Satellite imagery automated processing and analysis technology in IMAGE MEDIA CENTER software
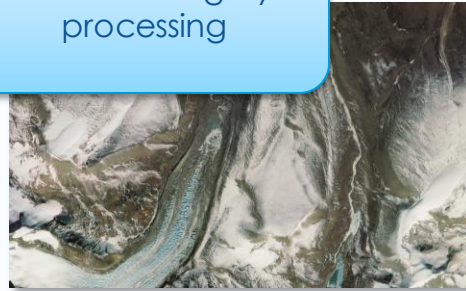
Speaker : Vyacheslav Lobzenev
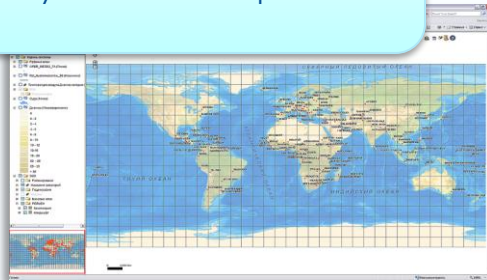
About Innovative Centre Company
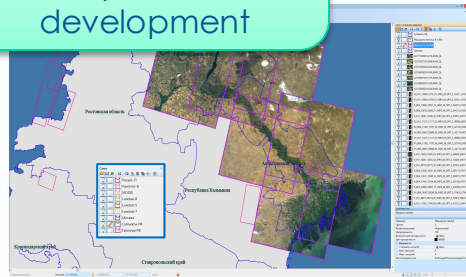
Specialized software development

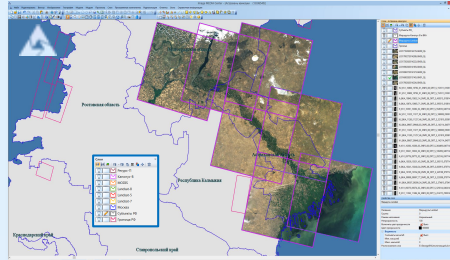Satellite imagery processing

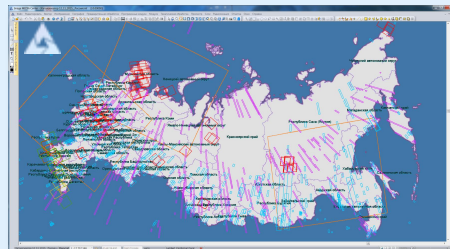Geographic information systems development

Data storage and management systems development

Remote sensing data processing cycle

Data storage and catalogization

Remote sensing data processing in IMC software
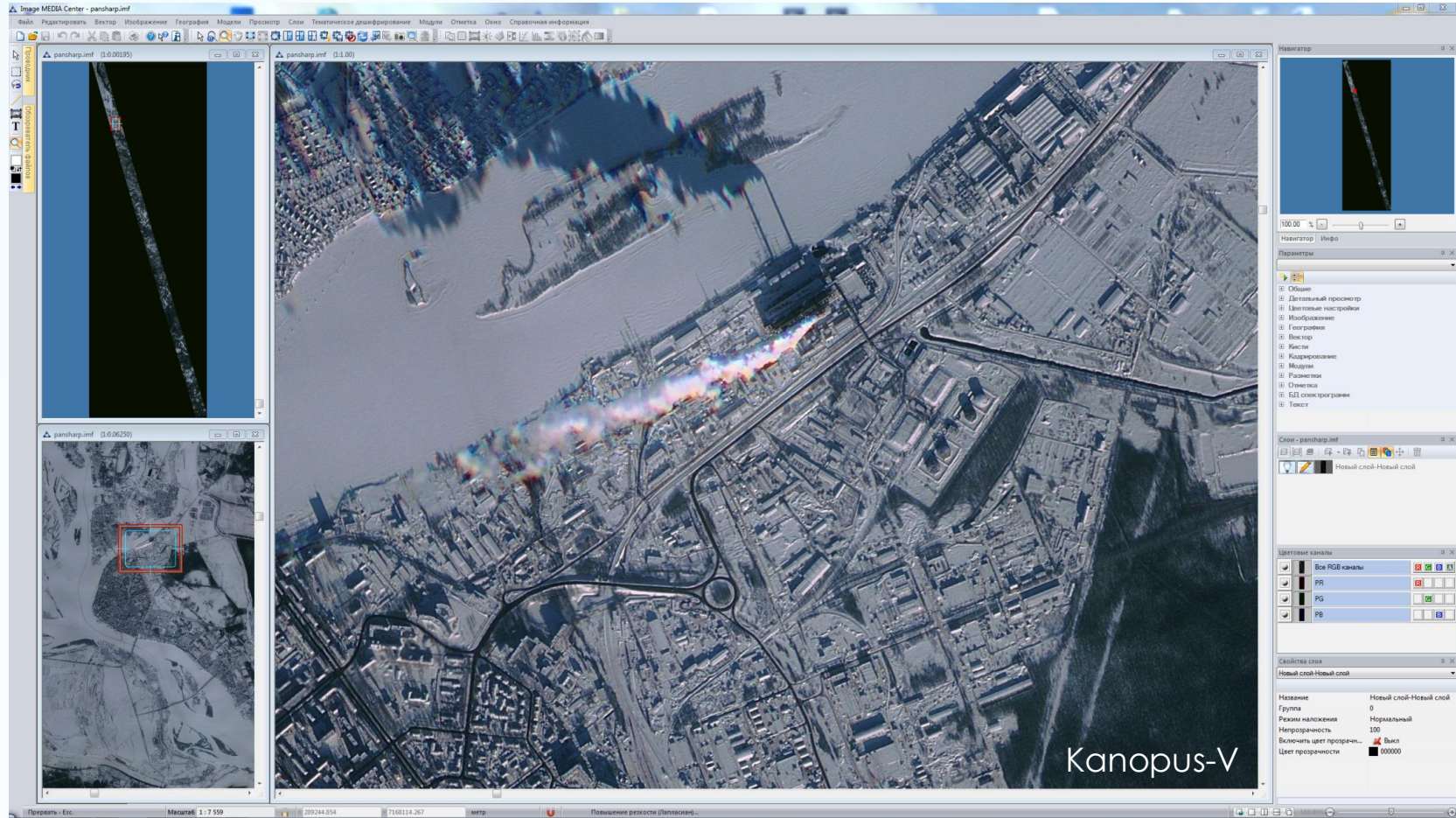
Primary processing cycle

Kanopus-V/BKA   **Resurs-P**

Automatic processing

STAGE		RESULT
1	Georeferencing improvement using reference points	Georeferencing error in degrees
2	Obtaining DEM for scene's geometric correction (GMTED 2010, 250m)	DEM in IMG file format
3	RPC-transformation for each single color band considering the error estimated during stage 1	Transformed spectral bands in IMF file format
4	Stitching of stripes (Resurs-P)/ micro frames (Kanopus-V) for individual bands in the route	5 bands (PAN+4 MUL) in IMG format
5	Eliminating offset between 4 spectral bands and panchromatic band. Formation of 4 multispectral bands image	5 files in IMG format
6	Formation of composite image consist of 4 spectral bands (pixel projection: Resurs-P ~ 2.1 m, Kanopus-V ~ 10 m)	4 bands in IMG file format
7	Panchromatic image resolution improvement (pixel projection: Resurs-P ~ 0.7 m, Kanopus-V ~ 2 m)	Resolution increase by 10-12%
8	Formation of pansharpened RGB image in natural colors with resolution of panchromatic image	File in IMG format
9	Noise elimination, Signal/noise ratio before processing ~10 dB	Signal/noise ratio after processing = 13 dB
10	Georeferencing accuracy and image resolution evaluation	Georeferencing accuracy ~10m

Remote sensing data obtainment automation

Pixel projection 2.0 m

Length 580 km

Effective area 11 600 km²

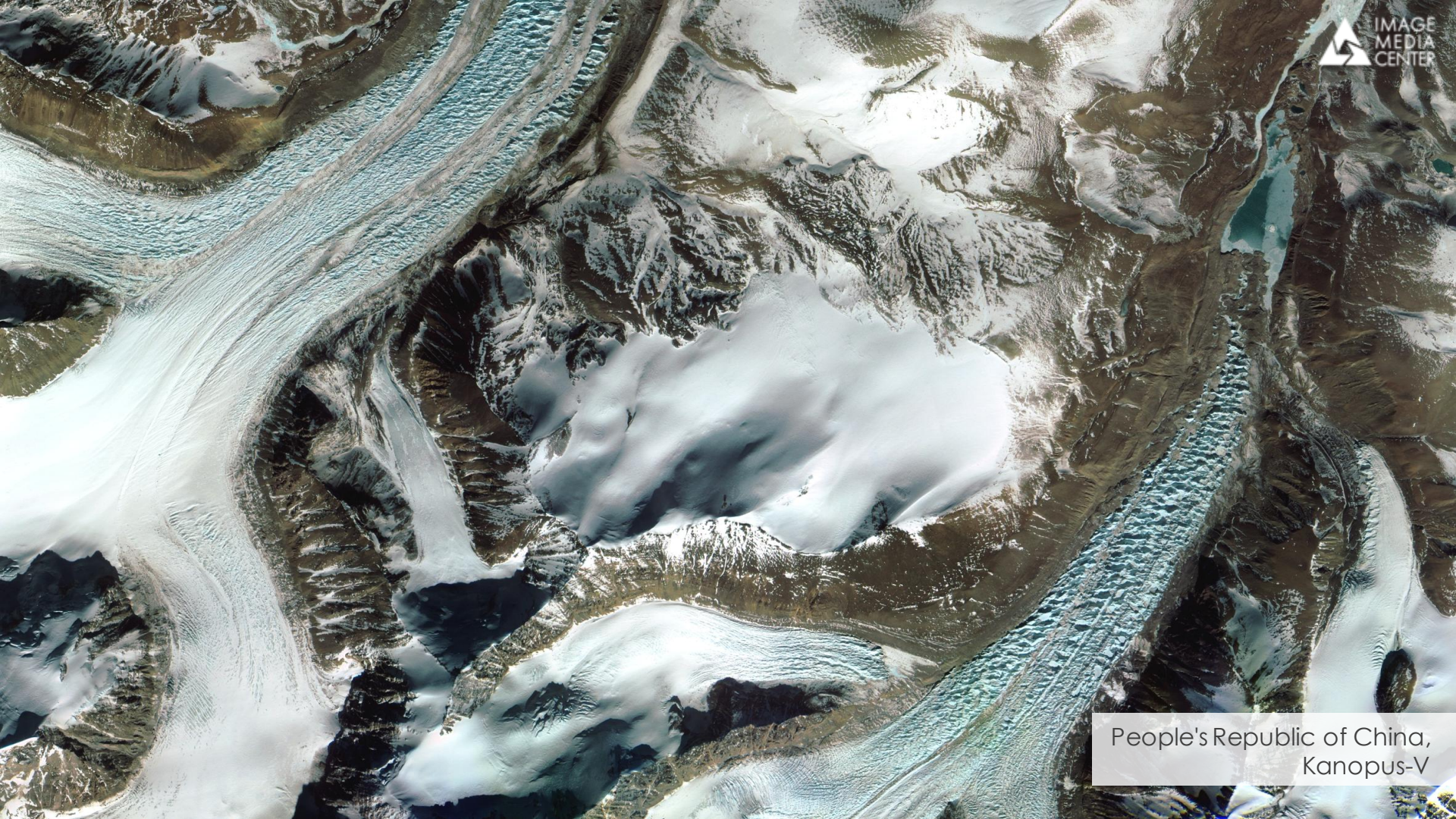**Image size >200 Gb**

Kanopus-V

Spain, Kanopus-V

Abu Dhabi,
Resurs-P

Realmadrid

Realmadrid

Spain, Resurs-P
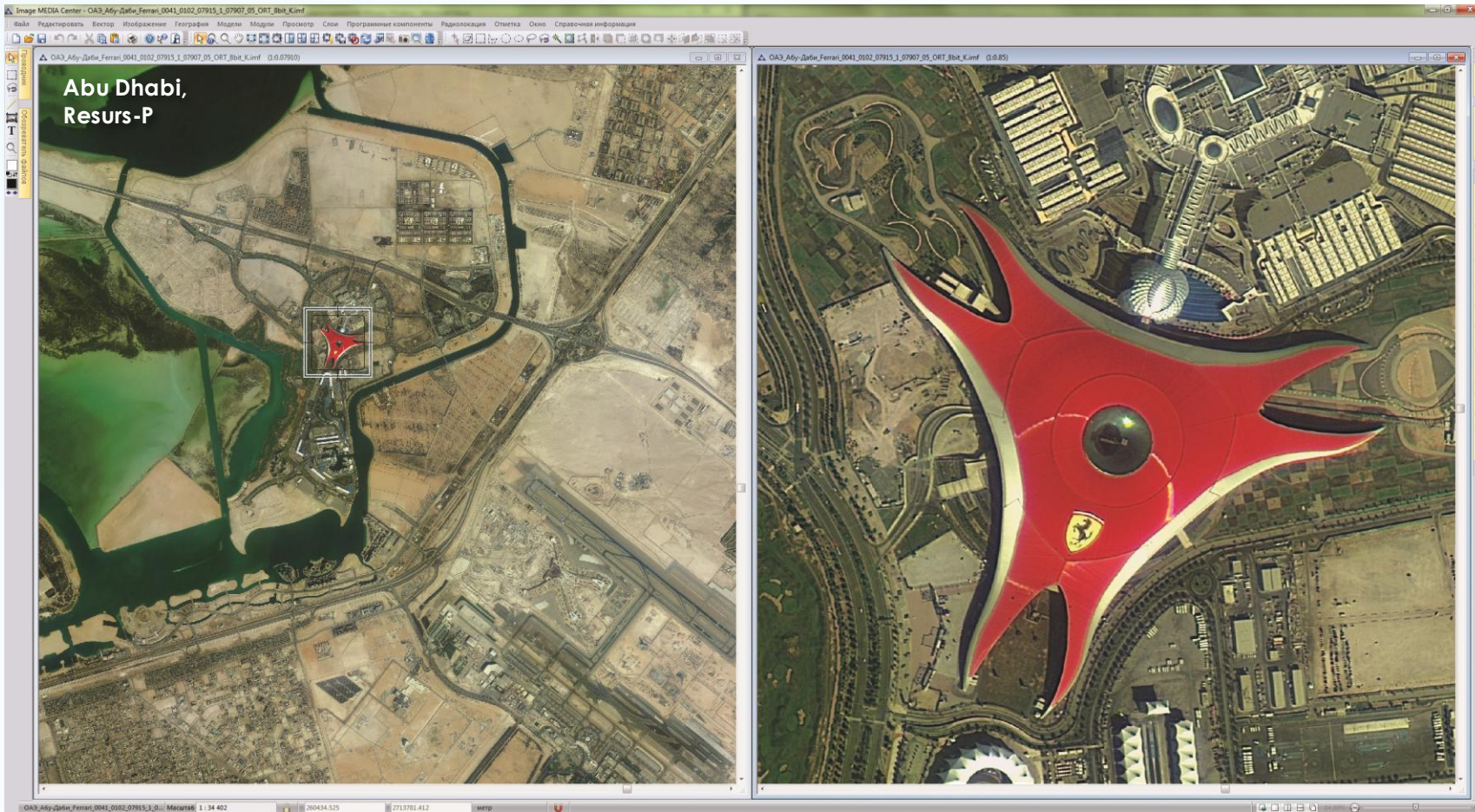
People's Republic of China,
Kanopus-V

Sweden, Resurs-P

Imagery catalog

Satellite imagery overview
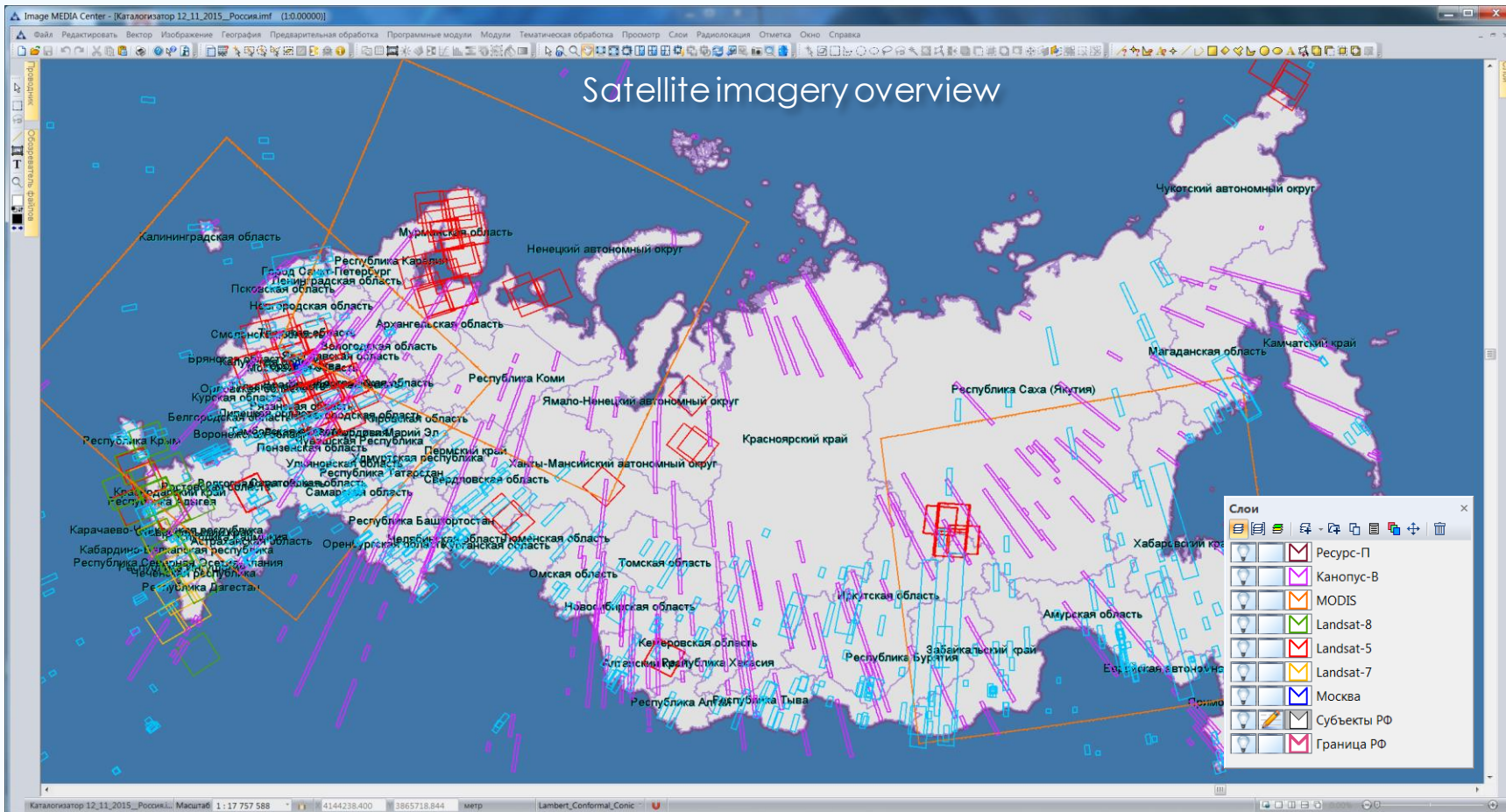
Google Maps layer background

Imagery catalog

Seamless mosaic creation

1 Contour detection

2 Alpha-channel edges blurring

3 Pixel projection unification

4 Georeferencing

5 Brightness adjustment

6 Seamline creation

7 Seamless raster mosaic creation

8 Area of interest masking

9 NoData value

10 Vector borders of the area with metadata saving

Original images
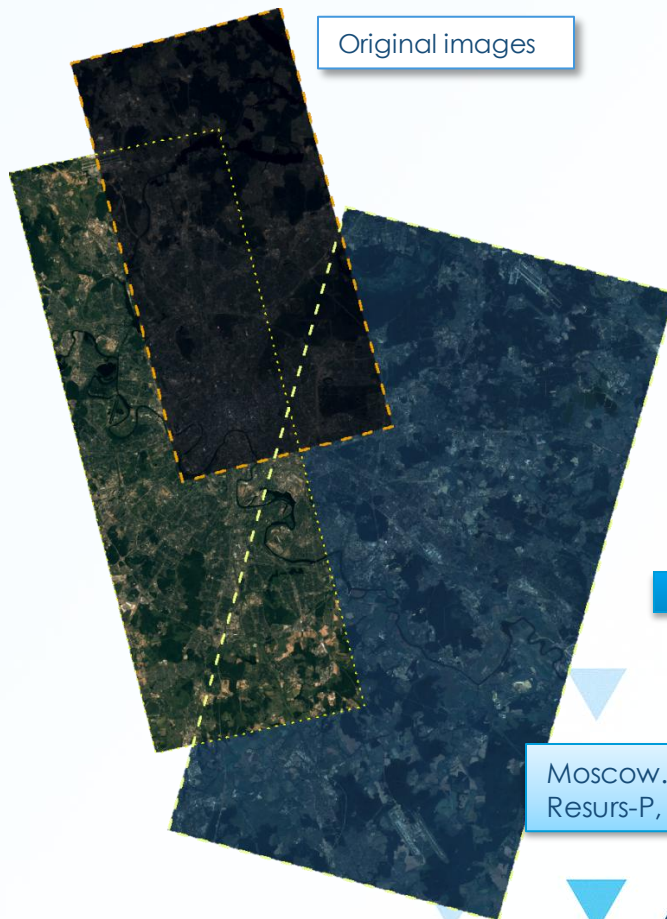
Result of mosaic creation in IMC software

Moscow.
Resurs-P, Kanopus-V

14

Result of automated georeferencing. Moscow. Kanopus-V, Resurs-P

Resurs-P
pixel- 0,72 m

Kanopus-V
pixel- 2,4 m

15

Seamless mosaic automated creation

Resurs-P
pixel - 0,72 m

Kanopus-V
pixel - 2,4 m

Resurs-P
pixel - 0,72 m

Kanopus-V
pixel - 2,4 m

Image cutting
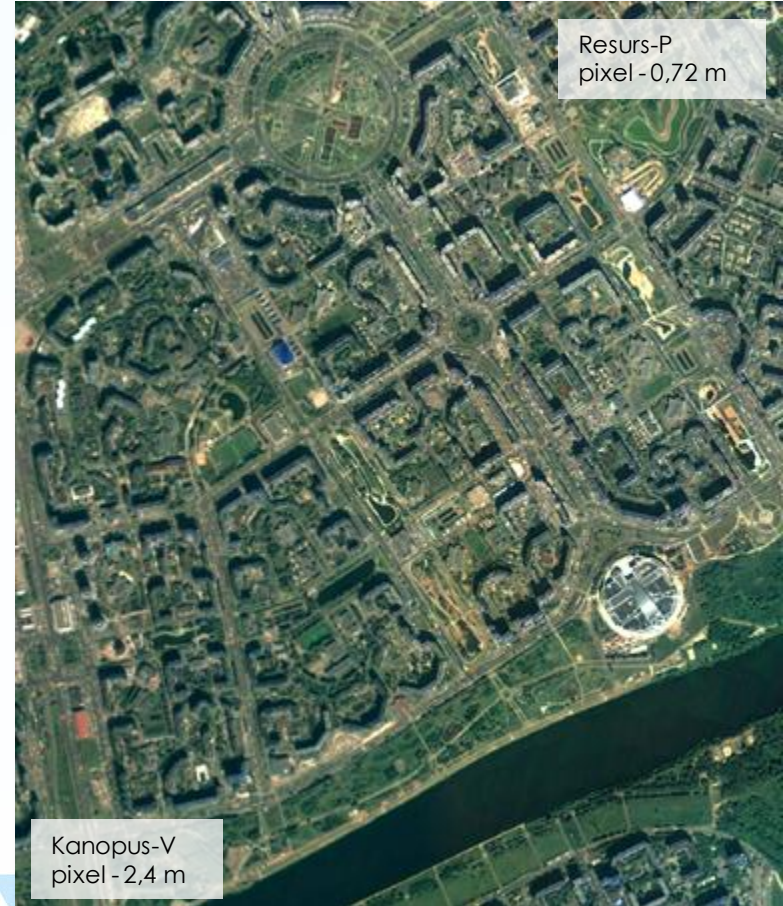
Cutting types:

1. Rectangular grid.
2. Nomenclature sheets.
3. Grate grid.
4. Size of the tile.
5. Arbitrary shape.
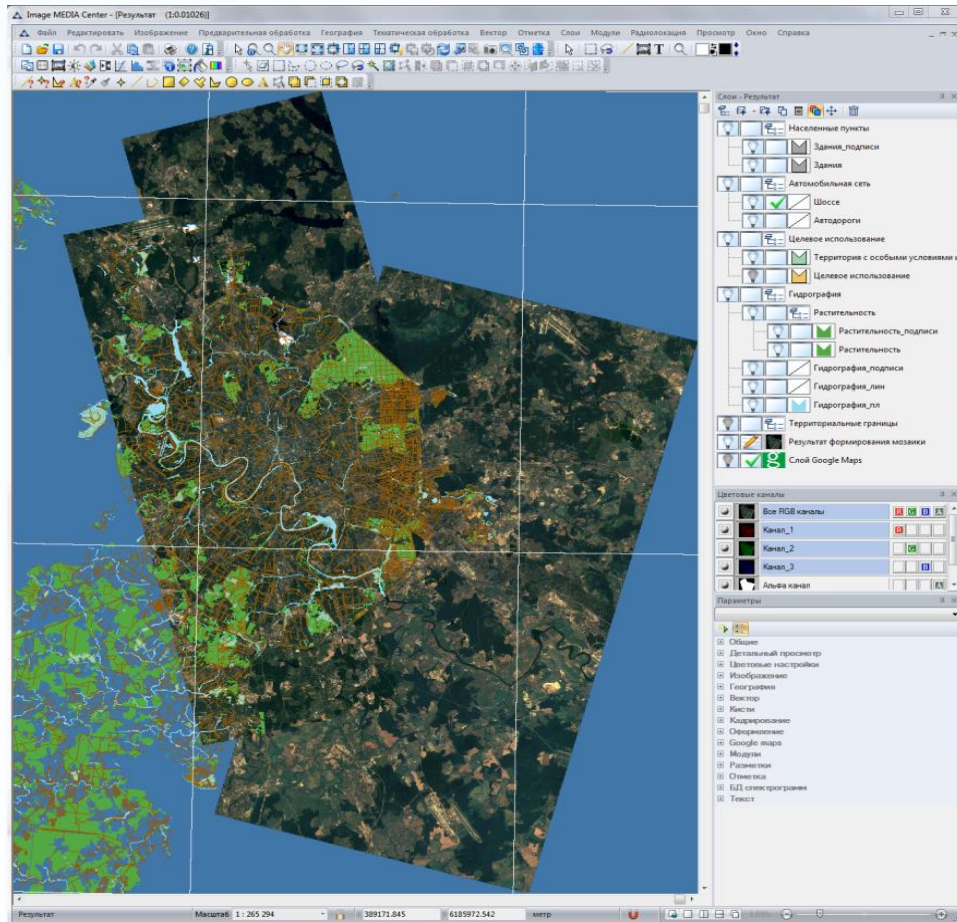
Remote sensing data processing cycle

Data storage and catalogization
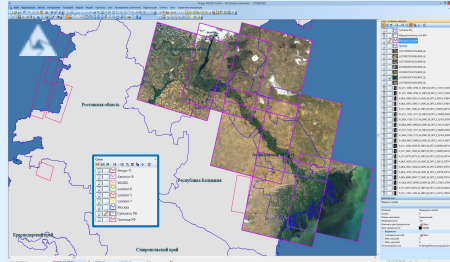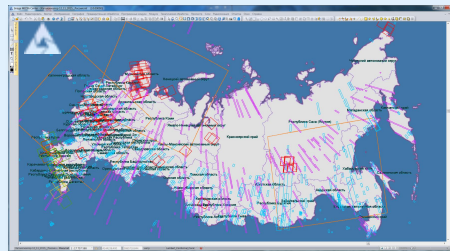
Remote sensing data processing in IMC software

Thematic areas

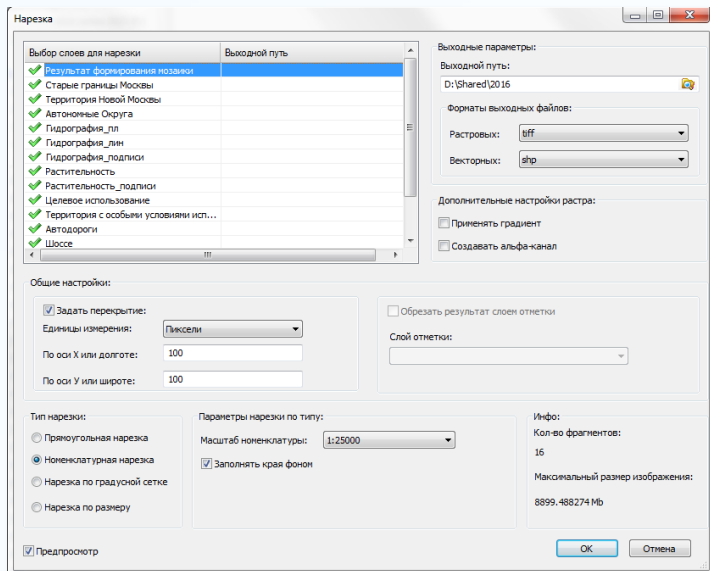|		
	Agriculture	• spatial distribution of agricultural lands; • crops monitoring; • plant distribution area analysis; • vegetation cover and soil degradation detection; • damp and saline soils detection, etc.
	Forestry	• forest stand and pest infested territories monitoring; • tree species distribution maps creation; • wood stock quantification; • areas of deforestation monitoring.
	Ecology	• oil and gas pipelines strains detection and localization; • oil firm on the water surface detection; • monitoring of lands polluted with oil; • defoliation detection ; • landfill detection.
	Mining	• mining areas monitoring; • oil and gas facilities monitoring; • temperature anomalies detection.
	Emergency situations and military tasks	• emergency situations simulation and monitoring; • search and rescue operation on the land and sea planning; • aftermath assessment.
	Other tasks	• mapping; • scientific research and government programs; • etc...

Thematic processing cycle

Remote sensing data processing in
IMAGE MEDIA CENTER

Processing stages

• Preliminary processing
(atmospheric correction,
mosaic creation, resolution
improvement).

• Thematic processing
(classification, indices,
analysis).

• Results vectorization
(attribute information, styles).

• Report generation (statistics,
diagrams, description)

Data storage

Satellite images

Resurs-P; Kanopus-V; BKA;
GeoEye-1; Landsat-5,7,8;
GeoEye, Pleiades, WV-2,3;
TerraSAR-X, TanDEM-X;
Radarsat-2; Sentinel-2A, 2B
etc

Vector maps

Road network; urban
infrastructure;
meteorological data;
floristries; protected areas;
agricultural lands; crops;
water bodies, etc

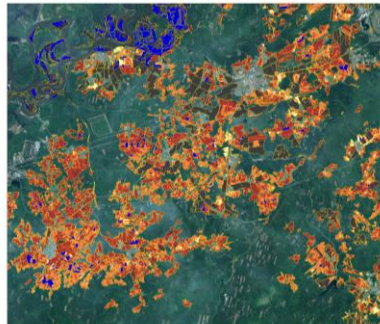## Remote sensing data processing results

• Image quality improvement.
• Vector maps and thematic vector layers.
• Forecasts and models.
• Statistical data.
• Graphic and text reports.

Vegetation cover monitoring

Crops vegetation phase, Russian Federation, Kirov region, Landsat 8 May 2014

Forest inventory

Quantitative and qualitative characteristics of forest determination

Kirov region, Pleiades

Multitemporal deforestation analysis

Result of the analysis, Russian Federation, Arkhangelsk region

30 June 2013

19 July 2014

Vector result of the detected changes

New deforestation areas 2013 – 2014.
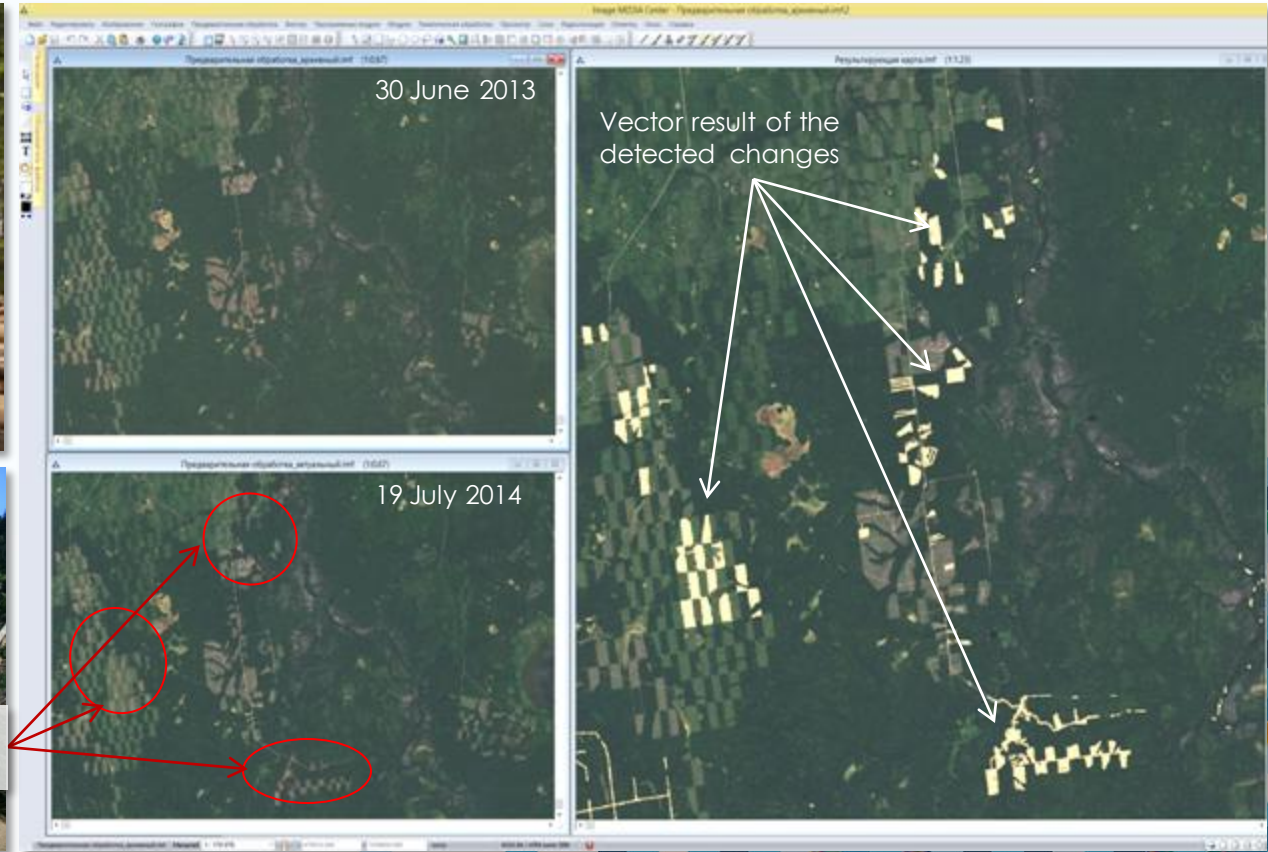
Water pollution monitoring

Russian Federation, Kirov region. Chemical factory. Pleiades. May 2013.

Условные обозначения

Чистая вода

Загрязнение

Граница Кирово-Чепецкого района

Flood monitoring and simulation
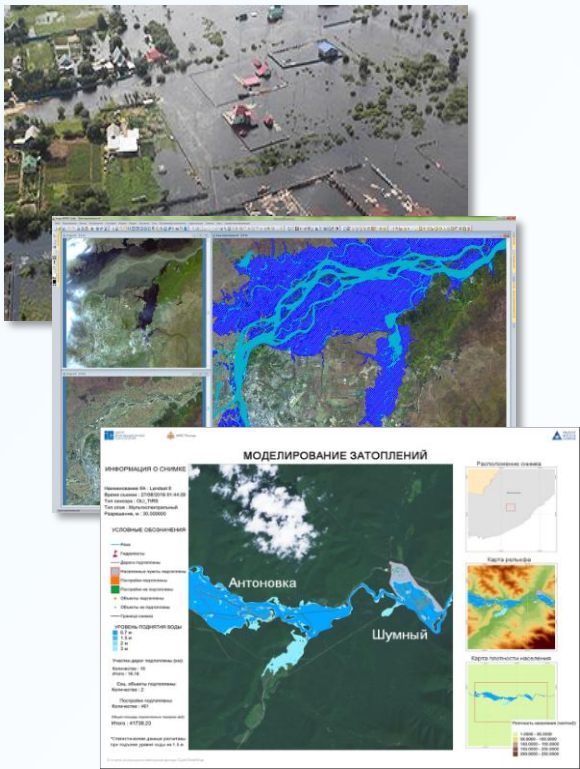
Wildfire monitoring

Earthquake monitoring
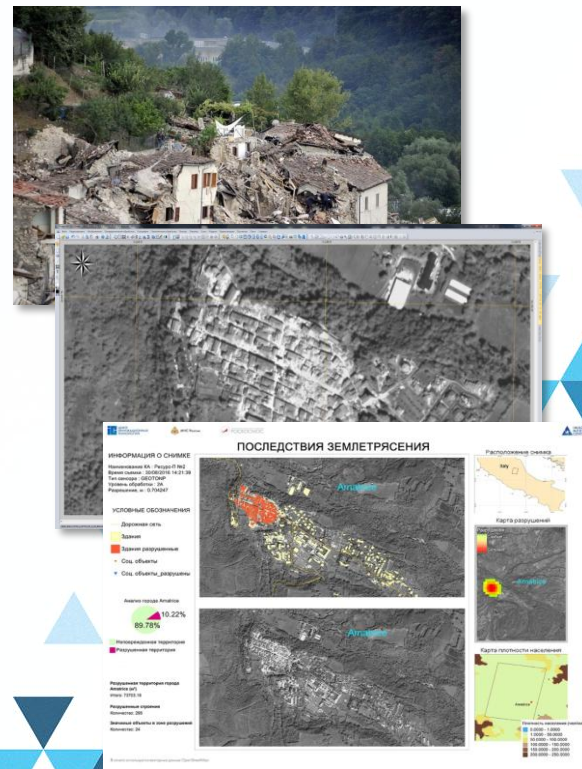
Flood simulation and monitoring

Result of simulation

Russian Federation, Vologda region
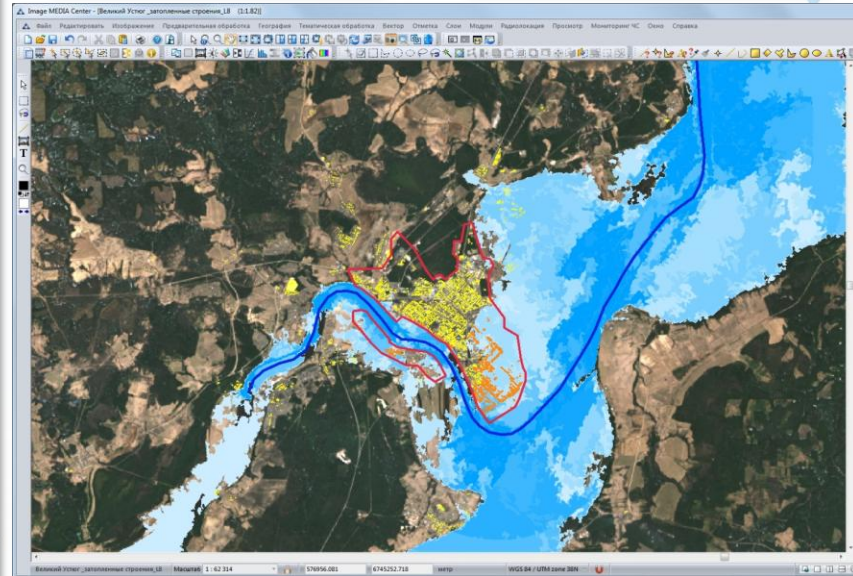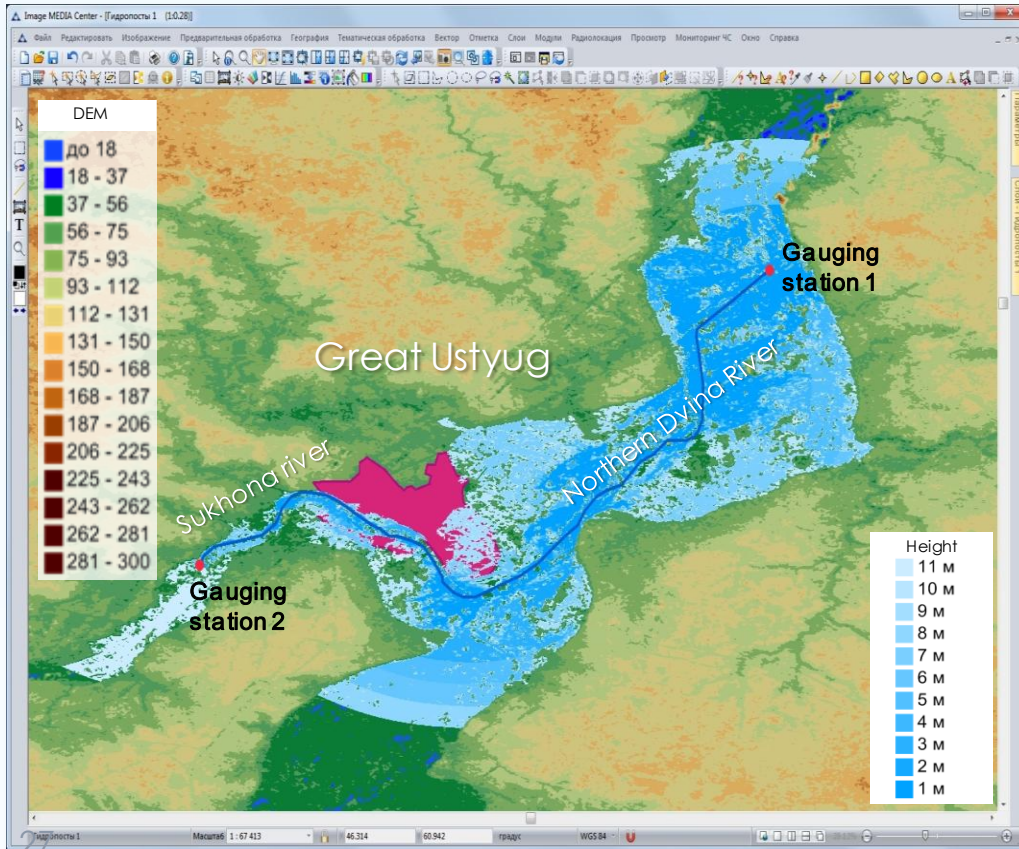
Flood simulation and monitoring

Russian Federation, Amur region
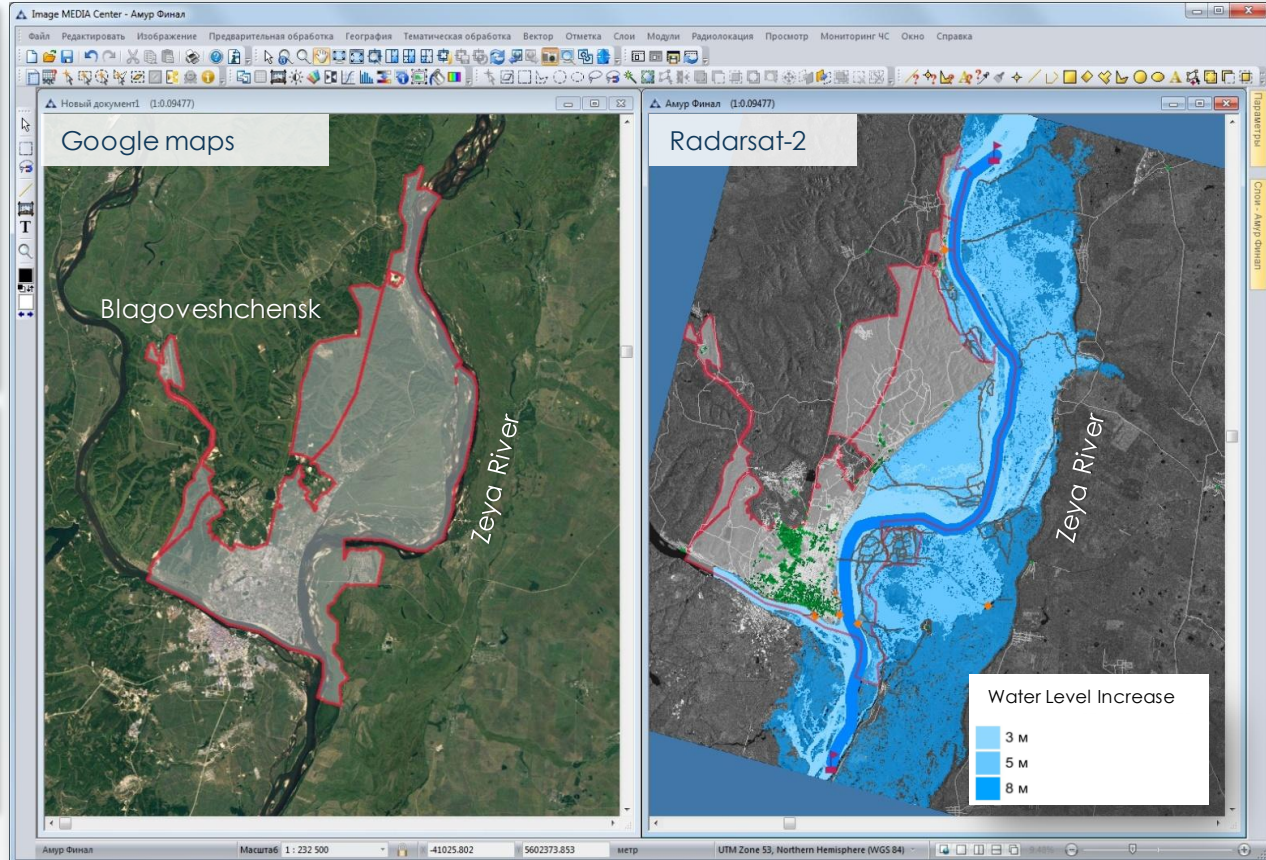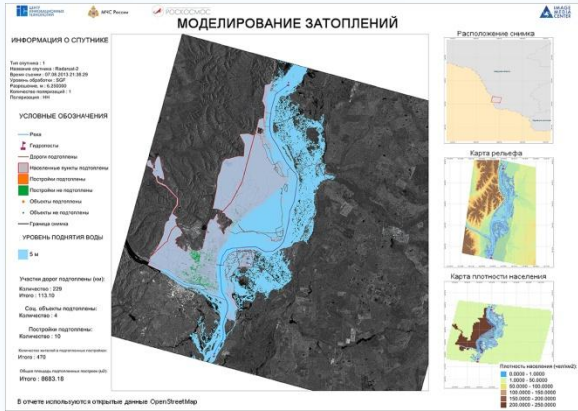
Vector data analysis
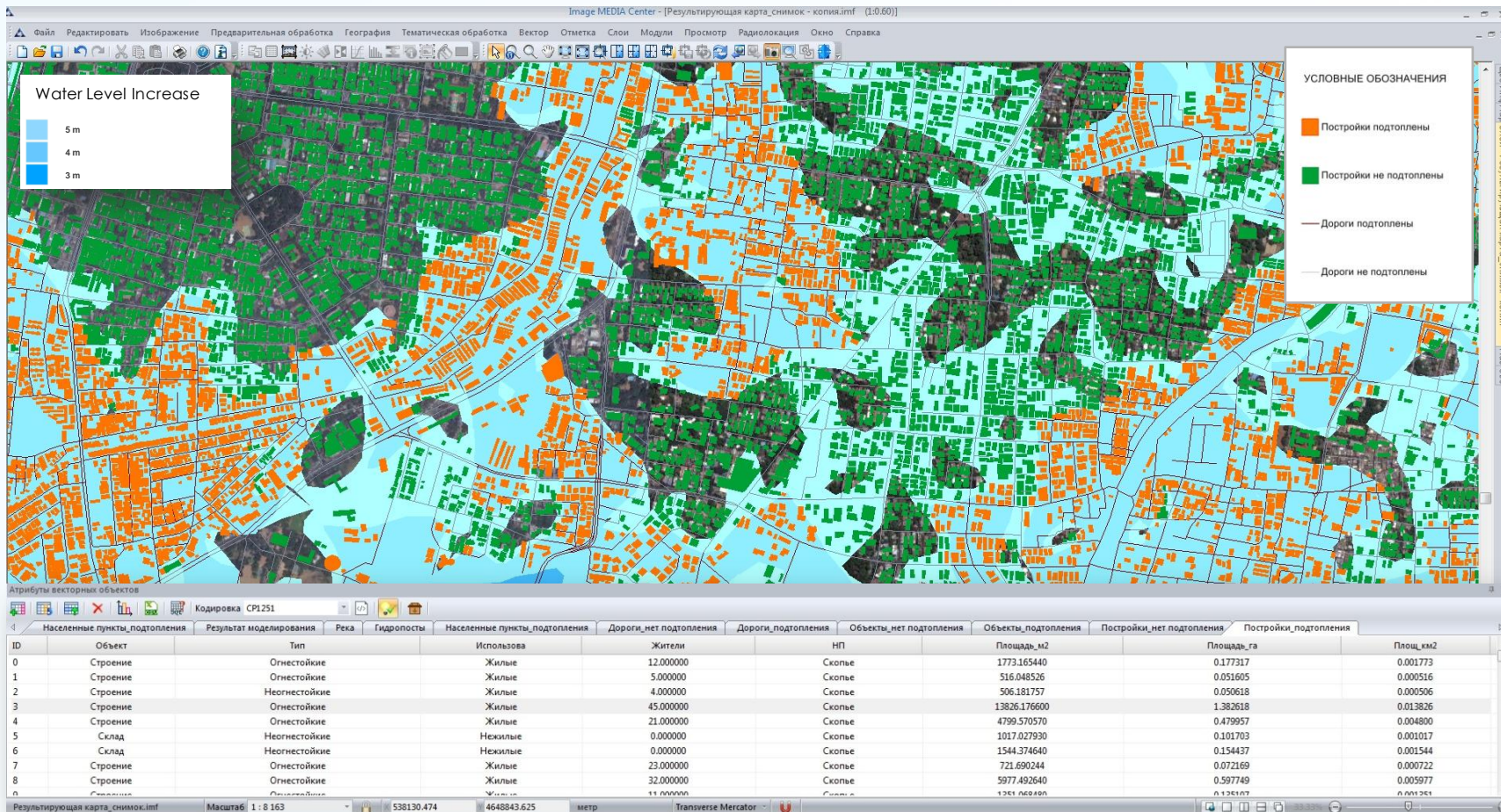
Relief changes displayed on the flood simulation

Embankment

Report generation
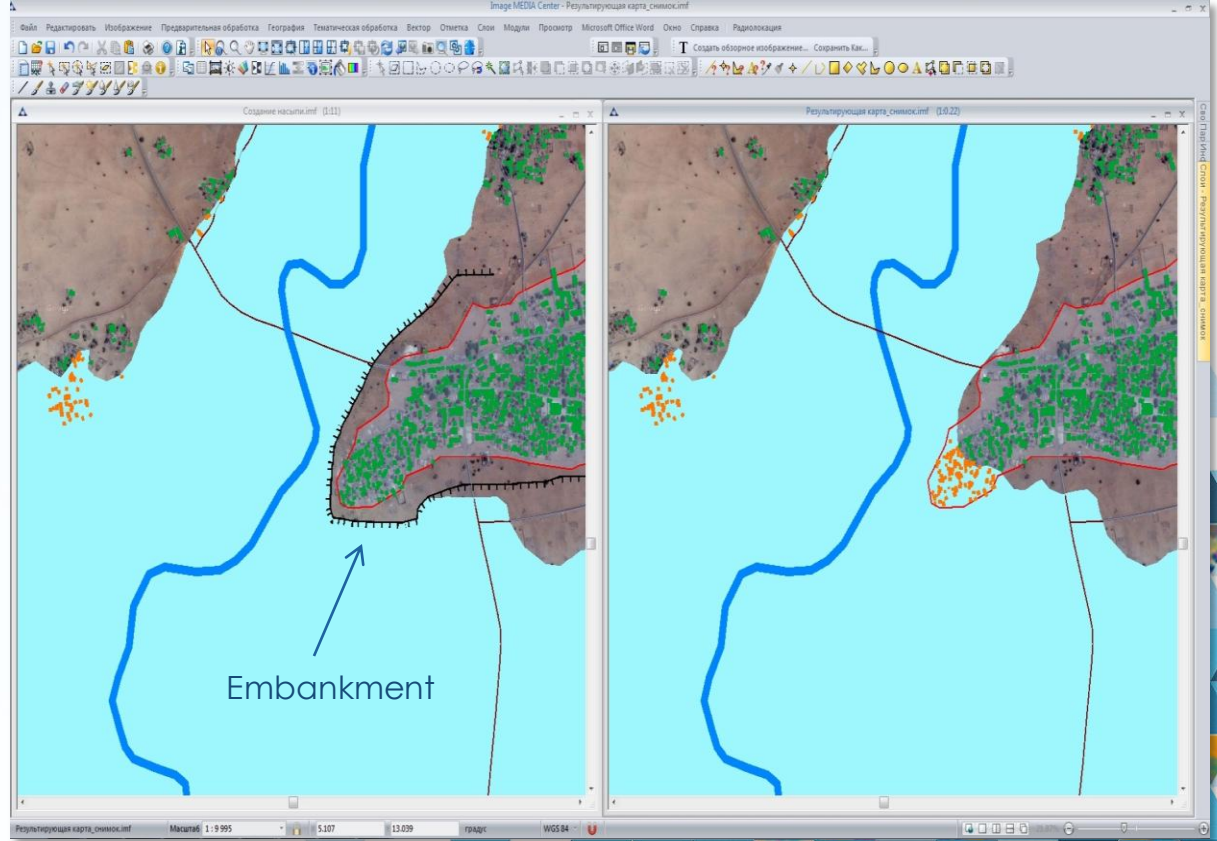
Report contains:

- Resulting vector map overlaid on the raster image of Google maps service.

- Information about the image.

- Legend.

- Water level increase.

- Information about flooded roads, points of interest and buildings.

- Image location on the world map.

- Relief map.

- Population density map.

INNOVATIVE CENTRE

IMAGE MEDIA CENTER
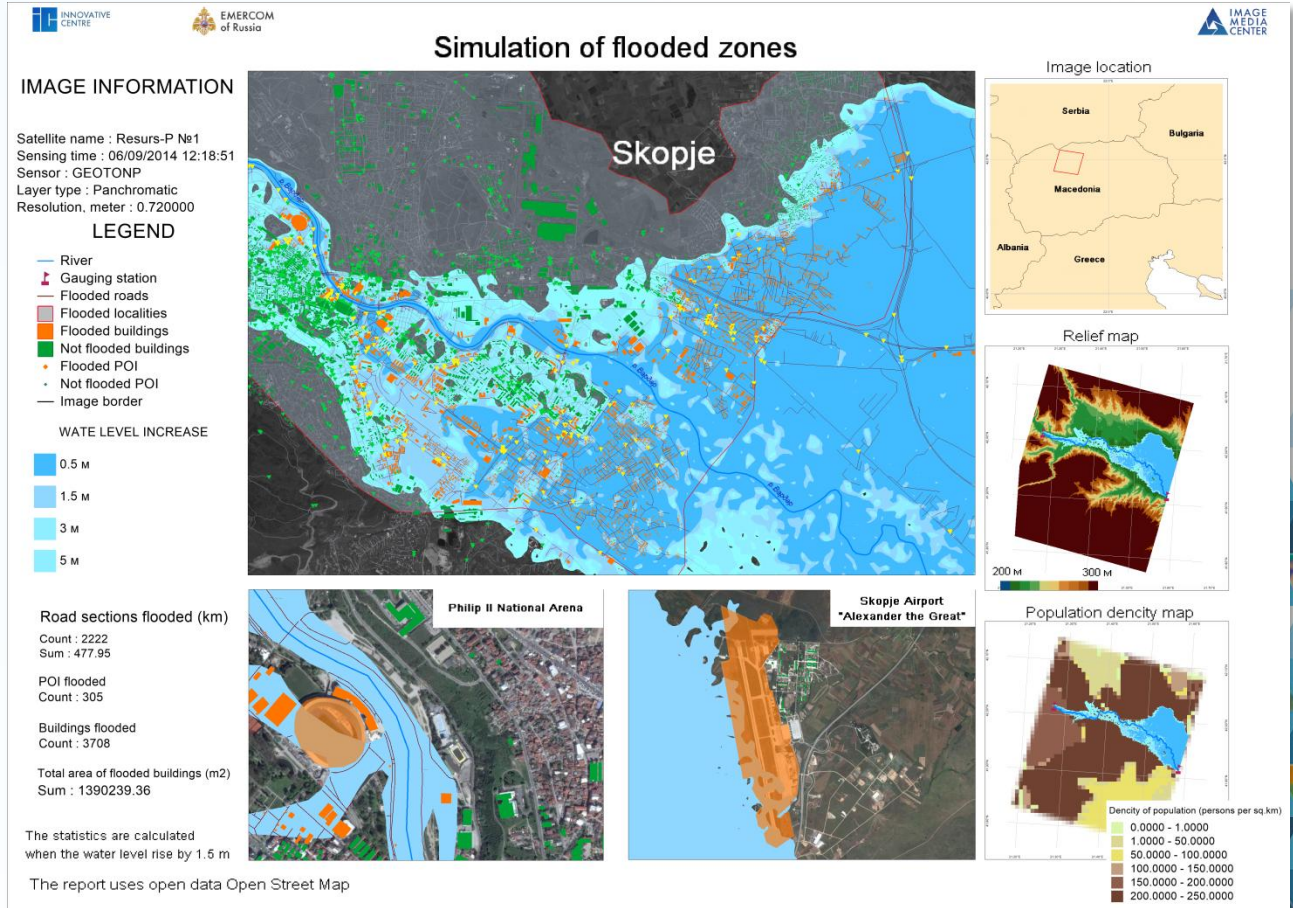
List of localities that may require evacuation

Rescue operation manpower and equipment requirements

Restoration works

Meteorological data

Flooded areas characteristics

List of inhabited localities affected by flood

Information about flooded buildings

Evaluation of flood situation conclusions

14.05.2014 21:03 Amur Oblast

1. 14.05.2014 21:03 as a result of drastic water level increase of the Amur river due to an intensive snow melting (continuous raining) 5 inhabited localities in the following regions: region Blagoveshchensk; have been flooded; total flooded area - 35331.09 ha.

Water level increased by 5.00 m.

Total population of the flooded area - 77 people; among them 53 citizens, 24 villagers, 0 possible casualties.

Flooded area's characteristics

Water level increase	Total flooded area
5.00 m	35331.09 ha

List of inhabited localities affected by flood

Amur Oblast

Name	Population, people	Population in the flooded area, people	Possible fatalities, people	Possible victims, people	Total area, square km	Flooded area, square km	Maximal depth, m
Belogorie	2900	0	0	0	20.530	11.637	0.000
Mykhinka	135	0	0	0	9.030	3.008	0.000
Prizeiskaya	206	0	0	0	2.500	3.603	0.000
Vladimirovka	883	0	0	0	6.770	1.398	0.000

Amur Oblast region Blagoveshchensk

Name	Population, people	Population in the flooded area, people	Possible fatalities, people	Possible victims, people	Total area, square km	Flooded area, square km	Maximal depth, m
Blagoveshchensk	224335	0	0	0	317.080	103.727	0.000

Total amount of buildings affected by flood 10; among them 2 residential buildings, 8 non-residential buildings, ____ socially significant objects.

It may require the evacuation of the residents of the following localities:

- Belogorie
- Mykhinka
- Prizeiskaya
- Vladimirovka

- Blagoveshchensk

2. Manpower and equipment required to carry out rescue operations

Rescue works:

- Number of river intelligence patrols – ____ units. (reconnaissance patrol – 4 people.)
  - Number of reconnaissance airplanes (helicopters) – ____ units
    - Number of rescuers – ____ people.
  - Number of vehicles required for evacuation works – ____ units.
- Number of watercrafts required for evacuation works – ____ units. (capacity of a single watercraft: 70 people.)
  - First Aid (total) – ____ people
    - Including medics- ____ people.
  - specialized medical care (total) - ____ people
    - Including medics - ____ people.

Restoration works (engineering units):

- Number of engineering units for moorings equipment - ____ units. (engineering unit - 20 people)
  - Number of engineering units for damaged roads restoration - ____ units. (engineering unit - 20 people)
  - Number of engineering units for damaged bridges restoration - ____ units. (engineering unit - 20 people)

Total amount of personnel required – ____ people

Number of temporary shelters for affected population accommodation -_____ units. (Single shelter's capacity – 250 people)

3. Meteorological data: without precipitation, air temperature ___°Ñ, west wind ___ m/s, atmospheric pressure ____ mm of mercury, humidity ___%, atmospheric conditions: inversion, visibility good

Increase in surface air temperature and intensive snow and ice melting can result into rapid water level increase or the Amur River.

Flash floodings caused by intensive imminent rains and thaws in winter pose a particular threat.

Increase in surface air temperature and intensive snow and ice melting (especially when the ground is frozen) can result into flooding of the roads, which can hamper rescue operations and evacuation.

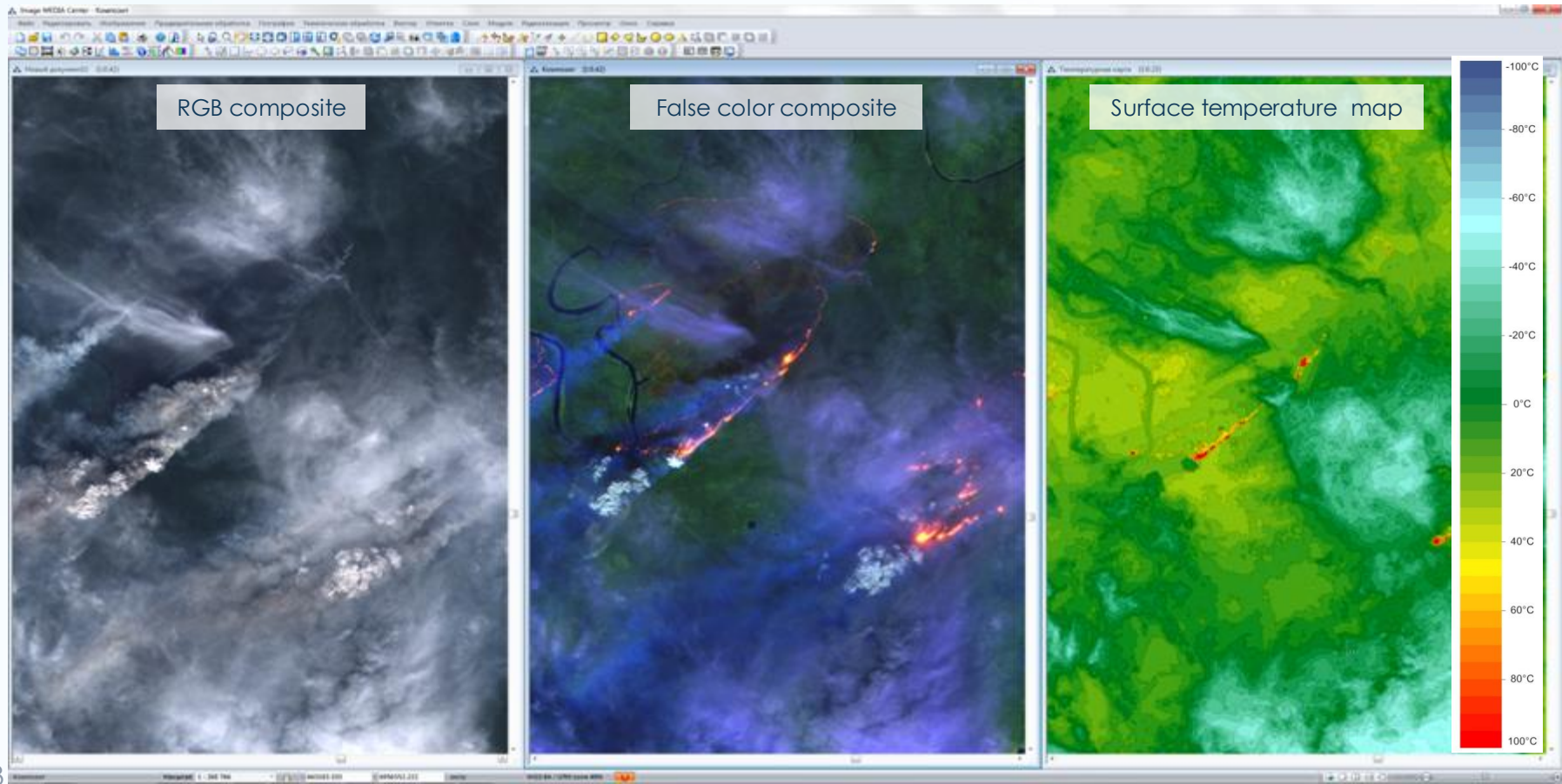| Position	Signature	Initials and surname

Wildfires monitoring

Open fire detection. Russian Federation, Landsat-8

Wildfires monitoring

As a part of cooperation with Ministry of Emergency Situations (Russia) Innovative Centre Company performed a monitoring of fires on the Portuguese island of Madeira.

Monitoring was performed in IMAGE MEDIA CENTER software based on the Landsat 8 data received on the August 11, 2016.

Earthquake monitoring

As a part of cooperation with Ministry of Emergency Situations (Russia) Innovative Centre Company performed an aftermath assessment of earthquake in Italy.

At least 247 people were killed and more were injured after a 6.2-magnitude earthquake struck central Italy.

INNOVATIVE CENTRE   EMERCOM of Russia   ROSCOSMOS   IMAGE MEDIA CENTER

EARTHQUAKE AFTERMATH ASSESSMENT

INFORMATION ABOUT SCENE

Satellite name : Resurs-P №1
Sensing time : 25/08/2016 12:03:36
Sensor : GEOTONP
Processing level : 2A
Resolution, meter : 0.824652

LEGEND
— Road network
☐ Buildings
☐ Destroyed buildings
▾ POI
▾ POI collapsed

Pescara del Tronto summary
23.31%
76.69%

Amatrice summary
10.22%
89.78%

☐ Unaffected area
☐ Ruined territory

Ruined territory - Amatrice (m²)
Sum: 73703.18

Ruined territory - Pescara del Tronto (m²)
Sum: 33557.85

Destroyed buildings
Count: 395

POI in the ruined area
Count: 24

Amatrice

Pescara del Tronto

Image location
Italy

Map of destructions
Destruction
Low
High
Pescara del Tronto
Amatrice
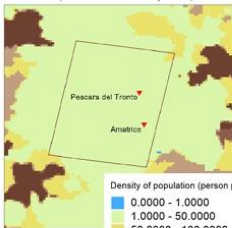
Population density map
Pescara del Tronto
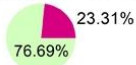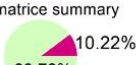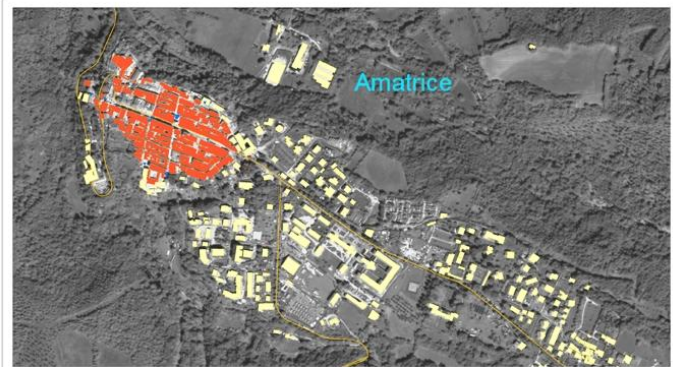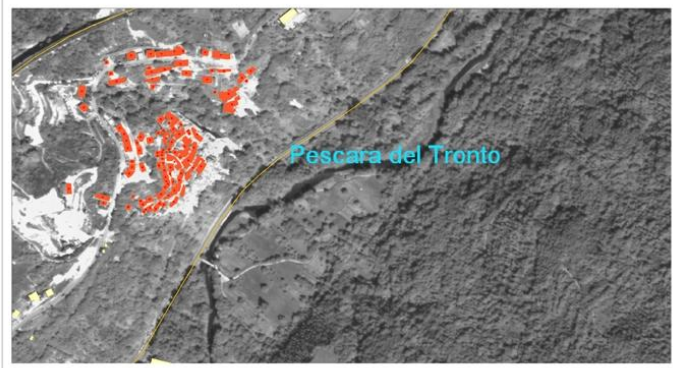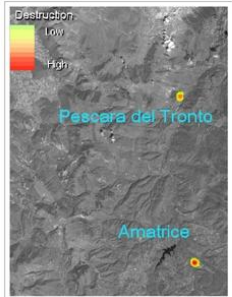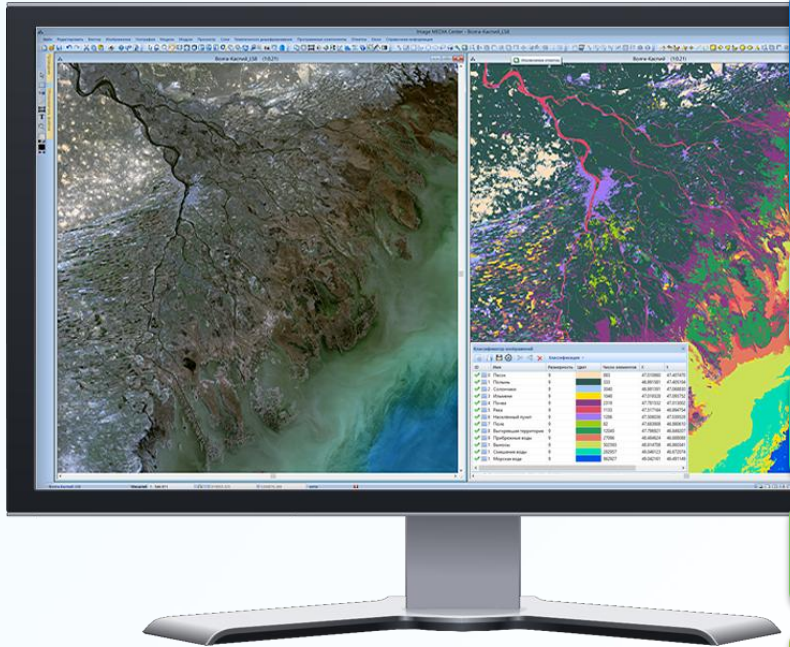Amatrice

Density of population (person per sq.km2):
☐ 0.0000 - 1.0000
☐ 1.0000 - 50.0000
☐ 50.0000 - 100.0000
☐ 100.0000 - 150.0000
☐ 150.0000 - 200.0000
☐ 200.0000 - 250.0000

OpenStreetMap vector data is used in the report.

IMAGE MEDIA CENTER advantages

Full cycle of satellite data processing and vector maps creation

Combination of raster and vector data in a single workspace

Possibility to store the whole project in one *.imf file

Creation of macros for automated data processing

Large amount of data stream processing

Creation of geographical databases based on DBMS

Opened program architecture and possibility of further program development

Thank you
for attention

Innovative Centre

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Website: www.novacenter.ru