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THE BALAKLAVSKAYA BAY WATERS' POLLUTION ASSESSMENT ON THE BASIS OF HYDROOPTICAL RESEARCH METHODS

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INTRODUCTION

The purpose of presented article – the Balaklavskaya bay waters' pollution assessment by total suspended matter (TSM) and dissolved organic matter (CDOM).

BASIC DATA AND RESEARCH METHODS

The materials of five hydrooptical expeditions, realized on the Balaklavskaya bay waters on September 21, 2004; September 11, 2005; August 23, 2006; October 6, 2007 and July 21-23, 2010 according to the stations' scheme shown on fig. 1 were used as the basic data. The series of cuts along the axial line of the bay were executed during the specified period, where the turbidity field structure was investigated.

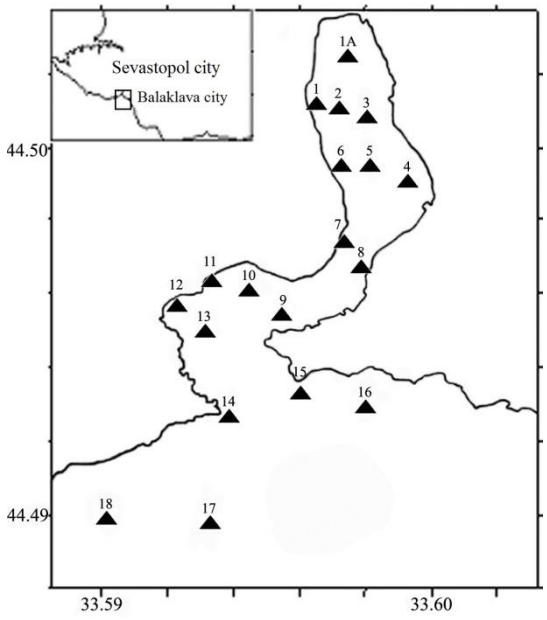

Fig. 1. The stations' scheme of hydrooptical research

Initial data used in this article was received by biophysical complex «Condor» [1]. All of vertical profiles were executed with a depth frequency of 0.1 m.

For the polluted local areas' identification, the concentrations of considered parameters were compared with concentrations observed in the open Black Sea waters. The last ones, borrowed from [2], and, equal to 0.2 mg/l for TSM, 2 mg/l for CDOM, were accepted as conditional natural norm.

DISCUSSION OF RESULTS

The considered identifying environment state parameters fields' analysis has shown that their structure from sensing to sensing didn't change qualitatively, the revealed distinctions had, mainly, the quantitative character. Therefore the result of one shooting, executed in August, 2006 (fig. 2) when the studied parameters' concentrations were the maximum ones, is illustrated below.

On the schemes of analyzed horizontal water environment state parameters' distribution the two main maxima identify two areas of extreme water pollution - the most remote internal part of the bay and the area of waters near the entrance of the bay where the main household sewers output pipe of the Balaklava city is located (fig. 2).

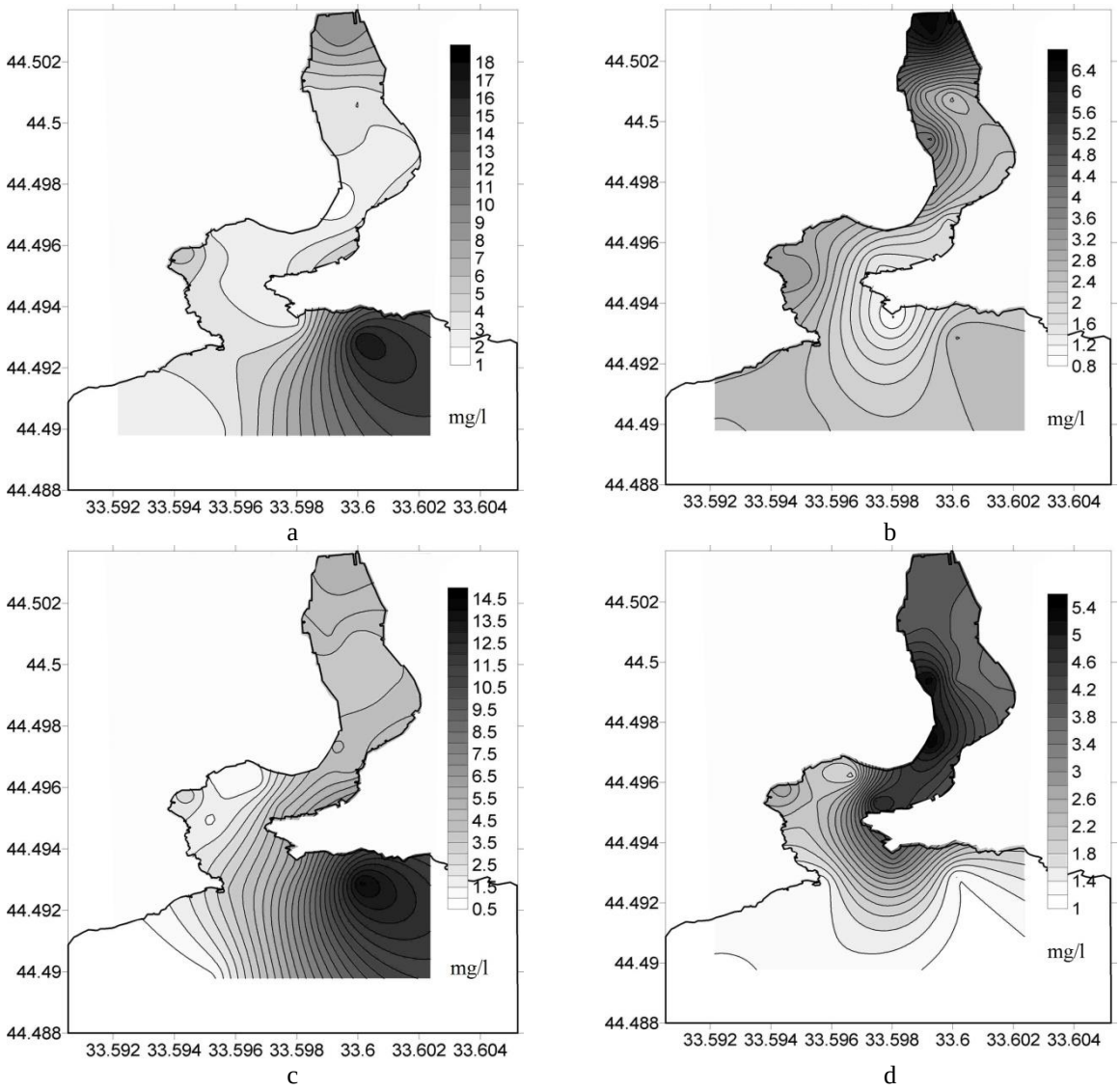

Fig. 2. The TSM, mg/l (a, b) and CDOM, mg/l (c, d) distribution on the surface and bottom layers on August 23, 2006.

The TSM distribution on the surface layer had well expressed maximum (18.1mg/l, that is 90 times higher than a conditional norm) in the local water area of the main household waters' output. The raised TSM concentrations were observed in the most internal part of the bay and the local area of Georgiyevsky fresh waters source – 8.8 and 5.5 mg/l. The lowest TSM concentrations - 1.2 mg/l, - were found in the central and the narrowest parts of the bay (fig. 2a).

At the bottom horizon the TSM concentration was lower in comparison with the surface layer. The maximum concentration - 6.4 mg/l (what is 32 times higher than a conditional norm) was found in the most remote internal part of the bay and the minimum one - 1.0-1.1 mg/l was identified in the entrance of the bay. This parameter distribution had rather uniform character here with the less expressed extrema than on the surface layer (fig. 2b).

The CDOM concentration maximum (14.2 mg/l, that is 7 times higher than a conditional norm) on the surface layer was observed in the local area of the main household waters output. Its local maxima were found in the very internal part of the bay (5.3 mg/l, 2,6 times higher than a conditional norm) and in the central narrowest part of the bay (4,3-4.5 mg/l) (fig. 2c).

At the bottom layer the maximum CDOM content (5.2 mg/l, that is 2.6 times higher than a conditional norm) was recorded in the waters of the central narrowest part of the bay (fig. 2d).

High, significantly surpassing the natural norm, TSM and CDOM concentrations testify the anthropogenous nature of these substances.

The area of waters near the Georgiyevsky fresh water source, both on the surface and the bottom horizon was allocated with the small CDOM concentration increasing from the surrounding background (fig. 2c, d).

The data presented above about the maxima of considered characteristics' content location zones allow revealing their sources and nature. The two main obvious significantly polluted local zones of the studied water area are the

most remote internal part of the Balaklavskaya bay and the area of waters near the entrance of the bay where the main household sewers output pipe of the Balaklava city is located.

In the most internal shallow part of the bay, because of limited water exchange the fresh sewers are accumulated with the TSM and CDOM concentrations content ten times higher than the natural concentration of these characteristics is. This fact points to their artificial origin. The nature and source of polluting characteristics in the entrance of the bay are obvious and don't demand interpretation.

The smallest pollutants' concentrations on the studied water area were found out during the expedition realized on September 11, 2005. The maintenance of all the characteristics was 1.5-3.5 times lower in comparison with situation shown on the fig. 2 practically everywhere. Waters of the bay differed by their high transparency and minimum turbidity content for all the time of supervisions (fig. 3a).

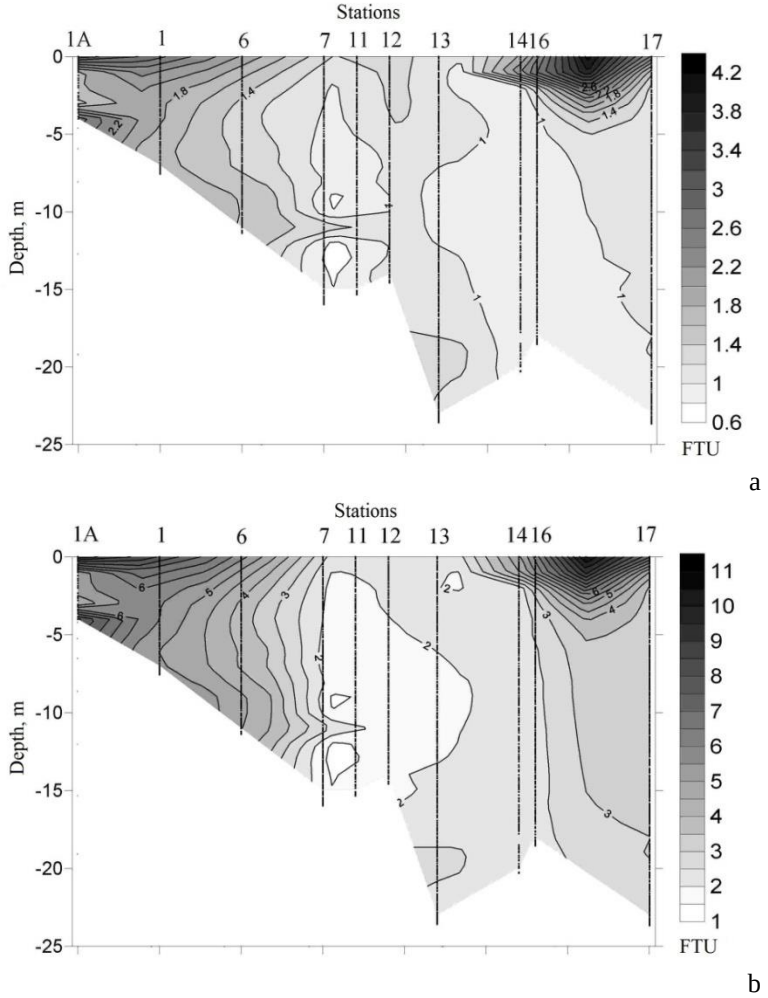

Fig. 3. Turbidity distribution (the optical units - FTU) on a section along the axial line of the Balaklavskaya bay: on September 11, 2005 (a) and August 23, 2006 (b).

The synoptic situation analysis has shown that the moderate western wind has probably caused the local upwelling development in the studied region the day before the experiment. The low TSM and CDOM concentrations are the probable this phenomenon clearing effect consequence.

According to pollutants fields' structure, their most significant source in the limits of the studied water area is the main household sewers output pipe of the Balaklava city which end is directed into the southeastern part of the bay at the depth of 10 m.

This conclusion confirms also the analysis of vertical turbidity distribution according to which the most turbid waters of 11-12 FTU are concentrated in the top 1-2-meter layer in the local area of waters near the pipe (fig. 3). The absolute turbidity maximum 22-23 FTU here was fixed in July, 2010.

The turbidity field structure analysis testifies that all the waters thickness from the surface to the bottom zone in the most internal shallow part of the Balaklavskaya bay is polluted. At the entrance of the bay the polluting matter comes from the main household sewers output pipe of the Balaklava city and is concentrated in the thin top layer. The polluting matter concentrations here exceed much a natural background. From the 1-2 m horizon their content decreases quickly with the depth, though in the wa-

ters spreading the top layer the pollutants' concentrations remain high in times surpassing their content in the open Black Sea waters.

CONCLUSION

The two most polluted areas of the Balaklavskaya bay waters were found, – the most remote internal part and the area of waters near the entrance of the bay where the main household sewers output pipe of the Balaklava city is located. The high turbidity and ten times surpassing the natural norm TSM and CDOM concentrations are recorded here.

All the water thickness, from the surface to the bottom layer in the most remote internal shallow part of the Balaklavskaya bay is polluted. Polluting substances in the waters near the entrance of the bay come here from the main household sewers output pipe of the Balaklava city. They are accumulated there in the thin top layer. The pollutants' concentrations here exceed much the natural background.

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On the basis of hydrooptical experiments' data, undertaken within the complex oceanographic monitoring of the Balaklavskaya bay in 2004-2010 turbidity field structure was analyzed, the total suspended matter and dissolved organic matter pollution assessment of the considered water area was executed.

The data about the maxima of considered characteristics' content location zones allow revealing their sources and nature.

The two most polluted areas of the Balaklavskaya bay waters were found, – the most remote internal part and the area of waters near the entrance of the bay where the main household sewers output pipe of the Balaklava city is located. The high turbidity and ten times surpassing the natural norm TSM and CDOM concentrations are recorded here. All the water thickness, from the surface to the bottom layer of the most remote internal shallow part of the Balaklavskaya bay is polluted. Polluting substances in the waters near the entrance of the bay come here from the main household sewers output pipe of the Balaklava city. They are accumulated there in the thin top layer. The pollutants' concentrations here exceed much the natural background.

High, significantly surpassing the natural norm, TSM and CDOM concentrations testify the anthropogenous nature of these substances.

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ОЦЕНКА ЗАГРЯЗНЕНИЯ ВОД БАЛАКЛАВСКОЙ БУХТЫ НА БАЗЕ ГИДРООПТИЧЕСКИХ МЕТОДОВ ИССЛЕДОВАНИЯ/П.Д.Ломакин, М.А.Попов, А.А.Чепыженко/ Трудов Института Гидрометеорологии Грузинского Технического Университета Грузии.-2013.-т.119.-с.274-277. - Рус., Рез. Анг., Рус.

На основе анализа данных гидрооптических съемок, реализованных в рамках комплексного океанографического мониторинга Балаклавской бухты в 2004-2010гг, проанализирована структура поля мутности и выполнена оценка загрязнения рассматриваемой акватории общим взвешенным и растворённым органическим веществом.

Представленные в данной статье данные о положении максимумов содержания рассмотренных веществ, позволяют выявить их источники и природу. В работе обнаружены две наиболее загрязненные области акватории Балаклавской бухты, – ее кутовая часть и участок, локализованный у оголовка выпуска сточных вод г. Балаклава. Здесь зафиксирована значительная мутность и высокая, в десятки раз превосходящая природную норму, концентрация ОВВ и РОВ.

В кутовой мелководной части Балаклавской бухты загрязнена вся толща вод, от поверхности до дна. В открытой ее области загрязняющие вещества, поступающие сюда из канализационного коллектора г. Балаклава, аккумулированы в тонком верхнем слое. Здесь их концентрация на порядок превышает природный фон.

Существенно превосходящие природную норму концентрации ОВВ и РОВ свидетельствуют об антропогенной природе этих веществ.