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Evaluation of climate change in Ukrainian part of Polissia region and ways of adaptation to it

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Abstract

The analysis of the current state of weather and climatic conditions and evaluation of their predicted changes for immediate and distant prospect in the drained areas of Ukrainian Polissia region was carried out in the article. The main trends in changes of meteorological characteristics and their possible effect on the conditions of functioning water management and ameliorative objects and complexes as well as on the natural and ameliorative state of drained areas were identified. The research uses a method of predictive-simulation modelling with used predictive assessment models of normalized distribution of the basic meteorological characteristics in the long-term and one-year vegetation context. According to the results of the research it was established that, for today a high variability in meteorological characteristics can lead to the significant deterioration of operation conditions of water management and ameliorative objects and units, as well as natural and ameliorative conditions of drained lands in Polissia region as a whole. Core measures regarding the adaptive potential enhancement and development in the region under the conditions of climate change were examined.

Key words: *climate change, evaluation, Polissia region, ways of adaptation*

INTRODUCTION

Global warming is one of the numerous ecological, social and economic problems, which the mankind started to face at the end of the last century.

Current climate change may have significant natural, economic and social aftermath. In view of the changes in climate conditions taking place even today, a vitally important part is assigned to the forecasting of possible climate change in future and solving of a number of crucial and complicated

tasks, related to the development and implementation of the strategies of farther mankind survival both on a world-wide basis and at a regional level. Therefore, for today a need of predicted evaluation of climate change and development of relevant adaptive decisions arise [GORZHYK *et al.* 1998; ROMASHCHENKO *et al.* 2003; 2007; ROMASHCHENKO *et al.* (ed.) 2015].

Ukraine belongs to the number of regions influenced by ongoing climate change that is rather essential. On the base of numerous meteorological factors and indices the domestic scientists (climate researchers) come to the point, that for the last 10–25 years a new climate is being formed over the territory of Ukraine [BOICHENKO *et al.* 2000]. These changes are very tangible in Polissia region of Ukraine where the drained lands are instrumental for the country economic development and provision of food security.

Thus, the evaluation of the predicted changes in weather and climate patterns under the conditions of climate change and their impact on the conditions of water management and ameliorative both objects and complexes as well as on the natural-ameliorative state of Polissia region of Ukraine is of a great concern.

METHODS

To solve the task a large-scaled computer experiment on PC was planned and performed based on long-term retrospective and current observational data obtained in Polissia region [MAZHAYSKIY *et al.* 2017; ROKOCHINSKIY 2010].

The following variants of study were planed and implemented for the average conditions of Western Polissia:

- **variant 1 – "Base"**: characterization of the meteorological characteristics over a period of vegetation (months IV–X), obtained on the base of long-term retrospective data (1891–1964) [Gidrometeoizdat 1990];
- **variant 2 – "Transitional"**: characterization of standardized average long-term values of the variables of basic meteorological characteristics and their distribution over the vegetation period, obtained under current conditions (1947–1990);
- **variant 3 – "Recent":** characterization of the dynamics and standardized average long-term values of the variables of basic meteorological characteristics and their distribution over the vegetation period, obtained under recent conditions over the years of 1991–2017;
- **variant 4a – "CCCM"** and **variant 4b – "UKMO"**: characterization of standardized average long-term values of the variables of basic meteorological characteristics and their distribution over the vegetation period, obtained in view of current and predicted climate change, in accordance with the recommendations [ROMASHCHENKO *et al.* 2003], by the models of Canadian Climate Center (CCCM) – as a more favourable forecast, and of the United Kingdom Met Office (UKMO) – as a less favourable forecast, which foresee an increase in average annual temperature up to 4°C and 6°C relatively – provided that the doubling CO_2 in atmosphere occurs [ROMASHCHENKO *et al.* 2003; SHEVCHUK *et al.* 2001].

Practicability of the application of "CCCM" and "UKMO" models is proved by their capabilities to involve both less and more critical scenarios of changing weather patterns, and they perfectly comply with the predictive estimate of the rationing of basic meteorological characteristics in the long-term and one-year vegetation context [ROKOCHINSKIY *et al.* 2008].

As a base variant of study were taken the retrospective long-term data (1891–1964 years) according to official reference data [Gidrometeoizdat 1990], because in this period the climate of the studied region had a pronounced stable character.

The forecast was made for five typical groups of vegetation periods of target years in view of general heat and moisture provision (very wet – 10%, wet – 30%, middle – 50%, dry – 70%, very dry – 90%) by such basic meteorological characteristics as air temperature, precipitation, relative humidity and air humidity deficit, photosynthetically active radiation (*PAR*) and water availability coefficient (precipitation/evapotranspiration ratio) by the given diagram (Fig. 1) [ROKOCHINSKIY *et al.* 2008].

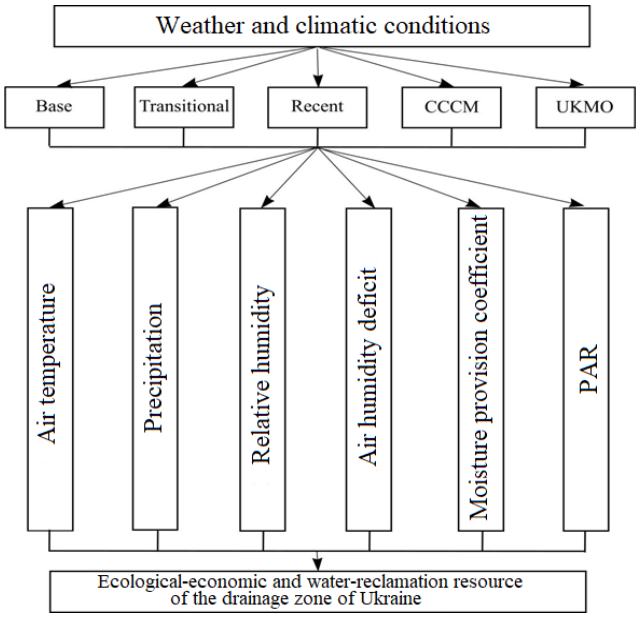

Fig. 1. Diagram of weather and climate characteristics assessment under retrospective (Base), transitional (Transitional), recent (Recent) and forecasted (CCCM, UKMO) conditions; CCM = model of Canadian Climate Center, UKMO = model of United Kingdom Met Office, PAR = photosynthetically active radiation; source: own elaboration

RESULTS AND DISCUSSION

The summarized results of the calculation of the values of basic meteorological characteristics (precipitation, temperature, air humidity deficit and relative air humidity) and their derivate characteristics (*PAR*, water availability coefficient) over the target years were given in the Table 1 as the percentage change of normalized vegetation values of the basic meteorological characteristics by the variants of study (Transitional, Recent, CCCM, UKMO) relative to their baseline values (Base).

Table 1. Comparative assessment of changes in the values of basic meteorological characteristics by the variants of study for the conditions of Polissia region

Model indicator		Typical group of target years					Average value (%)
		10%	30%	50%	70%	90%	
Precipitation *P*	transitional	–5.34	–17.90	–1.84	–0.47	–0.96	–5.30
	recent	–2.80	0.33	0.06	10.88	11.87	+4.07
	CCCM	1.29	1.43	1.62	1.87	2.23	+1.69
	UKMO	7.05	7.20	7.39	7.66	8.04	+7.47
Air temperature *T*	transitional	1.89	2.07	2.08	0.95	1.76	+1.75
	recent	4.89	7.27	5.42	6.14	0.49	+4.84
	CCCM	25.71	25.04	24.50	24.21	23.47	+24.59
	UKMO	36.12	35.45	34.82	34.53	33.76	+34.93
Air humidity deficit *D*	transitional	3.44	2.55	4.12	–2.12	0.77	+1.75
	recent	4.44	8.79	7.66	0.32	5.98	+5.44
	CCCM	24.07	24.00	22.97	21.95	21.04	+22.81
	UKMO	27.94	28.03	26.97	28.00	25.00	+27.19
Relative air humidity *H*	transitional	1.49	1.20	–1.75	1.32	1.89	+0.83
	recent	–4.85	–2.47	–2.37	0.61	–1.35	–2.09
	CCCM	–7.99	–6.72	–6.68	–6.41	–6.68	–6.90
	UKMO	–8.94	–7.72	–9.04	–8.74	–8.64	–8.62
Photosynthetically active radiation *PAR*	transitional	0.50	1.11	1.64	0.90	1.29	+1.09
	recent	2.84	4.64	3.77	3.84	0.06	+3.03
	CCCM	16.33	16.09	16.10	15.80	15.60	+15.98
	UKMO	22.82	22.65	22.72	22.40	22.23	+22.57
Water availability coefficient K_w	transitional	–8.49	–19.94	–5.73	1.69	–1.72	–6.84
	recent	–6.94	–7.77	–7.05	10.53	5.55	–1.14
	CCCM	–18.36	–18.20	–17.36	–16.47	–15.54	–17.19
	UKMO	–16.33	–16.27	–15.42	–15.89	–13.57	–15.49

Explanations: transitional, recent, CCCM, UKMO as in Fig. 1.
Source: own study.

The obtained results on the comparative assessment of changes in current and predicted values of basic meteorological characteristics over the target years and on the average for the years enable to make following conclusions [MAZHAYSKIY *et al.* (ed.) 2017]:

- **on precipitation**: in transitional conditions (Transitional) as compared with the base variant (Base) the precipitation decreases over the target years (from 0.47% in dry year (70%) up to 17.9% in wet year (30%), with an average of 5.30%. As to the current conditions (Recent), as a whole some of the increase in precipitation can be observed (it varies from 2.80% in very wet year (10%) up to 11.87% in very dry year (90%), with an average of 4.07%; respectively by the forecasting variants some of the increase in precipitation can be observed over all target years, with an average of 1.69% for CCCM and 7.47% for UKMO;
- **on air temperature**: over all examined variants the increase in air temperature was observed both over the target years and average for the years that is less evident in transitional conditions (Transitional) – 1.75%, more evident in current conditions (Recent) – 4.84%, and it increases significantly in forecasting conditions: CCCM – 24.59% and UKMO – 34.93%;
- **on air humidity deficit**: the nature of change of this index is similar to the air temperature change with some ranges over the target years and on the average for the years: Transitional – 0.83%; Recent – 5.44%, CCCM – 22.8% and UKMO – 27.19%;
- **on atmosphere relative humidity**: in transitional conditions (Transitional) the value of this index on the average increases – 0.83%, in current conditions (Recent) it decreases by 2.09%, according to the forecast it also decreases: for CCCM by 2.09% and for UKMO by 6.9%;
- **on *PAR***: the nature of change of this index corresponds to the change in air temperature, having a little lower intensity of the increase: Transitional – 1.09%, Recent – 3.03%, CCCM – 15.98% and UKMO – 22.57%;
- **on water availability coefficient**: the nature and rate of the change in precipitation and air humidity deficit both over the target years and on the average for the years determine some of the decrease in transitional conditions (Transitional) – 6.84%, less evident decrease in current conditions (Recent) – 1.14%, and a rather significant decrease by the forecast: CCCM – 17.19% and UKMO – 14.49%.

Comparative assessment of the dynamics of basic meteorological characteristics of the vegetative periods for the period of 1991–2017 along with their retrospective and perspective rates was given in Figure 2.

The obtained results enable to make the following statements [MAZHAYSKIY *et al.* (ed.) 2017]:

- **as to precipitation**: it was observed a rather wide range of precipitation for the studied period, namely it was from 200 up to 600 when having an average long-term rate as 443 mm with well-defined peaks in 1991, 1999, 2008 and 2017 and decays in 1991, 2002, 2004, 2015; in the next years after the year 2008 it was observed a steady decline in precipitation in all variants of study along with its drastic increase in 2016 and 2017; meanwhile the predicted rates by the models CCCM and UKMO are already within the current range of total values;
- **as to air temperature**: the opposite is the case; starting from the year it was observed an increase in air temperature along with well-defined peaks in 1999, 2002, 2012 and 2016, which were accordingly 15.1°C, 15.0°C, 15.3°C and 15.2°C; meanwhile the average annual air temperature for the studied period do not reach the predicted values by the models of CCCM and UKMO;
- **as to air humidity deficit**: the dynamics of changes in air humidity as a whole shows the characteristic features of the change in air temperature range: air humidity deficit reaches first and second peaks in the years 2002 and 2005, which were accordingly 1118 and 1112 mm, when having average values of 5.30 and 5.20 mm respectively; after the year 2005 the total values of air humidity deficit slightly decreased and manifested insignificant range of them; after that it was observed their third and fourth peaks in the years 2012 and 2016 – accordingly 1193 and 1250 mm, when having average values of 5.60 and 5.83 mm respectively; meanwhile, the value of air humidity deficit by the model Base is lower than the average annual rates by the models Transitional and Recent, and its corresponding rates by the models CCCM and UKMO are already within its current range;

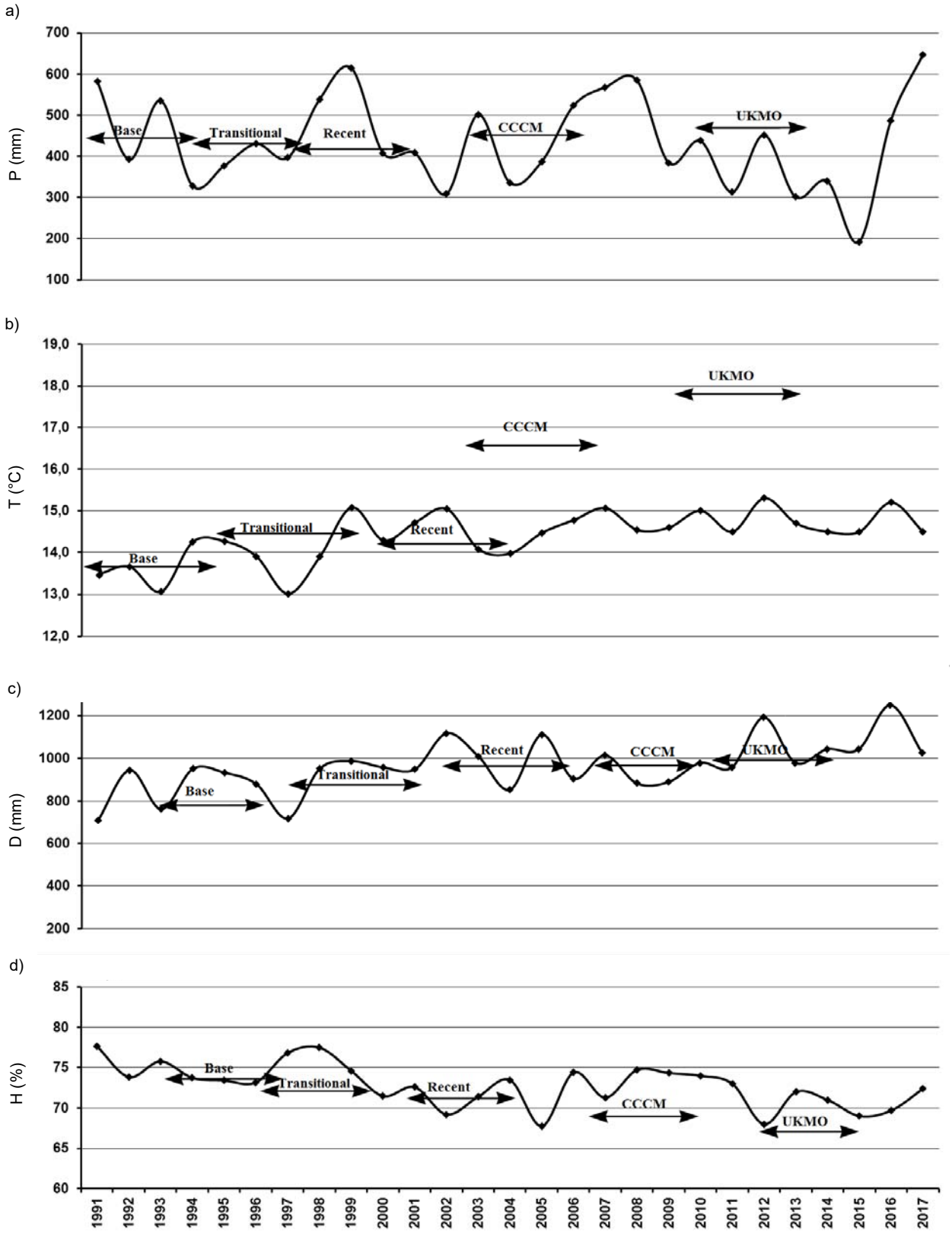

Fig. 2. Comparative assessment of normalized values of basic meteorological characteristics by the variants of study regarding the dynamics of their valid values in conditions of Polissia region: a) precipitation, b) air temperature, c) air humidity deficit, d) relative air humidity; base, transitional recent CCCM, UKMO as in Fig. 1; source: own study

– **as to air relative humidity**: the opposite is the case regarding the dynamics of the change in air relative humidity, it was observed two peaks (about 78%), one – in 1991 and another – in 1998, after that a drastic decrease in the values (near 68%) up to the first and second peaks was recorded in the years 2005 and 2012; meanwhile the average long-term value of air relative humidity by the model Base is higher than the average annual rates by the models Transitional and Recent, and its corresponding rates by the models CCCM and UKMO were within the current range of average annual values.

In whole the forecasting values of studied meteorological characteristics by the models CCCM and UKMO in Polissia region, excepting air temperature, are already within a current range and even higher for some indices, that proves the existence of a steady trend towards the change in climatic conditions.

Rising air temperatures, increase in climate deficit and aridity in the region will inevitably lead to the increase in evaporation and general water consumption while growing crops, including the land with regulated water regime (drained territories).

For the drained land with shallow ground waters, where the most of drainage systems in Ukraine are located, whether conditions have an effect on the formation of water regime of soils and ground waters, influencing the ways and behaviour of ground processes.

Climatic variability directly or indirectly influences soils, both mineral and organic. It increases the hazard of peatlands burning, their mineralization and deterioration as a result of their excessive draining, worsening of their water-physical properties, which leads to the loss in soil productivity.

Changes in soil and climate conditions necessitate some work to be performed so that crops to benefit. First of all it comes to the replacement of standard crops for the crops requiring a rather large sum of positive temperatures. It is also pressing issue about the possibility of growing new drought-tolerant crops with a rather short vegetation period.

Therefore, climate changes require the soils to be adaptive to these conditions. In this regard one of the most important issues of agrarian and ameliorative science for today is the enhancement of the adaptive capacity of agricultural lands with regulated water regime to benefit most.

Adaptation of agricultural production in conditions of sustainable development to the changes in soil and climatic features calls for the introduction of new technologies of operational water regulation, maximum accumulation of precipitation, reconstruction and renewal of existing ameliorative facilities as well as the construction of the most modern ones in the drained areas.

That in turn will have an effect on functioning water management and ameliorative objects and units, as a result of above mentioned changes in natural and ameliorative resources that requires developing some adaptive technical and technological measures for proper managing these objects based on relevant scientific state and international researches and programs.

Under such conditions the adaptation to climate change means an accommodation in natural or social systems as a response to actual or expected climate impacts or their consequences that enables to reduce their environmental risks and damages and take some advantages.

Agricultural lands located within water management and ameliorative objects and units should be considered as agricultural ecosystems. Efficient use of these lands is possible provided the evaluation of their adaptive capacities. In this it must be taking into account: firstly – their nature and exposure to essential climate change; secondly – their capabilities to contend with external effects and damages, which arise as a result of environmental changes [ADGER 2006]; thirdly – risk and frequency of natural disasters and their impacts [SCHMIDT-THOME 2007].

Based on the studied experience of European countries [MASSIER 2012] the adaptive measures on drained lands should involve a range of management, operational and agro-technical, construction and project activities (Tab. 2).

Table 2. Main activities on adaptation to climate change

Group of activity	Activity
Management activities	– establishment of organization and consulting centres – development of reporting, planning and prospective water balance by the basin principle – modelling of river ecological conditions in view of water quality indices in agro- ecosystems
Operational and agro-technical activities	– regulation of water regime – prevention of soil degradation – improvement of plant breeding
Construction activities	– construction, reconstruction and renaturalization of water management and ameliorative objects and units – construction and reconstruction of flood control hydrotechnical structures
Project activities	– ensuring ecological and safe conditions for environmental management – design of closed farming production cycles

Source: [MASSIER 2012].

There are various activities on adaptation as applied to agriculture [MASSIER 2012; Paris Agreement 2016], which involve different levels of decision-making: international, national, regional and local and are aimed at both prevention and elimination of consequences. Introducing the adaptive activities should be accompanied by raising awareness of public and land users.

CONCLUSIONS

Thus, for today a high variability in meteorological characteristics can lead to the significant deterioration of operation conditions of water management and ameliorative objects and units, as well as natural and ameliorative conditions of drained lands in Polissia region as a whole. The proposed adaptation activities have their own explicit objectives, which are closely related, therefore to develop a proper program of adaptation activities the potential impacts of climate change, risks and vulnerability as its results need to be better understood. This is the integrative approach to solving the problems will enable to enhance and develop the adaptive capacity of Polissia region.

REFERENCES

ADGER W. 2006. Vulnerability: Global environmental change. Vol. 16. p. 268–281.

BOICHENKO S., VOLOSHCHUK V., DOROSHENKO I. 2000. Hlobalne poteplinnia ta yoho naslidky na terytorii Ukrainy [Global warming and its consequences on the territory of Ukraine]. Ukrainskyi heohrafichnyi zhurnal. No. 2 p. 59–68.

Gidrometeoizdat 1990. Nauchno-prykladnoi spravochnik po klimatu SSSR. Ser. 3. Mnogoletnye dannye. Chasti 1–6. Vyp. 10. Ukraynskaia SSR. Kn. 1 [Scientific and applied handbook on the climate of the USSR. Ser. 3. Perennial data. Parts 1–6. Vol. 1. The Ukrainian SSR]. Leningrad p. 518–534.

GORZHYK I., YEMELYANOVA Zh., TROFIMOVA I., SHERESHEVSKIY A. 1998. Ukraina ta hlobalnyi parnykovyi efekt. Knyha 2. Vrazlyvist i adaptatsiia ekolohichnykh ta ekonomichnykh system do zmin klimatu [Ukraine and Global Greenhouse Effect. Book. 2. Vulnerability and adaptation of environmental and economic systems to climate change]. Kiev. Vydavnytstvo Ahentstva z ratsionalnoho vykorystannia enerhii ta ekolohii pp. 96.

MASSIER E.E. 2012. Dosvid yevropeiskoho soiuzu v adaptatsii do zminy klimatu ta zastosuvannia yoho v Ukraini [The experience of the European Union in adapting to climate change and its application in Ukraine. OSCE Coordinator for Economic and Environmental Activities]. Biuro Koordynatora z ekonomichnoi ta dovkilnoi diialnosti OBSIE. pp. 40.

MAZHAYSKIY Y., ROKOCHINSKIY A., VOLCHEK A., MESHYK O., JEZNACH J. (ed.) 2017. Pryrodoobustroistvo Polesia. Kn. 2. Vyp. 1 [Environmental management of Polissya Book 2. Vol. 1]. Ryazan. VNIIGiM of A. Kostiakov. ISBN 978-5-00077-654-4 pp. 902.

Paris Agreement ratified by the Law No. 1469-VIII of 14.07.2016. [Access 29.07.2018]. Available at: https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf

ROKOCHINSKIY A. 2010. Naukovi ta praktichni aspekti optimizaciï vodoregulyuvannya osushuvanikh zemel' na ekologo-ekonomichnikh zasadakh: Monografiya [The scientific and practical aspects optimization of water regulation drained lands on environmental and economic grounds. Monograph]. Ed. M.I. Romashchenko. Rivne. NUVGP. ISBN 978-966-327-141-5 pp. 351.

ROKOCHINSKIY A., HALIK O., FROLENKOVA N., VOLOSHCHUK SHALAI S., ZUBYK YA., BEZHUK V., ZUBYK L., POKLADNOV YE., SAVCHUK T., KOPTIUK R., NESTERUK L., VOLK P., KOTIAI L. 2008. Posibnyk do DBN V.2.4-1-99 «Melioratyvni systemy ta sporudy» (Rozdil 3. Osushuvalni systemy). Meteorolohichne zabezpechennia inzhenerno-melioratyvnykh rozrakhunkiv u proektakh budivnytstva y rekonstruktsii osushuvalnykh system [Guide to DBN V.2.4-1-99 "Reclamation systems and structures" (Chapter 3. Dehumidification systems). Meteorological support of engineering and reclamation calculations in drainage systems construction and reconstruction projects]. Kiev. Vidkryte aktsionerne tovarystvo VAT «Ukrvodproekt» pp. 64.

ROKOCHINSKIY A., VOLK P., PINCHUK O., MENDUS S., KOPTYUK R. 2017. Comparative evaluation of various approaches to the foundation of parameters of agricultural drainage. Journal of Water and Land Development. No. 34 p. 215–220. DOI 10.1515/jwld-2017-0056.

ROMASHCHENKO M., KHVESIK M., MIKHAILOV YU. (ed.) 2015. Vodna stratehiia Ukrainy na period do 2025 roku (naukovi osnovy) [Water strategy of Ukraine for the period till 2025 (scientific basis)]. Kiev. Nacional'na akademija agrarnykh nauk Ukraini. pp. 46.

ROMASHCHENKO M., ROKOCHINSKIY A., HALIK O., SAVCHUK T., KOLODICH O. 2007. Suchasni zminy klimatu ta yikh proiavy vid hlobalnoho do rehionalnoho proiaviv [Recent climate change and their manifestations from global to regional manifestations]. Hidromelioratsiia ta hidrotekhnichne budivnytstvo. Vol. 32. p. 65–79.

ROMASHCHENKO M., SOBKO O., SAVCHUK D., KULBIDA M. 2003. Pro deiaki zavdannia ahrarnoi nauky u zviazku zi zminamy klimatu [About some problems of agrarian science in connection with climate change]. Kiev. Instytut hidrotekhniky i melioratsii UAAN pp. 46.

SCHMIDT-THOME P. (ed.) 2007. The spatial effects and management of natural and technological hazards in Europe. Luxembourg. ESPON. ISBN 951-690-918-3 pp. 197.

SHEVCHUK V., TROFIMOVA I., TROFIMCHUK O. 2001. Problemy i stratehiia vykonannia Ukrainoiu ramkovoi konventsii OON pro zminu klimatu [Problems and strategy of Ukraine's implementation of the UN Framework Convention on Climate Change]. Kiev pp. 96.

Pyotr KOVALENKO, Anatoliy ROKOCHINSKIY, Jerzy JEZNACH, Roman KOPTYUK, Pavlo VOLK, Nataliia PRYKHODKO, Ruslan TYKHENKO

Ocena zmian klimatu i adaptacji do nich w ukraińskiej części Polesia

STRESZCZENIE

W pracy przeprowadzono analizę obecnego stanu pogody i warunków klimatycznych oraz ocenę spodziewanych zmian w krótszej i dłuższej perspektywie czasu na drenowanych obszarach ukraińskiej części regionu Polesia. Zidentyfikowano główne trendy zmian charakterystyk meteorologicznych i ich potencjalny wpływ na warunki funkcjonowania gospodarki wodnej w obiektach i kompleksach melioracyjnych oraz na naturalny i zmieniony stan drenowanych obszarów. W badaniach wykorzystano modelowanie prognostyczno-symulacyjne z użyciem modeli znormalizowanego rozkładu podstawowych charakterystyk meteorologicznych w kontekście wieloletnich i rocznych zmian roślinności. Ustalono, że duża zmienność elementów meteorologicznych może prowadzić do znaczącego pogorszenia gospodarki wodnej i stanu obiektów melioracyjnych oraz warunków naturalnych na drenowanych obszarach całego Polesia. Zbadano główne zabiegi związane ze wzmocnieniem potencjału adaptacyjnego i rozwojem regionu w warunkach zmian klimatycznych.

Słowa kluczowe: *ocena, Polesie, sposoby adaptacji, zmiany klimatu*