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INFLUENCE OF GLOBAL CLIMATE CHANGES ON HYDROMETEOROLOGICAL CONDITIONS OF AZERBAIJAN

Nowadays the existence of global climate changes was proved both scientifically and by real facts. Scientists worldwide have started to speak about climate change in 60-70 years and in 90-95 for Azerbaijan.

From paleoclimatology we know that climate of the Earth has always changed. That why some of climatologists prefer to speak about “climate fluctuations” instead of “climate changes”.

If the earth’s average temperature has risen by 0.6°-1.0° Celsius, in high altitude regions even higher increase of temperature were observed. So in Arctic, Greenland and Antarctic Peninsula’s glaciers regions temperature increased an average of 2.5°-3.0° Celsius. These glaciers giant plays important role in world climate system formation. In general, during last 50 years decrease of glacier coverage in Northern hemisphere’s seas makes about 10-15%, duration of glacier coverage of rivers and lakes – 15 days, decrease of thickness of glacier cover of Arctic Ocean – about 40%. Nowadays both melting process of mountain glaciers in mainland and raise of snow level at high altitudes continue. One of the basic facts in proving of existence of climate changes is that during whole observation period, XX century was declared as the most warm century, the last 10 years of the XX century were declared as the most warm decade, 1995, 1998, 2000, 2003, 2006 years – the most warm years in history.

All above mentioned facts prove existence of climate change.

Rising in dynamics of natural disasters results from anomalous climate changes.

According to the information provided by World Meteorological Organization (WMO) 80-85% of natural disasters all over the world were caused by dangerous hydro meteorological processes. Such natural disasters impact on world economics, economics of the different countries and on populations. Today society faced problems related to climate changes and these problems occupy special place even in high level discussions and during international scientific events.

Causes of climate change

To understand climate change fully, the causes of climate change must be first identified. Scientists divide the causes into two categories: natural and human causes.

The Earth’s climate is influenced and changed through natural causes like physical processes in cosmic space and on the sun surface, volcanic eruptions, ocean current, the earth’s orbital changes and solar variations.

Among the human factors influencing on climate change the main is population growth (if in 1850 word population was about 1 billion persons, in present this number 6 time increased) which leads, according to the increased demands of population, to scientific and technological development, which in turn is related to the increase of greenhouse gas concentration in atmosphere.

Paleoclimatologists who affirm that natural causes plays main role in climate change have proved that even before human beings warming and glacial periods existed and annual average temperature was more or less than contemporary one. One of such research based on the analysis of little air bubbles of Antarctic mainland formed approximately 800-900 thousands years ago in ice layers at the depth of 3-4 km. These researches prove that in those days concentration of GHG and corresponding temperature were higher than nowadays. But unlike to these historical periods today the human and natural causes coincide which make concern scientists worldwide.

World Ocean considered as a “climate forming kitchen” is the main indicator of climate changes. Nowadays at the bottom of World Ocean it could be often observed increase of temperature that cause changes of directions of the warm and cool streams forming mainland’s climate. According to the researchers’ opinion this factors are the main reason of recent change of direction of Gulf Stream which tempers climate in Europe. So it forecasts mainly cool, snowy and rainy weather within the next 20-25 at the territory of Europe. Nowadays one could observe some occurrences of this tendency there.

The average annual air temperature in Azerbaijan in comparison with 1961-1990, proposed to world countries for the calculation of multiyear norms of meteorological parameters by World Meteorological Organization consists of +0.8°C.

At the tables 1 and 2 there has been presented the change of the temperature and the precipitation in comparison with the multiyear norm of last years.

Table 1 The increase of temperatures by different altitudes in comparison with the increase of multiyear norm (1961-1990) in 2007, 2008, 2009 in the territory of Azerbaijan

Years	Altitudes					
	≤ 0	1-200	201 – 500	501 - 1000	>1000	Over the republic
Difference, °C	14.6	14.3	13.3	11.9	7.8	12.3
Average annual, 2007	15.3	14.9	13.7	12.4	8.5	12.9
Difference, °C	+0.7	+0.6	+0.4	+0.5	+0.7	+0.6
Average annual, 2008	15.4	15.1	14.2	12.5	8.9	13.0
Difference, °C	0.8	+0.8	+0.9	+0.6	+1.1	+0.7
Average annual, 2009	15.2	14.9	14.1	12.3	8.8	12.9
Difference, °C	+0.6	+0.6	+0.8	+0.4	+1.0	+0.7
Average annual, 2010	15.7	15.5	14.4	13.1	9.7	13.6
Difference, °C	+1.1	+1.2	+1.1	+1.2	+1.9	+1.3

Table 2 The change of temperatures in comparison with multiyear norm (1961-1990) over the different regions of republic in 2007, 2008, 2009, 2010

Years	Absheron-Gobustan	Lenkoran-Astara	Major Caucasus	Minor Caucasus	Kur-Araz	Nakhchivan AR	Over the republic
The norm, 1961-1990	14.5	12.9	10.7	9.2	14.3	12.4	12.3
Average annual, 2007	15.4	14.0	12.2	9.7	15.1	12.4	13.1
The difference from norm	+0.9	+1.1	+1.5	+0.5	+0.8	0	0.8
2008	15.0	13.4	11.1	10.0	15.4	13.3	13.0
The difference from norm	+0.5	+0.5	+0.4	+0.8	+0.7	+0.9	+0.7
2009	14.6	13.4	10.8	10.0	15.1	13.0	12.8
The difference from norm	+0.1	+0.5	+0.1	+0.8	+0.8	+0.6	+0.48
2010	15.4	13.9	12.3	11.1	16.1	14.0	13.8
The difference from norm	+0.9	+1.0	+1.6	+1.9	+1.8	+1.4	+1.5

As we see at the table 1 the increase of the temperature of Azerbaijan differs both in the interval of different altitudes, the different regions. So, the most increase of the temperature happens at the heights more than >1000m.

In 2010 the increase of the temperature in comparison with 1961-1990 has been higher (1,1-1,2°C), on the heights more than >1000m it has been +1.9°C yet. It shows that 2010 has been noted in the history as the warmest year of north hemisphere. At the figures 1 and 2 there has been presented the comparative analysis of the distribution of the temperature and precipitations by the months in the Azerbaijan in 2010 in comparison with multiyear norms.

As we see by the figure 1 the distribution of temperatures by months shows that the temperature has been more than the norm ever the all of months, except of April and September. But the precipitation has been few than the norm in January, June, August, November and December and more in other months.

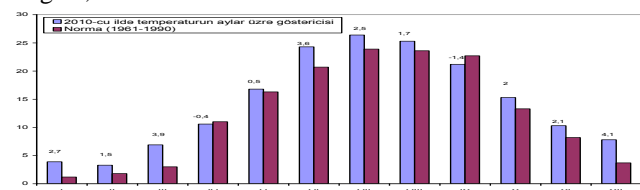


Figure 1. The distribution of temperatures by months in 2010 (in comparison with multiyear norm)

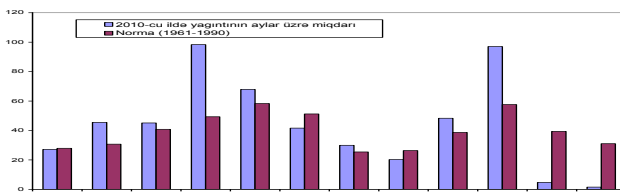


Figure 2. The distribution of precipitations by months (in comparison with multiyear norm) in 2010.

The change of temperature over 1991-2009 by the temperature's norm (12.3°C) of 1961-1990 over the republic has been presented at the following graphic (fig.3).

The influence of climate changes to the river's flow shows that over the winter low- water period the river flow increases merely and there happens the regime change in flow. According to different climate scenarios the application models show that it is possible to observe the 15-18% decrease in the annual flow of Azerbaijan's rivers.

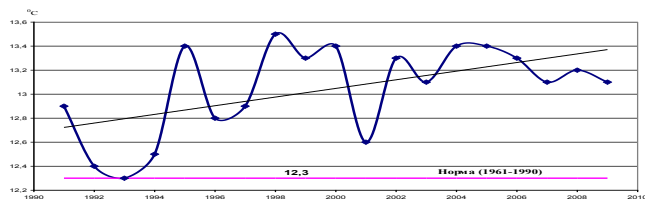


Figure 3. The change of the temperature over 1991-2010

Climate Changes and Caspian Sea

Caspian Sea is grand blind water drainage of the world. One of main characteristics that differs it from other impoundments is the systematic change, fluctuation of its level ever the some period. The drainage basin of Caspian Sea is 10 times bigger than its water table area. Therefore at the same time it is a indicator of climate-weather changes, which happens on the grand drainage basin.

In the Caspian Sea the water table area consists of 397 thous.km², the meridional length-1200km, the width-200450km, the average depth-207m, maximal depth - 1025 m. The length of shore-line in the countries around this territory is 2320 km in Ka-

zakhstan, 1200km–Turkmenistan, 900 km–Iran, 850 km – Azerbaijan, 70 0km–Russia. On the coastal zone of Caspian Sea in Azerbaijan there situated 13 administrative regions, for the official information 4 million but really approximately 5 million people have been populated here. The common area of this territory consists of 15 thousand. On the coastal zone of Caspian Sea there situated 4 economical–geographical areas (from north to south): Quba–Khachmaz, Absheron, Central–Aran and Lenkoran–Astara.

It is possible to note that only in 1978–1995, when the level of Caspian Sea has been increased to 2.5m, 50 settlements, 250 industrial enterprises, road with 60 km length, railway with 10km length 40 thousand ha winter pasture areas have been remained under the water.

One of greatest problems of Caspian Sea is the observation of sharp fluctuations. On remaining under the water the coastal territories expose –great economical, social and ecological problems. In 1837-1830 the average year level of Caspian Sea has been higher (-25.8). in 1930-1940 the level sharply decreased to -2 m. This decreasing lasted till 1977 and in Caspian Sea there observed the most minimal level over last 400 years (-29m). The level has been increased on 2.5 m over the short period from 1977 since 1995 and has reached – 26.5 m. Nowadays the level of Caspian Sea with slow fluctuations is around -27 m. Such level fluctuation of Caspian Sea, first of all, is connected with the change of the climate-weather condition on its aquatic environment and the blind water drainage. Because, along this time the precipitation, the vapor and the run-off of rivers, flowing into the of Caspian Sea, which are consisting of main water balance elements of Caspian Sea, flowing into Caspian Sea, on increasing on 50-60 km³ have been consisted of 300-500km³. First of all, it is connected with the increasing of the precipitation in result of climate changes on the blind water drainage basin.

It is possible to note that observations, held on the level of Caspian Sea by the countries around Caspian Sea, show that on October 2010 the last 50 years. Researchers explain it with the highest temperature on the North hemisphere and the decreasing of runoff in Volga River.

In 2010 the level of Caspian Sea has been decreased in 9sm in comparison with 2009 and consisted of 27.5m.

For the predictions of Hydrometeorological Scientific-Research Center of Russia Federation about the level of Caspian Sea in 2011 it will be decreased in 20-23sm in comparison with 2010. The level prediction for 2016 shows that the sea level will be decreased in 10-12sm in comparison with 2010.

The populating of great part of Azerbaijan Republic's population along the coastal zone of Caspian Sea and mutual relations between Azerbaijan economy ana Caspian Sea make more important to detail research its level fluctuations. The level fluctuation of Caspian Sea at the same time influences to the ecosystem of around territory, sea bioresources.

The increase of sea level has been influenced not only to the economy, but also to demographic and social processes. The worth condition has been observed on the coastal territories of Absheron peninsula. Here in result of the submergence of settlements, industrial enterprise and oil fields the sea has been polluted repeatedly. It has lead to the decrease of bioresources and the disappearance of different biosenzes. In the future the expecting level of sea level can strengthen these problems. The increase of sea level can sharply decrease places for fishes to caviar on the river sources and sea-coastal territories. The warming of the sea water in result of climate changes can lead to earlier beginning of caviar season of fishes.

But according to adaptation possibilities of fishes we can suppose that it will be no very dangerous.

Nowadays on the Caspian Sea by the aim to study the hydrometeorological condition of sea and complex monitoring measures there acts "The coordination Counsel for Caspian Sea's Hydrometeorology and it's Pollution's Monitoring" of Caspian Sea. By this Coordination Counsel there has been prepared CASPAS program embracing noted problems of Caspian Sea and its solution directions.

ლიტერატურა-ЛИТЕРАТУРА-REFERENCES

1. On the territory of Azerbaijan the average annual temperature has been increased in +0.8⁰C in comparison with multiyear norm.
2. Over the all of instrumental observation period the most maximal temperature has been +46⁰C (01-02 august, 2000).
3. Except of the spring in the all of seasons of the year there observes the increase of the temperature. The most increase of the temperature is observed in winter.
4. The increase of the temperature by heights is different on the territory. So, on the heights >1000m the increase of the temperature is often observed (+1.1⁰C).
5. In 2010 the increase of the temperature in comparison with multiyear norm has been highest (+1.3⁰C). On the heights >1000m it consisted +1.9⁰C.
6. Last times the dynamics of local processes and the number of natural disasters regarding on hydrometeorological processes last to increase. Including intensively, repetition of floods, hair, squall, submergence the events is increasing.

In the republic in spring months of 2010 the sustainable submergence event, happening on the low flow of Kura River, has caused 500 million dollars damage.

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კლიმატის გლობალური ცვლილების გავლენა აზერბაიჯანის ჰიდრომეტეოროლოგიურ პირობებზე /მაჰმუდოვი რ./საქართველოს ტექნიკური უნივერსიტეტის ჰიდრომეტეოროლოგიის ინსტიტუტის შრომათა კრებული -2011.-ტ.117.-გვ. 30-33.- ინგლ.; რეზ. ქართ., ინგლ., რუს.

სტატიაში ნაჩვენებია კლიმატის ცვლილების ფაქტები დედამიწაზე და გამოკვლეულია კლიმატის ცვლილების შემქმნელი მიზეზები. გაანალიზებულია კლიმატის ცვლილების რეალური შედეგები აზერბაიჯანისათვის და დად-

გენილია საშუალო წლიური ტემპერატურის ზრდა 0.8°C მრავალწლიურ ნორმასთან შედარებით. ინსტრუმენტული დაკვირვების პერიოდში მაქსიმალური ტემპერატურა აღინიშნებოდა ჯულფაში და ორდუბადში $+46^{\circ}\text{C}$ (01-02 აგვისტო 2000წ.).

გაანალიზებულია ტემპერატურის მომატება სეზონების მიხედვით მრავალწლიურ ნორმასთან შედარებით (1961-1999 წწ.).

სტატიაში განხილულია ტემპერატურის ცვლილება მაღლობებზე და ნაჩვენებია ტემპერატურის ზრდა განსაკუთრებით 1000მ ზევით მაღლობებზე. აქ ტემპერატურის ზრდამ შეადგინა $+1.4^{\circ}\text{C}$. გაანალიზებულია კასპიის ზღვის დონის რყევადობა 1837-2010 წწ. პერიოდში. 2010 წელს კასპიის ზღვის დონემ დაიწია 9 სმ 2009 წელთან შედარებით და შეადგინა -27.5 მ. კლიმატური სცენარების მიხედვით 2016 წლისათვის ზღვის დონე დაიწევს 10-12 სმ 2010 წელთან შედარებით.

2010 წელს იმატა ჰიდრომეტეოროლოგიურ პროცესებთან დაკავშირებული ლოკალური პროცესების და ბუნებრივი კატასტროფების დინამიკამ. მდ.მტკვრის ქვედა ნაწილში მუდმივმა დატბორვებმა მიაყენეს რესპუბლიკას 500 მლნ დოლარის ზარალი.

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In the presented article were shown the global climate changes with facts in the Earth and investigate the causes creating the climate changes.

Also in Azerbaijan were analyzed the real results of climate changes and determined the $+0.8^{\circ}\text{C}$ of increasing mean annual temperature in comparison with perennial norm. In the period of instrumental observation the maximum temperature was observed in Julfa and Ordubad $+46^{\circ}\text{C}$ (On 1-2 August 2000).

There were analyzed the increase of temperature on the seasons and in comparison with multi-annual norm (1961-1999) except of spring in other seasons especially in winter was observed the temperature increase.

In the article were considered the climate change on the heights and shown the temperature increase especially on the heights above $>1000\text{m}$. So, on the heights above $>1000\text{m}$ the temperature was even $+1.4^{\circ}\text{C}$.

There was analyzed the hesitation of Caspian Sea level from 1837 to 2010 and from time to time was shown the sharp hesitation that is explained by climate and atmosphere changes. In 2010 in comparison with 2009 the level of Caspian Sea decreased on 9sm and composed -27.5 m.

According to climate scenarios, the forecast of level till 2016 shows that in comparison with 2010 the sea level will recession to 10-12 sm.

There were observed the increase of dynamics of local processes and natural disasters (mudflow, flood, hail, strong typhoon, the intensive flooding, and repeat) connected with hydrometeorological processes and in the spring of 2010 the permanent flooding happening in the low part of Kura damaged to economics of republic for 500 million dollars.

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ВЛИЯНИЕ ГЛОБАЛЬНЫХ КЛИМАТИЧЕСКИХ ИЗМЕНЕНИЙ НА ГИДРОМЕТЕОРОЛОГИЧЕСКИЕ УСЛОВИЯ АЗЕРБАЙДЖАНА /Махмудов Р.Н./ Сб. Трудов Института Гидрометеорологии Грузинского Технического Университета Грузии. –2011. – т.117. – с. 30-33. – Англ.; Рез. Груз., Англ., Рус.

В статье представлены факты глобальных климатических изменений на Земле и исследованы причины, создающие климатические изменения.

Для Азербайджана были проанализированы реальные результаты климатических изменений и определено на $+0.8^{\circ}\text{C}$ увеличение средней годовой температуры по сравнению с многолетней нормой. В период инструментального наблюдения максимальная температура была отмечена в Джульфе и Ордубаде $+46^{\circ}\text{C}$ (01-02 августа 2000г.).

Было проанализировано увеличение температуры по сезонам по сравнению с многолетней нормой (1961-1999гг.). За исключением весеннего сезона в другие времена года, наблюдалось возрастание температуры, особенно в зимний период.

В статье рассмотрено изменение температуры на возвышенностях и показано возрастание температуры в основном на возвышенностях свыше > 1000 м., которое составило, $+1.4^{\circ}\text{C}$. Было проанализировано колебание уровня Каспийского моря в 1837-2010гг. и выявлено периодическое резкое колебание, что было объяснено климатическими и погодными изменениями. В 2010 году уровень Каспийского моря по сравнению с 2009 годом снизился на 9 см и составил -27.5 м.

Согласно климатическим сценариям прогноз уровня до 2016-года показывает, что по сравнению с 2010 годом уровень моря снизится на 10-12 см.

Увеличилась динамика локальных процессов и природных катастроф (сели, паводки, град, сильный тайфун, интенсивность наводнения), связанных с гидрометеорологическими процессами и в 2010 году. Во время весенних месяцев постоянные затопления, происходившие в нижней части Куры нанесла ущерб экономике республики на 500 млн. долларов.

