

International Research-to-Practice Conference
Climate Services: Science and Education

September 22-24, 2021
Odesa, Ukraine



Conference Proceedings



Co-funded by the
Erasmus+ Programme
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MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

ODESSA STATE ENVIRONMENTAL UNIVERSITY

**INTERNATIONAL RESEARCH-TO-
PRACTICE CONFERENCE ON
'CLIMATE SERVICES:
SCIENCE AND EDUCATION'**

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Odesa

Odesa State Environmental University

2021

UDC 378:551.58

I 73

I 73 International Research-to-Practice Conference on 'Climate Services : Science and Education': Conference Proceedings. Odesa : Odessa State Environmental University, 2021. 144 p.

ISBN 978-966-186-162-5

The proceedings of the international research-to-practice conference on 'Climate Services: Science and Education' are presented in the collected volume. The reports cover the principle results of researches in the field of issues of climate services in the climate-sensitive economic sectors; education in climate services; climate risks and adaptation to climate change on regional and local levels.



Supported by the Erasmus+ Programme of the European Union. The publication reflects the authors' view, the EACEA and the European Commission are not responsible for any use that may be made of the information it contains.

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ISBN 978-966-186-162-5

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ASSESSMENT OF CLIMATE CHANGE IMPACT ON PARAMETERS OF FRESHWATER BALANCE IN LAGOONS OF NORTH-WESTERN BLACK SEA COAST

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The study has been aimed to assess quantitatively the impact of regional climate change that occurred and expected in the near future on the freshwater balance of "choked" lagoons in the north-western Black Sea coast. These lagoons have no constant connection with the sea and are sporadically connected to the sea by artificially created channels or other waterworks. The ecosystems of the lagoons are the most sensitive and vulnerable to climate change. These include the Tylihulskyi, Dofinovskiy, Khadzhibeiskiy, Kuialnytskyi, Budakskyi limans, Tuzla lagoon group, and the Sasyk reservoir, which should be renaturalized in the future by restoring contact with the sea.

The incoming components of the freshwater balance for these "choked" lagoons include precipitation falling on the water surface of lagoons and the freshwater inflow from small and medium rivers, and the evaporation from the water surface of the lagoons is the component of expense. If during the year the amount of incoming components is less than the ones of the expense, then a deficit of annual water balance is observed. This deficit should be compensated by water from other external sources in order to prevent shallowing and salinization of a lagoon, deterioration of its water quality, ensuring the sustainable functioning of the ecosystem.

The climate changes of meteorological parameters in the north-western Black Sea coast, which determine the components of the lagoons' water balance, were assessed for the current period 2000-2018 and the near future 2021-2050, compared with the period 1961-1990 (according to the Climate Cadastre of Ukraine). Expected climatic conditions in the near future were determined by the results of the Euro-CORDEX project for two climate change scenarios RCP4.5 and RCP8.5. The 'best' run by the regional climate model CLMcom-CCLM4-8-17 was selected from the ensemble of 14 runs. This run provided the near-future monthly precipitation and evaporation from the lagoon water surface calculated by the data on temperature and relative humidity.

Using the changes in the meteorological parameters, it was revealed that from the beginning of the 21st century: (i) the air temperature is gradually increasing - the annual air temperature for 2000-2018 is 11-14% higher than for 1961-1990, and the expected temperature for 2021-2050 is 26- 28% higher; (ii) the relative humidity for 2021-2050 is reducing by 11-18%; (iii) the annual evaporation from the lagoons' water surface is increasing by 13-15% in 2000-2018 along the northern coast and by 7-9% along the west coast of the northwestern part of the Black Sea; the annual evaporation is increasing in 2021-2050 by 16-20% due to the rising air temperature only and by 33-56% considering

also the expected decrease in relative humidity; (iv) the annual precipitation is increasing by about 3% in 2000-2018 and is decreasing by 5% (up to 15% in the southern part) in 2021-2050 for the scenarios RCP4.5 and RCP8.5 as compared with 1961-1990.

The expected freshwater inflow from rivers into the lagoons in natural and disturbed water management conditions was estimated using the “climate-runoff” model using meteorological data of scenarios RCP4.5 and RCP8.5. It was revealed that in 2021-2050 as compared to the reference period 1990s, on average, the volume of freshwater inflow into the lagoons under natural conditions of runoff formation will decrease by 30% under the RCP4.5 scenario and by 49% under the RCP8.5 scenario.

These estimates indicate that climatic changes, which have already occurred and will be expected in the 21st century, are resulting in an increase in the deficit of the annual freshwater balance of "choked" lagoons in the north-western Black Sea coast; moreover, some lagoons can disappear (see Figure). According to the vulnerability to climate change due to a significant annual deficit of freshwater balance in the absence of other sources of water (e.g. from the Black Sea), the lagoons are ranked in the following order: Kuialnytskyi, Dofinovskiy, Budakskiy (in the absence of water from the Dniester estuary), Tuzla lagoon group, Sasyk, Tylihulskiy, Khadzhibeiskiy (in the absence of anthropogenic runoff). This requires the development of new strategies for their water and environmental management.

An effective solution to the problem of stabilizing the hydro-ecological regime of "choked" lagoons in the north-western Black Sea coast under the increasing deficit of freshwater balance due to climate change is to ensure constant year-round many-directional water exchange with the sea through artificial connecting channels with morphometric characteristics preventing salinization of lagoons in the long-term perspective.

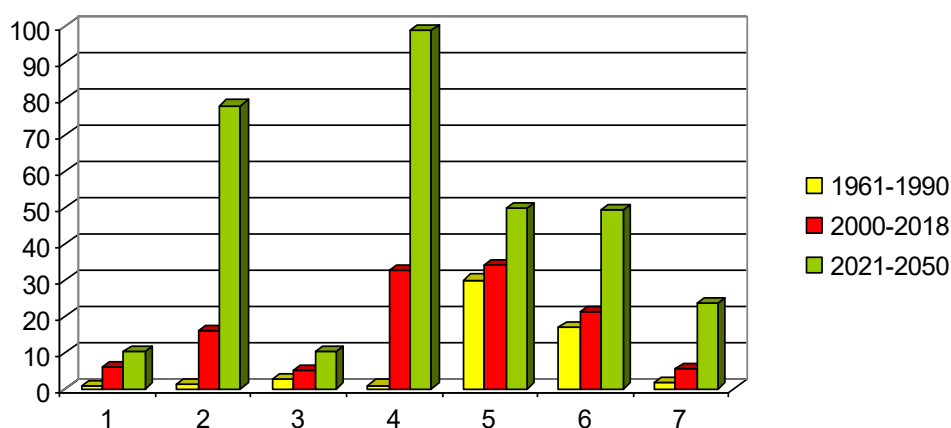


Fig. 1. Percentage of annual deficit of freshwater balance from the average annual volume of water in the "choked" lagoons in the north-western Black Sea coast under RCP8.5 scenario (1 - Tylihulskiy, 2 - Dofinovskiy, 3 - Khadzhibeiskiy, 4 - Kuialnytskyi, 5 - Budakskiy limans, 6 - Tuzla group, 7 - Sasyk).

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Наукове електронне видання

**МІЖНАРОДНА НАУКОВО-ПРАКТИЧНА
КОНФЕРЕНЦІЯ «КЛІМАТИЧНЕ ОБСЛУГОВУВАННЯ:
НАУКА І ОСВІТА»**

МАТЕРІАЛИ КОНФЕРЕНЦІЇ

22-24 вересня 2021

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(англійською мовою)

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Свідоцтво суб'єкта видавничої справи

ДК № 5242 від 08.11.2016