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Mean Long-Term Seasonal Variability of the Coastal Current at the Crimea Southern Coast in 2002–2020

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Abstract

Purpose. The study is aimed at systematizing new scientific knowledge on the regime, regularities and features of seasonal water circulation in the Black Sea coastal zone, i.e. in the dynamically active area near the of the Southern coast of Crimea. The data for the past decade were obtained in course of a long-term *in situ* experiment.

Methods and Results. The presented results were obtained by means of complex processing and analyzing the data on the currents monitored at the Black Sea hydrophysical sub-satellite test site of Marine Hydrophysical Institute of RAS in 2002–2020. Instrumental measurements were performed by a cluster of the autonomous Euler current meters using a verified monitoring information technology from a stationary oceanographic platform in the deep sea at a distance 0.5 km from the coast. The information of the generated long-term currents monitoring database has been confirmed by the metrological control of measurements quality and has got state registration. In the coastal zone, parameters of the along-coastal current directed to the west-south-west were studied at the average (for 19 years) flow velocity 8.1 cm/s which was maximal in the near-surface layer. When the eddy-wave oscillations propagate near the coast, the elliptical orbital circulation is transformed into a system of the along-coastal reciprocal water oscillations of the corresponding scales which are collinear to the existing coastal current. The existence of a bimodal distribution of occurrence frequency of the along-coastal current direction depends on intensity of contribution of the eddy-wave oscillations to water circulation. The bimodal structure of a current is arises at such modulus values of the perturbation orbital velocities that exceed the one of the velocity of the monomodal along-coastal current vector.

Conclusions. Based on the results of spectral analysis, the energy contribution of the coastal water different-scale fluctuations to variability of the stationary along-coastal current near the Cape Kikineiz was systematized. Analysis of the long-term average frequency spectra of distribution of the kinetic energy density of water oscillations in the coastal ecotone permitted to identify statistically reliably the intense seasonal current fluctuations for an annual period, as well as the fluctuations near the second and third annual harmonics. It is shown that large-scale variability of the quasi-stationary coastal current is controlled by water dynamics in the shelf-slope zone of the Black Sea, whereas on smaller scales it is affected by influence of the local wind conditions.

Keywords: Black Sea, instrumental monitoring of currents, coastal water circulation, seasonal fluctuations, kinetic energy spectrum

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Introduction

The southern coast of Crimea is a unique self-developing coastal landscape structure. Near the South Coast, in the zone of land and shelf water conjugation at depths over 70 m, a coastal ecotone is concentrated, where specific biocenoses, as well as concentration and enhancement of marine life diversity are observed [1]. In recent years, along with a significant increase in life indicators and natural resource potential consumption by society, an increase in the number of natural disasters and man-made crisis situations has been observed. It contributes to the intensive development of natural and anthropogenic processes in the coastal region. Stormwater runoff and regular discharges of industrial and domestic waste carry large amounts of anthropogenic origin pollution from the land to the coastal sea area near the South Coast [2]. Under such conditions, the coastal ecotone is subject to constant degradation. Excess of the norms of maximum permissible concentrations of water pollution significantly reduces the possibility of self-purification of the coastal ecotone of the sea, which ultimately causes irreparable damage to the entire ecosystem of the region. Totality of knowledge about the dynamics of climatic, hydrometeorological and hydrophysical factors [1, 2] [3] makes it possible to take into account the contribution of the natural environment variability in solving the problems of sustainable development of this unique coastal region. The results of complex monitoring of a dynamically active natural system enable prompt assessment of the evolution of the water area state in the coastal ecotone. Timely management decisions to ensure monitoring of crisis situations, assessments of the degree of economic development rationality and opportunities for further sustainable development of the coastal region are impossible without reliable scientific knowledge about the specific regime and features of the water circulation of the coastal ecotone.

Intense water dynamics is specific for various morphological structures of the coastal zones of the Russian part of the Black Sea; it is actively studied by Marine Hydrophysical Institute (MHI) of the Russian Academy of Sciences and the Institute of Oceanology of the Russian Academy of Sciences at stationary and operational marine polygons under various physical and geographical conditions [4–10]. The seasonal Black Sea level variability is mainly determined by the ratio of the components of the annual water balance [11], and the seasonal fluctuations of currents over the annual period and its harmonics are associated with the annual variation of solar radiation with seasonal changes in the hydrosphere, atmosphere and wind circulation state [12]. At present, the features of seasonal and interannual fluctuations of the Black Sea currents remain insufficiently studied. It is conditioned by the lack of representative data of long-term *in situ* measurements of currents in various physical and geographical conditions on annual and longer time scales. Systematization and obtaining new scientific results on the study of the characteristics of sub-inertial, seasonal and interannual variability of regional currents in the Black Sea is an urgent task. According to the results of early field [3]

[1] Blatov, A.S. and Ivanov, V.A., 1992. [*Hydrology and Hydrodynamics of the Black Sea Shelf Zone (on the Example of the Southern Coast of Crimea)*]. Kyiv: Naukova Dumka, 242 p. (in Russian).

[2] Lyalko, V.I., ed., 2010. [*Earth System Changes in Eastern Europe*]. Kyiv: Naukova Dumka, 582 p. (in Russian).

[3] Zats, V.I., Lukyanenko, O.Ya. and Yatsevich, G.V., 1966. [*Hydrometeorological Regime of the Southern Coast of Crimea*]. Leningrad: Gidrometeoizdat, 120 p. (in Russian).

experiments, systematized in the monograph [12], the isolated coastal zone of the shelf has a very variable nature of the currents [13], while the statistical characteristics of the coastal current regime show a bimodal distribution of the frequency of the current direction parallel to the coastline [14–21]. The bimodal distribution in most works is explained by the existence of a strong anticyclonic vorticity of currents in a narrow coastal zone, and in [18] – by the regime of local winds.

The present paper systematizes and supplements the results of studies of the annual and mean long-term seasonal variability of the structure, regime and circulation characteristics of the coastal ecotone waters near the South Coast of Crimea, obtained over the past decade based on the data of a long-term field experiment [22–25]. The results of statistical and spectral analysis enabled to get the reliable estimate of the regime characteristics, the spectral composition of the kinetic energy density distribution and the contribution of current fluctuations in the seasonal range of variability.

Materials and methods

Studies of currents, internal waves, turbulence, level and sea surface waves, as well as hydrometeorological conditions are carried out on a permanent basis at the stationary Black Sea Hydrophysical Sub-Satellite Polygon of MHI, located in the Golubaya Bay near Cape Kikineiz of the South Coast of Crimea [8, 26]. Instrumental measurements of coastal currents are carried out using a verified information monitoring technology by a cluster of autonomous Eulerian meters at hydrological horizons of 5, 10, 15 and 20 m from the pile foundation of an oceanographic platform in the sea at 0.5 km from the coast at a depth of 28 m [27, 28]. Autonomous MHI-1308 meters are used in the vector current averaging mode over a time interval of 1 or 5 min during every second measurements of the vector components. The vertical antenna of meters with a fixed aperture enabled the synchronous study of the spatial structure and regime characteristics of the depth-sheared flow in the presence of the contribution of intense wave, eddy and turbulent disturbances.

A detailed survey of the bottom topography of the MHI polygon water area was carried out in 1977. Subsequent surveys of the bottom relief to the present day demonstrate invariance of the forms of the bottom relief [23], which, along with the conservatism of climatic factors and the long-term stable cyclicity of the dynamics of anemobaric conditions in the region [3], ensures annual uniformity of natural measurement conditions. Operational control of metrological characteristics, methodological and procedural support of monitoring, while maintaining constancy and uniformity of conditions and measuring instruments, ensured metrological unity of long-term measurements while achieving the ultimate accuracy of measurements of current components. The MHI Metrology and Standardization Service provided standard certification of instrumental errors of primary measuring transducers in stationary laboratory conditions. In the intervals between laboratory verifications, the quality control of measurements was carried out by comparing the synchronous readings of a cluster of meters during methodical *in situ* settings [25, 27]. The procedure application for complex processing of the vector data set of the measuring antenna is guaranteed to exclude the contribution of faulty values, significant methodological, systematic, including additive, multiplicative and other additional

measurement errors. The high accuracy of measurements of vector-averaged data enabled to carry out reliable research of the regime characteristics and variability of the coastal current in the range of seasonal and interannual fluctuations. The error in determining the mean values of the velocity modulus did not exceed 0.1 cm/s and the direction of current did not exceed 3° [28].

The cardinal methodological problem in studying variability of the current regime in shallow water under the conditions of developed dynamics of the near-surface and near-bottom boundary layers is to take into account the contribution of intense high-frequency current fluctuations introduced by wind waves, current instability, turbulence and other factors with oscillation periods from units to tens of seconds. To eliminate the contribution of such perturbations, the standard microprocessor of the autonomous meter was used. The initial every second measurements of the vector components (projections onto orthogonal axes) were accumulated in real time, followed by their averaging and recording of the results over a base time interval of 1 or 5 min. Further vector averaging of the accumulated basic data of the meters was carried out upon completion of the next stage of the experiment. Based on the results of the MHI intellectual activity, a unified database structure for 19-year monitoring of the characteristics of coastal currents near Cape Kikineiz for 2002–2007 [4], 2008–2015 [5], 2016–2019 [6] and 2020, which passed the metrological quality control of measurements, was formed.

General set of long-term sequences of vector-averaged values of currents was used in full in statistical and spectral analysis. Spectral analysis of the chronological series of currents was carried out within the framework of a linear (filter) spectrum estimation through periodogram smoothing using the fast Fourier transform procedure [7] [13]. The choice of the appropriate types and parameters of digital filtering of the generated vector series excluded the possibility of the contribution to the studied energy spectra of other intense fluctuations of the current that are present but not included in the studied spectral range.

Results and discussion

Water area of the MHI Black Sea Hydrophysical Sub-Satellite Polygon is located near the South Coast between the zones of influence of the quasi-stationary Sevastopol and Crimean anticyclonic eddy formations [29].

To the south of the Crimea, on the traverse of Cape Kikineiz, the coastal periphery of the Black Sea Rim Current is expressed with the area of current velocity maxima of cyclonic direction [12]. This area of Rim Current intensification is located

[4] Kuznetsov, A.S. and Zima, V.V., 2021. *Database for Monitoring the Structure of the Black Sea Coastal Currents near Cape Kikineiz from the Southern Coast of Crimea for 2002–2007* [Database]. Moscow. State Registration No. 2021621800 (in Russian).

[5] Kuznetsov, A.S. and Zima, V.V., 2019. *Database for Monitoring the Dynamics of the Black Sea Coastal Currents near the Southern Coast of Crimea for 2008–2015 According to Measurements on a Stationary Oceanographic Platform near Cape Kikineiz* [Database]. Moscow. State Registration No. 2019620377 (in Russian).

[6] Kuznetsov, A.S. and Zima, V.V., 2020. *Database for Monitoring the Current Field of the Coastal Zone of the Black Sea near the Southern Coast of Crimea for 2016–2019* [Database]. Moscow. State Registration No. 2020621445 (in Russian).

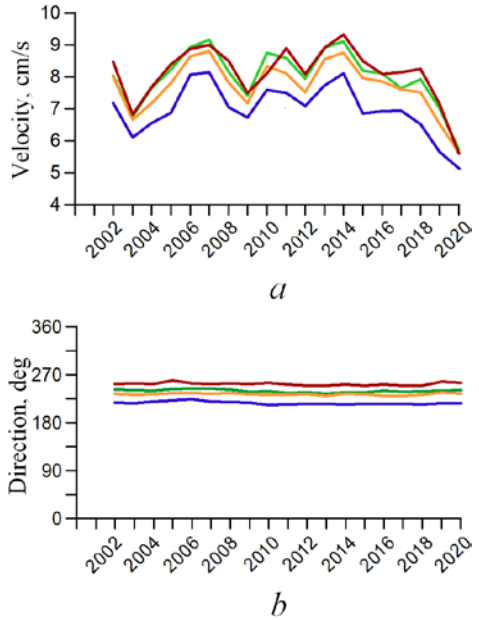
[7] Konyaev, K.V., 1981. [*Spectral Analysis of Random Oceanological Fields*]. Leningrad: Gidrometeoizdat, 207 p. (in Russian).

in the area of continental slope narrowing in the central part of the sea between the Crimean Peninsula and the Anatolian coast.

The primary task in studying the dynamics of coastal ecotone waters near the South Coast of Crimea is systematization of new ideas about the regime, structure and patterns of water circulation obtained at the polygon near Cape Kikineiz over the past decade when analyzing the statistical characteristics of a quasi-stationary current [22–25]. Previously, the existence of a monomodal current in the coastal zone near the South Coast of Crimea was not practically discussed.

In [19, 21] it is stated that in the coastal zones of the Caucasian, Crimean and western coasts (the Cape Kaliakra area) of the Black Sea, the only statistically reliable characteristic of the water circulation regime is the bimodal distribution of the frequency of occurrence of the direction of coastal currents parallel to the coastline. At the same time, on the North Caucasian coast shelf, over 5.5 years of continuous experiment, the fact of a clear predominance, more than 7 times, of the duration of the northwestern (cyclonic) water transfer compared to the southeastern transfer was established [21]. According to [19], near the Caucasian coast, most of the mesoscale cyclonic and anticyclonic eddies move together with meanders in the same direction as the Rim Current flow. In [30], the anticyclonic eddy movement in the direction of the Rim Current general flow was monitored in [30] during 5 days of recording radar satellite images of the coastal zone, which were carried out simultaneously with daily surveys of currents in sections near Gelendzhik. In [31], according to calculations carried out based on a hydrodynamic model, taking into account the real atmospheric impact, cyclonic vorticity prevailed in the fields of currents near the South Coast of Crimea; and anticyclonic mesoscale gyres formed and developed between the coastline and the Rim Current, which during their existence (up to 5 days) moved in the Rim Current direction.

Under conditions of intense variability and a pronounced bimodal distribution of the occurrence frequency of the direction of coastal water circulation near the South Coast of Crimea, the regime characteristics of the monomodal current of the west-south-west direction were revealed. The mean annual flow of coastal waters at a distance of 0.5 km from the coast is cyclonically oriented relative to the deep sea, like the coastal periphery of the Rim Current abeam Cape Kikineiz. Fig. 1, *a* presents chronological data for 2002–2020 realization of the mean annual module variability of the coastal current velocity at the horizons of 5, 10, 15 and 20 m, Fig. 1, *b* – realizations of the corresponding mean annual values of the current directions. The averaged modules of the horizontal component of the current velocity have maximum values in the near-surface layer and vary within certain limits. Thus, the long-term mean current velocity modulus at a 5-m horizon over the 7-year period 2002–2008 had a value of 8.2 cm/s [25]; for the 9-year period 2008–2016 – 8.4 cm/s [23]; for the triennium 2017–2019 – 7.8 cm/s [24]. The mean annual velocity maxima of the coastal current at a horizon of 5 m were recorded in 2006, 2007 and 2014 with values 9.0; 9.1 and 9.4 cm/s, respectively, the minimums are in 2003 and 2020 with values of 6.9 and 5.8 cm/s, respectively.



F i g. 1. Chronological realizations of variability (2002–2020) of the average annual values of velocity module (*a*) and direction (*b*) of the coastal current at the 5, 10, 15 and 20 m horizons (red, green, orange and blue lines, respectively)

Regime characteristics of the depth-sheared mean coastal current

Depth, m	Velocity, cm/s	RMS_1, cm/s	K_V	Direction, deg	RMS_2, deg
5	8.1	0.9	0.11	253	3
10	8.0	0.8	0.10	240	3
15	7.7	0.8	0.10	234	2
20	7.0	0.8	0.11	217	3

The mean long-term velocity of the coastal current at a horizon of 5 m is 8.1 cm/s and the direction is 253°, with a gradual decrease in velocity towards the horizon of 20 m to 7.0 cm/s and a direction of 217°. The velocity decrease from the near-surface to the bottom layer is due to the friction effect, and the stationary cyclonic turn of the coastal current to the bottom layer is formed when the current flows around a locally inhomogeneous structure of the bottom topography at the measurement site at a depth of 28 m [23]. At the same time, the alongshore current at each horizon is oriented along the corresponding bottom topography isobath, similar to the Rim Current water tendency near the South Coast of Crimea above the slope [1] [13]. The coefficient of K_V variation at all four horizons is an order of magnitude less than 1. Since the contribution of the variable component of the long-term mean alongshore water flow is insignificant, a quasi-stationary mono-modal current clearly dominates near Cape Kikineiz on annual scales.

The alongshore current is affected by various types of inertial and sub-inertial eddy-wave oscillations during their generation and propagation in the coastal shelf zone. When analyzing the variability of the structure of currents near the South Coast of Crimea, a significant transformation of the elliptical form of the orbital water

circulation was identified. Orbital motions of water during the propagation of eddy-wave oscillations near the coast are transformed into a collinear system with an alongshore current of practically reciprocating oscillations of the corresponding scales [22–25]. A similar transformation of the orbital oscillations of waters into reciprocating movements along the coast was previously identified near the North Caucasian coast [21]. According to the results of statistical field data analysis, it was reliably ascertained that the bimodal structure of the frequency of the current direction near the South Coast of Crimea occurs only at values of the modulus of the perturbation orbital velocities that are greater than the modulus of the velocity of the monomodal alongshore current vector [22, 25]. Otherwise, oscillations in the alongshore current velocity during the oscillation period occur practically without changes in the direction of the monomodal current. For example, the empirical probability density distribution function calculated for a 10 m horizon over 19 years of monitoring in 3° angular segments over ~ 2 million basic five-minute readings of the current direction demonstrates an asymmetric narrowly directed bimodal structure of the current direction frequency distribution. The direct mode of the cyclonic current direction was recorded in 74% of cases with a maximum in the 238–241° segment, and the diametrically opposite mode was recorded in 26% of cases with a maximum in the 58–61° segment. With a similar processing of centered vector series of flows, i. e., the same realizations, but with the deduction of the contribution of the average current vector value, in all cases, bimodal distributions of the recurrence of the residual current direction, being close to an equiprobable and quasi-symmetric form, are distinguished [22]. Thus, in the absence of a mean current and the presence in the realizations of the contribution of full periods of different-scale wave oscillations of waters, the bimodal distribution of the circulation direction of coastal waters should have an equiprobable symmetric form. This type of distribution was obtained in an experiment on the northeastern shelf near Yuzhnaya Ozereevka at point 3 at a distance of 0.2 km from the coast [19].

As is known, in the coastal zones of the oceans and seas, there are special types of long-wave motions that determine their dynamics, leading to the wave energy capture and accumulation, meandering of currents and formation of mesoscale eddies [8]. Generation, propagation and dissipation of long waves is a response of the marine environment to external impact, and the adaptation process is accompanied by the transition of a part of the oscillation energy into the energy of long waves of various nature. Long waves in the seas have a linear scale from tens to hundreds of kilometers, and periods – from minutes to months. Such long-wave motions as waves captured by the shore are most effectively generated by oscillations in the alongshore wind stress. In the observation area, the wind can excite such waves with a spatial scale of the order of the coastline length. The parameters of these waves, as a rule, correspond to the space-time scales of the forcing atmospheric systems. Waves captured by the coast at sub-inertial frequencies propagate in a cyclonic direction relative to the deep sea, leaving the coast on the right in the Northern Hemisphere.

In the 90s of the 20th century, MHI actively carried out complex expeditionary and modeling studies of the dynamics of sub-inertial trapped waves in the coastal

[8] Efimov, V.V., ed., 1985. [*Waves in the Boundary Regions of the Ocean*]. Leningrad: Gidrometeoizdat, 280 p. (in Russian).

zone of the South Coast of Crimea aimed to determine the types and spatio-temporal characteristics of waves, to assess the impact of the physical and geographical conditions of the observation area on the wave structure and characteristics. The results of a comprehensive analysis of the materials of these studies presented in monograph [9] and in [32] were used to compare the characteristics of quasi-inertial and sub-inertial oscillations of currents, identified from 2002–2020 field data in the coastal zone near Cape Kikineiz. The realizations of the alongshore current variability near the South Coast of Crimea, obtained on the MHI platform, contain integral information about different-scale oscillations in the waters of the coastal-shelf zone. Based on the spectral analysis results, the energy contribution of intense eddy-wave oscillations of coastal waters to the alongshore current variability is systematized. The distribution analysis of the dispersion of current oscillations by frequency made it possible to systematize the frequency-time localization of the kinetic energy density concentration maxima with the contribution of intense oscillations of the coastal current near the South Coast of Crimea in the range of inertial-gravitational, sub-inertial and seasonal oscillations.

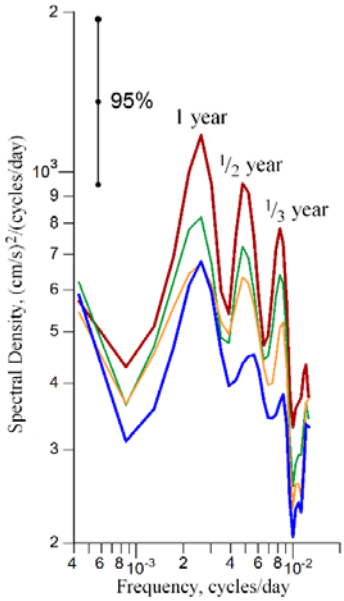
The general set of 7.9 million pairs of vector components obtained over 19 years at horizons of 5, 10, 15, 20 m from a stationary platform with a basic vector averaging interval of 5 min, allows a comprehensive study of the structural features and dynamics of trains of short-period internal waves playing important role in the long wave energy sink on the tidal Black Sea shelf [8–10]. However, the results of such studies are not considered in the present paper.

When analyzing the hourly mean data on the variability of currents in the coastal zone near Cape Kikineiz, intense oscillations of the local inertial (17.1 h) and daily periods were reliably identified [24]. The reasons for the generation, existence and possible varieties of oscillations of these periods are described in monograph [9] and in [32], where it is noted that such oscillations are similar in their properties to long-wave motions. During further processing, the contribution of current oscillations in this range of variability was removed by digital filtering methods. Based on the analysis of daily mean vector-averaged data, two reliable separate spectral peaks of the kinetic energy of oscillations were identified at periods ~ 6 and 12 days [24, 25]. The study [19] provides information that in the northeastern Black Sea, wavy oscillations of the Rim Current core with periods of ~ 6 and 12 days were previously experimentally identified, that in some cases turn into large cyclonic and anticyclonic meanders with mesoscale cyclonic and anticyclonic eddies. It was shown in [32] that oscillations of coastal waters with a period of ~ 6 days are associated with the surge circulation of the Black Sea waters with a periodicity of 5–7 days near the South Coast of Crimea. Formation of coastal water oscillations with a period of ~ 12 days is explained by the Rim Current meandering and the generation of sub-inertial waves captured by the shore. Their spatiotemporal characteristics were studied in field measurements and numerical simulation [9] [32]. The results of a comprehensive analysis of the data of these experiments made it possible to identify oscillations with a period of ~ 12 days as waves captured by the coast with a spatial scale of the order of the Black Sea coastline length. These trapped waves

[9] Ivanov, V.A. and Yankovsky, A.E., 1992. [*Long-Wave Motions in the Black Sea*]. Kyiv: Naukova Dumka, 110 p. (in Russian).

are generated by a distant wind action and propagate along the coast in a collinear mode with the monomodal coastal current, leaving the coast on the right. For the purpose of further spectral processing, the contribution of coastal current oscillations in the sub-inertial variability range was eliminated by digital filtering methods.

Spectral composition of the seasonal variability of the alongshore current was studied using linear estimates of the spectrum after removing the contribution of intense inertial-gravitational and sub-inertial oscillations from long-term chronological realizations. The distribution spectra of the kinetic energy density, calculated from mean monthly vector-averaged data, contain statistically significant oscillations of the current over the annual period, as well as intense oscillations near the second and third annual harmonics, identified with different reliability. Fig. 2 shows the results of calculating the long-term mean spectra of coastal current seasonal variability at 5, 10, 15 and 20 m horizons for oscillations in the range of periods of 75 days – 6 years, indicating the 95 % confidence interval size.



F i g. 2. Density spectra of the kinetic energy oscillations of the coastal current within the range 75 days – 6 years at the 5, 10, 15 and 20 m horizons (red, green, orange and blue lines, respectively) at the 95% confidential interval

Intensity of current oscillations near the second annual harmonic significantly decreases with depth and at 10, 15, and 20 m horizons no longer exceeds the 95% confidence interval values. At a horizon of 20 m, the intensity of oscillations also decreases near the third annual harmonic, i. e., the intensity of coastal current oscillations in the seasonal range of variability attenuates from the near-surface to the bottom layer. For comparison, reliable results of a long-term full-scale experiment, providing a reliable idea of the energy-carrying frequencies of the seasonal variability of the Black Sea level, were used [33]. This paper presents the mean spectrum of sea level oscillations calculated from long-term data of high-precision altimetry from artificial Earth TOPEX/Poseidon mission satellites. It is

noted that the two main maxima of the annual and semi-annual periods are due to seasonal changes in the tangential wind stress. Two additional maxima in the spectrum of sea level fluctuations at periods of ~ 280 and 125 days, apparently, as noted in [33], correspond to the internal variability of the Black Sea circulation.

The present paper presents basic information on the study of the water circulation features of different scales near the Crimean coast; a detailed analysis of the totality of these results remains to be done. The results obtained contribute to the improvement of the information technology of contact monitoring of multi-scale variability of the coastal current at the stationary MHI Black Sea Hydrophysical Sub-Satellite Polygon to obtain new scientific knowledge about the dynamics of coastal ecotone waters.

Conclusion

The present paper summarizes the results of 2002–2020 monitoring of multi-scale variability of water circulation in the coastal-shelf zone of the Black Sea near Cape Kikineiz (Southern Coast of Crimea). In terms of detailed studies of the regime characteristics and the range of quasi-stationary current variability, the coverage of depths and the duration of the full-scale experiment, the generated materials have no analogues in the practice of domestic and foreign instrumental monitoring of the Black Sea coastal currents. Based on the obtained materials, a database of vector data of spatiotemporal variability of coastal currents at measuring horizons of 5, 10, 15 and 20 m was formed. General data volume set for 6940 days of monitoring amounted to 666.24 thousand pairs of mean hourly values of the current vector components.

According to the results of the field data set analysis near Cape Kikineiz a quasi-stationary current of the west-south-west direction along the coast was reliably identified. The mean annual modulus of the unimodal current vector velocity maximum values in the near-surface layer and during the monitoring period varied within 5.8–9.4 cm/s. The elliptical type of water circulation from disturbances near the coast is transformed into reciprocating oscillations, which contributes to the formation of a bimodal distribution of the frequency of occurrence of the alongshore current direction. The bimodal structure of the alongshore current arises only in the case of dominance of the perturbation orbital velocity modulus over the modulus of the monomodal current vector velocity. According to the results of the spectral analysis, intense oscillations of the quasi-stationary current in the gravitational-inertial, sub-inertial and seasonal ranges of variability are reliably identified. In the sub-inertial and seasonal range of variability, there is a tendency to reduce the intensity of current oscillations from the near-surface to the bottom layer.

Ensuring high accuracy and quality of instrumental monitoring data carried out by domestic Eulerian current meters on a permanent basis *in situ* near Cape Kikineiz (the South Coast of Crimea), remains one of the MHI priorities. Representative experimental material is necessary for the validation and improvement of modern local numerical models in order to reliably analyze and predict the state and variability of coastal ecotone water circulation.

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