – allows to define extents for displaying content in the **Preview** window:
  - **By source images** – extents by full image;
  - **By sheets** – extents by all created sheets;
  - **By images and sheets** – edges of images and sheets.
- **Preview cache size** – allows to set the size of a cache for mosaic project images which are displayed in the **Preview** window.

  When setting this parameter, it is required to take into account available RAM of the workstation.

Appendix B. Raster data georeference

The program allows to georeference raster data located in *Windows* file system (for example, scanned cartographic maps, see also the "ScanCorrect" User Manual).

The following materials could be used to do this:

- A file, containing information about the points with known geodetic coordinates;
- The already georeferenced map for the same terrain area:
  - The raster georeferenced map located in *Windows* file system;
    - The additional vector map, located in *PHOTOMOD* active profile resources.

The system also allows to transfer GC points and measure them on project images, during the project processing (see the "Transfer GCP from georeferenced external data" and the "GC point transfer from DEM considering adjustment data" chapters of the "Aerial triangulation" User Manual).

The **Raster georeference** window is used to perform raster map georeference (**Service › Images georeferencing**).

To open this window in *PHOTOMOD* or *PHOTOMOD UAS* software, select **Rasters › Images georeferencing**.

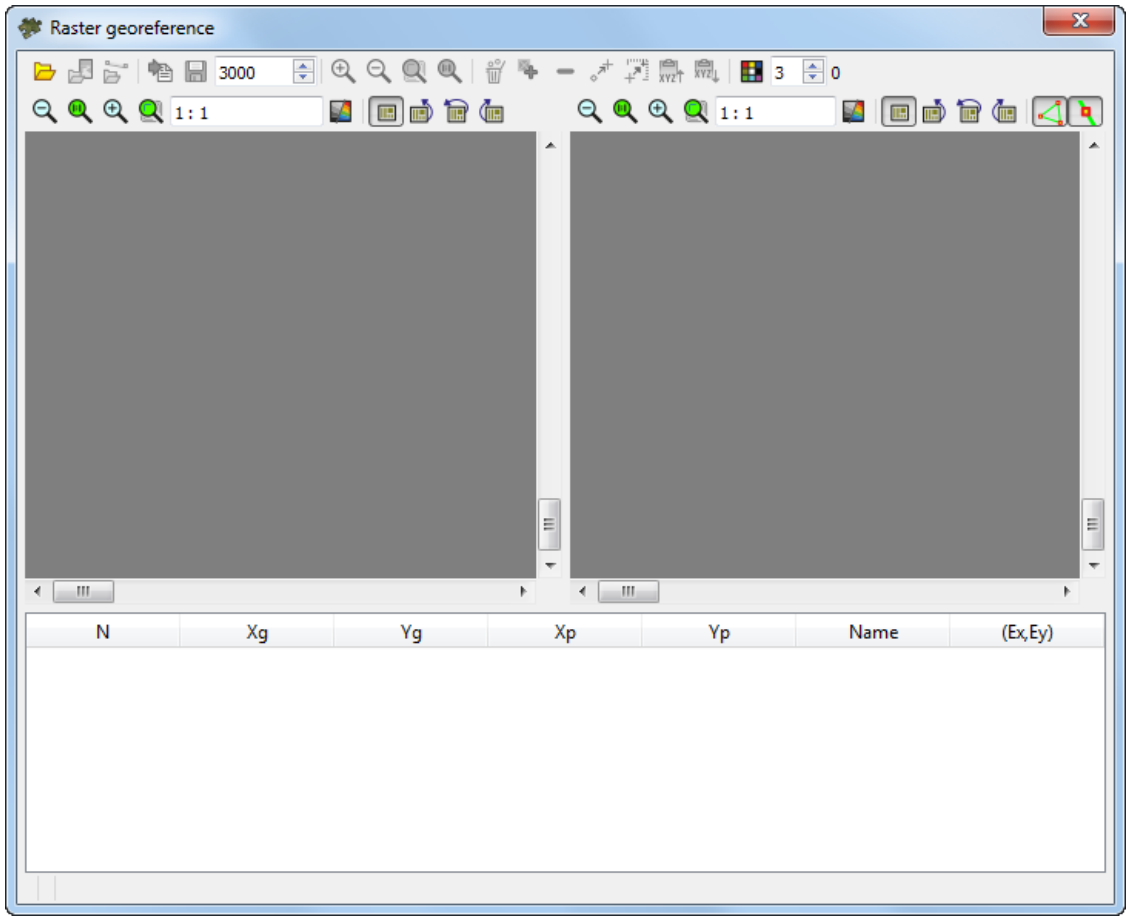


Fig. B.1. The Raster georeference window

The window contains the following GUI elements:

- The main window toolbar;
- The window in the left part of the working area (where the raster image, that need to be georeferenced is loaded) with the standard tools used to manage image's zoom and rotation;
- The window in the right part of the working area (there can be located reference raster map or raster and additional vector maps, if these maps are used) with the standard tools used to manage map's zoom and rotation;
- Table in the bottom part of the working area containing georeference points coordinates with the following columns:
  - `Xg`, `Yg` – point's geodetic coordinates;
  - `Xp`, `Yp` – pixel point's coordinates on the raster image, that need to be georeferenced;
  - `Name` – point's name;

- (Ex,Ey) – errors in point's X,Y coordinates measurements.

- A string in the lower part of the window, displaying the marker coordinates (Xp, Yp and Xg, Yg – the last ones are for the georeferenced data only).

Table B.1. Main toolbar of the Raster georeference window

Buttons	Functions
	to load raster image without georeference to the left part of the window
	to load georeferenced raster map to the right part of the window
	to add georeferenced additional vector map from the active profile resources, to the right part of the window (only if the raster data has been already loaded)
	to load GC points data from text file with *.txt or *.csv extensions
	to save the created georeference data to *MapInfo* files (with *.aux and *.tab extensions) with a names, that coincide with the processed raster image name
	to manage the zoom of image and map(s) display in both parts of the window
	to remove all GC points from the table and from the both images
	to add a new point both to the image(s) and to the coordinate's table. The pixel coordinates (Xp, Yp) are saved as marker's ones on the processed image (left), and geodetic coordinates (Xg, Yg) are taken from the marker's position on the reference map (right), in case if the reference data is loaded. Otherwise – Xg and Yg cells are assigned to 0 value. The points on the image(s) are marked by yellow X-shaped crosses by default (see the  button description)
	to delete a point selected in the table
	to refresh pixel and/or geodetic coordinates of selected point (to save the coordinates of a new marker position on the image (or on the image and on the map)
	to move marker on map point, selected in the table, that means that the system performs search for selected point on the map
	to copy coordinates of a point selected in the table to clipboard (the coordinates are copied in the following format: Xp Yp Xg Yg, separated by space symbol)
	to refresh coordinates of selected point – to paste them from a clipboard (the following formats are acceptable: Xg Yg; Xg Yg Zg; Xp Yp Xg Yg; Xp Yp Zp Xg Yg Zg, where Z coordinates will be not added to the table)
	to open *Windows* standard color settings window, that allows to choose color of GCP symbols shown on the image/map

Table B.2. Toolbar of the georeferenced raster image (left)

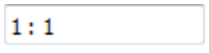
Buttons	Functions
	to manage the zoom of processed image display. The  field is used to display a current scale
	to hide/show the raster image
	to rotate image in the working window (no rotation, rotate by 90, 180, 270 degrees)

Table B.3. Toolbar of the reference raster and vector maps (right)

Buttons	Functions
	to manage the zoom of map(s) display. The  field is used to display a current scale
	to hide/show the raster map
	to rotate map(s) in the working window (no rotation, rotate by 90, 180, 270 degrees)
	to hide/show loaded vector objects
	to hide/show loaded vector object's vertices

B.1. Raster data georeference with manual data input

To perform georeference of raster map, using the known geodetical coordinates of GC points, do the following actions:

1. Select **Service › Images georeferencing**. The **Raster georeference** window opens.

   To open this window in *PHOTOMOD* or *PHOTOMOD UAS* software, select **Rasters › Images georeferencing**.

2. Click the  button of the main toolbar. Select a raster file without georeference, located out of active profile resources and click OK. After that a raster image is displayed in the left part of the window:

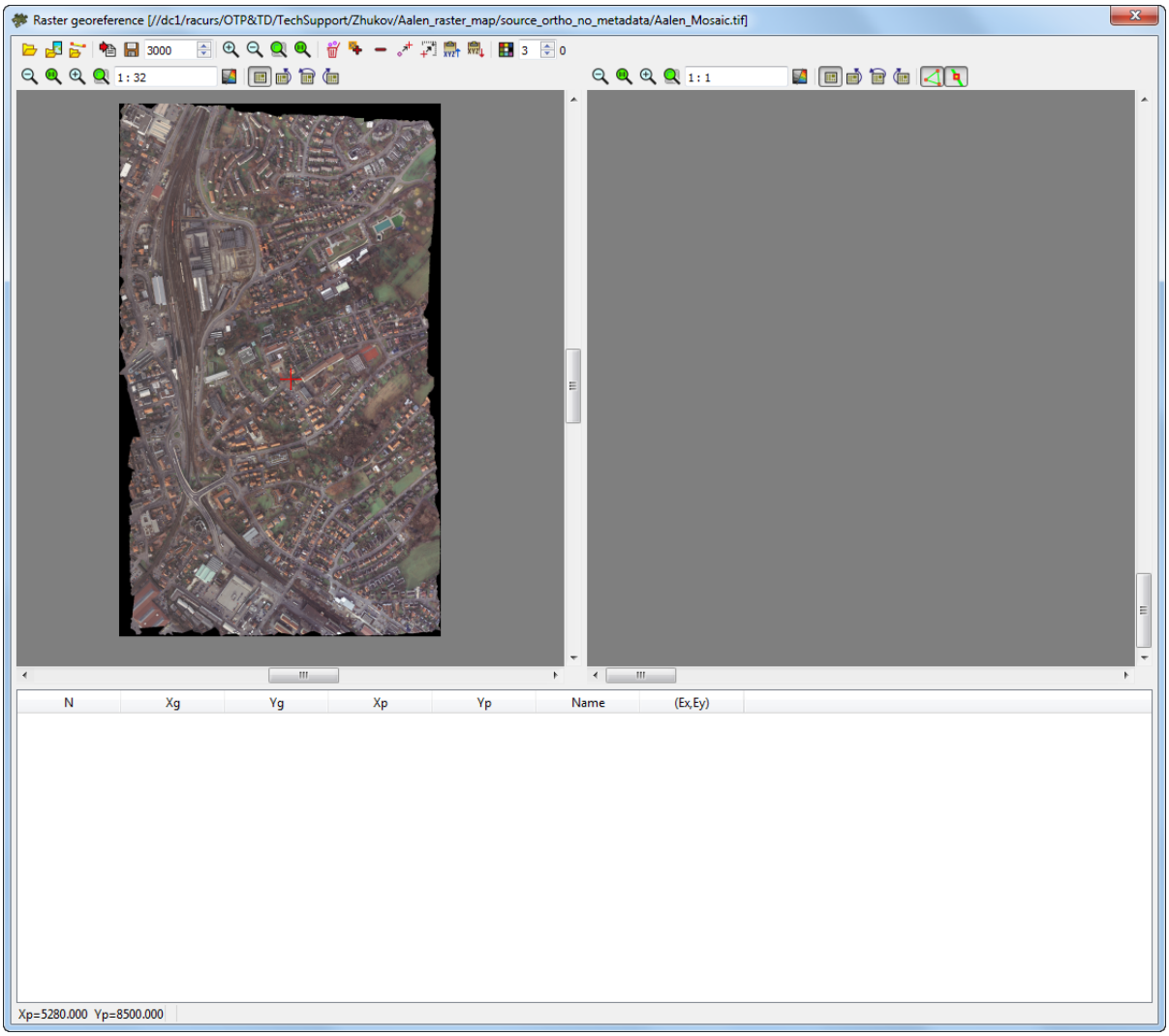


Fig. B.2. Loaded image that need to be referenced

3. Locate GC point on the image and place marker to this terrain point.

4. Click the button. The point with pixel coordinates is added to the table.

5. Input manually geodetic coordinates of this point into the Xg, Yg columns and specify the point's name in the Name field.

When the fifths point coordinates on the map are measured, coordinates measurement residuals are calculated automatically and are shown in the Ex, Ey columns of the table.

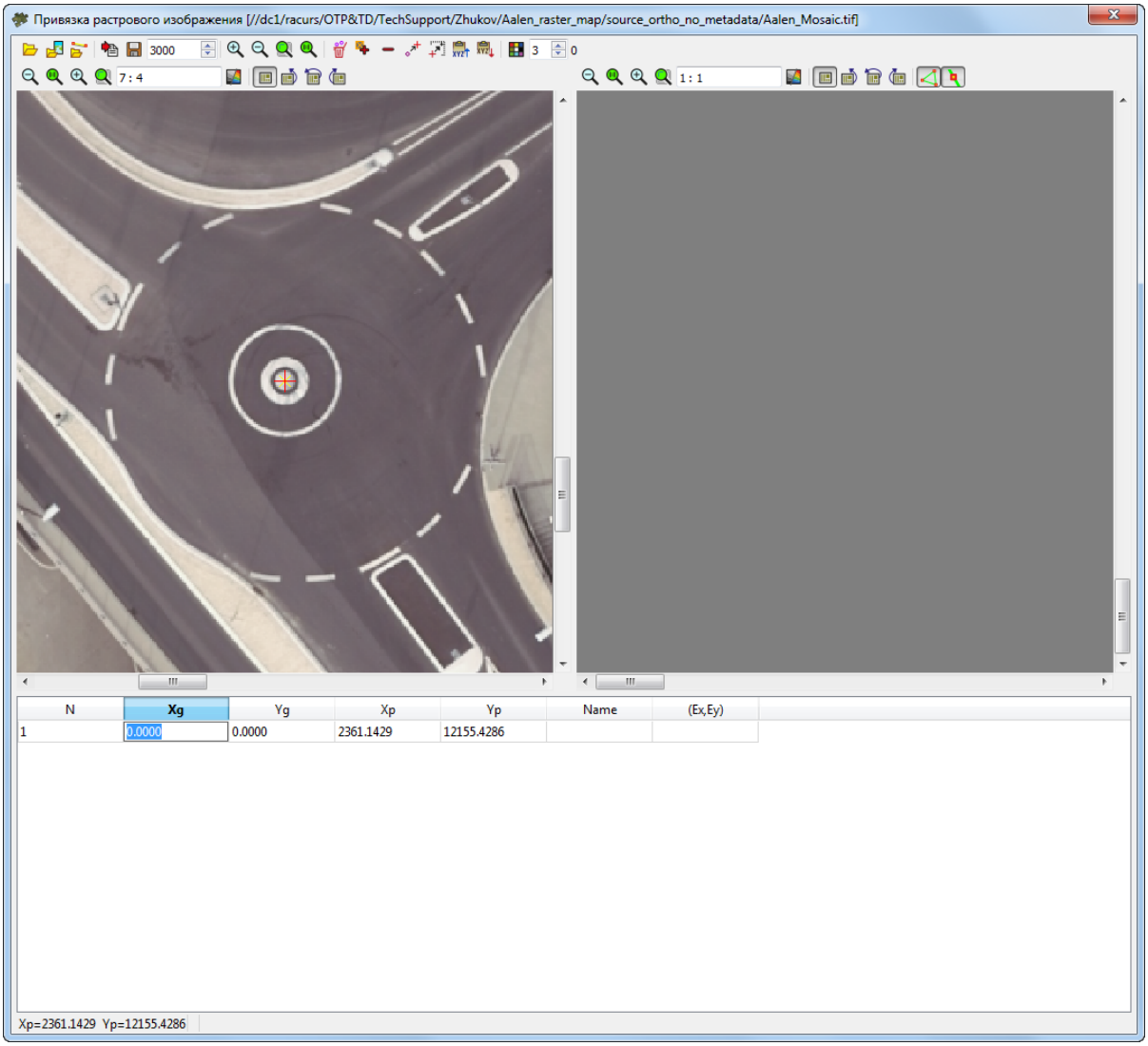


Fig. B.3. The geodetic coordinates manual input

6. Repeat these steps for other GC points.

For correct map reference it is recommended to recognize at least four points on the map. If the reference is performed using only one point, the system considers that measurement unit is one pixel and axes coincide. When two points are used for reference, the system performs image zoom and rotation, in case of reference by three points the system applies affine transformations.

7. [optional] Edit GC points (see the description of the main toolbar of the **Raster georeference** window).

8. Click the  button to save georeference file to *MapInfo* format.

B.2. Raster data georeference using points file

To perform georeference of raster map, using the file with points data, do the following actions:

1. Select **Service › Images georeferencing**. The **Raster georeference** window opens.

   To open this window in *PHOTOMOD* or *PHOTOMOD UAS* software, select **Rasters › Images georeferencing**.

2. Click the button of the main toolbar. Select a raster file without georeference, located out of active profile resources and click OK. After that a raster image is displayed in the left part of the window:

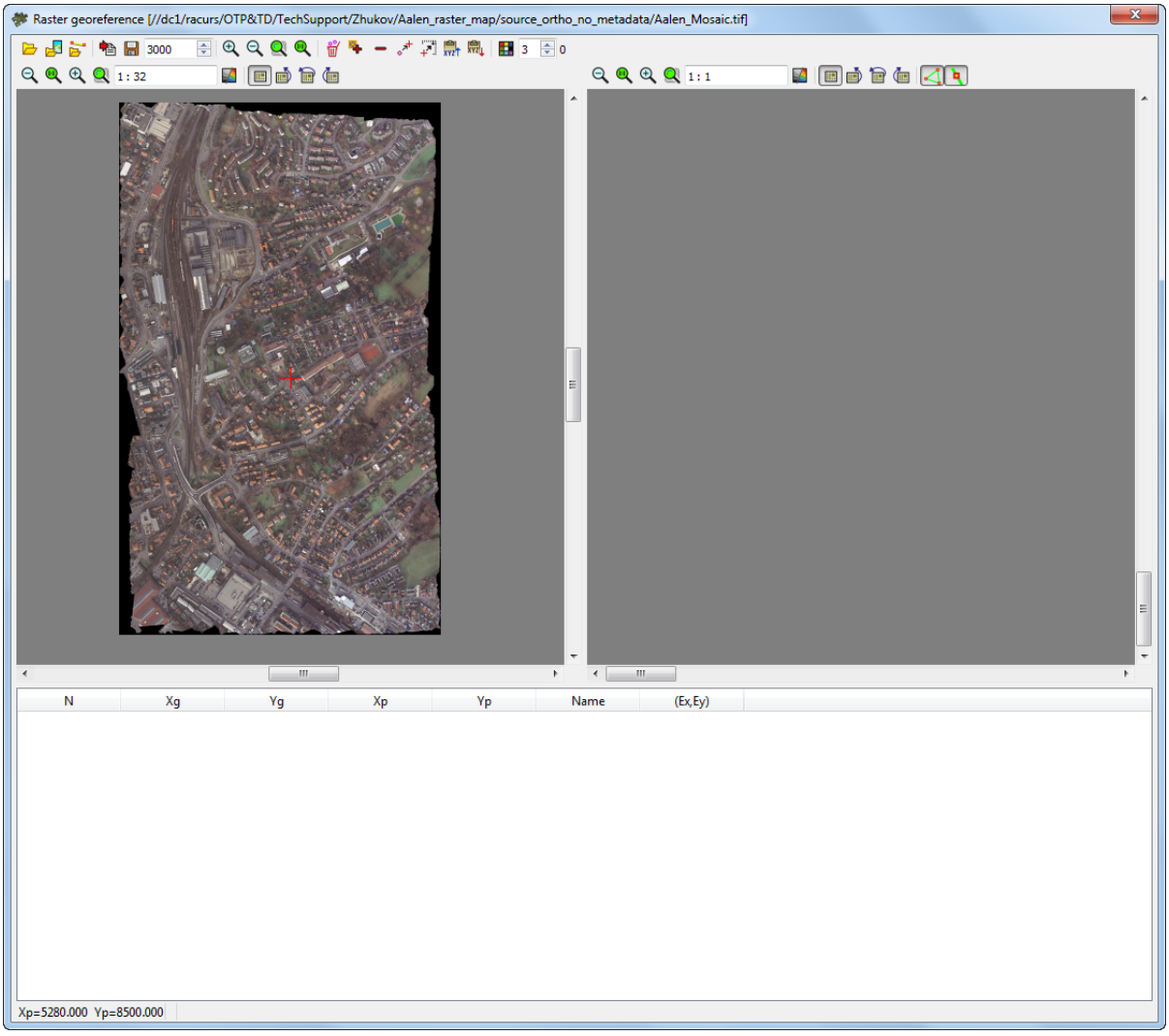


Fig. B.4. Loaded image that need to be referenced

3. Prepare the `*.txt` or `*.csv` file, containing the needed data: points names and geodetic coordinates (Xg, Yg) and, optionally, pixel coordinates (Xp, Yp) for the current processing image (if such data is available):

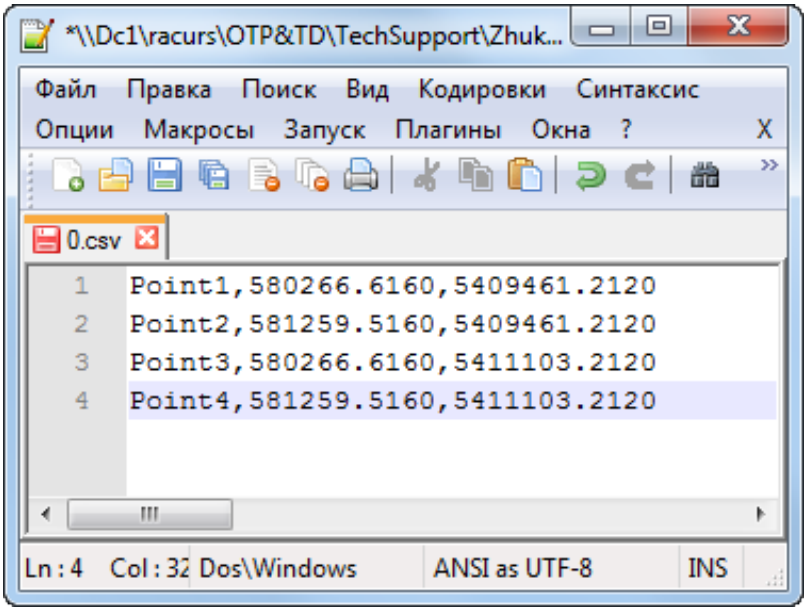


Fig. B.5. The CSV-file example with the geodetic coordinates (the comma is used as the columns separator)

4. In order to load data used for georeference, click the button. The **Import parameters** window opens:

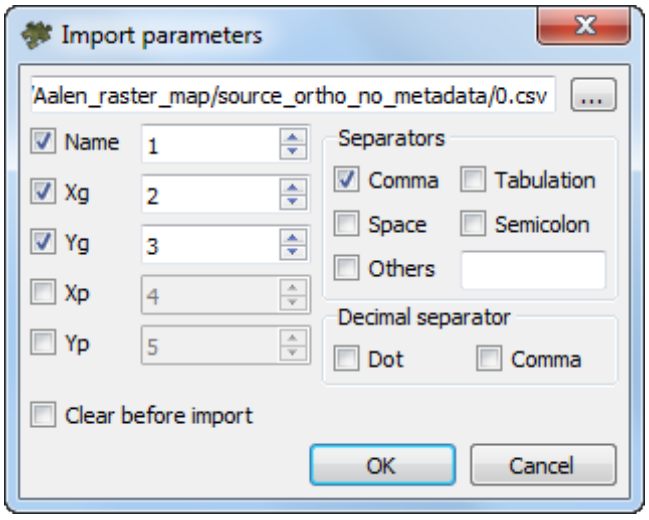


Fig. B.6. Import parameters of points coordinates from a text file

Click the ... button, to select the input text file;

5. Set the appropriate checkboxes, to specify the dataset to be imported and the data columns **separators** format. Specify the correct columns numbers in input text file;

6. [optional] In order to prevent change of points coordinates, which are already measured on images, set the **Clear before import** checkbox.

7. Click OK to add points to catalogue:

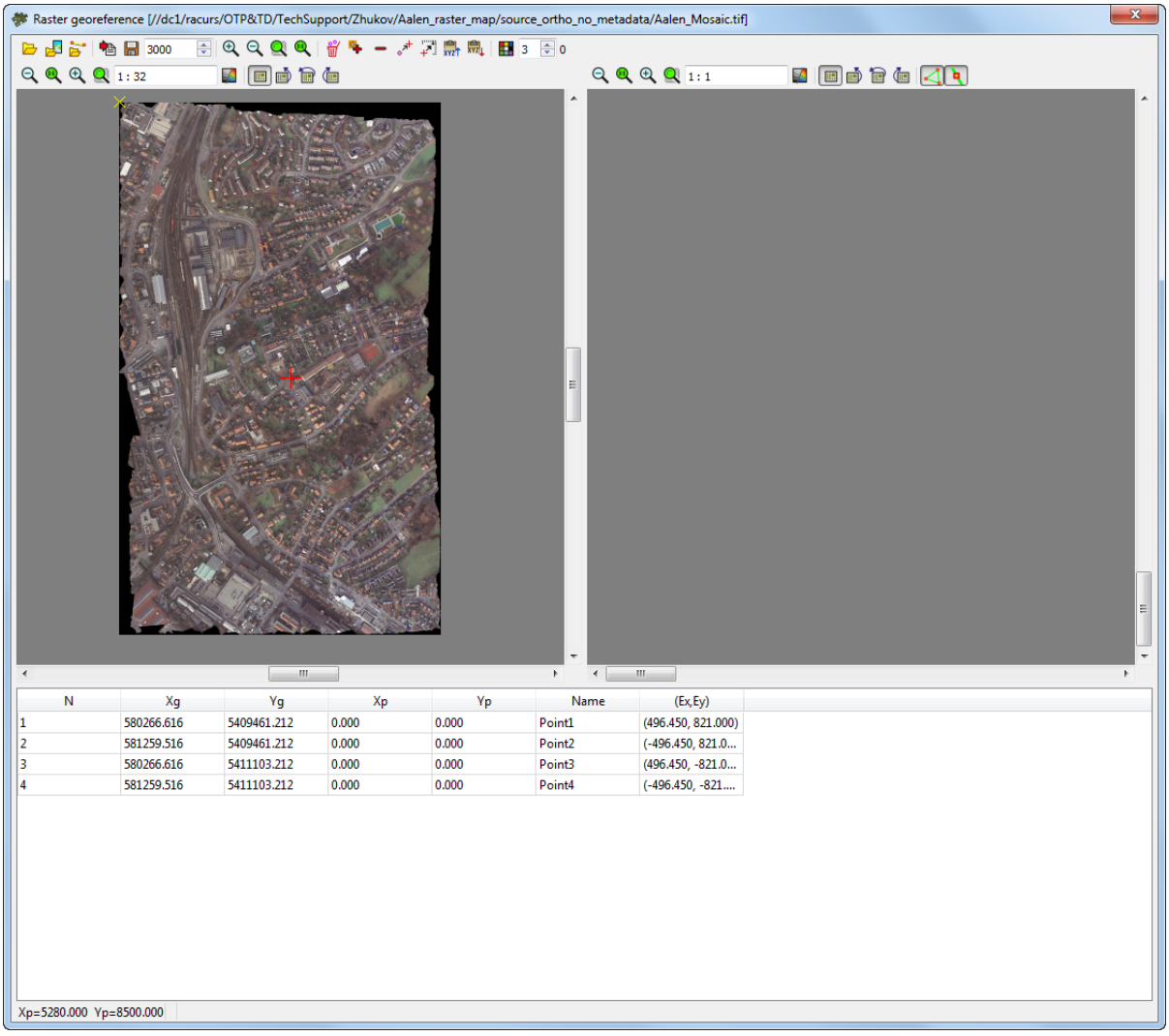


Fig. B.7. Loaded points with geodetic coordinates

8. In order to add pixel coordinates of GCP on the map perform the following actions:

    1. Select the point in the table;

    2. Locate GC point on the image and place marker to this terrain point.

3. Click the button to match geodetic coordinates of point selected in the table to pixel coordinates of the point on the image. The point's pixel coordinates are added to the table.

4. Repeat the 1 – 3 steps for other GC points.

For correct map reference it is recommended to recognize at least four points on the map. If the reference is performed using only one point, the system considers that measurement unit is one pixel and axes coincide. When two points are used for reference, the system performs image zoom and rotation, in case of reference by three points the system applies affine transformations.

When the fifths point coordinates on the map are measured, coordinates measurement residuals are calculated automatically and are shown in the `(Ex,Ey)` column of the table.

9. Click the button to save georeference file to *MapInfo* format.

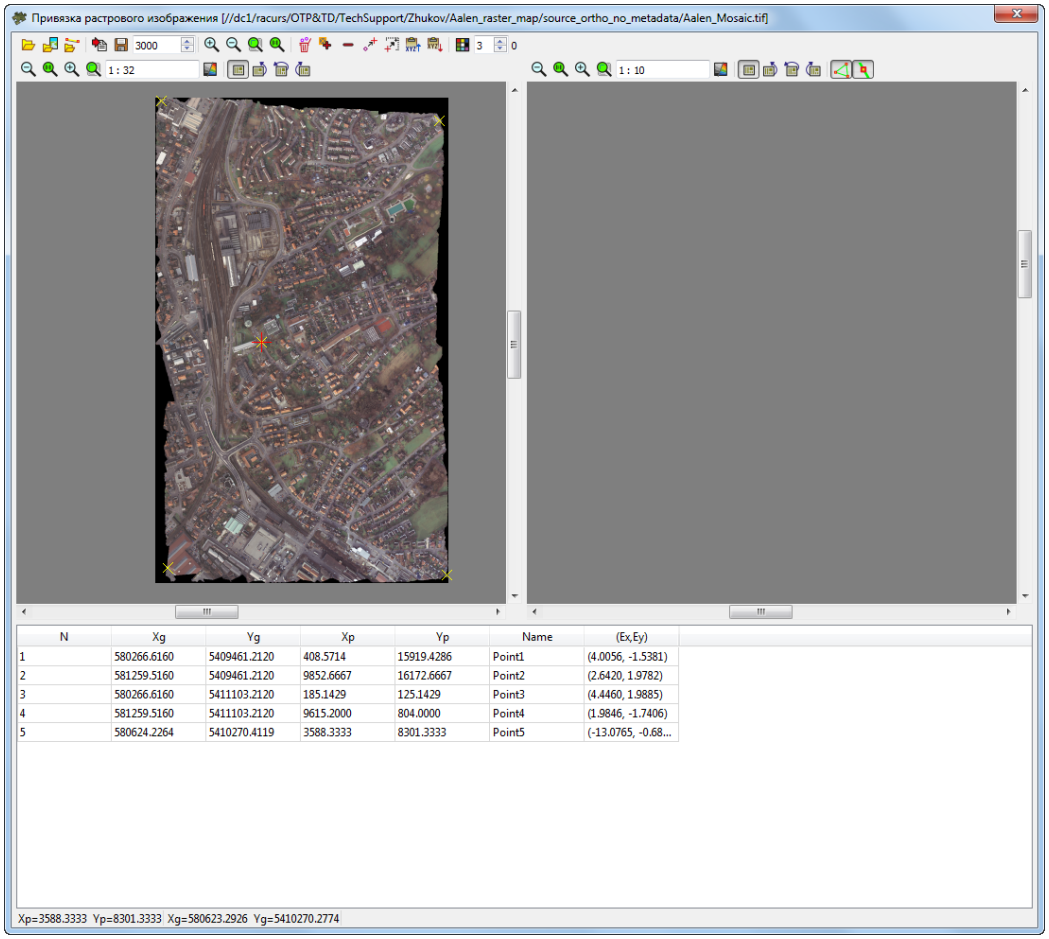


Fig. B.8. Loaded points with geodetic coordinates correctly placed on the image. The correct residuals are shown in the (Ex,Ey) column

B.3. Raster data georeference using reference raster and vector map(s)

To perform georeference of raster image, using the reference map(s), do the following actions:

1. Select **Service › Images georeferencing**. The **Raster georeference** window opens.

   To open this window in *PHOTOMOD* or *PHOTOMOD UAS* software, select **Rasters › Images georeferencing**.

2. Click the button of the main toolbar. Select a raster file without georeference, located out of active profile resources and click OK. After that a raster image is displayed in the left part of the window:

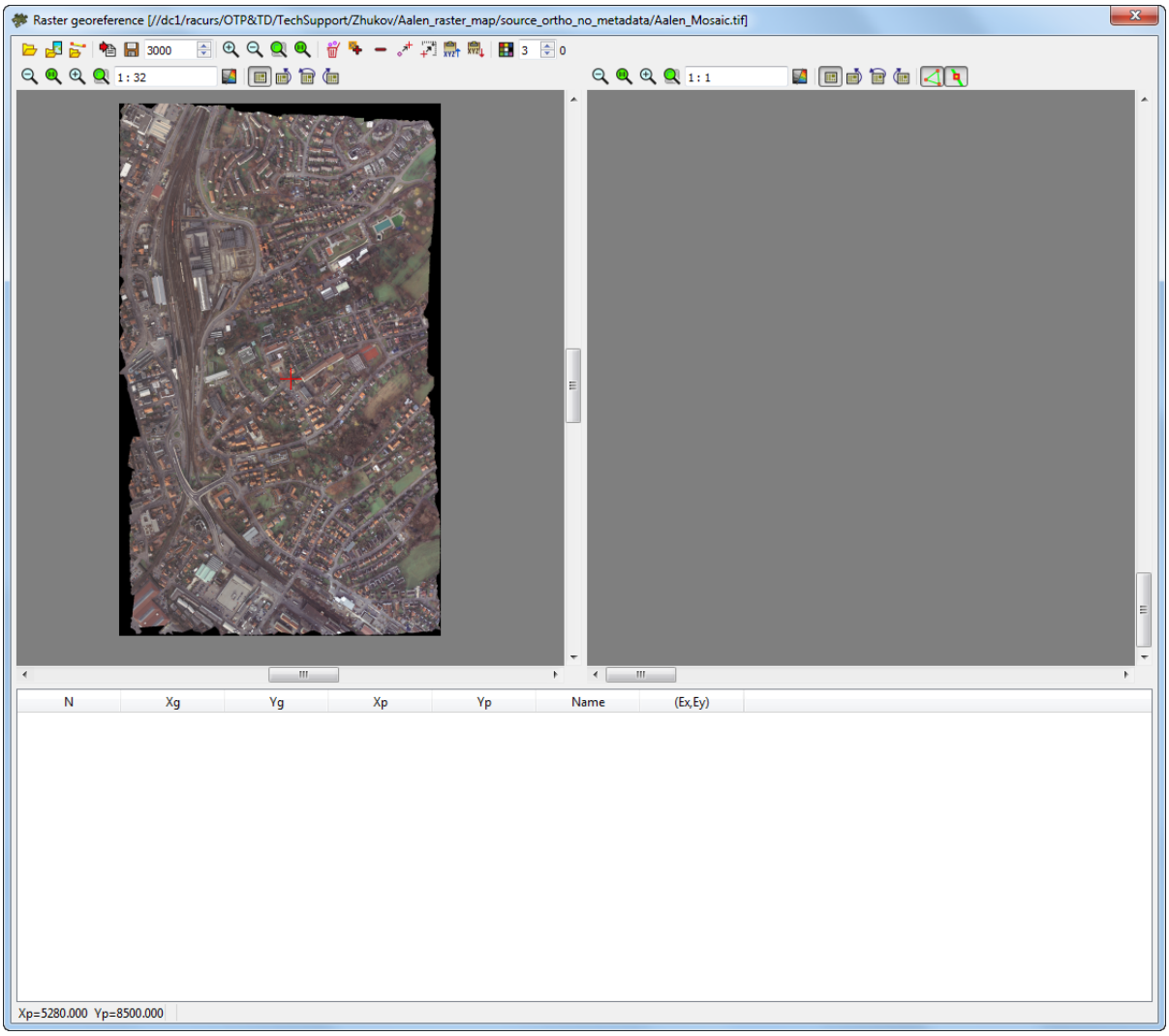


Fig. B.9. Loaded image that need to be referenced

3. To load georeferenced *raster* map click the button. Reference map is opened in the separate **Map** window (right to the window with unreferenced raster map) and allows to acquire geodetic coordinates in any point:

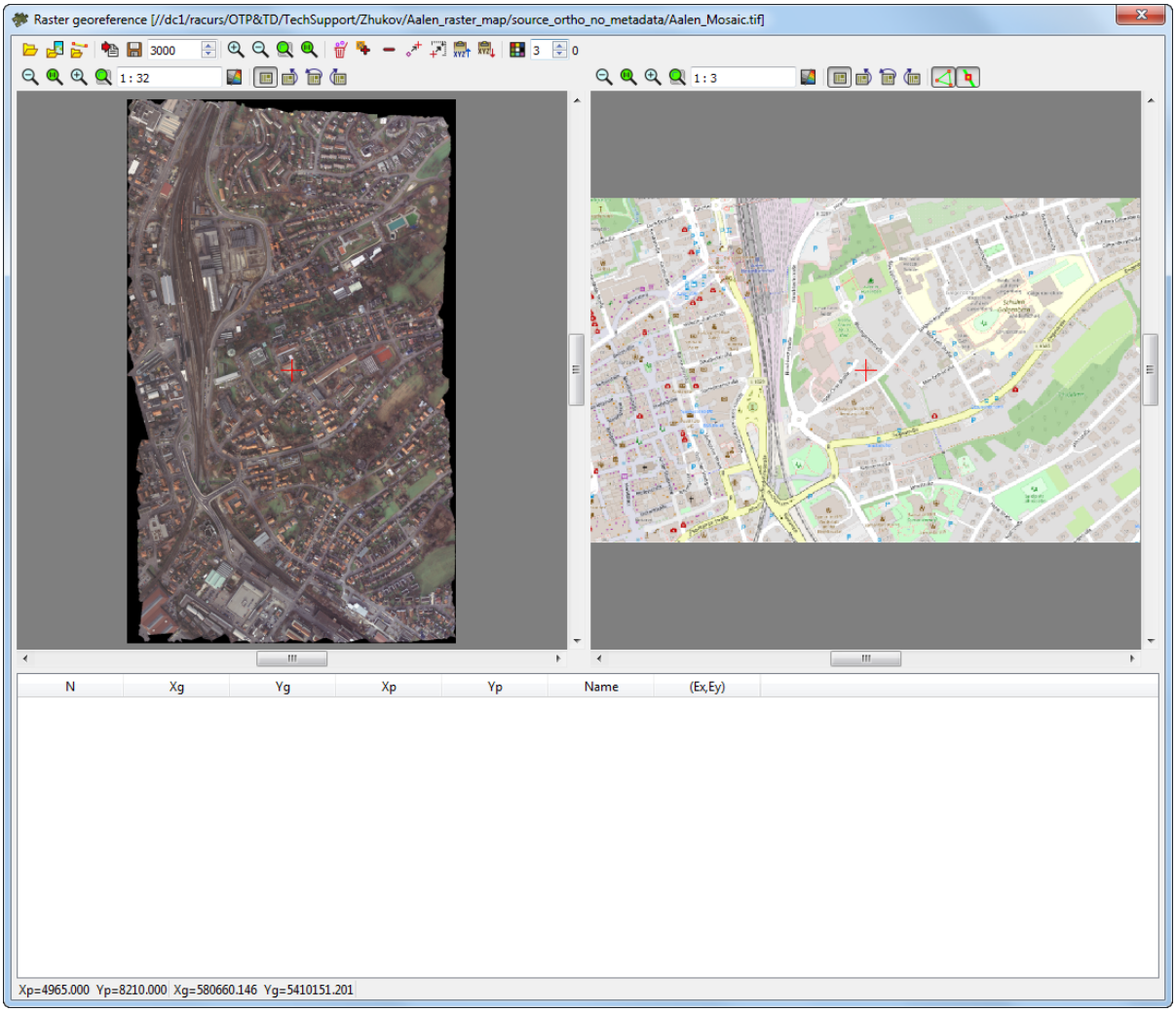


Fig. B.10. Loaded georeferenced raster map (right)

4. [optional] to load georeferenced *vector* map click the button. The **Parameters** window opens:

Available only if the raster data has been already loaded.

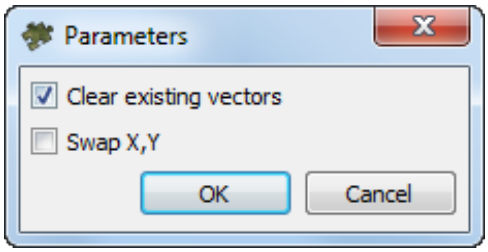


Fig. B.11. Import parameters of vector map

To **clear existing vectors** from the window (if any) before loading data – set the appropriate checkbox.

Click OK. The info message appears:

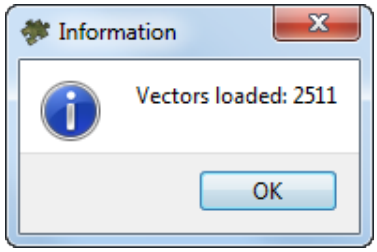


Fig. B.12. The info message

5. Reference vector map is opened in the separate **Map** window (right to the window with unreferenced raster map):

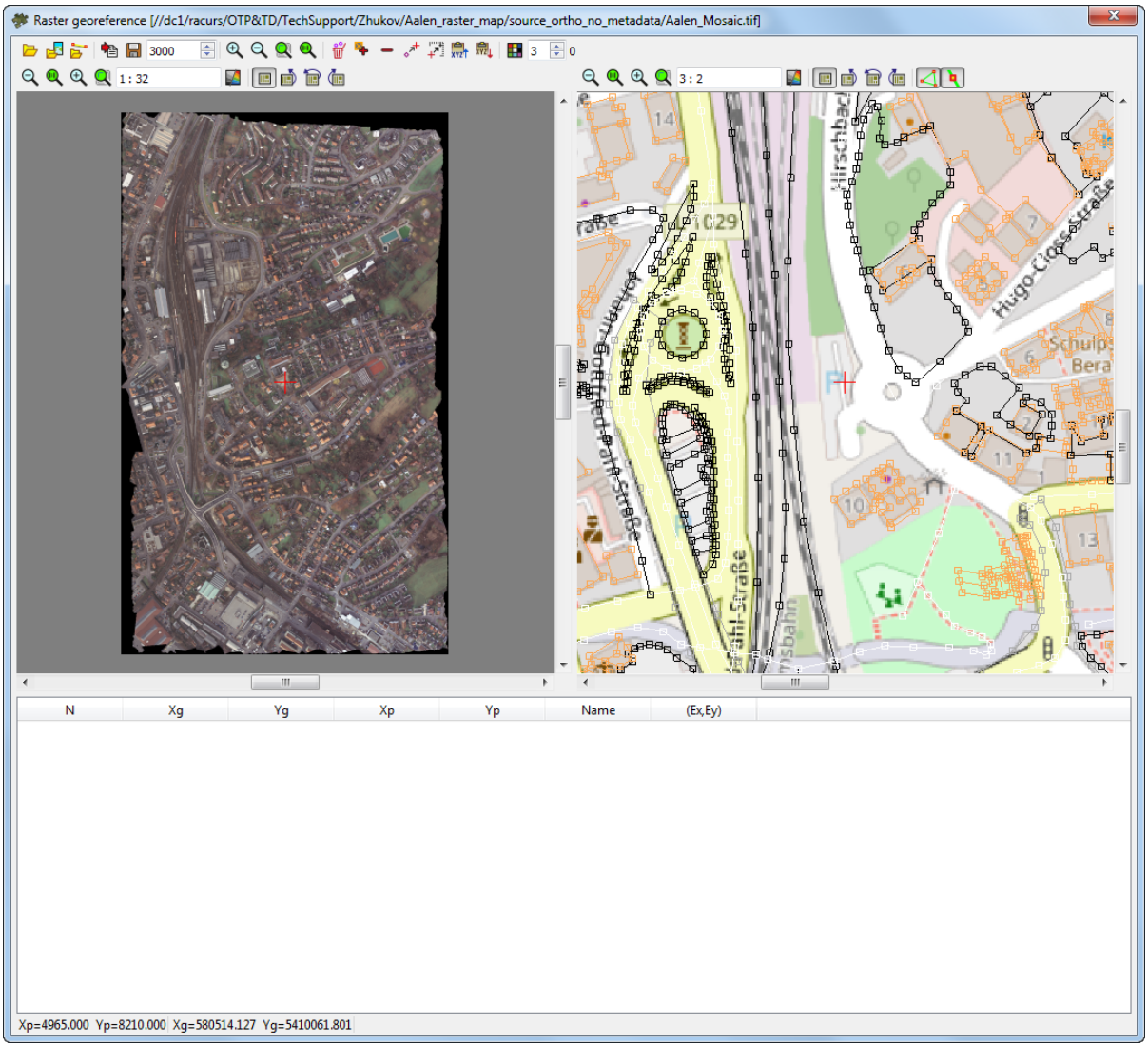


Fig. B.13. Loaded georeferenced raster and vector maps (right)

6. Click the button to add GC point with all required data on the raster image and to the coordinates table:

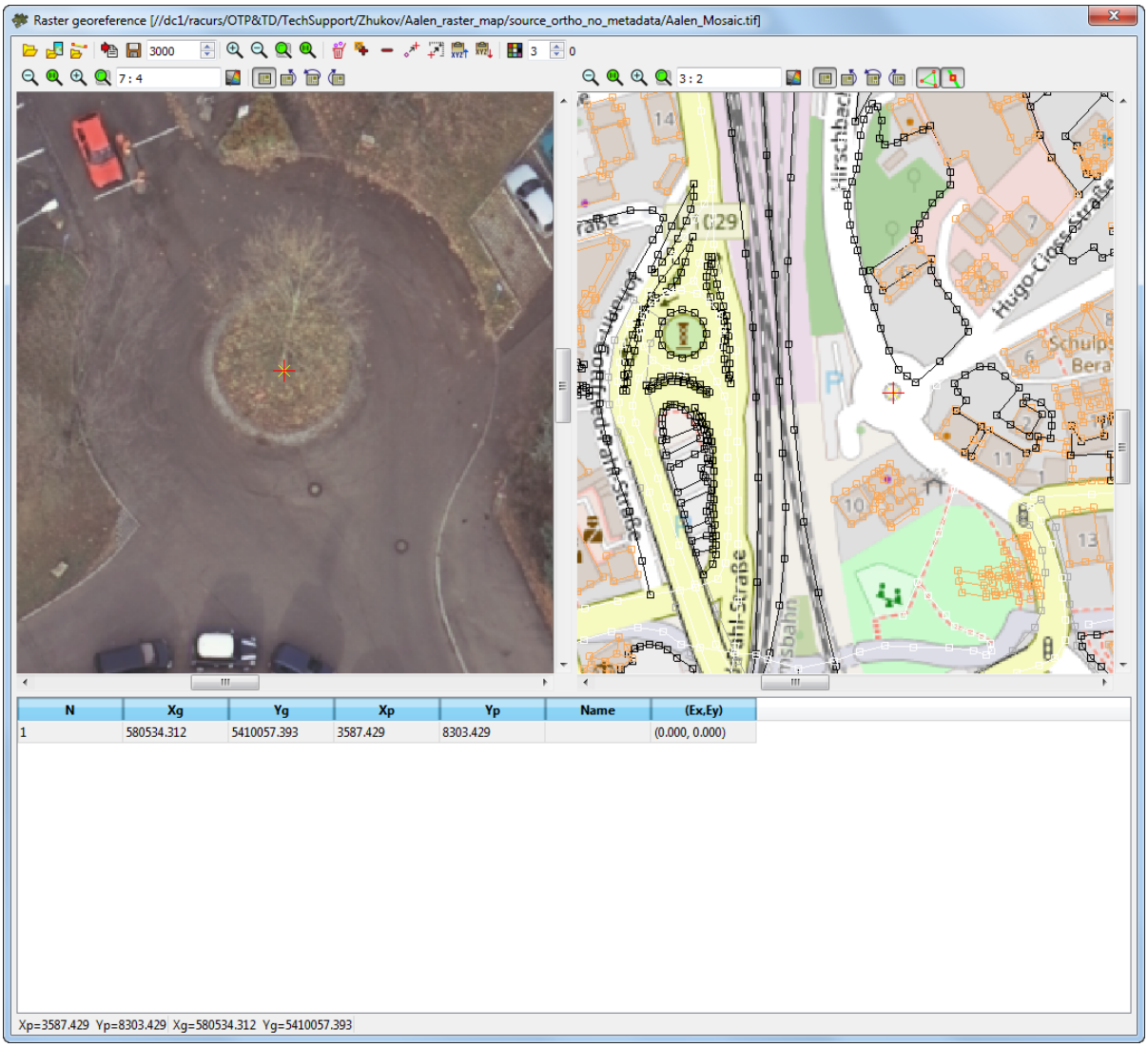


Fig. B.14. GC point transfer from the reference map to the raster image

7. Repeat this step for other GC points.

For correct map reference it is recommended to recognize at least four points on the map. If the reference is performed using only one point, the system considers that measurement unit is one pixel and axes coincide. When two points are used for reference, the system performs image zoom and rotation, in case of reference by three points the system applies affine transformations.

When the fifths point coordinates on the map are measured, coordinates measurement residuals are calculated automatically and are shown in the `(Ex,Ey)` column of the table.

8. Click the button to save georeference file to *MapInfo* format.

Appendix C. Notation sheets system

Scale	Latitude lower than 60°	60° – 76°	Latitude higher than 76°
1 000 000	N-37	R-35,36	T-35,36,37,38
500 000	N-37-Г	R-36-А,Б	T-35-В,Г,36-В,Г
200 000	N-37-36	R-36-09,10	T-35-10,11,12
100 000	N-37-144	R-37-019,020	T-35-005,006,007,008
50 000	N-37-111-Г	R-36-069-А,Б	T-35-115-А,Б,116-А,Б
25 000	N-37-111-Б-г	R-36-069-Г-а,б	T-35-116-А-а,б,Б-а,б
10 000	N-37-111-Б-б-4	R-36-069-Г-г-3,4	T-35-068-Г-а-3,4,б-3,4
5 000	N-37-111-(256)	R-36-069-(019,020)	T-35-068-(017,018,019,020)
2 000	N-37-111-(123-и)	R-36-069-(021,022-и)	T-35-068-(017-ж,з,и)

Appendix D. Creating marginalia for orthophotomap

PHOTOMOD GeoMosaic allows to create map frame and marginalia in styles and symbols used in Russian State Land Use Survey in map scales

- 1:2000
- 1:5000
- 1:10 000
- 1:25 000
- 1:50 000

for *MicroStation* and *MapInfo* systems. Marginalia contains the following data:

- *Decoration* – image frame, outer bold frame, text labels, scale segment, scheme of sheets, names of the neighbor sheets in frame cutouts;
- *Grid* – coordinate grid lines;
- *Frames* – frames of all the created sheets.

Marginalia for *MicroStation* consists of one `*.DGN` file for every orthophoto sheet (containing *Decoration* and *Grid*), and a single file for the entire project containing *Frames*.

Marginalia for *MapInfo* is saved as two (*Decoration* and *Grid*), or three (*Decoration*, *Grid* and *Text data*) `MIF/MID` file pairs per each orthophoto sheet, plus single *Frames* file pair for the entire project.

D.1. Workflow for creating marginalia

For marginalia creation perform the following:

Described int this section is the workflow for creating marginalia for *MicroStation* in 1:2000 map scale symbols.

1. After the orthophoto itself has been created, choose **Mosaic › Create Marginalia 1:2000 › MicroStation DGN...**. The **Marginalia parameters 1:2000** window opens;

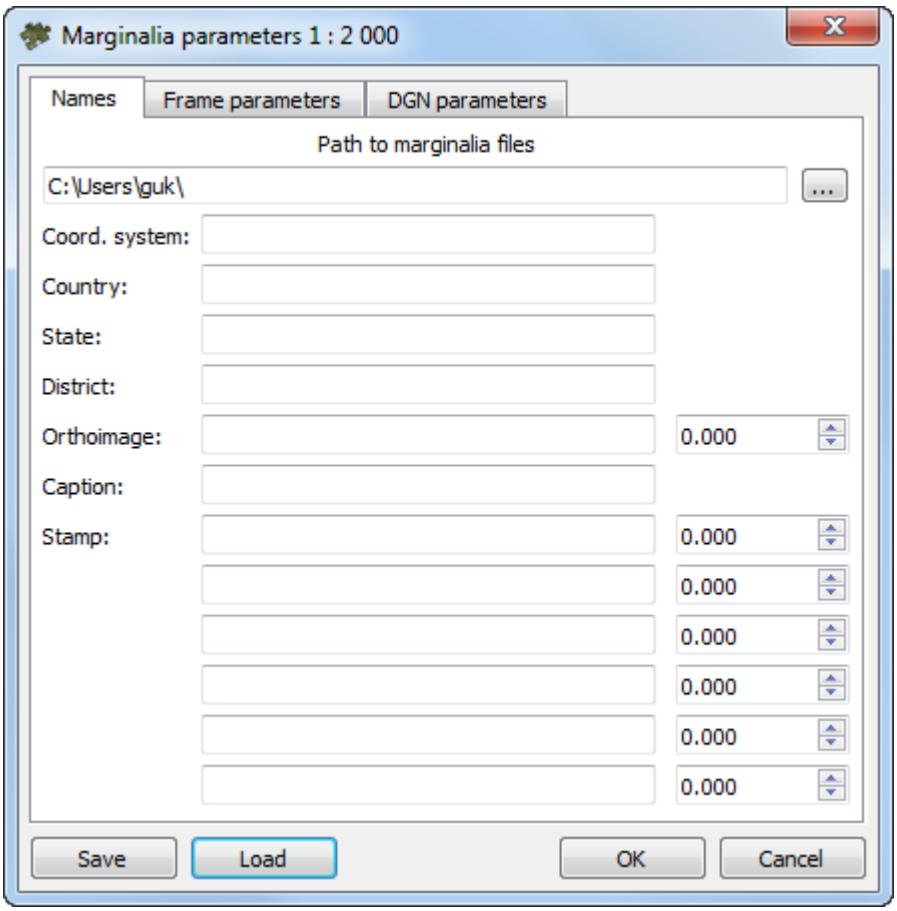


Fig. D.1. Marginalia parameters

2. In the **Names** tab of the **Marginalia parameters** window, set the **Path to marginalia files** (output);

3. [optional] Adjust the contents of the text labels for outside the frame (in the names **Names** tab), if necessary;

4. Specify the frame style (in the **Frame parameters** tab);

5. Set the `*.DGN` specific parameters in the **DGN parameters** tab;

6. Click OK. *.DGN files containing marginalia would be saved in the folder specified.

The system allows to save marginalia parameters settings. To save settings as a file with *.xini extension, click the **Save** button in the **Marginalia parameters** window. To set previously saved settings, click **Load**.

To open orthophoto with marginalia in *MicroStation* system perform the following:

1. Open the created *.DGN file in *MicroStation system;*

2. To open corresponding orthophoto raster sheet choose **File › Raster management › File › Attach** in *MicroStation* system. The program displays the orthophoto with marginalia.

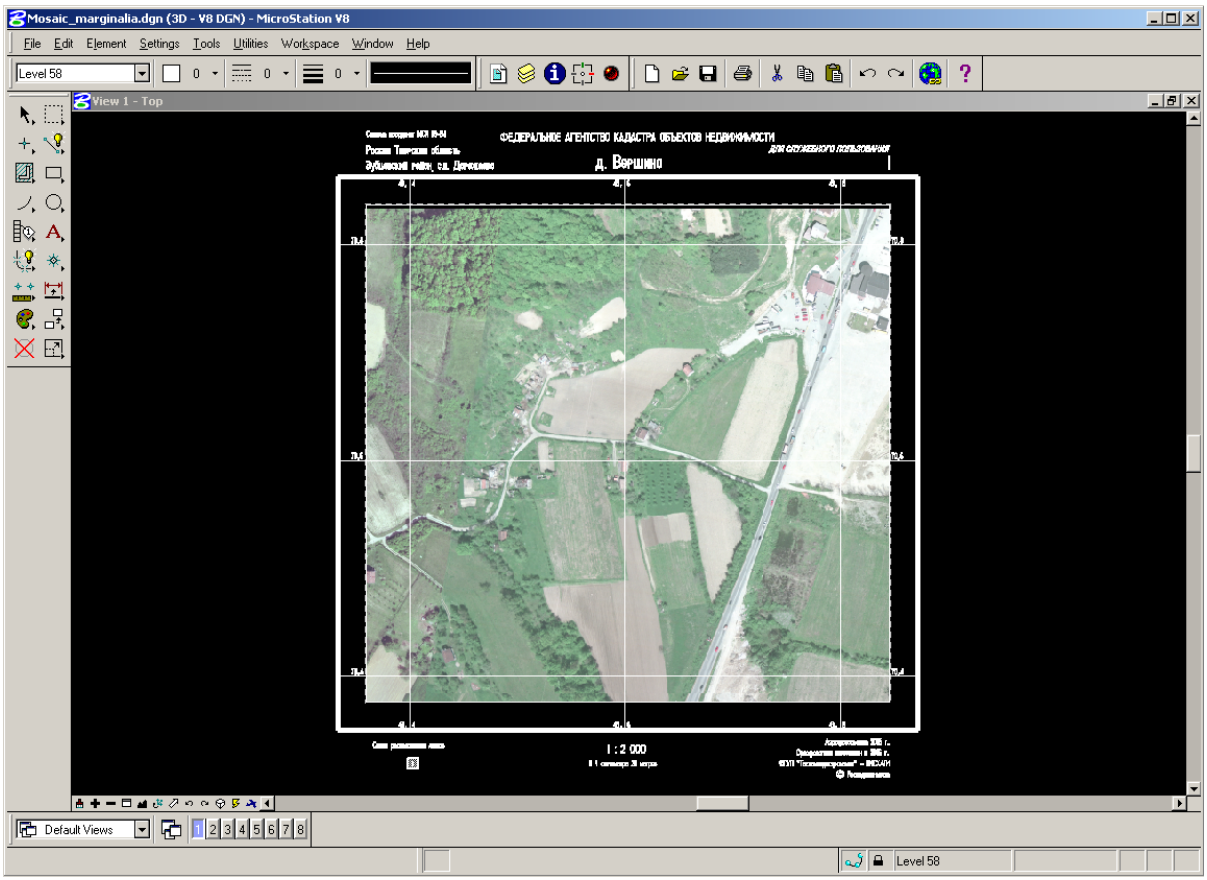


Fig. D.2. An orthophoto in MicroStation window

Marginalia can be created for the orthophoto as a whole as well as for the sheets in which it is split.

D.2. Marginalia parameters

This section contains detailed description of marginalia creation parameters for all supported scales.

D.2.1. Marginalia 1:2000

This section contains detailed description of marginalia creation parameters for 1:2000 scale for *MicroStation* and *MapInfo* systems.

MicroStation DGN

1. Marginalia is created using the menu command **Mosaic › Create Marginalia 1:2000 › MicroStation DGN...**. This command brings up the following dialog box with parameters:

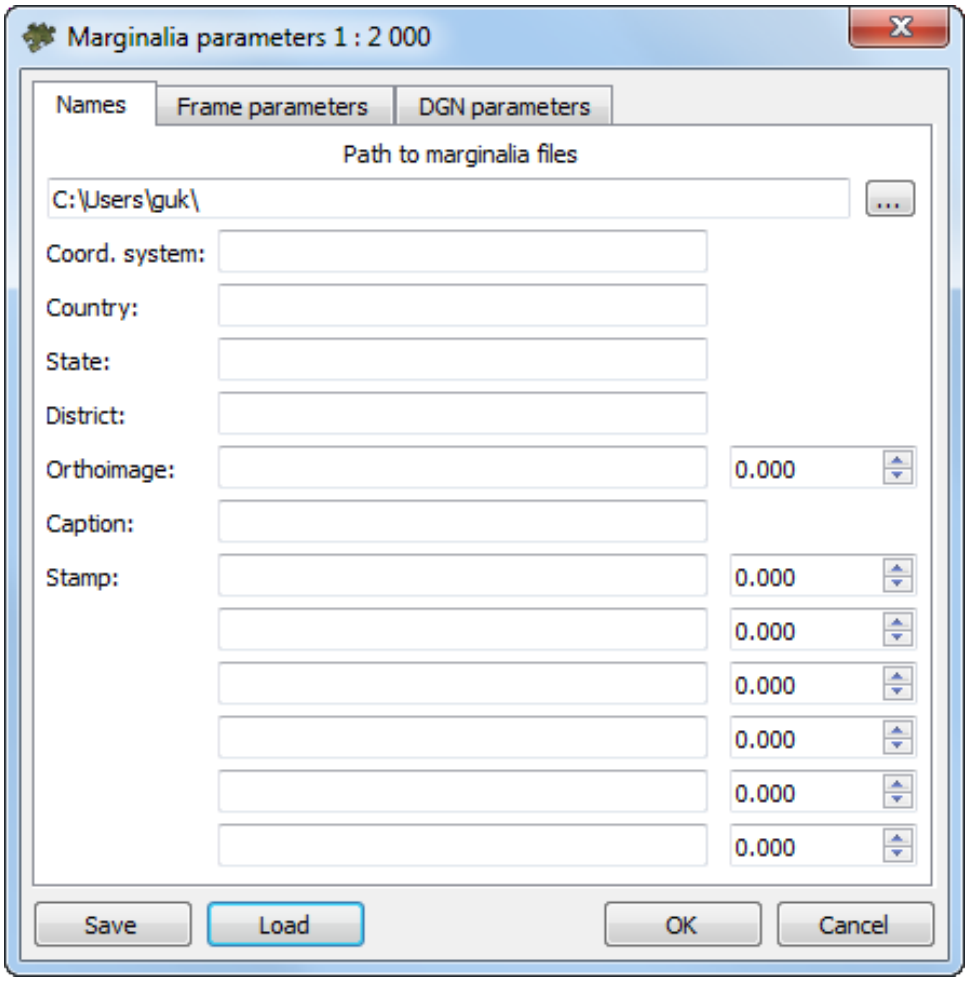


Fig. D.3. Marginalia parameters

2. The **Names** tab contains the following parameters:

- **Path to marginalia files** – the directory where the sheets with marginalia will be saved. By default, this is the folder where orthophoto has been created. If the setting is changed, it is saved and used the next time;
- **Coord. system**, **Country**, **State**, **District** – text lines placed consequently at the upper left corner of marginalia;
- **Caption**, **City** – text lines placed consequently at the top center of marginalia;
- **Stamp** – text line placed at the upper right corner of marginalia;
- Next come 5 strings placed consequently at the *bottom right corner* of marginalia. ;

The fields for entering numeric values to the right of some text input fields specify horizontal shift of the corresponding lines. The shift is given in the units of the *PHOTOMOD* project (usually in meters).

3. The **Frame parameters** tab contains the following parameters:
   - **Coordinate grid step** specifies the distance between the lines of grid on marginalia;
   - **External frame offset** specifies the indentation of external (thickened) frame from the frame along the outer edges of the corresponding image;
   - **External frame width** specifies thickness of external (thickened) frame;
   - **Internal / external frame layer**, **Coordinates grid layer**, **Coordinates grid labels layer** and **Text layer** specify the layer numbers (in `*.DGN` file) on which the relevant information is placed;
   - **Frames file suffix** specifies a text line attached to the base sheet name to get the combined file name with all created sheets frames;
   - **8 neighbour sheets only** option constrains the sheet scheme situated in the left bottom corner by 9 sheets. Current sheet is placed in the center, with not more than 8 neighbour sheets around it.;
   - [optional] set the **Sheet number instead of name** checkbox to change a notation into sheet number in marginalia;

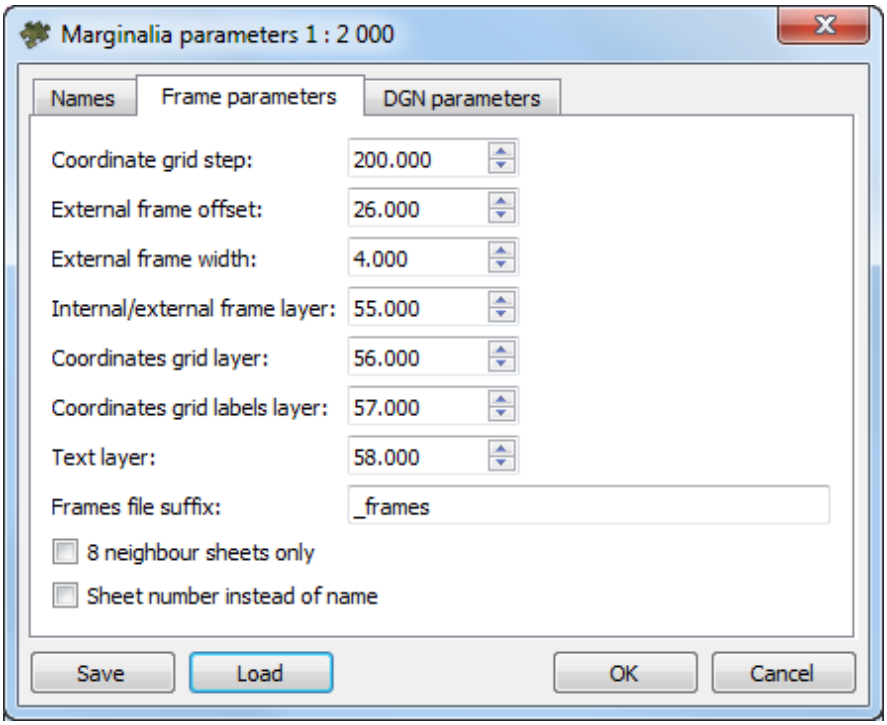


Fig. D.4. Marginalia parameters

4. The **DGN parameters** tab is used for setting standard DGN v7 parameters:

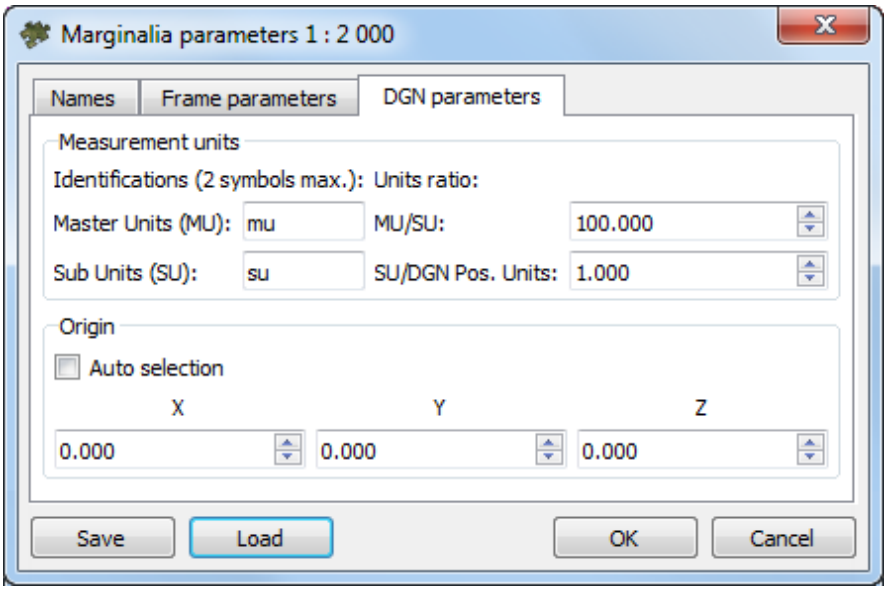


Fig. D.5. Marginalia parameters

- Names for **MU** and **SU** (see *MicroStation* system User Manual);
- Ratios **MU**/**SU** and **SU**/**Pos.Units**;

- Origin of coordinates in a file - **auto selection** or manual setting.

5. Click OK. `*.DGN` files containing marginalia would be saved in the folder specified.

MapInfo

Names tab is identical to the one in the parameters dialog for 1:2000 marginalia in DGN format. **Frame parameters** tab is identical to the one in the parameters dialog for 1:2000 marginalia in DGN format.

1. Marginalia is created using the menu command **Mosaic › Create Marginalia 1:2000 › MapInfo MIF/MID**. This command brings up the following dialog box with parameters:

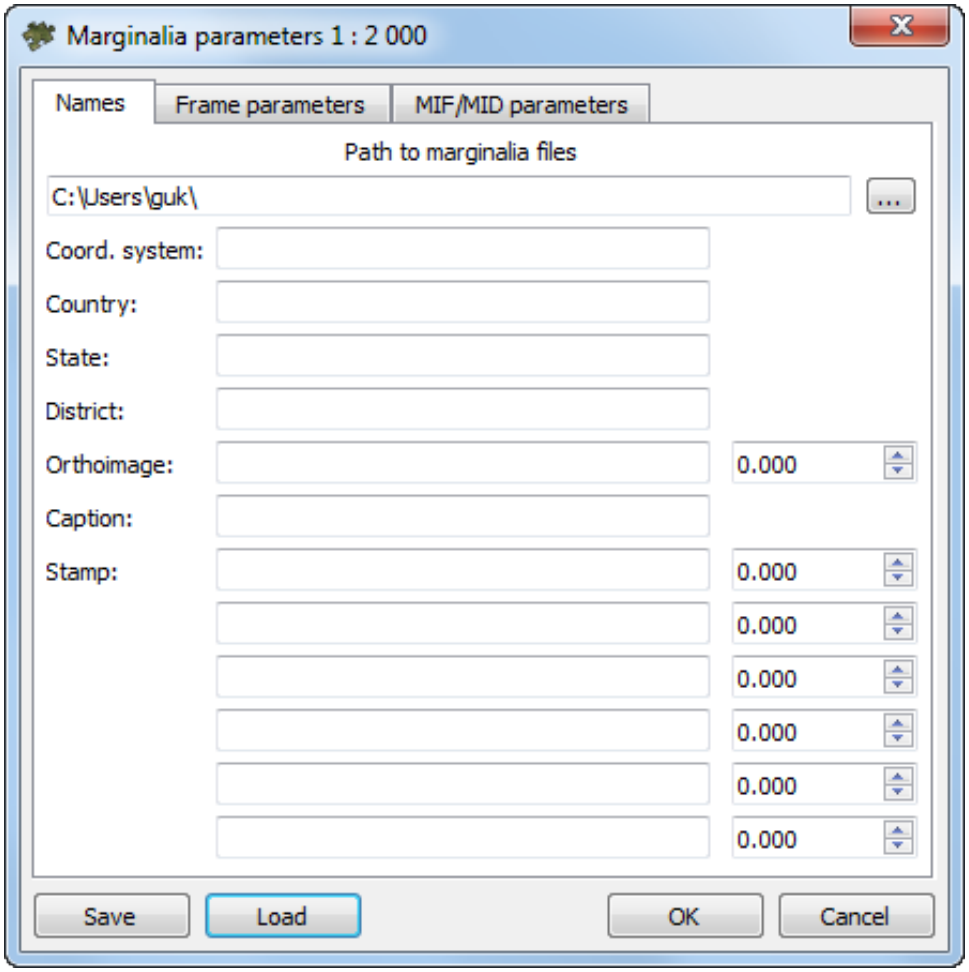


Fig. D.6. Marginalia parameters

2. The **Names** tab contains the following parameters:

- **Path to marginalia files** – the directory where the sheets with marginalia will be saved. By default, this is the folder where orthophoto has been created. If the setting is changed, it is saved and used the next time;
- **Coord. system**, **Country**, **State**, **District** – text lines placed consequently at the upper left corner of marginalia;
- **Caption**, **City** – text lines placed consequently at the top center of marginalia;
- **Stamp** – text line placed at the upper right corner of marginalia;
- Next come 5 strings placed consequently at the *bottom right corner* of marginalia. ;

The fields for entering numeric values to the right of some text input fields specify horizontal shift of the corresponding lines. The shift is given in the units of the *PHOTOMOD* project (usually in meters).

3. The **Frame parameters** tab contains the following parameters:
   - **Coordinate grid step** specifies the distance between the lines of grid on marginalia;
   - **External frame offset** specifies the indentation of external (thickened) frame from the frame along the outer edges of the corresponding image;
   - **External frame width** specifies thickness of external (thickened) frame;
   - **Internal / external frame layer**, **Coordinates grid layer**, **Coordinates grid labels layer** and **Text layer** specify the layer numbers on which the relevant information is placed;
   - **Frames file suffix** specifies a text line attached to the base sheet name to get the combined file name with all created sheets frames;
   - **8 neighbour sheets only** option constrains the sheet scheme situated in the left bottom corner by 9 sheets. Current sheet is placed in the center, with not more than 8 neighbour sheets around it.;
   - [optional] set the **Sheet number instead of name** checkbox to change a notation into sheet number in marginalia;

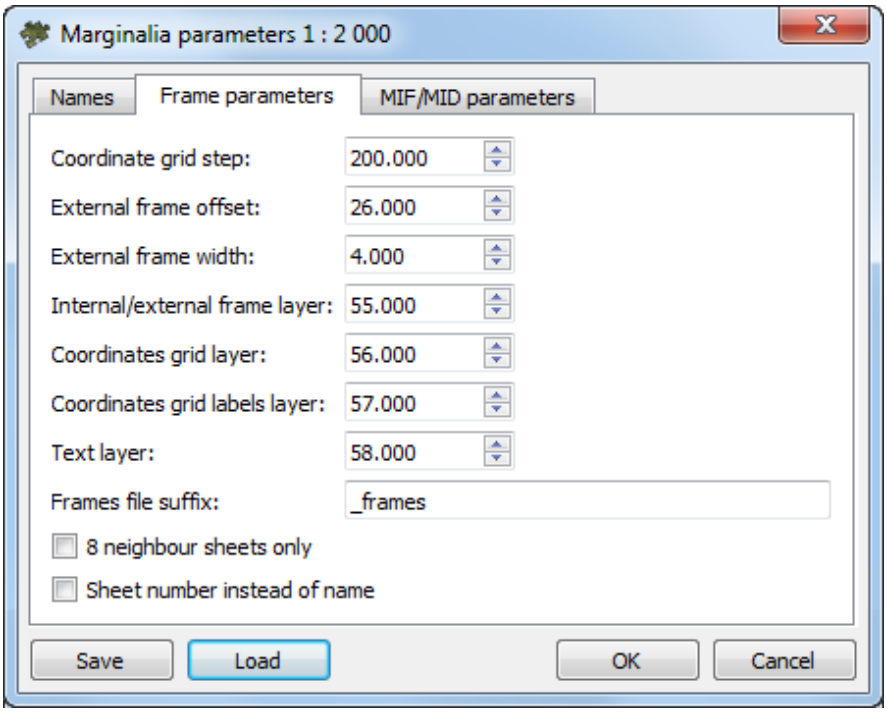


Fig. D.7. Marginalia parameters

4. The **MIF / MID parameters** tab contains the following parameters:

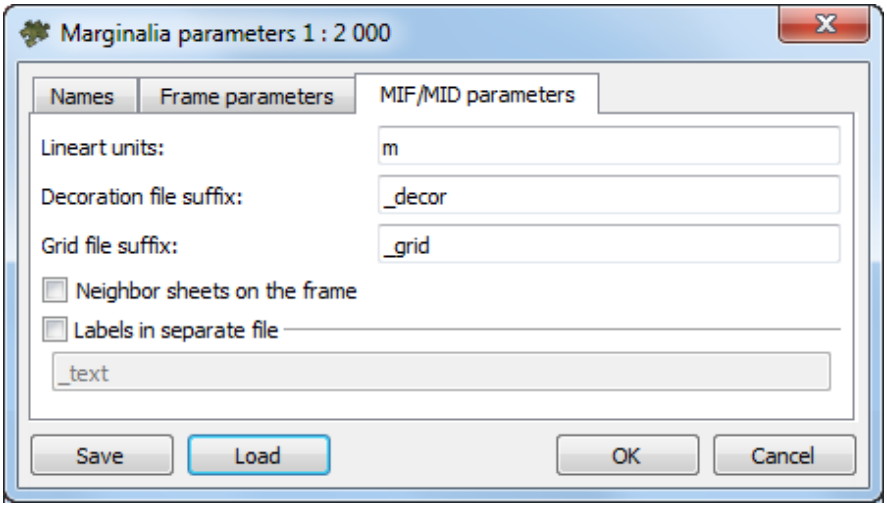


Fig. D.8. Marginalia parameters

- **User units** field specifies the name of the units of measurement in the MIF / MID `MIF/MID` file;
- **Decoration file suffix** and **Grid file suffix** fields specify the lines which are appended to the base name of the sheet to obtain separate files with corresponding data;

- **Neighbour sheets on the frame** option allows, along with the scheme of sheets in the lower left corner, insert the names of the neighbour sheets in the cut-outs of the external (thickened) frame;
- **Labels in separate file** option allows to save all text captions in a separate file with the specified suffix.;

5. Click OK.

D.2.2. Marginalia 1:5000

This section contains detailed description of marginalia creation parameters for 1:5000 scale for *MicroStation* and *MapInfo*.

Marginalia for *MicroStation* is created using the dialog box with parameters, which is identical to the one in the parameters dialog for 1:2000 marginalia in DGN format.

Marginalia for *MapInfo* is created using the dialog box with parameters, which is identical to the one in the parameters dialog for 1:2000 marginalia in MIF/MID format.

MicroStation

1. Marginalia is created using the menu command **Mosaic › Create Marginalia 1:5000 › MicroStation DGN...**. This command brings up the following dialog box with parameters:

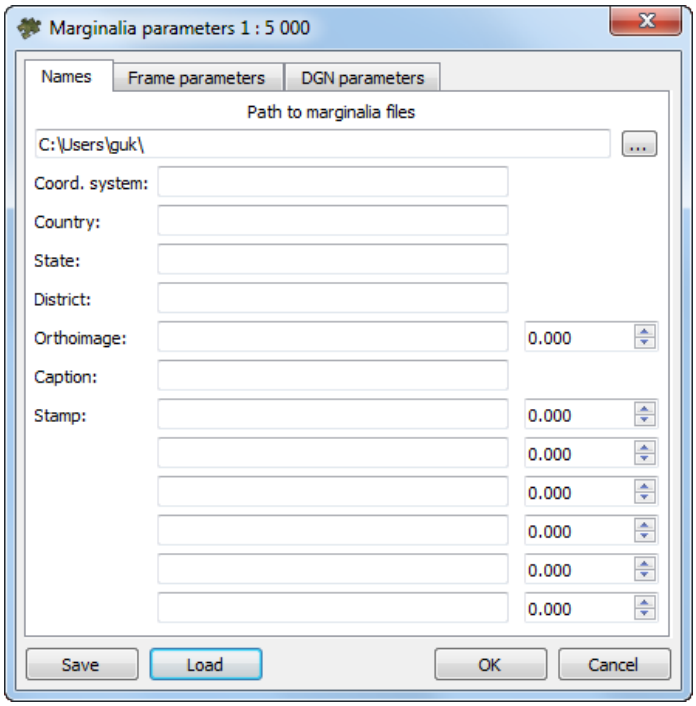


Fig. D.9. Marginalia parameters

2. The **Names** tab contains the following parameters:

   - **Path to marginalia files** – the directory where the sheets with marginalia will be saved. By default, this is the folder where orthophoto has been created. If the setting is changed, it is saved and used the next time;
   - **Coord. system**, **Country**, **State**, **District** – text lines placed consequently at the upper left corner of marginalia;
   - **Caption**, **City** – text lines placed consequently at the top center of marginalia;
   - **Stamp** – text line placed at the upper right corner of marginalia;
   - Next come 5 strings placed consequently at the *bottom right corner* of marginalia. ;

   The fields for entering numeric values to the right of some text input fields specify horizontal shift of the corresponding lines. The shift is given in the units of the *PHOTOMOD* project (usually in meters).

3. The **Frame parameters** tab contains the following parameters:

   - **Coordinate grid step** specifies the distance between the lines of grid on marginalia;
   - **External frame offset** specifies the indentation of external (thickened) frame from the frame along the outer edges of the corresponding image;
   - **External frame width** specifies thickness of external (thickened) frame;
   - **Internal / external frame layer**, **Coordinates grid layer**, **Coordinates grid labels layer** and **Text layer** specify the layer numbers (in `*.DGN` file) on which the relevant information is placed;
   - **Frames file suffix** specifies a text line attached to the base sheet name to get the combined file name with all created sheets frames;
   - **8 neighbour sheets only** option constrains the sheet scheme situated in the left bottom corner by 9 sheets. Current sheet is placed in the center, with not more than 8 neighbour sheets around it.;
   - [optional] set the **Sheet number instead of name** checkbox to change a notation into sheet number in marginalia;

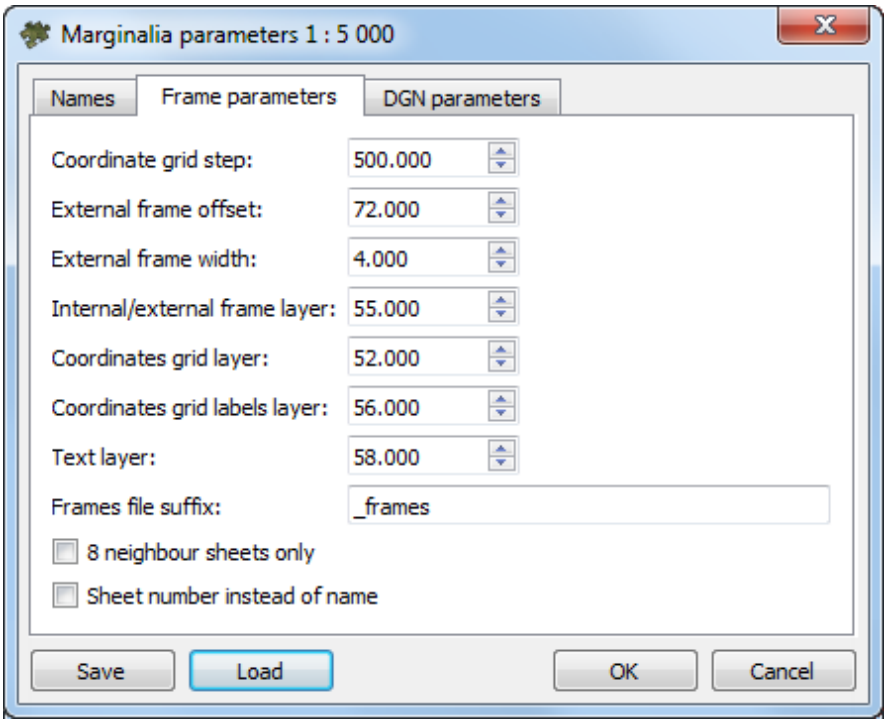


Fig. D.10. Marginalia parameters

4. The **DGN parameters** tab is used for setting standard DGN v7 parameters:

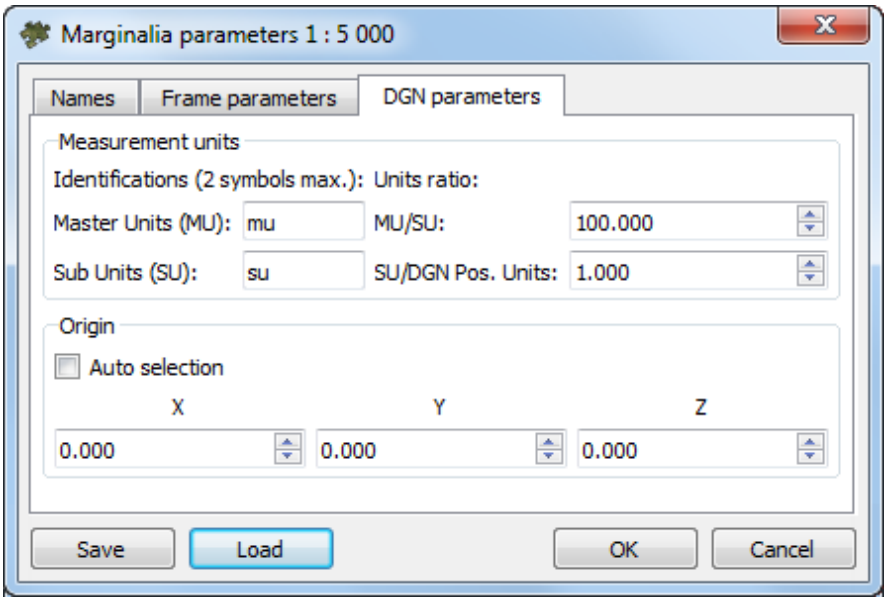


Fig. D.11. Marginalia parameters

- Names for **MU** and **SU** (see *MicroStation* system User Manual);
- Ratios **MU**/**SU** and **SU**/**Pos.Units**;

- Origin of coordinates in a file - **auto selection** or manual setting.

5. Click OK. `*.DGN` files containing marginalia would be saved in the folder specified.

MapInfo

1. Marginalia is created using the menu command **Mosaic › Create Marginalia 1:5000 › MapInfo MIF/MID**. This command brings up the following dialog box with parameters:

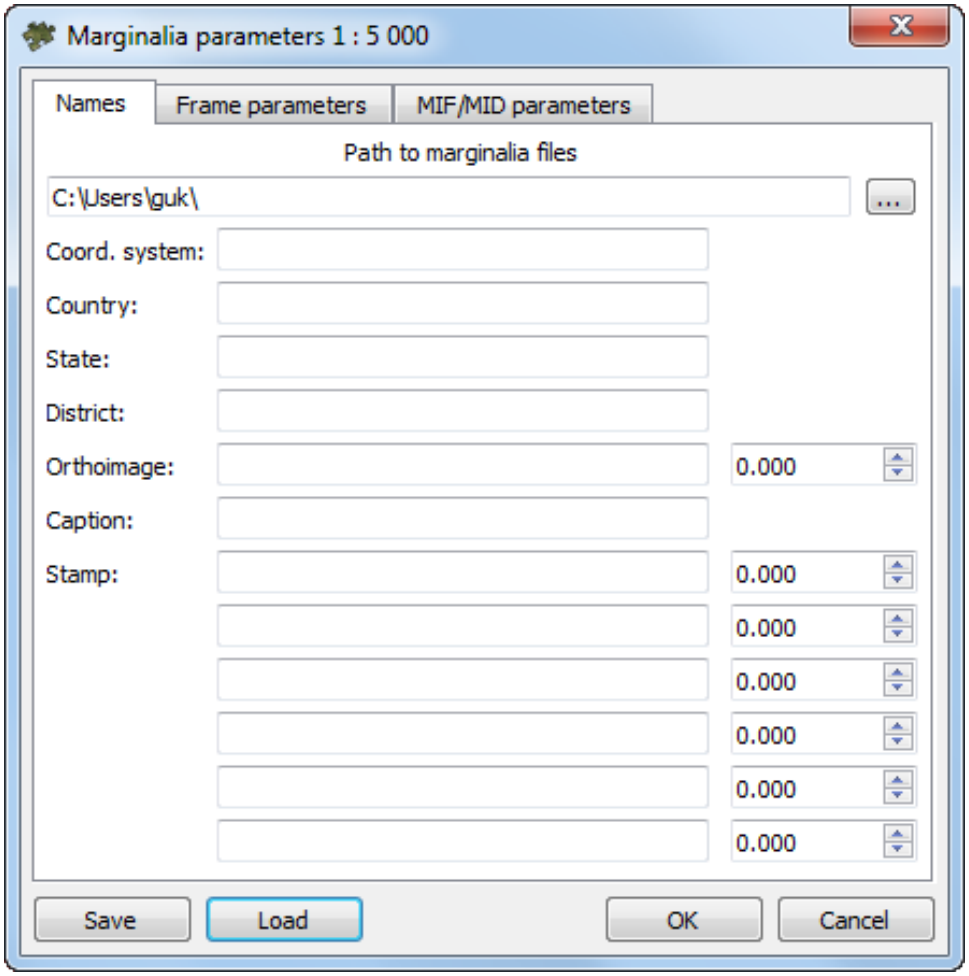


Fig. D.12. Marginalia parameters

2. The **Names** tab contains the following parameters:

- **Path to marginalia files** – the directory where the sheets with marginalia will be saved. By default, this is the folder where orthophoto has been created. If the setting is changed, it is saved and used the next time;

- **Coord. system**, **Country**, **State**, **District** – text lines placed consequently at the upper left corner of marginalia;
- **Caption**, **City** – text lines placed consequently at the top center of marginalia;
- **Stamp** – text line placed at the upper right corner of marginalia;
- Next come 5 strings placed consequently at the *bottom right corner* of marginalia. ;

The fields for entering numeric values to the right of some text input fields specify horizontal shift of the corresponding lines. The shift is given in the units of the *PHOTOMOD* project (usually in meters).

3. The **Frame parameters** tab contains the following parameters:
   - **Coordinate grid step** specifies the distance between the lines of grid on marginalia;
   - **External frame offset** specifies the indentation of external (thickened) frame from the frame along the outer edges of the corresponding image;
   - **External frame width** specifies thickness of external (thickened) frame;
   - **Internal / external frame layer**, **Coordinates grid layer**, **Coordinates grid labels layer** and **Text layer** specify the layer numbers on which the relevant information is placed;
   - **Frames file suffix** specifies a text line attached to the base sheet name to get the combined file name with all created sheets frames;
   - **8 neighbour sheets only** option constrains the sheet scheme situated in the left bottom corner by 9 sheets. Current sheet is placed in the center, with not more than 8 neighbour sheets around it.;
   - [optional] set the **Sheet number instead of name** checkbox to change a notation into sheet number in marginalia;

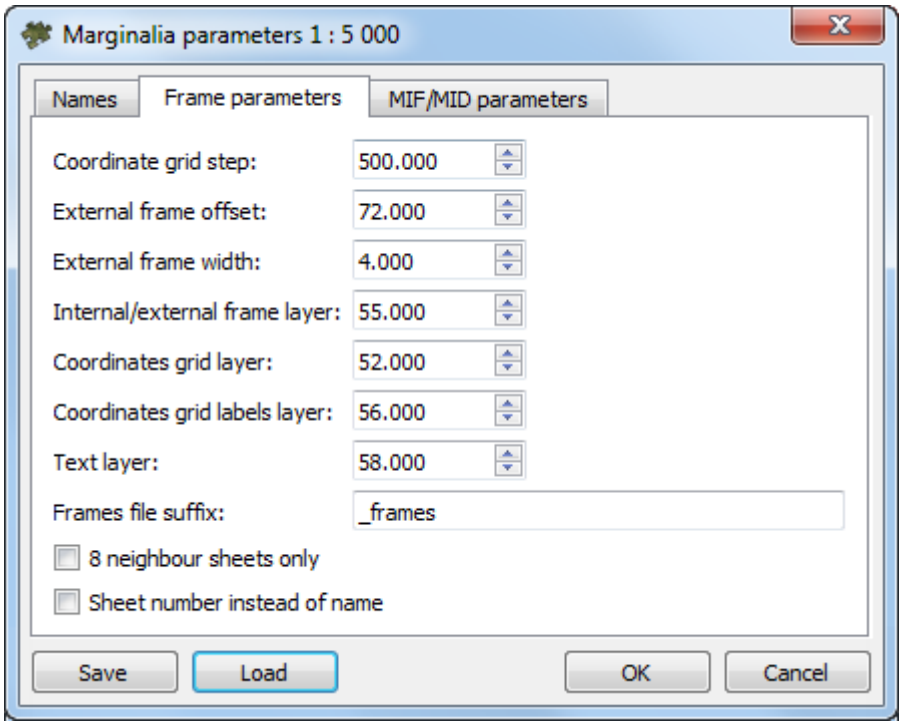


Fig. D.13. Marginalia parameters

4. The **MIF / MID parameters** tab contains the following parameters:

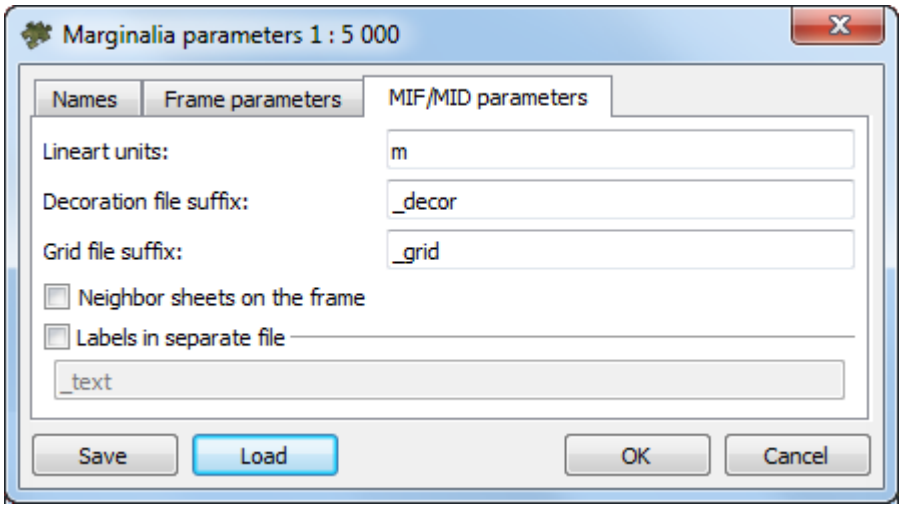


Fig. D.14. Marginalia parameters

- **User units** field specifies the name of the units of measurement in the MIF / MID `MIF/MID` file;

- **Decoration file suffix** and **Grid file suffix** fields specify the lines which are appended to the base name of the sheet to obtain separate files with corresponding data;

- **Labels in separate file** option allows to save all text captions in a separate file with the specified suffix.;

5. Click OK.

D.2.3. Marginalia 1:10 000

This section contains detailed description of marginalia creation parameters for 1:10 000 scale for *MicroStation* and *MapInfo*.

Marginalia for *MicroStation* is created using the dialog box with parameters, which is identical to the one in the parameters dialog for 1:25 000 and 1:50 000 marginalia in DGN format.

Marginalia for *MapInfo* is created using the dialog box with parameters, which is identical to the one in the parameters dialog for 1:25 000 and 1:50 000 marginalia in MIF/MID format.

MicroStation

1. Marginalia is created using the menu command **Mosaic › Create Marginalia 1:10 000 › MicroStation DGN...**. This command brings up the following dialog box with parameters:

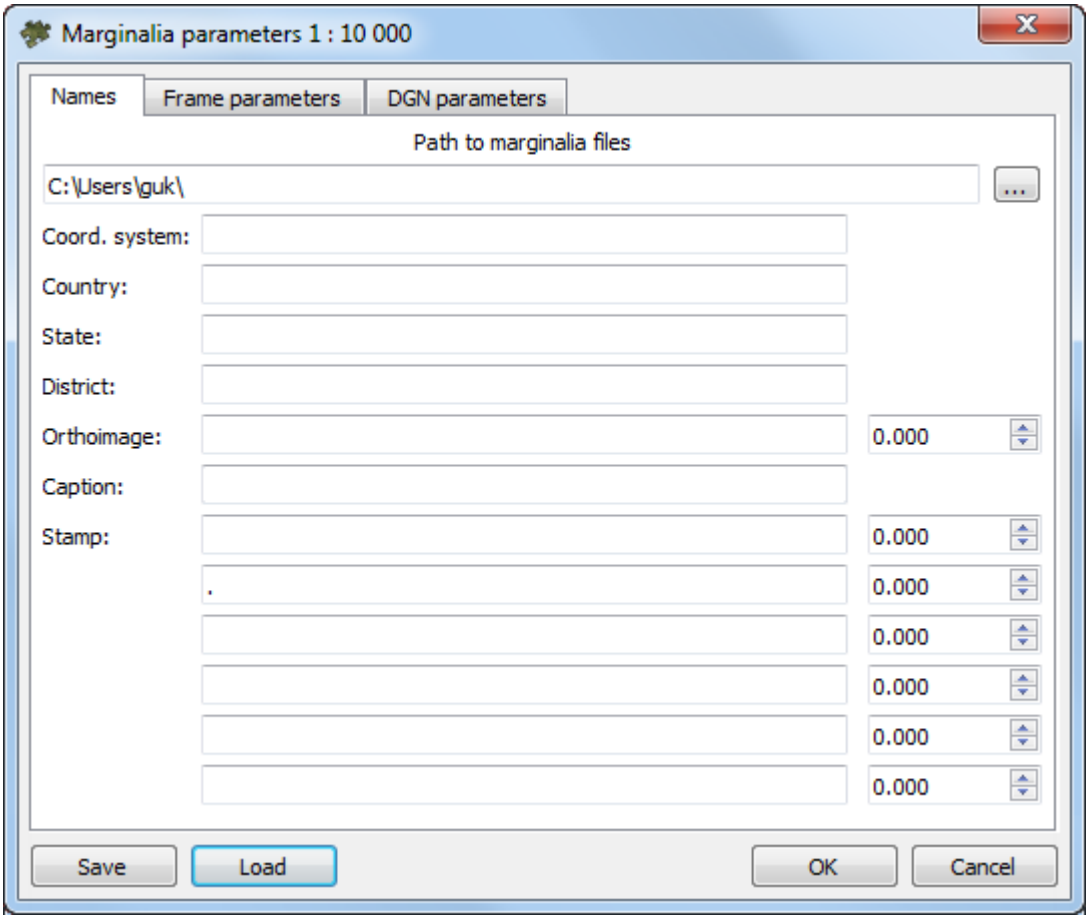


Fig. D.15. Marginalia parameters

2. The **Names** tab contains the following parameters:

   - **Path to marginalia files** – the directory where the sheets with marginalia will be saved. By default, this is the folder where orthophoto has been created. If the setting is changed, it is saved and used the next time;
   - **Coord. system**, **Country**, **State**, **District** – text lines placed consequently at the upper left corner of marginalia;
   - **Caption**, **City** – text lines placed consequently at the top center of marginalia;
   - **Stamp** – text line placed at the upper right corner of marginalia;
   - Next come 5 strings placed consequently at the *bottom right corner* of marginalia. ;

   The fields for entering numeric values to the right of some text input fields specify horizontal shift of the corresponding lines. The shift is given in the units of the *PHOTOMOD* project (usually in meters).

3. The **Frame parameters** tab contains the following parameters:

   - **Coordinate grid step** specifies the distance between the lines of grid on marginalia;
   - **External frame offset** specifies the indentation of external (thickened) frame from the frame along the outer edges of the corresponding image;
   - **External frame width** specifies thickness of external (thickened) frame;
   - **Internal / external frame layer**, **Coordinates grid layer**, **Coordinates grid labels layer** and **Text layer** specify the layer numbers (in `*.DGN` file) on which the relevant information is placed;
   - **Rename to work number** option causes renaming of the sheet (trapezoid) name in the upper right corner and in the cut-out of external (thickened) frame to the work number;
     - This requires the `CSV` file having both names of the sheets (the column number is defined by a *column with the nomenclature parameter*) and work numbers (the columns number is defined by *the column with numbers of trapezoid parameter*).
   - **Add sheet work name** option causes appending the work number of trapezoid to name of the sheet in parentheses at the top right corner of marginalia. For example:

`P-54-76-B-6-1 › P-54-76-B-6-1 (49)`

  - This requires the CSV file having both names of the sheets (the column number is defined by a *column with the nomenclature parameter*) and work numbers (the columns number is defined by *the column with numbers of trapezoid parameter*).

- **Frames file suffix** specifies a text line attached to the base sheet name to get the combined file name with all created sheets frames;

- **Delete first letter** of nomenclature option causes deleting the first symbol in the nomenclature of the sheet. For example:

  `P-54-76-B-6-1 › 54-76-B-6-1`

- [optional] There may be chosen one of the following **Type of file with neighbor sheets** values:

  - **No** – names of the neighbor sheets are calculated automatically based on the SK-42 topomaps nomenclature.

  - **Scheme** – a CSV file is used as the scheme file, which contains only the sheet names in accordance with the sheets topology. Row numbers correspond to north-south direction. Column numbers correspond to west-south direction. For example:

    ```
    P-54-76-B-6-1,P-54-76-B-6-2

    P-54-76-B-6-3,P-54-76-B-6-4
    ```

  - **List** – file in the CSV format, containing description of one sheet in each line. The line should contain the name of the sheet and the eight coordinates of four vertices of sheet. For example:

    ```
    P-54-76-B-6-3,1848.0,824.0,5848.0,824.0,5848.0,4824.0,1848.0,4824.0

    P-54-76-B-6-4,5848.0,824.0,9848.0,824.0,9848.0,4824.0,5848.0,4824.0

    P-54-76-B-6-1,1848.0,4824.0,5848.0,4824.0,5848.0,8824.0,1848.0,8824.0

    P-54-76-B-6-2,5848.0,4824.0,9848.0,4824.0,9848.0,8824.0,5848.0,8824.0
    ```

    If parameters **Scheme** or **List** are chosen, specify the path to the CSV file with neighbor sheet names and set the parameters of this file's import:

    - **Start import from string** option causes the import process to start from the given line in the file, skipping the previous lines;

- **Column with sheets names** – number of CSV column, which contains the names of the sheets;
- **Column with X1** – **Column with X4** and **Column with Y1** – **Column with Y4** – parameters - define the numbers of CSV columns, which contain corresponding coordinates of the sheets corners;
- **Swap X, Y** – if this option is checked then during import X and Y coordinates of objects vertices are swapped;
- **Separators** panel is used to select the symbols that separate fields in the CSV file, comma and space are selected as separators by default.

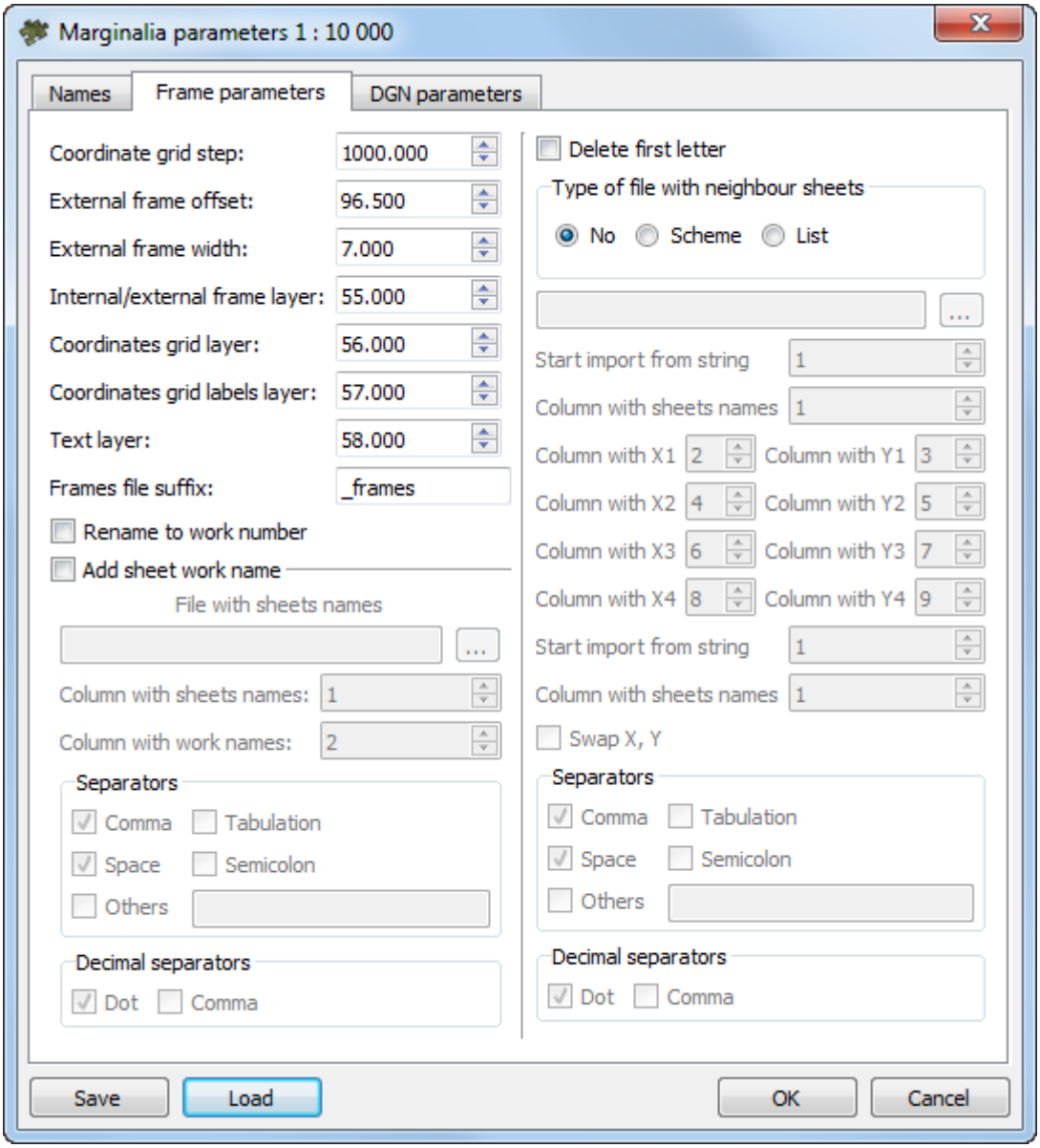


Fig. D.16. Marginalia parameters

4. The **DGN parameters** tab is used for setting standard DGN v7 parameters:

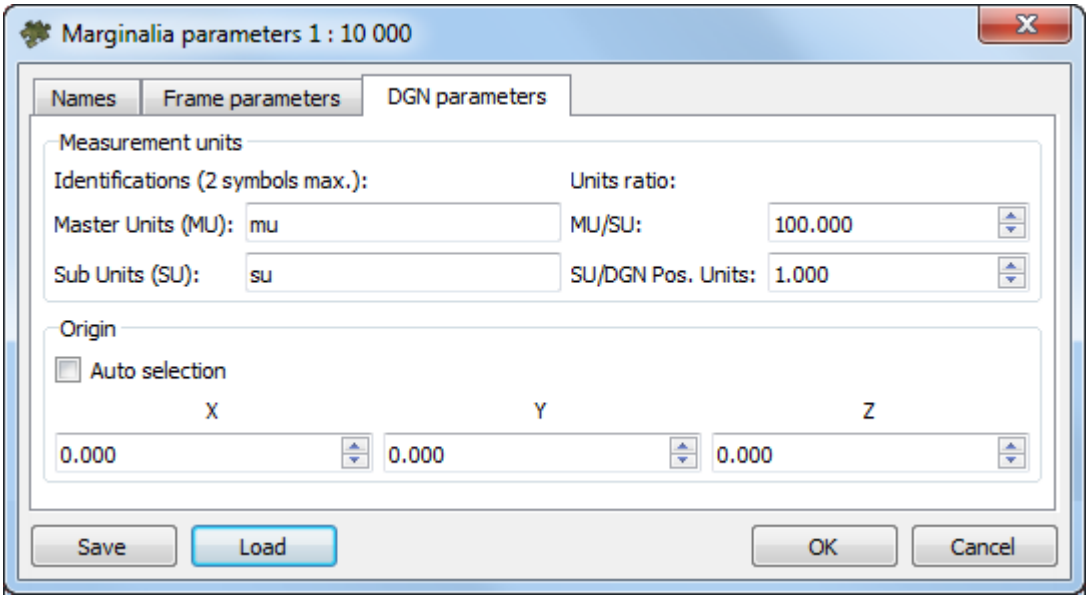


Fig. D.17. Marginalia parameters

- Names for **MU** and **SU** (see *MicroStation* system User Manual);
- Ratios **MU**/**SU** and **SU**/**Pos.Units**;
- Origin of coordinates in a file - **auto selection** or manual setting.

5. Click OK. `*.DGN` files containing marginalia would be saved in the folder specified.

MapInfo

1. Marginalia is created using the menu command **Mosaic › Create Marginalia 1:10 000 › MapInfo MIF/MID**. This command brings up the following dialog box with parameters:

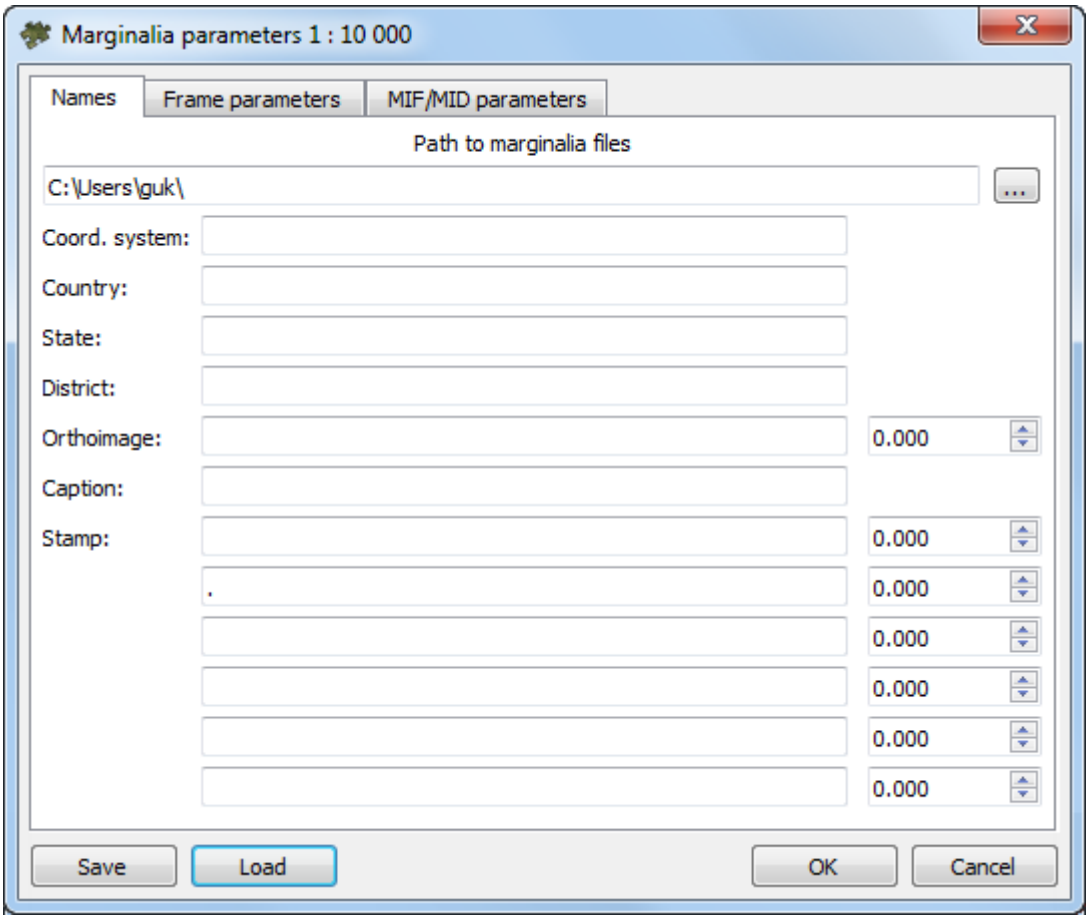


Fig. D.18. Marginalia parameters

2. The **Names** tab contains the following parameters:

   - **Path to marginalia files** – the directory where the sheets with marginalia will be saved. By default, this is the folder where orthophoto has been created. If the setting is changed, it is saved and used the next time;
   - **Coord. system**, **Country**, **State**, **District** – text lines placed consequently at the upper left corner of marginalia;
   - **Caption**, **City** – text lines placed consequently at the top center of marginalia;
   - **Stamp** – text line placed at the upper right corner of marginalia;
   - Next come 5 strings placed consequently at the *bottom right corner* of marginalia. ;

   The fields for entering numeric values to the right of some text input fields specify horizontal shift of the corresponding lines. The shift is given in the units of the *PHOTOMOD* project (usually in meters).

3. The **Frame parameters** tab contains the following parameters:

   - **Coordinate grid step** specifies the distance between the lines of grid on marginalia;
   - **External frame offset** specifies the indentation of external (thickened) frame from the frame along the outer edges of the corresponding image;
   - **External frame width** specifies thickness of external (thickened) frame;
   - **Internal / external frame layer**, **Coordinates grid layer**, **Coordinates grid labels layer** and **Text layer** specify the layer numbers (in `*.DGN` file) on which the relevant information is placed;
   - **Rename to work number** option causes renaming of the sheet (trapezoid) name in the upper right corner and in the cut-out of external (thickened) frame to the work number;
     - This requires the `CSV` file having both names of the sheets (the column number is defined by a *column with the nomenclature parameter*) and work numbers (the columns number is defined by *the column with numbers of trapezoid parameter*).
   - **Add sheet work name** option causes appending the work number of trapezoid to name of the sheet in parentheses at the top right corner of marginalia. For example:

     `P-54-76-B-6-1 › P-54-76-B-6-1 (49)`

     - This requires the `CSV` file having both names of the sheets (the column number is defined by a *column with the nomenclature parameter*) and work numbers (the columns number is defined by *the column with numbers of trapezoid parameter*).
   - **Frames file suffix** specifies a text line attached to the base sheet name to get the combined file name with all created sheets frames;
   - **Delete first letter** of nomenclature option causes deleting the first symbol in the nomenclature of the sheet. For example:

     `P-54-76-B-6-1 › 54-76-B-6-1`

   - [optional] There may be chosen one of the following **Type of file with neighbor sheets** values:
     - **No** – names of the neighbor sheets are calculated automatically based on the SK-42 topomaps nomenclature.

- **Scheme** – a CSV file is used as the scheme file, which contains only the sheet names in accordance with the sheets topology. Row numbers correspond to north-south direction. Column numbers correspond to west-south direction. For example:

  ```
  P-54-76-B-6-1,P-54-76-B-6-2

  P-54-76-B-6-3,P-54-76-B-6-4
  ```

- **List** – file in the CSV format, containing description of one sheet in each line. The line should contain the name of the sheet and the eight coordinates of four vertices of sheet. For example:

  ```
  P-54-76-B-6-3,1848.0,824.0,5848.0,824.0,5848.0,4824.0,1848.0,4824.0

  P-54-76-B-6-4,5848.0,824.0,9848.0,824.0,9848.0,4824.0,5848.0,4824.0

  P-54-76-B-6-1,1848.0,4824.0,5848.0,4824.0,5848.0,8824.0,1848.0,8824.0

  P-54-76-B-6-2,5848.0,4824.0,9848.0,4824.0,9848.0,8824.0,5848.0,8824.0
  ```

  If parameters **Scheme** or **List** are chosen, specify the path to the CSV file with neighbor sheet names and set the parameters of this file's import:

  - **Start import from string** option causes the import process to start from the given line in the file, skipping the previous lines;
  - **Column with sheets names** – number of CSV column, which contains the names of the sheets;
  - **Column with X1** – **Column with X4** and **Column with Y1** – **Column with Y4** – parameters - define the numbers of CSV columns, which contain corresponding coordinates of the sheets corners;
  - **Swap X, Y** – if this option is checked then during import X and Y coordinates of objects vertices are swapped;
  - **Separators** panel is used to select the symbols that separate fields in the CSV file, comma and space are selected as separators by default.

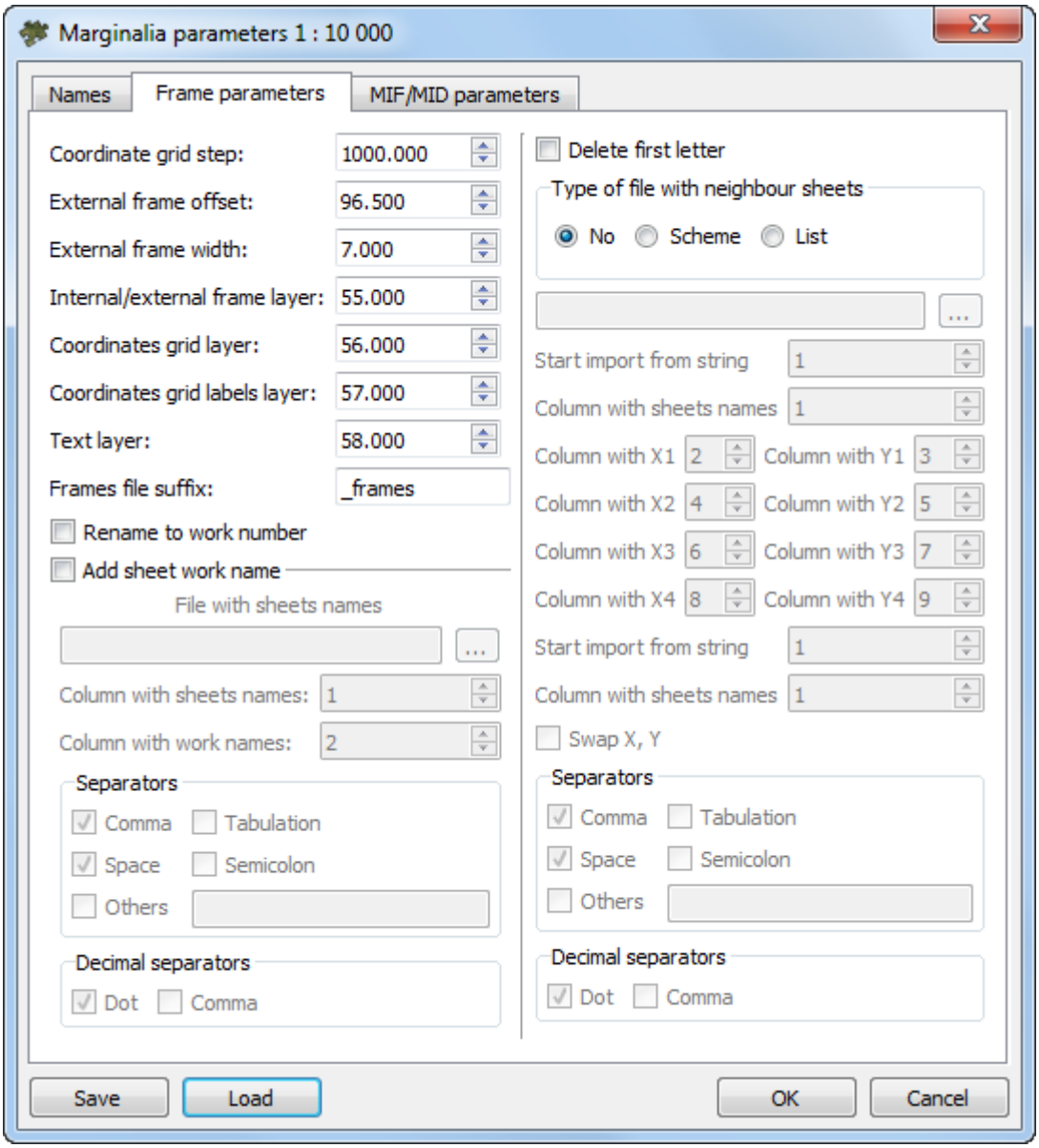


Fig. D.19. Marginalia parameters

4. The **MIF / MID parameters** tab contains the following parameters:

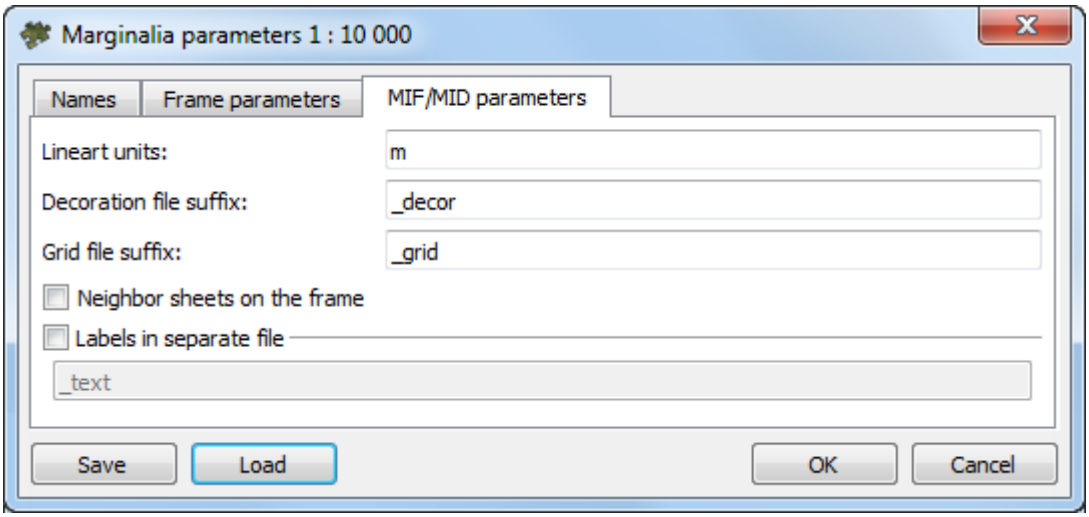


Fig. D.20. Marginalia parameters

- **User units** field specifies the name of the units of measurement in the MIF / MID `MIF/MID` file;
- **Decoration file suffix** and **Grid file suffix** fields specify the lines which are appended to the base name of the sheet to obtain separate files with corresponding data;
- **Labels in separate file** option allows to save all text captions in a separate file with the specified suffix.;

5. Click OK.

D.2.4. Marginalia 1:25 000

This section contains detailed description of marginalia creation parameters for 1:25 000 scale for *MicroStation* and *MapInfo*.

Marginalia for *MicroStation* is created using the dialog box with parameters, which is identical to the one in the parameters dialog for 1:10 000 and 1:50 000 marginalia in DGN format.

Marginalia for *MapInfo* is created using the dialog box with parameters, which is identical to the one in the parameters dialog for 1:10 000 and 1:50 000 marginalia in MIF/MID format.

MicroStation

1. Marginalia is created using the menu command **Mosaic › Create Marginalia 1:25 000 › MicroStation DGN...**. This command brings up the following dialog box with parameters:

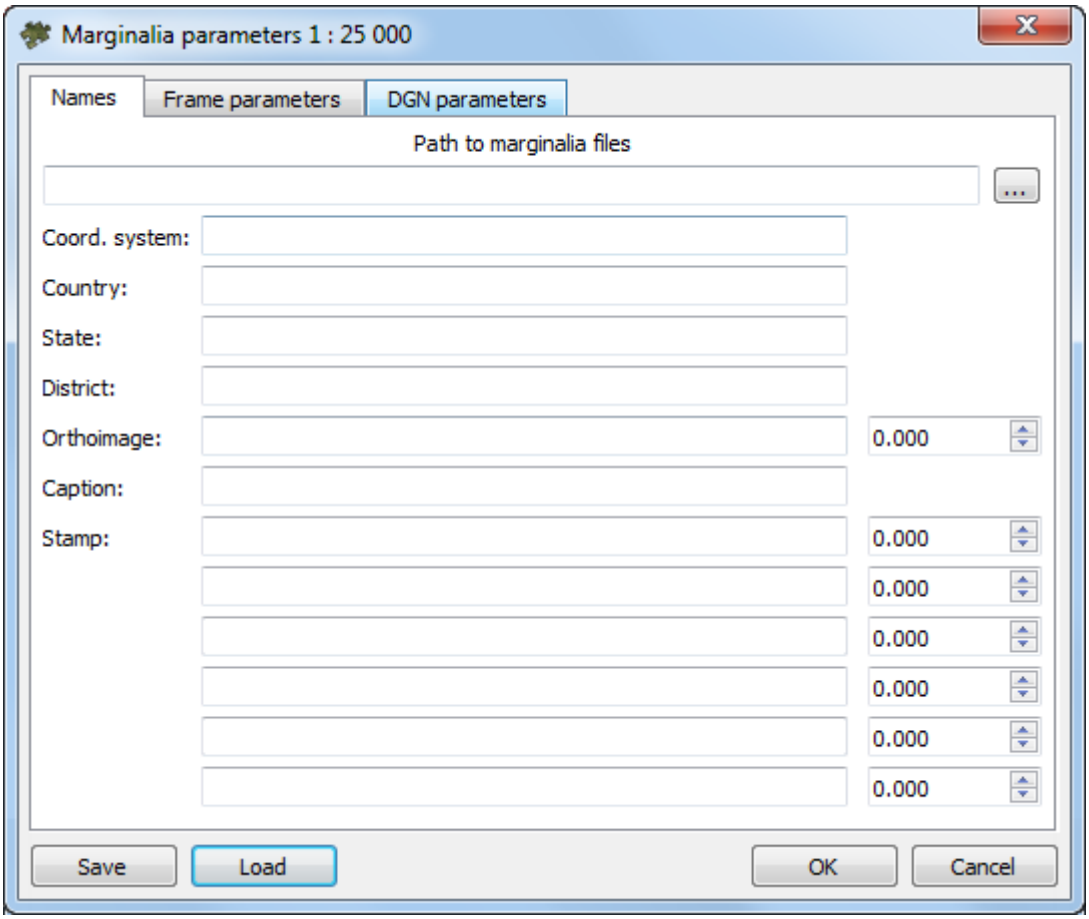


Fig. D.21. Marginalia parameters

2. The **Names** tab contains the following parameters:

   - **Path to marginalia files** – the directory where the sheets with marginalia will be saved. By default, this is the folder where orthophoto has been created. If the setting is changed, it is saved and used the next time;
   - **Coord. system**, **Country**, **State**, **District** – text lines placed consequently at the upper left corner of marginalia;
   - **Caption**, **City** – text lines placed consequently at the top center of marginalia;
   - **Stamp** – text line placed at the upper right corner of marginalia;
   - Next come 5 strings placed consequently at the *bottom right corner* of marginalia. ;

   The fields for entering numeric values to the right of some text input fields specify horizontal shift of the corresponding lines. The shift is given in the units of the *PHOTOMOD* project (usually in meters).

3. The **Frame parameters** tab contains the following parameters:

   - **Coordinate grid step** specifies the distance between the lines of grid on marginalia;
   - **External frame offset** specifies the indentation of external (thickened) frame from the frame along the outer edges of the corresponding image;
   - **External frame width** specifies thickness of external (thickened) frame;
   - **Internal / external frame layer**, **Coordinates grid layer**, **Coordinates grid labels layer** and **Text layer** specify the layer numbers (in `*.DGN` file) on which the relevant information is placed;
   - **Rename to work number** option causes renaming of the sheet (trapezoid) name in the upper right corner and in the cut-out of external (thickened) frame to the work number;
     - This requires the `CSV` file having both names of the sheets (the column number is defined by a *column with the nomenclature parameter*) and work numbers (the columns number is defined by *the column with numbers of trapezoid parameter*).
   - **Add sheet work name** option causes appending the work number of trapezoid to name of the sheet in parentheses at the top right corner of marginalia. For example:

     `P-54-76-B-6-1 › P-54-76-B-6-1 (49)`

     - This requires the `CSV` file having both names of the sheets (the column number is defined by a *column with the nomenclature parameter*) and work numbers (the columns number is defined by *the column with numbers of trapezoid parameter*).
   - **Frames file suffix** specifies a text line attached to the base sheet name to get the combined file name with all created sheets frames;
   - **Delete first letter** of nomenclature option causes deleting the first symbol in the nomenclature of the sheet. For example:

     `P-54-76-B-6-1 › 54-76-B-6-1`

   - [optional] There may be chosen one of the following **Type of file with neighbor sheets** values:
     - **No** – names of the neighbor sheets are calculated automatically based on the SK-42 topomaps nomenclature.

- **Scheme** – a CSV file is used as the scheme file, which contains only the sheet names in accordance with the sheets topology. Row numbers correspond to north-south direction. Column numbers correspond to west-south direction. For example:

  ```
  P-54-76-B-6-1,P-54-76-B-6-2

  P-54-76-B-6-3,P-54-76-B-6-4
  ```

- **List** – file in the CSV format, containing description of one sheet in each line. The line should contain the name of the sheet and the eight coordinates of four vertices of sheet. For example:

  ```
  P-54-76-B-6-3,1848.0,824.0,5848.0,824.0,5848.0,4824.0,1848.0,4824.0

  P-54-76-B-6-4,5848.0,824.0,9848.0,824.0,9848.0,4824.0,5848.0,4824.0

  P-54-76-B-6-1,1848.0,4824.0,5848.0,4824.0,5848.0,8824.0,1848.0,8824.0

  P-54-76-B-6-2,5848.0,4824.0,9848.0,4824.0,9848.0,8824.0,5848.0,8824.0
  ```

  If parameters **Scheme** or **List** are chosen, specify the path to the CSV file with neighbor sheet names and set the parameters of this file's import:

  - **Start import from string** option causes the import process to start from the given line in the file, skipping the previous lines;
  - **Column with sheets names** – number of CSV column, which contains the names of the sheets;
  - **Column with X1** – **Column with X4** and **Column with Y1** – **Column with Y4** – parameters - define the numbers of CSV columns, which contain corresponding coordinates of the sheets corners;
  - **Swap X, Y** – if this option is checked then during import X and Y coordinates of objects vertices are swapped;
  - **Separators** panel is used to select the symbols that separate fields in the CSV file, comma and space are selected as separators by default.

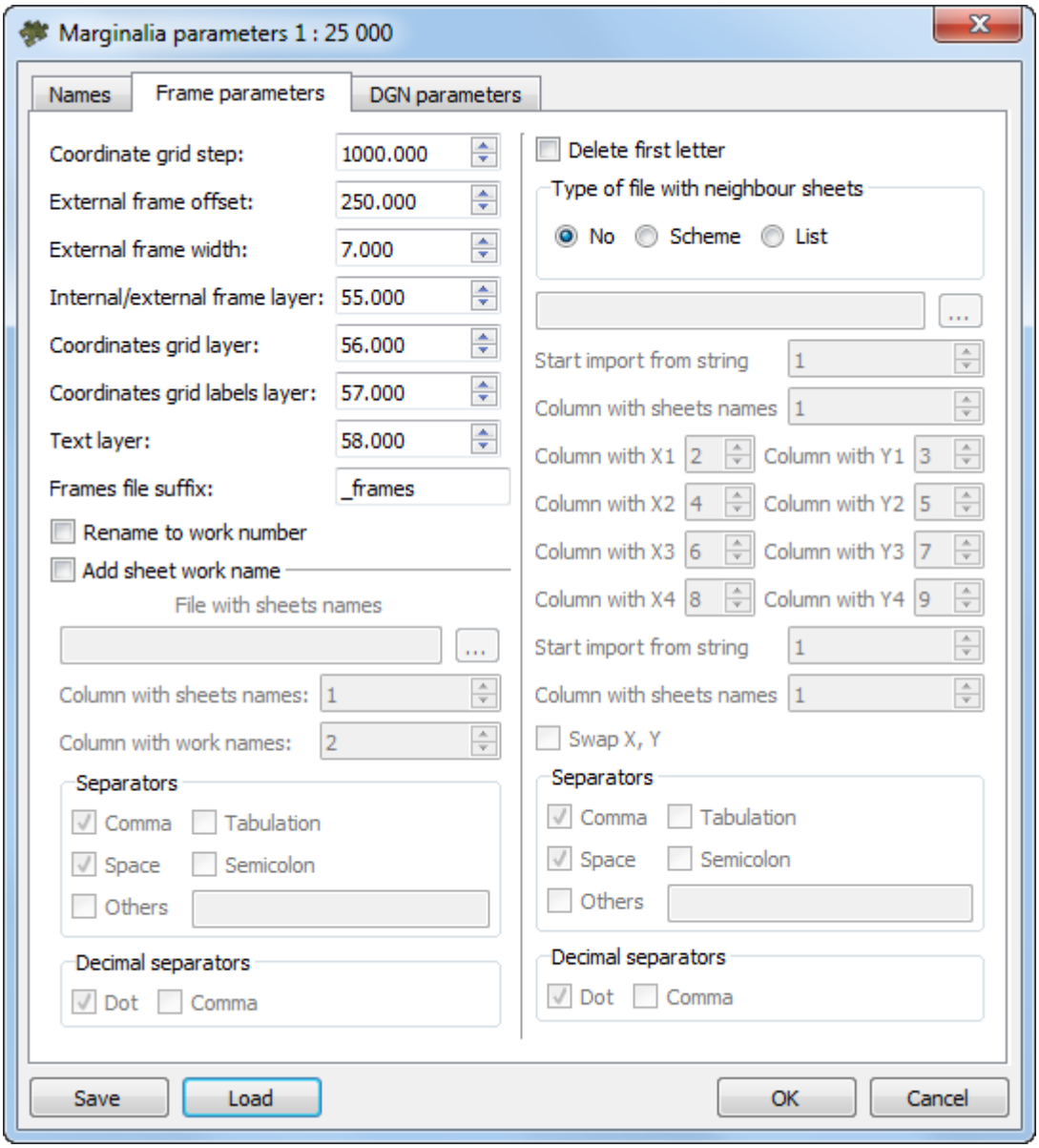


Fig. D.22. Marginalia parameters

4. The **DGN parameters** tab is used for setting standard DGN v7 parameters:

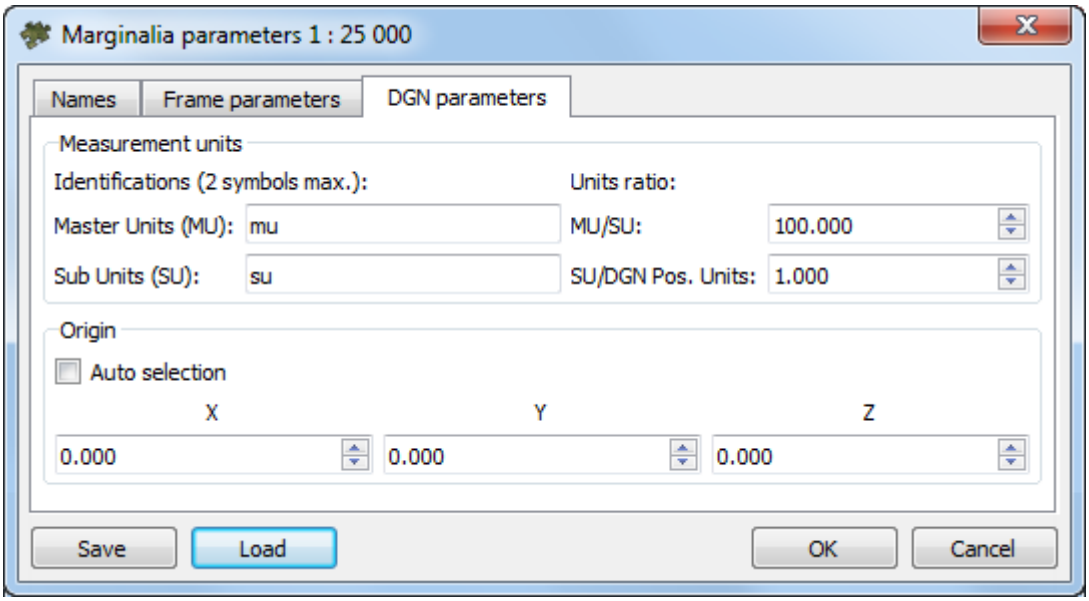


Fig. D.23. Marginalia parameters

- Names for **MU** and **SU** (see *MicroStation* system User Manual);
- Ratios **MU**/**SU** and **SU**/**Pos.Units**;
- Origin of coordinates in a file - **auto selection** or manual setting.

5. Click OK. `*.DGN` files containing marginalia would be saved in the folder specified.

MapInfo

1. Marginalia is created using the menu command **Mosaic › Create Marginalia 1:25 000 › MapInfo MIF/MID**. This command brings up the following dialog box with parameters:

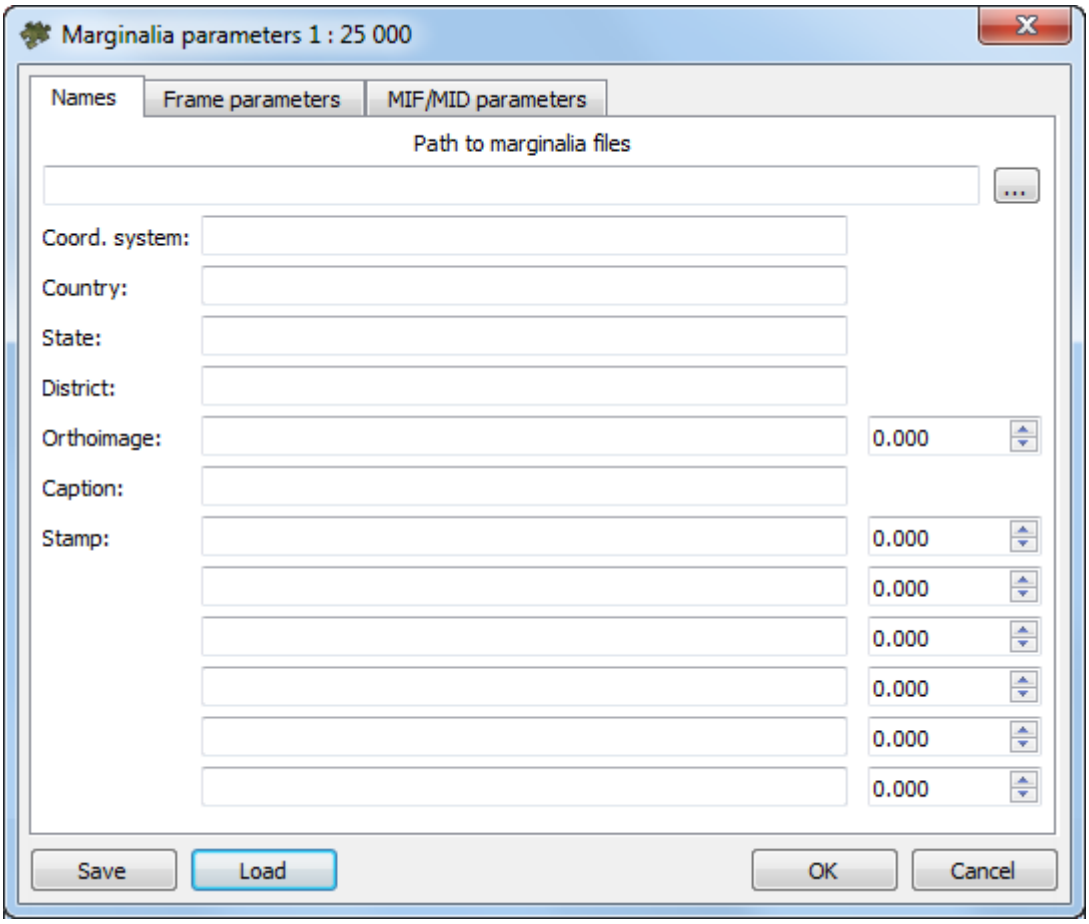


Fig. D.24. Marginalia parameters

2. The **Names** tab contains the following parameters:

   - **Path to marginalia files** – the directory where the sheets with marginalia will be saved. By default, this is the folder where orthophoto has been created. If the setting is changed, it is saved and used the next time;
   - **Coord. system**, **Country**, **State**, **District** – text lines placed consequently at the upper left corner of marginalia;
   - **Caption**, **City** – text lines placed consequently at the top center of marginalia;
   - **Stamp** – text line placed at the upper right corner of marginalia;
   - Next come 5 strings placed consequently at the *bottom right corner* of marginalia. ;

   The fields for entering numeric values to the right of some text input fields specify horizontal shift of the corresponding lines. The shift is given in the units of the *PHOTOMOD* project (usually in meters).

3. The **Frame parameters** tab contains the following parameters:

   - **Coordinate grid step** specifies the distance between the lines of grid on marginalia;
   - **External frame offset** specifies the indentation of external (thickened) frame from the frame along the outer edges of the corresponding image;
   - **External frame width** specifies thickness of external (thickened) frame;
   - **Internal / external frame layer**, **Coordinates grid layer**, **Coordinates grid labels layer** and **Text layer** specify the layer numbers (in `*.DGN` file) on which the relevant information is placed;
   - **Rename to work number** option causes renaming of the sheet (trapezoid) name in the upper right corner and in the cut-out of external (thickened) frame to the work number;
     - This requires the `CSV` file having both names of the sheets (the column number is defined by a *column with the nomenclature parameter*) and work numbers (the columns number is defined by *the column with numbers of trapezoid parameter*).
   - **Add sheet work name** option causes appending the work number of trapezoid to name of the sheet in parentheses at the top right corner of marginalia. For example:

     `P-54-76-B-6-1 › P-54-76-B-6-1 (49)`

     - This requires the `CSV` file having both names of the sheets (the column number is defined by a *column with the nomenclature parameter*) and work numbers (the columns number is defined by *the column with numbers of trapezoid parameter*).
   - **Frames file suffix** specifies a text line attached to the base sheet name to get the combined file name with all created sheets frames;
   - **Delete first letter** of nomenclature option causes deleting the first symbol in the nomenclature of the sheet. For example:

     `P-54-76-B-6-1 › 54-76-B-6-1`

   - [optional] There may be chosen one of the following **Type of file with neighbor sheets** values:
     - **No** – names of the neighbor sheets are calculated automatically based on the SK-42 topomaps nomenclature.

- **Scheme** – a CSV file is used as the scheme file, which contains only the sheet names in accordance with the sheets topology. Row numbers correspond to north-south direction. Column numbers correspond to west-south direction. For example:

  ```
  P-54-76-B-6-1,P-54-76-B-6-2

  P-54-76-B-6-3,P-54-76-B-6-4
  ```

- **List** – file in the CSV format, containing description of one sheet in each line. The line should contain the name of the sheet and the eight coordinates of four vertices of sheet. For example:

  ```
  P-54-76-B-6-3,1848.0,824.0,5848.0,824.0,5848.0,4824.0,1848.0,4824.0

  P-54-76-B-6-4,5848.0,824.0,9848.0,824.0,9848.0,4824.0,5848.0,4824.0

  P-54-76-B-6-1,1848.0,4824.0,5848.0,4824.0,5848.0,8824.0,1848.0,8824.0

  P-54-76-B-6-2,5848.0,4824.0,9848.0,4824.0,9848.0,8824.0,5848.0,8824.0
  ```

  If parameters **Scheme** or **List** are chosen, specify the path to the CSV file with neighbor sheet names and set the parameters of this file's import:

  - **Start import from string** option causes the import process to start from the given line in the file, skipping the previous lines;
  - **Column with sheets names** – number of CSV column, which contains the names of the sheets;
  - **Column with X1** – **Column with X4** and **Column with Y1** – **Column with Y4** – parameters - define the numbers of CSV columns, which contain corresponding coordinates of the sheets corners;
  - **Swap X, Y** – if this option is checked then during import X and Y coordinates of objects vertices are swapped;
  - **Separators** panel is used to select the symbols that separate fields in the CSV file, comma and space are selected as separators by default.

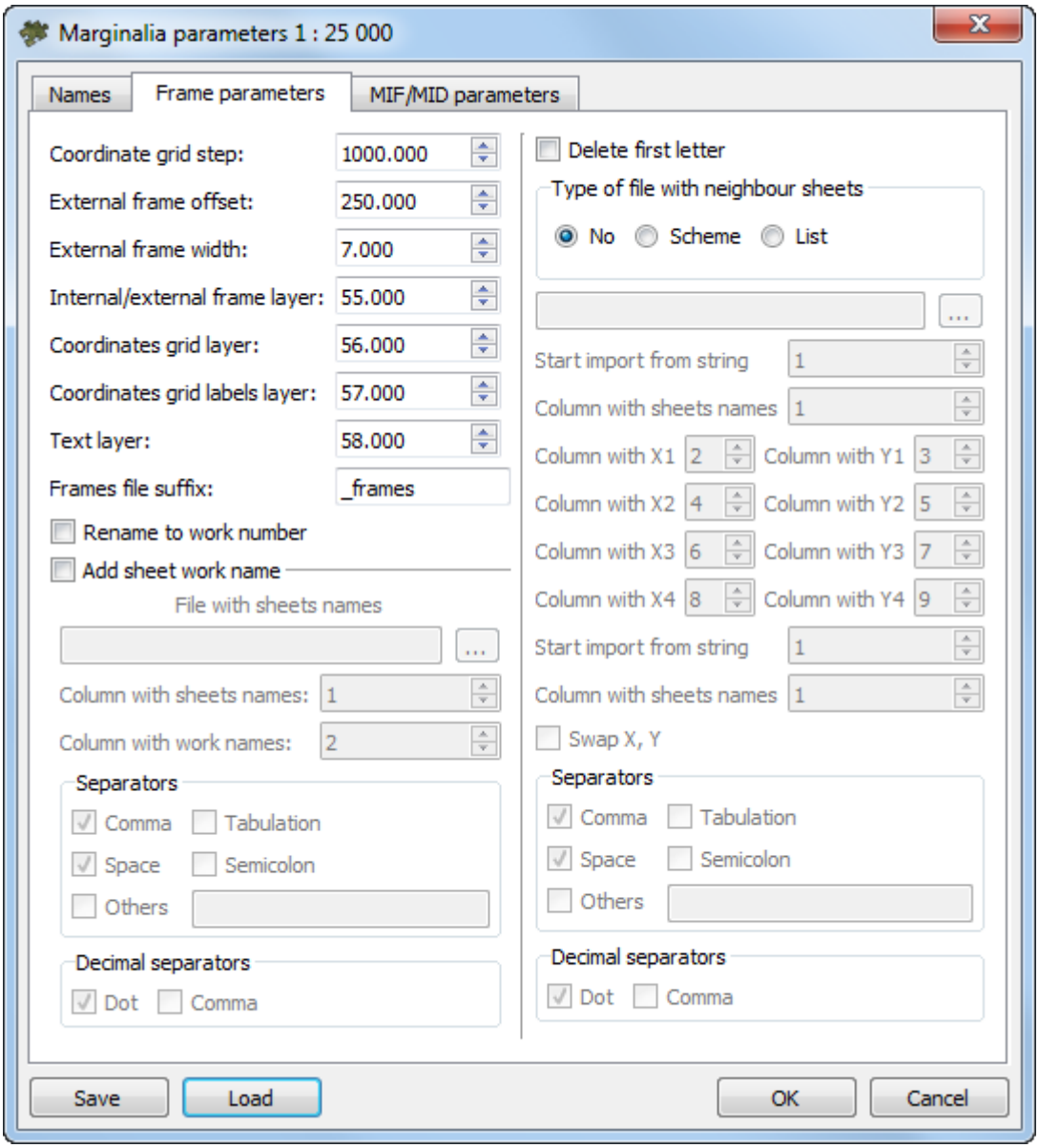


Fig. D.25. Marginalia parameters

4. The **MIF / MID parameters** tab contains the following parameters:

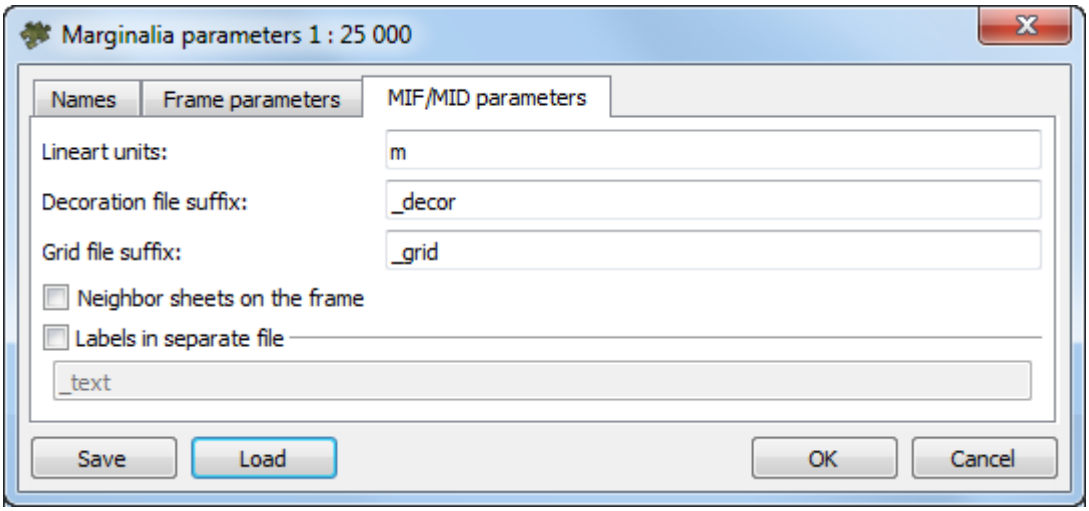


Fig. D.26. Marginalia parameters

- **User units** field specifies the name of the units of measurement in the MIF / MID `MIF/MID` file;
- **Decoration file suffix** and **Grid file suffix** fields specify the lines which are appended to the base name of the sheet to obtain separate files with corresponding data;
- **Labels in separate file** option allows to save all text captions in a separate file with the specified suffix.;

5. Click OK.

D.2.5. Marginalia 1:50 000

This section contains detailed description of marginalia creation parameters for 1:50 000 scale for *MicroStation* and *MapInfo*.

Marginalia for *MicroStation* is created using the dialog box with parameters, which is identical to the one in the parameters dialog for 1:10 000 and 1:25 000 marginalia in DGN format.

Marginalia for *MapInfo* is created using the dialog box with parameters, which is identical to the one in the parameters dialog for 1:10 000 and 1:25 000 marginalia in MIF/MID format.

MicroStation

1. Marginalia is created using the menu command **Mosaic › Create Marginalia 1:50 000 › MicroStation DGN...**. This command brings up the following dialog box with parameters:

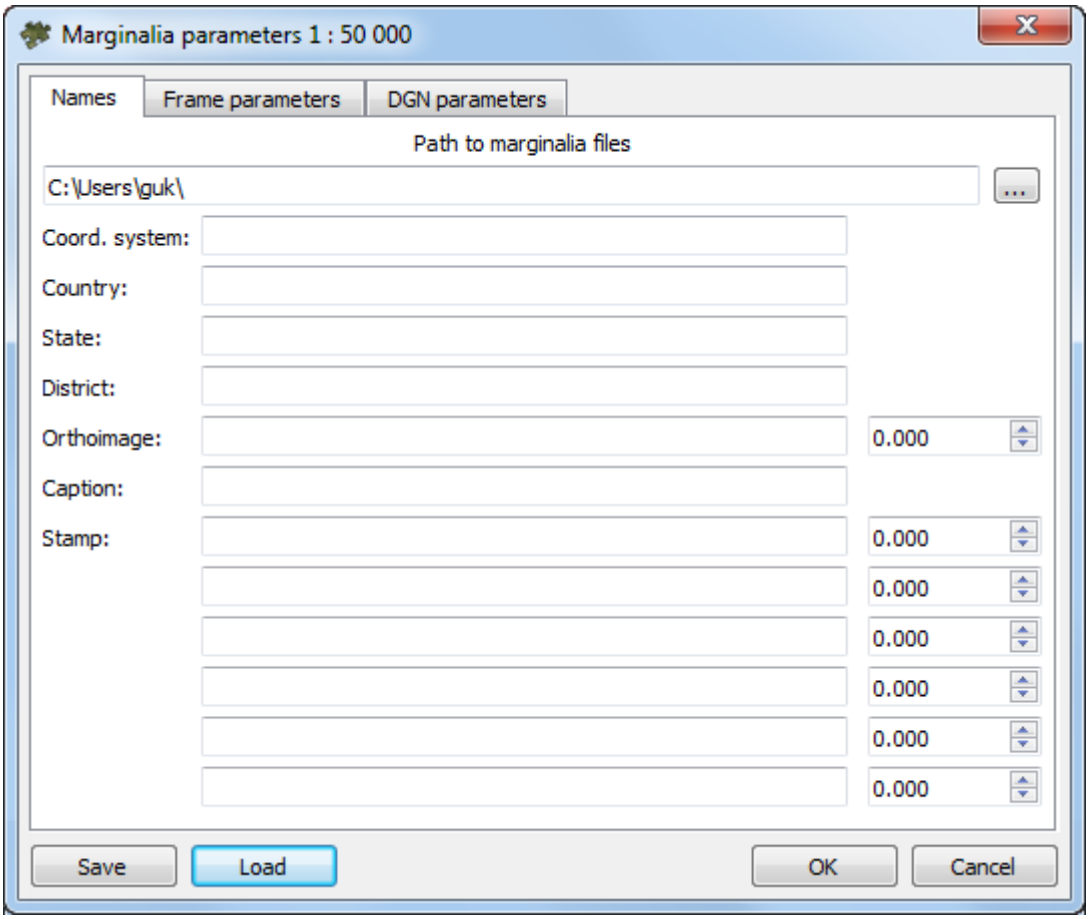


Fig. D.27. Marginalia parameters

2. The **Names** tab contains the following parameters:

   - **Path to marginalia files** – the directory where the sheets with marginalia will be saved. By default, this is the folder where orthophoto has been created. If the setting is changed, it is saved and used the next time;
   - **Coord. system**, **Country**, **State**, **District** – text lines placed consequently at the upper left corner of marginalia;
   - **Caption**, **City** – text lines placed consequently at the top center of marginalia;
   - **Stamp** – text line placed at the upper right corner of marginalia;
   - Next come 5 strings placed consequently at the *bottom right corner* of marginalia. ;

   The fields for entering numeric values to the right of some text input fields specify horizontal shift of the corresponding lines. The shift is given in the units of the *PHOTOMOD* project (usually in meters).

3. The **Frame parameters** tab contains the following parameters:

   - **Coordinate grid step** specifies the distance between the lines of grid on marginalia;
   - **External frame offset** specifies the indentation of external (thickened) frame from the frame along the outer edges of the corresponding image;
   - **External frame width** specifies thickness of external (thickened) frame;
   - **Internal / external frame layer**, **Coordinates grid layer**, **Coordinates grid labels layer** and **Text layer** specify the layer numbers (in `*.DGN` file) on which the relevant information is placed;
   - **Rename to work number** option causes renaming of the sheet (trapezoid) name in the upper right corner and in the cut-out of external (thickened) frame to the work number;
     - This requires the `CSV` file having both names of the sheets (the column number is defined by a *column with the nomenclature parameter*) and work numbers (the columns number is defined by *the column with numbers of trapezoid parameter*).
   - **Add sheet work name** option causes appending the work number of trapezoid to name of the sheet in parentheses at the top right corner of marginalia. For example:

     `P-54-76-B-6-1 › P-54-76-B-6-1 (49)`

     - This requires the `CSV` file having both names of the sheets (the column number is defined by a *column with the nomenclature parameter*) and work numbers (the columns number is defined by *the column with numbers of trapezoid parameter*).
   - **Frames file suffix** specifies a text line attached to the base sheet name to get the combined file name with all created sheets frames;
   - **Delete first letter** of nomenclature option causes deleting the first symbol in the nomenclature of the sheet. For example:

     `P-54-76-B-6-1 › 54-76-B-6-1`

   - [optional] There may be chosen one of the following **Type of file with neighbor sheets** values:
     - **No** – names of the neighbor sheets are calculated automatically based on the SK-42 topomaps nomenclature.

- **Scheme** – a CSV file is used as the scheme file, which contains only the sheet names in accordance with the sheets topology. Row numbers correspond to north-south direction. Column numbers correspond to west-south direction. For example:

  ```
  P-54-76-B-6-1,P-54-76-B-6-2

  P-54-76-B-6-3,P-54-76-B-6-4
  ```

- **List** – file in the CSV format, containing description of one sheet in each line. The line should contain the name of the sheet and the eight coordinates of four vertices of sheet. For example:

  ```
  P-54-76-B-6-3,1848.0,824.0,5848.0,824.0,5848.0,4824.0,1848.0,4824.0

  P-54-76-B-6-4,5848.0,824.0,9848.0,824.0,9848.0,4824.0,5848.0,4824.0

  P-54-76-B-6-1,1848.0,4824.0,5848.0,4824.0,5848.0,8824.0,1848.0,8824.0

  P-54-76-B-6-2,5848.0,4824.0,9848.0,4824.0,9848.0,8824.0,5848.0,8824.0
  ```

  If parameters **Scheme** or **List** are chosen, specify the path to the CSV file with neighbor sheet names and set the parameters of this file's import:

  - **Start import from string** option causes the import process to start from the given line in the file, skipping the previous lines;
  - **Column with sheets names** – number of CSV column, which contains the names of the sheets;
  - **Column with X1** – **Column with X4** and **Column with Y1** – **Column with Y4** – parameters - define the numbers of CSV columns, which contain corresponding coordinates of the sheets corners;
  - **Swap X, Y** – if this option is checked then during import X and Y coordinates of objects vertices are swapped;
  - **Separators** panel is used to select the symbols that separate fields in the CSV file, comma and space are selected as separators by default.

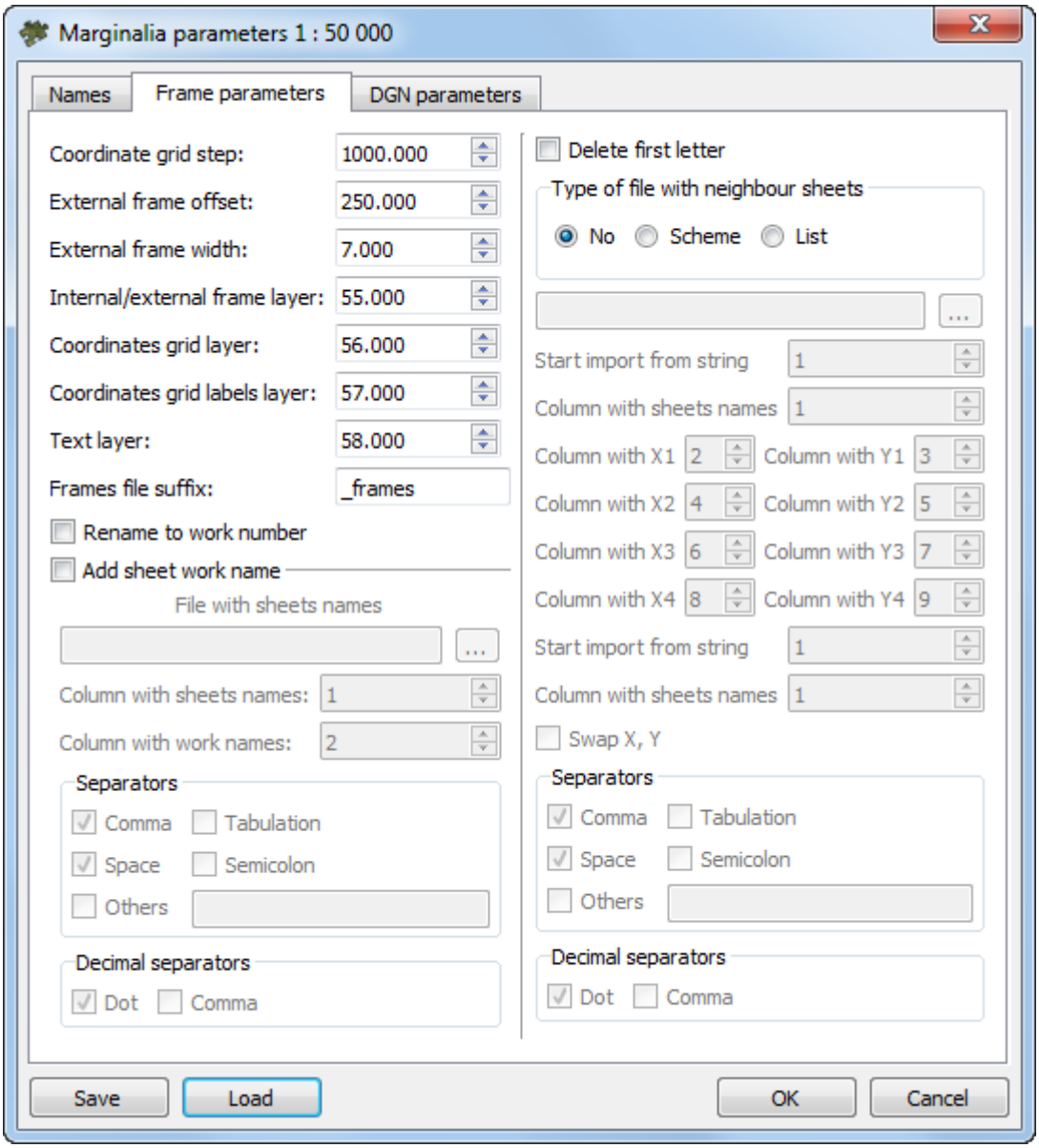


Fig. D.28. Marginalia parameters

4. The **DGN parameters** tab is used for setting standard DGN v7 parameters:

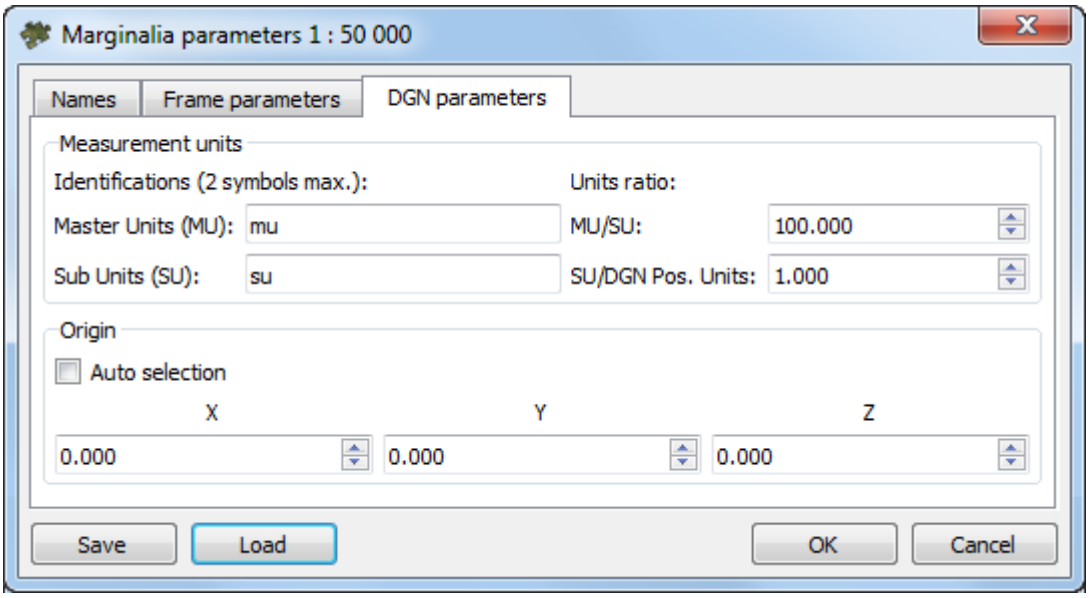


Fig. D.29. Marginalia parameters

- Names for **MU** and **SU** (see *MicroStation* system User Manual);
- Ratios **MU**/**SU** and **SU**/**Pos.Units**;
- Origin of coordinates in a file - **auto selection** or manual setting.

5. Click OK. `*.DGN` files containing marginalia would be saved in the folder specified.

MapInfo

1. Marginalia is created using the menu command **Mosaic › Create Marginalia 1:50 000 › MapInfo MIF/MID**. This command brings up the following dialog box with parameters:

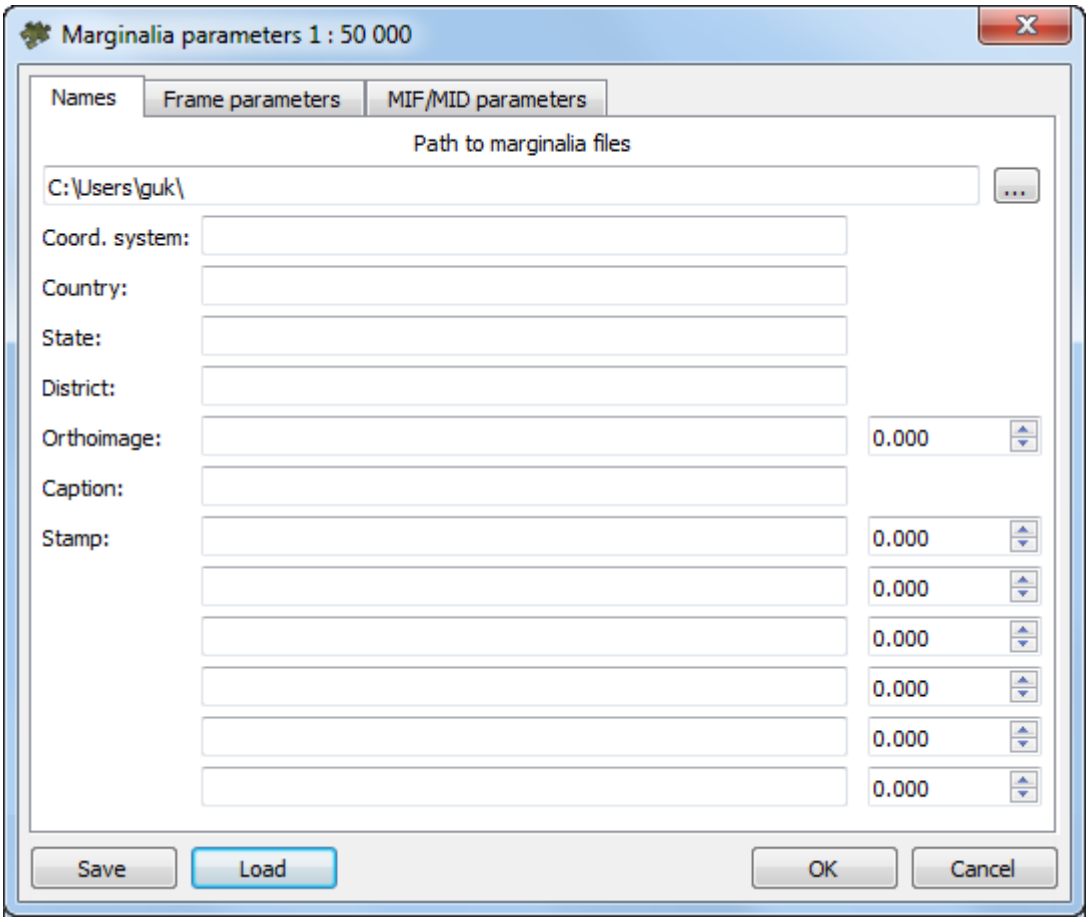


Fig. D.30. Marginalia parameters

2. The **Names** tab contains the following parameters:

   - **Path to marginalia files** – the directory where the sheets with marginalia will be saved. By default, this is the folder where orthophoto has been created. If the setting is changed, it is saved and used the next time;
   - **Coord. system**, **Country**, **State**, **District** – text lines placed consequently at the upper left corner of marginalia;
   - **Caption**, **City** – text lines placed consequently at the top center of marginalia;
   - **Stamp** – text line placed at the upper right corner of marginalia;
   - Next come 5 strings placed consequently at the *bottom right corner* of marginalia. ;

   The fields for entering numeric values to the right of some text input fields specify horizontal shift of the corresponding lines. The shift is given in the units of the *PHOTOMOD* project (usually in meters).

3. The **Frame parameters** tab contains the following parameters:

   - **Coordinate grid step** specifies the distance between the lines of grid on marginalia;
   - **External frame offset** specifies the indentation of external (thickened) frame from the frame along the outer edges of the corresponding image;
   - **External frame width** specifies thickness of external (thickened) frame;
   - **Internal / external frame layer**, **Coordinates grid layer**, **Coordinates grid labels layer** and **Text layer** specify the layer numbers (in `*.DGN` file) on which the relevant information is placed;
   - **Rename to work number** option causes renaming of the sheet (trapezoid) name in the upper right corner and in the cut-out of external (thickened) frame to the work number;
     - This requires the `CSV` file having both names of the sheets (the column number is defined by a *column with the nomenclature parameter*) and work numbers (the columns number is defined by *the column with numbers of trapezoid parameter*).
   - **Add sheet work name** option causes appending the work number of trapezoid to name of the sheet in parentheses at the top right corner of marginalia. For example:

     `P-54-76-B-6-1 › P-54-76-B-6-1 (49)`

     - This requires the `CSV` file having both names of the sheets (the column number is defined by a *column with the nomenclature parameter*) and work numbers (the columns number is defined by *the column with numbers of trapezoid parameter*).
   - **Frames file suffix** specifies a text line attached to the base sheet name to get the combined file name with all created sheets frames;
   - **Delete first letter** of nomenclature option causes deleting the first symbol in the nomenclature of the sheet. For example:

     `P-54-76-B-6-1 › 54-76-B-6-1`

   - [optional] There may be chosen one of the following **Type of file with neighbor sheets** values:
     - **No** – names of the neighbor sheets are calculated automatically based on the SK-42 topomaps nomenclature.

- **Scheme** – a CSV file is used as the scheme file, which contains only the sheet names in accordance with the sheets topology. Row numbers correspond to north-south direction. Column numbers correspond to west-south direction. For example:

  ```
  P-54-76-B-6-1,P-54-76-B-6-2

  P-54-76-B-6-3,P-54-76-B-6-4
  ```

- **List** – file in the CSV format, containing description of one sheet in each line. The line should contain the name of the sheet and the eight coordinates of four vertices of sheet. For example:

  ```
  P-54-76-B-6-3,1848.0,824.0,5848.0,824.0,5848.0,4824.0,1848.0,4824.0

  P-54-76-B-6-4,5848.0,824.0,9848.0,824.0,9848.0,4824.0,5848.0,4824.0

  P-54-76-B-6-1,1848.0,4824.0,5848.0,4824.0,5848.0,8824.0,1848.0,8824.0

  P-54-76-B-6-2,5848.0,4824.0,9848.0,4824.0,9848.0,8824.0,5848.0,8824.0
  ```

  If parameters **Scheme** or **List** are chosen, specify the path to the CSV file with neighbor sheet names and set the parameters of this file's import:

  - **Start import from string** option causes the import process to start from the given line in the file, skipping the previous lines;
  - **Column with sheets names** – number of CSV column, which contains the names of the sheets;
  - **Column with X1** – **Column with X4** and **Column with Y1** – **Column with Y4** – parameters - define the numbers of CSV columns, which contain corresponding coordinates of the sheets corners;
  - **Swap X, Y** – if this option is checked then during import X and Y coordinates of objects vertices are swapped;
  - **Separators** panel is used to select the symbols that separate fields in the CSV file, comma and space are selected as separators by default.

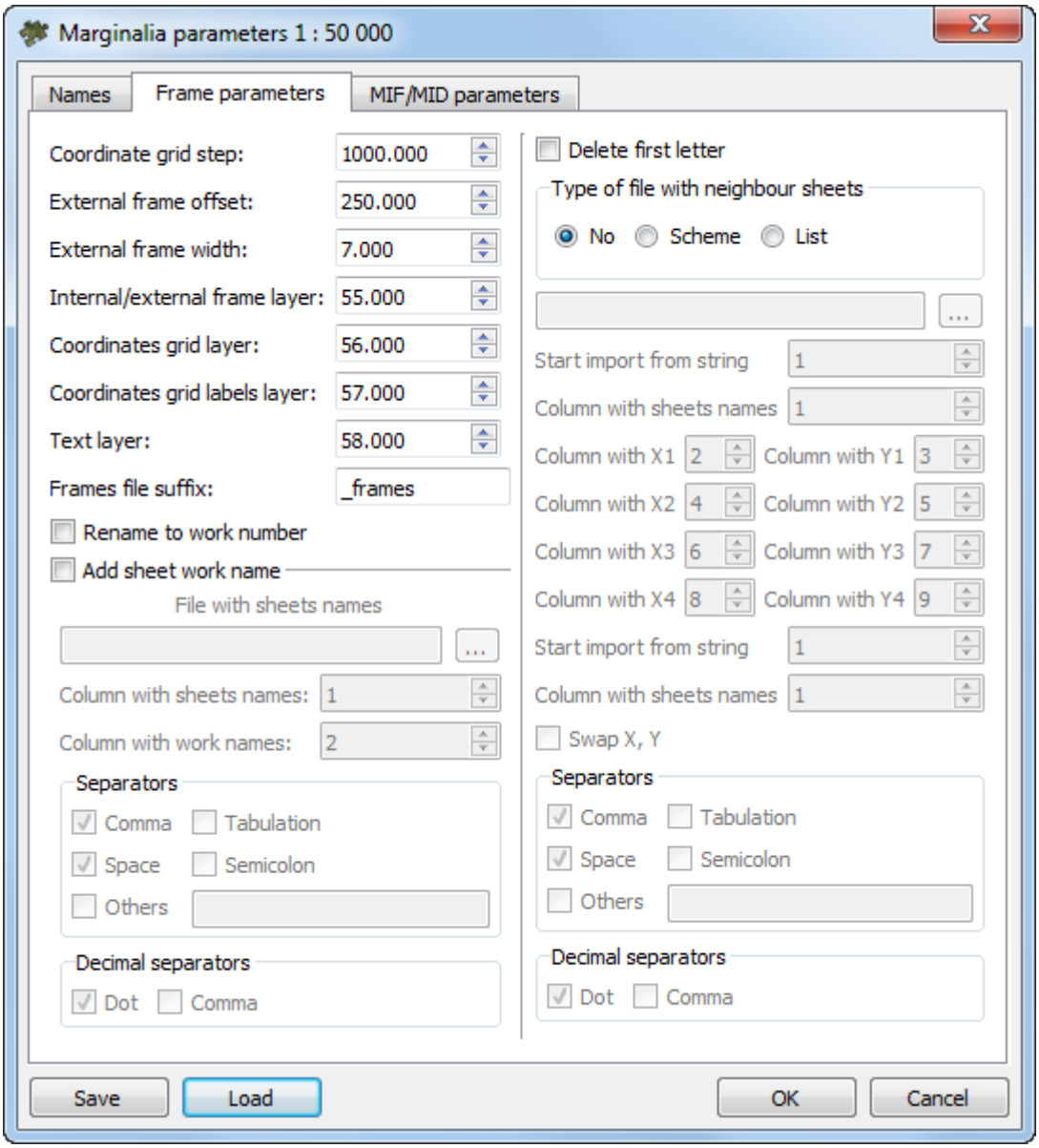


Fig. D.31. Marginalia parameters

4. The **MIF / MID parameters** tab contains the following parameters:

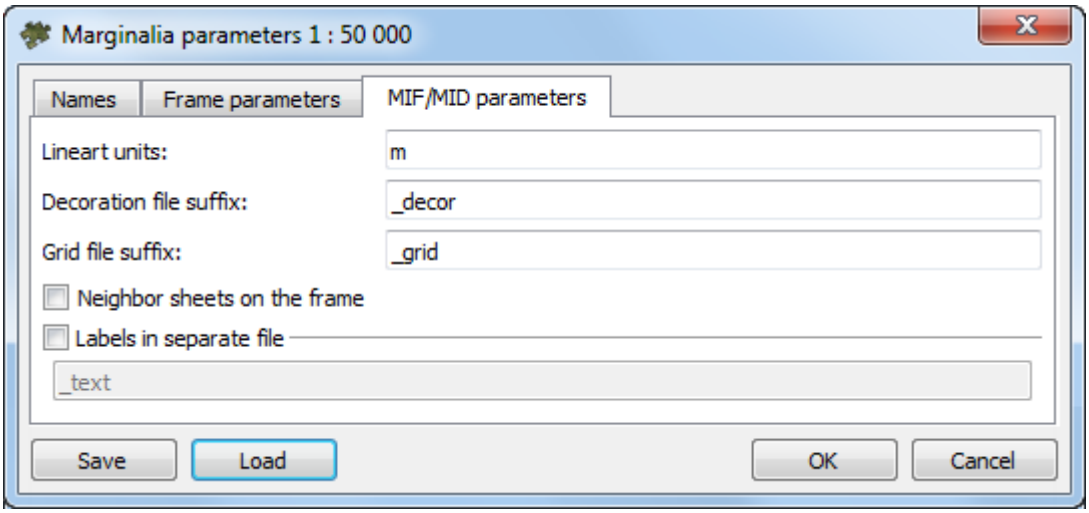


Fig. D.32. Marginalia parameters

- **User units** field specifies the name of the units of measurement in the MIF / MID `MIF/MID` file;
- **Decoration file suffix** and **Grid file suffix** fields specify the lines which are appended to the base name of the sheet to obtain separate files with corresponding data;
- **Labels in separate file** option allows to save all text captions in a separate file with the specified suffix.;

5. Click OK.

D.3. Arbitrary marginalia parameters

If necessary the orthophoto marginalia, created in scales 1:2 000 and 1:5 000, may be configured in accordance with the requirements of the user. To do this, use the following commands:

- **Mosaic › Create marginalia 1:2000 › MicroStation DGN (arbitrary)**
- **Mosaic › Create marginalia 1:2000 › MapInfo MIF/MID (arbitrary)**
- **Mosaic › Create marginalia 1:5000 › MicroStation DGN (arbitrary)**
- **Mosaic › Create marginalia 1:5000 › MapInfo MIF/MID (arbitrary)**

In the window that appears, you can edit the layout parameters in the appropriate fields:

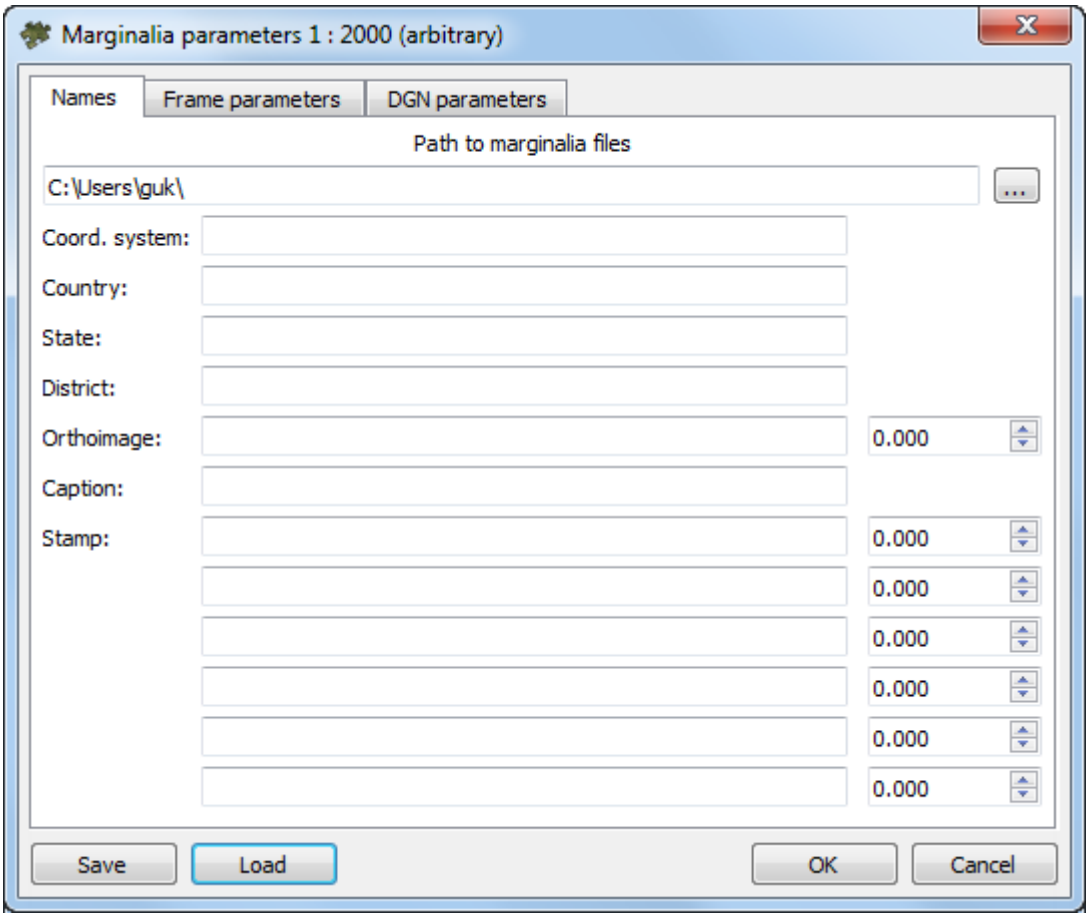


Fig. D.33. Marginalia parameters

1. **Names** tab is identical to the one in the parameters dialog for 1:2000 marginalia standard, except for additional **Contours** and **Elevation** system parameters, which specify two text strings, which are written consequently at the center bottom;

2. The **Frame parameters** tab contains the following parameters:

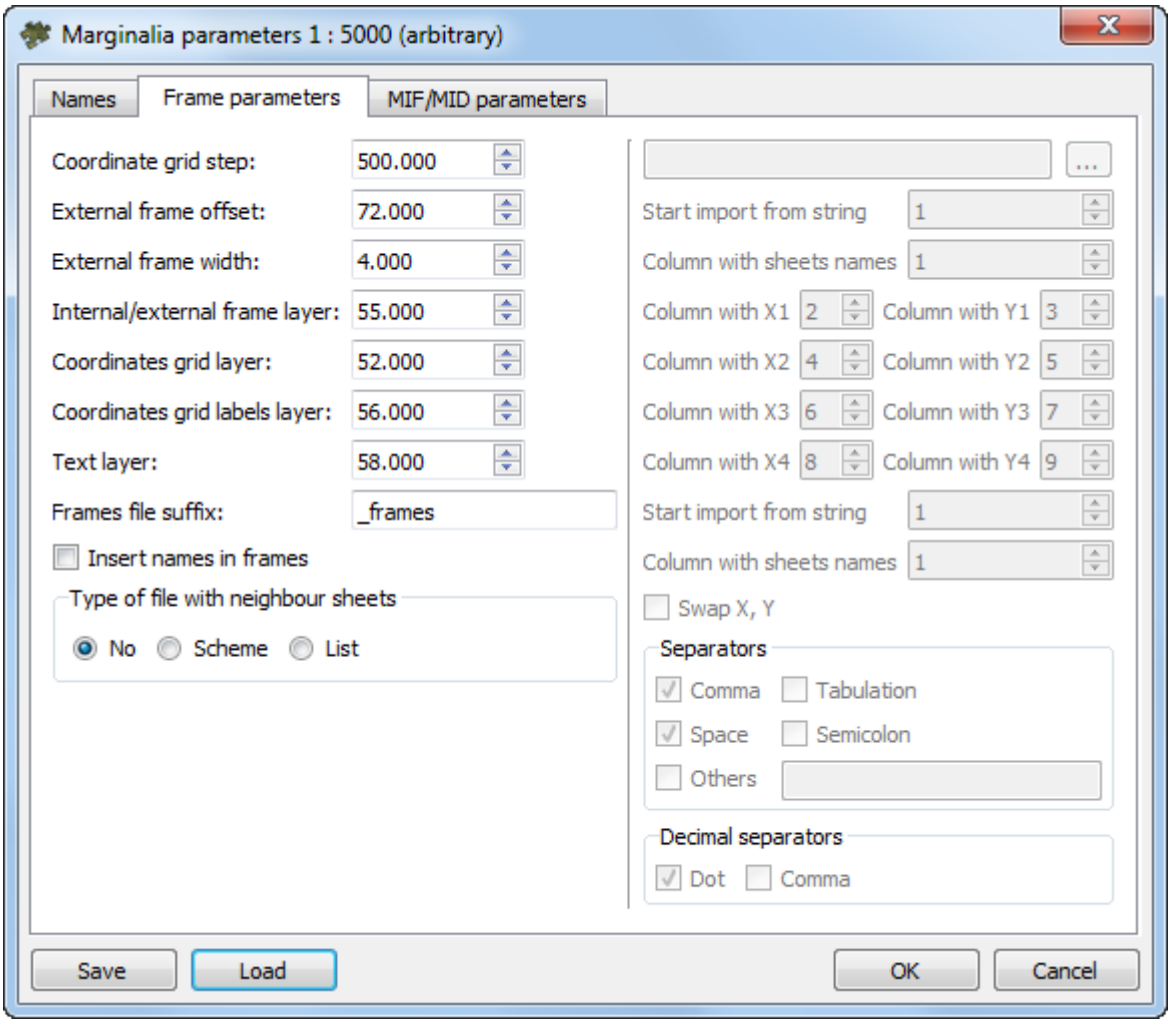


Fig. D.34. Marginalia parameters

- **Coordinate grid step** specifies the distance between the lines of grid on marginalia;
- **External frame offset** specifies the indentation of external (thickened) frame from the frame along the outer edges of the corresponding image;
- **External frame width** specifies thickness of external (thickened) frame;
- **Internal / external frame layer**, **Coordinates grid layer**, **Coordinates grid labels layer** and **Text layer** specify the layer numbers (in `*.DGN` file) on which the relevant information is placed;
- **Frames file suffix** specifies a text line attached to the base sheet name to get the combined file name with all created sheets frames;
- **Insert names in frames** option causes writing the names of sheets to a file with frames not only into the corresponding attribute, but also as a text string;

- [optional] There may be chosen one of the following **Type of file with neighbor sheets** values:
  - **No** – names of the neighbor sheets are calculated automatically based on the SK-42 topomaps nomenclature.
  - **Scheme** – a CSV file is used as the scheme file, which contains only the sheet names in accordance with the sheets topology. Row numbers correspond to north-south direction. Column numbers correspond to west-south direction. For example:

    ```
    P-54-76-B-6-1,P-54-76-B-6-2

    P-54-76-B-6-3,P-54-76-B-6-4
    ```

  - **List** – file in the CSV format, containing description of one sheet in each line. The line should contain the name of the sheet and the eight coordinates of four vertices of sheet. For example:

    ```
    P-54-76-B-6-3,1848.0,824.0,5848.0,824.0,5848.0,4824.0,1848.0,4824.0

    P-54-76-B-6-4,5848.0,824.0,9848.0,824.0,9848.0,4824.0,5848.0,4824.0

    P-54-76-B-6-1,1848.0,4824.0,5848.0,4824.0,5848.0,8824.0,1848.0,8824.0

    P-54-76-B-6-2,5848.0,4824.0,9848.0,4824.0,9848.0,8824.0,5848.0,8824.0
    ```

    If parameters **Scheme** or **List** are chosen, specify the path to the CSV file with neighbor sheet names and set the parameters of this file's import:

    - **Start import from string** option causes the import process to start from the given line in the file, skipping the previous lines;
    - **Column with sheets names** – number of CSV column, which contains the names of the sheets;
    - **Column with X1** – **Column with X4** and **Column with Y1** – **Column with Y4** – parameters - define the numbers of CSV columns, which contain corresponding coordinates of the sheets corners;
    - **Swap X, Y** – if this option is checked then during import X and Y coordinates of objects vertices are swapped;
    - **Separators** panel is used to select the symbols that separate fields in the CSV file, comma and space are selected as separators by default.

3. **Frame parameters** tab is identical to the one in the parameters dialog for 1:2000 and 1:5000 marginalia standard in DGN and MIF/MID formats.

D.3.1. Batch marginalia file names editing

Sometimes it may be necessary to rename sheet image files together with marginalia files to working numbers.

Choose **Sheets › Split into sheets by images**, if it's not done yet.

Use menu commands **Mosaic › Create Marginalia 1:2000 › Rename to work IDs** or **Mosaic › Create Marginalia 1:5000 › Rename to work IDs** when the preview window is open for the mosaic sheets of which are to be renamed.

Then in the dialogue box that appears, select the folder where files with marginalia and files with sheets, which must be renamed, are stored.

As a result of this operation, the files contained in the selected folder will obtain the names used in the PHOTOMOD Mosaic module by default, for example, *"Sheet_1*", *"Sheet_2"*. Files extensions will correspond to their content: for example, `*.tiff` - for sheets files, `*.tab` - for sheets georeferencing in *MapInfo*, `MIF/MID` - for files with marginalia.