Journal of
Marine Science and Engineering

MDPI

Editorial

Sea Level Fluctuations

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1. Introduction

We do not consider sea level change due to global warming, but only sea level fluctuations in our time scale. However, we understand that sea level changes and atmospheric pressure fluctuations, superimposed on these changes, are of tremendous significance, and should be studied when researching various non-uniformly scaled processes.

When studying various non-uniformly scaled processes in the sea/ocean that cause fluctuations in its level, it is necessary to identify their primary source, which can be located in any of the geospheres. The identification of primary sources, studying patterns of dynamics and the transformation of wave and non-wave processes at the interface of the geospheres, is one of the main tasks of modern science. The complexity of this identification is associated with ambiguous interpretation of the results of observations, obtained in only one geosphere.

Development of this direction will allow us to integrate several directions into the comprehensive whole, in which the causes of sea level fluctuations, from the hydroacoustic range to secular fluctuations, are studied, making it possible to establish the patterns of their occurrence, dynamics and transformation, with assessment of their impact on the earth's biosphere.

2. Some Results of the Sea Fluctuation Research

It is undeniable that the main cause of sea level change is gravity and infragravity sea waves at work [1], which occur in various regions of the world ocean; some of them are regional in nature. This paper considers several mechanisms of generation and propagation of waves with different periods during typhoon movement. The relationship between the variations of the main periods of gravity sea waves with dispersion and the Doppler effect, and the variations in wind speed and direction was studied. A thorough study of the dynamics of the main parameters of gravity sea waves in paper [2] revealed new patterns of surface progressive gravity waves and their transformation into primary microseisms, when the waves move on the shelf with decreasing depth. The non-isochronal behavior of progressive waves was established, which manifests itself in a decrease in the gravity waves' periods due to the conversion of a part of their energy into the energy of primary microseisms. A new method for studying modulation effects, based on regression analysis and general period change functions, was presented in work [3]. Using this method, it was shown that when wind waves are modulated by tides, waves with a large period and amplitude are concentrated at high points of the tide. However, when extraneous wave processes occur, such as seiches, the modulation of wave amplitude may have an extremum in the low point of the tide, i.e., modulation of the wave period and its amplitude will be in antiphase. These gravity sea waves interacting with the bottom transform into Rayleigh surface waves, moving along the water–bottom boundary. These waves are also known as surface Scholte waves. The general properties of these waves' propagation are actively used in solving some problems of geoacoustic parameter inversion [4].

Changes in the ocean level by various wave and non-wave processes, the action of typhoons and cyclones over the water area, and the presence of various currents directly

Citation: Dolgikh, G.I. Sea Level Fluctuations. *J. Mar. Sci. Eng.* **2022**, *10*, 330. https://doi.org/10.3390/jmse10030330

Received: 2 February 2022
Accepted: 21 February 2022
Published: 25 February 2022

affect the propagation of sound in the ocean [5,6]. On the other hand, solving the inverse problem, we can make hydroacoustics serve as a tool for studying various sea processes. For example, in paper [7], a mesoscale vortex in the Pacific Ocean and its dynamics are studied using hydroacoustic and oceanic methods.

Abnormal changes in ocean level can lead to devastating environmental consequences. Thus, the anomalous ocean level variability during the summer months of 2020 affected the routine behavior and food resource formation of microalgae at work [8]. The strongest temperature anomalies of the aquatic environment in the entire history of observations, combined with specific conditions of coastal water circulation, became extremely favorable for the seasonal development of phytoplankton, which ultimately led to an intense red tide and had a negative impact on the coastal waters of the Kamchatka Peninsula (even leading to the mass death of hydrobionts).

The studies of the processes leading to changes in the ocean level are carried out by contact and remote methods. Remote methods primarily include aerospace methods. A method for obtaining spatial spectra of slopes and heights of surface waves from aerospace optical images was developed, taking into account the nonlinear modulation of the brightness field at work by the slopes of the sea surface [9]. This method can be used for aerospace monitoring of sea areas, to identify and study the variability of sea waves spectra associated with abnormal phenomena and processes, including those of anthropogenic origin. The remote methods of a more economical nature undoubtedly include the technology of surface and underwater video monitoring [10]. This paper describes the technology for express analysis of images and videos recorded by coastal video surveillance systems. Its main feature is the ability to measure or evaluate in real time the parameters of sea waves, sea level fluctuations, underwater current fluctuations, etc.

When considering marine processes that lead to changes in sea level, one cannot disregard tsunamis, which bring significant troubles to humankind. Paper [11] presents a new method for short-term tsunami forecasting. General regularities of distribution of deformation anomalies associated with seafloor motions and leading to tsunamis were established in three seismically active zones of the earth [11]. The established regularities, the foremost of which is the general law of divergence, confirm the indisputable fact that these deformation anomalies, the behavior of which is described by the sine-Gordon equation, are related to the tsunami generation process. The heights of the tsunamis, however, are not directly proportional to the magnitude of the seabed displacements.

In conclusion, we can state that a comprehensive analysis of the papers, published in this thematic issue, is extremely useful for understanding the processes and phenomena of the interacting geospheres of the earth, its biosphere, and man. These papers are completely united by the common theme of the "Study of the fundamental foundations of the emergence, development, transformation and interaction of hydroacoustic, hydrophysical and geophysical fields in the World Ocean".

Funding: The work was carried out with financial support from the Russian Federation represented by the Ministry of Science and Higher Education of the Russian Federation, Agreement No. AAAA-A20-120021990003-3.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: I do not own the data.

Conflicts of Interest: The author declares no conflict of interest.

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