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ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ
Satbayev University

ХАБАРЛАРЫ

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
Satbayev University

NEWS

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MAIN CRITERIA DEFINING GLOF RISK ON THE TERRITORY OF ALMATY REGION, KAZAKHSTAN

Abstract. The ongoing retreat of glaciers in the mountainous areas of the Almaty region due to climate change has far-reaching consequences for the formation and expansion of moraine-glacial lakes. Subsequent moraine lake outburst floods (GLOFs) pose a serious threat to life and livelihoods as they can cause catastrophic damage up to hundreds of kilometres downstream. Previous studies have reported the rapid dynamics of moraine lake formation and several notable destructive GLOF events in the Ile Alatau in the past. The results of the distribution regularities study indicate the need for a timely and updated assessment of GLOF susceptibility. In this paper, an updated inventory of high-mountain moraine lakes in the Ile, Kungey, Terskey Alatau and Saryzhaz Ridge was developed based on the data of the Sentinel-2 satellite for 2021 and applying aerial surveys. In addition, the vulnerability of moraine lakes (≥0.045 km2) is determined using a multi-criteria assessment. Moraine lakes are classified into low, medium, high and very high GLOF susceptibility. The result shows the existence of 333 moraine lakes (> 0.001 km^2) with a total area of 3.5± 0.8 km^2 over the study area in 2021. In addition, out of 64 dangerous moraine lakes (≥0.045 km^2) assessed, 15 were identified with very high GLOF susceptibility. We emphasize that a pronounced glacier-lake interaction is likely to increase susceptibility to GLOF. Regular monitoring and more detailed field acquisition is required for these highly outburst moraine lakes. This will contribute to early warning and disaster risk reduction in downstream communities.

Key words: Moraine Lake, GLOF criteria, mudflow risk, Lake Inventory.

Introduction. The mountain ranges of the South-Eastern Kazakhstan are characterized by a dense distribution of moraine-glacial lakes [1,2], and they are rapidly expanding due to degradation of glaciers in light of an increase in the temperature background in the high-mountainous part [3,4]. Such lakes are located on the surface of glaciers (supra-glacial lakes or ponds), behind terminal or lateral moraines (proglacial lakes) and other lakes that do not have direct contact with the glacier, but lie on the periphery of the glacier and are fed by melting snow and glaciers [5,6]. The reduction of the open part of the glaciers leads to an increase in the area of modern moraines, which are a platform for the development of moraine lakes; small reservoirs appear on the glaciers.

These glacial lakes show characteristic differences in terms of formation, dam structure, lifespan, expansion, appearance, disappearance and outburst impact [7-9]. Moraine glacial lake outburst flood (GLOF) occurs when a sudden release of large volumes of water from glacial lakes is caused either by the collapse of a dam or by wave crawling due to external triggering or self-destruction, such as ice / rock avalanches and heavy precipitation into the lake [10,11]. GLOFs are often associated with mudflows that can cause catastrophic damage downstream [12,13].

Active thermokarst processes associated with an increase in the temperature background lead to an annual increase in the number of lakes, an increase in lake basins. These processes also lead to the degradation of

lakes by the appearance of intramorainic run-off channels. This type of emptying of lakes often leads to the formation of mudflows, including crushing mudflows.

Depending on the state of the lake basins, outburst-hazardous lakes are divided into: stationary, non-stationary, developing, degrading and temporarily empty basins [14].

Stationary lakes include basins constantly filled with melted glacial waters. The water filling level depends on the season and the meteorological conditions. In winter, the surface of the lakes is covered with ice of considerable thickness and the level and volume of water in the lake basins decrease due to its filtration into the moraine sub soils. During the period of intensive ablation of glaciers in July-August months, lake basins are filled with water to maximum levels, and the risk of a breakthrough hazard increases with the formation of a mudflow.

Unstable lakes are filled with water periodically, perhaps once every several years, usually this is facilitated by the collapse of thawed soils and plugging of channels, the formation of temporary ice and ice-snow plugs in the tunnels, etc. In winter and early spring, there is no water in the lake basin or there is a minor water volume. The water levels in lakes are influenced by the throughput capacity of intramorainic run-off channels.

The developing lake basins are characterized by an intensive increase in water volumes over a short period (1-10 years). During this period, an increase in the area of the lakes cape and the lake basin as a whole is observed. The intensive development of lake basins leads not only to the rapid accumulation of large volumes of melt water in them, but also increases their breakthrough hazard [15]. The most dangerous period of developing lakes is the first year or three years. After a period of 20 years or more, the lakes can go into the stage of degradation (aging), the breakthrough hazard is reduced to a minimum, and the processes of culmination of the surface of the lake basin occur.

Justification of the topic choice. Aims and objectives. Taking into account the geographical location, natural conditions, the wide distribution of moraine lakes along the ridges, dense population and the presence of a large number of economic facilities in mudflow-prone areas, reducing the threat of natural disasters and their consequences is an important priority in the strategy of the Local Authority of the Almaty city and Almaty region, Departments of the Ministry of Emergency Situations and the Government of the Republic of Kazakhstan.

In order to determine the category of the breakthrough hazard of moraine lakes on the territory of the Almaty region, the lakes of mountain ranges related to the spurs of the Northern Tien Shan in Kazakhstan part: Ile, Kungei and Teriskei Alatau, the Saryzhaz ridge were studied (Figure 1). Also, materials of past mudflows [16], research materials, and aero visual and ground surveys were studied.

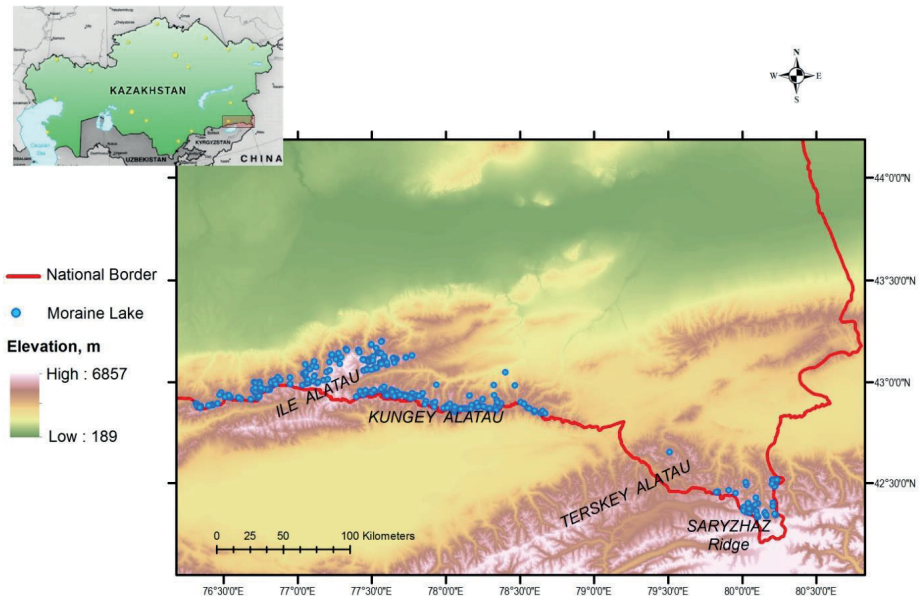


Figure 1 – Study area: High Mountain areas in the North-eastern part of Kazakhstan. The background is false-colour composite Landsat OLI image acquired from August 19, 2020.

Data and Lake Inventory. In the 70-80s of the last century, certification was carried out mainly only for the most dangerous moraine lakes in the central part of the Ile Alatau ridge. Certification of all moraine lakes in the study area began in 2015. Certification was carried out by specialists from State Agency "Kaz Mud

flow Protection" (KMP) using satellite data from Google Earth, SAS. Planet. Release and according to the available data of reconnaissance, bathymetric works, ground and aerial surveys.

Dangerous moraine lakes were identified based on the results of aerovisual and ground surveys. According to the latest data from the KMP services, there are 947 moraine lakes located on modern moraines, the lakes located on ancient moraines were not taken into account (the only exceptions were those representing a mudflow hazard). Annually, KMP takes preventive measures on 15-18 moraine lakes to reduce the risk of a breakthrough hazard.

Methodology of scientific research. The main reasons for the breakthrough of alpine lakes are considered: destruction of moraine dams (as a result of thawing of the soils of the run-off channel, collapse of the sides, etc.), with the formation of a powerful water flow; breakthrough by intramorainic run-off channels through funnels, grottoes with water flows coming to the surface on the lake dam, lower on the body of the modern moraine, or at a considerable distance from the lake from under the modern moraine [17].

Breakthrough hazard criteria for all moraine lakes in terms of potential risk levels have not been previously developed; an assessment was carried out for each lake separately based on the results of reconnaissance work.

The lakes have remained and remain to this day in the position of poorly studied in terms of stationary and systematic lake studies.

To assess the outburst hazard of moraine lakes, they were considered in the "glacier-moraine-lake" complex on the basis of the available scientific literature, characteristics of mudflows in recent years.

Based on the research results, the following indicators were used as *criteria for assessing lakes* at this stage:

- the state of the lake by type (stationary, non-stationary), volume of the lake, filling mode, lake basin, drain, run-off channel.
- the condition of the lake bulkhead (composition (friable materials, thawed and frozen soils, ice lenses, etc.), parameters of the bulkhead (height, width, length), general condition of the bulkhead)
- the state of the moraine (subsidence, cracks, thermokarst sinkholes, traces of micro mudflows and lake outbursts, etc.)
- the state of the moraine ledge (parameters, general condition, location of the lake relative to the moraine ledge, etc.).
- the state of the glacier (type, size, location of the lake relative to the glacier):

Additional criteria for a breakthrough hazard can be:

- location of the lake (elevation point, exposure, river basin area, number of glaciers, etc.);
- the possibility of collapse of the final part of the glacier tongue or the collapse of significant ice masses from the glacier with the splash of lake water;
- the possibility of collapse of soil masses from nearby slopes into the lake basin, followed by splashing water from the lake;
- abrupt re-filling of the lake bowl or abrupt filling of previously empty basins and significant depressions on the glacier moraine;
- an abrupt change in the water level (stepwise) in the lake associated with the pulsation regime of the submerged run-off during the period of intensive ablation of glaciers;
- increase in lake water run-off with mudflow-forming discharges;
-the presence of traces of micro mudflows and "backward" erosion in the run-off channel;
- steepness of the run-off channel;
- the steepness of the sides of the run-off channel;
- activation of thermokarst processes on the body of the lake dam and on the modern glacier moraine (subsidence, movements, thermokarst funnels, soil slides, etc.)
- the emergence of new foci of water wedging out through the body of the lake dam, or an increase in filtration with the removal of particles;
- also one of the factors canbeseismic and mudflow activity in the specifiedregion and many other factors

In the course of the research, the previously developed methods for determining the breakthrough hazard criteria were studied by Keremkulov A.R., Medeu P.A. Plekhanov and KMP [18].

The authors of the paper consider the developed method of Kazselezashchita with the additions and changes to be the most acceptable when carrying out certification of moraine-glacial lakes, reconnaissance work and

when carrying out operational measures to reduce the breakthrough hazard of moraine lakes. Determination of the potential danger of a lake breakthrough will provide real assistance in preventing the occurrence of uncontrolled natural processes in the glacial-moraine complex.

It is proposed to introduce an additional category "very dangerous lake" for outburst-hazardous moraine lakes in the presence of a settlement with a population of more than 500 people or a strategically important object in the mudflow risk zone.

As a result of the studies carried out to develop the breakthrough hazard criterion, outburst-hazardous lakes were identified, information was obtained on the morphometry and morphology of lake bowls and the hydrological regime for individual lakes, and a list of dangerous mountain lakes was determined, where measures should be taken to eliminate their possible breakthrough.

Research results and discussion. 333 lakes and temporarily empty lake basins were registered in the studied mountainous areas of the Almaty region. Including along the Ile Alatau – 188, along the Kungei Alatau – 86, Terskey Alatau - 14 and 45 lakes on the Saryzhaz ridge. In the course of the study, together with specialists from KMP, and during the interpretation of space images, the development of cartographic material, 17 new lakes were identified.

Dangerous volumes of lakes in the study area are 40 thousand m³, up to 6.4 million m³. The moraine lake with the largest water volume of 6.4 million m³ is the Maximov lake located under the glacier of the same name in the Shelek river basin.

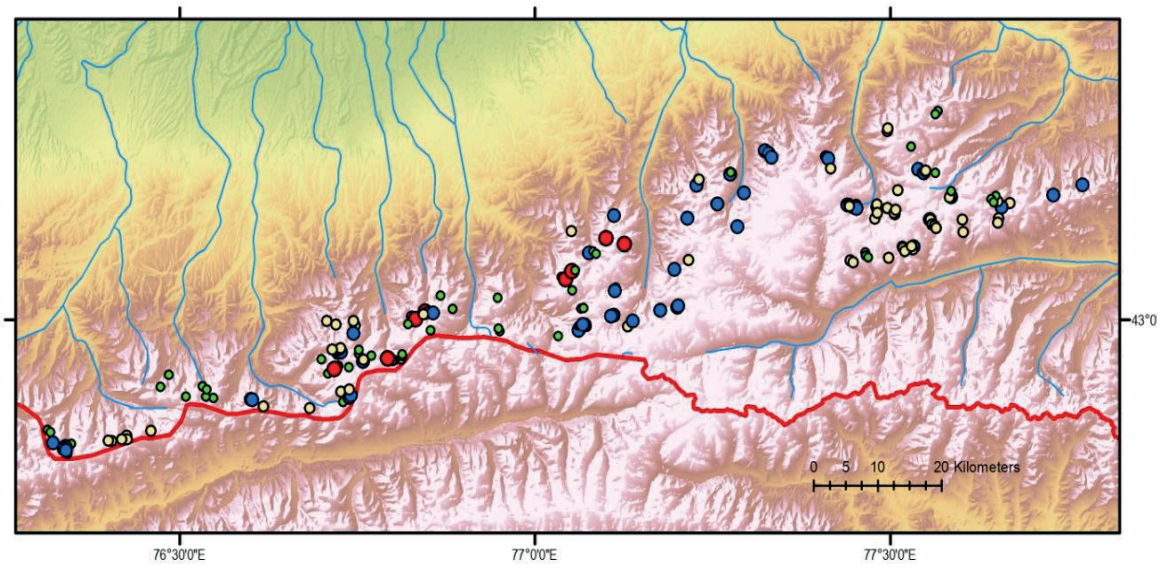
According to the criteria compiled from 64 moraine dammed lakes, 15 lakes are classified as very dangerous lakes; the breakdown by region is given in the table 1.

Table 1 - Distribution of moraine-glacial lakes with an indication of their outburst hazard

Mountain areas	GLOF susceptibility				
	Very high	High	Medium	Low	Developing Lake
Ile Alatau	11	25	38	21	93
Kungey Alatau	3	17	13	35	18
Terskey Alatau			6	8	
Saryzhaz Ridge	1	7	11	9	17

As a result of the studies carried out on the development of the breakthrough hazard criterion, outburst-hazardous lakes were identified, information was obtained on the morphometry and morphology of lake bowls and the hydrological regime for individual lakes, and a list of dangerous mountain lakes was determined, where it is necessary to take measures to eliminate their possible breakthrough.

a)



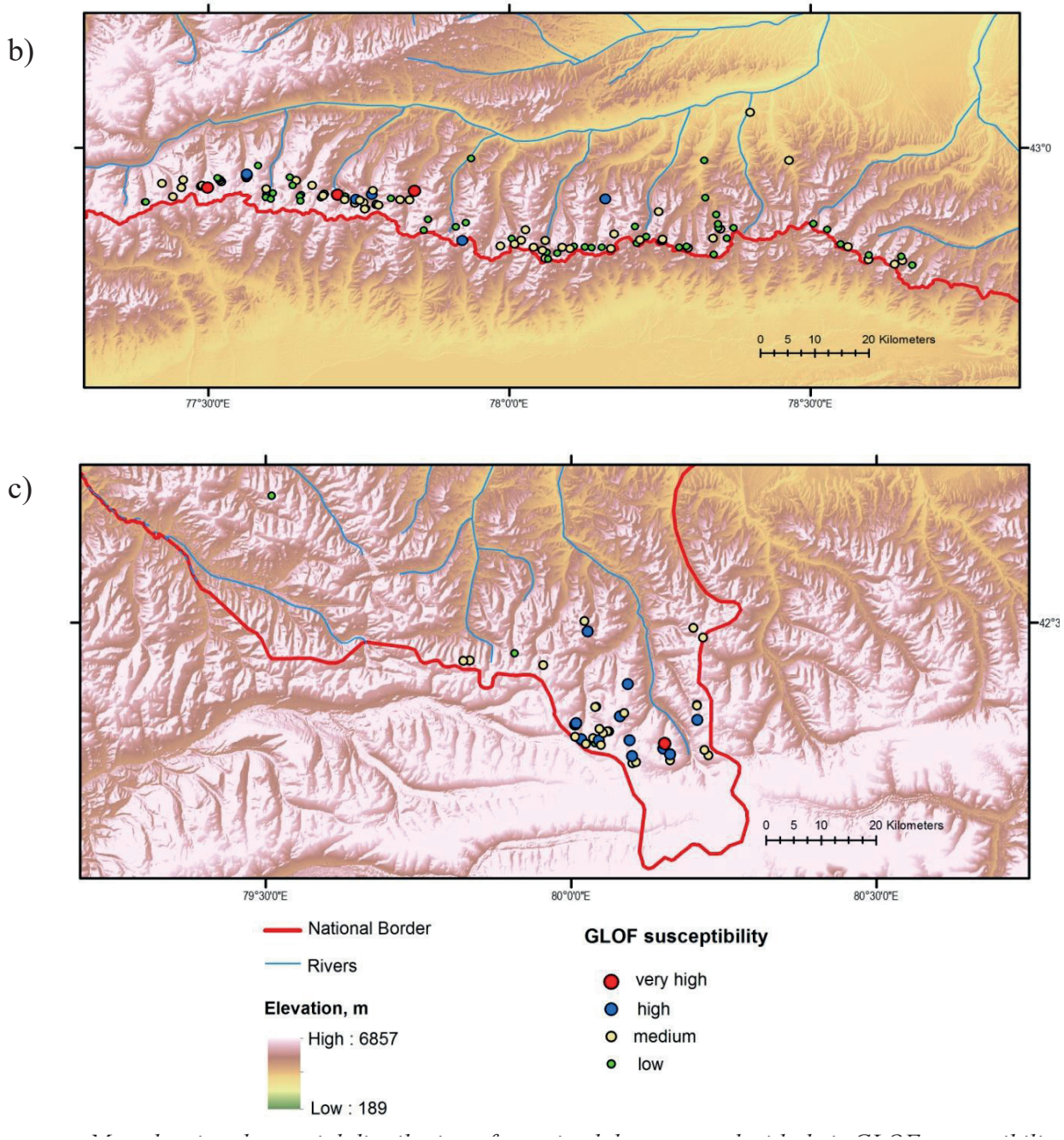


Figure 2 – Map showing the spatial distribution of moraine lakes assessed with their GLOF susceptibility classes in the areas: a) Ile Alatau; b) Kungey Alatau; c) Terskey Alatau and Saryzhaz Ridge.

Conclusion. The development of new criteria for determining the outburst hazard of moraine lakes is intended for use in carrying out an operational risk assessment of the potential mudflow hazard of moraine lakes in order to analyze the current situation, the situation in general, using risk mapping and taking operational measures on this basis to mitigate the consequences of possible outburst of lakes, and also the use of this material as a methodological guide and training of specialists from the monitoring services of moraine lakes.

We recommend for improving the methodology in future studies in other regions as GLOF mechanism, impacts and risk differs from one region to other.

To study and in more detail determine the outburst hazard of the moraine lake, it is necessary to carry out a set of works, including research and survey work to determine the geological, engineering-geological, cryological, geomorphological, glaciological, hydrometeorological factors of mudflow hazard of the glacial-moraine complex. In the process of these works, geological sections must be clarified and the physical and mechanical properties of rocks determined (open working-adits must be made directly on the cofferdam);

using geophysical methods, it is necessary to perform detailed geological mapping, study permafrost with the identification of the boundaries of the distribution and the thickness of permafrost; based on the study of the anomalies of the geo-temperature field - to identify underground voids. The results of these works should include the development of methods for the elimination of a high-mountain lake with scientific, technical and economic justification.

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АЛМАТЫ ОБЛЫСЫНЫҢ (ҚАЗАҚСТАН) АЙМАҒЫНДАҒЫ КӨЛДЕРДІҢ АҚТАРЫЛУ ҚАУІПТІЛІГІН АНЫҚТАЙТЫН НЕГІЗГІ КРИТЕРИЙЛЕР

Аннотация. Мақалада климаттың өзгеруіне байланысты Алматы облысының таулы аймақтарында мұздықтардың шегінуі мореналық-мұздық көлдердің пайда болуына және кеңеюіне алкен әсер етеді. Мореналық көл ақтарылуынан туындайтын селдік су тасқыны (GLOF) өмірге және тіршілікке елеулі қауіп төндіреді, себебі олар төменде жүз деген шақырымға дейін апатты зақым келтіруі мүмкін. Алдыңғы зерттеулер Іле Алатауында мореналық көлдердің пайда болуының қарқынды динамикасы мен GLOF-пен байланысты апатты оқиғалар туралы хабарлады. Таралу заңдылықтарын зерттеу нәтижелері GLOF сезімталдығын уақтылы және жаңартылған бағалау қажеттілігін көрсетеді. Бұл жұмыста Іле, Күнгей және Теріскей Алатауындағы, Сарыжаз жотасындағы биік таулы мореналық көлдердің жаңартылған инвентаризациясы Sentinel-2 жер серігінің 2021 жылға арналған мәліметтерінің негізінде әзірленді және әуеден шолу түсірілімдері қолданылды. Сонымен қатар, мореналық көлдердің осалдығы (≥0.045 км^2) көп критерийлі бағалау көмегімен анықталады. Мореналық көлдер GLOF сезімталдығы төмен, орташа, жоғары және өте жоғары болып жіктеледі. Нәтиже 2021 жылы зерттеу алаңынан жалпы ауданы 3,5 ± 0,8 км^2 құрайтын 333 мореналық көлдердің (> 0,001 км^2) бар екендігін көрсетеді. Сонымен қатар, бағаланған 64 қауіпті мореналық көлдердің (≥0.045 км^2) 15-і аса GLOF сезімталдығы өте жоғары, қауіпті санатқа жатқызылды. Біз мұздықтармен көлдердің айқын өзара әрекеттесуі GLOF сезімталдығын арттыруы мүмкін екенін атап көрсетеміз. Ақтарылу қаупі аса жоғары мореналық көлдер үшін жүйелі түрде мониторинг жүргізулуі және далалық зерттеу жұмыстары ұйымдастырылуы қажет. Бұл сел. Тасқынының төменгі бөлігіндегі шаруашылық нысандарды алдын ала ескерту мен апаттар қаупін төмендетуге ықпал етеді.

Түйінді сөздер: мореналық көл, GLOF критерийлері, сел. қаупі, көлдерді инвентаризациялау.

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ОСНОВНЫЕ КРИТЕРИИ ОПРЕДЕЛЕНИЯ РИСКА ПРОРЫВООПАСНОСТИ МОРЕННО-ЛЕДНИКОВЫХ ОЗЕР НА ТЕРРИТОРИИ АЛМАТИНСКОЙ ОБЛАСТИ, КАЗАХСТАН

Аннотация. Продолжающееся отступление ледников в горных районах Алматинской области из-за изменения климата имеет далеко идущие последствия для образования и расширения моренно-ледниковых озер. Последующие наводнения, вызванные прорывом моренных озер (GLOF),

представляют серьезную угрозу для жизни и средств к существованию, поскольку могут нанести катастрофический ущерб на расстоянии до сотен километров вниз по течению. Предыдущие исследования сообщили о быстрой динамике образования моренных озер и нескольких заметных разрушительных событиях, связанных с GLOF в Иле Алатау в прошлом. Результаты исследования закономерностей распространения указывают на необходимость своевременной и актуальной оценки восприимчивости к GLOF. В данной работе обновленная инвентаризация высокогорных моренных озер в Иле, Кунгей и Терскей Алатау, хребтах Сарыжаз была разработана на основе данных спутникового снимка Sentinel-2 за 2020 год и с применением аэрофотосъемки. Кроме того, уязвимость моренных озер (≥0,045 км^2) определяется с помощью многокритериальной оценки. Моренные озера подразделяются на низкую, среднюю, высокую и очень высокую восприимчивость к ГЛОФ. Результат показывает существование 333 моренных озер (> 0,001 км^2) с общей площадью 3,5 ± 0,8 км2 на исследуемой территории в 2021 году. Кроме того, из 64 оцененных опасных моренных озер (≥0,045 км^2) 15 были идентифицированы с очень высокая восприимчивость к GLOF. Мы подчеркиваем, что выраженное взаимодействие ледника и озера, вероятно, повысит восприимчивость к ГЛОФ. Для этих весьма прорывоопасных моренных озер требуется регулярный мониторинг и более подробные полевые исследования. Это будет способствовать раннему предупреждению и снижению риска бедствий в сообществах, расположенных ниже по течению.

Ключевые слова: моренное озеро, критерии прорывоопасности, селевой риск, инвентаризация озер.

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REFERENCES

[1] Kapitsa V., Shahgedanova M., MacHguth H., Severskiy I., Medeu A. (2017) Assessment of evolution and risks of glacier lake outbursts in the Djungarskiy Alatau, Central Asia, using Landsat imagery and glacier bed topography modelling. Natural Hazards and Earth System Sciences, 17(10), pp. 1837–1856. (in Eng).

[2] Medeu A.R., Blagoveshchenskiy V.P., Gulyayeva T.S., Ranova S.U. (2019) Debris flow activity in Trans-Ili Alatau in 20th - early 21st centuries // Geogr. Nat. Resour. № 40. P. 292-298. *https://doi.org/10.1134/S1875372819030120* (in Eng).

[3] Cherednichenko A., Cherednichenko A., Vilesov E.N., Cherednichenko V.S. (2015) Climate change in the City of Almaty during the past 120 years. Quaternary International 358, p. 101-105. (in Eng).

[4] Salnikov V., Turulina G., Polyakova S., Petrova Y., Skakova A. (2015) Climate change in Kazakhstan during the past 70 years. Quaternary International 358, p. 77-82 (in Eng).

[5] Salerno F., Thakuri S., D'Agata C., Smiraglia C., Manfredi E.C., Viviano G., et al. (2012). Glacial lake distribution in the Mount Everest region: uncertainty of measurement and conditions of formation. Global and Planetary Change. 92–93, 30–39. *https://doi:10.1016/j.gloplacha.2012.04.001* (in Eng).

[6] Otto J.C. (2019). "Proglacial lakes in high mountain environments" in Geomorphology of proglacial systems. New York: Springer. (in Eng).

[7] Richardson S.D., Reynolds J.M. (2000). An overview of glacial hazards in the Himalayas. Quaternary International. 65–66, 31–47. *https://doi:10.1016/s1040-6182(99)00035-x* (in Eng).

[8] Mertes J.R., Thompson S.S., Booth A.D., Gulley J.D., and Benn D.I. (2017). A conceptual model of supra-glacial lake formation on debris-covered glaciers based on GPR facies analysis. Earth Surf. Process. Landforms. 42, 903–914. *https://doi:10.1002/esp.4068* (in Eng).

[9] Nie Y., Liu Q., and Liu S. (2013). Glacial lake expansion in the central Himalayas by Landsat images, 1990-2010. PloS One. 8, e83973. *https://doi:10.1371/journal.pone.0083973* (in Eng).

[10] Somos-Valenzuela M.A., McKinney D.C., Byers A.C., Rounce D.R., Portocarrero C. and Lamsal D. (2015). Assessing downstream flood impacts due to a potential GLOF from Imja Tsho in Nepal. Hydrol. Earth Syst. Sci. 19, 1401–1412. *https://doi:10.5194/hess-19-1401-2015* (in Eng).

[11] Harrison S., Kargel J.S., Huggel C., Reynolds J., Shugar D.H., Betts R.A., et al. (2018). Climate change and the global pattern of moraine-dammed glacial lake outburst floods. The Cryosphere. 12, 1195. *https://doi:10.5194/tc-12-1195-2018* (in Eng).

[12] Osti R. and Egashira S. (2009). Hydrodynamic characteristics of the Tam Pokhari glacial lake outburst flood in the Mt. Everest region, Nepal. Hydrol. Process. 23, 2943–2955. *https://doi:10.1002/hyp.7405* (in Eng).

[13] Liu J.J., Cheng Z.L. and Li Y. (2014). The 1988 glacial lake outburst flood in Guangxieco Lake, Tibet, China. Nat. Hazards Earth Syst. Sci. 14, 3065. *https://doi:10.5194/nhess-14-3065-2014* (in Eng).

[14] Baymoldaev T., Vinokhodov V.N. (2007) Kazselezashchita - operational measures before and after the disaster. - Almaty: Bastau. 284 p. (in Rus.).

[15] Medeu A.P., Blagovechshenskiy V.P., Kasatkin N.E., Kapitsa V.P., Kasenov M.K., Raymbekova Z.T. (2020) Glacial debris flows in Zailiysky Alatau over the past 120 years. Ice and Snow. 60(2): 213-224. *https://doi.org/10.31857/S2076673420020035* (in Rus.).

[16] Medeu A.R., Baymoldayev T.A., Kirenskaya T.L. (2016) Mudflow phenomena of South-East Kazakhstan: Anthology of mudflow phenomena and their research. Almaty: Nauka: 575 p. (in Rus.).

[17] Bolch T., Peters J., Yegorov A., Pradhan B., Buchroithner M., Blagoveshchensky V. (2011). Identification of potentially dangerous glacial lakes in the northern Tien Shan // Natural Hazards. № 59 (3). P. 1691–1714. (in Eng).

[18] Medeu A.R., Blagovechshenskiy V.P., Baimoldayev T.A., Kirenskaya T.L., Stepanov B.S. (2018) Debris flow in the Southeast Kazakhstan. Vol. 2. Part 2. The basics of monitoring in the Ile Alatau. Almaty: Institute of Geography. P. 288. (in Rus.).

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