

Anthropogenic Transformation of Russian Arctic: dividing the area into zones based on cluster analysis

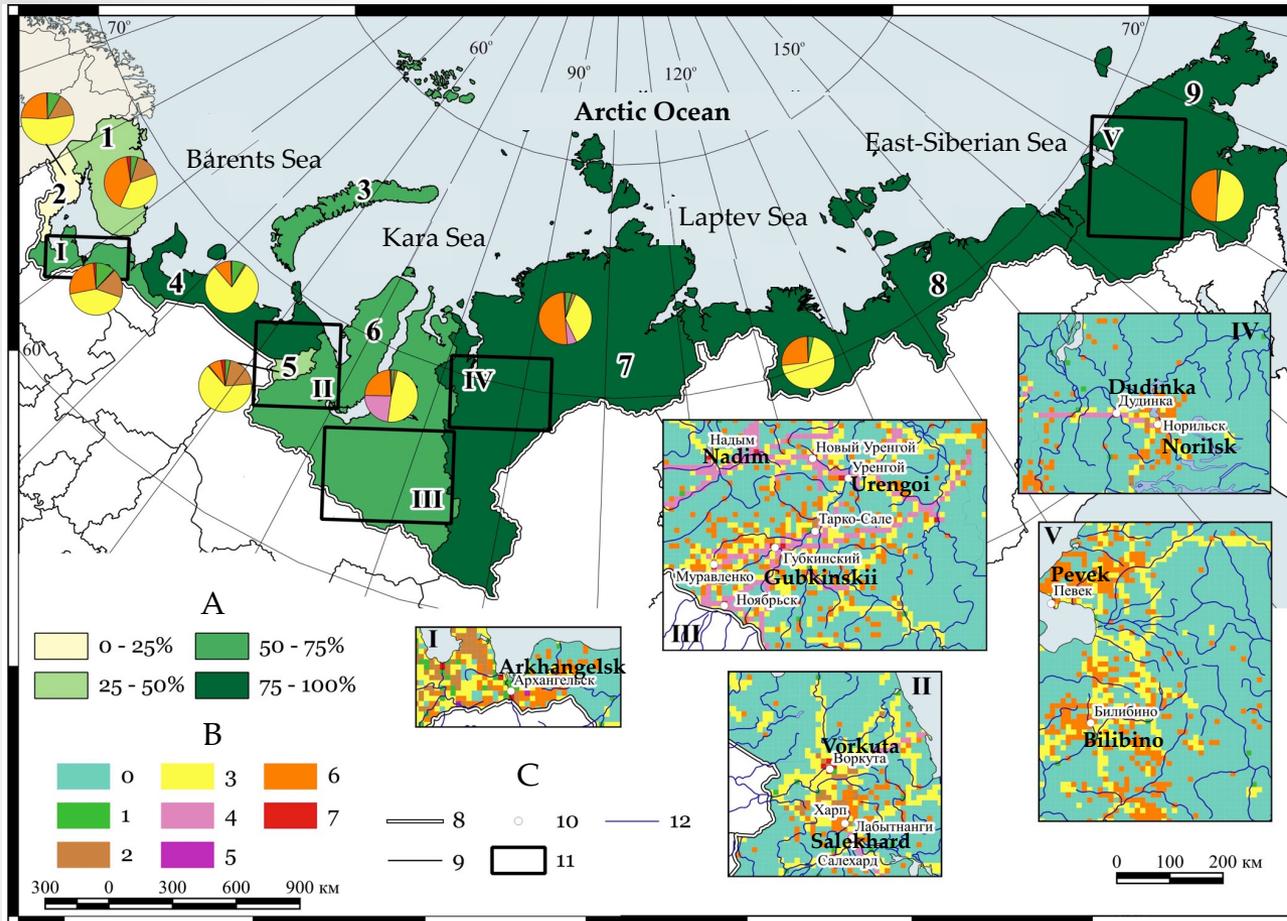
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- In this study we analyzed the information about the presence of different types of anthropogenic objects (settlements, transport infrastructure, mining areas, etc.) in the Arctic zone of Russia.
- Data analysis shows that only about 20% of Russian Arctic's area is affected by economic development, meanwhile on the other 80% of the area there are practically no anthropogenic objects.
- The economic development of the Arctic region decreases from West to East of Russia.
- Data on the presence, position, and types of anthropogenic objects were subjected to the k-means method of cluster analysis in order to identify characteristic combinations of objects corresponding to different types of development.
- Each type of the economical use of the territory is characterized by specific anthropogenic transformation of the topography of the area.
- The greatest transformation of the topography and geomorphological processes was found within the open mining areas.
- The least influence on the topography is connected with some of the linear transport structures (unpaved roads and underground gas pipelines).
- In general, economic activity in Russian Arctic is relatively low. Anthropogenic transformation of topography and geomorphic processes is typical for about 18% of the total area of the Russian Arctic.

The degree and types of land use of the Arctic zone of Russia

- **Legend:**
- **A** – the percentage of the cluster of «territories without anthropogenic impact» within individual subjects of administrative division (in %);
- **B** – types of land use according to the dominant types of anthropogenic objects:
- 0 - territories without anthropogenic impact,
- 1 - villages and military settlements,
- 2 - unpaved road,
- 3 - paved roads,
- 4 - trunk pipelines,
- 5 - forestry industry objects,
- 6 - mining,
- 7 - integrated development;
- **C** – other designations:
- 8 - the border of the Arctic zone of the Russian Federation,
- 9 - the borders of the constituent entities of the Russian Federation,
- 10 - large cities and towns,
- 11 - the boundaries of the inset maps,
- 12 - large rivers.
- Pie charts characterize the ratio of different clusters of land use (clusters 1-7) among themselves within a particular subject.



- The economic development of the Arctic region decreases from West to East of Russia.
- The Republic of Karelia is characterized by the highest economic development level (only 13,1% of the area are not affected by any economic activities), the lowest levels have Krasnoyarskiy kraj (95,2%) and the Republic of Sakha (Yakutia) (87,2%).
- Within the Arctic zone of Russia six main types of economical use of the territory were identified. Each of these types was characterized by the dominance of a certain type of anthropogenic objects (settlements, roads, mining industry objects, oil and gas transport infrastructure, wood industry objects).