APPLICATION OF REMOTE SENSING TECHNOLOGIES FOR FOREST COVER MONITORING

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Introduction

Relevant information on state of the forests is needed for planning and promoting sustainable forest management. As practical experience indicates, such information in Federal subjects of Russia is often outdated and untrue. It can also be said about existing forest maps. Old digital maps can't be used for navigation in the field, but only as layouts of low accuracy. Updating of forest management materials in office without objective information on the forest fund will significantly reduce the accuracy of the information about the state of forests and based on it forest management planning documents. A large area of forests dictates the use of remote sensing data.

Aims

Development of monitoring system of the forest Fund, actualization of databases and forest maps updating using high - resolution satellite imagery. Due to the large volume of incoming information (data), all processing algorithms should be automated as much as possible and that requires the evelopment of a number of tools.

Tasks:

- Obtaining accurate reference ortho-mosaic covering the territory of the Forest Fund of the Russian Federation.
- Development of monitoring technologies of the Forest Fund
- Automation of maps the and databases updating.
- Development of a system for data acquisition, processing and storage.
- Development of a system to control satellite imagery processing and data access.

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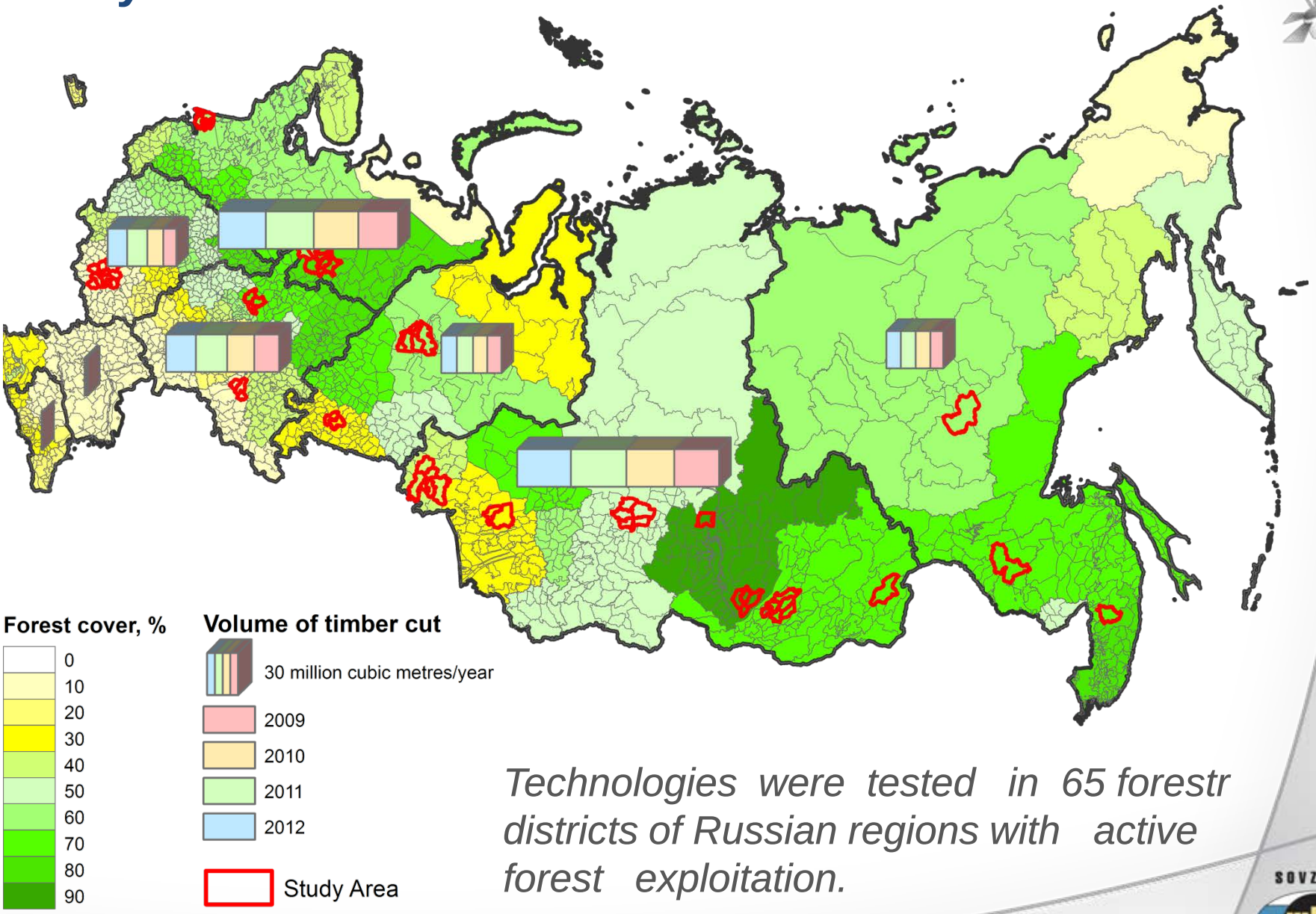
Study area



Technologies were tested in 65 forestr districts of Russian regions with active forest exploitation.

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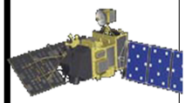
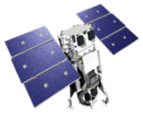
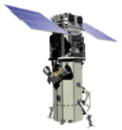
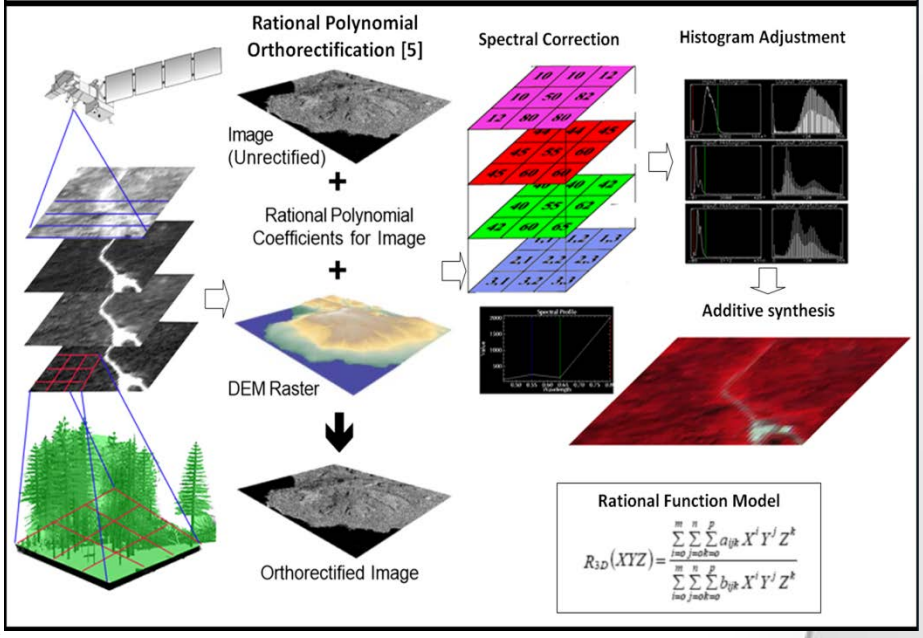
Data and Methods

REMOTE SENSING DATA				
Specifications				
	ALOS-PRISM (archive data only)	WorldView-1	WorldView-2	RapidEye
Scan Mode	Panchromatic	Panchromatic	Panchromatic/ Multispectral	Multispectral
Spectral Bands (µm)	0.52-0.77	0.50-0.90	Pan: 0.50-0.90 Blue: 0.45-0.51 Green:0.51-0.58 Red: 0.63-0.69 NIR: 0.77-0.895	Blue: 0.44-0.51 Green:0.52-0.59 Red: 0.63-0.685 RE: 0.69-0.73 NIR: 0.76-0.88
Spatial Resolution	2.5 m	0.5 m	0.5/2.0 m	6.5 m
Radiometric Resolution	8-bit	16-bit	16-bit	16-bit
Delivered Processing Level	1B2R (+RPC)	Standard Ortho Ready	Standard Ortho Ready	1B
Geolocation Accuracy of Ortho-Images Products (m)	CE90 = 10	CE90 = 5	CE90 = 5	CE90 = 20 (10 after Co-registration)
Appropriate Scale	1:25 000	1:10 000	1:10 000	1:50 000 (1:25 000)

Extraction and interpretation of information about the area from remote sensing data



Today data that are acquired by remote sensors borne by satellites are widely available and used by our company as a source of relevant and accurate information.

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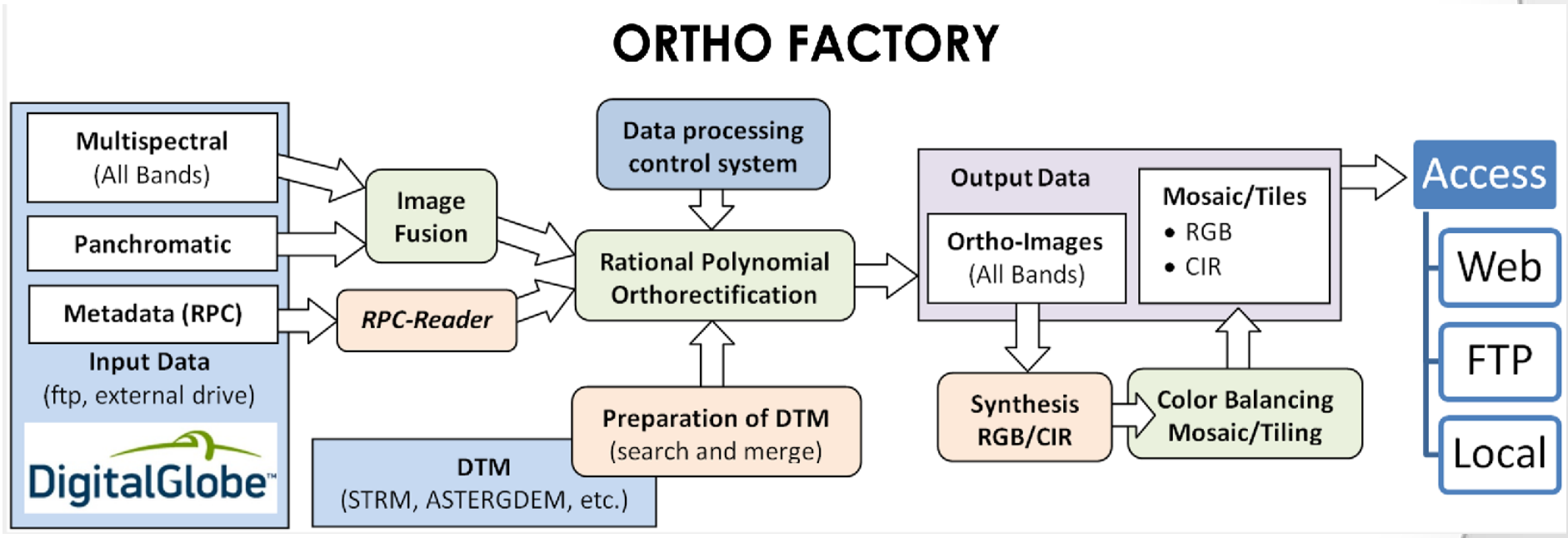
Step 1: Cartographic reference base

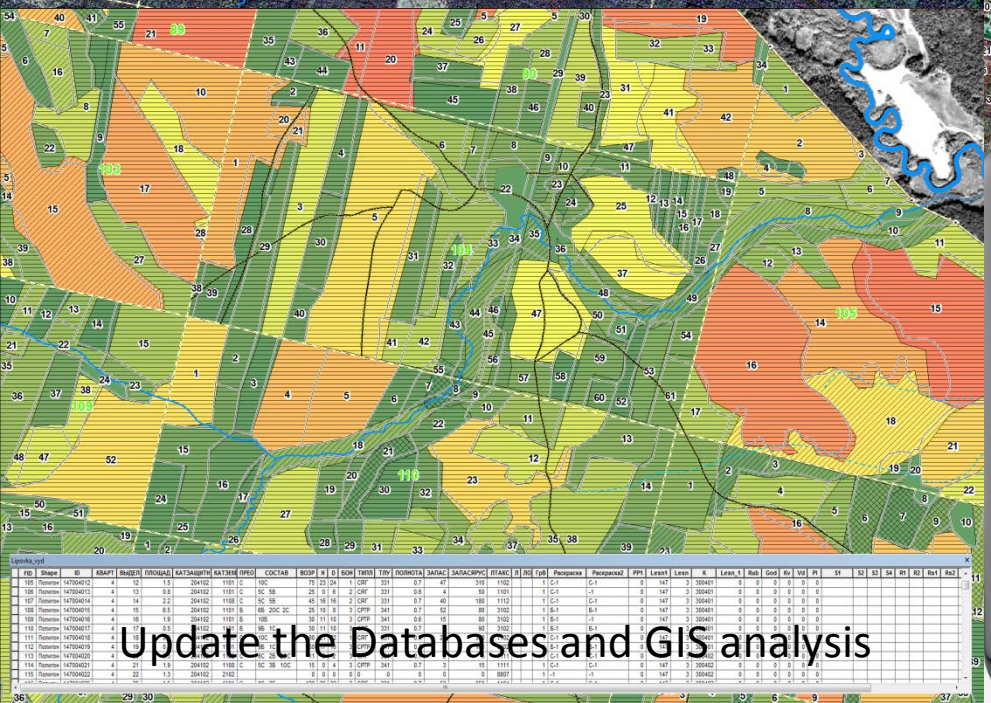
The first step of forest management is the preparation of geospatial reference – orthophoto plan – for an object area.

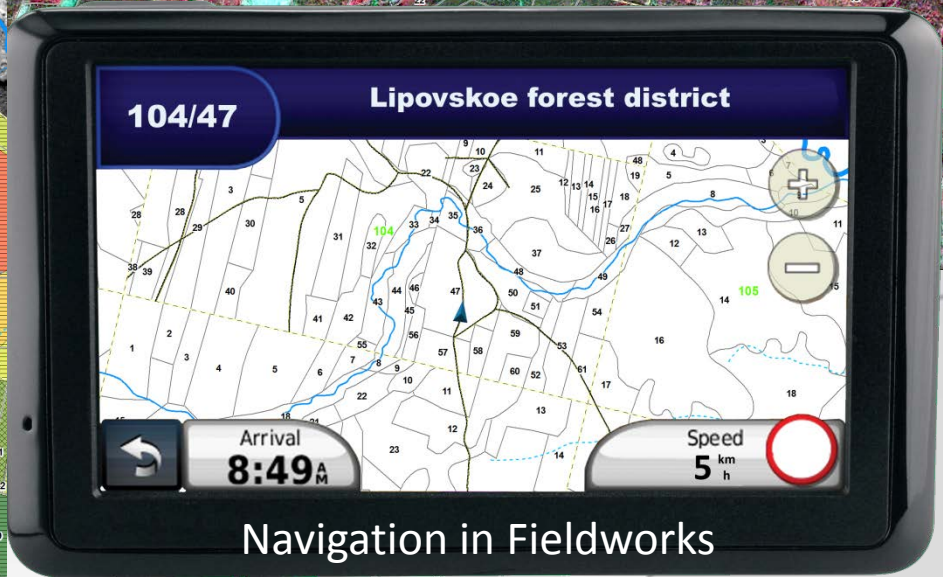


The ortho - image creation process is fully automated.

Cartographic reference base

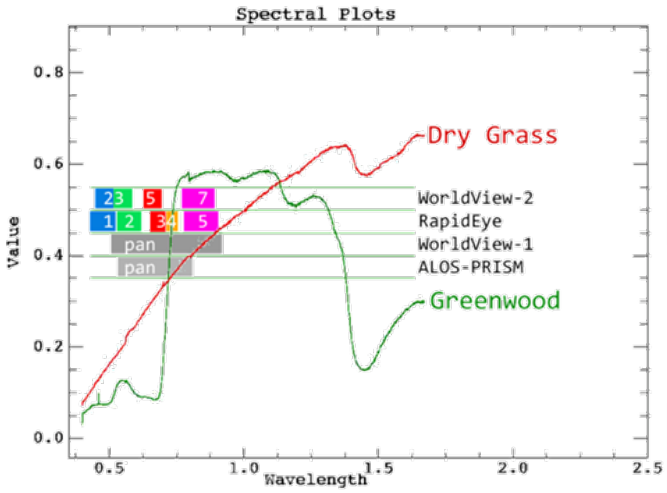
The resulting imagery is used as a reference for:





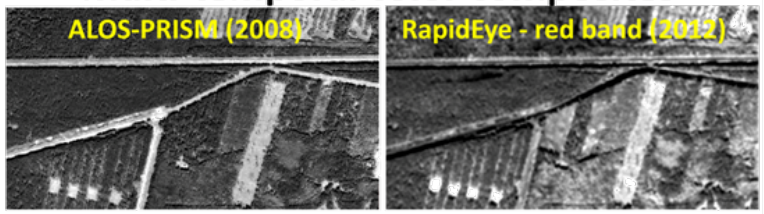
Step 2: Monitoring - identifying the disappearance of vegetation

The principle of interpretation of changes in forests (the disappearance of vegetation) was the result of the spectral analysis of the images and based on the spectral properties of vegetation.

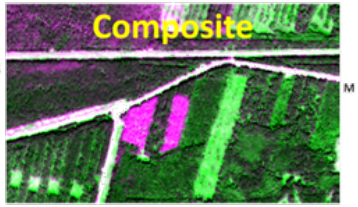


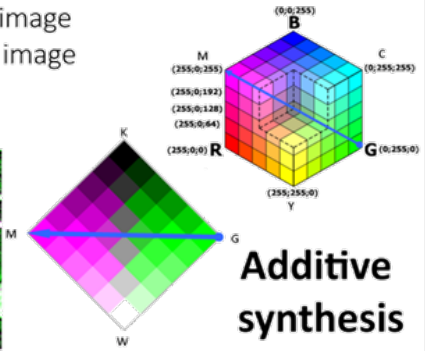
Generalized spectral reflectance curve for a vegetation and channels of imaging equipment on ALOS-PRISM, RapidEye, WorldView-1/2(over the wavelength range 0.4 μm- 2.5 μm)

Multi-temporal color composites

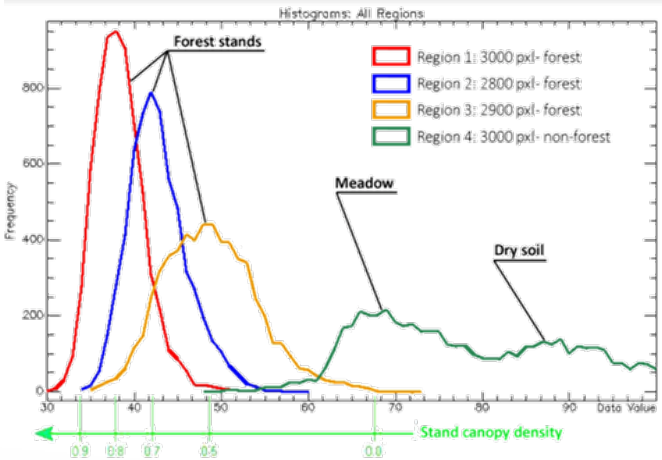


R- the red band of a new image
G- the red band of an old image
B- red, green or NIR band of a new image



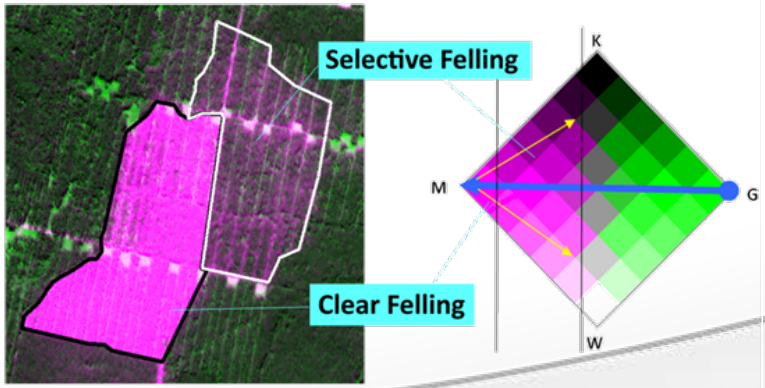


Additive synthesis



Histograms of the pixel brightness values for different densities of forest stands and non-forest areas

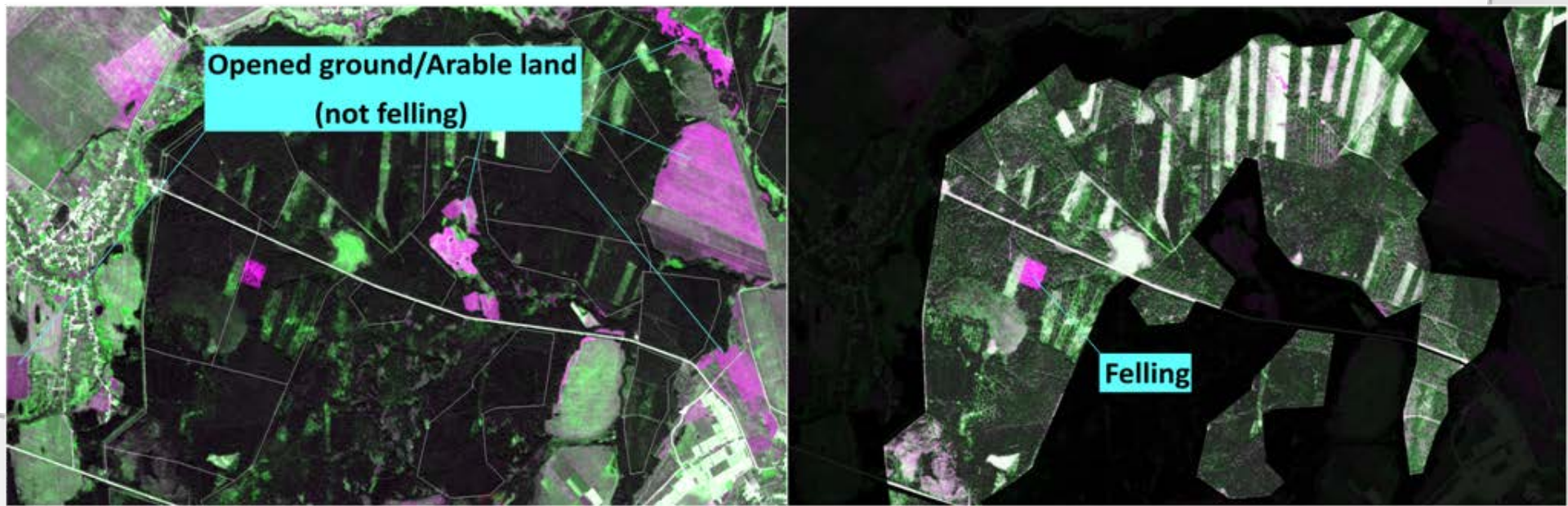
Possibility of interpretation of selective logging



Step 2: Monitoring - identifying the disappearance of vegetation

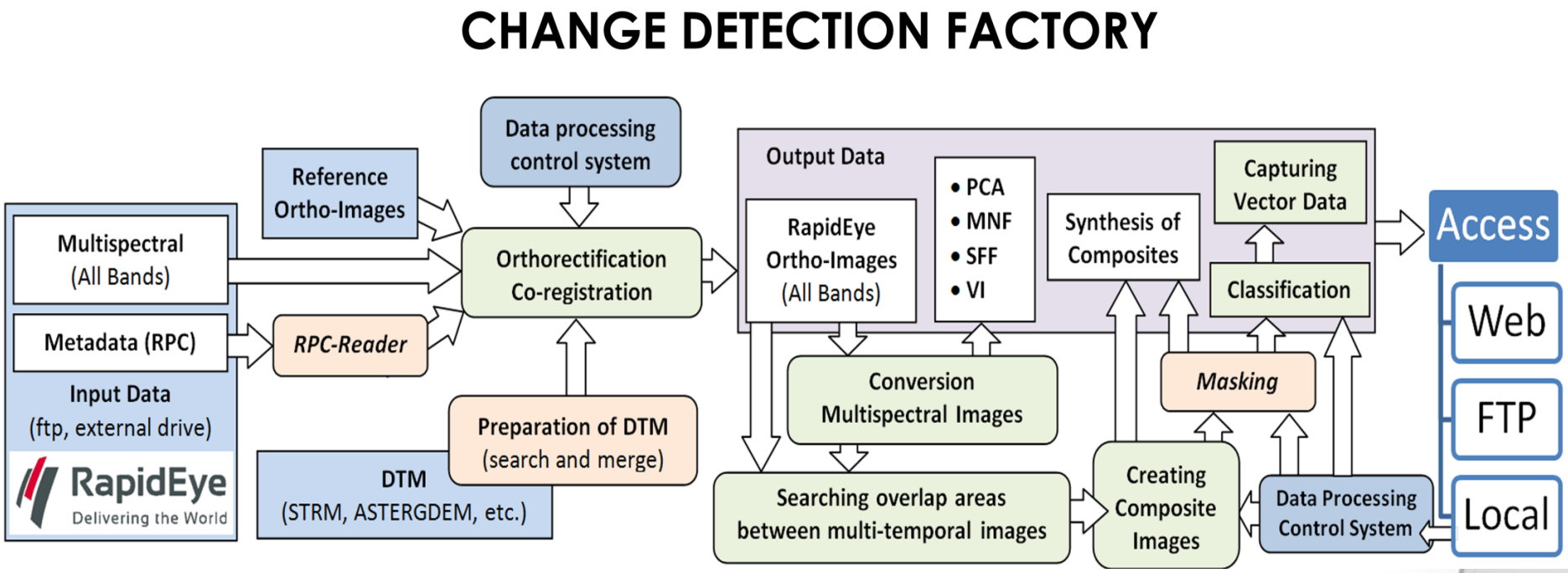
Automatic search for areas where (maybe) there were changes

Elimination of changes that not related to the disappearance of forest vegetation (mask)



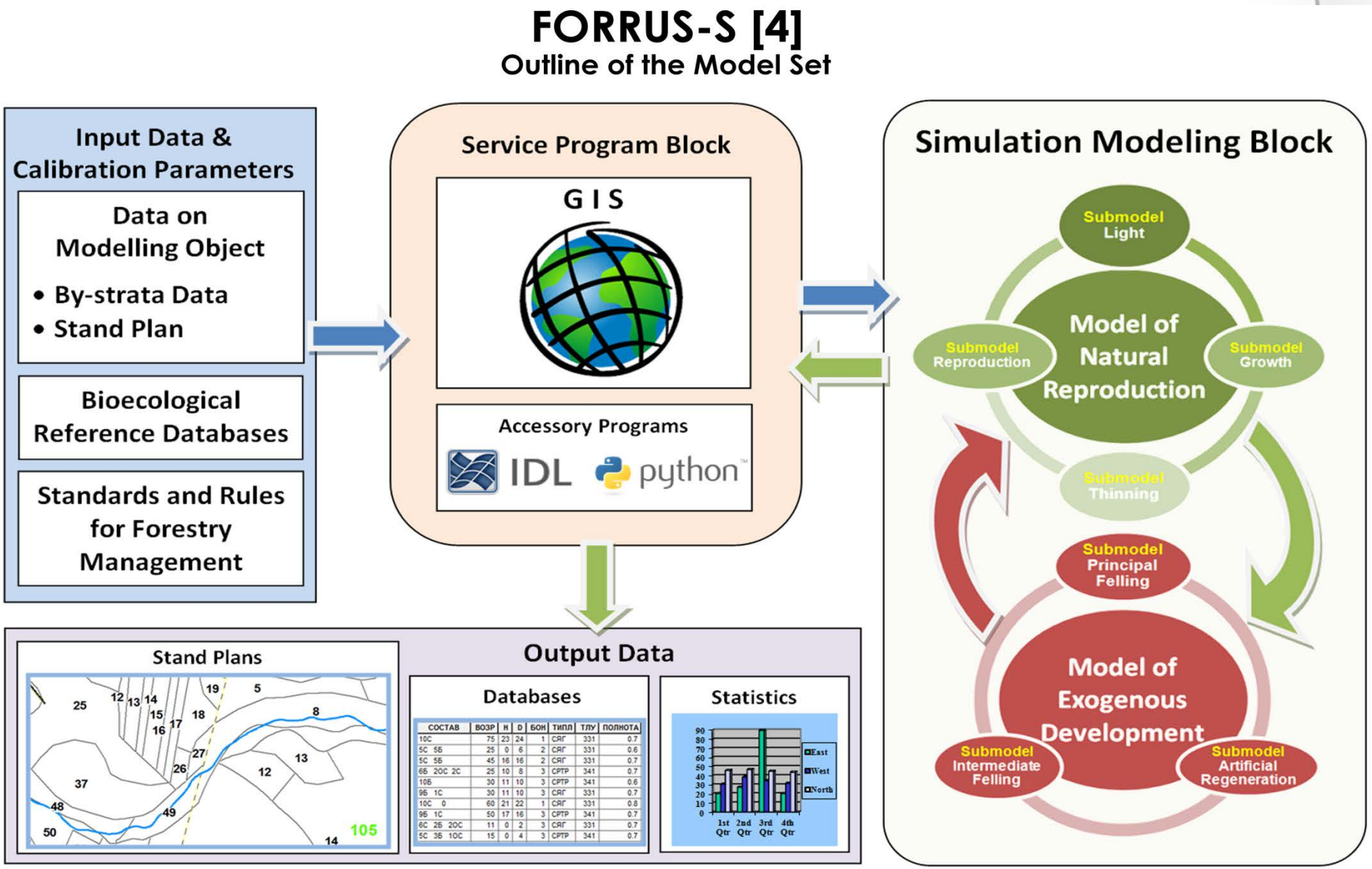
Step 2: Monitoring - identifying the disappearance of vegetation

All changed detection processes are automatic. we've created a special software for this purpose:



Step 3: Natural reproduction actualization

Forest stands without changes associated with the disappearance of vegetation (where was not identified felling, burning, etc.) are updated on the natural reproduction. For this purpose the simulation model of growth progress FORRUS- S is integrated into the system.



Results

After the update procedures of the information on the forest fund for the study areas were found significant errors in the determination of the main features, compared with the data obtained by classical methods of actualization in office:

- *Forest area is overestimated by an average of 10%*
- *Area of mature stands is overestimated by an average of 15%*

Also the spatial distribution of forests of different age classes has significantly changed.

Based on developed technologies we suggest to create a technological complex for the forest condition monitoring at the Federal Level.

Conclusion

Integrated satellite imagery processing technology can improve the quality of forest management data and significantly reduce the amount of field and office work. The system integrates technologies based on the latest tools of automated satellite imagery processing, whereby errors in the determination of basic parameters can be significantly reduced.

References

1. *USSR State Committee on Forestry, 1987. Instructions on how to create and reproduce the forest maps.*
2. *Federal Forestry Agency (FFA), 2012: Forest Inventory manual.*
3. *Sykhih V., 2005, Tutorial: Aerospace methods in forestry and landscape construction.*
4. *Chumatchenko S. et al., 2001. Forecast of forest indices of forest plantations under different scenarios of forest management: a model of the dynamics of forest plantations. Ecology monitoring and environmental management, 128–146.*
5. *TNTmips, 2010, Tutorial: Orthorectification using rational polynomials.*
6. *Coppin P., Bauer M., 1996. Change Detection in Forest Ecosystems with Remote Sensing Digital Imagery. Remote Sensing Reviews 13, 207-234.*

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