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Development of a Network of Landing Sites and Heliports: Ensuring Aviation Accessibility of Settlements in the Arctic Regions

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ABSTRACT

While considering the problems of ensuring aviation accessibility of remote settlements in the regions of the Eastern Arctic Area of Russia, the study has concretised the concept of aviation accessibility of a settlement.

The analysis of aviation mobility of the population of the Arctic zone of the Republic of Sakha (Yakutia) was carried out. It has been established that the lack of a sufficient number of landing sites is a limiting factor in performance of regular flights between settlements and the centres of the Arctic regions. Under these conditions, local flights are carried out mainly by MI-8 helicopters which are expensive in operation, with extremely low regularity and not full load.

To justify the construction of a network of landing sites in the Arctic region, a methodology has been developed for predicting seasonal distribution of passenger flows within local air transportation. This methodology is based on Ward's hierarchical clustering method, which allows, considering many criteria, to divide all settlements into clusters, in each of which the demand for air transportation is present during a certain number of months.

It is substantiated that construction of a landing site in a settlement is necessary if there is a demand for air transportation for more than five months a year. Using the example of 65 Arctic settlements of the Republic of Sakha (Yakutia), five clusters were identified. For three of them the need to build landing sites is proved. The zones of gravity of regional airports with a range of 150 km were determined, considering the possibility to get from the settlement to the airport in 3–4 hours. Based on the results of clustering and identification of gravity areas of regional airports, a predictable network of landing sites in the Republic of Sakha (Yakutia) was built.

Keywords: air transport, air accessibility, Arctic regions, remote settlements, landing sites, heliports.

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INTRODUCTION

The development of the transport system of the regions of the Arctic zone is of particular interest to the Russian economy in terms of their exploration and development. They englobe 90 % of coal reserves, 80 % of hydropower resources, large strategic reserves of oil and gas, almost the entire volume of explored rare metals and diamonds, half of iron ore deposits, 80 % of forest resources and more than 60 % of freshwater reserves. Therefore, the first and indispensable condition for ensuring the viability of these territories is availability of a reliable transport system that allows year-round movement of incoming and outgoing, as well as of internal material and human flows in harsh natural and climatic conditions [1; 2]. The transport system of the Arctic regions ensures their integrity, security, and integration into the common economic space of the country, creating attractive conditions for labour migration.

From the point of view of provision of transportation services, the Arctic zone (AZ) of Russia can be divided into two parts: the European and Eastern Arctic. The Eastern Arctic includes two districts and individual rural settlements of Krasnoyarsk region, thirteen districts of the Republic of Sakha (Yakutia) and the entire territory of the Chukotka Autonomous District (Pic. 1). These regions are characterised by the least low level of transport accessibility, lack of railways and year-round motorways.

Air transport in these territories is uncontested in providing year-round connectivity. However, for last decades, the airport and route networks have been significantly reduced, which has led to transport discrimination of remote settlements and a decrease in the level of aviation mobility of the population.

The strategic tasks of guaranteeing the security of state borders, developing cargo transportation along the Northern Sea Route, preserving the local population, and developing mineral fields in the regions under consideration require development of methods and techniques for ensuring aviation accessibility under the conditions of low population density.

According to the Decree of the President of the Russian Federation of May 07, 2018 «On national goals and strategic objectives of development of the Russian Federation for the period up to 2024», one of the priority tasks is development of the country's backbone infrastructure to ensure the economic connectivity of the territories, including through development of the air transportation subsystem, through

Pic. 1. Territory of the Eastern Arctic of the Russian Federation.
(The map was developed by A. V. Poturaeva, Ph.D. student of the Faculty of Geography of Moscow State University on the commission of the Institute of regional consulting, an autonomous non-profit organisation. In: Zamyatina, N. The future of Russian urbanisation. Interview with Nadezhda Zamyatinam 05.05.2021. [Electronic resource]: https://ion.ranepa.ru/news/budushchee-rossiyskoy-arkticheskoyurbanizatsii-intervyu-s-nadezhdoy-zamyatinoy/. Last accessed 03.02.2023)

reconstruction of regional airports and expansion of the network of interregional regular passenger transportation. Decree of the Government of the Russian Federation of September 30, 2018 No. 2101-r «On approval of a comprehensive plan for modernisation and expansion of the main infrastructure for the period up to 2024» the target indicator «aviation mobility of the population» was set, estimated in the number of flights per 1 person per year by 2024 at the level of 0,95. Also, this decree established an additional target indicator «increasing the level of transport services provision» of the constituent entities of the Russian Federation to the level of 2017 in percent, which in 2024 should be 107,7 %.[1]

The Decree of the Government of the Russian Federation of February 13, 2019, No. 207-r, approved the «Strategy for spatial development of the Russian Federation for the period up to 2025», the strategy determines the directions for development of the main transport infrastructure by «ensuring sustainable year-round transport connectivity of sparsely populated and island territories of the Arctic zone, the Far East, isolated from the single transport system of the Russian Federation, with administrative centres of the corresponding territorial entities of the Russian Federation and other territorial entities of the Russian Federation, including through reconstruction and construction of airfields and airports of local importance in sparsely populated geostrategic territories of the Russian Federation».[2]

In the context of the considered topic, very important are Transport Strategy f the Russian Federation till 2030 with the forecast for the period till 2035, approved by the decree of the Government of the Russian Federation of November 27, 2021, No. 3363-r, and the Strategy of development of the Arctic Zone of the Russian Federation and of ensuring national security for the period till 2035, approved by the Decree of the President of the Russian Federation of October 26, 2020, No. 645. Also is worth noting a decree of the government of the Republic of Sakha (Yakutia) of April 5, 2019, No. 364-r, on the Concept of the development of small aircraft aviation and general aviation in the Republic of Sakha (Yakutia).

Currently, there is no single methodology for assessing the level of transport accessibility and connectivity of the Arctic regions and districts, considering seasonal constraints for the use of various modes of transport [3]. Even less studied are the issues of assessing and ensuring aviation accessibility of remote northern settlements, year-round transport links with which are supported solely based on irregular air flights.

The *objective* of the study was to develop the methods of forecasting of seasonal distribution of passenger flows of local air transportation. The developments are based on Ward's *method* applied in hierarchical cluster analysis, that allows considering many criteria to divide settlements into clusters, in each of which the demand for air transportation is present during a certain number of months.

RESULTS

Air Transport System in the Russian Regions of the Eastern Arctic

Studies have shown that 98 % of passenger traffic in the Eastern Arctic of Russia is carried out by air, not only in inter-district, but also in intra-district (local) traffic. However, the level of development of air transport in these regions remains insufficient.

The experience of Alaska and Northern Canada in organisation of transport connectivity in the Arctic proves that it is air transport that is the basis of not only passenger, but also urgent cargo transportation of great social importance [4–6].

The insufficient level of development of the air transport system leads to transport discrimination of the population of these territories [7–9]. Many works are devoted to the study of issues of transport discrimination, those papers reflect the consequences of such discrimination. Among them, one can distinguish low mobility of the population, lack of access to socially significant services, poor food supply, and a high cost of living [10–15].

The average aviation mobility of the population of the Eastern Arctic, calculated as the number of passengers departing from the region with regular flights, divided by the number of residents, in 2019 was 1,4. In the Arctic zone

[1] Decree of the Government of the Russian Federation dated September 30, 2018, № 2101-r «On approval of a comprehensive plan for modernization and expansion of the main infrastructure for the period up to 2024» [Electronic resource]: https://mintrans.gov.ru/documents/2/9742. Last accessed 24.02.2023.

[2] Decree of the Government of the Russian Federation dated February 13, 2019, № 207-r «On approval of a strategy for spatial development of the Russian Federation for the period up to 2025» [Electronic resource]: https://www.consultant.ru/document/cons_doc_LAW_318094/. Last accessed 22.02.2023.

of Krasnoyarsk region, this figure is 1,43, in the Arctic zone of the Republic of Sakha (Yakutia) – 0,86, in the Chukotka Autonomous District – 1,64. For comparison, in the Kingdom of Norway in hard-to-reach localities, this figure is 4,2 trips per year per inhabitant, in Australia – 3,3 trips per year.[3] In the Republic of Sakha (Yakutia) (RS(Ya)) compared to 1989 this figure for interregional routes has decreased by five times.

The study revealed that air travel in the regions of the Eastern Arctic is performed in two stages: at the local level from the settlement to the central district airport with irregular flights and at the inter-district level from the centre of the Arctic district to the centre of the region. The demand for local air transportation influences the formation of demand for inter-district transportation and determines the occupancy of regularly operated inter-district flights. The aviation mobility of the population of remote settlements of the Eastern Arctic remains at an even lower level (from 0,3 to 0,6) due to the lack of regular transport connectivity with regional airports.

Air accessibility is determined, on the one hand, by availability and physical possibility of using air transport at any time, on the other hand, by an acceptable level of cost and duration of the transportation service for the user.

Thus, the *aviation accessibility of a region* means the ability to make a flight during a given time from certain points of departure to the required destinations by all interested parties, considering the cost of the flight and the level of their solvency.

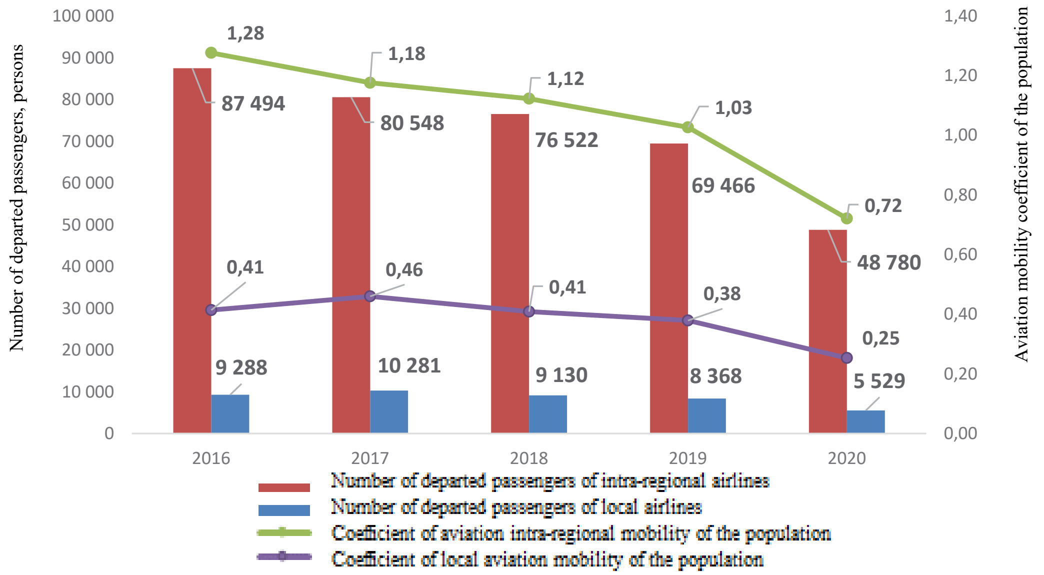
The aviation accessibility of the regions of the Eastern Arctic depends on the location of the airport network, the network of landing sites and heliports; route network structures; regularity of flights; operated aircraft fleet; aircraft bases, which determine the price and physical availability of air transportation for the local population and business entities [16; 17].

Over the past 30 years, the number of airports operating in Russia has decreased by almost six times, from 1450 to 240. The largest decrease referred to closure of class G and E airports (classification by the length of runway and runway load bearing capacity) that is airports of regional and local importance, located in hard-to-reach areas of the Arctic zone and the Far East [18], which led to aggravation of the problems of transport connectivity of these territories. Compared with 1991, the number of airports in the Eastern Arctic has decreased three times and amounted to 33 airports, or 0,01 airport per 1000 km² of area. Almost all operating airports are located in regional centres. For comparison, in Alaska, with an area of 1 718 000 km² and a population of 731 454 people, there are 459 airports, 300 of which are public and 159 are private. That is, there are 0,26 airports per 1000 km² [16].

Under these conditions, the air accessibility of remote Arctic settlements is determined by the presence of landing sites and heliports, as well as by the frequency of flights towards the district airport. In total, there are about 220 settlements in the Eastern Arctic with a population of 1 500 to 10 people. Between the centres of the Arctic regions and settlements, in the absence of airfields and landing sites of adequate quality, irregular flights are carried out by helicopters with a capacity of 22–24 seats. For comparison, the cost of a flight hour of an MI-8 helicopter, due to high fuel costs, is four times higher than the cost of a flight hour of an An-2 aircraft with a capacity of 9–12 seats. The incomplete loading of planned local flights forces airlines to reduce their number, which leads to an even greater decrease in the level of aviation mobility of the population, and as a result, to the risks of socio-economic degradation of territories. According to the data of the Ministry of Transport and Road Economy of the Republic of Sakha (Yakutia), on average, flights of local air lines (LAL) in the Republic of Sakha (Yakutia) are operated twice a month.

Studies have shown that about 30 % of the population lives in remote settlements in the Arctic zone of the Republic of Sakha (Yakutia). The coefficient of local aviation mobility of this population (the number of flights made from a settlement to a district airport per one inhabitant per year) averages 0,38, as calculated over five years. At the same time, the coefficient of intra-regional aviation mobility of the population (the number of completed flights outside the Arctic district per capita per year) is 1,06 (Pic. 2). The number of passengers departing by intra-regional (IR) and local airlines (LAL) has been declining over the past five years. In 2020, a sharp decrease was due to the restraints on flights because of the spread of COVID-19.

[3] Decree of the Government of the Russian Federation dated November 27, 2021 № 3363-r «Transport strategy of the Russian Federation until 2030 with a forecast for a period until 2035». [Electronic resource]: https://mintrans.gov.ru/documents/8/11577. Last accessed 27.05.2022.



Pic. 2. Dynamics of passenger traffic and aviation mobility of the population on IR and LAL in the Arctic zone of the Republic of Sakha (Yakutia) [compiled by the authors based on statistics from the Transport and Clearing Chamber].

An increase in the local aviation mobility of the population can be achieved by developing a network of landing sites in settlements. This will increase the frequency of flights by replacing helicopters with An-2/TVS-2MS aircraft. The construction and maintenance of landing sites is expedient if there is a demand for local air transportation for at least six months.

Studies have shown that seasonal distribution of demand for air transportation in Arctic settlements ranges from 3 to 12 months and depends on many criteria. For the first time, the method of hierarchical clustering of settlements was applied to assess seasonal distribution of passenger flows of local air transportation. This method allows, by considering several criteria and measuring the normalised distance between settlements, to divide all settlements into clusters in each of which the demand for air transportation is present for a certain number of months. For each cluster separately, a decision is made on the need to build landing sites.

Methodology for Hierarchical Clustering of Arctic Settlements

Cluster analysis is one of the data mining methods used in development of machine learning and artificial intelligence while developing management decisions [19].

To solve the problem, with the help of an expert assessment, 18 criteria were identified that affect the size and seasonal distribution of passenger flows of local and inter-district air transportation, Table 1.

30 people acted as qualified experts, including employees of the regional departments of air transport, heads of the Arctic districts, representatives of airlines and airports. Each expert had to form a ranked list of criteria that affect the passenger traffic of local and inter-district air transportation. As a result of expert evaluations, a matrix $\|r_{ju}\|\left(u=\overline{1,d};\, j=\overline{1,n}\right)$ was obtained, where r_{ju} is the rank of criterion j assigned by expert u. The sum of the ranks of each criterion in a row will look like:

$$r_j = \sum_{u=1}^{d} r_{ju};\left(j=\overline{1,n}\right). \quad (1)$$

Then the variance of expert estimates D_r is determined by the formula:

$$D_r = \frac{1}{d-1}\sum_{u=1}^{d}(r_{ju} - r_{av})^2\ ; \quad (2)$$

$$r_{av} = \frac{1}{d}\sum_{u=1}^{d} r_{ju}\ . \quad (3)$$

To solve the problem of clustering settlements, nine criteria were selected from the total number of criteria, which, according to all experts, directly affect formation of passenger flows of local air transportation. After evaluating the pairwise correlation, seven of them were selected, with a correlation of less than 0,6.

The most significant results for distribution of settlements by clusters can be obtained using the Ward's method, which can be used with

Table 1

Criteria determining seasonal distribution of air transport passenger flows in the Arctic region [compiled by the authors]

№	Criteria		Level
1	Population in the settlement / district centre, people	X1	Local
2	Flight distance from the settlement to the district airport, km	X2	Local
3	Distance from the settlement to the district airport by winter road, km	X3	Local
4	The amount of reimbursement (during trip to the place of annual vocation) for the fare for flights between settlements and district airport, rub.	X4	Local
5	Flight distance from the district airport to the centre of the region, km	X5	Inter-district
6	Average cost of an economy class flight from the district airport to the centre of the region, rub.	X6	Inter-district
7	Average monthly payroll of one employee in the district, rub.	X7	Inter-district
8	Share of the cost of the flight from the district airport to the centre of the region in the average monthly payroll of one employee in the district	X8	Inter-district
9	Presence of mining in the settlement	X9	Local
10	Total flight distance from arctic settlement to the centre of the region, km	X10	Inter-district
11	Local aviation mobility of the population, flights per year per inhabitant	X11	Local
12	Population in terms of the number of air flights between the settlement to the district airport per year, person/flight	X12	Local
13	Availability of alternative modes of transportation between the settlement and the district airport	X13	Local
14	Availability of year-round road transportation between the district airport and the centre of the region	X14	Inter-district
15	Availability of railway transportation between the district airport and the centre of the region	X15	Inter-district
16	Presence of a runway and/or heliport in a settlement	X16	Local
17	Complex coefficient of transport accessibility [20]	X17	Local
18	Assignment of the territory to the regions of the Far North	X18	Inter-district

a small number of observations. The objective function when using the Ward's method is to minimise the increment of the intragroup sum of squared deviations of the distances between each point (settlement) and the average for the cluster containing this object. At each step, two clusters are combined that lead to the minimum increase in the objective function. To solve the problem, the Ward's method is implemented according to the Lance–Williams formula for formation of non-overlapping clusters of settlements K_i, K_j, K_l with dimensions n_i, n_j, n_l, respectively; p_{ij}, p_{il}, p_{jl} are pairwise distances between clusters K_i, K_j, K_l. If clusters K_i, K_j are located nearby and can be combined into one, then $p_{(ij)k}$ is the distance between the new cluster $K_i \cup K_j, K_l$ calculated recursively:

$$p_{(ij)k} = \alpha_i p_{il} + \alpha_j p_{jl} + \beta p_{ij} + \gamma \left| p_{il} - p_{jl} \right|, \quad (4)$$

where α_i, α_j, β, γ, – parameters that depend on the size of population clusters:

$$\alpha_i = \frac{n_i + n_l}{n_i + n_j + n_l}; \quad (5)$$

$$\alpha_j = \frac{n_j + n_l}{n_i + n_j + n_l}; \quad (6)$$

$$\beta = \frac{-n_l}{n_i + n_j + n_l}; \quad (7)$$

$$\gamma = 0. \quad (8)$$

The distance between a new pair of clusters is found by the formula:

$$p\left(K_i \cup K_j, K_l\right) = \frac{n_i + n_l}{n_i + n_j + n_l} p\left(K_i, K_l\right) + \frac{n_j + n_l}{n_i + n_j + n_l} p\left(K_j, K_l\right) - \frac{n_l}{n_i + n_j + n_l} p\left(K_i, K_j\right). \quad (9)$$

To determine the optimal number of clusters, the Euclidean distance between settlements is

Statement of the clustering problem
(distribution of settlements by clusters, taking into account seasonal demand for air transportation)

$$s=\{s^{(1)},\ldots,s^{(N)}\}$$

↓

Selection of criteria describing the objects of study (expert assessment)

$$V=\left\{x_j^{(i)}\right\}, i=1,2,\ldots,N, j=1,2,\ldots,n$$

↓

Selection of criteria, the pairwise correlation between which is less than 0,7

n = x1,x2,x11,x12,x13,x16,x17; $n \in 18$

↓

Data standardisation for each evaluation criterion (z-transform):

$$x'_i=\left(x_i-\bar{X}\right)/\sigma_x$$

↓

Choosing a method for measuring the distance between features, taking into account the resulting matrix of factors:

$$p_E\left(s^{(i)},s^{(l)}\right)=\sqrt{\sum_{j=1}^{n}(x_j^{(i)}-x_j^{(l)})^2}$$

↓

Choosing a clustering method by calculation:

$$p_{max}\left(K_i,K_j\right)=\max p\left(x_i,x_j\right), x_i\in K_i, x_j\in K_j;$$

$$p_{(ij)k}=\alpha_i p_{il}+\alpha_j p_{jl}+\beta p_{ij}+\gamma\left|p_{il}-p_{jl}\right|$$

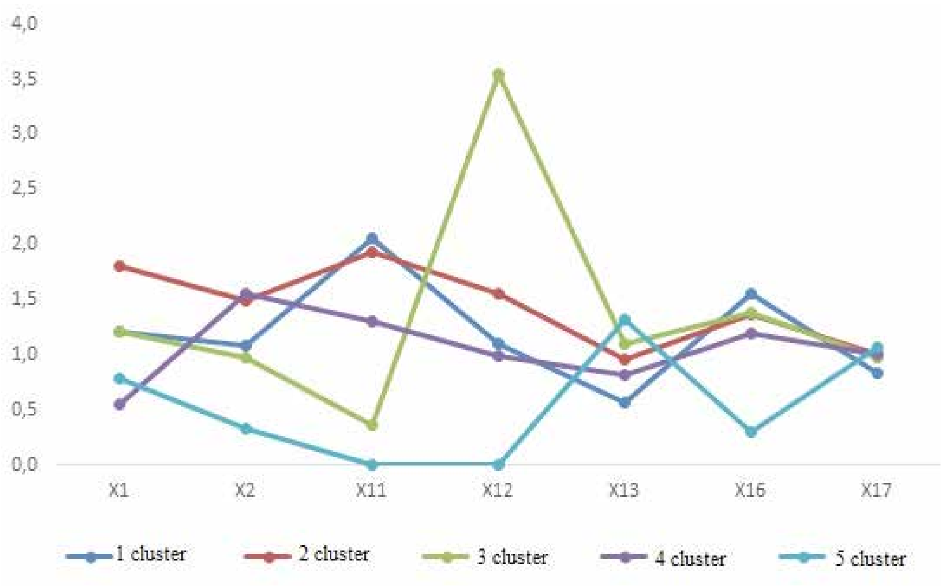
↓

Building a cluster model and deciding on the number of clusters of settlements
(analytically)

↓

Interpretation of the results and their presentation in a geographic information system, taking into account the zones of gravity of regional airports

Pic. 3. Mathematical description of the methodology of hierarchical clustering of Arctic settlements for assessment of seasonal distribution of passenger flows of local air transportation [compiled by the authors]



Pic. 4. Average normalised values of the criteria for clusters of Arctic settlements of the Republic of Sakha (Yakutia) [compiled by the authors].

Table 2

Maximum, minimum and average natural values of the criteria for clusters of settlements in the Republic of Sakha (Yakutia) [compiled by the authors]

Criteria			Clusters				
			I	II	III	IV	V
Variables		Values	Number of settlements				
			11	10	6	16	22
Population, people	X1	Mean Min-max	452 (242–578)	676 (469–1017)	454 (254–778)	210 (53–479)	297 (66–841)
Distance to the district airport in a straight line, km	X2	Mean Min-max	101 (39–159)	139 (67–261)	91 (60–133)	144 (53–249)	31 (1–76)
Aviation intra-ulus (district) mobility of the population	X11	Mean Min-max	0,50 (0,39–0,56)	0,47 (0,20–0,77)	0,09 (0,05–0,14)	0,32 (0,17–0,77)	0,00
Number of people per number of flights performed through the district airport per year	X12	Mean Min-max	28 (20–32)	39 (15–56)	89 (47–185)	25 (10–56)	0
Availability of alternative modes of transport connectivity with the district airport	X13	X	winter road	winter road and water transport	winter road and water transport	winter road and water transport	Year-round traffic
Presence of a landing site in the settlement, total (operational / non-operational)	X16	Total (operational/ non-operational)	11 (8/3)	8 (6/2)	5 (3/2)	10 (8/2)	2 (1/1)
Air transport accessibility factor	X17	Mean Min-max	0,392 (0,381–0,438)	0,468 (0,430–0,512)	0,455 (0,379–0,512)	0,466 (0,407–0,544)	0,501 (0,396–0,544)
Number of months in a year during which there is a demand for air transportation	q^{s^i}	**X**	**8 (May–November)**	**12 (January–December)**	**3 (May, October, November)**	**12 (January–December)**	**0 X**

analysed at each clustering step. The clustering step is selected at which the first large increase in the Euclidean distance occurred, then the number of clusters formed at this step is selected.

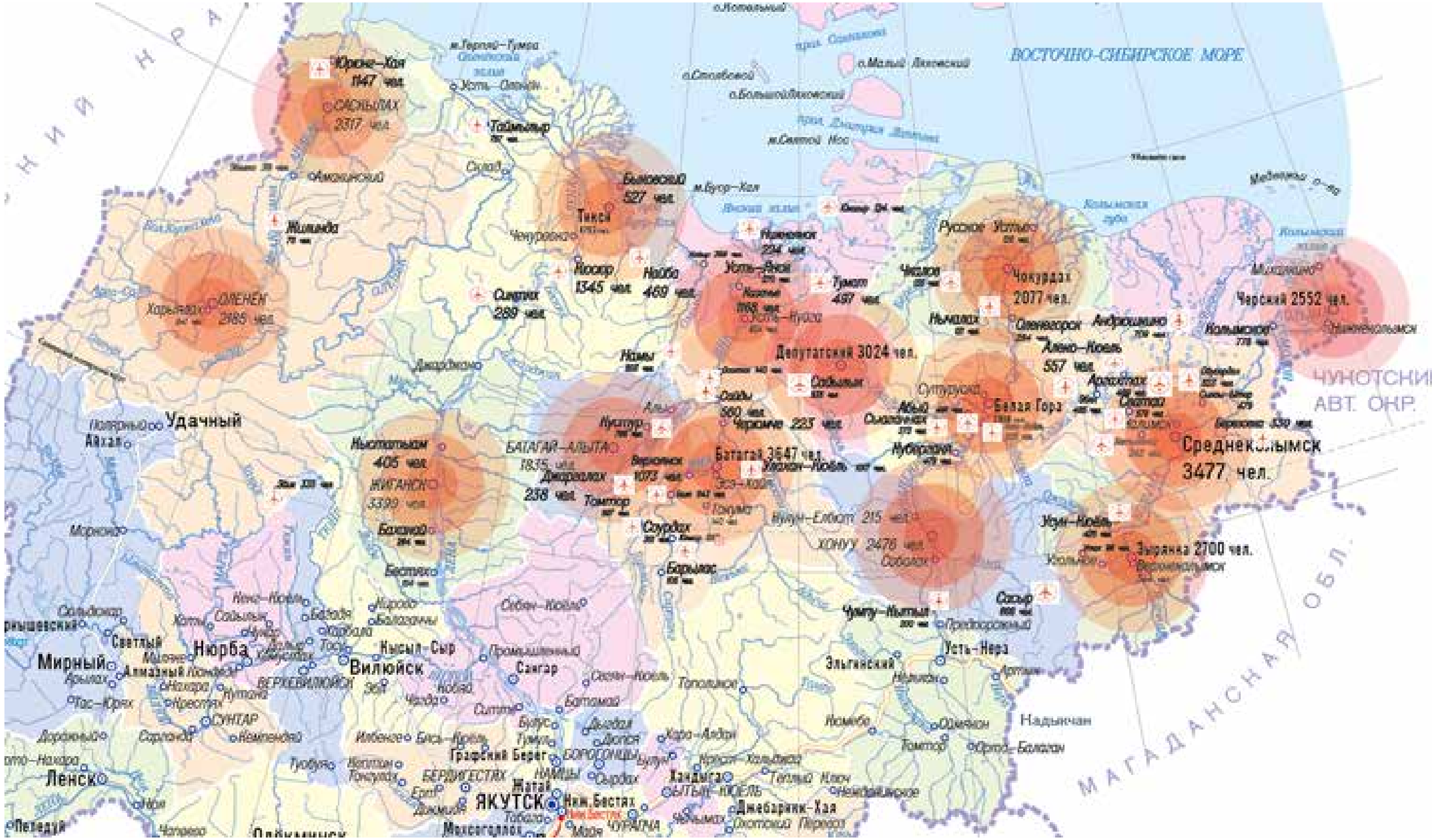
A mathematical description of the methodology for hierarchical clustering of Arctic settlements is presented in Pic. 3.

Results of Hierarchical Clustering of Settlements

The clustering method for predicting the seasonal distribution of demand for local air transportation was used on the example of 65 settlements of the Republic of Sakha (Yakutia). The *Statistica* program was used to calculate the distance between clusters. It was found that to solve the problem, the most optimal is the selection of five clusters of settlements, since at this step the largest increase in the Euclidean distance between clusters occurs. The average normalised values of the criteria for clusters are shown in Pic. 4.

Clusters of settlements formed by the Ward's method are quite uniform in number and include 11, 10, 6, 16 and 22 settlements, respectively. The characteristic of the obtained clusters of settlements in physical terms is presented in Table 2.

The first cluster comprises settlements with an average population, located at no more than 160 km from the district airport, with the highest aviation mobility of the population. Since there



Designations (names of settlements are in Russian; numbers mean population size):

gravity zone of the operating district airport (50□100□150 km).

planned landing sites.

Pic. 5. Illustration of gravity zones of operating district airports and a planned network of landing sites for servicing local air transportation in the Arctic settlements of the Republic of Sakha (Yakutia) [compiled by the authors].

is an alternative connectivity with the settlements of this cluster via winter roads, the demand for air transportation to the district airport exists only eight months a year.

The second cluster comprises the largest settlements located at up to 265 km from the district airport. Due to the great remoteness, the demand for local air transportation is present 12 months a year.

The third cluster includes medium-sized settlements located at no more than 135 km from the district airport and having both water (in summer) and road (in winter) connections with it. As a result, the demand for local air travelling exists for only three months of the year during the off-season.

The fourth cluster includes sparsely populated areas located at up to 250 km from the district airport with an average aviation mobility of the population. Due to their great remoteness, they also manifest demand for air travel 12 months a year.

The settlements of the fifth cluster do not show demand for air transportation, due to the presence of year-round connectivity with the district airport.

Based on the analysis of passenger traffic of local airlines in the Arctic regions and the time standards spent on the trip of passengers from a settlement to a district airport, it was found that the maximum gravity distance of a district airport is 150 km, since such a distance can be covered by a winter road in three hours. The calculation of the gravity distance of a district airport is confirmed by the data of foreign studies conducted in Northern Canada and Alaska [5; 6].

In Arctic settlements that do not fall within the area of gravity of the district airport, it is necessary to build a landing site for organisation of regular air traffic with a frequency of at least once a week.

Thus, the decision to build a landing site in an Arctic settlement is made in the following cases:

1. The settlement does not fall into the gravity zone of the operating district airport.

2. The settlement falls into the zone of gravity of the district airport, the demand for passenger air transportation towards it is present for more than five months a year.

The projected network of landing sites in the Republic of Sakha (Yakutia), built based on the results of assessing the seasonal distribution of passenger traffic, is shown in Pic. 5. Circles with a gradient fill on the map mark the gravity zones of operating district airports with a step of 50 km. The icon indicates the construction sites of landing sites. It is necessary to organise regular flights to twelve settlements (Taimalyr, Zhilinda, Eyik, Siktyah, Namy, Suordakh, Nizhneyansk, Yukagir, Tumat, Sasyr, Aleko-Kyuel, Andryushkino0, located outside the zone of gravity of existing district airports.

CONCLUSIONS AND SUGGESTIONS

The developed methodology for hierarchical clustering of Arctic settlements makes it possible to simplify the task of substantiating the need to build a network of landing sites based on many criteria.

Further research is required on the issues of forecasting the volume of passenger flows of local air transportation, considering their seasonal distribution. Forecasting passenger traffic will allow calculating the need for an aircraft fleet in terms of quantity and standard sizes for a given regularity of flights. The use of light aircraft with a capacity of up to 9–12 seats will ensure their greater loading with the possibility of increasing the regularity of flights, which in turn will increase the level of aviation accessibility of Arctic settlements.

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