The Russian Ministry of Education and Science
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Object-oriented classification for recognition of Earth surface in Arctic ecosystems

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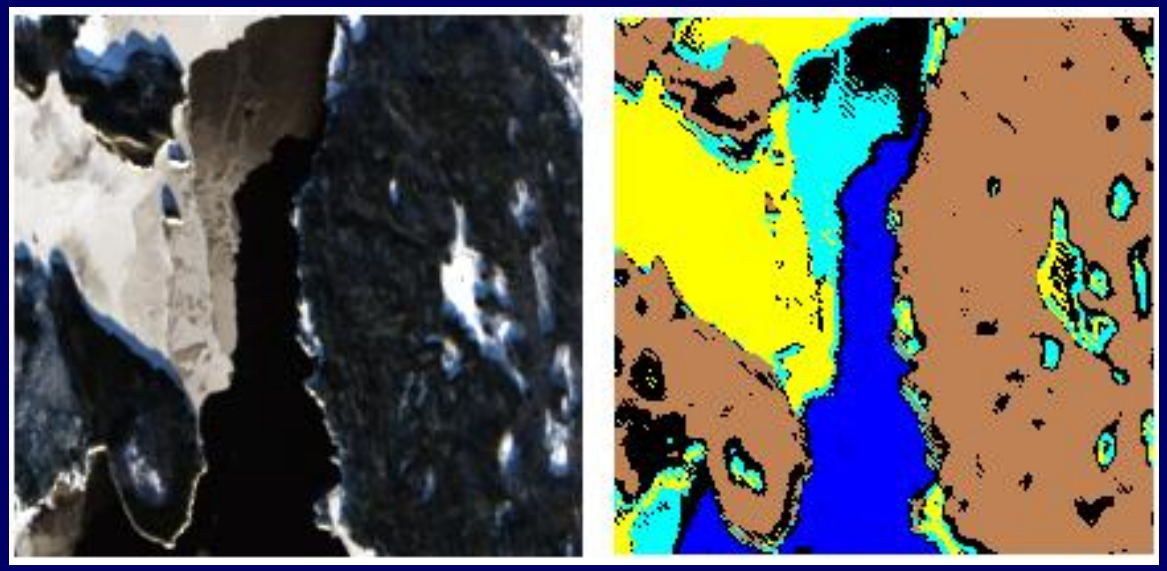
A problem of Earth surface types recognition

- General task: automated interpretation of space imagery



- Different methods make use of brightness, texture, geometrical features of the obbjects, depending on image parameters

Arctic region perculiar properties

- Complex nature of interaction of anthropogenous and natural objects in the region
- Complexity of interconnections and possible intersection of different infrastructure elements
- Absence of additional ground data that are necessary for matching the groups of pixels int the image to the objects at the surface of Earth

Object-oriented classification

It is important not only to specify a class of a certain pixel, but also to merge the pixels to assign areas of a certain type

Classification is conducted in two stages:

- **image segmentation**
- **classification of the separated**
- **segments (objects)**

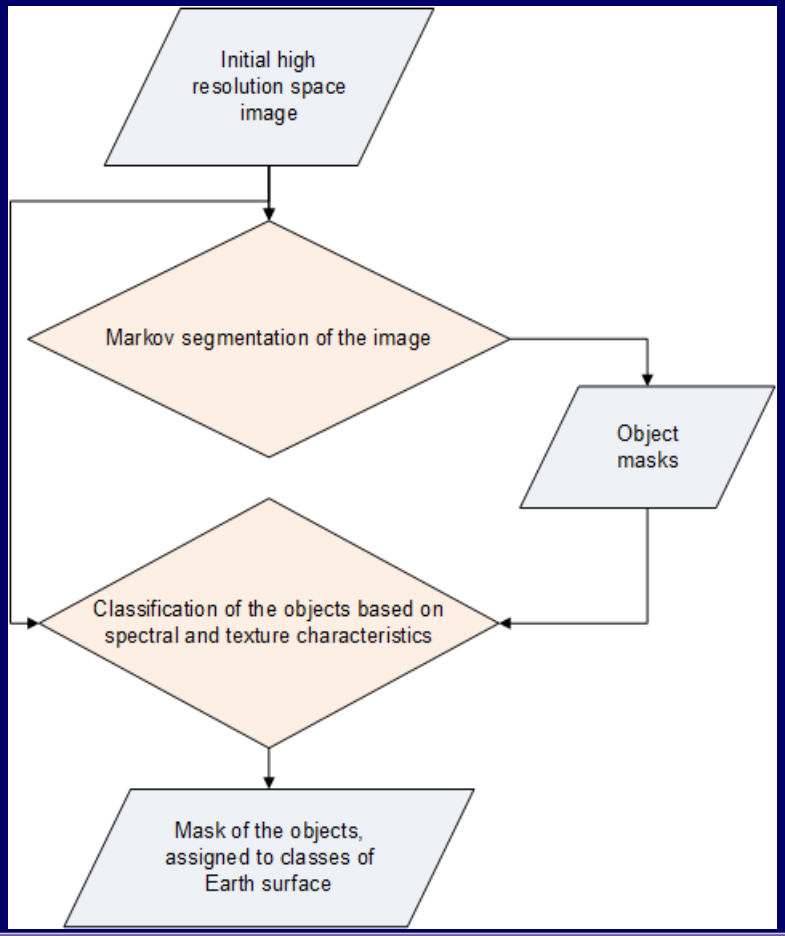


Image segmentation

This stage of image processing aims to assign objects in the image that are to be classified at the next stage.

Optimal Bayesian segmentation should produce the result **m*(x,y)** that corresponds the maximum of a posteriori probabilities distribution

$$M^* = \textit{argmax} P(M|N)$$

In this work we use the Random Markov Field method

Markov Random Field method

1. **Segmentation of MRF hidden component based on Bayesian principle**

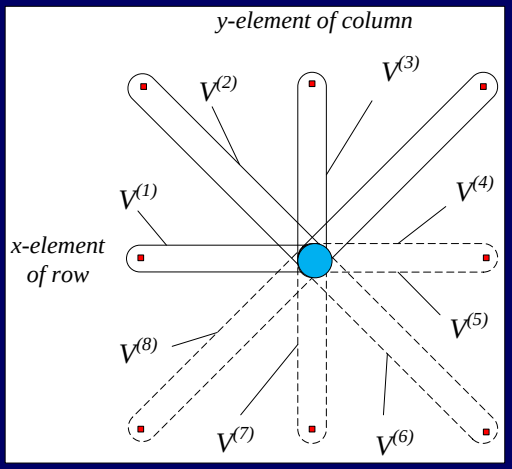
$$M^* = \arg\max_M P(M \mid N)$$

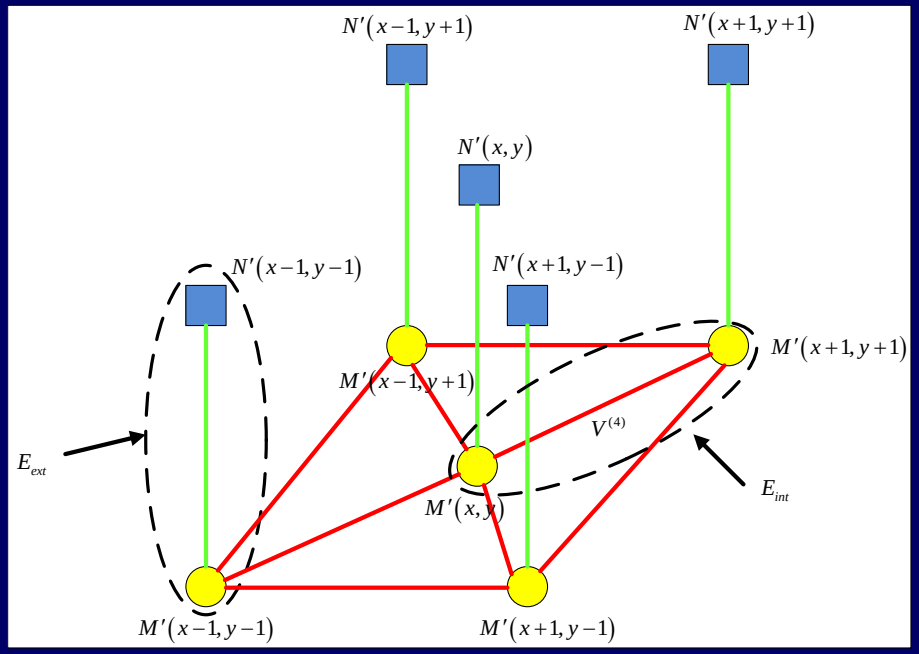
M^* - optimal segmentation map;

M - some segmentation map;

N - image brightness field;

2. **Graph-model of MRF representation**



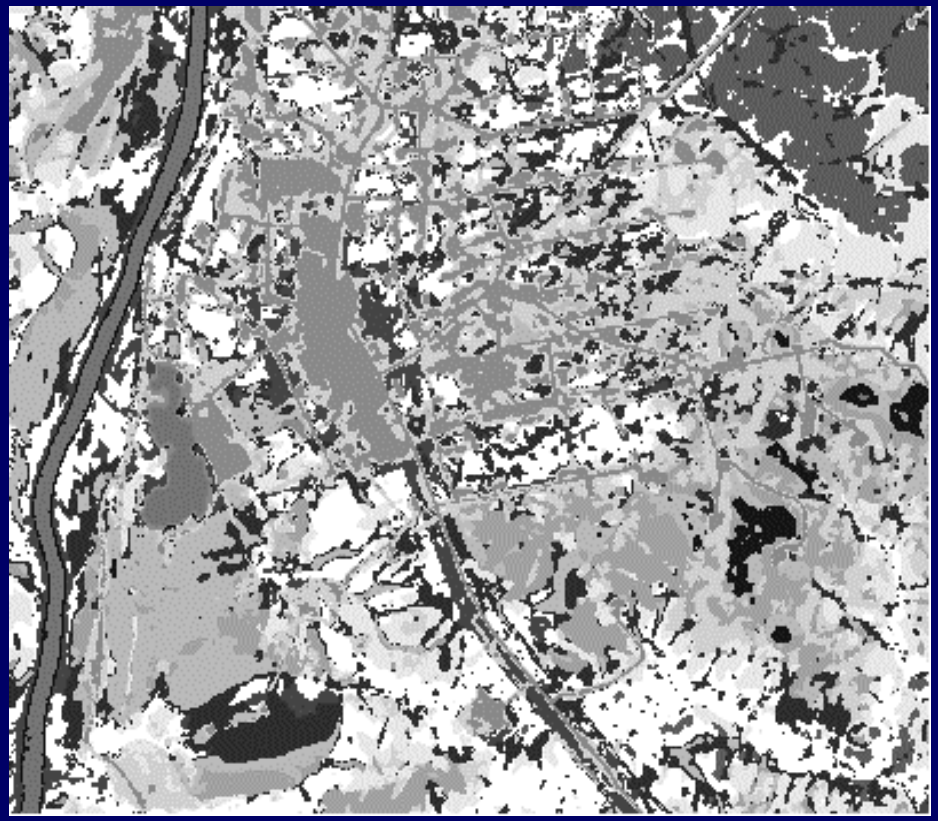


$$M^* = \arg\max_M P(M \mid N) \Leftrightarrow$$

$$\arg\min_M \left(E_{int} + E_{ext} \right)$$

Objects classification

After the segmentation the image is divided to separate connected areas. These areas are the objects that are to be classified.

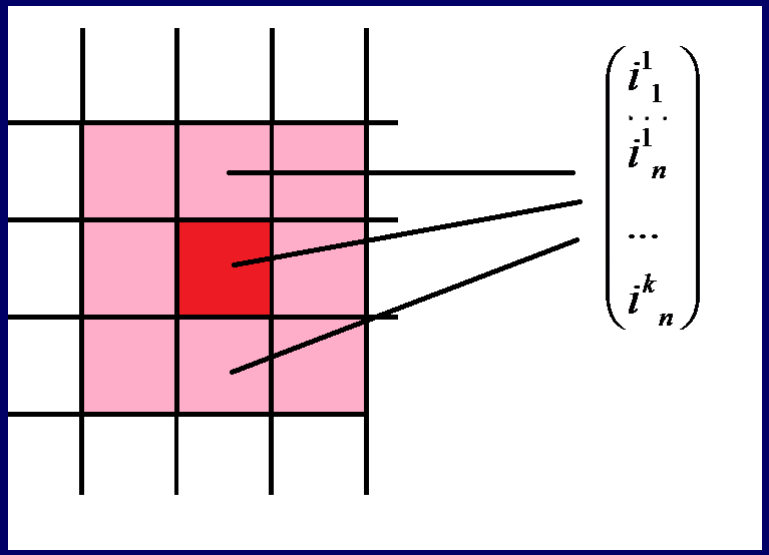


Objects are characterized by their form, size and brightness of all the pixels they contain.

Feature space

Taking into account the properties of arctic region, as well as the space imagery used (Landsat, 30 м.), we use brightness of the pixels and texture features of the segments as the features of the objects.

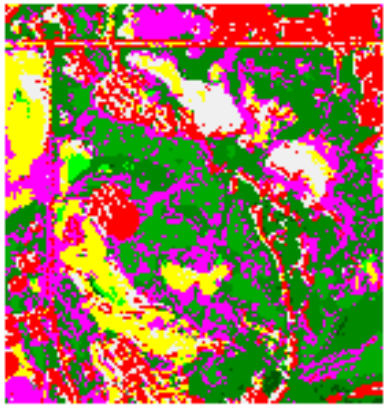
Brightness and texture features are incorporated in the vector formed by concatenation of the brightness vectors of the point and its neighbors



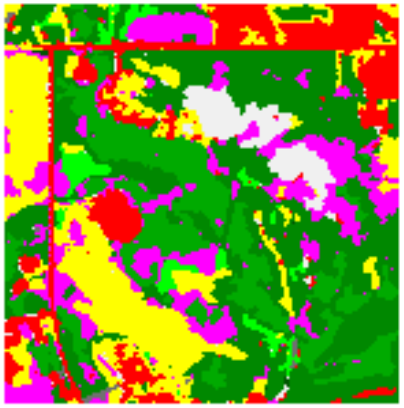
Objects classification

- We used Bayesian classifier (quadratic discriminant) for the pixel classification

- Every object is included in the class that contains most of the object's pixels.

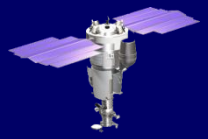


Point-oriented classification



Object-oriented classification

Input image

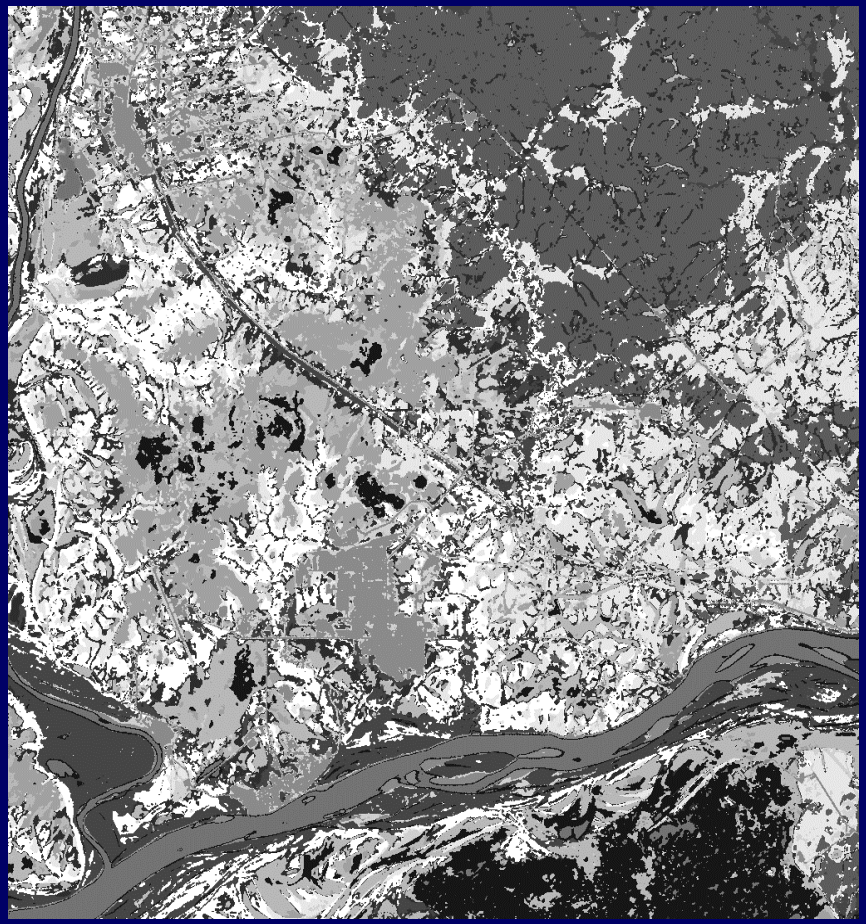


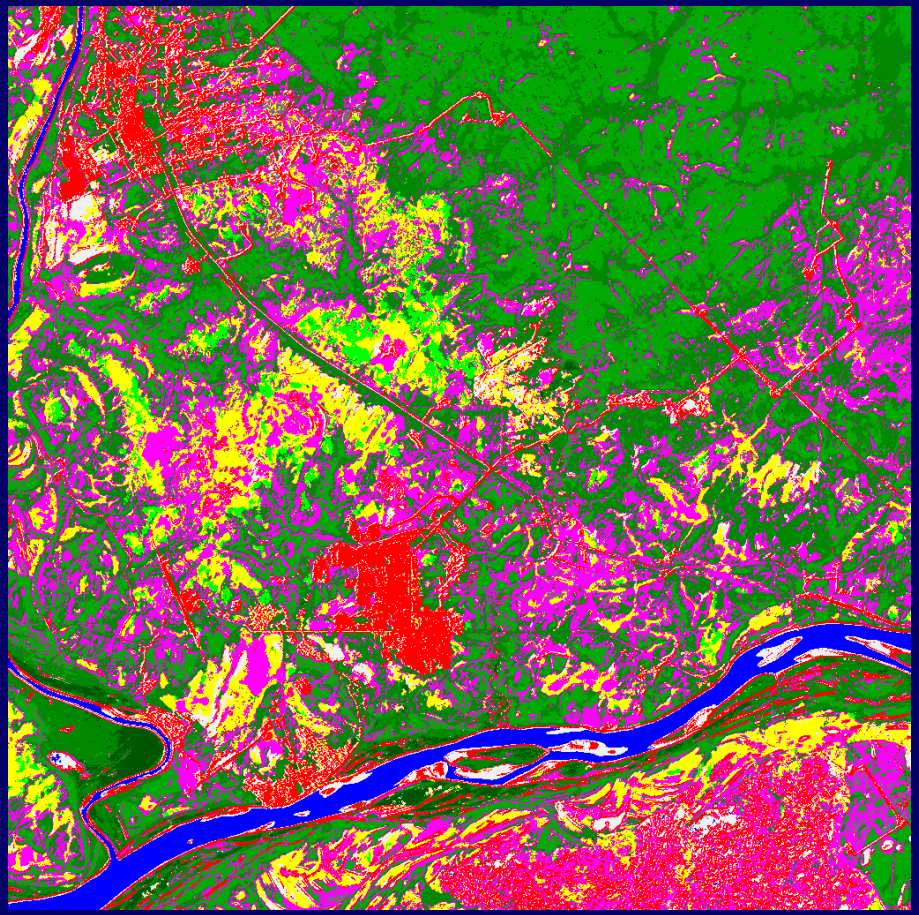
Experiments

- Initial data – Landsat 8.
- Spatial resolution - 30 м.
- 8 spectral bands (0,43 – 2,3 мкм)
- Area of study – Usinsk town and its neighborhood

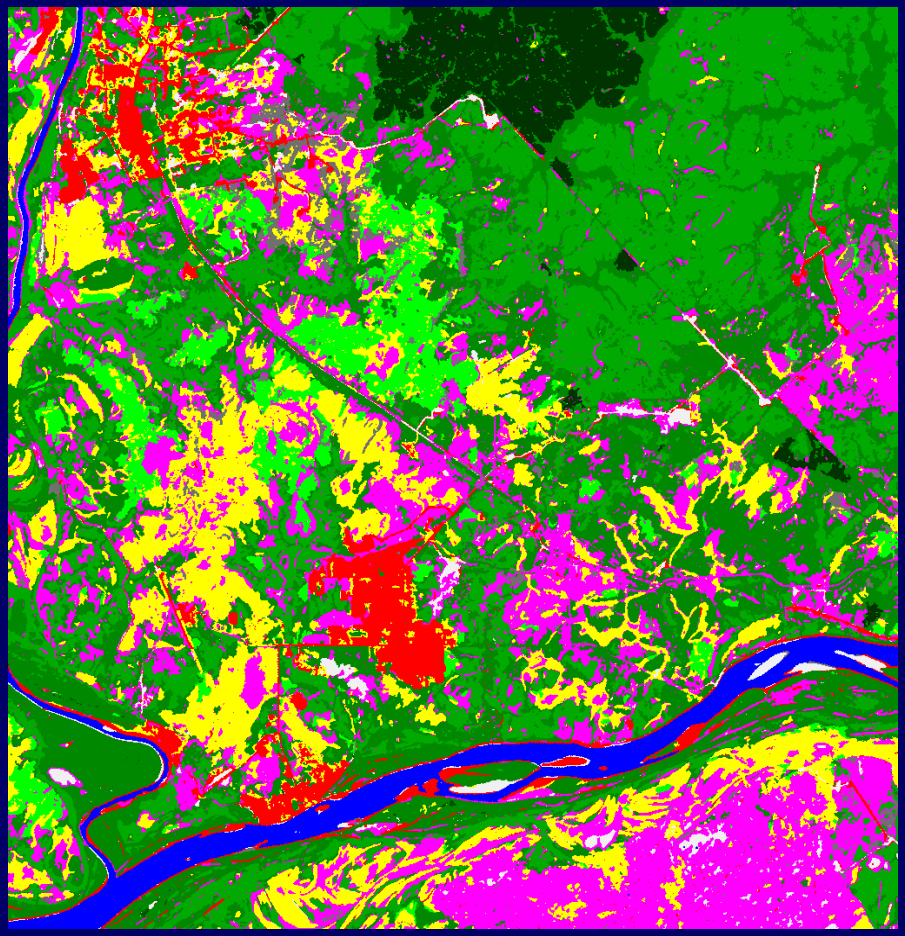
Input image

Segmentation (left) and point-oriented classification (right)

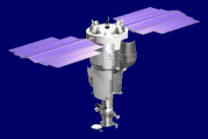




Result of object-oriented classification



- Водоемы
- Урбанизированные
- Растительность 1
- Растительность 2
- Растительность 3
- Растительность 4
- Растительность 5
- Почва 1
- Почва 2
- Почва 3
- Почва 4

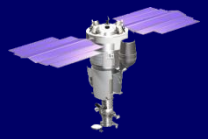


Perspectives of further development

1. The further development and improvement of the method is planned.

2. The object-oriented approach gives wide possibilities for improvement of the classification results by means of replacement or modification of either clustering or classification techniques, each of them can be developed independently.

3. However, this method also needs ground data for Improvement and evaluation of the recognition accuracy.



Summary

A method for object-oriented classification of space images is developed. It combines the possibilities of the clustering technique that can adequately detect the objects in an image, and the supervised classification that relates the detected objects to given classes. The method performance is tested over Landsat 8 multispectral space images

Thank you for the attention!