INDEX COPERNICUS INTERNATIONAL

ORIGINAL ARTICLE

Bulletin of the Maritime Institute in Gdańsk

Applications of correlation functions to determine optimal locations of autonomous measuring buoys in the Southern Baltic Sea

Możliwości wykorzystania funkcji korelacyjnych dla wyznaczania optymalnego rozmieszczenia autonomicznych stacji pomiarowych na obszarze Bałtyku Południowego

Maciej Kałas, Kazimierz Szefler

Instytut Morski w Gdańsku

Article history: Received: 18.02.2016 Accepted: 29.02.2016 Published: 31.03.2016

Abstract: The article is based on works published only in part, concerning elaboration of an effective method for design of measuring sea buoy nets, which should give a reliable picture of meteorological, hydrological and hydrophysical conditions at open seas. The method provides practical advice on how to locate autonomous measuring devices optimally in the Polish Exclusive Economic Zone (EEZ). It is an important in the context of growing demands of maritime market for online weather data.

Keywords: Optimum location of measurement stations, inter-correlation function, HIROMB model, Baltic Sea

Streszczenie: Przedstawiony artykuł jest w swej istocie komentarzem uzasadniającym decyzję udostępnienia nieopublikowanych dotychczas w pełni wyników prac mających na celu opracowanie skutecznej metody, pozwalającej na takie projektowanie sieci morskich stacji pomiarowych na morzu, aby za pomocą jak najmniejszej liczby autonomicznych boi pomiarowych uzyskiwać możliwie jak najbardziej wiarygodny obraz warunków meteorologicznych, hydrofizycznych i hydrodynamicznych w całym obszarze polskiej strefy odpowiedzialności na Bałtyku. Ze względu na szybko zwiększające się potrzeby różnych dziedzin gospodarki morskiej związane z pozyskiwaniem w czasie rzeczywistym aktualnej informacji pogodowej znad otwartego morza, zaprojektowanie i aplikacja optymalnego rozmieszczenia morskich stacji pomiarowych nabiera coraz większego znaczenia, także i ze względów ekonomicznych.

Słowa kluczowe: Optymalne rozmieszczenie stacji pomiarowych, funkcja interkorelacyjna, model HIROMB, Morze Bałtyckie

This work is a brief piece of information intended to present the explanations and updates for the publication "**Optimal locations of autonomous measuring buoys in the Southern Baltic Sea**." It is closely related to it, and the submission of such information in this form is necessary, because the said publication was written in 2006, based on the results of work done in years 2003-2005, in a research project of MSHE (Ministry of Science and Higher Education) 5T 12C 033 24: "Optimization of the network of autonomous hydrometeorological stations for the purpose of navigational safety and environmental protection," but so far, it has not been published in full. Only part of the obtained results was presented in form of oral presentations and short summaries at two international conferences (Gajewski 2006, Szefler 2008). The presented study includes an original, authorial concept, regarding the method of rational planning of a network of marine buoys, developed and tested for the Southern Baltic area, with hydrodynamic data from the predictions of the HIROMB model by one of the main contractors of the project - Leonard Gajewski. Unfortunately, his illness and premature death withheld the work on the development and practical implementation of the calculation method, elaborated by him, for a few years. However, this method can be very helpful in light of the current state, needs, and research capabilities of different marine areas.

Recently, a significant increase of interest for information obtained from the recording of meteorological, hydrodynamic, and hydrophysical parameters at sea (preferably received in operating mode) has been followed, which necessitates the need for its standardiza-

tion, (IMarEST, 2015). This also applies to different parts of the open sea, located within the Polish Exclusive Economic Zone (EEZ), both those in which it is necessary to carry out specific actions to protect hydrometeorological navigation, as well as those planned as locations for different hydro-technical investments (related to inter alia, shore protection, flood protection of coastal areas, development of harbor infrastructure) and power engineering investments (development of offshore renewable energy), and others.

Recordings at sea are performed by automatic measuring equipment, placed on the surface of water on buoys, floats, and beacons, or submerged in the depths of the sea and settled on the bottom. They allow to obtain information necessary, among others, to perform analyses of environmental status of selected sites and marine areas. Thus, the selection of locations in which measuring equipment is placed at sea, typically, results from the needs and requirements set by specific investors. On the other hand, other requirements result from the tasks of offshore hydrometeorological services (representative data are necessary for issuing accurate forecasts and for assimilation in forecasting models). Other requirements are set by System SWIBŻ (Maritime Safety Information Exchange System) used on navigation routes and harbor approach fairways (Wróbel, 2009). The Department of Operational Oceanography of the Maritime Institute in Gdansk has performed a wide range of different fixed and expeditionary registrations at sea for many years. As practice has shown, the degree of difficulty taking measurements at sea is far greater than the performance of similar registrations on land and requires significantly greater amounts of money (a good example is the procedure associated with the operation of exploiting automatic meteorological stations on buoys). This is due to a much faster wear of measuring equipment in a harsh marine environment and, above all, its limited capabilities of the current maintenance, which requires adequate weather conditions. At the same time, the representativeness criteria for measurements at sea are different than in the case of registrations done on land. Hence, the choice of locations and the number of necessary points for carrying out measurements at sea is essential for the economic analysis of the project.

The method proposed and tested by L. Gajewski, which allows the determination of optimal locations and the number of measuring buoys at sea, meets the described needs. It was developed and tested on the example of dynamic (currents) and physical (temperature and salinity) parameters of the sea. These parameters are characterized by the highest spatial variability. The next publication, currently being prepared, will present the results of calculations, regarding the optimal settlement of measuring buoys conducting registrations of meteorological parameters above the surface of the sea.

References:

[1] Gajewski L., Gajewski J., Kałas M., Staśkiewicz A., Szefler K. (2006) Use of Baltic operational model HIROMB results to optimize locations of autonomous measuring platforms in the Polish EEZ, US/EU Baltic International Symposium. 23-25 May 2006, Klaipeda, Lithuania

[2] Szefler K., Gajewski L., Staśkiewicz A. (2008) Conception for the optimization of autonomous measuring platforms locations in the Polish EEZ of the Baltic Sea, 7th International Conference on Coastal and Port Engineering in Developing Countries. 24-28. Feb. 2008, Dubay, United Arab Emirates

[3] IMarEST, Offshore Renewables Special Interests Group (2015) Metocean Procedures Guide for Offshore Renewables, Institute of Marine Engineering, Science and Technology, http://www.imarest.org/policy-news/newsroom-press/item/1797-imarest-publishes-seminal-metocean-procedures-guide

[4] Wróbel K. (2009), Zintegrowane systemy bezpieczeństwa morskiego, Zeszyty Naukowe Akademii Morskiej w Gdyni, nr 63, s. 95-103.

Word count: 4550 Page count: 2 Tables: – Figures: – References: 4

Scientific Disciplines: Geoscience

DOI: 10.5604/12307424.1196264

Full-text PDF: www.bullmaritimeinstitute.com/fulltxt.php?ICID=1196264

Cite this article as: Kałas M., Szefler K.: Applications of correlation functions to determine optimal locations of autonomous measuring buoys in the Southern Baltic Sea: BMI, 2016; 31(1): 45-58

Competing interests: The authors declare that they have no competing interests.

Corresponding author: Maciej Kałas, Maritime Institute in Gdansk, Poland, e-mail: Maciej.Kalas@im.gda.pl