тәжірибелік жұмыстар өндірістік бақылаумен, топырақтың далалық ылғал сыйымдылығы 70-70-60%, 70-80-60% және 70-80-60% (нормадан 30% артық) кезінде жүргізілді.

Кілт сөздер: Хорезм, оазис, суару, топырақ, мақта, шекті дала ылғалдылығы (ППВ), борозда, су, технология.

ЭФФЕКТИВНОСТЬ ВОДОСБЕРЕГАЮЩИХ ЭЛЕМЕНТОВ БОРОЗДКОВОГО ПОЛИВА ХЛОПЧАТНИКА

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Аннотация

В статье приводится сравнительный анализ режимов орошения хлопчатника на орошаемых луговых аллювиальных почвах Хорезмской области с уровнем грунтовых вод 2,0 - 3,0 м. по методикам НИИССАВХ и ФАО. Опытные работы в полевых условиях по определению поливной нормы хлопчатника проводились с производственным контролем, при полевой влагоемкости почвы 70-70-60%, 70-80-60% и 70-80-60% (30% больше нормы).

Ключевые слова: Хорезм, оазис, орошение, почва, хлопчатник, предельная полевая влагоёмкость (ППВ), борозда, вода, технология.

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CHANGES IN THE CHARACTERISTICS OF EXTREME TEMPERATURES IN THE REPUBLIC OF BELARUS

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Annotation

The article presents some results of the research of the extreme temperature regime in the Republic of Belarus. Transformations in maximum and minimum air temperatures correspond to the general theory of climate warming. The authors specify regional differences in temperature extremes.

Keywords: maximum temperature; minimum temperature; transformations; Belarus; forecast.

Introduction

Recently there has been a worldwide discussion about the impact of natural and anthropogenic factors into changes in climate regime. Here, air temperature plays a leading part for describing and modeling global meteorological processes [1]. In the Northern Hemisphere mean year temperature of surface air has grown by 0.6°C over the past century. By the middle XXI century it is expected to increase by over 2.5°C [2, 3, 4 et al.]. Global climate warming is primarily explained by man-made emissions of greenhouse gases into the atmosphere.

When describing Belarus climate, it is necessary to bear in mind various processes that are taking place on the whole planet and use measurement data about a great number of parameters which characterize both the climate itself (temperature, humidity, cloudiness, etc.) and the factors that predetermine the climate (solar and terrestrial radiation, chemical composition of the atmosphere, soil moisture and its temperature, etc.) In our opinion, it seems rewarding to describe space-time fluctuations of climate in terms of its circulation structure [5, 6, 7 et al.]. In a generalized case, fluctuations of air-circulation structures and their statistic parameters in a long-term perspective must show not only air-sun relationships but also their dependence on gravitation, geodynamic, and other factors. When interpreting peculiarities in multiyear fluctuations of climate parameters, we take into account a classification of atmospheric processes proposed by A. Girs [5], data about multiyear changes in the position of circulation pole, intensity of atmospheric processes, recurrence of cyclones and anticyclones, and other factors.

Materials and Methods

The subject of this research is absolute maxima and minima of the air temperature registered at 46 met stations in Belarus within the representative period of 1950-2014. Extreme air temperatures have considerable space-time variability.

Maximum and minimum air temperatures are measured at the met stations with corresponding thermometers according to the accepted rules and regulations. Maximum air temperature characterizes the temperature of the warmest time of the day (12 a.m – 5 p.m.) while the minimum one characterizes the coldest time (4–6 a.m. in summer, 6–9 a.m. in winter). It should be noted that meteorological observation in Belarus started in the mid-1800s but some gaps and lack of uniformity in observation series of that time put restrictions on using them in practice. Only starting from 1950 the time series of maximum and minimum air temperature can be considered as representative ones.

Results and Discussion

It is common practice to consider three main air temperature parameters: mean temperature, absolute maxima and minima, mean of absolute maximum and minimum temperature. Mean extreme air temperature (mean maximum/minimum) is an average multiyear value of extreme temperatures of the day in the period under observation.

Table 1 presents the ranked values of absolute maximum and minimum air temperatures. The drought in July-August 2010 resulted in day maxima exceeding 30.0°C over most of Belarus for quite a long time [8]. 15 met stations registered a temperature record of all the period of instrumental observation. At 7 stations absolute maximum of air temperature was over 38.0°C (Table 1). Maximum value of 38.9°C was registered in Gomel in August 2010 [9].

Table 1- Ranked absolute maxima and minima of air temperature in 1950-2013

t, °C	Month	Year	Met station	t, °C	Month	Year	Met station
38.9	August	2010	Gomel	-40.7	February	1956	Dokshytsy
38.8	August	2010	Kostyukovichi	-40.4	February	1956	Sharkawshchyna
38.7	August	2010	Gorki	-39.8	February	1956	Lyntupy
38.5	August	2010	Chechersk	-39.6	January	1956	Dokshytsy, Ezerische
38.2	August	2010	Orsha, Lelchitsy	-39.3	February	1956	Ezerische
38.1	August	2010	Bragin	-38.7	January	1956	Vitebsk
37.9	August	2010	Oktyabr	-38.6	December	1978	Ezerische
37.8	August	2010	Vitebsk, Slavgorod, Zhlobin	-38.6	January	1956	Sharkawshchyna
37.7	August	2010	Krichev	-38.5	January	1956	Gorki
37.6	August	2010	Vasilevichi	-38.4	February	1956	Vitebsk
37.5	August	2008	Lelchitsy	-38.2	January	1956	Vyerkhnyadzvinsk
37.4	August	2010	Senno, Lelchitsy	-38.2	January	1950	Vawkavysk
37.3	August	2008	Gomel	-38.2	January	1970	Hantsavichy

Most of the stations which register air temperature of over 36.0°C are located in the east of the country.

Absolute minimum air temperature is typical of the north-east area of Belarus. The lowest air temperature was registered in 1956. Absolute minimum was - 40.7°C at Dokshytsy station [9].

The analysis of time series (1950-2014) of temperatures reveals their distinct cyclic nature. We determine the cycles by using the method of integral differences and curves of sliding averages.

Figures 1 and 2 represent the curves of sliding 3-year averages for the main cities of Belarus. Cyclic recurrence of maximum and minimum values of air temperature at a number of met stations in Belarus (Figures 1 and 2) points at quite a distinct periodicity in the series of the observed characteristics. An 11-year cycle stands out against long-term fluctuations, which hints that it makes sense to look for a relationship between large weather abnormalities and solar activity. As a criterion for the assessment one can use the Wolf numbers or relative Zürich sunspot numbers which are considered as the main index of solar activity (Figure 3).

Climatologists report about a considerable growth in the abnormal summer and winter air temperatures observed since 1977 [10]. Figures 1 and 2 confirm this statement as they show a sharp increase in positive extreme values in this period in Belarus. The growth of negative extreme values takes place during almost all the period under consideration (1950-2014). Actually, it appears to be even more significant than that of maximum air temperature in summer. Recently (2001–2014), a slight rise in the values of abnormal temperature in the Northern Hemisphere has been observed only in summer while winters are reported to have even a fall in abnormal temperature values [10]. This recent pause in the temperature transformation is being discussed by a number of researchers in various scientific sources. One of the reasons mentioned is the approaching of a “cold” phase of the 11-year cycle of solar activity.

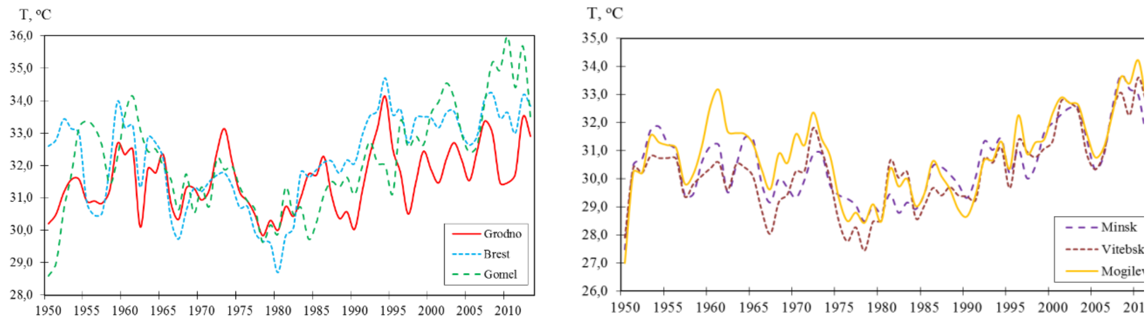


Figure 1-Curves of moving average of 3-year absolute maximum air temperature in main administrative cities of Belarus

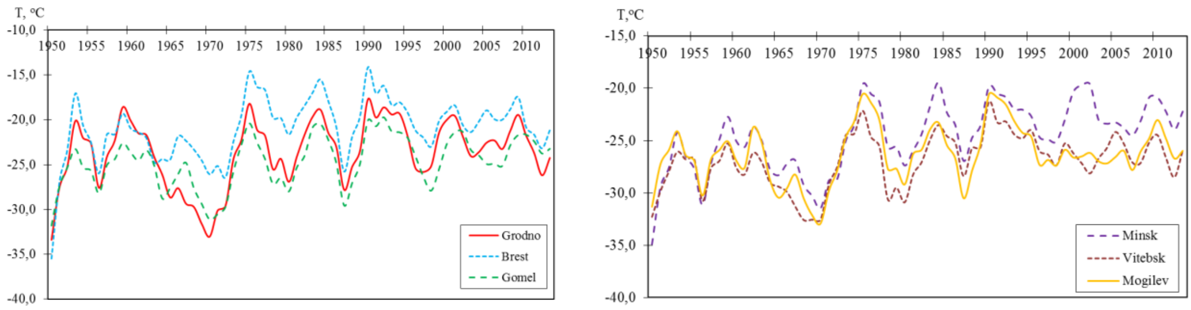


Figure 2-Curves of moving average of 3-year absolute minimum air temperature in main administrative cities of Belarus

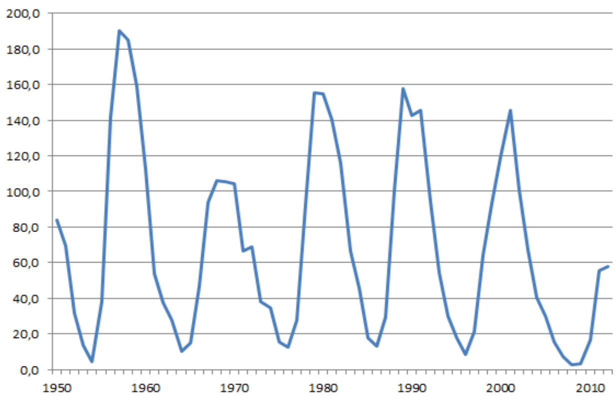


Figure 3- Wolf numbers (Zürich numbers)

The determined cycles (Figure 1 and 2) display regular patterns of spatial distribution of maximum and minimum values of air temperature within the country. We also observe quite synchronous time fluctuations of temperature values both within particular regions and the entire country.

Our analysis of multiyear series of maximum and minimum air temperature (1950-2014) resulted in constructing linear trends that reveal temperature transformations showing that short-term periods of warming in Belarus are alternated by similar in time and value periods of cooling. Table 2 presents linear trends of maximum and minimum air temperatures at particular met stations of Belarus.

Table 2- Linear trends of changes in maximum and minimum air temperatures, °C

Met station	Equation of linear trend	
	Maximum air temperature	Minimum air temperature
Mogilev	T=0.018t+30.283	T=0.037t-27.382
Minsk	T=0.026t+29.723	T=0.101t-27.839
Brest	T=0.034t+31.139	T=0.083t-23.183
Gomel	T=0.031t+31.128	T=0.064t-26.601

Positive trends for extreme air temperatures, both maximum and minimum, are observed at all the 46 meteorological stations. Maximum temperatures are growing over the territory of Belarus at the rate of 0.01–0.04°C per year. Minimum ones are increasing faster, at the rate of 0.04–0.11°C per year. In order to make our analysis more convenient, we use gradient (G) which is equal in value to a maximum temperature change in °C in 10 years. Extreme air temperatures have unstable statistical structure of the field. Moreover, the pattern of their growth shows a certain zoning. We performed a physical-geographical zoning of Belarus' territory in terms of changes in gradients (G) of extreme air temperatures (Figure 4).

In fact, this zoning reflects a tendency for maximum and minimum air temperatures in Belarus to level off. It confirms that Belarus is losing some features of a continental climate. The described changes correspond to the worldwide processes caused by global warming in the Northern Hemisphere. However, in our opinion a sharp rise of minimum air temperature in Minsk is a consequence of urbanization.

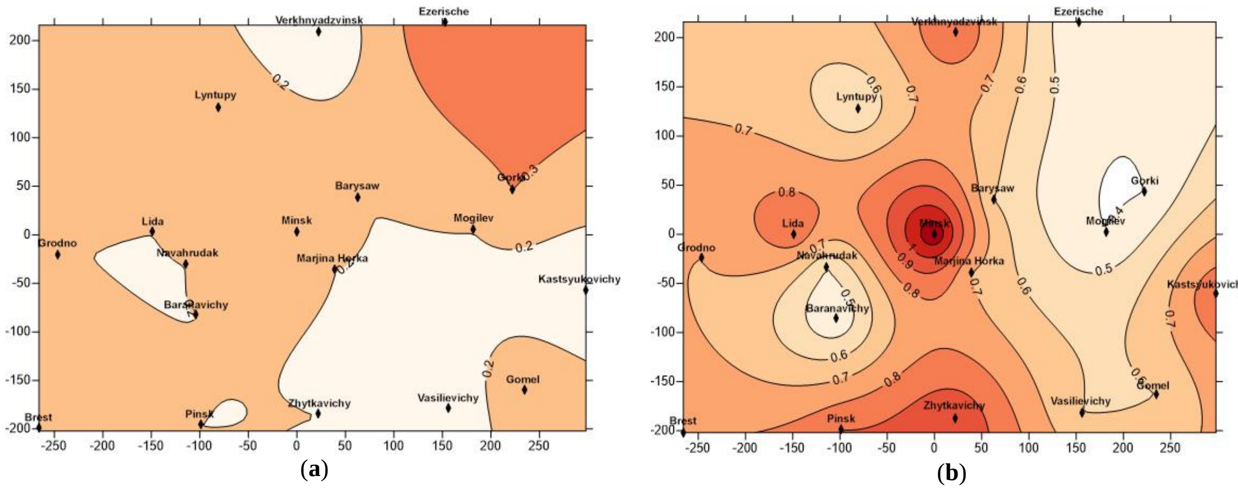


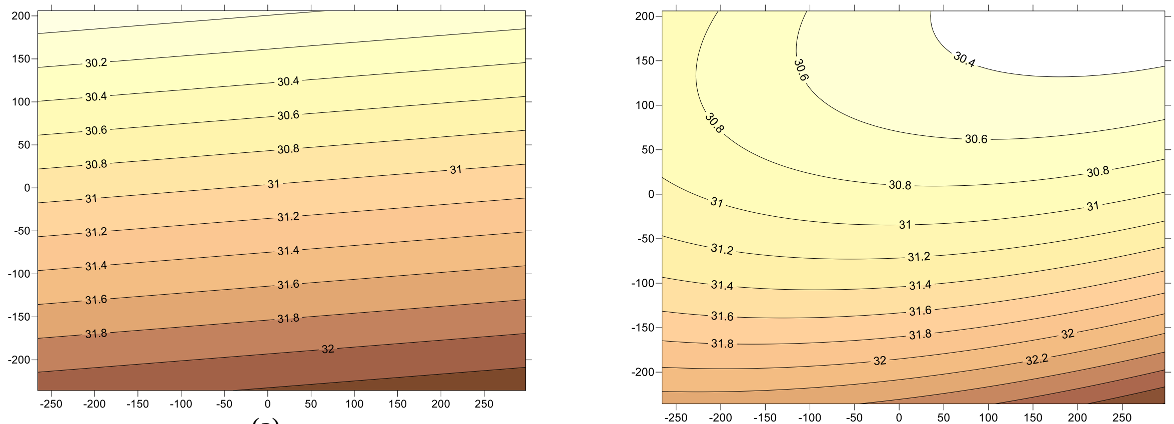
Figure 4- Gradient showing changes in air temperature, °C/10 years: (**a**) – maximum temperature, (**b**) – minimum temperature

In order to assess regional differences in the regime of extreme air temperatures, we divided the observation series into two parts (1950–1982, 1983–2014) and calculated differences in air temperatures for these periods.

A statistically relevant change is the one that deals with the growth of winter temperatures (January–February) by 2.0–4.0°C in the south-west of Belarus. Air temperature in March has increased by more than 2.0°C almost all over Belarus with its peaks in Pinsk, Gantsevichi, Slutsk, Bragin, and Kostyukovichi. It causes early snow melting. March is becoming the month with the highest overall increase in both maximum and minimum air temperatures. From April to August there is a gradual fall in the tendency for maximum air temperature to increase. Moreover, in September we even observe a slight decrease in air temperature by 0.2–0.8°C. The October–December period is characterized by a certain rise in maximum air temperature predominantly in southern Belarus. The highest positive growth of maximum air temperature (1.6°C) takes place in the south-west of Belarus.

Minimum air temperature rises all over Belarus in all seasons. In the north it increases more, which results in some leveling-off of minimum air temperature in the whole territory. One can pay special attention to the fact that minimum air temperature in Minsk (January–February) has grown by more than 3.0°C, which, in our opinion, is the result of urbanization.

In the structure of natural processes, one differentiates global, regional, and local constituents. The global constituent is systematic. It does not depend on peculiarities of a particular region. Global, regional, and local components can be assessed by analyzing trend surfaces of the characteristics under consideration. The global constituent and, to a certain degree, the regional one depends on geographical location. Figure 5 displays linear and polynomial trend surfaces of the analyzed air temperatures.



(**a**) (**b**)

Figure 5- Trend surfaces of maximum averaged air temperature in Belarus, ℃: (**a**) linear; (**b**) polynomial)

The linear trend surface (Figure 5 a) shows changes in weather abnormalities at a global scale. In Belarus, maximum air temperature grows in the south-west direction with the gradient of 2.2°C, which is predetermined primarily by the latitude.

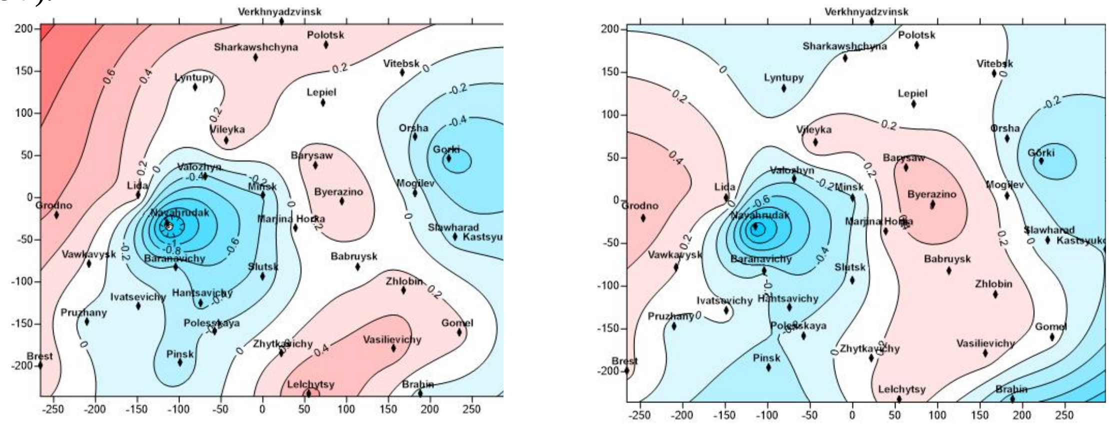
The polynomial trend surfaces (Figure 5 b) display regional peculiarities of Belarus. Extreme temperature regime is formed under the influence of several factors including warm advection. In summer there is a great influence of the Azores High which generates anticyclones [10]. The Gulf Stream predetermines the values of temperature trends during the year. Maximum intensity of the Gulf Stream in the second half of winter and that of summer coincides with the periods of maximum values of temperature trends in Belarus. Warm airflows by-pass highlands, go around valleys, and get them warmer.

If we exclude trends (Figure 5) from the values of the extreme temperatures, we calculate the local constituent of abnormal weather (Figure 6).

Figure 6 shows values of negative and positive differences which vividly demonstrate local peculiarities of the air temperature regime in Belarus. These maps show areas which are most effected by negative natural processes.

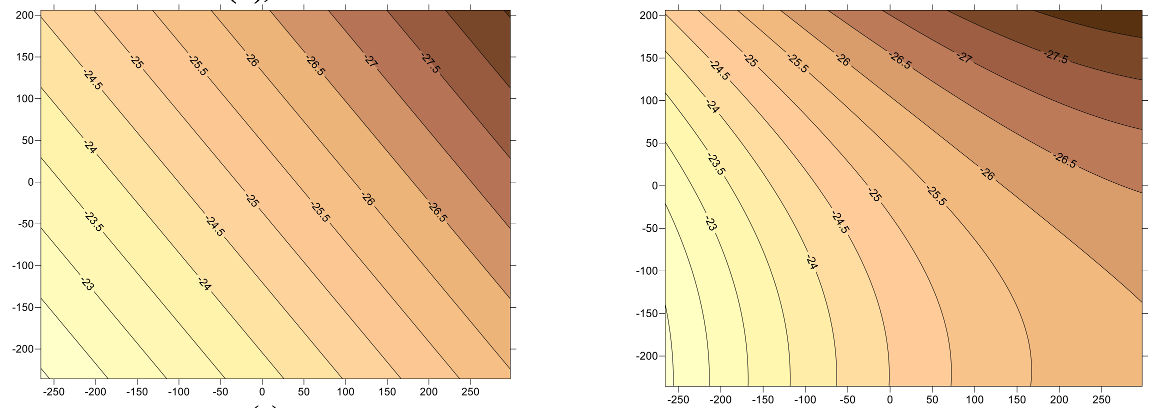
Thus, Figure 6 shows that positive differences of air temperatures are observed over the lowland area of Belarus. Novogrudok, Minsk, and Orsha Highlands have negative differences between averaged maximum air temperature and its trend surfaces. The negative differences correspond to the higher relief which partially compensate for the extreme air temperature regime. The winds in the highlands are of higher velocity. So intensive turbulent mixing of the air cools them down here. Rough underlying surface, on the contrary, slows the wind down significantly, which warms up the underlying surface better.

Minimum air temperatures decrease in the south-west direction with the gradient of 6.5 ^{0}C (Figure 7).



(**a**) (**b**)

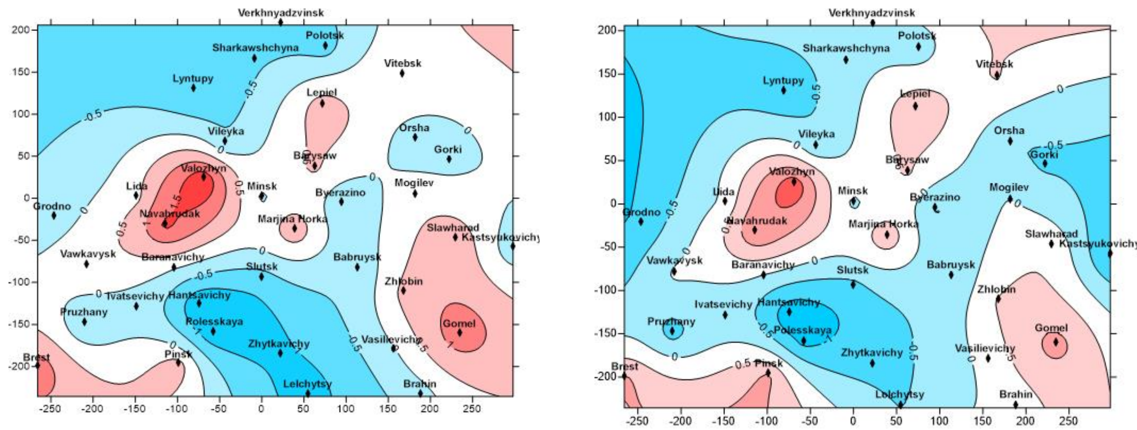
Figure 6- Maps of differences between maximum averaged air temperature and linear trend surface (**a**) and polynomial trend surface (**b**), °C



(**a**) (**b**)

Figure 7-Trend surfaces of minimum averaged air temperature in Belarus, °C: (**a**) linear; (**b**) polynomial

Isotherms of minimum air temperatures have a direction close to the meridian one. Their location is predetermined by arctic air convection and radiative cooling of the underlying surface. The south winds compensate for strong cooling as they bring warm air to the west part of Belarus. In winter the south winds predominate. Figure 8 presents the maps of differences between minimum averaged air temperature and their trend surfaces which help to specify regional peculiarities in generating strong frosts in Belarus.



(**a**) (**b**)

Figure 8-Maps of differences between minimum averaged air temperature and linear trend surface (**a**) and polynomial trend surface (**b**), °C

Thus, the relief and the type of underlying surface influence the way the air temperature is formed. Minimum air temperatures confine to open lowlands and large marshlands. The only exception is Pripyat Polesie where vast forests compensate for advective cooling of the surface. The highest positive differences between minimum averaged air temperature and its trend surfaces are observed in Volozhin, Novogrudok, Brest, and Gomel.

Conclusions

Current transformations of maximum and minimum air temperatures are of statistical significance. They are non-uniform over the territory of Belarus due to some peculiar features of air circulation and underlying terrain. Absolute temperature maxima in Belarus tend to level off while winter temperatures grow, which corresponds to the theory of global climate warming.

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ИЗМЕНЕНИЯ ХАРАКТЕРИСТИК ЭКСТРЕМАЛЬНЫХ ТЕМПЕРАТУР ВОЗДУХА В РЕСПУБЛИКЕ БЕЛАРУСЬ

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Аннотация

В статье представлены результаты исследования экстремального температурного режима в Республике Беларусь. Трансформации максимальных и минимальных температур воздуха соответствуют общей теории потепления климата. Авторы указывают региональные различия в экстремальном температурном режиме исследуемой территории.

Ключевые слова: максимальная температура, минимальная температура, трансформации, Беларусь, прогноз.

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БЕЛАРУСЬ РЕСПУБЛИКАСЫНДАҒЫ ЭКСТРЕМАЛДЫ АУА ТЕМПЕРАТУРАСЫ СИПАТТАМАЛАРЫНЫҢ ӨЗГЕРУІ

Аңдатпа

Мақалада зерттеу нәтижелері экстремалды температура режимін Беларусь Республикасында. Ауаның ең жоғары және ең төменгі температураларының өзгеруі климаттың жылынуының жалпы теориясына сәйкес келеді. Авторлар зерттелетін аумақтың экстремалды температуралық режиміндегі аймақтық айырмашылықтарды көрсетеді.

Кілт сөздер: ең жоғары температурасы, ең аз температура, трансформация, Беларусь, болжам

УДК 556.167

MODELING OF THE RIVER FLOW SMALL ALMATY

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Abstract

The article presents the results of using the HECRAS program for the River Small Almaty in the Ile-Balkash basin, the program is shown to work, simulations are made and its applicability boundaries are determined. Runoff modeling is a necessary element for stimulating the efficiency of processes and managing land and water resources.

To determine the effectiveness of using the HECRAS program using river data hydro meteorological, geomorphological characteristics, etc. which we will use for modeling using the HEC-RAS program; using the presented data to simulate our river with different river regime options; accurately determine the most significant starting point for correlating the input data of the method based on the results of analysis and specific river modeling projects. Recommended graphical and statistical data are calculated: Combination of fluctuations in water level and water flow in sections up and downstream, Cross-section of the river in the upper and lower reaches, and graphical schemes are used to evaluate the model.

Keywords: modeling, verification, flood, water flow, water level, Shezy coefficient, topography, air temperature, rainfall.

Introduction

The program was developed by the United States Army Corps of Engineers to manage rivers, ports, and other public works under their jurisdiction; it has been widely recognized by many others since its public release in 1995. The Hydrological Engineering Center (HEC) in Davis, California, has developed a River Analysis System (RAS) to assist hydraulic engineers in analyzing channel flow and floodplain detection. It includes numerous data entry capabilities, hydraulic analysis components, data storage, and management capabilities, as well as graphing and reporting