Data Article

Single beam echo-sounding dataset and digital elevation model of the southeastern part of the Baltic Sea (Russian sector)

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ABSTRACT

We present the bathymetric dataset of a single beam sounding. Surveys were conducted in 25 expeditions of the Atlantic branch of Shirshov Institute of Oceanology RAS in the Russian EEZ area of the southeastern part of the Baltic Sea in the period from 2004 to 2018. Acoustic data were acquired by echo sounders Simrad EA-400SP and Furuno FS-700. The raw sounding data were filtered and corrected by sound velocity values. The dataset is presented as spreadsheets (*.xlsx) and GIS point-class shapes (*.shp). The digital elevation model (DEM) of 1: 500 000 scale has been constructed for the entire Russian EEZ on base of the original array of sounding profiles and an open sources bathymetry [1]. DEM is presented by XYZ-grid (*.txt) and GeoTIFF raster (*.tif).

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1. Data

The presented dataset includes:

- The spreadsheets (*.xlsx) of processed data of single-beam sounding obtained by Simrad EA400SP (Fig. 1) and Furuno FS-700 (Fig. 2) in WGS84;

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The spreadsheets (*.xlsx) of thinned sounding data in WGS84 (distance between points is about 100–200 m);

- The ArcGis point class shapefiles (*.shp) of thinned sounding data in the UTM Zone 34 N projection, WGS84;
- The GeoTiff raster (*.tif) of DEM (Fig. 3) with a scale of 1:500 000 and spatial resolution of 200 m in the UTM Zone 34 N projection, WGS84;
- The ASCII XYZ-grid (*.txt) of DEM values in the UTM Zone 34N projection, WGS84;
- The isobaths in ArcGis lines feature class (.shp).

The raw XYZ data of echo sounding (*.txt) were converted into MS Excel spreadsheets (*.xlsx). Data preprocessing included filtering and sorting. The spreadsheets were converted in the point shapefiles with depth marks. We digitized isobaths from Ref. [1] for the areas of insufficient data. The dataset also includes coastline zero marks. The bathymetric raster surface was calculated by linear interpolation.

- The spreadsheets (*.xlsx) of thinned sounding data in WGS84 (distance between points is about 100–200 m);
- The ArcGis point class shapefiles (*.shp) of thinned sounding data in the UTM Zone 34 N projection, WGS84;
- The GeoTiff raster (*.tif) of DEM (Fig. 3) with a scale of 1:500 000 and spatial resolution of 200 m in the UTM Zone 34 N projection, WGS84;
- The ASCII XYZ-grid (*.txt) of DEM values in the UTM Zone 34 N projection, WGS84;
- The isobaths in ArcGis lines feature class (.shp).

The structure of the spreadsheets (*.xlsx) and the attribute tables of the shapefiles (*.shp) is presented in Table 1.

2. Experimental design, materials, and methods

2.1. Study area and expeditions

The study area is the Russian EEZ and territorial waters in the southeastern part of the Baltic Sea (Fig. 3).

The bottom relief of the Baltic Sea is characterized by series of depressions and sills between them, narrow troughs and shallow banks. The Gdansk basin is the most part of the study area. There is the Gdansk-Gotland Sill on the north of the study area. It separates the Gdansk Deep from the Gotland Deep (Fig. 3). The Gdansk Deep is a large negative relief form of the Gdansk Basin with maximum depth...
of about 110 m. There is a large positive form of relief — the Sambian-Curonian Plateau in the eastern part of the Gdansk basin.

The expeditions were carried out by the Atlantic Branch of the Shirshov Institute of Oceanology of the Russian Academy of Sciences with use of various research vessels, mostly on RV “Professor Stockman”. The map of original sounding data is on Fig. 4. The soundings were acquired by narrow-beam high-frequency echo-sounder Simrad EA400SP (Kongsberg, Norway) (Fig. 1) and the ship-installed echo-sounder Furuno FS-700 (Fig. 2).

The Simrad EA400SP is hydrographic two-frequency echo-sounder operated at 38 and 200 kHz frequency channels. As a rule, we used the frequency of 200 kHz because it gives more exact depth then lower frequencies. We used the frequency of 38 kHz as on dense sediments and with the absence of the technical possibility of using the frequency of 200 kHz (Fig. 4). The accuracy of depth measurements is 1 cm at 200 kHz frequency and 5 cm at 38 kHz.
The echo-sounder Furuno FS-700 was operated at 50 and 200 kHz frequency channels (Fig. 4). It was used in the absence of the Simrad EA400SP on a board. The accuracy of the Furuno FS-700 is 0.1 m or 2% of the depth.

The measured depths and coordinates from DGPS were recorded in the echo-sounders console in the digital format. The depths were measured from the echo-sounder transducer. The echograms and depth values were recorded in *.raw format which was converted into XYZ tables (*.txt) for further processing. We measured the temperature and salinity profiles for the sound velocity parameters (SVP) corrections in each expedition.

2.2. Processing of the sounding data

The processing of raw data was performed in the MS Excel software. The raw data were converted from the XYZ data files using macros written in the Visual Basic for Applications (VBA). The data were filtered for outliers and spurious depth values. The SVP and position of the transducer below water level were used for the depths correction. The processed data were compounded in spreadsheets (*.xlsx) as

![Fig. 2. The single-beam echo-sounding profiles by Furuno FS-700, where Psh[NN] – cruise number by RV “Professor Shtokman”](image)
shown in Table 1. These data were thinned through 150–200 m using a VBA macros and saved in another spreadsheets (*.xlsx). The spreadsheets of thinned data were converted into ArcGIS in point-class shapefiles (*.shp) of WGS1984 UTM Zone 34 N projection for further use and construction of the DEM.

2.3. The DEM construction

The dataset for DEM construction includes:

- the echo sounding data presented in this article;
- the digitized isobaths of the bathymetric map of the Central Baltic Sea [1];
- the digitized isobaths of the coastal nautical charts.

The shapefiles of the sounding data were plotted in ArcGIS. The areas with insufficient data were determined (Fig. 5). Isobaths from Ref. [1] and nautical charts were digitized and net of regular depths were calculated for these areas. These depth values were converted to the point shapefiles. We also added coastline zero marks as point shapefile to the general array for correct interpolation. All shapefiles of general data array were combined into ArcGIS dataset. From that one we created a terrain
Table 1
Description of columns in Excel spreadsheets and shapefiles attribute tables.

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessel</td>
<td>Research vessel: Professor Shtokman (abbreviated - Psh), Neman, Shelf, RZH1-0810 and no-name small rubber boats.</td>
</tr>
<tr>
<td>Cruise_num</td>
<td>Number of the expedition cruise (for Psh and Shelf only).</td>
</tr>
<tr>
<td>Date</td>
<td>Date of survey, dd.mm.yyyy.</td>
</tr>
<tr>
<td>Longitude</td>
<td>Geographical longitude, decimal degrees, WGS1984.</td>
</tr>
<tr>
<td>Device</td>
<td>Echo sounder device: Furuno FS-700 or Kongsberg Simrad EA 400SP.</td>
</tr>
<tr>
<td>Channel</td>
<td>Survey frequency channel: 50, 38 or 200 kHz.</td>
</tr>
<tr>
<td>Raw_depth</td>
<td>Raw depth, m. Corr_in_console – corrected in device console during of sounding.</td>
</tr>
<tr>
<td>SV_corr</td>
<td>Sound velocity profile correction, m. Corr_in_console – corrected in device console during of sounding.</td>
</tr>
<tr>
<td>Depth</td>
<td>Processed depth, m = Raw_depth (m) + SV_corr(m) + Transd_d(m).</td>
</tr>
<tr>
<td>Transd_d</td>
<td>Depth of transducer submergence, m.</td>
</tr>
</tbody>
</table>

Fig. 4. Echo-sounding tracks divided by survey frequency channels.
dataset by using the ArcGIS 3D Analyst module (Terrain To Raster). In this instrument, natural neighbor interpolation is applied through the triangulated terrain surface. The DEM has a spatial resolution of 50 m and a horizontal scale of 1:500 000 (Fig. 3). The obtained DEM of the bottom relief is presented as the GeoTIFF raster (*.tif), ASCII XYZ-grid (*.txt) and the ESRI ASCII Grid (*.txt).

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Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.
Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2019.104123.

References