Digital Photogrammetric System



Version 6.3

USER MANUAL

The GeoCalculator program



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1. Functions, installation and starting of the GeoCalculator *program*

The *GeoCalculator* (further – "program") is used for coordinates transformation from one coordinate system to another.

The program includes to the *PHOTOMOD* system and installing with it automatically. Also it could be installed as a separate application.

The international coordinate systems database is installed automatically with the program. It is required to work with GeoCalculator.

To start the program perform one of the following:

- [is it is installed as separate application] choose Star > Programs > PHOTOMOD GeoCalculator > GeoCalculator;
- choose Service > GeoCalculator in the main PHOTOMOD system's window.

To delete the program choose the **Start > Programs > PHOTOMOD GeoCalculator > Uninstall GeoCalculator**.

2. The GeoCalculator Program settings

The **Options** window is used to specify display parameters of the program.

The **Browse** window opens in the first program start to define coordinate systems database folder.



Coordinate systems database is loading to the C:\Program Files\PHOTOMOD GeoCalculator\CoordSys or C:\Program Files\PHOTOMOD\CoordSys folder during the installation of the PHOTOMOD system's window. The International folder is used to store international coordinate systems database.



To use a local database choose the folder with it.

Обзор папок	? ×
Select database folder	
🗄 🛅 Far	
🛅 FiducialTemplates	
🚞 gistool	
🛅 Hasp	
🖭 🧰 Help	
🗆 🧰 Legacy	
🖂 🧰 en	
Config	
🖃 🚞 CoordSys	
🗁 International	
🚞 Latvia	
🚞 Poland	
🛅 Taiwan	
🛅 Help	
🕀 🧰 ru	
🗄 🧰 Ing	-1
主 🕞 ManView11	
Создать папку ОК	Отмена

Fig. 1. Browse for the reference systems database folder

To open **Options** window choose **Service** > **Options** or click the **S** button on the main program's toolbar.

Options	×
Database Directory	
C:\Program Files\PHOTOMOD5\Legacy\CoordSys\Internati	
Colors	
Invalid Field Value Color Red	
Interface Mode	
Standard C Advanced	
✓ OK	

Fig. 2. Program settings

The window allows to set the following options:

• Database directory – allows to change the path to database folder;



For correct work of the program it is necessary to have a write access to the *Program Files* folder.

- Colors allows to set the Invalid Field Value Color which is used during the coordinates transformation from one coordinate system (CS) to another;
- Interface Mode allows to set one of the following program's modes:
 - Standard the default mode;



In order to open the main window of the *GeoCalculator* program, define the database folder and choose the default mode.

 Advanced – allows to use the additional functions to set parameters of the reference systems in the Database menu.

3. Workflow in the "Standard" и "Advanced" modes

The main window consists of two similar panels. There are the source data in one part, and the results of calculation in the other part.



It is possible to load source data both in left and in right part of the window.

S PHO	TOMOD GeoCalcu	lator								×
File Da	File Database Reference system Calculate Tools Help									
<u>n</u> -	i + + δ									
Refere	nce system		Select.		Referer	nce sys	tem		Select.	
Name: WGS 84 / UTM zone 11S Description: 120deg West to 114deg West; southern hemisphere. EPSG Units: metre		Name: N Descriptio min) North Supersed Units: me	TF (Paria m: Fran n. Alsou les NTF tre	s) / France II ce 50.5 to 53.9 ised over all m / Centre Franc	5 grads (45 deg 27 r) ainlant France, EPS Se (code 27592).	min to 48 deg 09 G Introduced 197	2.			
Points					Points					
Name	E	N	Н		Name	X		Y	Н	
2_0710	737973.885056	259599.602959	2016.807308		2_0710	-12820	2537.475	-86317928.346	2160.489	
2_0712	737212.662007	259582.396634	2014.345267		2_0712	-12853	37503.374	-86198249.477	2158.004	
2_0714	736466.161351	259560.135248	2017.754100		2_0714	-12886	64954.277	-86083113.616	2161.390	
3_0720	736280.343723	258378.746077	2050.214303		3_0720	-12890	0974.719	-86550817.105	2193.882	
3_0722	737050.709052	258385.557075	2046.812477	-	3_0722	-12855	58526.663	-86677420.615	2190.504	-
Loa	ad Save.	Clear	Calculate		Loa	d	Save	Clear	Calculate	
C:\Progra	am Files\PHOTOMO	06 x86 (Legacy (en (C	CoordSys\Interna	tional						11

Fig. 3. The main program's window

To transform coordinates of points form one coordinate system to another in **Standard** or **Advanced** modes perform the following:

- Choose the Reference system > Select left... (Ctrl+L) or click the Select... button on the *left* panel in the Reference system section to define input coordinate system of source data.
- Choose the File > Left > Load points... (Ctrl+Alt+L) or click the Load... button on the left panel in the Points section to choose the file in ASCII format with source coordinates of points.
- Choose the Reference system > Select right... (Ctrl+R) or click the Select... button on the right panel in the Reference system section to choose the output coordinate system.

As a result the list of points with recalculated coordinates from the *left* panel is shown in the **Points** section of the *right* panel.

4. Choose the **Calculate** → **Points...** → **Left to right** or click the **Calculate** button on the left panel or click the → button for coordinates system transformation.



To transform coordinates of points, loaded into the right panel, to the coordinate system defined in the left panel, choose the **Calculate** > **Points...** > **Right to left** or click the **Calculate** button on the right panel or click the **Calculate** button.

 \sum_{m}

Click the Save... button in the panel of result's window to save results in ASCII-file.

4. Batch coordinates transformation

The program provides coordinates transformation in several files at the same time.

To transform coordinates in several files, perform the following:

1. Choose the **Calculate** > **Files...**. The **Files conversion** window opens.

Files conversion	
Input	Output
Input format	Output format
CSV	CSV
Input reference system	Output reference system
Name: WGS 84 / UTM zone 56N Description: 150deg East to 156deg East; northern hemisphere. Russia. E Units: metre	Name: NTF (Paris) / France II Description: France 50.5 to 53.5 grads (45 deg 27 min to 48 de Units: metre
× ×	¥
Select	Preserve reference system Select
Input files	Output files
C:\import-export\56.csv C:\import-export\34.csv	Destination folder
Add Folder	File name prefix
Remove	File extension CSV
Clear	Log file name
Convert	Close
C:\Program Files\PHOTOMOD6 x86\Legacy\en\CoordSys\International	

Fig. 4. The "Files Conversion" window

- 2. Choose the data **Input format**: **CSV** or **GPX** to use the inner 4.x version system's format.
- 3. Click the **Select...** button of the **Input reference system** section and choose the source reference system.
- 4. The **Input files** section allows to prepare a file list with source points and contains buttons for the following actions:
 - Add file... allows to choose and load one file from a folder;
 - Add folder... allows to load all files with chosen file format from the folder;
 - Remove allows to remove the chosen file from the list;

- Clear allows to remove all files from the list.
- 5. Choose the data **Output format**: **CSV** or **GPX** to use the inner 4.x version system's format.
- 6. Click the **Select...** button of the **Output reference system** section and choose the result reference system. In order only to rename chosen files by the example, set on the **Preserve reference system** checkbox and define the **File name prefix**.
- 7. In the **Output files** section specify the following parameters of creating files:
 - Destination folder allows to define an output folder;
 - File name prefix allows to set an arbitrary text to be added as a prefix to names of source files while saving;
 - File extension allows to set the extension for output files;



Extension depends on output files format. Set the *.txt extension for easy viewing files.

- Log file name allows to define a pathname for the log-file.
- 8. Click the **Calculate** button. Files with transformed coordinate values are saves in the defined folder with the source names.

5. Coordinate Systems

5.1. The standard program's window

The program provides a possibility to search in the table, view settings, create, edit, remove, import and export both reference system and its separates parameters. The standard window and toolbar are used for this.

Standard program windows contains the table with two columns: Name and Description. In the table are displayed parameters, obtained from database or specified during creating of a coordinate system or its parameters.



It is recommended to enter detailed information in the **Description** field during creating of a coordinate system or its parameters.

View reference system	•	♦				
Name		Desc	ription			
Cartesian Left			Cartesian reference	e system		
Cartesian Right			Local right Cartesian reference system			
Local Curved Left			Local left Cartesian reference system which takes into			
Local Curved Right			Local right Cartesian reference system which takes int			
Abidjan 1987			Cote D'Ivoire (Ivory Coast). IGN Paris EPSG Supersed			
Abidjan 1987 / UTM zone 29N	n 1987 / UTM zone 29N Cote D'Ivoire (Ivory Coast) west of 6 deg West. IGN P				West. IGN P	
Details New	Edit	Remove	Export	Import	Close	

Fig. 5. Search in the reference system database

The toolbar contains buttons used to perform the following operations:

- Details allows to show parameters of selected reference system;
- New allows to open a window for creating new coordinate system or its parameters;
- Edit allows to edit chosen parameter value;
- Remove allows to remove chosen coordinate system from database;
- Export... allows to export coordinate system in a x-ref-system file;
- **Import...** allows to import coordinate system from a x-ref-system-file.



If there are the same file names during import, new file replaces the existing one.

5.2. The Database menu

Table 1. Brief description of the "Database" menu

Menu items	Function
Reference Systems	allows to create, edit, remove, export, import or view detail information about coordinate system in current database
Reference System types	[only for advanced mode] allows to choose reference system's type
Datum	allows to choose the Datum
Datum shift types	[only for advanced mode] allows to choose datum shift type
Datum shift	[only for advanced mode] allows to set datum shift settings
Reference ellipsoids	allows to choose the reference ellipsoid
Prime meridians	allows to choose the prime meridian
Map projections	[only for advanced mode] allows to choose/create map projection

Menu items	Function
Map projections types	[only for advanced mode] allows to choose map projection type
Linear units	allows to choose linear units
Angular units	allows to choose angular units
Scale units	allows to choose scale units

5.3. Choosing coordinate system

International and local databases are copied to the system's work folder during the program installing.

Define the database folder during the first launch of the program to use the reference systems database.

Coordinate systems database is loading to the C:\Program Files\PHOTOMOD GeoCalculator \CoordSys or C:\Program Files\PHOTOMOD\CoordSys folder during the installation of the PHOTOMODsystem's window. For international coordinate systems database is used the International folder and other folders for local databases.

The **Database** > **Reference system** menu item and the **Select** button are used for choosing reference system both in **Standard** and **Advanced** modes.

The list of coordinate systems opens in standard window. It allows to choose, create new one, edit, remove, export and import coordinate system from external file.

To scroll the coordinate systems list quickly, input name or its part (or keyword) into the **Search** field and choose direction of search: scroll down the list with the $\frac{1}{2}$ button or scroll up the list with the $\frac{1}{2}$ button. The name of found coordinate system is marked by black arrow leftward to its name.

Select reference system							
Search 🔽 🔶 🔺							
Name	Description						
Cartesian Left	Left Cartesian reference system						
Cartesian Right	Local right Cartesian reference system						
Local Curved Left	Local left Cartesian reference system which takes into account Earth cu						
Local Curved Right	Local right Cartesian reference system which takes into account Earth c						
Abidjan 1987	Cote D'Ivoire (Ivory Coast). IGN Paris EPSG Supersedes Locodjo 1967						
Abidjan 1987 / UTM zone 29N	Cote D'Ivoire (Ivory Coast) west of 6 deg West. IGN Paris EPSG Supers						
Abidjan 1987 / UTM zone 30N	Cote D'Ivoire (Ivory Coast) east of 6 deg West. IGN Paris EPSG Supers 💌						
OK Details New	Edit Remove Cancel						

Fig. 6. Search in the reference system database

5.4. International system coordinates 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 of aerial survey.

Select reference system	•••			
Name	Description			
Cartesian Left	Left Cartesian reference system			
Cartesian Right	Local right Cartesian reference system			
Local Curved Left	Local left Cartesian reference system which takes into account Earth cu			
Local Curved Right	Local right Cartesian reference system which takes into account Earth c			
Abidjan 1987	Cote D'Ivoire (Ivory Coast). IGN Paris EPSG Supersedes Locodjo 1967			
Abidjan 1987 / UTM zone 29N	Cote D'Ivoire (Ivory Coast) west of 6 deg West. IGN Paris EPSG Supers			
Abidjan 1987 / UTM zone 30N	Cote D'Ivoire (Ivory Coast) east of 6 deg West. IGN Paris EPSG Supers			
OK Details New	Edit Remove Cancel			

Fig. 7. International coordinate reference systems database

5.5. Coordinate reference systems types

The **Database** > **Reference system types** menu item allows to show provided types of reference systems:

- 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 axe is leftward in the left-handed coordinate reference system and it is northward in the right-handed reference system.

5.6. Creating reference system

Program provides a possibility both to use existing reference system or to create a new one.

Use the following steps to create a reference system:

- 1. Perform one of the following actions:
 - choose the Database > Reference systems... in the main window of GeoCalculator program;
 - choose the Service > Coordinate system builder in the main window of the PHOTOMOD system.

Search	•	♦				
Name		Desci	iption		-	
Cartesian Left	Left C	Left Cartesian reference system				
Cartesian Right	Local	Local right Cartesian reference system				
Local Curved Left	Local	Local left Cartesian reference system which takes into				
Local Curved Right	Local	Local right Cartesian reference system which takes int				
Abidjan 1987	Cote	Cote D'Ivoire (Ivory Coast). IGN Paris EPSG Supersed				
Abidjan 1987 / UTM zone 29N		Cote	Cote D'Ivoire (Ivory Coast) west of 6 deg West. IGN P			
Detaile New	Edit	Remove	Export	Import	Close	

The selecting of the coordinate reference system window opens.

Fig. 8. Selecting of the coordinate system

2. Click the **New** button. Selecting of the coordinate reference system type window opens.

5	Select reference system type						
1	Search						
	Name	Description					
	Geocentric	Geocentric equatorial reference system					
	Latitude/longitude	Geographic (latitude-longitude-height) reference system					
	Local cartesian	Local cartesian reference system					
	Local curved Local cartesian reference system which takes into account Earth curvature						
•							
Name of Street							

Fig. 9. Selecting of the coordinate system type

- 3. Choose the coordinate reference system type and click OK. The **Select reference** system type window opens.
- 4. Define the general settings of the reference system:
 - Name arbitrary name (e.g., Gauss-Kruger, 10 zone);
 - Abbreviation arbitrary short name;
 - **Description** arbitrary description.
- 5. Define other settings of the reference system depending on chosen reference system's type.
- 6. Click the **Save** button. Created reference system is shown in the list with defined name and description.

Do the same actions to edit settings of existing reference system.

5.7. Creating coordinate system settings

5.7.1. Settings of the geographic reference system

To create Latitude/Longitude reference system perform the following:

- 1. Define the general settings of the reference system.
- 2. Click the ____ button and choose **Prime meridian**.
- 3. Click the <u>___</u> button and choose the **Datum** from the list. Ellipsoid type is selected automatically in the **Ellipsoid** field for chosen datum.
- 4. [optional] To set ellipsoid press the <u>button</u> button and choose non-default **Ellipsoid** from the list.
- 5. In the Latitude/Longitude section define the following settings:
 - choose the latitude and longitude angular units from the list in the Units field;
 - set the arbitrary symbol as a Latitude Abbreviation;
 - set the arbitrary symbol as a Longitude Abbreviation;
 - [optional] to create a coordinate system Easter Greenwich, click on the **Positive** Longitude checkbox.
- 6. In the **Height** section set the following parameters:
 - choose the linear units from the **Unit** list;
 - set the **Abbreviation** as an arbitrary symbol for the Height:
 - set the Height System:
 - Height above ellipsoid to use geodetic heights;
 - Predefined geoid to use predefined EGM-96 or EGM 2008 geoid;
 - **arbitrary geoid** to use parameters of another geoid (only for *PHOTOMOD 4.x.* versions).

🛐 Edit geodetic	reference system
Name 🔽	//GS 84
Abbreviation	
Description V	Vorld EPSG GeogCS code 4327 reserved for use with ProjCS's.
Prime meridian G	âreenwich
Datum 🖲 🕅	Vorld Geodetic System 1984
Ellipsoid C 🔽	wGS 84
Latitude/Longitu	ude Height Hight Internet Inte
Latitude Abbrevi	iation Lat Abbreviation H
Longitude Abbre	eviation Long • Heights above ellipsoid
Positive Long	gitude C Predefined geoid V
Save	Close

Fig. 10. Selecting reference system type window

5.7.2. Settings of the geocentric reference system

To create a geocentric reference system perform the following:

- 1. Set the general parametres of reference system.
- 2. Click the <u>button</u> button and choose **Prime meridian**.
- 3. [optional] Set on the **Datum** checkbox, press the ____ button and choose the Datum from the list.
- 4. Choose the linear coordinate measure units from the list in the Linear units field.
- 5. Set the arbitrary symbol in the **X**, **Y**, **Z** axis name fields to denote reference axes.

🔀 Edit Topocentric Horizontal	ReferenceSystem 💶 🗖 🗙
Name System	
Abbreviation	
Description	
Primary Reference System	
Origin coordinates	
Azimuth	
Linear units metre	
X axis name	 Left-handed
Y axis name	C Right-handed
Z axis name	_
Save	Close

Fig. 11. Selecting of the coordinate reference system type window

5.7.3. Settings of the Local Cartesian reference system

To create a Local Cartesian coordinate reference system perform the following:

- 1. Set the general parametres of reference system.
- 2. Choose the linear coordinate measure units from the list in the Linear units field.
- 3. Set the arbitrary symbol in the **X**, **Y**, **Z** axis name fields to denote reference axes.
- 4. Set the direction of the axes: **Right-handed** or **Left-handed**.

🛐 Edit Loca	Cartesian Referenc 💶 🗵 🗙
Name	Cartesian Left
Abbreviation	Cartesian Left
Description	Left Cartesian reference system
Linear units	metre
X axis name	Eeft handed
Y axis name	C Right handed
Z axis name	Z
Save	Close

Fig. 12. Selecting of the reference system's type window

5.7.4. Settings of the projected reference system

To create a Projected reference system perform the following:

- 1. Set the general parametres of reference system.
- 2. Click the <u>button</u> button and choose the **Datum** from the list. **Ellipsoid** is set in current field automatically for chosen datum.
- 3. [optional] To define an Ellipsoid different to default click the ____ button and choose the **Ellipsoid** from the list.
- 4. Click the <u>button</u> button and choose the **Prime meridian** from the list.
- 5. Click the <u>button</u> button and choose the **Map projection** from the list.
- 6. Choose the linear coordinate measure units from the list in the Linear units field.
- 7. Define short names for **First plane axis** and **Second plane axis**.
- 8. Define short **Height axis name**.

- 9. Set the **Height System**:
 - · Height above ellipsoid allows to use geodetic altitude;
 - Predefined geoid allows to use parameters of preset geoid EGM-96 or EGM 2008;
 - **arbitrary geoid** allows to use parameters of other geoid (only for *PHOTOMOD 4.x* versions).

🛜 Edit project	ed reference system			
Name	WGS 84 / UTM zone 6N			
Abbreviation				
Description	150deg West to 144deg West; northern hemisphere. United States (USA) - Alaska (AK), EPSG			
Datum 📀	World Geodetic System 1984			
Ellipsoid C	WGS 84			
Prime meridian	Greenwich			
Map projection	UTM zone 6N			
Linear units	metre			
First plane axis r	name E			
Second plane a	xis name N			
Height axis nam	e H			
Height System Fields System Fields System Fields System				
Save	Close			

Fig. 13. Selecting of the reference system's type window

5.7.5. Settings of the Local Curved reference system

To create a Local Curved reference system perform the following:

- 1. Define the general settings of the reference system.
- 2. Click the <u>button</u> and choose the **Prime meridian** from the list.
- 3. [optional] To set the datum, set on the **Datum** checkbox, click the <u>button</u> button and choose it from the list.
- 4. Choose the linear coordinate measure units from the list in the Linear units field.
- 5. Set the arbitrary symbol in the **X**, **Y**, **Z** axis name fields to denote reference axes.
- 6. Set the direction of the axes: **Right-handed** or **Left-handed**.

- 7. Click the ____ button and choose the **Spheroid** from the list.
- 8. Choose the **Origin Coordinates** of the coordinate system in **X** and **Y** fields.

🛜 Edit Local Refe	renceSystem 📃 🗖 🗙
Name Loc	al Curved Right
Abbreviation Loca	al Curved Right
Description Loca	al right Cartesian reference
Linear units metre	
X axis name 🛛 🗙	C Left-handed
Y axis name	 Right-handed
Z axis name Z	
Spheroid	Sphere
Origin coordinates	X 0 Y 0
Save	Close

Fig. 14. Selecting of the reference system's type window

5.7.6. Settings of the Topocentric horizontal coordinate system

To create a Topocentric horizontal reference system perform the following:

- 1. Define the general settings of the coordinate system.
- 2. Click the <u>button</u> button and choose the **Prime meridian** from the list.
- 3. Choose the **Primary reference system**.
- 4. Input the **Origin coordinates** of the coordinate system.
- 5. Set the **Azimuth** in degrees.
- 6. Choose the linear coordinate measure units from the list in the Linear units field.
- 7. Set the arbitrary symbol in the **X**, **Y**, **Z** axis name fields to denote reference axes.
- 8. Set the direction of the axes: **Right-handed** or **Left-handed**.

🛐 Edit Topo	centric Horiz	zontal Refe	erence 9	iystem 💶	
Name	System				_
Abbreviation					_
Description					
Primary Refer	ence System				
Origin coordir	nates				
Azimuth		- 			
Linear units	metre				
X axis name	×		 Left 	-handed	
Y axis name	Y		O Rig	ht-handed	
Z axis name	Z				
Save				Close	

Fig. 15. Selecting of the reference system's type window

6. Datum

6.1. General information

Datum – is set of parameters used for shift and transform reference ellipsoind into local geographic coordinates.

For International reference systems database the system supports the following extended list of local and global datums:

- WGS 84, 72, 64 µ 60 of the World Geodetic System;
- ITRF 2000 (International Terrestrial Reference System);
- NAD83, the North American Datum which is very similar to WGS84;
- NAD27, the older North American Datum, of which NAD83 was basically a re-adjustmen;
- OSGB36 of the Ordnance Survey of Great Britain;
- ED50, the European Datum;
- Indian 1954 etc.

Search	
Name	Description
South Africa	"Private Communication, Directorate of Surveys and L
South American Datum 1969	EPSG SAD69 uses GRS67 ellipsoid with 1/f to exactly
South Asia	MapInfo 93
Southeast Base	MapInfo 94
Southwest Base	MapInfo 95
St. Kitts 1955	Fundamental point: station K12. Ordnance Survey of (
- •	Remove Export Import Close

Fig. 16. The list of datums in international database

To create a new datum perform the following actions:

1. Click the **New** button in the **View datum** window. The **Edit geodetic datum** window opens.

🛜 Edit geod	etic datum 💶 🗖 🗙
Name	World Geodetic System 1972
Abbreviation	WGS 72
Description	EPSG "Used by GPS before 1987. For Transit satellite positioning see also WGS 72BE.
Datum shift	WGS 72 to WGS 84 (2)
Ellipsoid	WGS 72
Save	Close

Fig. 17. Datum settings window

- 2. Define Name, Abbreviation and Description of the datum in appropriate fields.
- 3. Click the ____ button in the **Datum shift** field to choose the datum shift type.
- 4. Click the <u>button</u> button in the **Ellipsoid** field to choose reference-ellipsoid from the list (see the Section 7).
- 5. Click the **Save** button. Created datum is shown in the list with defined name and description.

6.2. Datum shift types

The Database > Datum shift types menu item is used for choosing datum shift type.



It is possible to choose datum shift type only in *advanced* mode.

N	ame	Description
В	ursa-Wolf 7-parameter transform	Translation: Tx Ty Tz; rotation: Rx Ry Rz; scale: 1+S
C	oordinate frame rotation 7-parameter tr	Translation: Tx Ty Tz; rotation: -Rx -Ry -Rz; scale: 1+S
М	folodensky 3-parameter transform	Translation: Tx Ty Tz

Fig. 18. The list of datum shift types

There are three datum shift types supported by the program:

- Coordinate frame rotation 7-parameter transform;
- Bursa-Wolf 7-parameter transform;
- Molodensky 3-parameter transform datum shift involves shift of reference point using three parameters (Tx Ty Tz);

The **Details** button allows to show information about selected shift type.

	🖥 View datun	n shift						
	Search			• • •				
Г	Name				Description			▲
Г	WGS 72BE to	WGS 72 (1)			World. EPSG			
Γ	WGS 72BE to	WGS 84 (1)			World. EPSG			
Γ	WGS-84				Tx=Ty=Tz=0			
Γ	World Geodet	ic System 1960	WGS 60)		MapInfo 101			
Γ	World Geodet	ic System 1966	WGS 66)		MapInfo 102			
Г	Yacare to WG	iS 84 (1)			Uruguay, U.S.	Defense Mappin	g Agency TR83	50.2 December 1987. Ef
Þ	Zanderij to Wi	GS 84 (1)			Suriname, U.S	6. Defense Mappir	ng Agency TR8:	350.2 December 1987. B
Г	_							•
Ŀ								▶
	Details	New	Edit	Remove	Export	Import	Close	

Fig. 19. Datum shift settings

6.3. Datum shift

The program provides a possibility to transform one datum parameters to another. There is a list of most popular datum shifts. Besides it is possible to create new datum shift parameters.



It is possible to transform datum only in *advanced* mode.

Просмотреть - преобразование datum					
Поиск					
Название	Описание				
▶WGS 84 в WGS 84	Tx=Ty=Tz=0				
ПЗ 90.02 в WGS 84 (ГОСТ Р 51794-2008)					
П 3-90 в WGS 84	FOCT P 51794-2001				
ПЗ-90 в WGS 84 (ГОСТ Р 51794-2008)	ГОСТ Р 51794-2008				
Пулково 1942 в WGS 84	Параметры рассчитаны по схеме: Пулково-1942=>П3-90=>WGS 84. Пар				
Пулково 1942 в WGS 84 (ГОСТ Р 51794-2008)	Параметры рассчитаны по схеме: Пулково-1942=>ПЗ-90.02=>WGS 84. I				
Пулково 1995 в WGS 84	Параметры рассчитаны по схеме: Пулково-1995=>ПЗ-90=>WGS 84. Пар				
Пулково 1995 в WGS 84 (ГОСТ Р 51794-2008)	Параметры рассчитаны по схеме: Пулково-1995=>ПЗ-90.02=>WGS 84. I 🖵				
Подробно Создать Изменить Удали	ть Экспорт Импорт Закрыть				

Fig. 20. Datum shift in International database

To create a set of datum shift parameters, perform the following actions:

1. Click the **Create** button. The **Select datum shift type** window opens.

5	View datum shift type		_ 🗆 ×
	Search	• <u>+</u> +	
Ē	Name	Description	
Þ	Bursa-Wolf 7-parameter transform	Translation: Tx Ty Tz; rotation: Rx Ry Rz; scale: 1+S	
Г	Coordinate frame rotation 7-parameter to	r Translation: Tx Ty Tz; rotation: -Rx -Ry -Rz; scale: 1+S	
Г	Molodensky 3-parameter transform	Translation: Tx Ty Tz	
Г			-
L			•
Yuuui	Details Edit Expo	ort Import Close	

Fig. 21. Selecting datum shift types

2. Choose the datum shift type and click OK. The Edit datum shift window opens.

🔀 Edit datum shift 🛛 📃 🗵		
Name Amersf	port to WGS 84 (1)	
Abbreviation		
Description Nether	lands. Nederlandse Com	missie voor Geodesie
Translation	Rotation	Scale
metre	microradian	parts per milli
Tx 593.16	Rx -6.3239	S 4.0775
Ту 26.15	Ry -0.5008	
Tz 478.54	Rz .5.5487	
Save		Close

Fig. 22. Datum shift parameters

3. Define the following parameters of datum:

If the **Molodensky** type is chosen only three parameters could be defined.

• Name - name of the datum shift;

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It is recommended to include names of source and target datum in the name of shift parameters.

- · Abbreviation arbitrary short name of datum shift;
- **Descreption** arbitrary text, description of shift's physical meaning.
- Translation units and value of translation by Tx Ty Tz;
- Rotation units and value of rotation by Rx Ry Rz;
- Scale units and value of scaled coefficient S.

4. Click the **Save** button. Created datum is shown in the list with defined name and description.

7. Reference ellipsoid

Reference ellipsoid is a mathematically-defined surface that approximates the geoid, the truer figure of the Earth, or other planetary body. Because of their relative simplicity, reference ellipsoids are used as a preferred surface on which geodetic network computations are performed and point coordinates such as latitude, longitude, and elevation are defined. Reference ellipsoid figure is best suited for the area of one country or several countries.

Used reference ellipsoid could be chosen both in standard and advanced program modes.

2	💦 Yiew ellipsoid 📃 🗆 🗙					
	Search					
	Name	Descri	ption			
Þ	Airy 1830	Ordna	nce Survey of Gr	eat Britain. EPSC	à Original defir	
	Airy Modified 1849	EPSG	OSGB Airy 1830	figure rescaled b	oy 1.000035 tc	
	Australian National Spheroid	"\"Au	"\"Australian Map Grid Technical Manual\"; National			
	Average Terrestrial System 1977	New E	New Brunswick Geographic Information Corporation Ia			
	Bessel 1841	US Ar	US Army Map Service Technical Manual; 1943. EPSC			
	Bessel Modified	EPSG	EPSG Used in Norway and also in Sweden with a 1mr			
Yanani	Details New Edit	Remove	Export	Import	Close	

Fig. 23. The list of reference ellipsoid in international database

To create a new reference ellipsoid with c defined parameters, perform the following actions:

 $[\]sim$ The <u>sector</u> button allows to choose units of translation, rotation and scale parameters from the list.

1. Click the **Create** button in the **View ellipsoid** window. The **Edit reference ellipsoid** window opens.



Fig. 24. Reference ellipsoid parameters

- 2. Define the **Name** and **Description** of the reference ellipsoid in the fields.
- 3. Set the option button and specify three main parameters of ellipsoid:
 - Spheroid;
 - Minor semi-axes;
 - Flattering.
- 4. Click the <u>button</u> button in the **Linear units** field to choose linear units from the list (see the Section 9).
- 5. Click the **Save** button. Created reference ellipsoid is shown in the list with defined name and description.

8. Prime meridian

The program provides an opportunity to choose prime meridian for used reference system.

S	Yiew prime meridian Search			
Π	Name	Description		
Þ	Athens	Topography Department; National Technical Universit		
	Bern	Bundesamt fur Landestopographie EPSG 1895 value.		
	Bogota	"Instituto Geografico \"Augustin Cadazzi\" (IGAC); Bo		
	Brussels	EPSG		
	Ferro	EPSG Used in Austria and former Czechoslovakia.		
	Greenwich	EPSG		
•		nove Export Import Close		

Fig. 25. The list of reference ellipsoid in international database

To create prime meridian, different from standard, perform the following actions:

1. Click the **New** button in the **View prime meridian** window. The **Edit prime meridian** window opens.

💦 Edit prin	ne meridian 📃 🗆 🗙
Name	Greenwich
Description	EPSG
Longitude	0.0
Units	DDD.MMSSsss
Save	Close

Fig. 26. Prime meridian settings

- 2. Define the **Name** and **Description** of the prime meridian in the fields.
- 3. Define the **Longitude** of the prime meridian.
- 4. Click the <u>button rightward to the Linear units</u> field to choose linear units from the list (see the Section 9).
- 5. Click the **Save** button. Created prime meridian is shown in the list with defined name and description.

9. Measurement units

The program provides an opportunity to choose angular, linear and scale units for parameters that have a dimension.

The **Database > Linear units**, **Database > Angular units** and **Database > Scale units** menu items are used to choose units of measure.

Meters and *kilometres* could be used as linear units, *unity* or parts per million (ppm) – as scale units.

The following angular units are supported:

- degree;
- degree minutes seconds;
- · degree minutes seconds milliseconds;
- · degree minutes seconds hemisphere;
- microradian;
- radian;
- arc-minute;
- arc-second;

The list of linear and angular units used in the world is supported for International database.

To create new unit of measure, perform the following actions:

1. Click the **Create** button in the **View unit** window. The **Edit linear unit** window opens.



Fig. 27. Settings of measurement units

- 2. Define the **Name**, **Abbreviation** and **Description** of the measure unit in appropriate fields. Abbreviation shows as a dimension of the right field if it was specified. In other way the **Name** value uses.
- 3. Input value in the left field depending on unit's type.
- 4. Input in the right field which part of the chosen unit equals to value in the left field.
- 5. Click the **Save** button. Created unit of measure is shown in the list with defined name and description.

10. Map projections

10.1. General information

The **Database** > **Map projection types** menu item is used for choosing the type of map projection.



It is possible to choose type of map projection only in *advanced* mode.

IName	·)		(
Lamb	ert Conic Conformal 2SP	Description	
Lamb	ert Conic Conformal 25P (F	Lambert Conic Conformal with two standard parallels modified form for Belgium	
Mercz	ator 1SP	Mercator projection with single standard parallel (equatorial)	
Merca	ator 2SP	Mercator projection with two standard parallels	
NZM	G	New Zealand Map Grid	
Obliqu	ue Mercator	General form ot the Oblique Mercator projection	Î
Dilqu	ue Mercator	General form ot the Oblique Mercator projection	

Fig. 28. Map projections list

The **Details** button allows to show the additional information about the projection.

10.2. Creating map projection

To define parameters of map projection manually, perform the following actions:

1. Choose the **Database > Map projections...** and click the **Create** button. The **Edit map projection** window opens.

🙀 Edit map projection			
Name Gauss-Kruge Projection type Transverse M	r zone 7 Mercator	Description	36deg East to 42deg East; northern hemisphere. EPSG Original transformation by
central meridian longitude	39.0		
latitude of origin	0.0		
central meridian scale factor	1.0		
false easting at origin	7500000.0		
false northing at origin	0.0		
Linear units metre .	Angular units d	egree	. Scale units unity
Linear units metre	Angular units d	Eirst avis nam	Scale units unity
Linear units metre .	Angular units d	First axis nam	e X
Linear units metre	Angular units d	First axis nam Second axis r	. Scale units unity e Χ name γ

Fig. 29. Creating map projection

- 2. Set the general map projection parameters:
 - Name arbitrary name of projection;
 - **Description** arbitrary description with additional information to identify projection in the list.
- 3. Click the ____ button and choose **Projection type**.

🖌 Select map projection type			
Search 💌 🔶 🔺			
Name	Description		
Lambert Conic Conformal 2SP	Lambert Conic Conformal with two standard parallels		
Lambert Conic Conformal 2SP (B Lambert Conic Conformal with two standard parallels modified form for Belgium		
Mercator 1SP	Mercator projection with single standard parallel (equatorial)		
Mercator 2SP	Mercator projection with two standard parallels		
NZMG	New Zealand Map Grid		
Oblique Mercator	General form ot the Oblique Mercator projection		
-	T		
	F		
OK Details	Edit Cancel		

Fig. 30. Map projection types

4. Specify in table the detail parameters of projection depending on its type.

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Click the empty field in parameter row to add detain parameters in the table.

5. Define the following parameters of map projection:

- Linear/Angular/Scale units allows to set units of measure for parameters;
- First/Second axis direction allows to set the direction of reference axes;
- First/Second axis name allows to set abbreviation for axes.

 $\mathcal{I}_{\overline{3}}$ Units, direction and names of axes are defined automatically, but they can be edited later.

6. Click the **Save** button. Created map projection is shown in the list with defined name and description.