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**МЕТОДЫ И ПРИНЦИПЫ ТЕМАТИЧЕСКОГО КАРТОГРАФИРОВАНИЯ  
НА ОСНОВЕ ДАННЫХ ДИСТАНЦИОННОГО ЗОНДИРОВАНИЯ НА  
ПРИМЕРЕ КАНАДСКОГО ЛЕСНОГО СЕКТОРА**

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## **METHODS AND PRINCIPLES OF THEMATIC MAPPING BASED ON REMOTE SENSING DATA IN THE CANADIEN FOREST SECTOR**

**Аннотация.** Статья посвящена описанию принципов и методов тематического картографирования при создании тематических карт на примере Канадского лесного сектора. Рассматривается системный подход в тематическом картографировании, который позволяет преодолеть узко информативный взгляд на карту, подчеркнуть ее связи с естественными и социально-экономическими дисциплинами. Описываются используемые особые методы при создании тематических карт, а также принципы их проектирования. Особое внимание уделяется технологии ГИС, которая применяется для мониторинга лесного покрова и экосистемы Канады, для разработки новых картографических программ и интерпретирующих приложений, помогающих отслеживать леса во всем мире и создавать карты состояния лесных массивов.

**Ключевые слова:** Канада, картографические программы, дизайн карты, тематическая карта, принципы проектирования, ГИС.

**Abstract.** The article is devoted to the description of the thematic mapping principles and methods when creating thematic maps of the Canadian forestry sector. The article deals with the systematic approach in thematic mapping which allows to overcome a narrowly informative view of the map as well as to emphasize its links with natural and socio-economic disciplines. When creating thematic maps special methods, design principles and GIS technology are used for monitoring forests cover and Canada ecosystem. Special attention is given to developing new mapping programs and interpretive applications to monitor forests globally and create forest health maps.

**Key words:** Canada, mapping programs, map design, thematic map, design principles, GIS.

### **Introduction**

The paper presents the ideas of thematic mapping, its components, principles and methods for displaying thematic maps as well as ground- and air- based data collection for thematic mapping and new GIS technologies for Canada`s forests sector.

Generally, thematic mapping is a complex of activities and processes to create thematic maps that reflect some aspects, for example, an object, a phenomenon and a process. Some phenomena are almost to see in the tabular form, but they are well manifested on a thematic map. Additionally, thematic maps have been developing since the 18<sup>th</sup> century. The earliest thematic maps included wind maps and navigation maps. Later geological maps began to appear. Accordingly thematic maps contributed to the development of many sciences, which in turn facilitated the further growth and expansion of the boundaries of thematic mapping.

Nowadays the first step in creating maps is to obtain remote sensing data. The main advantages of remote surveys are their high detail, the coverage of large areas, the possibility of obtaining repeated photographs and examining hard-to-reach areas. In addition, data received from satellites are used to create and update maps, to map poorly studied areas.

The second stage is data processing in GIS programs such as ENVI, ArcGIS, and MapInfo. GIS systems make it possible to determine availability, quantity and relative location of all available objects on a given territory. Lastly, thematic maps are produced with the help of both stages.

Methods for displaying thematic maps are the icons method, the isolation principle and the methods of qualitative and quantitative background. The first method of icons is used for displaying objects, localized in points (See, Figure 1).

### Methods for displaying thematic maps

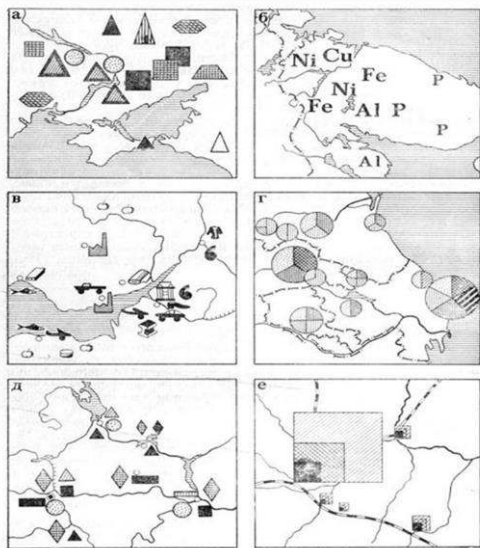


Fig. 1. Method of icons

Рис. 30. Значки:  
 а — геометрические; б — буквенные; в — закрашенные; г — структурные; д — раздельные; е — неправильные

Figure 2 shows the second principle of isolines that is used to display continuous and smoothly changing phenomena.

## Methods for displaying thematic maps

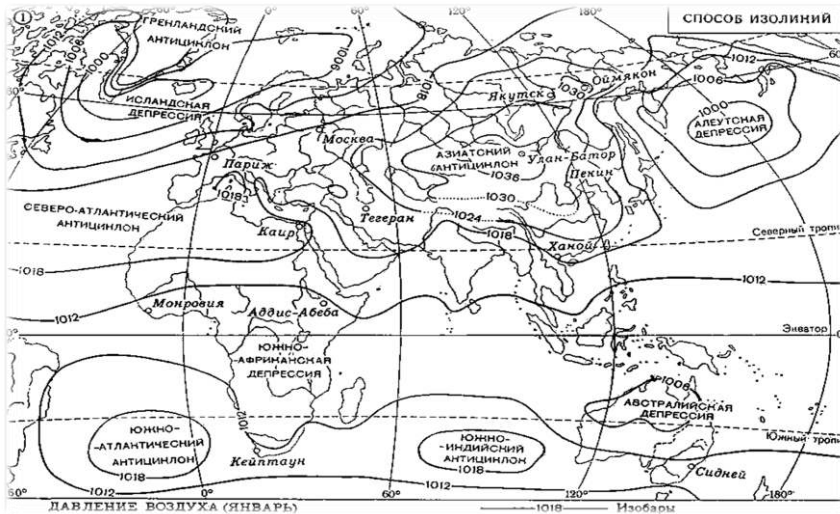


Fig. 2. Isoline principle

Figure 3 depicts the method of qualitative background that is to show the qualitative differences between the phenomena of continuous distribution in the selected areas. The quantitative background is to transmit quantitative differences in the phenomena of continuous propagation within the allocated areas.

## Methods for displaying thematic maps

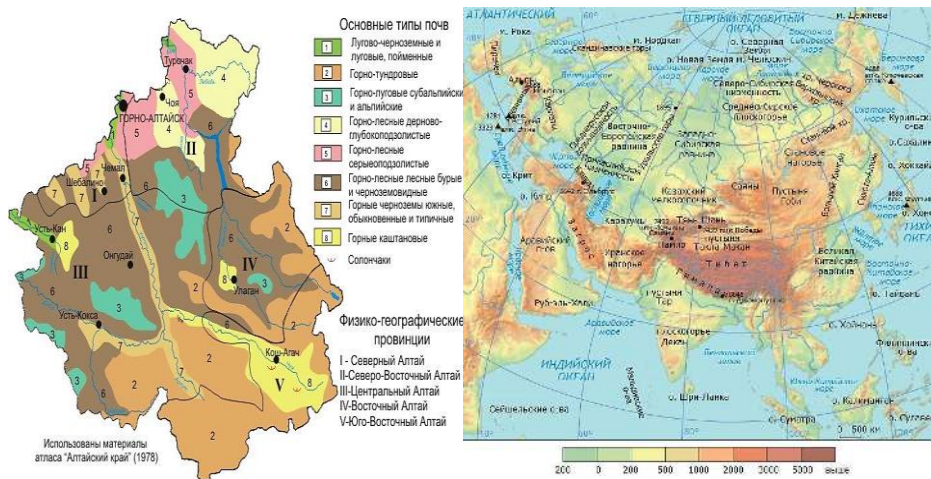


Fig. 3. Method of qualitative and quantitative background

Generally, thematic mapping traces the trends towards systemic mapping of the territory. System mapping requires the use of extensive arrays of versatile information

on geosystems, rational and efficient processing methods to build analytical, integrated and synthetic maps of natural and socio-economic phenomena.

Moreover, special attention is paid to the creation of thematic maps in the GIS MapInfo program. In MapInfo, thematic maps are created by assigning colours, hatching and character types to the graphic objects on the map. All thematic maps created in MapInfo are added to the Map window as a separate layer. The layer with a thematic map is placed on top of the layer which it is based on. Some data is given in Fig.4.

## The concept of modern thematic mapping in GIS

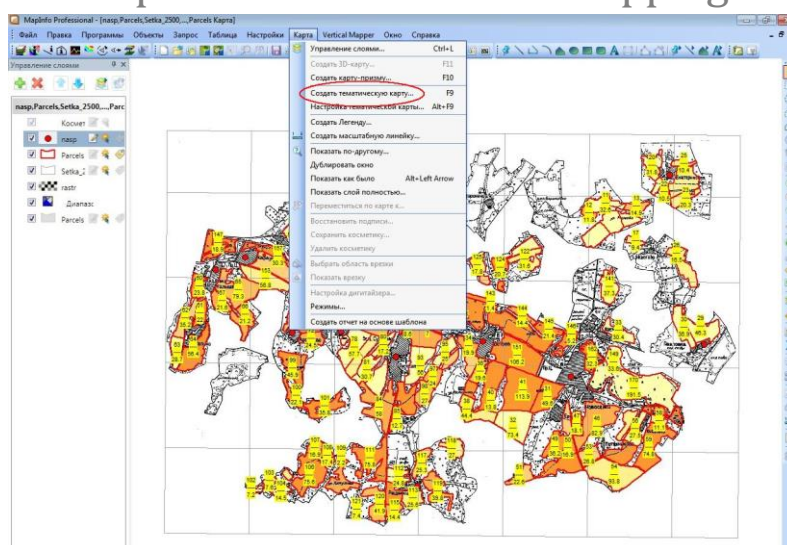


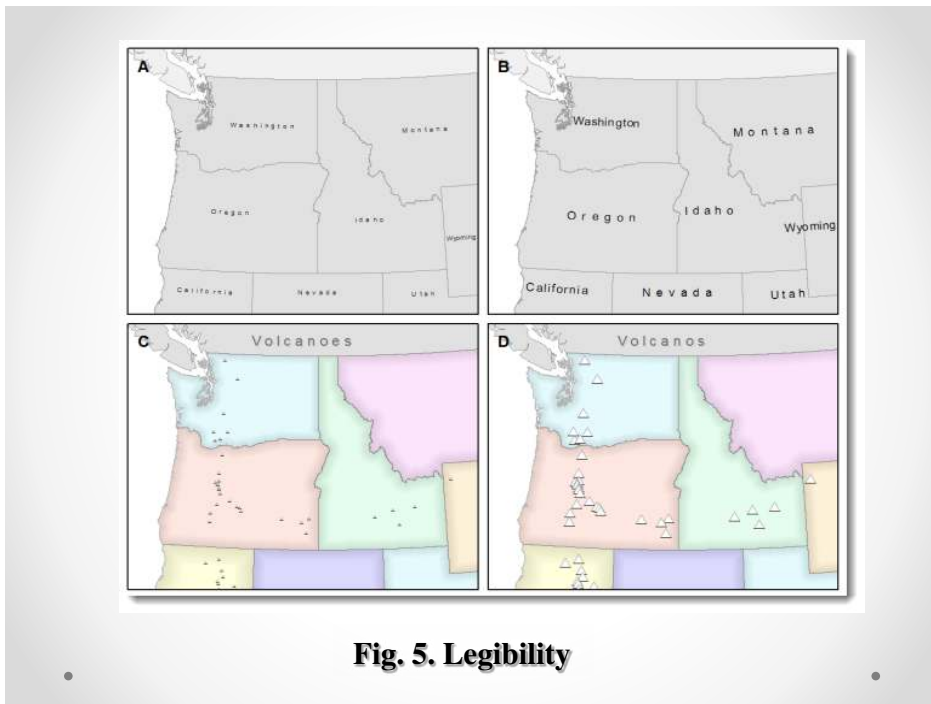
Fig. 4. Creating a thematic map in MapInfo

### 5 top principles

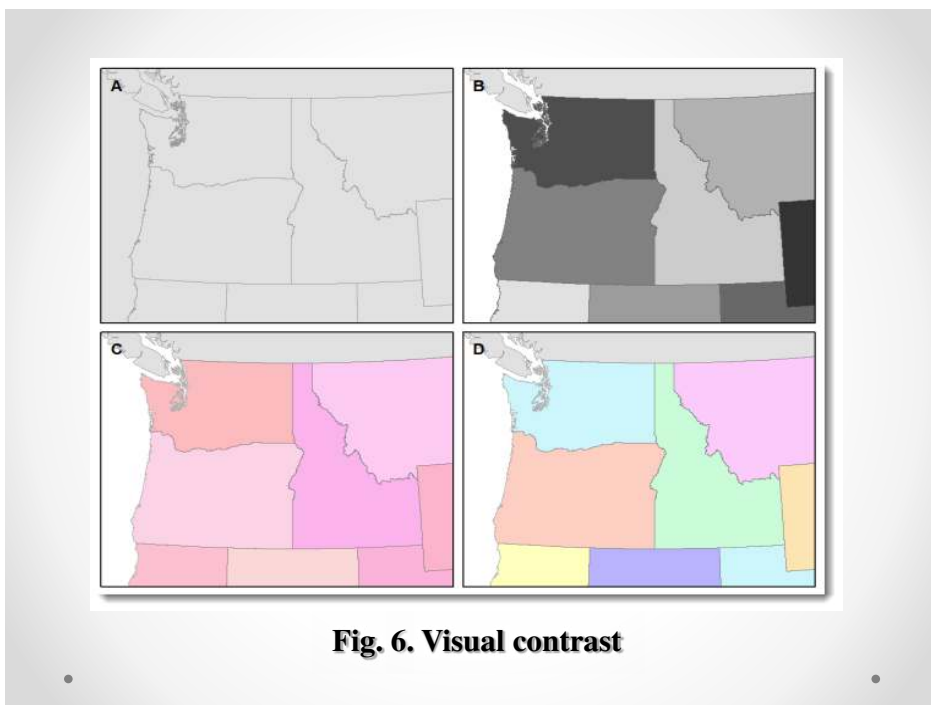
Thematic cartography is a tool for the analysis and visualization of spatial data. Thematic maps, through the use of certain methods, reflect some phenomenon or a group of phenomena of a physiographic or socio-economic nature. Also, when creating thematic maps, many design principles are applied.

First of all, cartographers apply many design principles when compiling thematic maps. Currently there are 5 top principles of design: legibility, visual contrast, figure-ground, hierarchical organization, and balance. All these principles complement each other and collectively they help cartographers create maps that successfully communicate geographic information.

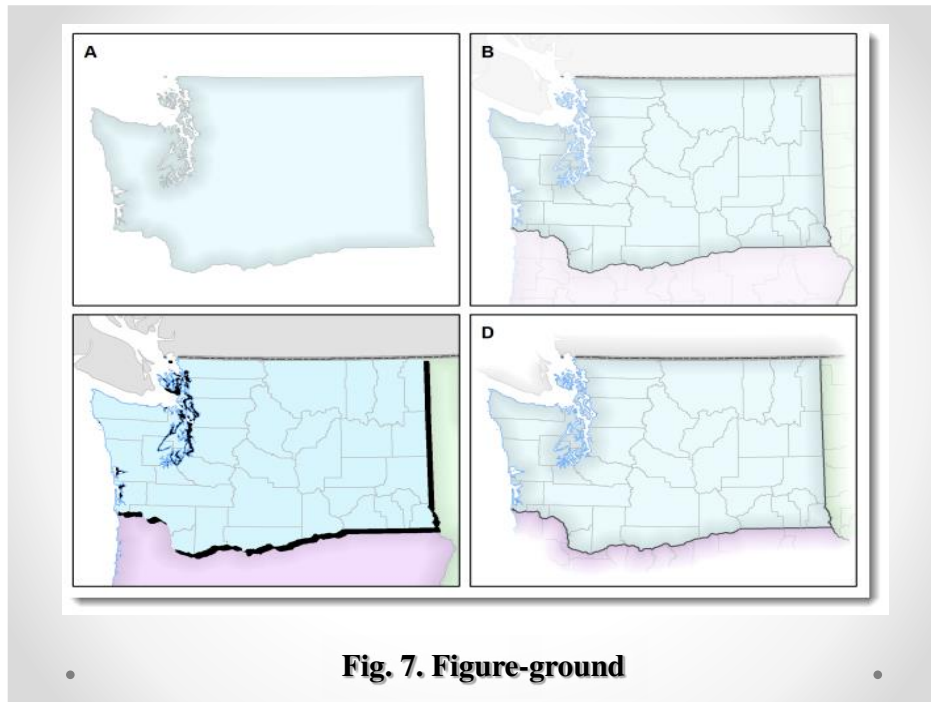
The first principle is legibility that depends on the correct choice of symbols and sizes. Geometric symbols are easier to read at smaller sizes, more complex symbols require the larger area.



The next principle is visual contrast which relates to how map features and page elements contrast with each other and their background. A well-designed map with a high degree of visual contrast can result in a crisp, clean, sharp-looking map.



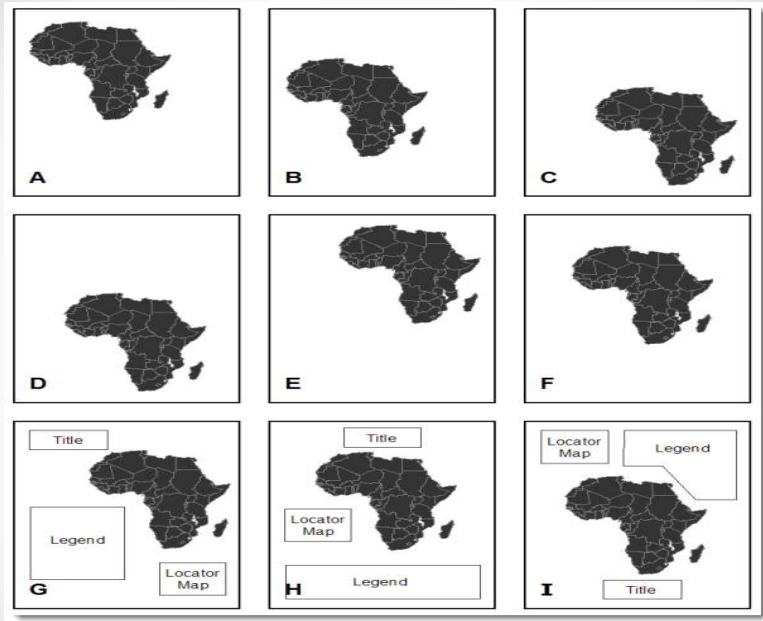
The third principle is figure-ground. Cartographers use this design principle to help their map readers find an area of the map to focus on.



Hierarchical organization principle is one of the major objectives in map making to separate meaningful characteristics and to portray likenesses, differences, and interrelationships. The internal graphic structuring of the map helps people read the thematic map.

The last principle is balance which involves the organization of the map and other elements on the page. A well-balanced map page culminates in an impression of equilibrium and harmony as in Fig.8. Together these five design principles significantly impact on thematic mapping.





**Fig. 8. Balance**

Thus, the advantages of the above mentioned principles of thematic mapping are depicted in Table 1.

**Table 1.**

<b>Principle</b>	<b>Advantages</b>
Legibility	The map becomes clear with the correct choice of symbols.
Visual contrast	A map with a high degree of visual contrast can lead to a clean and sharp-looking map.
Figure-ground	This design principle to help their map readers to find an area of the map or page to focus on.
Hierarchical organization	The internal graphic structuring of the map helps people read the map.
Balance	A well-balanced map page creates a harmonious map.

The other cartographic design principles are the following: understanding of user requirements, consideration of display format, simplicity, consistency, accessibility, and good composition; they play a secondary role and are less commonly used in cartography.

One of the points we would like to make is remote sensing vs. ground- and air-based data collection for thematic mapping. Canadian scientists observe forests by means of satellite data. For example, satellite information can be used for measuring vegetation productivity and mapping forest disturbance. Moreover, traditional methods of exploring are impractical and prohibitively expensive in some situations.

On the other hand, only ground- and air- based data collection can interpret the images. In addition, it helps creating scientific and technical expertise about forest ecosystems and natural processes. Table 2 compares remote sensing and ground- and air- based data collection possibilities.

**Table 2. Remote sensing and ground- and air- based data collection possibilities.**

Remote sensing	Ground- and air- based data collection
<ul style="list-style-type: none"> <li>• high detail;</li> <li>• coverage of large areas;</li> <li>• examining hard-to-reach areas;</li> <li>• determining the quantity and location of objects.</li> </ul>	<ul style="list-style-type: none"> <li>• explain the data from remote sensing;</li> <li>• contribute to detailing maps more;</li> <li>• help to create scientific and technical expertise.</li> </ul>

In fact, Canadian scientists have used these two methods for determining their forest sector today, they have found out that less than 0.02% of Canada’s forest lands are deforested each year. Following this we want to go on new GIS technologies for Canada`s forests sector.

Canadian researchers are developing new mapping programs and interpretive applications to help monitoring forests globally. These programs let cartographers obtain qualitative data for characterizing changes in forest cover quickly. Also, the

programs are used for monitoring and tracking fire activity daily in real-time. Besides, scientists are refreshing outdated maps using new data.

Lastly we want to give an overview ahead in forest monitoring.

Nowadays, many more applications of the data are created by remote sensing. Besides, scientists are producing a unique cross-country map detailing Canada's forested land cover from Landsat satellite data. It will represent the highest spatial resolution satellite-derived map data available for the total area of Canada covered. The maps will be used to provide information for biomass estimates, climate change modeling and monitoring condition of forests. In particular, it is very important for northern forest regions.

Mostly, remote sensing is used by mapmakers for detailing thematic maps. There are satellites for getting information, for example, Landsat, which has been used by Canadian mapmakers for detailing the map of Canada's forested land cover.

Besides, GIS technologies help processing satellite data for creating thematic maps. Satellite data is often processed in the GIS program ENVI.

On the other hand, all thematic maps use ground- and air- based data collection method. It allows controlling the accuracy of the remote sensing data.

## **Conclusion**

In this article we have considered current thematic mapping developing problems nowadays. Many good examples of methods for displaying thematic maps are observed. Much attention is paid to new GIS technologies for Canada's forests sector.

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