Digital Photogrammetric System

PHOTOMOD

Version 8.0

USER MANUAL

Project creation
(Windows x64)

RACURS

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1. Purpose of the document

The purpose of this User Manual is to give detailed information about how to create a project in the *PHOTOMOD* system (further – system), to add images into a block, to edit a images block, to manage projects in system, also information about types of projects and types of coordinate systems and about additional features.

2. Workflow in system

To create new project is used the following action sequence:

1. Creating and selecting active profile – creating local profile or creating/connecting network profile to place all project/project group files – resources, and selecting the profile as active.

2. Creating project – creating new project: specifying project type and name, choosing coordinate system and a folder into active profile resources to place new project files.

3. Forming images block – loading project images.

3. Creating and choosing active profile

Prior to work in the system you should create a profile for placing project resources such as project configuration files, images files, files processing projects/project group.

A profile represents a resources tree with the following structure:

*   *Root* – profile virtual name.

*   *Top level branches* – profile virtual folders – virtual names of physical local or network folders/disks.

    > One physical folder/disk or folders/disks group could be specified as a virtual folder (storages group).

    > *Storage* folders are a special type of virtual folder. Resources are automatically placed in storage folders by the system on the basis of free space analysis. Thus, storage folders allow optimization of multiple disk usage for storage resources, which is advantageous when network processing large projects.

*   *Resources* – all data of a profile – all subfolders and files of each virtual folder in profile.

Thus, profile resources are placed on any servers, workstations or network disks.

Profiles can be *local* or *network* to organize individual or shared work with projects, respectively.

For profiles creation and organizing resources structure of each profile you can use the *Control Panel module*.

To view and edit active profile resources is used the *PHOTOMOD Explorer module*.

To launch these modules is used the **Start › Programs › PHOTOMOD 8 x64** menu and also the context menu of the *System Monitor module* (the icon in the *Windows* system tray).

More details about system resources, recommendations on organizing of local or network work, and about creating profiles and virtual folders connecting see in the "General information" User Manual.

In one work session of the system could be used *only one* active profile.

Close all program modules an perform one of the following to choose *active* profile:

• choose active profile in the **Profile** list from the context menu of the *System Monitor module* (the icon in the*Windows*system tray);

• choose active profile with mouse double-click by profile name in the **Profile** list in the *Control Panel module*.

> Current active profile is marked in the profile list by the ✔ icon.

Restart program after chosen active profile. All active profile resources are available for work until another active profile is selected.
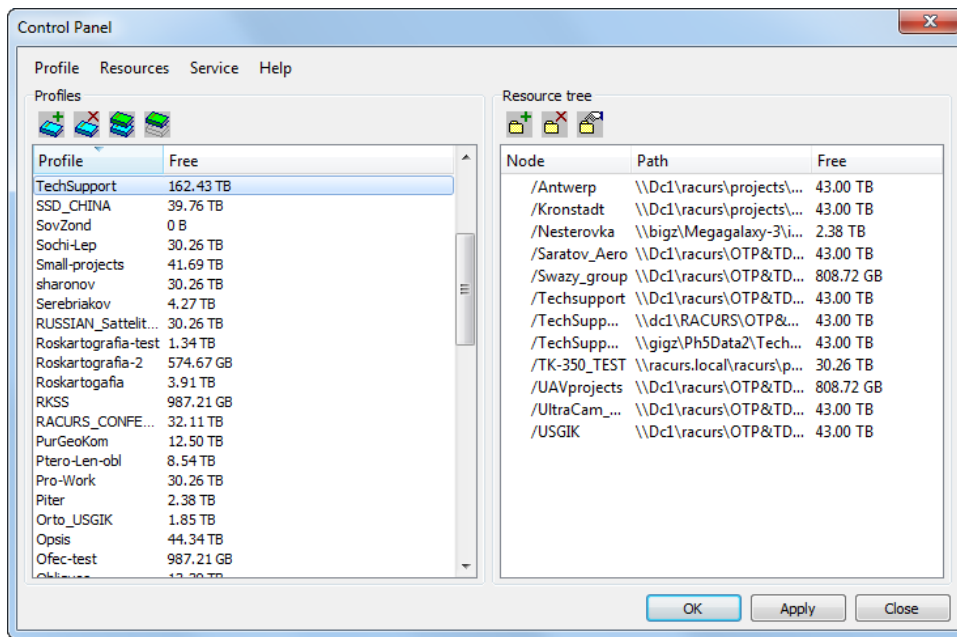
Fig. 1. Resources structure of network profile

The folder tree displays in the *PHOTOMOD Explorer* window after creating profile.
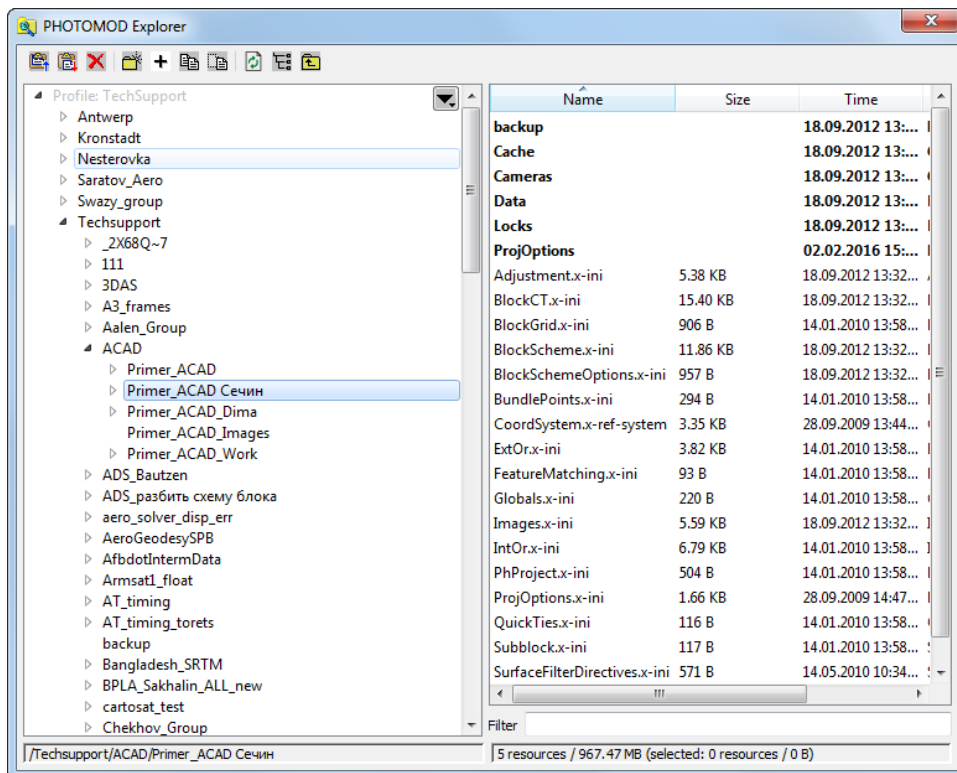
Fig. 2. Resources tree of network profile in the *Explorer window*

To avoid loss of data, it is not recommended to edit virtual folder for storage group.

4. Coordinate Systems

4.1. General information

Coordinate system should be selected on the step of project creation. It is possible to change the coordinate system of existing project in the **Project properties** window (see Section 8.3) or during block adjustment step (see the "Block adjustment" User Manual).

For coordinate system choose during project creation click the **Select** button of the **Coordinate system** section in the **New project** window (see Section 6.1). Project co-ordinate system could be chosen from the following sources:

- **From DB** – from the list of coordinate systems database (see Section 4.2);

- **From file** – from coordinate system files with `*.x-ref-system` extension, located *out* of profile resources (if any);

- **From resource** – from files with `*.x-ref-system` extension, located in active profile resources;

- **From GeoCalculator** – from the list of *GeoCalculator* program database (see the "Coordinate Systems" chapter in "The GeoCalculator program" User manual).

> The *GeoCalculator* program allows to edit coordinate systems, to create new ones, to perform import and export of coordinate systems (see the "The GeoCalculator program" User Manual).

This allows, for example, to choose coordinate system from another project of active profile. After selecting coordinate systems database, the **Coordinate systems database international** window with coordinate systems list included to the selected database appears.
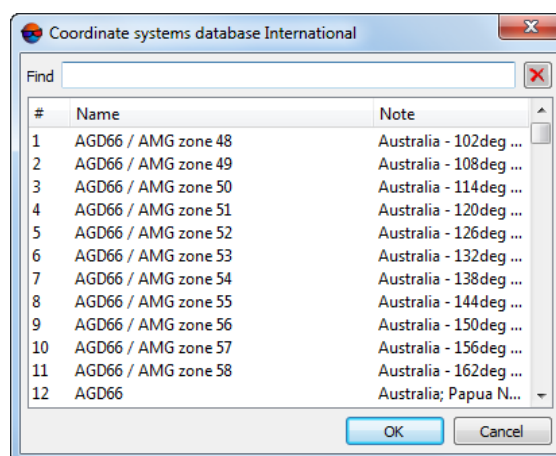
Fig. 3. Coordinate systems database window

4.2. Coordinate systems databases

4.2.1. International coordinate reference systems database

The **International reference system database** is the list of reference systems in supported formats with the *GeoTIFF* (the *EPSG* – European Petroleum Survey Group company's standard) image georeference. Besides EPSG database, the list includes **Cartesian** (on plane) and **Local Curved** (on the sphere) reference systems. Cartesian reference system is used for processing of small image blocks with large scale survey.
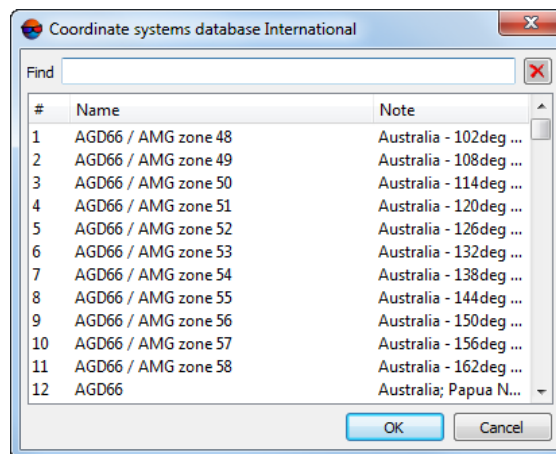
Fig. 4. International coordinate reference systems database

4.3. Coordinate reference systems types

Coordinate system database contains the following coordinate systems types:

- `Geodetic` – curvilinear, latitude/longitude/height reference system;

- `Geocentric` – Cartesian;

- `Local Cartesian` – reference systems on the plane;

- `Local Curved` – reference systems on the sphere;

- `Projected` – a reference system defined by the map projection;

- `Topocentric horizontal` – a coordinate reference system with coordinate origin in chosen point. The Y axes is leftward in the left-handed coordinate reference system and it is northward in the right-handed reference system.

> Ground control points coordinates specified by latitude/longitude should be converted to Projected coordinate system, using the *GeoCalculator program* (see description in the "The GeoCalculator program" User Manual).

5. Project types

5.1. General information

The system supports the following project types:

- Central projection is used to process aerial and space borne images of central projection, acquired by photographic camera

- Satellite scanner imagery is used to process space scanner images, acquired by different sensors, such as GeoEye-1, IKONOS, QuickBird, SPOT, ASTER, IRS, FORMOSAT, CARTOSAT, "Resours DK", WorldView- 1, 2;

- ADS 40/80/100 is used to process images acquired by scanner survey system ADS 40/80/100, installed on aircraft;

- VisionMap A3 SLF is used to process aerial images acquired by VisionMap A3 photogrammetric complex.

Depending on type of space survey the following kinds of images blocks are forming during images loading to the system:

- *Monoblock* – is a block where images do *not* form valid stereopairs (i.e. Imagery product is not a stereo product). Single space image also belongs to monoblock type. During monoblock forming images are loaded to separate strips, as usual.

> If each image is placed in a separate strip, images are placed in the order of names.

- *Stereoblock* – is images block formed by stereopairs. During stereoblock forming each stereopair is loaded to a separate strip.

5.2. Central projection imagery

In order to process images acquired by photographic camera you should choose the **Central projection** project type during project creation (see Section 6.1). Once the project of central projection type is created, you can load images and form images block. Processing of images block of central projection implies full photogrammetric processing, including interior, relative and exterior orientation. In case of a single image or monoblock could be performed interior orientation and direct georeferencing (see the "Aerial triangulation" User Manual).

5.3. Satellite scanner imagery

5.3.1. Processing images algorithms

In order to process space scanner images you should choose the **Satellite scanner imagery** project type (see Section 6.1).

Satellite scanner images are delivered consisting in remote sensing product, that is a set of images files and files of accompanying data, for example, metadata with interior/exterior orientation parameters. Data content of remote sensing product depends on a sensor model.

☞　Special aspects of loading satellite images to a project are described in Section 7.5.

Depending on data content of remote sensing product (sensor model) the system supports the following algorithms of images processing:

* *Rigorous algorithm* – allows to process remote sensing products, that include metadata files with interior and exterior orientation parameters. Rigorous algorithm of images processing provides accuracy that is about image resolution (by RMS on check points). It allows to use minimal number of ground control points and to obtain more accurate results during calculation of exterior orientation parameters.

* *Generic* – uses parallel-perspective model or DLT (Direct Linear Transformation) algorithm – allows to process any satellite images (including IRS, LandSat, etc.).

☞　However, it requires more GCP per stereopair (10 GCP is recommended, 6 at least) as compared with rigorous algorithm.

* *RPC-algorithm* – allows to process remote sensing products, that include metadata RPC-files (for example, IKONOS, QuickBird, OrbView-3). With RPC-coefficients available you can use fewer amount of GCP to obtain satisfying results of photogrammetric processing.

☞　About recommended amount of triangulation points used for satisfying accuracy of adjustment of satellite images block see in Section 5.3.4. How to adjust satellite images blocks depending on processing algorithm, see in the "Block adjustment" User Manual. Adjustment accuracies of scanner blocks see in Section 5.3.3.

5.3.2. Formats of satellite scanner images

Table 1. Generic (DLT and it's modifications)

Satellite	Format	Processing level	Stereo processing
ALOS (AVNIR-2)	CEOS	1B2	No

Satellite	Format	Processing level	Stereo processing
Landsat 8	TIFF	T	No
Landsat7/ETM+	TIFF/GeoTIFF, HDF	1R, 1G	No
IRS-1C, 1D/PAN	Super Structured, HDF, Fast C	1A, 1B	Yes, from the adjacent passes
Resourcesat-1(IRS P6)	Super Structured, HDF, Fast C	1, 2	Yes
Resours-DK	TIFF/GeoTIFF	0	No

Table 2. Rigorous algorithm

Satellite	Format	Processing level	Stereo processing
EROS A, B	RAW, TIFF	1A	Yes
FORMOSAT-2	DIMAP	1A	No
KazEOSat-1	DIMAP V2	1A	Yes
KazEOSat-2	TIFF/GeoTIFF	1R, 1G	Yes
KOMPSAT-2	TIFF/GeoTIFF	1R, 1G	Yes
Resours-DK	TIFF/GeoTIFF	0	Yes, from the adjacent passes
SPOT 1-5	CEOS (SISA, CAP), DIMAP	1A	Yes, same-pass
TERRA/ASTER	HDF	1A	Yes, same-pass
VNREDSAT1	TIFF	1A	Yes

Table 3. RPC-algorithm

Satellite	Format	Processing level	Stereo processing
ALOS (PRISM)	CEOS, GeoTIFF	1B1, 1B2	Yes, from the adjacent passes
Armsat-1	TIFF/GeoTIFF	1D	No
Cartosat-1, 2 (IRS P5)	TIFF/GeoTIFF	Orthokit	Yes
Deimos 1	TIFF/GeoTIFF	1R, 2R	-
Deimos 2	TIFF/GeoTIFF	1B	Yes, from the adjacent passes
DubaiSat-2	TIFF/GeoTIFF	Radio	Yes
GaoFen-7	TIFF+XML	SC	Yes
GeoEye-1	TIFF/GeoTIFF, NITF	2A, OR2A, OR2A Stereo	Yes, same-pass
GF-1, 2	TIFF/GeoTIFF	1A	No
IKONOS	TIFF/GeoTIFF, NITF	2A, OR2A, OR2A Stereo	Yes, same-pass
Jilin 1	TIFF/GeoTIFF	Standard Static Level 1	Yes

Satellite	Format	Processing level	Stereo processing
Kanopus-V	TIFF/GeoTIFF	1, 2, 3	Yes, from the adjacent passes
KazEOSat-1	TIFF/GeoTIFF	2A	Yes
KOMPSAT-2	TIFF/GeoTIFF	1R, 1G	Yes
KOMPSAT-3	TIFF/GeoTIFF	1R, 1G	Yes
KOMPSAT-3A	TIFF/GeoTIFF	1R, 1G, 1O	Yes
OrbView-3	TIFF/GeoTIFF	Basic	Yes, same-pass
Pleiades	DIMAP V2	Primary	Yes
PeruSat-1	DIMAP	Sensor	Yes, same-pass
QuickBird	TIFF/GeoTIFF, NITF	2A, OR2A, OR2A Stereo	Yes, same-pass
RapidEye	GeoTIFF, NITF	1B	No
Resours-P	TIFF/GeoTIFF	1A, 2A	Yes, from the adjacent passes
SkySat	TIFF+json+RPC	Basic	Yes, same-pass
SPOT 6, 7	DIMAP V2 (JPEG2000 или GeoTIFF)	Primary	Yes
StilSat-1	TIFF/GeoTIFF	L1	No
SuperView-1	TIFF/GeoTIFF	1A, 2B	Yes
TripleSat	TIFF/GeoTIFF	1A, 2A	Yes
TH-1	TIFF/GeoTIFF	1A, 1B	Yes
WorldView-1, 2, 3, 4	TIFF/GeoTIFF, NITF	2A, OR2A, OR2A Stereo	Yes, same-pass
ZY-3	TIFF/GeoTIFF	-	Yes
ZORKIY-2M	TIFF/GeoTIFF	1A	No
АИСТ	TIFF/GeoTIFF	1A, 2A	No

5.3.3. Accuracy of satellite scanner blocks adjustment

Accuracy parameters of satellite scanner blocks adjustment for the different survey systems are given in the table below:

Table 4. Accuracy of satellite scanner blocks adjustment

Survey system	Resolution (bw/color, m)	Scale of orthophoto (mosaic)	RMS Exy/Ez with GCP (m)	RMS Exy, without GCP (m)	Processing algorithms	Stereo processing*
ALOS Prism	2.5	25000	3 / 5	10	RPC	Yes (SO)
ASTER	15	50000	15 / 25	200	Rigorous	Yes (SO)
Cartosat-1 (IRS P5)	2.5	25000 (10000)	3 / 5	800	RPC	Yes (SO)
EROS A	2	25000	4	100	Rigorous	Yes

Survey system	Resolution (bw/color, m)	Scale of orthophoto (mosaic)	RMS Exy/Ez with GCP (m)	RMS Exy, without GCP (m)	Processing algorithms	Stereo processing*
EROS B	0.7	10000	2	30	Rigorous	Yes
FORMOSAT-2	2 / 8	25000 (10000)	3.5	100	Rigorous	No
GeoEye-1	0.5 / 2	5000 (2000)	0.5 / 1.5	3	RPC	Yes (SO)
IKONOS	1 / 4	5000	1 / 3	10	Rigorous, RPC	Yes (SO)
IRS 1C, 1D	6 / 23	100000	20 / 20	–	Generic	Yes (DO)
KANOPUS-V	2.5 / 10	25000 (10000)	1.3 / 3.3	50	RPC	Yes (DO)
KOMPSAT-2	1 / 4	10000	2 / 5	200	Rigorous, RPC	Yes (DO)
KOMPSAT-3	0.7 / 2.8	5000	2	40	RPC	Yes (SO)
KOMPSAT-3A	0.5 / 2.2	5000	2	40	RPC	Yes (SO)
OrbView-3	1 / 4	5000	1	15	RPC	Yes (SO)
Pleiades	0.5 / 2	5000 (2000)	0.8 / 2	4	RPC	Yes (SO)
QuickBird	0.6 / 2.4	5000	1	10	Rigorous, RPC	No
Resours-DK	1 / 3	10000	3-5	–	Rigorous, generic	No
Resours-P	0.7 / 4	5000	3 / 4	50	RPC	Yes (DO)
Resourcesat-1 (IRS P6)	– / 5.8	100000	20 / 20	–	Generic	Yes (DO)
SPOT 1-4	10 / 20	50000	10 / 15	100	Rigorous	Yes (DO)
SPOT 5	5 (in mode SuperMode - 2.5)/ 10	25000 (10000)	3 / 5	50	Rigorous	Yes (DO and SO)
SPOT 6, 7	1.5 / 6	10000 (5000)	2 / 2	17	RPC	Yes (SO)
TripleSat	1 / 4	10000 (5000)	1	26	RPC	Yes (SO)
WorldView-1, 2	0.5	5000 (2000)	0.5	15	Rigorous, RPC	Yes

☞   * DO – different orbits, SO – same orbit.

5.3.4. Number of points recommended for adjustment of scanner block

There are some recommendations about number of GCP and check points used for different methods adjustment of images included to scanner mono/stereo blocks.

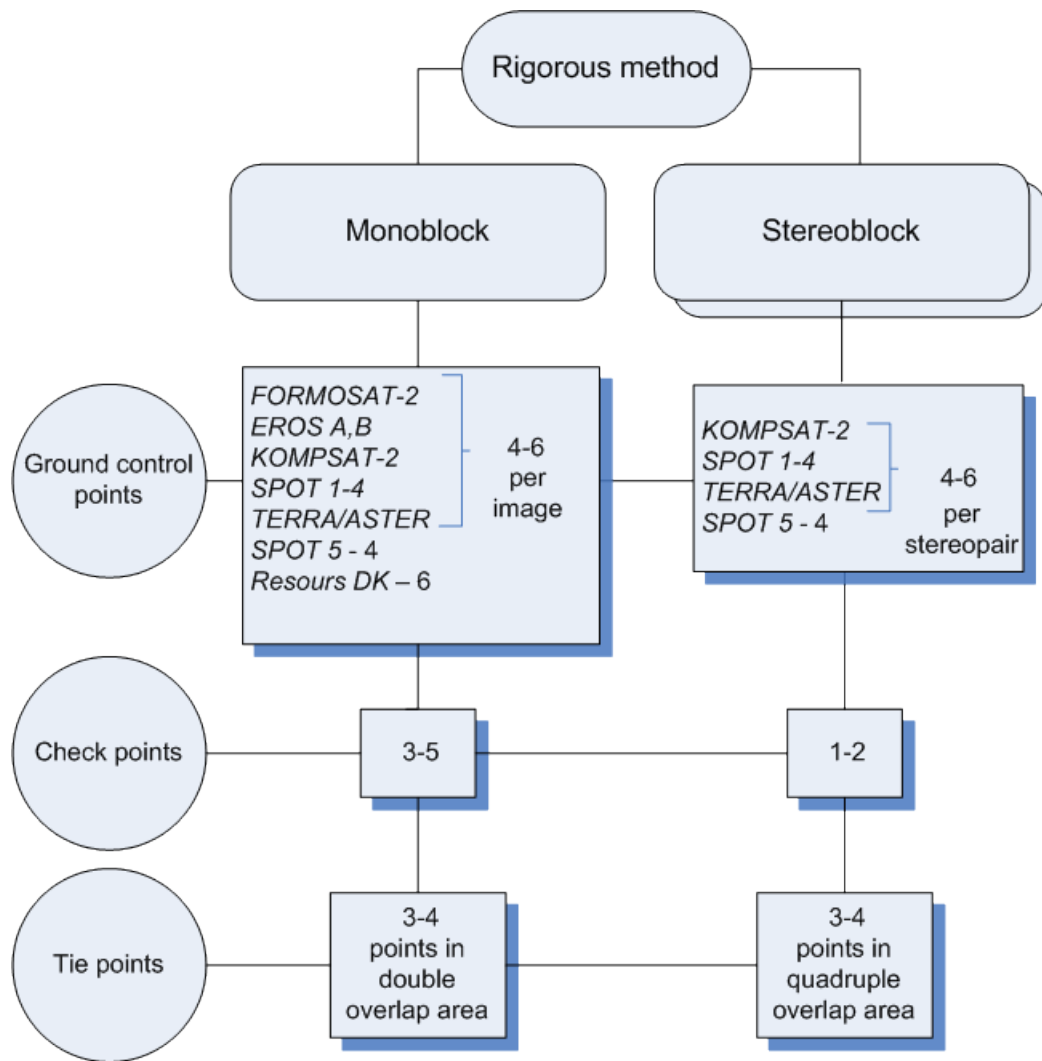☞   For space scanner images it is possible to use only XYZ GCP (with X, Y, Z coordinates).

Fig. 5. Number of points recommended for adjustment of scanner block by rigorous method

If a monoblock contains images with triple or quadruple overlap area, it is recommended to measure several points in this area.

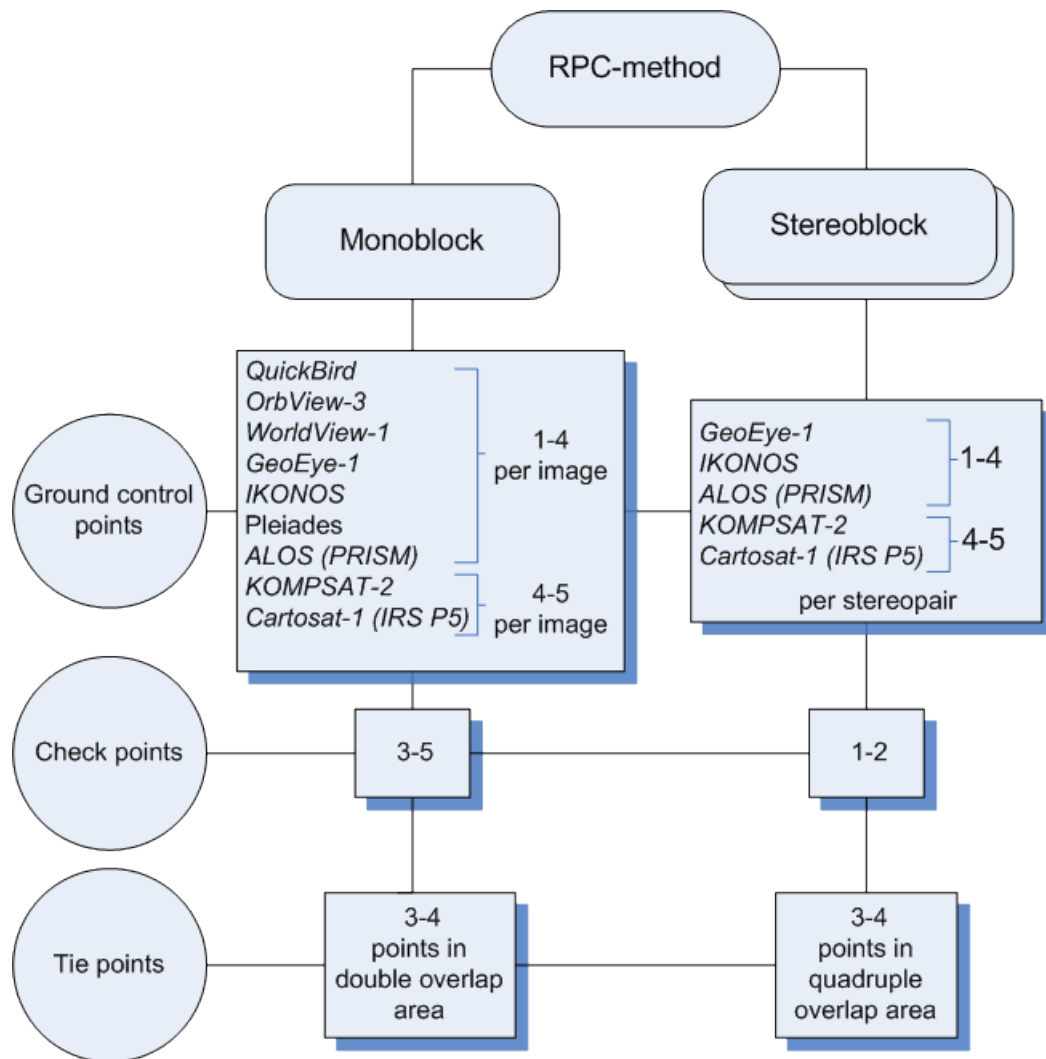Number of GCP could be decreased due to tie points measured in triple or quadruple overlap.

Fig. 6. Number of points recommended for adjustment of scanner block by RPC method

Number of GCP could be decreased due to tie points measured in quadruple overlap.
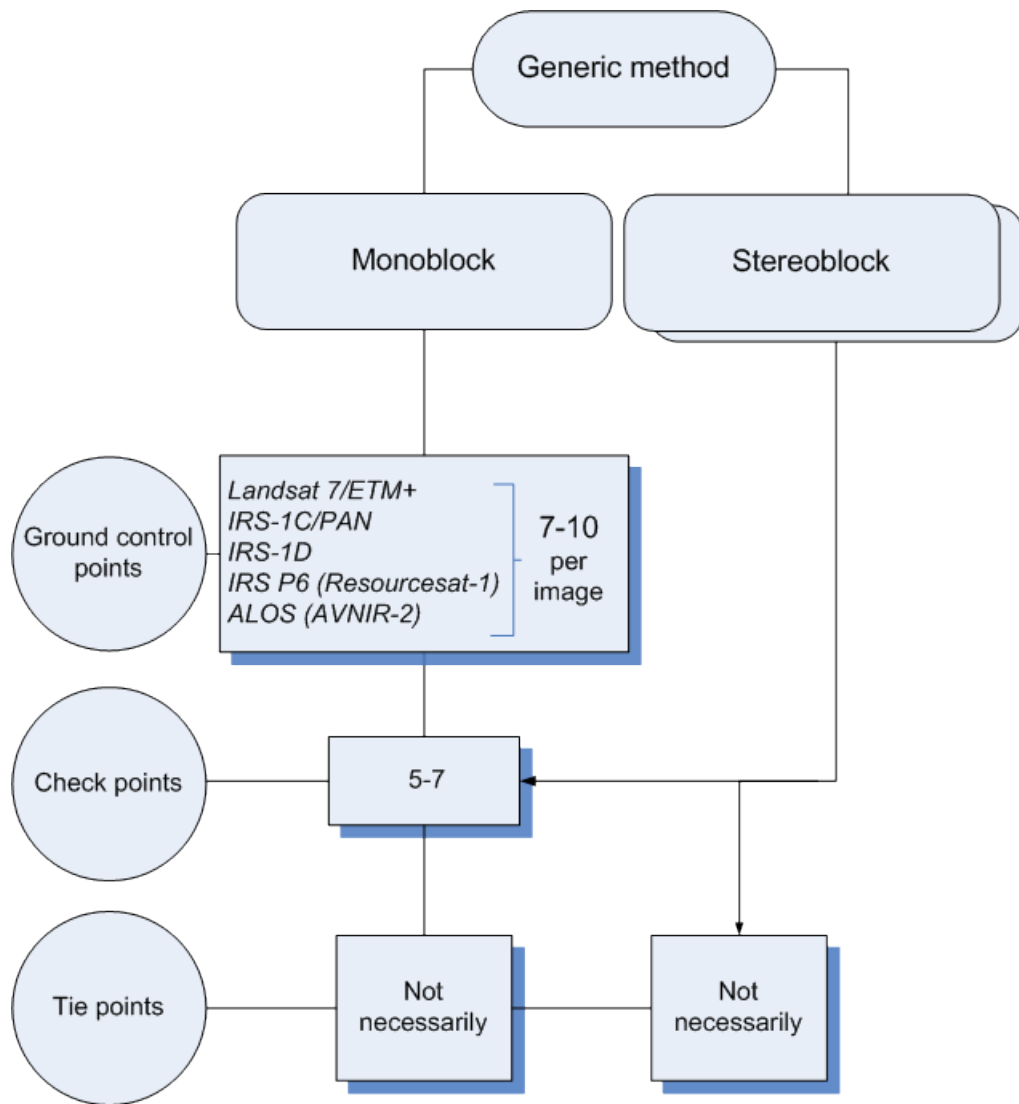
Fig. 7. Number of points recommended for adjustment of scanner block by generic method

Recommended number of check points on images is not absolute and in many cases is determined by the customer requirements to specific project. Nevertheless, it is necessary to have check points available for objective estimation of adjustment accuracy.

5.4. Airborne Digital Sensor ADS

5.4.1. Workflow of ADS processing

ADS 40/80/100 – Airborne Digital Sensor – by "Leica Geosystems" (Switzerland) is a scanner survey system installed on aircraft carrier, which allows to perform simultaneous survey in different spectral bands under different angles from nadir.

Processing of ADS project in the system implies performing the following steps:

1. Preprocessing of data, received from on board storage device, using dedicated software included to ADS set.

2. [optional] Preparing of ADS data for loading to a project using system functionality.

> It is necessary to perform this step if preprocessing of ADS data was executed on different workstation, so it is necessary to correct absolute paths to ADS data files in order to create ADS project in the system. This step could be skipped if data preprocessing and project creation was performed on the same machine.

3. Creation of ADS project in the system loading of ADS data to a project.

4. Creating of math models during the adjustment.

5. Stereoprocessing, DTM ant orthoimages creation.

5.4.2. Preprocessing ADS data

Working procedure with ADS data in the system implies its full processing using dedicated software included to delivery set of ADS survey complex, for example, *XPro/GPro* program by *Leica Geosystems*, and *ORIMA* software developed by *L. Hinsken*.

Usually, ADS data preprocessing contains the following steps:

1. *initial processing* – transfer of images and trajectory data from on board device to workstation; creating of `Level 0` images;

2. *post-processing of trajectory data* (GPS and inertial system measurements) to obtain exterior orientation parameters measured in flight (`*.odf` files);

3. *geometric transformations* – projection of `Level 0` images on some plane of constant height (rectification plane) in so called LSR (*Local Space Rectangular*) coordinate system, using exterior orientation parameters from previous step; creating of `Level 1` images;

> *Rectification plane* – is a plane in LSR coordinate system (Z=const), which constitutes a right topocentric horizon coordinate system with an origin placed in the center of the area captured; coordinates of the origin are supplied along with image metadata.

4. *automatic tie points measurement and block adjustment* of `Level 1` images with/without GCP (using *ORIMA* program).

Data obtained after preprocessing include the following files:

• *transformed Level 1 data* – `*.tif` files, each of them is an image or image fragment from a set of image fragments composed according to file of image description `*.ads`;

That means that during `Level 1` images creation the image may be split into several fragments (`tif`-files), as defined by options of images transformations performed by dedicated software.

• exterior orientation parameters measured in flight – `*.odf` files;

• adjusted exterior orientation parameters – `*.odf.adj` files;

• image description files – `*.ads` files, containing list of fragment files names, which consist the whole image;

• exterior orientation parameters – `*.cam` files, containing data about optical system focal length, as well as coordinates of each detector in sensor focal plane;

• *metadata* – `*.sup` files for `Level 1` images, which contain parameters of LSR coordinate system, and parameters of linking between rectification plane coordinates and `Level 1` image coordinates.

A limit of `Level 1` image size, and size of fragments, the image consists of, could be specified during preprocessing. It is recommended that each `Level 1` image is not more than 4 GB in size and consist of fragments not more than 500 MB in size each. Otherwise, during adding images to the project and their processing in the system the performance would considerably decrease.

Once the preprocessing results of ADS data are obtained, do one of the following:

• If ADS project would be created *on the same computer* where the preprocessing of the ADS data was performed, proceed to creation of ADS project in the system and images loading to it.

• Otherwise, perform preprocessing of ADS data in the system, that includes copying of files needed for ADS project creation to a separate folder, correction of absolute paths to ADS files, and histogram normalization (if necessary).
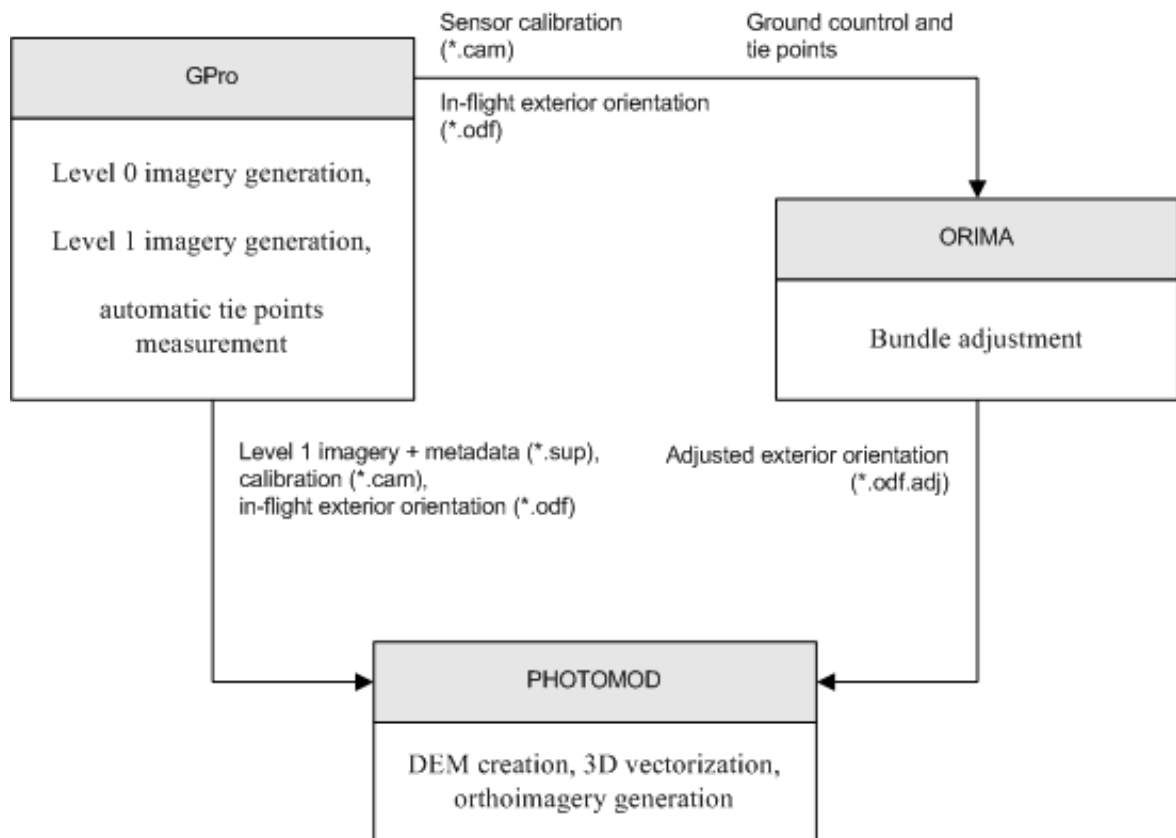
Fig. 8. Workflow of ADS data preprocessing

5.4.3. Preparing ADS data in the system

Preprocessing of ADS data in the system includes automatic extraction of necessary files from preprocessing data, copying them to the target folder with organization of storages structure and automatic correction of absolute paths to files according to their placement.

At the stage of ADS data preparing it is also could be process a converting of 16 bit images to 8 bit MS-TIFF images with histogram normalization.

⚠ It is recommended to prepare ADS data in the system only if you use *different workstations* for ADS data preprocessing in dedicated software and for creation of ADS project in the system.

In order to prepare ADS data in the system perform the following:

1. Choose **Service › Prepare ADS data**. The **Preparation of ADS data** window opens.
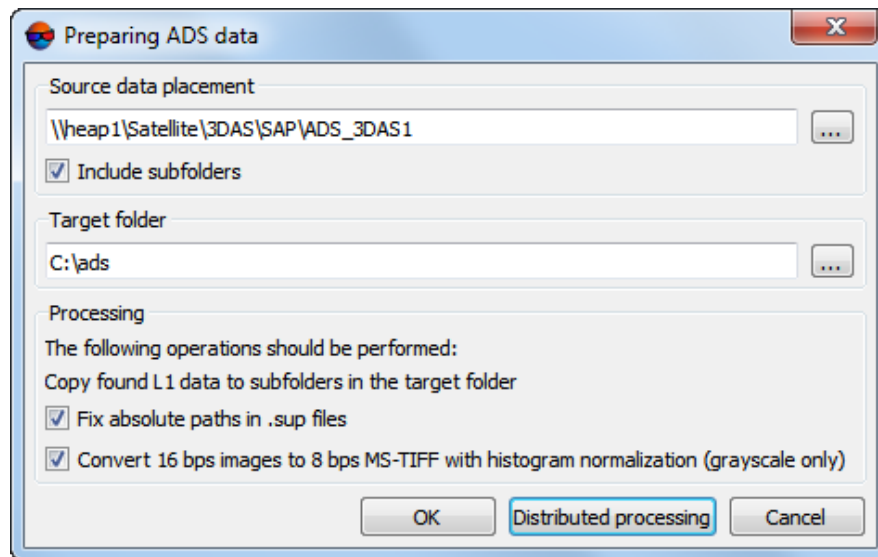
Fig. 9. Preparation of ADS data

2. Specify folder with ADS data, obtained after preprocessing, in the **Source data placement** section.

> Make sure that all necessary source data, including all *.cam files, are placed in this folder.

3. [optional] If ADS data folder includes subfolders (with data from on board device, Level 0 and Level 1 images, preprocessing files), you should set the **Including subfolders** checkbox.

4. In the **Target folder** section choose target folder for files needed for ADS project processing in the system.

5. In the **Processing** section choose what is necessary to perform:

   • **Fix absolute paths in .sup files** (strongly recommended) – is used for automatic input to sup-file absolute paths to the following files:

      ○ *.ads – images features;

      ○ *.odf – exterior orientation parameters measured in flight;

      ○ *.odf.adj – adjusted exterior orientation parameters;

      ○ *.cam – interior orientation parameters.

- **Convert 16 bps images to 8 bps MS-TIFF with histogram normalization (gray scale only)** – is used for images transformation that increases processing performance, but decreases the quality.

> The images also could be proceed later – when loading images to a project (see Section 5.4.4).

6. Click OK to start data search and copying operation.

In order to prepare big ADS data volumes in the system user can use distributed processing mode. Perform the following actions to do this:

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 **Preparation of ADS data: Distributed Processing** window opens.
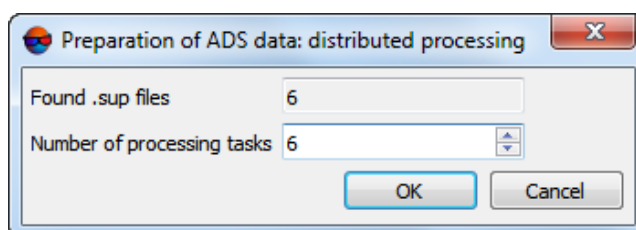
Fig. 10. Parameters of distributed processing of ADS data preparation

Quantile of found metadata files is displayed in the **Found *.sup files** field.

3. [optional] Specify the **number of tasks**.

4. Click OK to create distributed processing tasks.

As a result of ADS data preparing the following subfolders are created in the **target folder**:

- **ADS_Products** – contains the subfolders with names which are the same as images names. Each of subfolders contains the following files: `*.sup`, `*.odf`, `*.odf.adj`, `*.ads`, as well as image file (`*.tif`) or set of (`*.tif`) files that contain the image fragments according to description in `ads`-file;

- **Cameras** – contains the subfolders with the interior orientation parameters data – `*.cam` files and `misalignment.dat` files.

Once the ADS data is prepared you can proceed to ADS project creation and images loading to strips.

5.4.4. Loading ADS images

Since ADS sensor is able to make survey in different spectral bands (both pan and multispectral) and at different along-track off-nadir angles (for example, +28°, 0°, -14°), prior to images adding to a project you should define which of them are most suitable for specific tasks. Besides, when choosing off-nadir images (-14° or +28°) it is recommended to consider operators' opinions about comfort of work in stereo mode.

Depending on tasks to be solved, the system provides the following *ways of images block forming*:

• add images to each strip in order to form stereopairs using nadir image and one of off-nadir images (it is preferable to use off-nadir images taken along flight (+28°), since in this case you obtain more basis to height rate, that results in DEM accuracy decreasing.

• form images block using *only* nadir images to create orthomosaic as a result product. Nadir images are especially preferable if it is necessary to build panchromatic mosaic;

> *Orthoimage* is a high accuracy image of the earth's surface converted to the map projection.

• form stereopairs from two off-nadir images in each strip (-14° and +28°); that allows to reach maximal value of survey basis to height rate, and provides maximal DEM accuracy, but could bring poor result during automatic tie points measurement (if it is necessary for quality control of mathematical models creation after adjustment import, for instance);

• creating a "general" project where triplets were made by the following way: add off-nadir images to one strip (-14° and +28°) and nadir images in the other. It is recommended to use strips with off-nadir images for DEM creation, and strips with nadir images – for orthomosaic creation considering DEM, built by off-nadir images.

> The system provides for automatic splitting of images into strips in ADS projects, for further formation of triplets from one nadir and two oblique images. For this, choose **Block › Split into strips › By metadata**.

In order to load images to ADS images project perform the following actions:

1. Define a set of images block in ADS project, according to way of block forming listed above.

> It is strongly not recommended to use not adjustment exterior orientation parameters from `*.odf`-files. Otherwise, incorrect data could be used. In case of loading such data warning and full path to images are displayed.

2. Choose the **Block › Add strip** or click the ⊞ button in the **Block editor** window to create a strip (see Section 7.3).

3. Choose **Block › Add images from files** or click the 🖼 button in the **Block editor** window. The **Add pushbroom images** window opens.

    Operation of ADS images adding is the same as operation of satellite scanner images adding.

☞   During ADS project processing you can perform *search for ADS images only* (not any scanner images) in the **Add pushbroom images** window. And vice versa, for **Satellite scanner imagery** project you can search only for satellite scanner images and then recognize their metadata.

☞   For ADS project in the **Add pushbroom images** window there is the **Prepare ADS data** button, that duplicates the **Service › Prepare ADS data** menu item (see Section 5.4.3).
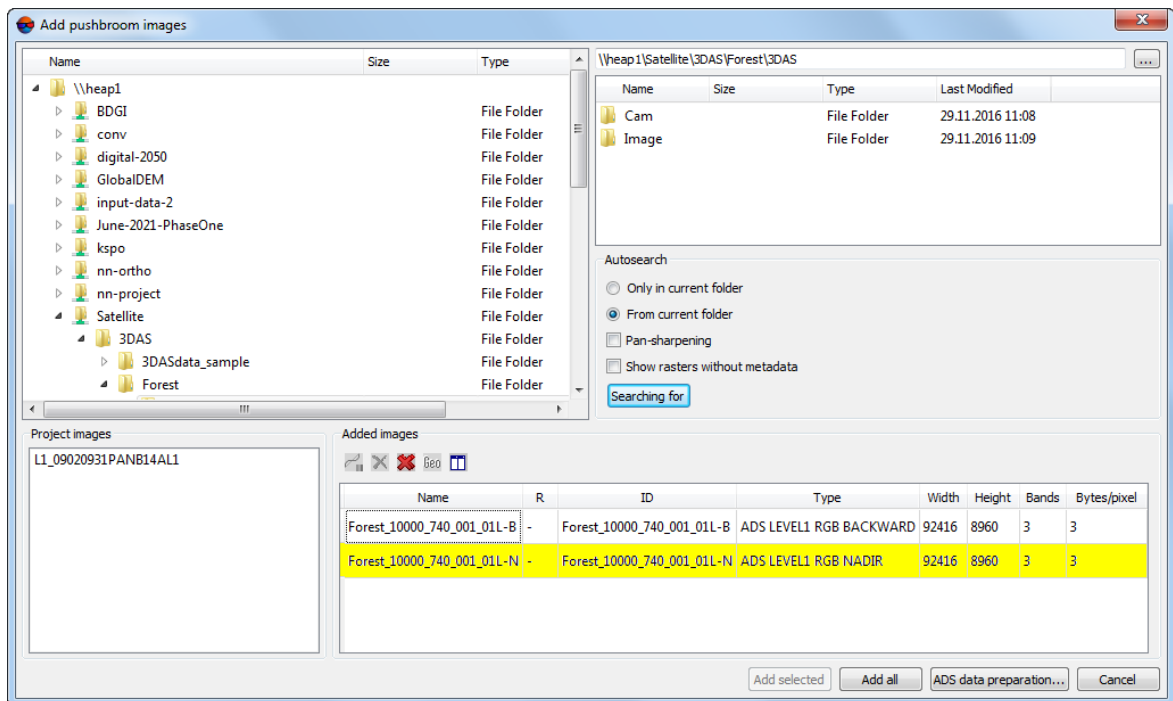
Fig. 11. Search for ADS images and accompanying data

4. Choose folder that contains images. The contents of selected path are displayed in the right part of the window.

5. In the **Autosearch** section define the following settings:

    • **Selected folder only** used to search for remote sensing data in the selected folder only;

- **Selected folder and subfolders** used to search for remote sensing data in the selected folder and its subfolders.

- **Pan-sharpening** allows to open the **Adding images found** window to view detailed parameters, to perform pan-sharpening operation and images setting.

- **Show rasters without metadata** – allows to perform search of all files with images in selected folder, including those without metadata.

6. Click the **Search** button. In the **Images to add** section are shown found data.

> The automatic split to strips feature allows to load all images to one strip at once, and then distribute images among strips using defined image name template or according to exterior orientation parameters.

> Non-ADS scanner images, found in specified folder, are marked in the table by *yellow* color.

> Images, already added in to project, are marked in the table by *gray* color.

7. [optional] Click the **Radiometry** button to perform radiometric correction of images, selected in the **Images to add** table.

8. Click the **Add all** button to add all images of the table to the list of convertible files. Click the **Add selected** button to add one or more images. The **Parameters** window opens for setting of output images parameters.
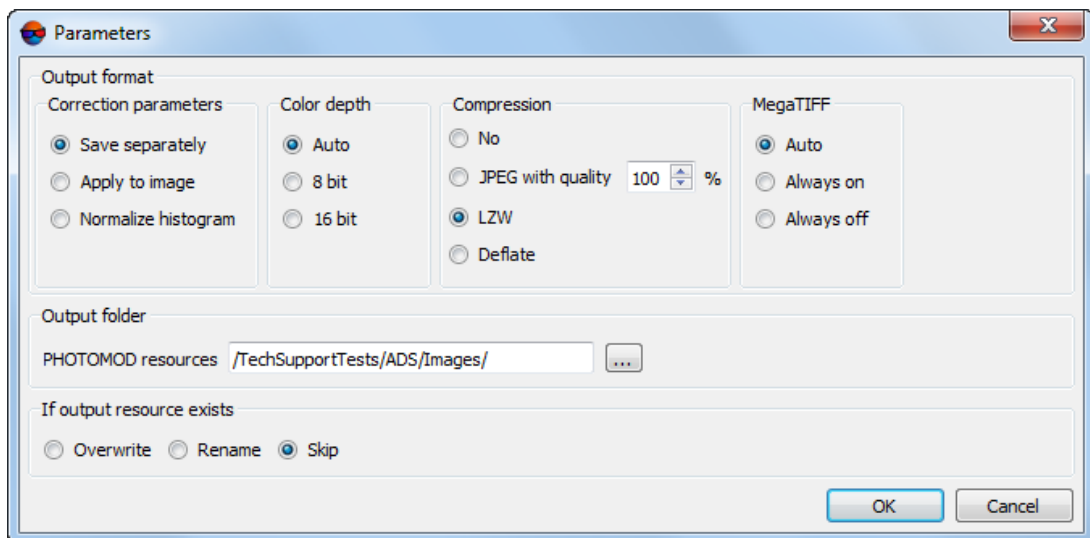
Fig. 12. Default parameters of images transformation

9. Setup parameters of ADS images transformation, specify target folder in profile resources where to save transformed images, and choose action for the case if the target folder already contains images files with the same names.

> ⚠ It is recommended to choose the **Auto** option in the **Format** section, since the size of ADS images is big.

> ☞ **MegaTIFF** format is used for converting of Level 1 images which size is more than 4 GB, and/or for images fragments if their size exceeds 500 MB. After **MegaTIFF** conversion all ADS images files will have prf extension and will be placed to target folder.

10. Click OK to start operation of images load and transformation. It could take noticeable time due to big size of ADS images.

11. [optional] Adjust images if necessary in the **ImageWizard** window and edit the block after images loading is completed.

12. After block forming from ADS images you should import adjustment results and proceed to project processing (see Section 5.4.5).

5.4.5. Processing ADS project

In order to proceed to project processing stage (stereo vectorization, DEM creation, mosaic creation) you should build mathematic models of images using data loaded to a project by the following way:

1. Choose **Adjustment › Block adjustment** (see also the "Block adjustment" User Manual).

2. Click the **Adjustment parameters** button. The **Parameters** window opens. Choose the **Images** tab.

3. Choose the **Import adjustment** in the **Method** section.

4. Set the **Create stereopairs** and **Use adjustment result to create epipole images** checkboxes.

5. Click the **Apply to all** button, then click OK.

> ☞ In order to analyze ADS 40/80/100 data adjustment and correctness of their loading to the system, it is necessary to measure GCP and check points (see the "Aerial triangulation" User Manual). Further it is necessary to measure at least three GCP on block stereopairs if the project is performed in local coordinate system like Cartesian (left or right).
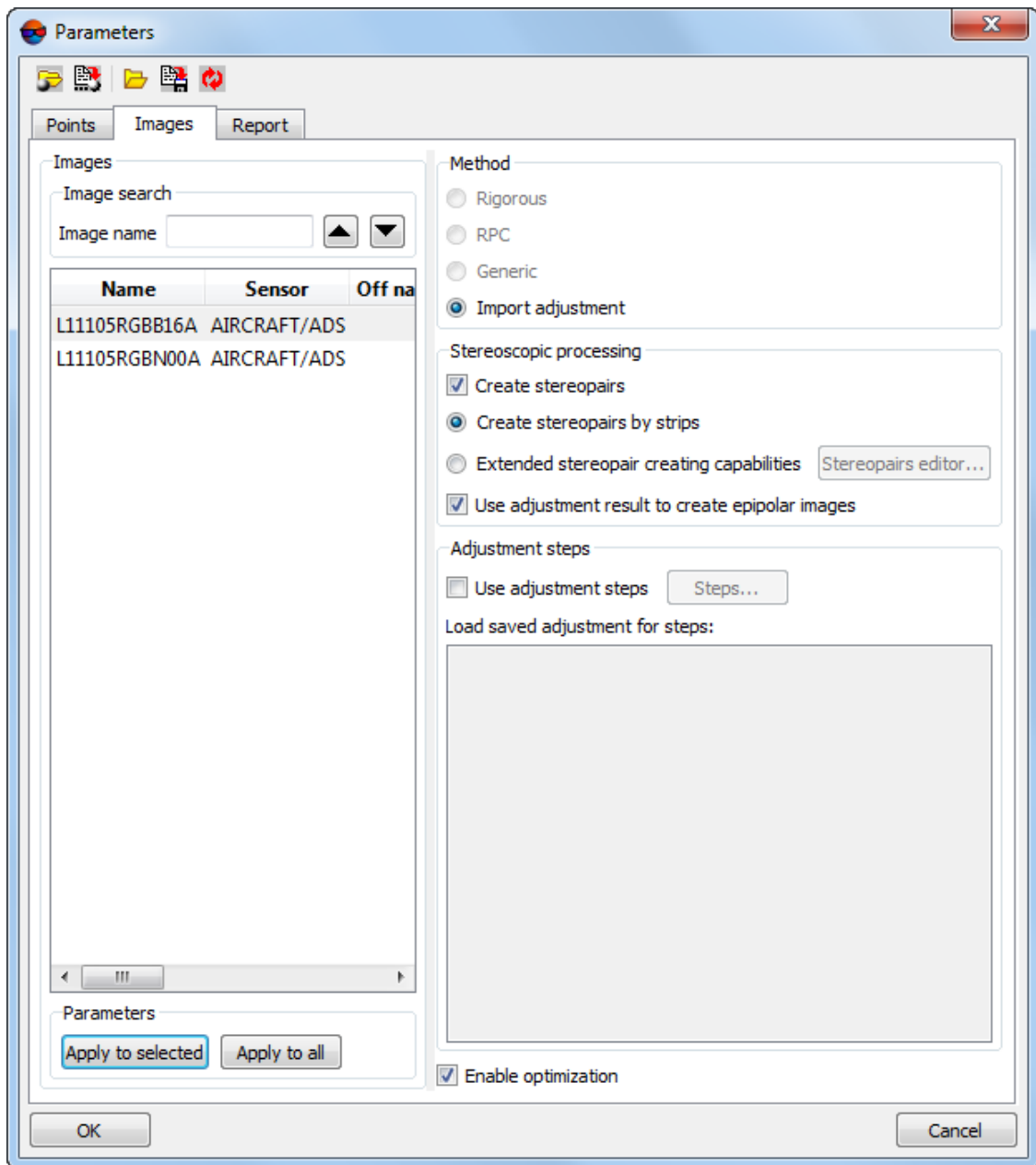
Fig. 13. Setting of adjustment parameters of ADS 40/80/100 images

After images models in ADS project were created, proceed to project processing stage (see the "Vectorization", "DTM Generation" and "Orthorectification" User Manuals).

5.5. VisionMap A3 imagery

5.5.1. VisionMap project processing

Aerial photogrammetric complex VisionMap A3 consists of digital metric aerial camera and ground-based system of automatic processing. Aerial camera provides wide aerial survey swath with high ground resolution. Ground-based system allows to perform

automatic processing of photogrammetric blocks, consisting of hundred thousands images and millions tie points.

Ground-based processing system provides full production cycle: from images upload to photogrammetric production output.

The processing includes the following operations:

• copying of images and accompanying information to the ground-based system;

• flight results preprocessing and validation;

• aerial triangulation (without GCP);

• check of aerial triangulation results;

• [optional] exterior orientation using GCP (with additional adjustment);

• [optional] DEM calculation;

• orthomosaic creation and quality control of work;

• import of large-format images (KCC or SLF) suitable for stereo vectorization in the system.

Depends on type of source image there are two ways of VisionMap A3 project processing:

• to export initial large-format images SLF (Super Large Frame), create a project of the **VisionMap A3 SLF** type (see Section 5.5.2);

• to small format images, create a project of the **Central projection** type (see Section 5.5.3).

5.5.2. VisionMap A3 SLF

In order to perform stereo processing of large-format SLF images in the system perform the following actions:

1. Specify VisionMap A3 data folder. The sufficient initial data for processing in the system are pairs of files of the same name, each includes image `tif`-file and metadata `dat`-file, that contain interior and exterior orientation parameters for corresponding image.

> In case of processing a big project, use the *Raster Converter module* in distributed processing mode for pre-processing of source SLF-images. After conversion add metadata `dat`-files to target folder with images files.

2. Create **VisionMap A3 SLF** project. Choose the **VisionMap A3 SLF** project type in the **Type** section, specify project name, coordinate system, terrain heights difference and folder to place project files in profile resources (see Section 6.1).

> ⚠️ It is strongly recommended to input terrain heights values to the **Relief elevation** section during creation of **VisionMap A3 SLF** projects type.

3. Load images to the project (see Section 7.4.2).

> 👉 The system allows to form strips of VisionMap A3 images automatically, using exterior orientation parameters from metadata (see Section 7.8.1).

4. Choose the **Project › Synchronize**.

5. Create block layout using adjustment results. For that in the **Block layout** window set the **By ties** option, set the **Adjustment results** checkbox only and click the **Apply** button. Block adjustment quality control is performed in the Aerial triangulation module (see the "Aerial triangulation" User Manual).
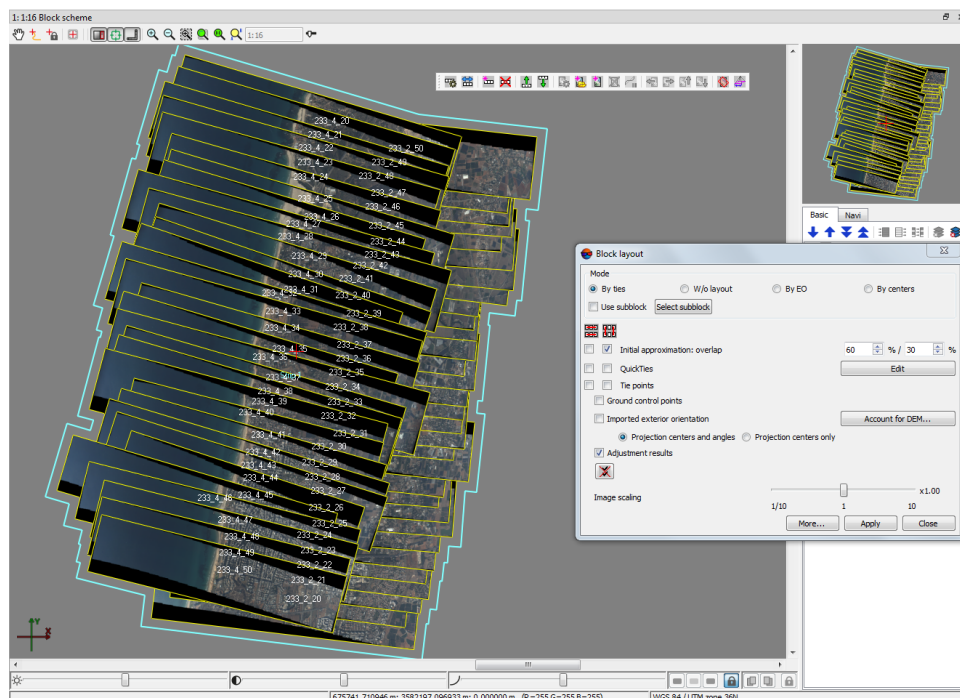
Fig. 14. VisionMap A3 SLF project

> ⚠️ For **VisionMap A3 SLF** projects the **Block adjustment** toolbar is not shown. Accuracy control could be checked by merging coordinates of the same points on neighbor stereopairs in stereomode.

Proceed to stereo processing step.

5.5.3. VisionMap A3 (central projection)

In order to perform processing of small-format images in the system, execute the following actions:

1. Specify folder with VisionMap A3 data.

2. Create a project of the **Central projection** type. In the **New project** window choose the **Central projection** project type, specify project name, coordinate system, terrain heights difference and folder to place project files in profile resources (see Section 6.1).

3. Load images to the project from a folder with VisionMap A3 data, including subfolders (see Section 7.4.2).

4. Choose **Orientation › Import orientation from metadata...**. The **Import orientation from metadata** window opens.

5. Set the **Import interior orientation** and **Import preliminary exterior orientation** checkboxes.

6. Click OK. After that the exterior and interior orientation parameters are imported from images metadata to the project. At that a camera file with name containing camera serial number is created for each project camera.
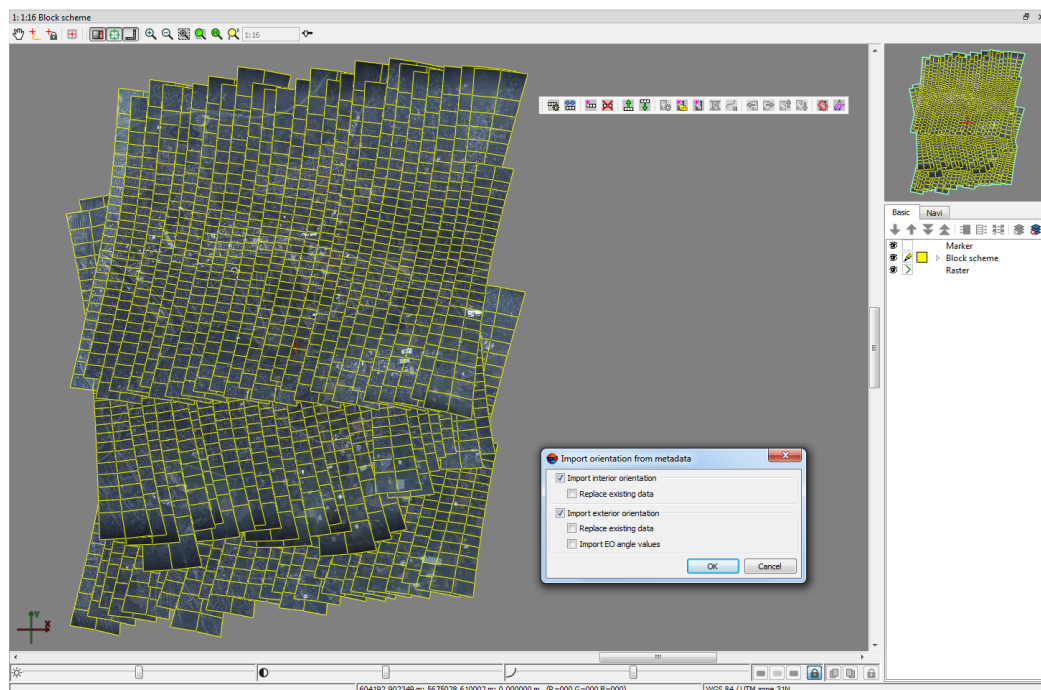
Fig. 15. VisionMap A3 project (central projection)

7.   Choose **Orientation › Direct georeferencing** or click the button of the **AT** toolbar. After that the system displays information window, which contains information about number of images adjusted using exterior orientation parameters.

      Proceed to stereo processing step.

6. Project creation

6.1. Creating new project

In order to create a new project perform the following actions:

1.   Choose active profile.

2.   Run the system.

3.   Open the **New project** window using one of the following ways:

     • choose **Project › Open/Manage...** (**Ctrl+Alt+O**) or click the button on the main toolbar. The **Manage project** window opens. Click the **New** button;

     • choose **Project › New**.

            The **New project** window opens automatically if there is no existed projects in the active profile.
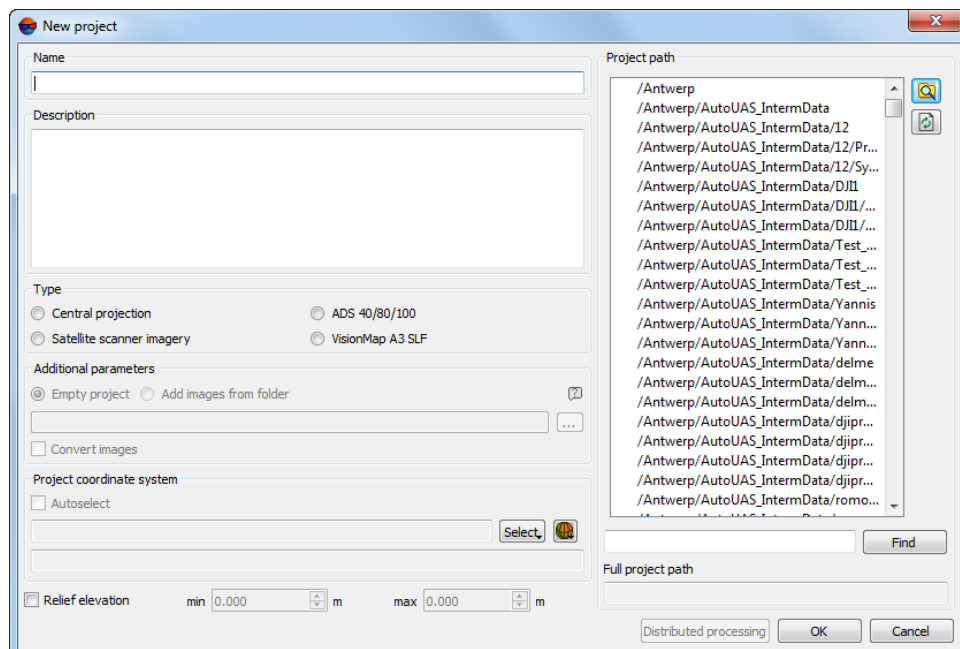
Fig. 16. New project window

4.   Define a **Name** of new project.

5.   [optional] Input to the **Description** section a brief project description, its main features, notes etc.

6.   Specify project type in the **Type** field depending on survey type:

   •   **Central projection** – used for processing of aerial or space borne images of central projection and also for small format images from VisionMap A3.

   ⚠   Acceptable image formats are `*.jpg` and `*.tiff`.

   In the **Additional parameters** section, select actions to be executed when creating a project:

   ○   [optional] create an **Empty project** to process it manually in usual way (see below);

   ○   [optional] **Add images from folder** (…) to the project, place all the project's images into one strip and perform automatic splitting images into strips using image names, exterior orientation parameters or metadata, as well as create block layout automatically (see Section 6.1.1).

   ■   [optional] To **convert images** when adding from `*.jpg` to `*.tiff` format, set the appropriate checkbox.

   ⚠   Fast project creation allows for automatic execution of some primary project processing stages which are usually executed manually according to this Manual after **Empty project** creation.

   Fast project creation is available only for **Central projection** type projects and this greatly facilitates and accelerates data processing.

   Fast project creation is recommended only if high quality initial data are available, i.e. `*.jpg` or `*.tiff` images, as well as interior and exterior orientation elements (see Section 6.1.1).

   •   **Satellite scanner imagery** – used for processing of space borne scanner images;

   •   **ADS 40/80/100** – used for processing of data, acquired by ADS 40/80/100 digital sensor;

   •   **VisionMap A3 SLF** – used for processing of images, acquired by VisionMap A3 camera.

7.   In the **Coordinate system** section click the **Select** button (see Section 4.1). Project coordinate system could be chosen from the following sources:

> In case of fast project creation, the **Autoselect** of a coordinate system is possible if the appropriate metadata are available (see Section 6.1.1).

- **From DB**: **International**, **Local** – used for coordinate system choosing from international or local database.

- **From file** – used to load a coordinate system from the `*.x-ref-system` file (if any), placed outside from active profile resources.

- **From resource** – used to load a coordinate system from the *.x-ref-system file, located in active profile resources (from another project of active profile, for instance);

- **From GeoCalculator** – from the list of *GeoCalculator* program database (see the "Coordinate Systems" chapter in "The GeoCalculator program" User manual).

> The *GeoCalculator* program allows to edit coordinate systems, to create new ones, to perform import and export of coordinate systems (see the "The GeoCalculator program" User Manual).

When choosing coordinate system from database the **Coordinate system database** opens, which contains the list of coordinate systems.

Fig. 17. Window used to select coordinate system from coordinate system database

> To perform fast search for coordinate system, input the whole coordinate system name or its part to the **Find** input filed.

To choose geoid to be used, click the 🌐 button. Select proper type of geoid usage:

- **No geoid**;

- **EGM 96**.

☞ The system allows to use the **EGM2008** geoid. See more details in the "Installation EGM2008 Geoid" User Manual. After installation the geoid is displayed in the list.
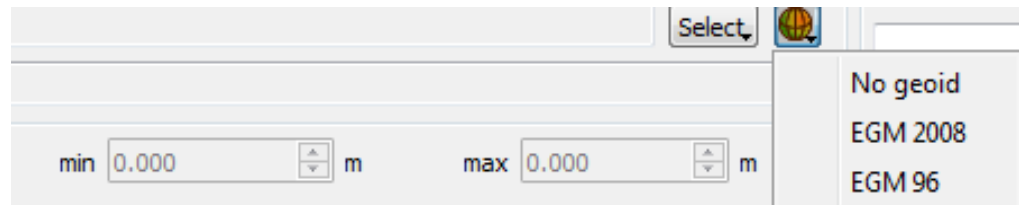
☞ *PHOTOMOD GeoCalculator* provides for creating a user height system (geoid) with preset parameters. *PHOTOMOD* system allows to use previously created custom vertical datum (geoid). See instructions in the "Creating custom height system" chapter of "The GeoCalculator program" User Manual.

8. [optional] Set the **Relief elevation** checkbox and specify approximate difference of terrain heights on project images in the **min** and **max** input fields.

☞ If the relief elevation data is unavailable or inaccurate by the time of project creation, the system allows to define the value later in project properties. Terrain elevation data is used to refine a block layout, it is considered during import of exterior orientation parameters and during calculation of ground sample distance (GSD).

If the **Relief elevation** was not indicated while project creation, it is in any case will be set when importing exterior orientation elements (see the "Aerial triangulation" User Manual), including in the case of fast project creation (if the appropriate metadata are available).

9. In the **Project path** list choose a folder of active profile resources to place project files there.

☞ Only folders of two upper levels could be used to place project files into the **Project path** list (virtual folders and their subfolders), which do not contain images files. To edit structure of profile resources use the *PHOTOMOD Explorer* module (see the "General information" User Manual).

Virtual folders connection to network profile is performed only in the *Control Panel module*. After update of profile resources structure click the 🔁 button to refresh the list in the **Project path** section.

☞ The search field that allows to **Find** a project in the list by its name or name part is situated below the **Project path** list. **F3** key allows to focus marker on the search field. Press **F3** again to focus marker on the next found project in the list.

The **Full project path** input field will show the project name and full path.

10. Click OK to complete a project creation. After that service folders and configuration files are created in the specified project folder.

   In case of fast creation of a **Central projection** type project, it is possible to use the distributed processing mode. For this, 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.

11. [optional] In case of creating the ADS project, proceed to ADS data preparing and images loading (see Section 5.4.4).
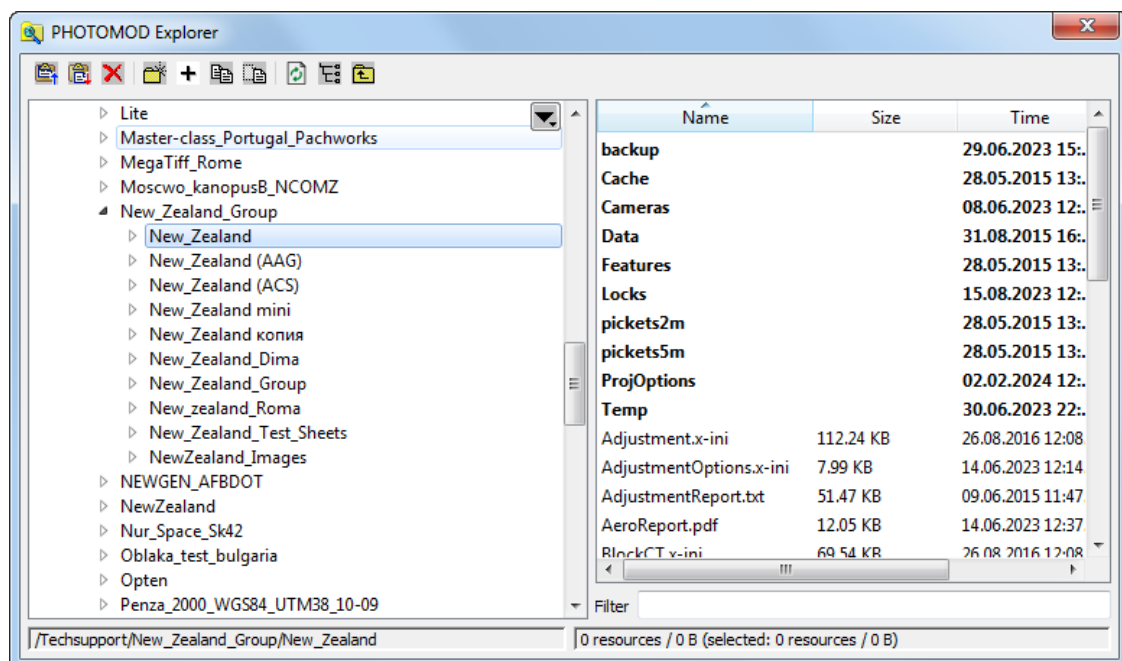
Fig. 18. Service folders and files of a new project

In order to view or edit some parameters of created project, use the **Project properties** window.

To display residuals vector perform one of the following:

• choose **Project › Properties** (see Section 8.3);

• double-click coordinate system name in status bar. The **Select reference system type** window opens. Click the **Project properties** button.

After project creation proceed to the image block forming step: load and setup project images (see Section 7).

6.1.1. Fast project creation

The system allows us to create projects of the **Central projection** type in two ways:

- [optional] create an **Empty project** manually in usual mode according to this Manual;

- [optional] use the function of fast project creation of the Central projection type.

Fast project creation supposes automatic execution of some primary project processing stages which in usual mode are executed manually according to this Manual after **Empty project** creation.

> ⚠️ Fast project creation is available only for **Central projection** type projects and greatly facilitates and accelerates data processing.
>
> Fast project creation is recommended only in case of high quality initial data, i.e. `*.jpg` or `*.tiff` images, as well as interior and exterior orientation elements.

Fast project creation allows you to automate the following operations:

- Image block forming – when finding suitable initial data in the folder indicated by the user, the system adds images in one strip and optionally convert them into `*.tiff`, otherwise the operation is interrupted and the following message is created:
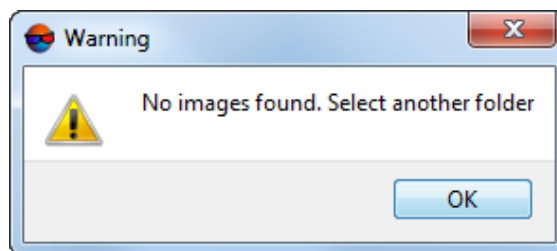
Fig. 19. Project creation interruption because of the lack of correct initial data.

> 🎓 In case of fast project creation, radiometric correction of images is not performed

- Image interior orientation (see the appropriate section in the "Aerial triangulation" User Manual);

> 🎓 In most cases metadata of modern digital aerial images contain necessary information for interior image orientation. When checking the correctness of interior orientation (after project creation), the user can also calibrate cameras if necessary data are available (see the "Aerial triangulation" User Manual).

- Import of image exterior orientation elements and further automatic splitting images into strips by image names, by exterior orientation elements, or by metadata, as well as automatic block layout (see the "Aerial triangulation" User Manual);

Execution of selected processing stages depends directly on the availability (and quality) of exterior orientation elements delivered with initial data. In many cases (depending on a sensor) these data can be incomplete.

The system provides possibility to create a block scheme by UAS images if angular exterior orientation parameters of block images are specified with low accuracy or are unavailable.

In this case the system automatically launches the algorithm that allows us to set kappa angle according to the flight path.

For each highlighted image the system calculates the direction from previous to next center in a strip (for utmost images of a strip – from adjacent image to the current one) and kappa angle is setup from this direction.

After automatic project primary processing completion, it is recommended to ensure that block splitting into strips and block layout is performed quite correctly.

- **Autoselection** of the project coordinate system and project elevation range by the exterior orientation elements, if they are not selected by the user manually (see below).

Autoselection of the coordinate system is possible if the appropriate data are available. If such a checkbox is set, but exterior orientation elements are not found and imported, the Cartesian right-handed coordinate system will be set by default

After automatic project primary processing completion, the appropriate message appears with the description of current project status and the list of executed operations (depending on input data quality).

In ideal case, given the satisfying results of fast project creation, the user can skip to relative image orientation execution (see the "Aerial triangulation" User Manual).

First, ensure that image interior orientation, automatic block splitting into strips, and block layout were made quite correctly. Optional, perform radiometric image correction (if necessary) and camera calibration (if the appropriate data are available).

Otherwise, it is necessary to execute skipped project primary processing stages manually (according to the info message, this document, as well as to the "Aerial triangulation" Manual).

6.1.2. Fast central projection project creation

For fast creation of a central projection project, perform the following:

1. Choose active profile;

2. Run the system;

3. Open the **New project** window using one of the following ways:

- choose **Project › Open/Manage...** (**Ctrl+Alt+O**) or click the 📂 button on the main toolbar. The **Manage project** window opens. Click the **New** button;

- choose **Project › New**.
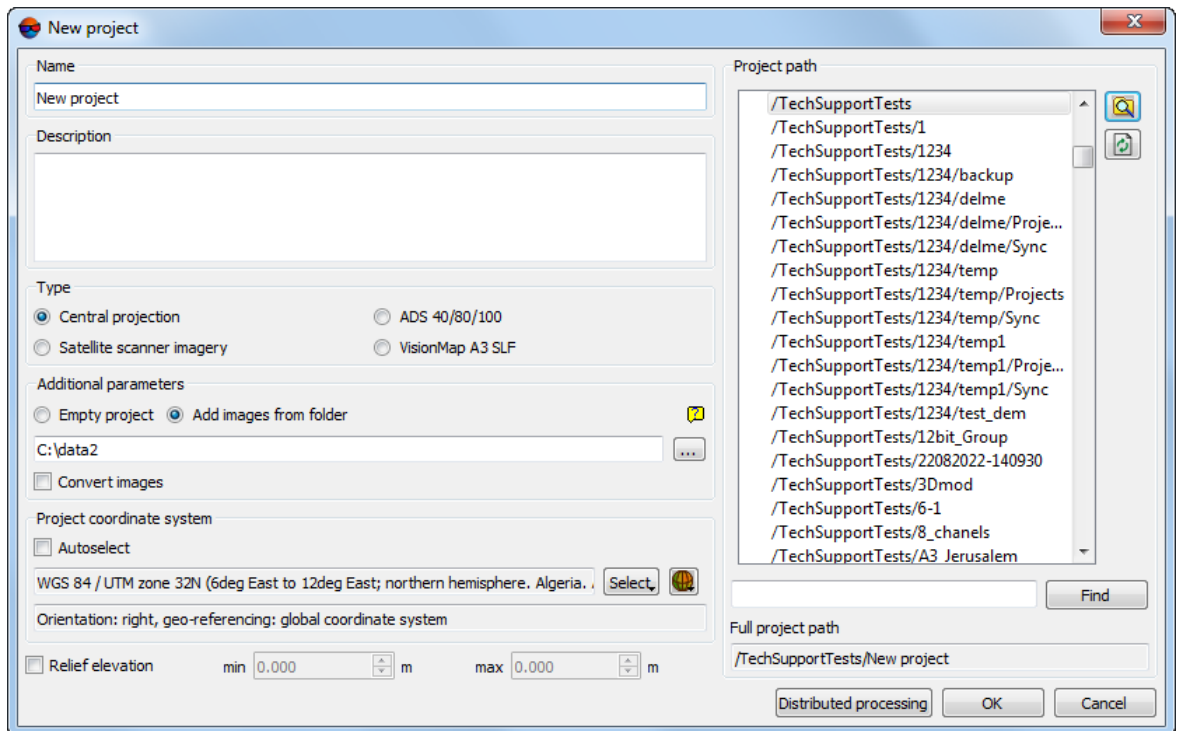
Fig. 20. New project window

☞ The **New project** window opens automatically if there is no existed projects in the active profile.

4. Define a **Name** of new project;

5. [optional] Input to the **Description** section a brief project description, its main features, notes etc;

6. Specify project **type** – **Central projection**;

7. In the **Additional parameters** section, select the **Add images from folder** option and click the ⌊…⌋ button to specify the folder with images in *Windows* file system;

⚠ Acceptable image formats are `*.jpg` and `*.tiff`.

- [optional] To **convert images** when adding from `*.jpg` to `*.tiff` format, set the appropriate checkbox.

When adding images, it is recommended to **convert** them into the `*.tiff` format to increase system performance during execution of some operations. Note, that `*.tiff` images take up larger amount of disk space.

8. In the **Coordinate system** section perform one of the following actions:

    - [optional] set the **Autoselect** checkbox;

        Autoselection of the coordinate system is possible if the appropriate metadata are available. If such a checkbox is set, but exterior orientation elements are not found and imported, the Cartesian right-handed coordinate system will be set by default.

    - [optional] click the appropriate button to **Select** coordinate system manually, if it's reasonable (see Section 4.1). Project coordinate system could be chosen from the following sources:

        ○ **From DB**: **International**, **Local** – used for coordinate system choosing from international or local database.

        To create new coordinate system is used the *Coordinate system builder* (see the "General information about system" User Manual).

        ○ **From file** – used to load a coordinate system from the `*.x-ref-system` file (if any), placed outside from active profile resources.

        ○ **From resource** – used to load a coordinate system from the *.x-ref-system file, located in active profile resources (from another project of active profile, for instance);

        ○ **From GeoCalculator** – from the list of *GeoCalculator* program database (see the "Coordinate Systems" chapter in "The GeoCalculator program" User manual).

        The *GeoCalculator* program allows to edit coordinate systems, to create new ones, to perform import and export of coordinate systems (see the "The GeoCalculator program" User Manual).

    When choosing coordinate system from database the **Coordinate system database** opens, which contains the list of coordinate systems.

    To perform fast search for coordinate system, input the whole coordinate system name or its part to the **Find** input filed.
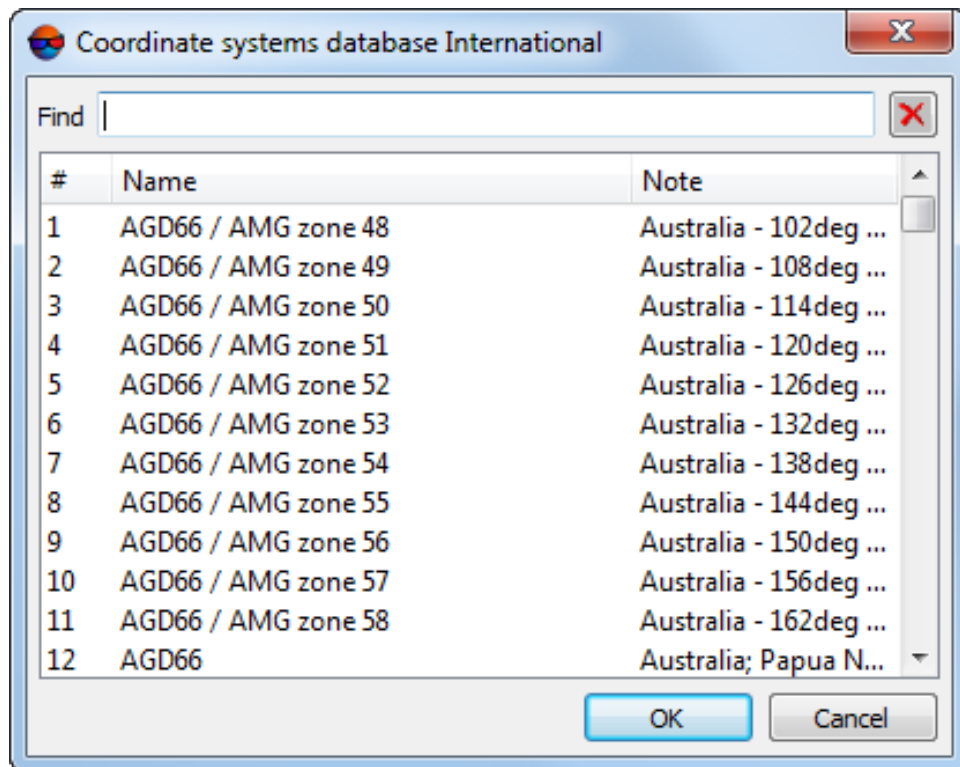
Fig. 21. Window used to select coordinate system from coordinate system database

To choose geoid to be used, click the 🌐 button. Select proper type of geoid usage:

• **No geoid**;

• **EGM 96**.

> ☞ The system allows to use the **EGM2008** geoid. See more details in the "Installation EGM2008 Geoid" User Manual. After installation the geoid is displayed in the list.
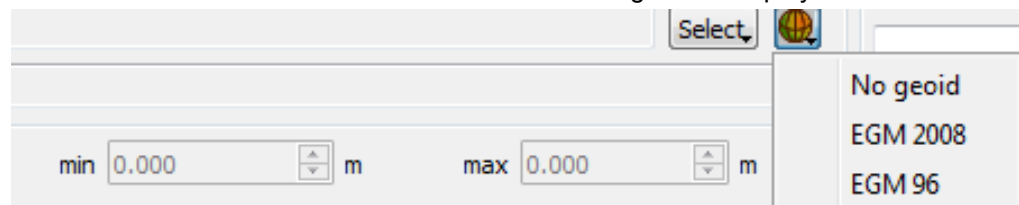
> ☞ *PHOTOMOD GeoCalculator* provides for creating a user height system (geoid) with preset parameters. *PHOTOMOD* system allows to use previously created custom vertical datum (geoid). See instructions in the "Creating custom height system" chapter of "The GeoCalculator program" User Manual.

9. [optional] Set the **Relief elevation** checkbox and specify approximate difference of terrain heights on project images in the **min** and **max** input fields.

> If the relief elevation data is unavailable or inaccurate by the time of project creation, the system allows to define the value later in project properties. Terrain elevation data is used to refine a block layout, it is considered during import of exterior orientation parameters and during calculation of ground sample distance (GSD).
>
> If the **Relief elevation** was not indicated while project creation, it is in any case will be set when importing exterior orientation elements (if the appropriate metadata are available).

10. In the **Project path** list choose a folder of active profile resources to place project files there.

    > Only folders of two upper levels could be used to place project files into the **Project path** list (virtual folders and their subfolders), which do not contain images files. To edit structure of profile resources use the *PHOTOMOD Explorer* module (see the "General information" User Manual).
    >
    > Virtual folders connection to network profile is performed only in the *Control Panel module*. After update of profile resources structure click the 🔁 button to refresh the list in the **Project path** section.

    The **Full project path** input field will show the project name and full path.

11. Click OK to complete a project creation.

    When fast project creation, it is strongly recommended to use the distributed processing mode (otherwise, click OK to complete project creation). To use the distributed processing mode, 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.

    During project creation, service folders and configuration files are created in the selected project folder. After automatic primary project processing completion, the appropriate info message describing current project status and the list of executed operations (depending on input data quality) appears.
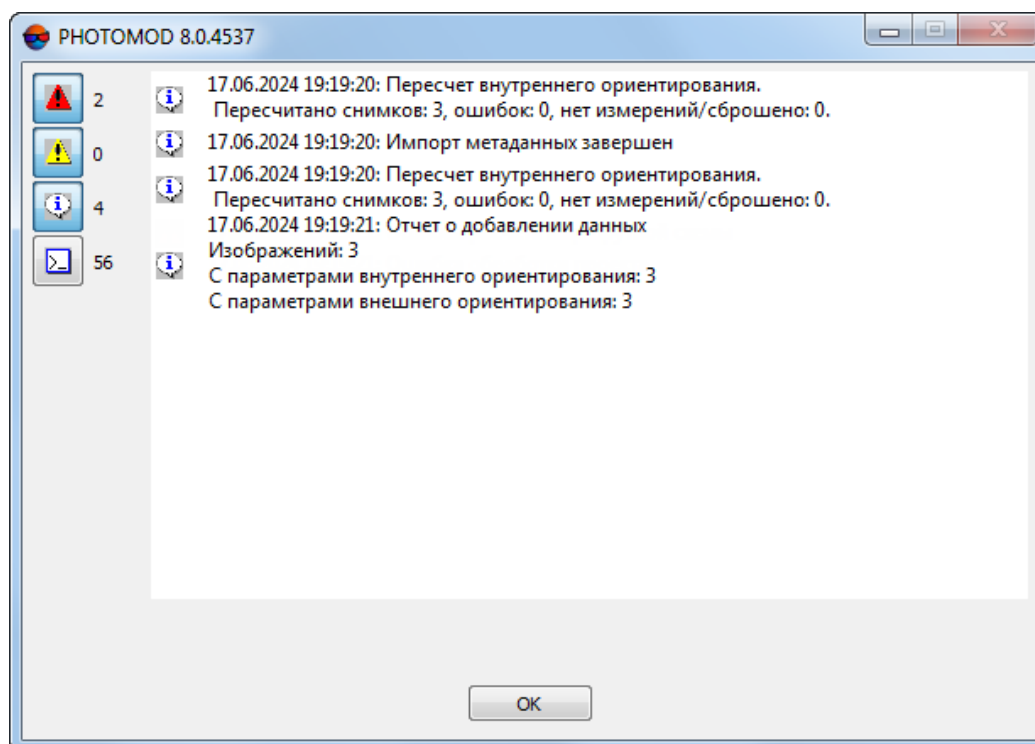
Fig. 22. An info message on download of imagery without metadata into the project.

12. Read the info message. According to this document, as well as to the "Aerial trian-gulation" Manual, ensure that interior imager orientation, automatic splitting block into strips, and block layout were performed quite correctly.

Perform radiometric image correction (if necessary) and calibrate camera (if the appropriate data are available).

If you are satisfied with fast project creation, go to relative orientation of images (see the "Aerial triangulation" Manual), otherwise, first perform manually the skipped stages of primary processing of the project (guided by the info message).

6.2. "Without project" mode

The system allows working without loading a project.

Without project mode allows to load processing data of some active profile project – vector objects, TIN, DEM – to view, edit, control accuracy, import/export.

Without project mode provides the following possibilities: changing working coordinate system, processing of georeferenced raster images, 3d-modeling in the *3D-Mod program*.

In order to work in the system without loading a project perform one of the following:

- in the **Project management** window click the **W/o project** button (see Section 8);

- choose **Project › Close** if there is some opened project in the system.

During working without project it is necessary to setup the working coordinate system for correct loading of georeferenced data to the system.

> Specifying the working coordinate system is required to display in *Yandex.Maps* and in *Google Maps*, for this, there should exist conversion between the working coordinate system and WGS84 (see Section 4.3).

To setup or change working coordinate system, perform one of the following:

- choose **Service › Working coordinate system**;

- double-click coordinate system name in status bar. The **Select reference system type** window opens. Click the **Project properties** button.

Working coordinate system allows to display marker coordinates in the **Marker** window and status bar, and also to show marker position in *Yandex.Maps* or in *Google Maps*. Also during import/export of objects working coordinate system is considering as a source coordinate system.
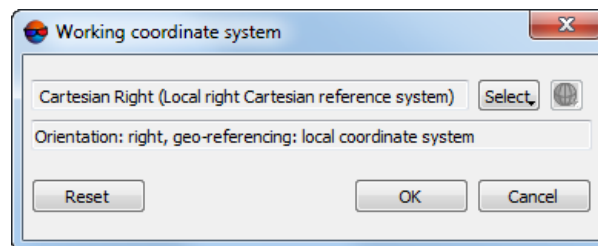
Fig. 23. Working coordinate system

7. Images block forming

7.1. The "Block" menu

The **Block** menu is used for work with images block in 2D-window. It includes extended features for images block forming, as well as additional functions for block scheme creation and obtaining of auxiliary data.

The **Block** menu functions are partially duplicated in the **Block editor** window (see Section 7.2) and in the **Block forming** toolbar.

Some menu items allow to manage operations with selected images in 2D-window. The **Tools** additional toolbar is used for group selection (highlighting) of images block in 2D-window (see the "Vectorization" User Manual).

Table 5. Brief description of the "Block" menu

Menu items	Function
🔳 **Add strip**	to add new strip
✂ **Delete strip**	to delete selected strips of block in 2D-window
🔲 **Strip properties**	to view and edit properties of selected strips – strip's name and type (regular or irregular)
Invert image order in strip	to invert strips order
Selected strips to block start	to move selected strips to the beginning
Selected strips to block end	to move selected strips to the end
🔼**Move selected strips up**	to move selected strips one strip up
🔽**Move selected strips down**	to move selected strips one strip down
Make selected strips irregular	to change regular strip to irregular
Make selected strips regular	to change irregular strip to regular
📂**Add images from files**	to add images from files located *out* of active profile resources to selected strip (see Section 7.4.2)
🖼**Add images from resources**	to add images located in active profile resources to selected strip (see Section 7.4.3)
Add images from resource folder	to automatically add images from specified folder of active profile resources to selected strip, with or without its subfolders
❎**Delete images**	to delete selected images from project (images files are not physically deleted at that)
Delete images selectively...	to select images in accordance with specified criteria for deleting (see Section 7.8.3)
🖼**Image properties**	to display and edit properties of selected image
Move images	opens a group of menu items used to images block editing; allows to invert images order in a strip, and to move selected image left/right/up/down
📈**Image radiometric correction**	to perform radiometric correction of selected image (see Section 7.7)
🖼**Show images**	to show images of block in 2D-window if the limitation on images display is specified on the **Block scheme | Raster** tab in the **Settings** window (see "General information" User Manual)
🖼**Show selected images only**	to turn on/of selected images display
Check images	to perform search for 16-bit project images without radiometric correction (no *.rmc file associated with the image, see "Radiometric correction" in the "General information" User Manual). If images are found in the project that meet the criteria described above, an appropriate info message is issued
Mark all images as checked	to exclude project images validation - check their presence and compliance to images files during project opening at the next working session

Menu items	Function
Marker to selected image	to move marker to center of the image, selected in the list of the **Block editor** window
Block layout	contains groups of menu items used to create block layout; allows to refresh, load, save block layout, apply **w/o layout** or **by exterior orientation** modes, build block layout automatically for Unmanned Aerial System (UAS) projects, delete results of automatic block layout (see the "Aerial triangulation" User Manual)
Split to strips	to split images block to strips automatically using images names, exterior orientation parameters, metadata, and split VisionMap images block (see Section 7.8.1)
🔴 **Rotate selected images**	to rotate selected images at any angle relatively to initial or current position of block images
Rotate images by block layout	to rotate all or selected images of block considering block layout data; images don't rotate if the **w\o layout** was used (see the "Aerial triangulation" User Manual)
⬓ **Set GSD for selected images**	to define/calculate GSD value in meters for all or selected images of block (see Section 10.1)
Create overlap map...	to create map of images and/or strips overlap in new vector layer (see Section 10.2)
Create vector layer from block layout	to create vector layers with common block outline, boundaries of all images or selected image of the block (see Section 10.3)
Build pre-regions	to create pre-regions by images/stereopairs to provide joint work on a project (see Section 10.4)
Export block layout to KML, KMZ...	to export block scheme to KML or KMZ format
Useful areas	to calculate useful areas in automatic mode
Reference crosses conversion	to open the TK-350 camera passport file (with `*.txt` extension) for the further processing
Brightness adjustment	to build brightness adjustment for all block scheme
Delete brightness adjustment	to delete the brightness adjustment results

7.2. The "Block editor" window

The **Block editor** window is used to form a block of project images.

The **Block editor** window contains a table of created strips and images loaded to project and contains tools for images block editing.

The **Block editor** window is synchronized with 2D-window: so all changes in the images list of the **Block editor** (choosing, adding, deleting, moving of strips and images) are shown in the block scheme in 2D-window and vice versa.

To open the **Block editor** window choose the **Windows › Block editor** (**Ctrl+Alt+B**) or click the 🖼 button on the main toolbar.
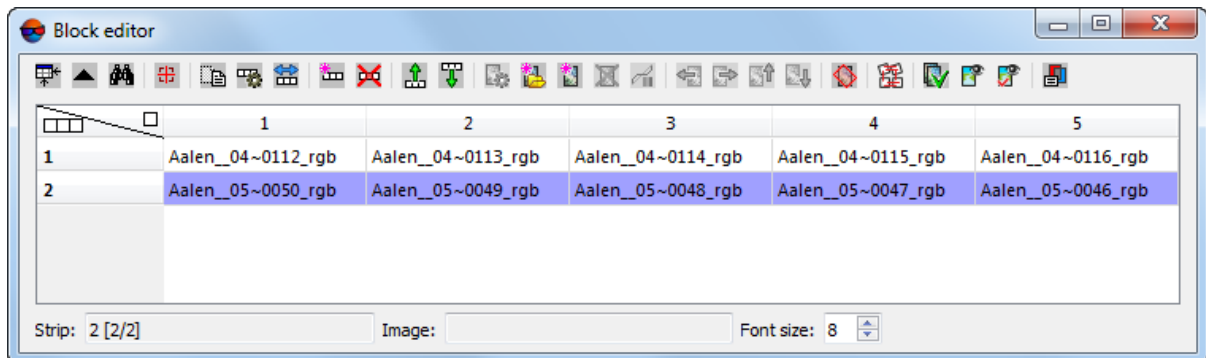
Fig. 24. The Block editor window

The **Block editor** window contains the following elements:

- toolbar to form and edit block images;

- the list of existed strips and loaded there images;

- the status bar with the following data:

  ○ **Strip** – the `Strip name [item No/total]` is displayed for strip selected in the table;

  ○ **Image** – the Image name `[item No/total in strip/total in block]` is displayed for image selected in the table;

  ○ **Font size** – allows to change the font size of table text.

To select (highlight) the image in the **Block editor** window click the image name in the list. To select strip click the name of strip.

☞ To select multiple images\strips use **Shift** and **Ctrl** keys.

☞ To highlight several images in 2D-window use additional toolbar of group selection (see the *Tool* section in the "Vectorization" User Manual).

The **Edit › Select all**, **Edit › Invert selection** and **Edit › Cancel selection** allows to change strip or images selection both in block scheme and in 2D-window.

The **Block** menu items, buttons of the **Forming block** toolbar and the toolbar of the **Block editor** window.

Table 6. The toolbox of Block editor window

Buttons	Function
	to change the **Block editor** window size so that window displays all list of strips/images
	to show/hide the list of strips/images and the status bar to comfort work with block images in 2D-window (in the **Block editor** window only toolbar displays)
	to search for an image by name (part of name)
	to select in the list initial images, that contain marker position
	to edit names of several strips of the block at the same time
	to display and edit properties of selected strip (name and type of strip)
	to reverse images in the strip order
	to add new strip
	to remove selected strip
	to move selected strips on one strip up
	to move selected strips on one strip down
	to display and edit properties of selected image
	to add images from files located out of active profile resources to selected strip
	to add images from files located in active profile resources to selected strip
	to delete selected images from project
	to radiometric correction of selected image
	to move selected images left/right/up/down
	to rotate selected images to any angle relatively to initial or current location of images in the block
	to open the **Block layout** window to build block scheme in 2D-window considering source or acquired data (see the Aerial triangulation User Manual)
	to open the ImageWizard utility to setup images
	to show block images in 2D-window, if they were not displayed during project loading, due to limitation specified in the system's setting window (see the "General information about system" User Manual)
	to set on/off displaying only selected images mode
	to open the list of images that form stereopairs with an image selected in the **Block editor** window, including the case when two images forming a stereopair are located on different strips

7.2.1. Search and select images

To search images in the **Block editor** window, perform the following:

1. Click the button at the **Block editor** toolbar. The **Find** section opens:
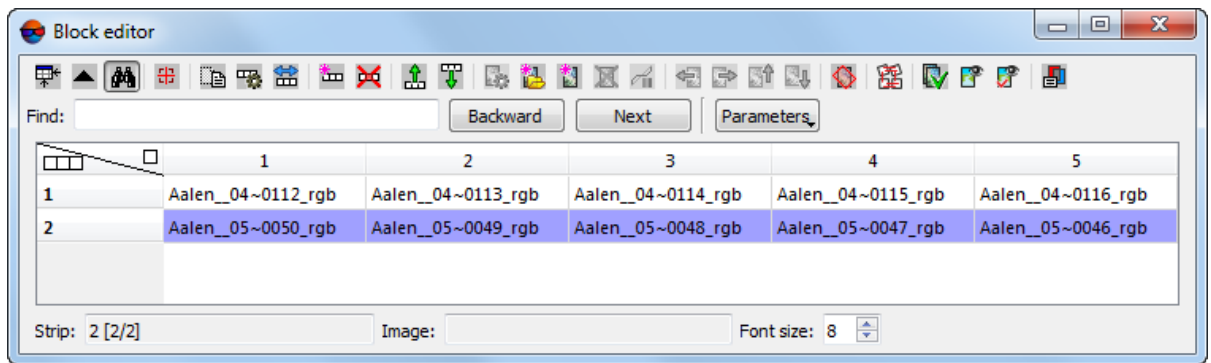
Fig. 25. The Find section in Block editor window

2. Customize search **parameters** in the appropriate drop-down menu:

    • [optional] set the appropriate checkbox to search **whole word**s only;

    • [optional] set the appropriate checkbox to **add to selected** found images;

3. To search, click the **next** (or **backward**) buttons repeatedly, as well as to add found images to selection (optional, if the appropriate checkbox is set).

7.3. Adding strips

During strip creation load images to the project using one of the following ways:

• estimate number of strips, define their names, number of images in each strip, then add strips one by one and load images there.

• load all images of the project into the same strip and then perform automatic splitting images into strips using images names, exterior orientation parameters (if such data is available) or metadata.

> Automatic splitting of VisionMap images is also available.

Perform the following actions for creating the single sheet:

1. Choose the **Block › Add strip** or click the 🔳 button in the Block editor window's toolbar. The **New strip** window opens.

> During creating of project the **New strip** window opens automatically to create the first strip.
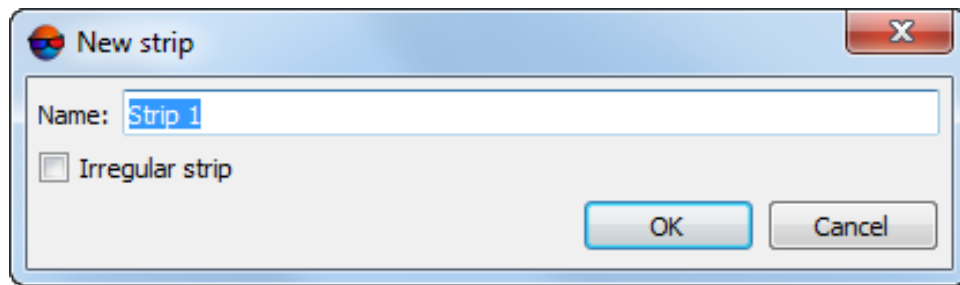
Fig. 26. New strip properties

2. Define **Name** of the strip.

3. [optional] To create block scheme not linked to regular grid, set the **Irregular strip** checkbox. Otherwise, the system creates strip of regular type.

> If there is no tie points between regular strips, by default overlap percent is used to tie strips (not less than 10%),

> If irregular strip is creating, block scheme does not stick to regular grid.

> Images with overlap are loaded in separate strip. If there is a strip with "gap" between images, it is recommended to create two strips, one of which is irregular.

4. Click OK. New strip creates and its frame displays in block scheme 2D-window. The row with name of strip displays in the table of the Block editor window.

> Frame of regular strip displays in block scheme 2D-window with blue color, irregular - with orange. Irregular strip is marked by orange color in the table of the **Block editor** window.

> To view and edit strip properties (name and type), click the ▦ button or double click the strip name in the table.

5. Repeat the 1-4 steps for adding new strips.

7.4. Adding images

7.4.1. Images formats

The system provides work with images of commonly used raster formats. However, for effective work in the system it is strongly recommended to use images of interior MS-TIFF format (or MegaTIFF for images with more than 4 GB size).

MS-TIFF format – raster TIFF format with *pyramid* (set of resampled copies of image). Pyramid provides fast refreshing of images on the screen.

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

The system contains some features used for conversion of images of different raster formats to files of MS-TIFF format. For conversion to MS-TIFF format or direct load to the system you can use initial images with the following raster formats:

- Tag Image File Format (TIFF) – images of TIFF, BigTIFF and GeoTiff formats, including 12-bit images with/without JPEG-compression (with pyramid or without it), that the system considers as 16-bit ones, so images radiometric correction is not necessary;

- Windows Bitmap File (BMP);

- VectOr Raster Maps (RSW) – images of *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 limitation on output file size of JPEG2000 format – no greater then 500 Mb.

7.4.2. Adding images from files

During adding of source images located out of profile resources system, the following operations are performed by the system: conversion files of internal format, saving converted files to specified folder of active profile resources, and loading images to selected strip of a block.

To add and correct source images is used the **Add images** window.
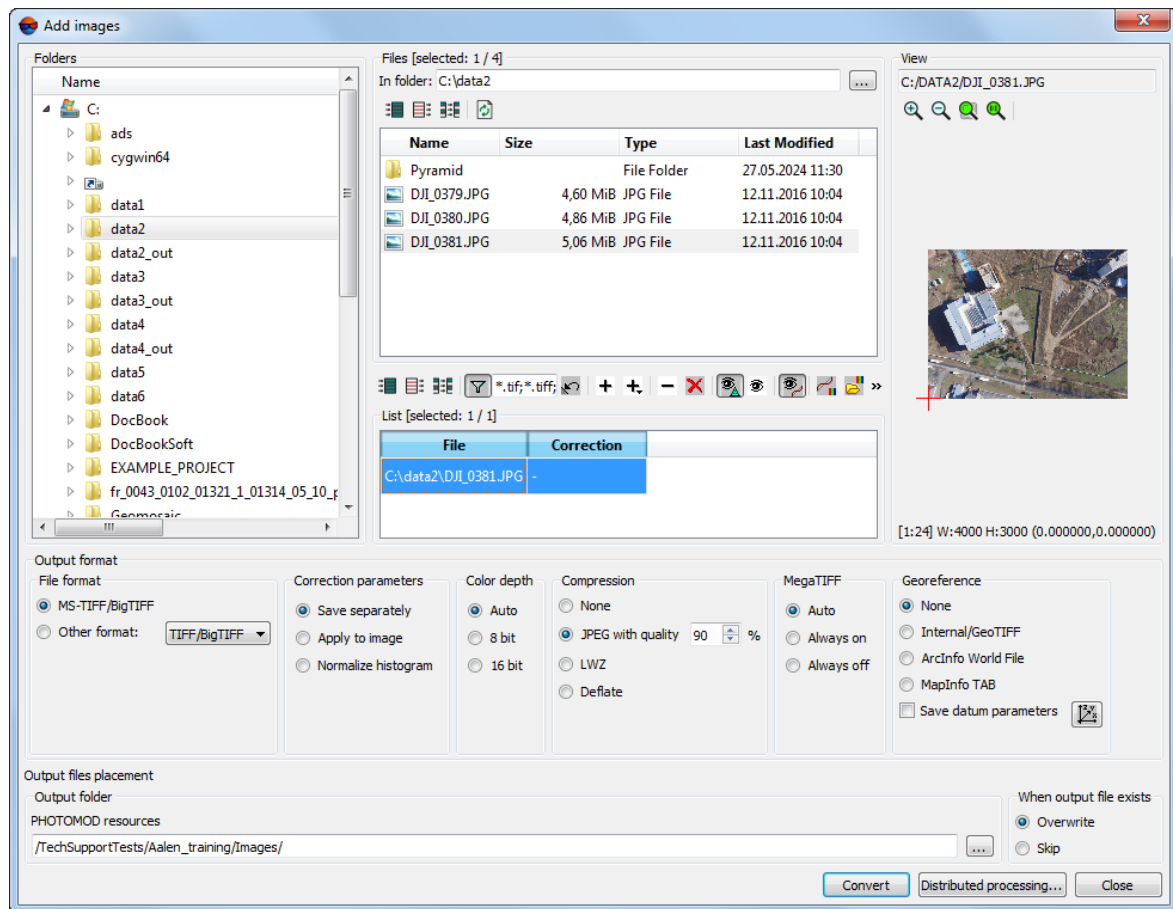
Fig. 27. Adding images from files, located out of profile resources

The **Add images** window allows to perform the following transformations of source images of acceptable raster formats:

- transformation file of source images in files of inner format: MS-TIFF – for images with size less than 4GB; MegaTIFF – for images with size more than 4 GB (for example, for satellite scanner images or images of ADS 40/80/100 project);

- apply JPEG compression of specified level or LZW compression without quality loss to 16-bit images;

- convert 8 or 16-bit images;

- perform radiometric correction to improve visual properties of images;

- save images georeference (if georeference files are available for source images);

- to use distributed processing for conversion.

The following buttons in the **Source** section allows to select images source files:

- ▤ – allows to select all files;

- ▤ – allows to unselect all files;

- ▤ – allows to invert selection of files.

Table 7. The "List" section toolbar

Buttons	Function
▤	to select all files
▤	to unselect all files
▤	to invert selection of files
▽	to enable display only source images of acceptable raster formats (enabled by default).
+	to add to the list images files selected in the **Files** section
+,	to open a drop-down menu that allows user to switch to other methods for adding files
−	to remove selected images files from the list (they are not removed physically at that)
✖	to remove all images files from the list (they are not removed physically at that)
◉	to enable display of selected images with created pyramid in the View window (enabled by default)
◉	to show in Preview window all images (if selected image without pyramid, temporary pyramid creates automatically)
◉	to enable display of images with radiometric correction applied (enabled by default)
◢	to perform radiometric correction of image selected in the list
🗁	to apply radiometric correction parameters saved in *.`rmc` file to selected images
🖫	to save radiometric correction parameters of selected image to *.`rmc` file
✓	to save radiometric correction parameters of each selected image to its own *.`rmc` file
📊	to perform the autolevels for selected images without opening the Radiometric correction window.
▲	to create the pyramid
▲	to create the pyramid (distributed processing)

The **View** section contains the image view window and toolbar with the following buttons:

- 🔍 – allows to zoom in an image by one step (*****);

- 🔍 – allows to zoom out an image by one step (*/*);

- 🔍 – allows to fit to page data of opened layers (**Alt+Enter**);

- 🔍 – allows to display data in 1:1 scale, when one pixel of the image corresponds to one pixel on the screen;

- 🖼 – allows to open image on full screen.

In order to add images from files, perform the following actions:

1. Choose/select a strip to add images to the **Block editor** window or to 2D-window.

2. Choose **Block › Add images from files** or click the button in the **Block editor** window. The **Add images** window opens.

    > See detailed description of the **Add images** window in the "General information" User Manual.

3. Select folder in the **Folders** section or click the ⎯ button in the **File** section for choosing folder.

4. Load image in the list by one of the following ways:

    *   Select image in the **File** section and click the **+** button.

        The **+** button allows to open menu used to perform one of the following actions:

        ○ **Add all from the current folder**;

        ○ **Add all from the current folder and subfolders**;

        ○ **Adding satellite images**;

        ○ **Merge channels from files** (see the "Merging channels from separate files" chapter in the "General information" User Manual).

    *   in the **File** section select the image, press and hold left mouse button to move selected image to the **List** section.

5. [optional] To build *temporary pyramids* to open source images and provide their fast redraw in the **View** window or in the **Radiometric correction** window click the button in the **List** section.

    > Temporary pyramid is build automatically, when you choose file without pyramid in mode of all images displaying. Temporary pyramid is also build automatically after Files with pyramids are placed to the Pyramid subfolder created automatically in the source image folder (see the "General information about system" User Manual).

6. [optional] Perform the radiometric correction to eliminate radiometric errors. To perform radiometric correction without additional settings click the button. The **Auto levels** window opens.
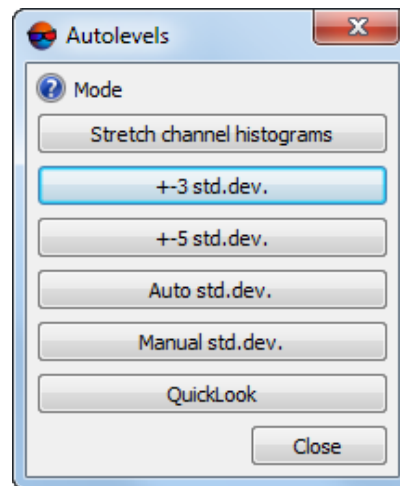
Fig. 28. Selecting image correction mode

The following types of correction are displayed in the window:

- **Stretch channel histogram** – allows to spread histogram evenly, separately in each channel;

  ○ Set the **Trims left and right** – area of histogram (in percent) which will not consider in stretching of histogram.

- **+-3 std. dev.** – allows to cut histogram area out of 3 standard deviations;

  ○ Set the **Trims left and right** – area of histogram (in percent) which will not consider in stretching of histogram.

- **+-5 std. dev.** – allows to cut histogram area out of 5 standard deviations;

  ○ Set the **Trims left and right** – area of histogram (in percent) which will not consider in stretching of histogram.

- **Auto std. dev** – allows to exclude light-exposed areas on image;

  ○ Set the **Trims left and right** – area of histogram (in percent) which will not consider in stretching of histogram.

- **Manual std. dev.** – allows to cut histogram area out of specified number of standard deviations;

  ○ Set the value of deviation each pixel from "average" in the **Standard deviations** field.

- **QuickLook** – allows to use brightness from remote sensing data files.

○ Set the **Trims left and right** – area of histogram (in percent) which will not consider in stretching of histogram.

> Processed channels are **Red**, **Blue**, and **Green**. The channels are identified according to the channel order displayed (or user defined) in the **Channels** window. Additional channels are processed using the average **QuickLook** histogram.

7. In the **Output format** section define the following output parameters to convert images from list:

- **File format** section specify output files format – interior MS-TIFF format.

- To perform radiometric correction, choose the following actions in the **Correction parameters** section:

  ○ **Save separately** (recommended) to save parameters of radiometric correction of images into separate *.rmc files. In this case just geometric transformations (rotation-flip) are applied to rasters directly;

  > At that the image is displayed in the system with all defined parameters of radiometric correction.

  ○ **Apply to image** to apply radiometric correction to the image directly without possibility to cancel radiometric transformations applied.

- **Color depth** – **Auto**, **8 bit** or **16 bit**.

  > If color depth of source image is less or equal 8 bit, then color depth of output image (with the Auto option selected) will be 8 bit, otherwise, 16 bit.

- **Compression** – choose compression type of output files:

  ○ **None** – files are creates 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.

  > This type of compression is applied to output images of MS-TIFF format only.

- In the **MegaTIFF** section define format to convert voluminous images:

  MegaTIFF format is a set of following files: `*.prf` and files of MS-TIFF format images placed to folder which has a name of source file and is created after conversion in specified target folder.

  To convert image in to MegaTIFF format, choose one of the following:

  - **Auto** (by default) for automatic identification of output format depending on source image size: MegaTIFF only if the size is more than 2 GB; otherwise – MS-TIFF format;

  - **Always on** to convert source images to MegaTIFF regardless of their size;

  - **Always off** to convert source images to MS-TIFF regardless of their size. Images with more than 4 GB size are displayed incorrectly in the system.

- In the **Georeference** section specify source files format with georeference:

  - **None** – in case of no georeferenced files;

  - **Internal/GeoTIFF** – to create GeoTIFF file;

  - **ArcInfo World File** – to create file in chosen format with ArcInfo georeference;

  - **MapInfo TAB** – to create file in chosen format with `*.tab` georeference file.

    The ⃞ button is used to choose coordinate system of georeference file. The **Save datum parameters** checkbox allows to save seven parameters of coordinate system to meta data of TIFF-file;

8. In the **Output files placement** section define the following parameters of output files:

   - click the ⃞...⃞ button to define target folder in active profile resources where to save output images files.

   - [if files with the same names exist in the target folder] In the **When output file exists** section you should define one of the following actions:

     - **Skip** – not overwrite existing file with the same name;

     - **Overwrite** – overwrite existing file.

9. Click the **Convert** button to convert initial images, save them to files in specified folder of active profile resources and load images to chosen strip. When the operation is completed the system displays information message that shows a number of added and skipped images.

10. [optional] In order to start distributed processing perform the following actions:

> ⚠️ To process images correctly, it is strongly not recommended to choose files on a local PC (in this case the system will display a warning that the input file list contains local paths)..

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

2. Click the **Distributed processing** button. The **Distributed image conversion** window opens.
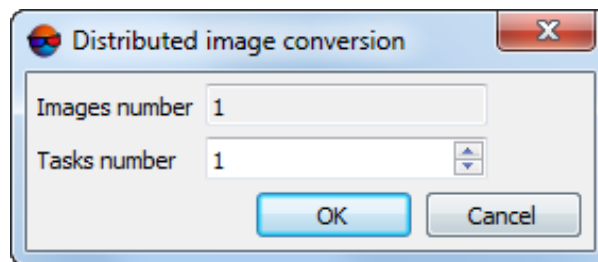
Fig. 29. Distributed image conversion parameters

3. Set the distributed processing **Tasks number**.

> ⚠️ It is recommended to define number of tasks depending on computer power and hardware, but not more than *five* tasks.

4. Click OK to create distributed processing tasks.

7.4.3. Adding images from resources

During adding images from active profile resources, they are loaded in their initial format, i.e. conversion to the system interior format is *not performed*. That is why, prior to adding it is strongly recommended to prepare source images in the *Raster Converter* program, save them to target folder and connect this folder to active profile resources as virtual (see the "General information" User Manual). Otherwise, the source images of acceptable raster formats are loaded to the system 'directly' (with creation of pyramids in separate files in the Pyramid folder), that could result in noticeable slowdown of the system work.

In order to select and add images located in active profile resources, perform the following actions:

1. Choose/create a strip in the **Block editor** window or in 2D-window to add images there.

2. Choose **Block › Add images from resources** or click the 🖼 button in the **Block editor** window. The **Open** window opens, that shows all active profile resources.
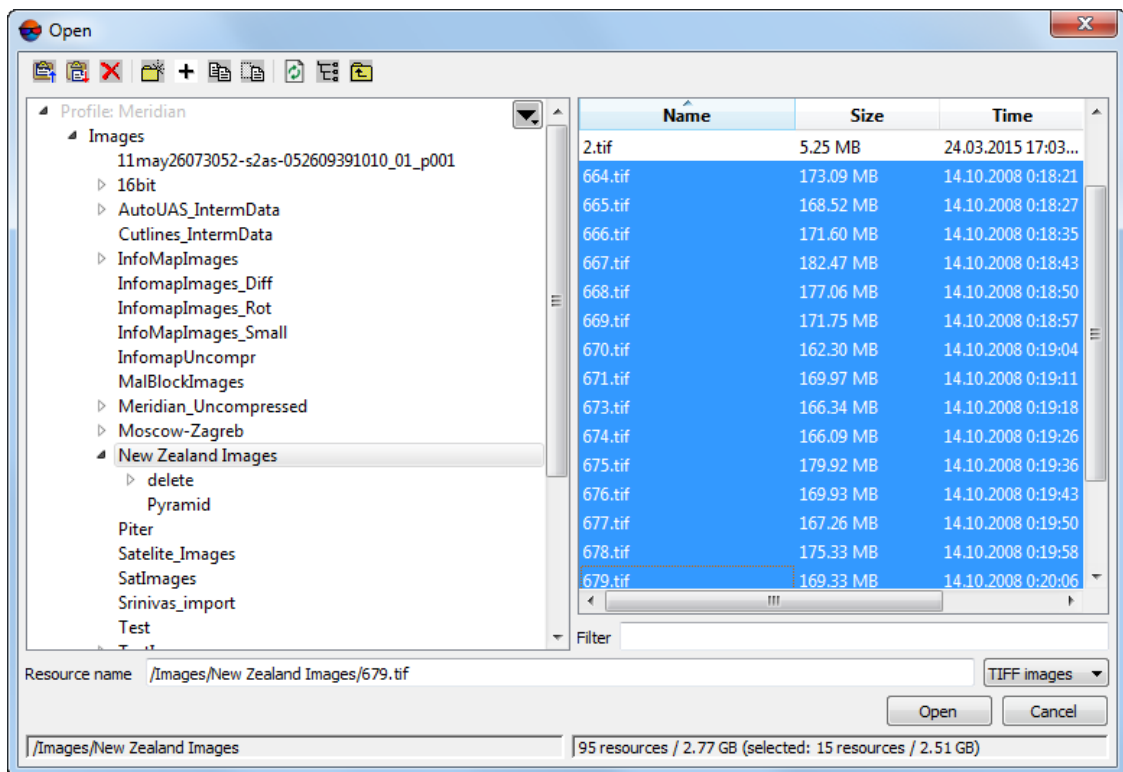
Fig. 30. Choosing images from active profile resources

3. Choose images files using one of the following ways:

    • To display images files of interior MS-TIFF format and usual TIFF format, choose
      the `TIFF images` option in the list located in the right lower corner of the window.

    • To display JPEG images files, choose the `JPEG images` option in the list located
      in the right lower corner of the window.

    • To display images files of acceptable image formats, except for MS-TIFF and
      TIFF formats, choose the `All resources` option in the list located in the right
      lower corner of the window.

      ☞   During images loading you will get a query whether to build a pyramid for speed up im-
          ages refresh on a screen. Files of such images will be saved to the `Pyramid` subfolder
          in source images folder.

4. Choose images files and click the **Open** button. The images are added to selected
    strip.

    If you are loading 16-bit images, for which it is strongly recommended to perform
    radiometric correction, you will get a query whether to start ImageWizard module
    to perform radiometric correction.

Click the **Yes** button to perform radiometric correction, or perform it later after loading images to a project (see Section 7.7).

For fast adding of all images of suitable raster formats from defined folder of active profile resources to chosen strip perform the following actions:

1. Choose **Block › Add images from resource folder**. The **Select folder** window opens that shows only active profile folders without displaying folders' content.

2. Choose a folder containing images files.

3. [optional] Set the **Including subfolders** checkbox to search for files with images in subfolders of chosen folder.

4. Click OK. Automatic images search and add them to selected strip is performed. When the operation is completed the system displays information message that shows a number of added and skipped images.

7.5. Adding scanner images

7.5.1. Adding scanner images

The system provides possibility of converting scanner images into internal format, their radiometric correction and also preparing ADS data to load into project.

For next strips adding choose the **Block › Add strip** or click the 🔧 button in the **Block editor** window. The **Add pushbroom images** window opens.

> To perform preliminary preparation, conversion and saving of scanner images in active profile resources use the *Raster Converter* module (see the "General information" User Manual);

> The **Block › Add images from resources** menu item is used for adding scanner images from active profile resources.
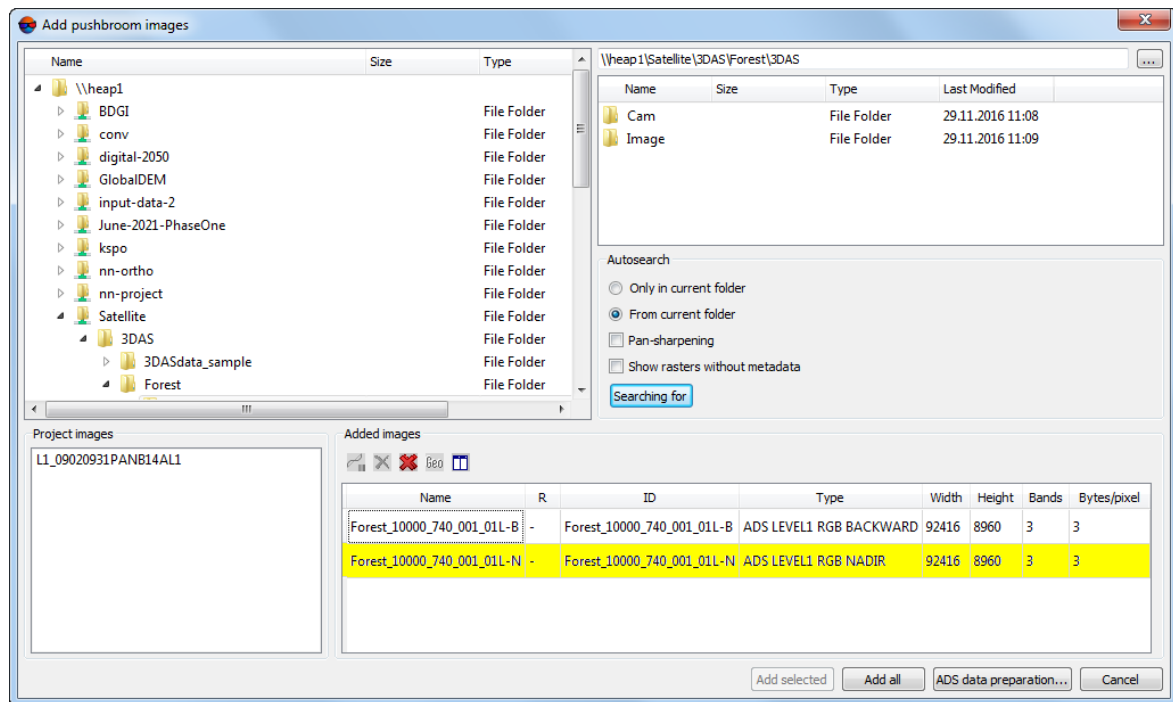
Fig. 31. Automatic images search in remote sensing product

The **Add pushbroom images** consists of the following parts:

- folder tree in the left part;

- in the **Project images** section is displayed the list of images already added in the project (their project names);

- list of found images in the right part;

- parameters of searching files specifies in the **Auto-search** section;

- the **Images to add** section contains table with found images, their names and properties and also buttons to edit properties of image.

  The table contains the following columns:

  ○ Name – image name;

  > Edit the appropriate cell to change project name of selected image (by default the image name is the same as the file name).

  ○ R – denotes that the radiometric correction was performed;

  ○ ID – source name of image, obtained from metadata;

○ `Type` – type of sensor, from which image was obtained;

○ `Width/Height` – linear size of sheet (in pixels);

○ `Bands` – number of channels in image;

○ `Bytes/pixel` – number of bytes per pixel of image.

The **Images to add** table contains the following features used to work with images:

○ ![icon] – allows to perform radiometric correction of selected image;

> If the radiometric correction is already performed the **R** column of the table displays **+** symbol for selected image, otherwise – **−** symbol.

> If a source image has more than three channels, it is recommended to perform histogram normalization without radiometric correction in order to obtain output orthophoto with the same number of channels and color depth (see Section 7.5.3).

○ ![icon] – allows to remove selected images from the table;

○ ![icon] – allows to remove all images from the table;

○ ![icon] – allows to display features of selected image;

```
Image ID: _PAN
Image type: KOMPSAT-3 Level1R PAN
Preprocessing level: Level1R
Format: GEOTIFF
Along track GSD (m): 0.865063
Across track GSD (m): 0.86909
Acquisition date and time: 24/03/2016
04:12:59.782
Revolution number: 20547
Satellite: KOMPSAT-3
Sensor: AEISS
Imaging mode: Stereo Imaging Mode
Off-nadir angle: 28.9
Raster height: 18496
Raster width: 24060
Bands count: 1
Image frame:
 upper left: (1 1) (-42.891417 147.156803)
 upper right: (24060 1) (-42.814553 147.392327)
 lower left: (1 18496) (-43.027698 147.211336)
 lower right: (24060 18496) (-42.951852
147.446752)
```

Fig. 32. Image properties

○ ![icon] `Geo` – allows to create the georeference file in **MIF/MID** format.

> **Ctrl+A** hotkeys allows to select all images.

The **ADS data preparing** allows to perform the preprocessing of ADS 40\80\100 data (see the Preprocessing of "ADS data in the system" section).

> Button is shown while working with ADS project only.

In order to add satellite images to a project perform the following actions:

1. Choose/create a strip (see Section 7.3).

   The first strip is created automatically after project creation. For next strips adding choose the **Block › Add strip** or click the ![icon] button in the **Block editor** window.

2. Choose **Block › Add images from files** or click the ![icon] button in the **Block editor** window. The **Add pushbroom images** window opens.

   > The system also allows to add scanner images from active profile resources (**Block › Add images from resources**). To perform preliminary preparation, conversion and saving of scanner images in active profile resources use the *Raster Converter* module (see the "General information" User Manual);

3. Choose folder that contains remote sensing product. The contents of selected path are displayed in the right part of the window.

4. In the **Autosearch** section define the following settings:

   • **Selected folder only** used to search for remote sensing data in the selected folder only;

   • **Selected folder and subfolders** used to search for remote sensing data in the selected folder and its subfolders.

   The **Pan-sharpening** checkbox allows to open the **Adding images found** window to view detailed parameters, to perform pan-sharpening operation and images setting.

   The **Show rasters without metadata** checkbox allows to perform search of all files with images in selected folder, including those without metadata.

5. Click the ![icon] **Search** button. The system performs search for remote sensing products – browses for files and images and recognizes their properties from metadata (see a list of scanner images formats in Section 5.3.2).

   Once the search is completed you will get one of the following results:

- If the system failed to recognize RS product format, you will get the following warning `No remote sensing imagery products is found`.

> Set the **Show rasters without metadata** checkbox on to add images from TH-1 sensor with incomplete data set. Images could be added if RPC-files are available.

> While working with ADS project **Add pushbroom images** window is used just to search for *ADS images* (not all the pushbroom images), for **Pushbroom scanner imagery** – to search for *satellite pushbroom images only* and to search for their metadata

- If in the **Auto-search** section the **Pan-sharpening** checkbox is *not* set, the **Images to add** table shows all images found and their properties from metadata.

- If in the **Auto-search** section the **Pan-sharpening** checkbox is set, the **Adding images found** window opens and you can view detailed parameters of remote sensing products, perform pan-sharpening, setup images and choose images *manually* to add them to the **Images to add** table (see description in Section 7.5).

> Already added images are marked in the table by gray color.

While searching for images with metadata, in the added images list they can be highlighted with various colours depending on processing level:

- *Red colour* – indicates non-photogrammetric images;

- *Yellow colour* – indicates images without any orientation data. Only generic adjustment method is applied to them (see Section 5.3).

6. [optional] Click the button to perform radiometric correction of images selected in the **Images to add**. If a source image has more than three channels, it is recommended to perform histogram normalization without radiometric correction in order to obtain output orthophoto with the same number of channels and color depth.

7. Form images list in the **Images to add** table to add them to a strip.

> The system allows to load all images in one strip and split them in to strips automatically later, using image names or exterior orientation parameters.

8. Click the **Add all** button to add all images of the table to the list of convertible files. Click the **Add selected** button to add one or more images. The **Parameters** window to define output parameters of images.

> In order to select multiple images in the **Images to add** table use the **Shift** and **Ctrl** keys, to select all images use **Ctrl+A** hotkeys.

9.   After setting of output parameters in the **Parameters** window, click OK. Selected images are saved to active profile resources, loaded to a strip and displayed in block scheme in 2D-window.

7.5.2. Detailed properties of adding images

To display detailed parameters of recognized remote sensing products, choose, prepare and add found images manually to load them to a project is used the **Add pushbroom images** window.

Perform the following actions to open **Adding images found** window:

1.   Choose folder that contains images. The contents of selected path are displayed in the right part of the window.

2.   In the **Autosearch** section set on the **Pan-sharpening** checkbox.

3.   Click the 🔍 **Search** button. The **Adding images found** window opens.
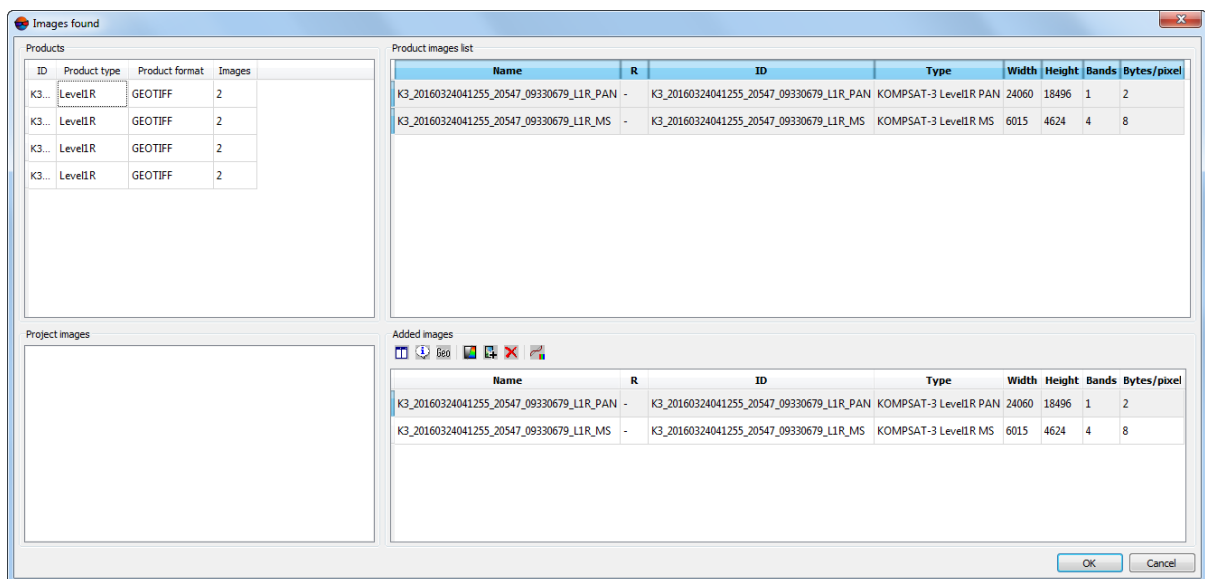
Fig. 33. Detailed properties of adding scanner images

When the images list is formed click the **Close** button in the **Images to add** section to go back to the **Add pushbroom images** window. The **Images to add** section of the **Add pushbroom images** window displays all images to be loaded (added both automatically and manually).

The **Adding images found** window is divided for **Products** and **Images** parts.

The **Products** panel is used to view properties of RS products found and contains the following features:

- The **Products** table is used to view found RS products and their properties (ID of product delivered by supplier, product type – sensor type and preprocessing level, product format, number of images included to the product);

> For images without metadata found by auto-search with the **Show rasters without metadata** checkbox set, you should specify `Raster` as a `product type`.

- The **Product images** table is used to display only images included to remote sensing product and their properties (ID, width, height, number of channels and number of bytes per pixel).

> ⚠ It is not recommended to change image ID received from supplier using standard OS*Windows tools, for instance.*Otherwise, you may face some issues during work with the image, since the rest of files related to the product may be associated with initial file name.

The **Images** panel is used to view images properties, perform radiometric correction, define project names and manually form a list of images to be added to a project. The panel **Images** contains the following features:

- The **Project images** list is used to display images loaded to a project (project names of the images).

- The **Images to add** section is used to display data selected for loading to a project.

  The table shows all images selected for loading: added manually to the **Adding images found** window and added automatically to the **Add pushbroom images** window.
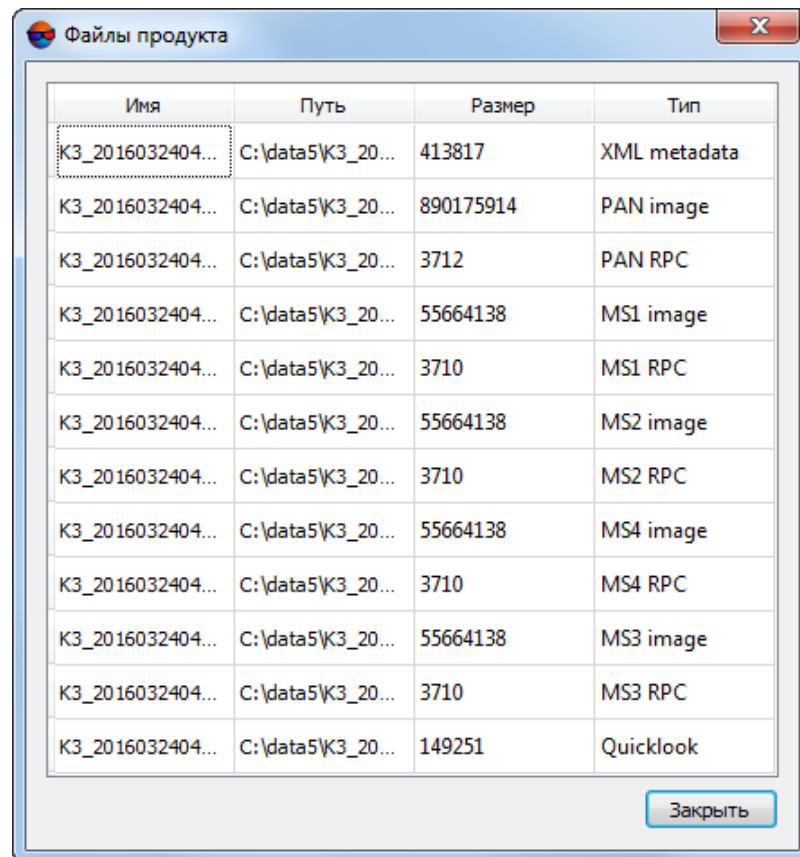
  The table displays the following images properties: ID, width, height, number of channels, number of bytes per pixel, and label about radiometric correction availability +/- in the R column (see Section 7.7).

  > Edit the appropriate cell to change project name of selected image (by default the image name is the same as the file name).

  The **Added images** section contains the following buttons used to work with images:

  ○ ▥ – allows to display the features of image, selected in **Added images** table;

  ○ ⓘ – allows to open the **Files of product** window, which is used to display all files (images files, files with metadata) of remote sensing product and their properties (name, path, size and extension);

Fig. 34. The product files list

○ Geo – allows to create the georeference file in **MIF/MID** format;

> **Ctrl+A** hotkeys allows to select all images.

○ ▨ – is used to start *pan-sharpening* operation – merging of color (multispectral) image with grayscale one with more high spatial resolution to obtain as a result color image with better resolution;

○ ▨ – allows to add selected image to the **Added images** table to load it then to the project;

○ ✕ – allows to remove selected images from the **Added images** table;

○ ⋰ – allows to perform radiometric correction of selected image.

> If the radiometric correction is already performed the **R** column of the table displays **+** symbol for selected image, otherwise – **–** symbol.

7.5.3. Parameters of images loading

After choosing images to be added to a strip in the **Add pushbroom images** window the **Parameters** window opens and you can use it to specify parameters of images conversion and to select a folder in profile resources to place there output images files.
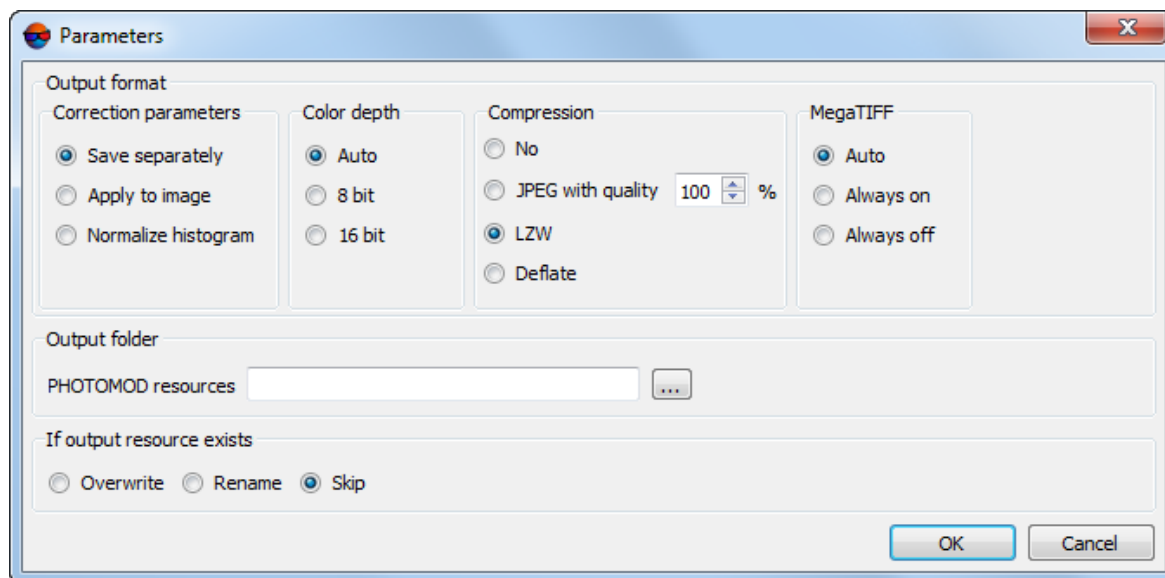
Fig. 35. Parameters of images loading

In order to setup images output parameters in the Parameters window perform the following actions:

1. In the **Correction parameters** section choose one of the following actions:

   - **Save separately** (by default) is used to save radiometric correction parameters to individual *.rmc files. In this case only geometric transformations will be applied to image. And the image is displayed in the system with all correction parameters specified;

   - **Apply to image** to apply all parameters of radiometric correction (except for histogram normalization) directly to the image, i.e. the file is saved with changes;

   - **Normalize histogram** is used only to apply histogram normalization automatically (to correct white color level).

     > If a source image has more than three channels, it is recommended to perform histogram normalization without radiometric correction in order to obtain output orthophoto with the same number of channels and color depth. In case of creating orthophoto, set off the **Use radiometric correction from project** checkbox in the **Output image parameters** window (see the "Orthorectification" User Manual).

2. Depending on the source image you should define color depth of output image in the **Color depth** section: **8 bit**, **16 bit** or **Auto** (by default) for automatic selection of color depth.

3. In the **Compression** section choose one of the following options:

    • **None** – without compression,

    • **JPEG with quality** – to compress image with specified quality;

    • **LZW** – without quality loss;

    • **Deflate** – without quality loss.

        Only LZW compression (selected by default) could be used to 16-bit images.

4. In the **Format** section choose one of the following options:

    • **MS-TIFF/Big TIFF** to convert images with size less than 2 GB;

    • **MegaTIFF** to convert images with size more than 2 GB;

        File of MegaTIFF format has `prf` extension.

        Besides, during MegaTIFF file creation a subfolder is created in target folder. The subfolder has the same name as image file and contains all necessary auxiliary files to display big size image in the system.

        It is strongly recommended to convert multichannel images (with more than 3 channels) to MegaTIFF format, otherwise, channels names will not comply with used ones.

    • **Auto** (by default) to define output format automatically depending on size of source image.

        The **Auto** option is recommended for scanner images.

5. In the **Output folder** section click the [...] button to define target folder of active profile resources to place converted images files there. In the **Output folder** section path to the *Images* folder is displayed or it could be created automatically .

        It is strongly not recommended to place image files in the root project folder (e.g., */Projects/Project_name*). It is necessary to place source images only in the *Images* folder.

6. In the **If output resource exists** section select one of the following actions for the case if the target folder already contains files with the same names:

    • **Skip** – allows to leave existing file;

    • **Overwrite** – allows to refresh existing file;

    • **Rename** – allows to save file with new name.

7. Click OK to start images loading operation. Once it is completed images loaded will be shown in 2D-window.

8. [optional] Setup paths to image files with the ImageWizard module.

After block forming proceed to aerial triangulation step (see the "Aerial triangulation" User Manual).

If metadata with exterior orientation parameters is available, create block layout in the **by exterior** mode, measure recommended amount of triangulation points and proceed to adjustment step (see the "Block adjustment" User Manual).

7.6. Image properties

To display properties of image, select an image in the 2D-window and choose the **Block › Image properties** or click the ⊞ button in the **Block editor** window or double-click on image name in the table of the **Block editor** window.

The **Image properties** window with the following information opens:
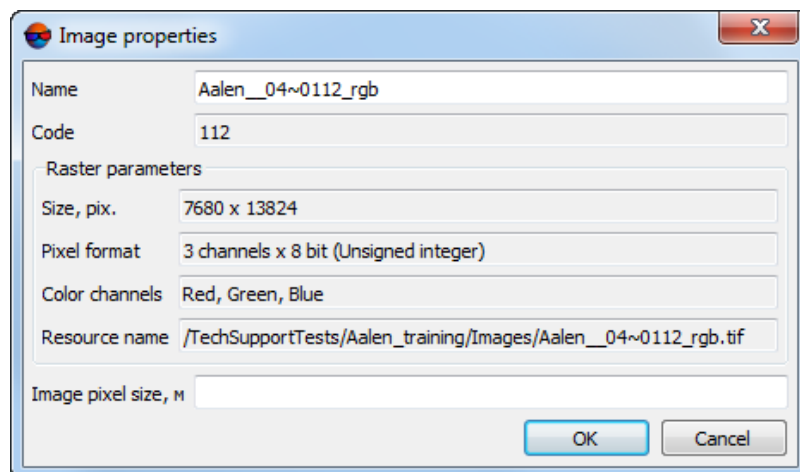
Fig. 36. Image properties

• Name of image in the project;

In case of changing image name, only name in project is changing, not file name.

* `Code` – unique ID of image that does not change in case of changing image name in project or file name (see Section 9.2.1);

    Image code by default is the same as image name.

* `Size` in pixels;

* `Pixel format` – number of channels/bit;

* `Color channels` – quantity and contents of image channels;

* `Resource name` – path to an image in active resources profile;

* `Ground sample distance`, in meters, if it has been specified.

    It is recommended to set GSD in case of different-scale survey or too much elevation difference on ground. Also GSD is used for accuracy control for points measurements in triplets. To do this set the tolerance for error in meters in the **Relative orientation report settings** window (see the "Aerial triangulation" User Manual).

    The **Block › Set GSD** menu item is also used to specify GSD for all or selected images (see Section 10.1).

7.7. Radiometric correction

Images radiometric correction – means improvement of visual features of initial images. Their insufficient quality may be due to the peculiar properties of the optical path of surveying devices, radiant energy converter, analog-digital converter, etc.

For example, in case of 16-bit image, that looks plain black on a screen, you have to perform histogram correction. For example, in case of 16-bit image, that looks plain black on a screen, you have to perform histogram correction.

    If a source image has more than three channels, it is recommended to perform histogram normalization without radiometric correction in order to obtain output orthophoto with the same number of channels and color depth (see Section 7.5.3).

Images radiometric correction could be performed on different stages of project processing, for example:

* on stage of initial images preparation in the *Raster Converter* module (see the "General information" User Manual);

- on stage of images loading from files, located out of profile resources, including loading of satellite scanner images, as well as ADS 40/80/100 scanner images;

- on stage of block forming from project images;

- on stage of project images setting in the*ImageWizard module*.

The **Radiometric correction** window is used to perform radiometric correction of selected image.

Perform one of the following to open the **Radiometric correction** window:

- click the 🖍 button in the **Block editor** window;

- choose the **Block › Image radiometric correction**.

- click the 🖍 button in the **Add pushbroom images** window;

Table 8. The toolbox of Radiometric correction window

Buttons	Function
	to load radiometric correction parameters from a `*.rmc` file
	to save radiometric correction parameters of image to `*.rmc` file
	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 change the channels order
	to perform the channel transformation
	to perform the radiometric correction
	to edit curves
	to change brightness, contrast and gamma of image
	to edit color balance of the image
	to apply filters
	to apply geometric transformation (rotate, reflection)
	to cancel all actions (up to 10 last actions)
	to undo the last action
	to redo the last undone action
	to view raster image histogram (see Section 9.11)

Perform the following actions for radiometric correction:

1. Select image in the **List** section in main window of the *Raster Converter* module.

2. Click the ![button] button or double click the strip name in the list. As a result, *temporary pyramid* for faster refresh of image creates and the **Radiometric correction** window opens.

> ☞ Temporary pyramid is placed in the *Pyramid* folder inside of folder with source images. To display images in scales differing from 1:1, required amount of free place on chosen disk to store temporary pyramid's files.
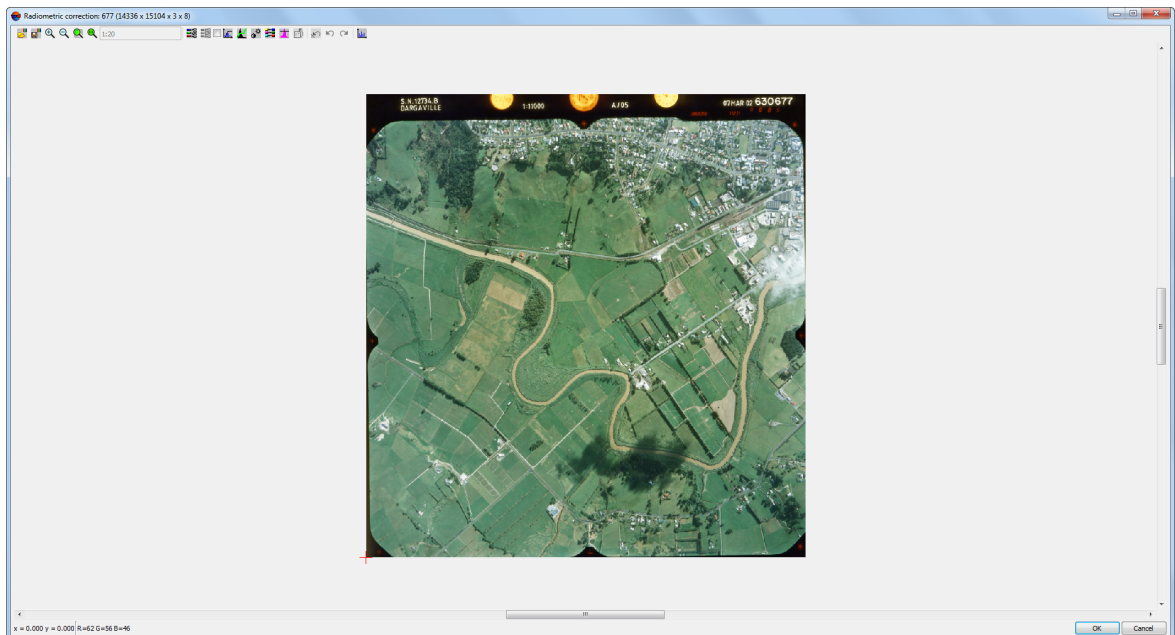
Fig. 37. The Radiometric correction window

Name, height, width and byte per pixel of image are displayed in the title of the **Radiometric correction** window. Coordinates of marker and brightness are displayed in the status bar of window.

3. It is recommended to perform autolevels setup for 16-bit image. Otherwise it is displayed with black color.

> ☞ If bytes per channel more than 8, histogram of images stretches for full brightness range separately on each channel.
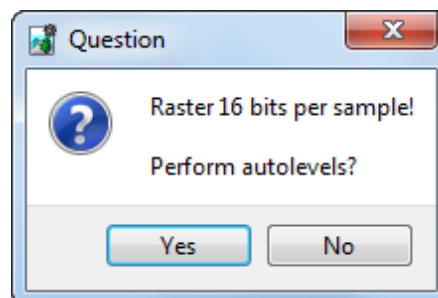
Fig. 38. Requirement to perform radiometric correction

4. Click the **Yes** button. The **Auto levels** window opens.
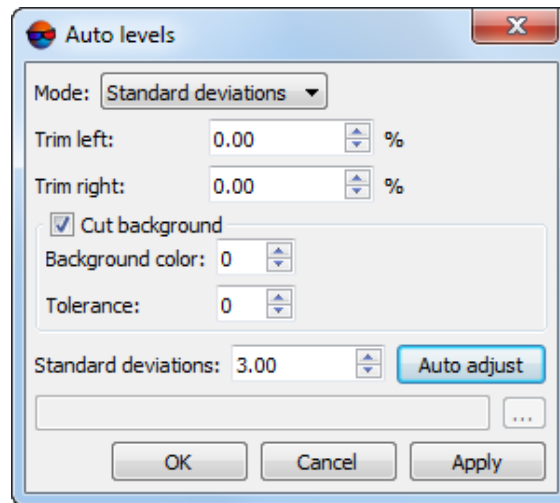
Fig. 39. The Auto levels window

5. Setup parameters of correction (see below) and click OK. Image radiometric correction is performed.

> Generally, it is suffices in the **Standard deviations** mode specify the **Standard deviations** value or click the **Auto adjust** button to correct image automatically.

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** section in main window of the *Raster Converter* module.

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.

> To save radiometric correction parameters in folder with source image, click the button.

4. Choose image for correction in the list.

5. Click the button. The **Load correction parameters** window opens.

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

Perform the following to change channel's order of output image:

1. In the **Radiometric correction** window click the 🖼 button. The **Channels** window opens.

> The first order of channels is set depending on their order in the source image.
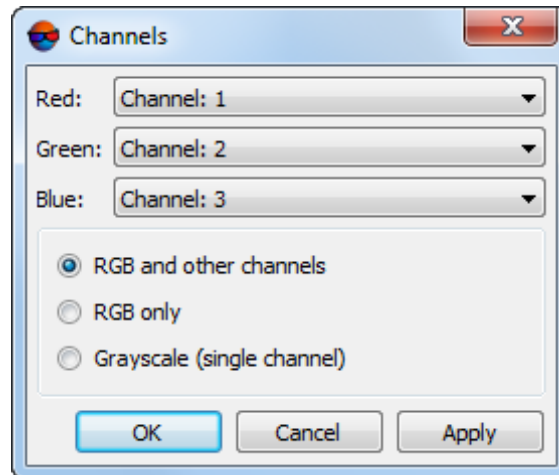
Fig. 40. Window of the order channels setup

2. Specify the mode of channel usage in the system:

- **RGB and other channels** – all image channels are to be used;

> The user can assign any channel as a red, green, or blue one (see below, next subsection). Other image channels will be considered as supplementary.

- **RGB only** – only three channels are used;

> The user can assign any channel as a red, green, or blue one (see below, next subsection).
>
> When processing images with a large number of channels, using **RGB only** mode (or channels designated as such) allows one to exclude "extra" channels from processing if the user does not need them to perform current tasks.

- **Grayscale (single channel)** – is used to display one channel.

> The **Raster Converter** module also provides for transforming a one-channel panchromatic raster image into a three-channel one. For this, when converting such an image, choose **RGB only**. As a result, when saved, the image has three identical channels.

3. Setup channels order to display and use in the system.

☞   The **Apply** button allows to display changes.

4. Click OK.

Perform the following to transform channels of output image:

⚠️   It is impossible to preform channels transformation for image with single channel.

1. In the **Radiometric correction** set the checkbox on near to the ▤ button and click the ▤ button. The **Channels transformation** window opens.

    The window contains table with weight coefficients image channels.
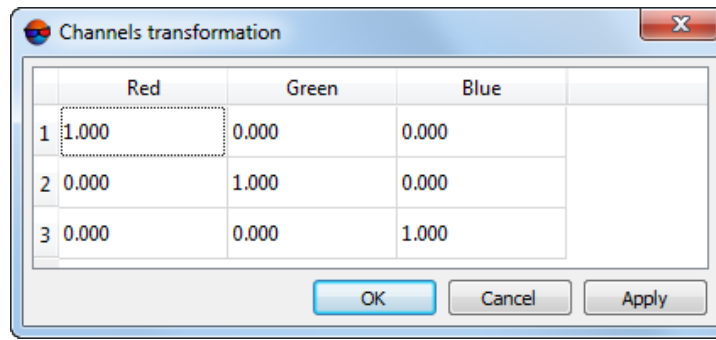
Fig. 41. The Channels transformation window

2. Change values in the channels table.

3. Click the **Apply** button to display changes.

4. Click OK to save changes.

Perform the following to perform more detailed radiometric correction (to correct white color level):

1. In the **Radiometric correction** window click the ▥ button. The **Auto levels** window opens.
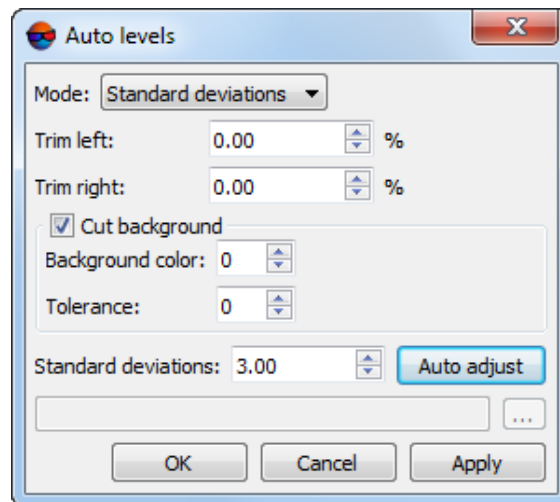
Fig. 42. The Auto levels window

2. Choose the correction **Mode**:

    • **Separate channels** - correction separately for each channel;

    • **All channels** – correction for all channels rateable;

    • **Red**, **Green**, **Blue** – correction only for chosen channel;

    • **Autocolor** – automatic selection of the best brightness for displaying;

    • **Standard deviations** – stretching histogram of source image for full brightness range;

    • **QuickLook** – allows to use brightness from remote sensing data files.

         Processed channels are **Red**, **Blue**, and **Green**. The channels are identified according to the channel order displayed (or user defined) in the **Channels** window. Additional channels are processed using the average **QuickLook** histogram.

    • **External image** – using image from folder as a sample for correction.

3. Set the **Trims left and right** – area of histogram (in percent) which will not consider in stretching of histogram.

4. [optional] By default the **Cut background** checkbox is set on for removing background on image edges. To remove background set the following parameters:

    • **Background color** – value of background color for cutting;

         If the 0 value is set in the **Background color** field, background does not consider during correction.

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

5. Set the value of deviation each pixel from "average" in the **Standard deviations** field.

> The **Auto adjust** button allows to calculate value of Standard deviations in such a way as to none of pixels was not light-exposed.

6. Click OK. As a result histogram stretches of source image for full brightness range.

To view histogram of image and setup activation function, that specify arbitrary brightness transformation, perform the following:

> Activation function in graphic form is a curve with color of chosen band. Values of brightness on source images are placed by **X**-direction (values in the **In** field), be **Y**-direction – values after transformation (values in the **Out** field). Activation function is specified by creating nodes on curve. Activation function between nodes is a cubic spline.

1. In the **Radiometric correction** window click the button. The **Curves** window opens.
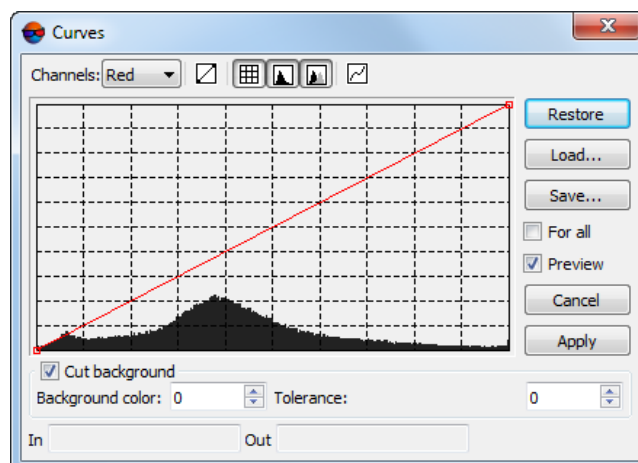
Fig. 43. The Curves window

The window contains the toolbar with buttons used to perform the following operations:

- – allows to restore linear dependence;

- – allows to display grid;

- – allows to show source histogram (with gray color);

- – allows to show destination histogram (with white color);

- – allows to smooth segment;

- **Restore** – allows to restore source curves;

- **Load** – allows to load curves from `crv`-file;

- **Save** – allows to save curves in to `crv`-file (by default in the folder with images).

Values of brightness of node in source and changed histograms are displayed accordingly in the **In** and **Out** fields.

2. [optional] To edit channels histogram separately, set the **For all** checkbox off and choose **Channel** for edit from the list.

>   By default the **For all** checkbox is set on to edit curve for all channels in one time.

3. [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.

4. [optional] Set the **Preview** checkbox on to preview changes.

5. To add node click on the histogram. To move node, move marker holding pressed **left mouse button**.

>   To select node, click in its vicinity. To delete node, right click on it.

6. Click the **Apply** button to apply changes and return to the **Radiometric correction** window.

To perform color correction do the following actions:

1. In the **Radiometric correction** window click the button. The **Brightness-Contrast-Gamma** window opens.
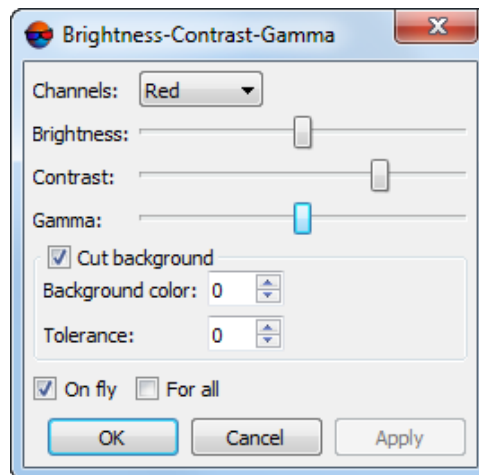
Fig. 44. The Brightness-Contrast-Gamma window

2. Choose **Channels** for correction: **All** in the same time or separately.

3. Setup balance of image **brightness**, **contrast** and **gamma** using sliders.

4. [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.

5. [optional] To display changes automatically set the **On fly** checkbox on.

    > The **Apply** button allows to display changes.

6. Click OK to apply color corrections of image.

To perform color balance do the following actions:

1. In the **Radiometric correction** window click the ▦ button. The **Color balance** window opens.
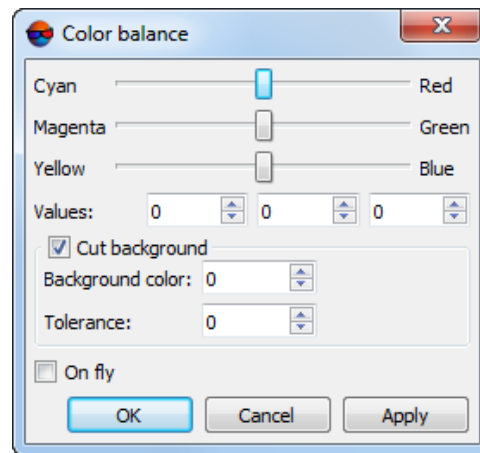
Fig. 45. The Color balance window

2. Set the red, green or blue channels balance using sliders or input values of color in the **Values** field with range from -100 to 100.

3. [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.

4. [optional] To display changes automatically set the **On fly** checkbox on.

    ☞   The **Apply** button allows to display changes.

5. Click OK to apply color balance of image.

To improve visual properties of source image with using different filters perform the following:

1. In the **Radiometric correction** window click the ⊥ button. The **Filters** window opens.
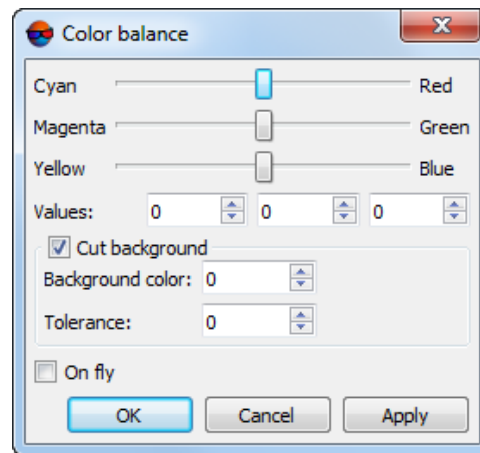
Fig. 46. The Filters window

2. Specify one of the following image processing types in the **Filter type** list:

   • **Blur** – is used for image details dithering;

   • **Gaussian blur** – is a type of blur filter where transfer value is not a linear function, but part of Gauss function ("Bell curve");

   • **Sharpen** – allows to highlight and intensify differences between image's individual details (image sharpness);

   • **Sharpen edges** – is used to setup image sharpness, but performs filtering only when brightness differences between details are exceeding some threshold;

   > Suits very well for identifying and highlighting of objects borders which are homogeneous insight (agricultural fields, for instance), at that inner part of objects remains unchanged.

   • **Median** – non-linear filter intended mainly for impulse noises filtration (single pixels with unnatural brightness);

   • **Sobel** – non-linear differential filter, which is the first derivative of the initial raster. Used to acquire contour borders of image in raster form.

3. In the **Aperture size** list define the matrix size from 3x3 pixels to 21x21pixels.

4. Move slider to define **Filtering level** in percent.

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. [optional] To display changes automatically set the **On fly** checkbox on.

> ☞ The **Apply** button allows to display changes.

7. Click OK to apply filter.

For geometric transformations of image in the **Radiometric correction** window, click the ![button] button. The **Rotate-flip** window opens, you can use it for selection of rotation angles (at 90,180, 270 degrees) or horizontal/vertical reflection. To cancel the last operation or all geometric transformations applied to image using appropriate buttons.
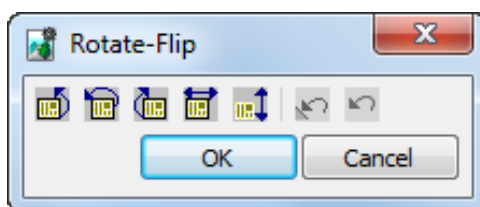
Fig. 47. The Rotate-flip window

7.8. Editing images block

7.8.1. Splitting into strips

The system provides possibility to split images, loaded in one strip, into different strips automatically. Strips recognition could be made by image names, by external orientation parameters or by metadata. Also images could be split into strips automatically for VisionMap project.

In order to split images into strips using images names perform the following actions:

1. Choose **Block › Split into strips › By image names**. The **Automatic splitting into strips by image names** window opens.
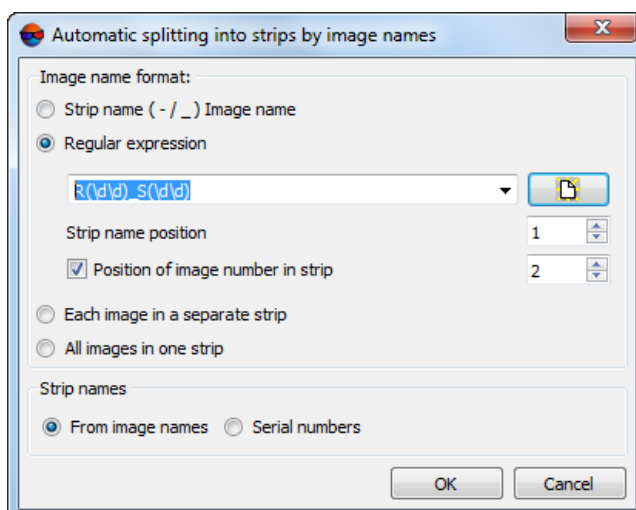
Fig. 48. Split images into strips by names

2. Choose one of the following name formats:

- **Strip name (- / _) Image name** is used for simple images names, where you can use the '-' or '_' separator to specify strip name and image name;

- **Regular expression** allows to define a template of images complex names to recognise a strip name and image number in the strip;

  > For example R09_56RS85 and R09_56RS86 – two images of 9-th strip, R10_56RS05 и R10_56RS06 – two images of 10-th strip.

  The template allows the following symbols combination:

  ○ \d – to define any digit;

  ○ \w – to define any digit or character;

  ○ . – to define any symbol.

  Specify position of strip name (R) and image number in images names (S) template.

3. [optional] Select one of the following options to split images:

- **Each image in a separate strip** is used to form scanner monoblock (see Section 7.5).

- **All images in one strip** allows to split all the images in one strip in the numerical order.

☞ Given operation allows to cancel the previous splitting into strips as well.

4. Set one of the following templates for strips name:

   • **From image names** – strip name obtained from images name is used;

   • **Serial numbers** – allows to specify strip name as a serial number.

To split images into strips by imported exterior orientation parameters (if any), perform the following:

1. Choose **Block › Split into strips › By exterior orientation data**. The **Split into strips by exterior orientation** window opens.
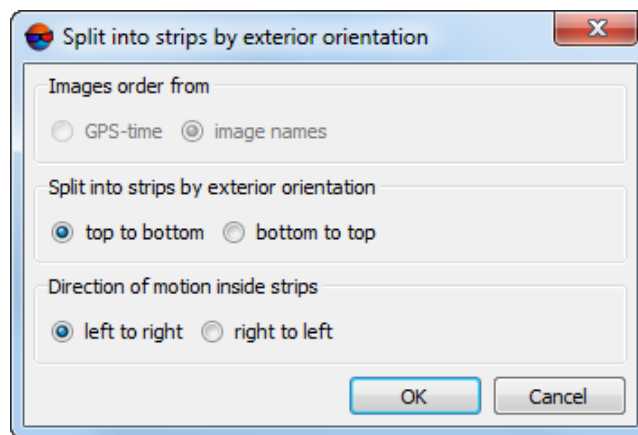
Fig. 49. Split images into strips by exterior orientation

2. Specify the following parameters of splitting images into strips:

   • **Images order from** by GPS-time or image names;

   ⚠ If the GPS-time is unavailable for part of images, they add to the separate strip automatically;

   • **Direction of motion between strips** – up to down or bottom up;

   • **Direction of motion inside strips** – left to right or right to left.

   See information about import of exterior orientation parameters in the "Aerial triangulation" User Manual.

To split images of the *VisionMap* project into strips by exterior orientation parameters (if any), choose **Block › Split into strips › By exterior orientation data** (see Section 5.5).

⚠️   It is not recommended to create stereopairs and perform Stereoprocessing for adjacent images
        of one strip in VisionMap project.

To split images into strips by metadata (if any), choose **Block › Split into strips › By
metadata**. As a result, exterior orientation parameters (approximate, i.e. calculated by
on-board devices) loads from metadata into project. As a result images split into strips
in such way that one strip contains images only from the same orbit.

☞   In case of ADS project processing, image splitting into strips by metadata is carried out when
        triplets are to be formed further from one nadir and two oblique images.

        If other ADS project processing options are intended, image blocks are split into strips manually.
        More information on the specifics of strip formation for ADS projects described in Section 5.4.4.

To split images collected by a system of several lens and CCD-sensors as they pass
over the same point of space (the *syntopic exposure* principle of image collection which
is used, for example, by *UltraCam* family cameras) into strips, perform the following
actions:

1.   Choose **Block › Split into strips › Split by multiple cameras**. The **Split paramet-
     ers** window opens.
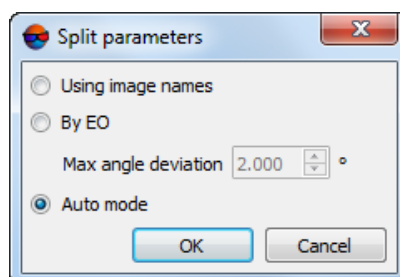
Fig. 50. The Split parameters window

2.   Set the parameters of splitting images into strips:

     • **By image names** – allows to split images into strips using images names;

     • **By exterior orientation** – allows to split images into strips by imported exterior
       orientation parameters (if any);

       ○ Set **Max angle deviation** in degrees to account for deviations due to surveying
         aircraft evolution;

         🎓   Too large values of maximum deviation angle may result in errors in the splitting of
                imagery taken by vertical and oblique cameras into strips.

                Unsorted images are to be added to strips having names of `unsorted_X` type, where
                X is the number of a strip containing unsorted images.

- **Auto mode** – allows to split images into strips using both images names and imported exterior orientation parameters (if any).

3. Click OK.

7.8.2. Renaming strips

The system provides possibility to group rename of strips in the block scheme: add prefix and suffix to names, remove a specified number of characters at the beginning/end of the name of selected strips.

To rename strips perform the following:

1. Select strips to rename In the **Block editor** window. To select strips, press and hold **Ctrl** key and click on the strips names to select them.

2. Click the 🖺 button. The **Group rename** window opens.

   `Original` and `New names` of selected strips are displayed in the window.
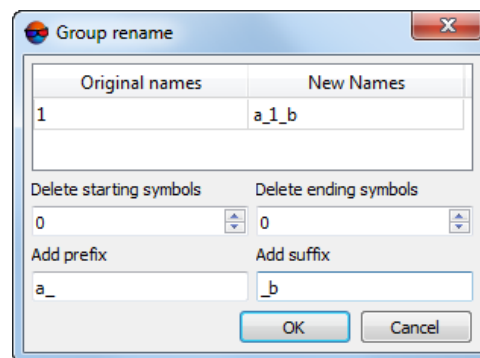
Fig. 51. Group rename

3. Choose one or more actions to rename strips:

   - Delete staring symbols;

   - Delete ending symbols;

   - Add prefix;

   - Add suffix.

   New names of strips are displayed in the right column of the table.

4. Click OK to apply changes and return to the **Block editor** window.

7.8.3. Deleting images selectively

The system allows to delete images selectively using specified selection criteria. Perform the following actions to do this:

⚠️   If images were removed from project, the do not remove from the *Windows file system*.

1. Choose **Block › Delete images selectively...**. The **Selective delete images** window opens.
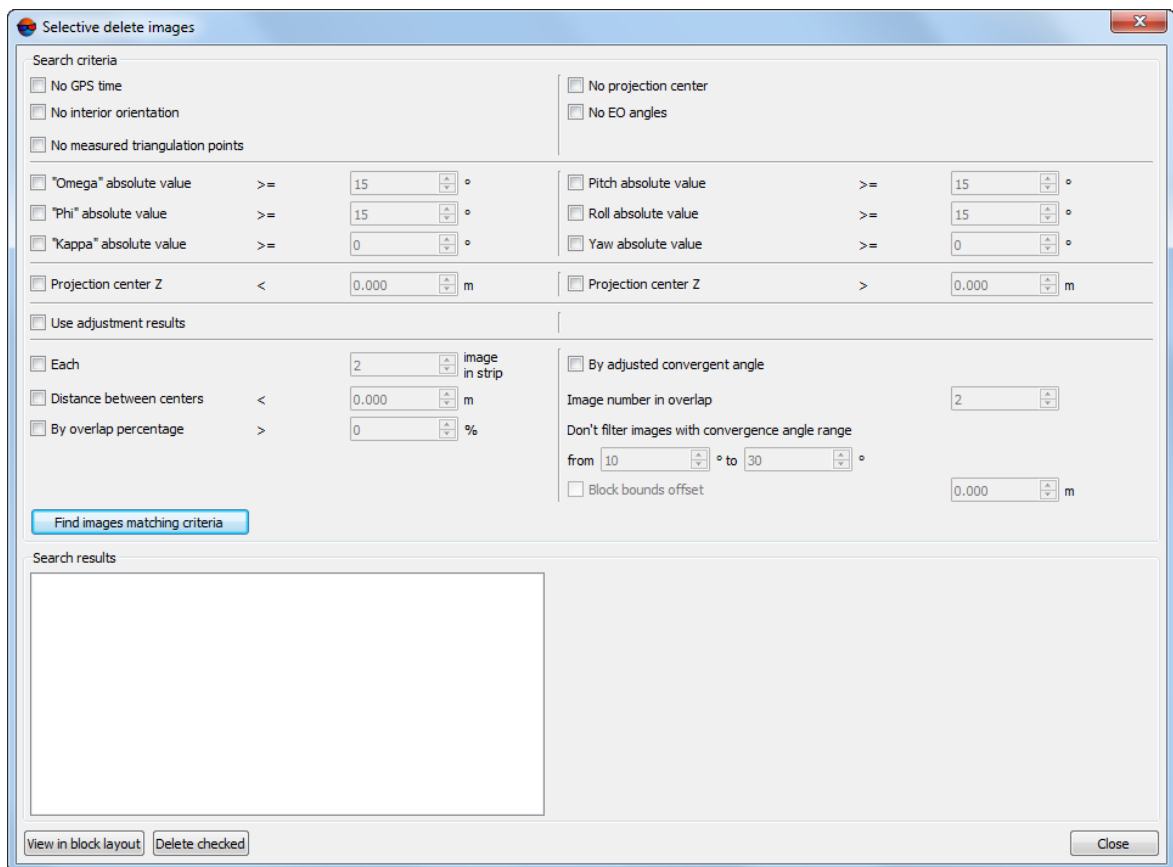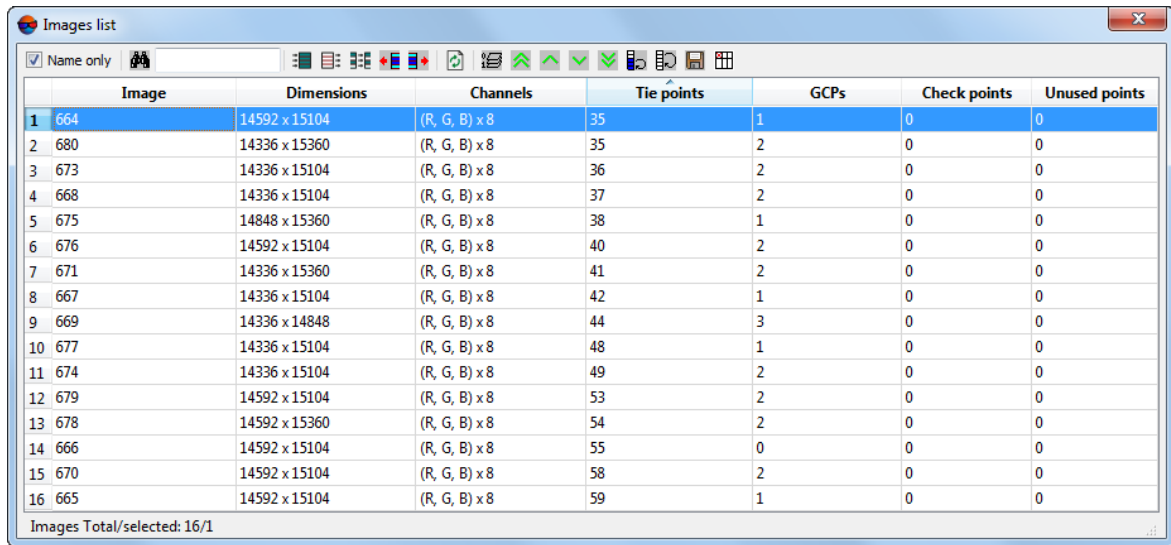
Fig. 52. Setting of images selection criteria for deleting

2. Set on one or more checkboxes to search images by chosen parameters:

   • set on the appropriate checkboxes to search images with **No GPS time**, **No interior orientation** or **No measured triangulation points**.

   • to search images where not specified projection centers and/or not specified exterior orientation angles set on the **No projection center** or **No EO angles** checkboxes;

- to search images with omega, phi, kappa or pitch/roll/yaw angles absolute values greater than specified value (in degrees), set on the **"Omega" absolute value**, **"Phi" absolute value**, **"Kappa" absolute value**, **Pitch absolute value**, **Roll absolute value** and **Yaw absolute value** checkboxes accordingly;

- to search images with projection center hight more or less specified value (in meters), set on the **Projection center Z <** or **Projection center Z >** accordingly;

- when the **Use adjustment results** checkbox is set and exterior orientation angles and heading angles are chosen, the adjusted exterior orientation values are used for search, otherwise the initial ones;

- to find **each** N-th **image in strip**, set the appropriate checkbox and set the step of image downsampling;

- to search images with **Distance between centers** in strip less than specified value, set on the appropriate checkbox;

- to choose images **By overlap percentage**, set the appropriate checkbox;

- The **By adjusted convergent angle** checkbox allows to set the following criteria for image search:

    ○ **Image number in overlap**;

    ○ **Don't filter images with convergence angle range from ...° to ...°**.

        ■ [optional] set the **block bounds offset** in meters to prevent the images deletion near the block bounds.

3. Click the **Find images matching criteria** button. Images found are shown in the **Search results** list and compose the list of images to delete.

4. [optional] To cancel deleting image set off the checkbox near to image name in the **Search results** section.

5. [optional] Click the **View in block layout** button to analyze images selection using block layout.

6. Click the **Delete checked** button to delete images selected in the list.

7.9. The Images list

The **Images list** window is provided to view the images list of the project. To open the **Image list** window choose the **Window › Image list...** or click the 🖼 button of the **Orthorectification** toolbar.

Fig. 53. The Images list window

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

- `Image` – attribute for full path to image file;

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

- `Dimensions` – image size in pixels;

- `Channels` – channels number and number of bytes per pixel;

- `Tie points` – the number of tie points on the image;

- `GCPs` – the number of GCPs on the image;

- `Check points` – the number of check points on the image;

- `Unused points` – the number of unused points on the image;

- The extra columns designated for satellite scanner survey projects.

To add extra columns designated for satellite scanner survey projects to the page, click the ⊞ button in the **Images list** window toolbar and set the appropriate checkboxes in the **Columns list** window that opens.
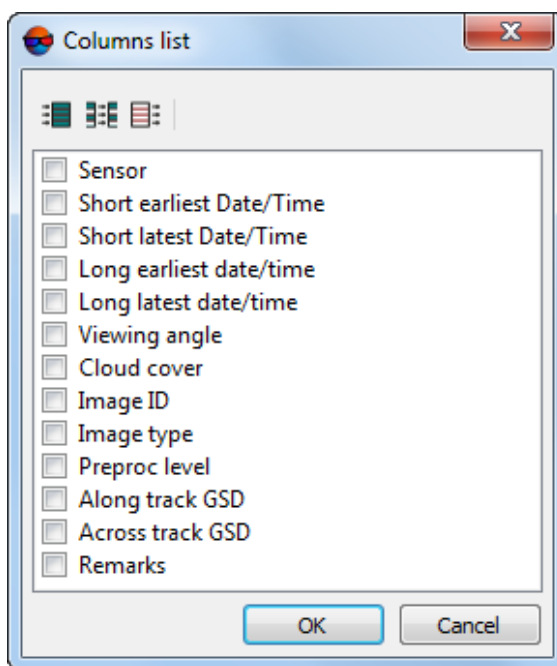
Fig. 54. The Columns list window

Number of `Images total/selection` displays in the status bar of the window.

Toolbar and standard selection and searching tools are placed in upper part of window:

Table 9. 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 refresh table of images and recalculate quantity of cutlines, which fall into images
	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 table content, for the selected images (including the additional columns selected to be displayed) in a text file
	to open the **Columns list** window (see above)

7.10. Brightness adjustment

The system allows for adjusting brightness and contrast image characteristics (relative to each other) within the whole image block.

Noticeable inhomogeneity of the abovementioned image characteristics within one block arises, as a rule, in case of abrupt changes in the luminosity parameters during the imaging (for example, as a result of the influence of cloudiness). Brightness adjustment often minimizes the influence of such factors.

Image brightness adjustment (in case of such data use) can facilitate manual project processing (e.g. during the stereovectorization), also it is recommended before such operations as orthorectification, True Ortho, Dense DEM generation using SGM method, or creation of textured 3D TIN surfaces.

Brightness adjustment settings for images within a block are selected automatically, the results of that operation are saved to a RMC file and can be reset or overwritten by a user if they are found to be unsatisfactory.

> *PHOTOMOD* provides for similar (but not identical) operation to create a united continuous mosaic image (see "Brightness adjustment" chapter of the "Orthophotomaps creation" User Manual).

> ⚠ Before brightness adjustment, tie points are to be measured and the project adjusted (see the "Aerial triangulation" and "Block adjustment" User Manuals). In the process of brightness adjustment, the results of analysis of brightness and contrast characteristics of the image regions located in the vicinity of the tie points are processed.
>
> The quality of image brightness adjustment directly depends on tie point number, density, and uniformity of spacing over block images (as well as on the quality of the measurements themselves, in particular, available measurements of a given tie point on all images where it is actually present).

> An identical set of bands for all images of the project is desirable. Otherwise, during brightness adjustment, only those bands that are present in each of the processed images will be taken into account.

To adjust brightness for the whole image block, perform the following:

1. Make sure that tie point measurement and project adjustment have been performed;

2. Choose **Block › Brightness adjustment**. The **Brightness adjustment** window opens:
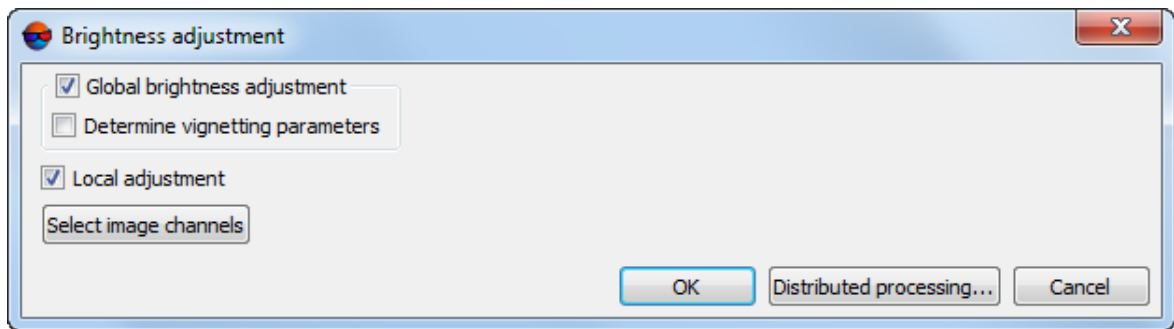
Fig. 55. The Brightness adjustment window

3. Set the appropriate checkboxes to perform **global brightness adjustment** and **local brightness adjustment**.

> *Global brightness adjustment* means transformation equally applied to all pixels of each source image.
>
> *Local brightness adjustment* is a non-linear local transformation that follow the global brightness adjustment, primarily affecting areas in the vicinity of tie points. The effect of those transformations gradually weakened with distance from a tie point.
>
> In case of unsatisfactory results of brightness adjustment (for example, local regions of images with non-uniform brightness), it is recommended to repeat brightness adjustment by clearing the **local brightness adjustment** checkbox (the results of the previous operation will be automatically reset and deleted beforehand).

4. **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.

*   **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 images: **8 bit** or **16 bit**;

*   **Monochrome output** – allows to create output files with one grayscale channel.

> In case of monochrome output it is impossible to choose structure of channels.
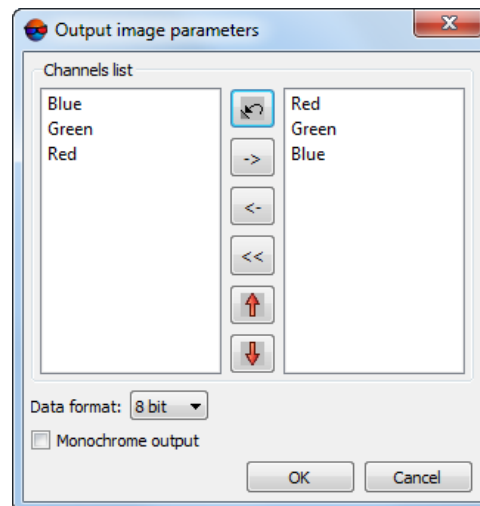
Fig. 56. Output channels parameters

5.   To start brightness adjustment, click Ok.

When adjusting brightness, it is possible to use the distributed processing mode. For this, perform the following:

1.   Configure and start the server/client of distributed processing mode (see the "Distributed processing" chapter in the "General information" User Manual).

2.   Click the **Distributed processing** button.

6.   After successful operation completion, an appropriate info message appears. If brightness adjustment has not been performed for some block images, an additional info message is issued with a list of unprocessed images.
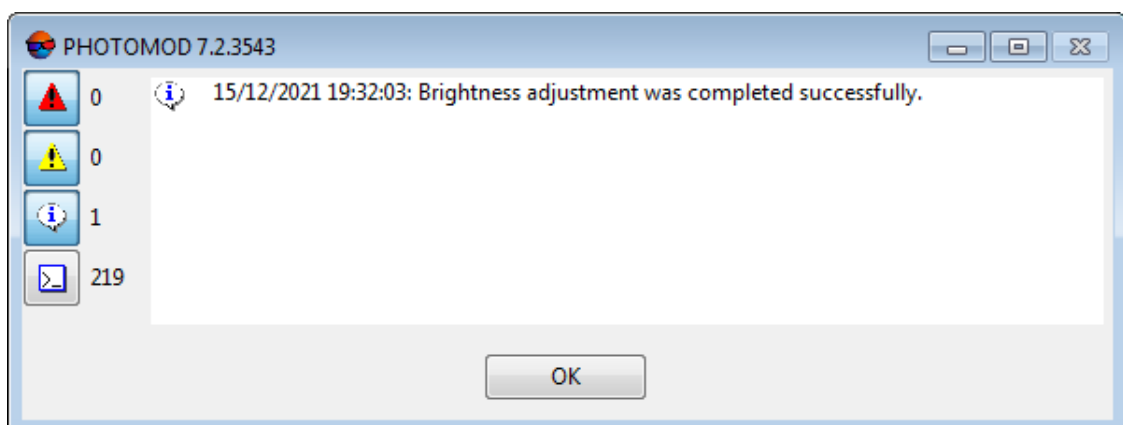
Fig. 57. An info message

☞   Brightness adjustment for a separate image may not be performed if there is an insufficient number of tie points in this image (or if they are completely absent).

7. To check the results of brightness adjustment, create an orthoimage (see "FastOrtho displaying" in the "Orthorectification" User Manual).

    Для того чтобы учитывать результаты выравнивания яркости при построении ортофотоплана в окне **Параметры выходного растра** установите флажок **Использовать радиометрию из RMC-файлов**. Для того чтобы построить ортофотоплан без учета результатов выравнивания яркости – снимите данный флажок

    To take brightness adjustment results into account when creating an orthoimage, set the **Use radiometric from RMC-files** checkbox in the **Output image parameters** window. To create an orthoimage without taking into account brightness adjustment results, clear this checkbox.

    > Note, that visual assessment of brightness adjustment results directly depends on the degree of inhomogeneity of the brightness and contrast characteristics of source images. In the case of using homogeneous source data, the results of brightness adjustment can be almost imperceptible during visual analysis of the constructed orthoimages.

8. [optional] To repeat a brightness adjustment operation (e.g. when after analyzing the results, it was decided to be limited to the global brightness adjustment, excluding the local one), choose **Block › Brightness adjustment** and repeat the steps described in items **3**, **4** and **5**. If any data on the operations performed before are available, the following dialog box opens:
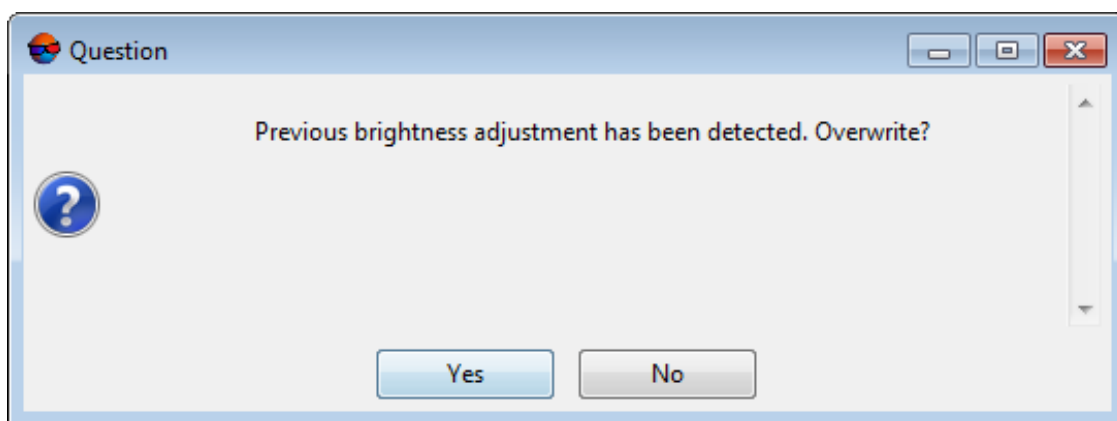
Fig. 58. Диалоговое окно

Click **Yes** to rebuild brightness adjustment (deleting the previous results);

9. [optional] To delete the results of brightness adjustment, choose **Block › Delete brightness adjustment**. If any data on the operations performed before are available, the following dialog box opens:
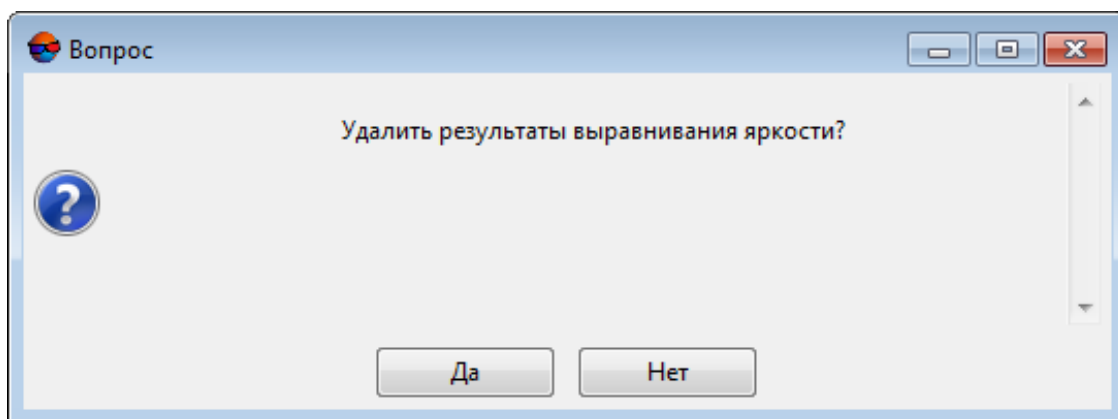
Fig. 59. A dialog box

Click **Yes** to delete the results of brightness adjustment.

8. Project management window

8.1. Project menu

Table 10. Brief description of 'Project menu'

Menu items	Function
New...	to create a new project
📂**Open/Manage** (**Ctrl+Alt+O**);	to open the Project management window
Copy	to create a copy of project selected in the list
Backup project...	to create project backup
Project export...	exports project data into a *.xml file, which is used in *Blocks Exchange XML* protocol between *PHOTOMOD* and external software such as *Agisoft Metashape* or *Bentley ContextCapture* (only for central projection projects)
Project import...	imports project data from a *.xml file, which is used in *Blocks Exchange XML* protocol between *PHOTOMOD* and external software such as *Agisoft Metashape* or *Bentley ContextCapture* (only for central projection projects)
🔄 **Reload**	to reloads a project to update it after changes appeared during mutual work
Synchronize	to re-calculate a project data after editing of some parameters, e.g. re-calculates interior orientation after changing camera parameters
Close	to close current project and to start "without project" mode (see Section 6.2)
Properties	to open the window used to view and edit some parameters of opened project (see Section 8.3)

Menu items	Function
Recent	to open a list of projects opened recently in the system
Delete temporary data...	is used for selective project temporary data deletion (see Section 8.12)
Join projects...	to merge data from several projects of active profile (see Section 8.9)
Project state	to display processing status of the following project stages (see Section 8.4)
Load work environment	to load during a project opening a project work environment (a set of all layers loaded to the system) saved previously to `*.x-work` file
Save work environment	to save a project work environment to `*.x-work` file, i.e. to memorize a set of all layers loaded before save operation
Exit	to close the main window of the system

8.2. Project management window

The **Project management** window shows the list of all projects of active profile and contains basic functions for project management.

Perform one of the following actions to open the **Project management** window:

• choose the **Project › Open/Manage...**;

• click the ⬛ button on the main toolbar;

• use the **Ctrl+Alt+O** hotkeys.
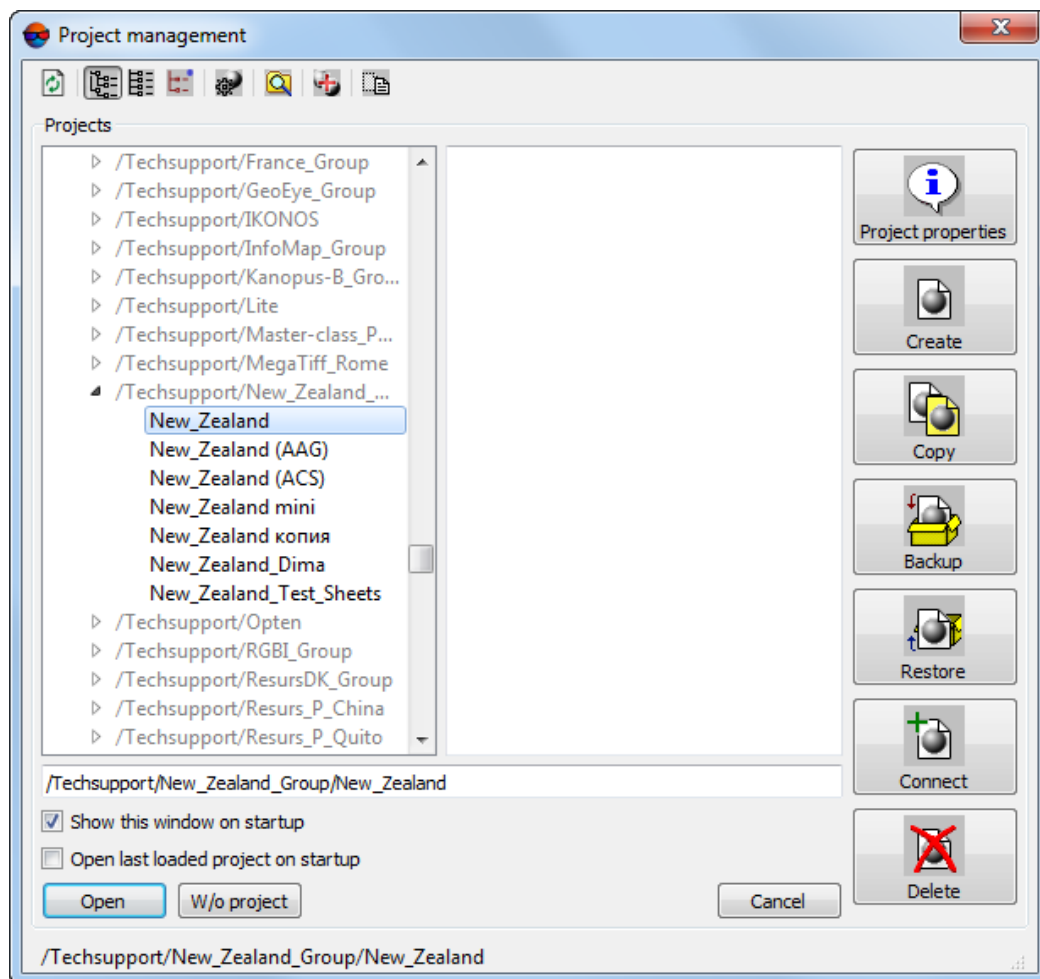
Fig. 60. Project management window

The **Project management** window contains the following elements:

• list of all projects of active profile;

• toolbar with the following buttons used for project list management:

   ○ 🔄 – allows to refresh project list after some changes made to resources structure of active profile using the *PHOTOMOD Explorer* (see Section 8.8) or after connecting a virtual folder (see Section 8.7);

   ○ 🗂 – allows to display all projects as hierarchic tree list – shows project folders (virtual folders and their subfolders);

   ○ 🗒 – allows to display all projects as linear list;

   ○ 🗒 – allows to display all projects opened recently in the system;

○ ⚙ – allows to open the **Control Panel** window used to manage profiles (see the "General information" User Manual);

⚠ After performing of some changes in profiles list resources structure in the **Control Panel** window you need to restart all opened modules of the system.

○ 🔍 – allows to open the **PHOTOMOD Explorer** window to change the structure of active profile resources (see the General information about system User Manual);

☞ After changing the resources structure of active profile in the *PHOTOMOD Explorer* window you should refresh projects list using the 🔁 button.

○ ➕ – allows to open the **Join projects** window used to merge data of several projects (see Section 8.9).

○ 📄 – allows to open the Rename project window used to rename a project selected in the list.

⚠ It is possible to change project name if it is not opened on other computers in the network.

- comments section shows project description, input by user during the project creation in the **New project** window or during project properties editing in the **Project properties** window;

- the following buttons are used for projects management:

○ **Project properties** – allows to open the window used to view and edit parameters of project selected in the list (see Section 8.3);

○ **Create** – allows to create new project and to setup its parameters and features;

○ **Copy** – allows to create a copy of project selected in the list;

○ **Delete** – allows to delete chosen project; delete project folder with all contents from active profile resources;

○ **Backup** – allows to create project backup;

○ **Restore** – allows to restore a project from backup;

○ **Connect** – allows to connect new folder to place projects there, i.e. to create new virtual folder in the profile resources (see Section 8.7).

- the search field that allows to search a project in the list by its name or name part;

> **F3** key allows to focus marker on the search field. Press **F3** again to focus marker on the next found project in the list.

• additional parameters:

  ○ **Show this window on startup** (enabled by default) – allows to open the **Project properties** window automatically on the system startup, otherwise, the system will be started *Without project*.

  ○ **Open last loaded project on startup** – allows to open last loaded project on startup.

• the following buttons used to manage the window:

  ○ **Open** – allows to close the Project properties window and to load a project selected in the list;

  ○ **W/o project** – allows to close the Project properties window to start work in the system without project (see Section 6.2);

  ○ **Cancel** – used to close the **Project properties** window.

• status bar shows path to selected project (in active profile resources).

In order to open project of active profile perform the following actions:

1. Open the **Project management** window.

2. Choose a project in projects list.

3. Click the **Open** button. Project data is load to the system.

8.3. Project properties

To view/edit project parameters specified during project creation use the **Project properties** window.

To open the **Project properties** window perform one of the following:

• choose **Project › Properties** to display properties of the project opened in the system;

• open the **Project management** window. Select a project in the list of all projects of active profile and click the **Project properties** button.

• make a double click into Coordinate system name in the status panel.
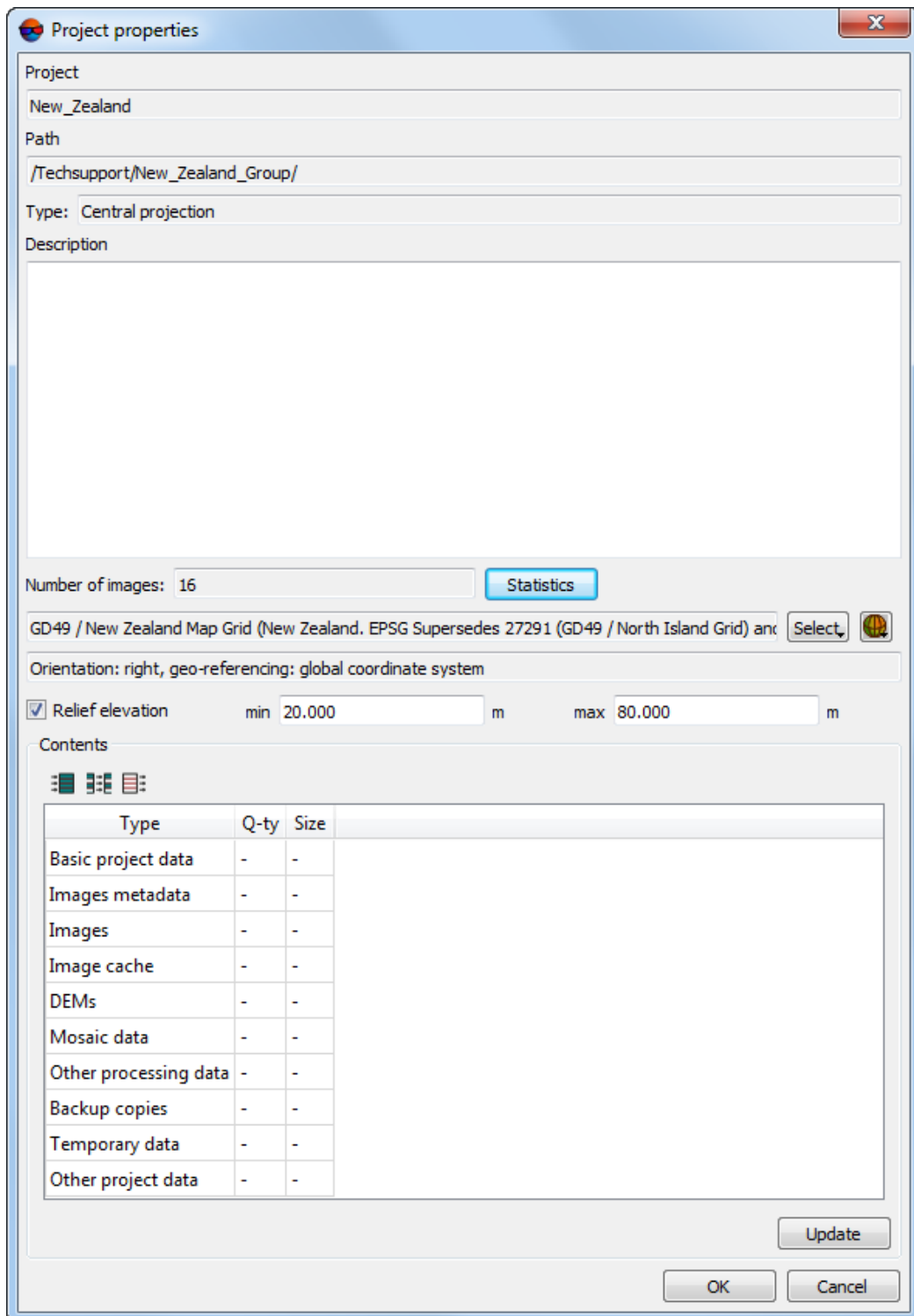
Fig. 61. Project properties

The window contains the following parameters:

• **Project** – shows opened/selected project name;

- **Path** – path to a project in active resources profile;

- **Type** – type of opened project: `central projection`, `satellite scanner survey`, `ADS 40/80/100` or `VisionMap A3 SLF`;

- **Description** - description input during project creation;

- **Number of images** – number of images loaded to a project;

> The **Statistics** button allows to display statistic data about images in project.
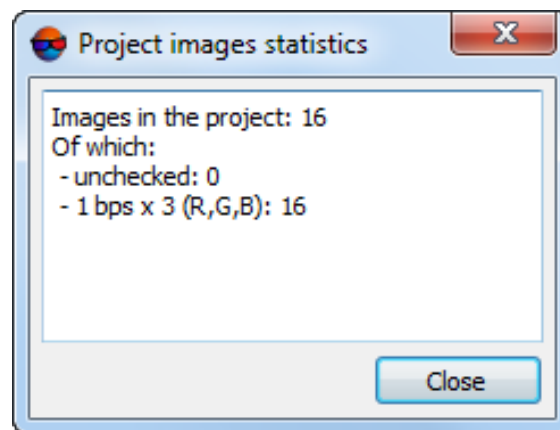
Fig. 62. Project images statistic

- **Coordinate system** – coordinate system and its parameters (see Section 4.1);

- **Relief elevation** – shows minimal and maximal values of terrain height, displayed on the project images, if these values were specified at project creation;

> Relief elevation data provides correct block scheme creation and is considered during import of external orientation parameters.

- **Contents** – content of project data and its size.

> To display the data contained in the **Contents** table, click the **Update** button. Calculation of necessary data may take considerable time. Click the **Cancel** button to terminate this operation.

Contains of **Description**, **Coordinate system** and **Relief elevation** fields could be changed on the **Project properties** window.

8.4. Viewing project report

The **Project state** window is used to view state report of opened project on steps of block forming, interior, relative and exterior orientation.

Choose **Project › Project state** or click the [icon] button on the main toolbar. The **Project state** window opens.
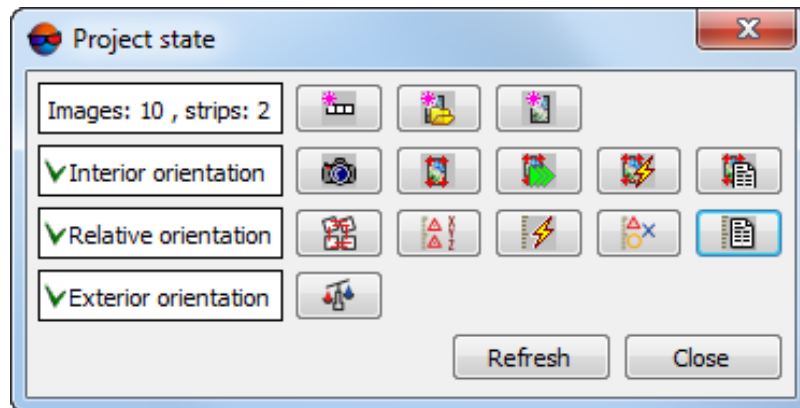
Fig. 63. Project state summary window

The **Project state** window contains a list of project processing steps and toolbars to perform these steps.

Project state on interior, relative and exterior orientation steps is marked by the following icons:

- [icon] – *completely* accomplished step;

- [icon] – *partly* accomplished step;

- [icon] – *not* accomplished step.

The window contains information about number of images/strips in the block and the following buttons used for block forming:

- [icon] – to add new strip;

- [icon] – to add the image from files located *out* from active profile resources to selected strip (see Section 7.4.2);

- [icon] – to add the image from active profile resources to selected strip (see Section 7.4.3).

You can use the following buttons to perform interior orientation step (see the "Aerial triangulation" User Manual):

- ⬤ – to define camera parameters;

- ⬤ - to perform manual measuring of fiducial marks;

- ⬤ – to perform interior orientation in semi-automatic mode;

- ⬤ – to perform interior orientation in automatic mode;

- ⬤ – to open interior orientation report.

The following buttons are used to perform relative orientation step (see the "Aerial triangulation" User Manual):

- ⬤ – to build block layout;

- ⬤ – to view, input and edit ground control points coordinates;

- ⬤ – to measure tie points in automatic mode;

- ⬤ – to view, input and edit tie points;

- ⬤ – to view relative orientation report.

The button is used to block adjustment (see the "Block adjustment" User Manual).

8.5. Copying project

In order to copy selected project to another folder of active profile resources perform the following actions:

1. Open the **Project management** window (see Section 8).

2. Choose a project in the list to delete.

3. Click the **Copy** button. The **Backup project** window opens. In the **Source project** field you can see a path to chosen project in active profile resources.

> ☞ In order to copy a current (opened) project – choose **Project › Copy**.
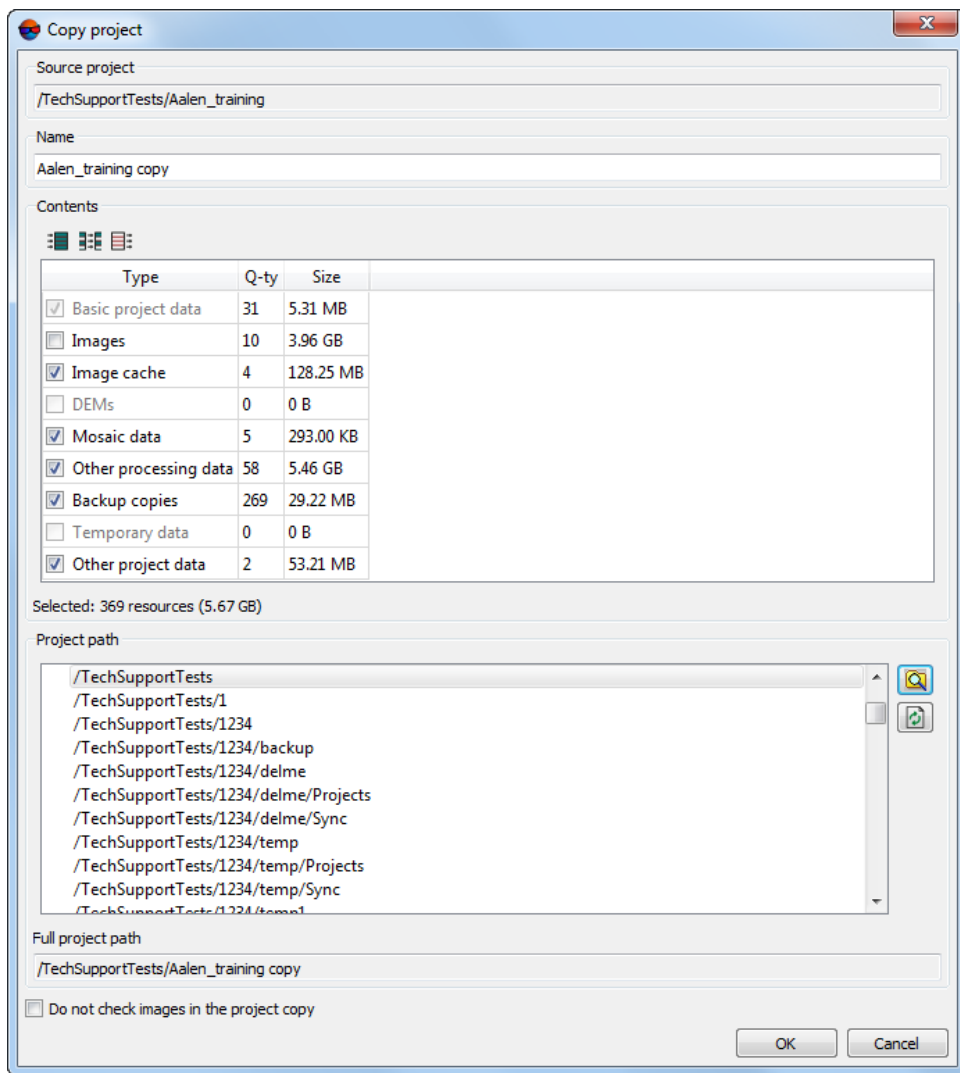
Fig. 64. Copying of project

4. Input a name for a project copy into the **Name** input field.

☞ By default the `Project_name_copy` is used as a name of project copy.

☞ In case of making copy from copy of project, the Project_name_copy 2 is used as a name.

5. Define a set of data to be copied in the **Contents** table. To do that, set on the checkbox of data for making copy.

☞ To copy source images into `/Images` folder of new project the **Images** checkbox is used.

The following buttons allows to manage the selections:

- ⊞ – allows to set all checkboxes;

- ⊞ – allows to clear all checkboxes;

- ⊞ – allows to invert selection.

6. In the **Placement** section choose a folder to place a project copy to active profile resources. The **Full project path** field displays a path to a new project copy in active profile resources.

7. [optional] Set the **Do not check images in the projects copy** checkbox to exclude check of presence of all project images (according to their relative paths) and their parameters, that could take a long time.

> This process could take much time in case of checking amount of source images. Thus in most cases it is not recommended to set on this checkbox.

8. Click OK to create a copy of project.

8.6. Deleting project

In order to delete selected project perform the following actions:

1. Open the **Project management** window (see Section 8).

2. Choose a project in the list to delete.

3. Click the **Delete** button;

4. Click the **Yes** to confirm the project deleting. At that the project folder will be completely removed (with all files and service folders) from *active profile resources*. To delete project files located *out* of project folder (e.g. images files) use *PHOTOMOD Explorer* (see Section 8.8).

8.7. Connecting new folder

The **Project management** window (see Section 8) allows to connect new virtual folder to active *local* profile to place projects during their creation or copying.

> In order to connect a virtual folder to *network* profile use the *Control Panel* module (see the "General information" User Manual);

In order to connect new virtual folder perform one of the following:

- click the **Connect** button. The **Browse for folder** window opens. Choose physical folder to connect it to a profile. Click OK. Input virtual folder name to the **Connect virtual folder** window and click OK.

- click the 🔍 button of the **Manage projects** window's toolbar. The *PHOTOMOD Explorer* window (see Section 8.8) opens, that displays all active profile resources and contains tools to manage resources structure. To connect a new virtual folder is used the ➕ button.

8.8. The "PHOTOMOD Explorer"

The **Project management** window (see Section 8) allows to open the *PHOTOMOD Explorer* to view resources and edit structure of active *local* profile: create folders. rename, copy and delete resources.

☞   In order to edit resources structure of *network* profile use the *Control Panel* module (see the "General information" User Manual);

☠   Do not delete, rename or remove configuration files in the *PHOTOMOD5.VAR* folder in order to avoid lost of project data.

⚠   Please, be careful during change resources structure of profile to avoid data loss.

To open the *PHOTOMOD Explorer window* click the 🔍 button in the **Project management** window. See detailed description in the "General information" User Manual.
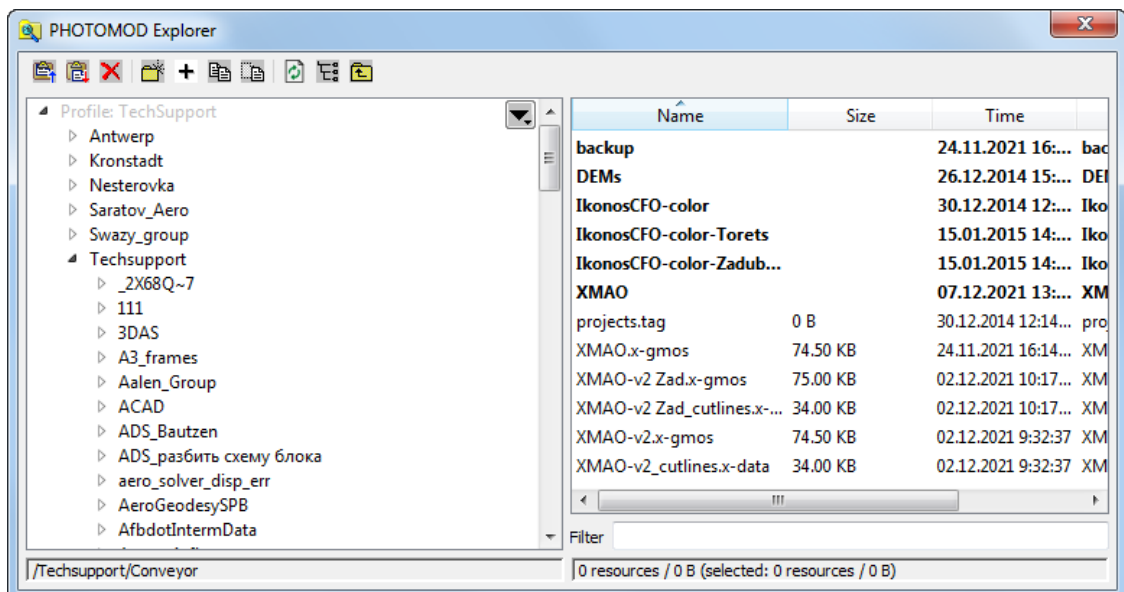
Fig. 65. The *PHOTOMOD Explorer* window

8.9. Joining projects

In some cases you need to share work with a project among several operators that requires creating separate projects for each strip of a block in order to their independent orientation/processing. For further joining of obtained project data into integrated project

you should use joining projects operation. The system supports joining of several projects.

For successful joining, the projects should meet the following requirements:

1. Contain ground control points and exterior orientation parameters in the same coordinate system.

    > In case of coordinate systems discrepancy, you should re-calculate them using the tool in the **GCP list** and **Exterior orientation parameters** windows (see the "Aerial triangulation" User Manual).

2. Joined projects should be placed in active profile resources.

    > Use the *Control Panel* module (see the "General information" User Manual); In the *Control Panel* it is also possible to prepare in advance new virtual folder, that will be used as a target folder for new joined project.

The main idea of projects joining is as follows:

1. Define a base project, and then to add data from additional projects to the base one. The base project is privileged, i.e. its data is copied to target project first of all, and then data from other projects, missing in the base project, is added to it.

2. Properties of joined target project are taken from selected base project.

3. Cameras used in additional projects are added to base project cameras.

4. Images are copied to joined project, if they are located in the project folders, otherwise only relative paths to images are copied. Those images could be connected later to joined project using replace and auto-replace operations in **ImageWizard** (see Section 9.2.1). Images from additional projects, that are absent in base project, are always added to new strips of target project. In case of some inconsistency in strips order you may use block editing features to adjust a block scheme (see Section 7).

5. Images, GCP/check points are joined by names matching.

6. Tie points are *not* joined, just added to triangulation points of a target project, i.e. are recognized as new points with new names.

7. Only data of preliminary exterior orientation is copied to a target project, so after projects joining you should perform block adjustment (see the "Block adjustment" User Manual).

8. Projects processing data (vector resources, DEMs, TIN, mosaics data) are copied to a target project. In case of names coincidence, the resources will obtain new unique names automatically.

9. Other data located in user project folders is also added to target project.

To join several projects of active profile perform the following actions:

1. Click the 🔧 button of the **Project management** window (see Section 8). The **Step 1 of 4: Base project** window opens.
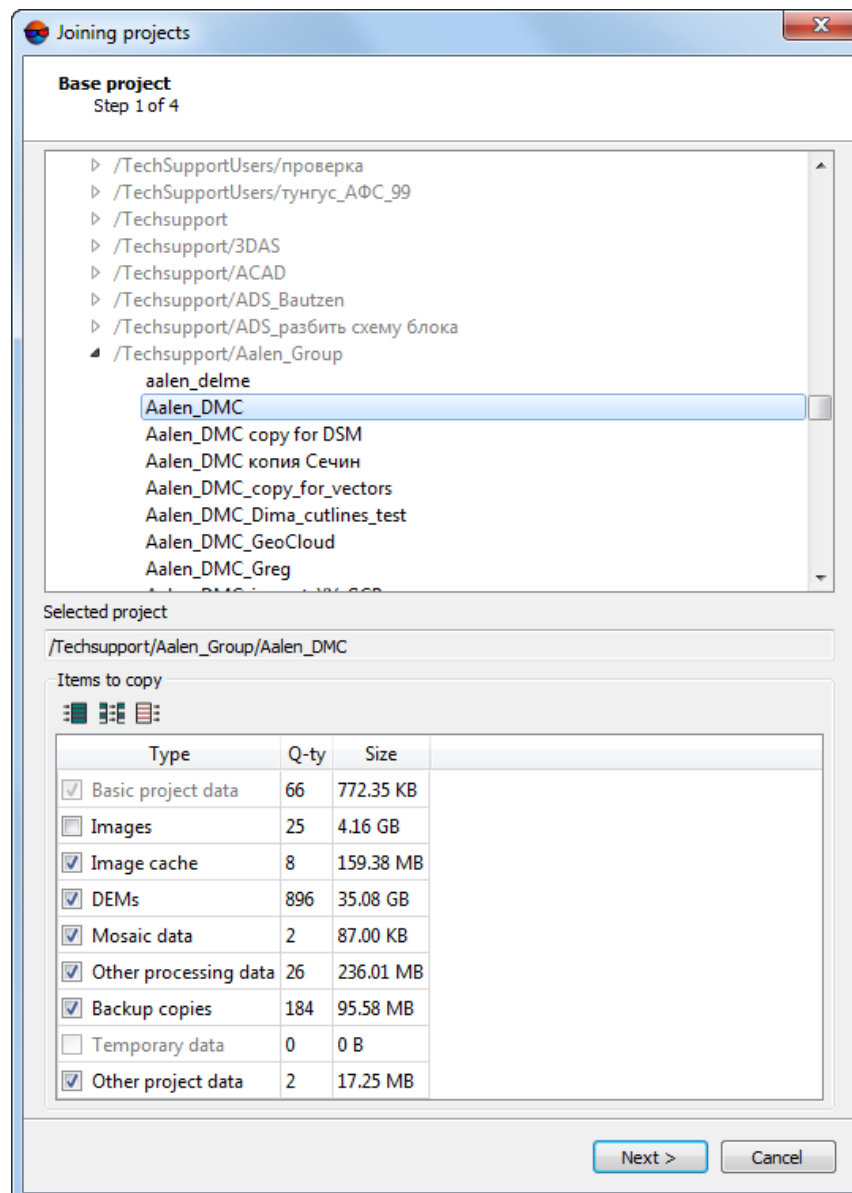
Fig. 66. Selection of base project used to be joined with other projects

2. Select a base project and in the **Items to copy** table define a set of data, that will be copied from the base to target project. Click the **Next** button. The **Step 2 of 4: Additional projects** window opens.
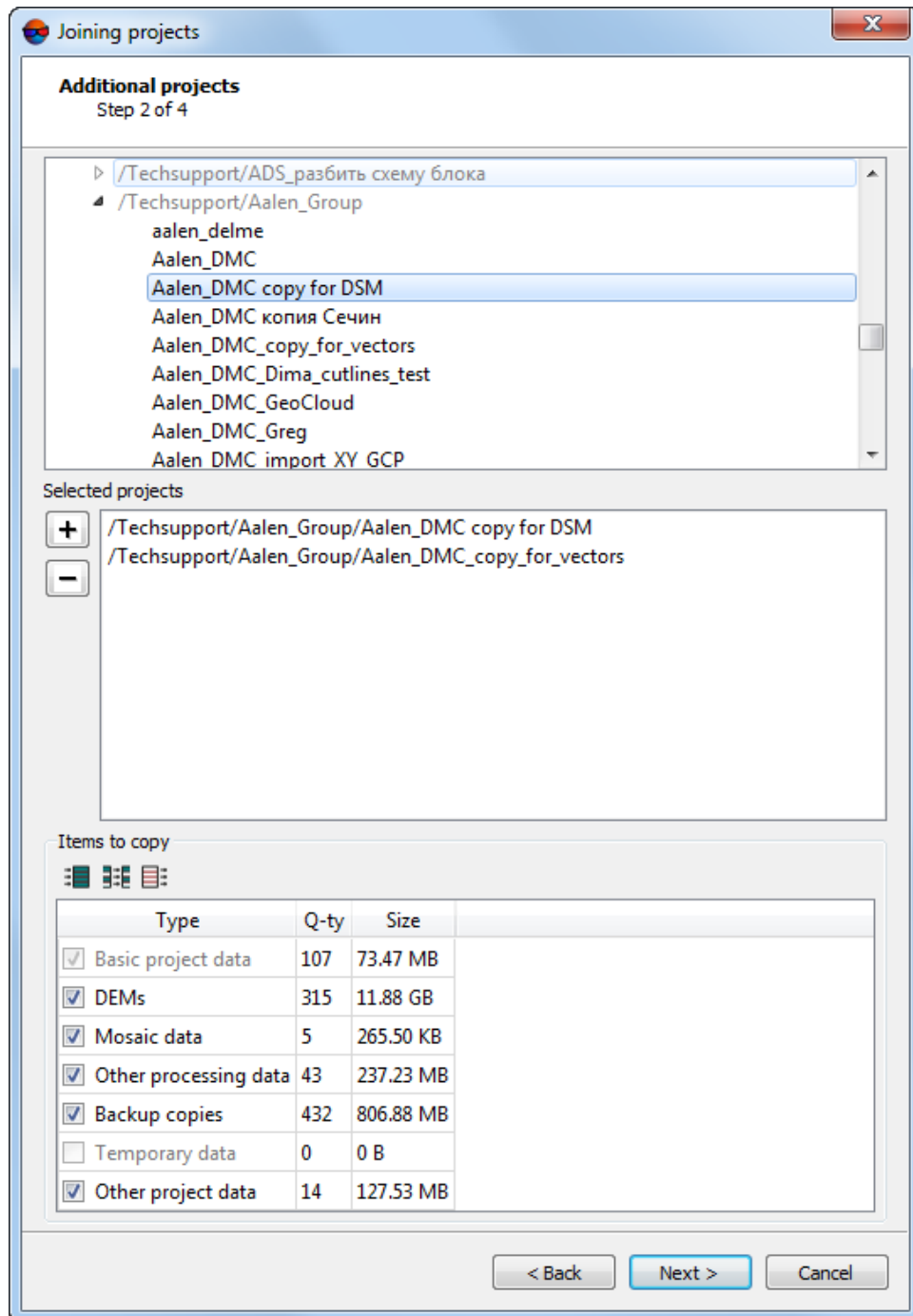
Fig. 67. Selection of additional projects

3. Define a list of additional projects and set of their data to be added to base project data. Use the **+** button to add and the **–** button to remove items from list of addi-

tional projects. Click the **Next** button. The **Step 3 of 4: Name and placement for the target project** window opens.
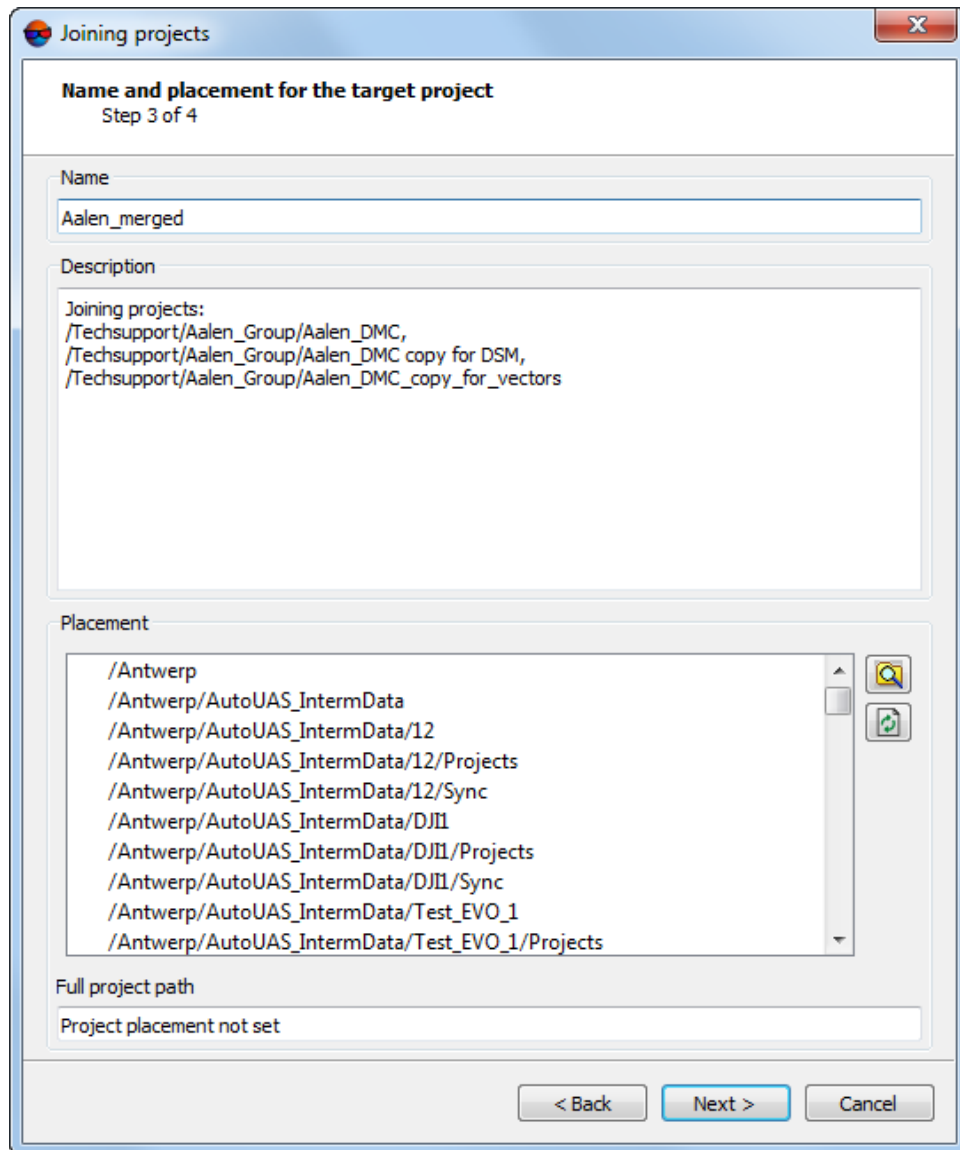
Fig. 68. Selection of name and placement of joined project

4. Specify name, description and placement of target project in active profile resources. Click the **Next** button. The **Step 4 of 4: Joining parameters** window opens.
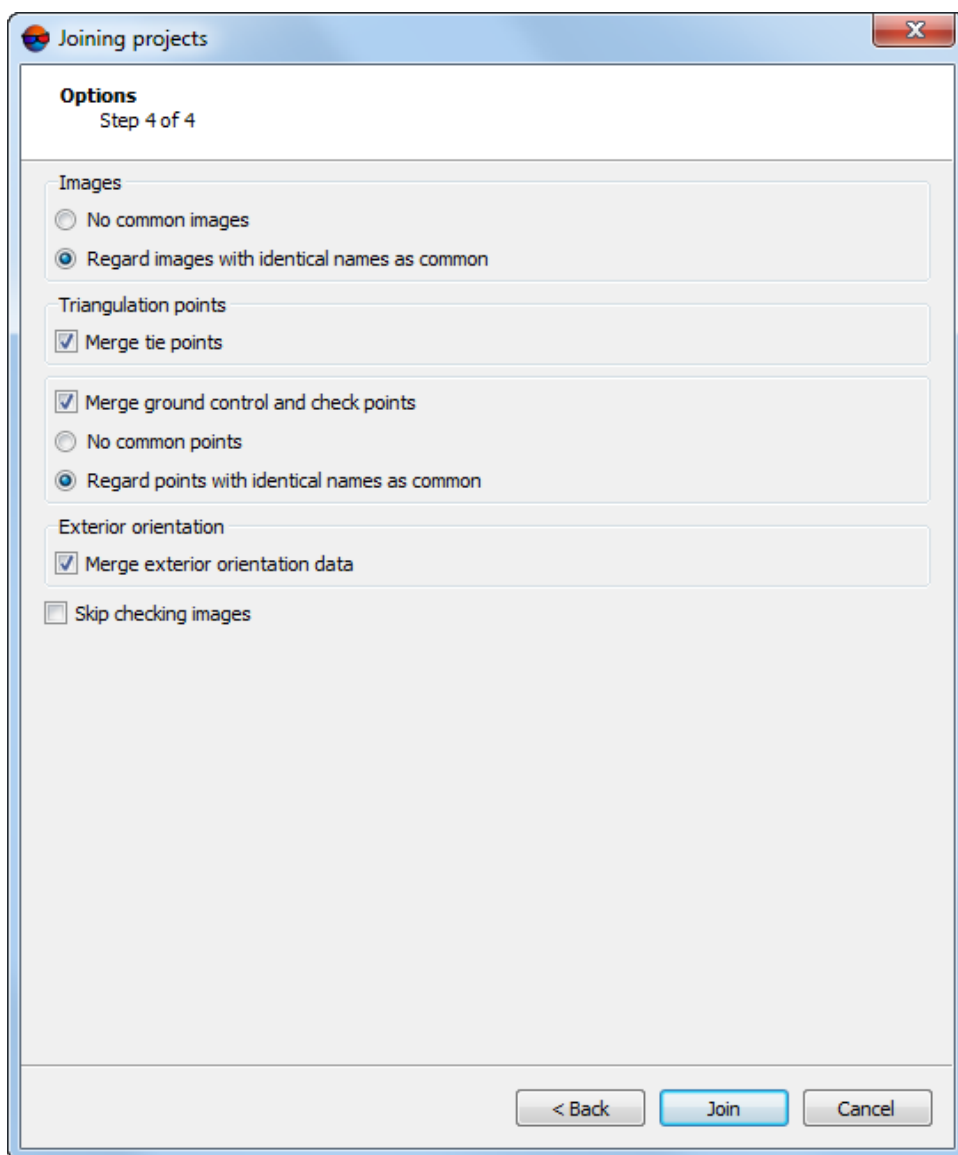
Fig. 69. Parameters of projects joining

5. In the **Images** section choose one of the following:

   - **No common images** – if projects do not contain identical names of images. In case of names coincidence and enabled option, images will be added to new strips under new names, composed as follows: `image name [N]`, where `N` is a number of image copy;

   - **Regard images with identical names as common** – allows to join images if their names are the same.

6. Set on the **Merge tie points** checkbox in the **Triangulation points** section to add tie points of additional projects to tie points of base project and they will get new

names automatically; if the option is disabled ' tie points are taken only from base project.

7. To merge ground control or add ground control\check points set on the **Merge ground control and check points** checkbox and choose:

    • **No common images** – points are not joined, but added (in case of identical names they will be added with the same names).

    • **Regard images with identical names as common** – points are joined by names.

8. Set on the **Merge exterior orientation data** checkbox in the **Exterior orientation** section to add exterior orientation parameters of additional projects to exterior orientation parameters of base project.

9. [optional] To avoid check for images existence according to their relative paths and parameters, set on the **Skip checking of images** checkbox.

> It is recommend to enable this option, to save time during joining operation.

10. Click the **Execute button** to start joining projects.

8.10. Creating project backup

The system provides creation of project backup in the form of compressed or uncompressed archive located *out* of profile resources (on any local or network disk), that is helpful for project storing or further sending/passing.

> Copy of project creates only in active profile resources during making copy of project.

In order to create backup copy of a project as compressed/uncompressed archive perform the following actions:

1. Select a project in the projects list of the **Project management** window (see Section 8).

2. Click the **Backup** button.

> In order to backup a current (opened) project – choose **Project › Backup project**.

3. Specify a file name for project backup and select a folder for backup placement in*Windows file system*.

4. Specify one of the following backup types in the **File type** list: TAR uncompressed archive (`*.tar`) or TAR-GZip compressed archive (`*.tar.gz`).

    ☞ It is recommended to create uncompressed TAR-archives for storing of projects copies. Creation of compressed archives (file `*.tar.gz`) is used to send small projects or part or project data by e-mail (see also Section 8.11).

5. Click the **Save** button. The **Backup project** window opens.
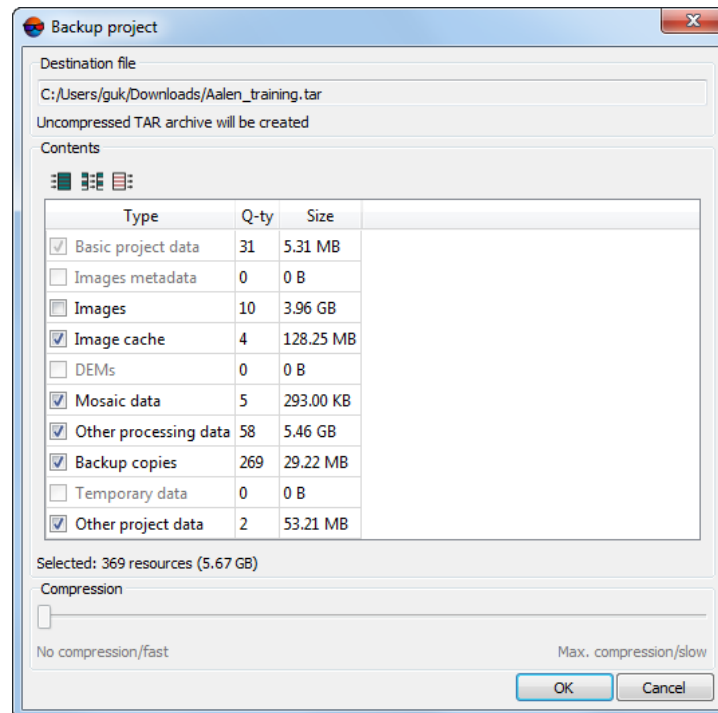
Fig. 70. Creating of TAR uncompressed archive

6. Define in the table content of data to project backup. To do that, set on the checkbox of data for making copy.

    The following buttons allows to manage the selections:

    -   ▤ – allows to set all checkboxes;

    -   ▤ – allows to clear all checkboxes;

    -   ▤ – allows to invert selection.

    During project backup creation only selected resources located in project folder are saved/archived. If images are placed out of project folder, you can backup only *raster cache* (reduced copies of images).

7. [optional] Define a compression level of backup copy using an appropriate slider in the **Compression** section (the panel is active only if compressed backup is selected (file `*.tar.zg`)).

8. Click OK to backup the project.

8.11. Restoring project backup

To restore a project from a backup copy using integrated tools of the system, as well as third-party tools (any standard archiving utility, for instance).

When restoring project in system, copy of project places in chosen path in active profile resources. In case of using external resources – in folder in Windows file system. This folder should be join to resources as a virtual folder.

In order to restore a project from a backup copy using system tools perform the following actions:

1. Click the **Restore** button in the **Project management** window (see Section 8). In the window opened you can choose a file with project backup `*.tar.gz` (compressed backup) or `*.tar` (uncompressed backup) to be restored.

    ⚠️ Maximum of data restore from archive in case of restore broken or incomplete archives. Warning is shown in case of error in restoring.

2. Choose a backup and click the **Open** button. The **Restore project** window opens allowing to specify a project's name and path in active profile resources.
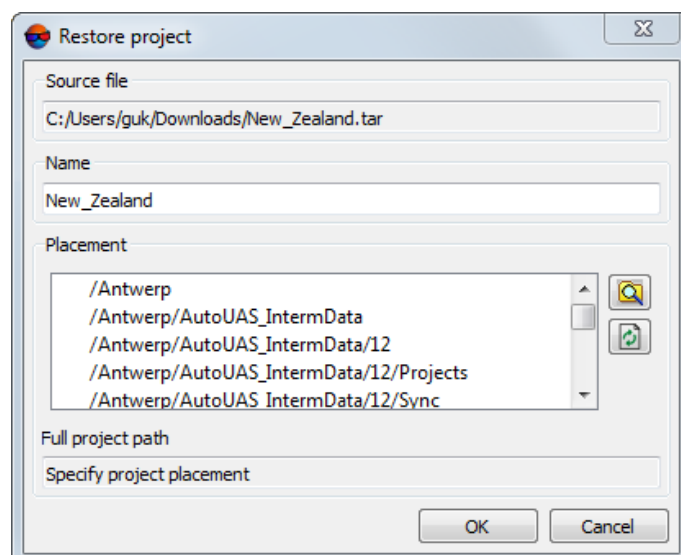
Fig. 71. Restore of project backup

3. Click OK to restore project from backup.

8.12. Deleting project temporary data

The system provides for selective project temporary data deletion from the active profile resources. For this, perform the following:

1. Choose **Project › Delete temporary data**. The **Delete temporary data** window opens:
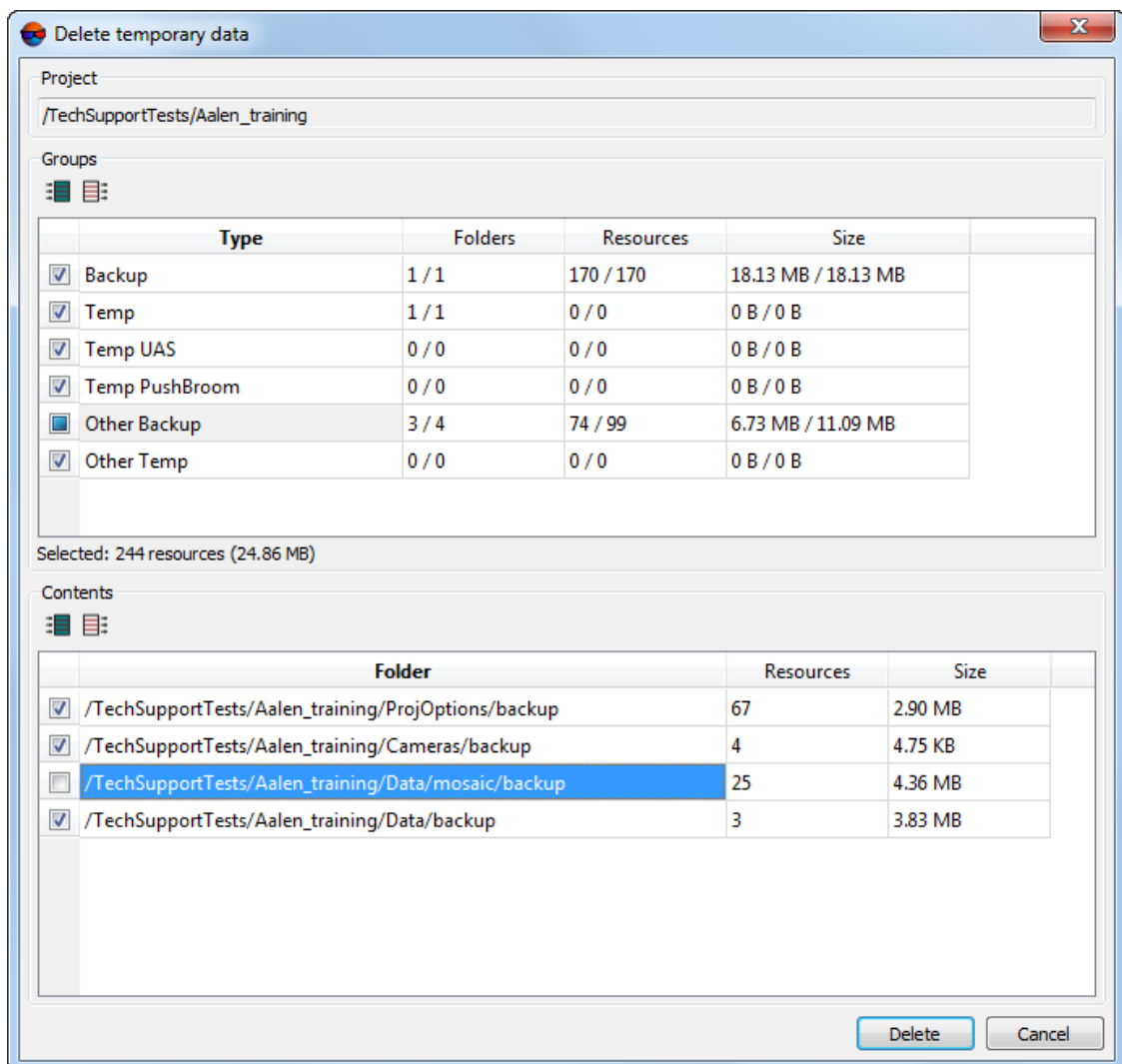
Fig. 72. The Delete temporary data window

The **Delete temporary data** window contains the following sections:

• The **Project** field displays a name of the current project for which temporary data will be deleted;

- The **Groups** table of temporary data containing the following columns:

  ○ Temporary data `Type`:

    ■ `Backup` – backup copies of project data (stored in the project root folder);

    ■ `Temp` – temporary project data (stored in the project root folder);

    ■ `Temp UAS` – temporary data on image relative orientation (for aerial survey);

    ■ `Temp Pushbroom` – temporary data on image relative orientation (for satellite scanner imaging);

    ■ `Other Backup` – all folders inside the project named `Backup` (other data of project processing);

    ■ `Other Temp` – all folders inside the project named `Temp` (other data of project processing).

  ○ `Folders` – the number of selected / existing folders in the active profile resources containing temporary data of the specified type;

  ○ `Resources` – the number of selected / existing resources containing temporary data of the specified type;

  ○ `Size` column contains sizes of selected / existing resources containing temporary data of the specified type.

  To select a group of temporary data for deletion, set the appropriate checkboxes:

  ○ the ▤ button allows to select all the groups of temporary data;

  ○ the ▤ button allows to cancel selection of all the groups of temporary data.

  The total number and size of the resources with temporary data that are chosen for deletion is displayed in the **Selected:** field under the **Groups** table.

- The table that displays the **Contents** of temporary data of the selected type contains the following columns:

  ○ `Folder` – folders with temporary data of the selected type in the active profile resources;

  ○ `Resources` – the number of resources containing temporary data in this folder;

  ○ `Size` of temporary data in this folder.

To choose the `Type` of temporary data the **Contents** of which it is required to display, select the appropriate line in the **Groups** table.

To delete only a portion of temporary data of the selected type, clear or set the appropriate checkboxes in the **Contents** table:

○ the 📑 button allows to select all the groups of temporary data;

○ the 📑 button allows to cancel selection of all the groups of temporary data.

2. Clear or set the appropriate checkboxes in the **Groups** and **Contents** tables;

3. Click **Delete** to start deletion of temporary project data.

8.13. Work environment

It is possible to save/load project work environments to work with project in new session with project data opened in previous session.

Project work environment is a set of all opened layers in the project (vector data, DEM and so on). The work environment is stored in the file `*.x-work` of the active profile resources.

To save the work environment do the following:

1. Choose the **Project › Save work environment**. The **Destination file** window opens.

2. Define name and path to save the work environment.

3. Click OK to save work environment.

> ✍ By default it is offered the folder `Data` in the project folder in active profile resources.

To load a work environment do the following:

1. Open a project.

2. Choose the **Project › Load work environment**. The **Save** window opens.

3. Select a file `*.x-work` with the work environment and click OK.

4. Click OK to load work environment.

8.14. Export and Import of Projects (Blocks Exchange XML)

The system provides for exporting and importing project data using the *Blocks Exchange XML* protocol. The data exchange between *PHOTOMOD* and external software such as *Agisoft Metashape* or *Bentley ContextCapture* could be performed that way.

An `*.xml` file is used for data exchange.

⚠️   This functionality is available only for the central projection project types.

The exchange file contains the following data:

• The project coordinate system info (including EPSG-code or full description);

> 🎓   Standard **EGM96** and **EGM2008** geoids are supported.

• Information about sub-blocks;

• Information about cameras, including calibration parameters – focal length calibration parameter (f); coordinates of symmetry point (zero distortion – $x0$, $y0$); coefficients of radial distortion ($k1$, $k2$, $k3$); coefficients of tangential distortion ($P1$, $P2$);

> ☞   *Metashape* calibration data will be recalculated for use in *PHOTOMOD*, with some parameters approximated.

> ☞   *ContextCapture* and *PHOTOMOD* calibration data are the same.

• Project imagery info;

> ☞   The *block exchange* protocol does not provide the ability to export/import images themselves or full paths to image files in the operating system file system (or in the *PHOTOMOD* resource system).

• Triangulation point info (GCP, check, tie).

> 🎓   When exporting data from *Metashape*, all the points from catalog are to be exported, including the excluded points.

To export *PHOTOMOD* project data, choose **Project › Export project**.

> ☞   To perform the data export from *Metashape* software, choose **Export › Export Cameras**. Choose the output file extension – **Blocks exchange (*.xml)**.

> ☞   To perform the data export from *ContextCapture* software, choose **Block › Export › Export to XML...**. Choose the output file format – **BlocksExchange XML format**.

To import data to *PHOTOMOD* from an exchange file, perform the following:

1. Choose **Project › Import project** project. The XML-file selection window opens;

2. Select the exchange file and click **Open**. The **Project import** window opens, where you can specify the project name and path in the active profile resources:
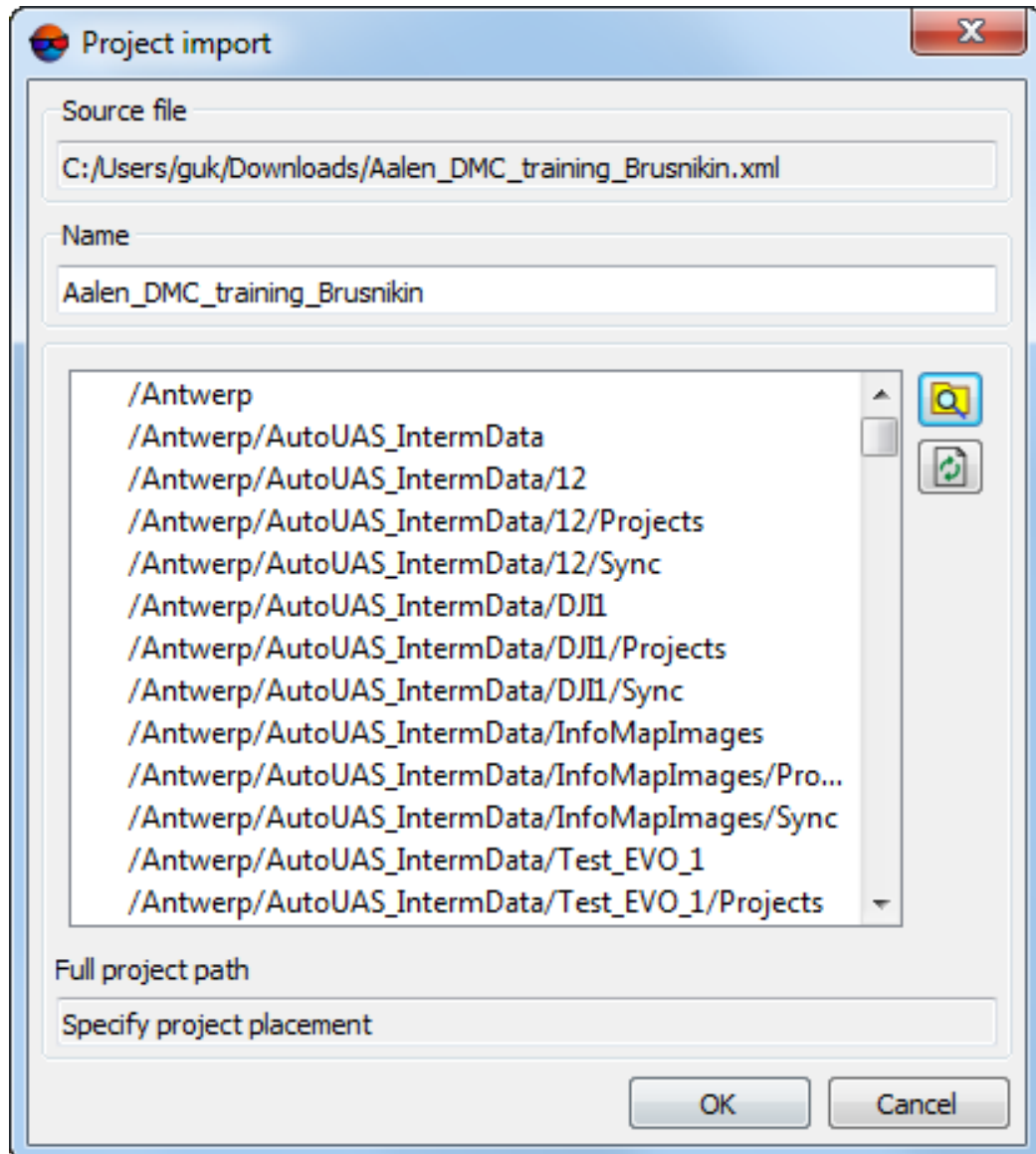
Fig. 73. The Project import window

3. Click OK to import the project data.

    After the project import in *PHOTOMOD*, the adjustment using imported exterior orientation parameters is performed.

9. Processing of raster images

9.1. The "Raster" menu

The system provides the **Raster** menu to perform various operations with raster images.

Table 11. Brief description of Raster menu

Menu items	Function
Raster Converter	to launch the *Raster Converter* program for preparing and converting raster images into the internal format files and then for placing them in active profile resources (see the "General information" User Manual).
ScanCorrect	to run the *ScanCorrect* program for compensation of metric errors occurred when scanning graphical data on flatbed polygraphic scanners (see the "ScanCorrect program" User Manual)
Image georeferencing	to perform georeferencing images by geodetic coordinates GCP points, obtained from vector/raster maps or from a list of file *.txt (see the "Aerial triangulation" User Manual)
Affine georeference correction	to perform affine correction of georeferenced images
Load georeferenced images (files)	to load georeference images from folder in *Windows file system* (see the "Georeferenced external data" section of the "Aerial triangulation" User Manual and the "Pseudo-stereo mode" section of the "Vectorization" User Manual)
Load georeferenced images (resources)	to load georeference images from active profile resources (see the "Georeferenced external data" section of the "Aerial triangulation" User Manual and the "Pseudo-stereo mode" section of the "Vectorization" User Manual)
Load web-map	to load georeferenced web-maps from the Internet (see Section 9.6)
Save raster layer	to save a georeference raster image of the active layer with specified parameters in output file format (TIFF, MS-TIFF, MegaTIFF)
Close all opened layers	to close all opened raster layers
Layers visibility	contains menu items which allow to perform batch management of raster layers visibility in the *Layer manager*
Orthorectification	to create orthophoto production and mosaicking (see the "Orthorectification" User Manual)
GeoMosaic	to run the *GeoMosaic program* allows to create the orthomosaic from georeferenced orthorectified aerial and satellite imagery, splitting of created orthomosaic with the capable of saving sheets in popular

Menu items	Function
	raster file format (see the "Orthophotomaps creation" User Manual)
Pan-sharpening	to perform pan-sharpening – a technique that merges high-resolution panchromatic data with medium-resolution multispectral data to create a multispectral image with higher-resolution features (see "The pan-sharpening operation" chapter of the "General information" User Manual)
Batch pan-sharpening	to perform the pan-sharpening for the list of image pairs with same properties and also in distributed processing mode (see "The pan-sharpening operation" chapter of the "General information" User Manual)
Dust Correct	to 'clean' images of dust particles, photo emulsion defects etc (see Section 9.8)
Clear cache	to delete raster cache from RAM
ImageWizard module	to edit path to image files (see Section 9.2.1)
Show rasters	to use one of three modes of displaying raster images in 2D-window: **Cached only** (**Ctrl+Shift+1**), **Depending on zoom** (**Ctrl+Shift+2**) or **Source only** (**Ctrl+Shift+3**)
Images order	to rearrange block images by z-order
Rebuild Mega Tiff pyramids	to rebuild image pyramids for MegaTIFF images (see Section 9.5)
Adjust zoom	to set zoom of images in 2D-window by set GSD in pixels

9.2. ImageWizard Adjustment of images

9.2.1. The ImageWizard window

To manage links to images is used the *ImageWizard module*.

Raster image file in active profile resources could be used in more than one project the same time. In this case each project contains only *links* to source images and information about size and color of images, interior and exterior orientation parameters.

ImageWizard module main function – is managing of the links to the source files, i.e. matching project images with raster files, as well as control of correctness of this matching, allows to build pyramids, and perform images radiometric correction.

> Pay attention when edit images in the *ImageWizard module* module to avoid of project data lost.

The *ImageWizard module* provides the following capabilities:

• view images properties and features;

- create/delete exterior pyramid of images (not for MS-TIFF format);

> ☞ Such as MS-TIFF images already have pyramids, it is not allowed to create pyramids for them again.

- images radiometric correction;

- edit links to images source files:

  ○ replace links to source files to match them to project images;

  ○ replace project images with *virtual rasters* of certain size with pattern fill;

  > 🎓 *Virtual rasters* are used in case of absence of source raster images. Virtual images are formed dynamically in RAM and do not occupy any disk space. Virtual images are used in case of absence of source images, for instance. This provides absolutely correct work with a project when the image information is not used, for example, in this case the system supports view/import/export of vector objects, TIN, and DEM.

  ○ remove links to source files to disable project images.

To start the module choose the **Rasters › ImageWizard** or click the 🗹 button in the **Block editor** window. The **ImageWizard** window opens.
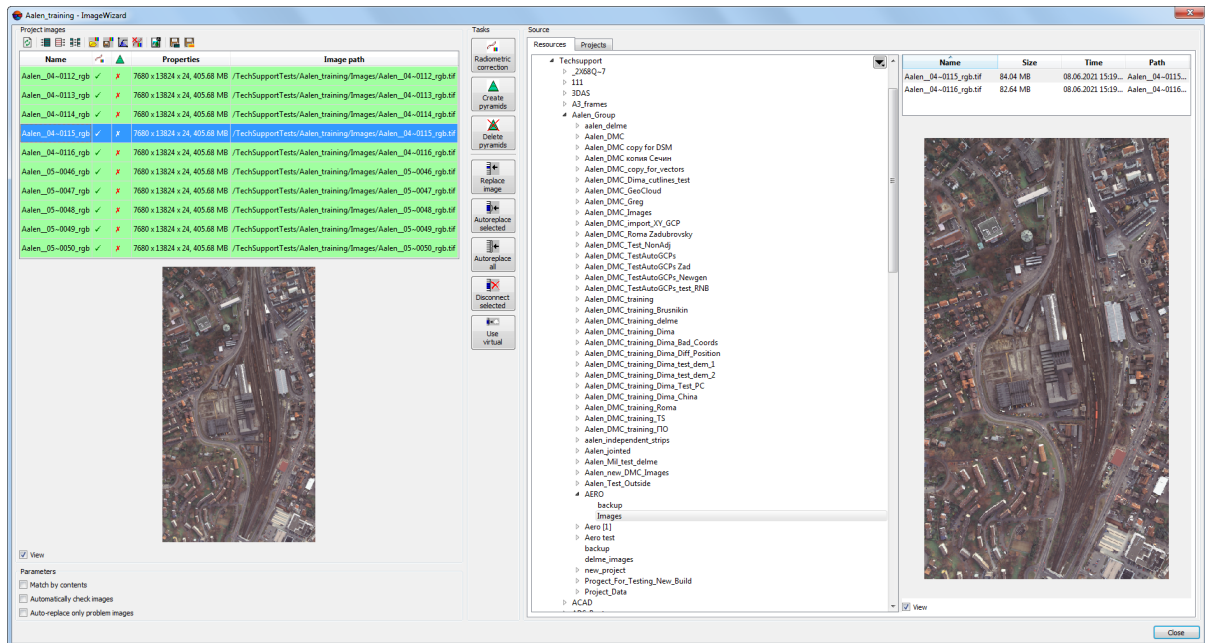
Fig. 74. The ImageWizard window

A name of opened project is shown in header of the **ImageWizard** window.

The **ImageWizard** window contains the following main sections:

- The **Project images** section is used for control of project images setting, view images properties and links to images source files. The section contains toolbar, project images table and window of selected image view.

  The table contains the following information:

  ○ **Name** – project image name;

  ○ 〽 – perform of radiometric correction;

  ○ ▲ – image pyramid;

  ○ **Properties** – size of image in pixels and size of source image in megabytes;

  ○ **Image path** – link to the source image file in active profile resources.

  The view window is used for displaying of project image selected in the table. To show image in the view window, set the **View** checkbox on.

  The toolbox contains the following buttons:

  ○ 🔁 – allows to refresh data;

  ○ 🔲 – allows to select all images;

  ○ 🔲 – allows to unselect all images;

  ○ 🔲 – allows to inverts images selection;

  ○ 📂 – allows to load radiometric parameters from `*.rmc` file and apply them to project image selected in the table;

  ○ 💾 – allows to save radiometric parameters of project image selected in the table to `*.rmc` file;

  ○ 📊 – allows to start radiometric parameters of selected images without additional parameters;

  ○ 〽 – allows to delete radiometric parameters of project image selected in the table;

  ○ 🖼 allows to start the *Raster Converter* to add new source images in active profile resources (see the "General information" User Manual);

  ○ 💾 - allows to save the selected images filenames list to the `*.txt` file stored in *Windows* file system;

○ 🖫 - allows to save the filenames list (a `*.txt` file stored in *Windows* file system) for those images that don't have link to source image (in the **Project images** section an `error` is displayed in **Properties** column).

• The **Parameters** section contains additional features for project images setting:

○ **Match by contents** (enabled by default) – during executing of auto-replace operations, in addition to automatic names matching the system checks content of images source files. This helps to reduce chance of errors during replacing links to source files in project images table;

○ **Automatically check images** (enabled by default) – allows to start initial images check and refresh properties in the table of project images after performing of any operation in the **ImageWizard** module. Otherwise, table data is not updated after operations performing;

○ **Auto-replace only problem images** (enabled by default) – during executing of auto-replace operations for search/replace links to images allows to perform preliminary check of project images and in case of problem images, the system will search images source files only for them. If the option is disabled, the images, which are matched with project images, are fully replaced.

• The **Tasks** panel is used to perform main operations of project images setting:

○ 🖋 **Radiometric correction** – allows to open the **Radiometric correction** window to perform radiometric processing of project image selected in the table, i.e. images from source file;

> 🎓 Radiometric correction applies only for image loaded into the system. Source image is not changed. It is possible to apply only geometric transformation (flip-rotate) to the source image.

○ 🔺 **Create pyramids** – allows to build external pyramids for project images selected in the table, i.e. images from source files. The pyramids are saved to subfolder of folder with initial images in active profile resources;

○ 🔺 **Delete pyramids** – allows to delete pyramids for project images selected in the table of **Project images** section, i.e. images from source files;

○ 🖳 **Replace image** – allows to match the image selected in project images list with another image source file selected in the **Source** section, i.e. the tool allows to change a link to source file in the table.

> ✍ To replace link in active profile resources, choose source file in the **Source** section on the **Resources** tab. To replace link to file from other project , choose source file in the **Source** section on the **Projects** tab.

○ **Autoreplace all** – allows to automatically replace links to images source files for all project images selected in the table, using matching of **project images** names shown in the table and names of source files in folder of active profile resources selected in the **Source** section (see also description of the **Match by contents** and **Auto-replace only problem images** additional parameters below).

> Autoreplace is used, for example, to connect initial images to a project in case, if the images were disabled or relocated by *Windows file system* tools.

○ **Autoreplace all** – allows to automatically replace links to images source files for all project images selected in the table, using matching of project images names shown in the table and names of source files in folder of active profile resources selected in the **Source** section (see also description of the **Match by contents** and **Auto-replace only problem images** additional parameters below).

> To replace link in active profile resources, choose source file in the **Source** section on the **Resources** tab. To replace link to file from other project , choose source file in the **Source** section on the **Projects** tab.

○ **Disconnect selected** – allows to remove links to source files selected in the table. **Autoreplace selected** and **Autoreplace all** buttons are used to re-link to source images.

○ **Use virtual** – allows to replace selected images in the table of the **Project images** section to virtual raster images with defined size and background.

> *Virtual rasters* are used in case of absence of source raster images. Virtual images are formed dynamically in RAM and do not occupy any disk space. Virtual images are used in case of absence of source images, for instance. This provides absolutely correct work with a project when the image information is not used, for example, in this case the system supports view/import/export of vector objects, TIN, and DEM.

• The **Source** section allows to select images source files to match them with **Project images**.

This section contains table of project images, preview window and toolbar.

The following tabs in the **Source** section are used to select source files:

○ **Resources** – displays all active profile resources. Resources tree containing a name of active profile in the root displays at the left. At the right – the whole content of selected folder of a profile – all subfolders and files. Only images source files from active profile resources could be matched with images of current project.

> To add new images source files to active profile resources without closing the click the button to start the *Raster Converter* module (see the "General information" User Manual); Save images files in active profile resources and close the *Raster Converter module* and

click the ![icon] button of the **Project images** section in the **ImageWizard** window. As a result source image files are displayed in the **Source** section on the **Resources** tab.

○ **Projects** – displays all projects of the profile. At the left only projects list of a profile is displayed. And at the right – only images list of selected project. When you replace image of current project by other project image, in fact you are dealing with a link to image source file of another project.

⚠️ At that, if in the **Source** section the **Resources** tab is selected, the image is replaced by source file from active profile resources.

9.2.2. Workflow

To re-link source image perform the following:

1. Choose **Rasters › ImageWizard** or click the ![icon] button in the **Block editor** window. The **ImageWizard** window opens.
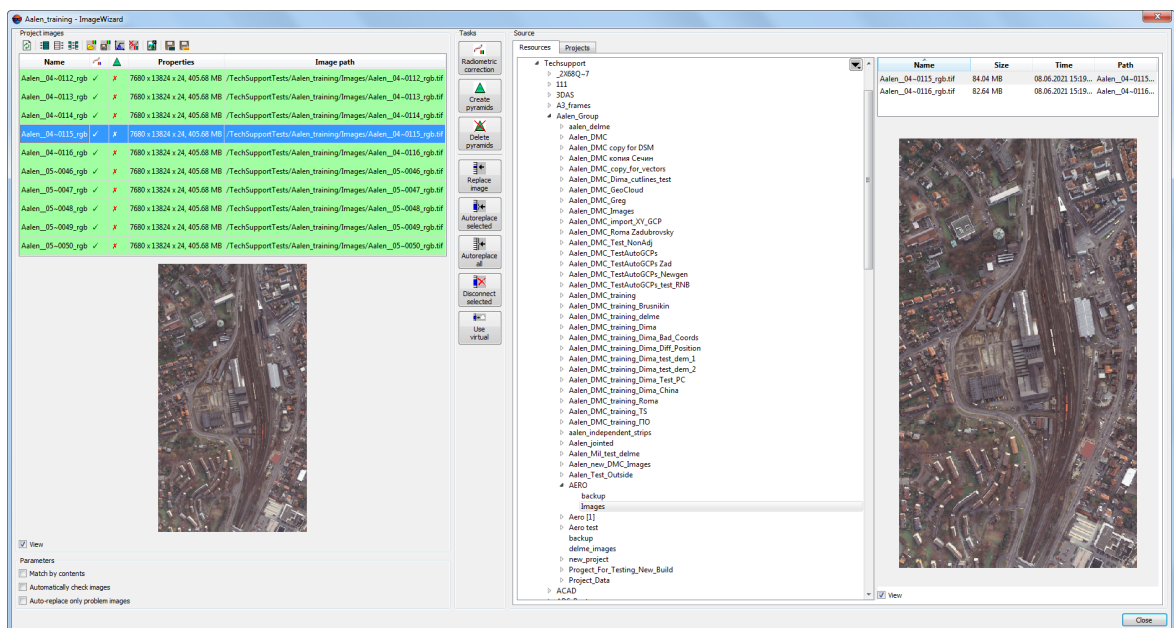
Fig. 75. The ImageWizard window

2. In the table of the **Project images** section select image to re-link.

3. In the **Source** section on the **Resources** or **Projects** tab choose the source image to re-link.

4. Click the ![icon] **Replace image** button to replace link for this source image.

5. Click the **Close** button to exit from **ImageWizard** module.

To join link to source image (if there is no link) perform the following:

⚠️ If one of the links to source file is unavailable, the system automatically offers to launch the *ImageWizard module* to search and add link to image.

1. Choose **Rasters › ImageWizard** or click the 🔧 button in the **Block editor** window. The **ImageWizard** window opens.
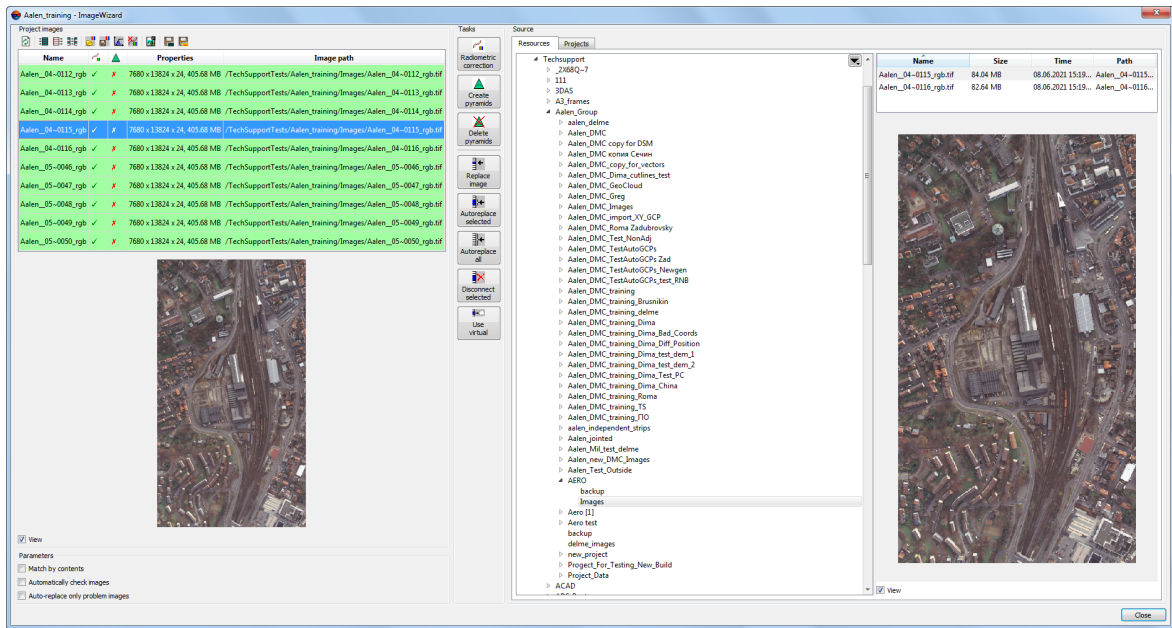
Fig. 76. The ImageWizard window

2. In the **Project images** section an `error` is displayed for those images that don't have link to source image.

✍️ Click the 📙 button in the main **ImageWizard** window toolbar to save these images filenames to the file with `*.txt` extension.

Fig. 77. Image without link to source file

3. Select images in the **Project images** table.

4. In the **Source** section on the **Resources** or **Projects** tab choose the source image.

5. Click the ⬛← **Autoreplace selected** button to get a link to selected file. As a result path to the source file is shown in the table of the **Projects images** section.

Fig. 78. Image with link to source file

6. Click the **Close** button to exit from **ImageWizard** module.

9.3. Affine georeference correction

The system provides possibility to perform affine correction for georeferenced data.

⚠️ This correction is necessary to affine coordinate system to obtain correct results.

🎓 An *affine coordinate system* is a coordinate system on an affine space where each coordinate is an affine map to the number line.

For correction perform the following:

1. Choose **Rasters › Affine georeference correction**. The **Georeference affine correction** window opens.
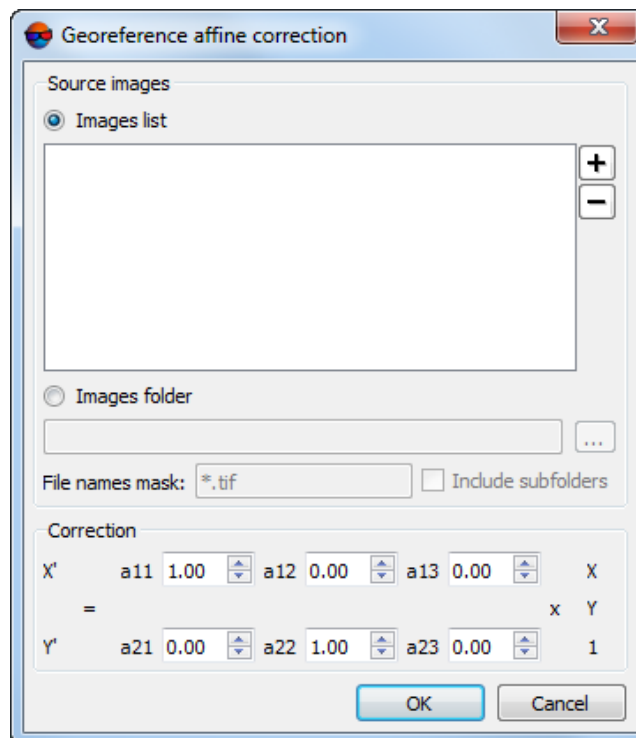
Fig. 79. Parameters of georeference affine correction

2. In the **Source images** section choose the way to obtain source image:

    • to apply correction only for some of project images, choose the **Image list**:

        ○ click the **+** button and select images;

        ○ click the ⸱⸱⸱ button to replace the appropriate image in the list to another;

        ○ click the **−** button to remove the selected image from the list.

- to apply correction for all images of project, which are placed in one path, choose the **Image folder**. Click the ⎡...⎤ button and choose path with images.

> In order to choose images of one format, specify the mask of extension in the **File name mask** field.

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

3. In the **Correction** section specify coefficients of polynomial approximate **a11..a23** in corresponding fields.

> In this method, finding new coordinates (X ', Y') task is merely the transformation of the initial coordinates of the point (X, Y) into new coordinates using the coefficients a1,..., an of the polynomial approximant.

4. Click OK. Information message with number of corrected images id displayed. Georeference files are creates in MapInfo TAB format and locates in folder with source images.

9.4. Saving of raster image

The system provides possibility to save georeferenced raster images, loaded to project, in chosen format.

To save georeferenced raster images, perform the following actions:

1. Load raster layer to the project (see the "Georeferenced external data" chapter in "Aerial triangulation" User Manual);

2. Make the *Raster* layer active.

3. Choose the **Raster › Save raster layer**. The **Save raster layer** window opens.
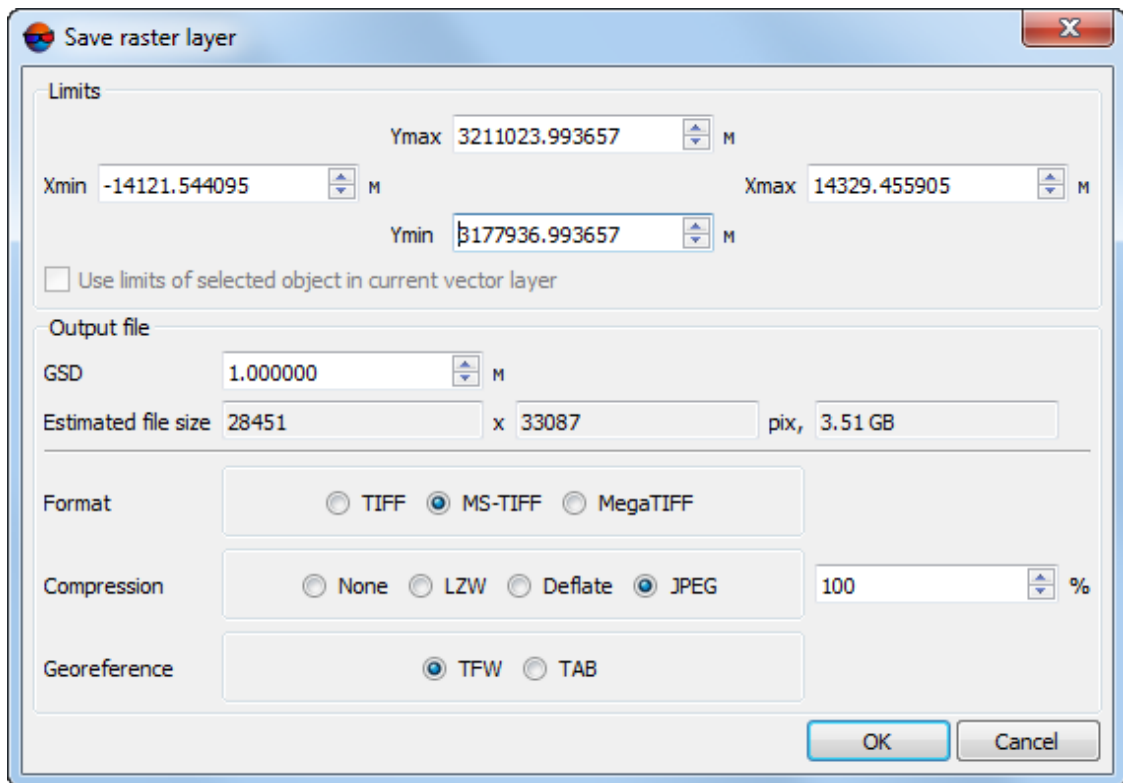
Fig. 80. Raster layer saving parameters

4. Specify coordinates of layer **Limits** to save.

5. [optional] To save image only inside of selected object, set the **Use limits of selec-
    ted objects in current vector layer** checkbox on.

6. Define the following parameters of **Output file**:

    • **GSD** of image in meters;

        In the field the **Estimated file size** in pixels and megabytes is displayed.

    • Image **Format** could be **TIFF**, **MS-TIFF** or **MegaTIFF**;

    • the **compression** type could be **None** (without compression), **LZW**, **Deflate** or
       JPEG;

        In case of JPEG-compression set the quality of compression.

    • type of the **georeference** file – **TFW** or **TAB**.

7. Click OK.

8. Define name and path for file and click the **Save** button.

9.5. Image pyramid creation

The system provides possibility to create pyramids for MegaTIFF image if images of this format without pyramid are used in the project.

Perform the following to create pyramids:

1. Choose the **Rasters › Rebuild MegaTiff pyramids**. The **Parameters** window opens.
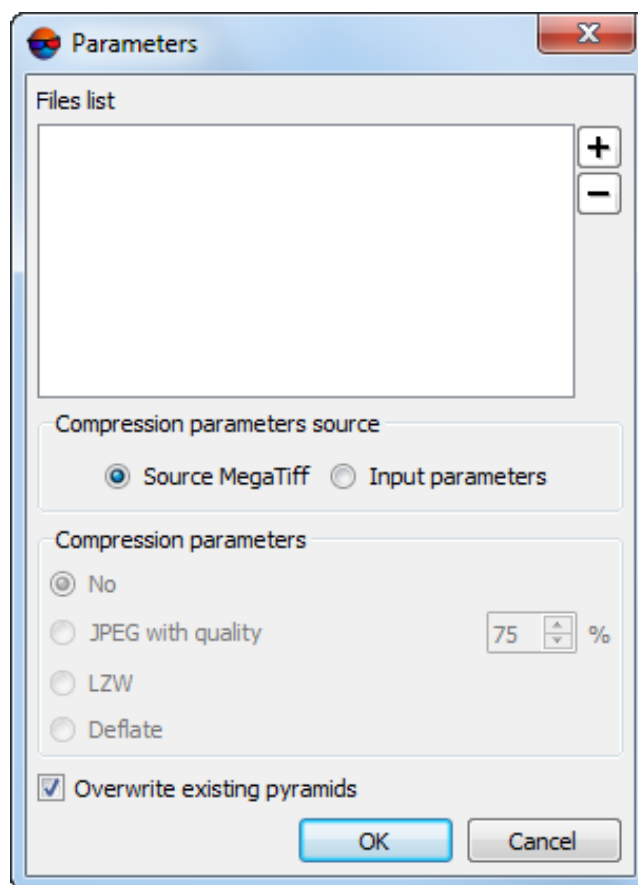
Fig. 81. Parameters of rebuilding MegaTiff pyramids

2. Create the MegaTIFF **files list**:

    • click the **+** button and select images;

    • click the **...** button to replace the appropriate image in the list to another;

- click the ━ button to remove the selected image from the list.

3. In the **Compression parameters source** set one of the following:

    - **Source MegaTIFF** to use parameters from the source image;

    - **Input parameters** to set the following **compression parameters** of images:

        ○ **None** – files are creates 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.

4. [optional] By default pyramids replace the existing one. To create only missing pyramids, set the **Overwrite existing pyramids** checkbox off.

5. Click OK to rebuild pyramids.

9.6. Web-map loading

The system provides possibility to load different web-maps as a raster layer (Internet connection is needed).

In order to load a web-map perform the following actions:

1. Choose the **Rasters › Load web-map**. The **Load web-map** window opens.
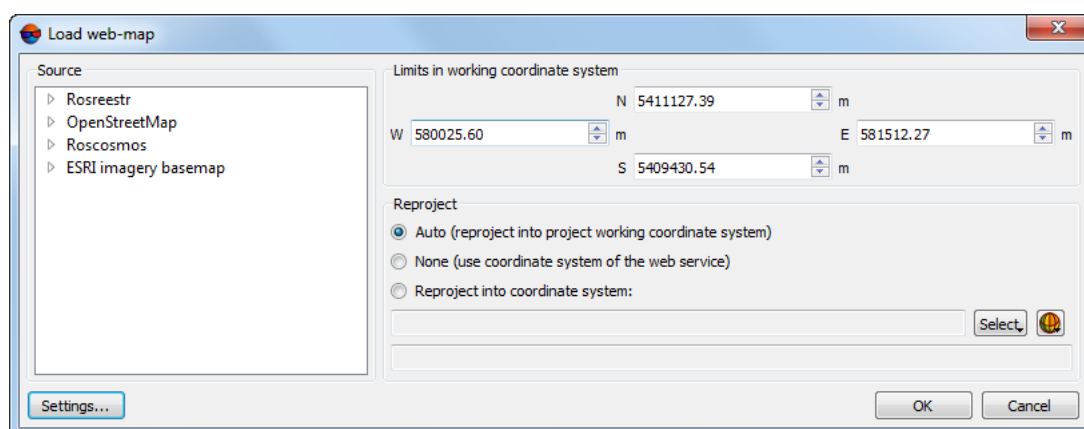
Fig. 82. Parameters of web-map

⚠ During the **Load web-map** window first launch, the **Settings** window opens at first (see paragraph **5** below).

2. In the **Source** section choose one of the web-source for 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`.

3. [optional] Defile limits of web-map loading in to the project.

4. In the **Reproject** section select one of the following:

   • **Auto** – to transform into projects coordinate system automatically (if possible);

   • **None** – to use coordinate system of the web-service;

   • **Reproject into coordinate system** – allows to choose the output coordinate system of web-map.

5. [optional] To setup web-map loading click the **Settings** button and setup parameters of network using.
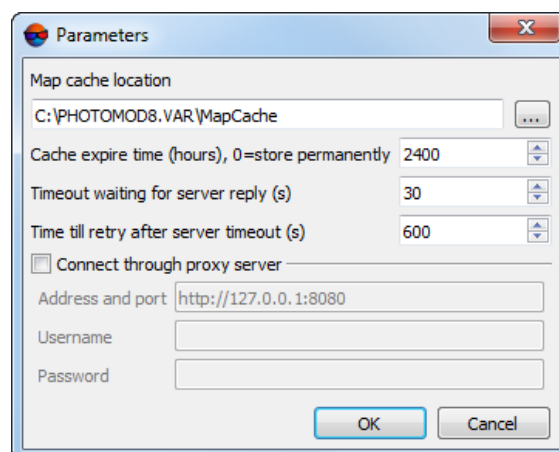
Fig. 83. Parameters of web-map loading

6.   Click OK. New vector layer adds in the *Layer Manager* and in the work are of the **Map** window loaded map is displayed.

9.7. Image georeferencing

The system provides possibility of georeferecing from one image to another (allows to transfer ground control points from one image to another).

The **Raster georeference** window is used for referencing one raster image to another.
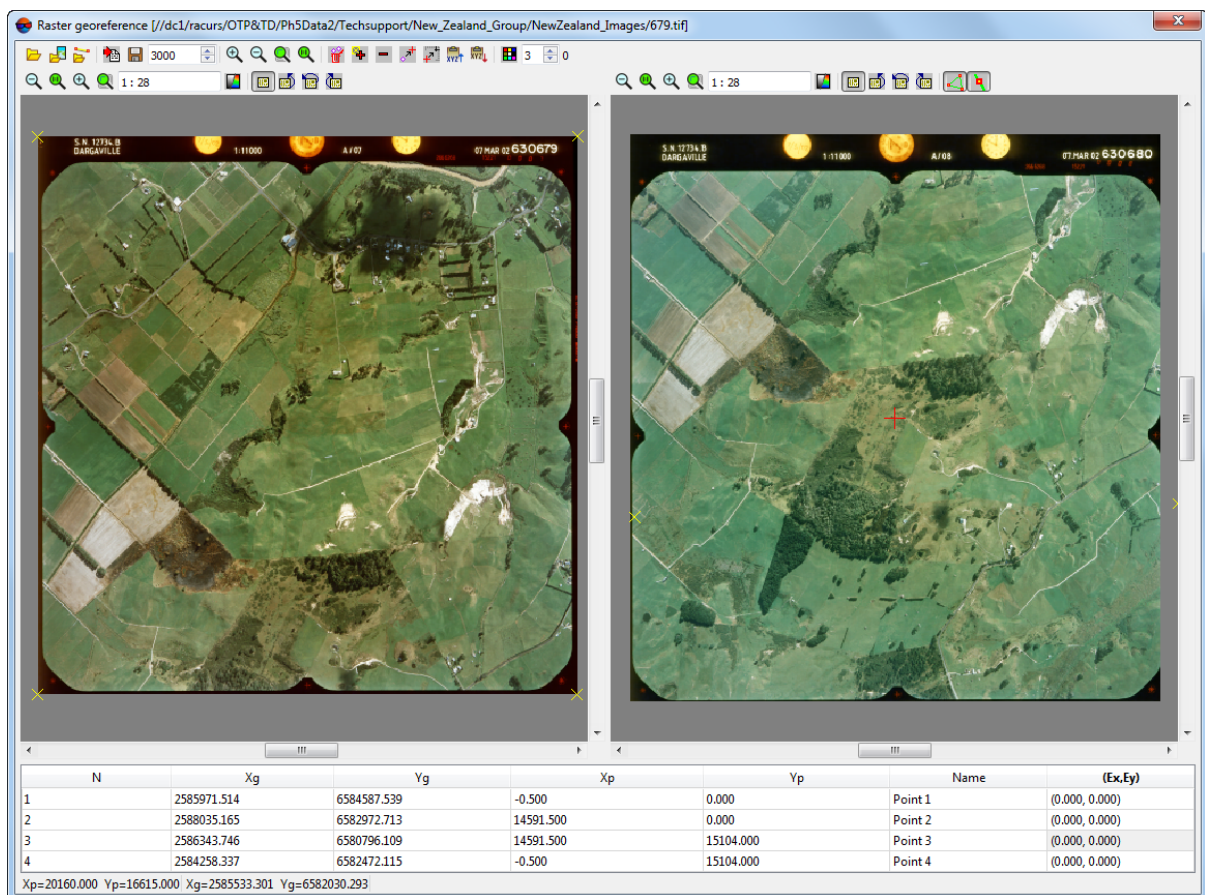
Fig. 84. Raster georefence window

The **Raster georeference** window contains the following elements:

* toolbar with buttons allow to load, save and scale image, add ant edit points and also to display coordinate system of used data;

* left part of window is used to load image;

* right part of image to load georeferenced image and/or vector layer;

* table with coordinates of points;

- status bar for displaying marker coordinates.

To perform georeference perform the following:

1. Choose the **Rasters › Images georeferencing**. The **Raster georeference** window opens.

2. Click the 📂 to load source image. Choose file and click the **Open** button. Image loads to the **Raster georeference** window.

3. Click the 📂 to load the second georeferenced image. Choose file and click the **Open** button. Image loads to the **Raster georeference** window.
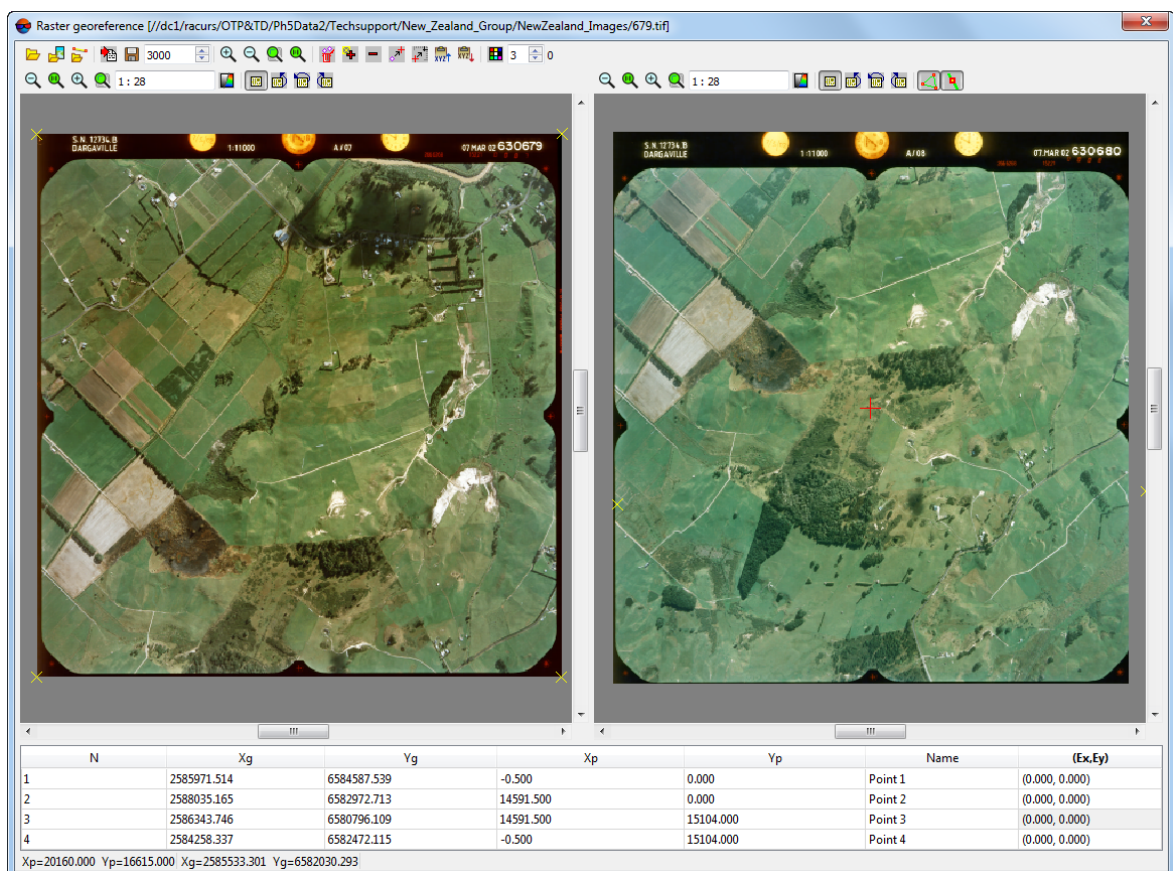
Fig. 85. Loading images

4. [optional] To load vector layer click the 📂 button. The **Parameters** window opens. The **Clear existing vectors** checkbox is set on by default to delete vector objects on the georeferenced image. Click OK. Then click the **Open** button. Information message about loaded vectors is displayed. Vectors are load over loaded georeferenced image.

> If the **Swap X Y** checkbox is cleared, the vector objects will be imported in the right coordinate system. Otherwise, in the left one.

5. [optional] To import coordinates of point from text file perform the following:

    1. Click the 🔖 button. The **Import parameters** window opens.
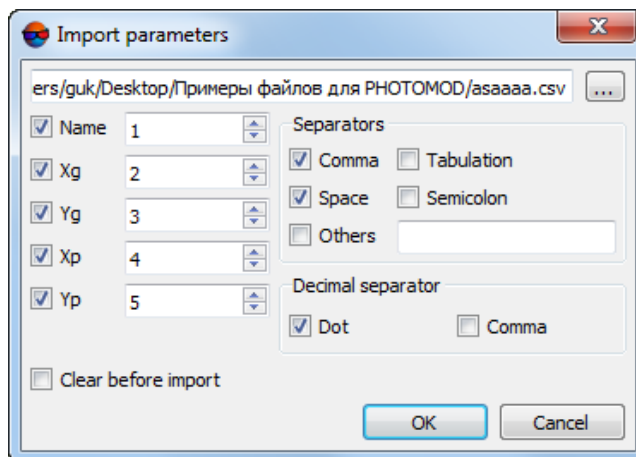
Fig. 86. Import parameters of points coordinates from a text file

    2. Click the ⟦...⟧ and choose *.txt or *.csv file. Click the **Open** button.

    3. Setup parameters of import.

    4. [optional] In order to prevent change of points coordinates, which are already measured on images, set the **Clear before import** checkbox.

    5. Click OK to add points to catalog.

    6. Find points from catalog on the map. To do this click the ✛ button and match geodetic coordinates of point selected in the table to pixel coordinates of the point on the map.

6. In order to add geodetic coordinates of GCP on the map manually perform the following actions:

    1. Locate GC point on the map and place marker to this terrain point.

    2. Click the ✛ button. The point's pixel coordinates are added to the table.

    3. 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.

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.

5. [optional] To move ground control points or to edit their coordinates see the description of the main toolbar of the **Raster georeference** window.

6. Click the button to save georeference file to TAB format.

Table 12. Main toolbar of the Raster georeference window

Buttons	Function
	to load source image without georeference
	to load georeferenced image
	to add georeferenced vector map of DXF, SHP or DGN format to another working window
	to load/add GC points data from text file to coordinate table
	to save georeference file in MapInfo format with name similar to image
	to zoom out of left and right parts of window for one step
	to display data in 1:1 scale
	to zoom in of left and right parts of window for one step
	to fit to page data of opened layers
	to delete all points from the table
	to add new point in the table (as a pixel coordinates (Xp, Yp) are displayed coordinates of marker, as a geodetic coordinates (Xg, Yg) – 0)
	to delete a point selected in the table
	to refresh coordinates of selected point (to save pixel coordinates of a new marker position on the map for the point selected in the table)
	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 selected point
	to refresh coordinates of selected point – to paste them from a clipboard (the following formats are acceptable:
	to open the *Windows* standard color box that allows to choose color of GCP symbols shown on the map
	[raster map window] to display raster image in grey scale
	to rotate image: No rotate, Rotate 90, 180 or 270 degree
	[raster map window] to show/hide loaded vectors

Buttons	Function
🔲	[raster map window] to show/hide nodes of vectors

9.8. Dust Correct

The *Dust Correct* module is used for 'cleaning' the *artifacts* on the orthoimages – images of dust particles, photo emulsion defects etc.

> 🎓 *Artifact* is called any object on image that shouldn't be on object: images of dust particles, photo emulsion defects, smooth, etc. Look like moire pattern, color errors, grainy lines etc.

> ⚠️ Image could be edited only in the `True Color` monitor mode.

Perform one of the following actions to start module:

• choose **Rasters › Dust Correct** in the main system menu;

• choose **Rasters › Dust Correct** in the *GeoMosaic* program.

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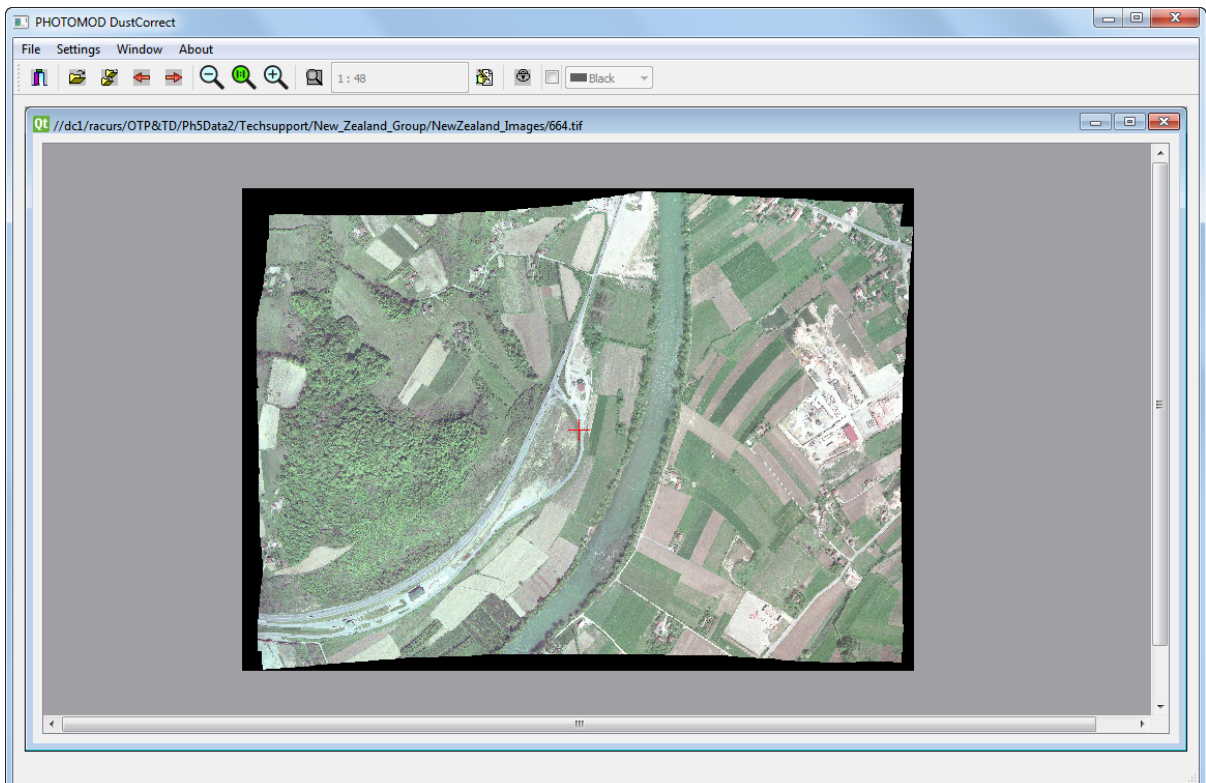

Fig. 87. The main program's window

The top toolbar contains the following buttons:

- ▮ (**Alt+X**) – allows to close the *DustCorrect module*;

- 📂 (**Ctrl+O**) – allows to open image to edit;

- 📂 (**Ctrl+Shift+O**) – allows to open more than one image;

- ⬅ – allows to return to previous image in module;

- ➡ – allows to move to next image in module;

- 🔍 – allows to zoom out an image;

- 🔍 (**Alt+1**) – allows to show raster image in zoom 1:1;

- 🔍 – allows to zoom in an image;

- 🔲 (**Alt+Enter**) – allows to zoom image to fit;

- 📝 – allows to open the **Editor** window;

- �'t – allows to disable image editing.

To set the image background color, set the checkbox in the right part of the window toolbar and select the appropriate item in the neighbor drop-down menu.

The **Window** menu contains the following menu items:

- **Cascade** – allows to stack opened windows;

- **Mosaic** – allows to arrange windows in a mosaic pattern;

- **Close** – allows to close active window;

- **Close all** – allows to close all windows in the *DustCorrect module*.

To specify the *Dust Correct* module settings, choose **Settings › Options**. The **Options** window opens:
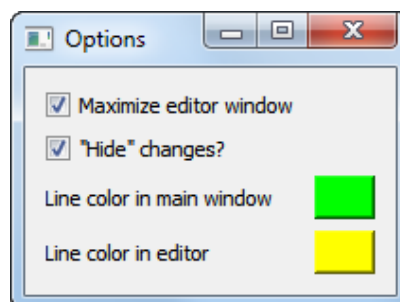

Fig. 88. The Options window

- to open the **Editor** window in fullscreen mode – set the **Maximize editor window** checkbox;

- use the appropriate standard tools to specify the **Line color in main window**;

- use the appropriate standard tools to specify the **Line color in editor** window.

To clear image from *artifacts* perform the following:

1. Choose **File › Open** (**Ctrl+O**) or click the ☞ button on the main module toolbar and choose image in BMP or TIFF without compression format to load into module.

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

    ☞ The module provides possibility to clear from artifact more several images at the same time. To open more than one image click the ☞ button. It is used the same workflow as for only one image.

2. Find artifact should be edited on image.

Fig. 89. Image fragment with artifact

To change scale of working window is used ***** key to zoom in and **/** to zoom out. To move on zoomed image right after mouse move press and hold **Alt** key and left mouse button or press and hold **Shift** key and use arrows on the keyboard.

3. Select fragment on image with artifact and "clear" fragment to replace artifact.

    Press and hold the **Shift** key and drag a rectangle by mouse.

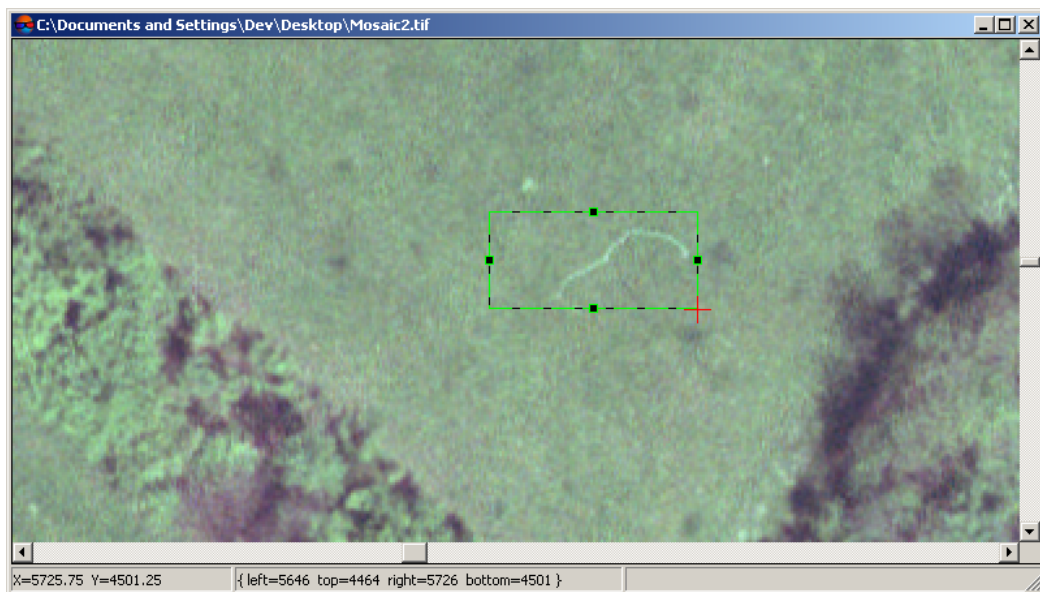☞   To break off selection, press the **Esc** key.

Fig. 90. Selecting fragment with artifact

4.   Click the 📝 button on the main module toolbar. The **Editor** window opens.
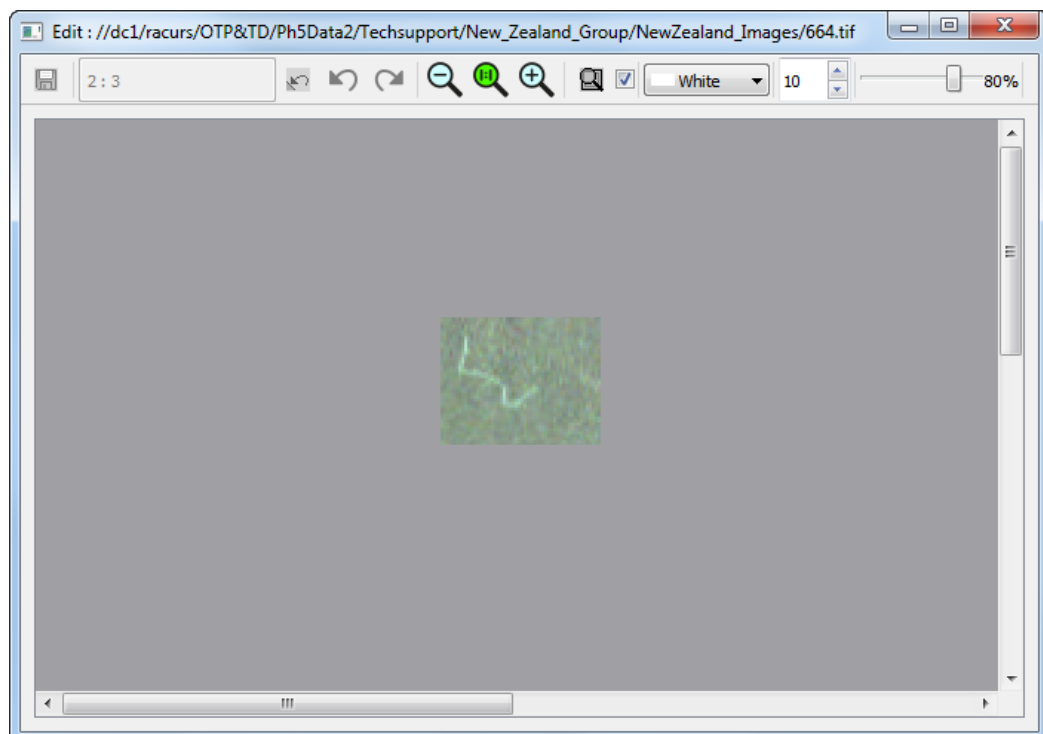

Fig. 91. The Editor window

5. In order to delete artifact perform the following actions:

> The tool described below (so called "clone brush") is used to retouch small local image defects by using multiple copies of adjacent image fragments used as data sources (so-called *samples*).

1. [optional] To specify the aperture size, input value in pixels in the field on the right of the scale, in **Editor** window toolbar.

> *Aperture* is a diameter of circle around the source point of which texture is used for correction (see below).

2. Use the appropriate slider (🔽) in the **Editor** window toolbar, to set the intensity of the "clone brush" impact (in percent);

3. Choose the source point with "clean" texture.

4. Place market in the chosen point and click, while holding pressed the **Shift** key, to mark the source point. The source point is marked by circle with the specified aperture diameter.

5. To "clear" image press and hold left mouse button and move rectangle on the artifact area.

> To cancel all actions in the editor click the ↶ button. To undo the last action in the **Editor** window click the ↶ button. To redo the last undone action click the ↷ button.

6. [optional] The background color is considered as transparent by default. Set the checkbox in the **Editor** window toolbar, to choose the desired background color in the appropriate drop-down list: **Black**, **White** or **Other**. Clear this checkbox in order to change the background pixels during image correction.

> ⚠ In most cases background on edges of image has constant value of color and brightness. It is not recommended to edit image on edge of raster and background to process image correctly, because in further image processing it could be necessary to merge raster image and background by color and brightness values.

7. Click the 💾 button to save results.
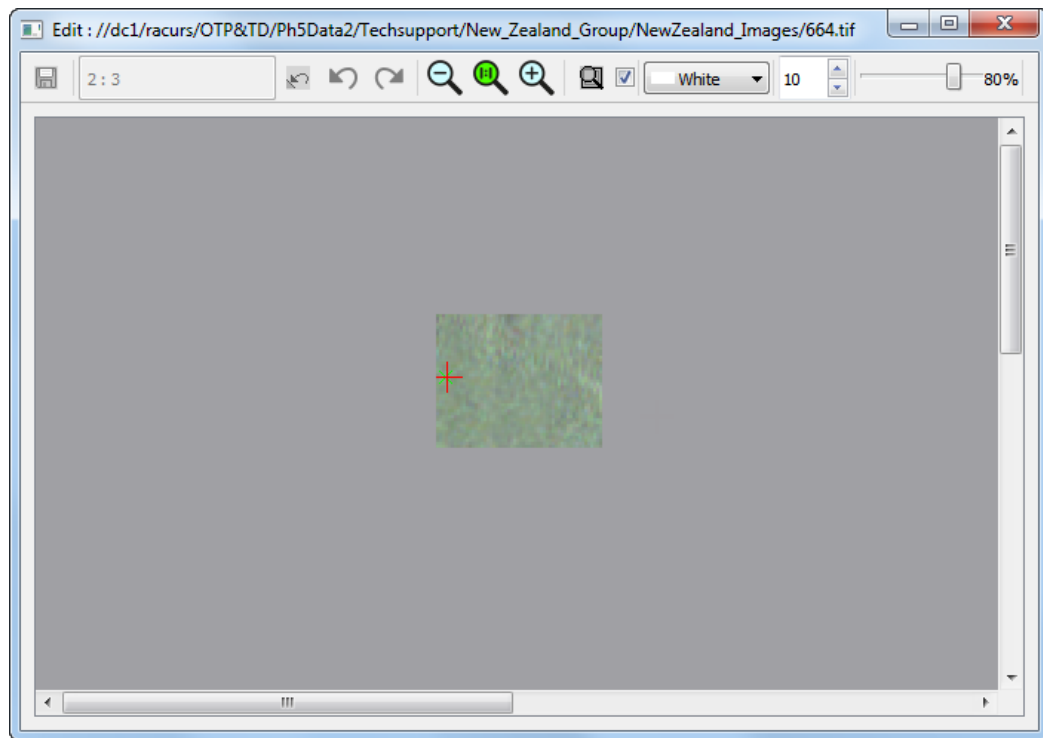
> To exit without saving close the **Editor** window.

Fig. 92. Image fragment without artifact

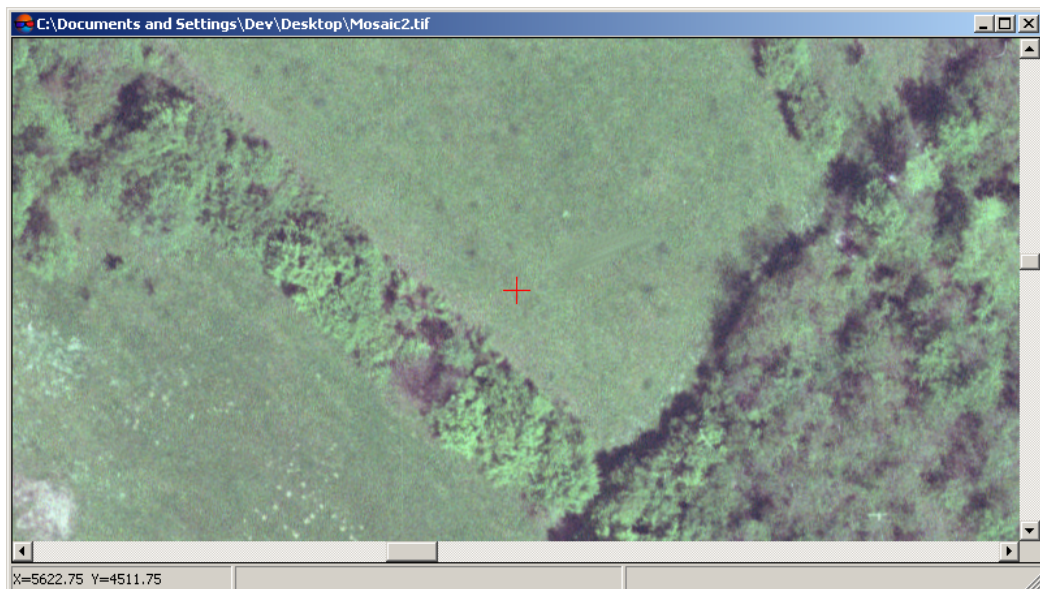6. Repeat the actions, described in step **5** to clear other parts of image.


Fig. 93. Results of image correction in the Dust Correct module

9.9. Changing of block images order

The **Images z-order** additional toolbar is used to change block scheme view and contains buttons used to perform the following operations:

- ⬚ –allows to reset images order (use the first order);

- ⬚ – allows to invert images order (images in all strips and order of strips);

- ⬚ – allows to move selected images to the top;

- ⬚ – allows to move selected strips to the top;

- ⬚ – allows to reverse images in the strip order;

- ⬚ – allows to invert strips order.

9.10. Creating areas without background (useful areas)

It is recommended to create areas without background before dense DEM generation using SGM method in Satellite scanner imagery projects (see the "Dense DEM generation using SGM method" chapter of the "DTM Generation" User Manual).

Useful area contains substantial part of image and excludes input background of image. Useful areas are represented as vector polygons.

Useful areas along with other information, are located in image description files, in the same folder with the images. Files with image description have `*.x-feat` extension.

> 🎓 The existing useful areas are used by the system's algorithms during dense DEM generation using SGM method (or they will be created automatically during DEM generation).

> 🎓 Areas without background, among other things, are necessary when creating a DEM using the SGM method (see the "Dense DEM generation using SGM method" in the "DTM Generation" User Manual).
>
> When processing Satellite scanner imagery or ADS projects, the program checks the presence of areas without background automatically, then, if they are absent, builds them automatically with default parameters or uses the areas without a background previously created by the user, if available.
>
> The areas without background created in such a way can then be edited by the user for further use, e.g. when rebuilding a DEM based on updated data (if appropriate). However, in most cases, the preliminary creation of areas without background and/or their manual correction are not required.
>
> When creating a DEM using the SGM method for projects on the base of central projection aerial imagery, automatic creation of areas without background is not performed. However, if areas without background, for some reason, will be manually created by the user beforehand, they will be taken into account when building a DEM.

This may be necessary in cases when aerial images have areas containing a background, and this, for example, cannot be corrected through the **Offset from image boundaries** customization (see the "Dense DEM generation using SGM method" in the "DTM Generation" User Manual).

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

Table 13. Brief description of menu 'Useful areas'

Menu items	Function
Build	to define parameters and calculate useful areas automatically as information located in files with image description (`*.x-feat`)
Load	to load *useful areas* as vector polygons after creation
Save	to save *useful areas* after manual correction

To load *Useful areas* as vector polygons after creation or verify their existence choose **Block › Useful areas › Load**.

For automatic calculation of useful areas perform the following actions:

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

Fig. 94. Useful areas parameters
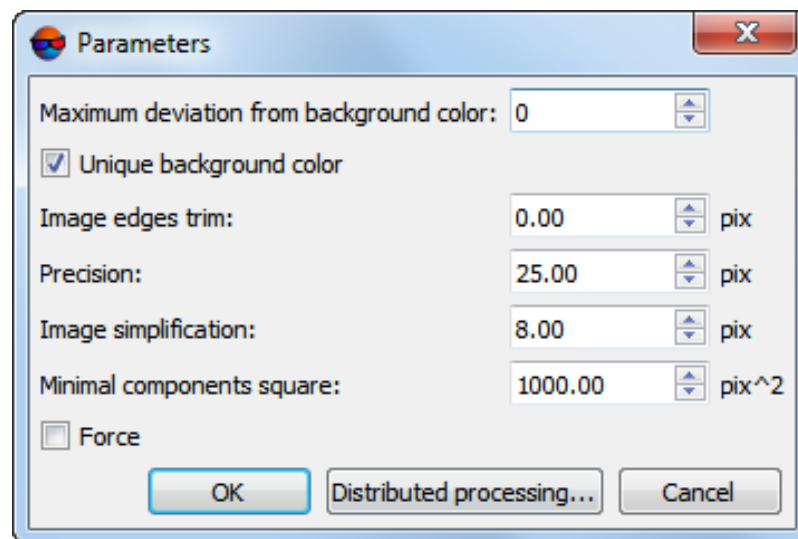
2. [optional] in case of areas on images with color equal to background color, set on the **Unique background color** checkbox and set the **Maximum deviation from background color** to define a range of color, which presents in background of source images.

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] 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.

8. 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.
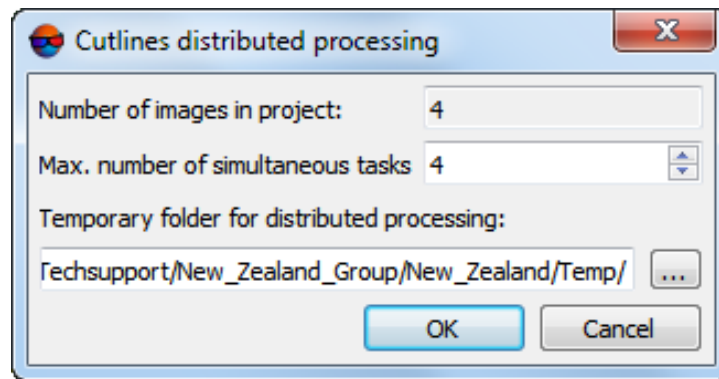
Fig. 95. Creating areas without background (useful areas)

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.
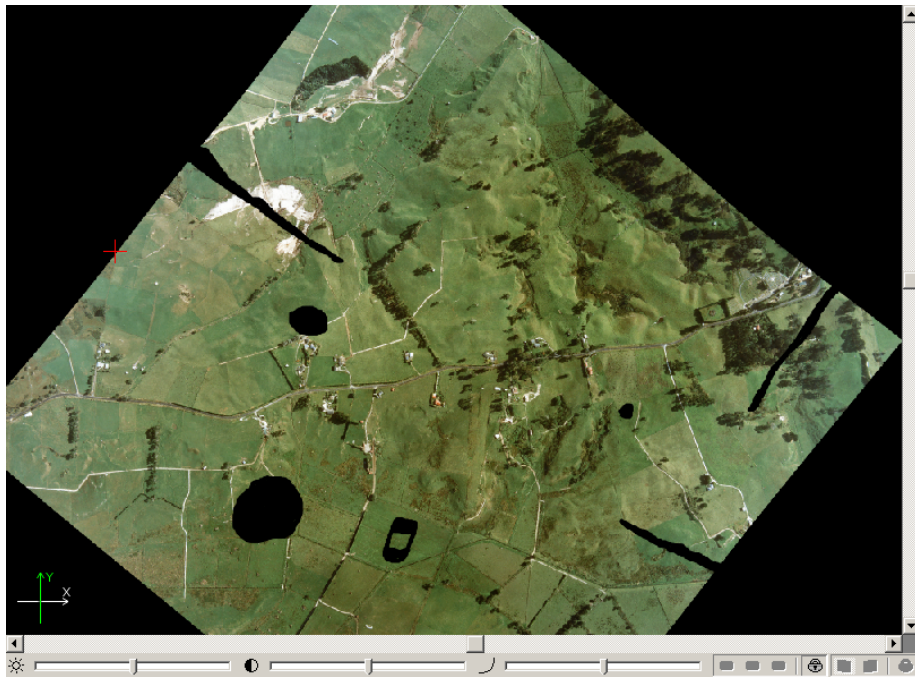
Fig. 96. Source image

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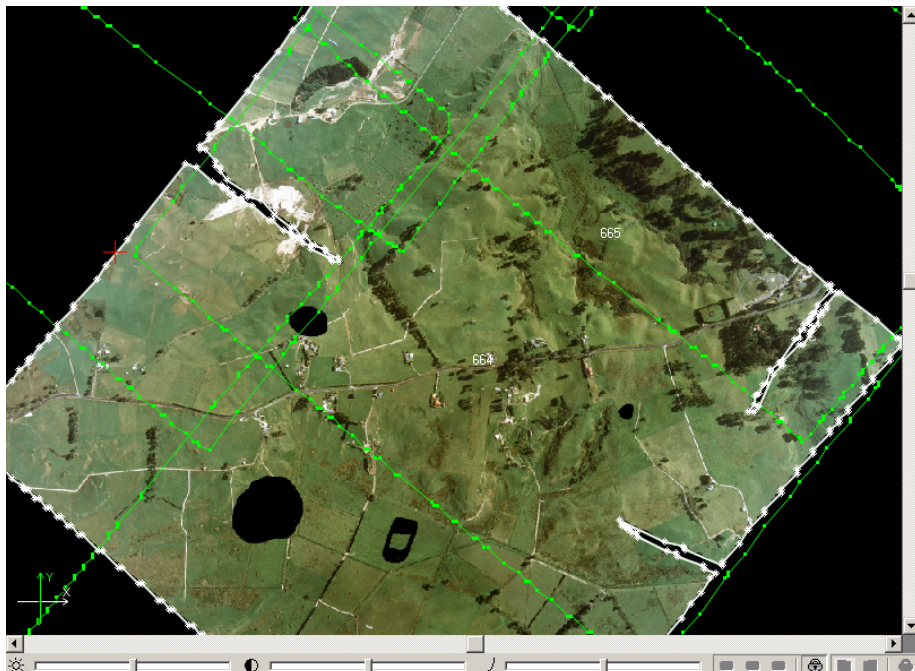

Fig. 97. Useful area in case of unique background color

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.
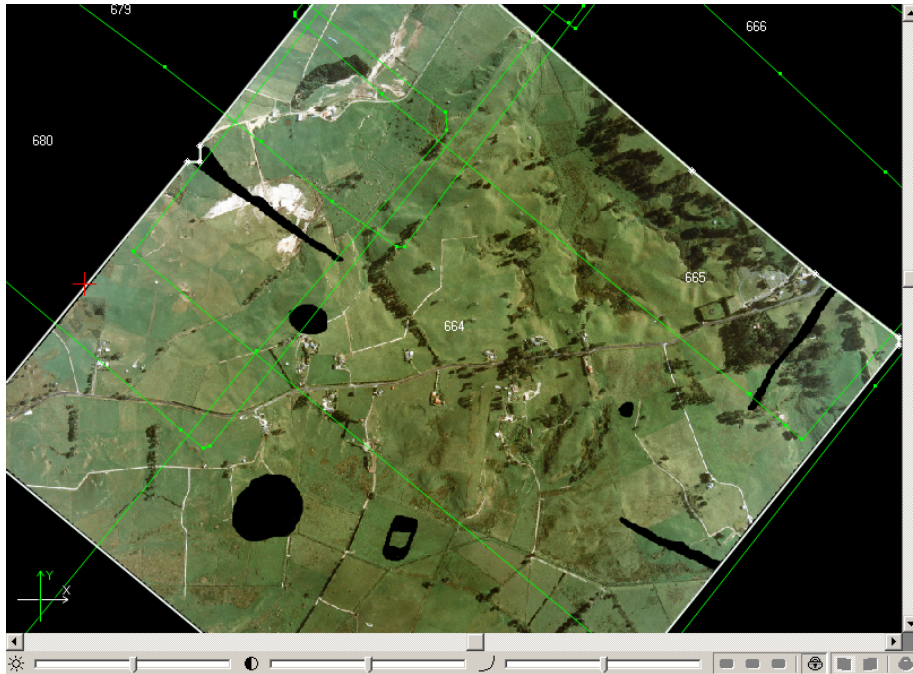

Fig. 98. Useful area in case of non-unique background color

9.11. Raster image histograms

The system provides for constructing raster image histograms.

An *image histogram* is the histogram of image brightness levels (either total or divided into color channels).

To create the raster image histogram, perform one of the following actions:

• Load a raster image layer into the project (see "Georeferenced external data" section in the "Aerial triangulation" User Manual and "Pseudo-stereo mode" in the "Vectorization" User Manual). Make the raster image layer editable ( ). Choose **Rasters › Create histogram by raster**.

• Click the button in **Radiometric correction** window toolbar (see the "Radiometric correction" section in the "General information" User Manual):

The **Histogram** window opens:

Fig. 99. The Histogram window

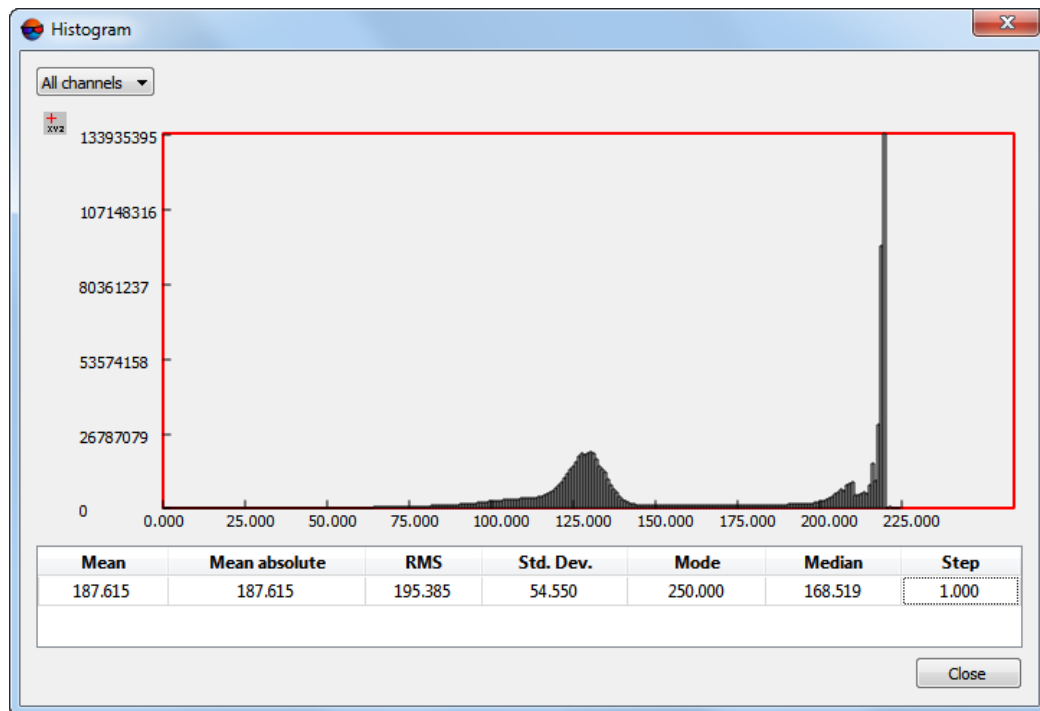The histogram is the graph of statistical distribution of a digital image elements with different brightness values. The horizontal axis represents the pixel brightness (0 to 255 for 8-bit rasters or 0 to 65535 for 16-bit ones), and the vertical axis denotes the number of pixels with particular brightness values.

There is a table in the bottom of the **Histogram** window that contains the following information on data used for histogram creation:

• Arithmetic **mean** brightness values used for histogram construction (the sum of pixel brightness values divided by the number of pixels);

• **Mean absolute** is the sum of pixel brightness moduli divided by the number of pixels;

• **RMS** (root mean square) is the square root of the sum of squared pixel brightness values divided by the number of pixels;

• **Std. Dev.** (standard deviation) is the square root of the sum of squared deviations divided by the number of pixels;

> *Deviation* is the difference between the pixel brightness and the arithmetic mean brightness in the data used (see above).

• **Mode** is the brightness value most frequent in the data used to construct the histogram;

- **Median** bisects a series of ordered brightness values, with an equal number of values both above and below the median (i.e. left and right on the X-axis);

- **Step**.

A total image histogram is to be constructed by default (**all channels** are to be used). To re-build the histogram for a particular channel, choose this channel in the drop-down list in the upper part of the window.

To display a tooltip with the exact values of the number of pixels (**Y** axis) and the boundaries of brightness range segment (**X** axis) when you hover the cursor over a separate chart column, click ![icon].

> To disable tooltips, click ![icon] once more.

10. Additional features

10.1. Specifying ground sample distance (GSD)

The systems provides an opportunity to set ground sample distance (GSD) for block images.

> *GSD* (Ground Sample Distance) is a pixel size on ground for satellite digital images.

The GSD parameter is used to create block layout and affect the size of block images (see the "Aerial triangulation" User Manual).

The GSD value could be set manually or calculate automatically by DEM (if any).

> ⚠ For automatic calculation of GSD data by DEM it is necessary to have both interior orientation and exterior orientation parameters available (projection centers coordinates, at least).

> GSD value also could be set in the **Image properties** window, that is opened using the ![icon] button in the **Block editor** window. However, this feature allows to set GSD value only manually and separately for each image selected in the table of the **Block editor** window.

In order to define GSD for block images perform the following actions:

1. Choose the **Block › Set GSD** or click the ![icon] of the **Block forming** additional toolbar. The **Ground sample distance (GSD)** window opens.
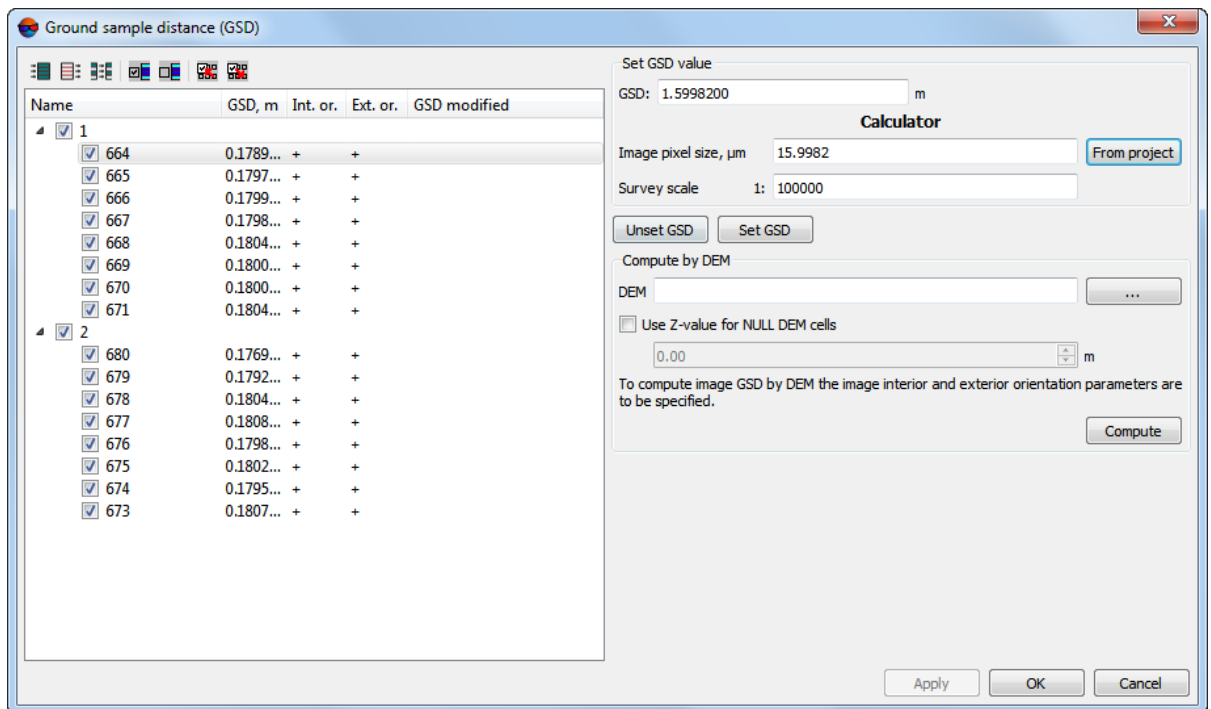
Fig. 100. Defining GSD

The table contains the following columns:

- **Name** – displays a list of all block strips and images;

- **GSD, m** – displays current GSD value (in case of unavailable GSD data, '-' is displayed);

- **Interior orientation** – displays statistics about interior orientation parameters availability for block images: '+' – available, '-' – unavailable;

- **Exterior orientation** – displays statistics exterior orientation parameters availability for block images: '+' – available, '-' – unavailable

- **GSD modified** – displays "*" if GSD value was changed.

Toolbar of the **Ground sample distance (GSD)** image contains the following buttons for selecting images:

- ⁞▤ – allows to select all images;

- ▤⁞ – allows to unselect all images;

- ▤⁞▤ – allows to invert selection of files;

- ☑▤ – allows to select highlighted images;

- ◻▮ – allows to unselect highlighted images;

- ▦ – allows to select in a table or list those images which are highlighted on a block scheme in 2D-window;

- ▦ – allows to highlight on a block scheme in 2D-window those images which are selected in a table or list.

2. Select images of block to set them GSD.

3. Set GSD value in the **Set GSD value** section.

> ⚠ For scanner images GSD could be set only manually.

> ☞ The **Unset GSD** button allows to cancel defined GSD value for selected images. In this case the GSD column in the table will display '-' for selected images.

To specify image GSD value manually input this value to the **GSD** field in the **Set GSD value** section and click the **Set GSD** button.

For calculating GSD automatically perform the following:

1. Define **Image pixel size, um** manually in the **Calculator** section or click the **From project** button to obtain information from metadata.

2. Set the **Survey scale** as `1:m` in meters. Calculated value is displayed in the **GSD** field in the **Set GSD value** section.

3. Click the **Set GSD** button. Set GSD values are displayed in the table for selected images.

To calculate GSD values by DEM perform the following:

1. Click the ⬚ button of the **Compute by DEM** section and specify DEM for automatic GSD calculation.

> ⚠ It is necessary to have data of interior and exterior orientation of image for automatic GSD calculation by DEM.

2. [optional] Set the **In void DEM cells use Z** checkbox on and specify Z-coordinate in the input field for empty DEM cells (if any).

3. [optional] Set the **Use image points out of DEM extents** checkbox on for the case when DEM does not "cover" images block completely.

4. Click the **Compute** button. GSD values calculated by DEM are displayed in the table for selected images.

4.   Save defined GSD values by clicking the **Apply** button.

10.2. Creating overlap map

For visual analysis of images and strips overlap in a block the system provides a feature of overlap map creating. After creating of such a map the overlap areas are created as kind of vector polygons on a new vector layer.

Perform the following actions to create overlap map:

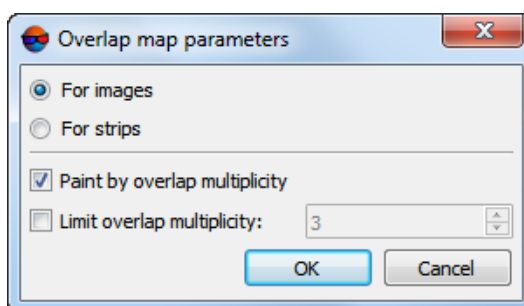1.   Choose **Block › Create overlap map**. The **Overlap map parameters** window opens.

Fig. 101. Parameters of overlap map creating

2.   Choose elements of a block to be used for overlap map creating: **For images** or **For strips**.

3.   [optional] Set on the **Paint by overlap multiplicity** checkbox to color overlap areas depending on overlap multiplicity, i.e. on number of images/strips that fall into the overlap. When the option is disabled overlap areas are not colored.

4.   [optional] Set on the **Limit overlap multiplicity** checkbox and input number of images/strips in overlap area, and when the value will be exceeded the fill color will be not changed.

5.   Click OK. A new vector layer containing overlap map is created.

> In order to obtain information about number of images that fall to chosen overlap area, allocate a part of overlap map and choose the **Window › Objects attributes**.

> You can export overlap map using the **Vectors › Export** menu item to choose export format.
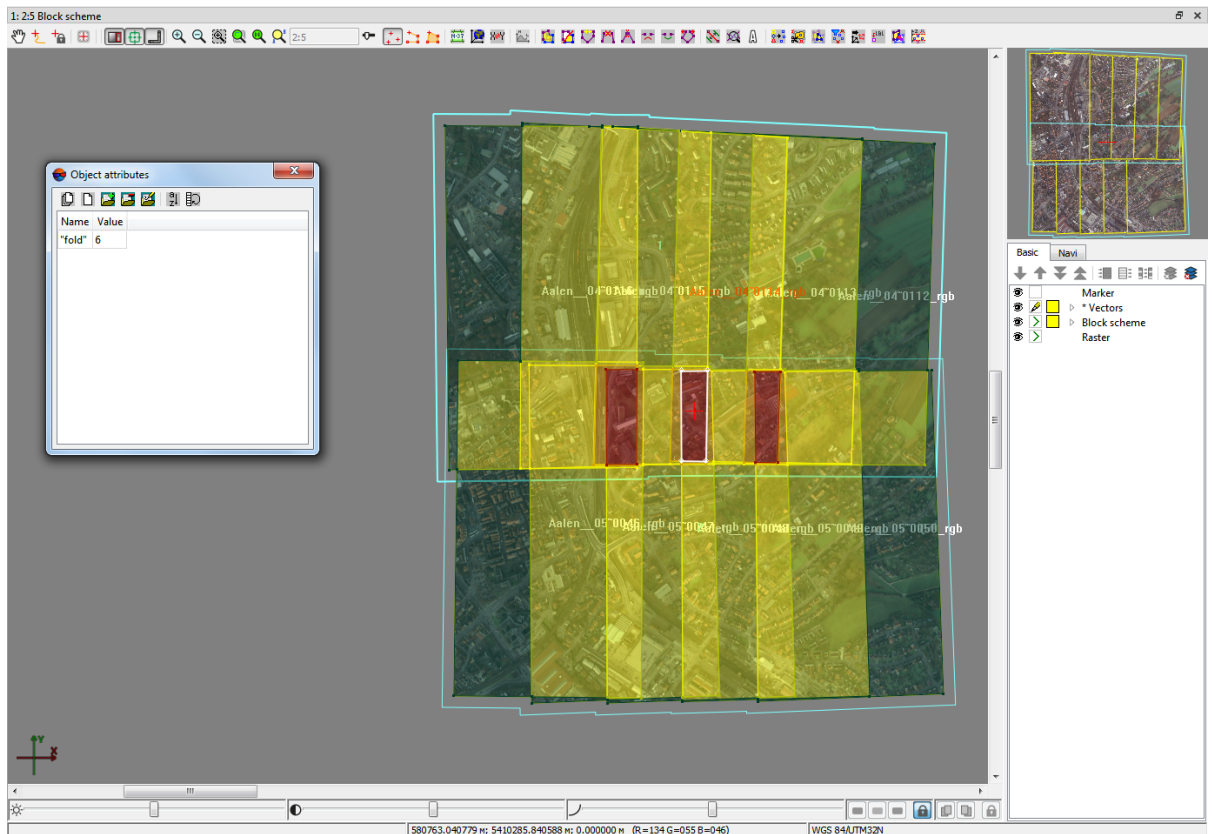
Fig. 102. Overlap map

10.3. Creating vector layers from block layout

The system allows to obtain auxiliary data from block scheme – outlines of all/selected block images (strips) or common boundary of block/group of selected images (strips) – as vector objects on new vector layers. This data from block scheme is used, for example, to define boundaries during TIN, or DEM building.

Perform the following actions to obtain vector data from block scheme:

1. [optional] Select block images (or strips) to build outlines for particular part of a block.

    ☞ To select (highlight) the image in the **Block editor** window click the image name in the list. To select strip click the name of strip.

2. Choose **Block › Create vector layer from block layout**. The **Create vector layer from block layout** window opens.

3. Click one of the following buttons:

- **All images (strips)**. The system creates and displays three vector layers: *Block outline* with common block boundary, *Block scheme* with outline of each block image and *Block strips scheme* with outline of each block strip.

- **Selected images (strips)**. The system creates and displays three vector layers: *Block outline* with common boundary of selected block images, *Block scheme* with outline of each block image selected and *Block strips scheme* with outline of each block strip selected.

> To export vector outlines, obtained from block scheme, choose export format in the **Vectors › Export** menu.

> For projects of Satellite scanner imagery type the *Block scheme* layer contains attributes of objects that helps to extract scanner images data from metadata.
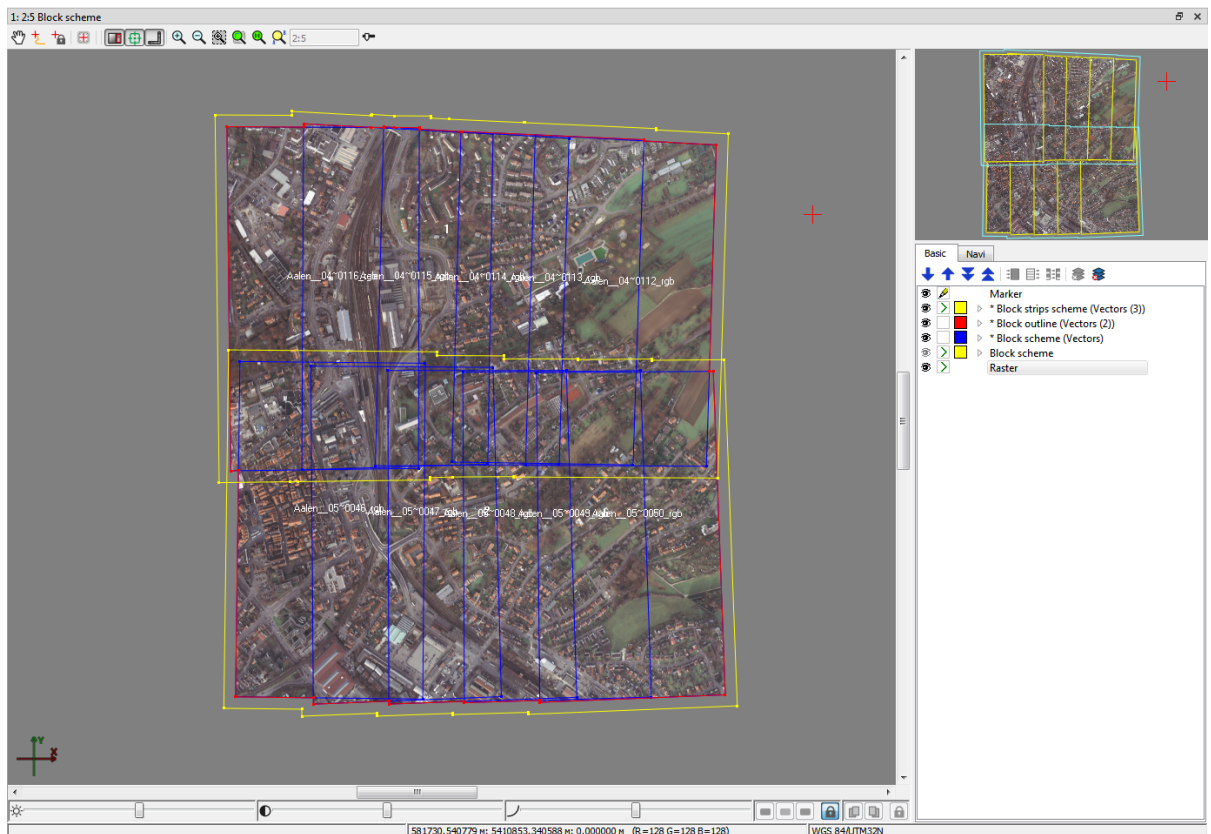

Fig. 103. Outlines from block scheme

10.4. Creation pre-regions for a block

The system provides possibility to create block pre-regions by images frames or by stereopair frames to allow mutual project processing during vectorization. Pre-regions created by stereopairs frames can also increase the speed of automatic points calculation

and building dense DEM by reducing the number of images overlap areas (see the "Creation of DTM" User Manual).

> *Pre-regions* – vector layer which consists of polygons, drawn by images block.

Perform the following actions to create pre-regions:

1. Select **Block › Build pre-regions**. The **Create pre-regions** window opens.
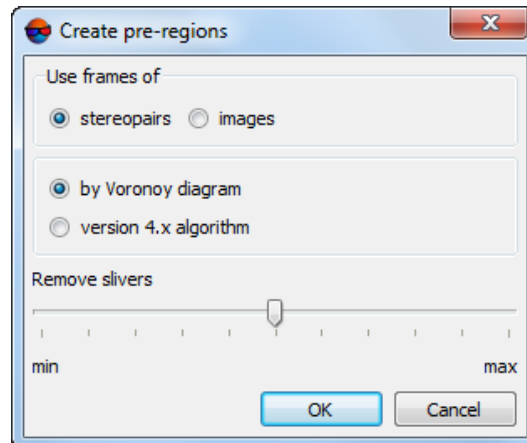

Fig. 104. Pre-regions parameters

2. In the **Use frames of** section select one of the following ways of pre-regions creation:

    -   **stereopairs** to create pre-regions using overlap areas of two stereopair images;

    > When using **stereopairs** frames the system fills in polygons attributes automatically as follows: *region_image_code* (with the left image code), *region_image_name* (with the left image name), region_image_code_2 (with the right image code), region_image_name_2 (with the right image name).

    -   **images** to create pre-regions by near-nadir areas of each image.

    > When using **images** frames the system fills in polygons attributes automatically as follows: *region_image_code*, *region_image_name*.

3. Select a way to create pre-regions using selected frames: Using **Voronoy diagram** or **version 4.x algorithms** earlier system's version algorithm (PHOTOMOD 4.x).

4. [optional] Set the **Remove slivers** slider (at **min** value the pre-regions are built considering narrow strips; at **max** value the pre-regions is created without narrow strips).

5. Click OK to create pre-regions. The system creates a new vector layer with pre-regions.

> To load, edit, save and close of pre-regions layer the system provides standard too for work with vector objects (see description in the *"Vector objects editing"* chapter of the Vectorization User Manual).
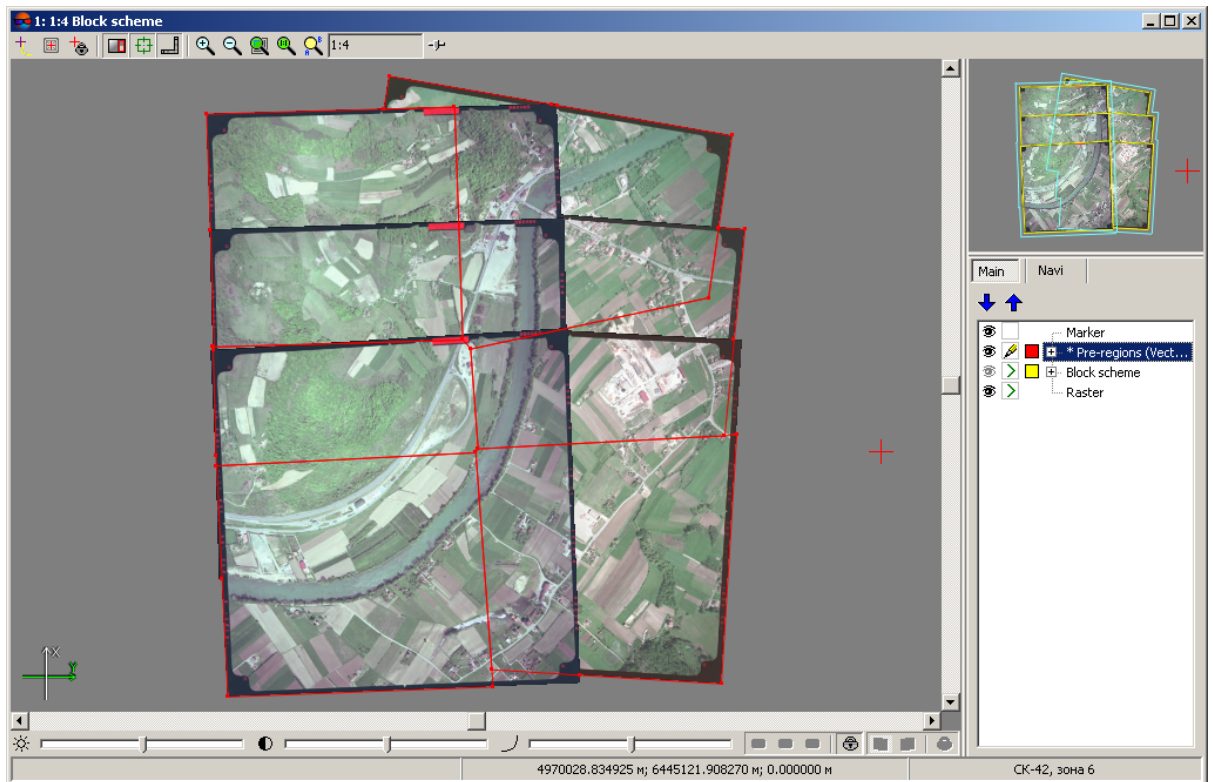

Fig. 105. Creation of pre-regions using Voronoy diagram, when the "Remove slivers" slider is placed to the middle position
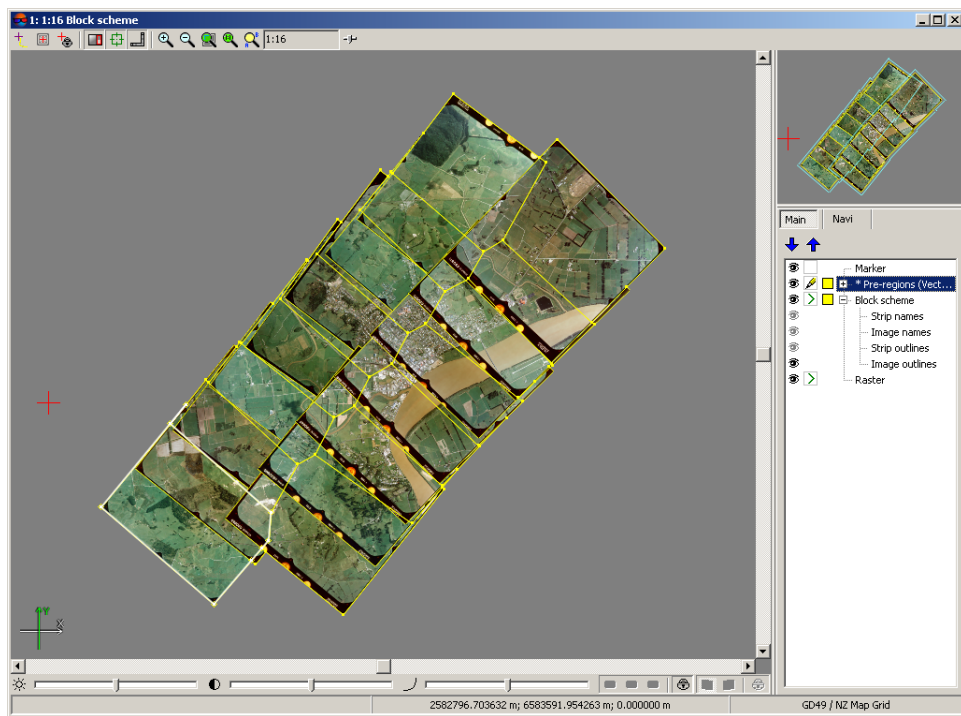
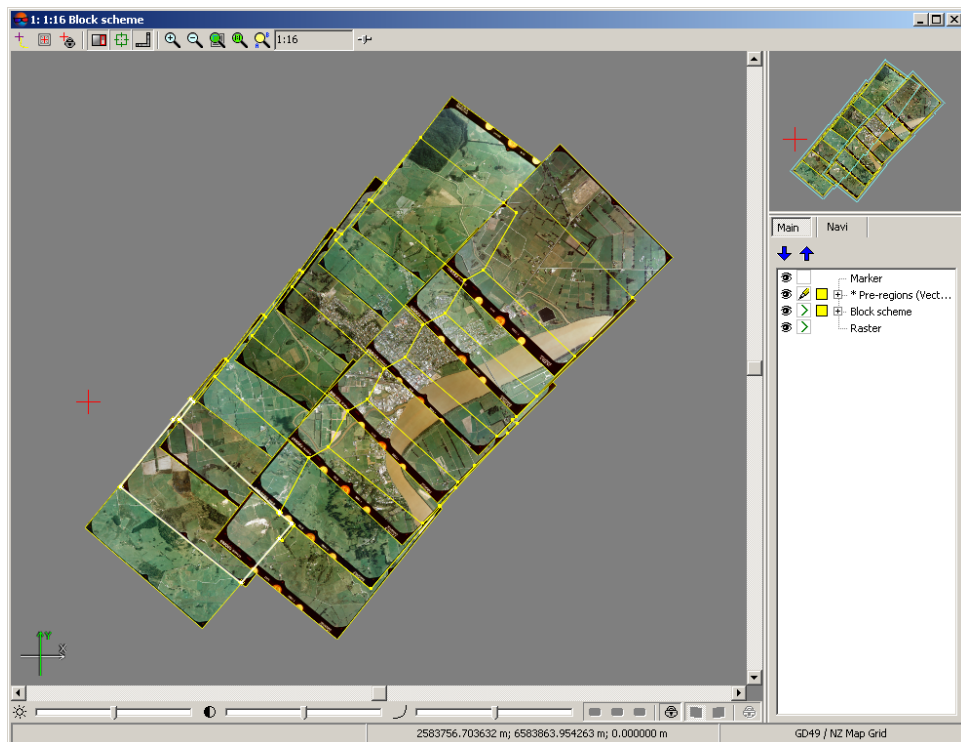Fig. 106. Pre-regions created using images frames

Fig. 107. Pre-regions created using stereopairs frames

10.5. The list of stereopairs for a selected image

The system allows to open the list of images that form stereopairs with an image selected in the **Block editor** window, including the case when two images forming a stereopair are located on different strips.

⚠️   Only two images adjacent to the selected image are displayed from among the images that form stereopairs with this selected image and located on the same strip with it.

⚠️   The displaying of images that form stereopairs with the selected image and located on different strips depends on the settings of interstrip stereopair formation in the **Settings** window (**Service › Settings › Block scheme**, **Forming interstrip stereopairs** section).

⚠️   Formation of stereopairs for the projects of **Satellite scanner imagery** and **Airborne Digital Sensor ADS** types is described in the "Manual creation of stereopairs" section in the "Block adjustment" User Manual.

To open the list, perform the following:

1. Select *one* image in the **Block editor** window and click the 🔲 button. The following window opens: **Stereopair images for image** which was selected in the **Block editor** window.
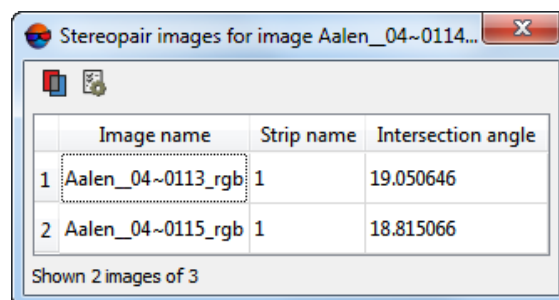

Fig. 108. The list of images with which the selected image forms stereopairs, additionally sorted by the convergence angle

This window contains the following elements:

* The table containing the list of images with which the selected image forms a stereopair. The table has the following columns:

   ○ `Image name` – with which the selected image forms a stereopair;

   ○ `Strip name` – the name of the strip this image is located in;

   ○ `Intersection angle`.

* The toolbar containing the following buttons:

○ ![icon] – allows to open a stereopair to the image selected in the abovementioned table;

○ ![icon] – allows to specify the **Settings for displaying a list of stereopair images** depending on the convergence angle.

- The section that displays the number of images contained in the table (depending on the preset convergence angle) as relating to the total number of images with which the selected image forms stereopairs.

2. To specify the **Settings for displaying a list of stereopair images** depending on the convergence angle, click the ![icon] button. The **Settings for displaying a list of stereopair images** window opens:
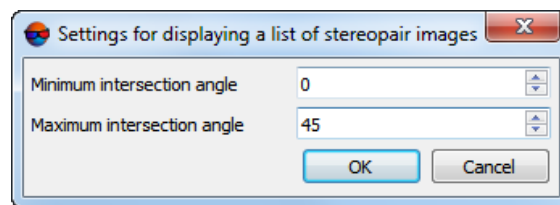

Fig. 109. The Settings for displaying a list of stereopair images window

- Set the **minimum intersection angle**;

- Set the **maximum intersection angle**;

- Click OK to close the window.

10.6. Block scheme settings

The system provides possibility of block scheme export to KML (KMZ) format.

1. For export choose the **Block › Export block layout to KML, KMZ**. The **Export block layout to KML** window opens.

2. Specify the following parameters:

- the **Export selected images only** checkbox is used to export part of block scheme;

- **Frames color** – allows to specify color of block scheme border;

- **Fill color** – allows to set on the color filling inside of block scheme border.
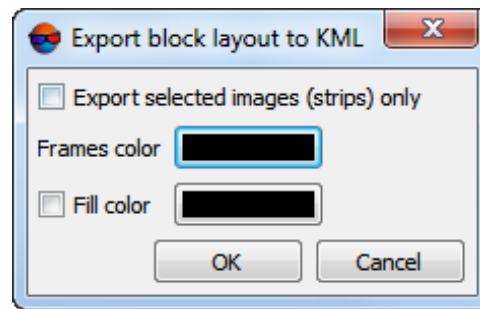
Fig. 110. Block scheme export settings

3. Click OK.

> The system allows to obtain auxiliary data from block scheme – outlines of all/selected
> block images (strips) or common boundary of block/group of selected images (strips) – as
> vector objects on new vector layers.
>
> To export vector outlines, obtained from block scheme, choose export format in the **Vectors ›
> Export** menu.

11. Convert reference crosses

The system provides the possibility to process data from `TK-350` topographic camera
installed on the `Kometa` satellite topographic unite designed to obtain high-precision to-
pographic imagery used for terrain mapping.

For data processing, the camera passport file (with `*.txt` extension) is used that cor-
responds to the orbit under processing, with grid cross coordinates corrected taking
into account calibrated distortion, refraction, and coordinates of the main point.

The system allows to convert this file to the camera passport file with `*.x-cam` extension
(required for further block adjustment with original imagery when measuring points of
laser reflection) and to the table of crosses with `*.txt` extension for its further processing
using *PHOTOMOD ScanCorrect* (see the "ScanCorrect" User Manual).

To convert `TK-350` camera passport file, perform the following:

1. Choose **Block › Reference crosses conversion**. The **Convert cross coordinates**
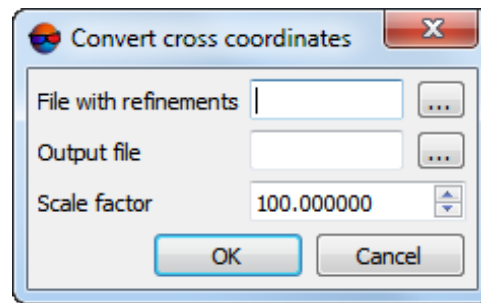   window opens.

Fig. 111. The Convert cross coordinates window

2. In the **File with refinements** input field, click the [...] button to locate an input camera passport file (with *.txt extension) in the *Windows* filesystem;

3. In the **Output file** input field, click the [...] button to locate output camera passport files and tables of crosses in the *Windows* filesystem;

4. Click OK to convert a file.