

The numerical calculation of hydrological processes in the coastal zone of the Black Sea region in the city of Poti

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The serious environmental problems started in Poti after transfer of the main flow of the river Rioni to the north. As a result the flooding of the city stopped, but the reduction of water consumption in the city channel, caused a decrease of the sediments carried away by the river, what leads to coastal erosion. The coast changes are connected with the movement of the waves and currents in the coastal part of the sea.

In the paper, the three-dimensional mathematical model of sediment transport and coastal zone lithodynamics is developed. The finite element formulations for the problems of wave modes, coastal currents, sediment transport and evolution of the coastal zone of the sea, are given. The numerical algorithms, implemented in the form of software. Programs are allowing to bring the solutions of the tasks to numerical results.

The numerical modeling was developed in three stages. In the first stage the topography of the coast and the initial geometry of the structures r considered as an input parameters. Then, coastal wave field is calculated for the conditions prescribed in the initial wave. In the second stage, the calculated wave field is used to estimate the spatial distribution of the radiation stresses near-bottom orbital velocity. In the third stage the coastal wave fields and flow fields are used in the sub-models of sediment transport and changes in the topography of the coast.

In the numerical solution of basic equations of motion of the waves, coastal currents and changes in sea bottom topography we use: finite element, finite difference methods and the method of upper relaxation, Crank-Nicolson scheme.

As an example, we are giving the results of research of the wave regime in the coastal area of the city of Poti (700X600m) adjacent to the port of Poti. The bottom profile, in this area is rather complicated. During the calculations of the average rise of sea level, 0.1m was taken as the initial value, which corresponds to the actual conditions

The calculations have found that in the excitement, the sediment transport rates at a depth of 10-15m are almost zero. The maximum value of the velocity of sediment transport change within 0.006-0.0065m²/s. In the case of the western waves it is essential for longshore sediment transport directions, which varies in the range 0.0015-0.0022m²/s. The rate of sediment transport perpendicular to the bank in this case is irrelevant, and their maximum values in the range 0.00001-0.000017m²/s. Changes in the water depth varies from -0.25 to 0.29m. The rate of coastal erosion south of the port of 8-10 m/year.