



ESTIMATION OF DYNAMICS CHANGE OF AVERAGE AND EXTREME ANNUAL VALUES OF ATMOSPHERIC AIR TEMPERATURE OF GROUND LAYER OF GYUMRI

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In this work clarified, analyzed and estimated of dynamics change average and extreme values atmospheric air temperatures, is worked out and suggested the ways of management and regulation of dynamics change of air temperature of city, using the values of actual observations of air temperature of Gyumri meteorological station.

Key words: city, atmospheric air temperature of surface layer, the average and extreme values air temperature, of dynamics change, management and regulation.

Air temperature is characteristics of situation on of links of climatic system (atmosphere). It is being determined by features of solar energy distribution on the earth surface, by the processes of interactions between links of climatic system. It is very important the role of air temperature in runoff formation, evaporation, ice events generation and disappearance, thermal and moisture circulation, in frosts, droughts and desertification processes also. The role of thermal regime is also very important in water requirement of agricultural crops and yield formation.

So, clarifying and estimation of regularities of temporal distribution of air temperature has importance, especially for more accurate definition of thermal balance, for productive using of thermal resources.

So, the goal of this work was to clarify, analyze and estimate regularities of change dynamics of air temperature in Gyumri city.

For solving this task are collected, clarified and analyzed results of actual observations of air temperature of Gyumri meteorological station, which are being kept in Armstatehydromet. During the studying process are analyzed and clarified appropriate literary sources, are used mathematical-statistical, extrapolation, geographical, analyze and correlation methods.

For solving of suggested problems as a theoretical base have been used appropriate researches [2-5, 7-9], and as a raw material - actual data of long-term observations of air temperatures the meteorological station of Gyumri, which are being kept in the fond of Armstatehydromet of Ministry of Territorial management and Emergency situations. As a methodological base in the work have been applied methods: mathematic-statistical, geographical, extrapolation, analysis, correlation, complex.

The meteorological station of Gyumri (the height is 1523 m) locates in Gyumri city, which is the centre of Shirak marz of the Republic of Armenia. By the population (119,9 thousand inhabitants, 01.01.2014) and by his significance Gyumri is second city of the Republic of Armenia, after the capital Yerevan. The western part of city is high and has two hills. Relief is flat, a little bit disjointed, covered by 300-350 m of lake-river and volcanic sediments. The city situated in 8-9 points earthquake prone zone. By the territory Gyumri city are flow the Gyumri, Jajur, Cherkez rivers.

Gyumri city locates in the northern part of Shirak plain (fig. 1), in the left bank of Akhurian river, which begins from Arpi lake, is far from Yerevan 118 km, height above sea level is about 1550m. The plain of Shirak is surrounded with the mountain Pambak from north-east, east and south-east. The meteorological square of Gyumri is far from the mountain 52-100 m and mountain height is higher 200-500 m than the meteorological square. About 40 km from the meteorological square to south-east locates mount Aragats, which has 4090 m height. The surrounding all mountains are covered with herbaceous vegetation.

The meteorological station of Gyumri founded in 1843, where meteorological continuous observations made since 1893. But in 1961 have been changed the place of meteorological square, and in the result of it is broken the homogeneity of observations. So, in the work are discussed and analyzed actual data of observation for 1961-2014.



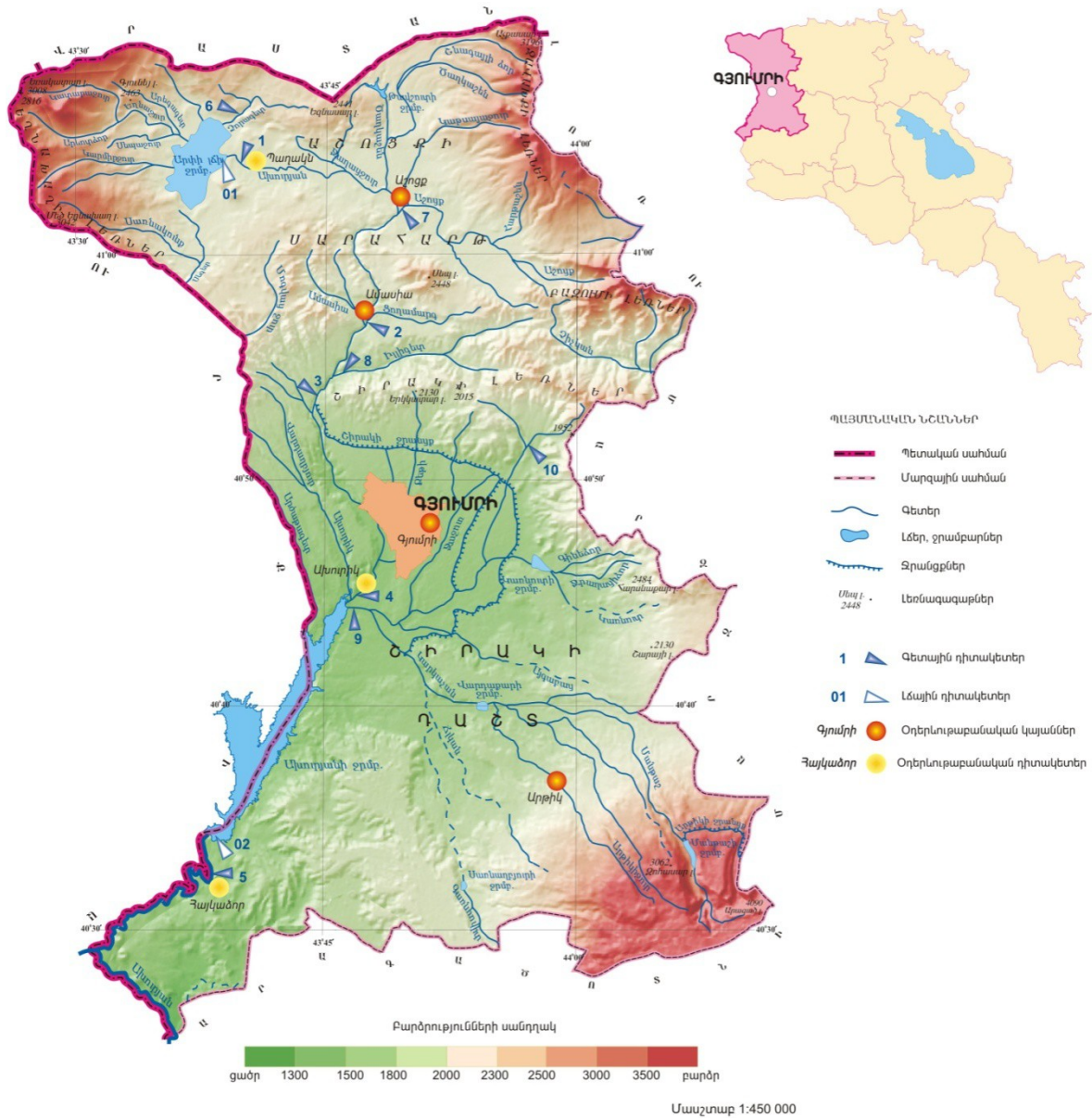


Fig. 1 Physical map of Shirak Marz

In the work are collected and worked out the results of actual observations of air temperature of Gyumri meteorological station, which are in table. 1.

Table 1 Monthly and annual average and extreme values of air temperature the meteorological Station of Gyumri ☀️

Months												Year
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Average												
-8,68	-7,17	-0,33	6,95	11,6	15,8	19,7	19,7	15,4	8,86	1,79	-5,01	6,56
Average maximum												
-1,92	0,30	4,57	10,4	13,7	19,8	23,6	22,8	18,7	11,3	5,34	1,20	9,39
Average minimum												
-15,7	-14,5	-6,20	3,40	9,14	13,1	16,9	16,8	12,7	4,04	-3,31	-11,7	4,66
Absolute maximum												
9,20	12,6	21,2	26,8	29,3	33,1	38,0	37,0	35,1	27,4	19,6	17,6	38,0
Absolute minimum												
-36,0	-35,0	-27,7	-16,0	-7,60	-3,60	0,30	1,90	-3,70	-12,5	-23,0	-30,0	-36,0

The climate of Gyumri is continental, compared with warm summers and cold winters [1, 6]. Average annual amplitude of vibration of air temperature is 23,2-35,8 °C, absolute amplitude - 50,8-68,9 °C. In winter sometimes

are strong frosts, minimum air temperature can decrease up to -36,0 °C. The winter is with a lot of snow and cold and occurs from December to March inclusively. The spring is short and cool. It occurs just one and half month. The summer is compared warm and on occurs from the beginning of June to the end of September. Autumn is warm too. Gyumri is one of the first in Armenia with the number of sunny days. Annual number of precipitation is 500 mm.

In the studying territory the warmest months are July and August with monthly average temperature 19,7 °C, the coldest month is January - with monthly average temperature 8,68 °C (table 1). According to annual average values of air temperature in Gyumri the coldest year was 1973, and the warmest year - 2010. During the all period of observations the absolute minimum value of air temperature observed 21 of January in 1972 and was 36,0 °C, and the absolute maximum value observed in 1986 9 of July and was 38,0 °C. 2010 was the warmest year in Armenia during all period of observations.

In the work have got the multifunctional correlation links ($R=0,68$) between annual average (\bar{T}) and absolute maximum (T_{max}) and absolute minimum (T_{min}) values of air temperature of Gyumri. This link can be shown with the following equation: $\bar{T}=0,17T_{max}+0,15T_{min}+4,71$. It gives possibility to calculate average annual air temperature in advance, if we have absolute minimum and maximum values.

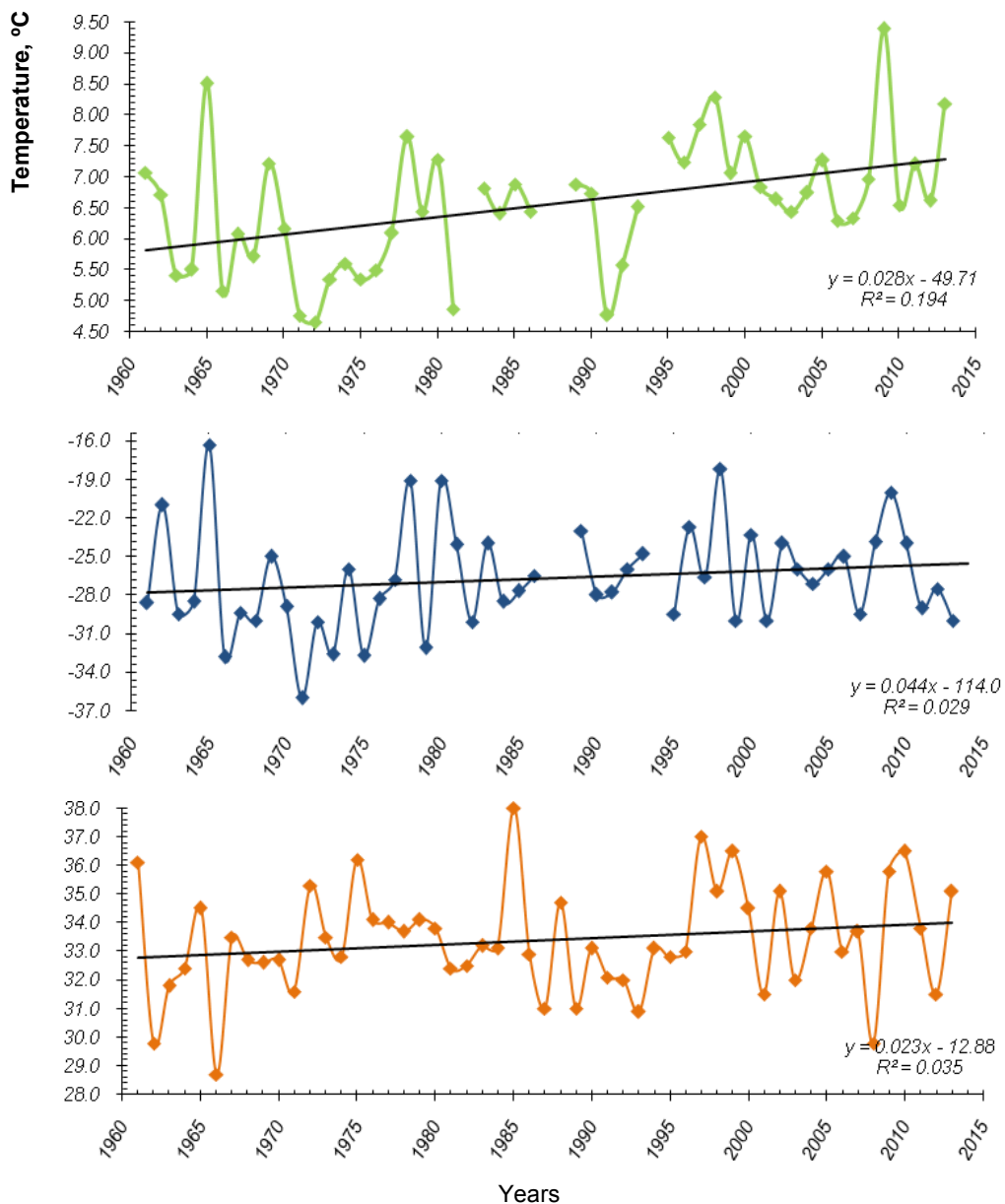


Fig. 1. Dynamics change of average annual and extreme values of air temperature of Gyumri

After researches became clear, that observes a tendency of increase of average annual and extreme values of air temperature of Gyumri city (fig. 1). Such regularity characterize to other regions republic also [3-5, 7-8]. In the work have been studied the dynamics change of air temperature Gyumri city by months, which has the following

view. Dynamics change of annual average and absolute maximum monthly values of air temperature characterized by increased tendency, exception are only the values of December. And absolute minimum monthly values of air temperature during all months have an increasing tendency, except April. So, in Gyumri during warm period is being waited increasing of dryness of climate, during cold period - softening and in December-increasing of cold weather.

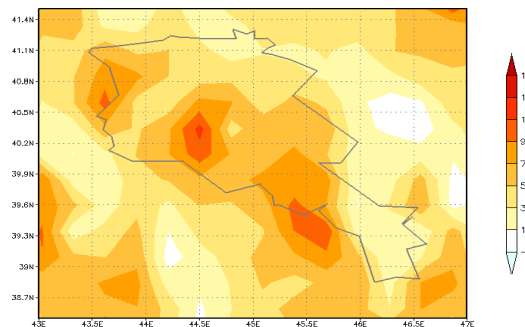
In the work tried define also the monthly average values of air temperature Gyumri in 2030, 2070, 2100, using the method of extrapolation. And the result is, if change process will be continue, the annual average values of air temperature will increase with comparison to now a day normal: in 2030 - 0,09 °C (1,37 %), in 2050 - 0,27 °C (4,12 %), in 2070 - 0,48 °C (7,32 %), in 2100 - 0,85 °C (13 %).

In Gyumri city are work hosiery, sugar and bur factories. Are known "Gyumri", "Alexandropol" beer factories, "Lusastgt Shugre" armenian-american building units and etc. It means that increase of temperature in Gyumri depends on microclimatic and local features of city mainly. So, for future prevention or decrease of air temperature is very important planting of greenery and creation of little basins. On the other hand it have to monitor the realization and care these works.

Changes of air temperature and rainfall in Armenia have been estimated for different periods, and results have been used in first and second national messages of Climate Change of RA [7]. The results show, that during last ten-years period in

Armenia observes increasing of air temperature. During 1935-96 period for comparison to basic period (1961-1990) average annual temperature increased on 0,4 °C, in 1935-2007 period - 0,85 °C, in 1935-2012 period - on 1,03 °C. It means that the temps of temperature increasing increased. Since 1994 deviations of average annual temperature were only positive.

By the forecasts of ECHAMS, GFDL, GISSER, HadCM3 models in Armenia predicts annual increase of air temperature for 1.1-1.5 °C in 2011-2040, 2.0-3.0 °C in 2041-2070, and 3.5-5.5 °C – in 2071-2099. But by our researches noted values of changes of air temperature are rather high than our predicted values of change of air temperature in Gyumri. So, estimation and management of air temperature dynamics change, also working out the ways of softening of impacts is necessary to make by local scale spatially in mountainous countries.



So, in the results of studies we have the following conclusions and suggestions:

- features and regularities of spatiotemporal distribution of air temperature depend on complex influence of physical-geographical and anthropogenic factors;
- in perennial observations notes a tendency of increase of annual average and extreme values of air temperature;
- have been made many researches, but there is not studies systemized of reasons of air temperature change yet, and existed are just for some sides of it. So, is better to continue studies and to develop future forecasts, using new models
- estimation of problems of air temperature dynamics change will get right solving, when will be known the relations, which it have with other components of nature area complex in conditions of direct influence of human

Is necessary:

- providing of meteorological stations with modern equipments (especially automatic);
- developing of notification of population about the climate change;
- realization legal-organization, institutional, technical arrangements for adaptation of economy to new natural conditions and soften of climate change consequences;
- strengthening of scientific studies of climatic problems and implementation of new technologies;
- working out of real climatic scenarios;
- working out of the programs for softening the negative effects of climatic change;
- financial satisfy support from government and other donor organizations made implementations must be visible for society, directed for realization of specific programs and have control by some organs;
- providing of modern ways of availability and outspread of information;
- working out and implementation of qualification programs, organization of studying processes, development of specialists' qualification;
- realization and providing international scientific-educational cooperation, strengthening of inter-agency cooperation.

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