ABOUT THE RFBR-RGO PROJECT "THE STUDY OF CUMULATIVE NATURAL HAZARDS DURING THE WINTER PERIOD AND THEIR IMPACT ON THE COASTAL AREA OF THE CASPIAN SEA"

N.A. Yaitskaya[1, 3], L.M. Shagarov[2], Yu.M. Lychagina[3], A.A. Magaeva[3], I.A. Tretyakova[3], G.V. Makarovskiy

[1]Southern Scientific Centre of the Russian Academy of Sciences, Rostov-on-Don, Russia
[2]Natural Ornithological Park in the Imeretinskaya Lowland, Sochi, Russia
[3]Institute of Arid Zones of the Southern Scientific Centre RAS, Rostov-on-Don, Russia
yaitskayan@gmail.com

О ПРОЕКТЕ РФФИ-РГО «ИССЛЕДОВАНИЕ КУМУЛЯТИВНЫХ ОПАСНЫХ ПРИРОДНЫХ ЯВЛЕНИЙ В ЗИМНИЙ ПЕРИОД И ИХ ВОЗДЕЙСТВИЕ НА БЕРЕГОВУЮ ЗОНУ КАСПИЙСКОГО МОРЯ»

Н.А. Яицкая[1, 3], Л.М. Шагаров[2], Ю.М. Лычагина[3], А.А. Магаева[3], И.А. Третьякова[3], Г.В. Макаровский

[1]Южный научный центр Российской академии наук, Ростов-на-Дону, Россия
[2]Природный орнитологический парк в Имеретинской низменности, Сочи, Россия
[3]Институт аридных зон Южного научного центра РАН, Ростов-на-Дону, Россия

The Caspian Sea is a unique largest in the world enclosed brackish waterbody. The main feature of the sea is the significant inter-annual fluctuations of the sea level. Due to peculiarities of geographical location the northern part of the sea is covered by ice during the winter period. The Caspian Sea is the important marine transport route, connecting five coastal states. Together with the coastal territories, the Caspian Sea forms a single natural and economic complex. The effectiveness of the functioning of this complex is determined, first of all, by the peculiarities of the internal processes dynamics of a closed reservoir. Along with this, the Caspian Sea is sensitive to fluctuations of external factors and quickly responds to such changes.

The beginning of the XXI century in the southern macro-region of Russia was marked by a number of weather disasters. Abnormally cold winters, such as the 2006 and 2012, when hummocks up to 2 m in height were observed in the Sea of Azov, the Black Sea was frozen to Bulgaria, and the Caspian Sea was covered by ice to Makhachkala. The number of extreme surges and storm surges have also increased.

Directly in the Caspian Sea a number of natural hazards, which have an impact to the socio-economic situation in the coastal region, can be identified: inter-annual

(long-period) sea level changes; storms; wind surges (daily short-period sea level fluctuations); wave load on the coast and infrastructure facilities; extreme ice phenomena; strong winds, hurricanes, squalls; ships icing.

Hydrometeorological phenomena in the Caspian Sea are considered as dangerous if they correspond to the following criteria [Hydrometeorology ... 1992]: wind speed 30 m/s and more; wind wave with wave height of 8 m and more; sea level fluctuations lower or higher of dangerous marks; formation of ice cover or fast ice in early dates; intense pressure and ice drift; ice cover impassable by ships. There is no need to argue that they can all be related to dangerous natural phenomena or natural hazards (NH). NH have the greatest impact on the shallow-water annualy freezing northern part of the sea. But the most catastrophic event is the "ice surge" or "ice storm". The combination of rapid surging water level rise or extreme wind wave in the Caspian Sea with the ice cover can be the reason of severe economic losses in the coastal areas spatially on the background of the inter-annual sea level fluctuations. The greatest probability of occurrence of such combinations (cumulative effect) in November-December and March, when the fast ice and ice cover has not yet formed and ice can break and move toward to the shore side under the influence of storms or surges, destroying everything on its path.

Multifactority and complexity of NH evolution, related to climatic, hydrological, geomorphological factors, cause the problems of their research. Accounting of all factors and description of their joint interaction based on the primary hydrometeorological information for the instrumental observation period, geoinformation technologies and mathematical modeling are the key elements.

The topic that interested a young researchers team was supported by Russian Foundation for Basic Research and Russian Geographical Society by three-years grant. The aim of the work was to study the winter cumulative dangerous natural phenomena in the Caspian Sea for the period from 1900 to 2015 and their impact on the coast, coastal infrastructure and hydraulic structures. During the project a number of important fundamental and applied results will be obtained.

Based on hydrometeorological information on the long-term regime of each NH separately (sea level fluctuations, surges, storms and extreme ice phenomena, wave load on the coast and infrastructure facilities) calendar incidence of adverse and dangerous situations will be highlighted. The cases of winter cumulative NH will be highlighted by combining and summarizing the data obtained. The final calendar of winter cumulative NH will include: dates of occurrence and decline of cumulative phenomenon, duration (in hours), the values of each parameter, description of meteorological situation at the moment of occurrence and decline of cumulative NH. Comparison with previously documented in the literature will be performed.

A retrospective analysis of occurrence and degeneration of cumulative NH will be performed by a set of hydrodynamic and hydrological models.. Reanalysis

of hydrometeorological characteristics fields will allow to understand the spatial specifics of the development of cumulative phenomena, in contrast to "point" field observations. Based on the restored data and reanalysis of meteorological parameters, analysis of the mechanisms of formation of unfavorable and dangerous winter cumulative NH, when two or more phenomena occur simultaneously and their total effect is intensified, will be performed.

Depending on the amount of simultaneous occurrence of adverse or dangerous hydrometeorological phenomena in the Caspian Sea from 1900 to 2015 (presence/absence surge phenomena, storm phenomena, extreme sea level increases/decreases, extreme ice conditions) the classification of winter periods will be developed. For each winter class on the basis of reanalysis the critical marks, after which the cumulative phenomenon is unfavorable or dangerous, will be determined (wind speed, water level, wave height etc). It should be noted that the danger criteria for cumulative NH will differ from the currently accepted criteria for individual NH, since the combined effects of unfavorable and dangerous values are achieved more quickly. Methodological description of the developed classification and criteria will be performed.

The quantitative assessment of the relationship between the number, frequency and timing of winter cumulative NH in the Caspian Sea with winter cumulative NH in the Sea of Azov and Black Sea will be received (RFBR research project №16-35-00318 мол_а).

Using hydrological mathematical models and spatial program modules the assessment of dynamic wave load on the coast, coastal infrastructure and hydraulic facilities, and the impact of surges on coastal areas and river deltas taking into account the ice conditions for identified cases of winter cumulative NH in the Caspian Sea will be implemented. Based on the simulation results the zonation of the Caspian Sea coast by the degree of sensitivity to the effects of the "ice storm" and "ice surges" will be conducted.

All results of the project will be published in electronic (on CD and Internet site) and in a paper edition of the "Atlas of winter cumulative natural hazards of the Caspian Sea during the XX-XXI centuries".

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