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ЗАГРЯЗНЕНИЕ АТМОСФЕРЫ ИССЫК-КУЛЬСКОГО РЕГИОНА

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Аннотация

В статье представлены результаты исследований влияния изменения климата на горные экосистемы. Получены интересные данные о загрязнении воздуха Кыргызстана, деградации уровня ледников, спутниковые фотографии. Применение многоуровневой геоинформационной системы, ориентированной на оценку опасности селевых потоков и мониторинг селевых процессов, является современной технологией мониторинга от природных аварий. В рамках рассматриваемого участка территория южного побережья озера Иссык-Куль от Тонского на Западе, до Кызыл - Суу на востоке была использована дистанционное зондирование и ГИС-технологии для анализа ледников и формирования селевого риска. В индустриальную эпоху, средняя температура на планете поднялась на один градус Цельсия, и, согласно существующих моделей прогнозирования климата, к середине XXI века вырастет как минимум еще на один градус. Поэтому ограничение роста средней температуры на Земле до двух градусов является более достижимой и вероятной задачей.

Ключевые слова: климат, деградация ледников, температура, спутниковая информация, загрязнение воздуха.

ATMOSPHERE POLLUTION OF THE ISSYK KUL REGION

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Abstract

The article presents the results of research on the impact of climate change on mountain ecosystems. Obtained interesting data on air pollution in Kyrgyzstan, the level degradation of glaciers, satellite photos. Application of the multilevel geo-information system focused on an estimation of danger mudflow and monitoring the mudflow processes is modern technology for monitoring from natural accidents. Within the limits of a considered site territory of southern coastal of Lake Issyk-Kul from Ton in the West, up to Kyzyl - Suu in the east it has been used Remote Sensing and GIS technologies for the analysis of glaciers and forming mudflow risk. In the industrial era, the average temperature on the planet has risen by one degree Celsius, and, according to the existing models of climate prediction, by the middle of the XXI century will grow by at least another degree. Limiting the increase in the average temperature on Earth to two degrees, therefore, is a more achievable and likely task.

Keywords: climate, degradation of glaciers, temperature, satellite information, air pollution.

Change of the sizes of Tien-Shan glaciers always drew attention of researchers. In the majority of cases the data on glacier contraction or expansion one were resulted for separate, readily available, as a rule, volleys glaciers. Mass definitions of glaciers fluctuations has been executed rather recently and made for glaciers zone of east part of Terskei Ala-Too ridge which described various orogenic-climatic conditions of development and was exposed to a quantitative estimation linear and areal changes which occurred during last years. Glaciers of five river basins, both in relation to an axial line of Terskei Ala-Too ridge and in relation to its center uppers of which are located unequally which was surveyed. For the beginning of reference point of position of the glacier was fixed on a map scale 1:25000 on space photography which were executed at the end of the seventieth years that the technique of work is extremely simple. Once visiting a glacier the map was guided by districts and displacement of the glacier front with drawing its new position on the map was defined. Naturally, there are mistakes at such rough definition and also they are inevitable.

For some glaciers the size recession is equal to a probable mistake of measurement. In such cases the condition of a glacier (recession) was defined on glaciers-geomorphologic attributes - flat or abrupt of glaciers tongue, a condition of a hydro network, character of moraine accumulation at the end of ice and color of a moraine. We will address to the received results.

A valley of Chon-Kyzyl-Suucut through the Terskei Ala-Too slopes of ridge in its central part. It has the congelation area is43.3km^2. Glaciers are confined by the most part for the main ridge. Despite of rather big annual humidifying and prevalence of heights over 4200-4400 meters, glaciers recede. This process is marked for all without exception of glaciers.

A valley of Chon-Kyzyl-Suuis located to the west on above mentioned. Sources of the river are on the lateral spurs which depart from an axial part of a ridge in this connection high-altitude marks hardly reaching 4100-4300 m. The glaciers are occupied only 3,5 km^2. They have the small sizes and have been reducedactively.

The river Chichkan forms the drain on a slope of the spur departing from the main watershed. There is only one steadily reduced glacier here, but traces of the former congelation meet everywhere.

River basin of Akterek locates down on the advanced ridge with the maximal elevation that exceeds 4600-4700м. Significant heights and humidifying promoted development concerning large glaciers. The length of the basic glacier makes 3,9 km, and the general area of a congelation is equal 6,7 km^2. All glaciers have been receding.

A valley of river Tosorbegins from the back side of the western part of Terskei Ala-Too ridge. It widely ramified and reaches an axial part. Glaciers cover area of 20,1 km^2. Glaciers in the sizes are not distinguished, their length seldom reaches 2,0 km, but they locate on rather compactly and lie highly. The bottom border for the majority of them is in a high-altitude interval about 3600-3700 m, and top in a range is 4300-4500м. A congelation has been degrading, but because of high bedding rates of recession are insignificant, though, by the big excess of lateral moraines over a surface of clean ice, the balance of a glacier steadily negative that testifies also position of a snow line during the maximal rise which on many glaciers falls outside the limits of the top border of a glaciation. About that as far as the reduction tendency of a glaciation in conditions of occurring the warming climate it is possible to judge sizes of weight annual balance of Kara-Batkak glacier. It is included in a world network of glaciers on which constant long-term supervision are carried out. On this glacier, from 1972, i.e. from the period of appreciable display of anthropogenic influence on a climate (rise in air temperature) there was no case of positive annual balance. The end of a glacier recedes with average annual speed 7,8м. Because of constant excess of supply part of balance above entering, thinning surfaces of the Kara-Batkak glacier for the period of supervision were made with 14,6 m. Such loss of ice substance for a glacier in final total appears more destructive process, than recession the end.

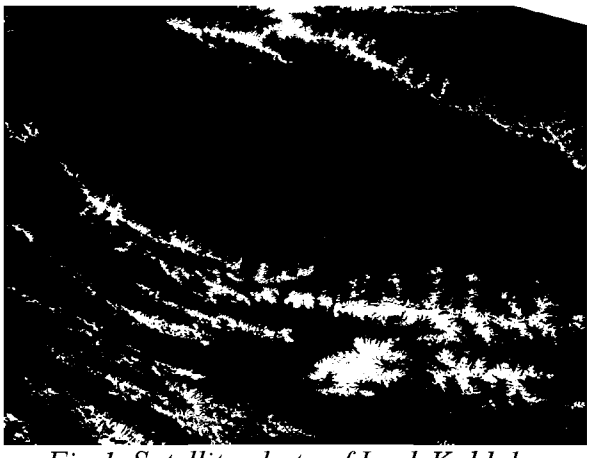

Fig.1. Satellite photo of Issyk Kul lake.

In connection with that the purpose of researches are a quantitative estimation of change areal and the linear sizes of glaciers, we did not try to define quantitatively influence of temperature on

glaciers fluctuations. This process is multifactorial and really to estimate intensity and duration of occurring changes of glacial Tien-Shan systems that becomes possible only after finding-out an air temperature influence [3]. The glaciation is one of the important elements of an underlying surface in a river basin Tone and in the greater measure impacting on quantitative characteristics of a drain. We had undertaken more detailed studying the glaciation. It was made as follows: definition of the area of a modern glaciation;

2 sources of the data for the various time periods have been used for work:

- A topographical map of scale 1:250000, executed on the basis of the air photography data in 1963;
- Space picture NASA for June, 2001.

The layer to a map was digitized with use ArcGIS-8.3 software, and a gridding of space pictures was carried out by means of ENVI 3.5 software [2].

The special attention was given to an accuracy of delimitation of a glaciation since in a space picture there was a small percent of overcast that could lead to a mistake in definition of the real sizes of researched objects. Digitized layers of 23 glaciers have indistinct borders, because of presence of insignificant overcast in NASA space picture. In figure 2 the layer of 23 researched glaciers is submitted.

Fig. 2. A layer of the glaciation of the Tone river basin over lay on NASA space picture(2001)/3-5/.

Scientists have been marking the universal reduction of glaciers in the world since 70th years and their sharp reduction since 80th years is an especial. The example of such research has been carried out by Kyrgyz-Switzerland project in river basin Sokuluk on northern slope of a ridge Kyrgyz Ala-Too. In figure 4 the diagram of change of the glaciation area observable since 1963 is submitted. Similar process occurred and on glaciers of ridge Terskei Ala-Too. Speed of glaciers reduction has increased practically twice, from 0,6 % for the period from 1963 to 1986 up to 1,3 % for the period from1986 to 2000.

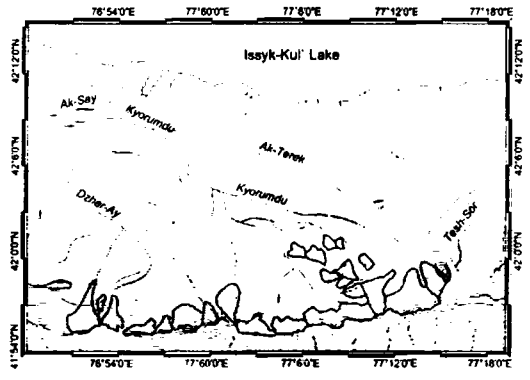

Fig.3. Area of a congelation of glaciers (a basis - topographical map 1963).

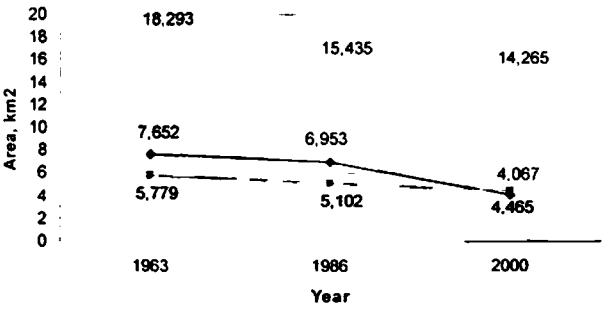

Fig. 4. The diagram of the glaciers area and their changes for the period of 1963-2000/3/.

In figure 3 the area of a glaciers congelation of northern slope of Terskai-Ala-Too ridge, a river basin Tone is submitted /4/.

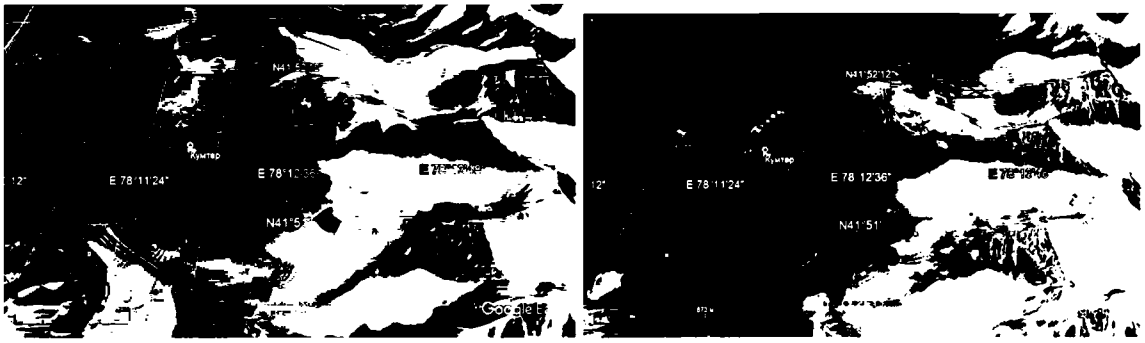

Fig.5. Davydov glacier (4 October 2002 and 9 August 2016)/3/.

The area of a glaciation for last 38 years has decreased more than for 28 %. From 1963 to 1986 the glaciers area has decreased for 13,3 %, and from 1986 to 2000 - for 17,1 %. During the period from 1963 to 2000 eight glaciers have completely disappeared. They belonged to I class (<0,5 км^2). In spite of the fact that I class occupies only the fourth part of all area of a glaciation;40 % on it is the missed area of glaciers. While for the period from 1963 to 1986 has disappeared 9,1 % of I class glaciers, for the period from 1986 to 2000 - 41,5 % of glaciers. That testifies that glaciers on the area less than 0,5 km melted more intensively, than glaciers of other classes [3].Fluctuations in air temperature, carbon dioxide concentration in the atmosphere and thus climate change is happening in the world regularly with a period of ~ 100,000 years (Fig. 1) [1].

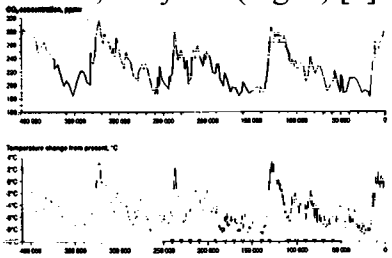

Fig.6. Changes in air temperature, carbon dioxide concentration in the atmosphere in the world over the past 400,000 years. [1].

Currently, the natural climate change affects the human factor, which is due to intensive deforestation, increase in the area of agricultural land, emissions of greenhouse gases, industrial, municipal and agricultural wastes, ozone depletion, etc. [2].

Climate change due to air pollution, the accumulation of greenhouse gases in it, and aerosol particles. An increase in the concentration of carbon dioxide in the atmosphere (~ 0.5% per year), even remote from industrial pollution sources mountainous area of Lake Issyk-Kul (Fig.6) [2].

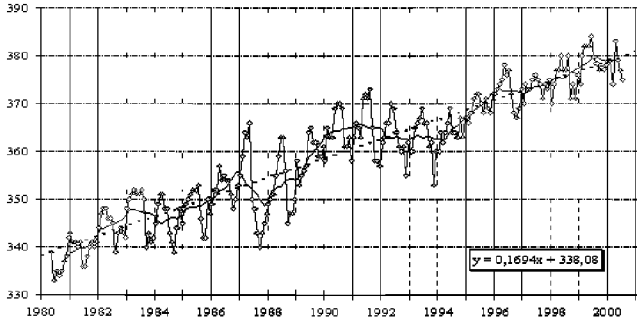

Fig.7. Average monthly changes in the concentration of carbon dioxide in the atmosphere over the Issyk-Kul lake/1/.

Integrated studies in the troposphere and stratosphere Central Asia, held at the Lidar station Teploklyuchenka (Kyrgyz Climate Observatory in Central Asia, CSR-CA 42.50N, 78.40E), established a noticeable influence of atmospheric aerosols on temperature change and regional climate [1-2]. Emissions of aerosols in the atmosphere are the result of natural disasters and

anthropogenic activity. Natural disasters are associated with volcanic eruptions, earthquakes, forest fires, dust storms. For example, during the eruption of Mount Pinatubo (Philippines) in 1991 (Fig. 4) was thrown into the atmosphere about 20 million tons of sulphur dioxide, ash and other substances [ ]. This affected the radioactive processes in the stratosphere and led to the formation of particulate sulphate aerosol, the concentration of which had an impact on ozone depletion (~ 4%) and the restructuring of the circulation regime of the atmosphere.

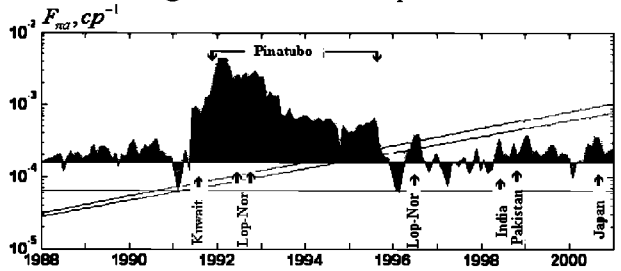

Fig.8. Changes in the concentration of stratospheric aerosol 15-30 km height above sea level (data CSR-CA)/1/.

The measurements revealed the presence of tropospheric aerosol particles consisting of sulphate, nitrate, ammonium, organic compounds, elements of the Earth's crust and water, which are part of the Atmospheric Brown Cloud (ACH) [1]. Brown clouds part of the absorption and scattering of solar radiation particles of soot (black carbon). Air flows from Africa, Asia and Europe ACH transfer to Central Asia (Fig. 5). Atmospheric pollution complement salt particles, dust and sand raised by the wind from the dried bottom of the Aral Sea and the Kara Kum desert and the Kyzyl Kum.

When offsets AKO with the Aral Sea basin most of the mass of aerosol particles fall to the glaciers of Central Tien-Shan (0,12 □ 0,16 g/m2 per day). This causes a change in reflectivity (albedo) of snow and ice, increasing the amount of absorbed solar energy and increased melting processes. During the period 1960-2010, on the Pamir-Alai glaciers disappeared more than 1000 on Ile Alatau - about 100. Decrease in the area of glaciers and snow cover mountain areas leads to a deficiency of water in the lowland areas, expansion of deserts, fertile arable land and reduce pasture.

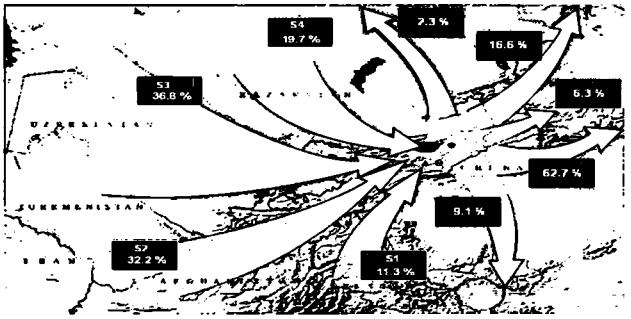

Fig.9. Frequency analysis of the trajectories of aerosols from pollution sources in Central Asia (height 3500 m) [4]

Weather changes are significant implications in the presence of nano-sized particles AKO, which are often formed in the locations petrochemical plants, vehicles and other sources [1,2]. Formation of sulphate and nitrate aerosols from the gas phase and their subsequent reaction with water contribute to the formation of acid rain, which in turn is one of the causes of death of life in ponds, forests, and reduce crop yields.

AKO fall under the category of air pollutants of the atmosphere and climate affect the radiation balance of solar radiation, temperature changes the atmosphere and the Earth's surface. There is a significant amount of aerosols, that scatter sunlight and reflect it in space - analogue reverse the greenhouse effect. Reduction of solar energy reaching the Earth's surface and heating of the atmosphere, causing regional climate changes. ACH absorbs about 25% of solar energy heats the surrounding air layers and the atmospheric pressure increases. This decreases the ability of clouds

to form precipitation in the form of rain, conditions are created for shielding the earth from solar radiation.

We will assess the impact of layers AKO carried in Central Asia and their contribution to the radiation balance, based on the analysis of experimental data (Fig. 6). The lower layer AKO (thickness from 0.8 to 4.0 km) resulted from the removal of dust with a touch of soot particles from the Aral Sea basin, absorbs solar radiation (+5.6 W/m2) and heats the ground boundary layer of the atmosphere. Upper aerosol layer (at a height of 7.3 to 8.4 km) associated with the trans boundary transport of sulphate and soot particles from Europe and the European part of Russia. Large absorption capacity of this layer (+19.8 W/m2) substantially exceeds the heating effect of the boundary layer of the Earth. The total inflow of heat in these layers ACH is 5.6 +19.8 = 24.4 W/m2, while excluding the impact of AKO solar radiation flux at the Earth's surface is 33 W/m2. This shows that the presence of ACH leads to shielding the Earth's surface from the effects of solar radiation. The upper spray layer (thickness 1.1 km) rate of heating of the atmosphere is 7.6 K / day , and the lower boundary layer (thickness 3.2 km) heating correspondence ~ 0.7 K / day. This is comparable with the effect of solar radiation shielding layer of dust from the Sahara desert . Since the underlying surface is cooled in the absence of rainfall occurs a gradual desiccation and for a long time , the region has a dry period , such as the summer 2012 [2].According to UNEP, in recent decades there is a regular increase in surface air temperature of about 0,6 ° C, and in mountainous areas - by 1,6 ° C . The greenhouse effect is the main cause of global climate change and atmospheric aerosol - a major factor impacts on regional climate: atmospheric pollution and glaciers, decrease in rainfall, changes in air temperature and the Earth's surface.

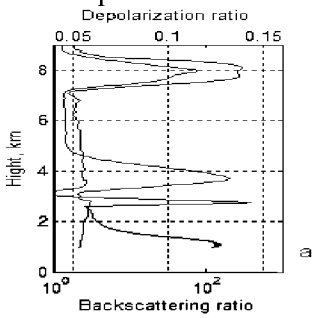

Fig.10. The Vertical profiles of aerosol and depolarization ratio/1/.

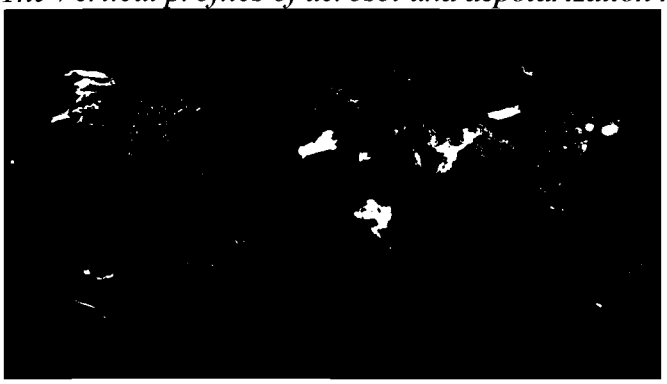

Fig.11. https://hi-tech.mail.ru/news/nasa-pokazalo-neobychnuyu-kartu-zemli/

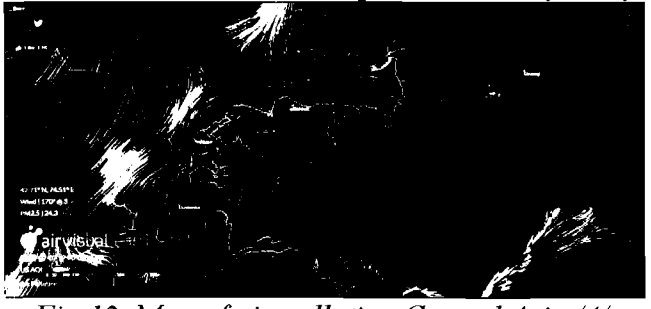

Fig.12. Map of air pollution Central Asia /4/.

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