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THE PROJECT FOR THE EXPERIMENTAL MODEL OF THE HYDROACOUSTIC RESEARCH TEST SITE IN THE AREA OF THE CAPE OF SHULTS

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At planning an experiment on the research of an ocean shelf zone by methods of acoustic tomography the aprioristic information about the area of work realization is of great significance. According to the measurements received in 2001-2006, the database of the sound velocity, depth and character of bottom sediments at the hydroacoustic research test site in the Cape of Shults area is created.

The work presents the software allowing at a stage of determination of coordinates of arrangement of components of reception and radiating systems in an interactive mode to receive the depths value, and also the data on the sound velocity measured in this point in different periods of time. At the chosen arrangement it is possible to make modelling calculation of sound distribution in beam approximation.

One of the most perspective methods of studying of dynamic processes at ocean is ocean acoustic tomography. Application of such methods allows us to carry out in a mode of real time the researches of structure and monitoring of dynamics of water mass. Construction of tomographic scheme in oceanologic researches is a technically complex problem, demanding heavy material and time expenses. Therefore at a stage of preparation for experiments it is necessary to have tentative estimations of laws of the formation of acoustic fields in the prospective areas of studies. Such estimations allow us to select optimal parameters of experiment the geometry: a choice of depths and sites of sources and receivers of sound, to set parameters of signals registration to determine necessary methods of processing received acoustic information. The solution of this problem becomes complicated as the processes of the formation of hydrophysical fields at ocean have stochastic character, besides; there are enough complex dependence between a transfer function of the channel of sound distribution and the medium parameters. Therefore it is topical the use of the information systems, allowing to estimate spatial and time characteristics of acoustic signals at randomly located corresponding points in preset area of ocean, at a stage of the experiment planning.

Such information system should involve the filled up databases including:

- results of hydroacoustic measurements, hydrological measurements, a relief of bottom and structure of bottom sediments;
- software of the applied programs (SAP) for registration, processing, ordering and keeping of information.

Creation of such system, certainly, is a very complicated problem. To receive exact forecasting solutions it is necessary to have the large volume of long-term supervision for all parameters taken into account besides this information should be checked up and systematized, should have necessary levels of access. It is also difficult enough to select mathematical methods to receive authentic estimations; the spectrum of problems being solved on the formation of forecasting data models may appear wide enough. In the SAP structure there should be the program modules realizing not only methods of classical processing of hydroacoustic signals, including spectral one, correlation one etc., but also factorial, discriminant, clustering analysis, decision taking theories.

In the given work the project of such system – THE PROJECT is presented; it is intended for preparation of the experiments on research of influence of hydrophysical and geomorphological characteristics of medium on the properties of acoustic signals by a method of remote sounding of ocean with reception of signals by a field of radio hydroacoustical buoys (RHB) and laser deformometer on at marine hydrophysical research test site the Cape of Shults [2,3].

Such research test site was created for realization of experimental researches at a marine expedition station of POI FEBRAS «The Cape of Shults» located in the area of the Posiet Bay. «The Cape of Shults» is equipped with modern equipments of radiation, receiving and processing of signals. The geographical position of the research test site allows us to carry out the work of not only research, but also methodological character. The received scientific results and techniques can be use and at studying the deep-water areas of the World Ocean as well. On the research test site "the Cape of Shults" in the period of 1996-2006 the experiments at participation of the experts from various institutes of not only the Russian Academy of Sciences, but also the USA, the People's Republic of China, Republic of Korea were organized and carried out



Fig. 1 Satellite image Cape of Shults of area

At planning an experiment on the research of an ocean shelf zone by methods acoustic it is of great tomography *the most significance* the aprioristic information about the area of realization of in-situ operation work. According to the measurements received in 2001-2006, it is created the database on a bottom profile, distribution of the sound velocity on depth, character of bottom sediments on the hydroacoustic research test site in area of the Cape of Shults. In this connection there is a necessity of develop the software, allowing to project new tomographic schemes by methods of computer modelling. Fig 2 presents the design interface of the program realizing a procedure of choice and estimation of lines.

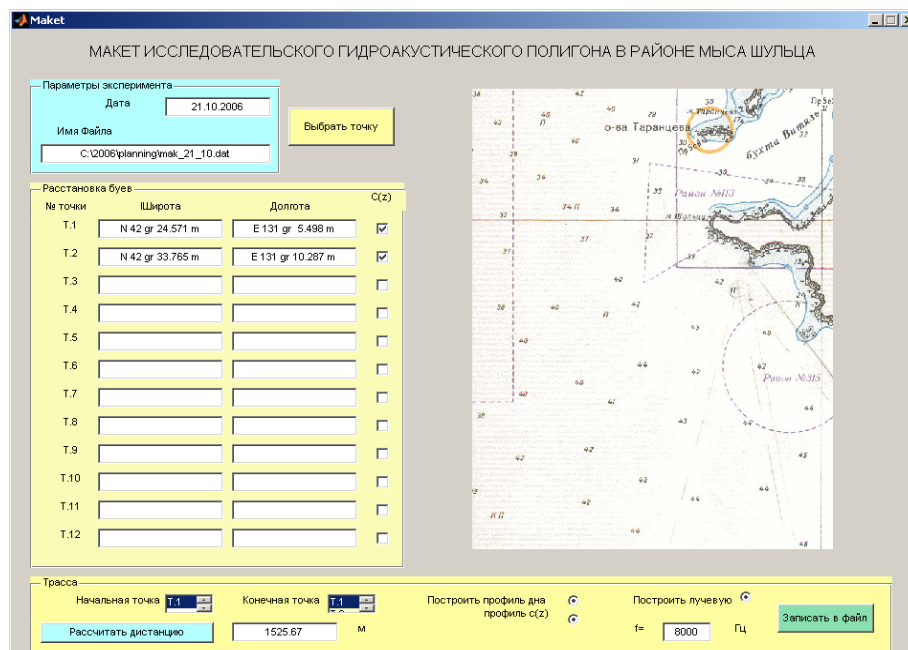


Fig 2 The design interface of the program THE PROJECT

Application of such software at a stage of planning the scheme of arrangement of the components of receiving and radiating systems in an interactive mode us:

- to choose a prospective site of the system modules on a map of the research test site;
- to receive values of depths by the given coordinates;

- the data on the sound velocity measured in this point in different periods of time, modelling calculation of a sound distribution in beam approximation of the chosen arrangement in view of geomorphological features of the bottom.

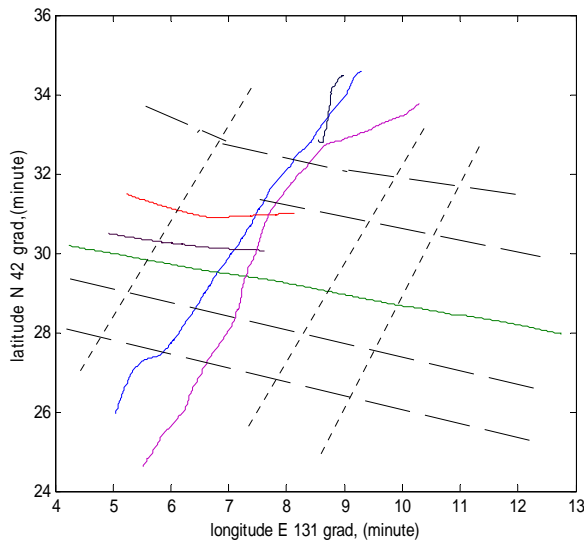


Fig.3 The lines echosounding a measurement

months). After it will be chosen more than 2 points, it is possible to estimate parameters of a line. For this purpose in the panel Line initial and the final points are chosen of the list, the distance between them is estimated. In a separate graphic window, which example is given in fig 4 the structure of the bottom is shown, thus it is necessary to choose a method of interpolation from the appearing contextual menu (linear, polynomial, MLS). Further, at the data accumulation, structures of the bottom will be more exact. For this purpose it is planned to carry out echosounding the measurements shown in fig. 3 by shaped lines.

The program uses a database of the area depths received with the echosounding in the research test site on lines in 2003-2006.

Fig 2 shows the lines echosounding a measurement in 2006. Continuous lines show the lines received in 2006, dotted - chosen of databases, and shaped - the planned routes of measurements.

The choice of a point is made in an interactive mode with the graphic cursor appearing on a map of the project. On click of the right button of the mouse in the appropriate windows of the panel Arrangement Buoys the coordinates of points will be shown. At the request of a user for the given point it will be chosen the sound velocity on the depth, measured earlier in the nearest points in the same period of time (the data are grouped

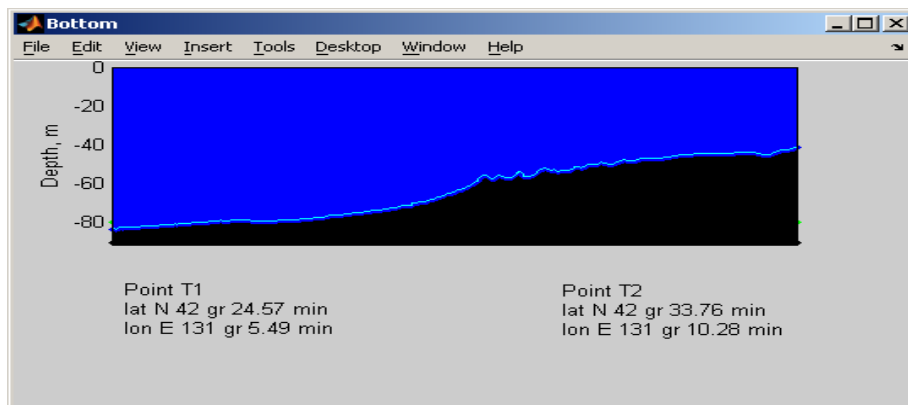


Fig.4. Example of the graphic window, showed profile of a bottom by chosen line

The program allows us to calculate a beam picture for the appropriate range of frequencies (performance of procedure is set by a tag). At the given calculation of a beam picture on the algorithm developed by A.A.Solov'ev [1], there is the edited window shown in Fig 5a in which parameters of calculation are set. The file containing the data on hydrology is created automatically in this case. The result is displaced in a separate graphic window shown in Fig 5a.

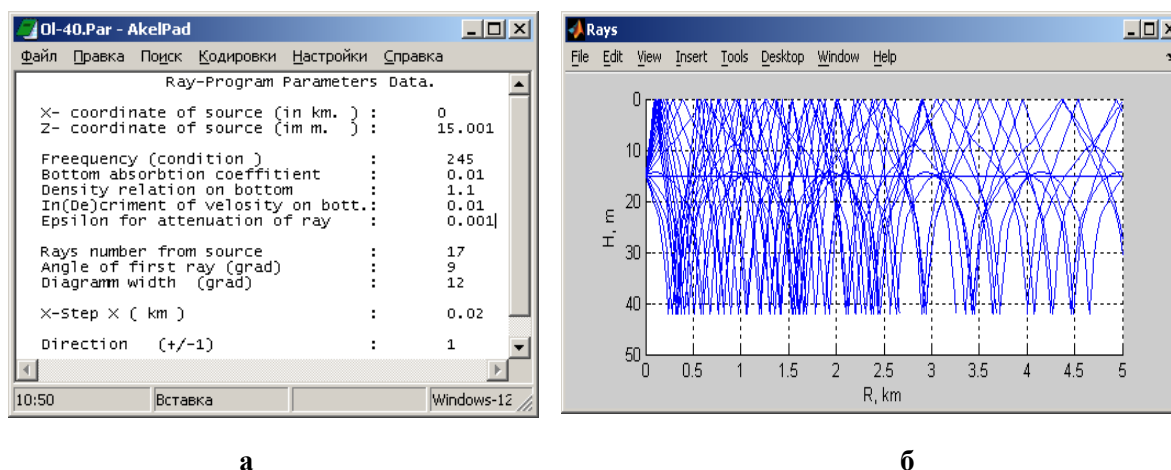


Fig.5. The calculation of a beam picture

Further the information system PROJECT will be completed with an opportunity of the numerical modelling based on known mathematical models, describing acoustic parameters of a source and of a sound receiver. In connection with complex physical-geographical and hydrological-acoustic conditions (a shelf zone and wedge areas, zones of interaction of water masses of various structure) it will be necessary to enter the check of adequacy of the used models, of the completeness of the initial data on the source and a sound receiver parameters, the channel of a sound distribution. It will enable us to estimate the laws of the formation of signals fields and noise at ocean. Computer experiments will allow us to make operatively an estimation of hydroacoustic characteristics for various sets of parameters variants of a wave guide and structure of the equipment describing a full spectrum of in the conditions considered area and a in the problem being solved. [4].

In the process of the development methods for researches test site and equipments for acoustic tomography of dynamics and structure of waters on a shelf and in deep-water areas of the Sea of Japan which practical realization is based on application of complex phase manipulated signals for sounding the sea medium with synchronous measurements of hydrological parameters on quasistationary lines of various distance, the database of a Project research test site will be completed by researches of a system "atmosphere – ocean - continent" parted out by remote satellite methods; vertical sounding of medium by 2 frequency echosounder in a mode of towage (a location in a "surface - bottom" direction) and permanently allocated on the bottom (a location in a "bottom - surface" direction) are planned. It will allow us to increase considerably the efficiency of experimental work and to expand essential a circle of the problems being solved.

REFERENCES

- 1 A.A Solov'ev The solving of the ray dynamic equations system// Collection of papers. Informatics at oceanologic. Vladivostok: POI FEB RAS, 1996. Pp. 67-80. (In Russian)
- 2 O.S. Gromasheva, G.I. Dolgikh, A.V. Kosheleva, B.J. Li, V.A. Yukhnovskiy Experimental researches of the channel of a sound distribution by application complex signals at quasi-stationary route // Collection of papers XI scientific school-seminar "Acoustics of ocean" Acad. L.M. Brekhovskikh, (XVII session of the RAS). 2006. 6. Pp. 261-264.
- 3 K.V. Bachinskii, O.S. Gromasheva, V.A. Yukhnovskii. Estimation of geometry parameters of experiments on positioning drifting radiohydroacoustic buoys. // Collection of papers 16 session of the RAS. 2005. V.2. Pp. 318-321.
- 4 Morgunov Y.N., Petuhov V.I. Information ensure of the tomographic researches in the ocean// Collection of papers. Informatics and modeling in oceanologic. Vladivostok: 1990. Pp. 96-104. (In Russian)