



# Photogrammetric technologies PHOTOMOD — effective solutions for spatial data acquisition

**Victor Adrov**  
**Managing Director**  
**Racurs**  
**Russia**

October 28-31, 2019  
Seoul, Republic of Korea



# Racurs

**Racurs company's business mission** is to provide the world-wide geospatial community with advanced and cost-effective digital photogrammetry solutions and services for creation of wide range of output products from the available remote sensing data.

## Racurs business activities:

- PHOTOMOD development and further integration into Russian and international markets;
- Photogrammetric production services using both airborne and satellite imagery;
- R&D in the field of RSD processing software, methods, and algorithms;
- Remote sensing data distribution in Russia and the CIS countries.



*Sustaining member*



*Certified Company*



*Member of International Industrial Advisory Committee (I2AC)*

# Racurs today

- Employees over **50** people
- 60 partners across **45** countries
- More than **900** user's companies over the world (**80+** countries)
- Almost **10.000** PHOTOMOD workplaces
- More than **100.000** delivered satellite images for processing
- More than **17.000.000** km<sup>2</sup> digital maps, DEM and orthophotoplans



# PHOTOMOD Software

**DPW PHOTOMOD** – digital photogrammetric system

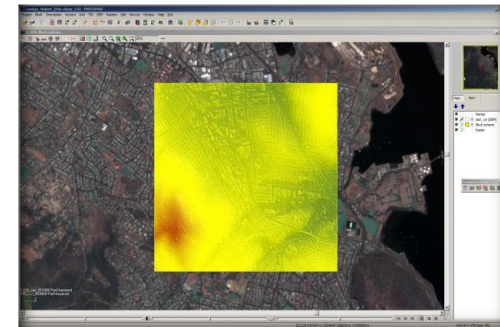
**PHOTOMOD Conveyor** – automatic photogrammetric processing

**PHOTOMOD GeoMosaic** – combining georeferenced images

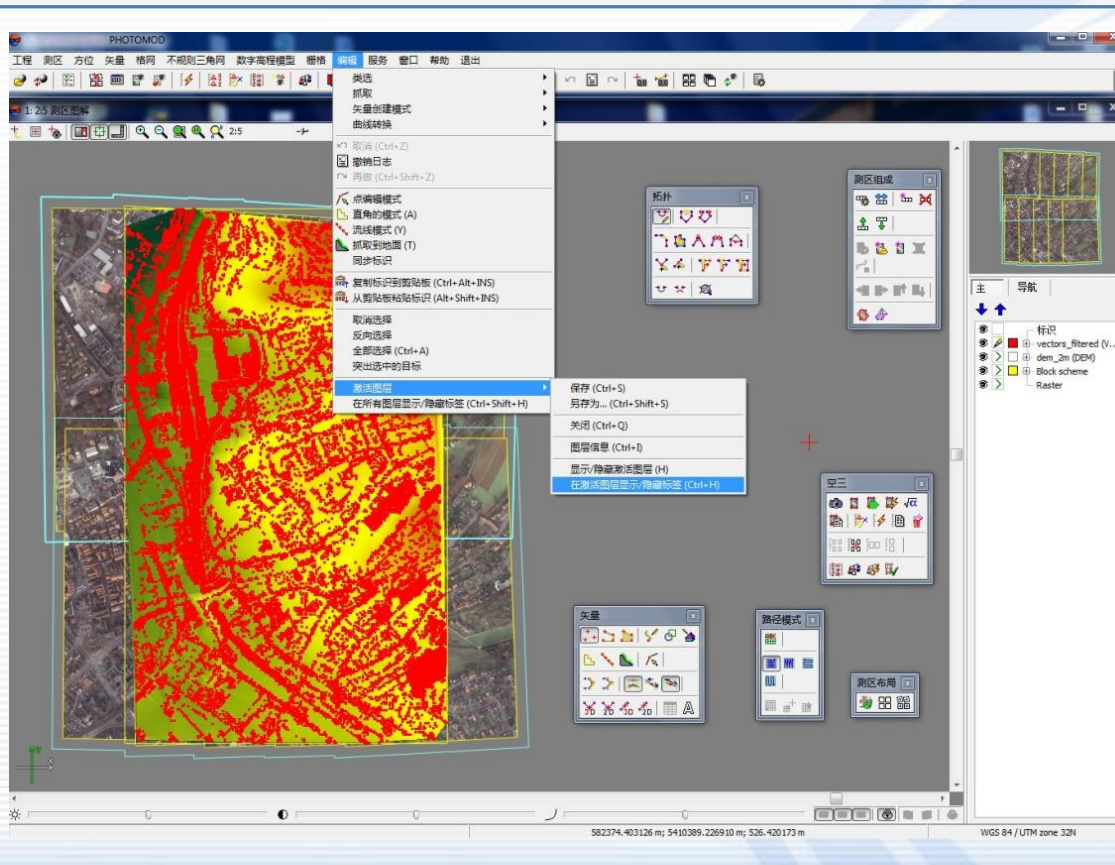
**PHOTOMOD UAS** – UAS data processing

**PHOTOMOD Radar** – SAR data processing

**PHOTOMOD Lite, PHOTOMOD Radar Viewer, PHOTOMOD Datum Parameters, PHOTOMOD DirectGeoreferencing, PHOTOMOD GeoCalculator** – utilities and free apps



# PHOTOMOD Localization



Chinese



Greek



English



Russian



Spanish

# PHOTOMOD Distribution Map



**10.000+ PHOTOMOD workplaces. 80+ countries.**

# PHOTOMOD. Input and output

Satellite images



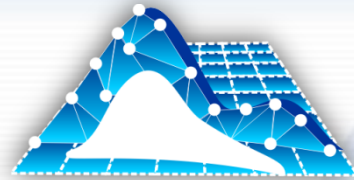
Aerial photos



Radar data



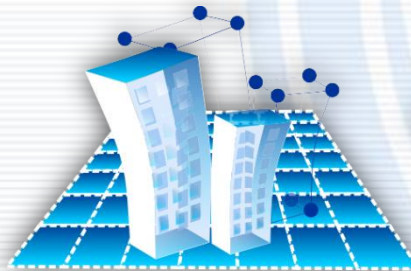
# PHOTOMOD



DTM, DDSM, contour lines



Orthophotos and mosaics



3D terrain models



2D and 3D vectors



Digital maps

Bentley Map



AutoCAD

ArcGIS



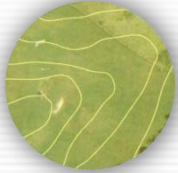
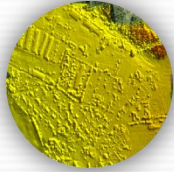
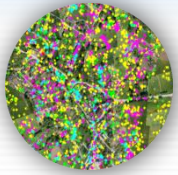
QGIS

MapInfo



GIS "Panorama"

# DPW PHOTOMOD. High-end photogrammetric system



- Processing of aerial and satellite images
- Aerial triangulation and block adjustment
- Flexible strategy for DTM generation and editing
- Contour lines building, editing and smoothing
- 3D feature extraction
- Orthomosaicking
- Digital maps creation and output
- 3D models creation



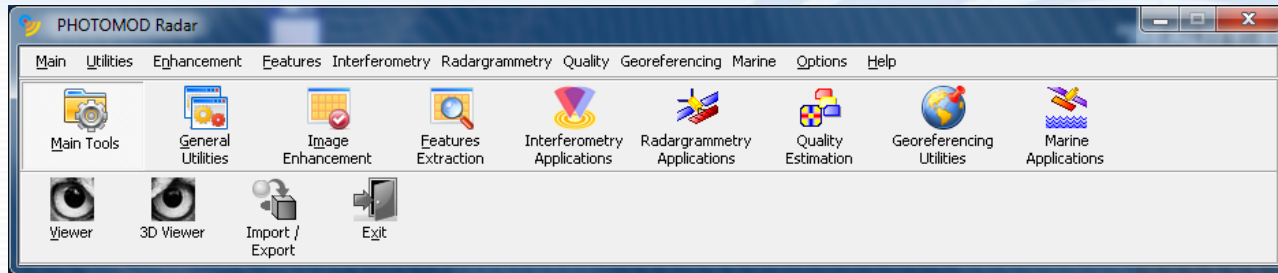
# PHOTOMOD Geomosaic



Combining georeferenced images in a single, seamless, color-balanced mosaic of high geometric accuracy

- Creating high-precision mosaics from any number of orthorectified images (tens of thousands source images can be processed)
- Building precise mosaics from georeferenced images of various formats
- Image processing: Radiometric image enhancements (filters, color/brightness/contrast balancing, histogram adjustment, etc.); Pan-Sharpening; DustCorrect
- Fully automatic seam line creation
- Automatic tiling

# PHOTOMOD Radar



- module for data visualization (viewer);
- module for data export/import, including CEOS ERS, CEOS Radarsat, CEOS SIR-C/X, CEOS Condor, CEOS PALSAR, ENVISAT ASAR, TerraSAR-X, ALOS and COSMO-SkyMed; Kompsat; Sentinel; Radarsat-2; Risat; etc.
- geocoding processor;
- interferometric processor;
- stereo processor;
- image processing tools;

- quality estimation software tools;
- oil slicks detection processor;
- ship detection processor;
- sea waves analysis software tool;
- polarimetric processor;
- software tool of coherent change detection;
- software tool of coherent co-registration of SAR images.

*More information in the report of A. Chekurin "PHOTOMOD Radar — a powerful tool for processing of SAR images"*

# PHOTOMOD UAS

## Photogrammetric UAS-oriented software

- Process UAS data and acquire all types of photogrammetric products: DEM, dDSM, 2D and 3D-vectors, orthomosaics.
- Complete image data processing workflow without third party products.
- Automation of photogrammetric operations.

### China, UAS, 3D-TIN

Images number – **386**, GSD – **25** MM

2x CPU Intel® Xeon® (12 cores), RAM 48&96 GB  
DSM (25 mm)/LAS – **14** hours **42** minutes (at 5 cores, TrueOrtho included)

3D-TIN by LAS – **51** hours **34** minutes



# PHOTOMOD Automation

Photogrammetric operations	Automation level
Aerial triangulation	●
DTM, DSM, denseDSM	●
Point cloud	●
Contour lines	●
Mosaicking	●
Orthorectification	●
3D modeling	●
2D-3D vectorization	●

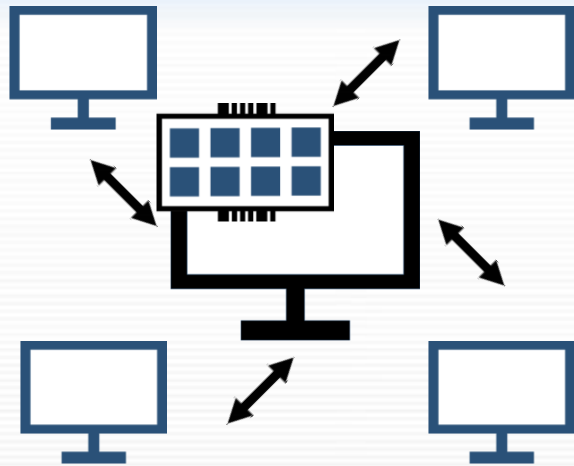


Fully automatic



Semi-automatic

# PHOTOMOD. Distributed Processing



Parallel tasks execution with multiple processor cores or multiple computers

Supported for:

- Converting images to PHOTOMOD format
- Aerial triangulation
- DEM creation
- Orthorectification and mosaicking

**Monitor for distributed processing**  
Tasks (total: 33, running: 16, completed: 0)

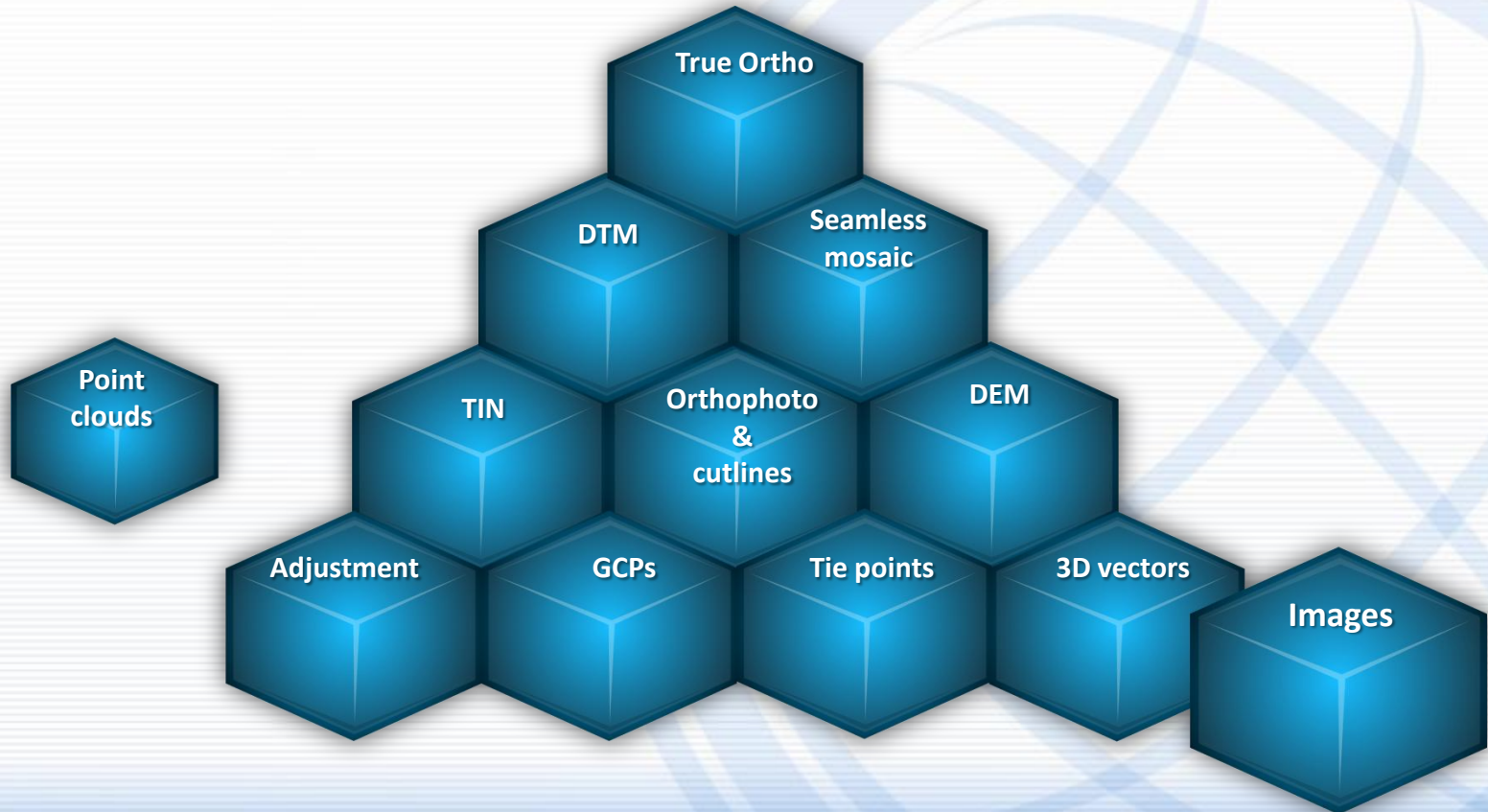
ID	State	Priority	Name	Created at	Started at	Executor	Est. time left
0x7C8082	68.17%	0	Do nothing for 120.0 seconds: ta	09.09.2010 21:47:30	09.09.2010 21:51:51	HAMMER2	38s
0xCB95B2	Waiting	0	Do nothing for 120.0 seconds: ta	09.09.2010 21:47:30	-	-	-
0x6E399E	51.05%	0	Do nothing for 120.0 seconds: ta	09.09.2010 21:47:30	09.09.2010 21:52:11	HAMMER3	58s
0xAA0BF4	31.41%	0	Do nothing for 120.0 seconds: ta	09.09.2010 21:47:30	09.09.2010 21:52:35	HAMMER1	1m 22s
0xD900DA	27.30%	0	Do nothing for 120.0 seconds: ta	09.09.2010 21:47:30	09.09.2010 21:52:41	HAMMER4	1m 27s
0x4D605C	54.87%	0	Do nothing for 120.0 seconds: ta	09.09.2010 21:47:32	09.09.2010 21:52:06	HAMMER3	54s
0x78E47C	71.90%	0	Do nothing for 120.0 seconds: ta	09.09.2010 21:47:32	09.09.2010 21:51:45	HAMMER2	33s
0x3776D4	Waiting	0	Do nothing for 120.0 seconds: ta	09.09.2010 21:47:32	-	-	-
0x6FF52C	Waiting	0	Do nothing for 120.0 seconds: ta	09.09.2010 21:47:32	-	-	-
0xBA5662	59.98%	0	Do nothing for 120.0 seconds: ta	09.09.2010 21:47:31	09.09.2010 21:52:00	HAMMER2	48s
0xD02F0A	Waiting	0	Do nothing for 120.0 seconds: ta	09.09.2010 21:47:30	-	-	-
0x7C00EC	43.77%	0	Do nothing for 120.0 seconds: ta	09.09.2010 21:47:31	09.09.2010 21:52:20	HAMMER3	1m 07s
0xDF1D6C	Waiting	0	Do nothing for 120.0 seconds: ta	09.09.2010 21:47:31	-	-	-

**Computers**

Name	IP-address	Type	Current tasks	Core quantity	Max tasks	PHOTOMOD version
HAMMER1	192.168.2.45	Client	4	4	4	5.0.1015
HAMMER2	192.168.2.46	Client	4	4	4	5.0.980
HAMMER3	192.168.2.47	Client	4	4	4	5.0.980
HAMMER4	192.168.2.48	Client	4	4	4	5.0.980
localhost	127.0.0.1	Client	0	2	2	5.0.1017

# Photogrammetric blocks

Blocks can be combined into automatic chains of algorithms and data



# PHOTOMOD Conveyor

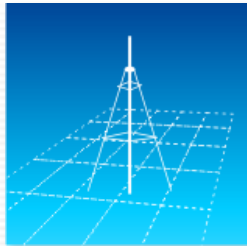
## Automatic photogrammetric processing

### Productivity

	GSD	Area	Output products	Processing time*
Aerial survey	3-5 cm	100 km <sup>2</sup>	Mosaic, DTM, orthophoto	60 min
Satellite survey	1 m	20 000 km <sup>2</sup>	Mosaic, DTM, orthophoto	60 min

\*Xeon E5-2680 2.40GHz – 10 CPU (140 cores, 280 hyper-threading),  
RAM 1280GB, 10Gb/s Ethernet

*More information in the report of D. Kochergin "PHOTOMOD 6.5. Productivity and new functions"*



# PHOTOMOD Cloud

CLOUDEO

Products

- ENVI in the Cloud - Home Geospatial Solutions
  - Industry solution for ENVI, IAC, photogrammetry and Siftscape
  - Full functionality of the desktop version
  - Ready
- ENVI in the Cloud - Academia - Home Geospatial Solutions
  - Monthly licenses for ENVI, IAC, and Siftscape for academic
  - Ready, installed on powerful IT
  - Strong, backup and...
- FootPrint - Geospatial
  - The simple, full access for land planner and decision makers in agriculture
  - Web based full monitoring using Lambert and...
- FootPrint - Desktop
  - Use the ICS or Android APP and monitor in real time
  - Action data and imagery on web, smartphone and tablet
- LandScan - Helpdesk Computing
  - Monitor land use and...
  - Overridden for making minor recent changes
  - Determine the presence
- PHOTOMOD Raster Workbench - Racurs
  - Full scale processing of SAR
- PHOTOMOD Raster Workbench - Academia - Racurs
  - Full scale processing of SAR data
  - Can handle training data or CloudEO or upload your own data
  - Special terms for a...
- PHOTOMOD Workbench - IP
  - Get full digital photogrammetry on a...
- PHOTOMOD Workbench - Academia - Racurs
  - Wide range of supported sensors
  - 2D and 3D feature extraction from airborne and satellite
  - Full IAC support
- StowlyFile - CloudEO
  - Get a brief's work control any location



Software	Categories	Company	US\$/hour
Photomod	AT & Camera calibration	Racurs	\$4.76 — \$1.95
Complete Digital Photogrammetry Workbench	AT & Camera calibration	Racurs	\$9.00 — \$0.51
Photomod IAC	AT & Camera calibration	Racurs	\$0.50 — \$0.51
Fully Functional PHOTOMOD for small scientific and educational projects	AT & Camera calibration	Racurs	\$0.50 — \$0.51
Photomod GeoCalculator	Coordinate Systems	Racurs	\$0.50 — \$0.37
GeoCalculator & Direct G	Offsetting & Datum Seven Parameters Calculator	Racurs	\$0.50 — \$0.37
Photomod GroundScan	Orthophotos	Racurs	\$1.30 — \$0.68
Complete photogrammetry	AT & Camera calibration	Racurs	\$1.30 — \$0.76
Photomod IACs	AT & Camera calibration	Racurs	\$1.30 — \$0.76
Full photogrammetric UN-generated software	AT & Camera calibration	Racurs	\$1.30 — \$0.76
Photomod Raf	SAR Processing	Racurs	\$2.76 — \$1.28
SAR processing	SAR Processing	Racurs	\$2.76 — \$1.28
Photomod Raster Viewer	SAR Processing	Racurs	\$0.96 — \$0.56
SAR viewer	SAR Processing	Racurs	\$0.96 — \$0.56
OGIS - RACS get	GIS	OGIS	\$0.96 — \$0.51
OGIS - Open Source Desktop GIS - RACS - Geographic Resources Analysis Support System	GIS	OGIS	\$0.96 — \$0.51
Geob3	GIS	Chicago University (Geob3)	\$0.86 — \$0.51
Introduction to Spatial Data Analysis: Exploratory Spatial Data Analysis & Spatial Regression	GIS	Heidelberg University (GEO3)	\$0.86 — \$0.51
SARSA	GIS	Heidelberg University (GEO3)	\$0.86 — \$0.51
System for automated geoscientific analysis and effective implementation of spatial algorithms	GIS	Heidelberg University (GEO3)	\$0.86 — \$0.51

More information in the report of A. Sechin "Affordable photogrammetry — stereo measurement with smartphone"



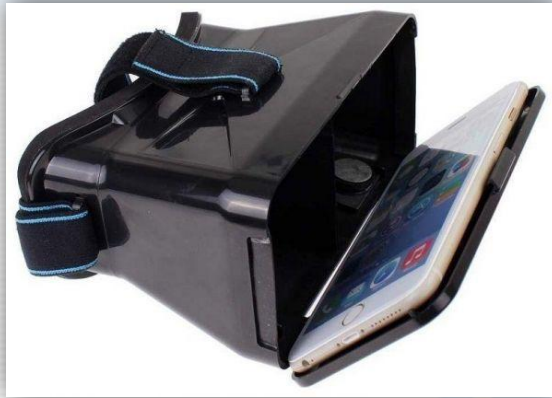
# Stereo vectorization efficiency



Stereo vectorization on  
a remote computer

# Affordable photogrammetry

VR headset



*More information in the report of A. Sechin "Affordable photogrammetry — stereo measurement with smartphone"*

# Utilities and free apps

## Free apps



*free software package which has all features of PHOTOMOD*



**PHOTOMOD  
GeoCalculator**

*stand-alone free application or Android app. for points coordinates transformation, included in the PHOTOMOD system*

## Free tools

■ **PHOTOMOD Radar Viewer** - *free version of PHOTOMOD Radar for SAR images viewing*

■ **PHOTOMOD DirectGeoreferencing** - *calculations of estimating accuracy assessment of terrain measurements*

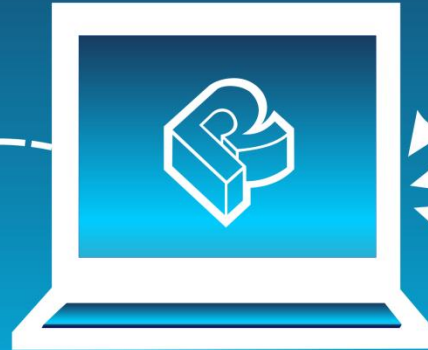
■ **PHOTOMOD Datum Parameters** - *calculations of datum parameters*

# PHOTOMOD. Factors of development

Demand of geodata



Photogrammetric technologies



- Processing data volume growth
- Processing speed increase
- Adaptation to new hardware and technologies
- Standardization
- Integration with other software

Sensors & platforms



Computer tools



Algorithms



# PHOTOMOD Trends

- Photogrammetric technology progress depends on **evolution of RS sensors and platforms**, increase of hardware productivity and new efficient algorithms developments
- One of directions of photogrammetric technology advancement is the development of special high-productive solutions for **fully automatic** creation of such products as orthomosaics, terrain models and 3D-models
- **Cloud technology** development leads to appearance of new models of photogrammetric production workflow and services
- Modern photogrammetric algorithms allow creation of accurate and detailed **3D-models** of cities and objects both as point clouds and vector models. Such models can be used as a spatial backbone of comprehensive 3D GIS
- Photogrammetric technologies become affordable and mobile



# Thank you